VOLUME 6

RIDER TELEVISION MANUAL

JOHN F. RIDER

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RIDER

TELEVISION MANUAL

VOLUME 6

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World Radio History

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AN HOUR A DAY WITH RIDER
ON:
RESONANCE AND ALIGNMENT
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ALTERNATING CURRENTS IN RADIO RECEIVERS
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General

BUILT-IN "ROTO-SCOPE" ANTENNA

The built-in "Roto-Scope" antenna is operated by the antenna control lever which extends from the back of the cabinet (near the top). Set the antenna control lever in that one of its three positions (left, center, or right) which gives the clearest picture.

When an external indoor or an outdoor antenna is required, be sure to disconnect the built-in Roto-Scope antenna leads from the antenna terminal board. When disconnected, tape the Roto-Scope antenna lead lugs and place them away from the chassis.

INPUT IMPEDANCE and TRANSMISSION LINES

The input impedance to the receiver is 300 ohm balanced (between antenna terminals). When using a 300 ohm transmission line connect it across the antenna terminals.

Input impedance between one antenna terminal and chassis is approximately 75 ohms. When using 75 ohm coaxial transmission line, connect the outer conductor to the chassis and the inner conductor to either antenna terminal; use the terminal which gives the most satisfactory picture on the weakest station.

FUSE LOCATION

The horizontal output circuit is fused with a 1/4 amp, 250 volt fuse, part #84A4-2. The fuse is located in the back end of the high voltage compartment.

CHASSIS NOTES

Chassis used in the straight TV and combination models differ in that the combination models have connectors for supplying power to the radio and the cabinet pilot light.

To service the television chassis in combination models with the radio disconnected, it will be necessary to complete the heater circuit by connecting a wire jumper from pin "L" to pin "K". See plug and socket drawing on schematic. Since the radio receives its power from the television chassis, it cannot be operated without the television chassis.

Important: If both the radio and television are turned on at the same time, neither unit will operate.

PICTURE TUBE HANDLING PRECAUTION

Due to the high vacuum and large surface area of picture tubes, great care must be exercised when handling these tubes. Shatterproof goggles and heavy gloves should be worn while handling or installing a picture tube. The picture tube must not be scratched or subjected to excessive pressure as fracture of the glass will result in an explosion of considerable violence which may cause personal injury or property damage.

HIGH VOLTAGE WARNING

High voltages are present throughout this receiver. Operation with cabinet removed involves shock hazard. Exercise normal high voltage precautions while working with this set.

Installing the Television Receiver

After the antenna is set properly, make all checks or adjustments given here to insure best performance and ease in tuning. ***It is especially important that the Channel Slugs and Ion Trap be adjusted upon installation or servicing of every set.***

For best results, all checks or adjustments should be made using a transmitted television test pattern. A mirror placed in front of the picture tube screen will be of help in observing the picture while adjusting rear panel controls.

NOTE: If both radio and television are turned on in combination models, neither unit will operate. Be sure set owner has been properly instructed on the operation.

TUNE IN A PICTURE

Tune in a picture as instructed in the customer instruction leaflet; note illustrations on interference effects.

ADJUST CHANNEL SLUGS

Individual channel oscillator adjustment of every receiver should be checked upon installation or servicing. If this adjustment is properly made, it is possible to tune from one station to another by merely turning the CHANNEL control and if necessary, slightly readjusting the TUNING control. With correct oscillator channel adjustment, best picture and satisfactory sound will be located at the approximate center (half rotation) of the range of the Tuning control.

This adjustment can be made without removing the chassis from the cabinet. Adjust as follows:

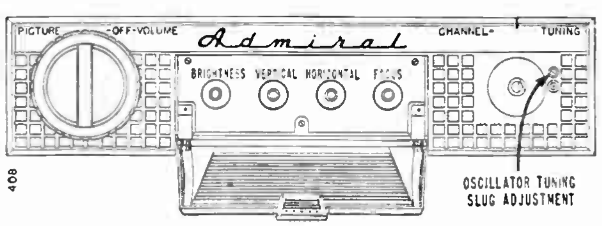
a. Turn the set on and allow 15 minutes to warm up.

b. Set the CHANNEL knob for a station; set other controls for normal picture and sound.

c. Set TUNING control at center of its range by rotating it approximately half-way.

d. Remove the CHANNEL and TUNING knobs.

e. Insert a 1/8" blade, NON-METALLIC screwdriver in the 1/4" hole (to the right of the channel tuning shaft). For each channel in operation, carefully adjust the oscillator slug for clearest picture detail. Then check sound, and if necessary readjust for minimum buzz. Only slight rotation of the slug will be required; turning the slug in too far will cause the slug to fall into the coil. (If an oscillator slug should fall into the channel coil, remove the coil, move the slug retaining spring aside, lightly tap the open end of the coil against a solid object until the slug slips out. Replace slug and set the slug retaining spring into its cut-out slot.)



Control Panel; CHANNEL and TUNING Knobs Removed.

ADJUST THE ION TRAP

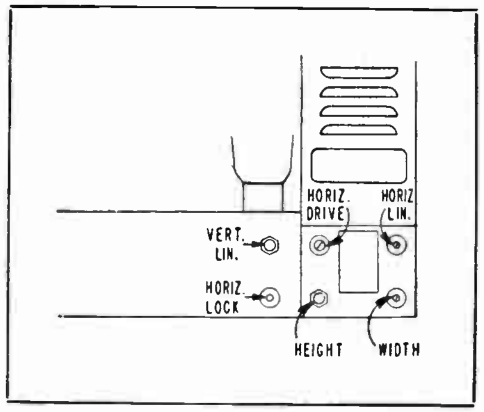
In order to prolong the life of the picture tube, it is important that this adjustment be made on every receiver upon installation or servicing.

These sets use a 16TP4 or 16RP4 picture tube. If the set has the 16TP4 tube, locate the ion trap on the neck of the tube with the blue sleeve on top and the magnet to the left (facing rear of chassis). With the 16RP4 tube, locate the blue sleeve to the left and the magnet at the bottom. Starting from a point close to the tube base, very carefully move the ion trap forward or backward, and at the same time rotate it slightly in either direction; adjust for the brightest picture possible with the BRIGHTNESS control set for average brightness.

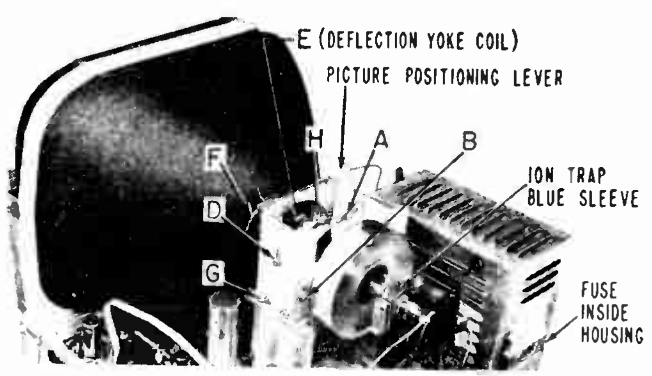
Note that there may be two locations where the brightest picture can be produced. The second ion trap location, which is further forward on the tube neck, should not be used.

Important: Should the corners of the picture become rounded off or shaded after adjusting the ion trap, correct this by moving the deflection yoke coil "E" as far forward as possible and then adjusting the picture positioning lever (or the focus coil if necessary) as described below. Do not try to remove shaded corners with adjustment of the ion trap. Be sure to readjust the ion trap after adjusting the picture positioning lever or repositioning the focus coil.

The 16TP4 picture tube uses ion trap, part number 94A15-2; the 16RP4 tube uses ion trap, 94A15-1. The part number is stamped on the ion trap magnet. The wrong ion trap may cause shaded corners or insufficient picture brightness.



Chassis Views Showing Adjustment Locations.



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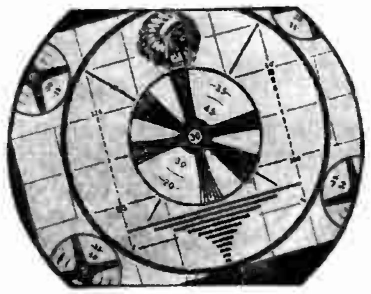
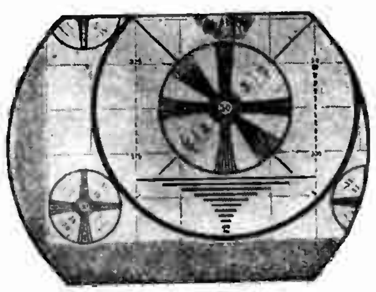
CHECK PICTURE TILT

If the picture is tilted, loosen the wing nut "H" on the deflection yoke coil and slightly rotate the yoke "E" until the picture is straight. Before tightening the wing nut, be sure that the yoke is moved as far forward as possible, otherwise corners of the picture may become shaded.


Picture Tilted; Adjust Deflection Yoke Coil.

CHECK PICTURE CENTERING

If the picture is off center, it can be centered by using the picture positioning lever, and when necessary, re-positioning the focus coil around the picture tube neck. Follow the instructions given below. *Note that the picture positioning lever can be moved sideways, or up and down.*


Picture Not Centered; Adjust Picture Positioning Lever.

Picture Slightly Off Center

a. Adjust ion trap as instructed on preceding page.
b. Slightly loosen the screw "A" which locks the picture positioning lever to the focus coil, adjust the lever for correct picture centering.
c. Readjust the ion trap.

Picture Greatly Off Center

a. Adjust ion trap as instructed on preceding page.
b. Slightly loosen the two screws "B" which hold the focus coil to the yoke bracket. Center focus coil around the tube neck; tighten screws.
c. Loosen the screw "A" and center the picture with the picture positioning lever. If the picture cannot be centered with the lever, it may be necessary to locate the focus coil slightly off center and then center the picture with the picture positioning lever.
d. Readjust the ion trap.

Difficulty in Centering Picture or Eliminating Shaded Corners

a. Loosen screws "G", then move the yoke support bracket forward until rubber grommet "F" is firmly against the flare of the picture tube.

b. Push the deflection yoke coil "E" as far forward as possible. In some cases, it may be necessary to loosen the two yoke bracket support screws "D" at the sides of the upper mounting bracket, move the bracket up or down, and then move the deflection yoke coil as far forward as possible.

Shaded corners may also result from use of the wrong ion trap. The 16TP4 picture tube uses ion trap 94A15-2; the 16RP4 picture tubes uses ion trap 94A15-1. The part number is stamped on the ion trap magnet.

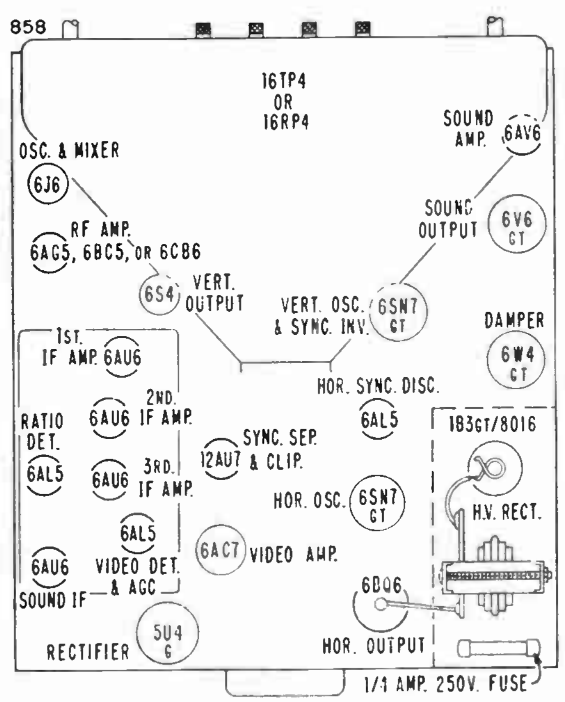
SCHEMATIC NOTES

[1], [2], [3] etc. are run numbers and indicate a production change. Run numbers are rubber stamped at rear of chassis.

(A1), (A2),......(Y), (Z), etc. indicate alignment points and alignment connections.

TV VOLTAGE DATA
(Voltages given on schematic diagram)

- PICTURE control turned fully clockwise. CHANNEL control set on an unused channel. Other front controls set at approximately half rotation. Vert. Lin. and Height set at approximately half rotation.
- Voltages marked with an asterisk * will vary widely with control setting.
  In combination models, B+ voltages in TV chassis will be slightly higher when set is switched to radio position. Alternate voltage readings for radio and TV are shown for sound output tube V204 (6V6GT).
- Line voltage 117 volts AC.
- Voltages measured with a vacuum tube voltmeter between tube socket terminals and chassis, unless otherwise indicated.
  Voltages at V101, V102, V306 measured from top of socket with tube removed.



Top View of Chassis.

- Antenna disconnected from set with terminals shorted.
- Under operating conditions, AGC (Automatic Gain Control) voltage developed at pin 1 of V301 (6AU6) should measure approximately —3 volts. This voltage depends on picture signal strength and Picture control setting.

CAUTION

Pulsed high voltages are present on the cap of the 6BQ6GT tube, and on the filament terminals and cap of the 1B3GT tube. NO ATTEMPT SHOULD BE MADE TO TAKE MEASUREMENTS FROM THESE POINTS UNLESS SUITABLE TEST EQUIPMENT IS AVAILABLE.

Picture tube 2nd anode voltage can be measured from the 2nd anode connector and should be taken only with a high voltage instrument such as a kilovoltmeter. 2nd anode voltage is approximately 12.5 KV. Proper filament voltage check of the 1B3GT tube may be made by observing filament brilliancy as compared with that obtained with a 1.5 volt dry cell battery.

RADIO VOLTAGE DATA
(Voltages given on schematic diagram)

- Line voltage 117 volts AC.
- Voltages measured with a vacuum tube voltmeter, between tube terminals and chassis.
- Voltages measured with band switch on FM position, unless otherwise indicated; an AM reading is given where difference is significant.
- Volume control set at minimum.
- Dial turned to low frequency end.
- Antennas disconnected.

▲When R602 is 240 ohms, voltage on pin 1 of V601 is 152 volts, pin 2 is —.5 volts, pin 6 is 152 volts and pin 8 is 1.9 volts.
When R602 is 1500 ohms, voltage on pin 1 of V601 is 160 volts, pin 2 is —3 volts, pin 6 is 160 volts and pin 8 is 3 volts.

IMPROVED NOISE IMMUNITY IN THE HORIZONTAL SYNC CIRCUIT OF 21B1 AND 21C1 CHASSIS

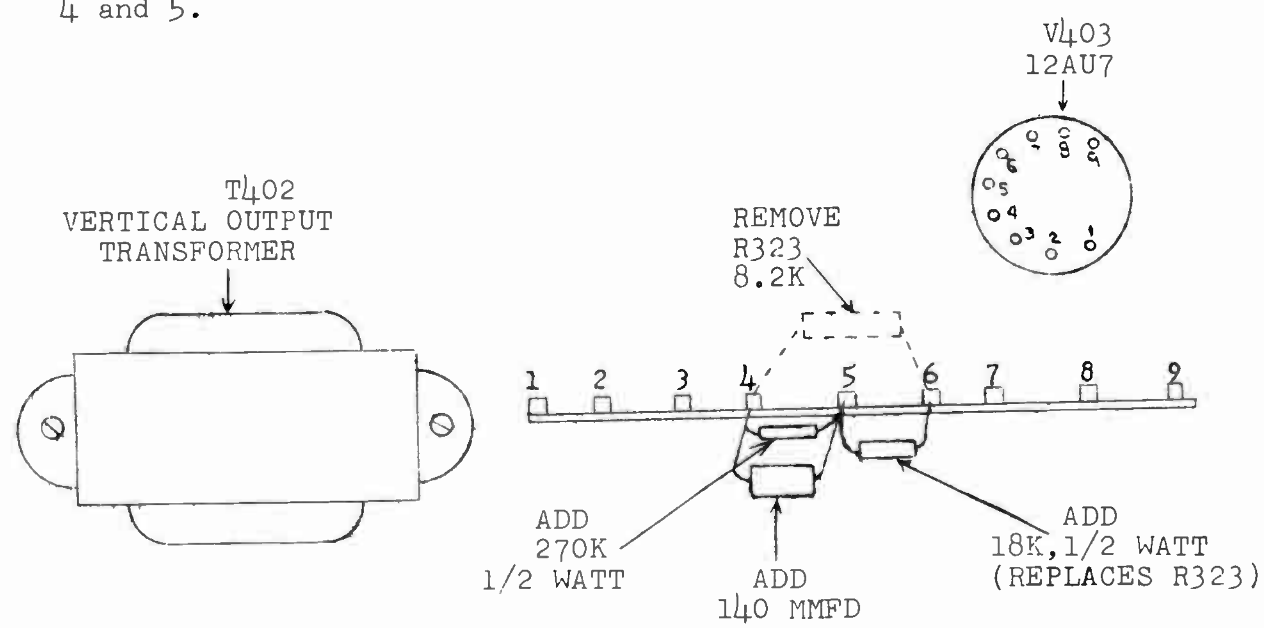
In some areas where the noise level is high, the noise peaks may affect the sync sircuit and cause the picture to shake horizontally or lose horizontal sync.

A change in resistor value and an additional filter in the sync circuit has been incorporated in late production to reduce this trouble.

The circuit change began with run 2 of 21B1 chassis and run 5 of 21C1 chassis.

Early production receivers may be modified by following the procedure given below:

1. Locate a 9 lug terminal strip adjacent to the vertical output transformer.
2. Remove R323 (8200 ohms) from lugs 4 and 6.
3. Connect an 18,000 ohm 1/2 watt resistor (part number 60B8-183) between lugs 5 and 6.
4. Connect a 140 μμfd condenser (part number 65B1-26 with a 270K 1/2 watt resistor, (part number 60B8-274) in parallel between lugs 4 and 5.



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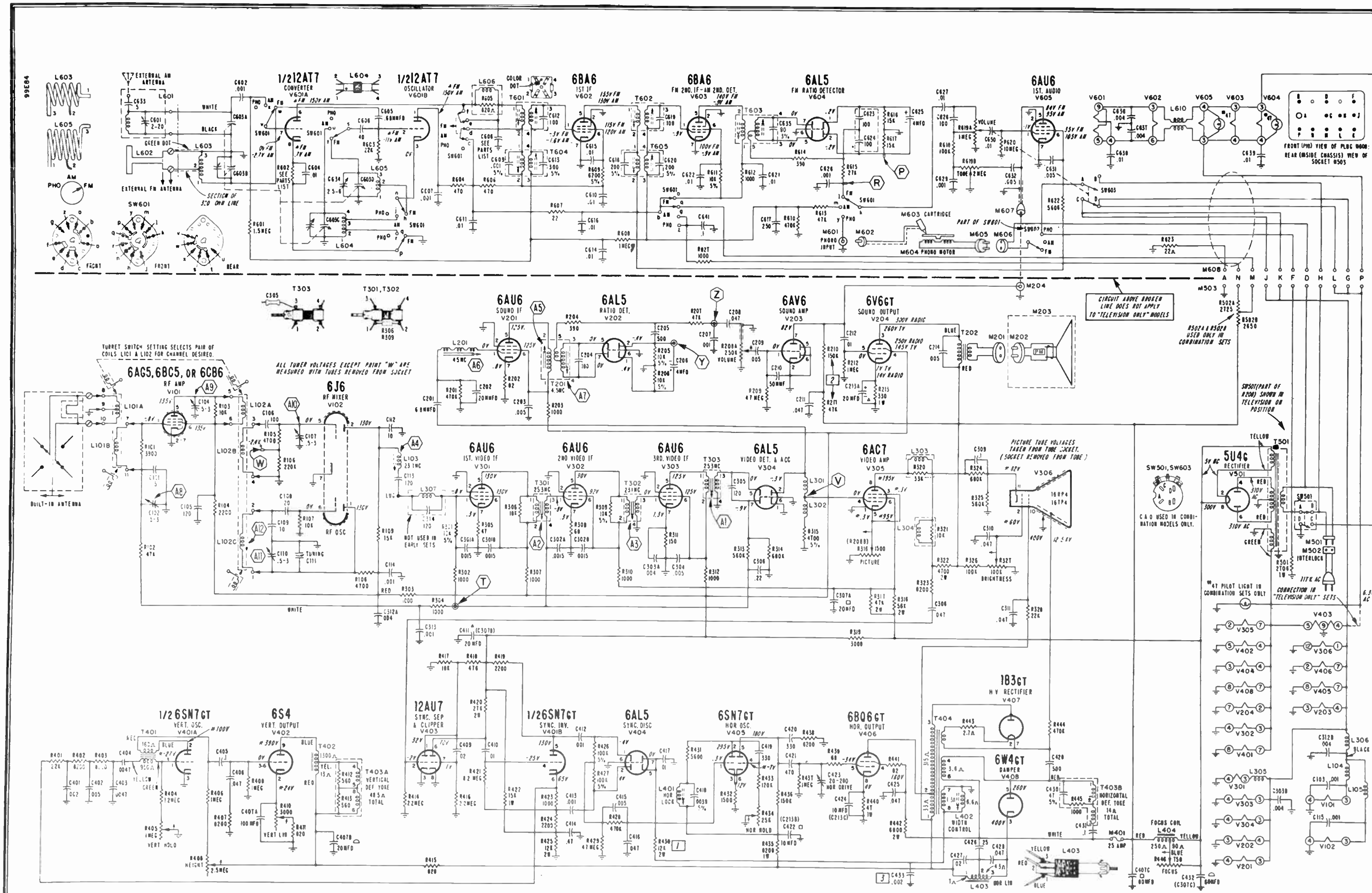

Schematic for 21B1, 21C1 Television Chassis; 5D2 radio circuit and connections also shown.

RECORD CHANGERS: Model RC500, See page RCD.CH.21-1; Model RC550, See page RCD.CH.21-9.

MODELS 36R37, 36R45, 36R46, Ch. 21B1, 21C1, Radio Ch. 5D2

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PRODUCTION CHANGES

RUN 1 in 21C1 CHASSIS

Resistor R430 was changed from 12,000 ohms, ½ watt to 12,000 ohms, 2 watt (part #60B20-123). This change was made to prevent possible increase in resistance of R430 due to increased power dissipation.

RUN 2 in 21C1 CHASSIS

In early sets R210 was 270,000 ohms; R211 was 100,000 ohms. In later sets R210 was changed to 150,000 ohms, ½ watt (part #60B8-154); R211 was changed to 47,000 ohms, ½ watt (part #60B8-473). This change resulted in improved audio response on radio operation.

RUN 3 in 21C1 CHASSIS

Condenser C433, .002 mfd, 600 volts (part #64B5-14) was added across width control L402 to increase sweep width.

INTERFERENCE TRAP ADDED

Later production sets have an Adjacent Channel Interference Trap added between the connector lug (terminal of C113) on the TV tuner and pin 1 of 1st video IF amplifier V301 (6AU6). This trap consists of L307 and C314; it has part number 72A102.

IMPORTANT

This preliminary service data contains the complete electrical parts list for models using the 21B1, 21C1 television chassis and for the 5D2 (AM-FM) radio chassis. It also includes cabinet parts for models 36R37, 36R45, 36R46. It contains alignment data for the television chassis.

This TV chassis uses a 16" rectangular picture tube. It uses an improved intercarrier sound system (adjacent channel trap and improved sound take-off) and Automatic Gain Control circuits which are similar to the 20X1, 20Y1, 20Z1 chassis. Sweep circuits are similar to 24D1, 24E1, 24F1, 24G1, 24H1 chassis.

Model RC500 or Model RC550 record changer is used.

21B1, 21C1, 5D2 CHASSIS PARTS

RESISTORS

Sym.	Description	Part No.
†R101	3,900 ohms, 1/2 watt	98A 45-16
R102	47,000 ohms, 1/2 watt	98A 45-17
R103	10,000 ohms, 1/2 watt	98A 45-18
R104	2,200 ohms, 1/2 watt	98A 45-19
†R105	4,700 ohms, 1/2 watt	98A 45-20
R106	220,000 ohms, 1/2 watt	98A 45-21
R107	10,000 ohms, 1/2 watt	98A 45-18
†R108	4,700 ohms, 1/2 watt	98A 45-20
R109	15,000 ohms, 1/2 watt	98A 45-67
R201	470,000 ohms, 1/2 watt	60B 8-474
R202	82 ohms, 1/2 watt, carbon resistor only	60B 28-31
R203	1,000 ohms, 1/2 watt	60B 8-102
R204	390 ohms, 1/2 watt	60B 8-391
R205	10,000 ohms, 1/2 watt, 5%	60B 7-103
R206	10,000 ohms, 1/2 watt, 5%	60B 7-103
R207	47,000 ohms, 1/2 watt	60B 8-473
R208A	250,000 ohms, Volume	75B 11-16
R208B	1,500 ohms, Picture (R208 includes switch SW501)	75B 11-16
R209	4.7 megohms, 1/2 watt	60B 8-475
R210	150,000 ohms, 1/2 watt	60B 8-154
R211	47,000 ohms, 1/2 watt	60B 8-473
R212	1 megohm, 1/2 watt	60B 8-105
R213	330 ohms, 1 watt	60B 14-331
R301	10,000 ohms, 1/2 watt, 5%	60B 7-103
R302	1,000 ohms, 1/2 watt	60B 8-102
R303	1,000 ohms, 1/2 watt	60B 8-102
R304	1,000 ohms, 1/2 watt	60B 8-102
R305	47 ohms, 1 watt	60B 14-470
R306	18,000 ohms, 1/2 watt	60B 8-183
R307	1,000 ohms, 1/2 watt	60B 8-102
R308	68 ohms, 1/2 watt, carbon resistor only	60B 28-44
R309	10,000 ohms, 1/2 watt, 5%	60B 7-103
R310	1,000 ohms, 1/2 watt	60B 8-102
R311	150 ohms, 1/2 watt	60B 8-151
R312	1,000 ohms, 1/2 watt	60B 8-102
R313	560,000 ohms, 1/2 watt	60B 8-564
R314	680,000 ohms, 1/2 watt	60B 8-684
R315	4,700 ohms, 1/2 watt, 5%	60B 7-472
R316	Picture control	See R208B
R317	47,000 ohms, 2 watt	60B 20-473
R318	56,000 ohms, 2 watt	60B 20-563
R319	3,000 ohms, 15 watt, candohm	61A 3-14
R320	33,000 ohms, 1/2 watt	Part of L303
R321	10,000 ohms, 1/2 watt	Part of L304
R322	4,700 ohms, 2 watt	60B 20-472
R323	8,200 ohms, 1/2 watt	60B 8-822
R324	680,000 ohms, 1/2 watt	60B 8-684
R325	560,000 ohms, 1/2 watt	60B 8-564
R326	100,000 ohms, 1/2 watt	60B 8-104
R327	100,000 ohms, Brightness	75B 13-12
R328	22,000 ohms, 1/2 watt	60B 8-223
R401	22,000 ohms, 1/2 watt	60B 8-223
R402	8,200 ohms, 1/2 watt	60B 8-822
R403	8,200 ohms, 1/2 watt	60B 8-822
R404	1.5 megohms, 1/2 watt	60B 8-155
R405	1 megohm, Vertical Hold	75B 13-14
R406	1 megohm, 1/2 watt	60B 8-105
R407	8,200 ohms, 1/2 watt	60B 8-822
R408	2.5 megohms, Height	75B 13-3
R409	1 megohm, 1/2 watt	60B 8-105
R410	3,000 ohms, Vert. Lin.	75B 13-7
R411	820 ohms, 1/2 watt	60B 8-821
R412	560 ohms, 1/2 watt	60B 8-561
R413	560 ohms, 1/2 watt	60B 8-561
R414	2.2 megohms, 1/2 watt	60B 8-225
R415	820 ohms, 2 watt	60B 20-821
R416	2.2 megohms, 1/2 watt	60B 8-225
R417	18,000 ohms, 1/2 watt	60B 8-183
R418	47,000 ohms, 1 watt	60B 14-473
R419	2,200 ohms, 1/2 watt	60B 8-222
R420	27,000 ohms, 2 watt	60B 20-273
R421	8.2 megohms, 1/2 watt	60B 8-825
R422	15,000 ohms, 1 watt	60B 14-153
R423	1,000 ohms, 1/2 watt	60B 8-102
R424	2,200 ohms, 1/2 watt	60B 8-222
R425	12,000 ohms, 2 watt	60B 20-123
R426	100,000 ohms, 1/2 watt, 5%	60B 7-104
R427	100,000 ohms, 1/2 watt, 5%	60B 7-104
R428	470,000 ohms, 1/2 watt	60B 8-474
R429	4.7 megohms, 1/2 watt	60B 8-475
R430	12,000 ohms, 2 watt	60B 20-123
R431	5,600 ohms, 1/2 watt	60B 8-562
R432	1,500 ohms, 1/2 watt	60B 8-152
R433	120,000 ohms, 1/2 watt	60B 8-124
R434	25,000 ohms, Hor. Hold	75B 13-13
R435	8,200 ohms, 1 watt	60B 14-822
R436	150,000 ohms, 1/2 watt	60B 8-154
R437	1 megohm, 1/2 watt	60B 8-105
R438	8,200 ohms, 1/2 watt	60B 8-822
R439	68 ohms, 1/2 watt, carbon resistor only	60B 28-44
R440	47 ohms, 1/2 watt, carbon resistor only	60B 28-45
R441	82 ohms, 1/2 watt, carbon resistor only	60B 28-31
R442	6,800 ohms, 2 watt	60B 20-682
R443	2.7 ohms, 1/2 watt	60B 28-47
R444	470,000 ohms, 1 watt	60B 14-474
R445	1,000 ohms, 1/2 watt	60B 8-102
R446	750 ohms, Focus	75B 13-16
R501	270,000 ohms, 1 watt	60B 14-274
R502A	2,725 ohms, 2.5 watt, candohm	61A 5-8
R502B	2,650 ohms, 10 watt, candohm	61A 5-8
R602	240 ohms, 1/2 watt, 5% (used in early 5D2 sets)	60B 7-241
	1,500 ohms, 1/2 watt (used in late 5D2 sets)	60B 8-152
	Before replacing, see 5D2 production change on reverse side.	
R603	22,000 ohms, 1/2 watt	60B 8-223
R604	470 ohms, 1/2 watt	60B 8-471
R605	820 ohms, 1/2 watt	Part of L606
R606	470 ohms, 1/2 watt	60B 8-471
R607	22 ohms, 1/2 watt	60B 8-220
R608	1 megohm, 1/2 watt	60B 8-105
R609	6,200 ohms, 1/2 watt, 5%	60B 7-622
R610	470,000 ohms, 1/2 watt	60B 8-474
R611	10,000 ohms, 1/2 watt	60B 8-103
R612	1,000 ohms, 1/2 watt	60B 8-102
R613	47,000 ohms, 1/2 watt	60B 8-473
R614	390 ohms, 1/2 watt	60B 8-391
R615	27,000 ohms, 1/2 watt	60B 8-273
R616	15,000 ohms, 1/2 watt	60B 8-153
R617	15,000 ohms, 1/2 watt	60B 8-153
R618	100,000 ohms, 1/2 watt	60B 8-104
R619A	1 megohm, Volume, Dual control	75B 11-12
R619B	2 megohms, Tone, Dual control (R619 includes on-off switch SW603)	75B 11-12
R620	10 megohms, 1/2 watt	60B 8-106
R622	560,000 ohms, 1/2 watt	60B 8-564
R623	22 ohms, 1/2 watt	60B 8-220
R627	1,000 ohms, 1 watt	60B 14-102

†To secure proper high frequency characteristics, order exact part from Admiral distributor or use IRC metalized resistor only.

CONDENSERS

Sym.	Description	Part No.
C101	5 mmfd, ±.5 mmfd, Zero temp. coeff.	98A 45-22
C102	.5 to 3 mmfd, ceramic trimmer	98A 45-87
C103	.001 mfd. min, ceramic	98A 45-24
C104	.5 to 3 mmfd, ceramic trimmer	98A 45-23
C105	120 mmfd, 5%, ceramic, -750 temp. coeff.	98A 45-25
C106	100 mmfd, ceramic, -750 temp. coeff.	98A 45-26
C107	.5 to 3 mmfd, ceramic trimmer	98A 45-23
C108	20 mmfd, Cer. Zero temp. coeff.	98A 45-27
C109	10 mmfd, 5%, ceramic, -750 temp. coeff.	98A 45-79
C110	.5 to 3 mmfd, ceramic trimmer	98A 45-23
C111	.3 to 5 mmfd, fine tuning rotor	98A 45-92
C112	10 mmfd, 5%, ceramic, Zero temp. coeff.	98A 45-64
C113	120 mmfd, 10%, silver mica	98A 45-78
C114	.001 mfd. min, ceramic	98A 45-24
C115	.001 mfd. min, ceramic	98A 45-24
C201	6.8 mmfd, -.00033 temp. coeff.	65B 6-71
C202	20 mmfd, 5%, ceramic	65B 6-51
C203	.005 mfd, ceramic	65A 10-1
C204	180 mmfd, 5%, -.00003 temp. coeff.	65B 6-59
C205	500 mmfd, ceramic	65B 6-6
C206	4 mfd, 50 V., electrolytic	67A 4-9
C207	.001 mfd, ceramic	65B 6-41
C208	.047 mfd, 200 volts, paper	64B 9-41
C209	.005 mfd, ceramic	65A 10-1
C210	50 mmfd, ceramic	65B 6-4
C211	.047 mfd, 400 volts, paper	64B 9-28
C212	.01 mfd, 400 volts, paper	64B 5-25
C213A	20 mfd, 25 V., electrolytic	67C 15-19
C213B	10 mfd, 25 V., electrolytic	67C 15-19
C213C	10 mfd, 450 V., electrolytic	67C 15-19
C214	.005 mfd, 600 volts, paper	64B 5-12
C301A	.0015 mfd., dual ceramic	65A 17-2
C301B	.0015 mfd., dual ceramic	65A 17-2
C302A	.0015 mfd., dual ceramic	65A 17-2
C302B	.0015 mfd., dual ceramic	65A 17-2
C303A	.004 mfd., dual ceramic	65A 17-1
C303B	.004 mfd., dual ceramic	65A 17-1
C304	.005 mfd, ceramic	65A 10-1
C305	120 mmfd, ceramic	65B 6-66
C306	.22 mfd, 200 volts, paper	64B 8-37
C307A	20 mfd, 350 V., electrolytic	67C 15-17
C307B	20 mfd, 350 V., electrolytic	67C 15-17
C307C	60 mfd, 400 V., electrolytic	67C 15-17
C308	.047 mfd, 400 volts, paper	64B 9-28
C309	.1 mfd, 400 volts, paper	64B 5-20
C310	.047 mfd, 400 volts, paper	64B 9-28
C311	.047 mfd, 600 volts, paper	64B 8-9
C312A	.004 mfd., dual ceramic	65A 17-1
C312B	.004 mfd., dual ceramic	65A 17-1
C313	.001 mfd, ceramic	65B 6-41
C314	120 mmfd, 3%, mica	65B 1-10
C401	.002 mfd, 600 volts, paper	64B 5-14
C402	.005 mfd, 600 volts, paper	64B 5-12
C403	.0047 mfd, mica	65B 21-472
C404	.0047 mfd, mica	65B 21-472
C405	.1 mfd, 600 volts, paper	64B 5-5
C406	.047 mfd, 600 volts, paper	64B 8-9
C407A	100 mfd, 50 V., electrolytic	67C 15-18
C407B	20 mfd, 450 V., electrolytic	67C 15-18
C407C	80 mfd, 350 V., electrolytic	67C 15-18
C409	.02 mfd, 400 volts, paper	64B 5-24
C410	.01 mfd, 400 volts, paper	64B 5-25
C411	Electrolytic	See C307B
C412	.001 mfd, mica	65B 21-102
C413	.001 mfd, mica	65B 21-102
C414	.47 mfd, 400 volts, paper	64B 9-72
C415	.005 mfd, 600 volts, paper	64B 5-12
C416	.047 mfd, 400 volts, paper	64B 9-28
C417	.01 mfd, 400 volts, paper	64B 5-25
C418	.0039 mfd, 5%, silver mica	65B 1-63
C419	330 mmfd, mica	65B 21-331
C420	330 mmfd, mica	65B 21-331
C421	470 mmfd, mica	65B 21-471
C422	Electrolytic	See C213B
C423	20 to 280 mmfd, trimmer, Hor. Drive	66A 30-1
C424	Electrolytic	See C213C
C425	.047 mfd, 600 volts, paper	64B 5-7
C426	.25 mfd, 600 volts, paper	64B 5-3
C427	.02 mfd, 400 volts, paper	64A 2-9
C428	.047 mfd, 200 volts, paper	64A 2-8
C429	500 mmfd, 20,000 V., ceramic	65B 18-5
C430	47 mmfd, 5%, 1,500 volts, silver mica	65B 1-64
C431	.1 mfd, 400 volts, paper	64A 2-10
C432	Electrolytic	See C307C
C433	.0022 mfd, 600 volts, paper	64B 9-11
C601	2 to 20 mmfd, trimmer	Part of L601
C602	.001 mfd. min, ceramic	65B 6-41
C603A	486 mmfd. (max.) AM RF, gang	68B 24
C603B	15 mmfd. (max.) FM RF, gang	68B 24
C603C	114 mmfd. (max.) AM Osc., gang	68B 24
C603D	15 mmfd. (max.) FM Osc., gang (Dial drum spotwelded to gang.)	68B 24
C604	.01 mfd. min, ceramic	65A 10-3
C605	.68 mmfd, ceramic	65A 16-1
C606	40 mmfd, ceramic, -.000750 temp. coeff.	65B 6-67
C607	.001 mfd, ceramic	65B 6-41

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C608	40 mmfd, silver mica (used in early 5D2 sets)	65B 1-65
	30 mmfd, silver mica (used in late 5D2 sets)	65B 1-69
	Before replacing, see 5D2 procedure change on reverse side.	
C609	.001 mfd, silver mica, 5%	Part of T604
C610	.01 mfd. min, ceramic	65A 10-3
C611	.01 mfd. min, ceramic	65A 10-3
C612	100 mmfd, silver mica, 5%	Part of T601
C613	300 mmfd, silver mica, 5%	Part of T604
C614	.01 mfd. min, ceramic	65A 10-3
C615	.01 mfd. min, ceramic	65A 10-3
C616	.01 mfd. min, ceramic	65A 10-3
C617	250 mmfd, ceramic	65B 6-5
C618	200 mmfd, silver mica, 5%	Part of T605
C619	100 mmfd, silver mica, 5%	Part of T602
C620	200 mmfd, silver mica, 5%	Part of T605
C621	.01 mfd. min, ceramic	65A 10-3
C622	.01 mfd. min, ceramic	65A 10-3
C623	100 mmfd } dual ceramic	63A 7-1
C624	100 mmfd	
	If a section of this dual condenser becomes defective, replace with exact duplicate or two condensers of the same value with a tolerance within 10% of each other.	
C625	4 mfd, 150 volts, electrolytic	67A 4-2
C626	.001 mfd. min, ceramic	65B 6-41
C627	.01 mfd. min, ceramic	65A 10-3
C628	100 mmfd, ceramic, -.000750 temp. coeff	65B 6-68
C629	.001 mfd, ceramic	65B 6-41
C630	.01 mfd. min, ceramic	65A 10-3
C631	.1 mfd, 400 volts, paper	64B 1-20
C632	.005 mfd. min. ceramic	65A 10-1
C633	5 mmfd, ceramic	65B 6-61
C634	2.5 to 6 mmfd, ceramic trimmer	66A 28-1
C635	90 mmfd, silver mica, 3%	Part of T603
C636	.004 mfd. min } dual ceramic	65A 17-1
C637	.004 mfd. min	
C638	.01 mfd. min, ceramic	65A 10-3
C639	.01 mfd. min, ceramic	65A 10-3
C641	.1 mfd, 400 volts, paper	64B 1-20

COILS and TRANSFORMERS

Sym.	Description	Part No.
L101	Antenna Coil	
	for Channel #2	98A 62-2
	for Channel #3	98A 62-3
	for Channel #4	98A 62-4
	for Channel #5	98A 62-5
	for Channel #6	98A 62-6
	for Channel #7	98A 62-7
	for Channel #8	98A 62-8
	for Channel #9	98A 62-9
	for Channel #10	98A 62-10
	for Channel #11	98A 62-11
	for Channel #12	98A 62-12
	for Channel #13	98A 62-13
L102	Mixer-Oscillator Coil	
	for Channel #2	98A 63-2
	for Channel #3	98A 63-3
	for Channel #4	98A 63-4
	for Channel #5	98A 63-5
	for Channel #6	98A 63-6
	for Channel #7	98A 63-7
	for Channel #8	98A 63-8
	for Channel #9	98A 63-9
	for Channel #10	98A 63-10
	for Channel #11	98A 63-11
	for Channel #12	98A 63-12
	for Channel #13	98A 63-13
	Before inserting replacement coil L101 or L102, see that teeth at inner end of coils fit together when fitted in detent plate at center of turret. If necessary file teeth slightly.	
L103	Mixer Plate Coil	98A 45-77
L104	Heater RF Choke	98A 45-13
L105	Heater Oscillator Choke	98A 45-14
L201	Sound Take-off Coil (includes R201, C201, C202)	72B 99-1
L301	Video Peaking Coil	73A 5-12
L302	Video Peaking Coil	73A 5-7
L303	Video Peaking Coil (wound on R320)	73A 5-13
L304	Video Peaking Coil (wound on R321)	73A 5-9
L305	Heater RF Choke	73A 2-5
L306	Heater RF Choke	73A 2-5
L307	Trap Coil (includes C314)	72A 102
L401	Horizontal Lock Coil (includes C418 and R431)	94A 17
L402	Width Control	94A 29-1
L403	Horizontal Linearity Control	94A 28
L404	Focus Coil	69C 117-3
L601	AM Loop Antenna, includes C601	69C 116-1
L602	FM Antenna	AB195
L603	FM Antenna Coil	69A 85
L604	AM Oscillator Coil	69A 86-1
L605	FM Oscillator Coil	69A 87
L606	FM Peaking Coil (wound on R605)	73A 5-11
L610	RF Dual Choke	69A 102
T201	Ratio Detector Transformer	72B 68
T202	Audio Output Transformer	
	for 21B1 chassis	79C 33-1
	for 21C1 chassis	79C 33-2
T301	1st IF Transformer (includes R306, R307, C302A, C302B)	72C 96-6
T302	2nd IF Transformer (includes R309)	72C 96-7
T303	3rd IF Transformer (includes C305)	72C 96-8
T401	Blocking Oscillator Transformer	79A 18-2
T402	Vertical Output Transformer	79B 29-1
T403	Deflection Yoke (includes R412, R413, R445, C430)	A3222
T404	Horizontal Output Transformer (includes tube cap clips)	79C 30-2
T501	Power Transformer	80C 26-1
T601	1st IF (FM) Transformer	
	for early 5D2 sets	72B 98
	for late 5D2 sets	72B 98-1
	Before replacing, see 5D2 procedure change on reverse side.	
T602	2nd IF (FM) Transformer	72B 76
T603	Ratio Det. Transformer	72B 39
T604	1st IF (AM) Transformer	
	for early 5D2 sets	72B 97
	for late 5D2 sets	72B 97-1
	Before replacing, see 5D2 procedure change on reverse side.	
T605	2nd IF (AM) Transformer	72B 94

MISCELLANEOUS PARTS for TV CHASSIS

Sym.	Description	Part No.
M201	Speaker Socket	88A 5-6
M202	Speaker Plug	88A 5-5
M203	Speaker	
	5" PM	78B 59-1
	8" PM	78B 49-1
	12" PM	78B 56-2
M204	Socket, Audio Input	88A 1
M401	Horizontal Output Fuse, 1/4 amp., 250 volts	84A 4-2
	Fuse Holder	84A 5-1
M501	Interlock Socket (Male)	89A 22-2
M502	Line Cord, with interlock socket	89A 22-1
M503	Cable Socket (Combination models only)	88A 20-2
SW501	Switch, On-Off Power (S.P.D.T.)	Part of R208
V306	Picture Tube	16RP4 or 16TP4
	Bracket, Deflection Yoke Holding	15A 572
	Bracket, Picture Tube Mounting (Supports front of picture tube)	
	Right side (facing tube)	15B 615-1
	Left side (facing tube)	15B 615-2
	Bracket (for mtg. picture tube and focus coil)	
	Top	15C 613
	Bottom	15C 614
	Bracket, Tuner Shaft (Bakelite)	32A 111-1
	Clamp, Picture Tube Front Mounting Bracket (clamps bracket to chassis)	15A 616
	Clamp, Webbing (for mtg. picture tube)	15A 526
	Clip, Tube Cap	
	for 6BQ6GT tube	88A 16-8
	for 1B3GT tube	19A 54
	Connector Lead, 2nd Anode (includes plug)	88A 16-7
	Cover, IF Strip	15B 641
	Fuse Holder	84A 5-1
	Insulating Plate (for 2nd anode filter condenser mtg.)	32A 135-1
	Ion Trap	
	for 16TP4 picture tube	94A 15-2
	for 16RP4 picture tube	94A 15-1
	Lever, Focus Coil Adjusting	15B 574
	Lock, 1B3 Mounting Shell Disk	15A 589
	Pilot Light (#47)	81A 1-8
	Pilot Light Socket (used in combination models)	82A 11-58
	Rubber Channel, 1" long (for picture tube bracket)	12A 9-11
	Rubber Collar (mounted over picture tube neck)	12B 40
	Rubber Grommet, 2nd Anode Housing	12A 2-7
	Rubber Insert, 1" diamter (bottom and side support of picture tube)	12A 16-1
	Rubber Strip, Adhesive (3/16"x3/8"x2" used under webbing band)	12A 5-6
	Shield, Tube	
	plain type	87A 7-7
	slotted type	98A 45-73
	Socket, Jewel Light	87A 6-3
	Socket, Shell (cover for 1B3 tube socket)	88A 27-1
	Socket, Tube	
	miniature bakelite (7 pin)	87A 3-7
	octal, plain	87A 5-1
	octal, ringmount (mica filled)	87A 20-2
	miniature (9 pin)	87A 25-1
	picture tube	87B 31-5
	Socket, Test (4 terminal)	10A 28
	Spring, Picture Tube Grounding	19A 23-2
	Tuner, Television (complete)	94A 18-4
	Webbing, Picture Tube Mtg. Strap (42" length)	50A 3-4

MISCELLANEOUS PARTS for TV TUNER 94C18-4

Sym.	Description	Part No.
M104	Shaft Shell & Rotor Assy. (Sharp Tuning) (with 4 1/16" long brass shaft shell)	98A 45-92
M107	Bracket, Sharp Tuning Rotor Retaining	98A 45-95
M108	Spring, Detent Plate Grounding	98A 45-94
M109	Shield, Tube (Slotted; for 6J6)	98A 45-73
M110	Shield, Tube (Plain; for 6AG5)	87A 7-7
M112	Spring, Slug Retaining (Osc. coil)	98A 45-52
M113	Washer, Fibre Spacer (1/4" IDx1/2" OD)	98A 45-63
M114	Nut, Locking Spring (for trimmers)	98A 45-31
M115	Screw, Trimmer (4-36x5/8")	98A 45-33
M116	Screw, Bracket Mtg. (6-32x1/4")	98A 45-62
M117	Slug, Brass Tuning	98A 45-88
M118	Stator Plate (ungrounded); Silver with Ceramic Insulator, for Sharp Tuning C111 (includes mtg. bracket)	98A 45-86
M120	Tuner, Television (complete)	94C 18-4
M121	Roller, Detent (3/8" dia., 3/32" dia. bearing)	98A 45-82
M122	Spring, Detent (2 5/16" long)	98A 45-81
M123	Contact Plate and Bracket Assembly (Uses Wiping Contacts)	98A 45-84
M124	Spring, Sharp Tuning Rotor Contact (Flat bronze 1 7/16"x1/2")	98A 45-83
M125	Spring, Front and Rear Turret Shaft (Wire 2 3/4" long, 3/64" dia.)	98A 45-85
M126	Turret and Shaft Assembly (less coils) (5 3/8" shaft and 3/16" rounded detent depression)	98A 45-91

MISCELLANEOUS PARTS for 5D2 RADIO

Sym.	Description	Part No.
M601	Socket, Phono Input	88A 1
M606	Socket, Phono Motor	88A 8-7
M607	Plug and Shielded Cable	89A 29-11
M608	Plug, 14 Pin	88A 20-1
	Cover, Plug (for M608)	88A 20-12
	Cable (9 wire), includes plug M608	AB216
	Socket and Leads, Pilot Light	82A 2-3
SW601	Switch, "PH-AM-FM" (includes SW602)	76B 22
SW602	Switch, Phono Motor	76B 23
SW603	Switch, ON-OFF Power (S.P.D.T.)	Part of R619
	Antenna Lead (300 ohm transmission line, 32" length)	95A 16-11
	Bracket, Tuning Sleeve	15A 394
	Clamp, Cable	11A 2-9
	Cover Assembly, Chassis	A1880
	Dial Back and Bracket Assembly	A3153
	Dial Cord (44" length)	50A 1-3
	Dial Scale	22B 22-1
	Escutcheon, Radio	23D 63-1
	Grommet, Rubber (Gang mounting)	12A 1-4
	Pilot Light (#47)	81A 1-8
	Plate, Switch	15A 409
	Pointer, Metal Dial	25A 37
	Pointer Cover, Plastic	25A 38
	Sleeve, Spacer (Gang mounting)	29A 2-10-71
	Sleeve, Spacer (AM loop mounting)	29A 3-15
	Snap Button (for mounting dial scale)	13A 1-1-71
	Socket, Tube	
	for Miniature Tube (7 pin)	87A 3-7
	for Miniature Tube (9 pin)	87A 25-2
	Speed Nut (for mtg. radio escutcheon)	2B 12-4-68
	Spring, Dial Cord Tension	19B 1-3
	Spring, Tube Retainer (for 12AT7)	19A 56-1

RECORD CHANGER PARTS

Model RC500 or Model RC550 record changers are used. The changer model number is on the top rear of the changer pan and also on the changer model label on the underside of the changer. For the RC500 changer refer to Service Manual No. S298; for the RC550 changer, refer to Service Manual No. S327.

Sym.	Description	Part No.
M602	Cable, Shielded (includes plug)	412A 11-2
M603	Cartridge, Push-in Needle Type (includes needle)	409A 13-1
	Cartridge, Knurled Nut Retaining Type (includes needle)	409A 13
M604	Motor (3 speed)	407B 19
M605	Plug, Motor (Male)	88A 8-1
	Adapter, 45 RPM (envelope of 12)	48A 8-1
	Belt, Rubber Drive	406A 20
	Idler Wheel Assembly (includes tire)	G400A 279
	Manual, Service	
	for RC500 changer	S298
	for RC550 changer	S327
	Needle, Phonograph	
	for 409A13 cartridge	98A 15-19
	for 409A13-1 cartridge	98A 15-18
	Needle Retaining Nut (for 409A13 cartridge)	98A 54-2
	Spring, Changer Float	405A 139
	Touch-Up Paint	
	Coppertone	98A 54-3
	Gold Hammertone	98A 54-12

PARTS for TILT-OUT MECHANISM

Description	Part No.
Eye Bolt (for tilt-out spring)	1A 87-1
Grommet, Rubber (for tilt-out spring)	12A 1-1
Hinge Assembly, Tilt-Out	
Left side (facing front)	AC183-1
Right side (facing front)	AC183-2
Screw, Tilt-Out Brkt. Shipping (10-24x3/8")	1A 51-25-71
Screw, Tilt-Out Adjusting Bracket Mtg. (#8-32x1/4" Bd. H.M.S.)	85-250-C2-71
Screw, Tilt-Out Tie Rod Mtg. (#6-32x1/4" Bd. H.M.S.)	365-250-C2-71
Spring, Tilt-Out Coil (2 3/8" unstretched)	19A 15-1
Spring, Tilt-Out Arm Retaining (7 1/4" unstretched)	19A 59
Tie Rod, Tilt-Out	28A 22-1

CABINET PARTS for 36R37 (Blond), 36R45 (Walnut), 36R46 (Mahogany)

The above model numbers may contain the suffix "N"

Part No.	Description
A3060	Antenna, Built-in TV
AB195	Antenna, Built-in FM
43C 129-1	Back, Radio-Phono and Record Compt.
A3224	Back, TV Compt. (Complete)
*35E 123-55	*Base, Cabinet (Legs), Blond
*35E 124-57	*Base, Cabinet (Legs), Walnut
*35E 124-58	*Base, Cabinet (Legs), Mahogany
*35E 123-3	*Cabinet, Blond
*35E 124-1	*Cabinet, Walnut
*35E 124-2	*Cabinet, Mahogany
44B 173	Carton and Fillers, for 36R37
44B 172	Carton and Fillers, for 36R45, 36R46
98A 60-7	Caster (for cabinet leg)
11A 2-6	Clamp, Cable
*35E 123-53	*Door, Record Compt. (Complete) Blond
*35E 124-53	*Door, Record Compt. (Complete) Walnut
*35E 124-54	*Door, Record Compt. (Complete) Mahog.
*35E 123-51	*Doors, TV and Radio-Phono Compt., Blond (matched pair)
*35E 124-50	*Doors, TV and Radio-Phono Compt., Walnut (matched pair)
*35E 124-51	*Doors, TV and Radio-Phono Compt., Mahogany (matched pair)
35E 124-56	Door Catch and Strike Plate, for Walnut and Mahogany
35E 123-59	Door Catch and Strike Plate, for Blond
23D 60-4	Escutcheon, Control (Plastic; less door)
23D 60-1	Escutcheon Door (Plastic)
23D 63-1	Escutcheon, Radio
98A 61-8	Gasket, Sponge Rubber (includes chipboard back for picture window)
36B 16-1	Grille, Metal, for Blond
36B 13	Grille, Metal, for Walnut and Mahogany
36B 13-1	Grille Rosette (for 36B13 grille)
36B 3-20	Grille Cloth (2 pieces) for Blond
36B 3-27	Grille Cloth (2 pieces) for Walnut & Mahog.
37A 23-1	Handle, Door (for upper doors) for Blond
37A 25-1	Handle, Door (for upper doors) for Walnut and Mahogany
33A 41-2	Handle, Door (for blond record compt. door)
35E 123-57	Hinge, Knife (Pair), for Blond
35E 124-55	Hinge, Knife (Pair), for Walnut & Mahog.
82A 10-8	Jewel, Pilot Light (Green)
33D 55-1	Knob, Radio, 'PH-AM-FM', 'Tuning'
33D 55-4	Knob, Radio, 'Off-Volume'
33D 55-5	Knob, Radio, 'Tone'
33C 53-9	Knob, TV, 'Channel'
33C 53-10	Knob, TV, 'Tuning'
33C 53-11	Knob, TV, 'Off-Volume'
33C 53-12	Knob, TV, 'Picture'
81A 1-8	Light, Pilot #47
89A 22-1	Line Cord and Interlock Socket
6A 4-6-0	Line Cord Mounting Rivet
1A 7-23-71	Screw, for mtg. picture window (#6x3/8 R.H.W.S.)
1A 7-9-57	Screw, for mtg. control escutcheon (#4x3/8 R.H.W.S.)
1A 7-24-71	Screw, for mtg. cabinet back (#6x1/2 R.H.W.S.)
1A 67-43-71	Screw, for mtg. TV chassis (1/4-20x1")
98A 44-47	Spacer, Fibre Cabinet Leveler (Kit of 6)
78B 56-2	Speaker, 12 inch PM
2B 10-24-59	Speed Nut (for mtg. radio escutcheon)
18A 45	Spring Clip (for mtg. picture window)
18A 41	Spring, Hinge (for mtg. escutcheon door)
18A 43-2	Spring, TV Knob Tension, "Off-Volume"
18A 43-1	Spring, TV Knob Tension, "Tuning"
18A 43-3	Spring, TV Knob Tension, "Channel"
	Tilt-Out Parts See "Parts For Tilt-Out Mechanism"
5A 4-14	Washer, Felt, behind "Channel" knob
5A 4-15	Washer, Felt, behind "Picture" knob
5A 4-11	Washer, Felt, behind radio knobs
23D 67	Window, Picture
	If only mounting tab is broken on picture window, a new metal tab (part number 15A668) can be installed with a soldering iron. Instructions (Form S340) included with tabs.

* To insure proper matching and fit, also specify cabinet manufacturer's code letters (usually burned or stamped on back rail of cabinet). Wood parts are supplied only if old part cannot be repaired. When ordering describe condition of old part in detail.

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TELEVISION ALIGNMENT PROCEDURE

ALIGNMENT ADJUSTMENT IDENTIFICATION

Adj.	Symbol	Frequency	Function	Adj.	Symbol	Frequency	Function
A1	T303	25.3 MC	3rd IF Transformer	A7	T201	4.5 MC	Secondary of Ratio Detector Transformer
A2	T301	25.3 MC	1st IF Transformer	A8	C102		Trimmer (RF Amplifier)
A3	T302	23.1 MC	2nd IF Transformer	A9	C104		Trimmer (RF Amplifier)
A4	L103	23.1 MC	Mixer Plate Coil	A10	C107		Trimmer (Mixer)
A5	T201	4.5 MC	Primary of Ratio Detector Transformer	A11	C110		Trimmer (HF Oscillator)
A6	L201	4.5 MC	Sound Take-off Coil	A12	L102		Slug, HF Oscillator Coils

IF AMPLIFIER ALIGNMENT

a. Before starting alignment, be sure IF cover shield is mounted to chassis.

b. Disconnect antenna and connect a jumper across antenna terminals.

c. Set receiver to channel 13 or other unassigned high channel to prevent signal interference during IF alignment.

d. Set Picture control fully to the right (clockwise). Retain this setting for all IF adjustments.

e. Allow about 15 minutes for receiver and test equipment to warm up.

f. To service TV chassis with radio disconnected, complete the heater circuit by connecting a jumper from pin "L" to pin "K" of socket M503. See schematic.

Step	Signal Gen. Freq. (MC)	VTVM and Signal Generator Connections	Instructions	Adjust
1	25.3	VTVM high side to test jack "T", common to chassis. Connect generator high side to 6J6 (V102) tube shield; insulate shield from chassis. Connect common to chassis near 6J6 tube base.	Use VTVM 3 volt DC scale. When peaking, keep reducing generator output for VTVM reading of approx. 1 volt or less.	A1 and A2 for maximum.
2	23.1			A3 and A4 for maximum.
3	To insure correct IF alignment, make the "IF Response Curve Check" given below, or make the "Overall RF and IF Response Curve Check (Step 1)" given later. The overall check should be made after making all other alignments.			

IF RESPONSE CURVE CHECK

(Using sweep generator and oscilloscope with sweep input to RF Mixer V102.)

Differences in tube gain and component values affect IF response. These differences are not apparent in alignment of IFs when using a signal generator and VTVM (single frequency alignment); hence it is preferable that an IF response curve check be made after completion of the IF amplifier alignment.

The IF response curve check can be made as indicated directly below. However, also note that a better check can be made by feeding the sweep signal through the entire RF and IF system as given under "Overall RF and IF Response Curve Check (Step 1)". The overall check should be made after making all other alignments.

a. Make all control settings and connections as given in the IF amplifier alignment chart; see "a" through "f" above.

b. Connect oscilloscope* between point "V" and chassis ground through a decoupling filter; see fig. 29. Keep leads away from receiver.

c. Connect sweep generator high side to tube shield of 6J6 (V102) osc-mixer tube. Be sure to insulate tube shield from chassis. Connect sweep generator common to chassis close to 6J6 tube base. Set sweep generator to sweep the IF band pass (19 to 29 MC).

d. Loosely couple marker generator high side to the sweep generator lead connected to tube shield on tuner; common to chassis ground.

To avoid distortion of the response curve, keep the sweep generator and marker generator outputs at a very minimum. Marker pips should be just kept barely visible. To minimize distortion, set sweep generator output for VTVM reading of approximately .5 volt DC, measured between test jack "T" and chassis. Connecting a 1½ volt battery (negative to test jack "T", positive to chassis) will allow greater signal input without distorting the response curve.

e. Check curve obtained against the ideal IF response curve shown in figure 28. Since it is not always possible to get ideal curves, it should be noted that the height of opposite peaks should be within 3db or 30% of each other. The dip or valley in the center of the curve should not be greater than 3db or 30% down from the highest peak of the curve. Check video and sound IF carrier points by means of marker generator. It is important that marker pips be in the proper location on the response curve. The 25.75 MC marker, should be 6db below the highest peak (50% point on the high frequency side of the curve). The 22 MC marker should be at the opposite side of the response curve, located approximately 18db (85%) below the highest peak. The 21.25 MC marker should be located at least 26db (95%) below the highest peak, and may or may not be visible.

Consistent with proper band width and correct location of markers, the response curve should preferably have maximum amplitude, symmetry, and flat top appearance.

If the procedure given has been carefully followed and the response curve obtained differs greatly from the curve shown in figure 28, repeat the IF Amplifier Alignment, making sure generator frequencies are precise and adjustments are accurately made.

* In dealing with RF and IF response curves, it is well to remember that an inverted or mirror image may result, depending on the sweep generator and oscilloscope used. The general waveform should still be identical.
When using a wide band oscilloscope for alignment, marker pips will be more distinct if condenser from 100 to 1,000 mmfd. is connected across the oscilloscope input. Caution: Use the smallest condenser possible, since too high a capacity will affect the shape of the response curve.

ALIGNMENT HINT

After becoming familiar with alignment procedure, some servicemen simplify subsequent alignment of sets by merely using the essential alignment data given in figures 29 and 30.

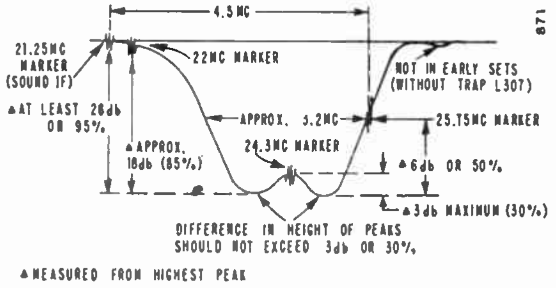

Figure 28. IF Response Curve.

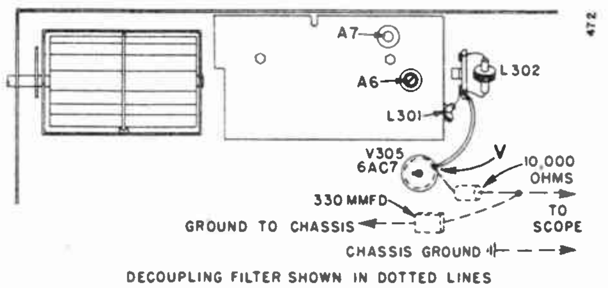

Figure 29. Bottom View Showing Test Point "V".

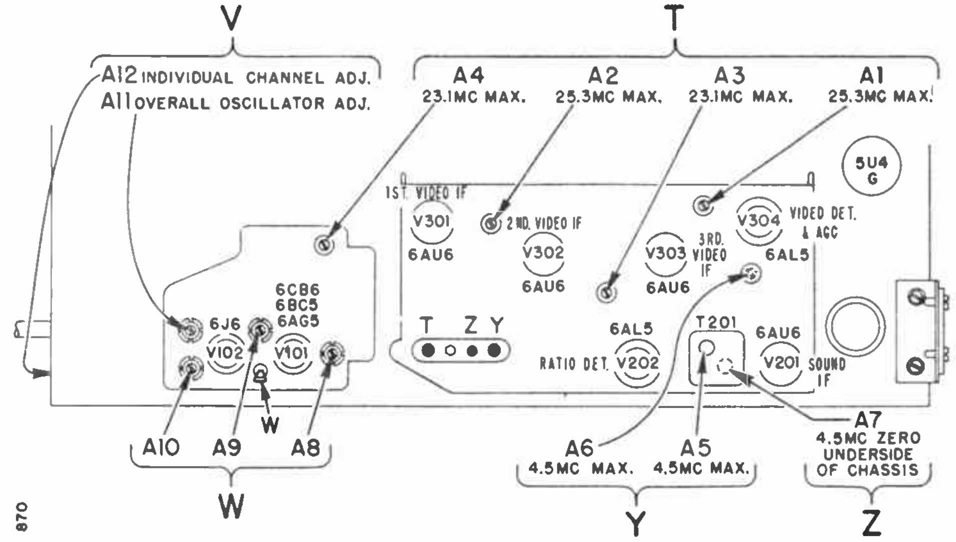

Figure 30. Top View of Chassis Showing Alignment Adjustment Locations.

4.5 MC SOUND IF ALIGNMENT

a. Disconnect antenna and connect a wire jumper across antenna terminals.

b. Set Picture control fully to the right (clockwise).

c. Connect signal generator high side to point "V" through a .01 mfd. condenser.

d. Allow about 15 minutes for receiver and test equipment to warm up.

e. Use a NON-METALLIC alignment tool. If Ratio Det. Transformer (T201) has hollow core slugs, bottom slug adjustment A7 can be made from top of chassis, if you use alignment tool #98A30-7 obtainable from Admiral Distributor. Bottom slug (A7) can be reached through the hole in the core of the upper slug (A5).

f. To service TV chassis with radio disconnected, complete the heater circuit by connecting a jumper from pin "L" to pin "K" of socket M503. See schematic.

Step	Signal Gen. Freq. (MC)	VTVM Connections	Instructions	Adjust
	Since the transmitted video and sound carriers have an accurate 4.5 MC frequency difference, a TV station signal may be used instead of a signal generator for alignment of steps below. When using a television signal, it may be necessary to use a higher scale on the VTVM. IMPORTANT: When using a signal generator, be sure to check it against a crystal calibrator or other frequency standard for accurate frequency calibration at 4.5 MC. Accuracy is required within one kilocycle.			
1	†4.5	To test jack "Y"	Use 3 volt DC scale on VTVM. Keep VTVM leads well separated from signal generator and chassis wiring.	A5 and A6 for maximum (keep reducing generator output to keep VTVM at approx. 1 volt).
2	†4.5	To test jack "Z"	Use 3 volt zero center scale on VTVM, if available. Keep VTVM leads well separated from signal generator and chassis wiring.	**A7 for zero on VTVM (the correct zero point is located between a positive and a negative maximum).

† Signal may be unmodulated or 400 cycle AM modulated.

** If A7 was far off, repeat steps 1 and 2.

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RF AND MIXER ALIGNMENT

a. Disconnect 1½ volt battery from test jack "T" if used earlier. Connect a wire jumper from test jack "T" (Fig. 30) to chassis. Leave connected for all steps in this alignment.

b. Disconnect antenna from receiver.

c. Connect sweep generator to antenna terminals. If sweep generator does not have a built-in marker generator, loosely couple a marker generator to the antenna terminals. To avoid distortion of the response curve, keep sweep generator output at a minimum, marker pips just barely visible.

d. Connect oscilloscope through a 10,000 ohm resistor to test point "W" on tuner (Fig. 30). Keep scope leads away from chassis.

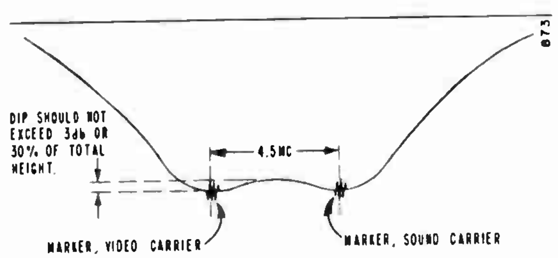
e. Allow about 15 minutes for receiver and test equipment to warm up.

f. To service TV chassis with radio disconnected, complete the heater circuit by connecting a jumper from pin "L" to pin "K" of socket M503. See schematic.

Step	Marker Gen. Freq. (MC)	Sweep Gen. Frequency	Instructions
1	*205.25 **209.75	Sweeping Channel 12	Check for curve resembling RF Response Curve shown below. If necessary, adjust A8, A9 and A10 (Figure 30) as required. Consistent with proper band width and correct marker location, response curve should have maximum amplitude and flat top appearance.
2	See table below.		Check each channel operating in the service area for curve resembling RF Response Curve shown below. When checking any channel, set the sweep and marker generators for the proper frequencies as indicated in the table below. In general, the adjustment performed in step 1 is sufficient to give satisfactory response curves on all channels. However, if reasonable alignment is not obtained on a particular channel, (a) check to see that coils have not been inter-mixed, or (b) try replacing the pair of coils for that particular channel, or (c) repeat step 1 for the weak channel as a compromise adjustment to favor this particular channel. If a compromise adjustment is made, other channels operating in the service area should be checked to make certain that they have not been appreciably affected.

* Video Carrier Frequency (MC). ** Sound Carrier Frequency (MC).

Channel Number	Channel Freq., MC	Video Carrier, MC	Sound Carrier, MC
2	54- 60	55.25	59.75
3	60- 66	61.25	65.75
4	66- 72	67.25	71.75
5	76- 82	77.25	81.75
6	82- 88	83.25	87.75
7	174-180	175.25	179.75
8	180-186	181.25	185.75
9	186-192	187.25	191.75
10	192-198	193.25	197.75
11	198-204	199.25	203.75
12	204-210	205.25	209.75
13	210-216	211.25	215.75



Full skirt of curve will not be visible unless generator sweep width extends beyond 10 MC.

Figure 31. RF Response Curve (see "Oscilloscope Note" below).

OSCILLOSCOPE NOTE

In dealing with RF and IF response curves, it is well to remember that an inverted or mirror image may result, depending on the sweep generator and oscilloscope used. The general waveform should still be identical.

When using a wide band oscilloscope for alignment, marker pips will be more distinct if condenser from 100 to 1,000 mmfd. is connected across the oscilloscope input. Caution: Use the lowest capacity condenser possible, since too high a capacity will affect the shape of the response curve.

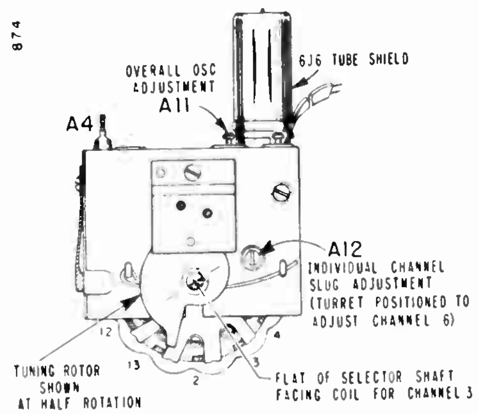


Fig. 32. Front View of Tuner.

OVERALL RF and IF RESPONSE CURVE CHECK (Step 1) and HF OSCILLATOR ALIGNMENT (Step 2)

(Using sweep generator and oscilloscope.)

a. Disconnect antenna.

b. Disconnect signal generator and VTVM (if used earlier).

c. Set the Tuning control at half rotation by rotating it approximately 150° as shown in figure 32. Set Picture control fully to the right (clockwise).

d. Connect sweep generator to antenna terminals. If sweep generator does not have a built-in marker generator, loosely couple a marker generator to the antenna terminals. To avoid distortion of the response curve, keep sweep generator output at a minimum, marker pips just barely visible. Connecting a 1½ volt battery (negative to test jack "T"; positive to chassis) will allow greater signal input without distorting response curve.

e. Connect oscilloscope between point "V" and chassis ground through a decoupling filter (see figure 29). Keep oscilloscope leads away from chassis.

f. Allow about 15 minutes for receiver and test equipment to warm up.

g. When adjusting A12, use a NON-METALLIC alignment screwdriver with a ⅛ inch blade.

h. To service TV chassis with radio disconnected, complete the heater circuit by connecting a jumper from pin "L" to pin "K" of Socket M503. See Schematic.

Step	Marker Gen. Freq. (MC)	Sweep Gen. Frequency	Instructions
1	While sweeping the RF band pass (channel 13 or other unassigned high channel), check the overall response curve obtained against the ideal curve shown below. If shape of curve is not within limits shown, it will be necessary to repeat the IF Amplifier Alignment. The IFs must be accurately aligned before correct oscillator adjustment can be made.		
2	See channel frequency table on previous page.		Check need for oscillator alignment by comparing the response curve obtained (for each channel operating in the service area) with the "Overall RF and IF Response Curve" shown below. With correct oscillator alignment, the video and sound markers should locate at the points shown on the response curve. The Tuning control must be at half rotation (see figure 32) when making this check. If a major number of channels are far off in the same direction, make the overall oscillator adjustment A11. (Touch-up of individual channel slugs A12 may also be required.) If only individual channel adjustment is required, adjust the proper channel slug A12. Make all oscillator adjustments so that the video and sound marker pips appear at the proper points on the response curve. Important: Before making oscillator adjustments, be sure that the Tuning control is set at half rotation; see figure 32. Only slight rotation of the slug (A12) will be required; turning the slug in too far will cause the slug to fall into the coil. (If an oscillator slug should fall into a coil, remove the coil, move the slug retaining spring aside, lightly tap the open end of the coil against a solid object until the slug slips out. Replace slug and set the slug retaining spring into its cut-out slot.)

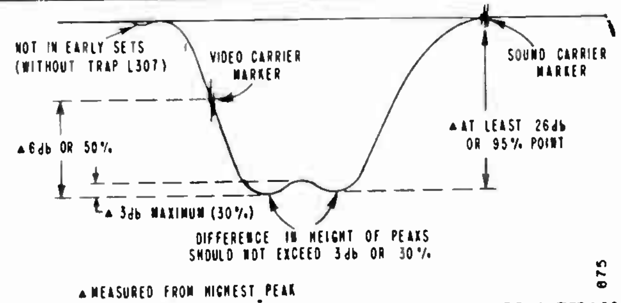
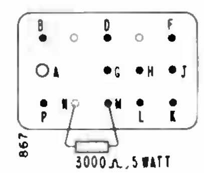


Fig. 33. Overall RF and IF Response Curve.

SERVICING RADIO SEPARATELY



The radio receives its operating voltages from the power supply on the TV chassis. It is necessary to use a separate power supply if the radio is to be operated without the TV chassis. The 2PA1 power supply, which is used in radio-phono-television combination sets with the 20Z1 (12" picture) television chassis and 5B2 radio, can be used to operate the 5D2 radio if a 3,000 ohm, 5 watt resistor (part number 61A1-15) is connected between pins M and N of the 2PA1 socket as illustrated.

5D2 RADIO PRODUCTION CHANGE

To improve sensitivity of the 5D2 radio, the 1st IF transformers in the AM and FM stages were changed.

The 1st AM-IF transformer (T604) used in early sets, part 72B97 has been replaced with part 72B97-1.

The 1st FM-IF transformer (T601) used in early sets, part 72B98 has been replaced with part 72B98-1.

To accommodate this change of the IF transformers, C608 has been changed from 40 mmfd (part 65B1-65) to 30 mmfd (part 65B1-69); R602 has been changed from 240 ohms, 5%, 1/2 watt (part 60B7-241) to 1,500 ohms, 1/2 watt (part 60B8-152).

IMPORTANT: All changes mentioned above must be made when replacing early IF transformers with late IF transformers.

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Form No. S336-2

(1) Additions to the preliminary service data already published on 21B1, 21C1, 5D2 chassis.

(2) Circuit information on 21D1, 21H1, 21J1 television chassis and 3C1 radio chassis.

(3) Revised instructions on Horizontal Drive and Horizontal Linearity adjustments.

(4) Cabinet parts for models 16R12, 26R12, 26X55A to 26X75A, 26R25A to 26R37A, and 39X35, 39X36.

21D1, 21H1 and 21J1 CHASSIS

The 21B1 and 21C1 chassis use a 16" rectangular picture tube. The 21D1 chassis use a 16" round picture tube. The 21H1 and 21J1 chassis use a 19" round picture tube, which is mounted separately from the chassis.

The 21B1, 21C1 chassis (16" rectangular tube) and the 21H1, 21J1 chassis (19" round tube) are the same electrically except for some differences in the deflection yoke. See the schematic and the schematic inset (for the deflection circuit used in 19" sets).

The 21D1 (16" round) chassis differs in that the vertical and horizontal output circuits have differences in some component values, in the tube complement, and in B+ distribution. The vertical output tube is a 6W6GT in the 21D1 chassis; the horizontal output tube is a 6CD6GT. Since there are differences in the horizontal output circuit of the 16" round sets, adjustment of the horizontal drive will be different. See the discussion on the following pages.

3C1 RADIO (AM ONLY)

Combination models 39X35, 39X36 use the 3C1 radio (AM only). See schematic. The radio receives its operating voltage from the TV chassis. The radio can be operated separately from the television chassis by using the 2PA1 power supply as instructed in "Preliminary Service Data", Form No. S336-1.

PRODUCTION CHANGES AND SERVICE NOTES

RUN 4 in 21C1 CHASSIS and RUN 1 in 21B1 CHASSIS

Adjacent Lower Channel Sound Trap (L307 and C314) Added. Later production sets have an Adjacent Lower Channel Sound Trap added between the connector lug (terminal of C113) on the TV tuner and pin 1 of this 1st IF amplifier tube V301 (6AU6). The trap (part number 72A102), consisting of L307 and C314, is pre-tuned at 27.25 MC.

This trap will eliminate the herringbone interference pattern produced by the sound carrier of the adjacent lower channel. Close examination of this type of interference will reveal that the fine lines of the herringbone pattern will vary in accordance with the speech or music on the adjacent lower channel.

Since FM interference from other sources will also produce a herringbone pattern, the presence of interference from a station on the adjacent lower channel should be definitely determined before deciding that the trap is required. This can be checked by quickly turning the channel selector to the adjacent lower channel. After installing the trap, realign slug A4 (mixer plate coil L105) as instructed under "IF Amplifier Alignment" in Preliminary Service Data, Form No. S336-1.

All 21D1, 21H1, 21J1 chassis have this trap.

RUN 5 in 21C1 CHASSIS and RUN 2 in 21B1 CHASSIS

Noise Filter Added to Improve Sync Immunity to Noise. In areas where the noise level is high, noise peaks may affect the horizontal or vertical sync and cause the picture to shake horizontally or lose horizontal or vertical sync. A change in value of resistor R323 and an additional filter (R329 and C315) have been incorporated in the sync circuit of later production chassis to reduce this trouble. See schematic.

This circuit change began with run 2 of 21B1 chassis and run 5 of 21C1 chassis; all 21D1, 21H1, 21J1 chassis will have this sync circuit. Early production receivers may be modified by following the procedure given below:

1. Locate the 9 lug terminal strip adjacent to vertical output transformer T402.
2. Remove resistor R323 (8200 ohms) from between lugs 4 and 6, counting 1 from end of strip near T402.
3. Connect a 18,000 ohms, ½ watt resistor (part number 60B8-183) between lugs 5 and 6.
4. Between lugs 4 and 5, connect a 150 mmfd. mica condenser (part number 65B21-151) with a 270,000 ohm, ½ watt resistor (part number 60B8-274) in parallel.

RUN 2 in 21D1 CHASSIS – CHANGE in 21J1 CHASSIS

In some 21D1 and 21J1 chassis, condenser C433 was changed from .002 mfd, to .0047 mfd, 600 volts (part number 64B9-15). Some sets having this change use a single .0047 mfd. condenser; other sets use two .002 mfd. condenser in parallel. This change was made to increase sweep width. Condenser C433 is .002 mfd, in later sets using an improved horizontal output transformer.

R411 in 21D1 CHASSIS CHANGED to INCREASE RANGE of VERTICAL LINEARITY CONTROL (R410)

Resistor R411 was changed from 820 ohms, 1 watt to 680 ohms, 1 watt (part number 60B14-681). This change was made to increase the range of the VERT. LIN. control R410.

ALTERNATE VERTICAL OUTPUT TUBE (V402) in 21B1, 21C1, 21H1, and 21J1 CHASSIS

Some sets with 16" rectangular or 19" round picture tube may use a 6SN7GT tube as an alternate for the 6S4 vertical output tube (V402). The schematic shows the circuit used with the 6S4 tube; the schematic inset shows the circuit used with the 6SN7GT tube.

ALTERNATE IF TUBE (V301, V302, V303)

Some sets may use a 6AG5 tube as an alternate for the 6AU6 tube in the 3rd IF stage (V303); other sets may use a 6AG5 tube for the 1st. 2nd and 3rd IF stages (V301, V302 and V303). When the 6AG5 tube is used, tube socket terminal 2 is unused (not grounded) as pins 2 and 7 of this tube are connected internally. A tube shield is used in the 1st and 3rd IF stages with the 6AG5 tube.

ALTERNATE TUBE USED IN 3C1 RADIO

Early sets used a 6AV6 tube for V703 (Det-AVC-AF). A few of these early sets used the 6AT6 tube. Later production sets use the 6SQ7 tube, which is the metal tube equivalent.

ALTERNATE CONTROL ESCUTCHEONS

Two alternate control escutcheons are used with these sets. Although the escutcheons are interchangeable as a complete unit, individual parts for the two alternate escutcheons are not interchangeable. The different escutcheons can be identified by the type of door spring used and the differences in the cutout slot which supports the ends of the door springs.

The parts for the control escutcheon having an "I" shaped slot using a flat (bronze) door spring are:

Escutcheon, Control (less door)......23D 60-3
Escutcheon Door....................23D 60-2
Escutcheon Door Spring, Flat (bronze)..18A 41

The parts for the control escutcheon having a "U" shaped slot using a coil (wire) door spring are:

Escutcheon, Control (less door)...... 23D 60-6
Escutcheon Door.................... 23D 60-7
Escutcheon Door Spring, Coil (wire)
right side (facing front)............19A 65-1
left side (facing front)............. 19A 65-2

REPAIRING MOUNTING LUGS on PICTURE WINDOW

If only the mounting lugs are broken on picture windows 23D67, 23E62-1, and 23D61-1, a metal replacement lug can be pressed into the plastic by heating it with a soldering iron. Instructions for installing (Form No. S340) are included with the 3 lugs supplied under part number 15A668.

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SERVICE ADJUSTMENTS

The following information on making the Horizontal Drive and Horizontal Linearity adjustment corrects and supercedes the information given in "Installation and Service Notes for 21B1, 21C1 Chassis", Form No. 41A9-13.

HORIZONTAL DRIVE and HORIZONTAL LINEARITY ADJUSTMENT for 21B1, 21C1, 21H1, 21J1 CHASSIS

If the large circle in the center of the test pattern has a cramped or flattened appearance at one side (non-linear horizontally), turn the HOR. DRIVE adjustment screw in fully (to the right), then slowly turn it out while adjusting for best linearity (circular shape). Note that the Horizontal Drive control also affects width and brightness.

If horizontal non-linearity can not be completely corrected with the HOR. DRIVE adjustment, further correction can be made by adjusting the HOR. LIN. control. Alternate adjustment of the Horizontal Drive and Horizontal Linearity controls may be necessary to obtain best linearity.

HORIZONTAL DRIVE ADJUSTMENT for 21D1 CHASSIS

This adjustment should be made so that the adjustment screw is as far out (to the left) as possible without producing vertical lines in the picture. Adjust as follows:

a. Turn the CHANNEL control to an unused channel.

b. Set BRIGHTNESS control at a lower than average setting.

c. Turn the HORIZONTAL control (front panel) completely to the left. (If the Horizontal control is not set at the extreme left position, the vertical lines may be removed in step "d", but may re-appear when the Horizontal control is rotated to the right.)

d. Turn the HORIZ. DRIVE adjustment screw to the left until a vertical line appear near the center of the raster. Then, turn the screw to the right just far enough to make the lines disappear. If the screw is turned further than required to eliminate the vertical lines, picture width and brightness may be affected.

Do not use the Horizontal Drive to correct width or linearity. If necessary, make the Width and Horizontal Linearity adjustments.

HORIZONTAL LINEARITY ADJUSTMENT for 21D1 CHASSIS

If the large circle in the center of the test pattern has a cramped or flattened appearance at either side (non-linear horizontally), adjust the HORIZ. LIN. adjustment screw by turning it to the left or right as required. Note that the Horizontal Drive and the Width adjustments also affect linearity. Be sure that these adjustments are set correctly if difficulty is encountered when making the horizontal linearity adjustment.

If vertical lines appear in the center of the picture when making the horizontal linearity adjustment, see "Horizontal Drive Adjustment for 21D1 Chassis" above.

Form No. S336-3

C433 INCREASED to OBTAIN SUFFICIENT WIDTH

To obtain sufficient width, C433 may be .0047 mfd, 600 V. (part number 64B8-15) in some 21D1, 21H1, 21J1 chassis. Also, some of the 21D1 chassis may use a .01 mfd, 600 V. condenser, part number 64B8-13.

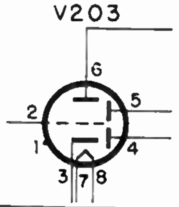
GRID RESISTOR REQUIRED WHEN V303 is 6AG5

When a 6AG5 is used at V303, an 18,000 ohms, ½ watt resistor (part number 60B8-183) is required from grid (pin 1) to ground.

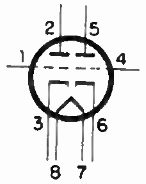
DIFFERENT TUBE USED for SOUND AMPLIFIER (V203)

Some sets may use a 6SQ7 tube instead of a 6AV6 tube at V203. There are no part changes necessary with this substitution. The pin numbering for the 6SQ7 is shown in the adjacent illustration.

6SQ7
V203



6SN7GT
V403



DIFFERENT TUBE USED for SYNC SEP. and CLIPPER (V403)

Some sets may use a 6SN7GT tube instead of a 12AU7 tube at V403. There are no part changes necessary with this substitution. The pin numbering for the 6SN7GT is shown in the adjacent illustration.

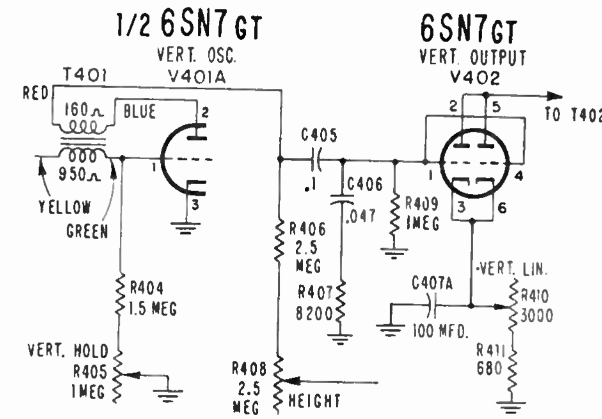
ALTERNATE CIRCUIT WHEN V402 is 6SN7GT

The schematic (in Form No. S336-2) for the 21B1, 21C1, 21H1, 21J1 television chassis shows an alternate circuit for V402 when a 6SN7GT tube is used in place of the 6S4. (See inset in lower left portion of schematic.)

Cross out this schematic inset and in its place use the circuit given in the adjacent illustration.

R404 1.5 megohms, ½ W....... 60B 8-155
R406 2.5 megohms, ½ W....... 60B 8-255

ALTERNATE CIRCUIT WHEN V402 IS 6SN7GT



RESISTOR ADDED in VERTICAL OSCILLATOR STAGE

In sets using a 6S4 or a 6W6GT tube in the vertical output stage (V402), a 150,000 ohms, 1/2 watt resistor (part number 60B8-154) is connected between R404 and the grid (pin 1) of the vertical oscillator (V401A, 6SN7GT). This resistor centers the operating point of the Vertical Hold control.

Add this resistor to both schematics. This resistor has been used since the beginning of production.

SUPPLEMENTARY PARTS LIST

This parts list contains corrections and additions to the parts list given in "Preliminary Service Data for models using 21B1, 21C1, 5D2 Chassis" (Form No. S336-1). Use this parts list FIRST, then use the list in the Preliminary Service Data.

RESISTORS

Sym.	Description	Part No.
§ R401	22,000 ohms, ½ watt	60B 8-223
§ R402	8,200 ohms, ½ watt	60B 8-822
§ R403	8,200 ohms, ½ watt	60B 8-822
R406	1 megohm, ½ watt, in sets using 6S4 vert. output tube (V402)	60B 8-105
	1.5 megohm, ½ watt, in sets using 6SN7GT vert. output tube (V402)	60B 8-155
	680,000 ohms, ½ watt, in sets using 6W6GT vert. output tube (V402)	60B 8-684
R407	8,200 ohms, ½ watt in 21B1, 21C1, 21H1, 21J1	60B 8-822
	10,000 ohms, ½ watt, in 21D1	60B 8-103
R409	1 megohm, ½ watt, in 21B1, 21C1, 21H1, 21J1	60B 8-105
	3.3 megohms, ½ watt, in 21D1, 21E1	60B 8-335
R410	3,000 ohms, Vert. Lin. for 21B1, 21C1, 21H1, 21J1	75B 13-7
	for 21D1, 21E1	75B 13-18
R411	820 ohms, ½ watt, in sets using 6S4 vert. output tube (V402)	60B 8-821
	680 ohms, ½ watt, in sets using 6SN7GT vert. output tube (V402)	60B 8-681
	680 ohms, 1 watt, in sets using 6W6GT vert. output tube (V402)	60B 14-821
	(R411 was 820 ohms in early (21D1) sets using 6W6GT tube, see production changes.)	
R415	820 ohms, 2 watt, in 21B1, 21C1, 21H1, 21J1	60B 20-821
	2,200 ohms, ½ watt, in 21D1, 21E1	60B 8-222
R435	8,200 ohms, 1 watt, in 21B1, 21C1, 21H1, 21J1	60B 14-822
	12,000 ohms, 1 watt, in 21D1, 21E1	60B 14-123
R619A	2 megohms, Volume pot.	75B 11-12
R619B	2 megohms, Tone pot.	
	(R619 includes on-off switch SW603)	

†Part of Diode Filter Unit 63A3-1 consisting of R707, C709, C710.
§ Component may be part of couplate, part number 63B6-2. Order exact duplicate or individual components.

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Sym.	Description	Part No.
R701	22,000 ohms, 1/2 watt	60B 8-223
R702	10,000 ohms, 1 watt	60B 14-103
R703	150 ohms, 1/2 watt	60B 8-151
R704	27,000 ohms, 1 watt	60B 14-273
R705	2,200 ohms, 2 watt	60B 20-222
R706	1 megohm, 1/2 watt	60B 8-105
†R707	47,000 ohms, 1/2 watt	
R708	4.7 megohms, 1/2 watt	60B 8-475
R709	27,000 ohms, 1/2 watt	60B 8-273
R710A	2 megohms, Tone } pot.	75B 11-12
R710B	2 megohms, Volume } (includes SW702)	
R711	22 ohms, ½ watt	60B 8-220

CONDENSERS

Sym.	Description	Part No.
§C401	.002 mfd, 600 volts, paper	64B 5-14
§C402	.005 mfd, 600 volts, paper	64B 5-12
§C403	.0047 mfd, mica	65B 21-472
C421	470 mmfd, mica in 21B1, 21C1, 21H1, 21J1	65B 21-471
	330 mmfd, mica, in 21D1	65B 21-331
C430	47 mmfd, 5%, 1,500 volts, mica, in 16" sets	65B 1-64
	75 mmfd, 5%, 1,500 volts, mica, in 19" sets	65B 1-66
C433	.002 mfd, 600 volts, paper	64B 9-11
	(.0047 mfd. used in some 21D1 and 21J1 chassis, see production changes)	
C701	5 mmfd, mica	65B 1-62
C702	2 to 20 mmfd, trimmer	66B 8-5
C703A	0 to 420 mmfd. } gang	68B 32
C703B	0 to 108 mmfd. }	
	(Note: Dial drum spot-welded to gang.)	
C704	50 mmfd, ceramic	65B 6-4
C705	.005 mfd. min, ceramic	65A 10-1
C706	.1 mfd, 200 volts, paper	64B 5-30
C707	.005 mfd. min, ceramic	65A 10-1
C708	.1 mfd, 400 volts, paper	64B 5-20
†C709	100 mmfd, ceramic	
†C710	100 mmfd, ceramic	
C711	.01 mfd, 400 volts, paper	64B 5-25
C712	250 mmfd, ceramic	65B 6-5
C713	.01 mfd, 400 volts, paper	64B 5-25
C714	.002 mfd, 600 volts, paper	64B 5-14

COILS and TRANSFORMERS

Sym.	Description	Part No.
L404	Focus Coil	
	for 21B1, 21C1, 21H1, 21J1	69C 117-3
	for 21D1, 21E1 (supplied less plug)	69C 117-4
L701	AM Antenna	
	Loop Antenna (includes C701, C702)	69C 116-2
	Iron Core Ant. (includes C701, C702)	69C 121-2
L702	Oscillator Coil	69A 52-1
T202	Audio Output Transformer	
	for TV only sets	79C 33-1
	for combination sets	79C 33-2
T402	Vertical Output Transformer	
	for 21B1, 21C1, 21H1, 21J1	79B 29-1
	for 21D1, 21E1	79B 34-1
T403	Deflection Yoke (includes R412, R413, R445, C430)	
	for 16" rectangular tube	A3222
	for 16" round tube	A3178
	for 19" round tube	A3197
	(A3197 includes connector plug)	
T404	Horizontal Output Transformer (includes tube cap clips)	
	for 21B1, 21C1, 21H1, 21J1	79C 30-2
	for 21D1, 21E1	79C 30-3
T701	1st IF Transformer	72B 28-7
T702	2nd IF Transformer	72B 28-17

MISCELLANEOUS PARTS for TV CHASSIS

Picture tube mounting parts listed below are for 16" tubes. See separate heading for 19" tube mounting parts.

Sym.	Description	Part No.
M203	Speaker	
	5" PM	78B 59-1
	8" PM	78B 49-1
	10" PM	78B 47-2
	12" PM	78B 56-2
M403	Socket, Focus Coil (5 contact wafer)	87A 4-4
M404	Plug, Focus Coil (5 pin)	88A 3-5
	Cover & Insulator (for 88A3-5 plug)	88A 3-4
M405	Socket, Deflection Yoke (6 contact, molded)	87A 30-2
M406	Plug, Deflection Yoke (6 pin)	88A 9-1
	Cover & Insulator (for 88A9-1 plug)	88A 17
M504	Socket, Light (4 contact, wafer; used only in 19" combination sets)	87A 6-3
	Band, Metal Tube (for mtg. 16" round tube)	28A 40-1
	Band, Plastic Insulating (for mounting 16" round tube)	33A 59-1
	Bracket, Picture Tube Mounting (supports front of rectangular picture tube)	
	Right side (facing tube)	15B 615-1
	Left side (facing tube)	15B 615-2
	Bracket, Picture Tube Mounting (supports front of 16" round tube)	15C 576
	Bracket, Top and Bottom (for mounting picture tube and focus coil)	
	for rectangular picture tubes	
	Top	15C 613
	Bottom	15C 614
	for 16" round tubes	
	Top	15C 628-1
	Bottom	15C 627
	Clamp, Picture Tube Front Mtg. Bracket (for mtg. rectangular picture tube)	15A 616
	Clamp, Webbing (for mtg. rectangular tube)	15A 526
	Clip, Tube Cap	
	for 6CD6G tube	88A 16-6
	for 6BQ6GT tube	88A 16-8
	for 1B3GT tube	19A 54
	Connector Lead, 2nd Anode	
	with plug for 16" rectangular tube	88A 16-7
	with contact spring for 16" round tube	A3171
	with female plug for 19" round tube	88A 25-1
	with male plug and contact spring for 19" round tube	A3200
	Ion Trap	
	for round picture tubes	94A 15-2
	for rectangular picture tubes	94A 15-1
	Nut, Tube Band Mounting (8-32)	2A 1-15-71
	Pilot Light (#47)	81A 1-8
	Rubber Channel, 1" long (for rectangular picture tube bracket)	12A 9-11
	Rubber Insert, 1" diameter (bottom and side support of rectangular picture tube)	12A 16-1
	Rubber Grommet (for 2nd anode load)	12A 1-15
	Screw, Wing (for deflection yoke)	1A 101-1-71
	Shield, Tube	87A 7-7
	Shield Base, Tube	87A 7-6
	Socket, Tube	
	miniature bakelite (7 pin)	87A 3-7
	octal, plain	87A 5-1
	octal, ringmount (mica filled)	87A 20-2
	miniature (9 pin)	87A 14-2
	picture tube	87B 31-8
	Spring, HV Contact (for front of round picture tube)	18A 37
	Spring, Picture Tube Grounding (used on rectangular tubes only)	19A 23-2
	Spring, Support (for 2nd anode lead)	19A 66
	Washer, Spring (for mounting picture positioning lever)	4A 5-10-71
	Webbing, Rectangular Picture Tube Mtg. Strap (42" length)	50A 3-4

PARTS for MOUNTING 19" PICTURE TUBE

Sym.	Description	Part No.
M403	Socket, Focus Coil (5 contact wafer)	87A 4-3
M404	Plug, Focus Coil (5 pin)	88A 3-5
	Cover & Insulator (for 88A3-5 plug)	88A 3-4
M405	Socket, Deflection Yoke (6 contact; molded)	87A 30-2
M406	Plug, Deflection Yoke (6 pin-includes interlock)	88A 9-1
	Cover & Insulator (for 88A9-1 plug)	88A 17
	Band, Tube Front Insulating (Plastic)	33B 59-2
	Band, Tube Retaining (Metal)	28A 40-2
	Bracket, Strap (supports yoke coil)	15A 572
	Bracket, Tube Mtg. (supports front of tube)	
	for right side facing tube	15C 564-1
	for left side facing tube	15C 564-2
	Bracket, Yoke (upper mtg. bracket)	15C 628-2
	Bracket, Yoke Base (lower support)	15C 627
	Connector Lead, 2nd Anode	
	with female plug	88A 25-1
	with male plug and contact spring	A3200
	Ground Wire Assembly	A3209
	Ion Trap	94A 15-2
	Lever, Picture Positioning	15B 574
	Nut (8-32 Hex, for tube band)	2A 1-15-71
	Picture Tube 19" TV	19AP4
	Rubber Collar (supports flare of picture tube)	12B 40
	Screw, Wing (for deflection yoke)	1A 101-1-71
	Shim, Focus Coil Mounting	32A 134
	Spacer Sleeve (1/8" in length)	29A 2-3-71
	Spring, HV Contact at front of tube	18A 37
	Tape, Aluminum Foil (order length needed)	52A 1-17
	Washer, Spring (for mtg. picture positioning lever)	4A 5-10-71

MISCELLANEOUS PARTS for 3C1 RADIO

Sym.	Description	Part No.
SW701	Switch, Radio-Phono	77A 28-2
SW702	Switch, On-Off	Part of R710
M701	Socket, Phono Input	88A 1
M706	Socket, Phono Motor	89A 6-1
M707	Shielded Cable Assembly	89A 29-11
M708	Plug, Cable Connector (14 pin rect.)	88A 20-1
	Cover and Insulator (for plug 88A20-1)	88A 20-6
	Cable (12 wire), including 88A20-1 plug and 88A20-6 cover	AB216
	Bracket, Mounting	
	for Off-Volume and Tone control	15A 409
	for Radio-Phono Switch	15A 385
	for Tuning Sleeve	15A 394
	Clip, IF Transformer Mtg.	72B 28-10
	Cover Assembly, Chassis	A1880
	Dial Back and Bracket Assembly	A1881
	Dial Cord (50" length needed)	50A 1-3
	Dial Scale	22B 23-1
	Escutcheon, Radio	23D 63-3
	Grommet, Gang Mounting	12A 1-2
	Hex Nut, Switch Retaining	2A 2-11-71
	Knob, 'Radio-Phono', 'Tuning'	33D 55-1
	Knob, 'Tone'	33D 55-4
	Knob, 'Volume'	33D 55-5
	Lockwasher, Osc. Coil & Gang (#6 I.T.)	3B 1-25-71
	Pilot Light, #47 Mazda	81A 1-8
	Pointer, Dial	25A 38
	Shaft, Tuning	28A 48-1
	Snap Button (for mtg. dial scale)	13A 1-1-71
	Socket, Tube	
	7 pin (for 6BA6, 6AV6)	87A 3-7
	7 pin (for 6BE6)	87A 24-3
	Socket, Pilot Light (includes 14" lead)	82A 2-3
	Socket, Pilot Light (includes 9" lead)	82A 2-9
	Spacer Sleeve (for gang mounting)	29A 2-1-71
	Spacer Sleeve (3 1/4" long, for mounting phono-radio switch)	29A 3-15
	Spring, Dial Cord Tension	19B 1-3
	Washer, Vellutex (Oscillator coil mtg.)	5A 1-21

PARTS for PHONO COMPARTMENT LIGHT and JEWEL LIGHT

Sym.	Description	Part No.
M505	Socket and Leads (miniature)	82A 11-58
M506	Plug (4 pin round)	88B 22-1
	Cover and Insulator for 88B22-1	88B 22-3
M507	Socket and Leads (candelabra)	82A 12-1
SW502	Switch, Light	77A 29
	Bracket, Switch	15B 502
	Bulb, Light (7 watt candelabra Mazda #7C7)	81A 2-4
	Bulb, Light (miniature #47 Mazda)	81A 1-8
	Light Assembly, Complete (less bulbs)	AB209
	Shield, Light	82A 13
	Washer, Insulating	5A 1-31

CABINET PARTS for 36R37 (Blond). 26R45 (Walnut), 36R46 (Mahogany)

When ordering parts for these models, use this list FIRST, then see Form No. S338-1 for any parts not listed here.

Part No.	Description
	Escutcheon, Control (less door)
23D 60-1	with "I" shaped slot, for flat door spring
23D 60-5	with "U" shaped slot, for coil door spring
	Escutcheon, Door
23D 60-4	used with 23D60-1 escutcheon (mounts with flat door spring)
23D 60-8	used with 23D60-5 escutcheon (mounts with coil door spring)
	Spring, Escutcheon Door
18A 41	flat (bronze) spring, used with 23D60-1 escutcheon, for left or right hinge
	coil (wire) spring, used with 23D60-5 escutcheon
19A 65-2	for left hinge (facing front)
19A 65-1	for right hinge (facing front)

CABINET PARTS for 16R12 (Mahogany), 26R12 (Mahogany)

Above model numbers may have the suffix "N".

Part No.	Description
A3131	Antenna, Built-in TV
	Back, Cabinet (includes line cord)
A3287	for table model
A3289	for console model
A3015	Baffle Board, Speaker, for table model
46B 26	" " " for console model
34E 36-2	Cabinet, Plastic, 16R12 (Mahogany)
34E 37-2	" " 26R12 (Mahogany)
44B 183	Carton and Fillers, for table model
44B 187	" " " for console model
98A 60-7	Caster (for cabinet leg)
	Escutcheon, Control (less door)
23D 60-1	with "I" shaped slot, for flat door spring
23D 60-5	with "U" shaped slot, for coil door spring
	Escutcheon, Door
23D 60-4	used with 23D 60-1 escutcheon (mounts with flat door spring)
23D 60-8	used with 23D 60-5 escutcheon (mounts with coil door spring)
12A 32-6	Gasket, Sponge Rubber (for back of pic. window)
36B 3-20	Grille Cloth, for table model
36B 3-44	" " for console model
33C 53-9	Knob, TV, maroon, 'Channel'
33C 53-10	" " maroon, 'Tuning'
33C 53-11	" " maroon, 'Off-Volume'
33C 53-12	" " maroon, 'Picture'
89A 22-1	Line Cord and Interlock Socket
6A 4-10	Mounting Rivet, for line cord

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85-437-C2-71 Screw, for pic. window (#8-32x7/16" BH MS)
65-375-C2-71 " for cabinet back (#6-32x3/8" BH MS)
1A 71-3-57 " for control escutcheon (#4x3/8" RH ST)
1A 67-44-71 " for TV chassis (1/4-20x1 1/4")

78B 59-1 Speaker, 5" PM, for table model
78B 49-1 " 8" PM, for console model
2B 10-26-59 Speed Nut (for mtg. speaker baffle) in floor models
Spring, Escutcheon Door
18A 41 flat (bronze) spring, used with 23D 60-1 escutcheon, for left or right hinge
coil (wire) spring, used with 23D60-5 escutcheon
19A 65-2 for left hinge (facing front)
19A 65-1 for right hinge (facing front)
18A 43-1 Spring, TV Knob Tension, for 'Tuning' knob
18A 43-2 " " " " for 'Off-Volume' knob
18A 43-3 " " " " for 'Channel' knob
5A 4-14 Washer, Felt, used behind 'Channel' knob
5A 4-15 " " used behind 'Picture' knob
23D 68 Window, Picture

CABINET PARTS for 26X55A, 26X56A, 26X57A, 26X65A, 26X66A, 26X67A, 26X75A, 26X76A

This parts list applies only to models having the suffix letters "A" or "AN" and does not apply to models with the suffix "N" only or without any suffix letter.

Part No.	Description
A3132	Antenna, Built-in TV
43D 102	Backing, Cardboard, for 23D61 picture window
43D 116	" " for 23D61-1 picture window
43C 101-3	Back, Lower TV Compartment
A3337	Back, Television Compartment (complete)
35E 130-1	*Cabinet, Wood, 26X55A (Walnut)
35E 130-2	" " 26X56A (Mahogany)
35E 130-3	" " 26X57A (Blond)
35E 131-1	" " 26X65A (Walnut)
35E 131-2	" " 26X66A (Mahogany)
35E 131-3	" " 26X67A (Blond)
35E 132-1	" " 26X75A (Walnut)
35E 132-2	" " 26X76A (Mahogany)
35E 131-53	*Cabinet Legs, 26X65A (Walnut)
35E 131-54	" " 26X66A (Mahogany)
35E 131-55	" " 26X67A (Blond)
35E 132-56	" " 26X75A (Walnut)
35E 132-57	" " 26X76A (Mahogany)
44B 182	Carton and Fillers, for 26X55A, 26X56A, 26X57A
44B 184	" " " for 26X65A, 26X66A, 26X67A
44B 185	" " " for 26X75A, 26X76A
98A 60-7	Caster, for Cabinet Leg
35E 131-50	*Doors, Matched Pair, 26X65A (Walnut)
35E 131-51	" " " 26X66A (Mahogany)
35E 131-52	" " " 26X67A (Blond)
35E 132-50	" " " 26X75A (Walnut)
35E 132-51	" " " 26X76A (Mahogany)
	*Door Catch and Strike Plate
35E 131-58	*for 26X65A (Walnut), 26X66A (Mahogany)
35E 131-59	*for 26X67A (Blond)
35E 132-55	*for 26X75A (Walnut), 26X76A (Mahogany)
	Escutcheon, Control (less door)
23D 60-3	with "I" shaped slot, for flat door spring
23D 60-6	with "U" shaped slot, for coil door spring
	Escutcheon, Door
23D 60-2	used with 23D60-3 escutcheon (mounts with flat door spring)
23D 60-7	used with 23D60-6 escutcheon (mounts with coil door spring)
12A 32-6	Gasket, Sponge Rubber (40" long, used with picture window)
36A 7-11	Grille, Metal, for 26X65A (Walnut), 26X66A (Mahog.), 26X67A (Blond)
	Grille Cloth
36B 3-49	for 26X55A (Walnut), 26X56A (Mahogany)
36B 3-50	for 26X57A (Blond)
36B 3-47	for 26X65A (Walnut), 26X66A (Mahogany)
36B 3-48	for 26X67A (Blond)
36B 3-41	for 26X75A (Walnut), 26X76A (Mahogany)
	Grounding Clip (includes 30" braided wire)
A3229	for grounding 23D61 picture window
A3232	for grounding 23D61-1 picture window
	Handle, Door
37A 30-1	pair for 26X65A (Walnut), 26X66A (Mahog.), 26X67A (Blond)
37A 34	pair for 26X75A (Walnut), 26X76A (Mahog.)
	*Hinge, Knife
35E 131-56	*pair for 26X65A (Walnut), 26X66A (Mahog.)
35E 131-57	*pair for 26X67A (Blond)
35E 132-53	*pair for 26X75A (Walnut), 26X76A (Mahog.)
33C 53-9	Knob, Television, 'Channel'
33C 53-10	" " 'Tuning'
33C 53-11	" " 'Off-Volume'
33C 53-12	" " 'Picture'
89A 22-1	Line Cord and Interlock Socket
1A 7-9-57	Screw, for control escutcheon (#4x3/8 RH WS)
1A 6-24-59	" for mtg. back & bumper strip (#6x½ RH WS)
1A 22-8-71	" for picture window (#6x½ RH WS)
1A 67-43-71	" for mtg. TV chassis (¼-20x1-1)
32D 127	Sheet, Insulating (mounts on cabinet in front of picture tube)
78B 47-2	Speaker, 10" PM
	Spring, Escutcheon Door
18A 41	flat (bronze) spring, used with 23D60-3 escutcheon for left or right hinge
	coil (wire) spring, used with 23D60-6 escutcheon
19A 65-2	for left hinge (facing front)
19A 65-1	for right hinge (facing front)
18A 43-1	Spring, TV Knob Tension, for 'Tuning' knob
18A 43-2	" " " " for 'Off-Volume' knob
18A 43-3	" " " " for 'Channel' knob
	Trim, Picture Window (Plastic; 55" long, used with 23D61 picture window)
33A 57-1	Maroon, for Walnut, Mahogany
33A 57-4	Beige, for Blond
5A 4-14	Washer, Felt, used behind 'Channel' knob
5A 4-15	" " used behind 'Picture' knob
	Window, Picture
23D 61	with round holes, for mtg. with screws
23D 61-1	with oblong holes, for mtg. with spring clips

If only the mounting lugs are broken on picture window 23D61-1, a metal replacement lug (part number 15A668) can be pressed into the plastic by heating it with a soldering iron. Instructions for installing (Form No. S340) are included with the 3 lugs furnished under part number 15A668.

CABINET PARTS for 39X35 (Walnut), 39X36 (Mahogany)

The above model numbers may contain the suffix "N".

Part No.	Description
A3023	Antenna, Built-in "Roto-Scope" TV
43C 108-2	Back, for Album Compartment
43C 114-2	" for Cabinet (below TV compartment)
43C 107-2	" for Record Changer Compartment
A3193	" for Television Compartment (Complete)
43D 105	Backing, Cardboard, for 23E 62 pic. window
43D 119	" " for 23E 62-1 pic. window
	Bracket, Slide to Pan Mtg.
15C 620-3	Left side (facing front of cabinet)
15C 620-4	Right side (facing front of cabinet)
15A 624	Bracket, Changer Stop
35E 136-1	*Cabinet, Walnut
35E 136-2	" Mahogany
	Carton and Fillers
98A 60-7	Caster, for cabinet leg
11B 12-6	Clamp, plastic, for cable
	Decal, Cabinet Door Refinishing
35E 136-60	for pair of doors, Walnut
35E 136-61	for pair of doors, Mahogany
98A 11-3	Decal Cement (1 pint)
35E 136-53	*Door, Record Compt. (Complete) Walnut
35E 136-54	" " " (Complete) Mahog.
	*Doors, TV and Radio-Phono Compt.,
35E 136-50	matched pair for Walnut
35E 136-51	matched pair for Mahogany
35E 136-63	Door Catch and Strike Plate
37A 25-2	Door Handle (for upper doors)
	Escutcheon, Control (less door)
23D 60-3	with "I" shaped slot, for flat door spring
23D 60-6	with "U" shaped slot, for coil door spring
	Escutcheon, Door
23D 60-2	used with 23D 60-3 escutcheon (mounts with flat door spring)
23D 60-7	used with 23D 60-6 escutcheon (mounts with coil door spring)
23D 63-3	Escutcheon, Radio
12A 32-7	Gasket, Sponge Rubber (for picture window)
36B 3-53	Grille Cloth (2 pieces)
	Grounding Clip (includes 30" braided wire)
A3229	for grounding 23D 61 picture window
A3232	for grounding 23D 61-1 picture window
35E 136-56	*Hinge, Knife (pair), for Radio and TV Compt.
35E 136-58	" " for Album Compt.
82A 10-8	Jewel, Pilot Light (green)
33D 55-1	Knob, Radio 'Radio-Phono', 'Tuning'
33D 55-4	" " 'Off-Volume'
33D 55-5	" " 'Tone'
33C 53-9	Knob, Television, for 'Channel'
33C 53-10	" " for 'Tuning'
33C 53-11	" " for 'Off-Volume'
33C 53-12	" " for 'Picture'
89A 22-1	Line Cord & Interlock Socket
6A 4-6-0	Line Cord Mounting Rivet
81A 1-8	Pilot Light, #47
37A 31-1	Pull, Record Changer Slide
46A 4-5	Rod, Wooden Dowel (Antenna Mtg.)
1A 7-9-57	Screw, for control escutcheon (#4x3/8 RH WS)
1A 6-24-59	" for back and bumper strip (#6x1/2 RH WS)
1A 7-23-71	" for pic. window (#6x3/8 RH WS)
1A 67-43-71	" for TV chassis (1/4-20x1)
361-375-C2-71	" for mounting slide-out bracket to slide (#6 32x3/8 FH MS)
32D 128	Sheet, Insulating (mounts on cabinet in front of picture tube)
37B 32-5	Slide and Track, Drawer
98A 44-17	Spacer, Fibre Cabinet Leveler (Kit of 6)
78B 56-2	Speaker, 12 inch PM
	Speed Nut
2B 12-4-68	for mounting radio escutcheon
2B 10-8-59	for mounting speaker
18A 45	Spring Clip (for mtg. 23E62-1 pic. window)
	Spring, Escutcheon Door
18A 41	flat (bronze) spring, used with 23D60-3 escutcheon, for left or right hinge
	coil (wire) spring, used with 23D60-6 escutcheon
19A 65-2	for left hinge (facing front)
19A 65-1	for right hinge (facing front)
18A 46	Spring, Slide Tension
18A 43-1	Spring, TV Knob Tension, for 'Tuning' knob
18A 43-2	" " " " for 'Off-Volume' knob
18A 43-3	" " " " for 'Channel' knob
33A 57-2	Trim, Picture Window (used with 23E62 picture window only)
5A 4-14	Washer, Felt, used behind 'Channel' knob
5A 4-15	" " used behind 'Picture' knob
5A 4-11	" " used behind radio tuning knobs
	Window, Picture
23E 62	with round holes, for mtg. with screws
23E 62-1	with oblong holes, for mtg. with spring clips

CABINET PARTS for 26R25A, 26R26A, 26R35A, 26R36A, 26R37A

This parts list applies only to models having the suffix letters "A" or "AN" and does not apply to models with the suffix "N" only or without any suffix letter.

Part No.	Description
A3091	Antenna, Built-in TV
A3337	Back, Cabinet (Complete)
35E 126-1	*Cabinet, Wood, 26R25A (Walnut)
35E 126-2	" " 26R26A (Mahogany)
35E 125-1	" " 26R35A (Walnut)
35E 125-2	" " 26R36A (Mahogany)
35E 125-3	" " 26R37A (Blond)
44B 175	Carton and Fillers, for 26R25A, 26R26A
44B 174	" " " for 26R35A, 26R36A, 26R37A
98A 60-7	Caster, for Cabinet Leg
35E 126-50	*Doors, Matched Pair, 26R25A (Walnut)
35E 126-51	" " " 26R26A (Mahogany)
35E 125-50	" " " 26R35A (Walnut)
35E 125-51	" " " 26R36A (Mahogany)
35E 125-52	" " " 26R37A (Blond)
	*Door Catch and Strike Plate
35E 126-56	for 26R25A (Walnut), 26R26A (Mahogany)
35E 125-56	for 26R35A (Walnut), 26R36A (Mahogany) 26R37A (Blond)
	Escutcheon, Control (less door)
23D 60-1	with "I" shaped slot, for flat door spring
23D 60-5	with "U" shaped slot, for coil door spring
	Escutcheon, Door
23D 60-4	used with 23D60-1 escutcheon (mounts with flat door spring)
23D 60-8	used with 23D60-5 escutcheon (mounts with coil door spring)
98A 61-8	Gasket, Sponge Rubber (includes chipboard back for picture window)
	Grille Cloth
36B 3-41	for 26R25A (Walnut), 26R26A (Mahogany)
36B 3-33	for 26R35A (Walnut), 26R36A (Mahogany)
36B 3-34	for 26R37A (Blond)
	Handle, Door
37A 34	pair for 26R25A (Walnut), 26R26A (Mahogany)
37A 30	pair for 26R35A (Walnut), 26R36A (Mahogany), 26R37A (Blond)
	*Hinge, Knife
35E 126-53	pair for 26R25A (Walnut), 26R26A (Mahogany)
35E 125-53	pair for 26R35A (Walnut), 26R36A (Mahogany)
35E 125-54	pair for 26R37A (Blond)
33C 53-9	Knob, Television, 'Channel'
33C 53-10	" " 'Tuning'
33C 53-11	" " 'Off-Volume'
33C 53-12	" " 'Picture'
89A 22-1	Line Cord and Interlock Socket
	Screw
1A 7-9-57	for mtg. escutcheon (#4x3/8 RH WS)
1A 6-23-71	for mtg. picture window (#6x3/8 RH WS)
1A 67-43-71	for mtg. TV chassis (¼-20x1)
78B 47-1	Speaker, 10" PM
	Spring, Escutcheon Door
18A 41	flat (bronze) spring, used with 23D60-1 escutcheon, for left or right hinge
	coil (wire) spring, used with 23D60-5 escutcheon
19A 65-2	for left hinge (facing front)
19A 65-1	for right hinge (facing front)
18A 43-1	Spring, TV Knob Tension, for 'Tuning' knob
18A 43-2	" " " " for 'Off-Volume' knob
18A 43-3	" " " " for 'Channel' knob
18A 45	Spring Clip (for mtg. 23D67 picture window)
5A 4-14	Washer, Felt, used behind 'Channel' knob
5A 4-15	" " used behind 'Picture' knob
23D 67	Window, Picture

If only the mounting lugs are broken on picture window 23D67, a metal replacement lug (part number 15A668) can be pressed into the plastic by heating it with a soldering iron. Instructions for installing (Form No. S340) are included with the 3 lugs supplied under part number 15A668.

*To insure proper matching and fit, also specify cabinet manufacturer's code letters (usually burned or stamped on the back rail of cabinet). Wood parts are supplied only if old part cannot be repaired. When ordering describe condition of old part in detail.

MODELS 16R12, 26R12, 26R25A, 26R26A, 26R35A, 26R36A, 26R37A, 26X55A, 26X56A, 26X65A, 26X66A, 26X67A, 26X75A, 26X76A, 39X35, 39X36, Ch. 21B1, 21C1, 21D1, 21H1, 21J1

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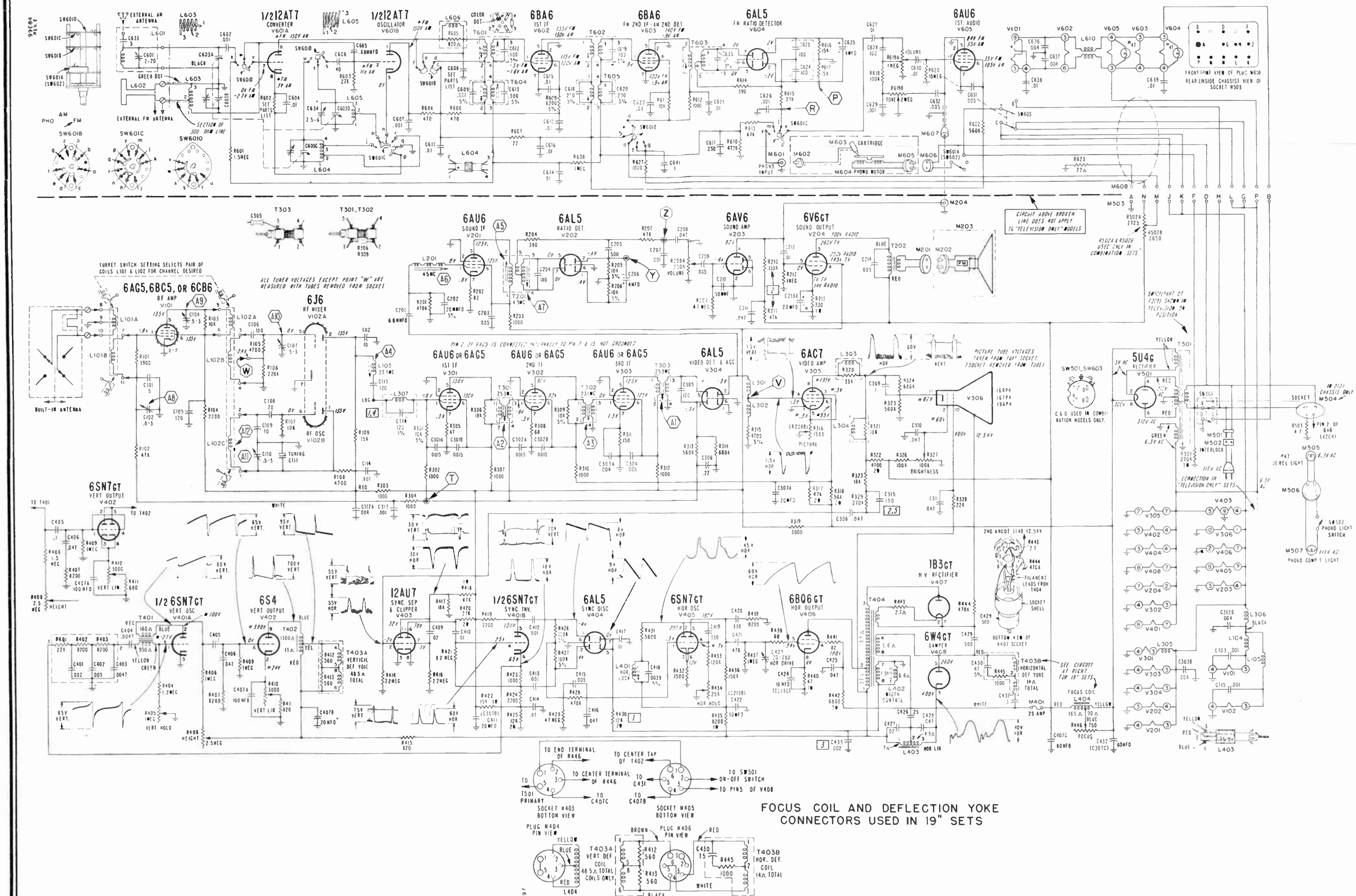
Schematic for 21B1, 21C1, 21H1, 21J1 Television Chassis; 5D2 radio circuit also shown.



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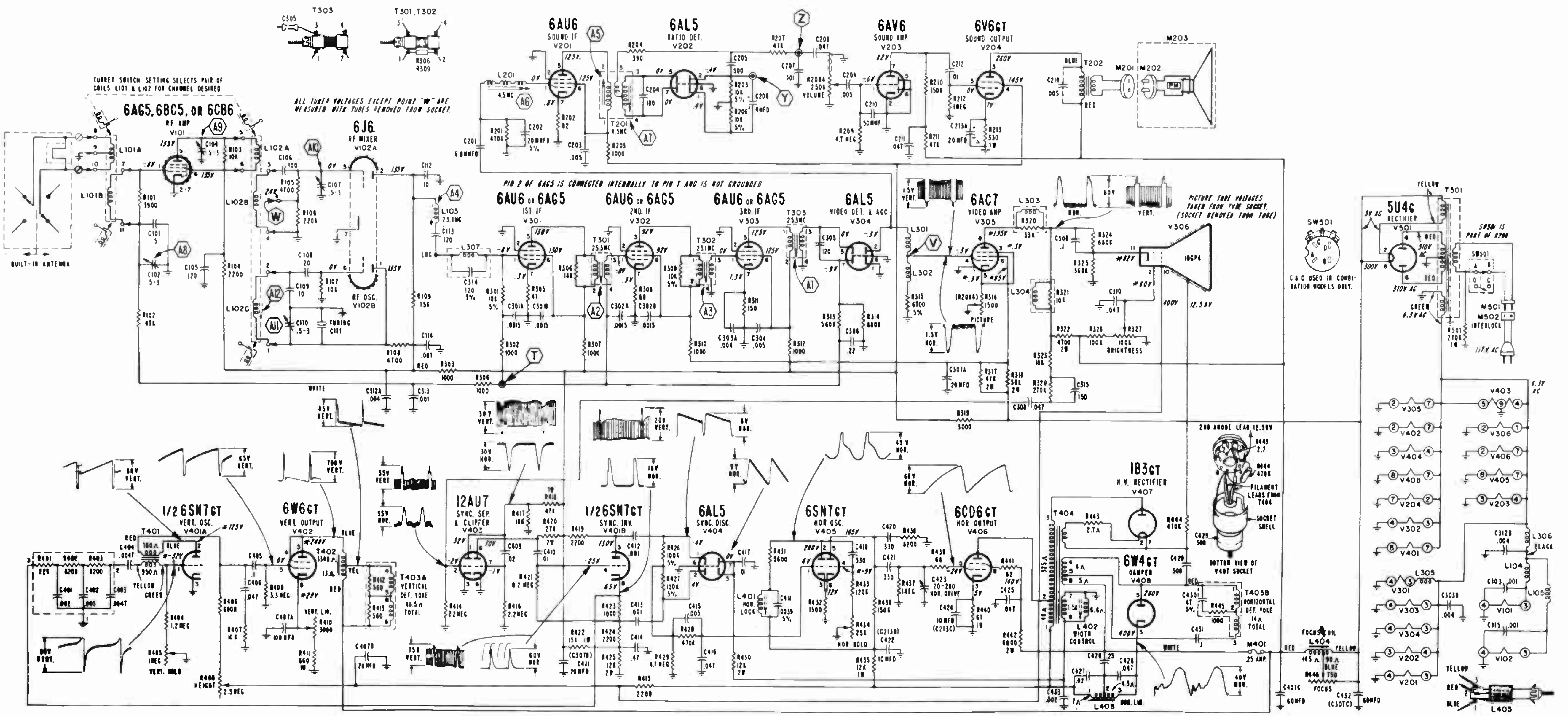
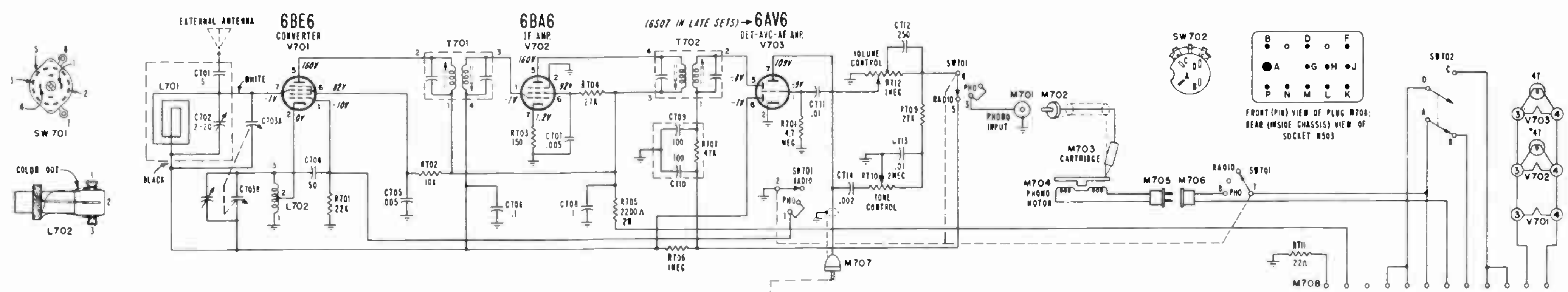
Schematic for 21D1 Television Chassis (16" round tube).



Schematic for 3C1 Radio Circuit



ADMIRAL TV PAGE 6-13

CHASSIS 21D1;
Radio Ch. 3C1

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General

BUILT-IN "ROTO-SCOPE" ANTENNA

The built-in "Roto-Scope" antenna is operated by the antenna control lever which extends from the back of the cabinet (near the top). Set the antenna control lever in that one of its three positions (left, center, or right) which gives the clearest picture.

When an external indoor or an outdoor antenna is required, be sure to disconnect the built-in Roto-Scope antenna leads from the antenna terminal board, tape them and place them away from the chassis.

INPUT IMPEDANCE and TRANSMISSION LINES

The input impedance to the receiver is 300 ohm balanced (between antenna terminals). When using 300 ohm transmission line, connect it across both antenna terminals.

Input impedance between one antenna terminal and chassis is approximately 75 ohms. When using 75 ohm coaxial transmission line, connect the outer conductor to the chassis and the inner conductor to either antenna terminal; use the terminal which gives the most satisfactory picture on the weakest station.

For best performance, use Admiral transmission line (part number 95A22-1 for 300 ohm line, part number 95A22-2 for 75 ohm line).

FUSE LOCATION

The horizontal output circuit is fused with a ¼ amp, 250 volt fuse, part #84A4-2. The fuse is located on top of the horizontal output transformer in the high voltage compartment.

CHASSIS NOTES

Chassis used in the straight TV and combination models differ in that the combination models have a connector socket for supplying power to the radio.

Important: If both the radio and television are turned on at the same time, neither unit will operate.

PICTURE TUBE HANDLING PRECAUTION

Due to the high vacuum and large surface area of picture tubes, great care must be exercised when handling these tubes. Shatterproof goggles and heavy gloves should be worn while handling or installing a picture tube. The picture tube must not be scratched or subjected to excessive pressure as fracture of the glass will result in an explosion of considerable violence which may cause personal injury or property damage.

HIGH VOLTAGE WARNING

High voltages are present throughout this receiver. Operation of the set outside of the cabinet or with the cabinet back removed involves shock hazard. Exercise normal high voltage precautions while working with this set.

Installing the Television Receiver

After the antenna is set properly, make all checks or adjustments given here to insure best performance and ease in tuning. ***It is especially important that the Channel Slugs and Ion Trap be adjusted upon installation or servicing of every set.***

For best results, all checks or adjustments should be made using a transmitted television test pattern. A mirror placed in front of the picture tube screen will be of help in observing the picture while adjusting rear panel controls. Removing the TV back disconnects the interlocking line cord; use a separate line cord (part number 89A22-1) when servicing.

NOTE: In combination models, if both radio and television are turned on at the same time, neither unit will operate. Be sure to instruct owner on proper operation.

TUNE IN A PICTURE

Tune in a picture as instructed in the customer instruction leaflet; note illustrations on interference effects.

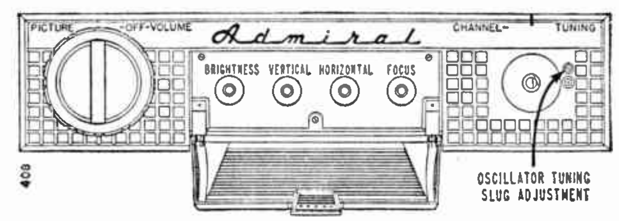
Be sure to check the setting of the auxiliary controls (behind escutcheon door).

ADJUST CHANNEL SLUGS

Individual channel oscillator adjustment of every receiver should be checked upon installation or servicing. If this adjustment is properly made, it is possible to tune from one station to another by merely turning the CHANNEL control and if necessary, slightly readjusting the TUNING control. With correct oscillator channel adjustment, best picture will be located at the approximate center of the range of the Tuning control.

This adjustment can be made without removing the chassis from the cabinet. Adjust as follows:

a. Turn the set on and allow 15 minutes to warm up.
b. Set the CHANNEL knob for a station in operation. Set all other controls for a normal picture.
c. Set TUNING control at center of its range by rotating it approximately half-way.
d. Remove the CHANNEL and TUNING knobs.
e. Insert a ⅛" blade, NON-METALLIC screwdriver in the ¼" hole (to the right of the channel tuning shaft). For each channel in operation, carefully adjust the channel slug for best picture with clear detail. Be sure that the Tuning control is set at the center of its range before adjusting each channel slug. Only slight rotation of the slug will be required; turning the slug in too far will cause it to fall into the coil. (If the slug falls into the coil, remove the coil, move the retaining spring aside, lightly tap the open end of the coil until the slug slips out. Replace slug and re-set retaining spring.)



Control Panel; CHANNEL and TUNING Knobs Removed.

ADJUST THE ION TRAP

To prolong the life of the picture tube, it is important that this adjustment be made on each receiver upon installation, or when servicing.

Position the ion trap on the picture tube neck so that the BLACK sleeve faces upward.

Turn the BRIGHTNESS control (at front of set) for normal brightness.

Starting from a point close to the tube base, very carefully move the ion trap forward or backward and at the same time, rotate it slightly in either direction until maximum brightness is produced.

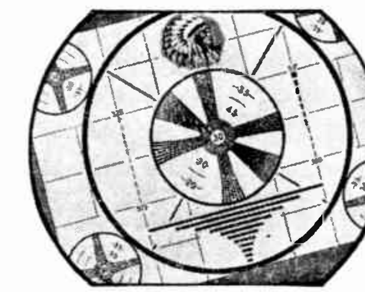
Turn the BRIGHTNESS control until normal brightness is obtained. Adjust the FOCUS control for good focus. Readjust the ion trap again for maximum brightness.

Care must be exercised in adjustment of the ion trap since there may be two locations on the neck of the tube where maximum brightness can be produced. The second ion trap location, which is further forward on the tube neck, should not be used.

Important: If the corners of the picture are shaded, be sure the ion trap has been properly adjusted. Do not sacrifice picture brightness when adjusting the ion trap to remove shaded corners. To eliminate shaded corners, see the discussion under "Check Picture Centering". Be sure to readjust the ion trap after adjusting the picture positioning lever or repositioning the focus coil. Tighten the ion trap mounting screw after adjustment.

CHECK PICTURE TILT

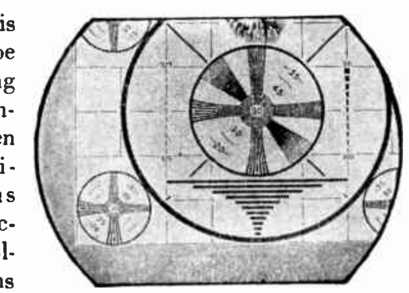
If the picture is tilted, loosen the wing screw "H" on the deflection yoke coil and slightly rotate the yoke "E" until the picture is straight. Before tightening the wing screw, be sure that the yoke is moved as far forward as possible, otherwise corners of the picture may become shaded.



Picture Tilted; Adjust Deflection Yoke Coil.

CHECK PICTURE CENTERING

If the picture is off center, it can be centered by using the picture positioning lever, and when necessary, re-positioning the focus coil around the picture tube neck. Follow the instructions given below. ***Note that the picture positioning lever can be moved sideways, and up and down.***



Picture Not Centered; Adjust Picture Positioning Lever.

Centering the Picture

a. Adjust ion trap as instructed on preceding page.
b. Slightly loosen the screw "A" which locks the picture positioning lever to the focus coil, adjust the lever for correct picture centering.
c. Readjust the ion trap.

Difficulty in Centering the Picture

a. Adjust ion trap as instructed on preceding page.
b. Slightly loosen the two screws "B" which hold the focus coil to the yoke bracket. Center focus coil around the tube neck; tighten screws.
c. Loosen the screw "A" and center the picture with the picture positioning lever. If the picture cannot be centered with the lever, it may be necessary to locate the focus coil slightly off center and then center the picture with the picture positioning lever.
d. Readjust the ion trap.

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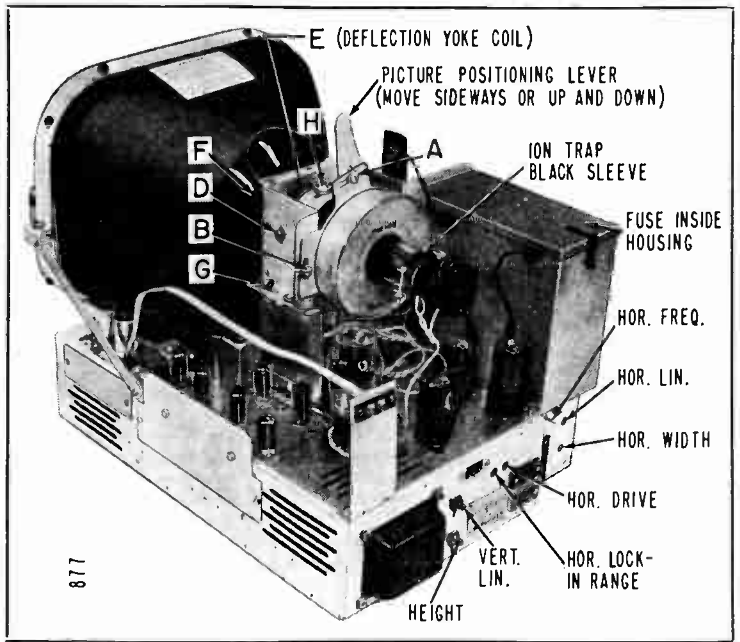
Difficulty in Eliminating Shaded Corners

a. Loosen screws "G", than move the yoke support bracket forward until rubber grommet "F" is firmly against the flare of the picture tube.

b. Push the deflection yoke coil "E" as far forward as possible. In some cases, it may be necessary to loosen the two yoke bracket support screws "D" at the sides of the upper mounting bracket, move the bracket up or down, and then move the deflection yoke coil as far forward as possible.

c. Adjust the ion trap as instructed on preceding page.



Chassis View Showing Adjustment Locations.

SCHEMATIC NOTES

[1],[2],[3] etc. are run numbers and indicate a production change. Run numbers are rubber stamped at rear of chassis.

(A1), (A2),......(Y), (Z), etc. indicate alignment points and alignment connections.

PRODUCTION CHANGES

RUN 1

Condenser C431, .02 mfd, 400 volts (part number 64B5-24) was added across width control L402 to increase width.

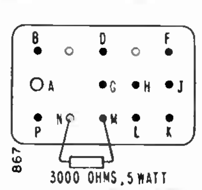
SUBSTITUTE TUBE (V703) USED IN 3C1 RADIO

In some sets a 6AT6 tube was used in place of the 6AV6 (V703) Det-AVC-AF Amplifier. These tubes are directly interchangeable.

SERVICING TV CHASSIS or RADIO SEPARATELY

In combination models, to service the television chassis with the radio disconnected, it will be necessary to complete the heater circuit by connecting a jumper wire between pins "L" and "K" of socket M503. See schematic.

The radio can be operated without the television chassis if a 1PA2 power supply (used with the 4S1 radio) or 2PA1 power supply (used with 5B2 radio) is available. Connect a 3,000 ohm, 5 watt resistor (part number 61A1-15) from pin "M" to "N" on the power supply socket.



Socket, Rear View (Inside Chassis).

TV VOLTAGE DATA

(Voltages given on schematic diagram)

- PICTURE control turned fully clockwise. CHANNEL control set on an unused channel. Other front controls set at approximately half rotation. Vert. Lin. and Height set at approximately half rotation.
- Voltages marked with an asterisk * will vary widely with control setting.

  In combination models, B+ voltages in TV chassis will be slightly higher when set is switched to radio position. Alternate voltage readings for radio and TV are shown for sound output tube V204 (6V6GT).
- Line voltage 117 volts AC.
- Voltages measured with a vacuum tube voltmeter between tube socket terminals and chassis, unless otherwise indicated. Voltages at V101, V102, V306 measured from top of socket with tube removed.
- Antenna disconnected from set with terminals shorted.
- Under operating conditions, AGC (Automatic Gain Control) voltage developed at test point "T" (see schematic) should measure approximately —2.5 volts. This voltage depends on signal strength.

CAUTION

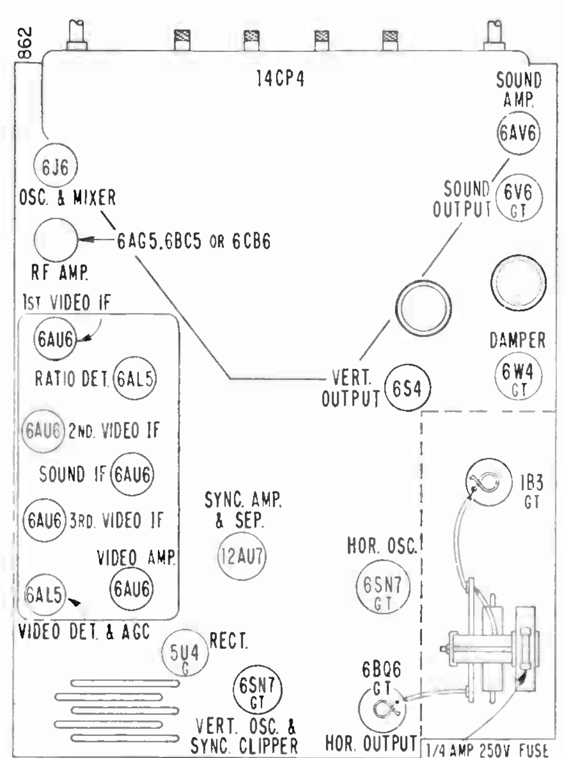
Pulsed high voltages are present on the cap of the 6BQ6GT tube, and on the filament terminals and cap of the 1B3GT tube. NO ATTEMPT SHOULD BE MADE TO TAKE MEASUREMENTS FROM THESE POINTS UNLESS SUITABLE TEST EQUIPMENT IS AVAILABLE.

Picture tube 2nd anode voltage can be measured from the 2nd anode connector and should be taken only with a high voltage instrument such as a kilovoltmeter. 2nd anode voltage is approximately 12 KV. Proper filament voltage check of the 1B3GT tube may be made by observing filament brilliancy as compared with that obtained with a 1.5 volt dry cell battery.

RADIO VOLTAGE DATA

(Voltages given on schematic diagram)

- Line voltage 117 volts AC.
- Voltages measured with a vacuum tube voltmeter, between tube terminals and chassis.
- Volume control set at minimum.
- Dial turned to low frequency end.



Top View of Chassis.

IMPORTANT

This preliminary service data contains the complete chassis parts list for models using the 20T1, 20V1 television chassis and for the 3C1 (AM) radio chassis. It also includes cabinet parts for models 34R15, 34R16. It contains alignment data for the television chassis. Model RC550 record changer is used.

This TV chassis uses a 14" rectangular tube. The IF and sweep circuits are similar to the circuits in the 20X1, 20Y1, 20Z1 chassis. The deflection circuits are similar to those used in the 24D1, 24E1, 24F1, 24G1, 24H1 chassis.

The intercarrier sound has been improved by taking the 4.5 MC sound IF from the video detector through an improved sound take-off coil. Adjacent channel interference has been minimized by the addition of an adjacent channel trap L301. A 4.5 MC trap coil L306 added in the cathode circuit of the picture tube, reduces 4.5 MC beat interference.

TELEVISION ALIGNMENT PROCEDURE

IF AMPLIFIER ALIGNMENT

a. **Before starting alignment, be sure IF cover shield is mounted to chassis.**

b. Disconnect antenna and connect a jumper across antenna terminals.

c. Set receiver to channel 13 or other unassigned high channel to prevent signal interference during IF alignment.

e. Allow about 15 minutes for receiver and test equipment to warm up.

f. To service TV chassis with radio disconnected, complete the heater circuit by connecting a jumper from pin "L" to pin "K" of socket M503. See schematic.

Step	Signal Gen. Freq. (MC)	VTVM and Signal Generator Connections	Instructions	Adjust
1	25.3	VTVM high side to test point "T", common to chassis.	Use VTVM 3 volt DC scale. When peaking, keep reducing generator output for VTVM reading of approx. 1 volt or less.	A1 and A2 for maximum.
2	23.1	Connect generator high side to 6J6 (V102) tube shield; insulate shield from chassis. Connect common to chassis near 6J6 tube base.		A3 and A4 for maximum.
3	To insure correct IF alignment, make the "IF Response Curve Check" given below, or make the "Overall RF and IF Response Curve Check (Step 1)" given later. The overall check should be made after making all other alignments.			

IF RESPONSE CURVE CHECK

(Using sweep generator and oscilloscope with sweep input to RF Mixer V102.)

Differences in tube gain and component values affect IF response. These differences are not apparent in alignment of IFs when using a signal generator and VTVM (single frequency alignment); hence it is preferable that an IF response curve check be made after completion of the IF amplifier alignment.

The IF response curve check can be made as indicated directly below. However, also note that a better check can be made by feeding the sweep signal through the entire RF and IF system as given under "Overall RF and IF Response Curve Check (Step 1)". The overall check should be made after making all other alignments.

a. Make all control settings and connections as given in the IF amplifier alignment chart; see "a" through "f" above.

b. Connect oscilloscope between point "V" and chassis ground through a decoupling filter; see fig. 29. Keep leads away from receiver.

c. Connect sweep generator high side to tube shield of 6J6 (V102) osc-mixer tube. Be sure to insulate tube shield from chassis. Connect sweep generator common to chassis close to 6J6 tube base. Set sweep generator to sweep the IF band pass (19 to 29 MC).

d. Loosely couple marker generator high side to the sweep generator lead connected to tube shield on tuner; common to chassis ground.

To avoid distortion of the response curve, keep the sweep generator and marker generator outputs at a very minimum. Marker pips should be just kept barely visible. To minimize distortion, set sweep generator output for VTVM reading of approximately .5 volt DC, measured between test point "T" and chassis. Connecting a 1½ volt battery (negative to test point "T", positive to chassis) will allow greater signal input without distorting the response curve.

e. Check curve obtained against the ideal IF response curve shown in figure 28. Since it is not always possible to get ideal curves, it should be noted that the height of opposite peaks should be within 3db or 30% of each other. The dip or valley in the center of the curve should not be greater than 3db or 30% down from the highest peak of the curve. Check video and sound IF carrier points by means of marker generator. It is important that marker pips be in the proper location on the response curve. The 25.75 MC marker, should be 6db below the highest peak (50% point on the high frequency side of the curve). The 22 MC marker should be at the opposite side of the response curve, located approximately 18db (85%) below the highest peak. The 21.25 MC marker should be located at least 26db (95%) below the highest peak, and may or may not be visible.

Consistent with proper band width and correct location of markers, the response curve should preferably have maximum amplitude, symmetry, and flat top appearance.

If the procedure given has been carefully followed and the response curve obtained differs greatly from the curve shown in figure 28, repeat the IF Amplifier Alignment, making sure generator frequencies are precise and adjustments are accurately made.

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ALIGNMENT HINT

After becoming familiar with alignment procedure, some servicemen simplify subsequent alignment of sets by merely using the essential alignment data given in figures 29 and 30.

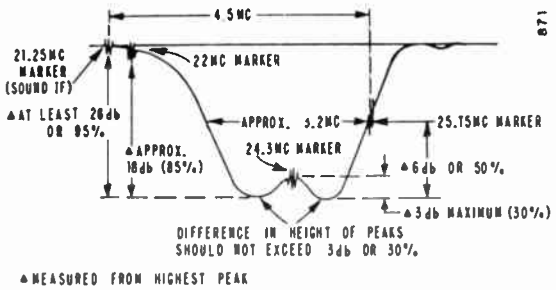


Figure 28. IF Response Curve.

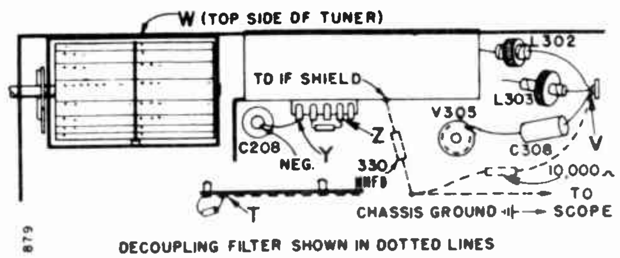


Figure 29. Bottom View Showing Test Point "V".

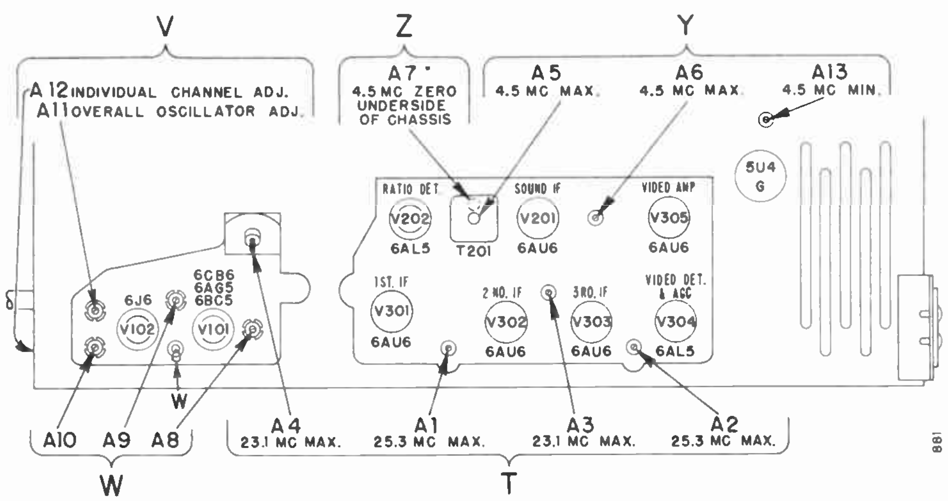


Figure 30. Top View of Chassis Showing Alignment Adjustment Locations.

4.5 MC SOUND IF ALIGNMENT

a. Disconnect antenna and connect a wire jumper across antenna terminals.

c. Connect signal generator high side to point "V" through a .01 mfd. condenser.

d. Allow about 15 minutes for receiver and test equipment to warm up.

e. Use a NON-METALLIC alignment tool. If Ratio Det. Transformer (T201) has hollow core slugs, bottom slug adjustment A7 can be made from top of chassis, if you use alignment tool #98A30-7 obtainable from Admiral Distributor. Bottom slug (A7) can be reached through the hole in the core of the upper slug (A5).

f. To service TV chassis with radio disconnected, complete the heater circuit by connecting a jumper from pin "L" to pin "K" of socket M503. See schematic.

Step	Signal Gen. Freq. (MC)	VTVM Connections	Instructions	Adjust
	Since the transmitted video and sound carriers have an accurate 4.5 MC frequency difference, a TV station signal may be used instead of a signal generator for alignment of steps below. When using a television signal, it may be necessary to use a higher scale on the VTVM. IMPORTANT: When using a signal generator, be sure to check it against a crystal calibrator or other frequency standard for accurate frequency calibration at 4.5 MC. Accuracy is required within one kilocycle.			
1	†4.5	To test point 'Y'	Use 3 volt DC scale on VTVM. Keep VTVM leads well separated from signal generator and chassis wiring.	A5 and A6 for maximum (keep reducing generator output to keep VTVM at approx. 1 volt).
2	†4.5	To test point 'Z'	Use 3 volt zero center scale on VTVM, if available. Keep VTVM leads well separated from signal generator and chassis wiring.	**A7 for zero on VTVM (the correct zero point is located between a positive and a negative maximum).

† Signal may be unmodulated or 400 cycle AM modulated.

** If A7 was far off, repeat steps 1 and 2.

RF AND MIXER ALIGNMENT

a. Disconnect 1½ volt battery from test point "T" if used earlier. Connect a wire jumper from test point "T" (Fig. 30) to chassis. Leave connected for all steps in this alignment.

b. Disconnect antenna from receiver.

c. Connect sweep generator to antenna terminals. If sweep generator does not have a built-in marker generator, loosely couple a marker generator to the antenna terminals. To avoid distortion of the response curve, keep sweep generator output at a minimum, marker pips just barely visible.

d. Connect oscilloscope through a 10,000 ohm resistor to test point "W" on tuner (Fig. 30). Keep scope leads away from chassis.

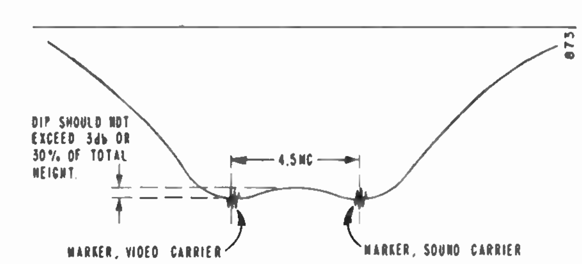
e. Allow about 15 minutes for receiver and test equipment to warm up.

f. To service TV chassis with radio disconnected, complete the heater circuit by connecting a jumper from pin "L" to pin "K" of socket M503. See schematic.

Step	Marker Gen. Freq. (MC)	Sweep Gen. Frequency	Instructions
1	*205.25 **209.75	Sweeping Channel 12	**Check for curve resembling RF Response Curve shown below. If necessary, adjust A8, A9 and A10 (Figure 30) as required. Consistent with proper band width and correct marker location, response curve should have maximum amplitude and flat top appearance.**
2	See table below.		**Check each channel operating in the service area for curve resembling RF Response Curve shown below. When checking any channel, set the sweep and marker generators for the proper frequencies as indicated in the table below. In general, the adjustment performed in step 1 is sufficient to give satisfactory response curves on all channels. However, if reasonable alignment is not obtained on a particular channel, (a) check to see that coils have not been intermixed, or (b) try replacing the pair of coils for that particular channel, or (c) repeat step 1 for the weak channel as a compromise adjustment to favor this particular channel. If a compromise adjustment is made, other channels operating in the service area should be checked to make certain that they have not been appreciably affected.**

* Video Carrier Frequency (MC). ** Sound Carrier Frequency (MC).

Channel Number	Channel Freq., MC	Video Carrier, MC	Sound Carrier, MC
2	54- 60	55.25	59.75
3	60- 66	61.25	65.75
4	66- 72	67.25	71.75
5	76- 82	77.25	81.75
6	82- 88	83.25	87.75
7	174-180	175.25	179.75
8	180-186	181.25	185.75
9	186-192	187.25	191.75
10	192-198	193.25	197.75
11	198-204	199.25	203.75
12	204-210	205.25	209.75
13	210-216	211.25	215.75



Full skirt of curve will not be visible unless generator sweep width extends beyond 10 MC.

Figure 31. RF Response Curve (see "Oscilloscope Note" below).

ALIGNMENT ADJUSTMENT IDENTIFICATION

Adj.	Symbol	Frequency	Function
A1	T303	25.3 MC	3rd IF Transformer
A2	T301	25.3 MC	1st IF Transformer
A3	T302	23.1 MC	2nd IF Transformer
A4	L103	23.1 MC	Mixer Plate Coil
A5	T201	4.5 MC	Primary of Ratio Detector Transformer
A6	L201	4.5 MC	Sound Take-off Coil
A7	T201	4.5 MC	Secondary of Ratio Detector Transformer
A8	C102		Trimmer (RF Amplifier)
A9	C104		Trimmer (RF Amplifier)
A10	C107		Trimmer (Mixer)
A11	C110		Trimmer (HF Oscillator)
A12	L102		Slug, HF Oscillator Coils
A13	L306	4.5 MC	Trap Coil

OSCILLOSCOPE NOTE

In dealing with RF and IF response curves, it is well to remember that an inverted or mirror image may result, depending on the sweep generator and oscilloscope used. The general waveform should still be identical.

When using a wide band oscilloscope for alignment, marker pips will be more distinct if condenser from 100 to 1,000 mmfd. is connected across the oscilloscope input. Caution: Use the lowest capacity condenser possible, since too high a capacity will affect the shape of the response curve.

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OVERALL RF and IF RESPONSE CURVE CHECK (Step 1) and HF OSCILLATOR ALIGNMENT (Step 2)

(Using sweep generator and oscilloscope.)

a. Disconnect antenna.

b. Disconnect signal generator and VTVM (if used earlier).

c. Set the Tuning control at half rotation by rotating it approximately 150° as shown in figure 32.

d. Connect sweep generator to antenna terminals. If sweep generator does not have a built-in marker generator, loosely couple a marker generator to the antenna terminals. To avoid distortion of the response curve, keep sweep generator output at a minimum, marker pips just barely visible. Connecting a 1½ volt battery (negative to test point "T"; positive to chassis) will allow greater signal input without distorting response curve.

e. Connect oscilloscope between point "V" and chassis ground through a decoupling filter (see figure 29). Keep oscilloscope leads away from chassis.

f. Allow about 15 minutes for receiver and test equipment to warm up.

g. When adjusting A12, use a NON-METALLIC alignment screwdriver with a ⅛ inch blade.

h. To service TV chassis with radio disconnected, complete the heater circuit by connecting a jumper from pin "L" to pin "K" of Socket M503. See Schematic.

Step	Marker Gen. Freq. (MC)	Sweep Gen. Frequency	Instructions
1	While sweeping the RF band pass (channel 13 or other unassigned high channel), check the overall response curve obtained against the ideal curve shown below. If shape of curve is not within limits shown, it will be necessary to repeat the IF Amplifier Alignment. The IFs must be accurately aligned before correct oscillator adjustment can be made.		
2	See channel frequency table on previous page.		Check need for oscillator alignment by comparing the response curve obtained (for each channel operating in the service area) with the "Overall RF and IF Response Curve" shown below. With correct oscillator alignment, the video and sound markers should locate at the points shown on the response curve. The Tuning control must be at half rotation (see figure 32) when making this check. If a major number of channels are far off in the same direction, make the overall oscillator adjustment A11. (Touch-up of individual channel slugs A12 may also be required.) If only individual channel adjustment is required, adjust the proper channel slug A12. Make all oscillator adjustments so that the video and sound marker pips appear at the proper points on the response curve. Important: Before making oscillator adjustments, be sure that the Tuning control is set at half rotation; see figure 32. Only slight rotation of the slug (A12) will be required; turning the slug in too far will cause the slug to fall into the coil. (If an oscillator slug should fall into a coil, remove the coil, move the slug retaining spring aside, lightly tap the open end of the coil against a solid object until the slug slips out. Replace slug and set the slug retaining spring into its cut-out slot.)

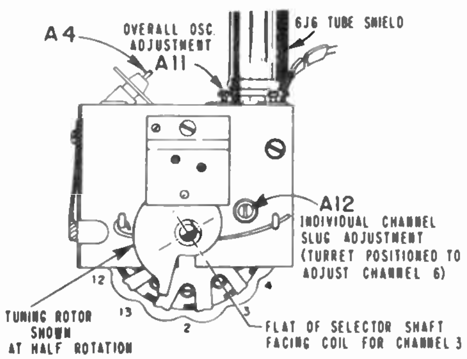


Fig. 32. Front View of Tuner.

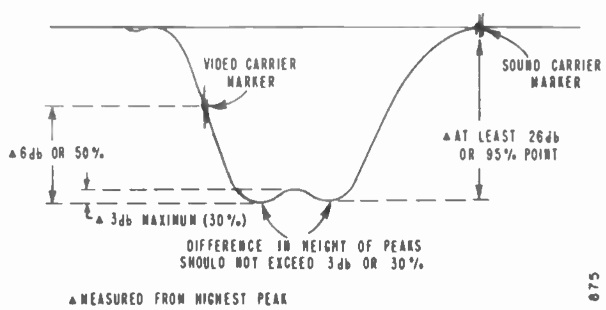


Fig. 33. Overall RF and IF Response Curve.

4.5 MC TRAP ALIGNMENT

A 4.5 MC trap coil (L306) is used in the cathode circuit of the picture tube to minimize 4.5 MC beat interference which might appear in the picture.

Since the transmitted video and sound carriers have an accurate 4.5 MC frequency difference, it may be preferable to use a TV station signal instead of a signal generator for this alignment. When using a television signal, it may be necessary to use a higher scale on the VTVM.

When using a signal generator, be sure to check it against a crystal calibrator or other frequency standard for accurate frequency calibration at 4.5MC.

a. If using a signal generator for this alignment, disconnect antenna and correct a wire jumper across antenna terminals. Set receiver to an unassigned channel to prevent signal interference.

b. Set PICTURE control for normal picture.

c. Allow about 15 minutes for receiver and test equipment to warm up.

d. If using a signal generator, connect generator high side to test point "V" through a .01 mfd. condenser; common to chassis. Signal may be unmodulated or AM modulated. Full generator output may be required for this alignment.

e. Connect a 15 mmfd. condenser from tie point connecting to yellow lead (terminal 11) of V306 to terminal one of L201 (junction of C201, C202 and R201).

f. Connect VTVM high side to test point "Y"; common to chassis. Keep VTVM lead separated from generator and chassis wiring.

g. Using a NON-METALLIC alignment screwdriver, carefully adjust slug A13 for minimum VTVM reading.

HORIZONTAL OSCILLATOR ALIGNMENT

This adjustment should not be required unless it is impossible to obtain horizontal sync with the "Horizontal Frequency and Horizontal Lock-In Range Adjustment" given in the "Installation and Service Notes for 20T1, 20V1 Television Chassis", Form No. 41A9-14.

NOTE: This adjustment requires the use of an oscilloscope, preferably one having a high input resistance and low input capacity. Making this adjustment without an oscilloscope may result in poor horizontal sweep stability.

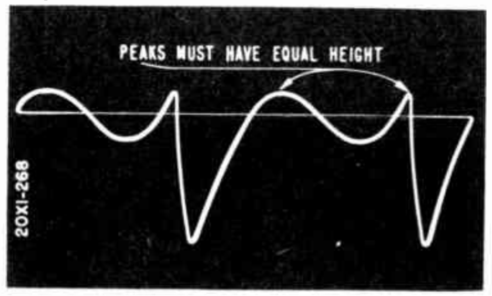
Adjust as follows:

a. Allow receiver to warm up for a few minutes.

b. Sync the picture horizontally with the HORIZONTAL control (on front panel); if necessary, adjust the HOR. LOCK-IN RANGE or HOR. FREQ. adjustments as required. If these adjustments have been greatly disturbed from the original setting, the approximate setting for the HOR. LOCK adjustment L401 (underside of chassis) is about one-quarter to one-half of its range in from its full-out position; the approximate setting for the HOR. LOCK-IN RANGE is about one-third turn out from its full-in position; the approximate setting of the HOR. FREQ. is about five to fifteen turns in from its full-out position.

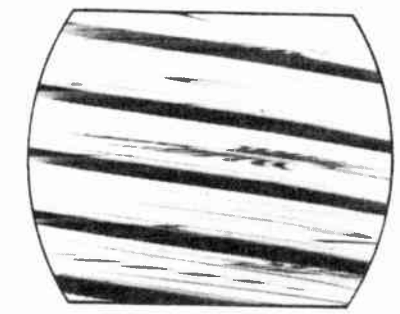
c. Connect oscilloscope high side through a 10 mmfd. condenser to terminal "C" or "2" on the Horizontal Blocking Transformer T404; ground to chassis. Set oscilloscope to horizontal frequency (15.75 KC) or a sub-multiple of it.

d. Tune in a station (preferably one with a test pattern). While keeping the picture in sync, adjust the HOR. LOCK adjustment L401 (underside of chassis) for oscilloscope waveform pattern as illustrated. Adjust for equal height of rounded and pointed peaks. Disconnect oscilloscope after adjusting waveform.



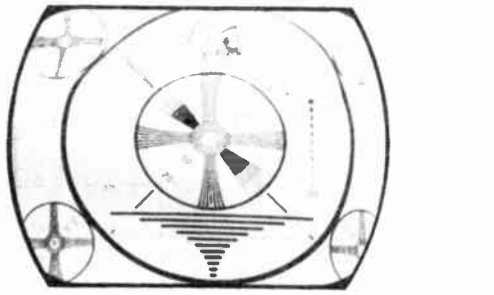
Horizontal Oscillator Waveform

e. Turn the HORIZONTAL control fully to the left, carefully adjust the HOR. LOCK-IN RANGE adjustment until 6 to 10 diagonal bars (of the type shown in the illustration "Picture Out of Horizontal Sync") are visible on the screen.


Picture Out of Horizontal Sync

f. Turn the HORIZONTAL control fully to the right; the picture should fall in sync. If it does not fall in sync, repeat adjustment in step "e". With the Horizontal control set fully to the right, turn the HOR. FREQ. adjustment out (to the left) until the picture just falls out of sync. Then very slowly turn it in (to the right) until the picture falls in sync. If "bending" appears at top of picture (see illustration), correct by very slowly turning the HOR. FREQ. adjustment to the right until the bending is removed. If bending is excessive and cannot be removed with HOR. FREQ. adjustment, repeat all steps above but in step "d", adjust oscilloscope waveform so the rounded peak is from 10 to 20% higher than the pointed peak of the waveform. This compensates for the oscilloscope loading effects.

When the above adjustments are properly made, the picture should hold horizontal sync through at least half-rotation of the Horizontal control.


"Bending" At Top of Picture

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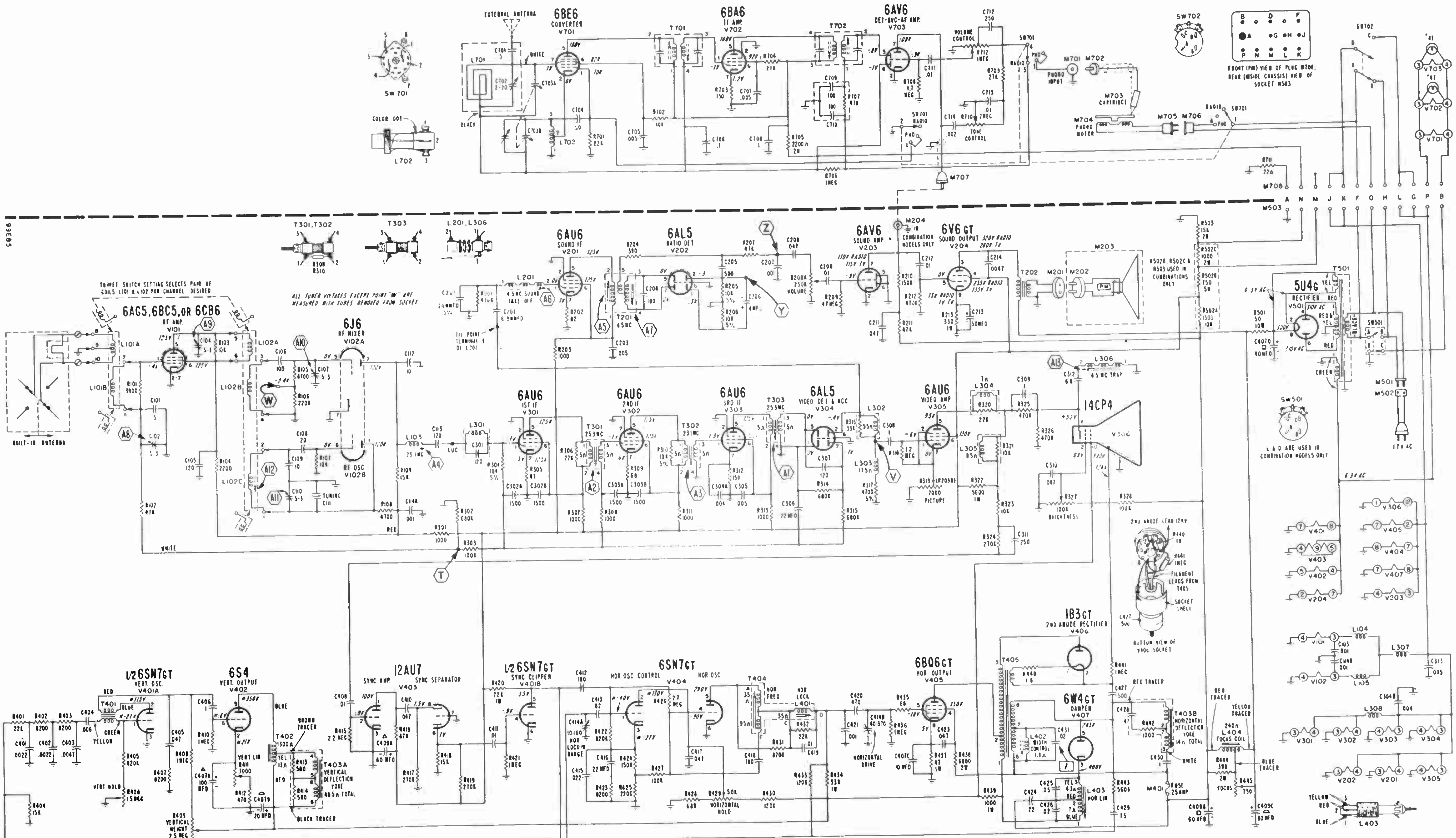
World Radio History

MODELS 34R15, 34R15A, 34R16, 34R16A, Ch. 20T1, 20V1; Radio Ch. 3C1



Schematic for 20T1, 20V1 Television Chassis; 3C1 radio circuit and connections also shown.

RECORD CHANGER: Model RC550, See Pages RCD.CH.21-9 through RCD.CH.21-16.

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20T1, 20V1, 3C1 CHASSIS PARTS

RESISTORS

Sym.	Description	Part No.
†R101	3,900 ohms, 1/2 watt	98A 45-16
R102	47,000 ohms, 1/2 watt	98A 45-17
R103	10,000 ohms, 1/2 watt	98A 45-18
R104	2,200 ohms, 1/2 watt	98A 45-19
R105	4,700 ohms, 1/2 watt	98A 45-20
R106	220,000 ohms, 1/2 watt	98A 45-21
R107	10,000 ohms, 1/2 watt	98A 45-18
†R108	4,700 ohms, 1/2 watt	98A 45-20
R109	15,000 ohms, 1/2 watt	98A 45-67
R201	470,000 ohms, 1/2 watt	60B 8-474
R202	82 ohms, 1/2 watt	60B 8-820
R203	1,000 ohms, 1/2 watt	60B 8-102
R204	390 ohms, 1/2 watt	60B 8-391
R205	10,000 ohms, 1/2 watt, 5%	60B 7-103
R206	10,000 ohms, 1/2 watt, 5%	60B 7-103
R207	47,000 ohms, 1/2 watt	60B 8-473
R208A	250,000 ohms, Volume } pot	75B 11-15
R208B	2,000 ohms, Picture } pot	
	(R208 includes switch SW501)	
R209	4.7 megohms, 1/2 watt	60B 8-475
R210	150,000 ohms, 1/2 watt	60B 8-154
R211	47,000 ohms, 1/2 watt	60B 8-473
R212	470,000 ohms, 1/2 watt	60B 8-474
R213	330 ohms, 1 watt	60B 14-331
R301	1,000 ohms, 1/2 watt	60B 8-102
R302	680,000 ohms, 1/2 watt	60B 8-684
R303	100,000 ohms, 1/2 watt	60B 8-104
R304	10,000 ohms, 1/2 watt, 5%	60B 7-103
R305	47 ohms, 1/2 watt	60B 8-470
R306	22,000 ohms, 1/2 watt	60B 8-223
R307	1,000 ohms, 1/2 watt	60B 8-102
R308	1,000 ohms, 1/2 watt	60B 8-102
R309	68 ohms, 1/2 watt	60B 8-680
R310	10,000 ohms, 1/2 watt, 5%	60B 7-103
R311	1,000 ohms, 1/2 watt	60B 8-102
R312	150 ohms, 1/2 watt	60B 8-151
R313	1,000 ohms, 1/2 watt	60B 8-102
R314	680,000 ohms, 1/2 watt	60B 8-684
R315	680,000 ohms, 1/2 watt	60B 8-684
R316	33,000 ohms, 1/2 watt	Part of L302
R317	4,700 ohms, 1/2 watt, 5%	60B 7-472
R318	1.2 megohms, 1/2 watt	60B 8-125
R319	Picture control	See R208B
R320	22,000 ohms, 1/2 watt	Part of L304
R321	10,000 ohms, 1/2 watt	Part of L305
R322	5,600 ohms, 1 watt	60B 14-562
R323	10,000 ohms, 1/2 watt	60B 8-103
R324	270,000 ohms, 1/2 watt	60B 8-274
R325	470,000 ohms, 1/2 watt	60B 8-474
R326	470,000 ohms, 1/2 watt	60B 8-474
R327	100,000 ohms, Brightness, pot	75B 13-11
R328	100,000 ohms, 1/2 watt	60B 8-104
R401	22,000 ohms, 1/2 watt	60B 8-223
R402	8,200 ohms, 1/2 watt	60B 8-822
R403	8,200 ohms, 1/2 watt	60B 8-822
R404	15,000 ohms, 1/2 watt	60B 8-153
R405	820,000 ohms, 1/2 watt	60B 8-824
R406	1.5 megohms, Vertical Hold, pot	75B 13-8
R407	8,200 ohms, 1/2 watt	60B 8-822
R408	1 megohm, 1/2 watt	60B 8-105
R409	2.5 megohms, Height, pot	75B 13-3
R410	1 megohm, 1/2 watt	60B 8-105
R411	3,000 ohms, Vert. Lin, pot	75B 13-7
R412	470 ohms, 1/2 watt	60B 8-471
R413	560 ohms, 1/2 watt	60B 8-561
R414	560 ohms, 1/2 watt	60B 8-561
R415	2.2 megohms, 1/2 watt	60B 8-225
R416	47,000 ohms, 1/2 watt	60B 8-473
R417	270,000 ohms, 1/2 watt	60B 8-274
R418	15,000 ohms, 1/2 watt	60B 8-153
R419	270,000 ohms, 1/2 watt	60B 8-274
R420	22,000 ohms, 1 watt	60B 14-223
R421	1 megohm, 1/2 watt	60B 8-105
R422	820,000 ohms, 1/2 watt	60B 8-824
R423	8,200 ohms, 1/2 watt	60B 8-822
R424	150,000 ohms, 1/2 watt	60B 8-154
R425	220,000 ohms, 1/2 watt	60B 8-224
R426	2.7 megohms, 1/2 watt	60B 8-275
R427	100,000 ohms, 1/2 watt	60B 8-104
R428	68,000 ohms, 1/2 watt	60B 8-683
R429	50,000 ohms, Hor. Hold, pot	75B 13-9
R430	120,000 ohms, 1/2 watt	60B 8-124
R431	8,200 ohms, 1/2 watt	60B 8-822
R432	22,000 ohms, 1/2 watt	60B 8-223
R433	120,000 ohms, 1/2 watt	60B 8-124
R434	33,000 ohms, 1 watt	60B 14-333
R435	68 ohms, 1/2 watt	60B 8-680
R436	1 megohm, 1/2 watt	60B 8-105
R437	47 ohms, 1 watt	60B 14-470
R438	6,800 ohms, 2 watt	60B 20-682
R439	1,000 ohms, 1 watt	60B 14-102
R440	1.8 ohms, 1/2 watt	60B 28-46
R441	1 megohm, 1 watt, carbon resistor only	60B 28-33
R442	1,000 ohms, 1/2 watt	60B 8-102
R443	560,000 ohms, 1/2 watt	60B 8-564
R444	390 ohms, 2 watt	60B 20-391
R445	750 ohms, Focus, pot	75B 13-17
R501	50 ohms, 10 watt	61A 7-54
R502A	1,500 ohms, 10 watt	
R502B	750 ohms, 5 watt	
R502C	1,000 ohms, 2 watt	
	In combination sets R502A, R502B and R502C are a tapped candohm	61B 14-1
	In TV only sets R502A is a single candohm resistor	61A 3-15
R503	15,000 ohms, 2 watt	60B 20-153
R701	22,000 ohms, 1/2 watt	60B 8-223
R702	10,000 ohms, 1 watt	60B 14-103
R703	150 ohms, 1/2 watt	60B 8-151
R704	27,000 ohms, 1 watt	60B 14-273
R705	2,200 ohms, 2 watt	60B 20-222
R706	1 megohm, 1/2 watt	60B 8-105
‡R707	47,000 ohms, 1/2 watt	
R708	4.7 megohms, 1/2 watt	60B 8-475
R709	27,000 ohms, 1/2 watt	60B 8-273
R710A	2 megohms, Tone } pot	75B 11-12
R710B	1 megohm, Volume } pot (includes SW702)	
R711	22 ohms, 1/2 watt	60B 8-220

CONDENSERS

Sym.	Description	Part No.
C101	5 mmfd, 10%, Zero temp. coeff	98A 45-22
C102	.5 to 3 mmfd, ceramic trimmer	98A 45-87
C103	.001 mfd. min, ceramic	98A 45-24
C104	.5 to 3 mmfd, ceramic trimmer	98A 45-23
C105	120 mmfd, 5%, ceramic, -750 temp. coeff.	98A 45-25
C106	100 mmfd, ceramic, -750 temp. coeff	98A 45-26
C107	.5 to 3 mmfd, ceramic trimmer	98A 45-23
C108	20 mmfd, Cer. Zero temp. coeff	98A 45-27
C109	10 mmfd, 5%, ceramic, -750 temp. coeff.	98A 45-79
C110	.5 to 3 mmfd, ceramic trimmer	98A 45-23
C111	Tuning rotor	98A 45-92
C112	10 mmfd, 5%, ceramic, Zero temp. coeff.	98A 45-64
C113	120 mmfd, 10%, silver mica	98A 45-78
C114A	.001 mfd. min. } dual ceramic	98A 45-93
C114B	.001 mfd. min. } dual ceramic	
C201	6.8 mmfd, -.00033 temp. coeff	65B 6-71
C202	20 mmfd, 5%, ceramic	65B 6-51
C203	.005 mfd. min, ceramic	65A 10-1
C204	180 mmfd, 5%, -.00003 temp. coeff	65B 6-59
C205	500 mmfd, ceramic	65B 6-6
C206	4 mfd, 50 volts, electrolytic	67A 4-9
C207	.001 mfd. min, ceramic	65B 6-41
C208	.047 mfd, 600 volts, paper	64B 9-9
C209	.01 mfd, 600 volts, paper	64B 9-13
C211	.047 mfd, 600 volts, paper	64B 9-9
C212	.01 mfd, 600 volts, paper	64B 9-13
C213	50 mfd, 25 volts, electrolytic	67A 4-10
C214	.0047 mfd, 600 volts, paper	64B 9-15
C301	120 mmfd, 3%, mica	65B 1-10
C302A	.0015 mfd. min } dual ceramic	65A 17-2
C302B	.0015 mfd. min } dual ceramic	
C303A	.0015 mfd. min } dual ceramic	65A 17-2
C303B	.0015 mfd. min } dual ceramic	
C304A	.004 mfd. min } dual ceramic	65A 17-1
C304B	.004 mfd. min } dual ceramic	
C305	.005 mfd. min, ceramic	65A 10-1
C306	.22 mfd, 200 volts, paper	64B 9-37
C307	120 mmfd, 3%, mica	65B 1-10
C308	.1 mfd, 200 volts, paper	64B 9-39
C309	.1 mfd, 400 volts, paper	64B 9-26
C310	.047 mfd, 600 volts, paper	64B 9-9
C311	250 mmfd, ceramic	65B 6-5
C312	6.8 mmfd, -.00033 temp. coeff	65B 6-71
C313	.005 mfd. min, ceramic	65A 10-1
C401	.002 mfd, 600 volts, paper	64B 5-14
C402	.002 mfd, 600 volts, paper	64B 5-14
C403	.0047 mfd, mica	65B 21-472
C404	.006 mfd, mica	65B 5-45
C405	.047 mfd, 600 volts, paper	64B 9-9
C406	.1 mfd, 600 volts, paper	64B 9-7
C407A	100 mfd, 50 volts } electrolytic	67C 15-16
C407B	20 mfd, 400 volts } electrolytic	
C407C	10 mfd, 50 volts } electrolytic	
C407D	40 mfd, 350 volts } electrolytic	
	Terminals on early electrolytic condenser C407 were coded differently. To identify capacity values, see stamping on side of electrolytic.	
C408	.01 mfd, 600 volts, paper	64B 9-13
C409A	60 mfd, 350 volts } electrolytic	67C 15-15
C409B	60 mfd, 350 volts } electrolytic	
C409C	80 mfd, 350 volts } electrolytic	
C410	.047, 600 volts, paper	64B 9-9
C411	.01 mfd, 600 volts, paper	64B 9-13
C412	180 mmfd, 5%, +.00003 temp. coeff, ceramic	65B 6-59
C413	82 mmfd, mica	65B 21-820
C414A	10 to 160 mmfd. } dual trimmer	66A 32-1
C414B	40 to 370 mmfd. } dual trimmer	
C415	.022 mmfd, 600 volts, paper	64B 9-11
C416	.22 mfd, 200 volts, paper	64B 9-37
C417	.047 mfd, 600 volts, paper	64B 9-9
C418	180 mmfd, 5%, +.00003 temp. coeff, ceramic	65B 6-59
C419	.01 mfd, 600 volts, 10%, paper	65A 13-3
C420	470 mmfd, 5%, mica	65B 1-57
C421	.001 mfd, 5%, mica	65B 21-102
C423	.047 mfd, 600 volts, paper	64B 9-9
C424	.22 mfd, 600 volts, paper	64B 9-55
C425	.047 mfd, 200 volts, paper	64A 2-8
C426	.02 mfd, 400 volts, paper	64A 2-9
C427	500 mmfd, 20,000 volts, ceramic	65B 18-5
C428	47 mmfd, 5%, 1,500 volts, silver mica	65B 1-64
C429	7.5 mmfd, 1,500 volts, ceramic	65A 23-3
C430	.1 mfd, 400 volts, paper	64A 2-10
C431	.02 mfd, 400 volts, paper (used in some sets; see Run 1 under production changes)	64B 5-24
C701	5 mmfd, mica	65B 1-62
C702	2 to 20 mmfd. trimmer	66B 8-5
C703A	0 to 420 mmfd } gang	68B 32
C703B	0 to 108 mmfd } gang	
	(Note: Dial drum spot-welded to gang.)	
C704	50 mmfd ceramic	65B 6-4
C705	.005 mfd. min, ceramic	65A 10-1
C706	.1 mfd, 200 volts, paper	64B 5-30
C707	.005 mfd. min, ceramic	65A 10-1
C708	.1 mfd, 400 volts, paper	64B 5-20
‡C709	100 mmfd, ceramic	
‡C710	100 mmfd, ceramic	
C711	.01 mfd, 400 volts, paper	64B 5-25
C712	250 mmfd, ceramic	65B 6-5
C713	.01 mfd, 400 volts, paper	64B 5-25
C714	.002 mfd, 600 volts, paper	64B 5-14

COILS and TRANSFORMERS

Sym.	Description	Part No.
L101	Antenna Coil	
	for Channel #2	98A 62-2
	for Channel #3	98A 62-3
	for Channel #4	98A 62-4
	for Channel #5	98A 62-5
	for Channel #6	98A 62-6
	for Channel #7	98A 62-7
	for Channel #8	98A 62-8
	for Channel #9	98A 62-9
	for Channel #10	98A 62-10
	for Channel #11	98A 62-11
	for Channel #12	98A 62-12
	for Channel #13	98A 62-13
L102	Mixer-Oscillator Coil	
	for Channel #2	98A 63-2
	for Channel #3	98A 63-3
	for Channel #4	98A 63-4
	for Channel #5	98A 63-5
	for Channel #6	98A 63-6
	for Channel #7	98A 63-7
	for Channel #8	98A 63-8
	for Channel #9	98A 63-9
	for Channel #10	98A 63-10
	for Channel #11	98A 63-11
	for Channel #12	98A 63-12
	for Channel #13	98A 63-13
	Before inserting replacement coil L101 or L102, see that teeth at inner end of coils fit together when fitted in detent plate at center of turret. If necessary file teeth slightly.	
L103	Mixer Plate Coil	98A 45-77
L104	Heater RF Choke	98A 45-13
L105	Heater Oscillator Choke	98A 45-14
L201	Sound Take-off Coil (includes R201, C201, C202)	72B 99-2
L301	Trap Coil, 27.25 MC (includes C301)	72A 102
L302	Video Peaking Coil (wound on R316)	73A 5-6
L303	Video Peaking Coil	73A 5-7
L304	Video Peaking Coil (wound on R320)	73A 5-8
L305	Video Peaking Coil (wound on R321)	73A 5-9
L306	Trap Coil, 4.5 MC (includes C312)	72B 99-3
L307	Heater RF Choke	73A 2-5
L308	Heater RF Choke	73A 2-5
L401	Horizontal Lock Coil	Part of T404
L402	Width Control	94A 29-2
L403	Horizontal Linearity Control	94A 28
L404	Focus Coil	69C 117-3
L701	AM Loop Antenna (includes C701, C702)	69C 100-1
L702	Oscillator Coil	69A 52-1
T201	Ratio Detector Transformer	72B 68
T202	Audio Output Transformer	
	for 20V1 chassis	79B 31-1
	for 20T1 chassis	79B 31-2
T301	1st IF Transformer (includes R306, R307, C302A, C302B)	72C 96-11
T302	2nd IF Transformer (includes R310)	72C 96-10
T303	3rd IF Transformer (includes C305)	72C 96-9
T401	Blocking Oscillator Transformer	79A 18-3
T402	Vertical Output Transformer	79B 29-2
T403	Deflection Yoke (includes R413, R414, R442, C428)	A3222
T404	Horizontal Blocking Transformer (includes L401)	69B 110
T405	Horizontal Output Transformer (includes tube cap clips)	79C 32-1
T501	Power Transformer	80C 26-2
T701	1st IF Transformer	72B 28-7
T702	2nd IF Transformer	72B 28-17

MISCELLANEOUS PARTS for TV CHASSIS

Sym.	Description	Part No.
M201	Speaker Socket	88A 5-6
M202	Speaker Plug	88A 5-5
M203	Speaker	
	5" PM	78B 60-1
	6" PM	78B 61
	10" PM	78B 47-2
M204	Socket, Audio Input	89A 29-22
M401	Horizontal Output Fuse, 1/4 amp, 250 V.	84A 4-2
	Fuse Holder	84A 5-1
M501	Interlock Socket (Male)	89A 22-2
M502	Line Cord, with interlock socket	89A 22-1
M503	Cable Socket (Combination models only)	88A 32-2
SW501	Switch, On-Off Power	Part of R208
V306	Picture Tube	14CP4
	Bracket, Deflection Yoke Coil Support	15A 572
	Bracket, Picture Tube Mounting (Supports front of picture tube)	
	Upper bracket	15B 652
	Lower bracket assembly	A3332
	Bracket (Yoke and focus coil support)	
	Upper	15C 613
	Lower	15C 650
	Clip, Tube Cap	
	for 6BQ6GT tube	88A 16-9
	for 1B3GT tube	19A 54
	Connector Lead, 2nd Anode (includes connector plug)	88A 16-10
	Cover, IF Strip	15B 531
	Fuse Holder	84A 5-1
	Insulating Plate (for mounting condenser C427)	32A 135-1
	Ion Trap	94A 15-2
	Lever, Picture Positioning	15B 574
	Lock, 1B3 Mounting Shell Disk	15A 589
	Plate, Channel Selector Shaft Bearing (Phenolic)	32A 111-1
	Plate, TV Tuner Inspection (Fibre)	32A 117
	Rubber Channel, 1" long (for front of picture tube bracket)	12A 9-9
	Rubber Collar (supports flare of picture tube)	12B 40
	Rubber Grommet (for 2nd anode housing)	12A 2-7
	Rubber Insert (cushion for picture tube bracket)	
	for top and sides, 9/16" dia	12A 16-2
	for bottom, 5/8" dia	12A 16-3
	Screw, Wing (for deflection yoke)	1A 101-1-71
	Shield, Tube	
	plain type	87A 7-7
	slotted type	98A 45-73
	Socket, Shell (cover for 1B3 tube socket)	84A 27-1
	Socket, Tube	
	miniature bakelite (7 pin)	87A 3-7
	octal, plain	87A 5-1
	octal, ringmount (mica filled)	87A 20-2
	miniature (plain 9 pin)	87A 25-1
	miniature (special 9 pin for 6S4 tube)	87A 25-4
	Spring, Picture Tube Grounding	19A 23-1
	Support Spring (for 2nd anode lead)	19A 68
	Tuner, Television (Complete)	94C 21-2

MISCELLANEOUS PARTS for TV TUNER 94C21-2

Sym.	Description	Part No.
M104	Shaft Shell & Rotor Assy. (Tuning) (with 1 7/8" long brass shaft shell)	98A 45-76
M107	Bracket, Tuning Rotor Retaining	98A 45-95
M108	Spring, Detent Plate Grounding	98A 45-94
M109	Shield, Tube (slotted; for 6J6)	98A 45-73
M110	Shield, Tube (plain; for 6AG5)	87A 7-7
M112	Spring, Slug Retaining (Osc. coil)	98A 45-52
M113	Washer, Fibre Spacer (1/4" IDx1/2" OD)	98A 45-63
M114	Nut, Locking Spring (for trimmers)	98A 45-31

† To secure proper high frequency characteristics, order exact part from Admiral Distributor or use IRC metalized resistor only.

‡ Part of Diode Filter Unit 63A3-1 consisting of R707, C709, C710.

MODELS 34R15, 34R15A, 34R16, 34R16A, Ch. 20T1, 20V1

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M115	Screw, Trimmer (4-36x5/8")	98A 45-33
M116	Screw, Bracket Mtg. (6-32x1/4")	98A 45-62
M117	Slug, Brass Tuning	98A 45-88
M118	Stator Plate (ungrounded); Silver with Ceramic Insulator, for Tuning C111 (includes mounting bracket)	98A 45-86
M120	Tuner, Television (Complete)	94C 21-2
M121	Roller, Detent (3/8" dia.. 3/32" dia. bearing)	98A 45-82
M122	Spring, Detent (2 5/16" long)	98A 45-81
M123	Contact Plate and Bracket Assembly (uses wiping contacts)	98A 45-84
M124	Spring, Tuning Rotor Contact (flat bronze 1 7/16"x1/2")	98A 45-83
M125	Spring, Front and Rear Turret Shaft (wire 2 3/4" long, 3/64" dia.)	98A 45-85
M126	Turret and Shaft Assembly (less coils) (3 1/4" shaft and 3/16" rounded detent depression)	98A 45-89

MISCELLANEOUS PARTS for 3C1 RADIO

SW701	Switch, Radio-Phono	77A 28-2
SW702	Switch, On-Off	Part of R710
M701	Socket, Phono Input	88A 1
M706	Socket, Phono Motor	89A 6-1
M707	Shielded Cable Assembly	89A 29-11
M708	Plug, Cable Connector (14 pin rect.)	88A 20-1
	Cover and Insulator (for plug 88A20-1)	88A 20-6
	Cable (12 wire), including 88A20-1 plug and 88A20-6 cover	AB216
	Bracket, Mounting	
	for Off-Volume and Tone control	15A 409
	for Radio-Phono Switch	15A 385
	for Tuning Sleeve	15A 394
	Clip, IF Transformer Mtg	72B 28-10
	Cover Assembly, Chassis	A1880
	Dial Back and Bracket Assembly	A1881
	Dial Cord (50" length needed)	50A 1-3
	Dial Scale	22B 23-1
	Escutcheon, Radio	23D 63-3
	Grommet, Gang Mounting	12A 1-2
	Hex Nut, Switch Retaining	2A 2-11-71
	Knob, 'Radio-Phono', 'Tuning'	33D 55-1
	Knob, 'Tone'	33D 55-4
	Knob, 'Volume'	33D 55-5
	Lockwasher, Osc. Coil & Gang (#6 I.T.)	3B 1-25-71
	Pilot Light, #47 Mazda	81A 1-8
	Pointer, Dial	25A 38
	Shaft, Tuning	28A 48-1
	Snap Button (for mtg. dial scale)	13A 1-1-71
	Socket, Tube	
	7 pin (for 6BA6, 6AV6)	87A 3-7
	7 pin (for 6BE6)	87A 24-3
	Socket, Pilot Light (includes 14" lead)	82A 2-3
	Socket, Pilot Light (includes 9" lead)	82A 2-9
	Spacer Sleeve (for gang mounting)	29A 2-1-71
	Spacer Sleeve (3 1/4" long, for mounting phono-radio switch)	29A 3-15
	Spring, Dial Cord Tension	19B 1-3
	Washer, Vellutex (Oscillator coil mtg.)	5A 1-21

RECORD CHANGER PARTS

Complete service information for the RC550 Record Changer is given in Service Manual No. S327. The changer model number is on the top rear of the changer pan and also on the model label on the underside of the changer pan.

M702	Cable, Shielded (includes plug)	412A 11-2
M703	Cartridge, Push-in Needle Type (includes needle)	409A 13-1
	Cartridge, Knurled Nut Retaining Type (includes needle)	409A 13
M704	Motor (3 speed)	407B 19
M705	Plug, Motor (Male)	88A 8-1
	Adapter, 45 RPM Record (envelope of 12)	48A 8-1
	Belt, Rubber Drive	406A 20
	Idler Wheel Assembly (includes tire)	G400A 279
	Needle, Phonograph	
	for 409A 13 cartridge	98A 15-19
	for 409A 13-1 cartridge	98A 15-18
	Needle Retaining Nut (for 409A13 cartridge)	98A 54-2
	Service Manual, RC550	S327
	Spring, Changer Float	405A 139
	Touch-Up Paint	
	Coppertone	98A 54-3
	Gold Hammertone	98A 54-12

PARTS for TILT-OUT MECHANISM

Eye Bolt (for tilt-out spring)	1A 87-1
Grommet, Rubber (for tilt-out spring)	12A 1-1
Hinge Assembly, Tilt-Out	
Left side (facing front)	AC183-1
Right side (facing front)	AC183-2
Screw, Tilt-Out Brkt.Shipping (#10-24x3/8 ST)	1A 51-25-71
Screw, Tilt-Out Adjusting Bracket Mtg. (#8-32x1/4" Bd. H.M.S.)	85-250-C2-71
Screw, Tilt-Out Tie Rod Mtg. (#6-32x1/4" Bd. H.M.S.)	365-250-C2-58
Spring, Tilt-Out Coil (2 3/8" unstretched)	19A 15-1
Spring, Tilt-Out Arm Retaining (7 1/4" unstretched)	19A 59
Tie Rod, Tilt-Out	28A 22-1

CABINET PARTS for 34R15 (Walnut), 34R16 (Mahogany)

The above model numbers may contain the suffix "N".

A3072	Antenna, Built-in TV
43C 128-1	Back, Radio-Phono and Record Compt.
A3292	Back, TV (includes line cord)
*35E 117-3	*Cabinet, Walnut
*35E 117-4	*Cabinet, Mahogany
44B 181	Carton and Fillers
98A 60-7	Caster (for cabinet leg)
11B 12-6	Clamp, Cable
*35E 117-52	*Door, Record Compt. (Complete) Walnut
*35E 117-53	*Door, Record Compt. (Complete) Mahog.
*35E 117-50	*Doors. TV and Radio-Phono Compt., Walnut (matched pair)
*35E 117-51	*Doors. TV and Radio-Phono Compt., Mahogany (matched pair)
35E 117-63	Door Catch and Strike Plate
23C 58-1	Escutcheon, Control (Plastic; less door)
23C 58-2	Escutcheon Door (Plastic)
23D 63-1	Escutcheon, Radio
12A 32-8	Gasket, Sponge Rubber (for picture window)
36B 3-28	Grille Cloth (2 pieces)
37A 27-1	Handle, Door (for upper doors)
35E 117-62	Hinge, Knife (Pair)
33D 55-1	Knob, Radio 'Radio-Phono', 'Tuning'
33D 55-4	Knob, Radio 'Off-Volume'
33D 55-5	Knob, Radio 'Tone'
33C 53-9	Knob, TV 'Channel'
33C 53-10	Knob, TV 'Tuning'
33C 53-11	Knob, TV 'Off-Volume'
33C 53-12	Knob, TV 'Picture'
81A 1-8	Light, Pilot #47
89A 22-1	Line Cord and Interlock Socket
6A 4-6-0	Line Cord Mounting Rivet
1A 7-24-59	Screw. for mtg. picture window (#6x3/8 R.H.W.S.)
1A 7-9-57	Screw. for mtg. control escutcheon (#4x3/8 R.H.W.S.)
1A 7-23-59	Screw, for mtg. cabinet back (#6x1/2 R.H.W.S.)
1A 67-44-71	Screw, for mtg. TV chassis (1/4-20x1")
98A 44-47	Spacer, Fibre Cabinet Leveler (Kit of 6)
78B 47-2	Speaker. 10 inch PM
2B 12-4-68	Speed Nut (for mtg. radio escutcheon)
18A 41	Spring. Hinge (for mtg. escutcheon door)
18A 43-2	Spring. TV Knob Tension, 'Off-Volume'
18A 43-1	Spring. TV Knob Tension, 'Tuning'
18A 43-3	Spring. TV Knob Tension, 'Channel'
	Tilt-Out Parts See "Parts For Tilt-Out Mechanism"
5A 4-14	Washer. Felt, behind 'Channel' knob
5A 4-15	Washer. Felt, behind 'Picture' knob
5A 4-11	Washer. Felt, behind radio knobs
23D 69	Window, Picture

* To insure proper matching and fit, also specify cabinet manufacturer's code letters (usually burned or stamped on back rail of cabinet). Wood parts are supplied only if old part cannot be repaired. When ordering describe condition of old part in detail.

* CORRECTIONS AND ADDITIONS TO PRELIMINARY SERVICE MANUAL 20T1 AND 20V1

CORRECTION:

Form 41A9-14 lists the part number for the video peaking coil L305 as 73A5-6. This is incorrect. The correct part number of L305 video peaking coil is 73A5-9.

PRODUCTION CHANGES

Some brands of 6S4 tubes do not have an internal connection between pins 3 and 6. When replacing the 6S4 tube in an early production 20V1 chassis it may be necessary to connect a wire jumper from terminal 3 to terminal 6 of the tube socket, or the result will be no vertical sweep. This jumper is in all late production 20V1 chassis and in all 20T1 chassis.

RUN 2 IN 20V1 CHASSIS

Sync buzz and plate dissipation in the 20V1 chassis can be reduced by replacing R213, 270 ohm, 1 watt resistor with a 330 ohm, 1 watt resistor (part number 60B14-331). 20V1 chassis having this change are stamped run 2 or higher. All 20T1 chassis will have this change.

Picture Window and Control Escutcheon Difference in Models 34R15, 34R16, and 34R15A, 34R16A

The picture window and the control escutcheon used in models 34R15 and 34R16 are different from those used in models 34R15A and 34R16A. Since the different picture windows and the control escutcheons are not interchangeable, it is important that correct replacement be ordered.

Order these parts from the parts list below. To avoid possibility of ordering incorrect replacements, either modify or cross out the listing for these parts in the parts list.

Escutcheon, Control (less door)	
for 34R15, 34R16	23C 58-1
for 34R15A, 34R16A	23D 71-2
Escutcheon Door	
for 34R15, 34R16	23C 58-2
for 34R15A, 34R16A	23D 71-3
Spring, Escutcheon Door	
for 34R15, 34R16	18A 41
for 34R15A, 34R16A	
left side, facing front	19A 65-2
right side, facing front	19A 65-1
Window, Picture	
for 34R15, 34R16	23D69
for 34R15A, 34R16A	23D71-1
Speednut for mounting 23D71-1 Window	2B10-30-68

REPLACING PICTURE TUBES IN 20V1 CHASSIS

Due to the difference in manufacturing tolerance between various brands of picture tubes, it may be found that replacing one brand with another will result in too much brightness, even with the brightness control turned fully off.

This may be corrected by connecting a 470K, 1/2 watt resistor (part number 60B8-474) across condenser C308 (.1 mfd).

The resistor places a negative bias on the video amplifier tube V305 and decreases the current through this tube. By connecting the resistor across C308 instead of between the grid of the video amplifier and ground, the DC reinsertion is also improved.

The 470K resistor is included in current production 20V1 chassis, commencing with run 3, code OP.

All 20T1 chassis will have this resistor.

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CHARACTERISTICS

Antenna impedance
300 ohm input

Picture area -
150 sq. inches,
14 1/4" by 10 3/4"

Speaker
4 by 6 oval PM

Voice coil impedance
3.2 ohms - 400 cycles

Dimensions
20½" high
23" wide
20" deep

I-F frequencies
Video - 26.1 mc.
Sound - 21.6 mc.
Audio strip - 4.5 mc.

Power Supply
117 volts, 60 cycles, AC

Power consumption
180 Watts

Tube complement
18 tubes - 2 rectifiers
(see parts list for
individual tubes)

The tubes are 6BH6, RF amplifier, 6AG5, converter, and 6J6 oscillator. The 6BH6 RF stage has a grid-cathode 300 ohm balanced input. The RF pass band is achieved by an overcoupled, double-tuned, interstage network which feeds the 6AG5 converter. The 6J6 is a push-pull oscillator of exceptional stability.

All oscillator adjustments are available from the front, and with the exception of channel 2 (which must be adjusted first) they are all independent. The vernier tuning mechanism is extremely rugged and simple. The pass-band of all RF channels is maintained above 75% relative response between picture and sound carriers.

The Video System

Three video i-f amplifiers, V-4, V-5, and V-6, each a 6AU6 tube, are employed. (The schematic, Fig. 9, should be consulted while reading the rest of the circuit analysis.) Four stagger-tuned i-f transformers, L4, L6, L9, and L12, are employed to produce the necessary bandwidth. Both the video and sound i-f signals are passed through this complete amplifier section which functions as a combined i-f system. There is no separation of the sound i-f signal from the video i-f signal, and they are both fed directly into V-7, the video detector. This is the basis upon which the intercarrier system operates. The over-all response of the i-f section is such that the amplitude of the sound i-f carrier is a very small percentage of the video i-f carrier when they are both fed to the video detector, which is one half of a 6AL5 tube. No sound traps are employed. Response shaping is discussed in the alignment section.

The video detector considers the sound i-f signal as a high-frequency sideband of the video i-f signal and detection occurs in the normal manner. The sound and video i-f carriers can be considered as beating together inside the video detector. The carriers of these two i-f signals are always separated by 4.5 mc, so that after detection their difference frequency of 4.5 mc appears in the output of the video detector. This 4.5-mc beat note contains all of the f-m characteristics of the input f-m sound i-f signal and very little a.m. effects. It is the amplitude relationship between the two input i-f signals that determines the character of the 4.5-mc output signal.

The 4.5-mc f-m signal as well as the video signal output from the detector is directly coupled to the grid of V-8, a 6AC7 video amplifier, through an L-R high-frequency compensating network. In this manner, the 4.5-mc signal receives additional amplification. In the plate of the video amplifier is the primary parallel-tuned circuit of a double-tuned 4.5-mc transformer, L2, which selects the f-m 4.5-mc signal to be fed to the sound section of the receiver. The video signal output is fed directly to the grid of the picture tube V-10, through peaking coil L3 and capacitor C223.

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AGC and Contrast

The video i-f signal output from the third video i-f stage, V-6, is fed to the plate, pin 7, of the other half of the 6AL5 tube, V-7, which serves as a delayed AGC rectifier. The AGC voltage is supplied to the r-f and first and second video i-f amplifiers. A small positive voltage on the cathode of this diode prevents rectification of the video i-f signal until the i-f signal voltage on the diode plate exceeds whatever voltage is on the cathode. The contrast control, PD4, which is in the cathode circuit of the video amplifier, V-8, besides controlling the bias and hence the gain of this stage, also controls the amount of delay voltage on the cathode of the AGC tube. The influence of the contrast control is such that the delay voltage will be greatest at the time the gain of the video amplifier is greatest. This makes for a better over-all control of the picture contrast.

The Sweep and Sync Circuits

One half of V-9, a 12AU7 tube, serves as the d-c restorer and sync clipper. The sync voltage output from this section is fed to the grid of the other half of V-9, which functions as a sync amplifier to the vertical sync pulses and as a phase splitter to the horizontal sync pulses. The positive sync output signal is taken directly from the plate, pin 6 of V-9, and applied to an integrating network which consists of C301, R301, C302, R302, and C303. This integrating network separates the vertical sync pulses from the horizontal and applies the former to the grid circuit, pin 1, of the vertical sweep oscillator, V-13. This latter circuit utilizes one half of a 6SN7-GT tube as a blocking oscillator. The other half of V-13 functions as the vertical sweep output amplifier. The output from this amplifier feeds into the vertical output transformer, T4, and then to the vertical deflection yoke.

The 1-megohm potentiometer (of dual-control unit PD5) in the grid circuit, pin 1, of the vertical sweep oscillator, controls the frequency of operations and is termed the VERT. HOLD control. The VERT. LINEARITY control is the 5000-ohm potentiometer, P2, in the cathode circuit, pin 6, of the vertical sweep output amplifier. The VERT. SIZE control is a 2.5-megohm potentiometer, P5, located in the B-supply lead to the plate of the vertical sweep oscillator.

The type 6SN7-GT tube, V-14, which is the horizontal sweep oscillator, is employed as a combined cathode-coupled sine wave oscillator and multivibrator. The output from the plate, pin 5, of this oscillator is coupled to the grid of V-15, a 6BQ6G tube serving as the horizontal sweep output amplifier. The output from the plate of this latter tube is fed to tap 2 on the primary of the horizontal output transformer, T5. From the high side of the primary of this transformer, tap 3, the horizontal sweep signal is fed to the plate of V-16, a 1B3-GT tube, serving as the high-voltage rectifier. This rectifier is employed in a kick-back type of high-voltage power supply, which supplies voltage for the second anode of the kinescope.

The horizontal deflection circuits used in this set are designed for a kinescope of 70 degree deflection angle. This is a highly efficient system employing new components that cannot be interchanged with parts used in previous systems.

The secondary of T-5 (ferrite core) consists of taps 4, 5, 6, and 8, and feeds the horizontal deflection yoke. A 6W4 tube, V-17, serves as the horizontal damper. From the secondary winding of the horizontal width coil, some of the sweep signal is applied to the cathode and plate (pins 1 and 2) of the horizontal phase detector, V-11, through an integrating network of R327 and C322. The horizontal sync pulses from the V9 phase splitter are applied to the other cathode and plate of the horizontal phase detector, and these sync pulses are compared with the phase of the horizontal sweep input. If their phases are different, an AFC voltage is developed across R323 and then applied to the grid, pin 1, of the horizontal sweep oscillator.

The 50,000-ohm potentiometer, PD5, in the grid circuit, pin 4, of V-14, regulates the horizontal sweep frequency and is called the HOR. HOLD control, and trimmer capacitor C325 between V-14 and V-15 is the HOR. DRIVE control. Coil L21 in the cathode circuit of the horizontal damper tube V-17 is the HOR. LINEARITY control and coil L20 across taps 5 and 6 of the horizontal output transformer functions as the horizontal WIDTH control.

The Sound Section

The 4.5-mc f-m signal from the secondary of the takeoff transformer L2 is fed to the grid circuit of the ratio detector driver and limiter, V-3, a 6AU6 tube. The output from this driver tube feeds the primary of the ratio detector transformer L1, which is tuned to 4.5 mc. The double diode section of a 6T8 tube, V-2, is used as the ratio detector, and the triode section of this same tube is used as the first audio amplifier. The 500,000-ohm potentiometer P7 in the output circuit of the ratio detector is the VOLUME control. The output from the first audio amplifier is R-C coupled to the grid of V-1, a 6AQ5 tube which is the audio output amplifier. The audio signal output from this latter stage is fed to the audio output transformer, T1, and then to the speaker.

Power Supply and Voltage Regulation

The low-voltage supply incorporates a 5U4-G tube, V-12, as the rectifier. Coil L17 in the output filter system is the focus coil and connected across this coil is the FOCUS control, P6, a 1500-ohm potentiometer. This low-voltage power supply provides a positive 360-volt B-plus source and a negative 2-1/2 volt bias supply. For the r-f and i-f section of the receiver the 360-volt output is decreased to 140 volts for the screens and plates of these tubes while the cathodes are returned to chassis ground. The 360-volt

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supply is used directly for the deflection circuits and also for the plates and screens of the tubes in the sound section. However, the cathodes of these audio tubes are connected in series with the B supply for the r-f and i-f tubes, which means that the cathodes of the audio section are 140 volts positive with respect to ground. Thus, the effective B supply between the plate and cathode of the tubes in the sound section is 360 less 140, or 220 volts.

The interesting thing about the 6AQ5 tube circuit, V-1, is that it functions as a series automatic voltage regulator for the 140-volt supply and prevents any current variations in the r-f and i-f circuit from changing this voltage. The grid of the 6AQ5 tube is connected to the 360-volt supply through a voltage divider. A positive voltage of 123 volts is applied to the grid, but since the cathode is 140 volts positive, the grid has an effective bias of -17 volts. Any change in the 140 volts will tend to change the bias of the 6AQ5 tube. This, in turn, will cause the tube current to change, which means that the voltage drop across the cathode load will likewise vary. This voltage drop will be such that it will bring the cathode back to the 140 volts.

For instance, if the voltage increases beyond 140 volts, the bias on the 6AQ5 tube will become more negative. Less current will flow in the tube and a smaller voltage drop will occur across the complete cathode load. This decrease in voltage drop will be just enough to offset the previous increase in the cathode voltage.

FUNCTIONING OF CONTROLS

The controls of the receiver are divided into two groups, the front panel operating controls and the rear panel pre-set controls.

FRONT PANEL OPERATING CONTROLS

There are seven front panel operating controls as indicated in Fig. 1, each operating independently of the other. Reading from left to right, the controls and their functions are as follows:

On-Off and Volume

This is a single control. The knob should be turned clockwise, until a click is heard. This supplies a.c. to the receiver. Further clockwise rotation of the control varies the input to the audio amplifier, and, consequently, controls the volume of sound output.

Vertical Hold

This control functions to keep the picture stationary in the vertical direction. Electrically it is a variable resistor which controls the frequency of the vertical sweep oscillator.

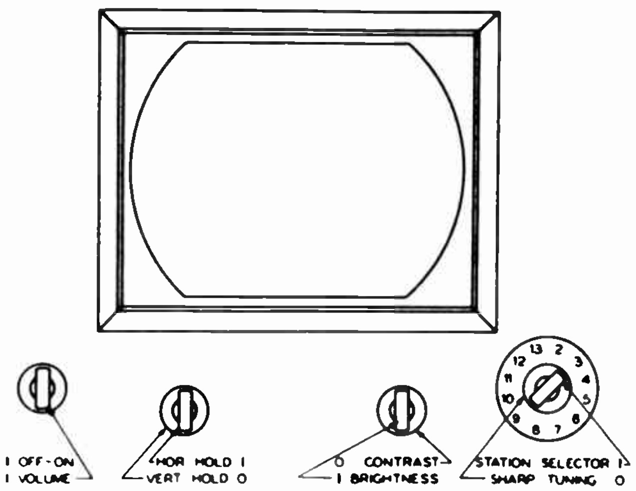

FIG. 1 — OPERATING CONTROLS

Horizontal Hold

The function of this control is to keep the picture stationary in the horizontal direction. It is a variable resistor which affects the frequency of the horizontal sweep oscillator.

Brightness

This control, which is also a variable resistor, affects the cathode voltage on the kinescope, thereby regulating the brightness of the picture.

Contrast

The contrast control provides a means for varying the relative intensities of black and white in the picture. Advancing this control toward excessive contrast will introduce a loud buzz.

Station Selector

This control permits selection of the channel desired.

Fine Tuning

This control varies the frequency of the r-f heterodyne oscillator. It is adjusted for best picture quality and is not used to tune in the sound.

REAR PANEL PRE-SET CONTROLS

There are six so-called pre-set controls at the rear of the chassis as indicated in Fig. 2. They are all screw driver adjustments. The SOUND DISC. is the alignment screw for the secondary of the ratio detector transformer L1, and is not considered a pre-set control.

Vertical Linearity

This control is a variable resistor in the cathode circuit of the vertical sweep output tube. Manipulation of this control affects the upper portion of the picture.

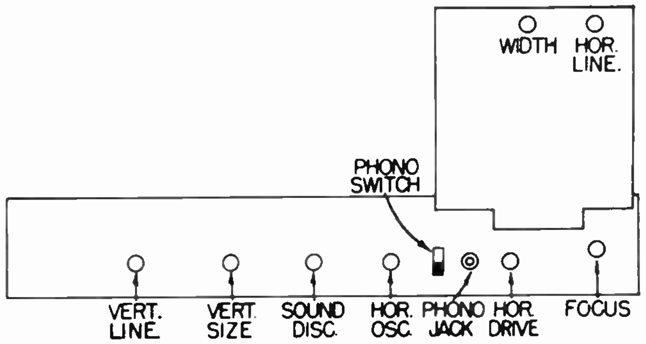

FIG. 2 — PRE-SET CONTROLS

Vertical Size

The vertical size control varies the plate voltage of the vertical sweep oscillator. It primarily causes a change in height of the picture but it also interacts with the vertical linearity so that these controls must be used in conjunction with each other.

Horizontal Oscillator Frequency

This control is a slug adjustment for L18 which controls the frequency of the horizontal oscillator. To set this control properly, connect an antenna to the receiver and tune in a station, preferably one with a test pattern on the air. Center the horizontal hold control. Adjust the L18 slug until the picture locks in. Set the horizontal hold control in the full clockwise position and slowly rotate it in the opposite direction. Just before the picture falls into sync, 3 or 4 black and white bars should appear sloping downward to the right. Repeat the process, but with the horizontal hold control in the full counterclockwise position. The same conditions should be observed except that the bars will slope downward to the left.

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If the sloping bar effect is as stated, then the picture should remain in sync over 1/4 rotation of the horizontal hold range and drop out of sync on either end of this range.

Horizontal Drive

This trimmer capacitor affects the height of the horizontal pulse, varying the horizontal linearity principally on the left side of the picture.

Focus

A variable resistor which controls the current flow through the focus coil on the neck of the tube.

Width

This slug adjustment inside the high-voltage cage affects the right side of the horizontal axis. The secondary winding of the width coil is used to feed back a comparison voltage for synchronizing the AFC horizontal hold circuit.

NOTE: There are no horizontal or vertical positioning controls. Centering of the picture is accomplished by positioning of the focus coil. The deflection yoke should be placed on the neck of the tube as far forward as possible.

ALIGNMENT PROCEDURE

Test Equipment

The test equipment required for the alignment of this receiver is as follows:

Marker Generator (RCA WR-39A, or equivalent)
Sweep Generator (RCA WR-59A, or equivalent)
Oscilloscope (RCA WO-55A, or equivalent)
VTVM (RCA Junior VoltOhmyst, or equivalent)
Volt-Ohmmeter (Simpson 260, or any 20,000 ohm-per-volt meter)

The marker generator is an r-f signal generator used for peaking the i-f coils and also to supply marker pips on the response pattern. The required frequency range of this generator is approximately from 20 to 30 mc and must also have provision for a 4.5 mc output. The accuracy of the frequency calibration of this generator is very important. It must also have provision for an amplitude modulated, as well as an unmodulated, r-f output.

The sweep generator has its output continually variable in frequency. In this alignment, only one output sweep signal is needed, that sweeping between 20 to 30 mc.

The oscilloscope used is a high-gain, general purpose type employed for test purposes. The size of the screen is unimportant.

The VTVM is of the standard type with a high input impedance. It should have provision for a-c and d-c measurements. A 20,000 ohm-per-volt meter should be used for d-c indications if the VTVM can only measure a.c.

Alignment

For the alignment points refer to the figure indicated in the discussion. Most of the adjustments are located on top of the chassis. The r-f marker generator is used in making most of the alignment adjustments. It is recommended that the order of alignment in the following procedure be adhered to if alignment is found necessary. The ground leads of the test instruments should be connected to the receiver chassis.

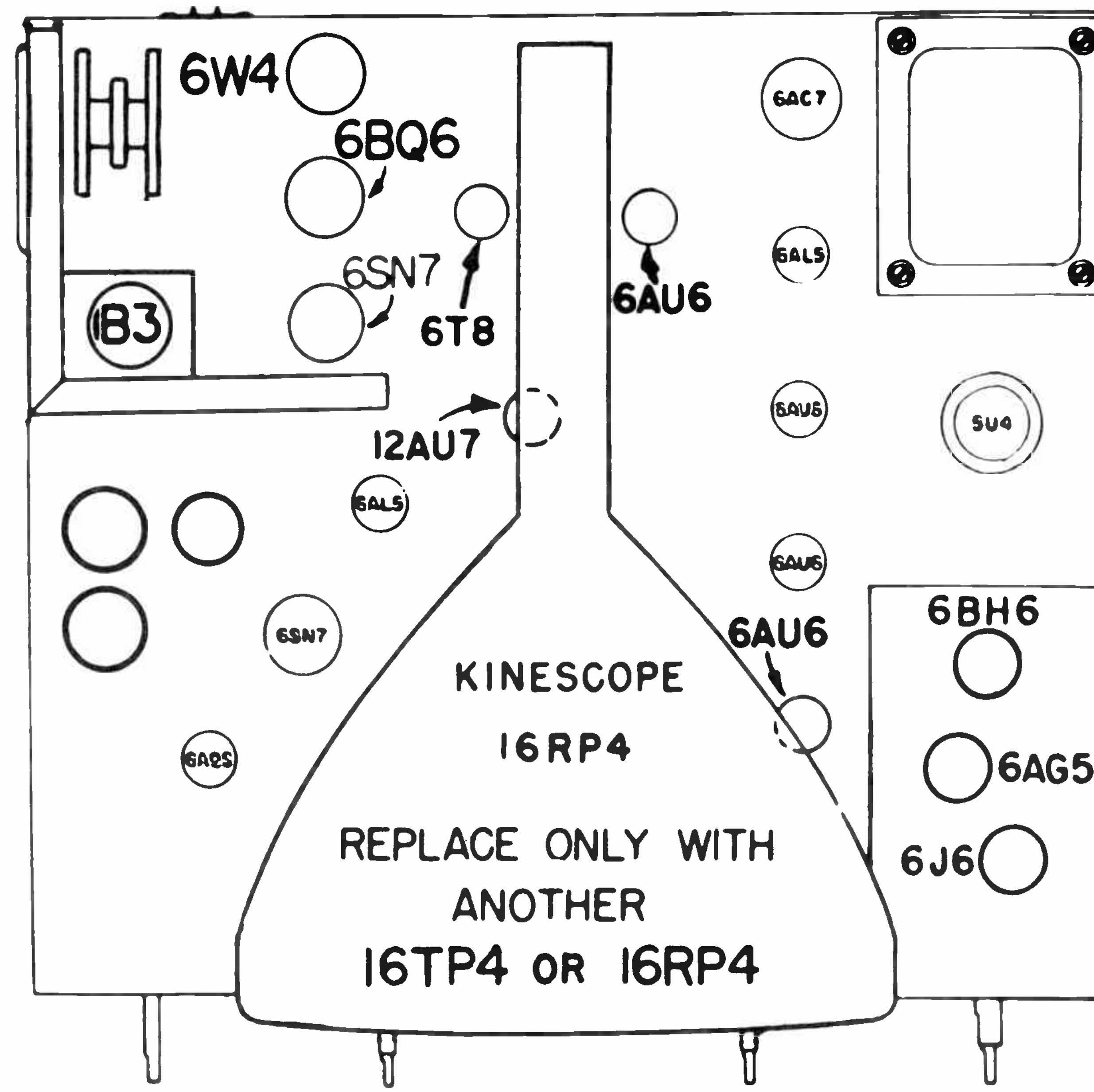

FIG. 3—TOP VIEW OF CHASSIS

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Picture I-F Alignment (Fig. 3)

Connect the VTVM (a-c scale), or oscilloscope to the grid of the kinescope at the junction of C223 and R222. (Do not attempt to take readings with the VTVM at the video detector.) Adjust the contrast control about 1/8 turn below its maximum setting. Connect the output of the signal generator (marker) to the nipple on top of the 6AG5 mixer tube of either tuner.

Set the generator at 25.6 mc, amplitude-modulated at approximately 400 cycles, and adjust the first and third video i-f coils for maximum response. For those receivers employing tuner TT-1, the first video i-f coil is L4 as indicated in Fig. 3(A). When tuner TT-3 is used, the first video i-f coil is LV-6 and is incorporated in the tuner and not the receiverproper, as shown in Fig. 3(B). Reset the generator to 23.4 mc, still amplitude-modulated, and tune the second and fourth video i-f coils, L6 and L12 respectively, for maximum response. Repeat the above process for fine adjustments of settings.

Over-all Picture Response

With the sweep generator adjusted for a 10-mc sweep, using a center frequency of about 25 mc, connect the generator to nipple of the 6AG5 mixer tube of either tuner. Loosely couple the marker generator to the same mixer tube. The oscilloscope should remain at the grid of the kinescope. Inject individual markers of 26.1 mc, 25.6 mc, 22.6 mc, and 21.6 mc in the order indicated and note positions of marker pips on response curve. Turning the adjustments very slowly, retune the four video i-f coils again for an over-all picture i-f response as indicated in Fig. 4.

NOTE: A 30% variation in amplitude between peaks and from peak to valley, of the response curve is permissible. The most important considerations here are that the video i-f carrier of 26.1 mc is approximately halfway down the right hand slope, and that the sound i-f carrier of 21.6 mc is 20 times down at the other end of the curve.

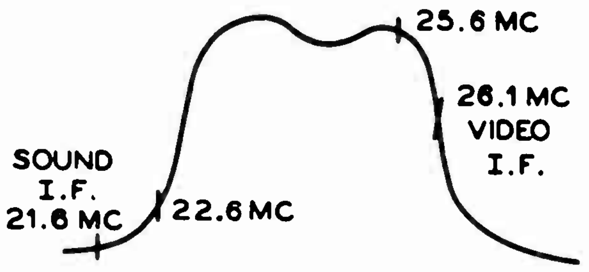

FIG. 4 - OVER-ALL I-F RESPONSE CURVE.

Sound Takeoff and Detector Transformer Alignment

Move the signal generator (marker) output lead to the junction of L13 and R217, between the video detector, V-7, and video amplifier V-8. Set the generator to a 4.5-mc unmodulated signal output. Connect the VTVM (d-c scale) or the 20,000 ohm-per-volt meter across C107 in the output circuit

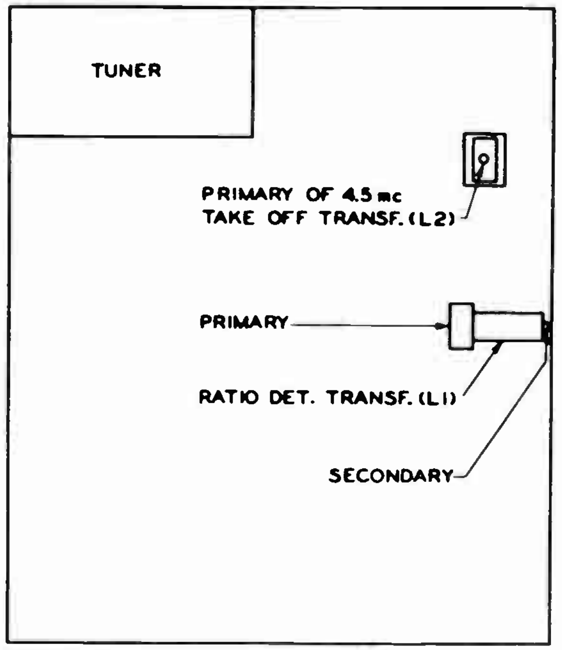

FIG. 5 - BOTTOM VIEW SHOWING ALIGNMENT POINTS FOR L1 AND PRIMARY OF L2

of the ratio detector, V-2. (Remember that the negative lead at this point is actually above -140 volts with respect to ground.)

Adjust the following for maximum reading on the meter in the order indicated. The primary of L1 (the ratio detector transformer), the adjustment of which is shown in Fig. 5. Next tune the secondary of L1; this adjustment, shown in Fig. 5, is also shown in Fig. 2 and indicated as SOUND DISC. Then adjust the primary L2, the 4.5-mc takeoff transformer; see Fig. 5. Next adjust the secondary of L2, shown in Fig. 3. Decrease the signal output from the generator to the minimum required to give a readable deflection on the meter and then repeat the sound alignment process.

After the alignment is complete, remove the generators and meters. Tune in a station. Turn up the contrast control until a buzz is heard. Adjust the secondary of the detector transformer (see Figs. 2 and 5) for minimum buzz.

NOTE: Alignment of the r-f and oscillator sections are not recommended and are therefore not included. If any misalignment of these sections is suspected, consult the manufacturer.

SERVICE NOTES

No Raster

Defective picture tube or misadjusted ion trap magnet.
No high voltage. Check tubes V-14, V-15, V-16, and V-17.
Check horizontal output transformer, T111; and also check C338, R326, and R338.
Check all voltages and waveforms in sweep section. Do not check voltage directly on plate of V-16.

Raster Present -- No Sound or Picture

Open transmission line.
Defective tube in r-f unit, or defective r-f unit.
Check B+ supply for sound and picture sections.
Check tubes V-1, V-2, V-3, V-4, V-5, V-6, V-7, and V-8.

Raster and Sound -- No Picture

Open green lead from picture tube socket.
Check tube V-8 and associated circuit.
Open C223.

Raster and Picture -- No Sound

Defective sound takeoff transformer, T2, or ratio detector transformer, T1.
Check tubes V-1, V-2, and V-3.
Defective audio output transformer, T1, or speaker.

Unable to Synchronize Vertically or Horizontally

Check tube V-9 and associated circuit.

Unable to Synchronize Vertically

Check tube V-13.
Defective vertical oscillator transformer, T3, or vertical output transformer, T4.

Unable to Synchronize Horizontally

Horizontal sweep oscillator coil L18 misadjusted.
Coil L18 or capacitor C315 defective.
Defective tubes V-11 or V-14, or feedback capacitor C330.
Check voltages, resistances, and waveforms in horizontal sync section.
Open width coil

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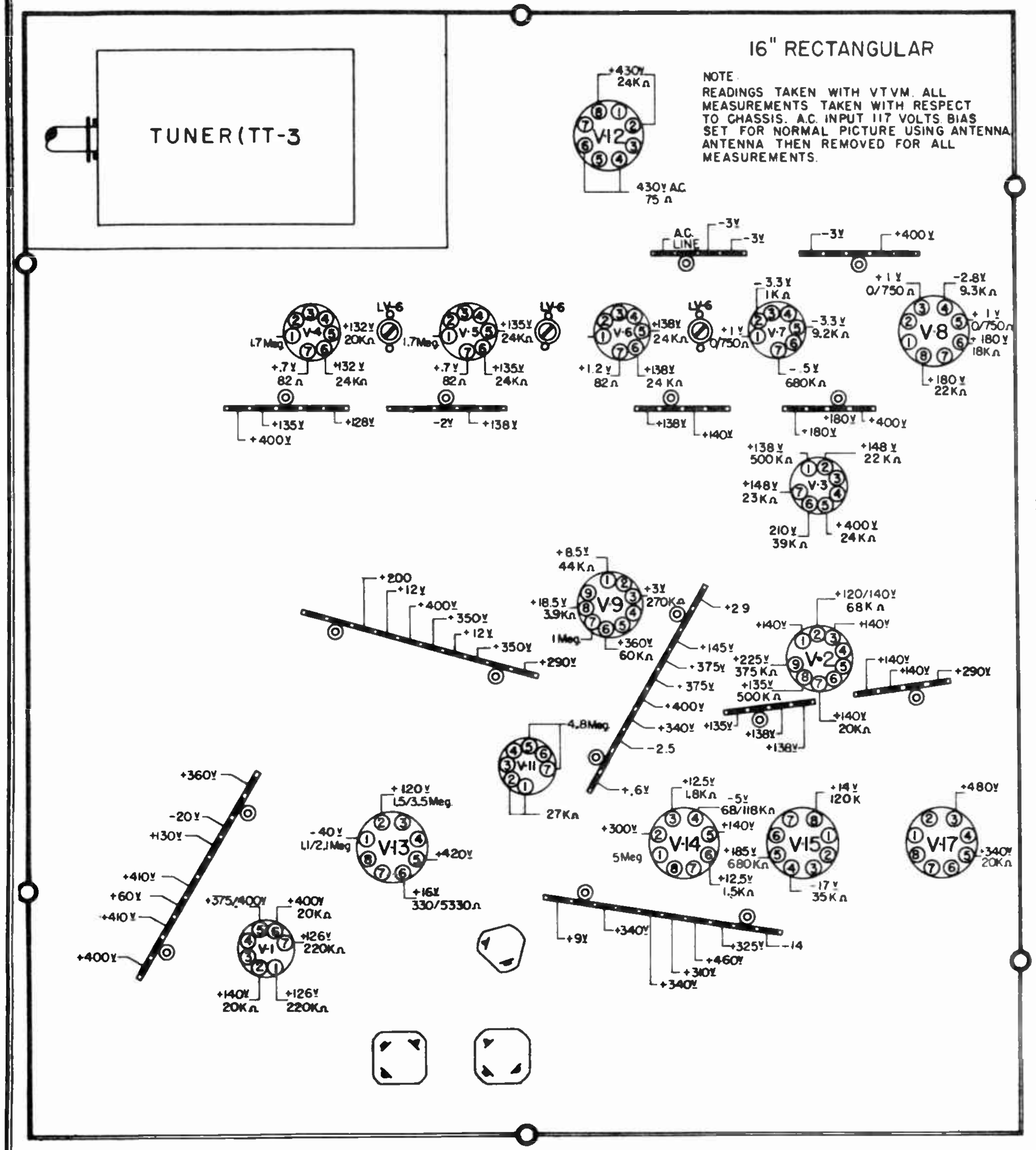

FIG·6- BOTTOM VIEW INDICATING VOLTAGE AND RESISTANCE VALUES

Insufficient Height

Defective vertical oscillator transformer, T3.
C313 increasing in capacity.
R304 and R310 changing in value.

Inability to Center Picture

Blanking on left side may be due to leaky C313.
Carefully try ning CR Tube.

NOTE: Entire audio circuit is at a potential of 140 volts above ground and the grids are hot. Also, V-1, 6AQ5, functions as a series voltage regulator to this 140 volts, as well as an audio output tube. Proper operation of this tube affects B+, and is, therefore, vital to normal operation of other circuits. A primary check of this circuit should be instituted when starting to service receiver.
For voltage and resistance analysis and waveforms, see Fig. 6.

DISASSEMBLY

To remove chassis from the cabinet, first pull off all knobs from controls in front of cabinet. Remove the six mounting bolts to be found underneath the cabinet and lift the chassis from the cabinet. Use care to prevent damage to the kinescope.

The kinescope is mounted on the chassis itself. It is held in place by a strap that is fastened over the outer rim of the bell of the kinescope.

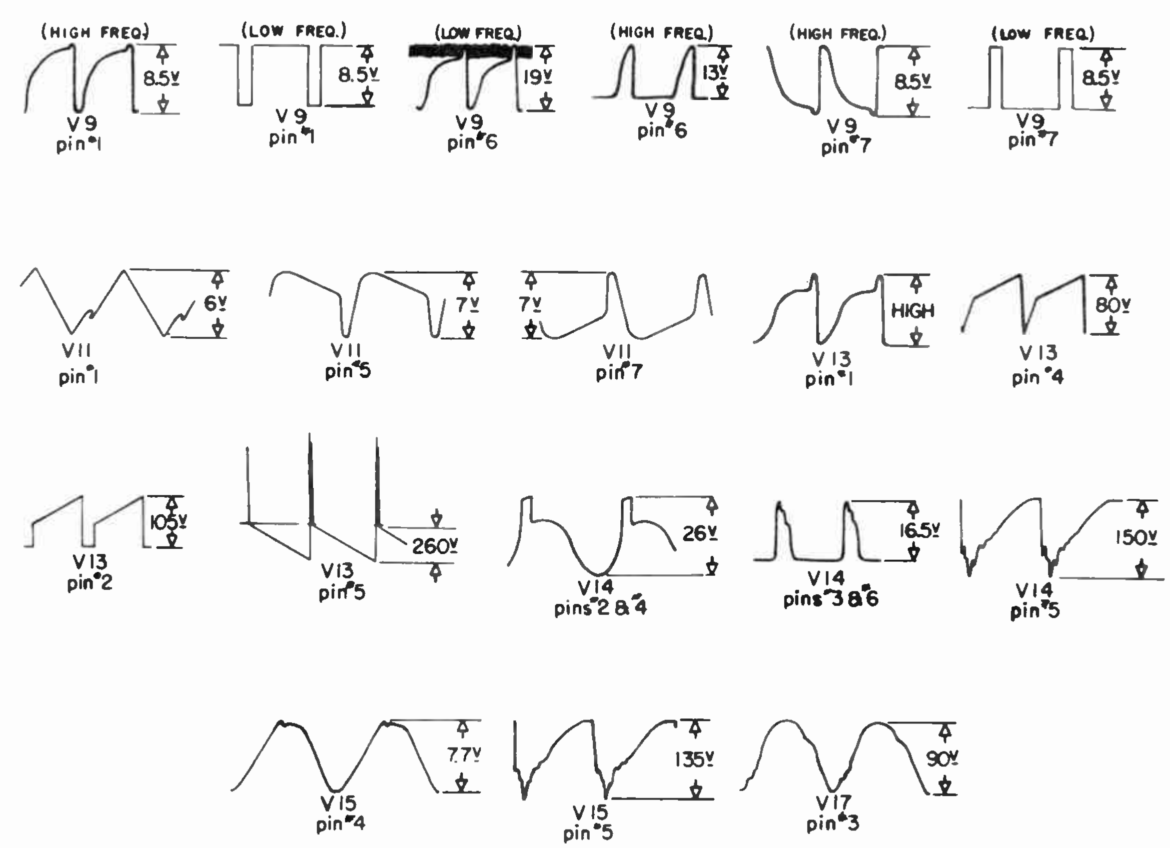

FIG. 7 - WAVE FORMS

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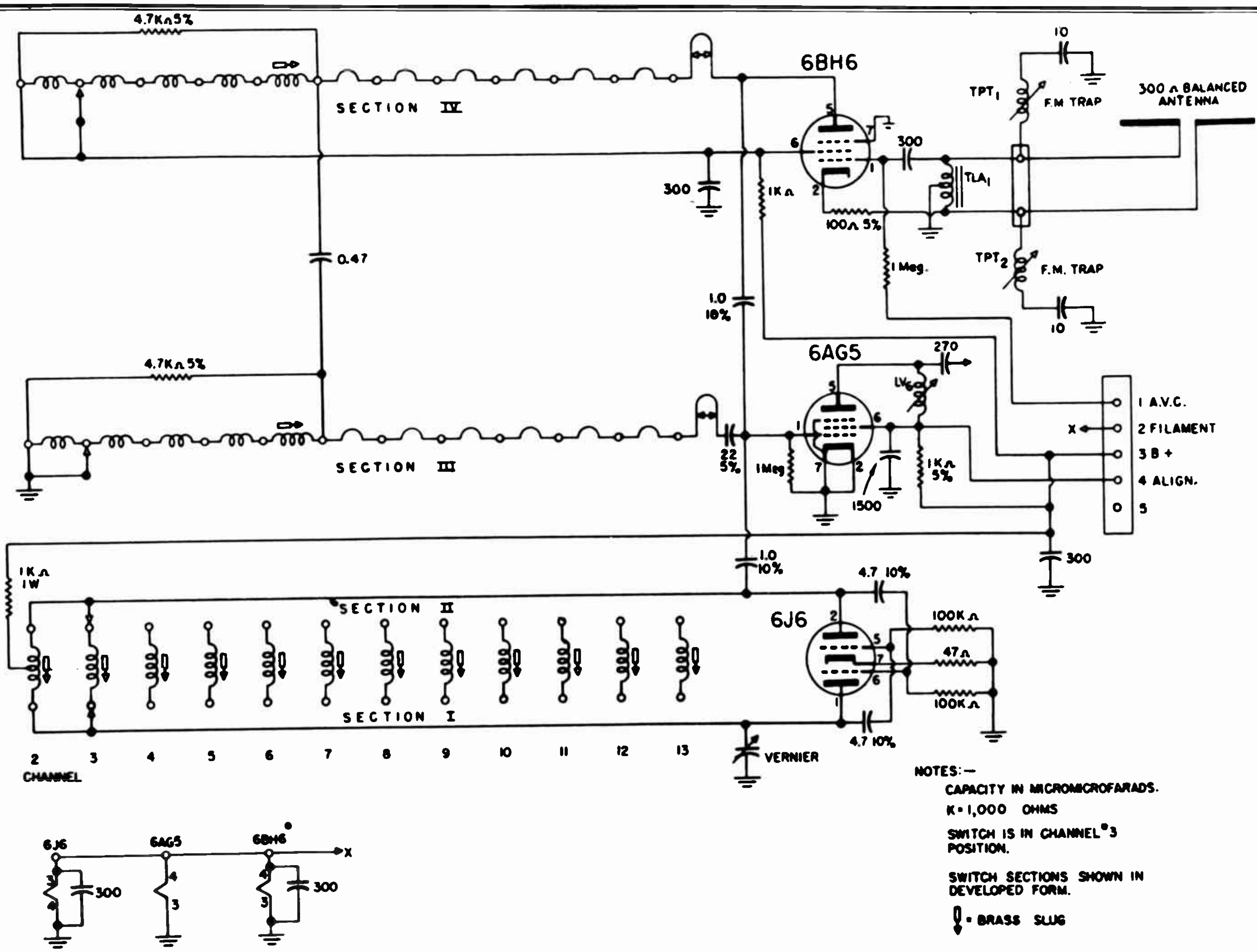

FIG. 8 - SCHEMATIC OF TT-3 TUNER

PARTS LIST

Ref Symbol	Description	Part No.
	CAPACITORS	
C101	Paper: 0.005 µf, 600 V	CP-6-25
C102	Tubular elect: 40 µf, strap mounting, 450 V	CET-4
C103	Can elect: 2-sect; 50 µf, 150 V; 500 µf, 5 V; size 1"	CEM-7
C104	Paper: 0.02 µf, 600 V	CP-6-12
C105	Paper: 0.05 µf, 600 V	CP-6-15
C106	Paper: 0.005 µf, 600 V	CP-6-25
C107	Tubular elect: 1 µf, 25 V	CET-6
C108	Paper: 0.005 µf, 600 V	CP-6-25
C109	Paper: 0.001 µf, 600 V	CP-6-21
C110	Paper: 0.02 µf, 600 V	CP-6-12
C111	Paper: 0.005 µf, 600 V	CP-6-25
C112	Paper: 0.02 µf, 600 V	CP-6-12
C113	Ceramic: 39 µµf, 20%	CC-439
C114	Paper: 0.1 µf, 600 V	CP-6-01
C115	Paper: 0.002 µf, 600 V	CP-6-22
C202	Ceramic: Herlec, GMV, 0.002 µf	CC-22
C203	GMV, 2-sect; each 0.002 µf	
C204 C205	Ceramic: Herlec	CCD-22
C206 C207	Ceramic: GMV, 100 µµf	CC-31
C208 C209	Ceramic: Herlec GMV, 2-sect; each 0.002 µf	CCD-22
C210	Paper: 0.1 µf, 600 V	CP-6-01
C211	Ceramic: Herlec GMV, 2-sect; each 0.002 µf	CCD-22
C212	Ceramic: Herlec GMV, 0.002 µf	CC-22
C213	Ceramic: Herlec GMV, 2-sect; each 0.002 µf	CCD-22
C214	Ceramic: GMV, 120 µµf	CC-312
C215	Ceramic: GMV, 100 µµf	CC-31
C216	Ceramic: Herlec GMV, 0.002 µf	CC-22
C217	Ceramic: 5 µµf, 20%	CC-55
C218	Paper: 0.1 µf, 600 V	CP-6-01
C219	Paper: 0.01 µf, 600 V	CP-6-11
C220	Ceramic: 680 µµf, 20%	CC-368
C221	Ceramic: 470 µµf, 20%	CC-347

MODELS AR-14-TR, AR-16-CR, AR-16-RO, AR-16-TR, AR-17-CD, AR-17-CR, AR-17-RO, AR-17-3D

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Ref Symbol	Description	Part No.
C222	Can elect: 4-sect; 10 µf, 150 V; 10, 20, 10 µf, 450 V; size 1-3/8"	CEM-6
C223	Paper: 0.1 µf, 600 V	CP-6-01
C225	Ceramic: Herlec	CC-22
C226	GMV, 0.002 µf	
C301	Paper: 0.002 µf, 600 V	CP-6-22
C302	Paper: 0.005 µf,	CP-6-25
C303	600 V	
C304	Paper: 0.02 µf, 600 V Molded	CPM-6-12
C306	Can elect: 3-sect;	CEM-5
C307	40, 40, 40 µf,	
C308	450 V; size 1-3/8"	
C309	Can elect: 2-sect; 50 µf, 150 V; 500 µf, 5 V; size 1"	CEM-7
C310	Paper: 0.005 µf, 600 V	CP-6-25
C311	Tubular elect: 100 µf, 150 V	CET-5
C312	Paper: 25 µf, 400 V	CP-4-025
C313	Paper: 0.1 µf, 600 V	CP-6-01
C314	Can elect: 4-sect; 10 µf, 150 V; 10, 20, 10 µf, 450 V; size 1-3/8"	CEM-6
C315	Mica, silver: 3900 µµf, 5%	CM-239
C316	Paper: 0.05 µf, 600 V	CP-6-15
C317	Mica, silver: 330 µµf, 10% 800 V	CM-333A
C318	Mica: 390 µµf, 20%	CM-339
C319	Can elect: 4-sect; 10 µf, 150 V; 10, 20, 10 µf, 450 V; size 1-3/8"	CEM-6
C320	Mica: 820 µµf, 20%	CM-382
C321	Paper: 0.05 µf, 400 V	CP-4-15
C322	Paper: 0.01 µf, 600 V	CP-6-11
C323	Paper: 0.005 µf, 600 V	CP-6-25
C324	Can elect: 4-sect; 10 µf, 150 V; 10, 20, 10 µf, 450 V; size 1-3/8"	CEM-6
C325	Mica: 25-280 uuf, padder, Hor. Drive	CT-1
C326	Paper: 0.25 µf, 400 V	CP-4-025
C327	Paper: 0.05 µf, 600 V	CP-6-15
C328	Paper oil-filled: 0.025 µf, 600 V	CO-6-125
C329	Paper oil-filled: 0.1 µf, 600 V	CO-6-01
C330	Mica: 12 µµf, 5%, 1500 V	CM-412
C331	Paper: 0.001 µf,	CP-6-21
C332	600 V	
C333	Paper: 0.01 µf, 600 V	CP-6-11
C334	Mica: 22 µµf, 20%	CM-422
C335	Mica: 220 µµf, 800 V	CM-332A
C336	Paper: 0.25 µf, 400 V	CP-4-025
C337	Mica: 10 µµf, 20%	CM-410A
C337A		
C338	500 µµfd 15KV STD	CHV-35-15
C339	270 µµf 20%	CM-327

COILS & CHOKES

L1	4.5 mc discrim. trans	LRD-1
L2	4.5 mc take-off trans	LTO-3
L3	Peaking coil	LP-7
L4	1st video i-f trans	LV-6
L5	Filament choke	LC-1
L6	2nd video i-f trans	LV-6
L7	Filament choke	LC-1
L8	R-f choke	LC-4
L9	3rd video i-f trans	LV-6
L10	Filament choke	LC-1
L11	R-f choke	LC-4
L12	4th video i-f trans	LV-6
L13	Peaking coil	LP-5
L14	Peaking coil	LP-6
L15	Peaking coil	LP-8
L16	Filter choke	LC-3
L17	Focus coil	LF-3
L18	Afc coil	LHO-2
L19	Deflect yoke	DY-6
L20	Width control	L-M77J4-3
L21	Hor linearity ol control	L-M77J-4

CONTROLS--POTENTIOMETERS

P-2	Vert Linearity, 5K, 1/2 W	P-2
P-5	Vert Size, 2.5 Meg, 1/2 W	P-5
P-6	Focus, 1500 Ω, 3 W	P-6
P-7	Volume, 500K, audio taper with switch	P-7
PD-4	Dual-control: Brightness, 100K, 1/2 W; Contrast, 750 Ω, 1 W, wire wound, tap at 250 Ω	PD-4
PD-5	Dual-control: Vert Hold, 1 Meg; Hor Hold, 50K	PD-5

RESISTORS

Ref Symbol	Description	Part No.
R101	390 Ω 10%, 1 W	RC-391-5
R102	4.7K 10%, 1/2 W	RC-472-2
R103	470K 10%, 1/2 W	RC-474-2
R104	100K 10%, 1/2 W	RC-104-2
R105	330K 5%, 1/2 W	RC-334-3
R106	180K 5%, 1/2 W	RC-184-3
R107	330K 10%, 1/2 W	RC-334-2
R108	470K 10%, 1/2 W	RC-474-2
R109	18K 10%, 2 W	RC-183-8
R110	15K 10%, 1/2 W	RC-153-2
R111	44K 10%, 1/2 W	RC-443-2
R113	1K 10%, 1/2 W	RC-102-2
R114	100K 10%, 1/2 W	RC-104-2
R115	22K 10%, 1/2 W	RC-223-2
R116	1K 10%, 1/2 W	RC-102-2
R117	470K 10%, 1/2 W	RC-474-2
R118	33K 10%, 1/2 W	RC-333-2
R119	220K 10%, 1/2 W	RC-224-2
R201	10K 10%, 1/2 W	RC-103-2
R202	330 Ω 10%, 1/2 W	RC-331-2
R203	82 Ω 10%, 1/2 W	RC-820-2
R204	100 Ω 10%, 1/2 W	RC-101-2
R205	330 Ω 10%, 1/2 W	RC-331-2
R206	8.2K 10%, 1/2 W	RC-822-2
R207	82 Ω 10%, 1/2 W	RC-820-2
R208	100 Ω 10%, 1/2 W	RC-101-2
R209	8.2K 10%, 1/2 W	RC-822-2
R210	82 Ω 10%, 1/2 W	RC-820-2
R211	100 Ω 10%, 1/2 W	RC-101-2
R212	1 Meg 10%, 1/2 W	RC-105-2
R213	680K 10%, 1/2 W	RC-684-2
R214	100 Ω 10%, 1/2 W	RC-101-2
R215	39K 10%, 1 W	RC-393-5
R216	1K 10%, 1/2 W	RC-102-2
R217	120K 10%, 1/2 W	RC-121-2
R218	44K 10%, 2 W	RC-443-8
R218A	44K 10%, 2 W	RC-443-8
R219	22K 10%, 2 W	RC-223-5
R220	54K 10%, 2 W	RC-543-8
R220A	54K 10%, 2 W	RC-543-8
R221	5.6K 10%, 1 W	RC-562-5
R222	2.2K 10%, 1/2 W	RC-222-2
R223	270K 10%, 1/2 W	RC-274-2
R224	8.2K 10%, 1/2 W	RC-822-2
R301	8.2K 10%, 1/2 W	RC-822-2
R302	8.2K 10%, 1/2 W	RC-822-2
R303	15 Ω 10%, 1 W	RC-150-5
R304	6.8 Meg 10%, 1/2 W	RC-685-2
R305	1 Meg 10%, 1/2 W	RC-105-2
R306	2.2 Meg 10%, 1/2 W	RC-225-2
R307	330 Ω 10%, 1/2 W	RC-331-2
R308	100K 10%, 1/2 W	RC-104-2
R309	3.9K 10%, 1/2 W	RC-392-2
R310	820K 10%, 1/2 W	RC-824-2
R311	5.6K 10%, 1/2 W	RC-562-2
R312	1.5K 10%, 1/2 W	RC-152-2
R313	68K 10%, 1/2 W	RC-683-2
R314	270K 10%, 1/2 W	RC-274-2
R315	22K 10%, 1 W	RC-223-5
R316	680K 10%, 1/2 W	RC-684-2
R317	22K 10%, 1 W	RC-223-5
R318	27K 10%, 1/2 W	RC-273-2
R319	470K 10%, 1/2 W	RC-474-2
R320	68 Ω 10%, 1/2 W	RC-680-2
R321	120 Ω 10%, 2 W	RC-121-8
R322	12K 10%, 2 W	RC-123-11
R323	4.7 Meg 10%, 1/2 W	RC-475-2
R324	100K 10%, 1/2 W	RC-104-2
R325	100K 10%, 1/2 W	RC-104-2
R326	3.3 Ω 10%, 1/2 W	RC-336-2
R327	18K 10%, 2 W	RC-183-8
R328	6300 Ω tapped 10% 500-500 50 W Std	RC-632-17
R329	22K 10%, 1/2 W	RC-223-2
R330	3.9K 10%, 1/2 W	RC-392-2
R331	3.9K 10%, 1/2 W	RC-392-2
R332	820K 10%, 1/2 W	RC-824-2
R333	47K 10%, 1/2 W	RC-473-2
R334	1 Meg 10%, 1/2 W	RC-105-2
R335	3.9K 10%, 1/2 W	RC-392-2
R336	1 Meg 10%, 1 W	RC-105-5
R337	6.8K 10%, 1 W	RC-682-5
R338	680K 10%, 2 W	RC-684-8
R339	5.6K 10%, 1/2 W	RC-562-2
R340	110K 20%, 2 W	RC-114-7
R341	100 Ω 10%, 2 W	RC-101-8
R342	750 Ω 10%, 2 W	RC-751-8

TRANSFORMERS

T1	Audio output trans	T-102
T2	Power trans	T-106
T3	Vert blocking osc. trans	T-104
T4	Vert output trans	T-112
T5	Hor output trans	T-111
IT-1	Ion trap	IT-1

TUBES

V-1	Audio ampl	6AQ5
V-2	Ratio det	6T8
V-3	Ratio det driver	6AU6
V-4	1st video i-f ampl	6AU6
V-5	2nd video i-f ampl	6AU6
V-6	3rd video i-f ampl	6AU6
V-7	Video det & AGC	6AL5
V-8	Video ampl	6AC7
V-9	D-c restorer, sync clipper & sync ampl	12AU7
V-10	Kinescope tube	10BP4 or 12LP4
V-11	Hor phase det	6AL5
V-12	Power rectifier	5U4G
V-13	Vert sweep osc. & vert sweep output	6SN7
V-14	Hor sweep osc.	6SN7
V-15	Hor sweep output	6BQ6
V-16	H-V rect	1B3/8016
V-17	Hor damper	6W4

Tubes in R-F Tuner not included

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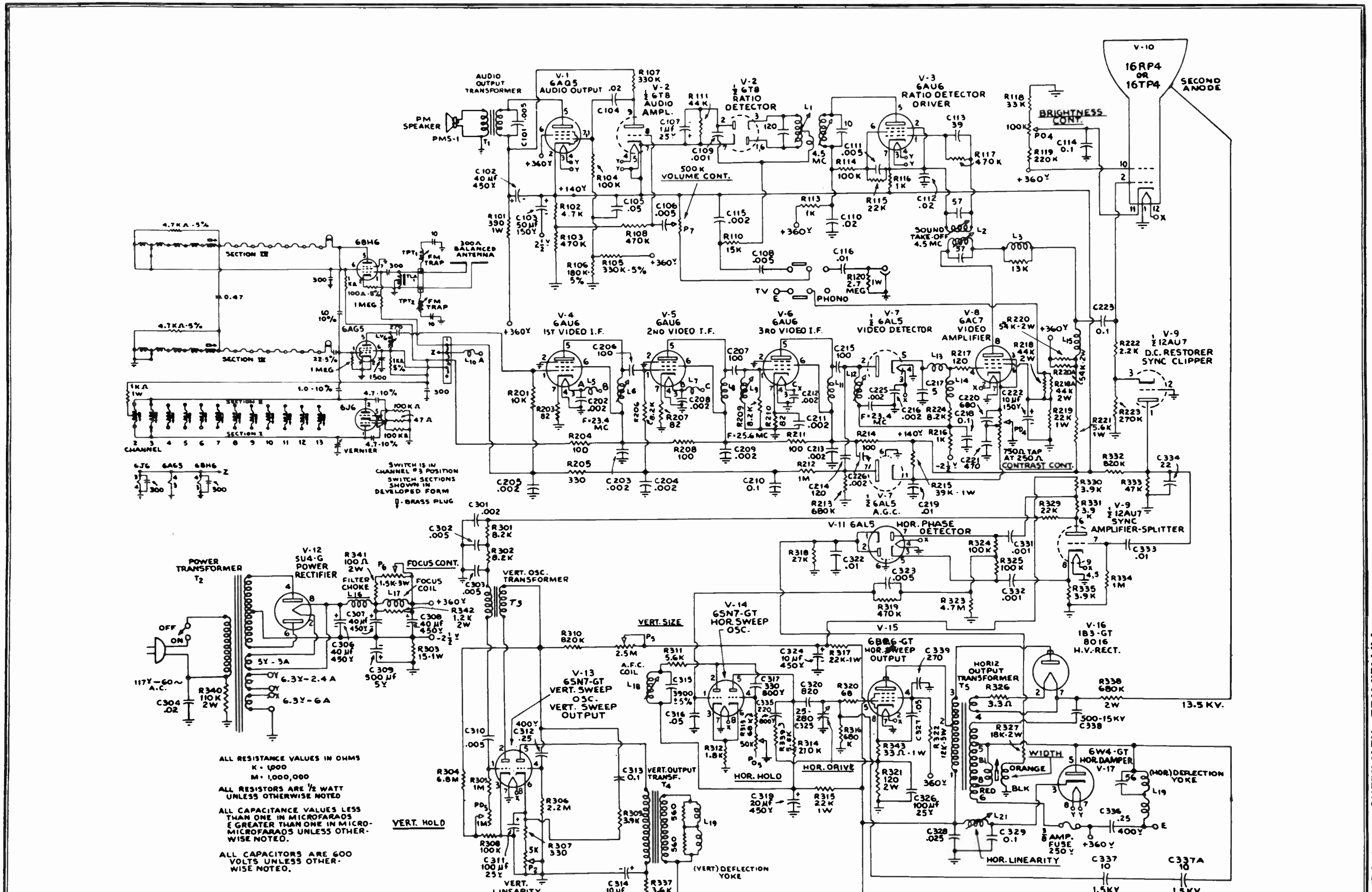

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CHARACTERISTICS

Voice-coil impedance
3.2 ohms - 400 cycles
Antenna type
Folded dipole with reflector
Antenna impedance
300 ohms input impedance to receiver
I-F frequencies
Video, 26.1 mc
Sound, 21.6 mc
Audio strip, 4.5 mc

Power supply
117 volts, 60 cycles, a.c.
Power consumption
180 Watts
Tube complement
See parts list

CIRCUIT ANALYSIS

The R-F Tuner

One of two r-f tuners is used with any of these receivers. Schematics of each tuner are included. Each tuner is a complete assembly in itself. Both tuners employ a 6BH6 tube as an r-f amplifier and a 6AG5 tube as a mixer.

The Video System

Three video i-f amplifiers, V-4, V-5, and V-6, each a 6AU6 tube, are employed. (The schematic, Fig. 9, should be consulted while reading the rest of the circuit analysis.) Four staggered-tuned i-f transformers, L4, L6, L9, and L12, are employed to produce the necessary bandwidth. Both the video and sound i-f signals are passed through this complete amplifier section which functions as a combined i-f system. There is no separation of the sound i-f signal from the video i-f signal, and they are both fed directly into V-7, the video detector. This is the basis upon which the intercarrier system operates. The over-all response of the i-f section is such that the amplitude of the sound i-f carrier is a very small percentage of the video i-f carrier when they are both fed to the video detector, which is one half of a 6AL5 tube. No sound traps are employed. Response shaping is discussed in the alignment section.

The video detector considers the sound i-f signal as a high-frequency sideband of the video i-f signal and detection occurs in the normal manner. The sound and video i-f carriers can be considered as beating together inside the video detector. The carriers of these two i-f signals are always separated by 4.5 mc, so that after detection their difference frequency of 4.5 mc appears in the output of the video detector. This 4.5-mc beat note contains all of the f-m characteristics of the input f-m sound i-f signal and very little a.m. effects. It is the amplitude relationship between the two input i-f signals that determines the character of the 4.5-mc output signal.

The 4.5-mc f-m signal as well as the video signal output from the detector is directly coupled to the grid of V-8, a 6AC7 video amplifier, through an L-R high-frequency compensating network. In this manner, the 4.5-mc signal receives additional amplification. In the plate of the video amplifier is the primary parallel-tuned circuit of a double-tuned 4.5-mc transformer, L2, which selects the f-m 4.5-mc signal to be fed to the sound section of the receiver. The video signal output is fed directly to the grid of the picture tube V-10, through peaking coil L3 and capacitor C223.

AGC and Contrast

The video i-f signal output from the third video i-f stage, V-6, is fed to the plate, pin 7, of the other half of the 6AL5 tube, V-7, which serves as a delayed AGC rectifier. The AGC voltage is supplied to the r-f and first and second video i-f amplifiers. A small positive voltage on the cathode of this diode prevents rectification of the video i-f signal until the i-f signal voltage on the diode plate exceeds whatever voltage is on the cathode. The contrast control, PD4, which is in the cathode circuit of the video amplifier, V-8, besides controlling the bias and hence the gain of this stage, also controls the amount of delay voltage on the cathode of the AGC tube. The influence of the contrast control is such that the delay voltage will be greatest at the time the gain of the video amplifier is greatest. This makes for a better over-all control of the picture contrast.

The Sweep and Sync Circuits

One half of V-9, a 12AU7 tube, serves as the d-c restorer and sync clipper. The sync voltage output from this section is fed to the grid of the other half of V-9, which functions as a sync amplifier to the vertical sync pulses and as a phase splitter to the horizontal sync pulses. The positive sync output signal is taken directly from the plate, pin 6 of V-9, and applied to an integrating network which consists of C301, R301, C302, R302, and C303. This integrating network separates the vertical sync pulses from the horizontal and applies the former to the grid circuit, pin 1, of the vertical sweep oscillator, V-13. This latter circuit utilizes one half of a 6SN7-GT tube as a blocking oscillator. The other half of V-13 functions as the vertical sweep output amplifier. The output from this amplifier feeds into the vertical output transformer, T4, and then to the vertical deflection yoke.

The 1-megohm potentiometer (of dual-control unit PD5) in the grid circuit, pin 1, of the vertical sweep oscillator, controls the frequency of operations and is termed the VERT. HOLD control. The VERT. LINEARITY control is the 5000-ohm potentiometer, P2, in the cathode circuit, pin 6, of the vertical sweep output amplifier. The VERT. SIZE control is a 2.5-megohm potentiometer, P5, located in the B-supply lead to the plate of the vertical sweep oscillator.

The type 6SN7-GT tube, V-14, which is the horizontal sweep oscillator, is employed as a combined cathode-coupled sine wave oscillator and multivibrator. The output from the plate, pin 5, of this oscillator is coupled to the grid of V-15, a 6BG6-G tube serving as the horizontal sweep output amplifier. The output from the plate of this latter tube is fed to tap 2 on the primary of the horizontal output transformer, T5.

From the high side of the primary of this transformer, tap 3, the horizontal sweep signal is fed to the plate of V-16, a 1B3-GT tube, serving as the high-voltage rectifier. This rectifier is employed in a kick-back type of high-voltage power supply, which supplies voltage for the second anode of the kinescope.

The secondary of T5 consists of taps 4, 5, and 6, and feeds the horizontal deflection yoke. A 6W4-GT tube, V-17, serves as the horizontal damper. From tap 6 of T5, some of the horizontal sweep signal is applied to the cathode and plate (pins 1 and 2 which are tied together) of the horizontal phase detector, V-11, through an integrating network essentially consisting of R327 and C322. The horizontal sync pulses from the V9 phase splitter is applied to the other cathode and plate sections of the horizontal phase detector and these sync pulses are compared with the phase of the horizontal sweep input. If their phases are different, an afc voltage is developed across R323 and then applied to the grid circuit, pin 1, of the horizontal sweep oscillator.

The 50,000-ohm potentiometer, PD5, in the grid circuit, pin 4, of V-14, regulates the horizontal sweep frequency and is called the HOR. HOLD control, and trimmer capacitor C325 between V-14 and V-15 is the HOR. DRIVE control. Coil L21 in the cathode circuit of the horizontal damper tube V-17 is the HOR. LINEARITY control and coil L20 across taps 5 and 6 of the horizontal output transformer functions as the horizontal WIDTH control.

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The Sound Section

The 4.5-mc f-m signal from the secondary of the takeoff transformer L2 is fed to the grid circuit of the ratio detector driver and limiter, V-3, a 6AU6 tube. The output from this driver tube feeds the primary of the ratio detector transformer L1, which is tuned to 4.5 mc. The double diode section of a 6T8 tube, V-2, is used as the ratio detector, and the triode section of this same tube is used as the first audio amplifier. The 500,000-ohm potentiometer P7 in the output circuit of the ratio detector is the VOLUME control. The output from the first audio amplifier is R-C coupled to the grid of V-1, a 6AQ5 tube which is the audio output amplifier. The audio signal output from this latter stage is fed to the audio output transformer, T1, and then to the speaker.

Power Supply and Voltage Regulation

The low-voltage supply incorporates a 5U4-G tube, V-12, as the rectifier. Coil L17 in the output filter system is the focus coil and connected across this coil is the FOCUS control, P6, a 1500-ohm potentiometer. This low-voltage power supply provides a positive 360-volt B-plus source and a negative 2-1/2 volt bias supply. For the r-f and i-f section of the receiver the 360-volt output is decreased to 140 volts for the screens and plates of these tubes while the cathodes are returned to chassis ground. The 360-volt supply is used directly for the deflection circuits and also for the plates and screens of the tubes in the sound section. However, the cathodes of these audio tubes are connected in series with the B supply for the r-f and i-f tubes, which means that the cathodes of the audio section are 140 volts positive with respect to ground. Thus, the effective B supply between the plate and cathode of the tubes in the sound section is 360 less 140, or 220 volts.

The interesting thing about the 6AQ5 tube circuit, V-1, is that it functions as a series automatic voltage regulator for the 140-volt supply and prevents any current variations in the r-f and i-f circuit from changing this voltage. The grid of the 6AQ5 tube is connected to the 360-volt supply through a voltage divider. A positive voltage of 123 volts is applied to the grid, but since the cathode is 140 volts positive, the grid has an effective bias of -17 volts. Any change in the 140 volts will tend to change the bias of the 6AQ5 tube. This, in turn, will cause the tube current to change, which means that the voltage drop across the cathode load will likewise vary. This voltage drop will be such that it will bring the cathode back to the 140 volts.

For instance, if the voltage increases beyond 140 volts, the bias on the 6AQ5 tube will become more negative. Less current will flow in the tube and a smaller voltage drop will occur across the complete cathode load. This decrease in voltage drop will be just enough to offset the previous increase in the cathode voltage.

FUNCTIONING OF CONTROLS

The controls of the receiver are divided into two groups, the front panel operating controls and the rear panel pre-set controls.

FRONT PANEL OPERATING CONTROLS

There are seven front panel operating controls as indicated in Fig. 1, each operating independently of the other. Reading from left to right, the controls and their functions are as follows:

On-Off and Volume

This is a single control. The knob should be turned clockwise, until a click is heard. This supplies a.c. to the receiver. Further clockwise rotation of the control varies the input to the audio amplifier, and, consequently, controls the volume of sound output.

Vertical Hold

This control functions to keep the picture stationary in the vertical direction. Electrically it is a variable resistor which controls the frequency of the vertical sweep oscillator.

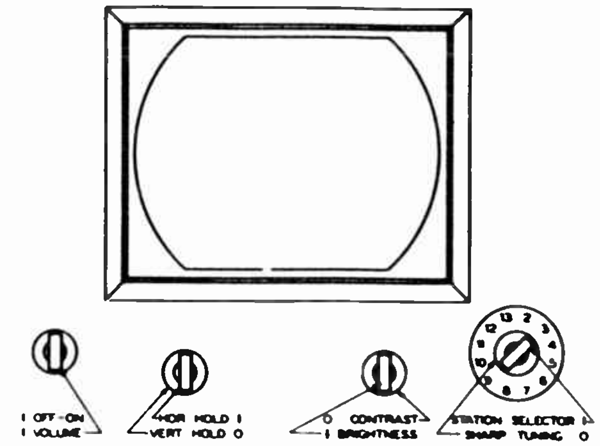

FIG. 1— OPERATING CONTROLS

If the sloping bar effect is as stated, then the picture should remain in sync over 1/4 rotation of the horizontal hold range and drop out of sync on either end of this range.

Horizontal Drive

This trimmer capacitor affects the height of the horizontal pulse, varying the horizontal linearity principally on the left side of the picture.

Focus

A variable resistor which controls the current flow through the focus coil on the neck of the tube.

Width

This slug adjustment inside the high-voltage cage affects the right side of the horizontal axis.

NOTE: There are no horizontal or vertical positioning controls. Centering of the picture is accomplished by positioning of the focus coil. The deflection yoke should be placed on the neck of the tube as far forward as possible.

ALIGNMENT PROCEDURE

Test Equipment

The test equipment required for the alignment of this receiver is as follows:

Marker Generator (RCA WR-39A, or equivalent)
Sweep Generator (RCA WR-59A, or equivalent)
Oscilloscope (RCA WO-55A, or equivalent)
VTVM (RCA Junior VoltOhmyst, or equivalent)
Volt-Ohmmeter (Simpson 260, or any 20,000 ohm-per-volt meter)

The marker generator is an r-f signal generator used for peaking the i-f coils and also to supply marker pips on the response pattern. The required frequency range of this generator is approximately from 20 to 30 mc and must also have provision for a 4.5 mc output. The accuracy of the frequency calibration of this generator is very important. It must also have provision for an amplitude modulated, as well as an unmodulated, r-f output.

The sweep generator has its output continually variable in frequency. In this alignment, only one output sweep signal is needed, that sweeping between 20 to 30 mc.

The oscilloscope used is a high-gain, general purpose type employed for test purposes. The size of the screen is unimportant.

The VTVM is of the standard type with a high input impedance. It should have provision for a-c and d-c measurements. A 20,000 ohm-per-volt meter should be used for d-c indications if the VTVM can only measure a.c.

Alignment

For the alignment points refer to the figure indicated in the discussion. Most of the adjustments are located on top of the chassis. The r-f marker generator is used in making most of the alignment adjustments. It is recommended that the order of alignment in the following procedure be adhered to if alignment is found necessary. The ground leads of the test instruments should be connected to the receiver chassis.

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Horizontal Hold

The function of this control is to keep the picture stationary in the horizontal direction. It is a variable resistor which affects the frequency of the horizontal sweep oscillator.

Brightness

This control, which is also a variable resistor, affects the cathode voltage on the kinescope, thereby regulating the brightness of the picture.

Contrast

The contrast control provides a means for varying the relative intensities of black and white in the picture. Advancing this control toward excessive contrast will introduce a loud buzz.

Station Selector

This control permits selection of the channel desired.

Fine Tuning

This control varies the frequency of the r-f heterodyne oscillator. It is adjusted for best picture quality and is not used to tune in the sound.

REAR PANEL PRE-SET CONTROLS

There are six so-called pre-set controls at the rear of the chassis as indicated in Fig. 2. They are all screw driver adjustments. The SOUND DISC. is the alignment screw for the secondary of the ratio detector transformer L1, and is not considered a pre-set control.

Vertical Linearity

This control is a variable resistor in the cathode circuit of the vertical sweep output tube. Manipulation of this control affects the upper portion of the picture.

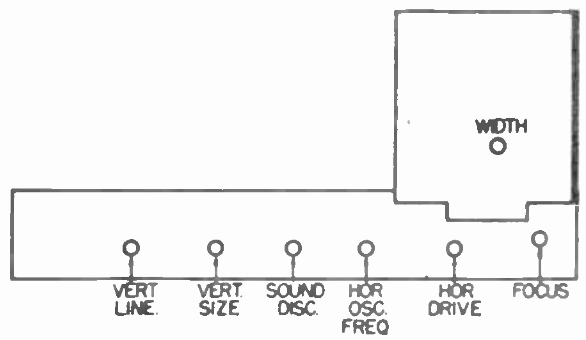


FIG. 2 — PRE-SET CONTROLS

Vertical Size

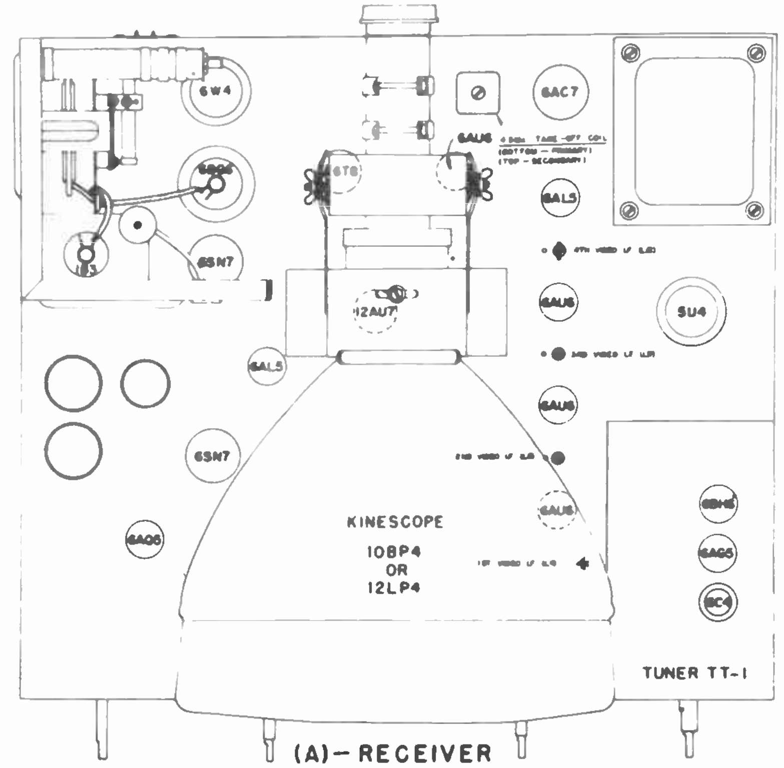
The vertical size control varies the plate voltage of the vertical sweep oscillator. It primarily causes a change in height of the picture but it also interacts with the vertical linearity so that these controls must be used in conjunction with each other.

Horizontal Oscillator Frequency

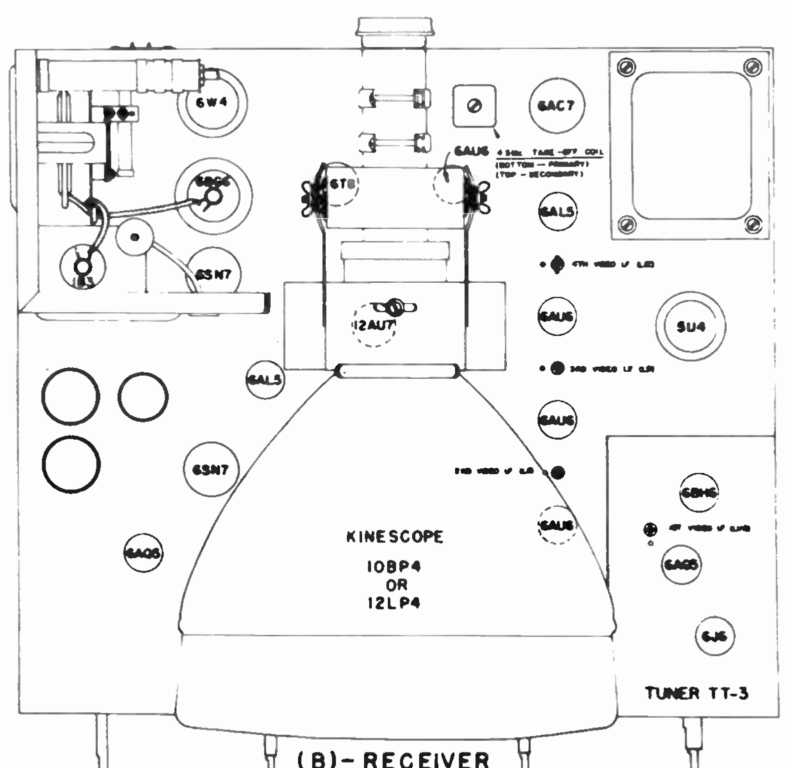
This control is a slug adjustment for L18 which controls the frequency of the horizontal oscillator. To set this control properly, connect an antenna to the receiver and tune in a station, preferably one with a test pattern on the air. Center the horizontal hold control. Adjust the L18 slug until the picture locks in. Set the horizontal hold control in the full clockwise position and slowly rotate it in the opposite direction. Just before the picture falls into sync, 3 or 4 black and white bars should appear sloping downward to the right. Repeat the process, but with the horizontal hold control in the full counterclockwise position. The same conditions should be observed except that the bars will slope downward to the left.

Picture I-F Alignment (Fig. 3)

Connect the VTVM (a-c scale), or oscilloscope to the grid of the kinescope at the junction of C223 and R222. (Do not attempt to take readings with the VTVM at the video detector.) Adjust the contrast control about 1/8 turn below its maximum setting. Connect the output of the signal generator (marker) to the nipple on top of the 6AG5 mixer tube of either tuner.



(A) — RECEIVER INCORPORATING TUNER TT-1.



(B) — RECEIVER INCORPORATING TUNER TT-3

FIG. 3 — TOP VIEW OF CHASSIS

Set the generator at 25.6 mc, amplitude-modulated at approximately 400 cycles, and adjust the first and third video i-f coils for maximum response. For those receivers employing tuner TT-1, the first video i-f coil is L4 as indicated in Fig. 3(A). When tuner TT-3 is used, the first video i-f coil is LV-6 and is incorporated in the tuner and not the receiver proper, as shown in Fig. 3(B). Reset the generator to 23.4 mc, still amplitude-modulated, and tune the second and fourth video i-f coils, L6 and L12 respectively, for maximum response. Repeat the above process for fine adjustments of settings.

Over-all Picture Response

With the sweep generator adjusted for a 10-mc sweep, using a center frequency of about 25 mc, connect the generator to nipple of the 6AG5 mixer tube of either tuner. Loosely couple the marker generator to the same mixer tube. The oscilloscope should remain at the grid of the kinescope. Inject individual markers of 26.1 mc, 25.6 mc, 22.6 mc, and 21.6 mc in the order indicated and note positions of marker pips on response curve. Turning the adjustments very slowly, retune the four video i-f coils again for an over-all picture i-f response as indicated in Fig. 4.

NOTE: A 30% variation in amplitude between peaks and from peak to valley, of the response curve is permissible. The most important considerations here are that the video i-f carrier of 26.1 mc is approximately halfway down the right hand slope, and that the sound i-f carrier of 21.6 mc is 20 times down at the other end of the curve.

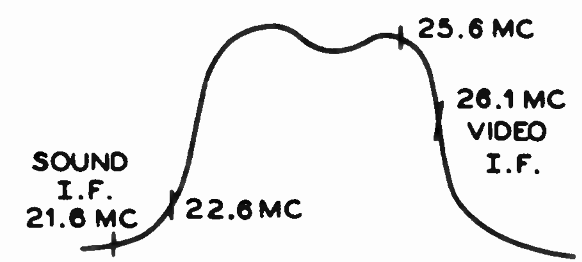


FIG. 4 — OVER-ALL I-F RESPONSE CURVE.

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Sound Takeoff and Detector Transformer Alignment

Move the signal generator (marker) output lead to the junction of L13 and R217, between the video detector, V-7, and video amplifier V-8. Set the generator to a 4.5-mc unmodulated signal output. Connect the VTVM (d-c scale) or the 20,000 ohm-per-volt meter across C107 in the output circuit

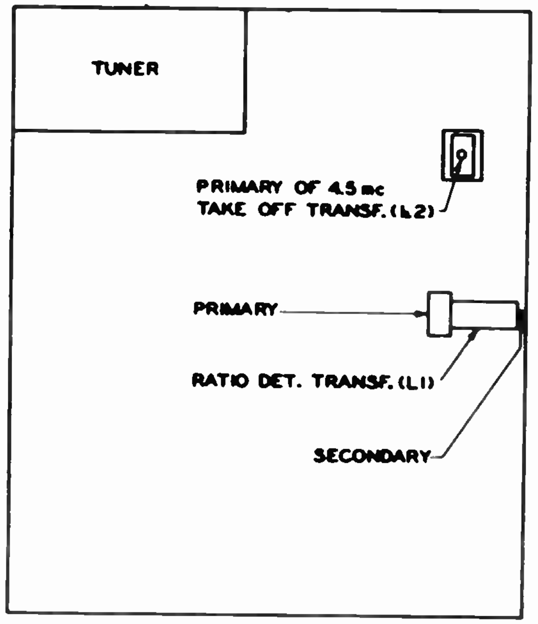

FIG. 5-BOTTOM VIEW SHOWING ALIGNMENT POINTS FOR L1 AND PRIMARY OF L2

of the ratio detector, V-2. (Remember that the negative lead at this point is actually above -140 volts with respect to ground.)

Adjust the following for maximum reading on the meter in the order indicated. The primary of L1 (the ratio detector transformer), the adjustment of which is shown in Fig. 5. Next tune the secondary of L1; this adjustment, shown in Fig. 5, is

also shown in Fig. 2 and indicated as SOUND DISC. Then adjust the primary L2, the 4.5-mc takeoff transformer; see Fig. 5. Next adjust the secondary of L2, shown in Fig. 3. Decrease the signal output from the generator to the minimum required to give a readable deflection on the meter and then repeat the sound alignment process.

After the alignment is complete, remove the generators and meters. Tune in a station. Turn up the contrast control until a buzz is heard. Adjust the secondary of the detector transformer (see Figs. 2 and 5) for minimum buzz.

NOTE: Alignment of the r-f and oscillator sections are not recommended and are therefore not included. If any misalignment of these sections is suspected, consult the manufacturer.

SERVICE NOTES

No Raster

Defective picture tube or misadjusted ion trap magnet.
No high voltage. Check tubes V-14, V-15, V-16, and V-17.
Check horizontal output transformer, T211T3; and also check C335, R326, and R336.
Check all voltages and waveforms in sweep section. Do not check voltage directly on plate of V-16.

Raster Present -- No Sound or Picture

Open transmission line.
Defective tube in r-f unit, or defective r-f unit.
Check B+ supply for sound and picture sections.
Check tubes V-1, V-2, V-3, V-4, V-5, V-6, V-7, and V-8.

Raster and Sound -- No Picture

Open green lead from picture tube socket.
Check tube V-8 and associated circuit.
Open C223.

Raster and Picture -- No Sound

Defective sound takeoff transformer, T2, or ratio detector transformer, T1.
Check tubes V-1, V-2, and V-3.
Defective audio output transformer, T1, or speaker.

Unable to Synchronize Vertically or Horizontally

Check tube V-9 and associated circuit.

Unable to Synchronize Vertically

Check tube V-13.
Defective vertical oscillator transformer, T3, or vertical output transformer, T4.

Unable to Synchronize Horizontally

Horizontal sweep oscillator coil L18 misadjusted.
Coil L18 or capacitor C315 defective.

Defective tubes V-11 or V-14, or feedback capacitor C330.
Check voltages, resistances, and waveforms in horizontal sync section.

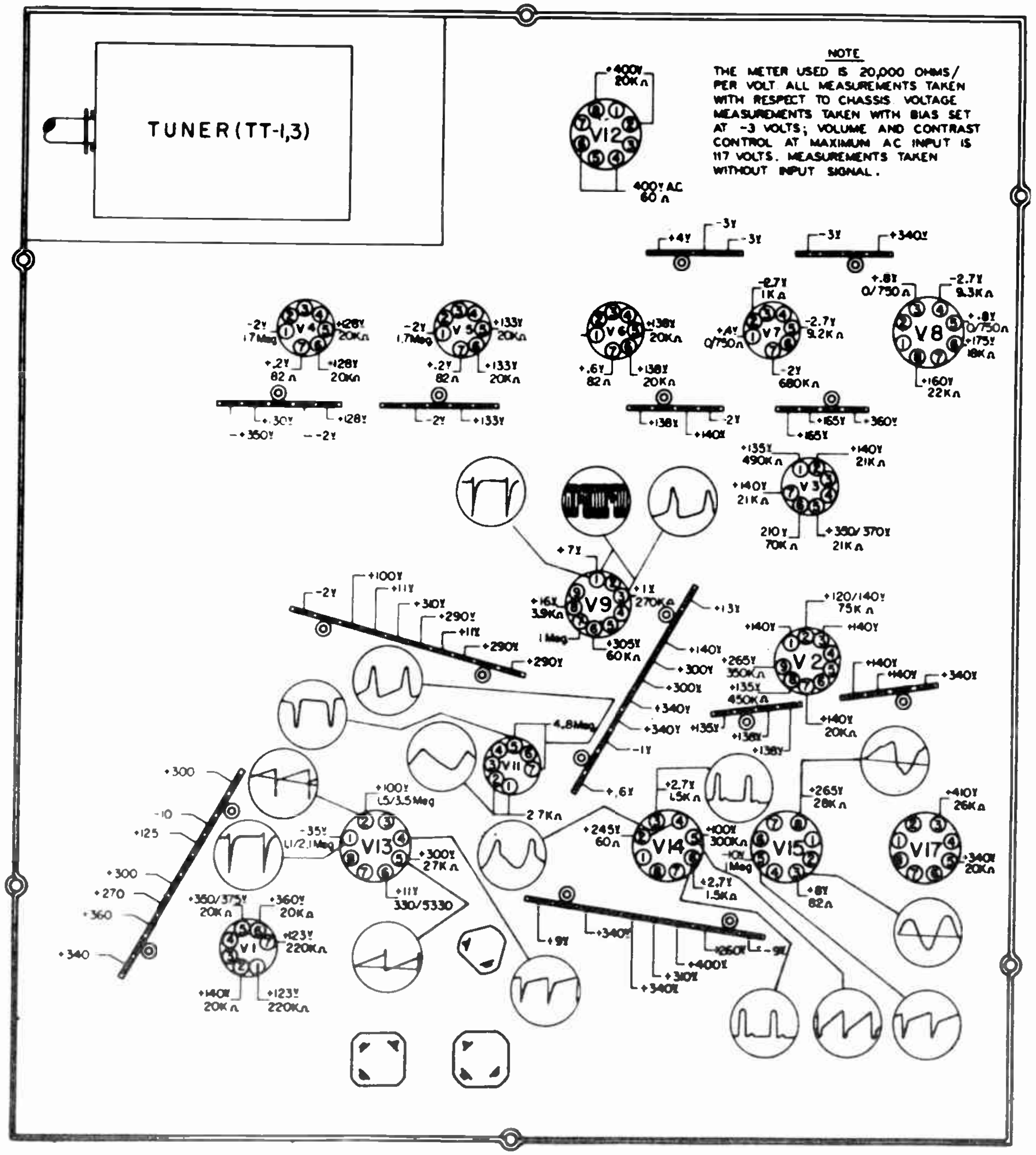

FIG. 6- BOTTOM VIEW INDICATING VOLTAGE AND RESISTANCE VALUES AND ALSO WAVE FORMS.

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Insufficient Height

Defective vertical oscillator transformer, T3.
C313 increasing in capacity.
R304 and R310 changing in value.

Inability to Center Picture

Blanking on left side may be due to leaky C313.
Carefully try turning CR Tube.

NOTE: Entire audio circuit is at a potential of 140 volts above ground and the grids are hot. Also, V-1, 6AQ5, functions as a series voltage regulator to this 140 volts, as well as an audio output tube. Proper operation of this tube affects B+, and is, therefore, vital to normal operation of other circuits. A primary check of this circuit should be instituted when starting to service receiver.

For voltage and resistance analysis and waveforms, see Fig. 6.

DISASSEMBLY

To remove chassis from the cabinet, first pull off all knobs from controls in front of cabinet. Remove the six mounting bolts to be found underneath the cabinet and lift the chassis from the cabinet. Use care to prevent damage to the kinescope.

The kinescope is mounted on the chassis itself. It is held in place by a strap that is fastened over the outer rim of the bell of the kinescope.

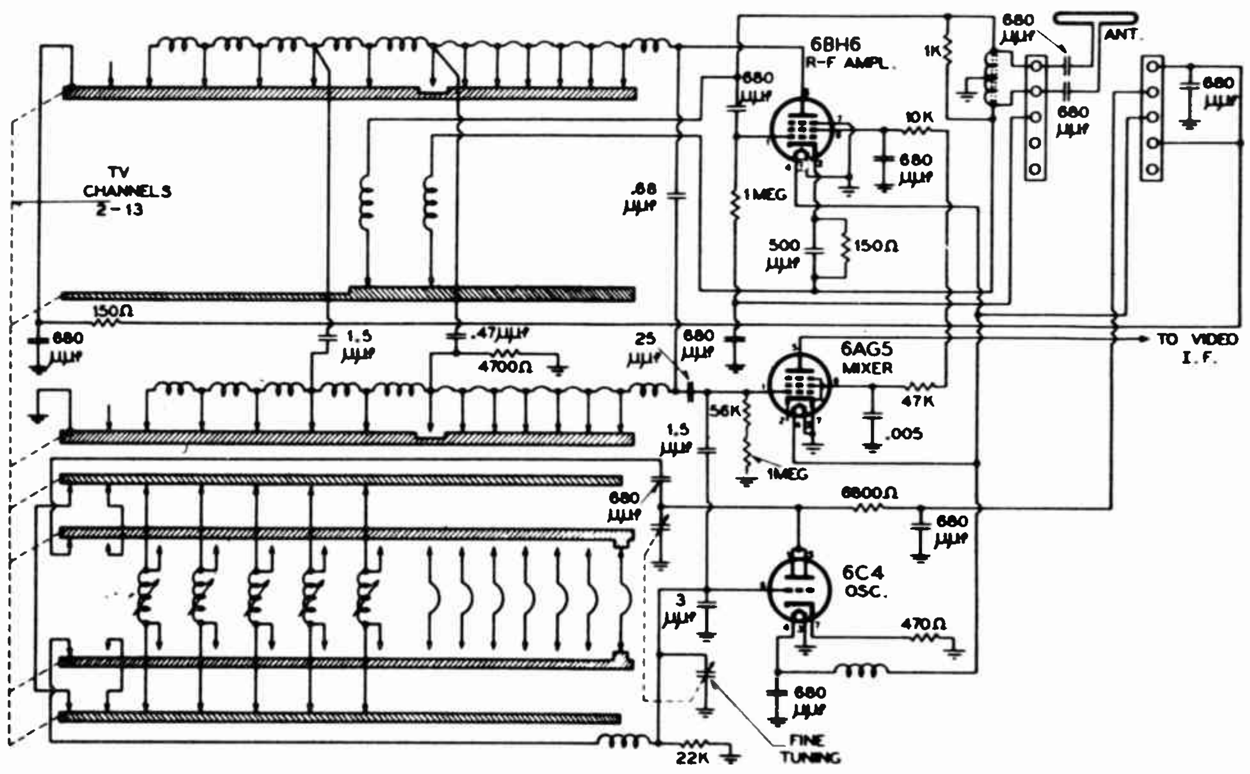

FIG. 7- SCHEMATIC OF TT-1 TUNER

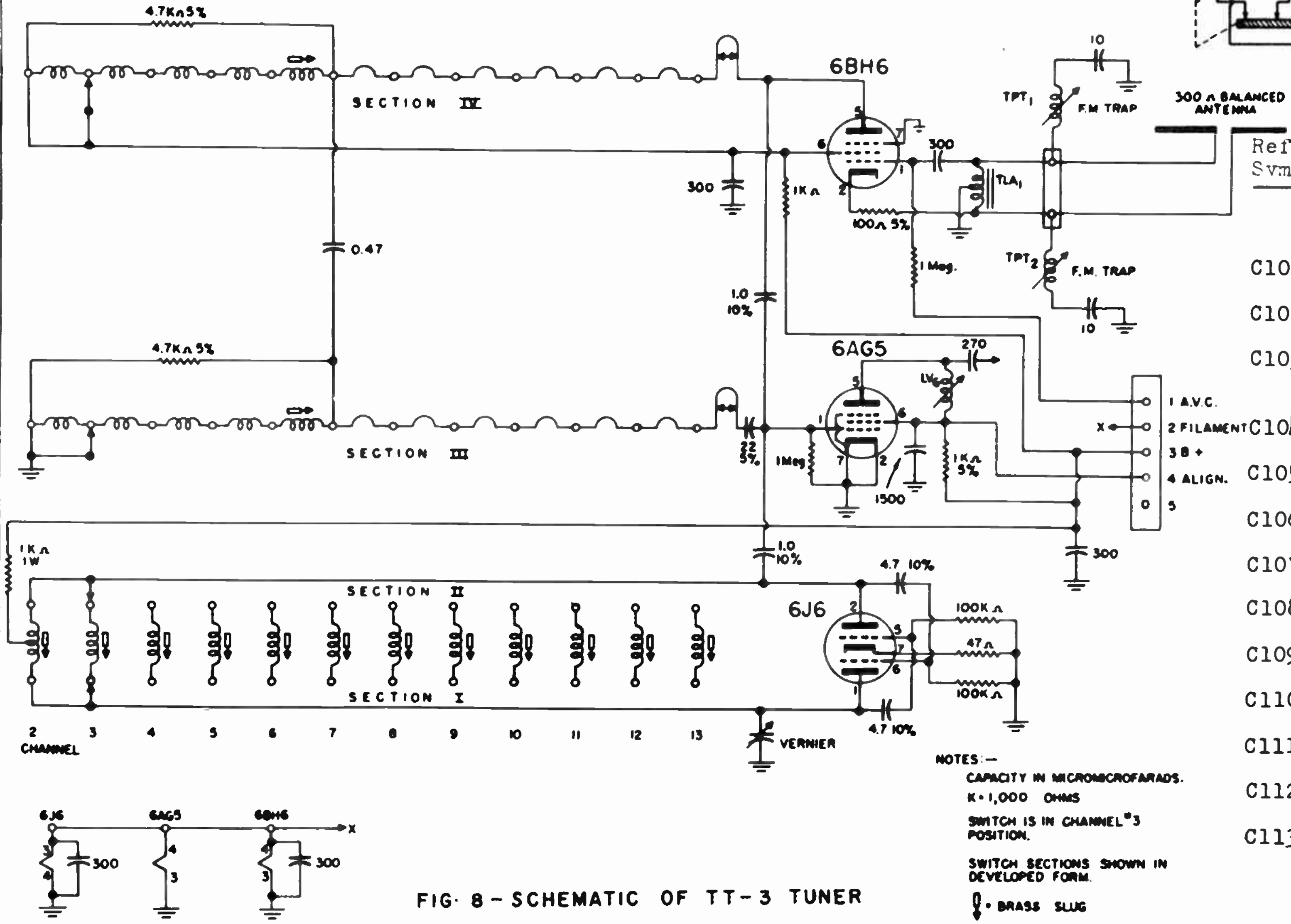

FIG. 8 - SCHEMATIC OF TT-3 TUNER

PARTS LIST

Ref Symbol	Description	Part No.
	CAPACITORS	
C101	Paper: 0.005 µf, 400 V	CP-4-25
C102	Tubular elect: 40 µf, strap mounting, 450 V	CET-4
C103	Can elect: 2-sect; 50 µf, 150 V; 500 µf, 5 V; size 1"	CEM-7
C104	Paper: 0.02 µf, 400 V	CP-4-12
C105	Paper: 0.05 µf, 400 V	CP-4-15
C106	Paper: 0.005 µf, 400 V	CP-4-25
C107	Tubular elect: 1 µf, 25 V	CET-6
C108	Paper: 0.005 µf, 400 V	CP-4-25
C109	Paper: 0.001 µf, 400 V	CP-4-21
C110	Paper: 0.02 µf, 400 V	CP-4-12
C111	Paper: 0.005 µf, 400 V	CP-4-25
C112	Paper: 0.02 µf, 400 V	CP-4-12
C113	Ceramic: 39 µµf, 20%	CC-439
C114	Paper: 0.1 µf, 400 V	CP-4-01
C115	Paper: 0.002 µf, 400 V	CP-4-22
C201	Ceramic: 100 µµf, GMV	CC-31
C202 C203 C204	Ceramic: Herlec GMV, 2-sect; each 0.002 µf	CCD-22
C205 C206	Ceramic: GMV, 100 µµf	CC-31
C207 C208 C209	Ceramic: Herlec GMV, 2-sect; each 0.002 µf	CCD-22
C210	Paper: 0.1 µf, 400 V	CP-4-01
C211	Ceramic: Herlec GMV, 2-sect; each 0.002 µf	CCD-22
C212	Ceramic: Herlec GMV, 0.002 µf	CC-22
C213	Ceramic: Herlec GMV, 2-sect; each 0.002 µf	CCD-22
C214	Ceramic: GMV, 120 µµf	CC-312
C215	Ceramic: GMV, 100 µµf	CC-31

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Ref Symbol	Description	Part No.
C216	Ceramic: Herlec GMV, 0.002 µf	CC-22
C217	Ceramic: 5 µµf, 20%	CC-55
C218	Paper: 0.1 µf, 400 V	CP-4-01
C219	Paper: 0.01 µf, 400 V	CP-4-11
C220	Ceramic: 680 µµf, 20%	CC-368
C221	Ceramic: 470 µµf, 20%	CC-347
C222	Can elect: 4-sect; 10 µf, 150 V; 10, 20, 10 µf, 450 V; size 1-3/8"	CEM-6
C223	Paper: 0.1 µf, 400 V	CP-4-01
C224, C225	Ceramic: Herlec GMV, 0.002 µf	CC-22
C301	Paper: 0.002 µf, 400 V	CP-4-22
C302, C303	Paper: 0.005 µf, 400 V	CP-4-25
C304, C305	Paper: 0.01 µf, 400 V	CP-4-11
C306, C307, C308	Can elect: 3-sect; 40, 40, 40 µf, 450 V; size 1-3/8"	CEM-5
C309	Can elect: 2-sect; 50 µf, 150 V; 500 µf, 5 V; size 1"	CEM-7
C310	Paper: 0.005 µf, 400 V	CP-4-25
C311	Tubular elect: 100 µf, 150 V	CET-5
C312	Paper: 25 µf, 400 V	CP-4-025
C313	Paper: 0.1 µf, 400 V	CP-4-01
C314	Can elect: 4-sect; 10 µf, 150 V; 10, 20, 10 µf, 450 V; size 1-3/8"	CEM-6
C315	Mica, silver: 3900 µµf, 5%	CM-239
C316	Paper: 0.05 µf, 400 V	CP-4-15
C317	Mica, silver: 330 µµf, 10%	CM-333
C318	Mica: 390 µµf, 20%	CM-339
C319	Can elect: 4-sect; 10 µf, 150 V; 10, 20, 10 µf, 450 V; size 1-3/8"	CEM-6
C320	Mica: 270 µµf, 20%	CM-327
C321	Paper: 0.05 µf, 400 V	CP-4-15
C322	Paper: 0.01 µf, 400 V	CP-4-11
C323	Paper: 0.005 µf, 400 V	CP-4-25

Ref Symbol	Description	Part No.
C324	Can elect: 4-sect; 10 µf, 150 V; 10, 20, 10 µf, 450 V; size 1-3/8"	CEM-6
C325	Mica: 25-280 µµf, padder, Hor. Drive	CT-1
C326	Paper: 0.25 µf, 400 V	CP-4-025
C327	Paper: 0.05 µf, 600 V	CP-6-15
C328	Paper oil-filled: 0.035 µf, 600 V	CO-6-135
C329	Paper oil-filled: 0.1 µf, 600 V	CO-6-01
C330	Mica: 12 µµf, 5%, 1500 V	CM-412
C331, C332	Paper: 0.001 µf, 400 V	CP-4-21
C333	Paper: 0.01 µf, 400 V	CP-4-11
C334	Mica: 22 µµf, 20%	CM-422
C335	Ceramic: 500 µµf, 10KV Std.	CHV-35
C336	Paper: 0.25 µf, 400 V	CP-4-025
	COILS & CHOKES	
L1	4.5 mc discrim.trans	LRD-1
L2	4.5 mc take-off trans	LTO-2
L3	Peaking coil	LP-7
L4	1st video i-f trans	LV-6
L5	Filament choke	LC-1
L6	2nd video i-f trans	LTO-2
L7	Filament choke	LC-1
L8	R-f choke	LC-4
L9	3rd video i-f trans	LV-6
L10	Filament choke	LC-1
L11	R-f choke	LC-4
L12	4th video i-f trans	LV-6
L13	Peaking coil	LP-5
L14	Peaking coil	LP-6
L15	Peaking Coil	LP-8
L16	Filter choke	LC-3
L17	Focus coil	LF-3
L18	Afc coil	LHO-2
L19	Deflect yoke	DY-2
L20	Width control	L-201R1
L21	Hor linearity control	L-201R3
	CONTROLS--POTENTIOMETERS	
P-2	Vert Linearity, 5K, 1/2 W	P-2
P-5	Vert Size, 2.5 Meg, 1/2 W	P-5
P-6	Focus, 1500 Ω, 3 W	P-6
P-7	Volume, 500K, audio taper with switch	P-7
PD-4	Dual-control: Brightness, 100K, 1/2 W; Contrast, 750 Ω, 1 W, wire wound, tap at 250 Ω	PD-4

Ref Symbol	Description	Part No.
PD-5	Dual-control: Vert Hold, 1 Meg; Hor Hold, 50K	PD-5
	RESISTORS	
R101	390 Ω 10%, 1 W	RC-391-5
R102	4.7K 10%, 1/2 W	RC-472-2
R103	470K 10%, 1/2 W	RC-474-2
R104	100K 10%, 1/2 W	RC-104-2
R105	330K 5%, 1/2 W	RC-334-3
R106	180K 5%, 1/2 W	RC-184-3
R107	330K 10%, 1/2 W	RC-334-2
R108	470K 10%, 1/2 W	RC-474-2
R109	18K 10%, 2 W	RC-183-8
R110	15K 10%, 1/2 W	RC-153-2
R111	44K 10%, 1/2 W	RC-443-2
R113	1K 10%, 1/2 W	RC-102-2
R114	100K 10%, 1/2 W	RC-104-2
R115	82K 10%, 1/2 W	RC-823-2
R116	1K 10%, 1/2 W	RC-102-2
R117	470K 10%, 1/2 W	RC-474-2
R118	10K 10%, 1/2 W	RC-103-2
R119	220K 10%, 1/2 W	RC-224-2
R201	10K 10%, 1/2 W	RC-103-2
R202	330 Ω 10%, 1/2 W	RC-331-2
R203	82 Ω 10%, 1/2 W	RC-820-2
R204	100 Ω 10%, 1/2 W	RC-101-2
R205	330 Ω 10%, 1/2 W	RC-331-2
R206	8.2K 10%, 1/2 W	RC-822-2
R207	82 Ω 10%, 1/2 W	RC-820-2
R208	100 Ω 10%, 1/2 W	RC-101-2
R209	8.2K 10%, 1/2 W	RC-822-2
R210	82 Ω 10%, 1/2 W	RC-820-2
R211	100 Ω 10%, 1/2 W	RC-101-2
R212	1 Meg 10%, 1/2 W	RC-105-2
R213	680K 10%, 1/2 W	RC-684-2
R214	100 Ω 10%, 1/2 W	RC-101-2
R215	39K 10%, 1 W	RC-393-5
R216	1K 10%, 1/2 W	RC-102-2
R217	120K 10%, 1/2 W	RC-121-2
R218	44K 10%, 2 W	RC-443-8
R218A	44K 10%, 2 W	RC-443-8
R219	22K 10%, 2 W	RC-223-5
R220	54K 10%, 2 W	RC-543-8
R220A	54K 10%, 2 W	RC-543-8
R221	5.6K 10%, 1 W	RC-562-5
R222	2.2K 10%, 1/2 W	RC-222-2
R223	270K 10%, 1/2 W	RC-274-2
R224	8.2K 10%, 1/2 W	RC-822-2
R301	8.2K 10%, 1/2 W	RC-822-2
R302	8.2K 10%, 1/2 W	RC-822-2
R303	15 Ω 10%, 1 W	RC-150-5
R304	6.8 Meg 10%, 1/2 W	RC-685-2
R305	1 Meg 10%, 1/2 W	RC-105-2
R306	2.2 Meg 10%, 1/2 W	RC-225-2
R307	330 Ω 10%, 1/2 W	RC-331-2
R308	100K 10%, 1/2 W	RC-104-2
R309	6.8K 10%, 1/2 W	RC-682-2
R310	1.5 Meg 10%, 1/2 W	RC-155-2
R311	5.6K 10%, 1/2 W	RC-562-2
R312	1.5K 10%, 1/2 W	RC-152-2
R313	68K 10%, 1/2 W	RC-683-2
R314	270K 10%, 1/2 W	RC-274-2

Ref Symbol	Description	Part No.
R315	22K 10%, 1 W	RC-223-5
R316	1 Meg 10%, 1/2 W	RC-105-2
R317	22K 10%, 1 W	RC-223-5
R318	27K 10%, 1/2 W	RC-273-2
R319	470K 10%, 1/2 W	RC-474-2
R320	68 Ω 10%, 1/2 W	RC-680-2
R321	82 Ω 10%, 1 W	RC-820-5
R322	8.2K 10%, 2 W	RC-822-8
R323	4.7 Meg 10%, 1/2 W	RC-475-2
R324	100K 10%, 1/2 W	RC-104-2
R325	100K 10%, 1/2 W	RC-104-2
R326	3.3 Ω 10%, 1/2 W	RC-336-2
R327	4.7K 10%, 1/2 W	RC-472-2
R328	6300 Ω tapped 10% 500-500 50 W Std	RC-632-17
R329	22K 10%, 1/2 W	RC-223-2
R330	3.9K 10%, 1/2 W	RC-392-2
R331	3.9K 10%, 1/2 W	RC-392-2
R332	820K 10%, 1/2 W	RC-824-2
R333	47K 10%, 1/2 W	RC-473-2
R334	1 Meg 10%, 1/2 W	RC-105-2
R335	3.9K 10%, 1/2 W	RC-392-2
R336	1 Meg 10%, 1 W	RC-105-5
R337	6.8K 10%, 1 W	RC-682-5
	TRANSFORMERS	
T1	Audio output trans	T-102
T2	Power trans	T-106
T3	Vert blocking osc. trans	T-104
T4	Vert output trans	T-107
T5	Hor output trans	T-211T3
IT-1	Ion trap	IT-1
	TUBES	
V-1	Audio ampl	6AQ5
V-2	Ratio det	6T8
V-3	Ratio det driver	6AU6
V-4	1st video i-f ampl	6AU6
V-5	2nd video i-f ampl	6AU6
V-6	3rd video i-f ampl	6AU6
V-7	Video det & AGC	6AL5
V-8	Video ampl	6AC7
V-9	D-c restorer, sync clipper & sync ampl	12AU7
V-10	Kinescope tube	10BP4 or 12LP4
V-11	Hor phase det	6AL5
V-12	Power rectifier	5U4G
V-13	Vert sweep osc. & vert sweep output	6SN7
V-14	Hor sweep osc.	6SN7
V-15	Hor sweep output	6BG6G
V-16	H-V rect	1B3/8016
V-17	Hor damper	5V4

Tubes in R-F Tuner not included

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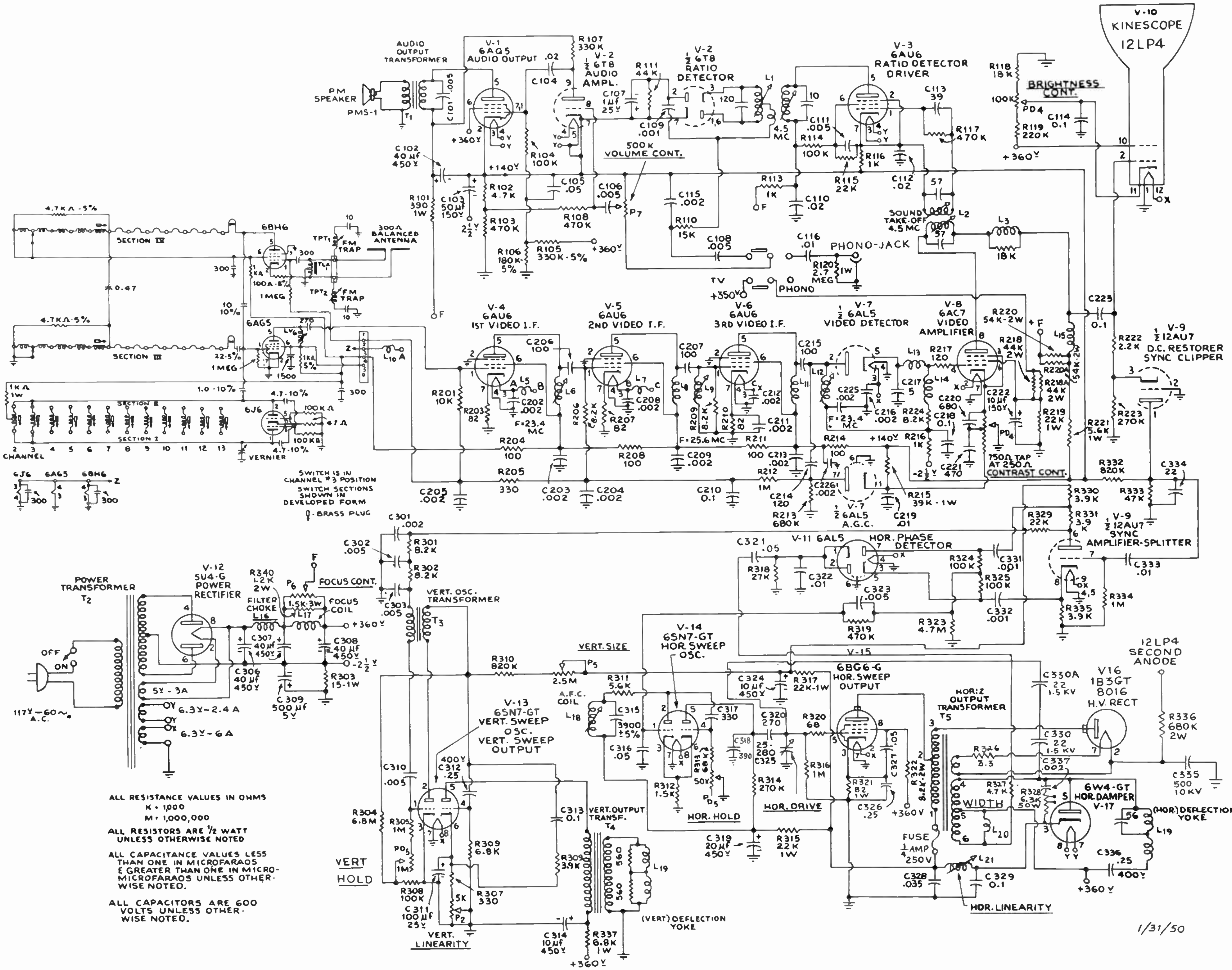

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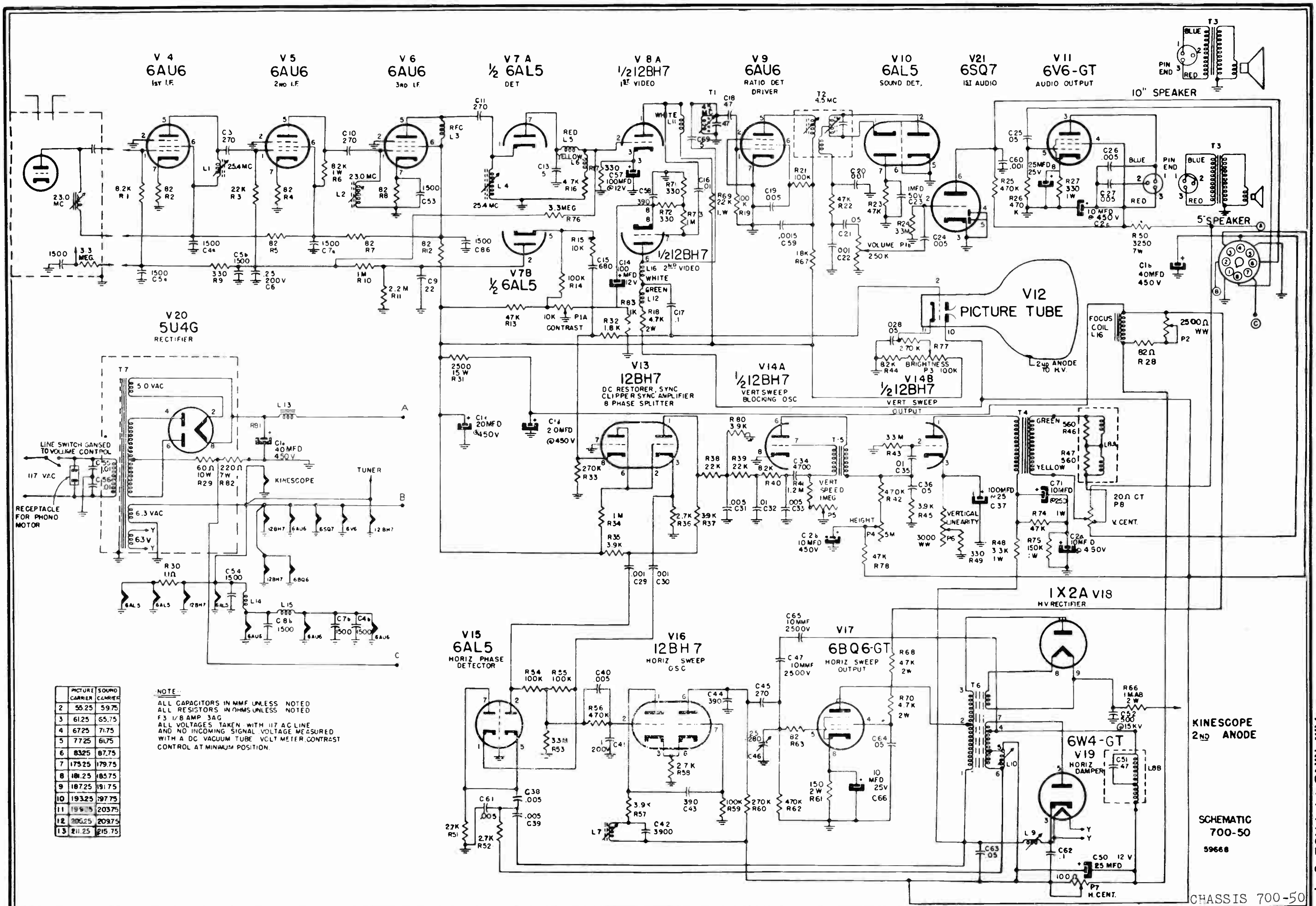

	PICTURE CARRIER	SOUND CARRIER
2	55.25	59.75
3	61.25	65.75
4	67.25	71.75
5	77.25	61.75
6	83.25	87.75
7	175.25	179.75
8	181.25	185.75
9	187.25	191.75
10	193.25	197.75
11	199.25	203.75
12	205.25	209.75
13	211.25	215.75

NOTE
ALL CAPACITORS IN MMF UNLESS NOTED
ALL RESISTORS IN OHMS UNLESS NOTED
F3 1/8 AMP 3AG
ALL VOLTAGES TAKEN WITH 117 AC LINE AND NO INCOMING SIGNAL VOLTAGE MEASURED WITH A DC VACUUM TUBE VOLT METER CONTRAST CONTROL AT MINIMUM POSITION.

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REPAIR PARTS LIST

700-50 TV Chassis

SCH. LOC.	PART No.	DESCRIPTION
	A5605	Antenna, Indoor
	A54928	Bracket, Focus Coil
	A54929	Bracket, Focus Coil Support
	A54609	Bracket, Horiz. Freq. Control Coil
	A54824	Bracket, Tube Mounting
C1	A20144	Capacitor, Electrolytic 40-40-20-20 @ 450
C2	A20135	Capacitor, Electrolytic 10-10-10 @ 450
C3, C10, C11, C45	A190-133	Capacitor, Mica 270 mmf ±10%
C4, C5, C7, C8	A19147	Capacitor, Ceramic Dual 1500 mmf Disc
C6	A194-67	Capacitor, Paper, .25 mfd 200v ±20%
C9	A190-7	Capacitor, Ceramic 22 mfd 500v ±20%
C12	A555-113-2	Capacitor, Ceramic 47 mmf ±20% Non Insulated
C13, C60	A555-100	Capacitor, Ceramic 5 mmf ±20%
C14, C57	A20141	Capacitor, Electrolytic 100 mfd 12v
C15	A190-143	Capacitor, Mica 680 mmf 500v ±10%
C16, C32, C35	A194-155	Capacitor, Paper .01 mfd 600v ±20%
C17, C62	A194-162	Capacitor, Paper .1 mfd 600v ±20%
C19, C24, C26, C27, C31, C33, C38, C39, C40, C61	A194-160	Capacitor, Paper .005 mfd 600v ±20%
C20, C22, C60, C29, C30	A194-145	Capacitor, Paper .001 mfd 600v ±20%
C21, C25, C28, C36, C63, C64	A194-160	Capacitor, Paper .05 mfd 600v ±20%
C23	A20138	Capacitor, Electrolytic 1 mfd 50v
C34	A192-163	Capacitor, Mica 4700 mmf 500v ±10%
C37	A20130	Capacitor, Electrolytic 100 mfd 25v
C41	A194-66	Capacitor, Paper .1 mfd 200v ±20%
C42	A193-261	Capacitor, Silver Mica 3900 mmf ±5% 500v
C43, C44, C58	A190-137	Capacitor, Mica 390 mmf ±10% 500v
C46	A1772	Capacitor, Trimmer 25 to 280 mmf
C47, C65	A19146	Capacitor, Mica 10 mmf 2500v
C50	A20147	Capacitor, Electrolytic 25 mfd 12v
C52	A1998-2	Capacitor, Ceramic 500 mmf 15kv
C53, C54, C59	A19148	Capacitor, Ceramic; Single Disc 1500 mmf
C55, C56	A19106	Capaictor, Moulded Bakelite .01 mfd 600v ±20%
C66	A20137	Capacitor, Electrolytic 10 mfd 25v
C67, C68	A19136	Capacitor, Mica 220 mmf 2500v
L3	A28253	Choke, I.F.
L4, L15	A28276	Choke, Filament
L13	A1406	Choke, Filter
L16	A28282	Coil, Focus
L9	A28292	Coil, Linearity
L5	A28255-1	Coil, Peaking, Red
L11, L16	A28255-2	Coil, Peaking, White
L12	A28255-4	Coil, Peaking, Green
L6	A28256-6	Coil, Peaking, Yellow
L10	A28279	Coil, Width Control
L7	A28263	Coil, Horizontal Frequency Control
	A55141	Connector, Anode
P1a, P1b	A24109	Control, Contrast and Volume
P2	A24113	Control, Focus 2500 ohm
P3	A24110	Control, Brightness 100k ohm
P4	A24111	Control, Height 5 meg ohm
P5	A24112	Control, Vert. Speed 1 meg ohm
P6	A24114	Control, Vert. Linearity 3000 ohm
P7	A24116	Control, Horiz. Centering
P8	A24118	Control, Vert. Centering

SCH. LOC.	PART No.	DESCRIPTION
	A55110	Cord, Line
	A54943	Holder, Anode Lead
	A54851	Hood, Yoke
	A54794	Ion Trap
	A54661	Plug, Male, Line Cord
R1, R40, R44	A231-1171	Resistor, Carbon 8200 ohm ½w ±10%
R2, R4, R5, R7, R8, R12, R28, R63	A231-1123	Resistor, Carbon 82 ohms ½w ±10%
R3, R38, R39	A231-1181	Resistor, Carbon 22,000 ohms ±10%
R6	A232-1171	Resistor, Carbon 8200 ohms 1w ±10%
R9, R17, R49, R71, R72	A231-1137	Resistor, Carbon 330 ohms ½w ±10%
R10, R34, R73	A231-1221	Resistor, Carbon 1 meg ohm ½w ±10%
R11	A231-1229	Resistor, Carbon 2.2 meg ohm ½w ±10%
R13, R22, R23, R78	A231-1189	Resistor, Carbon 47,000 ohm ½w ±10%
R14, R19, R21, R54, R55, R59	A231-1197	Resistor, Carbon 100,000 ohm ½w ±10%
R15	A231-1173	Resistor, Carbon 10,000 ohm ½w ±10%
R16	A231-1165	Resistor, Carbon 4700 ohm ½w ±10%
R18, R68, R70	A233-1165	Resistor, Carbon 4700 ohm 2w ±10%
R24, R43, R53, R76, R79	A231-1233	Resistor, Carbon 3.3 meg ohm ½w ±10%
R25, R26, R42, R56, R62	A231-1213	Resistor, Carbon 470,000 ohm ½w ±10%
R27	A232-1137	Resistor, Carbon 330 ohm 1w ±10%
R29	A21107	Resistor, Wirewound 60 ohm 10w
R30	A23151	Resistor, Carbon Wire wound 1.2 ohm 1w ±10%
R31	A21110	Resistor, Wirewound 2500 ohm 15w ±10%
R32, R67	A231-1155	Resistor, Carbon 1800 ohm ½w ±10%
R33, R60, R77	A231-1207	Resistor, Carbon 270,000 ohm ½w ±10%
R35, R37, R45, R57, R80	A231-1163	Resistor, Carbon 3900 ohm ½w ±10%
R36, R51, R52, R58	A231-1159	Resistor, Carbon 2700 ohm ½w ±10%
R41	A231-1223	Resistor, Carbon 1.2 meg ohm ½w 10%
R48	A233-1161	Resistor, Carbon 3300 ohm 2w ±10%
R50	A21111	Resistor, Wirewound 3250 ohm 7w ±10%
R61	A233-1129	Resistor, Carbon 150 ohm 2w ±10%
R66	A233-1221	Resistor, Carbon 1 meg ohm 2w ±10%
R69	A232-1157	Resistor, Carbon 2200 ohm 1w ±10%
R74	A232-1189	Resistor, Carbon 47,000 ohm 1w ±10%
R75	A232-1201	Resistor, Carbon 150,000 ohm 1w ±10%
R79	A231-2249	Resistor, Carbon 1000 ohms ½w ±20%
R81	A21115	Resistor, Wirewound 220 ohms 7w
	A18101	Socket, Speaker Plug
	A18147	Socket, 7 Pin Wafer
	A18155	Socket, Octal Moulded
	A18157	Socket, 9 Pin Wafer
	A18168	Socket, Bakelite Octal
	A18171	Socket, 9 pin moulded
	A18173	Socket, 9 pin moulded
	A54820	Socket, Hi Voltage Cond. Mtg.
	A18160-3	Socket, Kinescope
	A54827	Strap, Tube Mtg., R.H.
	A54828	Strap, Tube Mtg., L.H.
T1	A28286	Transformer, Audio Take Off
T6	A10104 or A10108	Transformer, Horizontal Output
L1, L2, L4	A3392	Transformer, I. F.
T7	A10109	Transformer, Power
T2	A1201-1202	Transformer, Ratio Detector
T5	A10106	Transformer, Vertical Oscillator
T4	A1350-2	Transformer, Vertical Output
L8	A28278-2	Yoke, Deflection

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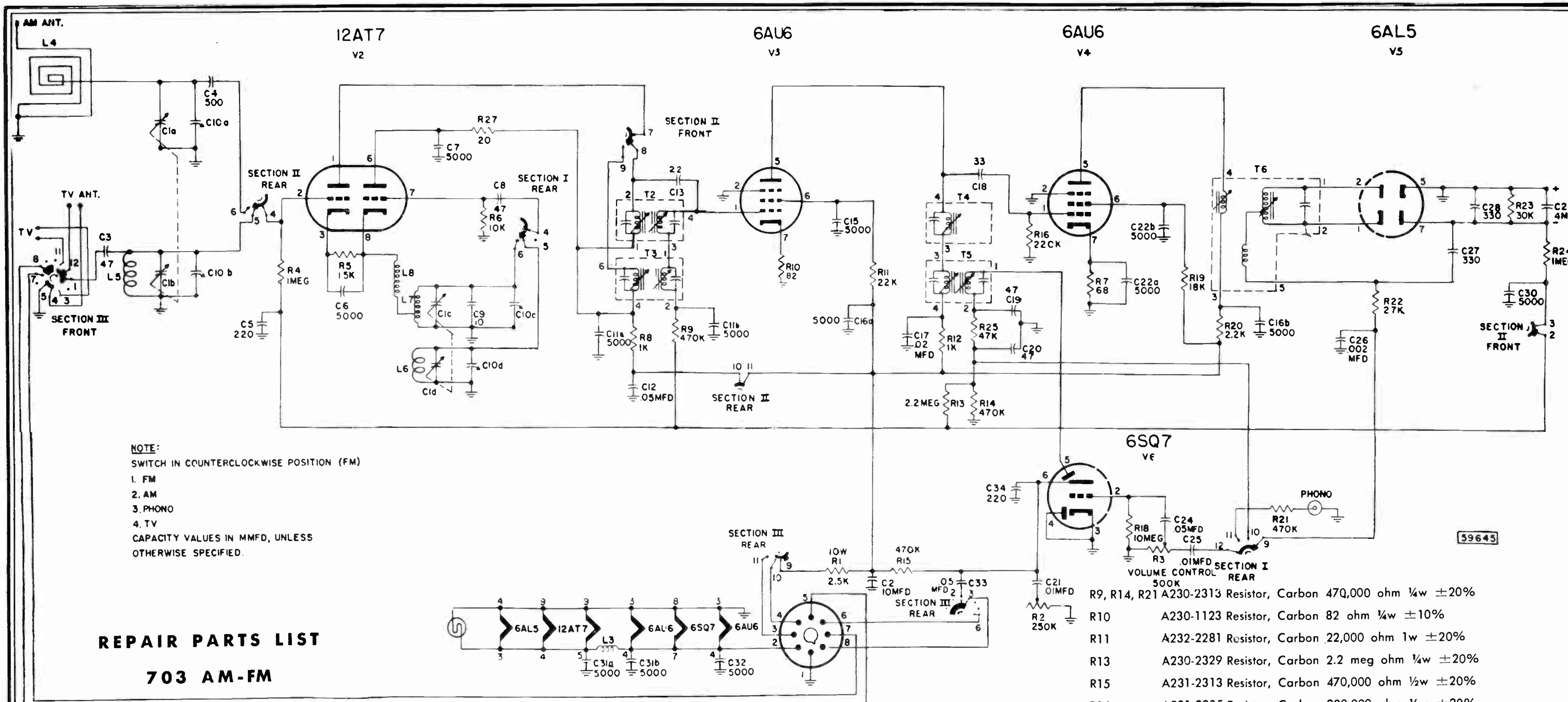

REPAIR PARTS LIST

703 AM-FM

SCH. LOC.	PART No.	DESCRIPTION
	A28293	Antenna, FM
L4	A62298	Antenna, AM Loop
C1	A16109	Capacitor, AM FM Variable
C2	A20148	Capacitor, Electrolytic 10 mfd 450v
C3, C8, C19, C20	A190-115	Capacitor, Mica 47 mmf ±10%
C4	A190-130	Capacitor, Mica 470 mmf ±10%
C5, C34	A190-131	Capacitor, Mica 220 mmf ±10%
C6, C15, C30, C32	A19109	Capacitor, Ceramic Disc 5000 mmf
C7	A19167	Capacitor, Ceramic Durez Coated 5000 mmf ±10%
C9	A555-201	Capacitor, Ceramic 10 mmf ±10%
C10	A1774	Capacitor, Trimmer
C11a, C11b, C16a, C16b, C22a, C22b, C31a, C31b	A19163	Capacitor, Ceramic Disc Dual 5000 mmf
C12, C24, C33	A194-112	Capacitor, Paper .05 mfd 400v ±20%
C13	A19165	Capacitor, Ceramic 2.2 mmf
C17	A194-108	Capacitor, Paper .02 mfd 400v ±20%
C18	A190-110	Capacitor, Mica 33 mmf 500v ±10%
C21, C25	A194-107	Capacitor, Paper .01 mfd 400v ±20%
C26	A194-98	Capacitor, Paper .002 mfd 400v ±20%
C27, C28	A190-135	Capacitor, Mica 330 mmf ±10%
C29	A20149	Capacitor, Electrolytic 4 mfd 50v
L3, L8	A28283	Choke, FM Osc.
L6	A28287	Coil, FM Osc.
L7	A28285	Coil, AM Osc.
L5	A28288	Coil, FM Antenna
R2	A2529	Control, Tone 250,000 ohm
R3	A24117	Control, Volume 500,000 ohm
R1	A21114	Resistor, Wirewound 2500 ohms 10w
R4, R24	A230-2321	Resistor, Carbon 1 meg ohm ¼w ±20%
R5	A230-2253	Resistor, Carbon 1500 ohm ¼w ±20%
R6	A230-2273	Resistor, Carbon 10,000 ohm ¼w ±20%
R7	A231-8	Resistor, Carbon 20 ohm ½w ±5%
R8, R12	A231-2249	Resistor, Carbon 1000 ohm ½w ±20%
R9, R14, R21	A230-2313	Resistor, Carbon 470,000 ohm ¼w ±20%
R10	A230-1123	Resistor, Carbon 82 ohm ¼w ±10%
R11	A232-2281	Resistor, Carbon 22,000 ohm 1w ±20%
R13	A230-2329	Resistor, Carbon 2.2 meg ohm ¼w ±20%
R15	A231-2313	Resistor, Carbon 470,000 ohm ½w ±20%
R16	A231-2305	Resistor, Carbon 220,000 ohm ½w ±20%
R17	A230-1221	Resistor, Carbon 68 ohm ¼w ±10%
R18	A230-2345	Resistor, Carbon 10 meg ohm ¼w ±20%
R19	A232-1177	Resistor, Carbon 15,000 ohm 1w ±20%
R20	A232-2257	Resistor, Carbon 2200 ohm 1w ±20%
R22	A230-1183	Resistor, Carbon 27,000 ohm ¼w ±10%
R23	A230-84	Resistor, Carbon 30,000 ohm ¼w ±5%
R25	A230-89	Resistor, Carbon 47,000 ohms
	A18147	Socket, 7 Pin Miniature
	A18174	Socket, Phono Input
	A6528	Socket, Pilot Light
	A18155	Socket, Octal
S1	A37102	Switch, AM FM Phono, TV
T2	A3395	Transformer, FM IF 1st
T3	A3396	Transformer, AM IF 1st
T4	A3394	Transformer, FM IF 2nd
T5	A3399	Transformer, AM IF 2nd
T6	A3397	Transformer, Ratio Detector

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VL 16 , VL 12, VL 19 CHASSIS
(Reference Numbers are for VL 16 in Most Cases)

ADJUSTMENT OF TUNING DIAL

Turn tuning shaft completely clockwise. Slide large dial into shaft. Engage gears so that line on flat surface of dial directly under number 13 lines up with Tuning Indicator marking on cabinet. Slip felt washer onto shaft. Now slide small dial onto shaft. Line up the numeral 1 of number 108 directly under numeral 1 of 13 on large dial and tighten set screw of small dial.

In very high signal strength areas the jumper between resistors R117 and R118 should be removed. This is located directly behind the contrast control.

For chassis with A.G.C. observe the following:

These conditions must be met for proper operation. A manual contrast control potentiometer must be connected by using a separate 10,000 Ohm control connecting one end to chassis, the other end to B- and the arm to the A.G.C. string before proceeding to align or adjust the Video IF, sound IF, head end and sync. adjustments as indicated in the regular service notes.

During sync. adjustment the regular contrast control in the set must be set so that the bias at the video output tube is +5 volts and left at this setting during all sync. adjustment procedure. After all alignment and adjustments are made and manual contrast control removed check operation of the A.G.C. on the air. The hold control will lock in signals at a point about 28% from clockwise rotation and must hold sync. for about 20% of additional rotation. If these conditions are not met the frequency control slug must be adjusted until the above conditions are met.

HEAD-END ALIGNMENT PROCEDURE FOR CHASSIS TYPES: VL-12, VL-16 & VL-19

A. Interstage Circuits:

1. Connect a 220-ohm resistor to pins 5 and 6 of mixer tube (V3).
2. Connect input of wide-band amplifier to pin 5 of V3.
3. Connect ground of wide-band amplifier to chassis of receiver.
4. Remove first video I.F. tube from socket.
5. Disconnect C5 from pin 1 of V1.
6. Connect sweep generator to pin 1 of V1 through a suitable capacitor (500 micro-microfarads). Adjust sweep to cover 44-70 mc range.
7. Set receiver tuning control to Channel 2.
8. Set contrast control at maximum contrast.
9. Couple the output of a suitable frequency marker generator, loosely to the r-f stage.
10. Adjust trimmer C10 and C12 to give the Channel 2 curve shown on INTERSTAGE RESPONSE CURVES, LOW CHANNELS.
11. Be sure that the signal level from the sweep generator is not too high otherwise the wide-band amplifier may be overloaded and produce a flat-topped response curve only as a result of clipping and not because proper tuning has been done.
12. Also, be sure that the signal level is not too low, otherwise, the non-linear detection of the amplifier will give a response curve on which the carriers appear to be located further down the sides than they really are.
13. Set receiver tuning control to Channel 13.
14. Adjust sweep to cover 200 to 226 mc range.
15. Adjust end inductors L5 and L6 to produce a curve similar to that shown in INTERSTAGE RESPONSE CURVES, UPPER CHANNELS for Channel 13. The end inductors are adjusted by unsoldering the junction of the crossed wires and varying the effective wire length in the circuit by sliding them over each other. When the correct adjustment is found, the junctions are resoldered.
16. The other channels should be checked for proper response curves.

B. Antenna Circuit:

1. Disconnect sweep generator from pin 1 of V1.
2. Re-connect C5 to pin 1 of V1.
3. Connect sweep generator to antenna input terminals of receiver through a 10-db. resistance attenuator designed to operate at VHF and having a characteristic resistance of 72 ohms.
4. The wide-band amplifier remains connected to pin 5 of V3 as before.
5. Set receiver tuning control to Channel 2.
6. Set contrast control at maximum contrast.
7. Couple the output of a suitable frequency marker generator, loosely to the r-f stage.
8. Adjust trimmer C4 to give the Channel 2 zero-volt curve shown on HEAD - END RESPONSE CURVES, LOW CHANNELS.
9. Repeat items 11, 12, 13 and 14 of part A.
10. Adjust end inductor L3 to produce a curve similar to that shown on HEAD-END RESPONSE CURVES, UPPER CHANNELS for Channel 13, zero-volt.
11. The other channels should be checked for proper response curves. The response curves should also be checked at -3 volts bias applied to the r-f tube.
12. Restore the receiver to its original condition by removing the 220-ohm resistor and by putting back V4.

C. Oscillator Circuit:

If the dial of the tuning control does not indicate correctly the TV channels or the FM frequencies, proceed as follows:

1. Make sure that the dial is oriented correctly on the tuner shaft by turning it to the extreme clockwise position. In this position the radial index mark on the dial and the numeral 1 of 108 mc should be at 12 O'clock, when the receiver is in normal viewing position.
2. If the dial calibration is still inaccurate, the lower channels are corrected by means of C41; the upper channels by end inductor L16.
3. If C41 is re-adjusted then L16 will require re-adjustment. But if only L16 is re-adjusted C41 will not need re-adjustment since L16 has no appreciable effect on the lower channels. L16 is adjusted by spreading or compressing its turns as required. Spreading the turns raises the oscillator frequency for a given dial setting in the upper channel region.

VIDEO IF ALIGNMENT

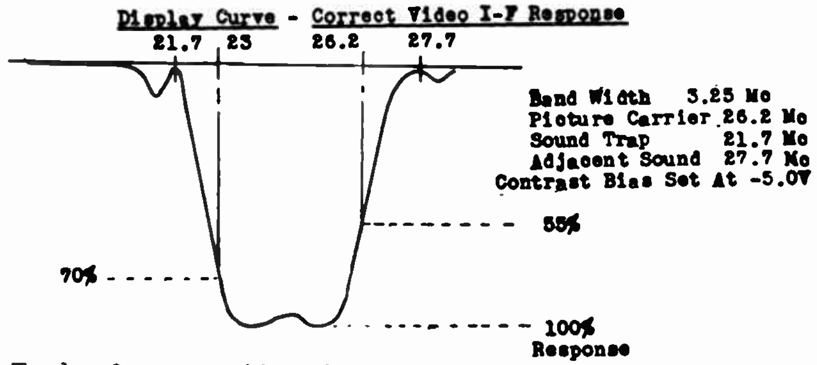
The video I.F. system employs stagger tuner stages consisting of a 6AK5, V3 mixer, three 6CB6, V4, V5. V6, 1st, 2nd and 3rd Video I.F. and 1/2 6AL5 video detector.

The converted pix carrier is 26.2 MC. and is adjusted to 55% down the slope of the Video I.F. pass band from the average top level. When adjusted correctly, the pass band extends from 26.2 MC to a point 70% down at 23 MC. see Figure 1. Traps are provided in the video I.F. system to properly attenuate the accompanying and adjacent sound carrier frequencies at 21.7 MC and 27.7 MC. The 21.7 Mc traps are located in the 2nd and 3rd video I.F. transformers. The 27.7 Mc adjacent sound traps are located in the 1st and 4th video I.F. transformers. The 21.7 Mc traps and 27.7 MC traps provide a 40 to 50 DB attenuation. All traps are tuned from the top of the chassis while all signal circuits are tuned from the bottom.

To align the video I.F., connect the video I.F. sweep generator to the mixer, V3 grid. Disconnect end inductor, L6. Set the sweep generator to cover 19 to 30 Mc and provide markers at 21.7, 23, 26.2 and 27.7 Mc. Connect the oscilloscope to the junction of L7 and L8 Peaking Coils in the circuit of the video detector, V7A. Adjust the contrast control for -5.0 volts. If the response curve obtained on the oscilloscope is appreciably different from that shown in Figure 1, the tuning slugs of the transformers T1, T2, T3 and T5 should be adjusted from the underside of the chassis.

Fig. 1

Display Curve - Correct Video I-F Response



The low frequency skirt of the response curve is principally affected by T1. The high frequency skirt by T3. The flatness of the central region is determined by T2 and T5.

The sound trap of T2, T3 and T4 are adjusted to provide maximum attenuation at 21.7. The traps in T1 and T5 are adjusted to provide maximum attenuation at 27.7 MC.

If T4 is tuned to frequencies above 21.7 Mc, it may cause the video I.F. amplifier to oscillate. This is normal and will stop when the cathode trap is tuned to the correct frequency.

SOUND I.F. ALIGNMENT

Set contrast voltage to 0 bias.
The sound I.F. is aligned stage by stage rather than the overall method.
Disconnect the negative side of C88, 2uf condenser. Connect scope to junction of R101 and R103. Connect FM sweep generator to grid of V19, 6AU6. Adjust bottom slug of T10 until pass band approximates Figure 2.

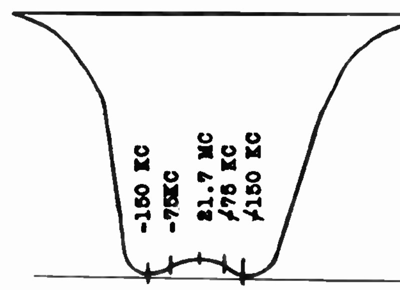


Fig. 2

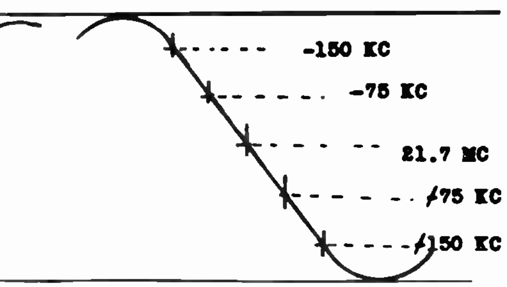


Fig. 3

Move scope to junction of R100 and R105. Adjust top slug on T10 until wave shape approximates Figure 3. This may detune bottom slug slightly. Leaving scope in last position adjust bottom slug of T10, if necessary, until S curve, Figure 3, is symmetrical with respect to center frequency.

Move scope to junction of R101 and 103. Connect FM sweep generator to grid of V18. Adjust primary and secondary, successively, so that wave shape approximates Figure 4.

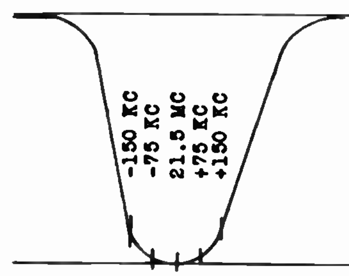


Fig. 4

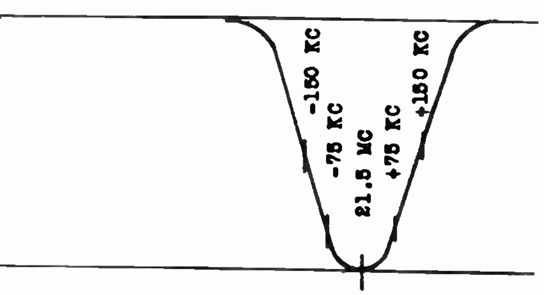


Fig. 5

Temporarily ground or disconnect junction of R94 and R104. Connect high side of R94 to -10 volts (this can be obtained from high side of contrast control through a 12K Resistor). Connect sweep generator to grid of V4. (Blocking condenser of about 500uuf must be used in series with sweep generator lead to prevent upsetting of bias on V4.) Adjust trap in T2 (Top slug) so that wave shape approximates Figure 5.

This completes Sound I.F. alignment.
Be sure to resolder all disconnected wires.

CAUTION: VL16 HORIZONTAL SYNC. ADJUSTMENT

Unless synchronization is carried out in the following manner carefully and accurately, poor Sync. operation will result.

MODELS T-VL12, Saybrook, Ch. VL-12; T-VL16, Mayfield; C-VL16, Sutton; CO-VL16, Fleetwood; Ch. VL16; CO-VL19, Caronia, Ch. VL19

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World Radio History

Equipment:

An oscilloscope with a 2 mc Minimum Pass Band and Low Capacity Probe not exceeding 20 uuf. If the Probe Capacity is more than 20 uuf, the Optimum Sync. Adjustment cannot be made.

Sync. Adjustment Procedure:

(A) Set Up in the Following Manner:

1. Tune in a station so that Sync. is available. A Peak to Peak Video Signal of 15-35V at the Grid of the Picture Tube will be satisfactory.
2. Set the Horizontal Hold Control, located in the front of the chassis, to its mid-position.
3. Set the Horizontal Lock in Trimmer. HCV-2120 located on the Rear Apron of the Chassis, to 1/4 turn from its extreme Clockwise position.
4. Set the Horizontal Drive Trimmer, HCV-2120 located on the Rear Apron, to 1/4 turn from its Extreme Clockwise position.
5. Set the Phase adjustment of SA-335, The Horizontal Oscillator Transformer, to 3 turns from its Extreme Counter Clockwise position. This is available from the bottom of SA-335.
6. Set the frequency Adjustment so that the Stud is 1 inch from the can. This is located on the top of SA-335.
7. Place the Low Capacity Probe of the Scope on Point "C" of SA-335, and Sync. the Scope to get 3 or 4 cycles.

(B) Proceed With the Following Adjustments:

1. Turn up the Brightness and Contrast Control until a Raster can be seen. Adjust the Vertical Hold Control until the picture stops rolling. The general appearance of the Raster, with the horizontal Sync. Circuits out of Adjustment, will appear as a number of Diagonal Bars. Then,
2. Observe the Waveform on the oscilloscope which is connected to Terminal "C" of SA-335. This should look like Figure 1.

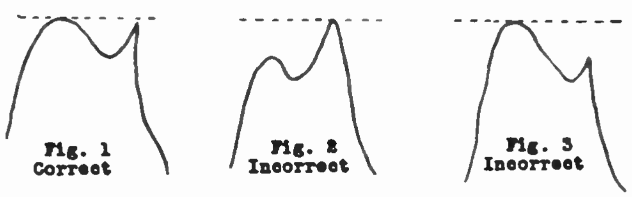

Fig. 1 Correct **Fig. 2** Incorrect **Fig. 3** Incorrect

During the Preliminary Sync. Adjustments, the Amplitude of the Broad and Sharp Peaks of this Waveform should be maintained within about 15% of each other. This may be accomplished by adjusting the Phase Control at the Bottom of SA-335.
3. Now turn the Frequency Adjustment, (Top of SA-335) or Horizontal Hold Control so that the Number of Diagonal Bars on the Cathode Ray Tube decreases until the Horizontal Locks in and a complete Picture is seen. If during the adjustment, the Broad and Sharp Peaks become more than 15% unequal. Reset them by means of the Phase Adjustment.
4. Now Adjust the Horizontal Width, Linearity and Drive Controls and the Vertical Linearity and Width Controls to get the Correct size and best Linearity.
5. Now turn the Phase Adjustment so that the Broad and Sharp Peaks are equal. The Picture may be held in Sync. during this adjustment by means of the Horizontal Hold Control.
6. Set the Horizontal Hold Control to its Extreme Clockwise Position, then turn the Frequency Adjustment until the Picture just holds Sync.
7. Now rotate the Horizontal Hold Control to its Extreme Counter Clockwise position and turn receiver off then on to cause loss of Horizontal Sync.; then, slowly rotate the horizontal Hold Control Clockwise until the picture Syncs. This should occur just after 3 Diagonal Bars appear. If more than 3 Bars are seen just before it pulls into Sync., turn the Horizontal Lock in Trimmer clockwise; If there are less than 3 Bars, turn Horizontal Lock in Trimmer counter-clockwise.
8. Then touch up the Phase Adjustments to equalize the Broad and Sharp Peaks in Amplitude and repeat steps (5) and (7).

The Sync. Adjustment is Optimum when the following conditions exist simultaneously:

1. Equal Amplitude of Broad and Sharp Peaks.
2. Sync. Holds over 90% of Hold Control Rotation with 15-20V Peak to Peak Video at C.R. Tube Grid.
3. Sync. will pull in just after 3 Diagonal Bars are seen.
4. Sync. will hold in at least 90° beyond the pull in point. The operating point should be about 30° beyond the pull-in point.

Caution:

(A) If the Broad Peak is Higher than the Sharp Peak, the pull-in Range is insufficient, while, if the Broad Peak is lower, the noise immunity is poorer.
(B) For Normal Settings of the Horizontal Drive the Grid of the 6CD6G will operate between 6 to 10V. A change of the Horizontal Drive Condenser will require a change in the Frequency Adjustment of SA-335.

Do not adjust Horizontal Drive Unless:

1. A White Bar occurs in the center of the Picture. Turn Horizontal Drive Condenser Clockwise until it disappears.
22. The Width is Insufficient. Turn Horizontal Drive Counter-Clockwise.
If sufficient Width cannot be obtained check tubes and other Circuit Constants.
(C) If Parts in the Horizontal Oscillator circuit have to be replaced tolerances should be observed. In particular if R76, 100K, or C56, 250uuf, are more than 10% above their nominal values, the Frequency Adjustment on SA-335 may not be sufficient to bring the oscillator into Sync.

VL12 VOLTAGE READINGS

Taken With Voltohmyst Set Contrast Bias to -5V Line 117V

Tube Pin No.	1	2	3	4	5	6	7	8	9	
V1 6CB6 R.F.	+1.3	+1.15	0	AC 5.2	+230	+100	0			
V2 6AB4 Oscillator	+120	0	AC 5.7	0	-	-8	0			
V3 6AK5 Mixer	-.1	+3	AC 5.7	0	+122	+122	+3			
V4 6CB6 1st Video IF	-4.8	+.2	0	AC 5.7	+200	+205	0			
V5 6CB6 2nd Video IF	-4.8	+.2	0	AC 5.6	+190	+190	0			
V6 6CB6 3rd Video IF	-12	+.85	AC 5.6	0	+175	+150	0			
V7 6AL5 Video Detector	0	-17	AC 5.8	0	0	0	-1.3			
V8 6AU6 1st Video	-3	0	AC 5.8	0	+140	+140	0			
V9 12AU7 1/2 Clipper, Sync. Seperator. 1/2 Video output	+270	-8	+1	AC 5.8	AC 5.8	+7	0	+22	0	
V10 6SN7 Inter Sync Seperator Vertical Osc	-1.2	+92	0	-26	+120	.0	0	AC 5.6		
V11 6S4 Vertical Output	-	+18	+18	0	AC 5.8	0	-	-	+300	
V12 6SN7 Horiz. Amplifier	-24	-24	+2.4	-24	+160	+1	AC 5.6	0		
V13 6SN7 Horiz.Osc. & Control	-60	+230	0	-26	+80	-17	AC 5.6	0		
V14 6CD6G Horiz. Output	-	0	+11	-5.8	-5.8	-	AC 6	+140		
V15 6W4 Horiz. Damper	-	-	+440	-	+370	-	+440	+440		
V16 1B3G High Volt Rectifier										RF 10K
V17 6BA6 1st Sound IF	-4.4	0	0	AC 5.8	+220	+160	+.7			
V18 6AU6 Driver	0	0	0	AC 5.8	+135	+135	+1			
V19 6AL5 Ratio Detector	+4.3	-5	AC 5.8	0	-1.5	0	-.9			
V20 6SQ7 1st Audio	0	-.7	0	0	0	+90	AC 5.8	0		
V21 6K6 Audio Output	0	AC 5.8	+240	+250	0	+220	0	+17		
V22 5U4G Low Volt. Rectifier		+400		AC 400		AC 400		+400		

Service Switch Position	Line	B+ at C90A	B+ at C90B	B- C90	Watts
TV	117V	400V	370V	-12.5V	210
FM	117V	430V	415V	-.8V	140
Phono	117V	430V	415V	.8V	140

VL-16 VOLTAGE READINGS TAKEN WITH VOLTOHMYST

Set Contrast Bias to -5V Line 117V

Tube Pin No.	1	2	3	4	5	6	7	8	9	Cap
V1 6CB6 R.F.	-.5	+.25	0	AC 5	+180	+80	0			
V2 6AB4 Oscillator	+120	0	AC 5.6	0	-	-6.4				
V3 6AK5 Mixer	0	+3	AC 5.6	0	+120	+120	+3			
V4 6CB6 1st I.F.	-5.3	+.2	0	AC 5.6	+160	+160	0			
V5 6CB6 2nd I.F.	-5	+.2	0	AC 5.6	+170	+170	0			
V6 6CB6 3rd I.F.	-8	+.7	AC 5.4	0	+155	+125	0			
V7 6AL5 Video Det. Delay Diode	0	-11	AC 5.6	0	0	0	-.6			
V8 6AU6 1st Video	-4.5	0	AC 5.4	0	+110	+110	0			
V9 12AU7 Video Output D.C.Reinserter	+230	-7.2	0	AC 5.4	AC 5.4	+5.6	0	+26	0	
V10 6SN7 Sync.Separator Vert. Osc.	-1.9	+95	0	-58	+130	0	0	AC 5.4		
V11 6S4 Vert. Output	-	+16	-	0	AC 5.8	-1.6	-	-	+410	
V12 6SN7 Horiz. Amp.	-19	-19	+2	+19	+130	+1.2	AC 5.4	0		
V13 6SN7 Horiz. Osc.	-52	+200	0	-19	+55	-8	AC 5.4	0		
V14 6CD6 Horiz.Output	-	0	+21	-2.8	-2.8	+200	AC 5.8	+140		
V15 6W4 Damper	-	-	+500	+350	+350	+350	+500	+500		
V16 1B3										
V17 1B3										12KV
V18 6BA6 1st Sound I.F.	-4.2	0	0	AC 5.6	+220	+180	+.2			
V19 6AU6 Driver	0	0	0	AC 5.6	+94	+115	+1.2			
V20 6AL5 Ratio Det.	+22	-25	AC 5.6	0	-.7	0	+1.2			
V21 6SQ7 1st Audio	0	-.5	0	0	0	+86	AC 5.6	0		
V22 6K6 Audio Output	0	AC 5.6	+260	+265	0	+230	0	+18		
V23 6X4	-22	-	AC 5.8	0	-	-22	+280			
V24 5U4 Rectifier	-	+380	-	AC 390	-	AC 390	-	+380		

Service Switch Position	Line	B+ at C98A	B+ at C98B	B+ at C99A	B+ at C99B	WATTS
TV	117V	290	275	380	350	245
FM	117V	310	295	365	355	145
PHONO	117V	310	295	365	355	145

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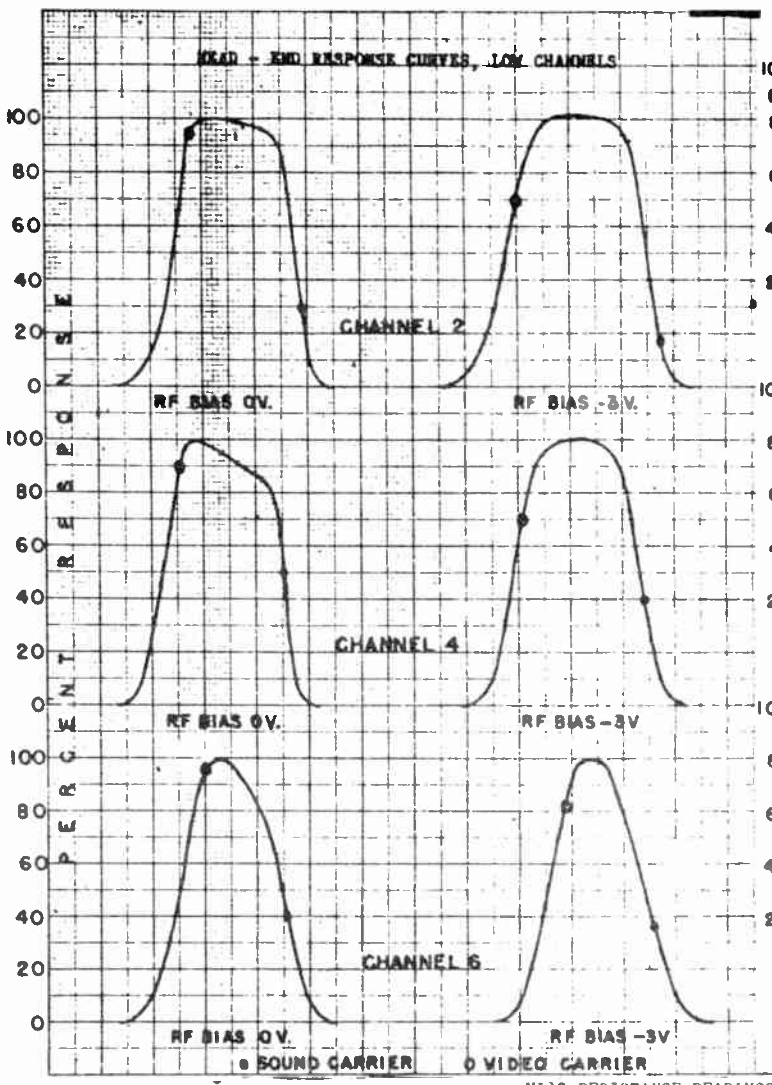

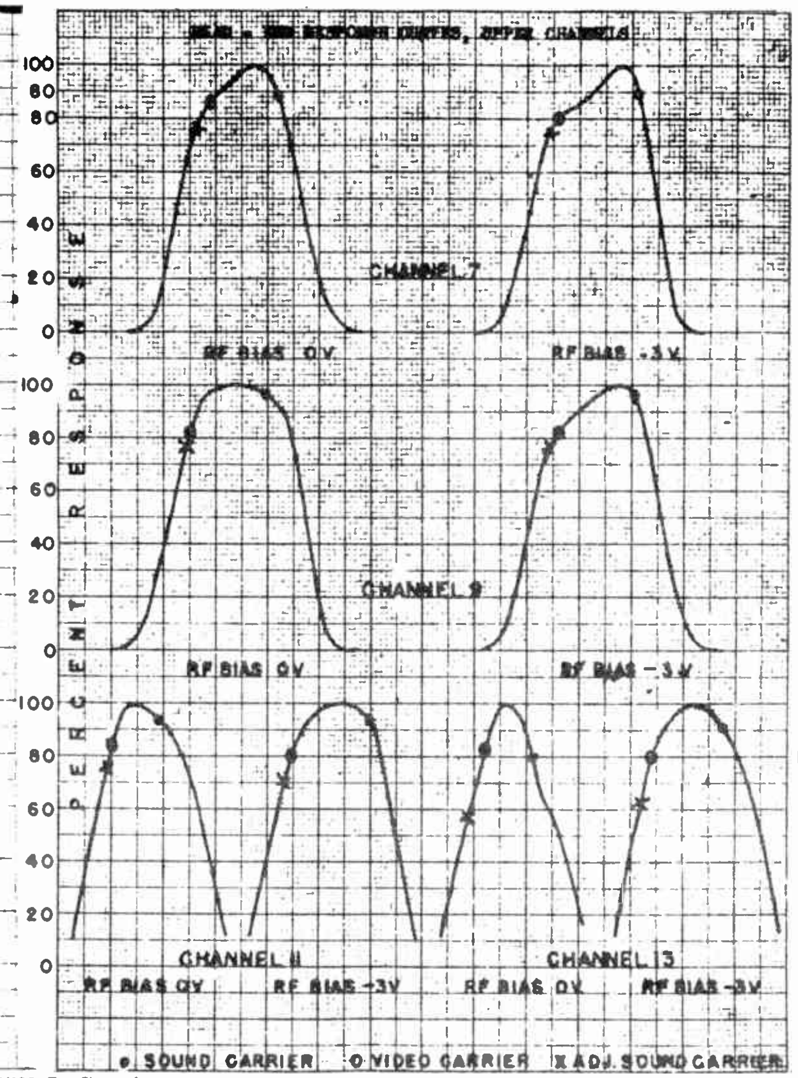

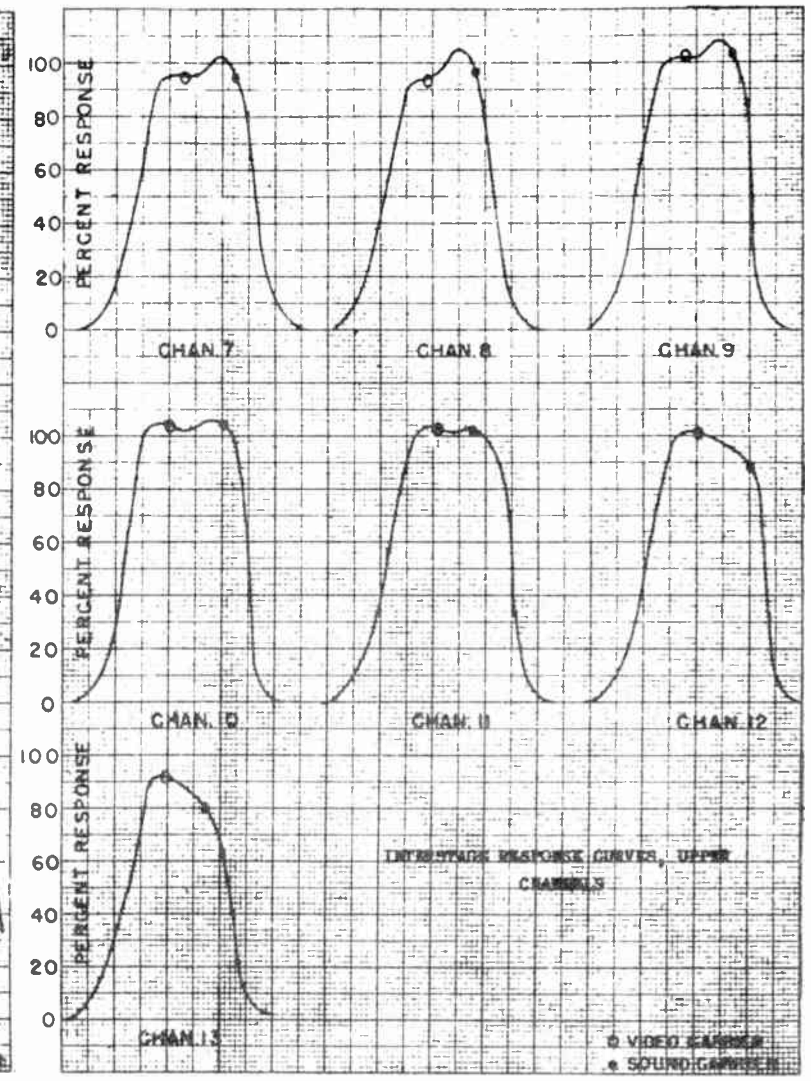

VL12 RESISTANCE READINGS To Chassis

Tube	Pin No.	1	2	3	4	5	6	7	8	9	Cap
V1	6CB6 R.F.	35K	47	h	H	30K	28K	0			
V2	6AB4 Oscillator	45K	0	H	H	-	12K	0			
V3	6AK5 Mixer	100K	470	H	H	40K	40K	470			
V4	6CB6 1st Video IF	110K	47	H	H	32K	30K	0			
V5	6CB6 2nd Video IF	100K	47	H	H	35K	35K	0			
V6	6CB6 3rd Video IF	15K	100	H	h	35K	75K	0			
V7	6AL5 Video Detector	0	4.7K	H	H	0	0	34K			
V8	6AU6 1st Video	450K	0	H	H	30K	24K	0			
V9	12AU7	26K	500K	100	H	H	47K	0	330K	H	
V10	6SN7GT Inter Sync Seperator Vert.Osc.	330K	50K	0	970K	800K	0	H	H		
V11	6S4 Vertical Output	-	19K	-	H	H	1 Meg	0	0	30K	
V12	6SN7GT Horiz. Amplifier	2.2 Meg	2.2 Meg	6.8K	2.2 Meg	18K	4.7K	h	H		
V13	6SN7GT Horiz.Osc. & Control	240M	100K	0	900K	50K	300K	H	H		
V14	6CD6G Horizontal Output	-	0	100	1 M	1 M	-	H	70K		40K
V15	6W4	-	-	40K	-	24K	-	40K	40K		
V16	1B3G High Volt. Rectifier										40K
V17	6BA6 1st sound	220K	0	H	H	25K	60K	82			
V18	6AU6 Driver	.2	0	H	H	40K	40K	150			
V19	6AL5 Ratio Detector	15K	16K	H	H	400K	0	400K			
V20	6SQ7 1st Audio	0	4.7M	0	0	0	400K	H	H		
V21	6K6GT Audio Output	0	H	23K	25K	680K	95K	H	680		
V22	5U4G Low Volt Rectifier	-	24K H	-	70	-	70	-	24K H		

VL-16 RESI TANCE READINGS TAKEN FROM TUBE PIN TO CHASSIS

Tube	Pin No.	1	2	3	4	5	6	7	8	9	Cap
V1	6CB6 R.F.	40K	47	H	H	35K	30K	0			
V2	6AB4 Oscillator	45K	0	H	H	0	12K	0			
V3	6AK5 Mixer	100K	500	H	H	45K	40K	470			
V4	6CB6 1st I.F.	110K	47	H	H	35K	35K	0			
V5	6CB6 2nd I.F.	100K	47	H	H	35K	35K	0			
V6	6CB6 3rd I.F.	16K	100	H	H	35K	70K	0			
V7	6AL5 Video Det. Delay Diode	0	5K	H	H	0	0	37K			
V8	6AU6 1st Video	500K	0	H	H	30K	24K	0			
V9	12AU7 Video Output D.C.Reinserter	27K	500K	0	H	H	45K	0	350K	0	
V10	6SN7 Inter Sync. Separator Vert. Osc.	350K	50K	0	800K	900K	0	H	H		
V11	6S4 Vert. Output	-	7K	-	H	H	1 Meg	-	-	60K	
V12	6SN7 Horiz.Amp.	2 Meg	2 Meg	7K	2 Meg	18K	4.5K	H	H		
V13	6SN7 Horiz. Osc.	260K	100K	0	900K	35K	300K	H	H		
V14	6CD6 Horiz.Output	-	H	180	500K	500K	100K	H	600K		600K
V15	6W4 Damper	-	-	600K	24K	24K		1 Meg	1 Meg		
V16	1B3										500K
V17	1B3										
V18	6BA6 1st Sound I.F.	220K	0	H	H	26K	70K	82			
V19	6AU6 Driver	.1	0	H	H	35K	35K	150			
V20	6AL5 Radio Det.	15K	16K	H	H	600K	0	600K			
V21	6SQ7 1st Audio	0	4.2Meg	0	0	0	400K	H	H		
V22	6K6 Audio Output	0	H	10K	9K	600K	70K	0	680		
V23	6X4	50	-	H	0	-	50	9K			
V24	5U4 Low Voltage Rectifier	-	24K	-	50	-	50	-	24K		

MODELS T-VL12, Ch. VL12; T-VL16, C-VL16, CO-VL16, Ch. VL16; CO-VL19, Ch. VL19

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**VL-19 VOLTAGE READINGS
TAKEN WITH VOLTOHMYST**

TUBE PIN NO.	1	2	3	4	5	6	Set Contrast Control Fully clockwise 7	8	9	CAP
V1-6CBC R.F.	-3.2	+.2	0	A.C. 5	+140	+80	0			
V2-6J6 OSC.	+90	0	AC 5.6	0	+105	+105	+1.4			
V3-6AK5 Mixer	0	+2.5	A.C. 5.6	0	+200	+200	0			
V4-6CB6 (1st Video (I.F.	-8.5	+.2	0	A.C. 5.6	+200	+200	0			
V5-6CB6 (2nd Video (I.F.	-8.5	0	0	A.C. 5.6	+210	+215	0			
V6-6CB6 (3rd Video (I.F.	0	+1.3	A.C. 5.4	0	+105	+100	0			
V7-6AL5 (Video Det. (Delay Diode	0	-1.2	A.C. 5.6	0	-1.1	0	-2.8			
V8-6AU6 (1st Video	-1.3	0	A.C. 5.4	0	+140	+135	0			
V9-6A46 (A.G.C.	+125	+130	A.C. 5.4	0	-16	+255	+130			
V10-12AU7 (Video out (DC Restorer	+235	-7	+.1	A.C. 5.4	A.C. 5.4	+6	0	+33	0	
V11-6SN7 (Sync. Sep. (Vert. Osc.	-1	+85	0	-26	+35	0	0	A.C. 5.4		
V21-6S4 (Vertical (Output	NC	+20	NC	0	A.C 5.8	0	NC	NC	+390	
V13-6SN7 (Horiz. (Amp.	-18	-18	+22	-18	+140	+.7	A.C 5.4	0		
V14-6SN7 (Horiz.Osc. (Control	-64	+190	0	-20	+95	-14	A.C 5.4	0		
V15-CD6 (Horiz. (Output	NC	0	+24	-2.3	-4.4	+195	A.C 5.8	+160		
V16-6W4 (Damper	NC	NC	+470	+350	+350	NC	+470			
V17-1B3										
V18-1B3										13.5Kv
V19-6BA6 (1st Sound (I.F.	-1.5	0	0	A.C 5.6	+195	+120	+.8			
V20-6AU6 (Driver	0	0	0	A.C. 5.6	+120	+120	+1.1			
V21-6AL5 (Ratio (Det.	+1.2	-1.4	A.C 5.6	0	0	0	.1			
V22-6BE6 (A.M. (Modulator	-6.2	0	0	A.C. 5.8	+170	+80	-1.9			
V23-6BA6 (A.M I.F (Amp.	-1.9	0	A.C. 5.8	0	+180	+100	+.6			
V24-6SQ7 (A.M. 2nd (Det; A.V.C.	0	0	0	-1.1	-1.1	0	0	A.C. 5.8		
V25-6SQ7 (1st (Audio	0	-.7	0	0	0	+90	A.C. 5.6	0		
V26-6K6 (Audio (Output	0	A.C. 5.6	+250	+260	+.1	+240	0	+20		
V27-6X4 (Rectifier	A.C. 270	NC	A.C. 5.8	0	NC	A.C. 270	+280			
V28-5U4 (Rectifier	NC	+375	NC	A.C. 380	NC	A.C. 380	NC	+375		

Service Switch Position	Line	B+at C115A	B+at C115B	B+ at C116A	B+at C116B	Watts
TV	117V	280V	260V	350V	370V	250
FM	117V	290V	275V	345V	350V	150
AM	117V	290V	275V	330V	340V	170
PHONO	117V	290V	275V	340V	350V	170

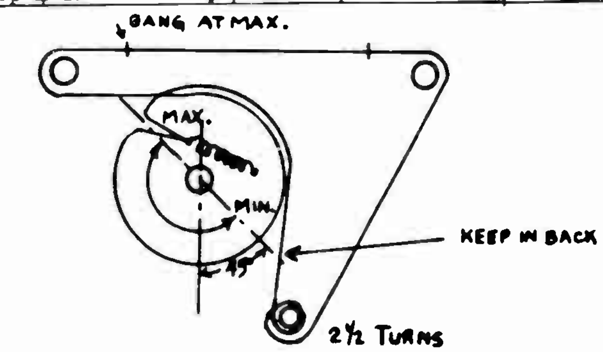
VL 19 CHASSIS---A.M. ALIGNMENT

Oscillator shunt trimmer is located on chassis beside gang condenser.

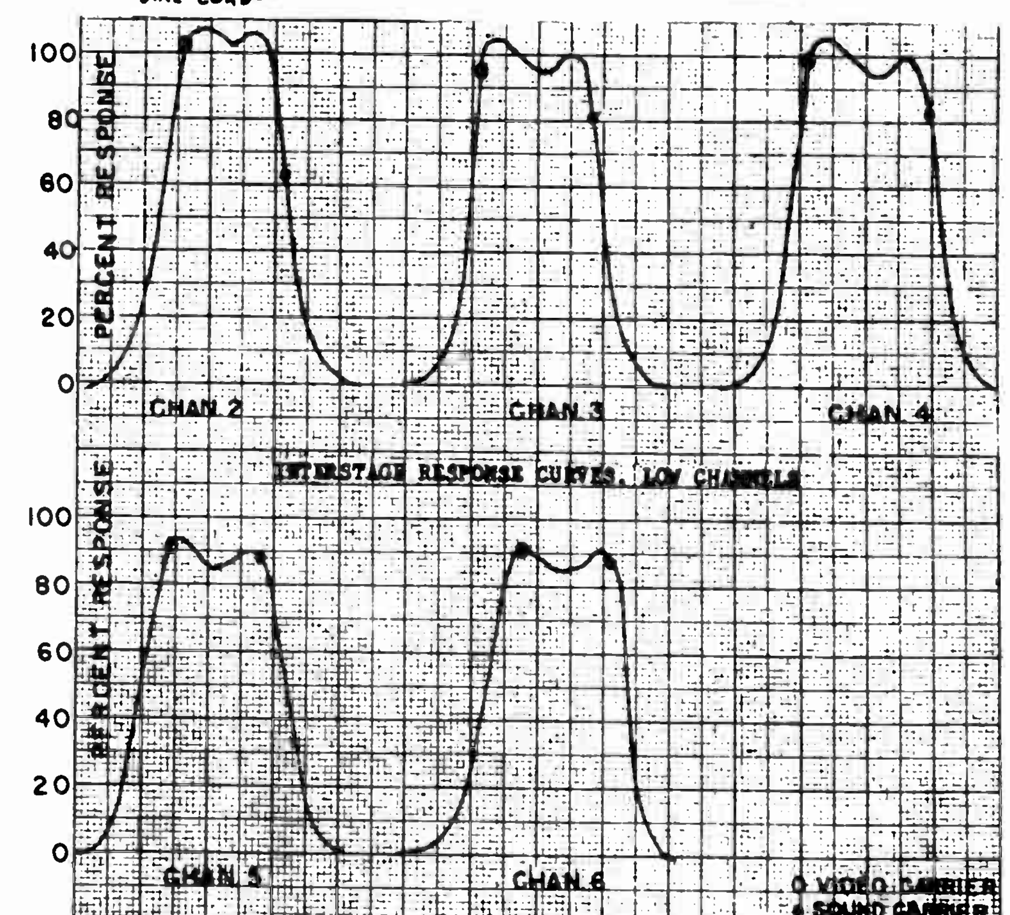
Oscillator series padder is located on chassis to the rear of service switch.

A signal generator that supplies a modulated carrier of 455, 600, 1500 and 1650KC is needed plus an output voltmeter.

Step	Connect high side of signal generator to:	tune signal gen.to	tune radio to	Adjust for max. output
1	Grid of 6BE6 through .01 cond.	455KC	quiet spot near 700KC	trimmers on 1st & 2nd I.F.T.
2	Terminal "A" on loop through 250 uuf cond.	1650KC	extreme rt. end of dial	oscillator shunt trimmer
3	Terminal "A" on loop through 240 uuf cond.	1500KC	tune in 1500KC sig.	trimmer on loop.
4	Terminal "A" on loop through 250 uuf cond.	600KC	rock in 600KC sign.	oscillator series trimmer
5	Repeat steps 2 & 3			
6	Repeat step 4 if necessary			



AM DIAL CORD ASSEMBLY



INTERSTAGE RESPONSE CURVES. LOW CHANNELS

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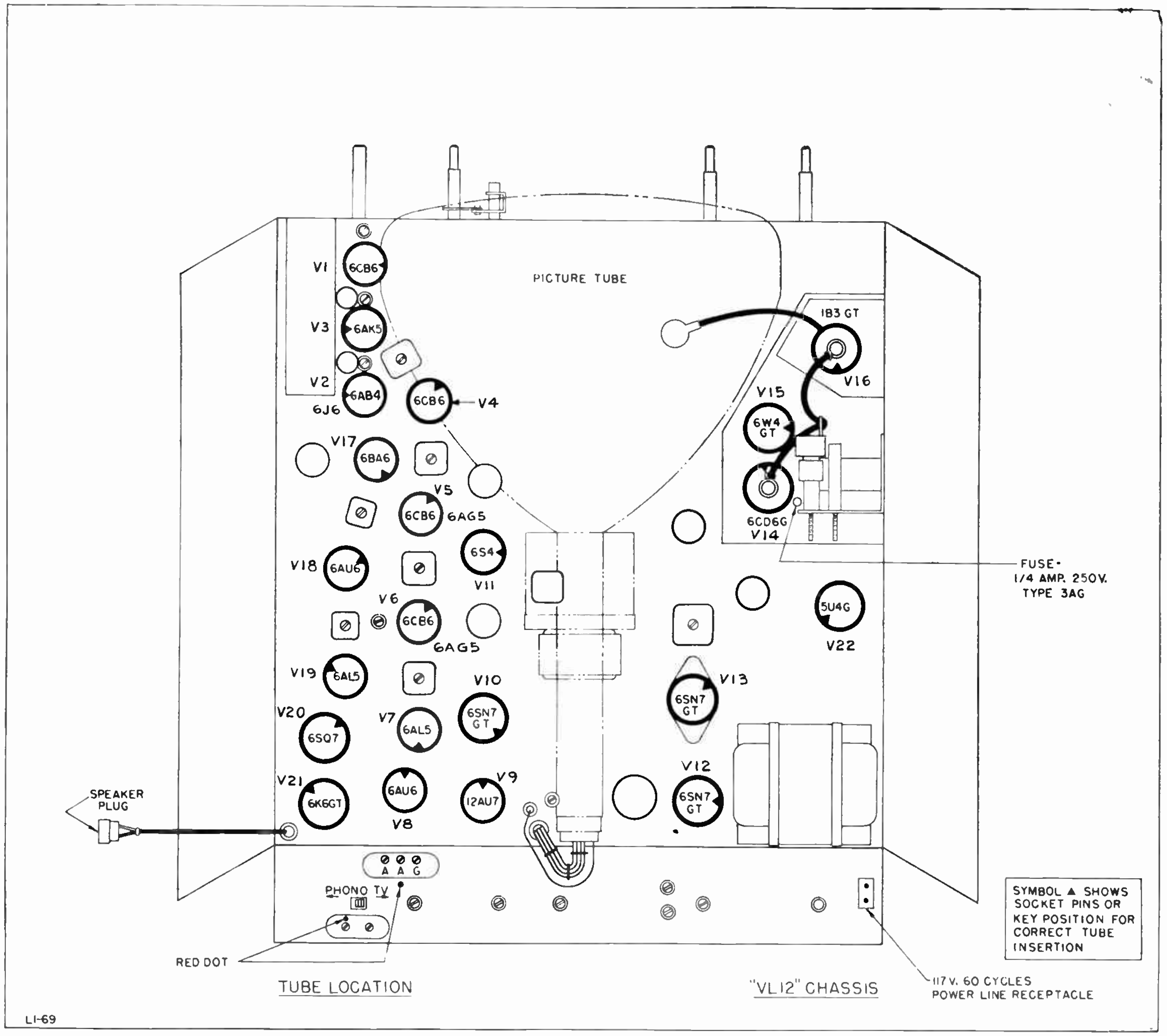
V 1	6CB6	R. F.
V 2	6J6 or 6AB4	Oscillator
V 3	6AK5	Mixer
V 4	6CB6	1st Video I. F.
V 5	6CB6 or 6AG5	2nd Video I.F.
V 6	6CB6 or 6AG5	3rd Video I. F.
V 7	6AL5	Video Detector
V 8	6AU6	1st Video
V 9	12AU7	D.C. Restorer -- Video Output
V 10	6SN7GT	Vertical Oscillator
V 11	6S4	Vertical Output
V 12	6SN7GT	Horiz. Amplifier
V 13	6SN7GT	Horiz. Osc. & Control
V 14	6CD6G	Horiz. Output
V 15	6W4	Damper
V 16	1B3	High Voltage Rectifier
V 17	6BA6	1st Sound I. F.
V 18	6AU6	Driver
V 19	6AL5	Ratio Detector
V 20	6SQ7	1st Audio Amplifier
V 21	6K6GT	Audio Output
V 22	5U4G	Low Voltage Rectifier



ANDREA TV PAGE 6-5

MODEL T-VL12,
Ch. VL12, Saybrook

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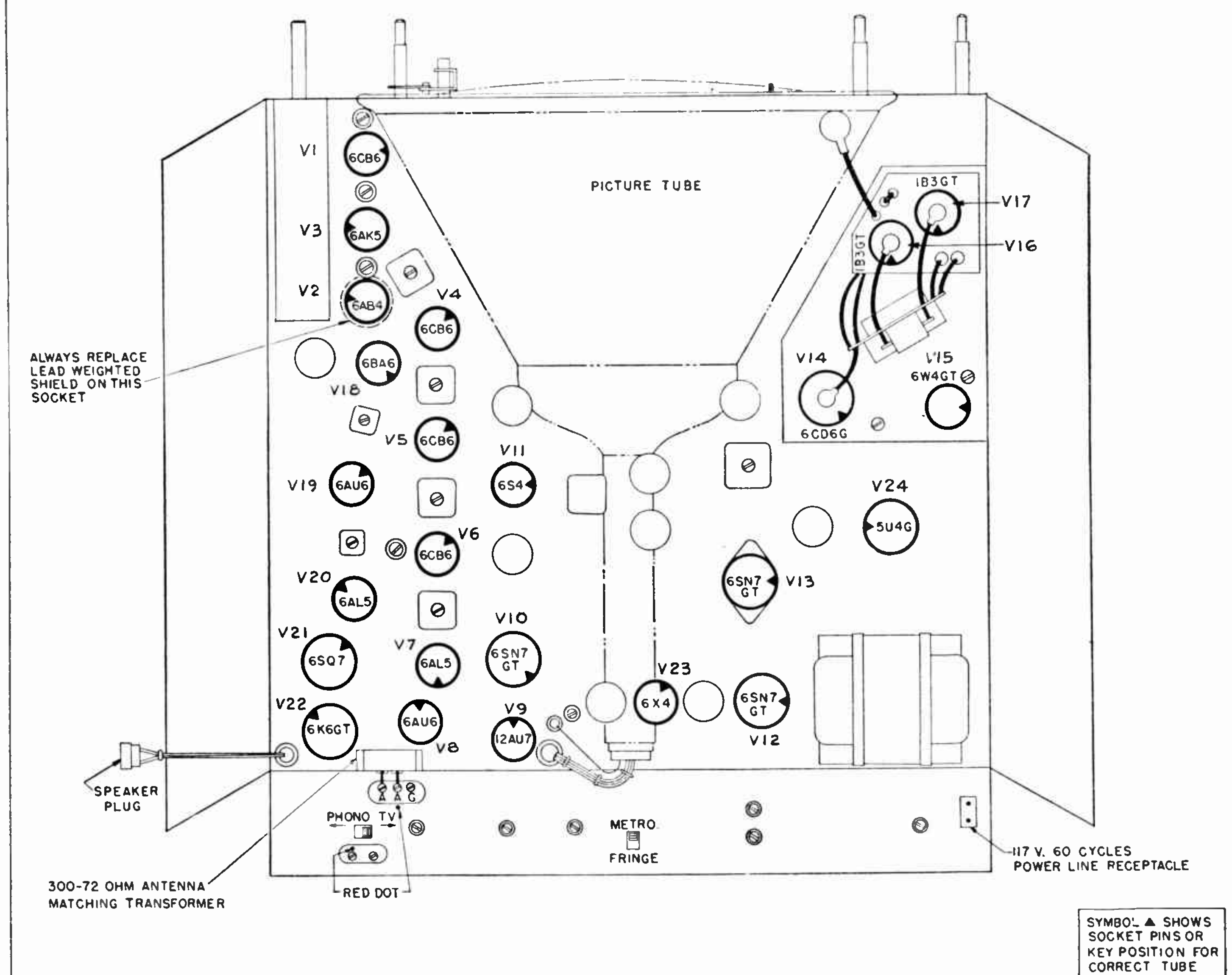
V 1	6CB6	R.F.
V 2	6J6 or 6AF4	Oscillator
V 3	6AK5	Mixer
V 4	6CB6	1st Video I. F.
V 5	6CB6 or 6AG5	2nd Video I. F.
V 6	6CB6 or 6AG5	3rd Video I. F.
V 7	6AL5	Video Det.--Delay Diode
V 8	6AU6	1st Video
V 9	12AU7	Video Output --D. C. Reinserter
V 10	6SN7GT	Sync.Separator--Vertical Osc.
V 11	6S4	Vertical Output
V 12	6SN7GT	Horiz. Amp.
V 13	6SN7GT	Horiz. Osc.
V 14	6CD6G	Horiz. Output
V 15	6W4	Damper
V 16	1B3	High Voltage Rectifier
V 17	1B3	High Voltage Rectifier
V 18	6BA6	1st Sound I. F.
V 19	6AU6	Driver
V 20	6AL5	Ratio Det.
V 21	6SQ7	1st Audio
V 22	6K6GT	Audio Output
V 23	6X4	Low Voltage Rectifier
V 24	5U4G	Low Voltage Rectifier



TUBE LOCATION "VL 16" CHASSIS

LATE MODELS CONTAIN ADDITIONAL 6AU6 A.G.C. TUBE SIMILAR TO MODEL VL-19 CHASSIS.

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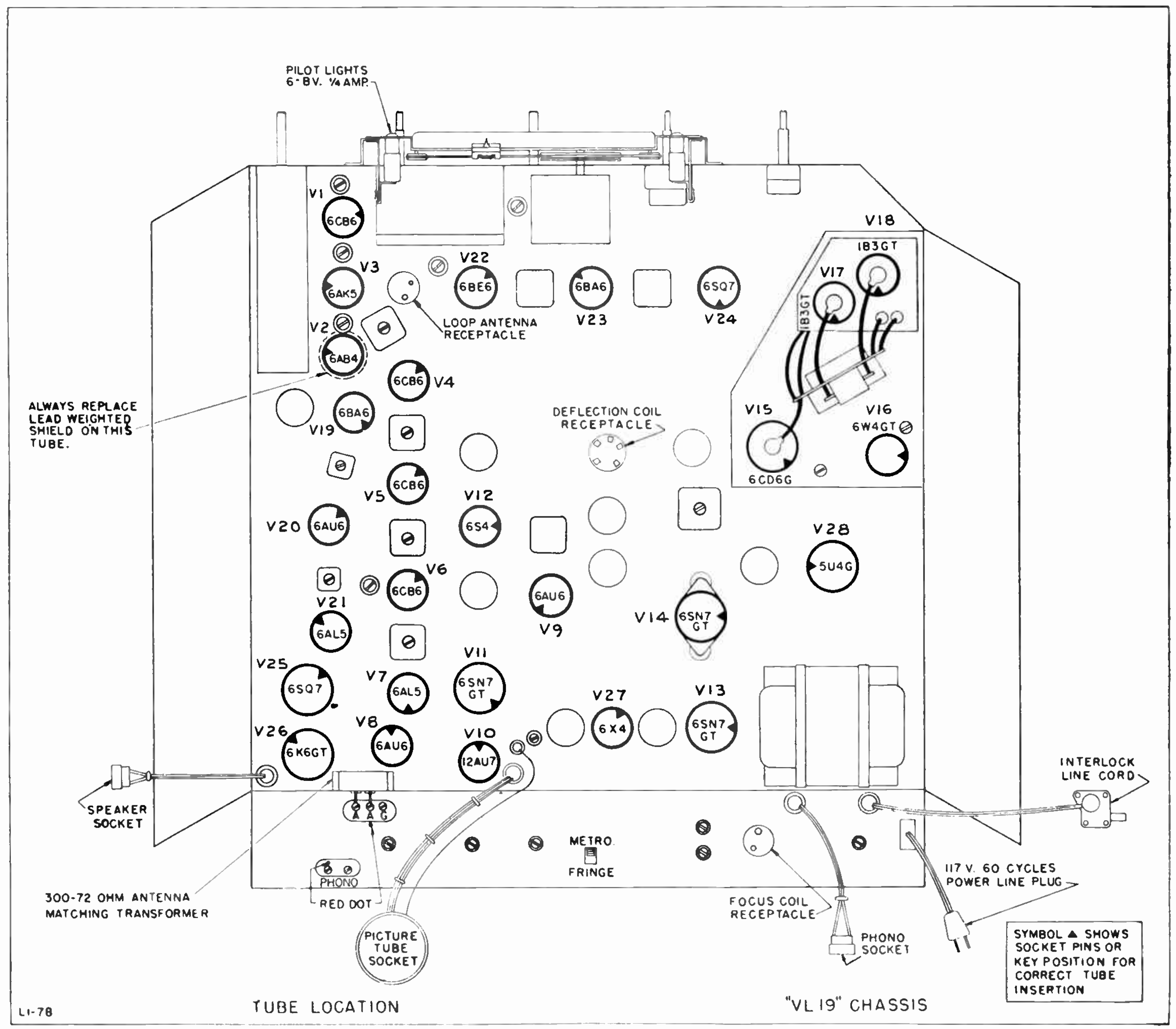
V 1	6CB6	R. F.
V 2	6J6 or 6AB4	Osc.
V 3	6AK5	Mixer
V 4	6CB6	1st Video I. F.
V 5	6CB6 or 6AG5	2nd Video I. F.
V 6	6CB6 or 6AG5	3rd Video I. F.
V 7	6AL5	Video Det--Delay Diode
V 8	6AU6	1st Video
V 9	6AU6	A. G. C.
V 10	12AU7	Video Output--D C Restorer
V 11	6SN7GT	Sync. Separator--Vert.Osc.
V 12	6S4	Vertical Output
V 13	6SN7GT	Horiz. Amplifier
V 14	6SN7GT	Horiz. Osc.--Control
V 15	6CD6G	Horiz. Output
V 16	6W4	Damper
V 17	1B3G	High Voltage Rectifier
V 18	1B3G	High Voltage Rectifier
V 19	6BA6	1st Sound I. F.
V 20	6AU6	Driver
V 21	6AL5	Ratio Detector
V 22	6BE6	A. M. Modulator
V 23	6BA6	A. M. I. F. Amplifier
V 24	6SQ7	A. M. 2nd Det. A V C
V 25	6SQ7	1st Audio
V 26	6K6GT	Audio Output
V 27	6X4	Low Voltage Rectifier
V 28	5U4G	Low Voltage Rectifier



MODEL CO-VL19,
Caronia, Ch. VL19

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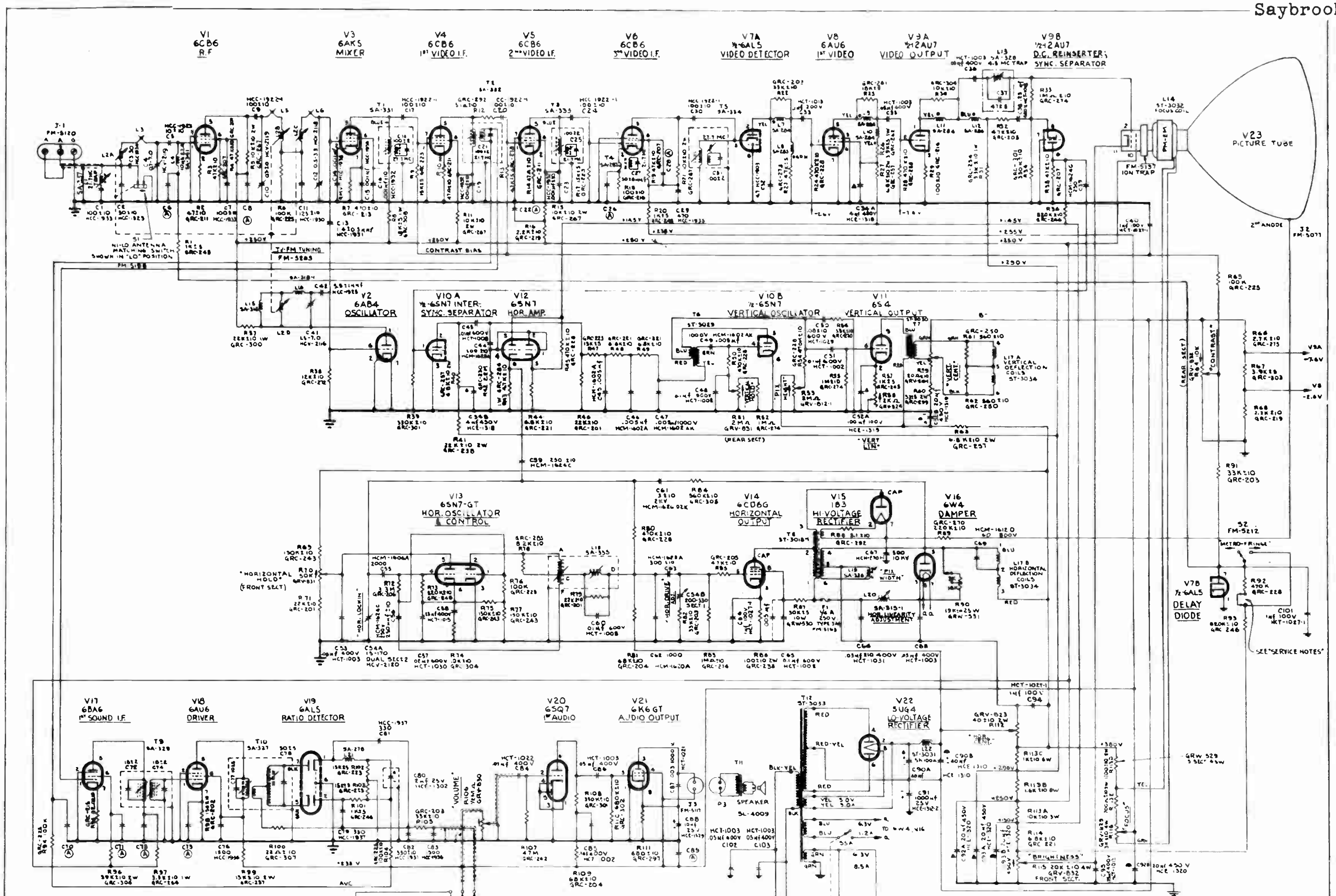
World Radio History

MODEL T-VL12, Saybrook, Ch. VL12



NOTE

TOLERANCES. ALL TOLERANCES ARE IN PERCENT UNLESS OTHERWISE SPECIFIED.

ARROWS ARROWS ALONGSIDE OF CONTROLS INDICATE CLOCKWISE ROTATION.

RESISTORS ALL RESISTORS ARE ±20%, ½ WATT, UNLESS OTHERWISE SPECIFIED. K=1000; M=1,000,000.

CAPACITORS ALL CAPACITORS ARE IN μμf ±20%, 500V UNLESS OTHERWISE SPECIFIED. SUFFIXES TO MICA CAPACITOR PART NO'S. (PREFIX: HCM-) HAVE THE FOLLOWING DESIGNATIONS: THE FIRST LETTER, SUCH AS A, B, C, D, OR E, IS A CLASS RATING DENOTING CAPACITANCE STABILITY DUE TO CHANGES IN TEMPERATURE OR TIME (AGEING). THE SECOND LETTER, SUCH AS K OR 2K, IS A VOLTAGE RATING. K=1000V, 2K=2000 V, NO LETTER = 500 V (UNDERSTOOD).

(A) 5000 μμf GMV (GUARANTEED MINIMUM VALUE) HCC-1926 C-6, 8, 22, 26, 28, 70, 71, 73, 75, 89, 96, 97, 98, 99, 100,

ST-3032 COMBINATION PM-EM MAGNET FOR USE WITH 12QP4, 12QP4A ONLY.

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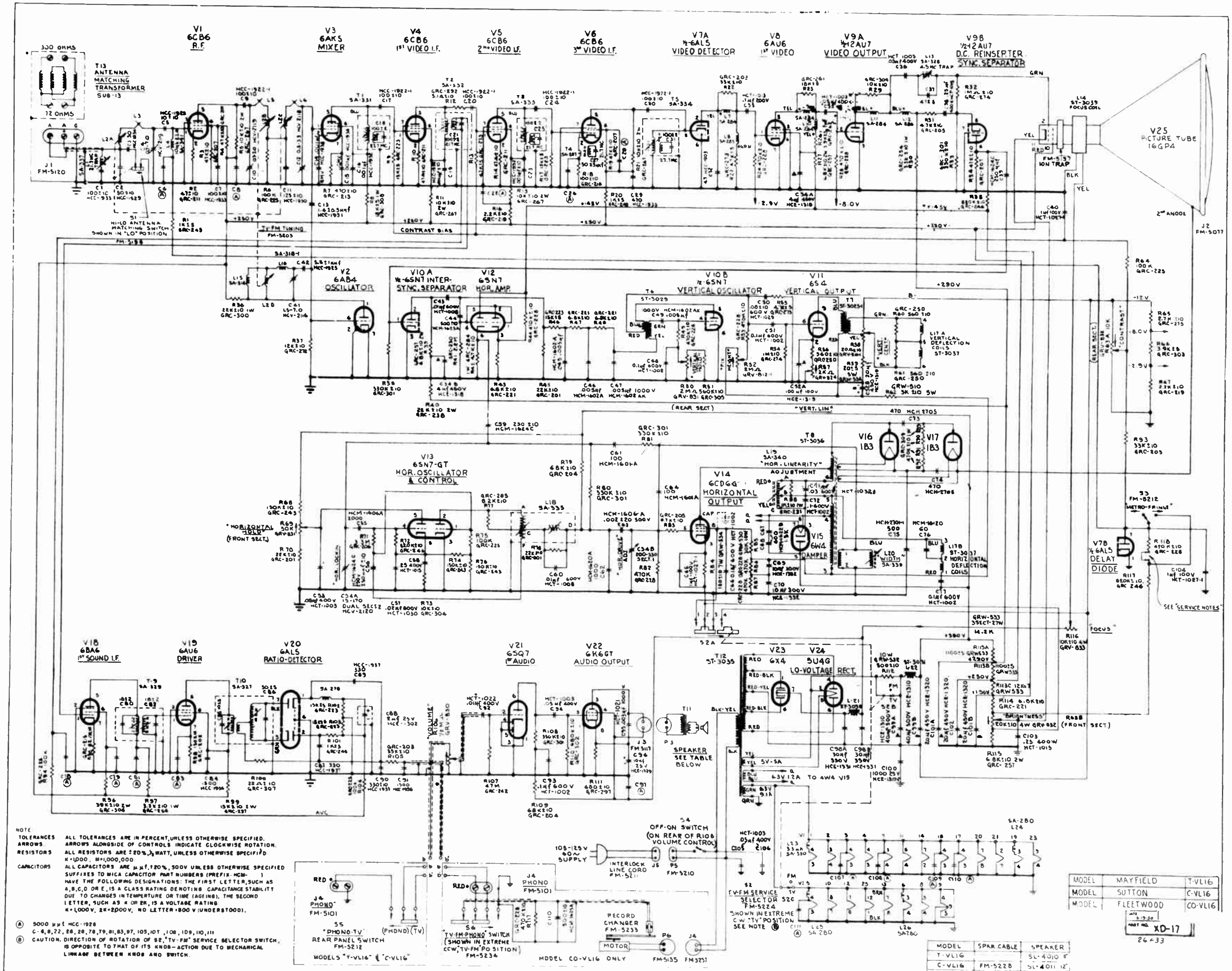

NOTE

TOLERANCES ALL TOLERANCES ARE IN PERCENT, UNLESS OTHERWISE SPECIFIED.
ARROWS ARROWS ALONGSIDE OF CONTROLS INDICATE CLOCKWISE ROTATION.
RESISTORS ALL RESISTORS ARE ±20%, ½ WATT, UNLESS OTHERWISE SPECIFIED K=1,000, M=1,000,000
CAPACITORS ALL CAPACITORS ARE μμf, ±20%, 500V UNLESS OTHERWISE SPECIFIED SUFFIXES TO MICA CAPACITOR PART NUMBERS (PREFIX-HCM-) HAVE THE FOLLOWING DESIGNATIONS: THE FIRST LETTER, SUCH AS A, B, C, D OR E, IS A CLASS RATING DENOTING CAPACITANCE STABILITY DUE TO CHANGES IN TEMPERATURE OR TIME (AGEING). THE SECOND LETTER, SUCH AS K OR 2K, IS A VOLTAGE RATING K=1,000V, 2K=2000V, NO LETTER=500 V (UNDERSTOOD).

(A) 5000 μμf HCC-1928
C-6, 8, 22, 26, 28, 78, 79, 81, 83, 97, 105, 107, 108, 109, 110, 111

(B) CAUTION. DIRECTION OF ROTATION OF S2, "TV-FM" SERVICE SELECTOR SWITCH, IS OPPOSITE TO THAT OF ITS KNOB—ACTION DUE TO MECHANICAL LINKAGE BETWEEN KNOB AND SWITCH.

MODEL	SPKR CABLE	SPEAKER
T-VL16		SL-4010 8"
C-VL16	FM-5228	SL-4011 12"
CO-VL16	FM 5165	SL-4012 10"

MODEL	MAYFIELD	T-VL16
MODEL	SUTTON	C-VL16
MODEL	FLEETWOOD	CO-VL16

DATE 6-19-50
PART NO. XD-17
26-33

MODELS T-VL16, C-VL16,
CO-VL16, Ch. VL16

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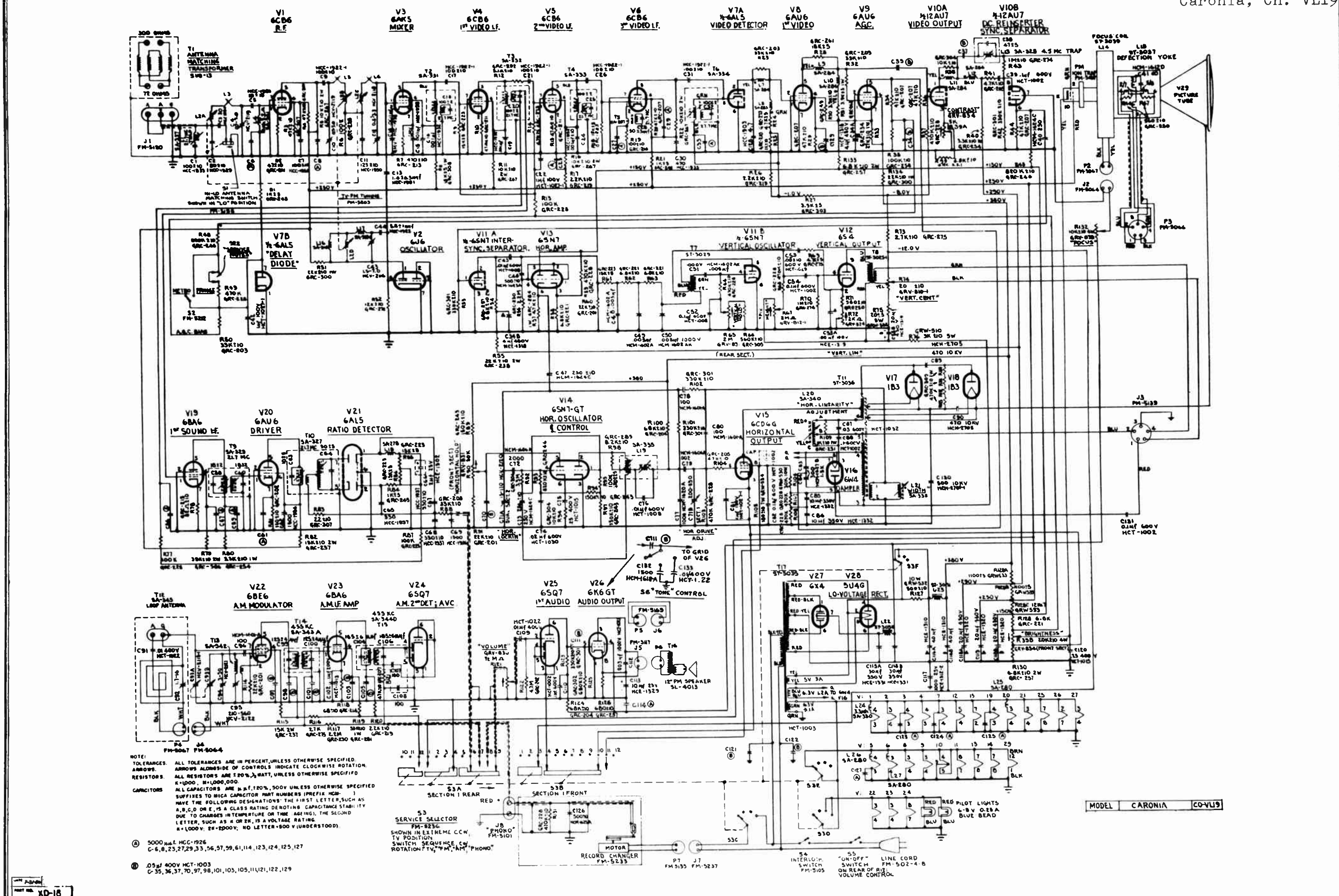
MODEL CO-VL19,
Caronia, Ch. VL19



NOTE:

TOLERANCES. ALL TOLERANCES ARE IN PERCENT, UNLESS OTHERWISE SPECIFIED.
ARROWS. ARROWS ALONGSIDE OF CONTROLS INDICATE CLOCKWISE ROTATION.
RESISTORS. ALL RESISTORS ARE ±20%, ½ WATT, UNLESS OTHERWISE SPECIFIED. K=1000, M=1,000,000.
CAPACITORS. ALL CAPACITORS ARE μμf. ±20%, 500V UNLESS OTHERWISE SPECIFIED. SUFFIXES TO MICA CAPACITOR PART NUMBERS (PREFIX HCM-) HAVE THE FOLLOWING DESIGNATIONS: THE FIRST LETTER, SUCH AS A,B,C,D OR E, IS A CLASS RATING DENOTING CAPACITANCE STABILITY DUE TO CHANGES IN TEMPERATURE OR TIME (AGEING). THE SECOND LETTER, SUCH AS K OR 2K, IS A VOLTAGE RATING. K=1,000V; 2K=2000V; NO LETTER=500 V (UNDERSTOOD).

(A) 5000 μμf. HCC-1926
C-6,8,23,27,29,33,56,57,59,61,114,123,124,125,127

(B) .05μf 400V HCT-1003
C-35,36,37,70,97,98,101,103,105,111,121,122,129

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World Radio History

INDEX

TUBE COMPLEMENT

V22	R-f Amplifier	6AG5	V13A	AGC Rectifier	6SN7GT
V23	R-f Oscillator	6AB4	V13B	1st Sync Separator	
V24	Converter	6AG5	V14A	Sync Amplifier	6SN7GT
V1	1st Sound I-f Amplifier	6AU6	V14B	2nd Sync Separator	
V2	2nd Sound I-f Amplifier	6AU6	V15	Vertical Sweep Output	6K6GT
V3	Sound Discriminator	6AL5	V16A	Horizontal Sweep Control	6SN7GT
V4	1st Audio Amplifier	6AV6	V16B	Horizontal Sweep Oscillator	
V5	Audio Output	6K6GT	V17	Horizontal Sweep Output	6BG6G
V6	1st Picture I-f Amplifier	6AG5	V18	Hi-Voltage Rectifier	1B3GT/8016
V7	2nd Picture I-f Amplifier	6AG5	V19	Damper	6W4GT
V8	3rd Picture I-f Amplifier	6AG5	V20	Power Supply Rectifier	5U4G
V9	4th Picture I-f Amplifier	6AG5	V21	Picture Tube (10 in.)	10BP4
V10B	Video Detector	6AL5	V21	Picture Tube (12 ½ in.)	12LP4
V10A	Sync Limiter		V21	Picture Tube (16 in.)	16AP4
V11A	1st Video Amplifier	12AU7	V25	Power Supply Rectifier (16 in. only)	5U4G
V11B	2nd Video Amplifier				
V12A	AGC Amplifier	6SN7GT	V26	Hi-Voltage Rectifier (16 in. only)	1B3GT/8016
V12B	Vertical Sweep Oscillator				

SPECIFICATIONS

Power Supply Rating (10 in. - 12 ½ in.)	115 volts, 60 cycles, 225 watts
Power Supply Rating (16 in.)	115 volts, 60 cycles, 250 watts
Audio Power Rating Max. (10 in. - 12 ½ in.)	2.5 watts
Audio Power Rating Max. (16in.)	4.0 watts
Antenna Input Impedance	300 ohms balanced
Video Response	To 4 Mc.
Focus	Magnetic
Sweep Deflection	Magnetic

I. F. Frequencies

Picture Carrier	25.75 Mc.
Adjacent Channel Sound Traps	27.25 Mc.
Adjacent Channel Picture Carrier Traps	19.75 Mc.
Accompanying Sound Traps	21.25 Mc.
Sound Carrier	21.25 Mc.
Sound Discriminator Band Width Between Peaks	350 Kc.

The ARVIN television receiver will in most cases be ready for installation when unpacked from its shipping carton. However, it is advisable to "air-check" the receiver before delivery and make any necessary final adjustments. A critical eye prior to and during installation will minimize service calls and promote a satisfied customer.

ADJUSTMENTS

ION-TRAP. Proper attention to ion-trap adjustment must be given to insure the normal long life and satisfactory operation of the picture tube. Assuming the ion-trap is off to the extent that no raster appears proceed as follows:

With an approximate mid-point setting of the brightness control and the rear pole of the ion-trap magnet positioned over the flags on the tube's gun structure rotate the trap. If no raster appears, slide the ion-trap slightly forward or backward and again rotate. Adjust the ion-trap finally for maximum brilliance with the brightness control set at the maximum position for which good line focus is had. If the ion-trap must be moved more than 1/4 inch away from the flags toward the focus coil, the ion-trap magnet is too weak and should be replaced.

Do not have the brightness control at maximum when positioning the ion-trap and do not use the ion-trap to remove side shadows if in so doing the brilliance of the raster decreases (adjust focus coil centering for this purpose.)

<u>SQUARING THE RASTER.</u> The Yoke Mount and Yoke should be positioned properly as follows:

The large front hole in the Yoke Mount Bracket is rimmed with rubber channel. Loosen the two screws in the feet of the Yoke Mount Bracket and push the mount forward so that the cone of the picture tube fits snugly into the rubber channel (neck of tube co-axially centered.) Loosen the top wing-nut and two side screws holding the Yoke within the bracket and slide the Yoke forward onto the cone of the picture tube-center the Yoke so the tube neck is co-axial and tighten the two side mounting screws. Rotate the Yoke to square the raster and tighten the top wing-nut.

<u>CENTERING.</u> No electrical provision in the circuit is made for centering. The focus coil must be positioned properly for centering of the picture. The focus coil of the 10 in. and 12 in. chassis is mounted by four adjustment screws. The focus coil of the 16 in. chassis is mounted by three adjustment screws. These screws must be properly adjusted for centering of the picture and removal of picture corner-clipping and side shadows.

<u>HEIGHT AND VERTICAL LINEARITY (Front).</u> The picture should fill the mask and be symmetrical from top to bottom. Adjustments of both the Height Control and Vertical Linearity Control will accomplish this if centering of picture by the focus coil is already proper.

<u>HORIZONTAL WIDTH, LINEARITY, AND HOLD.</u> If horizontal adjustments appear necessary, refer to the alignment section for procedure.

<u>FOCUS.</u> Adjust the Focus Control for best definition of the trace lines in the major central area of the picture or raster.

<u>AUTOMATIC GAIN THRESHOLD CONTROL (AGC).</u> The AGC Threshold Control is set at the factory and will seldom have to be readjusted. The effects of adjustment of this control are as follows:

1. Maximum counter-clockwise position allows the maximum AGC voltage to be developed. It will rarely ever have to be left in this position.

2. Advancing the control clock-wise slowly in a strong signal area will cause the blacks in the picture to get darker--advancing the control clockwise further will cause the picture to "bend" along the top--and even further, the picture in some cases could just blank out. At the point of rotation where the picture begins to bend is the overload point-- the bending being caused by sync-clipping in the video stage due to overdriving. On weaker signals the clockwise rotation will darken the blacks somewhat and also brighten the snow.

3. The optimum setting for the AGC Control is as follows:

a. Turn AGC Maximum counter-clockwise.

b. Turn AGC slowly clockwise while observing very closely the vertical interlace of the scanning lines in the raster.

c. Leave the AGC Control set at the point where interlace is best (least jitter and "pairing" between adjacent scanning lines).

d. Never should the control be left close to the overload point where strong signals could cause the picture to bend.

e. Approximately one-eighth of a turn clockwise is the usual best interlace point.

<u>OSCILLATOR TOUCH-UP.</u> All channels should come in best with the same approximate setting of the Fine Tuning Control.

If necessary, improvement of the setting on any channel can be made by slight adjustment of the oscillator screw for the particular channel. Remove the Station Selector Knob, Fine Tuning Knob, and Channel Escutcheon (slide the Escutcheon Spring to one side to free the Escutcheon). The numbered oscillator adjustment screws in the tuner can now be seen. Use an insulated screw driver and adjust the desired channel screw.

SERVICE TEST EQUIPMENT

<u>R-F SWEEP GENERATOR.</u>

To provide center Frequency Range--20 Mc. to 30 Mc. with 1 Mc. to 10 Mc. sweep width.

To provide center Frequency Range--50 Mc to 90 Mc.

To provide center Frequency Range--170 Mc. to 225 Mc.

Variable output-at least .1 volt maximum-flat sweep output all ranges.

<u>R-F SIGNAL GENERATOR.</u>

To provide frequencies from 19.75 Mc. to 27.25 Mc -55.25 Mc. to 87.75 Mc.--175.25 Mc. to 215.75 Mc.

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Variable Output and at least .1 volt maximum.

HETERODYNE FREQUENCY METER.

With crystal calibrator to check R-f Signal Generator.

CATHODE RAY OSCILLOSCOPE.

With wide band vertical deflection and means to calibrate input.

ELECTRONIC VOLT OHMMETER.

With multiplier probe for hi-voltage measurements to 10KV.

ALIGNMENT

It is very important that the proper condition of R-f ground for the test equipment with respect to the receiver be had before attempting alignment. To accomplish this place the receiver and test equipment on a conductive sheet of metal and bond or by-pass the equipment to it. Touching the test leads, test equipment, or receiver chassis should have no effect on the scope pattern or meter reading.

SEQUENCE FOR COMPLETE ALIGNMENT.

1. Sound discriminator.
2. Sound I-f.
3. Picture I-f Traps.
4. Picture I-f.
5. R-f oscillator.
6. R-f and converter.
7. 4.5 Mc. Video Trap.

SOUND DISCRIMINATOR.

1. Signal Generator setting--21.25 Mc.--.1 volt output--connect to pin 1 of V2, 2nd sound I-f.

2. Detune T102 secondary (bottom).

3. Connect voltohmyst through a 1 meg. resistor to the junction of R109, R108 (Test Point A).

4. Adjust primary T102 (top) for maximum meter reading.

5. Connect voltohymst to junction of C114 and R109 (pin 5, V3) (Test Point B).

6. Adjusting T102 (bottom) will vary meter reading from a plus voltage to minus voltage. Adjust for zero (point where it swings from plus to minus).

7. Connect sweep to pin 1 of V2, 2nd sound I-f, -sweep bandwidth approximately 1 mc. with center frequency of 21.25 mc.,-1 volt output.

8. Connect oscilloscope to pin 5 of V3 through 33,000 ohm isolating resistor. If pattern is not symetrical, adjust primary of T102 (top). See Fig. 1.

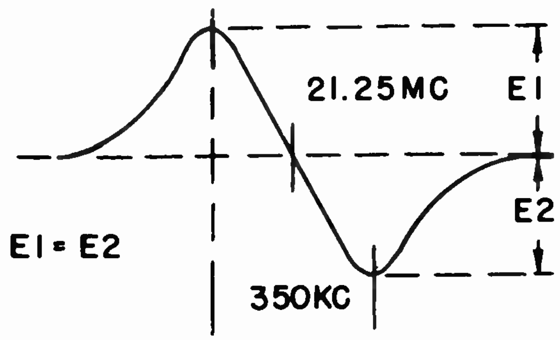

Figure 1

SOUND I-F. Switch Channel Selector to position 14 (kills oscillator).

1. Connect sweep to pin 1 of V1, 1st sound I-f. (Center frequency of 21.25 mc).

2. Connect oscilloscope to point A of T101 through a 33,000 ohm isolating resistor-(Test Point C). (If possible use sweep generator ex-ternal sweep for oscilloscope horizontal sweep).

3. Insert a 21.25 mc. marker from signal generator into pin 1 of V2. (It is best to couple the marker signal generator loosely--for instance, clipping the generator lead to a chassis point near pin 1 of V2).

4. Adjust top and bottom of T101 for maximum gain and symmetry around marker.

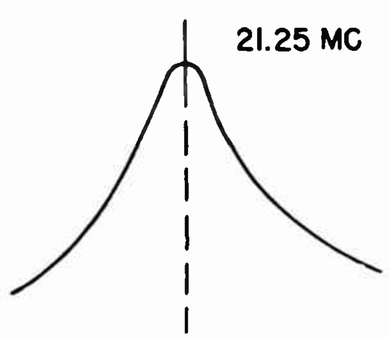

Figure 2

5. Final touch-up of curve should be with sweep input low enough so that the scope reading is not greater than .3 volt peak to peak or greater than .5 volt D-c.

PICTURE I-F TRAPS. Switch Channel Selector to position 14 (Kills oscillator).

1. Connect the voltohymst to junction of R155 and R156-(Test Point D).

2. Remove V12A, AGC Amplifier.

3. Connect a 250,000 ohm potentiometer between pins 5 and 6 of the V12A socket (Note-an old tube base with the 250,000 ohm pot soldered to its pin 5 and 6 is convenient since it can be plugged into the socket just like a tube.) (If the 250,000 ohm potentiometer isn't available, connect the minus terminal of a 4.5V battery to TEST POINT D and the plus terminal to ground).

4. Adjust potentiometer until meter reads (-4.5 volts).

5. Remove converter tube and twist one end of a small piece of wire around pin 1, the grid. Place tube back in socket and connect R-f generator to this wire clip through a small condenser (1500 MMFD).

6. Connect voltohmyst across R134, V10B load resistor (BETWEEN TEST POINTS E AND F). Since both meter leads are now at about minus 120 volts, do not ground meter case or touch it.

7. With a crystal calibrator check the generator setting for each of the following trap frequencies and then adjust each trap for minimum indication on meter:

21.25 mc. T106 (top)
21.25 mc. T108 (top)
27.25 mc. T105 (top)
27.25 mc. T107 (top)
19.75 mc. T104 (top)
19.75 mc. T109 (top)

The correct position of the cores is in the outside end of the form. The core can be run down through the coil for another dip, but in this position the coupling is wrong and overall response will be incorrect.

PICTURE I-F. Switch Channel Selector to position 14 (Kills oscillator).

1. Signal generator on converter grid as in trap adjustment.

2. Set generator to following and adjust transformers for peak reading on meter which is still across R134 (BETWEEN TEST POINTS E AND F).

22.65 mc.	T109 (bottom)	- - - output of V9,	4th Pix I-F
24.8 mc.	T107 (bottom)	- - - output of V8,	3rd Pix I-F
21.95 mc.	T106 (bottom)	- - - output of V7,	2nd Pix I-F
26.3 mc.	T105 (bottom)	- - - output of V6,	1st Pix I-F

3. Reduce input signal during alignment if overloading is indicated by very broad peak.

4. Overcoupled T1 and T104 (bottom) must be aligned by sweep.

5. Connect 330 ohm resistor (composition) across the primary coils of T105, T106, T107, T109.

6. Connect the oscilloscope to pin 1 of V11A, the 1st video amplifier plate, through 33,000 ohm isolating resistor (TEST POINT G).

7. Connect voltohmyst to the junction of R155 and R156 (TEST POINT D), and adjust the potentiometer (step 3 of trap adjustments) to minus 2 volts.

8. Connect a sweep generator (set to sweep from 20 mc. to 30 mc.) to the converter grid, through a 1500 MMFD condenser.

9. Adjust T1 and T104 for the following response:

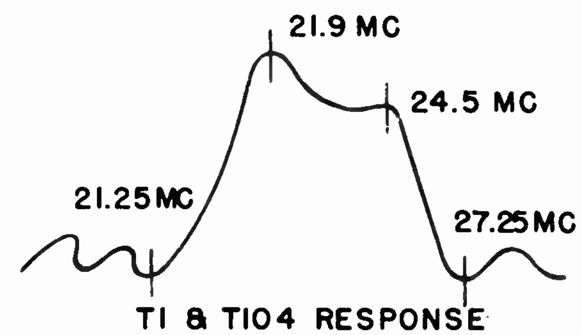

Figure 3

10. Remove the 330 ohm resistors.

11. It will be necessary to touch up the I-f adjustments to get the shown over-all response (Fig. 4).

NOTE: A defective V10B will cause a bad dip in the curve.

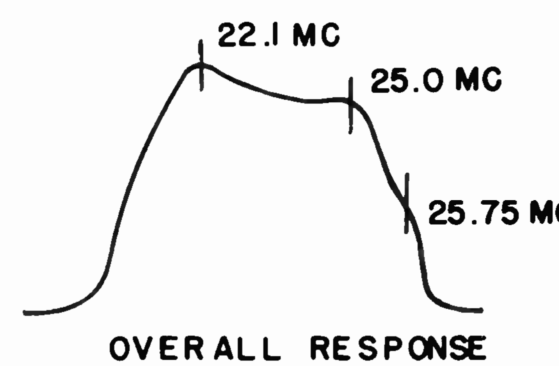

Figure 4

12. Adjust the bias pot for a 15 volt peak to peak signal on the scope (pin 1 of V11A). The measured bias should now be minus 4.5 volts or less.

NOTE: To see the response of any single stage, follow steps 5, 6, 7, 8 except remove the 330 ohm resistor on the particular stage to be observed.

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13. Remove bias potentiomenter and replace V15.

14. Remove clip from converter grid and replace tube in socket.

NOTE: Picture I-f oscillation can occur in a receiver that is badly misaligned and will show up as a voltage across R134, the video detector load resistor, that is unaffected by R-f input. By approximating the core positions of T104, T105, T106, T107, T108, and T109 as compared to those in a correctly aligned receiver, the oscillation may stop. If still existing, try increasing the bias on V6 and V8. If these attempts fail, shunt the grids of V8, V7, V6 to ground with a 1,000 MMFD capacitor, connect the signal generator to the grid of V9, and align T109. Progressively remove the shunts and align each I-f stage working back to T104. If oscillation is still present, it is not due to misalignment--therefore, an individual component and voltage check must be made in the I-f section.

AN ALTERNATE METHOD OF SWEEP ALIGNMENT OF T1 AND T104 AND PICTURE I-F.

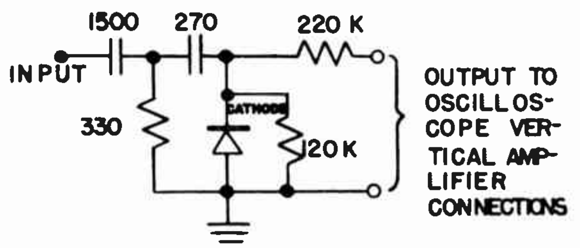

Figure 5

1. Adjust the bias at the junction of R155 and R156 (TEST POINT D) to minus 1.5 volts. (See bias adjustment of Step 3 on PICTURE I-F Traps).

2. Connect the detector input to pin 1 of V7 (See Figure 5).

3. Connect a sweep generator (sweep from 20 mc to 30 mc.) to the converter grid through a 1500 MMFD condenser.

4. Adjust T1 and T104 for the response of Fig. 3.

5. Remove the detector from the scope-input lead.

6. Connect the oscilloscope to pin 1 of V11A (TEST POINT G).

7. Overall I-f response should be as in Fig. 4. Markers should locate as shown.

NOTE: To see the response of any single stage, connect the sweep generator output to the input of the stage to be observed and the input terminal of Figure 5 to the output of the following stage.

FREQUENCY TABLE.

Channel No.	Band Width (mc.)	Picture Carrier (mc.)	Sound Carrier (mc.)	R-F Osc. (mc.)
2	54-60	55.25	59.75	81
3	60-66	61.25	65.75	87
4	66-72	67.25	71.75	93
5	76-82	77.25	81.75	103
6	82-88	83.25	87.75	109
7	174-180	175.25	179.75	201
8	180-186	181.25	185.75	207
9	186-192	187.25	191.75	213
10	192-198	193.25	197.75	219
11	198-204	199.25	203.75	225
12	204-210	205.25	209.75	231
13	210-216	211.25	215.75	237

R-F OSCILLATOR ALIGNMENT. Use non-metallic screw driver.

The oscillator adjustment screws are reached from the front of the tuner through the numbered holes around the channel switch. A few turns of the alignment screw on any channel can be made without concern for the effect on other channels, since for slight adjustments the channels are substantially independent. Channels 8 and 7 are affected by large screw displacement on channels 6 and 5.

The range of electrical effect for the screws is 7 turns from tight. Further turns may cause the coil sleeve to drop out on the high channels.

The following is for complete R-F Oscillator alignment:

1. Set fine tuning trimmer at mid-point as accurately as possible.

2. Set all oscillator alignment screws 4 turns from tight.

3. Align channel 6 as follows:

a. Connect a voltohmyst to pin 5 of V3 (discriminator output) (TEST POINT B).

b. Feed channel 6 sound carrier (87.75 mc.) into antenna terminals. (See Frequency Table).

c. Adjust channel 6 oscillator screw for zero voltage on voltohmyst. This actually indicates the center frequency of the "S" curve, so obviously the discriminator must first be known to be correctly aligned before R-F oscillator alignment can be made using this method.

4. Follow step 3 for channels 5 through 2 in that order.

5. Follow step 3 for channels 7 through 13 in that order.

6. Re-check channels 6 through 2 in that order-touch up if necessary.

7. Re-check channels 13 through 2 in that order-touch up if necessary.

NOTE: If on the high channels the adjustment screw has insufficient range, physical movement of the coils can be made with care for increasing or decreasing inductances.

R-F AND CONVERTER ALIGNMENT. Due to very close design these should require no future adjustments so no provisions have been made for such.

HORIZONTAL OSCILLATOR ALIGNMENT.

1. Turn the Channel Selector to a station.

2. Turn the Horizontal Hold Control Maximum clockwise.

3. Turn the Horizontal Lock Adjustment to almost tight.

4. Connect the oscilloscope to terminal "C" of T112.

5. Turn the T112 Blocking Waveform Adjustment maximum counter-clockwise.

6. Sync the picture by adjusting the Horizontal Frequency Adjustment Screw of T112.

7. Turn the Blocking Waveform Adjustment until the waveform is correct as in Figure 6.

8. Adjust the T112 Frequency Adjustment so that the picture just breaks syncs (the ideal is to have a wide vertical black bar representing horizontal blanking showing somewhere in the picture).

9. Turn the Horizontal Hold maximum counter-clockwise. If picture doewn't break sync, turn the Station Selector off-channel and then back. Picture will now be out-of-sync.

10. Turn the Horizontal Hold Control slowly clockwise and count the diagonal black bars just before "pull-in."

11. There should be 3 bars---adjust Horizontal Locking Range until only 3 bars are present before "pull-in".

12. Turn Horizontal Hold Control maximum clockwise. Picture should just break sync as in Step 8.

13. Adjust T112 Frequency Adjustment to obtain condition of Step 8.

14. Repeat steps 8 thru 12 if necessary to obtain conditions of Steps 8 and 11.

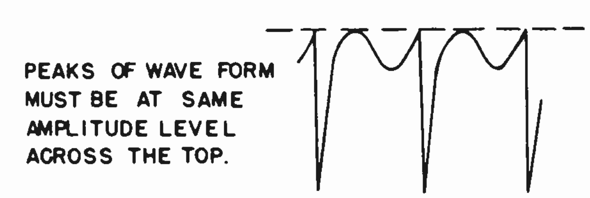

Figure 6

DRIVE, LINEARITY, WIDTH ADJUSTMENTS. The Drive Control, C186A, will have greatest effect on the left side of the picture---stretching or compressing.

The Linearity Control, L116, will have greatest effect on the right side of the picture.

The Width Control L115, adjusts the horizontal width of the raster to compensate for line voltage variations. On the 12 1/2 in. and 16 in. chassis a switch is provided for disconnecting the Width Control, L115, for the condition of maximum width.

4.5 MC. TRAP ADJUSTMENT

1. Tune in a strong station.

2. De-tune the Fine Tuning slightly from best sound.

3. Adjust L105 to eliminate any 4.5 Mc. beat pattern that may appear in the picture.

CRITICAL LEAD DRESS ON CHASSIS TE-272-1 AND TE-272-2 AND TE-276.

1. All by-pass condenser leads on the I-f strip as short as possible.

2. Short lead between body of R111 and pin 5 of V3.

3. Do not re-route bus wire from pin 2 of V2.

4. Filament leads between V3, V4, V5 keep down to chassis and away from grid and plate leads.

5. All leads crossing I-f circuits should be held close to chassis. Movement of such leads could change alignment.

6. Pix I-f coupling capacitors must be away from the chassis. Moving these will affect alignment.

7. All peaking coils should be held away from chassis.

8. Green lead from pin 2 of V11, white-orange lead from pin 8 of V11 away from chassis.

9. Blue lead from pin 5 of V4 close to chassis.

10. C124, C125 away from chassis.

11. R213, R214, R220, R221, R222, R219 should have long leads and held up and away from tube sockets and chassis.

12. Keep leads from L115 (width control) away from transformer frame.

13. Dress filament leads from horizontal transformer T113 away from chassis.

14. Dress lead from top cap of 6BG6 tube away from frame of transformer.

15. Dress lead from top cap of 1B3GT away from chassis.

16. Dress red lead from lug 4 of T113 down

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against chassis underneath bus wire from chassis to terminal strip to hold it in place.

17. C203 leads should be as short as possible (parasitic oscillations can occur with long leads).

18. White-orange lead from pin 8 of V11 dressed away from the volume control terminals and components.

NOTES ON SERVICING

No Raster.
1. Check ion trap adjustment.
2. Check Brightness Control, R120.
3. Check Hi-Voltage.
   a. Defective V16, V17, V18, or V19.
   b. Open Horizontal Deflection Coils.
   c. Defective C181.
   d. Defective picture tube.

One Vertical Line Only On Picture Tube.
1. No horizontal sweep.
   a. Defective Horizontal Deflection Coils.

Picture Very Narrow (1/2 in. wide or so) in the Center of Tube.
1. Defective Horizontal Output Transformer, T113.

One Horizontal Line Only On the Picture Tube.
1. No vertical sweep.
   a. Defective V14 or V15 or circuits.
   b. Defective Vertical Deflection Coils.

Not Enough Width.
1. Low line voltage.
2. Change V17.
3. Check C188.

Horizontal Linearity Poor Beyond Adjustment.
1. Change V17.
2. Check C183, L116, C182, C184, C185.
3. Check T113.

Vertical Linearity Poor Beyond Adjustment.
1. Check C176B, C175.
2. Defective T111.

Vertical Retrace Lines Showing (Brightness Control Does Not Correct.)
1. Defective T111.

Bright Horizontal Line In the Picture Which Is Moved By the Height Control.
1. Defective V15.

Wide Vertical Black Bar Dividing Picture.
1. High Resistance Short of C167.

No AGC--Possible Negative Picture.
1. Shorted C160.

Very Snowy Picture - No AGC.
1. Shorted C157.

Sound and Raster But No Picture.
1. Check I-F String.
2. Check V10B, V11.

Picture But No Sound.
1. Check T106 Trap.
2. Check V1, V2, V3, V4, V5.
3. Check Speaker.

No Vertical Sync.
1. Check R177, C170, R178, C171, R179, C172.
2. Check C173.

No Horizontal Sync.
1. Check C169.
2. Check V16A and Horizontal Alignment.

Poor Resolution.
1. Check L103, L104, L107, L106.
2. Check I-F Alignment.
3. Check C138, C139.
4. Check D-C Voltages in Video Circuit.

Black Horizontal Bars Moving With Sound.
1. Microphonic tube in tuner.
2. Check sound trap alignment.

No Sync.
1. Check V13, V14.
2. Check I-F Alignment.

PICTURE TUBE WARNING

IMPLOSION OF PICTURE TUBE IS DANGEROUS. AVOID SHARP BLOWS-DROPPING-OR FORCING WHEN MOUNTING. DO NOT HANDLE THE PICTURE TUBE BY ITS NECK. WEAR GOGGLES AND HEAVY GLOVES WHEN HANDLING. PLACE UNUSED PICTURE TUBES IN PROTECTIVE CARTONS.

HI-VOLTAGE WARNING

HI-VOLTAGES EXIST WITHIN THE RECEIVER CHASSIS. ONLY PERSONS FAMILIAR WITH THE LOCATION OF THESE HI-VOLTAGE POINTS AND HAVING KNOWLEDGE OF USUAL HI-VOLTAGE PRECAUTIONS SHOULD MAKE CHASSIS INVESTIGATIONS.

16" PICTURE TUBE WARNING

THE METAL CONE OF THE 16 IN. PICTURE TUBE SERVES AS THE HI-VOLTAGE ANODE HAVING 12.5 KV ON IT. USE EXTREME CAUTION WHEN OPERATING OUTSIDE OF CABINET AND DO NOT REMOVE THE PROTECTIVE HI-VOLTAGE SLEEVE COVER.

REMOVAL OF THE 10 IN. PICTURE TUBE

1. Loosen the screws (don't remove) holding the front picture tube stop bracket.

2. Remove the picture tube socket, ion-trap, and anode connector.

3. Free one end of the hold-down strap.

4. Lift up the front of the picture tube to clear the front stop bracket and slide the tube forward and out. CAUTION: DO NOT EXERT LEVERAGE ON THE TUBE NECK WHICH IS IN THE YOKE AND FOCUS COIL MOUNT.

5. PLACE THE TUBE IN AN UNUSED CARTON.

REMOVAL OF THE $12\frac{1}{2}$ IN. PICTURE TUBE

1. Remove the picture tube socket, ion-trap, and anode connector.

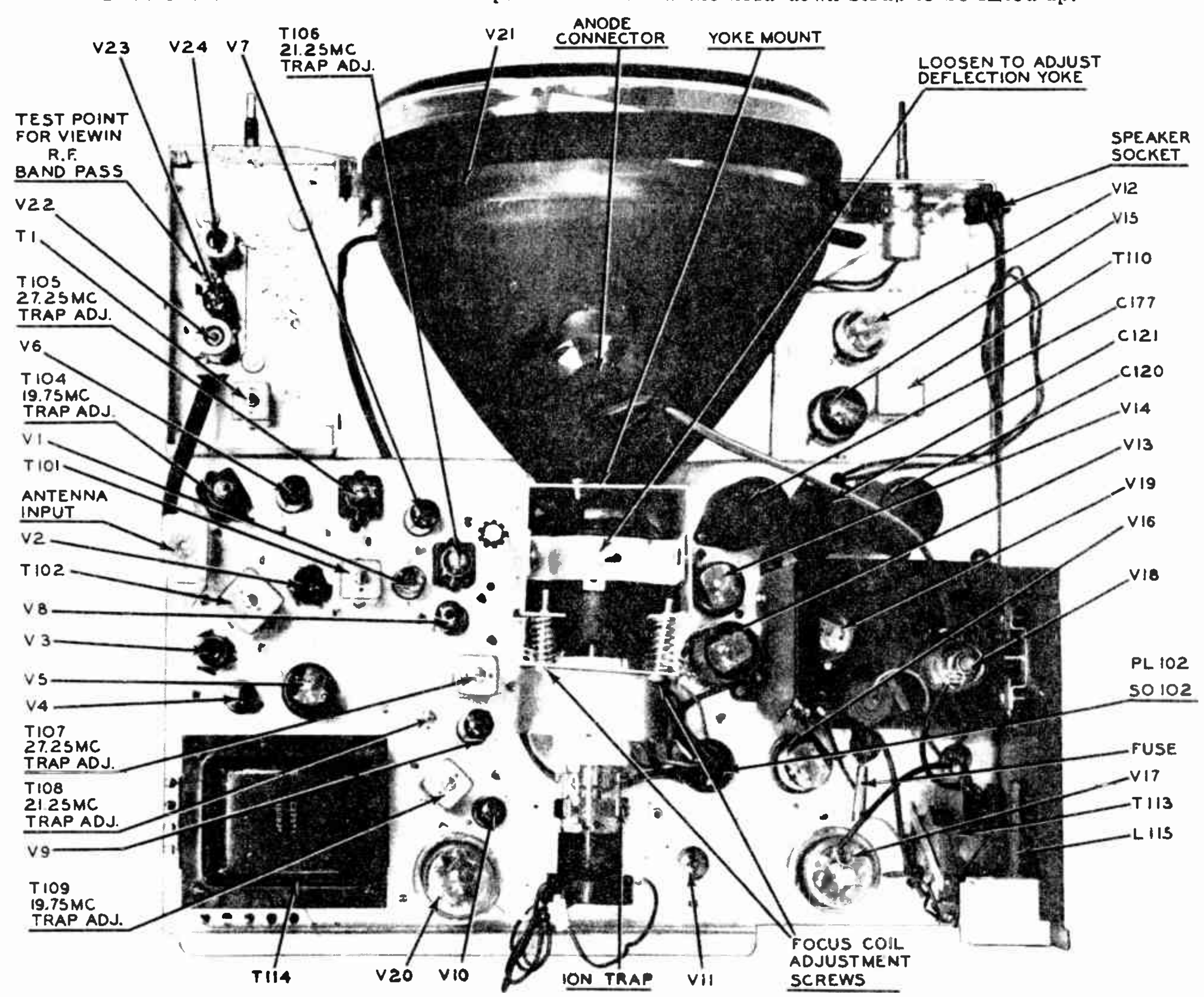
2. Free one end of the hold-down strap.

3. Lift up the front of the picture tube to clear the front stop bracket and slide the tube forward and out. CAUTION: DO NOT EXERT LEVERAGE ON THE TUBE NECK WHICH IS IN THE YOKE AND FOCUS COIL MOUNT.

4. PLACE THE TUBE IN AN UNUSED CARTON.

NOTE: If it is necessary to loosen the bottom-support-bracket, and drop it down to allow the tube to slide out, first mark the fixed position of the bracket on the chassis since this position is correct for proper alignment of the picture tube face with the cabinet mask. When the tube is replaced the front-bottom-support-bracket can then be adjusted to the marked position.

REMOVAL OF THE 16 IN. PICTURE TUBE. Follow the procedure for the 12 1/2 in. picture tube---. When freeing the hold-down strap, also remove the metal strut mounted between the hold-down strap, and the yoke mount. This will allow the hold-down strap to be lifted up.



Chassis Top View TE 272-1, TE 272 -2

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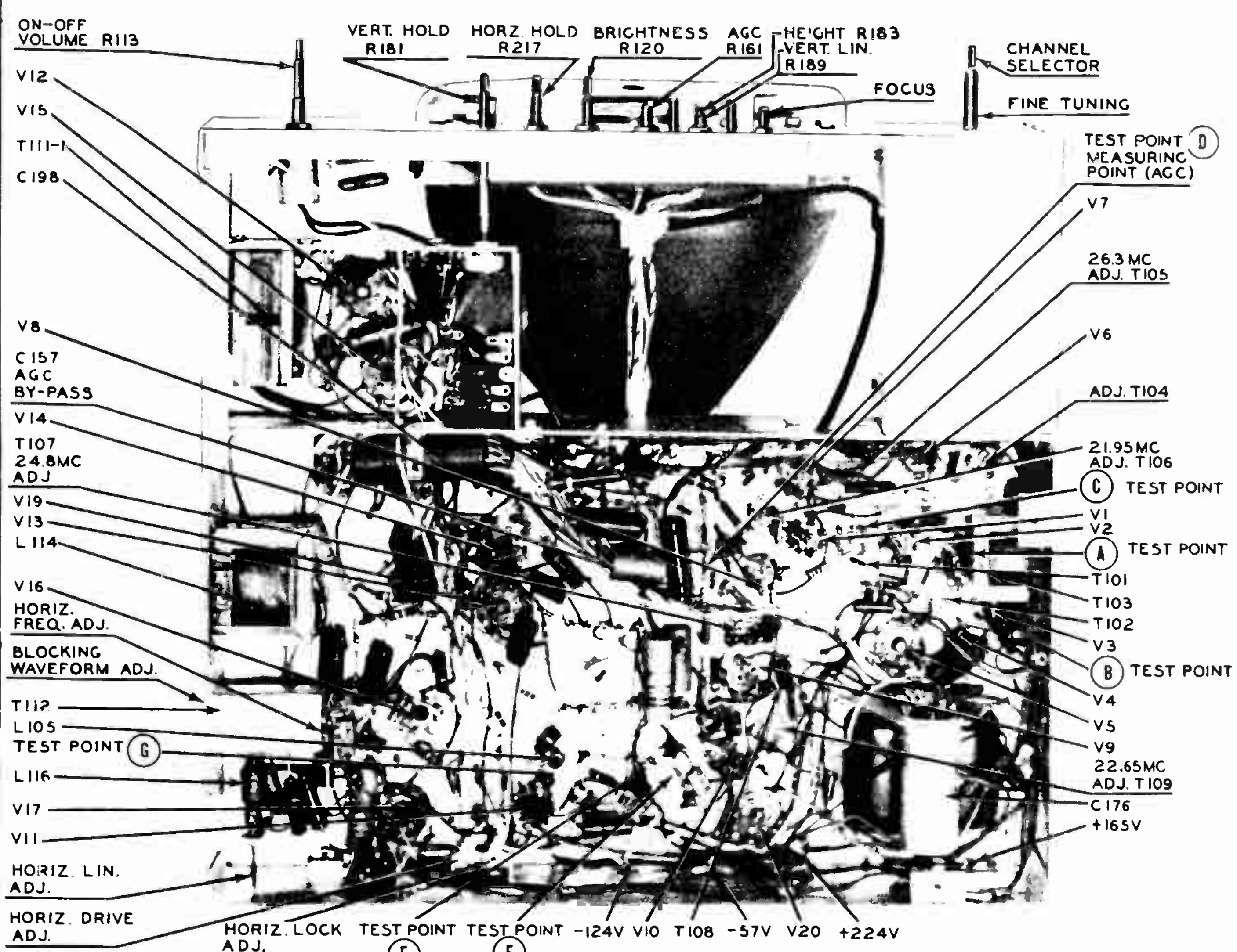
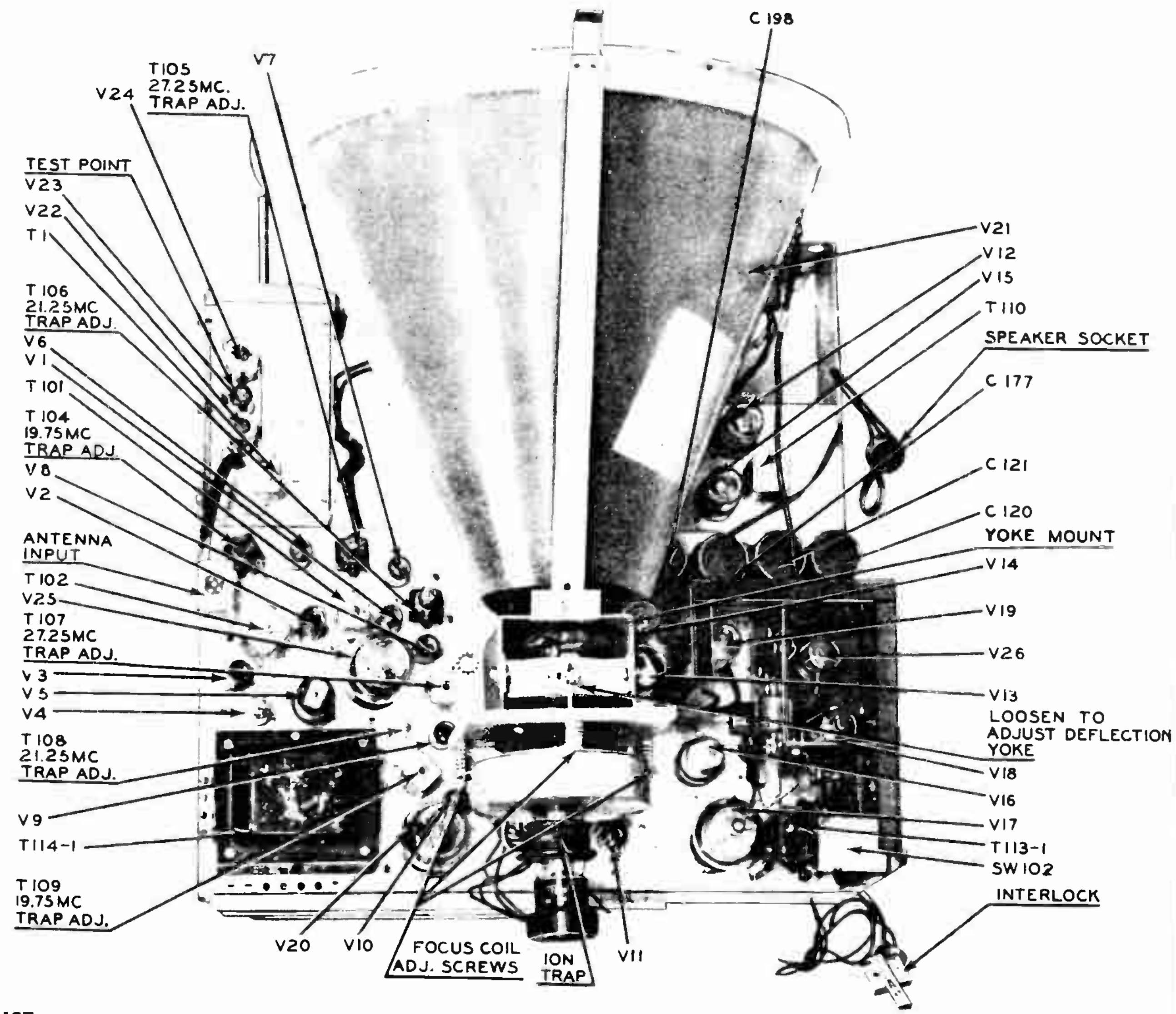


Chassis Bottom View TE 272-1, TE 272-2



Chassis Top View TE 276

PARTS LIST

PART NO.	DESCRIPTION
A22572	Shield, Min. Tube
A20304	Socket, Tube, Octal, 1 1/2 in. centers
C20305-1	Socket, Octal, Phenolic
A20306	Socket, Octal, Ceramic
A20310-3	Socket, 7 Contact, Min. Wafer
A20274	Socket, 9 Contact, Min. Wafer
C22486-1	Socket, Picture Tube
A19552	Socket, Phono
A22633	Socket, R-F Input
A22642	Socket, Speaker Leads
A22655	Socket Shell, Yoke & Focus Coil Leads
A22440	Socket Mtg. Ring. 1B3GT/8016
A22474	Spring Focus Coil
A22433	Strap Yoke Mtg.
AC22632-1	Strap, Kinescope Hold Down
A22549	Switch, Width
A22772	Switch, Phono
A21189	Terminal, Female, Hi-Voltage Capacitor
C22398	Transformer, Converter, T1
C22498	Transformer, 1st Pix 1-f, T104
C22502	Transformer, 2nd Pix 1-f, T105
C22555	Transformer, 3rd Pix 1-f, T106
C22556	Transformer, 4th Pix 1-f, T107
C22557	Transformer, 5th Pix 1-f, T109
C22565	Transformer, Sound 1-f, T101
C22566	Transformer, Discriminator, T102
C22446	Transformer, Vertical Oscillator, T110
C22905	Transformer, Choke, Vertical Output, T111-1
C22563	Transformer, Horizontal Oscillator, T112
C22564	Transformer, Horizontal Output, T113
C22808	Transformer, Horizontal Output, T113-1
C22497	Transformer, Audio Output, T103
E22571	Transformer, Power, T114
E22807	Transformer, Power, T114-1
C22558	Trap, Sound, T108
C22501	Trap, 4.5 mc., L105
AE22550-1	Tuner Unit (10 in. and 12 1/2 in.)
AE22550-2	Tuner Unit (16 in.)
A22574	Wafer, Electrolytic Mtg.
A22478	Yoke, Rubber Channel
C22575	Yoke, Deflection, L111, L112, L109, L110, R190, R191, C179
A22418	Capacitor, Double Trimmer, C186A, C186B
A22413	Capacitor, Mica, 5mmfd, ± 20%, 1500 V., C180
C20290-100	Capacitor, Mica, 10 mmfd, ± 10%, 500 V., C130
A22410	Capacitor, Mica, 33 mmfd, ± 10%, 1000 V., C145
A22623	Capacitor, Mica, 56 mmfd, ± 10%, 1000 V., Yoke
C22702	Capacitor, Ceramic, 82 mmfd, ± 5%, 500 V., C138
C20300-101	Capacitor, Ceramic, 100 mmfd, + 20%, 500 V., C106
C20290-101	Capacitor, Mica, 100 mmfd, + 10%, 500 V., C167
C20301-121	Capacitor, Ceramic, 120 mmfd, ± 10%, 500 V., C125
C20290-181	Capacitor, Mica, 180 mmfd, ± 10%, 500 V., C169
A22412	Capacitor, Mica, 180 mmfd, ± 5%, 1000 V., C190
A22809	Capacitor, Hi-Voltage, 250 mmfd, 20 KV., C204
A22411	Capacitor, Mica, 270 mmfd, ± 10%, 1000 V., C135, C142, C154, C203
C20301-271	Capacitor, Ceramic, 270 mmfd, + 10%, 500 V., C113, C114, C126
C20290-391	Capacitor, Mica, 390 mmfd, + 10%, 500 V., C168, C187
C20300-471	Capacitor, Mica, 470 mmfd, ± 10%, C152-1
A22496	Capacitor, Hi-Voltage, 500 mmfd, 20 KV, C181, C201
C20290-561	Capacitor, Mica, 560 mmfd, ± 10%, 500 V., C128, C129, C205
C20300-152	Capacitor, Ceramic, 1500 mmfd, ± 20%, 500 V.,
C20300-152 Cont'd.	C101, C102, C103, C107, C108, C109, C131, C132, C139, C133, C140, C143, C144, C147, C148, C149, C150, C151, C152, C156, C159, C161, C197
C20295-102	Capacitor, Molded Paper, Oil Filled, .001 mfd, + 20%, 600 V., C165
C20295-222	Capacitor, Molded Paper, Oil Filled, .0022 mfd, ± 20%, 600 V. C116, C118, C170, C192
C20324-222	Capacitor, Molded Paper, Oil Filled, .0022 mfd, 5%, C188
C20295-472	Capacitor, Molded Paper, Oil filled, .0047 mfd, ± 20%, 600 V., C115, C122, C171, C172
C20324-472	Capacitor, Molded Paper, Oil Filled, .0047 ± 5%, 600 V., C173
C20292-103	Capacitor, Molded Paper, .01 mfd, ± 20%, 400 V., C117, C163
C20295-103	Capacitor, Molded Paper, Oil Filled, .01 mfd, ± 20%, 600 V., C195, C196, C199, C200
C20296-103	Capacitor, Molded Paper, Oil Filled, .01 mfd, ± 20%, 1000 V., C119
C20324-103	Capacitor, Molded Paper, Oil Filled, .01 ± 5%, 600 V., C189
C20292-223	Capacitor, Molded Paper, Oil Filled, .022 mfd, ± 20%, 400 V., C194
C20296-333	Capacitor, Molded Paper, Oil Filled, .033 mfd, + 20%, 1000 V., C183
C20291-473	Capacitor, Molded Paper, Oil Filled, .047 mfd, ± 20%, 200 V., C162, C178, C202
C20292-473	Capacitor, Molded Paper, Oil Filled, .047 mfd, ± 20%, 400 V., C124, C166
C20295-473	Capacitor, Molded Paper, Oil Filled, .047 mfd, ± 20%, 600 V., C174, C191
C20296-473	Capacitor, Molded Paper, Oil Filled, .047 mfd, ± 20%, 1000 V., C182, C184
C20295-104	Capacitor, Molded Paper, Oil Filled, 0.1 mfd, ± 20%, 600 V., C123, C175
C20291-224	Capacitor, Molded Paper, Oil Filled, 0.22 mfd, ± 20%, 200 V., C164
C20292-224	Capacitor, Molded Paper, Oil Filled, 0.22 mfd, ± 20%, 400 V., C185, C193
C20291-474	Capacitor, Molded Paper, Oil Filled, 0.47 mfd, ± 20%, 200 V., C158
A22416	Capacitor, Electrolytic, 5 mfd, 50 V., C157
A22417	Capacitor, Electrolytic, 25 mfd, 50 V., C160
A22783	Capacitor, Electrolytic, 40 mfd, 450 V., C198
C22422-1	Capacitor, Electrolytic, 60, 10, 10 mfd, 450 V., 20 mfd, 150 V., C120
C22422-2	Capacitor, Electrolytic, 40, 40, 10 mfd, 450 V., C177
C22422-3	Capacitor, Electrolytic, 40, 10 mfd, 450 V., C121; 80 mfd, 200 V., C198
C22422-4	Capacitor, Electrolytic, 40 mfd, 450 V., 90, 50 mfd, 150 V., C176
C20308-33	Resistor, Wire Wound, 1/2 watt, 3.3 ohms, ± 10%, R202
C2033-39	Resistor, Wire Wound, 1/4 watt, 3.3 ohms, ± 10%, R202-1, R226
C20308-51	Resistor, Wire Wound, 1/2 watt, 5.1 ohms, ± 10%, R110
C20061-100	Resistor, 1/2 watt, 10 ohms, ± 20%, R136
C20061-150	Resistor, 1/2 watt, 15 ohms, ± 20%, R198
C22381-390	Resistor, 1/2 watt, 39 ohms, ± 10%, R142, R152
C20070-390	Resistor, 1 watt, 39 ohms, ± 10%, R206
C20070-470	Resistor, 1 watt, 47 ohms, ± 10%, R209
C20061-470	Resistor, 1/2 watt, 47 ohms, ± 20%, R207
C22381-680	Resistor, 1/2 watt, 68 ohms, ± 10%, R148
C22381-820	Resistor, 1/2 watt, 82 ohms, ± 10%, R102
C22381-101	Resistor, 1/2 watt, 100 ohms, ± 10%, R132
C20334-101	Resistor, 4 watt, 100 ohms, ± 10%, R197
C20061-151	Resistor, 1/2 watt, 150 ohms, ± 20%, R101, R141, R146, R150

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PARTS LIST (Cont'd)

PART NO.	DESCRIPTION
C20302-151	Resistor, 2 watt, 150 ohms, ± 10%, R223
C22381-151	Resistor, 1/2 watt, 150 ohms, ± 10%, R139
C22381-221	Resistor, 1/2 watt, 220 ohms, ± 10%, R130
C20070-681	Resistor, 1 watt, 680 ohms, + 10%, R117
C22499	Resistor, Wire Wound Metal Case, 650 ohms, ± 10%, 6 watts, R192C 650 ohms, ± 10%, 6 watts, R192B 850 ohms, ± 10%, 12 watts, R192A
C20061-102	Resistor, 1/2 watt, 1000 ohms, + 20%, R107, R137, R147, R151, R154, R200, R140, R142
C22381-122	Resistor, 1/2 watt, 1200 ohms, ± 10%, R103
C20302-152	Resistor, 2 watt, 1500 ohms, ± 10%, R231
C20302-182	Resistor, 2 watt, 1800 ohms, ± 10%, R118, R193
C22381-222	Resistor, 1/2 watt, 2200 ohms, ± 10%, R124
C22381-272	Resistor, 1/2 watt, 2700 ohms, ± 10%, R164, R185
C22382-332	Resistor, 1/2 watt, 3300 ohms, ± 5%, R126
C22381-332	Resistor, 1/2 watt, 3300 ohms, ± 10%, R225
C22381-472	Resistor, 1/2 watt, 4700 ohms, + 10%, R170
C22381-562	Resistor, 1/2 watt, 5600 ohms, ± 10%, R165, R176
C20070-562	Resistor, 1 watt, 5600 ohms, + 10%, R224
C22382-562	Resistor, 1/2 watt, 5600 ohms, + 5%, R134, R143, R155
C20070-562	Resistor, 1 watt, 5600 ohms, ± 10%, R125
C20302-682	Resistor, 2 watt, 6800 ohms, ± R194, R195
C22383-682	Resistor, 1 watt, 6800 ohms, ± 5%, R138
C20070-682	Resistor, 1 watt, 6800 ohms, ± 10%, R205
C22381-682	Resistor, 1/2 watt, 6800 ohms, ± 10%, R174
C22381-822	Resistor, 1/2 watt, 8200 ohms, ± 10%, R178, R179, R222
C22382-822	Resistor, 1/2 watt, 8200 ohms, ± 5%, R145, R158, R186, R215
C22383-822	Resistor, 1 watt, 8200 ohms, + 5%, R127
C22381-103	Resistor, 1/2 watt, 10,000 ohms, ± 10%, R204
C22382-103	Resistor, 1/2 watt, 10,000 ohms, ± 5%, R149, R153
C20302-123	Resistor, 2 watt, 12,000 ohms, ± 10%, R129
C22381-123	Resistor, 1/2 watt, 12,000 ohms, ± 10%, R119, R230
C20070-153	Resistor, 1 watt, 15,000 ohms, ± 10%, R173
C22382-183	Resistor, 1/2 watt, 18,000 ohms, ± 5%, R156
C20061-223	Resistor, 1/2 watt, 22,000 ohms, ± 20%, R106, R111
C22381-223	Resistor 1/2 watt, 22,000 ohms, ± 10%, R104, R177, R212
C22381-273	Resistor, 1/2 watt, 27,000 ohms, ± 10%, R169
C20061-473	Resistor, 1/2 watt, 47,000 ohms, ± 20%, R105
C22381-473	Resistor, 1/2 watt, 47,000 ohms, ± 10%, R168
C22381-563	Resistor, 1/2 watt, 56,000 ohms, ± 10%, R203
C22381-683	Resistor, 1/2 watt, 68,000 ohms, + 10%, R218
C22382-753	Resistor, 1/2 watt, 75,000 ohms, ± 5%, R157-1
C22381-823	Resistor, 1/2 watt, 82,000 ohms ± 10%, R112
C22382-104	Resistor, 1/2 watt, 100,000 ohms, ± 5%, R108, R109
C22381-104	Resistor, 1/2 watt, 100,000 ohms, ± 10%, R163, R185, R210-1

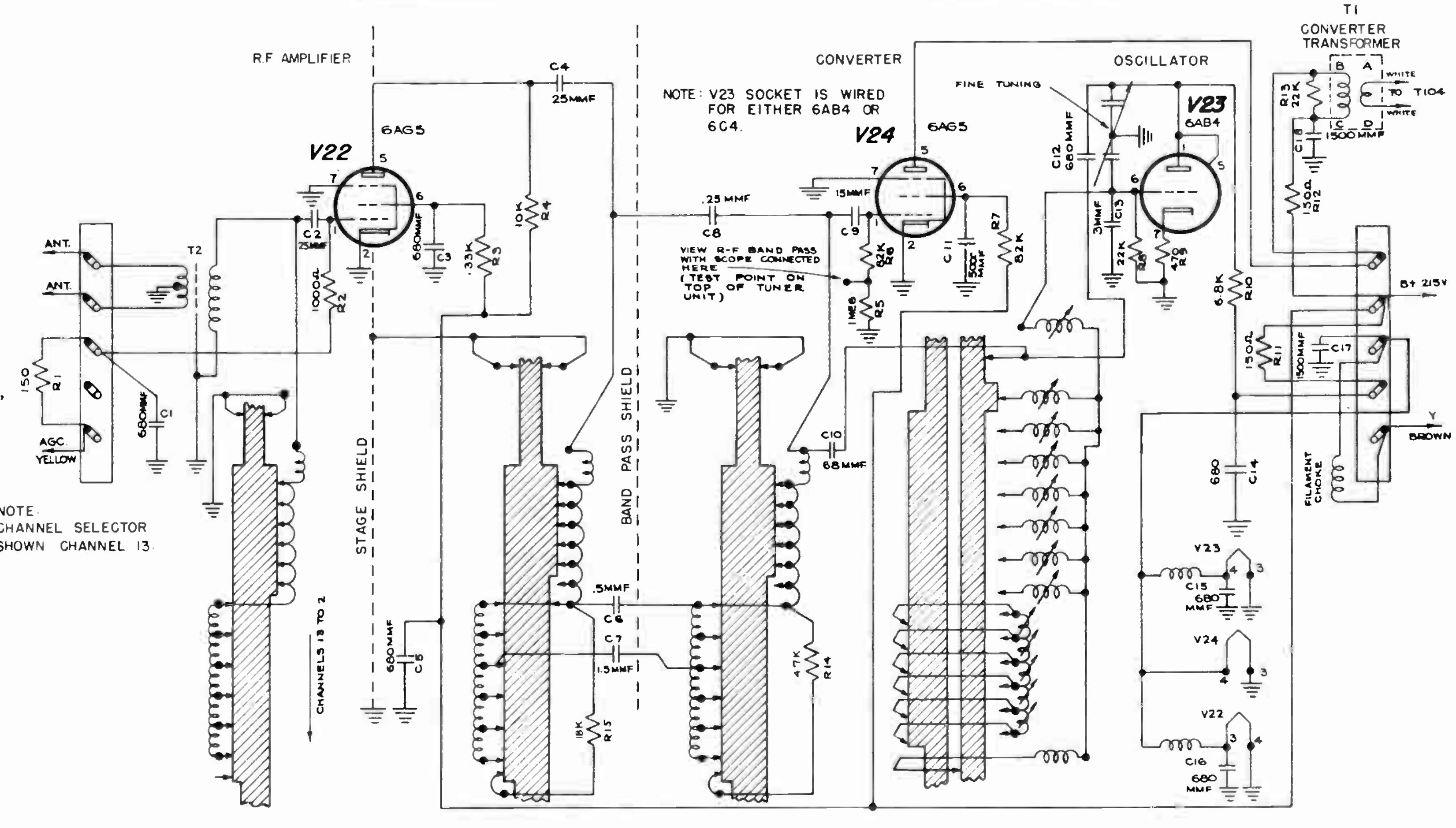
PART NO.	DESCRIPTION
C22383-104	Resistor, 1 watt, 100,000 ohms, ± 5%, R214
C20070-124	Resistor, 1 watt, 120,000 ohms, ± 10%, R210, R216
C20061-154	Resistor, 1/2 watt, 150,000 ohms, 20%, R167
C22381-154	Resistor, 1/2 watt, 150,000 ohms, 10%, R211, R221
C22383-154	Resistor, 1 watt, 150,000 ohms, 5%, R213
C20302-184	Resistor, 2 watt, 180,000 ohms, 10%, R227, R228, R229
C22381-224	Resistor, 1/2 watt, 220,000 ohms, 10%, R128, R182, R233
C22381-334	Resistor, 1/2 watt, 330,000 ohms, 10%, R115, R166
C20061-474	Resistor, 1/2 watt, 470,000 ohms, 20%, R116
C22381-564	Resistor, 1/2 watt, 560,000 ohms, 10%, R162, R201, R160-1
C22382-824	Resistor, 1/2 watt, 820,000 ohms, 5%, R219
C22381-105	Resistor, 1/2 watt, 1 megohm, 10%, R172, R208
C20103-105	Resistor, 1 watt, 1 megohm, 20%, R199
C22382-155	Resistor, 1/2 watt, 1.5 megohm, 5%, R180
C22382-185	Resistor, 1/2 watt, 1.8 megohm, 5%, R159
C22381-225	Resistor, 1/2 watt, 2.2 megohms, 10%, R212, R122, R184, R187
C22383-275	Resistor, 1 watt, 2.7 megohms, 5%, R220
C22381-395	Resistor, 1/2 watt, 3.9 megohms, 10%, R175
C20061-106	Resistor, 1/2 watt, 10 megohms, 20%, R114
C22381-106	Resistor, 1/2 watt, 10 megohms, 10%, R171
R22674	Cabinet, Mahogany, 3100TM
R22674-2	Cabinet, Lime Oak, 3100TB
R22776-1	Cabinet, Mahogany, 3101CM
R22784-1	Cabinet, Mahogany, 3120CM
R22870-1	Cabinet, Mahogany, 3121TM
R22784-2	Cabinet, White Oak, 3120CB
R22836-1	Cabinet, Red Mahogany, 3160CM
C22680	Cover, Back, Cabinet, 3100TM and 3101CM
C22680-2	Cover, Back, Cabinet, 3100TB
C22794-1	Cover, Back, Cabinet, 3120CM and 3121TM
C22794-2	Cover, Back, Cabinet, 3120CB
AE22841-1	Cover, Back, Cabinet, 3160CM
C22678	Cover, Bottom, Outside, 3100TN and 3101CM
D22681	Door, Control, Mahogany - Models 3100TM, 3101CM, 3121TM, 3160CM
D22681-2	Door, Control, Blonde - Models 3100TB, 3120CB
C22687-2	Escutcheon, Channel Indicator, Mahogany - Models 3100TM, 3101CM, 3121TM, 3160CM
C22687-4	Escutcheon, Channel Indicator, Blonde - Models 3100TB, 3120CB
C22687-1	Escutcheon, Volume and Picture, Mahogany - Models 3100TM, 3101CM, 3121TM, 3160CM.
C22687-3	Escutcheon, Volume and Picture, Blonde - Models 3100TB, 3120CB
D22675	Glass, Safety, 3100TM and 3101CM
D22675-2	Glass, Safety, 3100TB
E22767-1	Glass, Safety, 3120CM and 3121TM
E22767-2	Glass, Safety, 3120CB
E22768-1	Glass, Safety, 3160CM
A22869	Ion Trap, 16 in. chassis
C22568	Ion Trap, 10 in. and 12 1/2 in. chassis
A22682	Knob, Channel Selector, Mahogany
A22682-2	Knob, Channel Selector, Blonde
A22683	Knob, Fine Tuning, Mahogany
A22683-2	Knob, Fine Tuning, Blonde

PARTS LIST (Cont'd)

PART NO.	DESCRIPTION
A22684	Knob, Volume, Mahogany
A22684-2	Knob, Volume, Blonde
A22685	Knob, Picture, Mahogany
A22685-2	Knob, Picture, Blonde
A22686-1	Knob, Vertical Hold
A22686-2	Knob, Horizontal Hold
A22686-3	Knob Brilliance
D22749	Mask, 10 in. Picture Tube
D22792	Mask, 12 1/2 in. Picture Tube
E22837	Mask, 16 in. Picture Tube
D22699	Safety Glass Bottom Mtg. Rail, 3100TM and 3101CM
D22790-1	Safety Glass Bottom Mtg. Rail, 3120CM and 3121TM
D22790-2	Safety Glass Bottom Mtg. Rail, 3120CB
A22670	Shield, Control
C22475	Speaker, 5 in. x 7 in., PM, Models - 3100TM, 3100TB, 3121TM, 3101CM

PART NO.	DESCRIPTION
D22791	Speaker, 10 in., PM, Models 3120CM, 3120CB, 3160CM
A22688	Spring, Escutcheon
A22708	Spring, Knob, Channel and Picture
A22707	Spring, Knob, Volume
A22706	Spring, Knob, Fine Tuning
A22673	Terminal Board, Antenna Lead-in
AD23195-1	Loop Antenna Assembly, 10 in. and 12 1/2 in. models
AD23195-2	Loop Antenna Assembly, 16 in. model
C22789-1	Metal Grille, 3101CM
C22793	Metal Grille, 3120CM
A22689	Carton with fillers, 3100TB and 3100TM
A22788	Carton with fillers, 3101CM
A22795	Carton with fillers, 3120CM and 3120CB
A22889	Carton with fillers, 3121TM
A22840	Carton with fillers, 3160CM
AC22885-1	Tube Hold Down Strap, 3160CM
A22868	Interlock Switch, 3160CM

ARVIN BRANDED RECEIVING TUBES								TELEVISION PICTURE TUBES	
TYPE	LIST PRICE	TYPE	LIST PRICE	TYPE	LIST PRICE	TYPE	LIST PRICE	TYPE	LIST PRICE
6AB4	$2.65	6AG5	$2.65	6AV6	$1.50	5U4G	$1.50	10BP4	$34.75
6AL5	2.00	6AU6	2.00	6K6GT	1.50	6SN7GT	2.20	12LP4	43.00
6BG6G	4.80	1B3GT-8016	3.20	12AU7	2.40	6W4GT	1.80	16AP4	74.50



TUNER UNIT AE 22550-1

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World Radio History

ARVIN CHASSIS TE 272-1 TE 272-2

CIRCUIT DIAGRAM NOTES

1 ARROWS AT CONTROLS INDICATE CLOCKWISE ROTATION.
2 FOR RESISTANCE AND DC VOLTAGE MEASUREMENTS SET THE AGC THRESHOLD AND BRIGHTNESS CONTROLS MAXIMUM COUNTERCLOCKWISE AND VOLUME CONTROL CLOCKWISE.
3 RESISTANCES SHOWN ARE IN OHMS K=1000.
4 CAPACITANCE VALUES LESS THAN 1 ARE IN MFD AND MORE THAN 1 IN MMFD.
5 DC VOLTAGES BETWEEN TUBE PINS AND CHASSIS ARE READ WITH VOLTOHMYST USING A 100 K OHM ISOLATING RESISTOR ON THE PROBE - ANTENNA TERMINALS SHORTED - LINE VOLTAGE 117 V, 60~.
6 PIN VOLTAGES AFFECTED BY HORIZONTAL AND VERTICAL CONTROLS ARE TYPICAL FOR A PICTURE ADJUSTED TO SYNC AND LINEARITY.
7 PIN VOLTAGES AFFECTED BY PICTURE CONTROL, R131, ARE SHOWN WITH ARROWS GIVING APPROXIMATE RANGE OF VOLTAGE EFFECTED.
8 OSCILLATOR INJECTION VOLTAGE MEASURED FROM THE TUNER TEST POINT TO CHASSIS IS APPROXIMATE 1.8 V ON ALL CHANNELS.
9 WITH THE CONDITION OF A SNOWFREE PICTURE, AGC SET PROPERLY, AND PICTURE IN SYNC THE BIAS ON PIN 2, V11A, SHOULD BE ABOUT -2.4 V, THE DETECTED VIDEO SIGNAL SHOULD BE ABOUT 3.7 V PP, AND FOR WAVESHAPES USE OSCILLOSCOPE WITH 100,000 CYCLE VERTICAL RESPONSE AND USE A 100K OHMS ISOLATING RESISTOR ON SCOPE LEAD.

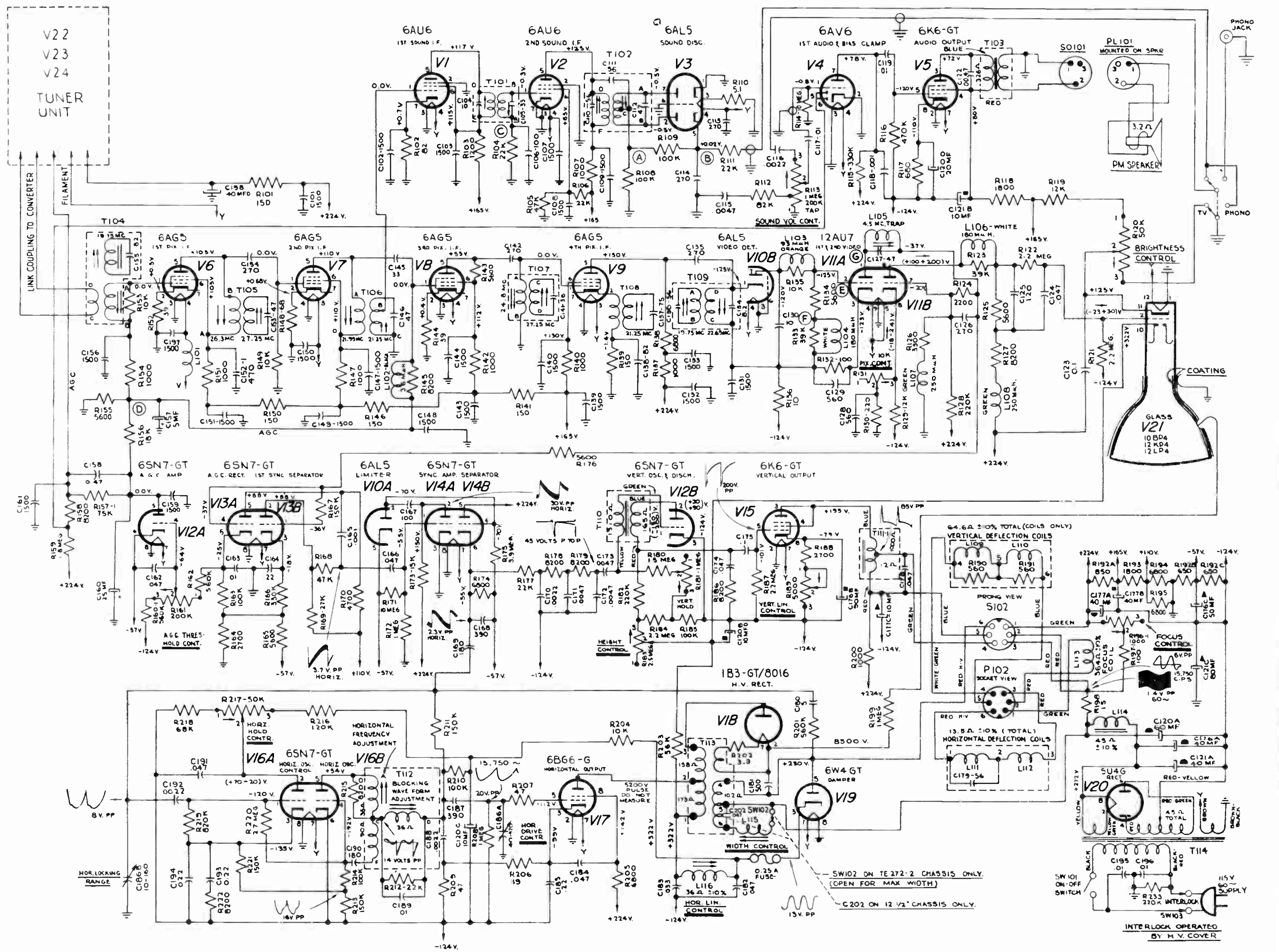
NOTED CHASSIS DIFFERENCES IN EARLY PRODUCTION-IN SOME CHASSIS.

1 C152 WAS 1500 MMFD.
2 R160 WAS 470K OHMS.
3 T111 WAS A 4 TERMINAL TRANSFORMER AND C178 CONNECTED TO GROUND.
4 R157 WAS 120K OHMS.
5 R198 WAS 10 OHMS (15 OHMS IMPROVES CENTERING)
6 NO PHONO JACK AND PHONO SWITCH WAS USED.
7 R197 WAS 330 OHMS AND R196 WAS 2250 OHMS (10" & 12" CHASSIS ONLY)

TE 272-1 TE 272-2 RESISTANCE CHART

	PIN 1	PIN 2	PIN 3	PIN 4	PIN 5	PIN 6	PIN 7	PIN 8
V1	0	0	0	0	6K	5.6K	82	—
V2	22K	0	0	0	5.5K	18K	0	—
V3	—	100K	20	0	200K	0	100K	—
V4	10 MEG	0	0	0	140K	140K	350K	—
V5	—	0	6.5K	6.2K	500K	—	0	1.7K
V6	6.7K	39	0	0	6K	6K	39	—
V7	10K	68	0	0	6K	6K	68	—
V8	5.5K	39	0	0	11.5K	5.5K	39	—
V9	0	150	0	0	14K	5.5K	150	—
V10	1K	3.9MEG	0	0	540	0	6.8K	—
V11	5.6K	6.8K	1.2K	0	0	19K	3.2K	5.7K
V12	2.1MEG	1MEG	1.1K	350K	19K	540	0	0
V13	200K	30K	350K	11K	8K	93K	0	0
V14	900K	20K	0	3.9MEG	5.5K	7.5K	0	0
V15	—	0	7K	7K	2.2MEG		0	
V16	900K		300K	250K	300K	1.1K	0	0
V17	CAP 220K	0	1.2K	—	1MEG	1.2K	0	12.5K
V18	CAP 220K	INF	—	INF	—	—	INF.	—
V19	—	—	220K	—	5.5K	—	0	0
V20	—	5.5K	—	1.1K	—	1.1K	—	5.5K
V21	0	1.1MEG	PIN 10 300K	PIN 11 3.5K	PIN 12 0	—	—	—
V22	140K	0	0	0	15K	38K	0	—
V23	1.1MEG	0	0	0	5.8K	87K	0	—
V24	13K	—	0	0	13K	22K	470	—

December 15, 1949



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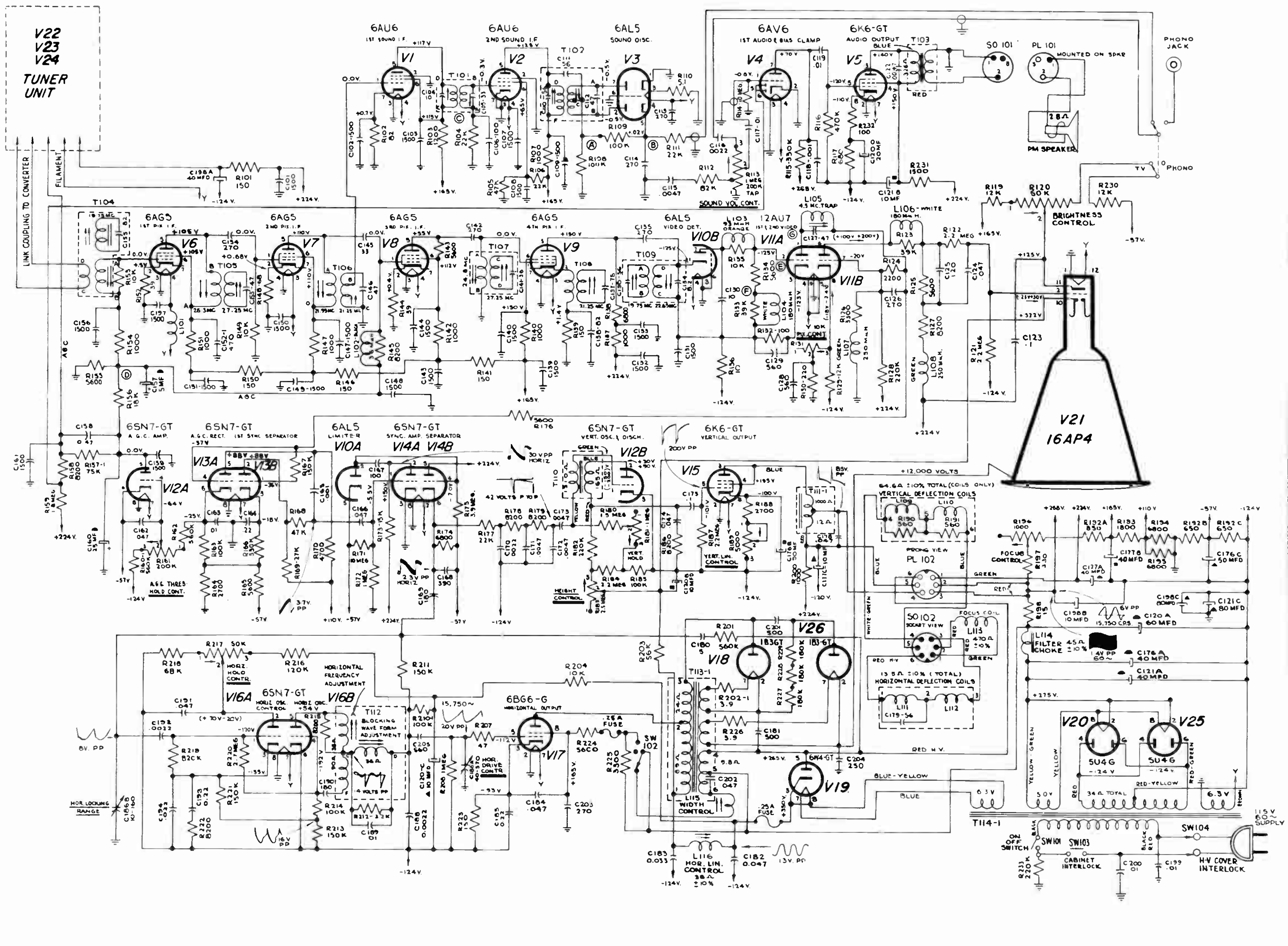
ARVIN CHASSIS TE 276

TE 276
RESISTANCE CHART

	PIN 1	PIN 2	PIN 3	PIN 4	PIN 5	PIN 6	PIN 7	PIN 8
V1	0	0	0	0	6K	5.6K	82	—
V2	22K	0	0	0	5.5K	18K	0	—
V3	—	100K	2.0	0	200K	0	100K	—
V4	10MEG	0	0	0	140K	140K	350K	—
V5	1700	0	6.5K	6.2K	500K	—	0	1.7K
V6	6.7K	39	0	0	6K	6K	39	—
V7	10K	68	0	0	6K	6K	68	—
V8	5.5K	39	0	0	115K	5.5K	39	—
V9	0	150	0	0	14K	5.5K	150	—
V10	1K	3.9MEG	0	0	540	0	68K	—
V11	5.6K	68K	1.2K	0	0	19K	3.2K	5.7K
V12	2.1MEG	1MEG	1.1K	350K	19K	540	0	0
V13	200K	30K	350K	11K	8K	93K	0	0
V14	900K	20K	0	3.9MEG	5.5K	7.5K	0	0
V15	—	0	7K	7K	2.2MEG		0	
V16	900K		300K	250K	300K	1.1K	0	0
V17	CAP 220K	0	1.2K	—	1MEG	1.2K	0	12.5K
V18	CAP 220K	INF.	—	INF	—	—	INF.	—
V19	—	—	220K	—	5.5K	—	0	0
V20	—	5.5K	—	1.1K	—	1.1K	—	5.5K
V21	0	1.1MEG	PIN 10 300K	PIN 11 13K	PIN 12 0	—	—	—
V22	140K	0	0	0	15K	39K	0	—
V23	1.1MEG	0	0	0	5.8K	87K	0	—
V24	13K	—	0	0	13K	22K	470	—
V25	—	5.5K	—	1.1K	—	1.1K	—	5.5K
V26	CAP INF	INF	—	INF	—	—	INF	—



December 15, 1949

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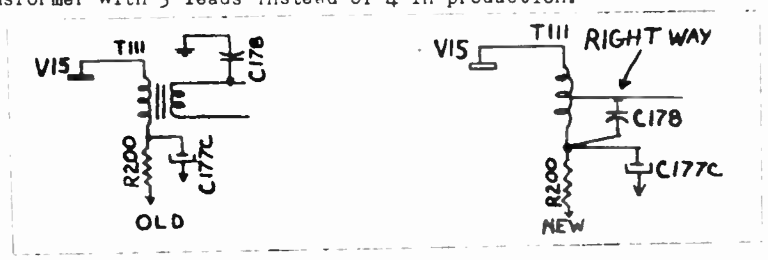
SUBJECT: Condition of One Wide Vertical Black Bar Dividing the Picture in Half Caused by High Resistance Short of C167.

The condition of one wide vertical black bar dividing the picture in half with the normal right side of the picture appearing on the left and left side on the right can be caused by C167 developing a high resistance short of 3 to 4 megohms.

The fault could prove to be difficult to find since normally the logical location of such a horizontal sync trouble would be in the horizontal oscillator and control circuit of V16. C167 connects between pin 2 of V10A and pin 2 of V14A.

SUBJECT: Buzz in the Speaker With Volume Control at Minimum

Recently the vertical output transformer, T111, was changed to an auto-transformer with 3 leads instead of 4 in production.



If C178 is left with one side hooked to ground, vertical buzz will be present in the speaker. In those receivers in which this fault exists C178 should be connected to the junction of R200 and C177C instead of ground. The location of C177C is shown on the "chassis - Bottom View" diagram in the preliminary service manual.

Two other possible sources of audio buzz are as follows:

1. The white and orange lead from pin 8 of V11B, the video amplifier being too loose and dressed close to the volume control terminals. Re-dress this lead.
2. C121C, 80MFD, having an undesirable power factor or being leaky. Replace such a capacitor.

SUBJECT: Focus Control on the 12 1/2" Chassis.

Some 12 1/2" receivers may exhibit lack of sufficient range of the Focus Control to properly focus the raster. A component change is being executed in production to eliminate this possibility for future production.

Any 12 1/2" set in the field can have this fault corrected quickly and easily by the following procedure without pulling the chassis from the cabinet.

1. Remove the bottom cabinet cover exposing a major portion of the chassis wiring.
2. On the front-side flange of the chassis two terminals strips are mounted in line. One of these terminals strips has on its end terminal a 330 ohm, 2 watt, and a 100 ohm, 1/2 watt tied to it. Also, 2 red wires join on this terminal.
3. Connect one side of an 1800 ohm, 2 watt, 10% resistor to this terminal.
4. Viewing the chassis from the bottom, one can see another terminal strip (6 terminals) mounted on the main chassis below the above two which are on the front flange.
5. A Green lead coming from the focus coil connects to a terminal beside the ground lug of the terminal strip.
6. Connect the other end of the 1800 ohm resistor to this point.

This 1800 ohm, 2 watt, shunt resistor across the focus coil will improve the range of the Focus Control satisfactorily.

SUBJECT: Buzz in the Audio on Strong Signals

In some locations of strong signal strength "Vertical buzz" is present in the audio. This buzz can be tuned to minimum by the fine tuning control when tuned carefully for best sound reception. The following change is now incorporated in present production improving the AGC characteristic:

Change R157 from 120K to 75K.

This greatly reduces the buzz in the audio and makes the fine tuning less critical.

SUBJECT: Buzz in the Audio on Strong Signals, Models 3100, 3101, 3120, 3121, 3160

In some locations of strong signal strength "vertical buzz" is present in the audio which can be tuned to a minimum by the fine tuning control when tuned to a minimum by the fine tuning control when tuned carefully for best sound reception. The following change can be made very easily in the field for reducing this buzz in strong signal areas.

Change R157-2 from 120K to 75K

R157-2 connects to pin 5 of V12 and is accessible when the bottom cabinet cover is removed. Soldering a 200K ohm resistor in parallel with the 120K ohm will be the same as replacing it with a 75K ohm resistor, and is probably easier.

SUBJECT: Accentuated white horizontal band near top of raster and touchy vertical sync on some 3100TM, 3121TM, 3121CM, 3121CB, 3160CM television receivers built this year.

It has been noted that some of the T110, Vertical Oscillator transformers, used in production since January 1, 1950 develope a parasitic which superimposes an added spike of voltage onto the return sweep part of the vertical sweep waveform. This results in a "bunching" of retrace lines about 1" from the top of the picture causing an accentuated white horizontal portion which can readily be seen when the brightness is increased.

A 2.2 megohm damping resistor across the primary of T110 (between the green and yellow leads) is being added in production to forestall any such parasitic developing.

The parasitic in some cases results also in very touchy vertical sync.

SUBJECT: Noted differences in the Chassis TE-272, Model 3100-TM (10" Table Model, Mahogany).

1. Early production receivers used the 6C4 tube for the R-f Oscillator. The 6AB4 tube is now used in production. The 6AB4 cannot replace the 6C4 in the early production receivers since the plate of the 6C4 is pin 5 and the plate of the 6AB4 is pin 1. Present production has pin 5 and pin 1 tied together so the tubes can be interchanged. The 6AB4 is preferred and recommended.
2. The 10" receiver chassis does not have a width switch, SW102, in some receivers the width control, L115, will have been disconnected (for maximum width).
3. A 40 ufd electrolytic by-pass to ground on the connection between R101 and the tuner unit does not show on the preliminary manual circuit diagram.
4. C113 connects to the -120V supply instead of ground as shown on the circuit diagram.
5. It has been found that horizontal pulses, coupled into the envelope of V13 by the red horizontal lead from the Hi-V doghouse going to socket, S102, being too close to V13, prevent good interlace. Dressing the lead down to the chassis as close as possible and wedging it away from V13 will aid the condition of good interlace. Future production receivers will have a shield on V13.

SUBJECT: Regeneration in the sound strip of Model 3100-TM, Chassis TE-272, (10" Table Model, Mahogany).

1. In some chassis the blue lead from pin 5 and 6 of V4 to the junction of R158 and R159 runs around the socket and input circuit of V6 and in some cases causes regeneration. The lead is now being rerouted (down close to the chassis) so that it runs between V5 and T109 and between V6 and T107 to the junction of R158 and R159.
2. The shield can of the discriminator transformer, T102, should have its mounting nuts holding the can down very tightly. Leakage radiation from the bottom of the can could cause regeneration - tightening of the mounting nuts in most cases will eliminate this particular cause of regeneration.

SUBJECT: Shorted Capacitors Across the Secondary of the Horizontal Output Transformer, T113, on the 12 1/2" Chassis.

Early production of the 12 1/2" chassis utilized two 270 mmfd condensers in series across terminals 4 and 6 of T113, the Horizontal Output Transformer. These capacitors in effect lower the Hi-Voltage sufficiently to allow greater scan and necessary picture width for the 12 1/2" picture tube. Breakdown of these condensers resulting in a short across terminals 4 and 6 will show up as follows:

1. No Hi-Voltage - therefore no raster.
2. More frequently there will still be some H-Voltage, but no horizontal scan. Only a narrow vertical white trace displaced to the right will appear on the picture tube.

Present production is using a .047mfd, 200V, Molded, Oil-filled capacitor across the width control, L115, instead of the two 270mmfd capacitors across terminals 4 and 6 of T113. This change is recommended whenever the above breakdown trouble occurs and also on any early production 12 1/2" model brought in for service to forestall future trouble of this nature. The best connection for the .047 mfd. capacitor is between terminal 6 of T113 and the switch terminal of SW102 that connects to terminal 5 of T113.

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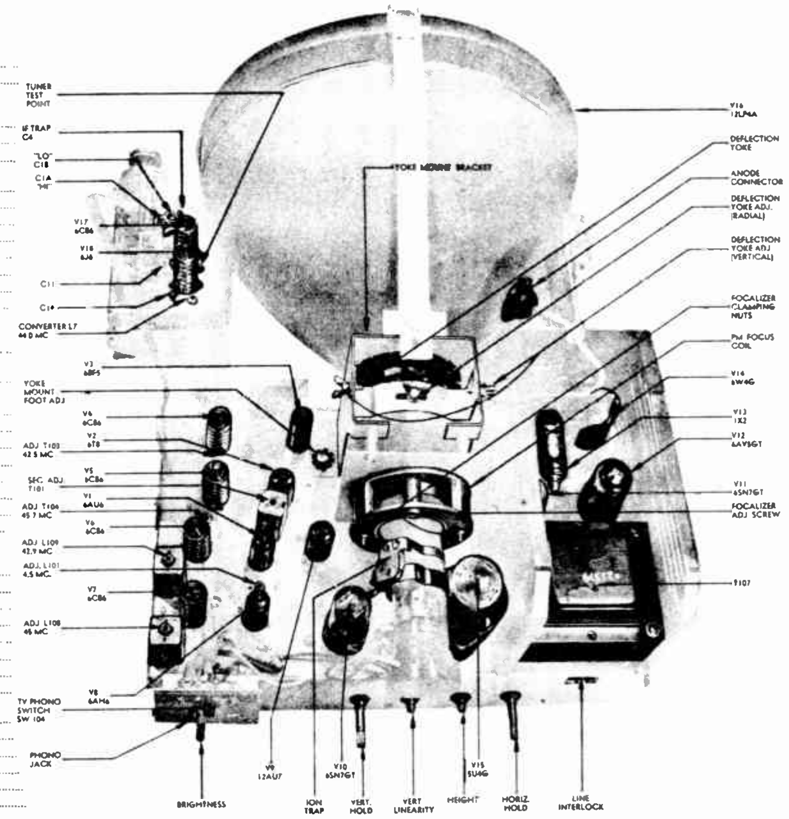
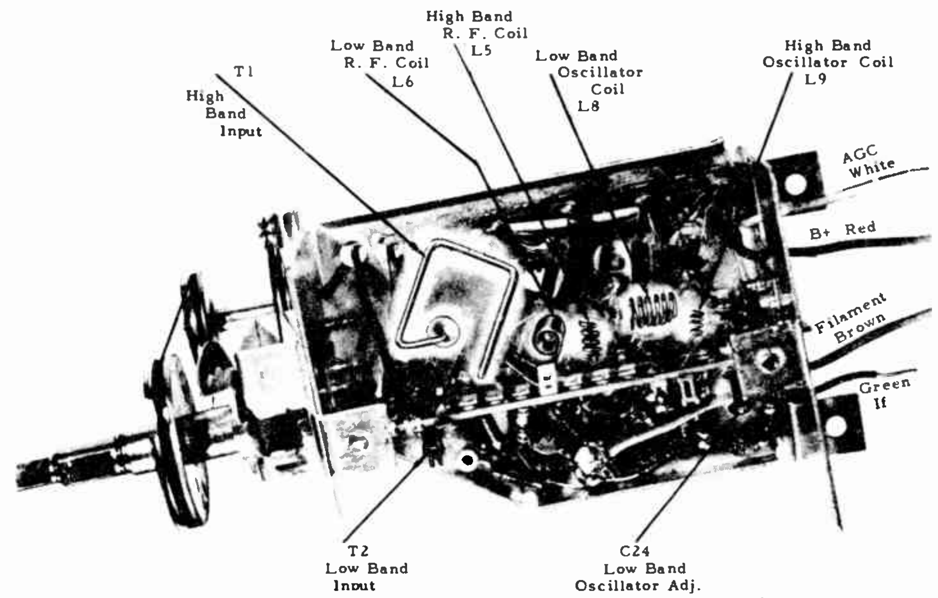
Schematic Location	Part No.	Description
	AC23344-1	Antenna Terminal & Switch Ass'y.
	A19552	Socket, one prong, Phone
SW104	A23245	Switch, Slide, TV-Phone
	A23081	Terminal Strip, Antenna
	A22491-1	Anode Connector & Lead Ass'y.
	C22568	Beam Bender, Ion Trap
	R23319-1	Cabinet Red Mahogany plus Carton
	AE23398-1	Cabinet Back Assembly
	D23434	Tube Esutcheon (Gold Bezel)
	E23435	Tube Mask
	D23433	Safety Glass
	A23039	Rubber Feet with screw for cabinet.
	A23326	Carton and Fillers
C168	A23130-0	Capacitor, (10-160) MMF, Double Trimmer
C101	C20205-7	Capacitor, 2.2 MMF ±.5 MMF 500 DCWV, Ceramic TC-N220
C106, C122 C118	C20205-9	Capacitor, 5MMF ±10% 500 DCWV, TC-N220 Ceramic
C123	C20205-17	Capacitor, 7 MMF ±.5 MMF 500 DCWV, Ceramic
C135	C20205-18	Capacitor, 22 MMF ±10% 500 DCWV, Ceramic
C103	C20206-12	Capacitor, 33 MMF ±10%, TC-N220, Ceramic Uninsulated
C131, C144	C20205-19	Capacitor, 47 MMF ±10%, 500 DCWV, Ceramic
C161	A22623-2	Capacitor, 47 MMF, 1000 V Mica ±10%
C102	C20205-11	Capacitor, 68 MMF ±10% 500 DCWV, TC-N220 Ceramic
C135, C149	C20204-101	Capacitor, 100 MMF ±20%, Ceramic Uninsulated
C152	C20065-151	Capacitor, 150 MMF ±20% 500 DCWV, Mica.
C172	C22412-181	Capacitor, 180 MMF ±5%. 1000 DCWV, Mica
C108	C20290-331	Capacitor, 330 MMF ±10% 500 DCWV, Mica
C171	C20290-391	Capacitor, 390 MMF ±10% 500 DCWV, Mica
C169	C20290-561	Capacitor, 560 MMF ±10% 500 DCWV, Mica
C124, C132 C139, C146	C20351-1	Capacitor, 610 MMF ±10% 500 DCWV, Ceramic, TC-N4700
C158	C23099-102	Capacitor, 1000 MMF ±10%, 1000 DCWV, Mica
C127, C129, C130, C133, C134, C137, C138, C140, C141, C142, C145, C147, C148, C151, C126	A23078	Capacitor, 1000 MMF, 500 V Button
C104, C105	A21674	Capacitor, 5000 MMF Minimum 500 DCWV Button
C111, C157	C20295-102	Capacitor, .001 MFD ±20%, 600 DCWV, Oil Paper
C167	C20324-152	Capacitor, .0015 MFD ±5%, 600 DCWV, Oil Paper
C154, C176	C20295-222	Capacitor, .0022 MFD ±20%, 600 DCWV, Oil Paper
C109, C112, C155, C156	C20295-472	Capacitor, .0047 MFD ±20%, 600 DCWV, Oil Paper
C162, C163	C20358-103	Capacitor, .01 MFD ±20%, 600 DCWV, Oil Paper
C117	C20295-103	Capacitor, .01 MFD ±20%, 600 DCWV, Oil Paper
C170	C20324-103	Capacitor, .01 MFD ±5%, 600 DCWV, Oil Paper
C113, C174	C20292-223	Capacitor, .022 MFD ±20%, 400 DCWV, Oil Paper
C160	C20295-333	Capacitor, .033 MFD ±20%, 600 DCWV, Oil Paper
C150 C153, C166	C20292-473	Capacitor, .047 MFD ±20%, 400 DCWV, Oil Paper
C175	C20295-473	Capacitor, .047 MFD ±20%, 600 DCWV, Oil Paper
C159, C121	C20291-104	Capacitor, .1 MFD ±20%, 200 DCWV, Oil Paper
C164	C20329-104	Capacitor, .1 MFD ±20%, 1000 DCWV, Oil Paper
C173, C114	C20291-224	Capacitor, .22 MFD ±20%, 200 DCWV, Oil Paper
C119	C20292-224	Capacitor, .22 MFD ±20%, 400 DCWV, Oil Paper
C165	C20291-474	Capacitor, .47 MFD ±20%, 200 DCWV, Oil Paper
C116	A23714	Capacitor, 4 MFD +100% −10%, 300 DCWV, Electrolytic
C110, C128	A23025-2	Capacitor, 5 MFD 150 DCWV, Electrolytic
C120	C22422-5	Capacitor, (30, 450V-40, 350V-10, 200V, 40-350V) MF Electrolytic
C115	C22422-6	Capacitor, (10, 450V-40, 350V-80, 200V-100, 50V) MF Electrolytic
L118	C22561-1	Choke, Filter
L110, L111 L112, L119	A23095	Choke, R. F. Filament
L113	C22905-1	Choke, Vertical Output
	AC23350-1	Cloth, Grille & Baffle Ass'y.
L106, R127	C22500-9	Coil, Peaking
L103, R118	C22500-11	Coil, Peaking
L102	C22500-12	Coil, Peaking
L104	C22500-10	Coil, Peaking
L107	C22500-6	Coil, Peaking
L105	C22500-3	Coil, Peaking
L101	C23093	Coil, Pick-off 4.5 Mc.
L120 R107, R120	C23894	Coil Width
SW103	E22464-21	Control, Volume Contrast, On-Off
R156	E22464-10	Control, Height
R161	E22464-11	Control, Vertical Hold
R163	E22464-12	Control, Vertical Linearity
R182	E22464-13	Control, Horizontal Hold
R123	E22464-14	Control, Brightness
	A23261	Crystal, IN64
	C23058-2	Focalizer
SW102	A22868	Interlock Switch
SW101	A22489	Interlock Plug
	AA23022-1	Knob, Band Change Assembly
	AA23023-1	Knob, Contrast Assembly
	A23020-1	Knob, Channel Selector
	C23001-1	Disc, Channel Indicator
	A23616	Channel Indicator Compress'on Spring (10)
	A23021-1	Knob, Volume
	C22686-1	Knob, Vertical Hold
	C22686-2	Knob, Horizontal Hold
	C22686-3	Knob, Brightness
SW101	A22644	Line Cord & Plug
R104, R135, R141, R146	C22381-470	Resistor, 47 ohms ½W ±10%
R119	C22381-680	Resistor, 68 ohms ½W ±10%
R184	C20061-101	Resistor, 100 ohms ½W ±20%
R132, R139, R140	C22381-151	Resistor, 150 ohms ½W ±10%
R115	C20103-221	Resistor, 220 ohms 1W ±20%

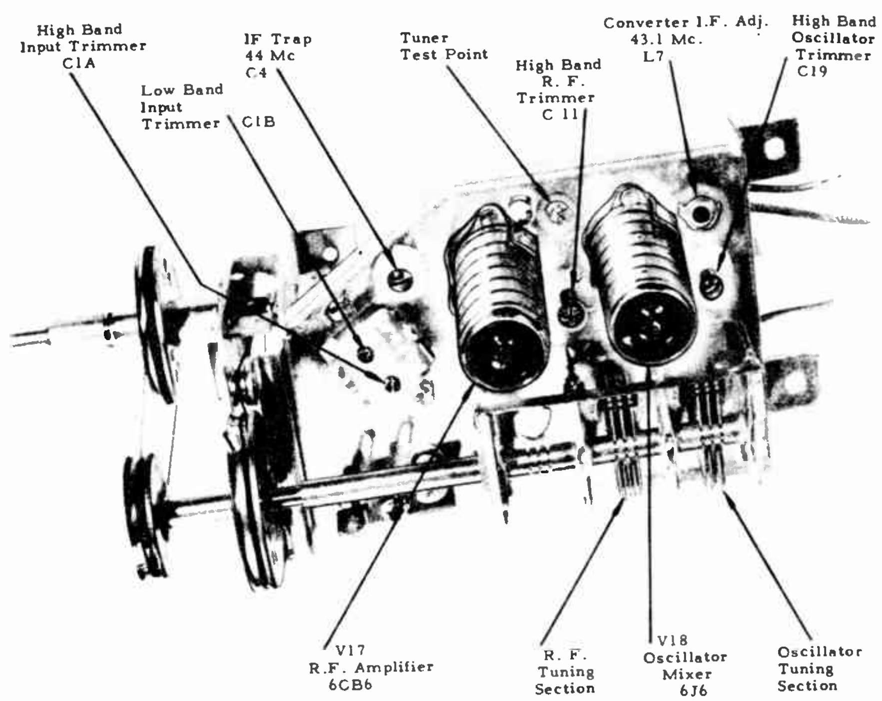
Schematic Location	Part No.	Description
R168	C20061-331	Resistor, 330 ohms ½W ±20%
R128, R134, R137, R144,	C20061-471	Resistor, 470 ohms ½W ±20%
R113	C20302-471	Resistor, 470 ohms 2W ±10%
R102, R103	C20061-102	Resistor, 1000 ohms ½W ±20%
R150, R164, R165	C22381-122	Resistor, 1200 ohms ½W ±10%
R170	C20061-152	Resistor, 1500 ohms ½ ±20%
R114	C20103-222	Resistor, 2200 ohms 1W ±20%
R162	C22381-272	Resistor, 2700 ohms ½W ±10%
R138, R145	C20061-332	Resistor, 3300 ohms ½W ±20%
R151	C22381-562	Resistor, 5600 ohms ½W ±10%
R116	C20070-562	Resistor, 5600 ohms 1W ±10%
R126	C22381-682	Resistor, 6800 ohms ½W ±10%
R122, R147, R153, R154, R177, R180	C22381-822	Resistor, 8200 ohms ½W ±10%
R117, R152, R171	C20061-103	Resistor, 10K ohms ½W ±20%
R133	C22382-123	Resistor, 12K ohms ½W ±5%
R167	C20302-153	Resistor, 15K ohms 2W ±10%
R106	C22381-183	Resistor, 18K ohms ½W ±10%
R136, R142	C22382-183	Resistor, 18K ohms ½W ±5%
R155, R174	C22381-223	Resistor, 22K ohms ½W ±10%
R105	C22381-273	Resistor, 27K ohms ½W ±10%
R131, R160	C22381-563	Resistor, 56K ohms ½W ±10%
R183	C22381-683	Resistor, 68K ohms ½W ±10%
R172	C22383-913	Resistor, 91K ohms 1W ±5%
R101, R110, R121, R124, R159	C20061-104	Resistor, 100K ohms ½W ±20%
R158	C22381-104	Resistor, 100K ohms ½W ±10%
R176	C22383-104	Resistor, 100K ohms 1W ±5%
R173	C20070-124	Resistor, 120K ohms 1W ±10%
R178	C22381-154	Resistor, 150K ohms ½W ±10%
R175	C22383-154	Resistor, 150K ohms 1W ±5%
R111	C22382-164	Resistor, 160K ohms ½W ±5%
R112	C22382-184	Resistor, 180K ohms ½W ±5%
R109, R129, R185	C22381-224	Resistor, 220K ohms ½W ±10%
R169, R130	C20061-334	Resistor, 330K ohms ½W ±20%
R166	C20061-474	Resistor, 470K ohms ½W ±20%
R181	C22382-824	Resistor, 820K ohms ½W ±5%
R125, R148	C20061-105	Resistor, 1 meg., ½W ±20%
R179	C22383-275	Resistor, 2.7 meg., 1W ±5%
R149	C20061-335	Resistor, 3.3 meg., ½W ±20%
R157	C22381-395	Resistor, 3.9 meg., ½W ±10%
R108	C20061-106	Resistor, 10 meg., ½W ±20%
	A22572	Shield, Min. Tube
S0101	A23202	Socket, Speaker
	AC23363-1	Socket Assembly Picture Tube
	C23347	Speaker, 5¼" P.M.
PL101	A23201	Speaker Plug
	AD23338-1	Strap Ass'y., Picture Tube Hold Down Strap
T103, C143, R143	C23614	Transformer, 1st Pix. I.F. with Trap
T104, C136	C23672	Transformer, 2nd Pix. I.F. with Trap
L109	C23673-1	Transformer, 3rd Pix. I.F.
L108	C23673-2	Transformer, 4th Pix. I.F.
T101, C107	C23094	Transformer, Ratio Detector
T105	D22563	Transformer, Horizontal Oscillator
T106	E23089	Transformer, Horizontal Output
T102	C23490	Transformer, Audio Output
T107	E23379	Transformer, Power
	AE23054-2	Tuner Unit Assembly, Complete with Tubes
C1	A23119	Capacitor, (4-70) (4-70) MMF, Double Trimmer
C2, C3, C6, C7, C8, C9, C10, C16	A23078	Capacitor, 1000 MMF, 600 V
C4, C24	C23106-3	Capacitor, (1-6) MMF
C5	C20204-470	Capacitor, 47 MMF ±20%, 500 V
C11, C19	C23106-1	Capacitor, (½ to 3) MMF
C12	C20205-10	Capacitor, 13 MMF, ±0.5 MMF
C13	C23057	Capacitor, (Tuning Gang)
C14, C23	C20205-14	Capacitor, 14 MMF, ±5%, 500 V. TC Ceramic
C15	C20205-9	Capacitor, 5 MMF, ±10%, 500 V N220 Ceramic
C17	C20205-13	Capacitor, 8.2 MMF, ±½, 500 V
C18	A20238-5	Capacitor, 3.3 MMF, ±20%
C20	C20205-15	Capacitor, 18 MMF, ±½, 500 V, TC, Ceramic
C21	C20204-820	Capacitor, 82 MMF, ±20%, 500 V, Ceramic
C22	C20205-12	Capacitor, 33 MMF, ±10%, 500 V, N220
L11, L4	AA23502-1	Choke, R.F.
L10	AA23257-1	Choke, R.F.
L1, L2, L3	AA22334-1	Choke, Filament
R1	C20061-332	Resistor, 3300 ohms, ½W, ±20%
R2	C22381-561	Resistor, 560 ohms, ½W, ±10%
R3	C22061-680	Resistor, 68 ohms, ½W, ±20%
R4	C20070-39	Resistor, 3.9 ohms, 1W, ±10%
R5, R7, R12	C20061-331	Resistor, 330 ohms, ½W, ±20%
R6, R11	C22381-103	Resistor, 10 K ohms, ½W, ±10%
R8	C22381-562	Resistor, 5600 ohms, ½W, ±10%
R9	C20061-104	Resistor, 100K ohms, ½W, ±20%
R10	C22381-223	Resistor, 22K ohms, ½W, ±10%
	A22572	Shield, Miniature Tube
L7	C23091-1	Transformer, I.F.
T^	C23112	Transformer, Antenna Low Band
		Tuner Mechanisms
	A23037	Cam Detent Stop Spring
	AA23056-1	Cam and Shaft Assembly
	AA23055-1	Pointer Pulley Shaft Ass'y.
	A19133	Drive Cord Spring (10)
	A23024-1	Spring Lock, Around tuning shaft (10)
	A23024-2	Spring Lock, Around Band Shaft (10)
	AA23841	Tuning Shaft & Brkt. Assembly
L114, L115 L116, L117	AC23084-2	Yoke, Deflection & Lead Assembly



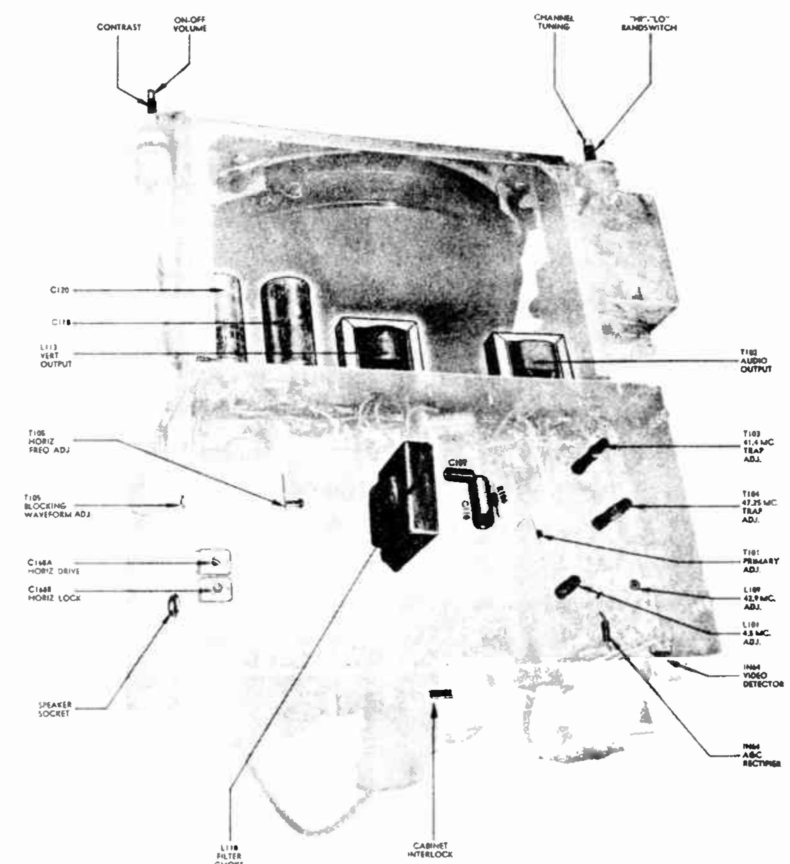
TOP VIEW — Chassis 289



BOTTOM VIEW - TUNER UNIT AE 23054-1



TOP VIEW - TUNER UNIT AE 23054-1



BOTTOM VIEW — Chassis 289

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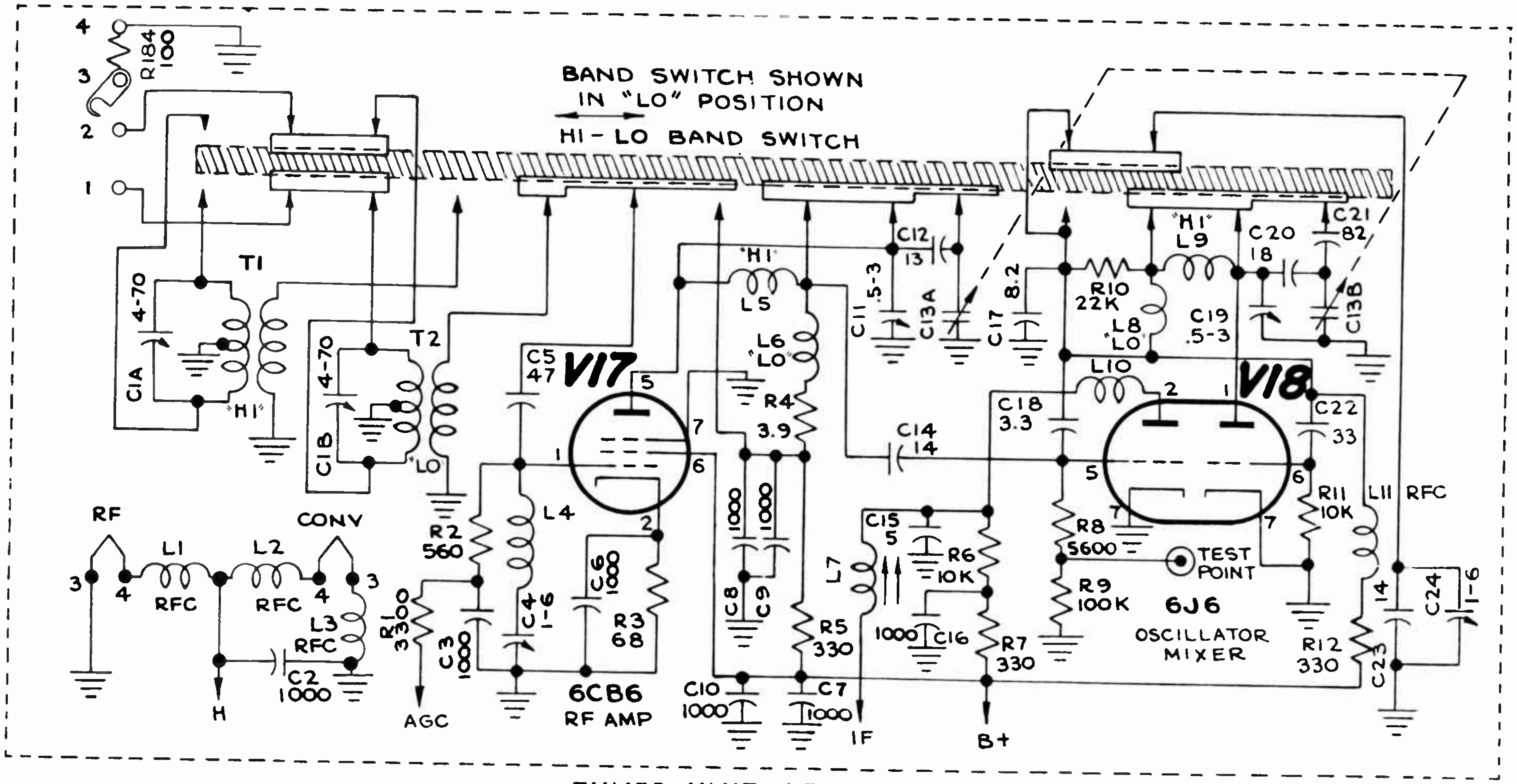
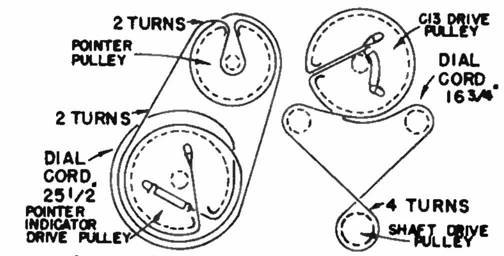


TUNER UNIT AE 23054-2



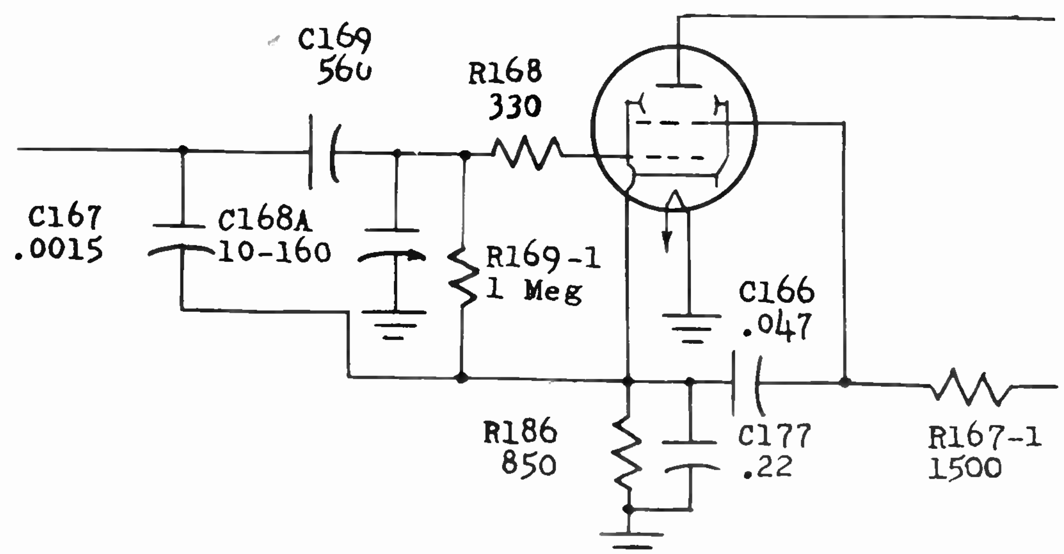
DIAL STRINGING ARRANGEMENT

SUBJECT: Model TE-2122TM V12, 6AV5GT -- Correcting excessive failure of this tube.

A kit of parts (per change) will be supplied upon request for any Chassis TE-289 in the field that has excessive 6AV5GT failure. Kit Part No. A24033-2.

All Chassis TE-289-2 incorporate the accompanying circuit change to devrease the dissipation in the 6AV5GT, V12, Horizontal Output, and increase the life of this tube. Model 2122TM used Chassis TE-389 in which the life of V12 can be increased by making this change.

a. R186, 850 ohm, 10 watt resistor added between cathode and ground of 6AV5GT tube.
b. Ground side of C166 condenser rerouted to cathode of 6AV5GT.
c. C177, 122 uf., 400V. condenser added to cathode circuit of 6AV5GT tube.
d. R167 Resistor changed to R167-1, 1500 ohm, 10 watt Resistor.
e. Ground side of C167 (.0015 mfd.) Condenser rerouted to 6AV5GT cathode.
f. R169-1 (1 meg.) Resistor ground side rerouted to 6AV5GT cathode.



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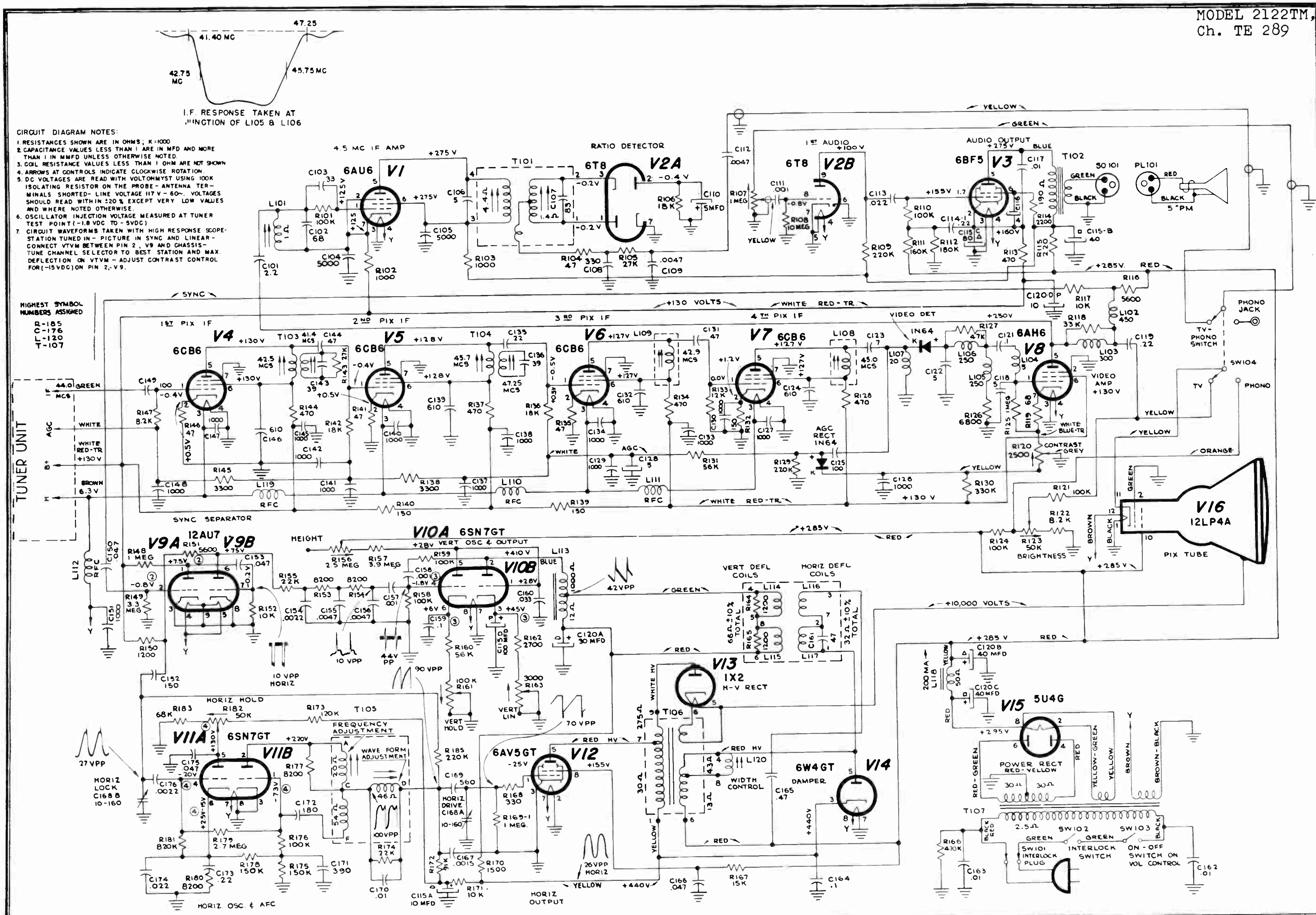
MODEL 2122TM, Ch. TE 289



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TUBE COMPLEMENT

V17	6CB6	R. F. Amplifier	V8	6AU6	Video Amplifier
V18	6J6	Oscillator-Mixer	V9A	12AU7	Sync. Amplifier
V1	6AU6	Sound I.F. Amplifier	V9B		Sync. Separator
V2A	6T8	Sound Discriminator	V10A	6SN7GT	Vert. Oscillator
V2B		1st Audio Amplifier	V10B		Vert. Output
V3	6AS5	Audio Output	V11A	6SN7GT	Horizontal AFC
V4	6CB6	1st Pix I.F. Amplifier	V11B		Horz. Oscillator
V5	6CB6	2nd Pix I.F. Amplifier	V12	6AV5GT	Horz. Output
V6	6CB6	3rd Pix I.F. Amplifier	V13	1X2	High-Voltage Rectifier
V7A	6AL5	AGC Rectifier	V14	6W4GT	Damper
V7B		D-C Restorer	V15	5Y3GT	Power-Supply Rectifier
			V16	8AP4A	Picture Tube (8½")

SPECIFICATIONS

Power Supply Rating	117 Volts, 60 Cycles, 135 Watts
Audio Power Rating	1.0 Watt
Antenna Input Impedance	72 or 300 ohm
Video Response	To 3 MC
Focus	Permanent Magnet (Focalizer)
Sweep Deflection	Magnetic
Picture Carrier	45.75 MC
Adjacent Channel Sound Trap	47.25 MC
Sound Carrier	41.25 MC

The ARVIN television receiver will in most cases be ready for installation when unpacked from its shipping carton. However, it is advisable to "air-check" the receiver before delivery and make any necessary final adjustments. A critical eye prior to and during installation will minimize service calls and promote a satisfied customer.

ADJUSTMENTS

ION TRAP

Proper attention to ion-trap adjustment must be given to insure satisfactory operation of the picture tube. Assuming the ion-trap is off to the extent that no raster appears, proceed as follows:

See that the magnet portion of the ion-trap is over the "top" of the gun with the rear plane of the ion-trap over the spot welds on the gun structure. (Be sure the trademark notations on the magnet portion of the ion-trap are to the rear of the C-R tube.) Now rotate the ion-trap until raster appears. It may be necessary to slide the ion-trap slightly forward or backward for best raster. With the contrast control at minimum (full counter-clockwise) adjust the brightness control for a dim raster, and rotate the ion-trap for maximum brightness.

FOCUS — CENTERING

No electrical provision in the circuit is made for centering. The focalizer must be positioned properly for centering of the picture. Both the focus adjustment screw and the ion-trap have an effect on picture centering, but the focalizer has the most effect. When the focalizer is rotated correctly, the other two are relatively simple and only slight adjustments will be necessary.

The permant magnet focalizer has both a "coarse" and "fine" adjustment. The "coarse" adjustment is made by rotation of the focalizer; the "fine" or vernier adjustment is made by movement of the focus adjustment screw mounted on the top of the focalizer.

Tune in any available station and set the contrast control to approximately ¾ maximum clockwise. Turn Brightness control to maximum and then back it off until retrace lines cannot be seen. Turn the focus adjustment screw in (clockwise) until it is approximately 1/16" from shorting the plates of the focalizer. Loosen the two 5/16" focalizer clamp nuts (see "C" on the top chassis view of the schematic diagram). Rotate the focalizer for best focus, centering and absence of side shadows. Turn the focus adjustment screw for touch-up on best definition and picture focus.

HEIGHT AND VERTICAL LINEARITY (REAR)

The picture should fill the mask and be symmetrical from top to bottom. Adjustments of both the Height Control and Vertical Linearity Control will accomplish this if centering of picture by the focalizer is already proper.

SQUARING THE RASTER

The Yoke Mount and Yoke should be positioned properly as follows:

The large front hole in the Yoke Mount Bracket is rimmed with rubber channel. Loosen the two screws in the feet of the Yoke Mount Bracket and push the mount forward so that the cone of the picture tube fits snugly into the rubber channel. Loosen the top wing-screw and two side wing-screws holding the Yoke and slide the mount forward onto the cone of the picture tube—center the Yoke so the tube neck is co-axial and tighten the two side mounting wing-screws. Rotate the Yoke to square the raster and tighten the top wing-screw.

HORIZONTAL HOLD

If Horizontal adjustments appear necessary, refer to the alignment section for procedure.

SERVICE TEST EQUIPMENT

R-F SWEEP GENERATOR

To provide center Frequency Range—40 Mc. to 50 Mc. with 1 Mc. to 10 Mc. sweep width.

To provide center Frequency Range—50 Mc. to 90 Mc.

To provide center Frequency Range—170 Mc. to 225 Mc.

Variable output—at least .1 volt maximum—flat sweep output all ranges.

R-F SIGNAL GENERATOR

To provide frequencies from 41.25 Mc. to 47.25 Mc.—55.25 Mc. to 130.5 Mc.—175.25 Mc. to 258.5 Mc.

Variable Output and at least .1 volt maximum.

HETERODYNE FREQUENCY METER

With crystal calibrator to check R-F Signal Generator.

CATHODE RAY OSCILLOSCOPE

With wide band vertical deflection and means to calibrate input.

ELECTRONIC VOLT OHMMETER

With multiplier probe for hi-voltage measurements to 10 Kv.

ALIGNMENT

SEQUENCE FOR COMPLETE ALIGNMENT

1. Video I. F. Trap.
2. Video I. F. Overall.
3. Audio take-off and ratio detector.
4. Tuner unit.

VIDEO I. F. ALIGNMENT

1. Connect signal generator to tuner test point.
2. Set contrast control in approximately middle of its range.
3. Connect DC probe of VTVM between junction of L105 and L106 (across the video detector load resistor, R124.)
4. Set unmodulated generator on 47.25 Mc. and adjust bottom of T103 for minimum VTVM deflection. A large signal input may be required.
5. Set unmodulated generator on 45.3 Mc. and adjust L102 and top of T103 for maximum VTVM deflection. NOTE: Reduce input if VTVM reading exceeds (4) volts (prevents overload).
6. Set unmodulated generator on 43.1 Mc. and adjust L7 (converter on tuner unit) and L103 for maximum VTVM deflection. NOTE: Reduce input if VTVM reading exceeds (4) volts.
7. Disconnect generator and VTVM. Connect sweep generator to tuner test point.
8. Connect vertical amplifier of scope to junction of L105 and L106.
9. Set the scope for external sweep and connect the "scope" terminals of the sweep generator to the horizontal amplifier input terminals on the oscilloscope.
10. Adjust sweep output and phasing and scope gains to obtain usable I. F. response curve.
11. Retouch L102 and top of T103, L7 and L103 to obtain proper curve as shown in Fig. 1. NOTE: Extreme care must be taken not to overload the I. F. circuit during test.

NOTE: Should great difficulty be noted in aligning, redressing locations of I. F. coupling condensers, C138, C133, C130, and C125 may be effective in shaping the response curve.

Figure 1—Video I.F. Response

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SOUND I. F. ALIGNMENT

Method A

1. Connect sweep generator of 4.5 Mc. center frequency to pin 1, of V8. Set sweep width to 500 Kc.
2. Connect AM modulated 4.5 Mc. signal to pin 1 of V8.
3. Connect horizontal amplifier of scope to "scope" terminals of sweep generator.
4. Connect vertical amplifier of scope to junction of R105 and C108. Adjust scope gains, phasing and output of sweep to obtain usable trace on scope.

   NOTE: Extreme care must be taken not to overdrive the circuit under test. (See Fig. 2.)
5. Adjust top of T101 for minimum ripple response on scope.
6. Adjust L101 and bottom of T101 for two equal and maximum curve peaks (See Fig. 2).
7. Disconnect all test equipment and tune in a transmitted signal. Adjust fine tuning and contrast until a low audible buzz is noted in the speaker. Check adjustment of T101 secondary (Top) to be certain it is set for minimum buzz (Maximum AM rejection).

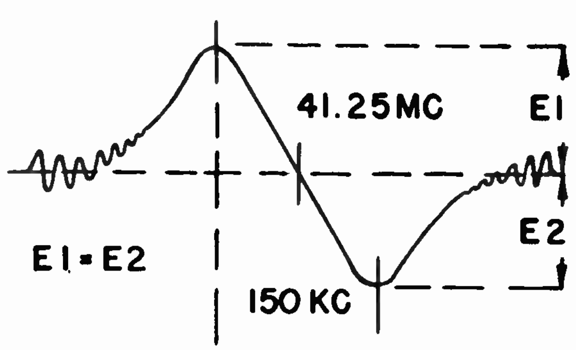

Figure 2

Method B

1. Tune in a transmitted test pattern signal with constant tone.
2. Connect DC probe of VTVM between pin 2, V2 and ground.
3. Adjust L101 and bottom of T101 for maximum deflection of VTVM.

   NOTE: Reduce contrast if meter reading exceeds 6 volts.
4. Adjust fine tuning and contrast until a low audible buzz is noted in the speaker. Adjust top of T101 carefully for minimum buzz.

   NOTE: An accurate 4.5 Mc. signal generator source could be used for step 1—step 2 and 3 would remain the same—AM modulate the 4.5 Mc. signal, connect a scope to the junction of R105 and C108 and adjust T101 (Top) for minimum ripple on the oscilloscope.

TUNER ALIGNMENT

ORDER OF PROCEDURE

1. High-band oscillator ranging.
2. Low-band oscillator ranging.
3. I. F. trap adjustment.
4. High-band antenna tuning.
5. Low-band antenna tuning.
6. High-band tracking.
7. Low-band tracking.

NOTE:

Tuner alignment should not be attempted until I. F. is correctly aligned and set is otherwise operating correctly. The condenser plates of the tuning condenser should never be bent out of correct alignment. The contrast control should be at mid-range. All final checks on the above steps should be made with the tuner shield on.

HIGH-BAND OSCILLATOR RANGING

1. The correct extreme tuning range of the high-band oscillator with the fine tuning is 219.5 Mc. to 258.5 Mc.
2. Connect the vertical input of the oscilloscope to the tuner side of C138 which is the input coupling capacitor to V4, the first I. F. amplifier. (Green lead from tuner)
3. Connect a signal generator to the antenna terminals tuned to 258.5 Mc. The signal generator output should exceed 100,000 microvolts.
4. Turn the band switch to the high channel position.
5. Set the tuning maximum clockwise for the highest frequency position and adjust C19 carefully for a zero beat indication on the oscilloscope.
6. Set the fine tuning maximum counter-clockwise and tune the signal generator around 219 Mc. very carefully to see what the zero beat frequency of the low end is.
7. If the oscillator frequency is above 219.5 Mc., squeeze the turns slightly together of L9 and then repeat the procedure of steps 5 and 6.
8. If the frequency of the oscillator is below, the turns of L9 will have to be spread slightly and the steps of 5 and 6 repeated.
9. By this procedure, the right value of inductance for L9 and the correct setting of C19 trimmer can readily be found in order that the oscillator will properly range from 219.5 Mc. to 258.5 Mc.

LOW-BAND OSCILLATOR RANGING

1. Test equipment as in High-Band oscillator ranging.
2. The correct extreme tuning range of the low-band oscillator with fine tuning is 99 Mc. to 130.5 Mc.
3. Turn the band switch to the low channels position.
4. With the fine tuning maximum clockwise, set the signal generator frequency to 130.5 Mc. and adjust C24 for zero beat on the oscilloscope.
5. Set the fine tuning maximum counter-clockwise and check the local oscillator frequency with the zero beat method as previously described.
6. If the oscillator is above 99 Mc., spread the turns slightly of L8 and repeat steps 4 and 5.
7. Should the local oscillator be below 99 Mc., squeeze the turns slightly together of L8 and repeat steps 4 and 5.
8. By this zero beat method, the range of the local oscillator in the tuner can be adjusted to cover from 99 Mc. to 130.5 Mc. (low-band).

I. F. TRAP ADJUSTMENT (TUNER)

1. Connect a signal generator to the antenna terminals tuned to 44 Mc.
2. Connect a VTVM to the junction of L105 and L106 (across video detector load, R124).
3. Adjust C4 for minimum meter deflection.

HIGH-BAND ANTENNA TUNING

1. Turn the band switch to the high channels position.
2. Connect the sweep generator to the antenna terminals to sweep for channel 11.
3. Adjust the fine tuning until a response curve appears on the scope.
4. Adjust C1A for maximum curve height.

LOW-BAND ANTENNA TUNING

1. Turn the band switch to the low channels position.
2. Connect the sweep generator to the antenna terminals to sweep around channel 5.
3. Connect the oscilloscope to the junction of L105-L106.
4. Tune the fine tuning until a response curve appears on the oscilloscope.
5. Adjust C1B for maximum curve height.

HIGH-BAND R. F. TRACKING

1. Connect sweep generator to antenna terminals and oscilloscope to the junction of L105 and L106.
2. Set the band switch to the high channels position.
3. Set the fine tuning and sweep for channel 11. Adjust the input for a clean response curve without over-loading.
4. Adjust C11 for maximum response curve height. If the response curve peaks are not level as in figure 3B, check the I. F. alignment and the setting of C1A. These peaks must be level.
5. Check the overall response on channel 7 and channel 13. These response curves should fall in the limits of figure 3A and 3C.
6. If the low frequency side of channel 7 curve is low and the high frequency side of channel 13 curve is high, the R. F. section is over-ranging. This condition can be corrected by spreading the turns of L5 slightly and re-adjusting C11 as in step 4.
7. Conversely, squeezing the turns of L5 slightly and re-adjusting C11 as in step 4 will increase the range of the R. F. section.
8. By this procedure it is readily possible to make the R. F. section track with the oscillator, resulting in overall response curves for each channel to fall within the limits as shown in figure 3A and 3C.

NOTE: When it is necessary to adjust the turns slightly of any of the coils, the tuner cover must be replaced during the checking.

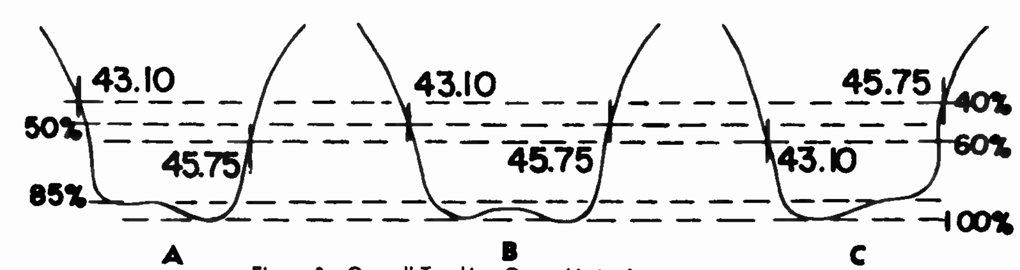

Figure 3—Overall Tracking Curve Limits for any Channel

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LOW-BAND R. F. TRACKING

1. Set the band switch in the low channels position and equipment as in high-band R. F. tracking.
2. Set the tuning and sweep for channel 5.
3. The overall response curve should be within the limits as shown in figure 3. Check the overall response of all the channels to see that they fall within the limits as shown in figure 3.
4. Adjust the turns spacing of L6 for maximum response curve height on channel 5 should result in having the response curves for all channels within the limits as shown in figure 3. If the response curves are out of limits, check the setting of C1B.

TUNER ADJUSTMENT TABLE

C19	Adjust for high-end of oscillotor	258.3 MC
L9	Squeeze turns to lower low-end of oscillotor	219.5 MC
L9	Spread turns to raise low-end of oscillotor	219.5 MC
C24	Adjust for high-end of oscillotor	130.5 MC
L8	Squeeze turns to raise low-end of oscillotor	99.0 MC
L8	Spread turns to lower low-end of oscillotor	99.0 MC
C11	Adjust to track R.F.	Channel 11
L5	Squeeze turns to lower low-end of R.F.	Channel 7
L5	Spread turns to raise low-end of R.F.	Channel 7
L6	Squeeze turns to lower low-end of R.F.	Channel 2
L6	Spread turns to raise low-end of R.F.	Channel 2
C4	IF Trap Adjustment	44 MC
C1A	R.F. input circuit-tune for maximum	Channel 11
C1B	R.F. input circuit-tune for maximum	Channel 5

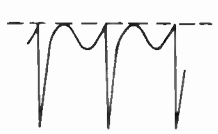
SENSITIVITY MEASUREMENT

Since the calibration in micro-volts output for signal generators varies so greatly between different generators used, it is recommended that a "relative-measurement" of sensitivity be taken as follows:

1. Use a model 4080T that is known to be correctly aligned as proven by a qualitative air-check on available stations.
2. Connect a signal generator to the antenna terminals set for the picture-carrier frequency of any desired channel.
3. Connect a VTVM to the junction of L105 and L106 (video detector load, R124).
4. Tune the station tuning for maximum meter deflection.
5. Adjust the signal generator output for 1 volt VTVM reading.
6. Record the generator's output attenuator reading and use this reading as a comparative standard for sensitivity measurement on other model 4080T receivers (normally, the contact potential across R124 is too little to take into account).

HORIZONTAL OSCILLATOR ADJUSTMENT (COMPLETE)

1. Tune in an available station.
2. Turn the Horizontal Hold Control maximum clockwise.
3. Turn the Horizontal Lock Adjustment to almost tight.
4. Connect the oscilloscope to Terminal "C" of T104.
5. Turn the T104 Blocking Waveform Adjustment maximum counter-clockwise (see chassis view).
6. Sync the picture by adjusting the Horizontal Frequency Adjustment Screw of T104.
7. Turn the Blocking Waveform Adjustment until the waveform is correct as in figure 4 (picture must be in sync when adjusting waveform).
8. Adjust the T104 Frequency Adjustment so that the picture just breaks sync (the ideal is to have a wide vertical black bar representing horizontal blanking showing somewhere in the picture).
9. Turn the Horizontal Hold maximum clockwise. If picture doesn't break sync, momentarily short antenna terminals. Picture will now be out-of-sync.
10. Turn the Horizontal Hold Control slowly conter-clockwise and count the diagonal black bars before "pull-in."
11. There should be 3 bars—adjust Horizontal Locking Range until only 3 bars are present before "pull-in."
12. Turn Horizontal Hold Control maximum counter-clockwise. Picture should just break sync as in Step 8.
13. Adjust T104 Frequency Adjustment to obtain condition of Step 8.
14. Repeat steps 8 thru 12 if necessary to obtain conditions of Steps 8 and 11.



PEAKS OF WAVE FORM MUST BE AT SAME AMPLITUDE LEVEL ACROSS THE TOP.

Figure 4

HORIZONTAL LOCK ADJUSTMENT

The Horizontal Lock can be adjusted without the need of test equipment if the Horizontal Waveform is assumed to be correct. Adjustment is available through marked hole in cabinet bottom.

1. Tune in an available station.
2. Turn the Horizontal Hold maximum clockwise. If picture doesn't break sync, momentarily short antenna terminals. Picture will now be out-of-sync.
3. Turn the Horizontal Hold Control slowly counter-clockwise and count the diagonal black bars just before "pull-in."
4. There should be 3 bars—adjust Horizontal Locking Range until only 3 bars are present before "pull-in."
5. Repeat steps 2 and 3 for the condition of step 4.

HORIZONTAL DRIVE

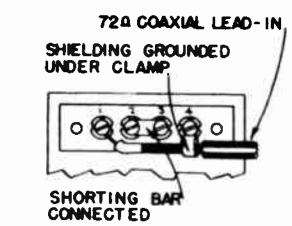
Slight adjustment of the Drive Trimmer will give an overall width control of the raster. Extreme adjustment counter clockwise will lower the high-voltage too greatly.

FREQUENCY TABLE

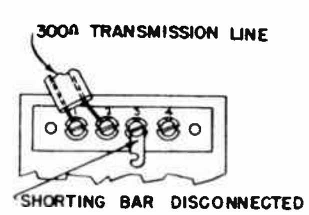
Channel No.	Band Width (mc.)	Picture Carrier (mc.)	Sound Carrier (mc.)	R-F Osc. (mc.)
2	54-60	55.25	59.75	101
3	60-66	61.25	65.75	107
4	66-72	67.25	71.75	113
5	76-82	77.25	81.75	123
6	82-88	83.25	87.75	129
7	174-180	175.25	179.75	221
8	180-186	181.25	185.75	227
9	186-192	187.25	191.75	233
10	192-198	193.25	197.75	239
11	198-204	199.25	203.75	245
12	204-210	205.25	209.75	251
13	210-216	211.25	215.75	257

USE OF MARKER SIGNALS

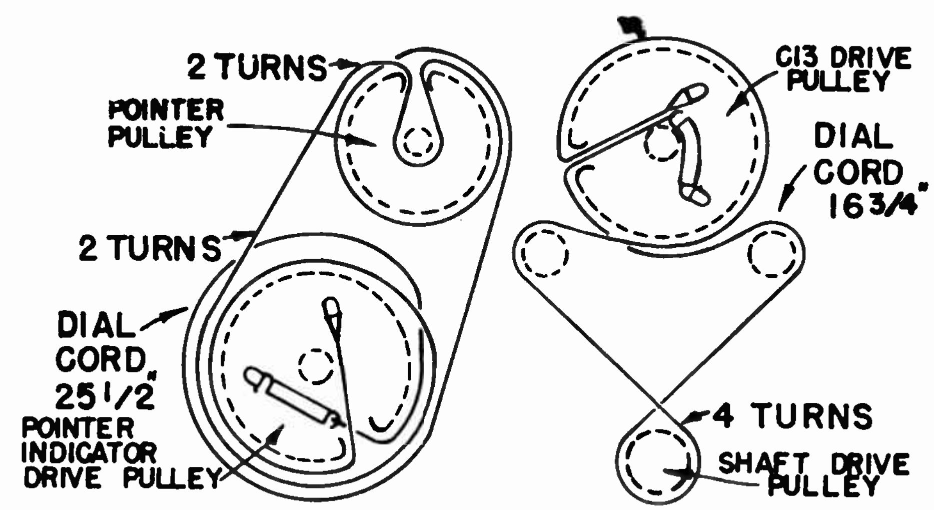
The illustrated response curves show where marker signals fall. For sweep generators that do not have built-in marker signals, calibrated signals from an R.F. generator must be used. Hooking the generator output lead to the chassis near the 1st I.F. input will usually spray enough signal in to be seen on the scope. Marker beats will show best when the sweep-input is low and the scope-gain set high. A .01 MFD condenser across the vertical input terminals of a wide response oscilloscope will cut the response down so the low frequency marker beat can more easily be seen.



ANTENNA CONNECTION USING COAXIAL LEAD-IN



ANTENNA CONNECTION USING 300Ω TRANSMISSION LINE



DIAL STRINGING ARRANGEMENT

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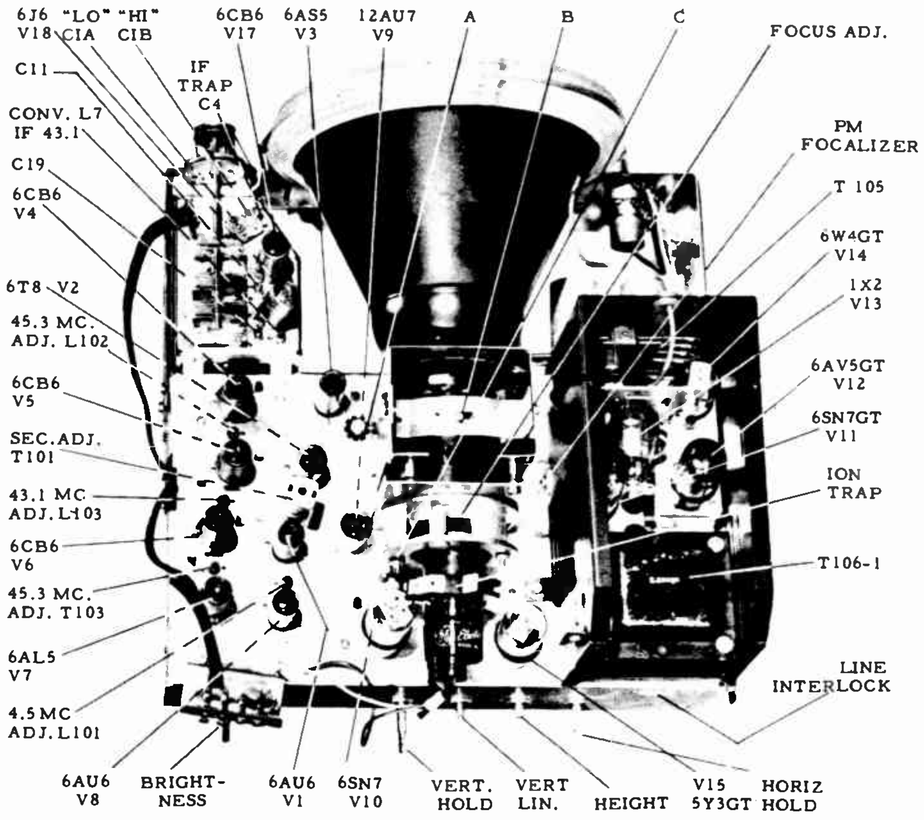
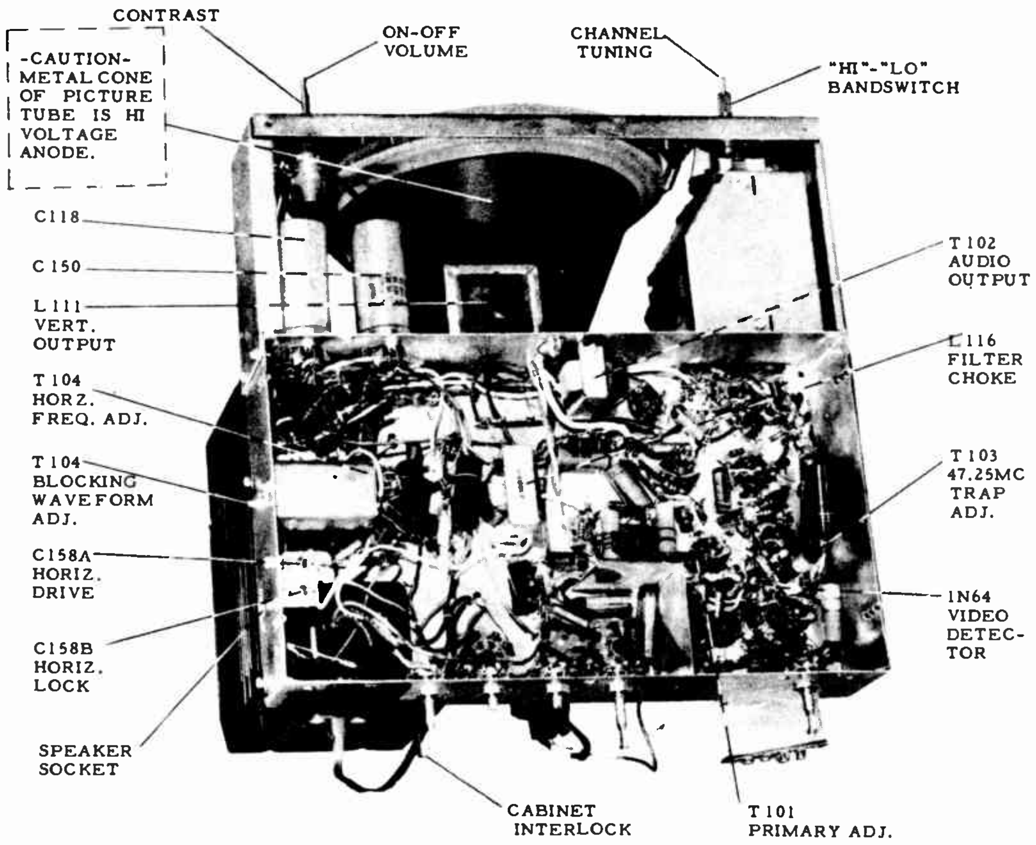
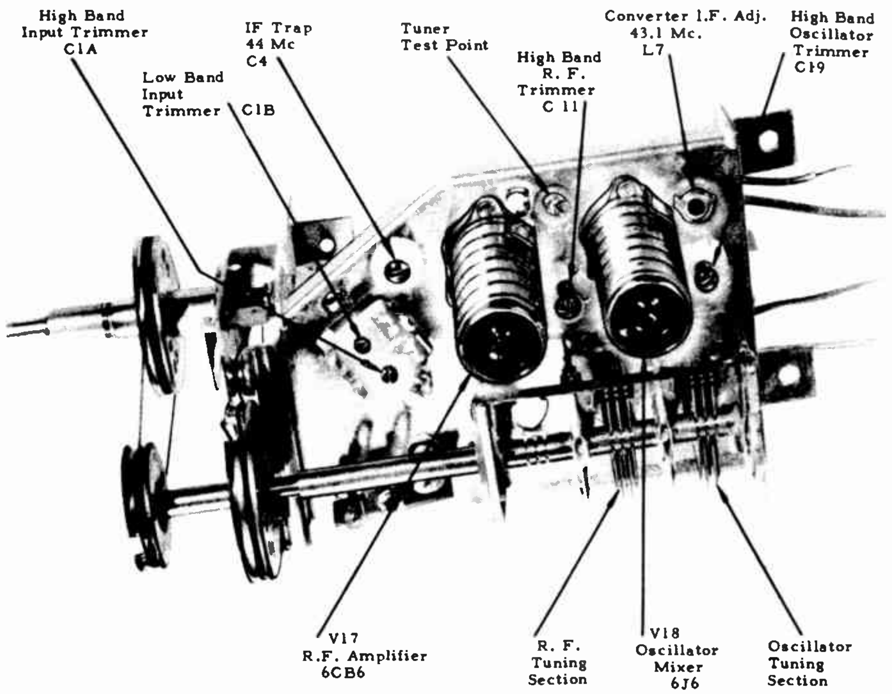
MODEL 4080T (8½")



TOP VIEW - CHASSIS TE 282

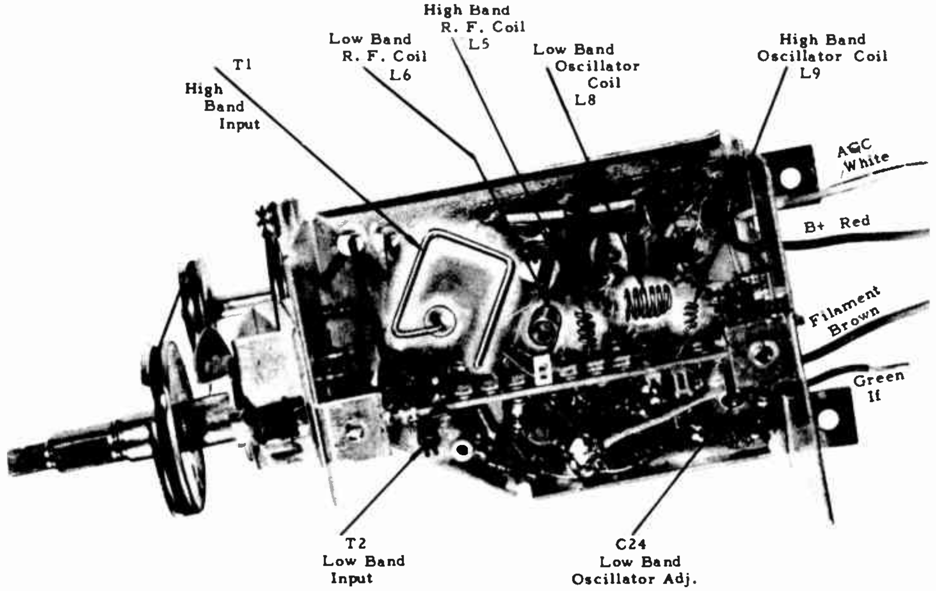


BOTTOM VIEW - CHASSIS TE 282



TOP VIEW - TUNER UNIT AE 23054-1

May 12, 1950



BOTTOM VIEW - TUNER UNIT AE 23054-1

Part No. R23076

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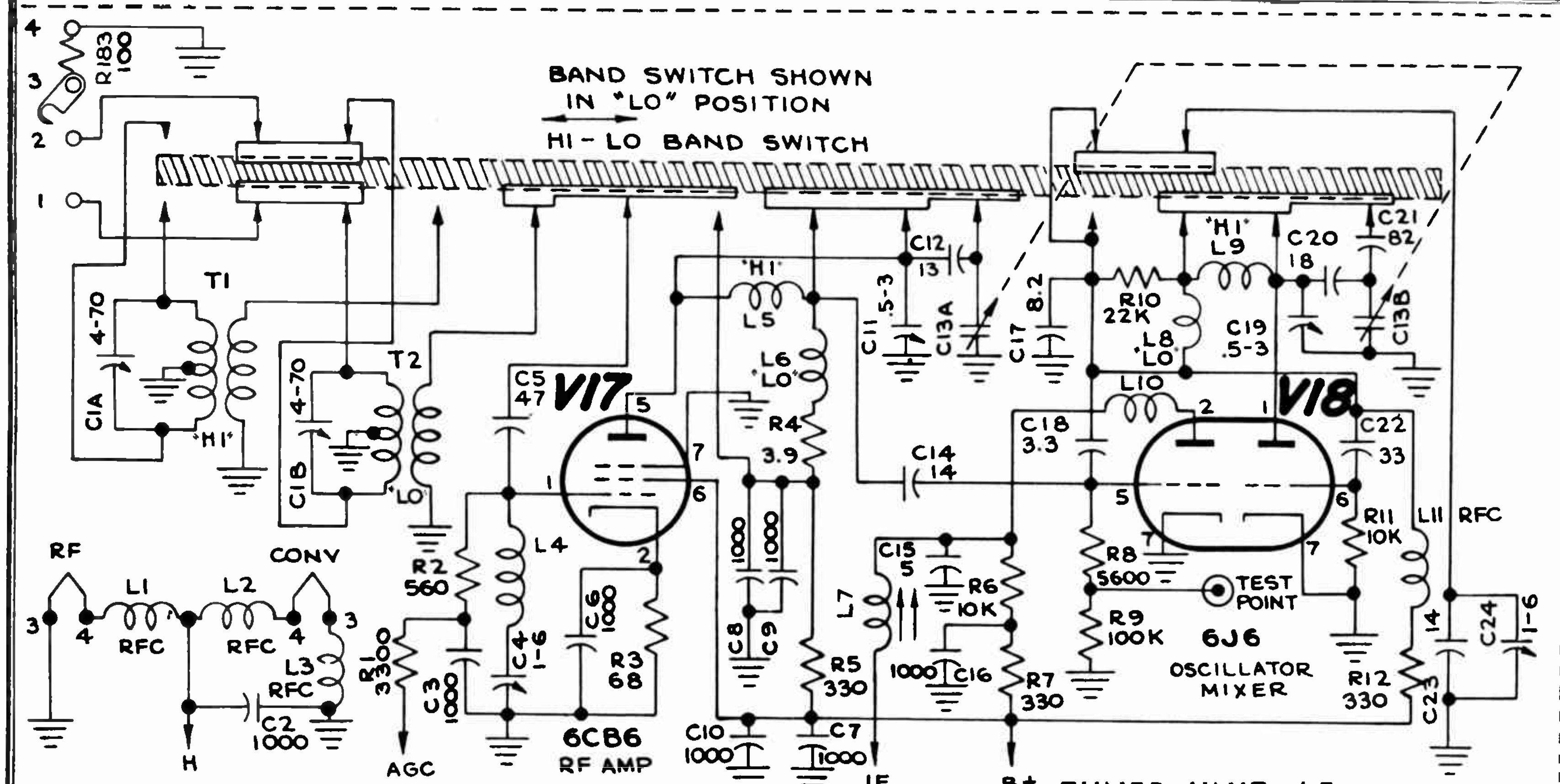

TUNER UNIT AE 23054-1

Part No.	Description
C23378	Beam Bender, Ion Trap
C23087	Choke, Filter L116
A23095	Choke, R-F Filament L109, L110
C22500-3	Coil, Peaking L106, L108
C22500-9	Coil, Peaking L105, L107, R121; R126
C22500-6	Coil, Peaking L104
C23093	Coil, Pick-Off, 4.5 Mc. L101
C23058-1	Coil, Focus, P.M.
A23120	Connector, Picture Tube Anode
D22464-16	Control, Volume, Contrast, On-Off R107, R125, SW103
D22464-11	Control, Vertical Hold R156
D22464-13	Control, Horizontal Hold R181
D22464-14	Control, Brightness R119
D22464-10	Control, Height R150
D22464-12	Control, Vertical Linearity R158
A22644	Cord, Power Cord & Plus SW101
A23261	Crystal, 1N64
A22489	Plug, Interlock SW101
A22572	Shield, Min. Tube
A23266	Socket, Picture Tube
A23202	Socket, Speaker Leads SO101
A22868	Switch, Interlock SW102
C23091-2	Transformer, 1st Pix, I. F. L102
C23091-2	Transformer, 2nd Pix, I. F. L103
C23092	Transformer, 3rd Pix, I. F. T103
C23094	Transformer, Ratio Detector T101
C22905-1	Transformer, Vertical Output Choke L111
D22563	Transformer, Horizontal Oscillator T104
E23089	Transformer, Horizontal Output T105
AC23090-1	Transformer, Audio Output T102
E23086	Transformer, Power T106
AE23054-1	Tuner Unit, Assembly, Complete With Tubes
AC23084-1	Yoke, Deflection & Lead Assembly, L112, L113, L114, L115, R159, R160, C152
C23085	Yoke, Deflection
A23130	Capacitor, (10-160) MMF, Double Trimmer, C158
C20205-7	Capacitor, 2.2 MMF, +.5 500 V., N220, Ceramic C101
C20205-9	Capacitor, 5 MMF, 10%, 500 V., N220, Ceramic, C105, C121
C20205-8	Capacitor, 15 MMF, 10%, 500 V., N220, Ceramic, C133, C130
C20205-12	Capacitor, 33 MMF, 10%, 500 V., N220, Ceramic, C125, C103
A22623-2	Capacitor, 47 MMF, 10%, 100 V., Mica, C152
C20205-11	Capacitor, 68 MMF, 10%, 500 V., N220, Ceramic, C102
C20204-101	Capacitor, 100 MMF, 20%, 500 V., Ceramic, C122, C138
C20065-151	Capacitor, 150 MMF, 20%, 500 V., Mica, C142
A22412	Capacitor, 180 MMF, 5%, 1000 V., Mica, C162
C20290-331	Capacitor, 330 MMF, 10%, 500 V., Mica, C107
C20290-391	Capacitor, 390 MMF, 10%, 500 V., Mica, C159
C20351-10	Capacitor, 610 MMF, 10%, 500 V., N4700, Ceramic, Insulated C127, C131, C135
C23099-102	Capacitor, 1000 MMF, 10%, 1000 V., Mica, C148
A23078	Capacitor, 1000 MMF, Minimum, 500 V., Ceramic Disc C134, C136, C137, C141, C120, C128, C129, C132
A21674	Capacitor, 5000 MMF, Minimum, 500 V., Ceramic Disc, C104
C20295-102	Capacitor, .001 MF, 20%, 600 V., Aerolene Paper, C111, C147
C20324-152	Capacitor, .0015 MF, 5%, 600 V., Oil Paper, C160
C20295-222	Capacitor, .0022 MF, 20%, 600 V., Aerolene Paper, C144, C164
C20295-472	Capacitor, .0047 MF, 20%, 600 V., Aerolene Paper, C108, C109 C145, C146
C20324-103	Capacitor, .01 MF, 5%, 600 V., Oil Paper, C161
C20295-103	Capacitor, .01 MF, 20%, 600 V., Aerolene Paper, C114
C20358-103	Capacitor, .01 MF, 20%, 600 V., Aerolene Paper Molded, C154, C155
C20292-223	Capacitor, .022 MF, 20%, 400 V., Aerolene Paper, C112, C139, C165
C20295-333	Capacitor, .033 MF, 20%, 600 V., Aerolene Paper, C151
C20295-473	Capacitor, .047 MF, 20%, 600 V., Aerolene Paper, C163
C20292-473	Capacitor, .047, 20%, 400 V., Aerolene Paper, C115, C140, C143, C157
C-20291-104	Capacitor, .1 MF, 20%, 200 V., Aerolene Paper, C119, C149
C20329-104	Capacitor, .1 MF, 20%, 1000 V., Aerolene Paper, C156
C20292-224	Capacitor, .22 MF, 20%, 400 V., Aerolene Paper, C117
C20291-224	Capacitor, .22 MF, 20%, 200 V., Aerolene Paper, C116, C123, C124, C166
C20291-474	Capacitor, .47 MF, 20%, 200 V., Aerolene Paper, C153
A23025-2	Capacitor, 5 MF, 150 V., Electrolytic, C110
A23025-1	Capacitor, 10 MF, 25 V., Electrolytic, C113
C22422-5	Capacitor, (30, 450 V.—40, 350 V.—40, 350 V.—10, 200 V.) MF Electrolytic, C118
C22422-6	Capacitor, (10, 450 V.—40, 350 V.—80, 200 V.—100, 50 V.) MF Electrolytic, C150
C22381-390	Resistor, 39 Ohms, ½ W., 10%, R122
C22381-470	Resistor, 47 Ohms, ½ W., 10%, R104
C22382-560	Resistor, 56 Ohms, ½ W., 5%, R139
C22381-680	Resistor, 68 Ohms, ½ W., 10%, R136
C20061-101	Resistor, 100 Ohms, ½ W., 20%, R101
C22381-151	Resistor, 150 Ohms, ½ W., 10%, R111, R133
C20103-221	Resistor, 220 Ohms, 1 Watt, 20%, R140
C20061-331	Resistor, 330 Ohms, ½ W., 20%, R165
C20061-471	Resistor, 470 Ohms, ½ W., 20%, R131, R135, R138
C20061-102	Resistor, 1000 Ohms, ½ W., 20%, R103, R162
C22381-122	Resistor, 1200 Ohms, ½ W., 10%, R161, R159, R160
C20061-152	Resistor, 1500 Ohms, ½ W., 20%, R164, R167
C22381-222	Resistor, 2200 Ohms, ½ W., 10%, R145
C22381-272	Resistor, 2700 Ohms, ½ W., 10%, R157
C20061-332	Resistor, 3300 Ohms, ½ W., 20%, R142
C22381-562	Resistor, 5600, ½ W., 10%, R146
C22381-682	Resistor, 6800, ½ W., 10%, R124
C20070-682	Resistor, 6800, 1 W., 10%, R112
C22381-822	Resistor, 8200, ½ W., 10%, R118, R149, R151, R172, R178
C20061-103	Resistor, 10 K., ½ W., 20%, R113, R114, R147, R168
C22382-123	Resistor, 12 K., ½ W., 5%, R134
C22382-183	Resistor, 18 K., ½ W., 5%, R132, R137, R141
C22381-183	Resistor, 18 K., ½ W., 10%, R106
C22381-223	Resistor, 22 K., ½ W., 10%, R148, R171
C22381-273	Resistor, 27 K., ½ W., 10%, R105
C22381-563	Resistor, 56 K., ½ W., 10%, R127, R155
C22381-683	Resistor, 68 K., ½ W., 10%, R180
C22383-913	Resistor, 91 K., 1 W., 5%, R169
C22381-104	Resistor, 100 K., ½ W., 10%, R153
C20061-104	Resistor, 100 K., ½ W., 20%, R102, R115, R117, R120, R154
C22383-104	Resistor, 100 K., 1 W., 5%, R174
C20070-124	Resistor, 120 K., 1 W., 10%, R173
C22381-154	Resistor, 150 K., ½ W., 10%, R176
C22383-154	Resistor, 150 K., 1 W., 5%, R175
C22381-224	Resistor, 220 K., ½ W., 10%, R129, R170
C20061-334	Resistor, 330 K., ½ W., 20%, R166
C20061-474	Resistor, 470 K., ½ W., 20%, R110, R109, R163
C22381-564	Resistor, 560 K., ½ W., 10%, R128, R130
C22382-824	Resistor, 820 K., ½ W., 5%, R179
C20061-105	Resistor, 1 Meg., ½ W., 20%, R116, R123, R143
C22383-275	Resistor, 2.7 Meg., 1 W., 5%, R177
C20061-335	Resistor, 3.3 Meg., ½ W., 20%, R144
C22381-395	Resistor, 3.9 Meg., ½ Watt, 10%, R152
C20061-106	Resistor, 10 Meg., ½ Watt, 20%, R108

TUNER UNIT

Part No.	Description
C23106-1	Capacitor, (½ to 3) MMF C11, 19
C23106-3	Capacitor, (1-6) MMF C4, C24
C23057	Capacitor, (Tuning Gang), C13
A23119	Capacitor, (4-70) (4-70) MMF, Double Trimmer, C1
A20238-5	Capacitor, 3.3 MMF, 20%, C18
C20205-9	Capacitor, 5MMF, 10%, 500 V., N220, Ceramic, C15
C20205-13	Capacitor, 8.2 MMF, ½, 500 V., Ceramic, C17
C20205-10	Capacitor, 13 MMF, ½, 500 V., Ceramic, C12
C20205-14	Capacitor, 14 MMF, 5%, 500 V., TC, Ceramic, C14, C23
C20205-15	Capacitor, 18 MMF, ½, 500 V., TC, Ceramic, C20
C20205-12	Capacitor, 33 MMF, 10%, 500 V., Ceramic, C22
C20204-470	Capacitor, 47 MMF, 20%, 500 V., Ceramic, C5
C20204-820	Capacitor, 82 MMF, 20%, 500 V., Ceramic, C21
A23078	Capacitor, 1000 MMF, 600 V., Mini., Ceramic Disc, C2, C3, C6, C7, C8, C9, C10, 16
C20070-39	Resistor, 3.9 Ohms, 1 Watt, 10%, R4
C20061-680	Resistor, 68 Ohms, ½ Watt, 20%, R3
C20061-331	Resistor, 330 Ohms, ½ Watt, 20%, R5, R7, R12
C22381-561	Resistor, 560 Ohms, ½ Watt, 10%, R2
C20061-332	Resistor, 3300 Ohms, ½ Watt, 20%, R1
C22381-562	Resistor, 5600 Ohms, ½ Watt, 10%, R8
C22381-103	Resistor, 10K Ohms, ½ Watt, 10%, R6, R11
C22381-223	Resistor, 22K Ohms, ½ Watt, 10%, R10
C20061-104	Resistor, 100K Ohms, ½ Watt, 20%, R9
AA21445-1	Choke, R. F., L11, L4
AA23257-1	Choke, R. F., L10
AA22334-1	Choke, Filament, L1, L2, L3
C23091-1	I. F. Transformer, L7
A23008	Tuning Shaft
A23024-1	Spring Lock, Around Tuning Shaft (10)
A23024-2	Spring Lock, Around Band Shaft (10)
A22572	Shield, Miniature Tube
A23037	Cam Stop Plate
A19133	Spring, Drive Cord (10)
AA23055	Pointer Pulley & Shaft Assembly
AA23056	Cam & Shaft Assembly
A23007	Pulley, Drive
A20202-6	Pulley, Idler (10)

MISCELLANEOUS

Part No.	Description
AR-23049-2	Cabinet
AE23069-1	Cabinet Rear Cover
A23075	Carton, With Fillers
C23001-1	Disc, Channel Indicator
AA23022	Knob, Band Change Assembly
AA23023	Knob, Contrast Assembly
A23020-1	Knob, Channel Tuning
A23021-1	Knob, Volume
A22686-1	Knob, Vertical Hold
A22686-2	Knob, Horizontal Hold
A22686-3	Knob, Brightness
A23201	Plug, Speaker, 3-Prong
D23006	Ring, Polyethelene, Picture Tube Mounting & Insulating
A23039	Rubber Feet, Cabinet, with Screws
D23047	Safety Glass
A23041	Screw, Decorative Head, Speaker Mounting (10)
C22875	Speaker, 4"
A21792	Spring Clip, Ratio Detector Mounting (10)
A20149-10	Spring, Pix Tube Mounting
A21992	Spring, Compression, Channel Indicator Disc (10)
A23012	Strap, Picture Tube Hold-Down
A23081	Terminal Strip, Antenna Lead-In

SUBJECT: Focusing--Centering--Removing Side Shadows

The new 4080T television receiver utilizes a unique 8 1/2" picture tube with a triode gun structure and a permanent magnet focus coil. To focus, center, and eliminate side shadows involves adjustment of three variables--rotation of the FOCALIZER (PM focus coil), adjustment of the FOCUS ADJUSTMENT SCREW MOUNTED ON THE TOP OF THE FOCALIZER, and proper location of the ION TRAP.

All three adjustments must be proper for a picture that is in focus, centered and without side shadows. The procedure could be somewhat as follows

1. Position the ion-trap with the magnet on top and about 3/4" from the FOCALIZER.
2. Turn the FOCUS ADJUSTMENT SCREW in (clockwise) to the FOCALIZER--in other words, almost shorting between the two plates of the FOCALIZER.
3. Loosen the two mounting screws (see "C" on the TOP CHASSIS VIEW of the schematic diagram) and rotate the FOCALIZER for optimum centering and absence of side shadows.
4. Touch-up the FOCUS ADJUSTMENT SCREW and the ION TRAP ADJUSTMENT for best picture focus and brightness.

NOTE: All three adjustments have some effect on centering, focus and side shadows. When the FOCALIZER is positioned correctly, the other two will be relatively simple. The raster lines should be in excellent detail when these adjustments are proper.

MODEL 4080T, Ch. TE 282

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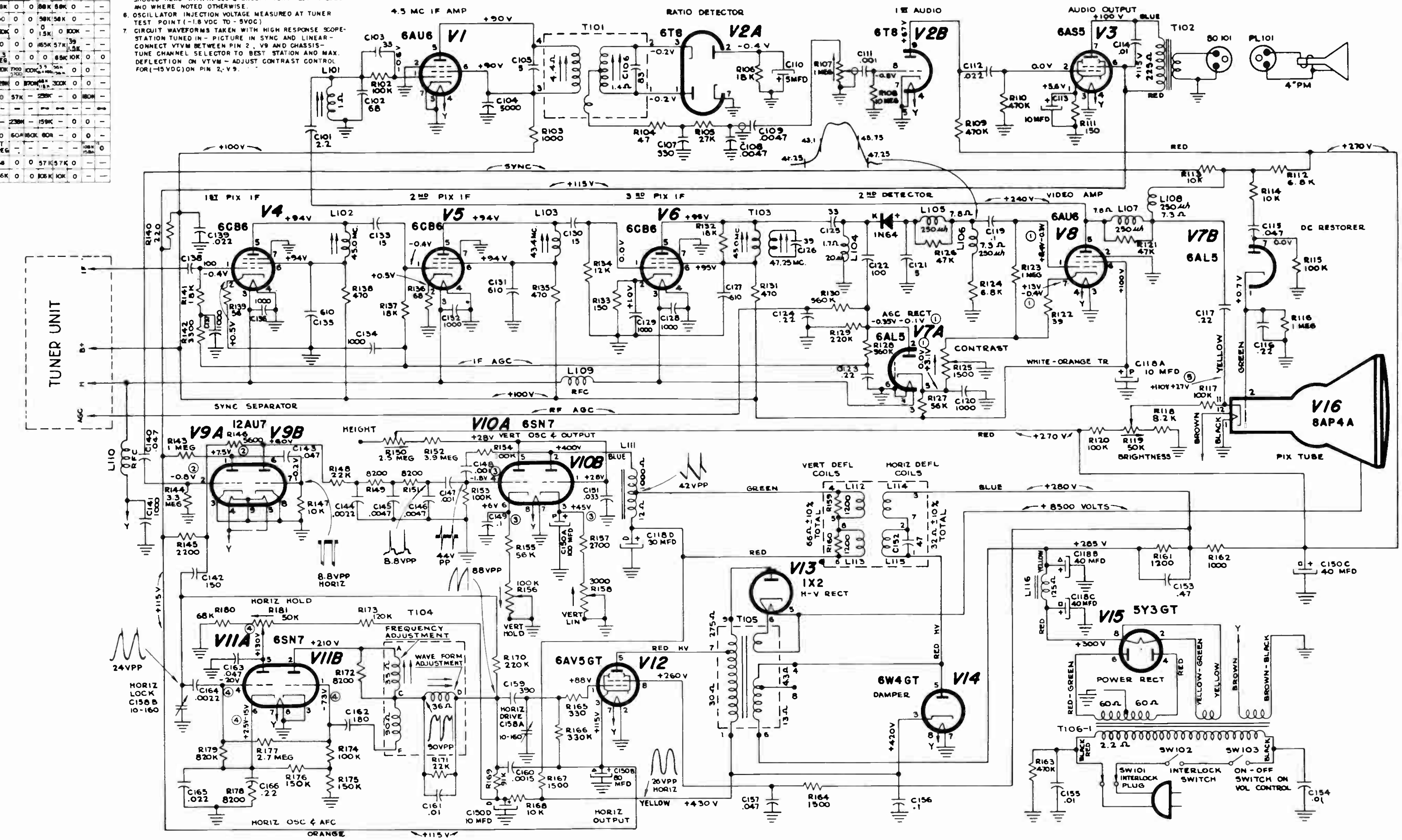
MODEL 4080T,
Ch. TE 282

ARVIN SCHEMATIC DIAGRAM TE 282

	PIN 1	PIN 2	PIN 3	PIN 4	PIN 5	PIN 6	PIN 7	PIN 8	PIN 9
V1	100K	0	0	0	58K	68K	0	–	–
V2	∞	18K	∞	0	0	–	0	10 MEG	[illegible]K
V3	150	470K	0	0	–	69K	69K	–	–
V4	1 MEG	56	0	0	58K	58K	0	–	–
V5	1 MEG	68K	0	0	58K	58K	0	–	–
V6	12K	150	0	0	58K	58K	0	–	–
V7	1 MEG	220K	0	0	0 1.5K	0	100K	–	–
V8	1 MEG	0	0	0	165K	57K	39 1.5K	–	–
V9	1.07 MEG	3.3 MEG	0	0	0	68K	10K	0	0
V10	3.9 [illegible]	[illegible]	2700 3700	100K	3.9 [illegible]	[illegible]	0	0	–
V11	[illegible]	[illegible]	0	270K	[illegible]	300K	0	0	–
V12	419K	0	57K	–	258K	–	0	180K	–
V13	CAP 258K	–	–	–	∞	∞	–	–	∞
V14	–	–	238K	–	159K	–	0	0	–
V15	–	0	60Ω	180K	60Ω	–	0	0	–
V16	0	1 MEG	–	–	–	–	–	[illegible]	0
V17	1 MEG	68	0	0	57K	57K	0	–	–
V18	56K	66K	0	0	105K	10K	0	–	–

CIRCUIT DIAGRAM NOTES:

1. RESISTANCES SHOWN ARE IN OHMS; K=1000
2. CAPACITANCE VALUES LESS THAN 1 ARE IN MFD AND MORE THAN 1 IN MMFD UNLESS OTHERWISE NOTED.
3. COIL RESISTANCE VALUES LESS THAN 1 OHM ARE NOT SHOWN
4. ARROWS AT CONTROLS INDICATE CLOCKWISE ROTATION.
5. DC VOLTAGES ARE READ WITH VOLTOHMYST USING 100K ISOLATING RESISTOR ON THE PROBE - ANTENNA TERMINALS SHORTED - LINE VOLTAGE 117 V - 60~. VOLTAGES SHOULD READ WITHIN ±20% EXCEPT VERY LOW VALUES AND WHERE NOTED OTHERWISE.
6. OSCILLATOR INJECTION VOLTAGE MEASURED AT TUNER TEST POINT (-1.8 VDC TO -5VDC)
7. CIRCUIT WAVEFORMS TAKEN WITH HIGH RESPONSE SCOPE - STATION TUNED IN - PICTURE IN SYNC AND LINEAR - CONNECT VTVM BETWEEN PIN 2, V9 AND CHASSIS - TUNE CHANNEL SELECTOR TO BEST STATION AND MAX. DEFLECTION ON VTVM - ADJUST CONTRAST CONTROL FOR (-15VDC) ON PIN 2, V9.



Change Note: C167. 390MMF Added From Junction of R174 & R175 to Ground.

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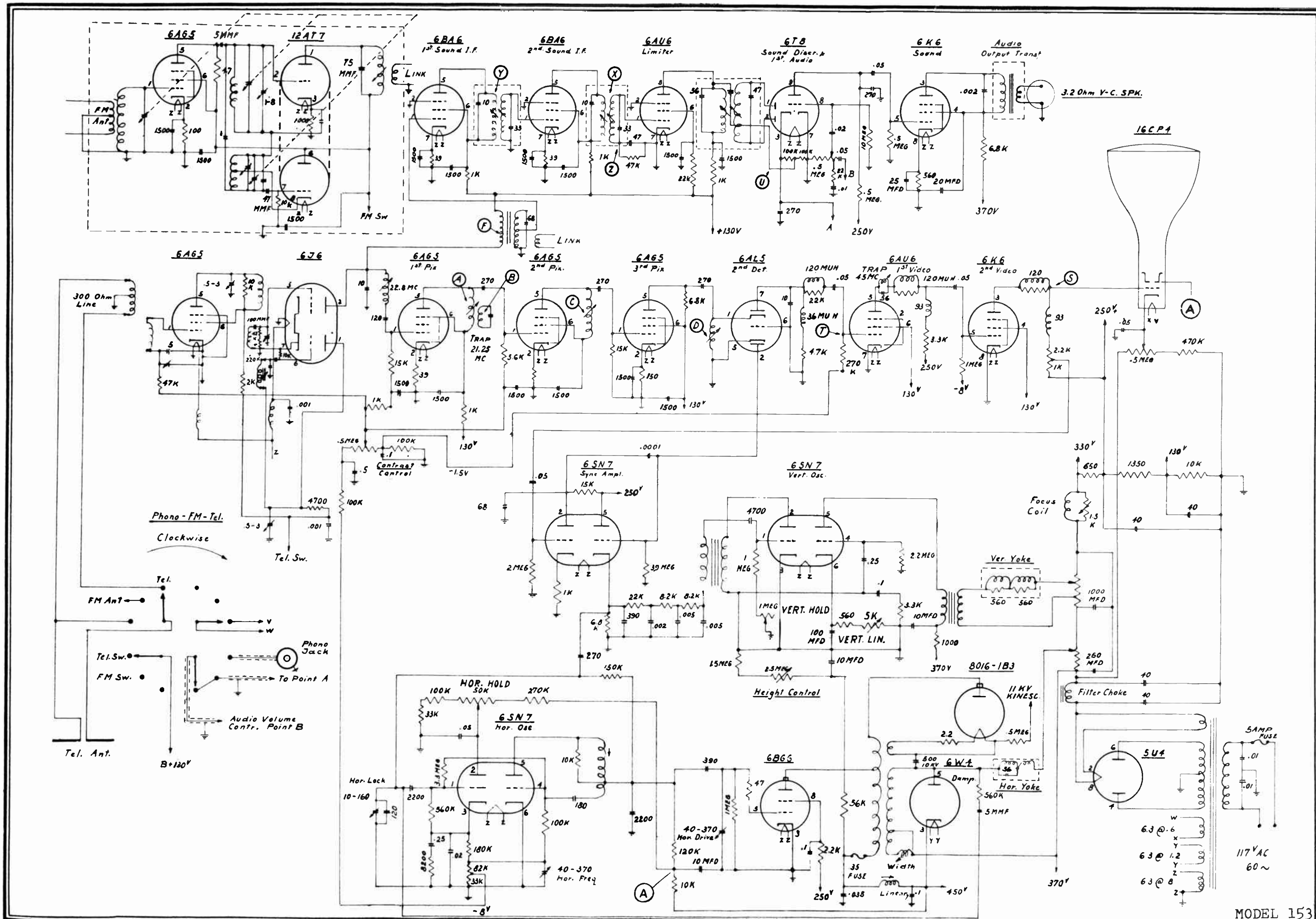

MODEL 153

ATWATER TELEVISION TV PAGE 6-1

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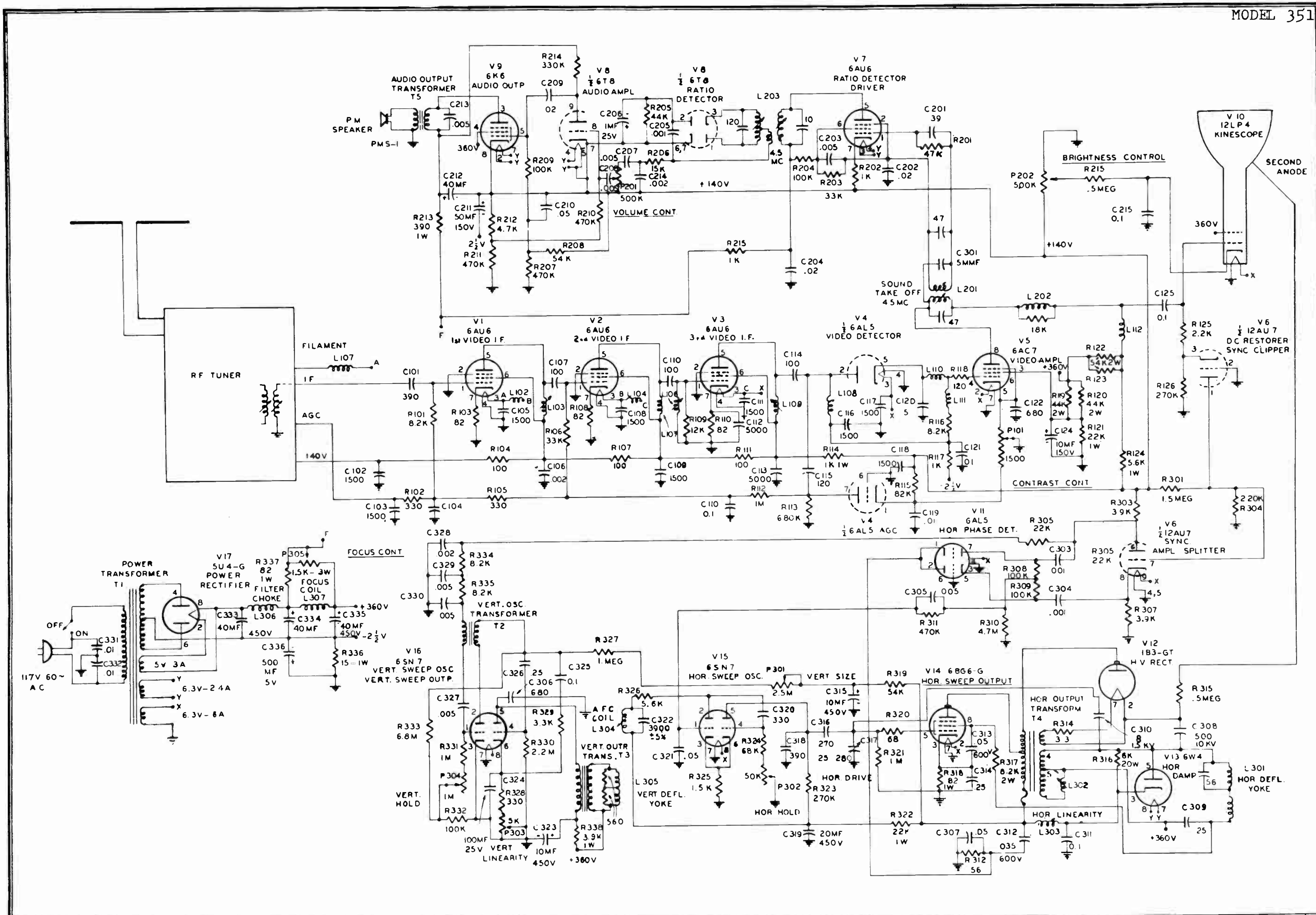

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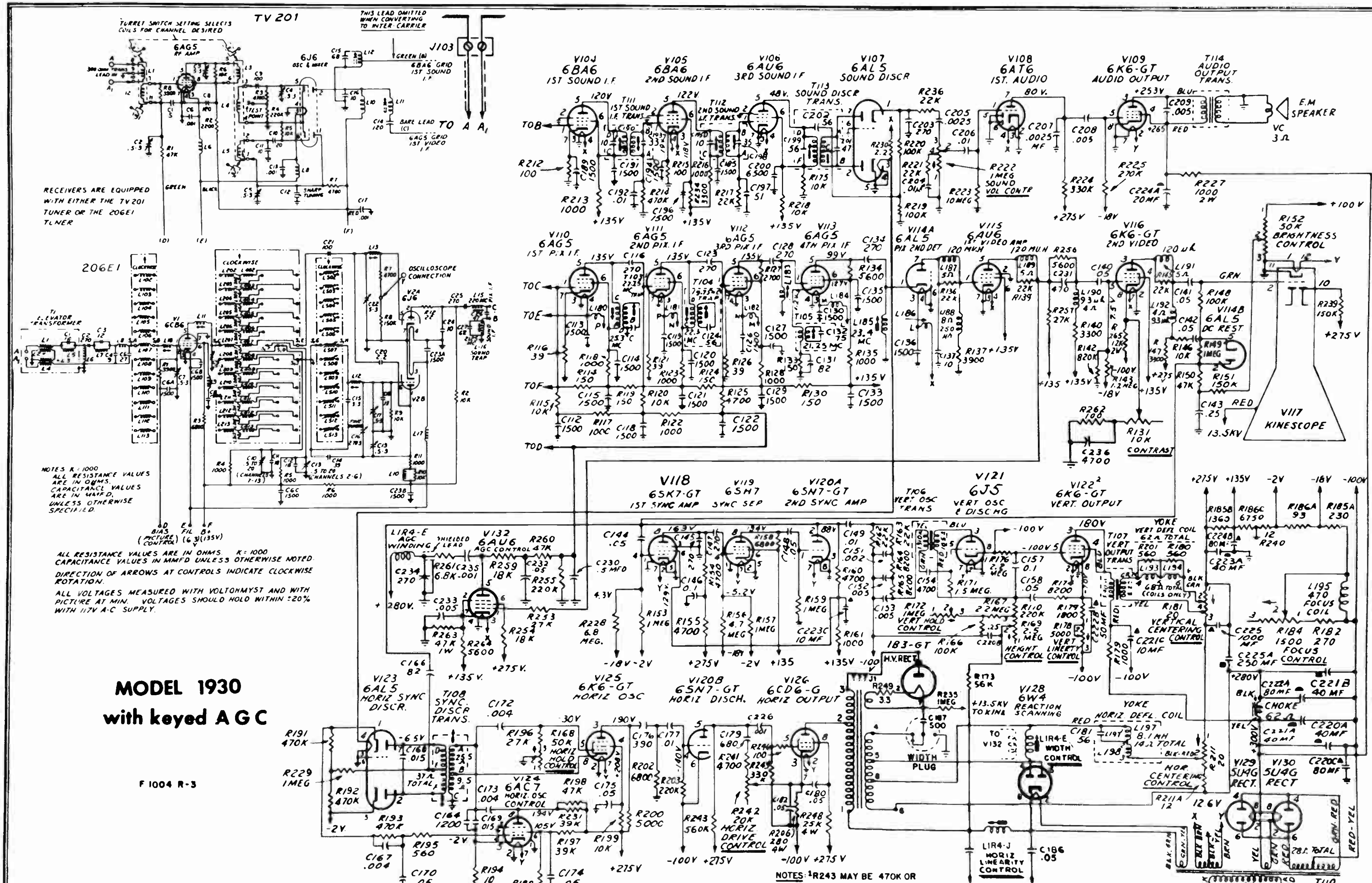

MODEL 1930
with keyed A G C

F 1004 R-3

NOTE:- These Models use a 19AP4, or a 19AP4A, C.R.T. and a 12" Speaker. For Service data, See RCA 630TS, on pages *1-76 through *1-116.

MODELS 1901, 1902, 19T4, 19C4, 19D4, Ch. 1930

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World Radio History

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SPECIFICATIONS

Sensitivity at the Antenna
Video—100 microvolts
Audio—100 microvolts

Power Supply Rating
115 volts, 50-60 cycles, AC
235 watts.

Audio Power Output Rating
Undistorted—3 watts
Maximum—4½ watts

Speaker
5″ PM
3.2 ohm voice coil impedance

Picture Size
70 square inches

Antenna Impedance Requirements
Balanced 300-ohm

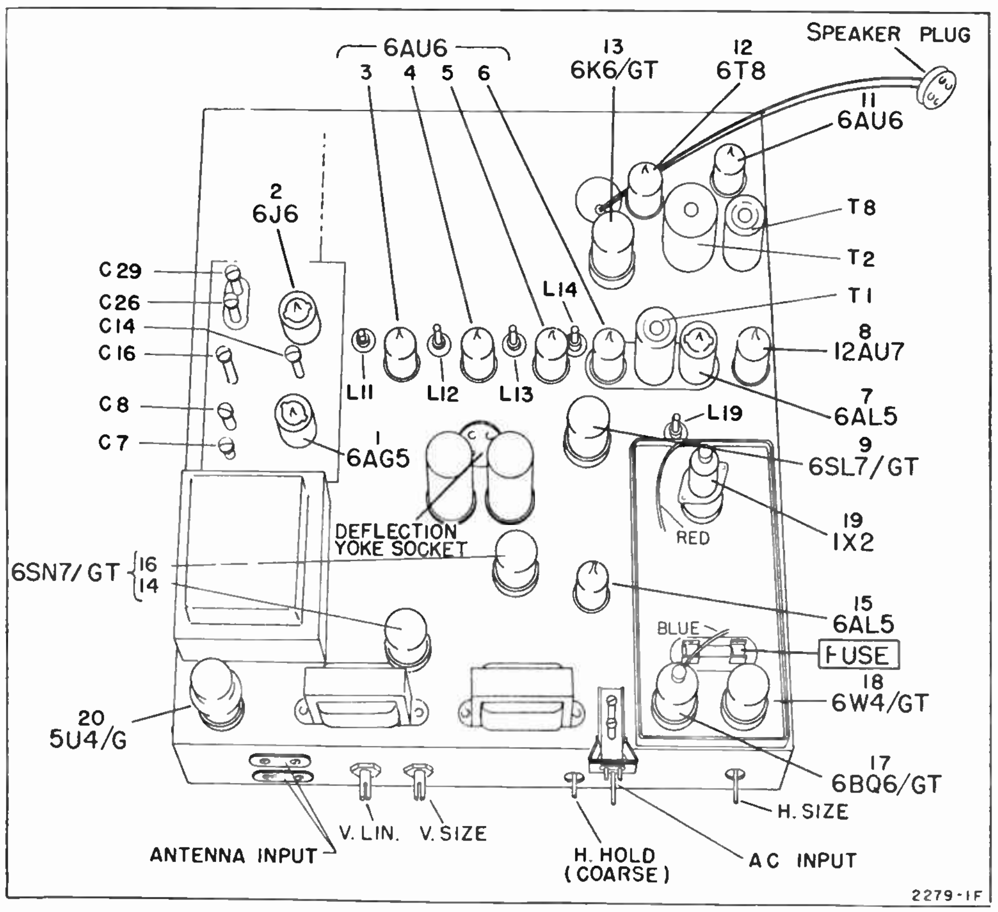
Dimensions
Chassis—16″x 16″x 2½″
Cabinet - 18½″ x 15¾″ x 21″

Tube Complement
6AG5, RF-Amplifier
6J6, Oscillator-Converter
6AU6's, (4) IF-Amplifier
6AL5, Detector, DC Restorer
and Sync Separator
12AU7, Video Amplifier
6SL7, Sync-Amplifier
A.G.C. Amplifier
6AU6, Sound IF-Amplifier
6T8, Audio Detector and Amp.
6K6, Audio Output
6SN7, Vertical Multivibrator
6AL5, AFC-Discriminator
6SN7, Horizontal Multivibrator
6BQ6, Pulse Amplifier
6W4, Damper
1X2, High Voltage Rectifier
5U4, Low Voltage Rectifier
10BP4, Picture Tube

GENERAL DESCRIPTION

The Model M-701 is a 20 tube, AC operated, direct view, 10-inch television receiver. The set is complete in one unit and features complete coverage of all 12 television channels, automatic gain control, automatic frequency control, intercarrier sound system, permanent magnet focused and magnetically deflected picture tube.

On the back of the cabinet is a safety interlock to prevent dangerous electrical shock. As an added safety measure, a fuse is located in the high voltage power supply to protect the set in case of overloading.



Tube Layout

OPERATION OF THE RECEIVER

FUNCTIONS OF THE CONTROLS

All the controls normally used in tuning in a program—both picture and sound—are located on the front of the receiver and at the top of the back of the cabinet. On the rear of the set are several controls which are pre-set at the factory and may need slight readjustment at the time of installation. After installation, they should not be adjusted further, unless required by replacement or aging of tubes, variations in power-line voltage, or other external conditions. The function of each of the controls is described below.

OPERATOR'S CONTROLS

Volume-Off — Turns set on or off and adjusts sound volume.

Contrast—Varies contrast between light and dark portions of picture.

Brightness—Controls brilliance of picture.

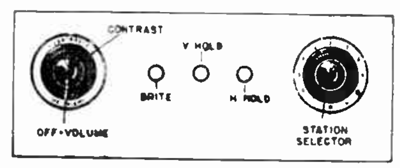
V. Hold—Stops pictures from moving up or down.

H. Hold—Stops pictures from moving left or right.

Station Selector Knob—Tunes set to desired channel (station). May be turned in either direction.

Antenna Tuning Knob — Tunes the antenna for maximum signal.

Model M-701 actually requires only three controls when tuning in a program. These controls are located on the front of the receiver. On the left is a dual knob, the large knob controls picture contrast, while the small outer knob is the off-on switch and volume control. The control on the right is the station selector. The three other controls on the front of the set: brightness, horizontal hold, and vertical hold, need only be adjusted periodically. The six operator's controls are shown below.



Three of the seven serviceman's controls; focus, horizontal centering, and vertical centering, are located on the picture tube assembly. The remaining four controls, vertical linearity, vertical size, horizontal size, and coarse horizontal hold are located on the rear of the set. (See tube layout).

SERVICEMAN'S CONTROLS

Vert. Lin.—Provides vertical distribution of picture.

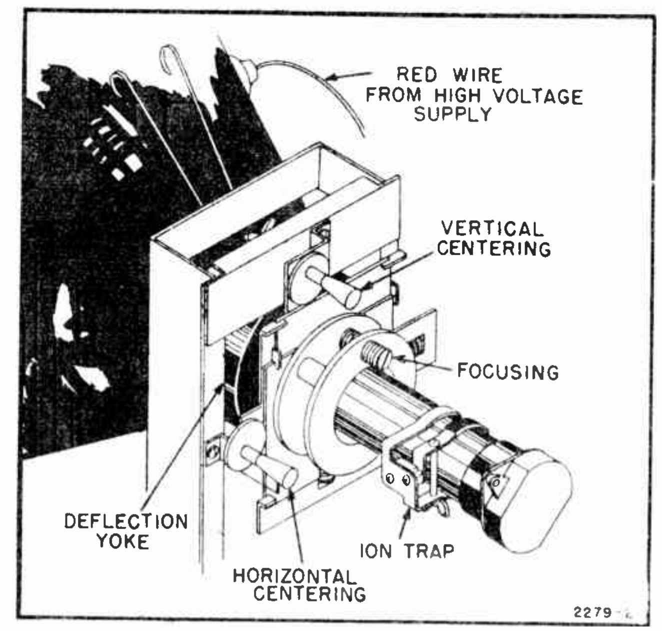
Vert. Size — Changes size of picture vertically. Does not affect horizontal size.

Horiz. Size—Changes size of picture horizontally. Does not affect vertical size.

Focus—Focuses picture on face of picture tube.

H. Centering—Moves entire picture horizontally.

V. Centering—Moves entire picture vertically.



Picture Tube Assembly

TUNING PROCEDURE

1. Turn the VOLUME control clockwise to turn the set on. Allow one-half minute for the set to warm up.
2. Rotate the Station Selector knob to the desired channel.
3. Adjust antenna tuning control for the best picture.
4. Turn the CONTRAST control fully counter-clockwise.
5. Turn the BRIGHTNESS control fully clockwise, and then turn it slowly counter-clockwise until the picture tube just becomes dark. *For any particular installation this adjustment of the BRIGHTNESS control need be made only the first time the set is used, unless required by replacement of tubes.*
6. Adjust the CONTRAST control until the proper contrast between blacks and whites is obtained.
7. Adjust the VOLUME control for the desired sound level.
8. When switching from one station to another, it may be necessary to readjust the CONTRAST control.

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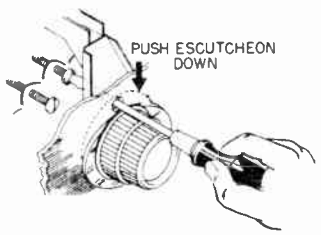
ADJUSTMENT OF STATION SELECTOR

The station selector of your television set has been partially pre-set at the factory, but readjustment of the settings may have to be made at the time of the initial installation. This should be done by the serviceman.

If at a later time a new station comes on the air, or if the receiver is moved to a locality where other stations can be received, adjust the station selector in the following manner.

1. Turn the set on. Allow the set to warm up for 20 minutes.
2. Turn the contrast control approximately two-thirds of the way toward its full clockwise position.
3. Turn the volume control approximately to its mid-position.
4. Set the station selector knob to the desired channel.
5. Turn the antenna tuning knob until maximum sound is heard. (Turn the volume control up if necessary).
6. Grasp the station escutcheon at the upper right edge and slowly push down until the hole above the station selector knob appears.
7. Insert a screwdriver into the hole (see illustration). Turn the screw slowly counter-clockwise (and then clockwise, if necessary) until maximum sound is heard. This may require several turns in one direction or the other. Turn up the volume control if necessary. (Do not at any time turn the screw in either direction more than 3 revolutions. Do not force it if turning becomes difficult as the screw has then reached the end of its travel in that direction and its direction should be reversed.)



8. When the sound is at maximum, the picture will appear on the screen but "sound bars" (dark horizontal bars of varying width) will be seen traveling vertically from bottom to top across the picture. With the screwdriver, turn the station selector screw counter-clockwise only far enough to remove the sound bars from the picture.
9. Push the station escutcheon back into place.

CAUTION!: 11,000 volts on all pins of the 1X2 high voltage rectifier. DO NOT MEASURE this voltage unless a high range voltmeter is used.

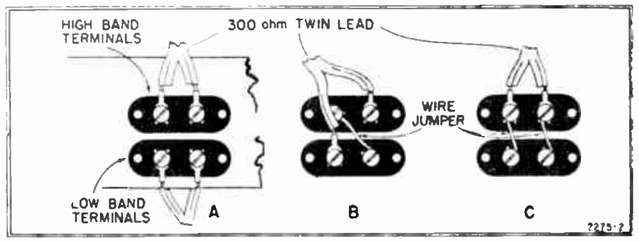
WARNING!: Do not tamper with or attempt to defeat the purpose of the safety interlock.

FUSE: To replace the fuse in the high voltage power supply, lift off the high voltage shield, remove the old fuse, and replace with the same type 1/4 ampere fuse.

ANTENNA CONNECTIONS

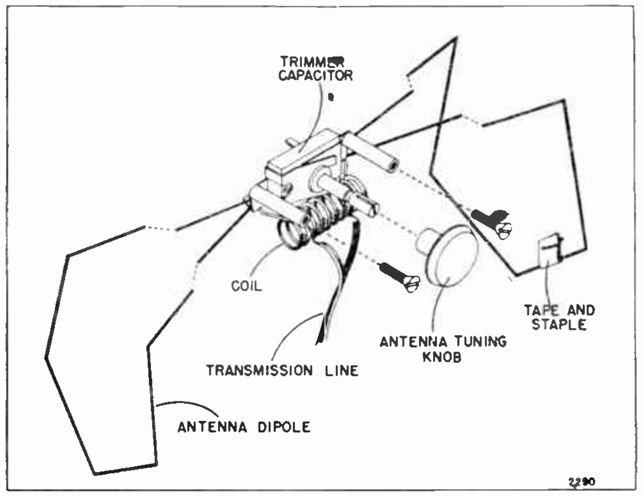
If an outside antenna is used with the receiver, one of the following connections should be made.

1. For those who use separate Hi and Low Band antennae, with two lead-in cables, connect the Hi-Band leads to the two top terminals marked Hi-Band, connect the Lo-Band leads to the two bottom terminals, marked Lo-Band. See fig. 4, sketch A.
2. For those who use a combined Hi-Lo Band antenna, better known as a "All Wave Antenna" with one lead-in cable, connect as shown in fig. 4, sketch B.
3. In some cases due to location or environment of the Receiving antennae, better results can be had by connecting the lead-in as shown in fig. 4, sketch C.
4. An alternate arrangement for those who receive from Hi-Band stations only (Channels 7 thru 13), the All Wave Antenna lead-in may be connected to the two top terminals marked Hi-Band, with no strap or connection to the Lo-Band terminals.
5. Use the arrangement which gives the most satisfactory results.



Alternate Antenna Connections

BUILT-IN TELEVISION ANTENNA



The new Built-In Television Antenna incorporated in the receiver eliminates the need of an outside antenna in many locations. In areas too distant for normal reception with a built-in antenna, provision is made for outside antenna connections. If any other type of antenna is used with the set, disconnect the transmission line from the built-in antenna to the antenna terminals.

The antenna is mounted inside the cabinet and is operated by the use of a knob at the top of the back of the cabinet. Since the antenna is fastened to the cabinet it may be necessary to orient the cabinet to obtain the best reception. It is desirable that either the front or the back of the cabinet face the transmitting station. If however, "ghosts" or multiple images appear, the cabinet may be rotated slightly to minimize this condition. In some cases it may be necessary to face the back or the front of the cabinet toward a window to obtain a television picture. This may be due to walls, water pipes, or a steel structure in the location preventing television reception.

The antenna tuning knob should be used as a fine tuning control and should be adjusted until the best picture is obtained. In order to eliminate "Body effect" when adjusting the antenna tuning knob, stand in front and reach over the top of the set. If at any time the knob becomes difficult to turn, reverse the direction of rotation. Do not force the knob in either direction.

If the receiver fails to operate satisfactorily with the built-in antenna, check for the following trouble:

1. Check the antenna dipole to make sure it is not touching the chassis or any other object.
2. Check the antenna dipole to make sure it is stapled to the side of the cabinet and does not vibrate.
3. Check the connections at the coil, transmission line, and trimmer capacitor.
4. Check to make sure that all four antenna terminal screws are moderately tight. The antenna terminals should be connected in parallel.

PRODUCTION CHANGES

As changes were made in the production of Model M-701 chassis, code numbers were assigned to distinguish the differences in the set. The differences between the different code numbers are explained below.

Code 1 Chassis.

Code 1 chassis are wired as shown in the schematic diagram except the grounded end of C-117 is connected to terminal 1 of T6 and a 1000 mmf capacitor is used in place of the parallel connection of C-109 and C-111.

Code 2 Chassis.

Code 2 chassis are wired as shown in the schematic diagram except a 1000 mmf capacitor is used in place of the parallel connection of C-109 and C-111.

Code 3 Chassis.

Code 3 chassis are wired as shown in the schematic diagram.

For test pattern adjustments, alignment procedure, and trouble-shooting charts, refer to the 12AX22 service manual.

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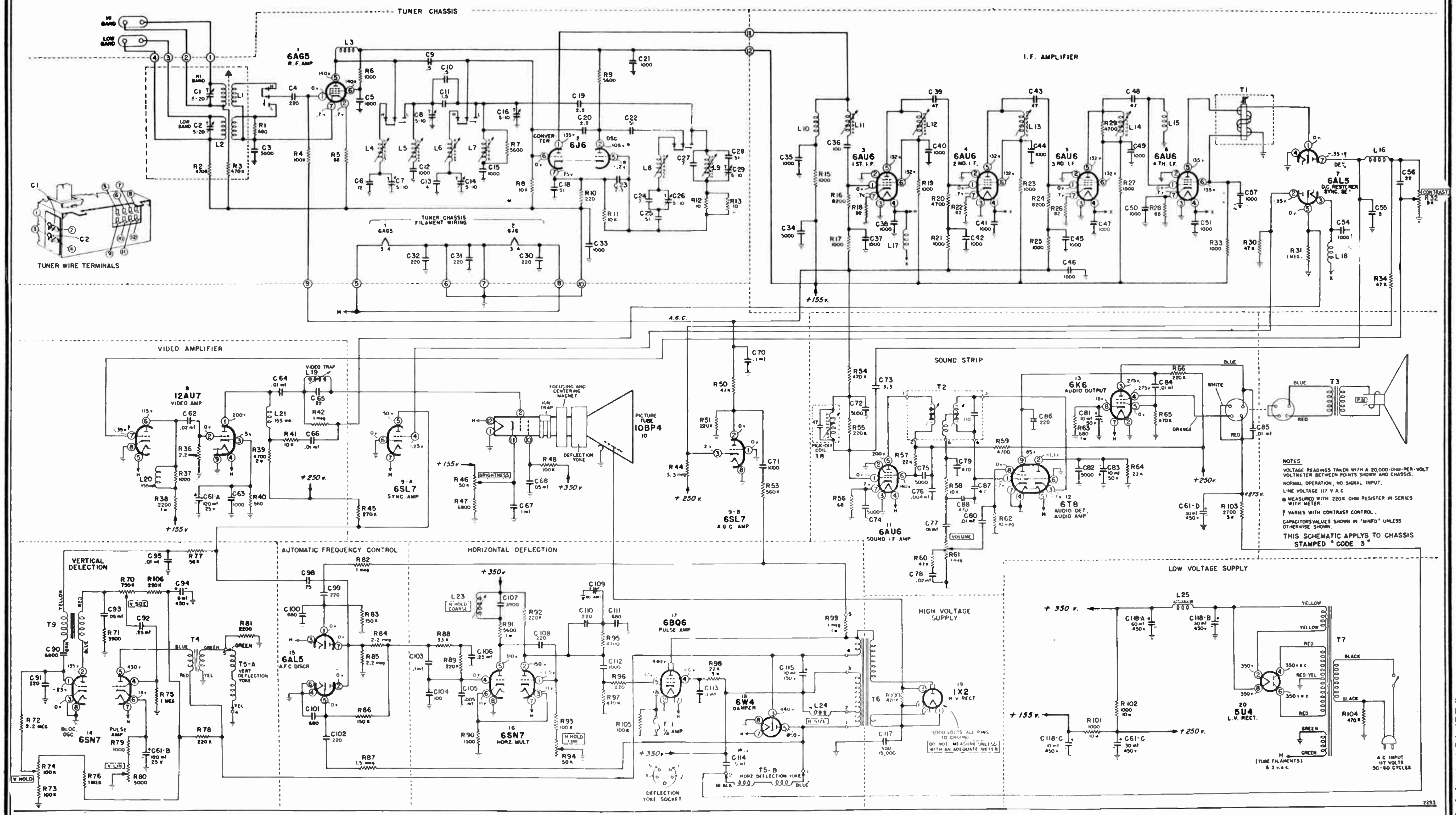

Schematic Diagram of Chassis - (Code 3)

BELMONT TV PAGE 6-3

MODEL M-701,
Ch. 10AX22, Code 3

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LIST OF REPLACEMENT PARTS

TUNER

Capacitors

Ref. Symbol	Part No.	Description
C3	A-8G-13962	Ceramic, .005 mfd
C4-30-31-32	C-8G-16045	Ceramic, 220 mmf, 20%
C5-12-15-17-21-33	C-8G-13201	Ceramic, 1000 mmf
C6	C-8G-17305	Ceramic, 12 mmf, 10%
C7-8-14-16-26-29	B-201-15142	Trimmer capacitor
C9-10	A-8G-12495-7	Ceramic, .5 mmf
C11	A-8G-12495-3	Ceramic, 1.5 mmf
C13	C-8G-11893	Ceramic, 4 mmf, ±1/4 mmf
C18-22-25-28	C-8G-11891	Ceramic, 51 mmf, 5%
C19-20	A-8G-12495-4	Ceramic, 2.2 mmf
C23	C-8G-15737	Ceramic, 2.5 mmf, 20%
C24-27	C-8G-15224	Ceramic, 7 mmf, ±1/2 mmf

Resistors

Ref. Symbol	Part No.	Description
R1	C-9B1-60	680 ohms, 1/2 watt, 10%
R4	C-9B1-86	100,000 ohms, 1/2 watt, 10%
R5	C-9B1-48	68 ohms, 1/2 watt, 10%
R6	C-9B1-13	1000 ohms, 1/2 watt, 20%
R7-9	C-9B1-71	5600 ohms, 1/2 watt, 10%
R8-11	C-9B1-74	10,000 ohms, 1/2 watt, 10%
R10	C-9B1-54	220 ohms, 1/2 watt, 10%
R12-13	C-9B1-38	10 ohms, 1/2 watt, 10%

Chokes, Transformers, Coils

Ref. Symbol	Part No.	Description
L1-2 (Incl. C1-2 R2-3)	B-201-17143	Antenna transformer assembly
L3	A-16A-17128	R.F. choke
L4-6-8	B-13E-17140	High band coils, Osc., RF pri., RF sec.
L5-7	B-13E-12046	Low band coils, RF pri., RF sec.
L9	B-13D-12155	Low band coil, oscillator

Miscellaneous

Part No.	Description
A-51A-15715	Iron core, for L5
A-51A-17162	Iron core, for L6
A-51A-17161	Iron core, for L7
A-51A-17513	Iron core, for L4-8-9
A-15C-10717	Tube socket, 7-prong, miniature
A-2M-16276	Core mounting clip
A-2M-15504	Leaf spring
A-2H-11494	Tube shield
A-49A-15977	Coil spring
C-5M-15487	Treadle bar, bakelite
A-49A-15837	Detent spring

MAIN CHASSIS

Capacitors

Ref. Symbol	Part No.	Description
C34-74-75-82	A-8G-13962	.005 mfd, ceramic disk
C35-37-38-40-41-42-44-45-46-47-49-50-51-54-57-	C-8G-13201	1000 mmf, ceramic
C36	C-8F3-8	100 mmf, mica, 20%
C39-43-48	C-8F3-109	47 mmf, mica, 10%
C55	C-8G-12166	5 mmf, ceramic
C56	C-8G-13909	22 mmf, ceramic
C61-A-B-C-D	A-8C-17844	30-30 mfd x 450 volts, 125-125 mfd x 25 volts
C62	C-8D-17268	.02 mfd 200 volts +30% —10%
C63	C-8G-13201	1000 mmf, ceramic
C64-66	C-8D-17270	.01 mfd, 400 volts
C65		22 mmf (See L19)
C67-113	C-8D-10760	.1 mfd, 400 volts, +30% —10%
C68	C-8D-10813	.05 mfd, 400 volts, 20%
C70	C-8D-10771	.1 mfd, 200 volts, +30% —10%
C71	C-8F6-125	1000 mmf, 500 volts, 10%
C72-105	C-8D-17785	.005 mfd, 200 volts, +50% —25%
C73	A-8G-12495-5	3.3 mmf, ceramic
C76	C-8D-17958	.004 mfd, 400 volts, +50% —25%
C77-80-84-93-95	C-8D-17258	.01 mfd, 200 volts, +30% —10%
C78-85	C-8D-17607	.02 mfd, 400 volts, +30% —10%
C79-88	C-8F3-12	470 mmf, mica, 20%
C81-83	A-8C-17183	10 mfd, 50 volts,
C85	C-8D-17258	.01 mfd, 200 volts, +30% —20%
C86	C-8F3-10	220 mmf, mica, 20%
C87	C-8G-13877	4.7 mmf, ±1/2 mmf
C90	C-8F9-19	6800 mmf, 300 volts, 20%
C91-99-102-108-110	C-8F3-117	220 mmf, 500 volts, 10%
C92	C-8D-17784	.25 mfd, 400 volts, +30% —10%
C93	C-8D-14461	.05 mfd, 400 volts, +30% —20%
C94	A-8C-13453	8 mfd, 450 volts, lytic
C98	C-8F3-222	75 mmf, 500 volts, 5%
C100-101-111	C-8F3-123	680 mmf, 300 volts, 10%
C103	C-8D-17259	.1 mfd, 200 volts, +30% —10%
C104	C-8F3-113	100 mmf, 500 volts, 10%
C106	C-8D-10775	.25 mfd, 200 volts, +30% —10%
C107	C-8F11-132	3900 mmf, 500 volts, 10%
C109	A-8E-18508	80-480 mmf, trimmer
C112	C-8D-10787	.001 mfd, 600 volts, 20%
C114	C-8D-17260	.5 mfd, 200 volts, +30% —10%
C115	A-8C-11495	10 mfd, 150 volts, lytic
C117	A-8C-17179	500 mmf, 15,000 volts
C118-A-B-C	A-8C-17845	60-30-10 mfd x 450 volts

Resistors

Ref. Symbol	Part No.	Description
R15-17-19-21-23-25-27-33	C-9B1-62	1000 ohms, 1/2 watt, 10%
R16-24	C-9B1-73	8200 ohms, 1/2 watt, 10%
R18-22-26	C-9B1-49	82 ohms, 1/2 watt, 10%
R20-29-59	C-9B1-70	4700 ohms, 1/2 watt, 10%
R28-56	C-9B1-48	68 ohms, 1/2 watt, 10%
R30-34-50-60	C-9B1-82	47K ohms, 1/2 watt, 10%
R31-42-75-82-76	C-9B1-98	1 megohm, 1/2 watt, 10%
R32	A-10B-17316	8000 ohms, (Contrast)
R36-72-84-85	C-9B1-102	2.2 megohms, 1/2 watt, 10%
R37-79	C-9B1-13	1000 ohms, 1/2 watt, 20%
R38	C-9B2-66	2200 ohms, 1 watt, 10%
R39-95	C-9B4-70	4700 ohms, 2 watts, 10%
R40-63	C-9B1-59	560 ohms, 1/2 watt, 10%
R41-58	C-9B1-74	10K ohms, 1/2 watt, 10%
R44	C-9B1-34	3.3 megohms, 1/2 watt, 20%
R45	C-9B1-91	270K ohms, 1/2 watt, 10%
R46	A-10B-17764	50K ohms, (Brightness)
R47	C-9B1-72	6800 ohms, 1/2 watt, 10%
R48-73-93-105	C-9B1-86	100K ohms, 1/2 watt, 10%
R49-51-55-66-78-89-106-92	C-9B1-90	220K ohms, 1/2 watt, 10%
R53	C-9B1-95	560K ohms, 1/2 watt, 10%
R54-65-97-100-104	C-9B1-94	470K ohms, 1/2 watt 10%
R57-64	C-9B1-78	22K ohms, 1/2 watt, 10%
R61	A-10A-17215	1 megohm, (Volume and Switch)
R62	C-9B1-37	10 megohms, 1/2 watt, 20%
R70	A-10B-18240	750K ohms, (Vertical Size)
R71	C-9B1-69	3900 ohms, 1/2 watt, 10%
R74	A-10B-17275	100K ohms, (Vertical Hold)
R77	C-9B1-83	56K ohms, 1/2 watt, 10%
R80	A-10B-17766	5000 ohms, (Vertical Linearity)
R81	C-9B1-66	2200 ohms, 1/2 watt, 10%
R83-86	C-9B1-88	150K ohms, 1/2 watt, 10%
R87	C-9B1-32	1.5 megohms, 1/2 watt, 20%
R88	C-9B1-80	33K ohms, 1/2 watt, 10%
R90	C-9B1-64	1500 ohms, 1/2 watt, 10%
R91	C-9B1-71	5600 ohms, 1 watt, 10%
R94	A-10B-17764	50K ohms, (Horizontal Hold)
R96	C-9B1-54	220 ohms, 1/2 watt, 10%
R98	C-9C12-1115	22K ohms, 5 watts, 10%
R99	C-9B2-98	1 megohm, 1 watt, 10%
R101-102	C-9C14-1099	1000 ohms, 10 watts 10%
R103	C-9C12-1104	2700 ohms, 5 watts

Chokes, Transformers, Coils

Ref. Symbol	Part No.	Description
T1	B-13B-17956	Output IF coil
T2	B-13M-17273	Ratio detector coil
T3		Output transformer mounted on spk
T4	B-12C-17303	Vertical output transformer
T5-A-B	B-13M-13590	Deflection yoke
T6	C-12M-18286	Horizontal deflection transformer
T7	C-12A-17822	Power transformer
T8	B-13A-17978	Input IF coil
T9	B-12M-18241	Vertical oscillator transformer
L10	A-16A-18025	Plate choke coil
L11	A-13M-18026	Converter coil
L12-13-14	B-201-15612	Stagger tune coil assembly
	A-51A-17966	Iron core (for above)
L15	A-201-15608	Choke coil assembly
L16	A-16A-17048	Peaking coil
L17	A-201-15609	Filament choke
L18	A-16A-17937	RF choke
L19	A-201-17962	Video trap and coil assembly
	A-51A-17966	Iron core (for above)
L20-21	A-16A-17961	Peaking coil
L23	A-13D-16943	Horizontal hold (course) coil
	A-51A-16945	Iron core (for above)
L24	A-13M-18233	Horizontal size coil
	A-51A-16945	Iron core (for above)
L25	B-16A-17959	Filter choke

Miscellaneous

Part No.	Description
N-201-18386	TV antenna assembly
A-8E-18360	Adjustable trimmer
A-3A-18380	Trimmer shaft
B-26D-3235	Terminal lug
A-13M-18359	Matching coil
C-13E-18361	Antenna dipole
B-14MA-18385	Twin lead transmission line
A-3C-18397	Stud
A-15C-18162	9-pin miniature tube socket
A-15C-17983	9-pin miniature tube socket (wafer)
A-15B-10440	Octal tube socket
A-15C-16007	7-pin miniature tube socket
B-2M-13062	Plug button
B-15B-14274	Yoke socket
A-19A-14275	Yoke plug
C-2B-18056	Shield can
A-19B-18023	Speaker socket assembly
B-15B-17278	Socket and cable
A-2B-17337	Coil shield
A-2M-17336	Coil retaining spring
A-2H-10974	Tube shield
A-7B-13050	Antenna terminal board
A-49A-18192	Antenna shorting bar
A-55F-18024	Fuse mounting
A-55F-18362	Fuse, 1/4 ampere, 250 volts
A-3A-17234	Extension shaft
A-6M-17744	Shaft connector
A-2D-17219	RH-tube bracket
A-2D-17218	LH- tube bracket
A-25M-16992	Rubber strap
A-2M-17241	Tube strap
A-2D-11493	Bracket
C-2D-17235	Deflection coil mounting bracket
A-49A-18269	Tube contact spring
B-55P-18282	Focus magnet
C-2D-18078	Focus magnet mounting bracket
A-49A-18084	Spring
B-16M-17982	Ion trap magnet
B-43D-17860	Coil-tube, mounting clip
B-14MA-11066-20	Twin lead transmission line
A-201-18085	AC chassis connector (male)

Cabinet Parts

Part No.	Description
R-24D-18206	Cabinet
C-18A-18176	5" PM speaker
B-30M-16962	Picture glass
C-4B-16958	Tube escutcheon
C-2M-18191	Escutcheon
B-2M-17067	Channel indicator plate
B-2M-17068	Contrast-Off volume plate
B-5B-17763-68	Tuning knob
B-5B-17761-68	Knob (off-on volume)
B-5B-17762-68	Knob (Contrast)
B-5B-18244-68	Knob (3)
B-5B-18382-36	Antenna knob
A-6M-17803	Indicator
A-3A-17760	Extension shaft
C-23J-18167	Back cover
B-14M-17758	Line cord and plug

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World Radio History

PRODUCTION CHANGES

As changes were made in the production of Model 10AX chassis, code numbers were assigned to distinguish the differences in the sets. The differences between the different code numbers are explained below.

CODE 1, 2, 3 CHASSIS.

Code 1, 2, 3 chassis are wired as explained in the service manual.

CODE 4 CHASSIS.

Code 4 chassis are wired as shown in the service manual schematic diagram except for the addition of capacitor C-116 (.2 mmf).

CODE 5 CHASSIS.

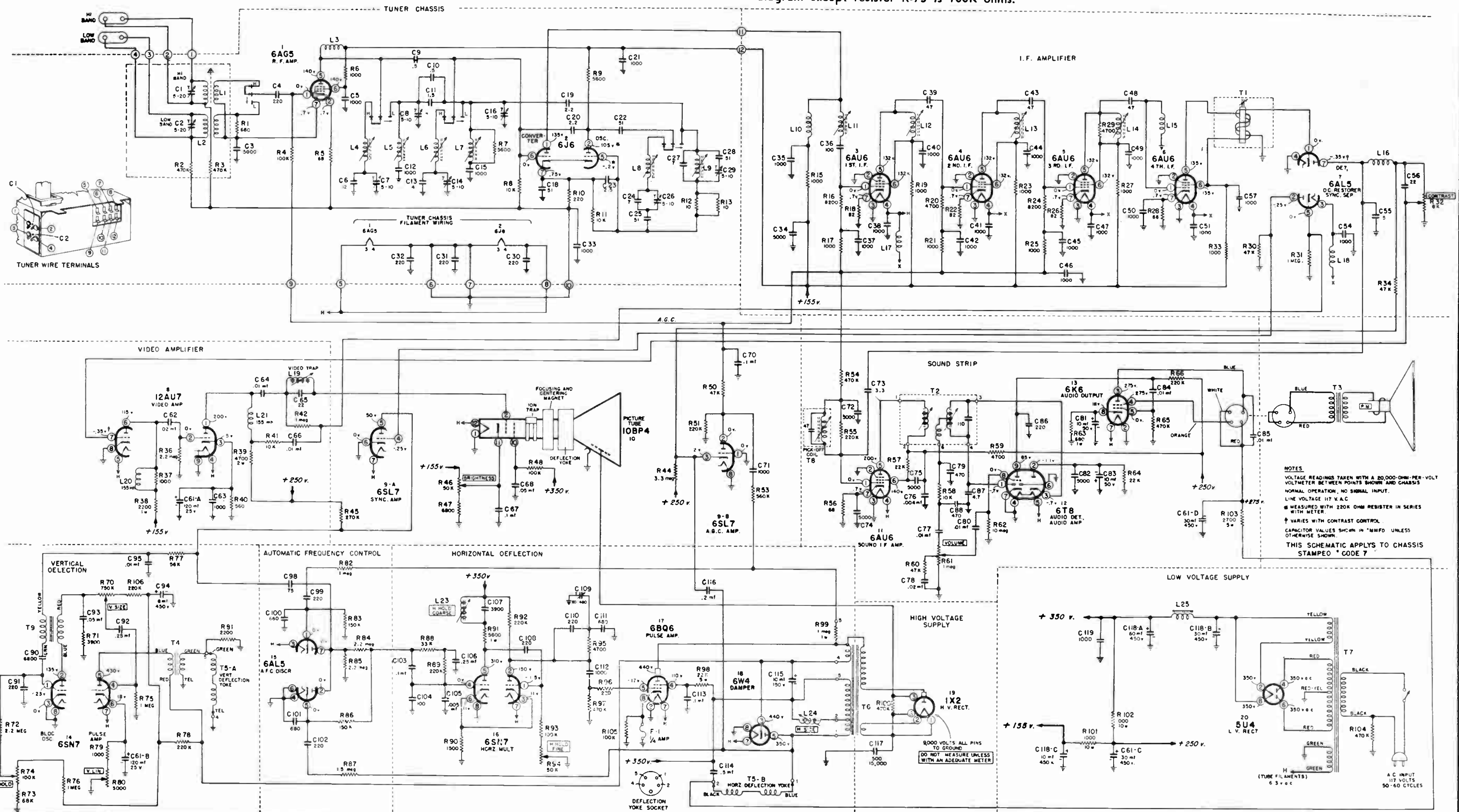
Code 5 chassis are wired as shown in the schematic diagram except resistor R-73 is 100K ohms and capacitor C-119 is not incorporated.

CODE 6 CHASSIS.

Code 6 chassis are wired as shown in the schematic diagram except resistor R-73 is 100K ohms.

CODE 7 CHASSIS.

Code 7 chassis are wired as shown in the schematic diagram.



SCHEMATIC DIAGRAM OF 10AX CHASSIS *(Code 7)*

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World Radio History

MODELS M-701, Ch. 10AX22; 10AXF44, Ch. 10AX21: Code 9

PRODUCTION CHANGES

As changes were made in the production of 10AX chassis, code numbers were assigned to distinguish the differences in the sets. The differences between the different code numbers are explained below.

CODE 1, 2, 3 CHASSIS.

Code 1, 2, 3 chassis are wired as explained in the Service Manual.

CODE 4, 5, 6, 7 CHASSIS.

Code 4, 5, 6, 7 chassis are wired as explained in the Supplement No. 1 Service Manual.

CODE 8 CHASSIS.

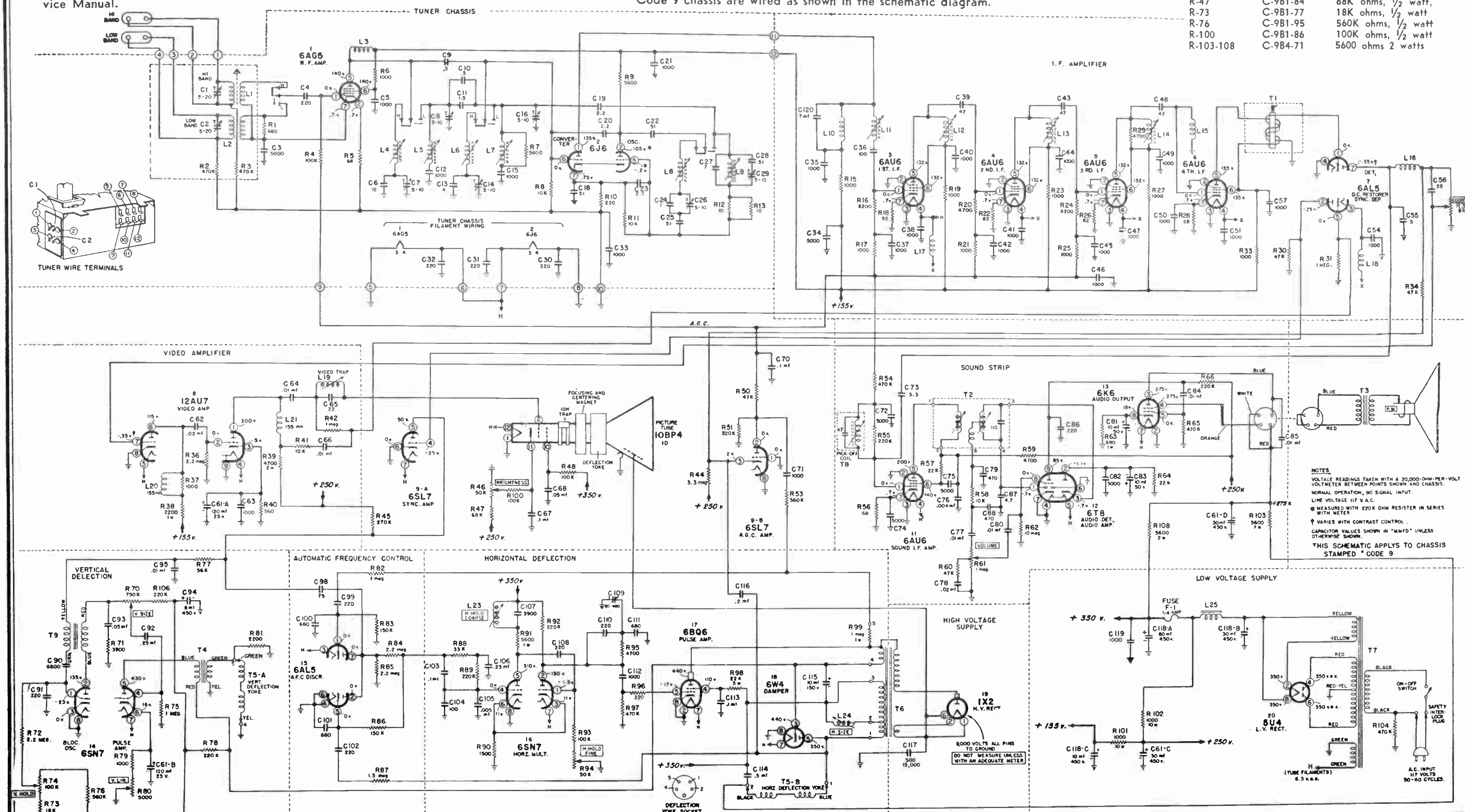
Code 8 chassis are wired as shown in the schematic diagram except capacitor C-120 is not incorporated.

CODE 9 CHASSIS.

Code 9 chassis are wired as shown in the schematic diagram.

PARTS LIST ADDITIONS

Ref. No.	Part No.	Description
C-116	A-5D-18507	.2 mmf, (coil form)
C-119	C-8F6-125	1000 mmf, mica
C-120	C-8G-11790	7 mmf, ceramic
R-47	C-9B1-84	68K ohms, 1/2 watt,
R-73	C-9B1-77	18K ohms, 1/2 watt
R-76	C-9B1-95	560K ohms, 1/2 watt
R-100	C-9B1-86	100K ohms, 1/2 watt
R-103-108	C-9B4-71	5600 ohms 2 watts



SCHEMATIC DIAGRAM OF 10AX CHASSIS (Code 9)

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TELEVISION SPECIFICATIONS

Sensitivity at the Antenna
Video—100 microvolts
Audio—100 microvolts

Power Supply Rating
115 volts, 50-60 cycles, AC
235 watts.

Audio Power Output Rating
Undistorted—3 watts
Maximum—4½ watts

Speaker
10" PM
3.2 ohm voice coil impedance

Picture Size
70 square inches

Antenna Impedance Requirements
Balanced 300-ohm

Dimensions
Chassis—16"x 16"x 2½"

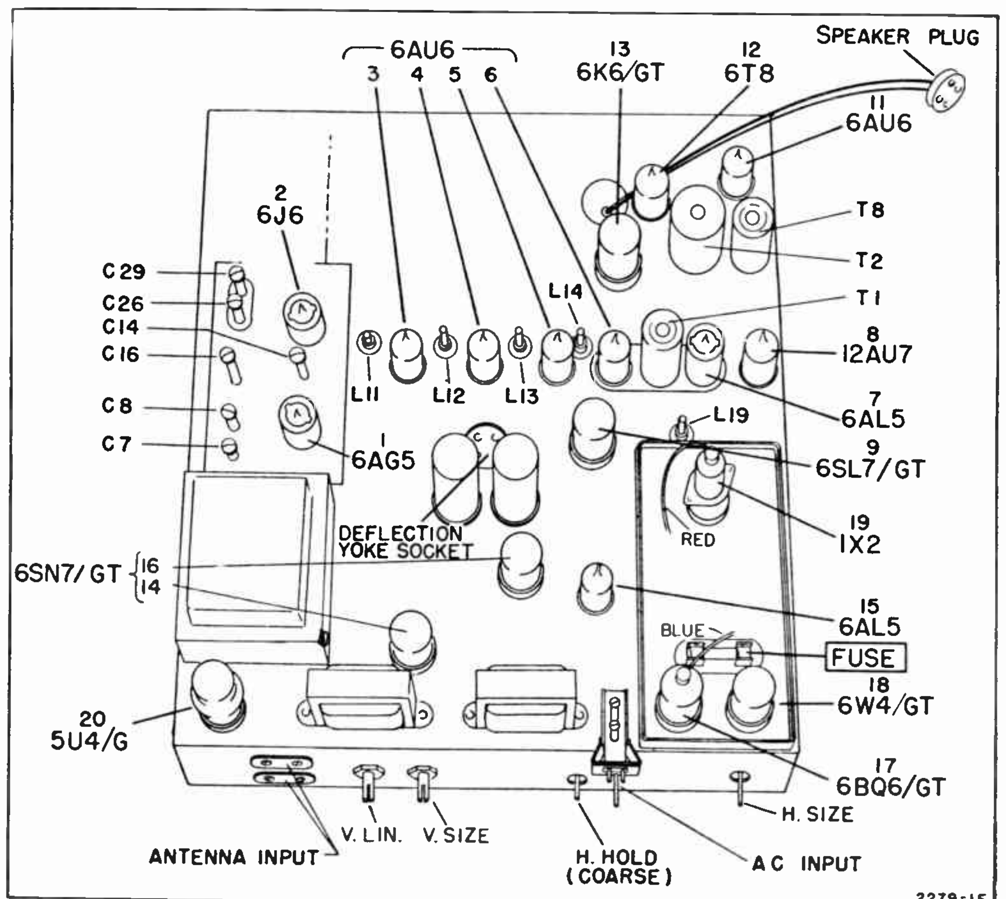
Tube Complement
6AG5, RF-Amplifier
6J6, Oscillator-Converter
6AU6's, (4) IF-Amplifier
6AL5, Detector, DC Restorer and Sync Separator
12AU7, Video Amplifier
6SL7, Sync-Amplifier A.G.C. Amplifier
6AU6, Sound IF-Amplifier
6T8, Audio Detector and Amp.
6K6, Audio Output
6SN7, Vertical Multivibrator
6AL5, AFC-Discriminator
6SN7, Horizontal Multivibrator
6BQ6, Pulse Amplifier
6W4, Damper
1X2, High Voltage Rectifier
5U4, Low Voltage Rectifier
10BP4, Picture Tube

GENERAL DESCRIPTION

The Model 10AXF44 is a combination television, AM-FM radio, and a 45 RPM record changer.

The Television set is a 20-tube, AC operated, direct view, 10-inch television receiver and features complete coverage of all 12 television channels, automatic gain control, automatic frequency control, intercarrier sound system, permanent magnet focused and magnetically deflected picture tube.

On the back of the cabinet is a safety interlock to prevent dangerous electrical shock. As an added safety measure, a fuse is located in the high voltage power supply to protect the set in case of overloading.



Tube Layout

OPERATION OF THE TELEVISION

FUNCTIONS OF THE CONTROLS

All the controls normally used in tuning in a program—both picture and sound—are located on the front of the receiver. On the rear of the set are several controls which are pre-set at the factory and may need slight readjustment at the time of installation. After installation, they should not be adjusted further, unless required by replacement or aging of tubes, variations in power-line voltage, or other external conditions. The function of each of the controls is described below.

OPERATOR'S CONTROLS

Volume-Off — Turns set on or off and adjusts sound volume.

Contrast—Varies contrast between light and dark portions of picture.

Brightness—Controls brilliance of picture.

V. Hold—Stops pictures from moving up or down.

H. Hold—Stops pictures from moving left or right.

Station Selector Knob—Tunes set to desired channel (station). May be turned in either direction.

SERVICEMAN'S CONTROLS

Vert. Lin.—Provides vertical distribution of picture.

Vert. Size — Changes size of picture vertically. Does not affect horizontal size.

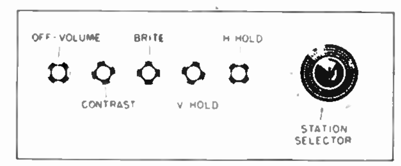
Horiz. Size—Changes size of picture horizontally. Does not affect vertical size.

Focus—Focuses picture on face of picture tube.

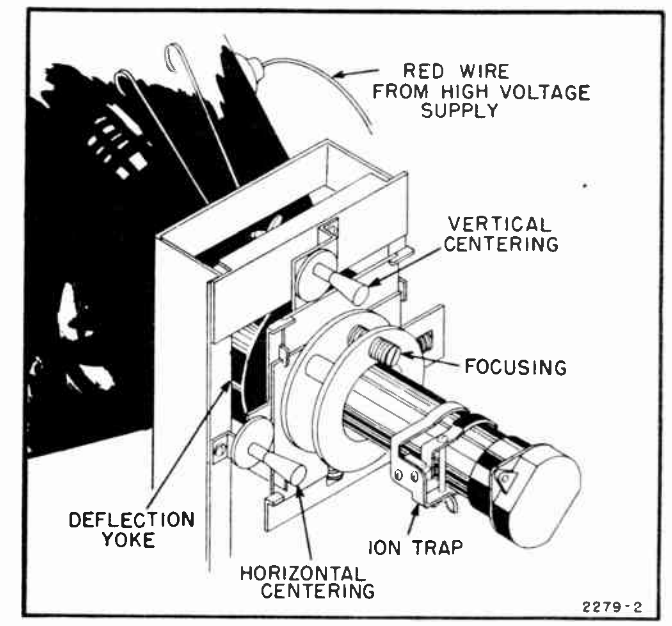
H. Centering—Moves entire picture horizontally.

V. Centering—Moves entire picture vertically.

Model 10AXF44 actually requires only three controls when tuning in a program. The three controls, off-on-volume, contrast and station selector are located on the front of the receiver. The three other controls on the front of the set: brightness, horizontal hold, and vertical hold, need only be adjusted periodically. The six operator's controls are shown below:



Three of the seven serviceman's controls; focus, horizontal centering, and vertical centering, are located on the picture tube assembly. The remaining four controls, vertical linearity, vertical size, horizontal size, and coarse horizontal hold are located on the rear of the set. (See tube layout).



Picture Tube Assembly

TUNING PROCEDURE

1. Turn the VOLUME control clockwise to turn the set on. Allow one-half minute for the set to warm up.
2. Rotate the Station Selector knob to the desired channel.
3. Turn the CONTRAST control fully counter-clockwise.
4. Turn the BRIGHTNESS control fully clockwise, and then turn it slowly counter-clockwise until the picture tube just becomes dark. *For any particular installation this adjustment of the BRIGHTNESS control need be made only the first time the set is used, unless required by replacement of tubes.*
5. Adjust the CONTRAST control until the proper contrast between blacks and whites is obtained.
6. Adjust the VOLUME control for the desired sound level.
7. When switching from one station to another, it may be necessary to readjust the CONTRAST control.

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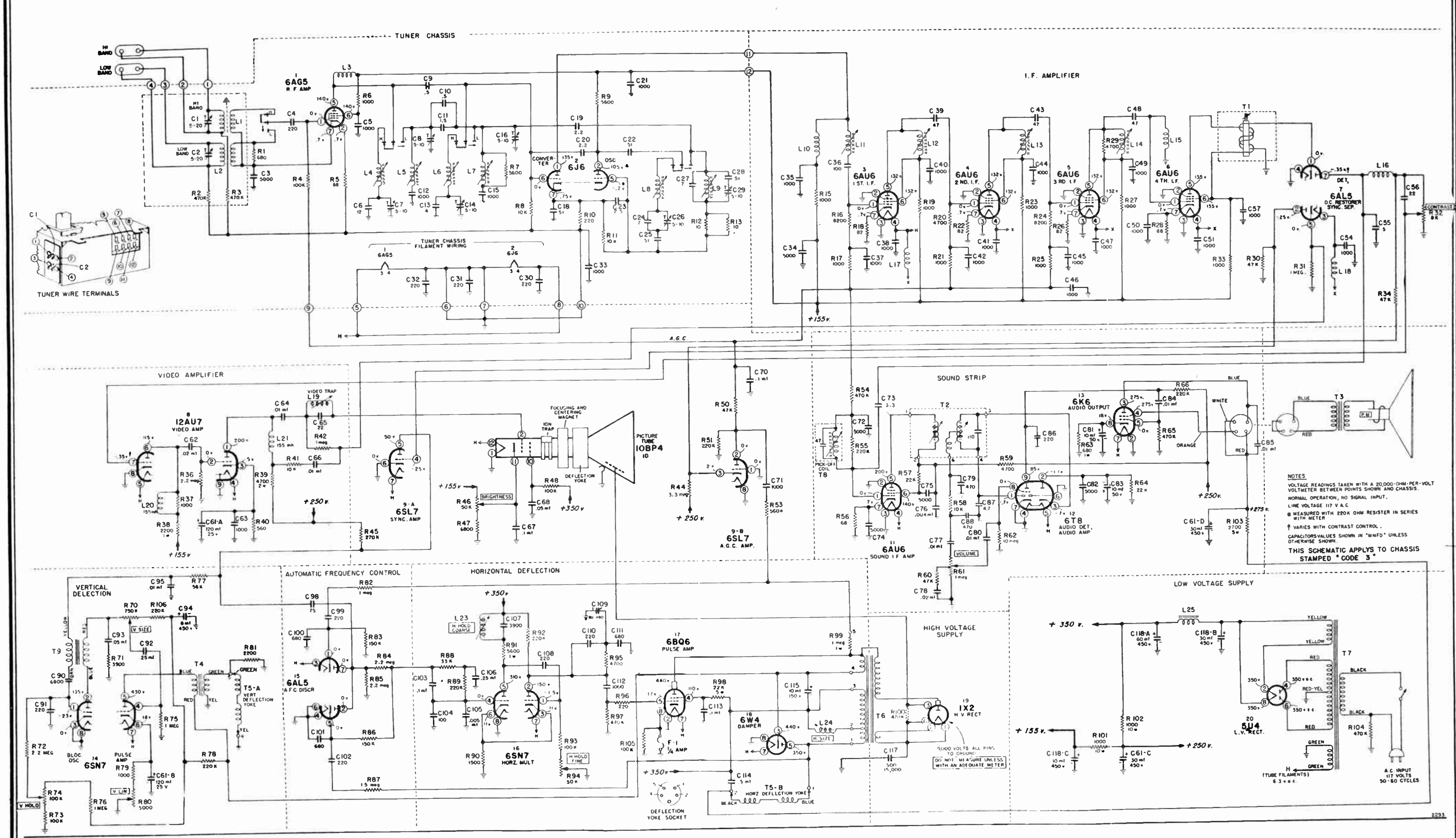

Schematic Diagram of Chassis - (Code 3)

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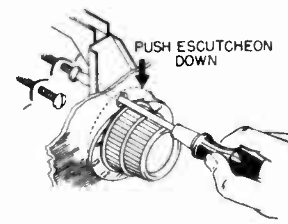
ADJUSTMENT OF STATION SELECTOR

The station selector of your television set has been partially pre-set at the factory, but readjustment of the settings may have to be made at the time of the initial installation. This should be done by the serviceman.

If at a later time a new station comes on the air, or if the receiver is moved to a locality where other stations can be received, adjust the station selector in the following manner.

1. Turn the set on. Allow the set to warm up for 20 minutes.
2. Turn the contrast control approximately two-thirds of the way toward its full clockwise position.
3. Turn the volume control approximately to its mid-position.
4. Set the station selector knob to the desired channel.
5. Grasp the station escutcheon at the upper right edge and slowly push down until the hole above the station selector knob appears.
6. Insert a screwdriver into the hole (see illustration). Turn the screw slowly counter-clockwise (and then clockwise, if necessary) until maximum sound is heard. This may require several turns in one direction or the other. Turn up the volume control if necessary. (Do not at any time turn the screw in either direction more than 3 revolutions. Do not force it if turning becomes difficult as the screw has then reached the end of its travel in that direction and its direction should be reversed.)



7. When the sound is at maximum, the picture will appear on the screen but "sound bars" (dark horizontal bars of varying width) will be seen traveling vertically from bottom to top across the picture. With the screwdriver, turn the station selector screw counter-clockwise only far enough to remove the sound bars from the picture.
8. Push the station escutcheon back into place.

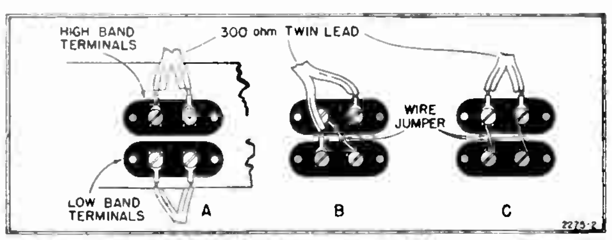
CAUTION!: 9,000 volts on all pins of the 1X2 high voltage rectifier. DO NOT MEASURE this voltage unless a high range voltmeter is used.

WARNING!: Do not tamper with or attempt to defeat the purpose of the safety interlock.

FUSE: To replace the fuse in the high voltage power supply, lift off the high voltage shield, remove the old fuse, and replace with the same type 1/4 ampere fuse.

ANTENNA CONNECTIONS

1. For those who use separate Hi and Low Band antennae, with two lead-in cables, connect the Hi-Band leads to the two top terminals marked Hi-Band, connect the Lo-Band leads to the two bottom terminals, marked Lo-Band. See fig. 4, sketch A.
2. For those who use a combined Hi-Lo Band antenna, better known as a "All Wave Antenna" with one lead-in cable, connect as shown in fig. 4, sketch B.
3. In some cases due to location or environment of the Receiving antennae, better results can be had by connecting the lead-in as shown in fig. 4, sketch C.
4. An alternate arrangement for those who receive from Hi-Band stations only (Channels 7 thru 13), the All Wave Antenna lead-in may be connected to the two top terminals marked Hi-Band, with no strap or connection to the Lo-Band terminals.
5. Use the arrangement which gives the most satisfactory results.



Alternate Antenna Connections

TELEVISION REPLACEABLE PARTS LIST

TUNER

Capacitors

Ref. Symbol	Part No.	Description
C3	A-8G-13962	Ceramic, .005 mfd
C4-30-31-32	C-8G-16045	Ceramic, 220 mmf, 20%
C5-12-15-17-21-33	C-8G-13201	Ceramic, 1000 mmf
C6	C-8G-17305	Ceramic, 12 mmf, 10%
C7-8-14-16-26-29	B-201-15142	Trimmer capacitor
C9-10	A-8G-12495-7	Ceramic, .5 mmf
C11	A-8G-12495-3	Ceramic, 1.5 mmf
C13	C-8G-11893	Ceramic, 4 mmf, ±1/4 mmf
C18-22-25-28	C-8G-11891	Ceramic, 51 mmf, 5%
C19-20	A-8G-12495-4	Ceramic, 2.2 mmf
C23	C-8G-15737	Ceramic, 2.5 mmf, 20%
C24-27	C-8G-15224	Ceramic, 7 mmf, ±1/2 mmf

Resistors

Ref. Symbol	Part No.	Description
R1	C-9B1-60	680 ohms, 1/2 watt, 10%
R4	C-9B1-86	100,000 ohms, 1/2 watt, 10%
R5	C-9B1-48	68 ohms, 1/2 watt, 10%
R6	C-9B1-13	1000 ohms, 1/2 watt, 20%
R7-9	C-9B1-71	5600 ohms, 1/2 watt, 10%
R8-11	C-9B1-74	10,000 ohms, 1/2 watt, 10%
R10	C-9B1-54	220 ohms, 1/2 watt, 10%
R12-13	C-9B1-38	10 ohms, 1/2 watt, 10%

Chokes, Transformers, Coils

Ref. Symbol	Port No.	Description
L1-2 (Incl. C1-2 R2-3)	B-201-17143	Antenna transformer assembly
L3	A-16A-17128	R.F. choke
L4-6-8	B-13E-17140	High band coils, Osc., RF pri., RF sec.
L5-7	B-13E-12046	Low band coils, RF pri., RF sec.
L9	B-13D-12155	Low band coil, oscillator

Miscellaneous

Ref. Symbol	Port No.	Description
	A-51A-15715	Iron core, for L5
	A-51A-17162	Iron core, for L6
	A-51A-17161	Iron core, for L7
	A-51A-17513	Iron core, for L4-8-9
	A-15C-10717	Tube socket, 7-prong, miniature
	A-2M-16276	Core mounting clip
	A-2M-15504	Leaf spring
	A-2H-11494	Tube shield
	A-49A-15977	Coil spring
	C-5M-15487	Treadle bar, bakelite
	A-49A-15837	Detent spring

MAIN CHASSIS

Capacitors

Ref. Symbol	Part No.	Description
C34-74-75-82	A-8G-13962	.005 mfd, ceramic disk
C35-37-38-40-41-42-44-45-46-47-49-50-51-54-57-	C-8G-13201	1000 mmf, ceramic
C36	C-8F3-8	100 mmf, mica, 20%
C39-43-48	C-8F3-109	47 mmf, mica, 10%
C55	C-8G-12166	5 mmf, ceramic
C56	C-8G-13909	22 mmf, ceramic
C61-A-B-C-D	A-8C-17844	30-30 mfd x 450 volts, 125-125 mfd x 25 volts
C62	C-8D-17268	.02 mfd 200 volts +30% —10%
C63	C-8G-13201	1000 mmf, ceramic
C64-66	C-8D-17270	.01 mfd, 400 volts
C65		22 mmf (See L19)
C67-113	C-8D-10760	.1 mfd, 400 volts, +30% —10%
C68	C-8D-10813	.05 mfd, 400 volts, 20%
C70	C-8D-10771	.1 mfd, 200 volts, +30% —10%
C71	C-8F6-125	1000 mmf, 500 volts, 10%
C72-105	C-8D-17785	.005 mfd, 200 volts, +50% —25%
C73	A-8G-12495-5	3.3 mmf, ceramic
C76	C-8D-17958	.004 mfd, 400 volts, +50% —25%
C77-80-84-93-95	C-8D-17258	.01 mfd, 200 volts, +30% —10%
C78-85	C-8D-17607	.02 mfd, 400 volts, +30% —10%
C79-88	C-8F3-12	470 mmf, mica, 20%
C81-83	A-8C-17183	10 mfd, 50 volts,
C85	C-8D-17258	.01 mfd, 200 volts, +30% —20%
C86	C-8F3-10	220 mmf, mica, 20%
C87	C-8G-13877	4.7 mmf, ±1/2 mmf
C90	C-8F9-19	6800 mmf, 300 volts, 20%
C91-99-102-108-110	C-8F3-117	220 mmf, 500 volts, 10%
C92	C-8D-17784	.25 mfd, 400 volts, +30% —10%
C93	C-8D-14461	.05 mfd, 400 volts, +30% --20%
C94	A-8C-13453	8 mfd, 450 volts, lytic
C98	C-8F3-222	75 mmf, 500 volts, 5%
C100-101-111	C-8F3-123	680 mmf, 300 volts, 10%
C103	C-8D-17259	.1 mfd, 200 volts, +30% —10%
C104	C-8F3-113	100 mmf, 500 volts, 10%
C106	C-8D-10775	.25 mfd, 200 volts, +30% —10%
C107	C-8F11-132	3900 mmf, 500 volts, 10%
C109	A-8E-18508	80-480 mmf, trimmer
C112	C-8D-10787	.001 mfd, 600 volts, 20%
C114	C-8D-17260	.5 mfd, 200 volts, +30% —10%
C115	A-8C-11495	10 mfd, 150 volts, lytic
C117	A-8C-17179	500 mmf, 15,000 volts
C118-A-B-C	A-8C-17845	60-30-10 mfd x 450 volts

Resistors

Ref. Symbol	Port No.	Description
R15-17-19-21-23-25-27-33	C-9B1-62	1000 ohms, 1/2 watt, 10%
R16-24	C-9B1-73	8200 ohms, 1/2 watt, 10%
R18-22-26	C-9B1-49	82 ohms, 1/2 watt, 10%
R20-29-59	C-9B1-70	4700 ohms, 1/2 watt, 10%
R28-56	C-9B1-48	68 ohms, 1/2 watt, 10%
R30-34-50-60	C-9B1-82	47K ohms, 1/2 watt, 10%
R31-42-75-82-76	C-9B1-98	1 megohm, 1/2 watt, 10%
R32	A-10B-17316	8000 ohms, (Contrast)
R36-72-84-85	C-9B1-102	2.2 megohms, 1/2 watt, 10%
R37-79	C-9B1-13	1000 ohms, 1/2 watt, 20%
R38	C-9B2-66	2200 ohms, 1 watt, 10%
R39-95	C-9B4-70	4700 ohms, 2 watts, 10%
R40-63	C-9B1-59	560 ohms, 1/2 watt, 10%
R41-58	C-9B1-74	10K ohms, 1/2 watt, 10%
R44	C-9B1-34	3.3 megohms, 1/2 watt, 20%
R45	C-9B1-91	270K ohms, 1/2 watt, 10%
R46	A-10B-17764	50K ohms, (Brightness)
R47	C-9B1-72	6800 ohms, 1/2 watt, 10%
R48-73-93-105	C-9B1-86	100K ohms, 1/2 watt, 10%
R49-51-55-66-78-89-106-92	C-9B1-90	220K ohms, 1/2 watt, 10%
R53	C-9B1-95	560K ohms, 1/2 watt, 10%
R54-65-97-100-104	C-9B1-94	470K ohms, 1/2 watt 10%
R57-64	C-9B1-78	22K ohms, 1/2 watt, 10%
R61	A-10A-17215	1 megohm, (Volume and Switch)
R62	C-9B1-37	10 megohms, 1/2 watt, 20%
R70	A-10B-18240	750K ohms, (Vertical Size)
R71	C-9B1-69	3900 ohms, 1/2 watt, 10%
R74	A-10B-17275	100K ohms, (Vertical Hold)
R77	C-9B1-83	56K ohms, 1/2 watt, 10%
R80	A-10B-17766	5000 ohms, (Vertical Linearity)
R81	C-9B1-66	2200 ohms, 1/2 watt, 10%
R83-86	C-9B1-88	150K ohms, 1/2 watt, 10%
R87	C-9B1-32	1.5 megohms, 1/2 watt, 20%
R88	C-9B1-80	33K ohms, 1/2 watt, 10%
R90	C-9B1-64	1500 ohms, 1/2 watt, 10%
R91	C-9B1-71	5600 ohms, 1 watt, 10%
R94	A-10B-17764	50K ohms, (Horizontal Hold)
R96	C-9B1-54	220 ohms, 1/2 watt, 10%
R98	C-9C12-1115	22K ohms, 5 watts, 10%
R99	C-9B2-98	1 megohm, 1 watt, 10%
R101-102	C-9C14-1099	1000 ohms, 10 watts 10%
R103	C-9C12-1104	2700 ohms, 5 watts

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REPLACEABLE PARTS LIST

Ref. Symbol	Part No.	Description
		Chokes, Transformers, Coils
T1	B-13B-17956	Output IF coil
T2	B-13M-17273	Ratio detector coil
T3		Output transformer mounted on spkr.
T4	B-12C-17303	Vertical output transformer
T5-A-B	B-13M-13590	Deflection yoke
T6	C-12M-18286	Horizontal deflection transformer
T7	C-12A-17822	Power transformer
T8	B-13A-17978	Input IF coil
T9	B-12M-18241	Vertical oscillator transformer
L10	A-16A-18025	Plate choke coil
L11	A-13M-18026	Converter coil
L12-13-14	B-201-15612	Stagger tune coil assembly
	A-51A-17966	Iron core (for above)
L15	A-201-15608	Choke coil assembly
L16	A-16A-17048	Peaking coil
L17	A-201-15609	Filament choke
L18	A-16A-17937	RF choke
L19	A-201-17962	Video trap and coil assembly
	A-51A-17966	Iron core (for above)
L20-21	A-16A-17961	Peaking coil
L23	A-13D-16943	Horizontal hold (course) coil
	A-51A-16945	Iron core (for above)
L24	A-13M-18233	Horizontal size coil
	A-51A-16945	Iron core (for above)
L25	B-16A-17959	Filter choke
		Miscellaneous
	A-15C-18162	9-pin miniature tube socket
	A-15C-17983	9-pin miniature tube socket (wafer)
	A-15B-10440	Octal tube socket
	A-15C-16007	7-pin miniature tube socket
	B-2M-13062	Plug button
	B-15B-14274	Yoke socket
	A-19A-14275	Yoke plug
	C-2B-18056	Shield can
	A-19B-18023	Speaker socket assembly
	B-15B-17278	Socket and cable
	A-2B-17337	Coil shield
	A-2M-17336	Coil retaining spring
	A-2H-10974	Tube shield

Ref. Symbol	Part No.	Description
	A-7B-13050	Antenna terminal board
	A-49A-18192	Antenna shorting bar
	A-55F-18024	Fuse mounting
	A-55F-18362	Fuse, 1/4 ampere, 250 volts
	A-3A-17234	Extension shaft
	A-6M-17744	Shaft connector
	A-2D-17219	RH-tube bracket
	A-2D-17218	LH- tube bracket
	A-25M-16992	Rubber strap
	A-2M-17241	Tube strap
	A-2D-11493	Bracket
	C-2D-17235	Deflection coil mounting bracket
	A-49A-18269	Tube contact spring
	B-55P-18282	Focus magnet
	C-2D-18078	Focus magnet mounting bracket
	A-49A-18084	Spring
	B-16M-17982	Ion trap magnet
	B-43D-17860	Coil-tube, mounting clip
	B-14MA-11066-20	Twin lead transmission line
	A-201-18085	AC chassis connector (male)
		Cabinet Parts
	R-24D-18589	Cabinet
	C-18A-18588	10" PM speaker
	B-30M-16962	Picture glass
	C-4B-16958	Tube escutcheon
	B-2C-18572	Control plate
	B-2M-17067-1	Channel indicator plate
	B-5B-17763-68	Tuning knob (T.V.)
	A-6M-17803	Indicator
	B-5B-18244-68	Knob (5) T.V.
	B-5B-16698-57	Tuning knob
	B-5B-16699-57	Volume knob
	B-5B-16700-57	Tone knob
	B-5B-16701-57	FM-AM-Phono knob
	C-23J-17182	Back cover
	B-14M-11479	Line cord and plug
	B-23J-17240	Bottom cover
	B-30A-16684	Dial scale
	A-23A-10344	Line cord lock

PRODUCTION CHANGES

As changes were made in the production of Model 10AXF44 chassis, code numbers were assigned to distinguish the differences in the set. The differences between the different code numbers are explained below.

Code 1 Chassis.

Code 1 chassis are wired as shown in the schematic diagram except the grounded end of C-117 is connected to terminal 1 of T6 and a 1000 mmf capacitor is used in place of the parallel connection of C-109 and C-111.

Code 2 Chassis.

Code 2 chassis are wired as shown in the schematic diagram except a 1000 mmf capacitor is used in place of the parallel connection of C-109 and C-111.

Code 3 Chassis.

Code 3 chassis are wired as shown in the schematic diagram.

For the alignment procedure and trouble-shooting charts, refer to the M-1101, C-1102 Service Manual.

OPERATION OF THE RADIO

Broadcast Band—This is the tuning band in which the standard broadcast stations operate. The left scale on the dial covers the broadcast range of 535-1620 Kc., and is calibrated in channel numbers. To obtain the kilocycle reading, multiply the number on the dial by 10; thus 80 on the dial corresponds to 800 kilocycles.

FM Band—The FM tuning range covers the newly allocated frequency-modulation band of 88 to 108 megacycles into which all FM stations were required to move. Check with your local newspaper to determine the frequency of your local FM stations.

On-off Switch and Volume Control- The knob second from the bottom is both the on-off switch and the volume control. When this control is turned all the way to the left the set is off. A slight rotation to the right will click the switch and turn the set on. The knob may then be used to regulate the volume. Be sure your set is turned completely off when not in use; otherwise the tubes will wear out unnecessarily.

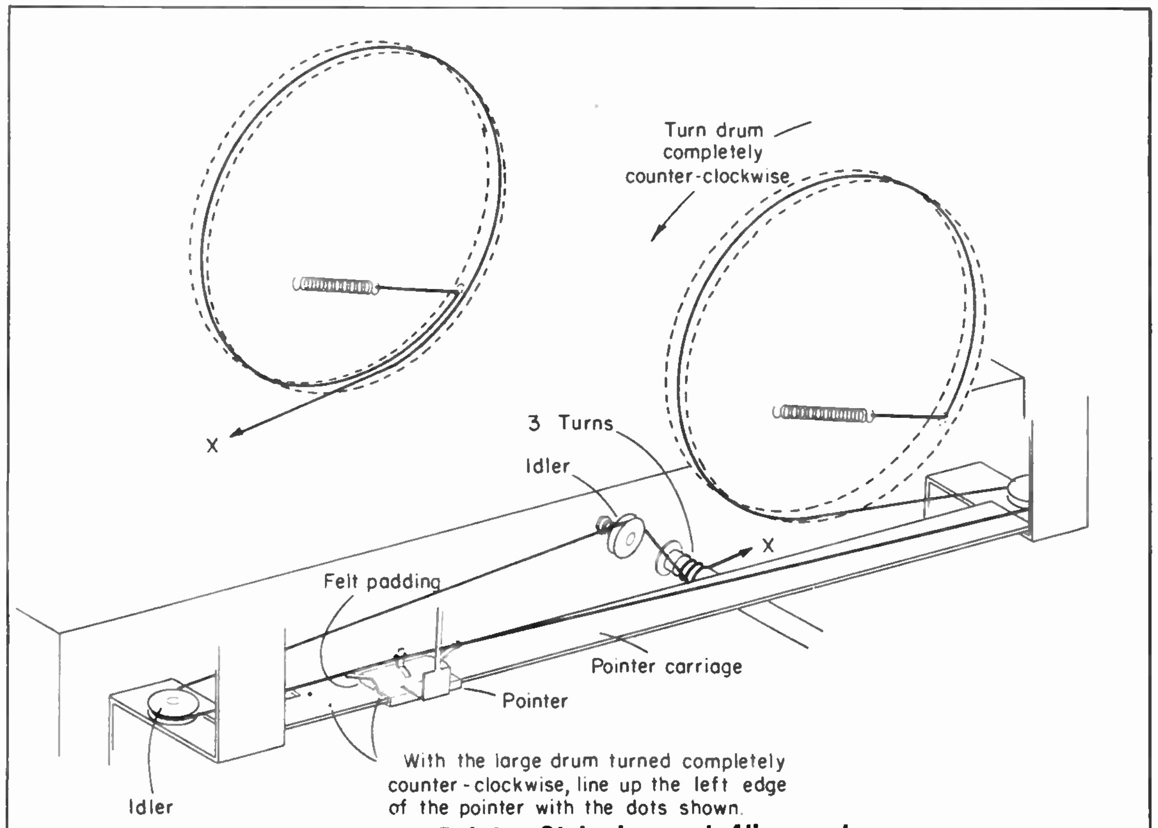
Tone Control—Rotating the bottom knob gives a full variation of the tonal response from a deep bass to a brilliant treble.

Tuning Knob—The knob second from the top is the tuning knob; rotation of this knob moves the indicator along the dial scales. When selecting a station turn the knob back and forth until the tone is clearest and loudest. Do not use the tuning knob to regulate volume; the volume control should be used for that purpose after the station has been tuned in properly. It is particularly important in FM reception to tune the station accurately; otherwise the tone is distorted and the background noise not eliminated.

Band Switch—The knob on the top is used to select FM BAND, BROADCAST BAND, or PHONO. When this knob is turned fully clockwise FM programs can be tuned in. In the center position STANDARD BROADCASTS can be heard.

Phonograph—Turning the Bandswitch fully counterclockwise allows the radio to be used for the playing of phonograph records in conjunction with the automatic record player mounted in this cabinet. This automatic Record Player accommodates eight of the NEW 45 RPM records, approximately 40 minutes of entertainment without attention. For operation of this unit please refer to the Automatic Record Changer Operating Instructions on separate sheet.

REPLACEMENT OF DIAL CORDS



Pointer Stringing and Alignment

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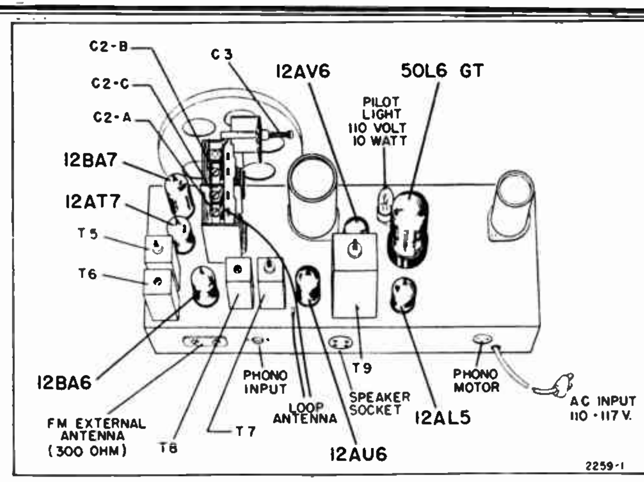
ALIGNMENT PROCEDURE

Broadcast Band Section I. F. and R. F.

The alignment procedure below includes the sensitivities at the inputs of various stages. All signal input values are based on an output of .50 watts. This may be measured by disconnecting the speaker voice coil and substituting a 3.2-ohm resistor across the secondary winding of the output transformer. A reading of 1.25 volts AC across this resistor will be approximately equivalent to .50 watt output with the speaker connected. The volume control must be set at maximum. The tone control must be set for maximum treble.

The signal source must be an accurately calibrated signal generator capable of supplying the frequencies designated, modulated 30% with a 400-cycle audio signal. A 400 cycle audio signal is required for the audio measurement. Variations in sensitivities of plus or minus 25% are usually permissable.



Chassis View

AM—I. F. ALIGNMENT

Band Switch in AM Position, Gang Open, Dummy Antenna .1 Mfd.

SIGNAL GENERATOR FREQUENCY	CONNECTION TO RADIO	ADJUSTMENTS TO BE MADE	ADJUST FOR
455 Kc. Use 2500 microvolts	Pin 1 of 12BA6 I.F. Amp. and B minus	Primary and Secondary of T8. See chassis view.	Maximum output should be .5 watts
455 Kc. Use 75 microvolts	Pin 7 of 12BA7 Converter and B minus	Primary and Secondary of T6. See chassis view.	Maximum output should be .5 watts
400 cycles. Use 45 millivolts	High side of Volume Control and B minus	None	Maximum output should be .5 watts

BROADCAST BAND—R. F. ALIGNMENT

Check pointer so that the right hand edge of the pointer skirt coincides with the right hand edge of dial marker at the extreme right when gang is closed. For Adjustment, see dial mechanism illustration.

SIGNAL GENERATOR FREQUENCY	SET POINTER AT	CONNECT TO RADIO	ADJUST
1620 Kc.	Extreme Right Calibration Marker	AM Antenna Clip and B minus	Oscillator trimmer C2-B for maximum
1400 Kc.	Second Calibration from Right	AM Antenna Clip and B minus	Antenna trimmer C2-A for maximum

Check tracking at 1000 Kc, 600 Kc, and 535 Kc to be sure oscillator is set correctly.

ELECTRICAL SPECIFICATIONS

Power Supply ..... 105 to 125 volts, AC, 60-cycles; Chassis only 75 watts. With phono operation 100 watts.

Frequency Ranges ..... Broadcast Band—535 to 1620 kc. FM Band—88 to 108 mc.

Intermediate Freq. ..... AM-455 kc.; FM-10.7 mc.

Selectivity ..... AM-43 kc. broad at 1000 times signal, measured at 1000 kc. I.F. FM-250 kc. broad at 2 times down. I.F. FM-650 kc. broad at 10 times down.

AM. Sensitivity ..... (For .5 watt output with external antenna)—18 microvolts average.

FM Sensitivity ..... (For .5 watt output)—16 microvolts average.

Power Output ..... 2 watts, 10% distortion. 4 watts maximum.

Loud Speaker ..... 10″ PM. Voice coil impedance 3.2 ohms, 400 cycles.

Tube Complement .....
12AT7, FM-RF amp. mixer;
12BA7, AM converter, FM oscillator;
12BA6, IF amplifier;
12AU6, FM driver;
12AL5, FM detector;
12AV6, AM detector, AVC, 1st audio;
50L6GT, output.

Automatic Changer See Manual 5084.

ALIGNMENT PROCEDURE

FM Band Section I. F. and R. F.

A non-metallic alignment tool must be used.

IMPORTANT

No alignment of the FM section of this radio should be attempted unless you are positive that the circuits are in need of adjustment and you have the necessary equipment.

All components used in this radio are extremely stable and the tuned circuits should require no adjustment over a long period of time.

NOTE

The following alignment is based on the use of the new Simpson vacuum tube voltmeter which has a "floating ground". In other words, the meter, when used as a vacuum tube voltmeter, can have both the positive and negative sides connected to points above ground and still give true readings.

A standard AM signal generator is required.

FM—I.F. ALIGNMENT

Band Switch in FM Position. Dummy Antenna .1 Mfd.

SIGNAL GENERATOR FREQUENCY	CONNECTION TO RADIO	VACUUM TUBE VOLT METER CONNECTION TO RADIO	ADJUSTMENTS TO BE MADE	ADJUST FOR
10.7 Mc. Use about .1 volt	Pin No. 1 of 12AU6	Pin No. 7 of 12AL5 and B minus	Bottom Core Primary of T9 Ratio Detector	Resonance should be about 3 volts
10.7 Mc. Use about .1 volt	Pin No. 1 of 12AU6	See note "A"	Top Core Secondary of T9 Ratio Detector	Zero. Use zero center scale See note "B"
10.7 Mc. Use about 330 microvolts	Pin No. 1 of 12BA6	Pin No. 7 of 12AL5 and B minus	Primary and Secondary of T7. FM Driver IF See chassis view.	Resonance should be about 3 volts
10.7 Mc. Use about 600 microvolts	Top end of C2-C	Pin No. 7 of 12AL5 and B minus	Primary and Secondary of T5. Input IF See chassis view.	Resonance should be about 3 volts

NOTES ON FM—I. F. ALIGNMENT

NOTE "A"—Connect two resistors in series, 100K OHMS each, from Pin No. 7 of 12AL5 to B minus (pin no. 5). These resistors must be matched within 5%. Connect vacuum tube voltmeter between the midpoint of the resistors and point zz.

NOTE "B"—If T9 has been tampered with, it is possible that no crossover point will be found at first. Careful adjustment of both primary and secondary is necessary.

NOTE "C"—To use a VTVM which does not have the "floating ground" feature, in step 2 above, connect "ground" side of VTVM to midpoint of resistors (Note "A") and "high" side to point zz.

GENERAL—Input signals should be adjusted to give approximately 3 volts. The ratio detector is operating at a reasonable level at this point and will give the truest indication of correct alignment with the procedure specified.

FM—R. F. ALIGNMENT

Check pointer so that the right hand edge of the pointer skirt coincides with the right hand edge of dial marker at the extreme right when gang is closed. For Adjustment, see dial mechanism illustration.

SIGNAL GENERATOR FREQUENCY	POINTER	CONNECTION TO RADIO	ADJUST	VTVM CONNECTIONS
108 MC.	108 MC. Marker	FM antenna terminals	FM Osc C3 for maximum	Pin No. 7 of 12AL5 to B minus
98 MC.	Tune in Gen. Signal	See Note "B" below	FM Mixer C2-C for maximum	

NOTE "A"—If a signal generator with the above fundamental frequency is not available, it is sometimes possible to use harmonics. Use extreme care in picking harmonics. An alternate procedure is to use a local station carrier of known frequency to align the FM Band and to use the vacuum tube volt-meter as above for resonance indication. A weak carrier, however, will not produce 3 volts.

NOTE "B"—Connect 300 ohms in series with "hot" side of generator and connect to left hand screw of external FM Antenna Terminals. Connect cold side of generator to right hand screw.

MODEL 10AXF44,
Radio Ch. 7AF24

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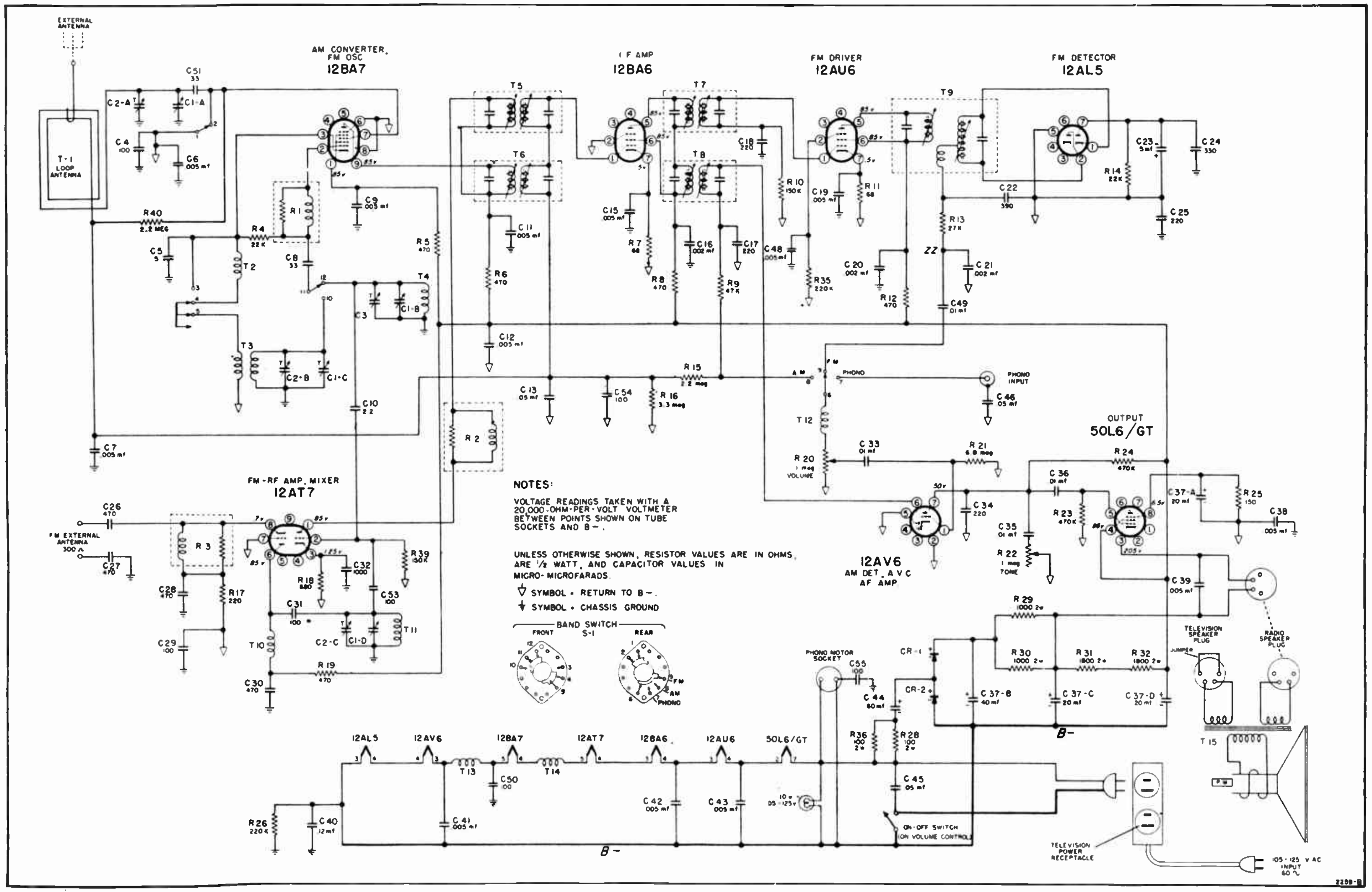

RADIO SCHEMATIC DIAGRAM

RADIO REPLACEMENT PARTS LIST

When ordering, specify part number, model number, and manual issue.

Ref. No.	Part No.	Description	Qty. Used In set
		CONDENSERS	
C1, ABCD	B-8A-16592	4 section gang condenser	1
C2, ABC		Trimmer on gang	
C3	A-201-15142	FM Osc. trimmer	1
C4,29,31,50,53,	C-8G-11734	100 mmf, ceramic	5
C5, 54	C-8G-12166	5 mmf, ceramic	1
C6,7,9,11,12, 15,19,38,41,42, 43,48,54	A-8G-13962	.005 mf, disk ceramic	12
C8,51	C-8G-14172	33 mmf, ceramic	2
C10	A-8G-12495-4	2.2 mmf, ceramic	1
C14,46	C-8D-10770	.05 mf, 200 volts, paper	2
C16,20,21	C-8G-16049	.002 mmf, ceramic	3
C17,18,25,34	C-8G-11733	220 mmf, ceramic	4
C22	C-8F3-120	390 mmf, mica	1
C23	C-8C-16013	5 mf x 100 volts, electrolytic	1
C24, 55	C-8F3-11	330 mmf, mica	1
C26,27,28,30	C-8G-11732	470 mmf, ceramic	1
C32	C-8G-13201	1000 mmf, ceramic	1
C33,35,36,49	C-8D-10761	.01 mf, 400 volts, paper	4
C37, ABCD	A-8G-16432-1	40-20-20 mf x 300 volts, electrolytic, 20 mf x 25 volts	1
C39	C-8D-10935	.005 mf, 600 volts, paper	1
C40	C-8D-16791	.12 mf, 200 volts, paper	1
C44	A-8C-16370	60 mf x 120 volts, electrolytic	1
C45	C-8D-10813	.05 mf, 400 volts, paper	1
		RESISTORS	
R1	A-16B-16615	Suppressor	1
R2	A-16B-16614	Suppressor	1
R3	A-16B-16616	Suppressor	1
R4,14	C-9B1-78	22K ohms, 1/2 watt	2
R5,6,8,12,19	C-9B1-58	470 ohms, 1/2 watt	5
R7,11	C-9B1-48	68 ohms, 1/2watt	2
R9	C-9B1-82	47K ohms, 1/2 watt,	1
R10,39	C-9B1-26	150K ohms, 1/2 watt	2
R13	C-9B1-79	27K ohms, 1/2 watt	1
R15,40	C-9B1-33	2.2 megohms, 1/2 watt	2
R16	C-9B1-34	3.3 megohms 1/2 watt	1
R17	C-9B1-54	220 megohms, 1/2 watt	1
R18	C-9B1-60	680 megohms, 1/2 watt	1
R20	A-10A-16503	1 megohm, volume control and switch	1
R21	C-9B1-36	6.8 megohm, 1/2 watt	1
R22	A-11B-16502	1 megohm, tone control	1
R23,24	C-9B1-94	470K ohms, 1/2 watt	2
R25	C-9B1-52	150 ohms, 1/2 watt	1
R26,35	C-9B1-27	220K ohms 1/2 watt	2
R28,36	C-9C4-50	100 ohms, 2 watts	2
R29,30	C-9B4-62	1000 ohms, 2 watts	2
R31,32	C-9B4-65	1800 ohms, 2 watts	2
		COILS AND TRANSFORMERS	
T1	C-13E-16496	Loop antenna	1
T2,13,14	A-16B-16023	RF choke	3
T3	B-13D-16611	AM Osc. coil	1
T4	A-13D-16617	FM Osc. coil	1
T5	B-13A-16612	FM input IF	1
T6	B-13A-16662	AM input IF	1
T7	B-13B-16000	FM driver IF	1
T8	B-13B-16302	AM output IF	1
T9	B-13M-16001	FM ratio detector	1
T10	A-16B-16613	RF choke	1
T11	A-13E-16618	FM mixer coil	1
T12	A-16A-16637	RF choke	1
T15		Output transformer	On Speaker
	C-18A-17238	10" PM speaker and output transformer	1
		DIAL PARTS	
	B-30A-16684	Dial scale	1
	B-23J-17158	Escutcheon gasket	1
	B-6B-16506	Diffuser	1
	A-3A-16504	Tuning shaft	1
	B-29C-15876	"C"washer for above	1
	B-2M-16656	Pointer bar	1
	A-3H-10299	Idler pulley	2
	B-2G-16505	Dial Pointer	1
	A-53A-10989	Dial string 60" req.	
	A-49A-10078	Tension spring	2
	B-4M-15913-1	Dial scale bracket	2
		RECORD CHANGER	
	C-201-17184	45 RPM Automatic Record Changer	1
	P-73	Crystal cartridge	1
		45 RPM needle	1
		MISCELLANEOUS	
	B-20A-16663	Band switch	1
	A-46A-16545	Pilot lite bulb	1
	A-15B-13430	Min. 9 pin tube socket	2
	A-15C-16297	Min. 7 pin tube socket	4
	A-15B-10440	Octal tube socket	1
	A-3B-16758	Tuning shaft bushing	1
	A-7B-13050	FM dipole Terminal strip	1
	A-47A-16546	Pilot lite assembly	1
	A-19B-12468	Phono motor socket	1
	B-14M-17244	Line cord with Pol. plug	1
	A-19B-12170	Phono pickup socket	1
	A-15B-11538	Speaker socket	1
	B-14MA-11066-6-16	FM dipole ribbon	1
CR-1,2	A-21J-12775	Selenium rectifier	2
	B-15B-13785	Large lytic mtg. plate	1
	B-15B-10076	Small lytic mtg. plate	1

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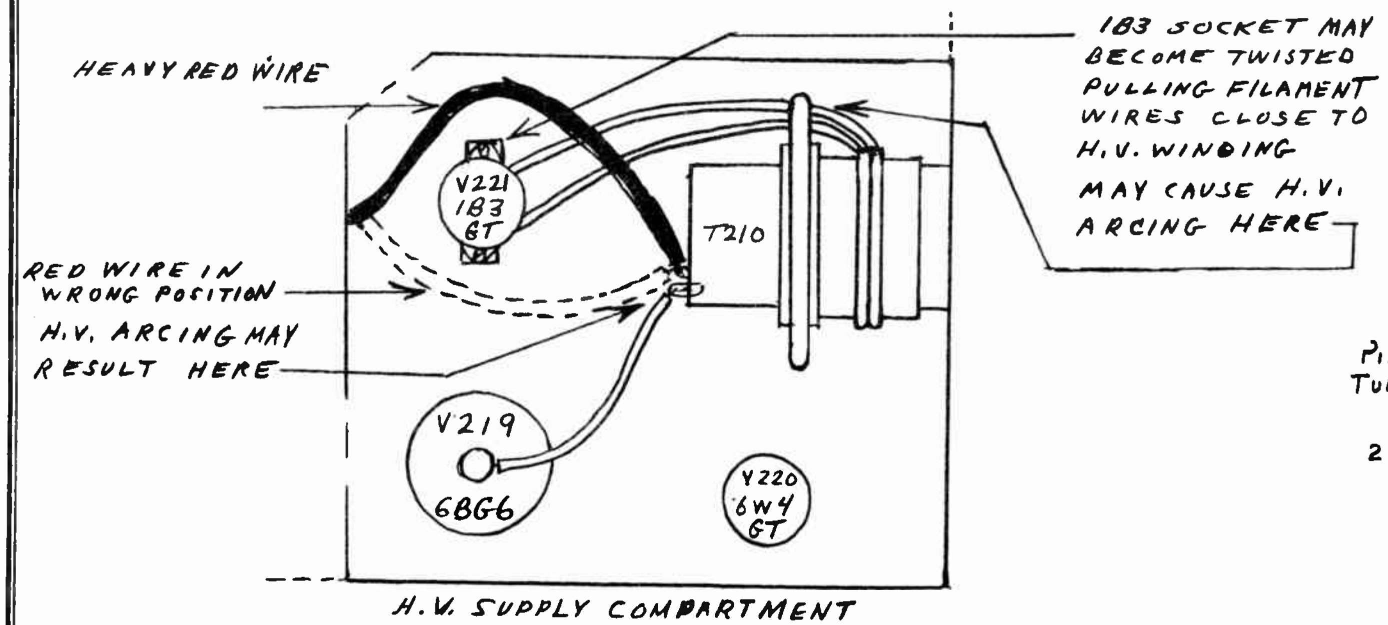
LEAD DRESS IMPORTANT IN CX-33 "HV" SECTION

If necessary to replace the 1B3 rectifier tube in the "HV" section of this receiver, it is possible if care is not exercised to disarrange the wiring. This might cause high voltage arcing or a short to develop resulting in a burned out transformer. Note carefully in the sketch below the proper position of the 1B3 socket, so as to avoid drawing the filament supply leads against the transformer coil. Also note correct position of the heavy red wire between the horizontal output transformer and the deflection yoke. It must be between the 1B3 tube and power supply shield -- not between the 1B3 and 6BG6 tubes.



EXPLANATION OF DIFFERENT TYPES OF ION TRAP MAGNETS USED

There are several different types of picture tubes currently being used in the CX-33 Chassis, these can be separated into two categories; the "tilt gun" type and the "straight gun" type. The type of Ion Trap Magnet used depends upon the category in which the picture tube is classified with regard to the electron gun structure. Ion Trap Magnet, part no. 650276A-1 is a "single magnet" type used with the "tilt gun" tubes.
Ion Trap Magnet, part no. 650161A-4 and 650161A-5 are "double magnet" types used with the "straight gun" tubes. (650161A-4 and 650161A-5 differ only in that they are obtained from different suppliers.)
Following is a classification of the different type rectangular tubes and the Ion Trap Magnet to be used with each.

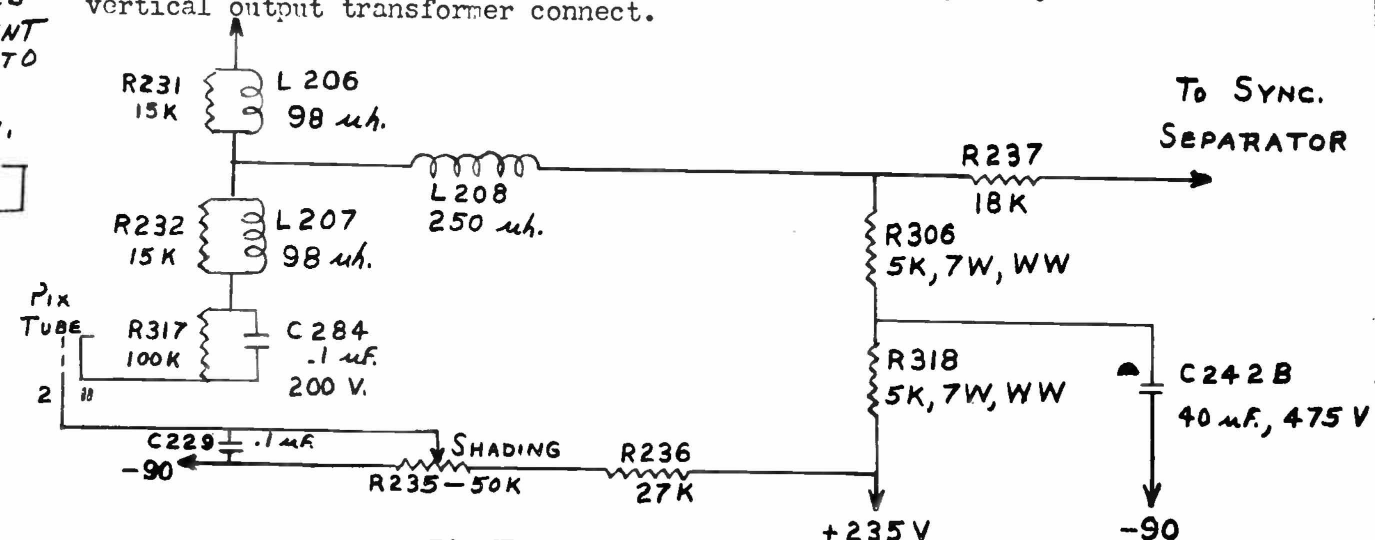
Tube Type		Ion Trap Magnet
16RP4	(Straight Gun)	650161A-4 or 650161A-5
16XP4	" "	" or "
160-AR Farnsworth	" "	" or "
16TP4	(tilt gun)	650276A-1
16KP4	" "	"

The two different types are not interchangeable with the two types of tubes in use. Use of the wrong type trap may result in failure to obtain maximum picture brilliance and possible damage to the tube screen through ion bombardment.

Important: Ion trap Magnets Parts No. 13917 and 650161A-1 are for use with "Round" picture tubes and are not to be used with the "Rectangular" tubes.

TO PREVENT BLOCKING ON STRONG SIGNALS

Remove the present leads from the positive terminal of C242B, connect together and insulate. Connect a 5K, 7 Watt wire-wound resistor between the positive terminals of C243C and C242B. This resistor is indicated in the diagram below as R318. Remove R236 from the plus 135 Volt circuit and connect to the plus 235 Volt circuit. Remove R306 from the plus 135 Volt circuit and connect to C242B. To provide by-passing at the plus 135 Volt tap, add a 20 ufd. 450 Volt tubular condenser between this point and ground. This condenser should be connected to the terminal board to the front of the 4.5 mc. sound I.F. stage and the ground lug of the terminal board to which the primary leads of the vertical output transformer connect.



TO REDUCE BLOOMING OF THE PICTURE

Connect in series with the lead to pin 11 (cathode) of the picture tube a parallel combination of a 100K resistor and a 0.1 ufd. 200V capacitor. Care should be taken that undue stray capacity is not introduced between the cathode lead of the picture tube and ground.

This change is also shown in the diagram above.

TO INCREASE HORIZONTAL SCAN

The 30 mmfd. 6KV condenser, C278, part No. 450954A-3, which was previously connected between the cathode of the 6W4 damper tube and ground to increase width should be re-connected between the 6BG6 plate connection of the high voltage coil and ground to further increase width.

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A soldering lug should be attached to the inside wall of the power supply housing in line with the present hole through which the yoke lead comes out and approximately 2-$\frac{1}{4}$ inches from the rear of the chassis. Care should be taken when installing the capacitor that it does not come in contact with either the 1B3 or 6BG6 tube. A wire ground should be installed between the terminal lug and the chassis to provide proper grounding. An easy method of connecting this is to run wire through the vent hole closest to the 6BG6 socket and ground the wire to the saddle of the socket.

INTERNAL ARCING IN H.V. CAPACITOR C261 - CX-33 TV CHASSIS

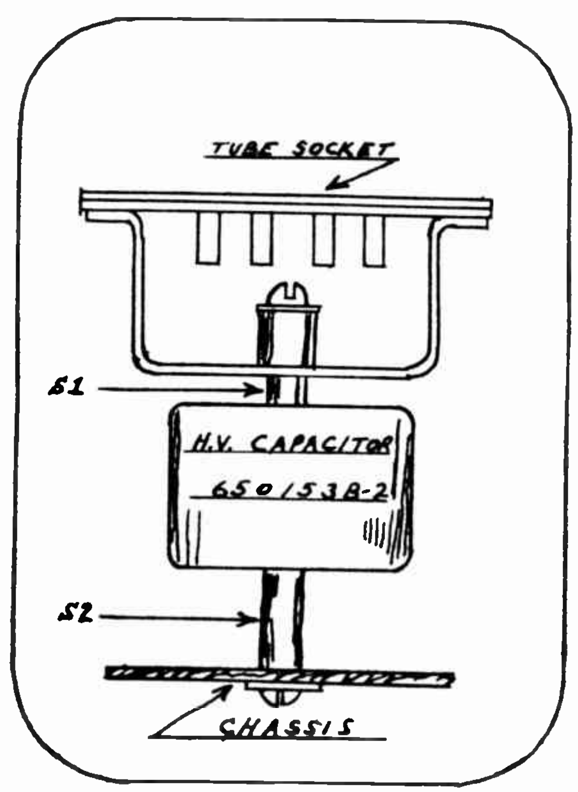
This is the 500 uufd., 20KV high voltage filter capacitor, part No. 650153B-2.

It is possible that the Jeffers Electronics H.V. capacitor, part No. 650153B-2, may be subject to failure, possibly caused by absorption of moisture in the dielectric or to mechanical failure in the event of being abused at time of assembly. This breakdown may not be apparent at once but may possibly show up over a period of several weeks in operation.

There are two colors of Jeffers capacitors -- mustard and tan. Do not confuse these with the Centralab capacitors which will have the trademark CRL stamped on them. We have had reports only of Jeffers capacitor failures although some CRL types might be found similarly defective.

Any of these capacitors found defective should be removed from the CX-33 chassis. These should be held for return to Capehart-Farnsworth on Return Goods Authorization issued by our Field Engineer and not scrapped in the field. We are anxious to receive defective samples for further engineering examination as soon as possible.

The failure of subject capacitors could be the result of a mechanical strain on the solder joint inside the capacitor where the stud is connected to the silver deposit on the ceramic dielectric. Excessive torque applied between the two studs or between the body of the capacitor and a stud during assembly or replacement may break the soldered joint or tear the silver away from the dielectric.

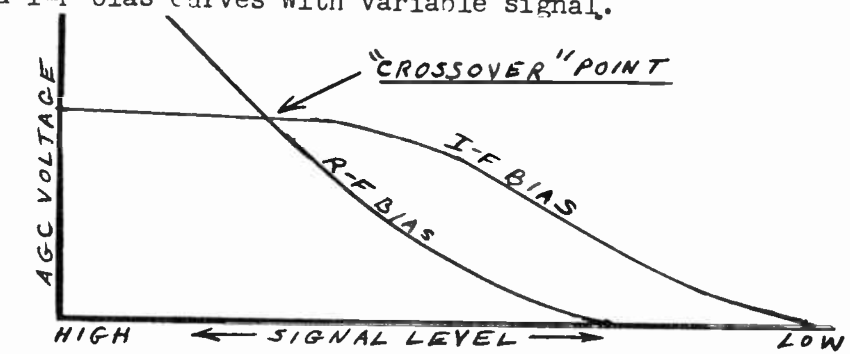


In assemblying the capacitor to the bracket, part No. 450512B-1, the assembly should be held by the bracket, not by the capacitor, as the screw is tightened. The double-D hole in the bracket prevents rotation between the bracket and stud S1.

In mounting the bracket-capacitor assembly on the chassis, stud S2 should be held by a pair of gas pliers as the mounting screw is tightened, so as not to produce any torque between S2 and the body of the capacitor.

VARIATION OF AGC CROSSOVER POINT--CX-33 CHASSIS

The CX-33 Chassis employs an AGC System wherein differential bias is supplied to the R-F and I-F stages. This means that at low signal levels, more AGC voltage is applied to the I-F Stages than to the R-F Stage, while at high signal levels, more AGC is applied to the R-F Stage than to the I-F. Therefore, there is a point of "crossover" at some value of signal level where the I-F and R-F bias is the same. This is illustrated in the following graph showing the R-F and I-F bias curves with variable signal.



Some reports have been received of excessive "snow" in moderate signal areas. This has been found to be caused, in certain cases, by a variation of resistance in R-252 and/or R-248 resulting in the AGC crossover point occurring at too low a signal level. A test is being incorporated in production wherein a 1000 microvolt signal must produce a relatively snow free picture. R-252, 2.4 megohms, R-248, 24K, and R-250, 120k resistors must all be held within their 5% tolerance. In cases of excessive snow these resistors should be checked for proper values. Since R-248 and R-250 are fairly low values, it is difficult to ascertain a 5% change in their resistance without the use of a bridge. Therefore, it is suggested that where a noticeable resistance change is not found in R-248 or R-250, that R-252 be changed to 2.2 meg. or, if snow is still excessive, to 2.0 meg. This has been found to remedy the condition in most cases.

INTERMITTENT DECREASE IN HORIZONTAL SCAN--CX-33 CHASSIS

A chassis developing the above mentioned trouble will have sufficient scan when first turned on. The width will decrease over a ten to fifteen minute period in most cases to about two-thirds original size, then gradually over a period of approximately one hour, the width will increase to normal size.

This trouble has been found to be the result of excessive winding capacity and insufficient baking of isolation transformer in the damper tube heater circuit. This transformer (part no. 650243A-1) is supplied by more than one vendor and this difficulty has been found to exist only in those transformers identified by the code letters "BC" following the part number. All of these transformers so coded should be removed from your stock and returned for credit with approval of your Field Service Representative.

As soon as the vendor in question can correct the above mentioned difficulty his transformer will again be accepted for use. These transformers will bear the code letters "BC", however, they will be identifiable by the code dating which will be 037 or higher.

ADDITIONAL INFORMATION ON 6KV CAPACITOR, C-278

The original capacitor is believed to have failed due to heat from the 6BG6 tube. A new capacitor, part #650310A-2, has a wax coating unaffected by high temperatures. Life tests, and field reports have shown this new capacitor to be entirely satisfactory.

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NEW FOCUS COIL MOUNTING FOR SHIPMENT

You were informed in the previous issue of the service bulletin that a special method of mounting the focus coil during shipment would be incorporated shortly.

As of September 12, 1950, the method described of mounting the focus coil under the chassis shelf, was incorporated in all models currently in production with exception of models 320 and 321. This method of mounting the coil is considered temporary and will be superceded, as soon as parts become available, by a second method wherein the coil is mounted on the H.V. Supply Shield. This second method will be applicable to all models including the 320 and 321.

This is an item which should be covered in your Dealer Bulletin specifically stressing the importance of properly installing the focus coil when the receiver is set up. It would be well to have all installation personnel informed of this proper mounting if they are not already familiar with the CX-33 Chassis. By referring to the CX-33 Chassis Maintenance Manual (Chassis Top View) an inexperienced man can determine the correct mounting of the coil. These men should also be cautioned to properly adjust the ion trap since the trap must be removed to install the focus coil.

We expect reports of picture tubes broken in shipment to drop off sharply with the use of this new mounting. In view of the precautions taken by the factory to avoid breakage, we believe no carrier will refuse to accept responsibility in the comparatively few cases where this may still occur. Please check each incoming shipment for glass rattle (not necessary to open) -- where noted, carrier claim should be filed immediately.

INTERMITTENT VERTICAL SYNC BUZZ--CX-33 CHASSIS

Most reports of "intermittent" sync buzz can be attributed to overmodulation at the TV Transmitter for which, of course, there can be no correction at the receiver end. Always check with the TV transmitter's engineers first upon receiving reports of intermittent sync buzz troubles.

At the receiver, this trouble may be the result of insufficient drive at the ratio detector resulting in lowered AM rejection. Increased drive can be obtained by supplementing the coupling of the sound take-off transformer (T204) with a 3 uuf capacitor. Connect the capacitor between terminals 2 and 4 of T204. After adding this capacitor the primary and secondary of T204 must be re-aligned carefully.

In addition to reducing sync buzz, this increased coupling will also provide an increase in sound output. Therefore, on reports of low sound output (where alignment is found to be O.K.), the addition of this capacitor is recommended.

REMOVAL OF SHIPPING SCREW ON VARIABLE CAPACITOR IN RADIO CHASSIS C-282 USED IN MODELS 328M & 337M

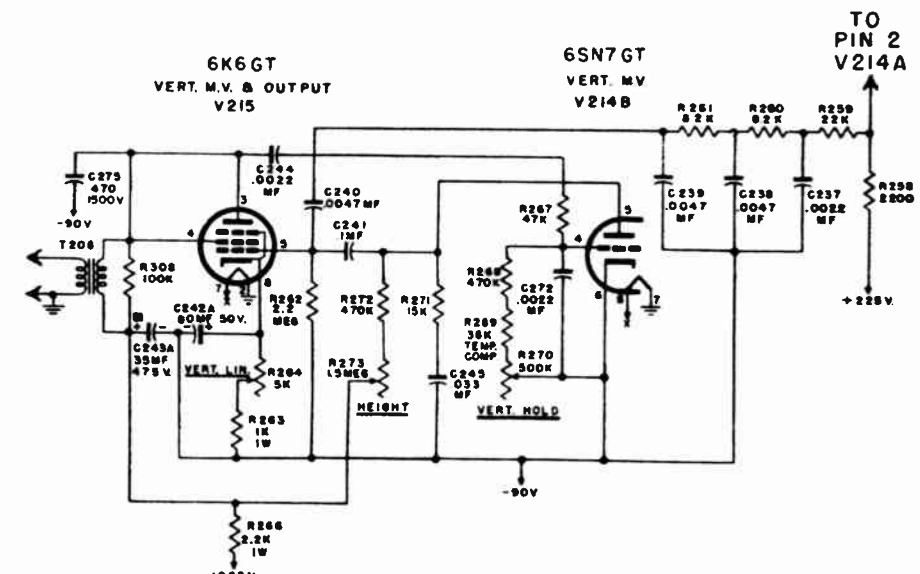
In order to prevent lead breakage during shipment, a method has been devised to fasten the variable capacitor and prevent vibration. A metal bracket is placed in back of the variable and fastened to the chassis. The variable is then secured to the bracket by means of a small screw. This screw should be removed upon installing of the set so that the variable will be "free floating". If the screw is not removed, it is likely that the set will be very microphonic. It is not necessary to remove the bracket; however, it may be necessary to bend it away from the variable in the event that it is touching the back of the variable and hindering its free mounting.

Production Changes

Early Production "CX-33" Chassis.

The following differences exist between the chassis used in early production of Models 3011 and 3012 only and the schematic diagram shown in Figure 6b.

1. The junction of R254 and R253 is connected to chassis ground.
2. R255 is a 22K, 2W resistor.
3. R286 is a 150K resistor.
4. R242 is a 47K resistor.
5. Terminal "B" on T209 is connected directly to plus 235 volts.
6. R314, C278 and C283 are not used.
7. The Vertical M. V. and Output Stage is as shown below.



CX-33, Series "-2" and CX-33F Chassis;

The following differences exist in the CX-33 Chassis, coded with a "-2" and CX-33F Chassis (which employs a 16 inch Round, metal C. R. T.).

In some receivers using these chassis:

1. R286 is a 150K resistor.
2. R267 is a 22K resistor.
3. R262 is a 2.2 megohm resistor.
4. R266 is connected to plus 295 volt
5. C283 is not used.

MODELS 321-B, 321-M, 322-M, 324-M, 325-F, Ch. C-281, CX -33; 328-M, Ch. C-290, CX-33M; 337-M, Ch. C-292, CX-33K; 323-M, 332-B, 334-M, Ch. C-286, CX-33F

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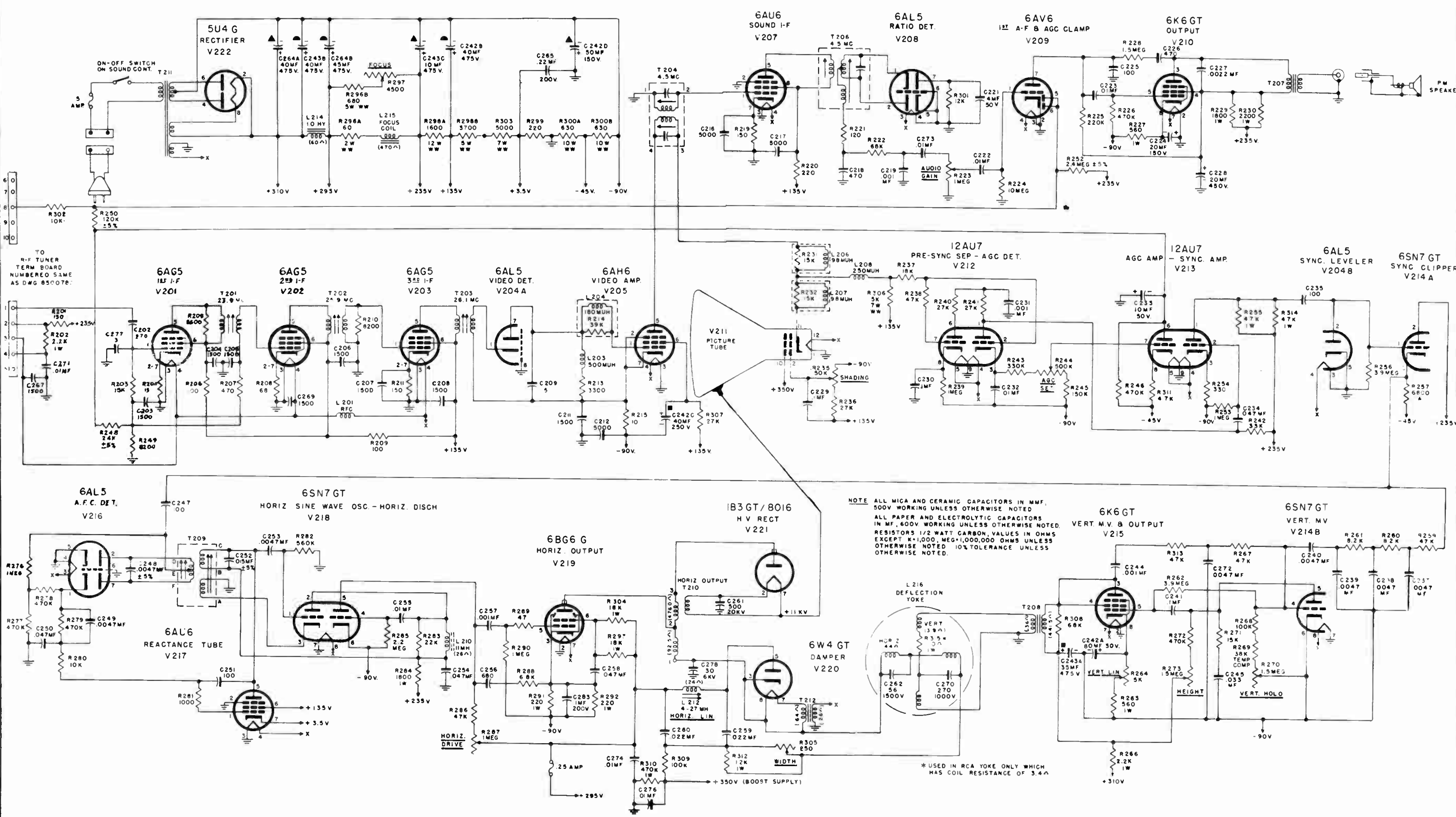
MODELS 321-B, 321-M, 322-M, 324-M, 325-F, Ch. C-281, CX-33; 323-M, 332-B, 332-M, 334-M, Ch. C-286, CX-33F

CAPEHART "CX-33" CHASSIS

THIS SCHEMATIC CORRECT FOR THE FOLLOWING CHASSES:

CHASSIS NO.	PICTURE TUBE	PRODUCTION NO.	SERIES
CX-33	FARNSWORTH "160-AR"	C-281	-2
CX-33F	16GP4	C-286	



NOTE ALL MICA AND CERAMIC CAPACITORS IN MMF, 500V WORKING UNLESS OTHERWISE NOTED

ALL PAPER AND ELECTROLYTIC CAPACITORS IN MF, 600V WORKING UNLESS OTHERWISE NOTED.

RESISTORS 1/2 WATT CARBON, VALUES IN OHMS EXCEPT K=1,000, MEG=1,000,000 OHMS UNLESS OTHERWISE NOTED 10% TOLERANCE UNLESS OTHERWISE NOTED.

Fig. 6b. Chassis Schematic

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THE CAPEHART CX-33 SERIES "-2" TELEVISION RECEIVER CHASSIS

The following changes are being incorporated in the CX-33 Chassis. Instruments including these chassis will be received in the field shortly. For identification, these chassis will be coded with a figure "-2" following the serial number; i.e., Serial No. 888888-2.

A schematic diagram of the Series "-2" CX-33 Chassis is attached. The changes may be grouped by their corrective purpose.

1. IMPROVED INTERLACE

The vertical sync take-off point is changed from the plate to the cathode of V214A. A few other changes were made in the vertical multivibrator to improve interlace. Refer to the attached schematic diagram for details.

2. INCREASED RANGE - VERTICAL HOLD

R270, Vertical Hold Control, is changed from 500K pot. to 1.5 meg. potentiometer to increase the "hold" range of this control.

3. IMPROVED SYNC CLIPPING

The junction of R254 and R253 is changed from chassis ground to minus 90V, R242, plate load resistor for V212, is decreased from 47K to 33K. These changes provide improved sync amplification and clipping. R255 in the plate circuit of V213 is changed from 22K, 1W to 47K, 1W and R314 also 47K, 1W is connected in parallel with it. This change is to provide adequate wattage tolerance.

4. INCREASED HORIZONTAL SCAN

C278, a 30 uuf., 6000V capacitor has been added between pin 3 of V220 Damper Tube and chassis ground. The schematic shows C278 to be 25 uuf., 5000V; however, its correct value as in current use is 30 uuf., 6000V. The addition of this capacitor provides approximately one inch additional horizontal scan (or width). A later production change to increase Horizontal Scan adds a .1 ufd. 200V capacitor across R291 in the cathode circuit of V219, 6BG6 Horizontal Output.

5. ELIMINATION OF SOUND MODULATION IN SYNC

Terminal "B" of T209, Horizontal Oscillator Transformer, is now connected to the junction of R283 and R284 rather than directly to plus 235 Volts. This provides the decoupling action of R284 and C254 for the plate supply to V217. Sound modulation in the horizontal sync circuit resulted in a "wiggle" or "swaying" of the picture horizontally.

6. RE-INCORPORATION OF 5 AMP. FUSE

Coincident with the other changes being incorporated in the Series "-2" chassis the 5 amp. fuse is also being put back in production. The required type fuse holders are available and will be mounted on the chassis rear panel. The spare fuse and spare fuse holder will also be returned to production. These items were temporarily removed from production at request of "UL" until approved type of fuse holder could be obtained.

THE CX-33F CHASSIS PRODUCTION NO. C-286 FOR CAPEHART MODEL 323M CONSOLE TV RECEIVER

This CX-33F Chassis is identical with the CX-33 "-2" electrically. It differs only with respect to the C.R.T. mounting bracket, deflection and focus coil mounting. These have been modified in order to support the type 16GP4 (metal envelope) picture tube, which is employed in the Model 323M receiver.

SPECIAL SERVICE INFORMATION CX-33 AND CX-33F CHASSIS

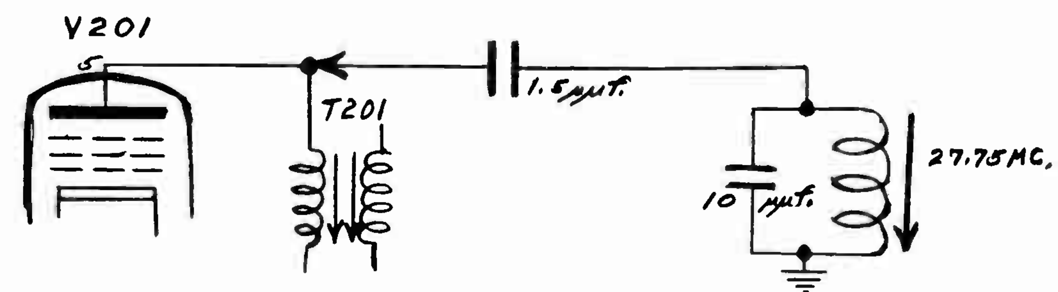
1. INCREASED VERTICAL SCAN IN CX-33 AND CX-33F CHASSIS

A production change has recently been incorporated in CX-33 Series "-2" and CX-33F Chassis to increase the size of the picture vertically.

To increase Vertical Scan, R262 has been changed from 2.2 meg. to 3.9 meg. and R266 is being connected to plus 310V instead of plus 295V. For an additional increase in Vertical Scan, V215, a 6K6GT tube, is being replaced with a 6V6GT (in production) only in those sets which require it. No circuit changes are necessary for this replacement.

2. ADJACENT CHANNEL SOUND TRAP FOR CX-33 CHASSIS

An adjacent channel sound trap tuned to 27.75 mc. will be available shortly for incorporation in the CX-33 Chassis in the field, in those localities in which this type of interference is encountered. The trap is such that it can be easily installed in an already drilled chassis hole near the 1st Pix. I-F Amplifier tube. The trap is to be connected electrically to the plate of the 1st Pix. I-F tube through a 1.5 uuf. capacitor. A sketch showing this trap schematically, follows:



Part number of the trap is 650299A-1; part number of the 1.5 uuf. capacitor is 650030A-9.

A suggested procedure for tuning this trap, after its installation, is to first tune the receiver to the channel on which the interference is obtained (if possible) and then adjust the trap to eliminate the interference. After doing this, check the overall I-f response curve and make adjustment to the I-F transformers, if necessary. The trap then can be re-adjusted slightly if any further interference is noted. In no event should this trap be installed without checking the overall I-F curve.

MODELS 321-B, 321-M, 322-M, 324-M, 325-F, Ch. C-281, CX-33; 323-M, 332-B, 332-M, 334-M, Ch. C-286, CX-33F

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SPECIAL SERVICE INFORMATION CX-33 AND CX-33F CHASSIS (CONTINUED)

3.

ADDITIONAL INFORMATION ON H.V. ARCING

SEE SERVICE BULLETIN VOL. VII - NO. 7 - ISSUED MAY 10, 1950

The following changes have been incorporated in production to eliminate the causes of this difficulty.

A. The heavy red lead in the H.V. Supply section has been shortened in order to maintain proper dress.

B. The H.V. Filter Capacitor mounting nut is being soldered to the chassis to prevent it and hence the 1B3 socket from rotating and causing arcing between the 1B3 filament leads and the H.V. Winding of T210.

C. A high voltage insulating material is being applied to the 1B3 plate cap lead at its connection to the H.V. Winding; this is to prevent corona between this point and the H.V. Supply Shield. Additional transformers purchased will be revised to include sufficient insulation at this point.

D. The 1B3 and 6W4 socket terminals and wiring are being coated with a H.V. insulating material to prevent corona.

4.

SHORTING OF FOCUS COILS

Several shorted focus coils have been received from the field and examination shows that these coils have developed shorts due to direct contact between the lead-in to one end of the coil and other portions of the winding.

The short may not show up until the coil has been in operation for a period of time depending upon the insulation of the wires and the pressure exerted between them. (This is why such a difficulty is not detected in final test.) The symptom resulting from this short, of course, is inability to focus. A resistance check will usually show a reduction from a standard of 470 ohms to between 30 and 60 ohms.

All shorted coils to date have been those manufactured by the I.T.E. Circuit Breaker Co. These coils are also supplied by the Guardian Co. This condition has been corrected by the vendor and no receivers are being shipped with the early type coil. This early type can be identified by observing the yellow plastic bobbin. (The bobbin can be seen by looking into the coil through the air gap).

The corrected focus coil, as supplied by I.T.E. can be identified by its use of a gray plastic bobbin.

The Service Department is stocking only the corrected coil with the gray bobbin. It is suggested that you check your stock on this item, and discuss this subject with your Field Service Representative. All focus coils re-ordered on the same part number will be of the corrected type.

On a national basis, the percentage of shorted coils has been low. You may be assured that this condition has been corrected.

SPECIAL SERVICE INFORMATION CX-33 AND CX-33F CHASSIS (CONTINUED)

5.

SUBSTITUTION OF 12AT7 FOR 12AU7 - V212 ONLY

Due to a shortage of 12AU7 tubes, a 12AT7 tube is temporarily being used for V212, Pre-Sync Separator - A.G.C. Detector. The 12AT7 should not be used to substitute for V213. When replacing V212, a type 12AU7 tube should be used.

6.

TEMPORARY REMOVAL OF 5 AMP. FUSE

The 5 amp. fuse, fuse holder and spare fuse and holder were deleted for a short time in production. The fuse, spare fuse and spare fuse holder are now being re-incorporated in production. In the meantime, some chassis have been shipped without the 5 amp. fuse.

7.

FAILURE OF R-258 IN EARLY CX-33 CHASSIS

R-258 is a 2.2K ½W plate load resistor supplying the plate of V214A Sync Clipper tube in early CX-33 Chassis (before the Series "-2" production changes). Some reports have been received stating that this resistor has opened up after a period of operation resulting in a lack of vertical sync. It is suggested, if this resistor is found defective, that it be replaced with a 2.2K, 1W resistor for an additional margin of safety.

8.

PROPER SETTING OF THE AGC SET CONTROL

We are receiving reports from dealers' service men and installation personnel which indicate that they do not understand the function or the proper method for adjusting this control. The adjustment of this control is covered in the Installation and Set-Up Instructions, which accompany each receiver and also in the CX-33 Maintenance Manual. The control does usually require adjustment in the field when setting the receiver up for operation.

If the control is adjusted to either extreme clockwise or counter-clockwise when the receiver is first placed in operation, it is possible that no picture will be seen. If the control is in the extreme counter-clockwise position, the level of the bias applied to the R-F and I-F stages is very high and these stages are operating at minimum gain. If the control is in the maximum clockwise position, the reverse condition exists; the operating bias would be at a very low level and hence, if the received signal is strong, the receiver will overload causing the picture to be blanked out.

For these reasons, the control should be set to approximately the center of its range, and then the adjustment between it and the shading control can be accomplished, arriving at a setting for the AGC control which will provide proper operation of the receiver on all available TV signals.

Please see that your dealers' service and installation men are properly informed on this procedure. Make it the subject of a Special Bulletin to them.

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Waveform Analysis

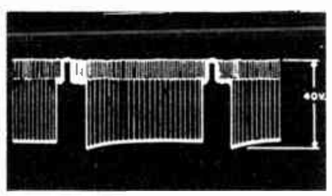
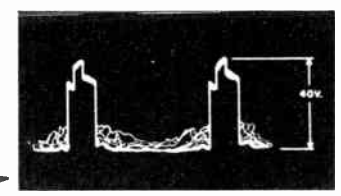
The following waveforms were obtained from a production run CX-33, Series "-2" receiver, with a standard transmitted picture signal connected to the input of the receiver.

The waveforms shown here have been sized for purposes of reproduction and they are not intended to show relative amplitudes. Approximate peak-to-peak voltages are shown on each waveform. These voltages were obtained by calibrating the oscilloscope used to observe the waveforms. The approximate values of peak-to-peak voltage are those that may be expected to be obtained with the AGC Set and Shading controls adjusted for optimum picture contrast and all other controls adjusted for normal operation.

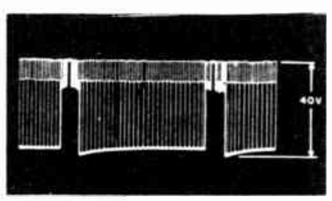
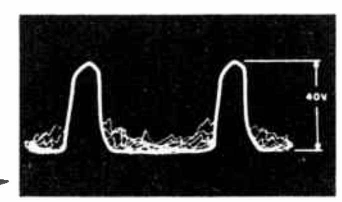
Two separate waveforms are shown at those points where it is intended to show both the vertical and horizontal pulses. For viewing the vertical sync pulse or waveforms in the vertical sweep circuits, the oscilloscope sweep is adjusted to one-half of the vertical sweep rate (30 c.p.s.). For viewing the horizontal sync pulse or waveforms in the horizontal sweep circuits, the oscilloscope sweep is adjusted to one-half the horizontal sweep rate (7875 c.p.s.).

Slight variations in waveform may be noticed in the sync circuits when the receiver is switched to different TV stations. This is due to the slight variation which is tolerated in the transmitted waveform at the station. Some variation in waveform and in peak-to-peak voltage may also be expected due to the response of the particular oscilloscope used to observe the waveforms. When using the waveforms in trouble shooting, these factors should be taken into consideration to avoid possible incorrect conclusions. CAUTION - No waveforms are shown for points in the Horizontal Output Stage other than the control grid and cathode due to the high pulse voltages which exists in the output of this stage. DO NOT attempt to observe waveforms in the horizontal deflection yoke, Horizontal Damper or H. V. Rectifier circuits.

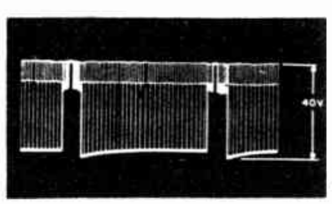
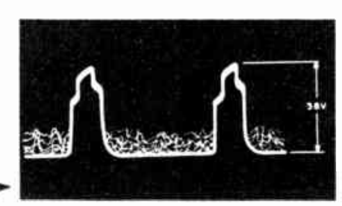
SYNC CIRCUITS

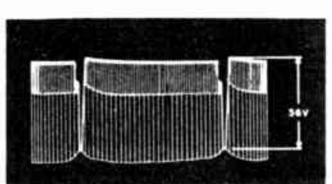
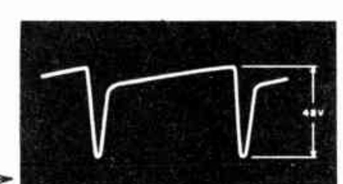
Picture Tube Cathode
(Pin 11 of V211)
← Vertical Horizontal →

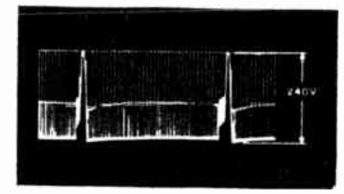
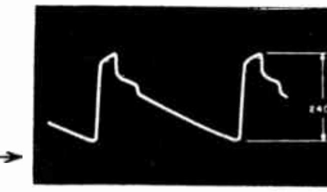
Input to Pre-Sync Separator
(Pin 7 of V212, ½12AU7)
← Vertical Horizontal →

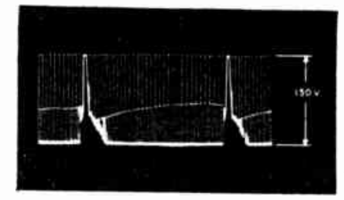
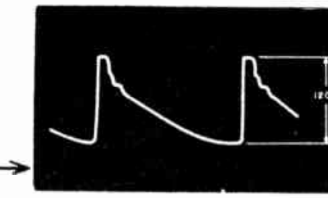
Input to AGC Detector
(Pin 2 of V212, ½12AU7)
← Vertical Horizontal →

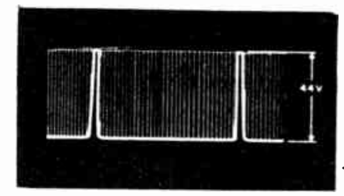
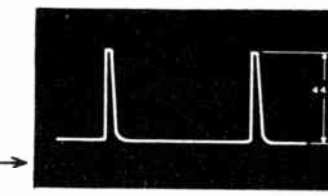
Input to Sync Amplifier
(Pin 2 of V213, ½12AU7)
← Vertical Horizontal →

Output of Sync Amplifier
(Pin 1 of V213, ½12AU7)
← Vertical Horizontal →

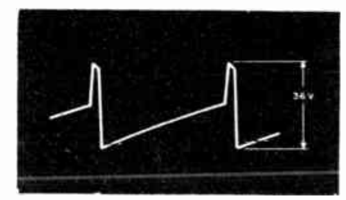



Input to Sync Clipper
(Pin 1 of V214A, ½ 6SN7)
← Vertical Horizontal →

Cathode of Sync Clipper
(Pin 3 of V214A, ½6SN7)
← Vertical Horizontal →

HORIZONTAL SCAN CIRCUITS



Input to AFC Detector
(Terminal E of T209)

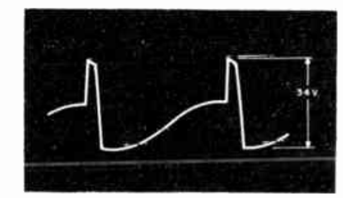


Plate of AFC Detector
(Terminal D of T209)

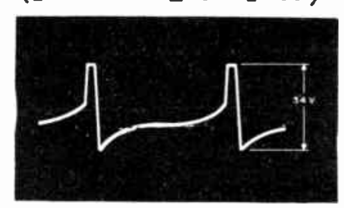
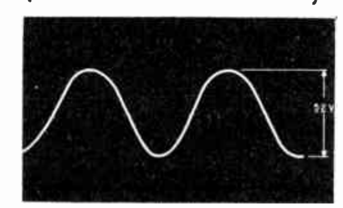
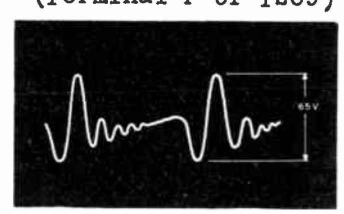


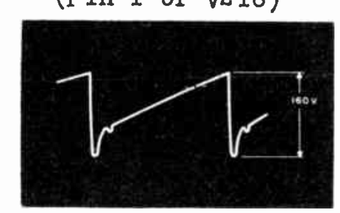
Plate of AFC Detector
(Terminal F of T209)



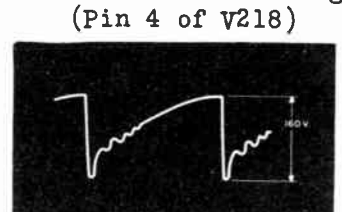
Grid of Horiz. Oscillator
(Pin 1 of V218)



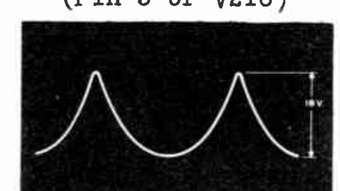
Grid of Horiz. Discharge
(Pin 4 of V218)



Output of Horiz. Discharge
(Pin 5 of V218)

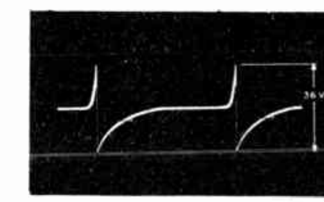


Input to Horiz. Output
(Pin 5 of V219)

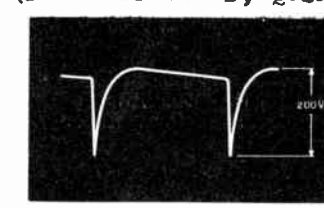


Cathode of Horiz. Output
(Pin 3 of V219)

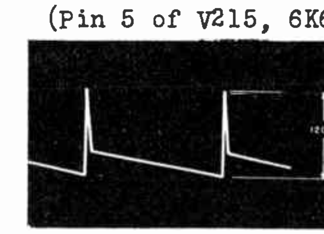
VERT. SCAN CIRCUITS



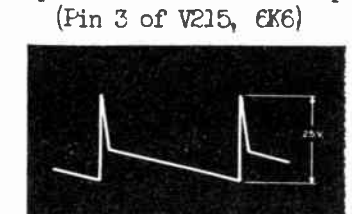
Grid of Vertical M. V.
(Pin 4 of V214B, ½6SN7)



Grid of Vert. M.V. & Output
(Pin 5 of V215, 6K6)



Output of Vert. M.V. & Output
(Pin 3 of V215, 6K6)



Input to Vert. Defl. Coils
(Green lead of L216)

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World Radio History

CHASSIS NO.	PRODUCTION NO.	PRODUCTION RUN
CX-33	C-281	Series "-3"
CX-33F	C-286	Series "-3"
CX-33A	C-285	Original
CX-33L	C-289	Original
CX-33M	C-290	Original
CX-33K	C-292	Original

Basic Difference Between Chassis

All of the above listed chassis are of similar design. The CX-33 is a complete unit using a 16 inch Rectangular picture tube; the CX-33F is a complete unit using a 16 inch round (metal) picture tube and the CX-33L is a complete unit using a 17 inch Rectangular picture.tube. The CX-33A is the basic chassis less the audio section (tubes V209 & V210) and using a 16 inch Rectangular picture tube. The CX-33M chassis is identical to the CX-33A chassis with exception that it employs a 17 inch Rectangular picture tube. The CX-33A chassis is used in model 327M in conjunction with C-284, an 11 tube AM chassis. The CX-33M is used in model 328M in conjunction with C-282, an 11 tube AM FM chassis, and C-243 (or C-295) a single tube phono pre-amplifier chassis. The CX-33K chassis is used in model 337M in conjunction with the C-282 radio chassis and C-295 phono pre amp chassis.

The RF Tuner Part Number 850103A

The RF tuner used in this chassis employs two tubes; a 6AG5 RF Amplifier and a 6J6 Mixer Oscillator. The input circuit employed is a balanced 300 ohm tuned input type. The RF Amplifier circuit, using a 6AG5, has a double tuned bandpass coupling to the mixer grid. The Mixer stage employs one triode section of the 6J6 type. Oscillator excitation is inductively coupled to the mixer grid. The oscillator section of the 6J6 tube is employed as a Grounded Cathode Colpitts type oscillator.

Tuning or channel selecting is accomplished in this tuner by switching inductances by means of a rotating turret. Channel sequence of tuning is progressive; channel 2 through 13, with clockwise rotation. The individual coils comprising the tuned circuits for each channel are fabricated on low-loss bakelite moldings which are held in position on the turret by a "key" and "latch spring" construction. All circuit switching in the tuner is accomplished by means of eleven spring pressure contacts. Vernier or "fine" tuning is accomplished by an auxiliary capacitor which is shunted across the plate section of the tank circuit. This capacitor is operated through a dial cord and pulley arrangement by the Balance Control. Average range of the fine tuning control on the low band is approximately + or -0.5 mc and on the high band + or -1.6 mc.

A single tuned inductance (tuned to 23.0 mc) in series with a 120 mmf capacitor form the resonant coupling circuit between the mixer plate and the grid of the 1st IF Amplifier.

This tuner is used in the CX-33 and CX-33F chassis starting with the series "-3" production run. The CX-33A, CX-33M, CX-33K, and CX-33L chassis employ this tuner exclusively.

Alignment Data

IF Amplifier

The IF Amplifier bandpass in these chassis has been increased from 3 mc to approximately 3.5 mc to provide improved picture definition. To accomplish this, the peaking of two of the IF coils in the stagger-tuned IF system have been changed. Therefore, when aligning any of the chassis listed on the front page of this supplement, the following important items should be noted;

1. T101, the coil in the mixer output stage (located on the RF tuner) should be peaked at 23.0 mc instead of 23.5 mc as stated in the CX-33 Maintenance Manual.
2. T202 should be peaked at 25.8 mc instead of 25.9 mc.
3. A co-channel sound trap (T213) has been added in the plate circuit of the 1st IF Amplifier and is located directly in rear of the 1st IF Amplifier tube (V201). This trap should be set up by tuning it for minimum response (as indicated by a VTVM connected across R213) to a 21.75 mc signal at the mixer grid.

The bandpass of the IF stages is shown in figure 1 of this supplement.

RF and Mixer Alignment (RF tuner, Part no. 850103A-1)

1. Connect the sweep and signal generators to the receiver antenna terminals. To avoid distortion keep the output of the signal generator (pix and sound carrier markers) at a minimum, markers just barely visible on the curve.
2. Connect the oscilloscope to the RF test point (wire loop) on the RF tuner, through a 10 K resistor.
3. Connect a "jumper" from the AGC lead to the tuner, to chassis ground. Leave the jumper connected for all steps under RF and Mixer Alignment.
4. Set the Channel Selector to channel 12.
5. Adjust the sweep generator to sweep channel 12 and adjust the signal generator to provide marker signals at the picture and sound carrier frequencies for channel 12.
6. Adjust C104, C103, and C102 (shown in figure 2) for the curve shown in figure 3. Consistent with proper band width and marker location, the response curve should have maximum amplitude and "flat top" appearance.
7. Adjust the sweep and signal generators progressively for each channel. Check the response curve obtained on each channel against the curve shown in figure 3. If the response of a particular channel does not come within these limits, check to see that the correct coils for that channel are being used or try replacing the coils for that channel. As a final step, it is possible that a compromise can be made by re-adjusting C104, C103, and C102 to improve the response of the particular channel that is off. The response of all other channels then should be re-checked to determine the extent to which they were affected by the compromise.

CHASSIS	MODEL NO.
CX-33L	320-M
CX-33	321-M
CX-33	321-B
CX-33	322-M
CX-33	324-M
CX-33	325-F
CX-33L	326-M
CX-33A	327-M
CX-33M	328-M
CX-33F	332-M
CX-33F	332-B
CX-33F	334-M
CX-33K	337-M

RF Oscillator Alignment

1. Connect the sweep and signal generators to the antenna terminals. To avoid destroying the response curve (due to overloading in the video detector) maintain outputs of the sweep and signal (marker) generators at a bare minimum. The marker pips should just be barely visible.
2. Connect a 500K potentiometer (on clip leads) between pins 6 and 8 of V213 and vary the "pot" to set the DC bias at the junction of R248 and R249 to -3 volts.
3. Connect the oscilloscope across R213. Attach the "high side" of the oscilloscope to the junction of R248 and R249 to -3 volts.
4. Adjust the sweep generator to sweep channel 13 and adjust the signal generator to provide markers at the picture and sound carrier frequencies for channel 13. Before attempting alignment, allow 15 minutes for receiver and test equipment to reach normal operating temperature.
5. Check the response curve obtained against the ideal curve shown in figure 4. If the shape of the curve is not within these limits, it will be necessary to repeat the IF Amplifier Alignment. The IF Amplifiers must be correctly aligned before the oscillator adjustments can be correctly made.
6. Set the Balance Control at the center of its mechanical range and adjust the channel 13 oscillator slug (see figure 5) to approximately the center of its range. Use a non-metallic screwdriver with about a 1/8 inch blade for adjustment of the individual oscillator slugs. If one of the slugs should "fall into" the coil form, remove the coil segment from the turret, move the slug retaining spring aside, and tap the coil segment until the slug slips forward. Set the slug retaining spring in place again to secure the slug.
7. If, with the conditions stated in step 6, the picture and sound carrier markers are not within the limits shown in figure 4, adjust the overall oscillator trimmer C105 to bring them within limits.
8. With the Balance Control adjusted to the center of its range, check the response curve on all channels for proper marker location. If adjustment is required on any channel use the individual channel oscillator slug to obtain the proper marker location.

NOTE: The individual channel oscillator slugs are accessible from the front of the cabinet, therefore oscillator "touch up" on any channel can be accomplished without removing the chassis from the cabinet. For further information, refer to "Oscillator Alignment Using a TV Signal" of the CX-33 Manual.

SERVICING SUGGESTIONS

Following is a summary of service conditions which may be observed in the CX-33 chassis and their recommended corrections. These are included herein to assist the service technicians in troubleshooting this chassis.

Condition	Correction
1. "Whistle" in sound and/or lines in picture (similar to Barkhausen oscillation)	a. Additional bypassing may be needed in the B minus circuit. Add a .1 mfd, 200V cap. from -90V point to chassis ground (near 6BG6 tube, junction of R291 & R-290).
2. Insufficient Vertical Scan	(if production run "2" or earlier) a. Change R262 from 2.2 meg to 3.9 meg. b. Connect R266 to 310V bus instead of 295V. c. Change R267 from 22K to 47K (any production run). d. Change 6K6 (Vert. output) to 6V6 or 6F6.
3. Picture "Jitter" Vertical	a. Possibly "leaky" coupling cap. between Sync, Amp., & Sync Clipper C235 (100 mmf)

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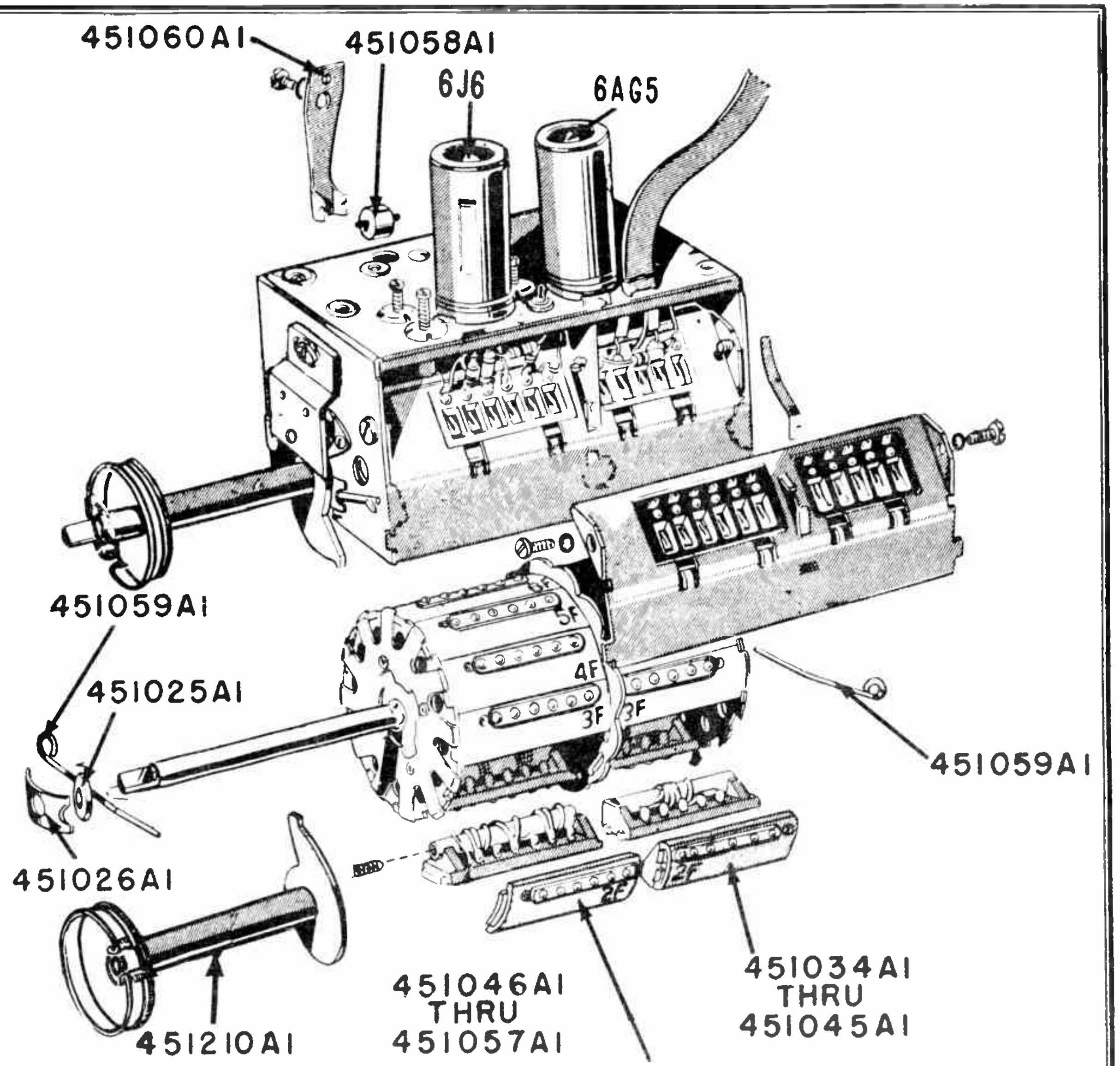
4.	Intermittent Vertical Sync Buzz	a. Over modulation at TV transmitter. b. Insufficient drive at ratio detector. Connect a 3 mmf cap. between terminals 2 and 4 of T204. Check sound alignment.
5.	Small section of Picture Shifts Horizontally	a. Leaky Capacitor C278, 30 mmf., 6KV.
6.	Sound Modulation of Horizontal Oscillation	a. Open or low value capacitor C228 b. R229 wrong value.
7.	Intermittent Narrowing of Picture	a. Possibly excessive winding capacity of Damper Tube heater isolation transformer T212. (if production run 2 or earlier)
8.	Insufficient Horizontal Scan	a. Add .1 mf, 200V across R291 cathode resistor of 6BG6 tube. b. Change R286 to 47K. c. Connect a 30 mmf, 6KV cap. 6W4 cathode to ground. If additional scan is needed connect it from 6BG6 plate to ground.
9.	Inability to Phase Picture Correctly	a. Change C253 to .001 mfd and R282 to 100K. b. Bad Horizontal Oscillator tube. C. C251 (100 uuf) open (on plate of Reactance tube).
10.	High Voltage Circuit Arcing or Corona	a. Check lead dress around 1B3 tube socket. b. Check dress of transformer (T210) leads.
11.	Picture Blooming	a. Connect in series with the cathode of the CRT (pin 11) a 100K resistor and .1 mfd, 200V cap. in parallel.
12.	Blocking on strong signals	a. Check setting of AGC set control. b. Remove present leads from plus terminals of C242B, connect together and insulate. Connect a 5K, 7W, ww resistor between plus terms. of C243C and C242B. Remove R236 and R306 from plus 135V and connect to C242B. Add a 20 mfd, 450V cap. from plus 135V to chassis ground.
13.	Corner cutting of Picture	a. Reposition focus coil by loosening 4 self-tapping screws which hold focus coil in bracket. b. Loosen deflection yoke Mtg. bracket and push yoke as forward as possible. c. Adjust ion trap magnet, within range of max. brilliance to eliminate.
14.	Unable to Properly Align Sound Take-Off Transformer (T204)	a. Possible that due to material variation the tuning range has drifted. If so, connect a 5 mmf cap. between terminals 3 & 4 of T204.
15.	Unable to Obtain Proper Focus	a. Check adjustment of focus control and position of focus coil. b. Check resistance of focus coil (should be 470 ohms) c. Connect a 2.2K, 2w resistor in parallel with R297 and R296B.
16.	Centering Lever too short to make adjustment with rear door closed.	a. Cabinet depth greater on models 332 & 334, therefore extension brackets have been made available. (2) brackets (#452345A-2) & (4) Screws (#2214A-020) required per instrument.
17.	Snow in Moderate signal areas.	a. Check value of R252, R250, & R248 must be within 5% tolerance. b. Replace R252 with a 2.2 meg. resistor, if snow still excessive use a 2.0 meg resistor.
18.	Vertical Instability	a. R269 (38K, Temp. Comp.) changes value. b. R256 decreases in value.
19.	Intermittent Horizontal Sync	a. C247 partially shorted.



Parts Identification R-F Tuner
Part No. 850103A-1

CX-33 CHASSIS PARTS LIST SUPPLEMENT

The following parts have been changed in value or added to sets coded production run "-3".

Ref. no.	Description	Part no.
R201	4K, 7w, 10% ww	
R203	22K, ½w, 10% Ins. Carb.	3229A-225
R282	100K, ½w, 10% Ins. Carb.	3229A-104
R272	540K, ½w, 10% Ins. Carb.	3229A-564
R268	470K, ½w, 10% Ins. Carb.	3229A-474
C253	.001 ufd MOPT 600V.	2248A-1020
C257	.0047 ufd MOPT 600V.	2248A-4720
C279	1.5 ufd Ceramic, 500V.	650030A-9
T213	Co-channel Sound trap (21.75 mc).	650275A-1

Add the following to the Miscellaneous section of the CX-33 parts list.

Ref. no.	Description	Part no.
T102	Antenna Coil (for RF tuner #850078D01).	451211A-1
T101	Converter Coil (for RF tuner #850078D-1).	451212A-1
	Balance Control Shaft (used with RF tuner #850078D-1)	450913B-1
	Balance Control Shaft (used with RF tuner #850103A-1)	452D20A-1
	RF tuner (sub-chassis assembly—850103A-1).	

MODELS 321-B, 321-M, 322-M, 324-M, 325-F, Ch. C-281; CX-33

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PARTS LIST FOR RF TUNER PART NO. 850103A-1

L101	Antenna Coil Assembly for Channel	2	451034A-1
"	" "	3	451035A-1
"	" "	4	451036A-1
"	" "	5	451037A-1
"	" "	6	451038A-1
"	" "	7	451039A-1
"	" "	8	451040A-1
"	" "	9	451041A-1
"	" "	10	451042A-1
"	" "	11	451043A-1
"	" "	12	451044A-1
"	" "	13	451045A-1
L102	RF and Oscillator Coil Assembly for Channel	2	451046A-1
"	" "	3	451047A-1
"	" "	4	451048A-1
	" "	5	451049A-1
"	" "	6	451050A-1
"	" "	7	451051A-1
"	" "	8	451052A-1
"	" "	9	451053A-1
"	" "	10	451054A-1
"	" "	11	451055A-1
"	" "	12	451056A-1
"	" "	13	451057A-1

L106 Choke, RF Heater. 451029A-1
L108 Choke, Oscillator Heater. 451030A-1
L110 Choke, RF. 451214A-1
T101 Coupling Coil, Mixer. 451209A-1
C101 Capacitor, 5 uuf, 10%, Zero Temp. Coeff. 451215A-1
C102, C103)
C104, C105)----Ceramic Trimmer, .5 to 3 uuf. 451216A-1
C106, C113,C117-Capacitor, .001 ufd, min. Hi K. 451061A-1
C108 & C114 Capacitor, 120 uuf, 5%, -750. . . . . 451064A-1
C109 Capacitor, 100 uuf, 10%, -750. . . . . .451065A-1
C110 Capacitor, 20 uuf, 10%, Zero Temp. Coeff. 451062A-1
C111 & C116 Capacitor, 10 uuf, 5%, -750, Zero Temp.Coeff. . . 451063A-1
C112 Capacitor, Fine Tuning (Part of #451210A-1) Detent Roller 451058A-1
Spring, Shaft retaining. 451059A-1
Balance (Fine Tuning) Assembly. 451210A-1
Fibre Washer. 451025A-1

Speaker Assemblies:

8" PM used in models 320M, 320B, 321M, & 321B. 750151A-1
12" PM used in models 322M, 322B, 324M, 325M, 326M, 332M, 334M,. . .850082A-1
12" PM used in Models 327M, 328M, 328B. 850105A-1
12" PM (2) used in model 337M. 850123A-1

Safety Glass Escutcheons:

Model 320M. 850116A-7
Model 320B. 850116A-8
Model 321M. 850085B-2
Model 321B. 850085B-5
Model 322M. 850085B-1
Model 322B. 850085B-7
Model 324M. 850116A-5
Model 325F. 850095A-3
Model 326M. 850116A-1
Model 327M. 850100A-1
Models 328M & 328B. 850114A-1
Model 332M. 850113A-3
Model 332B. 850113A-5
Model 334M. 850113A-1
Model 337M. 950079A-1

Picture Tube Masks

Models 320M & 320B. 850115A-3
Models 321M & 321B. 850086B-2
Models 322M & 322B. 850086B-1
Model 324M. 850115A-2
Model 325F. 850093B-1
Model 326M. 850115A-1
Model 327M. 850099A-1
Models 328M & 328B. 850121B-1
Models 332M & 332B. 950073A-3
Model 334M. 950073A-2
Model 337M. 950082B-1

Safety Glass Support Brackets:

Models 320M, 321M, 322M, 324M, 326M, 327M,328M. 450909A-1
Models 320B, 321B, 322B, 325F, 328B. 450909A-2

Metal Channel for Safety Glass:

Models 320M, 320B, 322M, 322B, & 3012. . . . . .452046C-2
Models 321M, 321B, & 3011. . . . . .452046C-1
Models 324M & 325F. 452046C-3
Models 326M. 452046C-5
Models 327M, 328M, 328B. 452046C-4

Knobs (Brown color, for all mahogany cabinets and model 328B)
Balance Knob. .650345A-1
Shading Knob. .650345A-2
Channel Knob. .650342A-1
Sound Knob (not used on models 327M, 328M, 328B or 337M) 650344A-1
Focus Knob (used on model 327M, 328M, 328B, & 337M). 650344A-1
Knobs (Green color, for all blonde cabinets except model 328B)
Balance Knob. .650345A-3
Shading Knob. .650345A-4
Channel Knob. .650342A-2
Sound Knob. 650344A-2
Knobs (Gold Gilt, for fruitwood cabinet model 325F and early production models using gilt knobs)
Balance knob. .650239A-5
Shading Knob. .650239A-6
Channel Knob (for tuner #850103A). 650287A-2
Channel Knob (for tuner #850058D-1). 650210B-5
Sound Knob. 650210B-6
Focus Knob (for early 327 & 328 models only). 650255A-2

Voltage Data

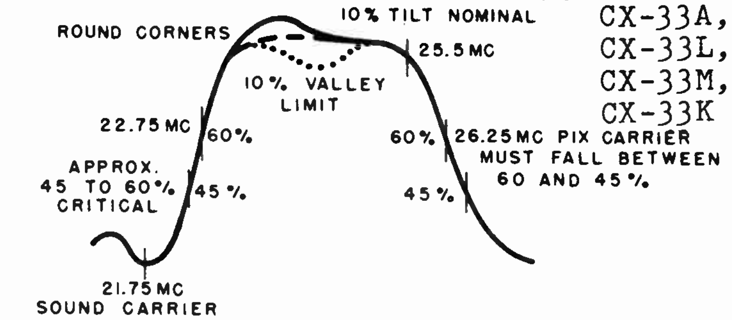
The following are voltage readings for the series -3 chassis which differ from those in the CX-33 Manual. Measurements conditions and notes are the same as those shown in the manual.

Tube No.	Tube Type & Function	Tube Socket Terminal Numbers 1	2	3	4	5	6	7	8	9	Remarks
V101 6AG5	RF Amplifier	G. -.3 -10	K. 0	H. 6.3AC	H. 0	P. +145	S.G. +145	K. 0	----	----	See Special
V102 6J6	Mixer Oscillator	Osc. P. +115	Mix.P. +110	H. 0	H. 6.3AC	Mix.G. -3	Osc.G. -8	K. 0	----	----	Note Below
V213 12AU7	A.G.C. Amp. & Sync Amp.	P_1 +65	G_1 -80	K_1 -78	H. 6.3AC	H. 6.3.AC	P_2 -3.4 -34	G_2 35 -75	K_2 -45	H. 0	Note 1
V214 6SN7	Sync Clipper & Vert. M.V.	G1 -3 -55	P_1 +235	K_1 -2 -62	G2 -78 -80	P_2 +135 0	K_2 -77	H. 0	H. 6.3AC	----	Note 1 Note 3
V215 6K6	Vert. M.V. & Output	N.C. - -	H. 0	P. +310	G2 +310	G1 -65 -90	N.C. - -	H. 6.3AC	K. -60 -70	----	Note 1 Note 3

SPECIAL NOTE: Voltages on pins 1,5 & 6 of V101 can be measured at the terminals on the stator contact strip at the right of the tuner chassis. These terminals are numbered in sequence from the front of the chassis. Pin 1 may be measured at terminal 7, pin 5 at terminal 5, and pin 6 at terminal 6.

Correction to CX-33 Manual

The voltage readings shown in the CX-33 Manual for tubes V213, V214, and V215 do not apply to the series -2 production run. The correct voltages for these tubes in the series -2 run are the same as shown above for the series -3 production run chassis.



I-F RESPONSE CURVE

Fig. 1

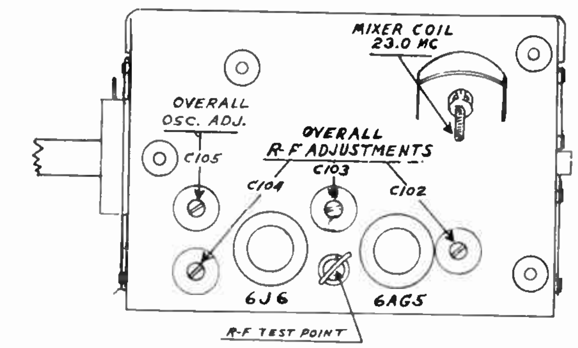


Fig. 2

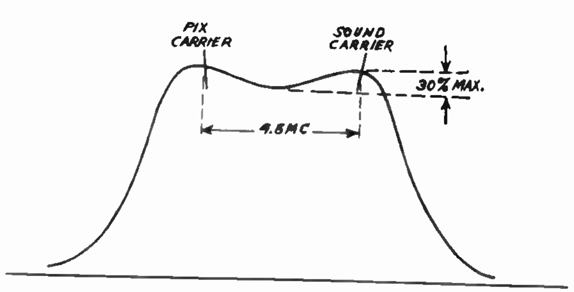


Fig. 3

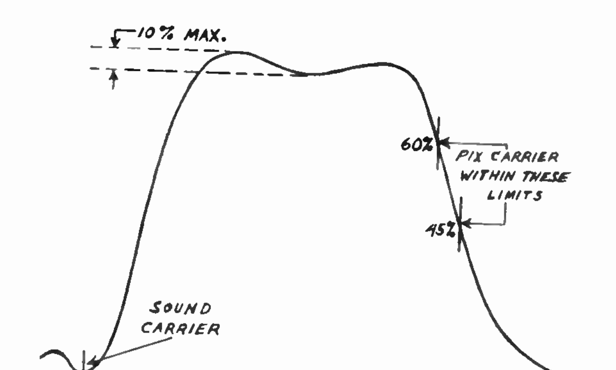


Fig. 4

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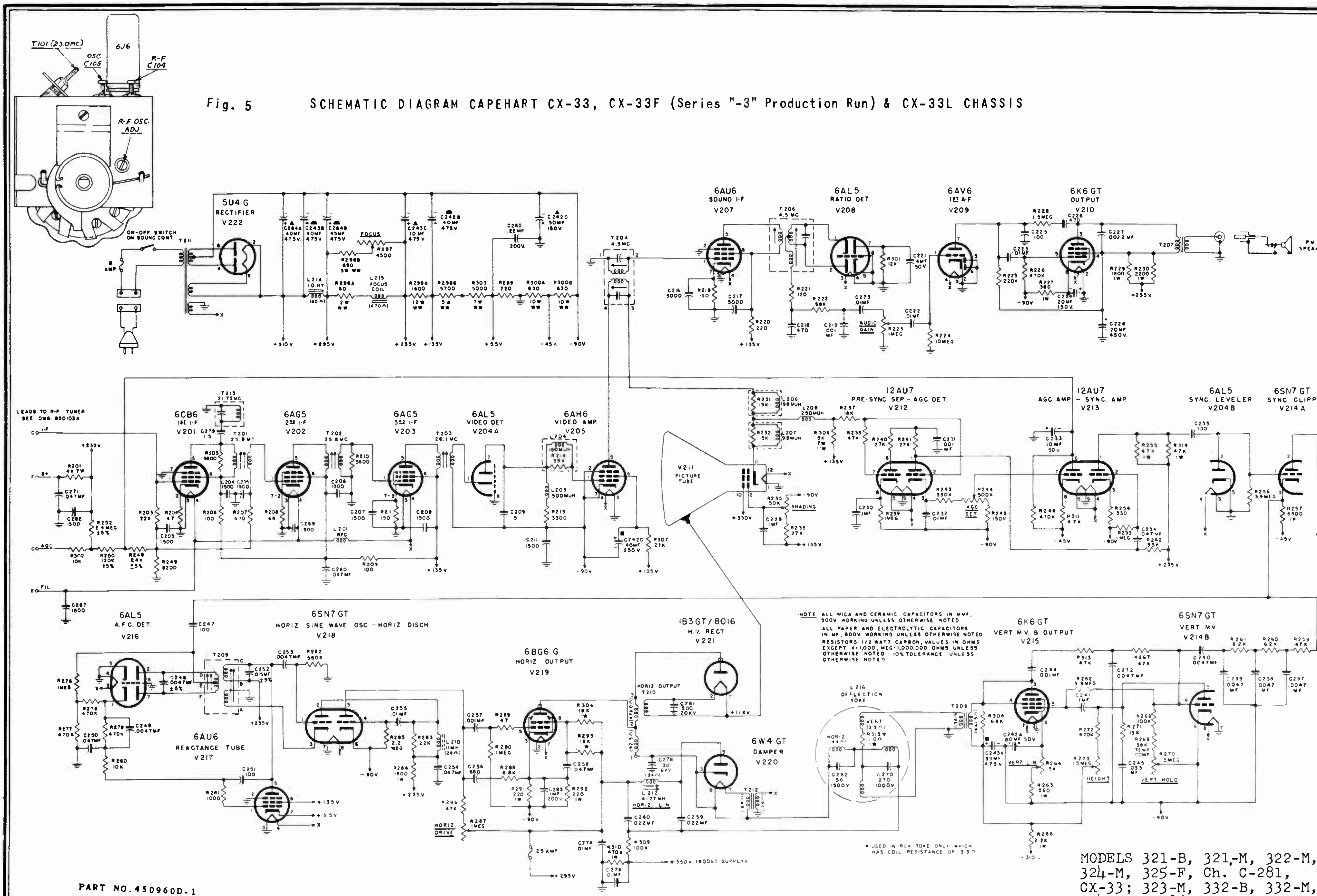
Fig. 5 SCHEMATIC DIAGRAM CAPEHART CX-33, CX-33F (Series "-3" Production Run) & CX-33L CHASSIS



PART NO. 450960D-1

MODELS 321-B, 321-M, 322-M, 324-M, 325-F, Ch. C-281, CX-33; 323-M, 332-B, 332-M, 334-M, C-286, CX-33F; 320-M, 326-M, Ch. C-289, CX-33L

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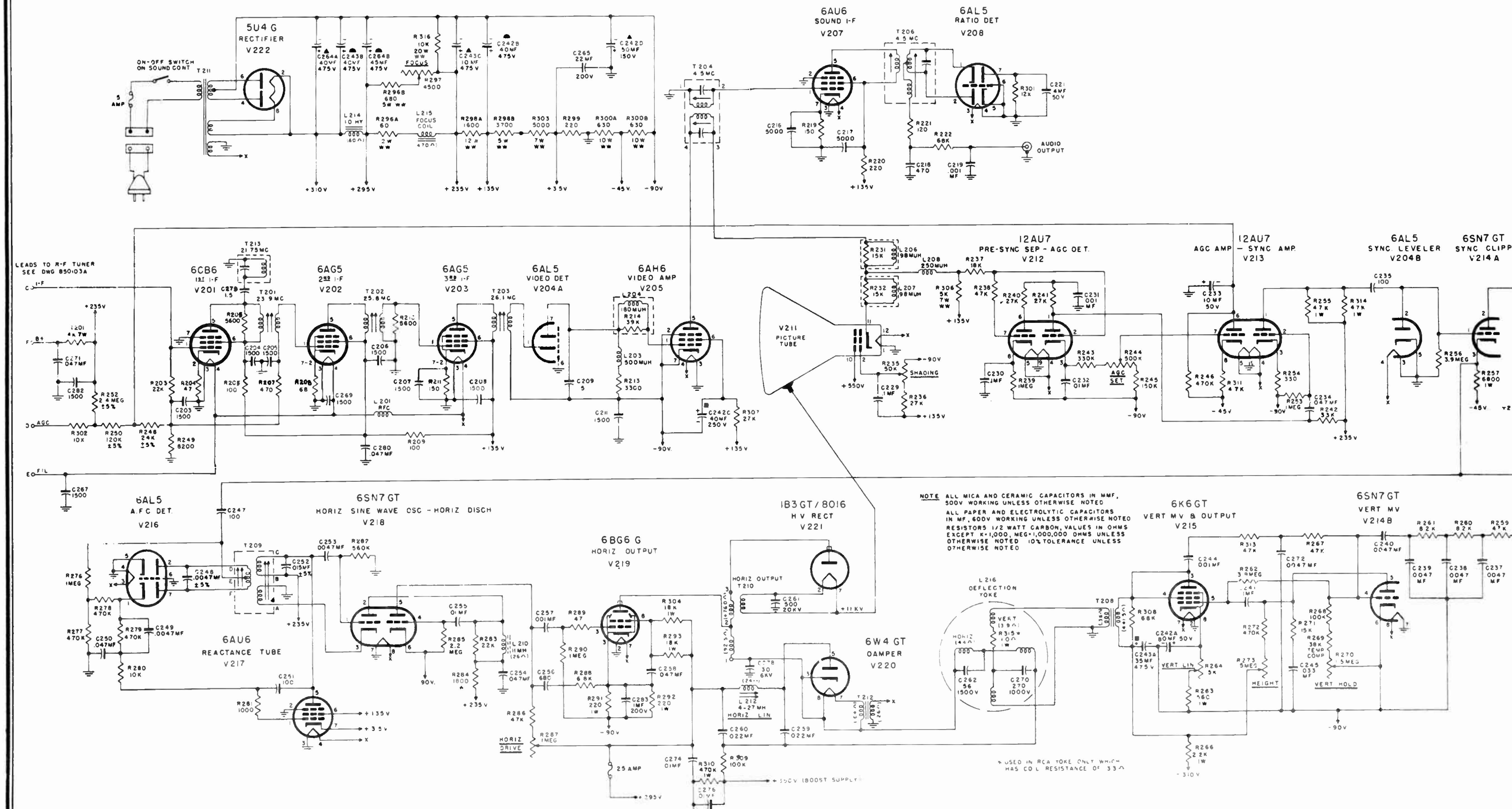
SCHEMATIC DIAGRAM CAPEHART CX-33A, CX-33M & CX-33K CHASSIS

(For information on Radio Chassis used with this TV chassis, refer to Maintenance Manual on Capehart Radio Chassis C-282 & C-284)



PART NO. 650273A-1

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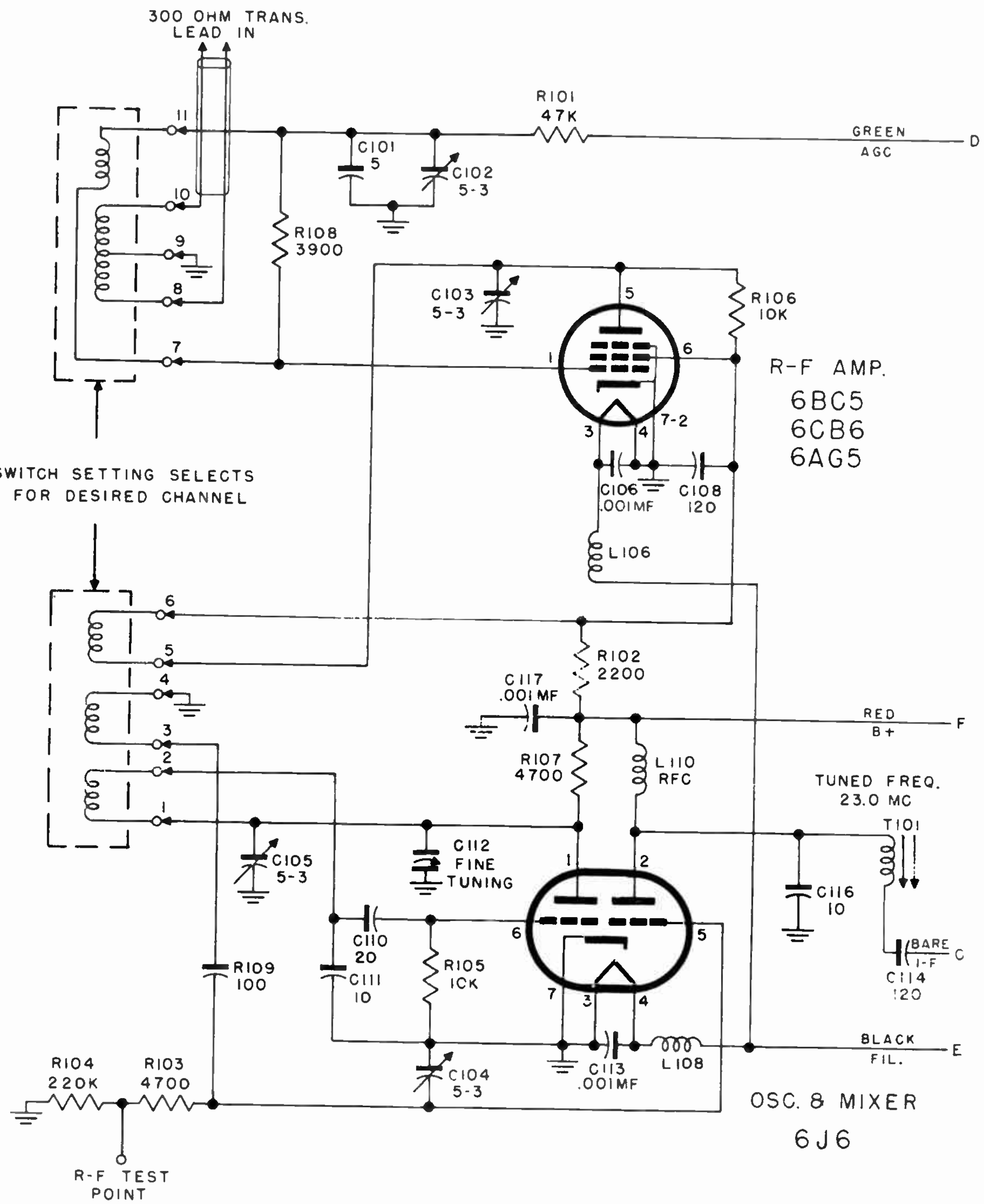
World Radio History

Radio Chassis
C-282
Used In Models
337-M & 328-M

Preliminary
Service Information

STANDARD COIL TV TUNER SCHEMATIC



General Information

Service information on the phono pre-amp chassis C-243 can be found in the Capehart P7,9, &10 Maintenance Manual (Serv. 128). Information on the Phono pre-amp chassis C-295 is included herein.

Receivers Used In:

Model	Radio Chassis	Record Changer	TV Chassis
328-M	C-282 (with pre-amp C-243 or C-295)	333A-VR	CX-33M
337-M	C-282 (with pre-amp C-295)	333A-VR	CX-33K

CHASSIS DESCRIPTION

The C-282 is an 11 tube radio chassis designed for reception of both AM (Broadcast Band) and FM (Frequency Modulation) signals. The chassis contains push-pull audio output amplifiers which are used for reproduction of the television sound as well as radio and phonograph. This chassis is used in conjunction with a phono pre-amplifier chassis in the models 328-M and 337-M. This is necessary since the record changer used in these models employs a variable Reluctance type pickup. The on-off switch on the radio chassis controls the power source for all functions of the receiver. Volume and Tone Controls on the radio chassis also function for television and phonograph operation.

NOTE: With the Operation Selector (Band Switch) in the phonograph position, the record changer will automatically shut off the power source to the entire instrument when it has played the last record. When the Operation Selector is then switched to either TV or radio, the power source will again automatically be turned on.

Specifications

Radio Tuning Range:
AM Band 540 KC to 1620 KC
FM Band 88 MC to 108 MC

Radio IF Frequencies:
AM IF 455 KC
FM IF 10.7 MC

Radio Chassis Tube Complement:

Type	Description
6BA6	AM FM RF Amplifier
6BE6	AM Converter-Oscillator
12AT7	FM Mixer-Oscillator
6BA6	1st AM FM IF Amplifier
6BA6	2nd AM FM IF Amplifier
6AL5	FM Ratio Detector
6SQ7	1st Audio AM Detector & Gas Gate
6SQ7	Phase Inverter
6V6GT (2)	Power Amplifiers (Push-Pull)
5Y3GT	Full Wave Rectifier

Total: 11 tubes, including one Rectifier.

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Pre-Amplifier Chassis Tube Complement

Type	Description
6SC7	1st & 2nd Pre-Amplifiers

Speaker (Used for all types of operation) . . . . 12 inch PM
Audio Output . . . . 12 watts
Power Source . . . . 105 to 125 volts, 60 cycle AC only

Alignment Instructions

Equipment Required

AM (Broadcast Band) IF & RF Alignment
1. Calibrated RF Signal Generator (range, 455KC to 1620KC).
2. Low Range Output Meter

FM (Frequency Modulation) IF & RF Alignment
1. FM Sweep Generator (range 10.7MC to 108.5MC)
2. Oscilloscope
3. RF Signal Generator
4. Vacuum Tube Voltmeter

AM Alignment (IF & RF)

a. Set Operation Selector to AM position.
b. See that the dial pointer coincides with the calibration marks at the extremes of the dial scale.
c. Connect the Output Meter across the speaker voice coil.
d. Turn set on and adjust Volume to maximum.

Step	Connect Generator	Set Generator At	Set Gang At	Adjust	To Obtain
1.	Grid of AM Conv., 6BE6 (pin 7 of V103) Through .1 mfd.	455KC	Fully Open	T102, T104 & T106 (IF Slugs)	MAXIMUM OUTPUT
2.	Ant. Section of Gang (through .1 mfd.)	1620KC	1620KC	C156, AM Osc. Trim. & C154, AM RF Trim.	
3.	-Same-	1500KC	1500KC	C152, AM Ant. Trim.	
4.	-Same-	600KC	600KC	L103, Loop Loading Coil & L111* AM Osc. Coil	
5.	"Ant" Terminal (on rear of chassis) with Loop connected.	455KC	Quiet Point	L102, Wave Trap (on Loop Ant.)	Minimum Output

* Adjust while rocking gang condenser.

FM Alignment

a. Connect the oscilloscope and FM or RF generator as shown in the chart.
b. Set the Operation Selector in the FM position.
c. Turn the Receiver on.
d. During alignment, reduce the generator output to keep the signal just above noise level to avoid overloading.

IF Section

Step	Connect FM Generator	Set Generator At	Set Gang At	Connect Oscilloscope	Adjust	Remarks
1.	Grid of 2nd IF 6BA6 (pin 1 V105) thru 1000 uuf.	10.7MC ± 100KC dev.	Fully Open	Across R132 (Disconnect C141)	T105 Ratio Det. Pri. & Sec.	Detune Sec. (top) and connect 350uuf. across Sec. adjust Pro. (botton) for max. Amplitude. Remove 350uuf. and adjust sec. for Max. Amplitude Refer to Fig.1 below
2.	Grid of 1st IF 6BA6 (pin 1, V104) thru 1000 uuf.	10.7MC ±100KC dev.	Fully Open	-Same-	T103 2nd IF Pri. & Sec.	Adjust for Maximum Amplitude
3.	Grid of FM Mixer 12AT7 (pin 2, V102) thru 1000 uuf.	10.7MC ±100KC dev.	Fully Open	-Same-	T101 1st IF Pri. & Sec.	-Same-
4.	-Same-	10.7MC ±100KC dev.	Fully Open	Junction of R148, R129 & C138 (Re-connect C121)	T105 Ratio Det. Secondary	Adjust for symmetrical Ratio Det. "S" curve. Refer to fig.2 below

RF Section

Step	Connect Signal Generator	Set Generator At	Set Gang At	Connect VTVM	Adjust	Remarks
1.	High side of FM dipole thru 330 ohms	108.5MC	108.5 MC	Across R132	C155, FM Osc. Trim.	Adjust for Maximum
2.	-Same-	105MC	105MC	-Same-	C153, Fm Mixer Trim. & C151, FM Ant. Trim.	Adjust for Maximum

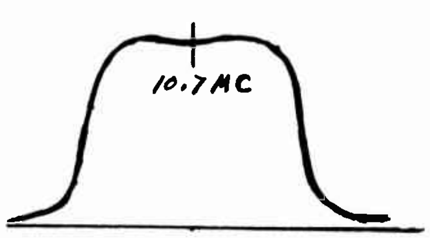

Figure 1 FM IF Curve

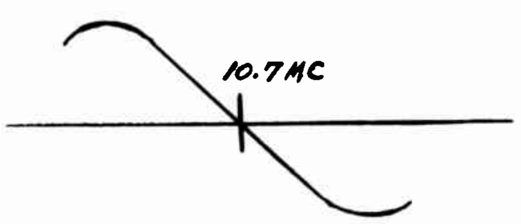

Figure 2 Ratio Det. "S" curve

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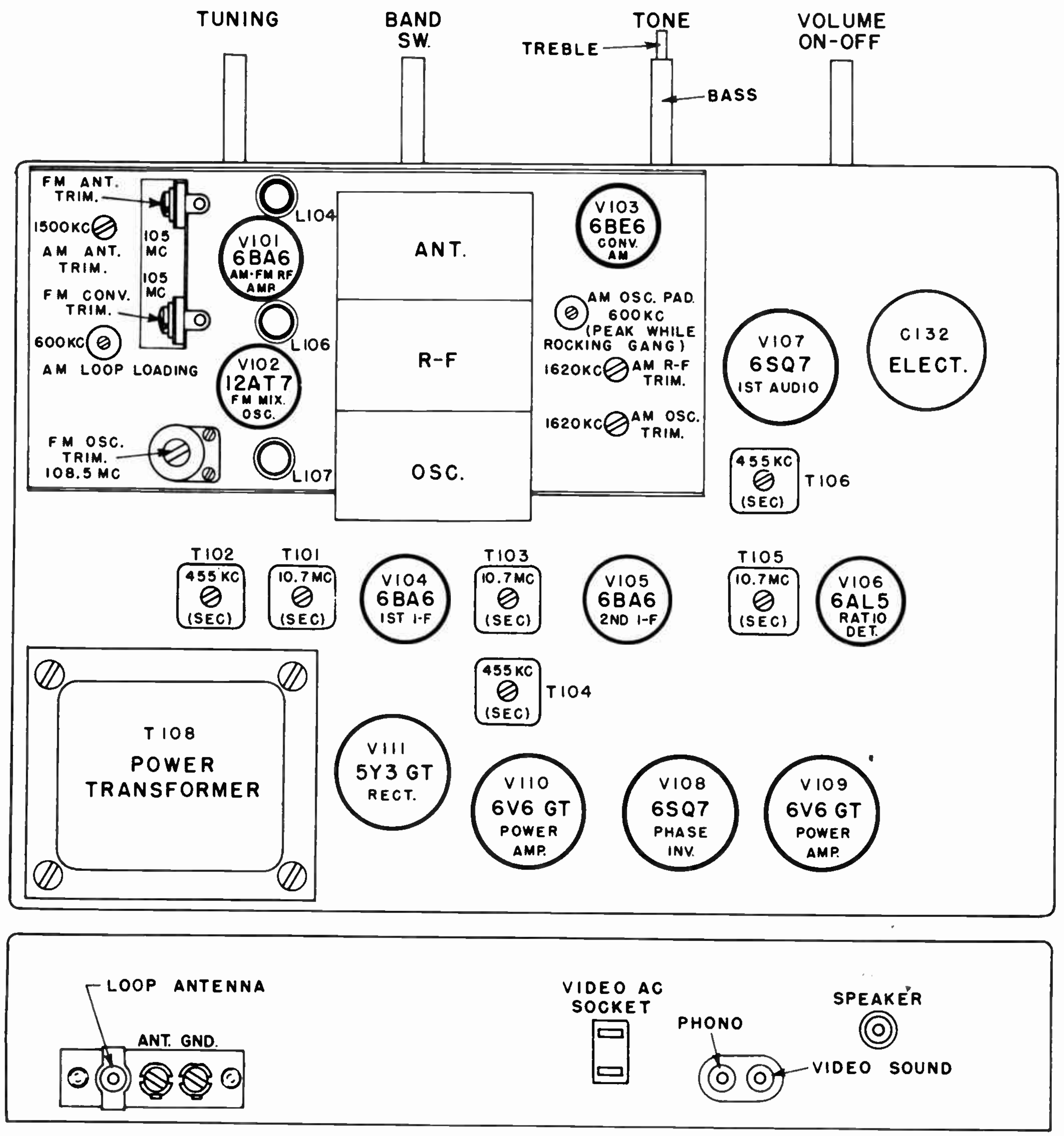
World Radio History

RADIO CHASSIS C-282



PARTS LIST RADIO CHASSIS C-282

-Capacitors-

Ref. no.	Description	Part no.
C101, C119	Mica, 47 uuf, 10%, 500V	25193
C136, C137, C145	Mica, 100 uuf, 10%, 500V	25188
C138	Mica, 150 uuf, 10%, 500V	650162A-8
C143	Mica, 470 uuf, 10%, 500V	25189
C121, C127	Silver Mica, 1500 uuf, 5%, 500V	25299
C102, C120	Ceramic, 20 uuf, 10%, 500V	25492
C103	Ceramic, 240 uuf, 10%, 500V	25427
C104, C105, C111, C114, C116, C107, C117, C118, C122, C125, C126, C128, C134, C135, C140, C159, C161	Ceramic, 5000 uuf, 10%, 500V	450469A-1
C108	Ceramic, 500 uuf, 10%, 500V	25493
C109, C112	Ceramic, 1 uuf, 20%, 500V	25497
C110	Ceramic, 30 uuf, 10%, 500V	650030A-8
C162	Ceramic, 100 uuf, 10%, 500V	2241A-367
C113	OPT, .047 ufd, 20%, 200V	2246A-4530
C123, C124	OPT, .0047 ufd, 20%, 600V	2244A-4720
C130, C131, C144, C149, C160	OPT, .01 ufd, 20%, 600V	2248A-1030
C136, C137, C147	OPT, .0033 ufd, 20%, 600V	2248A-3320
C142, C150	OPT, .022 ufd, 20%, 600V	2248A-2230
C158	OPT, .1 ufd, 20%, 200V	2246A-1040
C132A	Elect, 30 ufd, 450V)	
C132B, C132C	Elect, 20 ufd, 450V)	25424
C141	Elect, 4 ufd, 100V	25270
C148	Elect, 25 ufd, 25V	25158
C151, C153	Trimmer Strip (FM Ant. & Mixer)	26280
C152	Trimmer (AM Ant.)	26279
C154, C156	Trimmer Strip (AM Conv. & Osc.)	450468A-2
C155	Trimmer (FM Osc.)	452094A-1
C157	Variable Gang Capacitor Ass'y	452051A-G1

-Resistors-

Ref. no.	Description	Part no.
R101, R119, R124, R148	Carbon, 68 ohms, ½w, 10%	3229A-680
R102, R120, R125	Carbon 33K, ½w, 10%	3229A-333
R103, R104, R118, R123, R133, R149	Carbon, 1 megohm, ½w, 10%	3229A-105
R105, R110, R112, R111, R121, R126	Carbon, 1K, ½w, 10%	3229A-102
R106, R128, R131, R136, R140, R141, R142, R145	Carbon, 220K, ½w, 10%	3229A-224
R107	Carbon, 10K, ½w, 10%	3229A-103
R109	Carbon, 2.2K, ½w, 10%	3229A-222
R113	Carbon, 47 ohms, ½w, 10%	3229A-470
R114, R129	Carbon, 22K, ½w, 10%	3229A-223
R115	Carbon, 100K, pw, 10%	3229A-104
R116	Carbon, 15K, 1w, 10%	3229A-153
R127	Carbon, 47K, ½w, 10%	3229A-473

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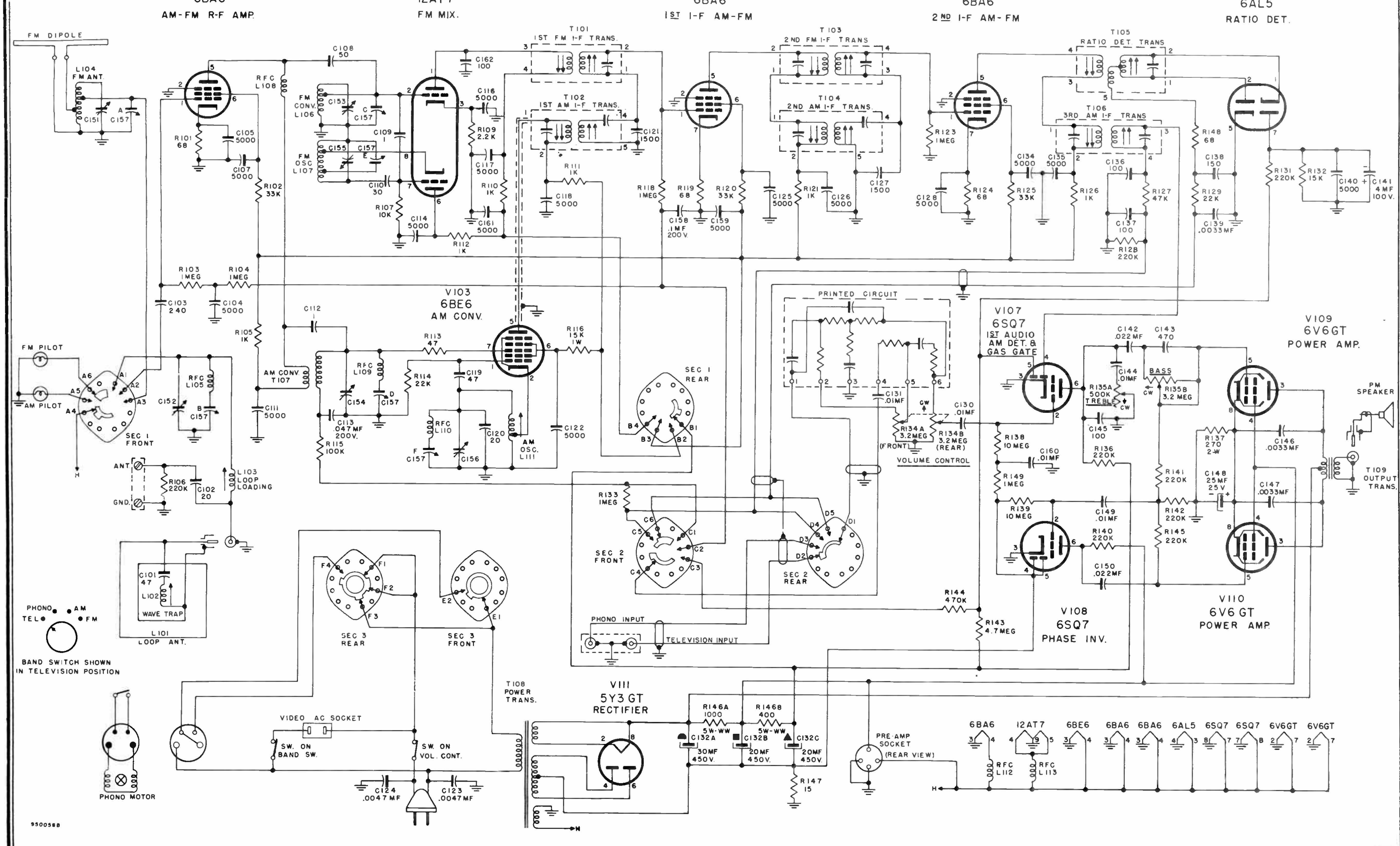
World Radio History

MODELS 337-M, Ch. C-292, CX-33K; 328-M, Ch. C-290, CX-33M; Radio Ch. C-282

NOTE:
ALL MICA AND CERAMIC CAPACITORS IN MMF, 500V WORKING UNLESS OTHERWISE NOTED.
ALL PAPER CAPACITORS IN MF, 600V WORKING UNLESS OTHERWISE NOTED.
RESISTORS 1/2 WATT CARBON, VALUES IN OHMS EXCEPT K=1,000; MEG = 1,000,000 OHMS UNLESS OTHERWISE NOTED.



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CHASSIS C-292, CX-33K;
C-290, CX-33M, Radio
Ch. C-282

Ref. No.	Description	Part no.
R132	Carbon, 15K, ½w, 10%	3229A-153
R137	Carbon, 270, 2w, 10%	3225A-271
R138, R139	Carbon, 10 megohm, ½w, 10%	3229A-106
R143	Carbon, 4.7 megohm, ½w, 10%	3229A-475
R144	Carbon, 470K, ½w, 10%	3229A-474
R147	Carbon, 15 ohms, ½w, 10%	3229A-150
R146A	Molded Resistor, 1000 ohms, 5w)	
R146B	Molded Resistor, 400 ohms, 5w)	77463
R134	Volume Control (dual 3.2 megohms)	650285A-1
R135A	Treble Tone Control, 500K)	
R135B	Bass Tone Control, 3.2 megohms)	78159

-Inductances-

Ref. No.	Description	Part no.
T101	Transformer, 1st FM IF	650251A-1
T102, T104	Transformer, 1st & 2nd AM IF	452091A-1
T103	Transformer, 2nd FM IF	452027A-1
T105	Transformer, Ratio Detector	452028A-1
T106	Transformer, 3rd AM IF	450336A-1
T107	Transformer, AM Converter	38961
T108	Transformer, Power	750182A-1
T109	Transformer, Output	650245A-1
L101	Loop Antenna Assembly (AM)	750165A-1
L102	Wave Trap Coil (Part of Ass'y, 750165A-1)	
L103	Coil Assembly, Loop Loading	38963
L104	Coil Assembly, FM Antenna	38958
L106	Coil Assembly, FM Mixer	38959
L107	Coil Assembly, FM Oscillator	38960
L111	Coil Assembly, AM Oscillator	452030A-1
L105, L108, L109) L110, L112, L113)	RF Choke Coil	38884

-Miscellaneous-

Description	Part no.
Printed Circuits	77462
Band Switch	750158B1
Cable--Pre Amp	670259A1
Cord--Phono AC	22193
Line Cord	650171A2
Pointer	650252A1
Pointer Sleeve	452043A2
Pointer Rod	55383
Drive Cord Assembly	452041AG1
Dial Glass (AM)	750161B1
Dial Glass (FM)	750161B2
Channel (Dial Glass)	452042A2
Hum Shield	05147
Speaker Socket	80030
Connector (Phono-Tel.)	450972A1

MODEL 327-M, Ch. C-289,
CX-33A; Radio Ch. C-284

Radio Chassis
C-284
Used in Model
327-M

Preliminary
SERVICE INFORMATION

General Information

Receivers Used In:

Model	Radio Chassis	Record Changer	TV Chassis
327-M	C-284	333A	CX-33A (C-289)

Chassis Description

The C-284 is an 11 tube radio chassis designed for reception of AM (Broadcast Band) signals only. The chassis contains push-pull audio output amplifiers which are used for reproduction of the television sound as well as radio and phonograph. The on-off switch on the radio chassis controls the power source for all functions of the receiver. Volume and Tone controls on the radio chassis function also for television and phonograph operation. NOTE: With the Operation Selector (Band Switch) in the phonograph position the record changer will automatically shut off the power source to the entire instrument when it has played the last record. When the Operation Selector is then switched to either TV or Radio the power source will again automatically be turned on.

Specifications

Radio Tuning Range	AM Band	540KC to 1620KC
Radio IF Frequency	AM IF	455KC

Radio Chassis Tube Complement

Type	Description
6SK7	RF Amplifier
6J5	Oscillator
6SA7	Mixer
6SK7	1st IF Amplifier
6SK7	2nd IF Amplifier
6SR7	Detector
6SQ7	1st Audio Amplifier
6SQ7	Phase Inverter
6V6 (2)	Power Amplifiers (Push-Pull)
5Y3GT	Full Wave Rectifier

Total: 11 tubes, including one Rectifier.

Speaker (Used for all types of operation)..............12 inch PM
Audio Output..12 watts
Power Source..................105 to 125 volts, 60 cycle AC only

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World Radio History

Antennas

Radio--Rotatble AM Loop mounted in cabinet. Terminals on rear of radio chassis for connection of outdoor antenna.
Television--Built-in antenna with "Phasing" switch. Terminals on rear of TV chassis for outdoor antenna.

Alignment Instructions

Equipment required:

1. Calibrated RF Signal Generator (Signals from 455KC to 1620KC).
2. Low Range Output Meter.

Alignment:

a. Set Operation Selector to AM position.
b. Turn set on and adjust Volume control to maximum.
c. See that the dial pointer coincides with the calibration marks at the extremes of the dial scale.
d. Connect the Output Meter across the Speaker voice coil.

Step	Connect Generator	Set Generator At	Set Gang At	Adjust	To Obtain
1.	Grid of Mixer, 6SA7 (pin 5 of V102) through .1 mfd.	455KC	Fully Open	IF Slugs T102, T103 & T104	MAXIMUM OUTPUT
2.	RF Section of Gang through 1. mfd.	1620KC	1620KC	C102C Osc. Trim. (on gang)	MAXIMUM OUTPUT
3.		1500KC	1500KC	C102A, Ant. Trim. C102B, RF Trim. (on gang)	MAXIMUM OUTPUT
4.		600KC	600KC	L103, Loop Loading Coil and L104* Osc. Coil	MAXIMUM OUTPUT
5.	Terminal "A" Ant. Term. Strip (with Loop connected)	455KC	Quiet Point	L102, Wave Trap on Loop	MINIMUM OUTPUT

* Adjust while rocking Gang Condenser.

PARTS LIST RADIO CHASSIS C-284

-Capacitors-

Ref.no.	Description	Part no.
C101	Variable (3 gang) tuning Capacitor... Assembly	452040A-G1
	Antenna Trimmer)	
C102A)		
C102B)	RF Trimmer)-------Part of Assembly	#452040A-G1
C102C)	Osc. Trimmer)	
C144	Ceramic, 3.3 uuf., 20%, 500V	650030-5
C103	Ceramic, 240 uuf., 20%, 500V	25427
C143	Ceramic, 50 uuf., 10%, 500V	25493
C108	Ceramic, 1uuf., 20%, 500V	25497
C110), C141), C142)	Ceramic, 10 uuf., 10%, 500V	25479
C146	Ceramic, 20 uuf., 10%, 500V	25492
C106, C109), C113, C116), C140, C144)	Ceramic Disk, 5000 uuf., 450 V	450469A-1
C104	Mica, 47 uuf., 10%, 500V (part of Assy, #750165A01)	
C112	Mica, 47 uuf., 10%, 500V	25193
C115	Silver Mica, 1500 uuf., 5%, 500V	25299
C120	Mica, 10 uuf., 10%, 500V	25049
C121, C122), C126, C139)	Mica, 100 uuf., 10%, 500V	25188
C127	Mica, 470 uuf., 20%, 500V	25285
C105, C107), C119, C123), C137, C148)	OPT., .047 ufd., 20%, 600V	2248A-4730
C125, C124), C128, C138), C147)	OPT., .01 ufd., 20%, 600V	2248A-1030
C118	OPT., .1 ufd., 20%, 200V	2246A-1040
C129, C130)	OPT., .022 ufd., 20%, 600V	2248A-2230
C131, C132)	OPT., .0033 ufd., 20%, 600V	2248A-3320
C134, C135)	MOPT., .0047 ufd., 20%, 600V	2244A-4720
C133	Elec., 25 ufd., 25V	25158
C136A	Elec., 30 ufd., 350V)	
C136B, C136C)	Elec., 20 ufd., 350V)	25424

-Resistors-

Ref.no.	Description	Part no.
R101, R116), R117, R118), R140)	Carbon, 1 meg. ½w., 10%	3229A-105
R102, R14	Carbon, 220 ohms, ½w. 10%	3220A-221
R103, R106	Carbon, 1K, ½w., 10%	3229A-102
R104, R107), R141)	Carbon 100K, ½w., 10%	3229A-104
R105	Carbon, 10K, 2w., 10%	3235A-103
R108	Carbon, 68 ohms, ½w., 10%	3229A-680
R109	Carbon, 22K, ½w., 10%	3229A-223
R111, R115), R138)	Carbon, 33K. ½2., 10%	3229A-333
R119	Carbon, 47K, ½w., 10%	3229A-473

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World Radio History

Ref.no.	Description	Part no.
R120, R127)		
R128, R129)		
R130, R132)		
R137)---------------	Carbon, 220 K. $\frac{1}{2}$w., 10%.............	3229A-224
R121	Carbon, 6.8K. $\frac{1}{2}$w., 10%	3229A-682
R122	Carbon, 68K, $\frac{1}{2}$w., 10%...............	3229A-683
R124, R125)---------	Carbon, 10 meg., $\frac{1}{2}$w., 10%...........	3229A-106
R131	Carbon, 270 ohms. 2w., 10%..........	3235A-271
R135	Carbon, 680K. $\frac{1}{2}$w., 10%..............	3229A-684
R136	Carbon, 15 ohms, $\frac{1}{2}$w., 10%...........	3229A-150
R139	Carbon, 470 ohms, $\frac{1}{2}$w., 10%..........	3229A-471
R123A	Front Section, 3.2 meg. $\frac{1}{4}$w.,) Dual Volume)	
R123B	Rear Section, 3.2 meg., $\frac{1}{4}$w.,) Control & Switch)--	650385A-1
R126A	Bass Section, 3.2 meg. $\frac{1}{4}$w.,)	
R126B	Treble Section, 3.2 meg. $\frac{1}{4}$w.,) Dual Tone Controls--	78159
R133A	1000 Ohm Section)	
R133B	400 Ohm Section)--Molded Resistor...	77463

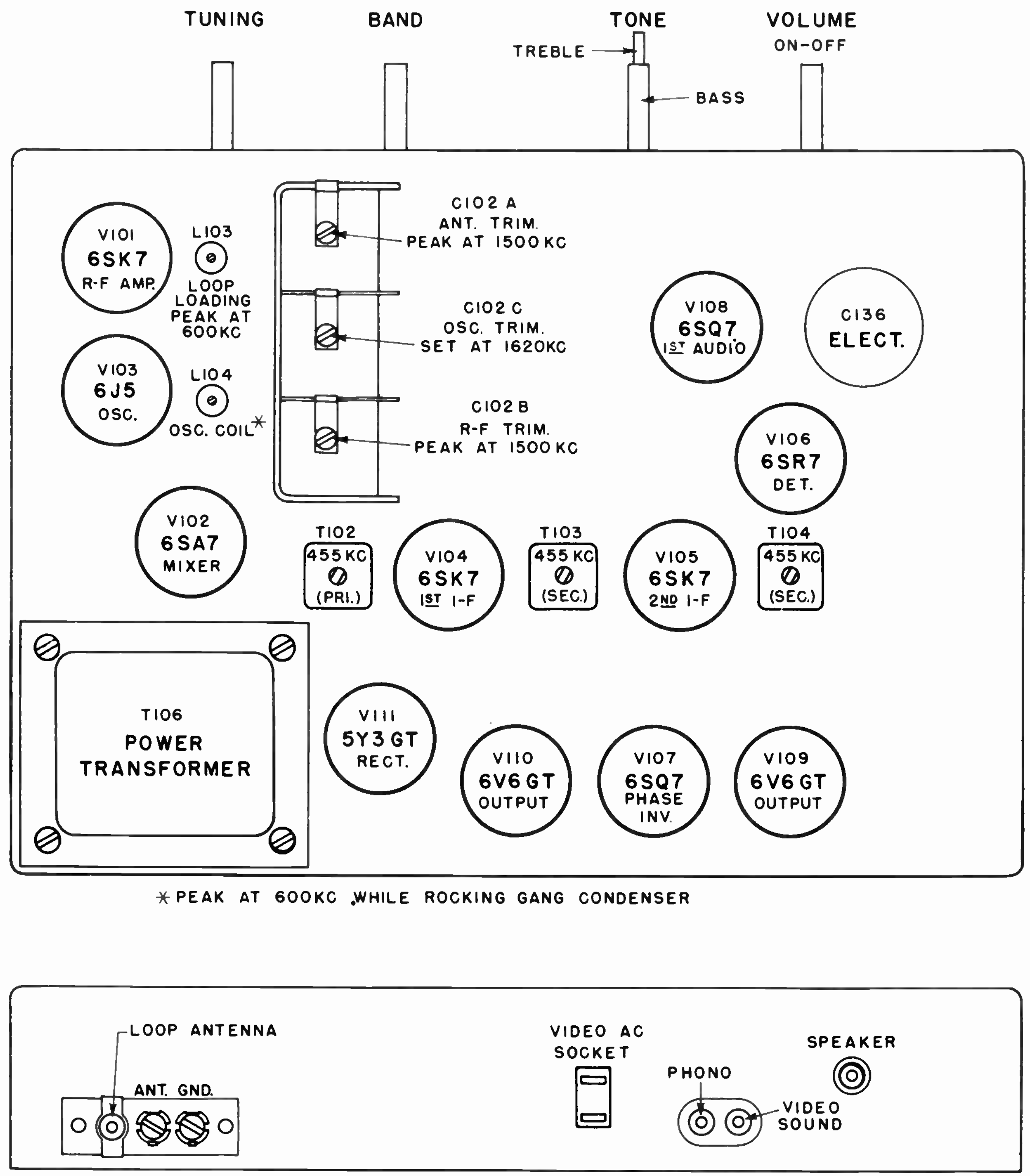
-Coils & Transformers-

Ref.no.	Description	Part no.
T101	RF Coil..............................	650248A-1
T102	1st IF Transformer..................	452019A-1
T103, T104	2nd & 3rd IF Transformer............	450336A-1
T105	Audio Output Transformer............	650245A-1
T106	Power Transformer...................	750182A-1
L101	Loop Antenna Assembly...............	750165A-1
L102	Wave Trap Coil (Part of 750165A-1)	
L103	Loop Loading Coil...................	452020A-1
L104	Oscillator Coil.....................	452021A-1

-Miscellaneous-

Description	Part no.
Operation Selector (Band) Switch........................	750156A-1
AC Line Cord..	650171A-1
Phono AC Cable..	22193
Dial Cord Assembly......................................	452041A-G1
Dial Pointer..	650252A-1
Dial Pointer Sleeve.....................................	452043A-2
Dial Glass..	650250B-1
Speaker Socket..	80030
Connector (Phono-TV Sound)..............................	450972A-1
Connector (Video AC)....................................	450973A-1

RADIO CHASSIS C-284



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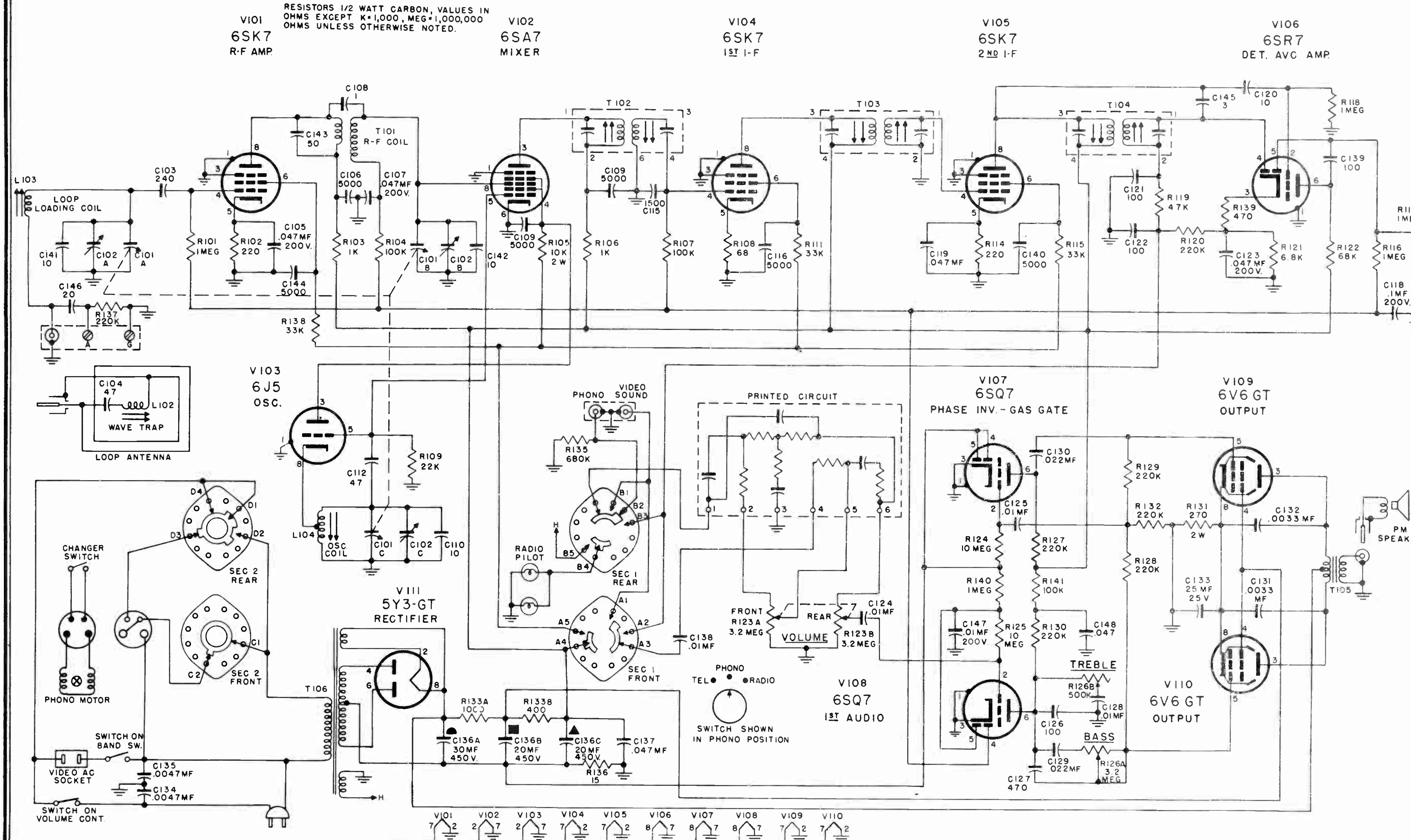
World Radio History

MODEL 327-M, Ch. C-289, CX-33A; Radio Ch. C-284

NOTE:
ALL MICA AND CERAMIC CAPACITORS IN MMF, 500V. WORKING UNLESS OTHERWISE NOTED.
ALL PAPER AND ELECTROLYTIC CAPACITORS IN MF, 600V. WORKING UNLESS OTHERWISE NOTED.
RESISTORS 1/2 WATT CARBON, VALUES IN OHMS EXCEPT K=1,000, MEG=1,000,000 OHMS UNLESS OTHERWISE NOTED.



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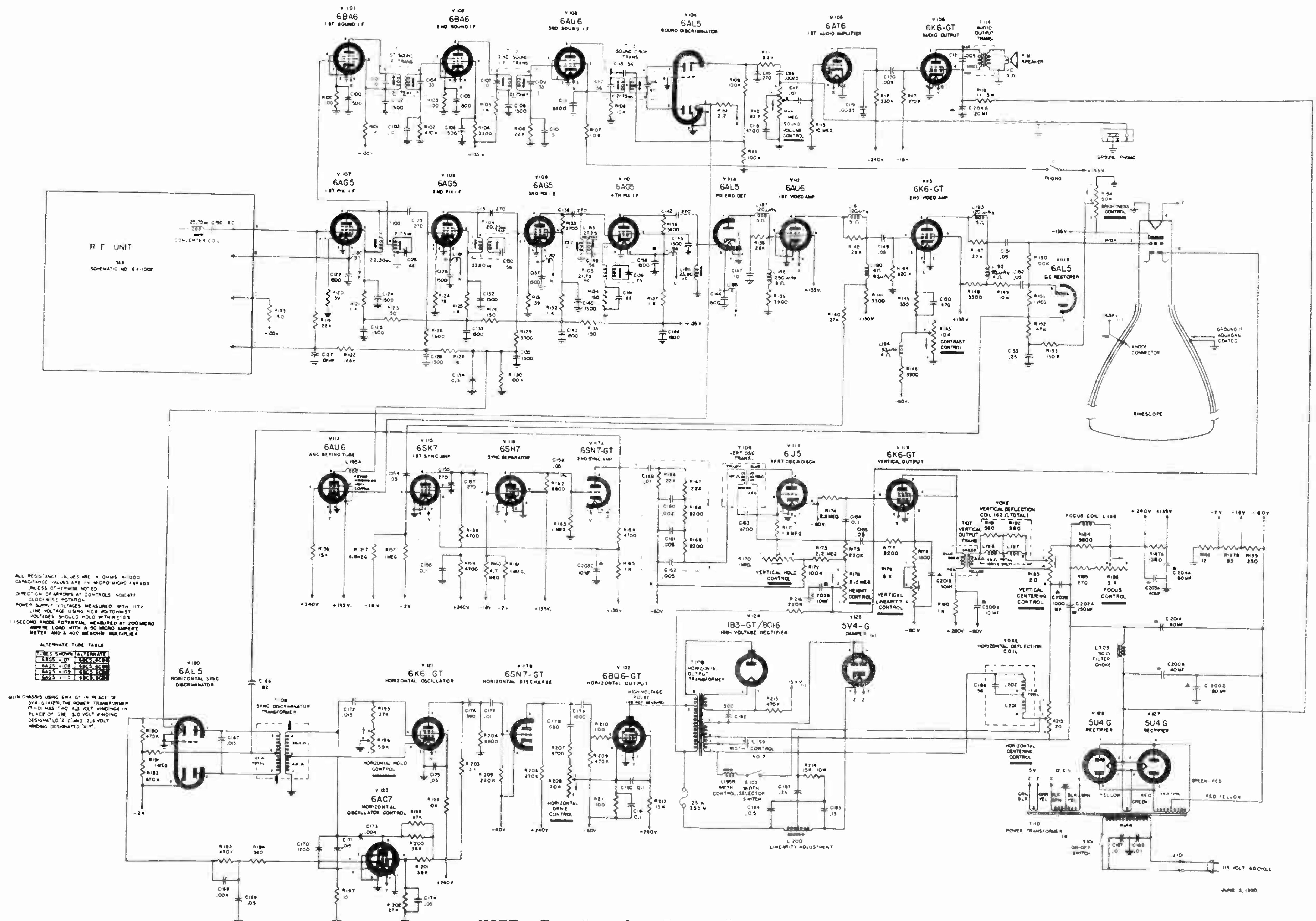

NOTE: For Service Data, See RCA Model 630TS, Pages *1-76 through *1-116.

MODEL 630-K2

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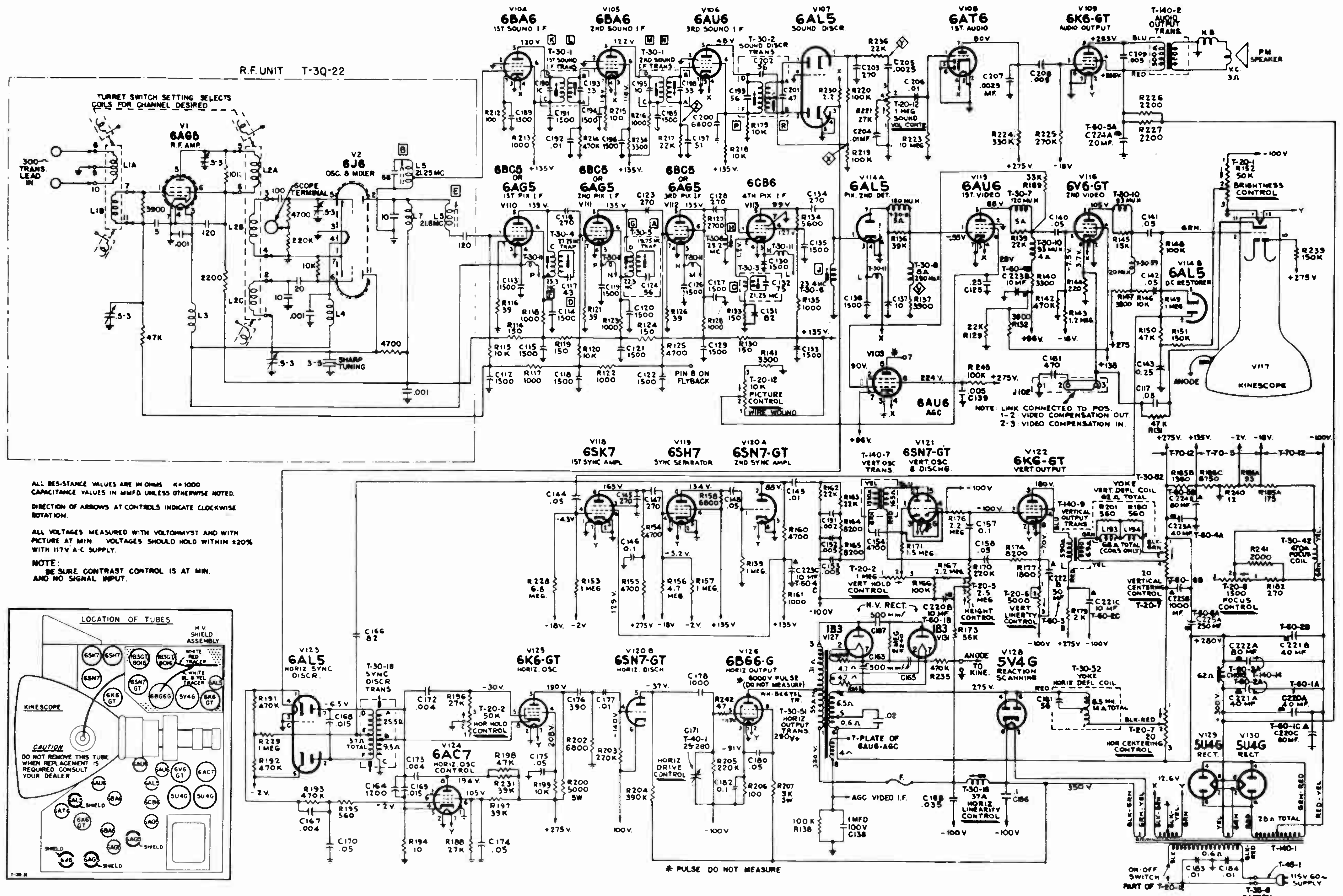
World Radio History



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NOTE: For Service Data, See RCA Model 630TS, Pages *1-76 through *1-116.

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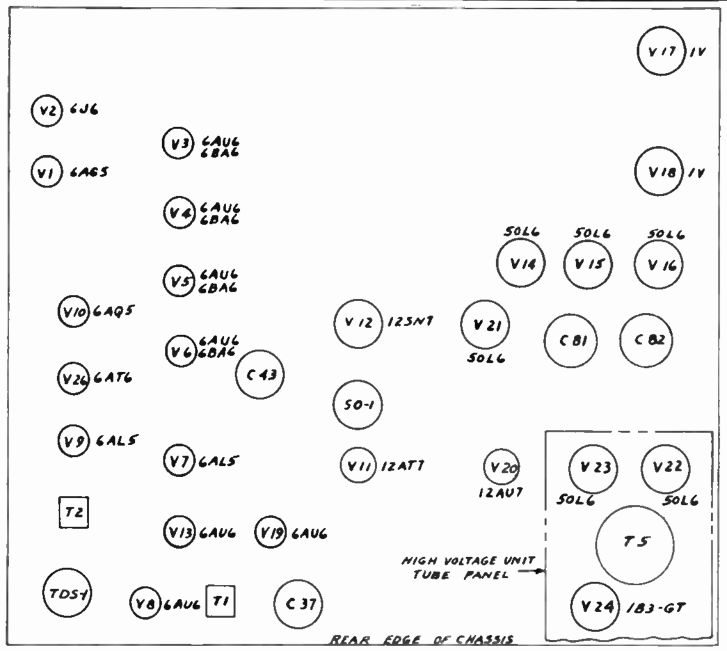
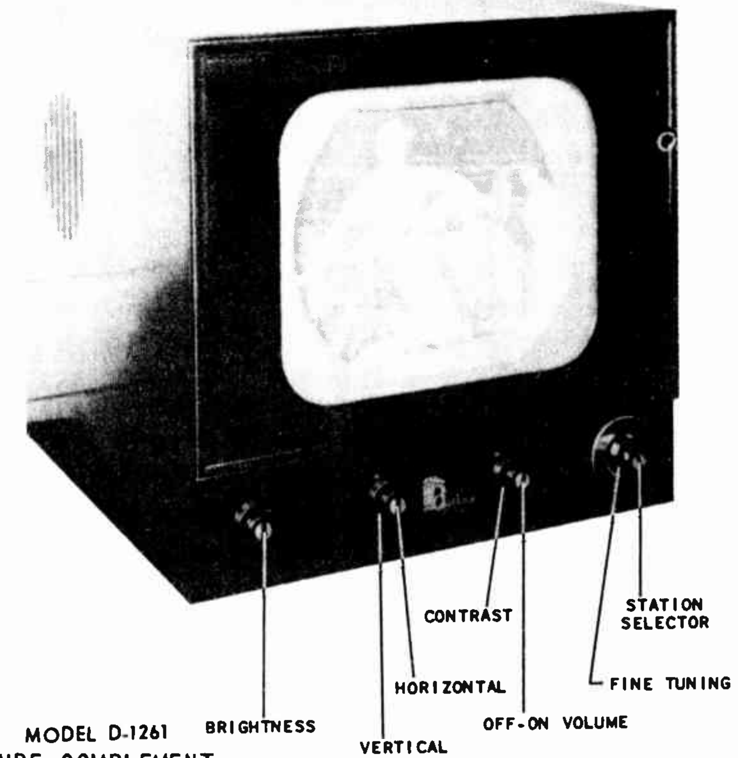
World Radio History

MODEL D-1265

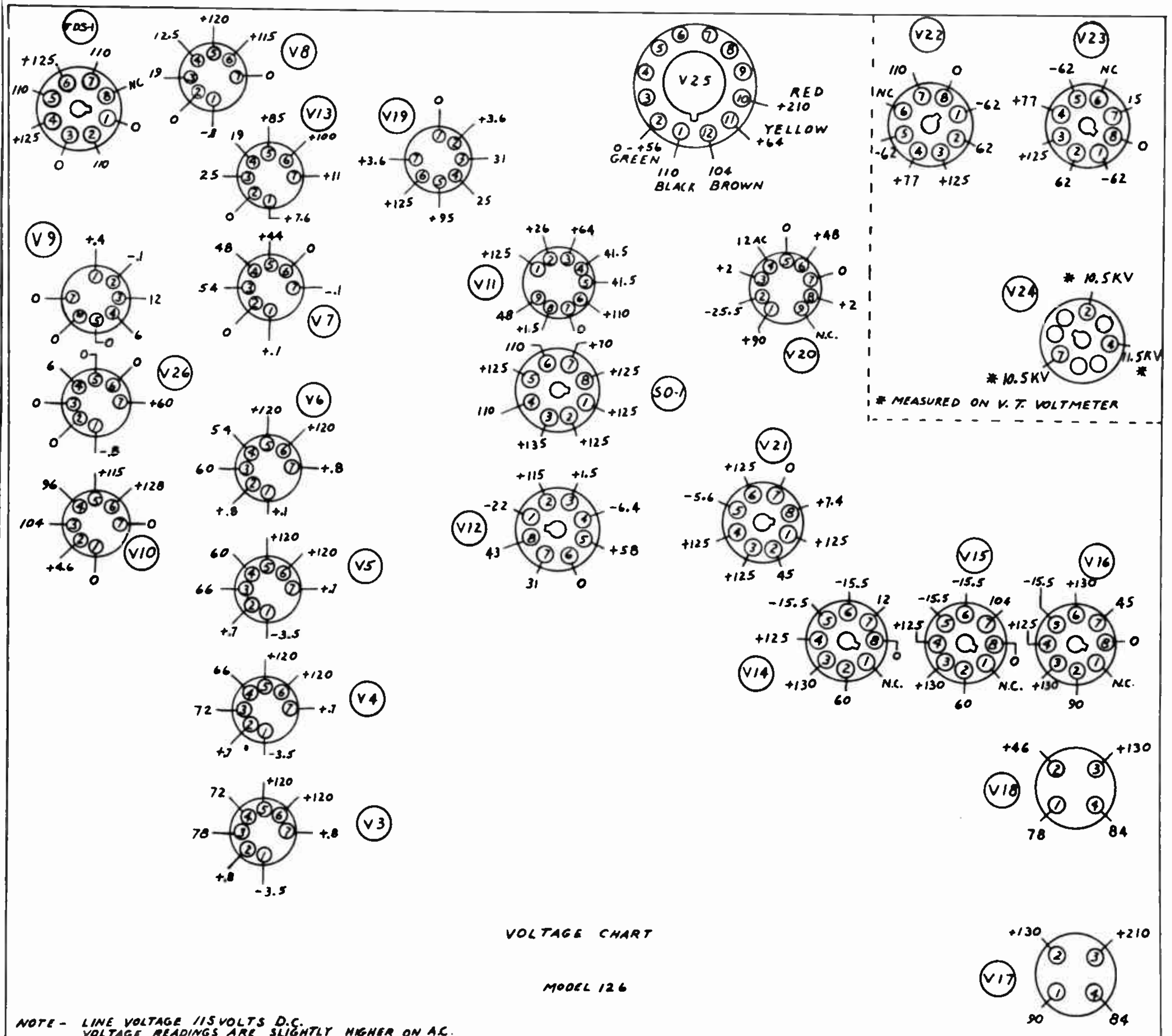
MODEL D-1263



TOP VIEW OF CHASSIS



MODEL D-1261



TUBE COMPLEMENT

TUBE NO.	TUBE	FUNCTION
V1	6AG5	R.F. Amplifier
V2	6J6	Oscillator-Converter
V3	6AU6	1st IF Amplifier
V4	6AU6	2nd IF Amplifier
V5	6AU6	3rd IF Amplifier
V6	6AU6	4th IF Amplifier
V7	6AL5	Video Detector
V8	6AU6	Sound IF Amplifier
V9	6AL5	Audio Ratio Detector
V10	6AQ5	Audio Output
V11	12AT7	Video Output & DC Restorer & Horiz. Multivibrator
V12	12SN7	Horiz. Multivibrator, Amplifier
V13	6AU6	Video Amplifier
V14	50L6	Horiz. Output
V15	50L6	Horiz. Output
V16	50L6	Horiz. Output
V17	1-V	Pulse Rectifier
V18	1-V	Damper
V19	6AU6	Sync. Separator
V20	12AU7	Vertical Multivibrator
V21	50L6	Vertical Output
V22	50L6	High Voltage Oscillator
V23	50L6	High Voltage Oscillator
V24	1B3-GT	High Voltage Rectifier
V25	12LP4	Picture Tube
V26	6AT6	Audio Amplifier

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World Radio History

WARNING

In this AC-DC television set, B- of the set is connected directly to one of the AC power lines. If test equipment is connected to chassis, the equipment may be at line voltage potential above ground (depending on how the line plug is inserted). Therefore, contact between equipment and ground may result in severe shock.

Use an isolation transformer between the television AC cord and the power receptacle.

If an isolation transformer is not available, make the following check before any test equipment is connected: Put an AC voltmeter between ground of the set and a good ground connection (radiator, water pipe, etc.). Plug the line cord into the power line. If meter does not read zero, reverse the plug in the receptacle.

Alignment Procedure

Test Equipment

The test equipment required for the alignment of this receiver is as follows:

Marker Generator
R.F. Sweep Generator
Oscilloscope
Electronic Voltmeter
3 Volt bias battery

The Marker Generator is used for peaking the i-f coils and to supply marker pips on the response pattern. The frequency range required of this generator is approximately from 20 to 30 mc. It must also have provision for a 4.5 mc. output. The accuracy of the frequency calibration is very important.

The Sweep Generator must have a continually variable frequency output. Only one output sweep signal is needed, that sweeping signal is needed, that sweeping between 20 to 30 mc.

The Oscilloscope should be a high gain, general purpose type employed for test purposes.

The Electronic Voltmeter is of the standard type.

Video I.F. Alignment

1. Connect the 3-Volt bias battery, minus to A.V.C. and plus, to chassis.
2. Connect the marker generator, through a 47 mmf. capacitor to the nipple located on the tuner, between V1 and V2. Ground the generator at the nearest convenient ground. The marker generator is used in making most of the alignment adjustments.
3. Connect the electronic voltmeter across R99, diode load resistor. Adjust the contrast control about 1/8 turn below its maximum setting.
4. Set the marker generator to each of the following frequencies and peak the specified adjustments for maximum indication on the voltmeter. During the alignment reduce the input signal to prevent overloading.

24.7 L15 (top)
23.2 L14, L12 (top)
26.3 L13, L11 (top)

5. Repeat the above process for fine adjustments of settings.
6. Disconnect the 3 volt bias battery.
7. Disconnect all equipment.

Overall Picture Response

1. With the sweep generator adjusted for a 10 mc sweep, using a center frequency of 26.75 mc, connect the generator to the nipple of the tuner between V1 and V2. Loosely couple the marker generator to the same tube.
2. Connect the oscilloscope across R99.
3. Inject individual markers of 26.3 mc, 24.7 mc, and 23.2 mc in order indicated and note positions of marker pips on response curve. Turning the adjustments very slowly, retune the video i.f. coils again for an overall picture response as indicated in fig. 1. The most important considerations are that the video i.f. carrier of 26.75 is approximately halfway down the slope of the curve and that the sound i.f. carriers 20 times down the other end of the curve.

I.F. RESPONSE CURVE

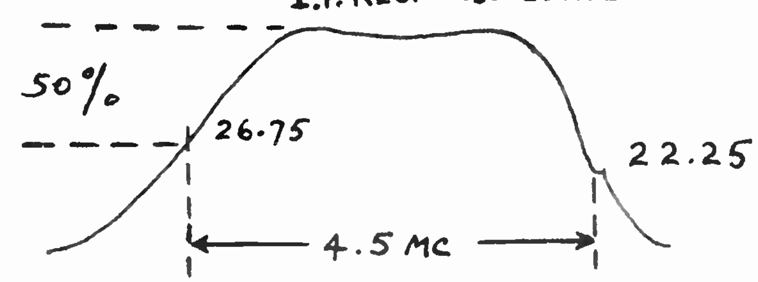

Fig. 1

Audio Take-Off and Ratio Detector Alignment

1. Connect the high side of the signal generator, through a 100 mmf capacitor, to the grid of the first video amplifier tube, V13 and the low side to ground. Tune the generator to 4.5 mc and adjust the output to approximately 10,000 microvolts.
2. From either side of capacitor C48, connect an electronic voltmeter to chassis decoupled through 10,000 ohms.
3. Set the contrast control for maximum gain (clockwise).
4. Peak T1, top and bottom slug for maximum indication on meter.
5. Peak T2, bottom for maximum reading on meter.
6. Disconnect meter and reconnect it to junction of R109 and the lead to the volume control.
7. Adjust T2, top, for zero response on the lowest scale on the meter. This corresponds to the cross over point on the FM detector curve. The symmetry of the curve may be checked by tuning the generator ±25kc from 4.5 mc and noting the voltage produced, reversing the meter connections as necessary. The voltage in each direction should be equal for proper balance of the ratio detector system.
8. If an accurately calibrated generator for 4.5 mc is not available, it is desirable to align the audio section from an actual station signal, since the 4.5 mc. alignment frequency will then be exact.

Note

Alignment of the r-f and oscillator sections are not recommended and are, therefore, not included. If any misalignment is suspected, consult the manufacturer.

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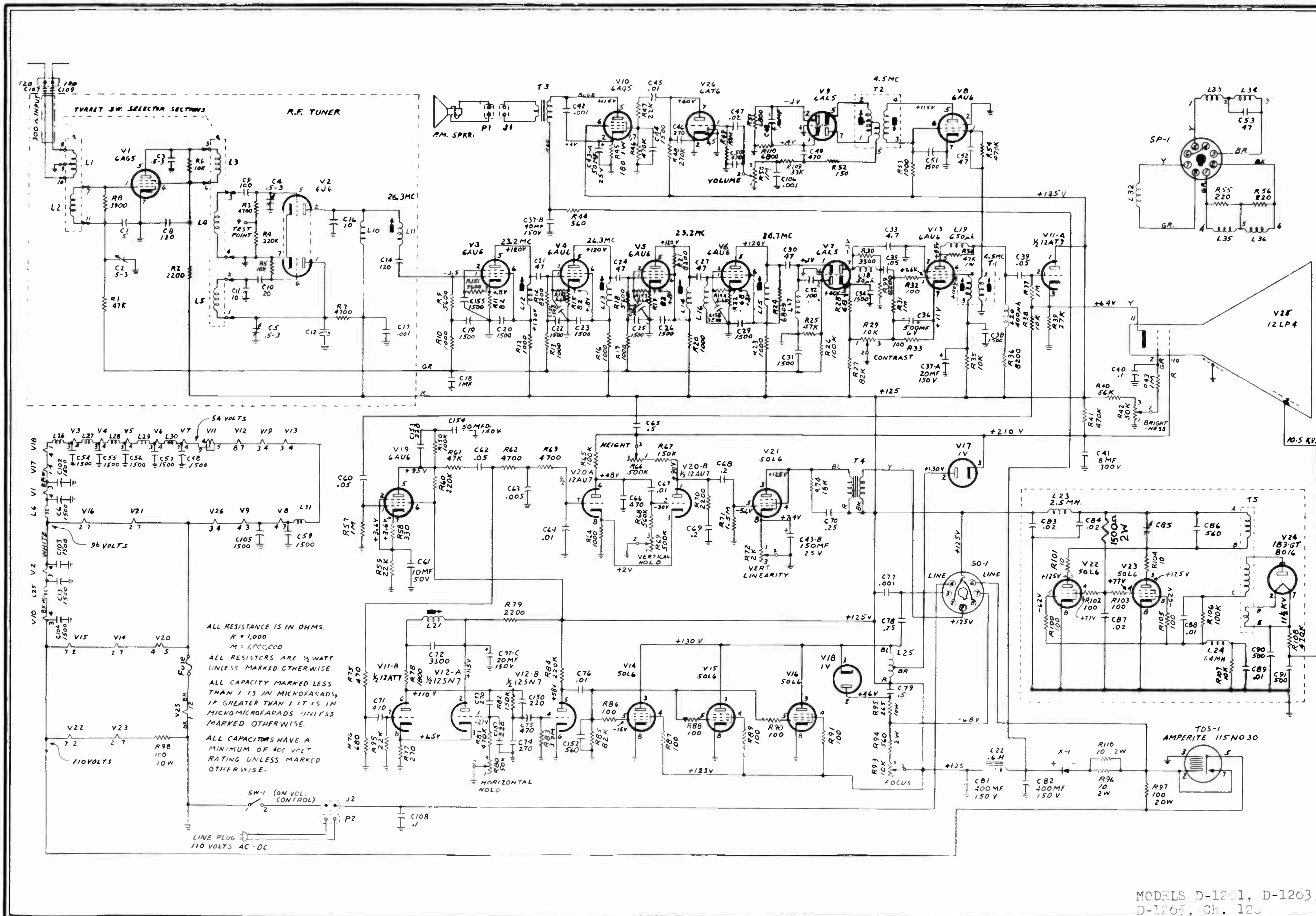

MODELS D-1201, D-1203, D-1205, Ch. 12

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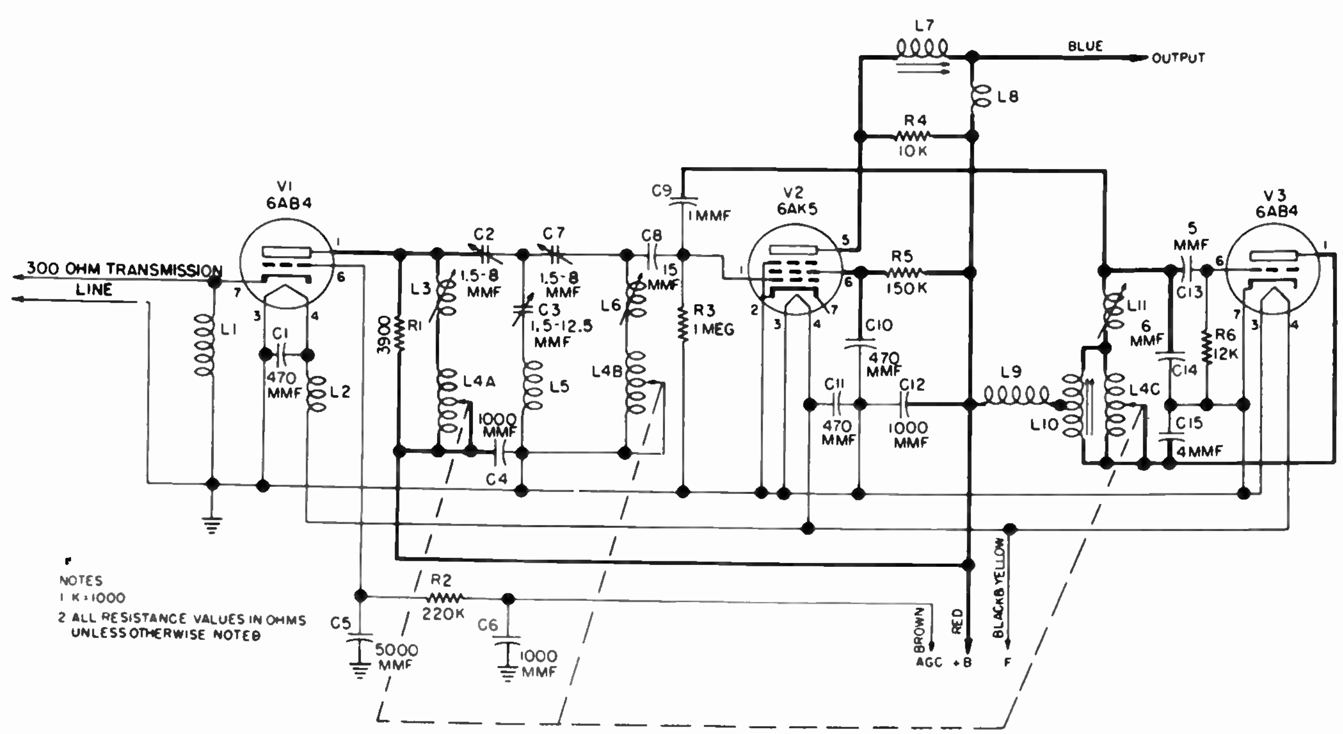
World Radio History

CROSLEY TELEVISION SERVICE INFORMATION

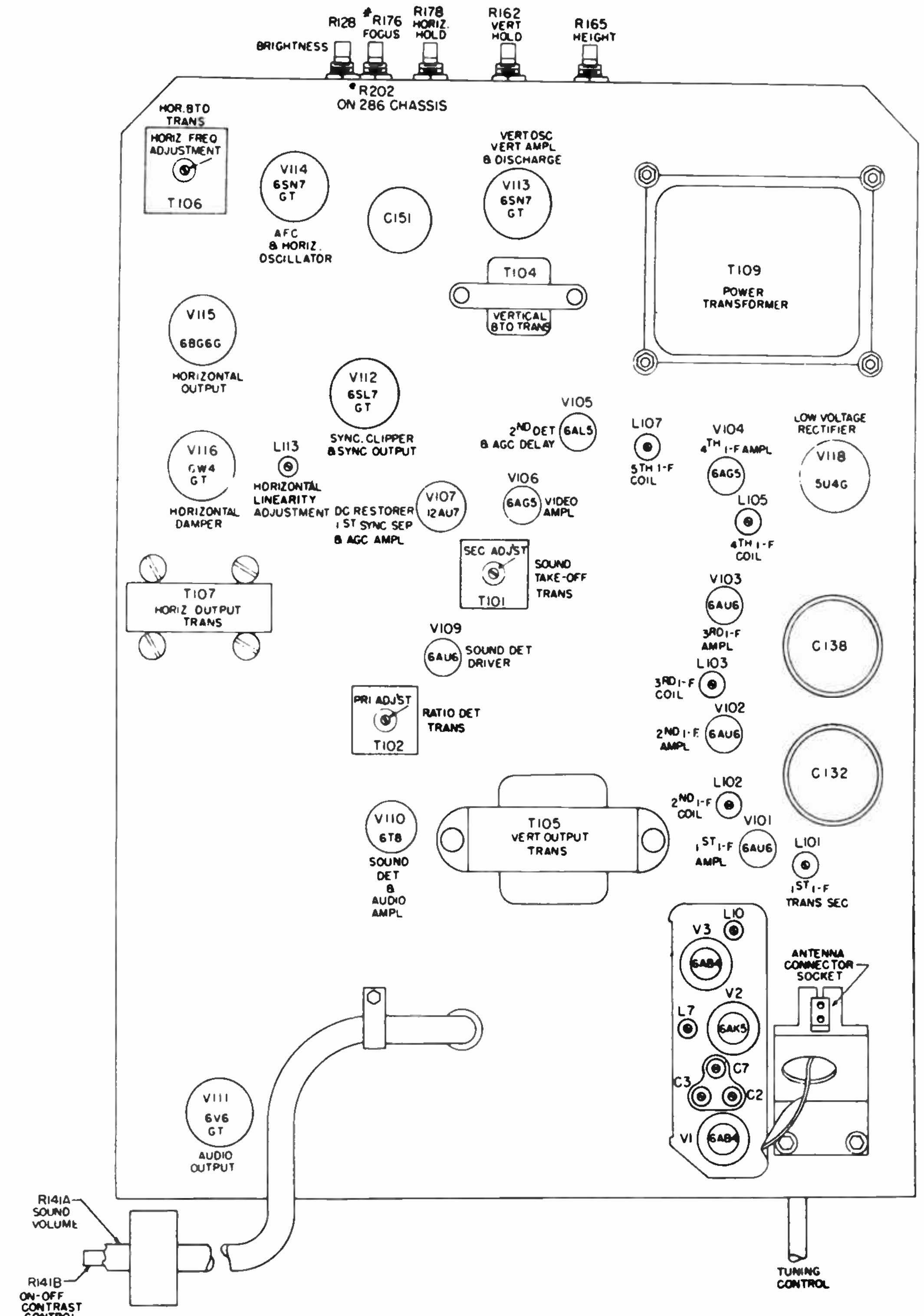
MODELS 10-404MU, 10-404M1U, 10-412MU, 10-418MU

This television receiver is designed to operate from a power source of 117 volts, 60 cycle, a.c. The average power consumption is 185 watts. The audio output system is capable of delivering 1.75 watts maximum. The tube complement is as follows:

SYMBOL	TUBE TYPE	FUNCTION
V1	6AB4	R-F Amplifier
V2	6AK5	Mixer
V3	6AB4	V.H.F. Oscillator
V101	6AU6	1st I-F Amplifier
V102	6AU6	2nd I-F Amplifier
V103	6AU6	3rd I-F Amplifier
V104	6AG5	4th I-F Amplifier
V105	6AL5	2nd Detector & AGC Delay
V106	6AG5	Video I-F Amplifier
V107	12AU7	DC Restorer, 1st sync Separator & AGC Amplifier
V108	12LP4 or 12TP4 {Models 10-404MU, 10-412MU, 10-418MU}	Picture Tube
V108	12QP4 Model 10-404M1U	Picture Tube
V109	6AU6	Sound Det. Driver
V110	6T8	Sound Det. & 1st Audio Ampl.
V111	6V6GT	Audio Output
V112	6SL7GT	Sync Clipper & Sync Output
V113	6SN7GT	Vertical Oscillator
V114	6SN7GT	A.F.C. & Horizontal Osc.
V115	6BG6G	Horizontal Output
V116	6W4GT	Horizontal Damper
V117	1B3GT	H.V. Rectifier
V118	5U4G	L.V. Rectifier



R.F. TUNER SCHEMATIC DIAGRAM



Chassis Top View Showing Tube and Alignment Locations

MODELS 10-404MU, 10-404M1U, 10-412MU, 10-418MU

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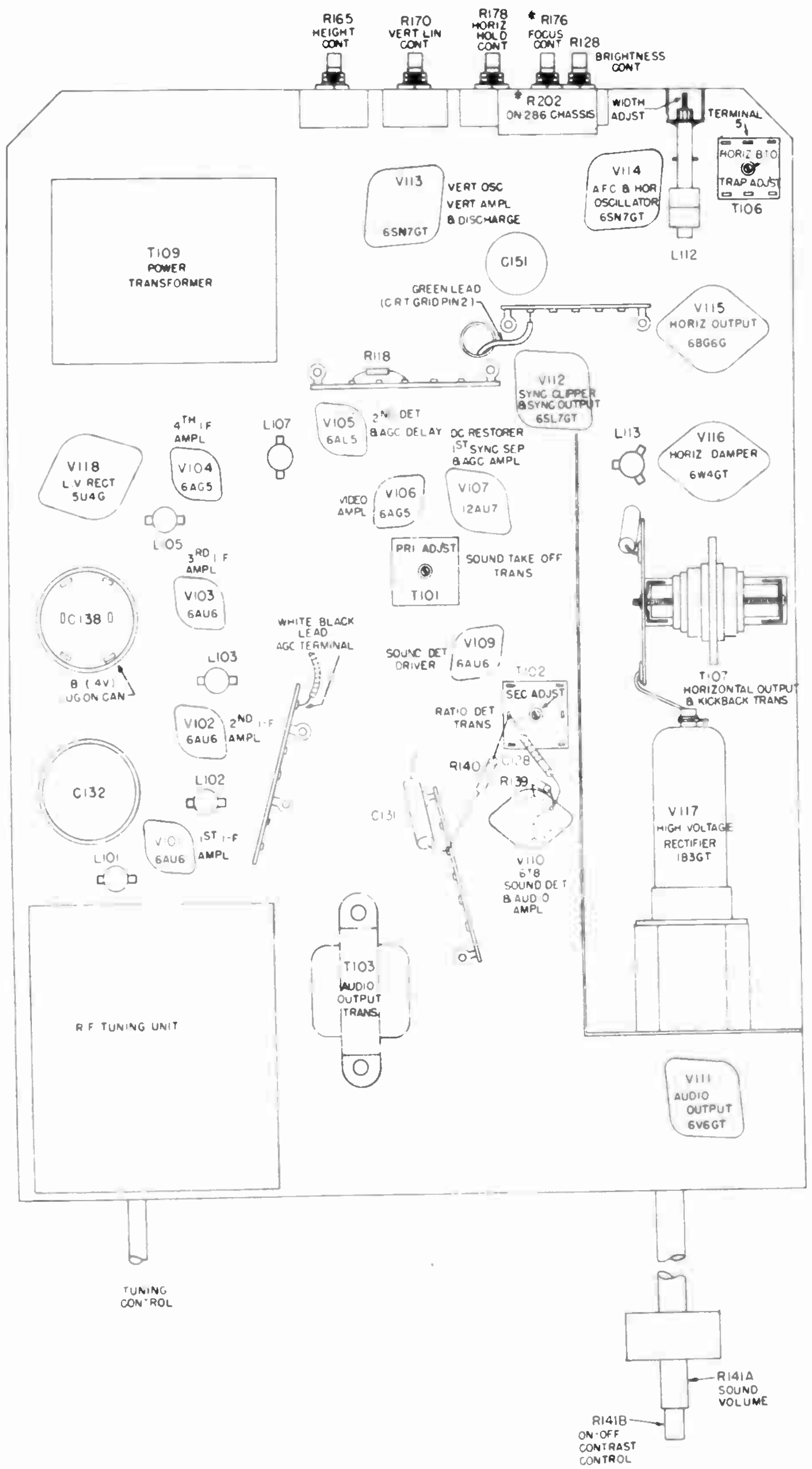

Chassis Bottom View Showing Tube Socket and Alignment Locations

REPLACEMENT PARTS LIST
Main Chassis

Symbol No.	Part No.	Description
C101	C-137727-108	Capacitor, 100 mmf., 500 v., ceramic
C102	C-144675-13	Capacitor, .01 mfd., 500 v., disc ceramic
C103	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C104	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C105	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C106	C-144675-13	Capacitor, .01 mfd., 500 v., disc ceramic
C107	C-137727-108	Capacitor, 100 mmf., 500 v., ceramic
C108	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C109	C-137727-108	Capacitor, 100 mmf., 500 v., ceramic
C110	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C111	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C112	C-137727-108	Capacitor, 100 mmf., 500 v., ceramic
C113	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C114	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C115	C-137727-108	Capacitor, 100 mmf., 500 v., ceramic
C116	C-137727-103	Capacitor, 5 mmf., 10%, 500 v., ceramic
C117	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C118	Part of T101	Capacitor, 22 mmf., 10%, 500 v., ceramic
C119	Part of T101	Capacitor, 33 mmf., 5%, 500 v., ceramic
C120	B-147047	Capacitor, 4 mfd., 350 v., Electrolytic
C121	39001-19	Capacitor, .1 mfd., 600 v., paper
C122	C-137727-108	Capacitor, 100 mmf., 500 v., ceramic
C124	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C125	39001-80	Capacitor, .02 mfd., 600 v., paper
C126	Part of T102	Capacitor, 10 mmf.
C127	Part of T102	Capacitor, 100 mmf.
C128	C-137727-110	Capacitor, 1000 mmf., 10%, 500 v., ceramic
C129	B-146883	Capacitor, 10 mfd., 50 v., Electrolytic
C130	39001-13	Capacitor, .01 mfd., 600 v., paper
C131	39001-11	Capacitor, .005 mfd., 600 v., paper
C132 A	B-146633	Capacitor, 40 mfd., 475 v. Two Section
C132 B		Capacitor, 40 mfd., 475 v. Electrolytic
C133	39001-13	Capacitor, .01 mfd., 600 v., paper
C134	39001-73	Capacitor, .00025 mfd., 600 v., paper
C135	39001-80	Capacitor, .02 mfd., 600 v., paper
C136	B-146725	Capacitor, 40 mfd., 300 v., Electrolytic
C137	39001-11	Capacitor, .005 mfd., 600 v., paper
C138 A	B-146633	Capacitor, 40 mfd., 475 v. Two Section
C138 B		Capacitor, 40 mfd., 475 v. Electrolytic
C139	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C140	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C141	39001-14	Capacitor, .015 mfd., 600 v., paper
C143	39477-41	Capacitor, .01 mfd., 600 v., molded paper
C144	B-137498-17	Capacitor, 120 mmf., 10%, 500 v., mica
C145	B-137498-28	Capacitor, 390 mmf., 5%, 500 v., mica
C146	B-137498-17	Capacitor, 120 mmf., 10%, 500 v., mica
C147	39001-74	Capacitor, .002 mfd., 600 v., paper
C148	39001-11	Capacitor, .005 mfd., 600 v., paper
C149	39001-11	Capacitor, .005 mfd., 600 v., paper
C150	39478-39	Capacitor, .0047 mfd., 10%, 600 v., paper
C151 A	B-146723	Capacitor, 10 mfd., 475 v. Three Section
C151 B		Capacitor, 10 mfd., 475 v. Electrolytic
C151 C		Capacitor, 100 mfd., 25 v.
C152	C-146434-3	Capacitor, .1 mfd., 10%, 400 v., paper
C153	39001-19	Capacitor, .1 mfd., 600 v., paper
C154 A	B-132386-16	Capacitor, Trimmer, 30-240 mmf. Two
C154 B		Capacitor, Trimmer, 10-160 mmf. Section
C155	39477-37	Capacitor, .0022 mfd., 600 v., molded paper
C156	39001-87	Capacitor, .25 mfd., 600 v., paper
C157	39001-80	Capacitor, .02 mfd., 600 v., paper
C158	39001-17	Capacitor, .05 mfd., 600 v., paper
C159	B-137498-47	Capacitor, 200 mmf., 5%, 1000 v., mica
C160	39001-13	Capacitor, .01 mfd., 600 v., paper
C161	B-137498-48	Capacitor, 2000 mmf., 5%, 500 v., mica
C162	B-137498-28	Capacitor, 390 mmf., 5%, 500 v., mica
C163	B-146944	Capacitor, 5 mfd., 25 v., Electrolytic
C164	39001-17	Capacitor, .05 mfd., 600 v., paper
C165	39001-23	Capacitor, .5 mfd., 600 v., paper
C166	C-146434-4	Capacitor, .05 mfd., 10%, 200 v., paper
C167	C-146434-7	Capacitor, .02 mfd., 10%, 200 v., paper
C168	B-137477-1	Capacitor, 500 mmf., 10 k.v.
C169	B-137498-15	Capacitor, 56 mmf., 10%, 500 v., mica
C170	B-144899-2	Capacitor, .5 mfd., 200 v., paper
C171	B-146841	Capacitor, 500 mfd., 10 v., Electrolytic
C172	AW-147000	Capacitor, 3 mmf., Transmission Line
C173	C-137727-103	Capacitor, 5 mmf., 10%, 500 v., ceramic

Symbol No.	Part No.	Description
C174	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C175	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C176	39001-17	Capacitor, .05 mfd., 600 v., paper
C177	B-137398-4	Capacitor, 2.2 mmf., 500 v.
C180	39001-11	Capacitor, .005 mfd., 600 v., paper
C182	W-160111	Capacitor, 220 mmf., 1500 v., mica
C183	W-160111	Capacitor, 220 mmf., 1500 v., mica
C184	W-160111	Capacitor, 220 mmf., 1500 v., mica
C185	39001-87	Capacitor, .25 mfd., 600 v., paper
C186	C-144675-2	Capacitor, .005 mfd., 500 v., disc, ceramic
R101	39375-77	Resistor, 15,000 ohm, 5%, ½ w.
R102	39374-11	Resistor, 68 ohm, 10%, ½ w.
R103	39373-14	Resistor, 100 ohm, ½ w.
R104	39373-33	Resistor, 1000 ohm, ½ w.
R105	39373-14	Resistor, 100 ohm, ½ w.
R106	39373-54	Resistor, 10,000 ohm, ½ w.
R107	39373-14	Resistor, 100 ohm, ½ w.
R108	39373-14	Resistor, 100 ohm, ½ w.
R109	39375-71	Resistor, 8200 ohm, 5%, ½ w.
R110	39374-11	Resistor, 68 ohm, 10%, ½ w.
R111	39373-14	Resistor, 100 ohm, ½ w.
R112	39375-73	Resistor, 10,000 ohm, 5%, ½ w.
R113	39374-11	Resistor, 68 ohm, 10%, ½ w.
R114	39375-73	Resistor, 10,000 ohm, 5%, ½ w.
R115	39373-14	Resistor, 100 ohm, ½ w.
R116	39374-13	Resistor, 100 ohm, 10%, ½ w.
R117	39374-49	Resistor, 100,000 ohm, 10%, ½ w.
R118	39375-67	Resistor, 5600 ohm, 5%, ½ w.
R119	Part of L109	Resistor, 22,000 ohm, 10%, ½ w.
R120	Part of L111	Resistor, 22,000 ohm, 10%, ½ w.
R121	39374-135	Resistor, 68,000 ohm, 10%, 1 w.
R122	39374-220	Resistor, 39,000 ohm, 10%, 2 w.
R123	39375-213	Resistor, 4700 ohm, 5%, 1 w.
R124	39374-60	Resistor, 820,000 ohm, 10%, ½ w.
R125	39374-31	Resistor, 3300 ohm, 10%, ½ w.
R126	39374-51	Resistor, 150,000 ohm, 10%, ½ w.
R127	39374-45	Resistor, 47,000 ohm, 10%, ½ w.
R128	B-146798	Control, Brightness (40,000 ohm)
R129	39374-121	Resistor, 4700 ohm, 10%, 1 w.
R130	39374-28	Resistor, 1800 ohm, 10%, ½ w.
R131	39374-219	Resistor, 33,000 ohm, 10%, 2 w.
R132	39374-220	Resistor, 39,000 ohm, 10%, 2 w.
R133	39374-214	Resistor, 12,000 ohm, 10%, 2 w.
R134	39373-80	Resistor, 220,000 ohm, ½ w.
R136	39374-45	Resistor, 47,000 ohm, 10%, ½ w.
R137	39374-35	Resistor, 6800 ohm, 10%, ½ w.
R138	39374-134	Resistor, 56,000 ohm, 10%, 1 w.
R139	39375-79	Resistor, 18,000 ohm, 5%, ½ w.
R140	39374-42	Resistor, 27,000 ohm, 10%, ½ w.
R141 A	C-146856	Control, Volume (1 megohm) Assembly
R141 B		Control, Contrast (1000 ohm)
R142	39373-107	Resistor, 10 megohm, ½ w.
R143	39374-49	Resistor, 100,000 ohm, 10%, ½ w.
R144	39375-97	Resistor, 100,000 ohm, 5%, ½ w.
R145	39375-129	Resistor, 2.2 megohm, 5%, ½ w.
R146	39374-196	Resistor, 390 ohm, 10%, 2 w.
R147	39373-92	Resistor, 1 megohm, ½ w.
R148	39374-40	Resistor, 18,000 ohm, 10%, ½ w.
R149	39373-100	Resistor, 3.3 megohm, ½ w.
R150	39374-35	Resistor, 6800 ohm, 10%, ½ w.
R151	39374-51	Resistor, 150,000 ohm, 10%, ½ w.
R152	39374-75	Resistor, 3.9 megohm, 10%, ½ w.
R153	39374-16	Resistor, 180 ohm, 10%, ½ w.
R154	39374-51	Resistor, 150,000 ohm, 10%, ½ w.
R155	39374-52	Resistor, 180,000 ohm, 10%, ½ w.
R156	39374-51	Resistor, 150,000 ohm, 10%, ½ w.
R157	39374-49	Resistor, 100,000 ohm, 10%, ½ w.
R158	39374-41	Resistor, 22,000 ohm, 10%, ½ w.
R159	39374-36	Resistor, 8200 ohm, 10%, ½ w.
R160	39374-36	Resistor, 8200 ohm, 10%, ½ w.
R161	39374-63	Resistor, 1.2 megohm, 10%, ½ w.
R162	B-146799	Control, Vertical Hold (1.5 megohm)
R163	39373-54	Resistor, 10,000 ohm, ½ w.
R164	39374-65	Resistor, 1.5 megohm, 10%, ½ w.
R165	B-144259	Control, Height (2.5 megohm)
R166	39374-31	Resistor, 3300 ohm, 10%, ½ w.

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World Radio History

Models 10-404MU, 10-404M1U, 10-412MU, 10-418MU
Main Chassis

Symbol No.	Part No.	Description
R167	39374-142	Resistor, 270,000 ohm, 10%, 1 w.
R168	39374-69	Resistor, 2.2 megohm, 10%, ½ w.
R169	39374-22	Resistor, 560 ohm, 10%, ½ w.
R170	B-144260	Control, Vertical Linearity (5000 ohm)
R171	39374-122	Resistor, 5600 ohm, 10%, 1 w.
R172	Part of L117A	Resistor, 1000 ohm, 10%, ½ w.
R173	Part of L117A	Resistor, 1000 ohm, 10%, ½ w.
R174	39374-193	Resistor, 220 ohm, 10%, 2w. (10-404MU, 10-412MU, 10-418MU)
R175	39374-193	Resistor, 220 ohm, 10%, 2w. (10-404MU, 10-412MU, 10-418MU)
R176	B-147083	Control, Focus, 650 ohm (10-404MU, 10-412MU, 10-418MU)
R177	39374-47	Resistor, 68,000 ohm, 10%, ½ w.
R178	B-146797	Control, Horizontal Hold (50,000 ohm)
R179	39374-139	Resistor, 150,000 ohm, 10%, 1 w.
R180	39374-71	Resistor, 2.7 megohm, 10%, ½ w.
R181	39374-60	Resistor, 820,000 ohm, 10%, ½ w.
R182	39374-36	Resistor, 8200 ohm, 10%, ½ w.
R183	39374-51	Resistor, 150,000 ohm, 10%, ½ w.
R184	39374-51	Resistor, 150,000 ohm, 10%, ½ w.
R185	39375-97	Resistor, 100,000 ohm, 5%, ½ w.
R186	39374-37	Resistor, 10,000 ohm, 10%, ½ w.
R187	39374-41	Resistor, 22,000 ohm, 10%, ½ w.
R188	39374-138	Resistor, 120,000 ohm, 10%, 1 w.
R189	39373-9	Resistor, 47 ohm, ½ w.
R190	39373-92	Resistor, 1 megohm, ½ w.
R191	39374-100	Resistor, 82 ohm, 10%, 1w.
R192	39374-127	Resistor, 15,000 ohm, 10%, 1 w.
R193	39374-25	Resistor, 1000 ohm, 10%, ½ w.
R194	39374-46	Resistor, 56,000 ohm, 10%, ½ w.
R196	39374-141	Resistor, 220,000 ohm, 10%, 1 w.
R197	39374-58	Resistor, 560,000 ohm, 10%, ½ w.
R198	39374-93	Resistor, 22 ohm, 10%, 1 w.
R199	39374-49	Resistor, 100,000 ohm, 10%, ½ w.
R200	39374-193	Resistor, 220 ohm, 10%, 2 w. (10-404M1U)
R201	39374-193	Resistor, 220 ohm, 10%, 2 w. (10-404M1U)
R202	B-147079	Control, Focus, 1500 ohm (10-404M1U)
R203	39374-46	Resistor, 56,000 ohm, 10%, ½ w.
R204	39374-48	Resistor, 82,000 ohm, 10%, ½w.
R206	39374-51	Resistor. 150,000 ohm, 10%, ½ w.
L101	AW-146763	Coil, 1st I.F. Secondary
L102	AW-146582	Coil, 2nd I.F.
L103	AW-146583	Coil, 3rd I.F.
L104	AW-146570	Coil, R.F. Choke
L105	AW-146582	Coil, 4th I.F.
L106	AW-146570	Coil, R.F. Choke
L107	AW-147022	Coil, 5th I.F.
L108	AW-146889	Coil, Video Peaking
L109	AW-147043	Coil, Video Peaking
L110	AW- 146889	Coil Video Peaking
L111	AW-147043	Coil Video Peaking
L112	AW-146984	Inductor, Width
L113	AW-147880	Inductor, Horizontal Linearity
L114	AB-146758	Coil, Focus (10-404MU, 10-412MU, 10-418 MU)
L115	AB-147017	Coil, Focus (10-404M1U)
L116	AW-146855	Coil, R. F. Heater Choke
L117A	AB-147560	Yoke, Deflection Assy. (10-412MU,
L117B		Yoke, Deflection 10-418MU)
L117A	AB-147631	Yoke, Deflection Assy. (10-404MU,
L117B		Yoke, Deflection 10-404M1U)
L119	147672	Filter Choke, 50 ohm (10-412MU, 10-418MU)
L119	Part of SP101	Filter Choke, 51 ohm (10-404MU, 10-404M1U)
L120	AW-146570	Coil, R. F. Choke
L121	AW-147575	Coil, R. F. Choke
IC101	W-160426	Iron Core
IC102	W-160426	Iron Core
IC103	W-160426	Iron Core
IC104	W-160426	Iron Core
IC105	W-160426	Iron Core
IC106	39012-100	Iron Core
IC107	39012-93	Iron Core
IC108	39012-96	Iron Core
IC109	39012-96	Iron Core
IC110	39012-97	Iron Core
IC111	39012-97	Iron Core
T101	AC-146782	Transformer, Sound Takeoff
T102	C-146874	Transformer, Ratio Detector
T103	B-142890	Transformer, Audio Output
T104	B-146842-1	Transformer, Vertical Blocking Osc.

Symbol No.	Part No.	Description
T105	B-146989	Transformer, Vertical Output
T106	AC-146698	Transformer, Horizontal Osc.
T107	AC-147552	Transformer, Horizontal Output
T109	C-147682	Transformer, Power (10-404MU, 10-404 M1U)
T109	C-146683	Transformer, Power (10-412 MU, 10-418 MU)
SP101	C-147265	Speaker & Choke Assy., 10" PM (10-412 MU, 10-418MU)
SP101	AD-146528	Speaker, 4x6 E. M., 51 ohm (10-404MU, 10-404M1U)
SW10	Part of R141	Switch, Power
CA101	AB-147581	Cable & Socket Assy., Speaker
CA102	C-132300-6	Cable & Plug Assy., Power
P101	AW-147510	Bracket & Plug Assy., Interlock
F101	W-144898-1	Fuse. 200 M. A.
	B-146602	Brace, Deflection Yoke Bracket
	AB-144853	Bracket Assy., Deflection Yoke
	AB-147551	Bracket & Terminal Assy., Deflection Yoke (10-412MU, 10-418MU)
	AB-147629	Bracket & Terminal Assy., Deflection Yoke (10-404MU, 10-404M1U)
	AW-146658	Bracket & Stud Assy., Gear
	B-146538-2	Bracket (L. H.), Chassis Mtg. (10-412MU, 10-418MU)
	B-146538-1	Bracket (R. H.), Chassis Mtg. (10-412MU, 10-418MU)
	C-147597	Bracket, Chassis Mtg. (10-412MU, 10-418MU)
	W-147639	Bracket, Chassis Mtg. (10-404MU, 10-404M1U)
	B-147669	Bracket, Antenna (10-404MU, 10-404M1U)
	W-146256	Board, Capacitor Mtg.
	W-130860	Clamp, Tube (V118 Socket)
	W-146627	Connector, Tube Cap
	W-146909	Connector, Picture Tube Anode (10-404 M1U, 10-412MU, 10-418MU)
	W-147283	Connector, Picture Tube Anode (10-404 MU)
	W-146560	Cover, Tube Shield
	W-160128-11	Cushion (Rubber), Picture Tube Strap
	W-160362-2	Cushion (Rubber), 4 1/8"
	W-160362-1	Cushion (Rubber), 2 9/16"
	AW-146701	Dial Sleeve & Gear
	B-147702-1	Foot, Deflection Bracket Extension (10-404MU, 10-404M1U)
	B-147702-2	Foot, Deflection Bracket Extension 10-404MU, 10-404M1U)
	AW-146651	Gear & Pinion
	W-134055	Grommet. Hor. Output Transformer
	W-160112-2	Grommet, Focus Coil
	W-142515	Grommet, Anode Cable Support
	W-45580	Grommet, Anode Connector
	W-138090-4	Insulator, Standoff
	39033-18CL	Nut Focus Coil (6 used)
	B-94704-20	Nut, Speed (High Voltage Shield)
	W-160128-12	Pad, Picture Tube Support
	W-146634	Ring, Lock (R. F. Tuner Shaft, Outer)
	W-160243-2	Ring Retainer (Gear Bracket)
	W-144957	Screw, Thumb
	W-147306	Screw, Focus Coil (3 used)
	AB-146628	Shield & Stud Assy., Tube
	B-147119-1	Socket & Cable Assy., Picture Tube
	39437-1	Socket, Tube (V111, V112, V113, V114)
	W-146439-2	Socket, Tube (V116)
	W-145789	Socket, Tube (V117)
	39388	Socket, Tube (V115, V118)
	W-146966	Socket, Tube (V101, V102, V103, V104 V105, V106, V109)
	W-144732	Socket, Tube (V107, V110)
	W-144668	Spring, Compression (Focus, Coil)
	AB-147630	Strap & Spring Assy., Picture Tube (10-404M1U)
	AB-147545	Strap & Spring Assy., Picture Tube (10-412MU, 10-418MU)
	D-147623	Strap, Picture Tube (10-404MU)
	W-146892-1	Stud, Hor. Output Trans. Mtg.
	W-147256-1	Support, Anode Cable (10-404M1U, 10-412MU, 10-418MU)
	W-147256-2	Support, Anode Cable (10-404MU)
	B-146480	Trap, Ion (10-404M1U, 10-412MU, 10-418MU)
	B-146479	Trap, Ion (10-404MU)
	W-147061	Washer, Spring

Models 10-404MU, 10-404M1U, 10-412MU, 10-418MU
R. F. Tuner

Symbol No.	Part No.	Description	Symbol No.	Part No.	Description
	AW-146843	R.F. Tuner Assembly (Complete)	R6	39374-38	Resistor, 12,000 ohm, 10%, ½ w.
C1	C-137727-104	Capacitor, 470 mmf., 10%, 500 v., ceramic	L1	AW-146735	Coil, Antenna Shunt Inductor
C2	B-146714-4	Capacitor, Trimmer (Spade Adj. Screw)	L2	AW-146858	Coil, Heater Choke
C2	B-147676-2	Capacitor, Trimmer (R. H. Adj. Screw)	L3	AW-146985	Inductor, End (R.F.)
C3	B-147676-1	Capacitor, Trimmer (R. H. Adj. Screw)	L4A	D-146656	Inductor, Variable (Three Section Inductuner)
C3	B-146714-2	Capacitor, Trimmer (Spade Adj. Screw)	L4B		Inductor, Variable
C4	C-137727-8	Capacitor, 1000 mmf., 300 v., ceramic	L4C		Inductor, Variable
C5	C-137727-48	Capacitor, 5000 mmf., 500 v., ceramic	L5	AW-146988	Coil, R.F. Coupling
C6	C-137727-8	Capacitor, 1000 mmf., 300 v., ceramic	L6	AW-146987	Inductor, End (Converter)
C7	B-146714-4	Capacitor, Trimmer (Spade Adj. Screw)	L7	AW-146755	Inductor, 1st I.F. Primary
C7	B-147676-2	Capacitor, Trimmer (R. H. Adj. Screw)	L8	AW-146735	Inductor, 1st I.F. Coupling
C8	C-137727-107	Capacitor, 15 mmf., 10%, 500 v., ceramic	L9	AW-147015	Coil, Choke
C9	W-137398-2	Capacitor, 1 mmf., 500 v.	L10	AW-146753	Inductor, Oscillator Shunt
C10	C-137727-104	Capacitor, 470 mmf., 10%, 500 v., ceramic	L11	AW-146986	Inductor, End (Oscillator)
C11	C-137727-104	Capacitor, 470 mmf., 10%, 500 v., ceramic	CA1	AW-147467	Cable, Antenna Lead
C12	C-137727-8	Capacitor, 1000 mmf., 300 v., ceramic		C-138648-4	Clip, Coil (L10, L7)
C13	C-137727-103	Capacitor, 5 mmf., 10%, 500 v., ceramic		W-147466	Connector (Female), Antenna Cable
C14	C-137727-106	Capacitor, 6 mmf., ±.5mmf., 500 v., ceramic		39012-99	Iron Core (L10)
C15	C-137727-105	Capacitor, 4 mmf., ±.5mmf., 500 v., ceramic		39012-98	Iron Core (L7)
R1	39374-32	Resistor, 3900 ohm, 10%, ½ w.		W-160204	Shield, Tube (Long)
R2	39374-53	Resistor, 220,000 ohm, 10%, ½ w.		W-160205	Shield, Tube (Short)
R3	39374-61	Resistor, 1 megohm, 10%, ½ w.		W-160065-2	Socket, Tube (V1, V2, V3)
R4	39374-37	Resistor, 10,000 ohm, 10%, ½ w.		C-135038-4	Terminal Board
R5	39374-51	Resistor, 150,000 ohm, 10%, ½ w.			

Cabinet

Part No.	Description
AD-147658	Antenna Assy. (10-412MU, 10-418MU)
AD-147708	Antenna Assy. (10-404MU, 10-404M1U)
AD-147645	Back & Power Cable Assy. (10-404MU, 10-404M1U)
AC-147604	Back & Power Cable Assy. (10-412MU, 10-418MU)
B-147647	Bracket, Chassis Mtg. (Rear), Fastens to Cabinet (10-404MU, 10-404M1U)
W-147646	Bracket, Chassis Mtg. (Rear), Fastens to Chassis (10-404MU, 10-404M1U)
W-147649	Bracket, Control Mtg. (10-404MU, 10-404M1U)
B-147508	Bracket, Control Mtg. (10-412MU, 10-418MU)
D-146364-2	Bottom Chassis (10-404MU, 10-404 M1U)
R-147651	Cabinet (10-404MU, 10-404M1U)
R-147650	Cabinet (10-412MU)
R-147613	Cabinet (10-418MU)
W-146335	Clamp, Cabinet Back
W-147300	Clip, Escutcheon (10-404MU, 10-404M1U)
W-147559	Clip, Trim Molding (10-412MU, 10-418MU)
W-147473	Connector (Male), Antenna
D-147570	Dial, Tuning (10-412MU, 10-418MU)
D-147569	Dial, Volume (10-412MU, 10-418MU)
146655	Doors, Matched Pair (10-412MU)
AC-147679	Escutcheon, Dial (10-404MU, 10-404M1U)
AC-147680	Escutcheon, Volume-Contrast (10-404MU, 10-404M1U)
146422	Foot, Cabinet (10-404MU, 10-404M1U)
144600	Grille Cloth (10-404MU, 10-404M1U)

Part No.	Description
W-147637	Gusset, Cabinet Corners (10-404MU, 10-404M1U)
147519	Hinge, R. H. (10-412MU)
147529	Hinge, L. H. (10-412MU)
W-147525	Indicator, Tuning (10-412MU, 10-418MU)
AW-146638-1	Knob, Tuning
AW-146637-1	Knob, Volume
AW-146640-1	Knob, Off-On-Contrast
R-147592	Mask, Picture Tube (10-412MU, 10-418MU)
D-147571	Molding, Trim (10-412MU, 10-418MU)
D-147626	Molding, Trim (10-404MU, 10-404M1U)
B-147747	Name Plate, CROSLEY (10-404MU, 10-404M1U)
B-145601-9	Name Plate, CROSLEY (10-412MU, 10-418MU)
W-147619	Plate, Chassis Mtg., Front (10-404MU, 10-404M1U)
W-146776	Pointer, Dial (10-404MU, 10-404M1U)
147654	Pull (Handle), Door (10-412MU)
W-147643	Rest, Chassis Foot (10-404MU, 10-404M1U)
W-145391	Ring (Compression), Dial (10-412MU, 10-418MU)
B-147690	Screw (Special) Molding (10-404MU, 10-404M1U)
W-147556-2	Screw (Special), Window (10-412MU, 10-418MU)
W-146484	Spring, Dial (10-412MU, 10-418MU)
139319	Strike & Catch Assy., Doors (10-412MU)
R-147584	Window (10-412MU, 10-418MU)
R-147687	Window (10-404MU, 10-404M1U)

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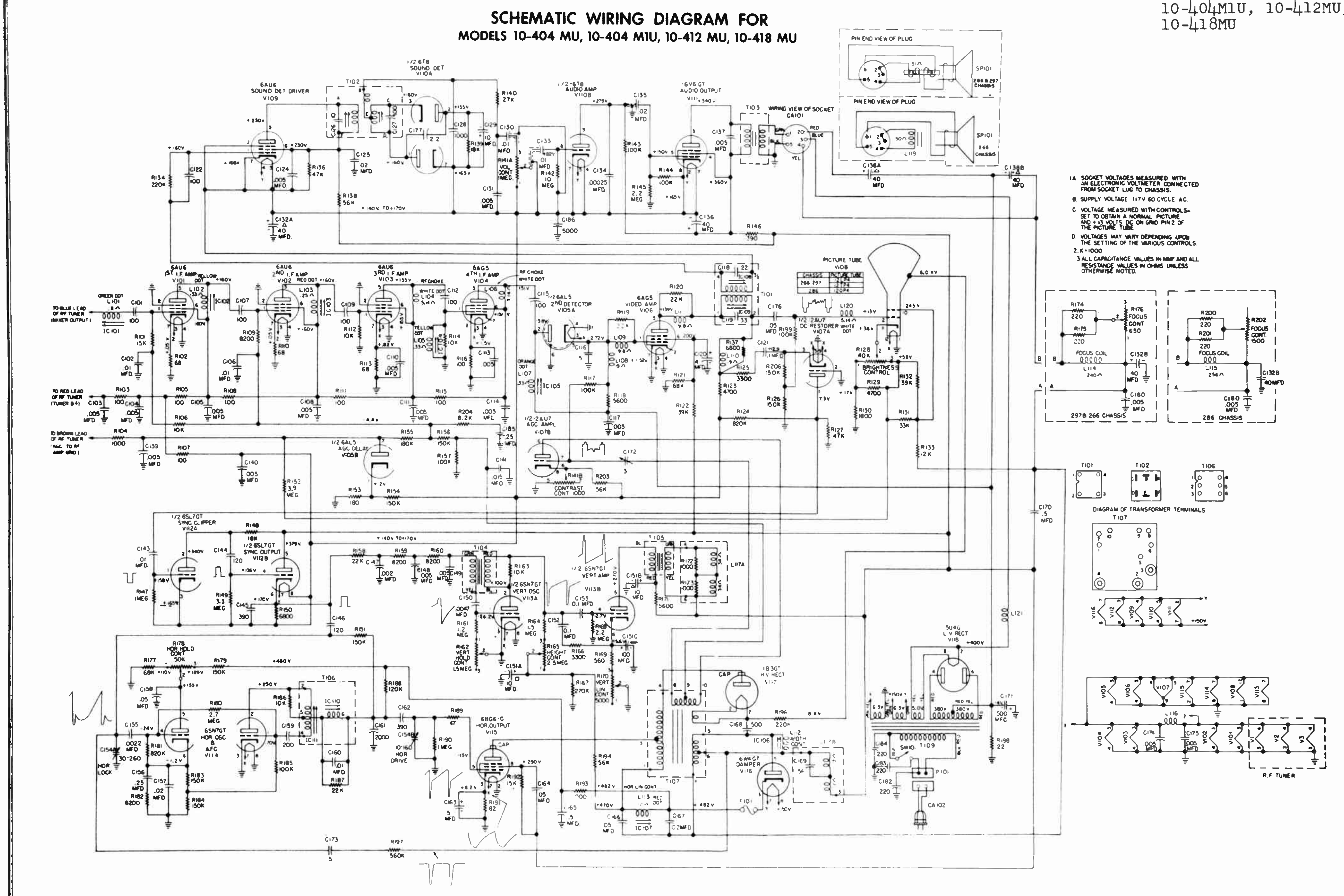
SCHEMATIC WIRING DIAGRAM FOR MODELS 10-404 MU, 10-404 M1U, 10-412 MU, 10-418 MU



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This television receiver is designed to operate from a power source of 117 volts, 60 cycle, a.c. The average power consumption is 185 watts. The audio output system is capable of delivering 1.5 watts maximum. The tube complement is as follows:

SYMBOL	TUBE TYPE	FUNCTION
V1	6AB4	R-F Amplifier
V2	6CB6	Mixer
V3	6AB4	V.H.F. Oscillator
V101	6AU6	1st I-F Amplifier
V102	6AU6	2nd I-F Amplifier
V103	6AU6	3rd I-F Amplifier
V104	6AG5	4th I-F Amplifier
V105	6AL5	2nd Detector & AGC Delay
V106	6AH6	Video Amplifier
V107	12AU7	DC Restorer, 1st sync Separator
V108	16TP4	Picture Tube
V109	6AU6	Sound Det. Driver
V110	6T8	Sound Det. & 1st Audio Ampl.
V111	6V6GT	Audio Output
V112	6SL7GT	Sync Clipper & Sync Output
V113	6C4	Vertical Oscillator
V114	6K6GT	Vert. Amplifier
V115	6SN7GT	A.F.C. & Horizontal Osc.
V116	6BQ6GT	Horizontal Output
V117	6BQ6GT	Horizontal Output
V118	6W4GT	Horizontal Damper
V119	1B3GT	H. V. Rectifier
V120	5Y3GT	L. V. Rectifier
V121	5U4G	L. V. Rectifier
V122	6AU6	AGC Amplifier

SUBJECT— IMPROVE VENTILATION FOR 6BQ6 AND 6W4 TUBES - MODEL 10-421MU

To improve the ventilation of these tubes, remove and discard the tube shield cover.

In the temporary service information parts list for this model, change the tube shield part number from 148154 to 148020.

SUBJECT— CAPACITOR (Symbol No. C168) MODEL 10-421MU

The temporary service information shows that symbol C168 is one 500 mmf., 20 k.v. capacitor (part No. W-147375). However, some sets were equipped with two 500 mmf., 10 k.v. capacitors connected in series.

When either or both of these capacitors require replacing, replacement should be made with one capacitor (part No. W-147375).

SUBJECT— INCREASE HORIZONTAL DRIVE - MODEL 10-421MU.

To increase the horizontal drive, some sets are equipped with an 18,000 ohm, 10%, 1/2 watt resistor (Symbol No. R210, Part No. 39374-40) connected in parallel with R197.

In some areas, the horizontal drive may be excessive on these sets. When this condition is experienced, remove R210.

ADJUSTMENTS

1. The DEFLECTION YOKE is positioned as far forward as possible on the neck of the cathode ray tube and rotated so as to make the top of the raster parallel with the top of the CRT.
2. The FOCUS COIL should be adjusted to be approximately perpendicular to the cathode ray tube axis with the front surface of the focus coil housing approximately 15/32" from the rear surface of the deflection and focus mounting bracket.
3. Adjust size of picture to 13 5/8" x 10 1/4" by the HEIGHT CONTROL, HORIZONTAL DRIVE, VERTICAL LINEARITY and WIDTH CONTROL. The HORIZONTAL DRIVE trimmer should be adjusted to a point where the vertical white bar across the center of the raster disappears.
4. Center the picture by adjusting the three focus coil mounting nuts.
5. The ION TRAP is positioned for maximum brightness, with low setting of the Brightness Control, and for no cutoff of the picture at high setting of the Brightness Control.
6. I-F Alignment (See I-F Alignment).
7. HORIZONTAL HOLD ADJUSTMENT (See Horiz. Blocking Osc. Alignment).
8. HORIZONTAL HOLD CONTROL is adjusted with a weak picture to center of pull in range.
9. VERTICAL HOLD CONTROL is adjusted with a weak picture to center of pull in range.
10. Vertical linearity is adjusted by the VERTICAL LINEARITY CONTROL and the HEIGHT CONTROL. Horizontal size is adjusted by the HORIZONTAL LINEARITY and WIDTH adjustments.
11. The FOCUS CONTROL is adjusted for best focus of the vertical and horizontal wedges at center of test pattern. If there is any astigmatism, the focus should be set to favor the vertical wedge. If corner focus is poor, check position of the DEFLECTION YOKE and ION TRAP.

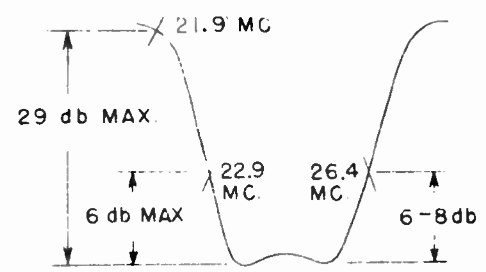
I-F ALIGNMENT

1. Connect a short clip lead from B- (-4 volts) to AGC terminal (white-black lead near V102) of the I-F stages.
2. Connect an electronic voltmeter across R118.
3. Connect "hot" lead of signal generator to grid (pin #1) of V101.

*4. Set signal generator to 25.65 mc. and adjust L107 and L103 for maximum meter deflection.

*5. Reset signal generator to 23.7 mc. and adjust L105 and L102 for maximum meter deflection.

6. Disconnect the electronic voltmeter and signal generator from grid of V101. Connect a scope to the CRT grid. Keep scope leads as far away as possible from the IF stages. Connect a video sweep signal to the adjusting screw (top of chassis on tuner) of C3. Ground lead of sweep signal should be connected to main chassis as close as possible to the hot lead. Remove the oscillator tube V3. Tuner should be approximately 1-1 2 turns counter-clockwise from the high end (Channel #13). Contrast control should be set as low as possible and still obtain reasonable deflection on the scope.



7. Adjust L101 for 26.4 mc. to fall 6 db down from the peak with as flat a curve as possible across the bottom.
8. Disconnect sweep signal and clip lead from B- to AGC terminal.

* NOTE: In steps 4 and 5 limit DC meter deflection to 3.5 volts maximum by adjusting attenuator of signal input.

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SOUND ALIGNMENT

1. Connect "hot" lead of signal generator to grid (pin #1) of V106. Set signal generator to 4.5 mc. with 400 c.p.s. amplitude modulated 30% or greater.
2. Connect scope to CRT grid through a detector probe.
3. Connect two 100 K ohm resistors (matched within 1%) in series across R139 (pin 2 and 7 of V110A) Connect common lead of electronic voltmeter to junction of the matched 100K ohm resistors and the DC lead to + 150 volt point at junction of C128 (pin #4 of V110).
4. Using a high level signal input and with the contrast control set at maximum, tune the sound takeoff transformer (T101) primary adjustment (bottom of chassis) for minimum deflection on the scope.
5. Reduce signal input to below limiting in V107 and adjust sound take-off transformer (T101) secondary (top of chassis), and ratio detector transformer (T102) primary (top of chassis) for peak meter reading.
6. Repeat steps 4 and 5.
7. Transfer DC lead only of electronic voltmeter to junction of R140 and C131.
8. Return to high level signal input for limiting in V107 and adjust ratio detector transformer (T102) secondary (bottom of chassis) for minimum buzz corresponding with undistorted output.
9. Remove the two 100 K ohm resistors, and all test equipment from the receiver.

AGC ADJUSTMENT

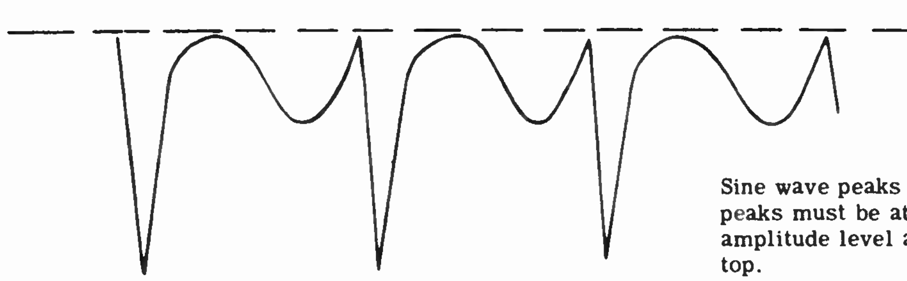
Connect scope (direct) to detector load resistor R118. Tune in a station with a strong signal and adjust the Automatic Gain Control on the rear apron of the chassis for 5 volts + 1/2 volt peak to peak (white to sync tip) detector output.

HORIZONTAL DRIVE ADJUSTMENT

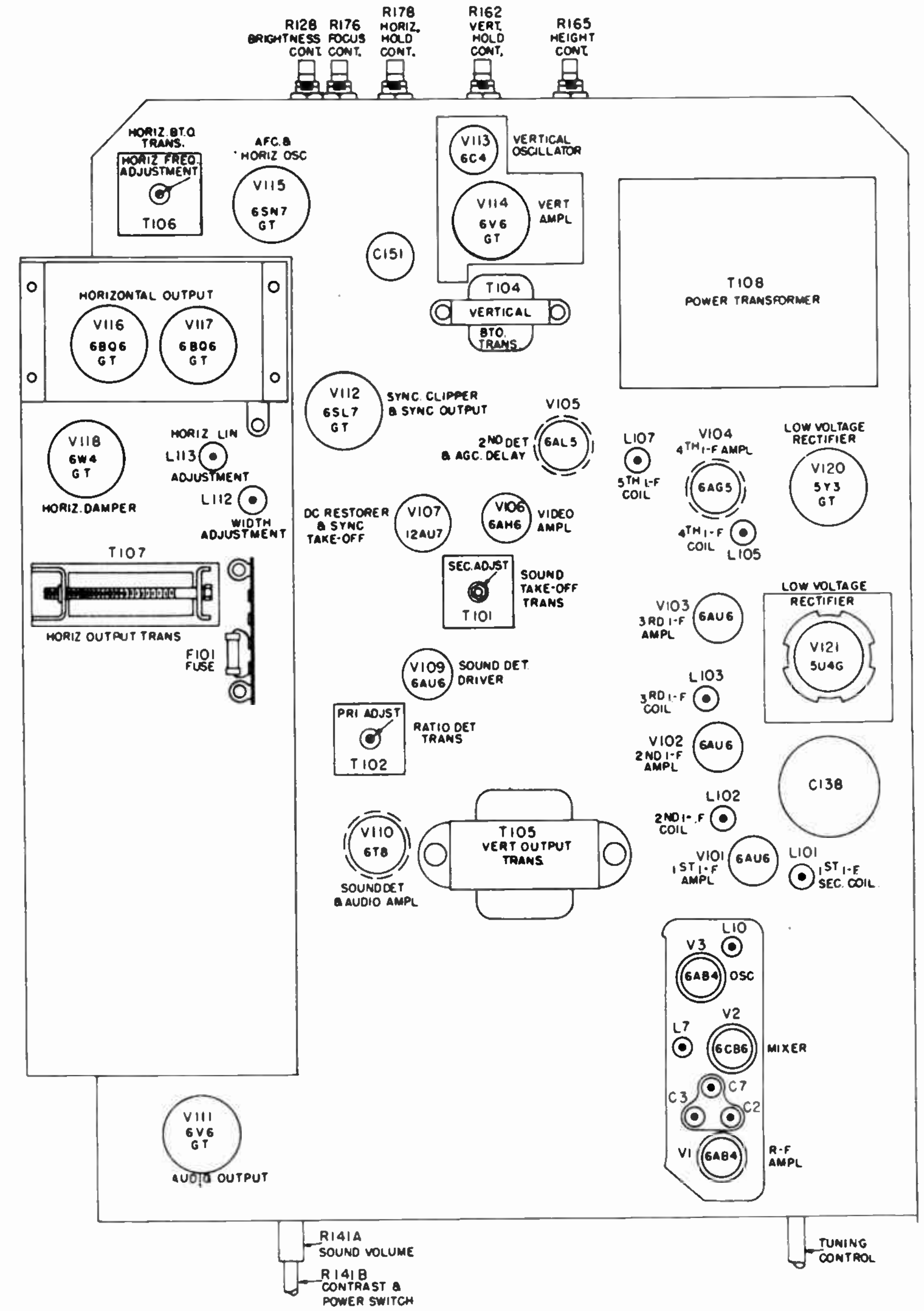
Before alignment of the horizontal blocking oscillator and AFC. circuit. Tune in a station with a strong signal and adjust the HORIZONTAL DRIVE trimmer just below the point where a white line and crowding appears in the center of the picture. Vary CONTRAST CONTROL during this alignment from minimum to maximum.

HORIZONTAL BLOCKING OSCILLATOR ALIGNMENT

1. Tune the receiver to a television signal and adjust the Contrast Control below limiting in the video amplifier (V106).
2. Connect scope thru a 10 mmf. capacitor to terminal #5 of the Horizontal Blocking Oscillator Transformer (T106) and adjust the horizontal BTO Trap (bottom of T106) for the wave form shown at bottom of page. The raster must be kept in sync by means of the Horizontal Hold Control, Horiz. Frequency Control and/ or Horizontal Lock.
3. Remove scope from the receiver and adjust HORIZONTAL LOCK trimmer for minimum capacity.
4. Set the HORIZONTAL HOLD CONTROL fully clockwise and turn the HORIZONTAL FREQUENCY adjustment (top of T106) out until the picture falls out of sync. (This is indicated by a wide black vertical or diagonal bar sloping to the right from top to bottom). Then turn the HORIZONTAL FREQUENCY adjustment slowly in until picture just falls into sync.
5. The final setting of the HORIZONTAL HOLD CONTROL should be made with the CONTRAST CONTROL turned so as to obtain a very weak picture. Rotate the dial on and off the station, and set the HORIZONTAL HOLD CONTROL so that the picture returns completely in sync.



Sine wave peaks and pulse peaks must be at the same amplitude level across the top.



Chassis Top View Showing Tube and Alignment Locations

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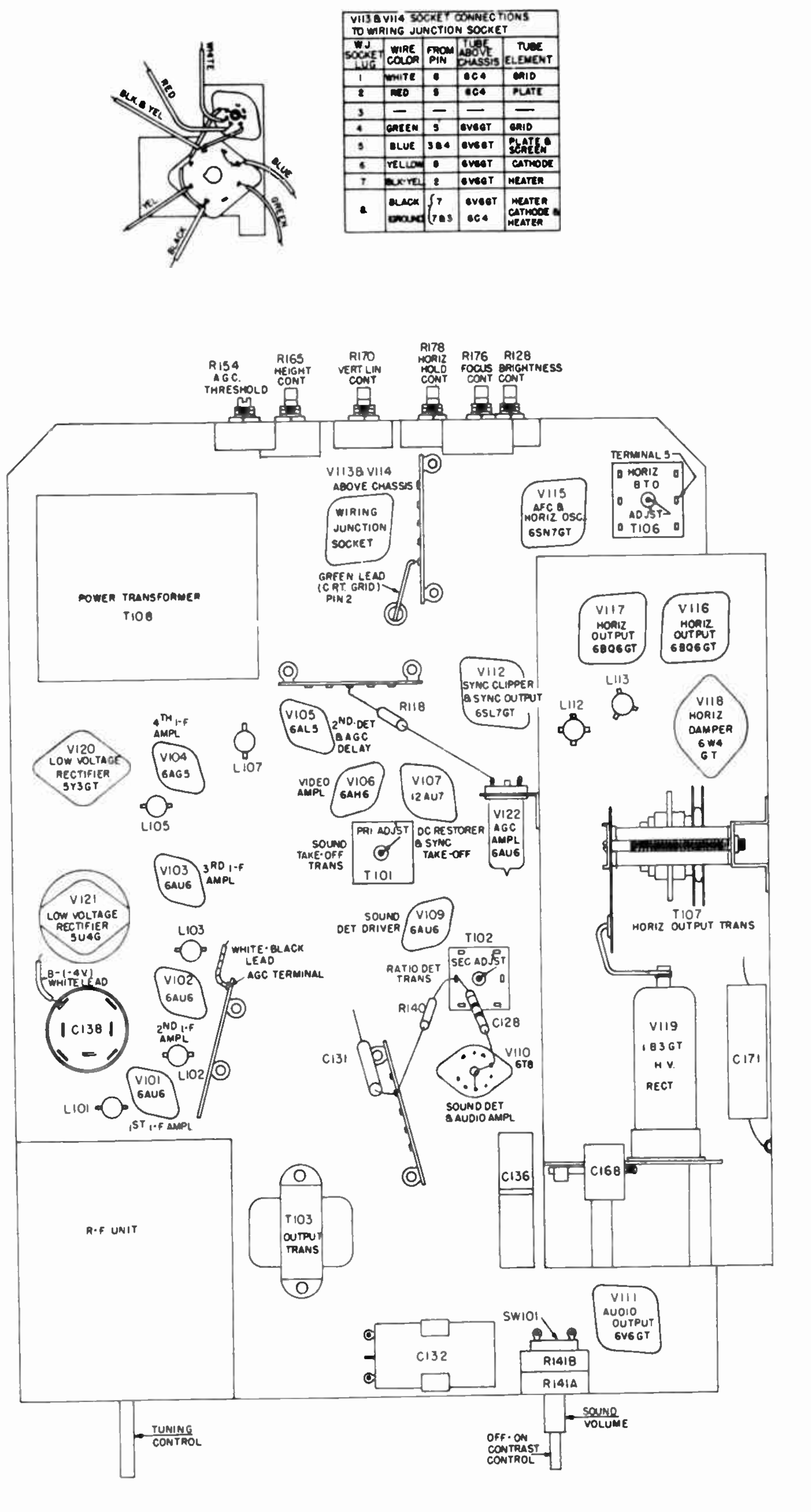

Chassis Bottom View Showing Tube Socket and Alignment Locations

REPLACEMENT PARTS LIST

Main Chassis

Symbol No.	Part No.	Description	Symbol No.	Part No.	Description
C101	C-137727-108	Capacitor, 100 mmf., 500 v., ceramic	C173	C-137727-103	Capacitor, 5 mmf., 10%, 500 v., ceramic
C102	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic	C174	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C103	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic	C175	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C104	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic	C176	W-160111	Capacitor, 220 mmf., 500 v., mica
C105	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic	C177	W-137398-4	Capacitor, 2.2 mmf., 500 v.
C106	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic	C178	C-144675-2	Capacitor, .005 mmf., 500 v., disc ceramic
C107	C-137727-108	Capacitor, .100 mmf., 500 v., ceramic	C179	39001-19	Capacitor, .1 mfd., 600 v., paper
C108	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic	C180	39001-11	Capacitor, .005 mfd., 600 v., paper
C109	C-137727-108	Capacitor, 100 mmf., 500 v., ceramic	R101	39375-77	Resistor, 15,000 ohm, 5%, ½w.
C110	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic	R102	39374-11	Resistor, 68 ohm, 10%, ½w.
C111	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic	R103	39374-13	Resistor, 100 ohm, 10%, ½w.
C112	C-137727-108	Capacitor, 100 mmf., 500 v., ceramic	R104	39374-25	Resistor, 1000 ohm, 10%, ½w.
C113	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic	R105	39374-13	Resistor, 100 ohm, 10%, ½w.
C114	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic	R106	39374-37	Resistor, 10,000 ohm., 10%, ½w.
C115	C-137727-108	Capacitor, 100 mmf., 500 v., ceramic	R107	39374-13	Resistor, 100 ohm, 10%, ½w.
C116	C-137727-103	Capacitor, 5 mmf., 10%, 500 v., ceramic	R108	39374-13	Resistor, 100 ohm, 10%, ½w.
C117	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic	R109	39375-71	Resistor, 8200 ohm, 5%, ½w.
C118	Part of T101	Capacitor, 22 mmf., 10%, 500 v., ceramic	R110	39374-11	Resistor, 68 ohm, 10%, ½w.
C119	Part of T101	Capacitor, 33 mmf., 5%, 500 v., ceramic	R111	39374-13	Resistor, 100 ohm, 10%, ½w.
C121	39001-19	Capacitor, .1 mfd., 600 v., paper	R112	39375-69	Resistor, 6800 ohm, 5%, ½w.
C122	C-137727-112	Capacitor, 47 mmf., 10%, 500 v., ceramic	R113	39374-11	Resistor, 68 ohm, 10%, ½w.
C123	39001-17	Capacitor, .05 mfd., 600 v., paper	R114	39375-73	Resistor, 10,000 ohm, 5%, ½w.
C124	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic	R115	39374-13	Resistor, 100 ohm, 10%, ½w.
C125	39001-80	Capacitor, .02 mfd., 600 v., paper	R116	39374-13	Resistor, 100 ohm, 10%, ½w.
C126	Part of T102	Capacitor, 10 mmf., 500 v., mica	R117	39374-49	Resistor, 100,000 ohm, 10%, ½w.
C127	Part of T102	Capacitor, 100 mmf., 500 v., mica	R118	39375-65	Resistor, 4700 ohm, 5%, ½w.
C128	C-137727-110	Capacitor, 1000mmf., 10%, 500 v., ceramic	R119	Part of L109	Resistor, 3900 ohm, 10%, ½w.
C129	B-147758	Capacitor, 10 mfd., 25 v., Electrolytic	R120	Part of L111	Resistor, 22,000 ohm, 10%, ½w.
C130	39001-13	Capacitor, .01 mfd., 600 v., paper	R121	39374-224	Resistor, 82,000 ohm, 10%, 2w.
C131	39001-11	Capacitor, .005 mfd., 600 v., paper	R122	39374-49	Resistor, 100,000 ohm, 10%, ½w.
C132A	B-148429	Capacitor, 40 mfd., 250 v. Three Section	R123	39375-221	Resistor, 10,000 ohm, 5%, 1w.
C132B		Capacitor, 40 mfd., 475 v. Electrolytic	R124	39374-60	Resistor, 820,000 ohm, 10%, ½w.
C132C		Capacitor, 100 mfd., 50 v.	R125	39374-31	Resistor, 3300 ohm, 10%, ½w.
C133	39001-13	Capacitor, .01 mfd., 600 v., paper	R126	39374-50	Resistor, 120,000 ohm, 10%, ½w.
C134	39001-73	Capacitor, .00025 mfd., 600 v., paper	R127	39374-45	Resistor, 47,000 ohm, 10%, ½w.
C135	39001-80	Capacitor, .02 mfd., 600 v., paper	R128	B-146798	Control, Brightness (40,000 ohm)
C136	B-146725	Capacitor, 40 mfd., 300 v., Electrolytic	R129	39374-123	Resistor, 6800 ohm, 10%, 1w.
C137	39001-11	Capacitor, .005 mfd., 600 v., paper	R130	39374-29	Resistor, 2200 ohm, 10%, ½w.
C138A	B-147757	Capacitor, 40 mfd., 475 v. Three Section	R131	39384-221	Resistor, 47,000 ohm, 10%, 2w.
C138B		Capacitor, 40 mfd., 475 v. Electrolytic	R132	39374-220	Resistor, 39,000 ohm, 10%, 2w.
C138C		Capacitor, 500 mfd., 10 v.	R133	39374-123	Resistor, 6800 ohm, 10%, 1w.
C139	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic	R134	39374-45	Resistor, 47,000 ohm, 10%, ½w.
C140	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic	R135	39374-9	Resistor, 47 ohm, 10%, ½w.
C141	39001-14	Capacitor, .015 mfd., 600 v., paper	R136	39374-45	Resistor, 47,000 ohm, 10%, ½w.
C142	39001-87	Capacitor, .25 mfd., 600 v., paper	R137	39374-52	Resistor, 180,000 ohm, 10%, ½w.
C143	39477-41	Capacitor, .01 mfd., 600 v., molded paper	R138	39374-130	Resistor, 27,000 ohm, 10%, 1w.
C144	B-137498-17	Capacitor, 120 mmf., 10%, 500 v., mica	R139	39375-79	Resistor, 18,000 ohm, 5%, ½w.
C145	B-137498-28	Capacitor, 390 mmf., 5%, 500 v., mica	R140	39374-42	Resistor, 27,000 ohm, 10%, ½w.
C146	B-137498-24	Capacitor, 180 mmf., 10%, 500 v., mica	R141A	C148098	Control, Volume Two Section
C147	39001-74	Capacitor, .002 mfd., 600 v., paper	R141B		Control, Contrast
C148	39001-11	Capacitor, .005 mfd., 600 v., paper	R142	39374-85	Resistor, 10 megohm, 10%, ½w.
C149	39001-11	Capacitor, .005 mfd., 600 v., paper	R143	39374-49	Resistor, 100,000 ohm, 10%, ½w.
C150	39478-39	Capacitor, .0047 mfd., 10%, 600 v.,	R144	39375-97	Resistor, 100,000 ohm, 5%, ½w.
		molded paper	R145	39375-129	Resistor, 2.2 megohm, 5%, ½w.
C151A	B-148556	Capacitor, 10 mfd., 475 v. Three Section	R146	39374-196	Resistor, 390 ohm, 10%, 2w.
C151B		Capacitor, 10 mfd., 475 v. Electrolytic	R147	39374-61	Resistor, 1 megohm, 10%, ½w.
C151C		Capacitor, 4 mfd., 350 v.	R148	39374-40	Resistor, 18,000 ohm, 10%, ½w.
C152	C-146434-6	Capacitor, .05 mfd., 10%, 400 v., paper	R149	39374-73	Resistor, 3.3 megohm, 10%, ½w.
C153	39001-19	Capacitor, .1 mfd., 600 v., paper	R150	39374-35	Resistor, 6800 ohm, 10%, ½w.
C154A	B-132386-17	Capacitor, Trimmer Two Section	R151	39374-57	Resistor, 470,000 ohm, 10%, ½w.
C154B		Capacitor, Trimmer	R152	39375-115	Resistor, 560,000 ohm, 5%, ½w.
C155	39477-37	Capacitor, .0022mfd., 600v., molded paper	R153	39374-35	Resistor, 6800 ohm, 10%, ½w.
C156	39001-87	Capacitor, .25 mfd., 600 v., paper	R154	B-148038	Control, A.G.C.
C157	39001-80	Capacitor, .02 mfd., 600 v., paper	R155	39375-109	Resistor, 330,000 ohm, 5%, ½w.
C158	39001-17	Capacitor, .05 mfd., 600 v., paper	R156	39375-95	Resistor, 82,000 ohm, 5%, ½w.
C159	B-137498-47	Capacitor, 200 mmf., 5%, 1000 v., mica	R157	39375-71	Resistor, 82,000 ohm, 5%, ½w.
C160	C-148813-1	Capacitor, .01 mfd., 400 v., paper	R158	39374-41	Resistor, 22,000 ohm, 10%, ½w.
C161	B-137498-53	Capacitor, 1300 mmf., 5%, 500 v., mica	R159	39374-36	Resistor, 8200 ohm, 10%, ½w.
C162	B-137498-28	Capacitor, 390 mmf., 5%, 500 v., mica	R160	39374-36	Resistor, 8200 ohm, 10%, ½w.
C163	B-146944	Capacitor, 5 mfd., 25 v., Electrolytic	R161	39374-63	Resistor, 1.2 megohm, 10%, ½w.
C164	39001-17	Capacitor, .05 mfd., 600 v., paper	R162	B-148228	Control, Vertical Hold
C165	B-148317-3	Capacitor, .1 mfd., 600 v., paper	R163	39374-37	Resistor, 10,000 ohm, 10%, ½w.
C166	C-146434-3	Capacitor, .1 mfd., 400 v., paper	R164	39374-53	Resistor, 220,000 ohm, 10%, ½w.
C167	C-146434-10	Capacitor, .15 mfd., 400 v., paper	R165	B-148227	Control, Height
C168	W-147375	Capacitor, 500 mmf., 20 k.v., ceramic	R166	39374-36	Resistor, 8200 ohm, 10%, ½w.
C170	B-148317-1	Capacitor, .5 mfd., 200 v., paper	R167	39374-25	Resistor, 1000 ohm, 10%, ½w.
C171	B-148317-2	Capacitor, .5 mfd., 600 v., paper	R168	39374-69	Resistor, 2.2 megohm, 10%, ½w.
C172	B-137498-54	Capacitor, 90 mmf., 500 v., mica	R169	39374-22	Resistor, 560 ohm, 10%, ½w.

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REPLACEMENT PARTS LIST-
Main Chassis

Symbol No.	Part No.	Description
R170	B-144260	Control, Vertical Linearity
R171	39374-117	Resistor, 2200 ohm, 10%, 1w.
R172	Part of L117A	Resistor, 1000 ohm, 10%, ½w.
R173	Part of L117A	Resistor, 1000 ohm, 10%, ½w.
R174	W-148554	Resistor, 400 ohm.
R175	39374-209	Resistor, 4700 ohm, 10%, 2w.
R176	B-147079	Control, Focus
R177	39374-47	Resistor, 68,000 ohm, 10%, ½w.
R178	B-146797	Control, Horizontal Hold
R179	39374-139	Resistor, 150,000 ohm, 10%, 1w.
R180	39374-71	Resistor, 2.7 megohm, 10%, ½w.
R181	39374-60	Resistor, 820,000 ohm, 10%, ½w.
R182	39374-36	Resistor, 8200 ohm, 10%, ½w.
R183	39374-51	Resistor, 150,000 ohm, 10%, ½w.
R184	39374-51	Resistor, 150,000 ohm, 10%, ½w.
R185	39375-97	Resistor, 100,000 ohm, 5%, ½w.
R186	39374-37	Resistor, 10,000 ohm, 10%, ½w.
R187	39374-41	Resistor, 22,000 ohm, 10%, ½w.
R188	39374-137	Resistor, 100,000 ohm, 10%, 1w.
R189	39374-13	Resistor, 100 ohm, 10%, ½w.
R190	39374-57	Resistor, 470,000 ohm, 10%, ½w.
R191	39374-97	Resistor, 47 ohm, 10%, 1w.
R192	39374-223	Resistor, 68,000 ohm, 10%, 2w.
R193	39374-13	Resistor, 100 ohm, 10%, ½w.
R194	39374-13	Resistor, 100 ohm, 10%, ½w.
R195	39374-13	Resistor, 100 ohm, 10%, ½w.
R196	39374-25	Resistor, 1000 ohm, 10%, ½w.
R197	39374-40	Resistor, 18,000 ohm, 10%, ½w.
R198	39374-48	Resistor, 82,000 ohm, 10%, ½w.
R199	39303-19	Resistor, 8.2 ohm, 10%, ½w.
R200	39374-149	Resistor, 1 megohm, 10%, 1w.
R201	39374-93	Resistor, 22 ohm, 10%, 1w.
R202	39374-60	Resistor, 820,000 ohm, 10%, ½w.
R203	39374-44	Resistor, 39,000 ohm, 10%, ½w.
R204	39374-223	Resistor, 68,000 ohm, 10%, 2w.
R205	39374-215	Resistor, 15,000 ohm, 10%, 2w.
R206	39374-209	Resistor, 4700 ohm, 10%, 2w.
R207	39374-142	Resistor, 270,000 ohm, 10%, 1w.
R208	39374-25	Resistor, 1000 ohm, 10%, ½w.
R209	39375-369	Resistor, 10,000 ohm, 5%, 2w.
L101	AW-146763	Coil, I.F.
L102	AW-146582	Coil, I.F.
L103	AW-146583	Coil, I.F.
L104	AW-146570	Coil, R.F. Choke
L105	AW-146582	Coil, I.F.
L106	AW-146570	Coil, R.F. Choke
L107	AW-147022	Coil, I.F.
L108	AW-146889	Coil, Video Peaking
L109	AW-147993	Coil, Video Peaking
L110	AW-146889	Coil, Video Peaking
L111	AW-147043	Coil, Video Peaking
L112	AW-148381	Coil, Width & A.G.C.
L113	AW-148452	Inductor, Horizontal Linearity
L114	AB-147430	Coil, Focus
L116	AW-146855	Coil, R.F. Heater Choke
L117A	AC-148887-3	Yoke, Deflection } Assembly
L117B		Yoke, Deflection } Assembly
L118	AW-146570	Coil, R.F. Choke
L119	AW-148440	Coil, Delay

Symbol No.	Part No.	Description
T101	AC-146782	Transformer, Sound Take Off
T102	C-146874	Transformer, Ratio Detector
T103	B-142890	Transformer, Audio Output
T104	B-146842-1	Transformer, Vertical Blocking Osc.
T105	B-148296	Transformer, Vertical Output
T106	AC-146698	Transformer, Horizontal Osc.
T107	AD-148258	Transformer, Horizontal Output
T108	C-148562	Transformer, Power
F101	W-145780	Fuse, 250 Ma.
P101	AW-147510	Connector (Female) & Bracket Assy., Interlock
P102	W-147415	Connector (7 Pin Male), Deflection-Focus Assy.
CO101	AB-148543	Connector (Female) & Cable, Speaker
CA101	C-132300-6	Cable & Plug Assy., Power
SP101	AD-148127	Speaker, 5¼" E.M., 51 ohm.
S101	W-147414	Connector (7 Pin Female), Deflection-Focus Assy.
SW101	Part of R141	Switch, Power
IC101	W-160426	Iron Core
IC102	W-160426	Iron Core
IC103	W-160426	Iron Core
IC104	W-160426	Iron Core
IC105	W-160426	Iron Core
IC106	39012-103	Iron Core
IC107	39012-102	Iron Core
IC108	39012-96	Iron Core
IC109	39012-96	Iron Core
IC110	39012-97	Iron Core
IC111	39012-97	Iron Core
	AW-146658	Bracket & Stud Assy., Gear
	AW-148428	Clip, Corona (V119 Tube)
	W-147542	Clip, Tube Shield Base (V110)
	W-147785	Clip, Tube Shield Base (V104, V105)
	W-146909-4	Connector, Picture Tube Anode
	AW-146701	Dial Sleeve & Gear
	AW-146651	Gear & Pinion
	W-45580	Grommet (Rubber), Sub-Chassis
	W-138090-4	Insulator, Standoff
	W-146634	Ring (Lock), Outer R.F. Tuner Shaft
	W-160243-2	Ring (Retainer), Gear Bracket
	AB-148154	Shield & Cover Assy., Tube (V116, V117)
	AB-148254	Shield, Corona (V119 Tube)
	W-142732	Shield, Tube (V104, V105)
	W-147784	Shield, Tube (V110)
	39388	Socket, Tube (V120)
	39437-1	Socket, Tube (V111, V112, V114, V115, V116, V117)
	W-144732	Socket, Tube (V107, V110)
	W-146439-2	Socket, Tube (V118)
	W-146966	Socket, Tube (V101, V102, V103, V104, V105, V106, V109, V113, V122)
	AW-147323	Socket & Plate Assy., Tube (V121)
	W-148425	Socket, Tube (V119)
	AB-148263	Socket & Board Assy. (V119)
	B-147505	Socket, Picture Tube
	AB-147703	Socket & Cable Assy., Picture Tube
	W-148355	Spring, Connector (C168 Capacitor)
	W-147474	Stud, Mounting (C168 Capacitor)

R. F. Tuner

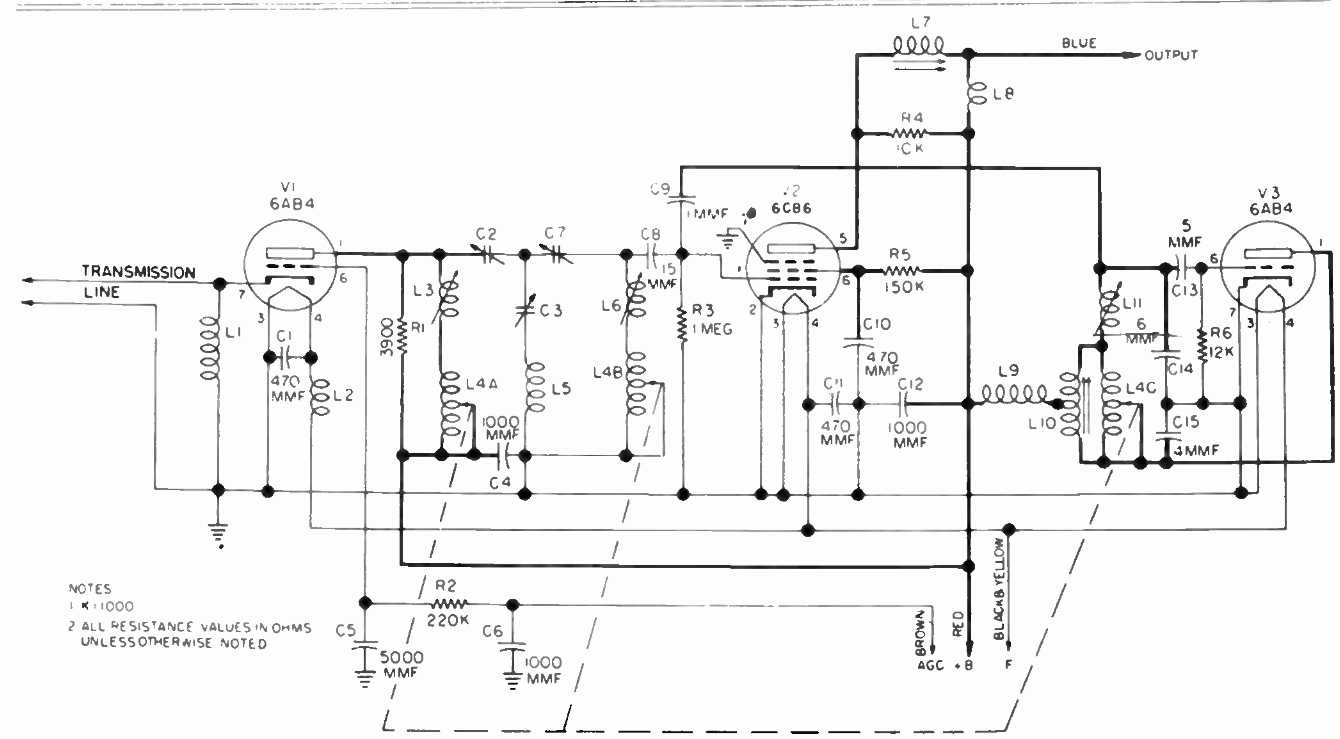
Symbol No.	Part No.	Description	Symbol No.	Part No.	Description
	AW-148164	R. F. Tuner Assembly (Complete)	C9	W-137398-2	Capacitor, 1 mmf., 500 v.
C1	C-137727-104	Capacitor, 470 mmf., 10%, 500 v., ceramic	C10	C-137727-104	Capacitor, 470 mmf., 10%, 500 v., ceramic
C2	B-146714-4	Capacitor, Trimmer (Spade Adj. Screw)	C11	C-137727-104	Capacitor, 470 mmf., 10%, 500 v., ceramic
C2	B-147676-2	Capacitor, Trimmer (R. H. Adj. Screw)	C12	C-137727-8	Capacitor, 1000 mmf., 300 v., ceramic
C3	B-147676-1	Capacitor, Trimmer (R. H. Adj. Screw)	C13	C-137727-103	Capacitor, 5 mmf., 10%, 500 v., ceramic
C3	B-146714-2	Capacitor, Trimmer (Spade Adj. Screw)	C14	C-137727-106	Capacitor, 6 mmf., ±.5 mmf., 500 v., ceramic
C4	C-137727-8	Capacitor, 1000 mmf., 300 v., ceramic	C15	C-137727-105	Capacitor, 4 mmf., ±.5 mmf., 500 v., ceramic
C5	C-137727-48	Capacitor, 5000 mmf., 500 v., ceramic	R1	39374-32	Resistor, 3900 ohm, 10%, ½ w.
C6	C-137727-8	Capacitor, 1000 mmf., 300 v., ceramic	R2	39374-53	Resistor, 220,000 ohm, 10%, ½ w.
C7	B-146714-4	Capacitor, Trimmer (Spade Adj. Screw)	R3	39374-61	Resistor, 1 megohm, 10%, ½ w.
C7	B-147676-2	Capacitor, Trimmer (R. H. Adj. Screw)	R4	39374-37	Resistor, 10,000 ohm, 10%, ½ w.
C8	C-137727-107	Capacitor, 15 mmf., 10%, 500 v., ceramic	R5	39374-51	Resistor, 150,000 ohm, 10%, ½ w.

R. F. Tuner (Continued)

Symbol No.	Part No.	Description	Symbol No.	Part No.	Description
R6	39374-38	Resistor, 12,000 ohm, 10%, ½ w.	L9	AW-147015	Coil, Choke
L1	AW-146735	Coil, Antenna Shunt Inductor	L10	AW-146753	Inductor, Oscillator Shunt
L2	AW-146858	Coil, Heater Choke	L11	AW-146986	Inductor, End (Oscillator)
L3	AW-146985	Inductor, End (R.F.)		C-138648-4	Clip, Coil (L10, L7)
L4A	D-146656	Inductor, Variable } Three Section Inductuner		39012-99	Iron Core (L10)
L4B		Inductor, Variable } Three Section Inductuner		39012-98	Iron Core (L7)
L4C		Inductor, Variable } Three Section Inductuner		W-160204	Shield, Tube (Long)
L5	AW-146988	Coil, R.F. Coupling		W-160205	Shield, Tube (Short)
L6	AW-146987	Inductor, End (Converter)		W-160065-2	Socket, Tube (V1, V2, V3)
L7	AW-146755	Inductor, 1st I.F. Primary		C-135038-4	Terminal Board
L8	AW-146735	Inductor, 1st I.F. Coupling			

Miscellaneous

Symbol No.	Part No.	Description	Symbol No.	Part No.	Description
	AC-148531	Antenna Assembly		C-148481	Dial, Volume-Contrast
	AD-148236	Back & Power Cable Assy.		B-142922	Emblem
	AB-148288	Bracket Assy., Deflection Yoke		146422	Foot (Metal Cup & Felt), Cabinet
	B-148598	Bracket, Chassis Mtg. (On Cabinet-Upper Rear)		144600	Grille Cloth
	W-147646	Bracket, Chassis Mtg. (On Chassis-Upper Rear)		W-160112-2	Grommet (Rubber), Focus Coil
	W-148130	Bracket, Chassis Mtg. (Lower Front & Rear)		W-147637	Gusset, Cabinet Corner
	W-148014	Bracket, Chassis Mtg. (On Chassis-Front)		B-148484	Ion Trap
	W-148015	Bracket, Chassis Mtg. (On Cabinet-Front)		AW-147887	Knob, Off-On-Contrast
	W-148291	Bracket, Tube Stop		AW-147888	Knob, Volume
	R-148200	Cabinet		AW-147889	Knob, Tuning
	W-146335	Clamp, Cabinet Back		39033-18CL	Nut (¼-20), Deflection-Focus
	B-160128-15	Cushion (Rubber, 9" x 1" x 3/16"), Tube Rest		W-148026	Retainer, Dial
	B-160128-16	Cushion (Rubber, 18" x 1" x 3/16"), Tube Strap		W-145391	Ring (Compression), Tuning Dial
	W-160362-1	Cushion (Rubber, 29/16"), Deflection Yoke		39176-77XDY	Screw, Window
	C-148482	Dial, Tuning		W-147921-1	Screw (¼-20 x 7/8 Special), Chassis to Cabinet
				W-147306	Screw (¼-20 Special), Deflection-Focus
				W-144957	Screw, Thumb
				148979	Spacer (Wood), Cabinet Foot
				W-144668	Spring (Compression), Focus Coil
				AW-148124	Terminal Board Assy., Antenna
				R-148155	Window



R. F. TUNER SCHEMATIC DIAGRAM

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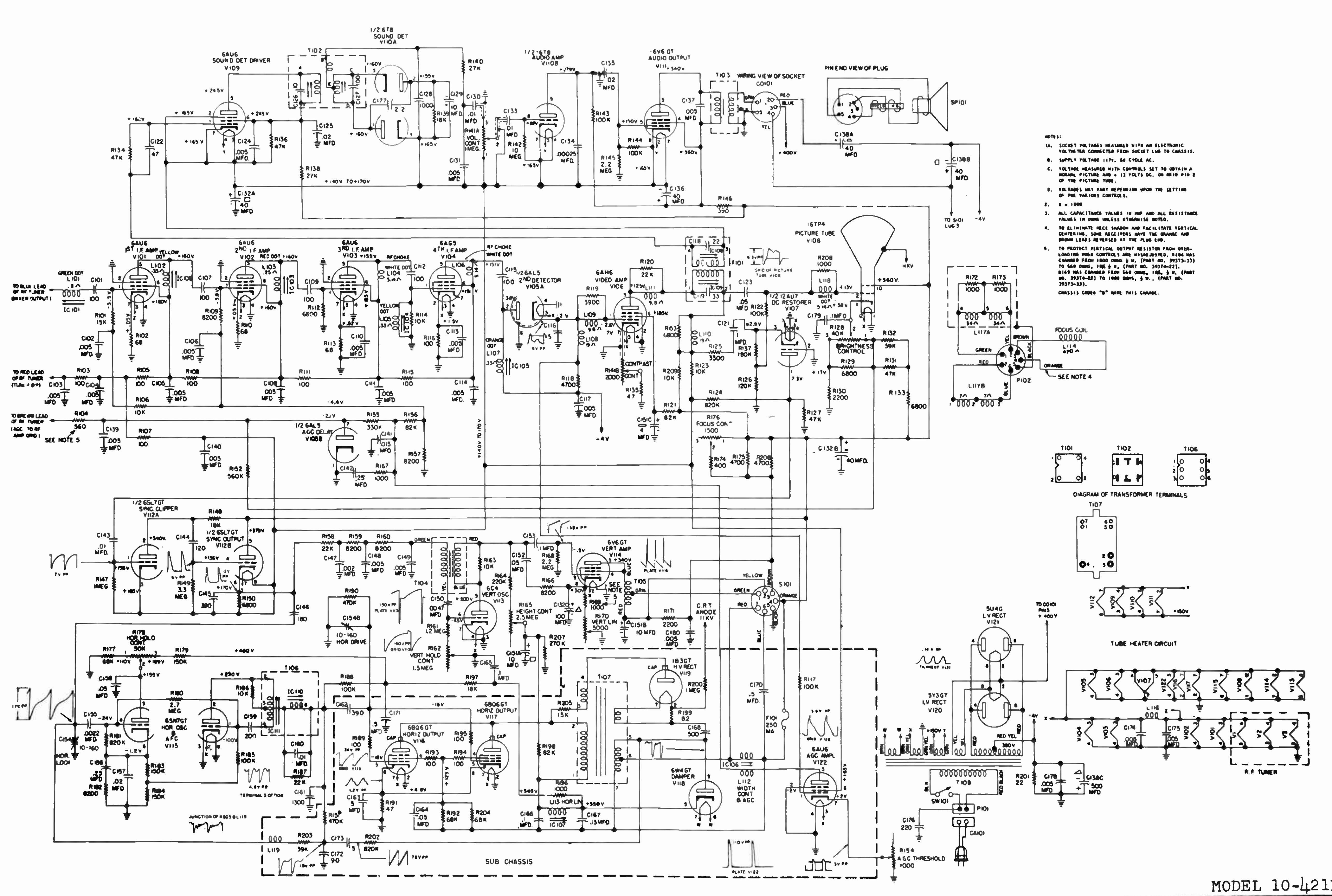
SCHEMATIC WIRING DIAGRAM



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MODEL 10-421MU

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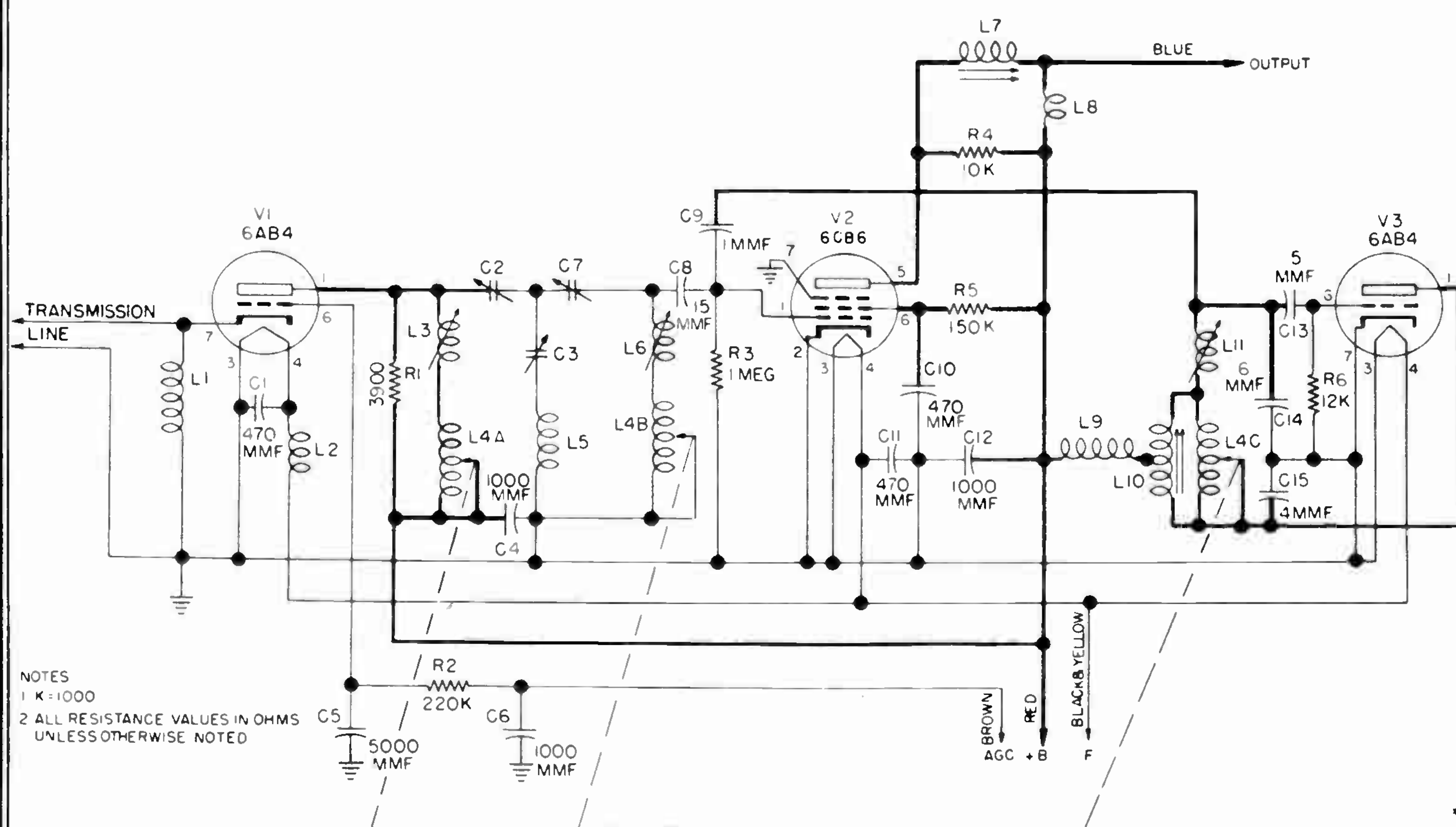
This television receiver is designed to operate from a power source of 117 volts, 60 cycle, a.c. The average power consumption is 195 watts. The audio output system is capable of delivering 1.5 watts maximum. The tube complement is as follows:

SYMBOL	TUBE TYPE	FUNCTION
V1	6AB4	R.F. Amplifier
V2	6CB6	Mixer
V3	6AB4	V.H.F. Oscillator
V101	6AU6	1st I.F. Amplifier
V102	6AU6	2nd I.F. Amplifier
V103	6AU6	3rd I.F. Amplifier
V104	6AG5	4th I.F. Amplifier
V105	6AL5	2nd Detector & AGC Delay
V106	6AU6	Video Amplifier
V107	12AU7	DC Restorer & Sync Separator
V108	14CP4	Picture Tube
V109	6AU6	Sound Det. Driver
V110	6T8	Sound Det. & 1st Audio Ampl.
V111	6V6GT	Audio Output
V112	6SL7GT	Sync Clipper & Sync Output
V113	6C4	Vertical Oscillator
V114	6SN7GT	AFC & Horizontal Oscillator
V115	6BG6GT	Horizontal Output
V116	6W4GT	Horizontal Damper
V117	1X2	H.V. Rectifier
V118	5U4G	L.V. Rectifier
V119	5U4G	L.V. Rectifier
V120	6V6GT	Vertical Amplifier
V121	6AU6	AGC Amplifier



NOTES
1 K=1000
2 ALL RESISTANCE VALUES IN OHMS UNLESS OTHERWISE NOTED

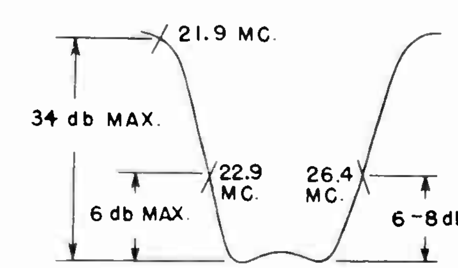
R. F. TUNER SCHEMATIC DIAGRAM

ADJUSTMENTS

1. The DEFLECTION YOKE is positioned as far forward as possible on the neck of the cathode ray tube and rotated so as to make the top of the raster parallel with the top of the CRT.
2. The FOCUS COIL should be adjusted to be approximately perpendicular to the cathode ray tube axis with the front surface of the focus coil housing approximately 15/32" from the rear surface of the deflection and focus mounting bracket.
3. Adjust size of picture to 11 19/32" x 8 23/32" by the HEIGHT CONTROL, HORIZONTAL DRIVE, VERTICAL LINEARITY and WIDTH CONTROL. The HORIZONTAL DRIVE trimmer should be adjusted to a point where the vertical white bar across the center of the raster disappears.
4. Center the picture by adjusting the three focus coil mounting nuts.
5. The ION TRAP is positioned for maximum brightness, with low setting of the Brightness Control, and for no cutoff of the picture (neck shadows) at high setting of the Brightness Control.
6. I-F Alignment (see I-F Alignment).
7. HORIZONTAL HOLD ADJUSTMENT (See Horiz. Blocking Osc. Alignment).
8. HORIZONTAL HOLD CONTROL is adjusted with a weak picture to center of pull in range.
9. VERTICAL HOLD CONTROL is adjusted with a weak picture to center of pull in range.
10. Vertical linearity is adjusted by the VERTICAL LINEARITY CONTROL and the HEIGHT CONTROL. Horizontal size is adjusted by the HORIZONTAL LINEARITY and WIDTH adjustments. Picture size as noted in 3 must be maintained.
11. The FOCUS CONTROL is adjusted for best focus of the vertical and horizontal wedges at center of test pattern. If there is any astigmatism, the focus should be set to favor the vertical wedge. If corner focus poor, check position of the DEFLECTION YOKE and ION TRAP.

I-F ALIGNMENT

1. Connect a short clip lead from B- (-4 volts) to AGC terminal (white-black lead near V102) of the I-F stages
2. Connect an electronic voltmeter across R118.
3. Connect "hot" lead of signal generator to grid (pin 1) of V101.
4. Set signal generator to 25.65 MC and adjust L107 and L103 for maximum meter deflection.
5. Reset signal generator to 23.7 MC and adjust L105 and L102 for maximum meter deflection.
6. Disconnect the electronic voltmeter and signal generator from grid of V101. Connect a video sweep signal to the adjusting screw (top of chassis on tuner) of C3. Ground lead of sweep signal should be connected to main chassis as closely as possible to the hot lead. Remove the oscillator tube V3. Tuner should be approximately 1 1/2 turns counterclockwise from the high end (channel No. 13). Contrast control should be set as low as possible and still obtain reasonable deflection on the scope.



7. Adjust L101 for 26.4 MC to fall 6 db down from the peak with as flat a curve as possible across the bottom.
8. Disconnect sweep signal and clip lead from B- to AGC terminal.

* Note: In steps 4 and 5 limit DC meter deflection to 3.5 volts maximum by adjusting attenuator of signal input.

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SOUND ALIGNMENT

1. Connect "hot" lead of signal generator to grid (pin 1) of V106. Set signal generator to 4.5 MC. with 400 c.p.s. amplitude modulated 30% or greater.
2. Connect scope to CRT grid through a detector probe.
3. Connect two 100 K ohm resistors (matched within 1%) in series across R139 (pins 2 and 7 of V110A). Connect common lead of electronic voltmeter to junction of the matched 100K ohm resistors and the DC lead to +150 volt point at junction of C128 (pin 4 of V110).
4. Using a high level signal input and with the contrast control set at maximum, tune the sound takeoff transformer (T101) primary adjustment (bottom of chassis) for minimum deflection on the scope.
5. Reduce signal input to below limiting in V107 and adjust sound take-off transformer (T101) secondary (top of chassis), and ratio detector transformer (T102) primary (top of chassis) for peak meter reading.
6. Repeat steps 4 and 5.
7. Transfer DC lead only of electronic voltmeter to junction of resistor R140 and capacitor C131.
8. Return to high level signal input for limiting in V107 and adjust ratio detector transformer (T102) secondary (bottom of chassis) for minimum buzz corresponding with undistorted output.
9. Remove the two 100 K ohm resistors, and all test equipment from the receiver.

AGC ADJUSTMENT

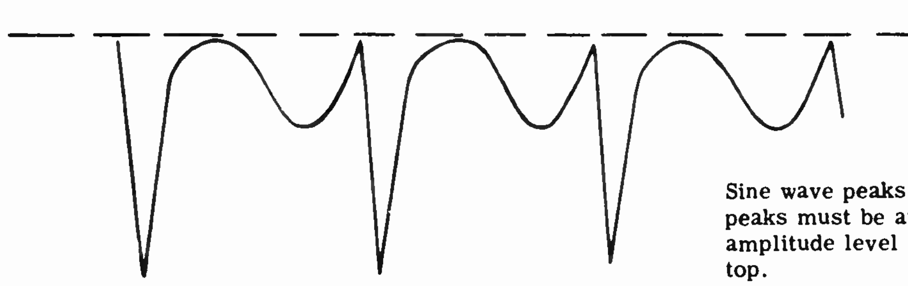
Connect scope (direct) to detector load resistor R118. Tune in a station with a strong signal and adjust the Automatic Gain Control on the rear apron of the chassis for 5 volts ± 1/2 volt peak to peak (white to sync tip) detector output.

HORIZONTAL DRIVE ADJUSTMENT

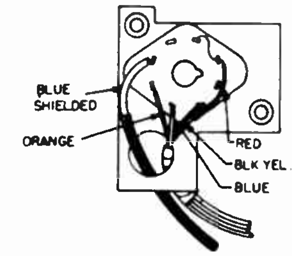
Before alignment of the horizontal blocking oscillator and AFC. circuit. Tune in a station with a strong signal and adjust the HORIZONTAL DRIVE trimmer just below the point where a white line and crowding appears in the center of the picture. Vary CONTRAST CONTROL during this alignment from minimum to maximum.

HORIZONTAL BLOCKING OSCILLATOR ALIGNMENT

1. Tune the receiver to a television signal and adjust the CONTRAST CONTROL below limiting in the video amplifier (V106).
2. Connect scope through a 10 mmf. capacitor to terminal 5 of the Horizontal Blocking Oscillator Transformer (T106) and adjust the horizontal BTO Trap (bottom of T106) for the wave form shown at bottom of page. The raster must be kept in sync by means of the HORIZONTAL HOLD CONTROL, HORIZ. FREQUENCY CONTROL and/or HORIZONTAL LOCK.
3. Remove scope from the receiver and adjust HORIZONTAL LOCK trimmer for minimum capacity.
4. Set the HORIZONTAL HOLD CONTROL fully clockwise and turn the HORIZONTAL FREQUENCY adjustment (top of T106) out until the picture falls out of sync. (This is indicated by a wide black vertical or diagonal bar sloping to the right from top to bottom). Then turn the HORIZONTAL FREQUENCY adjustment slowly in until picture just falls into sync.
5. The final setting of the HORIZONTAL HOLD CONTROL should be made with the CONTRAST CONTROL turned so as to obtain a very weak picture. Rotate the dial on and off the station, and set the HORIZONTAL HOLD CONTROL so that the picture returns completely in sync.

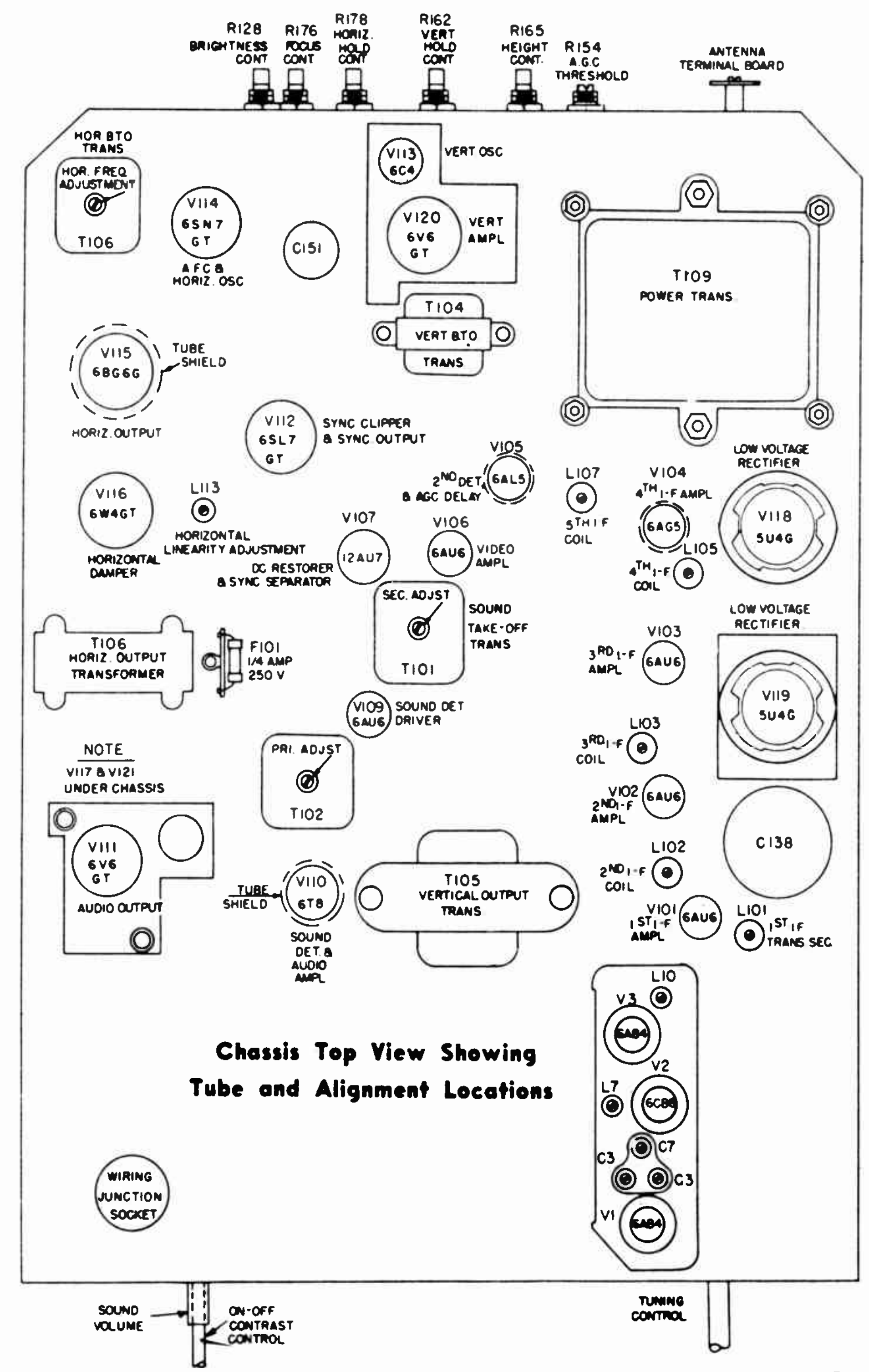


Sine wave peaks and pulse peaks must be at the same amplitude level across the top.



VIII SOCKET CONNECTIONS TO WIRING JUNCTION SOCKET

W.J. SOCKET LUG	WIRE COLOR	FROM PIN	TUBE ELEMENT
1	BLUE SHIELDED	5	GRID
2	RED	7 & 8	HEATER & CATHODE
3	—	—	—
4	—	—	—
5	BLK YEL	2	HEATER
6	BLUE	3	PLATE
7	ORANGE	4	SCREEN
8	—	—	—



Chassis Top View Showing Tube and Alignment Locations

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MODEL 10-428MU

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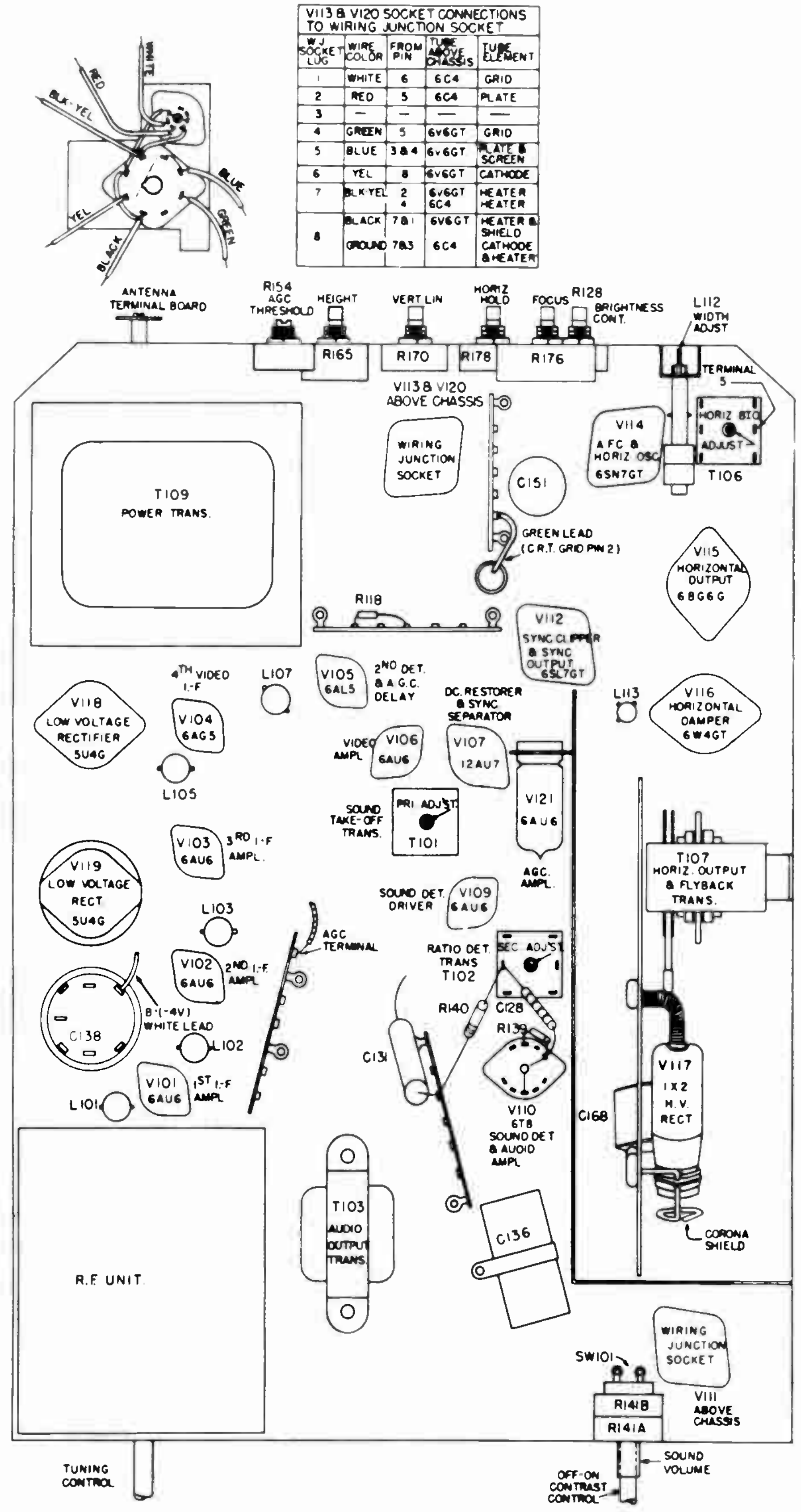

Chassis Bottom View Showing Tube Socket and Alignment Locations

REPLACEMENT PARTS LIST

Main Chassis

Symbol No.	Part No.	Description	Symbol No.	Part No.	Description
C101	C-137727-108	Capacitor, 100 mmf., 500 v., ceramic	C172	B-137498-54	Capacitor, 90 mmf., 500 v., mica
C102	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic	C173	C-137727-103	Capacitor, 5 mmf., 10%, 500 v., ceramic
C103	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic	C174	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C104	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic	C175	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C105	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic	C176	W-160111	Capacitor, 220 mmf., 1500 v., mica
C106	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic	C177	B-137398-4	Capacitor, 2.2 mmf., 500 v.
C107	C-137727-108	Capacitor, 100 mmf., 500 v., ceramic	C178	39001-11	Capacitor, .005 mfd , 600 v., paper
C108	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic	C179	39001-11	Capacitor,.005 mfd., 600 v., paper
C109	C-137727-108	Capacitor, 100 mmf., 500 v., ceramic	C180	B-137498-55	Capacitor, 390 mmf., 1500 v., mica
C110	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic	C181	W-160111	Capacitor, 220 mmf., 1500 v., mica
C111	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic	R101	39375-77	Resistor, 15.000 ohm, 5%, ½ w.
C112	C-137727-108	Capacitor, 100 mmf., 500 v., ceramic	R102	39374-11	Resistor, 68 ohm, 10%, ½ w.
C113	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic	R103	39373-14	Resistor, 100 ohm, ½ w.
C114	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic	R104	39374-22	Resistor, 560 ohm, 10%, ½ w.
C115	C-137727-108	Capacitor, 100 mmf., 500 v., ceramic	R105	39373-14	Resistor, 100 ohm, ½ w.
C116	C-137727-103	Capacitor, 5 mmf., 10%, 500 v., ceramic	R106	39374-54	Resistor, 10,000 ohm, ½ w.
C117	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic	R107	39373-14	Resistor, 100 ohm, ½ w.
C118	Part of T101	Capacitor, 22 mmf., 10%, 500 v., ceramic	R108	39373-14	Resistor, 100 ohm, ½ w.
C119	Part of T101	Capacitor, 33 mmf., 5%, 500 v., ceramic	R109	39375-71	Resistor, 8200 ohm, 5%, ½ w.
C120	39001-19	Capacitor, .1 mfd., 600 v., paper	R110	39374-11	Resistor, 68 ohm, 10%, ½ w.
C121	39001-19	Capacitor, .1 mfd., 600 v., paper	R111	39373-14	Resistor, 100 ohm, ½ w.
C122	C-137727-112	Capacitor, 47 mmf., 500 v., ceramic	R112	39375-69	Resistor, 6800 ohm, 5%, ½ w.
C123	39001-17	Capacitor, .05 mfd., 600 v., paper	R113	39374-11	Resistor, 68 ohm, 10%, ½ w.
C124	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic	R114	39375-73	Resistor, 10,000 ohm, 5%, ½ w.
C125	39001-80	Capacitor, .02 mfd., 600 v., paper	R115	39373-14	Resistor, 100 ohm, ½ w.
C126	Part of T102	Capacitor, 10 mmf.	R116	39374-13	Resistor, 100 ohm, 10%, ½ w.
C127	Part of T102	Capacitor, 100 mmf	R117	39374-49	Resistor, 100,000 ohm, 10%, ½ w.
C128	C-137727-110	Capacitor, 1000 mmf., 10%, 500 v., ceramic	R118	39375-65	Resistor, 4700 ohm, 5%, ½ w.
C129	B-147758	Capacitor, 10 mfd., 25 v., Electrolytic	R119	Part of L109	Resistor, 3900 ohm, 10%, ½ w.
C130	39001-13	Capacitor, .01 mfd., 600 v., paper	R120	Part of L111	Resistor, 22,000 ohm, 10%, ½ w.
C131	39001-11	Capacitor, .005 mfd., 600 v., paper	R121	39374-224	Resistor, 82,000 ohm, 10%, 2 w.
C132A	B-148429	Capacitor, 40 mfd., 475 v. Three Section	R122	39374-49	Resistor, 100,000 ohm, 10%, ½ w.
C132B		Capacitor, 40 mfd., 250 v. Electrolytic	R123	39375-213	Resistor, 4700 ohm, 5%, 1 w.
C132C		Capacitor, 100 mfd., 50 v.	R124	39374-60	Resistor, 820,000 ohm, 10%, ½ w.
C133	39001-13	Capacitor, .01 mfd., 600 v., paper	R125	39374-31	Resistor, 3300 ohm, 10%, ½ w.
C134	39001-73	Capacitor, .00025 mfd., 600 v., paper	R126	39374-50	Resistor, 120,000 ohm, 10%, ½ w.
C135	39001-80	Capacitor, .02 mfd., 600 v., paper	R127	39374-45	Resistor, 47,000 ohm, 10%, ½ w.
C136	B-146725	Capacitor, 40 mfd., 300 v., Electrolytic	R128	B-146798	Control, Brightness (40,000 ohm)
C137	39001-11	Capacitor, .005 mfd., 600 v., paper	R129	39374-123	Resistor, 6800 ohm, 10%, 1 w.
C138A	B-147757	Capacitor, 40 mfd., 475 v. Three Section	R130	39374-28	Resistor, 1800 ohm, 10%, ½ w.
C138B		Capacitor, 40 mfd., 475 v. Electrolytic	R131	39374-221	Resistor, 47,000 ohm, 10%, 2 w.
C138C		Capacitor, 500 mfd., 10 v.	R132	39374-220	Resistor, 39,000 ohm, 10%, 2 w.
C139	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic	R133	39374-123	Resistor, 6800 ohm, 10%, 1 w.
C140	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic	R134	39374-45	Resistor, 47,000 ohm, 10%, ½ w.
C141	39001-14	Capacitor, .015 mfd., 600 v., paper	R135	39374-9	Resistor, 47 ohm, 10%, ½ w.
C142	39001-87	Capacitor, .25 mfd., 600 v., paper	R136	39374-45	Resistor, 47,000 ohm, 10%, ½ w.
C143	39477-41	Capacitor, .01 mfd., 600 v.. molded paper	R137	39374-35	Resistor, 6800 ohm, 10%, ½ w.
C144	B-137498-17	Capacitor, 120 mmf., 10%, 500 v., mica	R138	39374-130	Resistor, 27,000 ohm, 10%, 1 w.
C145	B-137498-28	Capacitor, 390 mmf., 5%, 500 v., mica	R139	39375-79	Resistor, 18,000 ohm, 5%, ½ w.
C146	B137498-24	Capacitor, 180 mmf., 10%, 500 v., mica	R140	39374-42	Resistor, 27,000 ohm, 10%, ½ w.
C147	39001-74	Capacitor, .002 mfd., 600 v., paper	R141A	C-148098	Control, Volume (1 megohm) Two
C148	39001-11	Capacitor, .005 mfd., 600 v., paper	R141B		Control, Contrast (2000 ohm) Section
C149	39001-11	Capacitor, .005 mfd., 600 v., paper	R142	39373-107	Resistor, 10 megohm, ½ w.
C150	39478-39	Capacitor, .0047 mfd., 10%, 600 v., paper	R143	39374-49	Resistor, 100,000 ohm, 10%, ½ w.
C151A	B-148556	Capacitor, 10 mfd., 475 v. Three Section	R144	39375-97	Resistor, 100,000 ohm, 5%, ½ w.
C151B		Capacitor, 10 mfd., 475 v. Electrolytic	R145	39375-129	Resistor, 2.2 megohm, 5%, ½ w.
C151C		Capacitor, 4 mfd., 350 v.	R146	39374-196	Resistor, 390 ohm, 10%, 2 w.
C152	C-146434-6	Capacitor, .05 mfd., 10%, 400 v., paper	R147	39374-61	Resistor, 1 megohm, 10%, ½ w.
C153	39001-19	Capacitor, .1 mfd., 600 v., paper	R148	39374-40	Resistor, 18,000 ohm, 10%, ½ w.
C154A	B-132386-18	Capacitor, Trimmer Two Section	R149	39373-100	Resistor, 3.3 megohm, ½ w.
C154B		Capacitor, Trimmer	R150	39374-35	Resistor, 6800 ohm, 10%, ½ w.
C155	39477-37	Capacitor, .0022 mfd., 600 v., paper	R151	39374-51	Resistor, 150,000 ohm, 10%, ½ w.
C156	39001-87	Capacitor, .25 mfd., 600 v., paper	R152	39374-58	Resistor, 560,000 ohm, 5%, ½ w.
C157	39001-80	Capacitor, .02 mfd., 600 v., paper	R153	39374-25	Resistor, 1000 ohm, 10%, ½ w.
C158	39001-17	Capacitor, .05 mfd., 600 v., paper	R154	B148038	Control, A. G. C. (1000 ohm)
C159	B-137498-47	Capacitor, 200 mmf., 5%, 1000 v., mica	R155	39375-109	Resistor, 330,000 ohm, 5% ½ w.
C160	C-148813-1	Capacitor, .01 mfd., 400 v., paper	R156	39375-95	Resistor, 82,000 ohm, 5%, ½ w.
C161	B-137498-53	Capacitor, 1300 mmf., 5%, 500 v., mica	R157	39375-71	Resistor, 8200 ohm, 5%, ½ w.
C162	B-137498-56	Capacitor, 820 mmf., 5%, 500 v., mica	R158	39374-41	Resistor, 22,000 ohm, 10%, ½ w.
C163	B-146944	Capacitor, 5 mfd., 25 v., Electrolytic	R159	39374-36	Resistor, 8200 ohm, 10%, ½ w.
C164	39001-17	Capacitor, .05 mfd., 600 v., paper	R160	39374-36	Resistor, 8200 ohm, 10%, ½ w.
C165	B-148317-2	Capacitor, .5 mfd., 600 v., paper	R161	39374-63	Resistor, 1.2 megohm, 10%, ½ w.
C166	C-146434-6	Capacitor, .05 mfd., 10%, 400 v., paper	R162	B-148228	Control, Vertical Hold (1.5 megohm)
C167	C-146434-3	Capacitor, .1 mfd., 10%, 400 v., paper	R163	39373-54	Resistor, 10,000 ohm, ½ w.
C168	W-147375	Capacitor, 500 mmf., 20 k v.	R164	39374-53	Resistor, 220,000 ohm, 10%, ½ w.
C169	B-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic	R165	B-148227	Control, Height (2.5 megohm)
C170	B-144899-2	Capacitor, .5 mfd., 200 v., paper	R166	39374-36	Resistor, 8200 ohm, 10%, ½ w.
C171	39001-19	Capacitor, .1 mfd., 600 v., paper	R167	39374-142	Resistor, 270,000 ohm, 10%, 1 w.

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REPLACEMENT PARTS LIST
Main Chassis

Symbol No.	Part No.	Description
R168	39374-69	Resistor, 2.2 megohm, 10%, ½ w.
R169	39373-33	Resistor, 1000 ohm, ½ w.
R170	B-144260	Control, Vertical Linearity (5000 ohm)
R171	39374-117	Resistor, 2200 ohm, 10%, 1 w.
R172	Part of L117A	Resistor, 1000 ohm, 10%, ½ w.
R173	Part of L117A	Resistor, 1000 ohm, 10%, ½ w.
R174	39374-197	Resistor, 470 ohm, 10%, 2 w.
R175	39374-197	Resistor, 470 ohm, 10%, 2 w.
R176	B-147079	Control, Focus (1500 ohm)
R177	39374-47	Resistor, 68,000 ohm, 10%, ½ w.
R178	B-146797	Control, Horizontal Hold (50,000 ohm)
R179	39374-139	Resistor, 150,000 ohm, 10%, 1 w.
R180	39374-71	Resistor, 2.7 megohm, 10%, ½ w.
R181	39374-60	Resistor, 820,000 ohm, 10%, ½ w.
R182	39374-36	Resistor, 8200 ohm, 10%, ½ w.
R183	39374-51	Resistor, 150,000 ohm, 10%, ½ w.
R184	39374-51	Resistor, 150,000 ohm, 10%, ½ w.
R185	39375-97	Resistor, 100,000 ohm, 5%, ½ w.
R186	39374-37	Resistor, 10,000 ohm, 10%, ½ w.
R187	39374-41	Resistor, 22,000 ohm, 10%, ½ w.
R188	39374-137	Resistor, 100,000 ohm, 10%, 1 w.
R189	39374-9	Resistor, 47 ohm, 10%, ½ w.
R190	39374-61	Resistor, 1 megohm, 10%, ½ w.
R191	39374-100	Resistor, 82 ohm, 10%, 1 w.
R192	39374-118	Resistor, 2700 ohm, 10%, 1 w.
R193	39374-40	Resistor, 18,000 ohm, 10%, ½ w.
R194	39374-48	Resistor, 82,000 ohm, 10%, ½ w.
R195	39303-17	Resistor, 5.6 ohm, 10%, ½ w.
R196	39374-149	Resistor, 1 megohm, 10%, 1 w.
R197	39374-60	Resistor, 820,000 ohm, 10%, ½ w.
R198	39374-44	Resistor, 39,000 ohm, 10%, ½ w.
R199	39374-213	Resistor, 10,000 ohm, 10%, 2 w.
R200	39374-25	Resistor, 1000 ohm, 10%, ½ w.
R201	39374-52	Resistor, 180,000 ohm, 10%, ½ w.
R202	39374-25	Resistor, 1000 ohm, ½ w.
R203	39374-93	Resistor, 22 ohm, 10%, 1 w.
L101	AW-146763	Coil, 1st I. F. Secondary
L102	AW-146582	Coil, 2nd I. F.
L103	AW-146583	Coil, 3rd I. F.
L104	AW-146570	Coil, R. F. Choke
L105	AW-146582	Coil, 4th I. F.
L106	AW-146570	Coil, R. F. Choke
L107	AW-147022	Coil, 5th I. F.
L108	AW-146889	Coil, Video Peaking
L109	AW-147993	Coil, Video Peaking
L110	AW-146889	Coil, Video Peaking
L111	AW-147043	Coil, Video Peaking
L112	AW-147611	Inductor, width
L113	AW-147482	Inductor, Horizontal Linearity
L114	AB-148781	Coil, Focus
L116	AW-146855	Choke, R. F. Heater
L117A	AC-148887-3	Yoke, Deflection } Assembly
L117B		Yoke, Deflection
L118	AW-146570	Coil, R. F. Choke
L119	AW-148440	Coil, Delay
IC101	W-160426	Iron Core
IC102	W-160426	Iron Core
IC103	W-160426	Iron Core
IC104	W-160426	Iron Core
IC105	W-160426	Iron Core
IC106	39012-100	Iron Core
IC107	39012-93	Iron Core
IC108	39012-96	Iron Core
IC109	39012-96	Iron Core
IC110	39012-97	Iron Core
IC111	39012-97	Iron Core

Symbol No.	Part No.	Description
T101	AC-146782	Transformer, Sound Takeoff
T102	C-146874	Transformer, Ratio Detector
T103	B-142890	Transformer, Audio Output
T104	B-146842-1	Transformer, Vertical Blocking Osc.
T105	B-148296	Transformer, Vertical Output
T106	AC-146698	Transformer, Horizontal Osc.
T107	AC-148761	Transformer Assy., Horizontal Output
T109	C-147504	Transformer, Power
SP101	AD-146528	Speaker, 4"x6" E.M.
SW101	Part of R141	Switch, Power
CA101	AB-146717	Cable & Plug Assy., Speaker
CA102	C-132300-6	Cable & Plug Assy., Power
P101	W-139900	Plug, Interlock
F101	W-145780	Fuse, 250 M. A.
	AB-146691	Bottom, Chassis
	B-146602	Brace, Deflection Yoke Bracket
	AW-147510	Bracket & Plug Assy., Interlock
	W-148306	Bracket, Window Support (Lower)
	C-147597	Bracket, Chassis Mtg.
	B-146538-1	Bracket (R. H.), Chassis Mtg.
	B-146538-2	Bracket (L. H.), Chassis Mtg.
	AB-148853	Bracket, Deflection Yoke
	AB-148673	Bracket Assy., Deflection Focus
	AW-146658	Bracket & Stud Assy., Gear
	W-147542	Clamp, Tube Shield (V115)
	W-147785	Clip, Tube Shield (V104, V105)
	W-147542	Clip, Tube Shield (V110)
	W-146627	Connector, Tube Cap (V115)
	W-160362-1	Cushion (Rubber) $2\frac{9}{16}$", Deflection Yoke
	B-160128-21	Cushion (Rubber $20 \times 1\frac{1}{2} \times \frac{3}{16}$), Tube Strap
	B-160128-20	Cushion (Rubber $5\frac{13}{16} \times 1\frac{5}{8} \times \frac{3}{16}$), Tube Rest
	AW-146701	Dial Sleeve & Gear Assy.
	AW-146651	Gear & Pinion
	W-45580	Grommet, Anode Connector
	W-160112-2	Grommet, Focus Coil
	B-94704-7	Nut (speed), H. V. Terminal Board Retainer
	39033-18CL	Nut, Focus Coil (6 used)
	AD-148784	Power Supply Assy., H. V.
	B-148242	Rest (Wood), Picture Tube
	W-147514	Retainer (Phenolic), H. V. Terminal Board
	W-146634	Ring, Lock (R. F. Tuner Shaft, Outer)
	W-160243-3	Ring, Retainer (Gear Bracket)
	W-144957	Screw, Thumb
	147306	Screw, Focus Coil (3 used)
	W-147784	Shield, Tube (V104, V105, V110)
	AB-146628	Shield & Stud Assy., Tube (V115)
	AB147358	Shield Assy., Corona
	AW-147323	Socket & Mtg. Plate Assy., Tube (V119)
	AB-148238	Socket & Mtg. Plate Assy., Tube (V111)
	W-146439-2	Socket, Tube (V116)
	W-144732	Socket, Tube (V107, V110)
	W-147446	Socket, Tube (V117)
	39437-1	Socket, Tube (V120, V114, V112, V111)
	W-146966	Socket, Tube (V101, V102, V103, V104, V105, V106, V109, V113, V121)
	39388	Socket, Tube (V115, V118, V119)
	B-147119-1	Socket & Cable Assy., Picture Tube
	W-148239	Spacer, Deflection—Focus Bracket
	W-147502	Spring (Used on C168)
	W-147422	Spring, Connector (H. V. Supply)
	W-144668	Spring, Compression (Focus Coil)
	AB-148221	Strap (R. H.), Picture Tube
	AB-148222	Strap (L. H.), Picture Tube
	W-147474	Stud Mtg. (Used on C168)
	B-148803	Support, Anode Cable
	B-148484	Trap, Ion
	W-147061	Washer, Spring

REPLACEMENT PARTS LIST
R. F. Tuner

Symbol No.	Part No.	Description	Symbol No.	Part No.	Description
	AW-148164	R. F. Tuner Assembly (Complete)	R6	39374-38	Resistor, 12,000 ohm, 10%, ½ w.
C1	C-137727-104	Capacitor, 470 mmf., 10%, 500 v., ceramic	L1	AW-146735	Coil, Antenna Shunt Inductor
C2	B-146714-4	Capacitor, Trimmer (Spade Adj. Screw)	L2	AW-146858	Coil, Heater Choke
C2	B-147676-2	Capacitor, Trimmer (R. H. Adj. Screw)	L3	AW-146985	Inductor, End (R.F.)
C3	B-147676-1	Capacitor, Trimmer (R. H. Adj. Screw)	L4A	D-146656	Inductor, Variable } Three Section Inductuner
C3	B-146714-2	Capacitor, Trimmer (Spade Adj. Screw)	L4B		Inductor, Variable
C4	C-137727-8	Capacitor, 1000 mmf., 300 v., ceramic	L4C		Inductor, Variable
C5	C-137727-48	Capacitor, 5000 mmf., 500 v., ceramic	L5	AW-146988	Coil, R.F. Coupling
C6	C-137727-8	Capacitor, 1000 mmf., 300 v., ceramic	L6	AW-146987	Inductor, End (Converter)
C7	B-146714-4	Capacitor, Trimmer (Spade Adj. Screw)	L7	AW-146755	Inductor, 1st I.F. Primary
C7	B-147676-2	Capacitor, Trimmer (R. H. Adj. Screw)	L8	AW-146735	Inductor, 1st I.F. Coupling
C8	C-137727-107	Capacitor, 15 mmf., 10%, 500 v., ceramic	L9	AW-147015	Coil, Choke
C9	W-137398-2	Capacitor, 1 mmf., 500 v.	L10	AW-146753	Inductor, Oscillator Shunt
C10	C-137727-104	Capacitor, 470 mmf., 10%, 500 v., ceramic	L11	AW-146986	Inductor, End (Oscillator)
C11	C-137727-104	Capacitor, 470 mmf., 10%, 500 v., ceramic		C-138648-4	Clip, Coil (L10, L7)
C12	C-137727-8	Capacitor, 1000 mmf., 300 v., ceramic		39012-99	Iron Core (L10)
C13	C-137727-103	Capacitor, 5 mmf., 10%, 500 v., ceramic		39012-98	Iron Core (L7)
C14	C-137727-106	Capacitor, 6 mmf., ±.5 mmf., 500 v., ceramic		W-160204	Shield, Tube (Long)
C15	C-137727-105	Capacitor, 4 mmf., ±.5 mmf., 500 v., ceramic		W-160205	Shield, Tube (Short)
R1	39374-32	Resistor, 3900 ohm, 10%, ½ w.		W-160065-2	Socket, Tube (V1, V2, V3)
R2	39374-53	Resistor, 220,000 ohm, 10%, ½ w.		C-135038-4	Terminal Board
R3	39374-61	Resistor, 1 megohm, 10%, ½ w.			
R4	39374-37	Resistor, 10,000 ohm, 10%, ½ w.			
R5	39374-51	Resistor, 150,000 ohm, 10%, ½ w.			

Cabinet

Symbol No.	Part No.	Description	Symbol No.	Part No.	Description
	AC-148905	Antenna Assembly		AW-147889	Knob, Tuning
	AC-148802	Back & Power Cable Assy.		AW-147888	Knob, Volume
	W-148244	Bracket (Upper Support), Window		AW-144887	Knob, Off-On-Contrast
	W-146577	Bracket, Cabinet Front Mtg.		W-145391	Ring, Compression (Tuning Dial)
	W-146808	Bushing, Cabinet Front		B-146693	Screen, Cabinet Top
	W-146813	Button (Plug), Cabinet Front		39220-26CL	Screw, Window
	R-148601	Cabinet, Complete		39178-67CL	Screw, Speaker Mtg.
	R-148184	Cabinet Front		39178-68CL	Screw, Hinge
	R-146416	Cabinet Shell		W-148782	Spacer, Antenna Term. Board
	C-148482-1	Dial, Tuning		W-146484	Spring, Dial Retaining
	C-148481-1	Dial, Volume		W-148848	Terminal Board, Antenna
	W-146482	Hinge, Cabinet Back		W-148249	Washer, Window
	W-147525	Indicator, Tuning		R-148900	Window, Picture Tube

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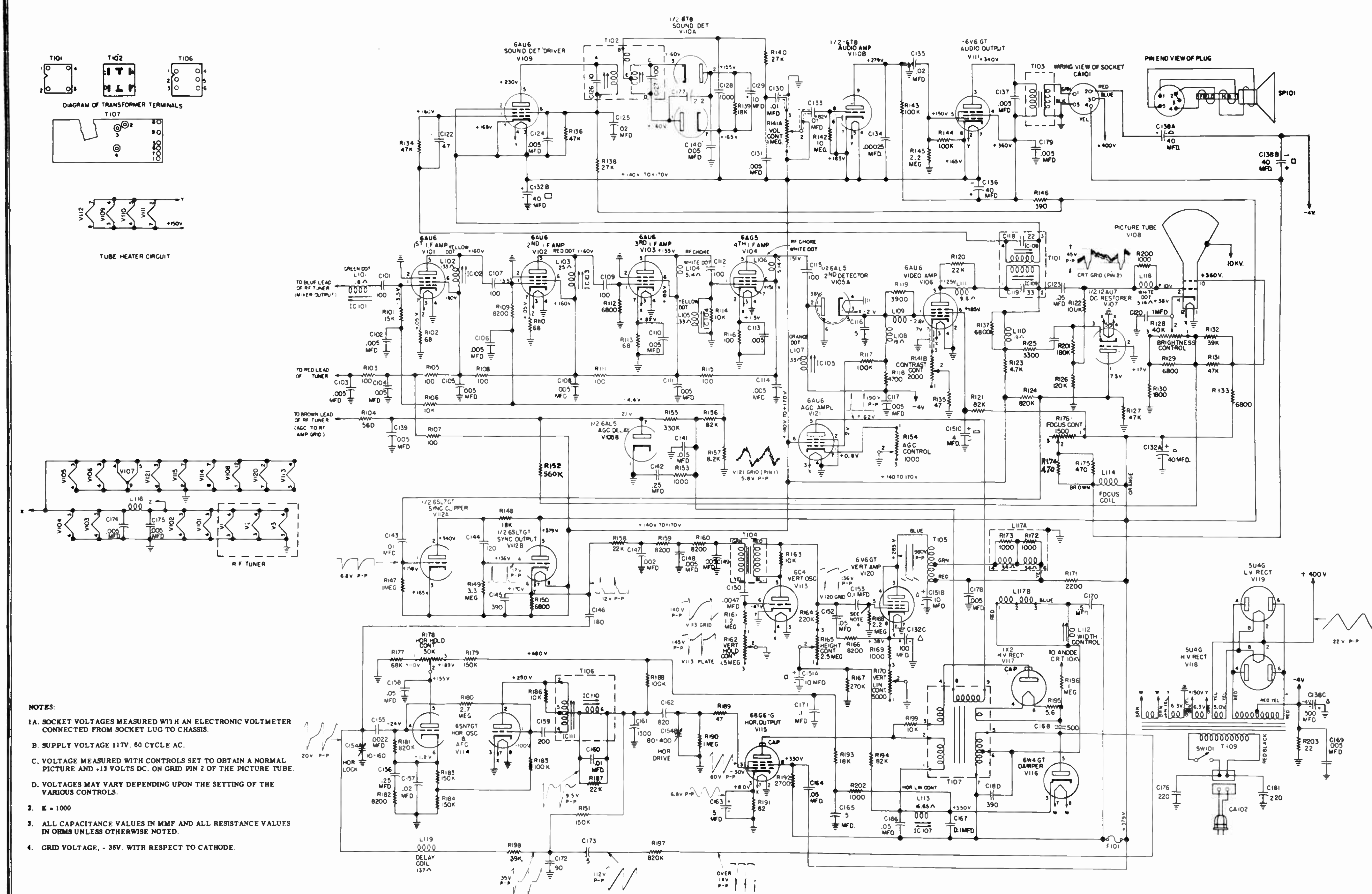
SCHEMATIC WIRING DIAGRAM



NOTES:

1A. SOCKET VOLTAGES MEASURED WITH AN ELECTRONIC VOLTMETER CONNECTED FROM SOCKET LUG TO CHASSIS.

B. SUPPLY VOLTAGE 117V. 60 CYCLE AC.

C. VOLTAGE MEASURED WITH CONTROLS SET TO OBTAIN A NORMAL PICTURE AND +13 VOLTS DC. ON GRID PIN 2 OF THE PICTURE TUBE.

D. VOLTAGES MAY VARY DEPENDING UPON THE SETTING OF THE VARIOUS CONTROLS.

2. K = 1000

3. ALL CAPACITANCE VALUES IN MMF AND ALL RESISTANCE VALUES IN OHMS UNLESS OTHERWISE NOTED.

4. GRID VOLTAGE, - 36V. WITH RESPECT TO CATHODE.

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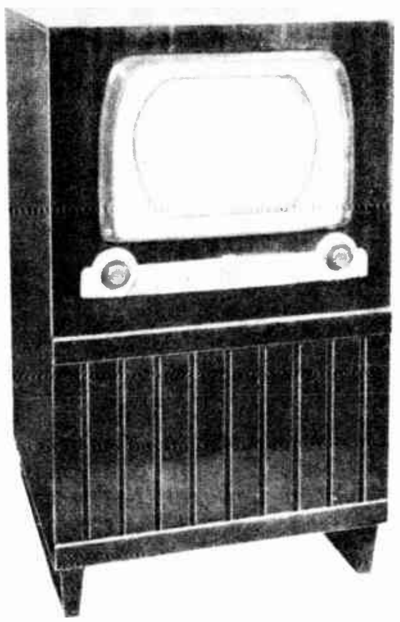

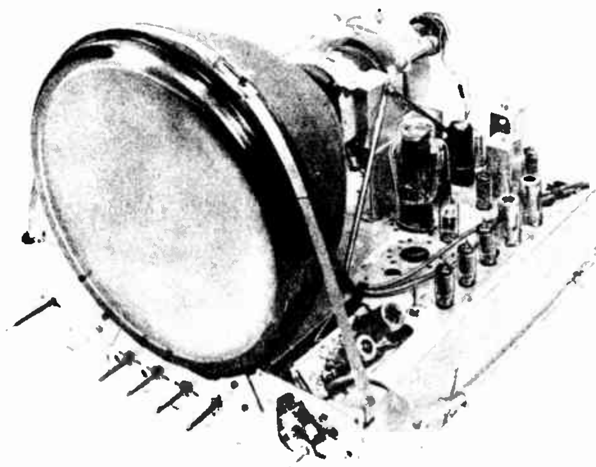

Figure 1. Chassis View

1. DESCRIPTION

Crosley Models 11-441MU, 11-461WU and 11-471BU are console model television receivers housed in attractive mahogany, walnut and limed oak cabinets. They are equipped with twelve and one-half inch picture tubes and are designed for operation on 117 volt, 60 cycle alternating current.

The chassis incorporates twenty tubes including the picture tube and two rectifiers.

These receivers will produce high definition pictures with fine detail and excellent brilliance and contrast on all twelve television channels. However, in no one area are there stations operating on all channels.

Features include:

1. Simplified tuning (tunes like a radio) with a continuous type tuner that permits precise tuning to the station's channel without the use of an extra vernier control that is necessary when a switch type or push-button tuner is used.

2. Intercarrier sound system in conjunction with the continuous tuner has the following advantages: (a) Permits tuning for best quality, high definition pictures. When the picture is clear the sound is also right. (b) In weak signal areas, permits tuning for maximum picture, thus assuring the best signal-to-noise ratio. (c) Eliminates re-tuning; once the station has been "tuned-in" properly, no re-adjustment of the tuning control is necessary. (d) Minimizes number of operating controls.

3. Auxilliary controls concealed behind a trap door on the front of the cabinet within easy reach.

4. Automatic Frequency control with "Stabilock" circuits holds pictures firm and steady even through electrical disturbances.

5. "Keyed" Automatic Gain Control Fade Eliminator removes interference from flying aircraft and other brightness fluctuations; it also eliminates re-adjustment of the brightness and contrast controls when tuning from one station to another and minimizes fading in areas of low signal strength.

6. Specially designed built-in antenna that needs no tuning.

7. Tilted picture tube window, prevents reflected light from interfering with the picture on the tube screen. The window is easily removed from the front of the cabinet so that picture tube screen may be cleaned.

8. Wide angle viewing and "Procenium Arch" styling of the picture tube window.

9. New "Black Face" picture tube provides better contrast and less glare.

10. FM sound system in conjunction with the audio amplifier and large permanent magnet speaker provides true, clear sound.

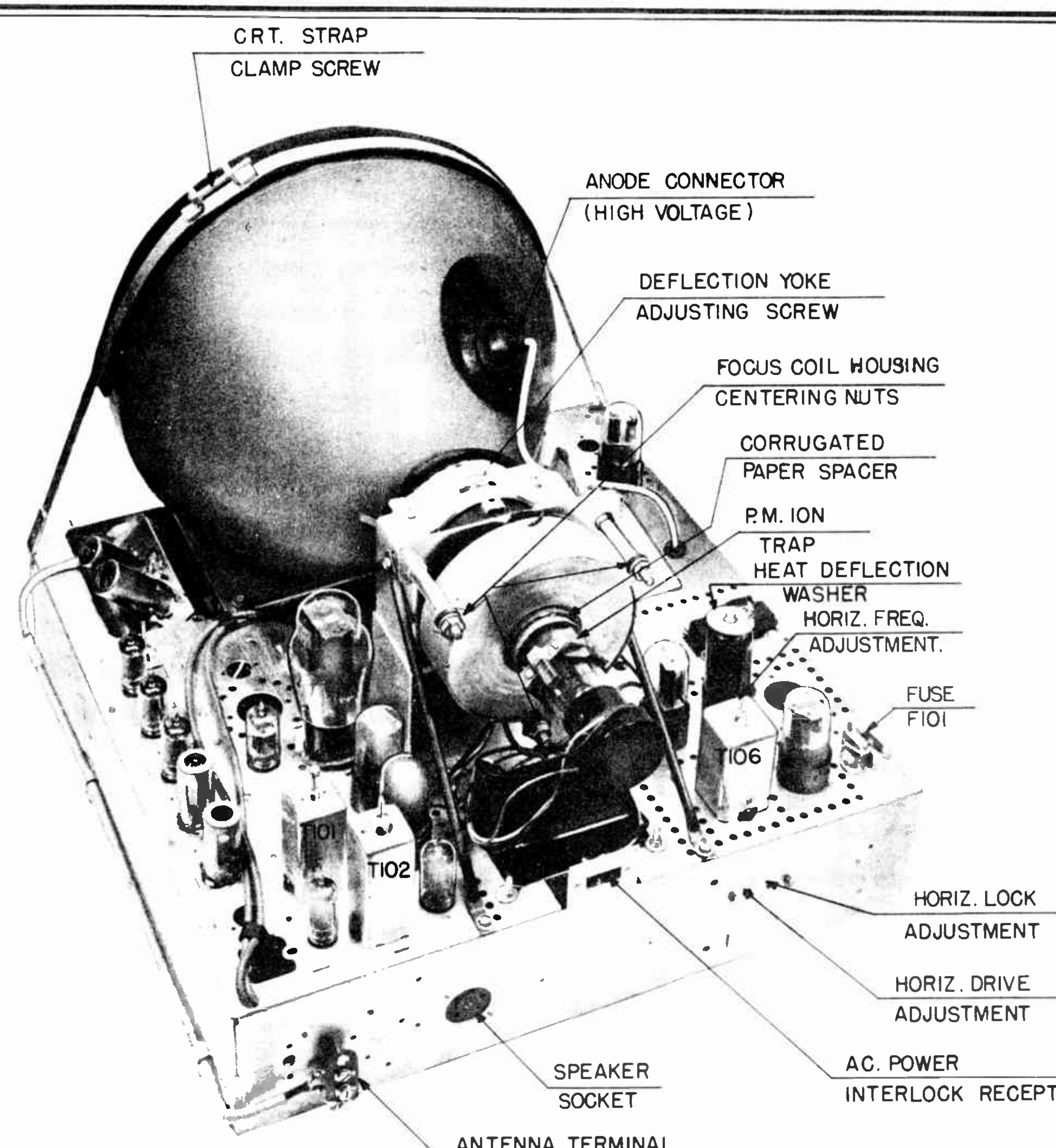

Figure 8. Chassis, Rear View

1.01 Specifications:

Power Requirements: 117 volts, 60 cycle, a.c.
Power Consumption: 175 watts at 117 volts 60 cycles.
Audio Power Output: 1.5 watts maximum.
Receiver Antenna Input Impedance: 300 ohms unbalanced.

Picture area: 85.5 sq. in.
Picture size: 11¼" x 8 7/16"

Intermediate Frequency:
Video Carrier .... 26.4 mc.
Sound Carrier .... 21.9 mc.
Intercarrier Sound ....4.5 mc.

Frequency Range:

Channel Number	Channel Frequency (mc)	Video Carrier Freq. (mc)	Aud. Carrier Freq. (mc)	Receiver Oscillator Freq. (mc)
2	54-60	55.25	59.75	81.65
3	60-66	61.25	65.75	87.65
4	66-72	67.25	71.75	93.65
5	76-82	77.25	81.75	103.65
6	82-88	83.25	87.75	109.65
7	174-180	175.25	179.75	201.65
8	180-186	181.25	185.75	207.65
9	186-192	187.25	191.75	213.65
10	192-198	193.25	197.75	219.65
11	198-204	199.25	203.75	225.65
12	204-210	205.25	209.75	231.65
13	210-216	211.25	215.75	237.65

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Deflection: . . . . Electro Magnetic
Focus: . . . . Electro Magnetic
Horizontal Scanning Frequency: . . . 15,750 cps.
Vertical Scanning Frequency: . . . . 60 cps.
Frame Frequency: . . . . 30 cps.
Scanning: . . . . Interlaced, 525 lines.
Speaker: . . . 10" Permanent Magnet. (Alnico V)
Voice Coil Impedance: 3.2 ohms at 400 cycles.
Overall Dimensions: 35 5/8" high, 20 3/4" wide, 20 13/64" deep.
Weights: Net Weight (not packaged) 85½ lbs.
Shipping Weight (packaged) 98 lbs.

1.02 Controls:

Operating Controls (Front Panel):

SOUND VOLUME / OFF-ON CONTRAST	Dual Control Knob
TUNING	Single Control Knob

Auxiliary Controls:
(Front Panel behind Small Door):

VERTICAL HOLD	Knurled shaft
HORIZONTAL HOLD	Knurled shaft
BRIGHTNESS	Knurled shaft
FOCUS	Knurled shaft

Non-Operational Controls & Adjustments (not including R. F. & I. F.):

HEIGHT	Front panel behind small door — Screwdriver adjustment
VERT. LINEARITY	Front panel behind small door — Screwdriver adjustment
WIDTH	Top of Chassis — Screwdriver adjustment
HORIZ. FREQUENCY	Top of T106 — Screwdriver adjustment
HORIZ. LOCK	Rear Chassis Apron (trimmer) — Screwdriver adjustment
HORIZ. DRIVE	Rear Chassis Apron (trimmer) — Screwdriver adjustment
HORIZ. B.T.O. TRAP	Bottom of T106 — Screwdriver adjustment
FOCUS COIL	Top of Chassis — Three hex. nuts
DEFLECTION COIL	Top of Chassis — Wing screw adjustment
ION TRAP MAGNET	Top of Chassis, picture tube neck

PRECAUTIONS

HIGH VOLTAGE WARNING — Operation of this receiver with the interlock by-passed, or the chassis removed from the cabinet involves a shock hazard from the receiver power supplies. Work on the receiver should not be attempted by anyone not thoroughly familiar with the precautions necessary when working on high voltage equipment. When handling the high voltage lead to the picture tube the receiver power plug should be disconnected from the power receptacle.

HANDLING PICTURE TUBE — Do not remove or handle the picture tube in any manner unless heavy gloves and protective goggles are worn. Persons not so equipped should be kept away while handling picture tube. Keep the tube away from the body while handling. NEVER GRASP THE TUBE BY ITS NECK OR ALLOW PRESSURE TO BE EXERTED ON THE NECK.

CLEANING PICTURE TUBE WINDOW — The window in front of the picture tube is made of a plastic material. It is possible to scratch or damage the surface of the window by using any abrasive material to clean it. USE ONLY A SOFT CLOTH TO REMOVE DUST OR OTHER FOREIGN MATTER. WINDOW MAY BE CLEANED WITH SOAP AND WATER.

2. CIRCUIT DESCRIPTION

2.01 Preliminary:

The "intercarrier" sound system used in this receiver differs from the "conventional" type of television circuit where the video and sound R.F. carriers are converted to their respective intermediate frequencies in the mixer tube. The video and sound I.F. are usually divided into two separate I.F. channels of different frequencies, separated by 4.5 mc. after leaving the plate of the mixer tube or at the plate of the 1st. I.F. amplifier. As it is important to keep the audio component off the picture tube grid, traps must be inserted in the video I.F. and/or video amplifier circuits to absorb the sound frequency.

In the "intercarrier" sound system the R.F. carriers are converted to their respective intermediate frequencies in the same manner as above (in the mixer tube), but the video and sound I.F. frequencies are not separated after leaving the mixer plate; instead they are amplified together in a common I.F. channel and both signals appear at the input to the video detector. As the video and sound carriers are always separated by a fixed difference frequency of 4.5 megacycles that must be maintained by the transmitting station in accordance with FCC regulations, both I.F. signals that appear at the grid of the video detector are separated exactly 4.5 megacycles. The video detector not only functions as a detector, but also as a mixer for the two I.F. signals. In the mixing process of the sound I.F. carrier with the video I.F. carrier, a 4.5 mc. beat signal is produced. This beat signal is frequency modulated in unison with the sound I.F. carrier.

The manner in which the 4.5 mc. beat signal is obtained is comparable to the mixer action in a superheterodyne radio receiver.

In place of a local oscillator, the incoming video I.F. carrier beats against the incoming sound I.F. carrier to produce the sum and difference frequencies at the output of the detector. As the sum frequency falls outside the range of the pass-band of the video amplifier, only the difference frequency need be considered.

After being amplified in the video amplifier, the 4.5 mc. signal is trapped or "sucked out" of the video signal and fed to the sound driver stage by means of the sound take-off transformer. The transformer serves a dual purpose of providing a 4.5 mc. trap to reduce sound interference in the picture and providing a sharp pass band for 4.5 mc. injection to the grid of the sound driver stage. The 4.5 mc. signal is amplified and limited in the sound driver which provides sufficient signal to operate the sound detector. FM demodulation of the sound I.F. signal is accomplished by the two diode sections (V110A) of V110, that function as an unbalanced ratio detector which converts frequency deviations of the I.F. carrier to audio frequencies and suppresses amplitude modulation interference. The I.F. input is applied to the diodes by mutual coupling between the tuned primary and secondary of the ratio detector transformer T102. The applied I.F. carrier rectified by the diodes, charges the electrolytic capacitor C135. The bias voltage developed across R142 holds the conduction level of the diodes at a definite value determined by the applied carrier. Any sudden change, such as may be caused by instantaneous noise impulses, cannot change the bias due to the relatively long time constant (approx. .8 sec.) of R142-C135. The rectified audio frequencies pass through the tertiary winding that is connected to the center tap of the secondary, and the sound volume control to the grid of the 1st. Audio Amplifier tube V110B. The audio amplifier consists of two stages of amplification, a triode 1st. stage coupled to a beam power output stage that drives the speaker.

2.02 R. F. Unit:

The incoming signals picked up by the antenna are applied to the tuned antenna circuit, L2A, L3, C4 and C2. This circuit passes the signal to which the tuner dial is set, and attenuates all other signals, and thus acts to reduce interference. The input circuit is shunted by the choke inductance L1, which provides additional attenuation to AM Broadcast signals and acts as a high-pass, radio-frequency filter, to suppress broadcast band and other low-frequency, cross-modulation interference that may be encountered when the receiver is located in an extremely intense field of a local AM Broadcast Station or other radiators.

The plate of the 6CB6 R.F. Amplifier V1, is coupled to the grid of the 12AT7 mixer section of V2A by means of the coupling capacitor C8.

The R.F. tuning assembly consists of three variable inductors mounted on a common shaft. The first (L2A) and second (L2B) inductors, in conjunction with their associated capacities, tune to any desired frequency between 53 mc. and 217 mc., while the third variable inductor circuit covers a range of approximately 77 mc. to 241 mc., and is used as the tuning circuit for the local oscillator V2B.

The VHF oscillator utilizes the second triode section of 12AT7, V2B, in a modified Colpitts oscillator circuit. The feedback voltage from the plate to the grid of the oscillator tube is obtained by means of the interelectrode capacity of the vacuum tube. The oscillator frequency is tuned by movement of the tap on the coil L2C which shorts a portion of the coil. The oscillator circuit is factory aligned to track with the signal circuits located in the grid and plate of the R.F. amplifier V1.

The oscillator output is coupled to the grid of the mixer tube section (V2A) of 12AT7 by means of capacitor C12 and coupling coil L10.

Both the incoming signal from the antenna and the local oscillator signal are fed into the grid of the mixer tube. The output of V2A has a wide band of frequencies. It includes both the video and sound intermediate frequencies which are fed into the 1st. I.F. primary inductor L6. L7 couples L6 to L101. The secondary of the 1st. I.F. inductor L101 is coupled to the grid of V101 through capacitor C101.

A.G.C. voltage is applied to the grid of the R.F. amplifier tube V1, through R150 and the choke inductance L11. This voltage controls the gain of the tube and tends to keep the contrast constant when tuning to stations of varying signal intensity and to minimize fading in areas of low signal strength. It also tends to prevent blocking on very strong signals.

2.03 I. F. Amplifier:

The I.F. amplifier consists of four stagger tuned stages using three 6AU6 and one 6AG5 or 6BC5 sharp cutoff high gain pentodes V101, V102, V103 and V104. Each I.F. coupling network consists of a variable iron core tuned inductance, which, with their respective tube capacities are resonated to the proper frequency. The 4th and 5th I.F. coils have a close coupled secondary winding over the primary of the coils. Interstage coupling is obtained by capacitors in the first three stages while the fourth stage and the 2nd. detector are coupled directly to the secondaries. Stagger tuning of the I.F. system provides a simple means of securing a sufficiently broad pass-band to accept both the video and sound I.F. carriers of the intercarrier sound system of this receiver. Alignment of the I.F. system is a simple matter as there are only six circuits to be tuned and trap circuits are eliminated. The A.G.C. voltage besides being applied to the R.F. stage is also applied to the 1st. and 2nd. I.F. stages in order to maintain constant output under varying signal intensity. To provide stabilizing degenerative feedback, the cathode resistors R102 and R109 of V101 and V102 are unbypassed.

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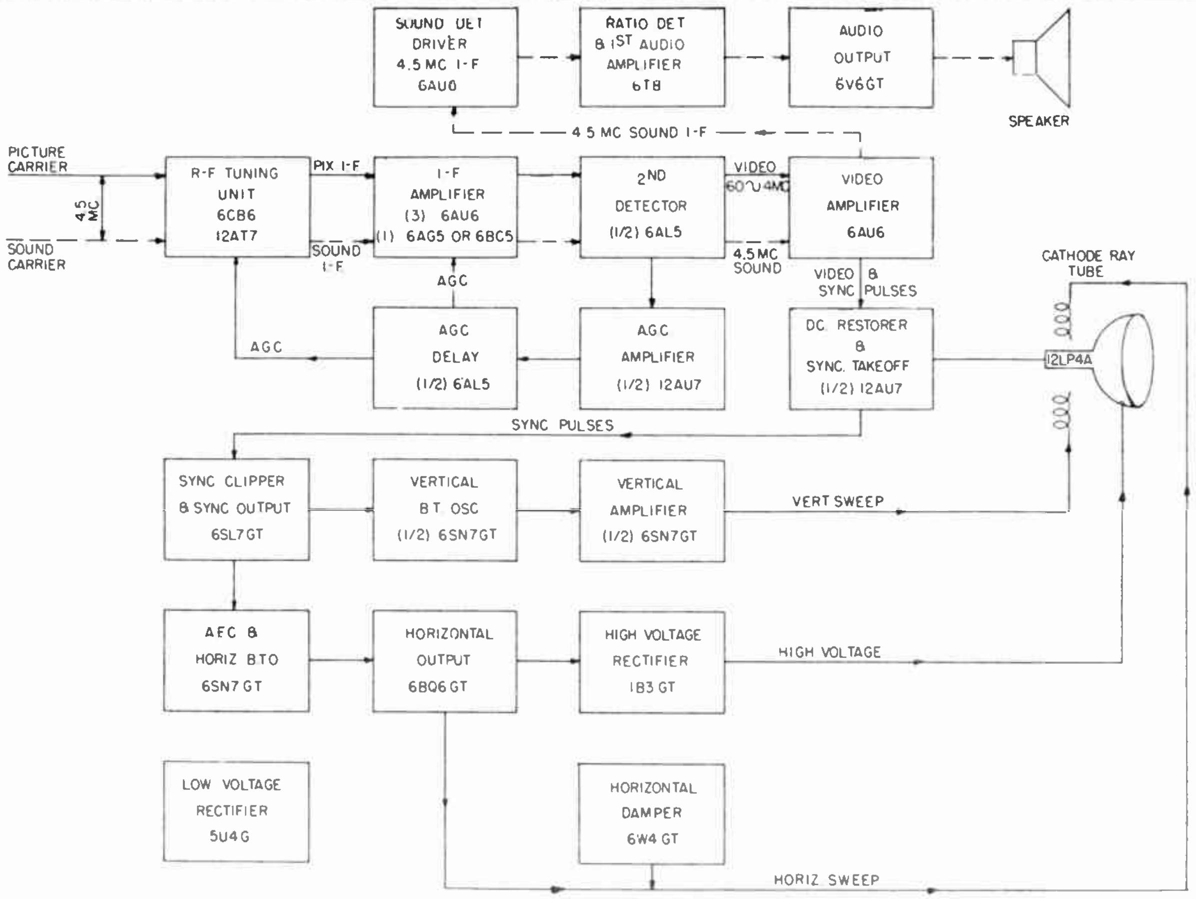

Figure 2. Receiver Block Diagram

2.04 2nd. Detector:

The 2nd. Detector is a diode type detector, the I.F. signal being applied to one plate of the 6AL5 twin diode (V105). The cathode of the 2nd Detector is directly coupled to the grid of the video amplifier (V106) through the series peaking coil L106 shunted by the damping resistor R116, and to the grid of the A.G.C. amplifier V107B through the shunt peaking coil L107 and the isolating resistor R119.

2.05 A. G. C. Circuit:

The purpose of the A.G.C. circuit is to maintain a constant output at the picture tube as the signal input varies due to different field strengths of the television station or flutter of field strength due to aeroplane interference.

The pulsed type A.G.C. circuit that is employed provides considerable immunity from the effects of impulse noise. A d.c. amplifier is used to maintain constant output over a greater range of signal input, and a delay diode is employed to improve signal to noise ratio at medium strength signal inputs.

Operation of the circuit is as follows: The plate voltage of the A.G.C. amplifier tube, V107B, is a positive pulse derived from half of the A.G.C. winding of the horizontal output transformer T107. In order to neutralize the grid to plate capacity of the tube a negative pulse from the other half of the A.G.C. winding is fed to the grid through the neutralizing capacitor C126.

The positive pulse is in time phase with the positive horizontal sync pulse fed to the grid through an isolating resistor R119 from the output of the detector V105A. Therefore, current flows through V107B during the interval when the plate and grid are pulsed and the capacitor C174 is charged. Part of the voltage across C174 leaks off through R151 and R152 during the time between sync pulses. This leakage voltage is governed by the time constant of C174, R151 and R152. The voltage across C174 is the A.G.C. control voltage, which is applied to the R.F. amplifier V1 and the I.F. amplifiers V101 and V102 through a special divider network. The voltage divider network composed of R151, R152, R153 and R202 applies a positive delay voltage to the plate of V105B which makes it conduct and assume ground potential so that until the output of the A.G.C. amplifier is sufficient to overcome the delay bias, no control voltage is developed at the grid of V1. However, the voltage divider R151 and R152 applies less delay to V101 and V102 so that control is applied to the two video I.F. tubes before it is applied to the R.F. amplifier tube V1. This increases signal to noise ratio at medium strength signal inputs. The performance of the system is such that as the detector level tends to rise or fall, the control voltage increases or decreases accordingly to maintain constant output level.

2.06 Video Amplifier: (V106)

A single stage of video amplification is used, the grid of the Video Amplifier tube V106, being directly coupled to the output of the 2nd. Detector. The cathode of V106 is connected through R121 to one end of the contrast control R124B. The other end of the contrast control is connected to the plate of the A.G.C. amplifier V107B with the control arm returning to ground. Connected in this manner the setting of the contrast control determines the bias on both the video amplifier and the A.G.C. amplifier. Increasing the contrast applies less bias voltage to the video amplifier and more bias voltage to the A.G.C. amplifier. Decreasing the contrast reverses the condition. At the plate of the Video Amplifier, both the 60 cycle to 4 megacycle video signal and the 4.5 megacycle sound I.F. signal are present. These signals are fed through the series peaking coil L108 to the primary winding of the Sound Takeoff Transformer T101. This winding traps the 4.5 mc. sound I.F. signal preventing it from reaching the grid of the picture tube, but passes the video signal on to the picture tube grid through the coupling capacitor C123.

2.07 Sound Channel : (V109, V110 & V111)

See last paragraph of "Preliminary Circuit Description" (2.01).

2.08 D. C. Restorer & 1st. Sync Separator: (V107A)

As the video amplifier is A.C. coupled to the CRT grid, the D.C. component of the video signal must be reinserted to maintain the background illumination equivalent to that of the original picture being transmitted.

One section (V107A) of the 12AU7 dual triode functions as a D.C. Restorer and 1st. Sync Separator. The cathode (pin 3) and the grid (pin 2) serves as a diode which performs the D.C. restoration. The output of the video amplifier is applied to the cathode of V107A through R127 and C124.

At the same time the grid and cathode of V107A are functioning as a D.C. Restorer, the entire triode including the plate (pin 1) serves as a sync clipper.

2.09 Picture Tube: (V108)

The picture tube, V108, is a 12½" direct viewing tube. Electromagnetic fields are used for both deflection and focus. The high voltage for the second anode is furnished by the H.V. power supply at approximately 8.5 kilovolts.

The Brightness control R135 varies the cathode bias and thus the tube illumination. The permanent magnet Ion Trap must be properly positioned on the neck of the picture tube for maximum brightness.

2.10 Sync Clipper & Sync Amplifier: (V112)

The vertical and horizontal sync pulses from the plate of V107A are coupled by C144 to the second Sync Clipper stage V112A. This stage and the second half of the 6SL7GT, V112B are voltage amplifiers that amplify and clip the sync pulses sufficiently for proper operation of the deflection circuits. The sync pulses developed at the cathode of the sync output stage remain substantially constant in amplitude over a wide range of input signal levels.

The sync signal is taken from the cathode of V112B to obtain a low impedance output of the correct polarity (positive).

2.11 Integrating Network:

To separate the horizontal from the vertical sync, an integrating network composed of R158, R159, R160, C148, C149 and C150 is used. This RC network acting as a low pass filter will pass the low frequency of the vertical sync, while the higher frequency of the horizontal sync is attenuated.

2.12 Vertical Oscillator & Amplifier: (V113)

The purpose of these circuits is to provide a sawtooth current of the proper amplitude and frequency to move the scanning beam across the picture tube screen slowly (16,000 µs) from top to bottom during the time the image is being placed on the screen and rapidly (250 µs) from the bottom to the top during retrace time. A blocking oscillator and discharge circuit is formed by the first section of the 6SN7GT dual triode V113 and its associated components. The operating frequency is determined by C151, R161 and R162, when no sync pulse is present. The Vertical Hold control R162, adjusts the free running frequency of the blocking oscillator. When the grid wave form goes negative the tube is held at cut-off and C152 is charged at a rate determined by C152, R164, and R165. When the grid wave form goes positive and plate current begins to flow, C152 discharges more rapidly, the rate of discharge being determined primarily by the plate resistance of the conducting tube and C152. This slow charging and rapid discharging of C152 generates a sawtooth voltage.

The peaking action of R166 provides a sharp negative pulse to insure that the second half of V113 will remain cut off during retrace time. By controlling the charging rate of C152 the amplitude of the sawtooth voltage is varied; this is accomplished by adjusting the Height Control R165.

Although the voltage on the plate of the vertical oscillator is of the basic shape to produce a sawtooth current in the vertical deflection coil, it must be amplified in the second section of V113 to obtain sufficient power.

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The plate of the Vertical Output section V113B is coupled to the Vertical Output Auto-transformer T105 that matches the impedance of the vertical deflection coils to the plate impedance of the vertical output tube.

The Vertical Linearity control R169 varies the cathode bias of the Vertical Output tube, so that the position of the applied sawtooth voltage is shifted along its operating characteristic. The Vertical Linearity and Height controls have a considerable amount of interaction and any change in adjustment of one may need to be accompanied by a change in the other.

2.13 A. F. C. & Horizontal Oscillator: (V114)

Automatic frequency control (A.F.C.) of the horizontal sweep is obtained from the circuit composed of one portion of V114 (pins 4, 5, and 6) and its associated components. Its operation is based on what may be described as "width modulation" of the synchronizing pulse.

Satisfactory operation of this circuit depends upon the proper wave shape being formed to apply to the grid of the A.F.C. section of the tube.

The synchronizing pulse, appearing across the network R157 and C146 in the cathode of V112B, is attenuated by capacitors C147 and C162A and is applied to the grid of the A.F.C. section of the tube through capacitor C155. The wave form shown in Fig. 3(A) is obtained from the grid circuit of the horizontal oscillator section of V114, at the junction of R181 and R182.

(A) Figure 3 (B)

This waveform has the advantage of a steep slope near the peak and a fast fall immediately following the peak, and therefore provides increased gating. It is fed to the grid of the A.F.C. section of V114 through L111 and R204. The inductance L111 (delay coil) serves two purposes: (1) It blocks the sharp negative peak and dampens out the rings of the waveform in Fig. 3(A) resulting in the waveform shown in Fig. 3(B): and (2) It delays the arrival of this waveform to the A.F.C. grid in order to center the action of its phase relationship with the synchronizing pulse, being so phased that a varying portion of the synchronizing pulse will fall atop the positive corner of this waveform while the remaining portion slides down the steep sides. The peak amplitude of the combined wave being essentially constant, the control voltage is a function of the width of the pulse atop the positive corner of this waveform. The combined wave which is coupled to the grid of the A.F.C. portion of the tube is shown below for three different conditions of the phase relationship between the horizontal oscillator and the synchronizing signal: (Fig. 4A) when most of the sync pulse is atop the waveform: (Fig. 4B) when one-half of the sync pulse is atop the waveform; and (Fig. 4C) when most of the sync pulse is down the slope.

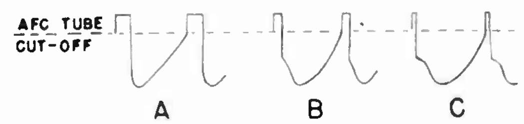

Figure 4

The A.F.C. portion of V114 is biased near cut-off by the D.C. component of the oscillator grid voltage applied through resistors R177 and R178. Its plate current consists essentially of pulses whose width is determined by the relative position of the sync pulse atop the peak of the waveform. The voltage developed across R181 by this average plate current is the control voltage injected from the cathode circuit of V114 into the grid of the oscillator section of V114 through resistor R182, and thus maintains the phase of the oscillator with respect to the synchronizing signal within very close limits.

The cathode circuit is an integrating network with the following properties: (1) a fast response as C157 is relatively small, and (2) a slow response as C156, R180 and R181 are relatively large. The former integrates the pulse of current and also tends to prevent "hunting", while the latter maintains control over a longer period of time, and filters out disturbances of greater duration. The Horizontal Hold Control in the plate circuit not only varies the plate voltage but also functions as a vernier speed control.

Capacitor C162A (Horizontal Lock) is made adjustable, so that the grid voltage of the A.F.C. tube can be varied to suit the characteristics of the individual tube, and thus maintain the control range at a uniform level.

The second triode portion (pins 1, 2 and 3) of V114 functions as a blocking tube oscillator. The Horizontal Oscillator Transformer T106 uses an adjustable powdered iron core, permitting a certain amount of frequency adjustment. The tertiary winding (terminals 5 and 6) of T106 shunted by the capacitor C159 and the damping resistor R184 tends to stabilize the horizontal frequency with relation to the line frequency (15,750 cps). The second section of V114 not only functions as the blocking tube oscillator; but also as the discharge tube. A sawtooth voltage is developed across C160, and is used for horizontal deflection. This sawtooth voltage is then fed to the grid of the output tube V115 through the divider network C161 and C162B. The Horizontal Drive capacitor C162B is made variable to adjust the amplitude of the sawtooth voltage in order to obtain optimum performance from each individual horizontal amplifier tube.

2.14 Horizontal Output, Damper & High Voltage Rectifier: (V115, V116 & V117)

The purpose of the Horizontal Output tube, V115 is to amplify the output of the Horizontal Oscillator so that sufficient current of the proper wave form is available to excite the horizontal deflection coils in order to provide horizontal scanning of the picture tube. During the return trace of the sweep, the current, which was flowing in the horizontal deflection coil, reverses. The induced voltage pulse in the primary winding of the Horizontal Output Transformer T107 appears in the form of a very sharp positive pulse. This pulse is increased by Auto-transformer action in the primary winding and is rectified by the High Voltage Rectifier V117. The rectified energy that is stored in the high voltage capacitor C169 is used to accelerate the electron beam in the picture tube. The Damper tube V116 helps to provide a linear trace by damping out oscillations of the energy stored in the horizontal deflection coil. It critically dampens the ringing in the horizontal deflection yoke which occurs just at the end of the line retrace period. Part of the energy so absorbed is utilized to boost the plate voltage of V115 by feeding the "B" supply in series with the voltage developed across C168 by the Damper Tube V116.

2.15 Low Voltage Power Supply: (V118)

The low voltage power supply of the television receiver is obtained from a 5U4G full wave rectifier with conventional filtering. This power supply furnishes all the plate and screen voltages required by the tubes of the receiver. The filter choke mounted on the speaker frame is in series with the B+ voltage. Therefore, the speaker plug must be connected in the socket on the chassis at all times. The focus coil L113 is in series with the section of the power supply that delivers 350 volts to most of the circuits. The current drain of these circuits provides more than sufficient current for proper focus. The focus current is adjusted to bring the picture tube to precise focus by means of the Focus Control R201 which is in series with the parallel combination of R199 and R200. This series combination is shunted across the Focus Coil.

Since several stages of the receiver require no more than half of the power supply output voltage for normal operation, these stages are connected in a series-parallel combination (See Figure 5). Connected in this manner, dropping resistors are eliminated, resulting in a more efficient use of the power supply output. Considering only the power supply connections, the sound detector driver V109, the ratio detector and first audio amplifier V110, the audio output V111, and the sync clipper and sync output V112 are all connected in parallel.

The R.F. amplifier (V1), VHF oscillator and mixer (V2), the I.F. stages (V101, V102, V103 and V104) and Video amplifier (V106) are connected in parallel with the stabilizer circuit of V111 and get their plate supply from the cathodes of V109, V110, V111, and V112. The vertical amplifier V113B is connected in parallel across the above series string and receives the full voltage of the power supply. Booster voltage from the cathode of the damper tube V116, that is added to the power supply voltage, furnishes the plate voltage for the parallel combination: V113A the vertical oscillator, V114 the A.F.C. and horizontal oscillator, and V115 the horizontal output.

3. ANTENNAS

3.01 Built-In Antenna:

An antenna, that in some localities will eliminate the need of an external TV antenna, is built into the receiver. The built-in antenna lead that is coded with paint is the ground lead and is connected to the screw on the antenna terminal board marked "G". The built-in antenna serves both the low (channel 2 to 6) and the high (channel 7 to 13) television bands.

For the high band, section "A" is the ½ wave folded dipole resonating at 200 mc. Section "B" is the lead-in and section "C" a ½ wave shorted stub resonating at 200 mc. For the low band, A, B, and C resonate at 70 mc.

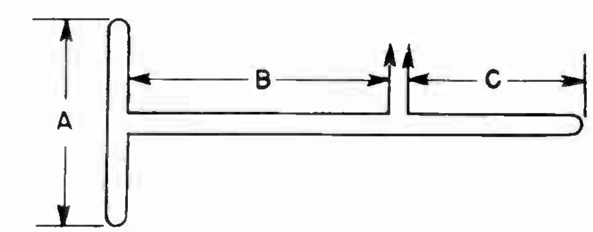

Figure 6. Schematic of Built-in Antenna

The antenna is mounted on a cardboard form fastened in the cabinet. For proper operation of the antenna, do not shorten or lengthen the leads as this will change the resonating frequencies. The results obtained by using the built-in antenna are limited by the distance between the receiver and the transmitter and the location and type of building in which the receiver is used.

Unless the signal transmitted by the television station is of sufficient strength to reach the area where the receiver is located, NO television receiver can reproduce the picture. Due to the high frequencies used for television transmission, the signals reach only to the "line of sight". This is determined by the height of the transmitting and receiving antennas. In addition, steel frame work buildings, mountains, hills etc. reflect the television signals so that even though the television station is only a short distance away, the built-in antenna may not function satisfactorily.

In locations where it is impossible to obtain satisfactory results with the built-in

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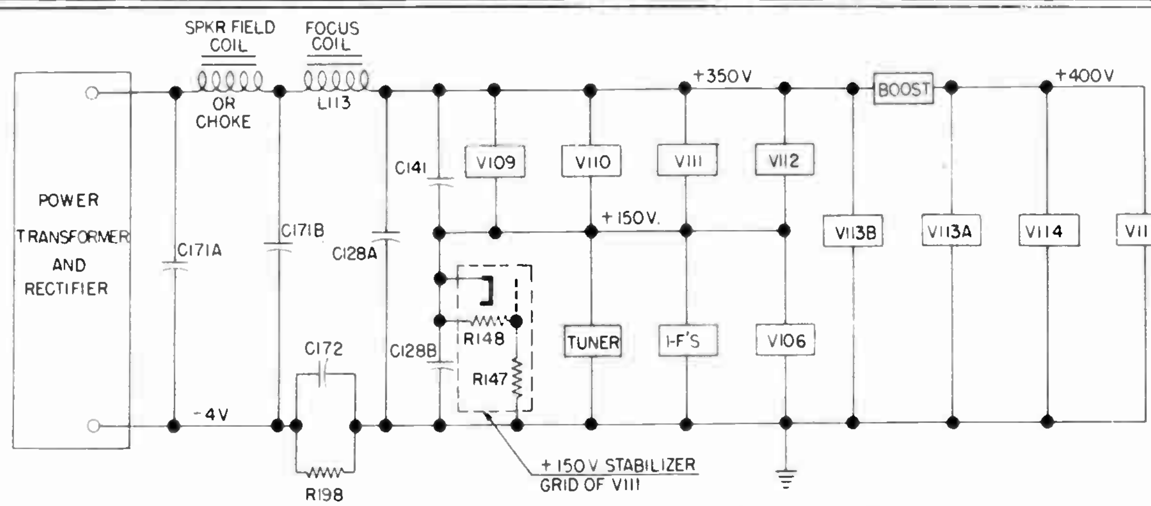

Figure 5. Block Diagram of Power Supply and Voltage Distribution System

antenna, due to shielding effects of buildings or mountains or if the receiver is located too far from the television station, it will be necessary to install an external indoor or outdoor antenna.

3.02 External Antenna:

A proper antenna installation is the most important factor in avoiding reflections in a picture, or a weak picture, although, in some localities where there are a number of stations operating, it may be impossible to eliminate all reflections. The Service Man should suggest the proper type of antenna to be used in the specific location and install and adjust the antenna for the best picture quality.

This television receiver has been designed to operate from a 300 ohm parallel lead transmission line.

3.03 Connecting External Antenna to Receiver:

1. Remove the two wires from the built-in antenna fastened to the two screws on the terminal board mounted on the rear apron of the chassis and fasten the lead-in from the external antenna under these screws. Tape the loose ends of the wires from the built-in antenna, as noisy reception would result if these wires come in contact with the antenna terminal screws.

NOTE: If a co-axial transmission line is used, see that the shield of the co-axial cable is connected to the terminal marked "G".

4. INSTALLATION

4.01 Unpacking:

The cabinet of this receiver is shipped in first class condition with considerable attention given to protecting the finish. Handle With Care. To remove the cabinet from the shipping container, turn the carton on its side and tear open the carton bottom flaps. Fold the flaps up along the side of the carton and turn the carton back up. Lift the carton up and off the cabinet. Tilt cabinet and carefully knock off the skid that is nailed to the bottom of the cabinet. Remove the screws in the cabinet back and swing back open. Check to see that all tubes are in place and firmly seated in their sockets. Check high voltage lead to see that it is connected to the CRT second anode connector socket on the bell of the tube. After inspection close cabinet back and reinsert and tighten the screws.

4.02 Location of the Receiver:

The receiver should be located to permit viewing from the proper distance. For best results in detail, the picture should be observed from a distance of five to ten feet. Locate the receiver where no bright light will fall directly on the picture. Care should be taken not to block the ventilating holes in the back or the bottom of the cabinet. The back of the cabinet should be kept at least two inches away from a wall or other obstructing surfaces.

5. OPERATING INSTRUCTIONS

The receiver is adjusted at the factory and is ready for operation after being connected to a 117 volt, 60-cycle a.c. outlet. To set the receiver in operation, follow the procedure outlined under "Normal Operation".

5.01 Normal Operation:

1. Turn the Off-On Contrast control knob half-way clockwise; this will turn the receiver "On". Wait one minute for the tubes to warm-up to the proper operating temperature.

2. Turn the Tuning control to the desired channel and move the dial slowly over this point until the best quality picture is obtained. The Contrast control might require slight adjustment.

3. Turn the Volume control to obtain the desired sound level. On some stations it may be necessary to make a slight readjustment of the tuning control to minimize noise in the sound.

4. Adjust Off-On-Contrast control for desired contrast.

5. To turn the receiver "Off", turn the Off-On-Contrast control completely counter-clockwise. Normally, only the main controls need be adjusted. At rare intervals it may be necessary to adjust the Auxiliary Controls due to the normal ageing of the tubes and other components.

5.02 Auxiliary Control Adjustment:

1. Turn the receiver "On" as described in paragraph "1" of "Normal Operation".

2. Adjust the Brightness control for moderate brightness, below the point where the raster size increases.

NOTE: If normal brilliance is not obtained at this point it may be necessary to adjust the Ion trap on the neck of the picture tube. For Ion trap adjustment, see "Ion Trap Magnet Adjustment" in section 6.01.

3. Turn the Brightness control counter-clockwise until the raster just becomes invisible.

4. Rotate the Tuning control to the desired channel and move the dial slowly over this point until the best quality picture is obtained. This may require adjustment of the Contrast control to obtain the proper contrast between the blacks and whites of the picture, or adjustment of the Focus control for greatest clarity of the lines in the center of the raster.

5. Adjust the Volume control to obtain the desired sound level. On some stations, a readjustment of the Tuning control may be necessary to minimize the noise in the sound.

6. If the picture rolls or jumps vertically, turn Contrast control counter-clockwise to obtain a weak picture and adjust the Vertical Hold control until the picture remains stationary. Then readjust Contrast control.

7. If the picture pulls to the right or tears, adjust the Horizontal Hold control until the picture remains stationary on the screen then set the control in the center of the range in which it makes the picture stationary. This adjustment should also be made with the Contrast control set to obtain a weak picture.

6. SERVICE NOTES

All controls are adjustable without removing the chassis from the cabinet. The back of the cabinet must be opened for the Width and Horizontal Frequency adjustments that are on the top of the chassis.

WARNING

An A.C. interlock is provided at the rear of the receiver so that when the back is removed, the power is off. Bypassing the interlock involves a shock hazard from the receiver high voltage power supply and the anode lead to the picture tube. Work on the receiver should not be attempted by anyone not thoroughly familiar with the precautions necessary when working on high voltage equipment.

6.01 Adjustments & Operating Check:

Remove the screws in the cabinet back and swing open the back. Connect an auxiliary power cord with suitable socket to the interlock receptacle on the rear of the receiver chassis.

1. ION TRAP MAGNET ADJUSTMENT - When making this adjustment do not exert pressure on the neck of the picture tube. Position the Ion trap for maximum brightness of the raster on the picture tube screen by moving the trap forward or backward and at the same time rotating it slightly around the neck of the tube. Reduce the brightness control setting until the raster is slightly above average brilliance. Adjust the Focus control until the line structure of the raster is clearly visible. Readjust the Ion trap for maximum brilliance. The final setting should be made with the Brightness control set to maximum position with which good line focus can be maintained.

2. DEFLECTION YOKE ADJUSTMENT - Position the Deflection Yoke as far forward as possible on the picture tube. If the lines of the raster are not horizontal, rotate the Deflection Yoke so as to make the top of the raster parallel with the top of the chassis, then tighten the yoke adjusting wing screw.

3. FOCUS COIL ADJUSTMENT - The Focus Coil should be adjusted to be approximately perpendicular to the picture tube axis with the front surface of the focus coil housing approximately 15/32" from the rear surface of the deflection and focus coil mounting bracket. Center The Picture by adjusting the three Focus Coil mounting nuts. If Focus Coil adjustment is made, the Ion trap may need readjustment, see "Ion Trap Magnet Adjustment".

4. HEIGHT AND WIDTH ADJUSTMENT - Picture size is adjusted to slightly overscan the mask both vertically and horizontally by the width adjustment on top of the chassis and the Height Control that is accessible through a hole in the front chassis apron.

5. HORIZONTAL OSCILLATOR ADJUSTMENT - The Horizontal Oscillator may re-

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quire adjustment when installing the television receiver. See "HORIZONTAL OSCILLATOR ALIGNMENT", Bulletin No. 412.

6. VERTICAL LINEARITY ADJUSTMENT - The Vertical Linearity control has the effect of expanding the picture at an increasing rate from the bottom to the top of the picture. Adjustment of this control has the greatest effect on the top portion of the picture, some effect on the middle and very little effect on the bottom of the picture. The Height Control and Focus control may need readjustment as a result of the change in position of the Vertical Linearity Control.

6.02 Horizontal Drive Adjustment:

The Horizontal Drive is a trimmer adjustment on the rear chassis apron. This Control should normally be all the way out (minimum capacity). In some receivers, a white vertical line may appear in the raster under this condition. If so, turn the trimmer screw in just far enough to eliminate the white line. The Width Control may need adjusting to reduce or increase the horizontal size.

6.03 Horizontal Lock-in Adjustment:

See "HORIZONTAL OSCILLATOR ALIGNMENT", Bulletin No. 412.

6.04 Removing Picture Tube Window:

The Picture Tube window may be removed from the cabinet by removing the four wood screws in the border of the window.

6.05 Cleaning Picture Tube Window:

See "CLEANING PICTURE TUBE WINDOW", page 16

6.06 Removal of the Chassis from the Cabinet: (Be Sure Power is Disconnected)

1. Remove the (slip-on type) knobs from the front panel controls. Remove the metal pointer from the tuning control shaft.
2. Remove the screws in the cabinet back and swing open the back.
3. Remove the built-in antenna leads from the antenna terminal board screws.
4. Disconnect the speaker plug from the chassis socket on the rear apron.
5. Remove the five hex head machine screws that secure the chassis in the cabinet. These are accessible from the bottom of the chassis shelf.
6. Slide the chassis from the cabinet.
7. To reinsert the television chassis in the cabinet, repeat steps 2 to 6 in reverse order, then proceed as follows: -
   (a) Replace the large and small knobs on the Volume Control and Off-On-Contrast control shafts.
   (b) Turn the tuning control completely clockwise to stop.
   (c) Push on the metal pointer over knurled portion of shaft so that the pointer is lined-up with the calibration mark of channel 13.
   (d) Push the dual knob on the Tuning control shaft.
   (e) Place the receiver in operation and tune in a station on a known channel. If the pointer is slightly to one side of the calibration mark, reset the pointer to the correct position.

6.07 Removal and Replacement of the Picture Tube:

HANDLING PRECAUTIONS - Do not remove or handle the picture tube in any manner unless heavy gloves and protective goggles are worn. KEEP THE TUBE AWAY FROM THE BODY WHILE HANDLING.

1. Remove the television chassis from the cabinet as outlined above.
2. Disconnect the tube socket and high voltage anode lead from the picture tube. Remove the Ion Trap from the neck of the tube.
3. Remove the corrugated paper around the neck of the picture tube within the focus coil.
4. Loosen the Phillips head screw on the picture tube strap, near the top of the tube, sufficiently to unhook the strap from the chassis.
5. Grasp the picture tube firmly with both hands along the outer edge and gently slide it out of the focus and deflection coils.

CAUTION NEVER GRASP THE PICTURE TUBE BY ITS NECK OR ALLOW PRESSURE TO BE EXERTED ON THE NECK.

6. Place the picture tube face down, on a flat surface covered by a clean cloth, in a location where it will not be disturbed.
7. When the picture tube is ready to be replaced in the receiver chassis, slide the picture tube gently back into the deflection coils and focus coil until the center of its face surface extends 1-3/32" beyond the front edge of the chassis and rotated so that the anode cap is 45° counter-clockwise from top when viewed from the front of the chassis.
8. Bottom of tube should rest on the rubber strips on the two angle brackets on the front of the chassis. Also, see that the neck of the tube is centered in the focus coil. This centering must be accomplished by proper seating of the front part of the picture tube. DO NOT ALLOW PRESSURE TO BE EXERTED ON THE NECK OF THE TUBE. Fasten the picture tube strap.
9. Slide the deflection coil bracket forward as far as possible until the rubber cushion fits snugly against the flare of the picture tube and the two grounding springs make good contact on the tube. Also make sure that the deflection coils are positioned firmly against the flare of the tube.
10. Replace the corrugated paper around the neck of the picture tube.
11. Replace the Ion Trap.
12. Connect the anode (high voltage) lead to tube.
13. Connect the tube socket to base of tube.

6.08 Removal and Replacement of the R. F. Unit:

1. Remove the two screws that hold the antenna board to the rear chassis apron and unhook shielded antenna leads from clamps on the bottom of the side chassis apron.
2. Unsolder - (a) blue lead to the lug on L101
   (b) the ground strap from the tuner to the chassis next to L101
   (c) the red, brown and black leads from the tuner.

   DO NOT CUT THE LEADS: KEEP THEM FULL LENGTH. Record the color coding of the wires and the terminals from which the wires were removed.
3. Remove the three hex head screws that fasten the R.F. Unit to the front chassis apron and carefully remove the unit from the bottom of the chassis.
4. To remove and replace Gear, Sleeve Assembly and Bracket: —
   (a) Remove the "C" washer that holds the gear sleeve to the tuner shaft.
   (b) Remove the gear sleeve and the two spring washers behind the gear.
   (c) To remove the gear on the bracket, remove the "C" washer and slide off the gear and the washer behind the gear.
   (d) To remove the bracket, remove the two hex head self tapping screws on the front of the tuner.
   (e) To replace Gear, Sleeve Assembly and Bracket, reverse the removal procedure in steps (a), (b), (c), and (d). Be sure the gears are firmly meshed, but loose enough to prevent binding. This adjustment is made by the hex head screw and lock-nut on the offset portion of the tuner bracket. After adjusting, tighten locknut.
5. To install the new R.F. TUNER UNIT, reverse steps "1" to "3". Replacement of the R.F. Unit may also require a slight readjustment of the 1st. I.F. Secondary Coil L101.

6.09 Critical Lead Dress R. F. Unit:

1. The Blue lead from the tuner to L101 should pass between the tuner ground strap and main chassis.
2. The Red and the Black-Yellow lead from the tuner should be dressed around the lance in the main chassis and then doubled back to remove all slack from lance to I.F. strip terminal board.
3. The Brown tuner lead should be dressed close to main chassis and directly to terminal socket.

6.10 Test Equipment:

Equipment Needed	Required Characteristics
A. *Trouble Shooting* Cathode-Ray Oscilloscope	Very high input impedance. Must readily synchronize with "Y" axis signal. Must have excellent frequency and phase response from 10 cycles to at least two megacycles and should be capable of passing a 60 cycle square wave without appreciable distortion. Must not compress input signal until a reasonably sized wave form appears. Wide range input attenuator.
Voltage Calibrator	Suitable for calibrating the amplitude of the wave shapes on the "Y" axis of the oscilloscope.
Electronic Voltmeter	Very high input impedance for d.c. voltage measurements. Having at least one megohm of d.c. resistance on the 3 volt scale.
B. *I.F. and Video Alignment* R.F. Sweep Generator or Wobbulator	Frequency range 20 to 250 megacycles, sweep width 10-12 megacycles (adjustable). Output adjustable with at least .1 volt maximum. Output constant on all ranges. Center frequency variable over the complete television spectrum of channels 2-13. Output impedance 150 ohms unbalanced.

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Signal Generator	High frequency signal generator: minimum frequency range 40-250 mc.; frequency calibrations reliable to better than 100KC. Attenuator should be adjustable and very accurate; modulation up to 30%.
Cathode-Ray Oscilloscope	Same as in "A".
Probe Detector	For connecting scope to circuits ahead of second detector. (See Fig. 7 for schematic diagram).
Non-Capacitive Screwdriver	Made of 1/4" fiber rod having screwdriver ends.

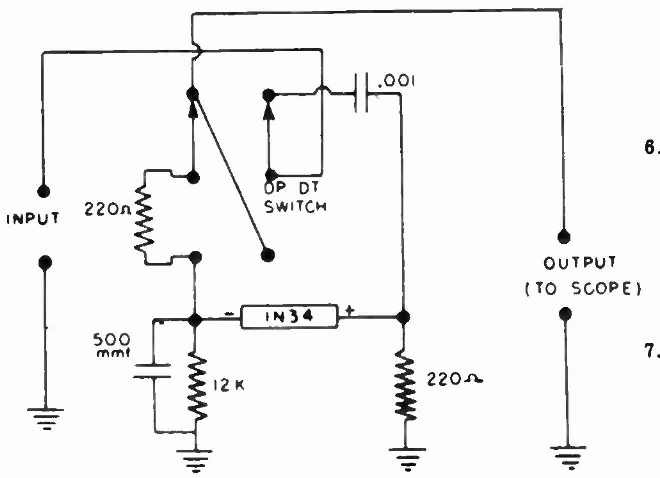

Figure 7 Probe Detector

6.11 Possible Failures:

NOTE: The following failures and possible solutions will aid the serviceman to locate and remedy the trouble.

Tubes should be changed first and if this will not remedy the trouble, check voltages.

1. DEAD RECEIVER:
   a. A.C. interlock not making connection.
   b. Power cord broken, check cord at interlock.
   c. Power switch SW101 contacts open.
   d. Primary winding of T108 open.

2. NO RASTER OR SOUND BUT TUBES LIGHT UP:
   a. Low voltage rectifier tube V118.
   b. Speaker plug disconnected.
   c. Open choke L115.
   d. Open Focus coil L113.

3. PICTURE BUT NO SOUND:
   a. Audio Tubes (V110, V111).
   b. Sound Det. Driver tube (V109).
   c. Defective Speaker voice coil.
   d. Receiver not tuned properly.
   e. T103 or T142 defective.

4. NO RASTER WITH SOUND PRESENT:
   a. Ion trap magnet not set properly.
   b. No high voltage cuased by 1B3 GT rectifier, T107 Horizontal output transformer, V114, V115 or V116.
   c. C169 shorted or R197 open.
   d. Defective Picture tube.

5. NO PICTURE OR SOUND WITH RASTER PRESENT:
   a. I.F. tubes V101, V102, V103 or V104.
   b. 2nd. detector tube V105 or Video amplifier V106.
   c. R.F. Unit.
   d. Antenna Lead-in.

6. NO VERTICAL DEFLECTION:
   a. Open Vert. Osc. Transformer T104.
   b. Shorted electrolytic capacitor C120.
   c. Vertical Output Transformer T105 open.
   d. Open deflection coil L112A.
   e. V113 tube defective or burnt out.
   f. C153 open.
   g. C152 shorted or R166 open.

7. NO HORIZONTAL DEFLECTION:
   a. Tubes V114, V115 or V116.
   b. Fuse F101 burnt out (Replace with same type and value).
   c. Horizontal B.T.O. Transformer T106.
   d. Open deflection coil L112B.

8. SOUND BARS OR GRAIN IN PICTURE:
   a. Station not "tuned-in" properly.
   b. Sound take-off Trans. T102 primary not adjusted properly.
   c. Microphonic tubes. (V2, V101, V102, V103 or V104).
   d. Oscillation in I.F. system due to lead dress or open by-pass capacitor.
   e. R.F. or I.F. not aligned properly.

9. SIGNAL BUT NO VERTICAL SYNC:
   a. Defective vertical oscillator Trans. T104.
   b. V113 tube.
   c. Resistors R158, R159, or R160 open.
   d. Vertical Hold Control R162 arm not making good contact.
   e. Capacitors C148, C149 or C150 defective.

10. SIGNAL BUT NO HORIZONTAL SYNC:
    a. Tube V114.
    b. C162A Plates grounded.
    c. Capacitors C147 or C155 open.
    d. L111 or R204 open.
    e. Horizontal frequency adjustment of T106 or Horizontal lock trimmer not properly adjusted.
    f. Horizontal Hold control R175 or resistor R174 open.

11. SIGNAL BUT NO VERT. OR HORIZ. SYNC:
    a. Tubes V107 or V112.
    b. C144 or C145 open.
    c. R155 open.

12. SHADOWS IN CORNERS OF PICTURE:
    a. Ion trap magnet adjustment
    b. Misadjusted Focus Coil.

13. "SNOW" IN PICTURE:
    a. Weak signal; check antenna and lead-in.
    b. Noisy tube V2 in R.F. Unit.
    c. Corona discharge from High Voltage power supply due to improper lead dress.

14. SMALL PICTURE:
    a. Low line voltage
    b. Horizontal Drive trimmer not properly adjusted.
    c. Width Inductance L110 shorted.
    d. V116 tube.

15. PICTURE WITH VERTICAL LINES: AND HORIZONTAL NON-LINEARITY:
    a. V116 tube.

16. WHITE VERTICAL BAR IN CENTER OF PICTURE:
    a. Horizontal Drive Trimmer not adjusted properly (See, "Horizontal Drive Adjustment", 6.02).

6.12 Critical Lead Dress:

CIRCUIT OR LEAD

R.F. TUNING UNIT:
1. Blue lead from tuner to L101 should pass between tuner ground strap and main chassis.
2. The Red and Black-Yellow lead from the tuner should be dressed around the lance in the main chassis and then doubled back to remove all slack from lance to I.F. strip terminal board.
3. The Brown Tuner lead should be dressed close to main chassis and directly to terminal socket.

I.F. STRIP:
4. All leads running parallel to the I.F. strip should be dressed away from the strip as far as possible, and down to chassis.

PICTURE TUBE:
5. Picture tube grid coupling capacitor .05 mfd, 400 V., C123 should be wired and dressed away from the chassis.

DISC CAPACITORS:
6. All composition disc type capacitors wherever used should be wired with leads as short as possible.

PEAKING COILS:
7. All peaking coils should be wired with short leads. Note connections before removing: when replacing, connect in the same manner.

A.G.C. NEUTRALIZING CAPACITOR C126:
8. The variable capacitor (transmission line) C126, should be dressed away from the I.F. strip.

RATIO DET. TRANS. T102:
9. The 22 ohm resistor. R143 and the 27 K ohm resistor, R144, connected to terminal "B" of T102, the ratio detector transformer, should be wired with short leads, as should be the 1000 mmf. capacitor C133.

OUTPUT TUBE V111:
10. The Blue lead going from pin 3 of the 6V6GT Audio Output tube, V111 to lug 5 of the speaker socket S101, should be reasonably free of slack so as to stand above other wiring.

CONTRAST CONTROL:
11. The White lead from the 22 ohm resistor, R121 on pin 7 of the 6AU6 Video Amplifier, V106, socket to the contrast control, should pass under other wiring and be dressed close to the chassis. The end going to the contrast control should be dressed against the shield away from the audio coupling capacitors, C138 and C139, on the Volume Control.

VERTICAL INTEGRATOR:
12. In receivers using separate components in the integrator circuit, capacitors C148, .002 mfd., 600 V; C149, .005 mfd. 600 V; C150, .005 mfd. 600 V. should be dressed to the chassis.

VERTICAL CIRCUIT:
13. All leads that cross (vertical circuit) terminal board next to the H.V. shield should be dressed to lay directly over the terminal board mounting foot in order to assure clearance in mounting shield.
14. The Red and the Red-Black lead in the vertical circuit should be placed under the .0047 mfd. capacitor lead and over the terminal board mounting foot, then dressed away from main chassis and behind center of control shield.

HORIZONTAL OUTPUT:
15. The fiberglass tubing on the 6BQ6 GT, V115, plate cap lead should be placed all the way up on the lead toward the plate connector.
16. The 6BQ6 GT, V115, grid lead to the Horizontal Drive trimmer should be dressed away from the chassis, short enough to stand above other wiring.

DEFLECTION YOKE:
17. Knots in deflection yoke leads should be loose enough to use up slack and keep leads under yoke bracket away from tubes.

HIGH VOLTAGE:
18. The plate cap lead and the filament leads of the 1B3 GT tube, V117, should be dressed to assure maximum clearance between them.

HIGH VOLTAGE COMPARTMENT:
19. Each lead leaving the H.V. compartment should be dressed to the chassis with no overlapping of leads to insure clearance when the H.V. shield is placed in position.

ANODE LEAD:
20. Force anode lead through slot in anode support (W-149322) before doubling over. Do not crease anode support. This will secure the anode lead.

6.13 Alignment and Adjustment Notes:

1. The sound I.F. and video I.F. carriers of this receiver are 21.9 megacycles and 26.4 megacycles respectively. Sound I.F. frequency 4.5 mc.
2. When the television receiver is repaired or aligned, always turn the chassis on its side with I.F. strip and R.F. Tuning unit up and block up the deflection coil mounting bracket to prevent the tube from resting on the bench.
3. Never disconnect the speaker while the power is on as the filter choke mounted on the speaker is in the B- circuit.
4. If the television receiver must be operated with the picture tube removed from the chassis, tape or cover the exposed end of the high voltage anode lead.
5. All lead connections from the signal generator and wobbulator must be shielded. Keep the exposed ends and ground leads as short as possible (about one inch).
6. Always locate the ground lead connections as close as possible to their respective "hot" leads in the television receiver chassis.
7. The wobbulator, signal generator output, and contrast control must be kept low enough to prevent over loading the television circuits.
8. The alignment procedure must be followed in the order shown in Bulletin No. 412.

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TUBE COMPLEMENT

Symbol	Tube Type	Function	Symbol	Tube Type	Function
V1	6CB6	R. F. Amplifier	V109	6AU6	Sound Det. Driver
V2	12AT7	V. H. F. Oscillator & Mixer	V110	6T8	Sound Det. & 1st Audio Ampl.
V101*	6AU6	1st. I. F. Amplifier	V111	6V6GT	Audio Output
V102	6AU6	2nd. I. F. Amplifier	V112	6SL7GT	Sync Clipper & Sync Output
V103	6AU6	3rd. I. F. Amplifier	V113	6SN7GT	Vert. Osc. & Vert. Ampl.
V104	6AG5 or 6BC5	4th. I. F. Amplifier	V114	6SN7GT	A. F. C. & Horiz. Oscillator
V105	6AL5	2nd. Detector & A. G. C. Delay	V115	6BQ6GT	Horizontal Output
V106	6AU6	Video Amplifier	V116	6W4GT	Horizontal Damper
V107	12AU7	D. C. Restorer, Sync Take-off & A. G. C. Ampl.	V117	1B3GT	H. V. Rectifier
			V118	5U4G	L. V. Rectifier
V108	12LP4A	Picture Tube			

SOCKET VOLTAGE TABLE

The following voltages are measured with an electronic voltmeter from socket lugs to ground (chassis) while the set is operating on a 117 volt, 60 cycle A. C. current. Controls are set to obtain a normal picture with +10 volts D. C. on grid (Pin 2) of the picture tube. Some A. C. voltages measured between socket lugs as noted.

Voltages may vary depending upon the setting of the various controls.

Symbol	Tube Type	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Pin 9
V1	6CB6	-0.1	0.9	Gnd.	*6.3	120	115	Gnd.	....	....
V2	12AT7	140	-2.7	Gnd.	Gnd.	Gnd.	110	-5	Gnd.	*6.3
V101	6AU6	-3.6	Gnd.	*6.3	Gnd.	142	142	<0.1	....	....
V102	6AU6	-3.6	Gnd.	*6.3	Gnd.	138	138	<0.1	....	....
V103	6AU6	0	Gnd.	*6.3	Gnd.	135	135	1.1	....	....
V104	6BC5or6AG5	0	1.1	Gnd.	*6.3	135	135	1.1	....	....
V105	6AL5	Gnd.	-3.6	*6.3	Gnd.	▲-0.7	Gnd.	-0.7	....	....
V106	6AU6	-0.8	Gnd.	*6.3	Gnd.	115	125	1.9	....	....
V107	12AU7	7.4	Gnd.	21	*6.3	*6.3	▲-20	-0.7	2.5	Gnd.
V108	12LP4A	Gnd.	10	....	....	....	(Pin 10) 220	(Pin 11) 40	(Pin 12) *6.3	(Anode) 8000
V109	6AU6	150	150	3 to 4 *6.3	4 to 3 *6.3	200	200	150	....	....
V110	6T8	140	135	140	4 to 5 *6.3	5 to 4 *6.3	150	150	98	235
V111	6V6GT	N. C.	2 to 7 *6.3	320	330	135	N. C.	7 to 2 *6.3	150	....
V112	6SL7GT	130	300	150	120	345	150	7 to 8 *6.3	8 to 7 *6.3	....
V113	6SN7GT	-33	125	Gnd.	0	330	12	*6.3	Gnd.	....
V114	6SN7GT	-95	245	Gnd.	-11	185	-7	*6.3	Gnd.	....
V115	6BQ6GT	N. C.	*6.3	N. C.	150	-25	W. J.	Gnd.	Gnd.	....
V116	6W4GT	N. C.	W. J.	390	N. C.	240	N. C.	7 to 8 *6.3	8 to 7 *6.3	....
V117	1B3GT	....	....	....	....	....	....	....	....	....
V118	5U4G	N. C.	375	W. J.	*380	N. C.	*380	N. C.	375	....

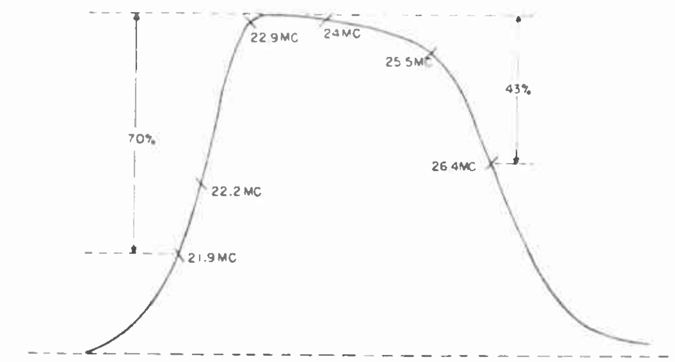
All voltages plus volts unless otherwise noted.
The following symbols denote:

* = A. C. voltage
N. C. = No connection
W. J. = Wiring junction
< = less than
▲ = A.G.C. voltage (variable with signal strength)

ALIGNMENT PROCEDURE

I.F. ALIGNMENT:

1. Connect a short clip lead from B- (-4 volts; white wire on C171) to the A.G.C. lead (orange wire) of the I.F. stages on the terminal board mounted to the I.F. strip close to L102.
2. Connect an electronic voltmeter across the 2nd Detector load resistor R117.
3. Set tuner near low frequency end of range, approximately 4 to 5 turns clockwise, at a point where there are no spurious responses.
4. Connect signal generator to the antenna terminals of the receiver (ground lead of generator to ground terminal of antenna terminal board). If when connected in this manner the signal from the generator is not of sufficient strength for indication on the electronic voltmeter, connect "hot" lead of signal generator through a 1000 mmf. capacitor to the junction of L101 and the 100 mmf. capacitor C101.
5. Set signal generator to 24 mc. and adjust L105 for maximum meter deflection, limiting meter deflection to 2 volts d.c. by adjusting input attenuator.
6. Reset signal generator to 22.2 mc. and tune L104 in a similar manner.
7. Next set signal generator to 26.55 mc. and tune L103.
8. Reset signal generator to 22.9 mc. and tune L102.
9. Repeat steps 5, 6, 7 and 8.
10. If signal generator was connected to the junction of L101 and C101 for steps 5, 6, 7, and 8, remove the generator from this point and connect the signal generator to antenna terminals. Set generator to 25.5 mc.
11. Set tuner near low frequency end of range approximately 4 to 5 turns clockwise at a point where there are no spurious responses.
12. Adjust L101 for maximum meter deflection.
13. Disconnect signal generator and electronic voltmeter.
14. To check alignment on oscilloscope:
    (a) Connect the oscilloscope across the detector load resistor R117.
    (b) Connect sweep signal generator to antenna terminals. Set the generator to sweep from 20 mc. to 30 mc. and adjust output to provide a 2 volt peak to peak signal on the scope.
    (c) Connect marker generator to sweep generator output leads and adjust to provide markers at 21.9 mc., 22.9 mc., 24 mc., 25.5 mc. and 26.4 mc.
    (d) Observe curve and position of markers (See response curve). 21.9 mc. should be approximately 70% down from the peak and 20.4 mc. approximately 43% down.



OVERALL I-F RESPONSE CURVE
SIGNAL CONNECTED TO ANTENNA TERMINALS

15. Disconnect generators, scope and the clip lead from B- to the A.G.C. terminal.

SOUND ALIGNMENT:

1. Connect "hot" lead of signal generator to grid (pin #1) of V106. Set signal generator to 4.5 mc. with 400 cps. amplitude modulated 30% or greater.
2. Connect scope to picture tube grid (pin #2) through a detector probe.
3. Connect two 100 K ohm resistors (matched within 1%) in series across R142. Connect common lead of the electronic voltmeter to junction of the matched 100 K ohm resistors and to D. C. lead to the + 150 volt point at junction of C135 and R142 on the lug of T101.
4. Using a high level signal input and with the contrast control set at maximum, tune the sound take-off transformer (T101) primary adjustment (bottom of chassis) for minimum deflection on the scope.
5. Reduce signal input to below limiting in V109 and adjust sound take-off transformer (T101) secondary (top of chassis), and ratio detector transformer (T102) primary (top of chassis) for peak meter reading.
6. Repeat steps 4 and 5.
7. Transfer D. C. lead only of the electronic voltmeter to junction of R144 and C137.
8. Return to high level input, for limiting in V109 and adjust ratio detector transformer (T102) secondary (bottom of chassis) for zero meter reading.
9. Remove the two 100 K ohm resistors, and all test equipment from the receiver.

A.G.C. NEUTRALIZING CAPACITOR ADJUSTMENT:

Adjust C126 (loop of transmission line under chassis) to neutralize amplifier by changing spacing in center of leads. Adjust with no signal input to the receiver. Remove one of the I.F. tubes from the receiver and set the Contrast control completely counter-clockwise. Neutralization is accomplished when no change in the A.G.C. amplifier D.C. output voltage is noticed (measured between cathode and ground) while an 0.1 mfd. capacitor is intermittently connected between the A.G.C. amplifier grid and ground.

HORIZONTAL OSCILLATOR ALIGNMENT:

1. Tune receiver to a television signal and adjust contrast control for normal picture, below limiting in the video amplifier (V106).

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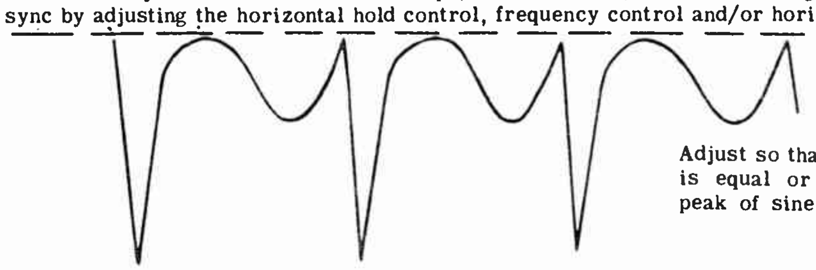
2. Adjust the horizontal frequency adjustment (top of T106) and the horizontal hold control until picture is in sync.

3. Connect scope to terminal #5 of the horizontal blocking oscillator transformer (T106) with a 10 mmf. capacitor in series and adjust the horizontal BTO trap (bottom of T106) for the following wave form; keeping raster in sync by adjusting the horizontal hold control, frequency control and/or horizontal lock adjustment.

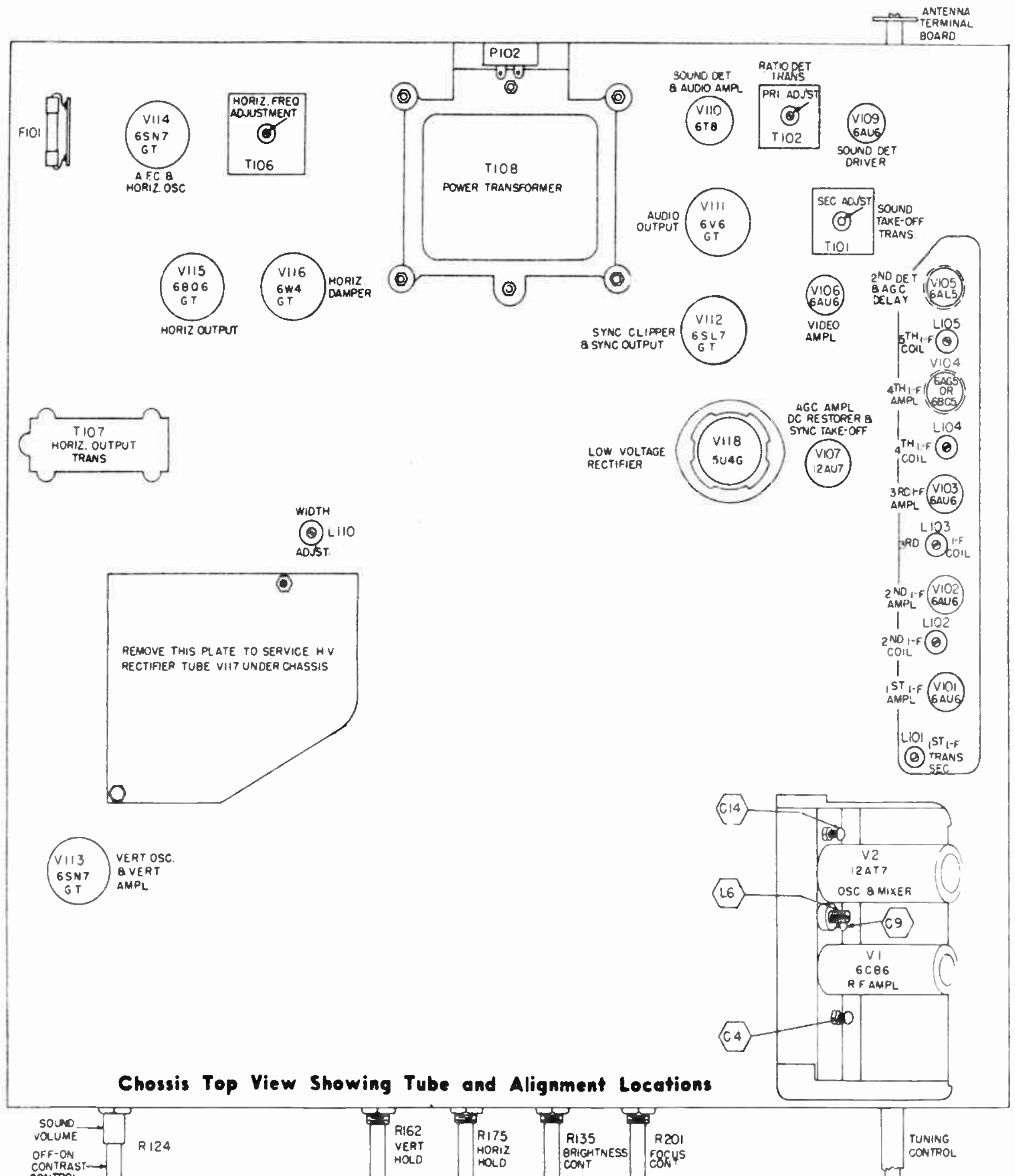


Adjust so that the peak of pulse is equal or 10% higher than peak of sine wave.

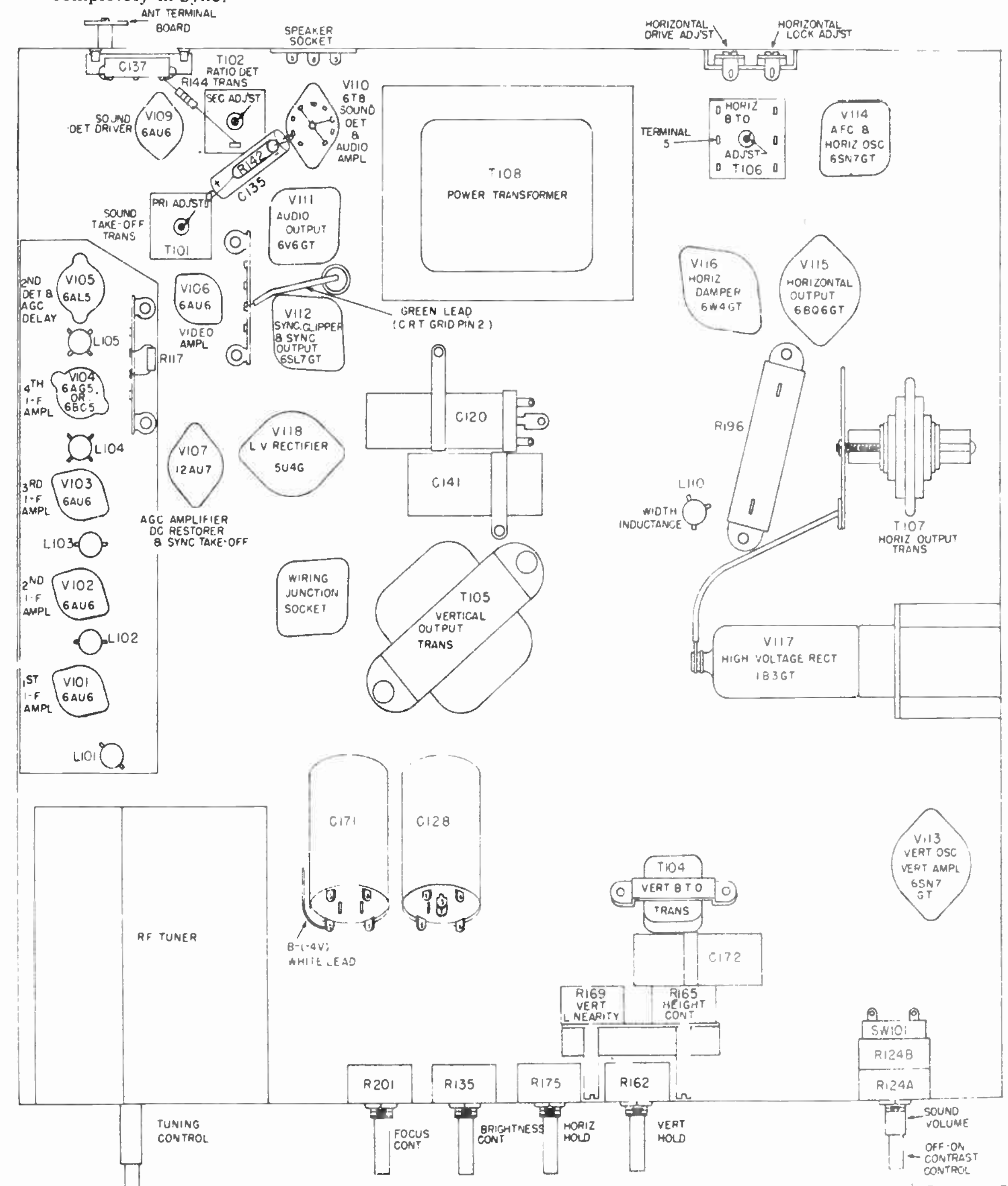
4. Turn the horizontal hold control fully clockwise. Adjust the horizontal frequency control (top of T106) by turning out until the raster is just out of sync, and then turning the frequency control in slowly until the raster is just ready to fall into sync (indicated by a wide black vertical or diagonal horizontal blanking bar).

5. Turn the horizontal hold control fully counter-clockwise. Picture should normally be in sync. Remove the signal by tuning off the station, then retune to the signal. If more than seven bars are present, adjust the Horizontal Lock trimmer slightly counter-clockwise, until five to seven bars appear before the picture falls into sync when the Horizontal Hold control is set in the extreme counter-clockwise position. If less than five bars are present, adjust the Lock trimmer clockwise. As the lock-in trimmer adjustment effects the horizontal frequency, the adjustments of both the horizontal frequency control and the lock-in trimer must be repeated until the conditions outlined above, in steps 4 and 5, exist simultaneously at the extreme positions of the Horizontal Hold Control. Check pull-in range. Pull-in range should be 120° minimum and 220° maximum.

6. The final setting of the Horizontal Hold control should be made with a very weak picture. Rotate the dial on and off the station, and set the Horizontal Hold control so that the picture returns completely in sync.



Chassis Top View Showing Tube and Alignment Locations



Chassis Bottom View Showing Tube Socket and Alignment Locations

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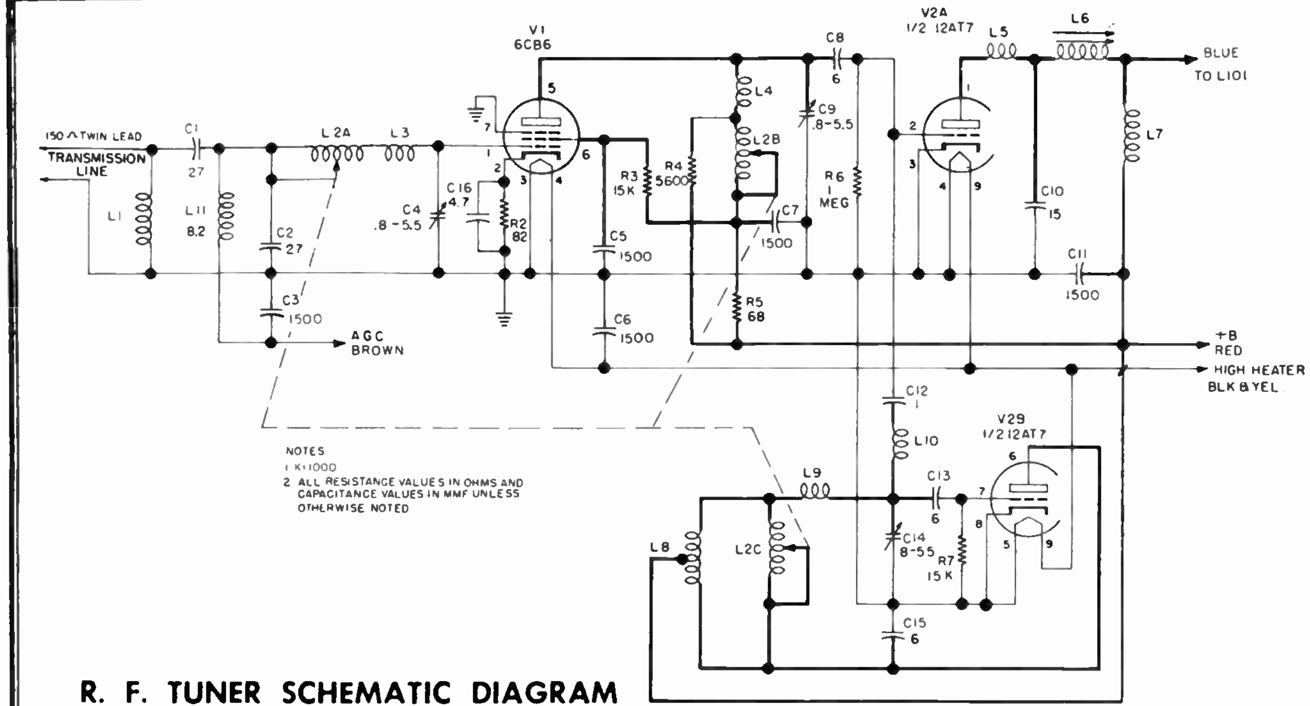
MODELS 11-441MU, 11-461WU, 11-471BU, Ch. 320



R. F. TUNER SCHEMATIC DIAGRAM

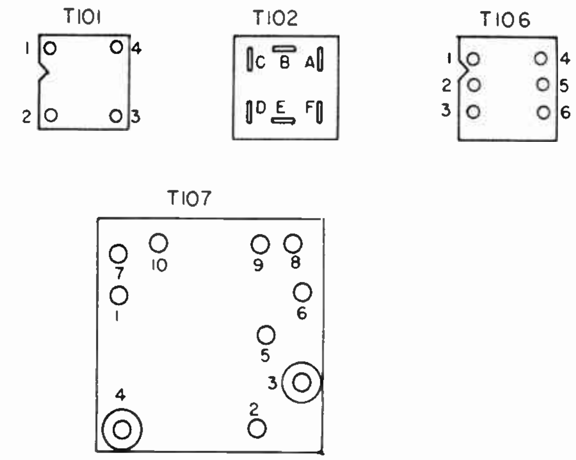
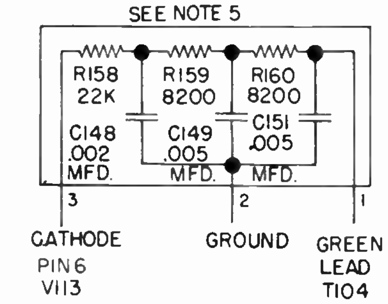
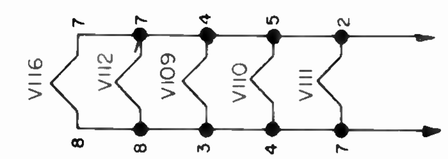
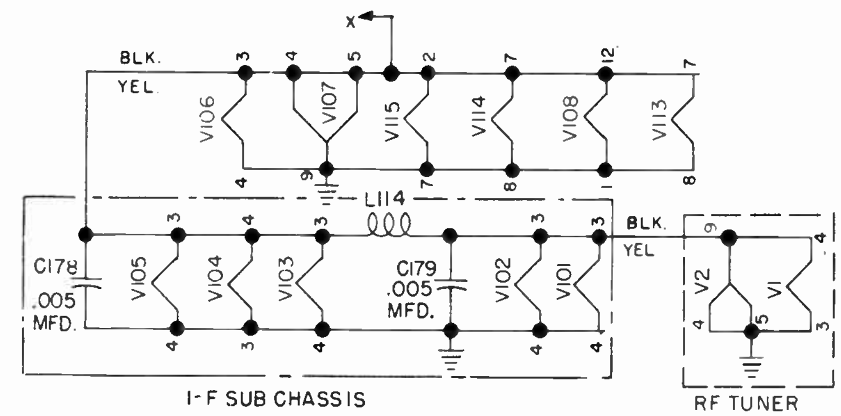


DIAGRAM OF VERTICAL INTEGRATOR
SEE NOTE 5







NOTES:

1A. SOCKET VOLTAGES MEASURED WITH AN ELECTRONIC VOLTMETER CONNECTED FROM SOCKET LUG TO CHASSIS.

B. SUPPLY VOLTAGE 117V. 60 CYCLE AC.

C. VOLTAGE MEASURED WITH CONTROLS SET TO OBTAIN A NORMAL PICTURE AND + 10 VOLTS DC. ON GRID PIN 2 OF PICTURE TUBE.

D. VOLTAGES MAY VARY DEPENDING UPON THE SETTING OF THE VARIOUS CONTROLS.

2. K = 1000 <= LESS THAN.

3. ALL CAPACITANCE VALUES IN MMF. AND ALL RESISTANCE VALUES IN OHMS UNLESS OTHERWISE NOTED.

4. DIRECTION OF ARROWS AT CONTROLS INDICATES CLOCKWISE ROTATION.

5. IN SOME RECEIVERS C148, C149, C150, R158, R159, AND R160 ARE A RESISTOR-CAPACITOR UNIT (PART NO. W-149878). SEE DIAGRAM ABOVE.

6. ON SOME SETS LUG 2 OF V103 IS CONNECTED TO GROUND AND NOT TO LUG 7. THESE SETS ARE EQUIPPED WITH A 6AU6 TUBE. BY CONNECTING LUG 2 TO LUG 7 AS SHOWN BY THE SOLID LINES IN SCHEMATIC, EITHER A 6AG5, 6AU6, OR 6BC5 TUBE MAY BE USED IN THE V103 SOCKET. WHEN REPLACING THIS TUBE, RE-ALIGN THE 3RD. I.F. STAGE.

7. IN EARLY PRODUCTION RECEIVERS C140 IS CONNECTED AS SHOWN BY DOTTED LINES. IN LATER PRODUCTION RECEIVERS, C140 IS CONNECTED AS SHOWN BY SOLID LINES TO PREVENT PARASITIC OSCILLATION IN THE AUDIO OUTPUT TUBE.

REPLACEMENT PARTS LIST

MAIN CHASSIS

Symbol No.	Part No.	Description	Symbol No.	Part No.	Description
C101	C-137727-108	Capacitor, 100 mfd., 500 v., ceramic	C110	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C102A	C-144675-6	Capacitor, .004 mfd., 500 v. Two Section	C111	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C102B		Capacitor, .004 mfd., 500 v. disc ceramic	C112	C-137727-103	Capacitor, 5 mmf., 10%, 500 v., ceramic
C103	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic	C113	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C104	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic	C114	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C105	C-137727-108	Capacitor, 100 mmf., 500 v., ceramic	C120A	B-149105	Capacitor, 10 mfd., 475 v. Three Section
C106	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic	C120B		Capacitor, 10 mfd., 475 v. Electrolytic
C107	C-137727-108	Capacitor, 100 mmf., 500 v., ceramic	C120C		Capacitor, 4 mfd., 350 v.
C108A	C-144675-6	Capacitor, .004 mfd., 500 v. Two Section	C121	Part of T101	Capacitor, 22 mmf., 10%, 500 v., ceramic
C108B		Capacitor, .004 mfd., 500 v. disc ceramic	C122	Part of T101	Capacitor, 33 mmf., 5%, 500 v., ceramic
C109	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic	C123	39001-17	Capacitor, .05 mfd., 600 v., paper

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Symbol	Part No.	Description
C124	39001-19	Capacitor, .1 mfd., 600 v., paper
C125	39001-19	Capacitor, .1 mfd., 600 v., paper
C126	AW-148980	Capacitor, 3 mmf., Transmission Line
C127	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C128A	B-149061	Capacitor, 40 mfd., 475 v. Three Section Electrolytic
C128B		Capacitor, 40 mfd., 250 v.
C128C		Capacitor, 100 mfd., 25 v.
C129	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C130	Part of T102	Capacitor, 10 mmf.
C131	Part of T102	Capacitor, 100 mmf.
C132	W-137398-4	Capacitor, 2.2 mmf., 500 v.
C133	C-137727-110	Capacitor, 1000 mmf., 10%, 500 v., ceramic
C134	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C135	B-149211	Capacitor, 10 mfd., 25 v., Electrolytic
C136	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C137	39001-11	Capacitor, .005 mfd., 600 v., paper
C138	39001-13	Capacitor, .01 mfd., 600 v., paper
C139	39001-13	Capacitor, .01 mfd., 600 v., paper
C140	39001-73	Capacitor, .00025 mfd., 600 v., paper
C141	B-146725	Capacitor, 40 mfd., 300 v., Electrolytic
C142	39001-11	Capacitor, .005 mfd., 600 v., paper
C143	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C144	39477-41	Capacitor, .01 mfd., 600 v., molded paper
C145	B-137498-17	Capacitor, 120 mmf., 10%, 500 v., mica
C146	B-137498-28	Capacitor, 390 mmf., 5%, 500 v., mica
C147	B-137498-17	Capacitor, 120 mmf., 10%, 500 v., mica
*C148	39001-74	Capacitor, .002 mfd., 600 v., paper
*C149	39001-11	Capacitor, .005 mfd., 600 v., paper
*C150	39001-11	Capacitor, .005 mfd., 600 v., paper
C151	39478-39	Capacitor, .0047 mfd., 10%, 600 v., molded paper
C152	C-146434-3	Capacitor, .1 mfd., 10%, 400 v., paper
C153	39001-19	Capacitor, .1 mfd., 600 v., paper
C154	39001-17	Capacitor, .05 mfd., 600 v., paper
C155	39477-37	Capacitor, .0022 mfd., 600 v., paper
C156	39001-87	Capacitor, .25 mfd., 600 v., paper
C157	39001-80	Capacitor, .02 mfd., 600 v., paper
C158	B-137498-47	Capacitor, 200 mmf., 5%, 1000 v., mica
C159	C-148813-1	Capacitor, .01 mfd., 400 v., paper
C160	B-137498-58	Capacitor, 1500 mmf., 5%, 5000 v., mica
C161	B-137498-3	Capacitor, 500 mmf., 5%, 500 v., mica
C162A	B-132386-17	Capacitor, Trimmer Two Section
C162B		Capacitor, Trimmer
C165	39001-17	Capacitor, .05 mfd., 600 v., paper
C166	39001-19	Capacitor, .1 mfd., 600 v., paper
C167	B-148317-2	Capacitor, .5 mfd., 600 v., paper
C168	B-148317-2	Capacitor, .5 mfd., 600 v., paper
C169	W-147994	Capacitor, .00047 mfd., 10,000 v.
C171A	B-146633	Capacitor, 40 mfd., 475 v. Two Section
C171B		Capacitor, 40 mfd., 475 v.
C172	B-149038	Capacitor, 500 mfd., 10 v., Electrolytic
C173	39001-80	Capacitor, .02 mfd., 600 v., paper
C174	39001-14	Capacitor, .015 mfd., 600 v., paper
C175	39001-87	Capacitor, .25 mfd., 600 v., paper
C176	B-148317-4	Capacitor, .2 mfd., 200 v., paper
C177	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C178	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C179	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C180	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C181	Part of L112B	Capacitor, 56 mmf., 1,000 v., mica
R101	39375-77	Resistor, 15,000 ohm, 5%, ½ w.
R102	39374-11	Resistor, 68 ohm, 10%, ½ w.
R103	39373-14	Resistor, 100 ohm, ½ w.
R104	39373-14	Resistor, 100 ohm, ½ w.
R105	39373-14	Resistor, 100 ohm, ½ w.
R106	39373-54	Resistor, 10,000 ohm, ½ w.
R107	39373-14	Resistor, 100 ohm, ½ w.
R108	39375-69	Resistor, 6800 ohm, 5%, ½ w.
R109	39374-11	Resistor, 68 ohm, 10%, ½ w.
R110	39373-14	Resistor, 100 ohm, 10%, ½ w.
R111	39375-71	Resistor, 8200 ohm, 5%, ½ w.
R112	39374-13	Resistor, 100 ohm, 10%, ½ w.
R113	39373-14	Resistor, 100 ohm, ½ w.
R144	39375-69	Resistor, 6800 ohm, 5%, ½ w.
R115	39374-13	Resistor, 100 ohm, 10%, ½ w.
R116	Part of L106	Resistor, 10,000 ohm, 5%, ½ w.
R117	39375-65	Resistor, 4700 ohm, 5%, ½ w.
R118	39373-14	Resistor, 100 ohm, ½ w.
R119	39374-49	Resistor, 100,000 ohm, 10%, ½ w.
R120	39374-224	Resistor, 82,000 ohm, 10%, 2 w.
R121	39374-5	Resistor, 22 ohm, 10%, ½ w.
R122	Part of L108	Resistor, 22,000 ohm, 10%, ½ w.
R123	39374-35	Resistor, 6800 ohm, 10%, ½ w.
R124A	C-148954	Control, Volume, 1 megohm Two Section
R124B		Control, Contrast, 1000 ohm
R125	39374-133	Resistor, 47,000 ohm, 10%, 1 w.
R126	39375-213	Resistor, 4700 ohm, 5%, 1 w.
R127	39374-31	Resistor, 3300 ohm, 10%, ½ w.
R128	39374-51	Resistor, 150,000 ohm, 10%, ½ w.
R129	39374-49	Resistor, 100,000 ohm, 10%, ½ w.
R130	39374-51	Resistor, 150,000 ohm, 10%, ½ w.
R131	39374-60	Resistor, 820,000 ohm, 10%, ½ w.
R132	39374-45	Resistor, 47000 ohm, 10%, ½ w.
R133	39374-28	Resistor, 1800 ohm, 10%, ½ w.

*See Note 5 on Main Chassis Schematic Wiring Diagram.

Symbol	Part No.	Description
R134	39374-121	Resistor, 4700 ohm, 10%, 1 w.
R135	B-148966	Control, Brightness (40,000 ohm)
R136	39374-220	Resistor, 39,000 ohm, 10%, 2 w.
R137	39374-219	Resistor, 33,000 ohm, 10%, 2 w.
R138	39374-214	Resistor, 12,000 ohm, 10%, 2 w.
R139	39374-17	Resistor, 220 ohm, 10%, ½ w.
R141	39374-133	Resistor, 47,000 ohm, 10%, 1 w.
R142	39375-79	Resistor, 18,000 ohm, 5%, ½ w.
R143	39374-5	Resistor, 22 ohm, 10%, ½ w.
R144	39374-42	Resistor, 27,000, 10%, ½ w.
R145	39373-107	Resistor, 10 megohm, ½ w.
R146	39374-49	Resistor, 100,000 ohm, 10%, ½ w.
R147	39375-129	Resistor, 2.2 megohm, 5%, ½ w.
R148	39375-97	Resistor, 100,000 ohm, 5%, ½ w.
R149	39374-196	Resistor, 390 ohm, 10%, 2 w.
R150	39373-33	Resistor, 1000 ohm, ½ w.
R151	39375-89	Resistor, 47,000 ohm, 5%, ½ w.
R152	39375-103	Resistor, 180,000 ohm, 5%, ½ w.
R153	39375-107	Resistor, 270,000 ohm, 5%, ½ w.
R154	39373-92	Resistor, 1 megohm, ½ w.
R155	39374-40	Resistor, 18,000 ohm, 10%, ½ w.
R156	39373-100	Resistor, 3.3 megohm, ½ w.
R157	39374-35	Resistor, 6800 ohm, 10%, ½ w.
*R158	39374-41	Resistor, 22,000 ohm, 10%, ½ w.
*R159	39374-36	Resistor, 8200 ohm, 10%, ½ w.
*R160	39374-36	Resistor, 8200 ohm, 10%, ½ w.
R161	39374-63	Resistor, 1.2 megohm, 10%, ½ w.
R162	B-148952	Control, Vertical Hold (1.5 megohm)
R163	39374-37	Resistor, 10,000 ohm, 10%, ½ w.
R164	39374-61	Resistor, 1 megohm, 10%, ½ w.
R165	B-148964	Control, Height (2.5 megohm)
R166	39374-31	Resistor, 3300 ohm, 10%, ½ w.
R167	39374-69	Resistor, 2.2 megohm, 10%, ½ w.
R168	39374-36	Resistor, 8200 ohm, 10%, ½ w.
R169	B-148965	Control, Vertical Linearity (5000 ohm)
R170	39374-22	Resistor, 560 ohm, 10%, ½ w.
R171	Part of L112A	Resistor, 1000 ohm, 10%, ½ w.
R172	Part of L112A	Resistor, 1000 ohm, 10%, ½ w.
R173	39373-33	Resistor, 1000 ohm, ½ w.
R174	39374-47	Resistor, 68,000 ohm, 10%, ½ w.
R175	B-148953	Control, Horizontal Hold (50,000 ohm)
R176	39374-137	Resistor, 100,000 ohm, 10%, 1 w.
R177	39374-71	Resistor, 2.7 megohm, 10%, ½ w.
R178	39374-60	Resistor, 820,000 ohm, 10%, ½ w.
R179	39374-36	Resistor, 8200 ohm, 10%, ½ w.
R180	39374-51	Resistor, 150,000 ohm, 10%, ½ w.
R181	39374-51	Resistor, 150,000 ohm, 10%, ½ w.
R182	39375-97	Resistor, 100,000 ohm, 5%, ½ w.
R183	39374-37	Resistor, 10,000 ohm, 10%, ½ w.
R184	39374-41	Resistor, 22,000 ohm, 10%, ½ w.
R187	39374-135	Resistor, 68,000 ohm, 10%, 1 w.
R188	39374-27	Resistor, 1500 ohm, 10%, ½ w.
R189	39373-92	Resistor, 1 megohm, ½ w.
R191	39374-220	Resistor, 39,000 ohm, 10%, 2 w.
R192	39374-219	Resistor, 33,000 ohm, 10%, 2 w.
R193	39374-29	Resistor, 2200 ohm, 10%, ½ w.
R194	39374-46	Resistor, 56,000 ohm, 10%, ½ w.
R195	39374-40	Resistor, 18,000 ohm, 10%, ½ w.
R196	B-149127	Resistor, 1300 ohm, 10%, 13 w.
R197	39374-141	Resistor, 220,000 ohm, 10%, 1 w.
R198	39374-93	Resistor, 22 ohm, 10%, 1 w.
R199	39374-195	Resistor, 330 ohm, 10%, 2 w.
R200	39374-195	Resistor, 330 ohm, 10%, 2 w.
R201	B-148951	Control, Focus (650 ohm)
R202	39375-119	Resistor, 820,000 ohm, 5%, ½ w.
R203	39373-1	Resistor, 10 ohm, ½ w.
R204	39374-51	Resistor, 150,000 ohm, 10%, ½ w.
R205	39375-71	Resistor, 8200 ohm, 5%, ½ w.
L101	AW-146763	Coil, 1st I. F.
L102	AW-146582	Coil, 2nd I. F.
L103	AW-146583	Coil, 3rd I. F.
L104	AW-147974	Coil, 4th I. F.
L105	AW-148983	Coil, 5th I. F.
L106	AW-149357	Coil, Video Peaking
L107	AW-146889	Coil, Video Peaking
L108	AW-149242	Coil, Video Peaking
L109	AW-146889	Coil, Video Peaking
L110	AW-148978	Induction, Width
L111	AW-148440	Coil, Delay
L112A	AC-148887-6	Yoke, Deflection Assembly
L112B		Yoke, Deflection
L113	AB-148971	Coil Assembly, Focus
L114	AW-146855	Coil, R. F. Choke
L115	B-149475	Choke, Filter (50 ohm)
T101	C-146782	Transformer, Sound Take-Off
T102	C-146874	Transformer, Ratio Detector
T103	B-149476	Transformer, Output
T104	B-146842-3	Transformer, Vertical Blocking Osc.
T105	B-149263	Transformer, Vertical Output
T106	AC-146698	Transformer, Horizontal Osc.
T107	AC-149146	Transformer, Horizontal Output

Symbol	Part No.	Description
T108	C-148975	Transformer, Power
F101	W-144898-1	Fuse (200 MA)
SW101	Part of R124A	Switch, Power
IC101	W-160426	Iron Core
IC102	W-160426	Iron Core
IC103	W-160426	Iron Core
IC104	W-160426	Iron Core
IC105	W-160426	Iron Core
IC106	39012-103	Iron Core
IC107	39012-96	Iron Core
IC108	39012-96	Iron Core
IC109	39012-97	Iron Core
IC110	39012-97	Iron Core
SP101	138762-5	Speaker (Less Choke and Transformer)
S101	W-148790	Socket, Speaker
CA101	C-132300-6	Cable & Plug Assy., Power
P101	G-131500-2	Plug, Speaker
P102	W-139900	Plug, Interlock
	B-149160-1	Brace, Deflection - Focus Assy.
	AD-149064-1	Bracket, Deflection - Focus
	AB-148853	Bracket, Deflection Yoke
	W-148854	Bracket, Control Mtg.
	W-148855	Bracket, Picture Tube Strap
	W-147883	Clip, Corona (V117 Tube)
	W-146909-1	Connector, Picture Tube Anode
	W-149316	Cover, Tube (V117)
	W-160362-1	Cushion (Rubber 2 3/16") Deflection Yoke
	B-160128-23	Cushion (Rubber, 1¾" x 1" x 3/16")
	B-160128-16	Cushion (Rubber 18" x 1" x 3/16")

Part No.	Description
W-160112-2	Grommet (Rubber, 3 used), Focus Coil
W-45580-1	Grommet (Rubber, 2 used) Chassis
W-138090-4	Insulator, Standoff
B-146480	Ion Trap
39033-18CL	Nut (6 used), Focus Coil
W-147306	Screw (3 used), Focus Coil
AC-148753	Shield & Cover Assy., High Voltage
AW-149214	Shielded Cable (32⅝")
AW-149215	Shielded Cable (36⅝")
W-149059	Shield Tube (V105)
B-147119-3	Socket & Cable Assy., Picture Tube
B-149098-4	Socket, Tube (V104, V105)
39437-1	Socket Tube (V111, V112, V114, V117)
W-146439-2	Socket, Tube (V113, V116)
39388	Socket, Tube (V115, V118)
W-146966	Socket, Tube (V101, V102, V103, V106, V109)
W-144732	Socket, Tube (V107, V110)
W-144668	Spring (Compression), Focus Coil
AB-148882-1	Strap, Picture Tube (L. H.)
AB-148882-2	Strap, Picture Tube (R. H.)
W-144957	Thumb Screw, Deflection Yoke

R. F. TUNER

Symbol No.	Part No.	Description
C1	C-137727-49	Capacitor, 27 mmf., 5%, 500 v., ceramic
C2	C-137727-49	Capacitor, 27 mmf., 5%, 500 v., ceramic
C3	C-137727-113	Capacitor, 1500 mmf., 500 v., ceramic
C4	B-148895-1	Capacitor, Trimmer
C5	C-137727-113	Capacitor, 1500 mmf., 500 v., ceramic
C6	C-137727-113	Capacitor, 1500 mmf., 500 v., ceramic
C7	C-137727-113	Capacitor, 1500 mmf., 500 v., ceramic
C8	C-137727-106	Capacitor, 6 mmf., ± .5 mmf., 500 v., ceramic
C9	B-148895-1	Capacitor, Trimmer
C10	C-137727-41	Capacitor, 15 mmf., 10%, 300 v., ceramic
C11	C-137727-113	Capacitor, 1500 mmf., 500 v., ceramic
C12	W-137398-2	Capacitor, 1 mmf., 500 v.
C13	C-137727-106	Capacitor, 6 mmf., ± .5 mmf., 500 v., ceramic
C14	B-148895-1	Capacitor, Trimmer
C15	C-137727-106	Capacitor, 6 mmf., ± .5 mmf., 500 v., ceramic
C16	W-137398-6	Capacitor, 4.7 mmf., 500 v.
R2	39374-12	Resistor, 82 ohm, 10%, ½ w.
R3	39374-39	Resistor, 15,000 ohm, 10%, ½ w.
R4	39374-34	Resistor, 5600 ohm, 10%, ½ w.
R5	39374-11	Resistor, 68 ohm, 10%, ½ w.
R6	39374-61	Resistor, 1 megohm, 10%, ½ w.
R7	39374-39	Resistor, 15,000 ohm, 10%, ½ w.
L1	B-148936-2	Coil, Antenna Shunt
L2A	W-149222	Inductor, Variable Three Section Inductuner
L2B		Inductor, Variable
L2C		Inductor, Variable
L3	AW-149071	Inductor, End (Antenna)

Symbol No.	Part No.	Description
L4	AW-149070	Inductor, End (R. F.)
L5	AW-149072	Choke, Plate
L6	AW-149088	Coil, I. F.
L7	AW-149063	Coil, I. F. Coupling
L8	AW-149062	Inductor, Shunt Oscillator
L9	AW-149069	Inductor, End (Oscillator)
L10	AW-149086	Coil, Converter Coupling
L11	B-148936-3	Choke, 8.2 mh., 10%
	AB-148839	Bracket & Stud Assy., Gear
	149417	Contact Assembly
	B-148920	Cover, R. F.
	149419	Cover, Inductuner
	AW-149156	Dial Sleeve & Gear Assy.
	AW-149124	Gear & Pinion Assy.
	149418	Nut (Lock), Inductuner Cover
	W-146634	Retainer, Dial Sleeve & Gear Assy.
	W-160243-2	Retainer, Gear & Pinion Assy.
	AW-149159	R. F. Tuner (Complete)
	149420	Screw, Shaft Clamp
	149410	Shaft Assembly
	W-149060	Shield, Tube (V2)
	W-149059	Shield, Tube (V1)
	W-149051	Socket, Tube (V2)
	B-149098-1	Socket, Tube (V1)
	149413	Spring (Steel "C" Washer), Shaft Retainer
	149414	Spring (Brass Washer), Shaft Thrust
	149416	Spring (Wire), Shaft Tension
	149411	Stop (No. 2 to 6)
	149412	Stop (No. 7)
	W-149180	Washer (Spring), Dial Sleeve & Gear Assy.
	149415	Washer (Fibre), Shaft Friction

MISCELLANEOUS

Part No.	Description
AD-149186	Antenna Assembly
AD-149129	Back & Power Cable Assy.
AW-149821	Cabinet (11-441MU)
AW-149822	Cabinet (11-461WU)
AW-149841	Cabinet (11-471MU)
W-160362-1	Cushion (Rubber), Chassis Mtg.
C-149128-1	Escutcheon (11-441MU, 11-461WU)
C-149128-2	Escutcheon (11-471BU)
150134-1	Grille Cloth (11-471BU)
AW-148865	Knob, Off-On Contrast (11-441MU, 11-461WU)
AW-148866	Knob, Volume (11-441MU, 11-461WU)
AW-148867	Knob, Tuning (11-441MU, 11-461WU)
AW-149852	Knob, Off-On Contrast (11-471BU)
AW-149854	Knob, Volume (11-471BU)
AW-149853	Knob, Tuning (11-471BU)

Part No.	Description
W-149046	Pointer, Dial
W-147921-3	Screw (Special), Chassis Mtg.
W-149126	Screw (Special), Cabinet Back
W-149158-1	Screw, Escutcheon (3 used; 11-441MU, 11-461WU)
W-149158-2	Screw, Escutcheon (3 used; 11-471BU)
W-144498-7	Screw, Window (11-471BU)
W-144498-3	Screw, Window (11-441MU, 11-461WU)
W-144498-4	Screw, Escutcheon (2 used)
W-148782	Spacer, Antenna Terminal Board
W-148848	Terminal Board, Antenna
W-149161	Washer (Composition), Escutcheon
R-148929-1	Window (11-441MU, 11-461WU)
R-148929-2	Window (11-471BU)

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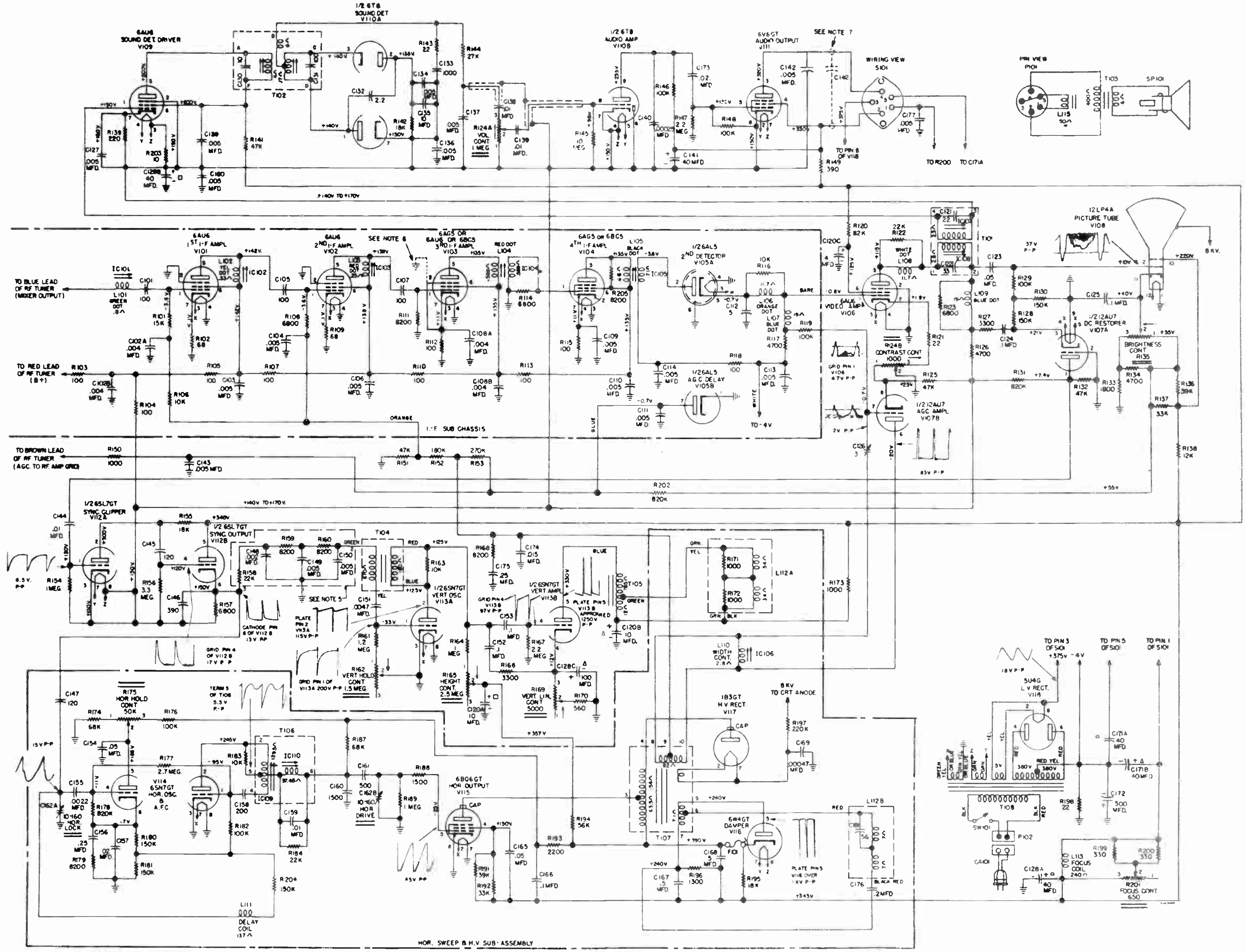
MODELS 11-441MU, 11-461WU, 11-471BU

(Chassis 320)



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TUBE COMPLEMENT

Symbol	Tube Type	Function	Symbol	Tube Type	Function
V1	6CB6	R. F. Amplifier	V111	6V6GT	Audio Output
V2	12AT7	V. H. F. Oscillator & Mixer	V112	6AU6	A. G. C. Amplifier
V101	6AU6	1st. I. F. Amplifier	V113	6SL7GT	Sync Clipper & Sync Output
V102	6AU6	2nd. I. F. Amplifier	V114	6C4	Vertical Oscillator
*V103	6AU6	3rd. I. F. Amplifier	V115	6V6GT	Vertical Amplifier
V104	6AG5 or 6BC5	4th. I. F. Amplifier	V116	6SN7GT	A. F. C. & Horiz. Osc.
V105	6AL5	2nd. Detector & A. G. C. Delay	V117	6BQ6GT	Horizontal Output
V106	6AH6	Video Amplifier	V118	6BQ6GT	Horizontal Output
V107	12AU7	D. C. Restorer, 1st. Sync Clipper & Noise Limiter	V119	1B3GT	H. V. Rectifier
			V120	6W4GT	Horiz. Damper
V108	17BP4	Picture Tube	V121	5U4G	L. V. Rectifier
V109	6AU6	Sound Detector Driver	V122	5U4G	L. V. Rectifier
V110	6T8	Sound Det. & 1st Audio Ampl.			

*Refer to Note 9 on Schematic Wiring Diagram

SOCKET VOLTAGE TABLE

The following voltages are measured with an electronic voltmeter from socket lugs to ground (chassis) while the set is operating on a 117 volt, 60 cycle A. C. current. Controls are set to obtain a normal picture with +15 volts D. C. on grid (Pin 2) of the picture tube. Some A. C. voltages measured between socket lugs as noted.

Voltages may vary depending upon the setting of the various controls.

Symbol	Tube Type	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Pin 9
V1	6CB6	-0.1	0.9	Gnd.	*6.3	120	115	Gnd.	....	....
V2	12AT7	140	-2.7	Gnd.	Gnd.	Gnd.	110	-5	Gnd.	*6.3
V101	6AU6	-3.2	Gnd.	*6.3	Gnd.	140	140	-2	....	....
V102	6AU6	-3.2	Gnd.	*6.3	Gnd.	140	140	<0.1	....	....
V103	6AU6	0	Gnd.	*6.3	Gnd.	135	135	0.9	....	....
V104	6AG5 or 6BC5	0	N. C.	Gnd.	*6.3	135	135	0.8	....	....
V105	6AL5	Gnd.	-4.8	*6.3	Gnd.	▲2.3	Gnd.	▲-2.4	....	....
V106	6AH6	▲2.3	Gnd.	*6.3	Gnd.	220	240	2.2	....	....
V107	12AU7	6.5	Gnd.	16	*6.3	*6.3	N. C.	▲2.3	4.8	Gnd.
V108	17BP4	Gnd.	15	....	....	....	(Pin 10) 350	(Pin 11) 45	(Pin 12) *6.3	Anode 12.3KV
V109	6AU6	0	Gnd.	*6.3	Gnd.	54	58	1	....	....
V110	6T8	-5.2	-7.6	-5.2	Gnd.	*6.3	Gnd.	Gnd.	-1	110
V111	6V6GT	N. C.	2 to 7 *6.3	350	360	135	W. J.	7 to 2 *6.3	175	....
V112	6AU6	-2.2	Gnd.	*6.3	Gnd.	-42	130	4.8	....	....
V113	6SL7GT	120	320	155	100	420	160	7 to 8 *6.3	8 to 7 *6.3	....
V114	6C4	N. C.	N. C.	*6.3	Gnd.	160	-36	Gnd.	....	....
V115	6V6GT	N. C.	*6.3	360	360	0.1	W. J.	Gnd.	33	....
V116	6SN7GT	-80	270	Gnd.	-25	140	-5	*6.3	Gnd.	....
V117	6BQ6GT	N. C.	*6.3	N. C.	120	-19	W. J.	Gnd.	Gnd.	....
V118	6BQ6GT	N. C.	*6.3	W. J.	120	-19	W. J.	Gnd.	Gnd.	....
V119	1B3GT	....	....	....	....	....	....	....	....	....
V120	6W4GT	N. C.	W. J.	515	N. C.	350	N. C.	7 to 8 *6.3	7 to 8 *6.3	....
V121	5U4G	N. C.	400	W. J.	*360	N. C.	*360	W. J.	400	....
V122	5U4G	N. C.	400	W. J.	*360	N. C.	*360	W. J.	400	....

All voltages plus volts unless otherwise noted.

The following symbols denote:

* = A. C. voltage
N. C. = No connection
W. J. = Wiring junction
< = less than
▲ = A.G.C. voltage (variable with signal strength)

Note: Models 11-444MU and 11-474BU are equipped with a Radio-Phone Unit (Radio chassis 332-Phone Unit V-950). For service information and parts lists refer to Radio Bulletin No. 418 and Record Changer Bulletin No. 408.

ADJUSTMENTS

1. The cathode ray tube should be located so that the center of its face is 6-1/2 inches above the chassis surface with the anode connector on the left when viewed from the front of the chassis.
2. I. F. Alignment (See I. F. Alignment).
3. The DEFLECTION YOKE is positioned as far forward as possible on the cathode ray tube and rotated so as to make the top and bottom of the raster parallel with the top of the chassis.
4. The FOCUS COIL should be adjusted to be approximately perpendicular to the cathode ray tube axis with the front surface of the focus coil housing approximately 15/32 inch from the rear surface of the deflection and focus coil mounting bracket.
5. The ION TRAP is positioned for maximum brightness, with low to medium setting of the Brightness Control, and for no cutoff of the picture at high setting of the Brightness Control.
6. Center the picture by adjusting the three FOCUS COIL mounting nuts.
7. Adjust size of picture to fill screen (as viewed from face of CRT) by the HEIGHT CONTROL, HORIZONTAL DRIVE, and WIDTH CONTROL.
8. HORIZONTAL HOLD ADJUSTMENT (See Horiz. Blocking Osc. Alignment).
9. HORIZONTAL HOLD CONTROL is adjusted with a weak picture to center of pull-in range.
10. VERTICAL HOLD CONTROL is also adjusted with a weak picture to center of pull-in range.
11. Vertical linearity is adjusted by the VERTICAL LINEARITY CONTROL and the HEIGHT CONTROL. Horizontal size is adjusted by the HORIZONTAL LINEARITY AND WIDTH adjustments.
12. The FOCUS CONTROL is adjusted for best focus of the vertical and horizontal wedges at center of test pattern. If there is any astigmatism, the focus should be set to favor the vertical wedge. If corner focus is poor, check position of DEFLECTION YOKE and ION TRAP.

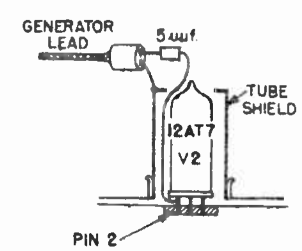
I. F. ALIGNMENT

1. To check I. F. alignment on oscilloscope:

   a. Connect a short clip lead from B- (-6.3 volts, white wire on C141) on the AGC terminal (orange lead) on the terminal board mounted on the I. F. strip close to L102.

   b. Connect high side of scope to the bare lead on pin 1 of the Video Amplifier V106, and the low side to ground (chassis).

   c. Connect sweep signal generator to the grid (pin 2) of the Mixer tube V2 (see illustration below) making sure that the leads are as short and direct as possible, connecting ground terminal of generator to the tube shield and the "hot" terminal through a 5 mmf. capacitor to the grid pin.

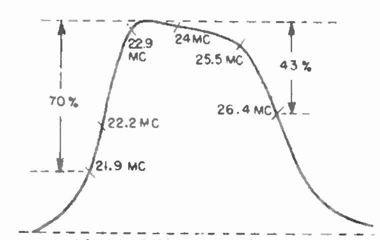


   d. Set generator to sweep from 20 mc. to 30 mc. and adjust output to provide a 2 volt peak to peak signal on the scope.

   e. Set tuner near the low frequency end of the range approximately 4 to 5 turns clockwise at a point where there are no spurious responses.

   f. Connect marker generator to sweep generator output leads and adjust to provide markers at 21.9 mc, 22.9 mc, 24 mc, 25.5 mc, and 26.4 mc.

   g. Observe curve and position of markers (see nominal response curve in column two), 21.9 mc. should be approximately 70% down from the peak and 26.4 approximately 43% down. Slight deviation in shape from the nominal response curve is permissible, but if any great variation is noted it will be necessary to realign the I. F. Amplifier. NOTE: The response curve may be distorted unless care is used in the method of connection to prevent feedback and regeneration.



NOMINAL OVERALL I-F RESPONSE CURVE

   h. Disconnect the generators, scope and the clip lead from B- to AGC terminal.

2. Connect a short clip lead from B- (-6.3 volts, white wire on C141) to the AGC terminal (orange lead) on the terminal board mounted on the I. F. strip close to L102.
3. Connect an electronic voltmeter across the 2nd Detector load resistor R117.
4. Connect signal generator as in (c) of "I. F. Alignment Check."
5. Set tuner near low frequency end of range approximately 4 to 5 turns clockwise at a point where there are no spurious responses.
6. Set signal generator to 24 mc. and adjust L105 for maximum meter deflection, limiting meter deflection to 2 volts d.c. by adjusting input attenuator.
7. Reset signal generator to 22.2 mc. and tune L104, in a similar manner.
8. Next set signal generator to 26.55 mc. and tune L103 for maximum meter deflection.
9. Reset signal generator to 22.9 mc. and tune L102.
10. Set signal generator to 25.5 mc. and tune L101 for maximum meter deflection.
11. Repeat steps 6, 7, 8, 9, and 10.
12. Disconnect signal generator, electronic voltmeter and clip lead from B- to the AGC terminal.

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MODELS 11-442M1U, 11-444MU, 11-453MU, 11-460MU, 11-470BU, 11-472B1U, 11-474BU, 11-483BU, Ch. 331

SOUND ALIGNMENT

1. Connect "hot" lead of signal generator to grid (pin #1) of V106. Set signal generator to 4.5 mc. with 400 cps. amplitude modulated signal modulated 30% or greater.

2. Connect scope to picture tube grid (pin #2) through detector probe.

3. Connect two 100 K ohm resistors (matched to within 1%) in series across ratio detector load resistor R143 (pin 2 of V110 to chassis). Connect common lead of the electronic voltmeter to the junction of the matched 100 K ohm resistors and the D.C. lead of the voltmeter to ground (chassis).

4. Using a high level signal input and with the Contrast control set at maximum, tune the Sound Take-off Transformer (T101) primary adjustment (bottom of chassis) for minimum deflection on the scope.

5. Reduce signal input to below limiting in V109 and adjust the Sound Take-off Transformer (T101) Secondary (Top of Chassis), and the Ratio Detector Transformer (T102) *primary for peak meter reading.

6. Repeat Steps 4 and 5.

7. Remove detector probe and scope from the picture tube grid.

8. Transfer D.C. lead only of the electronic voltmeter to junction of R144 and C133. (lower of T.V. phono switch terminal toward speaker socket.)

9. Return to high level signal input for limiting V109 and adjust the Ratio Detector Transformer (T102) *secondary for zero meter reading.

10. Remove the two 100 K ohm resistors and all test equipment from the receiver.

HORIZONTAL DRIVE

The setting of the HORIZONTAL DRIVE trimmer should be checked to see that no change in linearity in the center of the picture occurs with change in Contrast setting. When using two driver tubes in parallel operation, this setting becomes more critical than in single tube circuits. In adjusting the HORIZONTAL DRIVE trimmer it is necessary to observe the picture width and set the trimmer to the point of maximum width (toward minimum capacity). To set up this trimmer correctly, turn it counterclockwise until the picture width starts to decrease or until a compression in the center of the picture is noted, whichever condition occurs first. In the extreme case the compression in the center of the picture will appear as a vertical white line. A check should then be made to see if the horizontal linearity in the center of the picture changes with Contrast control setting. If it does, turn the drive trimmer slightly clockwise just enough to eliminate this change in linearity.

If the drive trimmer is misadjusted so that insufficient drive is applied to the tubes, they will draw excessive current which will seriously shorten their life. This condition corresponds to the drive trimmer being adjusted too far in the clockwise direction.

When it becomes necessary to replace one of the horizontal output tubes, two new tubes, matched to draw equal plate current should be chosen and both the driver tubes should be replaced.

After tube replacement, readjust the drive trimmer as outlined in the paragraph above. The best horizontal linearity coincides with the lowest plate dissipation of the horizontal driver tubes and this linearity should be obtained with the adjusting screw of the HORIZONTAL LINEARITY inductance as far out of the coil as possible. It should be noted that changing the linearity adjustment makes it necessary to readjust the HORIZONTAL DRIVE trimmer.

NOTE: In rare cases where low B+ voltage is encountered, it may be necessary to change the screen resistor connection of V117 and V118 to obtain sufficient width (see note 5 on schematic). Do not overdrive the tubes, make this change only if the width of the raster is not sufficient to cover face of the CRT.

A.G.C. ADJUSTMENT

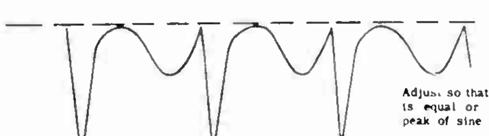
Tune in a station with a weak signal and adjust the A.G.C. threshold control on the rear apron of chassis to a point where the receiver will just begin to overload with the CONTRAST control set at maximum. If the receiver overloads on a strong signal, turn the CONTRAST control toward minimum to prevent overload.

HORIZONTAL BLOCKING OSCILLATOR ALIGNMENT

1. Tune receiver to a television signal and adjust CONTRAST control for normal picture below limiting in the video amplifier.

2. Adjust the HORIZONTAL HOLD control and the HORIZONTAL FREQUENCY adjustment (top of T106) until picture is in sync.

3. Connect scope in series with a 10 mmf. capacitor to terminal #5 of the HORIZONTAL BTO Transformer (T106) and adjust the HORIZONTAL BTO TRAP (bottom of T106) for the following wave form; keeping raster in sync by adjusting the HORIZONTAL HOLD control. HORIZONTAL FREQUENCY and/or HORIZONTAL LOCK adjustment.



Adjust so that the peak of pulse is equal or 10% higher than peak of sine wave.

4. Turn the HORIZONTAL HOLD control fully clockwise. Adjust the HORIZONTAL FREQUENCY control (top of T106) by turning out until the raster is just out of sync. and then turning the FREQUENCY control slowly in until the raster is just ready to fall into sync (indicated by a wide black vertical or diagonal horizontal blanking bar).

5. Turn the HORIZONTAL HOLD control fully counter-clockwise. Picture should normally be in sync. Remove the signal by tuning off the station then retune to the signal. If more than seven bars are present, adjust the HORIZONTAL LOCK trimmer slightly counter-clockwise until five to seven bars appear before the picture falls into sync when the HORIZONTAL HOLD control is set in the extreme counter-clockwise position. If less than five bars are present, adjust the LOCK trimmer clockwise. As the lock-in trimmer adjustment effects the horizontal frequency, the adjustments of both the horizontal frequency control and the lock-in trimmer must be repeated until the conditions outlined above in steps 4 and 5 exist simultaneously at the extreme positions of the horizontal hold control. Check pull-in range. Pull-in range should be 120° minimum and 220° maximum.

6. The final setting of the horizontal hold control should be made with a very weak picture.

Rotate the dial on and off the station and set the horizontal hold control so that the picture returns completely in sync.

The most important points in the Horizontal Oscillator and the AFC Alignment for most stable operation are: (1) that the raster just falls in sync at the clockwise end of the HORIZONTAL HOLD control, and (2) that the pull-in range is between 120° and 220°.

*Transformers (T102) with a red or green color code have the primary adjustment on bottom and the secondary adjustment on top. Transformers without a color code have the primary adjustment on top and the secondary adjustment on bottom.

REPLACEMENT PARTS
Main Chassis

Symbol No.	Part No.	Description
C101	C-137727-108	Capacitor, 100 mmf., 500 v., ceramic
C102A	C-144675-6	Capacitor, .004 mfd., 500 v. Two Section
C102B		Capacitor, .004 mfd., 500 v. disc ceramic
C103	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C104	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C105	C-137727-108	Capacitor, 100 mmf., 500 v., ceramic
C106	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C107	C-137727-108	Capacitor, 100 mmf., 500 v., ceramic
C108A	C-144675-6	Capacitor, .004 mfd., 500 v. Two Section
C108B		Capacitor, .004 mfd., 500 v. disc ceramic
C109	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C110	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C111	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C112	C-137727-103	Capacitor, 5 mmf., 10%, 500 v., ceramic
C113	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C114	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C118	Part of T101	Capacitor, 22 mmf., 10%, 500 v., ceramic
C119	Part of T101	Capacitor, 33 mmf., 5%, 500 v., ceramic
C120A	B-149106	Capacitor, 40 mfd., 475 v.
C120B		Capacitor, 10 mfd., 475 v. Four Section
C120C		Capacitor, 4 mfd., 350 v. Electrolytic
C120D		Capacitor, 40 mfd., 250 v.
C121	39001-19	Capacitor, .1 mfd., 600 v., paper
C122	39001-17	Capacitor, .05 mfd., 600 v., paper
C123	39001-19	Capacitor, .1 mfd., 600 v., paper
C124	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C125	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C126A	B-148429	Capacitor, 40 mfd., 475 v. Three Section
C126B		Capacitor, 40 mfd., 250 v. Electrolytic
C126C		Capacitor, 100 mfd., 50 v.
C127	Part of T102	Capacitor, 10 mmf., 500 v., mica
C128	Part of T102	Capacitor, 100 mmf., 500 v., mica
C129	39001-80	Capacitor, .02 mfd., 600 v., paper
C130	W-137398-4	Capacitor, 2.2 mmf., 500 v.
C131	C-137727-110	Capacitor, 1000 mmf., 10%, 500 v., ceramic
C132	B-149211	Capacitor, 10 mfd., 25 v., Electrolytic
C133	39001-74	Capacitor, .002 mfd., 600 v., paper
C134	39001-11	Capacitor, .005 mfd., 600 v., paper
C135	39001-13	Capacitor, .01 mfd., 600 v., paper
C136	39001-13	Capacitor, .01 mfd., 600 v., paper
**C137	39001-73	Capacitor, .00025 mfd., 600 v., paper
**C138	39001-13	Capacitor, .01 mfd., 600 v., paper
C139A	B-149261	Capacitor, 40 mfd., 350 v. Two Section
C139B		Capacitor, 10 mfd., 25 v. Electrolytic
C140	39001-11	Capacitor, .005 mfd., 600 v., paper
C141A	B-146633	Capacitor, 40 mfd., 475 v. Two Section
C141B		Capacitor, 40 mfd., 475 v. Electrolytic
C142	B-149262	Capacitor, 40 mfd., 100 v., Electrolytic
C143	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C144	39001-87	Capacitor, .25 mfd., 600 v., paper
C145	39001-14	Capacitor, .015 mfd., 600 v., paper
C146	39477-41	Capacitor, .01 mfd., 600 v., molded paper
C147	B-137498-17	Capacitor, 120 mmf., 10%, 500 v., mica
C148	B-137498-28	Capacitor, 390 mmf., 10%, 500 v., mica
*C149	39001-74	Capacitor, .002 mfd., 600 v., paper
*C150	39001-11	Capacitor, .005 mfd., 600 v., paper
*C151	39001-11	Capacitor, .005 mfd., 600 v., paper
C152	39478-39	Capacitor, .0047 mfd., 10%, 600 v., molded paper
C153	C-146434-6	Capacitor, .05 mfd., 10%, 400 v., paper
C154	39001-19	Capacitor, .1 mfd., 600 v., paper
C155	B-137498-24	Capacitor, 180 mmf., 10%, 500 v., mica
C156A	B-132386-17	Capacitor, Trimmer Two Section
C156B		Capacitor, Trimmer
C157	39477-37	Capacitor, .0022 mfd., 600 v., molded paper
C158	39001-87	Capacitor, .25 mfd., 600 v., paper
C159	39001-80	Capacitor, .02 mfd., 600 v., paper
C160	39001-17	Capacitor, .05 mfd., 600 v., paper
C161	B137498-47	Capacitor, 200 mmf., 5%, 1000 v., mica
C162	C-148813-2	Capacitor, .01 mfd., 10%, 400 v., paper
C163	B-137498-53	Capacitor, 1300 mmf., 5%, 500 v., mica
C164	B-137498-28	Capacitor, 390 mmf., 5%, 500 v., mica
C165	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C166	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
***C167	B-146944	Capacitor, 5 mfd., 25 v., Electrolytic
C168	B-148317-2	Capacitor, .5 mfd., 600 v., paper

*See Note 7 on Main Chassis Schematic Wiring Diagram.
**See Note 8 on Main Chassis Schematic Wiring Diagram.
***See Note 10 on Main Chassis Schematic Wiring Diagram.

Symbol No.	Part No.	Description
C169	39001-17	Capacitor, .05 mfd., 600 v., paper
C170	B-148317-3	Capacitor, .1 mfd., 600 v., paper
C171	C-146434-3	Capacitor, .1 mfd., 400 v., paper
C172	C-146434-10	Capacitor, .15 mfd., 400 v., paper
C173	W-147375	Capacitor, 500 mmf., 20 k.v.
C174	B-149488-2	Capacitor, .2 mfd., 200 v., paper
C175	B-149038	Capacitor, 500 mfd., 10 v., Electrolytic
C176	B-137498-60	Capacitor, 56 mmf., 1000 v., mica
C177	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C178	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C179	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
R101	39375-77	Resistor, 15,000 ohm, 5%, ½ w.
R102	39374-11	Resistor, 68 ohm, 10%, ½ w.
R103	39373-14	Resistor, 100 ohm, ½ w.
R104	39373-14	Resistor, 100 ohm, ½ w.
R105	39373-14	Resistor, 100 ohm, ½ w.
R106	39373-54	Resistor, 10,000 ohm, ½ w.
R107	39373-14	Resistor, 100 ohm, ½ w.
R108	39375-69	Resistor, 6800 ohm, 5%, ½ w.
R109	39374-11	Resistor, 68 ohm, 10%, ½ w.
R110	39373-14	Resistor, 100 ohm, ½ w.
R111	39375-71	Resistor, 8200 ohm, 5%, ½ w.
R112	39374-13	Resistor, 100 ohm, 10%, ½ w.
R113	39373-14	Resistor, 100 ohm, ½ w.
R114	39375-69	Resistor, 6800 ohm, 5%, ½ w.
R115	39375-25	Resistor, 100 ohm, 5%, ½ w.
R116	Part of L106	Resistor, 10,000 ohm, 5%, ½ w.
R117	39375-65	Resistor, 4700 ohm, 5%, ½ w.
R118	39373-14	Resistor, 100 ohm, ½ w.
R119	39374-49	Resistor, 100,000 ohm, 10%, ½ w.
R120	Part of L111	Resistor, 22,000 ohm, 10%, ½ w.
R121	39374-9	Resistor, 47 ohm, 10%, ½ w.
R122	39374-136	Resistor, 82,000 ohm, 10%, 1 w.
R123	39375-221	Resistor, 10,000 ohm, 5%, 1 w.
R124	39375-369	Resistor, 10,000 ohm, 5%, 2 w.
R125	39374-35	Resistor, 6800 ohm, 10%, ½ w.
R126	39374-31	Resistor, 3300 ohm, 10%, ½ w.
R127	39374-60	Resistor, 820,000 ohm, 10%, ½ w.
R128	39374-49	Resistor, 100,000 ohm, 10%, ½ w.
R129	39374-52	Resistor, 180,000 ohm, 10%, ½ w.
R130	39374-50	Resistor, 120,000 ohm, 10%, ½ w.
R131	39374-45	Resistor, 47,000 ohm, 10%, ½ w.
R132	39374-142	Resistor, 270,000 ohm, 10%, 1 w.
R133	B-148966	Control, Brightness (40,000 ohm)
R134	39374-123	Resistor, 6800 ohm, 10%, 1 w.
R135	39374-29	Resistor, 2200 ohm, 10%, ½ w.
R136	39374-220	Resistor, 39,000 ohm, 10%, 2 w.
R137	39374-221	Resistor, 47,000 ohm, 10%, 2 w.
R138	39374-123	Resistor, 6800 ohm, 10%, 1 w.
R139	39374-194	Resistor, 270 ohm, 10%, 2 w.
R140	39374-17	Resistor, 220 ohm, 10%, ½ w.
†R141	39374-5	Resistor, 22 ohm, 10%, ½ w.
R142	39374-130	Resistor, 27,000 ohm, 10%, 1 w.
R143	39375-79	Resistor, 18,000 ohm, 5%, ½ w.
R144	39374-42	Resistor, 27,000 ohm, 10%, ½ w.
R145A	C-149220	Control (Volume), 1 megohm Two
R145B		Control (Contrast), 2000 ohm Section
R146	39374-47	Resistor, 68,000 ohm, 10%, ½ w.
R147	39374-75	Resistor, 3.9 megohm, 10%, ½ w.
**R148	39374-53	Resistor, 220,000 ohm, 10%, ½ w.
R149	39374-42	Resistor, 27,000 ohm, 10%, ½ w.
**R150	39374-57	Resistor, 470,000 ohm, 10%, ½ w.
R151	39374-196	Resistor, 390 ohm, 10%, 2 w.
R153	39373-33	Resistor, 1000 ohm, ½ w.
R154	39375-115	Resistor, 560,000 ohm, 5%, ½ w.
R155	39375-109	Resistor, 330,000 ohm, 5%, ½ w.
R156	39375-97	Resistor, 100,000 ohm, 5%, ½ w.
R157	39374-36	Resistor, 8200 ohm, 10%, ½ w.
R158	39375-71	Resistor, 8200 ohm, 5%, ½ w.
R159	W-148861	Control, A.G.C. (1000 ohm)
R162	B-148963	Control, Focus (3000 ohm)
R163	W-148554-2	Resistor, 330 ohm, 10%, 7 w.
R164	39374-61	Resistor, 1 megohm, 10%, ½ w.

†See Note 11 on Main Chassis Schematic Wiring Diagram.

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REPLACEMENT PARTS LIST

Main Chassis

Symbol No.	Part No.	Description
R165	39373-100	Resistor, 3.3 megohm, ½ w.
R166	39374-40	Resistor, 18,000 ohm, 10%, ½ w.
R167	39374-35	Resistor, 6800 ohm, 10%, ½ w.
•R168	39374-41	Resistor, 22,000 ohm, 10%, ½ w.
•R169	39374-36	Resistor, 8200 ohm, 10%, ½ w.
•R170	39374-36	Resistor, 8200 ohm, 10%, ½ w.
R171	39374-63	Resistor, 1.2 megohm, 10%, ½ w.
R172	B-148952	Control, Vertical Hold (1.5 megohm)
R173	39374-37	Resistor, 10,000 ohm, 10%, ½ w.
R174	39374-53	Resistor, 220,000 ohm, 10%, ½ w.
R175	B-148964	Control, Height (2.5 megohm)
R176	39374-69	Resistor, 2.2 megohm, 10%, ½ w.
R177	39374-36	Resistor, 8200 ohm, 10%, ½ w.
R178	39374-113	Resistor, 1000 ohm, 10%, 1 w.
R179	B-148965	Control, Vertical Linearity (5000 ohm)
R180	39374-205	Resistor, 2200 ohm, 10%, 2 w.
R181	Part of L118A	Resistor, 1000 ohm, 10%, ½ w.
R182	Part of L118A	Resistor, 1000 ohm, 10%, ½ w.
R183	39374-47	Resistor, 68,000 ohm, 10%, ½ w.
R184	B-148953	Control, Horizontal Hold (50,000 ohm)
R185	39374-137	Resistor, 100,000 ohm, 10%, 1 w.
R186	39374-71	Resistor, 2.7 megohm, 10%, ½ w.
R187	39374-60	Resistor, 820,000 ohm, 10%, ½ w.
R188	39374-36	Resistor, 8200 ohm, 10%, ½ w.
R189	39374-51	Resistor, 150,000 ohm, 10%, ½ w.
R190	39374-51	Resistor, 150,000 ohm, 10%, ½ w.
R191	39375-97	Resistor, 100,000 ohm, 5%, ½ w.
R192	39374-37	Resistor, 10,000 ohm, 10%, ½ w.
R193	39374-41	Resistor, 22,000 ohm, 10%, ½ w.
R194	39374-51	Resistor, 150,000 ohm, 10%, ½ w.
R197	39374-135	Resistor, 68,000 ohm, 10%, 1 w.
R198	39373-14	Resistor, 100 ohm, ½ w.
R199	39373-92	Resistor, 1 megohm, ½ w.
•••R200	39374-97	Resistor, 47 ohm, 10%, 1 w.
R201	39373-14	Resistor, 100 ohm, ½ w.
R202	39373-14	Resistor, 100 ohm, ½ w.
R203	39373-14	Resistor, 100 ohm, ½ w.
R204	39374-222	Resistor, 56,000 ohm, 10%, 2 w.
R205	39375-71	Resistor, 8200 ohm, 5%, ½ w.
R206	39374-123	Resistor, 6800 ohm, 10%, 1 w.
R207	39374-40	Resistor, 18,000 ohm, 10%, ½ w.
R208	39374-41	Resistor, 22,000 ohm, 10%, ½ w.
R209	39374-123	Resistor, 6800 ohm, 10%, 1 w.
R210	39373-33	Resistor, 1000 ohm, ½ w.
R211	39303-19	Resistor, 8.2 ohm, 10%, ½ w. W.W.
R212	39373-202	Resistor, 1 megohm, 1 w.
R213	39374-93	Resistor, 22 ohm, 10%, 1 w.
R214	Part of T107	Resistor, 15,000 ohm, 10%, 2 w.
R215	39374-222	Resistor, 56,000 ohm, 10%, 2 w.
L101	AW-146763	Coil, 1st. I.F.
L102	AW-146582	Coil, 2nd. I.F.
L103	AW-146583	Coil, 3rd. I.F.
L104	AW-147974	Coil, 4th. I.F.
L105	AW-148983	Coil, 5th. I.F.
L106	AW-149357	Coil, Video Peaking
L107	AW-146889	Coil, Video Peaking
L110	AW-146889	Coil, Video Peaking
L111	AW-149242	Coil, Video Peaking
L112	AW-148440	Coil, Delay
L113	AW-148452	Inductor, Horizontal Linearity
L114	AW-143934	Choke, R.F. Heater
L115	AW-146570	Coil, Choke
L117	B-149475	Choke, 50 ohm
L118A	AC-148887-6	Yoke, Deflection } Assembly
L118B		Yoke, Deflection } Assembly
L119	AB-149539	Coil Assembly, Focus
L120	AW-149492	Inductor, Width and A.G.C.
T101	AC-146782	Transformer, Sound Take-off

Symbol No.	Part No.	Description
T102	C-146874	Transformer, Ratio Detector
T104	B-146842-3	Transformer, Vertical Blocking Osc.
T105	B-148970	Transformer, Vertical Output
T106	AC-146698	Transformer, Horizontal Osc.
T107	AD-149567	Transformer, Horizontal Output
T108	C-148950	Transformer, Power
T110	B-149654	Transformer, Audio Output
F101	W-150065	Fuse
SW101	W-148260	Switch, T.V.-Phono
SW102	Part of R145A	Switch, On-Off (Power)
IC101	W-160426	Iron Core
IC102	W-160426	Iron Core
IC103	W-160426	Iron Core
IC104	W-160426	Iron Core
IC105	W-160426	Iron Core
IC106	39012-103	Iron Core
IC107	39012-102	Iron Core
IC108	39012-96	Iron Core
IC109	39012-96	Iron Core
IC110	39012-97	Iron Core
IC111	39012-97	Iron Core
SP101	AD-149502	Speaker, 5 1/4", 50 ohm E.M. (11-442 M1U, 11-472 B1U)
SP103	138762-5	Speaker, Less Choke and Trans.
S102	W-148790	Socket, Speaker
CA102	C-132300-6	Cable & Plug Assy., Power (11-444MU, 11-474BU
P101	G-131500-2	Plug, Speaker
P102	W-139900	Plug, Interlock
J101	W-136998	Connector, Phono
	AC-149718	Bracket, Deflection-Focus
	AB-148462	Bracket, Deflection Yoke
	W-148854	Bracket, Control Mtg.
	B-149160-1	Brace, Deflection-Focus Assy.
	AW-149565	Cable, Shielded (35")
	W-146909-1	Connector, Picture Tube Anode
	AW-149188	Clip, Corona
	W-149316	Cover, Tube (V119)
	W-160362-1	Cushion (Rubber 2 9/16"), Deflection Yoke
	B-160128-27	Cushion (Rubber 23" x 1 1/4" x 3/16")
	W-160112-2	Grommet (Rubber, 3 used), Focus Coil
	W-45580-1	Grommet (Rubber, 2 used) Chassis
	W-138090-4	Insulator, Stand-off
	B-148484	Ion Trap
	39033-18CL	Nut (6 used), Focus Coil
	W-147306	Screw (3 used), Focus Coil
	AC-148753	Shield Assy., High Voltage
	AB-149798	Shield, Corona (V119 Socket)
	C-149179	Shield, Tube (V117, V118)
	W-149059	Shield, Tube (V104, V105)
	AB-149516-2	Socket and Board Assy. (V119)
	B-147119-4	Socket and Cable Assy., Picture Tube
	39437-1	Socket, Tube, (V111, V113, V116)
	W-146439-2	Socket, Tube (V115, V120)
	39388	Socket, Tube (V117, V118, V121, V122)
	W-146966	Socket, Tube (V101, V102, V103, V106, V109, V112, V114)
	W-144732	Socket, Tube (V107, V110)
	B-149098-4	Socket, Tube (V104, V105)
	W-149531	Spring, Capacitor (C173)
	W-149671	Spring (Grounding), Picture Tube
	W-144668	Spring (Compression, 3 used), Focus Coil
	AB-149698	Strap and Bracket Assy., Picture Tube
	W-147474	Stud (Mtg.), Capacitor (C173)
	AB-149697	Support and Bracket Assy., Picture Tube
	W-149322	Support, Anode

•See Note 7 on Main Chassis Schematic Wiring Diagram.
•••See Note 10 on Main Chassis Schematic Wiring Diagram.

R. F. TUNER

Symbol No.	Part No.	Description
C1	C-137727-49	Capacitor, 27 mmf., 5%, 500 v., ceramic
C2	C-137727-49	Capacitor, 27 mmf., 5%, 500 v., ceramic
C3	C-137727-113	Capacitor, 1500 mmf., 500 v., ceramic
C4	B-148895-1	Capacitor, Trimmer
C5	C-137727-113	Capacitor, 1500 mmf., 500 v., ceramic
C6	C-137727-113	Capacitor, 1500 mmf., 500 v., ceramic
C7	C-137727-113	Capacitor, 1500 mmf., 500 v., ceramic
C8	C-137727-106	Capacitor, 6 mmf., ± .5 mmf., 500 v., ceramic
C9	B-148895-1	Capacitor, Trimmer
C10	C-137727-41	Capacitor, 15 mmf., 10%, 300 v., ceramic
C11	C-137727-113	Capacitor, 1500 mmf., 500 v., ceramic
C12	W-137398-2	Capacitor, 1 mmf., 500 v.
C13	C-137727-106	Capacitor, 6 mmf., ± .5 mmf., 500 v., ceramic
C14	B-148895-1	Capacitor, Trimmer
C15	C-137727-106	Capacitor, 6 mmf., ± .5 mmf., 500 v., ceramic
C16	W-137398-6	Capacitor, 4.7 mmf., 500 v.
R2	39374-12	Resistor, 82 ohm, 10%, ½ w.
R3	39374-39	Resistor, 15,000 ohm, 10%, ½ w.
R4	39374-34	Resistor, 5600 ohm, 10%, ½ w.
R5	39374-11	Resistor, 68 ohm, 10%, ½ w.
R6	39374-61	Resistor, 1 megohm, 10%, ½ w.
R7	39374-39	Resistor, 15,000 ohm, 10%, ½ w.
L1	B-148936-2	Coil, Antenna Shunt
L2A	W-149222	Inductor, Variable } Three Section Inductuner
L2B		Inductor, Variable } Three Section Inductuner
L2C		Inductor, Variable } Three Section Inductuner
L3	AW-149071	Inductor, End (Antenna)

Symbol No.	Part No.	Description
L4	AW-149070	Inductor, End (R. F.)
L5	AW-149072	Choke, Plate
L6	AW-149088	Coil, I. F.
L7	AW-149063	Coil, I. F. Coupling
L8	AW-149062	Inductor, Shunt Oscillator
L9	AW-149069	Inductor, End (Oscillator)
L10	AW-149086	Coil, Converter Coupling
L11	B-148936-3	Choke, 8.2 mh., 10%
	AB-148839	Bracket & Stud Assy., Gear
	149417	Contact Assembly
	B-148920	Cover, R. F.
	149419	Cover, Inductuner
	AW-149156	Dial Sleeve & Gear Assy.
	AW-149124	Gear & Pinion Assy.
	149418	Nut (Lock), Inductuner Cover
	W-146634	Retainer, Dial Sleeve & Gear Assy.
	W-160243-2	Retainer, Gear & Pinion Assy.
	AW-149159	R. F. Tuner (Complete)
	149420	Screw, Shaft Clamp
	149410	Shaft Assembly
	W-149060	Shield, Tube (V2)
	W-149059	Shield, Tube (V1)
	W-149051	Socket, Tube (V2)
	B-149098-1	Socket, Tube (V1)
	149413	Spring (Steel "C" Washer), Shaft Retainer
	149414	Spring (Brass Washer), Shaft Thrust
	149416	Spring (Wire), Shaft Tension
	149411	Stop (No. 2 to 6)
	149412	Stop (No. 7)
	W-149180	Washer (Spring), Dial Sleeve & Gear Assy.
	149415	Washer (Fibre), Shaft Friction

Miscellaneous

Symbol No.	Part No.	Description
	AC-149376	Antenna Assembly (11-442M1U, 11-472B1U)
	AD-149717	Antenna Assembly (11-444MU, 11-474BU)
	AD-149877	Antenna Assembly (11-460MU, 11-470BU)
	AD-149744	Antenna Assembly (11-453MU, 11-483BU)
	AD-149379	Back and Power Cable Assy., (11-442M1U, 11-472B1U)
	AD-149604	Back and Power Cable Assy., (11-444MU, 11-474BU)
	AC-149835	Back and Power Cable Assy., (11-453MU, 11-483BU)
	AC-150391	Back and Power Cable Assy., (11-460MU, 11-470BU)
	R-150181	Base (11-551M), Solid Front (11-442M1U)
	R-150254	Base (11-552M), With Doors (11-442M1U)
	R-150182	Base (11-561B), Solid Front (11-472B1U)
	R-150311	Base (11-562B), With Doors (11-472B1U)
	W-150069	Button, Hole Plug (11-442M1U, (11-460MU, 11-470BU, 11-472B1U)
	R-150387	Cabinet (11-442M1U)
	D-149462	Cabinet (11-444MU)
	R-149741	Cabinet (11-453MU)
	R-150335	Cabinet (11-460MU)
	R-150371	Cabinet (11-470BU)
	R-149828	Cabinet (11-472B1U)
	R-149950	Cabinet (11-474BU)
	R-149855	Cabinet (11-483BU)
	W-146335	Clamp, Cabinet Back
	W-160362-1	Cushion (Rubber), Chassis Mtg.
	D-149040-1	Door, Control Access (11-442M1U, 11-444MU, 11-453MU, 11-460MU)
	D-149040-2	Door, Control Access (11-470BU, 11-472B1U, 11-474BU, 11-483BU)
	149464	Doors (1 pair), Cabinet (11-444MU)
	150370	Doors (1 pair), Cabinet (11-460MU)
	150372	Doors (1 pair), Cabinet (11-470BU)
	150046	Doors (1 pair), Cabinet (11-474BU)
	AC-149128-1	Escutcheon Assy., (11-442M1U, 11-444MU, 11-453MU, 11-460MU)
	AC-149128-2	Escutcheon Assy., (11-472B1U, 11-470BU, 11-474BU, 11-483BU)
	D-149774-1	Front, Mock Record Album (11-444MU)
	D-149774-2	Front, Mock Record Album (11-474BU)
	149097	Grille Cloth (11-460MU)
	149939	Grille Cloth (11-470BU, 11-474BU, 11-483BU)
	146786	Hinge, Upper Left and Lower Right (11-460MU)
	146787	Hinge, Upper Right and Lower Left (11-460MU)

Symbol No.	Part No.	Description
	149942	Hinge, Upper Left and Lower Right (11-470BU)
	149943	Hinge, Upper Right and Lower Left (11-470BU)
	147519-2	Hinge, Upper Left and Lower Right (11-474BU)
	147529-2	Hinge, Upper Right and Lower Left (11-474BU)
	147519-1	Hinge, Upper Left and Lower Left (11-444MU)
	147529-1	Hinge, Upper Right and Lower Left (11-444MU)
	AW-148865	Knob, Off-On-Contrast (11-442M1U, 11-444MU, 11-453MU, 11-460MU)
	AW-148866	Knob, Volume (11-442M1U, 11-444MU, 11-453MU, 11-460MU)
	AW-148867	Knob, Tuning (11-442M1U, 11-444MU, 11-453MU, 11-460MU)
	AW-149852	Knob, Off-On-Contrast (11-470BU, 11-472B1U, 11-474BU, 11-483BU)
	AW-149854	Knob, Volume (11-470BU, 11-472B1U, 11-474BU, 11-483BU)
	AW-149853	Knob, Tuning (11-470BU, 11-472B1U, 11-474BU, 11-483BU)
	W-149046	Pointer, Tuning
	147568	Pull, Door Handle (11-444MU, 11-474BU)
	149733	Pull, Door Handle (11-460MU)
	W-147921-1	Screw (Special) Chassis Mtg. (11-442M1U, 11-444MU, 11-453MU, 11-472B1U, 11-474BU, 11-483BU)
	W-147921-2	Screw (Special), Chassis Mtg. (11-460MU, 11-470BU)
	W-149158-1	Screw (3 used), Escutcheon (11-442M1U, 11-444MU, 11-453MU, 11-460MU)
	W-149158-2	Screw (3 used), Escutcheon (11-470BU, 11-472B1U, 11-474BU, 11-483BU)
	W-144498-4	Screw (2 used) Escutcheon
	W-144498-5	Screw, Window (11-442M1U, 11-444MU, 11-453MU, 11-460MU)
	W-144498-8	Screw, Window (11-472B1U)
	39355-46XA	Screw, Window (11-470BU, 11-474BU, 11-483BU)
	W-148782	Spacer, Antenna Terminal Assy.
	139319SB	Strike and Catch, Door (11-444MU, 11-460MU)
	149941	Strike and Catch, Door (11-470BU, 11-474BU)
	AW-149603	Terminal Assembly, Antenna
	W-149161	Washer (Composition), Window
	R-149691-1	Window (11-442M1U, 11-444MU, 11-453MU, 11-460MU)
	R-149691-2	Window (11-470BU, 11-472B1U, 11-474BU, 11-483BU)

MODELS 11-442M1U, 11-444MU, 11-453MU, 11-460MU, 11-470BU, 11-472B1U, 11-474BU, 11-483BU, Ch. 331

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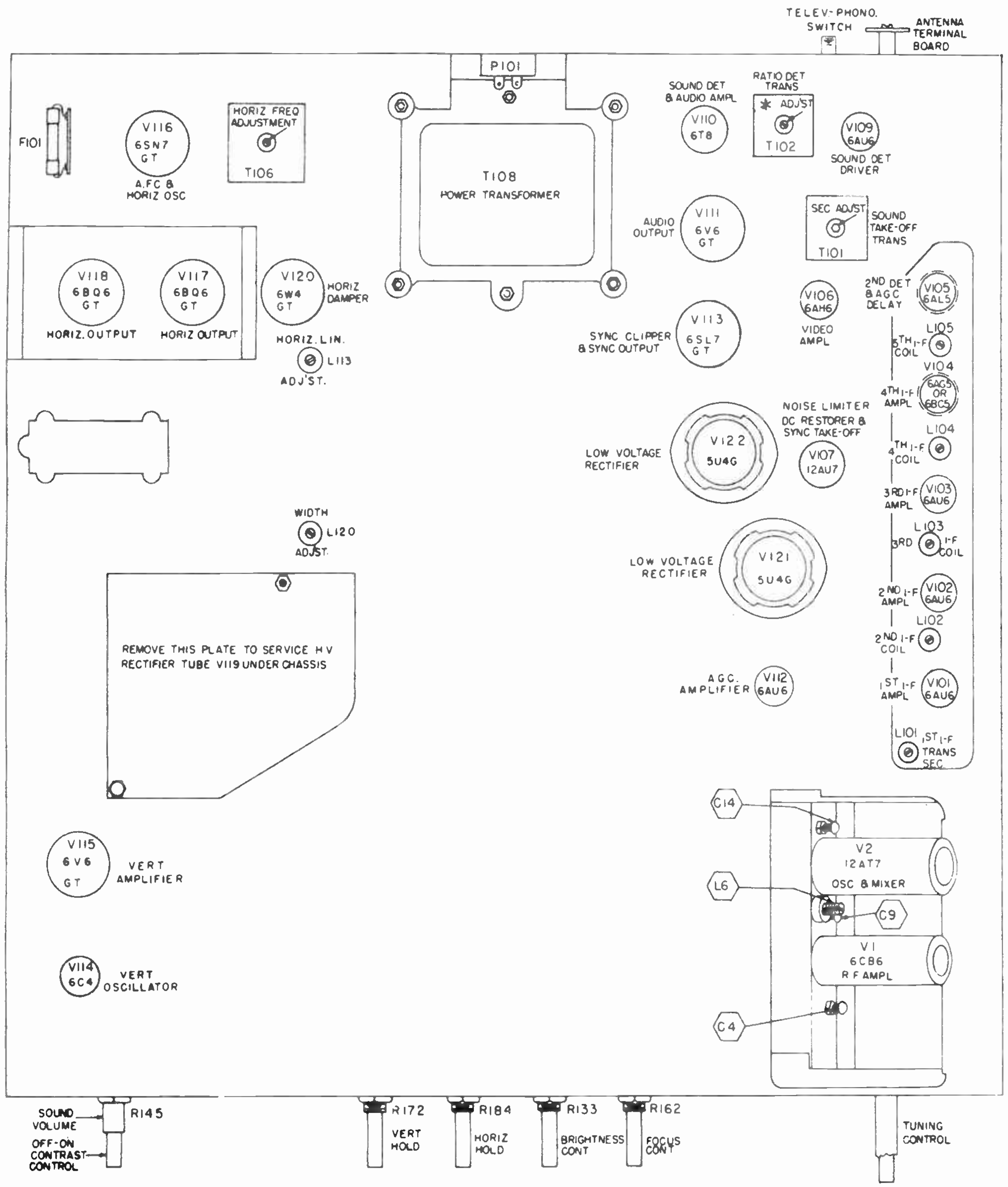
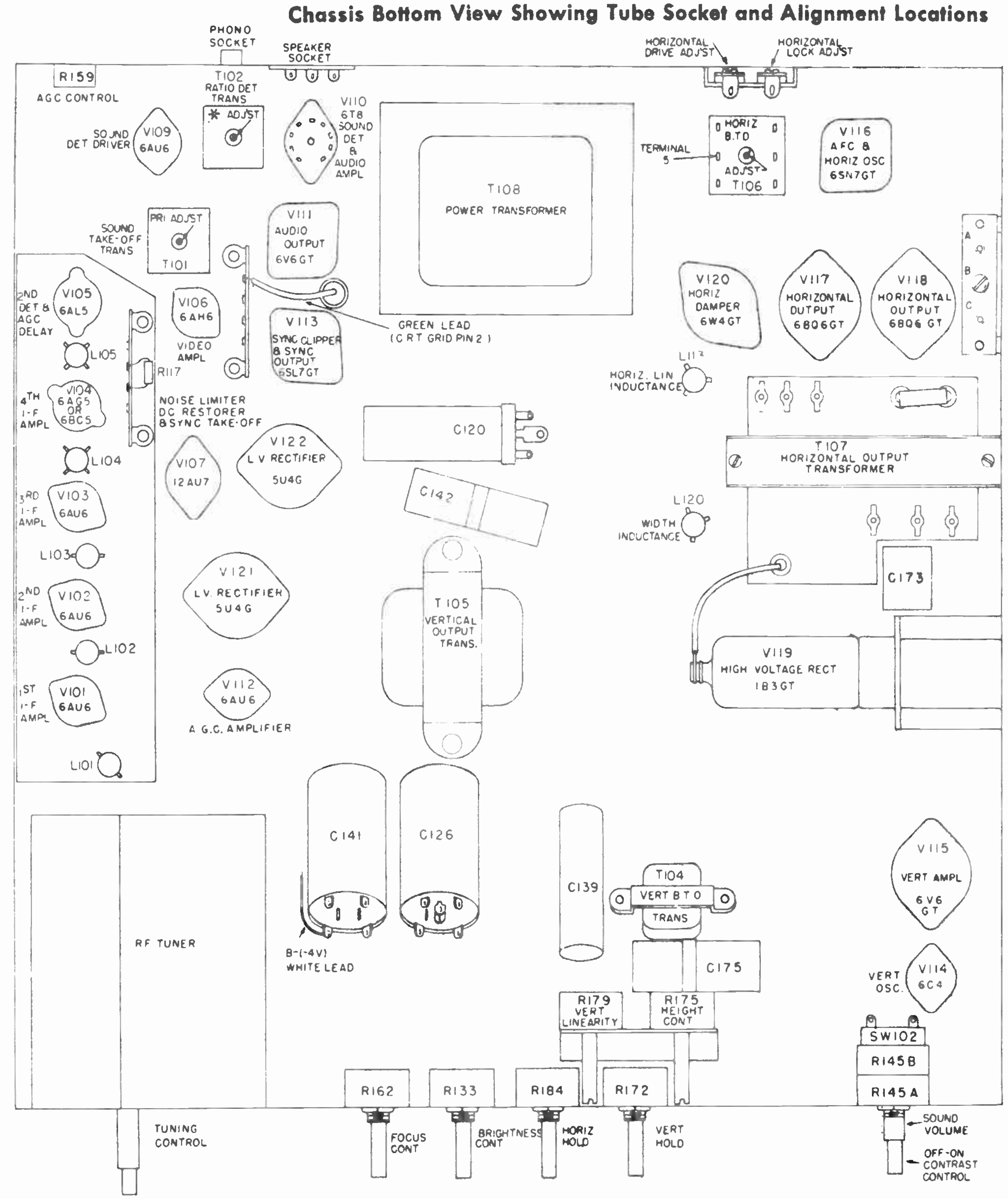
Chassis Top View Showing Tube and Alignment Locations



Chassis Bottom View Showing Tube Socket and Alignment Locations



*Transformers (T102) with a red or green color code have the primary adjustment on bottom and the secondary adjustment on top. Transformers without a color code have the primary adjustment on top and the secondary adjustment on bottom.

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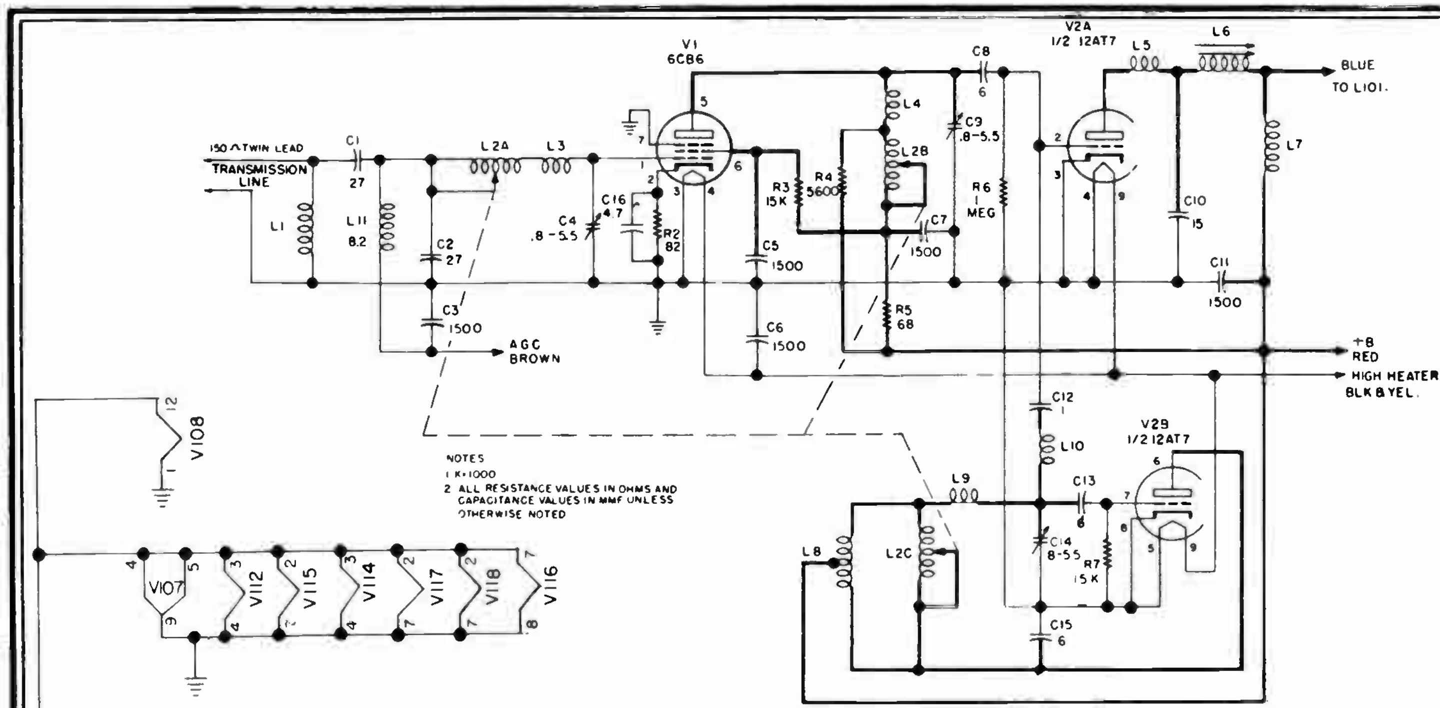


R. F. TUNER SCHEMATIC DIAGRAM

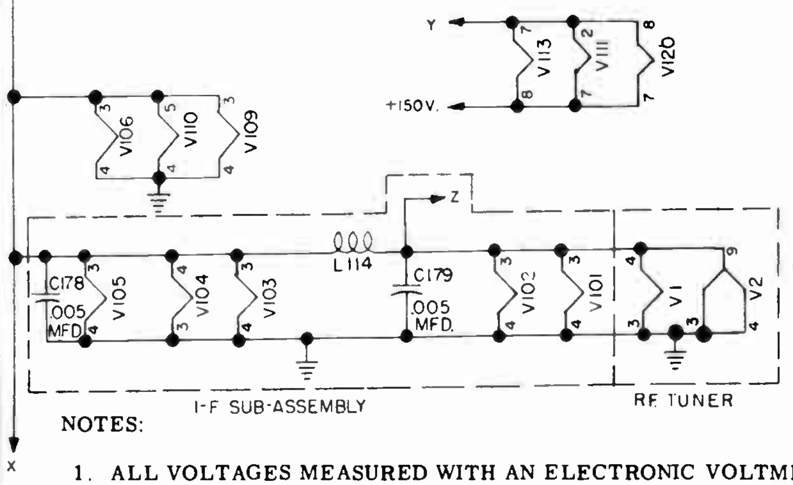


DIAGRAM OF VERTICAL INTEGRATOR SEE NOTE 7

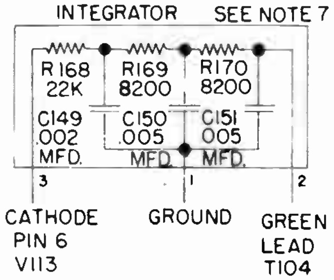
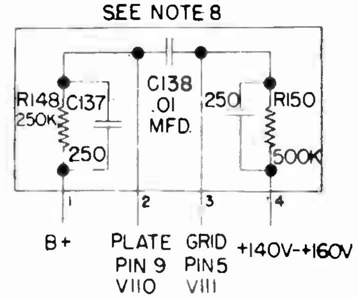


DIAGRAM OF AUDIO COUPLING SEE NOTE 8



NOTES:

1. ALL VOLTAGES MEASURED WITH AN ELECTRONIC VOLTMETER CONNECTED FROM SOCKET LUG TO CHASSIS.
2. SUPPLY VOLTAGE 117V., 60 CYCLE AC.
3. K = 1000
4. ALL CAPACITANCE VALUES IN MMF. & ALL RESISTANCE VALUES IN OHMS UNLESS OTHERWISE NOTED.
5. SCREEN VOLTAGE ADJUSTMENT FOR V117 & V118

   NOMINAL — TERMINAL B
   HIGH — TERMINAL A
   LOW — TERMINAL C
6. SOME SETS ARE EQUIPPED WITH A BARE WIRE SHUNTING R207. IF HORIZONTAL DRIVE IS EXCESSIVE, REMOVE THE BARE WIRE ACROSS R207.
7. IN SOME RECEIVERS, C149, C150, C151, R168, R169, AND R170 ARE A RESISTOR-CAPACITOR UNIT, (PART NO. W-149878). SEF DIAGRAM ABOVE.
8. IN SOME RECEIVERS C137, C138, R148 AND R150 ARE A RESISTOR-CAPACITOR UNIT (PART NO. W-149881). SEE DIAGRAM ABOVE.
9. ON SOME SETS LUG 2 OF V103 IS CONNECTED TO GROUND AND NOT TO LUG 7. THESE SETS ARE EQUIPPED WITH A 6AU6 TUBE. BY CONNECTING LUG 2 TO LUG 7 AS SHOWN BY THE SOLID LINES IN SCHEMATIC, EITHER A 6AG5, 6AU6, OR 6BC5 TUBE MAY BE USED IN THE V103 SOCKET. WHEN REPLACING THIS TUBE, RE-ALIGN THE 3rd. I.F. STAGE.
10. ON SETS LABELED TO USE A 175 M.A. DELAY TYPE FUSE (PART NO. W-150065), C167 AND R200 ARE DELETED; THE CATHODES OF V117 AND V118 ARE THEN GROUNDED. IN THE FIELD, IT IS NOT NECESSARY TO REMOVE C167 AND R200 AND TO GROUND THE CATHODES WHEN REPLACING THE FUSE WITH A DFLAY TYPE FUSE.
11. SOME SETS ARE EQUIPPED WITH A 68 OHM, 10%, 1/2 WATT RESISTOR (PART NO. 39374-11).
12. IN EARLY PRODUCTION RECEIVERS, C140 IS CONNECTED AS SHOWN BY DOTTED LINES. IN LATER PRODUCTION SETS, C140 IS CONNECTED AS SHOWN BY SOLID LINES TO PREVENT PARASITIC OSCILLATION IN THE AUDIO OUTPUT TUBE.

SUBJECT— SERVICE SUGGESTIONS - 1951 TELEVISION RECEIVERS

To Reduce Hum or Buzz:

1. Make certain that electrolytic capacitor (C120) has a good ground connection by soldering a wire from the chassis to one of the ground lugs on the capacitor. This should be done on all sets contacted in the field to prevent trouble developing as the set ages. Later production sets have the capacitor grounded in this manner.
2. Make certain that the sections of the electrolytic capacitor (C120) are properly connected as shown by the schematic.
3. If the shield in back of the contrast control has been removed, be sure to replace it.
4. On sets equipped with a resistor-capacitor unit (Part No. W-149881), dress the coupling capacitor (C122) as far as possible away from the resistor-capacitor unit.
5. If necessary, remove the resistor (R141).
6. Adjust the ratio-detector transformer (T102) secondary for minimum hum or buzz, while the set is tuned to the station. Only a slight adjustment is required. If the screw is turned too far, the result may be weak or distorted audio output.
7. Check overall alignment according to the service information bulletin.

Preventing Corona Or Arcing On Glass Portion (behind metal bell) Of 16 or 19-inch Metal Picture Tube.

1. To retard the accumulation of dust collecting on the glass area behind the metal bell of the picture tube, this area was sprayed with silicon lacquer. In some cases this lacquer was hydroscopic, permitting moisture to be absorbed which resulted in corona or arcing. When this condition is experienced, thoroughly clean all the silicon lacquer from the tube with acetone.

SUBJECT—INCREASE PICTURE WIDTH - TELEVISION MODELS USING CHASSIS 321, 321-1, 321-2 AND 331, 331-1, 331-2.

If it is necessary to increase the width of the picture beyond the range of the width control, remove the 15,000 ohm resistor (R214) and connect a wire from lug 2 to lug 3 of the Horizontal Output transformer (T107). Also connect a 220 mmf., 2000 volt capacitor (Part No. 137498-62) from lug 6 to lug 8 of the transformer.

MODELS 11-442M1U, 11-444MU, 11-453MU, 11-460MU, 11-470BU, 11-472B1U, 11-474BU 11-483BU, Ch. 321, 321-1,-2, 331,-1,-2

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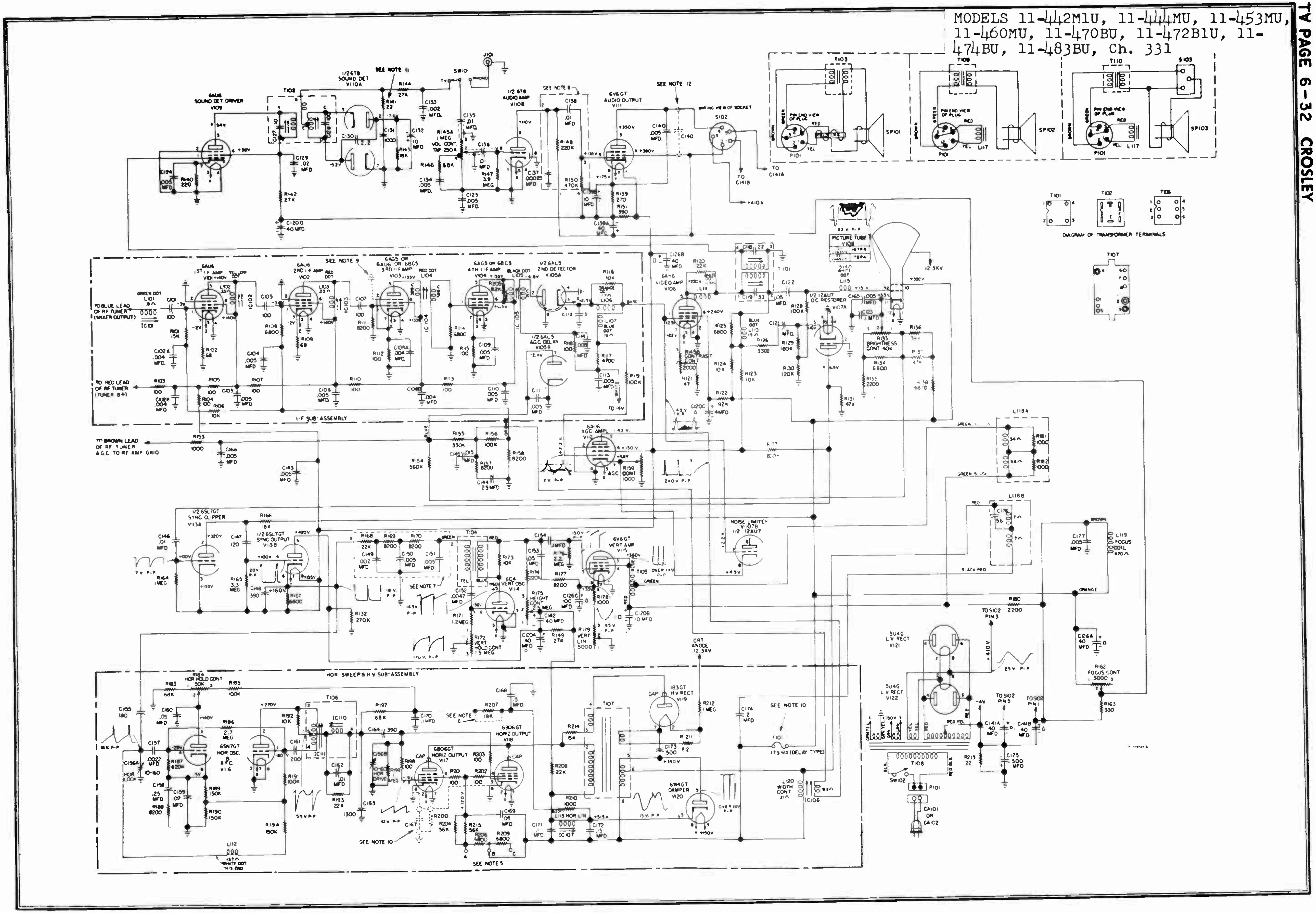
MODELS 11-442M1U, 11-444MU, 11-453MU, 11-460MU, 11-470BU, 11-472B1U, 11-474BU, 11-483BU, Ch. 331



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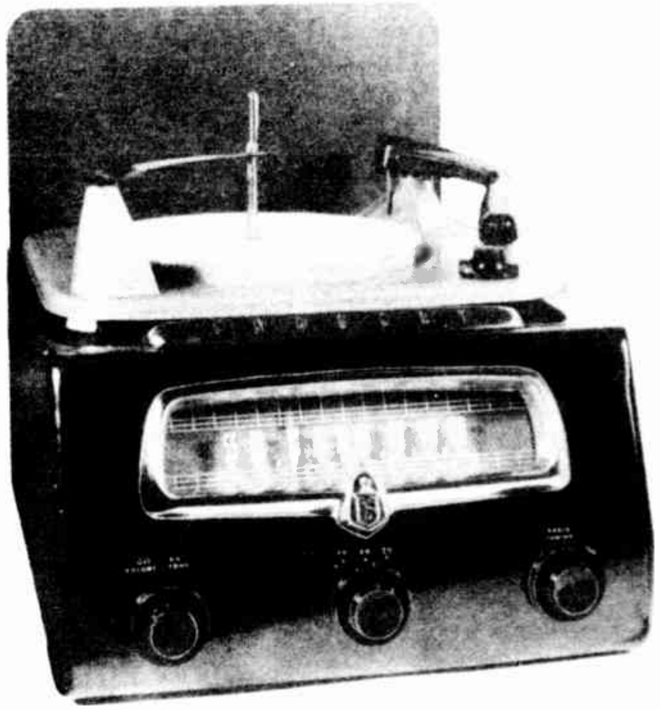


DESCRIPTION

TYPE: Eight-tube, single band, Superheterodyne.

FREQUENCY RANGE: 540 to 1600 kc.

INTERMEDIATE FREQUENCY: 455 kc.

POWER SUPPLY: 60 cycle, a.c. only.

VOLTAGE RATING: 105-125 volts.

POWER CONSUMPTION:

Radio Position .... 65 watts

Phono Position........................ 85 watts

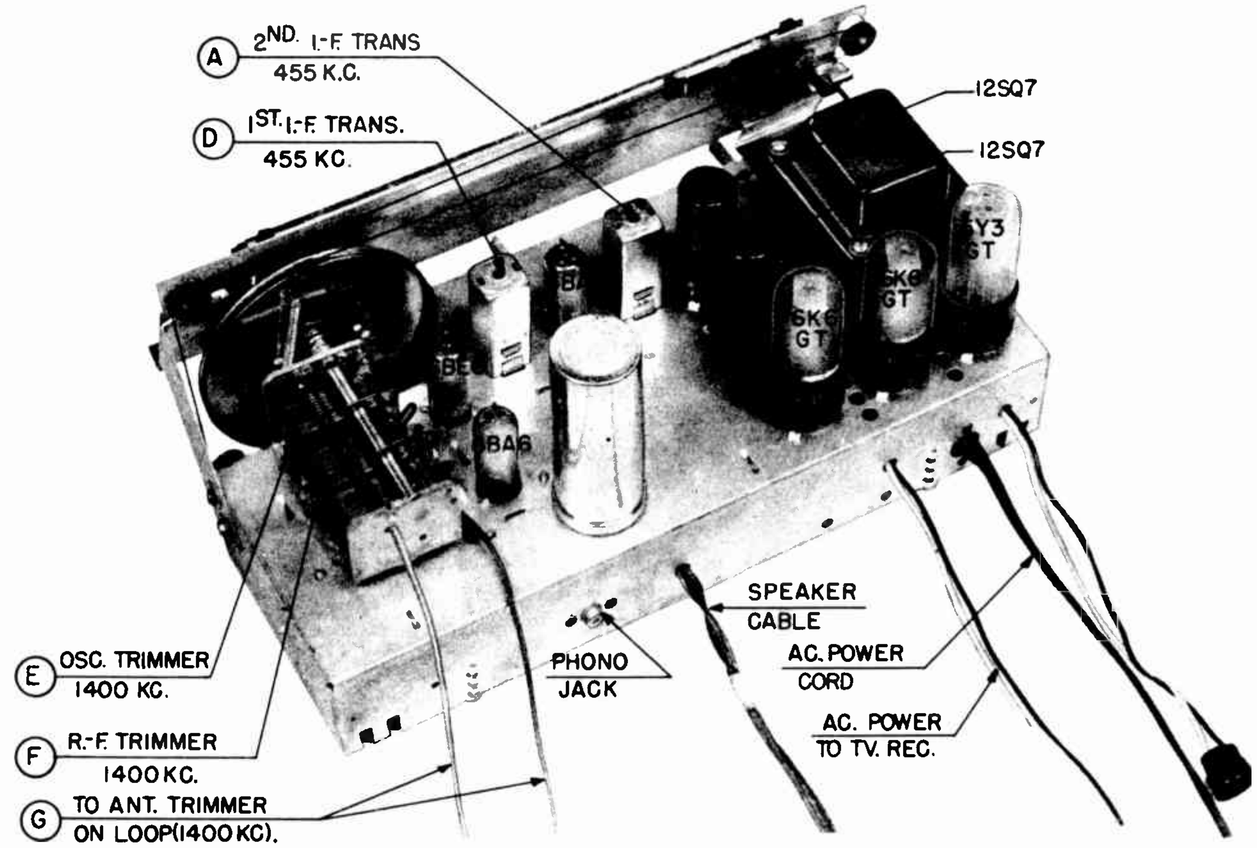
Phono Motor only..................... 20 watts

TUBE COMPLEMENT:

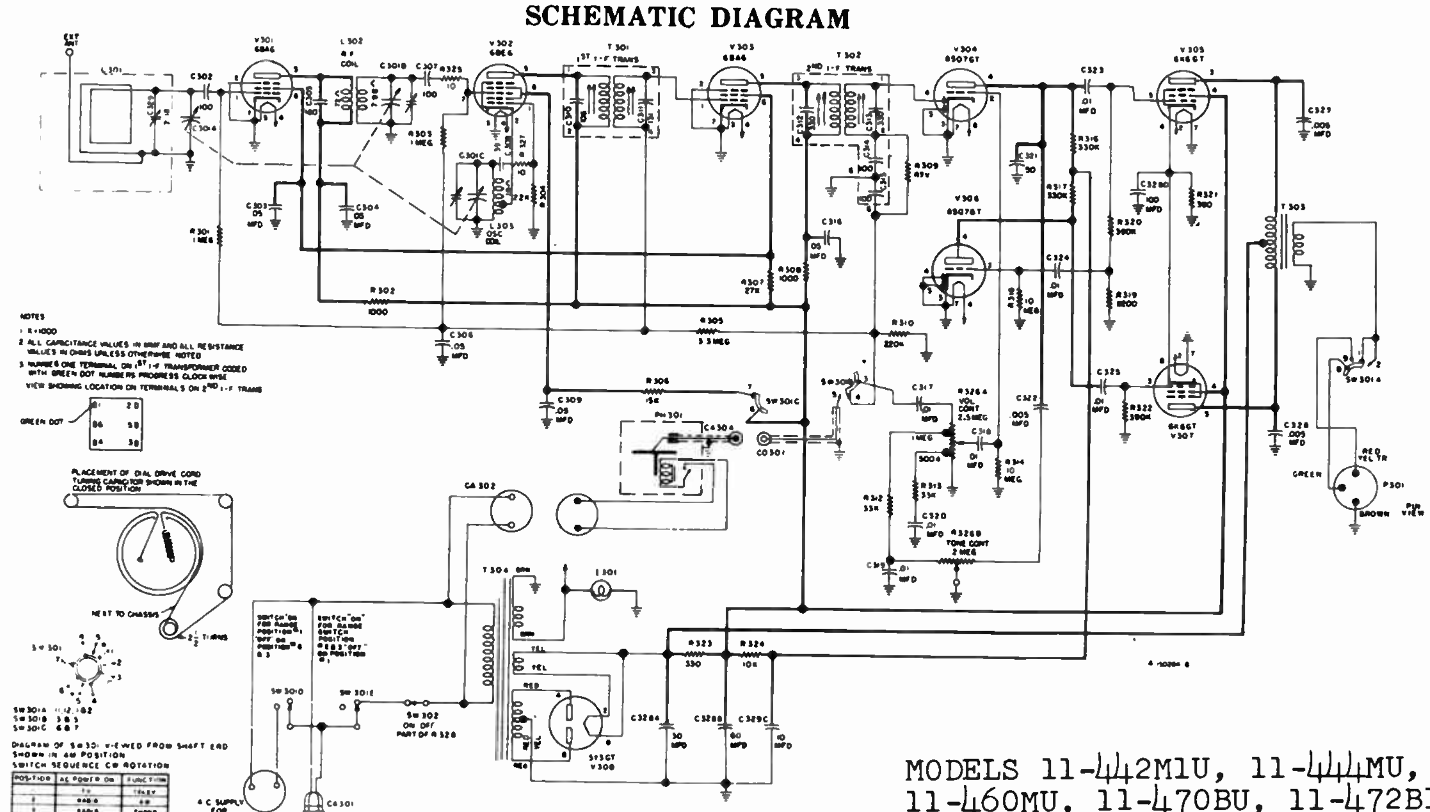
Symbol No.	Type	Function
V301	6BA6	R.F. Amplifier
V302	6BE6	Converter
V303	6BA6	I.F. Amplifier
V304	6SQ7GT	Diode Det., AVC, Audio Amplifier
V305	6K6GT	Audio Output
V306	6SQ7GT	Phase Inverter
V307	6K6GT	Audio Output
V308	5Y3GT	Rectifier

DIAL BULB: Type 47, 6.3V., .15 amp.

CHASSIS, TOP VIEW



SCHEMATIC DIAGRAM



MODELS 11-442M1U, 11-444MU, 11-453MU, 11-460MU, 11-470BU, 11-472B1U, 11-474BU, 11-483BU, Ch. 331; Radio Ch. 332

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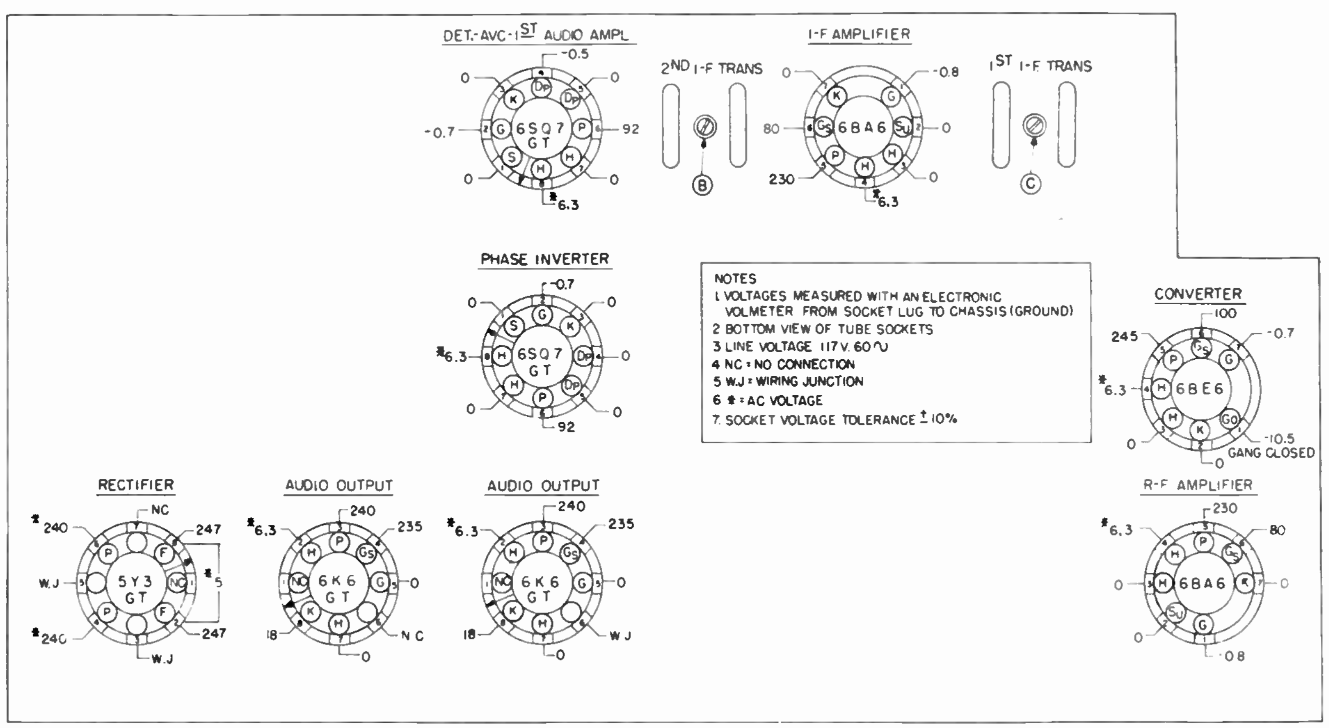
ALIGNMENT PROCEDURE

1. Turn the tuning capacitor to full mesh against stop and set the dial pointer to the reference point on the dial to the left of "55".
2. Connect output meter across speaker voice coil leads.
3. Feed an r.f. signal modulated 30% at 400 cycles to the receiver as indicated in the Alignment chart. Connect the signal generator ground terminal to the chassis of the receiver.
4. Turn the volume control to maximum clockwise position and the tone control to maximum treble position. Adjust the signal generator output to produce a noticeable output meter reading, keeping the signal generator output as low as possible to prevent AVC action in the receiver.
5. For all alignments the loop antenna must remain connected.

ALIGNMENT CHART

Alignment adjustment locations are shown on page 2, "CHASSIS, TOP VIEW."

Alignment Sequence	Signal Generator Output			Position of Tuning Dial or Tun. Cap.	Adjust for Maximum Output
	Frequency in kc.	In Series with	To		
1	455	.05 mfd.	Stator plates of C301B (center sect.)	Gang open	A & B
2	455	.05 mfd.	Stator plates of C301B (center sect.)	Gang open	C & D
3	1400	200 mmf.	Ext. Ant. Term.	1400	E (See Note 1)
4	1400	200 mmf.	Ext. Ant. Term.	1400	F (See Note 1)
5	1400	200 mmf.	Ext. Ant. Term.	1400	G (See Notes 1 & 2)



SOCKET VOLTAGE CHART

ALIGNMENT NOTES

1. Rock gang while adjusting r.f. and antenna trimmers for maximum sensitivity.
2. Antenna trimmer must be realigned at 1400 kc., after chassis is installed in its cabinet. A weak signal must be used so that the trimmer can be adjusted to maximum receiver sensitivity.

REPLACEMENT PARTS LIST

(Chassis 332)

Symbol No.	Part No.	Description	Symbol No.	Part No.	Description
C301A	B-150007	Capacitor, Variable	L301	AC-150005	Antenna Loop & Trimmer Assy. (11-474BU)
C301B		Capacitor, Variable } Three Section		AC-149582	Antenna Loop & Trimmer Assy. (11-444MU)
C301C		Capacitor, Variable	L302	AW-150151	Transformer, R.F.
C302	C-137727-25	Capacitor, 100 mmf., 500 v., ceramic	L303	AW-150150	Coil, Oscillator
C303	39001-17	Capacitor, .05 mfd., 600 v., paper	1301	138437-1	Bulb (Dial), Type 47, 6.3 v., .15 amp.
C304	39001-17	Capacitor, .05 mfd., 600 v., paper	SW301A	C-150021	Switch, Function
C305	C-137727-24	Capacitor, 180 mmf., 500 v., ceramic	SW301B		Switch, Function
C306	39001-17	Capacitor, .05 mfd., 600 v., paper	SW301C		Switch, Function } Assembly
C307	C-137727-25	Capacitor, 100 mmf., 500 v., ceramic	SW301D		Switch, Power
C308	C-137727-109	Capacitor, 39 mmf., 10%, 200 v., ceramic	SW301E		Switch, Power
C309	39001-17	Capacitor, .05 mfd., 600 v., paper	SW302	Part of R326	Switch, ON-OFF
C310	Part of T301	Capacitor, 106 mmf., 5%	T301	C-139919-3	Transformer, 1st I.F.
C311	Part of T301	Capacitor, 131 mmf., 5%	T302	D-145025-5	Transformer, 2nd I.F.
C312	Part of T302	Capacitor, 330 mmf., 5%	T303	B-150028	Transformer, Output
C313	Part of T302	Capacitor, 330 mmf., 5%	T304	B-150029	Transformer, Power
C314	Part of T302	Capacitor, 100 mmf.	PH301	D-149577-1	Record Changer (V950)
C315	Part of T302	Capacitor, 100 mmf.	CA301	C-132300-10	Cable & Plug Assy., Power
C316	39001-17	Capacitor, .05 mfd., 600 v., paper	CA302	B-139727-8	Cable & Plug Assy. Phono Motor
C317	39001-13	Capacitor, .01 mfd., 600 v., paper	CA303	B-139727-1	Cable & Plug Assy., T.V. Power
C318	39001-13	Capacitor, .01 mfd., 600 v., paper	CA304	AC-143896-10	Cable & Plug Assy. (Shielded), Phono
C319	39001-13	Capacitor, .01 mfd., 600 v., paper	CO301	W-136998	Connector (Female), Phono
C320	39001-13	Capacitor, .01 mfd., 600 v., paper	P301	W-47353	Plug, Speaker
C321	B-143686-1	Capacitor, 50 mmf., 500 v., molded disc		AB-149995	Background, Dial
		ceramic		W-149709	Bracket, Drive Shaft Support
C322	39001-11	Capacitor, .005 mfd., 600 v. paper		W-149356	Bushing, Chassis Mtg.
C323	39001-13	Capacitor, .01 mfd., 600 v., paper		W-136201	Clip, Dial Glass
C324	39001-13	Capacitor, .01 mfd., 600 v., paper		W-136999-1	Connector (Male), Shielded Phono Cable
C325	39001-13	Capacitor, .01 mfd., 600 v., paper		W-131154-1	Cotter (External), Drive Shaft
C326	39001-11	Capacitor, .005 mfd., 600 v., paper		W-136853	Cushion (Rubber), Dial Glass
C327	39001-11	Capacitor, .005 mfd., 600 v., paper		C-149991	Dial Glass
C328A	B-150035	Capacitor, 30 mfd., 350 v.		C-148995-1	Escutcheon
C328B		Capacitor, 60 mfd., 350 v. } Four Section		AD-149469-2	Front Panel, Radio-Phono Unit (11-474BU)
C328C		Capacitor, 10 mfd., 350 v. } Electrolytic		AD-149469-1	Front Panel, Radio-Phono Unit (11-444MU)
C328D		Capacitor, 100 mfd., 25 v.		W-148390	Grommet (3 used), Radio Chassis
C329	Part of L301	Capacitor, Trimmer		AW-148865	Knob, OFF-ON-Volume
R301	39373-92	Resistor, 1 megohm, 1/2 w.		AW-148866	Knob, Tone } 11-444MU
R302	39373-33	Resistor, 1000 ohm, 1/2 w.		AW-149455-1	Knob, Tunning
R303	39373-92	Resistor, 1 megohm, 1/2 w.		AW-149455-2	Knob, Function
R304	39373-60	Resistor, 22,000 ohm, 1/2 w.		AW-149852	Knob, OFF-ON-Volume
R305	39373-100	Resistor, 3.3 megohm, 1/2 w.		AW-149854	Knob, Tone } 11-474 BU
R306	39374-215	Resistor, 15,000 ohm, 10%, 2 w.		AW-150002-1	Knob, Tuning
R307	39374-130	Resistor, 27,000 ohm, 10%, 1 w.		AW-150002-2	Knob, Function
R308	39373-33	Resistor, 1000 ohm, 1/2 w.		C-149431	Pointer, Dial
R309	39373-67	Resistor, 47,000 ohm, 1/2 w.		C-149266	Pull (Handle), Wrap Around
R310	39373-80	Resistor, 220,000 ohm, 1/2 w.		W-137170	Retainer, Record Changer
R312	39373-64	Resistor, 33,000 ohm, 1/2 w.		39176-57CL	Screw, Front Panel (11-474BU)
R313	39373-64	Resistor, 33,000 ohm, 1/2 w.		39176-57AB	Screw, Front Panel (11-444MU)
R314	39373-107	Resistor, 10 megohm, 1/2 w.		W-149976	Shaft, Tuning
R316	39374-55	Resistor, 330,000 ohm, 10%, 1/2 w.		B-149581	Slide, Radio-Phono Unit
R317	39374-55	Resistor, 330,000 ohm, 10%, 1/2 w.		D-136565-16	Socket, Dial Light
R318	39373-107	Resistor, 10 megohm, 1/2 w.		39462-2	Socket, Tube (V301, V302, V303)
R319	39374-36	Resistor, 8200 ohm, 10%, 1/2 w.		W-149987	Socket, Tube (V304, V305, V306, V307, V308)
R320	39374-56	Resistor, 390,000 ohm, 10%, 1/2 w.		W-145080-3	Spacer, Record Changer Mtg.
R321	39374-196	Resistor, 390 ohm, 10%, 2 w.		W-145757	Spring, Drive Cord
R322	39374-56	Resistor, 390,000 ohm, 10%, 1/2 w.		W-143552	Strip, Pointer
R323	39374-107	Resistor, 330 ohm, 10%, 1 w.		W-148248	Trimount Stud, Barrier
R324	39373-54	Resistor, 10,000 ohm, 1/2 w.		W-134916	Washer (Spring), Tuning Shaft
R325	39373-1	Resistor, 10 ohm, 1/2 w.		AD-149272-1	Wrap Around, Case (11-444MU)
R326A	C-150020	Control (Volume), 2.5 Meg. Tapped } Two		AD-149272-2	Wrap Around, Case (11-474BU)
R326B		Control (Tone), 2.0 Meg. } Section			

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TUBE COMPLEMENT

Symbol	Tube Type	Function	Symbol	Tube Type	Function
V1	6CB6	R. F. Amplifier	V111	6V6GT	Audio Output
V2	12AT7	V. H. F. Oscillator & Mixer	V112	6AU6	A. G. C. Amplifier
V101	6AU6	1st. I. F. Amplifier	V113	6SL7GT	Sync Clipper & Sync Output
V102	6AU6	2nd. I. F. Amplifier	V114	6C4	Vertical Oscillator
•V103	6AU6	3rd. I. F. Amplifier	V115	6V6GT	Vertical Amplifier
V104	6AG5 or 6BC5	4th. I. F. Amplifier	V116	6SN7GT	A. F. C. & Horiz. Osc.
V105	6AL5	2nd. Detector & A. G. C. Delay	V117	6BQ6GT	Horizontal Output
V106	6AH6	Video Amplifier	V118	6BQ6GT	Horizontal Output
V107	12AU7	D. C. Restorer, 1st. Sync Clipper & Noise Limiter	V119	1B3GT	H. V. Rectifier
V108	19AP4A	Picture Tube	V120	6W4GT	Horiz. Damper
V109	6AU6	Sound Detector Driver	V121	5U4G	L. V. Rectifier
V110	6T8	Sound Det. & 1st Audio Ampl.	V122	5U4G	L. V. Rectifier

•Refer to Note 9 on Schematic Wiring Diagram

SOCKET VOLTAGE TABLE

The following voltages are measured with an electronic voltmeter from socket lugs to ground (chassis) while the set is operating on a 117 volt, 60 cycle A. C. current. Controls are set to obtain a normal picture with +7 volts D. C. on grid (Pin 2) of the picture tube. Some A. C. voltages measured between socket lugs as noted.

Voltages may vary depending upon the setting of the various controls.

Symbol	Tube Type	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Pin 9
V1	6CB6	-0.1	0.9	GND.	• 6.3	120	115	GND.	- - - -	- - - - - -
V2	12AT7	140	-2.7	GND.	GND.	GND.	110	-5	GND.	•6.3
V101	6AU6	-3	GND.	• 6.3	GND.	140	140	-2	- - - -	- - - - - -
V102	6AU6	-3.8	GND.	• 6.3	GND.	140	140	-2	- - - -	- - - - - -
V103	6AU6, 6AG5 or 6BC5	0	1.1	• 6.3	GND.	135	135	1.1	- - - -	- - - - - -
V104	6AG5 or 6BC5	0	1.2	GND.	• 6.3	135	135	1.2	- - - -	- - - - - -
V105	6AL5	GND.	-4.8	• 6.3	GND.	-2.3	GND.	▲-2.4	- - - -	- - - - - -
V106	6AH6	< -2.4	2.2	• 6.3	GND.	220	240	2.2	- - - -	- - - - - -
V107	12AU7	6.5	GND.	16	• 6.3	•6.3	N.C.	▲-2.4	▲4.8	GND.
V108	19AP4A	GND.	7	- - - -	- - - -	- - - -	(Pin 10) •350	(Pin 11) 45	(Pin 12) •6.3	Metal Cone 14.5 KV.
V109	6AU6	0	GND.	• 6.3	GND.	60	60	1	- - - -	- - - - - -
V110	6T8	-5.2	-7.6	-5.2	GND.	•6.3	GND.	GND.	-1	110
V111	6V6GT	N.C.	2 to 7 •6.3	350	360	135	W.J.	7 to 2 •6.3	175	- - - - - -
V112	6AU6	▲-2.4	▲4.8	• 6.3	GND.	-46	150	▲4.8	- - - -	- - - - - -
V113	6SL7GT	120	320	155	105	440	160	7 to 8 •6.3	8 to 7 •6.3	- - - - - -
V114	6C4	N.C.	N.C.	• 6.3	GND.	160	-36	GND.	- - - -	- - - - - -
V115	6V6GT	N.C.	•6.3	360	360	0.1	W.J.	GND.	33	- - - - - -
V116	6SN7GT	-77	260	GND.	-22	225	3.3	•6.3	GND.	- - - - - -
V117	6BQ6GT	N.C.	•6.3	W.J.	150	-20	W.J.	GND.	GND.	- - - - - -
V118	6BQ6GT	N.C.	•6.3	W.J.	150	-20	W.J.	GND.	GND.	- - - - - -
V119	1B3GT	- - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - - - -	- - - -	- - - - - -
V120	6W4GT	N.C.	W.J.	515	N.C.	300	N.C.	7 to 8 •6.3	8 to 7 •6.3	- - - - - -
V121	5U4G	N.C.	410	W.J.	•360	N.C.	•360	W.J.	410	- - - - - -
V122	5U4G	N.C.	410	W.J.	•360	N.C.	•360	W.J.	410	- - - - - -

All voltages plus volts unless otherwise noted.
The following symbols denote:

• = A. C. voltage
N. C. = No connection
W. J. = Wiring junction
< = less than
▲ = A.G.C. voltage (variable with signal strength)

CAUTION - HIGH VOLTAGE

The metal cone of the picture tube operates at high voltage. Do not touch while in operation. Ground cone before touching after power is turned off.

HANDLE WITH EXTREME CARE

Breakage of the picture tube, which contains a high vacuum, may result in injury from flying glass. Do not scratch tube face or subject to more than moderate pressure. NEVER GRASP THE TUBE BY THE NECK OR THE GLASS SURFACE BETWEEN THE NECK AND METAL CONE.

CONNECTING EXTERNAL ANTENNA

Remove the two wires from the built-in antenna fastened to the two screws on the antenna terminal board mounted on the rear apron of the chassis. Tape the ends of the wires from the built-in antenna. Keep the lead-in from the external antenna away from the power cord and speaker leads. Drape the transmission line over the two hinges on the back of the cabinet at the top and bring the line down to the antenna terminal board. Fasten the lead-in wires under the two screws on the antenna terminal board.

ADJUSTMENTS

1. Adjust height of deflection bracket to center cathode ray tube neck in focus coil housing. Key on tube base should point to chassis.
2. I.F. Alignment (See I-F Alignment).
3. The DEFLECTION YOKE is positioned as far forward as possible on the cathode ray tube and rotated so as to make the top and bottom of the raster parallel with the tube mounting board.
4. The FOCUS COIL should be adjusted to be approximately perpendicular to the cathode ray tube axis with the front surface of the focus coil housing approximately 15/32 inch from the rear surface of the deflection and focus coil mounting bracket.
5. The ION TRAP is positioned for maximum brightness, with low to medium setting of the Brightness Control, and for no cutoff of the picture at high setting of the Brightness Control.
6. Center the picture by adjusting the three FOCUS COIL mounting nuts.
7. Adjust size of picture (to fill screen horizontally and 13-3/32 inches vertically) by the HEIGHT CONTROL, HORIZONTAL DRIVE, and WIDTH CONTROL.
8. HORIZONTAL HOLD ADJUSTMENT (See Horiz. Blocking Osc. Alignment).
9. HORIZONTAL HOLD CONTROL is adjusted with a weak picture to center of pull-in range.
10. VERTICAL HOLD CONTROL is also adjusted with a weak picture to center of pull-in range.
11. Vertical linearity is adjusted by the VERTICAL LINEARITY CONTROL and the HEIGHT CONTROL. Horizontal size is adjusted by the HORIZONTAL LINEARITY and WIDTH adjustments.
12. The FOCUS CONTROL is adjusted for best focus of the vertical and horizontal wedges at center of test pattern. If there is any astigmatism, the focus should be set to favor the vertical wedge. If corner focus is poor, check position of DEFLECTION YOKE and ION TRAP.

I.F. ALIGNMENT

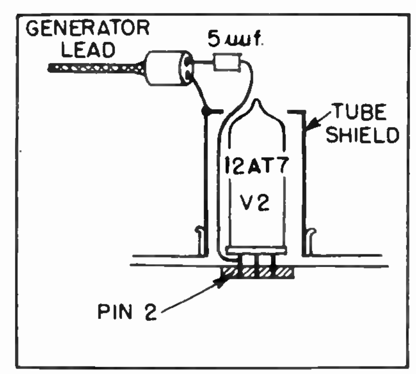
1. To check I.F. Alignment on Oscilloscope:

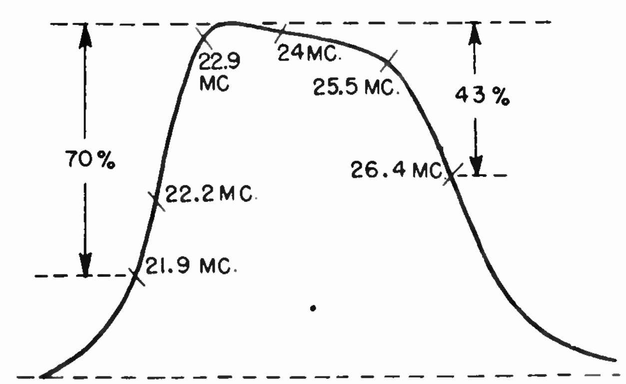
(a) Connect a short clip lead from B-(-6.3 volts, white wire on C141) to the AGC terminal (orange lead) on the terminal board mounted on the I.F. strip close to L102.
(b) Connect high side of scope to the bare lead on pin 1 of the Video Amplifier V106, and the low side to ground (chassis).
(c) Connect sweep signal generator to the grid (pin 2) of the Mixer tube V2 (see illustration below) making sure that the leads are as short and direct as possible, connecting ground terminal of generator to the tube shield and the "hot" terminal through a 5 mmf. capacitor to the grid pin.
(d) Set generator to sweep from 20 mc. to 30 mc. and adjust output to provide a 2 volt peak to peak signal on the scope.
(e) Set tuner near the low frequency end of the range, approximately 4 to 5 turns clockwise, at a point where there are no spurious responses.
(f) Connect marker generator to sweep generator output leads and adjust to provide markers at 21.9 mc., 22.9 mc., 24 mc., 25.5 mc., and 26.4 mc.
(g) Observe curve and position of markers (see nominal response curve below), 21.9 mc. should be approximately 70% down from the peak and 26.4 mc. approximately 43% down.

Slight deviation in the shape from the nominal response curve is permissible, but if any great variation is noted it will be necessary to realign the I.F. Amplifier.

NOTE: The response curve may be distorted unless care is used in the method of connection to prevent feedback and regeneration.

(h) Disconnect the generators, scope and the clip lead from B- to AGC terminal.





NOMINAL OVERALL I-F RESPONSE CURVE

2. Connect a short clip lead from B- (-6.3 volts, white wire on C141) to the AGC terminal (orange lead) on the terminal board mounted on the I.F. strip close to L102.
3. Connect an electronic voltmeter across the 2nd. Detector load resistor R117.
4. Connect signal generator as in (c) of "I.F. Alignment Check".
5. Set tuner near low frequency end of range approximately 4 to 5 turns clockwise at a point where there are no spurious responses.
6. Set signal generator to 24 mc. and adjust L105 for maximum meter deflection, limiting meter deflection to 2 volts d.c. by adjusting input attenuator.
7. Reset signal generator to 22.2 mc. and tune L104 in a similar manner.
8. Next, set signal generator to 26.55 mc. and tune L103 for maximum meter deflection.
9. Reset signal generator to 22.9 mc. and tune L102.
10. Set Signal generator to 25.5 mc. and tune L101 for maximum meter deflection.
11. Repeat steps 5, 6, 7, 8 and 9.
12. Disconnect signal generator, electronic voltmeter and clip lead from B- to the AGC terminal.

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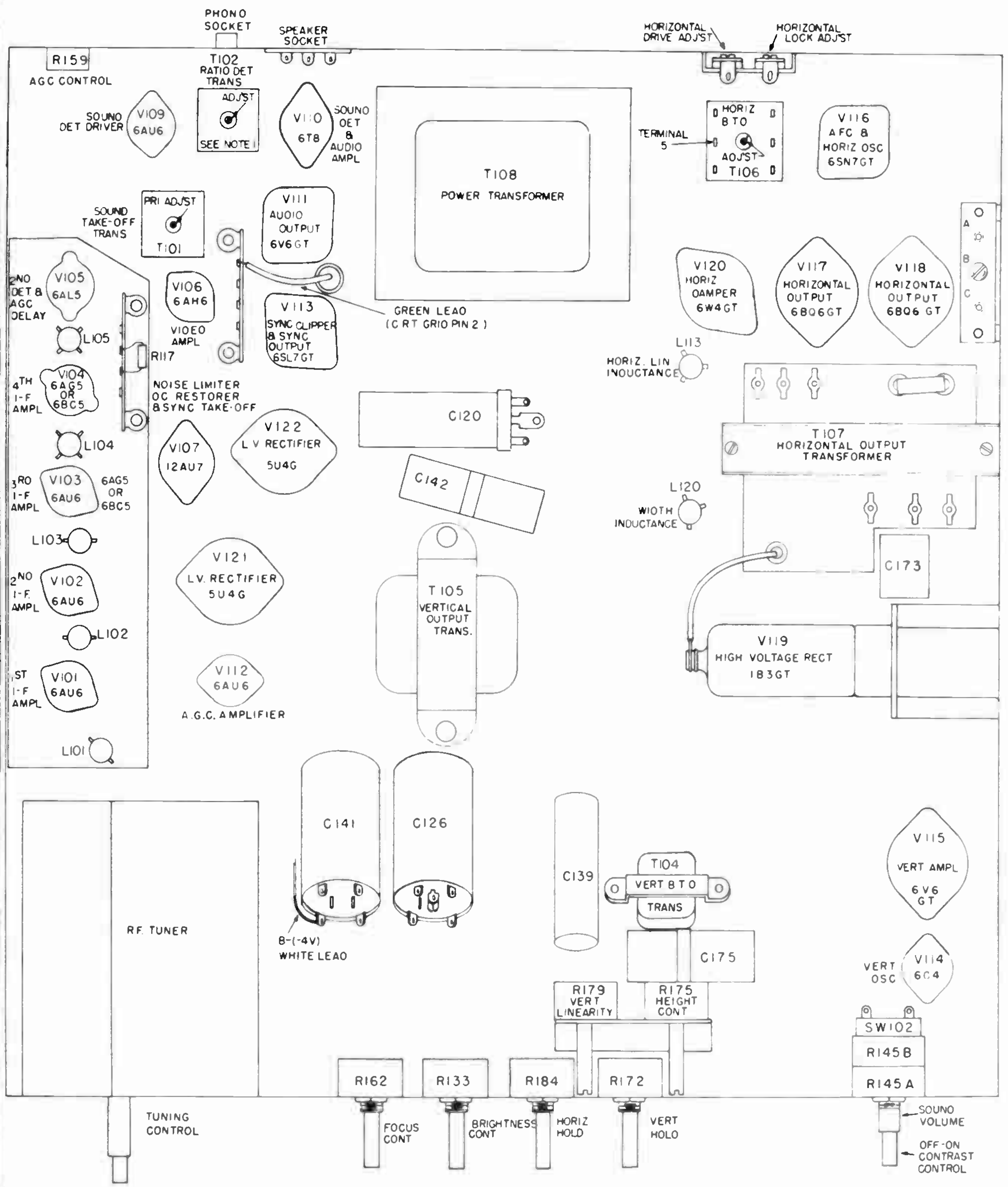


NOTE: 1. RATIO DETECTOR TRANSFORMERS (T102) WITH A RED OR GREEN COLOR CODE HAVE THE PRIMARY ADJUSTMENT ON THE BOTTOM AND THE SECONDARY ADJUSTMENT ON TOP. TRANSFORMERS WITHOUT A COLOR CODE HAVE THE PRIMARY ADJUSTMENT ON THE TOP AND THE SECONDARY ADJUSTMENT ON THE BOTTOM.

Chassis Bottom View Showing Tube Socket and Alignment Locations

SOUND ALIGNMENT

1. Connect "hot" lead of signal generator to grid (pin #1) of V106. Set signal generator to 4.5 mc. with 400 cps. amplitude modulated signal modulated 30% or greater.
2. Connect scope to picture tube grid (pin #2) through detector probe.
3. Connect two 100 K ohm resistors (matched to within 1%) in series across ratio detector load resistor R143. Connect common lead of the electronic voltmeter to the junction of the matched 100 K ohm resistors and the D.C. lead of the voltmeter to ground (chassis).
4. Using a high level signal input and with the Contrast control set at maximum, tune the Sound Take-off Transformer (T101) primary adjustment (bottom of chassis) for minimum deflection on the scope.
5. Reduce signal input to below limiting in V109 and adjust the Sound Take-off Transformer (T101) Secondary, and the Ratio Detector Transformer (T102) primary for peak meter reading.
6. Repeat steps 4 and 5.
7. Remove detector probe and scope from the picture tube grid.
8. Transfer D.C. lead only of the electronic voltmeter to junction of R141 and C133.
9. Return to high level signal input for limiting in V109 and adjust the Ratio Detector Transformer (T102) secondary for zero meter reading.
10. Remove the two 100 K ohm resistors and all test equipment from the receiver.

HORIZONTAL DRIVE

The setting of the HORIZONTAL DRIVE trimmer should be checked to see that no change in linearity in the center of the picture occurs with change in Contrast setting. In adjusting the HORIZONTAL DRIVE trimmer it is necessary to observe the picture width and set the trimmer to the point of maximum width (toward minimum capacity). This represents the optimum drive setting. Unless the DRIVE trimmer can be adjusted to either side of this point and a shrinkage noted in either case, the setting is incorrect. The best horizontal linearity coincides with the lowest plate dissipation of the horizontal driver tubes and this linearity should be obtained with the adjusting screw of the HORIZONTAL LINEARITY inductance as far out of the coil as possible. It should be noted, that changing the linearity adjustment makes it necessary to readjust the HORIZONTAL DRIVE trimmer setting to optimum.

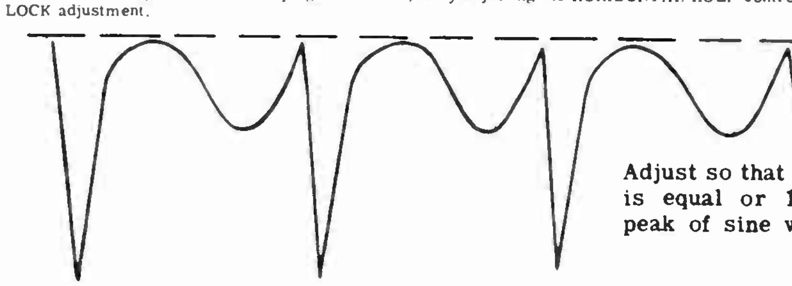
NOTE: In rare cases where low B+ voltage is encountered, it may be necessary to change the screen resistor connection of V117 and V118 to obtain sufficient width (see note 5 on schematic). Do not overdrive the tubes, make this change only if the width of the raster is not sufficient to cover the face of the tube.

A.G.C. ADJUSTMENT

Tune in a station with a weak signal and adjust the AGC threshold control on the rear apron of chassis to a point where the receiver will just begin to overload with the CONTRAST control set at maximum. If the receiver overloads on a strong signal, turn the CONTRAST control toward minimum to prevent overload.

HORIZONTAL BLOCKING OSCILLATOR ALIGNMENT

1. Tune receiver to a television signal and adjust CONTRAST control for normal picture below limiting in the video amplifier.
2. Adjust the HORIZONTAL HOLD control and the HORIZONTAL FREQUENCY adjustment (top of T106) until picture is in sync.
3. Connect scope in series with a 10 mmf. capacitor to terminal #5 of the HORIZONTAL BTO Transformer (T106) and adjust the HORIZONTAL BTO TRAP (bottom of T106) for the following wave form: keeping raster in sync by adjusting the HORIZONTAL HOLD control, HORIZONTAL FREQUENCY and/or HORIZONTAL LOCK adjustment.



Adjust so that the peak of pulse is equal or 10% higher than peak of sine wave.

4. Turn the HORIZONTAL HOLD control fully clockwise. Adjust the HORIZONTAL FREQUENCY control (top of T106) by turning out until the raster is just out of sync, and then turning the FREQUENCY control slowly in until the raster is just ready to fall into sync (indicated by a wide black vertical or diagonal horizontal blanking bar).
5. Turn the HORIZONTAL HOLD control fully counter-clockwise. Picture should normally be in sync. Remove the signal by tuning off the station, then retune to the signal. If more than seven bars are present, adjust the HORIZONTAL LOCK trimmer slightly counter-clockwise until five to seven bars appear before the picture falls into sync when the HORIZONTAL HOLD control is set in the extreme counter-clockwise position. If less than five bars are present, adjust the LOCK trimmer clockwise. As the lock-in trimmer adjustment effects the horizontal frequency, the adjustments of both the horizontal frequency control and the lock-in trimmer must be repeated until the conditions outlined above in steps 4 and 5 exist simultaneously at the extreme positions of the horizontal hold control. Check pull-in range. Pull-In range should be 120° minimum and 220° maximum.
6. The final setting of the horizontal hold control should be made with a very weak picture. Rotate the dial on and off the station, and set the horizontal hold control so that the picture returns completely in sync.

The most inportant points in the Horizontal Oscillator and the AFC Alignment for most stable operation are: (1) that the raster just falls in sync at the clockwise end of the HORIZONTAL HOLD control, and (2) that the pull-in range is between 120° and 220°.

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World Radio History

REPLACEMENT PARTS LIST
Main Chassis

Symbol No.	Part No.	Description
C101	C-137727-108	Capacitor, 100 mmf., 500 v., ceramic
C102A	C-144675-6	Capacitor, .004 mfd., 500 v. Two Section
C102B		Capacitor, .004 mfd., 500 v. disc ceramic
C103	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C104	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C105	C-137727-108	Capacitor, 100 mmf., 500 v., ceramic
C106	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C107	C-137727-108	Capacitor, 100 mmf., 500 v., ceramic
C108A	C-144675-6	Capacitor, .004 mfd., 500 v. Two Section
C108B		Capacitor, .004 mfd., 500 v. disc ceramic
C109	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C110	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C111	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C112	C-137727-103	Capacitor, 5 mmf., 10%, 500 v., ceramic
C113	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C114	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C118	Part of T101	Capacitor, 22 mmf., 10%, 500 v., ceramic
C119	Part of T101	Capacitor, 33 mmf.,10% 500 v., ceramic
C120A	B-149106	Capacitor, 40 mfd., 475 v.
C120B		Capacitor, 10 mfd., 475 v. Four Section
C120C		Capacitor, 4 mfd., 350 v. Electrolytic
C120D		Capacitor, 40 mfd., 250 v.
C121	39001-19	Capacitor, .1 mfd., 600 v., paper
C122	39001-17	Capacitor, .05 mfd., 600 v., paper
C123	39001-19	Capacitor, .1 mfd., 600 v., paper
C124	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C125	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C126A	B-148429	Capacitor, 40 mfd., 475 v. Three Section
C126B		Capacitor, 40 mfd., 250 v. Electrolytic
C126C		Capacitor, 100 mfd., 50 v.
C127	Part of T102	Capacitor, 10 mmf., 500 v., mica
C128	Part of T102	Capacitor, 100 mmf., 500 v., mica
C129	39001-80	Capacitor, .02 mfd., 600 v., paper
C130	W-137398-4	Capacitor, 2.2 mmf., 500 v.
C131	C-137727-110	Capacitor, 1000 mmf., 10%, 500 v., ceramic
C132	B-149211	Capacitor, 10 mfd., 25 v., Electrolytic
C133	39001-74	Capacitor, .002 mfd., 600 v., paper
C134	39001-11	Capacitor, .005 mfd., 600 v., paper
C135	39001-13	Capacitor, .01 mfd., 600 v., paper
C136	39001-13	Capacitor, .01 mfd., 600 v., paper
**C137	39001-73	Capacitor, .00025 mfd., 600 v., paper
**C138	39001-13	Capacitor, .01 mfd., 600 v., paper
C139A	B-149261	Capacitor, 40 mfd., 350 v. Two Section
C139B		Capacitor, 10 mfd., 25 v. Electrolytic
C140	39001-11	Capacitor, .005 mfd., 600 v., paper
C141A	B-146633	Capacitor, 40 mfd., 475 v. Two Section
C141B		Capacitor, 40 mfd., 475 v. Electrolytic
C142	B-149262	Capacitor, 40 mfd., 100 v., Electrolytic
C143	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C144	39001-87	Capacitor, .25 mfd., 600 v., paper
C145	39001-14	Capacitor, .015 mfd., 600 v., paper
C146	39477-41	Capacitor, .01 mfd., 600 v., molded paper
C147	B-137498-17	Capacitor, 120 mmf., 10%, 500 v., mica
C148	B-137498-28	Capacitor, 390 mmf., 10%, 500 v., mica
*C149	39001-74	Capacitor, .002 mfd., 600 v., paper
*C150	39001-11	Capacitor, .005 mfd., 600 v., paper
*C151	39001-11	Capacitor, .005 mfd., 600 v., paper
C152	39478-39	Capacitor, .0047 mfd., 10%, 600 v., molded paper
C153	C-146434-6	Capacitor, .05 mfd., 10%, 400 v., paper
C154	39001-19	Capacitor, .1 mfd., 600 v., paper
C155	B-137498-24	Capacitor, 180 mmf., 10%, 500 v., mica
C156A	B-132386-17	Capacitor, Trimmer Two Section
C156B		Capacitor, Trimmer
C157	39477-37	Capacitor, .0022 mfd., 600 v., molded paper
C158	39001-87	Capacitor, .25 mfd., 600 v., paper
C159	39001-80	Capacitor, .02 mfd., 600 v., paper
C160	39001-17	Capacitor, .05 mfd., 600 v., paper
C161	B137498-47	Capacitor, 200 mmf., 5%, 1000 v., mica
C162	C-148813-2	Capacitor, .01 mfd., 10%, 400 v., paper
C163	B-137498-53	Capacitor, 1300 mmf., 5%, 500 v., mica
C164	B-137498-56	Capacitor, 820 mmf.,10% 500 v., mica
C165	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C166	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
***C167	B-146944	Capacitor, 5 mfd., 25 v., Electrolytic
C168	B-148317-2	Capacitor, .5 mfd., 600 v., paper

Symbol No.	Part No.	Description
C169	39001-17	Capacitor, .05 mfd., 600 v., paper
C170	B-148317-3	Capacitor, .1 mfd., 600 v., paper
C171	C-146434-10	Capacitor, .15 mfd., 400 v., paper
C172	C-146434-3	Capacitor, .1 mfd., 400 v., paper
C173	W-147375	Capacitor, 500 mmf., 20 k.v.
C174	B-149488-2	Capacitor, .2 mfd., 200 v., paper
C175	B-149038	Capacitor, 500 mfd., 10 v., Electrolytic
C176	B-137498-60	Capacitor, 56 mmf., 1000 v., mica
C177	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C178	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C179	C-144675-2	Capacitor, .005 mfd., 500 v., disc ceramic
C180	W-160111	Capacitor, 220 mmf., 1500 v., mica
C181	B-137498-61	Capacitor, 190 mmf., 10%, 2000 v., mica
C182	39001-17	Capacitor, .05 mfd., 600 v., paper
R101	39375-77	Resistor, 15,000 ohm, 5%, ½ w.
R102	39374-11	Resistor, 68 ohm, 10%, ½ w.
R103	39373-14	Resistor, 100 ohm, ½ w.
R104	39373-14	Resistor, 100 ohm, ½ w.
R105	39373-14	Resistor, 100 ohm, ½ w.
R106	39373-54	Resistor, 10,000 ohm, ½ w.
R107	39373-14	Resistor, 100 ohm, ½ w.
R108	39375-69	Resistor, 6800 ohm, 5%, ½ w.
R109	39374-11	Resistor, 68 ohm, 10%, ½ w.
R110	39373-14	Resistor, 100 ohm, ½ w.
R111	39375-71	Resistor, 8200 ohm, 5%, ½ w.
R112	39374-13	Resistor, 100 ohm, 10%, ½ w.
R113	39373-14	Resistor, 100 ohm, ½ w.
R114	39375-69	Resistor, 6800 ohm, 5%, ½ w.
R115	39375-25	Resistor, 100 ohm, 10%, ½ w.
R116	Part of L106	Resistor, 10,000 ohm, 5%, ½ w.
R117	39375-65	Resistor, 4700 ohm, 5%, ½ w.
R118	39373-14	Resistor, 100 ohm, ½ w.
R119	39374-49	Resistor, 100,000 ohm, 10%, ½ w.
R120	Part of L111	Resistor, 22,000 ohm, 10%, ½ w.
R121	39374-9	Resistor, 47 ohm, 10%, ½ w.
R122	39374-136	Resistor, 82,000 ohm, 10%, 1 w.
R123	39375-221	Resistor, 10,000 ohm, 5%, 1 w.
R124	39375-369	Resistor, 10,000 ohm, 5%, 2 w.
R125	39374-35	Resistor, 6800 ohm, 10%, ½ w.
R126	39374-31	Resistor, 3300 ohm, 10%, ½ w.
R127	39374-60	Resistor, 820,000 ohm, 10%, ½ w.
R128	39374-49	Resistor, 100,000 ohm, 10%, ½ w.
R129	39374-52	Resistor, 180,000 ohm, 10%, ½ w.
R130	39374-50	Resistor, 120,000 ohm, 10%, ½ w.
R131	39374-45	Resistor, 47,000 ohm, 10%, ½ w.
R132	39374-142	Resistor, 270,000 ohm, 10%, 1 w.
R133	B-149611	Control, Brightness (40,000 ohm)
R134	39374-123	Resistor, 6800 ohm, 10%, 1 w.
R135	39374-29	Resistor, 2200 ohm, 10%, ½ w.
R136	39374-220	Resistor, 39,000 ohm, 10%, 2 w.
R137	39374-221	Resistor, 47,000 ohm, 10%, 2 w.
R138	39374-123	Resistor, 6800 ohm, 10%, 1 w.
R139	39374-194	Resistor, 270 ohm, 10%, 2 w.
R140	39374-17	Resistor, 220 ohm, 10%, ½ w.
R141	39374-5	Resistor, 22 ohm, 10%, ½ w.
R142	39374-130	Resistor, 27,000 ohm, 10%, 1 w.
R143	39375-79	Resistor, 18,000 ohm, 5%, ½ w.
R144	39374-42	Resistor, 27,000 ohm, 10%, ½ w.
R145A	C-149686	Control (Volume), 1 megohm Two
R145B		Control (Contrast), 2000 ohm Section
R146	39374-47	Resistor, 68,000 ohm, 10%, ½ w.
R147	39374-75	Resistor, 3.9 megohm, 10%, ½ w.
**R148	39374-53	Resistor, 220,000 ohm, 10%, ½ w.
R149	39374-42	Resistor, 27,000 ohm, 10%, ½ w.
**R150	39374-57	Resistor, 470,000 ohm, 10%, ½ w.
R151	39374-196	Resistor, 390 ohm, 10%, 2 w.
R153	39373-33	Resistor, 1000 ohm, ½ w.
R154	39375-115	Resistor, 560,000 ohm, 5%, ½ w.
R155	39375-109	Resistor, 330,000 ohm, 5%, ½ w.
R156	39375-97	Resistor, 100,000 ohm, 5%, ½ w.
R157	39374-36	Resistor, 8200 ohm, 10%, ½ w.
R158	39375-71	Resistor, 8200 ohm, 5%, ½ w.
R159	W-148861	Control, A.G.C. (1000 ohm)
R162	B-149612	Control, Focus (3000 ohm)
R163	W-148554-2	Resistor, 330 ohm, 10%, 7 w.
R164	39374-61	Resistor, 1 megohm, 10%, ½ w.

Symbol No.	Part No.	Description
R165	39373-100	Resistor, 3.3 megohm, ½ w.
R166	39374-40	Resistor, 18,000 ohm, 10%, ½ w.
R167	39374-35	Resistor, 6800 ohm, 10%, ½ w.
*R168	39374-41	Resistor, 22,000 ohm, 10%, ½ w.
*R169	39374-36	Resistor, 8200 ohm, 10%, ½ w.
*R170	39374-36	Resistor, 8200 ohm, 10%, ½ w.
R171	39374-63	Resistor, 1.2 megohm, 10%, ½ w.
R172	B-149610	Control, Vertical Hold (1.5 megohm)
R173	39374-37	Resistor, 10,000 ohm, 10%, ½ w.
R174	39374-53	Resistor, 220,000 ohm, 10%, ½ w.
R175	B-148964	Control, Height (2.5 megohm)
R176	39374-69	Resistor, 2.2 megohm, 10%, ½ w.
R177	39374-36	Resistor, 8200 ohm, 10%, ½ w.
R178	39374-113	Resistor, 1000 ohm, 10%, 1 w.
R179	B-148965	Control, Vertical Linearity (5000 ohm)
R180	39374-205	Resistor, 2200 ohm, 10%, 2 w.
R181	Part of L118A	Resistor, 1000 ohm, 10%, ½ w.
R182	Part of L118A	Resistor, 1000 ohm, 10%, ½ w.
R183	39374-47	Resistor, 68,000 ohm, 10%, ½ w.
R184	B-149609	Control, Horizontal Hold (50,000 ohm)
R185	39374-137	Resistor, 100,000 ohm, 10%, 1 w.
R186	39374-71	Resistor, 2.7 megohm, 10%, ½ w.
R187	39374-60	Resistor, 820,000 ohm, 10%, ½ w.
R188	39374-36	Resistor, 8200 ohm, 10%, ½ w.
R189	39374-51	Resistor, 150,000 ohm, 10%, ½ w.
R190	39374-51	Resistor, 150,000 ohm, 10%, ½ w.
R191	39375-97	Resistor, 100,000 ohm, 5%, ½ w.
R192	39374-37	Resistor, 10,000 ohm, 10%, ½ w.
R193	39374-41	Resistor, 22,000 ohm, 10%, ½ w.
R194	39374-51	Resistor, 150,000 ohm, 10%, ½ w.
R197	39374-135	Resistor, 68,000 ohm, 10%, 1 w.
R198	39373-14	Resistor, 100 ohm, ½ w.
R199	39373-92	Resistor, 1 megohm, ½ w.
***R200	39374-97	Resistor, 47 ohm, 10%, 1 w.
R201	39373-14	Resistor, 100 ohm, ½ w.
R202	39373-14	Resistor, 100 ohm, ½ w.
R203	39373-14	Resistor, 100 ohm, ½ w.
R204	39374-217	Resistor, 22,000 ohm, 10%, 2 w.
R205	39375-71	Resistor, 8200 ohm, 5%, ½ w.
R206	39374-211	Resistor, 6800 ohm, 10%, 2 w.
R207	39374-40	Resistor, 18,000 ohm, 10%, ½ w.
R208	39374-41	Resistor, 22,000 ohm, 10%, ½ w.
R209	39374-211	Resistor, 6800 ohm, 10%, 2 w.
R210	39373-33	Resistor, 1000 ohm, ½ w.
R211	39303-19	Resistor, 8.2 ohm, 10%, ½ w., W.W.
R212	39373-202	Resistor, 1 megohm, 1 w.
R213	39374-93	Resistor, 22 ohm, 10%, 1 w.
R214	Part of T107	Resistor, 15,000 ohm, 10%, 2 w.
R215	39374-217	Resistor, 56,000 ohm, 10%, 2 w.
L101	AW-146763	Coil, 1st I. F.
L102	AW-146582	Coil, 2nd I. F.
L103	AW-146583	Coil, 3rd I. F.
L104	AW-147974	Coil, 4th I. F.
L105	AW-148983	Coil, 5th I. F.
L106	AW-149357	Coil, Video Peaking
L107	AW-146889	Coil, Video Peaking
L110	AW-146889	Coil, Video Peaking
L111	AW-149242	Coil, Video Peaking
L112	AW-148440	Coil, Delay
L113	AW-148452	Inductor, Horizontal Linearity
L114	AW-143934	Choke, R. F. Heater
L115	AW-146570	Coil, Choke
L117	B-149475	Choke, 50 ohm
L118A	AC-148887-7	Yoke, Deflection Assembly
L118B		Yoke, Deflection
L119	AW-147430	Coil Assembly, Focus
L120	AW-149492	Inductor, Width and A.G.C.
T101	AC-146782	Transformer, Sound Take-off

Symbol No.	Part No.	Description
T102	C-146874	Transformer, Ratio Detector
T104	B-146842-3	Transformer, Vertical Blocking Osc.
T105	B-148970	Transformer, Vertical Output
T106	AC-146698	Transformer, Horizontal Osc.
T107	AD-149661	Transformer, Horizontal Output
T108	C-149559	Transformer, Power
T109	B-149476	Transformer, Output
F101	W-150431	Fuse, 250 M. A. (See Note 9 on Schematic)
SW101	W-148260	Switch, T. V.-Phono
SW102	Part of R145A	Switch, On-Off (Power)
IC101	W-160426	Iron Core
IC102	W-160426	Iron Core
IC103	W-160426	Iron Core
IC104	W-160426	Iron Core
IC105	W-160426	Iron Core
IC106	39012-103	Iron Core
IC107	39012-102	Iron Core
IC108	39012-96	Iron Core
IC109	39012-96	Iron Core
IC110	39012-97	Iron Core
IC111	39012-97	Iron Core
SP102	138762-5	Speaker, Less Choke and Trans.
S102	W-148790	Socket, Speaker
S103	W-147414	Socket, Deflection Yoke
CA101	C-132300-6	Cable & Plug Assy., Power
P101	G-131500-2	Plug, Speaker
P102	W-139900	Plug, Interlock
P103	W-147415	Plug, Deflection Yoke
J101	W-136998	Connector, Phono
	C-146351-3	Bracket, Deflection-Focus
	AB-148462	Bracket, Deflection Yoke
	W-148854	Bracket, Control Mtg.
	AW-149565	Cable, Shielded (35")
	AW-149188	Clip, Corona
	W-149316	Cover, Tube (V119)
	W-160362-1	Cushion (Rubber 2-9/16"), Deflection Yoke
	W-160112-2	Grommet (Rubber, 3 used), Focus Coil
	W-45580-1	Grommet (Rubber, 3 used), Chassis
	W-138090-4	Insulator, Stand-off
	39033-18CL	Nut (3 used), Focus Coil
	W-147306	Screw (3 used), Focus Coil
	AC-149618	Shield Assy., High Voltage
	AB-149798	Shield, Corona (V119 Socket)
	C-149179	Shield, Tube (V117, V118)
	W-149059	Shield, Tube (V104, V105)
	AB-149516-2	Socket and Board Assy. (V119)
	AB147703-2	Socket and Cable Assy., Picture Tube
	39437-1	Socket, Tube (V111, V113, V116)
	W-146439-2	Socket, Tube (V115, V120)
	39388	Socket, Tube (V117, V118, V121, V122)
	W-146966	Socket, Tube (V101, V102, V103, V106, V109, V112, V114)
	W-144732	Socket, Tube (V107, V110)
	B-149098-4	Socket, Tube (104, V105)
	W-149531	Spring, Capacitor (C173)
	W-144668	Spring (Compression, 3 used), Focus Coil
	W-147474	Stud (Mtg.), Capacitor (C173)

*See Note 7 on Main Chassis Schematic Wiring Diagram.
**See Note 8 on Main Chassis Schematic Wiring Diagram.
***See Note 10 on Main Chassis Schematic Wiring Diagram.

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World Radio History

R.F. TUNER

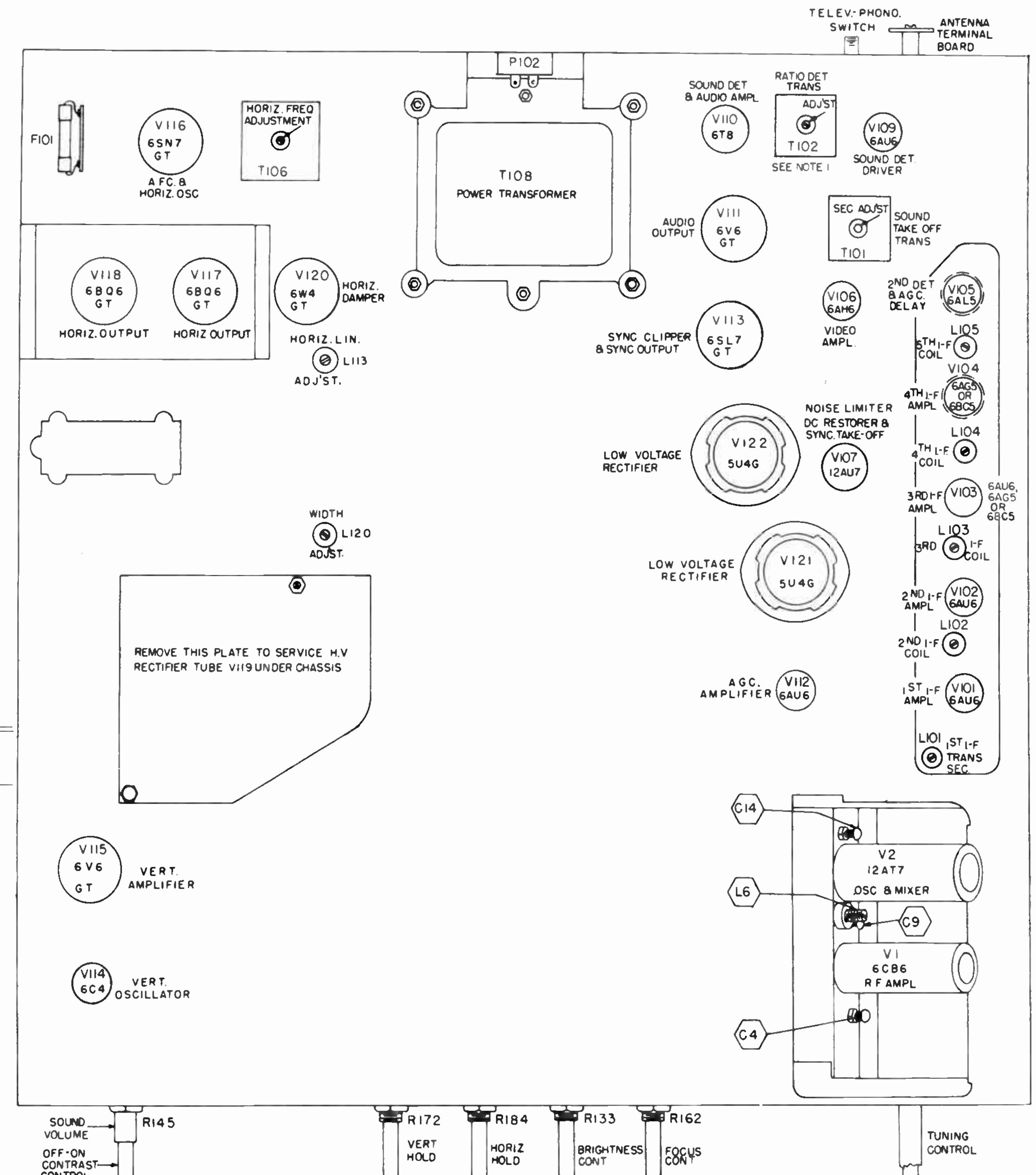
Symbol No.	Part No.	Description
C1	C-137727-49	Capacitor, 27 mmf., 5%, 500 v., ceramic
C2	C-137727-49	Capacitor, 27 mmf., 5%, 500 v., ceramic
C3	C-137727-113	Capacitor, 1500 mmf., 500 v., ceramic
C4	B-148895-1	Capacitor, Trimmer
C5	C-137727-113	Capacitor, 1500 mmf., 500 v., ceramic
C6	C-137727-113	Capacitor, 1500 mmf., 500 v., ceramic
C7	C-137727-113	Capacitor, 1500 mmf., 500 v., ceramic
C8	C-137727-106	Capacitor, 6 mmf., ± .5 mmf., 500 v., ceramic
C9	B-148895-1	Capacitor, Trimmer
C10	C-137727-41	Capacitor, 15 mmf., 10%, 300 v., ceramic
C11	C-137727-113	Capacitor, 1500 mmf., 500 v., ceramic
C12	W-137398-2	Capacitor, 1 mmf., 500 v.
C13	C-137727-106	Capacitor, 6 mmf., ± .5 mmf., 500 v., ceramic
C14	B-148895-1	Capacitor, Trimmer
C15	C-137727-106	Capacitor, 6 mmf., ± .5 mmf., 500 v., ceramic
C16	W-137398-6	Capacitor, 4.7 mmf., 500 v.
R2	39374-12	Resistor, 82 ohm, 10%, ½ w.
R3	39374-39	Resistor, 15,000 ohm, 10%, ½ w.
R4	39374-34	Resistor, 5600 ohm, 10%, ½ w.
R5	39374-11	Resistor, 68 ohm, 10%, ½ w.
R6	39374-61	Resistor, 1 megohm, 10%, ½ w.
R7	39374-39	Resistor, 15,000 ohm, 10%, ½ w.
L1	B-148936-2	Coil, Antenna Shunt
L2A	W-149222	Inductor, Variable } Three Section Inductuner
L2B		Inductor, Variable
L2C		Inductor, Variable
L3	AW-149071	Inductor, End (Antenna)

Symbol No.	Part No.	Description
L4	AW-149070	Inductor, End (R. F.)
L5	AW-149072	Choke, Plate
L6	AW-149088	Coil, I. F.
L7	AW-149063	Coil, I. F. Coupling
L8	AW-149062	Inductor, Shunt Oscillator
L9	AW-149069	Inductor, End (Oscillator)
L10	AW-149086	Coil, Converter Coupling
L11	B-148936-3	Choke, 8.2 mh., 10%
	AB-148839	Bracket & Stud Assy., Gear
	149417	Contact Assembly
	B-148920	Cover, R. F.
	149419	Cover, Inductuner
	AW-149156	Dial Sleeve & Gear Assy.
	AW-149124	Gear & Pinion Assy.
	149418	Nut (Lock), Inductuner Cover
	W-146634	Retainer, Dial Sleeve & Gear Assy.
	W-160243-2	Retainer, Gear & Pinion Assy.
	AW-149159	R. F. Tuner (Complete)
	149420	Screw, Shaft Clamp
	149410	Shaft Assembly
	W-149060	Shield, Tube (V2)
	W-149059	Shield, Tube (V1)
	W-149051	Socket, Tube (V2)
	B-149098-1	Socket, Tube (V1)
	149413	Spring (Steel "C" Washer), Shaft Retainer
	149414	Spring (Brass Washer), Shaft Thrust
	149416	Spring (Wire), Shaft Tension
	149411	Stop (No. 2 to 6)
	149412	Stop (No. 7)
	W-149180	Washer (Spring), Dial Sleeve & Gear Assy.
	149415	Washer (Fibre), Shaft Friction

Miscellaneous

Symbol No.	Part No.	Description
	AC-149405	Antenna Assembly
	AD-148931	Back and Cable Assy., Cabinet
	B-146602	Brace, Deflection-Focus
	W-149003	Bracket, Picture Tube Strap
	R-149875	Cabinet (11-473BU)
	R-149336	Cabinet (11-443MU)
	W-146335	Clamp, Cabinet Back
	W-147424	Clip, Anode Connector—Tube Strap
	AB-149712-1	Cover, Control (11-443MU)
	AB-149712-2	Cover, Control (11-473BU)
	B-160128-24	Cushion, Picture Tube Stop
	B-160128-25	Cushion, Picture Tube Strap
	C-149153-1	Dial, Tuning (11-443MU)
	C-148481-2	Dial, Volume (11-443BU)
	C-149153-2	Dial, Tuning (11-473MU)
	C-148481-3	Dial, Volume (11-473BU)
	149390	Door, Outer (11-443MU)
	149391	Door, Inner (11-443MU)
	149972	Door, Outer (11-473BU)
	149971	Door, Inner (11-473BU)
	149599	Grille Cloth (11-443MU)
	145472	Grille Cloth (11-473BU)
	149393	Hinge, Door (11-443MU)
	149974	Hinge, Door (11-473BU)

Symbol No.	Part No.	Description
	B-148484	Ion Trap
	AW-147889-1	Knob, Tuning (11-443MU)
	AW-147888-1	Knob, Volume (11-443MU)
	AW-147887-1	Knob, Off-On-Contrast (11-443MU)
	AW-147889-3	Knob-Tuning (11-473BU)
	AW-147888-3	Knob, Volume (11-473BU)
	AW-147887-3	Knob, Off-On-Contrast (11-473BU)
	R-149332	Mask, Picture Tube
	W-148788-2	Name (Crosley)
	149392	Pull, Door Handle (11-443MU)
	149977	Pull, Door Handle (11-473BU)
	AB-149745	Rest and Cushion Assy., Picture Tube
	W-145391	Ring (Compression), Tuning Dial
	W-147921-1	Screw (Special), Chassis Mtg.
	39350-23CL	Screw, Mask
	39352-54XD	Screw, Window (11-443MU)
	39355-46XA	Screw, Window (11-473BU)
	W-146484	Spring, Volume Dial
	AB-149308	Strap, Picture Tube
	139319SB	Strike and Catch, Door (11-443MU)
	149941	Strike and Catch, Door (11-473BU)
	AW-149603	Terminal Board Antenna
	R-149218-1	Window (11-443MU)
	R-149218-2	Window (11-473BU)



NOTE: 1. RATIO DETECTOR TRANSFORMERS (T102) WITH A RED OR GREEN COLOR CODE HAVE THE PRIMARY ADJUSTMENT ON THE BOTTOM AND THE SECONDARY ADJUSTMENT ON TOP. TRANSFORMERS WITHOUT A COLOR CODE HAVE THE PRIMARY ADJUSTMENT ON THE TOP AND THE SECONDARY ADJUSTMENT ON THE BOTTOM.

Chassis Top View Showing Tube and Alignment Locations

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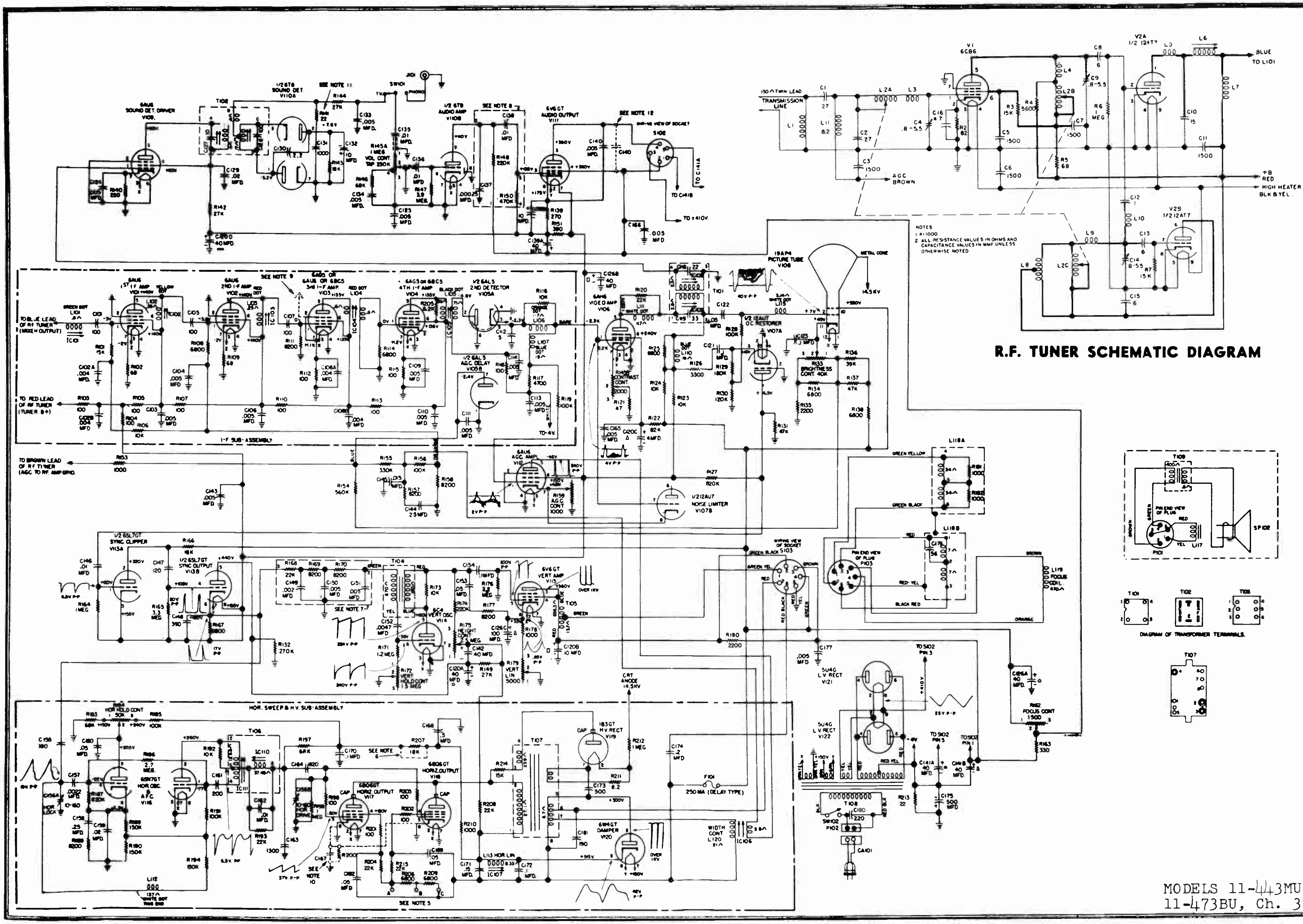

MODELS 11-443MU, 11-473BU, Ch. 323

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DIAGRAM OF VERTICAL INTEGRATOR
SEE NOTE 7

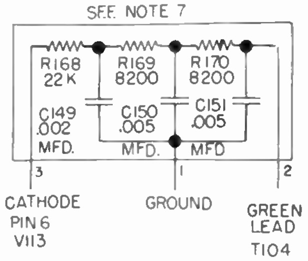
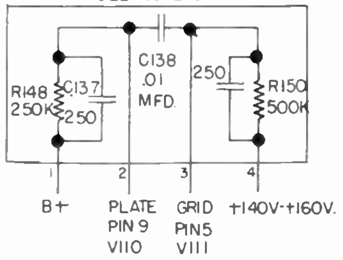
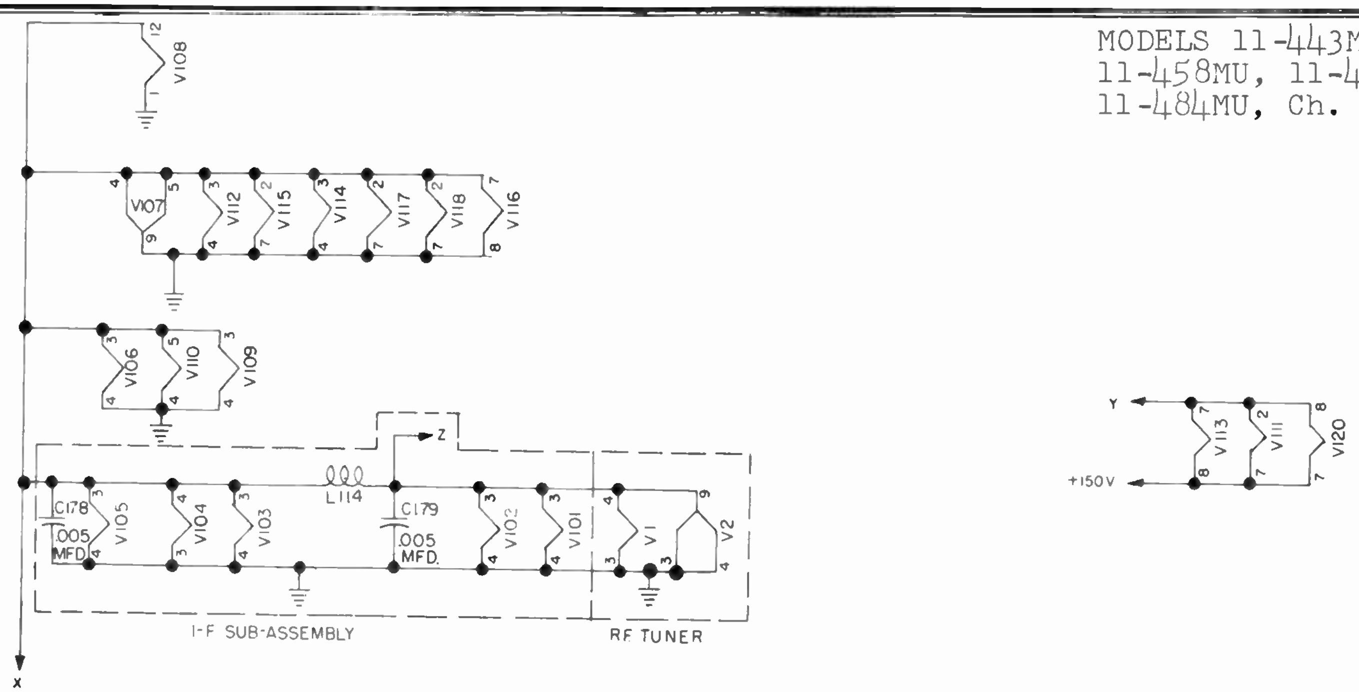


DIAGRAM OF AUDIO COUPLING
SEE NOTE 8





NOTES:

1. ALL VOLTAGES MEASURED WITH AN ELECTRONIC VOLTMETER CONNECTED FROM SOCKET LUG TO CHASSIS.
2. SUPPLY VOLTAGE 117V. 60 CYCLE AC.
3. K = 1000
4. ALL CAPACITANCE VALUES IN MMF. & ALL RESISTANCE VALUES IN OHMS UNLESS OTHERWISE NOTED.
5. SCREEN VOLTAGE ADJUSTMENT FOR V117 & V118

   NOMINAL — TERMINAL B
   HIGH — TERMINAL A
   LOW — TERMINAL C
6. SOME SETS ARE EQUIPPED WITH A BARE WIRE SHUNTING R207. IF HORIZONTAL DRIVE IS EXCESSIVE, REMOVE THE BARE WIRE ACROSS R207.
7. IN SOME RECEIVERS, C149, C150, C151, R168, R169, and R170 ARE A RESISTOR-CAPACITOR UNIT, (PART NO. W-149878). SEE DIAGRAM ABOVE.
8. IN SOME RECEIVERS C137, C138, R148 and R150 ARE A RESISTOR-CAPACITOR UNIT (PART NO. W-149881). SEE DIAGRAM ABOVE.
9. ON SOME SETS LUG 2 OF V103 IS CONNECTED TO GROUND AND NOT TO LUG 7. THESE SETS ARE EQUIPPED WITH A 6AU6 TUBE. BY CONNECTING LUG 2 TO LUG 7 AS SHOWN BY THE SOLID LINES IN SCHEMATIC, EITHER A 6AG5, 6AU6, or 6BC5 TUBE MAY BE USED IN THE V103 SOCKET. WHEN REPLACING THIS TUBE, RE-ALIGN THE 3rd. I.F. STAGE.
10. EARLY PRODUCTION SETS ARE EQUIPPED WITH C167 AND R200 CONNECTED IN THE CIRCUIT AS SHOWN BY THE DOTTED LINES.
11. SOME SETS ARE EQUIPPED WITH A 68 OHM, 10%, 1/2 WATT RESISTOR (PART NO. 39374-11).
12. IN EARLY PRODUCTION RECEIVERS, C140 IS CONNECTED AS SHOWN BY DOTTED LINES. IN LATER PRODUCTION SETS, C140 IS CONNECTED AS SHOWN BY SOLID LINES TO PREVENT PARASITIC OSCILLATION IN THE AUDIO OUTPUT TUBE.

MODELS: 11-454 MU, 11-458 MU, 11-484 MU
(Chassis 323)

NOTE:- These Models are the same as Model 11-443MU Except for the following:

REPLACEMENT PARTS LIST

Part No.	Description
AD-150193	Antenna Assy.
AC-150040	Back & Power Cable Assy.
B-146602	Brace Deflection - Focus Assy.
W-149003	Bracket, Picture Tube Strap
W-150069	Button, Hole Plug
R-150122	Cabinet (11-454 MU)
R-150294	Cabinet (11-458 MU)
R-150213	Cabinet (11-484 BU)
W-146335	Clamp Cabinet Back
W-147424	Clip, Anode Connector
AB-149712-1	Cover, Controls
W-149486	Cushion, Picture Tube Rest
B-160128-24	Cushion, Picture Tube Stop (11-454 MU, 11-484 BU)
B-160128-25	Cushion, Picture Tube Strap
C-149153-3	Dial Tuning
C-148481-4	Dial, Volume
150325	Doors (1 pair), Cabinet (11-454 MU)
150329	Doors (1 pair), Cabinet (11-458 MU)
150291	Doors (1 pair), Cabinet (11-484 BU)
150326	Door, Control Access (11-454 MU)
150330	Door, Control Access (11-458 MU)
150292	Door, Control Access (11-484 BU)
AB-149300	Foot Assy., Center Chassis Bracket
R-150098-1	Frame, Window (11-454 MU, 11-458 MU)
R-150098-2	Frame, Window (11-484 BU)
150377	Grille Cloth (11-454 MU, 11-458 MU)
149892	Grille Cloth (11-484 BU)
149393	Hinge, Control Access Door (11-454 MU, 11-458 MU)
149974	Hinge, Control Access Door (11-484 BU)
146786	Hinge (Cabinet Door), Upper L & Lower R (11-454 MU, 11-458 MU)
149942	Hinge (Cabinet Door), Upper L & Lower R (11-484 BU)
146786	Hinge (Cabinet Door), Upper R & Lower L (11-454 MU, 11-458 MU)
149943	Hinge (Cabinet Door), Upper R & Lower L (11-484 BU)
148484	Ion Trap
AW-147887-1	Knob, Off-On-Contrast (11-454 MU)
AW-147887-3	Knob, Off-On-Contrast (11-484 BU)
AW-147887-4	Knob, Off-On-Contrast (11-458 MU)
AW-147889-1	Knob, Tuning (11-454 MU)
AW-147889-3	Knob, Tuning (11-484 BU)
AW-147889-4	Knob, Tuning (11-458 MU)
AW-147888-1	Knob, Volume (11-454 MU)
AW-147888-3	Knob, Volume (11-484 BU)
AW-147888-4	Knob, Volume (11-458 MU)
R-150099	Mask, Picture Tube
B-148080-8	Medallion (11-454 MU, 11-458 MU)
B-148080-9	Medallion (11-484 BU)
W-150275	Pad (Composition), Window
150618	Pull, Door Handle (11-454 MU)
150290	Pull, Door Handle (11-458 MU, 11-484 BU)
AB-149745	Rest & Cushion Assy., Picture Tube
W-145391	Ring (Compression), Tuning Dial
W-147921-2	Screw (Special), Chassis Mtg.
39352-56XA	Screw, Window (11-484 BU)
39352-56XD	Screw, Window (11-454 MU, 11-458 MU)
W-148782	Spacer, Antenna Terminal Assy.
W-146484	Spring, Dial Retaining
AB-149308	Strap, Picture Tube
139319SB	Strike & Catch, Doors (11-454 MU, 11-458 MU)
149951	Strike & Catch, Doors (11-484 BU)
AW-149603	Terminal Assy., Antenna
B-150075	Window, Safety Glass

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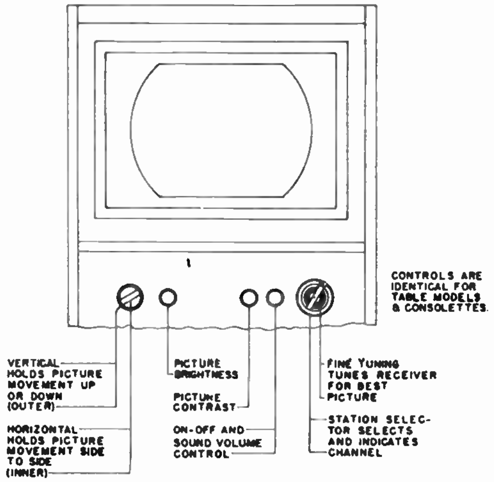
High Definition Television Receiver

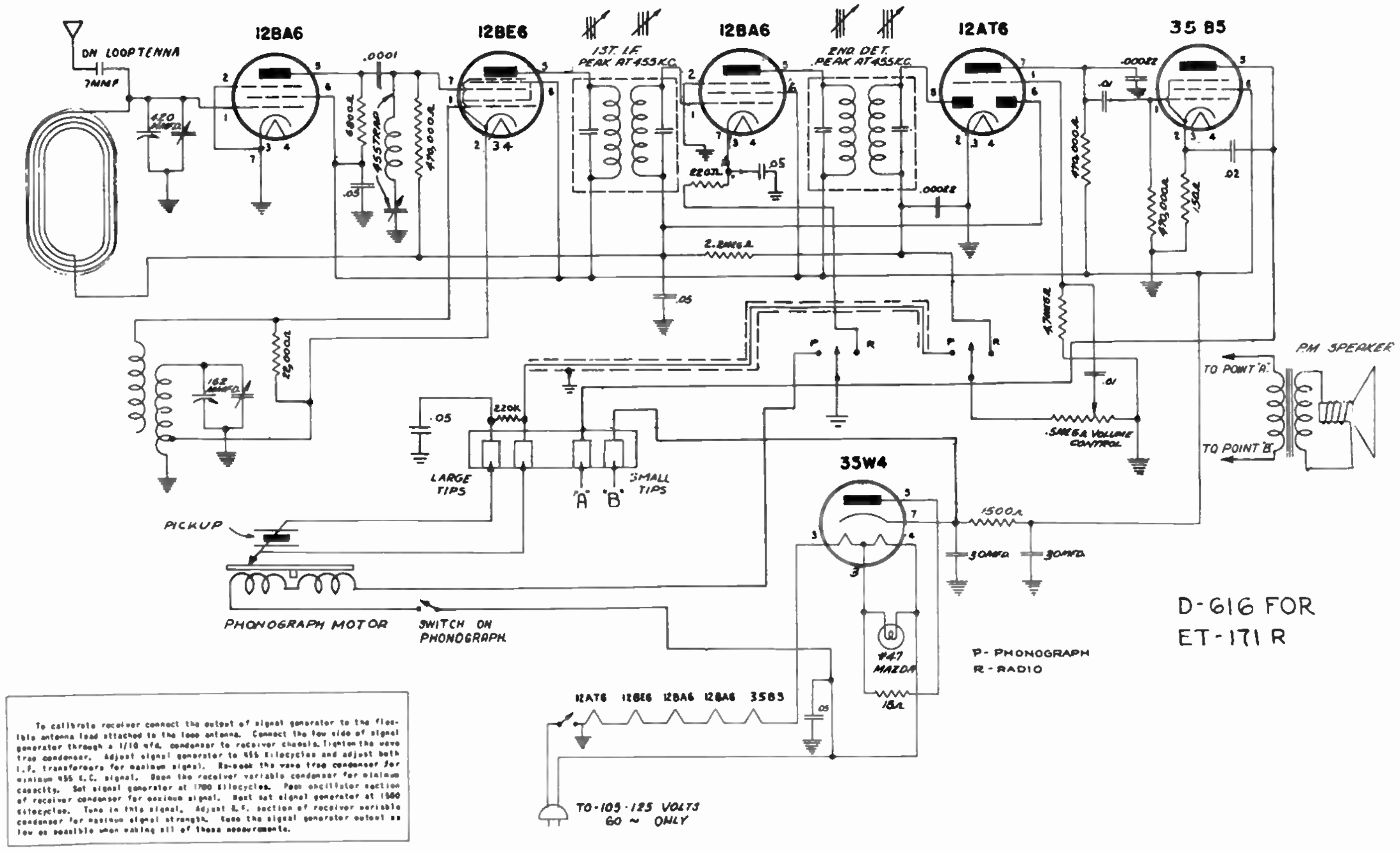


REPLACEMENT PARTS

1073B	ANT. LOOP
1011	OSCILLATOR COIL
1091B-4	1st I.F. COIL
1091B-1	2nd DETECTOR COIL
2000A	PAPER CONDENSERS
2012B	CERAMIC CONDENSERS
2005-1	COMB. ELECTROLYTIC
2003-C	VAR. CONDENSER
2056	TRIMMER CONDENSER
3029	½ W. RESISTOR
3001A	1 W. RESISTOR
3036	2 W. RESISTOR
1005	WAVE TRAP COIL
3013-3	VOLUME CONTROL AND SWITCH
8004	PHONO-RADIO SWITCH
5000	LINE CORD
4080-4	KNOB
6007	GLASS DIAL SCALE
7017-2	SPEAKER
8001-1	PILOT LAMP SOCKET
9109A-2	SHAFT
9818C	BUSHING
9069-3	DRIVE SPRING
	DIAL CORD
	#47 PILOT LAMP
9113A-6	DIAL POINTER

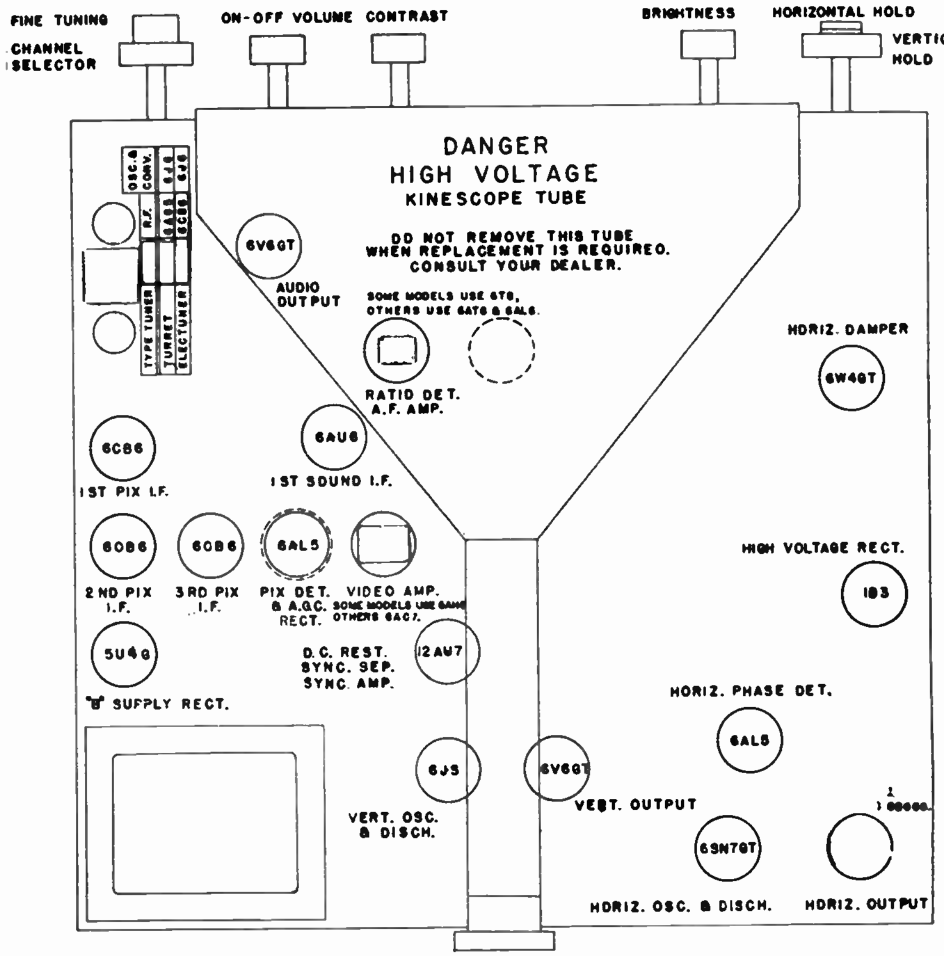
TUBES

2 12BA6 - 1 12BE6 - 1 12AT6 - 1 35B5 - 1 35W4



To calibrate receiver connect the output of signal generator to the flexible antenna lead attached to the loop antenna. Connect the low side of signal generator through a 1/10 mfd. condenser to receiver chassis. Tighten the wave trap condenser. Adjust signal generator to 455 kilocycles and adjust both I.F. transformers for maximum signal. Re-peak the wave trap condenser for minimum 455 K.C. signal. Open the receiver variable condenser for minimum capacity. Set signal generator at 1700 kilocycles. Peak oscillator section of receiver condenser for maximum signal. Next set signal generator at 1500 kilocycles. Tune in this signal. Adjust R.F. section of receiver variable condenser for maximum signal strength. Keep the signal generator output as low as possible when making all of these measurements.

D-616 FOR ET-171 R

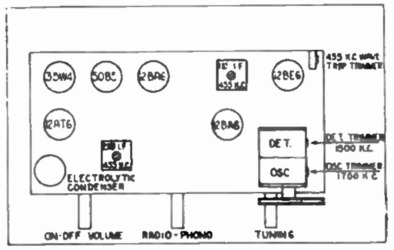


RADIO & 3 SPEED PHONOGRAPH SECTION

Superheterodyne

Range: 525-1700 Kilocycles

VOLTS	CYCLES	WATTS
105 - 125	60	25



A. C. ONLY	VOLTS	CYCLES	WATTS
	105-125	60	225 MAX.

MODELS DT-162R, DT-163A, DT-163AR, DT-190D, DT-191, ET-140R, ET-141R, ET-170, ET-171, ET-172

RECORD CHANGER: G.I. Model 700F, See Pgs. RCD.CH.19-1,2 to RCD.CH.19-9.

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MODELS DT-162R, DT-163A, DT-163AR, DT-190D, DT-191, ET-140R, ET-141R, ET-170, ET-171, ET-172

OPERATING INSTRUCTIONS

TUNING:

The following adjustments are necessary when turning the receiver on.

1. Turn ON-OFF VOLUME control slightly clockwise to switch receiver on. Then turn 1/2 turn clockwise for SOUND VOLUME.
2. Set the STATION SELECTOR so that the desired channel number is seen in the window.
3. Allow 15 to 20 seconds for the tubes to warm up.
4. Turn CONTRAST control fully counterclockwise.
5. Turn the BRIGHTNESS control fully counterclockwise, then clockwise until a faint glow just appears on the screen.
6. Turn CONTRAST control clockwise until a glow or a pattern appears on the screen.
7. If the desired channel is broadcasting, music or speech should now be heard and the FINE TUNING control be reset for best picture quality. Adjust VOLUME control for desired amount of sound.
8. Adjust the VERTICAL hold control until the pattern stops moving up or down.
9. Adjust the HORIZONTAL hold control until a picture is obtained and centered from side to side.
10. Adjust the CONTRAST control so that the picture is clear on the screen.

TO CHANGE FROM ONE CHANNEL TO ANOTHER:

11. Turn the STATION SELECTOR so that the desired channel number is seen in the window.
12. It may be necessary to repeat Steps 7 and 10 when switching from one channel to another.
13. When the set is turned on again after an idle period, it should not be necessary to repeat the adjustments if the positions of the controls have not been changed. If any adjustment is necessary, step 7 is generally sufficient.
14. If the position of the controls has been changed it may be necessary to repeat steps 1 through 10.

NOTE: If any difficulty is experienced with steps 8 or 9, turn the CONTRAST control 1/4 turn counterclockwise and repeat adjustments 8 and/or 9.

INSTALLATION:

The complete installation of your new DeWald Television Receiver and the Television Antenna (if needed) must be made by a qualified DeWald Television Service Technician. The dealer from whom you purchased the receiver will advise you so that a DeWald Service Technician will install and demonstrate DeWald Television Reception. Only an antenna which is designed to match the receiver circuits should be used. Reception up to and sometimes beyond the line of sight to the transmitter antenna may be obtained if local interference conditions permit. It is recommended that a combination low frequency and high frequency antenna with separate lead-ins be used when installing this receiver in poor reception areas. It is further advised that a double pole, double throw switch be used for switching either the high or low frequency antenna to the receiver input.

REPLACEMENT OF KINESCOPE:

For Models ET-170, ET-171, ET-172. Remove all control knobs, masonite back of cabinet, four mounting screws under cabinet and connecting plug from speaker. The chassis can now be removed from the cabinet. To replace the kinescope, remove the kinescope socket, ion trap and disconnect the second anode cap connector. Loosen and remove the screw which holds the tube straps together on top of kinescope tube. The tube may now be withdrawn from the yoke and focalizer. When installing the new kinescope do not force it into the yoke or focalizer if they are not properly aligned. The tube must be installed so that the second anode contact is about 45 degrees toward the high voltage can from the vertical position. Replace the screw which holds together the tube straps and the ion trap and kinescope socket. Slide the chassis back into the cabinet, replace the speaker connecting plug, push on the second anode cap connector, push on all control knobs, and tighten the four chassis mounting screws.

For the Model Et-140R, the procedure indicated above must be followed with the exception that to remove tube strap, slide strap forward.

For the Models DT-163R, DT-163A, ET-191, DT-190D, the procedure for replacement of the kinescope is as follows: Remove the front panel from cabinet by removing the two wing screws from behind the top of the panel. Take off this panel, the masonite back of the cabinet, the kinescope socket and the ion trap. The kinescope can now be removed from the set. To put the new kinescope in place, orient the tube with the key at the base of the tube pointing downward and reverse the above procedure.

CAUTION: FAILURE TO CONNECT THE SPEAKER TO THE CHASSIS BEFORE TURNING THE RECEIVER ON MAY RESULT IN SERIOUS DAMAGE TO THE FIRST FILTER CONDENSER AND 5U4 RECTIFIER.

NOTE: THE METAL ENVELOPE OF THE KINESCOPE PICTURE TUBE HAS HIGH VOLTAGE CONNECTED TO IT.

ION TRAP ADJUSTMENT:

The ion trap is to be put on with the magnet poles approximately over the Kinescope flags. Starting from this position adjust the ion trap by moving it forward or backward at the same time rotating it slightly around the neck of the tube for the brightest raster on the screen.

CENTERING AND FOCUSING ADJUSTMENTS:

Move the focalizer back 1/4" away from the back of the Deflection Yoke. Centering is then performed with the focalizer. Loosen the two wing screws on the sides of the focalizer and move it in the direction required to center the picture. When best centering is obtained, tighten the wing screws. When the picture is off center either horizontally or vertically it may be adjusted on some sets with the "beamadjuster" and on others with the focalizer centering lever. The "beamadjuster" is accessible just in front of the focalizer and movement of the flange will result in movement of the picture position. The focalizer centering lever projects from the rear of the focus unit and moves the picture horizontally & vertically. The focusing procedure is as follows: Turn the bottom focalizer screw in until it will go no further, then turn it out 2 turns. Next adjust the top screw for best focus. Readjust the ion trap for maximum brilliance and then touch up the focus with the top screw.

NOTE: If no pattern is on, turn contrast control counterclockwise fully and turn up brightness control so that the raster lines are visible. The adjustment of the focalizer adjusting screw can be made by getting the sharpest line detail.

DEFLECTION YOKE ADJUSTMENT:

If the lines of the raster are not horizontal or squared with the picture mask, rotate the deflection yoke until this condition is obtained. Tighten the yoke adjustment screw.

PLACEMENT:

The location in the room for your television receiver should be given careful consideration. Choose the location:

A - Where no bright light will fall directly on the picture (some illumination in the room is desirable).
B - To give easy access for operation and comfortable viewing.
C - To permit a convenient connection to an outdoor antenna if it is needed.
D - Convenient to an A-C electrical outlet of the proper voltage and frequency.
E - To allow adequate ventilation.

CAUTION: The receiver is provided with adequate ventilation apertures, under, in back of, and on the sides of the cabinet. THESE APERTURES SHOULD NOT BE ALLOWED TO BE COVERED OR VENTILATION IMPEDED IN ANY WAY.

NOTE: Always keep the rear of this television receiver at least 6 inches away from the wall to allow for proper ventilation.

ANTENNA:

This television receiver features a self-contained antenna which makes use of an external antenna unnecessary in many locations. For best results rotate the cabinet while checking the picture quality on all stations. Use the receiver in a position which gives best results.

If an external antenna is necessary, take both leads off the antenna connector at the left of the chassis rear, and connect the lead-in wires of the external antenna to this connector.

REPLACEMENT OF FUSE:

This receiver is provided with a pigtail Glass Tube Fuse on the left bottom side of the chassis. This is a protective fuse for the H.V. Transformer. If it blows out, replace the 6BG6G tube. Use a 0.2 amp. - 250 volt pigtail fuse when replacement is necessary.

POWER SUPPLY:

This receiver is designed to operate on 105-125 volts, A.C. 60 cycle power only. If plugged into an incorrect power supply, damage to the receiver may result. If in doubt about your power supply, call your power company.

HIGH VOLTAGE CHECK:

If there is no raster on the kinescope tube after the ion trap has been adjusted, the high voltage may be checked as follows: Place the metal portion of a well insulated screwdriver near the top cap of the 1B3 tube. Hold only the insulated portion of the screwdriver. The metal part of the screwdriver should draw approximately a 1/4" spark from this cap. If a spark is present and there is still no high voltage at the anode lead replace the 1 Megohm Filter Resistor underneath the 1B3 socket.

ALIGNMENT PROCEDURE:

TO ADJUST SOUND I.F.'S:

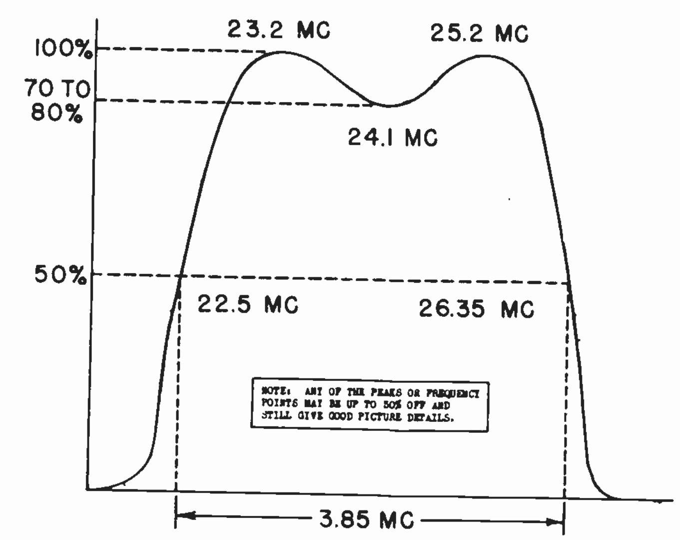
1. Set A.M. Signal generator to 4.5 Mc and connect high side of generator, thru a .01 MFD condenser, to grid of the Video Amplifier Tube (6AH6 Pin 1). Low side of generator to go to chassis ground.
2. Connect a VTVM between Pins 2 and 7 of the 6T8 sound ratio detector tube (across 5MFD electrolytic condenser or points A and B on schematic diagram). Connect the plus side of the VTVM to Pin 7 and the negative side in series with a 33K ohm resistor to Pin 2.
3. With the signal generator (unmodulated) set at 4.5 Mc, adjust the sound takeoff coil (L8) and ratio detector primary T1 (bottom slug) for maximum DC voltage on the VTVM.
4. Adjust the takeoff coil before adjusting the ratio detector primary. Use just enough signal generator output to obtain approximately 1 volt on the VTVM. Connect the plus side of the VTVM to the junction of the two 18K ohm resistors connected between Pins 2 and 7 of the 6T8 tube (point C on schematic). Connect the minus side of the VTVM to the junction point of the 47K ohm resistor and the .01 MFD condenser (point D on schematic) going to the sound volume control. Adjust the ratio detector (T1) secondary (top slug) for zero voltage output. It will be found that it is possible to procure a plus or minus voltage on the VTVM depending upon the adjustment. Obviously to pass from a plus to a minus voltage, the voltage must pass through zero. The top slug should be adjusted so that the meter indicates zero output as the voltage swings from plus to minus. This point then will be called ratio detector zero adjustment.
5. Shift the frequency of the signal generator either side of 4.5 Mc and touch up the ratio detector primary for approximately equal peaks. Use just enough signal generator output to obtain 1 volt peaks for the best results.
6. When using an oscilloscope and a wide band oscillator for calibrating sound I.F., connect the sweep generator high side, through a .01 MFD condenser, to grid of the Video Amplifier Tube (6AH6 Pin 1). Connect the oscilloscope high side (in series with a .01 MFD condenser and a 40K ohm resistor) to the point indicated in step 4 and the ground terminal to chassis. Adjust the bottom slug of the ratio detector (primary) to produce maximum amplitude and the top slug (secondary) to produce the correct center point and best linearity on the response curve. The curve should be "S" shaped.
7. Connect sweep generator to the point indicated in step 1. Connect oscilloscope high side (in series with a .01 MFD condenser and 40K ohm resistor) to pin 2 of the 6T8 sound ratio detector and the ground terminal to chassis. Remove minus side of the 5 MFD stabilizer capacitor from pin 2 of the 6T8 tube. Adjust takeoff coil to produce maximum amplitude at 4.5 Mc.

NOTE: During sound I.F. alignment the common lead of VTVM is connected to approximately 140 volts, with respect to chassis. Avoid touching or grounding the VTVM case. Keep Contrast control fully clockwise.

TO ADJUST PICTURE I.F.'S:

1. Connect the negative terminal of a 3 volt "A" battery to the junction of the 1 megohm and .25 Mfd in the AGC bias line, (point E on schematic) and positive terminal to a chassis ground. Set the contrast control to the fully clockwise position. Set fine tuning control with flat in horizontal position.
2. Set channel switch to channel 3 or any clear channel.
3. Connect a VoltOhmyst across the second picture detector load resistor of 4700 ohms. Plus end to go to junction point of peaking coil L-5 and 4700 ohm resistor and minus end to other side of load resistor (junction of 4700 ohm, 1K ohm and .1 Mfd condenser).
4. Couple the high side of the signal generator to the mixer tube of tuner by slipping a tight fitting insulated tube shield over the tube envelope and connecting the generator lead to it. Connect the ground side of the signal generator to the frame of the tuning unit.
5. Set A.M. Signal generator to 25.2 Mc and peak detector I.F. (L-3) and first picture I.F. coil (L-1) for maximum gain on VoltOhmyst.
6. Set A.M. Signal generator to 23 Mc and peak second I.F. coil (L-2) and converter I.F. coil on top of tuner for maximum output on VoltOhmyst.
7. When using an oscilloscope and a wide band oscillator for calibrating and checking bandwidth of the I.F.'s, connect sweep generator to the point indicated under step 4. Connect the oscilloscope high side (in series with a 40K ohm resistor) to the junction of the peaking coil L-5 and 4700 ohm resistor, and the ground terminal to chassis. Align the picture I.F. to produce a response curve similar to the one shown.

NOTE: During picture I.F. alignment the common lead of VoltOhmyst is connected to approximately minus 2.5 volts with respect to chassis. Avoid grounding the VoltOhmyst case.



TYPICAL OVERALL RESPONSE CURVE OF PICTURE I.F.'S

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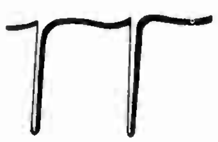
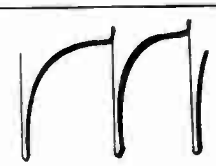


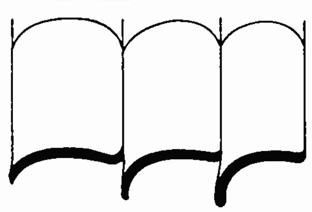
OUTPUT OF INTEGRATING NETWORK - VERTICAL

VERTICAL OSC. TRANS. YELLOW LEAD 25 V. P-P



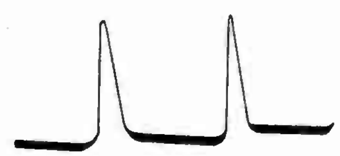
GRID OF VERTICAL OSC. TUBE

6J5GT - PIN 5 160V. P-P



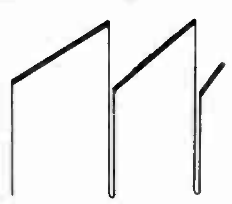
OUTPUT OF SYNC. SEPARATOR VERTICAL

12AU7 SYNC. AMP. - PIN 6 50 V. P-P



OUTPUT OF SYNC. SEPARATOR HORIZONTAL

12AU7 SYNC. AMP. - PIN 6 45 V. P-P

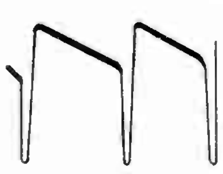


INPUT TO VERTICAL OUTPUT TUBE

RED LEAD OF VERTICAL OSC. TRANSFORMER 130V. P-P

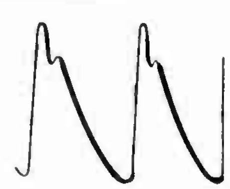
PLATE OF VERTICAL OUTPUT TUBE

6V6GT - PINS 3 & 4 550 V. P-P



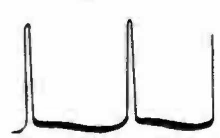
HORIZONTAL PHASE DETECTOR

6AL5 - PIN 5 17V. P-P



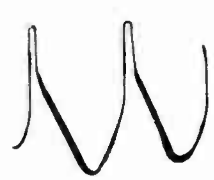
HORIZONTAL PHASE CONTROL VOLTAGE

6AL5 - PINS 1 & 2 15 V. P-P



HORIZONTAL OSC.

CATHODE OF 6SN7GT - PINS 3 & 6 15V. P-P



HORIZONTAL OSC.

PLATE OF 6SN7GT - PIN 5 45 V. P-P

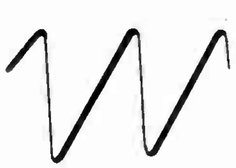
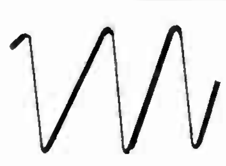


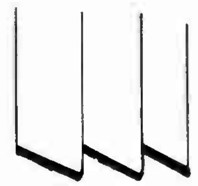
PLATE OF HORIZONTAL DISCH. TUBE

6SN7GT - PIN 2 72V. P-P



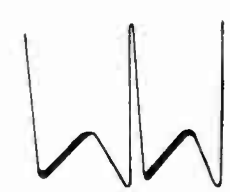
GRID OF HORIZONTAL OUTPUT TUBE

6BG6G - PIN 5 65V. P-P



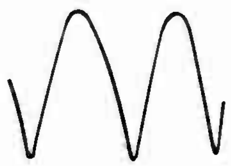
VOLTAGE ACROSS VERTICAL DEFLECTION COILS

VERTICAL OUTPUT TRANS. GREEN LEAD 120 V. P-P



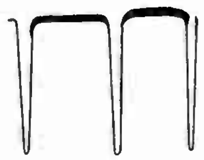
HORIZONTAL PHASE DETECTOR

6AL5 - PIN 7 17V. P-P



TERMINAL NO. 1 OF HIGH VOLTAGE FLYBACK TRANSFORMER & GROUND

85V. P-P



VOLTAGE ACROSS HORIZONTAL DEFLECTION COILS

DAMPER 6W4GT - PIN 5 APPROX. 1200V. P-P

NOTE: ALL MEASUREMENTS MADE WITH THE LOW SIDE OF OSCILLOSCOPE CONNECTED TO CHASSIS

TUBE	POSITION	PIN NUMBERS AND VOLTAGES (20,000 OHMS PER VOLT) 1	2	3	4	5	6	7	8	
5U4G	Rectifier								400	
6CB6	1st Pix I.F.	1.0	0.5			125				Contract Control fully c-w
6CB6	2nd Pix I.F.		0.8			125				" "
6CB6	3rd Pix I.F.		1.70			120				" "
6AL5	Video Det. A.G.C. Rect.	3.0	-2.5			-1				" "
6AH6	Video Amp.	-2.0	1.8			160	160	1.8		Cont. Contr. CCW
6AU6	Sound Input	130				330	180	135		Contrast Control fully c-w
6T8	Sound Det. 1st Audio	125	115	115				130	120	Pin 9 195 "
6V6GT	Audio Output			280	300	125			130	" "
12AU7	Sync. Sep. & Amp. D.C. Rest.	20	0	2.0			70	20	20	Cont. Contr. CCW
6SN7GT	Hor. Osc. & Disch.	-6.2	100	10		250	10			H-Hold fully ccw
6BG6GT	Hor. Output			7		-13.5			270	
6W4GT	Damper			510		360		135		
6AL5	Phase Det.	0	0			8.6		-8.2		
6J5GT	Vert. Osc.			250		-60				V-Hold fully ccw
6V6GT	Vert. Output			280		- 7			14	V-Lin & Height fully clockwise
	Kinescope	#2 0	#10 Red 325	#11 Yellow B'tness Cntrl: cw, 35; ccw, 70					#12 Brn 6.3 v, AC	

Main B+ Bus 350 v. to 360 v.
Intermediate B+ Bus 135 v.
NOTE: All voltages measured to ground.

MODELS DT-162R, DT-163A, DT-163AR, DT-190D, DT-191, ET-140R, ET-141R, ET-170, ET-171, ET-172

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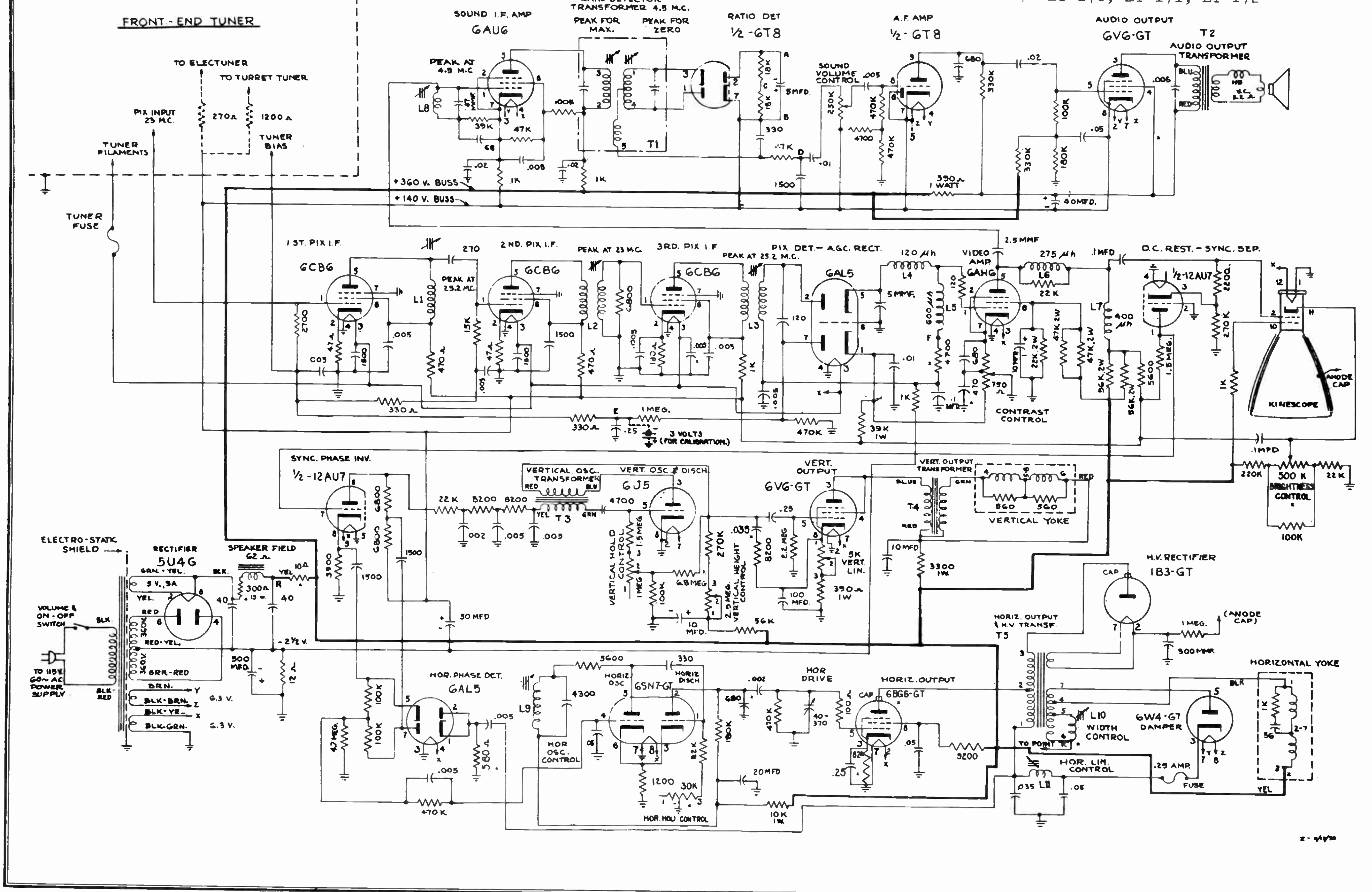
MODELS DT-162R, DT-163A, DT-163AR, DT-190D, DT-191, ET-140R, ET-141R, ET-170, ET-171, ET-172



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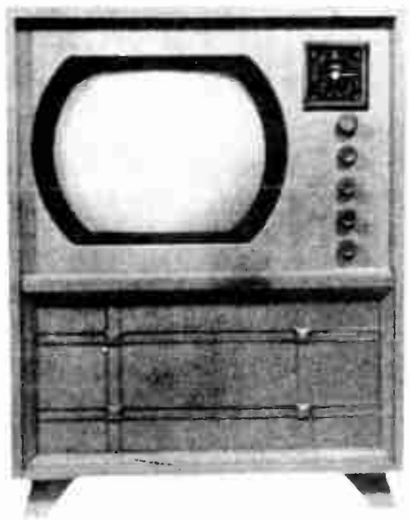
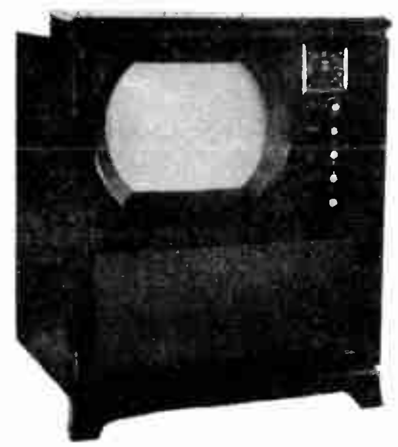
RA-112A CABINET STYLES


WESTERLY

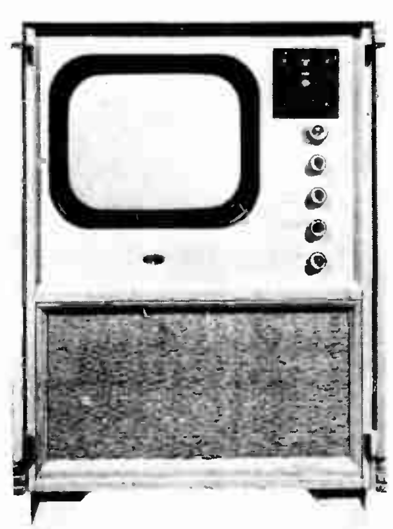

ARDMORE

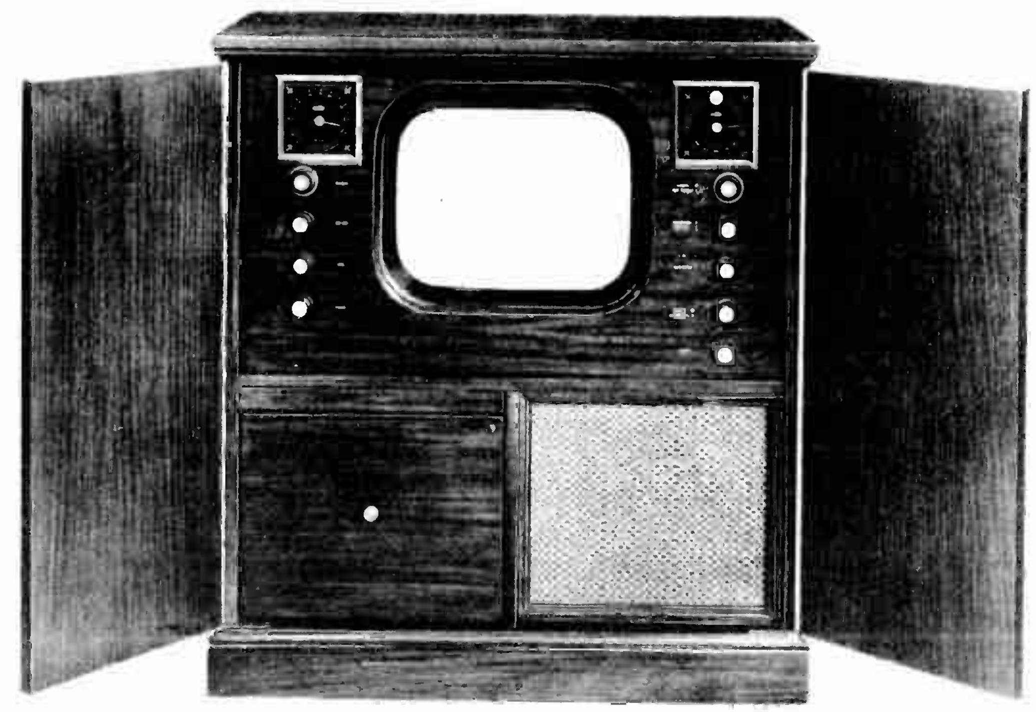

MT. VERNON

RA-113 CABINET STYLES


Revere


Brookville


Burlingame



TARRYTOWN

Model Number	Cabinet	Services
RA-113-B7	Mahogany Console/Doors	AM, FM, TV and 3 Speed Record Player
RA-113-B8	Blonde Console/Doors	AM, FM, TV and 3 Speed Record Player

RA-113 Combination Section

The Tarrytown tube complement is the same as that of the other RA-113 models plus six additional tubes used in the AM tuner chassis making a total of 32 tubes.

RA-113 TARRYTOWN AM TUNER TUBE COMPLEMENT

Tube Symbol	Tube Type	Tube Function
V401	6BA6	RF Amplifier
V402	6BE6	Converter
V403	6BA6	IF Amplifier
V404	6SQ7	Detector and 1st Sound Amplifier
V405	6V6-GT	Audio Output
V406	5Y3-GT	Rectifier

MODELS RA-112-A1, RA-112-A2, RA-112-A3, RA-112-A4, RA-112-A5, RA-112-A6, RA-113-B1, RA-113-B2, RA-113-B3, RA-113-B4, RA-113-B5, RA-113-B6, RA-113-B7, RA-113-B8

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RA-113 TARRYTOWN ELECTRICAL CHARACTERISTICS

Average Power Ratings - (Line Voltage - 117 volts AC)

Television and FM positions - 200 watts

AM position - 70 watts

CRT High Voltage - (Line Voltage - 117 volts AC)

13 KV ± 1.5 KV at zero brightness.

Audio Power Output - (400 cycles)

1 watt across 3.2 ohm resistive load in place of speaker.

RA-112A RA-113 Section

INTRODUCTION

The Model RA-112A Teleset is produced in the following styles:

Name	Model No.	Cabinet	Services
Ardmore	RA-112-A1	Mahogany Open Console	FM and TV
	RA-112-A4	Blonde Open Console	FM and TV
Westerly	RA-112-A2	Mahogany Console/Doors	FM and TV
	RA-112-A5	Blonde Console/Doors	FM and TV
Mt. Vernon	RA-112-A3	Mahogany Console/Doors	FM and TV
	RA-112-A6	Blonde Console/Doors	

	Picture Tube	Speaker
All Models	19"	10"

The Model RA-113 Teleset is produced in the following styles:

Name	Model No.	Cabinet	Services
Brookville	RA-113-B1	Mahogany Open Console	FM and TV
	RA-113-B2	Blonde Open Console	FM and TV
Revere	RA-113-B3	Mahogany Console/Doors	FM and TV
	RA-113-B4	Blonde Console/Doors	FM and TV
Burlingame	RA-113-B5	Mahogany Console/Doors	FM and TV
	RA-113-B6	Blonde Console/Doors	FM and TV
Tarrytown	RA-113-B7	Mahogany Console/Doors	AM, FM, TV and 3 Speed Record Player
	RA-113-B8	Blonde Console/Doors	AM, FM, TV and 3 Speed Record Player

	Picture	Speaker
All Models	17 in. Rectangular	10" (Except Tarrytown 12")

The chassis used in the RA-112A and RA-113 Telesets is basically the same chassis that was used in the RA-111 models. The horizontal output and high voltage circuits have been modified to supply adequate sweep and high voltage to the larger picture tubes. Certain other circuit improvements as outlined in the circuit description portion of these notes have been made.

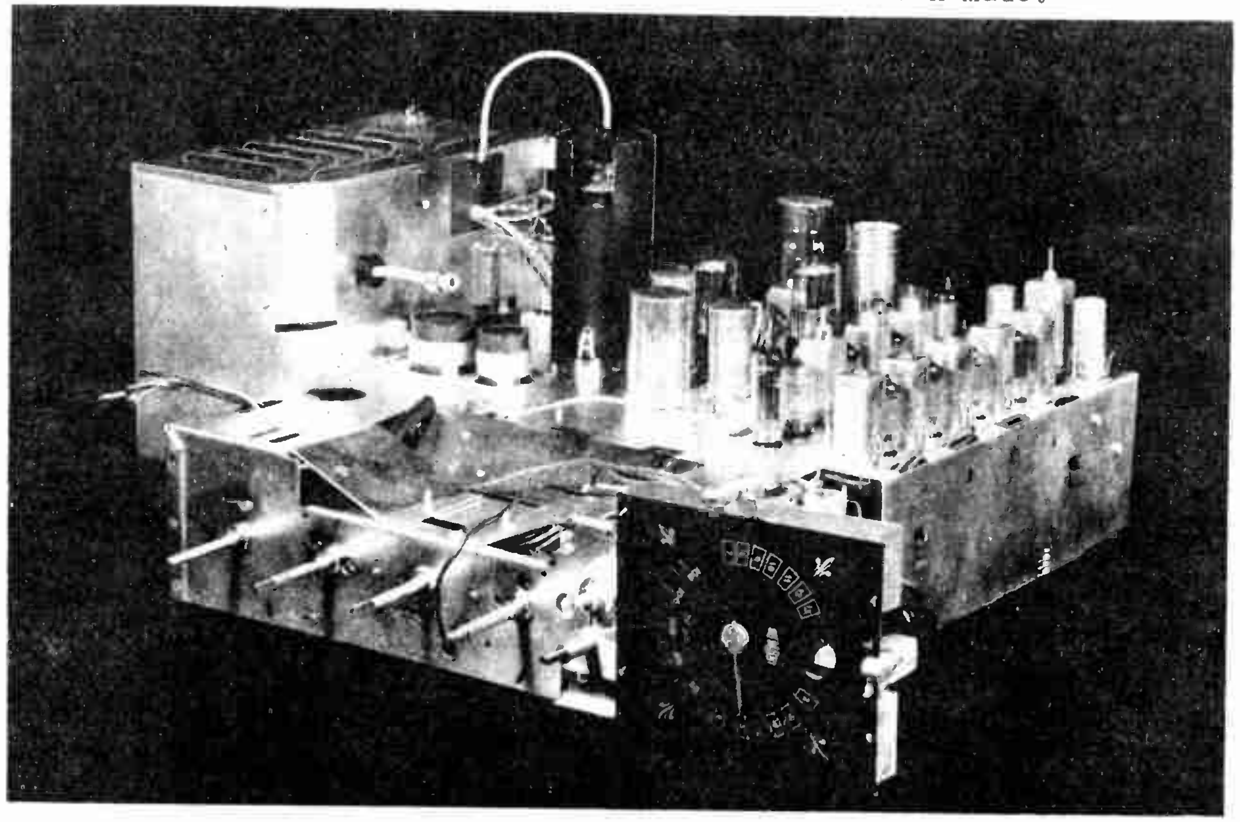

Figure 1 - RA-112A - RA-113 Chassis

RA-112A RA-113 TUBE COMPLEMENT

A total of twenty-six tubes, including the cathode-ray tube, the tuning indicator and three rectifiers are incorporated in this chassis.

Tube Symbol	Tube Type	Tube Function
V101	6J6	R.F. Amplifier
V102	6AK5	Mixer
V103	6AB4	V.H.F. Oscillator
V201	6AU6	1st Sound IF
V202	6AU6	2nd Sound IF
V203	6T8	Sound Discriminator, First Sound Amplifier and A.G.C. Clamp
V204	6AQ5	2nd Sound Amplifier
V205	6AU6	1st Video IF

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V206	6AU6	2nd Video IF
V207	6AU6	3rd Video IF
V208	6BC5	4th Video IF
V209A	1/2 6AL5	Video Detector
V209B	1/2 6AL5	D.C. Restorer
V210	6AH6	Video Amplifier
V211	19AP4	Picture Tube (Used in RA-112A)
V211	17AP4	Rectangular Picture Tube (Used in RA-113)
V212	6BA6	Narrow Band Sync Amplifier
V213	6AL5	Sync and A.G.C. Detector
V214	6SN7-GT	Horizontal A.F.C. and Saw Generator
V215	6BG-6	Horizontal Deflection Amplifier
V217	6W4-GT	Damper
V218	5U4G	Rectifier
V219	6AU6	1st Sync Clipper
V220A	1/2 6SN7-GT	2nd Sync Clipper
V220B	1/2 6SN7-GT	Vertical Saw Generator
V221	6SN7-GT	Vertical Deflection Amplifier
V222	6AL7-GT	Tuning Indicator
V401	1X2	High Voltage Rectifier
V402	1X2	High Voltage Rectifier

RA-112A RA-113 ELECTRICAL CHARACTERISTICS

Average Power Ratings (Line Voltage - 117 volts AC)
Television and FM positions - 200 watts

CRT High Voltage (Line Voltage - 117 volts AC)
13 KV $\pm$ 1.5 KV at zero brightness

Audio Power Output (400 cycles)
1 watt across 3.2 ohm resistive load in place of speaker.

RA-112A Picture Size

Dimensions: 13" x 17 3/8"
Area: 208 square inches

RA-113 Picture Size

Dimensions: 11 1/8" X 14 1/2"
Area: 150 square inches

RA-112A PHYSICAL CHARACTERISTICS

Cabinet Size

	Height	Width	Depth
Ardmore	40"	31 1/8"	22 11/16"
Westerly	40"	31 1/8"	23 3/4
Mt. Vernon	40 1/2"	33"	24 1/2"

RA-113 PHYSICAL CHARACTERISTICS

Cabinet Size

	Height	Width	Depth
Brookville	39 3/8"	26 3/4"	20 15/16"
Revere	39 7/8"	26 3/4"	22 1/2"
Burlingame	39 3/8"	26 3/4"	21 7/8"
Tarrytown	39"	35 3/4"	22 1/2"

2.0 Circuit Description

2.1 RF Tuning Assembly

The RA-112A RA-113 Telesets incorporate the latest Du Mont Four Section Inputuner. Up to and including serial no. 122695 in the RA-112A models and serial no. 132211 in the RA-113 models, the Inputuner used is electrically the same as that used in the RA-111A Telesets.

Starting with serial no. 122696 in the RA-112A models and serial no. 132212 in the RA-113 models the IF transformer in the plate circuit of the mixer is different than that in the above-mentioned tuner. The Inputuner schematic diagram appearing on the RA-112A RA-113 Service Sheet includes the new IF transformer in the mixer plate circuit.

The essential differences between this transformer and that previously used are as follows:

1. The coupling is fixed in the transformer. (The coupling adjustment now consists of an adjustable coil on the receiver chassis.)

2. An additional trap to attenuate the sound carrier of the lower adjacent channel to which the Teleset is tuned is included in this transformer. This is any absorption type trap and is tuned in the alignment procedure for maximum attenuation of 27.75 mc. With the new IF's of 21.75 mc for sound and 26.25 mc for picture, the beat produced between the local oscillator and the lower adjustment channel sound carrier is now 27.75 mc instead of 27.9 mc.

All post war Du Mont Telesets normally utilized a 26.4 mc IF for the video carrier and 21.9 mc for sound. In some receivers, this resulted in strong beat interference on channel 7 as a result of the 8th harmonic (175.2 mc) of the sound IF (21.9 mc) beating against the video carrier of channel 7, (175.25 mc) and producing a 50 kc beat. The result was a streaking of the picture. Although this condition could be cured by certain modifications, a change to a lower IF (21.75 mc) resulted in the complete elimination of the beat.

All RA-112A Telesets beginning with serial no. 12702 and all RA-113 Telesets beginning with serial no. 13580 are aligned to the new IF's as outlined in the enclosed alignment sheet. The new IF's are 26.25 mc for video and 21.75 mc for sound.

2.2 Video IF Strip

The video IF strip used in the RA-112A - RA-113 Telesets is basically the same as is used in the RA-11A chassis. The important differences which can be readily be seen by comparing the two schematics are as follows:

A. All RA-112A Telesets starting with serial number 122696 and all RA-113 Telesets starting with serial number 132212 utilize a different type of transformer at Z204, the input to the IF strip. The important difference in this transformer is that the method of coupling from the Inputuner output to the IF strip input has been changed. This transformer change took place at the same time that the IF transformer in the plate circuit of the mixer stage was changed. The coupling adjustment in the receiver is now made by adjusting L213, which is mounted on the receiver chassis proper.

B. The fourth video IF tube (V208) has been changed from a 6AU6 to a 6BC5. The purpose of this change is to improve the overall sen-

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sitivity and signal-to-noise ratio. In conjunction with this change the cathode resistor R231 was changed from a 120 ohm resistor to a 220 ohm resistor. In order to obtain proper alignment of this stage using a 6BC5, it was necessary to replace the transformer Z208 with a different type.

Other than the changes mentioned above, this strip is identical to the RA-111A.

2.3 Video Detector and Amplifier

The same tube lineup is used in this section as was used in the RA-111A.
R234, the 10K resistor that was connected across L202 in the early RA-111A models, was deleted. (All RA-111A models effective with chassis serial number 112214 also contained the same change.) In addition to the deletion of the resistor, the coil L202 was changed.

The purpose of these changes is to improve picture quality.

2.4 Sound IF Strip

As in the RA-111A, the sound take-off point is from the plate circuit of the first video IF stage. The coupling capacitor C280 has a value of 2.5 mmf in these models whereas it was 1.7 mmf in the early RA-111A models. The reason for this change is to improve sound attenuation.

The discriminator transformer Z203 has been changed. The purpose of the change is to produce more sound output. Examination of the schematic indicates the following changes:

The secondary winding of the discriminator is not center-tapped. Instead, two capacitors are connected across the secondary winding and the tap is taken off at the junction of these capacitors.

2.5 Audio Amplifier Section

The Audio Amplifier Section is practically identical to the RA-111A circuit.

The triode section of the 6T8 (V203) functions as the voltage amplifier. The output from this tube is then used to drive the sound output stage (V204) which uses a 6AQ5.

This chassis will also be used in a combination model to be known as the Tarrytown (includes AM radio and three speed record changer). Certain provisions have been made in the audio output stage for use in the Tarrytown only.

The AM radio used in the Tarrytown will include a tone control. The shielded lead shown between pin #1 of V204 and pin #1 of the connector J201 is used to connect the tone control in the AM tuner back to the grid of the audio output stage, thus permitting control of tone in the television chassis.

The short shown across R323 (grid circuit of V204) is not an error. This will be removed when the AM tuner is used. R323 is a new resistor and was not used on the RA-111A models. C279 (plate circuit of V204) will also be removed when this chassis is used in the Tarrytown.

2.6 Composite Sync Section

The composite sync section is substantially the same as it was in the RA-111 Telesets.

The differences in the circuit between the RA-111A and the RA-112A and RA-113 Telesets are as follows:

The video IF signal is coupled from the cathode (pin 1) of the video detector (V209A) to the grid of the narrow band sync amplifier (V212) through a 20 mmf capacitor, C298. In the RA-111A Telesets, this connection was direct with no capacitor. A coil, identified as L214, is connected from grid to ground in the narrow band sync. amplifier stage (V212). C298 and L124 were added to reduce sync compression. The remainder of the narrow band sync amplifier is identical to the RA-111A.

The sync detector half of V213 remains unchanged but the AGC circuit is slightly different. The change consists of the addition of a "Local-Distent" switch to permit the reduction of AGC voltage when operating the Teleset in fringe areas. This circuit was included in the later RA-111 Telesets.

2.7 Vertical Sweep Section

The vertical sweep circuit is practically identical to that used in the RA-111A.

The differences in the circuit between the RA-111A and the RA-112A and RA-113 Telesets are as follows:

R288 in the plate circuit of V220A, is changed from 2.7K to 3.3K to improve vertical sync.

C271 in the grid circuit of V220B is changed from .003 to .01 mf and R293 is changed from 1.8 meg to 390K to reduce the pulse voltage on the vertical deflection amplifier plate.

R296 in the plate circuit of V220B, is changed from 5.1K to 4.7K in order to reduce the packing at the top of the raster.

A 30 mf capacitor (C294) shown below V220B is added in series with C248A to reduce the possibility of C248A breaking down inasmuch as this part of the circuit is connected to the boosted B+ line.

The plate circuits of the vertical saw generator (V220B) and vertical deflection amplifier (V221) are returned to the boosted B+ line from terminal 5 of the flyback transformer (T401). This source of voltage has improved regulation under varying operating conditions. It also provides a higher voltage for the plates of the vertical deflection amplifier than is available from the low voltage supply. This insures adequate vertical size for the larger picture tube sizes.

The vertical output transformer usually used in Du Mont Telesets had a turns ratio from primary to secondary of 10 to 1. The vertical output transformer used in these Telesets has a turns ratio of 11 to 1. The specifications of the vertical output transformer were changed to accomodate the yoke used with these models.

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2.8 Horizontal Sync, Sweep and High Voltage Section

Five tubes are responsible for the function of horizontal sync, sweep and high voltage. The horizontal AFC and saw generator circuit (V214) is practically identical to that used in the RA-111A. The horizontal deflection amplifier (V215) has been replaced with a 6BG6 because of the greater sweep requirements of the Teleset. The circuitry of the high voltage section has been modified by the incorporation of cascade voltage doublers utilizing two 1X2 tubes (V401 and V402). This is necessary because of the increased high voltage required in the larger Teletron sizes. A single 6W4 (V217) performs the function of damping, as in the RA-111A.

2.9 Horizontal Deflection Circuit

The horizontal deflection amplifier circuit is substantially the same as that used in the RA-111A except that the cathode bias resistor and its associated condenser has been deleted and the value of the screen dropping resistor R271 has been changed due to the different operating characteristics of the 6BG6.

Examination of the simplified schematic shown on the following page shows that the secondary of the flyback transformer T401 (terminals 5 and 6) is essentially in series with primary, thus forming an auto-transformer circuit. This configuration permits tighter coupling between primary and secondary windings, resulting in a highly efficient output circuit and thus permitting the use of smaller wire size in order to produce a more compact transformer. Tighter coupling also reduces the possibility of Barkhausen oscillation. The screen voltage for the 6BG6 (V215) is taken from terminal 5 of T401. This source of voltage has improved regulation under varying operating conditions.

A horizontal size switch (S401) is used in this circuit. With this switch in the position shown in the schematic, maximum picture size will be obtained, but there will be no control of the size because L401 is not in the circuit. Somewhat reduced size will be obtained when S401 is turned to connect its pins 1 and 3 together, but then the horizontal size control, L401, will be effective. Further reduction in size will occur when S401 is turned to connect L403 in parallel with L401 and the size winding of T401.

The sweep signal is capacitively coupled to the horizontal deflection coil in order to prevent DC from flowing through the yoke and depositioning the beam. A 68 mmf capacitor is shunted across one-half of the horizontal deflection coil to prevent ringing in the yoke. If ringing persisted beyond the time required for horizontal retrace, vertical white and black bars would appear on the left side of the raster.

No static damping resistors are needed across the secondary of the horizontal output transformer because the application of the boosted voltage to the vertical deflection circuit provides adequate damping.

The horizontal linearity control adjusts the point at which the damper tube stops providing the sweep energy and the 6BG6 starts. Therefore, this control affects the linearity at the center of the picture where this effect takes place.

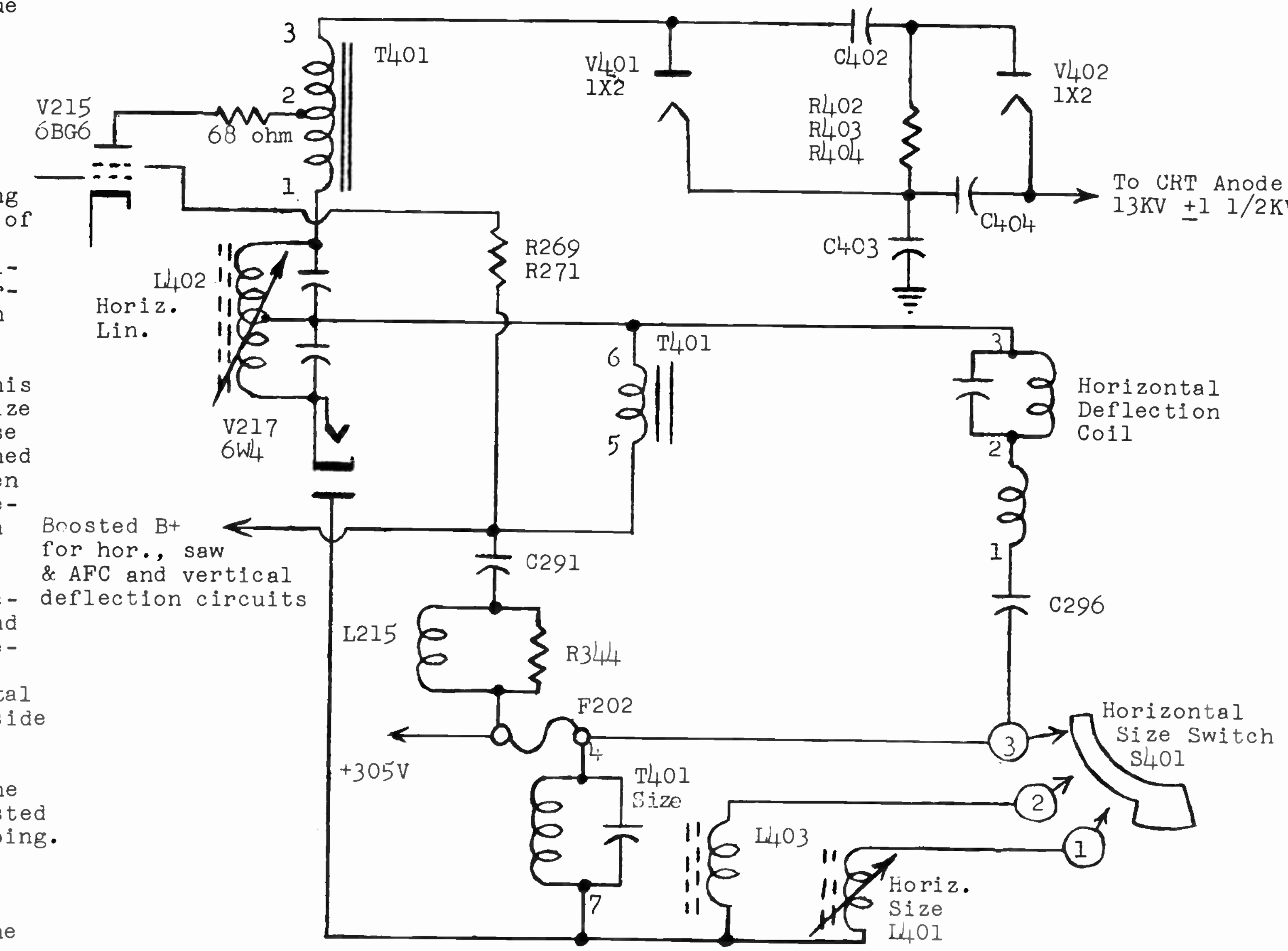
2.10 High Voltage Supply

The high voltage supply used in this Teleset is a voltage doubler type using two 1X2 rectifiers in cascade. The method of operation is the familiar "flyback" type. The high voltage pulse which appears between the 6BG6 tap (terminal 2) on transformer T401 and ground is stepped up in the conventional auto-transformer manner to a higher voltage pulse at terminal 3 of this transformer. These pulses are rectified and each 1X2 handles half of the total output high voltage of 13 KV ± 1 1/2 KV (at zero brightness). The high voltage appears across C403 and C404 in series to ground.

2.11 Low Voltage Power Supply

The low voltage power supply is very similar to that used in the RA-111A.

The differences in the circuit between the RA-111A and the RA-112A and RA-113 Telesets are as follows:



Simplified Schematic of Horizontal Flyback Circuit
RA-112A - RA-113

MODELS RA-112-A1, -A2, -A3, -A4, -A5, -A6, RA-113-B1, -B2, -B3, -B4, -B5, -B6, -B7, -B8

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A separate filament transformer (T205) insulated for 5000 volts is used for the 6W4 (V217) due to the higher peak voltage found in this circuit.

A 100K resistor (R324) has been added from one side of the AC line to ground to reduce the shock hazard.

Three dial lamps (I201, I202 and I203), rather than one, are used and the dial lamp dropping resistor (R309) found in the RA-111A has been deleted in order to adequately light the different type of dial used in these Telesets.

The values of R280 and R281 have been changed due to the different focus coil (L209) used in these Telesets.

3.0 Installation Section

The serviceman should encounter no particular difficulty when installing one of the RA-112A or RA-113 Telesets. It is suggested, however, that if these are the first Du Mont Telesets he will install, that reference be made to the Installation Section of the RA-111A Service Notes for further information.

Particular attention should be given to the use of the proper coaxial cable. This will depend upon the signal strengths of the stations at the location where the set is to be installed.

4.0 Service Sheets

Although the basic RA-111A chassis is used in these models, sufficient changes warranted the issuance of a special schematic diagram.

As indicated on the RA-112A - RA-113 Alignment Sheet, the procedure will apply to the RA-111A Telesets as well as these models.

No new block diagram was issued since the block diagram will be the same as the RA-111A except for the additional tubes and, in the case of the 4th video IF and horizontal deflection amplifier, different tubes.

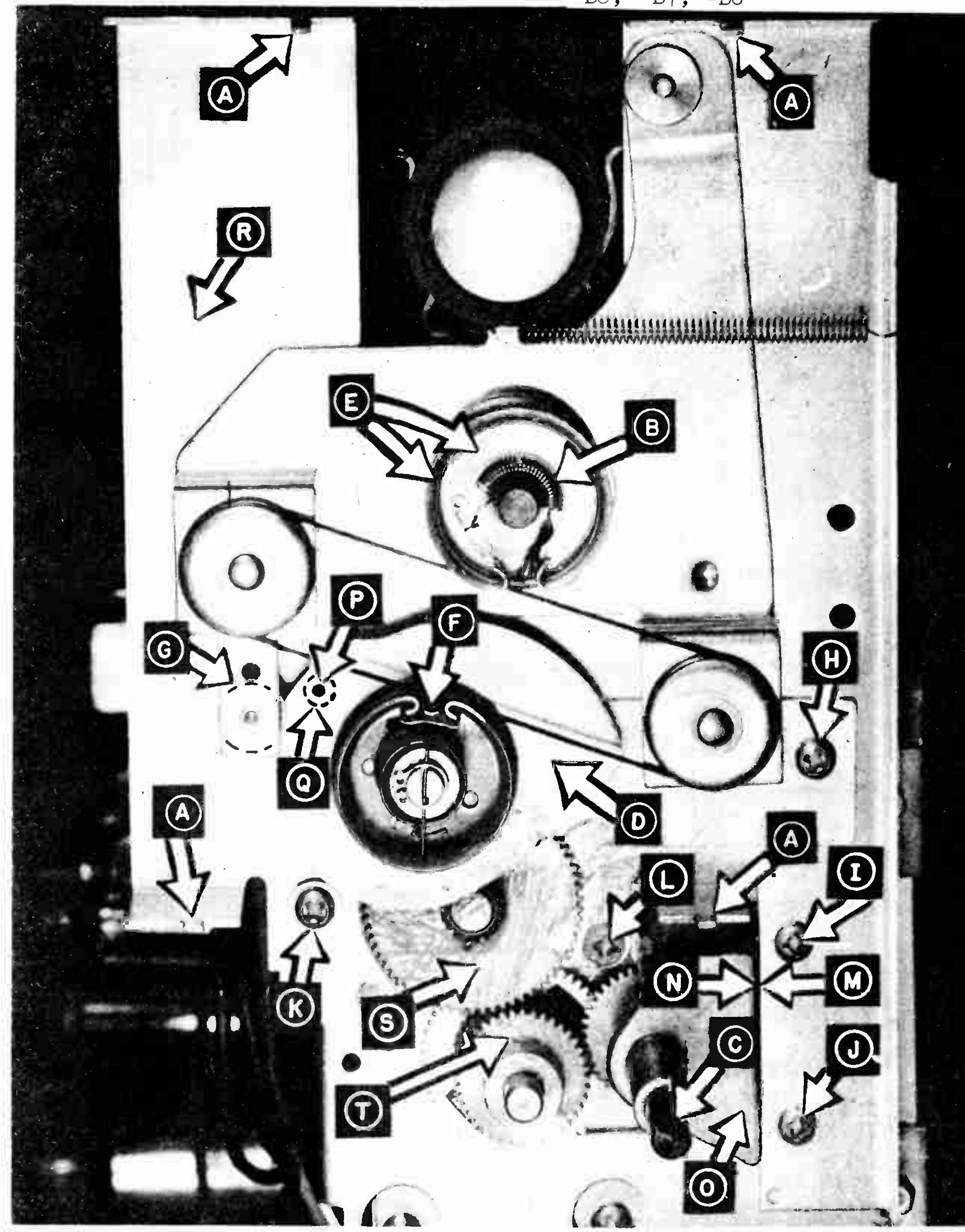
All adjustments on this model are identical to those in the RA-111A and the servicemen should refer to the "Block Diagram, Adjustments and Trouble Shooting Sheet for the model RA-111A".

5.0 Service Procedures and Troubleshooting Hints

This section of the service notes for the RA-112A RA-113 Telesets will include information pertaining to various servicing and troubleshooting procedures that require detailed information. Additions to this section will be made whenever necessary.

NOISY INPUTUNER

(See Section 5 of the RA-111A service notes for information on cleaning the Inputuner.)



INPUTUNER DIAL MECHANISM

(for serial numbers below 126293 and 135323)

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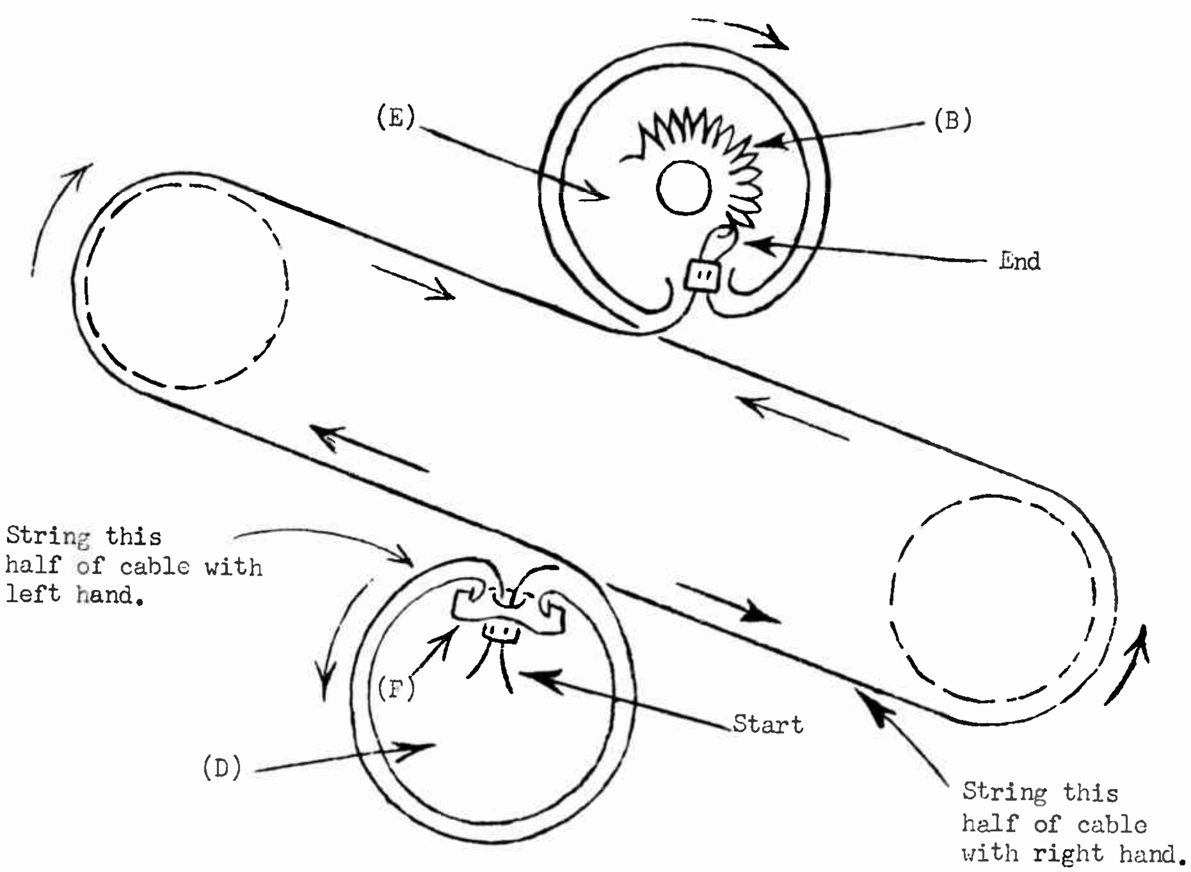
PROCEDURE FOR REPLACEMENT OF DIAL CABLE (30008310)

1. Remove three pilot lights, with their clips.
2. Remove dial pointer by pulling outward.
3. Twist four tabs (A) holding dial to mounting plate, and remove dial.
4. Remove defective dial cable, taking care to retain cable tension spring (B). If spring is missing, it may be obtained by ordering part #30014401.
5. Rotate Inputuner tuning shaft (C) full counter-clockwise. This will place the cam assembly (D) in the position shown.
6. Place pointer pulley (E) in position shown.
7. Fasten cable tension spring (B) to loop at end of dial cable.
8. String dial cable as shown, starting by placing cable guard (F) in position. Use both hands and string two halves of cable as illustrated. Make sure that cam follower (G) is not disengaged from cam (D).

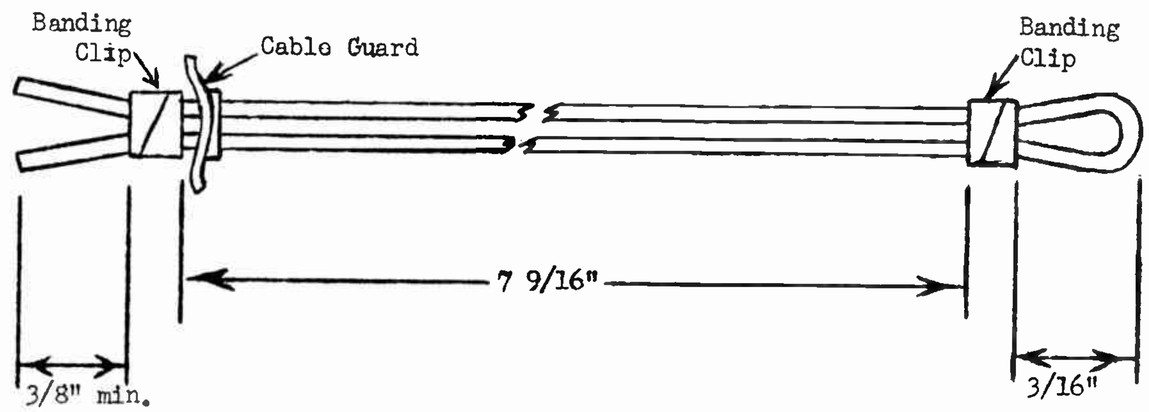
Note: If insufficient tension in cable, run cable tension spring (B) around pointer pulley (E) hub in direction opposite to that shown.

9. Replace dial, fastening by slight twisting of four tabs (A).
10. Replace three pilot lights.
11. Place Teleset in operation, tune in a known high channel station, and place dial pointer in correct position. Pointer should then fall in proper calibration for lower channels. If, necessary, minor adjustment of pointer position may be made to correct calibration. Take care that pointer does not rub against dial at any point.



DIAL STRINGING SKETCH

If dial cable not readily available, make up as follows:



PROCEDURE FOR DIAL CALIBRATION
(RA-112A below serial #126293 and RA-113 below serial #135323)

1. Remove three pilot lights, with their clips.
2. Remove dial pointer by pulling outward.
3. Slightly twist four tabs (A) holding dial to mounting plate, and remove dial. Care should be exercised not to break tabs(A).
4. If dial cable requires restringing, follow procedure shown previously.
5. If side (M) of dial mechanism is not parallel with side (N) of bearing bracket (O), loosen screws (I), (J) and (L) and square dial mechanism by aligning sides (M) and (N). Then tighten screws (I), (J) and (L).
6. Loosen screws (H) and (K).
7. Turn tuning shaft (C) fully counter-clockwise.
8. Turn cam (D) one turn clockwise until hole (P) in cam is aligned with hole (Q) in dial plate (R) behind cam (D).
9. Push gear (S) downwards until gears (S) and (T) mesh completely. Back gear (S) off slightly to prevent binding.
10. Re-check alignment of holes (P) and (Q).
11. Tighten screws (H) and (K).
12. Cautiously rotate tuning shaft (C) to check for binding of gears (S) and (T). If binding occurs, repeat steps 8, 9, 10 and 11.
13. Replace dial, fastening by <u>slight</u> twist of four tabs (A)!
14. Replace three pilot lights.
15. Return tuning shaft (C) to fully counter-clockwise position. Replace dial pointer so that it falls on high frequency side of channel 13 box by the width of the pointer.
16. Place Teleset in operation. Pointer should fall in proper calibration on all channels. Minor adjustment of pointer position may be made to correct calibration, if necessary, or four flanges at (A)(not tabs) may be bent slightly downwards. This will move calibration upwards on high channels (7-13) and downwards on low channels (2-6). Take care that neither pointer shaft nor pointer rubs against dial at any point.

Note: Calibration has been altered in some cases reported from the field due simply to the pointer sticking against the plastic dial window. To overcome this condition, the bolts holding the chassis mounting boards should be loosened and the chassis moun-

MODELS RA-112-A1, RA-112-A2, RA-112-A3, RA-112-A4, RA-112-A5, RA-112-A6, RA-113-B1, RA-113-B2, RA-113-B3, RA-113-B4, RA-113-B5, RA-113-B6, RA-113-B7, RA-113-B8

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ting board moved backward as far as possible. The bolts should then be re-tightened. This will provide sufficient clearance between the dial pointer and the plastic window. The pointer should then be reset according to steps 15 and 16 above.

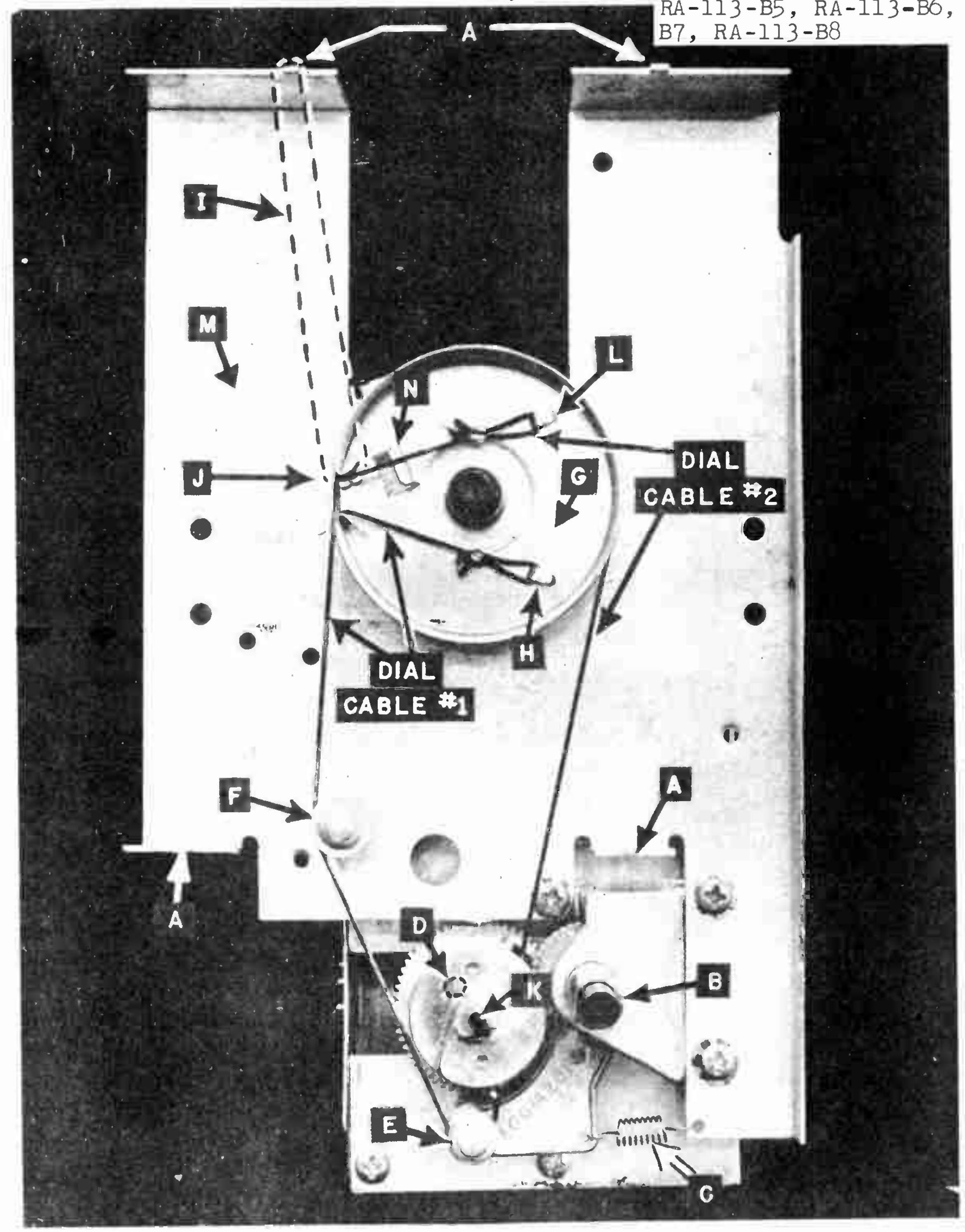
PROCEDURE FOR REPLACEMENT OF DIAL CABLE ON SKIP BAND TUNER 69003911 (used in RA-112A above serial #126293 and RA-113 above serial #135323)

1. Remove three pilot lights with their clips.
2. Remove dial pointer by pulling outward.
3. Twist four tabs (A) holding dial to mounting plate and remove dial.
4. Remove defective dial cable. (It consists of two identical cables. referred to as #1 and #2.)
5. Rotate the Inputuner tuning shaft (B) fully counter-clockwise (extreme high frequency position) and place pointer pulley (G) in position shown in dial stringing sketch.
6. Be sure that idler tension spring (C) is in place. If it is missing, it may be obtained by ordering part #30015901.
7. Wedge knotted end of dial cable #1 so that it is held in place by post on gear behind spiral pulley at (D).
8. String dial cable (1 in direction of arrows shown on dial stringing sketch. Dial cable #1 must ride in idler pulleys at (E) and (F) and must be strung on inside of groove of pointer (G) towards dial plate (M), making one complete turn around pointer pulley (G). Make sure that idler pulleys (E) and (F) are free to turn and move in and out.
9. Insert loop end of dial cable #1 over lance (H).
10. Hold pointer pulley (G) in position shown in photograph with rubber band (I) placed temporarily between (J) and upper left-hand tab (A).
11. Insert knotted end of dial cable #2 in hole at (K) and string in counter-clockwise grooves approximately four turns as shown in sketch.
12. String dial cable #2 in direction of arrows around pointer pulley (G) approximately one-half turn, as shown. Dial cable #2 must be strung on outside of groove of pointer pulley (G) away from dial plate (M).
13. Insert loop end of dial cable #2 over lance (L). Center dial cable #2 over extrusion(N).
14. Remove rubber band (I).
15. Cement knotted end of dial cable #2 in plate at (K).
16. Replace dial, fastening by slight twist of four tabs (A).
17. Replace three pilot lights.
18. With tuning shaft (B) fully counter-clockwise, replace dial pointer so that it falls just inside of high frequency side of channel 13 box by the width of the pointer.
19. Place Teleset in operation. Pointer should fall in proper calibration on all channels. Minor adjustment of pointer position may be made to correct calibration, if necessary. Take care that pointer does not rub against dial at any point.

PROPER POSITION OF AGC LOCAL-DISTANT SWITCH

If a condition is encountered in a strong signal area where the strongest station rolls vertically, whereas other stations hold sync properly, the trouble may be caused by improper setting of the local-distant switch. If the local-distant switch is set at the distant position in a strong signal area, it is possible that sync compression may result on the strongest stations, thus causing the picture to roll.

RA-112A - RA-113 Section



SKIP BAND TUNER DIAL MECHANISM

(for serial numbers above 126293 and 135323)

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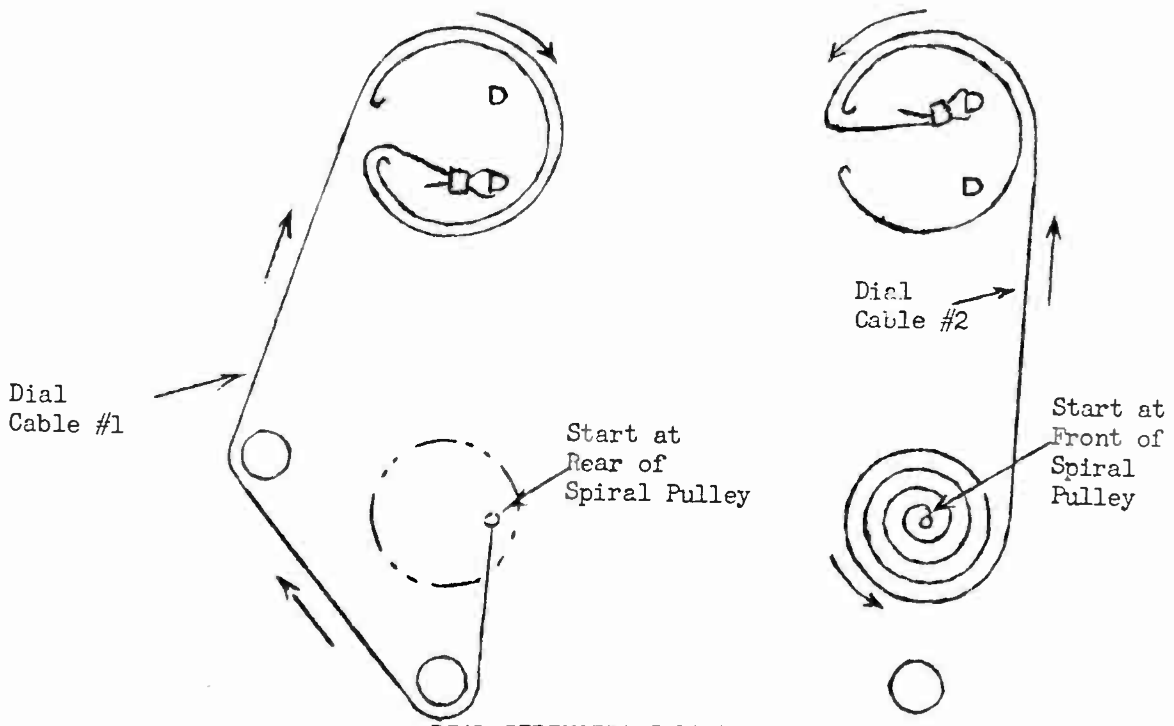
REDUCTION OF AM RADIO INTERFERENCE

Several cases of AM radio interference caused by sweep radiation have been reported. By-passing each side of the AC line at the Teleset with .02 mfd, 600 volt capacitors will reduce this interference. The capacitor leads should be kept as short as possible. The part number of these capacitors is 03018570. This change is incorporated in RA-112A Telesets beginning with serial number 1211601 and RA-113 Telesets beginning with serial number 1313901.

IMPROVEMENT OF SOUND SENSITIVITY

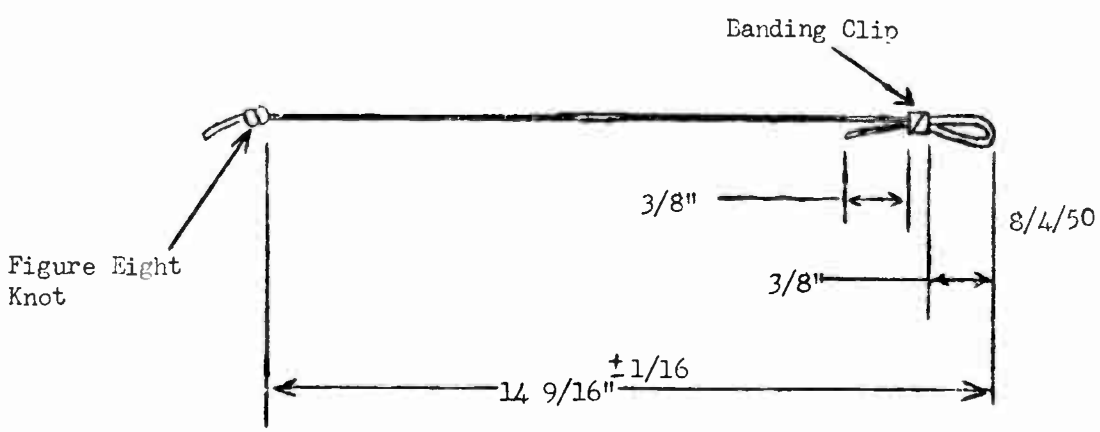
In any location where it is found that the sound output is insufficient, it may be substantially increased by making the following simple modification:

Connect a 10 mfd (or larger), 25 volt capacitor in parallel with R126 the cathode resistor of the 6AQ5 sound output stage. The part number for the 10 mfd, 25 volt capacitor is 03016730. This capacitor is being installed in current production.



DIAL STRINGING SKETCH
(above serial #126293 and #135353)
(Skip Band Tuner)

If dial cables are not readily available, make up as follows (two required):



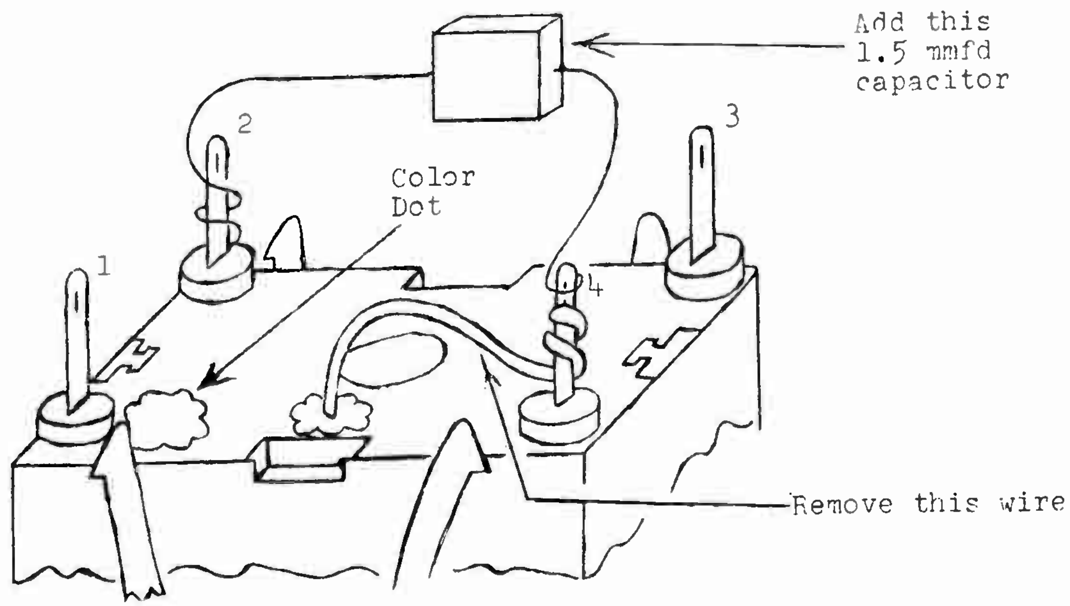
ION TRAP MAGNET ADJUSTMENT

You have probably noticed that on current Telesets it is necessary to place the ion trap magnet over the base of the cathode-ray tube in order to get the correct adjustment for maximum brightness.

Although contrary to the installation instructions, this new position is the result of a slight change in the design of the electron gun in the cathode-ray tube. Due to this design change, the magnetic field necessary for proper beam bending is decreased. Therefore, the position of the magnet indicates that it is too strong to be placed on the glass neck and, therefore, must be placed back over the base. Under no conditions should this magnet be placed next to the focus coil.

DEFECTIVE VIDEO IF TRANSFORMERS

Some complaints of breakdown of the ceramic coupling condenser in the video IF transformers have been received. The condition encountered was an arc-over between the end of the silvered ceramic tube and the bare wire that fits in it. These transformers are used in the RA-112A and RA-113 Telesets. The condition was corrected by the use of a synthetic coated wire. It is not necessary to replace the entire transformer to correct this defect. Instead, the bare wire should be removed from the ceramic tube and a 1.5 mmfd 400 volt type GA-3 Stackpole capacitor, or equivalent, should be connected between terminals 2 and 4 (grid to plate) of the transformer. After making this change, a slight amount of rephasing of the grid and plate coils of the respective transformers will usually be necessary.



MODELS RA-112-A1, RA-112-A2, RA-112-A3, RA-112-A4, RA-112-A5, RA-112-A6, RA-113-B1, RA-113-B2, RA-113-B3, RA-113-B4, RA-113-B5, RA-113-B6, RA-113-B7, RA-113-B8

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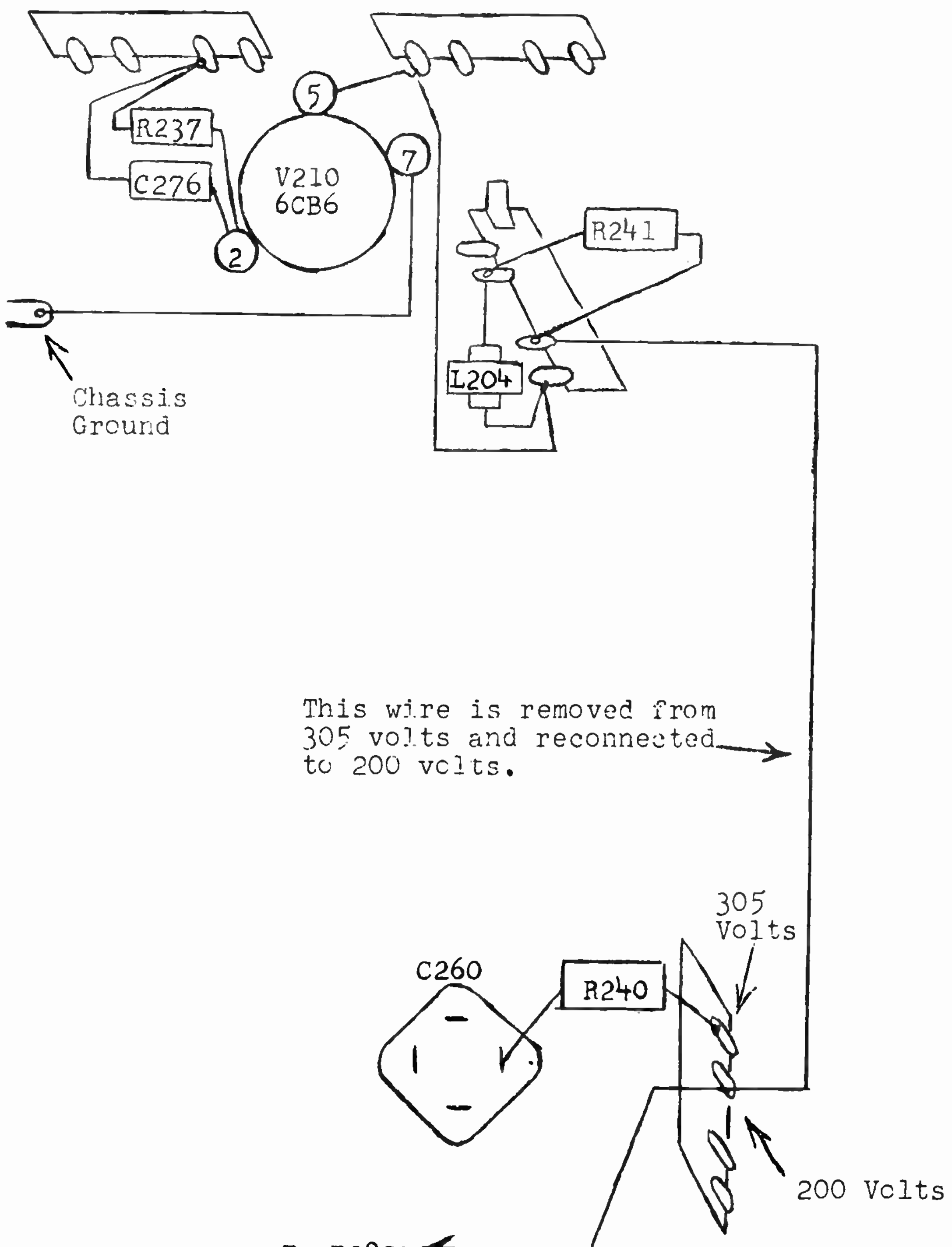
SUBSTITUTION OF TUBES

Rear of Chassis



Rewiring for 6CB6 Substitution
In Video Amplifier Stage

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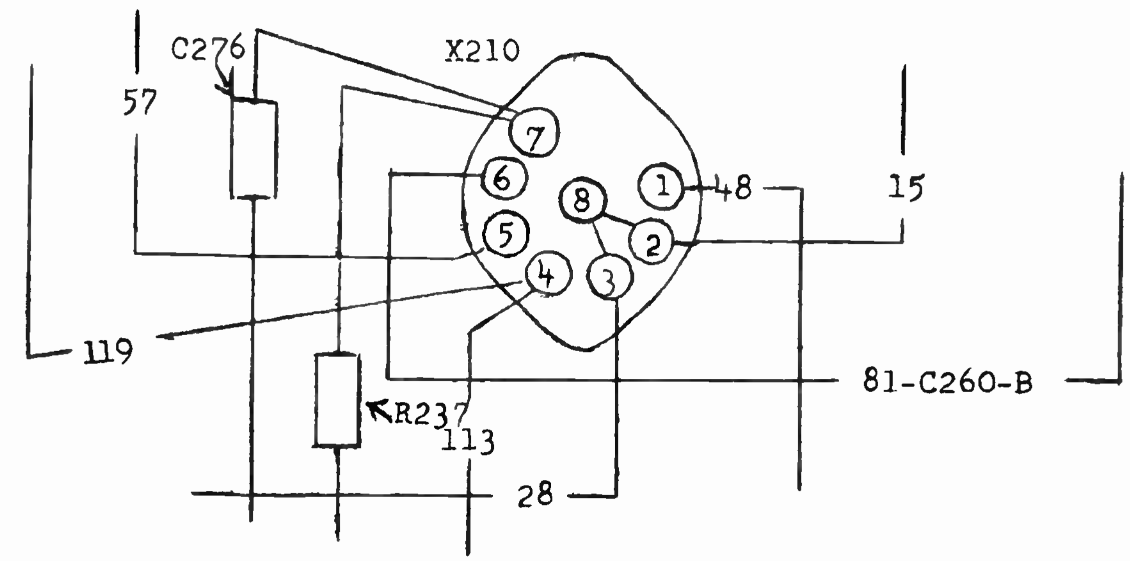
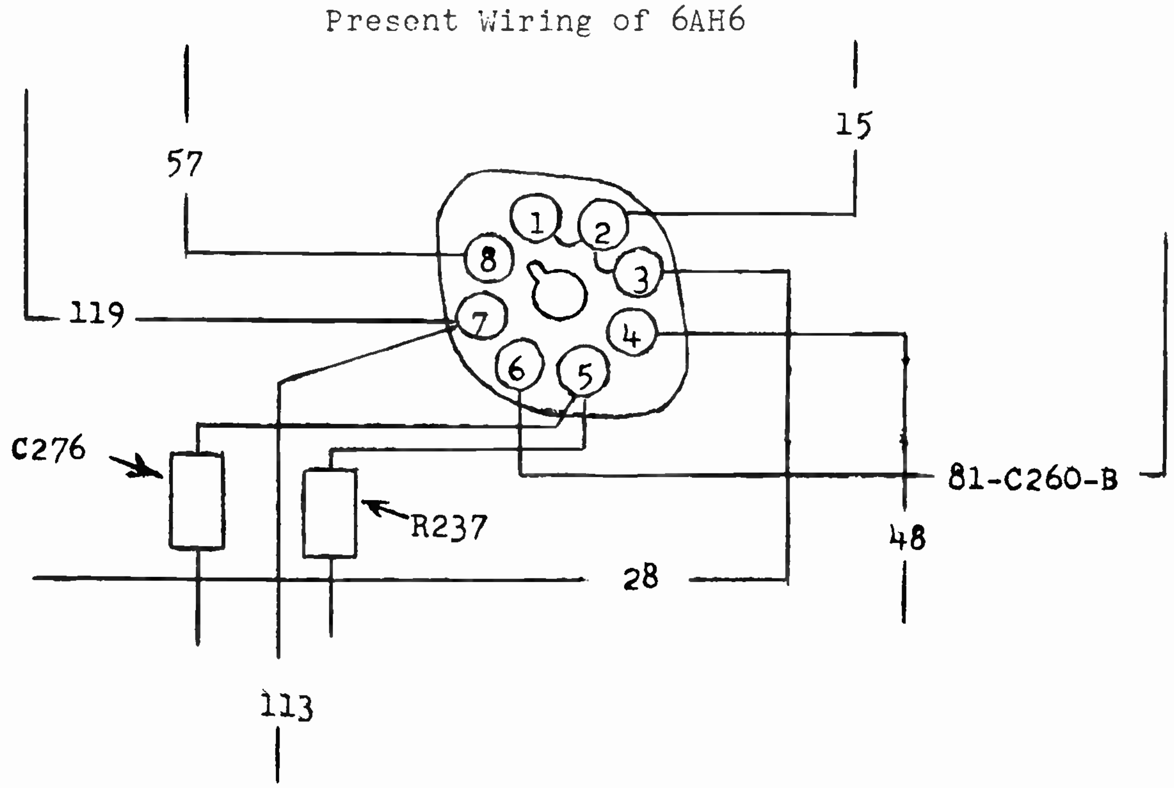
The wiring and circuit changes are shown on this page, G-14C and the following page, G-14D.



Present Wiring of 6AH6



New Wiring for 6AC7

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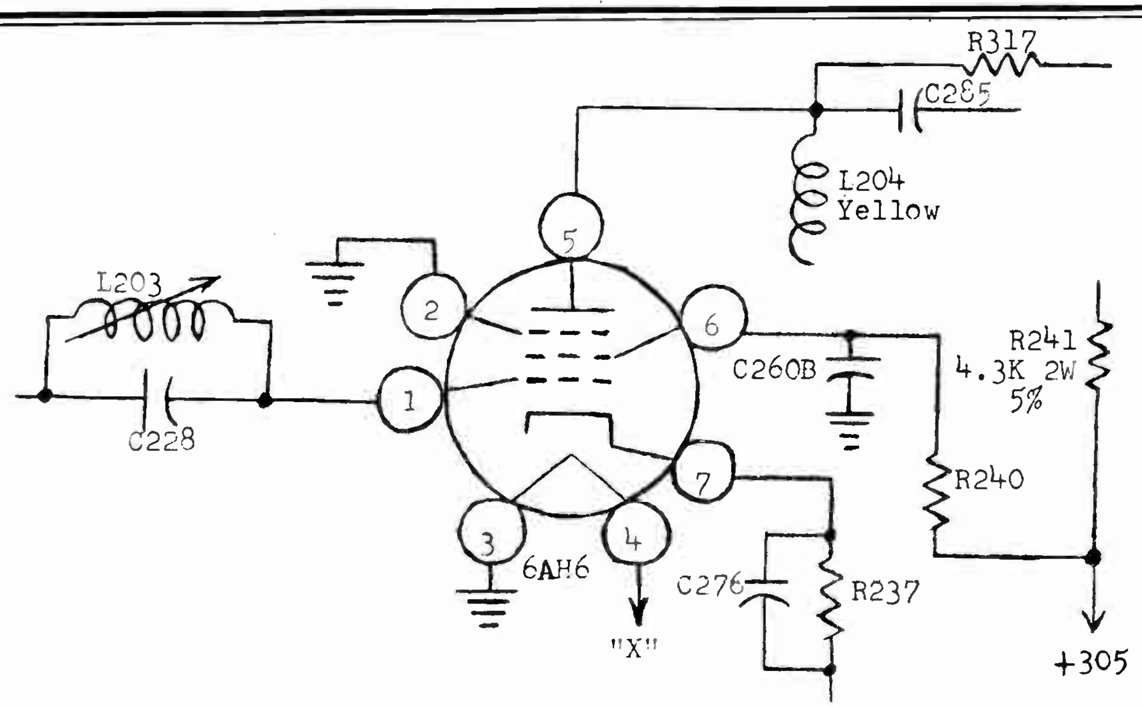
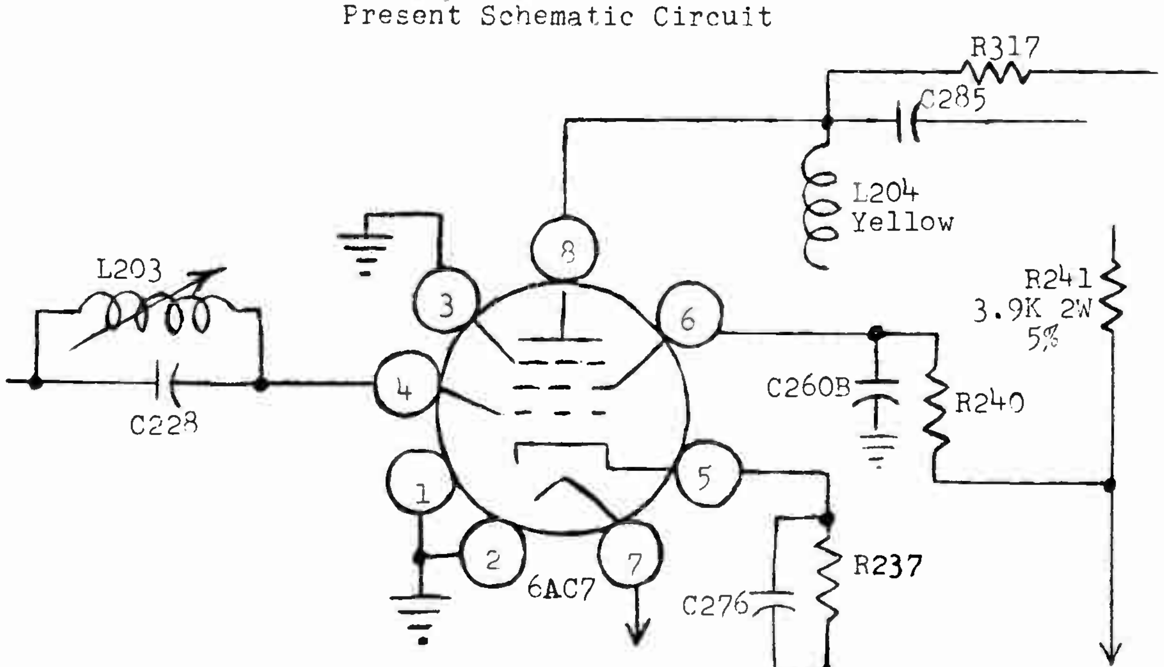


Video Amplifier Substitution
Present Schematic Circuit



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Video Amplifier Substitution
New Schematic Circuit

CRITICAL TUBE SUBSTITUTIONS

(4811) 1. The type 6BA6 tube may be used as a replacement for the type 6AU6 in the first and second video IF stages, providing that both 6AU6's are replaced by two 6BA6's simultaneously. (This substitution may be made in the field in any of the current Telesets.)

(4812) 2. A type 6CB6 tube may be substituted for the 6AU6 in the second sound IF amplifier of the RA-112A and RA-113. This substitution requires the addition of a tube shield, part number 42002530, and a shield base, part number 42002540. The latter may be readily soldered in place in the field, rather than riveted or bolted.

(4813) 3. A 6CB6 may be substituted for the 6AH6 video amplifier, V210, in the RA-112A and RA-113 without any component changes but with a simple wiring change. Pins 2 and 7 must be interchanged and the plate circuit must be tied to a 200 volt point rather than 305 volts, as shown in the sketch following.

(4814) 4. A 6BC5 may be substituted for the 6AU6 first sync clipper, V219, in the RA-112A and RA-113. This change does not require the addition of parts or wiring.

(4789) 5. The type 6AC7 may be substituted for the 6Ah6 video amplifier in the RA-112A and RA-113 Telesets. This tube is not a direct substitute and several items will have to be changed. These are as follows:

(a) The socket is to be changed from a miniature (part number 34001220) to an octal (part number 34002380).
(b) R241 is to be changed from 4.3K 5% 2W (part number 92036631) to 2 3.9K 5" 2W (part number 02036620 alternate parts are: 02046620 and 02056620).

Any of the above substitutions that have been made can be determined by identifying the code number stamped on the back of the chassis and referring to the following table. Normally, you will find a large letter stamped on the rear of the chassis. Alongside of this letter will be a number. The significance of the letter designation will be found in the service notes pertaining to the model Teleset in question, providing it has a bearing on the service information. The numerical designation refers to one of those listed below and thus indicates the substitutions that are made.

Obviously, future additional substitutions will result in higher code numbers (5, 6, etc. for example). However, these code numbers will apply each time the substitution is made.

Substitution	Code Stamped on Chassis	Model	Teleset Serial Numbers Affected
4813	1	RA-113	1311027 to 1311736, Incl.
			1312719 to 1312999 "
4813, 4814	2	RA-113	1311737 to 1312718 "
4811, 4814	3	RA-112A	1213901 to 1214650 "
4811	4	RA-112A	1214651 - still in effect.

Although any of the above substitutions may be made in the field to Telesets not already incorporating these changes, it is important that the combination of substitutions 4811 and 4813 not be made together. The reason is that if both substitutions are applied to one set, a loss of gain will result. This will not be apparent in the strong signal areas. However, in the weak signal areas, the decrease in sensitivity will be noticed.

The substitution listed below has been incorporated in the chassis designated under the heading "Serial Numbers". No code number appears on these chassis as this procedure was not in effect at the time the substitution was made.

Substitution	Model	Serial Numbers
4789	RA-112A	1210824 to 1212823

MODELS RA-112-A1, RA-112-A2, RA-112-A3, RA-112-A4, RA-112-A5, RA-112-A6, RA-113-B1, RA-113-B2, RA-113-B3, RA-113-B4, RA-113-B5, RA-113-B6, RA-113-B7, RA-113-B8

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6.0 Production Changes

Change #1 (M-117)

On Some early runs of RA-112A and RA-113 chassis, the sound discriminator transformer Z203 which was used was the same as that used in the RA-111A chassis. The circuit diagram of the discriminator circuit using the old type transformer is the same as that shown on the RA-111A Schematic Diagram (second edition, May 8, 1950.

This change with the addition of C299, coupling capacitor, is shown on the RA-112A, RA-113 Schematic Diagram (first edition, July 3, 1950) and was first incorporated in the following chassis starting with the serial number shown:

RA-112A - #123594
RA-113 - #132957

Purpose of Change - To increase the sound sensitivity.

Change #2 (M-132)

This change was made to alleviate interference on channel 7 by adding capacitor C230, .005 mf from pin 4 of V203 to ground. This change is shown on the RA-112A and RA-113 Schematic Diagram (first edition, July 3, 1950).

This change was first incorporated in the following chassis starting with serial number shown:

RA-112A - #12029
RA-113 -- #13497

Change #3 (M154) (ECN-4418)

The following changes are made to relieve regeneration, and to increase accompanying sound attenuation.

1. Add a 10K, (R305) 1/2 watt resistor across L202.
2. Add resistor R272, 68K ohms, across Z208-1 and Z208-2.
3. Change a .005 capacitor C230 from present location, pin 4 of V203 to ground, and connect it from ground to pin 4 of V207.
4. Change L213 from part #21005902 to part #21006781. This coil has lower inductance range obtained by using fewer turns.
5. Redress and shorten lead from junction of R237, C276 (cathod circuit of video amplifier, V210) to contrast control R239A, as shown in the sketch. Keep this lead away from the Inputuner.
6. Capacitor C290, .005 mf condenser is connected at junction of R246 and S135 volt line to ground.
7. Change C238 from .001 paper to .001 ceramic or mica, part #03015810 or part #03020730; and move to AGC lead closest to narrow band sync shield.
8. Add L205, part #21004465 between video detector and video detector peaking coil.
9. Add tube shield on 6BC5 fourth video IF amplifier tube.
10. L201 is to be changed from part #21006629 to part #21006627.

New parts are identified as follows:

Symbol	Part Number	Description
C238	03015810 03020730	Cap Ce .001 mf 20% 350V
C290	03015610	Cap Ce .005 mf min
L201	21006627	Coil Video Peaking
L205	21004465	Coil Video Peaking
L213	21006781	Coil Coupling
R272	02031990 02041990 02051990	Res F C 68K 10% 1/2W
R305	02031890 02041890 02051890	Res F C 10K 10% 1/2W
	42002530	Shield Tube
	42002540	Base Shield

These changes were first incorporated in the following chassis starting with the serial number shown:

RA-112A - #125274
RA-113 - #134415

All Telesets which have the above changes made - from change #1 to change #3 are stamped with letter "F" on rear of chassis.

Change #4 (M-164)

The following change is made on the RA-113 chassis only:

Resistor R296 (Pin 2, V220B) is changed from 4.7K to 5.1K.

New part is identified as follows:

Symbol	Part Number	Description
R296	02030650 02040650 02050650	Res F C 5.1K 5% 1/2W

Purpose of Change

Change is made due to a difference in the DC resistance of the yokes used in the RA-112A and RA-113.
This change was first incorporated in RA-113 chassis #138072 and letter "H" is stamped on rear of chassis.

Change #5 (M-169)

The following change is made in order to provide a glass window dial in place of the plastic window.
The part should read as follows in the Miscellaneous Parts List for the RA-112A and RA-113.

Part Number	Description
45002491	Window dial

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Change #6 (M-172)

Capacitor C216, 10 mf is added in parallel with R216, 270 ohm, cathode resistor of 6AQ5 second sound amplifier.
New part is listed as follows:

Symbol	Part Number	Description
C216	03016730	Cap E 10 mf 25V
	03014100	
	03015310	

Purpose of Change - To increase the sound sensitivity.

Change #7 (M-188)

Add capacitors C304 and C305, .02 mf condensers from each side of the AC line to ground.
New parts are identified as follows:

Symbol	Part Number	Description
C304	03018570	Cap Pa .02 mf 20% 600V
	03100230	
C305	Same as C304	

Purpose of Change - To reduce sweep radiation.
This change was first incorporated in the following chassis starting with the serial numbers shown:
RA-112A - #1213901
RA-113 - #1311795

These chassis are identified by a letter "J" stamped on rear of chassis.

Change #8 (ECN-4396)

The following changes are made to the RA-112 - RA-113 Schematic Diagram (first edition, July 3, 1950):

Color of peaking coil L201 changed from red to white.
Color of peaking coil L202 changed from white to orange.
Color of peaking coil L204 changed from yellow to blue.

New parts are identified as follows:

Symbol	Part Number	Description
L201	21006627	Coil Video Peaking
L202	21006624	Coil Video Peaking
L204	Same as L201	

Change #9 (ECN-4406)

Delete coupling capacitor C299 connected from pin 1 of V203 to ground.
Purpose of Change - Part is not required.

Change #10 (ECN-4419)

Inputuner assembly is replaced by new Skip Band Inputuner.
(See Note)
New unit is identified as follows:

Old Part Number	New Part Number	Description
89003902	89003911	Inputuner Assembly

The new Skip Band Inputuner was first incorporated in the following chassis starting with the serial numbers shown:
RA-112A - #126293
RA-113 - #135323

Note: If the tuner (Part #89003902) being replaced is in an RA-112A Teleset the serial number of which is 122696 or later, or if it is in an RA-113, the serial number of which is 132212 or later, the Skip Band Tuner is directly replaceable. However, if the tuner (Part #89003901) being replaced is in a Teleset the serial number of which is under those mentioned above, it will be necessary to remove the IF transformer mounted on the defective Inputuner and substitute it in place of the IF transformer mounted on the replacement tuner. The reason for this change is that the method of coupling with the new type tuner is different from that in earlier tuner.

Change #11 (ECN-4428)

Change value of capacitor C237 (V213-1 to ground) from 150 mmf to .05 mf.
New part is identified as follows:

Symbol	Part Number	Description
C237	03000950	Cap Pa .05 mf 20% 200V
	03100030	

Purpose of Change - To reduce tuneable hum.

This change was first incorporated in the following chassis starting with the serial numbers shown:
RA-112A - #1214676
RA-113 - #1312685
These chassis are identified by a letter "K" stamped on rear of chassis.

Change #12 (ECN-4391)

Specifications for the 19" CRT (V215) used in RA-112 models are changed due to change in color of face plate.
Cathode ray tube is now identified as follows:

Symbol	Part Number	Description
V211	25002640	Tube CRT 19AP4A

Change #13 (M-192)

The following changes in fuse connections (F202 are made as shown in sketch. This is done to reduce AC current through the fuse.

Dotted lines indicate old fuse connections.
Solid lines indicate new connections

7.0 PARTS LIST CHANGES

The following changes of part numbers and additions of alternate part numbers (items 1 - 4) are to be made to the Parts List of the first edition (July 3, 1950) of the Schematic Diagram for the RA-112A, RA-113 (issue #4 through M-146).

1. Part number changes in Main Chassis Parts List (June 17, 1950)

Symbol	Part Number	Description
C216	03016730	Cap E 10 mf 250
	13014100	
	03015310	
C238	03015810	Cap Ce .001 mf 20% 350V
	03020730	

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C290	03015610	Cap Ce .005 mf min
L201	21006627	Coil Video Peaking
L205	21004465	Coil Video Peaking
L213	21006781	Coil Coupling
R250	01029620	Res V C 25K 1/4W
R272	02031990	Res F C 68K 10% 1/2W
	02041990	
	02051990	
R292	01029660	Res V C 1 meg 1/4W
R295	01030140	Res V C 4 meg 40% 1/4W
R296	02030650	Res F C 5.1K 5% 1/2W
	02040650	
	02050650	
R299	01030200	Res V C 1.5K 20% 2W
R305	02031890	Res F C 10K 10% 1/2W
	02041890	
	02051890	
Z208	20005381	Trans Video IF
V211	25002640	Tube CRT 19AP4A
	42002530	Shield Tube
	42002540	Base Shield

Old Part Number	New Part Number	Description
34002375	34002378	Socket Assembly

2. Part number changes in Miscellaneous Parts List, RA-113 (June 9, 1950)

Symbol	Old Part Number	New Part Number	Description
	38003431	38003441	Cushion CRT Strap
	64003211	64003551	Mask CRT
L206	21005711	21006091	Yoke Deflection 70°

3. Part Number changes in Miscellaneous Parts List, RA-112A (June 9, 1950)

Old Part Number	New Part Number	Description
45001883	45001901	Knob Control (Mahogany)
45001961	45001971	Knob Control (Mahogany)
64002871	64003221	Dial Bezel
45001891	45001911	Knob Dual (Mahogany)
45001892	45001912	Knob Dual (Mahogany)
45001884	45001902	Knob Control (Blonde)
45001962	45001972	Knob Control (Blonde)
45001893	45001913	Knob Dual (Blonde)
45001894	45001914	Knob Dual (Blonde)
09003730	09003790	Connector, Male, 1 Contact

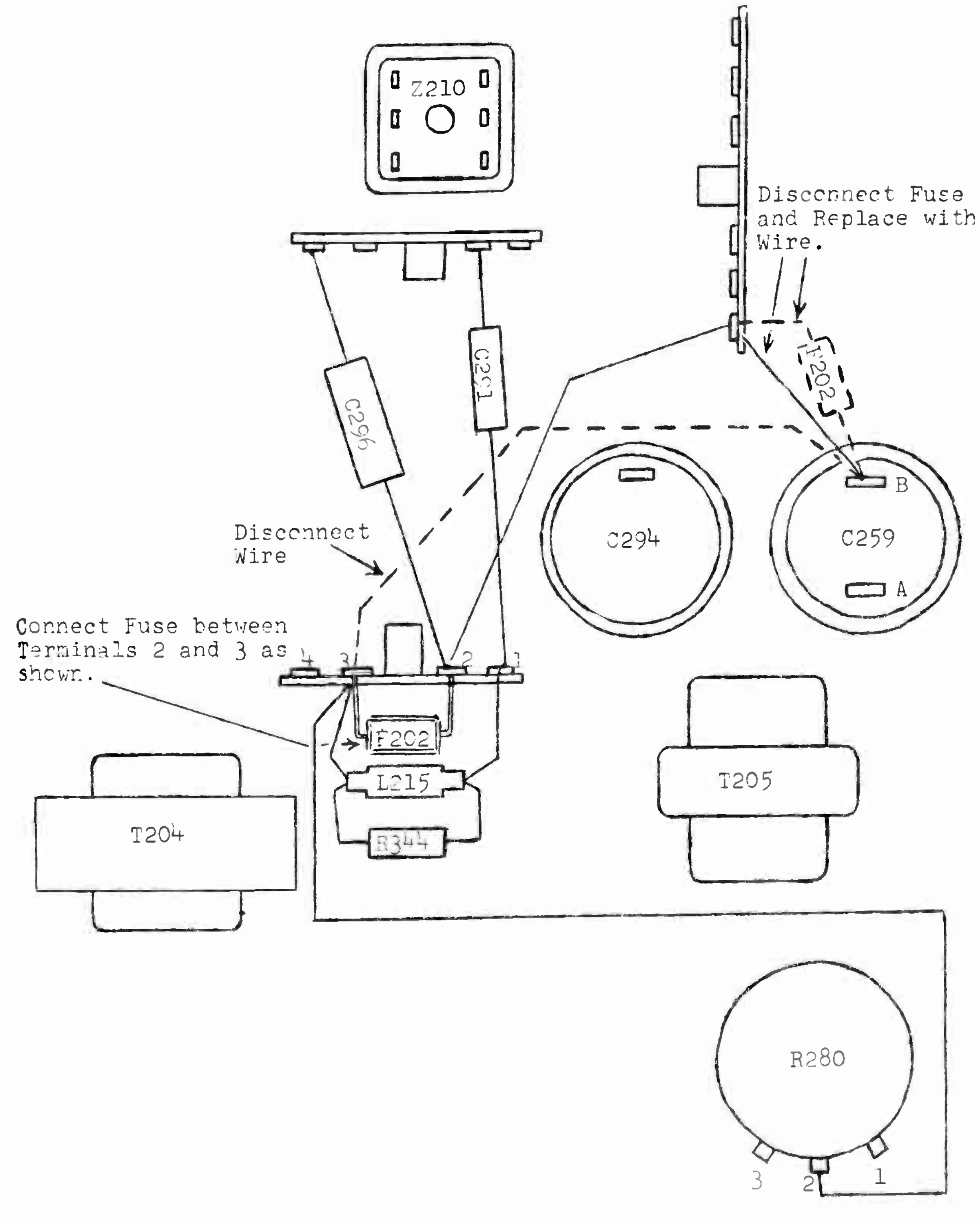
Addition:		
C300	03015610	Cap Ce 5000 mmf min

Addition Alternate part number:

Part Number	Added Alternate Part Number	Description
21005711	21006191	Yoke Deflection

4. Part Number change in RF Tuning Assembly Parts List (May 22, 1950)

Old Part Number	New Part Number	Description
89003902	89003911	Inputuner Assembly



Change in Fuse Connection (F202)
To Reduce AC Current Through The Fuse

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Note: Chassis incorporating all changes up to and including change #13 are stamped "V" on the right-hand side of the power supply.

Change #14(ECN-4366)
This change was made to prevent breakage of the AC interlock; the mounting bracket being redesigned.

The parts affected:

Old Part No.	New Part No.	Description	Model
35008761	35008762	Bracket AC Interlock	RA-112
09016450	09005000	Connector Male 2 contact	RA-112 RA-113
	35008763	Bracket AC Interlock	RA-113

Telesets incorporating this change are stamped with a letter "G" on the back of the chassis starting with the following serial numbers:
RA-112A - 127168 RA-113 - 136278

Note: Chassis incorporating all changes up to and including change #14 are stamped "W" on the right-hand side of the power supply.

Change #15 (M-198)

The following changes are made to increase the sound sensitivity and improve the limiting action in the RA-112, RA-113 chassis:

1. Change V205 and V207 from 6AU6's to 6BA6's.
2. Remove R222, the 8.2K in the screen supply circuit of V205. Connect the junction of R220, (screen dropping resistor of V205) and R225 (screen dropping resistor of V206) to the +135 volt line.
3. Remove R220 (1K screen dropping resistor of V205) and R229 (1K screen dropping resisotr of V207) and replace each with a 10K 1/2W 10% resistor.
4. Connect a 100K 1/2W 20% resistor between terminals 1 and 2 of Z202. This will be identified as R278.
5. Connect a 47K 1/2W 20% resistor between terminals 3 and 4 of Z201. This will be identified as R277.
6. Disconnect Z205 (blue dot) and Z206 (red dot) and exchange the positions of these two transformers.
7. Remove R227 (39 ohm cathode resistor of V206) and replace with a 120 ohm 1/2W resistor.
8. Remove C219 (.005 mfd cathode bypass of V207) and connect from pin 7 of V206 to ground.
9. Remove R228 (120 ohm cathode resistor of V207) and replace with a 68 ohm 1/2W resistor.
10. Disconnect terminal #3 of Z206 from ground.
11. Disconnect C217 (.005 mfd) and R223 (10K) from pin #3 of Z205 and reconnect to pin #3 of Z206 (see step 10.)
12. Connect terminal #3 of Z205 to ground.
13. Disconnect C280 (2.5 mmfd) from terminal 2 of Z205 and reconnect to terminal 2 of Z206.

Note: All of the above changes appear in the second edition of the schematic diagram for the RA-112, RA-113, dated October 2, 1950.

After making the above changes Z205 and Z206 should be realigned. Z205 should be aligned for the response curve listed for Z206 and Z206 should, therefore, be aligned for the response curve of Z205.

New Parts are identified as follows:

Symbol	Part Number	Description
C280	03016898	Cap Coupling 2.5 mmf
R220	02032480 02042480 02052480	Res F C 10K 10% 1/2W
R224	02031660 02051660	Res F C 120 ohm 10% 1/2W
R228	02031630 02051630	Res F C 68 ohm 10% 1/2W
R229	Same as R220	
R277	02032520 02042520	Res F C 47K 20% 1/2W
R278	02032540 02042540 02052540	Res F C 100K 20% 1/2W
V205	25000240	6BA6 1st video IF
V207	25000240	6BA6 3rd video IF
Z205	20004741	Trans video IF
Z206	20004711	Trans video IF

This change was first incorporated in the following chassis starting with the serial numbers as shown:
RA-112A - 1216694 RA-113 - 1314251

These chassis are identified by the letter "L" stamped on the rear of the chassis.

Change #16 (M-202)
The following changes are made in order to eliminate video smear in the video amplifier section of the RA-112A - RA-113 chassis.

1. Change value of R235 between L201 and ground from 4.3K to 3.9K 5% 1/2W.
2. Change value of R241 between L204 and +305 V from 4.3K to 3.9K 5% 2W.
3. Change value of R240 between V210-6 and +305 V from 62K to 68K 5% 1W.
4. Change value R305 between L205 and L203 from 10% to 10K 5% 1/2W. (See change #3).
5. Disconnect parallel combination of R305 and L202 and replace with solid connection.
6. Add R305 and L202 in series with V210-5 and the junction of R317, C285 and L204.
7. Change value of L202 from orange to red.
8. Disconnect C231 from junction of L204, C285, R317, and connect to V210-5.

New parts are identified as follows:

Symbol	Part Number	Description
R235	02030620 02040620 02050620	Res F C 3.9K 5% 1/2W
R240	02033920 02043920 02053920	Res F C 68K 5% 1W
R241	Same as R235	
R305	02030720 02040720 02050720	Res F C 10K 5% 1/2W
L202	21006623	Coil video peaking.

MODELS RA-112-A1, -A2, -A3, -A4, -A5, -A6, RA-113-B1, -B2, -B3, -B4, -B5, -B6, -B7, -B8

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This change was first incorporated in the following chassis starting with serial numbers as shown:

RA-112A - 1213684 RA-113 - 1314090

These chassis are identified by the letter "L" or "N" stamped on the rear of the chassis.

Change #17 (M-204)
The following change is made to eliminate video from sync which is occurring in some receivers and causing slight displacement of some parts of the picture. This condition can also cause a "whip" in the picture.

Change value of C298 between V212-1 and V209A-1 from 20 mmfd to 47 mmfd 10% 500V ceramic.

Symbol	Part Number	Description
C298	03012730 03015300 03020080	Capacitor Ce 47 mmfd 10% 500V.

This change was first incorporated in the following chassis starting with serial numbers as shown:
RA-112A - 1213684 RA-113 - 1314090

These chassis are identified by the letter "L" or "N" stamped on the rear of the chassis.

Change #18 (M-208)
The following change is desirable to provide greater surge protection for capacitor C291.

Change value of C291 from .02 mfd 10% 400V to .02 mfd 20% 600V.

New part numbers:

Symbol	Part Number	Description
C291	03015550 03100230	Cap .02 mfd 20% 600V

Change #19 (M-206)
In order to minimize horizontal frequency drift the present capacitor C246 is to be replaced by an oil impregnated type of the same value.

New part number:

Symbol	Part Number	Description
C246	03101540	Cap .01 5% 600V

Change #20 (M-212)

The following change is made in order to increase the sensitivity of the AM Tuner (in RA-113 Tarrytown).

Procedure:

Delete R419, 270K resistor replacing it with a wire jumper.

Change #21 (M-215)
The following change is to be made to reduce the possibility of vertical frequency drift.
Procedure:
Change value of C271 from .01 10% 400V to .01 5% 600V.

New part numbers:

Symbol	Part Number	Description
C271	03101540	Cap Pa .01 mfd 5% 600V

All production changes prior to this point are incorporated in the Main Chassis Schematic RA-112A RA-113, Second Edition, 10/2/50, and Tarrytown AM Tuner Schematic, First Edition, 8/15/50.

Change #22 (M-222)
The following change was made in order to decrease audio distortion at rated output.

Procedure:

1. Delete R308.
2. Change value of R307 from 3.9K to 1K 2W 10%.
   Both these resistors are located near V204-6.

New Part numbers:

Symbol	Part Number	Description
R307	02037770	Resistor F C 1K 2W 10%

Change "23 (M-239)
The following change should be made to prevent the shrinkage or complete loss of vertical size due to the increasing resistance of R294 caused by overheating.

Procedure:

Change R294, near V220B, from 910K 5% 1/2W to 910K 5% 1W.

Part Numbers affected:

Symbol	Part Number	Description
R294	02034190	Res F C 910K 5% 1W

Change #24 (M-213)
Several wiring changes have been made to simplify the manufacturing process and eliminate certain difficulties that existed due to lead dress and component location. None of these changes require new mechanical parts or electrical components.
The most significant change as far as servicemen are concerned is the relocation of R324 and C305. The new location will reduce sweep radiation and improve the audio noise level.
These parts have been removed from the front of the chassis (formerly connected from the terminal of power switch to ground) to a terminal strip at the rear of the chassis near the power transformer.
The chassis containing these changes are identified by a large letter "P" on the rear fold of the chassis. The serial numbers of the chassis containing these changes are:
RA-112A - 1216766 RA-113 1314928
The number 5 which follows the letter P signifies that a 6BC5 is substituted for a 6AU6 in the first sync clipper stage.

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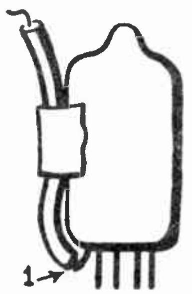
PRELIMINARY STEPS

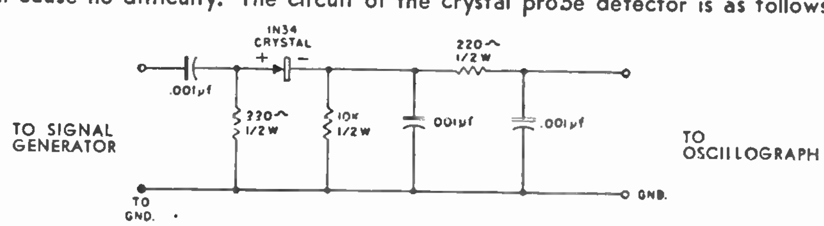
CAUTION: IT IS IMPORTANT THAT ALL NOTES BE READ IN CONJUNCTION WITH ALIGNMENT.

The following preliminary steps should be followed:
Remove 6W4 (V217) damper, 6AK5 (V102) mixer, 6AB4 (V103) oscillator, 6AQ5 (V204) AF output (note 1) and 6AU6 (V219) first sync clipper.
Adjust AGC control (R250) fully counter-clockwise. Turn selector switch to tele. position.

ALIGNMENT NOTES



1. 6AQ5 (V204) may be left in position only if speaker is connected.
2. Insert 6AU6 adapter at V219. This is a 6AU6 with pins 3 & 4 clipped off and an extension attached to pin 1. (Pin 1 is not clipped.)
3. If the sweep generator has no internal marker, a signal generator may be connected to the output cable of the sweep generator through a 100 mmf condenser to act as a marker generator.
4. Insert 6AK5 adapter at the mixer, V102. This adapter is a 6AK5 with pin 1 clipped off and an extension attached to the remainder of pin 1, as shown.
5. Inputuner should be tuned to channel 7, or higher.
   L213 adjusts the coupling. The bottom adjustment of T202 is reached through top of can with hex head alignment tool. Whenever the Inputuner is replaced, Steps 7 and 8 must be performed. RA-112A chassis bearing a serial number below 122696, and RA-113 below 132212, do not contain L213 and the following pertains: The bandwidth of the 1st stage of video IF is controlled by a coupling loop in the mixer transformer, T202. This is adjusted and sealed in position at the factory and should not be touched. However, in case of replacement of the Inputuner, it should be adjusted for the curve shown in Step No. 8. Steps No. 7 and 8 may have to be performed in order to obtain the proper curve. After adjustment, fasten the coupling loop in T202 with Miracle Adhesive C2M55 (obtainable from Du Mont Spare Parts Sales).
6. Maximum possible output of the sweep generator should be used, checking for overload.
7. If this curve cannot be obtained, proceed to Step 7, followed by Step 6.
8. If difficulty is encountered obtaining the proper bandwidth, heat the wire protruding from the bottom of this transformer with a soldering iron to soften the adhesive. Then slide the wire in (for increased bandwidth) or out (for decreased bandwidth) of the sleeve. Seal the wire in place with Miracle Adhesive C2M55 (obtainable from Du Mont Spare Parts Sales).
9. Reference is made in the Alignment Table to the use of a crystal probe. This device is merely a crystal rectifier with the necessary filter. The polarity of the curve will be reversed if the terminals of the 1N34 crystal are reversed. This will cause no difficulty. The circuit of the crystal probe detector is as follows:



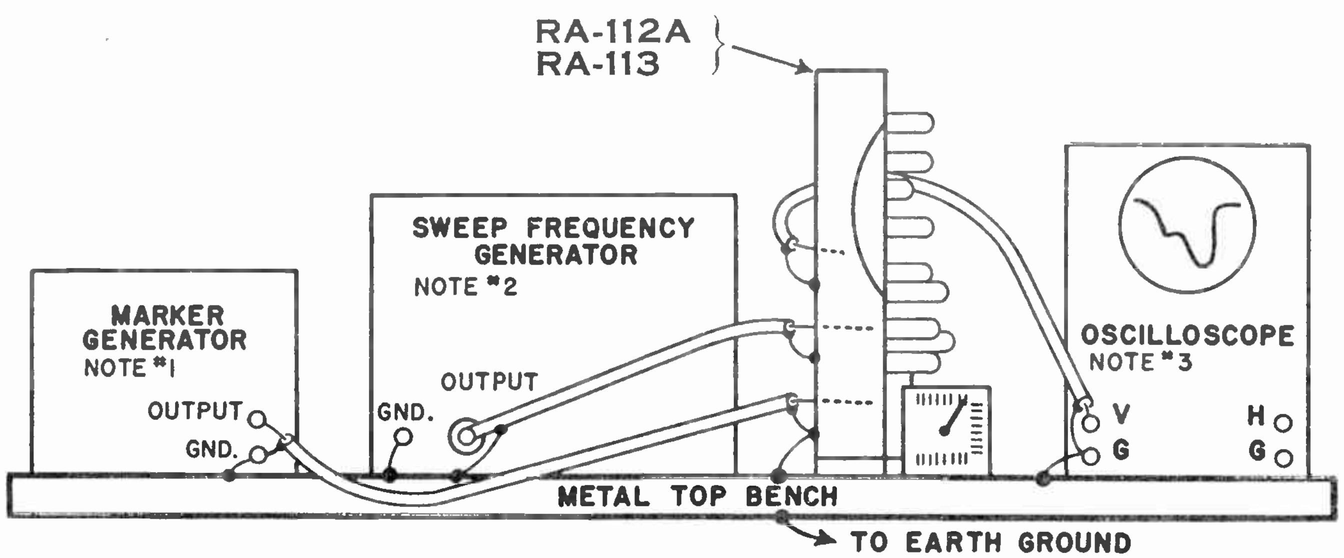
PROBE DETECTOR

10. Tune by tuning eye to the strongest station. Turn AGC control fully clockwise. Then turn this control counter-clockwise until the picture brightens. Finally, turn slowly clockwise to point where picture just starts to dim.
11. Even though the alignment has been performed properly, it is usually necessary to correct the phase response of the video IF strip in order to remove smearing and ringing from the picture. This is done in the factory by applying a 61.25 mc signal modulated by a 100 kc square wave to the front end of the Teleset and displaying the detected square wave (which has passed through the video strip) on an oscillograph after amplifying it by means of a special wideband amplifier. The alignment is checked by observation of the square wave and SLIGHTLY re-adjusted, if necessary. If slight re-adjustment does not correct the square waveform, the chassis is completely re-aligned. A practical approach to this method in the shop (after completing the alignment procedure) is to tune in a strong test pattern known to be of good quality and ghost-free (by observation on several normal Telesets). If smearing or ringing is observed, the following adjustments are recommended. No other adjustments should be made. Limit adjustments only to those absolutely necessary.

    SMEAR: Re-adjust Z204 bottom slug not more than 1 turn.
    Re-adjust Z208 bottom slug not more than 1/2 turn.
    RING: Re-adjust Z205 top slug not more than 1/2 turn.
    Re-adjust Z207 top slug not more than 1/2 turn.

ALIGNMENT SET-UP

1. Keep all coax cables as short and as well shielded as possible.
2. Ground metal bench to a good earth ground.
3. To test set-up feed signal into grid of mixer thru a 100 mmf condenser. If placing hand on any chassis or adding additional grounds at any point affects waveform or if Teleset has a tendency to oscillate, grounding must be added until these effects disappear.



NOTES:

1. Unmodulated and amplitude modulated RF should cover 20 to 30 mc range. Also 4.5 mc. Not necessary if marker is built into sweep frequency generator.
2. Should have center frequency range from 20 to 30 mc. Sweep should be adjustable up to 6 mc at least.
3. We recommend use of internal saw-tooth sweep. Waveforms shown were taken using this sweep. External sweep from sweep frequency generator may be used if preferred.

MODELS RA-112-A1, RA-112-A2, RA-112-A3, RA-112-A4, RA-112-A5, RA-112-A6, RA-113-B1, RA-113-B2, RA-113-B3, RA-113-B4, RA-113-B5, RA-113-B6, RA-113-B7, RA-113-B8

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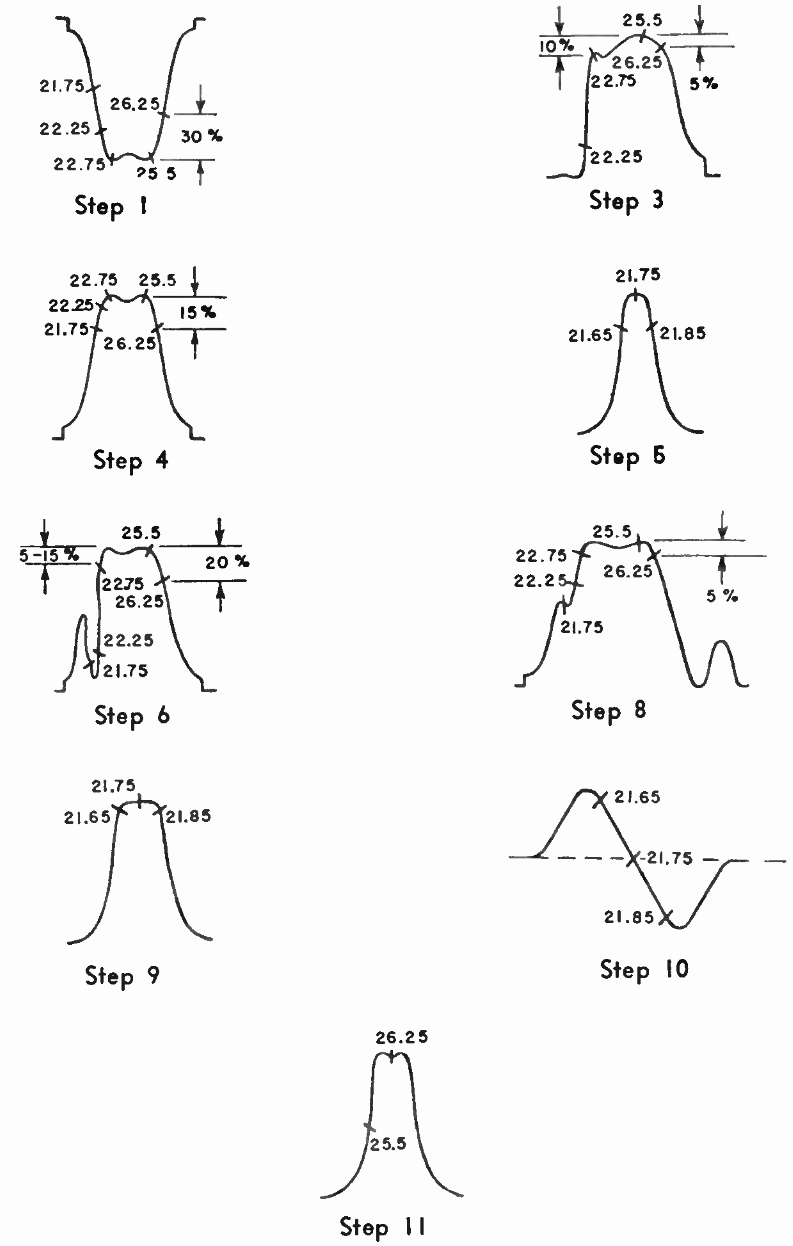
ALIGNMENT TABLE

Step No.	Connect Sweep Generator (Note 3)	*Marker Gen. Freq. (mc.)	*Sweep Gen. Center Freq. (mc.)	Connect Oscilloscope To:	Adjust	Remarks
1	Pin 1 V208 1	21.75, 22.25 22.75, 25.5 26.25	24 mc. 8 mc. dev. min.	Junction L201, L202, L203 Direct 1 DIR	Z208	Adjust for curve shown. Note 8
2	Pin 1 V207 2	21.75 AM mod.	Not used	Pin 5 V208 thru crystal probe 2 CP	L212	Adjust for minimum scope indication.
3	As above	22.25, 22.75 25.5, 26.25	24 mc. 8 mc. dev. min.	As above	Z207	Adjust for curve shown. Note 9
4	Pin 1 V206 3	21.75, 22.25 22.75, 25.5 26.25	As above	Pin 5 V207 thru crystal probe 3 CP	Z206	Adjust for curve shown. Notes 8 & 9
5	Pin 1 V205 4	21.65, 21.75 21.85	21.75 mc. 1 mc. dev. min.	Pin 5 V201 thru crystal probe 4 CP	Z201	Adjust for curve shown. Note 9
6	As above	21.75, 22.25 22.75, 25.5 26.25	24 mc. 8 mc. dev. min.	Pin 5 V206 thru crystal probe 5 CP	Z205	Adjust for curve shown. Notes 7, 8 & 9
7	Pin 1 V102 5	27.75 AM mod.	Not used	Pin 5 V205 thru crystal probe 6 CP	Top Z204 Top T202	Adjust for minimum scope indication. Note 4
8	As above	21.75, 22.25 22.75, 25.5 26.25	24 mc. 8 mc. dev. min.	As above	Bottom Z204 & T202, L213	Adjust for curve shown. Notes 5 & 9
9	Pin 1 V201 6	21.65, 21.75 21.85	21.75 mc. 1 mc. dev. min.	Pin 5 V202 thru crystal probe 7 CP	Z202	Adjust for curve shown. Note 9
10	As above	As above	As above	Junction R211 and C270 direct 8 DIR	Z203	Adjust for curve shown.
11	Pin 1 V208 1	25.5, 26.25	24 mc. 2 mc. dev. min.	Pin 1 V219, direct. Note 2 9 DIR	Z209	Adjust for curve shown.
12	Pin 7 V209 7	4.5 AM mod.	Not used	CRT cathode thru crystal probe 10 CP	L203	Adjust for minimum scope indication.
13	Replace original tubes.					
14	Adjust AGC control, R250. Note 10					
15	Phase correction. Note 11					

CP indicates that oscillograph is connected through crystal probe.
DIR indicates that oscillograph is connected directly.
Refer to top and bottom photos on reverse side of this sheet for reference points.

*RA-112A chassis bearing a serial number below 12702 and RA-113 below 13580 utilize a sound IF of 21.9 mc. and a video IF of 26.4 mc. For re-alignment of these chassis, use the RA-111A Alignment Procedure. In areas where the 8th harmonic of the 21.9 mc. sound IF causes a beat pattern on channel 7, these early chassis may be re-aligned to a sound IF of 21.75 mc., using this Alignment Procedure.

NOTE: THIS PROCEDURE MAY BE USED ON THE RA-111A WHENEVER THE 8TH HARMONIC OF THE 21.9 MC. SOUND *IF* CAUSES A BEAT PATTERN ON CHANNEL 7.



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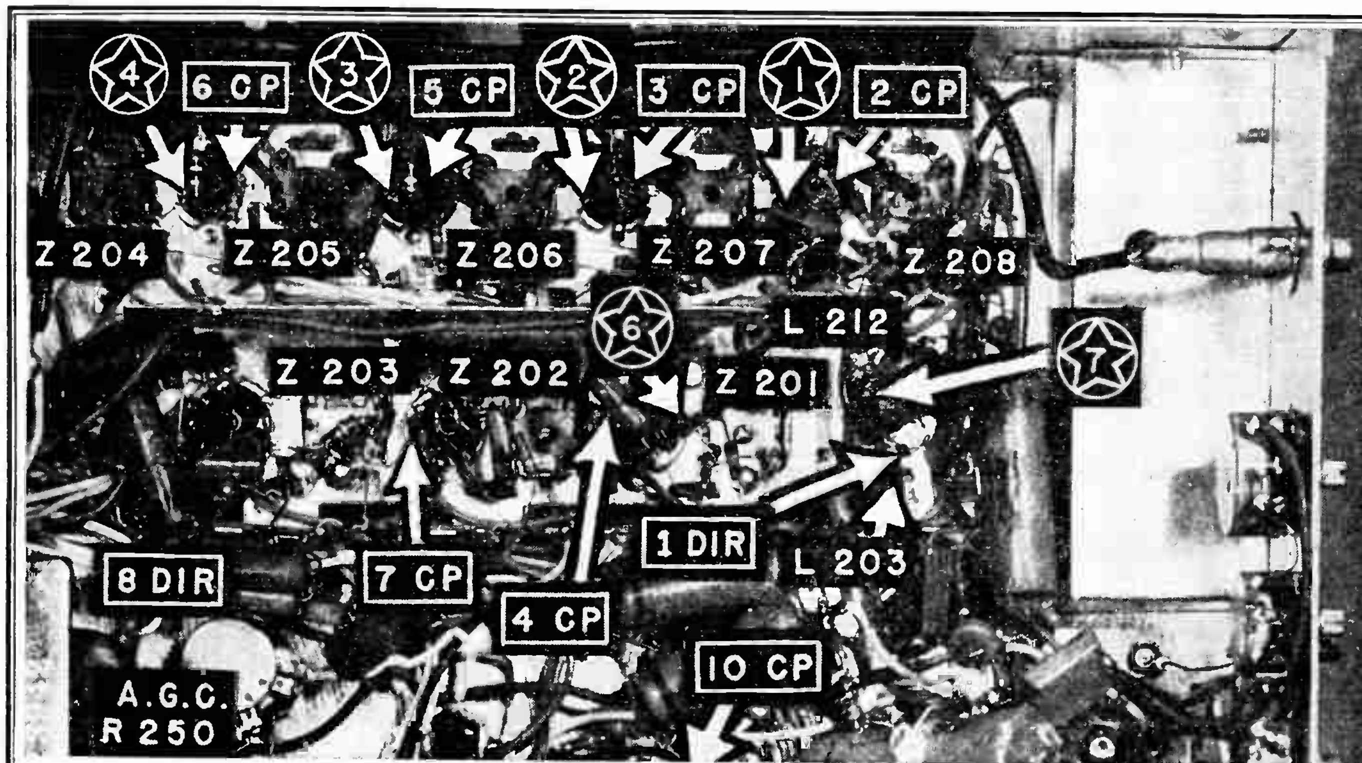


RESISTANCE MEASUREMENTS — ALL READINGS TO GROUND

TUBE	1	2	3	4	5	6	7	8
V201	1.5M	0	0	Fil	8K	6.7K	39	
V202	270K	0	0	Fil	8K	6.7K	0	
•V203	100K	100K	260K	Fil	0	1.8M	0	10M
V204	470K	270	Fil	0	9.5K	9K	NC	
V205	1.5M	0	0	Fil	8K	18K	39	
V206	1.5M	0	0	Fil	8K	18K	39	
V207	.7	0	0	Fil	10K	6.8K	120	
V208	6.8K	220	0	Fil	8K	6.7K	NC	
V209	.6	105K	0	Fil	1M	0	4.5K	
V210	4.5K	0	0	Fil	12K	73K	1K	
•V211	0	1M						
V212	1.5	0	0	Fil	8K	6.7K	340	
V213	3.5K	3.5K	0	Fil	23K	0	1M	
V214	1M	110K	330K	275K	280K	427	Fil	
••V215	NC	0	427	NC	1M	1M	Fil	280K
V217	NC	NC	260K	NC	8K	NC	260K	260K
V218	NC	8K	NC	470	NC	470	NC	8K
V219	1M	0	0	Fil	27K	2.4K	0	
V220	470K-1.4M	1.6M-7M	625	1.3M	5K	427	Fil	0
V221	2.3M	250K	2K	2.3M	250K	2K	0	Fil
V222	3.3K	Fil	7K	1.5M	0	0	0	3.3K
†V401	Inf	NC	Inf	NC	Inf	Inf	NC	NC
††V402	Inf	Inf	Inf	NC	NC	Inf	NC	NC

	9
•V203	360K

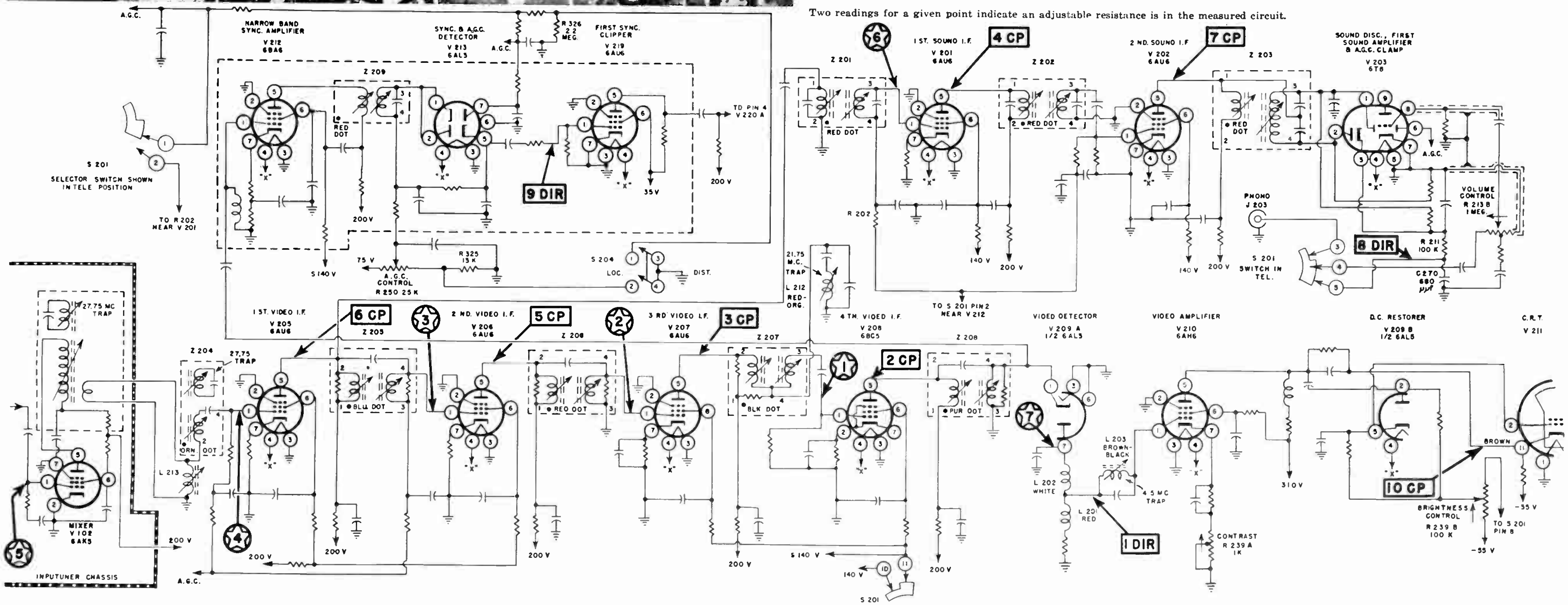
	10	11	12
•V211	8K	70K	Fil

	Cap
••V215	350K

	9	Cap
†V401	Inf	350K
††V402	Inf	Inf

Selector switch in 'Television' position.
Instrument Used — RCA Model 195-A Voltohmyst (for voltage and resistance).
All readings in ohms K= thousand M= million

Two readings for a given point indicate an adjustable resistance is in the measured circuit.



MODELS RA-112-A1, RA-112-A2, RA-112-A3, RA-112-A4, RA-112-A5, RA-112-A6, RA-113-B1, RA-113-B2, RA-113-B3, RA-113-B4, RA-113-B5, RA-113-B6, RA-113-B7, RA-113-B8

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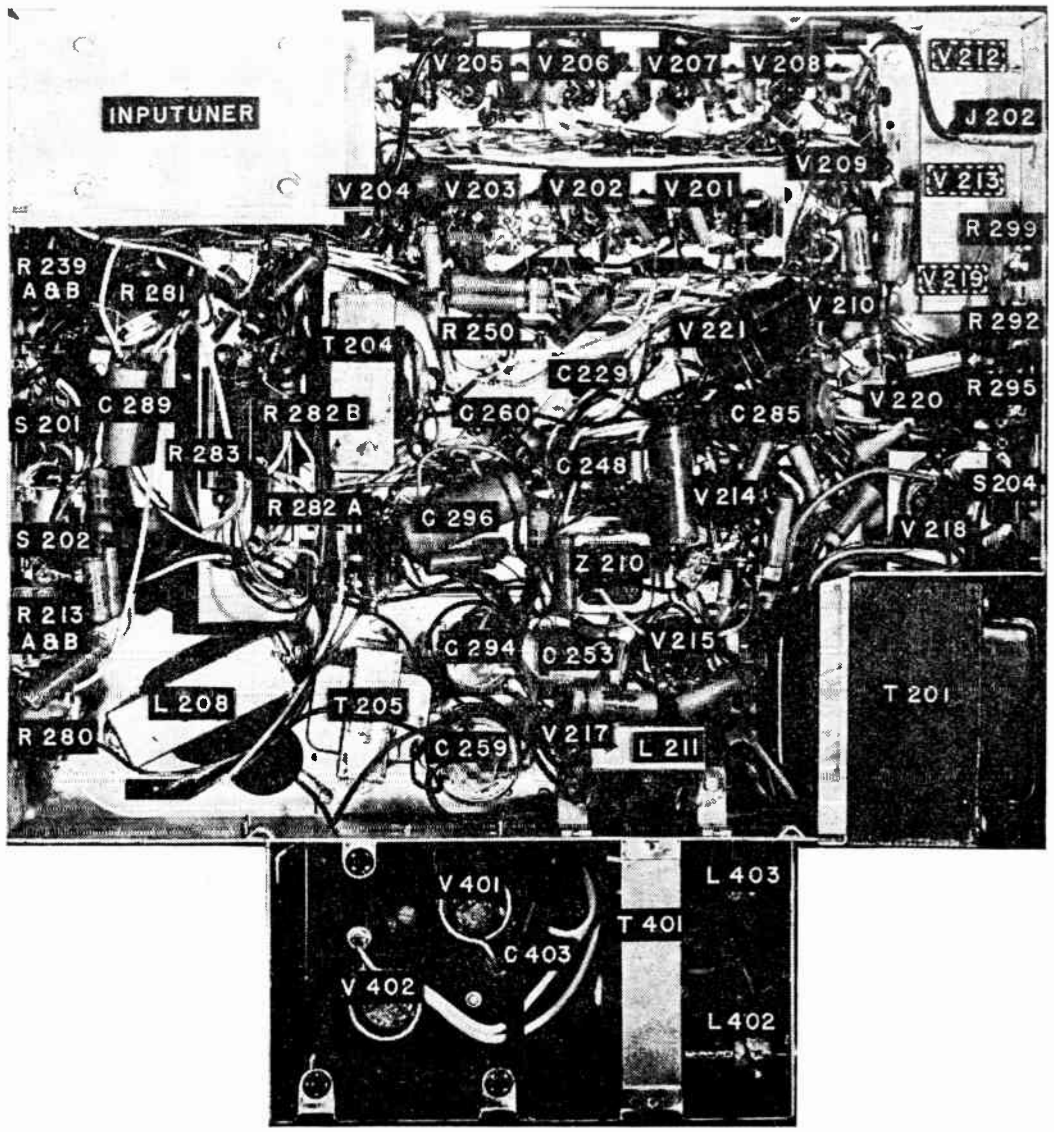
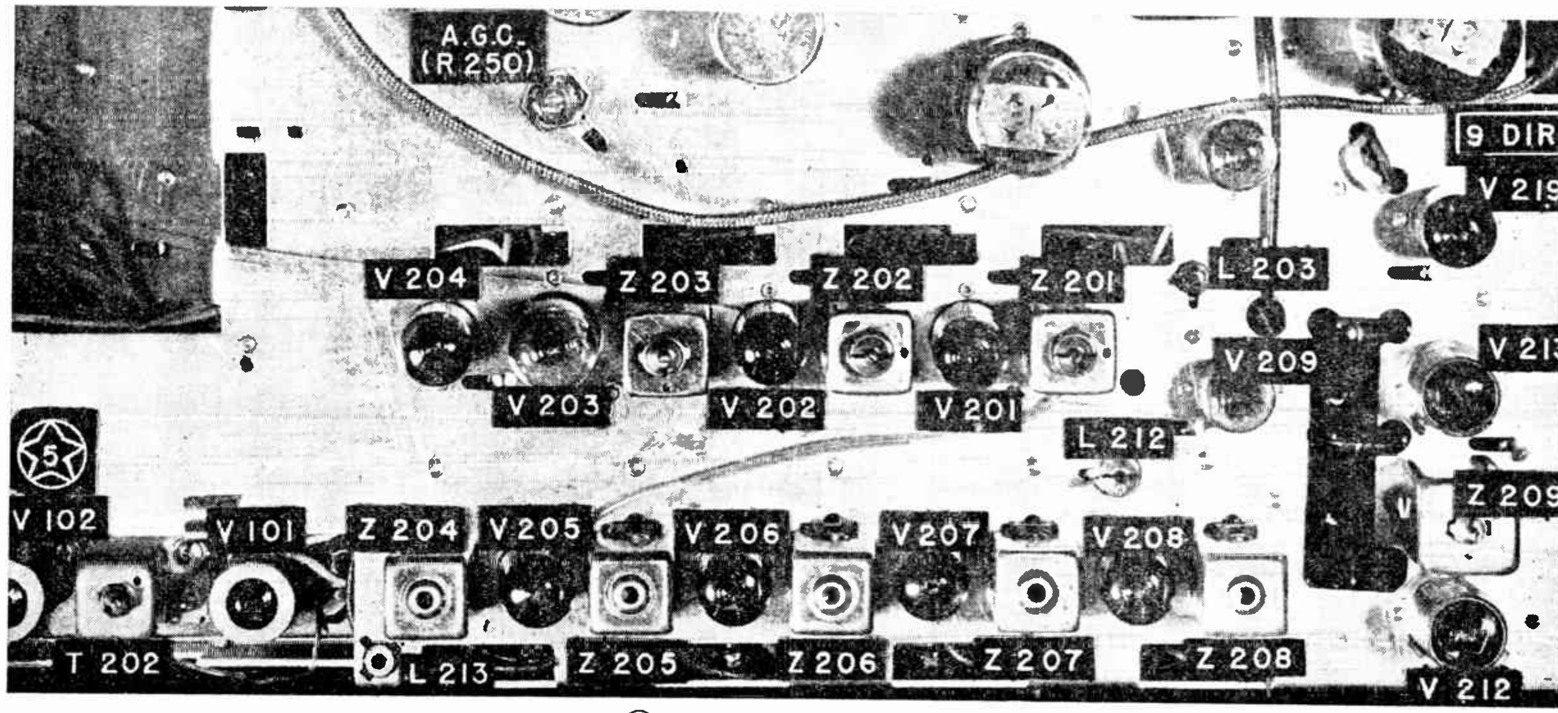
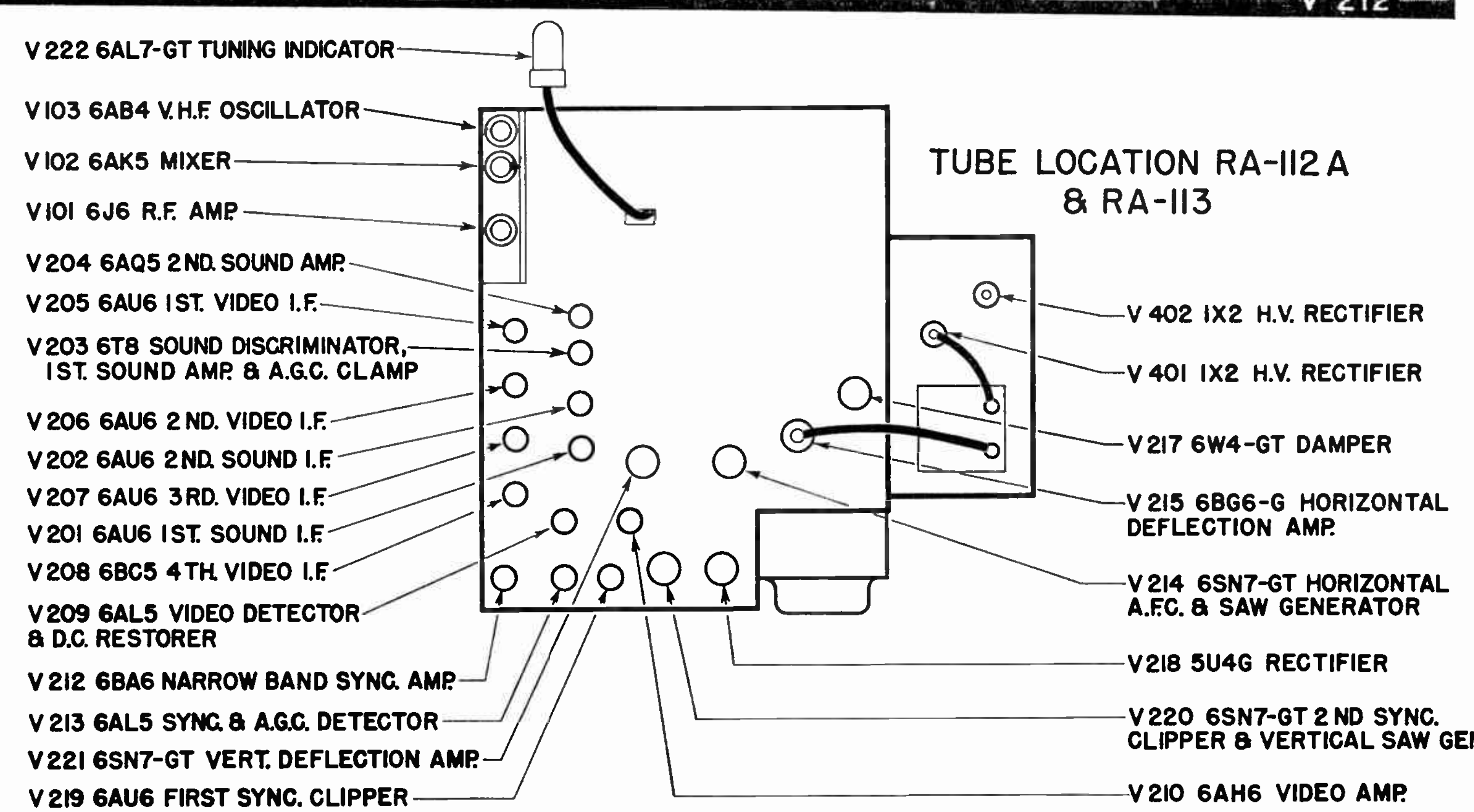
MODELS RA-112-A1, RA-112-A2, RA-112-A3, RA-112-A4, RA-112-A5, RA-112-A6, RA-113-B1, RA-113-B2, RA-113-B3, RA-113-B4, RA-113-B5, RA-113-B6, RA-113-B7, RA-113-B8







TUBE LOCATION RA-112 A & RA-113

RESISTANCE READINGS OF COILS

(All readings in ohms)

All coil readings shown were taken with coils disconnected.

Symbol	Reading
L201	10.5
L202	7.3
L203	2.5
L204	5.6
L212	.2
L214	1.5
L215	3

NOTES

1. Issue No. 4 through M-146.
2. Voltage, resistance and waveform measurements.
   a. Instrument used—RCA Model 195-A Voltohmyst (for voltage and resistance).
   b. Voltage measurements taken to ground, no signal input.
   c. Voltage measurements made with switch in TV position; contrast and brightness minimum.
   d. All coil readings were taken with coils disconnected.
   e. Video waveforms measured with contrast set for 30 volts p—p at cathode of CRT.
   f. Local-Distance Switch in local position.
3. Selector Switch section viewed from front end of switch. Rotor in TV position. Switch positions: 1. Phono, 2. TV, 3. F.M.

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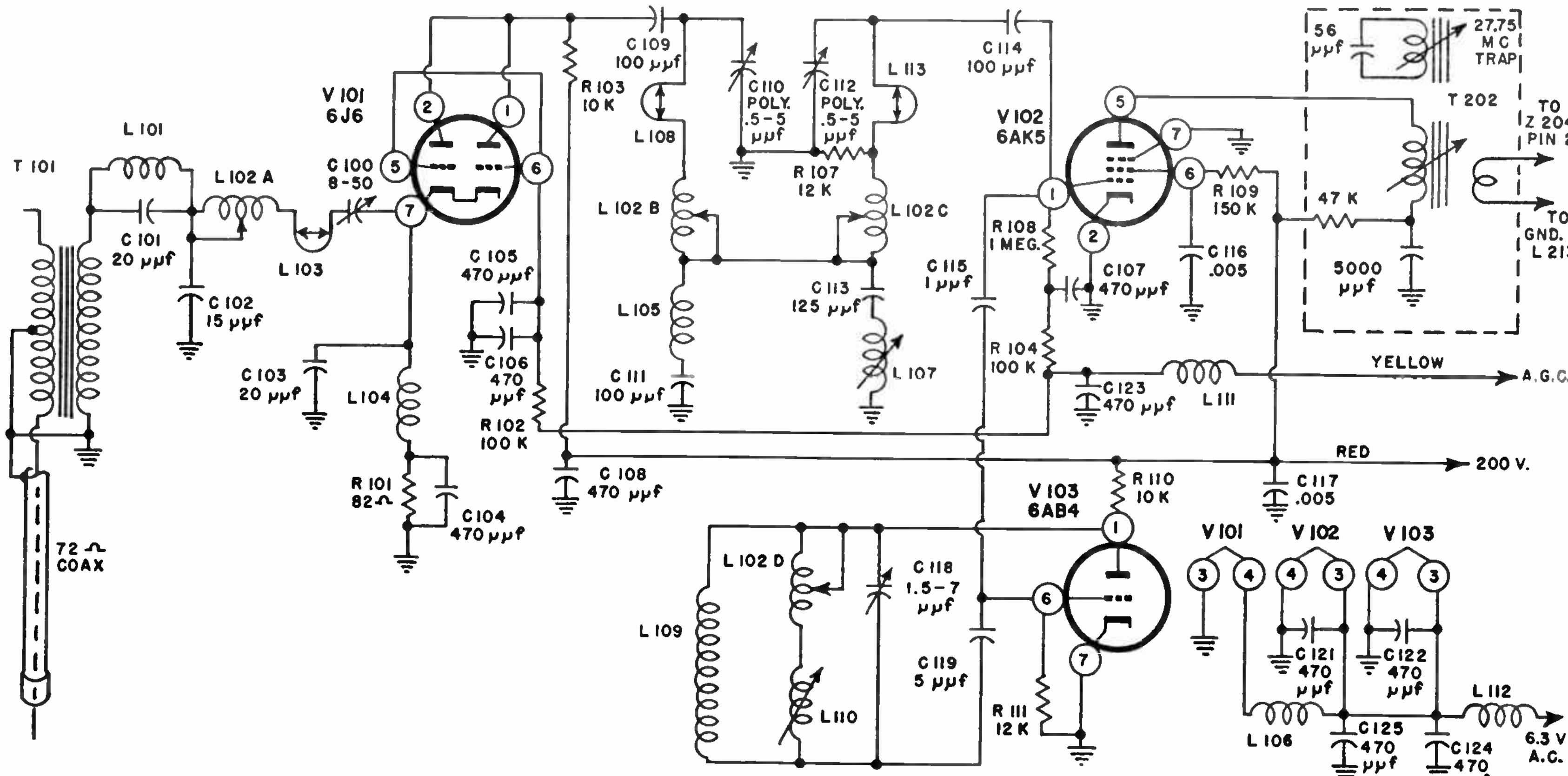

R.F. ASSEMBLY
(FOUR CIRCUIT BOTTOM COUPLED INPUTUNER)

MISCELLANEOUS PARTS LIST

Ardmore, Westerly, and Mt. Vernan — RA-112A

June 9, 1950

Symbol No.	Part No.	Description
R501	02031740	Res F C 560 ohms 10% ½W
	02041740	
	02051740	
R502	Same as R501	
C501	03019310	Cap M 68 mmf 10% 1500V
V211	25000870	Tube CRT 19AP4
L209	21005342	Focus Coil Assembly
L206	21005711	Yoke Deflection
	09003730	Connector Male 1 Cont
	09007491	Connector Pin
	09016480	Connector Male 7 Cont
	18002791	Assembly Loudspeaker
	21004473	Magnet Ion Trap
	21004853	
	35002141	Strap Bonding
	35008231	Mounting Defl Coil
	35008431	Mounting Focus Coil
	35008781	Strap Support
	35008783	Strap Support
	35009241	Plate 19 CRT Rear Mtg
	36000650	Clip Tube Contact
	37002241	Clamp CRT
	41001951	Sleeve Insulating
	42002091	Insulator Shield
	45001461	Window Safety Glass
	62000605	Washer Felt
	64001292	Mask CRT 19
	64002871	Dial Bezel
	45001881	* Knob Dial Vernier
	45001882	** Knob Dial Vernier
	45001883	* Knob Control
	45001884	** Knob Control
	45001891	* Knob Dual
	45001892	* Knob Dual
	45001893	** Knob Dual
	45001894	** Knob Dual
	45001921	* Knob Dial Main
	45001922	** Knob Dial Main
	45001961	* Knob Control
	45001962	** Knob Control

* Mahogany
** Blonde

RF TUNING ASSEMBLY PARTS LIST

Date of Issue May 22, 1950

89003902 Inputuner Assembly

Symbol No.	Part No.	Description
C100	03017500	Cap V Ce 8/50 mmf 350V
C101	03015790	Cap F Ce 20 mmf 10%
C102	03012050	Cap F Ce 15 mmf 10%
	03012180	
C103	Same as C101	
C104	03016470	Cap F Ce 470 min 350V
C105	Same as C104	
C106	Same as C104	
C107	Same as C104	
C108	03016480	Cap F Ce 470 min 600V
C109	03016700	Cap F Ce 100 mmf 500V
C110	03016650	Cap V P .5/5 mmf 500V
C111	Same as C109	
C112	Same as C110	
C113	03018020	Cap F Mica 125 mmf
C114	Same as C109	
C115	03012150	Cap F C 1 mmf 500V
C116	03015610	Cap F Ce 5000 mmf 450V
C117	Same as C116	
C118	03016870	Cap V Ce 1.5/7 N300
C119	03014730	Cap F Ce 5 mmf NPO
C121	Same as C104	
C122	Same as C104	
C123	Same as C104	
C124	Same as C104	
C125	Same as C104	
L101	21005801	Coil Antenna
L103	21005721	Inductor End
L104	21005741	Coil Antenna
L105	21005731	Coil Bandpass Coup
L106	21005421	Inductor Filter
L107	21005521	Inductor Bandwidth
L108	21005722	Inductor End
L109	21005131	Coil Shunt
L110	21005111	Inductor End Osc
L111	Same as L106	
L112	Same as L106	
L113	Same as L108	
R101	02031640	Res F 82 10% ½W
R102	02032010	Res F 100K 10% ½W
R103	02037890	Res F 10K 10% 2W
	02057890	
R104	Same as R102	
R107	02031900	Res F 12K 10% ½W
	02041900	
R108	02032130	Res F 1 meg 10% ½W
	02042130	
R109	02032030	Res F 150K 10% ½W
	02042030	
R110	Same as R103	
R111	Same as R107	
T101	20004592	Ant Trans Asy
T202	21005911	IF Link Asy
V101	25000190	Tube 6J6
V102	25000180	Tube 6AK5
V103	25001760	Tube 6AB4
	09003730	Connector Male
	42001250	Shield Tube
	42002860	Shield Tube

MISCELLANEOUS PARTS LIST

Brookville, Revere, and Burlingame — RA-113

June 9, 1950

Symbol No.	Part No.	Description
J 401	50109001	Cable Assembly
L206	21006091	Yoke Deflection 70°
L209	21005342	Focus Coil Assembly
R501	02031740	Res F C 560 ohms 10% ½W
	02041740	
	02051740	
R502	Same as R501	
C501	03019310	Cap M 68 mmf 10% 1500V
V211	25002610	Tube CRT 17 Rect
	09003730	Connector Male 1 Cont
	09016480	Connector Male 7 Cont
	18002791	Assembly Loudspeaker
	21004473	Magnet Ion Trap
	21004853	
	35008231	Mounting Defl Coil
	35008431	Mounting Focus Coil
	35008784	Strap Support
	35009242	Plate CRT Rear Mtg
	35009422	Strap CRT
	35009561	Bracket CRT Mask Supp
	38003421	Cushion Rear Supp CRT
	38003431	Cushion CRT Strap
	45000049	Window Safety Glass
	62000605	Washer Felt
	62000606	Washer Felt
	64003551	Mask CRT
	64003221	Dial Bezel
	45001881	* Knob Dial Vernier
	45001882	** Knob Dial Vernier
	45001901	* Knob Control
	45001902	** Knob Control
	45001911	* Knob Dual
	45001912	* Knob Dual
	45001913	** Knob Dual
	45001914	** Knob Dual
	45001921	* Knob Dial Main
	45001922	** Knob Dial Main
	45001971	* Knob Control
	45001972	** Knob Control

* Mahogany
** Blonde

PARTS LIST
HIGH VOLTAGE POWER SUPPLY
RA-112A and RA-113

May 16, 1950

Symbol No.	Part No.	Description
C401	03029240	Cap M 1000 mmf 5% 500V
	03024910	
	03033180	
C402	03017450	Cap Pa 470 mmf 20% 10KV
C403	Same as C402	
C404	Same as C402	
C405	03018340	Cap M 10/160 40/250
L401	21005821	Inductor Hor Size Var
L402	21005491	Inductor Hor Lin
L403	21005811	Inductor Hor Size Fix
R402	02038090	Res F C 470K 10% 2W
	02058090	
R403	Same as R402	
R404	Same as R402	
R405	02100730	Res F W 2.2 ohms 10% ½W
R406	Same as R405	
S401	05003431	Switch 3 position
T401	20005021	Transformer Hor Defl
V401	25001810	Tube Electron 1X2
V402	Same as V401	
	09007491	Connector Pin
	09016531	Connector Assy Tube
	34002471	Socket Asy HV
	36000650	Clip Tube Contact
	42002710	Shield Corona
	42003041	Shield Corona

MODELS RA-112-A1, RA-112-A2, RA-112-A3, RA-112-A4, RA-112-A5, RA-112-A6, RA-113-B1, RA-113-B2, RA-113-B3, RA-113-B4, RA-113-B5, RA-113-B6, RA-113-B7, RA-113-B8

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World Radio History

MODELS RA-112-A1, RA-112-A2, RA-112-A3, RA-112-A4, RA-112-A5, RA-112-A6, RA-113-B1, RA-113-B2, RA-113-B3, RA-113-B4, RA-113-B5, RA-113-B6, RA-113-B7, RA-113-B8

MAIN CHASSIS PARTS LIST

RA-112A and RA-113

June 17, 1950

Abbreviations used:

C	Composition	E	Electrolytic	Pa	Paper
Cap	Capacitor	Elec	Electronic	Res	Resistor
Ce	Ceramic	F	Fixed	W	Wire Wound

Unless otherwise stated, the tolerance shown is plus and minus of the indicated value. Where two or more part numbers are shown, the second and third numbers, if any, are alternate parts.

Symbol No.	Part No.	Description
C201	03015610	Cap Ce 5000 mmf min
C202	03033180	Cap M 1000 mmf 5% 500V
C204	03020000	Cap M 10 mmf 10% 500V
C205	03000950	Cap Pa .05 mf 25% 200V
	03100030	
C206	Same as C201	
C207	03017790	Cap 4000/4000 mmf min
C209	03020080	Cap M 47 mmf 10% 500V
C210	03001450	Cap Pa .01 mf 25% 400V
	03100090	
C211	03012560	Cap Pa .01 mf 25% 600V
	03100220	
C212	03001570	Cap Pa .005 mf 25% 600V
	03100400	
C214	Same as C201	
C215	Same as C207	
C217	Same as C201	
C218	Same as C207	
C219	Same as C201	
C221	Same as C207	
C222	Same as C201	
C223	Same as C201	
C224	Same as C207	
C226	Same as C205	
C227	03055500	Cap M 5 mmf 10% 500V
C228	03012730	Cap Ce 47 mmf 10% 500V
C229	03018440	Cap E 10/10/10 mf
C230	Same as C201	
C231	03015370	Cap Pa .05 mf 25% 600V
	03100250	
C232	Same as C205	
C233	03020560	Cap M 820 mmf 10% 500V
C234	Same as C201	
C235	Same as C201	
C236	03020060	Cap M 33 mmf 10% 500V
C237	03020140	Cap M 150 mmf 10% 500V
C238	03019440	Cap Pa .001 mf 25% 600V
	03100380	
C241	03014430	Cap Pa .002 mf 10% 600V
	03100300	
C242	03018350	Cap Pa .02 mf 5% 400V
	03100450	
C243	03018330	Cap Pa .2 mf 5% 400V
	03100470	
C244	03019640	Cap Pa .05 mf 20% 400V
	03100120	
C245	03021470	Cap M 270 mmf 5% 500V
C246	03003410	Cap Pa .01 mf 10% 400V
	03100320	
C247	Same as C202	
C248	03019400	Cap E 30/25 mf
C249	03020170	Cap M 270 mmf 10% 500V
C251	03015370	Cap Pa .05 mf 20% 600V
	03100250	
C253	03018430	Cap E 50 mf 150V
C255	03100360	Cap Pa .1 mf 10% 200V
C256	03100340	Cap Pa .03 mf 10% 200V
C259	03014130	Cap E 40/40 mf 450V
C260	03018450	Cap E 30/10/10 mf
C261	03014780	Cap Pa .1 mf 20% 200V
	03100040	
C262	03014770	Cap Pa .1 mf 20% 400V
	03100130	
C264	03021430	Cap M 180 mmf 5% 500V
C265	Same as C241	
C266	03018640	Cap Pa .005 mf 10% 400V
	03100310	
C267	03018470	Cap Pa .02 mf 25% 200V
	03100010	
C268	03014820	Cap Pa .1 mf 20% 600V
	03100260	
C269	Same as C268	
C270	03020210	Cap M 680 mmf 10% 500V
C271	03033660	Cap M .01 mf 10% 300V
C276	Same as C212	
C277	Same as C205	
C278	Same as C205	
C279	03020360	Cap F M 27 mmf 10% 500V
C280	03016897	Capacitor Coupling
C281	Same as C201	
C282	03055170	Cap M 100 mmf 5% 500V
C283	03055000	Cap M 20 mmf 5% 500V
C285	03014260	Cap Pa .5 mf 25% 400V
	03100160	
C286	03014900	Cap Pa .01 mf 20% 200V
	03100000	
C287	Same as C205	
C288	03100020	Cap Pa .03 mf 20% 200V
	03101230	
C289	03019410	Cap E 10 mf 450V
C291	03015940	Cap Pa .02 mf 10% 400V
	03100330	
C294	03019570	Cap E 30 mf 450V
C296	03014260	Cap Pa .5 mf 25% 400V
	03100160	
C298	Same as C283	
C299	03016895	Capacitor Coupling
F202	11001100	Fuse ¼ amp
I 201	12001310	Lamp 6 to 8 V
I 202	12001310	Lamp Inc .15 amp 6.3V
I 203	Same as I202	
J201	09016561	Connector Asy Speaker
J203	09002760	Connector Fem 1 Cont
J204	50017541	Cable Asy Yoke
L201	21004461	Coil Video Peaking
L202	21004463	Coil Video Peaking
L203	21004831	Coil 4.5 mc Trap
L204	21004467	Coil Video Peaking
L208	21005213	Choke Filter
L211	21005432	Choke Filter
L212	21004802	Coil Video IF Trap
L213	21005901	Coil Coupling
L214	21004465	Coil Video Peaking
L215	21006111	Inductor Fixed
R201	02031600	Res F C 39 ohms 10% ½W
	02051600	
R202	02032480	Res F C 10K 20% ½W
	02042480	
	02052480	
R203	02032420	Res F C 1K 20% ½W
	02042420	
	02052420	
R204	Same as R203	
R205	02032600	Res F C 1 meg 20% ½W
	02042600	
	02052600	
R206	02032060	Res F C 270K 10% ½W
	02042060	
	02052060	
R207	Same as R203	
R208	Same as R203	
R209	02032540	Res F C 100K 20% ½W
	02042540	
	02052540	
R210	Same as R209	
R211	Same as R209	
R212	02032660	Res F C 10 meg 20% ½W
	02042660	
	02052660	
R213	01028210	Res V C 50K/1 meg SPST
R214	02032070	Res F C 330K 10% ½W
	02042070	
	02052070	
R215	02032580	Res F C 470K 20% ½W
	02042580	
	02052580	
R216	02031700	Res F C 270 10% ½W
	02051700	
R218	Same as R202	
R219	Same as R201	
R220	Same as R203	
R221	Same as R203	
R222	02034880	Res F C 8.2K 10% 1W
	02044880	
	02054880	
R223	Same as R202	
R224	Same as R201	
R225	Same as R203	
R226	Same as R203	
R228	02031660	Res F C 120 ohms 10% ½W
	02051660	
R229	Same as R203	
R230	Same as R203	
R231	02031690	Res F C 220 ohms 10% ½W
	02051690	
R232	Same as R203	
R233	Same as R203	
R235	02030630	Res F C 4.3K 5% ½W
	02040630	
	02050630	
R237	02031570	Res F C 22 ohms 10% ½W
	02051570	
R239	01027020	Res V C 1K/100K ½W
R240	02036910	Res F C 62K 5% 2W
	02046910	
	02056910	
R241	02036630	Res F C 4.3K 5% 2W
	02056630	
R242	Same as R209	
R243	Same as R205	
R244	Same as R209	
R245	02031630	Res F C 68 ohms 10% ½W
	02051630	
R246	Same as R203	
R247	Same as R203	
R248	Same as R203	
R249	02031920	Res F C 18K 10% ½W
	02041920	
	02051920	
R250	01007540	Res V C 25K ¼W
R251	Same as R206	
R252	02032500	Res F C 22K 20% ½W
	02042500	
	02052500	
R254	02034300	Res F C 2.7 meg 5% 1W
R255	02031180	Res F C 820K 5% ½W
	02041180	
	02051180	
R256	02031000	Res F C 150K 5% ½W
	02041000	
	02051000	
R257	02030700	Res F C 8.2K 5% ½W
	02040700	
	02050700	
R258	02033960	Res F C 100K 5% 1W
	02043960	
	02053960	
R259	02034000	Res F C 150K 5% 1W
	02044000	
	02054000	
R260	Same as R257	
R261	02032530	Res F C 68K 20% ½W
	02042530	
	02052530	
R262	Same as R209	
R263	02032030	Res F C 150K 10% ½W
	02042030	
	02052030	
R264	02034970	Res F C 47K 10% 1W
	02044970	
	02054970	
R265	Same as R212	
R266	02032600	Res F C 1 meg 20% ½W
	02042600	
	02052600	
R267	02034910	Res F C 15K 10% 1W
	02044910	
	02054910	
R268	02032360	Res F C 100 ohms 20% ½W
	02052360	
R269	Same as R268	
R271	02109380	Res F W 25K 5% 5W
	02108810	
R280	01028300	Res V W 1200 ohms 10% 25W
R281	02122900	Res V W 1650 ohms 10% 11W
R282	02120300	Res F W 1480/2140
	02123300	
R283	02120210	Res F W 427 ohms 10% 10W
	02123400	
R284	Same as R202	
R285	Same as R205	
R286	Same as R252	
R287	Same as R205	
R288	02032450	Res F C 3.3K 20% ½W
	02042450	
	02052450	
R289	Same as R202	
R290	Same as R202	
R291	Same as R202	
R292	01007520	Res V C 1 meg ¼W
R293	02032080	Res F C 390K 10% ½W
	02042080	
	02052080	
R294	02031190	Res F C 910K 5% ½W
	02041190	
	02051190	
R295	01008570	Res V C 4 meg 40% ¼W
R296	02030640	Res F C 4.7K 5% ½W
	02040640	
	02050640	
R297	02032620	Res F C 2.2 meg 20% ½W
	02042620	
	02052620	
R298	02034740	Res F C 560 ohms 10% 1W
	02044740	
	02054740	
R299	01012400	Res V C 1.5K 20% 2W
	01024620	
	01025420	
R300	02112340	Res F W 5000 ohms 10% 5W
R301	02030680	Res F C 6.8K 5% ½W
	02040680	
	02050680	
R302	02036600	Res F C 3.3K 5% 2W
	02056600	
R303	Same as R302	
R304	02036570	Res F C 2.4K 5% 2W
	02046570	
	02056570	
R307	02037840	Res F C 3.9K 10% 2W
	02047840	
	02057840	
R308	Same as R307	
R310	Same as R205	
R315	Same as R216	
R316	02032590	Res F C 680K 20% ½W
	02042590	
	02052590	
R317	02035040	Res F C 180K 10% 1W
	02045040	
	02055040	
R318	Same as R205	
R319	Same as R205	
R320	Same as R252	
R323	02032100	Res F C 560K 10% ½W
	02042100	
	02052100	
R324	02035010	Res F C 100K 10% 1W
	02045010	
	02055010	
R325	02032490	Res F C 15K 20% ½W
	02042490	
	02052490	
R326	Same as R297	
R332	02030580	Res F C 2.7K 5% ½W
	02040580	
	02050580	
R344	02037790	Res F C 1.5K 10% 2W
	02047790	
	02057790	
S201	05004002	Switch Serv Selector
S202	Same as R213	
S204	05003690	Switch Toggle
	05003050	
T201	20004771	Transformer Power
T203	20004721	Trans Vert Block Osc
T204	20005031	Transformer Vert Out
T205	20005011	Transformer Filament
V201	25000050	Tube Elec 6AU6
V202	Same as V201	
V203	25001820	Tube Elec 6T8
V204	25000340	Tube Elec 6AQ5
V205	Same as V201	
V206	Same as V201	
V207	Same as V201	
V208	25002020	Tube Elec 6BC5
V209	25000020	Tube Elec 6AL5
V210	25001510	Tube Elec 6AH6
V212	25000240	Tube Elec 6BA6
V213	Same as V209	
V214	25000110	Tube Elec 6SN7GT
V215	25000140	Tube Elec 6BG6 G
V217	25000830	Tube Elec 6W4 GT
V218	25000060	Tube Elec 5U4G
V219	Same as V201	
V220	Same as V214	
V221	Same as V214	
V222	25000200	Tube Elec 6AL7 GT
Z201	20004511	Transformer Sound IF
Z202	Same as Z201	
Z203	20005271	Trans Sound Disc
Z204	20005211	Transformer Video IF
Z205	20004711	Transformer Video IF
Z206	20004741	Transformer Video IF
Z207	20004751	Transformer Video IF
Z208	20005241	Transformer Video IF
Z209	20005251	Transformer IF 26.4 mc
Z210	20004611	Transformer Hor Osc
	09016411	Connector Female
	09016450	Connector Male 2 Cont
	34001220	Socket Min 7 Prong
	34001670	Socket Min 9 Prong
	34002375	Socket Assy
	34002380	Socket Tube Octal
	42002530	Shield Tube
	42002960	Shield Tube

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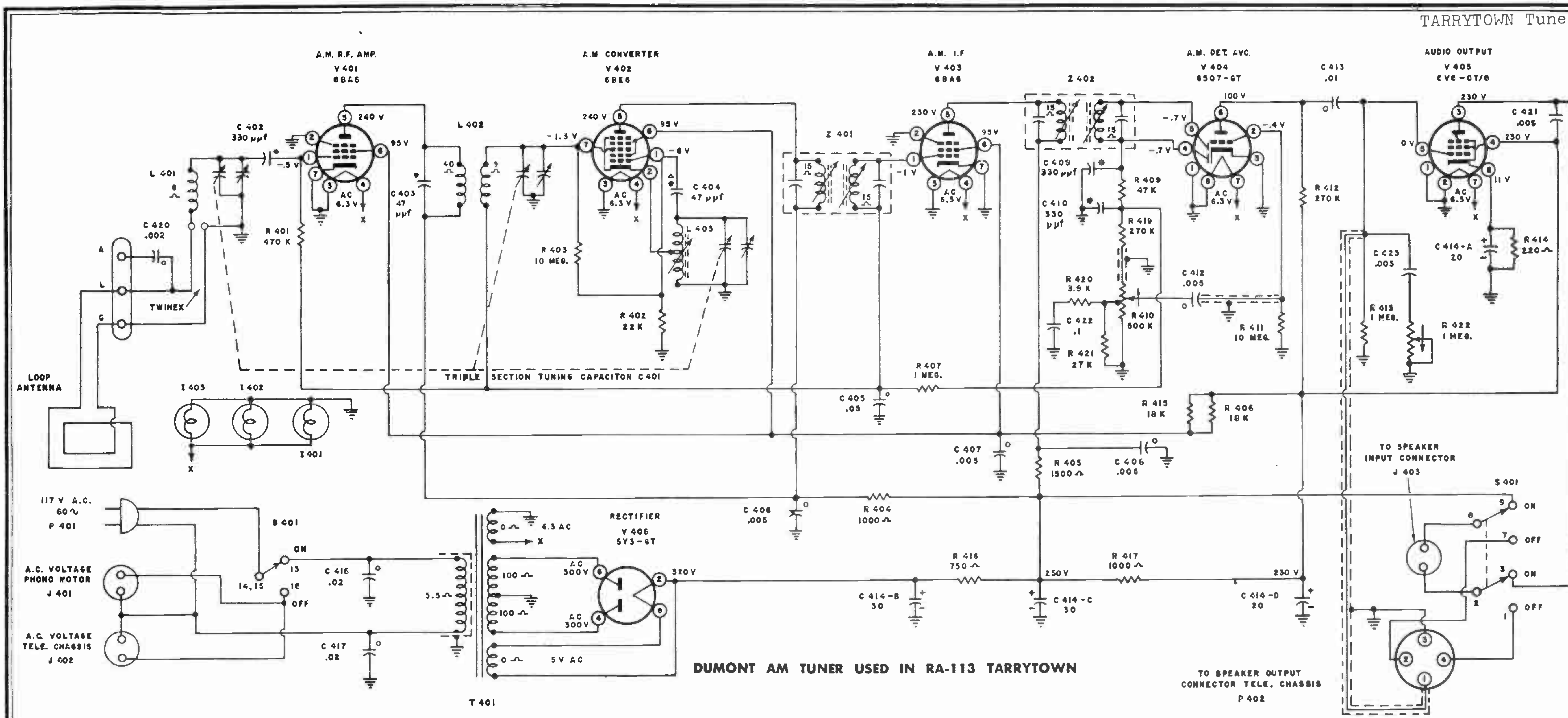
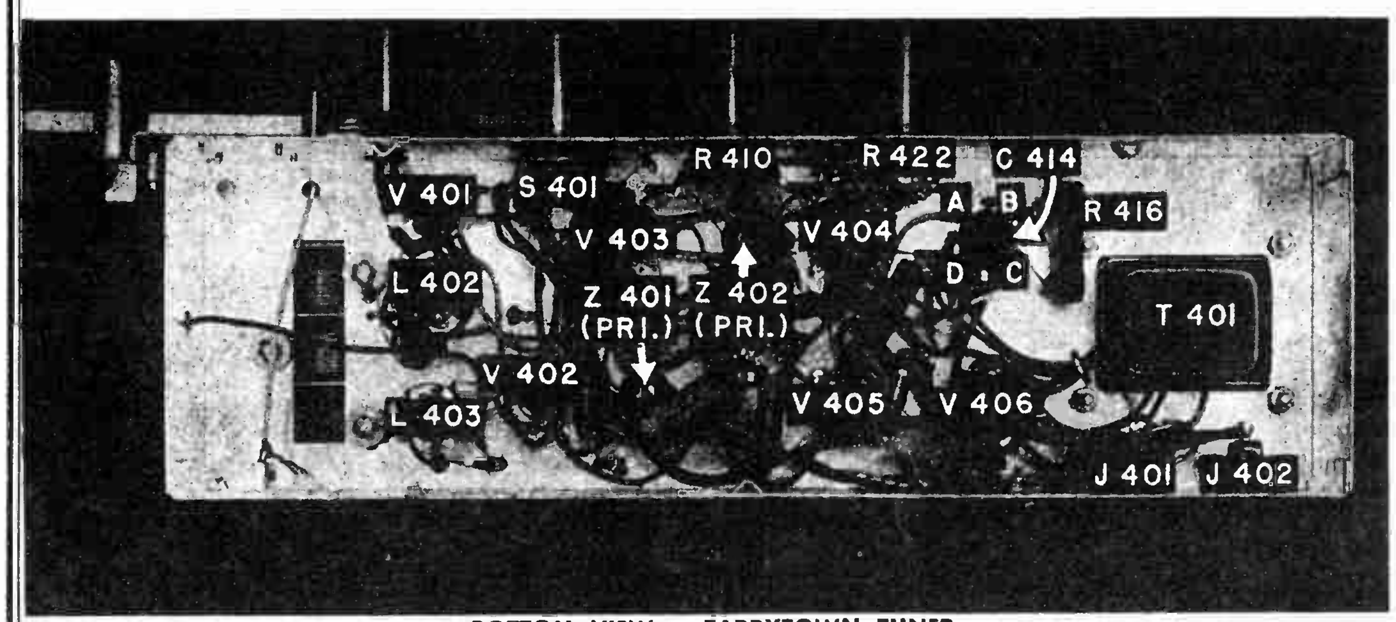
World Radio History

TARRYTOWN Tuner

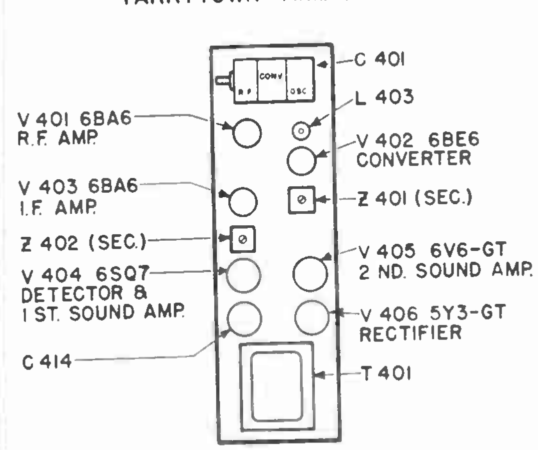


DUMONT AM TUNER USED IN RA-113 TARRYTOWN



BOTTOM VIEW — TARRYTOWN TUNER

TARRYTOWN A.M. TUNER



Resistance Measurements — All Readings to Ground

Tube	1	2	3	4	5	6	7	8
V401	2M	0	0	.05	Inf	Inf	0	
V402	20K	0.5	0	.05	Inf	Inf	1.5M	
V403	1.5M	0	0	.05	Inf	Inf	0	
V404	0	10M	0	500K	600K	Inf	.05	0
V405	0	0	Inf	Inf	1M	Nc	.05	220
V406	Nc	Inf	inf	100	Inf	100	Nc	Inf

Instrument used — RCA model 195-A Voltohmyst for voltage and resistance.
All readings in ohms. K = thousand M = million

Resistance Readings of Coils

All readings in ohms.
All readings shown were taken with coils disconnected.

Symbol	Resistance in ohms Pri.	Sec.
L401	8.0	
L402	40.0	9.0
L403	.5	5.0
Z401	15.	15.
Z402	15.	15.
T401	5.5	200.0

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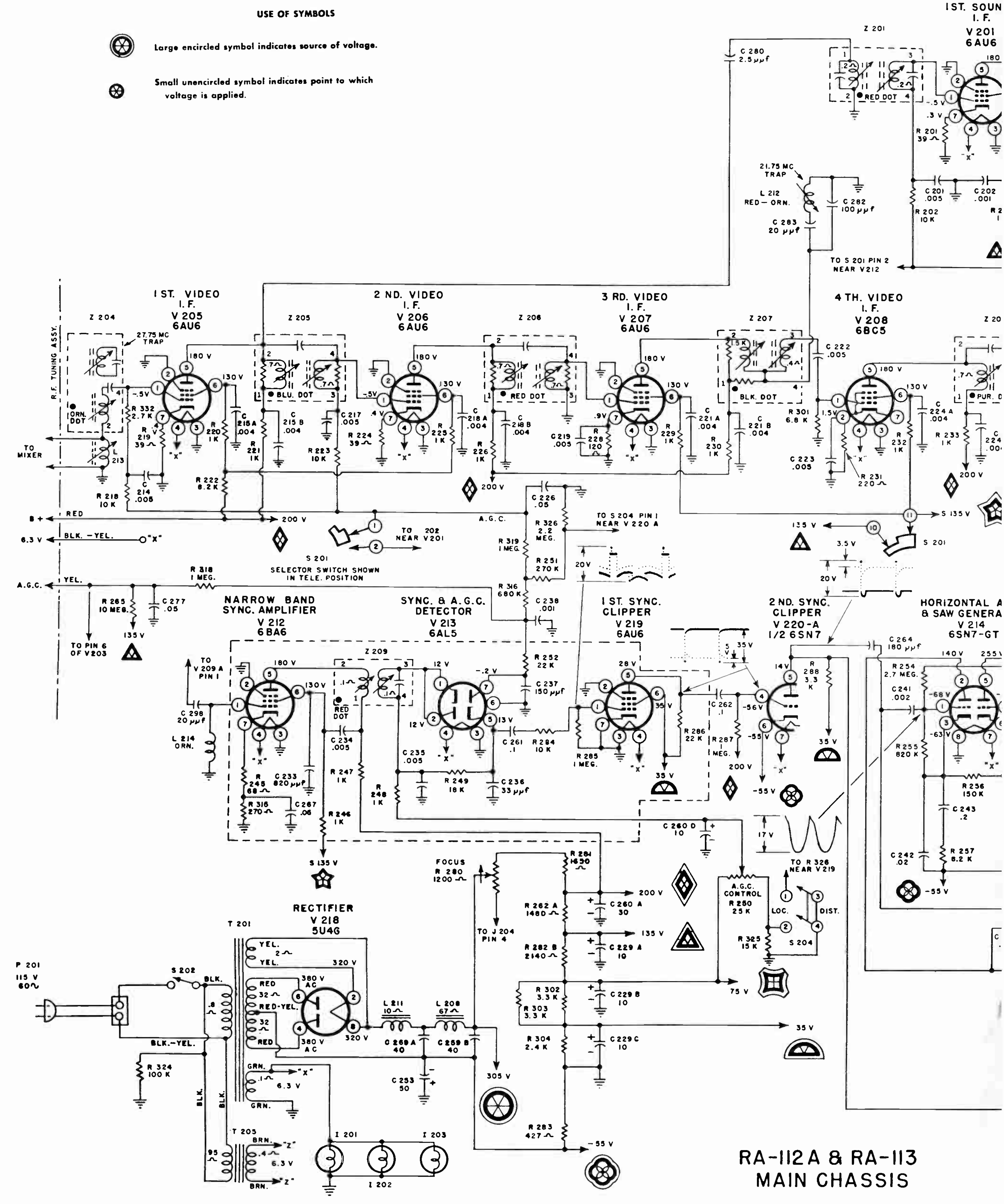
World Radio History

USE OF SYMBOLS

Large encircled symbol indicates source of voltage.

Small unencircled symbol indicates point to which voltage is applied.



RA-112A & RA-113
MAIN CHASSIS

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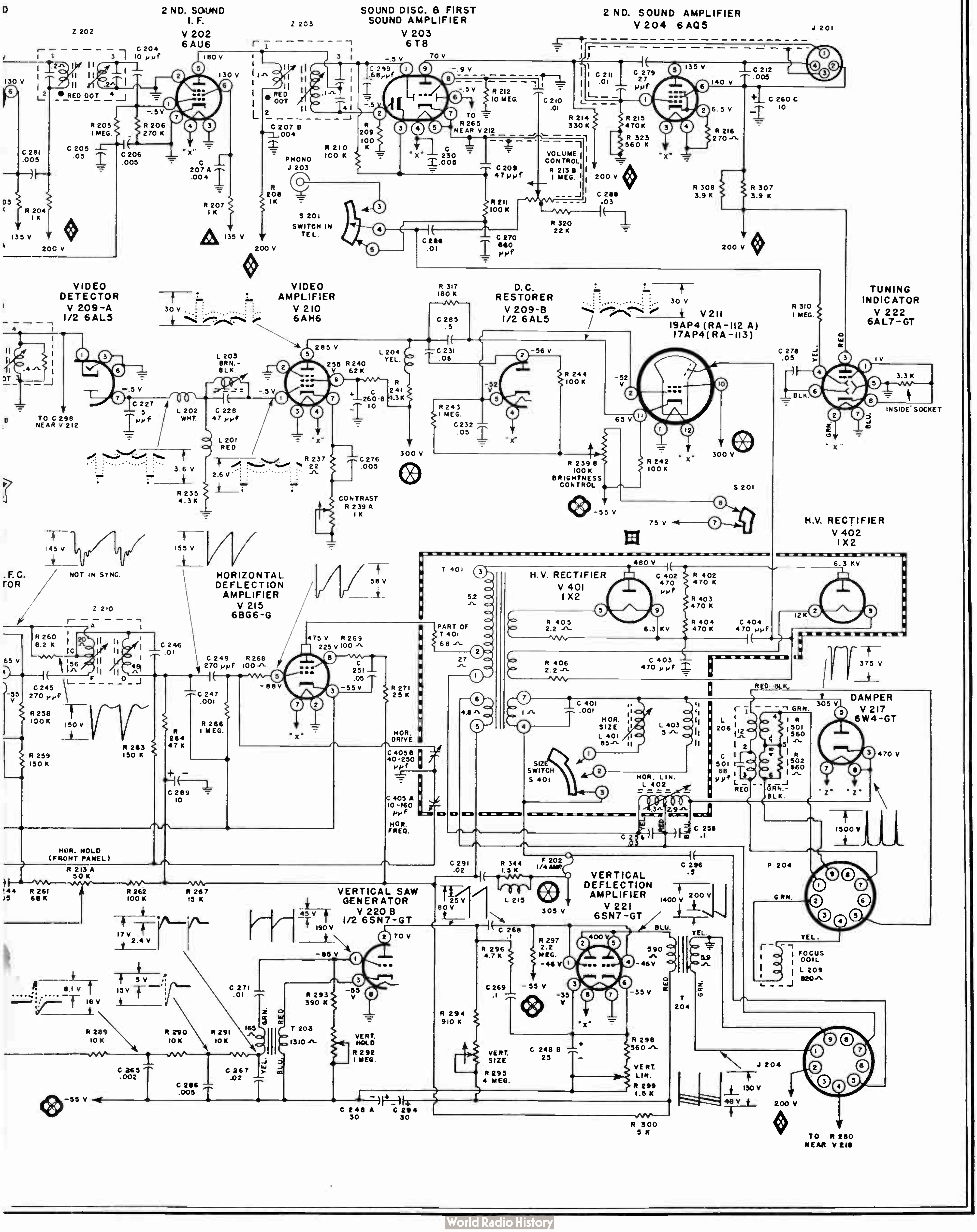
World Radio History

MODELS RA-112-A1, RA-112-A2, RA-112-A3, RA-112-A4, RA-112-A5, RA-112-A6, RA-113-B1, RA-113-B2, RA-113-B3, RA-113-B4, RA-113-B5, RA-113-B6, RA-113-B7, RA-113-B8



World Radio History

PARTS LIST FOR AM Tuner RA-113 Tarrytown
AUGUST 1, 1950

Symbol No.	Part No.	Description
C401	03019381	Cap V 3 Gang
C402	03014390	Cap Ce 330 mmf 20% 350V
C403	03012730	Cap Ce 47 mmf 10% 500V
	03014200	
C404	Same as C403	
C405	03000950	Cap Pa .05 mf 25% 200V
C406	03001570	Cap Pa .005 mf 25% 600V
C407	Same as C406	
C408	Same as C406	
C409	Same as C402	
C410	Same as C402	
C412	Same as C406	
C413	03012560	Cap Pa .01 mf 20% 600V
C414	03014400	Cap E 30/30/20/20 mf
C416	03018570	Cap F Pa .02 mf 20% 600V
	03018560	
C417	Same as C416	
C420	03014430	Cap Pa .002 mf 10% 600V
C421	Same as C406	
C422	03013910	Cap Pa .1 mf 20% 200V
C423	Same as C406	
I401	12001310	Lamp inc .15 amp 6.3V
I402	Same as I401	
I403	Same as I401	
J403	09018692	Connector Asy
L401	21004321	Antenna Coil Asy
L402	21004331	Asy RF Coil
L403	21004311	Coil Osc Asy
P401	50002980	Cable Asy Power
P402	09018702	Connector Asy
R401	02032580	Res F C 470K 20% ½W
	02042580	
	02052580	
R402	02032500	Res F C 22K 20% ½W
	02042500	
	02052500	
R403	02032660	Res F C 10 meg 20% ½W
	02042660	
	02052660	
R404	02032420	Res F C 1K 20% ½W
	02042420	
	02052420	
R405	02032430	Res F C 1.5K 20% ½W
	02042430	
	02052430	
R406	02037920	Res F C 18K 10% 2W
R407	02032600	Res F C 1 meg 20% ½W
	02042600	
	02052600	
R409	02032520	Res F C 47K 20% ½W
	02042520	
	02052520	
R410	01029100	Res V C 500K 20% ¼W
	01028900	
	01029000	
R411	Same as R403	
R412	02032060	Res F C 270K 10% ½W
	02042060	
	02052060	
R413	02032130	Res F C 11 meg 10% ½W
	02042130	
	02052130	
R414	02037690	Res F C 220 ohms 10% 2W
R415	Same as R406	
R416	02107830	Res F W 750 ohms 5% 10W
R417	02037770	Res F C 1K 10% 2W
R419	Same as R412	
R420	02031840	Res F C 3.9K 10% ½W
	02041840	
	02051840	
R421	02031940	Res F C 27K 10% ½W
	02041940	
	02051940	
R422	01029300	Res V C 1 meg 20% ¼W
	01029200	
S401	05003822	Switch AM Tuner
T401	20004151	Transformer Power
V401	25000240	Tube Elec 6BA6
V402	25000250	Tube Elec 6BE6
V403	Same as V401	
V404	25000210	Tube Elec 6SQ7GT/G
V405	25000090	Tube Elec 6V6GT/G
V406	25000220	Tube Elec 5Y3GT
Z401	20004045	Transformer IF
Z402	20004046	Transformer IF
	34002380	Socket Tube Octal
	34001220	Socket Tube 7 Prong
	09015560	Connector Female 2 contact
	45002211	Pointer Dial
	45002081	Dial AM Tuner

MISCELLANEOUS PARTS LIST*
Tarrytown Only — RA-113

AUGUST 1, 1950

Symbol No.	Part No.	Description
C502	03014430	Cap Pa .002 mf 10% 600V
	35009512	Strap Support
	19034593	Reproducer Sound
	89005501	AM Tuner Asy
	12002720	Light Ind Cand DC
	12002770	Lamp Ind Cand DC 6W
	09003400	Connector Male 2 Contact
	12003911	Lens Indicator Light
	45001891	Knob Dual AM (Mahogany)
	45001893	Knob Dual AM (Blonde)
	18003091	Asy Loudspeaker
	22001501	Asy Loop Antenna

* For all other miscellaneous parts used in the Tarrytown refer to the Miscellaneous Parts List for the RA-113 on the Schematic Diagram of Teleset Model RA-112A — RA-113 (First Edition July 3, 1950).

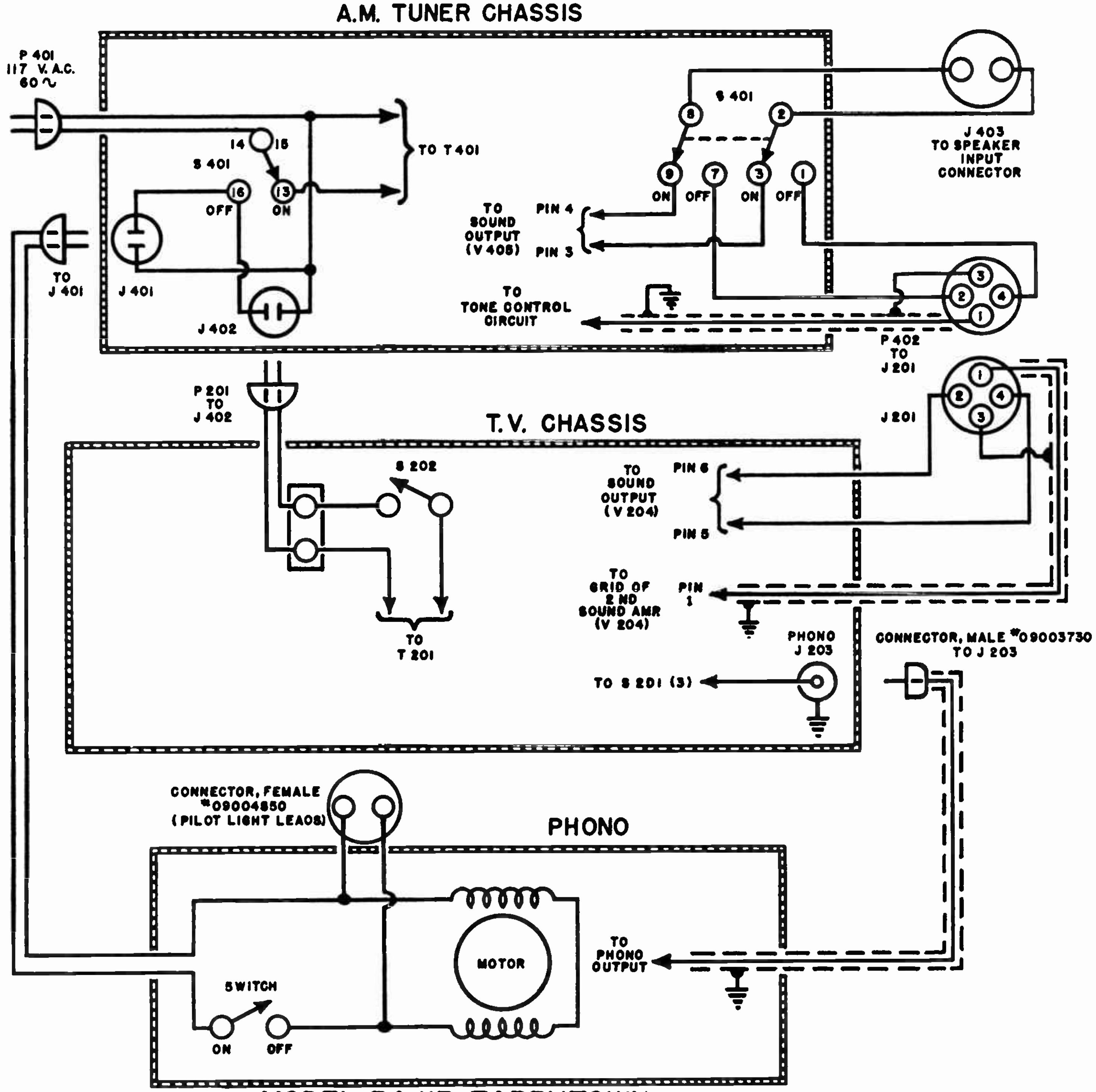
ALIGNMENT PROCEDURE FOR TARRYTOWN AM TUNER

The alignment should be made with the volume control fully on and tone control set for high frequency response. The output from the signal generator should be maintained as low as possible to prevent A. V. C. action from interfering with the correct alignment.

Connect an output meter across the voice coil of the speaker. Turn on signal generator and AM Tuner for approximately five minutes to stabilize. Connect a common ground to each unit. When connecting the signal generator output leads to the receiver, place a .25 mfd condenser in series with the inner conductor of the signal generator output lead.

1. Turn the tuning dial to the extreme low frequency end (gang condenser fully closed). At this position the tuning dial pointer should be halfway below the 550KC mark and the ends of the two concentric semi-circles.
2. Connect the signal generator output lead to the converter stator of tuning capacitor C401.
3. Set signal generator to 455KC and adjust tuning slugs (secondary and primary) on IF coils Z402 and Z401 in the order given for maximum deflection, reducing generator output as required. Repeat tuning until maximum output is obtained.
4. Connect generator to antenna input terminal.
5. Turn tuning dial pointer to 600 KC. Feeding in a 600KC signal from generator adjust oscillator coil L403 for maximum output.
6. Turn tuning dial pointer to 1500KC. Feeding in a 1500KC signal from generator adjust RF, converter and oscillator trimmers on tuning capacitor C401 for maximum audio output.

DIAGRAM SHOWING INTERCONNECTING CABLES AND AC LINES BETWEEN TV CHASSIS, AM TUNER CHASSIS AND RECORD PLAYER
TOP VIEW — TARRYTOWN TUNER



MODEL RA 113 TARRYTOWN
INTERCONNECTING CHASSIS CABLES

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Placement of Receiving Tubes

1. The receiving tubes shall be placed in the following sockets:

Socket	Tube type
A	5U4G L. V. Rectifier
O	5V4 Damper
Q	1B3/8016 H. V. Rectifier
I	6SN7 Vertical Osc. & Amp.
(in tuner)	6AK5 and 12AT7
E	6AU6 First Sound I.F.
F	6AU6 Second Sound I.F.
G	6T8 Sound Discriminator
H	6V6GT Audio Output
D	6AG5 First Video I.F.
C	6AG5 Second Video I.F.
B	6AG5 Third Video I.F.
K	6SN7 Video detector and 1st Video Amp.
L	6SN7 Video Output
M	6SN7 Separator and Sync. Amp.
N	6SN7 Hor. A.F.C. and Oscillator
Q	6AU5 Horizontal Output
Horizontal Transformer	2 - 1V2 High Voltage Rectifiers

The Picture Tube

The picture tube used with this kit is the 16GP4 metal shell, short, wide angle cathode ray tube. Before installing the picture tube be sure that all tubes are in place and firmly seated in their sockets. The picture tubes should be removed from its carton and handled carefully with both hands on the mètal portion. Try not to touch the flared glass portion of the tube immediately ahead of the neck as this is an insulating barrier between the charged portion (shell) and the deflection components (yoke, etc.) and finger marks can cause a leakage path for the high voltage to flow to ground. Never handle the tube by the neck unless it is held face down as this is a dangerous way to handle picture tubes. Note that there is a metal lip around the circumference of the tube at the screen end. This serves the purpose of allowing the anode connector to clip on and also serves to engage the plastic insulating ring which should be mounted at this time after snapping connector in place. The connector can be mounted at any point along the lip. The neck of the tube should now be inserted through the deflection yoke and focus coil assembly and pushed back until it is firmly seated against the exposed coils of the yoke. The plastic ring should rest on the thin portion of the tube rest. The beam bender should then be slipped on the neck of the picture tube. The correct adjustment of the beam bender will be determined later when testing for the raster of light, its function being to insure brightest illumination on screen. Do not connect high voltage anode wire to connector or connect picture tube socket to tube yet. CAUTION. DO NOT PLUG SET INTO A. C. OUTLET YET. ALSO ON HIGH VOLTAGE CHECK YOU MUST REALIZE AT ALL TIMES THAT THE METAL SHELL IS HIGHLY CHARGED AND CONTACT WITH ANY PART OF THE SHELL WILL RESULT IN A SHOCK. (STARTLING, BUT NOT DANGEROUS).

Alignment of Picture and Sound

Before attempting alignment, be sure that your antenna lead-in is connected.

1. Check with your local television station to find what hours during the day the static test pattern and sound signal is being transmitted. The station provides this service to assist in the alignment of receivers.

2. Procure these items:

   One (1) Pair Earphones
   One (1) .1 Condenser at 400 V.
   One (1) Tuning Stick (preferably plastic, non-metallic)

3. Proceed to align Receiver as Follows:

   (a) Turn set off, connect the .1 condenser to one of the earphone leads. Leave the other lead of the condenser open. Attach an alligator or similar clip to the other earphone lead and another clip to the open lead of the condenser. Clip the earphone lead to the chassis and the condenser lead to the #2 lug of socket L. Turn the channel selector to the number of your local television station. Turn on set. You can now "listen in" on the picture signal when it comes through. Be sure that volume control and contrast control are at full clockwise setting.

   (b) Rotate fine tuning condenser shaft and listen for buzz in earphones. If buzz gets too loud or blocks out reduce contrast control setting slightly. Keep brightness about halfway.

   (c) If no buzz is heard on this channel position of tuner, try same procedure on the channel above and channel below the channel number of your local station. If signal is heard there then it indicates that your I.F. Coils

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are set too high or too low. If results are negative then check antenna connections and positioning. If everything appears normal but still no buzz then check wiring and refer to technical section of your service notes.

(d) If buzz is heard picture content should appear on raster but probably will be streaking or jumping. Adjust vertical hold control to keep picture from jumping or sliding. If picture elements are streaking across screen then try to stop them with horizontal hold control.

(e) If a vertical bright bar appears on the left side of picture then slowly adjust the horizontal drive trimmer until it disappears. This trimmer also aids in adjusting for maximum high voltage. Adjust slowly until picture appears brightest. This adjustment should be clockwise.

(f) Adjust focus control until clearest line formation is obtained on picture. Adjust brightness control until satisfactory brilliance is achieved. Do not make too bright as it will impair picture quality. Note: it is sometimes necessary to move focus coil slightly along neck of tube and rotate slightly to secure focus. Before doing this adjust focus control to about mid-setting so that it will take picture through focus point after focus coil adjustment is made. After adjusting coil secure that position with shim.

(g) Remove earphone clip from set and locate the second sound I. F. coil. This is coil in hole #12. Rotate slug until sound is heard in speaker. Adjust for maximum volume. Adjust slug on top of discriminator can for maximum volume. Adjust slug which is mounted in the bottom of the can for best quality of sound with least incidental noise. For all difficulties encountered, refer to the technical section for service notes.

(h) A simple and effective means of aligning the picture I.F. coils is by the measuring of the brass tuning shafts from chassis to tip with a ruler. The Telekit is properly aligned when the measurements are as follows:

Coil	Inches
Hole 27 (second video)	3/4
Hole 12 (second sound)	3/4
Hole 24 (third video)	3/4
Hole 31 (fourth video)	7/8
Hole 23 (sound trap under chassis)	0 (all way in)
Top of Discriminator	1/2
Bottom of Discriminator	5/8

This sould provide pictures and sound of excellent quality. The fine tuning control will enable you to center the sound with the picture. For more precise information on coil alignment look under "Alignment of Telekit with Instruments" in technical section. If sound bars are seen in picture when picture and sound are coming in together turn out sound trap slug (hole #23) until they disappear.

(i) After all adjustments have been made on the I. F. coils, they should be locked with liquid cement or dope. This is important if the set is to be moved about much, as vibration will cause the slugs in the coils to change position.

(j) This television receiver will perform best with a television antenna kit and a 300 ohm lead in line. These may be purchased for a small cost from your jobber. For urban use, a single dipole kit or a folded dipole kit may be used. For suburban use, a multi-element antenna kit should be used. Antenna installations should be of sufficient height as to clear any "line of sight" obstacles between the transmitter and receiver. In some remote instances a "tower" may have to be used to secure satisfactory reception.

(k) Always locate your television receiver in a part of the room where no direct sunlight or window light falls on screen. After set is mounted in cabinet, it should be placed in its permanent place and should not be moved about. Always be sure to turn off your set when not in use. This will extend the life of your picture tube.

The following is a list of possible failures and an indication of procedure for their corrections:

	Indication	Possible Trouble
A.	No raster on kinescope No light	(1) No high voltage - see notes on "Checking High Voltage". (2) Defective Kinescope - heater open, open brightness control. (3) Incorrect adjustment of beam bender. (4) Damper inoperative. Check heater winding. (5) No B plus, shorted electrolytic or choke open. (6) Open peaking coil or resistor in plate circuit of video output. Check also for open cathode resistor. (7) Wrong or defective connections on picture tube socket. (8) A.F.C. coil slug screwed in too tightly.
B.	Wrinkles on left side of raster:	(1) Resistors on yoke, or condenser in yoke wrong value or defective. (2) Defective yoke.
C.	Trapezoid or non-symmetrical raster:	(1) Defective yoke. (2) Improper adjustment of focus coil or ion trap magnets.
D.	Bright horizontal line No vertical sweep	(1) Defective 6SN7 vertical tube. (2) Vertical size control improperly set. (3) Check for voltages.
E.	Poor vertical linearity:	(1) Check value of 40 MFD condenser on cathode of vertical amplifier. (2) Check 20 MFD condenser at vertical output transformer. (3) Check .1 condenser in vertical oscillator plate circuit. (4) Check voltage on vertical oscillator section of tube. (5) Low B plus. Check rectifiers and capacitors in supply circuits.
F.	Poor horizontal linearity:	(1) Horizontal drive trimmer adjustment incorrectly set. (2) Horizontal linearity control incorrectly set. (3) Low B plus or line voltage. (4) Check voltages in horizontal circuit.
G.	Raster - no image, but accompanying sound:	(1) No signal on kinescope grid, check for signal with earphones as explained in alignment procedure. Check I. F. amplifier tube, second detector, video amplifier. (2) Bad contact on kinescope tube socket. (3) The stage by stage method of trouble shooting should be used to isolate the defective stage.
H.	Signal on kinescope grid, but no sync:	(1) Check sync. amplifier tube and circuit. (2) Check sync. separator circuit. (3) Check voltages on above and associated circuits.
I.	Signal on kinescope grid and horizontal sync. only:	(1) Check vertical oscillator and associated circuit. Vertical oscillator transformer. (2) Vertical oscillator grid input condensers. (3) Check vertical oscillator input network.
J.	Signal on kinescope grid and vertical sync. only:	(1) Check horizontal hold control adjustment. (2) Check horizontal input network. (3) Check value of horizontal grid resistor to hold control. (4) Check drive control trimmer adjustment.
K.	Picture stable, but poor resolution:	(1) Check grid loading resistors on I. F. tubes. (2) Test all peaking coils for continuity. (3) Check plate loading resistor on detector and amplifier. (4) Measure all potentials on above tubes. (5) Make sure that the focus control operates on both sides of proper focus. If not readjust focus coil. If no improvement reverse focus coil wire connections in set. (6) Realign I. F. Circuits. (7) Peaking coils mixed. Change to proper places.
L.	Picture smear:	(1) This trouble can originate in either transmitter or signal source. Normally, smear can be attributed to phase shift at the low frequencies. This can be caused by improper values of R and C. Check for open or leaking electrolytic condenser in 1st video plate circuit. (2) Improper alignment. Re-align. (3) Open peaking coil. (4) Incorrect antenna orientation for observed station.

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Indication	Possible Trouble
M. Picture jumpy:	(1) If regular sections at the left of picture are displaced, check horizontal amplifier tube 6AU5 (2) Vertical instability may be due to loose connections or noise. (3) Vertical hold control not set properly. (4) Horizontal instability may be due to unstable transmitted sync. (5) Synchro-lock circuit improperly aligned. (6) Voltage on plate of separator tube too high. (7) Signal too strong or I. F. coils peaked instead of being staggered, overloading.
N. Oscillation or interference in video output: Most noticeable when contrast controls are advanced.	(1) Improper alignment of I. F. coils or cathode trap. (2) Condenser is open between 30,000 ohm resistor and ground in plate and screen circuits of the I. F., or (3) Wrong value or defective resistor between grid and ground of video I. F. tubes; or (4) Outside interference, such as excessive ignition interference, diathermy or beat frequency interference. (5) Improper lead or parts dress. Instructions not followed properly.
O. When detail is milky or not sharp: NOTE: Before proceeding, make sure focus control is set properly.	(1) Loss of high video frequencies due to I. F. coils being tuned too sharply. Re-align. (2) Peaking coils in wrong places. (3) The resistors connected to the plate of the first and second video output tubes may be off value. The resistor to the plate of the first video output tube should be of 2000 ohms; to the plate of second video output tube should be of 5000 ohms. (4) Poor antenna installation or improper orientation.
P. If focus control is set properly and sympton continues:	(1) Fine tuner improperly set. (2) Station switch on wrong channel.
Q. If picture is too small horizontally only:	(1) Trouble is in horizontal oscillator or amplifier circuit. Check parts. (2) Screen resistor of 6AU5 tube too low in value. Increase.
R. If picture is too large both horizontally and vertically:	(1) Indicates high voltage is not high enough - refer to notes on checking horizontal oscillator and high voltage circuit. (2) High voltage leakage due to High voltage wires touching grounded metal. Leaky high voltage condenser.
S. If sight and sound do not synchronize.	(1) Sight and sound I. F. frequencies may not be right. The should be separated by 4.5 megacycles. (2) TELEKIT tuner set on wrong channel. (3) Normal for remote or "fringe" areas. A more sensitive antenna or a booster required.
T. If picture is crowded top and bottom and spread in middle:	(1) Check 40 MFD condenser on cathode of vertical amplifier tube. (2) Defective yoke. (3) Check .25 MFD coupling condenser from vertical oscillator to vertical amplifier. (4) Check voltage on vertical oscillator.
U. Picture cannot be centered or Shadows exist in corners of picture:	(1) See that picture tube is pushed into yoke as far as it will go. (2) Manipulate focus coil. (3) After above readjust beam bender.

Circuit Description of Horizontal Deflection & High-Voltage Circuits

A 6AU5 beam deflection tube is used for producing the necessary amplitude of the sawtooth currents in the deflection coils. The high voltage for the second anode supply is also produced from the energy stored in the deflection inductances during each horizontal scan. The sawtooth voltage applied to the grid of the 6AU5 deflection amplifier produces a sawtooth of current in its plate circuit. The plate of this tube is connected to the primary winding of the deflection transformer. A sudden change of current in the primary will produce a high inductive pulse on the plate of the tube 6AU5. The sudden ceasing of plate current caused by the cutoff of the tube during retrace will cause the circuit to oscillate. The voltage across the yoke must be maintained uniformly constant during trace. In order to obtain this uniformity the 5V4 damper tube is connected across the deflection coils to remove the oscillation following the retrace pulse. Thus, during the trace period, the voltage is constant across the yoke which produces the desired linear sawtooth of current through the yoke for deflection. The pulse voltage on the plate of 6AU5 is stepped up and rectified, and the rectified voltage is filtered, doubled, and applied to the second anode of the kinescope.

Returning to the 5V4 damper, the B plus voltage is supplied to the 6AU5 through this tube which is conducting over the major portion of the trace. The condenser in the cathode circuit (10MFD.) is fully charged during this period and at the time when the damper is not conducting, this charge is sufficient to supply the 6AU5 plate.

The width control functions to increase or decrease horizontal scanning as required by variations of tube and circuit constants. Capacitor and resistor on the horizontal yoke coil and the resistors across the vertical coil serve to decrease the effects of crosstalk between the horizontal and vertical yoke coils, eliminating the effect of ringing of the horizontal output transformer due to leakage reactance.

Checking Horizontal Oscillator and High Voltage

1. Equipment necessary:

   1 pair earphones
   1 .005 - 600 Volt condenser
   1 Neon test lamp (readily obtainable - 59¢ variety)
   1 1000 ohm per volt volt-ohm-meter (volt-meter scale to 600 volts)

2. The neon lamp will be used to test for high A. C. voltage. The lamp will glow because of the high frequency of this voltage (15,750 cycles.). It is only necessary to hold lamp (glass end, not leads) within ½ inch of the 1V2 tube base

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Checking Horizontal Oscillator and High Voltage (Cont'd)

near yoke mount on horizontal output transformer, being cautious not to get fingers near terminal, as your finger will draw an arc from this terminal if high voltage is present.

3. Assuming you have no light on picture tube and you have tried all preliminary adjustments of ion trap etc., it is necessary to determine whether or not you have high voltage. Use the above test with neon lamp to find out if high voltage is present.

4. If neon lamp does not glow at all when held close to this terminal, it is safe to assume that no high voltage is present. You must now determine the cause of the missing voltage. Referring to the circuit diagram, you will note that the development of high voltage depends upon the proper functioning of the horizontal oscillator and amplifier circuits. The pulses from the horizontal circuit produce the high voltage. It is necessary, therefore, to check each stage to see if it is operating correctly.

5. To determine if oscillator is working, connect a pair of earphones with a .005 MFD condenser in series with one lead to pin #5 of horizontal oscillator tube 6SN7. Connect the condenser end to pin #5 and the other end of earphones to chassis. Turn set on. If a high pitched squeal or note is heard and if it changes in frequency as horizontal oscillator hold control is varied, the horizontal oscillator tube is operating.

6. If you do not hear the above-mentioned note in your earphones, you have localized the trouble as being in the horizontal oscillator circuit. You should then check voltages on this tube (6SN7). Refer to voltage chart. If this fails to bring the trouble to light, it will be necessary to turn set off and check component parts of the circuit.

7. Assuming you have heard the note in the earphones, the next step in localizing the trouble is to remove the earphone lead (with condenser) from pin #5 of 6SN7. Connect lead to pin #1 of horizontal amplifier tube (6AU5). This check is to determine whether or not coupling condenser is functioning properly. Turn set on. The same note should be heard. If not, turn set off an replace coupling condenser.

8. After this procedure, earphones can no longer be used as a test instrument. Caution! Never connect earphones to pin #5 of 6AU5 horizontal output tube, as there is high A.C. voltage present which would be dangerous to earphones as well as yourself!

9. Now that you have arrived at this point in the checking procedure and still have no high voltage as evidenced by the neon lamp not glowing (when held near 1V2 socket on horizontal output transformer), proceed to the next step in trouble-shooting.

10. Turn set off and check component parts of horizontal output circuit and tube 6AU5 Make certain that circuit is wired properly according to wiring diagram. If all is well, turn set on and check for voltages on this tube (6AU5). There should be 320 volts on pin #8 of 6AU5 which is screen grid and 400 volts on Pin #5 of 6AU5. Take care in measuring these voltages, so as not to make physical contact with yourself and the voltage points.

11. To check damper circuit 5V4 take two voltage readings - one from pin #6 on 5V4 tube to ground (350 to 400 volts) and one from terminal #5 on horizontal output transformer to ground (chassis). This voltage should be about 50 volts more than the preceding measurement (400 to 450 volts). If not, the damper tube is not functioning properly and tube and circuit should be checked.

12. These are the usual sources of trouble in the high voltage circuits. The correction of these faults should produce high A. C. voltage.

13. To check presence of high A. C. voltage, again use the neon lamp tester, a glow should appear in the neon lamp when held close to 1V2 socket of horizontal output transformer. The high A. C. voltage is then rectified and doubled in going through the 1V2 tubes and the resulting D. C. voltage is applied to the second anode of the picture tube.

14. The only source of trouble encountered in the H.V. rectifier circuit will be:

(a) Bad rectifier tubes.
(b) Leakage or arcing of high voltage from tube filament lugs to mounted components.
(c) Corona effects.
(d) Open or shortcircuited components.

The first is self explanatory; check tube filaments for continuity. The second case can be corrected by keeping maximum distance between filament pins on 1V2 tube sockets and compnents. If dirt, grease or dampness accumulates on sockets, it will provide a path for the high voltage to arc to components. Clean sockets thoroughly with carbon tetrachloride. The third trouble, corona effects, will be noticed by turning off all lights in the room with set on and observing a blue glow existing on any of the wires in the high voltage circuits or coming from the filament pins of the 1V2 tubes themselves. Pay particular attention to the filament pins. If the blue glow or corona discharge comes from these points, it can be prevented very simply by resoldering these pins, making sure that the finished pin is round and smooth and has not sharp, projecting points or edges. Corona effects will become apparent at these points if joints are not carefully made. Open or short circuited components can be checked with an ohmeter.

15. This brings you to the final check which includes the picture tube and associated coils. Assuming you have tried to position your beam bender to secure brightest illumination on screen, you should next check the voltages on the picture tube socket. Be sure the pins are connected properly. If you still have no light, remove cover from yoke housing and check wiring. Be sure there are no short circuits inside, due to burning of the insulation when soldering lugs.

16. We are quite sure any trouble originating in the horizontal oscillator, amplifier and high voltage circuits will be found if the above step by step procedure is followed.

Voltage Analysis

1. Do not attempt to read high voltage on the television receiver unless you are familiar with high tension circuits and have the proper equipment to do so. In order to get accurate readings in the high voltage circuits, it is essential that an extremely high resistance voltmeter be used (20,000 ohms per volt or more). A vacuum tube voltmeter is preferred. In our laboratories we use a 20,000 ohm per volt movement, in conjunction with a General Electric high voltage multiplier probe which has an internal resistance of 200 megohms.

2. Remember - DO NOT tamper unnecessarily with the high voltage circuits because of the shock and burn hazard involved.

3. A low voltage chart is supplied with each TELEKIT for your convenience in locating trouble.

4. The readings for the voltage chart were taken under certain conditions. These conditions should be duplicated if identical results are to be obtained. The constructor should bear in mind that it is not necessary to obtain identical readings. All voltage readings are taken with a 20,000 ohm per volt meter which is readily obtainable. The readings are taken from the pin numbers to ground of chassis. Negative being chassis. The chart has been based on an A. C. Line voltage of 110 volts. Consequently, if the line voltage is different, the entire set of voltages will be higher or lower in proportion to the line voltage change. All variable resistances (controls) should be turned in maximum clockwise direction (on full). No antenna or signal should be connected to the set.

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Alignment of TELEKIT

We have found through experience that it is relatively easy to align the video stages to get a preliminary picture as the video I.F. system is sufficiently broad to pass some signal at almost any setting.

It is, however, more difficult to adjust the sound channel because these circuits are sharply tuned. We, therefore, advise that a signal generator be used for this purpose. Our sound channel will be tuned to exactly 21.25 Mc. To simplify this adjustment it is recommended that the following procedure be used. Signal can be observed with either the speaker or output meter.

1. Tune signal generator to 21.25 Mc. (Using a 400 cycle note or tone).
2. Connect hot lead of generator through a .005 MFD. condenser to grid of second sound I. F. tube (#1 pin). Connect ground lead to chassis. Turn volume control to full clockwise setting. Turn on set and allow a one minute warmup period.
3. Tune primary of F. M. Transformer, which is the upper slug, for maximum sound in speaker. If too loud reduce generator output.
4. Move generator lead with condenser to grid of first sound I. F. tube.
5. Adjust slug which controls tuning of the sound I. F. coil for maximum intensity of signal.
6. Tune secondary of F. M. Transformer by means of the lower slug of discriminator mounted in the underside of chassis for null point. You will notice in making this adjustment that you will get maximum signal response from loud speaker or output meter on two settings of this slug very close together. Between these two settings there will be a null point; that is, a point that is considerably lower in intensity than on either side of this adjustment. It is this point that is desired. When this is found the operation is completed. Notice the signal will not completely disappear with this adjustment if the volume control is turned on full. This completes the sound adjustment.
7. Connect signal lead of generator through the .005 MFD. condenser to the grid lug (#1) of the first video I. F. tube (tube D). Clip the ground lead of the generator to chassis at base of tube D. Advance contrast control to maximum setting. Clip earphone lead through a .01 MFD. to lug #2 of video output tube (tube L). Clip other earphone lead to chassis. You can now listen to the modulated signal as you make coil adjustments. An output meter connected through a .1 MFD. condenser can be connected to the same points in lieu of earphones.

8. Keeping the signal generator set at 21.25 Mc. proceed to adjust cathode sound trap (hole #23). Adjust for minimum signal output. Keep signal generator attenuator low for all I. F. adjustments but do not reduce contrast control setting. Also keep signal generator and phones connected at same points throughout video I. F. alignment.

9. Set signal generator to 23.9 Mc. Adjust fourth video I. F. coil (hole #31) for maximum output at that frequency. Note that on these adjustments the coil should go through the desided points. Be sure that you can go through these points to be certain that the coils are in the correct frequency range. Then adjust to maximum or minimum as specified.

10. Set signal generator to 26 Mc. Adjust third video I. F. coil for maximum output at that frequency. If signal becomes too loud reduce generator output.

11. Set signal generator at 24.5 Mc. Adjust second video coil for maximum output at that frequency. If signal becomes too loud reduce generator output.

12. The first video coil (mixer output) is in the Telekit tuner. This has been adjusted at the factory to the frequency of 22.8 Mc. The sound take-off coil is also on the tuner and it has been prealigned to 21.25 Mc. at the factory. The sound coil adjustment is on the top of the large coil and the video adjustment is on the underside of the coil. Do not make any adjustments to this coil.

13. The above adjustments will produce a broad band frequency response of 4.5 Mc. which will insure pictures of high definition and sound of excellent clarity. If sweep generator and oscilloscope data is required it can be secured by written request.

VOLTAGE CHART

Controls all set clockwise
Readings taken with 20,000 ohm per volt movement

A.C. Voltage - 112 V. A.C.
60 Cycles

Tube Type	Purpose	Tube Pin Number 1	2	3	4	5	6	7	8	9
6AG5	1st Video I. F.	-.3	.2	0	6.3V A.C.	90V	90V	.2		
6AG5	2nd Video I. F.	-.3	.2	0	6.3V A.C.	110V	110V	.2		
6AG5	3rd Video I. F.	0	.8	0	6.3V A.C.	110V	115V	.8		
6SN7	Video Det. and 1st Video Amp.	-1.8	-1.8	0	-.1	150V	0	0	6.3V A.C.	
6SN7	2nd Video Amp.	0	170V	1.5	0	0	0	0	6.3V A.C.	
6SN7	Separator and Sync. Amplifier	.5	11V	0	.5	130V	0	0	6.3V A.C.	
6AU6	1st Sound I.F.	0	1.2V	0	6.3V A.C.	115V	110V	1.2 V	0	
6AU6	2nd Sound I.F.	0	1.2V	0	6.3V A.C.	115V	110V	1.2 V	0	
6T8	Discriminator and 1st Audio	-.4	-.4	0	0	6.3V A.C.	-.4	0	-.4	90V
6V6	Audio Output	0	0	310V	340V	0	0	6.3V A.C.	18V	
6SN7	Vertical Osc. and Amplifier	-22V	80V	0	-.5	300V	5V	0	6.3V A.C.	
6SN7	Horizontal Osc. and A.F.C. Cont.	-.8	135V	28V	-65V	125V	0	0	6.3V A.C.	
6AU5	Horizontal Output	-19V	0	0	0	400V **	0	6.3V A.C.	280 V	
5V4	Damper	0	400 V	0	300 V	0	300 V	0	400 V	
5U4	Rectifier	0	400V D.C.	370V D.C.	380V D.C.	0	380V A.C.	0	400 D.C.	

All D. C. Voltages unless otherwise indicated.

** A 6000 Volt A. C. pulse is present at this point. Do not measure this with your Volt Meter

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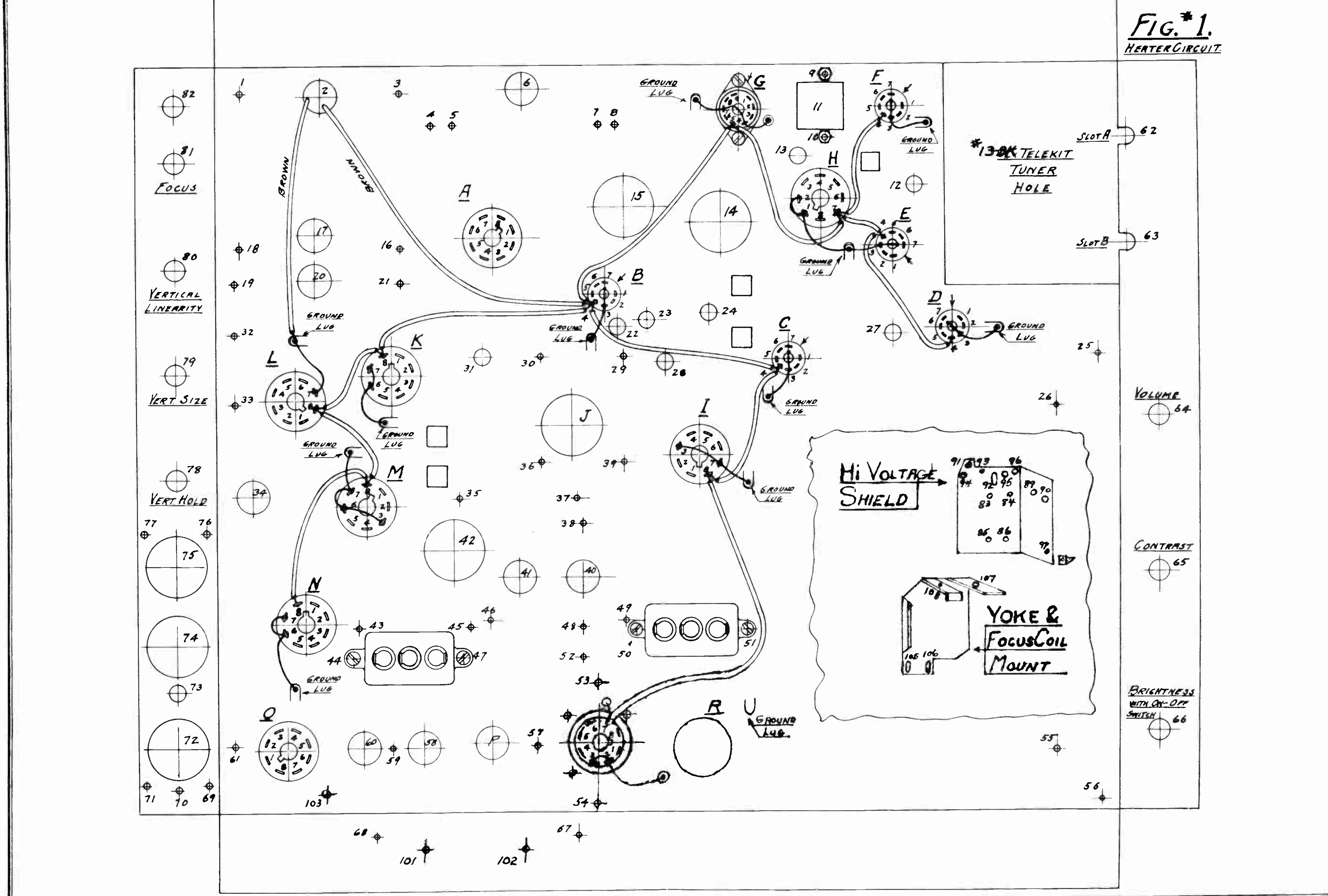

FIG. #1.

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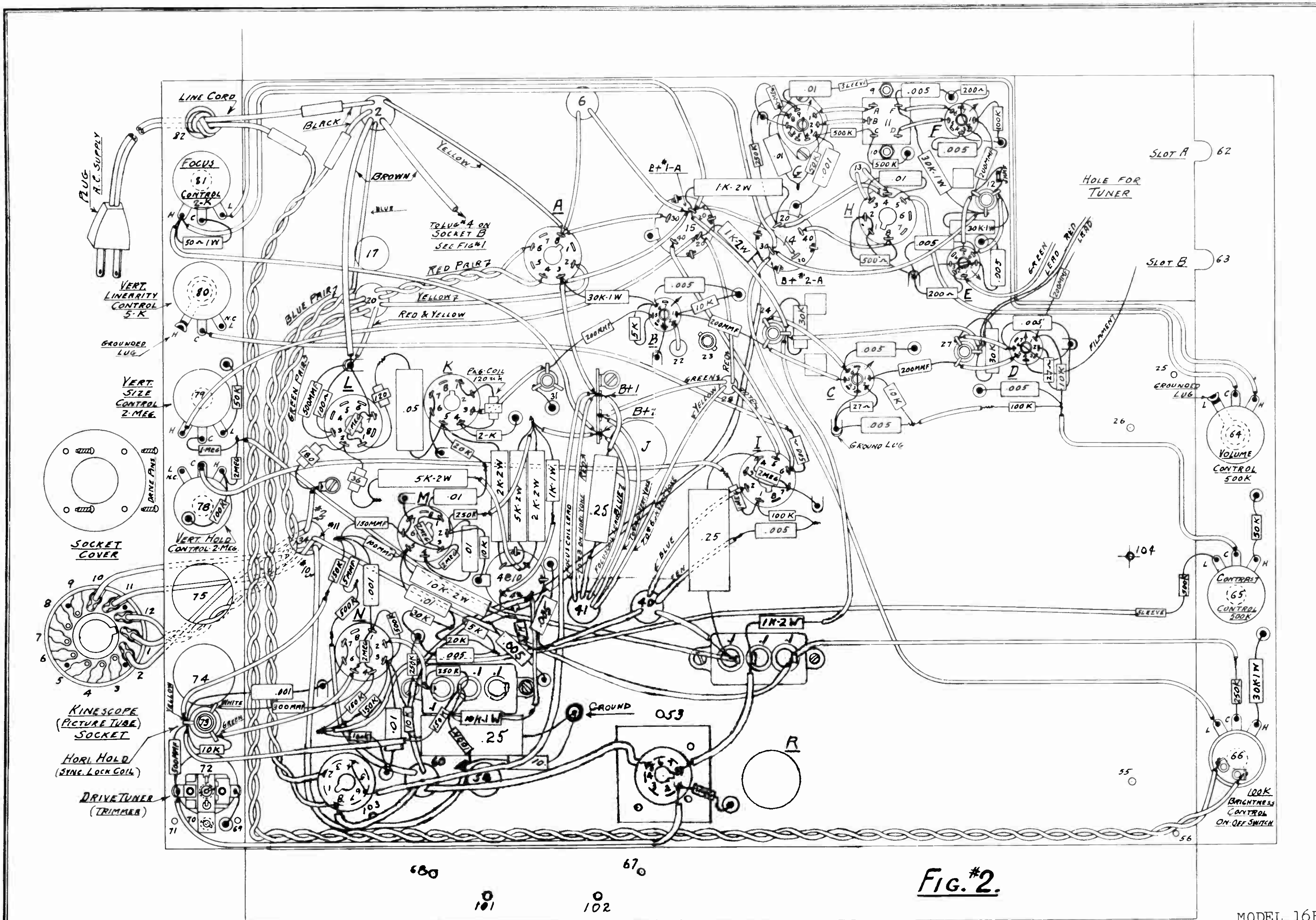

FIG. #2.

MODEL 16BG

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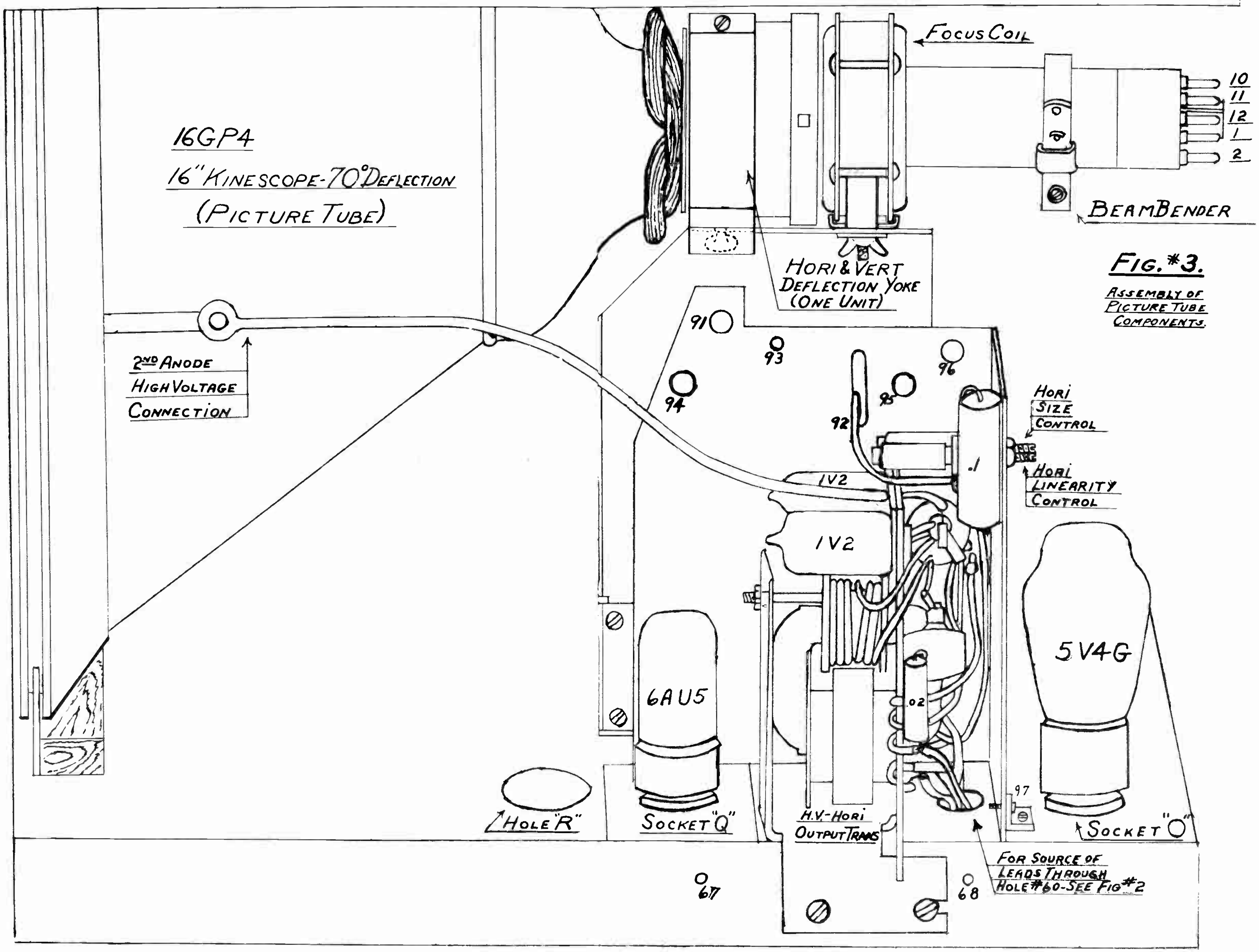

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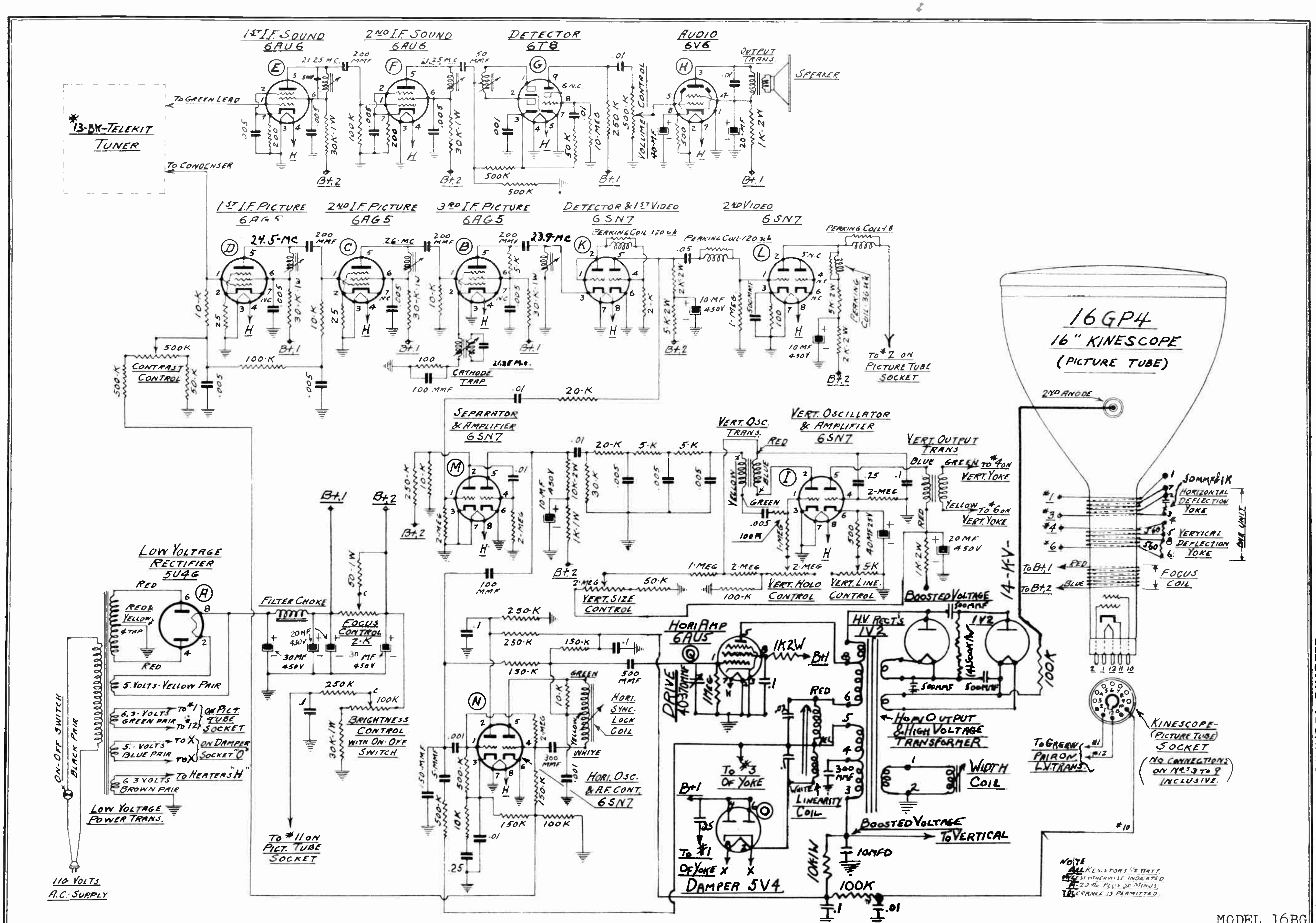

ELECTRO-TECHNICAL TV PAGE 6-9

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PRELIMINARY SERVICE NOTE

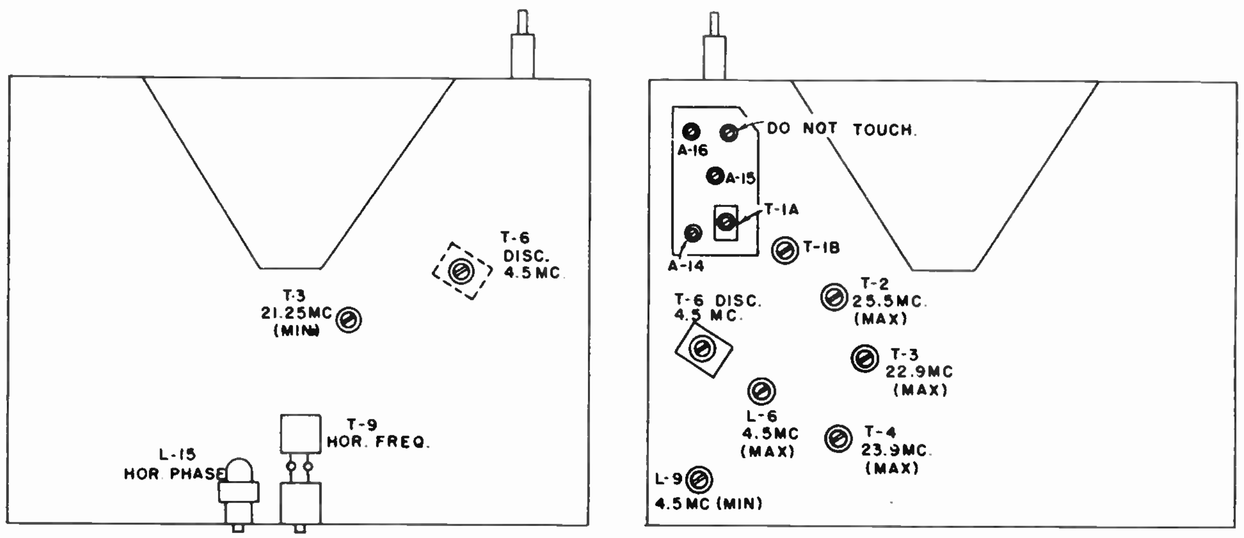
MODELS 614D AND 637A
CHASSIS MODEL 120095-B

I. ALIGNMENT

a. **Equipment Required** - A sweep generator, accurate marker generator, oscilloscope, and v.t.v.m. are required for alignment. The marker generator must be very accurate and supply frequencies of 4.5 MC., and 20 to 28 MC.

b. **Response Curves** - The i-f response curves for the video i-f stages are shown in figure 2.

c. **Alignment Points** - The location of all i-f transformers, tuned circuits, and trimmers is shown in figure 1.



BOTTOM OF CHASSIS   TOP OF CHASSIS

FIGURE 1 - LOCATION OF ALIGNMENT POINTS

d. **TV I-F Alignment** -

1) Tune receiver to Channel 3.
2) Connect 3 volt bias battery negative terminal from junction of C31 and R27 (positive terminal) to B-.
3) Shape overall response curve, after individual peaking of stagger-tuned and over-coupled i-fs, as indicated in steps 1-6 below. See curves A and B.

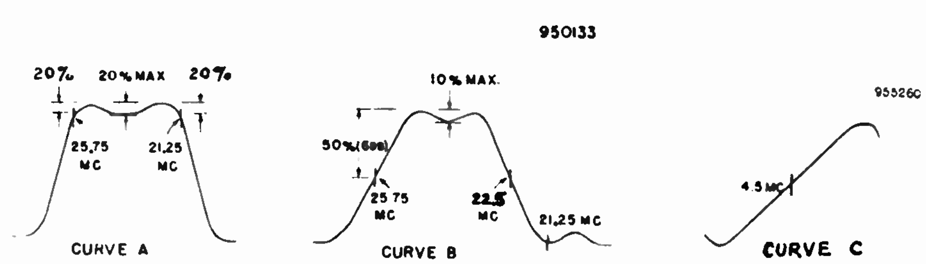


FIGURE 2 - RESPONSE CURVES

TABLE I - VIDEO I-F ALIGNMENT

STEP	SIGNAL GENERATOR INPUT: CONNECTION	SIGNAL GENERATOR INPUT: FREQUENCY	INSTRUMENT CONNECTION	ADJUST	PROCEDURE
1	Connect marker generator to pin 1 (grid) of V-1 (6AU6) through .001 mfd. condenser. Low side to chassis.	25.5 MC	Connect d.c. v.t.v.m. to pin 7 (grid of V4 (12AT7). Use 3 or 5 volt range.	T2	Peak for maximum response. Adjust generator signal level to produce one volt at grid of V4.
2	"	22.9 MC	"	T3 (Top)	"
3	"	21.25 MC	"	T3 (Bottom)	Adjust for minimum response. Repeat step 2.
4	"	23.9 MC	"	T4	Peak for maximum response.
5	Connect sweep generator to converter (V-20) input, using three turn loop of wire slipped over tube. Connect marker gen. in parallel.	Sweep-24.5 MC (10 MC sweep) Marker-21.25 MC and 25.75 MC	Connect vertical input of scope through "detector network to pin 1 (grid) of V-2 (6AU6). *Low input impedance of about 200 ohms	T1(A) T1(B)	Set markers as shown on response curve A, fig. 2. Note that the markers should be 20% down for this stage.
6	"	Sweep-24.5 MC (10 MC sweep) Marker-22.6 and 25.75 MC	Connect vertical input of scope in series with 10K resistor to pin 7 (grid) of V4 (12AT7).	T2, T3, and T4	Adjust for overall response as shown in curve B, fig. 2. Adjust T2 to position 25.75 MC marker; adjust T3 (Top) to set 22.6 MC marker. Do not readjust trap. Equalize peaks of response curve by adjusting T4.

e. **TV Sound Alignment** -

1) Set receiver to Channel 3.
2) Use accurate, crystal-controlled, marker generator.

STEP	SIGNAL GENERATOR INPUT: CONNECTION	SIGNAL GENERATOR INPUT: FREQUENCY	MEASURING INSTRUMENT	ADJUST	PROCEDURE
1	Marker generator through .001 mf to pin 2 of V-4 low side to B-.	Marker-4.5 MC.	Connect v.t.v.m. through 10K resistor to pin 1 (grid) of V5.	L6	Peak for maximum response. Adjust generator input to produce one volt at grid of V5. (Above no signal value).
2	Connect sweep generator in parallel with marker gen.	Sweep-4.5 MC (450 KC sweep) Marker-4.5 MC	Replace v.t.v.m. with scope connected through 10K resistor to junction of R21 and C22.	T6 (Secondary)	Position 4.5 MC. marker at center of S-curve, by adjusting secondary. (See Fig. 2, - curve C)
3	"	"	"	T6 (Primary)	Peak primary for maximum amplitude and linearity. Repeat step 2. (See Fig. 2 - curve C)
4	Marker generator through .001 mfd. to pin 7 of V4 (12AT7)	Marker-4.5 MC	A.C. v.t.v.m. or D.C. v.t.v.m. used with a peak detector probe to junction of R52, C47.	L9	Adjust for min. reading of v.t.v.m. Keep contrast control set for maximum contrast.

TABLE II - AUDIO I-F AND DISC ALIGNMENT

f. **TV R-F Alignment** -

1) Set fine tuning control to mechanical center. Retain this setting for entire r-f alignment.
2) Use 300 ohm carbon resistor as dummy antenna.
3) Couple marker generator in parallel with sweep generator.

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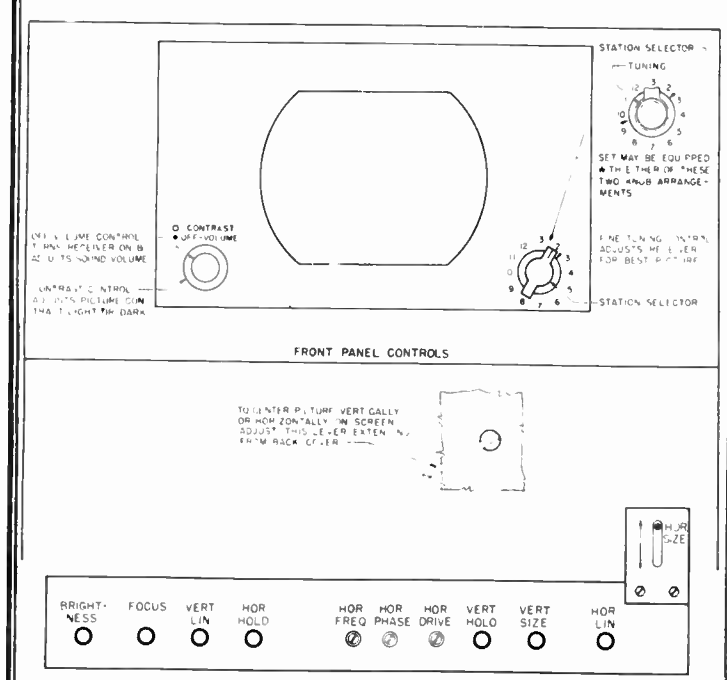
4) Use 10 MC. sweep for sweep generator. Couple generator to antenna terminals of receiver.

5) Connect vertical input of scope in series with 10K resistor to junction of R39 and L8 (pin 7 grid of V4).

STEP	SIGNAL GENERATOR INPUT		CHANNEL	ADJUST	PROCEDURE
	SWEEP GEN.	MARKER GEN.			
1	207.0 MC.	209.75 MC.	12	A12	Adjust for placement of 21.25 MC. marker as per response curve B.
2	"	"	12	A14, A15, A16	Adjust shape of response curve B for maximum amplitude and band-width.
3	213.0 MC.	215.75 MC.	13	A13	Adjust as in Step 1.
4	201.0 MC.	203.75 MC.	11	A11	"
5	195.0 MC.	197.75 MC.	10	A10	"
6	189.0 MC.	191.75 MC.	9	A9	"
7	183.0 MC.	185.75 MC.	8	A8	"
8	177.0 MC.	179.75 MC.	7	A7	"
9	85.0 MC.	87.75 MC.	6	A6	"
10	79.0 MC.	81.75 MC.	5	A5	"
11	69.0 MC.	71.75 MC.	4	A4	"
12	63.0 MC.	65.75 MC.	3	A3	"
13	57.0 MC.	59.75 MC.	2	A2	"

TABLE III - R.F. ALIGNMENT

2. OPERATING CONTROLS



OPERATING CONTROLS (FOR MODELS 614D AND 637A)
FIGURE 3

3. TUBE LOCATIONS

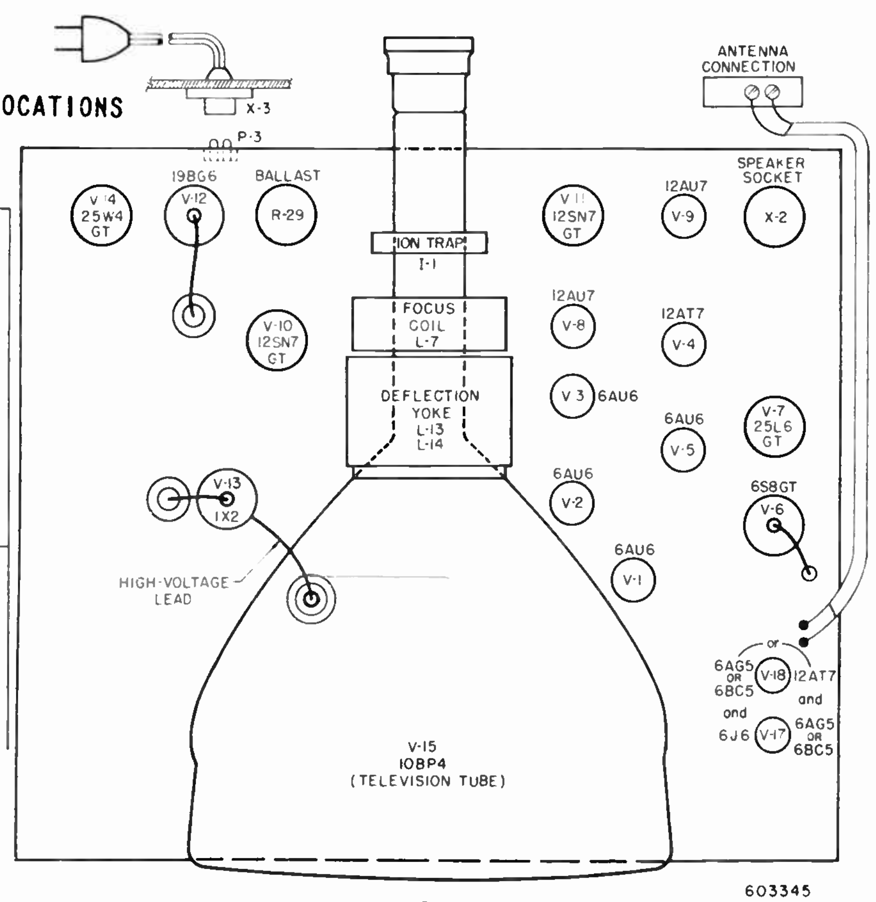


FIGURE 4 TUBE LOCATION DIAGRAM (FOR CHASSIS 120095-B)

4. CHASSIS PARTS LIST (CHASSIS 120095-B)

SCHEMATIC LOCATION	PT. NO.	DESCRIPTION	
C-1	928006	1500 MMF	400V
C-2	928006	1500 MMF	400V
C-3	928006	1500 MMF	400V
C-4	928006	1500 MMF	400V
C-5	928006	1500 MMF	400V
C-6	928006	1500 MMF	400V
C-7	928006	1500 MMF	400V
C-8	928006	1500 MMF	400V
C-9	928006	1500 MMF	400V
C-10	928006	1500 MMF	400V
C-11	928006	1500 MMF	400V
C-12	928006	1500 MMF	400V
C-13	928006	1500 MMF	400V
C-14	910017	470 MMF	±10%
C-15	928006	1500 MMF	400V
C-16	928006	1500 MMF	400V
C-17	910033	47 MMF	±20%
C-18	928006	1500 MMF	400V
C-19	928006	1500 MMF	400V
C-20	928006	1500 MMF	400V
C-21	910043	110 MMF	±10%
C-22	923079	.001 MF	600V
C-23	923061	.01 MF	400V
C-24	923088	.002 MF	600V
C-25	928006	1500 MMF	400V
C-26	923061	.01 MF	400V
C-27	925181	40 MF	300V
C-28	923061	.01 MF	400V
C-29	923062	.05 MF	400V
C-30	925166-1	200 MF	150V
C-31	923201	2 MF	50V
C-32	925166-3	120 MF	300V
C-33	PT.OF C-27	120 MF	300V
C-34	925070-1	30 MF	150V
C-35	925070-1	30 MF	150V
C-36	923091	.2 MF	200V
C-37	PT.OF C-27	50 MF	300V
C-38	928023	5 MMF	±10%
C-39	928006	1500 MMF	400V
C-40	925070-2	4 MF	200V
C-41	910047	200 MMF	500V
C-42	923062	.05 MF	400V
C-43	910047	200 MMF	500V
C-44	922032	.01 MF	600V
C-45	PT.OF L-9	47 MMF	
C-46	923062	.05 MF	400V
C-47	923062	.05 MF	400V
C-48	923064	.1 MF	400V
C-49	923088	.002 MF	600V
C-50	923079	.001 MF	600V
C-51	923088	.002 MF	600V
C-52	923092	.006 MF	400V
C-53	923079	.001 MF	600V
C-54	922021	.001 MF	600V
C-55	922014	.1 MF	200V
C-56	922024	.033 MF	600V
C-57	922008	.1 MF	400V
C-58	PT.OF C-32	15 MF	400V
C-59	923088	.002 MF	600V
C-60	910090	50 MMF	500V

SCHEMATIC LOCATION	PT. NO.	DESCRIPTION		
C-61	923102	.5 MF	200V	
C-62	928006	1500 MMF	400V	
C-63	928006	1500 MMF	400V	
C-64	928006	1500 MMF	400V	
C-65	928006	1500 MMF	400V	
C-66	910028	220 MMF	±10%	
C-67	910043-2	180 MMF	±10%	
C-68	923088	.002 MF	600V	
C-69	923114	.02 MF	400V	
C-70	923091	.2 MF	200V	
C-71	923062	.05 MF	400V	
C-72	910047	200 MMF	500V	
C-73	PT.OF C-32	10 MF	400V	
C-74	922041	.01 MF	600V	
C-75	910212	390 MMF	±10%	
C-76	910044	1200 MMF	±10%	
C-77	900073	45-400 MMF	Trimmer	
C-78	922024	.033 MF	600V	
C-79	910045	5 MMF	1000V	
C-80	923015	.0005 MF	10KV	
C-81	923062	.05 MF	400V	
C-82	922023	.047 MF	600V	
C-83	915000-1	47 MMF	±10%	
C-84	928006	1500 MMF	400V	
C-85	928006	1500 MMF	400V	
C-86	928006	1500 MMF	400V	
C-87	923088	.002 MF	600V	
F-1	808170	FUSE		
I-1	708086	ION TRAP - DOUBLE		
L-1	705016	R.F. CHOKE - 3.3 uh		
L-2	705016	R.F. CHOKE - 3.3 uh		
L-3	705016	R.F. CHOKE - 3.3 uh		
L-4	705014	R.F. CHOKE - 20 uh		
L-5	705016	R.F. CHOKE - 3.3 uh		
L-6	708032-1	SOUND I.F. COIL		
L-7	708045-1	FOCUS COIL - EM - 2250 ohm		
L-8	708090	PEAKING COIL - 80 uh		
L-9	708032	WAVE TRAP - 4.5 MC		
L-10	708090	PEAKING COIL - 80 uh		
L-11	708114	PEAKING COIL - 440 uh		
L-12	708095	PEAKING COIL - 180 uh		
L-13	708036	DEFLECTION YOKE - VERT. COILS		
L-14		DEFLECTION YOKE - HOR. COILS		
L-15	738037	HORIZ. PHASE COIL		
L-16	708052 OR	LINEARITY COIL		
L-16	708056	LINEARITY COIL		
L-17	708055	SIZE COIL		
L-18	PT.OF SP-1	FIELD COIL		
P-2	585056	PLUG & CABLE - SPEAKER		
P-3	505014	PLUG - INTERLOCK SWITCH		
R-1	340672	5,600 OHM	½W	±10%
R-2	340232	82 OHM	½W	±10%
R-3	350412	470 OHM	½W	±20%
R-4	350412	470 OHM	½W	±20%
R-5	350412	470 OHM	½W	±20%

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CHASSIS PARTS LIST (Continued)

SCHEMATIC LOCATION	PT. NO.	DESCRIPTION
R-6	340732	10,000 OHM ½W ±10%
R-7	340312	180 OHM ½W ±10%
R-8	350412	470 OHM ½W ±20%
R-9	350412	470 OHM ½W ±20%
R-10	340732	10,000 OHM ½W ±10%
R-11	PT.OF T-3	10,000 OHM ½W ±10%
R-12	340312	180 OHM ½W ±10%
R-13	350412	470 OHM ½W ±20%
R-14	340652	4,700 OHM ½W ±10%
R-15	340972	100,000 OHM ½W ±10%
R-16	340712	8,200 OHM ½W ±10%
R-17	340812	22,000 OHM ½W ±10%
R-18	350572	2,200 OHM ½W ±20%
R-19	340972	100,000 OHM ½W ±10%
R-20	340972	100,000 OHM ½W ±10%
R-21	340932	68,000 OHM ½W ±10%
R-22	390074-6	1 MEGOHM VOL.CONT.-FRONT
R-23	351372	4.7 MEGOHM ½W ±20%
R-24	351132	470,000 OHM ½W ±20%
R-25	351132	470,000 OHM ½W ±20%
R-26	340212	68 OHM ½W ±10%
R-27	340932	68,000 OHM ½W ±10%
R-28	351212	1 MEGOHM ½W ±20%
R-29	397036	2.5 OHM W.W. BALLAST TUBE
R-30	341052	220,000 OHM ½W ±10%
R-31	394060-4	55 OHM 7.5W ±10%
R-32	394060-3	75 OHM 10W ±10%
R-33	340572	2,200 OHM ½W ±10%
R-34	340732	10,000 OHM ½W ±10%
R-35	394060-2	1,500 OHM 5W ±5%
R-36	340092	22 OHM ½W ±10%
R-37	370652	4,700 OHM 1W ±10%
R-38	351212	1 MEGOHM ½W ±20%
R-39	340652	4,700 OHM ½W ±10%
R-40	370832	27,000 OHM 1W ±10%
R-41	340572	2,200 OHM ½W ±10%
R-42	340732	10,000 OHM ½W ±10%
R-43	351092	330,000 OHM ½W ±20%
R-44	341332	3.3 MEGOHM ½W ±10%
R-45	341052	220,000 OHM ½W ±10%
R-46	340812	22,000 OHM ½W ±10%
R-47	PT.OF R-22	5,000 OHM CONTRAST CONT.FRNT
R-48	351212	1 MEGOHM ½W ±20%
R-49	351212	1 MEGOHM ½W ±20%
R-50	340572	2,200 OHM ½W ±10%
R-51	370672	5,600 OHM 1W ±10%
R-52	340772	15,000 OHM ½W ±10%
R-53	340772	15,000 OHM ½W ±10%
R-54	390134-1	100,000 OHM BRTNS.CONT.-REAR
R-55	340812	22,000 OHM ½W ±10%
R-56	390132	100,000 OHM FOCUS CONT.-REAR
R-57	340812	22,000 OHM ½W ±10%
R-58	340812	22,000 OHM ½W ±10%
R-59	340872	39,000 OHM ½W ±10%
R-60	340972	100,000 OHM ½W ±10%
R-61	340932	68,000 OHM ½W ±10%
R-62	390134-1	100,000 OHM VERT.HOLD CONT.-REAR
R-63	390138	3 MEGOHM VERT.SIZE CONT.-REAR
R-64	341332	3.3 MEGOHM ½W ±10%
R-65	340972	100,000 OHM ½W ±10%

SCHEMATIC LOCATION	PT. NO	DESCRIPTION
R-66	340972	100,000 OHM ½W ±10%
R-67	340772	15,000 OHM ½W ±10%
R-68	351372	4.7 MEGOHM ½W ±20%
R-69	340712	8,200 OHM ½W ±10%
R-70	340532	1,500 OHM ½W ±10%
R-71	341012	150,000 OHM ½W ±10%
R-72	340812	22,000 OHM ½W ±10%
R-73	341032	180,000 OHM ½W ±10%
R-74	340712	8,200 OHM ½W ±10%
R-75	331192	820,000 OHM ½W ±5%
R-76	331012	150,000 OHM ½W ±5%
R-77	331012	150,000 OHM ½W ±5%
R-78	341012	150,000 OHM ½W ±10%
R-79	390134-1	100,000 OHM HOR.HOLD CONT.-REAR
R-80	340952	82,000 OHM ½W ±10%
R-81	331312	2.7 MEGOHM ½W ±5%
R-82	330972	100,000 OHM ½W ±5%
R-83	340712	8,200 OHM ½W ±10%
R-84	340812	22,000 OHM ½W ±10%
R-85	331012	150,000 OHM ½W ±5%
R-86	330942	75,000 OHM ½W ±5%
R-87	340652	4,700 OHM ½W ±10%
R-88	351212	1 MEGOHM ½W ±20%
R-89	350252	100 OHM ½W ±20%
R-90	341052	220,000 OHM ½W ±10%
R-91	381132	470,000 OHM 1W ±20%
R-92	390132	100,000 OHM VERT.LIN.CONT.-REAR
R-93	381132	470,000 OHM 1W ±20%
R-94	350892	47,000 OHM ½W ±20%
TUNER	470635	TUNER ASS'Y - STANDARD
TUNER	470640-1	TUNER ASS'Y - EMERSON
SP-1	180070	SPEAKER - 6" - EM
SW-1	PT.OF R-22	ON - OFF SWITCH
T-1	720104-1	1ST VIDEO I.F. TRANSFORMER
T-2	720098	2ND VIDEO I.F. TRANSFORMER
T-3	720106	3RD VIDEO I.F. TRANSFORMER
T-4	720098	4TH VIDEO I.F. TRANSFORMER
T-5		
T-6	708018	DISCRIMINATOR COIL
T-7	734058-1	SOUND OUTPUT TRANSFORMER
T-8	738029	VERT. OUTPUT TRANSFORMER
T-9	716052	HORIZ. OSC. COIL
T-10	738039	HORIZ. OUTPUT TRANSFORMER
V-1	800533	VACUUM TUBE - 6AU6
V-2	800533	VACUUM TUBE - 6AU6
V-3	800533	VACUUM TUBE - 6AU6
V-4	800047	VACUUM TUBE - 12AT7
V-5	800533	VACUUM TUBE - 6AU6
V-6	800015	VACUUM TUBE - 6S8GT
V-7	800490	VACUUM TUBE - 25L6GT
V-8	800026	VACUUM TUBE - 12AU7
V-9	800026	VACUUM TUBE - 12AU7
V-10	800039	VACUUM TUBE - 12SN7GT
V-11	800039	VACUUM TUBE - 12SN7GT
V-12	800044	VACUUM TUBE - 19BG6-G

SCHEMATIC LOCATION	PT. NO.	DESCRIPTION
V-13	800046	VACUUM TUBE - 1X2
V-14	800045	VACUUM TUBE - 25W4GT
V-15	810000	TELEVISION TUBE - 10BP4
V-16		
V-17	800536	VACUUM TUBE - 6J6 } T.V. TUNER STAND.
V-18	800535 OR	VACUUM TUBE - 6AG5 } T.V. TUNER STAND.
V-18	800052	VACUUM TUBE - 6BC5 } T.V. TUNER STAND.

SCHEMATIC LOCATION	PT. NO.	DESCRIPTION
V-17	800535 OR	VACUUM TUBE - 6AG5 } EMERSON TUNER
V-17	800052	VACUUM TUBE - 6BC5 } EMERSON TUNER
V-18	800047	VACUUM TUBE - 12AT7 } EMERSON TUNER
V-19	817000-1	SELENIUM RECTIFIER - 15 MA
V-20	817015	SELENIUM RECTIFIER - 250 MA
V-21	817015	SELENIUM RECTIFIER - 250 MA
X-1	585055	SOCKET - CABLE ASS'Y - KINESCOPE
X-2	500022	SOCKET - SPEAKER
X-3	583206	SOCKET - INTERLOCK SWITCH

5. CABINET PARTS LIST

DESCRIPTION	PART NUMBER MODEL 614D	PART NUMBER MODEL 637A
Cabinet	140335 Bakelite	140276-1 Mahogany
Speaker 6"	180070	180070
Mask	410805	--
Tube Protector Bracket	410970	--
Knob - Off Volume	450041S	450041S
Knob - Fine Tuning	450044	450044
Knob - Contrast	450045	450045
Knob - Selector	450051S	450051S
Selector Escutcheon Standard Tuner	520103	--
Twin Conductor Lead - Ant.	580689	580689
Line Cord	583206	583206
Safety Glass	635023	635020
Bakelite Front	--	450066
Back - Masonite	560133	560134
Plug and Cable - Speaker	585056	585056
Extruded Vinylite - Mask	591014	--

TABLE IV - CABINET PARTS LIST

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MODELS 614D, 637A,
Ch. 120095-B

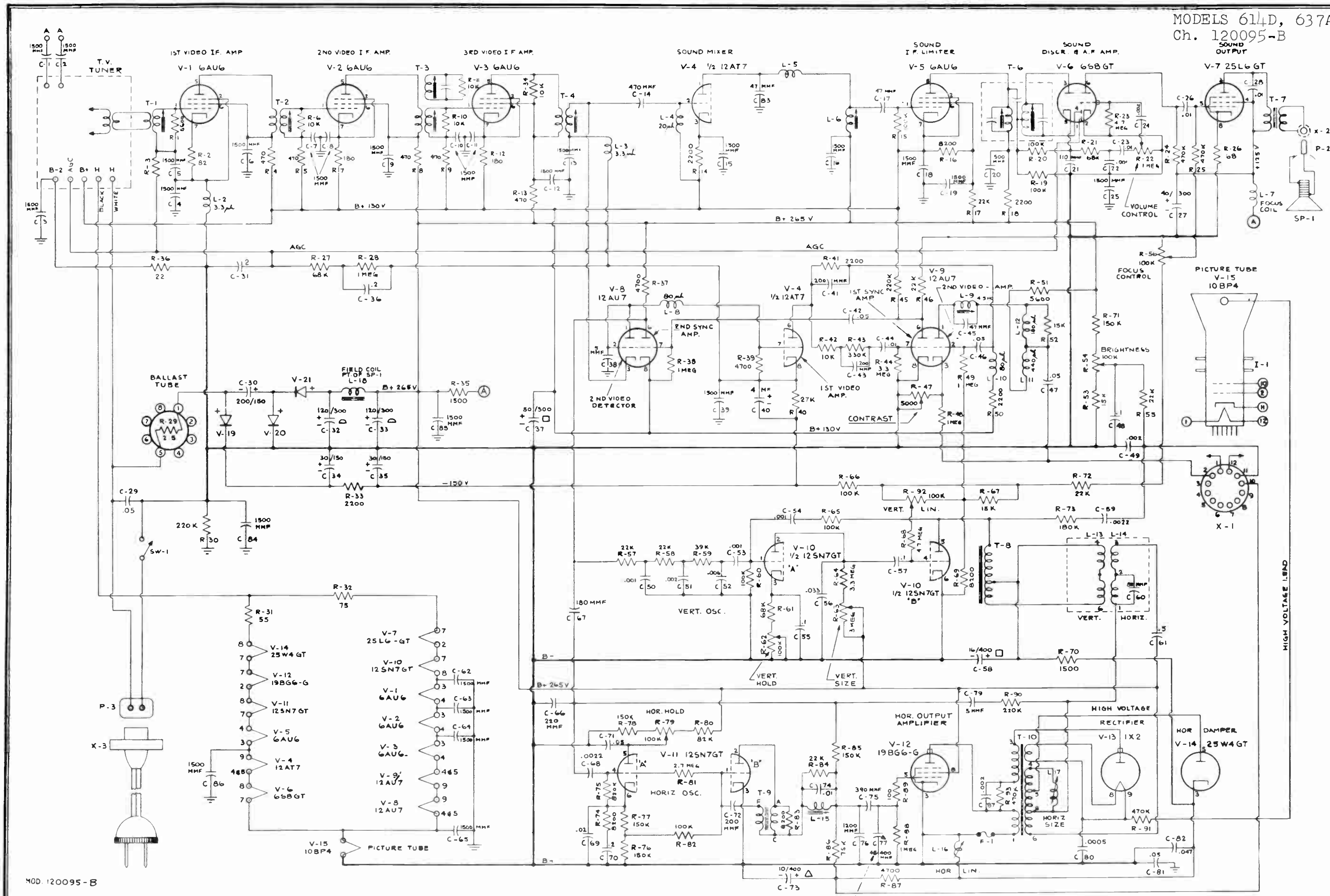

FIGURE 5 - SCHEMATIC DIAGRAM (CHASSIS 120095-B)

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I. ALIGNMENT

a. Equipment Required - A sweep generator, accurate marker generator, oscilloscope, and v.t.v.m. are required for alignment. The marker generator must be very accurate and supply frequencies of 4.5 MC., and 20 to 28 MC.

b. Response Curves - The i-f response curves for the video i-f stages are shown in figure 2.

c. Alignment Points - The location of all i-f transformers, tuned circuits, and trimmers is shown in figure 3.

NOTE: The Tail Piece as shown in Fig. I, will have to be removed so that the deflection yoke and focus coil will remain connected while the set is aligned. In order to do this, the high voltage lead must be removed from the picture tube cup. Plugs P-5 and P-2 must also be removed from chassis.

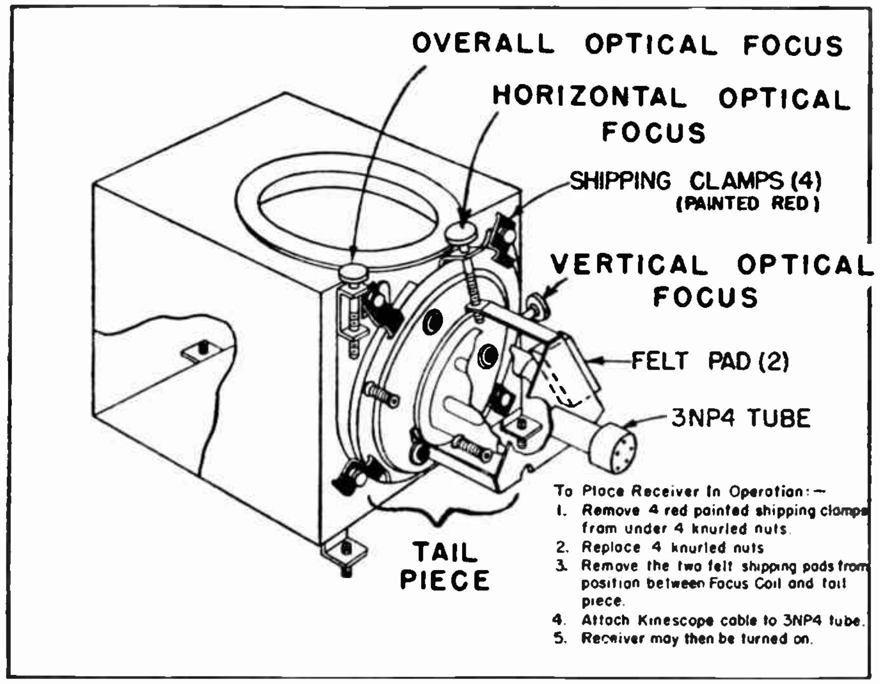

FIGURE 1

NOTE: In order to protect the picture tube, the optical box is shipped with (4) shipping clamps and (2) felt pads. See Figure I. These must be removed before the set is put in operation. While the Picture Tube is shipped in place, it is disconnected and must be plugged into its socket before set will operate.

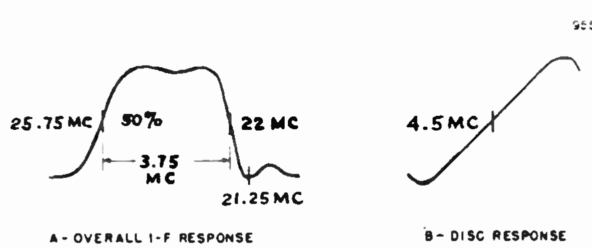

FIGURE 2 . IF AND DISC RESPONSE CURVE

d. TV I-F Alignment

1) Tune receiver to Channel 3.

2) Connect 3 volt bias battery from junction of R17 and C17 (negative terminal) to ground (positive terminal).

3) Shape overall response curve, after individual peaking of stagger-tuned and over-coupled i-fs, as indicated in steps 1-8 below. See curve A.

STEP	SIGNAL GENERATOR INPUT CONNECTION	SIGNAL GENERATOR INPUT FREQUENCY	MEASURING INSTRUMENT	ADJUST	PROCEDURE
1	Connect marker generator to pin 1 (grid) of V1 (6AU6), through .001 mfd. condenser. Low side to chassis.	25.75 MC	Connect d.c.probe of v.t.v.m. to (junction of L6 and R40). Low side to chassis.	L5	Peak for maximum response. Adjust generator signal level to produce approx. 1 volt at junction of L6 and R40.
2	"	25 MC	"	L3	"
3	"	22.3 MC	"	T3 (Bottom)	"
4	"	23 MC	"	T2 (Top)	"
5	"	21.25 MC	" (Use three or five volt meter scale)	T3 (Top)	Adjust for minimum response. Two peaks may be noted. The correct position is with the core at the outside end of the coil.
6	NOTE: TRAP SHORTED; NO ADJUSTMENT NECESSARY			T2 (Bottom)	
7	Connect marker generator to pin 1 (grid) of V1 (6AU6), through .001 mfd. condenser. Low side to chassis.		Connect d.c.probe of v.t.v.m. to (junction of L6 and R40). Low side to chassis.	L5, L4 T3, T2	Repeat steps 1 through 6. Readjust T3 (Bottom) after adjusting 21.25 MC trap.
8	Connect sweep generator to three turn loop of wire slipped over converter tube V22. Connect marker gen. in parallel.	Sweep Gen. 23.0 MC (10 MC Sweep) Marker Gen. 21.75 MC and 25.75 MC	Connect vertical input of scope in series with 10K resistor to (junction of L6 and R40).	T1 Both Slugs	Adjust to position markers as shown on the overall response curve, figure 2-A. It is essential that the video carrier marker (25.75 MC) be at the 50% point (6db down). Adjust T5 and T4 if necessary to correctly position this marker.

TABLE I - VIDEO IF ALIGNMENT

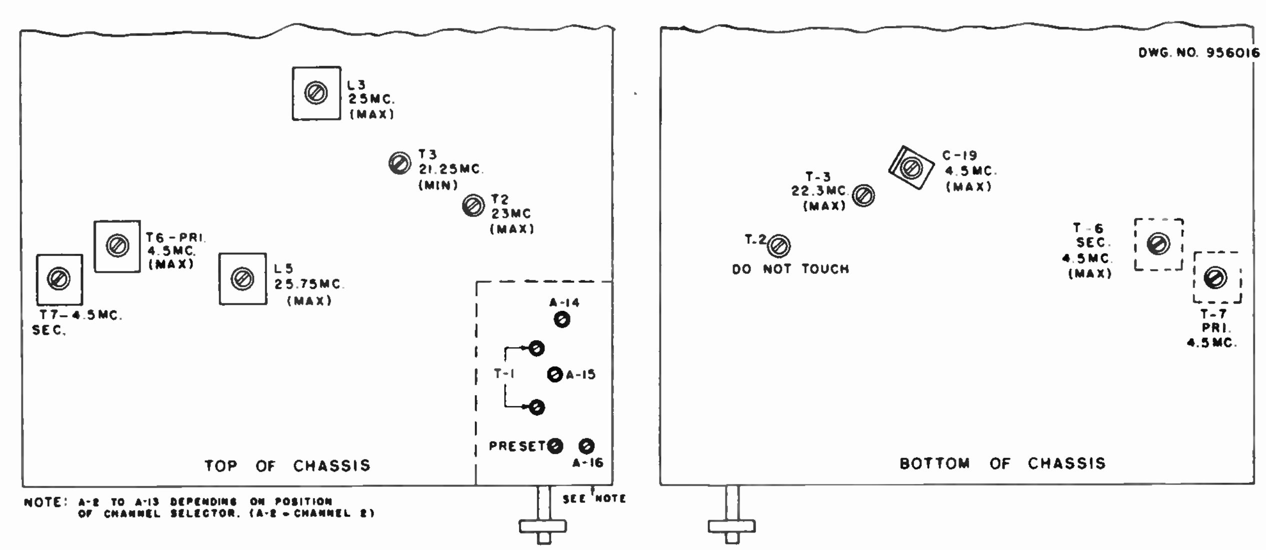

FIGURE 3 . LOCATION OF ALIGNMENT POINTS

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e. TV Sound Alignment -

1) Set receiver to Channel 3.

2) Use accurate, crystal-controlled, marker generator.

STEP	SIGNAL GENERATOR INPUT CONNECTION	SIGNAL GENERATOR INPUT FREQUENCY	MEASURING INSTRUMENT	ADJUST	PROCEDURE
1	Connect marker generator to pin 2 (plate) of V5 (6AL5), through 100K resistor.	4.5 MC	Connect d.c. probe of v.t.v.m. (junction of C22 and R22, T4). Low side to chassis.	C19	Peak for maximum response.
2	"	"	"	T4 (Top and Bottom)	"
3	"	"	Connect d.c. probe of v.t.v.m. to point D (pin 3 of V19): Low side to chassis.	T5 (Top)	Adjust secondary for minimum response.
4	Connect sweep generator in parallel with marker generator.	Sweep Gen. 4.5 MC (450 KC sweep) Marker Gen. 4.5 MC (Unmod.)	Connect vertical input of scope in series with 10K resistor to pin 3 of V19, in place of v.t.v.m.	T5 (Bottom)	Adjust primary for maximum linearity and symmetry. Adjust secondary to center marker, as shown in figure 2. curve B.

TABLE II IF AND DISC ALIGNMENT

f. TV R-F Alignment -

1) Set fine tuning control to mechanical center. Retain this setting for entire r-f alignment.
2) Use 300 ohm carbon resistor as dummy antenna.
3) Couple marker generator in parallel with sweep generator.
4) Use of 10 MC. sweep for sweep generator. Couple generator to antenna terminals of receiver.
5) Connect vertical input of scope in series with 10K resistor to junction of L6 and R40.

STEP	SIGNAL GENERATOR INPUT SWEEP GEN.	SIGNAL GENERATOR INPUT MARKER GEN.	CHANNEL	ADJUST	PROCEDURE
1	207.0 MC.	209.75 MC.	12	A12	Adjust for placement of 21.25 MC. marker as per response curve A.
2	"	"	12	A14, A15, A16	Adjust shape of response curve A for maximum amplitude and band-width.
3	213.0 MC.	215.75 MC.	13	A13	Adjust as in Step 1.
4	201.0 MC.	203.75 MC.	11	A11	"
5	195.0 MC.	197.75 MC.	10	A10	"
6	189.0 MC.	191.75 MC.	9	A9	"
7	183.0 MC.	185.75 MC.	8	A8	"
8	177.0 MC.	179.75 MC.	7	A7	"
9	85.0 MC.	87.75 MC.	6	A6	"
10	79.0 MC.	81.75 MC.	5	A5	"
11	69.0 MC.	71.75 MC.	4	A4	"
12	63.0 MC.	65.75 MC.	3	A3	"
13	57.0 MC.	59.75 MC.	2	A2	"

TABLE III - R.F. TUNER ALIGNMENT

2. OPERATING CONTROLS

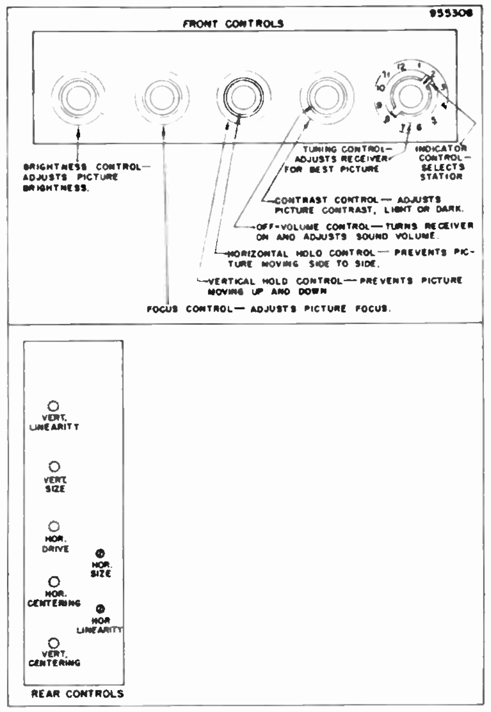

FIGURE 4 - OPERATING CONTROLS

CHASSIS PARTS LIST

SCHEMATIC LOCATION	PT. NO.	DESCRIPTION	
C-1	928006	1500 MMF	400V
C-2	928006	1500 MMF	400V
C-3	928006	1500 MMF	400V
C-4	910015	270 MMF	±10%
C-5	PT.OF T-2		
C-6	928006	1500 MMF	400V
C-7	928006	1500 MMF	400V
C-8	910015	270 MMF	±10%
C-9	PT.OF T-3		
C-10	928006	1500 MMF	400V
C-11	928006	1500 MMF	400V
C-12	910015	270 MMF	±10%
C-13	928006	1500 MMF	400V
C-14	928006	1500 MMF	400V
C-15	910015	270 MMF	±10%
C-16	910100	100 MMF	±10%
C-17	923080	.25 MF	200V
C-18	910130	10 MMF	±10%
C-19	900044	3-35 MMF	
C-20	928006	1500 MMF	400V
C-21	928006	1500 MMF	400V
C-22	910031	68 MMF	±20%
C-23	928006	1500 MMF	400V
C-24	928006	1500 MMF	400V
C-25	910010	110 MMF	±20%
C-26	923071	.001 MF	400V
C-27	923061	.01 MF	400V
C-28	923061	.01 MF	400V
C-29	923062	.05 MF	400V
C-30	923067	.1 MF	200V
C-31	925114	8 MF	350V
C-32	923078	.005 MF	400V
C-33	923066	.25 MF	400V
C-34	923066	.25 MF	400V
C-35	923061	.01 MF	400V
C-36	923062	.05 MF	400V
C-37	910015	270 MMF	±10%
C-38	923073	.05 MF	600V
C-39	923064	.1 MF	400V
C-40	923062	.05 MF	400V
C-41	923062	.05 MF	400V
C-42	910027	.001 MF	500V
C-43	923066	.25 MF	400V
C-44	923062	.05 MF	400V
C-45	910027	.001 MF	500V
C-46	910010	110 MMF	±20%
C-47	923077	.005 MF	600V
C-48	910023	780 MMF	±10%
C-49	910017	470 MMF	±10%
C-50	923079	.001 MF	600V

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CHASSIS PARTS LIST (continued)

SCHEMATIC LOCATION	PT. NO.	DESCRIPTION
C-51	923067	.1 MF 200V
C-52	923073	.05 MF 600V
C-53	923074	.035 MF 600V
C-54	923073	.05 MF 600V
C-55	925099	80 MF 150V
C-56	925128	80 MF 150V
C-57	925129	80 MF 300V
C-58	925132	80 MF 300V
C-59	925133	80 MF 300V
C-60	PT.OF C-57	80 MF 300V
C-61	925127	40 MF 450V
C-62	925127	40 MF 450V
C-63	925127	40 MF 450V
C-64	925131	80 MF 300V
C-65	PT.OF C-63	40 MF 450V
C-66	PT.OF C-64	80 MF 300V
C-67	925134	60 MF 300V
C-68	925114	8 MF 350V
C-69	923075	.01 MF 600V
C-70	923062	.05 MF 400V
C-71	923078	.005 MF 400V
C-72	923078	.005 MF 400V
C-73	923094	.004 MF 600V
C-74	923073	.05 MF 600V
C-75	923073	.05 MF 600V
C-76	925072	10 MF 50V
C-77	925114	8 MF 350V
C-78	923075	.01 MF 600V
C-79	923061	.01 MF 400V
C-80	923079	.001 MF 600V
C-81	925097	1000 MF 15V
C-82	925097	1000 MF 15V
C-83	922015	.01 MF 400V
C-84	928006	1500 MMF 400V
C-85	928006	1500 MMF 400V
C-86	928006	1500 MMF 400V
C-87	928006	1500 MMF 400V
C-88	923071	.001 MF 400V
F-1	808170	FUSE - 1/4A - 250V - 3AG
L-1	705014	R.F. CHOKE
L-2	705014	R.F. CHOKE
L-3	720078 OR	4TH VIDEO I.F. COIL
L-3	720079	4TH VIDEO I.F. COIL
L-4	708097	PEAKING COIL - 45 uh
L-5	720078 OR	5TH VIDEO I.F. COIL
L-5	720079	5TH VIDEO I.F. COIL
L-6	708096	PEAKING COIL - 75 uh
L-7	708097	PEAKING COIL - 45 uh
L-8	708095	PEAKING COIL - 180 uh
L-9	FURNISHED	DEFLECTION YOKE - VERT. COILS
L-10	AS PART OF	DEFLECTION YOKE - HOR. COILS
L-11	470421	FOCUS COIL
L-12	708099	PEAKING COIL - 330 uh
L-13	708092	PEAKING COIL - 150 uh
L-14	708094	PEAKING COIL - 125 uh
L-15	705009	R.F. CHOKE - 3 mh
L-16	708082	SIZE COIL
L-17	708003	LINEARITY COIL
L-18	737011	FILTER CHOKE
L-19	708099	PEAKING COIL - 330 uh

SCHEMATIC LOCATION	PT. NO.	DESCRIPTION			
P-2	505040	CONNECTUR PLUG - SPEAKER			
P-3	505007	PLUG - INTERLOCK SWITCH			
P-4	505021	PLUG - PT.OF PROJ.UNIT(470421)			
P-5	505019	PLUG - PT.OF HI-VOLT.UNIT(470419)			
R-1	330672	5,600	OHM	½W	±5%
R-2	340212	68	OHM	½W	±10%
R-3	340492	1,000	OHM	½W	±10%
R-4	340492	1,000	OHM	½W	±10%
R-5	340492	1,000	OHM	½W	±10%
R-6	330632	3,900	OHM	½W	±5%
R-7	340252	100	OHM	½W	±10%
R-8	340492	1,000	OHM	½W	±10%
R-9	340492	1,000	OHM	½W	±10%
R-10	330692	6,800	OHM	½W	±5%
R-11	340312	180	OHM	½W	±10%
R-12	340492	1,000	OHM	½W	±10%
R-13	360632	3,900	OHM	1W	±5%
R-14	340312	180	OHM	½W	±10%
R-15	330732	10,000	OHM	½W	±5%
R-16	340492	1,000	OHM	½W	±10%
R-17	341152	560,000	OHM	½W	±10%
R-18	340852	33,000	OHM	½W	±10%
R-19	340212	68	OHM	½W	±10%
R-20	340492	1,000	OHM	½W	±10%
R-21	340492	1,000	OHM	½W	±10%
R-22	340972	100,000	OHM	½W	±10%
R-23	340652	4,700	OHM	½W	±10%
R-24	370732	10,000	OHM	1W	±10%
R-25	340492	1,000	OHM	½W	±10%
R-26	340972	100,000	OHM	½W	±10%
R-27	340972	100,000	OHM	½W	±10%
R-28	340932	68,000	OHM	½W	±10%
R-29	351492	15	MEGOHM	½W	±20%
R-30	390074-1	1	MEGOHM VOL.CONT.-FRONT		
R-31	340972	100,000	OHM	½W	±10%
R-32	341132	470,000	OHM	½W	±10%
R-33	340732	10,000	OHM	½W	±10%
R-34	341132	470,000	OHM	½W	±10%
R-35	340892	47,000	OHM	½W	±10%
R-36	340812	22,000	OHM	½W	±10%
R-37	340892	47,000	OHM	½W	±10%
R-38	341072	270,000	OHM	½W	±10%
R-39	341292	2.2	MEGOHM	½W	±10%
R-40	330652	4,700	OHM	½W	±5%
R-41	341072	270,000	OHM	½W	±10%
R-42	341212	1	MEGOHM	½W	±10%
R-43	341292	2.2	MEGOHM	½W	±10%
R-44	340772	15,000	OHM	½W	±10%
R-45	340572	2,200	OHM	½W	±10%
R-46	PT.OF R-30	2,500	OHM CONTRAST CONT.-FRONT		
R-47	330592	2,700	OHM	½W	±5%
R-48	341132	470,000	OHM	½W	±10%
R-49	341132	470,000	OHM	½W	±10%
R-50	394097	3,300	OHM	4W	±5%
R-51	341212	1	MEGOHM	½W	±10%
R-52	341052	220,000	OHM	½W	±10%
R-53	390074-2	100,000	OHM BRIGHTNESS CONT.-FRONT		
R-54	341052	220,000	OHM	½W	±10%
R-55	341072	270,000	OHM	½W	±10%
R-56	340772	15,000	OHM	½W	±10%
R-57	340652	4,700	OHM	½W	±10%
R-58	330572	2,200	OHM	½W	±5%
R-59	360972	100,000	OHM	1W	±5%
R-60	341212	1	MEGOHM	½W	±10%
R-61	340292	150	OHM	½W	±10%
R-62	330492	1,000	OHM	½W	±5%

SCHEMATIC LOCATION	PT. NO.	DESCRIPTION			
R-63	330652	4,700	OHM	½W	±5%
R-64	340892	47,000	OHM	½W	±10%
R-65	330492	1,000	OHM	½W	±5%
R-66	341052	220,000	OHM	½W	±10%
R-67	341052	220,000	OHM	½W	±10%
R-68	330972	100,000	OHM	½W	±5%
R-69	330972	100,000	OHM	½W	±5%
R-70	371132	470,000	OHM	1W	±10%
R-71	340892	47,000	OHM	½W	±10%
R-72	390074-3	50,000	OHM HOR.HOLD CONT.-FRONT		
R-73	341132	470,000	OHM	½W	±10%
R-74	371132	470,000	OHM	1W	±10%
R-75	340732	10,000	OHM	½W	±10%
R-76	390035	20,000	OHM HOR.DRIVE CONT.-REAR		
R-77	341132	470,000	OHM	½W	±10%
R-78	397027	100	OHM	2W	±10%
R-79	397070	18,000	OHM	2W	±10%
R-80	394007	7,500	OHM	25W	±5%
R-81	394103	15	OHM		±10%
R-82	394103	15	OHM		±10%
R-83	394060-7	150	OHM	10W	±20%
R-84	394092	200	OHM	5W	±10%
R-85	394052	105	OHM	5W	±10%
R-86	394092	200	OHM	5W	±10%
R-87	PT.OF R-85	600	OHM	6W	±10%
R-88	390074-4	750	OHM FOCUS CONTROL-FRONT		
R-89	394044	2,500	OHM	10W	±10%
R-90	340812	22,000	OHM	½W	±10%
R-91	340972	100,000	OHM	½W	±10%
R-92	340812	22,000	OHM	½W	±10%
R-93	340652	4,700		½W	±10%
R-94	331252	1.5	MEGOHM	½W	±5%
R-95	PT.OF R-72	1	MEGOHM VERT.HOLD CONT.-FRONT		
R-96	390038	2	MEGOHM VERT.SIZE CONT.-REAR		
R-97	341132	470,000	OHM	½W	±10%
R-98	340692	6,800	OHM	½W	±10%
R-99	341372	4.7	MEGOHM	½W	±10%
R-100	390039	5,000	OHM VERT.LIN.CONT.-REAR		
R-101	340352	270	OHM	½W	±10%
R-102	397043	10,000	OHM	3W	±10%
R-103	340892	47,000	OHM	½W	±10%
R-104	341332	3.3	MEGOHM	½W	±10%
R-105	341332	3.3	MEGOHM	½W	±10%
R-106	341212	1	MEGOHM	½W	±10%
R-107	341212	1	MEGOHM	½W	±10%
R-108	340932	68,000	OHM	½W	±10%
R-109	340972	100,000	OHM	½W	±10%
R-110	341332	3.3	MEGOHM	½W	±10%
R-111	341212	1	MEGOHM	½W	±10%
R-112	340812	22,000	OHM	½W	±10%
R-113	390033	30	OHM VERT.CENT.CONT.-REAR		
R-114	390054	30	OHM HOR.CENT.CONT.-REAR		
R-115	340772	15,000	OHM	½W	±10%
R-116	394060-9	150	OHM	3W	±10%
R-117	341072	270,000	OHM	½W	±10%
R-118	340812	22,000	OHM	½W	±10%
R-119	341012	150,000	OHM	½W	±10%
R-120	340772	15,000	OHM	½W	±10%
R-121	340492	1,000	OHM	½W	±10%
R-122	340612	3,300	OHM	½W	±10%

SCHEMATIC LOCATION	PT. NO.	DESCRIPTION
SP-1	180050	SPEAKER - PM - 12"
SW-1	PT.OF R-30	ON-OFF SWITCH
TUNER	470469-1	TV TUNER ASS'Y - STANDARD
T-2	720042	2ND VIDEO I.F. TRANSFORMER
T-3	720042	3RD VIDEO I.F. TRANSFORMER
T-4	720081	SOUND I.F. TRANSFORMER-4.5 MC
T-5	708017 OR	DISCRIMINATOR COIL - 4.5 MC
T-5	708018	DISCRIMINATOR COIL - 4.5 MC
T-6	734018	SOUND OUTPUT TRANSFORMER
T-9	738042	HORIZ. OSC. TRANSFORMER
T-10	738012 OR	HORIZ. OUTPUT TRANSFORMER
T-10	738013	HORIZ. OUTPUT TRANSFORMER
T-11	738004	VERT. OSC. TRANSFORMER
T-12	738010-1	VERT. OUTPUT TRANSFORMER
T-13	730014-1	POWER TRANSFORMER
V-1	800533	VACUUM TUBE - 6AU6
V-2	800533	VACUUM TUBE - 6AU6
V-3	800533	VACUUM TUBE - 6AU6
V-4	800533	VACUUM TUBE - 6AU6
V-5	800541	VACUUM TUBE - 6AL5
V-6	800533	VACUUM TUBE - 6AU6
V-7	800038	VACUUM TUBE - 6AR5
V-8	800430	VACUUM TUBE - 6SQ7GT
V-9	800026	VACUUM TUBE - 12AU7
V-10	800380	VACUUM TUBE - 6SN7GT
V-11	800541	VACUUM TUBE - 6AL5
V-12	800380	VACUUM TUBE - 6SN7GT
V-13	800004	VACUUM TUBE - 6BG6-G
V-14	800011	VACUUM TUBE - 5V4G
V-15	800380	VACUUM TUBE - 6SN7GT
V-16	800016	VACUUM TUBE - 6K6-GT
V-17	800533	VACUUM TUBE - 6AU6
V-18	800533	VACUUM TUBE - 6AU6
V-19	800035	VACUUM TUBE - 6T8
V-20	800270	VACUUM TUBE - 6V6-GT
V-21		
V-22	800536	VACUUM TUBE - 6J6
V-23	800535	VACUUM TUBE - 6AG5
V-24	800160	VACUUM TUBE - 5Y3GT
V-26	800033	VACUUM TUBE - 6SR7
V-27	800004	VACUUM TUBE - 6BG6-G
V-28	810004	TELEVISION TUBE - 3NP4
V-29	817005	SELENIUM RECTIFIER - 200 MA
V-30	817004	SELENIUM RECTIFIER - 250 MA
V-31	817005	SELENIUM RECTIFIER - 200 MA
V-32	817004	SELENIUM RECTIFIER - 250 MA
X-1	585039	SOCKET & CABLE ASS'Y
X-2	508100	SOCKET - SPEAKER
X-3	500005	SOCKET - INTERLOCK SWITCH
X-4	500431	SOCKET - MOLDED OCTAL
X-5	500011	SOCKET - HIGH VOLTAGE UNIT

MODEL 649A, Ch. 120094A

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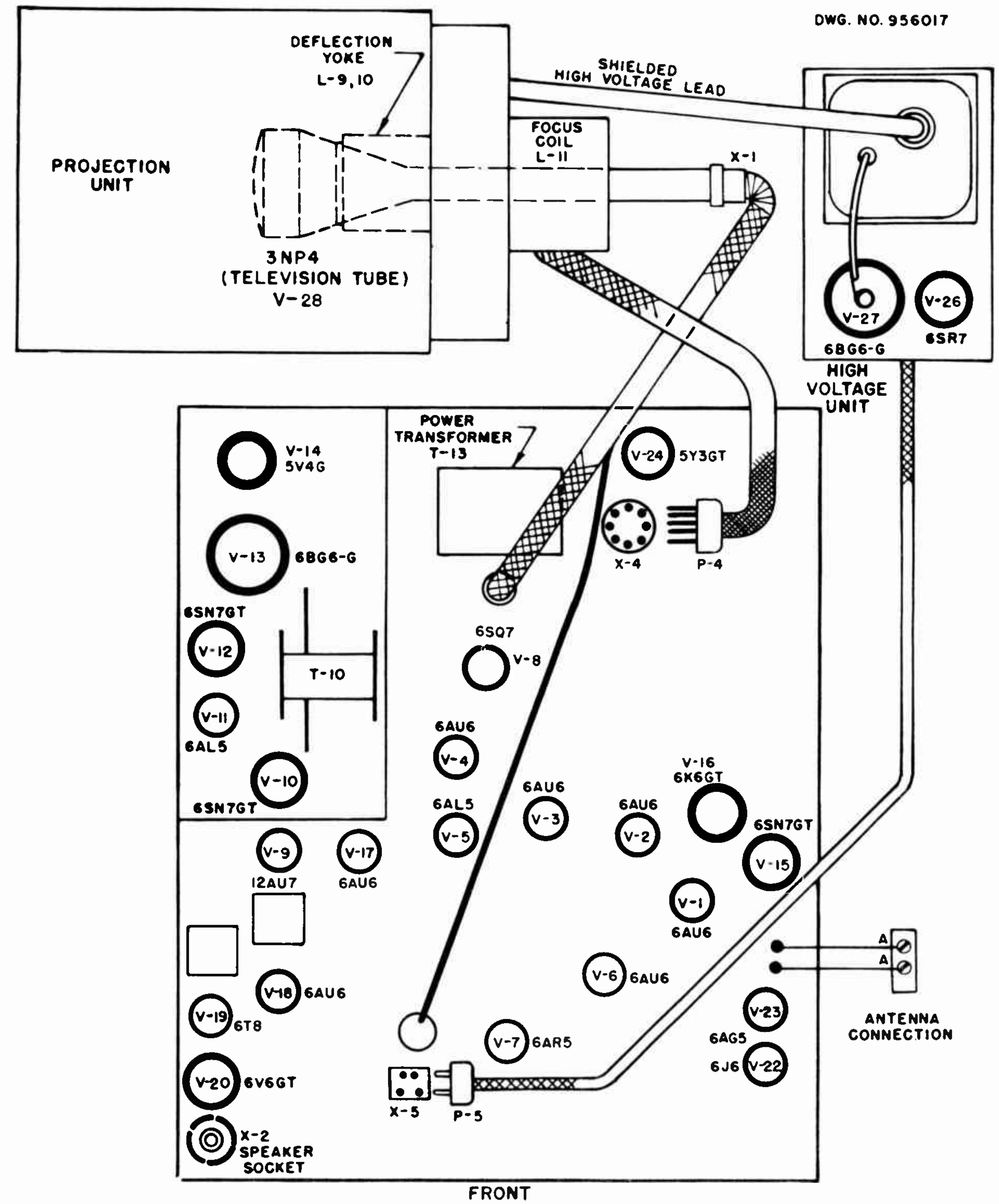
CABINET PARTS LIST

DESCRIPTION	PART NO.
Cabinet	140350
Tail Piece Assembly	470439
Optical Box	470481
Tube - 3NP4	810004
Cable and Socket	585039
High Voltage Unit	470419
Mounting Plate for Projection Box Assembly	410559
Plug - 4 Prong	505019
Plug Shell	410504
Plug - Octal	505021
Masonite Back	560128
Mirror	635027
Gasket - Mirror	445013
Mounting Strip - Mirror	413559
Screen	450086
Cardboard Mask - Screen	575609
Mounting Strip - Screen	413559
Selector Escutcheon	520103
Knob - Brightness - Focus	450046S
Knob - Vert. Hold - Contrast	450045
Knob - Horiz. Hold - Off Vol.	450041S
Knob - Selector	450051-1S
Knob - Fine Tuning	450044
Speaker 12"	180050
Connector Plug - Speaker	505040
Shell Holder Assembly	470339
Socket - Interlock	500005
Line Cord and Plug	583014
Cable Clamp - Plastic	460117

TABLE IV - CABINET PARTS LIST

TUBE LOCATIONS



PART NO 603326

FIGURE 5 - TUBE LOCATION DIAGRAM

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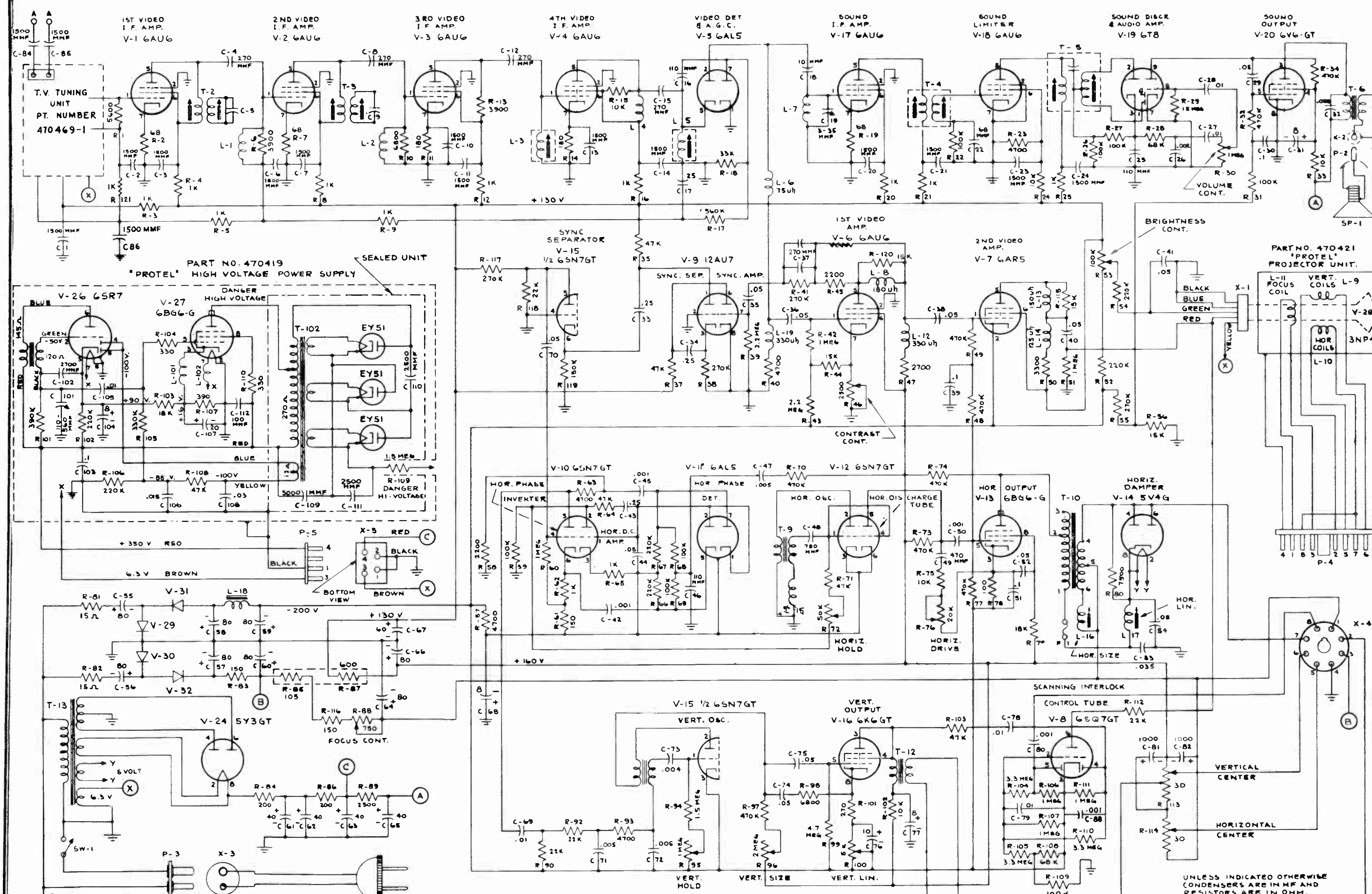

MOD. 120094-A PART NO. 950147

FIGURE 6 - SCHEMATIC DIAGRAM (CHASSIS 120094)

MODEL 649A, Ch. 120094A

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VOLTAGE AND RESISTANCE READINGS FOR CHASSIS 120094-A - MODEL 649A

The voltage and resistance measurements listed below are for chassis 120094-A with no triangle code number.

Due to component variations, voltage and resistance readings may vary slightly from those given in tables here. Slight variations may also be noticed if chassis is not coded as stated above.

CONDITIONS FOR TAKING VOLTAGE AND RESISTANCE READINGS:

1. Antenna disconnected and antenna terminals shorted.
2. Line voltage 117 volts.
3. All controls in position for normal picture.
4. All measurements taken with a vacuum tube voltmeter and ohmeter.
5. All readings listed in tables were taken between points shown and chassis.
6. Resistance readings are given in ohms unless otherwise noted.
7. N.C. denotes no connection.

RESISTANCE READINGS FOR CHASSIS 120094-A

SYMBOL	TUBE PIN NO.								
	PIN 1	PIN 2	PIN 3	PIN 4	PIN 5	PIN 6	PIN 7	PIN 8	PIN 9
V-1	500K	0	0	0	20K	20K	80		
V-2	600K	0	0	0	20K	20K	100		
V-3	2.5	0	0	0	20K	15K	200		
V-4	0	0	0	0	18K	18K	200		
V-5	0	4.5K	0	0	0	0	30K		
V-6	1M	0	0	0	15K	15K	1.0		
V-7	2M	40K	0	0	20K	0	N.C.		
V-8	0	500K	25K	25K	1M	1M	0	0	
V-9	60K	0	250K	0	0	50K	2M	0	0
V-10	INF.	950K	40K	1M	6K	40K	0	0	
V-11	INF.	INF.	0	0	180K	40K	200K		
V-12	150K	8.0	35K	150K	500K	50K	0	0	
V-13	N.C.	0	50K	1M	600K	40K	0	30K	
V-14	20K	20K	N.C.	15K	N.C.	15K	20K	20K	
V-15	2M	1.5M	50K	0	20K	150K	0	0	
V-16	N.C.	0	20K	20K	4M	40K	0	50K	
V-17	4.0	0	0	0	11K	11K	70		
V-18	80K	0	0	0	13K	5K	0		
V-19	90K	90K	200K	0	0	N.C.	0	15M	500K
V-20	0	0	100K	150K	500K	100K	0	0	
V-24	20K	20K	N.C.	10K	N.C.	10K	20K	20K	

N.C. Denotes "No Connection" *INF. Denotes "Infinity"*

VOLTAGE READINGS FOR CHASSIS 120094-A

SYMBOL	TUBE PIN NO.								
	PIN 1	PIN 2	PIN 3	PIN 4	PIN 5	PIN 6	PIN 7	PIN 8	PIN 9
V-1	-0.6	0	FIL.	FIL.	88	88	0.5		
V-2	-0.7	0	FIL.	FIL.	88	88	0.5		
V-3	0	0	FIL.	FIL.	74	88	1.0		
V-4	0	0	FIL.	FIL.	125	125	1.0		
V-5	0	-0.4	FIL.	FIL.	0	0	-0.6		
V-6	-1.5	0	FIL.	FIL.	130	150	0		
V-7	-230	-240	FIL.	FIL.	-50	0	N.C.		
V-8	0	-240	-240	-280	-320	-0.3	FIL.	FIL.	
V-9	90	0	0	FIL.	FIL.	30	-0.5	0	FIL.
V-10	-190	-160	-185	-150	-30	-180	FIL.	FIL.	
V-11	-190	-190	FIL.	FIL.	-190	-190	-190		
V-12	-185	-0.2	-185	-230	-130	-185	FIL.	FIL.	
V-13	N.C.	FIL.	-230	-230	-245	-240	FIL.	-7	
V-14	230	230	N.C.	150	N.C.	150	230	230	
V-15	-270	-60	240	0	7.5	3.0	FIL.	FIL.	
V-16	N.C.	FIL.	8.0	8.0	-215	-210	FIL.	-210	
V-17	0	0	FIL.	FIL.	90	90	0.5		
V-18	-0.2	0	FIL.	FIL.	90	30	0		
V-19	-0.2	-0.2	FIL.	FIL.	0	N.C.	0	-0.7	62
V-20	0	FIL.	250	230	-12	-13	FIL.	0	
V-24	N.C.	370	N.C.	340 A.C.	N.C.	340 A.C.	N.C.	370	

N.C. Denotes "No Connection" *FIL. Denotes "Filament"*

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VOLTAGE READINGS FOR CHASSIS 120118-B

SYMBOL	TUBE PIN NUMBER										
	PIN 1	PIN 2	PIN 3	PIN 4	PIN 5	PIN 6	PIN 7	PIN 8	PIN 9	PIN 10	PIN 11	PIN 12
V-1	-2.5	1.2	0	6.3 A.C.	100	115	1.2					
V-2	-0.7	0.4	0	6.3 A.C.	110	110	0.4					
V-3	0	0	0	6.3 A.C.	115	115	1.0					
V-4	-175	0	-175	-175	1.0	-175	-175					
V-5	-175	-175	-175	-175	0	0	-175					
V-6	-170	-170	-175	-175	0	-145	-170					
V-7	-0.7	-0.7	0	6.3 A.C.	0	N.C.	0	-0.7	49			
V-8	N.C.	*22 A.C.	-70	-65	-170	N.C.	*22 A.C.	-170				
V-9	-175	-175	-175	-175	-90	-40	-175					
V-10	-140	-175	-175	*5.6 A.C.	*5.6 A.C.	60	-170	-175	*5.6 A.C.			
V-11	-170	-175	-170	*5.6 A.C.	*5.6 A.C.	-180	-175	-175	*5.6 A.C.			
V-12	-175	-175	-180	-190	-4.5	-180	*12 A.C.	*12 A.C.				
V-13**	-14	160	1	-70	210	0	*12 A.C.	*12 A.C.				
V-14	N.C.	*18 A.C.	-180	N.C.	-200	-200	*18 A.C.	85				
V-15	N.C.	N.C.	260	N.C.	115	N.C.	*24 A.C.	*24 A.C.				
V-16	DO NOT MEASURE											
V-17	-120	-180	-165	*12 A.C.	*12 A.C.	215	-160	-150	N.C.			
V-18	0	-160								245	-150	6.3 A.C.
V-19	N.C.	140				310 A.C.	N.C.	140		N.C.	310 A.C.	N.C.

* Measured between filament pins on tube socket.

** All measurements of V-13 socket pins taken from points to B minus.

RESISTANCE READINGS FOR CHASSIS 120118-B

SYMBOL	TUBE PIN NUMBERS										
	PIN 1	PIN 2	PIN 3	PIN 4	PIN 5	PIN 6	PIN 7	PIN 8	PIN 9	PIN 10	PIN 11	PIN 12
V-1	1M	220	0	0	75K	70K	220					
V-2	1M	40	0	0	60K	60K	40					
V-3	3	0	0	0	60K	60K	150					
V-4	20K	60K	20K	20K	150	25K	30K					
V-5	20K	20K	20K	20K	2	0	25K					
V-6	120K	20K	20K	20K	2	20K	20K					
V-7	120K	120K	220K	0	0	N.C.	0	12M	500K			
V-8	N.C.	INF.	70K	70K	600K	N.C.	INF.	25K				
V-9	1.8M	20K	20K	20K	30K	10K	25K					
V-10	50K	200K	20K	INF.	INF.	60K	1M	20K	INF.			
V-11	40K	22K	1.2M	INF.	INF.	60K	3M	22K	INF.			
V-12	3M	15K	22K	1.5M	12K	22K	INF.	INF.				
V-13	1.2M	70K	350K	300K	15M	22K	INF.	INF.				
V-14	N.C.	INF.	20K	N.C.	1.2M	1.2M	INF.	50K				
V-15	N.C.	N.C.	20M	N.C.	50K	N.C.	INF.	INF.				
V-16	N.C.	INF.	N.C.	N.C.	N.C.	N.C.	INF.	N.C.				
V-17	3M	150K	120K	INF.	INF.	18M	1.2M	25K				
V-18	0	1.2M								17M	130K	0
V-19	N.C.	50K				20K	N.C.	50K		N.C.	20K	N.C.

N.C. Denotes no connection.

INF. Denotes infinity.

The voltage and resistance measurements listed below are for chassis 120118-B stamped with triangle code 8.

Due to component variations, voltage and resistance readings may vary slightly from those given in tables here. Slight variations may also be noticed if chassis is not coded as shown above.

CONDITIONS FOR TAKING VOLTAGE AND RESISTANCE READINGS:

1. Antenna disconnected and antenna terminals shorted.
2. Line voltage 117 volts.
3. All controls in position for normal picture.
4. All measurements taken with a vacuum tube voltmeter and ohmeter.
5. All readings listed in tables were taken between points shown and chassis.
6. Resistance readings are given in ohms unless otherwise noted.
7. N.C. denotes no connection.

I. GENERAL DESCRIPTION (See figure I)

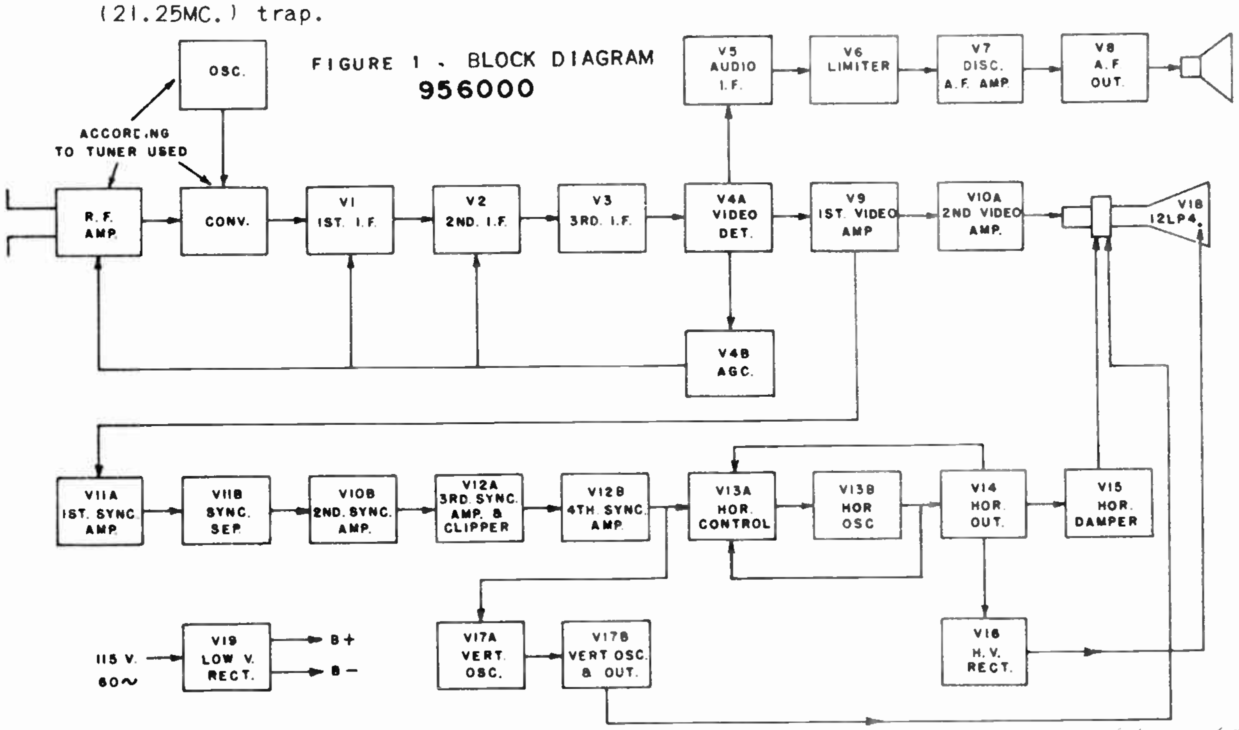
Model 650 uses chassis 120113C * and 120118B. Model 654 uses chassis 120118B only. Both models use a 12½ inch direct view kinescope tube type 12LP4 and both are housed in wooden cabinets. Model 650 is a table model television receiver while model 654 is a consolette receiver. These models feature Built-In Antenna, Inter-Carrier Sound, Automatic Gain Control and Miracle Picture Lock.

* For all information pertaining to chassis 120113C refer to Service Manual on models 614, 637, 644 and 647.

a. Tuner - Tuners 470606 and 470607 are used in the above mentioned models. Information pertaining to tuner 470607 will be found on pages 9 and 10 It uses a type 6J6 as the oscillator and converter (V21) and a type 6AG5 as the r-f amplifier (V22). This tuner contains the first i-f transformer (T-A), which is an overcoupled unit. Tuner 470606 will be used in later sets, therefore, information on this tuner will be released at a future date.

b. Video I-F Amplifiers - Both video (25.75MC.) and audio (21.25MC.) i-f carriers are amplified by the video i-f stages. Two stagger-tuned i-f transformers (T1 and T2) and an over-coupled i-f (T3) complete the i-f amplifier. (T3) feeds the video detector and AGC (V4). (T1) is provided with a (21.25MC.) trap.

FIGURE 1 . BLOCK DIAGRAM 956000



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c. **Video Detector and Amplifiers** - The output of the video-detector (V4A), one-half of a type 6AL5, is coupled to the first video amplifier (V9). The output of the second video amplifier (V10A), feeds the grid of the kinescope (V18).

NOTE: The 120118B chassis is also used in some sets on models 644C and 647B. See service note covering models 614, 637, 644 and 647 for photographs and cabinet parts list.

d. **Intercarrier Sound** - The (4.5MC.) heterodyne between video and audio i-f carriers is taken from the shunt-tuned circuit (L3,C16) at the output of the video detector. The (4.5MC.) signal feeds the sound i-f amplifier (V5), whose output is connected to the limiter (V6). The discriminator (V7) feeds the output stage (V8).

e. **AGC** - The other half of the 6AL5 (V4B) supplies a delayed AGC voltage to the r-f amplifier (V22) and first and second video i-f amplifiers (V1 and V2).

f. **Sync and Deflection** - The output of the first video amplifier (V9-6AU6) feeds the first sync amplifier (V11A-12AU7). The output of this tube is then fed to the sync separator (V11B-12AU7) where it is then amplified by a chain of sync amplifiers (V10B-12AU7, V12A-12SN7GT, and V12B-12SN7GT). The output of the fourth sync amplifier is then fed by means of an intergrating network to the vertical oscillator (V17A-12SN7GT) and also by means of a capacity voltage dividing network to the horizontal oscillator control tube (Miracle Picture Lock, V13A-12SN7GT).

The horizontal oscillator (V13B-12SN7GT) is controlled by the horizontal oscillator control tube (Miracle Picture Lock, V13A-12SN7GT). This is done by properly phasing three wave forms at the input grid of (V13A, See figure 2). The phasing coil C and D has a fly-wheel effect and helps greatly in stabilizing the sync. A sawtooth voltage is built up across condenser (C53) which is charged through resistor (R72) and is then coupled to the grid of the 19BG6-G. The drive padder (C55), adjusts the amount of sawtooth input required for most efficient operation of the 19BG6-G. The damper tube (V15-25W4GT) is effectively connected across the horizontal deflection yoke.

NOTE: Care must be taken not to load these circuits too much due to excessive scope input capacity or low resistance, otherwise erroneous adjustments will result.

956002

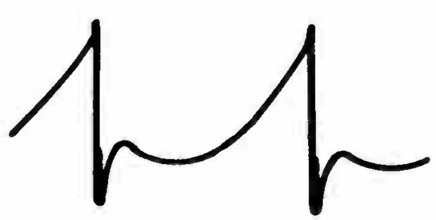

FIGURE 2 . COMPOSITE INPUT WAVEFORM AT CONTROL TUBE GRID OF V13A. (OBTAINED BY USING A LOW CAPACITY PROBE).

The vertical oscillator (V17A, V17B-12SN7GT) is controlled by the vertical sync pulses fed to pin 4 of (V17A-12SN7GT). The output of (V17B) is fed to the vertical deflection yoke by means of a matching transformer, (T9).

g. **High-Voltage Supply** - The high-voltage supply is the conventional flyback type. The high-voltage winding of (T8) is connected to the high-voltage rectifier (V16), a type 1B3GT, and produces about 9½ kilovolts for the kinescope.

h. **Low-Voltage Supply** - The low-voltage supply uses a full-wave rectifier (V19-5U4G) and transformer (T10). A series arrangement is used to supply a positive and negative voltage with respect to chassis. As a result, separate filament windings are used to keep the heater-cathode potentials within ratings, and the electrolytic filter condensers are not grounded to the chassis. (V8, V11, V10, V13, V14, V15, V17 and V12) have their filaments connected in series directly across the line.

i. **Chassis Adjustments** - These receivers are provided with normal vertical and horizontal adjustment controls. Vertical and horizontal centering however, is accomplished by mechanically adjusting the focus coil.

j. **Check of Miracle Picture Lock Alignment** - Turn the horizontal hold control to the extreme clockwise position. The picture should remain in horizontal sync. Momentarily remove the signal by switching off channel then back again. Normally the picture will be out of sync. Turn the control counter-clockwise slowly. The number of diagonal black bars will be gradually reduced and when only 3 or 4 bars sloping downward to the left are obtained, the picture will pull into sync upon slight additional clockwise rotation of the control. Pull-in should occur when the control is approximately 90 degrees from the extreme counter-clockwise position. The picture should remain in sync for approximately 90 degrees of additional counter-clockwise rotation of the control.

If the receiver passes the above checks and the picture is normal and stable, the horizontal oscillator is properly aligned. Skip "Horizontal Oscillator Adjustment".

k. **Miracle Picture Lock Adjustment** - Normally the adjustment of the horizontal oscillator is not considered to be a part of the alignment procedure, but since the oscillator waveform adjustment requires the use of an oscilloscope, it can not be done conveniently in the field. The waveform adjustment is made at the factory and normally should not require readjustment in the field. However, the waveform adjustment should be checked whenever the receiver is aligned or whenever the horizontal oscillator operation is improper.

l. **Horizontal Frequency Alignment** - With a clip lead, short circuit the coil between terminals C and D of the horizontal oscillator transformer (T7). Tune in a television station and sync the picture if possible.

a) Turn the horizontal hold control (R70) to the extreme counter-clockwise position. Adjust the (T7) Frequency Adjustment (under the chassis) so that the picture is just out of sync and the horizontal blanking appears in the picture as a vertical bar. The position of the bar is unimportant. See figure 3.

b) Turn the hold control approximately one quarter of a turn from the extreme clockwise position and examine the width and linearity of the picture. If picture width or linearity is incorrect, adjust the horizontal drive control (C55), the width control (L8) and the linearity control (L9) until the picture is correct. If (C55, L8 or L9) was adjusted, repeat step (a) above.

956001

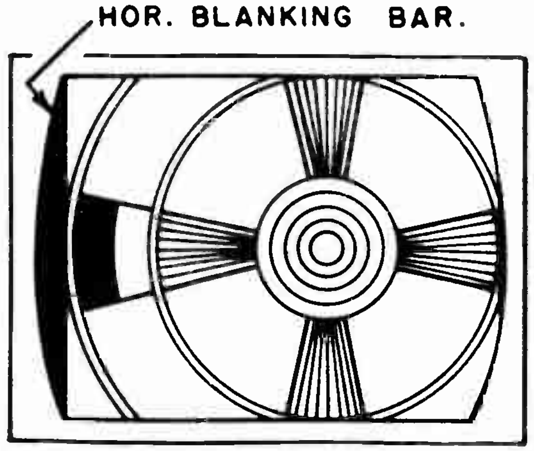

FIGURE 3 MIRACLE PICTURE LOCK ADJUSTMENT

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m. **Horizontal Oscillator Waveform Adjustment** - Remove the shorting clip from terminals C and D of (T7). Turn the horizontal hold control to the extreme counter-clockwise position. With a thin fibre screwdriver, adjust the Horizontal Phasing Slug of (T7 on the rear of the chassis) until the horizontal blanking bar appears in the raster.

a) Connect the vertical input of the scope in series with a 22,000 ohm de-coupling resistor to terminal C of (T7) and with the low side to chassis. Turn the horizontal hold control one quarter turn from the clockwise position so that the picture is in sync. The pattern on the oscilloscope should be as shown in figure 4. Adjust the Horizontal Phasing Slug of (T7) until the two peaks are at the same height. During this adjustment, the picture must be kept in sync by readjusting the hold control if necessary.

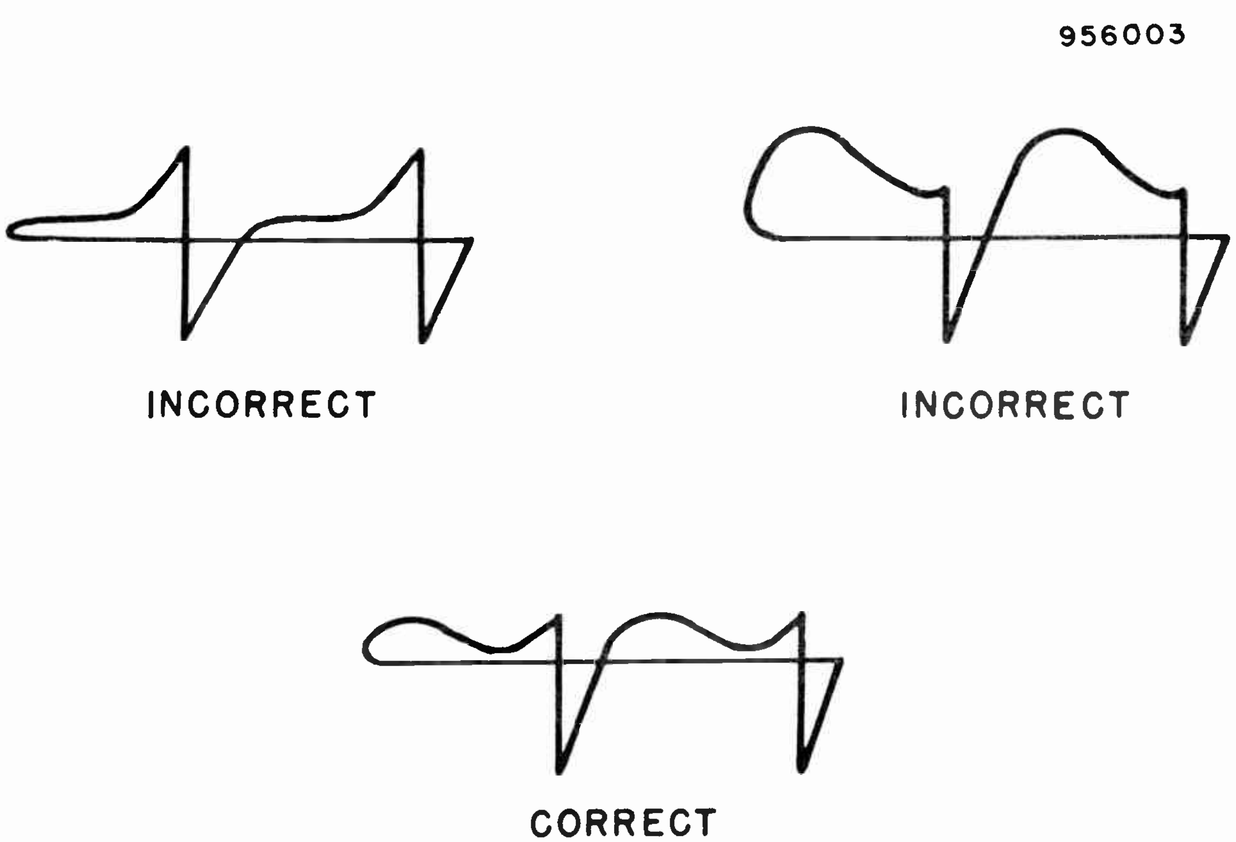

FIGURE 4 - HORIZONTAL OSCILLATOR WAVEFORMS

This adjustment is very important for correct operation of the circuit. If the broad peak of the wave on the oscilloscope is lower than the sharp peak, the noise immunity becomes poorer, the stabilizing effect of the tuned circuit is reduced and drift of the oscillator becomes more serious. On the other hand, if the broad peak is higher than the sharp peak, the oscillator is overstabilized, the pull-in range becomes inadequate and the broad peak can cause double triggering of the oscillator when the hold control approaches the clock-wise position.

Remove the oscilloscope upon completion of this adjustment.

2. TUBE COMPLEMENT (See figure 5)

The tube complement of Chassis 120118B is listed in the following table:

TUBE COMPLEMENT FOR CHASSIS 120118B

SYMBOL	TUBE TYPE	FUNCTION	SYMBOL	TUBE TYPE	FUNCTION
V1	6AG5	First video i-f amplifier	V13	12SN7GT	Miracle picture lock hor. osc.
V2	6AG5	Second video i-f amplifier	V14	19BG6-G	Hor. output amplifier
V3	6AU6	Third video i-f amplifier	V15	25W4GT	Hor. damper
V4	6AL5	Video detector	V16	1B3-GT 8016	H.V. rectifier
V5	6AU6	Sound i-f amplifier	V17	12SN7GT	Vert. oscillator
V6	6AU6	Sound i-f limiter	V18	12LP4	Kinescope
V7	6T8	Sound Discr. & a-f amplifier	V19	5U4G	Low voltage rect.
V8	12L6GT	Sound output			
V9	6AU6	First video amplifier	V21	6J6	•A Converter •B Oscillator
V10	12AU7	•A Second video amplifier •B Second sync amplifier	V22	6AG5	R-f amplifier
V11	12AU7	•A First sync amplifier •B Sync separator			
V12	12SN7GT	•A Third sync ampl. & clipper •B Fourth sync. ampl. & clipper			

•NOTE: Looking at the schematic, left side of tube is referred to as (A) - the right side is referred to as (B).

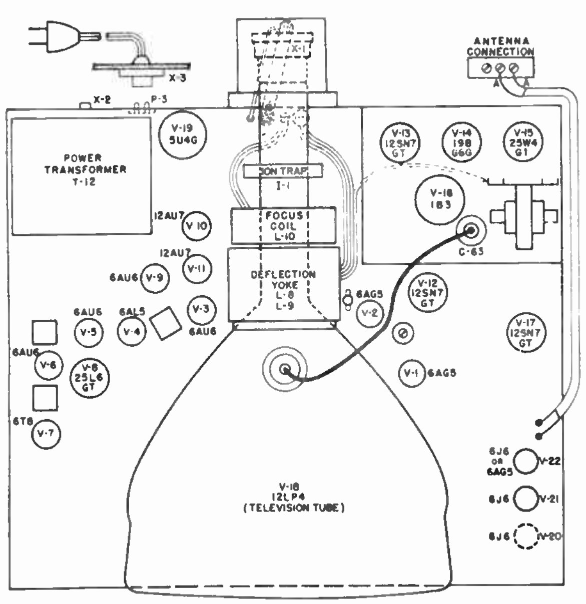

FIGURE 5 - TUBE LOCATION DIAGRAM

3. CHASSIS CONTROLS (See figure 6)

a. **Front** - The front panel of Chassis 120118B is provided with the following four controls: 1. Selector, 2. Fine Tuning, 3. Contrast - R32, 4. Off-Volume - R26 - SW-1

b. **Rear** - The rear controls are as follows:

1. Hor. Size - L8	4. Hor. Phasing - T7	7. Vert. Size - R90
2. Hor. Linearity - L9	5. Hor. Hold - R70	8. Vert. Linearity - R95
3. Hor. Drive - C55	6. Vert. Hold - R89	9. Focus - R30

c. **Centering** - Centering, both vertically and horizontally, is accomplished by positioning of the focus coil which is mounted on a swivel bracket with an adjustment arm protruding from the back cover of the set. See figure 6.

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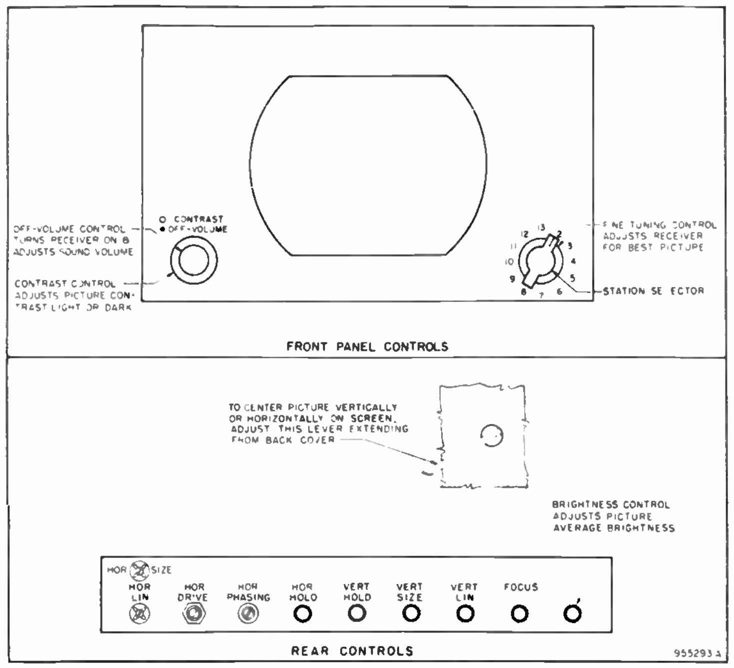


FIGURE 6 - FRONT AND REAR CONTROLS

4. ALIGNMENT

a. **Equipment Required** - A sweep generator, accurate marker generator, oscilloscope, and v.t.v.m. are required for alignment. The marker generator must be very accurate and supply frequencies of (4.5MC.), and (20 to 28MC.).

b. **Response Curves** - The i-f response curves for the video i-f stages are shown in the alignment tables.

c. **Alignment Points** - The location of all i-f transformers, tuned circuits, and trimmers is shown in figure 7.

d. **Sound I-F Alignment** -

(1) Set receiver to Channel 3.
(2) Use accurate marker generator.
(3) Return v.t.v.m. to B minus, not chassis.

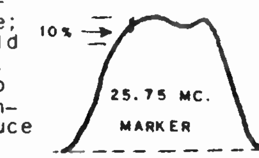
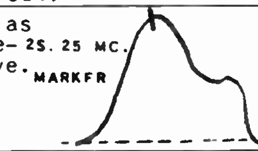
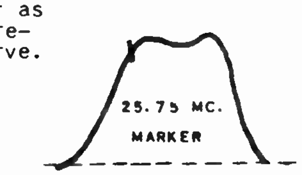
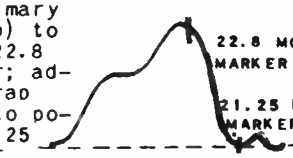
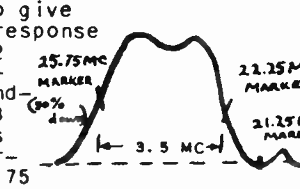
STEP	SIGNAL GENERATOR INPUT CONNECTION	SIGNAL GENERATOR INPUT FREQUENCY	MEASURING INSTRUMENT	ADJUST	PROCEDURE
1	Marker generator through .001 mfd. to pin 2 of V4 low side to B-.	Marker-4.5 MC.	Connect v.t.v.m. to junction of R19 and C17. Low side to B-.	C16	Peak for maximum response. Adjust generator input to produce one volt reading on v.t.v.m.
2	"	Marker-4.5 MC.	"	T4 (Top and bottom)	Peak for max. response.
3	Marker generator through .001 mfd. to pin one of V6 (6AU6).	4.5 MC. max input 1 volt	Vert. input of scope to junction R24, C21, C22. Low side to chassis.	T5 (Top and bottom)	(a) Slightly detune discriminator secondary (T-5 bottom pt. 708017, T-5 top pt. 708018) until scope shows an increase in vert. deflection. (b) Adjust discriminator primary (T-5 top pt. 708017, T-5 bottom pt. 708018) for max. vertical deflection. (c) Adjust discriminator secondary for minimum vert. deflection.

e. **Video I-F Alignment** -

(1) Set receiver to Channel 3.

(2) Connect 3 volt bias battery from junction of R1, R6, and R11 (negative terminal) to chassis (positive terminal) for step 5.

(3) Waveforms may be inverted depending on number of stages in the vertical amplifier of the scope being used.

STEP	SIGNAL GENERATOR INPUT CONNECTION	SIGNAL GENERATOR INPUT FREQUENCY	MEASURING INSTRUMENT	ADJUST	PROCEDURE
1	Lightly couple marker gen. to pin 1 of V3; sweep gen. from pin 1 to chassis, through .001 mfd.	Sweep-23.5 MC. (10 MC. sweep) Marker-25.75 MC.	Connect vertical input of scope through 10K resistor to junction of L1, R16, and C16. Low side to chassis.	T4 (Top and bottom)	Set marker as shown on response curve; marker should be 10% down. Adjust sweep generator input to produce one volt at junction of L1, R16, and C16. 
2	Connect marker and sweep generators to pin 1 of V2, through .001 mfd. Low side to chassis.	Sweep-23.5 MC. (10 MC. sweep) Marker-25.25 MC.	"	T3	Set marker as shown on response curve. 
3	Sweep generator coupled to converter (V27) input, using three turn loop slipped over tube. Marker gen. in parallel. Low side to chassis.	Sweep-23.5 MC. (10 MC. sweep) Marker-25.75 MC.	Connect scope through detector network to pin 1 of V2. Low side to chassis.	T1 (L7 and L9)	Set marker as shown on response curve. 
4	"	Sweep-23.5 MC. (10 MC. sweep) Markers-22.8 and 21.25 MC.	Connect scope through detector network to pin 1 of V3. Low side to chassis.	T2 (Top and bottom)	Adjust primary of T2 (Top) to position 22.8 MC. marker; adjust T2 trap (Bottom) to position 21.25 MC. marker 
5	" Connect AGC bias battery as indicated above.	Sweep-23.5 MC. (10 MC. sweep) Markers-25.75 and 22.25 MC.	Connect scope through 10K resistor to junction of L1, R16, and C16. Low side to chassis.	T2, T3	Adjust T2 (Top) and T3 to give overall response shown. T2 (Top) adjusts bandwidth; T3 positions video carrier (25.75 MC.) depending on accuracy of adjustment of T1 (25.75 MC. marker). 

f. **R-f Alignment** -

(1) Set fine tuning control to 50% rotation (approximately at center) to expose oscillator slugs. Retain this setting for all channels.
(2) Use 300 ohm carbon resistor as dummy antenna.
(3) Couple marker generator in parallel with sweep generator.
(4) Use 10 MC. sweep for sweep generator. Couple generator to antenna terminals of receiver.
(5) Connect vertical input of scope in series with 10K resistor to junction of L1, R15, and C34.
(6) A14, A15, A16 are r-f amplifier and converter trimmers and are adjusted on Channel 12; A13-A2 are oscillator slugs for the corresponding channels.

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STEP	SIGNAL GENERATOR INPUT: SWEEP GEN.	SIGNAL GENERATOR INPUT: MARKER GEN.	CHANNEL	ADJUST	PROCEDURE
1	207.0 MC.	209.75 MC.	12	A12	Adjust for placement of 21.25 MC. marker as per overall response curve.
2	"	"	12	A14, A15, A16	Adjust shape of overall response curve for maximum amplitude and bandwidth.
3	213.0 MC.	215.75 MC.	13	A13	Adjust as in Step 1.
4	201.0 MC.	203.75 MC.	11	A11	"
5	195.0 MC.	197.75 MC.	10	A10	"
6	189.0 MC.	191.75 MC.	9	A9	"
7	183.0 MC.	185.75 MC.	8	A8	"
8	177.0 MC.	179.75 MC.	7	A7	"
9	85.0 MC.	87.75 MC.	6	A6	"
10	79.0 MC.	81.75 MC.	5	A5	"
11	69.0 MC.	71.75 MC.	4	A4	"
12	63.0 MC.	65.75 MC.	3	A3	"
13	57.0 MC.	59.75 MC.	2	A2	"

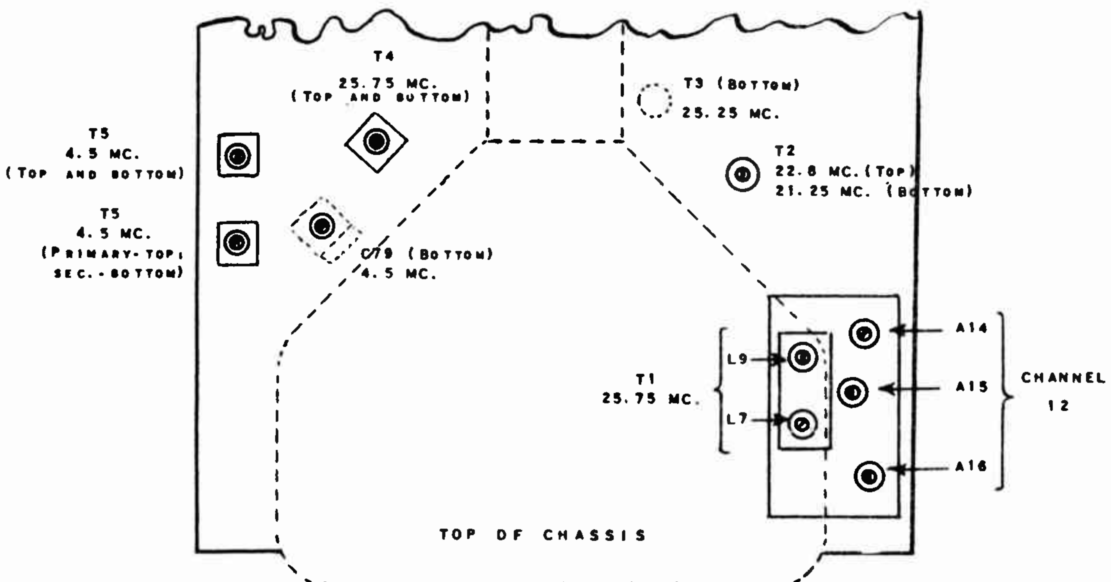

FIGURE 7 - LOCATION OF ALIGNMENT POINTS

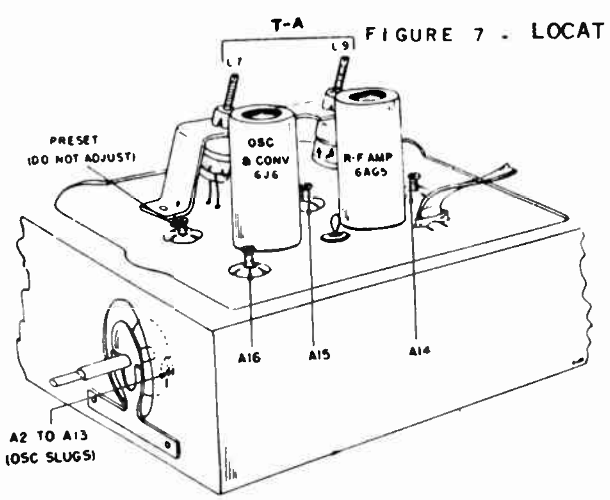

FIGURE 8 TUNER ALIGNMENT POINTS

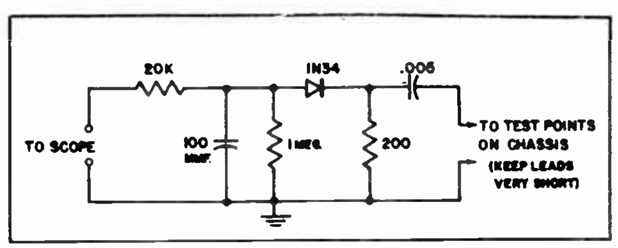

FIGURE 9 - SCOPE DETECTOR

950142-2

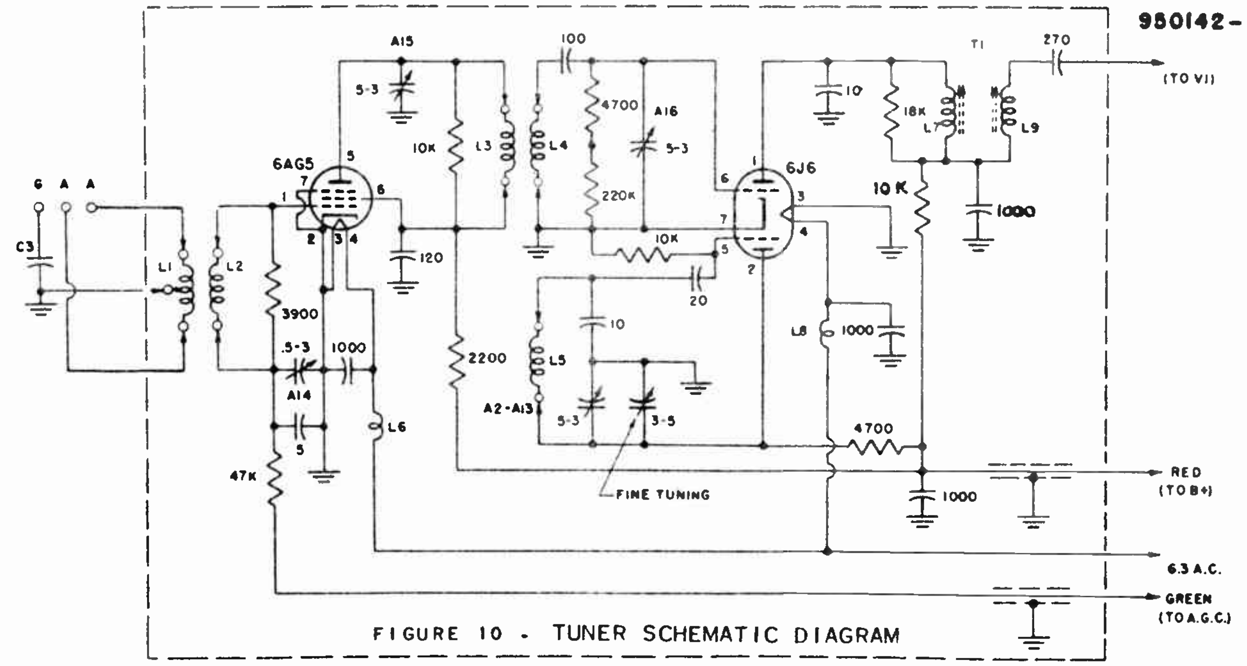

FIGURE 10 - TUNER SCHEMATIC DIAGRAM

ALL CAP IN MMF, RES. IN OHMS

TUNER - 470607

CABINET PARTS LIST - MODELS 650 AND 654

DESCRIPTION	PART NO. MODEL 650	PART NO. MODEL 654	DESCRIPTION	PART NO. MODEL 650	PART NO. MODEL 654
Cabinet	140333	140349	Knob - selector	450073	450073
Cabinet Back (chassis 120113C)	560121A	--	Knob - fine tuning	450074	450074
Cabinet Back (chassis 120118B)	560121B	560122	Connector Plug - speaker	505040	505040
Speaker	180041	180050	Escutcheon - selector	520103	520103
Metal Mask	410911	410911	Glass Panel	520124	520124
Escutcheon-off-vol-contrast	450028	450028	Line Cord	583206	583206
Knob - contrast	450071	450071	Shielded Lead - speaker	580530	.580108
Knob - volume	450072	450072	Twin Conductor Lead	580689	580689

5. PARTS LIST

ITEM	PT. NO.	DESCRIPTION		ITEM	PT. NO.	DESCRIPTION	
C-1	928006	1500 MMF	400V	C-19	928006	1500 MMF	400V
C-2	928006	1500 MMF	400V	C-20	910010	110 MMF	
C-3	928109	.005 MF	400V	C-21	910028	220 MMF	
C-4	928006	1500 MMF	400V	C-22	923079	.001 MF	600V
C-5	910015	270 MMF	500V	C-23	923061	.01 MF	400V
C-6	PT.OF T-1			C-24	923077	.005 MF	600V
C-7	928006	1500 MMF	400V	C-25	923114	.02 MF	400V
C-8	928006	1500 MMF	400V	C-26	925165	.80 MF	250V
C-9	910015	270 MMF	500V	C-27	PT.OF C-31	25 MF	50V
C-10	928006	1500 MMF	400V	C-28	923077	.005 MF	600V
C-11	928006	1500 MMF	400V	C-29	922101	.05 MF	400V
C-12	928109	.005 MF	400V	C-30	925166	40 MF	450V
C-13	910033	47 MMF		C-31	925161	40 MF	450V
C-14	923080	.25 MF	200V	C-32	PT.OF C-30	40 MF	450V
C-15	910130	10 MMF	400V	C-33	PT.OF C-31	40 MF	450V
C-16	928006	1500 MMF	400V	C-34	PT.OF C-26	80 MF	250V
C-17	900064	3-35 MMF		C-35	922025	047 MF	400V
C-18	910031	68 MMF	500V	C-36	PT.OF C-32	10 MF	450V

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PARTS LIST (continued)

ITEM	PT. NO.	DESCRIPTION		
C-37	922025	.047 MF	400V	
C-38	910029	150 MMF	500V	
C-39	922015	.01 MF	400V	
C-40	922015	.01 MF	400V	
C-41	923062	.05 MF	400V	
C-42	923062	.05 MF	400V	
C-43	923061	.01 MF	400V	
C-44	923062	.05 MF	400V	
C-45	910029	150 MMF	500V	
C-46	910031	68 MMF		
C-47	923083	.002 MF	400V	
C-48	923091	.2 MF	200V	
C-49	923114	.02 MF	400V	
C-50	922025	.047 MF	400V	
C-51	910042	180 MMF	400V	
C-52	922040	.01 MF	600V	
C-53	910048	1500 MMF		
C-54	910212	390 MMF		
C-55	900054	25-300 MMF		
C-56	923061	.01 MF	400V	
C-57	923073	.05 MF	600V	
C-58	923003	.0005 MF	10KV	
C-59	923067	.1 MF	200V	
C-60	923064	.1 MF	400V	
C-61	923088	.002 MF	600V	
C-62	923088	.002 MF	600V	
C-63	923079	.001 MF	600V	
C-64	923077	.005 MF	600V	
C-65	922014	.1 MF	200V	
C-66	922024	.033 MF	600V	
C-67	922008	.1 MF	400V	
C-68	910027	1000 MMF		
C-69	PT.OF C-30	100 MF	100V	
C-70	923077	.005 MF	600V	
C-71	PT.OF C-26	10 MF	450V	
C-72	PT.OF C-31	10 MF	450V	
C-73	910045	5 MMF	1000V	
C-74	910090	50 MMF	500V	
C-75	923102	.5 MF	200V	
C-76	922024	.033 MF	600V	
C-77	923073	.05 MF	600V	
C-78	928006	1500 MMF	400V	
F-1	808170 OR	FUSE		
F-1	808050	FUSE ¼ A. 250V - 3AG		
I-1	708086	ION TRAP		
L-1	720109	3RD VIDEO I.F. COIL		
L-2	705014	R.F. CHOKE - 20 uh		
L-3	708096	PEAKING COIL - 75 uh		
L-4	708097	SOUND I.F. COIL - 45 uh		
L-5	708143	FOCUS COIL		
L-6	708096	PEAKING COIL - 75 uh		
L-7	708095	PEAKING COIL - 180 uh		
L-8	708114	PEAKING COIL - 440 uh		
L-9	708082-1	SIZE COIL		
L-10	708037	LINEARITY COIL		
L-11		DEFLECTION YOKE - VERT. COILS		
L-12	708130 OR	DEFLECTION YOKE - HORIZ.COILS		
L-11	708130R	DEFLECTION YOKE - VERT. COILS		
L-12		DEFLECTION YOKE - HORIZ.COILS		
L-13	737011	FILTER CHOKE		

ITEM	PT. NO.	DESCRIPTION		
P-2	505040	CONNECTOR PLUG - SPEAKER		
P-3	505014	PLUG - INTERLOCK SWITCH		
R-1	340492	1,000 OHM	½W	±10%
R-2	340672	5,600 OHM	½W	±10%
R-3	340412	470 OHM	½W	±10%
R-4	340212	68 OHM	½W	±10%
R-5	340492	1,000 OHM	½W	±10%
R-6	340492	1,000 OHM	½W	±10%
R-7	340732	10,000 OHM	½W	±10%
R-8	340652	4,700 OHM	½W	±10%
R-9	340152	39 OHM	½W	±10%
R-10	340492	1,000 OHM	½W	±10%
R-11	340492	1,000 OHM	½W	±10%
R-12	340632	3,900 OHM	½W	±10%
R-13	340292	150 OHM	½W	±10%
R-14	340492	1,000 OHM	½W	±10%
R-15	340692	6,800 OHM	½W	±10%
R-16	340852	33,000 OHM	½W	±10%
R-17	341212	1 MEGOHM	½W	±10%
R-18	340272	120 OHM	½W	±10%
R-19	340972	100,000 OHM	½W	±10%
R-20	370650	4,700 OHM	1W	±10%
R-21	370730	10,000 OHM	1W	±10%
R-22	340972	100,000 OHM	½W	±10%
R-23	340972	100,000 OHM	½W	±10%
R-24	340932	68,000 OHM	½W	±10%
R-25	351492	15 MEGOHM	½W	±20%
R-26	390144	1 MEGOHM VOL CONT.-FRONT		
R-27	341132	470,000 OHM	½W	±10%
R-28	341132	470,000 OHM	½W	±10%
R-29	370312	180 OHM	1W	±10%
R-30	390139	4,000 OHM FOCUS CONT.		
R-31	340012	10 OHM	½W	±10%
R-32	PT.OF R-26	5,000 OHM CONTRAST CONT.-FRONT		
R-33	340572	2,200 OHM	½W	±10%
R-34	341212	1 MEGOHM	½W	±10%
R-35	341032	180,000 OHM	½W	±10%
R-36	370792	18,000 OHM	1W	±10%
R-37	370612	3,300 OHM	1W	±10%
R-38	340572	2,200 OHM	½W	±10%
R-39	340732	10,000 OHM	½W	±10%
R-40	341072	270,000 OHM	½W	±10%
R-41	341212	1 MEGOHM	½W	±10%
R-42	340292	150 OHM	½W	±10%
R-43	341032	180,000 OHM	½W	±10%
R-44	340792	18,000 OHM	½W	±10%
R-45	370652	4,700 OHM	1W	±10%
R-46	341212	1 MEGOHM	½W	±10%
R-47	341292	2.2 MEGOHM	½W	±10%
R-48	341072	270,000 OHM	½W	±10%
R-49	340892	47,000 OHM	½W	±10%
R-50	340812	22,000 OHM	½W	±10%
R-51	341132	470,000 OHM	½W	±10%
R-52	340892	47,000 OHM	½W	±10%
R-53	341212	1 MEGOHM	½W	±10%
R-54	341292	2.2 MEGOHM	½W	±10%
R-55	340732	10,000 OHM	½W	±10%
R-56	340612	3,300 OHM	½W	±10%
R-57	340572	2,200 OHM	½W	±10%
R-58	340652	4,700 OHM	½W	±10%
R-59	340712	8,200 OHM	½W	±10%
R-60	331192	820,000 OHM	½W	±5%

ITEM	PT. NO.	DESCRIPTION		
R-61	331312	2.7 MEGOHM	½W	±5%
R-62	331012	150,000 OHM	½W	±5%
R-63	331012	150,000 OHM	½W	±5%
R-64	330972	100,000 OHM	½W	±5%
R-65	341212	1 MEGOHM	½W	±10%
R-66	340712	8,200 OHM	½W	±10%
R-67	340812	22,000 OHM	½W	±10%
R-68	331012	150,000 OHM	½W	±5%
R-69	331012	150,000 OHM	½W	±10%
R-70	390132	100,000 OHM HORIZ. HOLD CONT.		
R-71	341012	150,000 OHM	½W	±10%
R-72	370972	100,000 OHM	1W	±10%
R-73	341212	1 MEGOHM	½W	±10%
R-74	341212	1 MEGOHM	½W	±10%
R-75	341212	1 MEGOHM	½W	±10%
R-76	340372	330 OHM	½W	±10%
R-77	397080-1	3,900 OHM	2W	±10%
R-78	394066	3.3 OHM	½W	±10%
R-79	341132	470,000 OHM	½W	±10%
R-80	371212	1 MEGOHM	1W	±10%
R-81	340932	68,000 OHM	½W	±10%
R-82	390132	100,000 OHM BRIGHTNESS CONT.		
R-83	340652	4,700 OHM	½W	±10%
R-84	340732	10,000 OHM	½W	±10%
R-85	340812	22,000 OHM	½W	±10%
R-86	340872	39,000 OHM	½W	±10%
R-87	340892	47,000 OHM	½W	±10%
R-88	340932	68,000 OHM	½W	±10%
R-89	390132	100,000 OHM VERT. HOLD CONT.		
R-90	390138	3 MEGOHM VERT.SIZE CONT.		
R-91	331332	3.3 MEGOHM	½W	±5%
R-92	341372	4.7 MEGOHM	½W	±10%
R-93	340972	100,000 OHM	½W	±10%
R-94	340872	39,000 OHM	½W	±10%
R-95	390135	3,000 OHM VERT. LIN. CONT.		
R-96	370572	2,200 OHM	1W	±10%
R-97	341132	470,000 OHM	½W	±10%
R-98	340432	560 OHM	½W	±10%
R-99	340432	560 OHM	½W	±10%
R-100	340712	8,200 OHM	½W	±10%
R-101	397014	10,000 OHM	2W	±10%
SP-1	180041	SPEAKER - PM - 6" - TABLE MOD.		
SP-1	180050	SPEAKER - PM - 12" - CONSOLE		
SW-1	PT.OF R-26	ON-OFF SWITCH		

ITEM	PT. NO.	DESCRIPTION
TUNER	470607	TV TUNER ASS'Y - STAND.
TUNER	470606	TV TUNER ASS'Y - G.I.
T-2	720042	2ND VIDEO I.F. TRANSFORMER
T-3	720089-1	4TH VIDEO I.F. TRANSFORMER
T-4	720081	SOUND I.F. TRANSFORMER
T-5	708017 OR	DISCRIMINATOR COIL - 4.5 MC
T-5	708018	DISCRIMINATOR COIL - 4.5 MC
T-6	734058	SOUND OUTPUT TRANSFORMER
T-7	738035	HORIZ.OSCIL. & PHASING COIL
T-8	738034	HORIZ.OUTPUT TRANSFORMER
T-9	738029	VERT. OUTPUT TRANSFORMER
T-10	730022	POWER TRANSFORMER
V-1	800535	VACUUM TUBE - 6AG5
V-2	800535	VACUUM TUBE - 6AG5
V-3	800533	VACUUM TUBE - 6AU6
V-4	800541	VACUUM TUBE - 6AL5
V-5	800533	VACUUM TUBE - 6AU6
V-6	800533	VACUUM TUBE - 6AU6
V-7	800035	VACUUM TUBE - 6T8
V-8	800490	VACUUM TUBE - 25L6 GT
V-9	800533	VACUUM TUBE - 6AU6
V-10	800026	VACUUM TUBE - 12AU7
V-11	800026	VACUUM TUBE - 12AU7
V-12	800039	VACUUM TUBE - 12SN7GT
V-13	800039	VACUUM TUBE - 12SN7GT
V-14	800044	VACUUM TUBE - 19BG6-G
V-15	800045	VACUUM TUBE - 25W4GT
V-16	800450	VACUUM TUBE - 1B3GT/8016
V-17	800039	VACUUM TUBE - 12SN7GT
V-18	810003	TELEVISION TUBE - 12LP4 - WHITE
V-19	800290	VACUUM TUBE - 5U4G
V-20		
V-21	800536	VACUUM TUBE - 6J6 } STAND. TUNER
V-22	800535	VACUUM TUBE - 6AG5 } STAND. TUNER
V-20	800535 OR	VACUUM TUBE - 6AG5 } G.I. TUNER
V-20	800052	VACUUM TUBE - 6BC5 } G.I. TUNER
V-21	800535 OR	VACUUM TUBE - 6AG5 } G.I. TUNER
V-21	800052	VACUUM TUBE - 6BC5 } G.I. TUNER
V-22	800536	VACUUM TUBE - 6J6 } G.I. TUNER
X-1	470232	SOCKET - CABLE ASS'Y - KINESC.
X-2	508010	SOCKET - SPEAKER
X-3	583206	SOCKET - INTERLOCK SWITCH

PRODUCTION CHANGES

Triangle codes will appear stamped next to the A.C. input on the chassis. For every production change, the triangle code number will change.

△1 These sets use power transformer 730022.

△2 Covering circuit modifications to reduce horizontal foldover.

a) Disconnect C-73, 5 uuf from junction of C4, .002 - C-46, 68 uuf and C-45, 150 uuf.

b) Insert 47,000 ohm resistor between C-73 and junction of C-47, C-66 and C-45.

c) Insert 68 uuf between junction of C-73 new 47,000 ohm resistor and B minus.

△3 Covering circuit modifications to improve picture sharpness and contrast.

a) Change 33,000 ohm resistor R16, connected from Pin 2 to Pin 5 of the 6AL5 video detector to a 68,000 ohm resistor.

b) Change the 47 mmfd. condenser C13, connected from Pin 2 to Pin 1 of the 6AL5 video detector to a 24 mmfd. condenser.

c) Change the 6800 ohm resistor R15, which is connected between the low end of the secondary of the 3rd video IF transformer to the low end of the peaking coil which runs to Pin 7 of the 6AL5 video detector to a 4700 ohm resistor.

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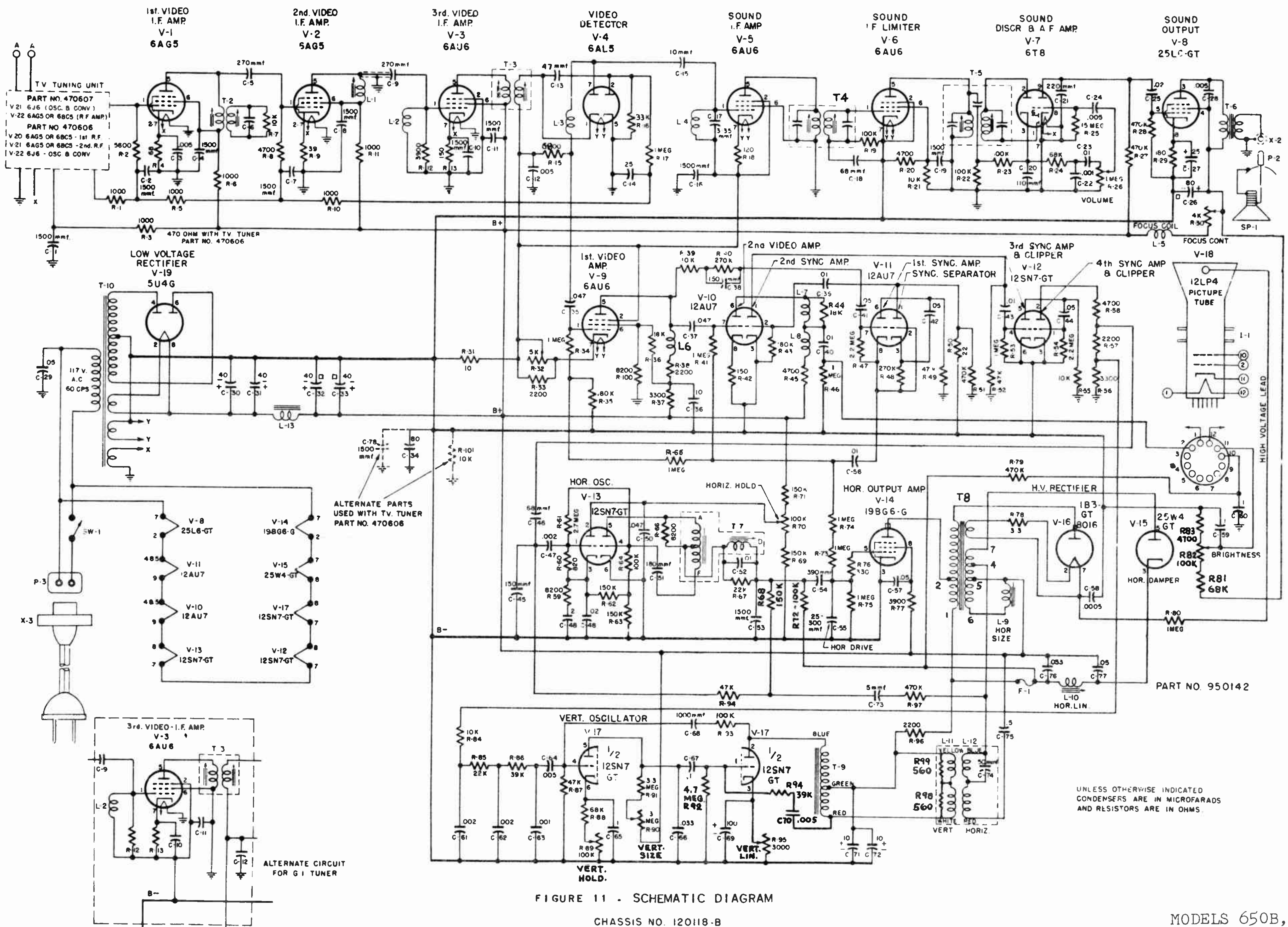

FIGURE 11 - SCHEMATIC DIAGRAM

CHASSIS NO. 120118-B

MODELS 650B, 654B,
Ch. 120118B

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NOTICE:

It will be noted in the service note on Models 650,654 using chassis 120118B, that two tuners are listed in the parts list:

1. Standard Tuner - Part No. 470607
2. General Instrument Tuner - Part No. 470606

A third alternative tuner has been added to Models 650,654. Some sets have been made incorporating the new Emerson tuner part no. 470640.

Since this tuner was added to Models 650,654 after the temporary service note on these sets was released, preliminary information on it is given in this addendum.

Complete information on the Emerson tuner will be furnished when the final service note on Models 650,654 is released.

TUNER ALIGNMENT

SIGNAL GENERATOR: Frequency range 40 to 225 mc.
Accurately calibrated.
AM modulated, 400 cycle.

The Emerson Tuner departs from the conventional type in that the individually tuned coils are replaced with a pretuned, tapped inductance. Channel selection is effected by switching in various values of inductance which combine with stray and tube capacitance to produce a given resonant frequency. Trimmers are provided in the oscillator and RF sections to compensate for the variable stray capacitances.

Assuming the trimmers to be properly set, the only cause of misalignment would be the distortion of the coil sections due to shipping, handling, etc. The coils are neither delicate nor critical, and must be bent considerably before detuning will occur. It follows, however, that should this be the case for a given coil section, all channels of lower frequency will be detuned to varying degrees. For this reason, the high channels are checked first and channel 2 last.

If, for any reason, it becomes advisable to replace a certain section or sections of coil, it is recommended that the entire coil be replaced. This is easily accomplished since the switch soldering lugs are slotted to receive the coil.

CAUTION: Switch lugs should be clean before new coil is installed.

It is possible, though not recommended, to replace individual sections. The section may be clipped from a new coil, or in an emergency, wound from #18 solid AWG, double nylon enamel (or similar) wire. Care should be taken to avoid overheating the wire and melting the insulation.

OSCILLATOR ADJUSTMENT

Proceed as follows:

1) If the oscillator has been disconnected during the IF alignment, put it back into circuit.

2) Connect the signal generator to the antenna terminal by means of a generator matching network.

3) Connect the vertical input terminals of the oscilloscope from cathode of V-2A (pin 8) to B minus through a shielded lead. Decouple this lead with 4.7K resistor. Set the vertical gain control at maximum. Synchronize the oscilloscope to 60 cycles or a harmonic of 60 cycles.

4) Set Fine Tuner to mid-capacity.

5) Set the generator to the oscillator frequency of channel 10 (170.35 mc) and adjust the oscillator trimmer C-1 (see Fig. 3) for zero beat viewed on the oscilloscope. Zero beat is indicated by a sharply defined minimum deflection that appears between two maximum deflections as the trimmer is tuned through resonance. Check all high channels (7-13) (see Fig. 4) to determine if zero beat occurs with fine tuner within 22½ degrees of mid-setting. It may be necessary to adjust coil L-1 (high band oscillator coil, Fig. 1) to bring channel 13 within this range. Adjustment is made by compressing or spreading the coil with an insulated screwdriver. If L-1 is adjusted, it may be necessary to retune trimmer to channel 10 to bring channels 7 to 10 within the 22½ degree range.

6) The low channels (2-6) are adjusted by starting at channel 6 and progressing through channel 2 (see Table 1).

7) Touching up a particular coil section is accomplished by spreading or compressing the individual coils. (See Fig. 1 for location of various coil sections).

CAUTION: Before checking a given channel, make certain the station selector switch is in the proper position.

To make certain that the trimmer is adjusted correctly, tune through the zero beat point and then back again to obtain the exact setting. Also, it is advisable when close to the zero beat setting, to vary the signal generator input voltage so as to obtain maximum response on the oscilloscope. However, before making the final trimmer setting, reduce the generator input as low as possible so as to reduce the lock-in range and obtain a sharp zero beat setting.

DWG. NO. 956010

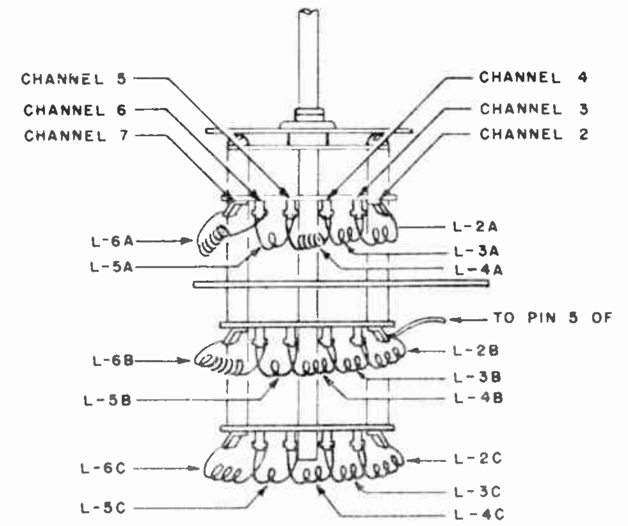

FIGURE 1 - ANTENNA, RF AND OSCILLATOR COILS

ANTENNA AND RF ALIGNMENT PROCEDURE

1) Connect the sweep generator to the antenna terminal by means of a generator matching network.

2) Disconnect choke (L-3) in cathode of oscillator tube V-2B at dummy lug.

3) Connect oscilloscope, through a decoupling resistor, across (R-1) in cathode circuit of mixer tube (V-2A).

4) Turn the station selector switch to channel 10. Set the center frequency of the sweep generator to the center frequency of channel 10 (195 mc). Adjust the RF trimmer (see Fig. 3) to place a (195 mc) marker at maximum amplitude of curve. This is the only RF adjustment and the RF stage of all high channels (7-13) should be properly tuned. Conversely, if channel 10 is not tuned properly, all high channels will be misaligned.

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5) Check channels 7 and 13, noting whether the mid-frequencies of these channels produce maximum amplitude on curve. The RF coil for channel 13 (L-2) is a straight piece of wire (Fig. 1). As its position with respect to the adjacent lead affects the tuning of the high channels, moving it is a simple means of touching up the curve. A slight readjustment of the RF trimmer may be necessary if (L-2) is moved.

NOTE: As the bandwidth of the high channels is very broad, the mid-frequency marker may not fall exactly at peak of curves for channels 7 and 13. A slight variation is permissible.

6) Check the low channels starting at channel 6 and moving downward to channel 2.

NOTE: If channel 6 is not tuned properly, all low channels will be misaligned. Therefore, it is important that a good response curve be obtained from this channel.

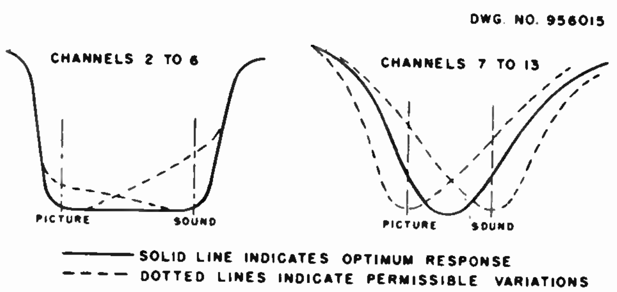


FIGURE 2 - R.F. RESPONSE CURVES

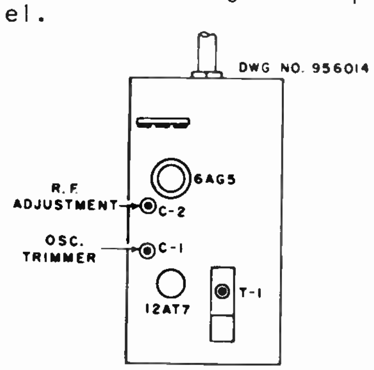


FIGURE 3 ALIGNMENT ADJUSTMENT LOCATIONS

In each case, with the center frequency of sweep at the channel center frequency, introduce markers corresponding to sound and picture carriers (see Fig. 2). It is permissible for the markers to appear slightly down on the skirt, but if they are too low (more than 6 db down), the curve may be changed by spreading or compressing the particular coil section with an insulated screwdriver.

NOTE: The RF coil is tuned to sound carrier. The antenna coil is tuned to video carrier.

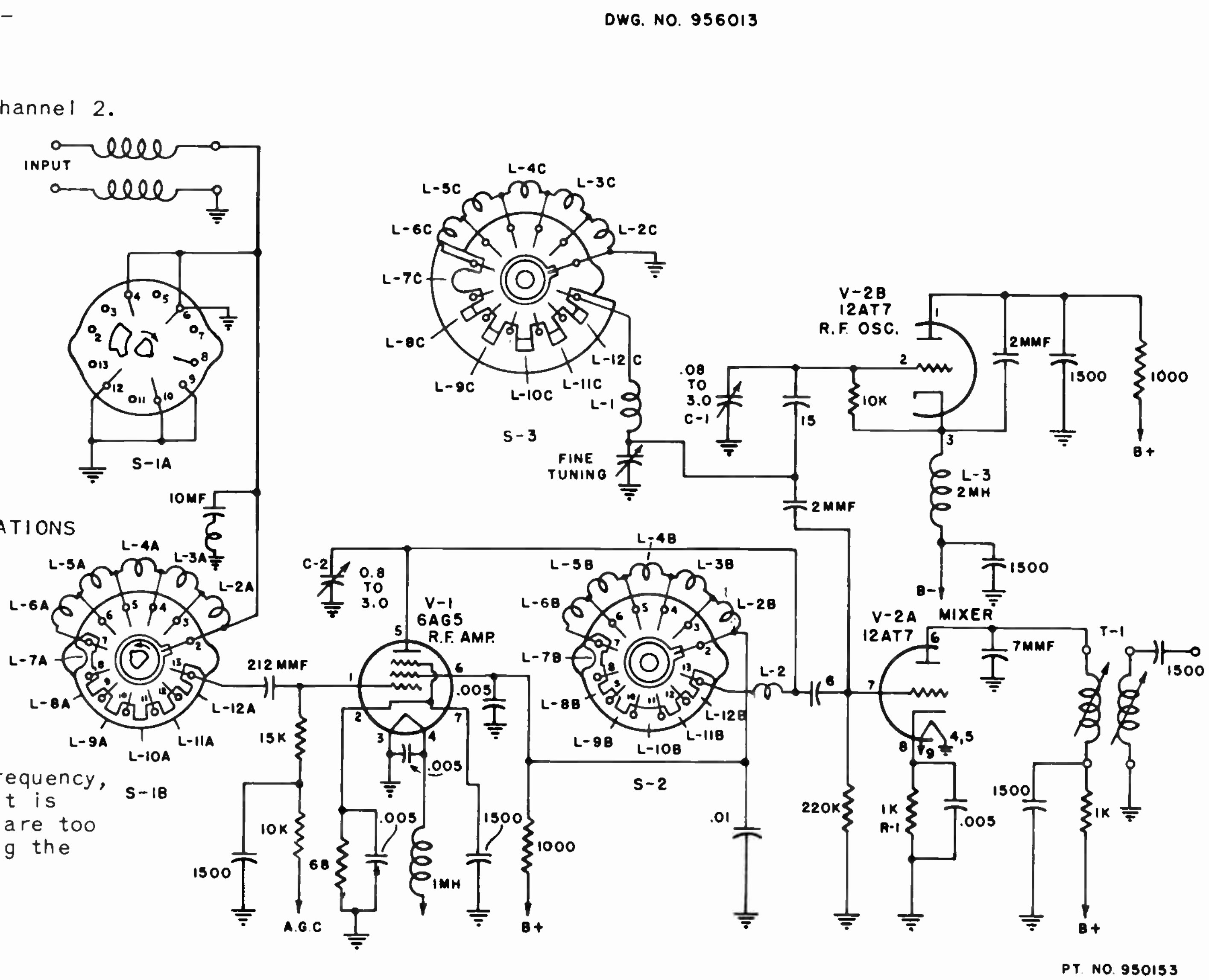
CAUTION: Be sure to turn station selector switch to correct channel before checking band pass of that channel.

FREQUENCY CHART

CHANNEL	FREQUENCY	PICTURE	SOUND	OSCILLATOR
2	54-60	55.25	59.75	81 MC
3	60-66	61.25	65.75	87 MC
4	66-72	67.25	71.75	93
5	76-82	77.25	81.75	103
6	82-88	83.25	87.75	109
7	174-180	175.25	179.75	153
8	180-186	181.25	185.75	159
9	186-192	187.25	191.75	165
10	192-198	193.25	197.75	171
11	198-204	199.25	203.75	177
12	204-210	205.25	209.75	183
13	210-216	211.25	215.75	189

TABLE 1 FREQUENCY CHART

It should be noted that from channels 7 to 13, the oscillator frequency is lower than the incoming signal by the IF frequency, therefore the relative positions of the video and audio carriers reverse themselves on the overall response curve.



EMERSON TUNER 470640

FIGURE 5 - SCHEMATIC DIAGRAM OF EMERSON TUNER 470640

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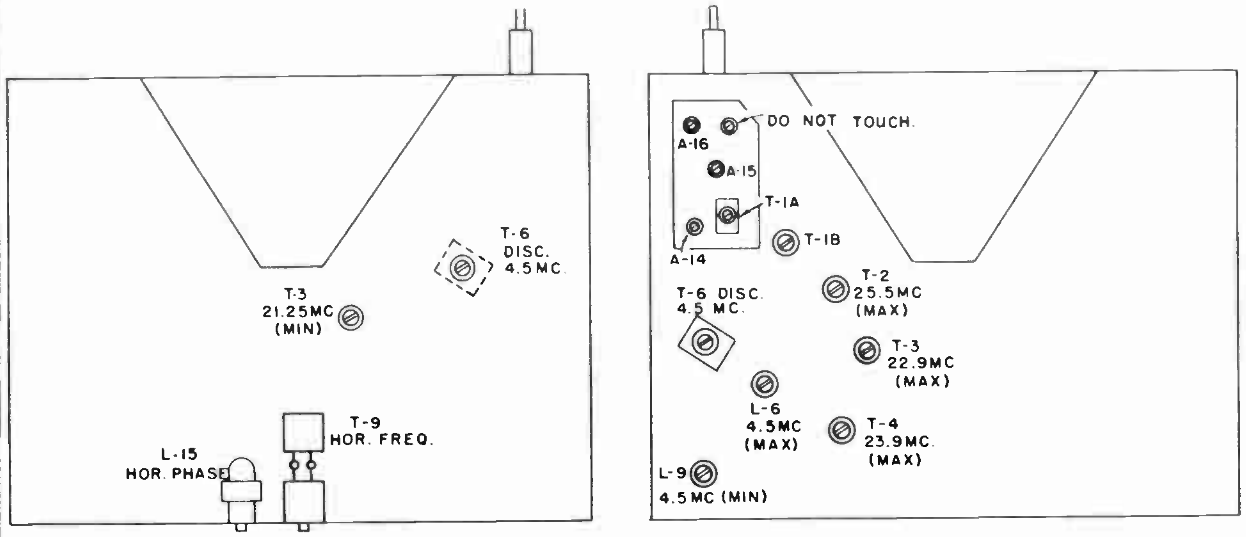
RECEIVER CHARACTERISTICS

ITEM	DESCRIPTION
Voltage Rating	115 volts, 60 cycles A.C.
Power Consumption	All Models - 155 watts
Current Drain (at 115 volts A.C.)	All Models - 1.4 Amps.
Frequency Range	54-88 MC; 174-216 MC.
Intermediate Frequencies	Video - 25.75 MC. Audio - 4.5 MC.
Antenna Input Impedance	300 Ohms, Balanced
Channel Selection	Twelve Position Rotary Turret
Chassis - Models	Models - 650D 654D, 655B Chassis - 120123-B

ALIGNMENT

a. **Equipment Required** - A sweep generator, accurate marker generator, oscilloscope, and v.t.v.m. are required for alignment. The marker generator must be very accurate and supply frequencies of 4.5 MC., and 20 to 28 MC.



BOTTOM OF CHASSIS TOP OF CHASSIS

FIGURE I . LOCATION OF ALIGNMENT POINTS

b. **Response Curves** - The i-f response curves for the video i-f stages are shown in figure 2.

c. **Alignment Points** - The location of all i-f transformers, tuned circuits, and trimmers is shown in figure I.

d. **TV I-F Alignment** -

1) Tune receiver to Channel 3.

2) Connect 3 volt bias battery negative terminal from junction of C31 and R27 (positive terminal) to B-.

3) Shape overall response curve, after individual peaking of stagger-tuned and over-coupled i-fs, as indicated in steps 1-6 below. See curves A and B.

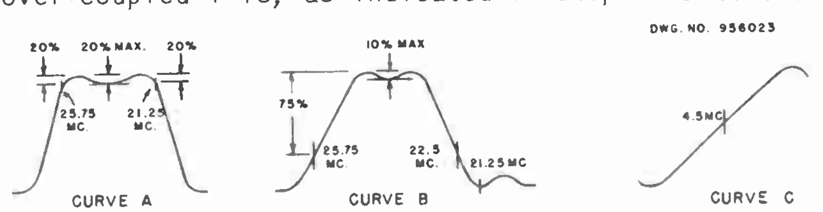


FIGURE 2 . RESPONSE CURVES

STEP	SIGNAL GENERATOR INPUT - CONNECTION	SIGNAL GENERATOR INPUT - FREQUENCY	INSTRUMENT CONNECTION	ADJUST	PROCEDURE
1	Connect marker generator to pin 1 (grid) of V-1 (6AU6) through .001 mfd. condenser. Low side to B neutral.	25.5 MC	Connect d.c. v.t.v.m. to pin 7 (grid of V4 12AT7). Low side to pin 8 of V4. Use 3 or 5 volt range.	T2	Peak for maximum response. Adjust generator signal level to produce one volt at grid of V4.
2	"	22.9 MC	"	T3 (Top)	"
3	"	21.25 MC	"	T3 (Bottom)	Adjust for minimum response. Repeat step 2.
4	"	23.9 MC	"	T4	Peak for maximum response.
5	Connect sweep generator to converter (6J6 or 12AT7) input, using three turn loop of wire slipped over tube. Connect marker gen. in parallel.	Sweep-24.5 MC (10 MC sweep) Marker-21.25 MC and 25.75 MC	Connect vertical input of scope through *detector network to pin 1 (grid) of V-2 (6AU6). Low side to B+ (130V). *Low input impedance of about 200 ohms	T1(A) T1(B)	Set markers as shown on response curve A, fig. 2. Note that the markers should be 20% down for this stage.
6	"	Sweep-24.5 MC (10 MC sweep) Marker-22.6 and 25.75 MC	Connect vertical input of scope in series with 10K resistor to pin 7 (grid) of V4 (12AT7). Low side to pin 8 of V4.	T2, T3, and T4	Adjust for overall response as shown in curve B, fig. 2. Adjust T2 to position 25.75 MC marker; adjust T3 (Top) to set 22.6 MC marker. Do not readjust trap. Equalize peaks of response curve by adjusting T4.

TABLE I . VIDEO I-F ALIGNMENT

e. **TV Sound Alignment** -

1) Set receiver to Channel 3.

2) Use accurate, crystal-controlled, marker generator.

STEP	SIGNAL GENERATOR INPUT - CONNECTION	SIGNAL GENERATOR INPUT - FREQUENCY	MEASURING INSTRUMENT	ADJUST	PROCEDURE
1	Marker generator through .001 mf to pin 2 of V-4 low side to B+ (130V).	Marker-4.5 MC.	Connect v.t.v.m. through 10K resistor to pin 1 (grid) of V5. Low side to B+ (130V).	L6	Peak for maximum response. Adjust generator input to produce one volt at grid of V5. (Above no signal value).
2	Connect sweep generator in parallel with marker gen.	Sweep-4.5 MC (450 KC sweep) Marker-4.5 MC	Replace v.t.v.m. with scope connected through 10K resistor to junction of R21 and C22. Low side to B neutral.	T6 (Secondary)	Position 4.5 MC. marker at center of S-curve, by adjusting secondary. (See Fig. 2 - curve C)
3	"	"	"	T6 (Primary)	Peak primary for maximum amplitude and linearity. Repeat step 2. (See Fig. 2 - curve C)
4	Marker generator through .001 mfd. to pin 7 of V4 (12AT7) low side to pin 8 of V4.	Marker-4.5 MC	A.C. v.t.v.m. or D.C. v.t.v.m. used with a peak detector probe to junction of R52,C47. Low side to B neutral.	L9	Adjust for min. reading of v.t.v.m. Keep contrast control set for maximum contrast.

TABLE II . AUDIO I-F AND DISC ALIGNMENT

f. **TV R-F Alignment** -

1) Set fine tuning control to mechanical center. Retain this setting for entire r-f alignment.

2) Use 300 ohm carbon resistor as dummy antenna.

3) Couple marker generator in parallel with sweep generator.

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4) Use 10 MC. sweep for sweep generator. Couple generator to antenna terminals of receiver.

5) Connect vertical input of scope in series with 10K resistor to junction of R39 and L8 (pin 7 grid of V4).

STEP	SIGNAL GENERATOR INPUT		CHANNEL	ADJUST	PROCEDURE
	SWEEP GEN.	MARKER GEN.			
1	207.0 MC.	209.75 MC.	12	A12	Adjust for placement of 21.25 MC. marker as per response curve B.
2	•	•	12	A14, A15, A16	Adjust shape of response curve B for maximum amplitude and bandwidth.
3	213.0 MC.	215.75 MC.	13	A13	Adjust as in Step 1.
4	201.0 MC.	203.75 MC.	11	A11	•
5	195.0 MC.	197.75 MC.	10	A10	•
6	189.0 MC.	191.75 MC.	9	A9	•
7	183.0 MC.	185.75 MC.	8	A8	•
8	177.0 MC.	179.75 MC.	7	A7	•
9	85.0 MC.	87.75 MC.	6	A6	•
10	79.0 MC.	81.75 MC.	5	A5	•
11	69.0 MC.	71.75 MC.	4	A4	•
12	63.0 MC.	65.75 MC.	3	A3	•
13	57.0 MC.	59.75 MC.	2	A2	•

TABLE III . R.F. ALIGNMENT

TUBE LOCATIONS

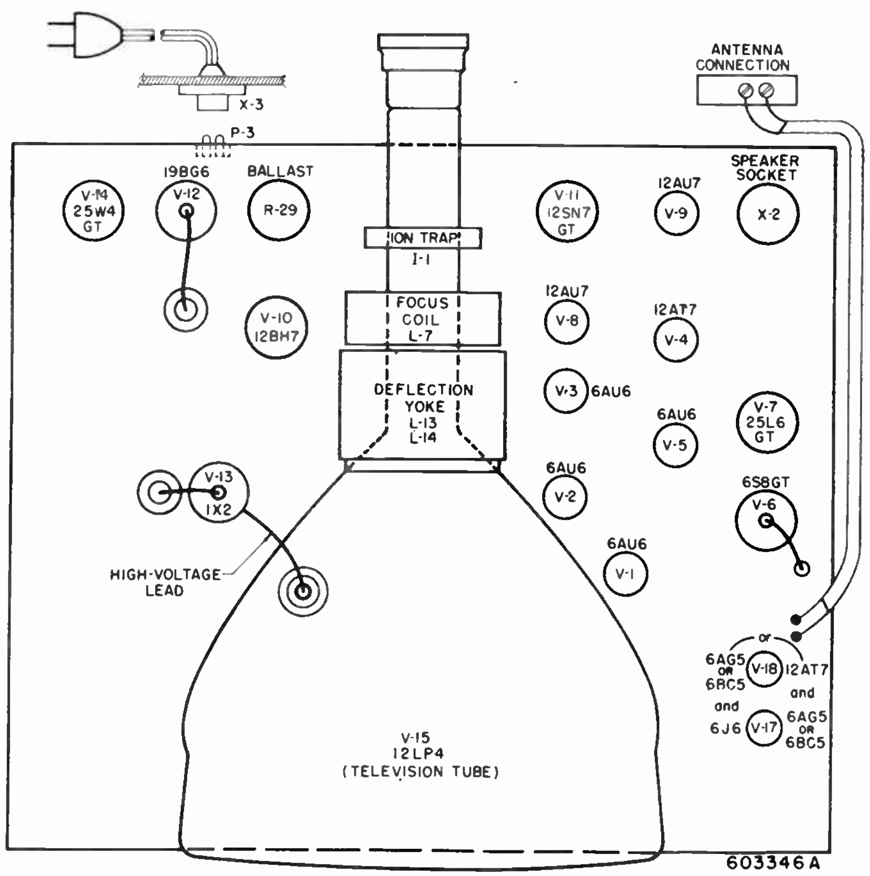

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FIGURE 4. TUBE LOCATION DIAGRAM (FOR CHASSIS 120123B)

OPERATING CONTROLS

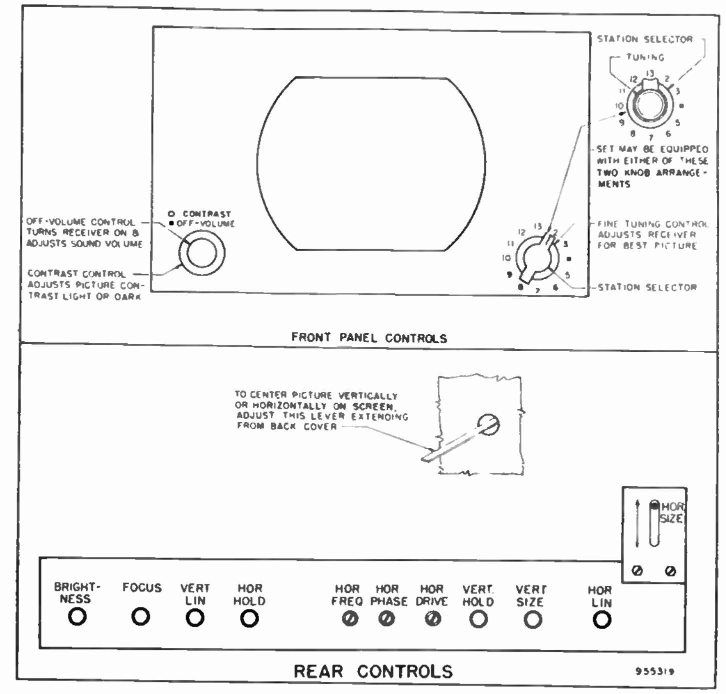

FIGURE 3. OPERATING CONTROLS (FOR MODELS 650D, 654D AND 655B)

ALIGNMENT OF MIRACLE PICTURE LOCK (Horizontal Sweep Automatic Freq. Control)

This must be done with chassis removed from cabinet and a scope.

1. Short phasing coil by using a clip lead across C-74 (.01 mf.)
2. Turn horizontal hold control counter clockwise when viewed from front of control. (Center tap at lowest B+ voltage).
3. Starting with frequency slug (T-9) all the way out rotate in until picture locks into synchronization.
4. Remove short from phasing coil and adjust in following manner.
   a) Place scope lead in series with 10,000 ohm resistor to junction R-83, L-15 low side to B neutral (B-).
   b) Set sweep frequency of scope to 8,000 and adjust fine frequency until pattern on scope is stationary (Note picture should be in synch during this adjustment.)
   c) Phasing slug (L-15) should be adjusted so that you have even peaks as shown in Figure 5 below.

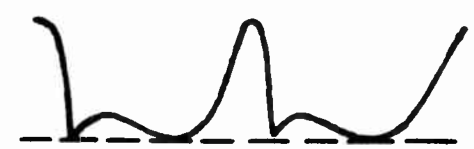

FIGURE 5

5. Switch tuner to off channel then back. Picture should be out of synch and from 4 to 5 black horizontal bars visible. If more or less, adjust horizontal frequency slug (T-9) until the 4 to 5 bars are seen.
6. Turn horizontal hold control slowly clockwise. Picture should synch in at about 1/4 of a turn. The picture should then remain in synchronization over the whole range of the horizontal hold control.

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MODELS 650D, 654D, 655B, Ch. 120123-B

CABINET PARTS LIST (Models 650D, 654D, 655B)

PART NO. MODEL 650D	MODEL 654D	MODEL 655B	DESCRIPTION
140354	--	--	Cabinet
--	140355	--	Cabinet
--	--	140360	Cabinet
520127	520127	--	Glass Panel
--	--	635028	Safety Glass
410982	410982	--	Metal Mask
--	--	411009	Mask
560141	--	560141	Masonite Back
--	560142	--	Masonite Back
583206	583206	583206	Line Cord
580689	580689	580689	Twin Conductor Wire Antenna 126" Approx.
520103	520103	520103	Escutcheon - Selector - Standard Tuner
450028	450028	450028	Escutcheon - Off Volume - Contrast
450071	450071	--	Knob - Contrast
--	--	450095	Knob - Contrast
450072S	450072S	--	Knob - Volume
--	--	450096S	Knob - Volume
450073S	450073S	--	Knob - Selector
--	--	450097S	Knob - Selector
450074	450074	--	Knob - Fine Tuning
--	--	450098	Knob - Fine Tuning
587011	587011	587011	Spring Insert 1/4"
587012	587012	587012	Spring Insert 3/8"
180070	--	--	Speaker - 6"
--	180072	--	Speaker - 12"
--	--	180073	Speaker - 6"
585061	--	585061	Speaker Plug and Cable
--	585062	--	Speaker Plug and Cable

CHASSIS PARTS LIST (CHASSIS 120123-B)

SYMBOL	PT. NO.	DESCRIPTION
C-1	928006	1500 MMF 400V
C-2	928006	1500 MMF 400V
C-3	928006	1500 MMF 400V
C-4	928006	1500 MMF 400V
C-5	928006	1500 MMF 400V
C-6	928006	1500 MMF 400V
C-7	928006	1500 MMF 400V
C-8	928006	1500 MMF 400V
C-9	928006	1500 MMF 400V
C-10	928006	1500 MMF 400V
C-11	928006	1500 MMF 400V
C-12	928006	1500 MMF 400V
C-13	928006	1500 MMF 400V
C-14	910017	470 MMF ±10%
C-15	928011	220 MMF 500V
C-16	928006	1500 MMF 400V
C-17	910033	47 MMF ±20%
C-18	928006	1500 MMF 400V
C-19	928006	1500 MMF 400V
C-20	928006	1500 MMF 400V
C-21	910043	110 MMF ±10%
C-22	923079	.001 MF 600V
C-23	923061	.01 MF 400V
C-24	923088	.002 MF 600V
C-25	928006	1500 MMF 400V
C-26	923061	.01 MF 400V
C-27	925181	40 MF 300V
C-28	923061	.01 MF 400V
C-29	923062	.05 MF 400V
C-30	925166-1	200 MF 150V
C-31	923201	2 MF 50V
C-32	925166-3	120 MF 300V
C-33	PT.OF C-27	120 MF 300V
C-34	925070-1	30 MF 150V
C-35	925070-1	30 MF 150V
C-36	923091	.2 MF 200V
C-37	PT.OF C-27	50 MF 300V
C-38	928023	5 MMF ±10%
C-39	928006	1500 MMF 400V
C-40	925070-2	4 MF 200V
C-41	910047	200 MMF 500V
C-42	923062	.05 MF 400V
C-43	910047	200 MMF 500V
C-44	922032	.01 MF 600V
C-45	PT.OF L-9	47 MMF
C-46	923062	.05 MF 400V
C-47	923062	.05 MF 400V
C-48	923064	.1 MF 400V
C-49	923088	.002 MF 600V
C-50	923079	.001 MF 600V
C-51	923088	.002 MF 600V
C-52	923092	.006 MF 400V
C-53	923079	.001 MF 600V
C-54	922021	.001 MF 600V
C-55	922014	.1 MF 200V
C-56	922024	.033 MF 600V
C-57	922008	.1 MF 400V
C-58	PT.OF C-32	15 MF 400V
C-59	923088	.002 MF 600V
C-60	910090	50 MMF 500V
C-61	923102	.5 MF 200V
C-62	928006	1500 MMF 400V
C-63	928006	1500 MMF 400V
C-64	928006	1500 MMF 400V
C-65	928006	1500 MMF 400V
C-66	910028	220 MMF ±10%
C-67	910043-2	180 MMF ±10%
C-68	923088	.002 MF 600V
C-69	923114	.02 MF 400V
C-70	923091	.2 MF 200V
C-71	923062	.05 MF 400V
C-72	910047	200 MMF 500V
C-73	PT.OF C-32	10 MF 400V
C-74	922041	.01 MF 600V
C-75	910212	390 MMF ±10%
C-76	910044	1200 MMF ±10%
C-77	900073	45-400 MMF Trimmer
C-78	922024	.033 MF 600V
C-79	910045	5 MMF 1000V
C-80	923015	.0005 MF 10KV
C-81	923062	.05 MF 400V
C-82	922023	.047 MF 600V
C-83	915000-1	47 MMF ±10%
C-84	928006	1500 MMF 400V
C-85	928006	1500 MMF 400V
C-86	928006	1500 MMF 400V
C-87	923088	.002 MF 600V
C-88	928054	68 MMF 1000V
F-1	808170	FUSE
I-1	708086	ION TRAP - DOUBLE
L-2	705016	R.F. CHOKE - 3.3 uh
L-3	705016	R.F. CHOKE - 3.3 uh
L-4	705014	R.F. CHOKE - 20 uh
L-5	705016	R.F. CHOKE - 3.3 uh
L-6	708032-1	SOUND I.F. COIL
L-7	708048	FOCUS COIL - EM - 2250 OHM
L-8	708090	PEAKING COIL - 80 uh
L-9	708032	WAVE TRAP - 4.5 MC.
L-10	708090	PEAKING COIL - 80 uh
L-11	708114	PEAKING COIL - 440 uh
L-12	708095	PEAKING COIL - 180 uh
L-13	708036	DEFLECTION YOKE - VERT.CLS.
L-14	708036	DEFLECTION YOKE - HOR.CLS.
L-15	738037	HORIZ. PHASE COIL
L-16	708052 OR	LINEARITY COIL
L-16	708056	LINEARITY COIL
L-17	708055	SIZE COIL
L-18	PT.OF SP-1	FIELD COIL
P-2	585056	PLUG & CABLE - SPEAKER
P-3	505014	PLUG - INTERLOCK SWITCH
R-1	340672	5,600 OHM ½W ±10%
R-2	340232	82 OHM ½W ±10%
R-3	350412	470 OHM ½W ±20%
R-4	350412	470 OHM ½W ±20%
R-5	350412	470 OHM ½W ±20%
R-6	340732	10,000 OHM ½W ±10%
R-7	340312	180 OHM ½W ±10%
R-8	350412	470 OHM ½W ±20%
R-9	350412	470 OHM ½W ±20%
R-10	340732	10,000 OHM ½W ±10%
R-11	PT.OF T-3	10,000 OHM ½W ±10%
R-12	340312	180 OHM ½W ±10%
R-13	350412	470 OHM ½W ±20%
R-14	340652	4,700 OHM ½W ±10%
R-15	340972	100,000 OHM ½W ±10%
R-16	340712	8,200 OHM ½W ±10%
R-17	340812	22,000 OHM ½W ±10%
R-18	340572	2,200 OHM ½W ±10%
R-19	340972	100,000 OHM ½W ±10%
R-20	340972	100,000 OHM ½W ±10%
R-21	340932	68,000 OHM ½W ±10%
R-22	390074-6	1 MEG.VOL.CNT.FRNT
R-23	351372	4.7 MEGOHM ½W ±20%
R-24	351132	470,000 OHM ½W ±20%
R-25	351132	470,000 OHM ½W ±20%
R-26	340212	68 OHM ½W ±10%
R-27	340932	68,000 OHM ½W ±10%
R-28	351212	1 MEGOHM ½W ±20%
R-29	397036	2.5 OHM W.W.BALLAST TUBE
R-30	341052	220,000 OHM ½W ±10%
R-31	394060-4	55 OHM 7.5W ±10%
R-32	394060-3	75 OHM 10W ±10%
R-33	340572	2,200 OHM ½W ±10%
R-34	340732	10,000 OHM ½W ±10%
R-35	394060-2	1,500 OHM 5W ±5%
R-36	340332	220 OHM ½W ±10%
R-37	370652	4,700 OHM 1W ±10%
R-38	351212	1 MEGOHM ½W ±20%
R-39	340652	4,700 OHM ½W ±10%
R-40	370832	27,000 OHM 1W ±10%
R-41	340572	2,200 OHM ½W ±10%
R-42	340732	10,000 OHM ½W ±10%
R-43	341092	330,000 OHM ½W ±10%
R-44	341332	3.3 MEGOHM ½W ±10%
R-45	341052	220,000 OHM ½W ±10%
R-46	340812	22,000 OHM ½W ±10%
R-47	PT.OF R-22	5,000 OHM CNTRST.CNT.-FRNT
R-48	351212	1 MEGOHM ½W ±20%
R-49	351212	1 MEGOHM ½W ±20%
R-50	340572	2,200 OHM ½W ±10%
R-51	370672	5,600 OHM 1W ±10%
R-52	340772	15,000 OHM ½W ±10%
R-53	340772	15,000 OHM ½W ±10%
R-54	390134-1	100,000 OHM BRTNS.CNT.-REAR
R-55	340812	22,000 OHM ½W ±10%
R-56	390132	100,000 OHM FOCUS CNT.-REAR
R-57	340812	22,000 OHM ½W ±10%
R-58	340812	22,000 OHM ½W ±10%
R-59	340852	33,000 OHM ½W ±10%
R-60	340972	100,000 OHM ½W ±10%
R-61	340932	68,000 OHM ½W ±10%
R-62	390134-1	100,000 OHM VERT.HOLD CONT.-R
R-63	390138	3 MEGOHM VERT.SIZE CONT.-R.
R-64	341332	3.3 MEGOHM ½W ±10%
R-65	340972	100,000 OHM ½W ±10%
R-66	340972	100,000 OHM ½W ±10%
R-67	340772	15,000 OHM ½W ±10%
R-68	351212	1 MEGOHM ½W ±20%
R-69	340712	8,200 OHM ½W ±10%
R-70	340532	1,500 OHM ½W ±10%
R-71	341012	150,000 OHM ½W ±10%
R-72	340812	22,000 OHM ½W ±10%
R-73	341012	150,000 OHM ½W ±10%
R-74	340712	8,200 OHM ½W ±10%
R-75	331192	820,000 OHM ½W ±5%
R-76	331012	150,000 OHM ½W ±5%
R-77	331012	150,000 OHM ½W ±5%
R-78	341012	150,000 OHM ½W ±10%
R-79	390134-1	100,000 OHM HORIZ.HOLD CONT-R
R-80	340952	82,000 OHM ½W ±10%
R-81	331312	2.7 MEGOHM ½W ±5%
R-82	330972	100,000 OHM ½W ±5%
R-83	340712	8,200 OHM ½W ±10%
R-84	340812	22,000 OHM ½W ±10%
R-85	331012	150,000 OHM ½W ±5%
R-86	330942	75,000 OHM ½W ±5%
R-87	340652	4,700 OHM ½W ±10%
R-88	351212	1 MEGOHM ½W ±20%
R-89	350272	120 OHM ½W ±10%
R-90	341052	220,000 OHM ½W ±10%
R-91	381132	470,000 OHM 1W ±20%
R-92	390132	100,000 OHM VERT. LIN.CONT.-R.
R-93	381132	470,000 OHM 1W ±20%
R-94	340892	47,000 OHM ½W ±10%
TUNER	470636	TUNER ASS'Y - STANDARD
TUNER	470640-1	TUNER ASS'Y - EMERSON
SP-1	180070	SPEAKER - 6" - EM
SW-1	PT.OF R-22	ON - OFF SWITCH
T-1	720104-1	1ST VIDEO I.F. TRANSF'M'R
T-2	720098	2ND VIDEO I.F. TRANSF'M'R
T-3	720106	3RD VIDEO I.F. TRANSF'M'R
T-4	720098	4TH VIDEO I.F. TRANSF'M'R
T-5		
T-6	708018	DISCRIMINATOR COIL
T-7	734058-1	SOUND OUTPUT TRANSFORMER
T-8	738050	VERT. OUTPUT TRANSFORMER
T-9	716052	HORIZ. OSC. COIL
T-10	738039 OR	HORIZ. OUTPUT TRANSF'M'R
T-9	716052-A	HORIZ. OSC. COIL
V-1	800533	VACUUM TUBE - 6AU6
V-2	800533	VACUUM TUBE - 6AU6
V-3	800533	VACUUM TUBE - 6AU6
V-4	800047	VACUUM TUBE - 12AT7
V-5	800533	VACUUM TUBE - 6AU6
V-6	800015	VACUUM TUBE - 6S8GT
V-7	800490	VACUUM TUBE - 25L6GT
V-8	800026	VACUUM TUBE - 12AU7
V-9	800026	VACUUM TUBE - 12AU7
V-10	800053	VACUUM TUBE - 12BH7
V-11	800039	VACUUM TUBE - 12SN7GT
V-12	800044	VACUUM TUBE - 19BG6-G
V-13	800046	VACUUM TUBE - 1X2
V-14	800045	VACUUM TUBE - 25W4GT
V-15	810003	TELEVISION TUBE - 12LP4
V-16		
V-17	800536	VACUUM TUBE - 6J6 T.V.
V-18	800535 OR	VACUUM TUBE - 6AG5 TUNER
V-18	800052	VACUUM TUBE - 6BC5 STANDARD
V-17	800536	VACUUM TUBE - 6J6 T.V.
V-18	800535 OR	VACUUM TUBE - 6AG5 TUNER
V-18	800052	VACUUM TUBE - 6BC5 STANDARD
V-17	800535 OR	VACUUM TUBE - 6AG5 EMERSON
V-17	800052	VACUUM TUBE - 6BC5 TUNER
V-18	800047	VACUUM TUBE - 12AT7
V-19	817001-1	SELENIUM RECTIFIER - 15 MA
V-20	817015	SELENIUM RECTIFIER - 250 MA
V-21	817015	SELENIUM RECTIFIER - 250 MA
X-1	585055	SOCKET - CABLE ASS'Y - KINES
X-2	500022	SOCKET - SPEAKER
X-3	583206	SOCKET - INTERLOCK SWITCH

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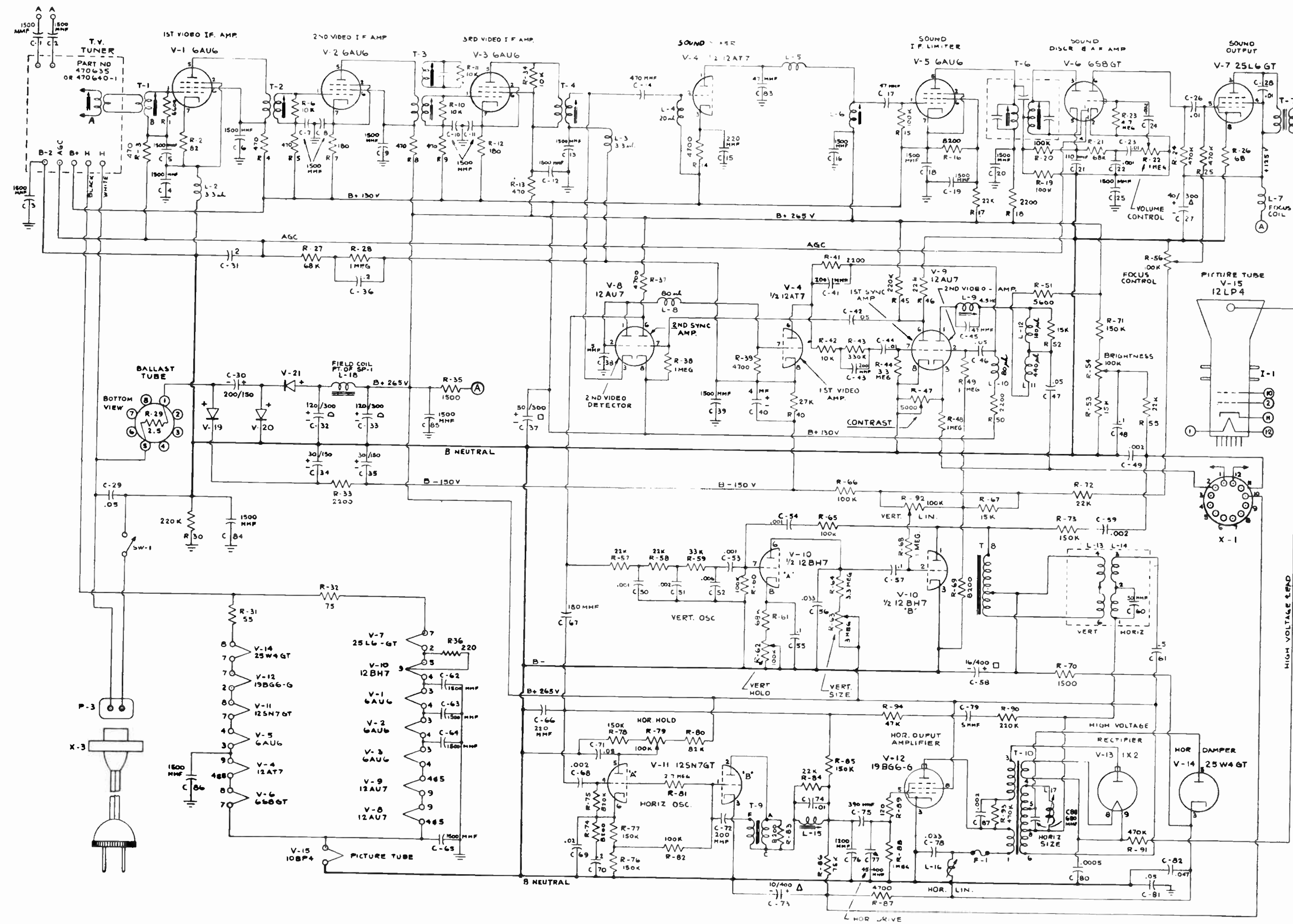

FIGURE 6 - SCHEMATIC DIAGRAM (CHASSIS 120123-B)

MODELS 650D, 654D, 655B, Ch. 120123-B

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Subject: Modifications to nullify effects of intercarrier buzz on Models 650D, 654D, 655B-Chassis 120123B.

I. Remove following components from circuit.

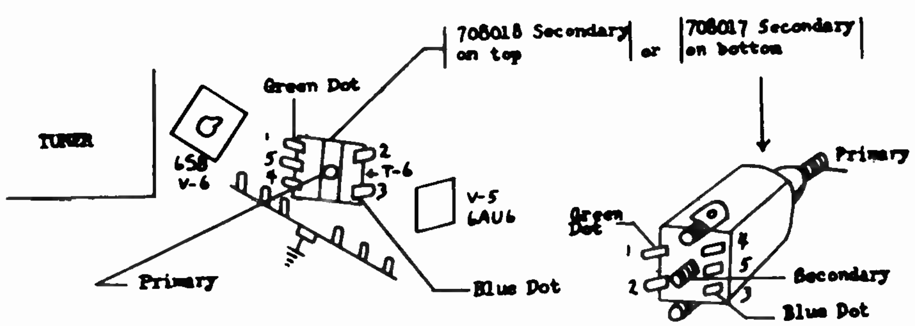
a) C-21 (110 mmf) connected between Pin #5 and Pin #2 of V-6 (6S8).
b) 2 - 100K (R-19, R-20) resistors from lug 5 of discriminator transformer (T-6).
c) R-16, C-19 (8200 ohms and 1500 mmf) from Pin #6 of V-5 (6AU6).
d) R-18 (2200) resistor from B+ point on terminal strip to lug 4 of T-6.

II Reconnect the following components

a) Remove pigtail of R-21 (68K) going to Pin #5 of 6S8 and connect to lug #5 of T-6.
b) Remove lead from Pin #3 of V-6 (6S8) and connect to Pin #5 of V-6.
c) Add a jumper wire from lug #4 of T-6 to Pin #6 of V-5 (6AU6).

III Add the following components

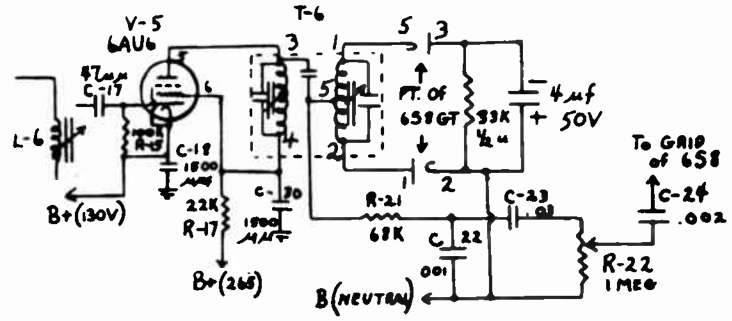
a) Place a 33K 1/2 watt resistor in parallel with a 4 mf 50 volt electrolytic condenser, part #925070-2 and connect from Pin #3 of V-6 (6S8GT) to neutral on nearby terminal board (2nd lug from tuner) with negative side of electrolytic to Pin #3, V-6 (6S8GT).
b) Add a .001 mf., 400 volt condenser from Pin #6 of V-6 (6S8GT) to B neutral.



IV Sound Alignment.

a) Place a D.C., V.T.V.M. (negative scale) across the 4 mf electrolytic ground terminal to B neutral (+side of electrolytic).
b) Tune in a good television station.
c) Adjust L-6 and primary of T-6 for maximum meter deflection.
d) Remove meter and adjust secondary (T-6) for maximum sound with minimum buzz.

NOTE: If buzz is not eliminated try changing the 6S8 tube and then repeat step IV.

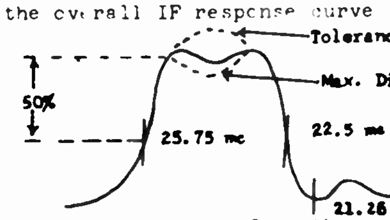


Subject: Change in overall I.F. response curve as shown in following preliminary service notes.

Models	Chassis
614D, 637A	120095B
650D, 654D, 655B	120123B
650F, 654F, 655F	120138B

Performance can be frequently be improved if the 25.75 mc picture IF marker and the 22.5 mc, IF bandpass marker appear at the 50% response point instead of the 75% down point as shown previously in the service notes for the above models.

When modified the overall IF response curve should appear as follows:



With 10 mc sweep width the output from the sweep generator should be adjusted to produce about .5 volts D.C. across the detector load (R-39, 4700 ohms).

Note: The above is particularly helpful when other expedients fail to minimize effects caused by station modulation variations.

VOLTAGE AND RESISTANCE READINGS

FOR CHASSIS 120123-B - MODELS 650D, 654D, 655B

NOTE: Voltage and resistance measurements listed here are for chassis 120123-B stamped with code marking triangle 2.

Voltages may vary slightly from table figures shown here if chassis is not coded as stated above. The peak to peak voltage given may vary slightly due to component variations.

CONDITIONS FOR TAKING VOLTAGE READINGS: (See table below).

1. Antenna disconnected and antenna terminals shorted.
2. Line voltage 117 volts.
3. All controls set for normal picture.
4. All readings taken with R.C.A. voltohmyst from points to B neutral (pin 8 of V9).

FOR A QUICK OVERALL RESISTANCE CHECK:

1. B plus (pin 6 of V2) to B neutral should read 80K approx.
2. B minus (pin 8 of V4) to B neutral should read 100K approx.
3. B neutral to chassis should read 300K approx.

CONDITIONS FOR TAKING RESISTANCE READINGS: (See table on other side).

1. Due to high leakage resistance between B plus, B neutral and B minus, these three points must be connected to obtain quick readings.
2. Connect pin 6 of V2 and pin 8 of V4 with B neutral.
3. After taking resistance readings remove shorting leads.

VOLTAGE READINGS FOR CHASSIS 120123-B

SYMBOL	TUBE PIN NO											
	PIN 1	PIN 2	PIN 3	PIN 4	PIN 5	PIN 6	PIN 7	PIN 8	PIN 9	PIN 10	PIN 11	PIN 12
V1	-1	0	39 A.C.	33 A.C.	120	120	0.6					
V2	125	125	33 A.C.	26 A.C.	260	260	130					
V3	125	130	26 A.C.	20 A.C.	260	260	130					
V4	265	125	130	13 A.C.	13 A.C.	105	-1.2	-0.9	20 A.C.			
V5	125	125	20 A.C.	26 A.C.	260	160	130					
V6	-0.5	0	-0.5	-0.8	0	46	7 A.C.	13 A.C.				
V7	0	49 A.C.	115	120	-8	-9	76A.C.	2.6				
V8	-1.5	-1.5	-0.5	7 A.C.	7 A.C.	220	115	130	13 A.C.			
V9	220	-7.5	0	20 A.C.	20 A.C.	15	-1	0	13 A.C.			
V10	350	-24	0	39 A.C.	49 A.C.	33	-1.5	8.5	49 A.C.			
V11	-88	215	0	-30	180	20	26A.C.	37 A.C.				
V12	N.C.	39 A.C.	0	-22	-22	N.C.	58A.C.	270				
V13	HIGH VOLTAGE - DO NOT MEASURE											
V14	N.C.	N.C.	380	N.C.	260	N.C.	58A.C.	82 A.C.				
V15	0	0								380	42	7 A.C.

RESISTANCE READINGS FOR CHASSIS 120123-B

SYMBOL	PIN NUMBER											
	PIN 1	PIN 2	PIN 3	PIN 4	PIN 5	PIN 6	PIN 7	PIN 8	PIN 9	PIN 10	PIN 11	PIN 12
V1	1M	3	22	20	30K	30K	85					
V2	30K	30K	20	17	0	0	30K					
V3	30K	30K	17	14	1K	1K	30K					
V4	500	30K	35K	11	11	34K	400	0	14			
V5	120K	30K	14	19	2500	25K	30K					
V6	0.1M	0	0.1M	1M	0.2M	0.4M	3	8				
V7	0	25	4K	4K	0.5M	35K	32	70				
V8	45K	45K	3	2	2	4500	0.8M	30K	9			
V9	6K	0.8M	60	10	10	19K	3M	0	7			
V10	INF.	1M	0	26	30	4.5M	90K	0.1M	26			
V11	0.25M	INF.	0	0.8M	80K	0.3M	17	23				
V12	N.C.	20	0	1M	1M	N.C.	22	500				
V13	FILAMENT INFINITY - PLATE 1.3 MEG.											
V14	N.C.	N.C.	INF.	N.C.	500	N.C.	25	35				

NOTE: Wave shapes for chassis 120123-B can be taken from "Preliminary Trouble Shooting Manual on Chassis 120133-B, Covering Models 660B, 664B and 673B." This manual is now being prepared and will be released in the near future.

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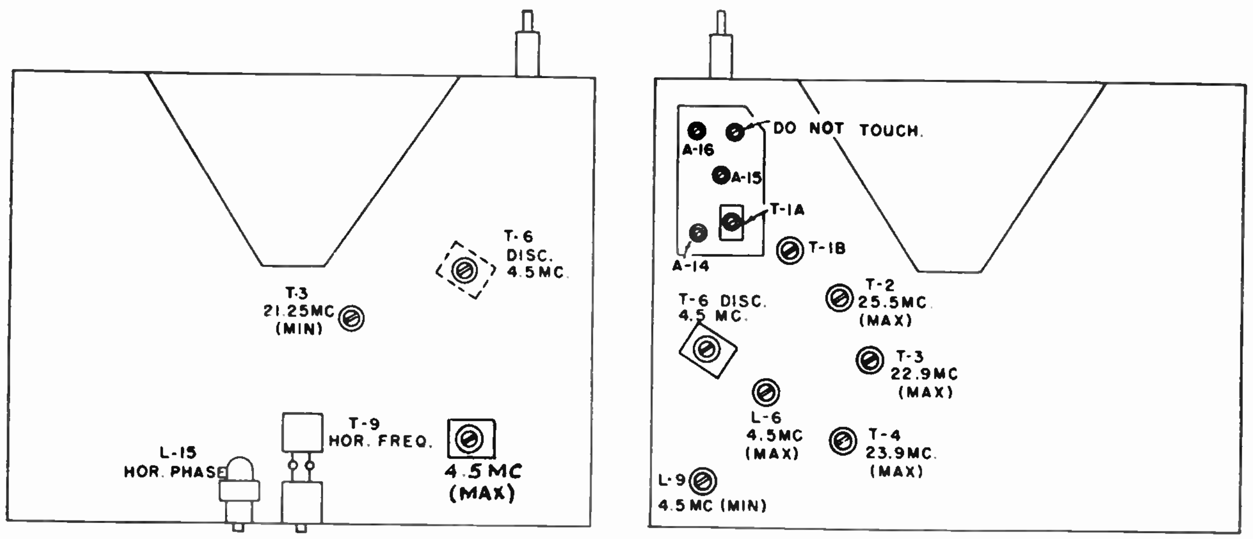
RECEIVER CHARACTERISTICS

ITEM	DESCRIPTION
Voltage Rating	115 volts, 60 cycles A.C.
Power Consumption	All Models - 155 watts
Current Drain (at 115 volts A.C.)	All Models - 1.4 Amps.
Frequency Range	54-88 MC; 174-216 MC.
Intermediate Frequencies	Video - 25.75 MC. Audio - 4.5 MC.
Antenna Input Impedance	300 Ohms, Balanced
Channel Selection	Twelve Position Rotary Turret
Chassis - Models	Models - 650F, 654F, 655F Chassis - 120138-B

I. ALIGNMENT

a. **Equipment Required** - A sweep generator, accurate marker generator, oscilloscope, and v.t.v.m. are required for alignment. The marker generator must be very accurate and supply frequencies of 4.5 MC., and 20 to 28 MC.



BOTTOM OF CHASSIS TOP OF CHASSIS

FIGURE I . LOCATION OF ALIGNMENT POINTS

b. **Response Curves** - The i-f response curves for the video i-f stages are shown in figure 2.

c. **Alignment Points** - The location of all i-f transformers, tuned circuits, and trimmers is shown in figure I.

d. **TV I-F Alignment** -

1) Tune receiver to Channel 3.

2) Connect 3 volt bias battery negative terminal from junction of C3I and R27 (positive terminal) to B-.

3) Shape overall response curve, after individual peaking of stagger-tuned and over-coupled i-fs, as indicated in steps I-6 below. See curves A and B.

STEP	SIGNAL GENERATOR INPUT CONNECTION	FREQUENCY	INSTRUMENT CONNECTION	ADJUST	PROCEDURE
1	Connect marker generator to pin 1 (grid) of V-1 (6AU6) through .001 mfd. condenser. Low side to B neutral.	25.5 MC	Connect d.c. v.t.v.m. to pin 7 (grid of V8 12AT7). Low side to pin 8 of V8. Use 3 or 5 volt range.	T2	Peak for maximum response. Adjust generator signal level to produce one volt at grid of V8.
2	"	22.9 MC	"	T3 (Top)	"
3	"	21.25 MC	"	T3 (Bottom)	Adjust for minimum response. Repeat step 2.
4	"	23.9 MC	"	T4	Peak for maximum response.
5	Connect sweep generator to converter (6J6 or 12AT7) input, using three turn loop of wire slipped over tube. Connect marker gen. in parallel.	Sweep-24.5 MC (10 MC sweep) Marker-21.25 MC and 25.75 MC	Connect vertical input of scope through *detector network to pin 1 (grid) of V-2 (6AU6). Low side to B+ (130V). *Low input impedance of about 200 ohms	T1(A) T1(B)	Set markers as shown on response curve A, fig. 2. Note that the markers should be 20% down for this stage.
6	"	Sweep-24.5 MC (10 MC sweep) Marker-22.6 and 25.75 MC	Connect vertical input of scope in series with 10K resistor to pin 7 (grid) of V8 (12AT7). Low side to pin 8 of V8.	T2, T3, and T4	Adjust for overall response as shown in curve B, fig. 2. Adjust T2 to position 25.75 MC marker; adjust T3 (Top) to set 22.6 MC marker. Do not readjust trap. Equalize peaks of response curve by adjusting T4.

TABLE I . VIDEO I-F ALIGNMENT

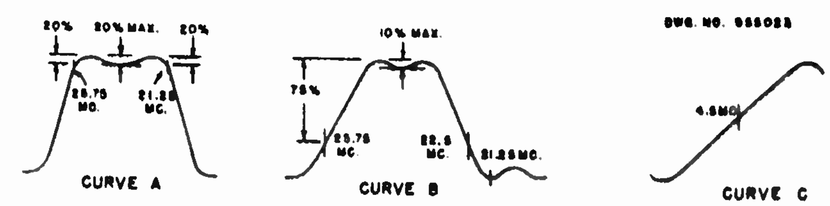


FIGURE 2 . RESPONSE CURVES

e. **TV Sound Alignment** -

1) Set receiver to Channel 3.

2) Use accurate, crystal-controlled, marker generator.

f. **TV R-F Alignment** -

1) Set fine tuning control to mechanical center. Retain this setting for entire r-f alignment.

2) Use 300 ohm carbon resistor as dummy antenna.

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STEP	SIGNAL GENERATOR INPUT CONNECTION	SIGNAL GENERATOR INPUT FREQUENCY	MEASURING INSTRUMENT	ADJUST	PROCEDURE
1	Marker generator through .001 uf to junction of L-4, C-38. Low side to chassis.	Marker-4.5 MC.	Connect v.t.v.m. through 10K resistor to pin 1 (grid of V-5). Low side to B+ (130V).	C-89	Peak for maximum negative response. Adjust generator input to produce one volt at grid of V5. (Above no signal value.
2	"	"	"	L6	"
3	Connect sweep generator in parallel with marker gen.	Sweep-4.5 MC (450 KC sweep) Marker-4.5 MC	Replace v.t.v.m. with scope connected through 10K resistor to junction of R21 and C22. Low side to B neutral.	T6 (Secondary)	Position 4.5 MC. marker at center of S-curve, by adjusting secondary. (See Fig. 2 - curve C).
4	"	"	"	T6 (Primary)	Peak primary for maximum amplitude and linearity. Repeat step 3. (See Fig. 2 - curve C)
5	Marker generator through .001 mfd. to pin 7 of V8 (12AT7) low side to pin 8 of V8.	Marker-4.5 MC	A.C. v.t.v.m. or D.C. v.t.v.m. used with a peak detector probe to junction of R52, C47. Low side to B neutral.	L9	Adjust for min. reading of v.t.v.m. Keep contrast control set for maximum contrast.

TABLE II. AUDIO I-F AND DISC ALIGNMENT

3) Couple marker generator in parallel with sweep generator.

4) Use 10 MC. sweep for sweep generator. Couple generator to antenna terminals of receiver.

5) Connect vertical input of scope in series with 10K resistor to junction of R39 and L4 (pin 7 grid of V8), low side to pin 8 of V8.

STEP	SIGNAL GENERATOR INPUT SWEEP GEN.	SIGNAL GENERATOR INPUT MARKER GEN.	CHANNEL	ADJUST	PROCEDURE
1	207.0 MC.	209.75 MC.	12	A12	Adjust for placement of 21.25 MC. marker as per response curve B.
2	"	"	12	A14, A15, A16	Adjust shape of response curve B for maximum amplitude and bandwidth.
3	213.0 MC.	215.75 MC.	13	A13	Adjust as in Step 1.
4	201.0 MC.	203.75 MC.	11	A11	"
5	195.0 MC.	197.75 MC.	10	A10	"
6	189.0 MC.	191.75 MC.	9	A9	"
7	183.0 MC.	185.75 MC.	8	A8	"
8	177.0 MC.	179.75 MC.	7	A7	"
9	85.0 MC.	87.75 MC.	6	A6	"
10	79.0 MC.	81.75 MC.	5	A5	"
11	69.0 MC.	71.75 MC.	4	A4	"
12	63.0 MC.	65.75 MC.	3	A3	"
13	57.0 MC.	59.75 MC.	2	A2	"

TABLE III. R.F. ALIGNMENT

2. OPERATING CONTROLS

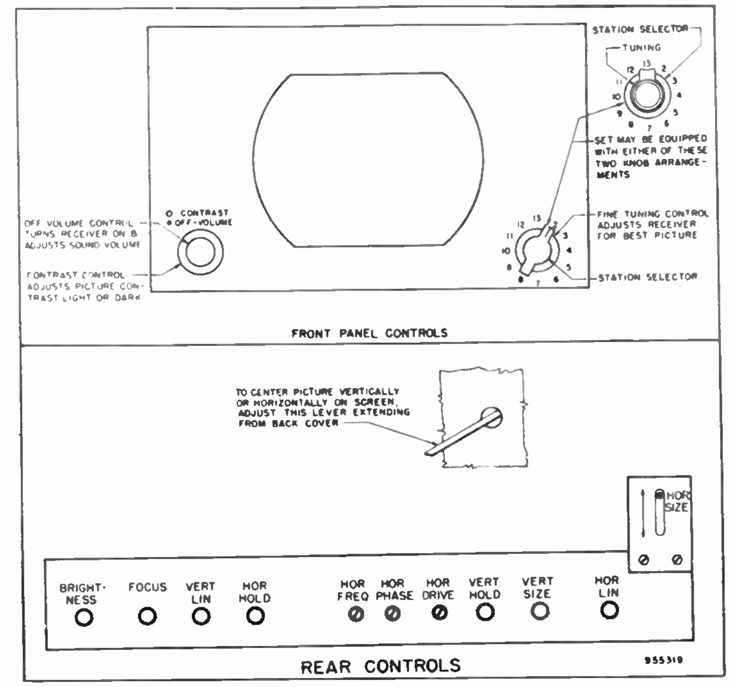

FIGURE 3. OPERATING CONTROLS (FOR MODELS 650F. 654F AND 655F)

3. TUBE LOCATIONS

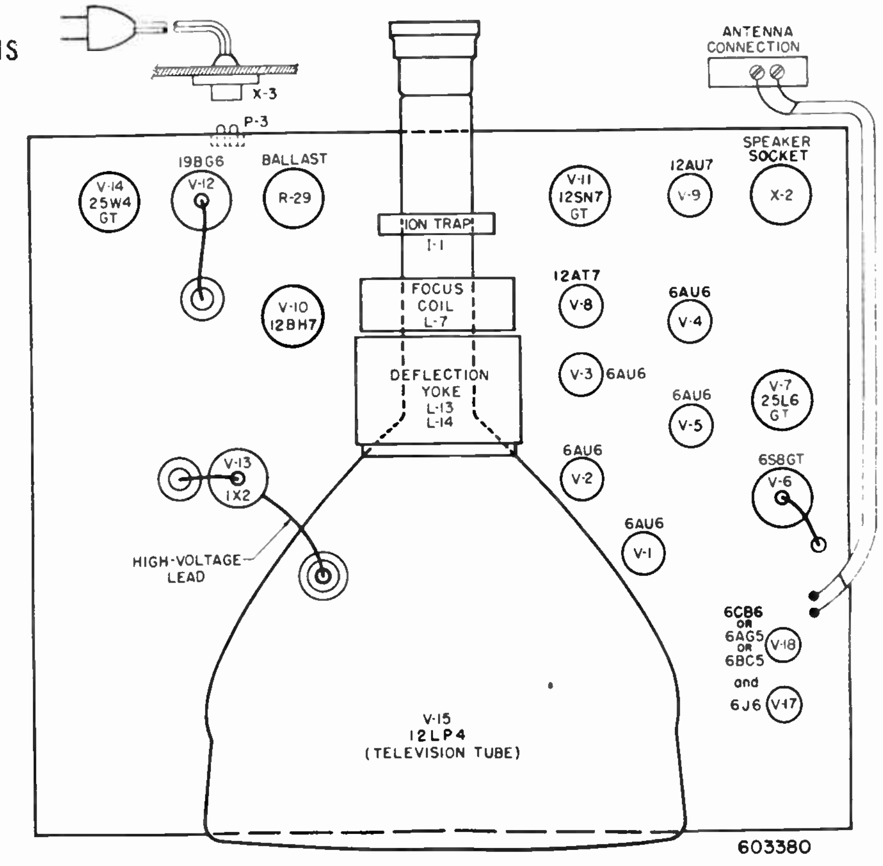

FIGURE 4. TUBE LOCATION DIAGRAM (FOR CHASSIS 120138B)

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4. ALIGNMENT OF MIRACLE PICTURE LOCK (Horizontal Sweep Automatic Freq. Control)

This must be done with chassis removed from cabinet and a scope.

1. Short phasing coil by using a clip lead across C-74 (.01 mf.)
2. Turn horizontal hold control counter clockwise when viewed from front of control. (Center tap at lowest B+ voltage).
3. Starting with frequency slug (T-9) all the way out rotate in until picture locks into synchronization.
4. Remove short from phasing coil and adjust in following manner.
   a) Place scope lead in series with 10,000 ohm resistor to junction R-83, L-15 low side to B neutral (B-).
   b) Set sweep frequency of scope to 8,000 and adjust fine frequency until pattern on scope is stationary (Note picture should be in synch during this adjustment.)
   c) Phasing slug (L-15) should be adjusted so that you have even peaks as shown in Figure 5 below.

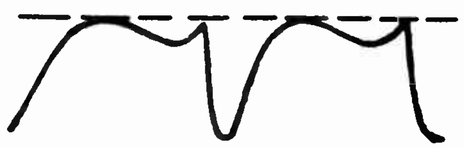

FIGURE 5

5. Switch tuner to off channel then back. Picture should be out of synch and from 4 to 5 black horizontal bars visible. If more or less, adjust horizontal frequency slug (T-9) until the 4 to 5 bars are seen.
6. Turn horizontal hold control slowly clockwise. Picture should synch in at about 1/4 of a turn. The picture should then remain in synchronization over the whole range of the horizontal hold control.

5. TUBE LOCATIONS

The tube complements of chassis 120138B are listed in the following table:

SYMBOL	TUBE TYPE	FUNCTION	SYMBOL	TUBE TYPE	FUNCTION
V-1	6AU6	1st Video I.F. Ampl.	V-14	25W4GT	Horizontal Damper
V-2	6AU6	2nd Video I.F. Ampl.	V-15	2LP4	Kinescope
V-3	6AU6	3rd Video I.F. Ampl.	V-16	IN60	2nd Det.(Video) Germanium Crystal
V-4	6AU6	Sound I.F. Amplifier	V-17	6J6	Oscillator & Converter
V-5	6AU6	Sound I.F. Limiter	V-18	6CB6 or 6AG5 or 6BC5	R.F. Amplifier
V-6	6S8GT	Sound Discr. & A.F. Ampl.	V-19		Selenium Rectifier
V-7	25L6GT	Sound Output	V-20		Selenium Rectifier
V-8	12AT7	2nd Sync. Ampl.	V-21		Selenium Rectifier
V-9	12AU7	2nd Video Ampl.			
V-10	12BH7	Vertical Osc. & Output			
V-11	12SN7GT	Horizontal Oscillator			
V-12	19BG6	Hor. Output Ampl.			
V-13	1X2	High Voltage Rectifier			

TABLE IV TUBE COMPLEMENTS

6. CHASSIS PARTS LIST (CHASSIS 120138-B)

SYMBOL	PT. NO.	DESCRIPTION
C-1	928006	1500 MMF (MIN.) 400V
C-2	928006	1500 MMF (MIN.) 400V
C-3	928006	1500 MMF (MIN.) 400V
C-4	928006	1500 MMF (MIN.) 400V
C-5	928006	1500 MMF (MIN.) 400V
C-6	928006	1500 MMF (MIN.) 400V
C-7	928006	1500 MMF (MIN.) 400V
C-8	928006	1500 MMF (MIN.) 400V
C-9	928006	1500 MMF (MIN.) 400V
C-10	928006	1500 MMF (MIN.) 400V
C-11	928006	1500 MMF (MIN.) 400V
C-12	928006	1500 MMF (MIN.) 400V
C-13	928006	1500 MMF (MIN.) 400V
C-14	928006	1500 MMF (MIN.) 400V
C-15	928002	10 MMF 500V . . .
C-16	928006	1500 MMF (MIN.) 400V
C-17	910033	47 MMF . . . . . .
C-18	928006	1500 MMF (MIN.) 400V
C-19	928006	1500 MMF (MIN.) 400V
C-20	928006	1500 MMF (MIN.) 400V
C-21	910043	110 MMF . . . . . .
C-22	923079	.001 MF 600V . . .
C-23	923061	.01 MF 400V . . .
C-24	923088	.002 MF 600V . . .
C-25	928006	1500 MMF 400V . . .
C-26	923061	.01 MF 400V . . .
C-27	925181	40 MF 300V . . .
C-28	923061	.01 MF 400V . . .
C-29	922101	.05 MF 400V . . .
C-30	925166-1	200 MF 150V . . .
C-31	923201	2 MF 50V . . .
C-32	925166-3	120 MF 300V . . .
C-33	PT-OF C-27	120 MF 300V . . .
C-34	925070-1	30 MF 150V . . .
C-35	925070-1	30 MF 150V . . .
C-36	923091	.2 MF 200V . . .
C-37	PT.OF C-27	50 MF 300V . . .
C-38	928023	5 MMF . . . . . .
C-39	928006	1500 MMF (MIN.) 400V
C-40	925070-2	4 MF 200V . . .
C-41	910047	200 MMF 500V . . .
C-42	923062	.05 MF 400V . . .
C-43	910047	200 MMF 500V . . .
C-44	922032	.01 MF 600V . . .
C-45	PT-OF L-9	47 MMF . . . . . .
C-46	923062	.05 MF 400V . . .
C-47	923062	.05 MF 400V . . .
C-48	923064	.1 MF 400V . . .
C-49	923088	.002 MF 600V . . .
C-50	923079	.001 MF 600V . . .
C-51	923088	.002 MF 600V . . .
C-52	923092	.006 MF 400V . . .
C-53	923079	.001 MF 600V . . .
C-54	922021	.001 MF 600V . . .
C-55	922014	.1 MF 200V . . .
C-56	922024	.033 MF 600V . . .
C-57	922008	.1 MF 400V . . .
C-58	PT.OF C-32	15 MF 400V . . .
C-59	923088	.002 MF 600V . . .
C-60	910090	50 MMF 500V . . .
C-61	923102	.5 MF 200V . . .
C-62	928006	1500 MMF 400V . . .
C-63	928006	1500 MMF 400V . . .
C-64	928006	1500 MMF 400V . . .
C-65	928006	1500 MMF 400V . . .
C-66	910028	220 MMF . . . . . .
C-67	910043-2	180 MMF . . . . . .
C-68	923088	.002 MF 600V . . .
C-69	923114	.02 MF 400V . . .
C-70	923091	.2 MF 200V . . .
C-71	923062	.05 MF 400V . . .
C-72	910047	200 MMF 500V . . .
C-73	PT.OF C-32	10 MF 400V . . .
C-74	922041	.01 MF 600V . . .
C-75	910212	390 MMF . . . . . .
C-76	910044	1200 MMF . . . . . .
C-77	900073	45-400 MMF . . . . . .
C-78	922024	.033 MF 600V . . .
C-79	910045	5 MMF 1000V . . .
C-80	923015	.0005 MF 10KV . . .
C-81	922101	.05 MF 400V . . .
C-82	922023	.047 MF 600V . . .
C-83	915000-1	47 MMF . . . . . .
C-84	928006	1500 MMF 400V . . .
C-85	928006	1500 MMF 400V . . .
C-86	928006	1500 MMF 400V . . .
C-87	923088	.002 MF 600V . . .
C-88	928054	680 MMF 1000V . . .
C-89	900064	3-35 MMF . . . . . .
F-1	808170	FUSE . . . .
I-1	708061	ION TRAP - SINGLE. .
L-2	705016	R.F. CHOKE - 3.3 uh.
L-3	705016	R.F. CHOKE - 3.3 uh.
L-4	708090	PEAKING COIL - 80 uh.
L-5	708093	PEAKING COIL - 35 uh.
L-6	708032-1	SOUND I.F. COIL. . .
L-7	708048	FOCUS COIL - EM - 2250 OHM . . . . .
L-8		
L-9	708032	WAVE TRAP - 4.5 MC. .
L-10	708090	PEAKING COIL - 80 uh.
L-11	708114	PEAKING COIL - 440 uh
L-12	708095	PEAKING COIL - 180 uh
L-13, L-14	708036	DEFLECTION YOKE - VERT. COILS; DEFLECTION YOKE - HORIZ. COILS
L-15	738037	HORIZ. PHASE COIL. .
L-16	708052	LINEARITY COIL . . .
L-17	708055	SIZE COIL. . . . . .
L-18	PT.OF SP-1	
P-2	585061	PLUG & CABLE - SPEAKER (TABLE MODEL) . . . . .

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SYMBOL	PT. NO.	DESCRIPTION
P-2	585062	PLUG & CABLE – SPEAKER (CONSOLE) . . . .
P-3	505014	PLUG – INTERLOCK SWITCH .
R-1	340672	5600 OHM ½W ±10% . .
R-2	340232	82 OHM ½W ±10% . .
R-3	350412	470 OHM ½W ±20% . .
R-4	350412	470 OHM ½W ±20% . .
R-5	350412	470 OHM ½W ±20% . .
R-6	340732	10,000 OHM ½W ±10% . .
R-7	340292	150 OHM ½W ±10% . .
R-8	350412	470 OHM ½W ±20% . .
R-9	350412	470 OHM ½W ±20% . .
R-10	340732	10,000 OHM ½W ±10% . .
R-11	PT. OF T-3	10,000 OHM ½W ±10% . .
R-12	340292	150 OHM ½W ±10% . .
R-13	350412	470 OHM ½W ±20% . .
R-14	340232	82 OHM ½W ±10% . .
R-15	340972	100,000 OHM ½W ±10% . .
R-16	340712	8,200 OHM ½W ±10% . .
R-17	340812	22,000 OHM ½W ±10% . .
R-18	340572	2,200 OHM ½W ±10% . .
R-19	340972	100,000 OHM ½W ±10% . .
R-20	340972	100,000 OHM ½W ±10% . .
R-21	340932	68,000 OHM ½W ±10% . .
R-22	390074-6	1 MEGOHM CONT. – FRONT
R-23	351372	4.7 MEGOHM ½W ±20% . .
R-24	351132	470,000 OHM ½W ±20% . .
R-25	351132	470,000 OHM ½W ±20% . .
R-26	340212	68 OHM ½W ±10% . .
R-27	340932	68,000 OHM ½W ±10% . .
R-28	351212	1 MEGOHM ½W ±20% . .
R-29	397036	2.5 OHM W.W. BALLAST TUBE
R-30	341052	220,000 OHM ½W ±10% . .
R-31	394060-4	55 OHM 7.5W ±10% . .
R-32	394060-3	75 OHM 10W ±10% . .
R-33	340572	2,200 OHM ½W ±10% . .
R-34	340732	10,000 OHM ½W ±10% . .
R-35	394060-2	1,500 OHM 5W ± 5% . .
R-36	340332	220 OHM ½W ±10% . .
R-37	370652	4,700 OHM 1W ±10% . .
R-38	397066	15,000 OHM 2W ±10% . .
R-39	340652	4,700 OHM ½W ±10% . .
R-40	370832	27,000 OHM 1W ±10% . .
R-41	340572	2,200 OHM ½W ±10% . .
R-42	340732	10,000 OHM ½W ±10% . .
R-43	341092	330,000 OHM ½W ±10% . .
R-44	341332	3.3 MEGOHM ½W ±10% . .
R-45	341052	220,000 OHM ½W ±10% . .
R-46	340812	22,000 OHM ½W ±10% . .
R-47	PT. OF R-22	5,000 OHM CONTRAST CONT.–FRONT
R-48	351212	1 MEGOHM ½W ±20% . .
R-49	351212	1 MEGOHM ½W ±20% . .
R-50	340572	2,200 OHM ½W ±10% . .
R-51	370672	5,600 OHM 1W ±10% . .
R-52	340772	15,000 OHM ½W ±10% . .
R-53	340772	15,000 OHM ½W ±10% . .
R-54	390134-1	100,000 OHM BRTNS. CNT.–FR.
R-55	340812	22,000 OHM ½W ±10% . .
R-56	390132	100,000 OHM CONT. – REAR
R-57	340812	22,000 OHM ½W ±10% . .
R-58	340812	22,000 OHM ½W ±10% . .
R-59	340852	33,000 OHM ½W ±10% . .
R-60	340972	100,000 OHM ½W ±10% . .

SYMBOL	PT. NO.	DESCRIPTION
R-61	340932	68,000 OHM ½W ±10% . .
R-62	390134-1	100,000 OHM VERT. HOLD CONT.–R
R-63	390138	3 MEGOHM VERT. SIZE CONT.–R
R-64	341312	2.7 MEGOHM ½W ±10%
R-65	340972	100,000 OHM ½W ±10% . .
R-66	340972	100,000 OHM ½W ±10% . .
R-67	340812	22,000 OHM ½W ±10% . .
R-68	351212	1 MEGOHM ½W ±20% . .
R-69	340712	8,200 OHM ½W ±10% . .
R-70	340532	1,500 OHM ½W ±10% . .
R-71	341012	150,000 OHM ½W ±10% . .
R-72	340812	22,000 OHM ½W ±10% . .
R-73	341012	150,000 OHM ½W ±10% . .
R-74	340712	8,200 OHM ½W ±10% . .
R-75	331192	820,000 OHM ½W ± 5% . .
R-76	331012	150,000 OHM ½W ± 5% . .
R-77	331012	150,000 OHM ½W ± 5% . .
R-78	341012	150,000 OHM ½W ±10% . .
R-79	390134-1	100,000 OHM HORIZ. HOLD CONT.–R
R-80	340952	82,000 OHM ½W ±10% . .
R-81	331312	2.7 MEGOHM ½W ± 5% . .
R-82	330972	100,000 OHM ½W ± 5% . .
R-83	340712	8,200 OHM ½W ±10% . .
R-84	340812	22,000 OHM ½W ±10% . .
R-85	331012	150,000 OHM ½W ± 5% . .
R-86	330942	75,000 OHM ½W ± 5% . .
R-87	340652	4,700 OHM ½W ±10% . .
R-88	351212	1 MEGOHM ½W ±20% . .
R-89	340272	120 OHM ½W ±10% . .
R-90	341052	220,000 OHM ½W ±10% . .
R-91	381132	470,000 OHM 1W ±20% . .
R-92	390132	100,000 OHM VERT. LIN. CONT.–R
R-93	381132	470,000 OHM 1W ±20% . .
R-94	340892	47,000 OHM ½W ±10% . .
R-95	350492	1,000 OHM ½W ±20% . .
R-96	351212	1 MEGOHM ½W ±20% . .
TUNER	470636	TUNER ASSY. – STANDARD. . .
SP-1	180070	SPEAKER – 6" – EM } TABLE MODEL
SP-1	or 180073	SPEAKER – 6" – EM } TABLE MODEL
SP-1	180072	SPEAKER – 12" (CONSOLE)
SW-1	PT. OF R-22	ON – OFF SWITCH
T-1	720104-1	1st VIDEO I.F. TRANSF'M'R .
T-2	720098	2nd VIDEO I.F. TRANSF'M'R .
T-3	720106	3rd VIDEO I.F. TRANSF'M'R .
T-4	720098	4th VIDEO I.F. TRANSF'M'R .
T-5		
T-6	708018	DISCRIMINATOR COIL. . . . .
T-7	734058-1	SOUND OUTPUT TRANSFORMER. .
T-8	738054	VERT. OUTPUT TRANSF'M'R
T-9	716052	HORIZ. OSC. TRANSFORMER
T-10	738039	HORIZ. OUTPUT TRANSFORMER
V-1	800533	VACUUM TUBE – 6AU6
V-2	800533	VACUUM TUBE – 6AU6
V-3	800533	VACUUM TUBE – 6AU6
V-4	800533	VACUUM TUBE – 6AU6
V-5	800533	VACUUM TUBE – 6AU6
V-6	800015	VACUUM TUBE – 6S8GT
V-7	800490	VACUUM TUBE – 25L6GT

SYMBOL	PT. NO.	DESCRIPTION
V-8	800047	VACUUM TUBE – 12AT7
V-9	800026	VACUUM TUBE – 12AU7
V-10	800053	VACUUM TUBE – 12BH7
V-11	800039	VACUUM TUBE – 12SN7GT
V-12	800044	VACUUM TUBE – 19BG6-G
V-13	800046	VACUUM TUBE – 1X2
V-14	800045	VACUUM TUBE – 25W4GT
V-15	810003-4	TELEVISION TUBE – 12LP4
V-16	817018	GERMANIUM CRYSTAL – IN60
V-17	800536	VACUUM TUBE – 6J6 } T.V. TUNER STANDARD
V-18	800535 or	VACUUM TUBE – 6AG5 } T.V. TUNER STANDARD
V-18	800052	VACUUM TUBE – 6BC5 } T.V. TUNER STANDARD

SYMBOL	PT. NO.	DESCRIPTION
V-19	817000-1	SELENIUM RECTIFIER – 15 MA
V-20	817015	SELENIUM RECTIFIER – 250 MA
V-21	817015	SELENIUM RECTIFIER – 250 MA
X-1	585063	SOCKET – CABLE ASSY. – KINESCOPE
X-2	500022	SOCKET – SPEAKER . . . . .
X-3	583206	SOCKET – INTERLOCK SWITCH – LINE CORD . . . .

7. CABINET PARTS LIST (Models 650F, 654F, 655F)

PART NO.			DESCRIPTION
MODEL 650F	MODEL 654F	MODEL 655F	
140354			Cabinet
140371			Cabinet (Blond)
	140367		Cabinet
	140361		Cabinet (Blond)
		140360	Cabinet
520124	520124		Glass Panel (Green)
		635028	Safety Glass
411060	411060	411060	Metal Mask (Green)
560149		560149	Masonite Back
	560142		Masonite Back
520103	520103	520103	Selector Escutcheon (Tuner)
450028	450028	450028	Escutcheon - Off Volume Contrast
450071	450071		Knob - Contrast
450072S	450072S		Knob - Volume
450073S	450073S		Knob - Selector
450074	450074		Knob - Fine Tuning
587011	587011	587011	Spring Insert - 1/4"
587012	587012	587012	Spring Insert - 3/8"
		450095	Knob - Contrast
		450096S	Knob - Volume
		450097S	Knob - Selector
		450098	Knob - Fine Tuning
180073		180073	Speaker (6")
	180072		Speaker (12")
585061		585061	Speaker Plug & Cable
	585062		Speaker Plug & Cable

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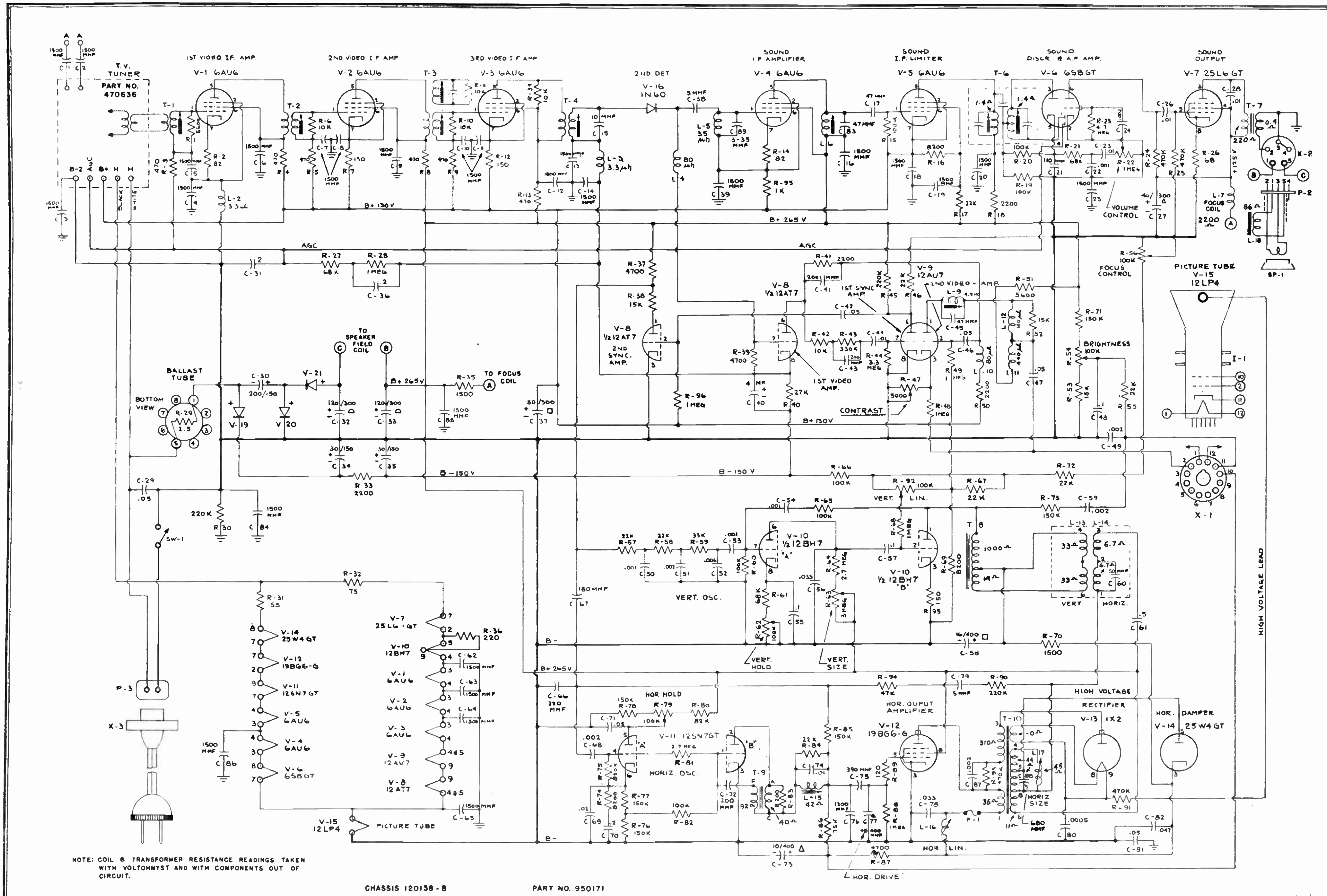

FIGURE 6 - SCHEMATIC DIAGRAM (CHASSIS 120138B)

MODELS 650F, 654F, 655F, Ch. 120138-B

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Subject: Circuit modifications in Models 650F, 654F, 655F using Chassis 120138B.

Sets coded Triangle 1 have the following changes incorporated to reduce the effects caused by station modulation variation and to make tuning easier.

1. R-16 (8200 ohms), R-17 (22K ohms) R-95 (1K ohms), C-19 (1500 mmf.) are removed from the circuit.
2. The junction of C-20, R-13 and T-6 is connected to Pin 6 of V-5 (6AU6) by means of a jumper wire.
3. The value of R-18 has been changed from 2200 ohms to 68K ohms, 1/2 watt.
4. All leads to junction of (L-5, C-89), C-39, R-14, and Pin 2 of V-4 are disconnected from one another and rewired as follows:

Note: L-5 and C-89 are left connected to one another.
a) R-14 (82 ohms) is wired to B+ (130 volt line).
b) Pin 2 of V-4 (6AU6) is wired to Pin 7 of the same tube.
C) C-39 (1500 mmf.) is wired to Pin 7 of V-4.

5. The following components have been added.
   a) A 1 megohm, 1/2 watt resistor from Pin 1 of V-5 to junction of L-5, C-89.
   b) A .01 mf., 200 volt condenser from junction L-5, C-89, 1 meg. to Pin 7 of V-4 (6AU6).
   c) A 33K ohm, 1 watt resistor from Pin 6 of V-8 (12AT7) to B+ (265 volt line).

VOLTAGE AND RESISTANCE READINGS FOR CHASSIS 120138-B - MODELS 650F, 654F, 655F

NOTE: Voltage and resistance measurements listed here are for chassis 120138-B stamped with a triangle but without a number stamped within the triangle.

Voltages may vary slightly from table figures shown here if chassis is not coded as stated above. The peak to peak voltage given may vary slightly due to component variations.

CONDITIONS FOR TAKING VOLTAGE READINGS: (See table below)

1. Antenna disconnected and antenna terminals shorted.
2. Line voltage 117 volts.
3. All controls set for normal picture.
4. All readings taken with R.C.A. voltohmyst from point to B neutral (pin 8 of V9).

FOR A QUICK OVERALL RESISTANCE CHECK:

1. B plus (pin 6 of V2) to B neutral should read 0.1M.
2. B neutral to chassis should read 220K.
3. B minus (pin 8 of V8) to B neutral should read 120K.

CONDITIONS FOR TAKING RESISTANCE READINGS: (See table)

1. Due to high leakage resistance between B plus, B neutral and B minus, these three points must be connected to obtain quick readings.
2. Connect B plus (pin 6 of V2) and B minus (pin 8 of V8) to B neutral (pin 8 of V9) to obtain resistance readings.
3. After taking resistance readings remove shorting leads.

VOLTAGE READINGS FOR CHASSIS 120138-B

SYMBOL	TUBE PIN NO.											
	PIN 1	PIN 2	PIN 3	PIN 4	PIN 5	PIN 6	PIN 7	PIN 8	PIN 9	PIN 10	PIN 11	PIN 12
V1	-0.3	0	38 A.C.	32 A.C.	115	115	0.8					
V2	120	120	32 A.C.	25 A.C.	245	245	120					
V3	120	120	25 A.C.	19 A.C.	245	245	120					
V4	130	130	12A.C.	18 A.C.	250	250	130					
V5	115	120	18 A.C.	25 A.C.	245	155	120					
V6	-1.2	0	-1.2	-0.3	0.3	86	5.5A.C.	12A.C				
V7	0	48A.C.	98	105	-5.8	-6	74 A.C.	2.5				
V8	110	-0.5	0	5.5A.C.	5.5A.C.	100	35	36	12A.C.			
V9	215	-6.7	0.2	18 A.C.	18 A.C.	22	-1.7	0	12A.C.			
V10	360	-16	0	37 A.C.	48 A.C.	36	-1.4	8.5	48A.C.			
V11	-84	210	0	-21	180	-11	25A.C.	37A.C.				
V12	N.C.	18A.C.	0	-22	-22	N.C.	56A.C.	270				
V13	HIGH VOLTAGE - DO NOT MEASURE											
V14	N.C.	N.C.	400	N.C.	260	N.C.	28A.C.	40A.C.				
V15	0	0								390	29	6A.C.

RESISTANCE READINGS FOR CHASSIS 120138-B

SYMBOL	TUBE PIN NOS											
	PIN 1	PIN 2	PIN 3	PIN 4	PIN 5	PIN 6	PIN 7	PIN 8	PIN 9	PIN 10	PIN 11	PIN 12
V1	1.2M	3	22	20	30K	30K	85					
V2	30K	30K	20	17	0	0	30K					
V3	30K	30K	17	13	1K	1K	30K					
V4	30K	30K	10	15	500	500	30K					
V5	120K	30K	15	18	3500	20K	30K					
V6	90K	0	90K	1.2M	180K	0.5M	2.5	10				
V7	0	28	4K	3.6K	450K	22K	36	70				
V8	20K	1M	0	2	2	30K	250	0	9			
V9	5.5K	0.8M	200	14	14	18K	3M	0	9			
V10	INF.	0.8M	0	22	28	4M	0.1M	0.1M	22			
V11	250K	INF.	0	0.8M	60K	0.3M	16	24				
V12	N.C.	24	0	0.8M	0.8M	N.C.	30	5.5				
V13	FILAMENT INFINITY - PLATE 1.3 MEG.											
V14	N.C.	N.C.	INF.	N.C.	22	N.C.	30	40				
V15	0	0.8M								INF.	50K	2

NOTE: Wave shapes for chassis 120138-B can be taken from "Preliminary Trouble Shooting Manual on Chassis 120133-B, Covering Models 660B, 664B and 673B."

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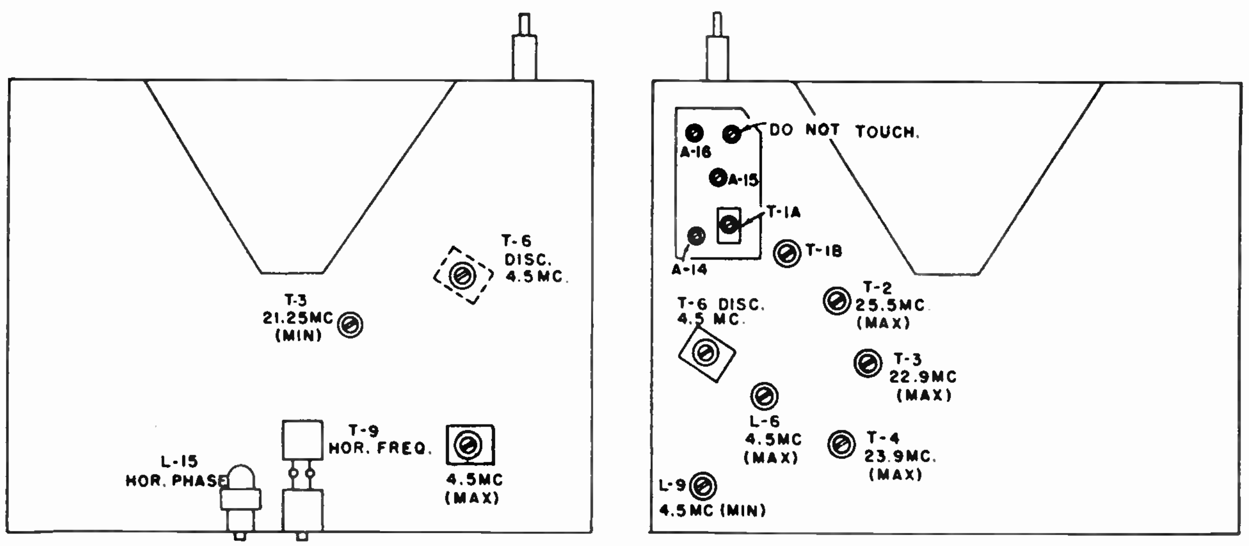
RECEIVER CHARACTERISTICS

ITEM	DESCRIPTION
Voltage Rating	115 volts, 60 cycles A.C.
Power Consumption	All Models - 155 watts
Current Drain (at 115 volts A.C.)	All Models - 1.4 Amps.
Frequency Range	54-88 MC; 174-216 MC.
Intermediate Frequencies	Video - 25.75 MC. Audio - 4.5 MC.
Antenna Input Impedance	300 Ohms, Balanced
Channel Selection	Twelve Position Rotary Turret
Chassis - Models	Models - 660B, 664B, 673B Chassis - 120133-B

I. ALIGNMENT

a. **Equipment Required** - A sweep generator, accurate marker generator, oscilloscope, and v.t.v.m. are required for alignment. The marker generator must be very accurate and supply frequencies of 4.5 MC., and 20 to 28 MC.



BOTTOM OF CHASSIS TOP OF CHASSIS

FIGURE 1 - LOCATION OF ALIGNMENT POINTS

b. **Response Curves** - The i-f response curves for the video i-f stages are shown in figure 2.

c. **Alignment Points** - The location of all i-f transformers, tuned circuits, and trimmers is shown in figure 1.

d. **TV I-F Alignment** -

1) Tune receiver to Channel 3.

2) Connect 3 volt bias battery negative terminal from junction of C31 and R27 (positive terminal) to B-.

3) Shape overall response curve, after individual peaking of stagger-tuned and over-coupled i-fs, as indicated in steps 1-6 below. See curves A and B.

STEP	SIGNAL GENERATOR INPUT: CONNECTION	SIGNAL GENERATOR INPUT: FREQUENCY	INSTRUMENT CONNECTION	ADJUST	PROCEDURE
1	Connect marker generator to pin 1 (grid) of V-1 (6AU6) through .001 mfd. condenser. Low side to B neutral.	25.5 MC	Connect d.c. v.t.v.m. to pin 7 (grid of V8 12AT7). Low side to pin 8 of V8. Use 3 or 5 volt range.	T2	Peak for maximum response. Adjust generator signal level to produce one volt at grid of V8.
2	"	22.9 MC	"	T3 (Top)	"
3	"	21.25 MC	"	T3 (Bottom)	Adjust for minimum response. Repeat step 2.
4	"	23.9 MC	"	T4	Peak for maximum response.
5	Connect sweep generator to converter (6J6 or 12AT7) input, using three turn loop of wire slipped over tube. Connect marker gen. in parallel.	Sweep-24.5 MC (10 MC sweep) Marker-21.25 MC and 25.75 MC	Connect vertical input of scope through *detector network to pin 1 (grid) of V-2 (6AU6) Low side to B+ (130V). *Low input impedance of about 200 ohms	T1(A) T1(B)	Set markers as shown on response curve A, fig. 2. Note that the markers should be 20% down for this stage.
6	"	Sweep-24.5 MC (10 MC sweep) Marker-22.6 and 25.75 MC	Connect vertical input of scope in series with 10K resistor to pin 7 (grid) of V8 (12AT7). Low side to pin 8 of V8.	T2, T3, and T4	Adjust for overall response as shown in curve B, fig. 2. Adjust T2 to position 25.75 MC marker; adjust T3 (Top) to set 22.6 MC marker. Do not readjust trap. Equalize peaks of response curve by adjusting T4.

TABLE I - VIDEO I-F ALIGNMENT

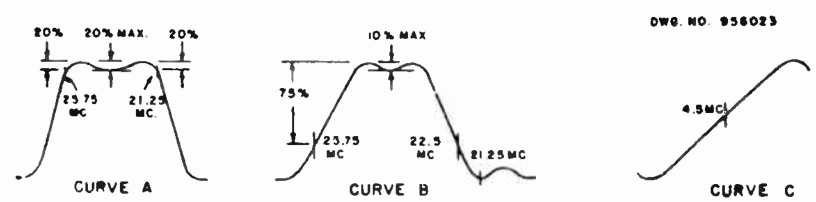


FIGURE 2 - RESPONSE CURVES

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e. **TV Sound Alignment -**

1) Set receiver to Channel 3.

2) Use accurate, crystal-controlled, marker generator.

STEP	SIGNAL GENERATOR INPUT CONNECTION	SIGNAL GENERATOR INPUT FREQUENCY	MEASURING INSTRUMENT	ADJUST	PROCEDURE
1	Marker generator through .001 uf to junction of L-4, C-38. Low side to chassis.	Marker- 4.5 MC.	Connect v.t.v.m. through 10K resistor to pin 1 (grid of V-5). Low side to B+ (130V).	C-89	Peak for maximum negative response. Adjust generator input to produce one volt at grid of V5. (Above no signal value.
2	"	"	"	L6	"
3	Connect sweep generator in parallel with marker gen.	Sweep- 4.5 MC (450 KC sweep) Marker- 4.5 MC	Replace v.t.v.m. with scope connected through 10K resistor to junction of R21 and C22. Low side to B neutral.	T6 (Secondary)	Position 4.5 MC. marker at center of S-curve, by adjusting secondary. (See Fig. 2 - curve C).
4	"	"	"	T6 (Primary)	Peak primary for maximum amplitude and linearity. Repeat step 3. (See Fig. 2 - curve C)
5	Marker generator through .001 mfd. to pin 7 of V8 (12AT7) low side to pin 8 of V8.	Marker- 4.5 MC	A.C. v.t.v.m. or D.C. v.t.v.m. used with a peak detector probe to junction of R52, C47. Low side to B neutral.	L9	Adjust for min. reading of v.t.v.m. Keep contrast control set for maximum contrast.

TABLE II - AUDIO I-F AND DISC ALIGNMENT

f. **TV R-F Alignment -**

1) Set fine tuning control to mechanical center. Retain this setting for entire r-f alignment.

2) Use 300 ohm carbon resistor as dummy antenna.

3) Couple marker generator in parallel with sweep generator.

4) Use 10 MC. sweep for sweep generator. Couple generator to antenna terminals of receiver.

5) Connect vertical input of scope in series with 10K resistor to junction of R39 and L4 (pin 7 grid of V8), low side to pin 8 of V8.

STEP	SIGNAL GENERATOR INPUT SWEEP GEN.	SIGNAL GENERATOR INPUT MARKER GEN.	CHANNEL	ADJUST	PROCEDURE
1	207.0 MC.	209.75 MC.	12	A12	Adjust for placement of 21.25 MC. marker as per response curve B.
2	"	"	12	A14, A15, A16	Adjust shape of response curve B for maximum amplitude and bandwidth.
3	213.0 MC.	215.75 MC.	13	A13	Adjust as in Step 1.
4	201.0 MC.	203.75 MC.	11	A11	"
5	195.0 MC.	197.75 MC.	10	A10	"
6	189.0 MC.	191.75 MC.	9	A9	"
7	183.0 MC.	185.75 MC.	8	A8	"
8	177.0 MC.	179.75 MC.	7	A7	"
9	85.0 MC.	87.75 MC.	6	A6	"
10	79.0 MC.	81.75 MC.	5	A5	"
11	69.0 MC.	71.75 MC.	4	A4	"
12	63.0 MC.	65.75 MC.	3	A3	"
13	57.0 MC.	59.75 MC.	2	A2	"

TABLE III - R.F. ALIGNMENT

2. OPERATING CONTROLS

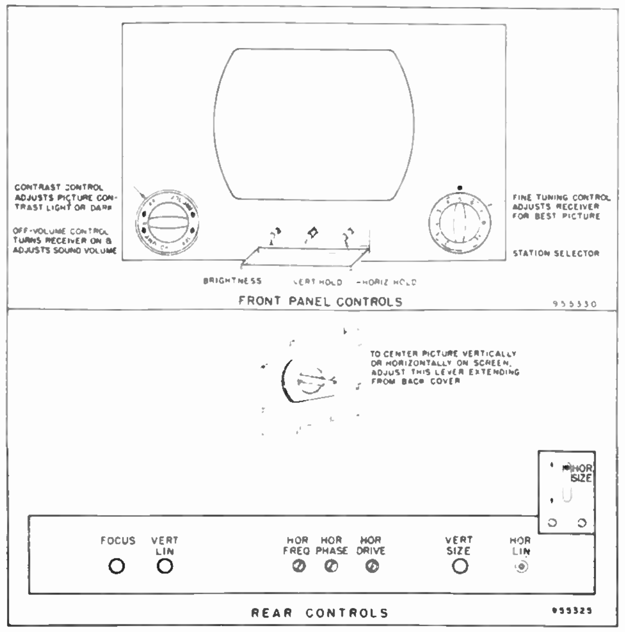

FIGURE 3. OPERATING CONTROLS (FOR MODELS 660B, 664B, 673B)

3. TUBE LOCATIONS

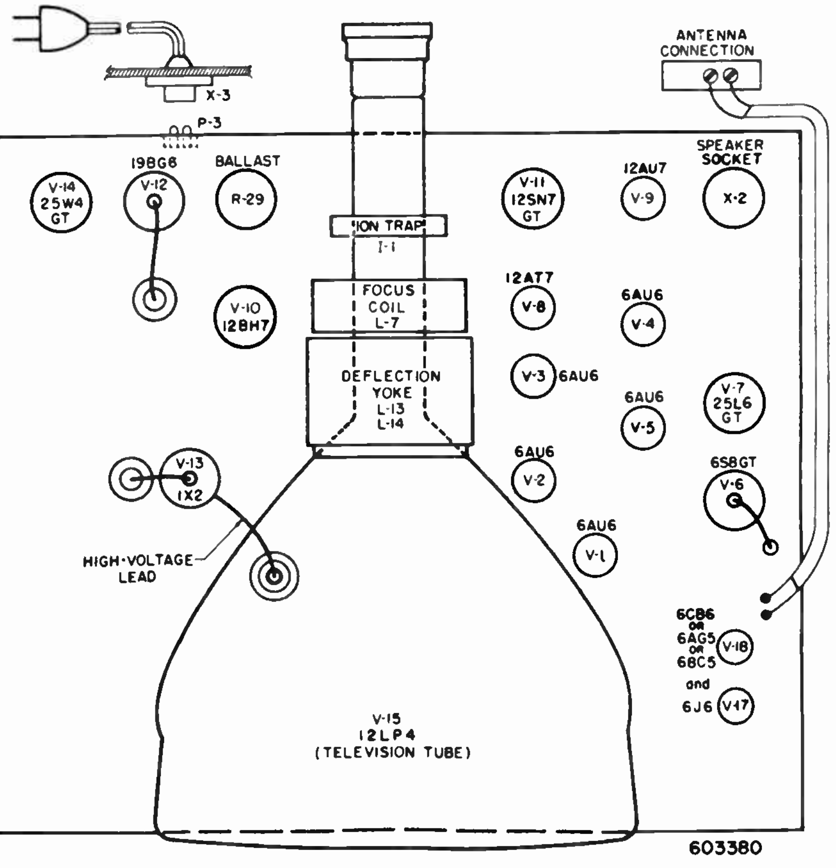

FIGURE 4. TUBE LOCATION DIAGRAM (FOR CHASSIS 120133B)

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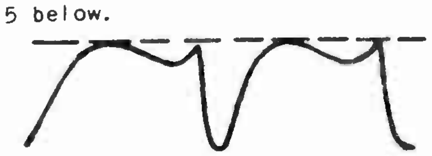
4. ALIGNMENT OF MIRACLE PICTURE LOCK (Horizontal Sweep Automatic Freq. Control)

This must be done with chassis removed from cabinet and a scope.

1. Short phasing coil by using a clip lead across C-74 (.01 mf.)
2. Turn horizontal hold control counter clockwise when viewed from front of control. (Center tap at lowest B+ voltage).
3. Starting with frequency slug (T-9) all the way out rotate in until picture locks into synchronization.
4. Remove short from phasing coil and adjust in following manner.
   a) Place scope lead in series with 10,000 ohm resistor to junction R-83, L-15 low side to B neutral (B-).
   b) Set sweep frequency of scope to 8,000 and adjust fine frequency until pattern on scope is stationary (Note picture should be in synch during this adjustment.)
   c) Phasing slug (L-15) should be adjusted so that you have even peaks as shown in Figure 5 below.

FIGURE 5



5. Switch tuner to off channel then back. Picture should be out of synch and from 4 to 5 black horizontal bars visible. If more or less, adjust horizontal frequency slug (T-9) until the 4 to 5 bars are seen.
6. Turn horizontal hold control slowly clockwise. Picture should synch in at about 1/4 of a turn. The picture should then remain in synchronization over the whole range of the horizontal hold control.

5. TUBE LOCATIONS

The tube complements of chassis 120133B are listed in the following table:

SYMBOL	TUBE TYPE	FUNCTION	SYMBOL	TUBE TYPE	FUNCTION
V-1	6AU6	1st Video I.F. Ampl.	V-14	25W4GT	Horizontal Damper
V-2	6AU6	2nd Video I.F. Ampl.	V-15	2LP4	Kinescope
V-3	6AU6	3rd Video I.F. Ampl.	V-16	IN60	2nd Det. (Video) Germanium Crystal
V-4	6AU6	Sound I.F. Amplifier			
V-5	6AU6	Sound I.F. Limiter	V-17	6J6	Oscillator & Converter
V-6	6SBGT	Sound Discr. & A.F. Ampl.			
V-7	25L6GT	Sound Output			
V-8	12AT7	2nd Sync. Ampl.	V-18	6CB6 or 6AG5 or 6BC5	R.F. Amplifier
V-9	12AU7	2nd Video Ampl.			
V-10	12BH7	Vertical Osc. & Output			
V-11	12SN7GT	Horizontal Oscillator	V-19		Selenium Rectifier
V-12	19BG6	Hor. Output Ampl.	V-20		Selenium Rectifier
V-13	1X2	High Voltage Rectifier	V-21		Selenium Rectifier

TABLE IV - TUBE COMPLEMENTS

Sets coded Triangle 1 have the following changes incorporated to reduce the effects caused by station modulation variation and to make tuning easier.

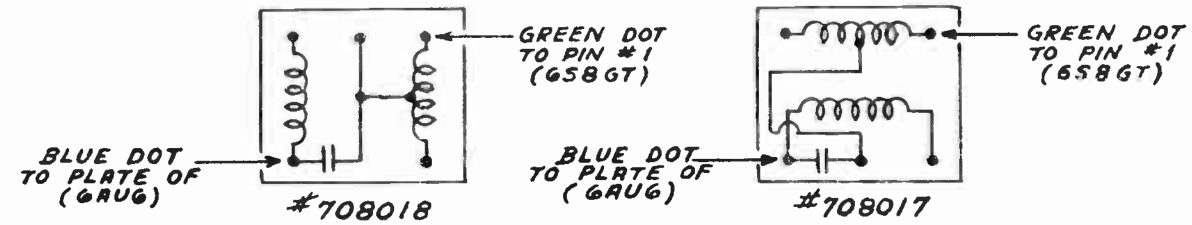
1. R-16 (6200 ohms), R-17 (22K ohms) R-95 (1K ohms), C-19 (1500 mmf.) are removed from the circuit.
2. The junction of C-20, R-18 and T-6 is connected to Pin 6 of V-6 (6AU6) by means of a jumper wire.
3. The value of R-18 has been changed from 2200 ohms to 68K ohms, 1/2 W.
4. All leads to junction of (L-5, C-89), C-39, R-14 and Pin 2 of V-4 are disconnected from one another and rewired as follows:

   Note: L-5 and C-89 are left connected to one another.
   (a) R-14 (82 ohms) is wired to B+ (130 volt line).
   (b) Pin 2 of V-4 (6AU6) is wired to Pin 7 of the same tube.
   (c) C-39 (1500 mmf.) is wired to Pin 7 of V-4.

5. The following components have been added.
   a) A 1 megohm, 1/2 watt resistor from Pin 1 of V-5 to junction of L-5, C-89.
   b) A .01 mf., 200 volt condenser from junction L-5, C-89, 1 meg. to pin 7 of V-4 (6AU6).
   c) A 33K ohm, 1 watt resistor from Pin 6 of V-8 (12AT7) to B+ (265 volt line).

Chassis coded with Triangle 2 have a .001 mf., 600 volt condenser from Pin 6 of 6S8GT to B neutral. The body of this condenser is dressed close to the rear of the tuner unit.

In production, two types of discriminator transformers are used. Electrically these transformers are identical, the difference being in the mechanical layout of the coils.



Chassis using part #708017 are coded with the letter S inside the code triangle. The secondary slug of this transformer is located underneath the chassis.

CORRECTION OF PRELIMINARY SERVICE NOTE FOR MODELS 660B, 664B, 673B, Chassis 120133B.

Please refer to overall video I.F. response curve in preliminary note. The 25.75 mc picture I.F. marker and the 21.5 mc I.F. bandpass marker should be at the 50% reference point instead of at the 75% point as shown.

Sets coded Triangle 3 have the following changes incorporated to facilitate sound alignment.

1. C-3 has been changed from 1500 mmf. to .005 mf. ceramic.
2. R-14 has been changed from 82 to 150 ohms 1/2 watt.
3. A 150 ohm 1/2 watt resistor has been inserted between Pin #2 of V-5 and B+130 volts.
4. A 470 ohm 1/2 watt resistor has been added from B+ 265 volt line to lug where L-6 is connected.

The following wiring changes have been made.
1. The 265 volt lines connected between dummy lug near V-5 and L-6 and also between L-6 and dummy lug near speaker socket have been removed.
2. A new 265 volt line has been added between dummy lug near V-5 and dummy lug near speaker socket.
3. The wire going from Pin #2 of V-5 has been removed from C-37 (50 mfd. 300 volt) and connected to B+ 130 volt point on dummy lug near V-5.

Sets coded Triangle 4 have the following changes:
1. C-80 (.0005 mf., 10KV) condenser has been removed.
2. C-87 has been changed from .002 mf., 600 volts to .002 mf., 1600 volts.
3. R-91 (470K ohms) has been removed and the high voltage lead connected directly to Pin #9 of V-13 (1X2).
4. Pigtail of R-93 has been removed from junction.
5. R-93 has been changed from 470K ohms to 940K ohms which is actually composed of R-93 (470K ohms) and R-91 (470K ohms) in series.

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CONDITIONS FOR TAKING VOLTAGE READINGS: (See table below)

1. Antenna disconnected and antenna terminals shorted.
2. Line voltage 117 volts.
3. All controls set for normal picture.
4. All readings taken with R.C.A. voltohmyst from point to B neutral (pin 8 to V9).

FOR A QUICK OVERALL RESISTANCE CHECK:

1. B plus (pin 6 of V2) to B neutral should read 0.1M.
2. B neutral to chassis should read 220K.
3. B minus (pin 8 to V8) to B neutral should read 120K.

CONDITIONS FOR TAKING RESISTANCE READINGS: (See table on page 5).

1. Due to high leakage resistance between B plus, B neutral and B minus, these three points must be connected to obtain quick readings.
2. Connect B plus (pin 6 of V2) and B minus (pin 8 of V8) to B neutral (pin 8 of V9) to obtain resistance readings.
3. After taking resistance readings remove shorting leads.

VOLTAGE READINGS FOR CHASSIS 120133-B

SYMBOL	TUBE PIN NUMBER											
	PIN 1	PIN 2	PIN 3	PIN 4	PIN 5	PIN 6	PIN 7	PIN 8	PIN 9	PIN 10	PIN 11	PIN 12
V-1	-0.3	0	38 A.C.	32 A.C.	115	115	0.8					
V-2	120	120	32 A.C.	25 A.C.	260	260	120					
V-3	120	120	25 A.C.	19 A.C.	265	265	120					
V-4	95	120	12 A.C.	18 A.C.	265	265	120					
V-5	115	120	18 A.C.	25 A.C.	150	150	120					
V-6	-3	0	-3	-3	0	95	5.5 A.C.	12 A.C.				
V-7	0	48 A.C.	90	100	-4	-4	74 A.C.	-3				
V-8	110	-0.5	0	5.5 A.C.	5.5 A.C.	115	14	14	12 A.C.			
V-9	215	-6.7	2	18 A.C.	18 A.C.	16	-1.7	0	12 A.C.			
V-10	365	-16	0	37 A.C.	48 A.C.	32	-1.4	8.5	48 A.C.			
V-11	-80	210	0	-21	155	-11	25 A.C.	37 A.C.				
V-12	N.C.	18 A.C.	0	-22	-22	N.C.	56 A.C.	270				
V-13	DO NOT MEASURE											
V-14	N.C.	N.C.	400	N.C.	260	N.C.	28 A.C.	40 A.C.				
V-15	0	0								390	29	6 A.C.

N.C. Denotes no connection.

RESISTANCE READINGS FOR CHASSIS 120133-B

SYMBOL	TUBE PIN NUMBER											
	PIN 1	PIN 2	PIN 3	PIN 4	PIN 5	PIN 6	PIN 7	PIN 8	PIN 9	PIN 10	PIN 11	PIN 12
V-1	1.2M	3	22	20	30K	30K	85					
V-2	30K	30K	20	17	470	470	30K					
V-3	35K	35K	17	13	1K	1K	30K					
V-4	1M	30K	10	15	2.5	0	30K					
V-5	120K	30K	15	18	65K	65K	30K					
V-6	90K	0	90K	1.2M	180K	0.5M	2.5	10				
V-7	0	28	4K	3.6K	450K	30K	36	70				
V-8	20K	1M	0	2	2	30K	120	0	9			
V-9	5.5K	0.8M	350	14	14	18K	3M	0	9			
V-10	INF.	0.8M	0	22	28	3.5M	0.1M	0.1M	23			
V-11	250K	INF.	0	0.8M	60K	0.3M	16	24				
V-12	N.C.	24	0	0.8M	0.8M	N.C.	30	0				
V-13	PLATE 1.3 MEG. - FILAMENT INFINITY											
V-14	N.C.	N.C.	INF.	N.C.	15	N.C.	20	30				
V-15	0	0.8M								INF.	50K	2

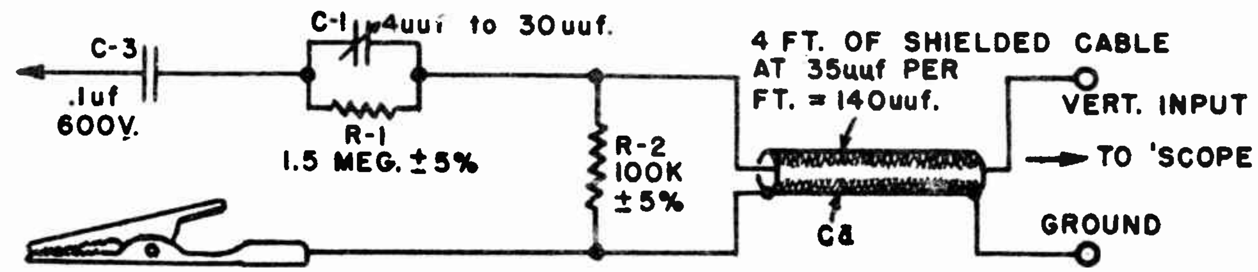
N.C. Denotes no connection.
INF. Denotes infinity.

NOTE: Voltage and resistance measurements listed here are for chassis 120133-B stamped with a triangle 2A.

Voltages may vary slightly from table figures shown here if chassis is not coded as stated above. The peak to peak voltage given may vary slightly due to component variations.

EMERSON LOW CAPACITY PROBE

A low capacity probe must be used in order to faithfully reproduce high frequency waveshapes (15 kc and higher) and to prevent loading of the circuit under observation. Such a probe can be readily constructed with parts on hand.



Mount parts on a small sheet of bakelite, preferably inside a paper or mica tube. A shielded cable must be used because it prevents stray pickup. The length of this cable is very important since its capacity is used in the design of the probe.

Due to the construction of the probe, the signal at the oscilloscope terminals is approximately 1/15 of its actual value. This means that a scope with at least .05 RMS volts per inch vertical sensitivity is required. The average scope will meet these requirements. Since the 'scope is calibrated on a 60 cycle sine wave through the probe, the attenuation of the probe will not effect the accuracy of the peak to peak voltage readings.

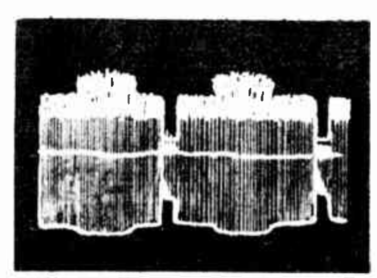
In trouble-shooting, it is of great value to know the peak to peak voltages of the various wave shapes. The oscilloscope can be easily calibrated to read these voltages. For information on calibrating the oscilloscope, see items (a to d) listed on next page.

TO CALIBRATE THE PROBE:

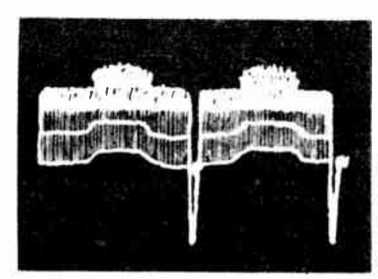
The probe must be calibrated for the oscilloscope in use due to the differences in oscilloscope input impedances. The following steps should be taken:

(a) Connect probe to the output of the video detector (across detector load resistor).

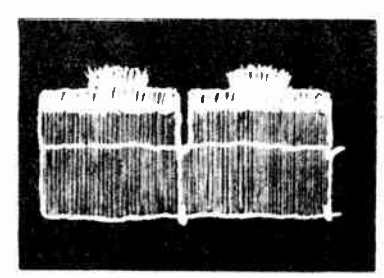
(b) With the scope sweep set at 30 c.p.s., adjust C-1 so that the vertical blanking pulses and the horizontal blanking pulses line up as shown in the drawing marked (RIGHT) listed below. The probe is now calibrated for the particular oscilloscope in use and should not be readjusted unless the oscilloscope is changed.



WRONG
C-1 TOO LARGE



WRONG
C-1 TOO SMALL



RIGHT
C-1 CORRECTLY ADJUSTED

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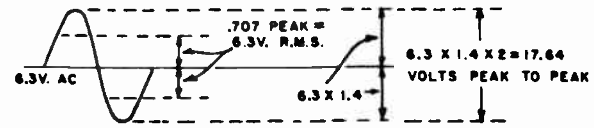
FOR TAKING WAVE SHAPES PROCEED AS FOLLOWS:

a) Observe the signal under test on the oscilloscope and set the gain control so that the whole signal is well within the screen limits.

b) Observe different 60 cycle sine wave voltages (12V, 25V, 117V, 350V a.c. etc.) on the oscilloscope with the same gain setting as before until one is found that is of the same peak to peak value, or less than the formerly observed signal. By measuring the 60 cycle voltage with a common a.c. meter, and then comparing the two signals on the oscilloscope, a good estimation can be made as to the peak to peak voltage of the signal.

c) An A.C. voltmeter is calibrated to read the R.M.S. value of 1/2 a sine wave and not the peak value. To convert from an R.M.S. value to a peak value, use the correction factor which is 1.4. The peak to peak value will therefore have a correction factor of 1.4 x 2 or 2.8.



The diagram at right should make this clear.

d) With a square celluloid face mask on the screen it is very easy to obtain accurate measurements.

For example: Take the 6.3 volt filament voltage, set the vertical gain control on the oscilloscope so that the wave covers 17.6 (6.3 x 2.8) boxes vertically from peak to peak. If the gain control is not moved the oscilloscope will read 1 volt peak to peak per box on any signal. For a very weak signal the calibration on a 6.3 volt AC wave can be made with the vertical distance from peak to peak to 176 boxes instead of 17.6 boxes. The oscilloscope will then read 0.1 volt peak to peak per box instead of 1 volt peak to peak per box.

If a stronger signal is encountered, the 117V. A.C. line can be used. The peak to peak value of this voltage is 117V. x 2.8 = 328 volts.

It is advisable that the serviceman familiarize himself with the above procedure on a good TV chassis.

6. CHASSIS PARTS LIST (CHASSIS 120133-B)

SYMBOL	PT. NO.	DESCRIPTION
C-1	928006	1500 MMF (MIN.) 400V
C-2	928006	1500 MMF (MIN.) 400V
C-3	928006	1500 MMF (MIN.) 400V
C-4	928006	1500 MMF (MIN.) 400V
C-5	928006	1500 MMF (MIN.) 400V
C-6	928006	1500 MMF (MIN.) 400V
C-7	928006	1500 MMF (MIN.) 400V
C-8	928006	1500 MMF (MIN.) 400V
C-9	928006	1500 MMF (MIN.) 400V
C-10	928006	1500 MMF (MIN.) 400V
C-11	928006	1500 MMF (MIN.) 400V
C-12	928006	1500 MMF (MIN.) 400V
C-13	928006	1500 MMF (MIN.) 400V
C-14	928006	1500 MMF (MIN.) 400V
C-15	928002	10 MMF 500V . . .
C-16	928006	1500 MMF (MIN.) 400V
C-17	910033	47 MMF . . . . . .
C-18	928006	1500 MMF (MIN.) 400V
C-19	928006	1500 MMF (MIN.) 400V
C-20	928006	1500 MMF (MIN.) 400V
C-21	910043	110 MMF . . . . . .
C-22	923079	.001 MF 600V . . .
C-23	923061	.01 MF 400V . . .
C-24	923088	.002 MF 600V . . .
C-25	928006	1500 MMF 400V . . .
C-26	923061	.01 MF 400V . . .
C-27	925181	40 MF 300V . . .
C-28	923061	.01 MF 400V . . .
C-29	922101	.05 MF 400V . . .
C-30	925166-1	200 MF 150V . . .
C-31	923201	2 MF 50V . . .
C-32	925166-3	120 MF 300V . . .
C-33	PT-OF C-27	120 MF 300V . . .
C-34	925070-1	30 MF 150V . . .
C-35	925070-1	30 MF 150V . . .
C-36	923091	.2 MF 200V . . .
C-37	PT.OF C-27	50 MF 300V . . .
C-38	928023	5 MMF . . . . . .
C-39	928006	1500 MMF (MIN.) 400V
C-40	925070-2	4 MF 200V . . .
C-41	910047	200 MMF 500V . . .
C-42	923062	.05 MF 400V . . .
C-43	910047	200 MMF 500V . . .
C-44	922032	.01 MF 600V . . .
C-45	PT-OF L-9	47 MMF . . . . . .
C-46	923062	.05 MF 400V . . .
C-47	923062	.05 MF 400V . . .
C-48	923064	.1 MF 400V . . .
C-49	923088	.002 MF 600V . . .
C-50	923079	.001 MF 600V . . .
C-51	923088	.002 MF 600V . . .
C-52	923092	.006 MF 400V . . .
C-53	923079	.001 MF 600V . . .
C-54	922021	.001 MF 600V . . .
C-55	922014	.1 MF 200V . . .
C-56	922024	.033 MF 600V . . .
C-57	922008	.1 MF 400V . . .
C-58	PT.OF C-32	15 MF 400V . . .
C-59	923088	.002 MF 600V . . .
C-60	910090	50 MMF 500V . . .
C-61	923102	.5 MF 200V . . .
C-62	928006	1500 MMF 400V . . .
C-63	928006	1500 MMF 400V . . .
C-64	928006	1500 MMF 400V . . .
C-65	928006	1500 MMF 400V . . .
C-66	910028	220 MMF . . . . . .
C-67	910043-2	180 MMF . . . . . .
C-68	923088	.002 MF 600V . . .
C-69	923114	.02 MF 400V . . .
C-70	923091	.2 MF 200V . . .
C-71	923062	.05 MF 400V . . .
C-72	910047	200 MMF 500V . . .
C-73	PT.OF C-32	10 MF 400V . . .
C-74	922041	.01 MF 600V . . .
C-75	910212	390 MMF . . . . . .
C-76	910044	1200 MMF . . . . . .
C-77	900073	45-400 MMF . . . . . .
C-78	922024	.033 MF 600V . . .
C-79	910045	5 MMF 1000V . . .
C-80	923015	.0005 MF 10KV . . .
C-81	922101	.05 MF 400V . . .
C-82	922023	.047 MF 600V . . .
C-83	915000-1	47 MMF . . . . . .
C-84	928006	1500 MMF 400V . . .
C-85	928006	1500 MMF 400V . . .
C-86	928006	1500 MMF 400V . . .
C-87	923088	.002 MF 600V . . .
C-88	928054	680 MMF 1000V . . .
C-89	900064	3-35 MMF . . . . . .
C-90	923067	.1 MF 200V . . .
F-1	808170	FUSE . . . .
I-1	708061	ION TRAP - SINGLE. .
L-2	705016	R.F. CHOKE - 3.3 uh.
L-3	705016	R.F. CHOKE - 3.3 uh.
L-4	708090	PEAKING COIL - 80 uh.
L-5	708093	PEAKING COIL - 35 uh.
L-6	708032-1	SOUND I.F. COIL. . .
L-7	708048	FOCUS COIL - EM - 2250 OHM . . . . .
L-8		
L-9	708032	WAVE TRAP - 4.5 MC. .
L-10	708090	PEAKING COIL - 80 uh.
L-11	708114	PEAKING COIL - 440 uh
L-12	708095	PEAKING COIL - 180 uh
L-13	708036	DEFLECTION YOKE - VERT. COILS
L-14	708036	DEFLECTION YOKE - HORIZ. COILS
L-15	738037	HORIZ. PHASE COIL. .
L-16	708052	LINEARITY COIL . . .
L-17	708055	SIZE COIL. . . . . .
L-18	PT.OF SP-1	

SYMBOL	PT. NO.	DESCRIPTION
P-2	585061	PLUG & CABLE - SPEAKER (TABLE MODEL) . . . . .
P-2	585062	PLUG & CABLE - SPEAKER (CONSOLE) . . . .
P-3	505014	PLUG - INTERLOCK SWITCH .
R-1	340672	5600 OHM ½W ±10% . .
R-2	340232	82 OHM ½W ±10% . .
R-3	350412	470 OHM ½W ±20% . .
R-4	350412	470 OHM ½W ±20% . .
R-5	350412	470 OHM ½W ±20% . .
R-6	340732	10,000 OHM ½W ±10% . .
R-7	340292	150 OHM ½W ±10% . .
R-8	350412	470 OHM ½W ±20% . .
R-9	350412	470 OHM ½W ±20% . .
R-10	340732	10,000 OHM ½W ±10% . .
R-11	PT.OF T-3	10,000 OHM ½W ±10% . .
R-12	340292	150 OHM ½W ±10% . .
R-13	350412	470 OHM ½W ±20% . .
R-14	340232	82 OHM ½W ±10% . .
R-15	340972	100,000 OHM ½W ±10% . .
R-16	340712	8,200 OHM ½W ±10% . .
R-17	340812	22,000 OHM ½W ±10% . .
R-18	340572	2,200 OHM ½W ±10% . .
R-19	340972	100,000 OHM ½W ±10% . .
R-20	340972	100,000 OHM ½W ±10% . .
R-21	340932	68,000 OHM ½W ±10% . .
R-22	390074-6	1 MEGOHM CONT. - FRONT
R-23	351372	4.7 MEGOHM ½W ±20% . .
R-24	351132	470,000 OHM ½W ±20% . .
R-25	351132	470,000 OHM ½W ±20% . .
R-26	340212	68 OHM ½W ±10% . .
R-27	340932	68,000 OHM ½W ±10% . .
R-28	351212	1 MEGOHM ½W ±20% . .
R-29	397036	2.5 OHM W.W. BALLAST TUBE
R-30	341052	220,000 OHM ½W ±10% . .
R-31	394060-4	55 OHM 7.5W ±10% . .
R-32	394060-3	75 OHM 10W ±10% . .
R-33	340572	2,200 OHM ½W ±10% . .
R-34	340732	10,000 OHM ½W ±10% . .
R-35	394060-2	1,500 OHM 5W ± 5% . .
R-36	340332	220 OHM ½W ±10% . .
R-37	370652	4,700 OHM 1W ±10% . .
R-38	397066	15,000 OHM 2W ±10% . .
R-39	340652	4,700 OHM ½W ±10% . .
R-40	370832	27,000 OHM 1W ±10% . .
R-41	340572	2,200 OHM ½W ±10% . .
R-42	340732	10,000 OHM ½W ±10% . .
R-43	341092	330,000 OHM ½W ±10% . .
R-44	341332	3.3 MEGOHM ½W ±10% . .
R-45	341052	220,000 OHM ½W ±10% . .
R-46	340812	22,000 OHM ½W ±10% . .
R-47	PT.OF R-22	5,000 OHM CONTRAST CONT.-FRONT
R-48	351212	1 MEGOHM ½W ±20% . .
R-49	351212	1 MEGOHM ½W ±20% . .
R-50	340572	2,200 OHM ½W ±10% . .
R-51	370672	5,600 OHM 1W ±10% . .
R-52	340772	15,000 OHM ½W ±10% . .
R-53	340772	15,000 OHM ½W ±10% . .

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SYMBOL	PT. NO.	DESCRIPTION
R-54	390162	100,000 OHM BRTNS.CNT.-FR.
R-55	340812	22,000 OHM ½W ±10% . .
R-56	390132	100,000 OHM CONT. - REAR .
R-57	340812	22,000 OHM ½W ±10% . .
R-58	340812	22,000 OHM ½W ±10% . .
R-59	340852	33,000 OHM ½W ±10% . .
R-60	340972	100,000 OHM ½W ±10% . .
R-61	340932	68,000 OHM ½W ±10% . .
R-62	390162	100,000 OHM VERT. HOLD CONT.-FR.
R-63	390138	3 MEGOHM VERT. SIZE CONT-R.
R-64	341312	2.7 MEGOHM ½W ±10%
R-65	340972	100,000 OHM ½W ±10% . .
R-66	340972	100,000 OHM ½W ±10% . .
R-67	340812	22,000 OHM ½W ±10% . .
R-68	351212	1 MEGOHM ½W ±20% . .
R-69	340712	8,200 OHM ½W ±10% . .
R-70	340532	1,500 OHM ½W ±10% . .
R-71	341012	150,000 OHM ½W ±10% . .
R-72	340812	22,000 OHM ½W ±10% . .
R-73	341012	150,000 OHM ½W ±10% . .
R-74	340712	8,200 OHM ½W ±10% . .
R-75	331192	820,000 OHM ½W ± 5% . .
R-76	331012	150,000 OHM ½W ± 5% . .
R-77	331012	150,000 OHM ½W ± 5% . .
R-78	341012	150,000 OHM ½W ±10% . .
R-79	390162	100,000 OHM HORIZ. HOLD CONT.-FR.
R-80	340952	82,000 OHM ½W ±10% . .
R-81	331312	2.7 MEGOHM ½W ± 5% . .
R-82	330972	100,000 OHM ½W ± 5% . .
R-83	340712	8,200 OHM ½W ±10% . .
R-84	340812	22,000 OHM ½W ±10% . .
R-85	331012	150,000 OHM ½W ± 5% . .
R-86	330942	75,000 OHM ½W ± 5% . .
R-87	340652	4,700 OHM ½W ±10% . .
R-88	351212	1 MEGOHM ½W ±20% . .
R-89	340272	120 OHM ½W ±10% . .
R-90	341052	220,000 OHM ½W ±10% . .
R-91	381132	470,000 OHM 1W ±20% . .
R-92	390132	100,000 OHM VERT. LIN. CONT.-R
R-93	381132	470,000 OHM 1W ±20% . .
R-94	340892	47,000 OHM ½W ±10% . .
R-95	350492	1,000 OHM ½W ±20% . .
R-96	351212	1 MEGOHM ½W ±20% . .
TUNER	470636	TUNER ASSY. - STANDARD. . .
SP-1	180070	SPEAKER - 6" - EM } TABLE MODEL
SP-1	or 180073	SPEAKER - 6" - EM } TABLE MODEL
SP-1	180072	SPEAKER - 12" (CONSOLE)
SW-1	PT. OF R-22	ON - OFF SWITCH
T-1	720104-1	1st VIDEO I.F. TRANSF'M'R .
T-2	720098	2nd VIDEO I.F. TRANSF'M'R .
T-3	720106	3rd VIDEO I.F. TRANSF'M'R .
T-4	720098	4th VIDEO I.F. TRANSF'M'R .
T-5		
T-6	708018	DISCRIMINATOR COIL. . . . .
T-7	734058-1	SOUND OUTPUT TRANSFORMER. .
T-8	738054	VERT. OUTPUT TRANSF'M'R
T-9	716052	HORIZ. OSC. TRANSFORMER
T-10	738039	HORIZ. OUTPUT TRANSFORMER
V-1	800533	VACUUM TUBE - 6AU6
V-2	800533	VACUUM TUBE - 6AU6
V-3	800533	VACUUM TUBE - 6AU6
V-4	800533	VACUUM TUBE - 6AU6
V-5	800533	VACUUM TUBE - 6AU6
V-6	800015	VACUUM TUBE - 6S8GT
V-7	800490	VACUUM TUBE - 25L6GT
V-8	800047	VACUUM TUBE - 12AT7
V-9	800026	VACUUM TUBE - 12AU7
V-10	800053	VACUUM TUBE - 12BH7
V-11	800039	VACUUM TUBE - 12SN7GT
V-12	800044	VACUUM TUBE - 19BG6-G
V-13	800046	VACUUM TUBE - 1X2
V-14	800045	VACUUM TUBE - 25W4GT
V-15	810003-4	TELEVISION TUBE - 12LP4
V-16	817018	GERMANIUM CRYSTAL - IN60
V-17	800536	VACUUM TUBE - 6J6 } T.V. TUNER STANDARD
V-18	800535 or	VACUUM TUBE - 6AG5 } T.V. TUNER STANDARD
V-18	800052	VACUUM TUBE - 6BC5 } T.V. TUNER STANDARD
V-19	817000-1	SELENIUM RECTIFIER - 15 MA
V-20	817015	SELENIUM RECTIFIER - 250 MA
V-21	317015	SELENIUM RECTIFIER - 250 MA
X-1	585063	SOCKET - CABLE ASSY. - KINESCOPE
X-2	500022	SOCKET - SPEAKER . . . . .
X-3	583206	SOCKET - INTERLOCK SWITCH - LINE CORD . . . .

WAVE SHAPE ANALYSIS CHART FOR CHASSIS 120133-B

For models 660B, 664B and 673B. The information listed below was taken from a chassis which was code marked triangle 2A

Slight peak to peak voltage differences may be noticed if chassis is not coded as shown above.

The wave shapes shown here are arranged so as to give the serviceman an easy method of signal tracing. The peak to peak voltage given may vary slightly depending on signal strength and component variations.

To accurately observe the following wave shapes, the relatively high input capacity of an oscilloscope must be reduced so as not to change the operating characteristics of the television set. Failure to do this will result in wrong wave shape readings.

The use of a special low capacity probe (as outlined on pages 5 and 6 of this manual), will reduce this input capacity to a minimum.

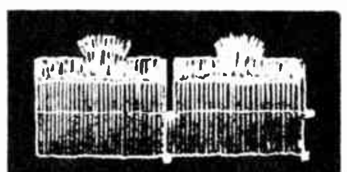
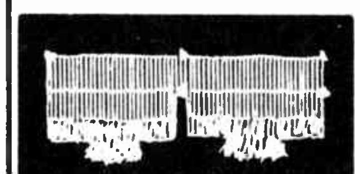
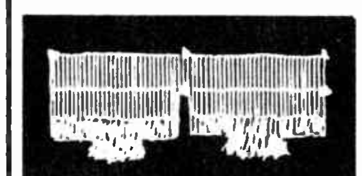
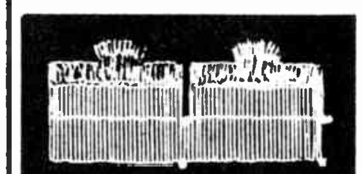
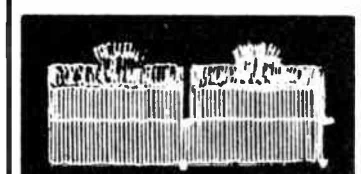
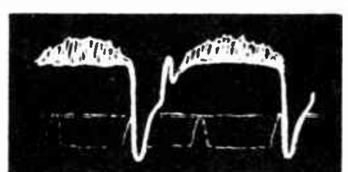
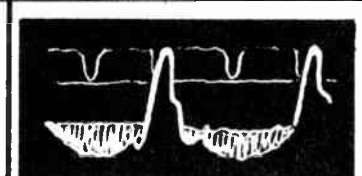
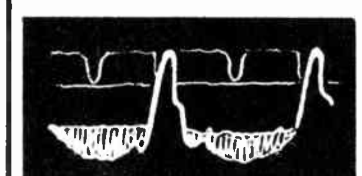
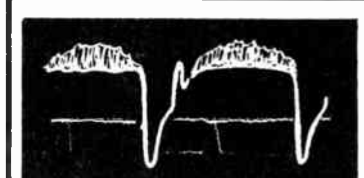
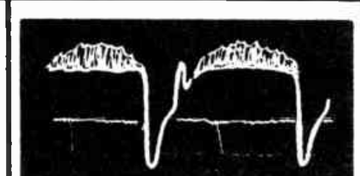
Connect antenna and tune receiver to channel where best reception has been obtained in the past.

Low end of the probe is connected to B neutral except where otherwise noted. Contrast control is set at MAXIMUM CONTRAST.

The 30 and 7875 C.P.S. oscilloscope sweep settings are used so as to permit the serviceman to observe two cycles of the wave shape.

Note: A wave shape seen in your oscilloscope may be upside down from same wave shape shown here. This will depend on the number of stages of amplification in the oscilloscope used.

I. VIDEO AND/OR SYNC. TROUBLES (LACK OF CONTRAST, TEAR, OVERLOAD, ETC.)

SCOPE SWEEP	PIN 7 OF V-8 TAKEN BETWEEN POINT AND JUNCTION OF R-39 AND C-40	PIN 6 OF V-8	PIN 2 OF V-9	PIN I OF V-9	PIN 2 OF V-15
30 C.P.S.	 PEAK TO PEAK 3V.	 PEAK TO PEAK 25V.	 PEAK TO PEAK 70V.	 PEAK TO PEAK 70V.	 PEAK TO PEAK 80V.
7875 C.P.S.	 PEAK TO PEAK 3V.	 PEAK TO PEAK 25V.	 PEAK TO PEAK 70V.	 PEAK TO PEAK 70V.	 PEAK TO PEAK 80V.

Note: Taken with Pin 5 of V-12 shorted to Junction of R-33 and C-35.

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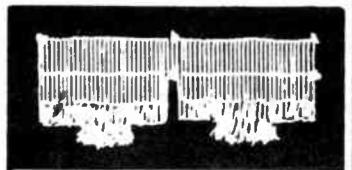
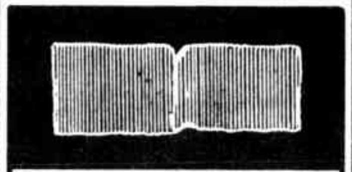
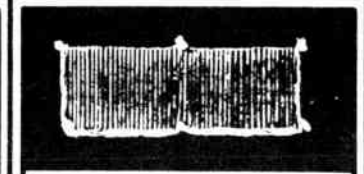
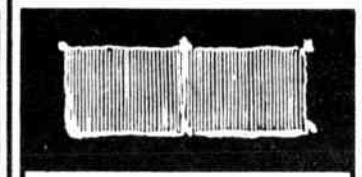
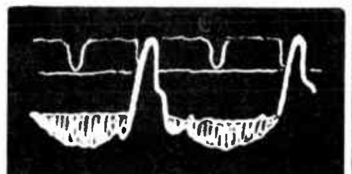
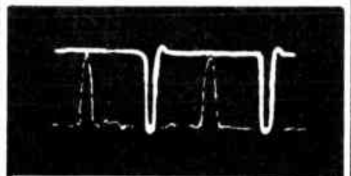
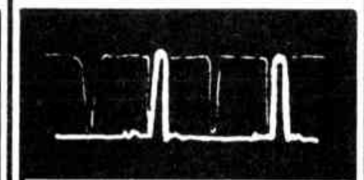
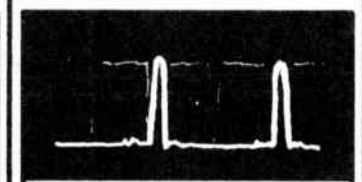
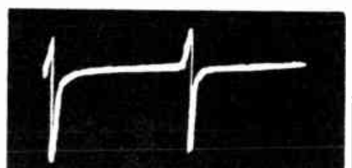
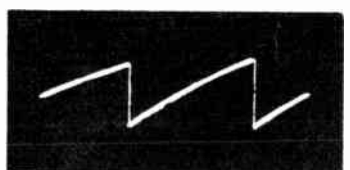
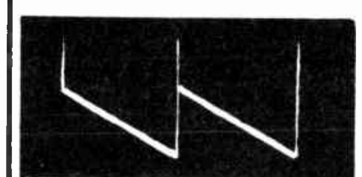
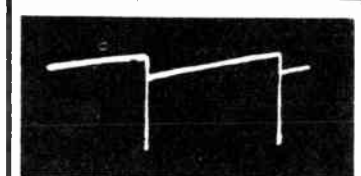
2. SYNC. TROUBLES (NO VERTICAL OR HORIZONTAL HOLD, POOR HOLD, JITTER, ETC.)

SCOPE SWEEP	PIN 7 OF V-9	PIN 6 OF V-9 ALSO PIN 2 OF V-8	PIN 1 OF V-8	JUNCTION OF R-37 AND R-38
30 C.P.S.	 PEAK TO PEAK 20V.	 PEAK TO PEAK 13V.	 PEAK TO PEAK 170V.	 PEAK TO PEAK 38V.
7875 C.P.S.	 PEAK TO PEAK 20V.	 PEAK TO PEAK 13V.	 PEAK TO PEAK 170V.	 PEAK TO PEAK 38V.

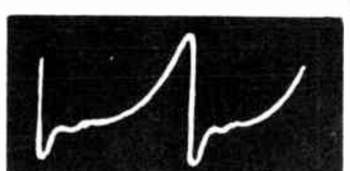
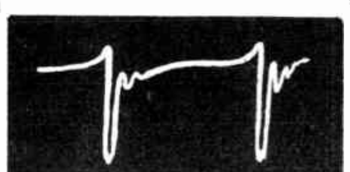
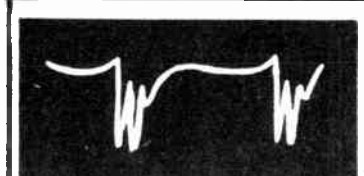
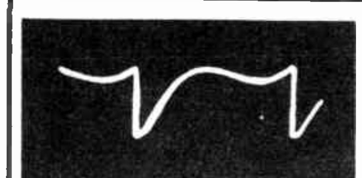
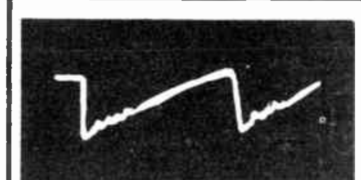
Note: Taken with Pin 5 of V-12 shorted to Junction of R-33 and C-35

3. VERTICAL HOLD TROUBLES (NO VERTICAL HOLD, NO VERTICAL SIZE, POOR VERTICAL HOLD, VERTICAL JITTER, POOR VERTICAL LINEARITY, ETC.)

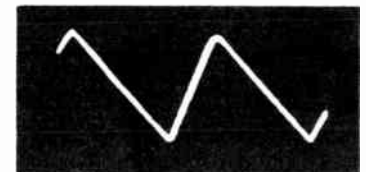
SCOPE SWEEP	PIN 7 OF V-10	PIN 6 OF V-10	PIN 2 OF V-10	PIN 1 OF V-10*	PIN 6 OF L-13
30 C.P.S.	 PEAK TO PEAK 45V.	 PEAK TO PEAK 30V.	 PEAK TO PEAK 30V.	 PEAK TO PEAK 280V.	 PEAK TO PEAK 35V.

Note: Taken with Pin 5 of V-12 shorted to Junction of R-33 and C-35
*This wave shape taken with shorting clip removed.

4. HORIZONTAL HOLD TROUBLES (POOR HOLD, TEAR, NO HORIZONTAL HOLD, NO HIGH VOLTAGE, POOR HORIZONTAL LINEARITY).

SCOPE SWEEP	PIN 4 OF V-11	PIN 1 OF V-11	PIN 2 OF V-11	PIN C OF T-9	PIN 5 OF V-12
7875 C.P.S.	 PEAK TO PEAK 25V.	 PEAK TO PEAK 400V.	 PEAK TO PEAK 120V.	 PEAK TO PEAK 100V.	 PEAK TO PEAK 45V.

5. FILTER TROUBLES (LOW B+ AND B-, A.C. IN PICTURE, NO SYNC., NON-LINEAR SWEEPS, ETC.)

SCOPE SWEEP	JUNCTION OF V-21 AND C-32
30 C.P.S.	 PEAK TO PEAK 20V.

WAVESHAPE OF RECTIFIED A.C. (RIPPLE)

NOTE: THE RIPPLE VOLTAGE AT OTHER POINTS IN THE FILTER NETWORK IS LESS THAN 1.0 VOLTS.

7. CABINET PARTS LIST (Models 660B, 664B, 673B

PART NUMBERS			DESCRIPTION
MODEL 660B	MODEL 664B	MODEL 673B	
		140384	Cabinet
140368			Cabinet
	140374		Cabinet
520135	520135		Glass Panel
410982	410982		Mask
		411009	Mask
		635028	Safety Glass
180073		180073	Speaker
	180072		Speaker
585061		585061	Speaker Plug & Cable
	585062		Speaker Plug & Cable
560162		560162	Masonite Back
	560163		Masonite Back
583206	583206	583206	Line Cord
		460171	Knob – Contrast
		460172	Knob – Volume
		460173	Knob – Selector
		460174	Knob – Fine Tuning
460175	460175		Knob – Contrast
460176	460176		Knob – Volume
460177	460177		Knob – Selector
460178	460178		Knob – Fine Tuning

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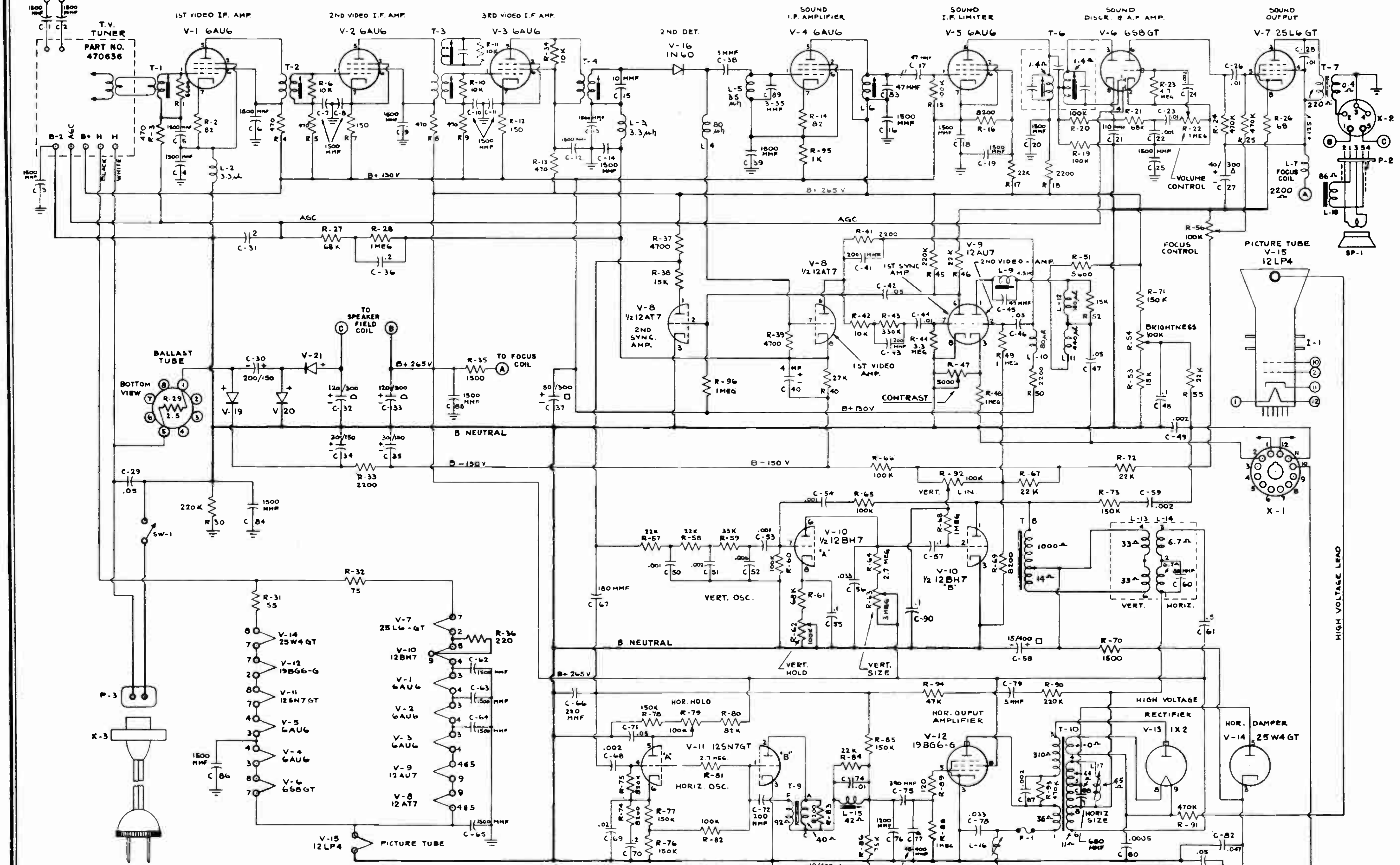
FIGURE 6. SCHEMATIC DIAGRAM (CHASSIS 120133B



NOTE: COIL & TRANSFORMER RESISTANCE READINGS TAKEN WITH VOLTOHMYST AND WITH COMPONENTS OUT OF CIRCUIT.

CHASSIS 120135-B PART NO. 950173

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MODELS S4T15, S4T30, S4C20, S4C40

GENERAL INFORMATION

Check all shipping instructions, tags and labels carefully. To avoid special handling problems the receiver is shipped complete with the kinescope tube, focus coil and ion trap securely installed.

The receiver is completely adjusted at the factory, so normally none other than the front panel operating instructions need be followed to put the receiver in operation. However, to provide for any misadjustment of the service controls due to handling, the following instructions are in order.

ION TRAP, FOCUS MAGNET AND
DEFLECTION YOKE ADJUSTMENTS

Before any adjustments can be made to the above, the back will have to be removed from the cabinet.

Remove all screws on sides and top of back, and lift cover back and away from cabinet. Since the power cord circuit is broken by the interlock when the cabinet back is removed, it will be necessary to obtain an extra power cord with the female interlock receptical in order to make a power connection to the receiver. A mirror placed in front of the receiver will help in making the adjustments.

1. ION TRAP ADJUSTMENT

Turn on the receiver and switch to one of the TV channels not in use in your area. With the brightness control in the maximum clockwise position and the picture control fully counter-clockwise, adjust the ion trap by moving it forward or backward at the same time rotating it slightly around the neck of the kinescope for the brightest raster on the screen. Reduce the brightness control setting until the raster is just visible on the screen, readjust the ion trap for maximum brilliance. Adjust the focuser adjustment (shown in Figure 1) until the line structure of the raster is clearly visible. Readjust the ion trap for maximum raster brilliance. The final touches of this adjustment should be made with the brightness control at the maximum position with which good line focus can be maintained.

2. FOCUS MAGNET ADJUSTMENT

The focus magnet should be adjusted so that there is approximately three-eighths inch of space between the rear cardboard shell of the yoke and the flat of the front face of the focus magnet. This spacing gives best average focus over the face of the tube.

The axis of the hold through the focus magnet should be parallel with the axis of the kinescope neck. See Figure 1.

3. DEFLECTION YOKE ADJUSTMENT

If the lines of the raster are not horizontal or squared with the picture mask, loosen the wing screw on the yoke (shown in Figure 1) and rotate the yoke until this condition is obtained. Tighten the wing screw.

CENTERING ADJUSTMENTS

No electrical centering controls are provided. Centering is accomplished by means of a separate plate on the focus magnet. See Figure 1. The centering plate has a locking screw which must be loosened before centering.

Up and down adjustment of the plate moves the picture side to side and sidewise adjustment moves the picture up and down.

If a corner of the raster is shadowed, check the position of the ion trap. Reposition the ion trap within the range of maximum raster brightness to eliminate the shadow and recenter the picture by adjustment of the focus centering plate. In no case should the ion trap be adjusted to cause any loss of brightness since such operation may cause immediate or eventual damage to the kinescope. In some cases it may be necessary to shift the position of the focus magnet in order to eliminate a center shadow.

NON-OPERATING CONTROL ADJUSTMENTS (Figure 2)

With the deflection system of the kinescope in proper mechanical alignment, the "non-operating" controls may be adjusted. The mechanical adjustments ordinarily will not require further attention until the kinescope tube is replaced. Using a test pattern from a local TV station, make the "non-operating" control adjustments as follows: (Normal picture contrast and brightness should be maintained during the adjustment for best results).

(1) Set the HORIZONTAL and VERTICAL HOLD controls for a steady test pattern. If Horizontal synchronization cannot be effected within the normal range of the HORIZONTAL HOLD control, set this control in the center of its range and adjust the Horizontal Frequency control for a steady clear picture. This screw driver adjustment is reached from the top rear part of the chassis.

(2) Set the PICTURE control at minimum (counter-clockwise) and advance the BRIGHTNESS control (clockwise) to the point where the retrace lines (wide spaced lines) on the raster begin to show, then back off the Brightness control slightly to eliminate the lines. Reset the PICTURE control for the desired picture contrast. If necessary, readjust Brightness control for most desirable picture.

(3) Advance the HORIZONTAL DRIVE control (clockwise) as far as possible without causing fold over of the test pattern, (Vertical white line). Insufficient horizontal drive will cause the raster to fall short of filling the mask horizontally or cause the picture to lack the brilliance normally obtained with a correct adjustment.

(4) Set the WIDTH control so that the test pattern fills the horizontal dimension of the kinescope mask. A minor adjustment of the focus centering position may be required to recenter the pattern.

(5) Set the HORIZONTAL LINEARITY control so that the test pattern is symmetrical from left to right. A slight readjustment of the HORIZONTAL DRIVE control may be necessary when making this adjustment.

(6) Set the HEIGHT control so that the test pattern fills the vertical dimension of the kinescope mask. A minor adjustment of the focus centering position may be required to recenter the pattern.

(7) Set the VERTICAL LINEARITY control for a symmetrical test pattern in the vertical dimension. A slight readjustment of the Height control may be required when making this adjustment.

(8) Set the BRIGHTNESS and PICTURE controls for a normal test pattern and adjust the FOCUSER adjustment for best definition.

IMPORTANT NOTE: If difficulty is experienced in obtaining sufficient picture width, or if the picture lacks brilliance after all of the adjustments have been made, the input line voltage may be lower than 110 volts A.C. Carefully check this voltage with a suitable meter.

If the line voltage is lower than 110 volts A.C. remove chassis from cabinet. Lay chassis on side, with the power transformer down. Locate the

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five lug terminal strip adjacent to the power transformer. Remove gray wire from the lug stamped No. 4 replace on lug No. 2. Replace chassis in cabinet.

CAUTION: Never change the input connection until it has been accurately determined that the line voltage is less than 110 volts A.C.

BUILT-IN-ANTENNA

The receiver is normally shipped with the built-in-antenna connected. If the installation is located in a "good signal" area, this antenna should bring in the picture satisfactorily without further antenna problems.

To check the operation of the built-in antenna, turn on the receiver and check the reception on all the active high and low channels. Adjust the operating controls as outlined under operation. If reception is poor, try other locations in the room, since a few feet may make a big difference in signal strength.

If satisfactory reception cannot be obtained with the built-in antenna, you may assume that it will be necessary to install an outdoor antenna. Disconnect the built-in antenna leads from the terminal board and connect the two transmission line leads from the terminal board and connect the two transmission line leads of the outdoor antenna to the same terminals. It is immaterial which lead is connected to which terminal. It is very important that the built-in antenna be disconnected from the antenna terminals when the outdoor antenna is used.

EQUIPMENT REQUIRED FOR ALIGNMENT

RF sweep generator meeting the following requirements:

18 to 30 MC	10 MC sweep width
40 to 90 MC	10 MC sweep width
170 to 225 MC	10 MC sweep width

Signal generator to cover all I.F. frequencies of from 4.5 MC to 28 MC and all picture and sound carrier frequencies.

CATHODE RAY OSCILLOSCOPE -Electronic Voltmeter of junior voltohmyst type.

R.F. UNIT

Normally the R.F. Tuner will not require any adjustments. If realignment is necessary, refer to attached Service Notes before attempting to align the Unit.

ORDER OF ALIGNMENT

Sound Radio Detector
Sound I.F. Transformer
Picture I.F. Transformers. (preliminary and flat topping)

PRECAUTION

Before proceeding with I.F. Alignment the following precautions should be observed:
Disconnect antenna. Set contrast control for minimum (Maximum counter clockwise Position). Adjust channel tuning to non-assigned channel (2-3-4-7-8-9 Depending Upon Location) to prevent T.V. signal from interfering with alignment.

For all I.F. alignment insert a 47 K ohm resistor in series with the V.T.V.M. probe; also, a 47 K ohm resistor should be inserted between the take-off point and oscilloscope lead for decoupling.

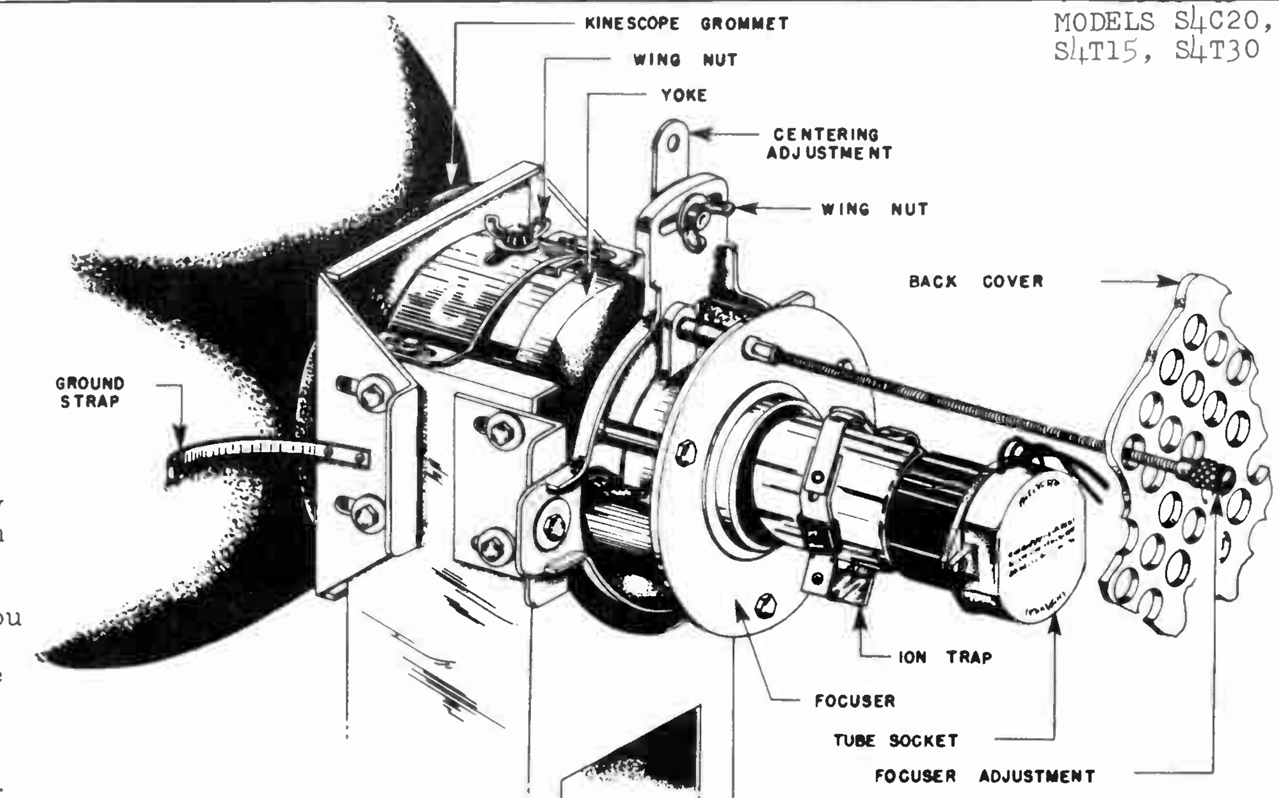

FIG. I

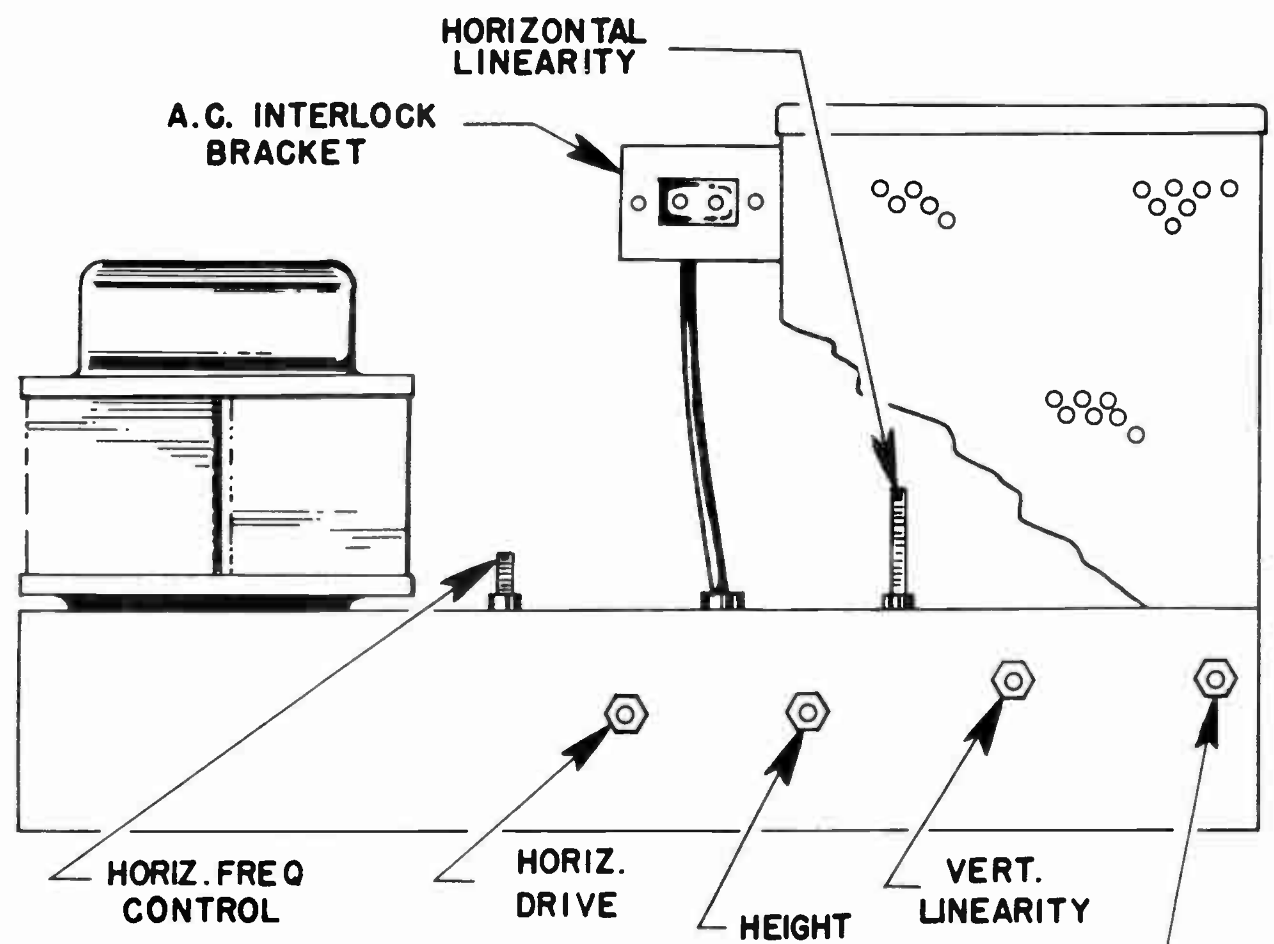

FIG. II

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SOUND RATIO DETECTOR AND I.F. ALIGNMENT

(1) Connect V.T.V.M. common lead to chassis and probe to Pin #2 of 6T8 tube.
(2) Connect signal generator to Pin #1 of 6AU6 Ratio Detector Driver Tube.
(3) Adjust signal generator (4.5 MC) output so that the V.T.V.M. voltage will not exceed 3 volts during entire alignment.
(4) Adjust L16 (Bottom) for MAXIMUM.
(5) Adjust L17 (Top) for MAXIMUM.
(6) Adjust attenuator of generator to give exactly 3 volts on the V.T.V.M.
(7) Move probe of V.T.V.M. to junction of R35 - C28 & C29.
(8) Adjust L17 (Top) for exactly 1.5 volts.
(9) Move signal generator to Pin #4 of 6AC7 Video Output Tube and repeat steps #1 and #3.
(10) Adjust L12 (Bottom) and L13 (Top) for MAXIMUM.
(11) Repeat with care steps 1-3-4-5-6-7-8.

ALTERNATIVE PROCEDURE FOR STEPS 6-7-8:
Connect common lead of V.T.V.M. to junction of R33 and R34.
Connect probe of V.T.V.M. to junction of R35 - C28 and C29.
Adjust L17 (Top) for zero reading on V.T.V.M.

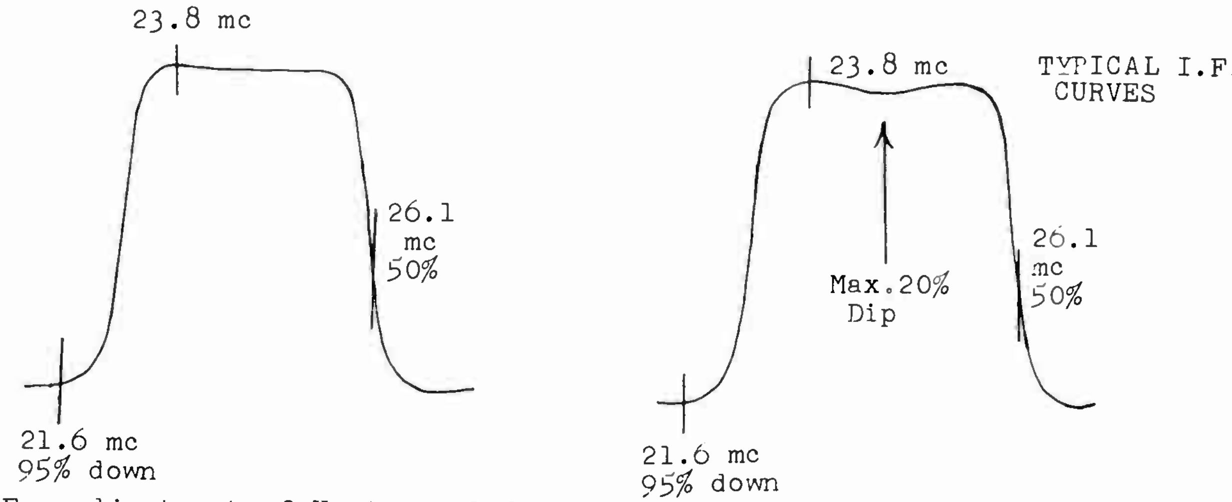
PICTURE I.F. TRANSFORMER

Rough I.F. Alignment:

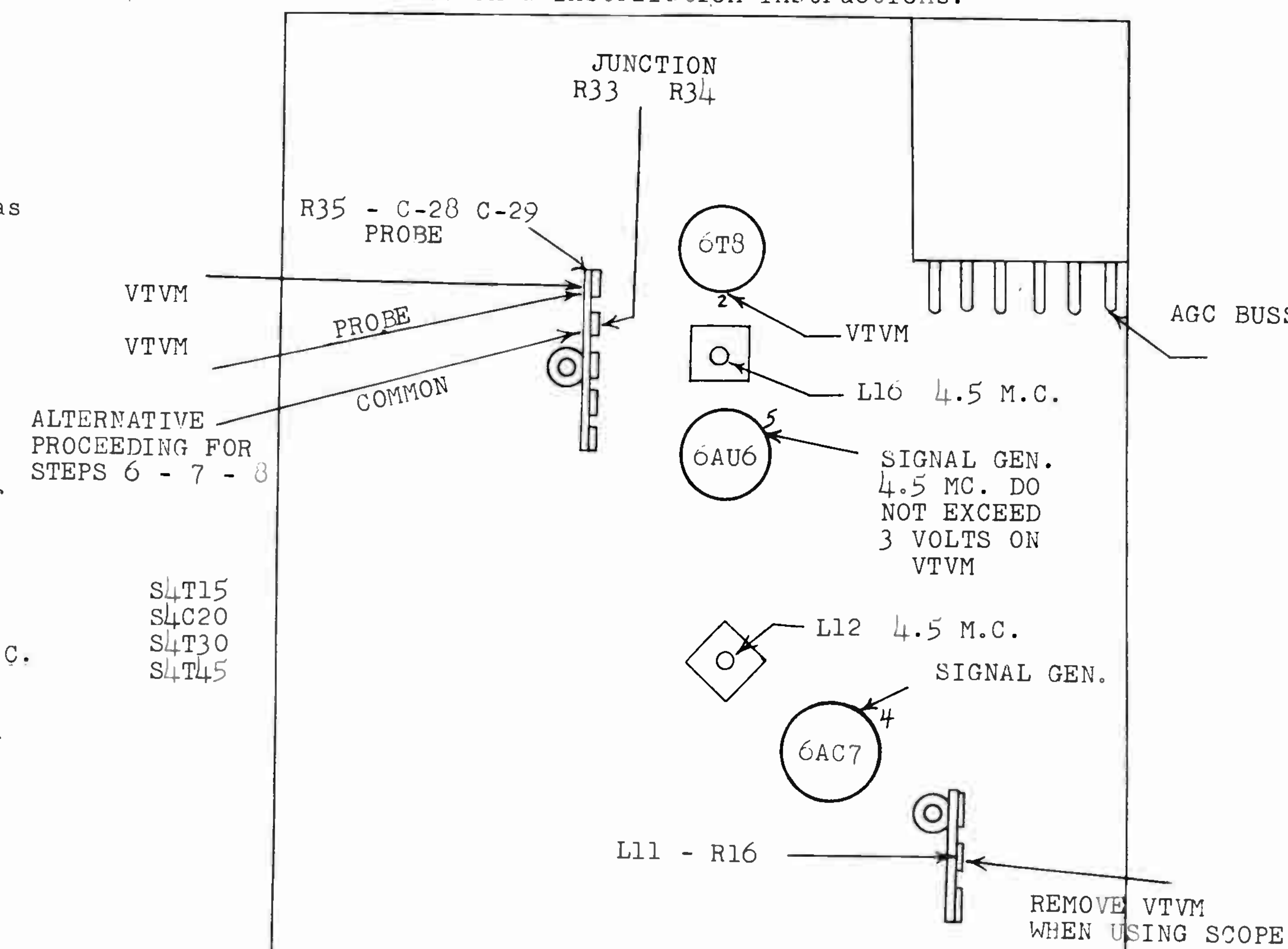
1. Lift shield of 6J6 converter tube. Use cut down goat shield placed over 6J6 converter tube to spray signal into receiver in all of the following alignment procedures. The original tube shield can also be used if care is taken so that the shield does not touch the shield grounding springs.
2. Connect the signal generator to shield.
3. Connect probe of V.T.V.M. to junction of L11 and R16. Connect common lead of V.T.V.M. to ground end of R16.
4. Set signal generator to 23.4 MC and output of generator is to be kept as low as possible.
5. Align First Video I.F. Coil (Located on R.F. Unit "Left Rear Corner") and L6 (Third Video I.F. Coil) for maximum.
6. Set generator to 25.7 MC and adjust L3 (Second Video I.F. Coil) and L9 (Fourth Video I.F. Coil) for maximum.

PICTURE I.F. FLATTOPPING:
1. Remove signal generator and V.T.V.M.
2. Connect sweep generator to converter shield.
3. Connect scope between junction of L11 and R16.
4. Place signal generator lead near 6J6 tube shield. Ground both leads of the generator near the rear apron of the R.F. Unit.
5. For best results the Video I.F. should be aligned on an non-assigned channel (2-3-4-7-8-9). If signal pips are noticed on the curve adjust the channel tuning control. (The Shape of the I.F. Curve Should Not Change When Tuning Control Is Adjusted).
6. Adjust signal generator to zero output and place a V.T.V.M. on the A.G.C. buss. Vary the output of the sweep generator until minus 1.5 volts is read on the V.T.V.M.
7. Adjust signal generator to 26.1 MC and advance the generator output until a marker pip is visible on the Video I.F. curve. Adjust L3 and L9 so that the marker is at the 50% point (SEE CURVE BELOW).
8. Set signal generator to 23.8 MC and flat top video curve by adjusting I.F. on R.F. Tuner and L6. Marker should be close to the end of the curve.
(See Curve

9. Repeat steps 7 & 8 until an acceptable curve is achieved.
10. Set generator to 21.6 MC. This marker should appear at the bottom of the curve (See Curve Below). The exact position of the 23.8 MC marker is governed by where the 21.6 MC marker falls. Should the 21.6 marker be more than 5% up on the curve intercarrier buzz will result and if the marker is too low, weak audio will result. The 21.6 MC marker should be kept as low as possible and yet give enough audio signal.



For adjustment of Horizontal frequency oscillator and non-operating controls refer to attached Installation Instructions.



BOTTOM
CHASSIS ADJUSTMENTS

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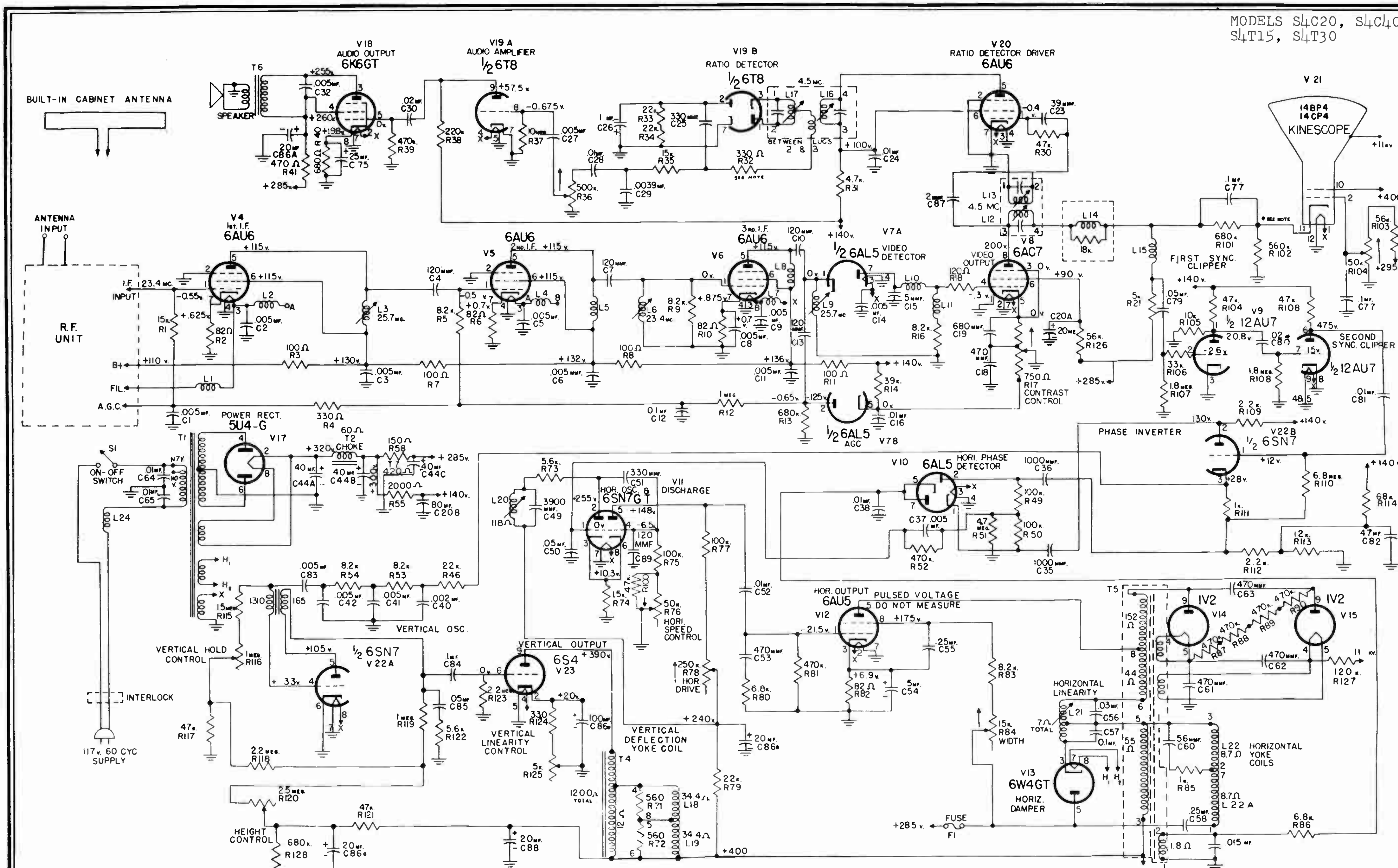
MODELS S4C20, S4C40, S4T15, S4T30



K-1000

All resistance values in ohms. Direction of arrows at controls indicates clockwise rotation.

All voltages measured with vacuum tube voltmeter with no signal input, the contrast control at its maximum counterclockwise position and a normal raster. Voltages should hold within ±20% with 117 V. A.C. supply.

NOTE: The voltage at this point shall not exceed +150 volts.

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INDEX

13-G-46
16" RECTANGULAR PIX TUBE

13-G-47
16" RECTANGULAR PIX TUBE

SPECIFICATIONS

POWER REQUIREMENTS

117 volts   60 cycles   240 watts

PICTURE SIZE

Height	Width	Viewing Area (sq. inches)
10¼"	13¾"	135

SPEAKER

P.M. Dynamic

Model	Size	V.C. Imped.
Stock No. 13-G-46	6"	3.2 ohms
Stock No. 13-G-47	6" x 9"	3.2 ohms

ANTENNA INPUT IMPEDANCE

300 ohms—balanced to ground.

DEFLECTION

Magnetic

BUILT-IN ANTENNA

High "Q" dipole with tunable matching stub.

FOCUS

Magnetic

R. F. TUNER

Turret type construction; individually removable coil assemblies for all channels. All components are easily accessible for servicing.

"KEYED" AUTOMATIC GAIN CONTROL

Outstanding new development; minimizes "airplane flutter"; reduces contrast variation when changing from one channel to another; increases immunity of sync system to external interference.

INTERMEDIATE FREQUENCIES

Sound Carrier—22.25 Mc.
Picture Carrier—26.75 Mc.

VIDEO AMPLIFIER

Two Stage—broad band.

HORIZONTAL SYNCHRONIZATION

Automatic frequency control and "keyed" A.G.C. provide excellent picture stability and noise immunity.

HIGH VOLTAGE POWER SUPPLY

"Fly-back" type. Completely enclosed in a shielded compartment.

I.F. SYSTEM

Four Stage—stagger tuned—for composite signal.
Two additional stages for sound channel.

RETRACE LINE SUPPRESSOR

Eliminates retrace lines thruout the normal range of picture brightness and contrast.

TUBE COMPLEMENT

TUBE NO.	TUBE TYPE	FUNCTION
V1	*6AU6 or 6BH6	1st Sound Amplifier
V2	*6AU6 or 6BH6	2nd Sound Amplifier — Limiter
V3	6T8	Dynamic Limiter — Sound Discriminator — Sound Amplifier
V4	6V6GT	Sound Output
V5	6AG5 or 6BC5 or 6CB6	RF Amplifier (These tubes are directly interchangeable)
V6	6J6	Oscillator — Mixer
V7	6AU6	1st IF Amplifier
V8	6AU6	2nd IF Amplifier
V9	6AU6	3rd IF Amplifier
V10	6AU6	4th IF Amplifier
V11	6AL5	Detector — DC Restorer
V12	*6AU6 or 6AG5	Video Amplifier
V13	6C4	Cathode Follower
V14	6K6GT	Video Output
V15	16TP4 or 16RP4	Picture Tube
V16	*6AU6 or 6AG5	Keyer AGC
V17	12AU7	Sync Clipper — Phase Splitter
V18	6AL5	Horizontal AFC — Phase Detector
V19	6SN7GT	Horizontal Scanning Multivibrator
V20	6CD6G	Horizontal Scanning Output
V21	1B3GT/8016	High Voltage Rectifier
V22	6W4GT	Horizontal Damping
V23	6X5GT	Rectifier
V24	5U4G	Rectifier
V25	6J5GT	Vertical Blocking Oscillator
V26	*6S4 or 6SN7GT	Vertical Scanning Output

* CAUTION: Some of these alternate type tubes are not directly interchangeable; see circuit diagram or Name Label for correct tube complement and complete explanation of alternate tube.

RECEIVER OPERATING CONTROLS

The various controls on the receiver may be divided into two classes, Operating and Pre-set. Operating controls are those which control program selection as well as sound and picture quality.

All but one of the operating controls of the receiver are located on the front panel and the name and use of each are described in Figure 1. The built-in antenna tuning control is accessible at the rear of the receiver. The Pre-set controls are those which require adjustment at the time the receiver is installed and they rarely need attention thereafter. There are nine Pre-set controls, three of which are located at the back of the chassis (see Figure 9). Five controls are accessible by removing the Name Plate located directly above the Operating controls—see Fig. 4.

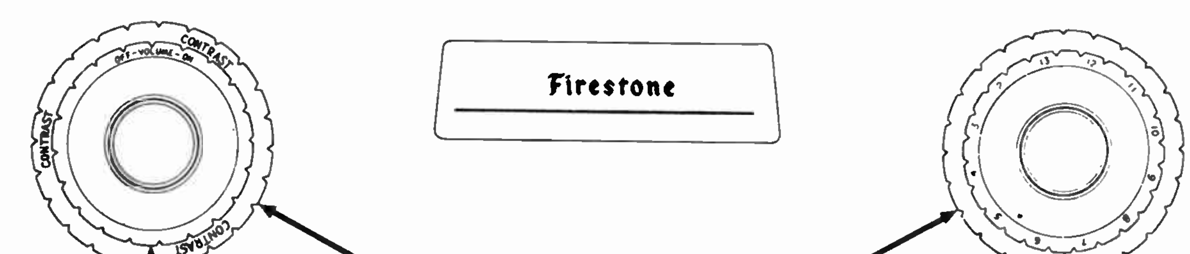

Fig. 1

ON-OFF SWITCH & VOLUME CONTROL
(front knob)
Use to turn receiver on or off and to adjust for desired sound volume.

CONTRAST CONTROL
(rear knob)
Adjust to receive picture and obtain correct contrast between light and dark shades.

FINE TUNING CONTROL
(rear knob)
Use to tune in station after "Channel Selector" is set to desired channel. See next section for complete description of tuning procedure.

CHANNEL SELECTOR
(front knob)
Set knob so that desired channel designation becomes illuminated. Then use Fine Tuning control to tune in station.

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CONTROL ADJUSTMENT PROCEDURE

Although the Pre-set controls have been factory adjusted for optimum performance, it is usually necessary to make some fine adjustments of these controls at the time of installation.

There are nine Pre-set controls, three of which are located at the back of the chassis (see Figure 9). Five controls are located under the Name Plate on the front panel. This plate can be removed by grasping it at its ends and pulling forward. The Auxiliary Fine Tuning Screw can be reached by removing the "Channel Selector" and "Television Fine Tuning" knobs.

A Centering Arm, used to center the picture on the screen, is accessible at the back of the cabinet. Two holes are also provided in the cabinet back for adjustment of the Focusing Slugs (see Figure 9).

To gain access to the ion trap, it will be necessary to remove the back cover of the cabinet by first removing the built-in antenna tuning knob and then taking out the screws around the rim of the back cover. Removal of the cabinet back automatically opens an interlock to disconnect the receiver power cord, therefore, an auxiliary power cord assembly will be required when making ion trap adjustment. This cord may be obtained by requesting Part #507699. **Do not attempt to supply power to the receiver using any other device.**

The receiver is now ready for an operational check.

1. **TURN SET ON**—Rotate the "On-Off Switch and Volume" knob approximately ½ turn clockwise to turn set on and obtain sufficient sound volume during the tuning process. Allow several minutes for all tubes in the receiver to warm up and for circuits to stabilize before attempting to obtain a picture on the screen.

   A Channel Lite, located behind the "Channel Selector" knob, illuminates the particular television station designation corresponding to the setting of the Channel Selector.

2. **ADJUST ION TRAP**—If screen remains dark or is only dimly illuminated when "Brightness" control is turned clockwise, the ion trap may require adjustment.

   The ion trap is located on the neck of the picture tube as shown in Figure 9 and consists of a magnet held in position by metal bands.

   With "Brightness" control (located behind Name Plate) set approximately ¾ turn clockwise, rotate the entire ion trap assembly while sliding it back and forth until picture tube screen is illuminated to maximum brilliance. Reduce "Brightness" control setting and repeat this operation to assure accurate positioning of ion trap.

   Do not turn "Brightness" control to its maximum clockwise position until ion trap is correctly adjusted—failure to observe this precaution may result in damage to the picture tube.

3. **ADVANCE CONTRAST CONTROL**—Turn the "Contrast" control knob to its maximum clockwise position.

4. **POSITION CHANNEL SELECTOR**—Set "Channel Selector" knob so that the call letters or channel number of the desired television channel appears in the illuminated opening. If the call letter tabs were not previously inserted in this knob when receiver was installed, you can readily do so by following the procedure given in the next section of this booklet.

5. **ADJUST FINE TUNING CONTROL**—After "Channel Selector" knob has been set, then use the "Television Fine Tuning" control to obtain the correct tuning point for both picture and sound. That is accomplished as follows:

   a. Turn "Television Fine Tuning" control in either direction until sound volume is maximum—if sound cannot be heard, advance the volume control and repeat fine tuning.

   b. When the point of maximum sound volume has been reached it will be noted that the picture has a "ragged" or "saw-tooth" appearance or is partially obscured by "sound bars" (dark horizontal bars of varying width—see Fig. 2).

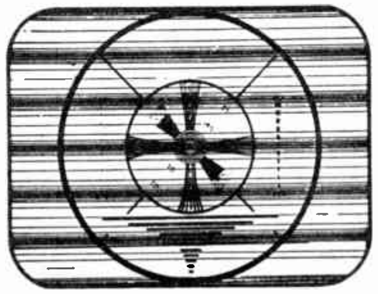

Fig. 2—SOUND INTERFERENCE CAUSED BY INCORRECT TUNING

THE CORRECT SETTING OF THE TELEVISION FINE TUNING CONTROL is now obtained by turning it away from the maximum volume position only for enough to eliminate the "sound bar" interference and permit sharp reproduction of the picture.

6. **AUXILIARY FINE TUNING ADJUSTMENT**—If it is found that the tuning range of the "Fine Tuning" control is inadequate to permit correct tuning of a station in its assigned channel, then adjustment of the "Auxiliary Fine Tuning" screw will be necessary. This special screw is accessible after removal of the "Channel Selector" and "Fine Tuning" knobs. They may be removed by merely pulling them forward.

   Adjustment of the "Auxiliary Fine Tuning" screw may be undertaken in accordance with the following procedure.

   a. Set "Channel Selector" to desired channel; then remove this knob.

   b. Set "Fine Tuning" knob to the center of its range; then remove this knob. The flat portion of the main tuning shaft (outer brass shaft) should now be in the uppermost position. Note the location of the "Auxiliary Fine Tuning" adjustment screw on receiver chassis—see Fig. 4.

   c. Using a thin screwdriver (preferably non-metallic), adjust the setting of "Auxiliary Fine Tuning" screw for correct tuning of the desired television station—**CAUTION: Do not attempt to rotate this screw more than two full turns in either direction, as further rotation may release it from the thread clip within the tuning mechanism and the coil for that channel (located in R.F. Tuner Unit) would then have to be removed in order to restore the screw to the correct position.** If a metal screwdriver is used, detuning occurs when the screwdriver is removed but it will be noted that this degree of detuning can now be compensated by resetting the "Fine Tuning" control (brass shaft). Thus the range of the "Fine Tuning" control (after knob is replaced on the shaft) will be adequate to tune in the station.

   d. This completes the adjustment of the "Auxiliary Fine Tuning" screw for one channel. Identical screws are provided on each channel and they are all accessible thru the same opening in the tuning mechanism as each successively moves into position when the "Channel Selector" knob is rotated.

7. **ADJUST SOUND VOLUME**—Readjust the setting of the "Volume" control until the sound accompanying the television broadcast is received at a satisfactory level.

8. **ADJUST BUILT-IN ANTENNA TUNING CONTROL**—If the receiver's built-in television antenna system is used, rotate the antenna tuning knob (located at rear of cabinet) until the best picture is obtained. It may be possible to find a single setting for this knob which will give satisfactory performance for a group of stations. In the event that this is not the case, adjust the control for optimum performance each time the Channel Selector is rotated to a different station.

9. **HORIZONTAL HOLD**—Should the picture appear to move horizontally across the screen or break up into a series of light and dark streaks as shown in Figure 3, adjust the "Horizontal Hold" control (located behind Name Plate) until the picture remains stationary and does not slip horizontal sync when operating "Channel Selector" knob.

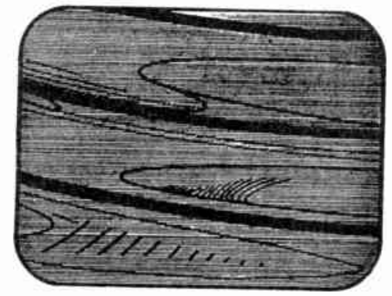

Fig. 3—HORIZONTAL MOVEMENT; ADJUST HORIZ. HOLD CONTROL

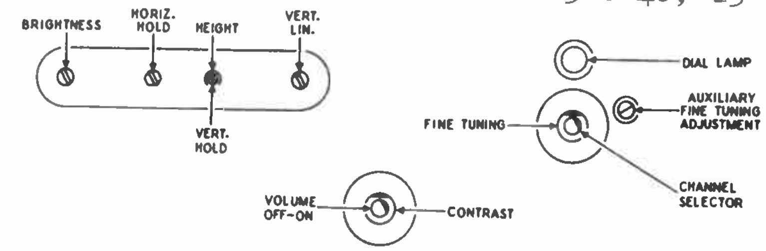

Fig. 4—LOCATION OF PRE-SET CONTROLS

10. **VERTICAL HOLD**—Should the picture appear to roll by in a vertical direction or cause multiple vertical images as shown in Figure 5, it will be necessary to adjust the "Vert. Hold" control located behind the Name Plate (see Figure 4).

    After this adjustment is made, reduce contrast until picture is barely visible and check setting of "Vertical Hold" control for proper picture synchronization.

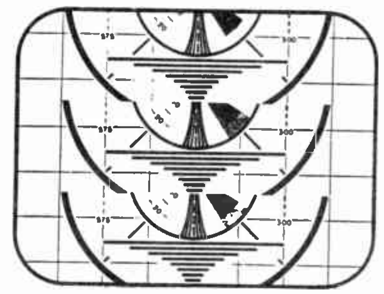

Fig. 5—VERTICAL MOVEMENT; ADJUST VERTICAL HOLD CONTROL

11. **INITIAL FOCUS**—Set Channel Selector knob to an inactive television channel. Then set the Brightness control to its maximum clockwise position and the Contrast control to its maximum counter-clockwise position, and adjust the position of the Focusing Slugs (see Fig. 9) until scanning lines in center of raster are most clearly defined; this should provide best focusing over the entire area of the picture when controls are returned to their normal positions.

    If picture brilliance decreases while adjusting picture focus, readjust ion trap as explained in step #2. Fuzzy picture may also be due to reproduction of poor quality film when station is televising a motion picture. Incorrect tuning of receiver produces a similar effect. Check for proper tuning point as described in step 5 of this section.

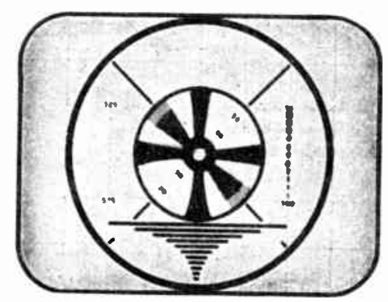

Fig. 6—BLURRED APPEARANCE; ADJUST FOCUSING SLUGS

The following adjustments should be made while the station is transmitting its circular test pattern.

12. **STRAIGHTENING TILTED RASTER**—If the pattern should appear on the screen in a tilted position as shown in Figure 7, loosen the deflection yoke locking screw (see Figure 9) and rotate the yoke sufficiently to correct this condition. Be sure to retighten the screw securely.

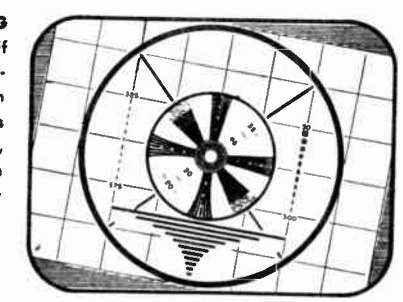

Fig. 7—TILTED PICTURE; ADJUST YOKE POSITION

13. **CENTERING**—To center the test pattern on the screen, proceed as follows:

    a. Position Centering Arm (see Figure 9) for correct centering of test pattern.

    b. If picture cannot be centered using this arm, change the position of the focus magnet assembly by adjusting the three knurled nuts labeled A in Figure 9.

    NOTE: If a decrease in picture tube brilliance is noted when making the centering adjustment, readjust ion trap as explained in step #2.

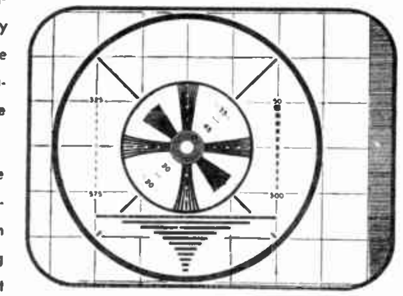

Fig. 8—OFF CENTER; ADJUST CENTERING ARM

14. **HEIGHT** — Control of picture size in the vertical direction is accomplished by means of the "Height" control located behind the Name Plate. Height and width adjustments should be checked for all transmitting stations to be sure that picture properly fills the viewing area. It may be necessary to change the setting of the "Height" control after the "Vertical Linearity" control is adjusted.

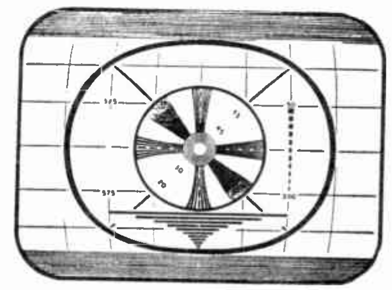

Fig. 10—TOO SHORT; ADJUST HEIGHT CONTROL

15. **WIDTH** — Control of picture size in the horizontal direction is accomplished by means of the "Width" control located on the rear of H. V. power supply (see Fig. 9).

    If abnormally low line voltage makes it difficult to obtain sufficient picture width when using the "Width" control, then the setting of the "Horizontal Drive" control may be incorrect. The method of adjusting this control is explained in paragraph #18.

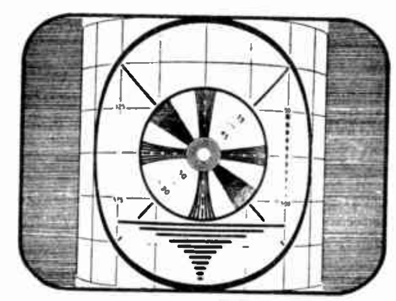

Fig. 11—TOO NARROW; ADJUST WIDTH CONTROL

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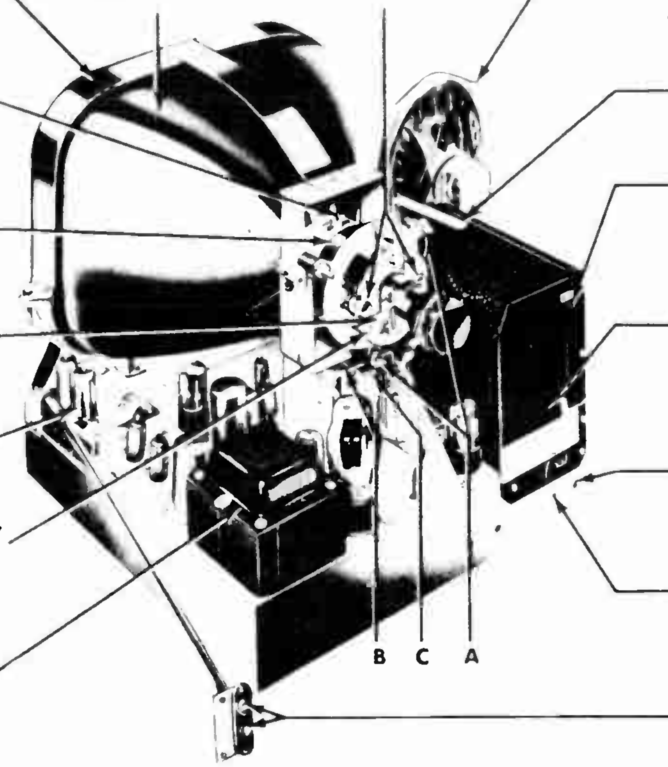


Fig. 9—CHASSIS AND PICTURE TUBE ASSEMBLY

16. **VERTICAL LINEARITY** — Improper vertical linearity causes the circular test pattern to appear condensed on the upper edge of the screen and extended on the lower edge or vice versa. This effect is illustrated in Figure 12. Adjust for proper linearity by using "Vertical Linearity" control located behind Name Plate. It may be necessary to readjust the "Height" control if an appreciable change is made in the linearity control setting.

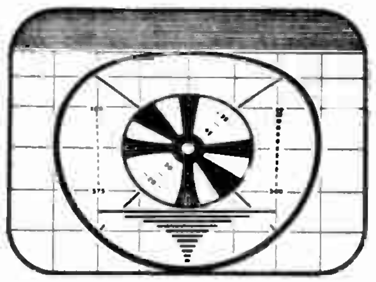


Fig. 12—VERTICAL DISTORTION; ADJUST VERTICAL LINEARITY CONTROL

17. **HORIZONTAL DRIVE** — The "Horizontal Drive" control located at rear of chassis (see Fig. 9) should be rotated clockwise to the point where any white (or black) vertical lines near the left side of the picture are eliminated. As width and linearity of the picture are affected by the setting of "Horizontal Drive" control, it will be necessary to adjust this control in conjunction with the Horiz. Linearity and Width controls to obtain desired picture width and linearity.

18. **HORIZONTAL LINEARITY** — Improper horizontal linearity causes the circular test pattern to appear condensed on the right edge of the screen and extended on the left edge or vice versa. This effect is illustrated in Figure 13. Adjust for proper linearity by using "Horizontal Linearity" control located at rear of chassis (see Figure 9). In event that proper horizontal linearity cannot be obtained by adjusting this control, then check the setting of the "Horizontal Drive" control.

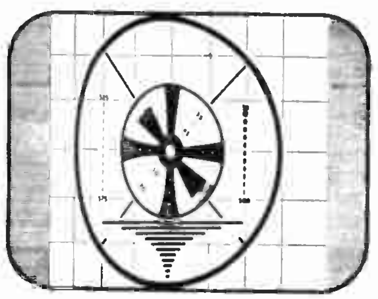


Fig. 13—HORIZONTAL DISTORTION; ADJUST HORIZONTAL LINEARITY CONTROL

19. **ELIMINATING SEMI-CIRCULAR SHADOW** — This shadow is caused by the electron stream striking the neck of the tube and it can generally be corrected by applying one or a combination of the following procedures:

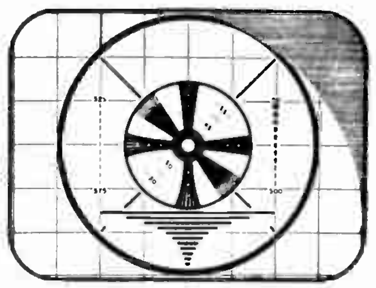


Fig. 14 SEMI-CIRCULAR SHADOW

a. Make sure deflection yoke is positioned as far forward as possible by loosening the three wing nuts labeled B in Fig. 9.

b. Reposition the focus magnet assembly by readjusting the three nuts labeled A in Fig. 9 to shift the assembly forward.

c. In event neck shading cannot be eliminated by the above procedures, release the four wing nuts labeled C in Figure 9 and raise or lower entire yoke and focus magnet assembly so that focus magnet can be repositioned vertically with respect to the tube neck.

20. **BRIGHTNESS** — The "Brightness" control (located behind Name Plate) should be initially adjusted in conjunction with the "Contrast" control for the brightness level desired by set owner—check on all active station channels. Too much brightness will have the same effect as too little contrast, and vice versa, therefore, it is necessary to strike a proper balance between contrast and brilliance.

21. **FINAL ADJUSTMENT** — Recheck settings of Focusing Slugs for best picture focus.

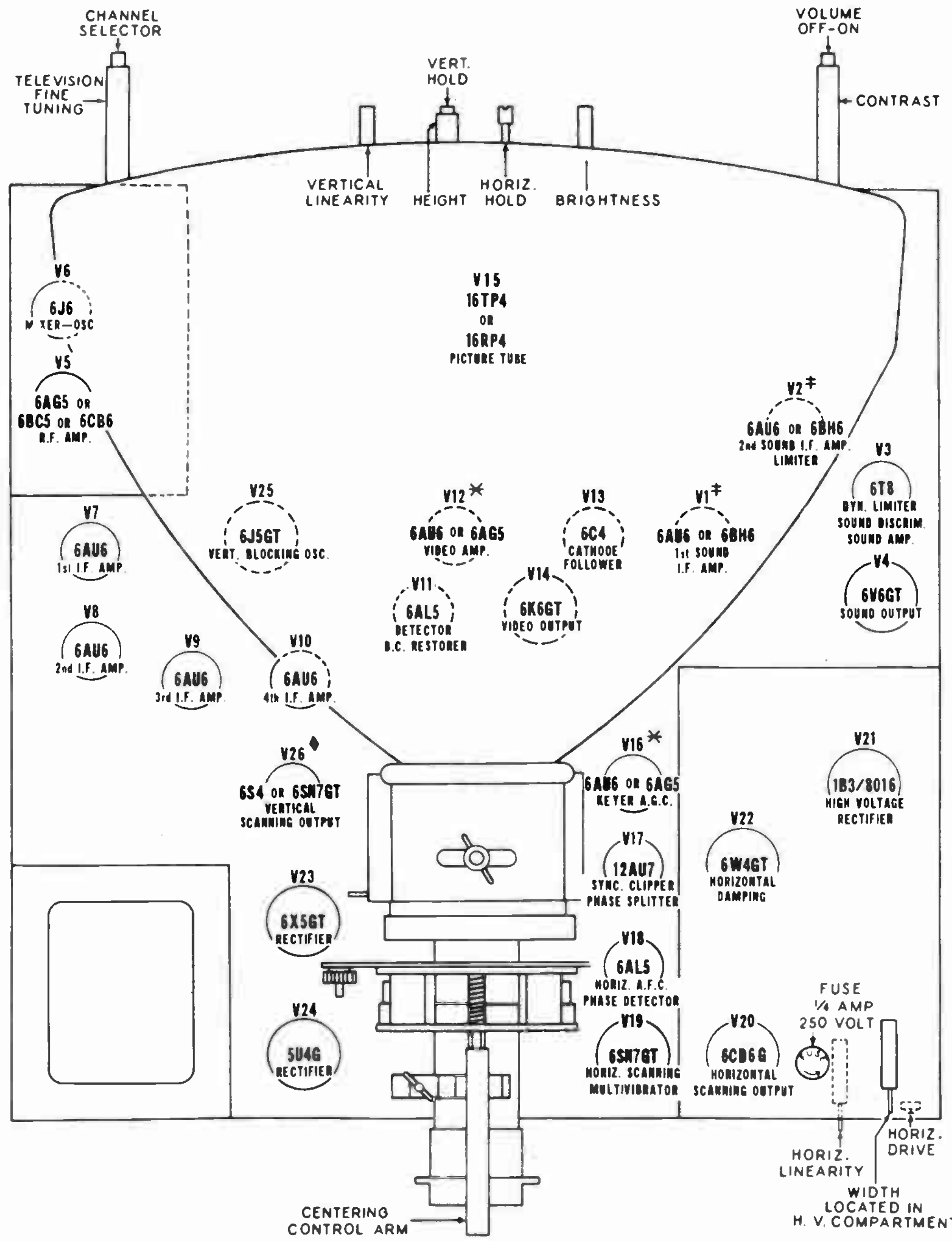
INSERTING STATION CALL LETTER TABS

A set of television station call letter tabs and channel numbers is supplied with this receiver and is to be used for labelling the Channel Selector knob. To install these tabs, merely remove the Channel Selector knob by pulling it forward, and insert either the correct station call letters or channel numbers into the proper circular recesses on the rear surface of the knob. The correct recess may be identified by the station channel number stamped on the outer edge of this knob adjacent to each recess.

(Information on channel numbers and corresponding station call letters may be obtained from the radio page of your local newspaper.) Insert blank tabs in the remainder of the circular holes.

Retain any unused tabs. Your list of call letter tabs includes some television stations which are not yet on the air. When a new station begins broadcasting in your area, its call letter tab may be inserted in the Channel Selector knob as described above.

TUBE LOCATIONS & FUNCTIONS



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TUBE REPLACEMENT

Some chassis use alternate type tubes in the positions designated by V1, V2, V12, V16 and V26 in the above chart. **These alternate type tubes are not interchangeable and failure to install the correct type tube may result in damage to the receiver.**

When replacing these tubes, check for series designation stamped on rear of chassis adjacent to model number. This identification may consist of one or more letters following the word SERIES.

The following symbols refer to similar symbols on the above tube location chart.

* A type 6AG5 tube is used when the letter "A" is included in the series designation. A type 6AU6 tube is used when letter "A" is **not** included in the series designation.

‡ A type 6BH6 tube is used when the letter "B" is included in the series designation. A type 6AU6 tube is used when letter "B" is **not** included in the series designation.

♦ A type 6SN7GT tube is used when the letter "C" is included in the series designation. A type 6S4 tube is used when letter "C" is **not** included in the series designation.

SOCKET VOLTAGES

CAUTION

THE PICTURE TUBE is highly evacuated and if broken, glass fragments will be violently expelled. Scratching, chipping, undue pressure, or careless handling such as lifting the tube by its neck is dangerous and should be avoided. If it is necessary to handle the picture tube, use safety goggles and heavy gloves. Be sure to discharge the voltage developed across the capacitor formed by the inner and outer coating of the picture tube. This can be done by connecting the high voltage socket on the tube to the outer coating with a well insulated metal conductor.

HIGH VOLTAGE (11 to 13.5 kilovolts) is produced in a supply circuit of this receiver. Exercise care to avoid contact with elements of this circuit and particularly the tube terminals which are labeled "CAUTION" in the adjoining voltage chart. If measurement of voltage at these points is necessary, see procedure given below under the note "L".

THE HIGH VOLTAGE LEAD, which supplies approximately 11 to 13.5 kilovolts to the picture tube, should be momentarily shorted to the chassis whenever it is disconnected for service purposes. This discharges the high voltage filter condenser and prevents a shock hazard when working on the receiver after it has been turned off.

INTERMEDIATE B+ VOLTAGES, 480 and 360, are dangerous and caution should be observed when the receiver chassis components are exposed for service purposes.

THE VOLTAGES SHOWN IN THE ADJOINING CHART WERE MEASURED UNDER THE FOLLOWING CONDITIONS

1.	Power Supply—117 volts 60 cycle AC.
2.	All voltages are measured between socket terminals and chassis unless otherwise indicated on adjoining chart.
3.	* Measurements made with voltmeter having sensitivity of 20,000 ohms per volt except where indicated by (*). The (*) symbol designates a vacuum tube voltmeter measurement.
4.	Channel Selector and Fine Tuning Controls set for normal reception of a local station.
5.	All controls are set for normal reception of the transmitted signal unless the voltage shown on the chart is followed by a letter or letters indicating a special condition of measurement as explained in subsequent notes.
6.	The external or built-in antenna should remain connected to the receiver only when taking voltage measurements in the sweep and sync circuits—for all other measurements, disconnect antenna, short antenna terminals together and connect them to ground.
7.	Certain voltages were measured with two different settings of specific controls. It should therefore be understood that in these instances all controls, with the exception of one or two, were set for normal reception—letters following the voltage shown on the chart indicate the exceptions and are explained below.

EXPLANATION OF NOTES

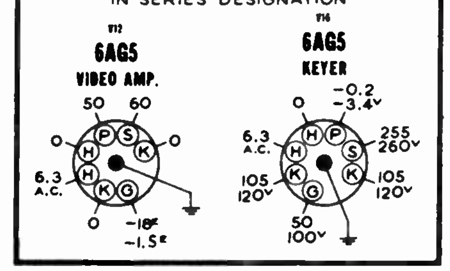
A.	Vert. Hold Control max. counter-clockwise
B.	Brightness Control max. counter-clockwise
b.	This voltage will vary from 11 to 15 depending upon setting of Horizontal Hold Control.
C.	Contrast Control max. clockwise
D.	Horiz. Drive Control max. clockwise
d.	This voltage will vary from 300 to 320 depending upon setting of Horizontal Hold Control.
E.	Before making this measurement, remove one of the four 6AU6 IF Amplifier tubes (V7, V8, V9 or V10). This will prevent noise in the RF stages from affecting the voltage measured at this point.
e.	This voltage will vary from —4.2 to —7.6 depending upon setting of Horizontal Hold Control.
F.	Height Control max. counter-clockwise
G.	Width Control max. counter-clockwise
H.	Height Control max. clockwise
h.	This voltage will vary from +8 to —2 depending upon setting of Horizontal Hold Control.
J.	Horiz. Hold Control set for normal picture
K.	The measurement should be made with a vacuum tube voltmeter. The voltage reading will fluctuate in the vicinity of 0.15 volts.
k.	This voltage will vary from 10 to 15 depending upon setting of Horizontal Hold Control.
L.	If you do not have an instrument capable of directly measuring voltages in this range, the voltage can be measured by using a voltage divider network consisting of twenty 2.2 megohm 2 watt resistors and one 1 megohm 2 watt resistor, all connected in series. Avoid using resistors of higher values as their individual voltage rating may be exceeded. It is also important to use resistors of equal wattage. Solder all connections between resistors. Accurately measure the overall resistance of the entire combination as well as the resistance of the 1 megohm section. **With the set turned off,** connect the 2.2 megohm end of the resistance voltage divider to the filament of the 1B3GT/8016 tube, or H. V. terminal of the picture tube, and connect the 1 megohm end to chassis. Now, turn the set on and measure the voltage drop across the 1 megohm resistor with a vacuum tube voltmeter. The voltage at the tube terminal can then be calculated as follows: $\left[\text{Volts At Tube Terminal}\right] = \dfrac{\left[\text{Measured Resistance Of Entire Voltage Divider}\right]}{\left[\text{Measured Resistance Of 1 Meg. Section}\right]} \times \left[\text{Volts Measured Across 1 Meg. Section}\right]$
M.	Vertical Linearity Control max. counter-clockwise.
N.	Channel Selector set to channel #4
n.	This voltage will vary from —3.6 to —7.5 depending upon setting of Horizontal Hold Control.
q.	This voltage will vary from 9 to 14 depending upon setting of Horizontal Hold Control.
R.	Do not attempt to measure the voltage at the tube cap. There is a high R. F. potential at this point.
r.	Contrast Control max. counter-clockwise
S.	Channel Selector set to channel #10
T.	Grounding of center stud on tube socket is necessary to reduce capacity coupling between other pins. Oscillation may result if this ground is omitted.
t.	This voltage will vary from —3.5 to —4.5 depending upon setting of Horizontal Hold Control.
U.	Vertical Hold Control max. clockwise
u.	This voltage will vary from —7 to —12 depending upon setting of Horizontal Hold Control.
V.	Before measuring this voltage, connect external antenna and adjust controls for normal reception of station signal.
W.	This voltage will vary from +0.01 to —0.25 depending upon setting of Horizontal Hold Control.
X.	Brightness Control max. clockwise
Y.	Vertical Linearity Control max. clockwise.
Z.	This voltage will vary from +6.2 to —1.8 depending upon setting of Horizontal Hold Control.

NOTE

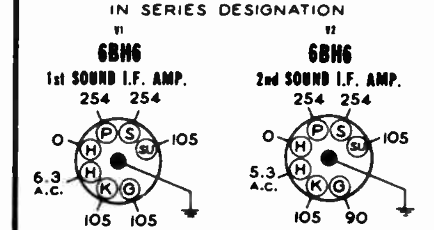
The socket voltages shown in the three charts below indicate measurements made on certain alternate tubes used in coded chassis. This coding consists of one or more letters following the word "SERIES" stamped on rear surface of chassis. A chassis incorporates only that change indicated by letter designation i.e., chassis stamped "SERIES BD" does not include changes "A" or "C".

For complete description of these changes, refer to Production Change column on circuit diagram page.

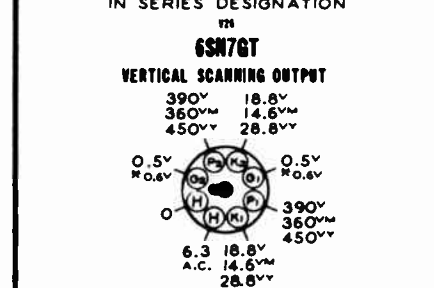
USED WHEN LETTER "A" IS INCLUDED IN SERIES DESIGNATION



USED WHEN LETTER "B" IS INCLUDED IN SERIES DESIGNATION



USED WHEN LETTER "C" IS INCLUDED IN SERIES DESIGNATION



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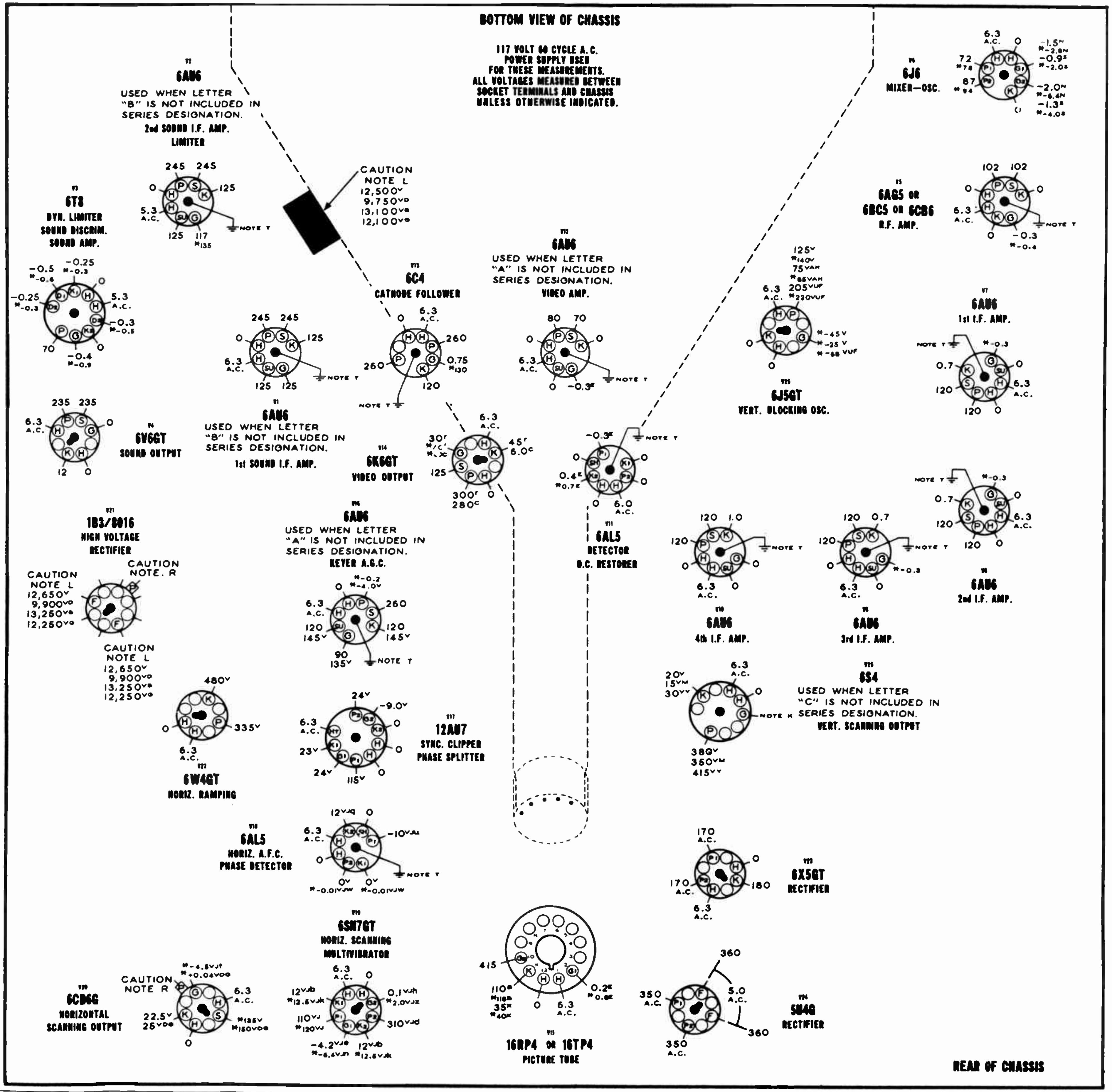


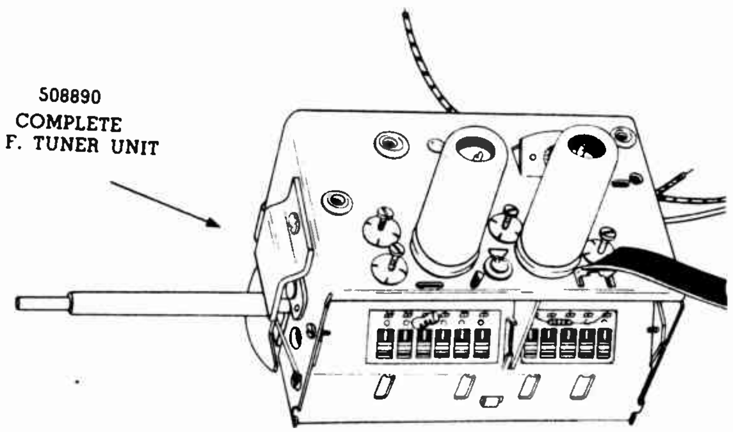
REPAIR DATA FOR 508890 RF TUNER UNIT

All replacement parts for the RF Tuner Unit are included in the complete receiver parts list.

This RF Tuner Unit consists of an RF amplifier stage (using 6AG5, 6BC5, or 6CB6 tube) and a mixer-oscillator stage (using 6J6 tube). Channel selection is accomplished by rotation of a turret assembly having 2 sets of snap-in coils for each of the 12 channels. The tuner also incorporates a Fine Tuning control.

Antenna Coils for each channel consist of a center-tapped primary and an RF amp. grid winding (secondary). The individual RF-Oscillator Coils include an RF amplifier plate section, a mixer grid section and an oscillator winding. Signal output from the mixer stage is coupled to the IF amplifiers through the input IF coil located on the tuner unit.

508890
COMPLETE
R. F. TUNER UNIT



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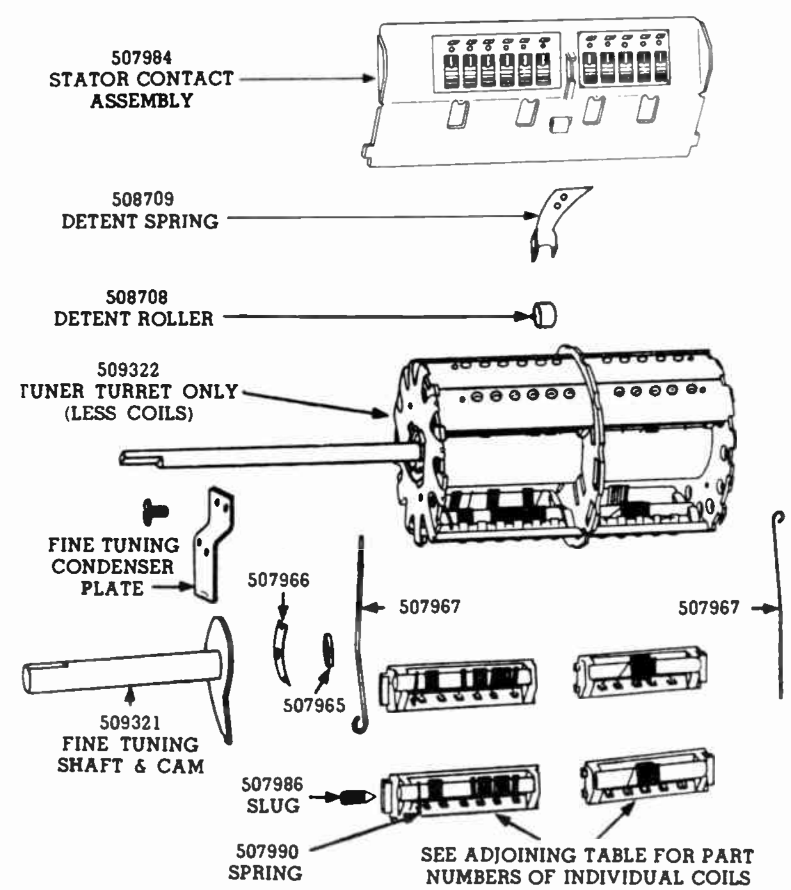
SERVICE PRECAUTIONS

SUBJECT	PRECAUTIONS
ELECTRICAL COMPONENTS	The high frequencies used in the RF section of a television receiver make it necessary that considerable care be exercised in servicing the tuner. Lead dress and location of components are very critical at these frequencies. When replacing parts, it is important to use components of identical electrical characteristics and physical size. Always reconnect the replacement item in the same location and position in the tuner as the original component.
TUBES	Replacement of tubes in the Tuner Unit may cause slight detuning of RF circuits due to inherent differences in inter-electrode capacitances. When replacing tubes (especially V6, 6J6 mixer-oscillator tube) make sure that Fine Tuning control will tune in television stations at approximately the middle of its range. It may be necessary to change the setting of the individual oscillator coil slugs for some channels to accomplish this.
CHANNEL COILS AND SLUGS	Channel Coils must be handled with care. Do not disturb coil windings. If an oscillator slug "falls into" its coil form during adjustment, remove the Channel Coil from the turret assembly and lift the Slug Retaining Spring aside. By tapping the coil form it should be possible to make the slug move toward the end so that its threads will be engaged by the Slug Retaining Spring when that spring is returned to its normal position.
FINE TUNING CONTROL	Rubbing of the bakelite Fine Tuning Cam against the Fine Tuning Condenser Plate is intentional in order to avoid vibration with resulting microphonics. However, the Fine Tuning Cam should not rub or contact the small circular plate located on the body of the tuner.

REMOVAL AND REPLACEMENT OF PARTS

ITEM	PROCEDURE
RF TUNER UNIT	To remove the Tuner Unit from receiver chassis, proceed as follows: 1. Remove channel selector dial lamp socket. 2. Remove support bracket which positions front of Tuner Unit and also remove screws which hold tuner to rear support bracket. 3. Disconnect the leads from the tuner to the main chassis. See illustration on circuit diagram page showing tuner connections. After the Tuner Unit is replaced, make sure that channel selector dial lamp socket is correctly positioned so that channel selector knob will be properly illuminated.
CHANNEL COILS	Insert a screwdriver blade between Coil Retainer Spring and the end of the Tuner Turret. Twist the blade to pull spring away from the molded body of Channel Coil. Lift this end of coil body upward and remove individual coil assembly from tuner. When replacing Channel Coils, be sure they are reinstalled in their correct positions. Coil numbers should increase consecutively in a counter-clockwise direction when tuner is viewed from the front. If all the Channel Coils have been removed from the Tuner Turret, rotate turret until flat surface on end of tuner shaft points down. Install #3 Channel Coils into bottom position on turret. Then follow the correct sequence indicated above to replace other coils.
TUNER TURRET ASSEMBLY	To remove turret from RF Tuner Unit, proceed as follows: 1. Remove tuner from receiver chassis. 2. Remove rear Turret Shaft Retaining Spring by disengaging straight end of spring from projection on tuner. 3. Remove Fine Tuning Condenser Plate from front of Tuner Unit. This plate forms one side of Fine Tuning control condenser and is held in place by one screw. 4. Slide Fine Tuning Cam and Brass Shaft off of main Channel Selector Shaft. 5. Remove Contactor Washer Spring and Fiber Spacer Washer from Channel Selector Shaft. 6. Remove Shaft Retaining Spring at front of tuner by disengaging straight end of spring from projection on case. 7. Remove turret assembly from case. To replace turret, reverse the above procedure. Tooth on bakelite Fine Tuning Cam should point downward during assembly so that it does not become locked between the stops on the Fine Tuning Condenser Plate.

ITEM	PROCEDURE
STATOR CONTACT ASSEMBLY	To remove this assembly, proceed as follows: 1. Remove the two screws at the front and rear of the Stator Contact Assembly. 2. Unsolder all electrical connections to contact plate. 3. Unsolder five soldered joints between Stator Contact Assembly and Tuner Unit. 4. Contact Assembly may now be withdrawn from case. To reinstall this assembly: 1. Place Stator Contact Assembly in position and replace, but do not tighten, the two screws at the front and rear of the assembly. 2. Remove 3 consecutive pairs of Channel Coils from the turret (for example, the antenna and rf-osc. coils for channels #5, 6 and 7). 3. Position Tuner Turret so that the edges of the next highest Channel Coils (in this case, the coils for channel #8) just pass the row of 11 contacts on the Stator Contact Assembly. 4. Adjust position of the Stator Contact Assembly so that there are a few thousandths of an inch spacing between the contacts on the contact plate and the molded body of the Channel Coils. 5. The Contact Assembly is now correctly positioned and screws at front and rear may be tightened. 6. Solder Stator Contact Assembly to tuner frame at same points that were used previously. 7. Make all electrical connections to contact plate. 8. Replace Channel Coils.



CHANNEL NUMBER	ANTENNA COIL PART NUMBER	RF & OSC COIL PART NUMBER
2	507952	507972
3	507953	507973
4	507954	507974
5	507955	507975
6	507956	507976
7	507957	507977
8	507958	507978
9	507959	507979
10	507960	507980
11	507961	507981
12	507962	507982
13	507963	507983

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ALIGNMENT PROCEDURE

Alignment of all RF and IF tuned circuits in this receiver may be accomplished by utilizing the procedures described in the following charts.

SEQUENCE OF ALIGNMENT: These procedures should preferably be applied in the order in which they are presented, however, alignment of the Sound Channel or IF Channel may be accomplished individually if desired.

The RF Amplifier and Mixer alignment may also be accomplished independent of Sound or IF Channel alignment, but oscillator calibration can only be done after IF Channel has been correctly aligned. Proper IF band pass characteristic is necessary for Oscillator alignment as results of RF circuit tuning are observed by means of an oscilloscope connected to the output of the detector stage.

REMOVAL OF CHASSIS: The receiver chassis must be removed from the cabinet in order to accomplish alignment of all tuned circuits as there are adjustment points located on the underside of the unit.

This can be accomplished by first removing all knobs and disconnecting the receiver "built-in" antenna and speaker. The chassis may then be removed by releasing the hold-down screws located on the underside of the cabinet.

Removal of the cabinet back automatically opens an interlock to disconnect the receiver power cord, therefore, an auxiliary power cord assembly will be required when aligning this receiver. This cord may be ordered from Firestone by requesting Part #507699. **Do not attempt to supply power to the receiver by using any other device.**

CAUTION

The picture tube is highly evacuated and if broken, glass fragments will be violently expelled. Handle with care, using safety goggles and gloves. Avoid contact with high voltage terminal at side of tube even after it has been disconnected from the receiver—this precaution is necessary as inner and outer coatings on the tube form a capacitor which may carry a high voltage charge for an extended period of time after disconnection from the receiver.

INSTRUMENTS: The following instruments will be required as signal sources and output indicators during the alignment process. Since accurate alignment of a television receiver is heavily dependent upon the performance of your instruments, it is imperative that they meet the essential specifications described here.

1. **STANDARD SIGNAL GENERATOR** to provide unmodulated (pure RF) signals at the following frequencies. Maximum output on all ranges should be at least .1 volt with provision for attenuation as desired. This instrument must have good frequency stability and be accurately calibrated. Generators which incorporate a separate crystal controlled oscillator and heterodyne circuit are self calibrating and therefore capable of providing the accuracy of frequency calibration required for television circuit alignment.

   a. IF Frequencies:

   4.5 Mc. Sound Channel
   22.25 Mc. Sound IF marker
   22.4 Mc. 1st IF Trap Coil
   23.5 Mc. 1st and 3rd IF stages
   24.75 Mc. 4th IF stage
   26.3 Mc. Converter and 2nd IF stages
   26.75 Mc. Picture IF marker

   b. RF Frequencies:

   54 to 88 Mc.
   174 to 216 Mc.

2. **RF SWEEP GENERATOR** to provide frequency modulated signals at the following frequencies:

   20 to 30 Mc. with 10 Mc. sweep width.
   54 to 88 Mc. with 10 Mc. sweep width.
   174 to 216 Mc. with 10 Mc. sweep width.

   Output adjustable with at least .1 volt maximum.

   Output should be "flat" (no amplitude variation) for all settings of the sweep width control.

   Provision for connection of generator sweep modulating voltage to horizontal deflection system of an oscilloscope.

   Provision for blanking the output signal on each return sweep so that oscillogram will not show retrace.

3. **CATHODE RAY OSCILLOSCOPE**, preferably a unit with vertical amplifier having wide range frequency response and low capacity pick-up probe.

4. **VACUUM TUBE VOLTMETER.** The lowest voltage range of this instrument should preferably permit a 1.0 volt reading to be indicated at not less than one third of full scale deflection.

INSTRUMENT CONNECTIONS: The method of connection, including details of matching and coupling networks, for instruments used in this alignment procedure is given in several illustrations on subsequent pages. Specific instructions for each instrument application will be found in various sections of the alignment charts.

GENERAL INSTRUCTIONS: When aligning IF and RF circuits it is necessary to apply a fixed bias voltage to the AGC system of the receiver. This fixed bias is obtained by using a 3 volt battery and connecting it as described in Fig. 14.

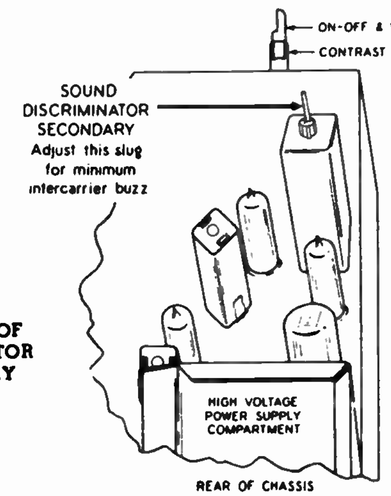
IMPORTANT

When observing the receiver band pass characteristic on an oscilloscope, it is exceedingly important to avoid distortion of that characteristic which would occur when using a large input signal from the sweep generator or standard generator (marker signal). Always set attenuator on sweep generator so that the reading on the vacuum tube voltmeter does not exceed one volt (when meter is connected from high side of video detector load resistor, symbol 196, to receiver chassis). Standard generator output should also be attenuated so that marker signal does not pull or tear the band pass characteristic as shown on the 'scope.

SOUND CHANNEL ALIGNMENT PROCEDURE

1. Short antenna terminals together with a jumper wire.
2. Set receiver Channel Selector to any inactive television channel; other controls may be left at any desired setting.
3. No special aligning tool is required to adjust the cores in the Sound IF and discriminator transformers. The blade of a small screwdriver will fit the slot in these cores, however, the screwdriver should be of a non-metallic or insulated type to prevent detuning when inserted in the transformer can.

STANDARD SIGNAL GENERATOR — CONNECTIONS	STANDARD SIGNAL GENERATOR — FREQUENCY	VTVM CONNECTIONS	MISCELLANEOUS INSTRUCTIONS	TRIMMER OR SLUG	TYPE OF ADJUSTMENT AND OUTPUT INDICATION
Connect as shown in Fig 1.	**4.5 MC.** unmodulated **IMPORTANT** This signal must be accurate within 1/4 of 1% of 4.5 Mc. Check generator calibration against a crystal controlled signal source by "zero beating" (heterodyning) with harmonics of the crystal frequency.	Connect as shown in Fig. 2.	A "swishing" sound may be heard in the speaker during Sound Channel Alignment. This spurious oscillation is caused by horizontal sweep voltage being picked up in the audio system thru stray coupling of instrument leads; it should be disregarded as it will have no effect on alignment of the sound channel.	**#1** Discriminator Secondary	Adjust for maximum reading on VTVM.
				#2 Discriminator Primary	Adjust for maximum reading on VTVM.
				#3 2nd Sound IF Secondary	Adjust for maximum reading on VTVM.
				#4 2nd Sound IF Primary	Adjust for maximum reading on VTVM.
				#5 1st Sound IF Secondary	Adjust for maximum reading on VTVM.
				#6 1st Sound IF Primary	Adjust for maximum reading on VTVM.
Same as above.	Same as above.	Connect as shown in Fig 3.	Same as above.	**#1** Discriminator Secondary	Note that as slug #1 is rotated, a point will be found where the voltmeter will swing rather sharply from a positive to a negative reading or vice versa. The correct setting of slug #1 is obtained when the meter reads zero as the slug is moved thru this point.



LOCATION OF DISCRIMINATOR SECONDARY SLUG

REDUCTION OF INTERCARRIER BUZZ

Slight "dynamic" unbalance of the discriminator secondary can emphasize intercarrier buzz due to incomplete amplitude modulation rejection. Therefore it is vitally important to obtain an accurate setting of the discriminator secondary slug under actual reception conditions.

Disconnect all instruments and then connect an antenna to the receiver to obtain program reception from a local station. If intercarrier buzz is prominent, a slight readjustment of the discriminator secondary slug (#1) should be made to obtain the "dip" point for the buzzing sound. Note that program sound will be clear and free from distortion at this point. Buzz should now be at an acceptable minimum if station transmission is not at fault.

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INSTRUMENT CONNECTIONS FOR SOUND CHANNEL ALIGNMENT

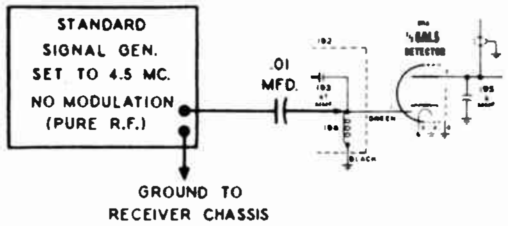

FIG. 1
Generator Connections for Sound Channel Alignment

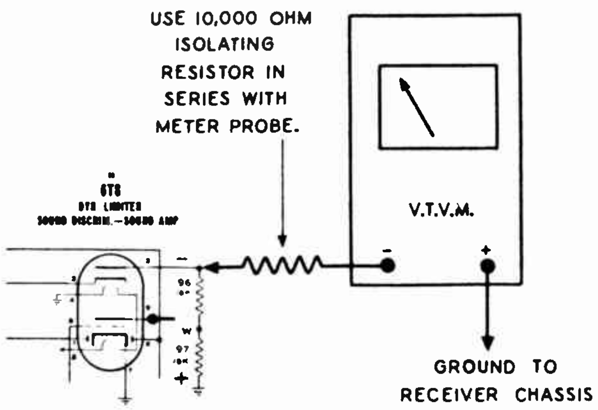

FIG. 2
VTVM Connections for Sound IF Alignment

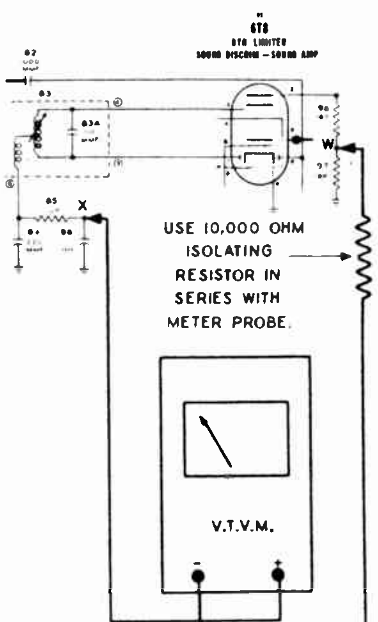

FIG. 3
VTVM Connections for Sound Discriminator Alignment

INSTRUMENT CONNECTIONS FOR IF CHANNEL ALIGNMENT

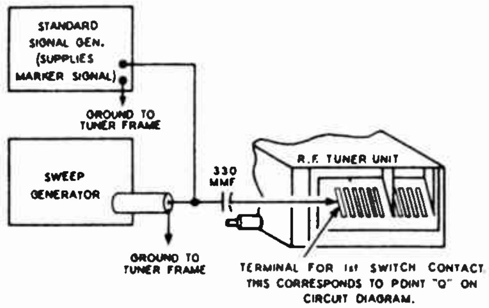

FIG. 4
Generator Connections for IF Channel Alignment

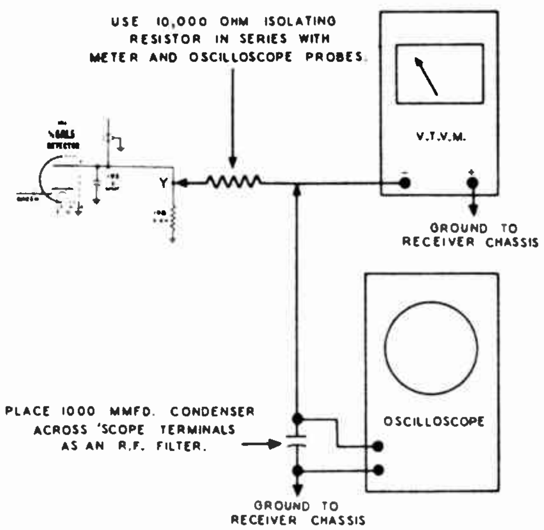

FIG. 5
VTVM and Oscilloscope Connections for IF Channel Alignment

IF CHANNEL ALIGNMENT PROCEDURE

1. A special aligning tool designed to fit the stems on adjustable cores of the IF and Trap coils (see points 8, 9, 10, 11 and 12 in Fig. 13) is available and may be obtained by requesting IF Alignment Tool #507479.
2. Turn receiver Channel Selector to television channel #12 and short antenna terminals together with a jumper wire.
3. Connect a 3 volt battery to the receiver AGC system so that negative terminal of battery connects to the AGC line and positive terminal of battery connects to receiver chassis. See Fig. 14 for convenient point of connection.
4. If the IF channel is badly misaligned and two or more immediately adjoining IF stages are tuned to the same frequency, oscillation may occur. Such oscillation shows up as a voltage across the video detector load resistor, symbol 196, and is indicated by the VTVM that is connected to this point during alignment. It should be noted that voltage due to IF oscillation is unaffected by strength of signal from the generator.

Where IF oscillation is encountered, it is generally possible to correct the condition by detuning the IF coils in different directions. If that does not have the desired effect, increase fixed bias on AGC line by using a 4½ volt battery instead of the 3 volt battery referred to in instruction #3. After stopping the oscillation in this manner it will then be possible to align all IF stages using the following procedure, however, the AGC bias battery must be changed back to 3 volts when using the oscilloscope to observe band pass characteristics. Once all stages have been aligned using the 4½ volt bias, the IF channel should be stable with reduced bias.

STANDARD SIGNAL GENERATOR		SWEEP GENERATOR		VTVM CONNECTIONS	OSCILLOSCOPE CONNECTIONS	MISCELLANEOUS INSTRUCTIONS	TRIMMER OR SLUG	TYPE OF ADJUSTMENT AND OUTPUT INDICATION
CONNECTIONS	FREQUENCY	CONNECTIONS	FREQ.					
Connect as shown in Fig. 4.	26.3 MC. or 26.1 MC. "E" See note below.	Use a 330 Mmf. isolating condenser and connect as shown in Fig. 4 but keep power switch turned off during this step.	——	Connect as shown in Fig. 5.	Not used.	——	#7 Converter plate coil	Adjust for maximum reading on VTVM.
							#8 2nd I.F.	Adjust for maximum reading on VTVM.
Same as above.	24.75 MC.	Same as above.	——	Same as above.	Not used.	——	#9 4th I.F.	Adjust for maximum reading on VTVM.
Same as above.	23.5 MC.	Same as above.	——	Same as above.	Not used.	——	#10 1st I.F.	Adjust for maximum reading on VTVM.
							#11 3rd I.F.	Adjust for maximum reading on VTVM.
Same as above.	22.4 MC.	Same as above.	——	Same as above.	Not used.	——	#12 1st IF Trap Coil	Adjust for minimum reading on VTVM.
Same as above.	26.75 MC.	With connections made as shown in Fig. 4, turn on this generator and set controls for operation as specified in next column.	25 MC. Sweeping ± 5 Mc.	Same as above.	Connect as shown in Fig. 5.	IMPORTANT: 1. Adjust output attenuator on sweep generator so that reading on VTVM is approximately one volt. 2. Set attenuator on standard signal generator so that marker signal does not distort the pattern on the oscilloscope. 3. Be sure that a 3 volt battery is connected to AGC line as specified in instruction #3 at the head of this chart. Do not use a battery of any other voltage.	The IF band pass characteristic now displayed on the 'scope should be compared with the curve shown in Fig. 6. If top of curve is not properly shaped, make a slight readjustment of slug #9. Should that adjustment fail to yield the desired result, then note whether the curve has a peak on the high or low frequency side. Slugs #7 and #8 control high frequency response (26.3 Mc.) and slugs #10 and #11 affect the low frequency response (23.5 Mc.): by making a small change in the settings of the high or low frequency slugs, it will be possible to obtain correct band pass curve. FIG. 6. The 26.75 Mc. picture IF carrier marker should now appear at the 40% amplitude position on side of the band pass characteristic (see Fig. 6). If position of the marker appears too high or too low, slight readjustment of slugs #7, 8 and 9 is required.	
Same as above.	22.25 MC.	Same as above.	Same as above.	Same as above.	Same as above.	Same as above.	Adjust the vertical gain control on the 'scope in order to magnify the sound portion of the response curve. The 22.25 Mc. sound IF carrier marker should appear at the position indicated in Fig. 6. If the position of the sound marker is incorrect, readjust Trap Coil #12.	

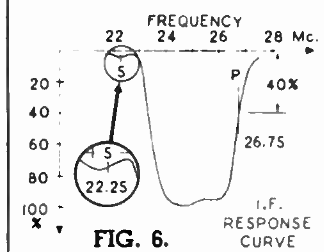

FIG. 6.

NOTE: Chassis which have the letter "E" in the series designation on rear of chassis must be aligned using 26.1 Mc. at these two points. See circuit diagram page for details of complete change.

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TELEVISION RF CHANNEL ALIGNMENT PROCEDURE

1. Turn the band switch to the "TV" position.
2. Connect a 3 volt battery to the receiver AGC system so that negative terminal of battery connects to AGC line and positive terminal of battery connects to receiver chassis. (See Fig. 19 for convenient point of connection.)

RF AMPLIFIER AND MIXER ALIGNMENT

STANDARD SIGNAL GENERATOR CONNECTIONS	STANDARD SIGNAL GENERATOR FREQUENCY	SWEEP GENERATOR CONNECTIONS	SWEEP GENERATOR FREQ.	VTVM CONNECTIONS	OSCILLOSCOPE CONNECTIONS	MISCELLANEOUS INSTRUCTIONS	TRIMMER OR SLUG	TYPE OF ADJUSTMENT AND OUTPUT INDICATION
Connect as shown in Fig. 15.	*209.75 MC. ‡205.25 MC.	Connect as shown in Fig. 15 and set controls for sweep width of 10 Mc. on television channel specified in the next column.	CHANNEL #12	Not used.	Connect as shown in Fig 16.	Set Channel Selector to #12 IMPORTANT: Keep output of standard signal generator at a level that provides a readable marker but does not distort the curve that is being observed on the scope.	#13 Mixer Grid. #14 RF Amp. Plate. #15 RF Amp. Grid.	Adjust these trimmers to obtain properly shaped RF band pass characteristic as shown in Fig 12. Use Mixer Grid trimmer #13 and RF Amplifier Plate trimmer #14 to obtain correct amplitude of characteristic in vicinity of picture and sound carrier markers. Then adjust RF Amp. Grid trimmer #15 to equalize overall amplitude. Repeat adjustment of trimmers to be sure correct response has been obtained. IMPORTANT: When adjusting trimmers #13, 14 and 15 it will be noted that the band pass characteristic can be broadened by sacrificing amplitude. It is undesirable to overly broaden the curve as that would result in a loss of sensitivity.
Same as above.	*215.75 MC. ‡211.25 MC.	Same as above.	CHANNEL #13	Not used	Same as above.	Set Channel Selector to #13		The RF band pass characteristic of the other television channels should now be checked without disturbing the settings of trimmers #13, 14 and 15. Adjust the RF sweep generator and marker generator for operation on the other television channels, observing position of both the sound carrier and picture carrier markers.
	*203.75 MC. ‡199.25 MC.		CHANNEL #11			Set Channel Selector to #11		
	*197.75 MC. ‡193.25 MC.		CHANNEL #10			Set Channel Selector to #10		
	*191.75 MC. ‡187.25 MC.		CHANNEL #9			Set Channel Selector to #9		
	*185.75 MC. ‡181.25 MC.		CHANNEL #8			Set Channel Selector to #8		
	*179.75 MC. ‡175.25 MC.		CHANNEL #7			Set Channel Selector to #7		
	* 87.75 MC. ‡ 83.25 MC.		CHANNEL #6			Set Channel Selector to #6		
	* 81.75 MC. ‡ 77.25 MC.		CHANNEL #5			Set Channel Selector to #5		
	* 71.75 MC. ‡ 67.25 MC.		CHANNEL #4			Set Channel Selector to #4		Band pass characteristic of these channels should conform to the RF response curve in Fig. 12. If necessary, a compromise may be obtained to compensate for small variations in channel response by returning to channel #12 and making slight changes in the settings of trimmers #13, 14 and 15.
	* 65.75 MC. ‡ 61.25 MC.		CHANNEL #3			Set Channel Selector to #3		
	* 59.75 MC. ‡ 55.25 MC.		CHANNEL #2			Set Channel Selector to #2		

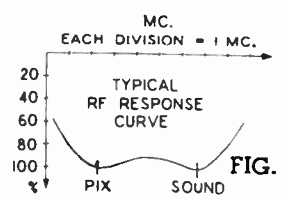

FIG. 7.

*Sound Carrier Marker
‡Picture Carrier Marker

(Continued on next page)

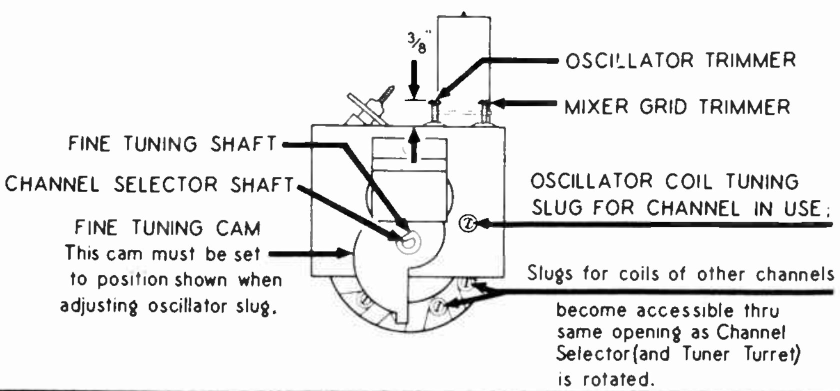

FIG. 8
Front view of RF Tuner Unit

OSCILLATOR ALIGNMENT

1. IMPORTANT: Before undertaking oscillator alignment be sure IF circuits are correctly aligned for band pass characteristic illustrated in Fig. 6.
2. During oscillator alignment, it is necessary to set the Fine Tuning control so that the tooth on the bakelite fine tuning cam points downward (correct position for this control is shown in Fig. 8).

STANDARD SIGNAL GENERATOR CONNECTIONS	STANDARD SIGNAL GENERATOR FREQUENCY	SWEEP GENERATOR CONNECTIONS	SWEEP GENERATOR FREQ.	VTVM CONNECTIONS	OSCILLOSCOPE CONNECTIONS	MISCELLANEOUS INSTRUCTIONS	TRIMMER OR SLUG	TYPE OF ADJUSTMENT AND OUTPUT INDICATION
Connect as shown in Fig. 10.	*209.75 MC. ‡205.25 MC.	Connect as shown in Fig. 10 and set controls for sweep width of 10 Mc. on television channel specified in the next column.	CHANNEL #12	Connect as shown in Fig. 12	Connect as shown in Fig. 12	Be sure that Fine Tuning control has been properly positioned (tooth on the cam pointing down—see Fig. 8). During this step and thru-out all succeeding steps it is necessary to: 1. Keep output of sweep generator at a level that does not allow reading on VTVM to exceed one volt. 2. Keep output of standard signal generator at a level that provides a readable marker but does not distort the curve that is being observed on the 'scope.	#16 Oscillator	Adjust height of Oscillator trimmer #16 to be approximately 3/8" from the top of trimmer screw to the top surface of RF tuner unit (see Fig. 8). NOTE: Before making the following adjustment, advance the vertical gain control on the 'scope in order to magnify the sound portion of the response curve. Then, use a non-metallic screwdriver to adjust channel #12 oscillator slug (accessible thru hole on front of RF Tuner Unit —see Fig. 8) and shift response curve so that sound carrier marker is located at the position indicated in Fig. 9. Now, reduce gain control setting of 'scope to restore pattern to normal amplitude and observe position of picture carrier marker. This marker should appear at the 50% amplitude position on the low frequency side of the characteristic curve (see Fig. 9).
Same as above.	*215.75 MC. ‡211.25 MC.	Same as above.	CHANNEL #13	Same as above.	Same as above.	Set Channel Selector to #13		Adjust the RF sweep generator and marker generator for operation on the other television channels; set marker generator to sound carrier frequency. After setting Channel Selector to corresponding channel, adjust oscillator slug thru hole on front of RF Tuner Unit (see Fig. 8). This permits response curve to be shifted so that sound carrier marker
	*203.75 MC. ‡199.25 MC.		CHANNEL #11			Set Channel Selector to #11		
	*197.75 MC. ‡193.25 MC.		CHANNEL #10			Set Channel Selector to #10		
	*191.75 MC. ‡187.25 MC.		CHANNEL #9			Set Channel Selector to #9		
	*185.75 MC. ‡181.25 MC.		CHANNEL #8			Set Channel Selector to #8		
	*179.75 MC. ‡175.25 MC.		CHANNEL #7			Set Channel Selector to #7		
	* 87.75 MC. ‡ 83.25 MC.		CHANNEL #6			Set Channel Selector to #6		
	* 81.75 MC. ‡ 77.25 MC.		CHANNEL #5			Set Channel Selector to #5		will appear at the position indicated in Fig. 9. The picture carrier marker for the corresponding channel should then appear at the 50% amplitude position on the opposite side of the band pass characteristic curve. NOTE: Make sure that cam on fine tuning control shaft remains properly positioned during this step (tooth on the cam pointing downward—see Fig. 8).
	* 71.75 MC. ‡ 67.25 MC.		CHANNEL #4			Set Channel Selector to #4		
	* 65.75 MC. ‡ 61.25 MC.		CHANNEL #3			Set Channel Selector to #3		
	* 59.75 MC. ‡ 55.25 MC.		CHANNEL #2			Set Channel Selector to #2		

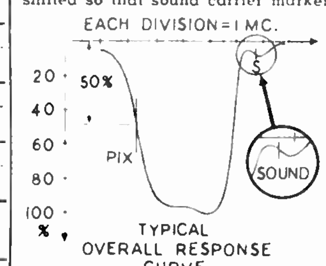

FIG. 9

If an oscillator slug "falls into" its coil form during adjustment, remove the Channel Coil from the turret assembly and lift the Slug Retaining Spring aside. By tapping the coil form it should be possible to make the slug move toward the end so that its threads will be engaged by the Slug Retaining Spring when that spring is returned to its normal position.

If an unsatisfactory overall response is obtained for a particular channel, observe RF Amp. and Mixer response curve for that channel as described on preceding page. If characteristic does not conform reasonably well within the typical curve shown in Fig. 7, then, (1) attempt to obtain a better compromise for RF response on all channels by realigning RF Amp. and Mixer circuits, or (2) try replacing Antenna, RF and Oscillator coils for the particular channels.

*Sound Carrier Marker
‡Picture Carrier Marker

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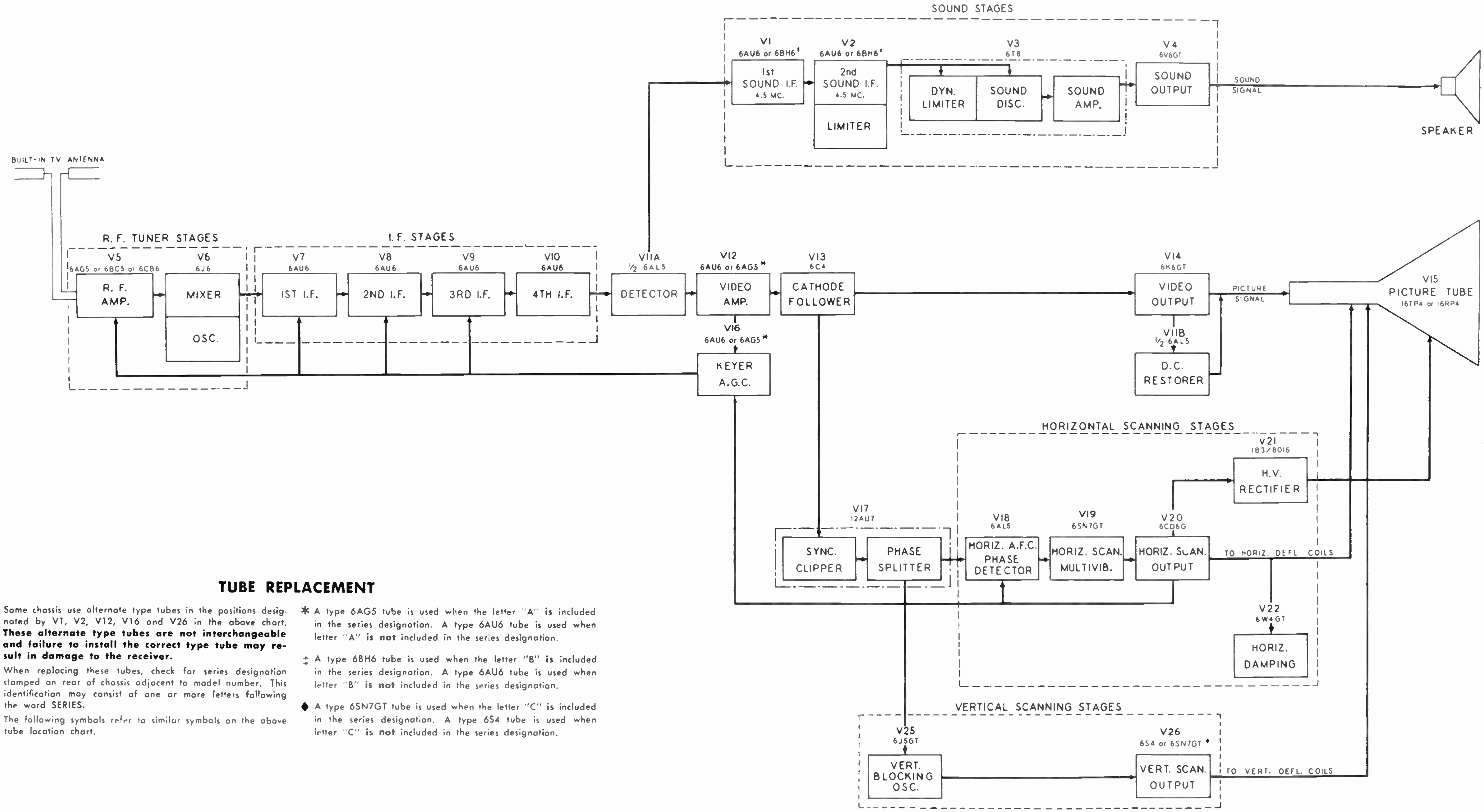

TUBE REPLACEMENT

Some chassis use alternate type tubes in the positions designated by V1, V2, V12, V16 and V26 in the above chart. **These alternate type tubes are not interchangeable and failure to install the correct type tube may result in damage to the receiver.**

When replacing these tubes, check for series designation stamped on rear of chassis adjacent to model number. This identification may consist of one or more letters following the word SERIES.

The following symbols refer to similar symbols on the above tube location chart.

* A type 6AG5 tube is used when the letter "A" **is** included in the series designation. A type 6AU6 tube is used when letter "A" **is not** included in the series designation.

‡ A type 6BH6 tube is used when the letter "B" **is** included in the series designation. A type 6AU6 tube is used when letter "B" **is not** included in the series designation.

♦ A type 6SN7GT tube is used when the letter "C" is included in the series designation. A type 6S4 tube is used when letter "C" **is not** included in the series designation.

FIG. 15. Block Diagram

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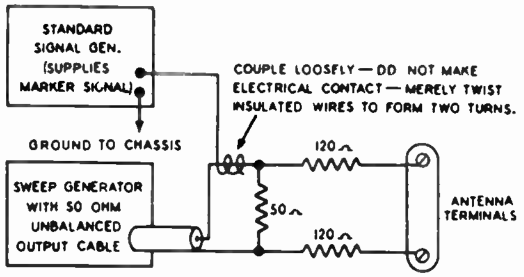


FIG. 10
Generator Connections
for RF Channel Alignment

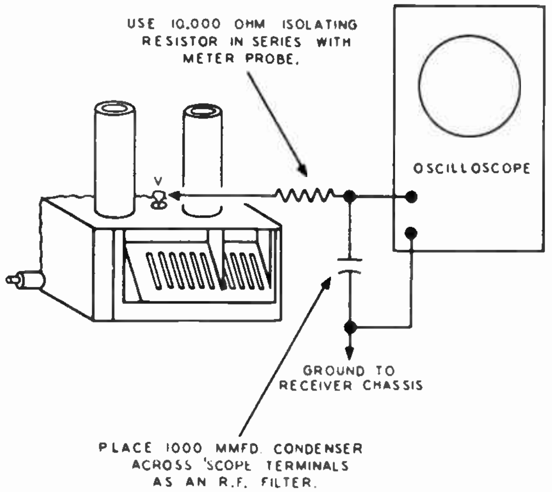


FIG. 11
Oscilloscope Connections
for RF Amp. and Mixer Alignment

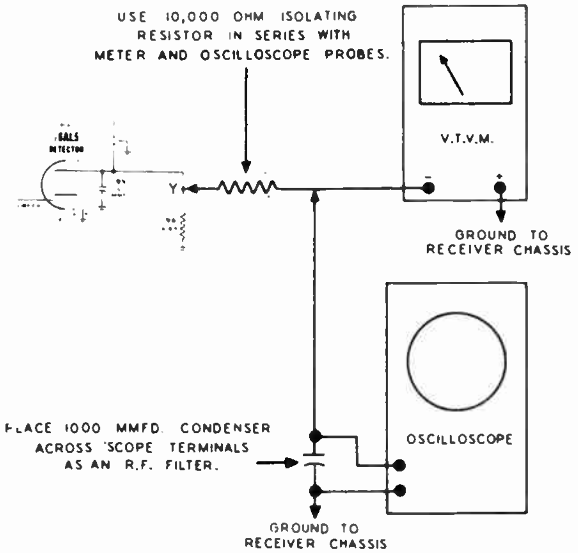
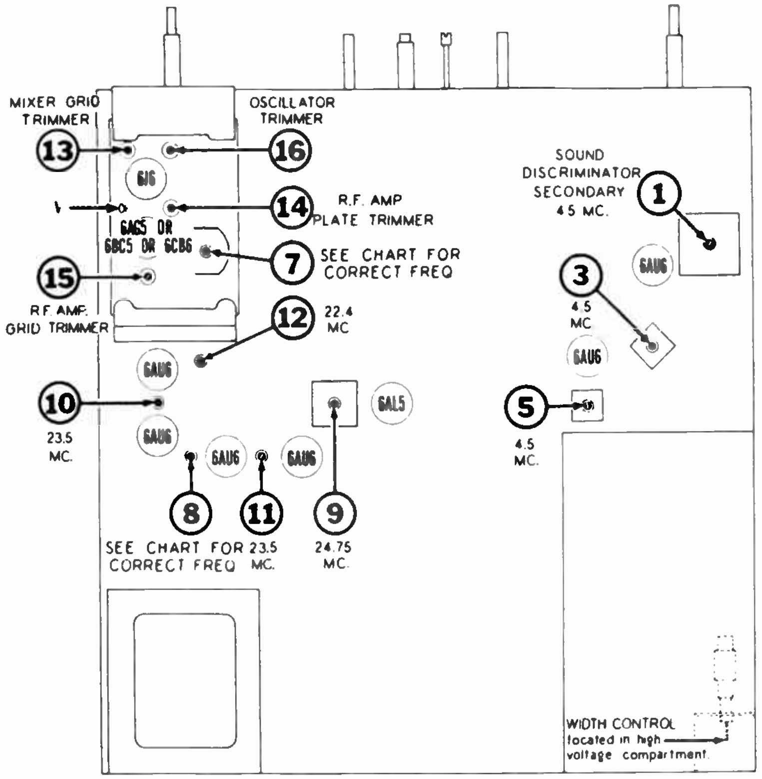
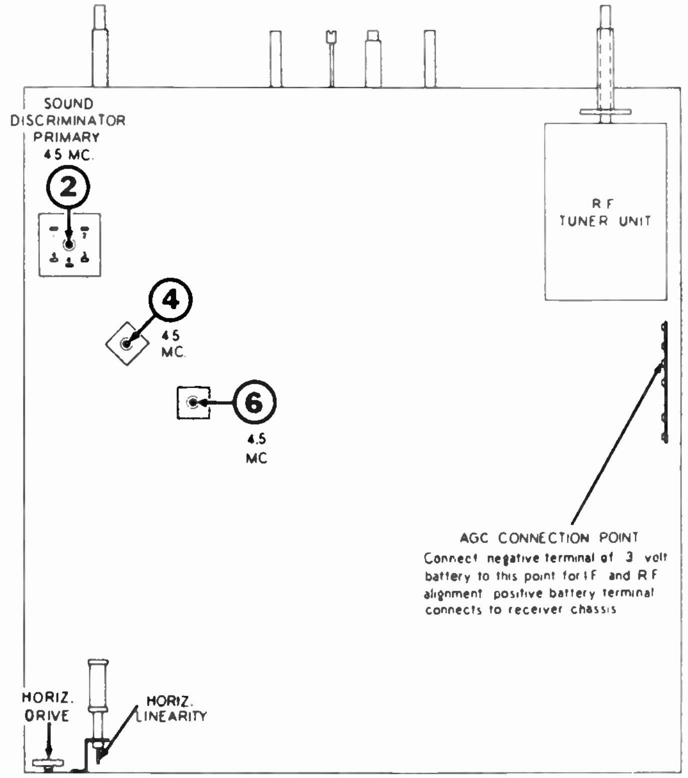


FIG. 12
VTVM and Oscilloscope Connections
for Oscillator Alignment



TOP VIEW OF CHASSIS

FIG. 13



BOTTOM VIEW OF CHASSIS

FIG. 14

DIAGRAM NO.	PART NO.	DESCRIPTION
		CONDENSERS
67	513001	Condenser—ceramic 2.2 Mmfd. 500 volt
68-A, B	508061	Condenser—ceramic 51 Mmfd. (part of 1st TV sound I.F. transformer)
69	513013	Condenser—ceramic 5000 Mmfd. 450 volt
72	513013	Condenser—ceramic 5000 Mmfd. 450 volt
74-A, B	508061	Condenser—ceramic 51 Mmfd. (part of 2nd TV sound I.F. transformer)
75	513013	Condenser—ceramic 5000 Mmfd. 450 volt
77	513433	Condenser—ceramic 47 Mmfd. ± 10% 500 volt (Temperature compensating)
78	513018	Condenser—ceramic 220 Mmfd. 500 volt
80	513013	Condenser—ceramic 5000 Mmfd. 450 volt
82	513009	Condenser—ceramic 1000 Mmfd. 500 volt
83-A	507321	Condenser—ceramic 110 Mmfd. (part of TV discriminator transformer)
84	512527	Condenser—mica 220 Mmfd. ± 10% 500 volt
86	513010	Condenser—ceramic 1500 Mmfd. 350 volt
87	512027	Condenser—.05 Mfd. 200 volt
89	512007	Condenser—.005 Mfd. 600 volt
91	512007	Condenser—.005 Mfd. 600 volt
93	505174	Condenser—electrolytic 10 Mfd. 150 volt
98	513010	Condenser—ceramic 1500 Mmfd. 350 volt
99	502547	Condenser—electrolytic 4 Mfd. 150 volt
100-B	505858	Condenser—ceramic 250 Mmfd. 450 volt; (part of Audio Coupling Unit)
100-C	505858	Condenser—ceramic .005 Mfd. 450 volt; (part of Audio Coupling Unit)
101	513010	Condenser—ceramic 1500 Mmfd. 350 volt
102	502527	Condenser—electrolytic 50 Mfd. 25 volt
104	504719	Condenser—electrolytic 4 Mfd. 450 volt
106	512003	Condenser—.002 Mfd. 600 volt
110	508324	Condenser—trimmer 4-70 Mmfd.
125	507968	Condenser—trimmer 0.5-3 Mmfd. (used only in chassis which have condenser 126)
125	509064	Condenser—trimmer 3-9 Mmfd. (used only in chassis which do not have condenser 126)
126	513432	Condenser—ceramic 5 Mmfd. ± 10% 500 volt (Temperature compensating) (used in some chassis; see note under condenser 125)
127	513439	Condenser—ceramic 120 Mmfd. ± 5% 500 volt (Temperature compensating)
142	507968	Condenser—trimmer 0.5-3 Mmfd.
143	513442	Condenser—ceramic 10 Mmfd. ± 10% 500 volt (Temperature compensating)
144	*	Condenser—3-5 Mmfd. (Fine Tuning)
145	513440	Condenser—ceramic 100 Mmfd. ± 10% 500 volt (Temperature compensating)
148	507968	Condenser—trimmer 0.5-3 Mmfd.
149	513441	Condenser—ceramic 20 Mmfd. ± 10% 500 volt (Temperature compensating)
150	509063	Condenser—trimmer 0.5-3 Mmfd.
154	513444	Condenser—ceramic 10 Mmfd. ± 5% 500 volt
157	513009	Condenser—ceramic 1000 Mmfd. 500 volt
162	512532	Condenser—mica 240 Mmfd. ± 5% 500 volt
		CONDENSERS—Continued
164	513009	Condenser—ceramic 1000 Mmfd. 500 volt
167	513016	Condenser—ceramic 82 Mmfd. ± 10% 500 volt
170	513009	Condenser—ceramic 1000 Mmfd. 500 volt
172	513009	Condenser—ceramic 1000 Mmfd. 500 volt
175	513016	Condenser—ceramic 82 Mmfd. ± 10% 500 volt
178	513009	Condenser—ceramic 1000 Mmfd. 500 volt
182	513009	Condenser—ceramic 1000 Mmfd. 500 volt
186	513016	Condenser—ceramic 82 Mmfd. ± 10% 500 volt
190	513009	Condenser—ceramic 1000 Mmfd. 500 volt
193	513433	Condenser—ceramic 47 Mmfd. ± 10% 500 volt (Temperature compensating)
195	513432	Condenser—ceramic 5 Mmfd. ± 10% 500 volt (Temperature compensating)
198	512045	Condenser—.25 Mfd. ± 10% 200 volt
202	512027	Condenser—.05 Mfd. 200 volt
205	512045	Condenser—.25 Mfd. ± 10% 200 volt
208	513003	Condenser—ceramic 100 Mmfd. 500 volt
211	512033	Condenser—.1 Mfd. 200 volt
214	512027	Condenser—.05 Mfd. 200 volt
217	512542	Condenser—mica 120 Mmfd. ± 10% 500 volt
223	512031	Condenser—.05 Mfd. 600 volt
225	512031	Condenser—.05 Mfd. 600 volt
231	512019	Condenser—.02 Mfd. 600 volt
232	512031	Condenser—.05 Mfd. 600 volt
238	513015	Condenser—mica 56 Mmfd. ± 10% 500 volt
242	512045	Condenser—.25 Mfd. ± 10% 200 volt
247, 248	513009	Condenser—ceramic 1000 Mmfd. 500 volt
251	512013	Condenser—.01 Mfd. 600 volt
254	513013	Condenser—ceramic 5000 Mmfd. 450 volt
256	512027	Condenser—.05 Mfd. 200 volt
259	512540	Condenser—mica 3900 Mmfd. ± 5% 500 volt
260	512541	Condenser—mica 330 Mmfd. 500 volt
264	512535	Condenser—mica 390 Mmfd. ± 10% 500 volt
265	512536	Condenser—mica 270 Mmfd. ± 10% 500 volt
266	508071	Condenser—trimmer 10-160 Mmfd. (Horizontal Drive Control)
269	508684	Condenser—electrolytic 5 Mfd. 50 volt
271	513025	Condenser—ceramic 3.3 Mmfd. ± 15% 1500 volt
272	512031	Condenser—.05 Mfd. 600 volt
278	512031	Condenser—.05 Mfd. 600 volt
280	512037	Condenser—.1 Mfd. 600 volt
281	508888	Condenser—ceramic 500 Mmfd. 20,000 volt
283	512031	Condenser—.05 Mfd. 600 volt
285	512031	Condenser—.05 Mfd. 600 volt
287	508680	Condenser—electrolytic 10 Mfd. 600 volt
289	512255	Condenser—.01 Mfd. 400 volt
290	512255	Condenser—.01 Mfd. 400 volt
292	513013	Condenser—ceramic 5000 Mmfd. 450 volt
294, 295	513009	Condenser—ceramic 1000 Mmfd. 500 volt
297, 298	513009	Condenser—ceramic 1000 Mmfd. 500 volt

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CONDENSERS—Continued

DIAGRAM NO.	PART NO.	DESCRIPTION
301-A, B	508073	Condenser—electrolytic A—20 Mfd. 300 volt B—60 Mfd. 300 volt
302-A,B,C	508072	Condenser—electrolytic A—40 Mfd. 450 volt B—40 Mfd. 450 volt C—40 Mfd. 450 volt
305	513009	Condenser—ceramic 1000 Mmfd. 500 volt
307	513013	Condenser—ceramic 5000 Mmfd. 450 volt
309	513018	Condenser—ceramic 220 Mmfd. 500 volt
311	513009	Condenser—ceramic 1000 Mmfd. 500 volt
317-A	508062	Condenser—ceramic .01 Mfd. 450 volt (part of Integrator Unit)
317-C	508062	Condenser—ceramic 2000 Mmfd. 450 volt (part of Integrator Unit)
317-E	508062	Condenser—ceramic 5000 Mmfd. 450 volt (part of Integrator Unit)
317-G	508062	Condenser—ceramic 5000 Mmfd. 450 volt (part of Integrator Unit)
319	512533	Condenser—mica 4700 Mmfd. ± 5% 1000 volt
325	512037	Condenser—.1 Mfd. 600 volt
327	512308	Condenser—.05 Mfd. ± 10% 600 volt
331	508682	Condenser—electrolytic 100 Mfd. 50 volt
334	513009	Condenser—ceramic 1000 Mmfd. 500 volt
352-A, B	508576	Condenser—ceramic A—1000 Mmfd. 500 volt B—1000 Mmfd. 500 volt
353	512019	Condenser—.02 Mfd. 600 volt (used when letter "C" is included in series designation at rear of chassis)
355	512005	Condenser—.003 Mfd. 600 volt (used when letter "F" is included in series designation at rear of chassis)

RESISTORS

DIAGRAM NO.	PART NO.	DESCRIPTION
70	510117	Resistor—carbon 82 Ohms ± 10% ½ watt
73	510137	Resistor—carbon 1000 Ohms ½ watt
76	510185	Resistor—carbon 470,000 Ohms ½ watt
79	510117	Resistor—carbon 82 Ohms ± 10% ½ watt
81	510137	Resistor—carbon 1000 Ohms ½ watt
85	510160	Resistor—carbon 22,000 Ohms ± 10% ½ watt
88	510170	Resistor—carbon 68,000 Ohms ½ watt
92	510197	Resistor—carbon 10 Meg. ½ watt
95	510163	Resistor—carbon 33,000 Ohms ± 10% ½ watt
96, 97	510159	Resistor—carbon 18,000 Ohms ± 10% ½ watt
100-A	505858	Resistor—carbon 470,000 Ohms ⅕ watt; (part of Audio Coupling Unit)
100-D	505858	Resistor—carbon 470,000 Ohms ⅕ watt; (part of Audio Coupling Unit)
103	510227	Resistor—carbon 330 Ohms ± 10% 1 watt
105	510153	Resistor—carbon 8200 Ohms ± 10% ½ watt
123	510167	Resistor—carbon 47,000 Ohms ½ watt
124	510147	Resistor—carbon 3900 Ohms ± 10% ½ watt
128	510143	Resistor—carbon 2200 Ohms ½ watt
141	510155	Resistor—carbon 10,000 Ohms ½ watt
146	510149	Resistor—carbon 4700 Ohms ½ watt
147	510179	Resistor—carbon 220,000 Ohms ½ watt
151	510155	Resistor—carbon 10,000 Ohms ½ watt
152	510149	Resistor—carbon 4700 Ohms ½ watt
155	510158	Resistor—carbon 15,000 Ohms ½ watt
158	510151	Resistor—carbon 6800 Ohms ± 10% ½ watt
159	510137	Resistor—carbon 1000 Ohms ½ watt
161	510126	Resistor—carbon 270 Ohms ± 10% ½ watt (used when letter "E" is included in series designation at rear of chassis)
	510117	Resistor—carbon 82 Ohms ± 10% ½ watt (used when letter "E" is not included in series designation at rear of chassis)
166	510137	Resistor—carbon 1000 Ohms ½ watt
168	510153	Resistor—carbon 8200 Ohms ± 10% ½ watt
169	510137	Resistor—carbon 1000 Ohms ½ watt
171	510117	Resistor—carbon 82 Ohms ± 10% ½ watt
174	510137	Resistor—carbon 1000 Ohms ½ watt

RESISTORS—Continued

DIAGRAM NO.	PART NO.	DESCRIPTION
176	510153	Resistor—carbon 8200 Ohms ± 10% ½ watt (used when letter "E" is included in series designation at rear of chassis)
	510148	Resistor—carbon 4700 Ohms ± 10% ½ watt (used when letter "E" is not included in series designation at rear of chassis)
177	510137	Resistor—carbon 1000 Ohms ½ watt
180	510117	Resistor—carbon 82 Ohms ± 10% ½ watt
183	510151	Resistor—carbon 6800 Ohms ± 10% ½ watt (used when letter "E" is included in series designation at rear of chassis)
	510153	Resistor—carbon 8200 Ohms ± 10% ½ watt (used when letter "E" is not included in series designation at rear of chassis)
184	510137	Resistor—carbon 1000 Ohms ½ watt
188	510119	Resistor—carbon 100 Ohms ½ watt
189	510153	Resistor—carbon 8200 Ohms ± 10% ½ watt
191	510137	Resistor—carbon 1000 Ohms ½ watt
196	510148	Resistor—carbon 4700 Ohms ± 10% ½ watt (used when letter "E" is included in series designation at rear of chassis)
	510151	Resistor—carbon 6800 Ohms ± 10% ½ watt (used when letter "E" is not included in series designation at rear of chassis)
197	510257	Resistor—carbon 15,000 Ohms ± 10% 1 watt
199	510253	Resistor—carbon 8200 Ohms ± 10% 1 watt
201	510166	Resistor—carbon 47,000 Ohms ± 10% ½ watt
203	510164	Resistor—carbon 33,000 Ohms ½ watt
204	510155	Resistor—carbon 10,000 Ohms ½ watt
206	510173	Resistor—carbon 100,000 Ohms ½ watt
207	510150	Resistor—carbon 5600 Ohms ± 10% ½ watt
210	510150	Resistor—carbon 5600 Ohms ± 10% ½ watt
212	510191	Resistor—carbon 1 Meg. ½ watt
213	510356	Resistor—carbon 12,000 Ohms ± 10% 2 watt
215	510191	Resistor—carbon 1 Meg. ½ watt
216	510126	Resistor—carbon 270 Ohms ± 10% ½ watt
219	510723	Resistor—carbon 12,000 Ohms ± 5% ½ watt
221, 222	510339	Resistor—carbon 1500 Ohms ± 10% 2 watt
224	510156	Resistor—carbon 12,000 Ohms ± 10% ½ watt
226	510173	Resistor—carbon 100,000 Ohms ½ watt
227	510191	Resistor—carbon 1 Meg. ½ watt
228	510171	Resistor—carbon 82,000 Ohms ± 10% ½ watt
230	510161	Resistor—carbon 22,000 Ohms ½ watt
233	510159	Resistor—carbon 18,000 Ohms ± 10% ½ watt
234	510143	Resistor—carbon 2200 Ohms ½ watt
237	510136	Resistor—carbon 1000 Ohms ± 10% ½ watt
240, 241	510132	Resistor—carbon 560 Ohms ± 10% ½ watt
243	510180	Resistor—carbon 270,000 Ohms ± 10% ½ watt
244	510181	Resistor—carbon 330,000 Ohms ± 10% ½ watt
245, 246	510739	Resistor—carbon 1800 Ohms ± 5% ½ watt
249, 250	510172	Resistor—carbon 100,000 Ohms ± 10% ½ watt
252	510162	Resistor—carbon 27,000 Ohms ± 10% ½ watt
253	510195	Resistor—carbon 4.7 Meg. ½ watt
255	510185	Resistor—carbon 470,000 Ohms ½ watt
258	510147	Resistor—carbon 3900 Ohms ± 10% ½ watt (used when letter "D" is included in series designation at rear of chassis)
	510150	Resistor—carbon 5600 Ohms ± 10% ½ watt (used when letter "D" is not included in series designation at rear of chassis)
261	510139	Resistor—carbon 1500 Ohms ± 10% ½ watt
262	510172	Resistor—carbon 100,000 Ohms ± 10% ½ watt
263	510180	Resistor—carbon 270,000 Ohms ± 10% ½ watt
267	510184	Resistor—carbon 470,000 Ohms ± 10% ½ watt
268	510116	Resistor—carbon 68 Ohms ½ watt
270	510716	Resistor—wire wound 220 Ohms ± 10% 5 watt
273	510356	Resistor—carbon 12,000 Ohms ± 10% 2 watt
277	510254	Resistor—carbon 10,000 Ohms ± 10% 1 watt
279	510725	Resistor—carbon 3.3 Ohms ± 10% ½ watt
282	510391	Resistor—carbon 1 Meg. 2 watt
286	510713	Resistor—carbon 3000 Ohms ± 5% 2 watt
288	510179	Resistor—carbon 220,000 Ohms ½ watt

RESISTORS—Continued

DIAGRAM NO.	PART NO.	DESCRIPTION
299	510319	Resistor—carbon 100 Ohms 2 watt
303	510726	Resistor—wire wound 850 Ohms 5 watt
306	510754	Resistor—wire wound 1000 Ohms ± 10% 10 watt
315	510704	Resistor—wire wound 4.3 Ohms ± 10% 1 watt
317-B	508062	Resistor—carbon 22,000 Ohms ⅕ watt (part of Integrator Unit)
317-D	508062	Resistor—carbon 8200 Ohms ⅕ watt (part of Integrator Unit)
317-F	508062	Resistor—carbon 8200 Ohms ⅕ watt (part of Integrator Unit)
320	510721	Resistor—carbon 1.5 Meg. ± 5% ½ watt
322	510172	Resistor—carbon 100,000 Ohms ± 10% ½ watt
323	510196	Resistor—carbon 6.8 Meg. ½ watt
324	510738	Resistor—carbon 1.2 Meg. ± 10% ½ watt
326	510151	Resistor—carbon 6800 Ohms ± 10% ½ watt
328	510193	Resistor—carbon 2.2 Meg. ½ watt
329	510133	Resistor—carbon 680 Ohms ± 10% ½ watt
351	510739	Resistor—carbon 1800 Ohms ± 5% ½ watt (used when letter "D" is included in series designation at rear of chassis)
356	510133	Resistor—carbon 680 Ohms ± 10% ½ watt (used when letter "F" is included in series designation at rear of chassis)

CONTROLS

DIAGRAM NO.	PART NO.	DESCRIPTION
90-A,B,C	508892	Contrast and Volume control (with switch) A—Volume control; 1 Meg. ¼ watt B—Contrast control; 3000 Ohms ± 10% 4 watt C—On-Off switch
110	508324	Built-in Antenna Tuning condenser (4-70 Mmfd.)
144	*	Fine Tuning condenser (3-5 Mmfd.)
229	508889	Brightness potentiometer (50,000 Ohms)
257	508967	Horizontal Hold coil (includes slug and clip)
	508963	Slug core for Horizontal Hold coil
266	508071	Horizontal Drive trimmer condenser (10-160 Mmfd.)
276	508667	Width coil (includes slug and clip)
	508784	Slug core for Width coil
284	162190	Horizontal Linearity coil (includes slug and clip)
	507429	Slug core for Horizontal Linearity coil
321-A, B	508893	Height and Vertical Hold potentiometers A—Vertical Hold control; 1 Meg. B—Height control; 2.5 Meg.
330	508891	Vertical Linearity potentiometer (5000 Ohms)

COILS AND TRANSFORMERS

DIAGRAM NO.	PART NO.	DESCRIPTION
68	508061	Transformer—1st TV sound I.F. (includes condensers 68-A and 68-B)
71	507373	Coil—choke
74	508061	Transformer—2nd TV sound I.F. (includes condensers 74-A and 74-B)
83	507321	Transformer—TV sound discriminator (includes condenser 83-A)
	508438	Slug core (5/16" dia. x ⅜" long) for primary of TV sound discriminator transformer
	508894	Slug core (¼" dia. x ½" long) for primary of TV sound discriminator transformer
	508439	Slug core (5/16" dia. x ¾" long) for secondary of TV sound discriminator transformer
	508894	Slug core (¼" dia. x ½" long) for secondary of TV sound discriminator transformer
94	507373	Coil—choke
108	505912	Transformer—sound output
111	507952	Coil—antenna; channel #2
112	507953	Coil—antenna; channel #3
113	507954	Coil—antenna; channel #4
114	507955	Coil—antenna; channel #5
115	507956	Coil—antenna; channel #6
116	507957	Coil—antenna; channel #7
117	507958	Coil—antenna; channel #8
118	507959	Coil—antenna; channel #9
119	507960	Coil—antenna; channel #10
120	507961	Coil—antenna; channel #11
121	507962	Coil—antenna; channel #12
122	507963	Coil—antenna; channel #13
129	507972	Coil—R.F. and osc.; channel #2
130	507973	Coil—R.F. and osc.; channel #3
131	507974	Coil—R.F. and osc.; channel #4
132	507975	Coil—R.F. and osc.; channel #5
133	507976	Coil—R.F. and osc.; channel #6
134	507977	Coil—R.F. and osc.; channel #7

*—This part is not supplied as a Service replacement item.

COILS AND TRANSFORMERS—Continued

DIAGRAM NO.	PART NO.	DESCRIPTION
135	507078	Coil—R.F. and osc.; channel #6
136	507979	Coil—R.F. and osc.; channel #9
137	507980	Coil—R.F. and osc.; channel #10
138	507981	Coil—R.F. and osc.; channel #11
139	507982	Coil—R.F. and osc.; channel #12
140	507983	Coil—R.F. and osc.; channel #13
	507986	Slug for osc. fine tuning adjustment
156	509061	Coil—converter plate (I.F.)
	509062	Slug core for converter plate coil
160	509056	Coil—1st I.F. trap (includes slug and clip)
	507357	Slug core for 1st I.F. trap
165	507343	Coil—1st video I.F. (less slug)
	507357	Slug core for 1st video I.F. coil
173	507343	Coil—2nd video I.F. (less slug)
	507357	Slug core for 2nd video I.F. coil
185	507343	Coil—3rd video I.F. (less slug)
	507357	Slug core for 3rd video I.F. coil
187	507367	Coil—choke
192	507591	Coil—4th video I.F. assembly (includes condenser 193 and choke coil 194)
	507357	Slug core for 4th video I.F. coil
194	507367	Coil—choke
200	507374	Coil—peaking
209	507374	Coil—peaking
218	508069	Coil—peaking
220	508070	Coil—peaking
239	508675	Yoke—picture tube deflection
257	508967	Coil—Horizontal Hold (includes slug and clip)
	508963	Slug core for Horizontal Hold coil
275	508679	Transformer—horizontal sweep
276	508667	Coil—Width (includes slug and clip)
	508784	Slug core for Width coil
284	162190	Coil—Horizontal Linearity (includes slug and clip)
	507429	Slug core for Horizontal Linearity coil
291	508702	Transformer—power
293	507586	Coil—choke
296	507587	Coil—choke
300	507584	Coil—choke
304	508341	Choke—filter
308	507586	Coil—choke
310	507584	Coil—choke
312	507970	Coil—choke
314	507971	Coil—choke
318	508076	Transformer—vertical blocking oscillator
332	508956	Transformer—vertical output
354	509615	Coil—trap (used when letter "F" is included in series designation at rear of chassis)

OTHER ELECTRICAL PARTS

DIAGRAM NO.	PART NO.	DESCRIPTION
100	505858	Audio coupling unit A—Resistor—carbon 470,000 Ohms ⅕ watt B—Condenser—ceramic 250 Mmfd. 450 volt C—Condenser—ceramic .005 Mfd. 450 volt D—Resistor—carbon 470,000 Ohms ⅕ watt
107	508325	Built-in antenna (includes condenser 54)
109	508157	Speaker—P.M. Dynamic (6"); Stock 13-G-46
	508174	Speaker—P.M. Dynamic (6" x 9"); Stock 13-G-47
235	508603	Ion trap
236	509595	Focus magnet assembly
274	508713	Fuse for horizontal sweep circuit; ¼ Amp. 250 volt
316	118921	TV Channel Lite (Mazda #47) 6-8 v. 150 Ma.
317-A to G	508062	Integrator coupling unit A—Condenser—ceramic .01 Mfd. 450 volt B—Resistor—carbon 22,000 Ohms ⅕ watt C—Condenser—ceramic 2000 Mmfd. 450 volt D—Resistor—carbon 8200 Ohms ⅕ watt E—Condenser—ceramic 5000 Mmfd. 450 volt F—Resistor—carbon 8200 Ohms ⅕ watt G—Condenser—ceramic 5000 Mmfd. 450 volt
343	509517	Fuse; 1 Amp., 250 volt (used when letter "D" is included in series designation at rear of chassis)

MECHANICAL PARTS OF R.F. TUNER

(for electrical parts see preceding classified listings of condensers, resistors and coils)

DIAGRAM NO.	PART NO.	DESCRIPTION
	508890	R.F. Tuner complete with coils and tubes
	508666	Bracket for mounting R.F. tuner (front)
	508955	Bracket for mounting R.F. tuner (rear)

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MECHANICAL PARTS OF R. F. TUNER—Continued

DIAGRAM NO.	PART NO.	DESCRIPTION
	509321	Fine Tuning cam and brass shaft
	508708	Roller—detent
	507989	Shield—tube; miniature (fits solid ring type clip)
	505367	Shield—tube; miniature (fits wing type clip)
	509062	Slug core for converter plate coil
	507986	Slug for osc. coil fine tuning adjustment
	507987	Socket—miniature (for 6J6) (includes solid ring type clip for shield)
	509065	Socket—miniature (for 6J6) (includes wing type clip for shield)
	507988	Socket—miniature (for 6AG5) (includes solid ring type clip for shield)
	509066	Socket—miniature (for 6AG5) (includes wing type clip for shield)
	507966	Spring contactor washer (on front turret shaft)
	508709	Spring—detent
	507990	Spring—retains osc. fine tuning slug
	507967	Spring—turret shaft retaining
	507984	Stator contact assembly (includes 11 contacts and metal frames)
	509322	Tuner turret and shaft assembly (less coils)
	507965	Washer, fiber spacer (on turret shaft)

CABINET PARTS

DIAGRAM NO.	PART NO.	DESCRIPTION
	509085	Back for cabinet; Stack 13-G-46 (less power cord)
	509124	Back for cabinet; Stack 13-G-47 (less power cord)
	507783	Bottom plate for Stock 13-G-46
	509100	Cabinet for Stock 13-G-46
	509110	Cabinet for Stack 13-G-47
	507930	Call letter tabs
	509081	Escutcheon for glass window
	509082	Glass window
	502563	Knob—built-in antenna
	509088	Knob—"OFF-VOLUME-ON"
	507916	Knob—Channel Selector
	509087	Knob—"Contrast"
	507917	Knob—Fine Tuning
	509079	Mask for picture tube
	509117	Name plate
	509131	Rubber (flat sponge type) gasket between mask and picture tube
	18796	Screw—#10x1"; mounts chassis
	162163	Terminal strip for TV antenna connection
	509482	Washer, felt for contrast knob

MOUNTING PARTS FOR YOKE AND FOCUS MAGNET ASSEMBLY

Chassis which utilize four wing screws for height adjustment (located on both the left inside and right inside of base bracket) have the following parts:

DIAGRAM NO.	PART NO.	DESCRIPTION
	508829	Bracket base for support of yoke and focus magnet assembly (left hand)
	508830	Bracket base for support of yoke and focus magnet assembly (right hand)
	509005	Bracket for deflection yoke mounting
	508154	Bracket ("U" shaped) for support of yoke and focus magnet assembly
	507793	Rubber spacer support between flared neck of picture tube and yoke bracket
	170817	Wing screw—#10-24; for height adj. of yoke and focus magnet assembly
	170741	Wing screw—#10-32; for mounting yoke
	170195	Wing nut—#8-32; for mounting yoke and focus magnet assembly

Chassis which utilize two wing nuts and bolts for height adjustment (located only on the left outside of base bracket) have the following parts:

DIAGRAM NO.	PART NO.	DESCRIPTION
	14045	Bolt—1/4"-20 x 3 3/4"; for height adjustment of yoke and focus magnet assembly
	509389	Bracket base for support of yoke and focus magnet assembly (bottom left hand)
	509390	Bracket base for support of yoke and focus magnet assembly (bottom right hand)

MOUNTING PARTS—Continued

DIAGRAM NO.	PART NO.	DESCRIPTION
	509391	Bracket base for support of yoke and focus magnet assembly (top left hand)
	509392	Bracket base for support of yoke and focus magnet assembly (top right hand)
	509395	Bracket, mounts yoke and focus magnet assembly (circular type)
	507793	Rubber spacer support between flared neck of picture tube and yoke bracket
	509393	Spacer for base mounting brackets of yoke and focus magnet assembly
	50876	Wing nut—1/4"-20; for height adjustment of yoke and focus magnet assembly
	170741	Wing screw—#10-32; for mounting or forward adjustment of yoke

MISCELLANEOUS PARTS

DIAGRAM NO.	PART NO.	DESCRIPTION
	301270	Base for mounting electrolytic condenser
	508666	Bracket for mounting R.F. tuner (front)
	508955	Bracket for mounting R.F. tuner (rear)
	508976	Bracket—tube support (bottom front; less rubber pad
	509132	Call letter tabs
	509007	Centering arm
	508681	Clip for mounting electrolytic condenser #287
	508715	Clip for mounting fuse holder
	505101	Clip for mounting I.F. sound discriminator transformer
	507339	Clip for mounting video converter plate, 1st video I.F., 2nd video I.F., 3rd video I.F., 1st I.F. trap, or Horizontal Linearity coil
	507592	Clip for mounting 4th video I.F. coil
	508964	Clip for mounting Horizontal Hold coil
	507286	Connector for H.V. terminal of picture tube
	509595	Focus magnet assembly
	508714	Fuse holder
	508623	Grounding spring for coating on picture tube
	508603	Ion trap
	508617	Nut—for retaining focus magnet assembly mounting plate
	508962	Nut on end of Horizontal Hold control slug
	507699	Power cord assembly (includes plugs at both ends)
	507361	Rubber cover for H.V. terminal connector
	508619	Rubber spacer on picture tube support bracket
	18796	Screw—#10 x 1"; mounts chassis
	170182	Screw—#10-32 x 1 1/2"; retains tube support strap
	162138	Shield—H.V. supply (front section)
	508088	Shield—H.V. supply (rear section)
	509086	Shield—rubber, for Centering Arm
	162324	Shield for TV channel lite
	509062	Slug core for converter plate coil
	507357	Slug core for 1st, 2nd, 3rd or 4th video I.F. coil and 1st I.F. trap coil
	508963	Slug core for Horizontal Hold coil
	507429	Slug core for Horizontal Linearity coil
	508438	Slug core (5/16" dia. x 3/8" long) for primary of TV sound discriminator transformer
	508894	Slug core (1/4" dia. x 1/2" long) for primary of TV sound discriminator transformer
	508439	Slug core (5/16" dia. x 3/4" long) for secondary of TV sound discriminator transformer
	508894	Slug core (1/4" dia. x 1/2" long) for secondary of TV sound discriminator transformer
	508784	Slug core for Width coil
	508049	Socket and cable assembly for picture tube
	508957	Socket and mounting bracket for TV Channel Lite
	162259	Socket assembly for 1B3GT/8016 tube (includes corona ring and mounting frame)
	507932	Socket—male, power cord interlock
	507364	Socket—miniature (7 pin)
	508044	Socket—miniature (9 pin)
	508044	Socket—miniature (9 pin) (for 6S4 tube; when small mtg. hole is used)
	509507	Socket—miniature (9 pin) (for 6S4 tube; when large mtg. hole is used)
	508703	Socket—octal
	506469	Socket, octal (for 6W4 tube)
	509006	Spring—compression for focus magnet assembly mounting
	508514	Spring—retains H.V. lead
	508838	Strap for picture tube support (includes rubber pad)

*—This part is not supplied as a Service replacement item.

PRODUCTION CHANGES

The following tabulation furnishes complete details on changes which occurred during receiver production. The receivers incorporating these changes are identified by coding stamped on rear surface of chassis. This coding consists of one or more letters following the word SERIES, as SERIES B, SERIES AC, etc., and corresponds to similarly lettered changes shown below. Chassis incorporate only that change indicated by letter designation i.e., chassis stamped "SERIES BE" does not include changes "A" or "C" or "D".

The circuit shown on this page applies to "SERIES DEF" chassis.

LETTER INCLUDED IN DESIGNATION FOLLOWING THE WORD "SERIES"	CHANGE INCORPORATED IN CHASSIS
"A"	There is no performance advantage to a chassis containing this change—circuit revisions are due to short supply of certain tubes. 1. Tube V12 (Video Amp.) was changed from a type 6AU6 to a type 6AG5. 2. Tube V16 (Keyer A.G.C.) was changed from a type 6AU6 to a type 6AG5. **In order for this receiver to operate properly, V12 and V16 must be the same type tube.**
"B"	There is no performance advantage to a chassis containing this change—circuit revisions are due to short supply of certain tubes. 1. Tube V1 (1st Sound I. F. Amp.) was changed from a type 6AU6 to a type 6BH6. 2. Connection point of resistor 70 (82 Ohms) was changed from pin 7 of tube V1 (1st Sound I.F. Amp.) to pin 2 of this tube. 3. Connection point of blue lead from pin 2 of transformer 68 (1st Sound I.F. transformer) was changed from pin 2 of tube V1 (1st Sound I.F. Amp.) to pin 7 of this tube. 4. Tube V2 (2nd Sound I.F. Amp.-Limiter) was changed from a type 6AU6 to a type 6BH6. 5. Connection point of resistor 79 (82 Ohms) was changed from pin 7 of tube V2 (2nd Sound I.F. Amp.-Limiter) to pin 2 of this tube. 6. Connection point of blue lead from pin 2 of transformer 74 (2nd Sound I. F. transformer) was changed from pin 2 of tube V2 (2nd Sound I.F. Amp.-Limiter) to pin 7 of this tube. **In order for this receiver to operate properly, V1 and V2 must be the same type tube.**
"C"	There is no performance advantage to a chassis containing this change—circuit revisions are due to short supply of certain tubes. 1. Tube socket for V26 (Vertical Scanning Output) was changed from 7 pin miniature to octal base. 2. Tube V26 (Vertical Scanning Output) was changed from a type 6S4 to a type 6SN7GT. 3. Connections to tube socket of V26 (Vertical Scanning Output) were changed to those shown in schematic illustrated below. 4. Condenser 353 (.02 Mfd.) was added in parallel with condenser 327 (.05 Mfd.) as shown in schematic, illustrated

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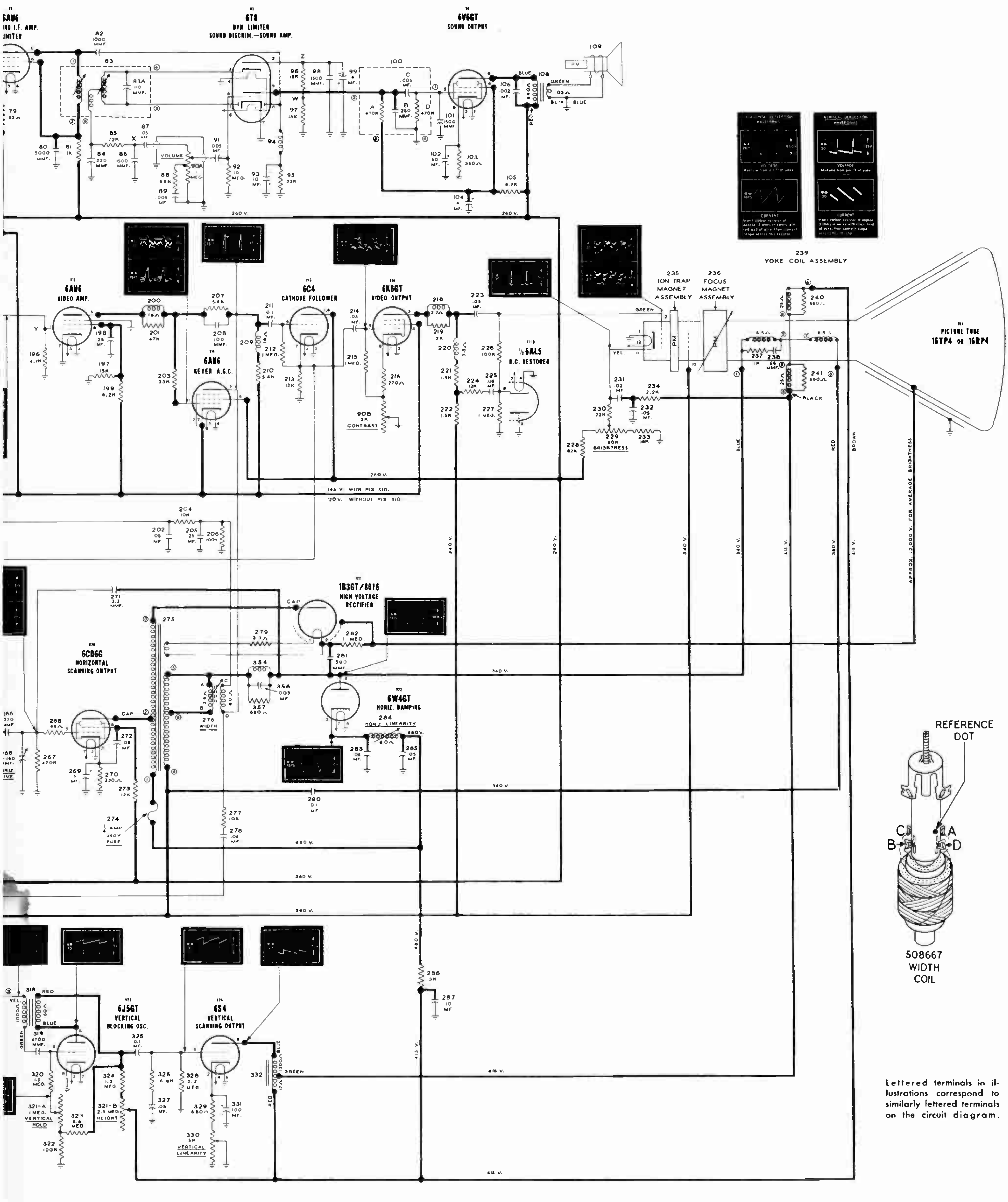
MODELS 13-G-46, 13-G-47



Lettered terminals in illustrations correspond to similarly lettered terminals on the circuit diagram.

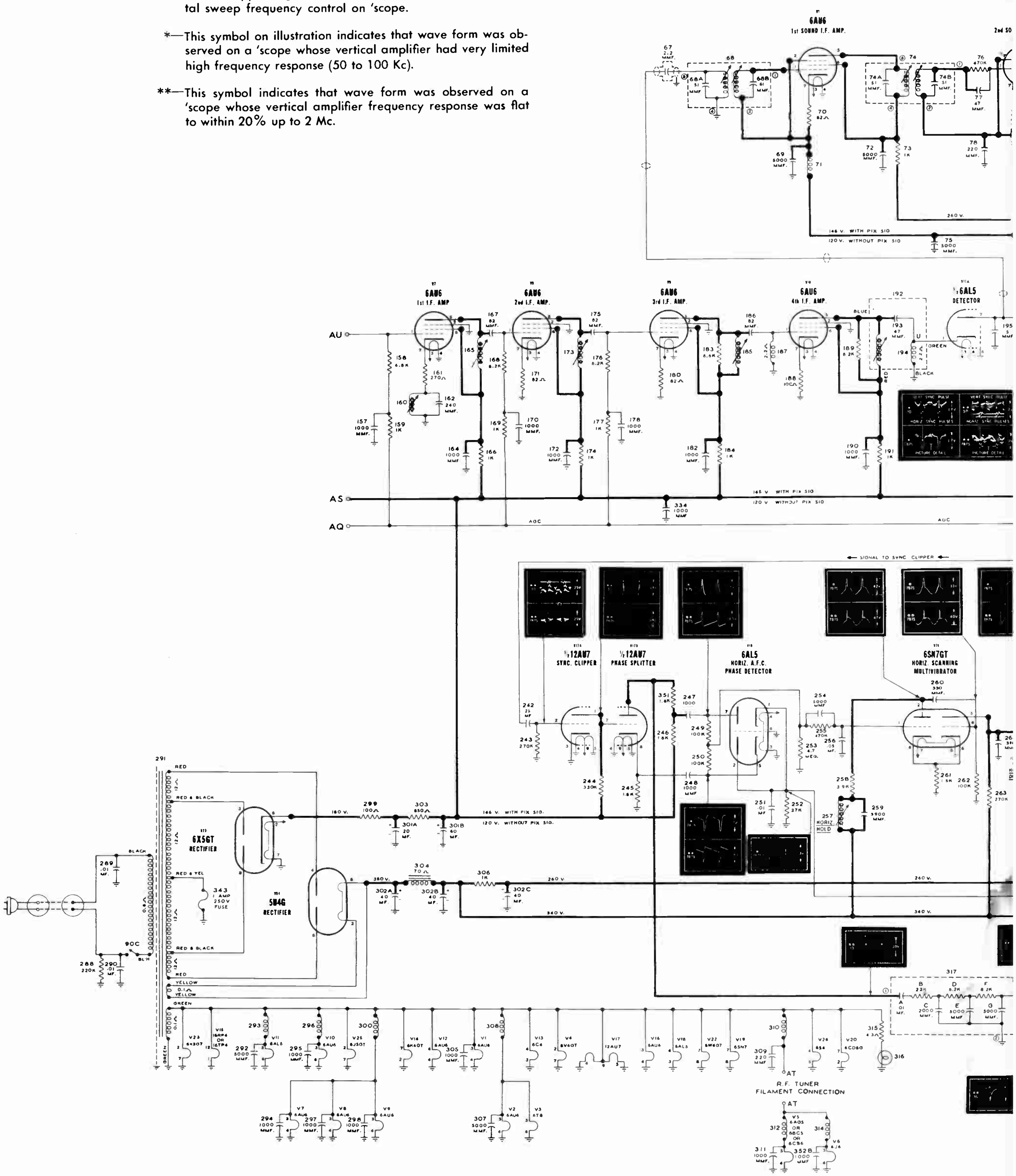
OSCILLOGRAMS

All oscillograms taken with ground lead of 'scope connected to receiver chassis (unless otherwise indicated) and with receiver controls set for normal reception of a station transmitting its standard test pattern.

Number appearing below asterisk specifies setting of horizontal sweep frequency control on 'scope.

*—This symbol on illustration indicates that wave form was observed on a 'scope whose vertical amplifier had very limited high frequency response (50 to 100 Kc).

**—This symbol indicates that wave form was observed on a 'scope whose vertical amplifier frequency response was flat to within 20% up to 2 Mc.



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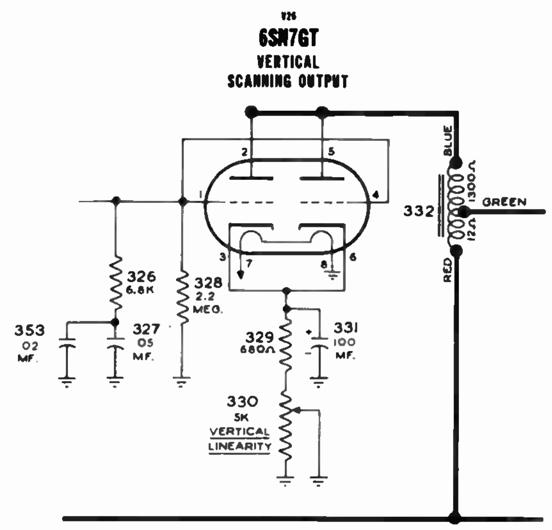
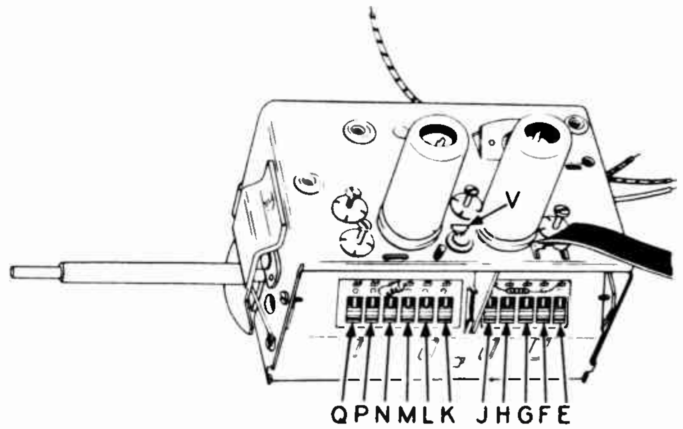
MODELS 13-G-46, 13-G-47



"D"	This change was incorporated in the chassis to improve vertical and horizontal sync. stability. 1. Resistor 351 (1800 Ohms) was added in plate circuit of V17B (12AU7) Phase Splitter. The junction of resistor 246 (1800 Ohms) and condenser 247 (1000 Mmfd.) was formerly connected directly to pin 6 of this tube. 2. Resistor 258 in plate circuit of V19 (6SN7GT) Horizontal Scanning Multivibrator stage was changed from 5600 Ohms to 3900 Ohms. 3. Fuse 343 (1 Amp. 250 Volt) was added between red and yellow lead of power transformer 291 and chassis ground.
"E"	This change was incorporated to decrease tube noise level and improve picture quality. 1. Resistor 161 in the cathode circuit of V7 was changed from 82 Ohms to 270 Ohms. 2. Resistor 176 in grid circuit of V9 (6AU6) 3rd I.F. Amp. stage was changed from 4700 Ohms to 8200 Ohms. 3. Resistor 183 in plate circuit of V9 (6AU6) 3rd I.F. Amp. stage was changed from 8200 Ohms to 6800 Ohms. 4. Resistor 196 in plate circuit of V11A (6AL5) Detector stage was changed from 6800 Ohms to 4700 Ohms. In addition the alignment frequency of the Converter Plate coil and 2nd I.F. coil was changed from 26.3 Mc. to 26.1 Mc. **Voltages** measured at certain tube socket terminals on a chassis which includes the letter "E" in the series designation will differ from those shown on the voltage chart. New measurements are as follows: Pin 7 of V7 (6AU6) .... 1.5 volts Pin 1 of V9 (6AU6) .... .4 volts In chassis that have been stamped with the letter "E" as a series designation, the Focus Magnet Assembly 236 (Part #509003) was changed to a new type (Part #509595) which uses a single focusing slug. This new unit provides an easier means of obtaining focus.
"F"	In order to reduce the "ringing effect" of the horizontal sweep transformer and defection yoke, which appears as white (or black) vertical lines on left side of picture screen, the following change was undertaken. 1. Trap coil 354 was added in series with yoke lead. 2. Condenser 355 (.003 mfd.) was placed in shunt across coil 354. 3. Resistor 356 (680 Ohms) was placed in shunt across coil 354. The following change was made to limit Picture tube beam current. 1. Connection to pin 10 of tube V15 (16TP4 or 16RP4) picture tube was changed from the 415 B+ Boost voltage bus to the 340 B+ bus.

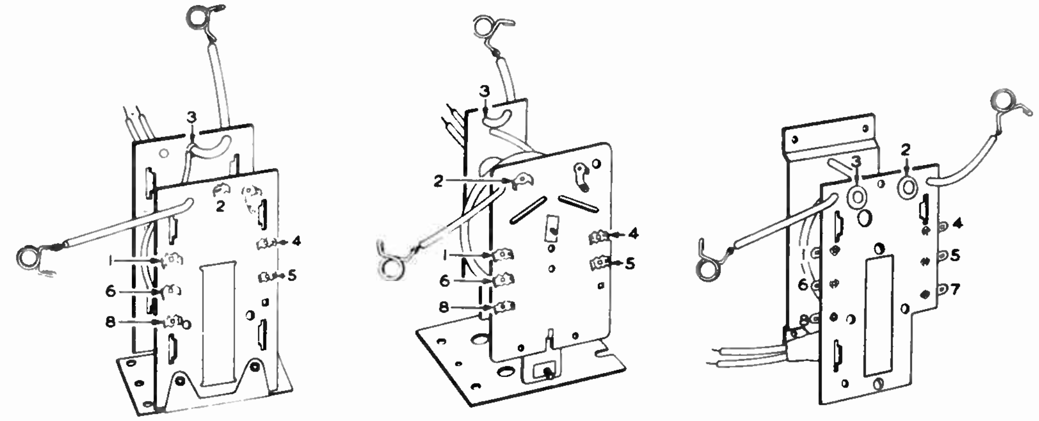
Voltages measured at certain tube socket terminals on a chassis which includes the letter "F" in the series designation will differ from those shown on the voltage chart. New measurements are as follows:

Pin 10 of V15 (16TP4 or 16RP4) .... 340 volts



508890 TUNER UNIT

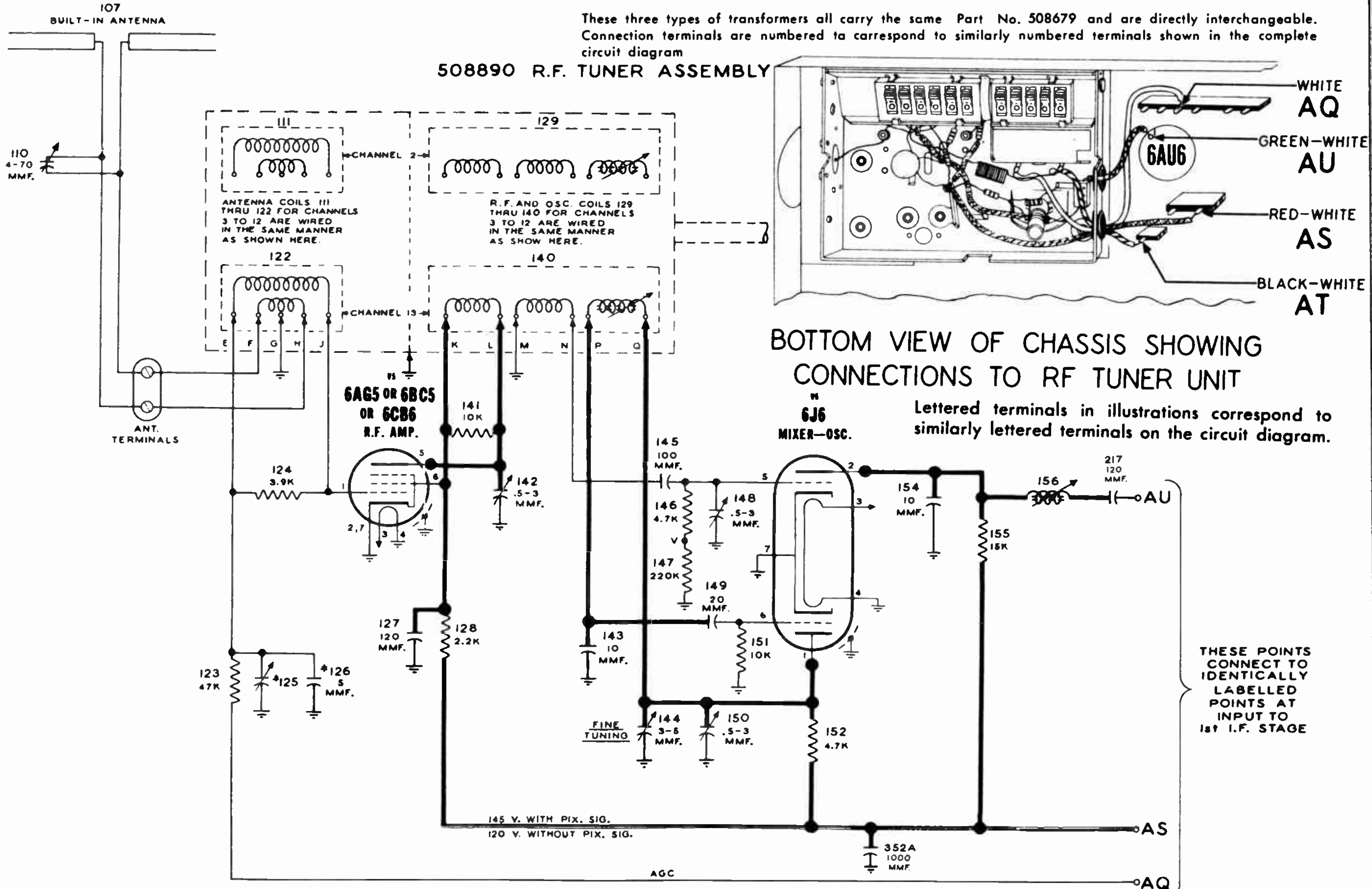
ALTERNATE HORIZONTAL SWEEP TRANSFORMERS



RESISTANCE MEASUREMENT	RESISTANCE MEASUREMENT	RESISTANCE MEASUREMENT
Between terminal 1 & 2— 40 Ohms	Between terminal 1 & 2— 40 Ohms	Between terminal 1 & 2— 40 Ohms
Between terminal 2 & 3—400 Ohms	Between terminal 2 & 3—400 Ohms	Between terminal 2 & 3—400 Ohms
Between terminal 5 & 8— 13 Ohms	Between terminal 5 & 8— 11 Ohms	Between terminal 5 & 8— 5 Ohms
Between terminal 6 & 8— 6.5 Ohms	Between terminal 6 & 8— 5.5 Ohms	Between terminal 6 & 8— 2.5 Ohms

These three types of transformers all carry the same Part No. 508679 and are directly interchangeable. Connection terminals are numbered to correspond to similarly numbered terminals shown in the complete circuit diagram

508890 R.F. TUNER ASSEMBLY



* THESE PARTS DIFFER IN SOME CHASSIS; SEE NOTE UNDER ITEM 125 AND 126 IN PARTS LIST.

BOTTOM VIEW OF CHASSIS SHOWING CONNECTIONS TO RF TUNER UNIT

Lettered terminals in illustrations correspond to similarly lettered terminals on the circuit diagram.

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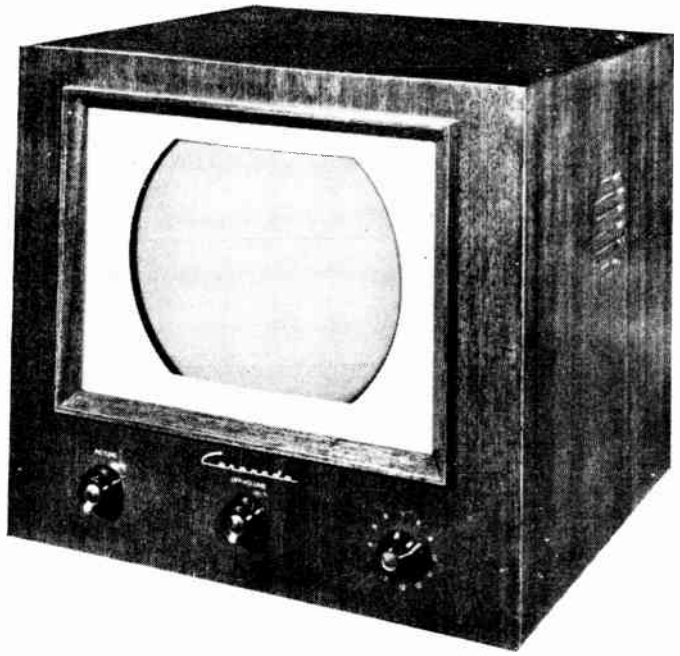

ELECTRICAL SPECIFICATIONS

Power Supply	105-125 Volts AC 60 Cycles Only
Power Consumption	150 Watts
Power Output	3.5 Watts Maximum 2 Watts Undistorted
Antenna Input Impedance	300 Ohms Balanced
Picture Area	90 Square Inch
Tuning Range	12 Channel
Intermediate Frequencies	Picture—25.75 MC Sound—4.5 MC
Loud Speaker	5" PM Dynamic
Voice Coil Impedance	3.2 Ohms 400 Cycles
Video Response	to 3 MC
Focus	Magnetic
Sweep Deflection	Magnetic
Scanning	Interlaced, 525 Line
Horizontal Scanning Frequency	15,750 CPS
Vertical Scanning Frequency	60 CPS
Frame Frequency	30 CPS

THIS RECEIVER CONTAINS THE FOLLOWING:

Symbol	Type	Function
V1	6AU6	1st I.F. Amplifier
V2	6AU6	2nd I.F. Amplifier
V3	6AU6	3rd I.F. Amplifier
V4	6AU6	Video Amplifier
V5	12LP4	Kinescope—12½"
V6	6AQ5	Audio Output
V7	6T8	FM Detector and 1st Audio
V8	6AU6	Sound I.F.
V9	6SN7GT	Vertical blocking oscillator and amplifier
V10	6AL5	Phase detector
V11	12AU7	Sync limiter and DC restorer
V13	6SN7GT	Horizontal oscillator
V14	6BG6G	Horizontal output
V16	6W4	Diode damper
V17	6AG5 or 6BC5	R.F. Amplifier
V18	6J6	Oscillator and Mixer
V12	5U4G	Low Voltage Rectifier
V15	1B3	High Voltage Rectifier

HIGH VOLTAGE WARNING

This television receiver contains high voltages which are dangerous to life. Never operate or service the receiver outside of the cabinet or with the covers removed until all the safety precautions necessary for working with high voltage equipment have been observed.

RADIO FREQUENCY RANGES

Channel Number	Channel Frequency Mc.	Picture Carrier Frequency Mc.	Sound Carrier Frequency Mc.	Receiver R-F Osc. Frequency Mc.
2	54-60	55.25	59.75	81
3	60-66	61.25	65.75	87
4	66-72	67.25	71.75	93
5	76-82	77.25	81.75	103
6	82-88	83.25	87.75	109
7	174-180	175.25	179.75	201
8	180-186	181.25	185.75	207
9	186-192	187.25	191.75	213
10	192-198	193.25	197.75	219
11	198-204	199.25	203.75	225
12	204-210	205.25	209.75	231
13	210-216	211.25	215.75	237

RECEIVER LOCATION—Advise the owner as to the proper location for the television receiver. The following may be used as a guide:

1. Choose an area in the home where sunlight or light from lamps do not strike the face of the picture tube and cause glare.
2. Remember the necessity of an electrical outlet and the location of the point at which the antenna leads enter the room.
3. The receiver should be placed a short distance from the wall to allow adequate ventilation.
4. The receiver should be placed to permit easy access for operation and comfortable viewing from all angles.
5. Try the set in various locations in room for best clarity.

ANTENNA—This television receiver contains a built-in antenna, which is sufficient for satisfactory reception in areas where average strength television signals are received. At the rear of the cabinet and on the left side of the chassis (as viewed from behind) are the terminals for the antenna. There are three wires with spade lugs for connection. In a given locality one connection may result in better performance than another. Try various combinations of the three wires, two at a time, and use the two which give the best picture. Be sure that the line cord is unfolded its full length. In the event that the signal strength in your locality is not sufficient to give a satisfactory picture with the self-contained antenna, it is recommended that an external antenna installation be made. This receiver has been designed to use an antenna with a 300 ohm balanced transmission line. When an external antenna installation is to be used, disconnect the wires referred to above, and connect the transmission line to the terminals instead. This line must be as short as possible because the longer the line the greater the chances are for picking up electrical disturbances. Stand off insulation should be used to keep the line away from the mast, metal or walls. Twist the line about one turn per foot throughout the line to cancel out direct signal and/or noise pickup by the transmission line. It should also be securely anchored in place so that a change in weather will not affect its position.

KINESCOPE (Picture Tube)

HANDLING PRECAUTION

Shatterproof goggles and heavy gloves must be worn by individuals while handling the kinescope or installing the kinescope into the receiver.

The kinescope encloses a high vacuum and due to the large surface area, is subjected to excessive air pressure. Therefore, care should be taken not to bump or scratch the picture tube accidentally as it may cause the tube to implode resulting in damage to property or injury to an individual.

MODELS 05RA4-43-8935A, 05TV6-43-8935A

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MODELS 05RA4-43-8935A, 05TV6-43-8935A

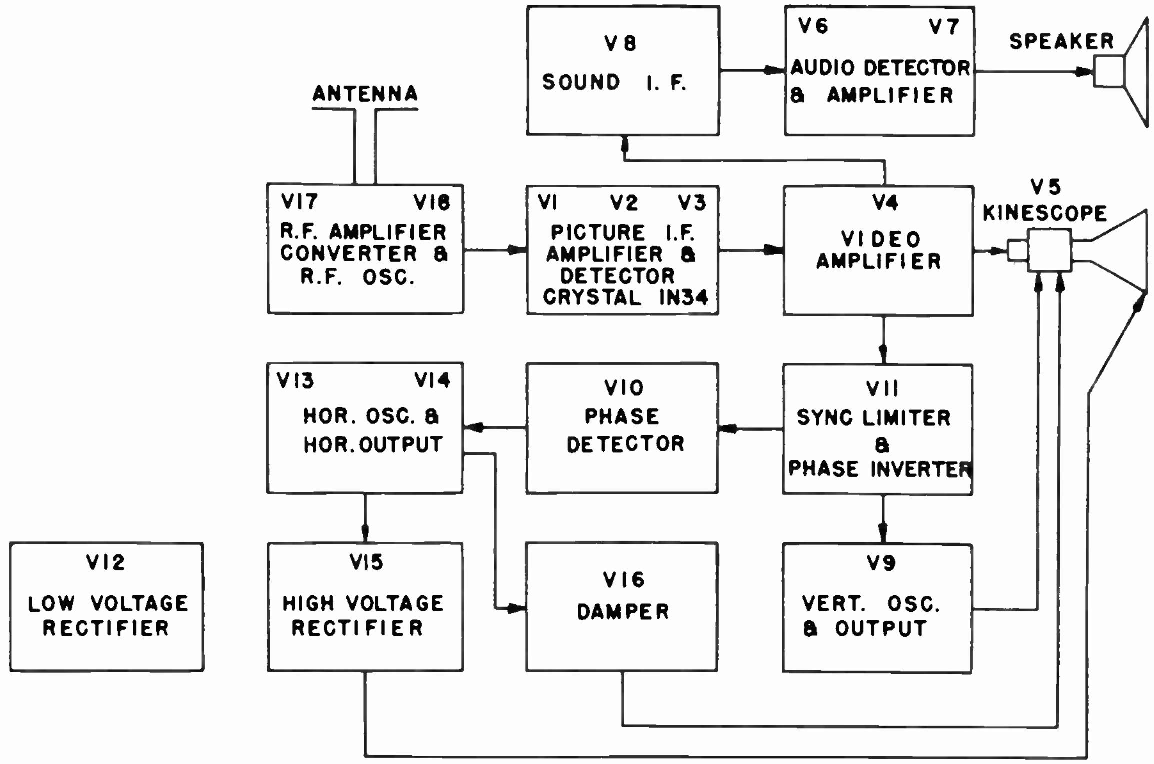

Fig. 1—Block Diagram

TUNING PROCEDURE

To turn the receiver on, rotate the ON-OFF-VOLUME control (center knob) about half a turn to the right (clockwise), and allow about thirty seconds for the tubes to warm up. After the station has been tuned in, turning this knob farther to the right increases the volume, to the left decreases the volume. Turn the left hand control, PICTURE, about half way clockwise. On the right hand there is a dual control, the CHANNEL SELECTOR and FINE TUNING, with two knobs. The bar type knob is the CHANNEL SELECTOR. Turn this knob, one step at a time, until the line on the bar is opposite the number of the channel you wish to tune in. The round knob on this same control is the FINE TUNING. Rotate this knob in either direction until the best picture is obtained. The left hand control, PICTURE, should now be turned in either direction to bring the picture to the proper brightness and contrast level.

When the receiver is first turned on and tuned to a station, the picture may not stand still, but keep moving upward. This is a result of the initial temperature changes taking place within the set and preventing the vertical hold from locking the picture in place. After a few moments for warm-up this symptom will disappear.

INSTALLATION ADJUSTMENTS—The receiver is shipped with the kinescope in place. However, some of the kinescope adjustments may have been jarred loose in shipment. Some adjustments may be necessary. The following should be used as a guide:

1. After the receiver has been unpacked, take off the cabinet back and make sure that all the tubes are properly mounted in their respective sockets.
2. Insert the line cord plug into a convenience outlet, turn on the receiver and wait about thirty seconds for the tubes to warm up.
3. Turn the channel selector to a station that is transmitting and check the picture. If the picture is not centered on the screen or not visible at all, make adjustments on the deflection yoke, focus coil and ion trap magnet assemblies as outlined on page four.

KINESCOPE REPLACEMENT—Should the kinescope have to be replaced, remove the defective kinescope in the following manner:

1. Remove the front panel control knobs by pulling them straight from their shafts.
2. Remove the four screws (bottom of cabinet) which secure the chassis, remove the cabinet back and take the chassis out of the cabinet.
3. Disconnect the kinescope socket connector at the base of the tube and the high voltage anode lead from the front of the kinescope. WARNING: REMOVE THE STATIC CHARGE FROM THE ANODE LEAD BY GROUNDING IT AGAINST THE CHASSIS.
4. Remove the ion trap magnet, slipping it from the neck of the tube past the socket.
5. Remove the rubber sleeve (under the focus coil) from the neck of the tube.
6. Loosen one of the self-tapping screws, and remove the second one, on the front stop bracket and turn the bracket down.
7. Remove the screw from the retaining strap which secures the kinescope at the front and withdraw the kinescope toward the front of the chassis.
8. To install a new kinescope, reverse the above procedure, making sure that the kinescope is fitted closely against the kinescope cushion and that the high voltage well connector is at the top of the kinescope. If the kinescope sticks or fails to slip into place smoothly, investigate and remove the source of trouble. Never force the tube.

KINESCOPE WINDOW—Clean the kinescope window with a dampened cloth or a soft lint-free cloth if dust or finger marks are present.

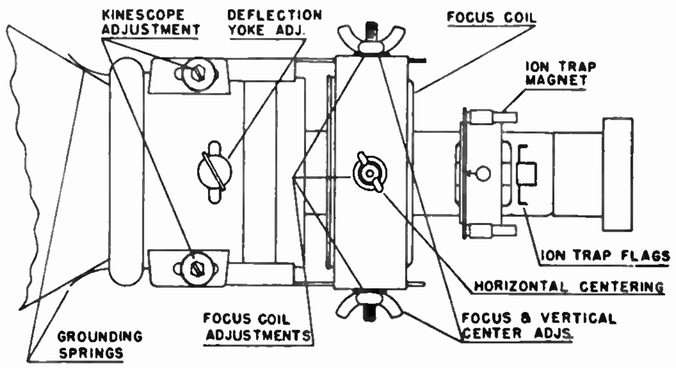

Fig. 2—Focusing Adjustments

NON-OPERATING CONTROLS
(Rear of Chassis)

Brilliance	R13
Vertical Linearity	R41
Vertical Hold	R43
Height	R45
Focus	R65
Horizontal Hold	R67
Width Control (H.V. cage)	L9
Horizontal Drive	C45
Horizontal Osc. Coil (H.V. cage)	L8
Focus Coil	Wing nut adjustment
Deflection Coils	Wing nut adjustment
Ion trap magnet	

Turn on the set and tune to a channel on which a station is operating.

1. Adjust the Horizontal Hold (R67) to the center of its rotation. With the control in this position adjust the Horizontal Oscillator coil (L8) until a picture appears. If no raster or pattern appears on the screen, leave this control in the center position and continue with the following instructions until a picture does appear then return for this adjustment.
2. Advance the Brilliance control (R13) in a clockwise direction until a raster appears. Allow this to remain in a clockwise position whether a raster appears or not.
3. Adjust the ion trap magnet for maximum brightness by moving it forward or backward along the neck of the picture tube, rotating it about the neck of the tube at the same time. The Brilliance should then be reduced to a suitable level by means of control R13.
4. Adjust the Vertical Hold control (R43) until the test pattern remains stationary. The Contrast (R9, front panel) and Brilliance (R13) should then be adjusted for normal picture contrast.
5. At this point the Focus control (R65) should be adjusted for the sharpest horizontal lines at the center of the pattern.
6. Adjust the Height control (R45) until the proper height is attained. Adjustment of this control may effect the Vertical Hold (R43), in which case, that control will have to be re-adjusted to maintain a stationary pattern.
7. The Vertical Linearity (R41) control should be adjusted to give maximum linearity in the upper portion of the raster.
8. Adjust the Horizontal Drive (C45) to give the best linearity.
9. Loosen the wing-nut on top of the yoke housing and square the pattern with the screen escutcheon by rotating the yoke. Be sure that the yoke is pushed as far forward as possible.
10. Loosen the wing-nut on top of the focus coil and center the picture horizontally by rotating the coil. Tighten the wing-nut to lock the coil in final position. Loosen the wing-nuts on the side of the focus coil mounting, and center the picture vertically by rocking the cradle that holds the coil backward and forward. Tighten the wing-nuts to lock the cradle in final position.
11. The Width control (L9) is a screw-driver adjustment located on top of the high voltage cage. The width is increased by turning this control in a clockwise direction.

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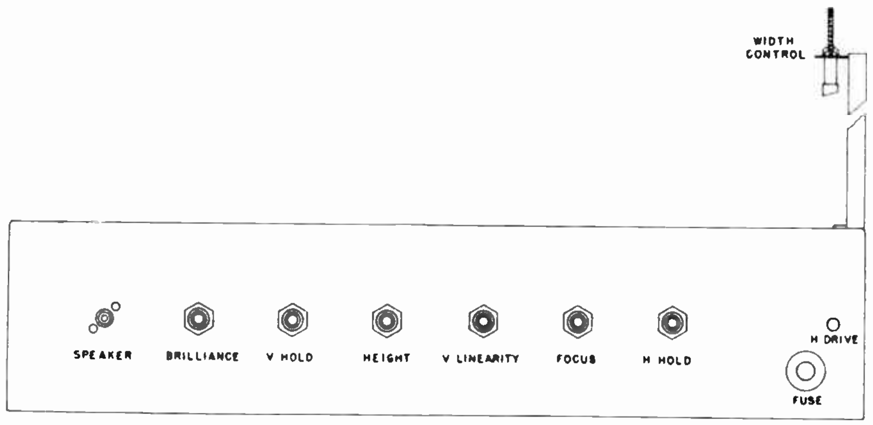

Fig. 3—Rear View of Chassis

SERVICE SUGGESTIONS

NO RASTER ON KINESCOPE—If raster cannot be obtained, check below for possible causes.

1. Ion trap magnet adjustment is incorrect.
2. Check .25 amp. fuse in plate circuit of V14.
3. No high voltage—check V14 (6BG6-G) and V15 (1B3-GT) tubes and circuits. If the horizontal deflection circuits are operating as evidenced by the correct waveform measured on terminal 4 of horizontal output transformer (T9), the trouble can be isolated to the high voltage rectifier circuit (V15). Either the high voltage winding (points 2 to 3 on T9) is open, tube V15 is defective or its filament circuit is open.
4. Damper tube (V16) (6W4) defective. Plate voltage supply for V14 (6BG6-G) horizontal output tube is obtained through the damper tube. Check tube and heater winding on power transformer (T7).
5. Defective kinescope. Heater open, cathode return circuit open.
6. No plate voltage. Electrolytic capacitor shorted. All B voltages are accessible for measurement underneath the chassis.

HORIZONTAL DEFLECTION ONLY—If only horizontal deflection is obtained as evidenced by a straight line across the face of the kinescope, it can be caused by the following:

1. Vertical oscillator and output tube V9 (6SN7-GT) inoperative. Check voltages on grid and plate.
2. Vertical output transformer (T5) open.
3. Yoke vertical coils (L6) open.
4. Vertical blocking transformer (T6) open or shorted.

POOR VERTICAL LINEARITY—If adjustment of the vertical height and linearity controls will not correct this condition, any of the following may be the cause:

1. Vertical output transformer (T5), capacitors C30, C31, C32, or resistor R38.
2. V9 (6SN7GT) defective; check voltages.
3. Low plate and bias voltages. Check rectifier tube and capacitors in B supply.

POOR HORIZONTAL LINEARITY—Check the following:

1. V14 (6BG6-G) screen voltage.
2. Horizontal drive (C45) for incorrect adjustment.
3. Horizontal output tube V14 (6BG6-G).
4. Damper tube V16 (6W4).

TRAPEZOIDAL OR NON-SYMMETRICAL RASTER — Check for:

1. Improper adjustment of focus coil or ion trap magnet.
2. Defective yoke.

WRINKLES ON LEFT SIDE OF RASTER—This condition can be caused by incorrect adjustment of the horizontal drive C45.

SMALL RASTER—This condition can be caused by:

1. Low B or line voltage.
2. Insufficient output from horizontal output tube (V14) (6BG6-G). Replace tube.
3. Insufficient output from vertical output tube V9 (6SN7GT). Replace tube.
4. Damper tube V16 (6W4) filament to cathode short.

RASTER; NO IMAGE, BUT ACCOMPANYING SOUND —This condition can be caused by:

1. No signal on kinescope cathode. Check for open coupling condenser C11.
2. Bad contact to kinescope or lead to socket broken.

SIGNAL APPEARS ON KINESCOPE CATHODE BUT IMPOSSIBLE TO SYNCHRONIZE THE PICTURE HORIZONTALLY AND VERTICALLY—A condition of this nature can be caused by:

1. Defective sync limiter V11 (12AU7) or phase detector V10 (6AL5).
2. If tubes are O.K. check voltages and associated circuits.

SIGNAL ON KINESCOPE CATHODE AND HORIZONTAL SYNC ONLY—Check:

1. Vertical integrating network capacitors C18, C19, C33, and resistors R20, R21, R22.

PICTURE STABLE BUT WITH POOR RESOLUTION— If the picture resolution is not up to standard, it may be caused by any of the following:

1. Defective picture detector (crystal 1N34) or video amplifier V4 (6AU6).
2. Open video peaking coil. Check coils L1, L2, L3 and L4 for continuity. Note that L1 and L3 have shunting resistors.
3. Leakage in V4 (6AU6) grid capacitor C10, or C11 on V5 (kinescope).

If the above components are not found to be defective, check the following:

A. Check all potentials in video circuits.

B. Check the kinescope grid for poor or dirty contacts.

C. Check adjustment of focus control R48. It should be effective on either side of proper focus.

D. Check and re-align if necessary, the picture I.F. and the local oscillator.

E. Check for proper coils in turret switch.

PICTURE SMEAR:

1. Normally, smear can be attributed to phase shift at the low frequency end of the video characteristic. This can be caused by improper values of resistors and capacitors in the video circuits.
2. This trouble can also originate at the transmitter. Check reception from another station.

PICTURE JITTER:

1. Vertical instability may be due to loose connections or noise received with the signal.
2. Horizontal instability may be due to unstable transmitted sync or to noise.

ALIGNMENT PROCEDURE

TEST EQUIPMENT—To service this receiver properly, it is recommended that the following test equipment be available:

R-F SWEEP GENERATOR meeting the following requirements:

(a) Frequency range: 4 to 5 MC; 1 MC sweep width.
(b) Output adjustable with at least .1 volt maximum.
(c) Output constant on all ranges.
(d) Flat output in all attenuator positions.

CATHODE RAY OSCILLOSCOPE preferably one with a wide band vertical deflection and an input calibrating source.

SIGNAL GENERATOR to provide the following frequencies:

(Output on these ranges should be adjustable and at least .1 volt max.)

(a) Intermediate frequencies:
4.5 MC Sound I.F.
21.25 MC Trap (L18)
22.8 MC 1st I.F. (L20)
25.3 MC 2nd I.F. (T1)
24.6 MC 3rd I.F. (T2)
23.4 MC 4th I.F. (T3)

(b) Radio frequencies:

Channel Number	Picture Carrier Freq. Mc	Sound Carrier Freq. Mc
2	55.25	59.75
3	61.25	65.75
4	67.25	71.75
5	77.25	81.75
6	83.25	87.75
7	175.25	179.75
8	181.25	185.75
9	187.25	191.75
10	193.25	197.75
11	199.25	203.75
12	205.25	209.75
13	211.25	215.75

HETERODYNE FREQUENCY METER with crystal calibrator if the signal generator is not crystal controlled.

ELECTRONIC VOLTMETER and a high voltage probe for use with this meter to permit measurements up to 10 kilovolts.

SERVICE PRECAUTIONS—To service the receiver remove the chassis from the cabinet. To do so, remove the knobs, the cabinet back and the three chassis mounting bolts (bottom of cabinet). The chassis should normally be serviced without the kinescope. However, if it is necessary to view the raster during servicing, turn the chassis on its side, with the power transformer and high voltage cage down. In this position the chassis is self-balancing, and all controls and components are readily accessible for adjustment or measurement.

CAUTION: Do not permit the kinescope second-anode lead to become shorted to the chassis.

SENSITIVITY CHECK—A comparative sensitivity check can be made by operating the receiver on a weak signal from a television station and comparing the picture and sound obtained to that obtained on other receivers under the same conditions.

This weak signal can be obtained by connecting the shop antenna to the receiver through an attenuator pad of the type shown in figure 11. The number of stages in the pad depends upon the signal strength available at the antenna. A sufficient number of stages should be inserted so that a somewhat less than normal contrast picture is obtained when the picture control is at the maximum clockwise position.

Only carbon type resistors should be used to construct the attenuator pad. Since many of the low value moulded resistors generally available are of wire wound construction, it is advisable to break and examine one of each type of resistor used in order to determine its construction.

OSCILLATOR ADJUSTMENT—The oscillator slug for each channel can be adjusted by removing the chassis from the cabinet. Use only an insulated alignment tool. When adjusting the slugs to be sure that the fine tuning control is at the mid-capacity position (tip pointing down, as illustrated in Fig. 10).

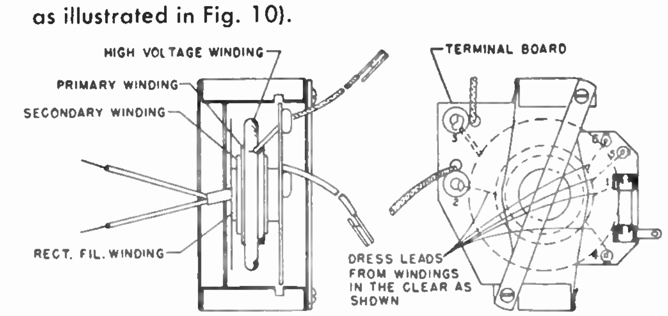

Fig. 4—High Voltage Transformer Winding Leads

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ALIGNMENT TABLE

DISCRIMINATOR AND SOUND I-F ALIGNMENT

Step No.	Connect Signal Generator to	Signal Gen. Freq. Mc.	Connect Sweep Generator to	Sweep Gen. Freq. Mc.	Connect Oscilloscope to	Connect Voltmeter to	Miscellaneous Connections and Instructions	Adjust	Refer to
1	Video Grid (pin 1, V-4)	4.5 .1 volt output	Not used		Not used	Pin 2 V-7	Meter on 10 volt scale	T4 (bottom) and L5 for max. on meter	Figs. 5 and 9
2	Video Grid (pin 1, V-4)	4.5 .1 volt output	Not used		Not used	See Note 1	Meter on 3 volt scale	T4 (top) for zero on meter	Fig. 9
3	Not used		Video Grid (pin 1, V-4)	4.5 center 1 mc .1 volt output	Discriminator output (Junction R32-R33)	Not used	Check for symmetrical response waveform (positive and negative). If not equal, adjust T4 (bottom) until they are equal. See Note 2.		Fig. 5

NOTE 1: Connect two 100 K resistors in series. Connect one end to pin 2 of V-7 (6T8) and the other end to ground. Connect the hot side of the VTVM to center of the two 100 K resistors and ground side to junction of R33 (220 ohms) and R32 (47 K ohms).

NOTE 2: The peak to peak band width at the discriminator should be approximately 300 KC and should be linear from 4.425 MC to 4.575 MC.

ALIGNMENT PROCEDURE

I-F ADJUSTMENTS

Step No.	Connect Signal Generator to	Signal Gen. Freq. Mc.	Connect Voltmeter to	Miscellaneous Connections and Instructions	Adjust	Refer to
4	Wire loop (top of tuner between V17 and V18)	23.4	Junction R7 and L2	Set station selector between channels; meter on 3 volt scale	T3 (top) maximum	Fig. 9
5	Wire loop (top of tuner between V17 and V18)	24.6	Junction R7 and L2		T2 (top) maximum	Fig. 9
6	Wire loop (top of tuner between V17 and V18)	25.3	Junction R7 and L2		T1 (top) maximum	Fig. 9
7	Wire loop (top of tuner between V17 and V18)	22.8	Junction R7 and L2		L20 maximum	Fig. 9
8	Wire loop (top of tuner between V17 and V18)	21.25	Junction R7 and L2		L18 minimum	Fig. 9

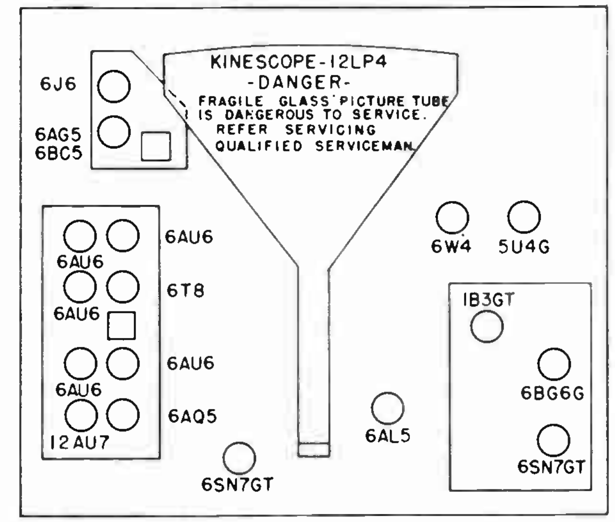

Fig. 8—Tube Layout

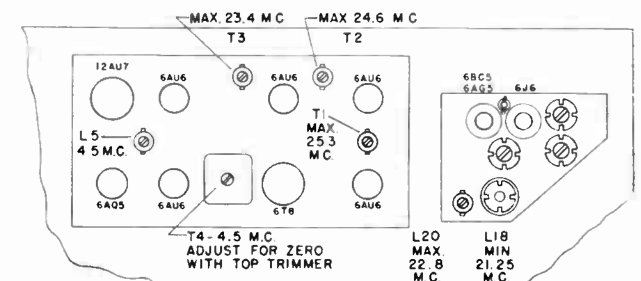

Fig. 9—Top Chassis—Video I.F. Adjustment

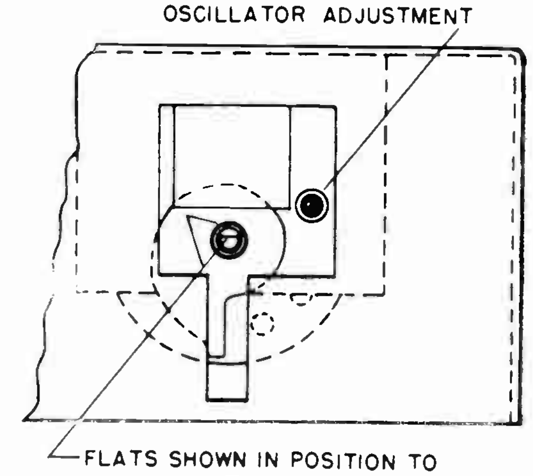

Fig. 10—Oscillator Adjustment

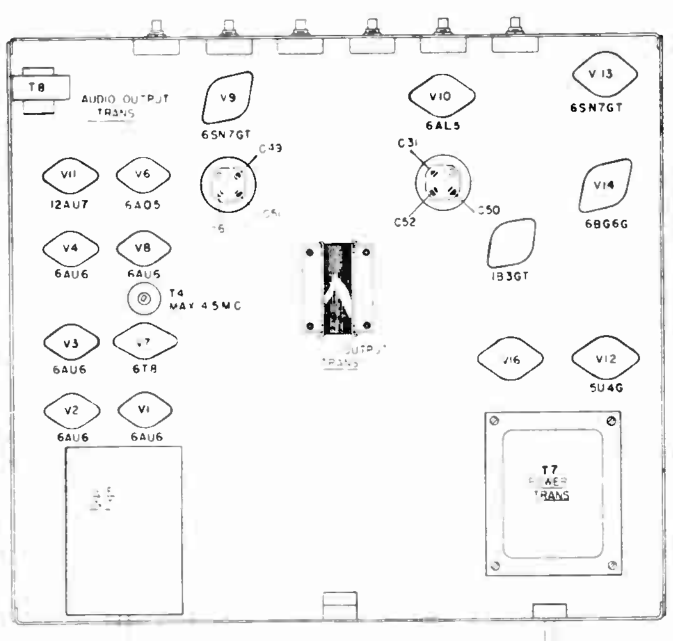

Fig. 5—Bottom Chassis Components

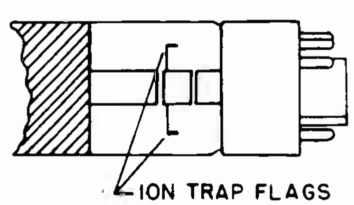

Fig. 6—Ion Trap Flags

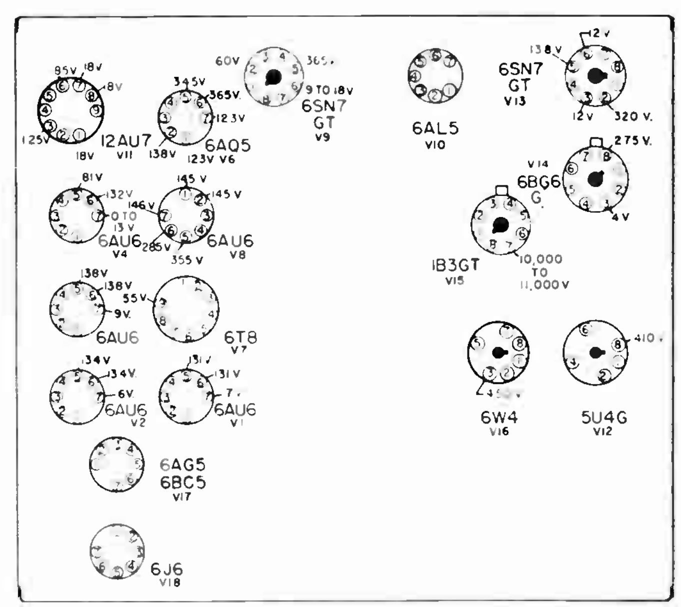
Fig. 7—Bottom Socket View

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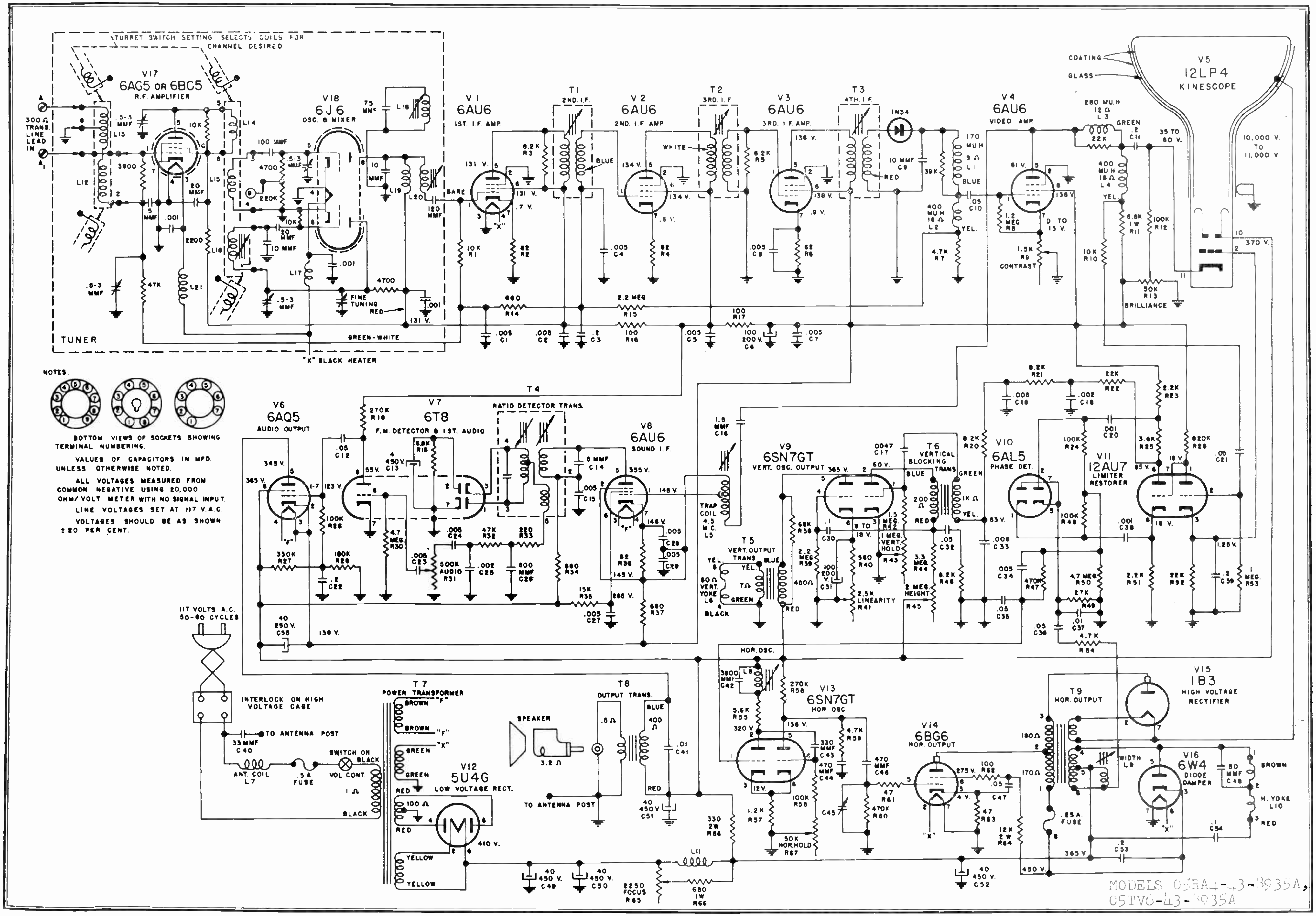

GAMBLE-SKOGMO TV PAGE 6-5

MODELS 05RA4-43-8935A, 05TV6-43-8935A

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Ref. No.	Part No.	Description
C-1, C-2, C-4, C-5, C-7, C-8, C-15, C-23, C-24, C-27, C-28, C-29	16-177	Capacitor, ceramic; .005 mfd.
C-3, C-11, C-22, C-39, C-53	16-188	Capacitor, tubular; .2-400 v. 85 C
C-6, C-31, C-49, C-50, C-51, C-52	18-295	Capacitor, electrolytic; 100 mfd. 200 v. 40-40 mfd. 450 v.
C-9	15-223	Capacitor, ceramic; 10 mmfd.
C-10, C-12, C-21, C-32, C-35	16-189	Capacitor, tubular; .05-400 85 C
C-13	18-292	Capacitor, electrolytic; 4 mfd. 50 v.
C-14	15-222	Capacitor, ceramic; 5 mmfd.
C-16	15-224	Capacitor, gimmick; 1.5 mmfd.
C-17	16-211	Capacitor, tubular; .0047-600 v. 85 C
C-18, C-33	16-209	Capacitor, tubular; .006-600 v. 85 C
C-19	16-198	Capacitor, tubular; .002-600 v. 85 C
C-20, C-38	15-220	Capacitor, ceramic; 1000 mmfd.
C-25	15-228	Capacitor, ceramic; 2000 mmfd.
C-26	15-221	Capacitor, ceramic; 500 mmfd.
C-30, C-54	16-208	Capacitor, tubular; .1-600 v. 85 C
C-34	16-190	Capacitor, tubular; .005-600 v. 85 C
C-36, C-47	16-193	Capacitor, tubular; .05-600 v. 85 C
C-37, C-41	16-201	Capacitor, tubular; .01-600 v. 85 C
C-40	15-210	Capacitar, ceramic; 33 mmfd.
C-42		Capacitor; 3900 mmfd. Part of L-8
C-43	15-226	Capacitor, silver mica; 330 mmfd.
C-44, C-46	15-200	Capacitor, mica; 470 mmfd.
C-45	20-145	Capacitor, trimmer; Horizontal drive
C-48	15-204	Capacitor, ceramic; 500 mmfd.
C-55	18-299	Capacitor, electrolytic 40 mfd. 250 v.

RESISTORS

Ref. No.	Part No.	Description
R-1, R-10	60-760	Resistor, carbon; 10 K ohm ½ w.
R-2, R-4, R-6, R-36	60-776	Resistor, carbon; 82 ohm ½ w.
R-3, R-5, R-20, R-21, R-46	60-778	Resistor, carbon; 8.2 K ohm ½ w.
R-7, R-54, R-59	60-759	Resistor, carbon; 4.7 K ohm ½ w.
R-8	60-782	Resistor, carbon; 1.2 megohm ½ w.
R-9	25-18	Resistor, variable; 1.5 K ohm Contrast
R-11	60-785	Resistor, carbon; 6.8 K ohm 1 w.
R-12, R-24, R-28, R-48, R-58	60-727	Resistor, carbon; 100 K ohm ½ w.
R-13, R-67	25-10	Resistor, variable; 50 K ohm Brilliance Horiz. Hold
R-14, R-34, R-37	60-790	Resistor, carbon; 680 ohm ½ w.
R-15	60-668	Resistor, carbon; 1 megohm ½ w.
R-16, R-17	60-743	Resistor, carbon; 100 ohm ½ w.
R-18, R-56	60-747	Resistor, carbon; 270 K ohm ½ w.
R-19	60-786	Resistor, carbon; 6.8 K ohm ½ w.
R-22, R-52	60-744	Resistor, carbon; 22 K ohm ½ w.
R-23, R-51	60-714	Resistor, carbon; 2.2 K ohm ½ w.
R-25	60-710	Resistor, carbon; 3.9 K ohm ½ w.
R-26	60-799	Resistor, carbon, 820 K ohm ½ w.
R-27	60-787	Resistor, carbon; 330 K ohm ½ w.
R-29	60-788	Resistor, carbon; 180 K ohm ½ w.
R-30, R-50	60-779	Resistor, carbon; 4.7 megohm ½ w.
R-31	24-189	Resistor, variable; 500 K ohm Volume
R-32	60-730	Resistor, carbon; 47 K ohm ½ W.
R-33	60-753	Resistor, carbon; 220 ohm ½ w.
R-35	60-783	Resistor, carbon; 15 K ohm ½ w.
R-38	60-775	Resistor, carbon; 68 K ohm ½ w.
R-39, R-53	60-726	Resistor, carbon; 2.2 megohm ½ w.
R-40	60-758	Resistor, carbon; 560 ohm ½ w.
R-41	25-13	Resistor, variable; 2.5 K ohm Vertical Linearity
R-42	60-780	Resistor, carbon; 1.5 megohm ½ w.
R-43	25-17	Resistar, variable; 1 megohm Vert. Hold
R-44	60-761	Resistor, carbon; 3.3 megohm ½ w.
R-45	25-15	Resistor, variable; 2 megohm Height
R-47, R-60	60-731	Resistor, carbon; 470 K ohm ½ w.
R-49	60-745	Resistor, carbon; 27 K ohm ½ w.
R-55		Resistor, 5.6 K ohm Part of L-8
R-57	60-756	Resistor, carbon; 1.2 K ohm ½ w.
R-61, R-63	60-798	Resistor, carbon; 47 ohm ½ w.
R-62	60-752	Resistor, carbon; 100 ohm ½ w.
R-64	60-720	Resistor, carbon; 12 K ohm 2 w.
R-65	25-14	Resistor, variable; 2250 ohm Focus
R-66	60-797	Resistor, carbon; 680 ohm 1 w.
R-68	60-814	Resistor, carbon; 330 ohm 2 w.

TRANSFORMERS AND COILS

Ref. No.	Part No.	Description
T-1	10-541	2nd I.F. (blue)
T-2	10-542	3rd I.F. (white)
T-3	10-543	4th I.F. (red)
T-4	10-552	Ratio detector
T-5	80-255	Vertical output
T-6	80-257	Vertical blocking Oscillator
T-7	80-254	Power
T-8	80-253	Audio output
T-9	80-252	Horizontal output
L-1	10-546	Coil—peaking (blue)
L-2, L-4	10-545	Coil—peaking (yellow)
L-3	10-547	Coil—peaking (green)
L-5	10-544	Coil—4.5 MC sound trap
L-6, L-10	83-650	Coil—Horizontal and Vertical yoke
L-7	10-550	Coil—line antenna choke
L-8	10-555	Coil—Horizontal oscillator
L-9	10-551	Coil—width control
L-11	10-549	Coil—Focus

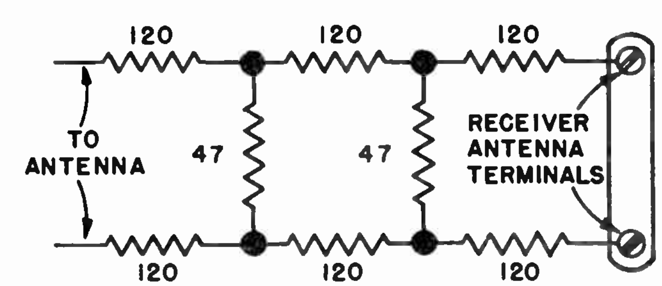

Fig. 11. Attenuator Pad.

MISCELLANEOUS CHASSIS PARTS

Part No.	Description
22-158	Connector, H.V.
48-45	Crystal, 1N34
43-11	Fuse, .25 amp. 250 volt
43-12	Fuse, 5 amp. 250 volt
83-651	Ion trap magnet
37-122	Insulator, ceramic, socket support
22-133	Jack, speaker
84-386	Line cord and shield assembly
28-106	Pad, cork, 1½" x 2"
28-114	Pad, sponge rubber, 10"
28-115	Pad, sponge rubber, 20"
31-126	Plate, electrolytic mounting
45-125	Plug, speaker
95-20	R.F. tuner
68-18	Socket, octal, molded
68-43	Socket, miniature, 7 pin
68-44	Socket, miniature, 9 pin
68-45	Socket, octal, wafer
68-46	Socket, kinescope
27-17	Strap, kinescope support, 11⅜"
27-18	Strap, kinescope support, 21⅛"
79-388	Speaker, 5" P.M.
83-652	Yoke, mounting hood

CABINET PARTS

Part No.	Description
32-12	Back
42-472	Cabinet
48-48	Glass, TV
98-11	Grille cloth
52-311	Knob, PICTURE and OFF-VOLUME
52-312	Knob, CHANNEL SELECTOR
52-313	Knob, FINE TUNING
31-163	Plate, mask
36-127	Wire screen mesh

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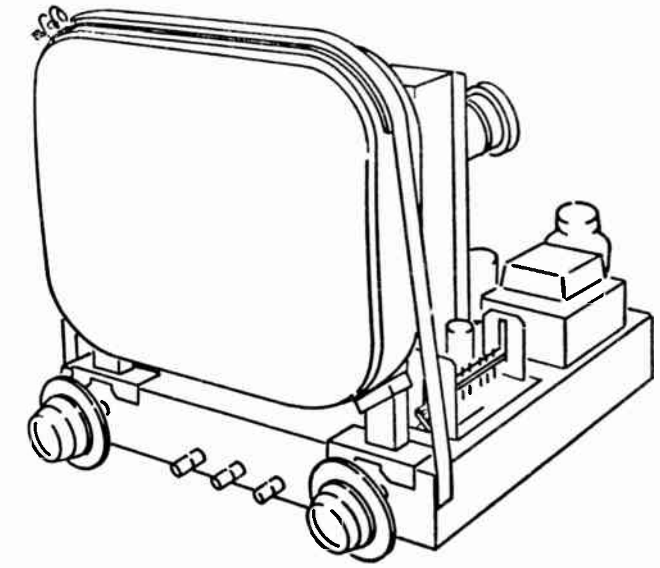
Model 05TV1-43-9014A

GENERAL DESCRIPTION

The above models are a 22 tube, AC operated, direct view, 16-inch rectangular television receivers. The sets are complete in one unit and feature complete coverage of all 12 television channels, automatic gain control, automatic horizontal frequency control, intercarrier sound system, permanent magnet focused and magnetically deflected picture tube.

On the back of the cabinet is a safety interlock to prevent dangerous electrical shock. As an added safety measure, a fuse is located in the power supply to protect the set in case of overloading.

Located on the rear of the chassis are a phono input plug and phono TV switch for connection of a phonograph.



Television Chassis

FUNCTIONS OF THE CONTROLS

All the controls normally used in tuning in a program —both picture and sound—are located on the front of the receiver and at the top of the back of the cabinet. At the rear of the set are several controls which are preset at the factory and may need slight readjustment at the time of installation. After installation, they should not be adjusted further, unless required by replacement or aging of tubes, variations in power-line voltage, or other external conditions.

The receiver actually requires only four controls when tuning in a program. On the left is a dual knob, the large knob controls picture contrast, while the small outer knob is the off-on switch and volume control. The control on the right is the station selector and the antenna tuning knob is located at the top of the back of the cabinet.

The three other controls on the front of the set; brightness, horizontal hold, and vertical hold need only be adjusted periodically. The six front controls are shown below in figure 1.

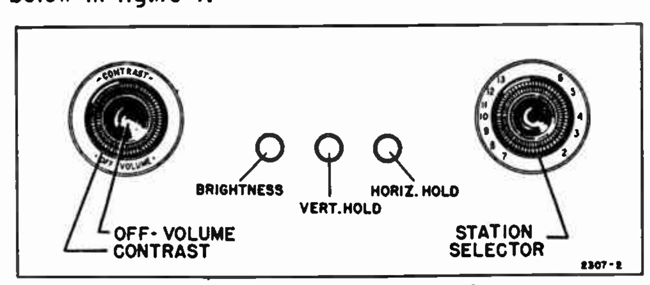


Figure 1. Front Controls

The focus and centering controls are located on the picture tube assembly (figure 2). These controls can be operated through the opening provided in the cabinet back. The remaining six controls, vertical linearity, vertical size, horizontal size, horizontal drive, horizontal linearity and coarse horizontal hold are located on the rear of the chassis (figure 3).

OPERATOR'S CONTROLS

Volume-Off — Turns set on or off and adjusts sound volume.

Contrast—Varies contrast between light and dark portions of picture.

Brightness—Controls brilliance of picture.

V. Hold—Stops picture from moving up or down.

H. Hold—Stops picture from moving left or right.

Station Selector Knob—Tunes set to desired channel (station). May be turned in either direction.

Antenna Tuning Knob—Tunes the antenna for maximum signal.

Centering—Moves entire picture both horizontally and vertically.

SERVICEMAN'S CONTROLS

V. Linearity—Provides vertical distribution of picture.

V. Size—Changes size of picture vertically. Does not affect horizontal size.

H. Size — Changes size of picture horizontally. Does not affect vertical size.

Focus—Focuses picture on face of picture tube.

H. Linearity — Provides horizontal distribution of picture.

H. Drive—Controls the drive to the Pulse Amplifier.

Coarse H. Hold — Stops picture from moving left or right.

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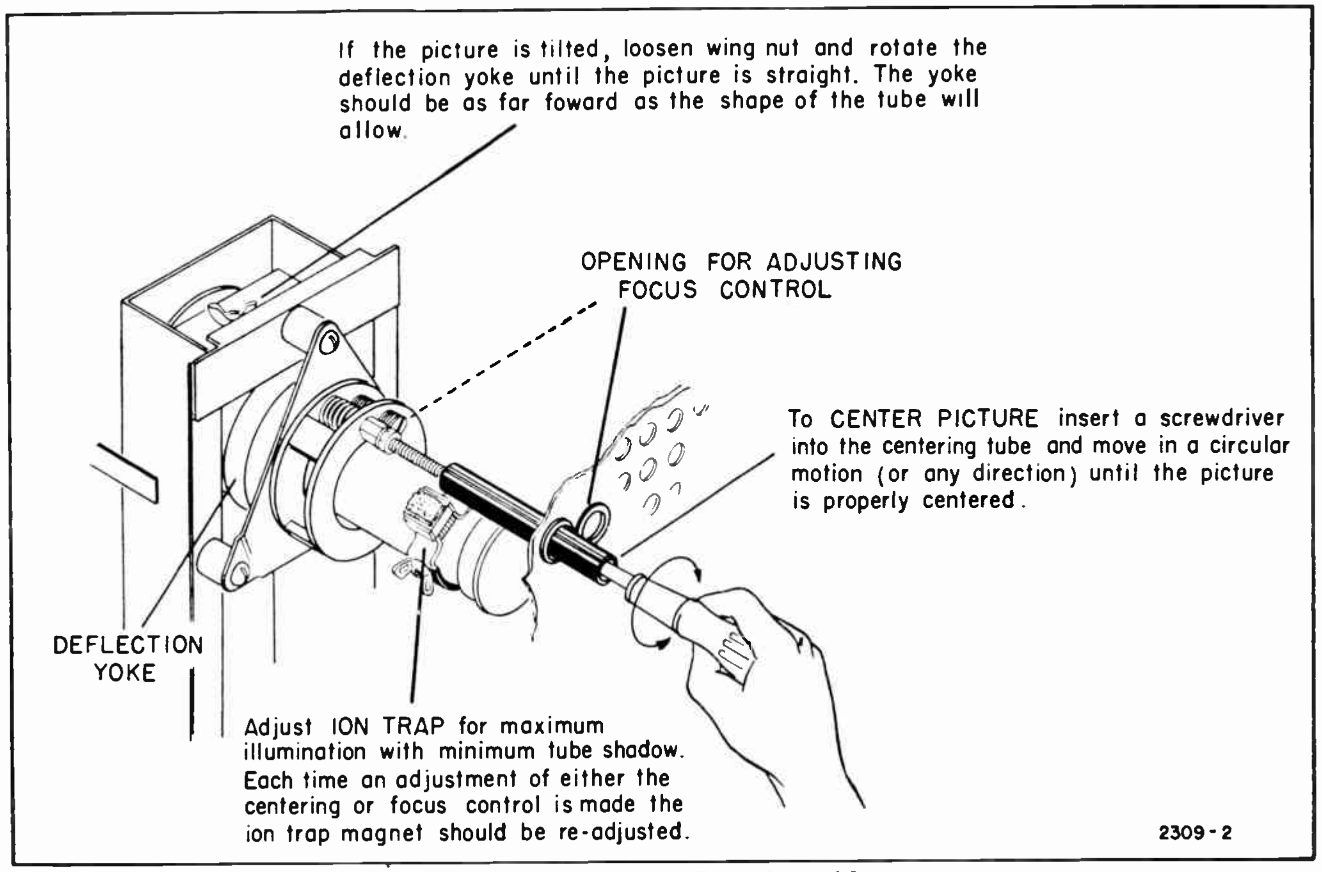

Figure 2. Picture Tube Assembly

TUBE COMPLEMENT

1	6AG5, RF Amplifier
2	6J6, IF Amplifier
3-4-5-6	6AU6, IF Amplifier
7	6AL5, Detector, D.C. Restorer
8	12AT7, Video Amplifier
9	6SN7, Sync Amp.- Sync Sep.
10	6AU6, AGC Amplifier
11	6AU6, Sound IF Amplifier
12	6AV6, Audio Amplifier
13	6K6, Audio Output
14	6SN7, Blocking Osc. Pulse Amp.
15	6AL5, AFC Discriminator
16	6SN7, Horizontal Multivibrator
17	6BG6, Pulse Amplifier
18	6W4, Damper
19	1X2, H. V. Rectifier
20	5U4, L. V. Rectifier
21	6AL5, Audio Detector
22	16" Retangular Picture Tube

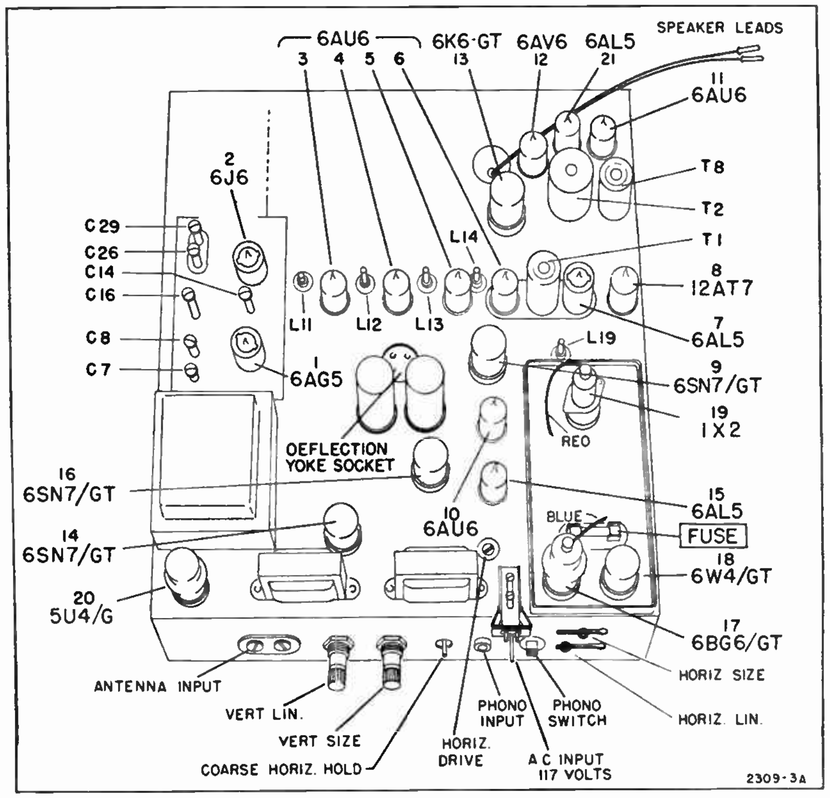

Figure 3. Tube Layout

INSTALLATION

Power Source.

The receiver should be operated from a 115 Volt, 60-Cycle A.C. power source. The power consumption is 235 watts.

Location of Receiver.

The set should be so located in the room that no direct light strikes the face of the picture tube. However, some indirect illumination in the room is desirable; it is not necessary to darken the room completely for proper viewing of the picture. Due consideration should be given also to the convenience of the electric outlet, and to the position of the receiver which gives the best reception with the built-in antenna.

Built-In Antenna.

The new Built-In Television Antenna incorporated in the receiver eliminates the need of an outside antenna in many locations. In areas too distant for normal reception with a built-in antenna, provision is made for outside antenna connections. If any other type of antenna is used with the set, disconnect the transmission line from the built-in antenna to the antenna terminals.

The antenna is mounted inside the cabinet and is operated by the use of a knob at the top of the back of the cabinet. Since the antenna is fastened to the cabinet it may be necessary to orient the cabinet to obtain the best reception. It is desirable that either the front or the back of the cabinet face the transmitting station. If however, "ghosts" or multiple images appear, the cabinet may be rotated slightly to minimize this condition. In some cases it may be necessary to face the back or the front of the cabinet toward a window to obtain a television picture. This may be due to walls, water pipes, or a steel structure in the location preventing television reception.

The antenna tuning knob should be used as a fine tuning control and should be adjusted until the best picture is obtained. In order to eliminate "Body effect" when adjusting the antenna tuning knob, stand in front and reach over the top of the set. If at any time the knob becomes difficult to turn, reverse the direction of rotation. Do not force the knob in either direction.

If the receiver fails to operate satisfactorily with the built-in antenna, check the following trouble:

1. Check the antenna dipole to make sure it is not touching the chassis or any other object.
2. Check the antenna dipole to make sure it is stapled to the side of the cabinet and does not vibrate.
3. Check the connections at the coil, transmission line, and trimmer capacitor.
4. Check to make sure that the antenna terminal screws are moderately tight.

Final Adjustments.

The television receiver has been completely assembled and adjusted for operation before shipment. It is recommended, however, that the adjustments discussed in this section be checked over at the time the set is installed.

While the required adjustments, if any, will probably be slight, the instructions may also be used for receivers which are considerably misadjusted because of replacement parts, etc.

Deflection Yoke.

If the picture seems to be tilted or the edges of the raster are not vertical, loosen the deflection coil adjusting wing nut (located at the top of the picture tube assembly, Figure 2) and using the wing nut as a handle, rotate clockwise or counter-clockwise until the edges of the raster are exactly vertical.

The correct position for the deflection yoke is as far forward on the neck of the picture tube as the shape of the tube will allow. Tube shadow may be the result of an incorrectly positioned deflection yoke.

To correctly position the yoke, loosen the wing nut and push the yoke as far forward as the tube will allow and while keeping the edges of the raster vertical tighten the wing nut.

Ion Trap Magnet.

The initial setting for the Ion trap magnet is over the "L" shape metallic flags inside the glass neck of the picture tube. See figure 2. From this starting position rotate the magnet about the neck of the tube and slide forward and backward until the position that gives maximum illumination with minimum tube shadow is found. This adjustment should be made with the brightness control set at slightly less than ½ its clockwise rotation.

If the ion trap magnet interferes with the centering control, rotate the magnet 180° and readjust for maximum illumination.

Each time an adjustment of either the centering or focus control is made, the ion trap magnet should be readjusted.

Centering.

The receiver may require centering at the time of installation. To recenter the picture follow the centering instructions on page 5.

Other Adjustments.

Refer to the "Service Adjustments" section and touch up each control following the instructions carefully.

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SERVICE ADJUSTMENTS

Station Selector.

The station selector pointer should not rub or scrape against the channel indicator plate, and the knob should not rub against the pointer, otherwise the control may slip between channel 6 and 13. This condition can be corrected either by a fast turn or moving the pointer itself.

Brightness Control (R-46).

The brightness control located behind the front name plate need only be adjusted at the time of installation. The control is adjusted in conjunction with the contrast control. Turn the contrast control fully counter-clockwise. Then turn the brightness control clockwise until the picture tube just becomes dark. The contrast control may then be adjusted for proper picture quality.

H. and V. Hold Controls (R-94 and R-74).

For the best results the H. and V. Hold controls should be adjusted at low contrast levels. After a station has been tuned in, turn the contrast control fully counter-clockwise and then turn the brightness control clockwise until the picture reappears. Adjust the H. Hold control (if necessary) for a steady picture. Adjust the V. Hold control until the picture stops moving up or down. The controls should be set mid-way between positions where the picture is effected.

If you cannot obtain a steady picture at minimum contrast, turn the contrast control slightly clockwise.

After the H. and V. Hold controls have been properly set, they will not have to be used when tuning in a station.

Centering Control.

The centering control is located on the picture tube assembly (figure 2). This control is operated through the opening provided in the cabinet back. The control should be operated in the following manner.

1. Place a screwdriver in the centering tube.
2. Observe the face of the picture tube while making the adjustment.
3. Moving the control to the left will move the entire picture (looking at the face of the picture tube) upward.
4. Moving the control to the right will move the picture downward.
5. Moving the control up will move the picture to the left. Down will move the picture to the right.

V. Size and V. Linearity Controls (R-70 and R-80).

The V. Size and V. Linearity controls should both be adjusted at the same time while a test pattern is being transmitted. The Linearity control effects the upper portion of the picture while the Size control effects the lower portion of the picture. Adjust both the controls simultaneously until the test pattern is symmetrical and fills the entire screen vertically. Readjust the V. Hold control if necessary.

H. Size and H. Linearity Controls (L-24 and L-26).

The H. Size and H. Linearity controls should be adjusted only when a test pattern is being transmitted. The Size control should be adjusted until the test pattern fills the entire screen horizontally, and the Linearity control should be adjusted for a horizontal symmetrical test pattern. The H. Drive control must be readjusted after adjusting either the H. Size or H. Linearity controls.

Coarse and Fine Hold Controls (L-23 and R-94).

The coarse horizontal hold control should be adjusted in the following manner.

Set the Fine H. Hold control to the center of its range.

Set the contrast control to the normal operating position. Adjust the Coarse H. Hold control until there is a steady picture (no horizontal movement).

When the Coarse H. Hold control is adjusted properly, a fast turn of the Fine H. Hold control in either direction (clockwise or counter-clockwise) will make the picture go out of sync (only in low signal areas). Turning the Fine H. Hold control slowly in either direction should not make the picture go out of sync. If the Coarse H. Hold control is not adjusted properly, the horizontal sync will not come in immediately (or not at all) when the tuner is switched from one station to another.

Focus Control.

The permanent magnet focus assembly is essentially a magnet within an assembly so designed as to provide a flexible means of adjusting focus and centering on the face of the picture tube. Do not use a steel screwdriver or any magnetic material when adjusting the focus control. A non-magnetic material should be used, as a magnetic material will increase the flux density of the assembly and a correct adjustment cannot be obtained. This control is located on the picture tube assembly and can be operated through the hole provided in the cabinet back. A long adjusting tool is necessary for the adjustment.

There are two focus screws on the focus magnet assembly. The focus screw on the side is preset at the factory and should be all the way in. Only the top screw should be used for the focus adjustment.

Adjust the focus screw for the best focus. Reset the ion trap magnet and again re-focus the picture. If the focus is best at the edge turn the slug in, if best at center turn the slug out. Turn in or out until the best average focus is obtained and then reset the ion trap magnet.

H. Drive Control.

The H. Drive control is located next to the A.C. input at the rear of the chassis (figure 3). The control requires a small screwdriver for adjustment. The control should be adjusted in the following manner.

1. Tune in a station.
2. Turn the drive control counter-clockwise until a fold-over (white vertical line) appears at the left side of the picture.
3. Turn the drive control clockwise until the fold-over just disappears.
4. Turn the drive control one-half turn clockwise.

SERVICE DATA

SPECIFICATIONS

Sensitivity at the Antenna
Video — 100 microvolts
Audio — 100 microvolts

Power Supply Rating
115 volts, 50-60 cycles, AC, 235 watts.

Audio Output Rating
Undistorted — 3 watts.
Maximum — 4½ watts.

Speaker
Permanent magnet type,
3.2 ohm voice coil impedance.

Antenna Impedance Requirements
Balanced 300-ohm.

Dimensions
Chassis — 16" x 16¼" x 2¾".

R. M. A. WIRE COLOR CODE

Listed below is a R. M. A. wire color code chart to aid in circuit tracing.

Wire Color	Where used
Black	B- or Ground leads
Brown	Filament leads
Red	B+ leads
Orange	Screen leads
Yellow	Cathode leads
Green	Grid or Control leads
Blue	Plate leads
Violet	Not used
Gray	A.C. leads
White	Bias leads

WARNING.

High voltage on all pins of the 1X2 high voltage rectifier and the plate cap of the 6BG6. DO NOT MEASURE this voltage unless a high range voltmeter is used.

Replacing ¼ amp. Fuse.

To check or replace the fuse, first turn off the set. Remove the High Voltage shield cover, short the 6BG6 plate cap to chassis, and remove the 6W4 tube and then take out the fuse. Replace fuse and reverse procedure.

Schematic Diagram.

The schematic diagram located at the rear of the manual shows all the values of resistance and capacitance and gives all the proper voltages at the pins of the tube sockets. The voltage readings were taken with a 20,000 ohm/volt voltmeter with normal operation, no signal input, and line voltage at 117 V. A. C.

Replacing Tubes

Before replacing any tubes the cabinet back must first be removed. Removing the cabinet back disengages the safety interlock and removes the power to the receiver. Do not tamper with or attempt to defeat the purpose of the safety interlock.

Before replacing the High Voltage tubes first be sure the power is turned off and then short the plate caps of the 6BG6 and 1X2 tubes to the chassis.

WARNING: Do not remove any tubes while the receiver is in operation as overloading and component failures may result.

If the receiver has been in operation for some time, the tubes become hot and gloves should be used when replacing tubes to prevent finger burns.

Phono T V Switch.

The phono T V switch is located on the rear flange of the chassis and should be in the "off" position (up) for T V operation. In the "on" position there will be **no** sound or raster, and the audio input plug can be utilized.

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TELEVISION FREQUENCY RANGES

(All figures represent megacycles)

Channel	Channel Frequencies	Picture Carrier Frequency	Sound Carrier Frequency	Receiver RF Oscillator Frequency
Low Band				
2	54-60	55.25	59.75	82
3	60-66	61.25	65.75	88
4	66-72	67.25	71.75	94
5	76-82	77.25	81.75	104
6	82-88	83.25	87.75	110
High Band				
7	174-180	175.25	179.75	202
8	180-186	181.25	185.75	208
9	186-192	187.25	191.75	214
10	192-198	193.25	197.75	220
11	198-204	199.25	203.75	226
12	204-210	205.25	209.75	232
13	210-216	211.25	215.75	238

COIL DC RESISTANCE CHART

The DC resistance readings shown in the chart below have been taken with an ohmmeter directly across the coil being measured. Only a few of the coils were disconnected to obtain a correct reading and these are indicated by an asterisk after the coil reference number. All the coils not listed in the chart have a DC resistance reading of approximately zero ohms.

COILS	RESISTANCE IN OHMS	COILS	RESISTANCE IN OHMS
L3	.8	T1 Pri.	1
L10	10	Sec.	1
L11	.2	T2 term 1 to 2	3.8
L12	.2	term 3 to 4	.1
L13	.2	term 3 to 6	.5
L14	.2	term 4 to 6	.5
L15	.2	T3 Pri.	500
L16	.2	Sec. (speaker out)	.4
L17*	.1	T4 Pri.	650
L18*	.1	Sec. (yoke plug out)	8
L19	1.5	T5A (yoke plug out)	60
L20	13	B (yoke plug out)	11
L21	19	T6 (6BG6 to 1X2)	560
L23	58	(6BG6 to term 1)	60
L24*	.2	(term 5 to 7)	5
L25	35	(term 5 to 6)	9.5
L26 (H. Lin.)	3.5	(term 1 to 2)*	1
L28	35	(term 1 to 3)	4
L30	23	(term 1 to 4)	7
		T7 Pri.	1
		Sec.	65
		T8	1.6
		T9 Pri.	192
		Sec.	1090

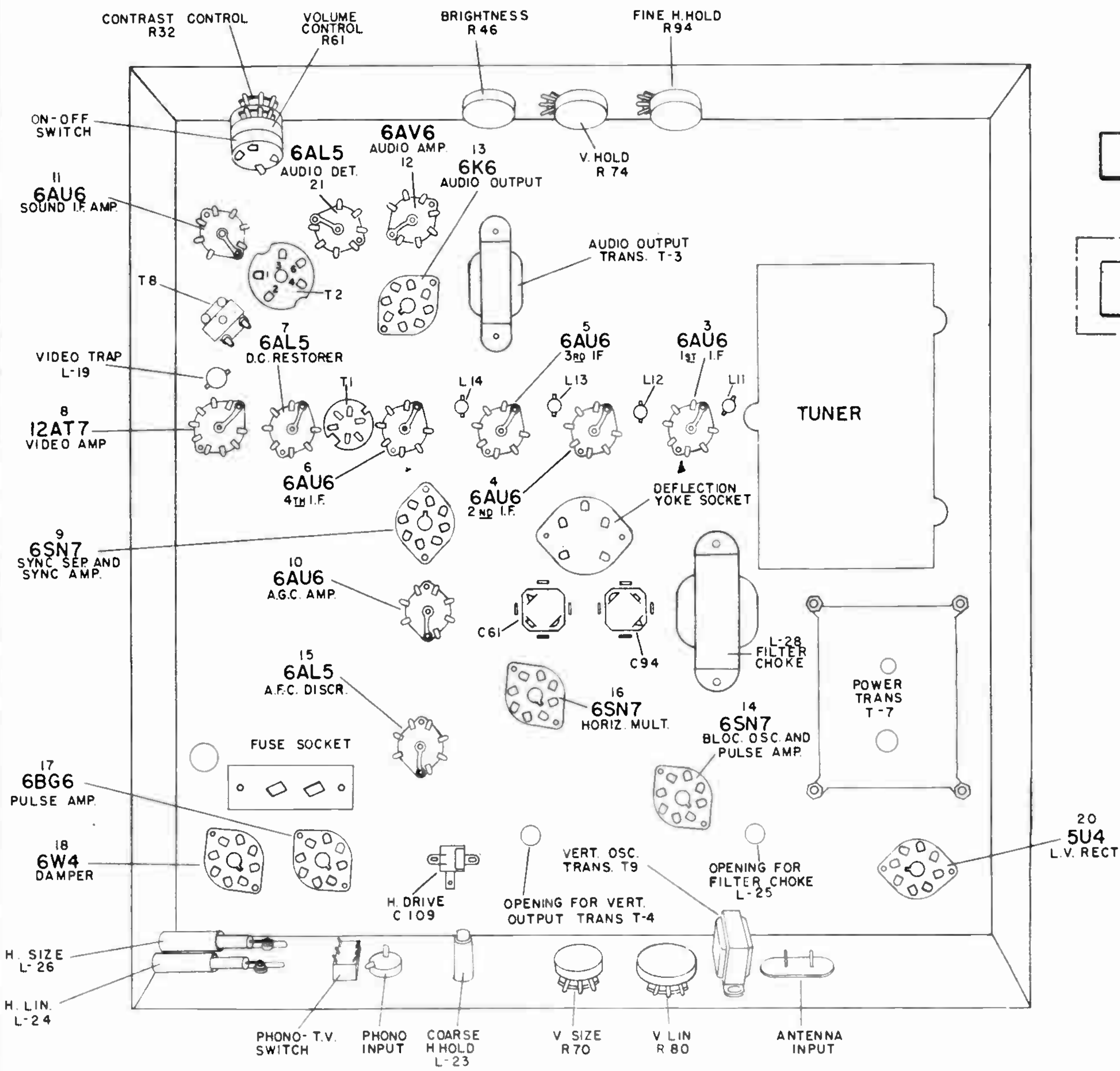

Figure 4. Bottom view of Chassis.

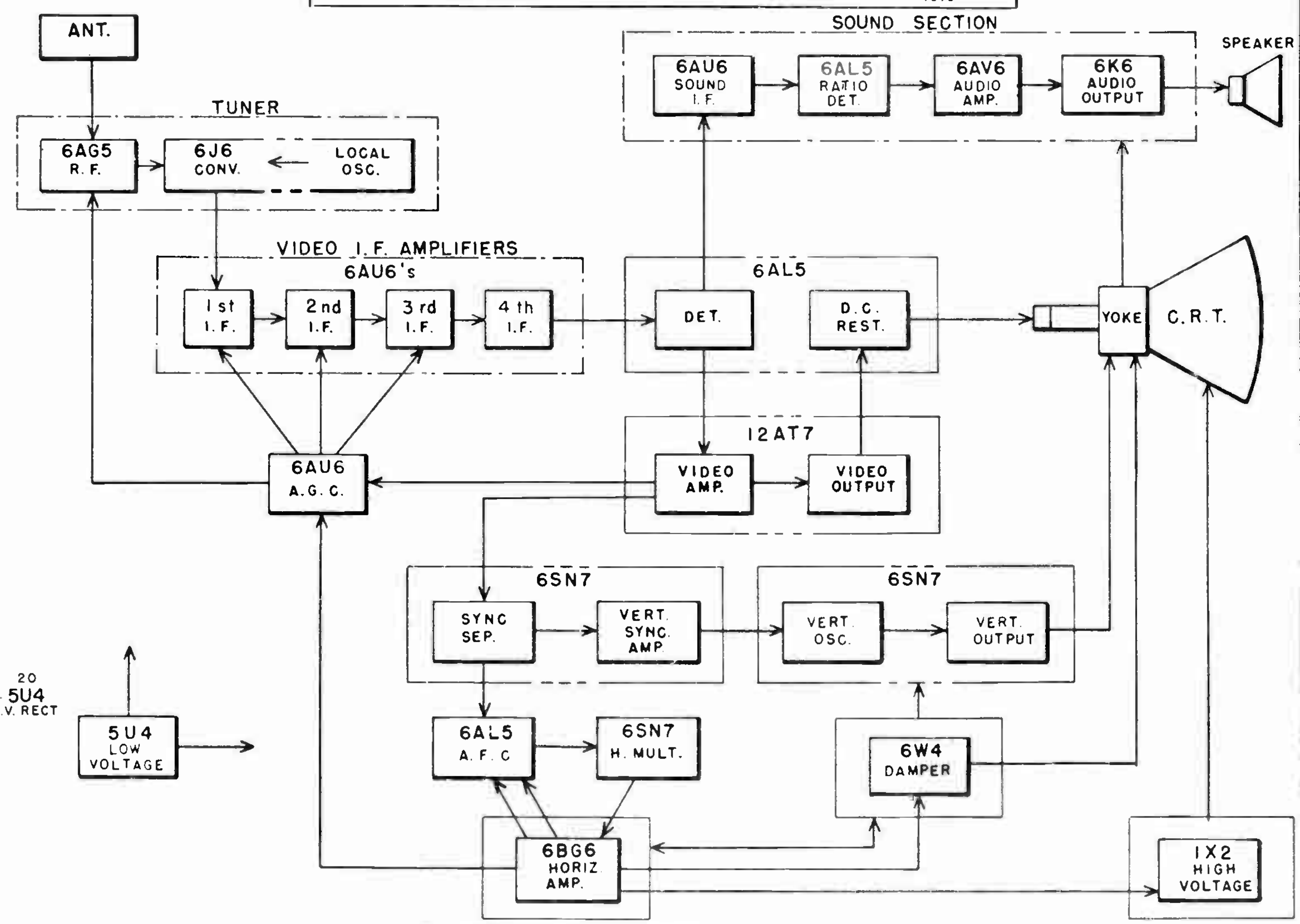

Figure 5. Block Diagram of the Receiver

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GENERAL DESCRIPTION

Tuner.

The tuner is composed of a separate sub-chassis using a 6AG5 (pentode) R.F. Amplifier and a 6J6 tube (twin triode) for the Oscillator and Converter. Separate high and low band coils and trimmers are used with a switching device to change bands. The tuner selects and amplifies the station signal and converts it to the carrier IF frequencies of 26.75 Mc for video and 22.25 Mc for sound which in turn is then fed to the IF amplifiers for further amplification.

Video IF Amplifiers.

The IF Amplifiers, video detector and DC restorer stages are all mounted on a sub-chassis. The IF amplifier section consists of four (4) stagger-tuned stages using 6AU6 (pentode) tubes with self-resonant slug tuned coils. Since the receiver is of the intercarrier type, both the video and sound IF frequencies are amplified simultaneously. The signal is then detected by one half of the 6AL5 (twin diode) and coupled to the video amplifier. The other half of the 6AL5 is used as the DC Restorer.

Sound Section.

The sound section is also mounted on a sub-chassis and consists of a 6AU6 (pentode) IF amplifier, 6AL5 (twin diode) detector, 6AV6 (triode) amplifier and a 6K6 (pentode) output tube. Due to the hetrodyne action between the video and sound IF frequencies a 4.5 mc signal is obtained containing the audio information. After the video detector, the audio information is separated from the video signal by the pick-off coil T8. The signal is then amplified, detected and further amplified by the 6AV6 and the 6K6.

Video Amplifier.

The video section is a conventional two stage amplifier using the 12AT7 (twin triode) tube. The parallel resonant video trap coil (L-19 and C-65) is tuned to 4.5 MC to separate the audio from the video. A combination of shunt and series peaking coils are used with a degenerative contrast control to vary the signal to the grid of the cathode-ray tube.

DC Restorer.

One half of the 6AL5 tube is used as the DC restorer. Since the video is coupled to the grid of the CRT by capacitor C-64 the DC component of video signal will not be passed, therefore the background level of the picture will vary. A bias voltage proportional to the average video signal level will be developed across resistor R-31 and maintain the proper brightness level.

Sync Separator and V. Sync Amplifier.

The sync pulses from the plate of the first video amplifier are coupled to the sync separator tube (½ of 6SN7) thru capacitor C-103. The sync pulses are then separated from the blanking pedestal and due to the low plate voltage sync clipping is accomplished. The horizontal pulses are coupled to the AFC Discriminator thru capacitor C-91 and the vertical pulses are coupled thru capacitor C-121 and amplified by the other half of the 6SN7 before being fed to the intergrating network of the vertical deflection circuit.

Vertical Deflection.

The vertical deflection circuit consists of a 6SN7 (twin triode) tube one half used as a blocking oscillator and the other half as a pulse amplifier. The V. Hold control varies the oscillators operation point thus providing an adustment for synchronization. The V. Size control varies the amplitude of the pulse to the grid of the amplifier and controls the amount of vertical deflection. Thus V. linearity control varies the cathode resistance thus changing the operating characteristics of the amplifier tube to obtain a linear sawtooth pulse. Therefore, it can be seen that the V. Size and V. Linearity controls must be operated in conjunction with one another.

AFC Discriminator.

The automatic frequency control section utilizes a 6AL5 (twin diode) tube. The sync separator feeds the horizontal sync pulses to the AFC tube while at the same time two voltages of opposite polarity are fed back from the horizontal deflection transformer. Any phase shift between the horizontal sync pulses and the horizontal multivibrator signal will cause the input voltage applied to one diode section to differ from that of the other. This results in a DC bias voltage applied to the grid of the multivibrator. The output of the AFC discriminator thus synchronizes the horizontal multivibrator to the horizontal pulse of the video signal. This arrangement improves horizontal stability and offers ease of operation.

Horizontal Multivibrator.

The horizontal multivibrator circuit (6SN7 tube) is of the conventional cathode coupled type using a parallel resonant circuit (L-23 and C-107) as a coarse hold adjustment to control the frequency of oscillation. The fine hold adjustment R-94 varies the grid resistance thus slightly controlling frequency of oscillation. The horizontal sawtooth pulse is then fed to the grid of the pulse amplifier.

Pulse Amplifier.

The horizontal drive control, C-109 in the grid circuit controls the amount of voltage applied to the pulse amplifier. (Increasing the capacity decreases the drive.) The 6BG6 is a beam tetrode used to develop the necessary power for the flyback pulse and the horizontal deflection coil. The Horizontal size coil, L-24 shunts a portion of the horizontal deflection transformer winding. Varying the inductance of the H. size coil varies the high voltage which in turn controls the size of the picture.

Damper.

The damper tubes (6W4) main function is to damp out oscillations which occur over part of the horizontal scanning cycle. The damper tube is connected in such a way as to give an crease in plate supply voltage for the vertical output amplifier. This additional voltage is developed across capacitor C-115 and gives an additional 90 volts increase in plate supply voltage. Varying the inductance of the H. Linearity coil, L-26 changes the damper tubes operating point and thus controls the linearity of the horizontal sweep.

High Voltage Supply.

The high voltage is obtained from the auto-transformer type primary winding of the horizontal output transformer. When the plate current of the pulse amplifier tube is cut off, the field built up in the primary winding collapses and induces a high voltage surge which is rectified by the 1X2 tube, filtered by the aqua-dag coating of the Cathode-ray tube and applied to the second anode.

Automatic Gain Control.

Plate voltage for the 6AU6 (pentode) gated AGC tube is obtained from a separate winding on the horizontal deflection transformer. The plate voltage is thus applied at a horizontal rate while the grid signal is obtained from the output of the first video amplifier. The AGC voltage is developed across resistor R-50 and fed to the first three IF amplifiers. Due to the divider network of R-44 and R51 only a portion of this voltage is fed to the RF amplifier. The AGC voltage will vary considerably according to the strength of the transmitted signal but should be in the vicinity of the voltage across R-37 (detector output).

SERVICE HINTS

Tuner.

If the receiver is "dead" and the picture tube shows nothing but a raster (no snow) first check the I.F. and video amplifier stages before looking into the tuner. If the set is dead and snow appears on the face of the picture tube, first determine whether a signal is being transmitted and then check the antenna or lead-in connections before suspecting the tuner for trouble.

The tuner can easily be serviced by removing the three (3) hex-head screws holding the bottom cover in place. Removing the bottom cover makes all the tuner components within easy reach and all parts can be serviced. When working inside the tuner do not move any component a great distance as a change in the distributed capacity will result and offset the alignment. When replacing components be sure to obtain the same lead lengths and replace the components in the same position.

A majority of tuner troubles are often open and high resistance ground or coil solder connections, defective trimmers or coils and defective contacts.

Open or high resistance connections can easily be repaired by placing a hot soldering iron at the solder connection.

Defective contacts may cause an intermittent condition or the loss of one or both bands. Contact replacement is easily accomplished by following the simple procedure on page 14, figure C.

The tuner should never be removed from the chassis unless contact replacement is necessary.

CAUTION:—If the 6AG5 (RF Amp.) is placed in the 6J6 (osc.-con.) socket resistors R-9 and R-10 will burn up.

Speaker Leads.

To insure minimum video interference, dress the speaker leads away from the 6AL5 (detector tube 7) as shown in figure 3, on page 3.

A.G.C.

A defective AGC system will not effect the sound but over-load the video amplifier circuit and the result will be a loss of both horizontal and vertical sync and very weak video. This condition can easily be noticed and checked by measuring the AGC voltage and the voltage across resistor R-37. Under normal operating conditions these two voltages will be approximately the same. A defective AGC system will cause a large increase in voltage across R-37 and a decrease in AGC voltage.

To determine the cause for trouble check the 6AU6 tube, capacitors C-70 and C-59 and resistors R-44, R-50, R-51 and R-107. To check the AGC winding of the horizontal deflection transformer, place a scope on pin 5 of AGC tube and a horizontal pulse similar to wave shape number 20, on page 13, should be obtained with a peak-to-peak voltage of 400 volts.

CORRESPONDING CATHODE-RAY TUBES

Due to the fact that 16RP4 and 16TP4 Cathode-Ray tubes from various suppliers are not directly interchangeable, different focus or ion trap magnets must be used. A B.R.C. part number sticker will be pasted on the tubes coating in 16AY210 chassis. When replacement is necessary be sure to state the B.R.C. part number of the picture tube. This is necessary as a supplier may manufacture two of the same RMA tube types which will differ in construction.

Listed below is a chart showing the various 16-inch rectangular tubes used in the 16AY210 chassis.

SUPPLIER	BRC NUMBER	FOCUS MAGNET	ION TRAP MAGNET
Raytheon	C-55W-19341	A-55P-19336	B-16M-19337
Sylvania	" 19344	" 19336	" 19343
Martin	" 19345	" 18915	" 18623
Raytheon	" 19362	" 19336	" 18623
Martin	" 19362	" 19336	" 18623
Thomas	" 19426	" 18915	" 19343
Arcturus	" 19345	" 18915	" 18623

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TROUBLE-SHOOTING

Trouble	Probable Location
No Raster No Sound	1. Phono TV switch defective or in "ON" position. 2. Defective 5U4 tube (20). 3. Defective power transformer (T-7). 4. Defective filter choke (L-25 or L-28). 5. Defective filter condenser (C-61 or C-94) 6. Defective fuse.
No Raster Sound Normal	1. High voltage lead disconnected. 2. Ion trap magnet incorrectly positioned. 3. Yoke plug not in place or loose. 4. Insufficient or no high voltage, (refer to "No high voltage section"). 5. Defective resistors R46-47-48-100 and capacitor C-67. 6. Defective picture tube.
No Picture No Sound Raster Normal	1. Defective antenna or lead-in. 2. Defective tubes 1 through 7, or associated circuits. 3. Improper voltages or resistances at sockets of tubes 1 through 7. 4. Improper alignment.
No Sound Picture Normal	1 Defective tubes 11, 12, 13, and 21 or associated circuits. 2. Improper voltages or resistances at sockets of tubes 11, 12, 13 and 21. 3. Speaker leads broken or not in place. 4. Improper alignment of transformer T2, T8 (see page 14).
No Picture Raster Normal Sound Normal	1. Defective tubes 7, 8, 10. 2. Improper voltages or resistances at sockets of tubes 7, 8, 10. 3. Defective capacitors C-64-70, and L-20-21-30.
No Sync	1. Defective tubes 8, 9, 10. 2. Defective capacitors C-103, 121 and resistors R-45, 114.
No Vertical Sync Picture otherwise normal	1. Defective capacitors C-71, C-90, C-95. 2. Defective tube 9. 3. Defective resistors R-73, R-77, R-88.
No Horiz. Sync Picture otherwise normal	1. Defective tubes 15, 16. 2. Defective resistors R-81-82-83-84-85-86-87, and capacitors C-91-98-99-100-101-102-105-125. 3. Defective Horizontal transformer T-6.
No Vertical Sweep	1. Defective tube 14. 2. Defective transformers T-9, T-4, T-5A. 3. Defective capacitors C-92, 95, 116 and resistors R-75, 78.
Picture cannot be Centered	1. Defective ion trap magnet. 2. Defective focus magnet. 3. Defective picture tube. 4. Defective capacitor C-114.
Picture cannot be Focused	1. Focus magnet not properly located or centered on the picture tube neck. 2. Ion trap magnet not properly adjusted or defective. 3. Defective picture tube. 4. Improper high voltage.
No High Voltage	1. Defective tubes 16, 17, 18, 19. 2. Defective transformer T-6, yoke T-5B. 3. Defective capacitors C-108, 112, 113, 114 or resistors R-90 through R-98 and R-112-118-119-120.
Bunching or folding at side of Picture	1. Improper adjustment of horizontal drive control C-109. 2. Defective tubes 17, 18. 3. Defective C-115 or H. Linearity coil.
Audio in Picture	1. Improper alignment and ratio of video carrier to sound response (see page 14).
Snow or poor Signal	1. Improper adjustment of antenna tuning knob (see page 6). 2. Cabinet (built-in antenna) not properly oriented. 3. Check alignment of C-1 and C-2 (see page 15). 4. Insufficient signal input. 5. Defective capacitors C-59, C-62 or peaking coil L-21.

WAVE FORM ANALYSIS

The drawings in this section illustrate the wave shapes at various positions within the set. These wave shapes are not theoretical but exact copies of the oscilloscope wave shapes taken with a transmitted signal.

The peak-to-peak voltage indicated was measured by a calibrated oscilloscope under typical operating conditions.

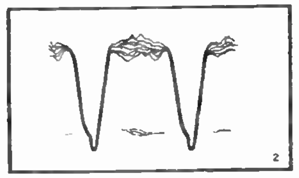
When analyzing a particular wave shape, the peak-to-peak voltage may vary somewhat depending upon the setting of the contrast control and the strength of the signal. The wave shapes may vary somewhat in video section depending on the picture being transmitted.

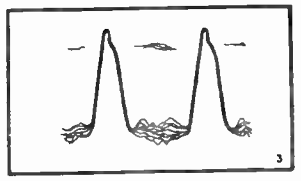
When checking these wave shapes connect the ground lead from the oscilloscope to the chassis and the hot lead to the position shown in the chart.

The chart below lists the test point, peak-to-peak voltage and the corresponding wave shape number. Under each drawing is the type of wave shape referring either to a Horizontal (15,750 cycles) or Vertical pulse (60 cycles).

Test Point	Taken At	Peak-to-peak Voltage	Wave Form Number
1	Pin 7 of Tube 7	8	1 and 2
2	Pin 7 of Tube 8	8	1 and 2
3	Pin 6 of Tube 8	42	3 and 4
4	Pin 2 of Tube 8	12	3 and 5
5	Pin 1 of Tube 8	32	1 and 2
6	Pin 4 of Tube 9	26	3 and 5
7	Pin 5 of Tube 9	11	6
8	Pin 1 of Tube 9	11	6
9	Pin 2 of Tube 9	40	7
10	Pin 5 of Tube 10	410	20
11	Junction of R77 and C90	13	8
12	Junction of C90 and C95	27	9
13	Pin 1 of Tube 14	40	10
14	Pin 2 of Tube 14	76	11
15	Pin 4 of Tube 14	28	12
16	Pin 5 of Tube 14	650	13
17	Pin 5 of Yoke Socket	42	13
18	Pin 1 of Tube 15	8	14
19	Pin 2 of Tube 15	7	22
20	Pin 7 of Tube 15	11	21
21	Pin 4 of Tube 16	1	15
22	Pin 5 of Tube 16	48	16
23	Pin 1 of Tube 16	32	17
24	Pin 2 of Tube 16	45	18
25	Pin 5 of Tube 17	50	18
26	Pin 5 of Tube 18	1500	19


1. Vertical Pulse


2. Horizontal Pulse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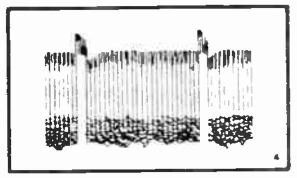
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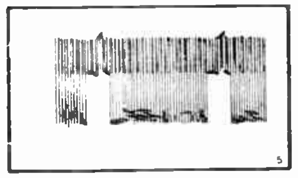
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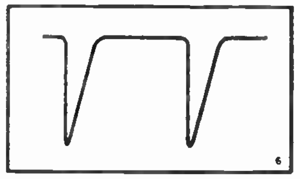
6. Horizontal Pulse

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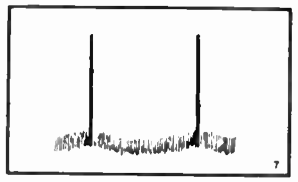
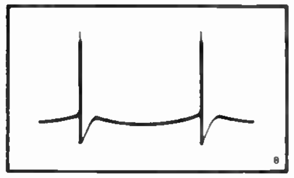
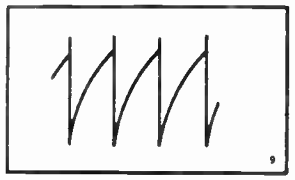
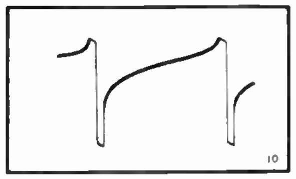
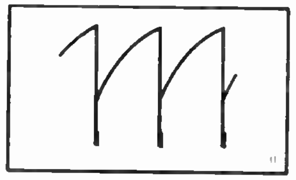
WAVE FORMS

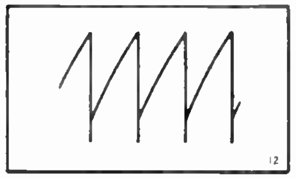

7. Vertical Pulse

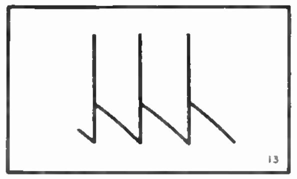

8. Vertical Pulse

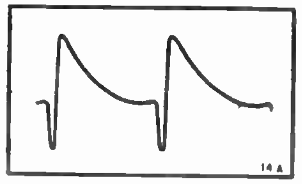

9. Vertical Pulse

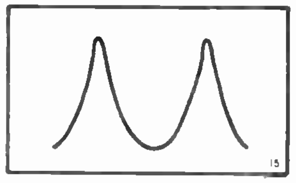

10. Vertical Pulse

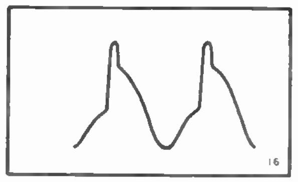

11. Vertical Pulse

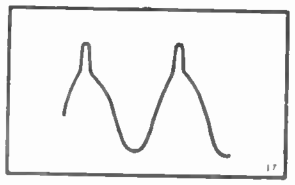

12. Vertical Pulse

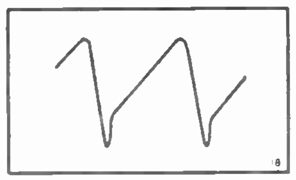

13. Vertical Pulse


14. Horizontal Pulse


15. Horizontal Pulse


16. Horizontal Pulse


17. Horizontal Pulse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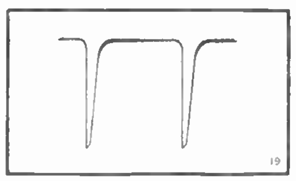
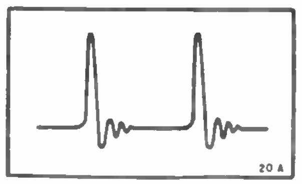
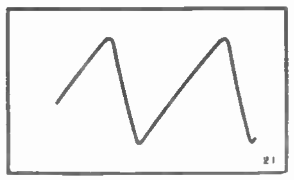
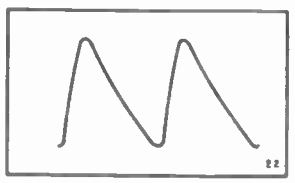
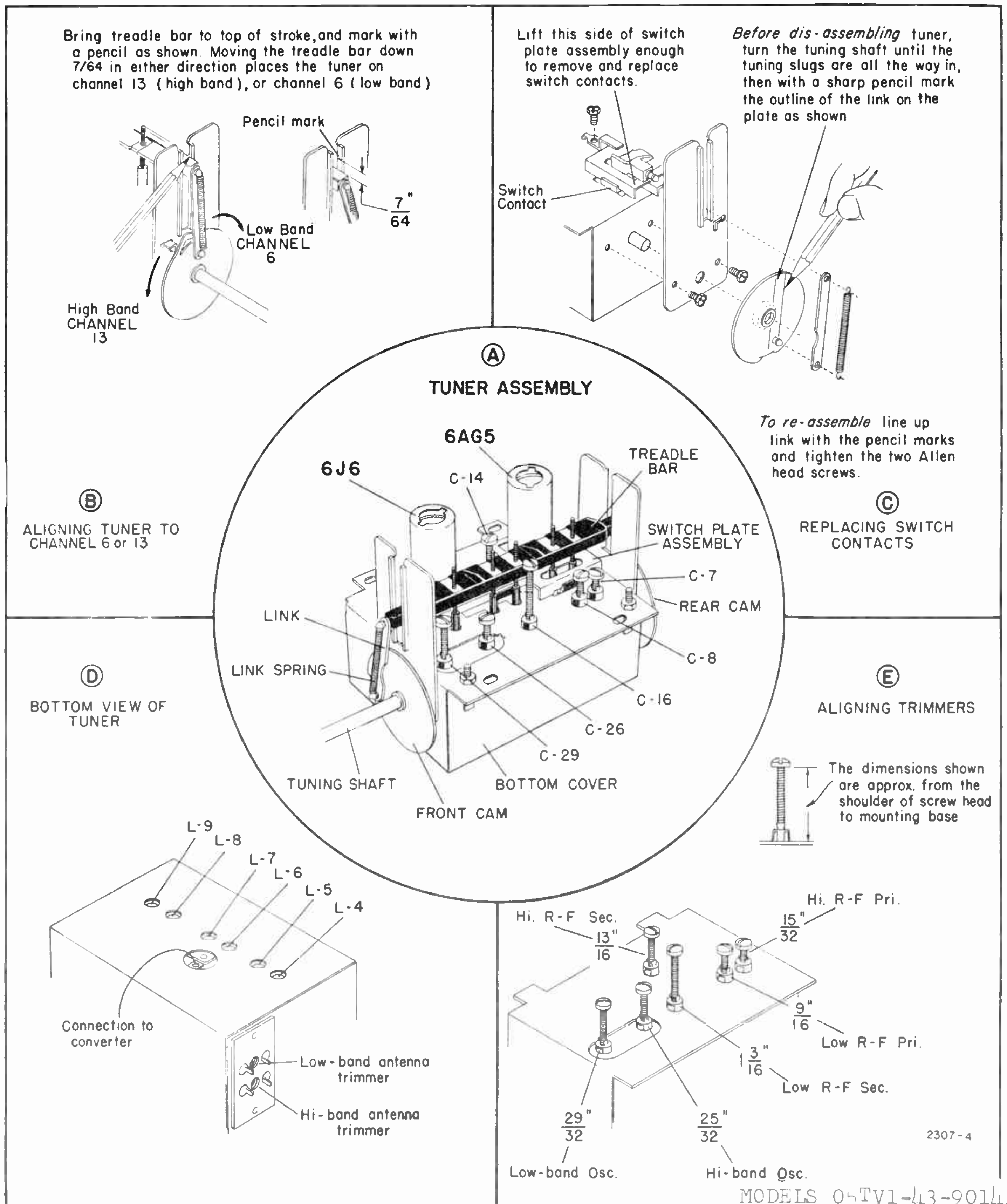

19. Horizontal Pulse


20. Horizontal Pulse


21. Horizontal Pulse


22. Horizontal Pulse



MODELS 05TV1-43-9014A, 15RA2-43-9105A, Ch. 16AY210

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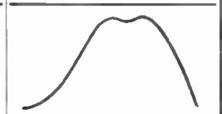
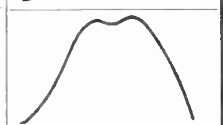
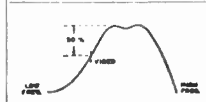
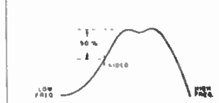
TUNER ALIGNMENT

1. Preset trimmer screws C7, 8, 14, 16, 26, 29 to dimensions shown on page 14, figure E.
2. Preset coil cores L4, 5, 6, 7, 8, 9 in the following manner.
   (a) In low band position, turn tuner shaft to top of stroke as on page 14, figure B.
   (b) The switch will be in low band position.
   (c) Adjust coil cores 1.6" from core to coil mounting strip. (Use core aligning tool if available).
   (d) Turn L-9 core (low band oscillator) an additional four (4) turns out of coil.

LOW BAND TRACKING

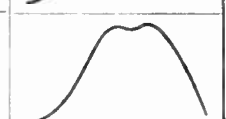
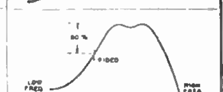
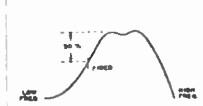
Turn tuner to channel 6. See page 12, figure B.

Step No.	Signal Generator Freq. (mc.)	Sweep Generator Freq. (mc.)	Signal Input Point	Output Point	Adjust	Remarks	Response
1	——	Channel 6	Antenna Terminals	Scope across R-37	C-2	Adjust for maximum response with symmetrical peaks	
2	——	Channel 6	Antenna Terminals	Scope across R-37	C-8 C-16	Adjust for maximum response with symmetrical peaks	
3	83.25	Channel 6	Antenna Terminals	Scope across R-37	C-29	Adjust until marker is 50% down on low frequency slope. Repeat step 2 if necessary.	
4	(a) 61.25 (b) 67.25 (c) 77.25 (d) 55.25	(a) Channel 3 (b) Channel 4 (c) Channel 5 (d) Channel 2	Antenna Terminals	Scope across R-37	C-8 C-16	Adjust tuner until response curve appears on scope. Adjust trimmers for compromise which will give the best overall response across band.	

NOTE: If trimmer C-8 reaches maximum and additional capacity is needed, turn L-5 core, into coil.

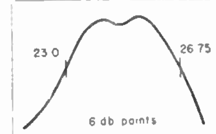
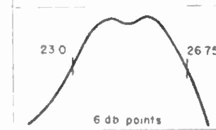
HIGH BAND TRACKING

Turn tuner to channel 13. See page 12, figure B.

1	——	Channel 13	Antenna Terminals	Scope across R-37	C-1	Adjust for maximum response with symmetrical peaks	
2	——	Channel 13	Antenna Terminals	Scope across R-37	C-7 C-14	Adjust for maximum response with symmetrical peaks	
3	211.25	Channel 13	Antenna Terminals	Scope across R-37	C-26	Adjust until marker is 50% down on low frequency slope. Repeat step 2 if necessary.	
4	(a) 205.25 (b) 199.25 (c) 193.25 (d) 187.25 (e) 181.25 (f) 175.25	(a) Channel 12 (b) Channel 11 (c) Channel 10 (d) Channel 9 (e) Channel 8 (f) Channel 7	Antenna Terminals	Scope across R-37	C-7 C-14	Adjust tuner until response curve appear on scope. Adjust trimmers for compromise which will give the best overall response across band.	

VIDEO I F ALIGNMENT

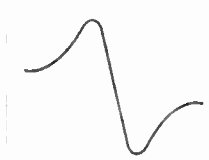
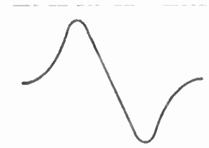
Turn to any high band channel. Connect the generator thru a 1000 mmf capacitor and set the contrast control to maximum.

Step No.	Signal Generator Freq. (mc.)	Sweep Generator Freq. (mc.)	Signal Input Point	Output Point	Adjust	Remarks	Response
1	26.4	——	Converter Grid	VTVM across R-37	L-11 L-13	Adjust generator output approx. 1 volt	Maximum Reading
2	23.4	——	Converter Grid	VTVM across R-37	L-12 L-14	Adjust generator output approx. 1 volt	Maximum Reading
3	25.0	——	Converter Grid	VTVM across R-37	T-1	Adjust generator output approx. 1 volt	Maximum Reading
4	25.0	——	Converter Grid	VTVM across R-37	——	SENSITIVITY Generator output should be less than 100 microvolts. (If not, repeat alignment).	1 volt VTVM Reading
5	26.75 23.0	25.0	Converter Grid	Scope across R-37	——	SELECTIVITY Markers should be as shown in response column. (If not, repeat alignment).	
6	——	Channels 2-4-6-8-10-12	Antenna Terminal	Scope across R-37	T-1 for flat response	Check channels for band width (3.5 to 4 mc. at 6db points).	

Picture I.F. frequency 26.75 mc — Sound I.F. frequency 22.25 mc.

SOUND I-F ALIGNMENT

Short antenna to ground and connect generator thru a 1000 mmf capacitor.

1	4.5	——	Pin 1 of Tube 11	VTVM junction of R-53 and C-77	T-8 and T-2 primary (bottom of can)	——	Maximum Reading
2	——	4.5	Pin 1 of Tube 11	Scope junction of R-58 and C-77	T-2 secondary (top of can)	Sweep approx. 100 kc. Adjust for max linearity	
3	——	4.5	Pin 1 of Tube 11	Scope junction of R-58 and C-77	T-2 primary (bottom of can)	Sweep approx. 100 kc. Adjust for symmetry of peaks	
4	4.5	——	Pin 1 of Tube 11	VTVM junction of R-58 and C-77	——	Generator output should be less than .01 volt	.05 watt output

Video trap Coil (L-19) Adjustment.

(a) Tune in a station.
(b) Adjust the tuner until sound bars just appear.
(c) Turn L-19 slug all the way out (counter-clockwise).
(d) Turn the slug in (clockwise) until the horizontal scanning lines are smooth and continuous.

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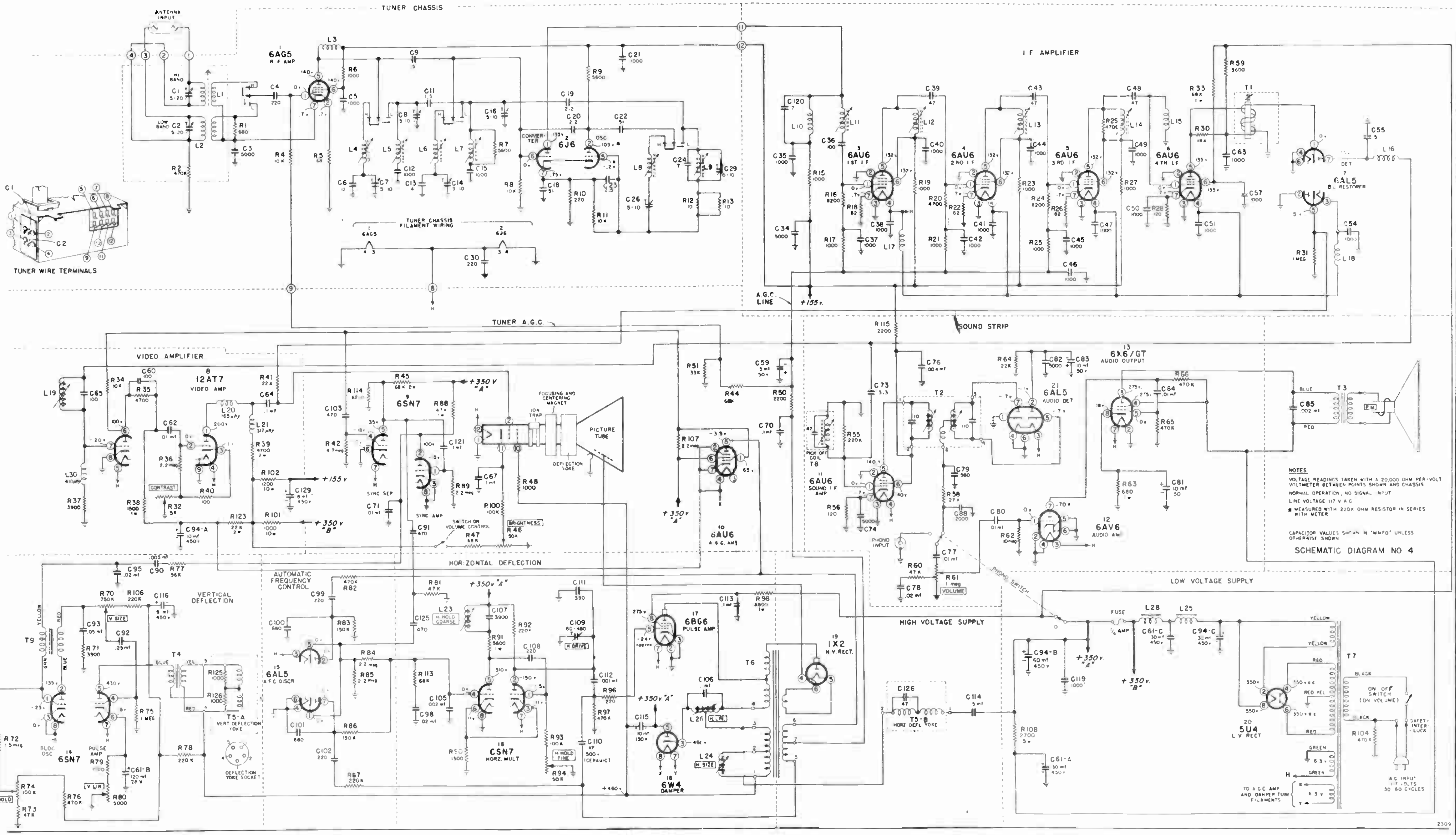
World Radio History



NOTE: Resistor R98 should be 4700 ohms, 1 watt.

16AY210 SCHEMATIC DIAGRAM

MODELS 05TV1-13-001A, 15RA2-13-9105A, Ch. 16AY210

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World Radio History

REPLACEMENT PARTS LIST

TUNER

Capacitors

Ref. No.	Part No.	Description
C3	A-8G-13962	Ceramic, .005 mfd
C4-30	C-8G-16045	Ceramic, 220 mmf, 20%
C5-12-15-21	C-8G-13201	Ceramic, 1000 mmf
C6	C-8G-17305	Ceramic, 12 mmf, 10%
C7-8-14-16-26-29	B-201-15142	Trimmer capacitor (5-10 mmf)
C9	A-8G-12495-7	Ceramic, .5 mmf
C11	A-8G-12495-4	Ceramic, 1.5 mmf
C13	C-8G-11893	Ceramic, 4 mmf, ± 1/4 mmf
C18-22	A-8G-11891	Ceramic, 51 mmf, 5%
C19-20	A-8G-12495-4	Ceramic, 2.2 mmf
C23	C-8G-15737	Ceramic, 2.5 mmf 20%
C24	C-8G-15224	Ceramic, 7 mmf, ± 1/2 mmf

Resistors

Ref. No.	Part No.	Description
R1	C-9B1-60	680 ohms, 1/2 watt, 10%
R4-8-11	C-9B1-74	10K ohms, 1/2 watt, 10%
R5	C-9B1-48	68 ohms, 1/2 watt, 10%
R6	C-9B1-13	1000 ohms, 1/2 watt, 20%
R7-9	C-9B1-71	5600 ohms, 1/2 watt, 10%
R10	C-9B1-54	220 ohms, 1/2 watt, 10%
R12-13	C-9B1-38	10 ohms, 1/2 watt, 10%

Chokes, Transformers, Coils

Ref. No.	Part No.	Description
L1-2 (incl. C1-2, R2)	B-201-17143	Antenna transformer assembly
L3	A-16A-17128	R.F. choke
L4-6-8	B-13E-17140	High band coils, Osc., RF pri., RF sec.
L5-7	B-13E-12046	Low band coils, RF pri., RF sec.
L-9	B-13D-12155	Low band coil, oscillator

Miscellaneous

Ref. No.	Part No.	Description
	A-51A-15715	Iron core, for L5
	A-51A-17162	Iron core, for L6
	A-51A-17161	Iron core, for L7
	A-51A-15713	Iron core, for L4-8-9
	A-15C-10717	Tube socket, 7-prong, miniature
	A-2M-16276	Core mounting clip
	A-2H-11494	Tube shield
	B-200-18825	Shaft assembly
	B-5M-18807	Treadle bar
	A-200-18824	Rear switch plate assembly
	A-49A-18799	Link spring
	A-2H-12337	Tube shield base
	A-7M-15510-1	Coil alignment strip
	A-2J-16310	Sliding contact
	A-5F-16311	Contact holder
	B-200-18840	Switch lever assembly
	C-2E-15486-1	Bottom cover

VIDEO I-F STRIP ASSEMBLY

Capacitors

Ref. No.	Part No.	Description
C34	A-8G-13962	.005 mfd, disc type
C35-37-38-40-41-42-44-45-46-47-49-50-51-54-57-63	C-8G-13201	1000 mmf, ceramic
C36	C-8F3-8	100 mmf, mica
C39-43-48	C-8F3-109	47 mmf, mica
C55	C-8G-12166	5 mmf, ceramic
C120	C-8G-11790	7 mmf, ceramic

Resistors

Ref. No.	Part No.	Description
R15-17-19-21-23-25-27	C-9B1-13	1000 ohms, 1/2 watt, 10%
R16-24	C-9B1-73	8200 ohms, 1/2 watt, 10%
R18-22-26	C-9B1-49	82 ohms, 1/2 watt, 10%
R20-29	C-9B1-70	4700 ohms, 1/2 watt, 10%
R28	C-9B1-51	120 ohms, 1/2 watt, 10%
R30	C-9B1-77	18K ohms, 1/2 watt, 10%
R31	C-9B1-98	1 megohm, 1/2 watt, 10%
R33	C-9B2-84	68K ohms, 1 watt, 10%
R40	C-9B1-50	100 ohms, 1/2 watt, 10%
R41	C-9B1-78	22K ohms, 1/2 watt, 10%
R59	C-9B1-71	5600 ohms, 1/2 watt, 10%

Chokes, Transformers, Coils

Ref. No.	Part No.	Description
T1	B-13B-18784	Output IF coil
L10	A-16A-18025	Plate choke coil
L11	A-13M-18026	Converter coil
	A-51A-17966	Iron core (for above)
L12-13-14	B-201-15612	Stagger tuned coil
	A-51A-17966	Iron core (for above)
L15	A-201-15608	Choke coil assembly
L17	A-201-15609	Filament choke
L18	A-16A-17937	RF choke

Miscellaneous

Ref. No.	Part No.	Description
	A-15C-16007	7-pin, miniature tube socket
	B-43D-17860	Coil tube fastener
	A-2H-10974	Tube shield

AUDIO STRIP ASSEMBLY

Capacitors

Ref. No.	Part No.	Description
C73	A-8G-12495-5	3.3 mmf, ceramic
C74-82	A-8G-13962	.005 mfd, ceramic disk
C76	C-8D-17958	.004 mmf x 400 volts
C79	C-8F3-122	560 mmf ± 20%
C80	C-8D-17258	.01 mfd x 200 volts
C81-83	A-8C-17183	10 mmf x 50 volts
C84	C-8D-17270	.01 mfd x 400 volts
C85	C-8D-10789	.002 mfd x 600 volts
C88	C-8G-16049	2000 mmf, ceramic

Resistors

Ref. No.	Part No.	Description
R55-66	C-9B1-90	220K ohms, 1/2 watt, 10%
R56	C-9B1-51	120 ohms, 1/2 watt, 10%
R58	C-9B1-79	27K ohms, 1/2 watt, 10%
R60	C-9B1-82	47K ohms, 1/2 watt, 10%
R62	C-9B1-37	10 megohms, 1/2 watt, 20%
R63	C-9B2-60	680 ohms, 1 watt, 10%
R64	C-9B1-78	22K ohms, 1/2 watt, 10%
R65-66	C-9B1-29	470K ohms, 1/2 watt, 20%
R115	C-9B1-66	2200 ohms, 1/2 watt, 10%

Miscellaneous

Ref. No.	Part No.	Description
T2	B-13M-19257	Ratio detector coil
T8	B-13A-18783	Pick-off coil
	A-15C-16007	7-pin, miniature tube socket
	A-15B-10440	Octal tube socket

HIGH VOLTAGE POWER SUPPLY

Ref. No.	Part No.	Description
T6	C-12M-19407-1	H. V. Deflection transformer
	A-5M-18733	Standoff insulator
	A-62D-18734	Hi-Voltage ring
	B-29G-3217	Vellutex washers
	A-15C-18735	1X2 tube socket
	B-14C-19133	H. V. lead assembly
	A-2M-18193	Power supply clamp
	C-2B-19184	Shield can
	A-46B-18033	1/4 ampere, 250 volt fuse
	A-55F-18024	Fuse mounting
	B-2M-11382	Cable clamp

MAIN CHASSIS

Capacitors

Ref. No.	Part No.	Description
C59	B-8C-19424	5 mfd x 50 volts
C60	C-8F3-111	100 mmf, mica
C61-A-B-C	A-8C-18487	30-30 mfd x 450 volts, 120 mfd x 25 volts
C62	C-8D-17270	.01 mfd x 400 volts
C64-113	C-8D-10983	.1 mfd x 600 volts
C67	C-8D-10760	.1 mfd x 400 volts
C70-121	C-8D-17259	.1 mfd x 200 volts
C71	C-8D-10761	.01 mfd x 400 volts
C77	C-8D-17258	.01 mfd x 200 volts
C78-98	C-8D-17268	.02 mfd x 200 volts
C90	C-8D-10935	.005 mfd x 600 volts
C91-103-125	C-8F3-121	470 mmf, mica
C92	C-8D-13439	.25 mfd x 400 volts
C93	C-8D-14461	.05 mfd x 400 volts
C94-A-B-C	A-8C-17845	10-30-60 mfd x 450 volts
C95	C-8D-10774	.02 mfd x 400 volts
C99-102-108	C-8F3-117	220 mmf, mica
C100-101	C-8F3-123	680 mmf, mica
C105	C-8D-10778	.002 mmf x 600 volts
C106	C-8D-10771	.1 mfd x 200 volts
C107	C-8F11-132	3900 mmf, mica
C111	C-8F3-120	390 mmf x 500 volts, mica
C112	C-8D-12020	.001 mfd x 600 volts
C114	C-8D-11270	.5 mfd x 200 volts
C115	A-8C-11495	10 mfd x 150 volts
C116-129	A-8C-13453	8 mfd x 450 volts
C119	C-8F6-125	1000 mmf, mica
C126-110	C-8G-12198	47 mmf

Resistors

Ref. No.	Part No.	Description
R34	C-9B1-74	10K ohms, 1/2 watts, 10%
R35	C-9B1-70	4700 ohms, 1/2 watt, 10%
R36-84-85-89-107	C-9B1-102	2.2 megohms, 1/2 watt 10%
R38	C-9B2-64	1500 ohms, 1 watt, 10%
R39	C-9B4-70	4700 ohms, 2 watts, 10%
R42	C-9B1-106	4.7 megohms, 1/2 watt, 10%
R44-47-113	C-9B1-84	68K ohms, 1/2 watt, 10%
R45	C-9B4-84	68K ohms, 2 watts, 10%
R48-79-125-126	C-9B1-62	1000 ohms, 1/2 watt, 10%
R50	C-9B1-66	2200 ohms, 1/2 watt, 10%
R51	C-9B1-80	33K ohms, 1/2 watt, 10%
R71-37	C-9B1-69	3900 ohms, 1/2 watt, 10%
R72	C-9B1-100	1.5 megohms, 1/2 watt, 10%
R73-81	C-9B1-82	47K ohms, 1/2 watt, 10%
R75	C-9B1-98	1 megohm, 1/2 watt, 10%
R76-82-97-104	C-9B1-94	470K ohms, 1/2 watt, 10%
R77	C-9B1-83	56K ohms, 1/2 watt, 10%
R78-87-92-106	C-9B1-90	220K ohms, 1/2 watt, 10%
R88	C-9B2-82	47K ohms, 1 watt, 10%
R83-86	C-9B1-88	150K ohms, 1/2 watt, 10%
R90	C-9B1-64	1500 ohms, 1/2 watt, 10%
R91	C-9B2-71	5600 ohms, 1 watt, 10%
R93-100	C-9B1-86	100K ohms, 1/2 watt, 10%
R96	C-9B1-54	220 ohms, 1/2 watt, 10%
R98	C-9B2-72	6800 ohms, 1 watt, 10%
R101	C-9C14-1099	1000 ohms, 10 watts, 10%
R102	C-9C14-1100	1200 ohms, 10 watts, 10%
R108	C-9C12-1104	2700 ohms, 5 watts, 10%
R114	C-9B1-73	8200 ohms, 1/2 watt, 10%
R123	C-9B4-21	22K ohms, 2 watts, 20%

Chokes, Transformers, Coils

Ref. No.	Part No.	Description
T3	B-12C-18743	Audio output transformer
T4	B-12C-19048	Vertical output transformer
T5A-B	B-13M-18888	Deflection yoke
T7	C-12A-18839	Power transformer
T9	B-12M-18241	Vertical oscillator transformer
L16	A-16A-17961	Peaking coil
L19 (incl. C65)	A-201-19363	Video trap and coil assembly
	A-51A-17966	Iron core for above
L20-21	A-16A-18685	Peaking coil
L25-28	B-16A-17959	Filter choke

Controls

Ref. No.	Part No.	Description
C109	A-8E-18508	H. Drive (80-480 mmf trimmer)
L23	A-13D-19355	Coarse H. Hold coil
L24	A-13M-18233	H. Size coil
L26	A-13M-19320	H. Linearity coil
R32-61	A-10A-18441	Dual control and switch Contrast (5K ohms); Volume (1 megohm)
R46-94	A-10B-17764	Brightness and H. Hold control, 5K ohms
R70	A-10B-18240	V. Size control, 750K ohms
R74	A-10B-17275	V. Hold control, 100K ohms
R80	A-10B-17766	V. Linearity control, 5K ohms

Miscellaneous

Ref. No.	Part No.	Description
	A-2M-19325	Tube clamp
	A-19B-11044	Phono receptacle
	A-19A-12465	Phono plug
	A-20F-12108	Phono TV switch
	A-2D-19159	R. H. tube bracket
	A-2D-19157	L. H. tube bracket
	A-25B-18536	Rubber bumper
	A-2M-18808	Tube strap
	A-2M-18790	Tube strap
	A-2D-18542	Tube strap bracket
	A-25M-16992	Rubber strap
	C-2D-18775	Deflection coil mounting bracket
	A-25H-18363	Tube gasket
	A-38A-18283-1	Anode retainer
	B-2M-11382	Cable clamp (H. V.)
	B-2D-17237	Deflection coil support bracket
	A-23M-16744	Wing nut, 8-32x7/16 (yoke)
	A-15C-17983	9-pin, tube socket
	A-15C-16007	7-pin, tube socket
	A-15B-10440	Octal tube socket
	B-15B-14274	Yoke socket
	A-19A-14275	Yoke plug
	B-15B-17278	C.R.T. socket and cable assembly
	A-7B-13050	Antenna terminal board
	B-43D-17860	Coil tube fastener
	A-51A-17966	Iron core for L-19
	A-51A-16945	Iron core for L23-24-26
	A-49A-19012	Springs for L-24-26
	A-3M-18885	Centering tube
	B-29J-18887	Rubber washer
	A-3M-18274	Groove pin
	B-55A-18896	Vinyl tubing
	N-201-18386	Inside antenna assembly
	A-8E-18360	Adjustable trimmer
	A-3A-18380	Trimmer shaft
	A-13M-18359	Matching coil
	C-13E-18514	Antenna dipole
	A-3C-18496	Stud
	A-2D-19390	Reinforcing bracket
	B-55P-19336	Focus magnet
	B-55P-18915	Focus magnet
	B-16M-19337	Ion trap magnet
	B-16M-19343	Ion trap magnet
	B-16M-18623	Ion trap magnet

CABINET PARTS (05TV1-43-9014A)

Part No.	Description
R-24D-18960	Cabinet
C-2M-18944	Escutcheon
D-2M-18943	Escutcheon mask
C-30M-18966	Picture glass
B-2M-18768-2	Channel indicator plate
B-2M-17068-2	Contrast off volume plate
C-18A-18745	6" PM speaker
A-5B-18781-76	Tuner knob
B-5B-17761-76	Off-on volume knob
B-5B-17762-76	Contrast knob
B-5B-18244-76	Knob (3 used)
C-23J-18998	Cabinet back
B-14M-17758	Line cord and plugs
N-43E-15569	Wing nut (6-32)
N-201-18386	T.V. inside antenna assembly
A-2G-18788	Pointer

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World Radio History

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05TV2-43-9010A

05TV2-43-8950A

ELECTRICAL SPECIFICATIONS

Power Supply	105-125 Volts AC 60 cycles only
Power Consumption	12½" Tube Receivers—220 watts 16" Tube Receivers — 250 watts
Power Output	2.4 watts Maximum 1.8 watts Undistorted
Antenna Input Impedance	300 Ohms Balanced
Picture Area (12½" Tube)	90 Sq. In.
Picture Area (16" Tube)	144 Sq. In.
Tuning Range	12 Channel
Intermediate Frequencies	Picture—26.20 MC Sound—21.70 MC
Loud Speaker (Console)	12" PM Dynamic
Loud Speaker (Mantel)	6" PM Dynamic
Voice Coil Impedance	3.2 Ohms 400 Cycles

TUBE COMPLEMENT

Symbol	Type	Function
	6J6	R-F Osc. & Mixer
	6AG5 or	R-F Amplifier
	6AK5	R-F Amplifier
V1	6BA6	1st Sound I-F
V2	6AU6	Sound Limiter
V3	6AL5	Sound Discriminator
V4	6AV6	1st Audio
V5	6K6-GT	Audio Output
V6	6AG5	1st Pix I-F Amp.
V7	6AG5	2nd Pix I-F Amp.
V8	6AG5	3rd Pix I-F Amp.
V9A-9B	6AL5	Picture Det. and D. C. Restorer
V10 A & B	12AT7	1st Video Amp. and 1st Sync Amp.
V11 A & B	12AU7	Video Output and Sync Separator
V12	6AU6	Automatic Gain Control
*V13 A & B	6SN7-GT	Phase Splitter & Vert. Osc
V13 A & B	6SN7-GT	Sync Output & Vert. Osc.
V14	6K6-GT	Vertical Output
V15	1B3-GT	High Voltage Rectifier
V16	5U4-GT	Low Voltage Rectifier
*V17	6SN7-GT	Horizontal Osc.
V17	6SN7-GT	Horizontal Osc. & Sync Guide
*V18	6BQ6-GT	Horizontal Output
V18	6BG6	Horizontal Output
V19	6W4-GT	Damper
V20	12LP4A	Picture Tube 12½"
*V20	16EP4	Picture Tube 16"
*V21	6BQ6-GT	Horizontal Output
*V22	6AL5	Horizontal Phase Disc.
*V23	5Y3-GT	Low Voltage Rectifier

*Tubes not used in 12½" Picture Tube Receivers.

RADIO FREQUENCY RANGES

Channel Number	Channel Frequency Mc	Picture Carrier Frequency Mc	Sound Carrier Frequency Mc	Receiver R-F Osc. Frequency Mc
2	54-60	55.25	59.75	81.45
3	60-66	61.25	65.75	87.45
4	66-72	67.25	71.75	93.45
5	76-82	77.25	81.75	103.45
6	82-88	83.25	87.75	109.45
7	174-180	175.25	179.75	201.45
8	180-186	181.25	185.75	207.45
9	186-192	187.25	191.75	213.45
10	192-198	193.25	197.75	219.45
11	198-204	199.25	203.75	225.45
12	204-210	205.25	209.75	231.45
13	210-216	211.25	215.75	237.45

RECEIVER LOCATION—Advise the owner as to the proper location for the television receiver. The following may be used as a guide:

1. Choose an area in the home where sunlight or light from lamps does not strike the face of the picture tube and cause glare.
2. Remember the necessity of an electrical outlet and the location of the point at which the antenna leads enter the room.
3. The receiver should be placed a short distance from the wall to allow adequate ventilation.
4. The receiver should be placed to permit easy access for operation and comfortable viewing from all angles.

ANTENNA—This receiver has been designed to use an antenna with a 300 ohm balanced transmission line. This line must be as short as possible because the longer the line the greater the chances are for picking up electrical disturbances. Stand-off insulation should be used to keep the line away from the mast, metal or walls. Twist this line about one turn per foot throughout the line to cancel out direct signal and/or noise pickup by the transmission line. It should also be securely anchored in place so that a change in weather will not affect its position.

HIGH VOLTAGE WARNING

This television receiver contains high voltages which are dangerous to life. Never operate or service the receiver outside of the cabinet or with the covers removed until all the safety precautions necessary for working with high voltage equipment have been observed.

PICTURE TUBE HANDLING PRECAUTION

Shatterproof goggles and heavy gloves must be worn by individuals while handling the picture tube or installing the picture tube into the receiver.

The picture tube encloses a high vacuum and due to the large surface area, is subjected to excessive air pressure. Therefore, care should be taken not to bump or scratch the picture tube accidentally as it may cause the tube to implode resulting in damage to property or injury to an individual.

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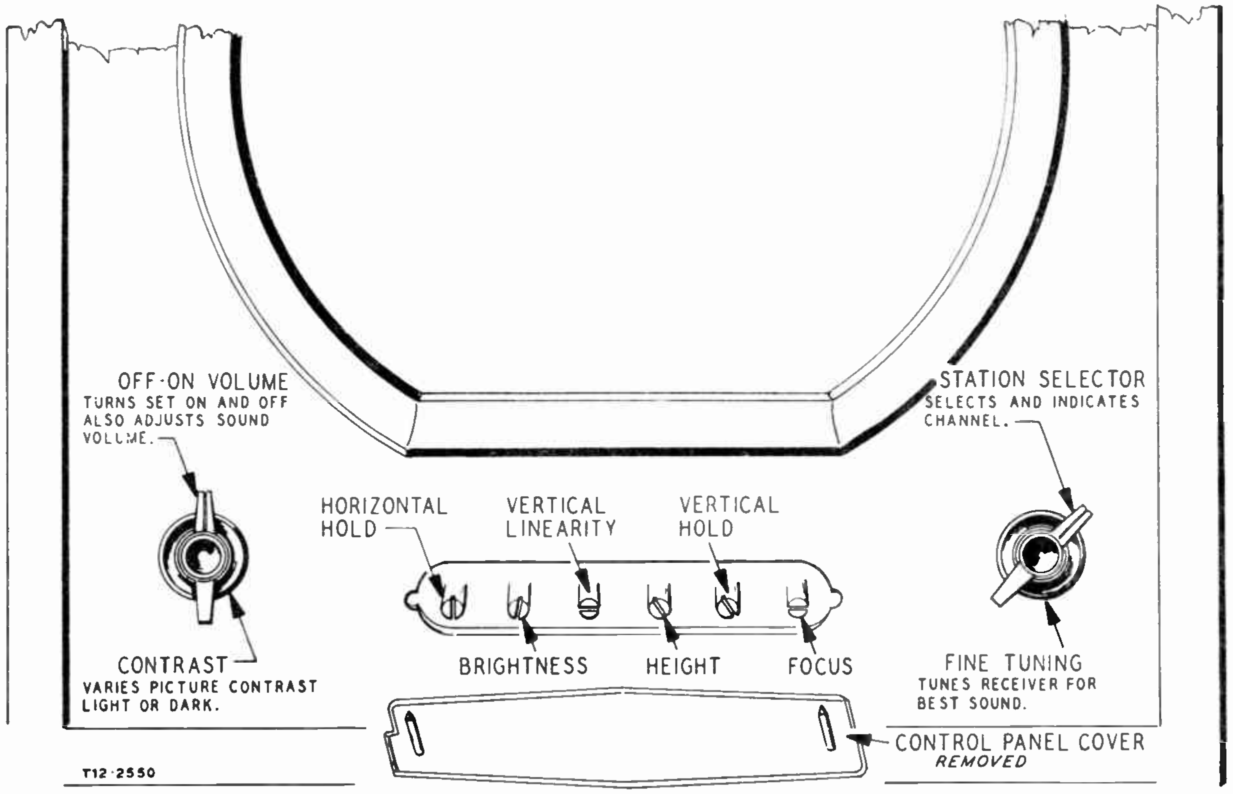

Fig. 2—Front Panel Controls

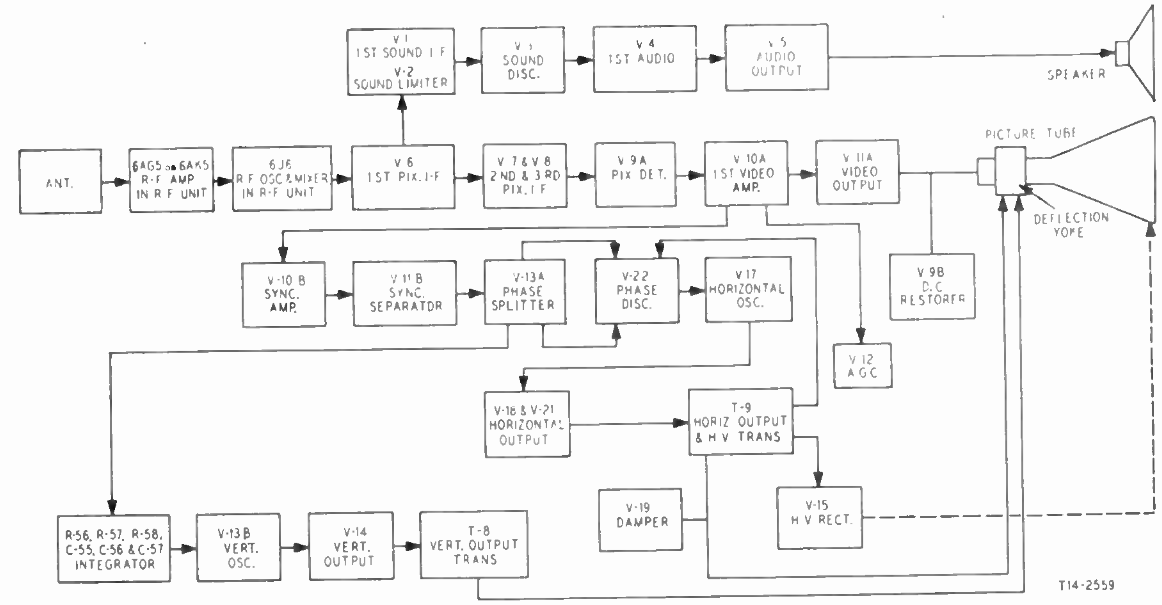

Fig. 3—Block Diagram (16" Pix Tube Receivers)

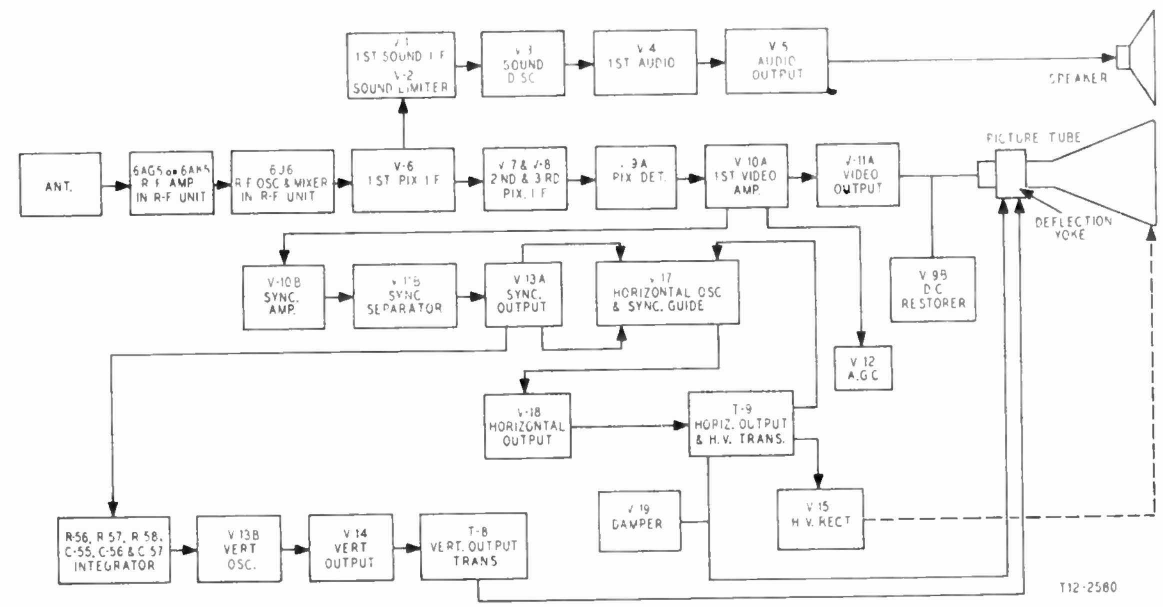

Fig. 4—Block Diagram (12½" Pix Tube Receivers)

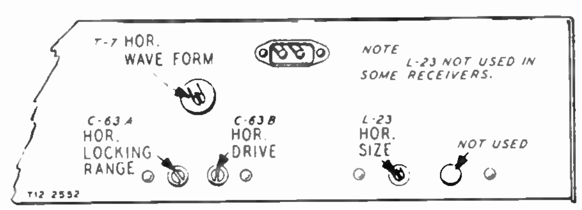

Fig. 5—Rear Chassis Adjustments (12½" Pix Tube Receivers)

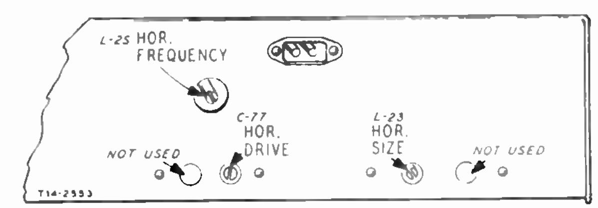

Fig. 6—Rear Chassis Adjustments (16" Pix Tube Receivers)

TUNING PROCEDURE

1. To turn the television receiver on, turn the OFF-ON SOUND CONTROL clockwise until a click is heard. Allow approximately 30 seconds for the tubes to warm up.
2. Turn the STATION SELECTOR CONTROL to the desired channel. This control may be turned in either direction.
3. Turn the CONTRAST CONTROL clockwise until activity or definite form is noted on the screen.
4. Adjust the FINE TUNING CONTROL for best tonal quality and the SOUND CONTROL for desired volume.
5. After the receiver has been on for a while it may be necessary to readjust the FINE TUNING CONTROL for best sound quality.
6. To turn off the receiver, turn only the OFF-ON SOUND CONTROL counterclockwise until a click is heard.

OCCASIONAL ADJUSTMENTS TO IMPROVE PICTURE RECEPTION

There are six controls at the front of the chassis. These controls are accessible after the removal of the control panel cover at the front of the cabinet. (See illustration) The controls are pre-set at the factory and may occasionally need adjustment due to aging of the components in the receiver and the fluctuating line voltages in different areas.

If any adjustments are necessary, follow the instructions under "Controls and Functions."

IMPORTANT—Be sure that the fine tuning control has been set for best tonal quality and clearest picture before adjusting any controls.

CONTROLS AND FUNCTIONS

HORIZONTAL HOLD—Stops horizontal movement (diagonal bars.)
BRIGHTNESS—Adjusts for desired picture brilliance.
VERTICAL LINEARITY—Adjusts picture symmetry, top to bottom.
HEIGHT—Adjusts picture to fit mask vertically.
VERTICAL HOLD—Stops upward or downward picture movement.
FOCUS—Adjusts picture sharpness and clarity.

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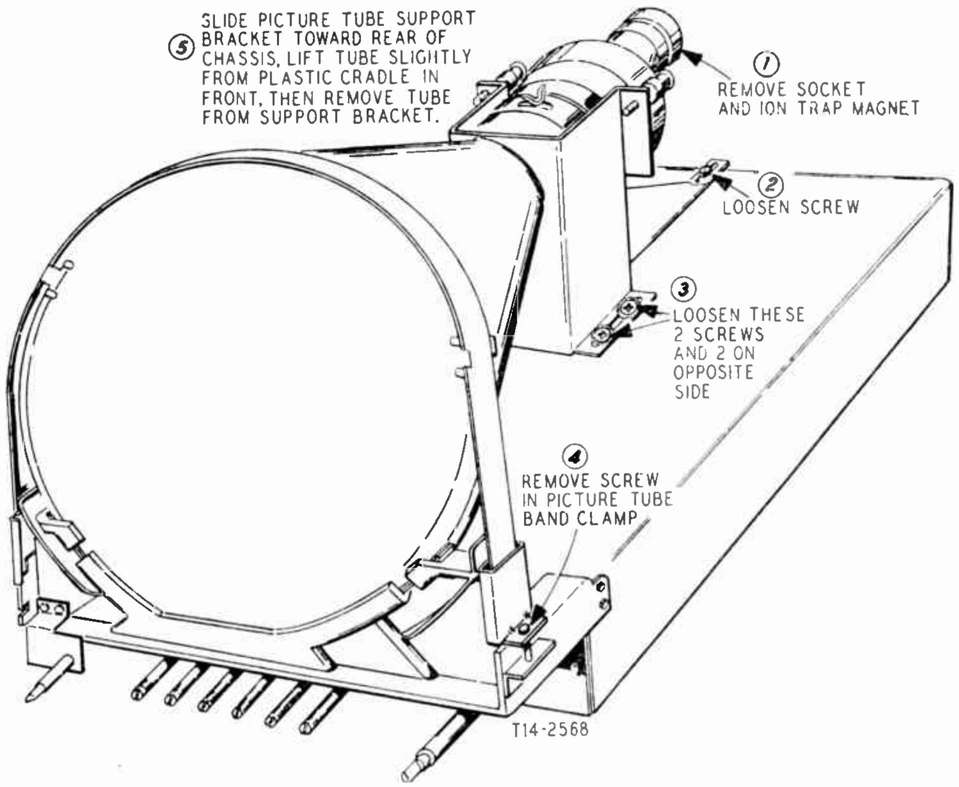

Fig. 7—Removal of Picture Tube

PICTURE TUBE — All receivers are shipped with the picture tube in place. However, to prevent picture tube breakage in 16" pix tube receivers the three focus coil mounting screws were drawn up tight. To place the receiver in operation the following must be performed:

1. Remove the interlocked cabinet back. Make sure that all the tubes are firmly seated in their respective sockets and note the location of the focus coil mounting screws. Back out the focus coil mounting screws until there is approximately a 3/8 inch space between the focus coil and the deflection yoke. Replace the cabinet back.

2. Connect the receiver to a power outlet and turn the receiver on. Turn the channel selector knob to a channel that you know is operating.

3. Observe the picture and adjust the three focus coil mounting screws (through the openings in the cabinet back with a screwdriver which has a seven inch blade) until proper horizontal and vertical centering is obtained.

WARNING — If a screwdriver with a blade longer than seven inches is used, it may accidentally touch a portion of the receiver that carries a high potential.

4. If adjustments are necessary on the deflection yoke or the ion trap magnet, follow the procedures on page 20.

PICTURE TUBE REPLACEMENT — To replace the picture tube it is necessary to remove the chassis from the cabinet. This may be accomplished in the following manner:

1. Remove the front panel control knobs by pulling them straight from their shafts.

2. Remove the cabinet back. You will note that the interlocked line cord disconnects the power when the cabinet back is removed.

3. Disconnect the leads to the speaker, remove the antenna terminal board at rear of cabinet, remove the five chassis mounting bolts and pull the chassis CAREFULLY out of the cabinet.

WARNING — Before handling the picture tube, it will be necessary to remove the static charge. In receiv rs with glass picture tubes, ground the anode lead to chassis, and insert an insulated wire from the well in the tube to chassis. In receivers with metal picture tubes, remove the static charge by grounding an insulated wire from the chassis to the metal portion of the tube.

4. Remove the picture tube as shown and outlined in the illustration. To install a new picture tube, reverse the procedure making sure that the picture tube is fitted closely against the picture tube cushion. If the picture tube sticks or fails to slip into place smoothly, investigate and remove the source of the trouble. Never force the tube. It is important that all the clips and shims used in mounting the tube be replaced, otherwise difficulty may be encountered when horizontal or vertical centering is required.

ION TRAP MAGNET ADJUSTMENT — The ion trap magnet should be positioned exactly as shown in Figure 8. Adjust the magnet by moving it back and forth and at the same time rotating it slightly around the neck of the picture tube until the brightest raster is obtained on the picture screen. Reduce the brightness control setting until the raster is slightly above average brilliance. Adjust the Focus Control R-81 (see Figure 2) until the line structure of the raster is clearly visible. Readjust the ion trap magnet for maximum raster brilliance.

DEFLECTION YOKE ADJUSTMENT — If the lines of the raster are not horizontal or squared with the picture mask, rotate the deflection yoke until this condition is obtained. Tighten the yoke adjustment wing screw.

FOCUS COIL ADJUSTMENT — If horizontal or vertical centering is required, adjust the three focus coil mounting screws until proper centering is obtained. See Fig. 8.

PICTURE ADJUSTMENT — For further adjustments, obtain a test pattern on the receiver. Turn on receiver and follow tuning procedure on page18. When a test pattern is obtained it may be necessary to slightly re-adjust the focus control for maximum picture detail.

12½" PIX RECEIVER ADJUSTMENTS

CHECK OF HORIZONTAL OSCILLATOR ALIGNMENT — Turn the horizontal hold control to the extreme counter-clockwise position. The picture should remain in horizontal sync. Momentarily remove the signal by switching off channel and then back. Normally the picture will be out of sync. Turn the control clockwise slowly. The number of diagonal bars will be gradually reduced and when only 3-1/2 to 4-1/2 bars sloping downward to the left are obtained, the picture will pull into sync upon slight additional clockwise rotation of the control. The pull-in should occur when the control is approximately 90 degrees from the extreme counter-clockwise position. The picture should remain in sync for approximately 90 degrees of additional clockwise rotation of the control.

At the extreme clockwise position the picture should be just starting to pull out of sync. Usually one vertical bar will be seen.

If the receiver passes the above checks and the picture is normal and stable, the horizontal oscillator is properly aligned.

ALIGNMENT OF HORIZONTAL OSCILLATOR — If in the above check the receiver failed to hold sync with the hold control at the extreme counter-clockwise position or failed to hold sync for at least 60 degrees of clockwise rotation of the control from the pull in point, it will be necessary to make the following adjustments.

NON-OPERATING CONTROLS
REAR OF CHASSIS

Focus Coil .... } Focus Coil
Horizontal Centering .... } Screw
Vertical Centering .... } Adjustments

Ion Trap Magnet .... Wing Nut Adjustment

Deflection Yoke .... Wing Screw

Horizontal Size L-23

Horizontal Locking Range (12½" Picture Tube) .. C-63A
Horizontal Drive .... Receivers) .. C-63B

Horizontal Drive (16" Picture Tube Receivers) C-77

Horizontal Wave Form (12½" Picture Tube Receivers)
Back of Chassis T-7

Horizontal Frequency (16" Picture Tube Receivers) ... L-25

Horizontal Frequency (12½" Picture Tube Receivers)
Inside Chassis T-7

FRONT OF CHASSIS

(Accessible After The Removal of Front Panel Control Cover)

Horizontal Hold R-110

Brightness R-54

Vertical Linearity R-87

Height R-63

Vertical Hold R-60

Focus R-81

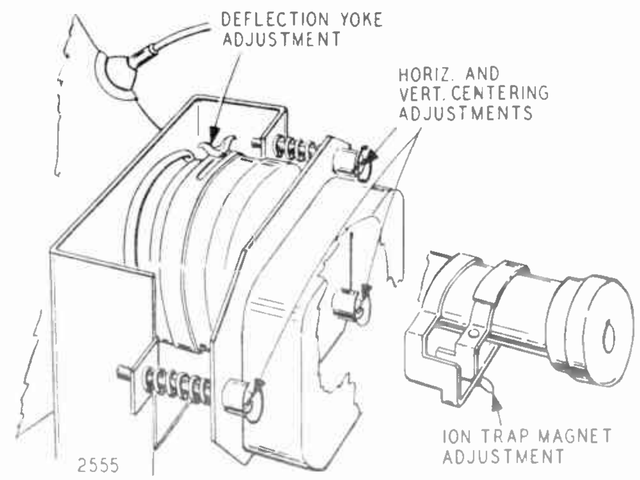

Fig 8- Ion Trap, Focus and Yoke Adjustments.

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HORIZONTAL FREQUENCY ADJUSTMENT — Turn the horizontal hold control to the extreme clockwise position. Tune in a station and adjust the horizontal frequency control (T-7-See Fig. 17) until the picture is just out of sync and shows one vertical bar. In order to obtain this condition it may be necessary to slightly re-adjust the horizontal locking range trimmer (C-63A) on the rear apron.

HORIZONTAL WAVE FORM ADJUSTMENT — This is a factory adjustment and it should not be necessary to re-adjust unless the setting has been disturbed. However, if it is found that re-adjustment is required, follow this procedure: With the picture in sync, connect an oscilloscope through about a 10 mmf isolation condenser to Terminal C of T-7. Adjust the horizontal wave form (T-7 See Fig. 5) until the two peaks of the wave form shown in Fig. 9 are equal. NOTE: Picture must be in sync during this adjustment.

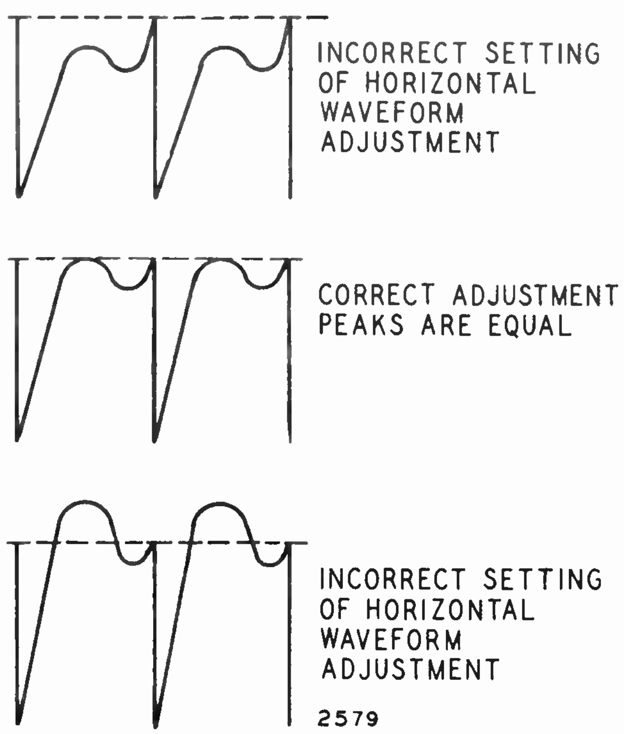

Fig. 9—Horizontal Wave Form Adjustment

HORIZONTAL LOCKING RANGE ADJUSTMENT — Set the horizontal hold control to the extreme counter-clockwise position. Momentarily remove the signal by switching off channel and then back. Slowly turn the horizontal hold control clockwise and note the least number of diagonal bars obtained just before the picture pulls into sync. If more than 4-1/2 bars are present just before the picture pulls into sync, adjust the horizontal locking range trimmer C-63A (See Figure 5) slightly clockwise. If less than 3-1/2 bars are present, adjust trimmer C-63A slightly counter-clockwise. Turn the horizontal hold control counter-clockwise, momentarily remove the signal and recheck the number of bars present at the pull-in point. Repeat this procedure until 3-1/2 to 4-1/2 bars are present. Repeat the adjustments under "Horizontal Frequency Adjustment" and "Horizontal Locking Range Adjustment" until the condition specified under each are fulfilled. When the horizontal hold operates as outlined under "Check of Horizontal Oscillator Alignment" the oscillator is properly adjusted.

16" PIX RECEIVER ADJUSTMENTS

CHECK OF HORIZONTAL OSCILLATOR ALIGNMENT —Tune in a station and adjust the horizontal hold control until the picture falls into sync. Momentarily remove the signal by switching off channel and then back. The picture should pull into sync over a range of 90° rotation of the horizontal hold control. If in the above check the receiver fails to hold sync or the pull-in range is at the extreme end of the control, and is less than 60°, it will be necessary to make the following adjustment.

HORIZONTAL FREQUENCY ADJUSTMENT - With the horizontal hold control set to the center of its range of rotation, adjust the horizontal frequency control (L-25) until the picture pulls into sync. Recheck the "Horizontal Oscillator Alignment."

THE FOLLOWING ADJUSTMENTS ARE APPLICABLE TO 12½" AND 16" PIX TUBE RECEIVERS.

HEIGHT AND LINEARITY ADJUSTMENTS —Adjust the height control (R-63) until the picture fills the mask vertically. Adjust the vertical linearity control (R-87) until the picture is symmetrical from top to bottom. Adjustment of either control will require a re-adjustment of the other control. Adjust vertical centering (3 focus coil mounting screws) to align picture with the mask.

HORIZONTAL SIZE AND DRIVE ADJUSTMENTS—Turn the horizontal size control L-23 (See Fig. 5 & 6) to the maximum clockwise position. Vary the horizontal drive trimmer (C-63B on 12-1/2" Pix Tube Receiver) (C-77 on 16" Pix Tube Receiver) to yield the best linearity. Re-adjust the horizontal size control L-23 until the picture just fills the mask. Adjust horizontal centering (3 focus coil mounting screws) to align the picture with the mask.

If the horizontal drive trimmer is opened too far counter-clockwise, a white line may appear to the left of the center of the picture.

CHECK OF R-F OSCILLATOR ADJUSTMENTS

With an accurately calibrated signal generator (crystal calibrated type preferred check to see if the receiver R-F oscillator is adjusted to the proper frequency on all channels. For this check, it will be necessary to remove the chassis from the cabinet. Illustrated on this page are the two types of tuners used in these receivers. For switch-type tuners adjust as shown in Fig. 10. When Channel 6 (low) and Channel 13 (high) trimmers are adjusted properly, other channels in the high and low frequency band will fall in automatically.

For turret type tuners adjust each channel through the clearance hole as shown in Fig. 11.

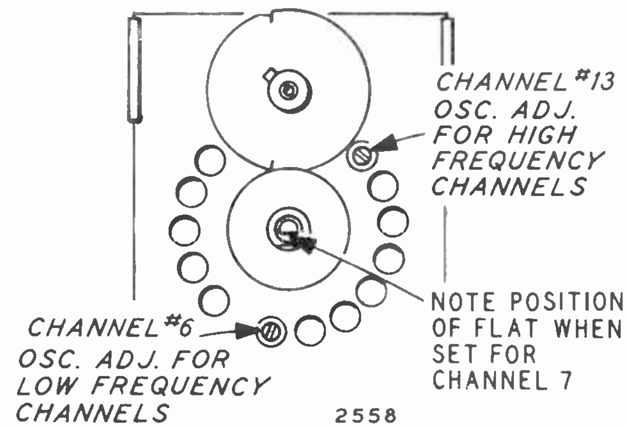

Fig. 10 Switch Type Tuner Adjustment

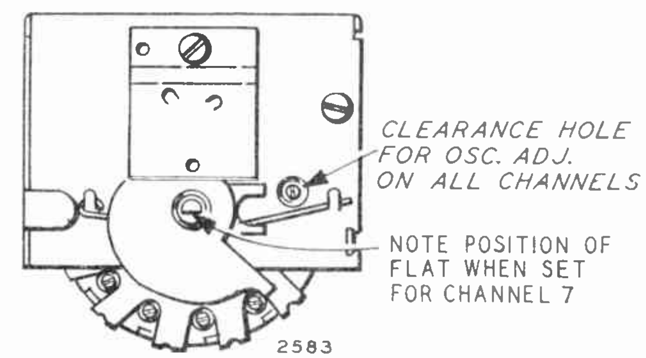

Fig. 11 Turret Type Tuner Adjustment

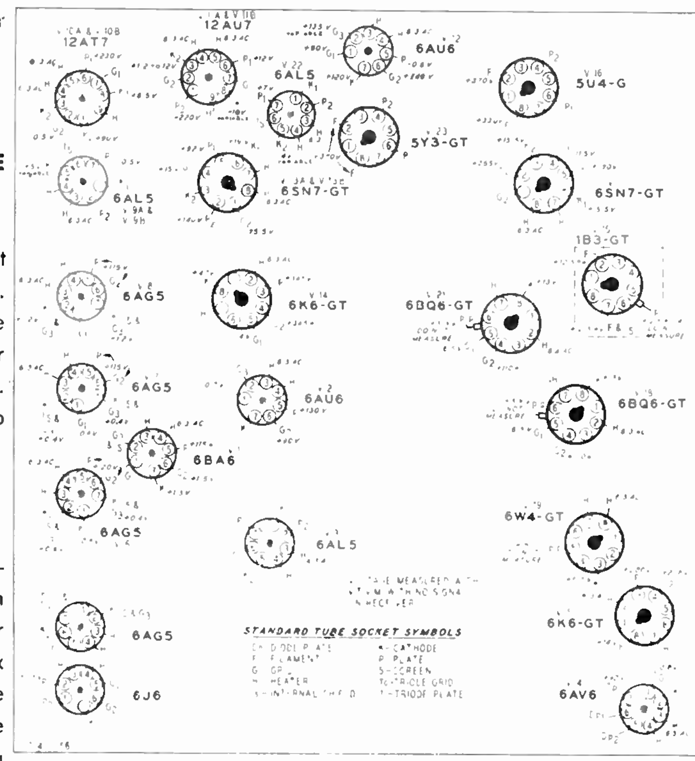

Fig. 12—16" Pix Receiver Voltages

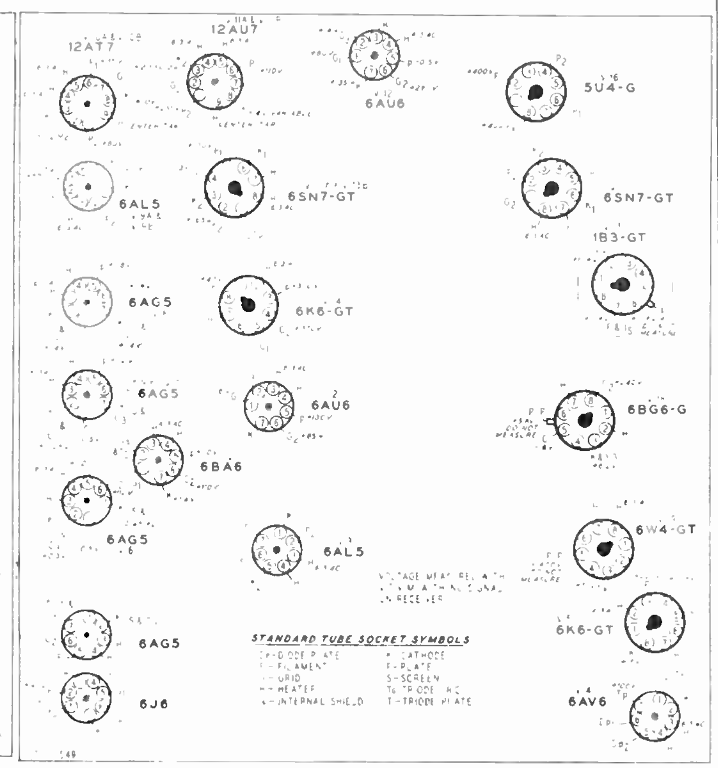

Fig. 13—12½" Pix Receiver Voltages

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SERVICE SUGGESTIONS

NO RASTER ON PICTURE TUBE —If raster cannot be obtained check below for the possible causes.

1. Ion trap magnet adjustment is incorrect.
2. No +B voltage. Check 1/4 ampere fuse (F-1). *Replace if defective. If fuse continually burns out, check (A) Horizontal output tube V-18 (6BG6-G in 12-1/2" pix tube receivers) or V-18 and V-21 (6BQ6-GT's) in 16" pix tube receivers. (B) Check damper tube V-19 (6W4-GT). (C) Check horizontal oscillator V-17 (6SN7-GT) for proper operation. In the 16" pix tube models, connect a jumper wire from the +B side of F-1 to the junction of C-79 and R-85. For the 12-1/2" pix tube models use a similar wire from the +B side to the junction of R-70 and R-73. (D) With an ohm-meter, check for a short between terminal 2 of the horizontal output transformer T-9 and the chassis. (E) Check capacitors C-22C and C-73C.
3. No high voltage. Check V-15 and V-18 tubes and circuits. If the horizontal deflection circuits are operating as evidenced by the correct voltage measured on terminal 2 of the horizontal output transformer T-9, the trouble can be isolated to the high voltage rectifier V-15 circuit. Either the high voltage winding (points 6 to 7 on T-9) is open, tube V-15 is defective, its filament circuit is open, or the high voltage filter capacitor C-86 or C-83 on 12-1/2" models is shorted.
4. Defective picture tube. Heater open or cathode return circuit open.

*This fuse is accessible from bottom of cabinet. Remove wire screen, unsolder old fuse, solder in the new fuse and replace wire screen.

HORIZONTAL DEFLECTION ONLY —If only horizontal deflection is obtained as evidenced by a straight line across the face of the picture tube, it can be caused by the following:

1. Vertical oscillator V-13 (6SN7-GT) or vertical output tube V-14 (6K6-GT) inoperative. Check voltages on grid and plate.
2. Vertical output transformer (T-8) open.
3. Yoke vertical coils open.
4. Vertical hold, height or linearity controls may be defective.

POOR VERTICAL LINEARITY —If adjustment of the vertical hold, height or linearity controls will not correct this condition, any of the following may be the cause.

1. Vertical output transformer (T-8) defective.
2. Capacitors C-73A or C-73B defective.
3. V-13 (6SN7-GT) or V-14 (6K6-GT) defective, check voltages.
4. Excess leakage or incorrect value in capacitor C-64.
5. Low plate voltages. Check rectifier tubes and capacitors in +B supply circuits.
6. Capacitor C-65 defective.

POOR HORIZONTAL LINEARITY—If adjustment of the Horizontal drive control does not correct this condition, check the following:

1. Check or replace horizontal output tubes V18 & V-21.
2. Check or replace damper tube V-19 (6W4-GT).
3. Check capacitor C-82 for defects.

TRAPEZOIDAL OR NONSYMMETRICAL RASTER

1. Improper adjustment of focus coil or ion trap magnet.
2. Defective yoke.
3. Open condenser C-85 on horizontal yoke coil L-21.

WRINKLES ON LEFT SIDE OF RASTER—This condition can be caused by:

Defective yoke due to C-85 (internal in yoke assembly) being wrong value or open. This component is mounted in rear of yoke assembly.

SMALL RASTER —This condition can be caused by:

1. Low +B or line voltage.
2. Insufficient output from horizontal output tubes V-18 or V-21. Replace tubes.
3. Insufficient output from vertical oscillator V-13 or vertical output tube V-14. Replace tubes.

RASTER; NO IMAGE, BUT ACCOMPANYING SOUND —This condition can be caused by:

1. No signal on picture tube grid. Check picture I-F amplifier tubes V-6, 7 and 8 (6AG5's), second detector V-9A (6AL5) and video amplifiers V-10 (12AT7) and V-11 (12AU7).
2. Bad contact to picture tube grid (lead to socket broken).

SIGNAL APPEARS ON PICTURE TUBE GRID BUT IMPOSSIBLE TO SYNCHRONIZE THE PICTURE VERTICALLY AND HORIZONTALLY —A condition of this nature can be caused by:

1. Defective sync amplifier and separator V-11 (12AU7-V-10 (12AT7) or V-13 (6SN7-GT).
2. If tubes are O.K. check voltages, and associated circuits.
3. AGC system inoperative. Check V-12 (6AU6) AGC tube and associated circuits.

SIGNAL ON PICTURE TUBE GRID AND HORIZONTAL SYNC ONLY —If this condition is encountered, check:

1. Vertical integrating network capacitors C-55, C-56, and C-57; and resistors R-56, R-57 and R-58.
2. Vertical hold control R-60 defective.

PICTURE STABLE BUT WITH POOR RESOLUTION —If the picture resolution is not up to standard, it may be caused by any of the following:

1. Defective picture detector V-9A (6AL5) or video amplifier V-10 (12AT7) and V-11 (12AU7).
2. Open video peaking coil. Check all peaking coils L-9, L-10, L-11, L-12 and L-13 for continuity. Note that L-10 and L-12 have shunting resistors.
3. Leakage in V-11 (12AU7) grid capacitor C-90. If the above components are not found to be defective, check the following:

1. Check all potentials in video circuits.
2. Check picture tube grid circuit for poor or dirty contact.
3. Check adjustment of focus control R-81. It should be effective on either side of proper focus.
4. Check and realign, if necessary, the picture I-F and R-F circuits.

PICTURE SMEAR:

1. Normally, smear can be attributed to phase shift at the low frequency end of the video characteristic. This can be caused by improper values of resistors and capacitors in the video circuits. Check for grid current on video output tube V-11 (12AU7).
2. This trouble can also originate at the transmitter. Check reception from another station.
3. Check and realign, if necessary, the picture I-F and R-F circuits.

PICTURE JITTER:

1. If regular sections at left of the picture are displaced, replace the horizontal output tubes V-18 or V-21.
2. Vertical instability may be due to loose connections or noise received with the signal.
3. Horizontal instability may be due to unstable transmitted sync or to noise.
4. Check receiver AGC system for proper operation.

ALIGNMENT PROCEDURE

TEST EQUIPMENT —To service this receiver properly, it is recommended that the following test equipment be available:

R-F SWEEP GENERATOR meeting the following requirements:
(a) Frequency ranges:
18 to 30 mc, 10 mc sweep width
40 to 90 mc, 10 mc sweep width
170 to 225 mc, 10 mc sweep width
(b) Output adjustable with at least .1 volt maximum.
(c) Output constant on all ranges.
(d) Flat output in all attenuator positions.

CATHODE-RAY OSCILLOSCOPE preferably one with a wide band vertical deflection and an input calibrating source.

SIGNAL GENERATOR to provide the following frequencies:
(Output on these ranges should be adjustable and at least .1 volt maximum.)
(a) Intermediate alignment frequencies:
*17.0 mc adjacent picture trap
20.2 mc adjacent picture trap
22.7 mc first picture I-F coil
**24.1 mc third picture I-F coil
25.7 mc second picture I-F coil
27.7 mc adjacent sound trap
21.7 mc sound trap (takeoff)
4.5 mc video trap

* This frequency is not used in receivers with the turret type tuner.

** If turret type tuner is used the frequency will be 23.7 mc.

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ALIGNMENT PROCEDURE (continued)

(b) Radio frequencies:

Channel Number	Picture Carrier Freq. Mc.	Sound Carrier Freq. Mc.
2	55.25	59.75
3	61.25	65.75
4	67.25	71.75
5	77.25	81.75
6	83.25	87.75
7	175.25	179.75
8	181.25	185.75
9	187.25	191.75
10	193.25	197.75
11	199.25	203.75
12	205.25	209.75
13	211.25	215.75

HETERODYNE FREQUENCY METER with crystal calibrator if the signal generator is not crystal controlled.

ELECTRONIC VOLTMETER and a high voltage probe for use with this meter to permit measurements up to 20 kilovolts.

SERVICE PRECAUTIONS — To service the receiver remove the chassis from the cabinet. To do so, remove the knobs, the cabinet back, the antenna terminal board at rear of cabinet and the 5 chassis mounting bolts. The chassis may be serviced with the picture tube in place provided the chassis is turned on its side with the power transformer on the bottom. The weight of the chassis will be supported against the high voltage housing.

CAUTION: Do not permit the kinescope second-anode lead to become shorted to the chassis. To do so will cause a considerable overload on the high voltage filter resistor R-79 on 12½" receivers or R-97 on 16" receivers.

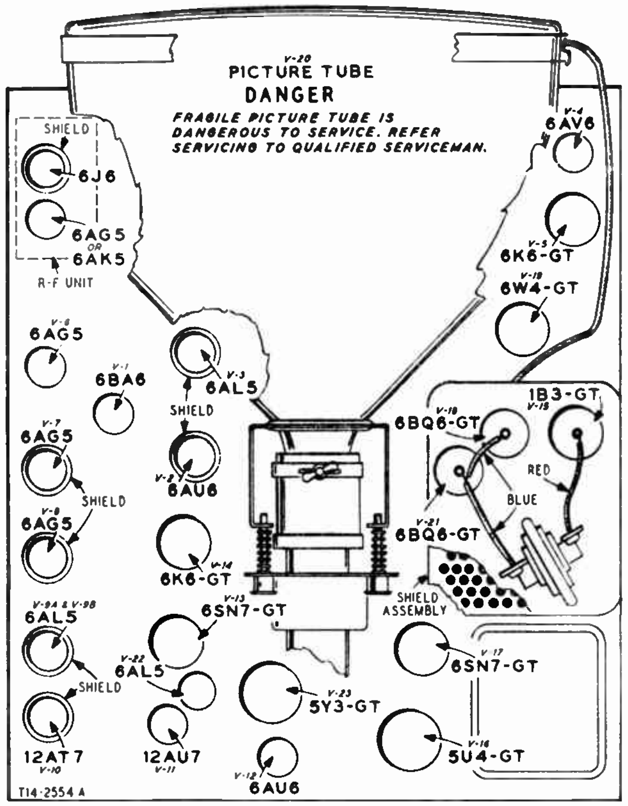

Fig. 14—Tube Layout—16" Pix Tube Receivers

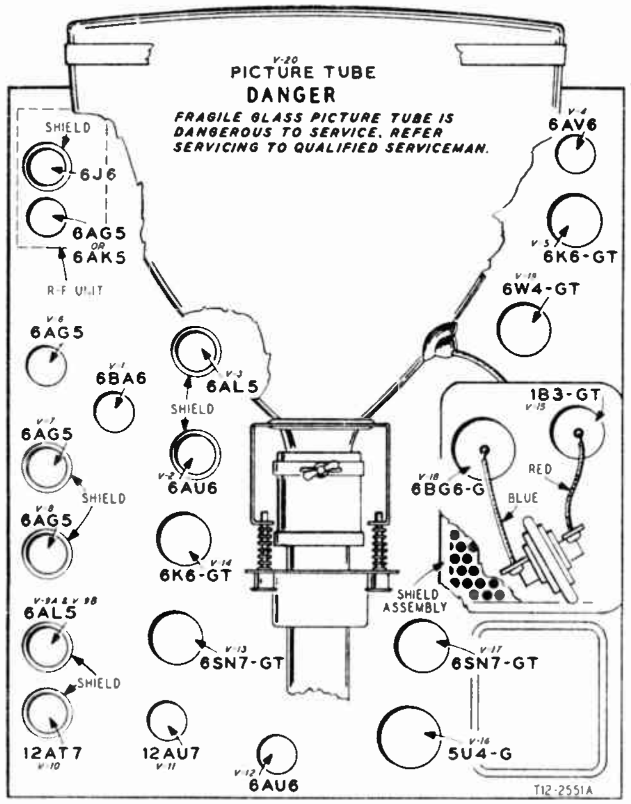

Fig. 15—Tube Layout—12½" Pix Tube Receivers

ALIGNMENT PROCEDURE
PIX I-F

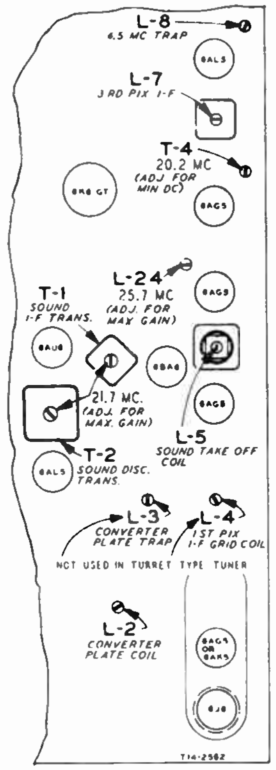

Fig. 16. Top Chassis
Video and Audio I-F Adjustments

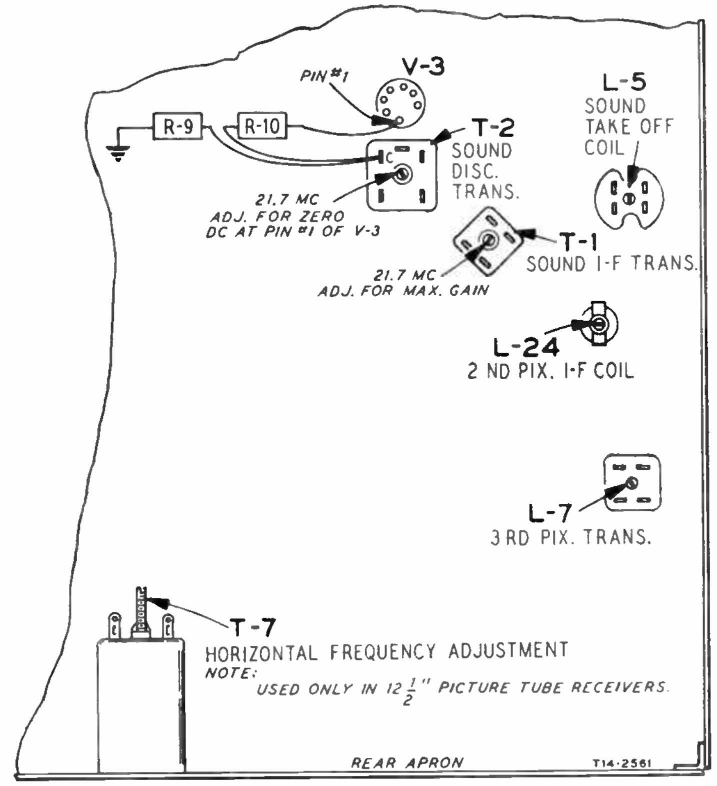

Fig. 17—Bottom Chassis
Video and Audio I-F Adjustments

A. CW Carrier into Converter Grid.

VTVM with filter in lead of 10 K ohms and 5000 uuf connected to pic. det. load resistor, (R-31) 4700 ohms, in series with peaking coil (L-9) from Pin 7 of 6AL5. Input level should be such that output is less than 2 volts DC.

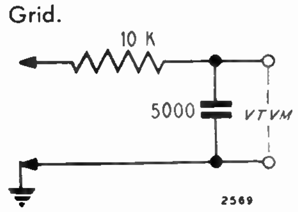

Fig. 18—VTVM Connections

	FREQUENCY	ADJUST
1.	20.2	Adjacent pix trap (T-4) — (3rd P-IF Cathode Coil) (above chassis) for minimum dc at picture detector.
2.	22.7	1st pix IF (L-5) (Sound Take-off Coil) primary (below chassis) for maximum dc at picture detector.
3.	25.7	2nd pix IF (L-24) (top of chassis) for maximum dc at picture det.
4.	24.1 (Switch Type Tuner) 23.7 (Turret Type Tuner)	3rd pix IF (L-7) (below chassis) for maximum dc at picture detector.
5.	27.7	2nd pix IF (L-24) transformer (below chassis) for minimum dc at picture detector.
6.	21.7	Sound Take-off Coil (L-5) (1st picture IF) (top of coil) For minimum dc at picture detector.
7.	21.7	3rd pix IF (L-7) (top of can) adjust for minimum dc at picture detector.
*8.	17 MC (2 volts required)	Converter plate trap coil (L-3) for minimum dc at pic. detector.

*Step 8 omitted in Receivers with turret type tuner.

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ALIGNMENT PROCEDURE (continued)

B. I-F Sweep Generator into converter grid (through tube shield insulated from chassis) with markers at 21.7 MC, and 26.2 MC.

Connect oscilloscope probe to plate of 1st I-F tube V-6 (Pin 5 of 6AG5).

Ground A-G-C Line.

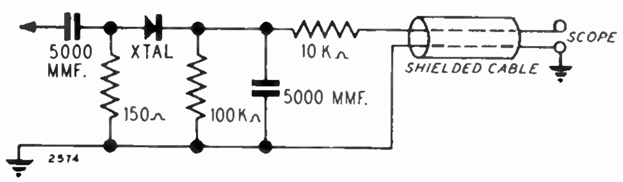

Fig. 19—Oscilloscope Connection

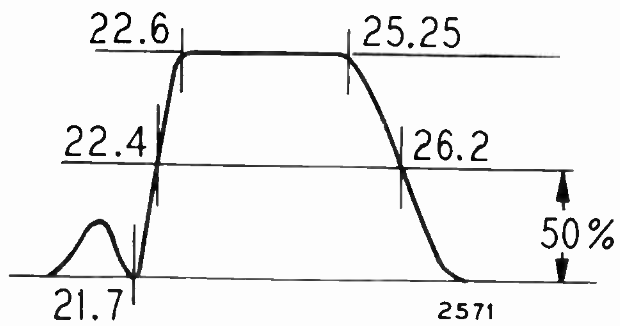

Fig. 22—Overall Response Curve

SWITCH TYPE TUNERS

Adjust converter plate coil (L-2) and 1st Pic. I-F grid coil (L-4) (top of chassis) to give the response shown below in figure 20.

A slight re-adjustment of L-3 converter plate trap may be necessary.

TURRET TYPE TUNERS

Adjust converter plate coil (L-2) to give response shown in dotted line in figure 20.

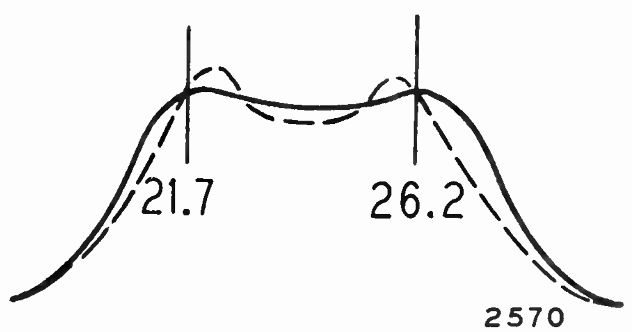

Fig. 20—Response Curve

C. With same I-F sweep input, connect scope probe to second detector (junction of peaking coil (L-9) and 4700 ohm resistor (R-31) off Pin 7, 6AL5). Input should be adjusted to give 2 volt P to P output.

Apply 3 V, bias (dc) to AGC line. (battery).

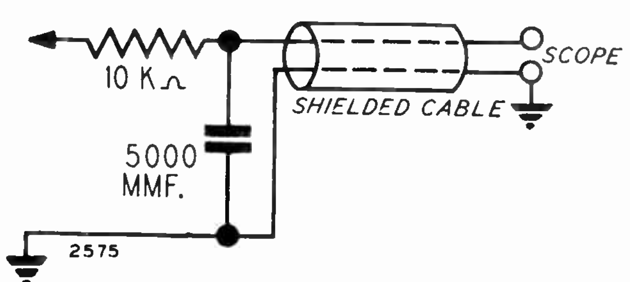

Fig. 21—Oscilloscope Connection

Observe overall I-F response, which should be as shown in Figure 22. Slight touch-up may be required.

D. Sweep generator with balanced 300 ohm output into antenna for each channel. Adjust fine tuning to receive sound and observe overall response at second detector as in C. above.

If 26.2 marker is not at 50% point, a slight touch-up of 2nd Pix-IF transformer (L-24 on top of chassis) is required.

If there is a noticeable peak near 23 MC, a slight touch-up of 1st Pix-IF transformer (L-5 sound take-off coil on bottom of chassis) is required.

If the top of the curve is tilted, a slight re-adjustment of the 3rd Pix-IF transformer L-7 (bottom of chassis) may be necessary.

AUDIO I-F

With 21.7 CW Carrier into converter grid as in A., and VTVM connected to terminal "C" of sound discriminator transformer, adjust sound I-F transformer (T-1) pri. and sec., and pri. (top of can) of discriminator (T-2) for max. dc. Input should be adjusted for 2 volts out.

Connect VTVM to Pin 1 of 6AL5 discriminator and adjust secondary of discriminator (T-2) (bottom of can) for cross-over. (Zero voltage).

VIDEO

With 4.5 MC CW Carrier from a high impedance source, (10,000 ohms in series with generator), into grid of 1st video tube (Pin 7 of 6AL5 second detector) and VTVM on picture tube grid, tune 4.5 MC trap L-8 (top of chassis) for minimum response.

REPLACEMENT PARTS LIST (16" PIX TUBE)

Ref. No.	DESCRIPTION	Part No.
	CAPACITORS	
C-1, C-2, C-3, C-4, C-7, C-8, C-12, C-15, C-26, C-27, C-28, C-32, C-33, C-25, C-46, C-47, C-48, C-49, C-50, C-51, C-66, C-67, C-88	Capacitor, Ceramic; 1000 mmf	47X519
C-5	Capacitor, Ceramic; 68 mmf	47X501
C-6, C-19, C-24, C-29, C-34, C-76	Capacitor, Malded Mica; 270 mmf	47X445
C-9, C-17	Capacitor, Ceramic; 5000 mmf	47X507
C-16, C-56, C-57	Capacitor, Tubular; .005 mf 200 V	B65502
C-18, C-41, C-43, C-53, C-83, C-89, C-90, C-91	Capacitor, Tubular; .05 mf 400 V	D67503
C-20, C 59, C-72	Capacitor, Tubular; .01 mf 200 V	B65103
C-21, C-69	Capacitor, Tubular; .05 mf 200 V	B65503
C-22A, C-22B, C-22C	Capacitor, Dry Electrolytic; 40 mf 50 V, 10 mf 450 V, 10 mf 450 V	45X375
C-23	Capacitor, Tubular; .005 mf 600 V	F65502
C-25	Part of L-5 (Sound Take-Off Coil)	
C-30	Part of L-24 (2nd Pix Trans.)	
C-31	Capacitor Molded Mica; 47 mmf 500 V	47X565
C-36	Part of L-7 (3rd Pix Trans.)	
C-37	Capacitor, Ceramic; 5 mmf 500 V	47X562
C-38	Capacitor, Molded Mica; 360 mmf 500 V	47X568
C-39	Capacitor, Ceramic; 43 mmf 500 V	47X563
C-40	Capacitor, Dry Electrolytic; 5 mf 25 V	45X378
C-42	Capacitor, Tubular; .1 mf 600 V	F65104
C-44	Capacitor, Tubular; .1 mf 400 V	D65104
C-45	Capacitor, Tubular; .1 mf 200 V	B65104
C-52, C-84, C-93	Capacitor, Tubular; .5 mf 200 V	B65504
C-54	Capacitor, Molded Mica; 1000 mmf 1000 V	47X569
C-55	Capacitor, Tubular; .002 mf 200 V	B65202
C-58	Capacitor, Moldel Mica; 4700 mmf	47X543
C-60, C-70	Capacitor, Molded Paper; .01 mf 400 V	46X410
C-61A, C-61B	Capacitor, Dry Electrolytic; 80 mf 450 V, 30 mf 450 V	45X376

MODELS 05TV2-43-8950A, 05TV2-43-9010A

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REPLACEMENT PARTS LIST Cont. (16" PIX TUBE)

Ref. No.	DESCRIPTION	Part No.
C-62A, C-62B	Capacitor, Dry Electrolytic; 80 mf 450 V, 30 mf 450 V	45X376
C-64	Capacitor, Tubular; .02 mf 600 V	Fo5203
C-65	Capacitor, Tubular; .25 mf 400 V	D65254
C-68, C-81	Capacitor, Tubular; .05 mf 600 V	F67503
C-71	Capacitor, Molded Mica; 330 mmf 500 V	47X570
C-73A, C-73B, C-73C	Capacitor, Dry Electrolytic; 40 mf 50 V, 10 mf 450 V, 10 mf 450 V	45X375
C-75	Capacitor, Molded Mica; 390 mmf 500 V	47X571
C-77	Capacitor, Trimmer; 40-370 mmf	17A261
C-78	Capacitor, Tubular; .35 mf 200 V	B65354
C-79	Capacitor, Molded Mica; 3900 mmf 500 V	47X572
C-80	Capacitor, Ceramic; 12 mmf 2500 V	47X574
C-82	Capacitor, Tubular; .25 mf 200 V	B65254
C-85	Part of Deflection Yoke	
C-86	Capacitor, Hi Voltage; 500 mmf 20,000 V	47X560
C-87	Part of Tuner Assembly	
C-94	Capacitor, Dry Electrolytic; 30 mf 450 V	45X379
	RESISTORS	
R-1, R-2, R-3, R-5, R-8, R-24, R-26, R-27, R-65	Resistor, Carbon; 1 K ohms 0.5 W.	B85102
R-4	Resistor, Carbon; 82 ohms 0.5 W.	B84820
R-6, R-17, R-36, R-73, R-89	Resistor, Carbon; 470 K ohms 0.5 W.	B85474
R-7, R-23, R-37, R-39, R 56, R-113	Resistor, Carbon; 22 K ohms 0.5 W.	B84223
R-9, R-10, R-53, R-55, R-61, R-70, R-72, R-109, R-112	Resistor, Carbon; 100 K ohms 0.5 W	B84104
R-11	Resistor, Wirewound; 5.1 ohms 0.5 W.	43X239
R-12, R-106	Resistor, Carbon; 68 K ohms 0.5 W.	B84683
R-13, R-44	Resistor, Variable; 1 megohm On-Off Volume, 3 K ohms Contrast	78X4
R-14	Resistor, Carbon; 10 megohms 0.5 W.	B85105
R-15, R-35	Resistor, Carbon; 270 K ohms 0.5 W.	B85274
R-16	Resistor, Carbon; 470 ohms 1.0 W.	C84471
R-18	Resistor, Carbon; 1 K ohms 2.0 W.	D84102
R-19	Resistor, Carbon; 47 ohms 0.5 W.	B83470
R-20	Resistor, Carbon; 8.2 K ohms 0.5 W.	B83822
R-21	Resistor, Carbon; 33 ohms 0.5 W.	B83330
R-22	Resistor, Carbon; 12 K ohms 0.5 W.	B83123
R-25, R-28, R-92, R-93	Resistor, Carbon; 150 ohms 0.5 W.	B84151
R-29	Resistor, Carbon; 330 ohms 0.5 W.	B84331
R-30, R-43, R-80, R-88, R-108	Resistor, Carbon; 2.2 K ohms 0.5 W.	B84222

Ref. No.	DESCRIPTION	Part No.
R-31, R-74, R-79	Resistor, Carbon; 4.7 K ohms 0.5 W.	B83472
R-32	Resistor, Carban; 5.6 K ohms 0.5 W.	B83562
R-33	Part of L-10	
R-34	Resistor, Carbon; 2.7 K ohms 1.0 W.	C83272
R-38	Resistor, Carbon; 33 K ohms 0.5 W.	B84333
R-40, R-45, R-52, R-62, R-69	Resistor, Carbon; 1 megohm 0.5 W.	B84105
R-41, R-50	Resistor, Carbon; 10 K ohms 0.5 W.	B84103
R-42	Resistor, Carbon; 12 K ohms 0.5 W.	B84123
R-46, R-94, R-95	Resistor, Carbon; 100 ohms 0.5 W.	B84101
R-47	Resistor, Carbon; 820 K ohms 0.5 W.	B84824
R-48	Resistor, Carbon; 47 K ohms 0.5 W.	B84473
R-49	Part of L-12	
R-51	Resistor, Carbon; 3.9 K ohms 1.0 W.	C83392
R-54	Resistor, Variable; 500 K ohms (Brightness Control)	40X297
R-57, R-58, R-64	Resistor, Carbon; 8.2 K ohms 0.5 W.	B84822
R-59	Resistor, Carbon; 1.5 megohms 0.5 W.	B84155
R-60	Resistor, Variable; 1 megohm (Vert. Hold Control)	40X298
R-63	Resistor, Variable; 2.5 megohms (Height Control)	40X293
R-66, R-67	Resistor, Carbon; 3.3 K ohms 0.5 W.	B83332
R-68	Resistor, Carbon; 3.3 megohms 0.5 W.	B85335
R-71	Resistor, Carbon; 4.7 megohms 0.5 W.	B85475
R-75	Resistor, Carbon; 1.5 K ohms 0.5 W.	B84152
R-76	Resistor, Carbon; 270 ohms 0.5 W.	B85271
R-77A, R-77B	Part of Deflection Yoke	
R-78	Resistor, Wirewound; 3.9 K ohms 0.5 W.	43X251
R-81	Resistor, Variable; 6.5 K ohms (Focus Control)	40X302
R-82	Resistor, Wirewound; 500 ohms 10.0 W.	43X245
R-83	Resistor, Wirewound; 1 K ohms 10.0 W.	43X248
R-84	Resistor, Wirewound; 10 K ohms 5.0 W.	43X247
R-85	Resistor, Carbon; 270 K ohms 0.5 W.	B84274
R-86	Resistor, Carbon; 27 K ohms 0.5 W.	B84273
R-87	Resistor, Variable; 5 K ohms (Vert. Linearity Control)	40X294
R-90, R-91	Resistor, Carbon; 220 ohms 2.0 W.	D84221
R-96	Resistor, Wirewound; 22 K ohms 5.0 W.	43X253
R-97	Resistor, Carbon; 1 megohm 1.0 W.	C85105
R-98	Resistor, Carbon; 10 K ohms 1.0 W.	C84103
R-99	Resistor, Carbon; 18 K ohms 1.0 W.	C84183
R-100	Resistor, Carbon; 100 K ohms 2.0 W.	D84104
R-101	Resistor, Carbon; 5.6 K ohms 1.0 W.	C84562
R-102, R-103	Resistor, Carbon; 22 ohms 1.0 W.	C84220
R-107	Part of Tuner Assembly	
R-110	Resistor, Variable; 50 K ohms (Horiz. Hold Control)	40X299
R-111	Resistor, Carbon; 47 K ohms 0.5 W.	B85473
R-114	Resistor, Carbon; 2.2 megohms 0.5 W.	B84225
R-115	Resistor, Carbon; 3900 ohms 2.0 W.	D84392
	TRANSFORMERS AND COILS	
L-1, L-16, L-17, L-18	Filament Choke	9A2033

Ref. No.	DESCRIPTION	Part No.
L-2	Part of Tuner (See Miscellaneous)	
L-3	Converter Plate Trap	9A2059
L-4	Ist Pix I.F. Grid Coil	9A2072
L-5	Sound Take-Off Coil	9A2076
L-6	Plate Choke	9A1979
L-7	3rd Pix I.F. Trans.	9A2071
L-8	4.5 MC Trap	9A2074
L-9	Peaking Coil	9A2090
L-10	Peaking Coil	9A2086
L-11	Peaking Coil	9A2088
L-12	Peaking Coil	9A2089
L-13	Peaking Coil	9A2087
L-14	Filter Choke	52X88
L-15	Focus Coil	9A2081
L-19, L-20, L-21, L-22	Part of 9A2080 Deflection Yoke Assembly (See Miscellaneous)	
L-23	Horizontal Size Control	9A2075
L-24	2nd Pix I.F. Trans.	9A2055
L-25	Horizontal Frequency	9A2096
T-1	Sound I.F. Trans.	9A1986
T-2	Sound Disc. Trans.	9A2049
T-3	Audio Output Trans.	51X146
T-4	Cathode Trap Assembly	9A2073
T-5	Power Trans.	53X302
T-6	Vert. Oscillator Trans.	54X5
T-8	Vertical Output Trans.	51X147
T-9	High Voltage Trans.	53X303
	MISCELLANEOUS	
	Ion Trap Magnet	2A401
	Tube Socket (Octal)	3A303
	Tube Socket (miniature)	3A428
	Tube Socket (12AU7)	3A453
	Tube Socket (H. V. Rectifier)	3A454
	Tube Socket (12AT7)	3A455
	Deflection Yoke Assembly	9A2080
	Knob (Channel Selector)	10A741
	Knob (Fine Tuning)	10A742
	Knob (Contrast)	10A752
	Knob (Off-Volume)	10A753
	Speaker 12" P.M. (Console)	12A490
	Speaker 6" P.M. (Mantel)	12A497
	R. F. Tuner Assembly (Turret Type)	25A1070
	R. F. Tuner Assembly (Switch Type)	25A1074
	Escutcheon (Off-Volume and Contrast)	4X1029
	Escutcheon (Tel. Knob)	4X1065
	Pix Mask	4X1077
	Front Panel Cover	4X1080
	Rubber Cushion (Mtg. Pix Tube)	BX217
	Tube Insulator	11X145
	Cabinet Back & Power Cord Assembly (With Stud)	S-14X19
	Cabinet Back & Power Cord Assembly (Less Stud)	S-14X23
	Ventilator Grille	14X485
	Tube Socket (Pix Tube)	13X772
	Fuse (1/4 Amp.) 250 V	16X145
	Tube Holder Bracket Assembly	16X136
	Tube Cradle (Part of 16X136 Tube Bracket Assembly)	16X137
	Strap Assembly (Part of 16X136 Tube Bracket Assembly)	16X138
	Tube Clip (Part of 16X136 Tube Bracket Assembly)	16X139
	Strap Mtg. Brk't Assembly (Part of 16X136 Tube Bracket Assembly)	16X140
	Pix Crystal	17X113
	Wing Screw (Mtg. Def. Yoke)	20X1558
	Eyelet (Screwdriver Guide), No. 10-32 x 1-3/4 Fillister Head Steel Machine Screw — Mtg. Focus Coil	20X1646
	Tube Mtg. Bracket (Right Hand)	25X1665
	Tube Mtg. Bracket (Left Hand)	25X1666
	Support Bracket (Mtg. Rear Pix Tube)	25X1667
	Spring (Mtg. Focus Coil)	28X578
	Ground Spring	28X587
	Tube Shield	32X390
	Tube Shield (12AT7)	32X401

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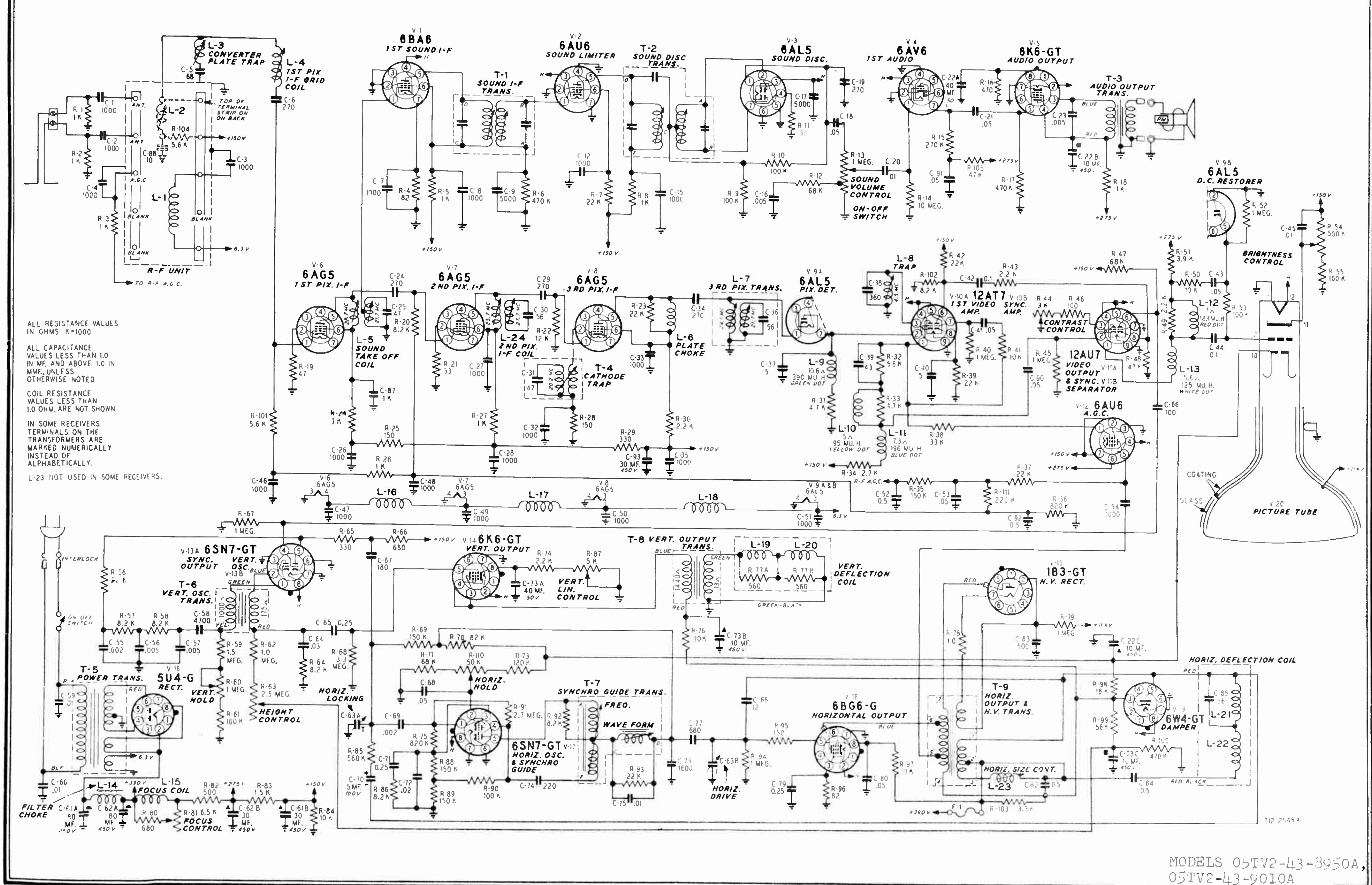
12½ inch PICTURE TUBE MODELS



ALL RESISTANCE VALUES IN OHMS K=1000

ALL CAPACITANCE VALUES LESS THAN 1.0 IN MF. AND ABOVE 1.0 IN MMF., UNLESS OTHERWISE NOTED

COIL RESISTANCE VALUES LESS THAN 1.0 OHM, ARE NOT SHOWN

IN SOME RECEIVERS TERMINALS ON THE TRANSFORMERS ARE MARKED NUMERICALLY INSTEAD OF ALPHABETICALLY.

L-23 NOT USED IN SOME RECEIVERS.

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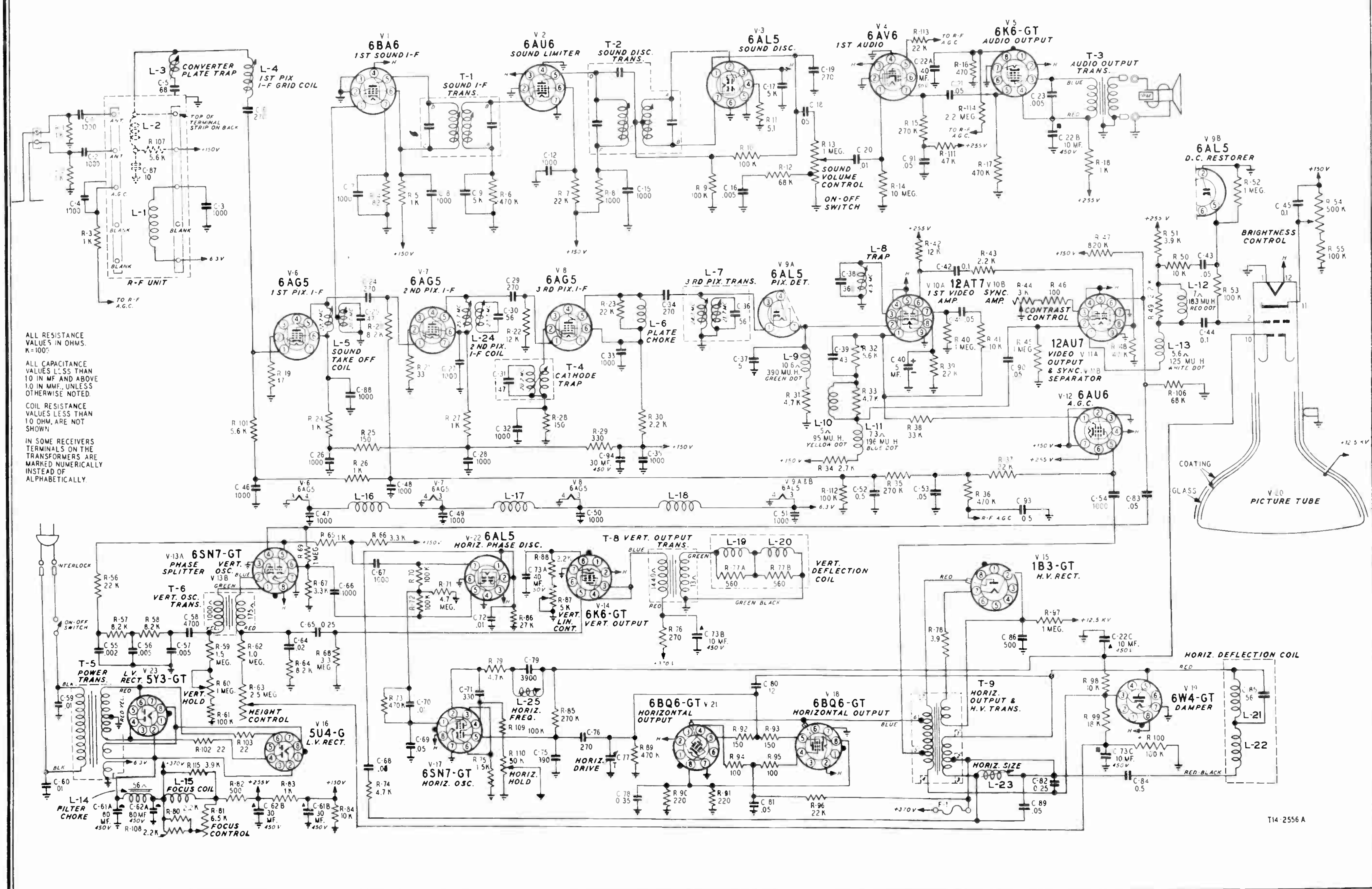
MODELS 05TV2-43-8950A, 05TV2-43-9010A

16 inch PICTURE TUBE MODELS



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SPECIFICATIONS

OVER-ALL DIMENSIONS:	Height .... $19\frac{3}{4}$ inches Depth .... $20\frac{1}{16}$ inches Width .... $17\frac{1}{4}$ inches
ELECTRICAL RATING:	Frequency .... 60 cycles Voltage .... 115 volts Wattage .... 150 watts
INTERMEDIATE FREQUENCIES:	Television Video ...... 45.75 MC Television Audio .... 4.5 MC
AUDIO POWER OUTPUT:	Undistorted .... 1.0 watt Maximum .... 2.0 watts
LOUDSPEAKER:	Type ...... Alnico PM Dynamic Cone Diameter ...... $5\frac{1}{4}$ inches Voice Coil Impedance (400 cps) .... 3.2 ohms
ANTENNA:	Built-in Antenna System External Antenna: Type ..... Folded Dipole or equ. Impedance .... 300 ohms

R-F FREQUENCY RANGE:

Selector Switch Position	Frequency Range	Picture Carrier	Sound Carrier
	Megacycle		
No. 2	54–60	55.25	59.75
No. 3	60–66	61.25	65.75
No. 4	66–72	67.25	71.75
No. 5	76–82	77.25	81.75
No. 6	82–88	83.25	87.75
No. 7	174–180	175.25	179.75
No. 8	180–186	181.25	185.75
No. 9	186–192	187.25	191.75
No. 10	192–198	193.25	197.75
No. 11	198–204	199.25	203.75
No. 12	204–210	205.25	209.75
No. 13	210–216	211.25	215.75

TUBES CRYSTAL Symbol	Purpose	Type
V1	1st RF Amplifier	6AB4
V2	2nd RF Amplifier	6BC5
V3	Converter Oscillator	12AT7
V4	1st Video IF Amplifier	6BC5
V5	2nd Video IF Amplifier	6BC5
V6	3rd Video IF Amplifier	6BC5
V7	Video Amplifier	12AT7
V8	Picture Tube	12LP4A
V9	Vertical Sweep Generator and Output	12SN7GT
V10	Sync Amplifier and Clipper	6SL7GT
V11	Horizontal Discriminator	6AL5
V12	Horizontal AFC and Sweep Oscillator	12SN7GT
V13	Horizontal Output	19BG6
V14	High Voltage Rectifier	1B3G/8016
V15	Damper	25W4GT
V16	Audio IF Amplifier	6AU6
V17	Audio Limiter and Amplifier	6AU6
V18	Audio Detector	6AL5
V19	Audio Amplifier	6SQ7
V20	Audio Output	25L6GT
Y1	Video Detector (crystal)	1N64

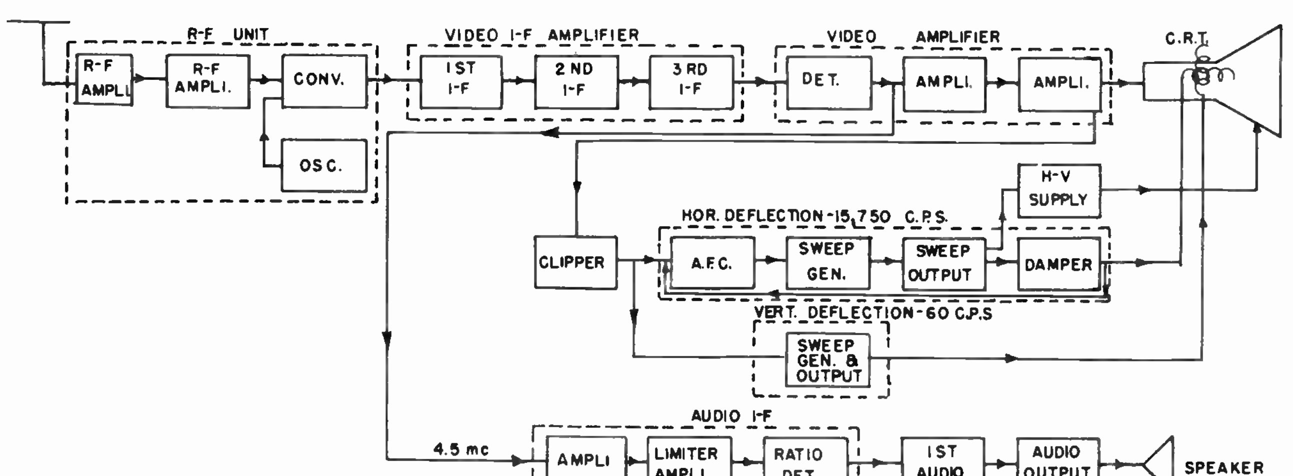

Fig. 1. Block Diagram, Model 12T7

CAUTION NOTICE

THE REGULAR B+ VOLTAGES ARE DANGEROUS AND PRECAUTIONS SHOULD BE OBSERVED WHEN THE CHASSIS IS REMOVED FROM THE CABINET FOR SERVICING. THE HIGH VOLTAGE SUPPLY (10,000 VOLTS) AT THE PICTURE TUBE ANODE WILL GIVE AN UNPLEASANT SHOCK BUT DOES NOT SUPPLY ENOUGH CURRENT TO GIVE A FATAL BURN OR SHOCK. HOWEVER, SECONDARY HUMAN REACTIONS TO OTHERWISE HARMLESS SHOCKS HAVE BEEN KNOWN TO CAUSE INJURY. SINCE THE HIGH VOLTAGE IS OBTAINED FROM THE B+ VOLTAGE, CERTAIN PORTIONS OF THE HIGH VOLTAGE GENERATING CIRCUIT ARE DANGEROUS AND EXTREME PRECAUTIONS SHOULD BE OBSERVED.

THE PICTURE TUBE IS HIGHLY EVACUATED AND IF BROKEN, GLASS FRAGMENTS WILL BE VIOLENTLY EXPELLED. IF IT IS NECESSARY TO CHANGE THE PICTURE TUBE OR TO REMOVE CHASSIS FROM CABINET ALWAYS WEAR SAFETY GOGGLES.

GENERAL INFORMATION

The General Electric Model 12T7 is a table model type television receiver providing reception on all twelve commercial television channels. The picture is produced on a $12\frac{1}{2}$-inch picture tube with electromagnetic deflection.

Features of this television receiver include a built-in antenna, a two stage r-f amplifier, balanced input impedance, selenium type rectifier, intercarrier sound system, ratio detector, efficient high voltage supply for picture tube, automatic frequency control for horizontal sweep synchronization. The head-end assembly which contains the r-f amplifier, the oscillator and converter section is mounted on a separate chassis which is isolated from the main chassis and is readily demounted. The local oscillator operates on the high-frequency side of the r-f channel frequencies for all channels. The r-f amplifier uses stagger tuned circuits on both high and low channels.

The video i-f is stagger tuned to pass the video i-f of 45.75 mc and the sound carrier of 41.25 mc. As this receiver uses intercarrier sound i-f, the video signal is detected at Y1 as well as a 4.5 mc FM television sound signal which is the beat frequency between the 45.75 mc video i-f and the 41.25 mc sound carrier.

The horizontal and vertical sync signals are available at the plate load of V7B and fed into the sync amplifier and clipper, V10. The vertical sweep generator and output (V9) is a 12SN7 connected as a multivibrator. The horizontal sync circuit contains a 6AL5 (V11) tube which is the automatic frequency control discriminator and a reactance tube (V12A) which is one section of a 12SN7 tube.

Tube section V12B operates as a sine-wave oscillator and sawtooth generator. V13 is a type 19BG6 tube which serves as the horizontal sweep output tube. V15 (25W4GT) is a damper tube in the horizontal sweep output circuit. V14 (1B3GT/8016) is a rectifier tube to supply high-voltage d-c from the kick voltage during the retrace period of the horizontal sweep developed at the horizontal output transformer, T351.

The 4.5 mc FM sound signal is taken from the diode load of Y1 and is fed into tube V16 (6AU6) which is a sound i-f amplifier.

Tube V16 is coupled by a transformer T401 to the tube V17 (6AU6) which is a limiter amplifier. Tube V17 is coupled to tube V18 (6AL5) ratio detector by the ratio detector transformer T402. The television audio is then amplified by V19 tube (6SQ7) and coupled to the audio output tube V20, (25L6GT) and then to the loudspeaker through the output transformer T403.

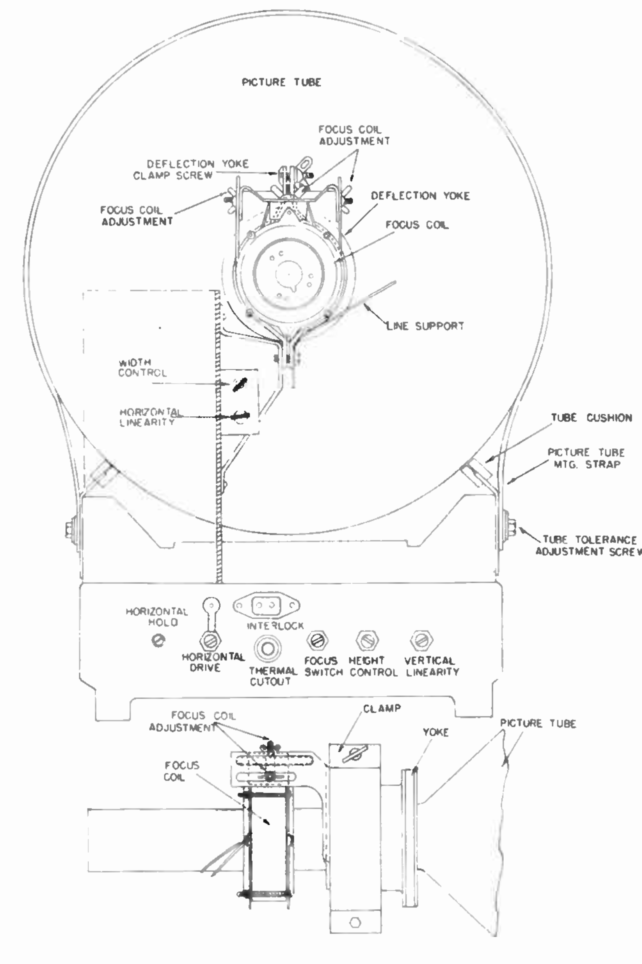

Fig. 2. Preset Controls

INSTALLATION AND SERVICE ADJUSTMENTS

NOTE: ALWAYS WEAR SAFETY GLASSES WHEN HANDLING PICTURE TUBE.

RECEIVER INSTALLATION

The receiver leaves the factory with the picture tube installed. Use care to unpack the receiver. For shipping purposes, the rectifier tube 1B3GT is secured in its socket by means of a rubber band and the horizontal output Type 19BG6 to its socket with a piece of glass tying tape. However, it is not necessary to remove rubber band and tying tape when installing the receiver, but they should be removed the first time the chassis is taken out of the cabinet for service. The two tubes are easily accessible by opening the hinged high voltage compartment shield.

In order to prevent damage to the picture tube during transit, the focus coil is moved close to the yoke assembly and a shipping sleeve is slipped between the focus coil and the tube neck. Loosen all wing nuts on the focus coil bracket, remove the shipping sleeve and move the focus coil back. Then focus and center the picture using a temporary power cord. (See Preset Control Adjustments.)

1. This receiver incorporates a built-in antenna system which

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allows reception without the use of an outdoor antenna installation in many locations. In order to obtain best reception it is advisable to observe the reception in various locations of the room.

2. In case an outdoor antenna has to be used, the antenna lead-in should be as short as possible. The built-in antenna is connected to the dipole terminal, therefore, it is necessary to disconnect the wires of the built-in antenna altogether and connect the transmission line (impedance 300 ohms) of the outdoor antenna installation to the dipole terminals. Any type of antenna system may be used as long as it is connected through a balanced transmission line to the 300 ohm input of the receiver. The choice of the antenna depends on the operating area of the receiver, the number and location of stations to be received. In order to avoid multiple images (ghosts) and interferences, careful experimentation with the antenna system is necessary to obtain satisfactory reception. These problems may be aggravated in fringe areas and sometimes an elaborate installation has to be made to obtain satisfactory results.

Lightning Protection—All outdoor antenna installations must conform to certain standards as set up by the National Electric Code which is usually supplemented by Local Code requirements. In general, some of the requirements are as follows:

1. The metal mast supporting the antenna should be permanently and effectively grounded. Use a ground wire of minimum size as specified in the Local Code.

2. An approved television lightning arrester must be used with the antenna lead-in conductors at a point of entrance to the building. If shielded lead-in cable is used, the shield may be permanently grounded in lieu of using the lightning arrester.

For detailed information on antenna installations, refer to Chapter XIII of the Television Course RSM-4-13.

3. A power outlet providing 115 volts at 60 cycles per second must be in easy reach of the television receiver.

4. Locate so that the room illumination, in daytime or nighttime, falling on the screen of the picture tube may be controlled. If this cannot be done, locate the receiver in such a position that light from a window does not fall directly on the screen of the picture tube. For nighttime use, it is unnecessary to turn out all lights when viewing.

5. Ventilation of the television receiver is very important. Slots are provided in the cabinet back and bottom for ventilation. These slots should not be obstructed. Do not locate the receiver on or too near any heating device.

PRESET CONTROL ADJUSTMENTS
(See Figure 2)

Remove the shipping sleeve between the focus coil and the tube neck and move the focus coil backwards towards the tube base. Then adjust the ion trap for maximum illumination of the screen. The adjustments of the preset controls should be made during transmission of a picture and are greatly enhanced by viewing a station test pattern.

1. ION TRAP—After the receiver is turned on, start with the ion trap set on the picture neck midway between the focus coil assembly and picture tube base. Leaving the receiver with maximum setting of brightness control without adjusting the ion trap might damage the gun structure of the picture tube. Alternately rotate and the move the trap forward and backward along the neck of the tube for maximum brightness of the screen. As the screen becomes brighter, reduce brightness by adjusting the front panel Brightness control. Power should not be applied for any great length of time without the ion trap adjusted for some illumination.

2. FOCUS—The focus switch, S401, on the rear panel should be set to the position which allows the front control, R421, to focus the picture nearest the center of its rotation and to give uniform focus over the greatest picture area.

NOTE: The focus coil should be located as near to the picture tube base as possible when centering the picture to give most uniform focus. (See Picture Centering.) It is important to readjust the ion trap for maximum brilliance after the focus coil has been adjusted.

3. PICTURE TILT—If the picture or raster does not square with the picture tube mask, loosen the wing nut at the top of the yoke clamping bracket and rotate the deflection yoke in the proper direction until the picture squares with the mask. Clamp the yoke tightly in place.

4. PICTURE CENTERING—Centering of the picture or raster is accomplished by loosening the wing nuts which secure the focus coil and adjusting the position of the focus coil until the raster or the picture is centered.

The focus coil may be moved slightly in various directions: it may be moved vertically by loosening the two side wing nuts; it may be moved horizontally or rotated about its vertical axis by loosening the top wing nut. Furthermore, it may be tilted about a horizontal axis by loosening the two side wing nuts.

When making the adjustment, it is advisable to loosen all three wing nuts and make an approximate adjustment of the focus coil. Tighten the three wing nuts enough to maintain the focus coil in place but loose enough so it may be moved to a final position. After a final position has been found which gives good centering of the picture, tighten the three wing nuts securely.

Do not leave the focus coil set in such a position as to give neck shadow at one edge of the picture. (Fig. 13.)

5. HORIZONTAL HOLD—Rotate the front panel Horizontal Hold control R365 to the middle of its range. Adjust the core of the rear panel Horizontal Hold control L351 until the picture is synced and is phased at the center of the raster.

The pull in range should be equally distributed either side of the front panel horizontal hold control center position. Readjust the rear panel hold control if necessary.

Check pull in sensitivity by switching from an empty channel to a station with the receiver properly tuned to that station.

6. HORIZONTAL LINEARITY—The Horizontal Linearity control (L352) adjusts the picture for correct horizontal proportions. For best adjustment, use a test pattern and adjust the Horizontal Linearity control until the distance from the center of the test pattern to the left- and right-hand edges of the test pattern measures approximately the same. The adjustment of this control is very broad and it should be made simultaneously with the adjustment of the Width control (L353) to get proper picture width and correct horizontal linearity. (See Fig. 12.)

7. HORIZONTAL DRIVE—The Horizontal Drive control (R369) should be set approximately 1/3 of its total rotation from the counterclockwise end of its rotation. If white vertical bars or black beaded lines appear in the picture, the Drive control should be turned in either direction to just remove these white vertical bars or beaded lines.

8. WIDTH—Adjust the Width control (L353) so that the edges of the picture extend approximately one-eighth inch past the right- and left-hand edge of the mask and are not visible (Fig. 11).

9. VERTICAL LINEARITY—This control (R311) should be adjusted to give good vertical proportions to the picture. The adjustment should be made on a test pattern so that the distance from the center to the top and bottom edges of the pattern measures approximately the same. This adjustment will alter the height of the picture slightly. (See Fig. 9.)

10. HEIGHT—This control (R308) changes the picture height and should be adjusted so that the picture extends approximately 1/8 inch beyond the top and bottom edges of the mask. This adjustment should be made simultaneously with the Vert. Linearity Control R311.

11. THERMAL CUT-OUT—This is a protective device to remove line voltage from the receiver in case of excessive current drain or excessive heat, within the chassis. A five minute period should be allowed after this control has tripped before resetting. If the control continues to trip out, the receiver should be checked.

12. HIGH CHANNEL TRAP—This receiver incorporates a trap on the head-end unit which is switched into the antenna circuit on all low-band channels and will eliminate high channel interference on these channels. If the receiver is tuned to Channel No. 5, a strong station operating on Channel No. 11 may beat with the second harmonic of the local oscillator to form an i-f frequency which will ride through unhindered and appear on the picture screen. In order to prevent the interfering signal from reaching the converter, a trap consisting of a fixed inductance and a variable capacitance is adjusted for maximum rejection of the interfering station. This type of interference is also possible on Channels No. 4 and No. 6 due to interfering stations on Channels No. 8 and No. 13, respectively. The trap is adjusted at the factory approximately for Channel No. 11 rejection. It may be necessary to readjust the trap slightly for maximum rejection of Channel No. 11.

The adjustment of the trap can be made by means of a signal generator and an oscilloscope or an a-c meter as indicating device. The signal generator must be terminated to match 300 ohms impedance. For elimination of Channel No. 8, No. 11, or No. 13 interference, feed a strong signal of the picture carrier frequency of the interfering station modulated with an audio signal into the antenna terminals and connect the indicating device to the picture grid tube. Set the band selector to the Channel No. 4, No. 5, or No. 6, respectively, and tune local oscillator of receiver for maximum deflection on indicating device. Then tune trimmer C206 for minimum signal on picture tube grid.

The adjustment of the trap can be made without instruments as follows: When the channel interference appears in the picture, set the tuning control for maximum interference. Then tune trimmer C206 for minimum interference or maximum rejection.

PICTURE DEFECTS

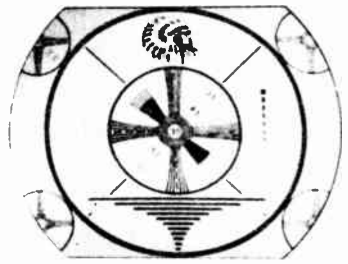
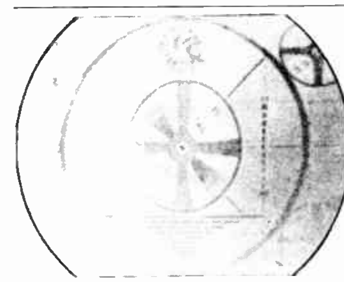
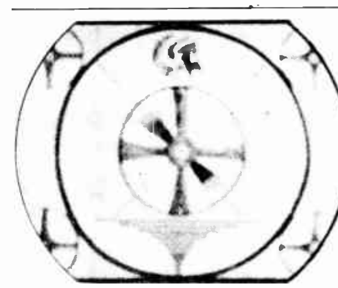
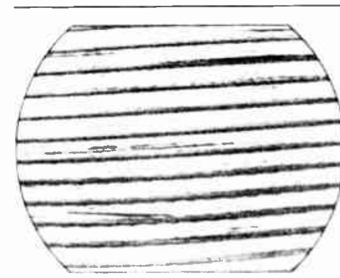
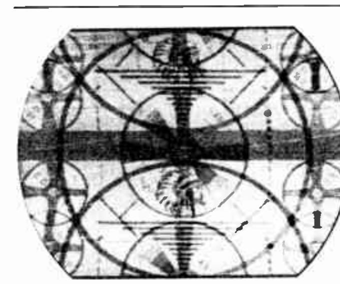


Fig. 3
Normal picture.

The following illustrations show picture defects which are caused by incorrect setting of operation controls, the preset controls or by interference picked up by the antenna. The possible remedy is indicated for each defect.

The adjustment of controls is most efficiently accomplished by the use of a test pattern, similar to that illustrated to the left, which is normally transmitted just prior to the scheduled program.

The normal picture should show good focus and a good contrast between blacks and whites with intermediate shades of gray. The picture should not tend to either move vertically or horizontally out of sync. It should show good vertical and horizontal linearity.

PICTURE	DEFECT	REMEDY
	**Fig. 4** **Picture too light.**	1. Increase Picture control setting and/or reduce brightness. 2. Weak signal. This may be caused by insufficient pickup on antenna or defective lead-in. Insufficient pickup at maximum contrast usually is accompanied by "snow" on the picture.
	**Fig. 5** **Picture too dark (contrast).**	1. Reduce Picture control setting and/or increase Brightness control setting. 2. Too strong signal. If it is not possible to reduce signal adequately with Picture control, install suitable resistor pad in antenna input circuit.
	**Fig. 6** **Picture defocussed.**	1. Adjustment of Focus controls. 2. Check for optimum uniformity of focus by moving focus coil (see installation and service adjustments, page 1). 3. Mistuning of receiver or misalignment of electrical circuits.
	**Fig. 7** **Horizontal sync.**	1. Adjust Horizontal Hold control (front panel control). 2. Check adjustment of rear panel Horizontal Hold control. 3. Horizontal Drive control set too far clockwise. 4. Signal improperly tuned.
	**Fig. 8** **Vertical sync.**	1. Adjust Vertical Hold control until picture shows no tendency to slide up or down or lock out of frame.

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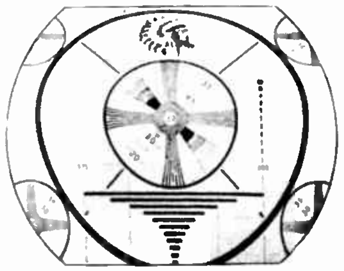
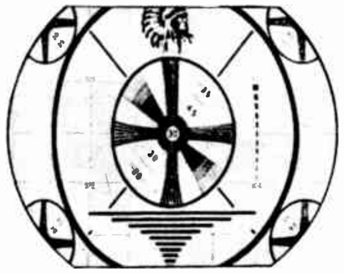
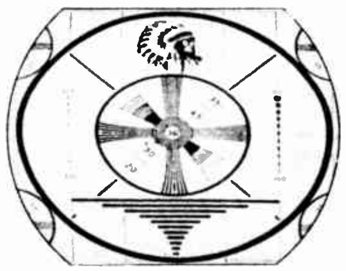
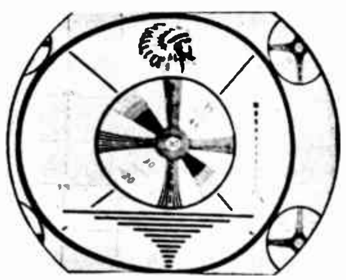
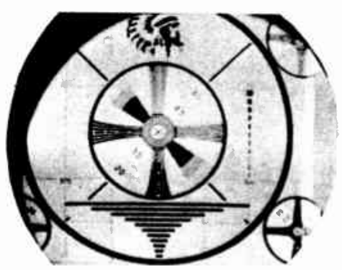
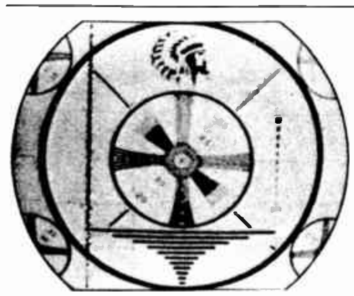
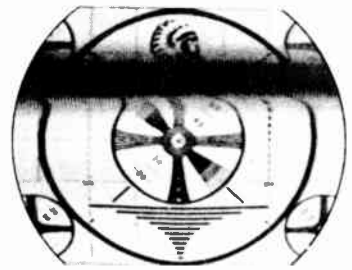
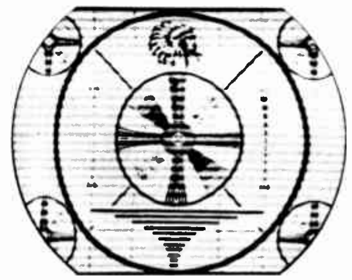
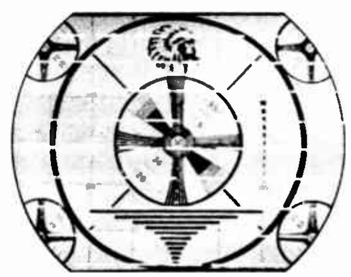
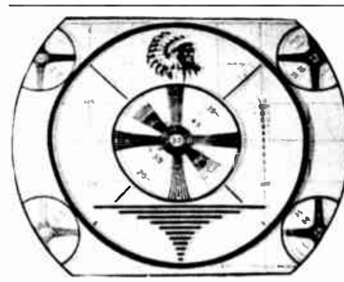
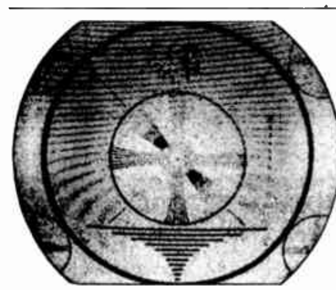
PICTURE	DEFECT	REMEDY
	**Fig. 9** Vertical linearity.	1. Adjust Vertical Linearity control. This adjustment may alter the Height control adjustment.
	**Fig. 10** Vertical height.	1. Adjust Height control so that the top and bottom picture edges are just covered by mask. Recheck Vertical Linearity control setting.
	**Fig. 11** Picture too wide.	1. Adjust Width control so that the right and left picture edges are just covered by the mask.
	**Fig. 12** Horizontal linearity.	1. Adjust Horizontal Linearity control. This adjustment may require resetting of Width control. 2. Adjust Drive control as described under Installation and Service Adjustments, page 1.
	**Fig. 13** Neck shadow.	1. Misadjustment of Focus coils—tilted too far. 2. Deflection yoke too far back. 3. Readjust Ion Trap.
	**Fig. 14** Barkhausen oscillation.	One or several vertical dark lines when program is being received. 1. Readjust horizontal drive control, R369. 2. Change 19B6G sweep output tube.

PICTURE INTERFERENCES

PICTURE	DEFECT	REMEDY
	**Fig. 15** Herringbone pattern over picture.	This interference is caused by a television station operating on the next lower channel or by a short-wave radio transmitting and receiving equipment. Police and "ham" transmitters in your locality will usually cause the most severe conditions. The interference produces moving ripples or diagonal streaks or, in some cases, may cause loss of contrast of the picture. The use of an antenna wavetrap tuned to the interfering signal may assist. If the interference is from a TV or FM station, a transmission line shorted stub may remove the interference. If the pickup is on the lead-in, a shielded lead-in will help correct the trouble.
	**Fig. 16** Diathermy interference	Diathermy equipment is used by hospitals and doctors and can be very annoying because it might ruin the reception completely. This interference manifests itself in a herringbone pattern or one or two dark bars moving slowly up or down the picture. If the disturbance is extremely strong, the interference pattern will remain stationary while the picture floats in the background. Improve your antenna installation using directive antenna systems and shielded transmission line.
	**Fig. 17** Horizontal bars on picture.	This interference is caused by adjacent channel sound or microphonics in receiver. If adjacent channel sound is responsible for this defect, readjust the adjacent channel trap. See Video IF alignment. A microphonic video amplifier tube, V7, may cause this condition.
	**Fig. 18** Ignition interference.	Ignition interference from trucks, automobiles, and airplanes may be identified by streaks and splashes on the picture. The ignition system of trucks will produce the most intense interference pattern. Install antenna away from road carrying traffic. Shielded lead-in may help if interference is picked up on it.
	**Fig. 19** Multiple images (ghosts).	This is caused by the television signal following a multiple path, one of which is the direct path, and the other is reflected from some object such as a tall building or a large storage tank or hills. The signal following the longer reflected path arrives later at the receiver producing the second image. In case a built-in antenna is used, try to turn the cabinet until the ghost picture is a minimum. If your receiver is connected to an outdoor installation, a reorientation of the antenna might improve the reception.
	**Fig. 20** "Snow."	1. Too weak signal; increase efficiency of antenna installation 2. Adjust tuning control.

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CIRCUIT ALIGNMENT

TO PROTECT TEST EQUIPMENT ALWAYS USE AN ISOLATION TRANSFORMER

GENERAL

A complete alignment of the receiver tuned circuits is given in the following charts. Read all alignment notes before making an alignment. The alignment procedure described follows the sweep method using General Electric test equipment. When other test equipment is used, check that they meet the different requirements for proper alignment. Suitable test equipment is essential for proper alignment of the receiver and under no circumstances try to align with inadequate test equipment. For a detailed discussion of this problem, refer to our publication Television Principles and Practice, Chapter 14. In order to speed up the alignment procedure, it is advisable to use the service diagram, Figure 29, page 8, and the tube and trimmer location, Figure 22, page 5.

In connecting the test equipment to the points indicated on the charts, make the leads as short as possible. This is particularly necessary of the ground leads of the test equipment which should be connected to the B− bus of the receiver.

Always allow test equipment and receiver to warm up for at least 15 minutes before starting the alignment.

It is often advisable to perform the alignment with the picture tube removed. The filament circuit can be completed by using a Type 6SN7 tube with all pins clipped off except pins No. 7 and No. 8 which must be plugged into No. 1 and No. 12 of the picture tube socket.

TEST EQUIPMENT

The following test equipment is necessary in order to affect alignment of the tuned circuits of the receiver:

1. R-F SWEEP GENERATOR.
(G-E Type ST-4A or Equivalent)

a.) Frequency Requirements:

4.5 MC with 500 KC and 2 MC sweep width.
40–50 MC with approximately 10 MC sweep width.
50–90 MC, 170–220 MC with 15 MC sweep width

b.) Constant output in the sweep range.

c.) Minimum output 0.1 volt.

2. MARKER GENERATOR.
(G-E Type ST-5A or Equivalent)

The marker generator must have good frequency stability, accurate calibration and must cover the following frequencies:

a.) 41.25 MC for video IF
42.50 MC for video IF
44.20 MC for video IF
44.50 MC for video IF
45.00 MC for video IF
45.75 MC for video IF
47.25 MC for video IF

b.) 4.5 MC for sound IF and trap alignment.

c). Picture and sound carrier frequencies for Channel No. 2 through No. 13.

3. BALANCED OUTPUT ADAPTER.
(G-E ST-8A or Equivalent)
See RF Alignment, note 1.

4. OSCILLOSCOPE.
(G-E Type ST-2A or Equivalent)

The oscilloscope should have good sensitivity and preferably a 5-inch screen with a good wide-band frequency response on the vertical deflection circuits. Although the high frequency response is not necessary for alignment, it is imperative when making waveform measurements.

5. VACUUM TUBE VOLTMETER.

A vacuum tube voltmeter (VTVM) is necessary to measure the bias of 4 volts required for video and RF alignment.

6. DETECTOR NETWORK.

A crystal detector network as shown in Figure 27 is necessary when aligning the 4.5 mc trap, L260.

7. MISCELLANEOUS.

a.) One 10,000 ohm resistor to isolate the scope as noted in the charts.

b.) One .01 mf. capacitor for isolation of sweep generator.

c.) One 680 ohm resistor for IF coil shunt (RF alignment).

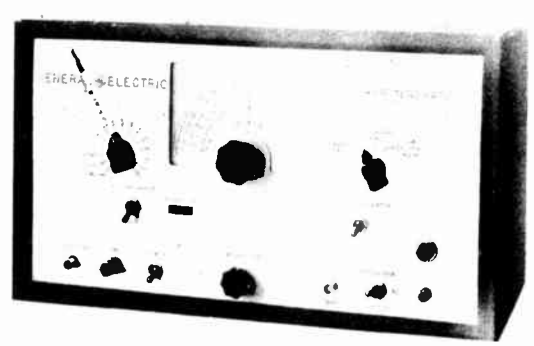
d.) One 400 mf. electrolytic capacitor, 350 volt for reducing hum (RF alignment).

e.) One 100 ohm resistor for reducing hum (RF alignment).

f.) Impedance matching pad for RF alignment as shown in Figure 28.

g.) Bias battery to supply −4 volts as noted for Video IF and RF Alignment.

GENERAL ELECTRIC
R-F SWEEP GENERATOR
MODEL ST-4A



GENERAL ELECTRIC
MARKER GENERATOR, MODEL ST-5A

VIDEO I-F ALIGNMENT

NOTES:

1. The sweep generator should be properly terminated in its characteristic impedance. Couple the signal to the input point through a .01 mf. capacitor and adjust signal input to give a video response curve of ¾ volt as shown in Figure 21.

2. Connect a bias battery from junction of C261, R263, and the picture control R262 to B− with the positive side of the battery connected to B−. Adjust picture control to give a −4 volt bias at the grid pin 1 of tube V4 measured with a VTVM. Disconnect its leads during alignment.

3. The traps L227 and L253 must be detuned before aligning the video i-f amplifier by turning the cores all the way out of the coil. When returning these traps to 47.25 mc (as in step 6), for minimum amplitude, increase scope gain as amplitude at 47.25 mc marker point is attenuated, to provide optimum setting.

4. Set channel switch to Channel #12 or #13 and check for oscillator influence by turning the tuning control. If response curve is affected, switch to another channel where oscillator influence is absent.

5. In general, it is only necessary to perform an over-all alignment of the video i-f, as in step 7 of the Video Alignment Chart, in order to obtain i-f response curve of Figure 21-E.

When aligning the i-f coils, L251 will adjust the audio or low frequency side of the i-f response curve, while L252 will adjust the video or high frequency side of the i-f response curve. L226 and L254 should be adjusted simultaneously to reduce the saddle-back at the peak of the curve and to give maximum gain and retain 45.75 mc and 42.50 mc markers at the 50% mark.

6. It is necessary to detune the i-f coils by shorting as noted in the alignment chart to prevent the coil preceding the signal input point from influencing the response curve.

7. It is important that the 45.75 mc marker should fall at the 50% response point to give proper curve of Figure 21-E.

8. After adjustment of the two sound traps, readjust the i-f curve to obtain the proper response curve as illustrated in Figure 21-E.

Video I-F Alignment Chart

STEP	MARKER GENERATOR FREQUENCY	SWEEP GENERATOR FREQUENCY	SIGNAL INPUT POINTS BETWEEN	CONNECT OSCILLOSCOPE BETWEEN	ADJUST	SEE NOTE NO.
1	—	—	—	—	Detune L227 and L253 by turning cores out of coil.	3
2	44.50 MC	40–50 MC	V6 grid (pin 1) through .01 mf. cap. and B− on head-end shield. Pins 5-6 shorted on V5.	Junction L256, R265, C268 through 10K ohms and B− on V7 socket.	Core of L254 for curve of Fig. 21A.	
3	45.75 MC		V5 grid (pin 1) through .01 mf. cap. and B− on head-end shield. Short L251. Remove short of step 2.		Core of L252 for curve of Fig. 21-B.	1, 2, 4, 6
4	42.50 MC, 45.75 MC		V4 grid (pin 1) through .01 mf. cap. and B− on head-end shield. Short L226. Remove short of step 3.		Core of L251 for curve of Fig. 21-C.	
5	44.2 MC		Junction L215 and L216 on second RF switch wafer through .01 mf. cap. and B− on head-end shield. Remove short of step 4.		Core of L226 for curve of Fig. 21-D.	1, 2, 3, 4, 7
6	47.25 MC				Cores of L227 and L253 for min. output at 47.25 MC (Fig. 21-E).	
7	41.25 MC, 42.50 MC, 45.00 MC, 45.75 MC, 47.25 MC				Cores of L251, L252, L254 and L226 for curve of Fig. 21-E.	1, 2, 4, 5, 7, 8

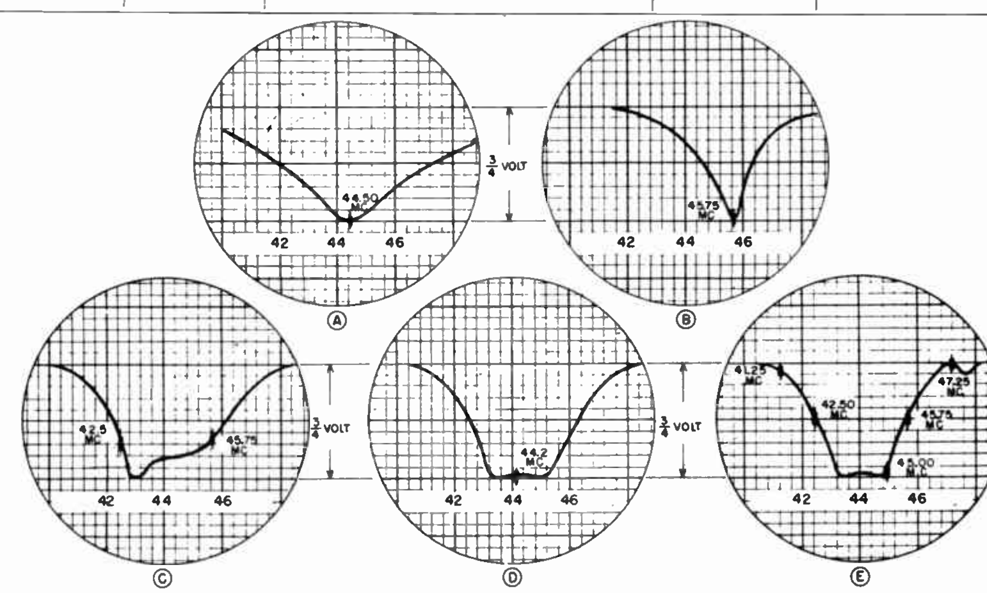


Fig. 21. Video I-F Curves

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AUDIO I-F ALIGNMENT

NOTES:

1. Feed a 4.5 mc signal with a 500 kc sweep and adjust for proper response curve as indicated in the chart.

2. Transformer T401 is adjusted for maximum amplitude and symmetry of the response curve about 4.5 mc marker (Figure 23-A).

3. The secondary of T402 is adjusted for curve, Figure 23-B. This adjustment should give as straight a slope as possible between the positive and negative peaks with the center of the 4.5 mc marker falling midway between the peaks.

4. The primary of T402 is adjusted for maximum of the positive and negative peaks. If necessary, readjust the secondary of T402 so that the marker falls midway between the peaks.

5. Keep the input signal of the sweep generator low enough so that limiting does not take place, otherwise the response curve will broaden out preventing correct adjustment. Check by increasing the output generator: the response curve should increase in amplitude.

6. As a final check (step 12), readjust the secondary of T402 for minimum buzz on all available stations.

7. An alternate method to the visual alignment is the sound output method using an operating television station, preferably when transmitting tone modulation during test pattern transmission.

a. Tune the receiver for best detail.

b. Set the picture control to give reduced contrast or by using a resistor pad in the antenna circuit.

c. Adjust transformer T401 and primary of T402 for maximum sound output.

d. Adjust the secondary of T402 for best quality audio reception and for minimum buzz in the output.

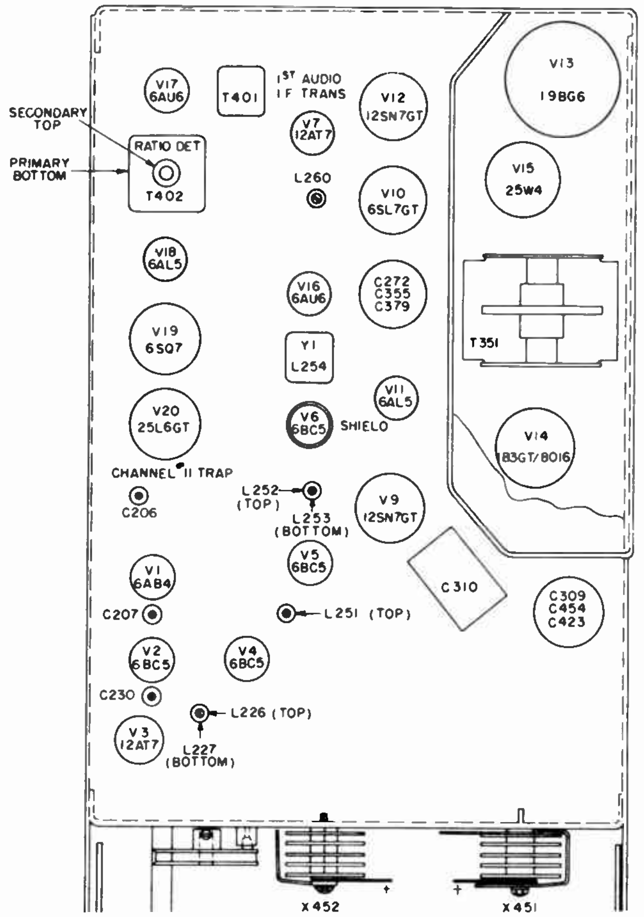

Fig. 22. Tube and Trimmer Location

Audio I-F Alignment Chart

STEP	MARKER GENERATOR FREQUENCY	SWEEP GENERATOR FREQUENCY	SIGNAL INPUT POINTS BETWEEN	CONNECT OSCILLOSCOPE BETWEEN	ADJUST	SEE NOTE NO.
8			Pin 1 of V16 through .01 mfd. cap. and B−.	Junction of R404, C404 & sec. of T401 through 10K and B−.	Primary and secondary of T401. See Fig. 23-A.	1, 2, 5
9	4.5 MC	4.5 MC ± 500 KC keep signal below limiting level of receiver.			Secondary of T402. See Fig. 23-B.	1, 3, 5
10			Pin 1 of V17 through .01 mfd. cap. and B−.	Junction of R408, C411 and R411 through 10K and B−.	Primary of T402. See Fig. 23-B.	1, 4, 5
11					Secondary of T402. See Fig 23-B.	1, 3, 5
12	Recheck alignment of step 11 on operating station as in note 6.					6

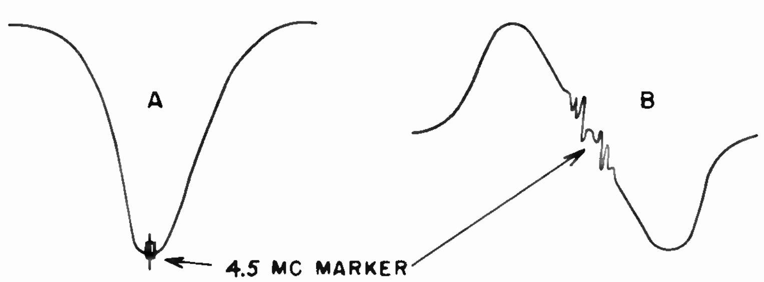

Fig. 23. Audio I-F Curve

R-F ALIGNMENT

Notes:

1. Disconnect the transmission line to the antenna from the head-end. Couple the input of the sweep generator to the head-end terminals through balanced output adapter G-E ST-8A, or equivalent. Couple this to the head-end terminals through a piece of 300-ohm transmission line. Terminate the 300 ohm line in a pad, as shown in Figure 28-A, page 6

If a balanced output is not available for the sweep generator a matching network as shown in Figure 28-B may be used. A balanced output is recommended since a matching network as shown in Figure 28-B may introduce frequency shift and cause a misleading tilt to the response curve.

Ro shown in Figure 28-B is the terminating resistor. If this resistor is not already incorporated in the output of the sweep generator, it should be added to the matching network as shown.

2. It is necessary to connect a bias battery from the junction of the picture control, C261, and R263 to B− with plus of bias battery to B−. Adjust the picture control to give a −4 volts bias measured from pin 1 of V2 to the head-end chassis B−.

3. Shunt L226 with a 680 ohm; ½ watt resistor during r-f alignment to prevent the oscillator from influencing the response curve. To reduce the effect of hum on the response curve, connect a 100 ohm resistor between the head-end B+ and the chassis B+ and connect an electrolytic capacitor of approximately 400 mf., 350 volt from head-end B+ to head-end B−.

4. On all channels the picture carrier marker should not be less than 75% of the peak of the r-f response curve. The sound carrier marker should not be less than 50% of the peak of the response curve. On the high channels the picture carrier marker should ride up nearer to the top of the curve provided the sound carrier marker does not go below 50%. On the low channels the picture carrier marker should ride as high up on the curve as possible and still keep the sound carrier marker above 50%.

5. Coils for Channels #12 through #7 are fixed inductances. Check the alignment on these channels as in steps 16 through 21 for proper response curve. Readjust L210 and L217 on Channel #13 and C207 and C230 on Channel #7 if necessary.

6. Coils for Channels #5 and #4 are fixed inductance. Check the alignment on these channels for proper curve. Readjust coils L208 and L215 to give proper curve on Channels #6, #5, and #4.

7. The coil for Channel #2 is a fixed inductance. Check the alignment on this channel for proper curve. Readjust L205 and L212 to give proper curve on Channels #3 and #2.

8. The trimmers C207 and C230 may be used to compensate for differences in tube capacities which affect tracking when it is necessary to change the tubes V1 or V2. The variations in tube capacities has normally little effect on the over-all performance of the head-end.

R-F Alignment Chart

STEP NO.	MARKER GENERATOR FREQUENCY	SWEEP GENERATOR FREQUENCY	SIGNAL INPUT POINT	CONNECT OSCILLOSCOPE	CHANNEL SWITCH	ADJUST	SEE NOTE
13	211.25 MC, 215.75 MC	No. 13 with 15 MC sweep			No. 13	Screw of L210, screw of L217, for Fig. 24-A.	1, 2, 3, 4, 5
14	175.25 MC, 179.75 MC	No. 7 with 15 MC sweep			No. 7	Trimmers C207 and C230 for response curve, Fig. 24-A.	1, 2, 3 4, 5, 8
15	211.25 MC, 215.75 MC	No. 13 with 15 MC sweep			No. 13	Readjust screw of L210 and screw of L217 for curve, Fig. 24-A.	1, 2, 3, 4, 5
16	205.25 MC, 209.75 MC	No. 12 with 15 MC sweep			No. 12		
17	199.25 MC, 203.75 MC	No. 11 with 15 MC sweep			No. 11		
18	193.25 MC, 197.75 MC	No. 10 with 15 MC sweep			No. 10		
19	187.25 MC, 191.75 MC	No. 9 with 15 MC sweep	Antenna terminals at head-end (see Note 1).	Junction of L226, C217 and R218 through 10K resistor and B− at head-end chassis.	No. 9	No adjustment.	5
20	181.25 MC, 185.75 MC	No. 8 with 15 MC sweep			No. 8		
21	175.25 MC, 179.75 MC	No. 7 with 15 MC sweep			No. 7		
22	83.25 MC, 87.75 MC	No. 6 with 15 MC sweep			No. 6	Screw of L208 to place 83.25 MC marker and screw of L215 to place 87.75 MC marker as shown in Fig. 24-B.	1, 2, 3, 4, 6
23	77.25 MC, 81.75 MC	No. 5 with 15 MC sweep			No. 5		
24	67.25 MC, 71.75 MC	No. 4 with 15 MC sweep			No. 4	No adjustments.	6
25	61.25 MC, 65.75 MC	No. 3 with 15 MC sweep			No. 3	Screw of L205 to place 61.25 MC marker and screw of L212 to place 65.75 MC marker, as shown in Fig. 24-B.	1, 2, 3, 4, 7
26	55.25 MC, 59.75 MC	No. 2 with 15 MC sweep			No. 2	No adjustment.	7

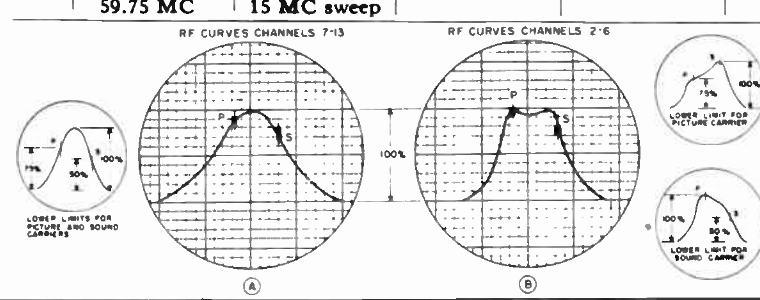

Fig. 24. R-F Alignment Curves

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OSCILLATOR ALIGNMENT

Notes:

Before attempting this oscillator alignment, it must be certain that the video i-f stages and r-f stages are properly aligned as outlined previously.

1. Disconnect the 300 ohm line from the r-f head-end terminals and connect sweep generator to head-end properly terminating sweep generator output cable as shown in Figure 28-A or 28-B. See Note 1 of RF Alignment.

2. Alignment is made by viewing the response curve at the output of the video i-f detector.

3. Use a video carrier marker as shown in each step of the Alignment Chart.

4. The oscillator inductance for Channels #12 through #7 are fixed. The alignment on these channels should be checked to see that the tuning control C213 will move the video carrier marker up and down the entire high frequency side of the response curve. Readjust L225 if necessary.

5. When adjusting L225 as in step 27, the tracking on Channels #12 through #7 should be checked. Set C213 at the center of its rotation. Adjust L225 so that the video carrier marker falls as near as possible to the 50% point on the high frequency slope as the receiver is switched to each channel from 7 through 13 with this setting of C213 for all channels from 7 through 13.

6. On Channels #6 through #2 set the tuning control C213 at the center of its rotation and make the indicated adjustment so that the video carrier marker falls at the 50% mark on the high frequency slope of the response curve.

Oscillator Alignment Chart

STEP NO.	MARKER GENERATOR FREQUENCY	SWEEP GENERATOR FREQUENCY FOR CHANNEL	SIGNAL INPUT POINTS	CONNECT OSCILLOSCOPE BETWEEN	CHANNEL SWITCH SETTING	ADJUST	SEE NOTE
27	211.25 MC	No. 13 with 15 MC sweep	Antenna terminals of head-end (see Note 1).	Junction of L256, R265, C268 through 10K ohm resistor and B− at V7 socket (pin 3).	No. 13	L225 by squeezing or spreading turns slightly.	1, 2, 3, 4
28	205.25 MC	No. 12 with 15 MC sweep			No. 12	No adjustments.	5
29	199.25 MC	No. 11 with 15 MC sweep			No. 11		
30	193.25 MC	No. 10 with 15 MC sweep			No. 10		
31	187.25 MC	No. 9 with 15 MC sweep			No. 9		
32	181.25 MC	No. 8 with 15 MC sweep			No. 8		
33	175.25 MC	No. 7 with 15 MC sweep			No. 7		
34	83.25 MC	No. 6 with 15 MC sweep			No. 6	Screw of L223.	1, 2, 3
35	77.25 MC	No. 5 with 15 MC sweep			No. 5	Screw of L222.	
36	67.25 MC	No. 4 with 15 MC sweep			No. 4	Screw of L221.	
37	61.25 MC	No. 3 with 15 MC sweep			No. 3	Screw of L220.	
38	55.25 MC	No. 2 with 15 MC sweep			No. 2	Screw of L219.	

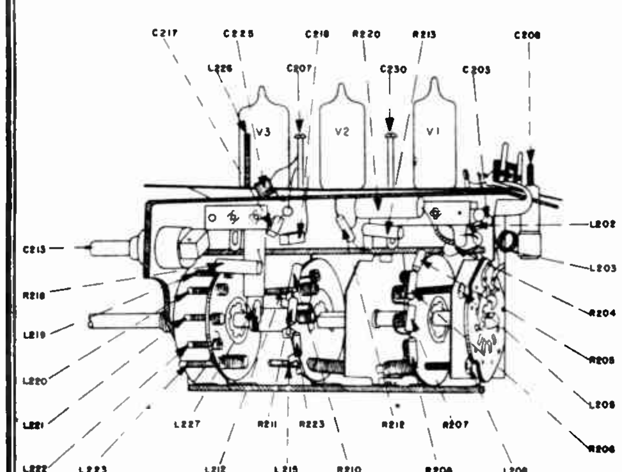

Fig. 25. Head-end Unit

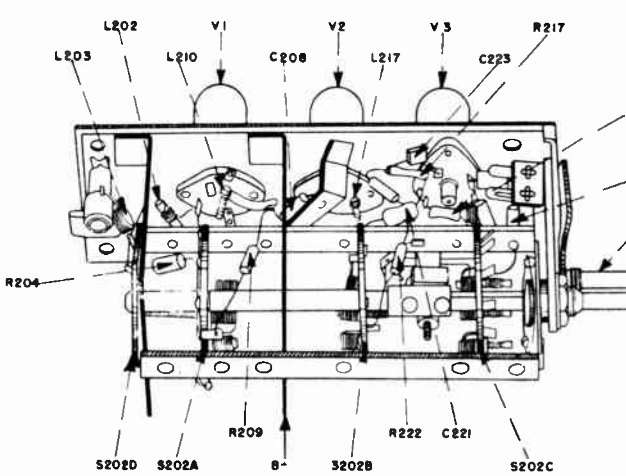

Fig. 26. Head-end Unit

ADJUSTMENT OF VIDEO AMPLIFIER 4.5 MC TRAP (L260)

Notes:

This trap is used to remove 4.5 mc audio i-f from the video amplifier which shows up in the picture as a cross-hatch pattern. This trap will vary rarely require adjustment. Adjustment is as follows:

1. The trap (L260, C271, C270) is adjusted for minimum amplitude of the 4.5 mc marker. Use a detector network as shown in Figure 27 connected from junction of L264 and C275 to B− to detect the signal.

2. Adjust the vertical hold control to remove the vertical pulses from the response curve.

3. Short horizontal oscillator coil L351 to remove horizontal oscillator interference in the response curve.

4.5 MC TRAP (L260) ALIGNMENT CHART

STEP	MARKER GENERATOR FREQUENCY	SWEEP GENERATOR FREQUENCY	SIGNAL INPUT POINT	OSCILLOSCOPE	ADJUST	SEE NOTE
39	4.5 MC	4.5 MC ±1 MC	Junction L256, R265, C268 and B− thru .01 mf.	Across 100K resistor as shown in Fig. 27. (See Note 1.)	L260 for min. amplitude of 4.5 mc marker. Increase scope gain as amplitude at 4.5 mc is attenuated	1, 2, 3

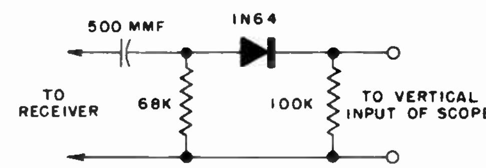

Fig. 27. Detector Network

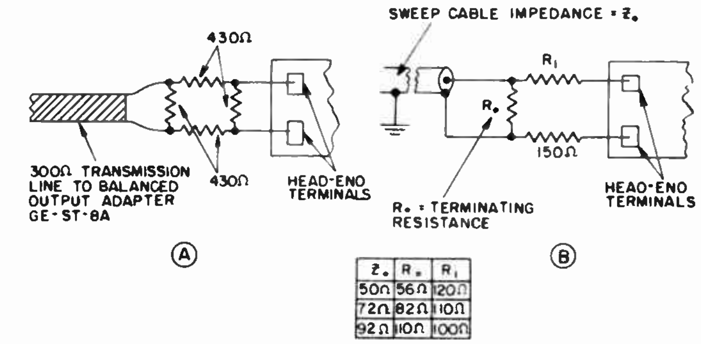

Fig. 28. Sweep Generator Termination

TROUBLE SHOOTING SECTION

In order to speed up trouble shooting procedure, this trouble shooting section is divided in two parts: Trouble Shooting Charts and Trouble Shooting Analysis. The charts are subdivided according to the symptoms as they affect the picture or sound so that it is an easy matter to find the symptoms observed on the particular receiver. The second columns of the charts indicate the part or section to be checked. The third columns refer to the respective paragraphs in the following Trouble Shooting Analysis which describe in detail the possible source of defect or the necessary adjustments to obtain normal operation of the receiver.

TROUBLE SHOOTING CHARTS

Symptom	Check	Analysis No.
Picture Quality Defects		
1. No picture, no raster, no sound.	(a) Power supply.	
2. No picture, no raster, sound normal.	(a) Picture tube. (b) High voltage power supply. (c) Ion trap.	
3. No picture, no sound, raster normal.	(a) RF and video IF circuit.	A, 1
4. No picture, raster and sound normal.	(a) Video amplifier.	B, 1
5. Poor focus. (See Fig. 6)	(a) Focus coil. (b) Focus coil circuit.	
6. Poor focus and picture blooming.	(a) For gassy picture tube.	C, 3
7. Neck shadow. (See Fig. 13)	(a) Focus coil adjustment. (b) Ion trap adjustment. (c) Yoke assembly adjustment.	G, 1 G, 2 G, 4
8. Ghost. (See Fig. 9)	(a) Antenna orientation. (b) Antenna lead-in. (See page 3)	
9. "Snow." (See Fig. 20)	(a) Antenna installation. (See page 3)	
10. Poor detail.	(a) RF and video IF circuits. (b) Picture control circuit.	A, 1 A, 4
11. Insufficient brightness.	(a) Ion trap adjustment. (b) Picture tube. (c) Pix tube anode or bus voltage.	G, 2
12. Excessive contrast. (See Fig. 5)	(a) Sync Section.	F, 1
13. Excessive contrast with shaky picture.	(a) Sync Section.	F, 2
14. Very bright, fuzzy picture.	(a) Picture tube circuit.	C, 5
15. No picture on one channel.	(a) Channel switch.	A, 6
16. Distorted picture.	(a) Video amplifier.	B, 1
17. Smeared picture.	(a) Video amplifier.	B, 4

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TROUBLE SHOOTING SECTION (Cont'd)

Symptom	Check	Analysis No.
Raster Defects		
1. Raster not centered.	(a) Focus coil adjustment.	G, 1
2. Tilted raster.	(a) Focus coil adjustment.	G, 1
3. Excessive raster size.	(a) Low anode voltage to pix tube.	
4. Raster width too small.	(a) Circuit of horizontal sweep output tube. (b) Width control shorted or misadjusted.	
5. Raster height too small.	(a) Height control circuit. (b) Circuit of vertical sweep output tube.	G, 5
6. Unsymmetrical, trapezoidal raster.	(a) Deflection yoke position.	G, 3
7. Barrel distortion.	(a) Deflection yoke position.	G, 3
Sweep and Sync Defects		
1. No horizontal or vertical sync.	(a) Clipper circuit of V10.	D, 6
2. Insufficient sweep width.	(a) Horizontal sweep circuit.	D, 2
3. No raster, one horizontal line.	(a) Vertical sweep circuit. (b) Vertical deflection yoke.	E, 1 G, 3
4. No raster, one vertical line.	(a) Horizontal deflection yoke.	G, 3
5. Raster not stable.	(a) High voltage power supply.	
6. Poor horizontal linearity.	(a) Horizontal sweep circuit. (b) Horizontal linearity control.	D, 3
7. Poor vertical linearity.	(a) Vertical linearity control. (b) Vertical sweep circuit.	E, 3
8. Picture not centered.	(a) Focus coil adjustment. (b) Horizontal sweep circuit.	D, 4
9. Unstable horizontal sync.	(a) Horizontal sweep circuit.	D, 5
10. Unstable vertical sync.	(a) Vertical sync input.	E, 5
11. Reduction of height.	(a) Height control. (b) Vertical sweep circuit.	E, 3, 4, 6
12. Small picture.	(a) Picture tube circuit.	C, 5
13. Retrace lines increasing towards top.	(a) Picture tube circuit.	C, 4
14. Vertical does not sync.	(a) Vertical sweep circuit.	E, 2
Audio Defects		
1. No sound, picture normal.	(a) Audio section.	H, 1
2. Hum or buzz.	(a) Audio section.	H, 2
3. Distortion.	(a) Crystal Y1. (b) Audio IF alignment. (See page 7)	
Miscellaneous		
1. Sound bars.	(a) Picture tube circuit.	C, 2
2. Light and dark vertical bars, poor horizontal linearity.	(a) Damper tube.	
3. Two heavy black horizontal bars across screen.	(a) Power supply (electrolytic capacitor)	
4. Excessive contrast with bright lines on bottom and top.	(a) Sync section.	F, 2
5. Picture distorted and reverse action of picture control.	(a) Sync section.	F, 3
6. Picture flutters at 60 cycles rate.	(a) Capacitor C251 in video IF circuit.	A, 5
7. "Window shade" effect.	(a) Picture tube circuit.	C, 5
8. Barkhausen oscillation. (See Fig. 14)	(a) Drive control, R369. (b) 19BG6 tube.	
9. "Busy background" on trailing edge.	(a) Video amplifier.	B, 2
10. Black lines across picture.	(a) Video amplifier.	B, 3
11. Very bright picture with black lines.	(a) Video amplifier.	B, 5

TROUBLE SHOOTING ANALYSIS

A. R-F and Video I-F Circuit

1. Misalignment of RF, video IF stages or sound traps will cause poor picture detail. If some stages are totally detuned, the signal might not get through at all, failing to produce a picture.

2. If the oscillator circuit fails to produce the required frequencies, no IF signal is formed and no signal will get through: No picture and no sound will be the result. Any defective component in the oscillator circuit may have this effect.

3. Any interruption of the signal path through the RF and video IF stages will result in a distorted picture or no picture at all. The location of an open component is easily accomplished by methods used in radio service work.

4. An overloading of the stages will result in loss of picture detail; check picture control circuit.

5. In case the capacitor C251 is short circuited, sound bars will appear in the picture and trailing white shadows. If this capacitor opens up, the picture will flutter at a 60-cycle rate and at minimum picture control audio motorboating will start.

6. A defective channel switch will result in intermittent reception of one channel or in extreme cases a channel might be interrupted completely. Clean switch with a cleaning fluid or bend the contacts to increase contact pressure. In some cases it is best to replace head-end unit.

B. Video Amplifier

1. If the path of the signal within the video amplifier is broken, the picture will be distorted or wiped out completely. This may be caused by open chokes L259, L261, L262 or coupling capacitor C268.

2. Misalignment of the 4½ mc trap will cause a "busy background" effect on the trailing edge of the picture.

3. If choke L264 or coupling capacitor C275 is open, there will be always enough coupling capacity to carry along at least a fraction of the signal. The resultant picture will have black lines across the picture.

4. Open or shorted resistances are easily located. Before resistors open up completely, they often show high resistance value. If this happens with the resistors R269 and R272, the effect will be a smeared picture. A high resistance of R273 will cause picture distortion at high values of picture control.

5. A shorted capacitor C275 will have the following effects: The picture is very bright with black lines across it. Brightness control does not reduce the brightness.

C. Picture Tube Circuit

1. A defective picture tube can be the cause of a faint picture, a distorted and unsteady picture or no picture at all.

2. Parts of the electron gun structure might vibrate under the influence of a strong loudspeaker output, resulting in sound bars in the picture.

3. A gassy picture tube will cause a blooming picture which is out of focus.

4. In case the capacitor C279 on the cathode of the picture tube breaks down, a high voltage will be right on the cathode blanking out the picture. If this capacitor opens up, horizontal lines appear on the picture increasing towards the top.

5. A leaking capacitor C278 will cause a small picture with poor brightness and vertical linearity. If the other capacitor C277 becomes defective, the following effects occur: A shorted capacitor will produce a fuzzy and very bright picture while an open capacitor will produce a bright horizontal area advancing towards the top with increasing brightness control setting ("window shade" effect).

D. Horizontal Sweep Section

1. No raster on the picture tube indicates a lack of high voltage or horizontal sweep voltage.
This may be caused by a defect in the high voltage rectifier circuit (V14), in the horizontal sweep output circuit (V13); the horizontal oscillator (V12B) may not be functioning properly or there may be a short in the horizontal deflection circuits (the secondary of T351, width control L353 or deflection coils D351).

2. Insufficient sweep width may be caused by defective components in the horizontal deflection circuits. Check the secondary circuits of T351 for defective components. When L353 is shorted or has shorted turns, the picture will be too narrow and L353 will have no or little control on the width.

3. Poor horizontal linearity may be caused by a short in L352, resulting in L352 having no control on the horizontal linearity. High leakage in capacitor C370 will cause poor linearity and also will increase the width.

4. A short in capacitor C377 will change the d-c component through the horizontal deflection coils which will shift the picture horizontally such that it may not be centered with the focus coil setting.

5. Poor horizontal sync with good vertical sync may be caused by a defect in the circuits of V11, or V12-A or -B.

6. No vertical or horizontal sync may be caused by defects in the clipper circuits of V10.

E. Vertical Sweep Section

1. The vertical sweep generator contains a multivibrator circuit which is made inoperative by the defects of the following capacitors: If shorted capacitor C304, C305 or C308. If the capacitor C305 is open, the oscillator is stopped.

2. The frequency of the generator is thrown off by a short circuit of the capacitors C301 and C302 with the effect that the vertical does not sync.

3. The linearity of the vertical sweep is impaired when the electrolytic capacitor C309 loses its capacity to an appreciable extent. If it opens up completely, the height reduces to approx. 1/5 of the normal size.

4. If the paper capacitor C308 develops any leakage, the vertical size is reduced so that the height control R308 does not suffice to obtain the desired height.

5. In case the capacitor C302 has an open circuit, the vertical sync becomes less stable.

6. If the B+ voltages supplied to the circuit is too low, the deflection voltages will not suffice to deflect the beam across the entire surface of the tube.

7. Microphonic tubes might give rise to a very unstable operation, resulting in a jumpy picture.

F. Common Sync Section

1. A shorted capacitor C354 on pin 1 of V10 tube will produce excessive contrast which cannot be reduced to normal by the picture control. If this capacitor opens up, both horizontal and vertical sync will be inoperative.

2. An open capacitor, C353 on the plate (pin 5) of tube V10 will produce a shaky picture with excessive contrast, while an open capacitor on the grid (pin 4) of tube V10 (C351) will produce bright lines on bottom and top together with poor horizontal and vertical sync which is independent of picture control setting.

3. Distorted picture and reverse action of picture control is caused by an open capacitor C261 on the picture control. If C261 is open, increasing picture control will decrease picture control and vice-versa.

G. Focus Coil, Ion Trap and Deflection Yoke

1. To obtain good focus and centered raster, the focus coil must be carefully positioned as outlined under Preset Control Adjustment, #2.
No sharp picture will be possible with an open or shorted coil. A partial short will throw the picture out of focus. Before looking for obscure trouble, be sure to check the focus control circuit for defective components.

2. The correct adjustment of the ion trap will result in maximum brilliance and at the same time will insure long tube life. For adjustment of this trap, see Preset Control Adjustment, #1.

3. Any unsymmetry of the deflection yoke will cause picture distortion. A shorted coil or shorted turns will cause barrel distortion and unsymmetric trapezoidal distortion. An open deflection yoke will produce a horizontal or vertical line across the screen: An open horizontal deflection coil produces a vertical line while an open vertical deflection coil produces a horizontal line.

4. The yoke assembly must be pressed against the bell of the picture tube to avoid neck shadow.

5. The correct picture size is obtained by adjusting the width and height control, as outlined under Preset Control Adjustment, #8 and #11.

H. Audio Stages

1. The FM modulated signal can reach the 1st audio tube only when the two IF transformers are aligned properly. In localizing defective components, follow normal radio trouble shooting procedure.

2. In case of improper alignment especially of discriminator secondary, a buzz or hum is heard when receiving a television station.

3. In case of no sound output the following components should be checked in turn: tubes (V16 through V20) output transformer T403, capacitors C419, C421, C418, C409, C403. and defective speaker.

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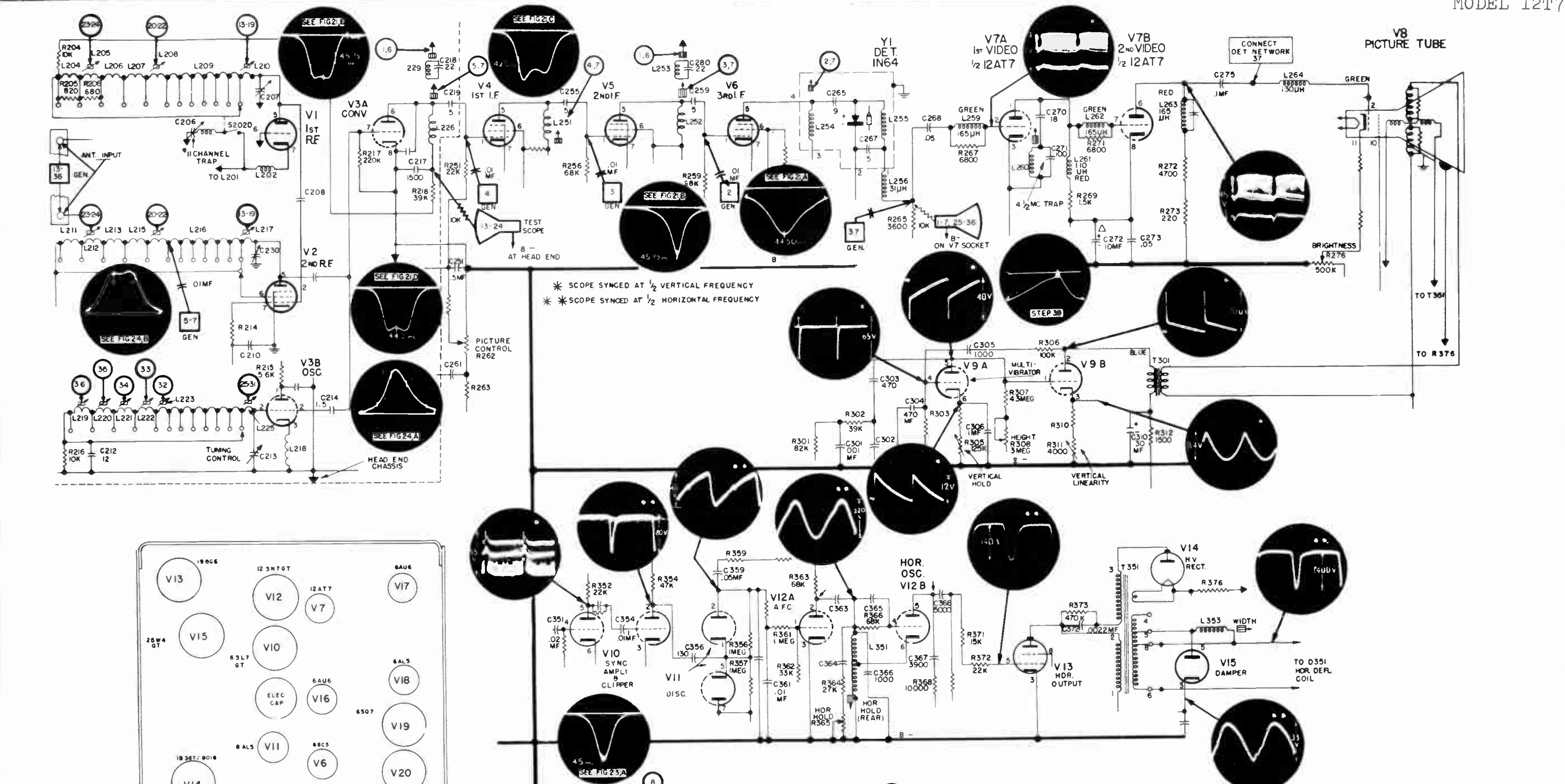

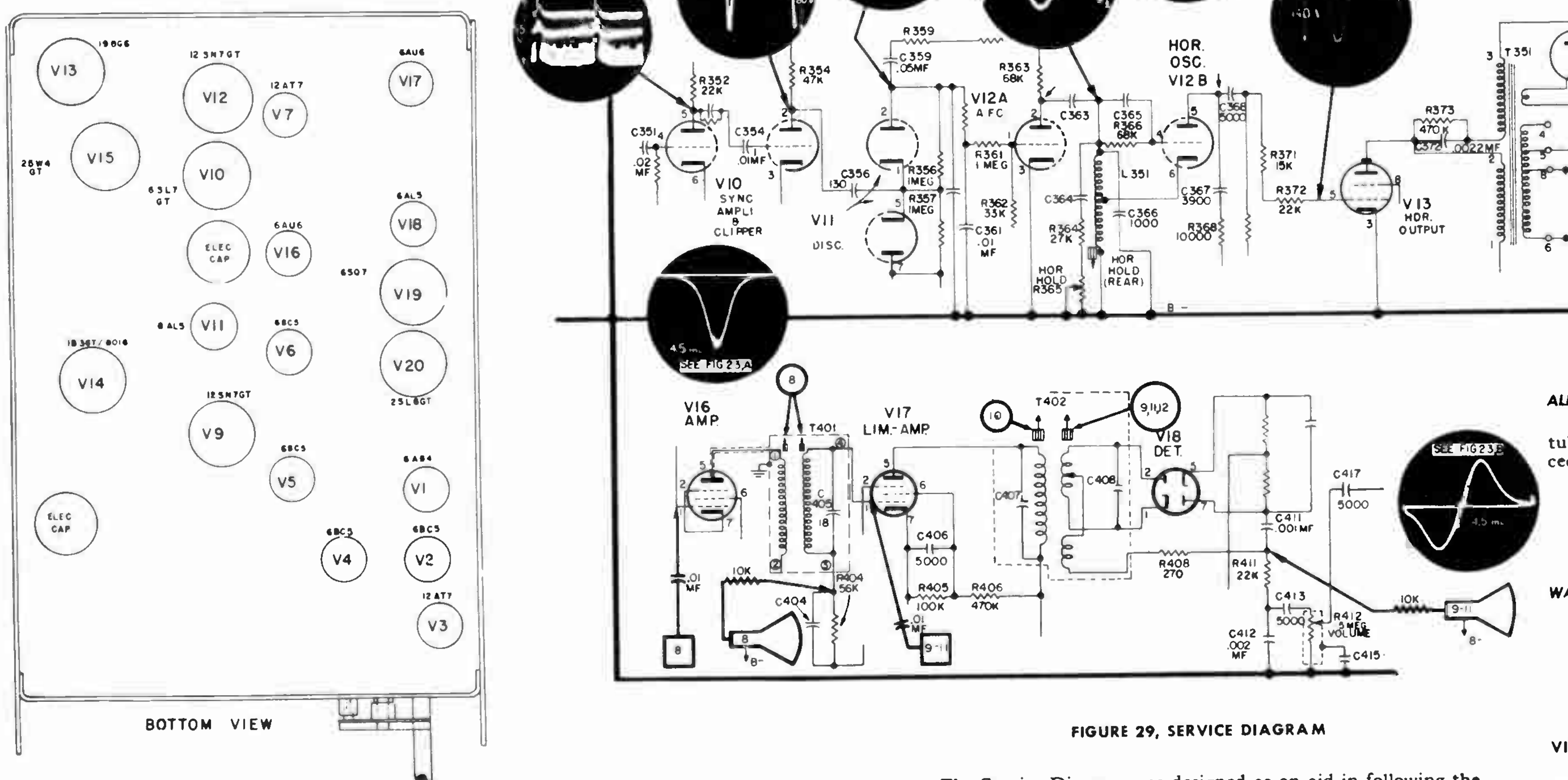

FIGURE 29, SERVICE DIAGRAM

The Service Diagram was designed as an aid in following the alignment procedure and in trouble shooting by observing waveforms at important points of the various circuits.

ALIGNMENT

The numbers enclosed by symbols—square, circle and C-R tube—refer to the various step numbers in the alignment procedure.

(a) The square indicates the point of connection for the sweep and/or signal generator.
(b) The circle indicates the trimmer or slug to be adjusted.
(c) The picture tube symbol indicates the point where the test oscilloscope is connected.

WAVEFORMS

(a) For waveform measurement use a scope with good wide band frequency response.
(b) The waveforms shown were taken from a typical receiver, tuned to a good signal, properly adjusted for sync and linearity. Measurement is made from the points indicated and ground.

VIDEO IF-CURVE

Referring to the final curve (E) take note that the markers are spaced 1.5 mc apart.

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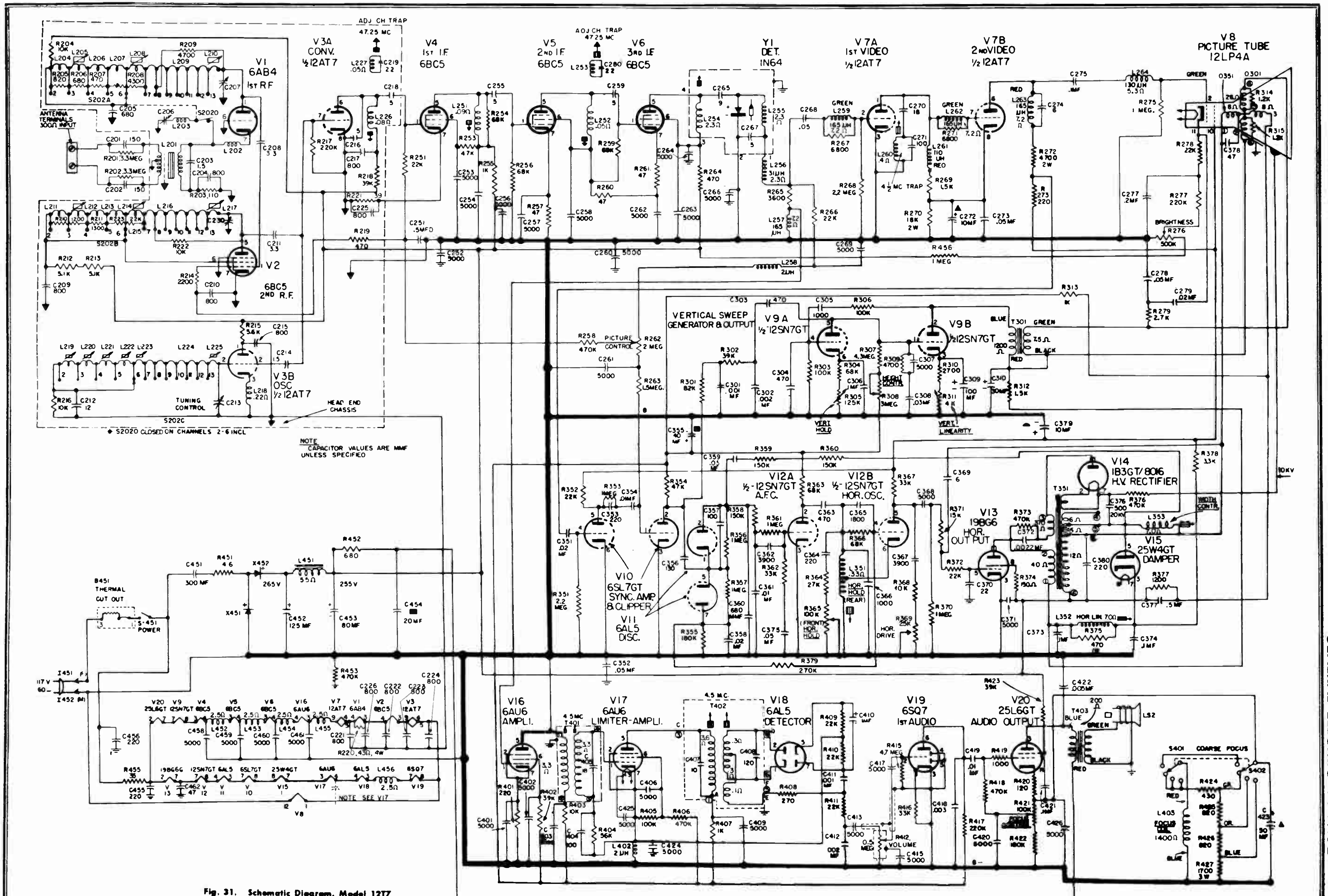

Fig. 31. Schematic Diagram, Model 12T7

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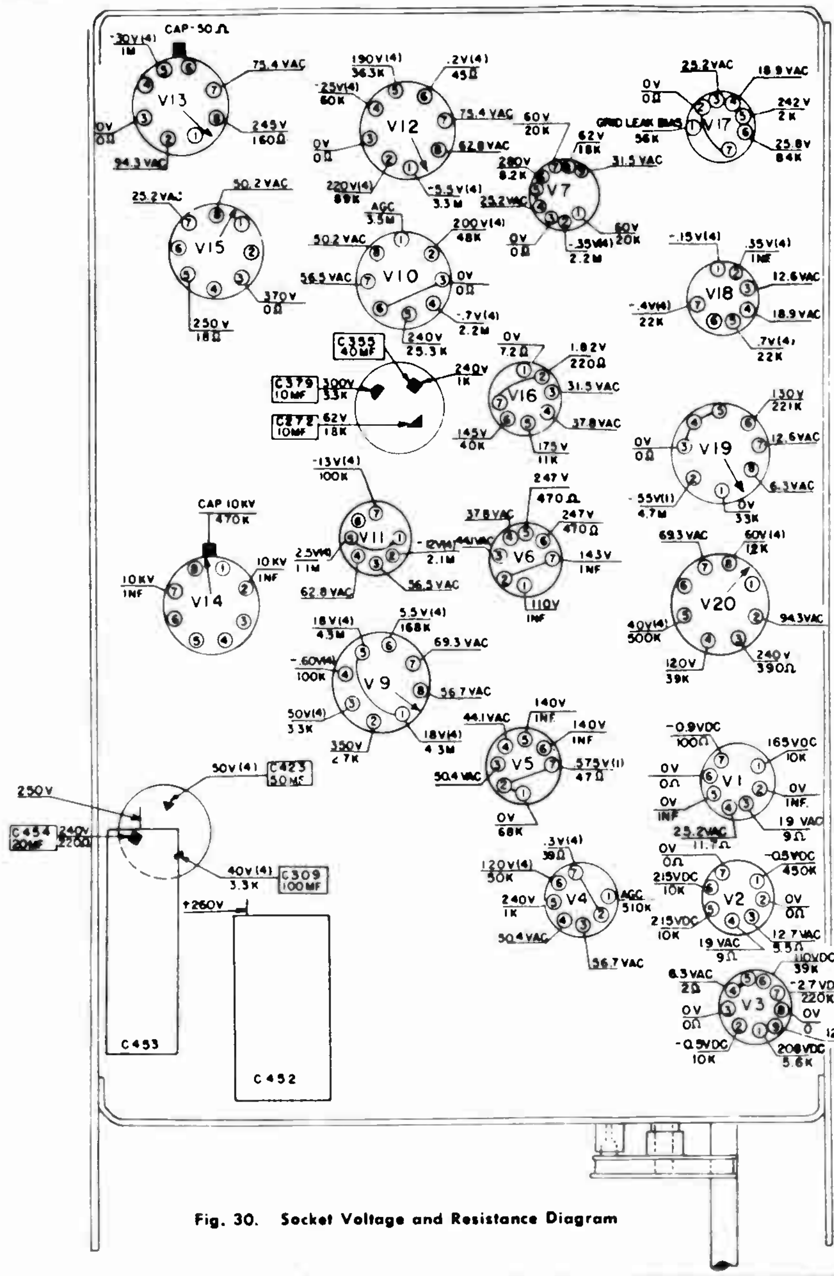

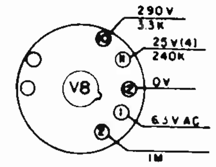

VOLTAGE MEASUREMENTS (IN RESPECT TO B −)

METER 20000Ω/VOLT
LINE VOLTS 117V, 60~

ALL CONTROLS SET FOR NORMAL SWEEPS, FOCUS AND BRIGHTNESS

(1) USE 2.5V RANGE
(2) " 10V "
(3) " 25V "
(4) VOLTAGE VARY MORE THAN ± 20%

RESISTANCE MEASUREMENTS

SHORT CAPACITOR C 453.
SHORT PIN 3 OF V15 TO B−

INF. DENOTES INFINITE RESISTANCE
TURN THE FOLLOWING CONTROLS FULL CLOCKWISE:
FOCUS CONTROL
CONTRAST
BRIGHTNESS
VERTICAL HOLD
VERTICAL SIZE
VERTICAL LINEARITY
VALUES LISTED MAY HAVE A TOLERANCE OF ± 20%

Fig. 30. Socket Voltage and Resistance Diagram

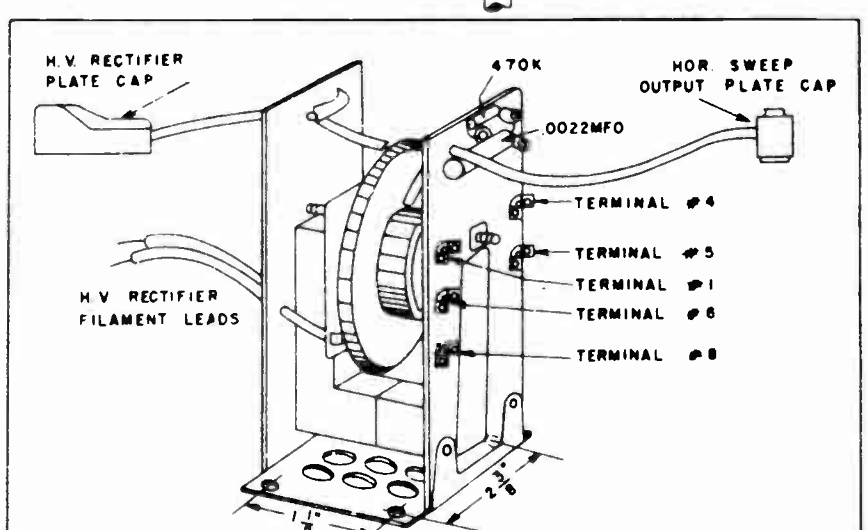

Fig. 32. Horizontal Sweep Transformer RTO-076

MODEL 12T7—REPLACEMENT PARTS LIST

Cat. No.	Symbol	Description
UNIVERSAL REPLACEMNT PARTS		
*UCC-035	C301, 411	CAPACITOR—.001 mf., 600 v., paper
*UCC-036	C302, 412	CAPACITOR—.002 mf., 600 v., paper
*UCC-037	C418	CAPACITOR—.003 mf., 600 v., paper
*UCC-040	C354	CAPACITOR—.01 mf., 200 v., paper
*UCC-041	C279, 351, 358	CAPACITOR—.02 mf., 400 v., paper
*UCC-042	C308	CAPACITOR—.03 mf., 600 v., paper
*UCC-045	C268, 273, 278, 352	CAPACITOR—.05 mf., 600 v., paper
*UCC-048	C275, 374, 421	CAPACITOR—.1 mf., 600 v., paper
*UCC-050	C277	CAPACITOR—.25 mf., 600 v., paper
*UCC-052	C251, 377	CAPACITOR—.5 mf., 600 v., paper
*UCG-1005	C216, 218, 255, 259, 267	CAPACITOR—5 mmf., 500 v., silver mica
UCG-1010	C270	CAPACITOR—18 mmf., mica
*UCG-1012	C219, 280, 370	CAPACITOR—22 mmf., 500 v., silver mica
UCG-1020	C378, 462	CAPACITOR—47 mmf., 500 v., silver mica
UCG-1030	C408	CAPACITOR—120 mmf., silver mica
UCG-1036	C353, 364	CAPACITOR—220 mmf., 500 v., silver mica
*UCG-2006	C212	CAPACITOR—12 mmf., 500 v., silver mica
*UCU-002	C274	CAPACITOR—6 mmf., 500 v., mica
*UCU-028	C357, 404	CAPACITOR—100 mmf., 500 v., mica
*UCU-036	C455, 456	CAPACITOR—220 mmf., 500 v., silver mica
*UCU-052	C366	CAPACITOR—1000 mmf., 500 v., mica
UCU-532	C201, 202	CAPACITOR—150 mmf., 500 v., mica
*UCU-1004	C407	CAPACITOR—10 mmf., ceramic
*UCU-1044	C303, 304, 363	CAPACITOR—470 mmf., 500 v., mica
*UCU-1528	C271	CAPACITOR—100 mmf., mica
*UCU-2031	C356	CAPACITOR—130 mmf., 500 v., mica
*UJB-014		TERMINAL STRIP—4 terminals
*UJB-017		TERMINAL STRIP—Double, 2 terminals
*URD-015	R221	RESISTOR—39 ohms, ½ w., carbon
*URD-017	R257, 260, 261	RESISTOR—47 ohms, ½ w., carbon
*URD-027	R420	RESISTOR—120 ohms, ½ w., carbon
*URD-029	R374	RESISTOR—150 ohms, ½ w., carbon
*URD-033	R273, 401	RESISTOR—220 ohms, ½ w., carbon
*URD-035	R408	RESISTOR—270 ohms, ½ w., carbon
*URD-041	R207, 219, 264	RESISTOR—470 ohms, ½ w., carbon
*URD-045	R206	RESISTOR—680 ohms, ½ w.
*URD-047	R205	RESISTOR—820 ohms, ½ w., carbon
*URD-049	R255, 407, 419	RESISTOR—1000 ohms, ½ w., carbon
*URD-051	R210, 314, 315, 377	RESISTOR—1200 ohms, ½ w., carbon
*URD-053	R269	RESISTOR—1500 ohms, ½ w., carbon
*URD-057	R214	RESISTOR—2200 ohms, ½ w.,
*URD-059	R279	RESISTOR—2700 ohms, ½ w., carbon
*URD-065	R209, 309	RESISTOR—4700 ohms, ½ w., carbon
*URD-073	R216, 222, 368, 403	RESISTOR—10,000 ohms, ½ w., carbon
*URD-077	R371	RESISTOR—15,000 ohms, ½ w., carbon
*URD-081	R223, 266, 278, 372, 411	RESISTOR—22,000 ohms, ½ w., carbon
*URD-083	R364	RESISTOR—27,000 ohms, ½ w., carbon
*URD-085	R362, 416	RESISTOR—33,000 ohms, ½ w., carbon
*URD-087	R218, 302, 402	RESISTOR—39,000 ohms, ½ w., carbon
*URD-089	R253, 354	RESISTOR—47,000 ohms, ½ w., carbon
*URD-091	R404	RESISTOR—56,000 ohms, ½ w., carbon
*URD-093	R254, 256, 259, 304, 366	RESISTOR—68,000 ohms, ½ w., carbon
*URD-095	R301	RESISTOR—82,000 ohms, ½ w., carbon
*URD-101	R358	RESISTOR—150,000 ohms, ½ w., carbon
*URD-103	R355, 422	RESISTOR—180,000 ohms, ½ w., carbon
*URD-105	R217, 277, 417	RESISTOR—220,000 ohms, ½ w., carbon
*URD-107	R379	RESISTOR—270,000 ohms, ½ w., carbon
*URD-113	R258, 406, 418, 453	RESISTOR—470,000 ohms, ½ w., carbon
*URD-121	R275, 353, 356, 357, 361, 370, 456	RESISTOR—1 meg., ½ w., carbon
*URD-125	R263	RESISTOR—1.5 meg., ½ w., carbon
*URD-129	R268, 351	RESISTOR—2.2 meg., ½ w., carbon
*URD-133	R201, 202	RESISTOR—3.3 meg., ½ w., carbon
*URD-137	R415	RESISTOR—4.7 meg., ½ w., carbon
*URD-1026	R203	RESISTOR—110 ohms, ½ w.
*URD-1052	R211	RESISTOR—1300 ohms, ½ w., carbon
*URD-1062	R265	RESISTOR—3600 ohms, ½ w., carbon
*URD-1066	R208	RESISTOR—4300 ohms, ½ w.
*URD-1081	R409, 410	RESISTOR—22,000 ohms, ½ w., carbon
*URD-1097	R303, 306, 405	RESISTOR—100,000 ohms, ½ w., carbon
*URD-1136	R307	RESISTOR—4.3 meg., ½ w., carbon
*URE-041	R375	RESISTOR—470 ohms, 1 w., carbon
*URE-049	R313	RESISTOR—1000 ohms, 1 w., carbon
*URE-053	R312	RESISTOR—1500 ohms, 1 w., carbon
*URE-061	R378	RESISTOR—3300 ohms, 1 w., carbon
*URE-065	R272	RESISTOR—4700 ohms, 2 w., carbon
*URE-067	R215	RESISTOR—5600 ohms, 1 w., carbon
*URE-073	R204	RESISTOR—10,000 ohms, 1 w., carbon
*URE-081	R352	RESISTOR—22,000 ohms, 1 w., carbon
*URE-085	R367	RESISTOR—33,000 ohms, 1 w., carbon
*URE-087	R423	RESISTOR—39,000 ohms, 1 w., carbon
*URE-093	R363	RESISTOR—68,000 ohms, 1 w., carbon
*URE-101	R359, 360	RESISTOR—150,000 ohms, 1 w., carbon
*URE-113	R376	RESISTOR—470,000 ohms, 1 w., carbon
*URE-1040	R424	RESISTOR—430 ohms, 1 w., carbon
*URE-1047	R425, 426	RESISTOR—820 ohms, 1 w., carbon
*URE-1059	R310	RESISTOR—2700 ohms, 1 w., carbon

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MODEL 12T7—REPLACEMENT PARTS LIST (Continued)

UNIVERSAL REPLACEMENT PARTS (Continued)

Cat. No.	Symbol	Description
*URE-1066	R212, 213	RESISTOR—5100 ohms, 1 w., carbon
*URF-045	R452	RESISTOR—680 ohms, 2 w., carbon
*URF-079	R270	RESISTOR—18,000 ohms, 2 w. carbon
*URF-113	R373	RESISTOR—470,000 ohms, 2 w., carbon
*S-527D-7		SPEAKER—5¼-inch PM speaker

SPECIALIZED REPLACEMENT PARTS

Cat. No.	Symbol	Description
RAB-127		BACK—Cabinet back
RAV-120		CABINET—Model 12T7
*RCC-059	C422	CAPACITOR—.005 mf., 1000 v., paper
*RCC-102	C359	CAPACITOR—.05 mf., 600 v., paper
*RCC-103	C306	CAPACITOR—.1 mf., 200 v., paper
*RCC-104	C373	CAPACITOR—.1 mf., 600 v., paper
RCC-105	C375	CAPACITOR—.05 mf., 200 v., paper
*RCE-090	C410	CAPACITOR—1 mf., 50 v., electrolytic
*RCE-092	C310	CAPACITOR—30 mf., 450 v., electrolytic
*RCE-100	C272, 355, 379	CAPACITOR—10 mf., 450 v., 40 mf., 300 v., 10 mf., 150 v., electrolytic
RCE-110	C451	CAPACITOR—300 mf., 150 v., electrolytic capacitor
RCE-111	C452	CAPACITOR—125 mf., 350 v., electrolytic capacitor
RCE-112	C453	CAPACITOR—80 mf., 300 v.
*RCE-115	C309, 423, 454	CAPACITOR—20 mf., 300 v., 50 mf., 100 v., 100 mf., 75 v., electrolytic
*RCN-018	C419	CAPACITOR—.01 mf., 600 v., paper
*RCN-019	C372	CAPACITOR—.0022 mf., 1000 v., paper
*RCN-023	C376	CAPACITOR—500 mmf., 20,000 v.
*RCN-025	C361	CAPACITOR—.01 mf., 600 v., paper
*RCN-029	C265	CAPACITOR—9 mmf., silver mica
*RCN-033	C365	CAPACITOR—1800 mmf., 600 v., paper
*RCN-034	C362, 367	CAPACITOR—3900 mmf., 500 v., paper
*RCU-286	C369	CAPACITOR—6 mmf., 800 v., mica
*RCU-290	C305	CAPACITOR—1000 mmf., 1000 v., mica
*RCU-294	C360	CAPACITOR—680 mmf., 500 v., mica
RCU-295	C380	CAPACITOR—220 mmf., 1500 v., mica
*RCW-1045	C203, 214	CAPACITOR—1.5 mmf., ±.25 mmf., 500 v., ceramic
RCW-1076	C211, 208	CAPACITOR—3.3 mmf., ±.25 mmf., ceramic
*RCW-3014	C252, 253, 254, 256, 257, 258, 260, 261, 262, 263, 264, 266, 269, 307, 368, 371, 401, 402, 403, 406, 409, 413, 415, 417, 420, 424, 425, 426, 458, 459, 460, 461	CAPACITOR—5000 mmf., 450 v., ceramic
*RCW-3026	C204, 209, 210, 215, 217, 221, 222, 223, 224, 225, 226	CAPACITOR—800 mmf., 350 v., ceramic
*RCW-3027	C205	CAPACITOR—680 mmf., ceramic (stand-off)
*RCY-048	C207, 230	TRIMMER
*RCY-059	C213	CAPACITOR—Tuning capacitor
*RCY-060	C206	TRIMMER—Trimmer for #11 channel trap
*RDE-083		OVERLAY—12-inch
*RDE-084		ESCUTCHEON—Knob escutcheon
*RDE-085		ESCUTCHEON — Picture tube escutcheon
*RDK-168		KNOB—Mah. Brightness, Vertical Hold
*RDK-190		KNOB—Fawn, Tuning Control
*RDK-192		KNOB—Mahogany, Channel Selector
*RDK-193		KNOB—Mahogany, Volume—OFF-ON
*RDK-197		KNOB—Mahogany, Focus, Horizontal
RDM-022		MASK—Speaker mask
*RDW-041		GLASS—Safety glass
*REI-014		TUNING SLUG (BRASS) for head-end
*REI-016		IRON CORE—For L255
RER-009	X451, 452	RECTIFIER—300 ma., selenium
*RET-005		TRAP—Ion trap
*RHC-024		CLIP—For electrolytic capacitor mount
*RHG-004		GROMMET—Chassis grommet
RHS-045		SCREW—Headless screw, ⅜ in.
RHS-046		SCREW—Headless screw, ⅝ in.
*RII-021		INSULATOR—For volume control
*RII-023		INSULATOR—For deflection yoke
*RII-026		INSULATOR—Hi-voltage insulator
RII-041		INSULATOR—For rectifier
*RJC-008		CONNECTOR—Anode connector
*RJJ-007	I372	RECEPTACLE—Power cord receptacle (male)
*RJS-003		SOCKET—Tube socket, octal, for V19, V9, V10
*RJS-026		SOCKET—Tube socket for V20
*RJS-030		SOCKET—Tube socket, octal, for V13 and V14
*RJS-085		SOCKET—Tube socket, for V15
*RJS-127		SOCKET—9-pin tube socket for V3
*RJS-132		SOCKET—9-pin tube socket for V18 and V11
*RJS-133		SOCKET—7-pin shielded tube socket for for V5, V6, V17
*RJS-135		SOCKET—Tube socket, shock mounted, for V12
*RJS-136		SOCKET—Tube socket, for V1, V2, V16
*RJS-138		SOCKET—9-pin tube socket for V7
RJX-040		RF HEAD-END—Completely aligned with tubes
RLA-034	L201	TRANSFORMER—Input transformer
*RLC-091	L351	COIL—Horizontal oscillator coil
*RLC-095	L219	COIL—Oscillator coil, Channel #2
*RLC-096	L207, 214	COIL—1st and 2nd RF, Channel #5

SPECIALIZED REPLACEMENT PARTS (Continued)

Cat. No.	Symbol	Description
*RLC-097	L222	COIL—Oscillator coil, Channel #5
*RLC-098	L223	COIL—Oscillator coil, Channel #6
*RLC-099	L225	COIL—Oscillator coil, Channel #13, and channel trap coil
*RLD-013	D301, 351, R314, 315, C378	DEFLECTION YOKE
*RLD-014	L353	COIL—Width control
*RLD-020	L352	COIL—Horizontal linearity
*RLF-024	L254, 255, 256	CHOKE—RF choke, 31 uh., choke coil for video detector
*RLF-026	L401	COIL—Focus coil
*RLI-003	L218	CHOKE—Cathode choke, 1.4 mh.
RLI-006	L202	COIL—Choke coil
*RLI-038	L257, 263	CHOKE—Video comp., 165 mh.
*RLI-072	L206, 212	COIL—1st RF (Channel #4), and 2nd RF (Channel #3)
*RLI-077	L205	COIL—1st RF, Channel #3
*RLI-093	L259, 262, R271, 267	CHOKE—Video comp. choke, 165 uh.
*RLI-096	L251	COIL—IF coil
*RLI-097	T401, C405	COIL—1st audio IF transformer
*RLI-099	L221	COIL—Oscillator, Channel #4
*RLI-100	C270, 271, L260	TRAP COIL—4.5 mc video trap coil
*RLI-108	L261, R237	COIL—Video peaking coil, 110 uh.
*RLI-109	L264	CHOKE—Video comp. choke, 130 uh.
*RLI-110	L252, 253	COIL—IF coil
*RLI-114	L203	COIL—Channel #11 trap coil
*RLI-116	L208, 215	COIL—1st and 2nd RF, Channel #6
RLI-117	L204	COIL—1st RF, Channel #2
RLI-118	L213	COIL—2nd RF, Channel #4
RLI-119	L211	COIL—2nd RF, Channel #2
RLI-120	L210	COIL—1st RF, Channel #13
RLI-121	L217	COIL—2nd RF, Channel #13
*RLI-122	L258, 402, 452, 453, 454, 455, 456	COIL—Heater choke, 2 uh.
*RLP-016	L226, 227	COIL—Converter plate coil
*RLX-029	C265, 267, L254, 255	ASSEMBLY—Video detector assembly
RMC-049		CLAMP—Tube sling clamp
*RMM-134		SHIELD—Corona shield for V14
RMM-143		CUSHION—Tube cushion, sling and center
RMM-144		CUSHION—Tube cushion, strap
RMM-145		CUSHION—Tube cushion, large
*RMM-150		GLASS—Cushion for safety glass
RMS-182		STRAP—Tube strap
*RMS-130		SPRING—For tuning control
RMS-215		SLING—Tube mounting sling
*RMU-055		SHAFT—Extension shaft
*RMU-058		SHAFT—Tubular tuning shaft
*RMX-169		PULLEY AND HUB ASSEMBLY—For tuning control
*RRC-096	R308	POTENTIOMETER—3 meg., height control
RRC-127	R311	POTENTIOMETER—4000 ohms, 2 w., vertical linearity
RCC-128	R412, 262, S451	POTENTIOMETER DUAL—500 K (volume), 2 meg. (picture control)
RCC-130	R421, 276	POTENTIOMETER DUAL—Focus (100 K) and Brilliance control (500 K)
RRC-136	R305, 365	POTENTIAL DUAL—100 K and 125 K Vertical and Horizontal Hold
RRC-140	R369	POTENTIOMETER—Drive control, 25,000 ohms, ½ w.
*RRW-048	R451	RESISTOR—4.6 ohms, 5 w., w.w.
RRW-045	R427	RESISTOR—1700 ohms, 3 w., w.w.
RRW-049	R220	RESISTOR—43 ohms, 4 w., w.w.
*RRW-054	R455	RESISTOR—Globar, 35 ohms, 0.6 amp.
*RSR-002	B451	THERMAL CUT-OUT
*RSW-066	S401, 402	SWITCH—Focus switch
*RTD-008	T402, C407, 408	TRANSFORMER—Ratio detector
*RTL-096	L451	REACTOR—Filter reactor
*RTO-064	T-301	TRANSFORMER—Vertical sweep output
*RTO-076	T351, R373	TRANSFORMER—Horizontal sweep output
RTO-081	T403	TRANSFORMER—Audio output
*RWL-019	I371	POWER CORD—Interlock female
RWX-029		SOCKET—Picture tube socket assembly
*1N64††	Y1	DETECTOR—Germanium crystal detector

*Parts used on previous models. ††Obtainable from tube distributor.

PRODUCTION CHANGES

1. SUPPRESSION OF RF OSCILLATION

To minimize the tendency to oscillate on Channel #12 and #13, a ceramic capacitor, C226, 800 mmf., has been added from pin 3 of the tube V3 to chassis in the head-end unit. Part number is RCW-3026.

2. INCREASE OF HORIZONTAL SWEEP

In order to increase horizontal sweep, the following changes were incorporated during production: a capacitor, C380, was added across the terminals 6 and 8 of the horizontal sweep transformer. The type used is a 220 mmf. capacitor, 1500 volt, with a parts number of RCU-295. At the same time the wiring of capacitor C376 was changed to connect to terminal 5 of the damper tube V15, 25W4GT.

In case a capacitor of 220 mmf., 1500 volts is not available, use two capacitors of values 390 mmf. (part number UCU-1042, or 470 mmf. (part number UCU-1044,) in series connection.

3. INCREASE OF LOW FREQUENCY RESPONSE

To increase the low frequency response of the video amplifier, the capacitor C268 was changed from a .02 mf. to a .05 mf. value. The new number is UCC-045.

4. IMPROVEMENT OF HORIZONTAL PULL-IN RANGE

In the biasing network for the horizontal control tube, V12A, the resistor R379 was changed from a 180,000 to a 270,000 value with a part number of URD-107.

5. TEMPORARY SUBSTITUTION

Because of temporary procurement difficulties, some receivers were wired with the following changes:

Resistor R277: a substitution of 180,000 ohms was used instead of the correct value of 220,000 ohms.

Resistor R379: a substitution of 220,000 ohms was used instead of the correct value of 270,000 ohms.

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World Radio History

MODEL 14T2 MAHOGANY
MODEL 14T3 BLONDE

MODEL 14C102 MAHOGANY
MODEL 14C103 BLONDE

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SPECIFICATIONS

OVER-ALL DIMENSIONS:

Model	Height Inches	Width Inches	Depth Inches
14T2	18¼	17¼	22⅜
14T3			
14C102	36¼	20	22⅜
14C103			

ELECTRICAL RATING:

Frequency .... 60 cycles
Voltage .... 115 v. a-c
Watts .... 165 watts

INTERMEDIATE FREQUENCIES:

Television video .... 45.75 MC
Television audio .... 41.25 and 4.5 MC

LOUDSPEAKER:

PM Alnico

Model	14T2 14T3	14C102 14C103
Cone Diameter Size	5¼ in.	12 in.
Voice Coil Imp. at 400 Cycles	3.2 ohms	3.2 ohms

AUDIO POWER OUTPUT:

Undistorted .... 1.0 watt
Maximum .... 2.0 watts

ANTENNA REQUIREMENTS:

Built-in Antenna System

For External Antenna Use:
Type.....Folded dipole, or equivalent
Impedance .... 300 ohms

R-F FREQUENCY RANGE:

Selector Switch Position	Frequency Range MC	Picture Carrier MC	Sound Carrier MC
No. 2	54–60	55.25	59.75
No. 3	60–66	61.25	65.75
No. 4	66–72	67.25	71.75
No. 5	76–82	77.25	81.75
No. 6	82–88	83.25	87.75
No. 7	174–180	175.25	179.75
No. 8	180–186	181.25	185.75
No. 9	186–192	187.25	191.75
No. 10	192–198	193.25	197.75
No. 11	198–204	199.25	203.75
No. 12	204–210	205.25	209.75
No. 13	210–216	211.25	215.75

TUBES:

Symbol	Purpose	Type
V1	1st RF Amplifier	6AB4
V2	2nd RF Amplifier	6BC5
V3	Converter-Oscillator	12AT7
V4	1st Video IF Amplifier	6BC5
V5	2nd Video IF Amplifier	6BC5
V6	3rd Video IF Amplifier	6BC5
V7	Video Amplifier	12AT7
V8	Picture Tube	14CP4
V9	Vertical Sweep Generator and Blanking	12SN7GT
V10	Vertical Sweep Output	12AU7
V11	Sync Amplifier and Clipper	6SL7GT
V12	Horizontal Frequency Discriminator	6AL5
V13	Horizontal AFC and Sweep Oscillator	12SN7GT
V14	Horizontal Sweep Output	25BQ6
V15	High Voltage Rectifier	1X2
V16	Horizontal Damper Tube	25W4GT
V17	Audio IF Amplifier	6AU6
V18	Audio IF Amplifier-Limiter	6AU6
V19	Audio Detector	6AL5
V20	Audio Amplifier	6SQ7
V21	Audio Output	25L6GT
Y1	Video Detector	1N64

CAUTION

HIGH VOLTAGES ARE USED IN THE OPERATION OF THIS TELEVISION RECEIVER. THE BACK COVER, WHILE IN PLACE, PREVENTS ACCIDENTAL CONTACT WITH THESE HIGH VOLTAGES AND SHOULD NOT BE REMOVED EXCEPT BY A QUALIFIED TELEVISION TECHNICIAN.

THE PICTURE TUBE IS A HIGH VACUUM TUBE AND, IF BROKEN, PIECES OF GLASS MAY FLY WITH FORCE IN ALL DIRECTIONS. ANY WEAKENING OF THE GLASS, AS MAY BE CAUSED BY CHIPPING, SCRATCHING, OR MORE THAN NORMAL PRESSURE, MAY CAUSE THIS TUBE TO BREAK. THE USE OF SAFETY GLASSES IS RECOMMENDED WHEN IT IS NECESSARY TO REMOVE OR REPLACE THE PICTURE TUBE.

ALWAYS USE AN ISOLATING TRANSFORMER IN THE POWER LINE, WHEN SERVICING THESE RECEIVERS, TO PROTECT TEST EQUIPMENT.

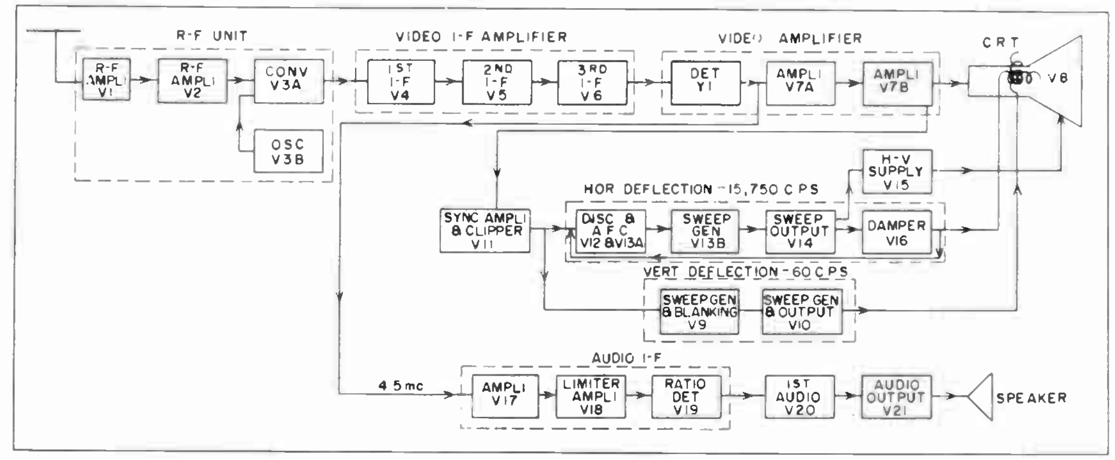

Fig. 1. Block Diagram

GENERAL INFORMATION

The General Electric Models 14T2, 14T3, 14C102, and 14C103 provide reception on all the twelve commercial television channels as specified on page 12. The picture is reproduced on a 14-inch picture tube.

Features of these television receivers include; a two stage r-f amplifier, balanced antenna input circuit, selenium type rectifiers, intercarrier sound, ratio detector, safe high voltage supply for the picture tube, automatic frequency control for horizontal sweep synchronization and electromagnetic deflection.

The r-f tuner assembly is mounted on a separate chassis which is readily demounted from the main chassis. The coils which tune the 1st and 2nd r-f stages and the oscillator are mounted on individual wafers of the selector switch. The local oscillator V3B operates on the high frequency side of the incoming r-f signal. The picture carrier is converted to a 45.75 mc video i-f frequency, while the FM sound carrier is converted to a 41.25 mc frequency.

The video i-f is stagger tuned to pass the video i-f (45.75 mc) and the (41.25 mc) with the proper amplitude relationship between the two frequencies. The video information is detected by the detector Y1 as well as a 4.5 mc FM signal which is the beat frequency between the video i-f (45.75 mc) and (41.25 mc). The 4.5 mc audio FM is amplified and limited by V17 and V18 and detected by the ratio detector V19. The audio is amplified by V20. V21 is the audio output tube.

The horizontal and vertical sync signals are taken off at the plate circuit of V7B and amplified and separated from the video signal by V11. The vertical sweep is generated by one section of a 12SN7 (V9) and a 12AU7 (V10) connected in a multivibrator circuit. The 12AU7 (V10) also serves as the vertical sweep output tube. The other section of the 12SN7 (V9) is used to produce the vertical retrace blanking signal. The horizontal sync signal is mixed with a sawtooth signal from the plate of the damper tube (V16) by the discriminator (V12). A change in phase between these two signals increases or decreases the bias voltage which is applied to the grid of V13A. V13A is a reactance tube which changes the frequency of the horizontal oscillator V13B. V14, the horizontal sweep output, is coupled to the horizontal deflection coils by T351.

V15 is the high voltage rectifier for rectifying the kickback voltage, produced in T351 by the horizontal retrace current, to supply approximately 12 kilovolts to the picture tube high voltage anode.

These receivers use two selenium rectifiers in a half-wave voltage doubling circuit to supply the B+ voltage of approximately 255 volts. The tube filaments are a series parallel connection across the 117 volt a-c line.

RECEIVER INSTALLATION

The receiver is shipped from the factory with the picture tube installed and all components preadjusted and checked for normal operation. Upon unpacking the receiver and removing the wood shipping skid from the bottom of the cabinet it is necessary only to connect the power cord into the 115 volt a-c power outlet to make it ready for use. However, if in checking receiver performance, should an analysis indicate a service control out of adjustment due to handling, shipping, or that incurred through normal service to the chassis, the receiver should be prepared for making the adjustments outlined for the Service Controls and Adjustment Procedure.

To prepare the receiver for adjustment remove the cabinet back, connect the antenna to the dipole terminals and connect the input power to the interlock receptacle by way of a power cord terminated in a matching plug. Make certain that the deflection yoke sets up against the bell of the picture tube. If it is not, loosen each deflection yoke clamp adjustment screw slightly and push yoke assembly against bell of tube. Remove tape holding ion trap to tube neck. A study of the following paragraphs and use of the adjustment procedures given will give satisfactory results with a minimum of time and effort.

ANTENNA REQUIREMENTS

GENERAL—The receiver circuit is designed with a balanced input circuit whose impedance is 300 ohms. This receiver is equipped with a built-in antenna giving favorable reception from television signals within their prime service area. Where reception is weak due to less favorable receiving conditions with the built-in antenna, an outdoor antenna, properly matched with transmission line of 300 ohms impedance in a balanced feed system and designed for operation at the television channel frequencies is recommended.

When an external antenna system is connected to the dipole terminals, the built-in antenna connecting leads must be disconnected.

OUTDOOR ANTENNA—In receiving areas of moderate signal strength, the simple folded dipole and transmission line of 300 ohms will be found adequate for favorable reception. Receiving areas of less than moderate signal strength (fringe areas) require the more complex antenna systems designed for higher gain. The high gain antennas are usually more directive and in addition provide a favorable reduction in pickup of undesirable signals or noise from the back side of such an antenna system.

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INSTALLATION AND SERVICE ADJUSTMENTS

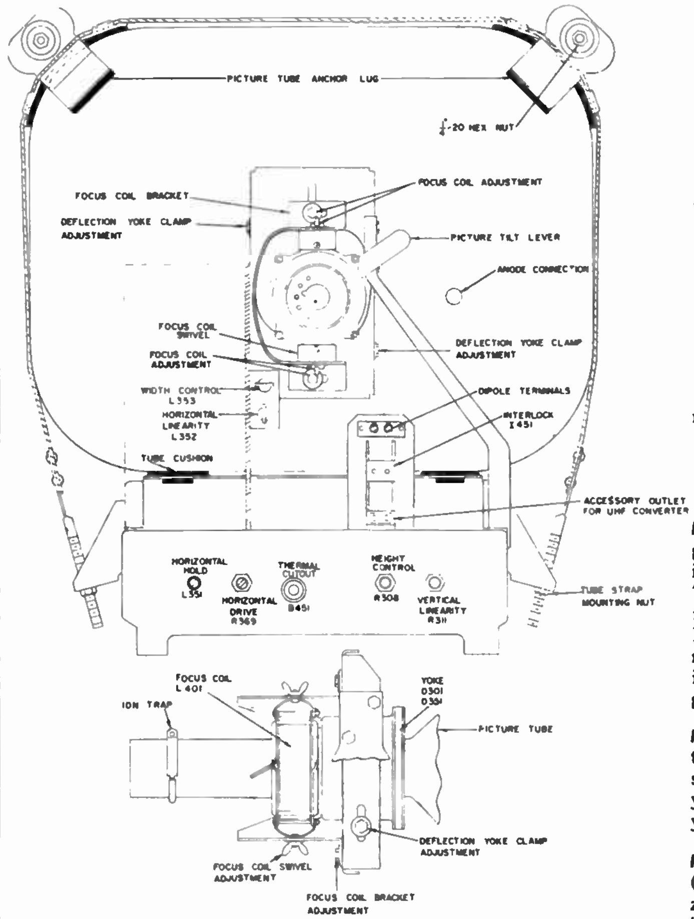


Fig. 2. Service Adjustments and Yoke Assembly

LIGHTNING PROTECTION—All outdoor antenna installations must conform to certain standards as set up by the National Electrical code which is usually supplemented by Local Code requirements. In general, some of the requirements are as follows:

1. The metal mast supporting the antenna should be permanently and effectively grounded. This should be grounded by a wire of size as specified in the codes.

2. An approved lightning arrester must be used with the antenna lead-in conductors at a point of entrance to the building. If shielded lead-in cable is used, the shield may be permanently grounded in lieu of using the lightning arrester.

ANTENNA PLACEMENT AND ORIENTATION—All television antenna systems have directional characteristics and their location may have a pronounced effect upon the results obtained. Therefore, the antenna should be turned in a horizontal plane for maximum signal pickup. Several antenna locations may have to be tried, since nearby objects, especially those of metal, may affect picture quality or even cause dead spots in reception to occur. Relocating the antenna, at increments of as much as a few feet, may produce a better picture.

GHOST RECEPTION—Ghost images are sometimes encountered, appearing as a second picture image in various degrees of contrast and displacement from the main picture. If ghosts are evident in the received picture, a relocation of the antenna should be made. In many cases this will eliminate reception of these signals which are received from some other than the direct signal path from the television transmitter. If the ghost images cannot be eliminated in this manner, a compromise in antenna orientation for maximum signal pickup and image rejection may be made without seriously impairing picture quality.

SERVICE CONTROLS AND ADJUSTMENT PROCEDURE

It will be noted that some adjustments react upon each other and therefore should be adjusted alternately and as a final step all adjustments rechecked.

Power should not be applied to the receiver for any great length of time without the ion trap adjusted for some illumination.

The ion trap, deflection yoke, focus coil and the installation adjustment controls are adjusted in the procedure given below. These are described in greater detail under their respective titles immediately following this procedure.

Reference is made to Figure 2 for the service adjustments and yoke assembly.

1. Adjust ion trap to get brightest raster.
2. Adjust for no tilt of raster and tighten yoke clamp screws.
3. Tune in a television signal.
4. Adjust Horizontal Hold controls.
5. Adjust Drive control.
6. Adjust for good Horizontal and Vertical linearity.
7. Adjust Horizontal and Vertical size controls.
8. Adjust Focus coil for centering of test pattern, removal of neck shadow and for most uniform focus.
9. Readjust ion trap.
10. Recheck adjustments of steps 6, 7, 8 and 9.
11. Tighten Focus Coil adjustment screws and wing nuts.

ION TRAP—Power should not be applied to the receiver for any great length of time without the ion trap adjusted for some illumination. Set the Brightness control to maximum (clockwise). To adjust ion trap, rotate the trap on the neck of the tube and move it forward and backward to give maximum brightness. Reduce the picture Brightness during ion trap adjustment, if raster becomes too bright as maximum brightness with the trap is approached. Always make certain the ion trap is finally set to give maximum brightness of the raster

PICTURE TILT—If the picture or raster does not lie squarely within the picture tube mask, loosen one of the Yoke Adjustment Clamp screws and by grasping the Picture Tilt Lever, turn lever to rotate yoke until picture or raster squares with the mask. Tighten the yoke clamp screws after squaring picture with mask.

HORIZONTAL HOLD—Set the front panel Horizontal Hold control (R365) to the center of its range. Adjust the core of the Horizontal Hold control (L351) at the rear of chassis, until the picture is synchronized and is phased at the center of the raster—a slight rotation of the front panel control in either direction will move the picture slightly to the left or right without losing synchronization.

The pull-in to synchronization range should be equally distributed each side of the front panel Horizontal Hold control's center range and may be checked with the control set at center, observing the pull-in to synchronization sensitivity as the Channel Selector switch is flipped alternately back and forth from the received channel to an adjacent channel having no signal. For any other setting of the front panel Horizontal Hold control, the pull-in to synchronization time will be longer.

HORIZONTAL DRIVE—Adjust the Horizontal Drive control (R369) for optimum drive indicated by a maximum width of picture.

If any compression of picture is noted on the right-hand side of the raster, the condition may be corrected by a slight decrease of drive (clockwise rotation). If a vertical beaded line appears in the picture at this setting, a further clockwise adjustment should be made to eliminate it.

HORIZONTAL LINEARITY—The Horizontal Linearity control (L352) adjusts the picture for correct horizontal proportions. For best adjustment, use a test pattern and adjust the Horizontal Linearity control until the distances from the center of the test pattern to the left- and right-hand edges of the test pattern measure approximately the same. The adjustment of this control is very broad and it should be made simultaneously with the adjustment of the Width control (L353) to get proper picture width and correct horizontal linearity.

VERTICAL LINEARITY—This control (R311) should be adjusted to give best symmetry to the test pattern for correct vertical proportions in the picture. The adjustment should be made on a test pattern so that the distances from the center to the top and bottom edges of the test pattern measure approximately the same. This adjustment will alter the height of the picture slightly.

WIDTH—Adjust the Width control (L353) so that the edges of the picture extend approximately one-eighth inch past the right- and left-hand edge of the mask so that raster edges are not visible.

HEIGHT—The Height control (R308) changes the picture height and should be adjusted so that the picture extends approximately ⅛ inch beyond the top and bottom edges of the mask. This adjustment should be made simultaneously with the Vertical Linearity control (R311).

FOCUS COIL ADJUSTMENT—The Focus coil bracket adjustment screws and the swivel wing nuts are loosened in preparation for adjustment of the focus coil. These should not be too loose but should allow movement of the coil and yet retain each new position of coil adjustment.

The focus coil and bracket may be moved up and down, to the right or left, or the coil may be tilted in any direction by the swivel mounting. In addition, the coil may be moved forward or backward.

Adjust position of the focus coil to center picture test pattern within picture tube mask and to eliminate neck shadow. The focus coil should be as far back toward the base of the picture tube as possible for best focus consistent with maximum picture brightness.

MISCELLANEOUS SERVICE DATA

REMOVAL OF CHASSIS FROM CABINET—

1. Remove knobs and cabinet back.
2. Disconnect speaker leads.
3. Remove ¼-20 nuts and washers which hold picture tube anchor lugs to top inside corners of cabinet.
4. Remove chassis mounting screws.

PICTURE TUBE AND CHASSIS REPLACEMENT—

1. The deflection yoke clamp screws and focus coil adjustments should be loosened before attempting to install the picture tube—this will prevent any strain upon the tube neck when positioning and fastening the tube later.

2. Install the picture tube as shown in Figure 1. The bottom rim of tube should be forward against rubber stop on chassis front apron.

3. Place picture tube strap around rim of tube, inserting the picture tube anchor lugs between tube rim and strap as shown in Figure 1. Center tube approximately with regard to front of chassis and install tube strap mounting nuts to hold tube lightly.

4. Place chassis and tube into the receiver cabinet, repositioning tube anchor lugs to fit over stud screws in top corners of cabinet.

5. Install chassis mounting screws and tighten to fasten chassis securely.

6. Move picture tube if necessary to center tube in mask, as viewed from front of the cabinet.

7. Tighten tube strap mounting nuts, accessible from bottom of cabinet.

8. Install washer and ¼ inch-20 hex nut over picture tube anchor lug screws and tighten to hold lugs securely to cabinet.

9. Push deflection yoke forward to set against bell of picture tube and tighten yoke clamp screws.

10. Place ion trap on picture tube neck as shown in figure 2.

11. Connect picture tube socket to base of tube and high voltage lead to anode connection.

12. Install control knobs.

HIGH CHANNEL TRAP—This receiver incorporates a trap circuit (C206, L203, S202D) on the head-end unit which is switched into the antenna circuit on the low band channels. The trap may be used to eliminate any one of the following high channel interferences on the corresponding lower channel shown.

Channel #8 on Channel #4
Channel #11 on Channel #5
Channel #13 on Channel #6

The receiver is adjusted at the factory approximately for rejection of Channel #11 interference on Channel #5. It may be necessary to readjust the trap slightly, if Channel #11 interference is experienced when operating the receiver on Channel #5.

High channel interference manifests itself as horizontal bars, a herringbone pattern in the picture, or the high channel station picture superimposed upon the low channel picture for which the receiver has been tuned.

If none of the above combinations of channels exist in the locality where the receiver is to be used, the trap need not be adjusted.

THERMAL CUT-OUT—This is a protective device, which operates in a similar manner to a fuse, removing line voltage from the receiver in case of excessive current drain due to circuit overload. A five minute period should be allowed after the cut-out has tripped, before depressing the reset button to restore power to the receiver. If the receiver does not return to normal operation within a reasonable warm-up time after the cut-out has been reset, an analysis of the receiver circuit should be made to determine the cause of overload.

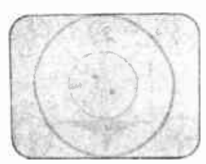
PICTURE DEFECTS

Fig. 3 Normal picture.

The following illustrations show picture defects which are caused by incorrect setting of operating controls, the preset controls or by interference picked up by the antenna. A possible remedy is indicated for each defect.

The adjustment of controls is most efficiently accomplished by the use of a test pattern, similar to that illustrated to the left, which is normally transmitted just prior to the scheduled program.

The normal picture should show good focus and a good contrast between blacks and whites with intermediate shades of gray. The picture should not tend to move either vertically or horizontally and should have good linearity.

PICTURE	DEFECT	REMEDY
	**Fig. 4 Picture too light.**	1. Increase Picture control setting and/or reduce brightness. 2. Weak signal. This may be caused by insufficient pickup on antenna or defective lead-in. Insufficient pickup at maximum contrast usually is accompanied by "snow" on the picture.
	**Fig. 5 Picture too dark (contrast).**	1. Reduce Picture control setting and/or increase Brightness control setting. 2. Too strong signal. If it is not possible to reduce signal adequately with Picture control, install suitable resistor antenna pad.

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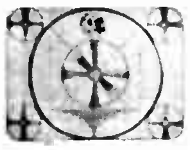
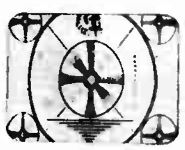
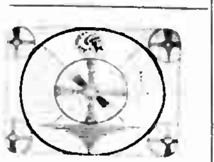
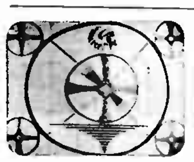
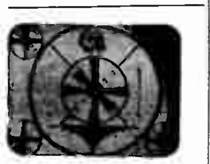
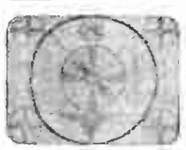
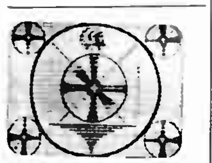
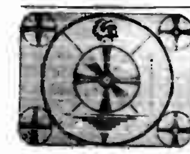
PICTURE DEFECTS (Cont'd)

PICTURE	DEFECT	REMEDY
	**Fig. 6 Picture defocussed.**	1. Adjustment of front panel focus control, R421. 2. Check for uniformity of focus by moving focus coil (see Installation and Service Adjustments, page 3). 3. Mistuning of receiver or misalignment.
	**Fig. 7 Horizontal sync.**	1. Adjust Horizontal Hold control (front panel control). 2. Check adjustment of rear panel Horizontal Hold control. 3. Signal improperly tuned. 4. Defective horizontal sync circuit.
	**Fig. 8 Vertical sync.**	1. Adjust Vertical Hold control until picture shows no tendency to slide up or down or lock out of frame. 2. Check the vertical sync circuits.
	**Fig. 9 Vertical linearity.**	Adjust Vertical Linearity control. This adjustment may alter the Height control adjustment.
	**Fig. 10 Vertical height.**	Adjust Height control so that the top and bottom picture edges are just covered by mask. Recheck Vertical Linearity control setting.
	**Fig. 11 Picture too wide.**	Adjust Width control so that the right and left picture edges are just covered by the mask.
	**Fig. 12 Horizontal linearity.**	1. Adjust Horizontal Linearity control. This adjustment may require resetting of Width control. 2. Adjust drive control as described under Installation Adjustments, page 3.
	**Fig. 13 Neck shadow.**	1. Misadjustment of Focus coil—tilted too far. 2. Move the deflection yoke forward against the bell of the picture tube.
	**Fig. 14 Herringbone pattern.**	This interference is caused by a television station operating on the next lower channel or by short-wave radio transmitting and receiving equipment. Police and "ham" transmitters in your locality will usually cause the most severe conditions. The interference produces moving ripples or diagonal streaks, or in some cases, may cause loss of contrast of the picture. The use of an antenna wavetrap tuned to the interfering signal may assist. If the interference is from a TV or FM station, a transmission line shorted stub may remove the interference. If the pickup is on the lead-in, a shielded lead-in will help correct the trouble. See page 4 for high channel trap adjustment.
	**Fig. 15 Horizontal bars.**	This interference is caused by adjacent channel sound or microphonics in receiver. If adjacent channel sound is responsible for this defect, readjust the adjacent channel traps L227 and L253 as outlined on page 8. A microphonic video amplifier tube, V7, may cause this condition.
	**Fig. 16 Ignition interference**	Ignition interference from trucks, automobiles, and airplanes may be identified by black or white streaks and splashes on the picture. The ignition system of trucks will produce the most intense interference pattern. Install antenna away from road carrying traffic. Shielded lead-in may help if interference is picked up on it.
	**Fig. 17 Multiple images. (ghosts).**	This is caused by the television signal following multiple paths, one of which is the direct path, and the other is reflected from some object such as a tall building or a large storage tank or hills. The signal following the longer reflected path arrives later at the receiver producing the second image. In case a built-in antenna is used, try to turn the cabinet until the ghost picture is dimmed out. If your receiver is connected to an outdoor installation, a reorientation of the antenna might improve the reception.
	**Fig. 18 "Snow."**	1. Too weak signal; increase efficiency of antenna installation. 2. Adjust tuning control.

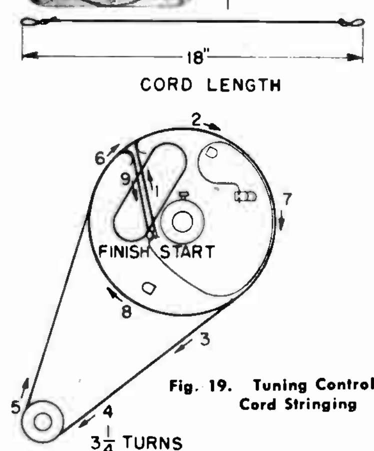
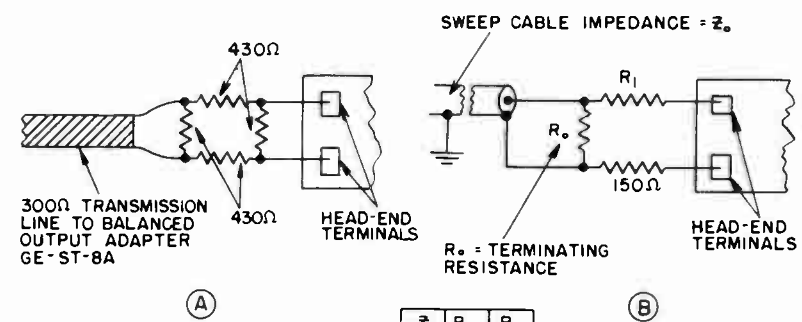


Fig. 19. Tuning Control Drive Cord Stringing



Z_o	R_o	R_1
50Ω	56Ω	120Ω
72Ω	82Ω	110Ω
92Ω	110Ω	100Ω

Fig. 20. Sweep Generator Termination

CAUTION: TO PROTECT TEST EQUIPMENT ALWAYS USE AN ISOLATION TRANSFORMER

GENERAL—A complete alignment of the receiver tuned circuits is given in the following charts. Read all alignment notes prior to making an alignment. The procedure shown in the charts is based upon the use of the G-E test equipment specified and if other equipment is used which has different characteristics, the charts may have to be modified slightly. A diagram showing the location of adjustments used in alignment is shown in Figure 22 on page 9. Use the alignment service diagram, Figure 29, on page 15 with the charts.

The illustrations of Figure 30 and 33 show the alignment equipment connection points given in the alignment charts.

It is necessary to connect the low side of the test equipment to the B— bus of the receiver keeping the lead as short as possible.

Dress signal generator and oscilloscope cables away from both vertical and horizontal oscillator sweep circuits to prevent their interference from influencing the output response curve.

Always permit a 15 minute warm-up period for the receiver and test equipment prior to attempting alignment.

To align the receiver with the picture tube removed, a Type 6SN7 tube with all pins clipped off except pins #7 and #8 may be used to complete the filament circuit. Plug pins #7 and #8 of the 6SN7 into pins #1 and #12 of the picture tube socket.

To protect the test equipment, always use an isolation transformer between the power line and the TV receiver. See caution notice at top of page 2.

TEST EQUIPMENT—The following test equipment is necessary.

1. R-F Sweep Generator (G-E Type ST-4A or Equivalent).

a. Frequency Requirements.
4.5 MC with 500 KC and 2 MC sweep width.
40-50 MC with approximately 10 MC sweep width.
50-90 MC, 170-220 MC with 15 MC sweep width.

b. Constant output in the sweep range.

c. At least 0.1 volt output

2. Marker Generator (G-E Type ST-5A or Equivalent).

The marker generator must have good frequency stability, must be accurately calibrated and must cover the following frequencies.

41.25 MC for video I-F
42.50 MC for video I-F
44.20 MC for video I-F
44.50 MC for vidoe I-F
45.00 MC for video I-F
45.75 MC for video I-F
47.25 MC for video I-F
4.5 MC for sound I-F and trap alignment

Picture and sound carrier frequencies for Channels #2 through #13.

3. Balanced Output Adapter G-E ST-8A or Equivalent (See Figure 2.0 and RF Alignment, Note 1, page 10).

4. Oscilloscope (G-E Type ST-2A or Equivalent)—The oscilloscope should have good sensitivity and preferably a 5-inch screen with a good wide-band frequency response on the vertical deflection circuits. Although the high frequency response is not necessary for alignment, it is important when making waveform measurements shown in Figure 29, page 15.

5. Vacuum Tube Voltmeter—A vacuum tube voltmeter is necessary to measure the bias of —2.7 volts required for video and r-f alignments.

6. Detector Network—A crystal detector network as shown in Figure 27 is necessary to detect the video output response when aligning L260, the 4.5 mc trap.

7. Miscellaneous—One 10,000 ohm resistor to isolate the scope as noted in the charts.

One .01 mfd. capacitor to isolate the sweep generator as noted in the chart.

Impedance matching pad for r-f alignment as shown in Figure 20.

Bias battery to supply —2.7 volts as noted for video i-f and r-f alignment.

Resistor, 680 ohms, to shunt L226 described in note 3 of R-F Alignment on page 10.

Capacitor, 400 mf., 350 volt, to reduce hum on R-F response curve. See note 3. page 10.

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VIDEO I-F ALIGNMENT

1. Connect a bias battery from junction of C261, R263 and the Picture control to B −. Connect positive of battery to B −. Adjust the Picture control to give a −2.7 volts bias at the grid, pin 1, of V4 as measured with a vacuum tube voltmeter. Adjust the signal generator for a ¾ volt video output response on a calibrated oscilloscope. Disconnect VTVM leads during alignment.

2. The sweep generator should be properly terminated in its characteristic impedance. Couple the signal to the point of input through a .01 mf. capacitor.

3. The traps L227 and L253 must be detuned before aligning the amplifier by turning the cores all the way out of the coil. These traps are to be retuned for minimum amplitude at 47.25 mc in step 6 of the procedure. This adjustment is greatly enhanced by increasing the scope gain.

4. Set the Channel switch to Channel #12 or #13. Check for oscillator influence by turning the tuning control. If the shape of the response curve changes, switch to another channel where oscillator influence is not noted.

5. In most cases it is only necessary to perform an over-all alignment of the video i-f, as in Step 7 of the Video Alignment Chart, to obtain i-f response curve of Figure 21-E.

When aligning the i-f coils, L251 will adjust the audio or low frequency side of the i-f response curve, while L252 will adjust the video or high frequency side of the i-f response curve. L226 and L254 should be adjusted simultaneously to reduce the saddleback at the peak of the curve and to give maximum gain and retain 45.75 mc and 42.50 mc markers at the 50% mark.

6. It is necessary to detune the i-f coils by shorting as noted in the alignment chart to prevent the coil preceding the signal input point from influencing the response curve.

7. The 45.75 mc marker should fall at the 50% point to give proper sideband response. See Fig. 21E.

8. After adjustment of the two adjacent sound traps, make the final adjustments to obtain the proper curve and markers as illustrated in Fig. 21E, in step 7.

VIDEO I-F ALIGNMENT CHART

Step	Marker Generator Frequency	Sweep Generator Frequency	Signal Input Points Between	Connect Oscilloscope Between	Adjust	See Note No.
1		40 to 50 MC		Fig. 30, point A Junction L256, R265, C268 and R266 thru 10K ohms and B − on V7 socket.	Detune L227 and L253 by turning cores out of coil.	3
2	44.50 MC		Fig. 30, point B V6 grid (pin 1) thru .01 mf. cap. and B − on head-end shield. Short L252.		Core of L254 for curve of Fig. 21-A.	1, 2, 4, 6
3	45.75 MC		Fig. 30, point C V5 grid (pin 1) thru .01 mf. cap. and B − on head-end shield. Short L251. Remove short on L252.		Core of L252 for curve of Fig. 21-B.	
4	42.50 MC, 45.75 MC		Fig. 30, point D V4 grid (pin 1) thru .01 mf. cap. and B − on head-end shield. Short L226. Remove short on L251.		Core of L251 for curve of Fig. 21-C.	
5	44.2 MC				Core of L226 for curve of Fig. 21-D.	
6	47.25 MC		Fig. 30, point E Junction L215 and L216 on second r-f switch wafer thru .01 mf. cap. and B − on head-end shield. Remove short on L226.		Cores of L227 and L253 for min. output at 47.25 MC (Fig. 21-E).	1, 2, 3, 4, 7
7	41.25 MC, 42.50 MC, 45.00 MC, 45.75 MC, 47.25 MC				Cores of L251, L252, L254 and L226 for curve of Fig. 21-E.	1, 2, 4, 5, 7, 8

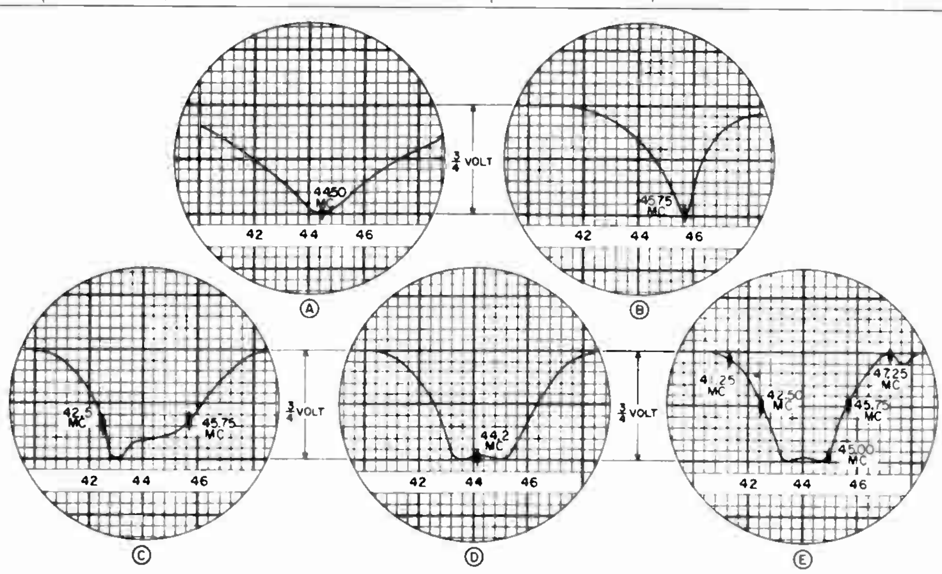

Fig. 21. Video I-F Curves

AUDIO I-F ALIGNMENT

1. Audio i-f alignment is performed by putting in a 4.5 mc ±500 kc sweep and viewing the response curve as noted in the audio i-f chart.

2. As a final check, step 12, the secondary of T402 adjustment, should be checked on a television signal if possible. Try several operating television stations and if buzz in the audio is heard, the secondary of T402 should be readjusted as follows.

Tune in the station and adjust the contrast control for a weak sound output. Readjust the secondary of T402 until the buzz is a minimum or disappears and the best quality audio is obtained.

3. Keep the input of the sweep generator low enough so that limiting does not take place, otherwsie the response curve will broaden out resulting in a slight misadjustment. Check by increasing the output of the sweep generator; the response curve should increase in amplitude.

4. T401 is adjusted for maximum amplitude and symmetry of the response curve about the 4.5 mc marker as shown in Fig. 23-A.

5. The secondary of T402 is adjusted for the curve of Figure 23-B. This adjustment should give as straight a slope as possible between the positive and negative peaks of the curve with the center of the 4.5 mc marker falling midway between the peaks.

6. The primary of T402 is adjusted for maximum amplitude of the positive and negative peaks with as straight a trace as possible between the peaks. If necessary, readjust the secondary of T402 so that the marker falls midway between the peaks.

7. An alternate method to the visual alignment is the sound output method using an operating television station, preferably when transmitting tone modulation during the test pattern.

(a) Tune the receiver for optimum detail.
(b) Keep the input below limiting level by reducing the contrast by the Picture control or by using a resistor pad in the antenna circuit.
(c) Adjust primary and secondary of T401 for maximum sound output. Adjust primary of T402 for maximum audio output.
(d) Adjust the secondary of T402 for best quality audio (low distortion, least noise) and for minimum buzz in the output.

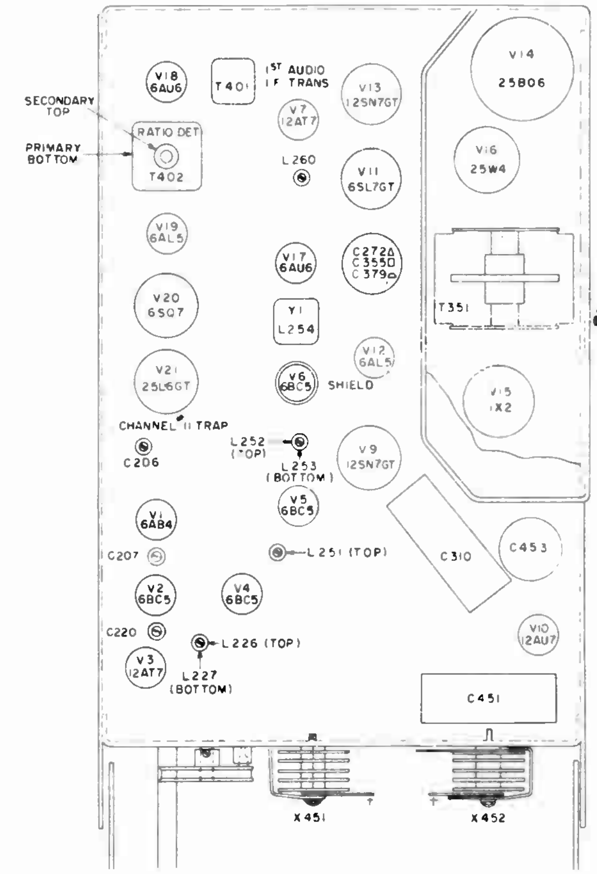

Fig. 22. Tube and Trimmer Location

AUDIO I-F ALIGNMENT CHART

Step	Marker Generator Frequency	Sweep Generator Frequency	Signal Input Points Between	Connect Oscilloscope Between	Adjust	See Note No.
8	4.5 MC	4.5 MC ±500 KC keep signal below limiting level of receiver.	Fig. 30, point F Pin 1 of V17 through .01 mfd. cap. and B −	Fig. 33, point G Junction of R404 and C404 & sec. of T401 through 10K and B −.	Primary and secondary of T401. See Figure 23-A.	1, 3, 4
9			Fig. 33, point H Pin 1 of V18 through .01 mfd. cap. and B −.	Fig. 30, point I Junction of R408, C411 and R411 through 10K and B −.	Secondary of T402. See Fig. 23-B.	1, 3, 5
10					Primary of T402. See Figure 23-B.	1, 3, 6
11					Secondary of T402. See Figure 23-B.	1, 3, 5
12	Recheck alignment of step 11 on operating station as in note 2.					

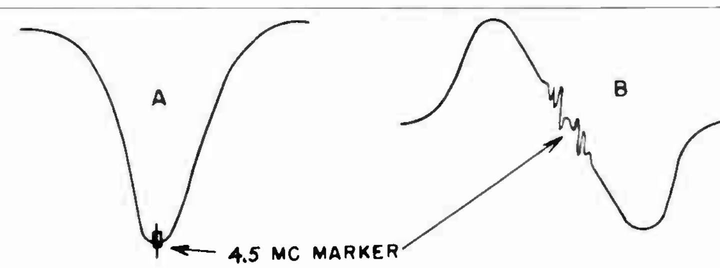

Fig. 23. Audio I-F Curve

MODELS 14C102, 14C103, 14T2, 14T3

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R-F ALIGNMENT

R-F Alignment Notes

1. Disconnect the transmission line to the antenna terminals at the head-end. Couple the output of the sweep generator to the balanced output adapter G-E ST-8A, or an equivalent adapter for the particular type sweep generator used. Couple the adapter to the head-end terminals through a piece of 300-ohm transmission line and the pad network shown in Figure 20A.

If a balanced output adapter is not available for the sweep generator, a matching network as shown in Figure 20B may be used. A balanced output is recommended, since a matching network as shown in Figure 20B may introduce frequency shift and cause a misleading tilt to the response curve. Ro shown in Figure 20B is the terminating resistor. If this resistor is not already incorporated in the output of the sweep generator, it should be added to the matching network as shown in the table for the impedance Zo of the particular signal generator used.

2. It is necessary to connect a bias battery from the junction of the Picture control, C261, and R263 to B−. Connect plus of bias battery to B−. Adjust the Picture control to give a −2.7 volts bias measured from pin 1 of V2 to the head-end chassis B−.

3. Shunt L226 with a 680 ohm, ½ watt resistor during r-f alignment to prevent the oscillator from influencing the response. curve. In order to reduce the effect of hum on the response curve, connect a 100 ohm resistor in series with the B+ line to the head-end chassis and connect an electrolytic capacitor of approximately 400 mf, 350 volt from head-end B+ to head-end B−.

4. On all channels the picture carrier marker should not be less than 75% of the peak of the r-f response curve. The sound carrier marker should not be less than 50% of the peak of the response curve. However, the two minimum values should not occur simultaneously. On the high channels the picture carrier marker should ride up nearer to the top of the curve provided the sound carrier marker does not go below 50%. On the low channels the picture carrier marker should ride as high up on the curve as possible and still keep the sound carrier marker above 50%.

5. Coils for Channel No. 12 through No. 7 are fixed inductances. Check the alignment on these channels as in steps 16 through 21 for proper response curve. Readjust L210 and L217 on Channel No. 13 and C207 and C220 on Channel No. 7 if necessary.

6. Coils for Channels No. 5 and No. 4 are fixed inductances. Check the alignment on these channels for proper curve. Readjust coils L208 and L215 if necessary to give proper curve on Channels No. 6, No. 5 and No. 4.

7. The coil for Channel No. 2 is a fixed inductance. Check the alignment on this channel for proper-curve. Readjust L205 and L212 if necessary to give proper curve on Channels No. 3 and No. 2.

8. The trimmers C207 and C220 may be used to compensate for differences in tube capacities which affect tracking when it is necessary to change the tubes V1 or V2. The variations in tube capacities normally have little effect on the over-all performance of the head-end.

R-F ALIGNMENT CHART

Step No.	Marker Generator Frequency	Sweep-Generator Frequency	Signal Input Point	Connect Oscilloscope	Channel Switch	Adjust	See Note
13	211.25 MC, 215.75 MC	No. 13 with 15 MC sweep	Antenna terminals at head-end (see Note 1).	Fig. 30, point J Junction of L226, C217 and R218 thru 10K-resistor and B− at head-end chassis.	No. 13	Screw of L210, screw of L217, for Fig. 24-A.	1, 2, 3, 4
14	175.25 MC, 179.75 MC	No. 7 with 15 MC sweep			No. 7	Trimmers C207 and C220 for response curve, Fig. 24-A.	1, 2, 3, 4, 8
15	211.25 MC, 215.75 MC	No. 13 with 15 MC sweep			No. 13	Readjust screw of L210 and screw of L217 for curve, Fig. 24-A.	1, 2, 3, 4
16	205.25 MC, 209.75 MC	No. 12 with 15 MC sweep			No. 12	No adjustment.	1, 2, 3, 4, 5
17	199.25 MC, 203.75 MC	No. 11 with 15 MC sweep			No. 11		
18	193.25 MC, 197.75 MC	No. 10 with 15 MC sweep			No. 10		
19	187.25 MC, 191.75 MC	No. 9 with 15 MC sweep			No. 9		
20	181.25 MC, 185.75 MC	No. 8 with 15 MC sweep			No. 8		
21	175.25 MC, 179.75 MC	No. 7 with 15 MC sweep			No. 7		
22	83.25 MC, 87.75 MC	No. 6 with 15 MC sweep			No. 6	Screw of L208 to place 83.25 MC marker and screw of L215 to place 87.75 MC marker as shown in Fig. 24-B.	1, 2, 3, 4
23	77.25 MC, 81.75 MC	No. 5 with 15 MC sweep			No. 5	No adjustments.	1, 2, 3, 4 6
24	67.25 MC, 71.75 MC	No. 4 with 15 MC sweep			No. 4		
25	61.25 MC, 65.75 MC	No. 3 with 15 MC sweep			No. 3	Screw of L205 to place 61.25 MC marker and screw of L212 to place 65.75 MC marker, as shown in Fig. 24-B.	1, 2, 3, 4
26	55.25 MC, 59.75 MC	No. 2 with 15 MC sweep			No. 2	No adjustment.	1, 2, 3, 4, 7

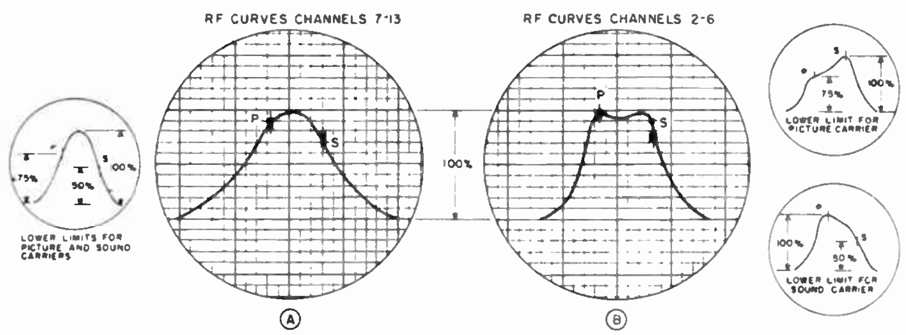

Fig. 24. R-F Alignment Curves

OSCILLATOR ALIGNMENT

Before attempting this oscillator alignment, it must be certain that the video i-f stages and r-f stages are properly aligned as outlined previously.

1. Disconnect the 300-ohm line from the r-f head-end terminals and connect sweep generator to head-end properly terminating sweep generator output cable as shown in Figure 20. See RF Alignment Note 1.

2. Alignment is made by viewing the response curve at the output of the video i-f detector.

3. Use a video carrier marker as shown in each step of the Alignment Chart.

4. Set the tuning control C213 at the center of its rotation. Adjust L225 to place the video carrier marker at the 50% point on the high frequency slope of the curve for step 28. The oscillator inductance L224 for channels #12 through #7 is fixed. The alignment on these channels is checked to see that the picture marker falls at the 50% point on the high frequency slope of the curve. If the picture marker position does not meet these conditions, it is necessary to readjust L225 for a compromise on channels #13 through #7. The tuning range of C213 on channels #13 through #7 should be sufficient to move the video carrier marker up and down the entire high frequency side of the response curve. Readjust L225 if necessary.

5. On Channel #6 through #2 set the tuning control C213 at the center of its rotation and make the indicated adjustment so that the video carrier marker falls at the 50% mark on the high frequency slope of the response curve.

OSCILLATOR ALIGNMENT CHART

Step No.	Marker Generator Frequency	Sweep Generator Frequency for Channel	Signal Input Point	Connect Oscilloscope Between	Channel Switch Setting	Adjust	See Note
27	211.25 MC	No. 13 with 15 MC sweep	Antenna terminals of head-end. See note 1.	Fig. 30, point A Junction of L256, R265, C268 through 10K ohms and B− at V7 socket (pin 3).	No. 13	L225 by squeezing or spreading turns slightly.	1, 2, 3, 4
28	205.25 MC	No. 12 with 15 MC sweep			No. 12	No Adjustment	
29	199.25 MC	No. 11 with 15 MC sweep			No. 11		
30	193.25 MC	No. 10 with 15 MC sweep			No. 10		
31	187.25 MC	No. 9 with 15 MC sweep			No. 9		
32	181.25 MC	No. 8 with 15 MC sweep			No. 8		
33	175.25 MC	No. 7 with 15 MC sweep			No. 7		
34	83.25 MC	No. 6 with 15 MC sweep			No. 6	Screw of L223.	1, 2, 3, 5
35	77.25 MC	No. 5 with 15 MC sweep			No. 5	Screw of L222.	
36	67.25 MC	No. 4 with 15 MC sweep			No. 4	Screw of L221.	
37	61.25 MC	No. 3 with 15 MC sweep			No. 3	Screw of L220.	
38	55.25 MC	No. 2 with 15 MC sweep			No. 2	Screw of L219.	

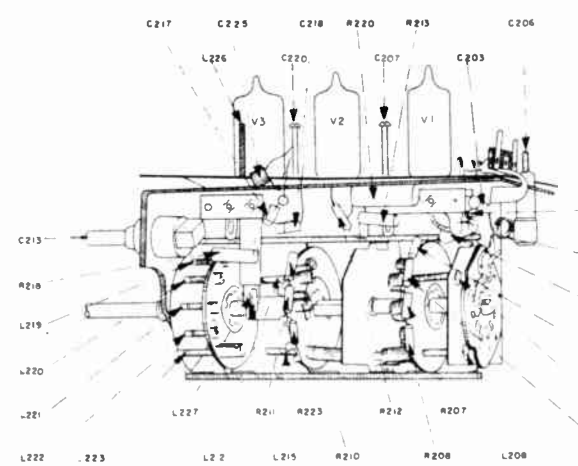

Fig. 25. Head-end Unit

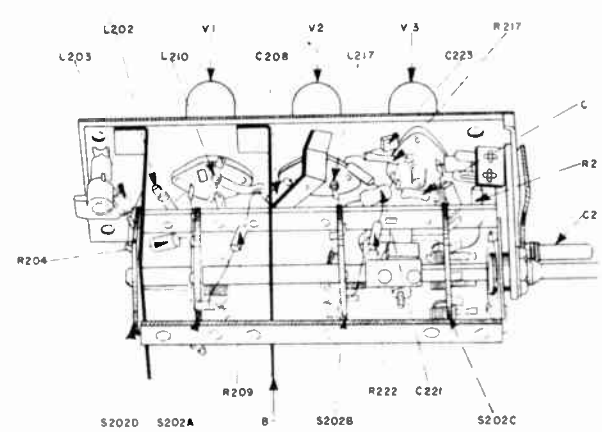

Fig. 26. Head-end Unit

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ADJUSTMENT OF VIDEO AMPLIFIER 4.5 MC TRAP (L260).

This trap is used to remove 4.5 mc audio i-f from the video amplifier which shows up in the picture as a cross-hatch pattern. This trap will very rarely require adjustment. Adjustment is as follows:

1. The trap (L260, C271, C270) is adjusted for minimum amplitude of the response curve at the 4.5 mc marker point. Use a detector network as shown in Figure 27, connected from junction of L264 and C275 (Fig. 30, point K) to B−, to detect the signal.

2. Adjust the vertical hold control to remove the vertical pulses from the response curve.

4.5 MC TRAP (L260) ALIGNMENT CHART

Step	Marker Generator Frequency	Sweep Generator Frequency	Signal Input Point	Oscilloscope	Adjust	See Notes
39	4.5 MC	4.5 MC ±1 MC	Fig. 30, point A Junction L256, R265, C268, R266 and B− thru .01 mf.	Across 100K resistor of detector network as shown in Fig. 27. (See Note 1.)	L260 for min. amplitude of response curve at the 4.5 mc marker. Increase scope gain.	1, 2, 3

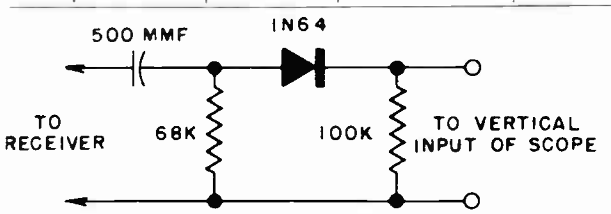

Fig. 27. Detector Network.

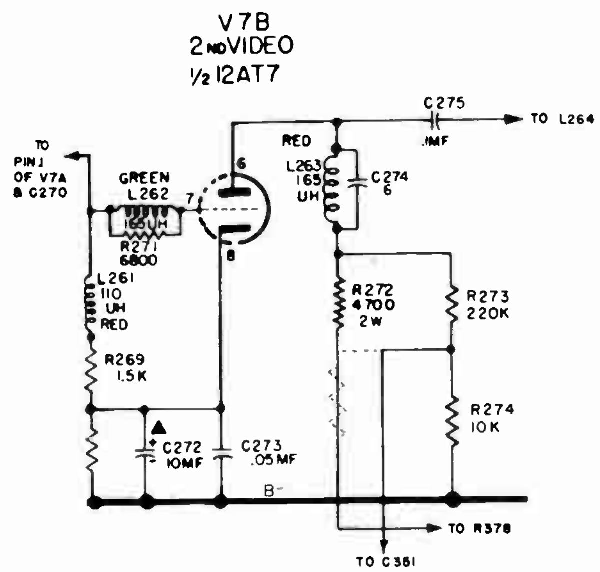

Fig. 28. Early Sync Take-off Circuit

PRODUCTION CHANGES

1. TO CORRECT BENDING AT TOP OF PICTURE

In early production receivers R273, R274 and the sync voltage take-off capacitor C351 was connected as shown in Figure 28.

In late production R274 was deleted. R273 was changed to 220 ohms and is reconnected in series with R272. C351, the sync coupling capacitor, is now connected at the junction of R272 and R273 as shown in the schematic diagram of Figure 32, page 17.

2. ELIMINATION OF VERTICAL LINES AT LEFT SIDE OF PICTURE (ADDITION OF C371)

Capacitor C371, .05 mfd., 600 volts, was added to later production receivers, to by-pass transient voltages developed by the horizontal sweep circuit at the B+ supply. These voltages would produce the effect of vertical, light and dark bars in the left part of the picture.

The capacitor, C371, is connected from the B+ terminal of the terminal strip adjacent to the damper tube, V16, on the chassis side apron and to the B− bus connection of C374.

TROUBLE SHOOTING

This trouble shooting chart is divided into sections for quick trouble shooting. In most cases a trouble may be localized by noting the condition of the picture or test pattern and the presence or absence of sound.

In general, the tubes in the defective circuit should be checked first since they are fairly easy to check. When substituting tubes in the RF or video IF circuits, the original tube should be replaced in the socket if it is found not to be defective. When a tube is replaced in the video IF or RF circuits, alignment should be checked.

The block diagram (Figure 1), the waveforms of the service diagram (Figure 29), and the socket voltage and resistance diagram (Figure 31) may be used to locate troubles. Alignment equipment may be used to isolate defective RF, video IF or audio IF stages by checking for the response curves as given in the alignment procedure.

Defects of the R-F and I-F Circuits.

A. NO PICTURE, NO SOUND, RASTER NORMAL.

1. Check the RF head end circuits of V1 and V2.
2. Check to see that local oscillator, V3B, is operating properly.
3. Check Video IF amplifier circuits of V4, V5 and V6.
4. Check crystal detector, Y1.
5. Check channel switch.

B. SNOW IN PICTURE.

1. Open input circuit in C278, C279 or L201.
2. Defective antenna installation or transmission line.
3. Antenna orientation.

C. LACK OF PICTURE DETAIL (FOCUS SATISFACTORY).

1. Misalignment of Video I-F.
2. Misalignment of R-F amplifier.
3. Mismatch of input impedances at antenna input terminals of receiver.
4. Overloading of r-f stages.

D. MOTORBOAT OR FLUTTER IN PICTURE AND AUDIO.

1. Open by-pass, C251.
2. Open filament by-passes C222 and C458.
3. Misalignment of video I-F and R-F amplifiers.

E. WIGGLES IN PICTURE BACKGROUND, TRAILING WHITES ON PICTURE, SOUND NORMAL.

1. Misalignment of R-F and I-F amplifier.
2. Improper tuning of receiver.

F. SOUND BARS IN PICTURE (BLACK HORIZONTAL BARS).

1. Microphonic tubes, V3, V4, V7 or picture tube V8.
2. Misalignment of adjacent channel sound traps, L253, L227.

Defects of the Video Amplifier

A. NO PICTURE, SOUND SATISFACTORY, RASTER SATISFACTORY.

1. Open chokes L263, L261, L264.
2. Shorted capacitor C270, C272, C273.
3. Open capacitor, C268.
4. Open resistors R269, R272.
5. Short from pin 2 to pin 11 of V8 picture tube.

B. POOR LOW FREQUENCY RESPONSE (TRAILING WHITES AFTER BLACK).

1. Low value of resistors R269, R272, R265.
2. Low capacity or open capacitor C272.
3. Low capacity of C268, C275.

C. LACK OF PICTURE DETAIL, FOCUS SATISFACTORY (SMEARING OF VERTICAL WEDGES OF TEST PATTERN).

1. Shorted chokes L259, L261, L262.
2. Open chokes L259, L262.
3. High resistance of R272, R269, R265.

D. BRIGHT PICTURE WITH BLACK LINES.

A shorted capacitor C275 will give a very bright picture with black lines across the picture. The picture control will have no effect.

E. PICTURE DISTORTED AT HIGH SETTINGS OF PICTURE CONTROL.

Check for high resistance of R273.

Defects of the Sync Section

A. NO VERTICAL SYNC, HORIZONTAL SYNC SATISFACTORY.

1. Check waveform of sync input, V9 pin 5.
2. Check C303, R301, R302, C301 for leakage or shorted.
3. Check components C306, R304, R305.
4. Check for leakage of C305.

B. WEAK VERTICAL SYNC, HORIZONTAL SYNC AND PICTURE NORMAL.

1. Leakage or low value of capacitor of C303.
2. Leakage of C301, C302 or incorrect values.
3. Check frequency determining components C306, R304, R305 for value or defective.

C. WEAK OR NO VERTICAL AND HORIZONTAL SYNC. PICTURE INFORMATION PRESENT AND SOUND NORMAL.

1. Check waveform at pin 4 of V11 for proper waveform from video amplifier.
2. Improper B+ voltage on V11.
3. Incorrect value of R354.
4. Open or low capacity of C351.
5. Defective coupling capacitor C353, C354.

D. WEAK OR NO HORIZONTAL SYNC, VERTICAL SYNC SATISFACTORY.

1. Check waveform at pin 2 of V12.
2. Check sweep frequency determining components L351, C366, C364, R365, R364.
3. Check for leakage in V12 components, C356, C357, C360, C358.
4. Check for proper value of resistors R356, R357, R358, R361.
5. Check C359, R359 and R360 in the feedback circuit.
6. Check coupling between V13A and V13B (C363, C365, R366).

Defects of the Vertical Sweep

A. KEYSTONING (PICTURE NARROWS AT TOP OR BOTTOM).

1. Defective vertical deflection coil, D301.
2. Check R314, R315.

B. NO VERTICAL DEFLECTION (SINGLE WHITE HORIZONTAL LINE ON SCREEN).

1. Open deflection coil, D301.
2. Defective sweep output transformer, T301.
3. Multivibrator V9 and V10 defective, no B+ to V10, open R312 or shorted C310.

C. INSUFFICIENT HEIGHT.

1. Open C310.
2. High resistance of R307.
3. Excessive leakage of C308.
4. Defective T301.
5. Incorrect voltage values on V10.
6. Low capacity of C309 (this also results in poor vertical linearity).

D. POOR VERTICAL LINEARITY, SIZE NORMAL.

1. Leaky or improper value of C309.
2. Check B+ to V10 (leaky capacitor C310).
3. Check C303 for leakage.

E. POOR VERTICAL LINEARITY, INSUFFICIENT HEIGHT.

1. Defective output tube, V10.
2. Inadequate drive voltage from V9. Check waveform at pin 5 of V9.
3. Low plate voltage to V9 or V10.
4. Open or low capacity of C309.

F. EXCESSIVE VERTICAL SIZE, SYNC SATISFACTORY.

1. Low value of R307 or defective size control R308.
2. Open or low capacity of C308.
3. Low picture tube anode voltage.
4. Open R309.

G. NO VERTICAL SYNC, VERTICAL HOLD HAS NO EFFECT, INSUFFICIENT HEIGHT.

1. Shorted capacitor C306.
2. Shorted R305.

H. POOR VERTICAL LINEARITY, FOLD-OVER AT BOTTOM OF PICTURE, TOO MUCH HEIGHT.

1. Shorted or high leakage of C303.
2. Low capacity of C308.

I. CURTAIN RAISING EFFECT (PICTURE ROLLS UP FROM BOTTOM AS VERTICAL HOLD IS ADVANCED).

1. Leaky capacitor, C304.
2. Low resistance of R303.

Defects of the Horizontal Sweep

A. INADEQUATE SWEEP WIDTH.

1. Low B+ boost to plate of V14 or low B+ to screen of V14.
2. Shorted turns of width control, L353.
3. Shorted turns or arc-over in T351.
4. Parasitic oscillations in V14 (open filament by-pass C462, or defect V14).

B. TOO GREAT SWEEP WIDTH.

1. Open width control, L353.
2. Low value of picture tube anode voltage.
3. Check voltages of V14.
4. High value of C382.

C. POOR HORIZONTAL LINEARITY.

1. Check for shorted, or shorted turns of L352.
2. Leaky capacitor C370 in grid of V14.
3. Check screen by-pass capacitor C380.
4. Defective transformer T351.

D. SINGLE WHITE VERTICAL LINE ON SCREEN.

1. Open deflection coil, D351.

E. BLACK BEADY VERTICAL LINE OR LINES (BARKHAUSEN OSCILLATION).

1. Check sweep output tube, V14.
2. Check for open C382.

F. KEYSTONING (PICTURE NARROWS AT TOP OR BOTTOM).

1. Check for shorted capacitor, C378.
2. Shorted turns of Horizontal Deflection coil D351.

G. NO HORIZONTAL SYNC, BRIGHT VERTICAL BAR OR BARS IN PICTURE.

1. Shorted, open or leaky C365.
2. Shorted R366.

H. GEAR-TOOTH EFFECT, TEARING OF PICTURE (HUNTING OF HORIZONTAL SYNC).

1. Open or low capacity of C375.
2. Open or high resistance of R362.

I. POOR HORIZONTAL LINEARITY, BRIGHT VERTICAL BARS, INADEQUATE HORIZONTAL SIZE.

1. Open or low capacity of C374.

J. DIM PICTURE, POOR HORIZONTAL LINEARITY, INSUFFICIENT WIDTH AND HEIGHT.

1. Open or low capacity of C377.

Audio Defects

NO SOUND, PICTURE NORMAL.

1. This indicates a defect in the circuits of V17, V18, V19, V20, V21 or the loudspeaker.
2. Misalignment of T401 or T402 may also cause no sound to be received.

BUZZ OR HUM IN THE SOUND.

1. Misalignment of T402 secondary may cause buzz.
2. Reverse power plug in power outlet.

Power Supply and Picture Tube Circuits

A. NO RASTER, NO SOUND (NO B+).

1. Check power input circuit (cord and interlock).
2. Check rectifier (X451, X452, L451, C451, R451).
3. Check thermal cutout.

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B. *PICTURE SIZE SMALL, BRILLIANCE LOW, SOUND NORMAL (LOW B+)*
1. Open or low value of C452.
2. Low emission of X451 or X452.

C. *LOW PICTURE BRILLIANCE, SOUND SATISFACTORY.*
1. Misadjustment of ion trap.
2. Low voltage at high voltage anode of picture tube caused by leaky C376, defective V15, or shorted L353.
3. Low B+ to V14 (check B+ boost at pin 3 of V16. V16 may be defective).
4. Improper waveform at grid of pin 5 of V14.
5. Defective Brightness control circuit or improper voltages to Brightness control R276.
6. Low voltage at second grid (pin 10) of picture tube.
7. Defective picture tube.

D. *NO RASTER, SOUND SATISFACTORY.*
1. No high anode voltage to picture tube.
2. Ion trap misadjusted.
3. Brightness control circuit open.
4. No voltage at pin 10 of V8 pix tube.
5. Defective picture tube.
6. No drive voltage from V14. Check waveform at pin 5 of V14.
7. Open L352.

Miscellaneous Defects

A. *RETRACE LINES VISIBLE.*
1. Check waveform of V9, pin 2.
2. R316, C311, R318 open.
3. C311 shorted.

B. *BRIGHTNESS CONTROL R276 PARTIALLY OR TOTALLY INOPERATIVE.*
1. Defective R276.
2. Too low or too high B+ to R276.
3. Short or leaky capacitor, C275 or C277.
4. Gassy picture tube.

C. *PICTURE CONTRAST EXCESSIVE (PICTURE CONTROL WILL NOT REDUCE CONTRAST).*
1. Excessive antenna input signal.
2. Defective picture control.
3. Shorted or leaky coupling capacitor, C354.
4. Open capacitor C353, C354.
5. Shorted AGC by-pass capacitor, C251.

D. *PICTURE CONTROL INEFFECTIVE.*
1. Shorted C261 (this will make the picture control work backwards).
2. Open choke L258.
3. AGC by-pass C251 shorted.
4. Check waveform at pin 4 of V11.

E. *POOR FOCUS.*
1. Open or shorted focus coil.
2. Defective audio output tube V21.
3. Demagnetized permanent magnet of focus coil.
4. Defective picture tube V8.

F. *NECK SHADOW (SEE FIGURE 13).*
1. Misadjustment of focus coil or ion trap.
2. Deflection yoke not forward against the bell of the picture tube.

G. *WAVY LEFT OR WHITE EDGES OF PICTURE (HUM).*
1. Check tube V11, V12, V13 for filament to cathode leakage.
2. Check C379 or C355.

H. *WIDE BLACK HORIZONTAL BAR IN PICTURE, WAVY LEFT OR RIGHT EDGES OF PICTURE (HUM).*
1. Check filter capacitors C452, C453, C272.

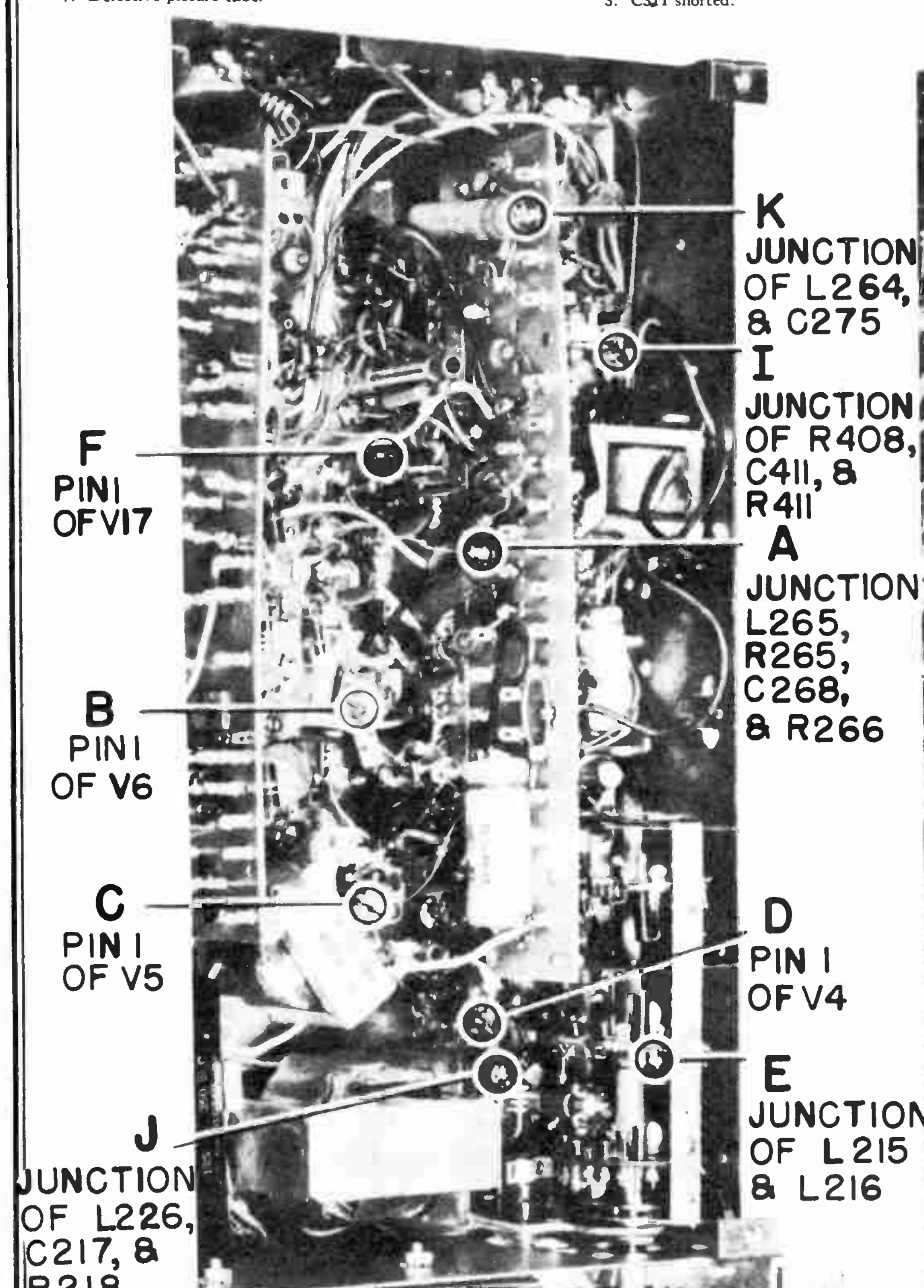


Fig. 30. Alignment Connection Points

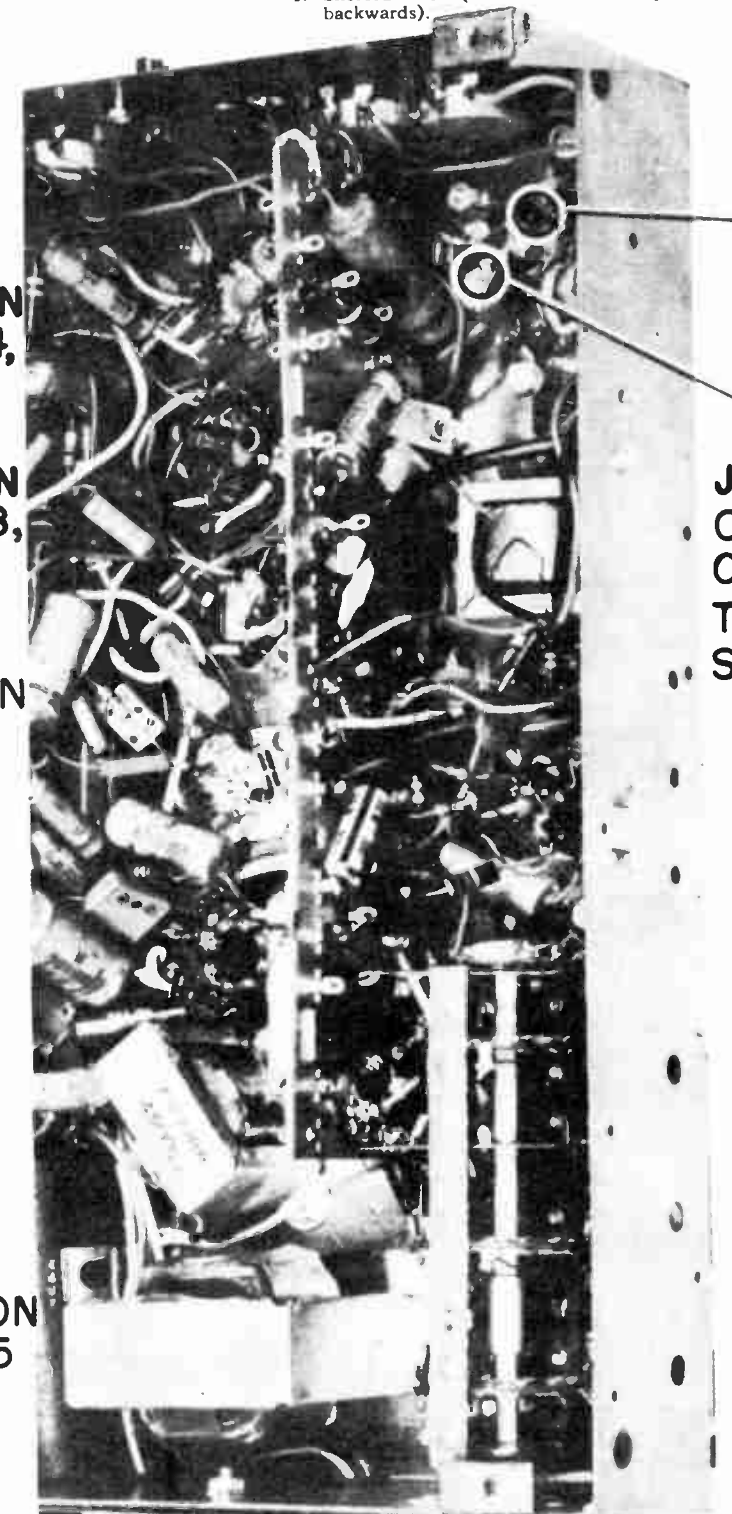


Fig. 33. Alignment Connection Points

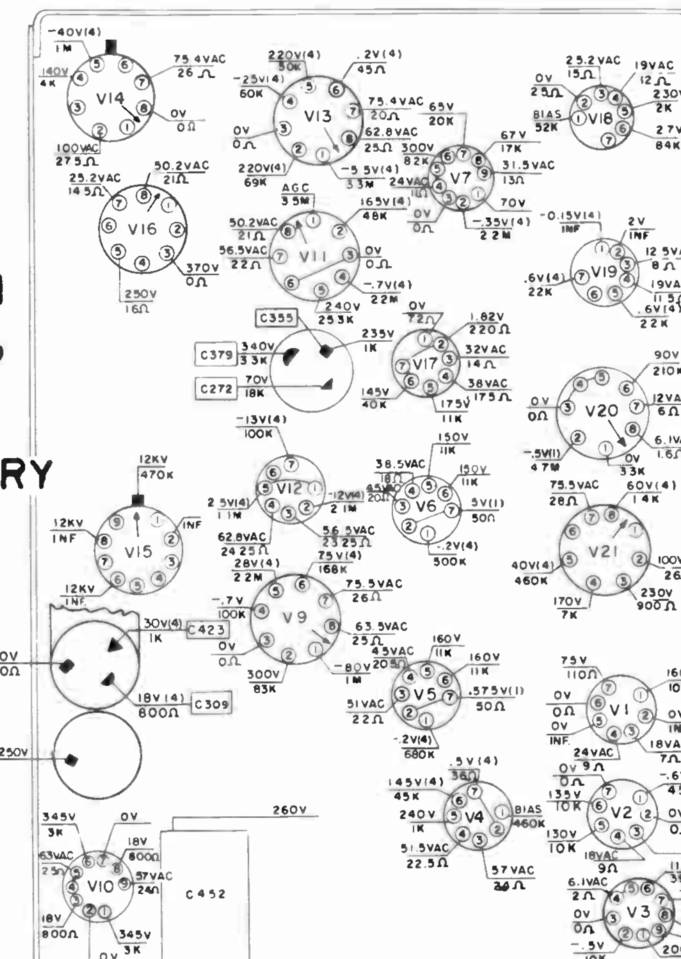
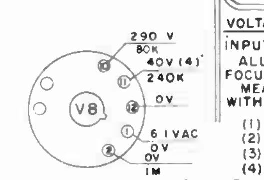


Fig. 31. Socket Voltage Diagram



VOLTAGE MEASUREMENTS

INPUT 117V, 60
ALL CONTROLS SET FOR NORMAL SWEEPS, FOCUS AND BRIGHTNESS
MEASUREMENTS ARE IN RESPECT TO B−
WITH A 20,000Ω/VOLT METER
(1) 2.5 VOLT RANGE
(2) 10 " "
(3) 25 " "
(4) VOLTAGE WILL VARY MORE THAN 20%

RESISTANCE MEASUREMENTS
SHORT CAPACITOR C453
SHORT PIN 3 OF V16 TO B−

M DENOTES MEG
INF DENOTES INFINITE RESISTANCE
TURN THE FOLLOWING CONTROLS FULL CLOCKWISE
FOCUS CONTROL
CONTRAST
BRIGHTNESS
VERTICAL HOLD
VERTICAL SIZE
VERTICAL LINEARITY
VALUES LISTED MAY HAVE A TOLERANCE OF ± 20%

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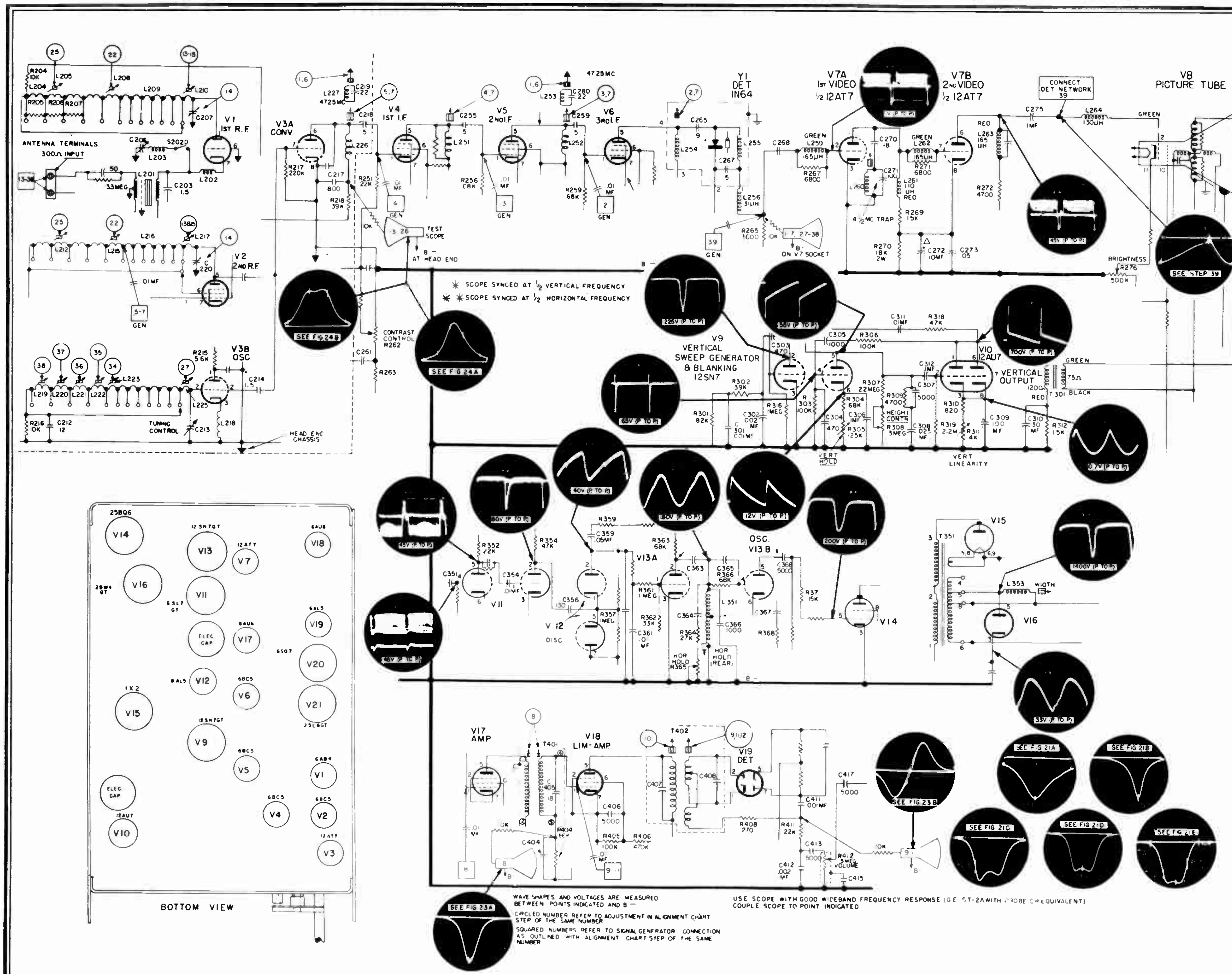

Fig. 29. Service Diagram

SERVICE DIAGRAM

The alignment procedure is shown in table form on pages 7 through 12. In order to accelerate the whole procedure, the service diagram (Figure 29) should be consulted. The encircled numbers indicate the number of the step of the alignment chart and the arrow points to the component to be adjusted. The generator is symbolized by a square with the number of the step of the alignment chart. The exact point of feed-in is indicated by the arrow connected with the numbered square. The oscilloscope is represented by the symbol of the cathode ray tube. The number inside the symbol refers to the step of the alignment chart. On the left side of the diagram is shown the tube location inside the chassis so that it is easy to locate the correct points for connection to the generator and the oscilloscope. In order to clarify the diagram only those parts of the circuits are shown which are needed for location of the test points. Within the large circles are shown the actual photo waveforms of an average television receiver, wherein the controls have been adjusted for a normal picture with correct height, width and linearity, and the picture control set for 1 volt peak to peak output of the waveshape shown at pin 2 of V7A. Waveshape voltages are peak to peak (P to P)—the asterisks note the following:

* Scope synced at 1/2 of vertical sweep frequency.
** Scope synced at 1/2 of horizontal sweep frequency.

Most measurements must be made when a signal is being received.

The oscilloscope of which the vertical amplifier has been precalibrated is used to make measurements at the point indicated by the arrow connected to the individual waveshape within the circle.

Alignment waveform photos are supplemented in graphic detail in the curves of Figures 21, 23 and 24. R-F alignment waveform photos are shown with markers at intervals of 4.5 megacycles.

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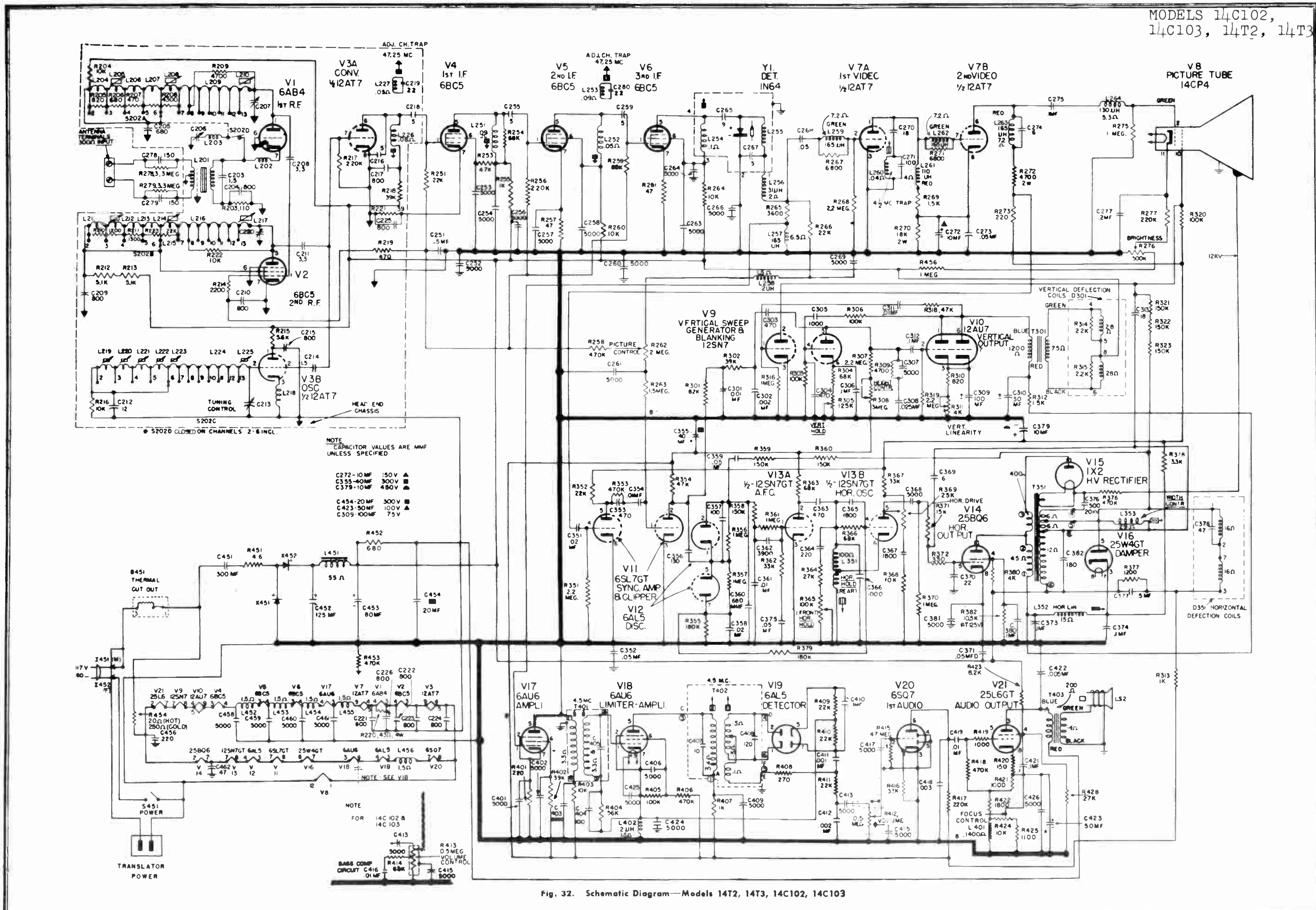

Fig. 32. Schematic Diagram—Models 14T2, 14T3, 14C102, 14C103

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MODELS 14T2, 14T3, 14C102, 14C103
REPLACEMENT PARTS LIST

UNIVERSAL REPLACEMENT PARTS

Cat. No.	Symbol	Description
*UCC-035	C301, C411	CAPACITOR—.001 mfd., 600 v., paper
*UCC-036	C302, C412	CAPACITOR—.002 mf., 600 v., paper
*UCC-037	C418	CAPACITOR—.003 mf., 600 v., paper
*UCC-040	C416, C311, C354	CAPACITOR—.01 mfd., 600 v., paper
*UCC-041	C351, C358	CAPACITOR—.02 mf., 600 v., paper
*UCC-045	C273, C352, C268, C371 C375, C359	CAPACITOR—.05 mf., 600 v., paper
*UCC-048	C275, C373, C374, C421, C312, C380	CAPACITOR—.1 mf., 600 v., paper
*UCC-050	C277	CAPACITOR—.2 mf., 200 v., paper
*UCC-052	C251, C377	CAPACITOR—.5 mf., 600 v., paper
*UCG-1005	C255, C259, C267, C216, C218	CAPACITOR—.5 mmf., 500 v., silver mica
*UCG-1012	C370, C280	CAPACITOR—22 mmf., 500 v., silver mica
*UCG-1030	C408	CAPACITOR—120 mmf., silver mica
UCG-1036	C364	CAPACITOR—220 mmf., 500 v., mica
*UCG-2006	C212	CAPACITOR—12 mmf., 500 v., silver mica
*UCG-2010	C405, C270	CAPACITOR—18 mmf., silver mica
*UCG-2022	C281	CAPACITOR—56 mmf., silver mica
UCG-2030	C407	CAPACITOR—120 mmf., mica
*UCU-002	C274	CAPACITOR—6 mmf., 500 v., silver mica
*UCU-028	C357, C404	CAPACITOR—100 mmf., 500 v., mica
*UCU-036	C456	CAPACITOR—220 mmf., 500 v., silver mica
UCU-532	C201, C202	CAPACITOR—150 mmf., 500 v., mica
*UCU-1044	C303, C304, C363	CAPACITOR—470 mmf., 500 v., mica C363
*UCU-1052	C366	CAPACITOR—1000 mmf., 500 v., ±10%, mica
*UCU-1520	C462	CAPACITOR—47 mmf., 500 v., mica
*UCU-1528	C271	CAPACITOR—100 mmf., 500 v., mica
*UCU-2004	C407	CAPACITOR—10 mmf., ±5%
*UCU-2031	C356	CAPACITOR—130 mmf., 500 v., mica
*UCW-032	C278, C279	CAPACITOR—150 mmf., 300 v., ceramic
*UJB-014		TERMINAL STRIP—4 terminals
*UJB-016		TERMINAL STRIP—6 terminals
*UJB-017		TERMINAL STRIP—2 terminals
*URD-015	R221	RESISTOR—39 ohms, ½ w., carbon
*URD-017	R257, R261	RESISTOR—47 ohms, ½ w., carbon
*URD-029	R420	RESISTOR—150 ohms, ½ w., carbon
*URD-033	R273, R401	RESISTOR—220 ohms, ½ w., carbon
*URD-035	R408	RESISTOR—270 ohms, ½ w., carbon
*URD-037	R372	RESISTOR—33 ohms, ½ w., carbon
*URD-041	R219, R207	RESISTOR—470 ohms, ½ w., carbon
*URD-045	R206	RESISTOR—680 ohms, ½ w., carbon
*URD-047	R205	RESISTOR—820 ohms, ½ w., carbon
*URD-049	R255, 407, 419, 421	RESISTOR—1000 ohms, ½ w., carbon
*URD-051	R377, R210	RESISTOR—1200 ohms, ½ w., carbon
*URD-053	R269	RESISTOR—1500 ohms, ½ w., carbon
*URD-057	R214, R314, R315	RESISTOR—2200 ohms, ½ w., carbon
*URD-065	R309, R209	RESISTOR—4700 ohms, ½ w., carbon
*URD-073	R222, R403, R368	RESISTOR—10,000 ohms, ½ w., carbon
*URD-077	R371	RESISTOR—15,000 ohms, ½ w., carbon
*URD-081	R266, R411, R223, R251	RESISTOR—22,000 ohms, ½ w., carbon
*URD-083	R364	RESISTOR—27,000 ohms, ½ w., carbon
*URD-085	R362, R416	RESISTOR—33,000 ohms, ½ w., carbon
*URD-087	R302, R402	RESISTOR—39,000 ohms, ½ w., carbon
*URD-089	R354, R253, R318	RESISTOR—47,000 ohms, ½ w., carbon
*URD-091	R404	RESISTOR—56,000 ohms, ½ w., carbon
*URD-093	R254, R256, R259, R304, R366, R414	RESISTOR—68,000 ohms, ½ w., carbon
*URD-095	R301	RESISTOR—82,000 ohms, ½ w., carbon
*URD-101	R358	RESISTOR—150,000 ohms, ½ w., carbon
*URD-103	R379, R355	RESISTOR—180,000 ohms, ½ w., carbon
*URD-105	R217, R256, R277, R417	RESISTOR—220,000 ohms, ½ w., carbon
*URD-113	R258, R406, R418, R353, R453	RESISTOR—470,000 ohms, ½ w., carbon
*URD-121	R275, R356, R357, R316, R361, R370, R456	RESISTOR—1 meg., ½ w., carbon
*URD-125	R263	RESISTOR—1.5 meg., ½ w., carbon
*URD-129	R268, R351, R307, R319	RESISTOR—2.2 meg., ½ w., carbon
*URD-133	R278, R279	RESISTOR—3.3 meg., ½ w., carbon
*URD-137	R415	RESISTOR—4.7 meg., ½ w., carbon
URD-1026	R203	RESISTOR—110 ohms ½ w., carbon
*URD-1052	R211	RESISTOR—1300 ohms, ±5%, ½ w., carbon
*URD-1062	R265	RESISTOR—3600 ohms, ±5%, ½ w., carbon
*URD-1064	R208	RESISTOR—4300 ohms, ±5%, ½ w., carbon
*URD-1073	R216	RESISTOR—10,000 ohms, ±5%, ½ w., carbon
*URD-1081	R409, R410	RESISTOR—22,000 ohms, ±5%, ½ w., carbon
*URD-1097	R303, R306, R405, R320	RESISTOR—100,000 ohms, ½ w., carbon
*URE-049	R313	RESISTOR—1000 ohms, 1 w., carbon
*URE-053	R312	RESISTOR—1500 ohms, 1 w., carbon
URE-055	R422	RESISTOR—1800 ohms, 1 w., carbon
*URE-061	R378	RESISTOR—3300 ohms, 1 w., carbon
*URE-067	R215	RESISTOR—5600 ohms, 1 w., carbon
*URE-071	R423	RESISTOR—82,000 ohms, 1 w., carbon
*URE-073	R204	RESISTOR—10,000 ohms, 1 w., carbon
*URE-081	R352	RESISTOR—22,000 ohms, 1 w., carbon
*URE-085	R367	RESISTOR—33,000 ohms, 1 w., carbon
*URE-087	R218	RESISTOR—39,000 ohms, 1 w., carbon
*URE-093	R363	RESISTOR—68,000 ohms, 1 w., carbon
*URE-101	R359, R360, R321, R322, R323	RESISTOR—150,000 ohms, 1 w., carbon
*URE-113	R376	RESISTOR—470,000 ohms, 1 w., carbon
*URE-1047	R310	RESISTOR—820 ohms, ±5%, 1 w., carbon
*URE-1066	R212, R213	RESISTOR—5100 ohms, ±5%, 1 w., carbon
*URF-045	R452	RESISTOR—680 ohms, 2 w., carbon
*URF-065	R272	RESISTOR—4700 ohms, 2 w., carbon
*URF-073	R260, R264	RESISTOR—10,000 ohms, 2 w., carbon
*URF-079	R270	RESISTOR—18,000 ohms, 2 w., carbon
*URF-083	R428	RESISTOR—27,000 ohms, 2 w., carbon
URF-1050	R425	RESISTOR—1100 ohms, 2 w., carbon
*S-1200D7		SPEAKER—Models 14C102, 14C103
*S-527D7		SPEAKER—Models 14T2, 14T3

SPECIALIZED REPLACEMENT PARTS

Cat. No.	Symbol	Description
RAB-138		CABINET BACK—Back cover with power cord for Models 14T2 and 14T3
RAB-140		CABINET BACK—Back cover with power cord for Models 14C102 and 14C103
RAD-056		TRAP DOOR—Door cover over concealed front panel controls
*RAP-022		HEAD END FRONT PLATE—Textolite plate
†RAV-134		CABINET—Mahogany cabinet for Model 14T2
†RAV-135		CABINET—Korina (Blonde) cabinet for Model 14T3
†RAV-136		CABINET—Mahogany cabinet for Model 14C102
†RAV-137		CABINET—Korina (Blonde) cabinet for Model 14C103
*RCC-059	C422	CAPACITOR—.005 mf., 1000 v., paper
*RCC-101	C308	CAPACITOR—.025 mfd., 600 v., paper
RCC-102	C359	CAPACITOR—.05 mf., 600 v., paper
RCC-103	C306	CAPACITOR—.1 mf., 200 v.
RCC-104	C373	CAPACITOR—.1 mf., 600 v., paper
RCC-105	C268, C375	CAPACITOR—.05 mf., 200 v., paper
*RCE-090	C410	CAPACITOR—1 mf., 50 v., electrolytic
*RCE-092	C310	CAPACITOR—30 mf., 450 v., electrolytic
*RCE-110	C451	CAPACITOR—300 mf., 150 v., electrolytic
*RCE-111	C452	CAPACITOR—125 mf., 350 v., electrolytic
*RCE-112	C453	CAPACITOR—80 mf., 300 v., electrolytic
*RCE-115	C454, C423, C309	CAPACITOR—20 mf., 300 v., 50 mf., 100 v., 100 mf., 75 v., electrolytic
*RCE-118	C379, C355, C272	CAPACITOR—10 mf., 450 v., 40 mf., 300 v., 10 mf., 150 v., electrolytic
*RCN-018	C354, C419	CAPACITOR—.01 mf., 600 v., paper molded
*RCN-025	C361	CAPACITOR—.01 mf., ±10%, 600 v.
*RCN-029	C265	CAPACITOR—9 mmf., silver mica
*RCN-033	C365, C367	CAPACITOR—1800 mmf., 600 v., paper
*RCN-034	C362	CAPACITOR—3900 mmf., ±10%, 600 v., paper
RCN-035	C376	CAPACITOR—500 mmf., 20,000 v., anode voltage supply filter
RCN-037	C378	CAPACITOR—47 mmf., 1500 v., mica
*RCU-286	C369	CAPACITOR—6 mmf., 800 v., mica
*RCU-290	C305	CAPACITOR—1000 mmf., 1000 v., mica
*RCU-293	C313	CAPACITOR—18 mmf., 1500 v., mica
*RCU-294	C360	CAPACITOR—680 mmf., ±20%, 500 v., mica
*RCU-296	C382	CAPACITOR—180 mmf., 1500 v., mica
*RCW-1056	C203, C214	CAPACITOR—1.5 mmf., ±25 mmf., 500 v., ceramic
*RCW-1076	C208, C211	CAPACITOR—3.3 mmf., ±.25 mf.
*RCW-3014	C252, C253, C254, C256, C257, C258, C260, C261, C263, C264, C266, C269, C307, C368, C401, C402, C403, C406, C409, C413, C415, C417, C424, C458, C459, C460, C461, C426, C381	CAPACITOR—5000 mmf., 450 v.
*RCW-3037	C204, C209, C210, C215, C217, C221, C222, C223, C224, C225, C226	CAPACITOR—800 mmf., 500 v., ceramic
*RCW-3027	C205	CAPACITOR—680 mmf., ceramic
RCW-3035	C203, C214,	CAPACITOR—1.5 mmf., 500v., ceramic
*RCY-048	C207	CAPACITOR—Trimmer, .4-2.4 mmf.
*RCY-059	C213	CAPACITOR—Trimmer, 1.4-2.8 mmf.
*RCY-060	C206	CAPACITOR—Trimmer, for high channel trap, .7-7 mmf.
RCY-063	C220	TRIMMER
*RDC-032		CORD—For tuning control
RDE-091		PICTURE TUBE MASK—Metal overlay masking tube face
RDE-093		ESCUTCHEON—Picture screen escutcheon on front of cabinet
RDE-095		ESCUTCHEON—Control knob panel escutcheon (less trap door)
RDK-222		KNOB—Tuning control knob
RDK-223		KNOB—Picture contrast control knob
RDK-224		KNOB—Channel selector control knob
RDK-225		KNOB—Volume and OFF-ON control knob
RDK-226		KNOB—Focus or Horizontal Hold control knob
RDK-227		KNOB—Brightness or Vertical Hold control knob
RDM-023		MASK—Speaker mask for Models 14T2, 14T3
RDW-042		SAFETY GLASS—Glass in cabinet over face of picture tube
REC-006		CLIP—For mounting high voltage capacitor, C376
*REI-014		CORE—Brass screw for L210, L217
*REI-016		CORE—Iron core for L254
*RER-008	X451, X452	RECTIFIER—Selenium, 350 ma.
*RET-003		ION TRAP
RHC-008		CLIP—For mounting electrolytic (1")
*RHC-024		CLIP—For mounting electrolytic (⅞")
RHC-036		CLIP—For front panel door cover pin springs
*RHG-004		GROMMET—¼ in. chassis grommet
*RHG-010		GROMMET—Shock mounting, for V13 socket
RHG-013		GROMMET—Speaker mounting grommet for Models 14T2, 14T3
RHG-030		GROMMET—½ inch grommet in high voltage supply shield
RHG-031		GROMMET—⅜ inch grommet in chassis
RHN-014		WING NUT—Focus coil swivel adjustment wing nut
*RHS-045		SCREW—Headless, L223, L205, L208
*RHS-046		SCREW—Headless, L219, L220, L221, L222
RHS-050		SCREW—Chassis to cabinet mounting screw, #10-32 x 1¼ inches long
RHS-051		SCREW—Chassis to cabinet mounting screw, ¼-20 x 1⅛ inches long
RII-021		INSULATOR—For mounting volume control
RII-026		INSULATOR—Grommet in high voltage shield
RII-041		INSULATOR—Insulating barrier for selenium rectifier X451 or X452
*RJC-001		PIN—Speaker contact pin
*RJC-018		CONNECTOR—High voltage anode connector
RJJ-008		RECEPTACLE—Translator power receptacle
*RJJ-010	I451	RECEPTACLE—For power cord, male rivets to antenna bracket
*RJS-003		SOCKET—Octal tube socket for V11, V9, V20
RJS-004		ELECTROLYTIC MOUNTING PLATE—Textolite, for ¾ inch dia. electrolytic
RJS-024		ELECTROLYTIC MOUNTING PLATE—Textolite, for 1 inch dia. electrolytic
*RJS-026		SOCKET—Tube socket, octal, for V21
*RJS-031		SOCKET—Tube socket for V14
*RJS-085		SOCKET—Tube socket for V16
*RJS-127		SOCKET—Tube socket, 9-pin, for V3
*RJS-132		SOCKET—Tube socket, 7-pin, for V12, V19
*RJS-133		SOCKET—Tube socket, 7-pin, shielded, for V5, V6, V18
*RJS-135		SOCKET—Shock mounting, V13
*RJS-138		SOCKET—Tube socket, 9-pin, V7
*RJS-139		SOCKET—Tube socket, 9-pin, miniature for V10
*RJS-144		SOCKET—Tube socket, 7-pin, for V4, V17
RJS-148		SOCKET—Tube socket for V15
RJS-149		SOCKET—Tube socket for V1 or V2
*RJX-043		RF HEAD-END—Complete with tubes and aligned
*RLA-036	L201	TRANSFORMER—Antenna input transformer
*RLC-091	L351	COIL—Horizontal oscillator
*RLC-095	L219	COIL—Oscillator, for Channel #2
*RLC-096	L220, L207, L214	COIL—Oscillator, for Channel #3, Channel #5, 1st and 2nd RF
*RLC-097	L222	COIL—Oscillator, for Channel #5
*RLC-098	L223	COIL—Oscillator, for Channel #6
*RLC-099	L225	COIL—Oscillator, for Channel #13
*RLD-014	L353	COIL—Width control
*RLD-016	L352	COIL—Horizontal linearity
RLD-025	D301, D351, C378, R314, R315	DEFLECTION YOKE
*RLF-024	L256	CHOKE COIL—RF coil
RLF-039	L401	COIL—Focus
*RLI-003	L218	COIL—Cathode choke
*RLI-038	L257, L263	COIL—Video choke coil
*RLI-072	L206, L212	COIL—Channel #4, 1st RF, Channel #3, 2nd RF
*RLI-077	L205	COIL—Channel #3, 1st RF
*RLI-093	L259, R267, L262, R271	COIL—Video choke and resistor
*RLI-096	L251	COIL—2nd video IF coil
*RLI-097	T401, C405	COIL—First audio IF coil
*RLI-099	L221	COIL—Oscillator coil, Channel #4
*RLI-100	L260, C270, C271	TRAP—4.5 mc video trap
*RLI-106	L202	COIL—Choke coil
*RLI-108	L261	CHOKE—Video choke
*RLI-109	L264	CHOKE—Video choke
*RLI-110	L252, L253, C280	COIL—IF coil
*RLI-114	L203	COIL—Trap coil
*RLI-116	L208, L215	COIL—Channel #6, 1st and 2nd RF
*RLI-117	L204	COIL—Channel #2, 1st RF
*RLI-118	L213	COIL—Channel #4, 2nd RF
*RLI-119	L211	COIL—Channel #2, 2nd RF
*RLI-120	L210	COIL—Channel #13, 1st RF
*RLI-121	L217	COIL—Channel #13, 2nd RF
*RLI-122	L402, L452, L453, L454, L455, L456, L258	COIL—Heater choke
*RLP-016	L226, L227, C219	COIL—Converter plate
*RLX-029	L254, L255, 1N64, C265, C267	VIDEO DETECTOR ASSEMBLY
*RMC-017		CLIP—⅜ in. for electrolytic
RMC-051		CLAMP—Deflection yoke clamp
RMM-146		SHIELD—Shield in head-end assembly between V1 and V2 sockets
*RMM-147		TUBE CUSHION—Under pix tube, 2 required
*RMM-149		TUBE CUSHION—Top of pix tube under tube, support brackets 2 required
*RMS-130		SPRING—Tension spring for tuning control cord
*RMS-220		CLIP—Spring grounding clip contacts pix tube
RMS-222		SPRING—Right hand spring on front panel door cover
RMS-223		SPRING—Left hand spring on front panel door cover
RMS-227		PICTURE TUBE STRAP
*RMU-055		EXTENSION SHAFT—For L352 and L353
RMU-065		SHAFT—Tubular shaft on switch shaft for tuning
*RMX-169		PULLEY AND HUB ASSEMBLY—For tuning control
RRC-096	R308	POTENTIOMETER—3 meg., Height
RRC-127	R311	POTENTIOMETER—Vertical Linearity, 4000 ohms, 2 w.
RRC-128	R262, R412, S451	POTENTIOMETER—Dual, 2 meg., 500,000 ohms, Contrast, Volume and OFF-ON switch. Models 14T2, 14T3
RRC-131	R262, R412, S451	POTENTIOMETER—Dual, 2 meg., 500,000 ohms, Contrast, Volume and OFF-ON switch. Models 14C102, 14C103
RRC-140	R369	POTENTIOMETER—25,000 ohms, Horizontal Drive
RRC-145	R424, R276	POTENTIOMETER—Dual, 10,000-500,000 ohms, Focus and Brightness
RRC-146	R305, R365	POTENTIOMETER—Dual, 125,000-100,000 ohms, Vertical Hold and Horizontal Hold
RRI-038		INSULATOR—Chassis apron bushing for channel selector and tuning shaft
RRW-048	R451	RESISTOR—4.6 ohms, 5 w., w.w.
*RRW-049	R220	RESISTOR—43 ohms, 4 w., w.w.
*RRW-051	R454	RESISTOR—20 ohms, Globar temperature compensating
*RRW-052	R382	RESISTOR—10.5 K, Globar voltage sensitive resistor
*RRW-053	R380	RESISTOR—4000 ohms, 7 w., w.w.
*RSR-002	B451	CUT-OUT—Thermal cut-out
RSW-082	S201	CHANNEL SELECTOR SWITCH
*RTD-008	T402, C407, C408	TRANSFORMER—Ratio detector
*RTL-096	L451	REACTOR—Filter
*RTO-064	T301	TRANSFORMER—Vertical sweep output
*RTO-081	T403	TRANSFORMER—Audio output for Models 14T2, 14T3
*RTO-086	T403	TRANSFORMER—Audio output for Models 14C102, 14C103
RTO-090	T351	TRANSFORMER—Horizontal sweep output
*RWL-019	I452	POWER CORD AND FEMALE PLUG—For Models 14T2, 14T3
*RWL-021	I452	POWER CORD AND FEMALE PLUG—For Models 14C102, 14C103
RWX-034		SOCKET—Picture tube socket assembly

NOTE:
* Parts used on previous models.
† Special discount applies.

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World Radio History

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CAUTION NOTICE

HIGH VOLTAGES ARE USED IN THE OPERATION OF THIS TELEVISION RECEIVER. THE BACK COVER, WHILE IN PLACE, PREVENTS ACCIDENTAL CONTACT WITH THESE HIGH VOLTAGES AND SHOULD NOT BE REMOVED EXCEPT BY A QUALIFIED TELEVISION TECHNICIAN.
THE PICTURE TUBE IS A HIGH VACUUM TUBE AND, IF IT IS BROKEN, PIECES OF GLASS MAY FLY WITH FORCE IN ALL DIRECTIONS. ANY WEAKENING OF THE GLASS, AS MAY BE CAUSED BY CHIPPING, SCRATCHING, OR MORE THAN NORMAL PRESSURE, MAY CAUSE THIS TUBE TO BREAK. THE USE OF SAFETY GLASSES IS RECOMMENDED WHEN IT IS NECESSARY TO REMOVE OR REPLACE THE PICTURE TUBE.

R-F FREQUENCY RANGE:

Selector Switch Position	Frequency Range MC	Picture Carrier	Sound Carrier
Radio	.54-1.6	MC	
FM	88-108		
No. 2	54-60	55.25	59.75
No. 3	60-66	61.25	65.75
No. 4	66-72	67.25	71.75
No. 5	76-82	77.25	81.75
No. 6	82-88	83.25	87.75
No. 7	174-180	175.25	179.75
No. 8	180-186	181.25	185.75
No. 9	186-192	187.25	191.75
No. 10	192-198	193.25	197.75
No. 11	198-204	199.25	203.75
No. 12	204-210	205.25	209.75
No. 13	210-216	211.25	215.75

SPECIFICATIONS

OVER-ALL DIMENSIONS:	Height 38¼ inches Depth 23 5/16 inches Width 34 9/16 inches
ELECTRICAL RATING:	Frequency 60 cycles Voltage 115 v. Wattage (Television Op.) 250 w. Wattage (Radio Op.) 85 w.
INTERMEDIATE FREQUENCIES:	Television Video 45.75 MC Television Audio 4.5 MC Radio, AM 455 KC Radio, FM 10.7 MC
AUDIO POWER OUTPUT:	Undistorted 3 watts Maximum 5 watts
LOUDSPEAKER:	Type Alnico PM Dynamic Cone Diameter 12 inches Voice Coil Impedance (400 cps) 3.2 ohms
RECORD PLAYER:	Type Triple speed (Type P15) Pickup 2 styli GE Variable Reluctance Pickup Impedance 340 ohms
ANTENNA REQUIREMENTS: (Built-in Antenna)	For external use Type. Folded dipole or equivalent Impedance 300 ohms
PILOT LAMP:	Type Mazda No. 47

TUBES & CRYSTAL

Symbol	Purpose	Type
	Television Chassis	
V1	1st RF Amplifier	6AB4
V2	2nd RF Amplifier	6BC5
V3	Converter-Oscillator	12AT7
V4	1st Video IF Amplifier	6BC5
V5	2nd Video IF Amplifier	6BC5
V6	3rd Video IF Amplifier	6BC5
V7	Video Amplifier	12AT7
V8	Picture Tube	16KP4A
V9	Vert. Blanking & Sweep Gen.	12SN7GT
V10	Vert. Sweep Gen. & Output	12AU7
V11	Sync. Amplifier & Clipper	6SL7GT
V12	Hor. AFC Discriminator	6AL5
V13	Hor. AFC & Oscillator	12SN7GT
V14	Hor. Sweep Output	25BQ6
V15	High Voltage Rectifier	1X2
V16	Hor. Damper Tube	25W4GT
V17	Audio IF (4.5 mc) Amplifier	6AU6
V18	Audio IF Ampl. & Limiter	6AU6
V19	Ratio Detector	6AL5
V20	Audio Amplifier	6J5
V21	Focus Control	25L6GT
Y1	Video Det. (Germanium Diode)	1N64
	Radio Chassis	
V1	AM-FM Converter	6BE6
V2	RF & FM Amplifier	6BA6
V3	IF Amplifier (2nd FM, 1st AM)	6BA6
V4	Limiter (FM)	6AU6
V5	AM Det., FM. Discriminator & Audio Amplifier	6T8
V6	Power Output	6V6/GT
V7	Rectifier	5Y3/GT
V8	Phono Preamplifier	6SC7

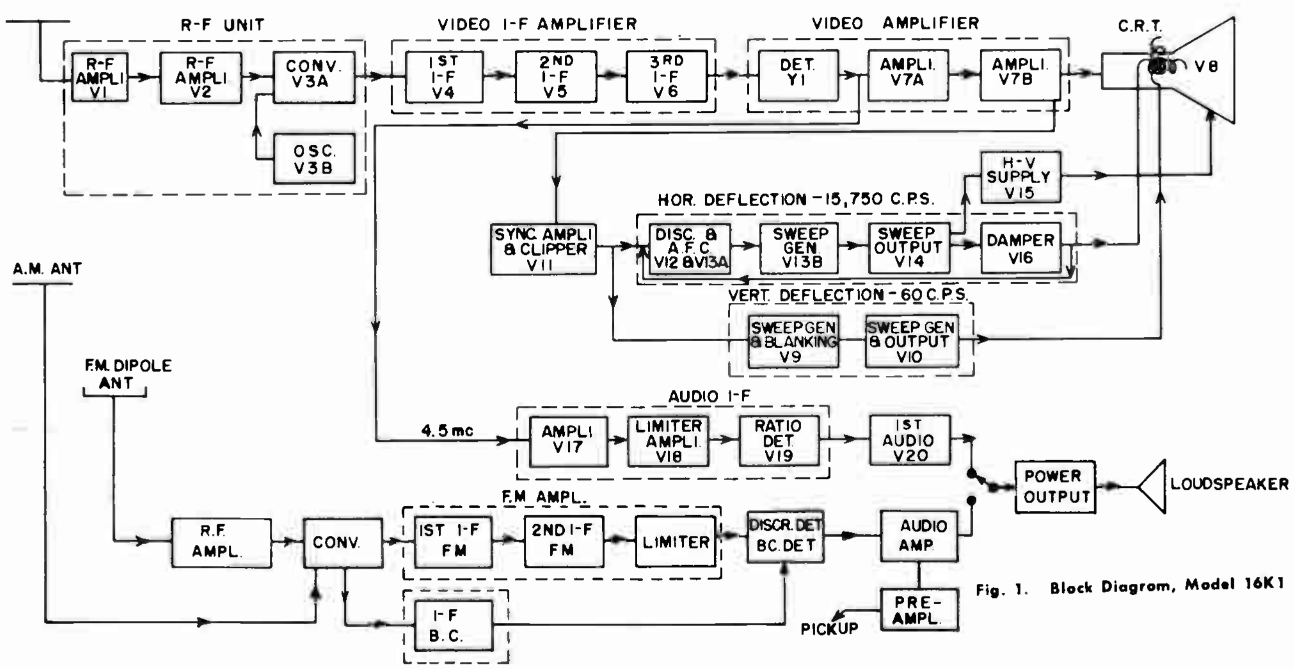

Fig. 1. Block Diagram, Model 16K1

GENERAL INFORMATION

The General Electric Model 16K1 is a television-radio receiver and phonograph, console type, 29-tube instrument providing reception of all 12 commercial television channels, radio reception in the AM and FM bands using a 752 radio chassis, and triple-speed phonograph operation (33 rpm, 45 rpm and 78 rpm) using the new General Electric Variable Reluctance Pickups. The television picture is reproduced on a 16-inch electromagnetically deflected picture tube. This receiver uses a P15 record changer to play 10-inch or 12-inch records intermixed or 7-inch records. The records with speeds of 33⅓, 45 or 78 rpm cannot be played intermixed.

The service information on the Model 16K1 record changer P15 is contained in ER-S-P15.

The instrument contains one television chassis, one radio chassis with loudspeaker which is used for both radio and television operation, and a record changer chassis with a two styli pickup head.

Features of this television receiver include a two stage r-f amplifier, balanced input to the r-f, selenium type rectifiers, intercarrier sound, ratio detector, safe high voltage supply for the picture tube, automatic frequency control for horizontal sweep synchronization and electromagnetic deflection.

The r-f tuner assembly is mounted on a separate chassis which is readily demounted from the main chassis. The coils which tune the 1st and 2nd r-f stages and the oscillator are mounted on individual wafers of the selector switch. The local oscillator V3B operates on the high frequency side of the incoming r-f signal. The picture carrier is converted to a 45.75 mc video i-f frequency, while the FM sound carrier is converted to a 41.25 mc frequency.

The video i-f is stagger tuned to pass the video i-f (45.75 mc) and the sound carrier (41.25 mc) with the proper amplitude relationship between the two frequencies. The video information is detected by the detector Y1 as well as a 4.5 mc FM signal which is the beat frequency between the video i-f (45.75 mc) and 41.25 mc.

The 4.5 mc audio FM is amplified and limited by V17 and V18 and detected by the ratio detector V19. The audio is amplified by V20.

The horizontal and vertical sync signals are taken off at the plate circuit of V7B and amplified and separated from the video signal by V11. The vertical sweep is generated by one section of a 12SN7 (V9) and a 12AU7 (V10) connected in a multivibrator circuit. The 12AU7 (V10) also serves as the vertical sweep output tube. The other section of the 12SN7 (V9) is used to produce the vertical retrace blanking signal. The horizontal sync signal is mixed with a sawtooth signal from the plate of the damper tube (V16) by the discriminator (V12). A change in phase between these two signals increases or decreases the bias voltage which is applied to the grid of V13A. V13A is a reactance tube which changes the frequency of the horizontal oscillator V13B. V14 the horizontal sweep output is coupled to the horizontal deflection coils by T351.

V15 is the high voltage rectifier for rectifying the kickback voltage, produced in T351 by the horizontal retrace current, to supply approximately 12 kilovolts to the picture tube high voltage anode.

This receiver uses two selenium rectifiers in a half-wave voltage doubler circuit to supply the B+ voltage of approximately 255 volts. The tube filaments are a series parallel connection across the 117 volt a-c line.

The television chassis and the radio chassis are connected by a push-button switch. To operate the television receiver, it is necessary to have the "ON" button depressed. The television sound portion is coupled from the television chassis to the audio amplifier of the radio chassis which is used to amplify the television sound. To operate the radio receiver, it is necessary to have the television "OFF" button depressed. The radio may then be turned on and operated on AM, FM or Phono. To turn this receiver off completely, the television "OFF" button must be depressed and the radio tone switch turned to "OFF."

INSTALLATION AND SERVICE ADJUSTMENTS

GENERAL—This receiver is equipped with a built-in television antenna giving good reception within the primary service area. Where reception is weak due to less favorable receiving conditions, an outdoor antenna is recommended. Since the receiver is designed with a balanced input of 300 ohms impedance, a 300 ohm transmission line should be used to connect the outdoor antenna to the receiver. When the external antenna system is connected to the dipole terminals, the built-in antenna connecting leads must be disconnected.

PREPARATION FOR USE—Remove receiver from carton and place the cabinet on its back and remove the shipping skids from the base of the cabinet. Remove the two screws (¼-28 and 10-32) which hold the record changer in position. Remove the block spacer underneath the record shelf and unpack turntable and spindle assemblies. After the turntable has been put in place, cut the rubber band which is tied around the control knob, thereby releasing the drive wheel and remove the rubber. Remove the two shipping bolts which hold the motor board tight for shipment. Small metal snap covers are provided to cover the holes exposed when the shipping screws are removed. They will be found in a small envelope in the phono compartment. A metal clip which clamps over the stylus of the pickup arm should be removed.

The receiver is shipped with the picture tube installed in place. Normally, it is not necessary to make any centering adjustments since a positive clamping mechanism has been employed to insure picture centering.

In case Installation Adjustments must be made, it is only necessary to remove the cabinet back, connect the antenna to the dipole terminals and connect input power to the interlock receptacle by way of a power cord terminated in a matching plug.

Make certain that the deflection yoke sets up against the bell of the picture tube. If this is not the case, loosen each deflection yoke clamp adjustment screw slightly and push yoke assembly against bell of tube.

OUTDOOR ANTENNA—The simple folded dipole will suffice in areas with medium signal strength. In fringe areas with weak field strength, a more elaborate antenna system must be installed. These high gain antennas are usually more directive which is desirable in many cases to reduce undesired signal or noise pickup.

ANTENNA PLACEMENT AND ORIENTATION—All television antenna systems have directional characteristics and their very location may have a pronounced effect upon the results obtained. Therefore, the antenna (or in case the built-in antenna is used, the receiver) should be turned in a horizontal plane for maximum signal pickup. Since nearby objects, especially those of metal may affect the picture, several antenna locations may have to be tried. Sometimes relocation of only a few feet may produce a great improvement.

GHOST RECEPTION—This name is given to a second picture image in various degrees of contrast and displacement from the main picture. A relocation of the antenna might drive out any ghost present. If the ghost images cannot be eliminated totally in this manner, a compromise in antenna orientation for maximum signal pickup and image rejection may be made without seriously impairing picture quality.

LIGHTNING PROTECTION—The outdoor antenna installations must conform to the National Electrical Code Standards which are usually supplemented by Local Code requirements. When installing the antenna, observe the following rules:

1. The metal mast supporting the antenna should be permanently and effectively grounded by a wire of a size specified in the codes.
2. An approved lightning arrester must be used with the antenna lead-in conductors at the point of entrance to the building. If a shielded lead-in cable is used, the shield may be permanently grounded instead of using the lightning arrester.

ADJUSTMENT PROCEDURE

It will be noted that some adjustments react upon each other and therefore should be adjusted alternately and as a final step all adjustments should be rechecked.

Power should not be applied to the receiver for any great length of time without the ion trap adjusted for some illumination.

The ion trap, deflection yoke, focus coil and the installation adjustment controls are adjusted in the procedure given below. These are described in greater detail under their respective titles immediately following this procedure.

1. Adjust ion trap to get brightest raster.
2. Adjust for no tilt of raster and tighten yoke clamp screws.
3. Tune in a television signal.
4. Adjust Horizontal Hold controls.
5. Adjust Drive control.
6. Adjust for good Horizontal and Vertical linearity.
7. Adjust Horizontal and Vertical size controls.
8. Adjust Focus coil for centering of test pattern, removal of neck shadow and for most uniform focus.
9. Readjust ion trap.
10. Recheck adjustments of steps 6, 7, 8 and 9.
11. Tighten Focus Coil adjustment screws and wing nuts.

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ION TRAP—Power should not be applied to the receiver for any great length of time without the ion trap adjusted for some illumination. Set the Brightness control to maximum (clockwise). To adjust ion trap, rotate the trap on the neck of the tube and move it forward and backward to give maximum brightness. Reduce the picture Brightness during ion trap adjustment, if raster becomes too bright as maximum brightness with the trap is approached. Always make certain the ion trap is finally set to give maximum brightness of the raster.

PICTURE TILT—If the picture or raster does not lie squarely within the picture tube mask, loosen one of the Yoke Adjustment Clamp screws and by grasping the Picture Tilt Lever, turn lever to rotate yoke until picture or raster squares with the mask. Tighten the yoke clamp screws after squaring picture with mask.

HORIZONTAL HOLD—Set the front panel Horizontal Hold control (R381) to the center of its range. Adjust the core of the Horizontal Hold control (L351) at the rear of chassis, until the picture is synchronized and is phased at the center of the raster—a slight rotation of the front panel control in either direction will move the picture slightly to the left or right without losing synchronization.

The pull-in to synchronization range should be equally distributed each side of the front panel Horizontal Hold control's center range and may be checked with the control set at center, observing the pull-in to synchronization sensitivity as the Channel Selector switch is flipped alternately back and forth from the received channel to an adjacent channel having no signal. For any other setting of the front panel Horizontal Hold control, the pull-in to synchronization time will be longer.

HORIZONTAL DRIVE—Adjust the Horizontal Drive control (R369) for optimum drive indicated by a maximum width of picture.

If any compression of picture is noted on the right-hand side of the raster, the condition may be corrected by a slight decrease of drive (clockwise rotation). If a vertical beaded line appears in the picture at this setting, a further clockwise adjustment should be made to eliminate it.

HORIZONTAL LINEARITY—The Horizontal Linearity control (L352) adjusts the picture for correct horizontal proportions. For best adjustment, use a test pattern and adjust the Horizontal Linearity control until the distances from the center of the test pattern to the left- and right-hand edges of the test pattern measure approximately the same. The adjustment of this control is very broad and it should be made simultaneously with the adjustment of the Width control (L353) to get proper picture width and correct horizontal linearity.

VERTICAL LINEARITY—This control (R311) should be adjusted to give best symmetry to the test pattern for correct vertical proportions in the picture. The adjustment should be made on a test pattern so that the distances from the center to the top and bottom edges of the test pattern measure approximately the same. This adjustment will alter the height of the picture slightly.

WIDTH—Adjust the Width control (L353) so that the edges of the picture extend approximately one-eighth inch past the right- and left-hand edge of the mask so that raster edges are not visible.

HEIGHT—The Height control (R308) changes the picture height and should be adjusted so that the picture extends approximately 1/8 inch beyond the top and bottom edges of the mask. This adjustment should be made simultaneously with the Vertical Linearity control (R311).

FOCUS COIL ADJUSTMENT—The Focus coil bracket adjustment screws and the swivel wing nuts are loosened in preparation for adjustment of the focus coil. These should not be too loose but should allow movement of the coil and yet retain each new position of coil adjustment.

The focus coil and bracket may be moved up and down, to the right or left, or the coil may be tilted in any direction by the swivel mounting. In addition, the coil may be moved forward or backward.

Adjust position of the focus coil to center picture test pattern within picture tube mask and to eliminate neck shadow. The focus coil should be as far back toward the base of the picture tube as possible, for best focus consistent with maximum picture brightness.

PICTURE TUBE AND CHASSIS REPLACEMENT

1. The deflection yoke clamp screws and focus coil adjustments should be loosened before attempting to install the picture tube—this will prevent any strain upon the tube neck when positioning and fastening the tube later.

2. Install the picture tube as shown in Figure 2. The bottom rim of tube should be forward against rubber stop on chassis front apron.

3. Place picture tube strap around rim of tube, inserting the picture tube support bracket between tube rim and strap as shown in Figure 2. Center tube approximately with regard to front of chassis and install tube strap mounting nuts to hold tube lightly.

4. Place chassis and tube into the receiver cabinet, repositioning tube support bracket to fit over stud screws in top corners of cabinet, making sure that chassis is pushed forward against cabinet.

5. Install chassis mounting screws and tighten to fasten chassis securely.

6. Move picture tube if necessary to center tube in mask, as viewed from front of the cabinet.

7. Tighten tube strap mounting nuts, accessible from bottom of cabinet.

8. Install spacer and 1/4 inch-20 hex nut over picture tube support bracket screws and tighten to hold brackets securely to cabinet.

9. Push deflection yoke forward to set against bell of picture tube and tighten yoke clamp screws.

10. Connect picture tube socket to base of tube and high voltage lead to anode connection.

11. Install control knobs.

HIGH CHANNEL TRAP—This receiver incorporates a trap circuit (C206, L203, S202D) on the head-end unit which is switched into the antenna circuit on the low band channels. The trap may be used to eliminate any one of the following high channel interferences on the corresponding lower channel shown.

Operating Channel	Interfering Channel
No. 4	No. 8
No. 5	No. 11
No. 6	No. 13

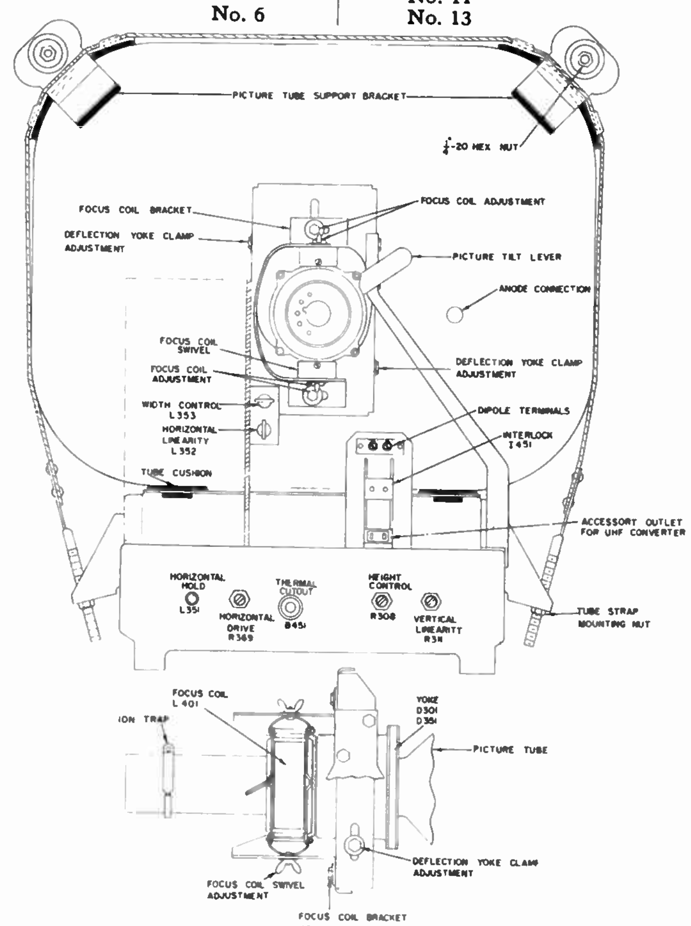


Fig. 2. Preset Controls

The receiver is adjusted at the factory approximately for rejection of Channel #11 interference on Channel #5. It may be necessary to readjust the trap slightly, if Channel #11 interference is experienced when operating the receiver on Channel #5.

High channel interference manifests itself as horizontal bars, a herringbone pattern in the picture, or the high channel station picture superimposed upon the low channel picture for which the receiver has been tuned.

If none of the above combinations of channels exist in the locality where the receiver is to be used, the trap need not be adjusted.

THERMAL CUT-OUT—This is a protective device, which operates in a similar manner to a fuse, removing line voltage from the receiver in case of excessive current drain due to circuit overload. A five minute period should be allowed after the cut-out has tripped, before depressing the reset button to restore power to the receiver. If the receiver does not return to normal operation within a reasonable warm-up time after the cut-out has been reset, a check-up of the receiver circuit should be made to determine the cause of overload.

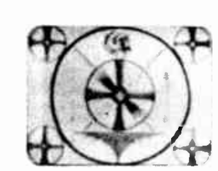
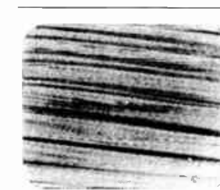
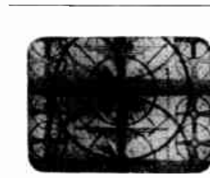
PICTURE DEFECTS

Fig. 3 Normal picture.

The following illustrations show picture defects which are caused by incorrect setting of operating controls, the preset controls or by interference picked up by the antenna. A possible remedy is indicated for each defect.

The adjustment of controls is most efficiently accomplished by the use of a test pattern, similar to that illustrated to the left, which is normally transmitted just prior to the scheduled program.

The normal picture should show good focus and a good contrast between blacks and whites with intermediate shades of gray. The picture should not tend to move either vertically or horizontally and should have good linearity.

PICTURE	DEFECT	REMEDY
	**Fig. 4 Picture too light.**	1. Increase Picture control setting and/or reduce brightness. 2. Weak signal. This may be caused by insufficient pickup on antenna or defective lead-in. Insufficient pickup at maximum contrast usually is accompanied by "snow" on the picture.
	**Fig. 5 Picture too dark (contrast).**	1. Reduce Picture control setting and/or increase Brightness control setting. 2. Too strong signal. If it is not possible to reduce signal adequately with Picture control, install suitable resistor antenna pad.
	**Fig. 6 Picture defocussed.**	1. Adjustment of front panel focus control, R435. 2. Check for uniformity of focus by moving focus coil (see Installation Adjustments, page 3). 3. Mistuning of receiver or misalignment.
	**Fig. 7 Horizontal sync.**	1. Adjust Horizontal Hold control (front panel control). 2. Check adjustment of rear panel Horizontal Hold control. 3. Signal improperly tuned. 4. Defective horizontal sync circuits.
	**Fig. 8 Vertical sync.**	1. Adjust Vertical Hold control until picture shows no tendency to slide up or down or lock out of frame. 2. Check the vertical sync circuits.
	**Fig. 9 Vertical linearity.**	Adjust Vertical Linearity control. This adjustment may alter the Height control adjustment.

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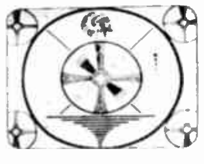
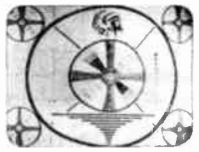
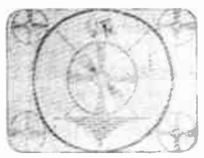
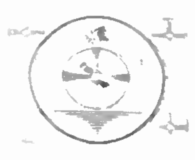
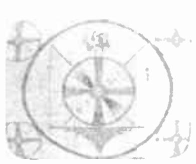
PICTURE DEFECTS (Cont'd)

PICTURE	DEFECT	REMEDY
	**Fig. 10** **Vertical height.**	Adjust Height control so that the top and bottom picture edges are just covered by mask Recheck Vertical Linearity control setting.
	**Fig. 11** **Picture too wide.**	Adjust Width control so that the right and left picture edges are just covered by the mask.
	**Fig. 12** **Horizontal linearity.**	1. Adjust Horizontal Linearity control. This adjustment may require resetting of Width control. 2. Adjust Drive control as described under Installation Adjustments, page 3.
	**Fig. 13** **Neck shadow.**	1. Misadjustment of Focus coil—tilted too far. 2. Move the deflection yoke forward against the bell of the picture tube.
	**Fig. 14** **Herringbone pattern over picture.**	This interference is caused by a television station operating on the next lower channel or by short-wave radio transmitting and receiving equipment. Police and "ham" transmitters in your locality will usually cause the most severe conditions. The interference produces moving ripples or diagonal streaks, or in some cases, may cause loss of contrast of the picture. The use of an antenna wavetrap tuned to the interfering signal may assist. If the interference is from a TV or FM station, a transmission line shorted stub may remove the interference. If the pickup is on the lead-in, a shielded lead-in will help correct the trouble. See page 3 for high channel trap adjustment.
	**Fig. 15** **Horizontal bars on picture.**	This interference is caused by adjacent channel sound or microphonics in receiver. If adjacent channel sound is responsible for this defect, readjust the adjacent channel traps L227, L253 as outlined on page 8. A microphonic video amplifier tube, V7, may cause this condition.
	**Fig. 16** **Ignition interference**	Ignition interference from trucks, automobiles, and airplanes may be identified by black or white streaks and splashes on the picture. The ignition system of trucks will produce the most intense interference pattern. Install antenna away from road carrying traffic. Shielded lead-in may help if interference is picked up on it.
	**Fig. 17** **Multiple images (ghosts).**	This is caused by the television signal following multiple paths, one of which is the direct path, and the other is reflected from some object such as a tall building or a large storage tank or hills. The signal following the longer reflected path arrives later at the receiver producing the second image. In case a built-in antenna is used, try to turn the cabinet until the ghost picture is dimmed out. If your receiver is connected to an outdoor installation, a reorientation of the antenna might improve the reception.
	**Fig. 18** **"Snow."**	1. Too weak signal; increase efficiency of antenna installation. 2. Adjust tuning control.

CIRCUIT ALIGNMENT

TO PROTECT TEST EQUIPMENT ALWAYS USE AN ISOLATION TRANSFORMER

GENERAL

A complete alignment of the receiver tuned circuits is given in the following charts. Read all alignment notes before making an alignment. The alignment procedure described follows the sweep method using General Electric test equipment. When other test equipment is used, check that they meet the different requirements for proper alignment. Suitable test equipment is essential for proper alignment of the receiver and under no circumstances try to align with inadequate test equipment. For a detailed discussion of this problem, refer to our publication Television Principles and Practice, Chapter 14. In order to speed up the alignment procedure, it is advisable to use the service diagram, Figure 30, page 15, and the tube and trimmer location, Figure 22, page 9.

In connecting the test equipment to the points indicated on the charts, make the leads as short as possible. This is particularly necessary of the ground leads of the test equipment which should be connected to the B— bus of the receiver.

Always allow test equipment and receiver to warm up for at least 15 minutes before starting the alignment.

It is often advisable to perform the alignment with the picture tube removed. The filament circuit can be completed by using a Type 6SN7 tube with all pins clipped off except pins No. 7 and No. 8 which must be plugged into No. 1 and No. 12 of the picture tube socket.

TEST EQUIPMENT

The following test equipment is necessary in order to effect alignment of the tuned circuits of the receiver:

1. *R-F SWEEP GENERATOR.*

(G-E Type ST-4A or Equivalent)

a. Frequency Requirements:
4.5 MC with 500 KC and 2 MC sweep width.
40–50 MC with approximately 10 MC sweep width.
50–90 MC, 170–220 MC with 15 MC sweep width

b. Constant output in the sweep range.

c. Minimum output 0.1 volt.

2. *MARKER GENERATOR.*

(G-E Type ST-5A or Equivalent)

The marker generator must have good frequency stability, accurate calibration and must cover the following frequencies:

a. 41.25 MC for video IF
42.50 MC for video IF
44.20 MC for video IF
44.50 MC for video IF
45.00 MC for video IF
45.75 MC for video IF
47.25 MC for video IF

b. 4.5 MC for sound IF and trap alignment.

c. Picture and sound carrier frequencies for Channel No. 2 through No. 13.

3. *BALANCED OUTPUT ADAPTER.*

(G-E ST-8A or Equivalent)
See RF Alignment, note 1.

4. *OSCILLOSCOPE.*

(G-E Type ST-2A or Equivalent)

The oscilloscope should have good sensitivity and preferably a 5-inch screen with a good wide-band frequency response on the vertical deflection circuits. Although the high frequency response is not necessary for alignment, it is imperative when making waveform measurements.

5. *VACUUM TUBE VOLTMETER.*

A vacuum tube voltmeter (VTVM) is necessary to measure the bias of 2.7 volts required for video and RF alignment.

6. *DETECTOR NETWORK.*

A crystal detector network as shown in Figure 27 is necessary when aligning the 4.5 mc trap, L260.

7. *MISCELLANEOUS.*

a. One 10,000 ohm resistor to isolate the scope as noted in the charts.

b. One 1000 mmf. mica &.01 mf. capacitors for isolation of sweep generator.

c. One 680 ohm resistor for IF coil shunt (RF alignment).

d. One 400 mf. electrolytic capacitor, 350 volt for reducing hum (RF alignment).

e. One 100 ohm resistor for reducing hum (RF alignment).

f. Impedance matching pad for RF alignment as shown in Figure 28.

g. Bias battery to supply —2.7 volts as noted for Video IF and RF Alignment.

FIG. 19. GENERAL ELECTRIC R-F SWEEP GENERATOR MODEL ST-4A

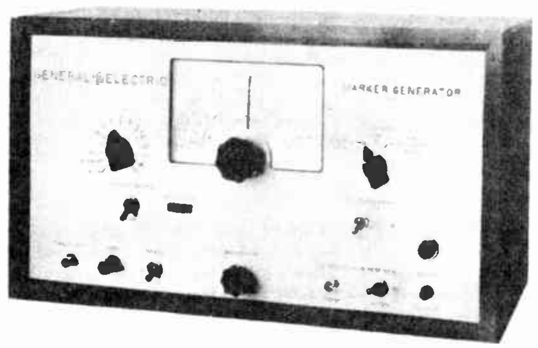


FIG. 20. GENERAL ELECTRIC MARKER GENERATOR, MODEL ST-5A

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VIDEO I-F ALIGNMENT

NOTES:

1. The sweep generator should be properly terminated in its characteristic impedance. Couple the signal to the input point through a 1000 mmf. mica capacitor and adjust signal input to give a video response curve of ¾ volt as shown in Figure 21.

2. Connect a bias battery from junction of C261, R263, and the picture control R285 to B− with the positive side of the battery connected to B−. Adjust picture control to give a −2.7 volt bias at the grid pin 1 of tube V4 measured with a VTVM. Disconnect its leads during alignment.

3. The traps L227 and L253 must be detuned before aligning the video i-f amplifier by turning the cores all the way out of the coil. When retuning these traps to 47.25 mc (as in step 6), for minimum amplitude, increase scope gain as amplitude at 47.25 mc marker point is attenuated, to provide optimum setting.

4. Set channel switch to Channel 2 or 3 and check for oscillator influence by turning the tuning control. If response curve is affected, switch to another channel where oscillator influence is absent.

5. In general, it is only necessary to perform an over-all alignment of the video i-f, as in step 7 of the Video Alignment Chart, in order to obtain i-f response curve of Figure 21-E.

When aligning the i-f coils, L251 will adjust the audio or low frequency side of the i-f response curve, while L252 will adjust the video or high frequency side of the i-f response curve. L226 and L254 should be adjusted simultaneously to reduce the saddle-back at the peak of the curve and to give maximum gain and retain 45.75 mc and 42.50 mc markers at the 50% mark.

6. It is necessary to detune the i-f coils by shorting as noted in the alignment chart to prevent the coil preceding the signal input point from influencing the response curve.

7. It is important that the 45.75 mc marker should fall at the 50% response point to give proper curve of Figure 21-E.

8. After adjustment of the two sound traps, readjust the i-f curve to obtain the proper response curve as illustrated in Figure 21-E.

VIDEO I-F ALIGNMENT CHART

Step	Marker Generator Frequency	Sweep Generator Frequency	Signal Input Points Between	Connect Oscilloscope Between	Adjust	See Note No.
1	—	—	—	—	Detune L227 and L253 by turning cores out of coil.	3
2	44.50 MC	40–50 MC	Point B (Fig. 31) V6 grid (pin 1) thru 1000 mmf. mica cap. and B − on head-end shield; short L252.	Point A (Fig. 31) Junction L256, R265, C268 thru 10K ohms and B − on V7 socket.	Core of L254 for curve of Fig. 21-A.	1, 2, 4, 6
3	45.75 MC		Point C (Fig. 31) V5 grid (pin 1) thru 1000 mmf. mica cap. and B − on head-end shield. Short L251. Remove short on L252.		Core of L252 for curve of Fig. 21-B.	
4	42.50 MC, 45.75 MC		Point D (Fig. 31) V4 grid (pin 1) thru 1000 mmf. mica cap. and B − on head-end shield. Short L226. Remove short on L251.		Core of L251 for curve of Fig. 21-C.	
5	44.2 MC		Point E (Fig. 31) Junction L215 and L216 on second RF switch wafer thru 1000 mmf. mica cap. and B − on head-end shield. Remove short on L226.		Core of L226 for curve of Fig. 21-D.	1, 2, 3, 4, 7
6	47.25 MC				Cores of L227 and L253 for min. output at 47.25 MC (Fig. 21-E).	
7	41.25 MC, 42.50 MC, 45.00 MC, 45.75 MC, 47.25 MC				Cores of L251, L252, L254 and L226 for curve of Fig. 21-E.	1, 2, 4, 5, 7, 8

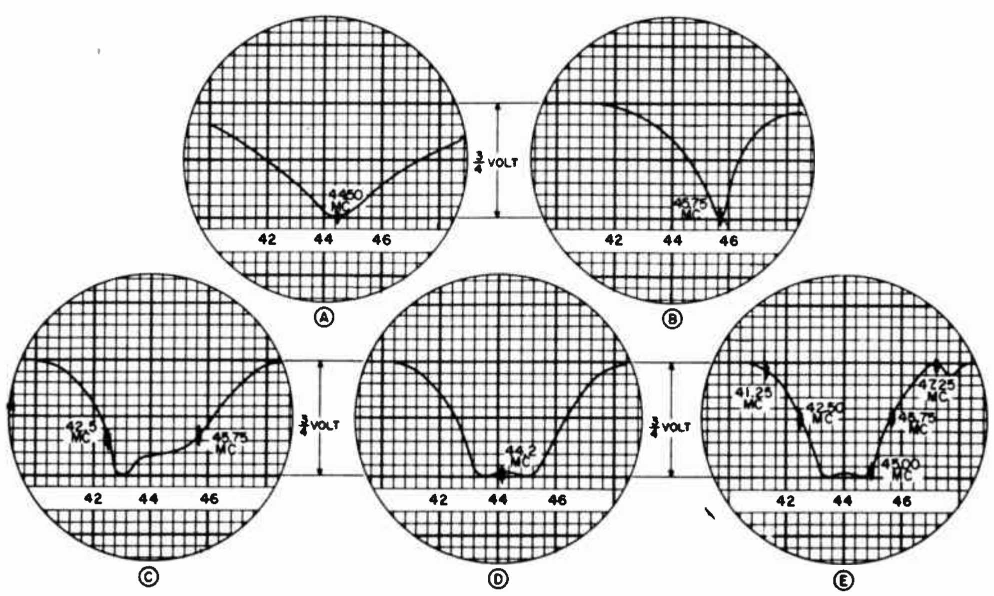

Fig. 21. Video I-F Curves

AUDIO I-F ALIGNMENT

1. Feed a 4.5 mc signal with a 500 kc sweep and adjust for proper response curve as indicated in the chart.

2. Transformer T401 is adjusted for maximum amplitude and symmetry of the response curve about 4.5 mc marker (Figure 23-A).

3. The secondary of T402 is adjusted for curve, Figure 23-B. This adjustment should give as straight a slope as possible between the positive and negative peaks with the center of the 4.5 mc marker falling midway between the peaks.

4. The primary of T402 is adjusted for maximum of the positive and negative peaks. If necessary, readjust the secondary of T402 so that the marker falls midway between the peaks.

5. Keep the input signal of the sweep generator low enough so that limiting does not take place, otherwise the response curve will broaden out, preventing correct adjustment. Check by increasing the output generator: the response curve should increase in amplitude.

6. As a final check (step 12), readjust the secondary of T402 for minimum buzz on all available stations.

7. An alternate method to the visual alignment is the sound output method using an operating television station, preferably when transmitting tone modulation during test pattern transmission.

a. Tune the receiver for best detail.

b. Set the picture control to give reduced contrast or by using a resistor pad in the antenna circuit.

c. Adjust transformer T401 and primary of T402 for maximum sound output.

d. Adjust the secondary of T402 for best quality audio reception and for minimum buzz in the output.

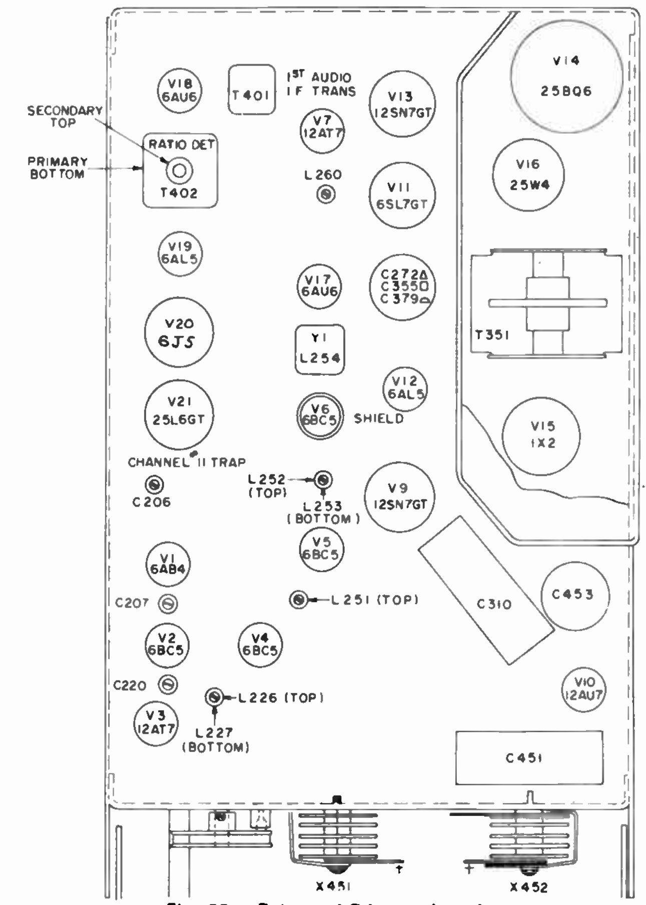

Fig. 22. Tube and Trimmer Location

AUDIO I-F ALIGNMENT CHART

Step	Marker Generator Frequency	Sweep Generator Frequency	Signal Input Points Between	Connect Oscilloscope Between	Adjust	See Note No.
8	4.5 MC	4.5 MC ±500 KC keep signal below limiting level of receiver.	Point F (Fig. 31) Pin 1 of V17 thru .01 mfd. cap. and B −.	Point G (Fig. 35) Junction of R404, C404 & sec. of T401 thru 10K and B −.	Primary and secondary of T401. See Fig. 23-A.	1, 2, 5
9			Point H (Fig. 35) Pin 1 of V18 thru .01 mfd. cap. and B −.	Point I (Fig. 31) Junction of R408, C411 and R411 thru 10K and B −.	Secondary of T402. See Fig. 23-B.	1, 3, 5
10					Primary of T402. See Fig. 23-B.	1, 4, 5
11					Secondary of T402. See Fig. 23-B.	1, 3, 5
12	Recheck alignment of step 11 on operating station as in Note 6.					

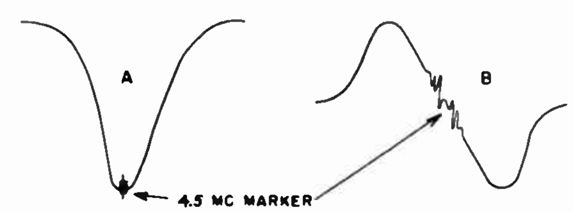

Fig. 23. Audio I-F Curve

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R-F ALIGNMENT

1. Disconnect the transmission line to the antenna from the head-end. Couple the input of the sweep generator to the head-end terminals through balanced output adapter G-E ST-8A, or equivalent. Couple this to the head-end terminals through a piece of 300-ohm transmission line. Terminate the 300 ohm line in a pad, as shown in Figure 28-A.

If a balanced output is not available for the sweep generator a matching network as shown in Figure 28-B may be used. A balanced output is recommended since a matching network as shown in Figure 28-B may introduce frequency shift and cause a misleading tilt to the response curve.

Ro shown in Figure 28-B is the terminating resistor. If this resistor is not already incorporated in the output of the sweep generator, it should be added to the matching network as shown.

2. It is necessary to connect a bias battery from the junction of the picture control, C261, and R263 to B− with plus of bias battery to B−. Adjust the picture control to give a −2.7 volts bias measured from pin 1 of V2 to the head-end chassis B−.

3. Shunt L226 with a 680 ohm, ½ watt resistor during r-f alignment to prevent the oscillator from influencing the response curve. To reduce the effect of hum on the response curve, connect a 100 ohm resistor between the head-end B+ and the chassis B− and connect an electrolytic capacitor of approximately 400 mf., 350 volt from head-end B+ to head-end B−.

4. On all channels the picture carrier marker should not be less than 75% of the peak of the r-f response curve. The sound carrier marker should not be less than 50% of the peak of the response curve. On the high channels the picture carrier marker should ride up nearer to the top of the curve provided the sound carrier marker does not go below 50%. On the low channels the picture carrier marker should ride as high up on the curve as possible and still keep the sound carrier marker above 50%.

5. Coils for Channels #12 through #7 are fixed inductances. Check the alignment on these channels as in steps 16 through 21 for proper response curve. Readjust L210 and L217 on Channel #13 and C207 and C220 on Channel #7 if necessary.

6. Coils for Channels #5 and #4 are fixed inductance. Check the alignment on these channels for proper curve. Readjust coils L208 and L215 to give proper curve on Channels #6, #5, and #4.

7. The coil for Channel #2 is a fixed inductance. Check the alignment on this channel for proper curve. Readjust L205 and L212 to give proper curve on Channels #3 and #2.

8. The trimmers C207 and C220 may be used to compensate for differences in tube capacities which affect tracking when it is necessary to change the tubes V1 or V2. The variation in tube capacities has normally little effect on the over-all performance of the head-end.

R-F ALIGNMENT CHART

Step No.	Marker Generator Frequency	Sweep Generator Frequency	Signal Input Point	Connect Oscilloscope	Channel Switch	Adjust	See Note
13	211.25 MC, 215.75 MC	No. 13 with 15 MC sweep	Antenna terminals at head-end See Note 1	Point J (Fig. 31) Junction of L226, C217 and R218 thru 10K resistor and B − at head-end chassis.	No. 13	Screw of L210, screw of L217, for Fig. 24-A.	1, 2, 3, 4, 5
14	175.25 MC, 179.75 MC	No. 7 with 15 MC sweep			No. 7	Trimmers C207 and C220 for response curve, Fig. 24-A.	1, 2, 3, 4, 5, 8
15	211.25 MC, 215.75 MC,	No. 13 with 15 MC sweep			No. 13	Readjust screw of L210 and screw of L217 for curve, Fig. 24-A.	1, 2, 3, 4, 5
16	205.25 MC, 209.75 MC	No. 12 with 15 MC sweep			No. 12	No adjustment.	5
17	199.25 MC, 203.75 MC	No. 11 with 15 MC sweep			No. 11		
18	193.25 MC, 197.75 MC	No. 10 with 15 MC sweep			No. 10		
19	187.25 MC, 191.75 MC	No. 9 with 15 MC sweep			No. 9		
20	181.25 MC, 185.75 MC	No. 8 with 15 MC sweep			No. 8		
21	175.25 MC, 179.75 MC	No. 7 with 15 MC sweep			No. 7		
22	83.25 MC, 87.75 MC	No. 6 with 15 MC sweep			No. 6	Screw of L208 to place 83.25 MC marker and screw of L215 to place 87.75 MC marker as shown in Fig. 24-B.	1, 2, 3, 4, 6
23	77.25 MC, 81.75 MC	No. 5 with 15 MC sweep			No. 5	No adjustments.	6
24	67.25 MC, 71.75 MC	No. 4 with 15 MC sweep			No. 4		
25	61.25 MC, 65.75 MC	No. 3 with 15 MC sweep			No. 3	Screw of L205 to place 61.25 MC marker and screw of L212 to place 65.75 MC marker as shown in Fig. 24-B.	1, 2, 3, 4, 7
26	55.25 MC, 59.75 MC	No. 2 with 15 MC sweep			No. 2	No adjustment.	7

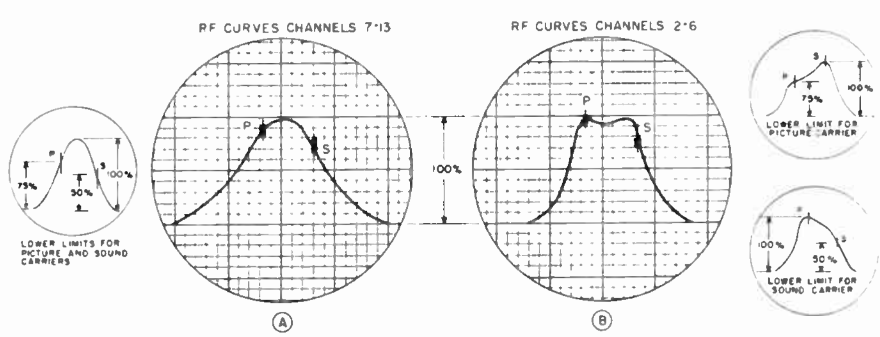

Fig. 24. R-F Alignment Curves

OSCILLATOR ALIGNMENT

Before attempting this oscillator alignment, it must be certain that the video i-f stages and r-f stages are properly aligned as outlined previously.

1. Disconnect the 300 ohm line from the r-f head-end terminals and connect sweep generator to head-end properly terminating sweep generator output cable as shown in Figure 28. See RF Alignment Note 1.

2. Alignment is made by viewing the response curve at the output of the video i-f detector.

3. Use a video carrier marker as shown in each step of the Alignment Chart.

4. Set the tuning control C213 at the center of its rotation. Adjust L225 to place the video carrier marker at the 50% point on the high frequency slope of the curve for step 28. The oscillator inductance L224 for Channels #12 through #7 is fixed. The alignment on these channels is checked to see that the picture marker falls at the 50% point on the high frequency slope of the curve. If the picture marker position does not meet these conditions, it is necessary to readjust L225 for a compromise on Channels #13 through #7. The tuning range of C213 on Channels #13 through #7 should be sufficient to move the video carrier marker up and down the entire high frequency side of the response curve. Readjust L225 if necessary.

5. On Channel #6 through #2 set the tuning control C213 at the center of its rotation and make the indicated adjustment so that the video carrier marker falls at the 50% mark on the high frequency slope of the response curve.

OSCILLATOR ALIGNMENT CHART

Step No.	Marker Generator Frequency	Sweep Generator Frequency For Channel	Signal Input Point	Connect Oscilloscope Between	Channel Switch Setting	Adjust	See Note
27	211.25 MC	No. 13 with 15 MC sweep	Antenna terminals of head-end. See Note 1.	Point A (Fig. 31) Junction of L256, R265, C268 thru 10K ohms and B − at V7 socket (pin 3.)	No. 13	L225 by squeezing or spreading turns slightly.	1, 2, 3, 4
28	205.25 MC	No. 12 with 15 MC sweep			No. 12	No adjustment.	
29	199.25 MC	No. 11 with 15 MC sweep			No. 11		
30	193.25 MC	No. 10 with 15 MC sweep			No. 10		
31	187.25 MC	No. 9 with 15 MC sweep			No. 9		
32	181.25 MC	No. 8 with 15 MC sweep			No. 8		
33	175.25 MC	No. 7 with 15 MC sweep			No. 7		
34	83.25 MC	No. 6 with 15 MC sweep			No. 6	Screw of L223.	1, 2, 3, 5
35	77.25 MC	No. 5 with 15 MC sweep			No. 5	Screw of L222.	
36	67.25 MC	No. 4 with 15 MC sweep			No. 4	Screw of L221.	
37	61.25 MC	No. 3 with 15 MC sweep			No. 3	Screw of L220.	
38	55.25 MC	No. 2 with 15 MC sweep			No. 2	Screw of L219.	

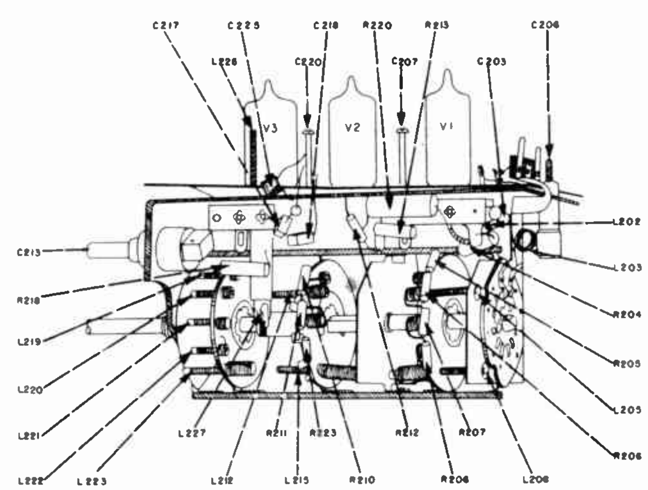

Fig. 25. Head-end Unit

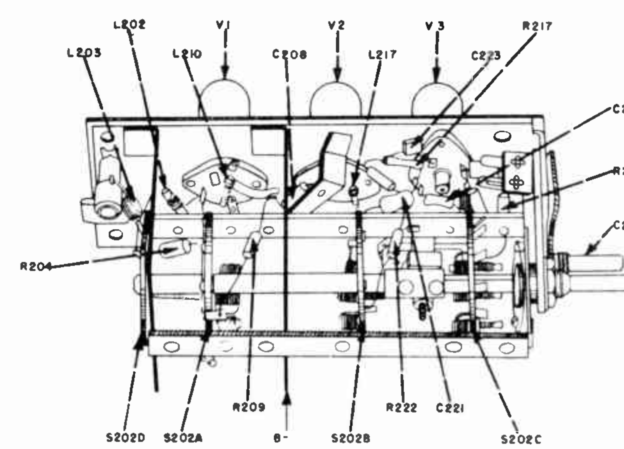

Fig. 26. Head-end Unit

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ADJUSTMENT OF VIDEO AMPLIFIER 4.5 MC TRAP (L260)

NOTES:

This trap is used to remove 4.5 mc audio i-f from the video amplifier which shows up in the picture as a cross-hatch pattern. This trap will very rarely require adjustment. Adjustment is as follows:

1. The trap (L260, C271, C270) is adjusted for minimum amplitude of the 4.5 mc marker. Use a detector network as shown in Figure 27 connected from junction of L264 and C275 to B− to detect the signal.

2. Adjust the vertical hold control to remove the vertical pulses from the response curve.

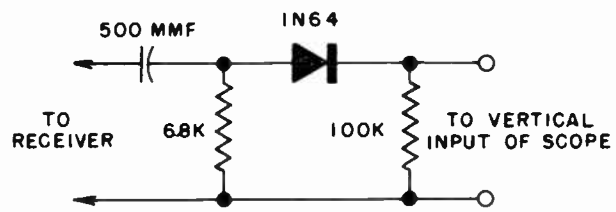

Fig. 27. Detector Network

4.5 MC TRAP (L260) ALIGNMENT CHART

Step	Marker Generator Frequency	Sweep Generator Frequency	Signal Input Point	Oscilloscope	Adjust	See Note
39	4.5 MC	4.5 MC ±1 MC	Point A (Fig. 31) Junction L256, R265, C268 and B− thru .01 mf.	Across 100K resistor as shown in Fig. 27. (See Note 1.)	L260 for min. amplitude of 4.5 mc marker. Increase scope gain as amplitude at 4.5 MC is attenuated.	1, 2

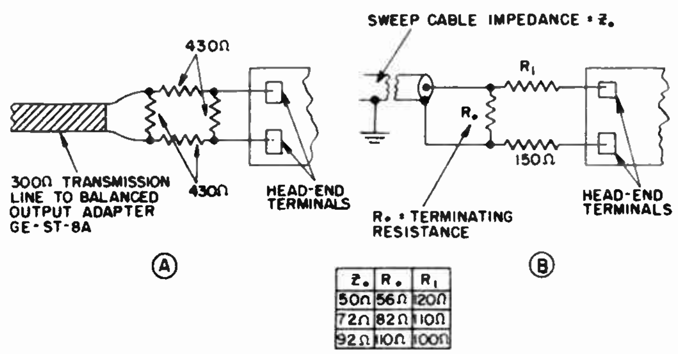

Fig. 28. Sweep Generator Termination

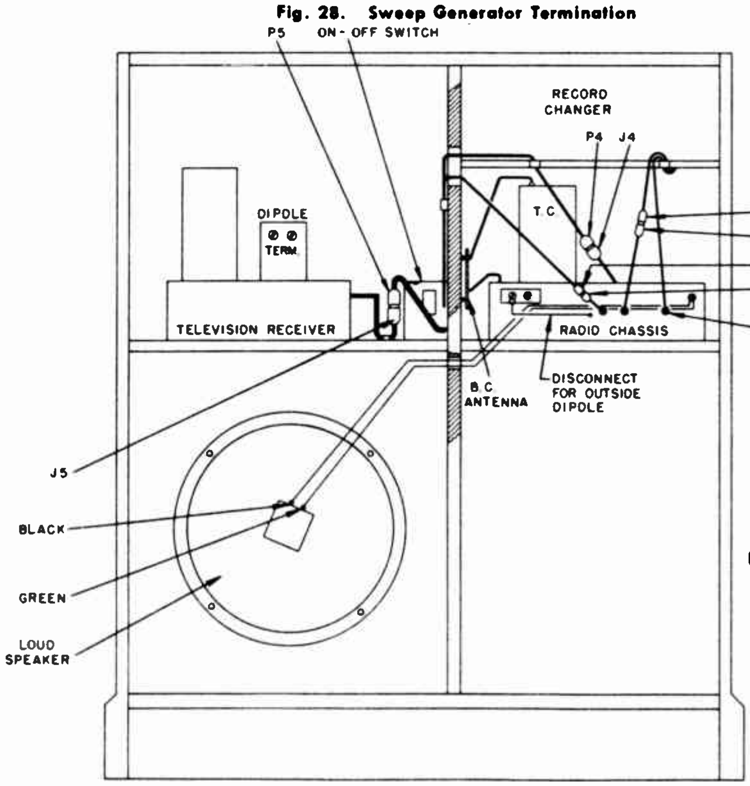

Fig. 29. Cabling Diagram, Model 16K1

TROUBLE SHOOTING

This trouble shooting chart is divided into sections for quick trouble shooting. In most cases a trouble may be localized by noting the condition of the picture or test pattern and the presence or absence of sound.

In general, the tubes in the defective circuit should be checked first since they are fairly easy to check. When substituting tubes in the RF or video IF circuits, the original tube should be replaced in the socket if it is found not to be defective. When a tube is replaced in the video IF or RF circuits, alignment should be checked.

The block diagram (Figure 1), the waveforms of the service diagram (Figure 30), and the socket voltage and resistance diagram (Figure 32) may be used to isolate defective RF, video IF or audio IF stages by checking for the response curves as given in the alignment procedure.

DEFECTS OF THE R-F AND I-F CIRCUITS

A. No Picture, No Sound, Raster Normal.

1. Check the R-F head-end circuits of V1 and V2.
2. Check to see that local oscillator, V3B, is operating properly.
3. Check Video I-F amplifier circuits of V4, V5 and V6.
4. Check crystal detector, Y1.
5. Check channel switch.

B. Snow in Picture.

1. Open input circuit in C278, C279 or L201.
2. Defective antenna installation or transmission line.
3. Antenna orientation.

C. Lack of Picture Detail (Focus Satisfactory).

1. Misalignment of Video I-F.
2. Misalignment of R-F amplifier.
3. Mismatch of input impedances at antenna input terminals of receiver.
4. Overloading of r-f stages.

D. Motorboat or Flutter in Picture and Audio.

1. Open by-pass, C251.
2. Open filament by-passes C222, and C458.
3. Misalignment of video I-F and R-F amplifiers.

E. Wiggles in Picture Background, Trailing Whites on Picture, Sound Normal.

1. Misalignment of R-F and I-F amplifiers.
2. Improper tuning of receiver.

F. Sound Bars in Picture (Black Horizontal Bars).

1. Microphonic tubes, V3, V4, V7 or picture tube V8.
2. Misalignment of adjacent channel sound traps, L227, L253.

DEFECTS OF THE VIDEO AMPLIFIER

A. No Picture, Sound Satisfactory, Raster Satisfactory.

1. Open chokes L261, L263, L264.
2. Shorted capacitor C270, C272, C273.
3. Open capacitor, C268.
4. Open resistors R269, R272.
5. Short from pin 2 to pin 11 of V8 picture tube.

B. Poor Low Frequency Response (Trailing Whites after Black).

1. Low value of resistors R269, R272, R265.
2. Low capacity or open capacitor C272.
3. Low capacity of C268, C275.

C. Lack of Picture Detail, Focus Satisfactory (Smearing of Vertical Wedges of Test Pattern).

1. Shorted chokes L259, L261, L262.
2. Open chokes L259, L262.
3. High resistance of R272, R269, R265.

D. Bright Picture with Black Lines.

A shorted capacitor C275 will give a very bright picture with black lines across the picture. The picture control will have no effect.

E. Picture Distorted at High Settings of Picture Control.

Check for high resistance of R273.

DEFECTS OF THE SYNC SECTION

A. No Vertical Sync, Horizontal Sync Satisfactory.

1. Check waveform of sinc input, V9 pin 5.
2. Check C303, R301, R302, C301 for leakage or shorted.
3. Check components C306, R304, R305.
4. Check for leakage of C305.

B. Weak Vertical Sync, Horizontal Sync and Picture Normal.

1. Leakage or low value of capacitor of C303.
2. Leakage of C301, C302 or incorrect values.
3. Check frequency determining components C306, R304, R305 for exact value.

C. Weak or no Vertical and Horizontal Sync, Picture Information Present and Sound Normal.

1. Check waveform at pin 4 of V11 for proper waveform from video amplifier.
2. Improper B+ voltage on V11.
3. Incorrect value of R354.
4. Open or low capacity of C351.
5. Defective coupling capacitor C353, C354.

D. Weak or no Horizontal Sync, Vertical Sync Satisfactory.

1. Check waveform at pin 2 of V12.
2. Check sweep frequency determining components L351, C366, C364, R381, R364.
3. Check for leakage in V12 components, C356, C357, C360, C358.
4. Check for proper value of resistors R356, R357, R358, R361.
5. Check C359, R359 and R360 in the feedback circuit.
6. Check coupling between V13A and V13B (C363, C365, R366).

DEFECTS OF THE VERTICAL SWEEP

A. Keystoning (Picture Narrows at Top or Bottom).

1. Defective vertical deflection coil, D301.
2. Check R314, R315.

B. No Vertical Deflection (Single White Horizontal Line on Screen).

1. Open deflection coil, D301.
2. Defective sweep output transformer, T301.
3. Multivibrator V9 and V10 defective, no B+ to V10, open R312 or shorted C310.

C. Insufficient Height.

1. Open C310.
2. High resistance of R307.
3. Excessive leakage of C308.
4. Defective T301.
5. Incorrect voltage values on V10.
6. Low capacity of C309 (this also results in poor vertical linearity).

D. Poor Vertical Linearity, Size Normal.

1. Leaky or improper value of C309.
2. Check B+ to V10 (leaky capacitor C310).
3. Check C303 for leakage.

E. Poor Vertical Linearity, Insufficient Height.

1. Defective output tube, V10.
2. Inadequate drive voltage from V9. Check waveform at pin 5 of V9.
3. Low plate voltage to V9 or V10.
4. Open or low capacity of C309.

F. Excessive Vertical Size, Sync Satisfactory.

1. Low value of R307 or defective size control R308.
2. Open or low capacity of C308.
3. Low picture tube anode voltage.
4. Open R309.

G. No Vertical Sync, Vertical Hold has no Effect, Insufficient Height.

1. Shorted capacitor C306.
2. Shorted R305.

H. Poor Vertical Linearity, Fold-over at Bottom of Picture, Too Much Height.

1. Shorted or high leakage of C303.
2. Low capacity of C308.

I. Curtain Raising Effect (Picture Rolls up from Bottom as Vertical Hold is Advanced).

1. Leaky capacitor, C304.
2. Low resistance of R303.

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DEFECTS OF THE HORIZONTAL SWEEP

A. *Inadequate Sweep Width.*

1. Low B+ boost to plate of V14 or low B+ to screen of V14.
2. Shorted turns of width control, L353.
3. Shorted turns or arc-over in T351.
4. Parasitic oscillations in V14 (open filament by-pass C462, or defective V14).

B. *Too Great Sweep Width.*

1. Open width control, L353.
2. Low value of picture tube anode voltage.
3. Check voltages of V14.
4. High value of C382.

C. *Poor Horizontal Linearity.*

1. Check for short, or shorted turns of L352.
2. Leaky capacitor C370 in grid of V14.
3. Check screen by-pass capacitor C380.
4. Defective transformer T351.

D. *Single White Vertical Line on Screen.*

1. Open deflection coil, D351.

E. *Black Beady Vertical Line or Lines (Barkhausen Oscillation).*

1. Check sweep output tube, V14.
2. Check for open C382.

F. *Keystoning (Picture Narrows at Top or Bottom).*

1. Check for shorted capacitor, C378.
2. Shorted turns of Horizontal Deflection coil D351.

G. *No Horizontal Sync, Bright Vertical Bar or Bars in Picture.*

1. Shorted, open or leaky C365.
2. Shorted R366.

H. *Gear-tooth Effect, Tearing of Picture (Hunting of Horizontal Sync).*

1. Open or low capacity of C375.
2. Open or high resistance of R362.

I. *Poor Horizontal Linearity, Bright Vertical Bars, Inadequate Horizontal Size.*

1. Open or low capacity of C374.

J. *Dim Picture, Poor Horizontal Linearity, Insufficient Width and Height.*

1. Open or low capacity of C377.

AUDIO DEFECTS

A. *No Sound, Picture Normal.*

1. This indicates a defect in the circuits of V17, V18, V19, V20.
2. Misalignment of T401 or T402 may also cause no sound to be received.

B. *Buzz or Hum in the Sound.*

1. Misalignment of T402 secondary may cause buzz.
2. Reverse power plug in power outlet.

POWER SUPPLY AND PICTURE TUBE CIRCUITS

A. *No Raster, No Sound (No B+).*

1. Check power input circuit (cord and interlock).
2. Check rectifier (X451, X452), check L451, C451, R451.
3. Check thermal cutout.

B. *Picture Size Small, Brilliance Low, Sound Normal (Low B+).*

1. Open or low value of C452.
2. Defective rectifiers X451 or X452.

C. *Low Picture Brilliance, Sound Satisfactory.*

1. Misadjustment of ion trap.
2. Low voltage at high voltage anode of picture tube caused by leaky C376, defective V15, or shorted L353.
3. Low B+ to V14 (check B+ boost at pin 3 of V16. V16 may be defective).
4. Improper waveform at grid of pin 5 of V14.
5. Defective Brightness control circuit or improper voltages to Brightness control R286.
6. Low voltage at second grid (pin 10) of picture tube.
7. Defective picture tube.

D. *No Raster, Sound Satisfactory.*

1. No high anode voltage to picture tube.
2. Ion trap misadjusted.
3. Brightness control circuit open.
4. No voltage at pin 10 of V8 pix tube.
5. Defective picture tube.
6. No drive voltage from V14. Check waveform at pin 5 of V14.
7. Open L352.

MISCELLANEOUS DEFECTS

A. *Retrace Lines Visible.*

1. Check waveform of V9, pin 2.
2. R316, C311, R318 open.
3. C311 shorted.

B. *Brightness Control R286 Partially or Totally Inoperative.*

1. Defective R286.
2. Too low or too high B+ to R286.
3. Short or leaky capacitor, C275 or C277.
4. Gassy picture tube.

C. *Picture Contrast Excessive (Picture Control will not Reduce Contrast).*

1. Excessive antenna input signal.
2. Defective picture control.
3. Shorted or leaky coupling capacitor, C354.
4. Open capacitor C353, C354.
5. Shorted AGC by-pass capacitor, C251.

D. *Picture Control Ineffective.*

1. Shorted C261 (this will make the picture control work backwards).
2. Open choke L258.
3. AGC by-pass C251 shorted.
4. Check waveform at pin 4 of V11.

E. *Poor Focus.*

1. Open or shorted focus coil.
2. Defective focus control tube V21.
3. Demagnetized permanent magnet of focus coil.
4. Defective picture tube V8.

F. *Neck Shadow (See Figure 13).*

1. Misadjustment of focus coil or ion trap.
2. Deflection yoke not forward against the bell of the picture tube.

G. *Wavy Left or White Edges of Picture (Hum).*

1. Check tube V11, V12, V13 for filament to cathode leakage.
2. Check C379 or C355.

H. *Wide Black Horizontal Bar in Picture, Wavy Left or Right Edges of Picture (Hum).*

1. Check filter capacitors C452, C453, C272.

PRODUCTION CHANGES

1. *REDUCTION OF AUDIO BUZZ.*

The following changes were made in the receiver at the start of production to reduce vertical sweep buzz in the audio output. These changes are incorporated in all receivers shipped.

a. In the cathode circuit of the audio amplifier tube V20 two capacitors, C426 (5000 mmf.) and C423 (50 mf.), were removed.

b. At the secondary of the audio interstage transformer (T406), a 330,000 ohm, ½ watt resistor, R429, was connected.

2. *REDUCTION OF "TWEET" ON CHANNEL #4 AND OSCILLATION ON CHANNEL #6.*

a. A capacitor of 800 mmf. was connected between the head-end unit and the main receiver. The change-over should be made as follows: With as short a lead as possible, solder one end of an 800 mmf. ceramic capacitor (C227) to the mounting clip of the trap trimmer (C206) on the head-end unit. The other end of the capacitor is soldered to a lug fastened securely at the punched receiver chassis hole adjacent to the tube socket, V21.

b. Relocation of the ceramic capacitor C252 from its present termination at the 7th B− bus hole of the terminal board #1 and the chassis weld between tube sockets, V5 and V6. Relocate this capacitor by soldering one end of it to the 1st hole in the B− bus of the same terminal strip. The other end is soldered to the chassis hole nearest L251. For convenience, the capacitor lead may be inserted through the ⅜ inch hole nearest L251 and then soldered from the top of the chassis to a cleaned and tinned top edge of the hole.

CRITICAL LEAD DRESS AND COMPONENT REPLACEMENT

Since the operating frequencies are relatively high in a television receiver, it is essential that all components be placed in exactly the same position they occupied when they were wired in the factory; all leads should be made as short as possible and exact replacement parts to be used when replacing components. Leads in wiring between components are usually critical as to placement against chassis or proximity to other components. Some of critical wiring precautions are listed below:

1. *YELLOW LEAD ON TUBE V18.*

The yellow lead should be as short as possible to connect to pin #7 of V18. All leads which run past the terminal board to which the yellow lead is connected are pushed down against the chassis and dressed as far away as possible from the yellow lead.

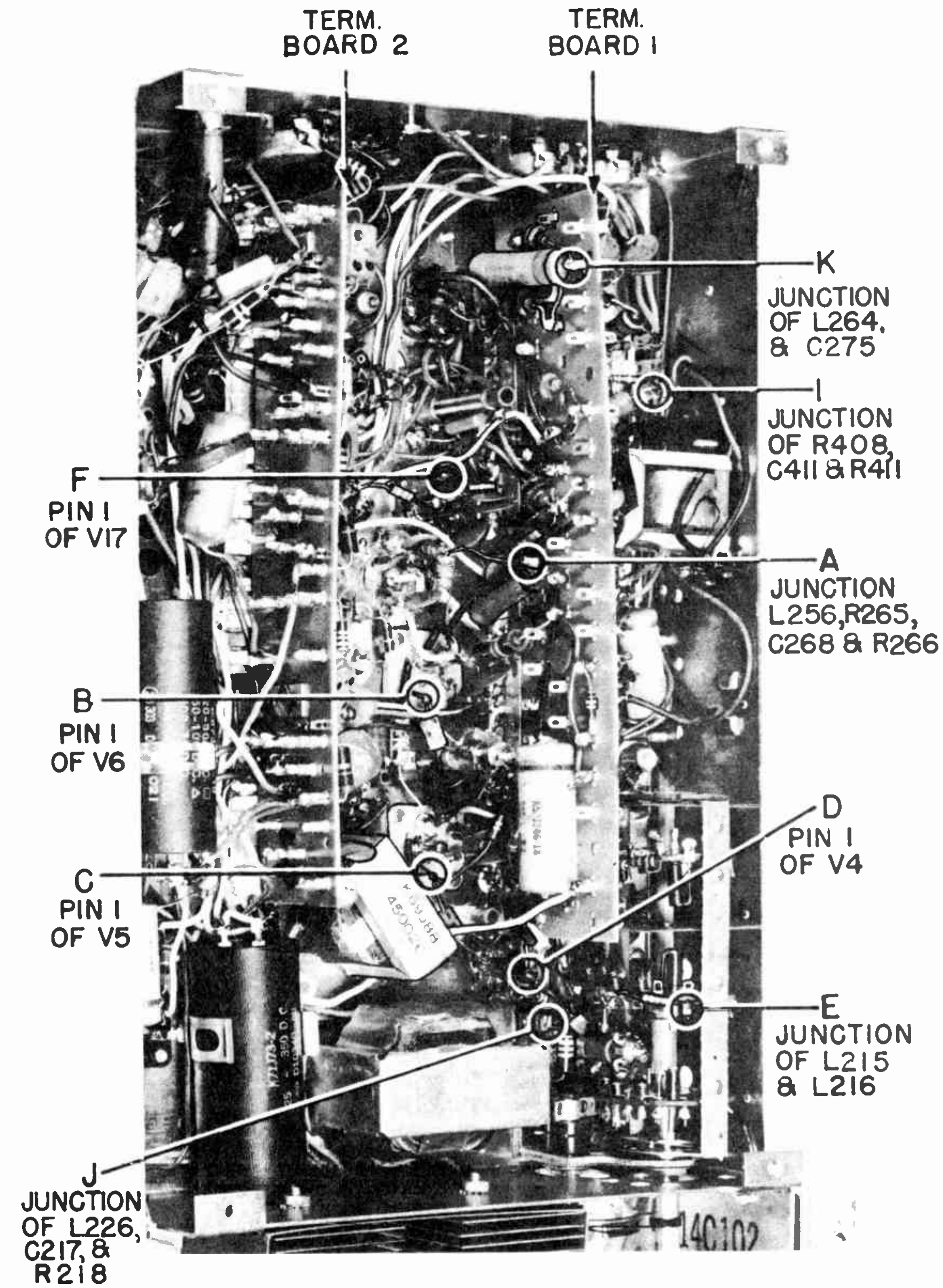

Fig. 31. Alignment Connection Points

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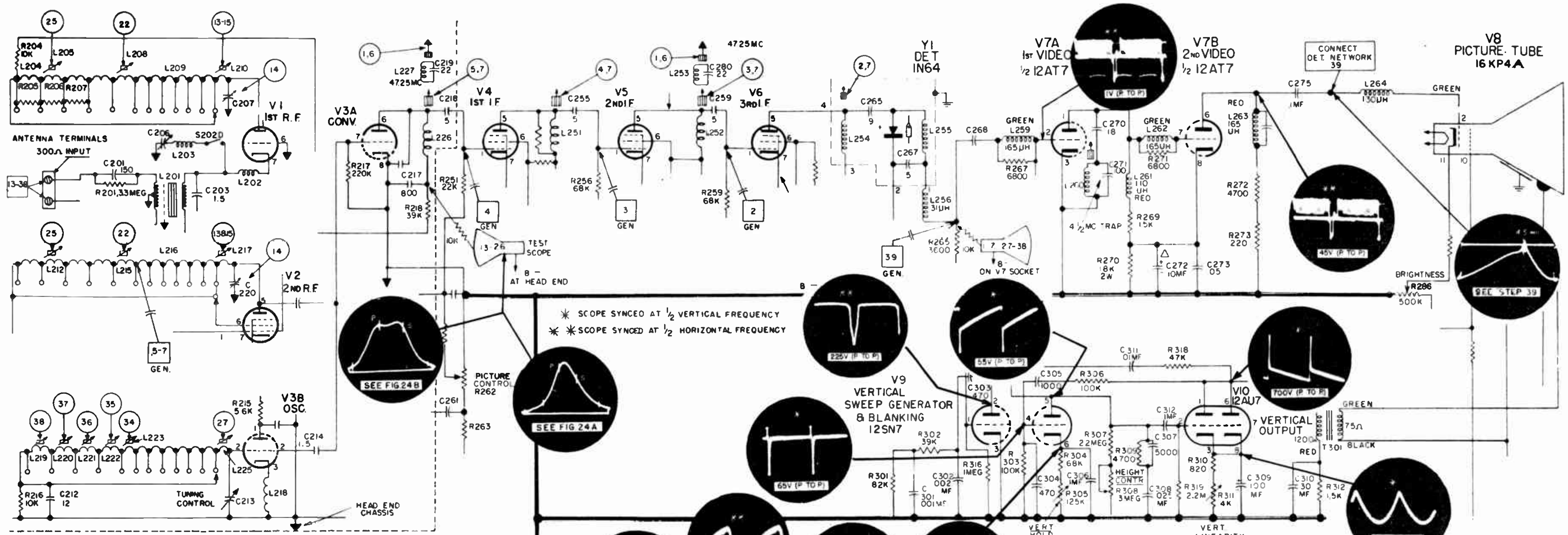
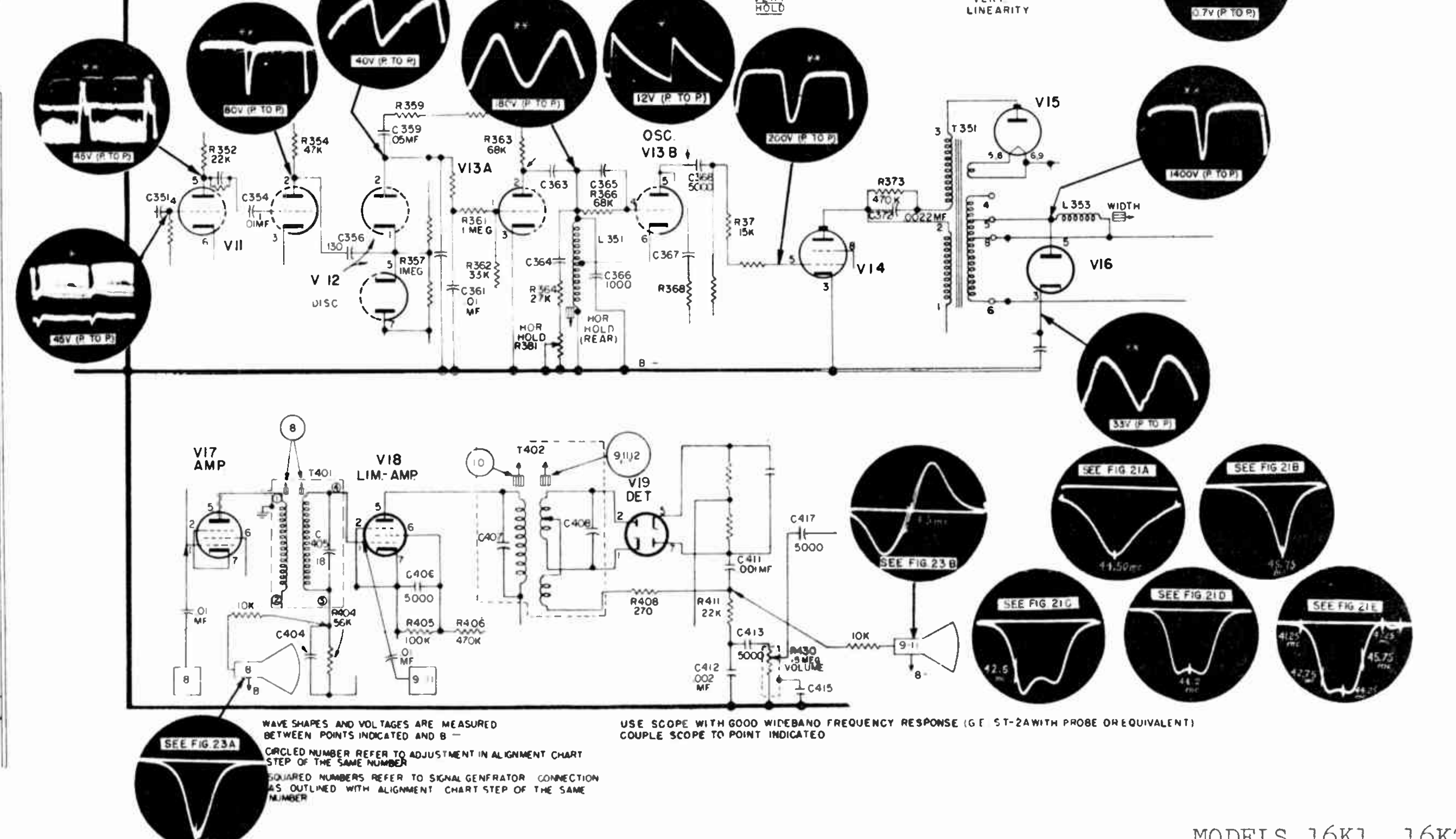
Fig. 30. Service Diagram, Television Chassis, Model 16K1

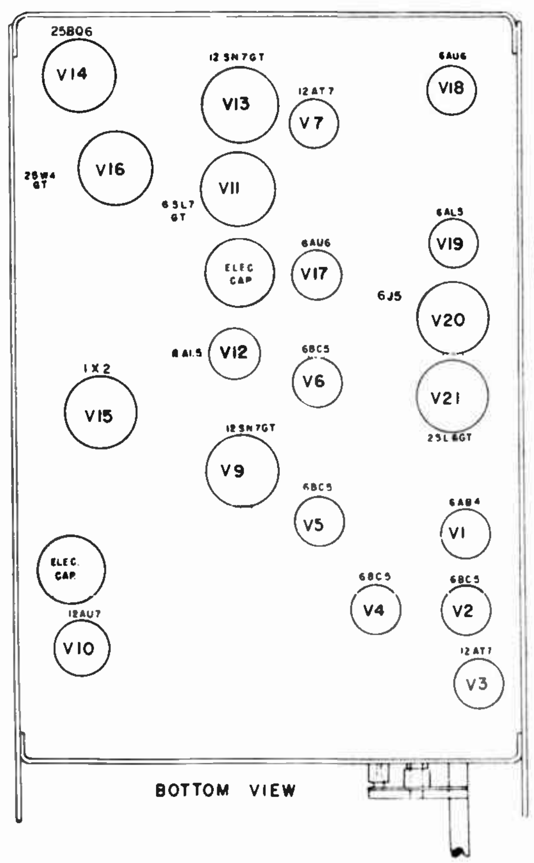




SERVICE DIAGRAM

The alignment procedure is shown in table form on pages 24 through 27. In order to accelerate the whole procedure, the service diagram (Figure 29) should be consulted. The encircled numbers indicate the number of the step of the alignment chart and the arrow points to the compartment to be adjusted. The generator is symbolized by a square with the number of the step of the alignment chart. The exact point of feed-in is indicated by the arrow connected with the numbered square. The oscilloscope is represented by the symbol of the cathode ray tube. The number inside the symbol refers to the step of the alignment chart. On the left side of the diagram is shown the tube location inside the chassis so that it is easy to locate the correct points for connection to the generator and the oscilloscope. In order to clarify the diagram, only those parts of the circuits are shown which are needed for location of the test points. Within the large circles are shown the waveform of an average television receiver, wherein the controls have been adjusted for a normal picture with correct contrast, height, width and linearity. Most measurements must be made when a signal is being received. Adjust picture control for 1-volt peak to peak at pin 2 of V7A as shown.

The oscilloscope of which the vertical amplifier has been precalibrated is used to make measurements at the point indicated. The oscilloscope is synced at half of the respective sweep frequency of the circuit being analyzed.



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RADIO RECEIVER

GENERAL.

The receiver is designed to operate either from the built-in antenna or from an external FM 300 ohm dipole antenna. The receiver may be operated on an external FM antenna by disconnecting from the antenna terminal strip the wire extending from the rear of the radio chassis. The 300 ohm transmission line should be connected to the antenna terminals on the radio chassis.

On AM operation, the receiver operates with the signal fed directly into the converter grid. On FM, the receiver uses a reflex circuit, the Armstrong type discriminator and a special limiter circuit.

In the reflex circuit V2 (6BA6) works both as an r-f amplifier and as the 1st i-f amplifier. The FM r-f signal is fed into the grid of the V2 tube through the secondary of transformer T1. It is amplified by the tube and tuned at the converter grid by L4, C1B and trimmer C6. The converter changes the r-f to 10.7 mc i-f and is fed into the primary of transformer T1 and again applied to the grid of tube V2 which works now as an i-f amplifier. The i-f signal is fed from the plate of V2 through choke L9 into the second i-f transformer. Capacitor C4 and coil L2 are designed to peak at 98 mc to increase the FM r-f sensitivity. At the FM r-f frequencies, the capacitor C46 offers little series impedance to the r-f signal. Coil L9 and capacitor C7 form a high-pass filter to pass the FM r-f signal into the converter grid and to shunt the FM i-f frequency into the primary of the second FM i-f transformer.

STAGE GAIN AND VOLTAGE CHECKS

In order to check circuit performance and to facilitate trouble shooting stage gain measurements by vacuum tube voltmeter or similar measuring device may be used. The gain values listed may have tolerances of ±20%. Readings should be taken with low signal input applied through IRE dummy antenna so that AVC is not effective.

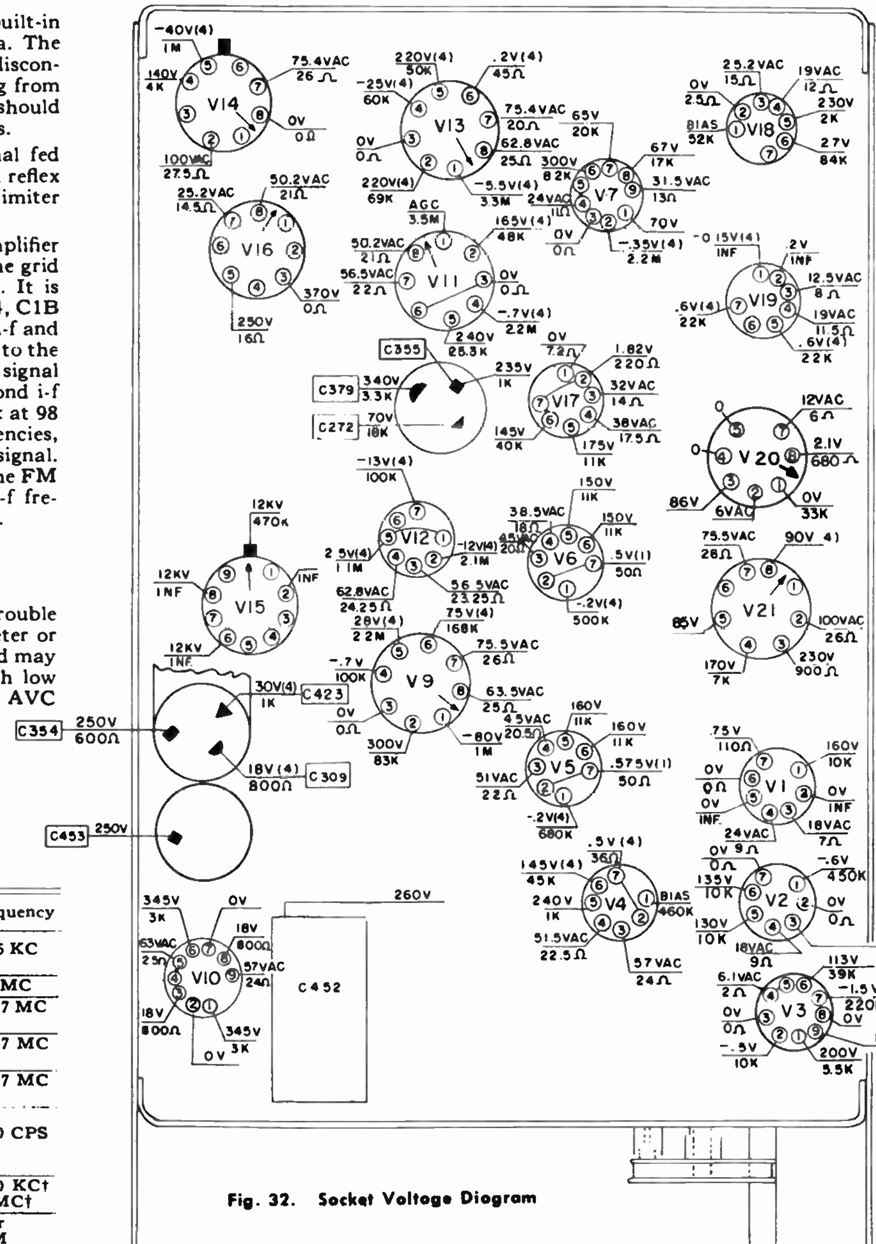
Stage Gains	Stage	Stage Gain	Frequency
	Converter grid 6BE6 (V1) to grid of IF amplifier, 6BA6 (V3)	40	455 KC
	Dipole terminal to grid of V2	1.0	98 MC
	Converter, 6BE6 (V1) grid to grid of V2 (6BA6)	1.5	10.7 MC
	Grid of V2 (6BA6) to i-f amplifier grid (6BA6, V3)	50	10.7 MC
	I-f amplifier (6BA6, V3) grid to limiter grid (6AU6, V4)	22	10.7 MC
Audio Gain	Volume Control (R18) to speaker voice coil	Input .07V* Output 0.5W**	400 CPS
Oscillator Grid Bias	Voltage across R3	7 volts 3 volts	1000 KC† 98 MC†
Hum Measurements	Measured across voice coil of speaker with volume control at minimum	Maximum 7 millivolts	For AM
	Measured across voice coil of speaker with volume control at max.; ground limiter grid through .01 capacitor	Maximum 15 millivolts	FM
Socket Voltages	Fig. 37 shows typical tube pin voltages. AM readings should be made from tube pin to chassis, unless otherwise indicated.		

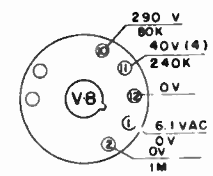
*Across R18.
**Across voice coil.
† Use resistor of 220,000 ohms to isolate VTVM.

CIRCUIT ALIGNMENT

GENERAL.

Two methods of alignment may be used: (1) The regular meter alignment as used for standard AM radios and (2) the visual alignment, which is more exact in aligning the circuits, particularly the discriminator where it is necessary that the negative and positive half cycles of the output wave have equal amplitude and symmetry.





VOLTAGE MEASUREMENTS
INPUT 117V, 60
ALL CONTROLS SET FOR NORMAL SWEEPS, FOCUS AND BRIGHTNESS
MEASUREMENTS ARE IN RESPECT TO B- WITH A 20,000Ω/VOLT METER
(1) 2.5 VOLT RANGE
(2) 10 " "
(3) 25 " "
(4) VOLTAGE WILL VARY MORE THAN 20%

RESISTANCE MEASUREMENTS
SHORT CAPACITOR C453
SHORT PIN 3 OF V16 TO B-
M DENOTES MEG
INF. DENOTES INFINITE RESISTANCE
TURN THE FOLLOWING CONTROLS FULL CLOCKWISE
FOCUS CONTROL
CONTRAST
BRIGHTNESS
VERTICAL HOLD
VERTICAL SIZE
VERTICAL LINEARITY
VALUES LISTED MAY HAVE A TOLERANCE OF ± 20%

Fig. 32. Socket Voltage Diagram

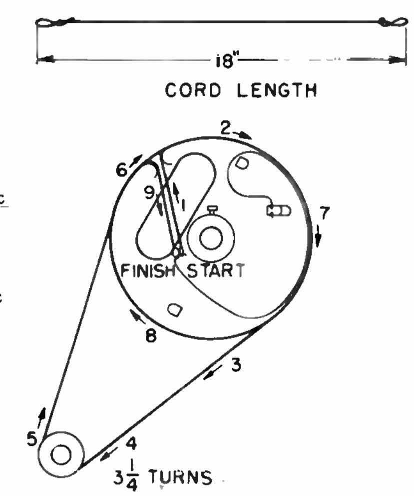


Fig. 33. Tuning Control Stringing Diagram

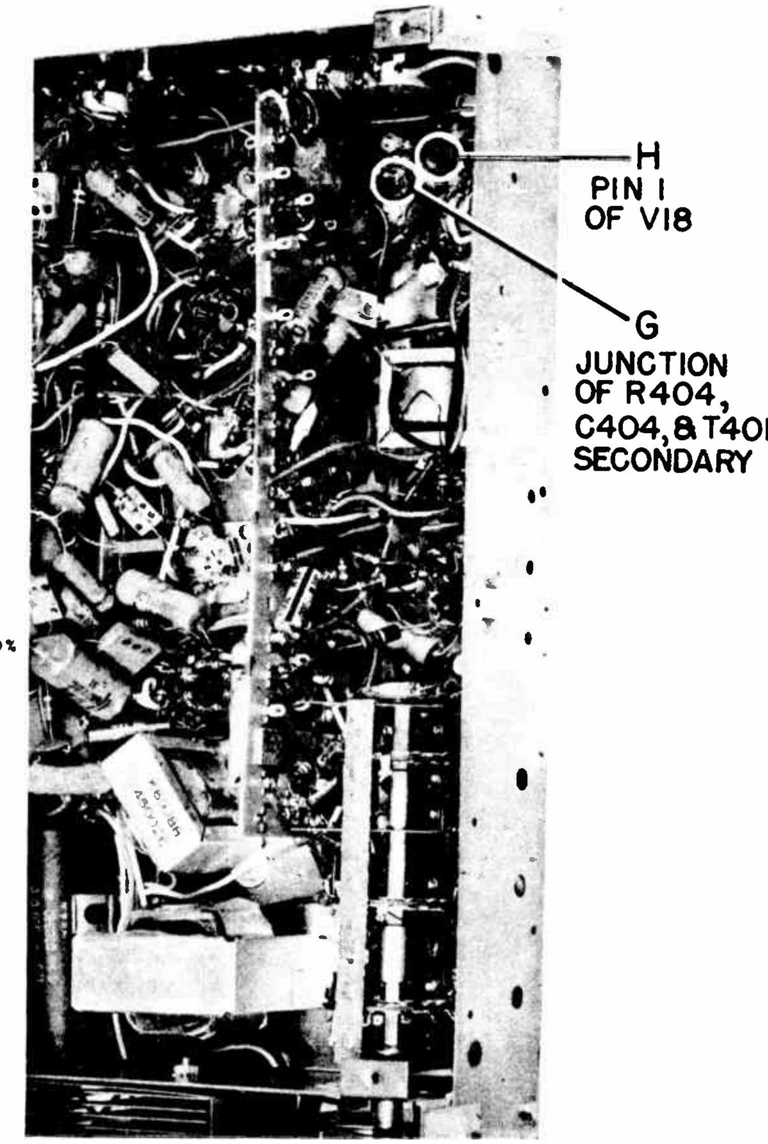


Fig. 35. Alignment Connection Points

METER ALIGNMENT

EQUIPMENT REQUIRED FOR METER ALIGNMENT.

1. Test oscillator with tone modulation to cover 455 kc, 520 to 1620 kc, 10.7 mc and 88 to 108 mc.
2. Voltmeter, 20,000 ohm-per-volt or VTVM.
3. Output Meter.
4. Paper Capacitor, .01 mf.
5. Resistor, ½ watt, 200,000 ohms.
6. Loop Antenna, see note 6.

METER ALIGNMENT NOTES.

1. Use an unmodulated signal.

2. Connect a meter (20,000 ohms/volt) from junction of resistor R26 and capacitor C27 to chassis; use 10-volt scale, steps 4 and 5.

3. Connect a meter (20,000 ohms/volt) from pin 1 of limiter tube V4 (6AU6) to ground in series with a resistor of 200,000 ohms. The resistor must be connected directly to the grid pin to minimize capacity loading and to isolate the i-f signal from the meter. Keep input signal so that meter indicates not more than 1 volt with VTVM or 5 microamps through 200,000 ohms with standard meter.

4. Use 400 cycle modulation.

5. Connect standard output meter across speaker voice coil, turn volume control full on and keep signal down so that output meter indicates not more than ½ watt output.

6. For alignment of the AM oscillator and RF trimmer, the signal should be inductively coupled to the loop antenna of the receiver by connecting a four turn, six inch diameter loop of wire across the signal generator terminals, and then locate the loop about one foot from the radio loop antenna which should be kept at the same distance and position (relative to the chassis) as it is mounted in the cabinet. To prevent possible errors in peak readings, the position of the loop in respect to the radio loop should not be changed during any set of adjustments.

7. In order to align the first FM i-f transformer T1, it is necessary to disconnect the copper strap from the band switch to pin 7 of converter tube 6BE6 (V1) by unsoldering the strap from the tube pin connection. Resolder the strap after T1 is aligned.

8. When tuning the secondary of the discriminator transformer T6, three minimum points will be obtained of which the center one is the correct setting. As the transformer is tuned either side of 10.7 mc, the meter reading should increase.

9. Termination impedance of signal generator should be 300 ohms.

10. When detuning the signal generator in step 4, two maximum readings will be obtained, one on each side of 10.7 mc. The primary of the discriminator transformer T6 should be aligned for maximum when the signal generator is tuned to the smaller of these two peaks.

11. Make all chassis connections for FM i-f alignment as short as possible. In step 9 connect the ground side of the signal generator at the chassis ground in the center of the 6BE6 socket using a short ground connection.

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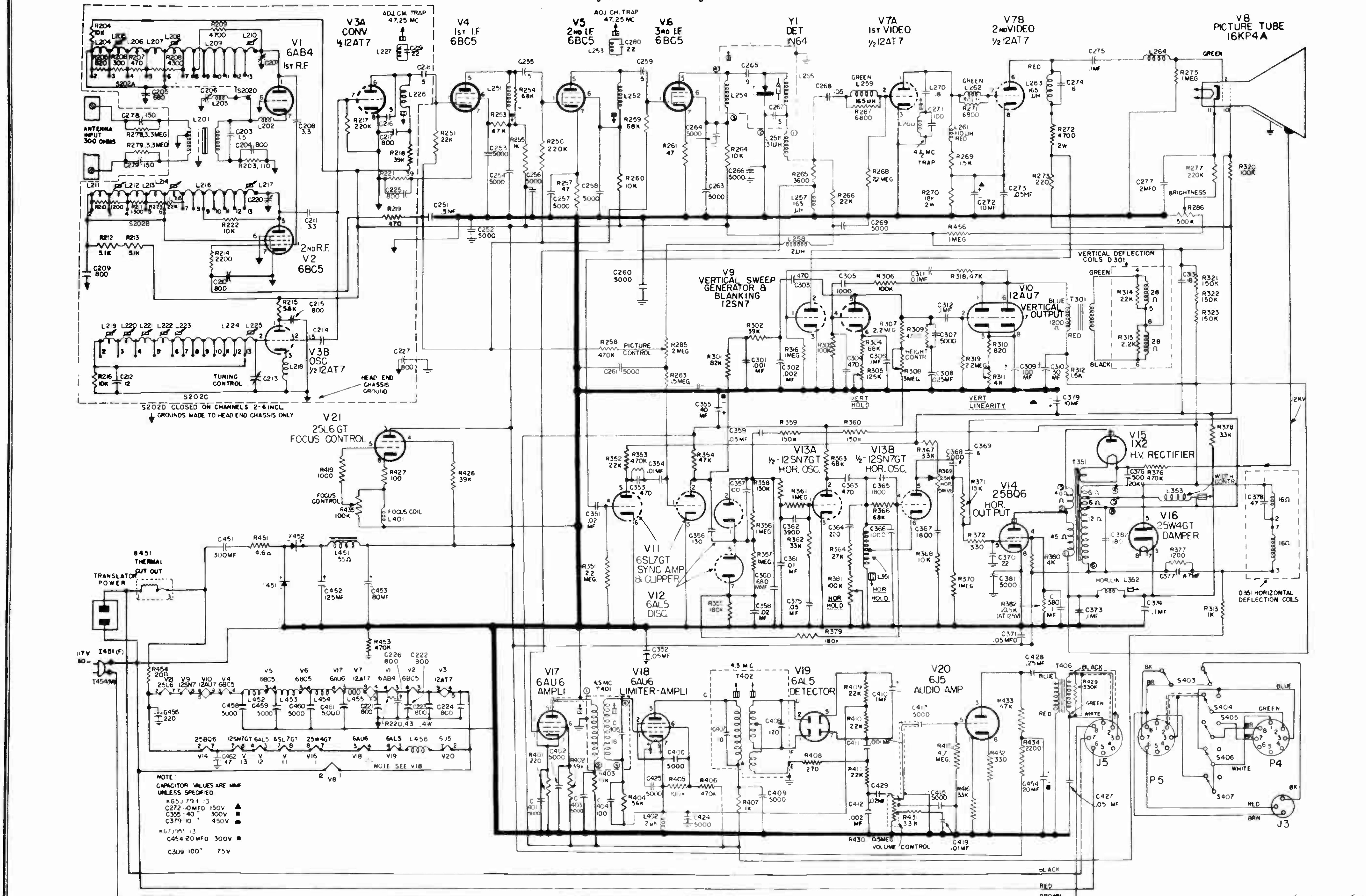
Fig. 34. Schematic Diagram—Model 16K1



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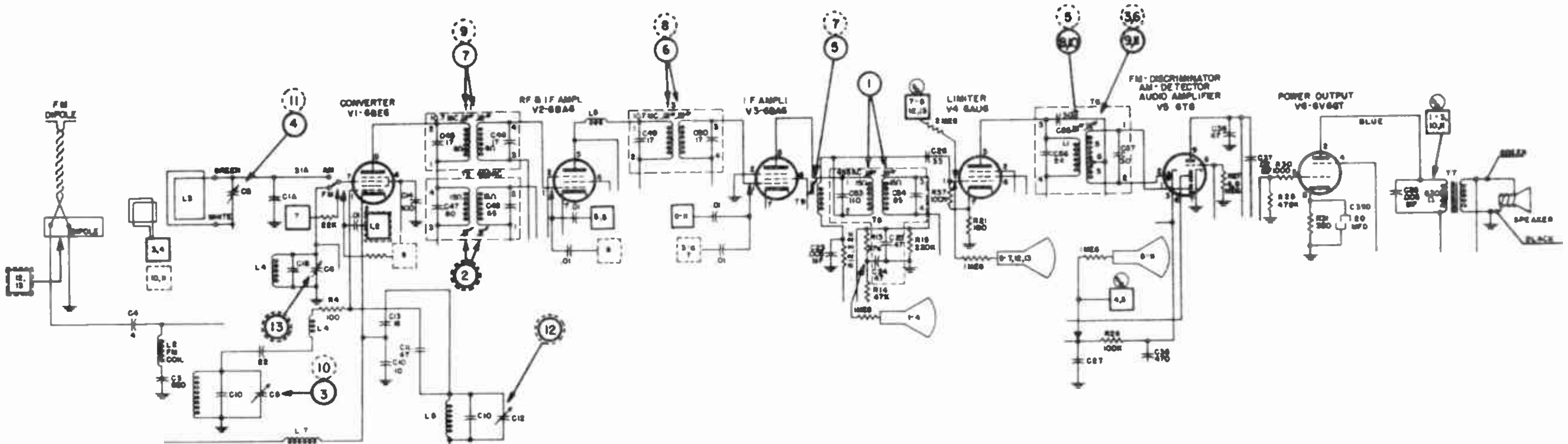

Fig. 38. Alignment Diagram 16K1, Radio Chassis

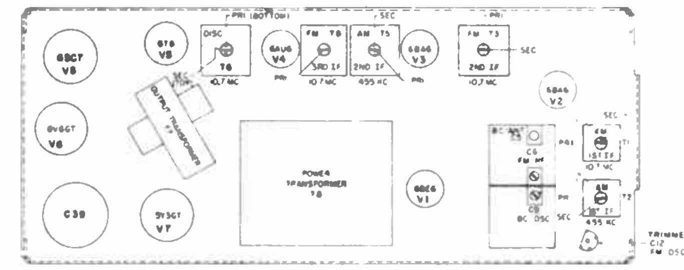

Fig. 39. Tube and Trimmer Location (Radio Chassis)

METER ALIGNMENT CHART

Step No.	Signal Generator Frequency	Signal Input Point	Band Switch	Dial Setting	Adjust	See Note
		AM-IF ALIGNMENT				
1	455 KC	6BE6 grid (Pin 7 of V1) thru .01 mfd.	AM	550 KC	Primary and secondary cores of T5 for max.	4, 5
2					Primary and secondary cores of T2 for max.	
		FM DISCRIMINATOR ALIGNMENT				
3	10.7 MC	6BA6 grid (Pin 1 of V3) thru .01 mfd.	FM		T6 secondary core for minimum	4, 5, 8
4	See Note 10.				Detune signal generator to point of max. meter reading.	1, 2, 10
5					T6 primary for maximum.	
6	Repeat Step 3					
		FM-IF ALIGNMENT				
7	10.7 MC unmodulated	6BA6 grid (Pin 1 of V3) thru .01 mfd.	FM		Core of T9 for max.	1, 3, 11
8		6BA6 grid (Pin 1 of V2) thru .01 mfd.			Primary and secondary cores of T3 for max.	
9		6BE6 grid (Pin 1 of V1) thru 22K resistor.			Primary and secondary cores of T1 for max.	1, 3, 7, 11
		AM-RF ALIGNMENT				
10	1620 KC	Inductively coupled.	AM	C1 completely open.	Adjust C9 for max.	4, 5, 6
11	1500 KC			For max. output.	Adjust C5 for max. while rocking generator. Set pointer to 1500 KC.	
		FM-RF ALIGNMENT				
12	108 MC unmodulated.	Dipole terminals	FM	C1 completely open.	Adjust C12 for max.	1, 3, 6, 9
13	108 MC unmodulated.			For max. output.	Adjust C6 for max. while rocking generator.	

VISUAL ALIGNMENT CHART

Step No.	Signal Generator Frequency	Signal Input Point	Band Switch	Dial Setting	Connect Oscilloscope Between	Adjust	See Note
			AM-IF ALIGNMENT				
1	455 KC ±20 KC at 60 cps sweep rate	Grid of V1 (6BE6) pin 1 thru .01 mf. capacitor.	AM		Junction C24, R13 and R14 thru 1 meg. & chassis.	Cores of T5 for max. ampl. & symmetry.	
2						Cores of T2 for max. ampl. & symmetry.	
			AM-RF ALIGNMENT				
3	1620 KC AM mod. with 60 cps	Inductively coupled.	AM	C1 completely open. Min. cap.	Junction C24, R13 and R14 thru 1 meg. & chassis.	C9 for steepest slope of straight line trace.	4
4	1500 KC ±20 KC at 60 cps sweep rate.			For max. ampl. of curve.		C5 for max. ampl. & symmetry.	2, 3, 4
			FM-IF ALIGNMENT				
5	10.7 MC ±300 KC at 60 cps sweep rate.	Grid of V2 (6BA6), pin 1, thru .01 mf. cap.	FM		Grid of V4 (6AU6) pin 1 thru 1 meg. and chassis.	Core of T9 for max. ampl. & symmetry.	6
6						Cores of T3 for max. ampl. & symmetry.	6, 7
7		Grid of V1 (6BE6), pin 1, thru 22K ohm resistor.				Cores of T1 for max. ampl. & symmetry.	6, 7
			FM DISCRIMINATOR ALIGNMENT				
8	10.7 MC ±300 KC sweep rate.	Grid of V3 (6BA6), pin 1, thru .01 mf. cap.	FM		Junction of C27 and R26 thru 1 meg. and chassis	Prim. of T6 for max. ampl.	
9						Sec. of T6 for equal ampl. & symmetry of pos. & neg. peaks	6
10						Recheck step 8.	
11						Recheck step 9.	
			FM-RF ALIGNMENT				
12	108 MC AM mod. with 60 cps.	Dipole terminals.	FM	C1 completely open. Min. cap.	Grid of V4 (6AU6), pin 1, thru 1 meg. and chassis.	C12 for steepest slope of straight line trace.	1
13	98 MC ±300 KC at 60 cps sweep rate.			For max. ampl. of curve		C6 for max. ampl. & sym. of curve	1, 2, 3

VISUAL ALIGNMENT

EQUIPMENT REQUIRED FOR VISUAL ALIGNMENT.

1. Signal Generator, AM and FM, G-E Type YGS-3, or equivalent.
2. Oscilloscope, G-E Type ST-2A, or equivalent.
3. Voltmeter, 20,000 ohms/volt.
4. Resistors, 200,000 ohms, ½ watt, and 1 megohm, ½ watt.
5. Paper Capacitor, .01 mf.

NOTES FOR VISUAL ALIGNMENT.

1. The termination resistance of the signal generator should be 300 ohms to match the input impedance of this receiver for FM r-f alignment.

2. In some cases tuning of the converter grid will cause "pulling" of the oscillator producing a change in the oscillator frequency.

3. If peaking of C5 on AM alignment or C6 on FM alignment causes the curve to move off the screen after centering, it will be necessary to recalibrate the oscillator as in steps 3 and 12.

4. For alignment of the AM oscillator and r-f trimmers, the signal should be inductively coupled to the loop antenna of the radio receiver by connecting a four turn, six inch diameter loop of bell wire across the signal generator terminals, and then locate this loop about one foot from the radio loop antenna which should be kept at the same distance and position relative to the chassis as it is mounted in the cabinet. To prevent possible errors in peak readings, the position of the loop with respect to the radio loop should not be changed during any one set of adjustments.

5. When using a sweep signal, it is necessary to apply the same sweep voltage to the horizontal plates of the oscilloscope which is used to sweep the r-f frequency.

It may be necessary to use an RF phase shift network to properly phase the input to the scope. This may be done by shunting a capacitor of .005 mf. across the horizontal plate terminals of the scope and by using a ½ megohm potentiometer in series with the high side of the horizontal sweep voltage line. Adjust the potentiometer to superimpose the retrace on the trace.

6. Make all chassis connections for FM i-f alignment as short as possible. In step 7 connect the ground side of the signal generator at the chassis ground at the center pin of the 6BE6 socket (V1).

7. To align the 1st i-f FM transformer T1, it is necessary to disconnect the copper strap from pin 7 of converter tube V1 (6BE6) to the band switch by unsoldering it from the tube pin; resolder strap after aligning T1.

8. If slight distortion is encountered on weak FM stations, it may be necessary to increase the FM-IF bandwidth to a minimum of 120 kc or a maximum of 140 kc width at 50% of peak amplitude. This should be done by stagger tuning T3 only. The amplitude of the video IF response should not be reduced more than 20%. Use a signal generator accurately calibrated to supply markers for the bandwidth measurement.

In order to stagger tune transformer T3, use a sweep voltage as in step 7. Connect a scope as in note 1, then turn the primary transformer T3 (bottom core) slightly clockwise and turn the secondary of T3 (top core) counterclockwise to center the 10.7 mc marker at the peak of the curve and check bandwidth according to specification given.

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MODELS 16K1 & 16K2

REPLACEMENT PARTS LIST

Cat. No.	Symbol	Description
*UCC-035	C301, 411	CAPACITOR—.001 mfd., 600 v., paper
*UCC-036	C302, 412	CAPACITOR—.002 mf., 600 v., paper
*UCC-040	C354	CAPACITOR—.01 mfd., 600 v., paper
*UCC-041	C351, 358	CAPACITOR—.02 mf., 600 v., paper
*UCC-045	C273, 352, 359, 375	CAPACITOR—.05 mf., 600 v., paper
*UCC-048	C275, 373, 374, 312, 380	CAPACITOR—.1 mf., 600 v., paper
*UCC-050	C277, 428	CAPACITOR—.2 mf., 600 v., paper
*UCC-052	C251, 377	CAPACITOR—.5 mf., 600 v., paper
*UCG-1005	C216, 218, 255, 259, 267	CAPACITOR—5 mmf., 500 v., silver mica
*UCG-1012	C280, 370	CAPACITOR—22 mmf., 500 v., silver mica
*UCG-1036	C353, 364	CAPACITOR—220 mmf., silver mica
*UCG-2006	C212	CAPACITOR—12 mmf., 500 v., silver mica
*UCG-2010	C270, 405	CAPACITOR—18 mmf., silver mica
*UCG-2030	C408	CAPACITOR—120 mmf., silver mica
*UCU-020	C274	CAPACITOR—6 mmf., 500 v., silver mica
*UCU-028	C357, 404	CAPACITOR—100 mmf., 500 v., mica
*UCU-036	C456	CAPACITOR—220 mmf., 500 v., silver mica
UCU-532	C278, 279	CAPACITOR—150 mmf., 500 v., mica
*UCU-1044	C303, 304, 363	CAPACITOR—470 mmf., 500 v., mica
*UCU-1052	C366	CAPACITOR—1000 mmf., 500 v., ±10% mica
*UCU-1520	C462	CAPACITOR—47 mmf., 500 v., mica
*UCU-1528	C271	CAPACITOR—100 mmf., 500 v., mica
*UCU-2004	C407	CAPACITOR—10 mmf. ±5%
*UCU-2031	C356	CAPACITOR—130 mmf., 500 v., mica
*UCW-032	C278, 279	CAPACITOR—150 mmf., 300 v., ceramic
*UJB-001		TERMINAL STRIP
*UJB-014		TERMINAL STRIP—4 terminals
*UJB-016		TERMINAL STRIP—6 terminals
*UJB-017		TERMINAL STRIP—2 terminals
*URD-015	R221	RESISTOR—39 ohms, ½ w.
*URD-017	R257, 261	RESISTOR—47 ohms, ½ w., carbon
URD-025	R427	RESISTOR—100 ohms, ½ w., carbon
*URD-033	R273, 401	RESISTOR—220 ohms, ½ w., carbon
*URD-035	R408	RESISTOR—270 ohms, ½ w., carbon
URD-037	R372, 432	RESISTOR—330 ohms, ½ w., carbon
*URD-041	R219	RESISTOR—470 ohms, ½ w., carbon
*URD-045	R432	RESISTOR—680 ohms, ½ w., carbon
*URD-047	R205	RESISTOR—820 ohms, ½ w., carbon
*URD-049	R255, 407, 419	RESISTOR—1000 ohms, ½ w., carbon
*URD-051	R210, 377	RESISTOR—1200 ohms, ½ w., carbon
*URD-053	R269	RESISTOR—1500 ohms, ½ w., carbon
*URD-057	R214, 314, 315	RESISTOR—2200 ohms, ½ w., carbon
*URD-065	R309	RESISTOR—4700 ohms, ½ w., carbon
*URD-073	R222, 403, 368	RESISTOR—10,000 ohms, ½ w., carbon.
*URD-077	R371	RESISTOR—15,000 ohms, ½ w., carbon
*URD-081	R266, 411, 251	RESISTOR—22,000 ohms, ½ w., carbon
*URD-083	R364	RESISTOR—27,000 ohms, ½ w., carbon
*URD-085	R362, 416	RESISTOR—33,000 ohms, ½ w., carbon
RAB-141		BACK—Cabinet back, tel. compartment.
RAC-084		COVER—Changer pan
RAD-056		DOOR—Knob door
RAP-022		PLATE—Tuner chassis front plate
RAV-138		CABINET—Model 16K1 less overlay, safety glass and rubber channels
RAV-139		CABINET—Model 16K2 (blonde) less overlay, safety glass and rubber channels
*RCC-101	C308	CAPACITOR—.025 mfd., 600 v., paper
*RCC-102	C359	CAPACITOR—.05 mf., 600 v., paper
*RCC-103	C306	CAPACITOR—.1 mf., 200 v.
*RCC-104	C373	CAPACITOR—.1 mf., 600 v., paper
*RCC-105	C375	CAPACITOR—.05 mf., 200 v., paper
*RCE-090	C410	CAPACITOR—1 mf., 50 v., electrolytic
*RCE-092	C310	CAPACITOR—30 mf., 450 v., electrolytic
*RCE-100	C379, 355, 272	CAPACITOR—10 mf., 450 v., 40 mf., 300 v., 10 mf., 150 v., electrolytic
*RCE-110	C451	CAPACITOR—300 mf., 150 v., electrolytic
*RCE-111	C452	CAPACITOR—125 mf., 350 v., electrolytic
*RCE-112	C453	CAPACITOR—80 mf., 300 v., electrolytic
*RCE-115	C454, 309	CAPACITOR—10 mf., 350 v., 50 mf., 100 v., 100 mf., 75 v., electrolytic
RCE-118	C272, 355, 379	CAPACITOR—10 mf., 450 v., 40 mf., 300 v., 10 mf., 150 v., electrolytic
*RCN-018	C354, 419	CAPACITOR—.01 mf., 600 v., paper, molded
*RCN-025	C361	CAPACITOR—.01 mf. ±10%, 600 v.
*URD-087	R302, 402	RESISTOR—39,000 ohms, ½ w., carbon
*URD-089	R253, 354, 318	RESISTOR—47,000 ohms, ½ w., carbon
*URD-091	R404	RESISTOR—56,000 ohms, ½ w., carbon
*URD-093	R254, 259, 304, 366	RESISTOR—68,000 ohms, ½ w., carbon
*URD-095	R301	RESISTOR—82,000 ohms, ½ w., carbon
*URD-101	R358	RESISTOR—150,000 ohms, ½ w., carbon
*URD-103	R379, 355	RESISTOR—180,000 ohms, ½ w., carbon
*URD-105	R217, 277	RESISTOR—220,000 ohms, ½ w., carbon
URD-109	R429	RESISTOR—330,000 ohms, ½ w., carbon
*URD-113	R258, 406, 453	RESISTOR—470,000 ohms, ½ w., carbon
*URD-121	R275, 353, 356, 357, 316, 361, 370, 456	RESISTOR—1 meg., ½ w., carbon.
*URD-125	R263	RESISTOR—1.5 meg., ½ w., carbon
*URD-129	R268, 351, 307, 319	RESISTOR—2.2 meg., ½ w., carbon
*URD-133	R278, 279	RESISTOR—3.3 meg., ½ w., carbon
*URD-137	R415	RESISTOR—4.7 meg., ½ w., carbon
URD-1026	R203	RESISTOR—110 ohms, ½ w., carbon
*URD-1052	R211	RESISTOR—1300 ohms, ±5%, ½ w., carbon
*URD-1062	R265	RESISTOR—3600 ohms, ±5%, ½ w., carbon
*URD-1064	R208	RESISTOR—4300 ohms, ±5%, ½ w., carbon
*URD-1073	R216	RESISTOR—10,000 ohms, ±5%, ½ w., carbon
*URD-1081	R409, 410	RESISTOR—22,000 ohms, ±5%, ½ w., carbon
*URD-1097	R303, 306, 320, 405	RESISTOR—100,000 ohms, ½ w., carbon
*URE-049	R313	RESISTOR—1000 ohms, 1 w., carbon
*URE-061	R378	RESISTOR—3300 ohms, 1 w., carbon
*URE-063	R312	RESISTOR—1500 ohms, 1 w., carbon
*URE-067	R215	RESISTOR—5600 ohms, 1 w., carbon
*URE-073	R204	RESISTOR—10,000 ohms, 1 w., carbon.
*URE-081	R352	RESISTOR—22,000 ohms, 1 w., carbon
*URE-085	R367	RESISTOR—33,000 ohms, 1 w., carbon.
*URE-087	R218	RESISTOR—39,000 ohms, 1 w., carbon.
URE-089	R433	RESISTOR—47,000 ohms, 1 w., carbon.
*URE-093	R363	RESISTOR—68,000 ohms, 1 w., carbon.
*URE-101	R359, 360, 321, 322, 323	RESISTOR—150,000 ohms, 1 w., carbon.
*URE-113	R376	RESISTOR—470,000 ohms, 1 w., carbon.
*URE-1047	R310	RESISTOR—820 ohms, ±5%, 1 w., carbon
*URE-1066	R212, 213	RESISTOR—5100 ohms, ±5%, 1 w., carbon
URF-033	R452	RESISTOR—220 ohms, 2 w., carbon
*URF-045	R432	RESISTOR—680 ohms, 2 w., carbon
*URF-065	R272	RESISTOR—4700 ohms, 2 w., carbon
URF-073	R260, 264	RESISTOR—10,000 ohms, 2 w., carbon.
*URF-079	R270	RESISTOR—18,000 ohms, 2 w., carbon.
URF-113	R453	RESISTOR—470,000 ohms, 2 w.
1N64		DIODE—Crystal diode
P15		RECORD CHANGER—3 speed changer
*S1212D-7		SPEAKER—12-inch PM speaker
*RCN-029	C265	CAPACITOR—9 mmf., silver mica.
RCN-030	C311	CAPACITOR—.01 mf., 1000 v. molded
*RCN-033	C365, 367	CAPACITOR—1800 mmf., 600 v., paper.
*RCN-034	C362	CAPACITOR—3900 mmf. ±10%, 600 v., paper
RCN-035	C376	CAPACITOR—500 mmf., 20,000 v., high voltage capacitor
*RCU-286	C369	CAPACITOR—6 mmf., 800 v., mica
*RCU-290	C305	CAPACITOR—1000 mmf., 1000 v., mica
*RCU-293	C313	CAPACITOR—18 mmf., 1500 v., mica
*RCU-294	C360	CAPACITOR—680 mmf. ±20%, 500 v., mica.
*RCU-296	C382	CAPACITOR—180 mmf., 1500 v., mica
*RCW-1056	C203, 214	CAPACITOR—1.5 mmf., ±0.25 mmf.
*RCW-1076	C208, 211	CAPACITOR—3.3 mmf., ±0.25 mmf.
*RCW-3014	C252, 253, 254, 256, 257, 258, 260, 261, 263, 264, 266, 269, 307, 368, 381, 401, 402, 403, 406, 409, 415, 417, 424 425, 455 460, 461	CAPACITOR—5000 mmf., 450 volt, ceramic.
*RCW-3027		CAPACITOR—680 mmf., ceramic
RCW-3035	C214	CAPACITOR—1.5 mmf., 500 v., ceramic
*RCW-3037	C204, 209, 210, 215, 217, 221, 222, 223, 224, 225, 226	CAPACITOR—800 mmf., 350 v., ceramic
*RCY-048	C207	CAPACITOR—Trimmer.
*RCY-059	C213	CAPACITOR—Trimmer.
*RCY-060	C206	CAPACITOR Trimmer for high channel trap
RCY-063	C220	CAPACITOR—Trimmer.
*RDB-019		BUTTON—Pushbutton (ON-OFF), 16K1
RDB-023		BUTTON—Pushbutton, for 16K2
*RDC-032		CORD—For tuning control.
*RDE-077		OVERLAY—Metal mask
RDE-096		ESCUTCHEON—For radio compartment
RDE-103		ESCUTCHEON—For television compartment
*RDK-212		PULL—Phono drawer pull
RDK-213		KNOB—Radio knob
RDK-214		KNOB—Radio knob with arrow
RDK-222		KNOB—Tuning control.
RDK-223		KNOB—Volume control
RDK-224		KNOB—For selector switch
RDK-225		KNOB—Picture control
RDK-226		KNOB—For brightness & vertical hold
RDK-227		KNOB—For focus and horizontal hold.
*RDW-040		GLASS—Safety glass
REC-006		CAP—For high voltage rectifier
*REI-014		CORE—Brass screw for L210, L217
*REI-016		CORE—Iron core for L254
*RER-008	X451, 452	RECTIFIER—Selenium, 350 ma.
*RET-003		TRAP—Ion trap
RHC-008		CLIP—1-inch for mounting electrolytic.
*RHC-024		CLIP—For mounting electrolytic
RHC-036		CLIP—For knob door pin spring
RHG-004		GROMMET—5/16 in. for chassis
RHG-010		GROMMET—Shock mounting
RHG-013		GROMMET—For speaker
RHG-030		GROMMET—½ inch for voltage shield
RHG-031		GROMMET—Chassis grommet
RHN-014		WING NUT—No. 8-32.
*RHS-045		SCREW—Headless for L223, L205, L208
*RHS-046		SCREW—Headless for L219, L220, L221, L222
RHS-050		SCREW—Hex. Head screw
RHS-051		SCREW—Round H for television chassis mounting
RHS-052		SCREW—R. H. Philips for phono slide mounting
RHS-053		SCREW—Hex H. for radio chassis mounting
RHS-056		SCREW—Flat H. for phono slide mounting
RHS-057		SCREW—For cabinet back and loop
RHS-058		SCREW—For radio and television escutcheon
RHS-059		SCREW—Round head Philips for television top escutcheon
RHS-060		SCREW—Self tapping for pushbutton switch
RHY-020		DOOR PULL—Small, for 16K1
RHY-21		DOOR PULL—Large, for 16K1
RHY-022		DOOR PULL—Small, for 16K2
RHY-023		DOOR PULL—Large, for 16K2
*RII-021		INSULATOR—For mounting control
*RII-023		INSULATOR—For yoke
*RII-026		INSULATOR—Grommet in high voltage shield
RII-038		GUIDE—Insulating guide
*RII-041		INSULATOR—For mounting rectifier.
*RII-044		SUPPORT—For power cord
*RJC-013	J3	PLUG—(Eby) for connection to radio chassis
*RJC-018		CONNECTOR—High voltage anode connector
RJJ-003	J5	CONNECTOR—(Plug, female)
RJJ-008		RECEPTACLE—Power receptacle
RJJ-010		RECEPTACLE—For power cord
RJP-003		PLUG—AC power plug
RJP-004		PLUG—Phono plug
*RJP-008	P4, P5	PLUG—Amphenol octal plug
*RJS-003		SOCKET—Octal tube socket for V11, V9, V20
RJS-004		PLATE—For electrolytic condenser
*RJS-024		PLATE—Mounting plate for elec. cond.
*RJS-026		SOCKET—Tube socket, octal, for V21
*RJS-031		SOCKET—Tube socket for V14
*RJS-085		SOCKET—Tube socket for V16
*RJS-127		SOCKET—Tube socket, 9-pin, for V3
*RJS-132		SOCKET—Tube socket, 7-pin, for V12, V19
*RJS-133		SOCKET—Tube socket, 7-pin, shielded, for V5, V6, V18
*RJS-135		SOCKET—Shock mounting for V13.
*RJS-138		SOCKET—Tube socket, 9 pin, for V7 miniature
*RJS-139		SOCKET—Tube socket, 9 pin, for V10
*RJS-144		SOCKET—Tube socket, 7 pin, for V4, V17
RJS-148		SOCKET—Tube socket for high voltage rectifier
RJS-149		SOCKET—Tube socket for V1 and V2
RJS-150		SHELL—Connector shell for P5
*RJX-043		R-F HEAD-END—R-F tuner, aligned & incl. tubes
*RLA-036	L201	TRANSFORMER—Input transformer.
*RLC-091	L351	COIL—Horizontal oscillator
*RLC-095	L219	COIL—Oscillator coil, Channel #2
*RLC-096	L220, 214, 207	COIL—Oscillator coil for Channel #3, 1st and 2nd R-F Channel #5
*RLC-097	L222	COIL—Oscillator for Channel #5
*RLC-098	L223	COIL—Oscillator for Channel #6
*RLC-099	L225	COIL—Oscillator for Channel #13
*RLD-014	L353	COIL—Width control
*RLD-016	L352	COIL—Horizontal linearity
RLD-025	D301, 351	YOKE—Deflection yoke
*RLF-024	L256	CHOKE COIL—R-F coil, 31 uh
RLF-039	L401	COIL—Focus coil
*RLI-003	L218	COIL—Cathode choke
*RLI 006	L202	COIL—Coil choke
*RLI-038	L257, 263	COIL—Video choke coil, 165 uh.
*RLI-072	L206, 212	COIL—1st R-F Channel #4, 2nd R-F Channel #3
*RLI-077	L205	COIL—1st R-F Channel #3
*RLI-093	L259, R262	COIL—Video choke, 165 uh.
*RLI-096	L251	COIL—2nd video I-F coil
*RLI-097	T401	COIL—1st audio I-F coil
*RLI-099	L221	COIL—Oscillator coil, Channel #4
*RLI-100	L260, 270, 271	TRAP—4.5 mc video trap
*RLI-108	L261	CHOKE—Video choke, 110 uh.
*RLI-109	L264	CHOKE—Video choke.
*RLI-110	L252, 253	COIL—I-F coil
*RLI-114	L203	COIL—Trap coil.
*RLI-116	L208, 215	COIL—1st and 2nd R-F, Channel #6
*RLI-117	L204	COIL—Channel #2, 1st R-F
*RLI-118	L213	COIL—2nd R-F, Channel #4
*RLI-119	L211	COIL—2nd R-F, Channel #2.
*RLI-120	L210	COIL—1st R-F, Channel #13
*RLI-121	L217	COIL—2nd R-F Channel #13.
*RLI-122	L258, 452, 453, 402, 454, 455, 456	COIL—Heater choke, 2 uh.
RLL-040		LOOP—AM loop assembly
*RLP-016	L226, 227	COIL—Converter plate
RLX-029	L254, 255, 1N64, C265, 267	VIDEO DETECTOR ASSEMBLY—With crystal
*RMC-017		CLIP—⅜ in. for electrolytic
RMC-051		CLAMP—For yoke
RMM-146		SHIELD—Socket shield on V2
*RMM-147		TUBE CUSHION—Under pix tube, 2 required
*RMM-148		TUBE CUSHION—Front pix tube, 1 required
*RMM-149		TUBE CUSHION—Top pix tube, under tube support brackets, 2 required
RMM-151		RUBBER—Channel rubber
*RMM-153		SLIDE—For record changer
RMM-155		CUSHION—For safety glass
RMR-009		CASTERS—Casters with sleeves
*RMS-130		SPRING—Tension spring for tuning control cord
*RMS-220		CLIP—Spring grounding clip, contacts pix tube
RMS-221		SPRING—Stabilizer spring
RMS-222		SPRING—Right-hand spring for knob door
RMS-223		SPRING—Left-hand spring for knob door
*RMU-055		EXTENSION SHAFT—For L352 and L353
RMU-065		SHAFT—Insulator shaft
RMX-169		PULLEY AND HUB ASSEMBLY.
RQB-001		BRUSH—For pickup styli
*RRC-096	R308	POTENTIOMETER—Vertical size, 3 meg.
*RRC-127	R311	POTENTIOMETER—Vertical linearity, 4000 ohms, 2 w.
*RRC-140	R369	POTENTIOMETER—Horizontal drive, 25,000 ohms
RRC-144	R435, 286	POTENTIOMETER—Focus and brightness
RRC-146	R381, 305	POTENTIOMETER—Dual Hor. (100K) and Vert. Hold (125K).
RRC-147	R430, 285	POTENTIOMETER—Dual control, volume
*RRW-048	R451	RESISTOR—4.6 ohms, 5 w., w.w.
*RRW-049	R220	RESISTOR—43 ohms, 4 w.
*RRW-051	R454	RESISTOR—20 ohms, Globar, temperature compensating.
*RRW-052	R382	RESISTOR—10,500 ohms, Globar, voltage sensitivity resistance
RRW-053	R380	RESISTOR—4000 ohms, 7 w., w.w.
*RSR-002	B451	CUT-OUT—Thermal cut-out
RSW-082		SWITCH—Channel selector switch
RSW-083	S403, 407	SWITCH—Pushbutton switch
*RTD-008	T402	TRANSFORMER—Ratio detector
*RTL-096	L451	REACTOR—Filter reactor
RTM-005	T406	TRANSFORMER—Interstage
*RTO-064	T301	TRANSFORMER—Vertical sweep output transformer
RTO-090	T351	TRANSFORMER—Horizontal output transformer
*RWL-027	I452	POWER CORD AND FEMALE PLUG
RWX-030		OCTAL CABLE ASSEMBLY
RXW-034		SOCKET—Picture tube socket assembly

*Parts used on previous models.

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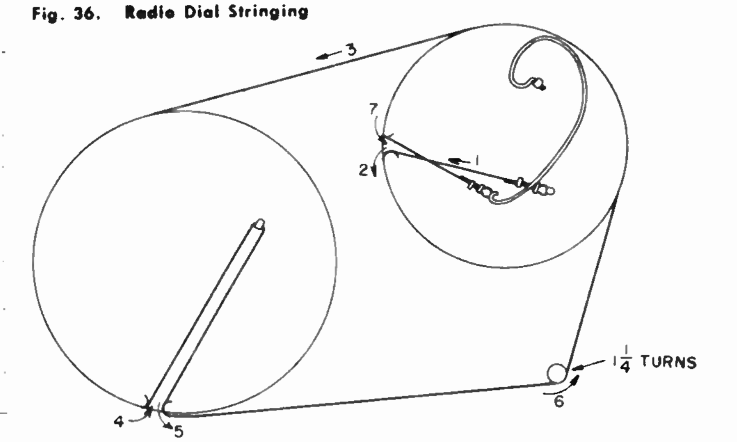
MODELS 16K1 AND 16K2

REPLACEMENT PARTS LIST FOR RADIO CHASSIS

Cat. No.	Symbol	Description
*UCC-035	C34	CAPACITOR—.001 mf., 600 v., paper.
*UCC-036	C19	CAPACITOR—.002 mfd., 600 v., paper
*UCC-037	C31	CAPACITOR—.003 mfd., 600 v., paper
*UCC-039	C23, 30, 32	CAPACITOR—.005 mfd., 600 v., paper.
*UCC-040	C15, 28, 33, 45	CAPACITOR—.01 mfd., 600 v., paper.
*UCC-041	C21, 37	CAPACITOR—.02 mfd., 600 v., paper.
*UCC-045	C29, 40, 41, 42, 44	CAPACITOR—.05 mfd., 600 v., paper.
*UCU-001	C4	CAPACITOR—4 mmfd., 500 v., mica
*UCU-016	C26	CAPACITOR—33 mmfd., 500 v., mica
*UCU-020	C2, 36	CAPACITOR—47 mmfd., 500 v., mica
*UCU-044	C35	CAPACITOR—470 mmfd., 500 v., mica
*UCU-1036	C27	CAPACITOR—220 mmfd., 500 v., mica
UJB-004		STRIP—Terminal strip for antenna
*URD-025	R4, 10, 38	RESISTOR—100 ohms, ½ w., carbon
*URD-031	R21	RESISTOR—180 ohms, ½ w., carbon
*URD-049	R30	RESISTOR—1000 ohms, ½ w., carbon
*RCC-059	C38	CAPACITOR—.005 mf.—1000 v.
*RCE-039	C39A, 39B, 39C, 39D	CAPACITOR—Electrolytic capacitor
RCE-068	C43	CAPACITOR—Electrolytic capacitor, 10 mf.
RCT-043	C1A, 1B, 1C, 1D	CAPACITOR—Tuning capacitor
*RCW-1043		CAPACITOR—47 mmf., ceramic cap.
*RCW-1047	C14	CAPACITOR—100 mmf., ceramic
*RCW-1053	C8	CAPACITOR—22 mmf., ceramic
*RCW-1060	C7, 10	CAPACITOR—10 mmf., 0-coef., ceramic
*RCW-2031	C13	CAPACITOR—18 mmf., ceramic
*RCW-1043	C11	CAPACITOR—47 mmf., ceramic
RCY-055	C12	CAPACITOR—Trimmer
*RDC-032		DRIVE CORD
RDP-053		POINTER
RDS-099		PLATE—Backplate & dial scale
*RHC-017		COIL CLIP—For mounting L5
*RHC-034		CLIP—For mounting IF can
*RHG-010		GROMMET RUBBER (tube).
*RHG-015		GROMMET—For tuning condenser.
RHI-011		STRAIN RELIEF—On power cord
*RHJ-006		SPACER—For tuning condenser
RII-047		INSULATING WASHER—Under phono jack
RJC-012	P3	PLUG—Chassis power plug
*RJC-019		SPEAKER LEAD PINS
RJJ-003	J4	CONNECTOR—Octal connector
RJP-003	P2	AC POWER PLUG
*RJP-004	P1	PHONO PLUG
*RJP-010	J1	PHONO JACK & PLUG (female)
RJS-003		SOCKET—Tube socket for V6, V7.
RJS-012		MOUNTING PLATE—For electrolytic
*RJS-049	J2	PHONO POWER SOCKET (female).
*RJS-085		SOCKET—Tube socket
RJS-118		SOCKET—Tube socket for V5
*URD-053	R32	RESISTOR—1500 ohms, ½ w., carbon
*URD-057	R7, 12	RESISTOR—2200 ohms, ½ w., carbon
URD-061	R6, 5	RESISTOR—3300 ohms, ½ w., carbon
*URD-069	R49	RESISTOR—6800 ohms, ½ w. carbon
*URD-081	R3, 23	RESISTOR—22,000 ohms, ½ w., carbon
URD-083	R47	RESISTOR—27,000 ohms, ½ w., carbon
*URD-085	R40, 42	RESISTOR—33,000 ohms, ½ w., carbon
*URD-089	R13, 14, 43	RESISTOR—47,000 ohms, ½ w.
*URD-093	R41	RESISTOR—68,000 ohms, ½ w., carbon
*URD-097	R17, 26, 37	RESISTOR—100,000 ohms, ½ w.
*URD-099	R24, 25	RESISTOR—120,000 ohms, ½ w.
*URD-105	R15	RESISTOR—220,000 ohms, ½ w.
*URD-113	R28,29	RESISTOR—470,000 ohms, ½ w.
*URD-121	R20	RESISTOR—1 meg., ½ w.
*URD-129	R16	RESISTOR—2.2 meg., ½ w.
*URD-133	R44, 51	RESISTOR—3.3 meg., ½ w.
*URD-141	R27	RESISTOR—6.8 meg., ½ w.
*URD-1104	R46	RESISTOR—200,000 ohms, ½ w., carbon
URE-037	R31	RESISTOR—330 ohms, 1 w.
RJS-145		SOCKET—Tube socket for V1, V2, V3, V4
RJS-147		PILOT LIGHT SOCKET
RJS-150		SHELL—Connector shell
*RLB-029	L4	COIL—FM R-F coil
*RLC-066	L5	COIL—B-C oscillator coil
*RLC-102	L8	COIL—FM oscillator coil
RLI-044		CHOKE—In FM line
RLI-087	L7	COIL—Choke coil
*RLI-088	L2	CHOKE COIL—FM antenna coil
*RLI-122	L6, 10, 11	CHOKE COIL
RLI-124	L9	CHOKE COIL—FM R-F pl. oscillator cathode
RLL-039	L3	LOOP ASSEMBLY
*RMS-111		SPRING (DIAL CORD)
RMX-171		DRIVE SHAFT AND BUSHING ASSEMBLY
RMX-177		DRUM AND SHAFT ASSEMBLY
RRC-141	R18	VOLUME CONTROL, 2 meg.
*RRT-003	R33, 34	RESISTOR—1220-6500 ohms, 9 w., w.w.
RSW-079	S1A, 1B, 1C, 1D	BAND CHANGE SWITCH
RSW-080	S2A, 2B, 2C, 2D	TONE CONTROL SWITCH
*RTD-010	T6, C55, C56, 57	DISCRIMINATOR TRANSFORMER
*RTL-097	T2, C74, C48	1ST I-F TRANSFORMER—AM
*RTL-098	T5, C25, C24, 53, 54	2ND I-F TRANSFORMER—AM
*RTL-099	T1, 3, C45, 46, 49, 50	1ST, 2ND I-F TRANSFORMER—FM
*RTL-114	T9	FM COIL
RTO-089	T7	OUTPUT TRANSFORMER
RTP-302	T8	POWER TRANSFORMER

*Parts used on previous models.

Fig. 36. Radio Dial Stringing



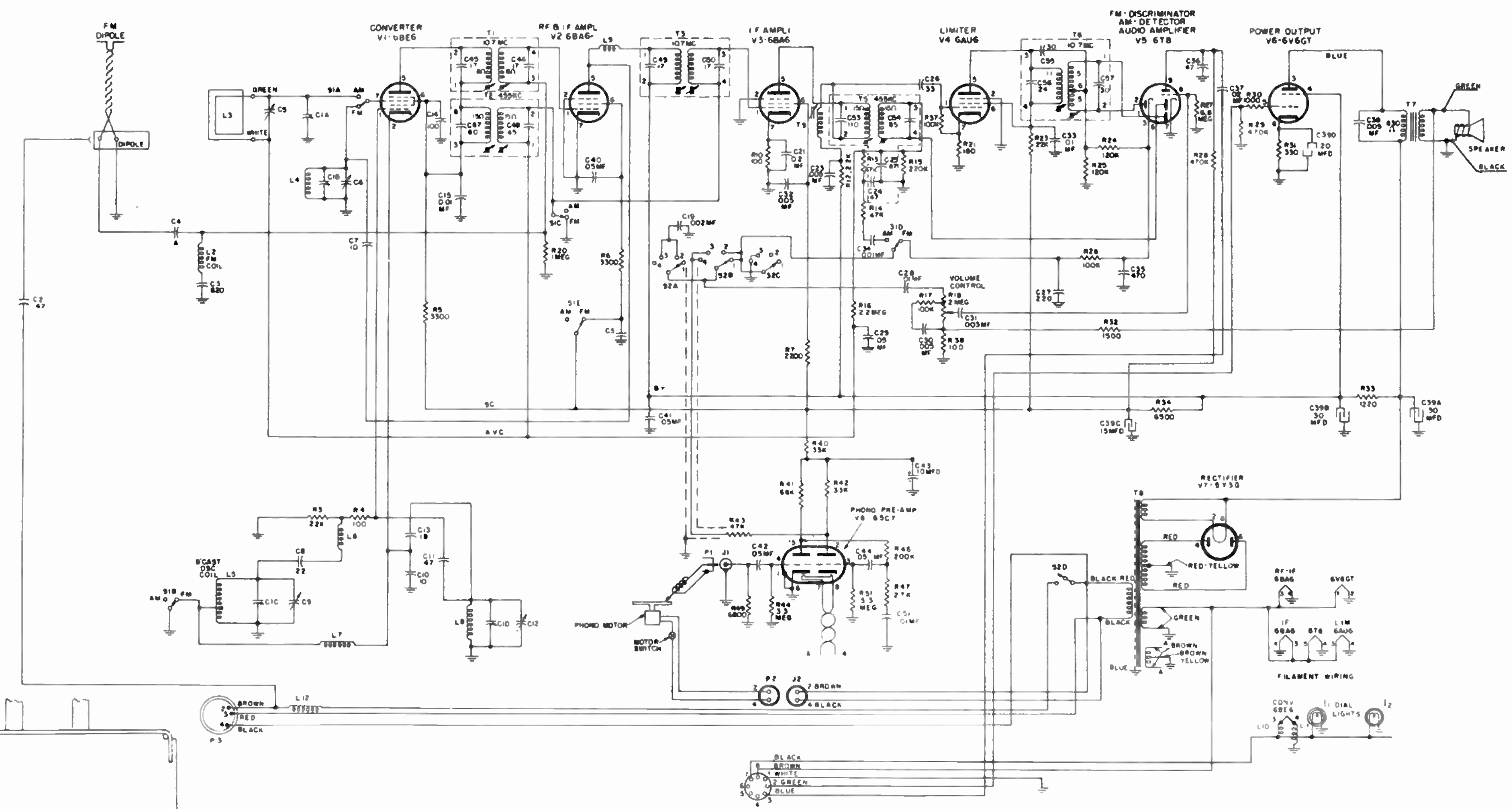
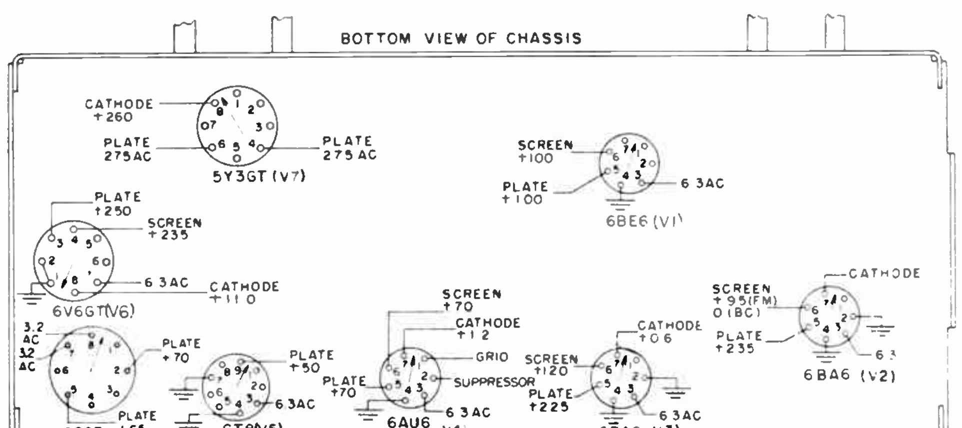


Fig. 37 Socket Voltage Diagram (Radio Chassis)



ALL VOLTAGES MEASURED TO CHASSIS USING A 20,000 OHM PER VOLT METER

Fig. 40. Schematic Diagram, Radio Chassis, Model 16K1

RECORD CHANGER: Model P15, Pages RCD.CH.21-13 through RCD.CH.21-18.

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MODEL 16T1 MAHOG.

MODEL 16T2 BLONDE

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MODEL 16C110 MAHOG.

MODEL 16C111 BLONDE

MODEL 16C115

CAUTION

HIGH VOLTAGES ARE USED IN THE OPERATION OF THIS TELEVISION RECEIVER. THE BACK COVER, WHILE IN PLACE, PREVENTS ACCIDENTAL CONTACT WITH THESE HIGH VOLTAGES AND SHOULD NOT BE REMOVED EXCEPT BY A QUALIFIED TELEVISION TECHNICIAN.

THE PICTURE TUBE IS A HIGH VACUUM TUBE AND, IF BROKEN, PIECES OF GLASS MAY FLY WITH FORCE IN ALL DIRECTIONS. ANY WEAKENING OF THE GLASS, AS MAY BE CAUSED BY CHIPPING, SCRATCHING, OR MORE THAN NORMAL PRESSURE, MAY CAUSE THIS TUBE TO BREAK. THE USE OF SAFETY GLASSES IS RECOMMENDED WHEN IT IS NECESSARY TO REMOVE OR REPLACE THE PICTURE TUBE.

ALWAYS USE AN ISOLATING TRANSFORMER IN THE POWER LINE, WHEN SERVICING THESE RECEIVERS, TO PROTECT TEST EQUIPMENT.

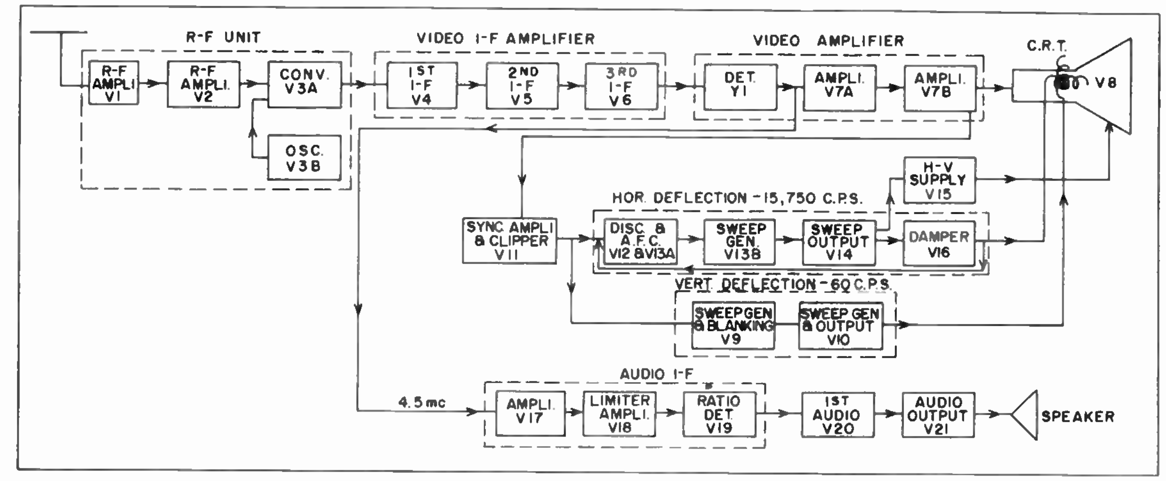

Fig. 1. Block Diagram

SPECIFICATIONS

OVER-ALL DIMENSIONS

Model	Height Inches	Width Inches	Depth Inches
16T1	19¾	17¼	21
16T2	19¾	17¼	21
16C110	35⅞	20⅛	21
16C111	35⅞	20⅛	21
16C115	37⅜	25	22 13/16

ELECTRICAL RATING

Frequency . . . 60 cycles
Voltage . . . 115 v. a-c
Watts . . . 150 watts

INTERMEDIATE FREQUENCIES:

Television video . . . 45.75 MC
Television audio . . . 41.25 and 4.5 MC

AUDIO POWER OUTPUT:

Undistorted . . . 1.0 watt
Maximum . . . 2.0 watts

LOUDSPEAKER:

PM Alnico

	16T1 16T2	16C110 16C111 16C115
Model	16T1, 16T2	16C110, 16C111, 16C115
Cone Diameter Size	5¼ in.	12 in.
Voice Coil Imp. at 400 Cycles	3.2 ohms	3.2 ohms

ANTENNA:

Type . . . Folded dipole, or equivalent
Impedance . . . 300 ohms

R-F FREQUENCY RANGE:

Selector Switch Position	Frequency Range MC	Picture Carrier MC	Sound Carrier MC
No. 2	54–60	55.25	59.75
No. 3	60–66	61.25	65.75
No. 4	66–72	67.25	71.75
No. 5	76–82	77.25	81.75
No. 6	82–88	83.25	87.75
No. 7	174–180	175.25	179.75
No. 8	180–186	181.25	185.75
No. 9	186–192	187.25	191.75
No. 10	192–198	193.25	197.75
No. 11	198–204	199.25	203.75
No. 12	204–210	205.25	209.75
No. 13	210–216	211.25	215.75

TUBES:

Symbol	Purpose	Type
V1	1st RF Amplifier	6AB4
V2	2nd RF Amplifier	6BC5
V3	Converter-Oscillator	12AT7
V4	1st Video IF Amplifier	6BC5
V5	2nd Video IF Amplifier	6BC5
V6	3rd Video IF Amplifier	6BC5
V7	Video Amplifier	12AT7
V8	Picture Tube	16KP4
V9	Vertical Sweep Generator and Blanking	12SN7GT
V10	Vertical Sweep Output	12AU7
V11	Sync Amplifier and Clipper	6SL7GT
V12	Horizontal Frequency Discriminator	6AL5
V13	Horizontal AFC and Sweep Oscillator	12SN7GT
V14	Horizontal Sweep Output	25BQ6
V15	High Voltage Rectifier	1X2
V16	Horizontal Damper Tube	25W4GT
V17	Audio IF Amplifier	6AU6
V18	Audio IF Amplifier-Limiter	6AU6
V19	Audio Detector	6AL5
V20	Audio Amplifier	6SQ7
V21	Audio Output	25L6GT
Y1	Video Detector	1N64

GENERAL INFORMATION

The General Electric Models 16T1, 16T2, 16C110, 16C111, and 16C115 provide reception on all the twelve commercial television channels as specified on page 35 The picture is reproduced on a 16-inch picture tube.

Features of these television receivers include a two stage r-f amplifier, balanced input to the r-f, selenium type rectifiers, intercarrier sound, ratio detector, safe high voltage supply for the picture tube, automatic frequency control for horizontal sweep synchronization and electromagnetic deflection.

The r-f tuner assembly is mounted on a separate chassis which is readily demounted from the main chassis. The coils which tune the 1st and 2nd r-f stages and the oscillator are mounted on individual wafers of the selector switch. The local oscillator V3B operates on the high frequency side of the incoming r-f signal. The picture carrier is converted to a 45.75 mc video i-f frequency, while the FM sound carrier is converted to a 41.25 mc frequency.

The video i-f is stagger tuned to pass the video i-f (45.75 mc) and the (41.25 mc) with the proper amplitude relationship between the two frequencies. The video information is detected by the detector Y1 as well as a 4.5 mc FM signal which is the beat frequency between the video i-f (45.75 mc) and (41.25 mc). The 4.5 mc audio FM is amplified and limited by V17 and V18 and detected by the ratio detector V19. The audio is amplified by V20. V21 is the audio output tube.

The horizontal and vertical sync signals are taken off at the plate circuit of V7B and amplified and separated from the video signal by V11. The vertical sweep is generated by one section of a 12SN7 (V9) and a 12AU7 (V10) connected in a multivibrator circuit. The 12AU7 (V10) also serves as the vertical sweep output tube. The other section of the 12SN7 (V9) is used to produce the vertical retrace blanking signal. The horizontal sync signal is mixed with a sawtooth signal from the plate of the damper tube (V16) by the discriminator (V12). A change in phase between these two signals increases or decreases the bias voltage which is applied to the grid of V13A. V13A is a reactance tube which changes the frequency of the horizontal oscillator V13B. V14 the horizontal sweep output is coupled to the horizontal deflection coils by T351.

V15 is the high voltage rectifier for rectifying the kickback voltage, produced in T351 by the horizontal retrace current, to supply approximately 12 kilovolts to the picture tube high voltage anode.

These receivers use two selenium rectifiers in a half-wave voltage doubler circuit to supply the B+ voltage of approximately 255 volts. The tube filaments are a series parallel connection across the 117 volt a-c line.

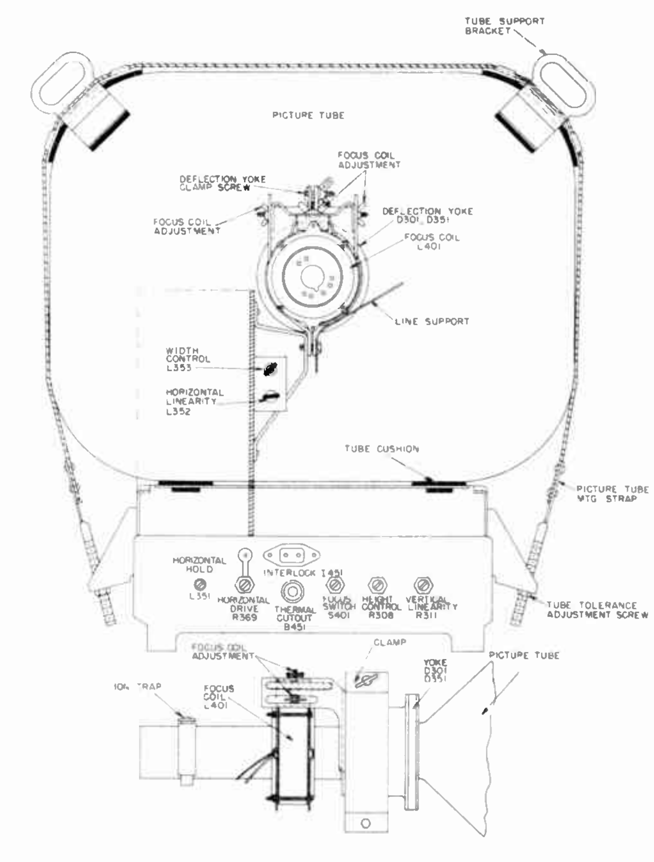

Fig. 2. Preset Controls

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World Radio History

INSTALLATION AND SERVICE ADJUSTMENTS

NOTE: ALWAYS WEAR SAFETY GLASSES WHEN HANDLING PICTURE TUBE

PREPARATION FOR USE

These receivers are shipped with the picture tube installed. Carefully unpack the receiver.

In order to prevent damage to the picture tube, all receivers have their focus coil moved close to the yoke assembly and a shipping sleeve slipped between the focus coil and the tube neck. Loosen all wing nuts on the focus coil bracket, remove the shipping sleeve and move the focus coil back. Then focus and center the picture, using a temporary test power cord (see Preset Control Adjustment Fig. 2).

It is necessary to remove the speaker to allow the chassis to be removed from the cabinet.

When the picture tube is removed from the chassis and replaced, it is necessary to replace the tube support brackets, as shown in Fig. 2, to support the picture tube. Secure these two support brackets to the front of the cabinet when the chassis is replaced in the cabinet.

RECEIVER INSTALLATION

1. If the built-in antenna is used, it is advisable to observe the reception in various locations of the room in order to obtain best results.

2. In case an outdoor antenna has to be used, the antenna lead-in should be as short as possible. The built-in antenna is connected to the dipole terminals, therefore, it is necessary to disconnect the wires of the built-in antenna and connect the transmission line (impedance 300 ohms) of the outdoor antenna installation to the dipole terminals. Any type of antenna system may be used as long as it is connected by a balanced transmission line to the balanced input of 300 ohms of the receiver. The choice of the antenna depends on the operating area of the receiver, the number and location of stations to be received. In order to avoid multiple images (ghosts) and interferences, careful experimentation with the antenna system is necessary to obtain satisfactory reception. These problems may be aggravated in fringe areas and sometimes an elaborate installation has to be made to obtain satisfactory results.

LIGHTNING PROTECTION—All outdoor antenna installations should conform to standards set by the National Electric Code which is usually supplemented by Local Electrical Code requirements. In general, some of the requirements are as follows:

1. The metal mast supporting the antenna should be permanently and effectively grounded. Use a ground wire of minimum size as specified in the Electrical Code.

2. An approved television lightning arrester should be used in the antenna lead-in conductors at the point of entrance to the building. If shielded lead-in cable is used, the shield may be permanently grounded in lieu of using the lightning arrester.

For detailed information on antenna installations, refer to Chapter XIII of the Television Course RSM-4-13.

3. A power outlet providing 110 volts at 60 cycles per second must be in easy reach of the television receiver.

4. Locate so that the room illumination, in daytime or nighttime, falling on the screen of the picture tube may be controlled. If this cannot be done, locate the receiver in such a position that light from a window does not fall directly on the screen of the picture tube. For nighttime use, it is unnecessary to turn out all lights when viewing.

5. Ventilation of the television receiver is very important. Slots are provided in the cabinet back and bottom for ventilation. These slots should not be obstructed. Do not locate the receiver on or too near any heating device.

PRESET CONTROLS

THERMAL CUT-OUT—This is a protective a-c circuit breaker which disconnects the line voltage in case of excessive current drain of the receiver caused by an internal short circuit or breakdown of components. In case this cut-out cuts off, a five minute period should be allowed to elapse before resetting this cut-out. Depress this cutout button to reset.

ION TRAP—An ion trap is placed around the neck of the picture tube between the focus coil and the picture tube base. It is important that the Ion Trap be always adjusted for maximum brilliance. When adjusting the Ion Trap if the raster gets too bright, reduce the brilliance control and readjust Ion Trap for maximum brilliance.

To adjust, rotate the Ion Trap on the neck of the tube and move it forwards or backwards to give maximum brightness.

FOCUS—The focus switch, S401, S402 on the rear panel should be set to the position which allows the front control, R421, to focus the picture nearest the center of rotation of R421 and to give uniform focus over the greatest picture area.

Note: The focus coil should be located as near to the picture tube base as possible, when centering the picture, to give most uniform focus. (See Picture Centering.) As the focus coil is moved near to the base of the picture tube, brilliance will be diminished. It is advisable to sacrifice some brilliance to achieve uniform focus.

PICTURE TILT—If the picture or raster does not square with the picture tube mask, loosen the wing nut at the top of the yoke clamping bracket and rotate the deflection yoke in the proper direction until the picture squares with the mask. Clamp the yoke tightly in place.

PICTURE CENTERING—Centering of the test pattern is accomplished by loosening the wing nuts which secure the focus coil and adjusting the position of the focus coil until the test pattern is centered.

The focus coil may be moved slightly in various directions: it may be moved vertically by loosening the two side wing nuts; it may be moved horizontally or rotated about its vertical axis by loosening the top wing nut. Furthermore, it may be tilted about a horizontal axis by loosening the two side wing nuts.

NOTE: The focus coil should be kept as far back towards the base of the picture tube as possible to give uniformity of focus over the greatest picture area.

When making the adjustment, it is advisable to loosen all three wing nuts and make an approximate adjustment of the focus coil. Tighten the three wing nuts enough to maintain the focus coil in place but loose enough so it may be moved to a final position. After a final position has been found which gives good centering of the picture, tighten the three wing nuts securely.

A slight dimming of the picture may be encountered as the focus coil is moved towards the base of the picture tube. It may be necessary to lose some brightness to obtain good centering and uniformity of focus, since the brightness may be regained by increasing the brightness control.

Do not leave the focus coil set in such a position as to give neck shadow at one edge of the picture. (Fig. 13.)

HORIZONTAL HOLD—Rotate the front panel Horizontal Hold control (R365) to the middle of its range. Adjust the core of the rear panel Horizontal Hold control (L351) until the picture is synched and is phased at the center of the raster. Slight rotation of the front panel Horizontal Hold control (R365) either way should move the picture slightly left or right without losing horizontal sync.

The pull in range should be equally distributed either side of the front panel horizontal hold control center position. Readjust the rear panel hold control if necessary.

Check pull in sensitivity by switching from an empty channel to a station with the receiver properly tuned to that station. If the picture snaps into synchronization immediately, the adjustment is satisfactory.

HORIZONTAL LINEARITY—The Horizontal Linearity control (L352) adjusts the picture for correct horizontal proportions. For best adjustment, use a test pattern and adjust the Horizontal Linearity control until the distance from the center of the test pattern to the left- and right-hand edges of the test pattern measures approximately the same. The adjustment of this control is very broad and it should be made simultaneously with the adjustment of the Width control (L353) to get proper picture width and correct horizontal linearity. (See Fig. 12.)

HORIZONTAL DRIVE—The Horizontal Drive control (R369) should be set approximately ⅓ of its total rotation from the counterclockwise end of its rotation. If white vertical bars appear in the picture, the Drive control should be turned slightly in either direction to just remove these white vertical bars.

The Drive control R369, on late production receivers, connected as shown in the schematic diagram, should be set to give maximum width of the picture or raster. The control should be rotated counterclockwise to just remove any picture compression which appears at the right-hand edge of the raster.

WIDTH—Adjust the Width control (L353) so that the edges of the picture extend approximately one-eighth inch past the right- and left-hand edge of the mask and are not visible (Fig. 11).

VERTICAL LINEARITY—This control (R311) should be adjusted to give good vertical proportions to the picture. The adjustment should be made on a test pattern so that the distance from the center to the top and bottom edges of the pattern measures approximately the same. This adjustment will alter the height of the picture slightly. (See Fig. 9.)

HEIGHT—This control (R308) changes the picture height and should be adjusted so that the picture extends approximately ⅛ inch beyond the top and bottom edges of the mask. This adjustment should be made simultaneously with the Vert. Linearity control (R311).

HIGH CHANNEL TRAP—This receiver incorporates a trap (C206, L203) on the head-end unit which is switched into the antenna circuit on all low-band channels and will eliminate high-channel interference on these channels. This interference manifests itself as horizontal bars or herringbone pattern or as a picture in the background. If the receiver is tuned to Channel #5, a strong station operating on Channel #11 will beat with the second harmonic of the local oscillator to form an i-f frequency which will ride through unhindered and appear on the picture screen. In order to prevent the interfering signal from reaching the converter, a trap consisting of a fixed inductance and a variable capacitance is adjusted for maximum rejection of the interfering station. This type of interference, is also possible on the Channels #4 and #6 due to interfering stations on Channel #8 and #13, respectively. The trap is adjusted at the factory approximately for Channel #11 rejection. It may be necessary to readjust the trap slightly for maximum rejection of Channel #11.

ADJUSTMENT OF TRAP—The adjustment of the trap can be made by means of a signal generator and an oscilloscope or an a-c meter as indicating device. The signal generator must be terminated to match 300 ohms impedance. For elimination of Channel #8, #11 or #13 interference, feed a strong signal of the picture carrier of the interfering station modulated with an audio signal into the antenna terminals and connect the indicating device to the picture tube grid. Set the band selector to the Channel #4, #5 or #6, respectively, and tune local oscillator of receiver for maximum deflection on indicating device. Then tune trimmer C206 for minimum signal on picture tube grid.

The adjustment of the trap can be made without instruments as follows: When the channel interference appears in the picture, set the tuning control for maximum interference. Then tune trimmer C206 for minimum interference or maximum rejection.

PICTURE DEFECTS

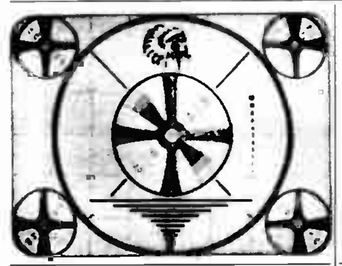
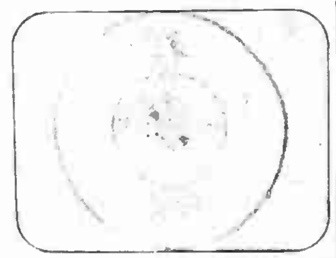
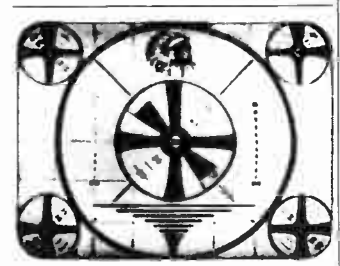
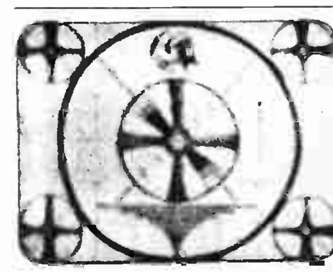
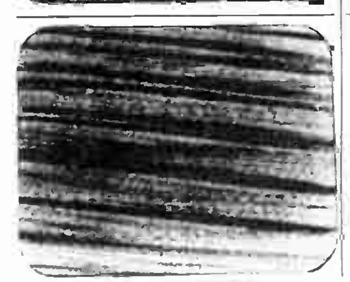


Fig. 3
Normal picture.

The following illustrations show picture defects which are caused by incorrect setting of operating controls, the preset controls or by interference picked up by the antenna. A possible remedy is indicated for each defect.

The adjustment of controls is most efficiently accomplished by the use of a test pattern, similar to that illustrated to the left, which is normally transmitted just prior to the scheduled program.

The normal picture should show good focus and a good contrast between blacks and whites with intermediate shades of gray. The picture should not tend to move either vertically or horizontally and have good linearity.

PICTURE	DEFECT	REMEDY
	**Fig. 4** **Picture too light.**	1. Increase Picture control setting and/or reduce brightness. 2. Weak signal. This may be caused by insufficient pickup on antenna or defective lead-in. Insufficient pickup at maximum contrast usually is accompanied by "snow" on the picture.
	**Fig. 5** **Picture too dark (contrast).**	1. Reduce Picture control setting and/or increase Brightness control setting. 2. Too strong signal. If it is not possible to reduce signal adequately with Picture control, install suitable resistor antenna pad.
	**Fig. 6** **Picture defocussed.**	1. Adjustment of front panel focus control, R421. 2. Check for optimum uniformity of focus by moving focus coil (see installation and service adjustments, page 3). 3. Check coarse focus control at rear of chassis. 4. Mistuning of receiver or misalignment.
	**Fig. 7** **Horizontal sync.**	1. Adjust Horizontal Hold control (front panel control). 2. Check adjustment of rear panel Horizontal Hold control. 3. Signal improperly tuned. 4. Defective horizontal sync circuits.

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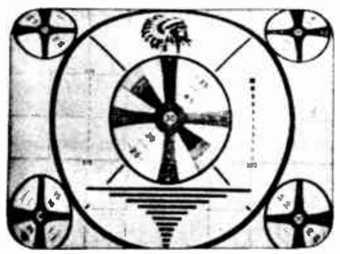
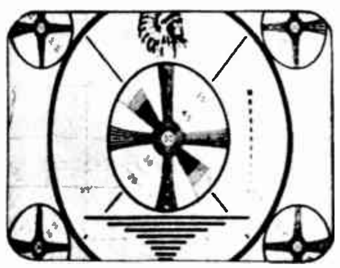
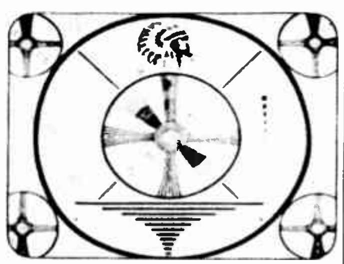
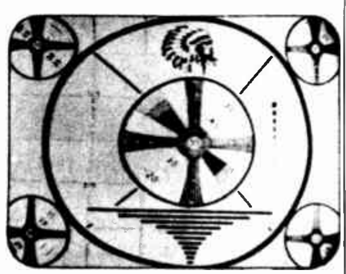
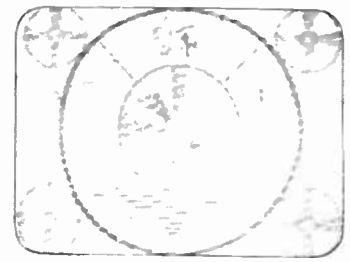
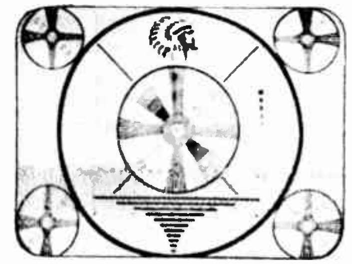
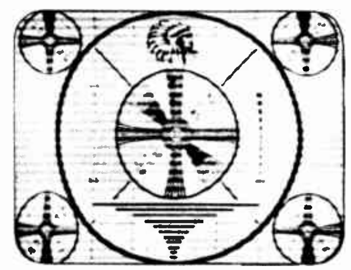
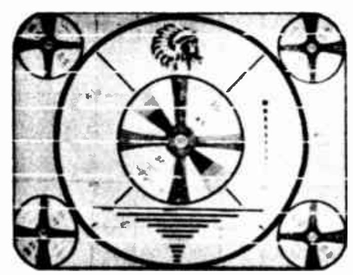
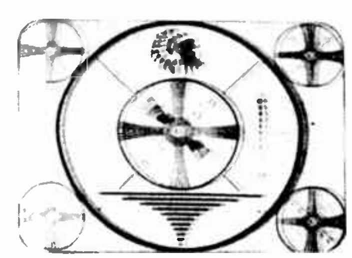
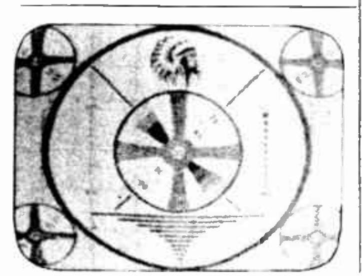
PICTURE	DEFECT	REMEDY
	**Fig. 8** Vertical sync.	1. Adjust Vertical Hold control until picture shows no tendency to slide up or down or lock out of frame. 2. Check the vertical sync circuits.
	**Fig. 9** Vertical linearity.	Adjust Vertical Linearity control. This adjustment may alter the Height control adjustment.
	**Fig. 10** Vertical height.	Adjust Height control so that the top and bottom picture edges are just covered by mask. Recheck Vertical Linearity control setting.
	**Fig. 11** Picture too wide.	Adjust Width control so that the right and left picture edges are just covered by the mask.
	**Fig. 12** Horizontal linearity.	1. Adjust Horizontal Linearity control. This adjustment may require resetting of Width control. 2. Adjust Drive control as described under Installation and Service Adjustments, page 3.
	**Fig. 13** Neck shadow.	1. Misadjustment of Focus coils—tilted too far. 2. Move the deflection yoke forward against the bell of the picture tube.

PICTURE INTERFERENCES

PICTURE	DEFECT	REMEDY
	**Fig. 14** Herringbone pattern over picture.	This interference is caused by a television station operating on the next lower channel or by a short-wave radio transmitting and receiving equipment. Police and "ham" transmitters in your locality will usually cause the most severe conditions. The interference produces moving ripples or diagonal streaks, or in some cases, may cause loss of contrast of the picture. The use of an antenna wavetrap tuned to the interfering signal may assist. If the interference is from a TV or FM station, a transmission line shorted stub may remove the interference. If the pickup is on the lead-in, a shielded lead-in will help correct the trouble. See page 3 for high channel trap adjustment.
	**Fig. 15** Diathermy interference.	Diathermy equipment is used by hospitals and doctors and can be very annoying because it might ruin the reception completely. This interference manifests itself in a herringbone pattern or one or two dark bars moving slowly up or down the picture. If the disturbance is extremely strong, the interference pattern will remain stationary while the picture floats in the background. Improve the antenna installation using directive antenna systems and shielded transmission line.
	**Fig. 16** Horizontal bars on picture.	This interference is caused by adjacent channel sound or microphonics in receiver. If adjacent channel sound is responsible for this defect, readjust the adjacent channel trap as outlined on page 8. A microphonic video amplifier tube, V7, may cause this condition.
	**Fig. 17** Ignition interference.	Ignition interference from trucks, automobiles, and airplanes may be identified by streaks and splashes on the picture. The ignition system of trucks will produce the most intense interference pattern. Install antenna away from road carrying traffic. Shielded lead-in may help if interference is picked up on it.
	**Fig. 18** Multiple images (ghosts).	This is caused by the television signal following multiple paths, one of which is the direct path, and the other is reflected from some object such as a tall building or a large storage tank or hills. The signal following the longer reflected path arrives later at the receiver producing the second image. In case a built-in antenna is used, try to turn the cabinet until the ghost picture is dimmed out. If your receiver is connected to an outdoor installation, a reorientation of the antenna might improve the reception.
	**Fig. 19** "Snow."	1. Too weak signal; increase efficiency of antenna installation. 2. Adjust tuning control.

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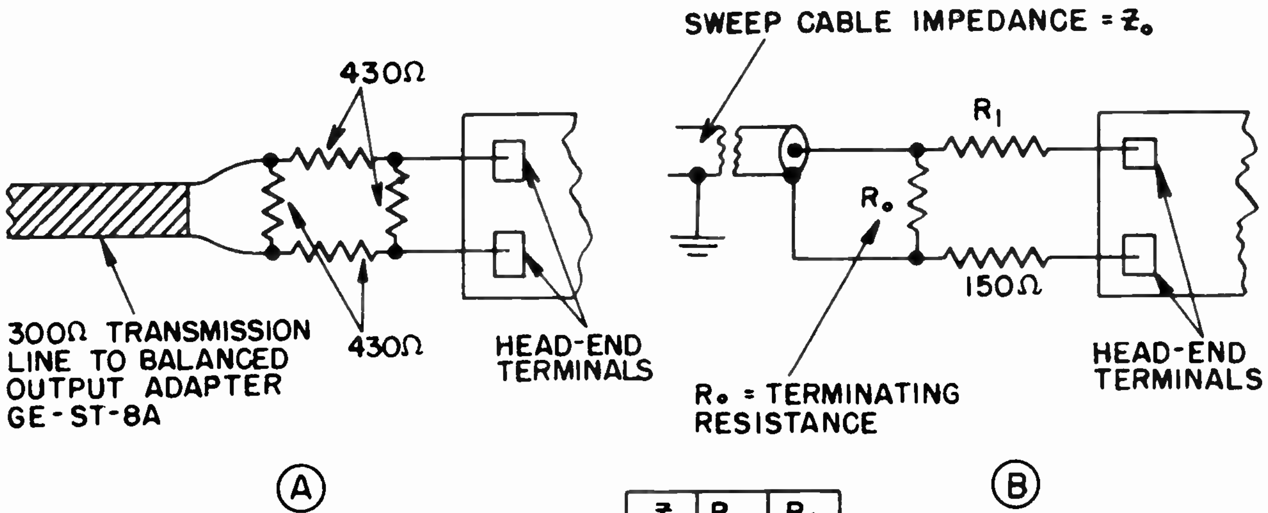

Z_0	R_0	R_1
50Ω	56Ω	120Ω
72Ω	82Ω	110Ω
92Ω	110Ω	100Ω

Fig. 20. Sweep Generator Termination

CIRCUIT ALIGNMENT

CAUTION: TO PROTECT TEST EQUIPMENT ALWAYS USE AN ISOLATION TRANSFORMER

GENERAL—

A complete alignment of the receiver tuned circuits is given in the following charts. Read all alignment notes prior to making an alignment. The procedure shown in the charts is based upon the use of the G-E test equipment specified and if other equipment is used which has different characteristics, the charts may have to be modified slightly. A diagram showing the location of adjustments used in alignment is shown in Figure 22 on page39. Use the alignment service diagram, Figure 29 on page 42 with the charts.

It is necessary to connect the low side of the test equipment to the B− bus of the receiver keeping the lead as short as possible.

Always permit a 15 minute warm-up period for the receiver and test equipment prior to attempting alignment.

To align the receiver with the picture tube removed, a Type 6SN7 tube with all pins clipped off except pins #7 and #8 may be used to complete the filament circuit. Plug pins #7 and #8 of the 6SN7 into pins #1 and #12 of the picture tube socket.

To protect the test equipment, always use an isolation transformer between the power line and the TV receiver.

TEST EQUIPMENT—The following test equipment is necessary.

1. R-F Sweep Generator (G-E Type ST-4A or Equivalent).

a. Frequency Requirements.

4.5 MC with 500 KC and 2 MC sweep width.
40-50 MC with approximately 10 MC sweep width.
50-90 MC, 170-220 MC with 15 MC sweep width.

b. Constant output in the sweep range.

c. At least 0.1 volt output.

2. Marker Generator (G-E Type ST-5A or Equivalent).

The marker generator must have good frequency stability, must be accurately calibrated and must cover the following frequencies.

41.25 MC for video I-F
42.50 MC for video I-F
44.20 MC for video I-F
44.50 MC for video I-F
45.00 MC for video I-F
45.75 MC for video I-F
47.25 MC for video I-F
4.5 MC for sound I-F and trap alignment

Picture and sound carrier frequencies for Channels #2 through #13

3. Balanced Output Adapter G-E ST-8A or Equivalent (See RF Note 1).

4. Oscilloscope (G-E Type ST-2A or Equivalent)—The oscilloscope should have good sensitivity and preferably a 5-inch screen with a good wide-band frequency response on the vertical deflection circuits. Although the high frequency response is not necessary for alignment, it is important when making waveform measurements.

5. Vacuum Tube Voltmeter—A vacuum tube voltmeter is necessary to measure the bias of −4 volts required for video and r-f alignments.

6. Detector Network—A crystal detector network as shown in Figure 27 is necessary to detect the response when aligning L260, the 4.5 mc trap.

7. Miscellaneous—One 10,000 ohm resistor to isolate the scope as noted in the charts.

One .01 mfd. capacitor to isolate the sweep generator as noted in the chart.

Impedance matching pad for r-f alignment as shown in Figure 20.

Bias battery to supply −4 volts as noted for video i-f and r-f alignment.

VIDEO I-F ALIGNMENT

1. Connect a bias battery from junction of C261, R263 and the Picture control to B−. Connect positive of battery to B−. Adjust contrast control to give a −4 volts bias at the grid pin 1 of V4 measured with a VTVM. Disconnect VTVM leads during alignment.

2. The sweep generator should be properly terminated in its characteristic impedance. Couple the signal to the point of input through a .01 mf. capacitor. See Fig. 20.

3. The traps L227 and L253 must be detuned before aligning the amplifier by turning the cores all the way out of the coil. Retune these traps to 47.25 mc (as in step 6) for minimum amplitude. This adjustment is greatly enhanced by increasing the scope gain.

4. Set the Channel switch to Channel #12 or #13. Check for oscillator influence by turning the tuning control. If the shape of the response curve changes, switch to another channel where oscillator influence is not noted.

5. In most cases it is only necessary to perform an over-all alignment of the video i-f, as in Step 7 of the Video Alignment Chart, to obtain i-f response curve of Figure 21-E.

When aligning the i-f coils, L251 will adjust the audio or low frequency side of the i-f response curve, while L252 will adjust the video or high frequency side of the i-f response curve. L226 and L254 should be adjusted simultaneously to reduce the saddleback at the peak of the curve and to give maximum gain and retain 45.75 mc and 42.50 mc markers at the 50% mark.

6. It is necessary to detune the i-f coils by shorting as noted in the alignment chart to prevent the coil preceding the signal input point from influencing the response curve.

7. The 45.75 mc marker should fall at the 50% point to give proper sideband response. See Fig. 21E.

8. After adjustment of the two adjacent sound traps, readjust the i-f curve to obtain the proper curve and marker as illustrated.

9. Adjust the signal input to give a video response curve of ¾ volt, as shown in Figure 21.

VIDEO I-F ALIGNMENT CHART

Step	Marker Generator Frequency	Sweep Generator Frequency	Signal Input Points Between	Connect Oscilloscope Between	Adjust	See Note No.
1					Detune L227 and L253 by turning cores out of coil.	3
2	44.50 MC		V6 grid (pin 1) thru .01 mf. cap. and B− on head-end shield. Pins 5-6 shorted on V5.		Core of L254 for curve of Fig. 21-A.	
3	45.75 MC	40 to 50 MC	V5 grid (pin 1) thru .01 mf. cap. and B− on head-end shield. Short L251. Remove short on pins 5-6, V5.	Junction L256, R265, C268 and R266 thru 10K ohms and B− on V7 socket.	Core of L252 for curve of Fig. 21-B.	1, 2, 4, 6, 9
4	42.50 MC, 45.75 MC		V4 grid (pin 1) thru .01 mf. cap. and B− on head-end shield. Short L226. Remove short on L251.		Core of L251 for curve of Fig. 21-C.	
5	44.2 MC				Core of L226 for curve of Fig. 21-D.	
6	47.25 MC,		Junction L215 and L216 on second r-f switch wafer thru .01 mf. cap. and B− on head-end shield. Remove short on L226.		Cores of L227 and L253 for min. output at 47.25 MC (Fig. 21-E).	1, 2, 3, 4, 7, 9
7	41.25 MC, 42.50 MC, 45.00 MC, 45.75 MC, 47.25 MC				Cores of L251, L252, L254 and L226 for curve of Fig. 21-E.	1, 2, 4, 5, 7, 8, 9

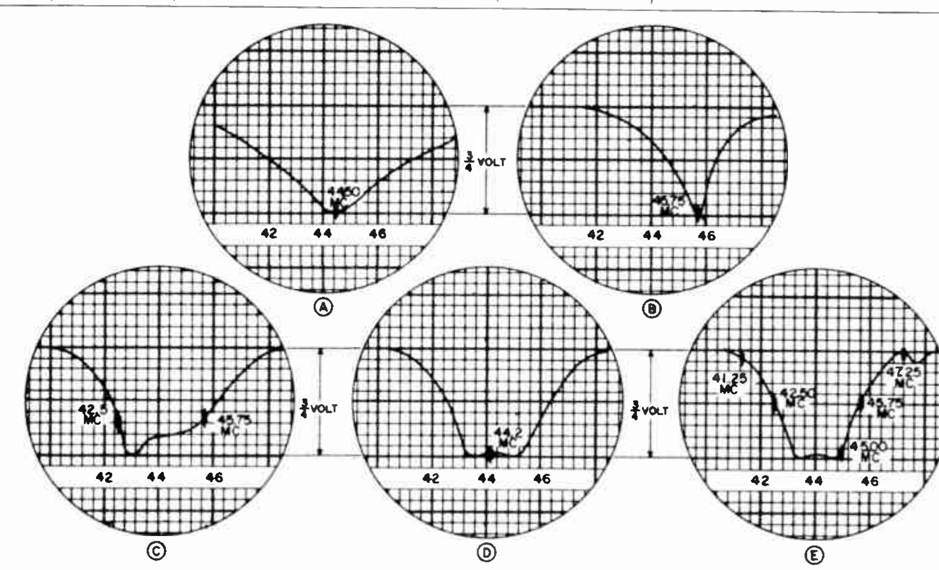

Fig. 21. Video I-F Curves

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AUDIO I-F ALIGNMENT

1. Audio i-f alignment is performed by putting in a 4.5 mc ±500 kc sweep and viewing the response curve as noted in the audio i-f chart.

2. As a final check, step 12, the secondary of T402 adjustment, should be checked on a television signal if possible. Try several operating television stations and if buzz in the audio is heard, the secondary of T402 should be readjusted as follows.

Tune in the station and adjust the contrast control for a weak sound output. Readjust the secondary of T402 until the buzz is a minimum or disappears and the best quality audio is obtained.

3. Keep the input of the sweep generator low enough so that limiting does not take place, otherwise the response curve will broaden out, permitting slight misadjustment. Check by increasing the output of the sweep generator; the response curve should increase in amplitude.

4. T401 is adjusted for maximum amplitude and symmetry of the response curve about 4.5 mc marker as shown in Fig. 23-A.

5. The secondary of T402 is adjusted for the curve of Figure 23-B. This adjustment should give as straight a slope as possible between the positive and negative peaks of the curve with the center of the 4.5 mc marker falling midway between the peaks.

6. The primary of T402 is adjusted for maximum of the positive and negative peaks with as straight a trace as possible between the peaks. If necessary, readjust the secondary of T402 so that the marker falls midway between the peaks.

7. An alternate method to the visual alignment is the sound output method using an operating television station, preferably when transmitting tone modulation during the test pattern.

(a) Tune the receiver for optimum detail.
(b) Keep the input below limiting level by reducing the contrast by the Picture control or by using a resistor pad in the antenna circuit.
(c) Adjust primary and secondary of T401 for maximum sound output. Adjust primary of T402 for maximum audio output.
(d) Adjust the secondary of T402 for best quality audio (low distortion, least noise) and for minimum buzz in the output.

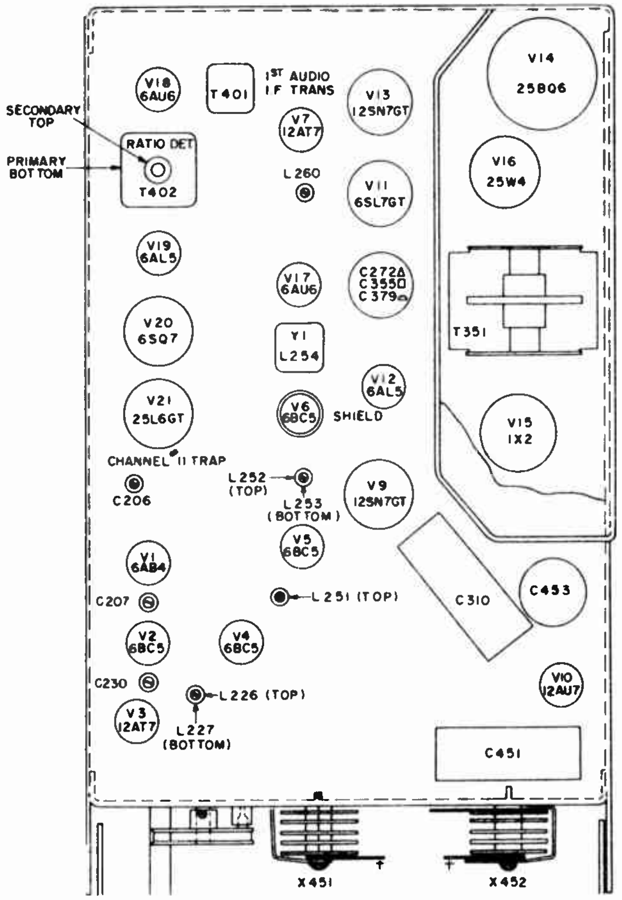

Fig. 22. Tube and Trimmer Location

AUDIO I-F ALIGNMENT CHART

Step	Marker Generator Frequency	Sweep Generator Frequency	Signal Input Points Between	Connect Oscilloscope Between	Adjust	See Note No.
8	4.5 MC	4.5 MC ±500 KC keep signal below limiting level of receiver.	Pin 1 of V17 through .01 mfd. cap. and B−.	Junction of R404 and C404 & sec. of T401 through 10K and B−.	Primary and secondary of T401. See Figure 23-A.	1, 3, 4
9			Pin 1 of V18 through .01 mfd. cap. and B−.	Junction of R408, C411 and R411 through 10K and B−.	Secondary of T402. See Fig. 23-B.	1, 3, 5
10					Primary of T402. See Figure 23-B.	1, 3, 6
11					Secondary of T402. See Figure 23-B.	1, 3, 5
12	Recheck alignment of step 11 on operating station as in note 2.					

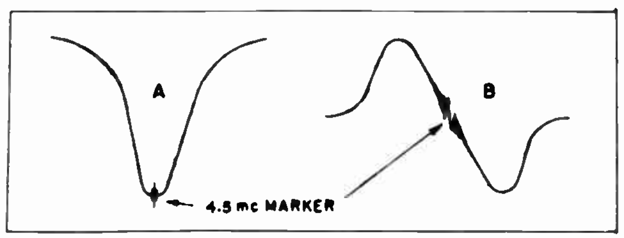

Fig. 23. Audio I-F Curve

R-F ALIGNMENT

R-F Alignment Notes

1. Disconnect the transmission line to the antenna terminals from the head-end. Couple the input of the sweep generator to the head-end terminals through balanced output adapter G-E ST-8A, or equivalent. Couple this to the head-end terminals through a piece of 300-ohm transmission line. Terminate the 300-ohm line in a pad, as shown in Figure 20A.

If a balance output is not available for the sweep generator a matching network as shown in Figure 20B may be used. A balanced output is recommended since a matching network as shown in Figure 20B may introduce frequency shift and cause a misleading tilt to the response curve.

Ro shown in Figure 20B is the terminating resistor. If this resistor is not already incorporated in the output of the sweep generator, it should be added to the matching network as shown.

2. It is necessary to connect a bias battery from the junction of the Picture control, C261, and R263 to B−. Connect plus of bias battery to B−. Adjust the Picture control to give a −4 volts bias measured from pin 1 of V2 to the head-end chassis B−.

3. Shunt L226 with a 680 ohm, ½ watt resistor during r-f alignment to prevent the oscillator from influencing the response curve. In order to reduce the effect of hum on the response curve, connect a 100 ohm resistor between the head-end B+ and the chassis B+ and connect an electrolytic capacitor of approximately 400 mf, 350 volt from head-end B+ to head-end B−.

4. On all channels the picture carrier marker should not be less than 75% of the peak of the r-f response curve. The sound carrier marker should not be less than 50% of the peak of the response curve. However, the two minimum values should not occur simultaneously. On the high channels the picture carrier marker should ride up nearer to the top of the curve provided the sound carrier marker does not go below 50%. On the low channels the picture carrier marker should ride as high up on the curve as possible and still keep the sound carrier marker above 50%.

5. Coils for Channel No. 12 through No. 7 are fixed inductances. Check the alignment on these channels as in steps 16 through 21 for proper response curve. Readjust L210 and L217 on Channel No. 13 and C207 and C230 on Channel No. 7 if necessary.

6. Coils for Channels No. 5 and No. 4 are fixed inductances. Check the alignment on these channels for proper curve. Readjust coils L208 and L215 to give proper curve on Channels No. 6, No. 5 and No. 4.

7. The coil for Channel No. 2 is a fixed inductance. Check the alignment on this channel for proper curve. Readjust L205 and L212 to give proper curve on Channels No. 3 and No. 2.

8. The trimmers C207 and C230 may be used to compensate for differences in tube capacities which affect tracking when it is necessary to change the tubes V1 or V2. The variations in tube capacities have normally little effect on the over-all performance of the head-end.

R-F ALIGNMENT CHART

Step No.	Marker Generator Frequency	Sweep-Generator Frequency	Signal Input Point	Connect Oscilloscope	Channel Switch	Adjust	See Note
13	211.25 MC, 215.75 MC	No. 13 with 15 MC sweep	Antenna terminals at head-end (see Note 1.)	Junction of L226, C217 and R218 thru 10K-resistor and B− at head-end chassis.	No. 13	Screw of L210, screw of L217, for Fig. 24-A.	1, 2, 3, 4, 5
14	175.25 MC, 179.75 MC	No. 7 with 15 MC sweep			No. 7	Trimmers C207 and C230 for response curve, Fig. 24-A.	1, 2, 3, 4, 5, 8
15	211.25 MC, 215.75 MC	No. 13 with 15 MC sweep			No. 13	Readjust screw of L210 and screw of L217 for curve, Fig. 24-A.	1, 2, 3, 4, 5
16	205.25 MC, 209.75 MC	No. 12 with 15 MC sweep			No. 12		
17	199.25 MC, 203.75 MC	No. 11 with 15 MC sweep			No. 11	No adjustment.	5
18	193.25 MC, 197.75 MC	No. 10 with 15 MC sweep			No. 10		
19	187.25 MC, 191.75 MC	No. 9 with 15 MC sweep			No. 9		
20	181.25 MC, 185.75 MC	No. 8 with 15 MC sweep			No. 8		
21	175.25 MC, 179.75 MC	No. 7 with 15 MC sweep			No. 7		
22	83.25 MC, 87.75 MC	No. 6 with 15 MC sweep			No. 6	Screw of L208 to place 83.25 MC marker and screw of L215 to place 87.75 MC marker as shown in Fig. 24-B.	1, 2, 3, 4, 6
23	77.25 MC, 81.75 MC	No. 5 with 15 MC sweep			No. 5		
24	67.25 MC, 71.75 MC	No. 4 with 15 MC sweep			No. 4	No adjustments.	6
25	61.25 MC, 65.75 MC	No. 3 with 15 MC sweep			No. 3	Screw of L205 to place 61.25 MC marker and screw of L212 to place 65.75 MC marker, as shown in Fig. 24-B.	1, 2, 3, 4, 7
26	55.25 MC, 59.75 MC	No. 2 with 15 MC sweep			No. 2	No adjustment.	7

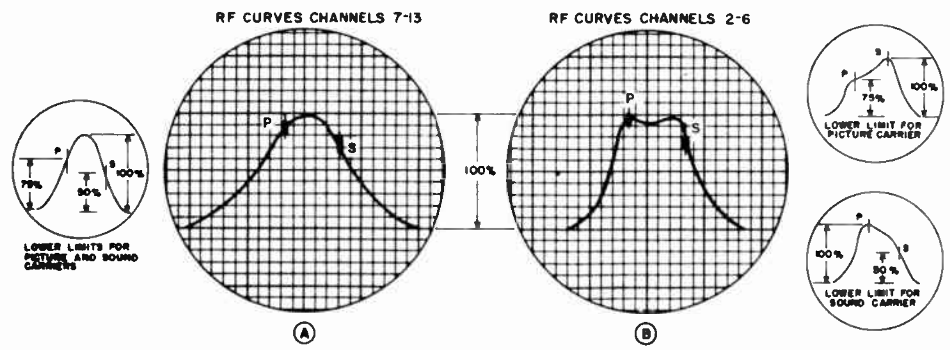

Fig. 24. R-F Alignment Curves

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OSCILLATOR ALIGNMENT

Before attempting this oscillator alignment, it must be certain that the video i-f stages and r-f stages are properly aligned as outlined previously.

1. Disconnect the 300-ohm line from the r-f head-end terminals and connect sweep generator to head-end properly terminating sweep generator output cable as shown in **Figure 20**. See RF Alignment Note 1.

2. Alignment is made by viewing the response curve at the output of the video i-f detector.

3. Use a video carrier marker as shown in each step of the Alignment Chart.

4. Set C213 at the center of its rotation. Adjust L225 to place marker at the 50% point on the high frequency slope of the curve for step 27. The oscillator inductance L224 for Channels #12 through #7 are fixed. The alignment on these channels should be checked to see that the tuning control, C213, will move the video carrier marker up and down the entire high frequency side of the response curve. Readjust L225 if necessary.

5. When adjusting L225 as in step 27, the tracking on Channels #12 through #7 should be checked. Set C213 at the center of its rotation. Adjust L225 so that the video carrier marker falls as near as possible to the 50% point on the high frequency slope as the receiver is switched to each channel from 7 through 13 with this setting of C213 for all channels from 7 through 13.

6. On Channel #6 through #2 set the tuning control C213 at the center of its rotation and make the indicated adjustment so that the video carrier marker falls at the 50% mark on the high frequency slope of the response curve.

OSCILLATOR ALIGNMENT CHART

Step No.	Marker Generator Frequency	Sweep Generator Frequency for Channel	Signal Input Point	Connect Oscilloscope Between	Channel Switch Setting	Adjust	See Note
27	211.25 MC	No. 13 with 15 MC sweep	Antenna terminals of head-end. See note 1.	Junction of L256, R265, C268 through 10K ohms and B− at V7 socket (pin 3).	No. 13	L225 by squeezing or spreading turns slightly.	1, 2, 3, 4
28	205.25 MC	No. 12 with 15 MC sweep			No. 12	No Adjustment	5
29	199.25 MC	No. 11 with 15 MC sweep			No. 11		
30	193.25 MC	No. 10 with 15 MC sweep			No. 10		
31	187.25 MC	No. 9 with 15 MC sweep			No. 9		
32	181.25 MC	No. 8 with 15 MC sweep			No. 8		
33	175.25 MC	No. 7 with 15 MC sweep			No. 7		
34	83.25 MC	No. 6 with 15 MC sweep			No. 6	Screw of L223.	1, 2, 3, 6
35	77.25 MC	No. 5 with 15 MC sweep			No. 5	Screw of L222.	
36	67.25 MC	No. 4 with 15 MC sweep			No. 4	Screw of L221.	
37	61.25 MC	No. 3 with 15 MC sweep			No. 3	Screw of L220.	
38	55.25 MC	No. 2 with 15 MC sweep			No. 2	Screw of L219.	

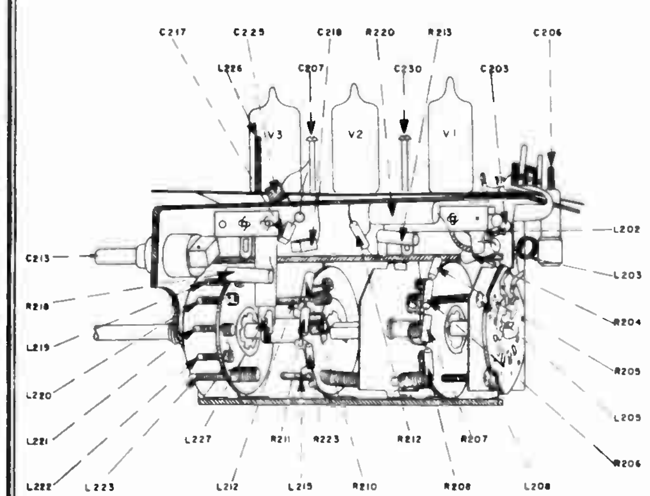

Fig. 25. Head-end Unit

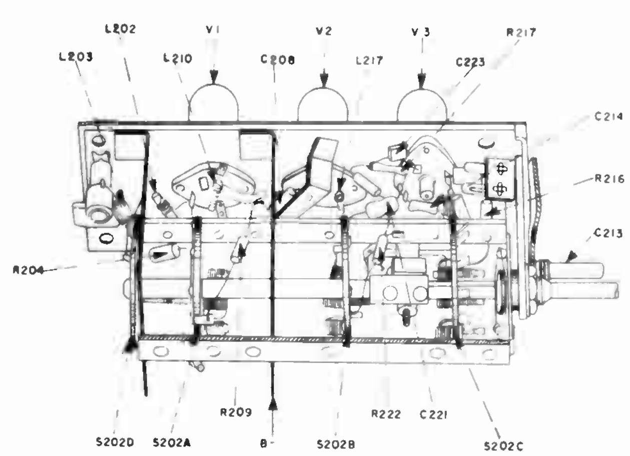

Fig. 26. Head-end Unit

ADJUSTMENT OF VIDEO AMPLIFIER 4.5 MC TRAP (L260).

This trap is used to removed 4.5 mc audio i-f from the video amplifier which shows up in the picture as a cross-hatch pattern. This trap will very rarely require adjustment. Adjustment is as follows:

1. The trap (L260, C271, C270) is adjusted for minimum amplitude of the 4.5 mc marker. Use a detector network as shown in **Figure 27**, connected from junction of L264 and C275 to **B** −, to detect the signal.

2. Adjust the vertical hold control to remove the vertical pulses from the response curve.

3. Short horizontal oscillator coil L351 to remove horizontal oscillator interference in the response curve.

4.5 MC TRAP (L260) ALIGNMENT CHART

Step	Marker Generator Frequency	Sweep Generator Frequency	Signal Input Point	Oscilloscope	Adjust	See Notes
39	4.5 MC	4.5 MC ±1 MC	Junction L256, R265, C268 and B− thru .01 mf.	Across 100K resistor as shown in Fig. 27. (See Note 1.)	L260 for min. amplitude of 4.5 mc marker. Increase scope gain	1, 2, 3

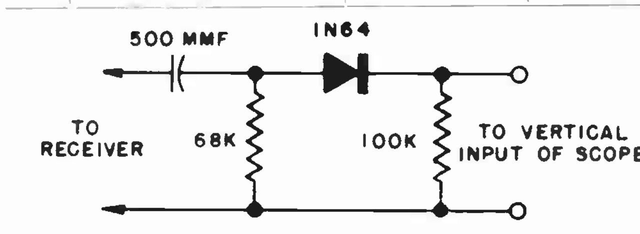

Fig. 27. Detector Network

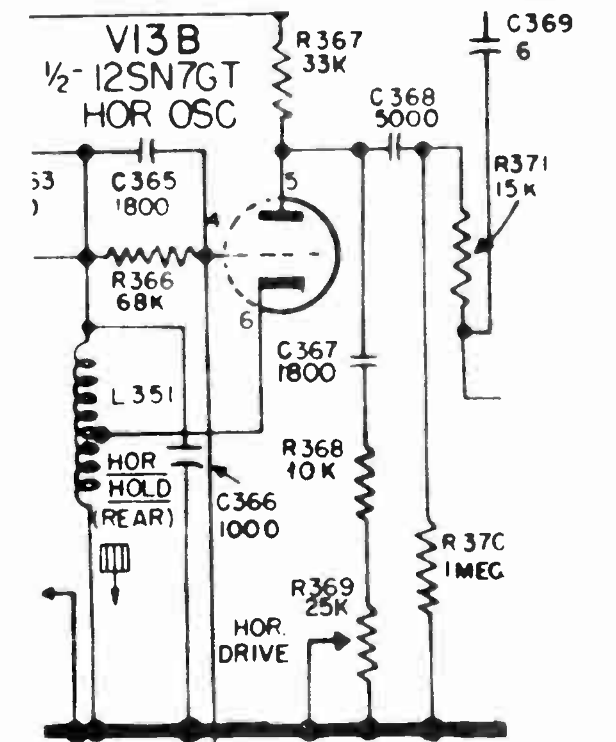

Fig. 28. Hor. Drive Control connections, early production

PRODUCTION CHANGES

1. The Horizontal Drive control R369 has been reconnected, as shown in the schematic, to remove the effect of the drive control setting on the horizontal pull-in sensitivity.

If any early production receivers are wired as shown in the schematic diagram, R369 potentiometer should be changed to one of higher wattage rating. Catalog number for the higher wattage rating R369, 25K potentiometer, is RRC-140.

Figure 28 shows the drive control (R369) connections for early production receivers.

2. Capacitor C268 has been changed from .02 mfd. to .05 mfd., Cat. No. UCC-045. This change was made to improve the low frequency response of the video amplifier.

3. To eliminate Barkhausen oscillation (vertical black beady lines in raster when not receiving a station) the following resistor was added to early production receivers.

Pin 8 of V14 was connected to B − through a 47 ohm, 1 watt, resistor, Cat. No. URE-017.

4. Two mica capacitors, 390 mmf., 500 volt each, were connected in series between terminals 6 and 8 of T351 as a substitute for C382, 180 mmf.

TROUBLE SHOOTING CHART

This trouble shooting chart is divided into two parts: Trouble Shooting Chart and analysis which explains in more detail the particular defect. The chart is divided into five sections. 1. Picture defects, 2. Deflection defects, 3. Sync defects, 4. Audio defects, 5. Miscellaneous defects.

When trouble shooting, full use should be made of the block diagram Fig. 1, the socket voltage diagram Fig. 30, page **41**, and the Service diagram Fig. 29, page **42**, to help localize defective components.

It is not possible to cover all troubles, which may occur in this receiver, in this publication. However this information will serve as a guide in locating troubles.

Picture Defects

SYMPTOM	CHECK
1. No picture or sound. Raster normal.	(a) RF and Video IF circuits #3.
2. Poor picture detail.	(a) Misalignment see Defects of RF and Video IF circuits #1. (b) Misalignment of L260 see Defects of Video amplifier circuits #4.
3. Faint picture	(a) Low signal input. (b) Loss of gain in video amplifier, video IF or RF amplifier (c) Misalignment
4. Ghosts in picture (secondary images)	(a) Antenna installation. See Fig. 18
5. Snow effect in picture	(a) Defective head end or low signal input to the television receiver.

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6. Reverse action of picture control and distorted picture. Excessive contrast. — (a) C261 shorted see miscellaneous defects section #3

7. Sound bars in picture (black horizontal bars) — (a) Alignment of L227 and L253 see RF and Video IF Circuits #2. (b) See defects of the picture tube circuit #3. (c) Microphonic tubes V3, V4, V7.

8. No Raster. Sound normal. — (a) No high voltage to picture tube. (b) See defects of the horizontal sweep section #1. (c) Picture tube.

Deflection Defects

1. Barrel distortion of picture or Keystoning (picture narrow at top or bottom or side). — (a) Shorted turns of deflection yoke.
2. Insufficient sweep width — (a) See defects of horizontal sweep section #2.
3. Poor horizontal linearity See Fig. 12 — (a) L352 shorted (b) High leakage of C370. (c) Damper tube V16.
4. Picture not centered horizontally — (a) Shorted capacitor C3 77. See defects of the horizontal deflection circuit #4.
5. No vertical deflection — (a) Defect in T301 or D301. See defects of vertical sweep section #4.
6. Poor vertical linearity. Height reduced. — (a) Check capacitor C309. See defects of vertical sweep section #2.
7. Insufficient height. — (a) See defects of vertical sweep section #3.

Sync Defects

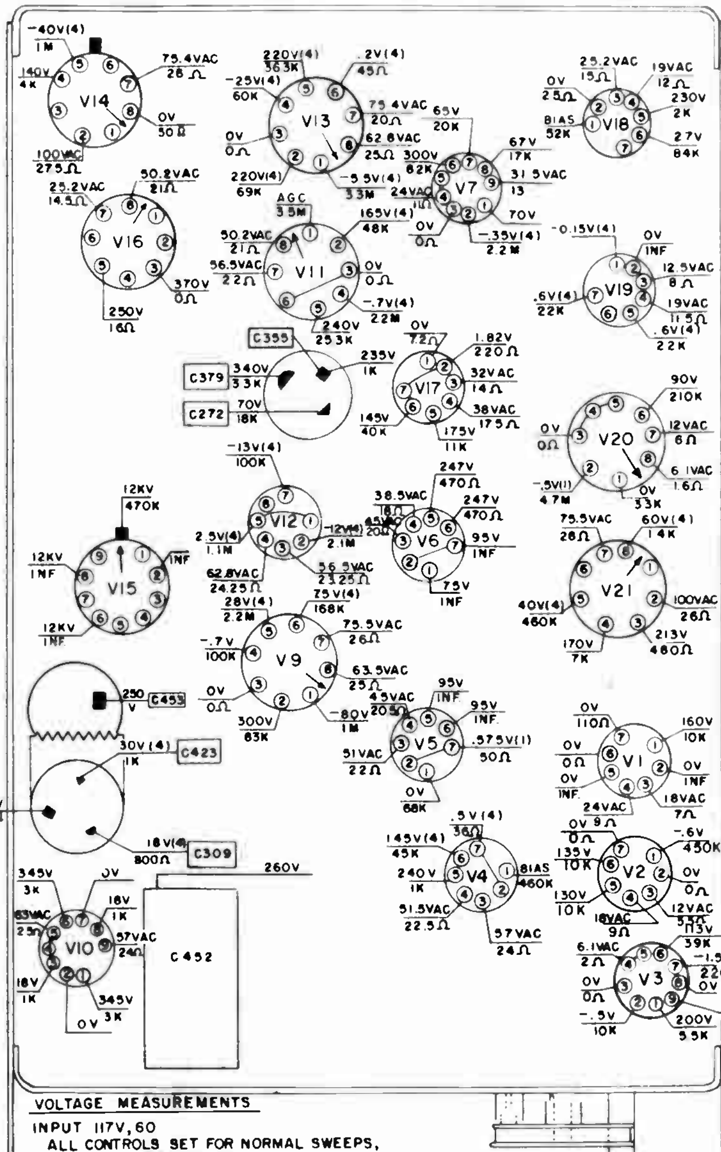
SYMPTOM	CHECK
1. Picture unstable. Excessive contrast.	(a) Open capacitor C353. See defects of Common Sync section #2.
2. No vertical sync. Hor. sync normal.	(a) C301, C302, C303, R301, R302.
3. No horizontal sync, vertical sync normal.	(a) Defect in circuits of V12, V13A, and V13B.

Audio Defects

1. No sound. Picture normal.	(a) T401, T402, T403. (b) Speaker. (c) Circuits of V17, V18, V19, V20, and V21.
2. Hum or buzz.	(a) Alignment of T402.
3. Distorted sound.	(a) Crystal. (b) Alignment of T402.

Miscellaneous Defects

1. Excessive contrast	(a) C354 shorted see common sync section #1 (b) Shorted C251, C354.
2. Poor focus, picture very bright and no control of brightness.	(a) C277 shorted.
3. Poor focus	(a) Setting of focus coil or switch S401-S402. (b) Defect in focus coil circuit (c) Check for open or shorted focus coil.
4. Neck shadow See Fig. 13.	(a) Misadjustment of focus coil or Ion Trap. (b) Deflection yoke not forward against bell of picture tube.
5. Picture flutters	(a) C251 capacitor open
6. No picture on one operating channel.	(a) Defective channel switch or head end.



VOLTAGE MEASUREMENTS
INPUT 117V, 60
ALL CONTROLS SET FOR NORMAL SWEEPS, FOCUS AND BRIGHTNESS
MEASUREMENTS ARE IN RESPECT TO B-
WITH A 20,000Ω/VOLT METER
(1) 2.5 VOLT RANGE
(2) 10 " "
(3) 25 " "
(4) VOLTAGE WILL VARY MORE THAN 20% RESISTANCE MEASUREMENTS
SHORT CAPACITOR C453
SHORT PIN 3 OF V16 TO B-
M DENOTES MEG
INF DENOTES INFINITE RESISTANCE
TURN THE FOLLOWING CONTROLS FULL CLOCKWISE
FOCUS CONTROL
CONTRAST
BRIGHTNESS
VERTICAL HOLD
VERTICAL SIZE
VERTICAL LINEARITY
VALUES LISTED MAY HAVE A TOLERANCE OF ± 20%

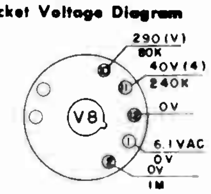


Fig. 30. Socket Voltage Diagram

DETAILED ANALYSIS

Defects of the RF and Video IF Circuits

1. POOR PICTURE DETAIL

(a) Misalignment of the video IF coils or the RF coils may cause poor detail. See Fig. 21E for the over-all response curve of the video IF. Check Video IF alignment RF and Oscillator alignment.

(b) Any overloading of the r-f, i-f or Video amplifier stages will cause distortion. Check the operation of the picture control to see that the bias may be varied by the control.

2. SOUND BARS IN PICTURE

Misalignment of traps L227 and L253 may allow adjacent channel sound to get onto the picture tube grid causing horizontal sound bars in the picture.

3. NO PICTURE, NO SOUND. RASTER NORMAL

This condition indicates a defect in the circuits of the RF head end, the video IF or the detector circuits of Y1.
Defective antenna connections.

Defects of the Video Amplifier

1. NO PICTURE, SOUND AND RASTER NORMAL

Open chokes L259, L261 or L262, L263 or open capacitor C268 in the video amplifier circuit will cause no picture.

2. BRIGHT PICTURE WITH BLACK LINES

A shorted capacitor C275 will give a very bright picture with black lines across the picture. The picture control will have no effect.

3. PICTURE DISTORTED OR SMEARED

If the resistance of R273 has increased the picture will be distorted at high values of picture control setting.
If the resistance of R269 and R272 has increased a smeared picture will result.

4. POOR DETAIL

Misalignment of the 4½ mc trap (L260, C270, C271) will cause a (busy background) or a trailing edge on picture elements.

5. WEAK PICTURE WITH BLACK LINES

If either L264 or C275 is open only a fraction of the signal will be coupled to the picture tube grid by the stray coupling.

Defects of the Picture Tube Circuit

1. NO PICTURE, NO RASTER, SOUND NORMAL

(a) Defective picture tube.
(b) An open brightness control (R276) circuit.
(c) No High Voltage to picture tube.

2. BLOOMING PICTURE AND POOR FOCUS

A gassy picture tube will cause the picture to bloom and will also cause poor focus. If C277 becomes shorted the picture will appear fuzzy or out of focus.

3. SOUND BARS IN PICTURE

Parts of the electron gun structure may vibrate under the influence of strong loudspeaker output causing sound bars in the picture tube.

Defects of the Horizontal Sweep Section

1. NO RASTER OR DIM RASTER

No raster indicates a lack of high voltage to the picture tube. This may be caused by a defect in the High Voltage Rectifier circuit V15, the Horizontal Oscillator V13B or the Horizontal Sweep Output Circuits V14 may not be functioning properly.
A short in the Horizontal Deflection circuits may result in low High Voltage to the picture tube and a dim raster.
Width control L353 may be shorted causing low High Voltage to the picture tube.

2. INSUFFICIENT SWEEP WIDTH

Insufficient sweep width may be caused by defects in the horizontal deflection circuits such as shorted Width control L353. Low B+ to V14.
Check waveform at grid of V14.

3. POOR HORIZONTAL LINEARITY

A short in L352 will cause poor horizontal linearity.
High leakage in C370 will cause poor linearity and increased sweep width.

4. PICTURE WILL NOT CENTER HORIZONTALLY

A short in C377 will increase the d-c current through the horizontal deflection coils which will shift the picture horizontally so that it may not be centered with the focus coil adjustment.

5. NO HORIZONTAL SYNC VERTICAL SYNC NORMAL

Check for defects in circuits of V12, V13A or V13B.

Defects of the Vertical Sweep Section

1. NO VERTICAL SYNC

Check capacitors C301, C302, C303.
Check resistors R301, R302.

2. POOR VERTICAL LINEARITY

If the capacitor C309 has lost its original capacity, linearity will be poor and height will be reduced.

3. INSUFFICIENT HEIGHT

If the B+ voltages are low to tubes V9 and V10 the Vertical height will be small.
If C308 develops excessive leakage Vertical height will be reduced.

4. NO VERTICAL DEFLECTION

Check for shorted capacitors C304, C305, C308.
Check for open Deflection coils of yoke.
Defective transformer T301.
Check circuits of V9 and V10.

Defects of the Common Sync Section

1. EXCESSIVE CONTRAST

A shorted capacitor C354 on pin 1 of V11 will result in excessive contrast which cannot be controlled by the picture control.

2. UNSTABLE PICTURE WITH EXCESSIVE CONTRAST

An open capacitor C353 will cause the picture to be shaky with excessive contrast.

3. POOR SYNC HOR. AND VERT. WITH BRIGHT LINES

An open capacitor C351 on pin 4 or V11 will cause bright lines at the top and bottom of the picture and poor vertical and horizontal sync.

4. NO VERTICAL OR HORIZONTAL SYNC

Open capacitor C354 will cause no horizontal or vertical sync.

Miscellaneous Defects

1. BARREL DISTORTION OF THE PICTURE

A shorted coil or shorted turns will cause barrel distortion and unsymmetrical trapezoidal distortion of the raster or picture.

2. NECK SHADOW

The deflection yoke should be pushed forward against the bell of the picture tube to avoid neck shadow.

3. DISTORTED PICTURE AND REVERSE ACTION OF PICTURE CONTROL

If C261 is shorted the picture control will have a reverse action, that is increasing the picture control will cause the contrast to diminish while decreasing the picture control will cause the contrast to increase.

Audio Defects

NO SOUND. PICTURE NORMAL

This indicates a defect in the circuits of V17, V18, V19, V20, V21 or the loudspeaker.
Misalignment of T401 or T402 may also cause no sound to be received.

BUZZ OR HUM IN THE SOUND

Misalignment of T402 secondary may cause buzz. Reverse the power plug in the power outlet.

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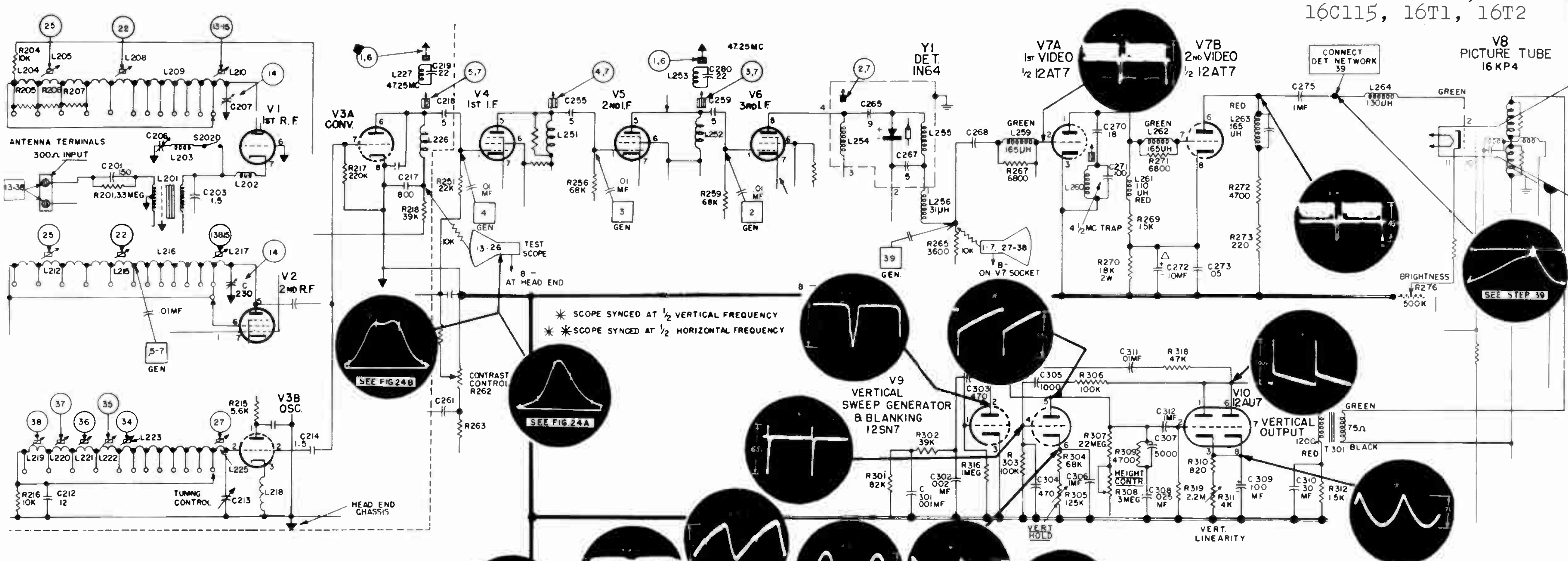
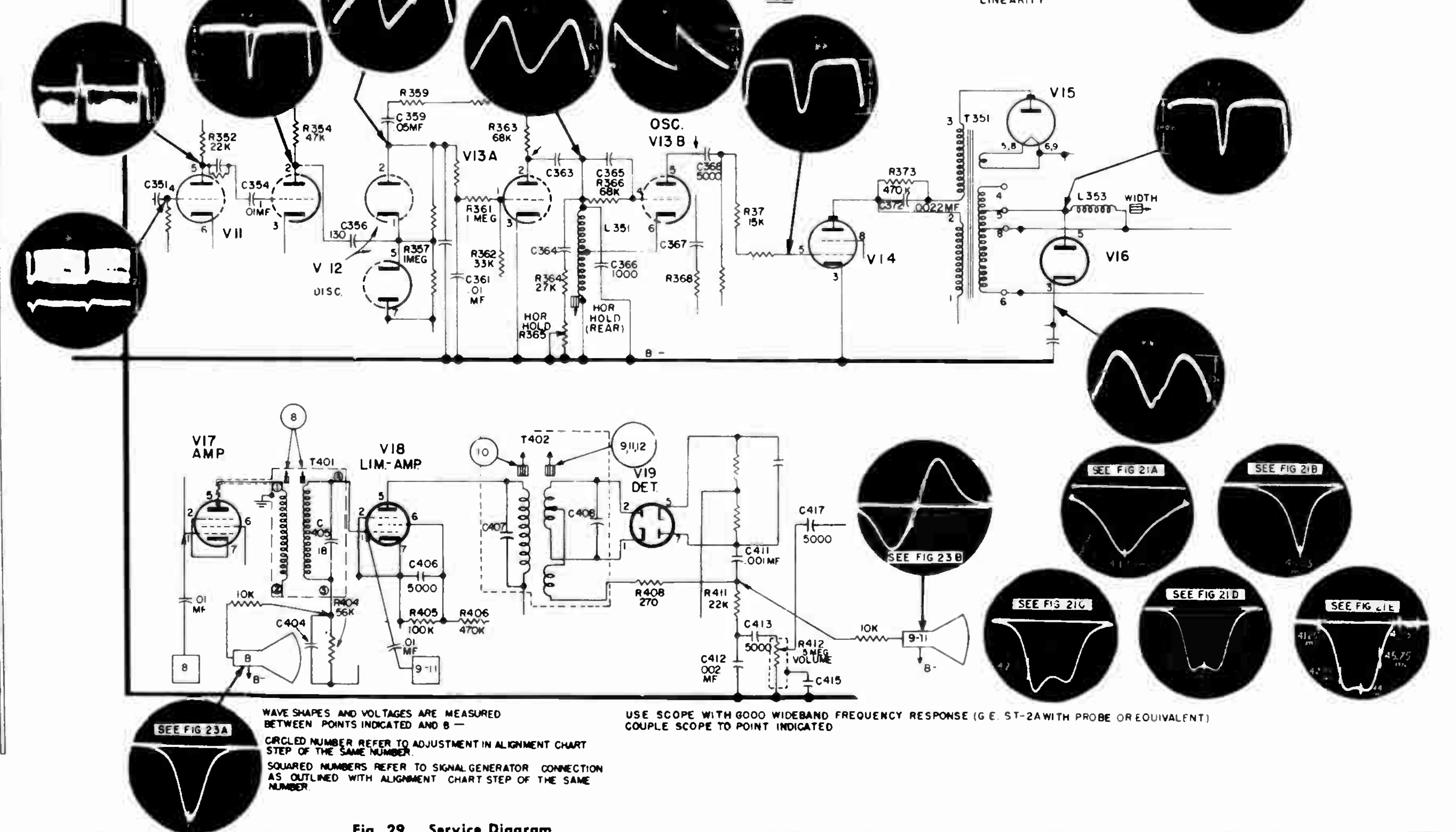
MODELS 16C110, 16C111, 16C115, 16T1, 16T2

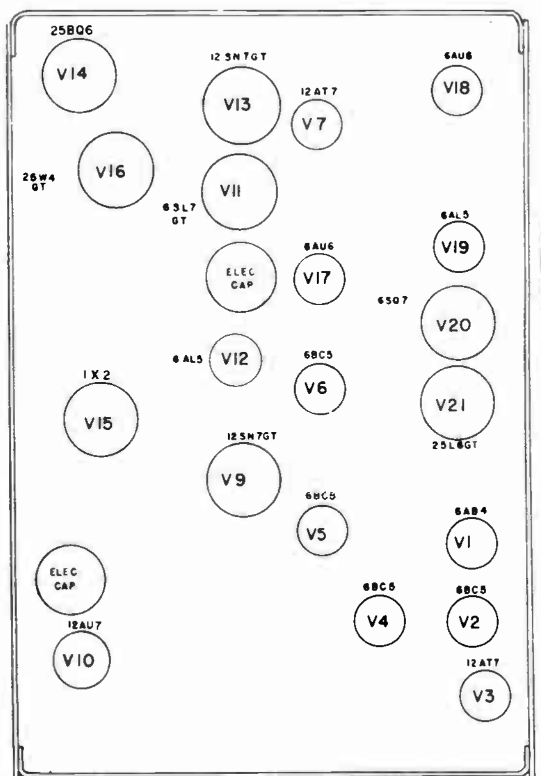




SERVICE DIAGRAM

The alignment procedure is shown in table form on pages 38 through 40. In order to accelerate the whole procedure, the service diagram (Figure 29) should be consulted. The encircled numbers indicate the number of the step of the alignment chart and the arrow points to the component to be adjusted. The generator is symbolized by a square with the number of the step of the alignment chart. The exact point of feed-in is indicated by the arrow connected with the numbered square. The oscilloscope is represented by the symbol of the cathode ray tube. The number inside the symbol refers to the step of the alignment chart. On the left side of the diagram is shown the tube location inside the chassis so that it is easy to locate the correct points for connection to the generator and the oscilloscope. In order to clarify the diagram, only those parts of the circuits are shown which are needed for location of the test points. Within the large circles are shown the waveform of an average television receiver, wherein the controls have been adjusted for a normal picture with correct contrast, height, width and linearity. Most measurements must be made when a signal is being received.

The oscilloscope of which the vertical amplifier has been precalibrated is used to make measurements at the point indicated by the arrow connected to the individual waveshape within the circle. The oscilloscope is synced at half of the respective sweep frequency of the circuit being analyzed.



BOTTOM VIEW

Fig. 29. Service Diagram

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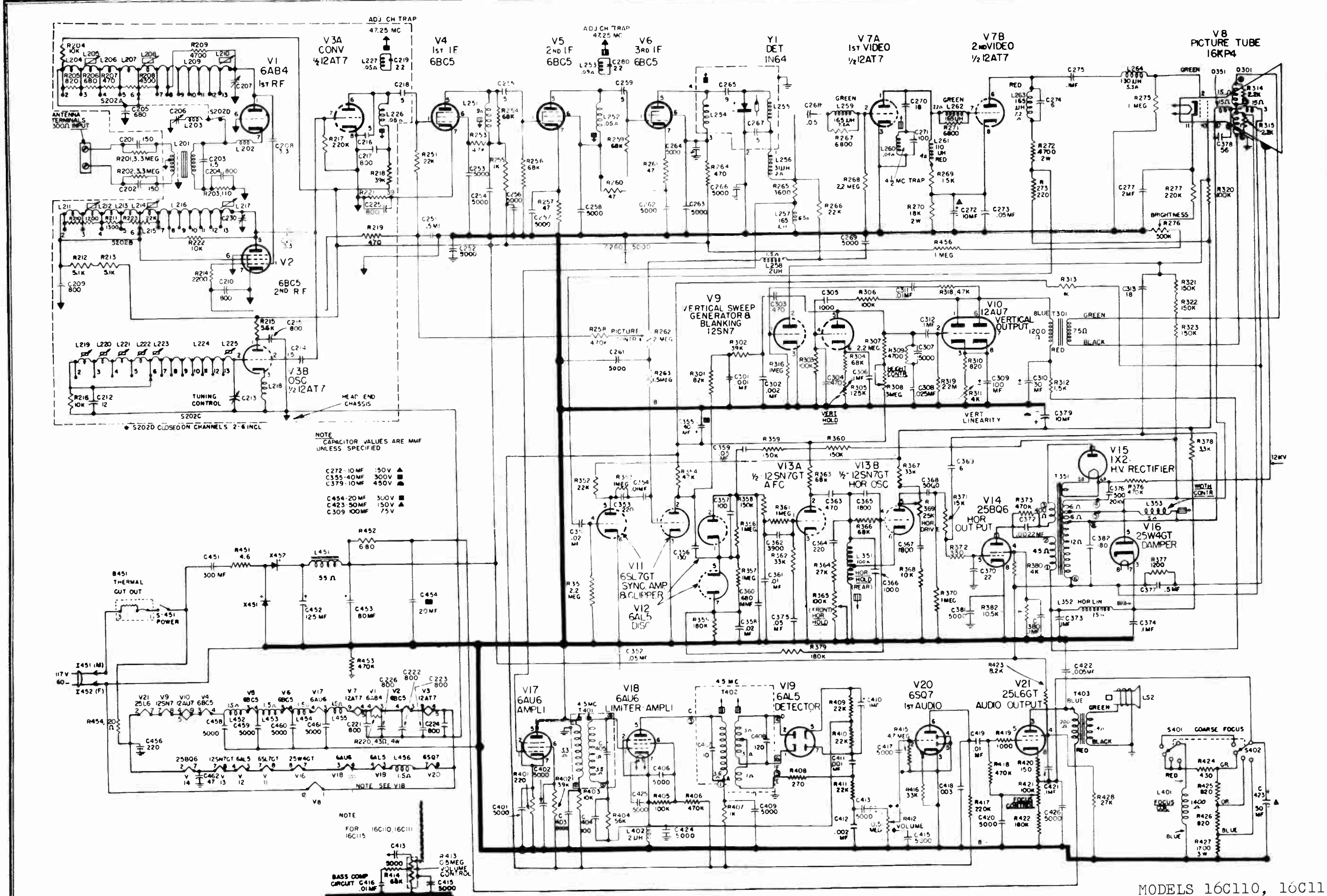

Fig. 31. Schematic Diagram—Models 16T1, 16T2, 16C110, 16C111, 16C115

MODELS 16C110, 16C111, 16C115, 16T1, 16T2

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MODELS 16T1, 16T2, 16C110, 16C111, 16C115
REPLACEMENT PARTS LIST

UNIVERSAL REPLACEMENT PARTS

Cat. No.	Symbol	Description
*UCC-035	C301, 411	CAPACITOR—.001 mfd., 600 v., paper
*UCC-036	C302, 412	CAPACITOR—.002 mf., 600 v., paper
*UCC-037	C418	CAPACITOR—.003 mf., 600 v., paper
*UCC-040	C416, 311, 354	CAPACITOR—.01 mfd., 600 v., paper
*UCC-041	C351, 358	CAPACITOR—.02 mf., 600 v., paper
*UCC-045	C273, 352, 268, 375, 359	CAPACITOR—.05 mf., 600 v., paper
*UCC-048	C275, 373, 374, 421, 312, 380	CAPACITOR—.1 mf., 600 v., paper
*UCC-050	C277	CAPACITOR—.2 mf., 200 v., paper
*UCC-052	C251, 377	CAPACITOR—.5 mf., 600 v., paper
*UCG-1005	C255, 259, 267, 216, 218	CAPACITOR—5 mmf., 500 v., silver mica
*UCG-1012	C370, 280	CAPACITOR—22 mmf., 500 v., silver mica
*UCG-1030	C408	CAPACITOR—120 mmf., silver mica
*UCG-2006	C212	CAPACITOR—12 mmf., 500 v., silver mica
*UCG-2010	C405, 270	CAPACITOR—18 mmf., silver mica
*UCG-2022	C281	CAPACITOR—56 mmf., silver mica
*UCU-002	C274	CAPACITOR—6 mmf., 500 v., silver mica
*UCU-028	C357, 404	CAPACITOR—100 mmf., 500 v., mica
*UCU-036	C456	CAPACITOR—220 mmf., 500 v., silver mica
*UCU-1036	C353, 364	CAPACITOR—220 mmf., mica
*UCU-1044	C303, 304, 363	CAPACITOR—470 mmf., 500 v., mica
*UCU-1052	C366	CAPACITOR—1000 mmf., 500 v. ±10%, mica
*UCU-1520	C462	CAPACITOR—47 mmf., 500 v., mica
*UCU-1528	C271	CAPACITOR—100 mmf., 500 v., mica
*UCU-2004	C407	CAPACITOR—10 mmf. ±5%
*UCU-2031	C356	CAPACITOR—130 mmf., 500 v., mica
*UCW-032	C201, 202	CAPACITOR—150 mmf., 300 v., ceramic
UJB-001		TERMINAL STRIP
*UJB-014		TERMINAL STRIP—4 terminals
*UJB-016		TERMINAL STRIP
*UJB-017		TERMINAL STRIP—2 terminals
*URD-015	R221	RESISTOR—39 ohms
*URD-017	R257, 260, 261	RESISTOR—47 ohms, ½ w., carbon
*URD-029	R420	RESISTOR—150 ohms, ½ w., carbon
*URD-033	R273, 401	RESISTOR—220 ohms, ½ w., carbon
*URD-035	R408	RESISTOR—270 ohms, ½ w., carbon
URD-037	R372	RESISTOR—33 ohms, ½ w., carbon
*URD-041	R219, 264, 207	RESISTOR—470 ohms, ½ w., carbon
*URD-045	R206	RESISTOR—680 ohms, ½ w., carbon
*URD-047	R205	RESISTOR—820 ohms, ½ w., carbon
*URD-049	R255, 407, 419	RESISTOR—1000 ohms, ½ w., carbon
*URD-051	R377, 210	RESISTOR—1200 ohms, ½ w., carbon
*URD-053	R269	RESISTOR—1500 ohms, ½ w., carbon
*URD-057	R214, 314, 315	RESISTOR—2200 ohms, ½ w., carbon
*URD-065	R309, 209	RESISTOR—4700 ohms, ½ w., carbon
*URD-073	R222, 403, 368	RESISTOR—10,000 ohms, ½ w., carbon
*URD-077	R371	RESISTOR—15,000 ohms, ½ w., carbon
*URD-081	R266, 411, 251, 253	RESISTOR—22,000 ohms, ½ w., carbon
*URD-083	R364	RESISTOR—27,000 ohms, ½ w., carbon
*URD-085	R362, 416	RESISTOR—33,000 ohms, ½ w., carbon
*URD-087	R302, 402	RESISTOR—39,000 ohms, ½ w., carbon
*URD-089	R354, 253, 318	RESISTOR—47,000 ohms, ½ w., carbon
*URD-091	R404	RESISTOR—56,000 ohms, ½ w., carbon
*URD-093	R254, 256, 259, 304, 366, 414	RESISTOR—68,000 ohms, ½ w., carbon
*URD-095	R301	RESISTOR—82,000 ohms, ½ w., carbon
*URD-101	R358	RESISTOR—150,000 ohms, ½ w., carbon
*URD-103	R379, 422, 355	RESISTOR—180,000 ohms, ½ w., carbon
*URD-105	R217, 277, 417	RESISTOR—220,000 ohms, ½ w., carbon
*URD-113	R258, 406, 418, 453, 373	RESISTOR—470,000 ohms, ½ w., carbon
*URD-121	R275, 353, 356, 357, 316, 361, 370, 456	RESISTOR—1 meg., ½ w., carbon
*URD-125	R263	RESISTOR—1.5 meg., ½ w., carbon
*URD-129	R268, 351, 307, 319	RESISTOR—2.2 meg., ½ w., carbon
*URD-133	R201, 202	RESISTOR—3.3 meg., ½ w., carbon
*URD-137	R415	RESISTOR—4.7 meg., ½ w., carbon
*URD-1052	R211	RESISTOR—1300 ohms, ±5%, ½ w., carbon
*URD-1062	R265	RESISTOR—3600 ohms ±5%, ½ w., carbon
*URD-1064	R208	RESISTOR—4300 ohms ±5%, ½ w., carbon
*URD-1073	R216	RESISTOR—10,000 ohms, ±5%, ½ w., carbon
*URD-1081	R409, 410	RESISTOR—22,000 ohms ±5%, ½ w., carbon
*URD-1097	R303, 306, 405, 320	RESISTOR—100,000 ohms, ½ w., carbon
*URE-049	R313	RESISTOR—1000 ohms, 1 w., carbon
*URE-053	R312	RESISTOR—1500 ohms, 1 w., carbon
*URE-061	R378	RESISTOR—3300 ohms, 1 w., carbon
*URE-067	R215	RESISTOR—5600 ohms, 1 w., carbon
*URE-071	R423	RESISTOR—82,000 ohms, 1 w., carbon
*URE-073	R204	RESISTOR—10,000 ohms, 1 w., carbon
*URE-081	R352	RESISTOR—22,000 ohms, 1 w., carbon
*URE-085	R367	RESISTOR—33,000 ohms, 1 w., carbon
*URE-087	R218	RESISTOR—39,000 ohms, 1 w., carbon
*URE-093	R363	RESISTOR—68,000 ohms, 1 w., carbon
*URE-101	R359, 360, 321, 322, 323	RESISTOR—150,000 ohms, 1 w., carbon
*URE-113	R376	RESISTOR—470,000 ohms, 1 w., carbon
*URE-1040	R424	RESISTOR—430 ohms ±5%, 1 w., carbon
*URE-1047	R425, 426, 310	RESISTOR—820 ohms ±5%, 1 w., carbon
*URE-1066	R212, 213	RESISTOR—5100 ohms ±5%, 1 w., carbon
*URF-045	R452	RESISTOR—680 ohms, 2 w., carbon
*URF-065	R272	RESISTOR—4700 ohms, 2 w., carbon
*URF-079	R270	RESISTOR—18,000 ohms, 2 w., carbon
*URF-083	R428	RESISTOR—27,000 ohms, 2 w., carbon
*S-1200D7		SPEAKER—Models 16C110, 16C111, 16C115
*S-527D7		SPEAKER—Models 16T1, 16T2

SPECIALIZED REPLACEMENT PARTS

Cat. No.	Symbol	Description
*RAB-117		BACK—Cabinet back, Models 16T1, 16T2
*RAB-118		BACK—Cabinet back, Models 16C-110, 16C111
*RAB-119		BACK—Cabinet back, Model 16C115
RAG-031		GRILLE—Model 16C115
RAV-115		CABINET—Model 16T1, less overlay, safety glass and rubber
RAV-116		CABINET—Model 16C110, less overlay, safety glass and rubber channels
RAV-117		CABINET—Model 16C115, less overlay, safety glass and rubber channels
RAV-118		CABINET—Model 16T2, less overlay, safety glass and rubber channels
RAV-119		CABINET—Model 16C111, less overlay, safety glass and rubber channels
*RCC-059	C422	CAPACITOR—.005 mf., 1000 v., paper
*RCC-101	C308	CAPACITOR—.025 mfd., 600 v., paper
RCC-102	C359	CAPACITOR—.05 mf., 600 v. paper
RCC-103	C306	CAPACITOR—.1 mf., 200 v
RCC-104	C373	CAPACITOR—.1 mf., 600 v. paper
RCC-105	C375	CAPACITOR—.05 mf., 200 v. paper
*RCE-090	C410	CAPACITOR—1 mf., 50 v., electrolytic
*RCE-092	C310	CAPACITOR—30 mf., 450 v., electrolytic
*RCE-100	C379, 355, 272	CAPACITOR—10 mf., 450 v., 40 mf., 300 v., 10 mf., 150 v., electrolytic
*RCE-110	C451	CAPACITOR—300 mf., 150 v., electrolytic
*RCE-111	C452	CAPACITOR—125 mf., 350 v., electrolytic
*RCE-112	C453	CAPACITOR—80 mf., 300 v., electrolytic
*RCE-115	C454, 423, 309	CAPACITOR—20 mf., 350 v., 50 mf., 100 v., 100 mf., 75 v., electrolytic
*RCN-018	C354, 361, 419	CAPACITOR—.01 mf., 600 v., paper molded
RCN-019	C372	CAPACITOR—.0022 mf., 1000 v., molded
*RCN-023	C376	CAPACITOR—500 mmf., 20,000 v
RCN-025	C361	CAPACITOR—.01 mf. ±10% 600 v
*RCN-029	C265	CAPACITOR—9 mmf., silver mica
*RCN-033	C365, 367	CAPACITOR—1800 mmf., 600 v. paper
*RCN-034	C362	CAPACITOR—3900 mmf., ±10% 600 v., paper
*RCU-286	C369	CAPACITOR—6 mmf., 800 v., mica
*RCU-290	C305	CAPACITOR—1000 mmf., 1000 v., mica
*RCU-294	C360	CAPACITOR—680 mmf., ±20% 500 v., mica
RCU-293	C313	CAPACITOR—18 mmf., 1500 v., mica
RCU-296	C382	CAPACITOR—180 mmf., mica 1500 v
RCU-297	C378	CAPACITOR—56 mmf., 800 v mica
*RCW-1056	C203, 214	CAPACITOR—1.5 mmf. ±.25 mmf., 500 v.
*RCW-1076	C208, 211	CAPACITOR—3.3 mf., ±.25 mf.
*RCW-3014	C252, 253, 254, 256, 257, 258, 260, 261, 262, 263, 264, 266, 269, 307, 368, 401, 402, 403, 406, 409, 413, 415, 417, 420, 424, 458, 459, 460, 461, 425, 426, 381	CAPACITOR—5000 mmf., 450 v.
*RCW-3026	C204, 209, 210, 215, 217, 221, 222, 223, 224, 225	CAPACITOR—800 mmf., 350 v., ceramic
*RCW-3027	C203	CAPACITOR—680 mmf., ceramic
*RCY-048	C207, 230	CAPACITOR—Trimmer
*RCY-059	C213	CAPACITOR—Trimmer capacitor
*RCY-060	C206	CAPACITOR—Trimmer for high channel trap
*RDC-032		CORD—For tuning control
RDE-077		OVERLAY—Metal Mask
*RDE-078		ESCUTCHEON and TRAP DOOR
RDK-159		KNOB—Fawn, Models 16T2, 16C111 (Brightness and Vertical Hold)
*RDK-168		KNOB—Brightness and Vertical Hold, Models 16T1, 16C110, 16C115
*RDK-188		KNOB—Channel Selector, Models 16T2, 16C111
*RDK-189		KNOB—Volume and ON-OFF, Models 16T2, 16C111
*RDK-190		KNOB—Tuning control knob
*RDK-191		KNOB—Picture control
*RDK-192		KNOB—Channel selector, Models 16T1, 16C110, 16C115
*RDK-193		KNOB—Volume and ON-OFF, Models 16T1, 16C110, 16C115
*RDK-197		KNOB—Focus and Horizontal Hold Models 16T1, 16C110, 16C115
RDM-022		MASK—Speaker mask for Models 16T1, 16T2
RDW-040		SAFETY GLASS
*REI-014		CORE—Brass screw for L210, L217
*REI-016		CORE—Iron core for L254
*RER-008	X451, 452	RECTIFIER—Selenium, 350 ma.
*RET-003		ION TRAP
*RHC-024		CLIP—For mounting electrolytic
*RHG-004		GROMMET—1/16 in. chassis
*RHG-010		GROMMET—Shock mounting
*RHM-066		RING—Centering ring for shipping pix tube
*RHS-045		SCREW—Headless, L223, L205, L208
*RHS-046		SCREW—Headless, L219, L220, L221, L222
*RII-021		INSULATOR—For mounting control
*RII-023		INSULATOR—Yoke
*RII-026		INSULATOR—Grommet in high voltage shield
*RII-041		INSULATOR—For mounting rectifier
*RII-042		INSULATOR—For interlock
*RII-043		INSULATOR—For antenna terminals
*RII-044		SUPPORT—Power cord
RJC-001		PIN—Speaker contact pin
RJC-008		CONNECTOR—High voltage anode connector
*RJJ-007	I451	RECEPTACLE—For power cord, male rivets to chassis
*RJS-003		SOCKET—Octal tube socket for V11, V9, V20
*RJS-026		SOCKET—Tube socket, octal, for V21
*RJS-031		SOCKET—Tube socket for V14
*RJS-085		SOCKET—Tube socket for V16
*RJS-127		SOCKET—Tube socket, 9-pin, for V3
*RJS-132		SOCKET—Tube socket, 7-pin, for V12, V19
*RJS-133		SOCKET—Tube socket, 7-pin, shielded, for V5, V6, V18
*RJS-135		SOCKET—Shock mounting, V13
*RJS-138		SOCKET—Tube socket, 9-pin, V7
*RJS-139		SOCKET—Tube socket, 9-pin, miniature for V10
*RJS-144		SOCKET—Tube socket, 7-pin, for V4, V1, V2, V17
*RJX-040		RF HEAD-END—RF tuner
*RLA-034	L201	TRANSFORMER—Input
*RLC-091	L351	COIL—Horizontal oscillator
*RLC-095	L219	COIL—Oscillator, for Channel #2
*RLC-096	L220, 207, 214	COIL—Oscillator, for Channel #3, Channel #5, 1st and 2nd RF
*RLC-097	L222	COIL—Oscillator, for Channel #5
*RLC-098	L223	COIL—Oscillator, for Channel #6
*RLC-099	L225	COIL—Oscillator, for Channel #13
*RLD-014	L353	COIL—Width control
*RLD-016	L352	COIL—Horizontal linearity
RLD-024	D351, 301	YOKE—Deflection
*RLF-024	L256	CHOKE COIL—RF coil
RLF-038	L401	COIL—Focus
*RLI-003	L218	COIL—Cathode choke
*RLI-038	L257, 263	COIL—Video choke coil
*RLI-072	L206, 212	COIL—Channel #4, 1st RF, Channel #3, 2nd RF
*RLI-077	L205	COIL—Channel #3, 1st RF
RLI-085	L402	COIL—Choke coil
*RLI-093	L259, T401, R262, 267, 271	COIL—Video choke
*RLI-096	L251	COIL—2nd video IF coil
*RLI-097	T401	COIL—First audio IF coil
*RLI-099	L221	COIL—Oscillator coil, Channel #4
*RLI-100	L260, 270, 271	TRAP—4.5 mc video trap
*RLI-106	L202	COIL—Choke coil
*RLI-108	L261	CHOKE—Video choke
*RLI-109	L264	CHOKE—Video choke
*RLI-110	L252, 253	COIL—IF coil
*RLI-114	L203	COIL—Trap coil
*RLI-116	L208, 215	COIL—Channel #6, 1st and 2nd RF
*RLI-117	L204	COIL—Channel #2; 1st RF
*RLI-118	L213	COIL—Channel #4, 2nd RF
*RLI-119	L211	COIL—Channel #2, 2nd RF
*RLI-120	L210	COIL—Channel #13, 1st RF
*RLI-121	L217	COIL—Channel #13, 2nd RF
*RLI-122	L452, 453, 454, 455, 456, 258	COIL—Heater choke
*RLP-016	L226, 227, 219, 218	COIL—Converter plate
*RLX-029	L254, 255, 1N64, C265, C267	VIDEO DETECTOR ASSEMBLY
*RMC-017		CLIP—⅜ in. for electrolytic
RMM-147		TUBE CUSHION, under pix tube, 2 required
RMM-148		TUBE CUSHION, front pix tube, 1 required
RMM-149		TUBE CUSHION, top pix tube under tube support brackets, 2 required
*RMS-130		SPRING—Tension spring for tuning control cord
RMS-219		STRAP—Picture tube strap assembly
RMS-220		CLIP—Spring grounding clip contacts pix tube
RMU-055		EXTENSION SHAFT—For L352 and L353
*RMU-058		SHAFT—Tubular shaft on switch shaft for tuning
*RMX-169		PULLEY AND HUB ASSEMBLY—For tuning control
RRC-096	R308	POTENTIOMETER—3 meg., height
RRC-127	R311	POTENTIOMETER—Vertical Linearity
RRC-128	R412, 258	POTENTIOMETER—Dual, 500 K, and 2 meg., Volume and Picture, Models 16T1, 16T2
RRC-130	R421, 276	POTENTIOMETER—Dual, 100K, 500K, Focus and Brightness
RRC-131	R412, 258, S451	POTENTIOMETER—Dual, 500K, 2 meg., Volume and Picture, Models 16C110, 16C111, 16C115
RRC-136	R305, 365	POTENTIOMETER—Dual, 100K, 125K, Vertical and Horizontal Hold
RRC-140	R369	POTENTIOMETER—25K, Horizontal Drive
RRW-045	R427	RESISTOR—1700 ohms, 5 w., w.w.
RRW-048	R451	RESISTOR—4.6 ohms, 5 w., w.w.
RRW-049	R220	RESISTOR—43 ohms, 4 w.
RRW-051	R454	RESISTOR—20 ohms, Globar temperature compensating
RRW-052	R382	RESISTOR—10.5K, Globar voltage sensitive resistor
RRW-053	R380	RESISTOR—4000 ohms, 7 w., w.w.
*RSR-002	B451	CUT-OUT—Thermal cut-out
*RSW-066	S401, 402	SWITCH—Focus switch
*RTD-008	T402	TRANSFORMER—Ratio detector
*RTL-096	L451	REACTOR—Filter
RTO-064	T301	TRANSFORMER—Vertical sweep output
*RTO-081	T403	TRANSFORMER—Audio output for Models 16T1, 16T2
RTO-085	T351, R373, C372	TRANSFORMER—Horizontal sweep output
*RTO-086	T403	TRANSFORMER—Audio output for Models 16C110, 16C111, 16C115
RWL-019	I452	POWER CORD AND FEMALE PLUG—For 16T1, 16T2
RWL-021	I452	POWER CORD AND FEMALE PLUG—For 16C110, 16C111, 16C-115
RWX-025		SOCKET—Picture tube socket assembly

* Parts used on previous models.

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GENERAL DISCUSSION OF THE ELECTUNER DESIGN

The Electuner Model 45 is a capacity tuned TV Tuner covering Channels 2 through 6 in the first (Lo) range and 7 through 13 in a second (Hi) range. Continuous tuning is provided in each range. In order to facilitate tuning, a certain amount of additional coverage above the highest and below the lowest tunable channel in each range is provided. The extra coverage is referred to as "overtravel" in this text. A two position switch, actuated by a knob concentric with the fine tuning shaft, is used to switch all circuits and will be referred to as the "Range Switch".

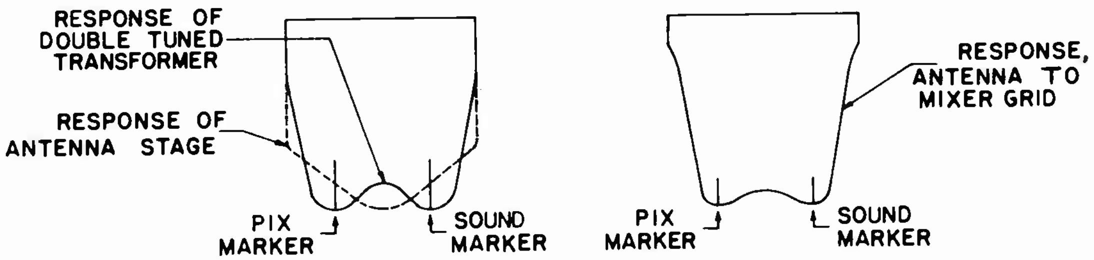
Two tubes are employed as follows:

Model 45-A		Model 45-B	
1 - 6AK5	RF Amplifier	1 - 6CB6	RF Amplifier
1 - 6J6	Oscillator-Mixer	1 - 6J6	Oscillator-Mixer

A four section 180° rotation gang condenser is used for tuning. A mechanical drive ratio of approximately 5 to 1 is provided between the main tuning shaft and the gang condenser shaft.

The following circuits are tuned in both ranges: Antenna, RF Plate, Mixer Grid, and the Oscillator Plate - Grid circuit. A split stator design is incorporated in the gang condenser section used for tuning the oscillator. All circuits are designed to track continuously through both the Hi and Lo ranges.

The overall RF response from the antenna terminals to the mixer grid is determined in each range by the combined selectivities of a single tuned antenna circuit and a double tuned overcoupled inter-stage transformer circuit as shown in the sketches below.



The antenna stage transformer consists of a tuned secondary suitably coupled to a primary designed to match a 300 ohm antenna transmission line. In the Lo range, the entire secondary inductance is tuned. In the Hi range, by means of a tap, only a part of the secondary inductance is tuned in conjunction with a suitable inductance shunt. The primary is common to both the Hi and Lo ranges. An electrostatic shield is provided between the primary and secondary to minimize the asymmetrical capacitance coupling which generally impairs the balance to unbalance response of an antenna input system.

Two overcoupled double-tuned interstage transformers are provided, one for the Lo range, and a second for the Hi range. In each transformer low side mutual inductance is employed to provide the coupling necessary to obtain the required bandwidth. A 0.68 MMF high side coupling condenser is employed to oppose the low side mutual inductive coupling and thereby minimize variations of bandwidth as a function of operation frequency.

In the Model 45B, which employs a 6CB6 RF Amplifier, a slight amount of inductance is intentionally introduced in series with the screen bypass capacitor so as to partially neutralize the input grid conductance in the high channels, thereby reducing the loading on the antenna transformer secondary. The inductance takes the form of about 3/8" of wire in each connecting lead of the bypass condenser. Because of the higher input resistance of the grid of the 6AK5, neutralization of input conductance is not required in the Model 45A.

The Model 45A differs principally from the Model 45B in Hi range performance. The use of the 6AK5 in the Model 45A results in an increased gain and lower noise factor in channels 7 - 13. However, because of the difference in grid loading and interelectrode capacities the tubes are not directly interchangeable. Attempts at substitution of the 6AK5 for the 6CB6 or vice versa will result in considerable mistracking of the antenna and RF tuning and in some instances may produce instability in the RF amplifier section.

The oscillator stage utilizes one triode section of the 6J6 in a stable low drift Colpitts circuit. Circuit parameters have been chosen to guarantee satisfactory operation over a wide range of operating voltages. Sufficient oscillator injection is provided to the mixer stage to accomodate power line voltage fluctuations and variations in +B caused by AGC action in normal receiver applications. The oscillator operates above the signal frequency in both ranges.

The mixer circuit uses the second triode section of the 6J6, its grid is tuned by a section of the gang condenser. Its plate circuit may feed either a series IF output coil or some form of double tuned IF transformer, depending on the receiver manufacturer's requirements.

Various sound and picture IF frequencies are used in both the 20 Mc and 40 Mc regions and in every instance the Electuner is tracked to the required IF of the receiver design. For any installation, the receiver manufacturer's service notes should be consulted for the applicable intermediate frequencies, inasmuch as both tracking and frequency coverage are involved.

Either a shunt fed heater system or a series heater connection may be used. Tuners employing either system are not strictly interchangeable since some modification in the heater filter system is generally involved and internal connections which are not readily accessible in the final assembly are encountered.

The normally recommended B+ voltage is 125V. The actual operating value may vary between 90 and 160 volts depending on the receiver application. With a B+ voltage of 125 volts and -1 volt on the AGC terminals of the tuner a +B drain of approximately 20 milliamperes is normal.

In accordance with Figure 2, the following tuning adjustments are available at the top of the tuner chassis:

Antenna trimmer; RF amplifier plate trimmer; mixer grid trimmer; oscillator grid trimmer; oscillator plate trimmer; and IF adjustments. The recommended use of each of the adjustments is discussed in the alignment procedure outlines in this text.

EQUIPMENT REQUIRED FOR ALIGNMENT

(1) Sweep Generator
(2) Oscilloscope
(3) Electronic Voltmeter
(4) RF Marker Generator
(5) Pix and Sound IF Marker Generator
(6) Bias supply 2-1.5 volt Dry Cells
(7) IN 34 Crystal Detector

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SUGGESTED SUITABLE EQUIPMENT

(1) Sweep Generator similar to RCA type WR59A, covering frequencies of 54 to 88 Mc, and 174 to 216 Mc with a minimum sweep of 10 Mc in any channel, and a 300 ohm balanced output at least .1 volt line to line.
(2) Oscilloscope equivalent in vertical deflection sensitivity to DuMont type 208-B.
(3) Electronic voltmeter similar to the Voltohmyst.
(4) RF marker generator similar to RCA type WR-39A.
(5) Pix and sound IF marker generator may be crystal controlled oscillators in the vicinity of 25.75 Mc and 21.25 Mc (actually whatever frequency receiver manufacturer lists as the correct pix and sound IF frequency for the particular set in question). As alternates, either a second WR-39-A or an all wave signal generator of suitable accuracy may be used to supply IF markers.

EQUIPMENT SET-UP See Fig. 1

DISCUSSION OF EQUIPMENT SET-UP

In reference to Figure 1, the following precautions should be taken in making the equipment set-up.
(1) The detector circuit should be so constructed as to maintain leads as short as possible. Connection of the detector circuit to the 1st IF grid terminal (See Fig. 1 for location) should also be made with short leads.
(2) Shielded leads should be used in making the following connections to reduce hum and synchronous voltage pick-up.
   (A) The lead for observation of the RF response from the scope isolating resistor (10 K ohms located at the tuner "looker point") to the RF output switch position of the scope switch.
   (B) The connection from the IF detector circuit output to the IF switch position of the scope switch.
   (C) The connection from the sweep generator to the horizontal input of the scope. (Use externally generated sweep instead of internal oscilloscope sweep in order to obtain synchronization).
(3) The single pole double throw "Scope Switch" should be located at the vertical input terminals of the scope. This switching arrangement will permit observation of either the IF response or the overall RF response. The aforementioned positions will be referred to in subsequent text as the "IF" and "RF" positions respectively.
(4) The marker generator coupling condenser should be as small a value as possible to prevent any effect on tuner response, but must be large enough to permit easy observation of markers on either the IF response or overall RF response. (Approximately 2 or 3 MMF should be satisfactory in most cases.
(5) For all tuner alignment tests which are outlined in this text, remove the second IF amplifier tube from the receiver, or bypass its plate circuit with approximately 1000 MMF to prevent coupling back from the receiver IF system.
(6) In all of the following tests the oscilloscope vertical gain should be as close to maximum gain as possible, consistent with hum and synchronous voltage interference limitations. This precaution will allow the use of low levels from RF Sweep Generator and increase the visibility of IF and RF markers.

PROCEDURE FOR OSCILLATOR ALIGNMENT

OVERTRAVEL CHART FOR OSCILLATOR COVERAGE

CHANNEL	OVERTRAVEL	MARKER FREQ. MC	OSC END FREQ. MC
13	+4.5 Mc	215.75	(215.75 +Pix IF)
7	-4.5 Mc	175.25	(175.25 +Sound IF)
6	+1.5 Mc	84.75	(84.75 +Pix IF)
2	-3.0 Mc	56.75	(56.75 +Sound IF)

REFERENCE DATA - TV ALLOCATIONS

CHANNEL NO.	PICTURE CARRIER Mc	SOUND CARRIER Mc
2	55.25	59.75
3	61.25	65.75
4	67.25	71.75
5	77.25	81.75
6	83.25	87.75
7	175.25	179.75
8	181.25	185.75
9	187.25	191.75
10	193.25	197.75
11	199.25	203.75
12	205.25	209.75
13	211.25	215.75

The design of all Electuners is such that the oscillator will automatically track, separated by IF, with the tuning indicator dial calibration in each range when the total oscillator frequency range is adjusted to tune the channel assignments of 7-13 and 2-6 plus and minus the additional frequency coverages listed in the overtravel chart above. In other words, it is only necessary to set the oscillator to prescribed end points in each tuning range for proper tuning.

In making adjustments of oscillator tuning it should be noted that any change in the setting of the Hi range oscillator trimmer will also affect the Lo range oscillator tuning. However, because of the switching arrangements. adjustments of the Lo range oscillator trimmer will not affect the Hi range oscillator frequency adjustment.

A step by step outline of oscillator adjustments based on an equipment set up as shown in Fig. 1 and related to the tuning elements illustrated in Fig. 2 follows. For purposes of illustration only a sound IF of 21.25 Mc and a picture IF of 25.75 Mc are assumed. For any actual receiver application consult the set manufacturer's service notes for the exact IF's.

HI RANGE OSCILLATOR ALIGNMENT

It must be noted that there is a slight shift of the oscillator frequency in the Hi range only when the bottom cover shield is removed from the tuner. Generally, if the oscillator overtravel is correctly adjusted at the low end of the Hi range with the cover off, a frequency shift of about .1 to .2 Mc to a higher frequency is encountered when the cover is mounted in place. Therefore, final checks must be made with the shield cover in place.

(1) Align oscillator frequency at low end of Hi range as follows:

Remove bottom cover. Turn tuner range switch to Hi range. Rotate variable condenser of tuner to maximum capacity (counter clockwise rotation of fine tuning knob). Turn sweep generator to channel 7. Adjust sweep width to maximum. Feed in an RF marker generator frequency of 175.25 Mc. Set scope switch (Fig.1) to IF output position. Inject required sound IF marker (i.e. 21.25 Mc). Using a non-metallic alignment tool (bakelite or plastic) vary the spacing of the turns of the Hi range oscillator coil (See Fig.2) so as to make the RF and IF markers coincide on the IF response curve viewed on the oscilloscope. Replace tuner bottom cover, and note any frequency shift between markers. Remove tuner cover and make a compensating adjustment if necessary, and repeat until proper oscillator setting is obtained. Increasing the separation between turns will raise the oscillator frequency. Conversely pushing turns closer together will lower the oscillator frequency.

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(2) Align Oscillator frequency at high end of Hi range as follows:

With the bottom cover in place, rotate the tuner variable condenser to minimum capacity (maximum clockwise rotation at the fine tuning knob). Turn sweep generator to channel 13. Feed in an RF marker generator frequency of 215.75 Mc and an IF picture marker (i.e. 25.75 Mc). Adjust the oscillator grid trimmer (Hi range Osc. trimmer Fig.2) to make the RF and IF markers coincide on the IF response curve viewed on the oscilloscope.

(3) Repeat steps (1) and (2) until proper end frequencies are reached at maximum and minimum capacity settings of the variable condenser. This completes the Hi range oscillator tuning.

LO RANGE OSCILLATOR ALIGNMENT

(4) Align oscillator frequency at low end of Lo range as follows:

Remove bottom cover of tuner and turn the range switch to Lo range setting. Rotate variable condenser of tuner to maximum capacity (max. counter clockwise rotation of fine tuning knob). Turn sweep generator to channel 2. Feed in an RF marker generator frequency of 56.75 Mc and a sound IF marker (i.e. 21.25 Mc). Using a non-metallic alignment tool, vary the spacing between turns of the Lo range oscillator coil (See Fig.2) to make the RF and IF markers coincide on the IF response as viewed on the oscilloscope.

(5) Align oscillator frequency at high end of Lo range as follows:

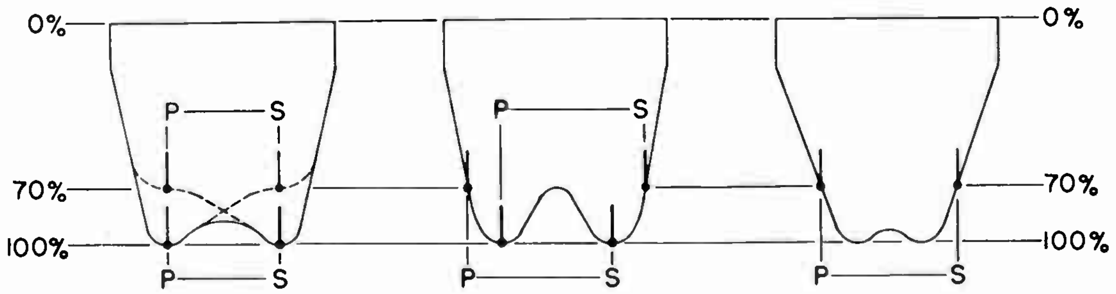
Rotate the tuner variable condenser to minimum capacity (maximum clockwise rotation of the fine tuning knob). Turn the sweep generator to channel 6. Feed in an RF marker generator frequency of 84.35 Mc and an IF picture marker (i.e. 25.75 Mc). Adjust the oscillator plate trimmer (Lo range osc. trimmer - Fig. 2) to make the RF and IF markers coincide on the IF response as viewed on the oscilloscope.

(6) Replace cover on tuner and recheck alignment of steps (4) and (5) making slight adjustments if necessary.

(7) Recheck all four oscillator frequencies as per steps (1), (2), (4), and (5) for final recheck.

PROCEDURE FOR RF PASSBAND ALIGNMENT

Since continuous tracking over each entire range (Hi and Lo) is functional to the Electuner design, the tracking problem is simplified to the extend that alignment of only four channels, that is 2 and 6 in the Lo range, and 7 and 13 in the Hi range automatically results in alignment of all channels from 2-13 inclusive.



ACCEPTABLE RF PASS BANDS AND TRACKING

Before undertaking RF pass band alignment, it is advisable to check oscillator coverage as per steps (1) through (7).

In order to check alignment of the RF pass bands, an equipment set up as per Fig. 1 is required. Refer to Fig. 2 for location of the various RF coils and trimmer capacitors mentioned in the following alignment procedure.

In checking RF pass bands it is important that all extra capacity at the antenna input terminals be kept at a minimum. Short leads from the sweep generator are necessary and if any form of clips are used, the clips should be separated as much as possible. The sweep generator should be fed in directly at the antenna terminals of the tuner, and the antenna feed line from the rear of the receiver disconnected from the tuner.

(8) Align Channel 7 RF Pass Band as follows:

Remove the tuner bottom cover and with the tuner range switch set for Hi range reception turn the fine tuning knob so that the pointer is at channel 7 on the dial calibration. Set the sweep generator to channel 7. Feed in a channel 7 RF picture marker signal of 175.25 Mc and an IF picture marker (i.e. 25.75 Mc). With the scope switch (Fig. 1) at IF output adjust the fine tuning knob so that the RF and IF markers coincide on the IF response as viewed on the oscilloscope. Leave the fine tuning in the latter setting for the remainder of channel 7 RF pass band alignment. Switch the scope switch to the RF output position. If the RF response differs noticeably from those illustrated under the heading of acceptable RF passbands shown above, proceed as follows:--Adjust the inductance of the Hi range RF plate coil (See Fig. 2) and then the Hi range mixer grid coil for proper bandwidth and the Hi range antenna coil for symmetry. In determining bandwidth, it will be necessary to adjust the RF marker generator alternately between the channel 7 picture and sound carrier frequencies 175.25 Mc and 179.75 Mc respectively. Proper alignment of the RF coils is attained when a slight variation of the inductance of either the RF plate coil or mixer grid coil results in a frequency shift of the entire response and no noticeable narrowing of bandwidth. When the antenna coil is properly adjusted, a slight variation of its inductance will cause both response peaks to rock slightly. If only one peak moves, the antenna is staggered away from the center of the passband. The inductance of the Hi range coils is controlled by pushing the respective coils on and off brass studs. Pushing any coil on to the stud will decrease its inductance (raise the frequency) and conversely pulling the coil away from the stud increases its inductance. The bandwidth of the response in channel 7 interstage transformer is controlled by the lead dressing of the returns of the RF plate coil and mixer grid coil with respect to the cut-out or window in the RF shield plate. If the ground ends of both coils are pulled out so as to cross the window, the coupling increases and a greater separation or peaks is encountered. For maximum gain the bandwidth should be adjusted so that the response is no greater than required to keep the sound and picture carrier frequencies on the peaks of the overall RF response. After alignment replace the tuner bottom cover and observe RF pass band. It may be necessary to remove the cover and make a slight compensating adjustment of the coils.

(9) Align Channel 13 RF Pass Band as follows:

With the bottom cover on the tuner, turn the fine tuning knob so that the pointer falls on channel 13 on the dial. Turn the sweep generator to channel 13. Feed in a channel 13 RF sound marker (215.75 Mc) and an IF sound marker (i.e. 21.25 Mc). With the scope switch (Fig.1) at IF output, adjust the fine tuning knob so that the RF and IF markers coincide on the IF response as viewed on the scope. Leave the fine tuning in the latter setting for the rest of the RF passband alignment procedure which follows. Switch the scope to RF output position. If the RF response differs noticeably from the acceptable RF passbands shown, proceed as follows:

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Adjust the antenna trimmer, the RF plate trimmer, and mixer grid trimmer for proper bandpass and maximum amplitude of response. Normally the antenna trimmer operates in the middle of its range; the RF plate operates toward maximum capacity and the mixer grid trimmer operates toward its minimum capacity setting (least screw engagement). In determining bandwidth, it will be necessary to shift the RF marker generator back and forth between the sound and picture carrier frequencies of channel 13, that is, 215.75 Mc and 211.25 Mc.

(10) After aligning the RF channel 13 with the bottom cover on the tuner, return to channel 7 and examine its pass band, as per step (8). A slight compensating change in inductance may be necessary if the trimmer settings were changed in step (9). Repeat the checks outlined in steps (8) and (9) compromising the adjustments for tilt if necessary, until satisfactory Hi range RF pass bands are obtained.

(11) Align Channel 2 RF Passband as follows:

With the tuner range switch set for Lo range reception, turn the fine tuning knob so that the pointer is at channel 2 according to the dial calibration. Set the sweep generator to channel 2. Feed in an RF marker signal of 59.75 Mc and an IF sound marker (i.e. 21.25 Mc). With the scope switch (Fig. 1) at IF output, adjust the fine tuning knob so that the RF and IF markers coincide on the IF response as viewed on the oscilloscope. Leave the tuning in the latter setting for the remainder of Channel 2 RF passband alignment. Switch the scope switch to the RF output position. If the RF passband does not appear satisfactory, in accordance with the acceptable RF passbands shown, proceed as follows:

Alternate the RF marker generator between channel 2 sound and picture carrier frequencies, that is 59.75 Mc and 55.25 Mc while performing the alignment of the RF so as to simultaneously determine proper bandwidth and tuning. The Lo range RF plate, mixer grid and antenna transformer secondary inductance are to be adjusted by spacing their respective turns until the desired passband is obtained. The bandwidth of the interstage overcoupled circuit may be altered by the Lo range mutual coil (See Fig.1). At proper alignment, slight variations of the RF plate or mixer grid coil inductance should cause no narrowing of the passband, and variations of the antenna transformer secondary inductance should cause a rocking of both peaks of the overall response. If only one peak of the response is affected by a slight change in antenna secondary inductance, the antenna is staggered away from the center of the double tuned circuit response. As regards to the Lo range mutual coil, squeezing the turns together will increase inductance and broaden the response, spacing turns apart will narrow the response. After alignment replace bottom cover and note if any compensating adjustment is necessary.

(12) Align Channel 6 RF Pass Band as follows:

With the bottom cover of the tuner in place, turn the fine tuning knob so that the pointer falls on channel 6 on the dial. Turn the Sweep generator to channel 6. Feed in an RF marker of 83.25 Mc and a picture IF marker (i.e. 25.75 Mc). With the scope switch (fig.1) at IF output, adjust the fine tuning knob so that the RF and IF markers coincide on the IF response as viewed on the oscilloscope. Leave the tuning at the latter setting for the remainder of channel 6 alignment. Switch the scope switch to the RF output position. If the RF response is not satisfactory as per the illustrations, proceed as follows:

Alternate the RF marker generator between channel 6 sound and picture carrier frequencies, that is 87.75 Mc and 83.25 Mc as required while performing the alignment so as to simultaneously determine bandwidth and tuning. Remove the bottom cover of the tuner and slightly alter the inductance of the Lo range RF plate and mixer grid coils and antenna secondary bearing in mind that Channel 2 response will be altered. Therefore, keep the changes at a minimum.

(13) Return to channel 2 and examine its passband as per step (11) and if tilt is excessive, select a compromise tuning of the Lo range coils which gives satisfactory passbands in both channels 2 and 6 with the tuner bottom cover in place.

SERVICE NOTES

(1) Tube replacement

In replacing defective tubes in the Electuner, use the same tube type as called for by the receiver manufacturer's Service Notes. Do not attempt to substitute alternate pentode types such as the 6AC5, 6BC5, or 6AK5 for the type 6CB6 RF amplifier in the Model 45-B. Similarly, in the Model 45-A, use only type 6AK5 tubes in the RF amplifier socket.

In general, RF amplifier tubes may be replaced by the same type without the need of tuner RF realignment. An occasional extreme limit tube may be encountered which will call for a minor correction of the antenna trimmer setting. However, in the latter event, it will undoubtedly be found more expedient to select another tube and avoid the necessity of aligning the RF pass bands.

In replacing type 6J6 tubes, check for injection voltage at the "Looker Point" (Fig.1) to determine that adequate oscillator injection voltage is provided to the mixer grid. Use a Voltohmyst or equivalent vacuum tube type voltmeter. Normal injection should be at least -2.0 volts. Some variations of tube capacity will be encountered from one 6J6 to another. The capacity variations will affect the oscillator coverage and tracking to some extent. If after replacement of the 6J6, an air check of the receiver indicates that the end channels 2, 6, 7, and 13 to be within the tuning range and in agreement with the dial calibration, no oscillator adjustments are necessary. Minor changes of oscillator tuning range due to tube capacity variation may be accommodated by the oscillator grid trimmer. Adjustment should be made with the receiver tuned in the vicinity of channel 13.

(2) Replacement of Parts.

Any component replacement should be made with parts of equivalent physical size and value within the specified tolerance. All Hi range series pads are specified to be within ±5% of published values. Replacement of any component in frequency determining circuits should be followed with an electrical check of oscillator coverage and RF alignment as outlined in these notes.

The gang condenser is closely tracked from section to section and also to a prescribed capacity vs. rotation curve. Any attempt to alter the capacity to favor any one channel will disturb other channels in both ranges. In working inside the tuner, every caution should be exercised to avoid bending the gang condenser plates.

(3) Drive Cord Replacement.

Figure 3 illustrates the details of the drive cord arrangement. Details of cord length, stringing and fastening are shown. The details must be adhered to closely in order to avoid slippage, excessive torque, and wear. The cord should be of the fibre glass core, nylon braid variety.

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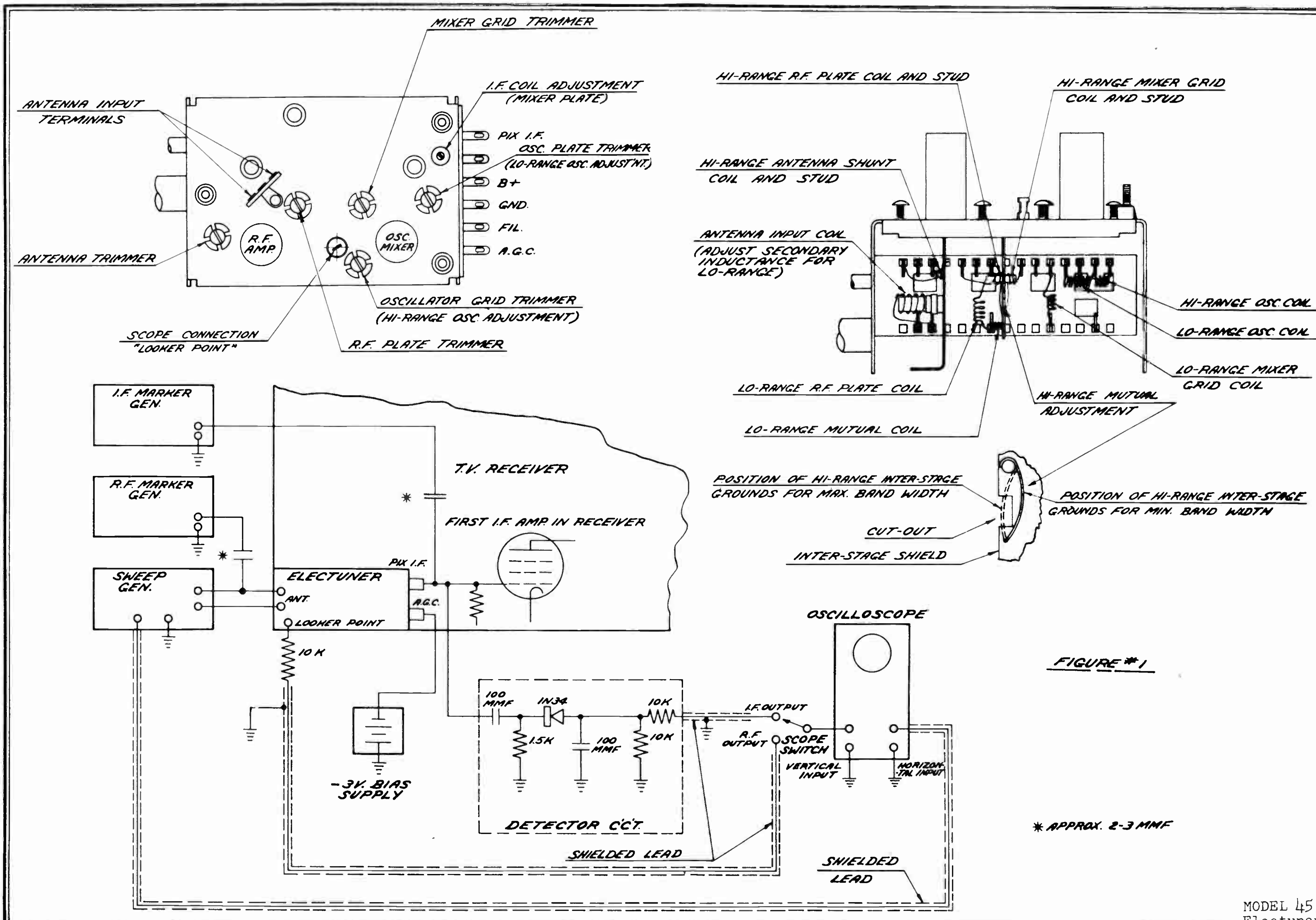

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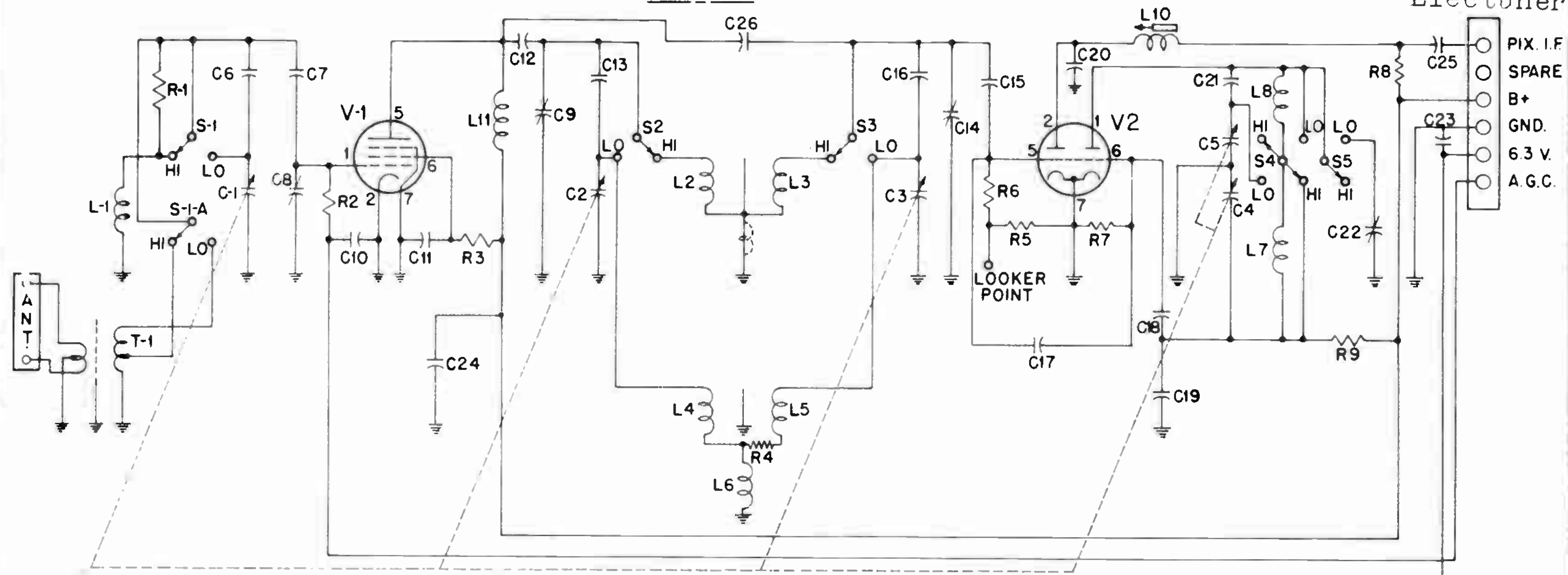
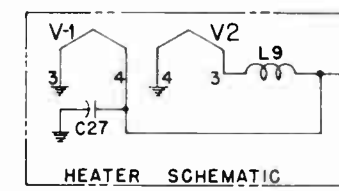
MODEL 45, Electuner

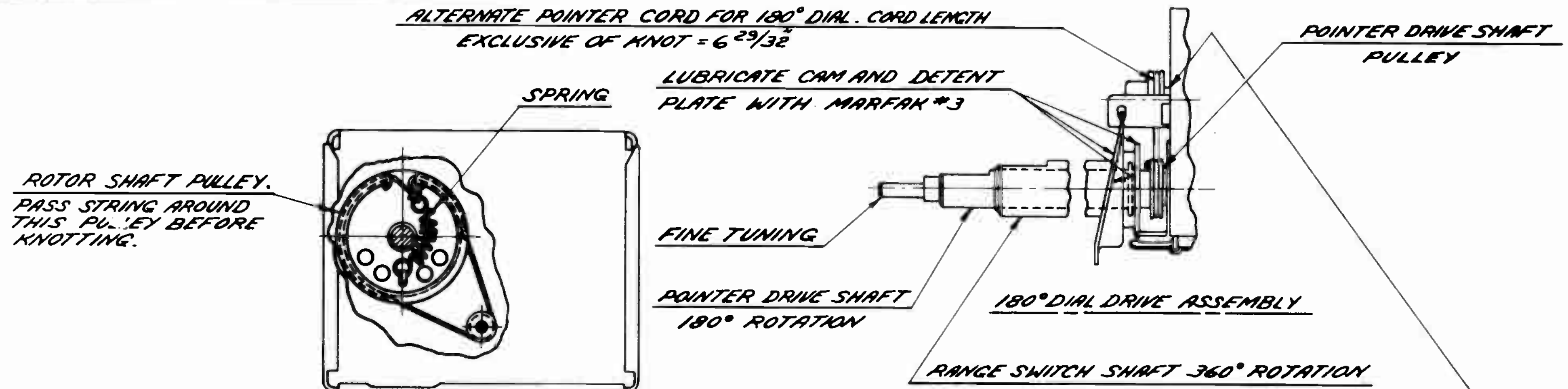
ITEM NO.	DESCRIPTION
	RESISTORS -- CARBON 1/2 WATT
R-1	1500 OHM ±10%
R 2	10,000 OHM ±10%
R 3	6,800 OHM ±20%
R 4	6 OHM ±20%
R 5	100,000 OHM ±20%
R 6	10,000 OHM ±10%
R 7	22,000 OHM ±20%
R 8	10,000 OHM ±10%
R 9	10,000 OHM ±10%
	CAPACITORS
C-1 to 5	VARIABLE CONDENSER
C 6	29.0 MMF ±5% N150 CERAMIC
C 7	100 MMF ±20% GP CERAMIC
C 8	1-3 MMF CERAMIC TRIMMER
C 9	1-3 MMF CERAMIC TRIMMER
C 10	800 MMF MIN. DISC CERAMIC
C 11	800 MMF MIN. DISC CERAMIC
C 12	100 MMF ±20% GP CERAMIC
C 13	14.5 MMF ±5% NPO CERAMIC
C 14	1-3 MMF CERAMIC TRIMMER
C 15	100 MMF ±20% GP CERAMIC
C 16	16.5 MMF ±5% NPO CERAMIC
C 17	3.3 MMF ±20% STACKPOLE TYPE GA5
C 18	33 MMF ±10% GP CERAMIC
C 19	2-12 MMF CERAMIC TRIMMER
C 20	10 MMF ±10% N750 CERAMIC
C 21	12.5 MMF ±5% N470 CERAMIC
C 22	1-3 MMF CERAMIC TRIMMER
C 23	800 MMF MIN. DISC CERAMIC
C 24	800 MMF MIN. DISC CERAMIC

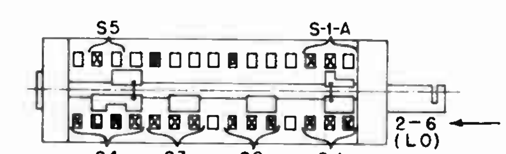
ITEM NO.	DESCRIPTION
C25	100 MMF ±20% GP CERAMIC
C26	.68 MMF ±20% STACKPOLE TYPE GA1
C27	800 MMF MIN. DISC CERAMIC
	COILS
T-1	LO-BAND ANT. TRANSFORMER
L-1	HI-BAND ANT. TRANSFORMER
L2	HI-BAND R.F. PLATE
L3	HI-BAND MIXER GRID
L4	LO-BAND R.F. PLATE
L5	LO-BAND MIXER GRID
L6	LO-BAND COUPLING
L7	LO-BAND OSCILLATOR
L8	HI-BAND OSCILLATOR
L9	HEATER CHOKE
L10	I.F. COIL ASSEMBLY
L11	R.F. CHOKE
	MISCELLANEOUS
V-1	TUBE - 6AK5 (MODEL A)
	TUBE - 6CB6 (MODEL B)
V2	TUBE - 6J6
S-1 to 5	SLIDE SWITCH (TWO POSITION)

FIGURE 4

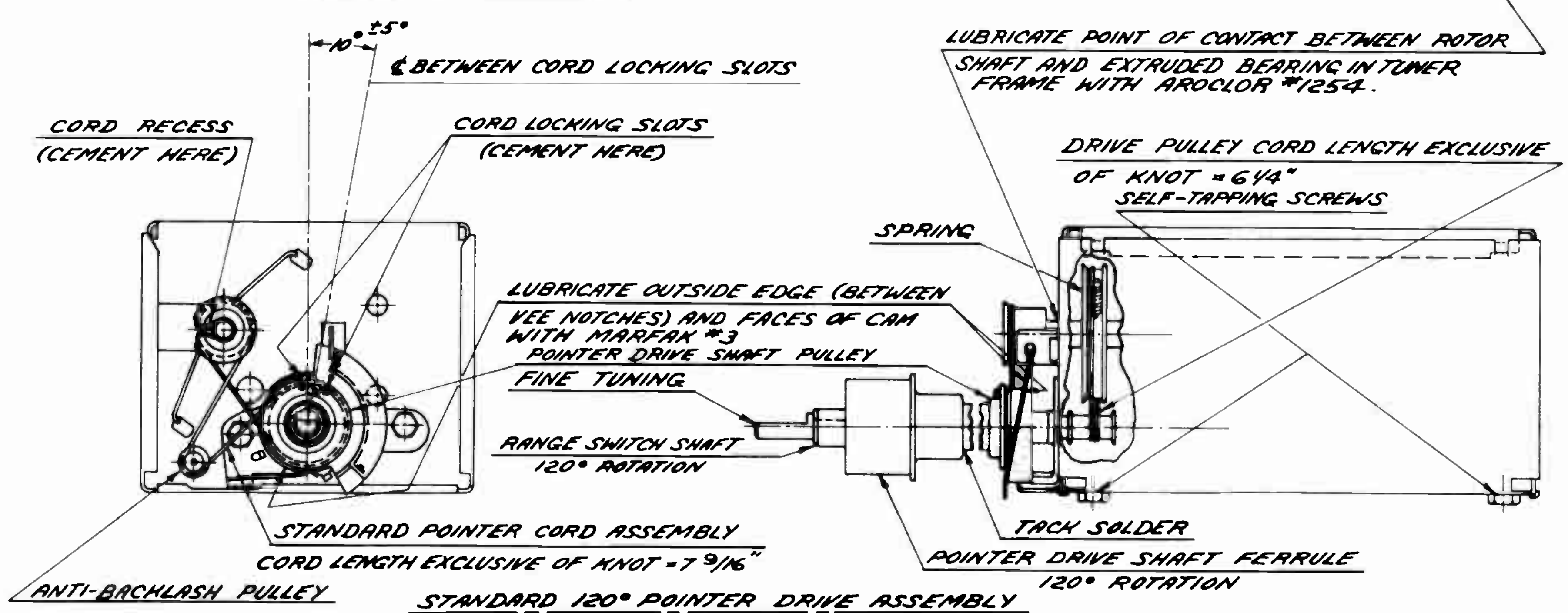








NOTES-
1 SWITCH SECTIONS S-1 TO 5 ARE PARTS OF A TWO POSITION SLIDE SWITCH AS PICTURED ABOVE.
2 SWITCH SHOWN IN POSITION FOR HI-BAND RECEPTION.
R REVERSED CONTACT
X SHORT CONTACT
L LONG CONTACT
B MOUNTING LUG



STANDARD 120° POINTER DRIVE ASSEMBLY

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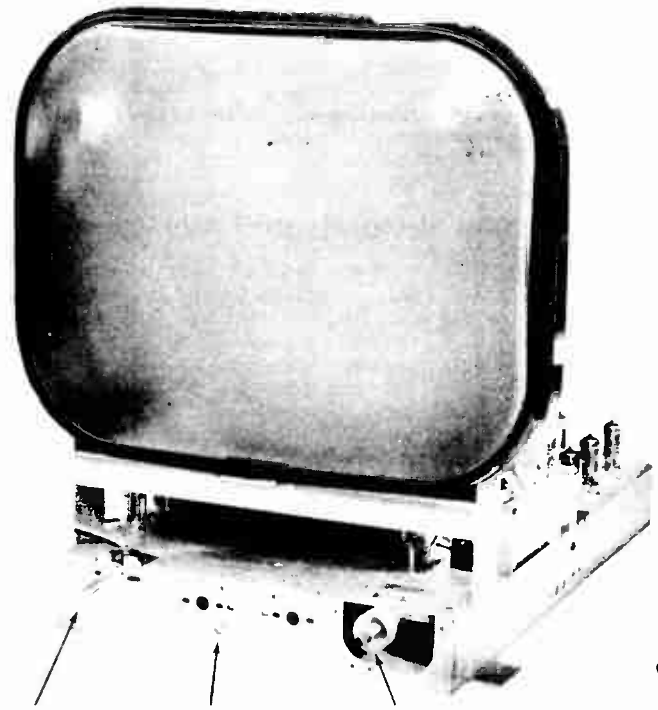
INDEX

GENERAL

Picture Area . . . . 139 square inches
Tubes . . . . Nineteen plus two rectifiers
Speaker . . . . Model 745, 747 & 748 - 5-inch P.M. (3.2 ohm V.C.) Models 750/751/760/761 - 8-inch P.M. (3.2 ohm V.C.)
Antenna . . . . Built-in cabinet antenna with provision for external antenna using 300-ohm transmission line.
Tuning. . . . . Two step range selector plus manual station tuning adjustment.
Tuning Range . . . . Twelve channels in two ranges.

1st Range		2nd Range	
Channel No.	Frequency (mc)	Channel No.	Frequency (mc)
2	54-60	7	174-180
3	60-66	8	180-186
4	66-72	9	186-192
5	72-82	10	192-198
6	82-88	11	198-204
		12	204-210
		13	210-216

Intermediate Frequency
Picture carrier. . . . . 26.25 mc
Sound carrier . . . . 21.75 mc
Intercarrier sound system. . 4.5 mc
Power Supply . . . . 105-125 V. 60 cycles AC
Power Consumption . . . . 200 Watts
Model Differences . . . . Model 745 - Wood table model finished in mahogany
Model 747 Pyroxylin covered table model finished in mahogany brown.
Model 748 Pyroxylin covered table model finished in mahogany blonde.
Models 750/760 - Wood consolette finished in mahogany.
Models 751/761 - Wood consolette finished in limed oak.



Chassis D919120

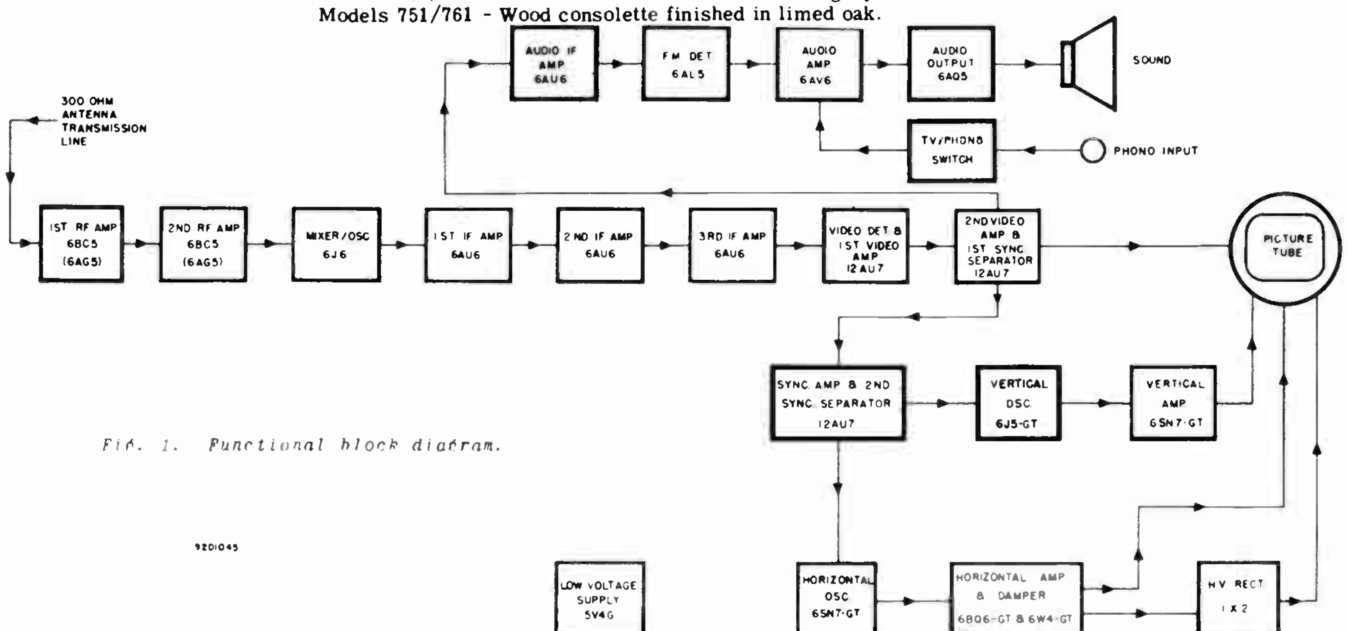


Fig. 1. Functional block diagram.

CARE OF THE KINESCOPE WINDOW

The window in front of the picture tube is made of safety glass, hence may be cleaned by any of the conventional window cleaning processes. Abrasive or strong solvent type cleaning solutions that may scratch the glass or damage the cabinet finish, however, should be avoided.

HIGH VOLTAGE WARNING

Operation of the receiver chassis outside of the cabinet involves a shock hazard. An interlock in the line cord disconnects the power when the back cover is removed. The HIGH VOLTAGE supply, while of low current capacity, operates at a 11,000 volt potential. Exercise all normal HIGH VOLTAGE precautions while working this equipment.

KINESCOPE HANDLING PRECAUTIONS

The kinescope housing provides adequate protection against possible tube implosure while in the cabinet. Do not expose the kinescope or handle it in any way without providing personal protection in the form of shatterproof goggles and heavy gloves. The kinescope should be handled by qualified personnel only.

The kinescope envelope encloses a high vacuum and with the large surface area of glass involved, the stresses set up, particularly at the front rim of the tube, are considerable. An abnormal handling stress, accidental blow at a highly stressed surface, or even a scratch on the surface of the tube could cause it to implode or collapse with destructive violence.

NON-OPERATING CONTROLS ADJUSTMENTS

The "non-operating" or screw-driver adjustments normally will require an occasional minor adjustment if any circuit work or tube changing is required. A test pattern, generated either locally in the shop or obtained from a television station is recommended for best results. Normal picture contrast and brightness should be maintained during the following adjustments for best results.

HORIZONTAL HOLD, VERTICAL HOLD, HORIZONTAL OSC., BRIGHTNESS AND FOCUS ADJUSTMENTS

1. Set the HORIZONTAL and VERTICAL HOLD controls for a steady test pattern. Should the HORIZONTAL HOLD control fail to hold the test pattern in the normal manner, set the HORIZONTAL HOLD control in the center of its range and adjust the HORIZONTAL OSC. ADJ. screw on the under side of the chassis for horizontal sync. (See Fig. 11 for location). If the adjustment of the top slug has been tampered with, turn the top screw to its top limit and adjust the bottom slug for sync.

2. The focus adjustment may be made with or without the aid of a TV station. If a test pattern is available, adjust the receiver for best picture and set the FOCUS control for best picture detail, watching the wedges of the test pattern. If no signal is available, turn the picture control counter-clockwise, advance the brightness control until the scanning lines just begin to show distinctly and adjust the FOCUS control for sharp clean lines. Note that a misadjustment of the ion trap or focus coil positions may prevent even focusing over the entire raster.

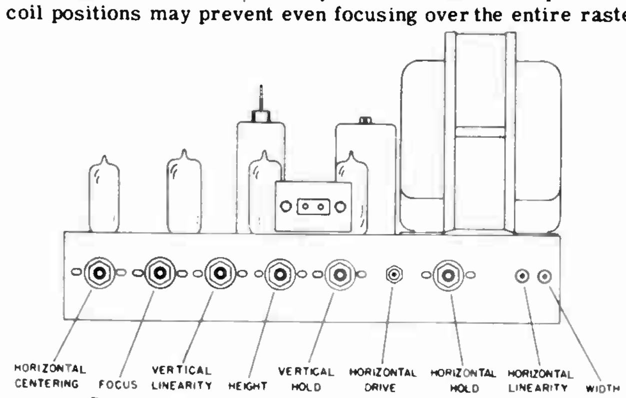


Fig. 2. Rear chassis view, location of "non-operating" controls.

HORIZONTAL — DRIVE, — LINEARITY, — CENTERING AND WIDTH ADJUSTMENTS

HORIZONTAL DRIVE CONTROL MISADJUSTMENT

1. Advance the HORIZONTAL DRIVE control (clockwise) as far as possible without causing fold over of the test pattern. (Vertical white line.) Insufficient horizontal drive will cause low second anode voltage with consequent loss of picture brilliance.

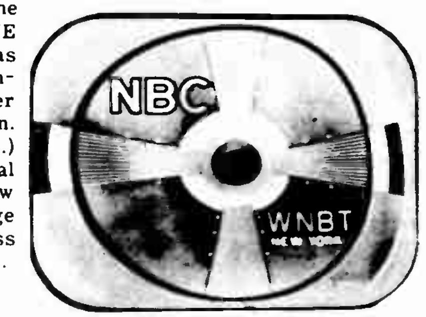


Figure 3.

WIDTH CONTROL MISADJUSTMENT

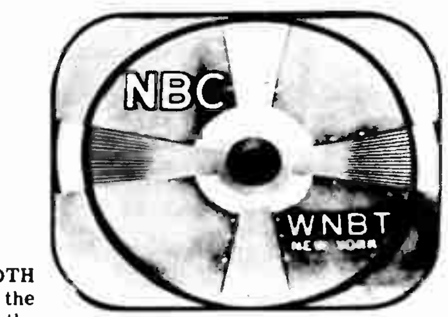


Figure 4.

2. Set the WIDTH control so that the test pattern fits the horizontal dimension of the kinescope escutcheon. A minor adjustment of the focus coil position may be required to recenter the pattern.

HORIZONTAL CENTERING MISADJUSTMENT

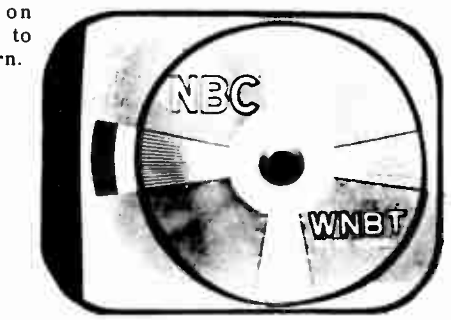


Figure 5.

HORIZONTAL LINEARITY CONTROL MISADJUSTMENT

3. Set the HORIZONTAL LINEARITY control so that the test pattern is symmetrical from left to right. A slight readjustment of the HORIZONTAL DRIVE control may be necessary when making this adjustment.

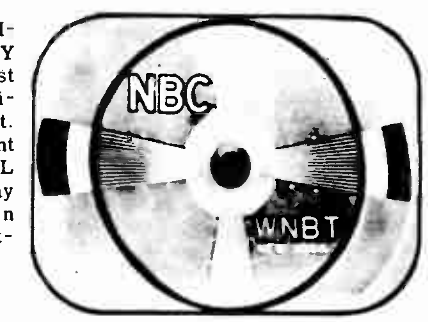


Figure 6.

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VERTICAL — CENTERING, — LINEARITY, AND HEIGHT ADJUSTMENTS

HEIGHT CONTROL MISADJUSTMENT

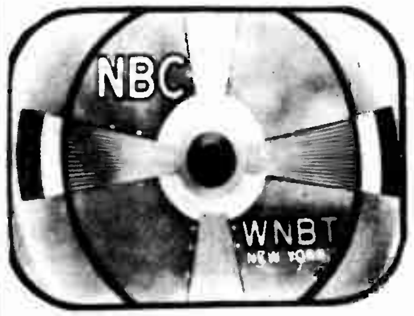

Figure 7.

1. Set the HEIGHT control so that the test pattern fits and centers in the vertical dimension of the kinescope escutcheon. A minor adjustment of the focus coil position may be required to recenter the pattern.

VERTICAL CENTERING MISADJUSTMENT

Figure 8.

VERTICAL LINEARITY CONTROL MISADJUSTMENT

Figure 9.

2. Set the VERTICAL LINEARITY control for a symmetrical test pattern in the vertical dimension. A slight readjustment of the HEIGHT control may be required when making this adjustment.

Note - The sequence of "non-operating" control adjustments outlined above is suggested as a convenient method of approach and not an arbitrary procedure. Variations of the procedure is permitted to obtain the final result.

DISMANTLING FOR KINESCOPE REPLACEMENT OR ALIGNMENT ADJUSTMENTS

1. Remove the three front panel control knobs by pulling them straight from their shafts. The dual control knob must be removed in two pieces, removing the center unit first.

2. Remove the back cover disconnecting the cable connector for the phono socket and switch mounted on the back cover. Note that the line cord and half of the interlock connector come along with the back cover.

3. Disconnect the speaker and remove the two wood screws holding the antenna terminal strip bracket to the cabinet. Note that for the table models the speaker will have to be removed to clear the picture tube.

4. Remove the five chassis bolts holding the receiver chassis in the cabinet and slide the entire assembly from the cabinet. The KINESCOPE is now accessible for replacement or adjustment.

REMOVING THE KINESCOPE

Refer to the warning KINESCOPE HANDLING PRECAUTIONS. Read all warning notices on both tube and carton. Follow the dismantling instructions above to expose the KINESCOPE and proceed as follows:

1. Disconnect the KINESCOPE SOCKET at the base of the kinescope.

2. Disconnect the high voltage anode lead.

3. Slip the ION TRAP from the neck of the tube past the kinescope base connector.

4. Measure the distance from the front edge of the steel band to the face of the tube. Keep this dimension handy for installation of a new tube.

5. Remove the steel band at the front rim of the kinescope and carefully slip the neck of the kinescope out of the FOCUS COIL and DEFLECTION YOKE. If the tube fails to slip out smoothly, investigate and remove the cause of the trouble. Do not use force.

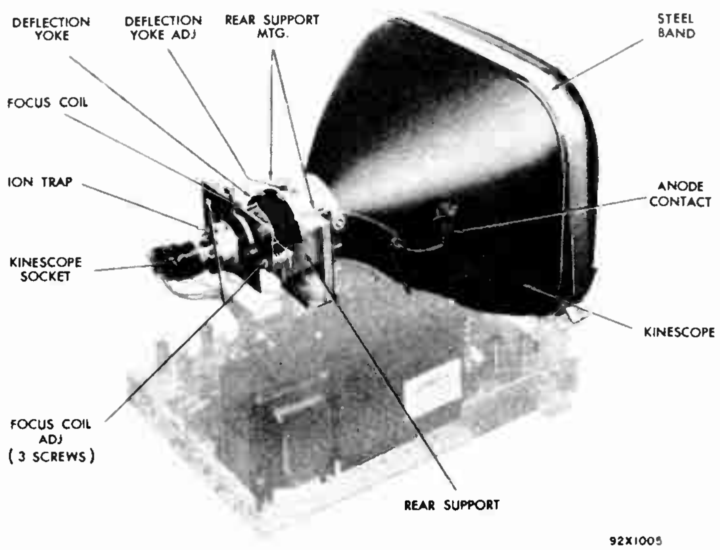

Fig. 10. Kinescope mounting detail.

INSTALLING AND ADJUSTING THE KINESCOPE

1. Wrap the RUBBER STRIP around the front rim of the kinescope and position the tube so that the anode contrast is located at the left side of the tube as viewed from the screen.

2. Slip the neck of the kinescope through the REAR SUPPORT, DEFLECTION YOKE and FOCUS COIL and seat the tube firmly against the REAR SUPPORT. If it fails to slip into place smoothly, investigate and remove the cause of the trouble. Do not force the tube. Check the distance from the face of the tube to the front edge of the steel band. Refer to the measurement made in step 3 above. If this dimension is off; loosen the two REAR SUPPORT MTG. screws, position the tube correctly and fasten the steel band firmly about the rim of the tube.

3. The REAR SUPPORT must seat firmly against the flare of the tube and be securely anchored in place by the two REAR SUPPORT MTG. screws. Check the SPRING CONTACT grounding the outer coating of the kinescope tube. A high potential is developed on the outer coating of the tube if this contact is faulty.

4. The DEFLECTION YOKE must seat firmly against the flare of the kinescope. Check by loosening the single DEFLECTION YOKE ADJ. screw and pushing the DEFLECTION YOKE forward as far as it will go. Take up the slack in the screw temporarily to hold the coil in place.

5. Slip the ION TRAP over the neck of the tube; the arrow points toward the face of the tube.

6. Reconnect the KINESCOPE SOCKET and anode connector and turn on the receiver.

7. After allowing a few minutes for warm up, turn up the BRIGHTNESS control and set the ION TRAP for maximum raster brilliance, backing off the brightness control adjustment as the maximum point is approached. The ION TRAP must be rotated about the axis of the tube as well as shifted along the neck of the tube to obtain the proper setting. The arrow on the ion trap will generally point at the HV anode connector when properly positioned as far as rotation is concerned, hence a rough setting may be obtained immediately with this type of trap.

With the BRIGHTNESS control set for slightly above average brilliance and the PICTURE control full counter-clockwise, adjust the FOCUS control until the line structure of the raster is clearly visible and reajust the ION TRAP for maximum raster brilliance. The final touches on this adjustment should be made with the BRIGHTNESS control at the maximum position with which good line focus can be maintained, then back off the setting of the BRIGHTNESS control until the retrace lines disappear.

8. Check the position and appearance of the test pattern. If the test pattern is off center or shadowed at the corners (Electron beam striking the neck of the tube), adjust the three FOCUS COIL ADJ. screws for a centered, evenly illuminated raster. Note that the three spring loaded adjustment screws tilt the focus coil to shift the position of the raster on the face of the kinescope. Do not turn all three screws up tight, use them to tilt the FOCUS COIL only.

CAUTION - It is not necessary to tilt the focus coil excessively. Excessive tilt may snap the neck of the kinescope if sufficient force is used.

The position of the test pattern may also be shifted by rotating the focus coil. To rotate the coil, loosen the two knurled nuts holding the coil to the mounting plate. Tighten the nuts after the adjustment has been made.

9. If the lines of the raster are not horizontal or square with the escutcheon, loosen the DEFLECTION YOKE ADJ. screw and rotate the DEFLECTION YOKE until this condition is obtained. Tighten the adjustment.

10. Follow the procedure under NON-OPERATING CONTROL ADJUSTMENTS and make any minor adjustments of the FOCUS COIL or DEFLECTION YOKE necessary to obtain the desired results. The final adjustment of the focus coil should leave the test pattern approximately centered.

MEASUREMENT OF H.V. POTENTIAL ON KINESCOPE ANODE

The second anode potential will be approx. 11,000 V. on a receiver that is functioning properly. Since the high potential for the kinescope anode is obtained from the horizontal output transformer, the "non-operating" control adjustments outlined above must be made or be known to be in proper adjustment before the H.V. measurement will have any meaning. Improper operation of the horizontal sweep circuit or circuit faults in the high voltage filter will generally account for an abnormal anode potential. If the anode potential is low, check the HORIZONTAL DRIVE adjustment outlined above.

CAUTION HIGH VOLTAGE

Do not use hand held flexible test leads when making the following measurement. Keep the hands clear of the circuit during measurement. A 11 KV. potential exists in this circuit. Exercise all normal high voltage precautions.

1. Connect a 50-megohm resistor string in series with a 300 microampere meter. Connect the free meter terminal to the chassis and the high side of the resistor string to the anode cap of the kinescope. The connection to the anode cap may be made with a fine wire slipped under the connector. Make up the resistor string with 5-megohm one or two watt resistors to provide a safety factor for voltage breakdown. If 5-megohm resistors are used, a total of ten will be required to obtain the 50 megohms. Make the setup self-supporting and allow adequate clearance between the resistor string and chassis parts to prevent high voltage breakdown.

2. Turn on the receiver and set the BRIGHTNESS and PICTURE controls at minimum. The microammeter will read approx. 220 microamperes for 11,000 V. at the kinescope anode. The anode potential is measured in this manner (PICTURE and BRIGHTNESS control at minimum; meter current approx. 200 microamperes) to simulate the kinescope load on the high voltage power supply.

I-F AMP. ALIGNMENT PROCEDURE

Note - The following alignment adjustments do not require the use of the kinescope tube. It is recommended that the tube be removed if extensive alignment adjustments are to be made.

CAUTION - Removal of the kinescope tube exposes the HIGH VOLTAGE anode connector contact. Keep this lead and contact clear of personnel servicing equipment and grounded objects on the service bench. Exercise all normal high voltage precautions while working with the exposed units.

EQUIPMENT REQUIRED

Signal generator covering 4 mc to 30 mc

Electronic voltmeter

F-M SOUND CHANNEL I-F ALIGNMENT

1. Connect the low frequency signal generator output across resistor (R-118) in the plate circuit of the 12AU7 VIDEO DET. tube (V-104). This resistor is located at the terminal strip near the tube socket.

2. Connect the electronic voltmeter between pin 7 of the 6AL5 FM DET. tube (V-109) and chassis ground.

3. With the signal generator (unmodulated) set at 4.5 mc. set the 4.5 MC LIMITER GRID ADJ. and FM DET PRI. ADJ. (See Fig. 11) for maximum d-c voltage as measured by the electronic voltmeter. Adjust the limiter grid transformer (T-105) before adjusting the f-m detector transformer (T-108) primary. Use just enough signal generator output to obtain approximately one volt at the electronic voltmeter.

4. Connect the electronic voltmeter across the 1000 mmf condenser (C-135) at the output of the f-m detector stage and adjust the FM DET. SEC. ADJ. of the f-m detector transformer (T-108) for the null.

5. Shift the frequency of the signal generator either side of 4.5 mc and touch up the FM DET. PRI. ADJ. for approximately equal peaks. Use just enough signal generator output to obtain one volt peaks for the best results.

6. After completing the alignment procedure and placing the receiver in operation again, carefully tune in a TV test pattern and adjust the 4.5 MC TRAP ADJ. for maximum vertical wedge definition. This adjustment is located on the under side of the chassis and on the same coil form as the 4.5 MC LIMITER GRID ADJ. shown in Fig. 11.

NOTE - The primary adjustment of T-108, the coarse frequency adjustment of T-111 and the 4.5 mc trap adjustment may all be made through the holes in the cabinet bottom or chassis mtg. board.

I-F AMPLIFIER ALIGNMENT

1. Connect the electronic voltmeter across resistor R-118 in the plate circuit of the 12AU7 VIDEO DET. tube (V-104). This resistor is located on the terminal strip near the tube socket.

2. Couple the high side of the signal generator to the OSC./MIXER tube (V-3) by removing its shield and slipping a tight fitting tube shield or length of copper braid over the bulb of the tube and connecting the generator lead to it. Connect the ground side of the signal generator to the frame of the tuning unit.

3. Set the channel selector at channel 2.

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4. Set the signal generator output (unmodulated) to develop one or two volts at the electronic voltmeter and adjust the four i-f amplifier coils, according to the following chart, for maximum d-c voltage as measured by the electronic voltmeter. Readjust the signal generator output as required to maintain the two-volt potential at the electronic voltmeter.

I-F AMPLIFIER ALIGNMENT CHART

Signal Generator Frequency (No Modulation)	Adjustment (Refer to Fig. 11)	Stage Adjusted
24.5 Mc	*24.5 Mc IF Adj.	1st IF amp.
23.4 Mc	23.4 Mc IF Adj.	2nd IF amp.
24.6 Mc	24.6 Mc IF Adj.	3rd IF amp.
25.6 Mc	25.6 Mc IF Adj.	Video Detector
21.75 Mc	21.75 Mc Sound Trap Adj.	*Sound Trap Adj. for Null (Min. Voltage)

*Note; After adjusting the 21.75 Mc Sound Trap recheck the setting of the 1st IF Transformer (T101).

5. Check the i-f amplifier frequency response by tuning the signal generator from 21 mc through 26.25 mc and observing the change in d-c voltage at the electronic voltmeter. If the signal generator output is set for an electronic voltmeter reading of 1.5 volts at the peak i-f amplifier response, the d-c voltage should not drop below one volt between the two peaks normally obtained with this i-f amplifier. If the response is unsatisfactory, repeat the procedure or try slight modifications of the recommended settings to obtain the desired response. Avoid resonating the coils with the iron core at the bottom end of the coil form. (Adjustment screw near limit of its travel).

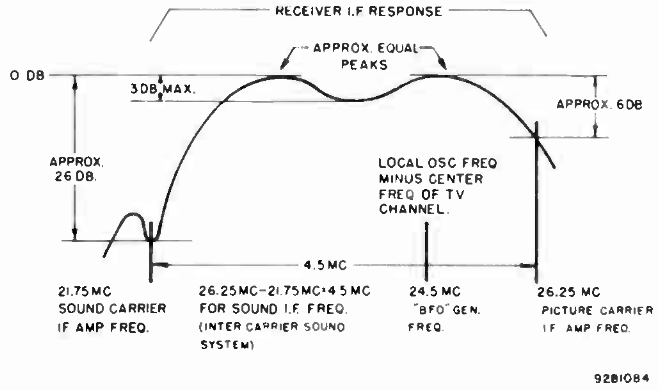

Fig. 12. I-F amplifier response

If a sweep type signal generator and oscilliscope is available the problem of making the final adjustments will be much easier. Check the two carrier i-f responses, 21.75 mc and 26.25 mc. The 21.75 mc response will be approximately 20 db below the peak response (Approx. 0.15 volt) and the 26.25 mc response will fall approximately 6 db below the peak (Approx. 0.4 volt). Refer to Fig. 12.

The average i-f amplifier sensitivity, when feeding the signal generator output through the receiver as described in step 2, will run approx. 2000 to 5000 microvolts for the one volt d-c peak measured at resistor R-118. (Receiver's oscillator operating on channel 2.)

CARRIER vs I-F FREQUENCY CHART

Channel No.	Channel Freq. (mc)	Picture Carrier Freq. (mc)	Sound Carrier Freq. (mc)	Receiver Osc. Freq. (mc)	Picture IF Freq. (mc)	Sound IF Freq. (mc)	Picture IF less Sound IF (mc)
2	54-60	55.25	59.75	81.5	26.25	21.75	4.5
3	60-66	61.25	65.75	87.5	26.25	21.75	4.5
4	66-72	67.25	71.75	93.5	26.25	21.75	4.5
5	76-82	77.25	81.75	103.5	26.25	21.75	4.5
6	82-88	83.25	87.75	109.5	26.25	21.75	4.5
7	174-180	175.25	179.75	201.5	26.25	21.75	4.5
8	180-186	181.25	185.75	207.5	26.25	21.75	4.5
9	186-192	187.25	191.75	213.5	26.25	21.75	4.5
10	192-198	193.25	197.75	219.5	26.25	21.75	4.5
11	198-204	199.25	203.75	225.5	26.25	21.75	4.5
12	204-210	205.25	209.75	231.5	26.25	21.75	4.5
13	210-216	211.25	215.75	237.5	26.25	21.75	4.5

*NOTE - The 1st IF amp coil (T-101) has two iron cores and must be adjusted from both top and bottom for 24.5 mc. response. Since this is an overcoupled transformer with a broad response, it will be necessary with this method of alignment to connect a 1000 ohm resistor across the primary winding (at the tuner terminals) when tuning the secondary (bottom core) and then connect the same resistor across the secondary winding when adjusting the primary (top) core.

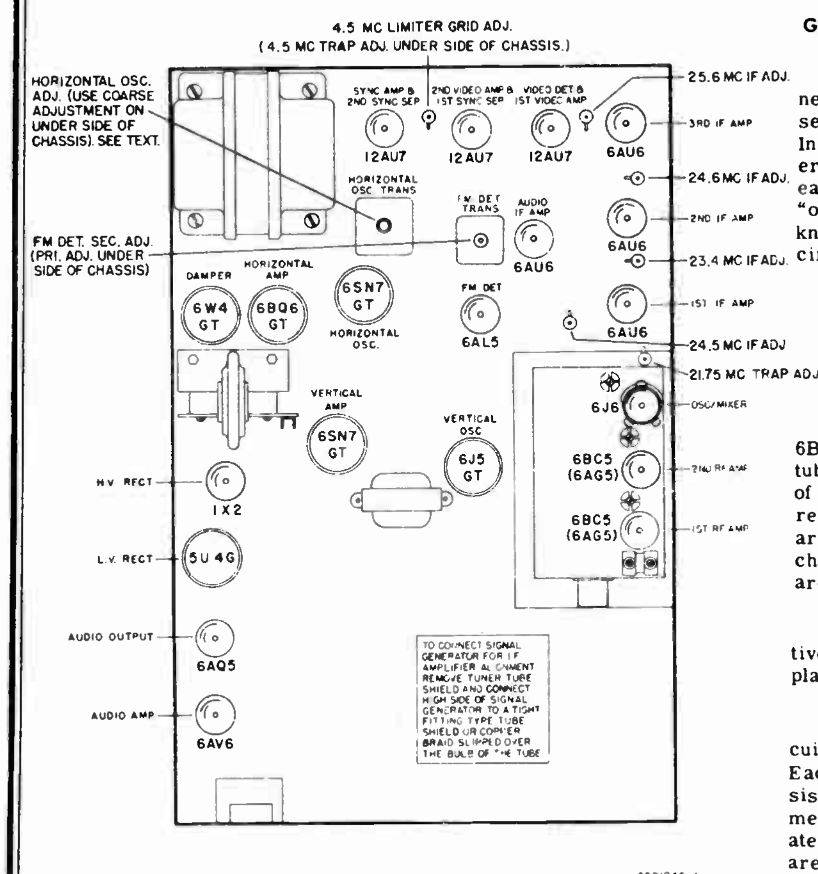

Fig. 11. Top view, i-f amplifier alignment points

TUNER ALIGNMENT PROCEDURE

GENERAL

The Electuner is a capacity tuned TV tuner covering channels 2 through 6 in the first (Lo) range and 7 through 13 in the second (Hi) range. Continuous tuning is provided in each range. In order to facilitate tuning, a certain amount of additional coverage above the highest and below the lowest tunable channel in each range is provided. The extra coverage is referred to as "overtravel" in this text. A two position switch, actuated by a knob concentric with the fine tuning shaft, is used to switch all circuits and will be referred to in this text as a "Range Switch".

Three tubes are employed as follows:

6AG5 or 6BC5 *first r-f amplifier
6AG5 or 6BC5 *second r-f amplifier
6J6 oscillator-mixer

* Field replacement of r-f amplifier tubes should be with 6BC5 tubes only. After the start of Electuner production, the tube manufacturers reduced the transconductance (Gm) rating of 6AG5 tubes and designated the high Gm version as 6BC5. A reduction in receiver sensitivity will result unless 6BC5 tubes are used for replacement. The 6BC5 tube is completely interchangeable with the 6AG5 tube, so no socket wiring changes are involved.

A three section gang condenser is used for tuning respectively the 1st r-f plate circuit, 2nd r-f plate circuit, and the plate circuit of the oscillator.

The antenna input system consists of two band-pass circuits. The required circuit is selected by the range switch. Each antenna band-pass circuit is a double tuned circuit consisting of a center tapped primary coil resonated by a trimmer capacitor and suitably coupled to a secondary coil resonated by the first r-f grid input capacity. The antenna circuits are designed to match a 300-ohm transmission line.

Sketches of antenna band-pass characteristics are shown in Fig. 13.

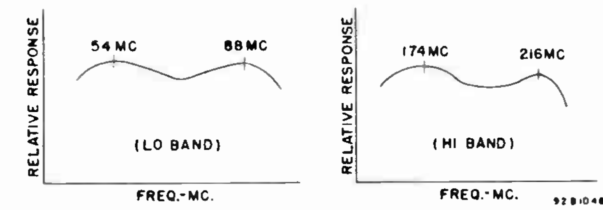

Fig. 13. Antenna band pass characteristics

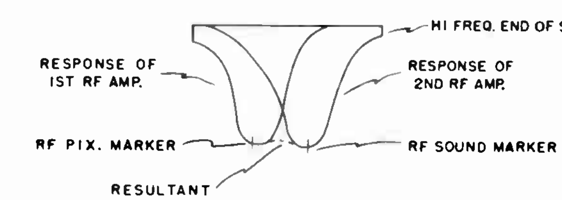

Fig. 14. Typical r-f pass band

The r-f amplifiers are used as stagger tuned amplifiers to provide a band pass circuit of the proper band width. In both Hi and Lo ranges, the plate circuit of the 1st r-f amplifier provides the low frequency stagger component, and the plate circuit of the second r-f amplifier provides the high frequency stagger component as indicated below in a sketch of a typical r-f pass band.

With an r-f sweep input to the antenna and an oscilloscope suitably connected to the mixer grid return at the LOOKER POINT shown in Fig. 19, the resultant overall r-f response, which is a combination of the stagger responses, in any channel appears as shown below:

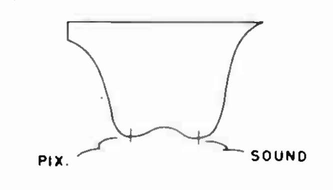

Fig. 15. Typical overall response

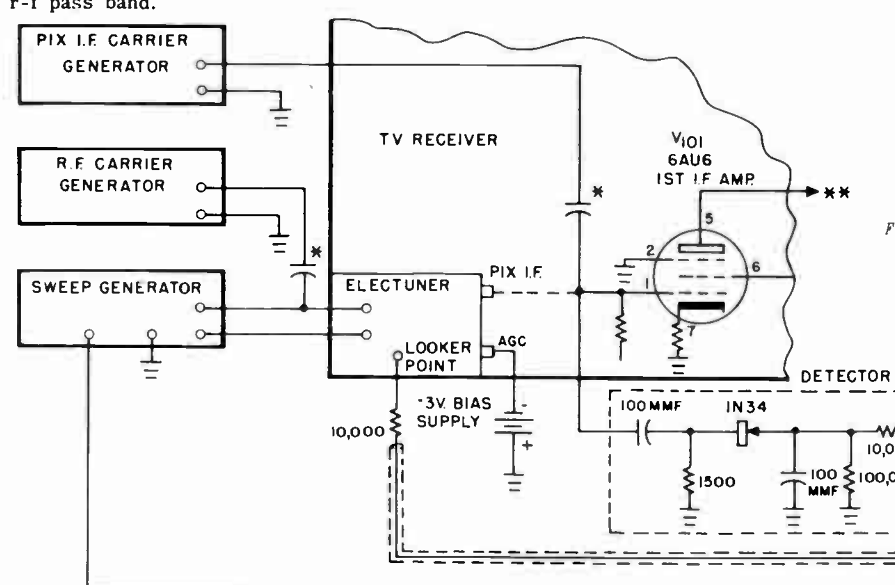

Fig. 16. Recommended test equipment circuits

92B1054

* SEE TEXT ITEM 4 UNDER EQUIPMENT SET UP
** SEE TEXT ITEM 5 UNDER EQUIPMENT SET UP

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The oscillator employs a modified Colpitts circuit with one plate of the 6J6 tuned by the third section of the variable condenser.

In accordance with Fig. 19, the following tuning elements are brought out at the top of the tuner chassis:

Hi and Lo band antenna band-pass primary tuning trimmers
1st and 2nd r-f plate tuning trimmers
Oscillator plate tuning trimmer

EQUIPMENT REQUIRED

Sweep Generator
Oscilloscope
Electronic Voltmeter
R-F Marker Generator
Pix I-F Marker Generator
Bias supply 2-1.5 volt Dry Cells
IN-34 Crystal Detector

EQUIPMENT SPECIFICATIONS

Sweep Generator similar to RCA type WR59A, covering frequencies of 54 to 88 Mc, and 174 to 216 Mc with a minimum sweep of 10 Mc in any channel, and a 300-ohm balanced output at least 0.1 volt line to line.

Oscilloscope equivalent in vertical deflection sensitivity to Dumont type 208-B.

Electronic voltmeter similar to the Voltohymist.

RF maker generator similar to RCA type WR-39-A.

Pix IF marker generator may be a crystal controlled oscillator in vicinity of 26.25 Mc. As alternates, either a second WR-39-A or an all wave signal generator of suitable accuracy may be used to supply a picture IF marker.

EQUIPMENT SETUP

In reference to Fig. 16, the following precautions should be taken in making the equipment set up.

(1) The detector circuit should be so constructed as to maintain leads as short as possible. Connection of the detector circuit to the 1st i-f amplifier grid terminal should also be made with short leads.

(2) Shielded leads should be used in making the following connections to reduce hum and synchronous voltage pick up.

(a) The lead for observations of the r-f response from the scope isolating resistor (10,000 ohms located at the tuner LOOKER POINT) to the RF output switch position of the scope switch.
(b) The connection from the i-f detector circuit output to the IF switch position of the scope switch.
(c) The connection from the sweep generator to the horizontal input of the scope. (Use the externally generated sweep instead of internal oscilloscope sweep in order to obtain synchronization).

(3) The single pole double throw SCOPE SWITCH should be located at the vertical input terminals of the scope. This switching arrangement will permit observation of either the i-f response or the overall r-f response. The aforementioned positions will be referred to in subsequent text as the "IF" and "RF" positions respectively.

(4) The marker generator coupling condenser should be as small a value as possible to prevent any effect on tuner response, but must be large enough to permit easy observation of markers on either the i-f response or overall r-f response. (Approximately 2 or 3 mmf should be satisfactory in most cases).

(5) For all tests which are outlined in this text, remove the second i-f amplifier tube to prevent coupling back from the receiver i-f system.

PROCEDURE FOR OSCILLATOR ALIGNMENT

TV CHANNEL VS. PIX AND SOUND CARRIER FREQUENCY

Channel No.	Picture Carrier (Mc)	Sound Carrier (Mc)
2	55.25	59.75
3	61.25	65.75
4	67.25	71.75
5	77.25	81.75
6	83.25	87.75
7	175.25	179.75
8	181.25	185.75
9	187.25	191.75
10	193.25	197.75
11	199.25	203.75
12	205.25	209.75
13	211.25	215.75

OVERTRAVEL CHART FOR OSCILLATOR COVERAGE

Channel No.	Overtravel	RF Overtravel Marker Frequency
13	+ 1.5 Mc	Pix carrier + 1.5 Mc = 212.75 Mc
7	- 2.5 Mc	Pix carrier - 2.5 Mc = 172.75 Mc
6	+ 1.5 Mc	Pix carrier + 1.5 Mc = 84.75 Mc
2	- 1.0 Mc	Pix carrier - 1.0 Mc = 54.25 Mc

In all of the following tests the oscilloscope vertical gain should be as close to maximum gain as possible, consistent with hum and synchronous voltage interference limitations. This precaution will allow the use of low levels from the r-f sweep generator and increase the visibility of i-f and r-f markers.

HI BAND OSCILLATOR ALIGNMENT

(1) Turn range switch of the tuner to the Hi band (counter-clockwise rotation of switch knob), rotate variable condenser to minimum capacity (clockwise rotation of tuning shaft), and adjust sweep generator for channel 13.

(2) With the scope switch in IF position, adjust scope gain, r-f sweep input level, inject required i-f picture marker, (i.e. 26.25 Mc), and an r-f overtravel marker of 212.75 Mc.

(3) Adjust OSC. TRIMMER (Fig. 19) so that picture i-f marker and 212.75 Mc overtravel markers coincide on the i-f response characteristic on the scope.

(4) Remove the two self tapping screws used for fastening the tuner shield and slide shield off until a point is reached where coils on switch are exposed and accessible.

(5) Rotate variable condenser to maximum capacity (counter-clockwise) and adjust sweep generator for channel 7.

(6) Inject r-f overtravel marker of 172.75 Mc.

(7) With a bakelite alignment tool, adjust the spacing of the turns of the HI BAND OSC. COIL (Fig. 19) so that Pix i-f marker and 172.75 Mc markers coincide. Spreading the coils apart will raise the oscillator frequency; squeezing the coils together will lower the frequency. After adjustment, slide shield back into its original position and note any frequency shift of markers. Slide shield off and compensate for the frequency shift by a slight readjustment of the Hi band oscillator coil. Slide shield back into original position and note if markers coincide. If they do not, repeat this process until proper adjustment is made and markers coincide.

(8) Repeat steps 1 to 7 inclusive until correct oscillator coverage of entire Hi band is obtained.

LO BAND OSCILLATOR ALIGNMENT

(9) Remove tuner shield completely, turn tuner range switch to Lo band position (clockwise), rotate variable condenser to minimum capacity and adjust sweep generator for channel 6.

(10) Inject Pix i-f marker and r-f overtravel marker of 84.75 Mc.

(11) With a bakelite alignment tool, adjust LOW BAND OSC. COIL (Fig. 19) so that the Pix i-f marker and 84.75 Mc marker coincide.

(12) Rotate variable condenser to maximum capacity (counter-clockwise) and adjust sweep generator for channel 2.

(13) Inject r-f overtravel marker of 54.25 Mc.

(14) Adjust LOW BAND OSC. SERIES PAD (See Fig. 19) until Pix i-f marker and 54.25 Mc marker coincide.

(15) Repeat steps (9) to (14) inclusive for satisfactory coverage of entire Lo band.

PROCEDURE FOR RF PASS BAND ALIGNMENT

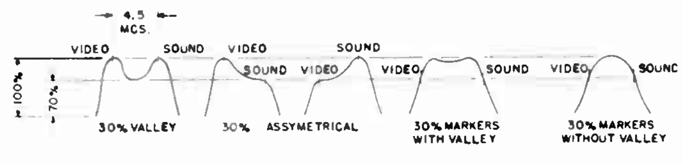

Fig. 17. Acceptable r-f pass bands

HI BAND RF PASS BANDS

(16) Repeat step (1).

(17) Replace tuner shield, set scope switch to i-f position, and adjust scope gain.

(18) Inject a Pix i-f marker and a channel 13 Pix r-f marker (211.25 Mc).

(19) Rotate tuning shaft until Pix i-f marker and 211.25 Mc marker coincide on the i-f response. Do not disturb this setting of the variable condenser for the remainder of alignment of channel 13 r-f pass band.

(20) Set scope switch to RF, adjust scope gain and turn 1ST RF TRIMMER (Fig. 19) for maximum amplitude of first r-f amplifier response in the region of the r-f Pix marker.

(21) Inject Channel 13 sound r-f marker (215.75 Mc) and adjust 2ND RF TRIMMER (Fig. 19) for maximum amplitude of second r-f amplifier response in the vicinity of the r-f sound marker.

(22) Repeat steps (20) and (21) until desired pass band is obtained. See Fig. 17. for acceptable r-f band pass response shapes.

(23) Remove tuner shield as in step (4) and repeat step (5).

(24) Set scope switch to IF position, adjust scope gain, and inject required Pix i-f marker and channel 7 Pix r-f marker of 175.25 Mc.

(25) Rotate tuning shaft until Pix i-f marker and channel 7 Pix r-f markers coincide in i-f response. Do not disturb this variable setting for remainder of alignment of channel 7 r-f pass band.

(26) Set scope switch to RF position and with a bakelite alignment tool, adjust 1ST RF HI BAND COIL (Fig. 19) for maximum amplitude of 1st r-f amplifier response in the region of the Pix r-f marker.

(27) Inject a channel 7 r-f sound marker of 179.75 Mc and adjust 2ND RF HI BAND COIL (Fig. 19) for maximum amplitude of 2nd r-f amplifier response in the region of the sound r-f marker.

(28) Repeat steps (26) and (27) until desired pass band is obtained, consistent with shapes shown in Fig. 17.

(29) Repeat steps (16) to (28) inclusive for satisfactory coverage of entire Hi band r-f response.

LO BAND RF PASS BANDS

(30) Repeat step (9), set scope switch to IF position, adjust scope gain, and inject a channel 6 Pix r-f marker (83.25 Mc).

(31) Rotate tuning shaft until Pix i-f marker and 83.25 Mc markers coincide. Do not disturb this variable condenser setting for remainder of alignment of channel 6 r-f pass band.

(32) Set scope switch to RF position and adjust scope gain.

(33) Adjust 1ST RF LO BAND COIL (Fig. 19) for maximum amplitude of 1st r-f amplifier response in the region of channel 6 Pix r-f marker.

(34) Inject channel 6 sound r-f marker of 87.75 Mc and adjust 2ND RF LO BAND COIL (Fig. 19) for maximum amplitude of 2nd r-f amplifier response in the region of the channel 6 sound r-f marker.

(35) Repeat step (32) until desired pass band is obtained in accordance with acceptable r-f pass bands shown in Fig. 17.

(36) Rotate variable to maximum capacity (counter-clockwise) and adjust sweep generator for channel 2.

(37) Set scope switch to IF position, adjust scope gain, and inject a channel 2 Pix r-f marker (55.25 Mc).

(38) Rotate fine tuning shaft until Pix i-f markers and 55.25 Mc markers coincide. Do not disturb this variable condenser setting for remainder of alignment of channel 2 r-f pass band.

(39) Set scope switch to RF position and adjust scope gain.

(40) Adjust 1ST RF LO BAND COIL (Fig. 19) for maximum amplitude for 1st r-f amplifier response in region of channel 2 Pix r-f marker.

(41) Inject channel 2 sound r-f marker (59.75 Mc) and adjust 2ND RF LO BAND COIL (Fig. 19) for maximum amplitude for 2nd r-f amplifier response in region of channel 2 sound r-f marker.

(42) Repeat step (40) until desired pass band is obtained in accordance with acceptable r-f pass band shown in Fig. 17.

(43) Repeat steps (30) through (42) inclusive for satisfactory coverage of entire Lo band r-f response.

PROCEDURE FOR ANTENNA PASS BAND ALIGNMENT

The band pass antenna stages are normally aligned in the factory for minimum standing waves with a wide range sweep oscillator and a delay line. The coupling between the primaries and secondaries are carefully adjusted and in general should not be disturbed. Minor corrections of the primary trimmer tuning may be necessary, if they are accidentally or otherwise varied after leaving the factory. The procedure for resetting antenna primary trimmers is outlined below.

HI BAND PRIMARY ANTENNA TRIMMER ALIGNMENT

With scope switch in RF position and equipment set for observation of channel 13 r-f pass band (see step 1) turn HI BAND PRIMARY ANT. TRIMMER screw (counter-clockwise) i.e. to a reduced capacity setting. Start turning trimmer screw clockwise (increasing capacity) while observing the channel 13 r-f pass band amplitude and shape. It will be noticed that the amplitude will increase to a certain point and thereafter the shape of the response will change as shown in Fig. 18, indicating the antenna to be cutting into the r-f pass band. Back out the trimmer screw to a maximum amplitude and minimum "cutting-in" position.

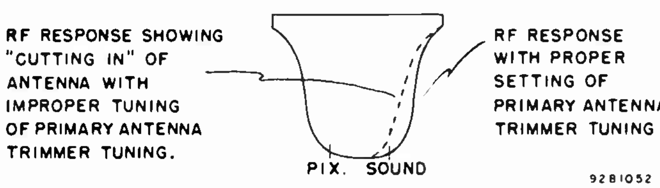

Fig. 18. Effect of primary antenna trimmer on r-f pass band response

LO BAND PRIMARY ANTENNA TRIMMER ALIGNMENT

Procedure for aligning LO BAND PRIMARY ANT. TRIMMER is the same as outlined for Hi band primary antenna trimmer except the tuner should be tuned to channel 6 and adjustment of the Lo band antenna primary trimmer screw should be done while observing the r-f response characteristic of channel 6.

FINAL CAUTION NOTE

Upon completion of tuner alignment, remove crystal detector in 1st IF grid. Replace tuner shield and fastening screws, reinsert 2nd i-f amplifier tube removed at start of alignment, and check performance of receiver with all available local stations.

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TUNER SERVICE NOTES

OSCILLATOR INJECTION VOLTAGE

The oscillator injection voltage is specified as 2 volts minimum with normal B+ applied and is measured from the LOOKER POINT (Fig. 19) to ground with a Voltohymst through a 10,000 ohms isolating resistor.

In the event of failure to meet these specifications, it is necessary to replace the 6J6 tube.

NOTE - If a tube is changed, it may be necessary to realign tuner to compensate for difference of tube characteristics. A slight adjustment of the oscillator trimmer (Fig. 19) will correct for any change of tube capacitance. Follow instructions for alignment of Hi Band and Lo Band oscillator alignment. Low oscillator injection voltage will reduce conversion gain with resulting loss in picture sensitivity.

REPLACING TUBES

See note under Oscillator Injection Voltage concerning replacement of oscillator - converter tube (6J6).

If either r-f tube is replaced, it may be necessary to realign tuner to compensate for a variation of tube characteristics. A slight adjustment of the r-f trimmers (Fig. 19) will compensate for this. Follow instructions for alignment of Hi band and Lo band r-f pass band alignment.

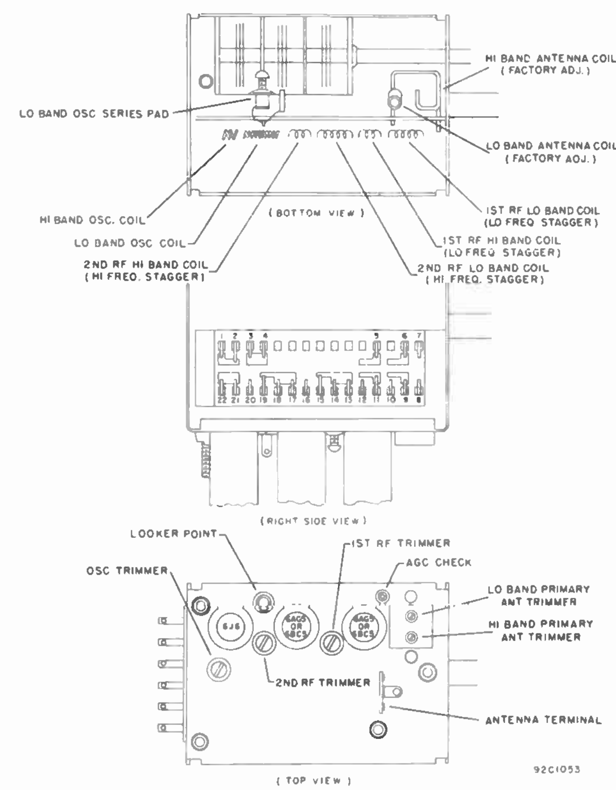

Fig. 19. Location of tuner alignment adjustments.

VARIABLE CONDENSER

Do Not Attempt to bend variable condenser plates, as they have been calibrated in the factory on special equipment.

RESTRINGING PULLEY DRIVE

CONDENSER DRIVE

Wrap drive cord assembly 1-1/2 turns on drive pulley (Fig. 20) and slip other end over pulley on rotor shaft, keeping prong clip in center of slot, hook one end of spring over cord, and the other end over tab on pulley.

POINTER DRIVE

With condenser at maximum capacity and hole in pointer sleeve pulley in position shown, press prong clip on pointer cord assembly into hole and wrap end of loop around end of condenser rotor shaft (Fig. 20), making certain that cord is seated in groove in rotor shaft. Loop loose end of cord assembly over anti-backlash pulley as shown. Apply a drop of "Duco" household cement over cord seated in groove in rotor shaft to prevent cord from slipping.

RESETTING POINTER SLEEVE EXTENSION

If pointer cord breaks, it may be necessary to reset the pointer sleeve ferrule after restringing in order to maintain coincidence of pointer and dial escutcheon.

(1) Tune unit to channel 13 (station or signal generator).
(2) Unsolder pointer sleeve ferrule and rotate until pointer registers on number 13 of dial escutcheon.
(3) Solder pointer sleeve extension to pointer sleeve (Fig. 20).

TROUBLE SHOOTING GUIDE

(1) No sound or picture, but no B+ short.	Defective oscillator - mixer tube (6J6); open filament; prongs on sockets shorted to each other; open cathode to ground; open i-f coil; open converter plate lead. Open i-f coupling condenser.
(2) No sound or picture with B+ short.	Tube shorted internally; r-f trimmer shorted; screen by-pass shorted; r-f choke shorting; B+ by-pass condenser shorted; leads from variable to switch shorting.
(3) One tube does not light.	Bad tube; open filament return (from socket to chassis).
(4) All tubes do not light.	Filament short at socket to chassis; open filament lead; filament by-pass shorted.
(5) No high band response.	Open contact; high band antenna trimmer shorted; open or shorted high band oscillator or r-f coils.
(6) No low band response	Open low band r-f or oscillator coil; low band antenna coil open; antenna trimmer shorted; open contact on switch.
(7) Intermittents.	Socket pins not tight; switch contacts loose; accidental shorting between components.

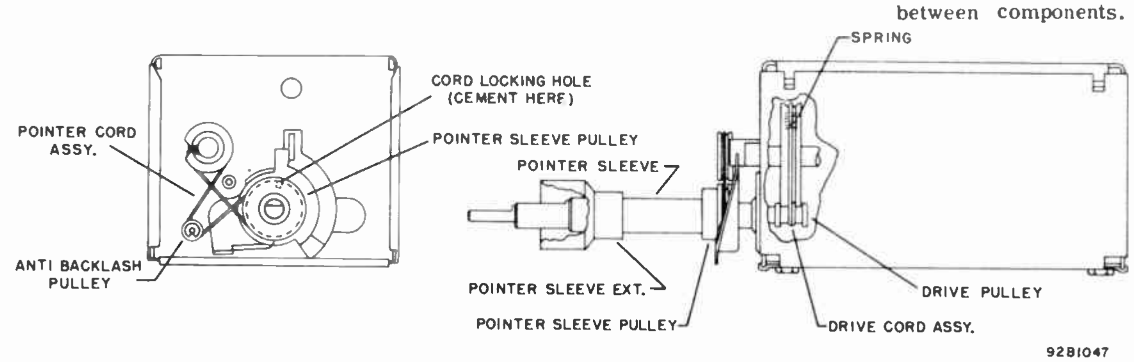

Fig. 20. Dial drive detail

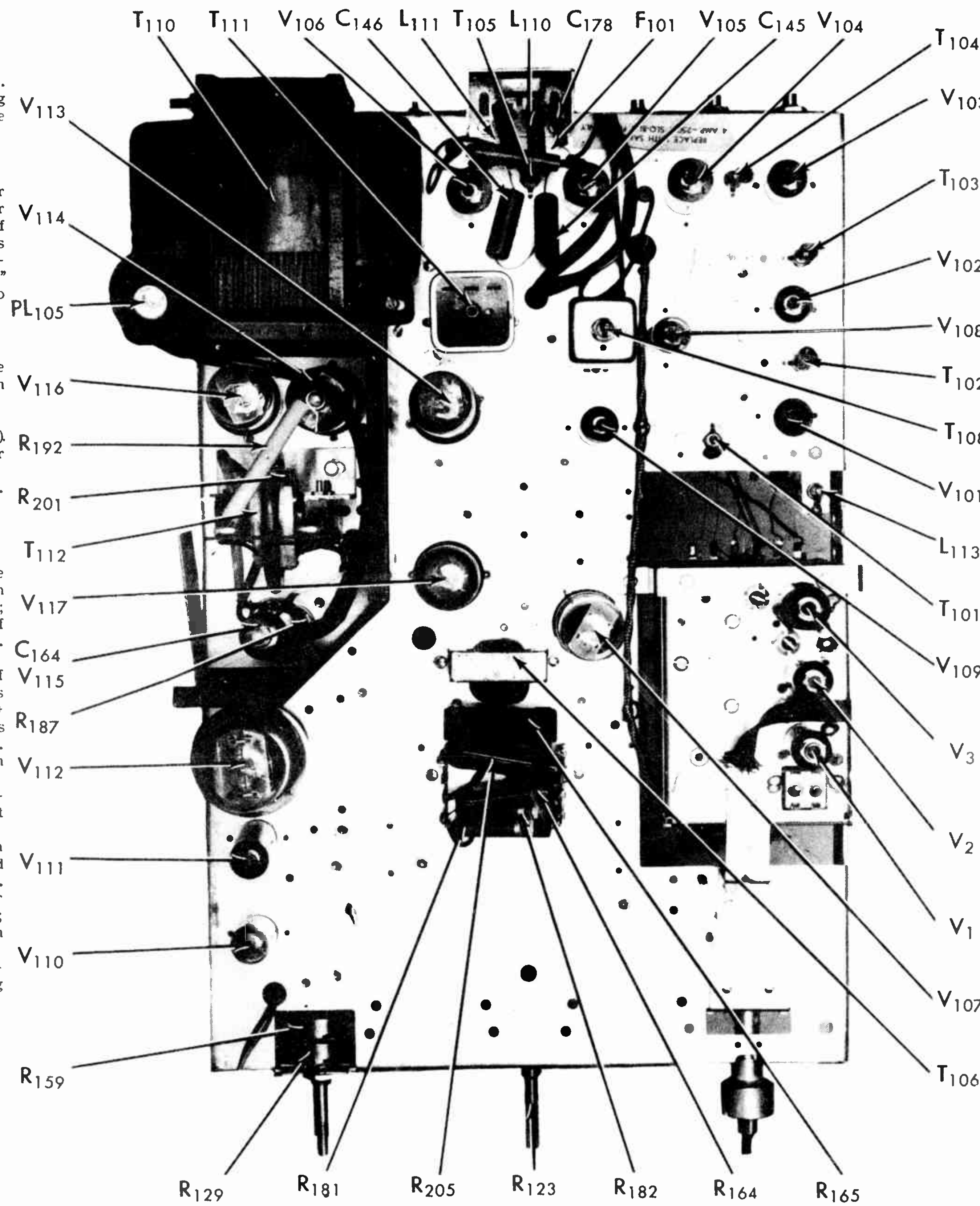

Fig. 21. Top chassis view, component location.

92X1025-A

MODELS 745, 747, 748, 750, 751, 760, 761, Ch. D919120

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1. SOCKET VIEWS ARE BOTTOM VIEWS
2. ALL VOLTAGES ARE MEASURED BETWEEN TUBE SOCKET TERMINALS AND CHASSIS WITH ZERO SIGNAL INPUT
3. LINE VOLTAGE — 117 V AC.
4. ALL VOLTAGES SHOWN ARE DC UNLESS OTHERWISE SPECIFIED.
5. DC VOLTAGES SHOWN WERE MEASURED WITH AN ELECTRONIC VOLTMETER
6. "NC" NO CONNECTION. VOLTAGE SHOWN FOR THIS TERMINAL ONLY WHEN TERMINAL IS USED AS A TIE LUG
7. "NR" NOT READABLE VOLTAGE MEASURED AT THESE TERMINALS GENERALLY MEANINGLESS.
8. ALL VOLTAGES ON KINESCOPE WERE TAKEN AT TIE POINTS OF TUBE SOCKET LEADS.
9. OPERATING CONTROLS SET FOR NORMAL PICTURE UNLESS OTHERWISE SPECIFIED.
10. NON-OPERATING CONTROLS SET FOR NORMAL PICTURE.
11. MEASUREMENT OF 2ND ANODE POTENTIAL AT KINESCOPE RECOMMENDED FOR CHECK ON 1X2 RECTIFIER.
12. ▭ SPACE PROVIDED FOR SERVICE METER READINGS.

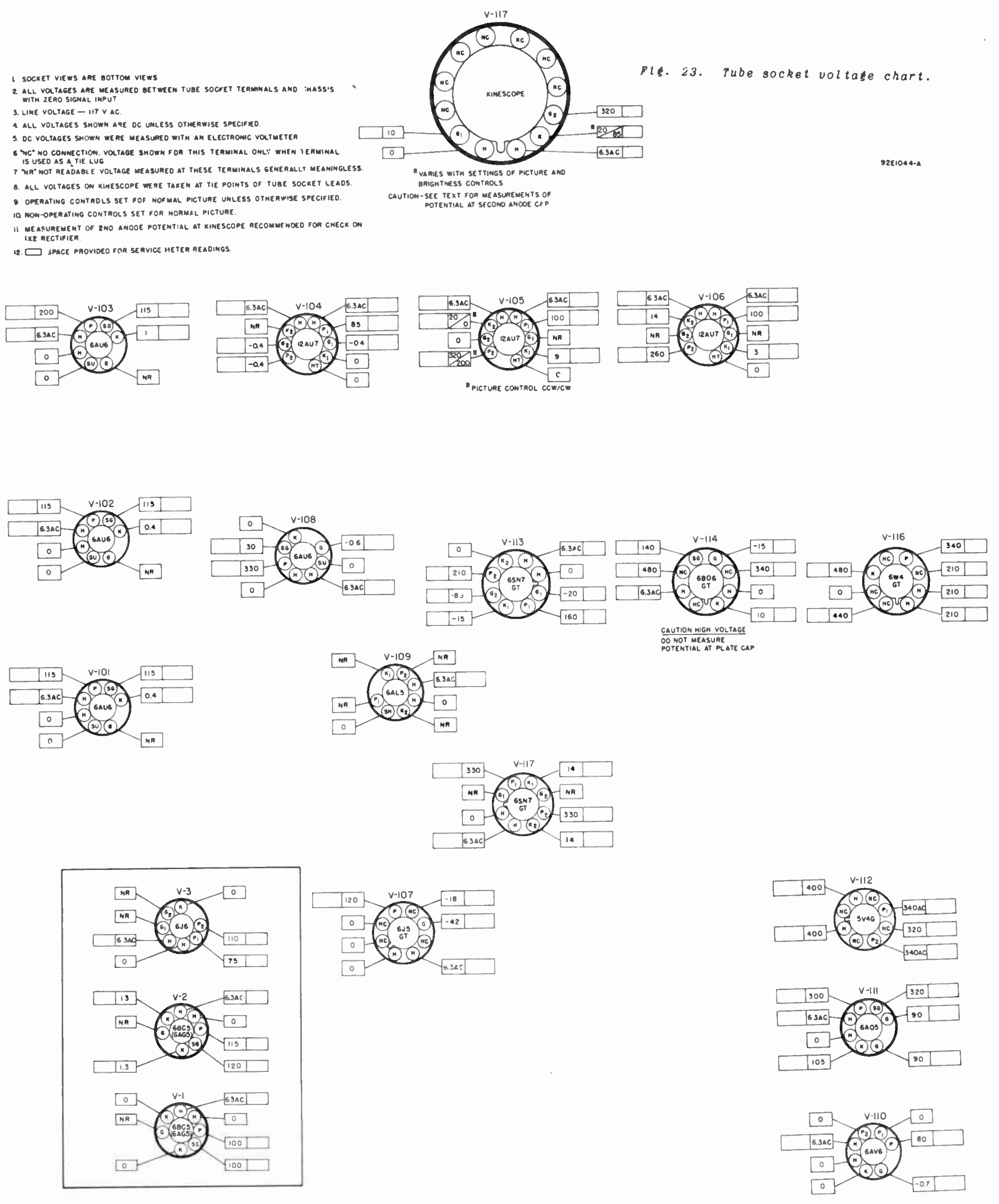

Fig. 23. Tube socket voltage chart.

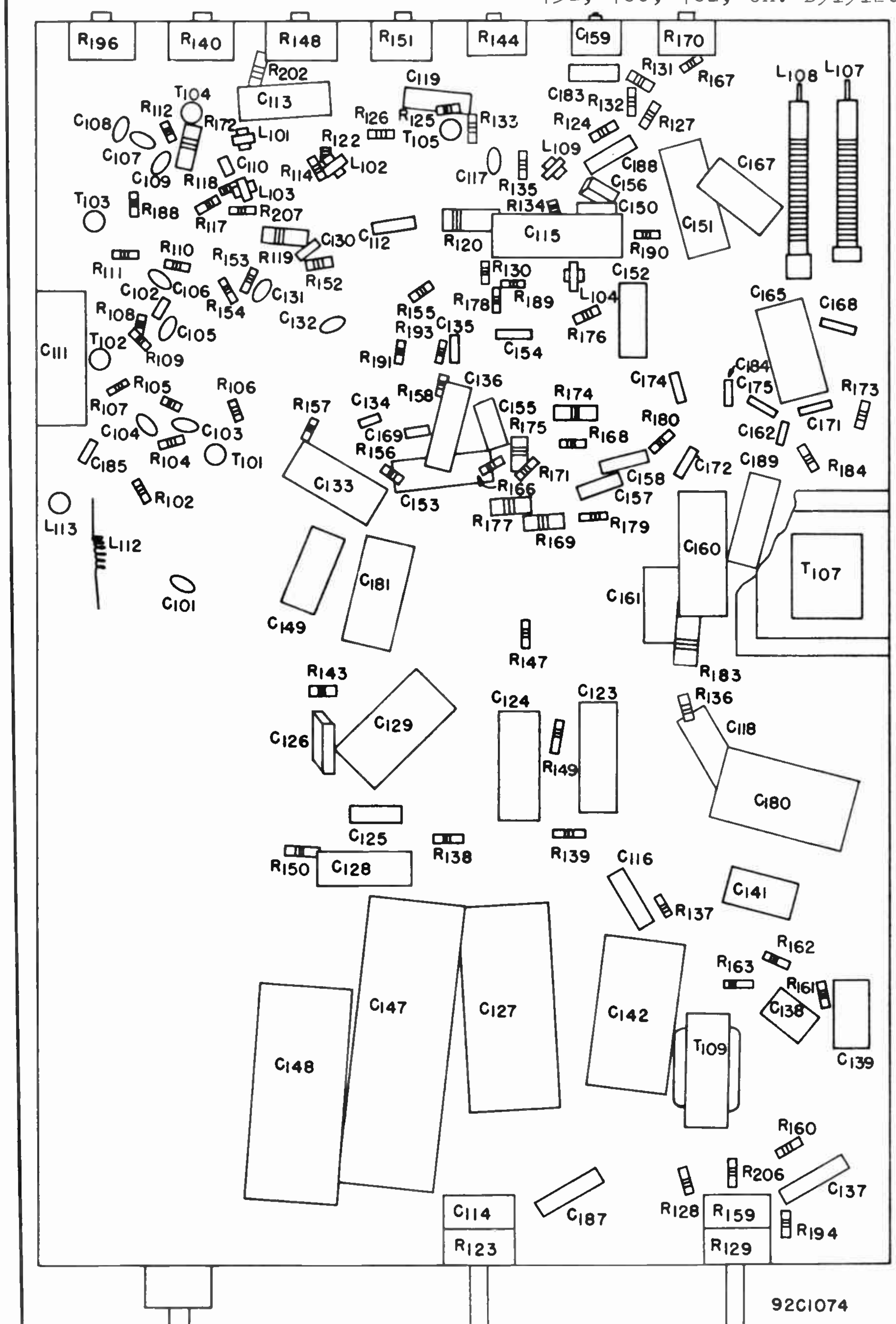

Fig. 22. Bottom chassis view, component location.

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SERVICE PARTS LIST

Ref. No.	Description	Manufacturer's Part Number
	ELECTRICAL PARTS	
	TRANSFORMERS AND COILS	
L-101,102, 109	Coil, video peaking	51A1154
L-103,104	Coil, video peaking	51A1155
L-105	Coil, focus	51B1159
L-106	Deflection yoke	53C195
L-107	Coil, WIDTH control	51B1072-1
L-108	Coil, HORIZONTAL LINEARITY control	51B1232
L-110,111	Choke, cabinet antenna	53B009
L-112	Choke, heater	53A191
L-113	Coil, 21.75 mc. trap	51B1231
T-101	Transformer, 1st i-f amplifier	50B458
T-102,103, 104	Transformer, i-f amplifier	50A431
T-105	Coil, 4.5 mc. sound trap	50A432
T-106	Transformer, vertical oscillator	55B115
T-107	Transformer, vertical output	55A128
T-108	Transformer, ratio detector	50B406
T-109	Transformer, audio output	55C134
T-110	Transformer, power	52C199
T-111	Transformer, horizontal osc.	51B1153
T-112	Transformer, horizontal output	55C145
	CONDENSERS	
C-1	50 mmf. 500 V., ceramic	47X20CK500J
C-2	1500 mmf. 500 V., ceramic	47X50CJ152J
C-3,5,9,11, 21,22	5000 mmf. 450 V., ceramic	47A168
C-4,10	14 mmf. 500 V., ceramic	47X0CK140J
C-6	4.7 mmf. 500 V., ceramic	47A160-6
C-7	680 mmf. 500 V., ceramic	47B20681K5
C-8,12	100 mmf. 500 V., ceramic	47B20101K5
C-13	2.2 mmf. 500 V., ceramic	47X20CK022J
C-14	30 mmf. 500 V., ceramic	47X20CK300J
C-15	18 mmf. 500 V., ceramic	47X20CK180J
C-16	19 mmf. 500 V., ceramic	47X20CK190J
C-101,103, 104,105, 106,107, 108,109, 117,131, 132	5,000 mmf. 450 V., ceramic	47A168
C-102	3.3 mmf. 500 V., ceramic	47A160-5
C-110,168	5 mmf. 500 V., ceramic	47X20UJ050M
C-111,113, 149,160	.25 mfd. 200 V., tubular	46AT254J
C-112	22 mmf. 500 V., mica	47X20A220K
C-114	56 mmf. 500 V., mica	47X20A560M
C-115,118, 165,161, 189	.05 mfd., 600 V., tubular	46AY503J
C-116,136, 137	.01 mfd. 200 V., tubular	46AU103J
C-119,188	.05 mfd. 200 V., tubular	46AU503J
C-123,152	.002 mfd. 600 V., tubular	46AZ202J
C-124,125	.005 mfd. 200 V., tubular	46AU502J
C-126	4700 mmf. 500 V., mica	47X35A472M
C-127	50 mfd. 250 V., 75 mfd. 50 V., electrolytic	45B165
C-128,151	.1 mfd. 600 V., tubular	46AY104J
C-129	.25 mfd. 600 V., tubular	46AX254J
C-130	100 mmf. 500 V., ceramic	47B20101K5
C-133	5 mfd. 50 V., electrolytic	45A109
C-134,169	330 mmf. 500 V., ceramic	47B20331K5
C-135,172, 174,175, 184	1000 mmf. 500 V., ceramic	47B20A102M5
C-138	330 mmf. 500 V., mica	47X20A331M
C-139,141, 157	.01 mfd. 600 V., tubular	46AY103J
C-142	50 mfd. 300 V., electrolytic	45B171
C-144	56 mmf. 500 V., mica	47X15D560K
•C-145,146	.01 mfd. 600 V., molded	46BR103L6
C-147	40-40 mfd. 450 V., electrolytic	45A159
C-148	60 mfd. 450 V., electrolytic	45B166
C-150	220 mmf. 500 V., mica	47X20A221M
C-153	.02 mfd. 600 V., tubular	46AY203J
C-154	390 mmf. 500 V., mica	47X20A391M
C-155	10,000 mmf. 500 V., mica	47X35A103K
C-156,183	100 mmf. 500 V., mica	47X20A101M
C-159	HORIZONTAL DRIVE control	44A361
C-162,171	47 mmf. 500 V., ceramic	47B20470K5
C-164	500 mmf. 20,000 V., ceramic	47A216
C-167	.035 mfd. 600 V., tubular	46AY353J
C-178	1000 mmf. 500 V., mica	47X20A102M
C-180	100 mfd. 10 V., electrolytic	45B170
C-181	8 mfd. 475 V., electrolytic	45A103
C-185	2.2 mmf. 500 V., ceramic	47A160-4
C-187	.1 mfd. 200 V., tubular	46AU104J

Ref. No.	Description	Manufacturer's Part Number
	RESISTORS	
R-1	560 ohms 1/2 watt, carbon	23X20X561K
R-2	150 ohms 1/2 watt, carbon	23X20X151M
R-3	1000 ohms 1/2 watt, carbon	23X20X102M
R-4	1200 ohms 1/2 watt, carbon	23X20X122K
R-5,11,12	10,000 ohms 1/2 watt, carbon	23X20X103K
R-6	100 ohms 1/2 watt, carbon	23X20X101M
R-7	220 ohms 1/2 watt, carbon	23X20X221M
R-8	1500 ohms 1/2 watt, carbon	23X20X152K
R-9	5600 ohms 1/2 watt, carbon	23X20X562M
R-10	100,000 ohms 1/2 watt, carbon	23X20X104M
R-102,108, 188	100 ohms 1/2 watt, carbon	23X20X101K
R-104	5600 ohms 1/2 watt, carbon	23X20X562K
R-105,110, 180	47 ohms 1/2 watt, carbon	23X20X470K
R-106,109, 112,191	150 ohms 1/2 watt, carbon	23X20X151K
R-107,152, 158,194	33,000 ohms 1/2 watt, carbon	23X20X333K
R-111	3300 ohms 1/2 watt, carbon	23X20X332K
R-114,124, 178	22,000 ohms 1/2 watt, carbon	23X20X223K
R-117,122, 143	1 megohm 1/2 watt, carbon	23X20X105K
R-118,126, 137,155	10,000 ohms 1/2 watt, carbon	23X20X103K
R-119	2200 ohms 1 watt, carbon	23X30X222M
R-120	4700 ohms 2 watts, carbon	23X40X472K
R-123	7500 ohms WW, PICTURE control	25B791
R-125	27,000 ohms 1/2 watt, carbon	23X20X273K
R-127,131	2200 ohms 1/2 watt, carbon	23X20X222K
R-128	6800 ohms 1/2 watt, carbon	23X20X682M
R-129,159	50,000 ohms/1 meg., BRIGHTNESS/VOLUME control	25B874
R-130,161, 179,193	470,000 ohms 1/2 watt, carbon	23X20X474M
R-132,168	820,000 ohms 1/2 watt, carbon	23X20X824M
R-133	270,000 ohms 1/2 watt, carbon	23X20X274K
R-134,136, 149	4700 ohms 1/2 watt, carbon	23X20X472K
R-135,153, 206	47,000 ohms 1/2 watt, carbon	23X20X473K
R-138,139, 166,189	8200 ohms 1/2 watt, carbon	23X20X822K
R-140	2500 ohms 2 watts, WW, FOCUS	25B710
R-141,142	560 ohms 1/2 watt, carbon	23X20X561K
R-144	1 megohm, VERTICAL control	25B857
R-147	2.2 megohms 1/2 watt, carbon	23X20X225M
R-148	5,000 ohms, VERTICAL LINEARITY control	25B712
•R-150	820,000 ohms 1 watt, carbon	23X30BF824K
R-151	2.5 megohms 1/2 watt, HEIGHT control	25B711
R-154	100,000 ohms 1/2 watt, carbon	23X20X104M
•R-156,157	10,000 ohms 1/2 watt, carbon	23X20X103J
R-160	4.7 megohm 1/2 watt, carbon	23X20X475M
R-162	330,000 ohms 1/2 watt, carbon	23X20X334M
•R-163	4.7 megohms 1/2 watt, carbon	23X20X475J
R-164	8200 ohms 10 watts, WW	24BG822E
R-165	200 ohms 20 Watts, WW	24BH201E
R-167	82,000 ohms 1/2 watt, carbon	23X20X823K
•R-169,171	150,000 ohms 1 watt, carbon	23X30BF154K
R-170	50,000 ohms, HORIZONTAL control	25A858
R-172	18,000 ohms 1 watt, carbon	23X30X183K
R-173	120,000 ohms 1/2 watt, carbon	23X20X124M
•R-174	2.7 megohms 1 watt, carbon	23X30BF275K
•R-175,177	120,000 ohms 1 watt, carbon	23X30BF124J
R-176,207	150,000 ohms 1/2 watt, carbon	23X20X154M
R-181,182	39,000 ohms 2 watts, carbon	23X40X393K
R-183	100 ohms 2 watts, carbon	23X40X101K
R-184	10,000 ohms 1 watt, carbon	23X30X103K
R-187	1 megohm 1 watt, carbon	23X30X105M
R-190	560,000 ohms 1/2 watt, carbon	23X20X564K
R-195	33 ohms 1 watt, carbon	23X30X330K
R-196	400 ohms 2 watts, WW, HORIZONTAL CENTERING	25B713
R-202	390 ohms 1 watt, carbon	23X30X391K
R-205	25,000 ohms 10 watts, WW	24BG253E

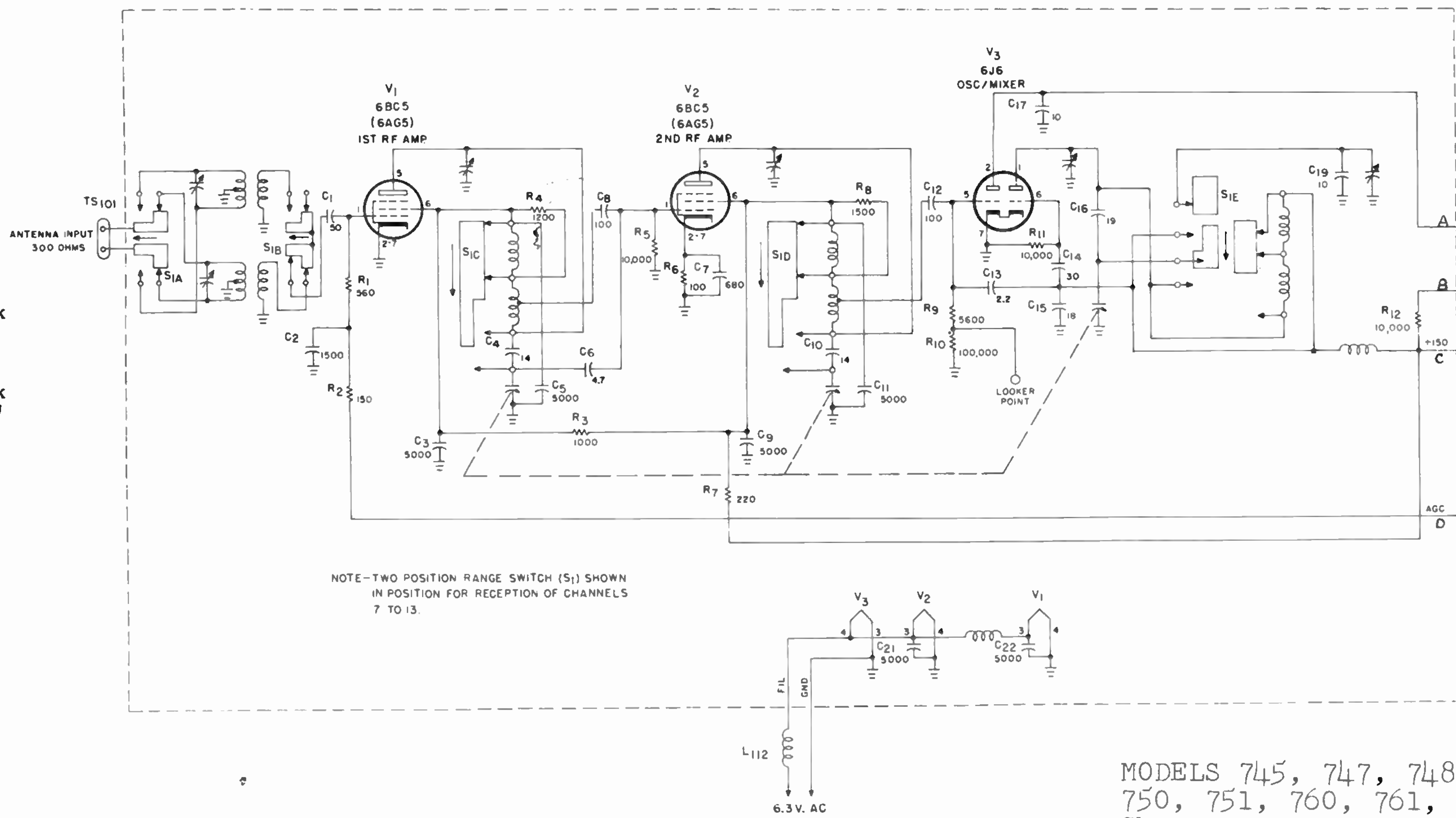
Tol. on carbon resistors -- M-20%, K-10%, J-5%

TUBE COMPLEMENT

Ref. No.	Description	Manufacturer's Part Number
V-1,2	Type 6BC5; 1st and 2nd r-f amp.	90X6BC5
V-3	Type 6J6; osc./mixer	90X6J6
V-101,102, 103,108	Type 6AU6: 1st, 2nd and 3rd i-f amp: and audio i-f amp.	90X6AU6
V-104,105, 106	Type 12AU7: video detector and 1st video amp: 2nd video amp. and sync. separator: sync. amp and 2nd sync. separator	90X12AU7
V-107	Type 6J5-GT: Vertical osc.	90X6J5-GT
V-109	Type 6AL5: f-m detector	90X6AL5
V-110	Type 6AV6: audio amp.	90X6AV6
V-111	Type 6AQ5: audio output	90X6AQ5
V-112	Type 5U4G: low voltage rectifier	90X5U4G
V-113,117	Type 6SN7-GT: horizontal osc; and vertical amp.	90X6SN7-GT
V-114	Type 6BQ6-GT: horizontal amp.	90X6BQ6-GT
V-115	Type 1X2: high voltage rectifier	90X1X2
V-116	Type 6W4-GT: damper	90X6W4-GT
V-118	Type 16RP4: kinescope	90X16RP4

Ref. No.	Description	Manufacturer's Part Number
	MISCELLANEOUS ELECTRICAL PARTS	
	Tuning unit assembly complete	1C945
LS-101	Speaker assembly (Models 745, 747 and 748)	85C101
LS-101	Speaker assembly (Models 750, 751, 760 and 761)	85C102
PL-101	Line cord and plug PL-102	87A1668
PL-103	Plug, speaker (Includes SO-102)	10A287
PL-105	Plug, 16RP4 anode	10A300-3
PL-106	Plug, 4 prong (PHONO/TELEVISION)	10A302
	Shell, plug (used on PL-106)	10A305
	Socket, kinescope	6A348
F-101	Fuse, 4 amp. (With wire leads)	39A345
S-102	Switch, D.P.D.T.; PHONO/TELEVISION	60B381
	MECHANICAL PARTS	
	CHASSIS PARTS	
SO-101	Socket, a-c power	10A286
SO-103	Socket, phono input	36A041
SO-104	Socket, 4 prong (PHONO/TELEVISION)	10A296
	Shell, socket (Used on SO-104)	10A294
	Socket, octal (Tube)	6A339
	Socket, octal (Tube V-107)	6B296
	Socket, miniature 7 pin (Tube)	6A340
	Socket, miniature 9 pin (Tube)	6A334
	Socket, miniature 9 pin (Tube V-115)	6A343
	Rear Tube support (Deflection yoke housing)	67D1190
	Bracket, rear tube support mtg.	67C1165
	Bracket, rear tube support (Riveted to 67C1165)	67C1162
	Bracket, rear tube support brace (Right or left hand)	67C1163
	Cradle, bar	67C1161
	Cradle, bar mtg. bracket (Right or left hand)	67C1164
	Plate, focus coil mtg.	67B1127
	Coil spring, focus coil adj.	75A170
	Clamp, kinescope mtg.	76B558
	Protective strip, rubber	16A185
	CABINET PARTS	
TS-101	Terminal strip, antenna	88A020
	Bracket, antenna terminal strip mtg.	67B1060
	Mask, escutcheon (Model 745)	7D166
	Mask, escutcheon (Models 747 and 748)	7D185
	Mask, escutcheon (Models 750, 751, 760 and 761)	7D170
	Escutcheon, kinescope (Models 750, 751, 760 and 761)	7D158
	Glass, safety (Model 745)	22D288
	Glass, safety (Models 747 & 748)	22D303
	Glass, safety (Models 750, 751, 760 and 761)	22D292
	Knob, VOLUME (Models 745, 747, 750 and 760)	15B234
	Knob, VOLUME (Models 748, 751 and 761)	15A243
	Knob, BRIGHTNESS (Models 745, 747, 750 and 760)	15C233
	Knob, BRIGHTNESS (Models 748, 751 and 761)	15A242
	Knob, OFF-PICTURE (Models 745, 747, 750 and 760)	15C232
	Knob, OFF-PICTURE (Models 748, 751 and 761)	15A241
	Knob, range selector (Models 745, 747, 750 and 760)	15C231
	Knob, range selector (Models 748, 751 and 761)	15A240
	Indicator, channel selector (Models 745, 747, 748, 750 & 760)	15C230
	Indicator, channel selector (Models 751 and 761)	15C230
	Knob, channel selector (Models 745, 747, 750 and 760)	15B229
	Knob, channel selector (Models 748, 751 and 761)	15A238
	Dust seal, rubber	16C163
	Ion Trap	21A101
	Cabinet back (Model 745)	8E1087
	Cabinet back (Models 750, 751, 760 and 761)	8E1077

• Use exact replacement part only.



MODELS 745, 747, 748, 750, 751, 760, 761, Ch. D919120

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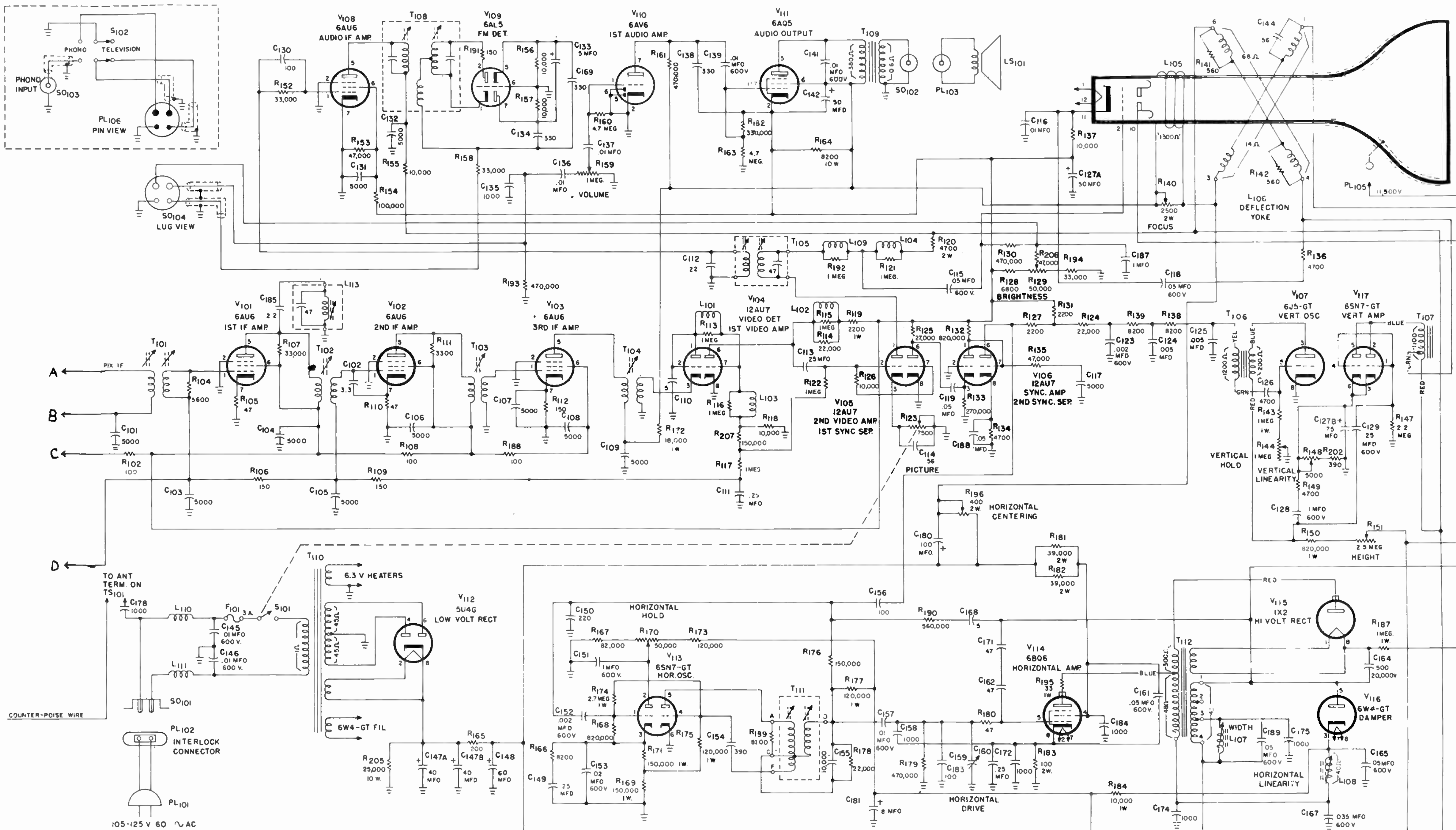

LAST R SYMBOL R-207
LAST C SYMBOL C-189
LAST L SYMBOL L-113
LAST T SYMBOL T-112

NOTE - CAPACITOR VALUES ARE IN MMF UNLESS OTHERWISE SPECIFIED.
RESISTOR VALUE ARE IN OHMS & 1/2 WATT RATING UNLESS OTHERWISE SPECIFIED.

S-102 SHOWN IN TELEVISION POSITION

89F343-E

Fig. 24. Schematic diagram.

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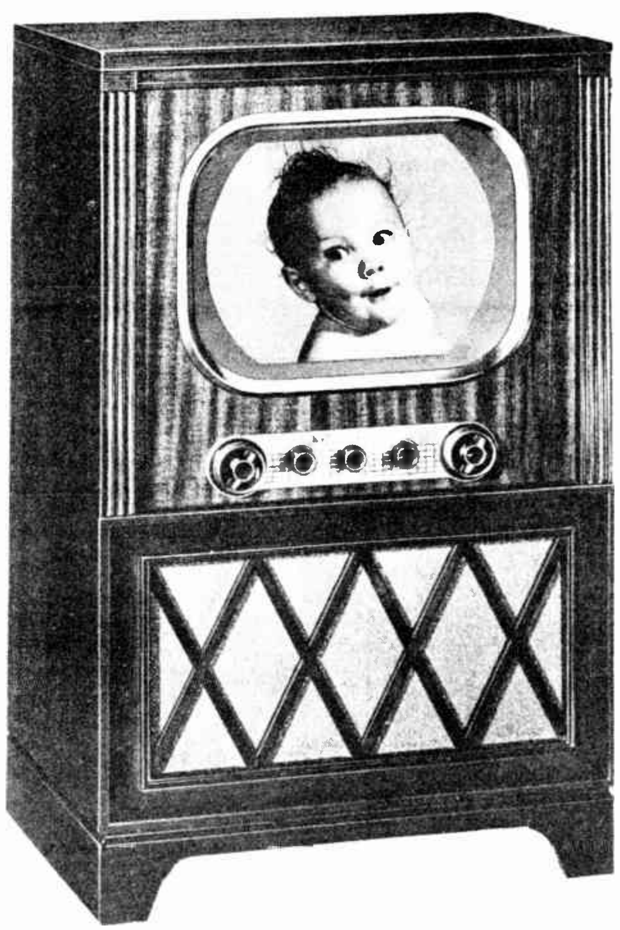

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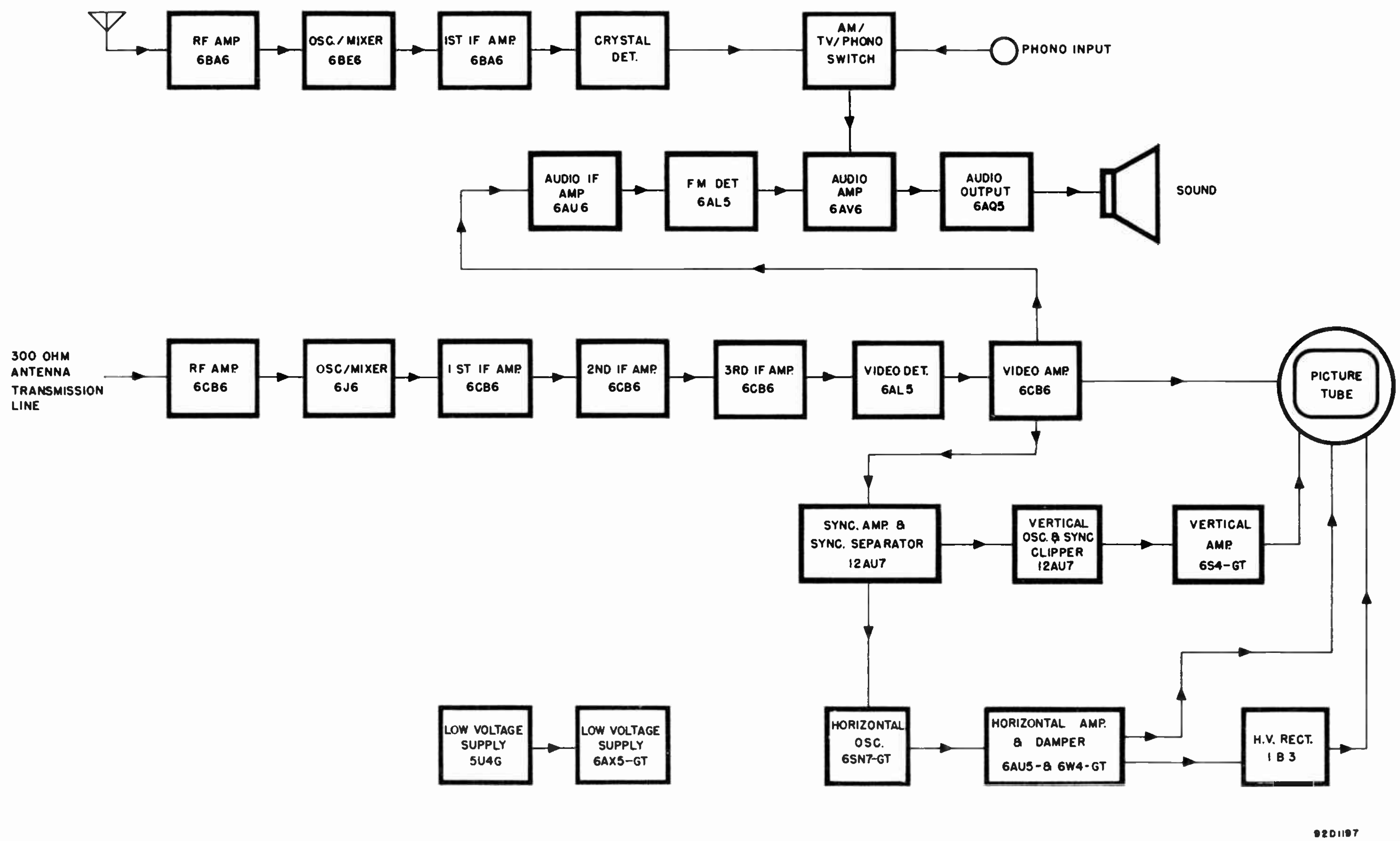

FIG. 1. FUNCTIONAL BLOCK DIAGRAM

NOTE: FOR ALTERNATE TUBE TYPES REFER TO TUBE COMPLEMENT ON PAGE 3.

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GENERAL SPECIFICATIONS

TUNING (TV)	12 CHANNELS, 2 - 13
TUNING (AM)	535 KC - 1620 KC
ANTENNA (TV)	HALLICRAFTERS BUILT-IN SILVER VORTEX
ANTENNA (AM)	BUILT-IN LOOP
INTER-CARRIER SOUND SYSTEM	4.5 MC
POWER SUPPLY	105-120 VOLTS 60 CYCLES AC
PICTURE AREA	135 SQ. INCHES
SPEAKER	8 INCH P.M.
PICTURE CARRIER IF	26.25 MC
SOUND CARRIER IF	21.75 MC
AM TUNER IF	455 KC
POWER INPUT	235 WATTS
TUBES	24 INCLUDING 3 RECTIFIERS

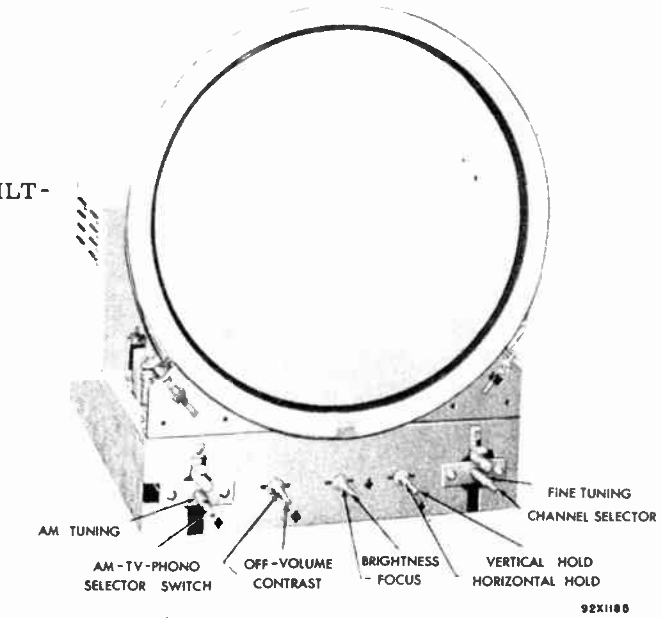

FIG. 2. CHASSIS FRONT VIEW

SERVICE ADJUSTMENTS

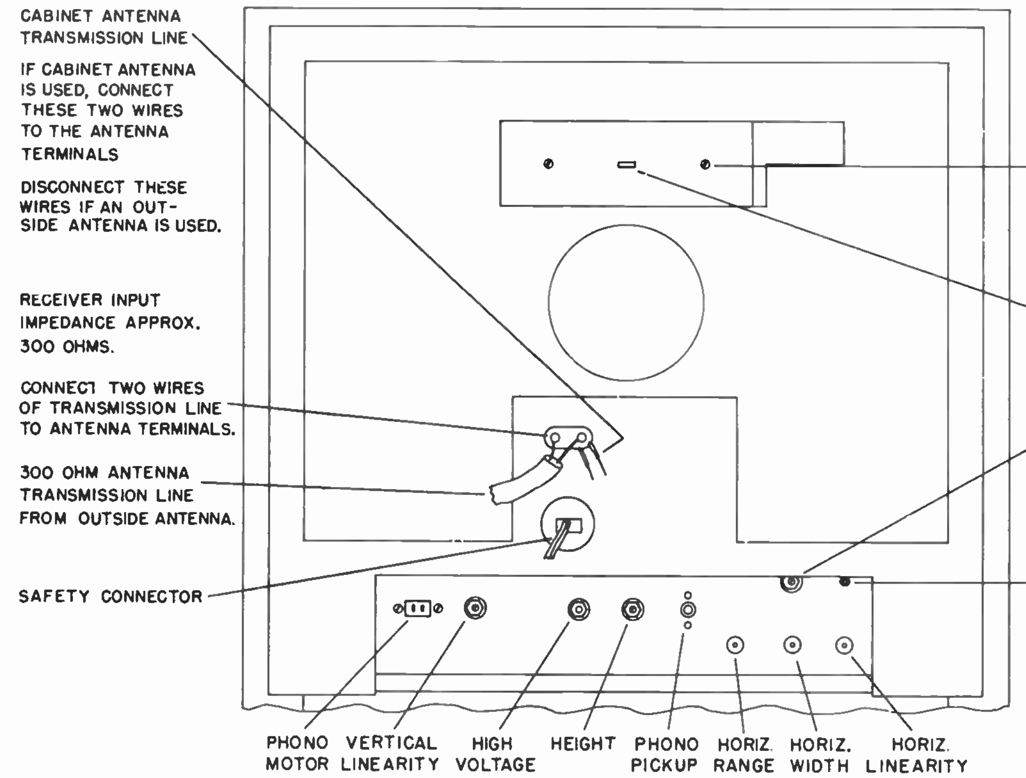

FIG. 3. REAR VIEW

The service adjustments normally will require an occasional minor adjustment if any circuit work or tube replacement is required. A test pattern, generated either locally in the shop or obtained from a television station is recommended for best results. The operating and auxiliary controls, located on the front panel, should be set for as good a pattern as possible before making the following adjustments.

TUBE COMPLEMENT

V 1	6CB6	RF AMPLIFIER	V 111	6AV6 or 6SQ7	1ST AUDIO AMPLIFIER
V 2	6J6	OSC/MIXER	V 112	6AQ5	AUDIO OUTPUT
V 101	6CB6	1ST IF AMPLIFIER	V 113	6AX5GT or 6X5GT	LV RECTIFIER
V 102	6CB6	2ND IF AMPLIFIER	V 114	5U4G	LV RECTIFIER
V 103	6CB6	3RD IF AMPLIFIER	V 115	6SN7GT	HORIZONTAL OSC.
V 104	6AL5	VIDEO DETECTOR	V 116	6AU5GT or 6AV5GT	HORIZONTAL AMP.
V 105	6CB6	VIDEO AMPLIFIER			
V 106	12AU7 or 6SN7	SYNC AMP & SEP	V 117	6W4GT	DAMPER
V 107	12AU7 or 6SN7	SYNC CLIPPER & VERTICAL OSC.	V 118	1B3GT	HV RECTIFIER
			V 119	16GP4	16" BLACK PICTURE TUBE
V 108	6S4	VERTICAL AMPLIFIER	V 201	6BA6	RF AMPLIFIER (AM)
V 109	6AU6	AUDIO IF AMPLIFIER	V 202	6BE6	CONVERTER (AM)
V 110	6AL5	AUDIO DETECTOR	V 203	6BA6	IF AMPLIFIER (AM)

PRODUCTION CHANGES

Chassis in which minor changes or substitutions were made during production may be identified as follows:

CHASSIS STAMP	CHANGE OR SUBSTITUTIONS
A.	Fuse added to the circuit
1.	Tube type 6SQ7 substituted for type 6AV6
4.	Tube type 6SN7 substituted for type 12AU7
5.	Both of the above tube substitutions.

Note: See notation on the schematic diagram for those changes above that involve changes in wiring or connections.

FIG. 4. CENTERING MISADJUSTMENT

If the picture is not properly centered remove the two centering control lock screws and move the centering control lever a short distance in any direction required to recenter the picture. Do not use undue force in making this adjustment as excessive strain may be exerted on the neck of the picture tube. If proper centering cannot be restored in this manner a slight readjustment of the deflection yoke mounting may be necessary.

HIGH VOLTAGE WARNING

OPERATION OF THE RECEIVER CHASSIS OUTSIDE OF THE CABINET INVOLVES DANGER OF ELECTRICAL SHOCK.

EXERCISE ALL NORMAL HIGH VOLTAGE PRECAUTIONS WHEN WORKING WITH THIS RECEIVER.

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FIG. 5. HEIGHT CONTROL MISADJUSTMENT

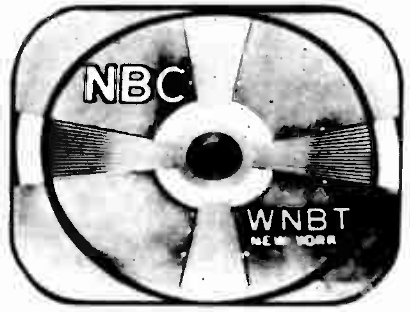

FIG. 6. WIDTH CONTROL MISADJUSTMENT

Adjust the HEIGHT and WIDTH controls so that the picture fills out the dimensions of the screen. A slight readjustment of the CENTERING control may then be necessary.

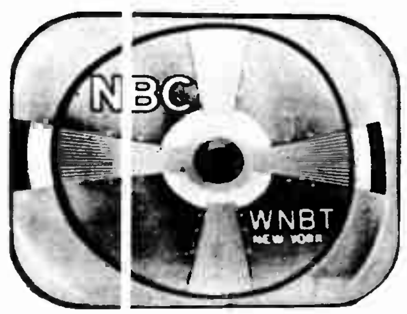

FIG. 7. HORIZONTAL DRIVE CONTROL MISADJUSTMENT

The HORIZONTAL DRIVE is adjusted by advancing the adjustment to a point where a vertical white line appears in the pattern and then backing it off just beyond the point where the white line disappears.

Note - The sequence of "non-operating" control adjustments outlined is suggested as a convenient method of approach and not an arbitrary procedure. Variations of the procedure are permitted to obtain the final result.

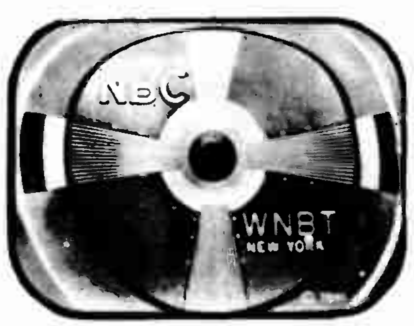

FIG. 8. VERTICAL LINEARITY CONTROL MISADJUSTMENT

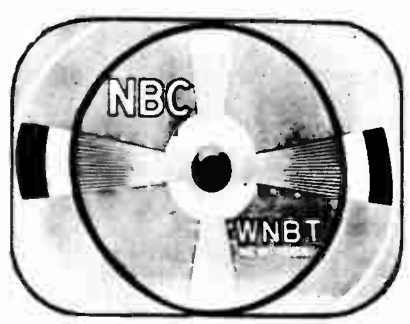

FIG. 9. HORIZONTAL LINEARITY CONTROL MISADJUSTMENT

Adjust the HORIZONTAL LINEARITY and VERTICAL LINEARITY adjustments for a symmetrical pattern. A slight readjustment of the HEIGHT and WIDTH controls may then be necessary.

WARNING

PICTURE TUBE HANDLING PRECAUTIONS

The picture tube envelope encloses a high vacuum and with the large surface area of glass involved, the stresses created are considerable. Any accidental blow or rough handling could cause the tube to implode with extreme violence. The picture tube should be handled only by qualified persons protected by heavy gloves and shatterproof goggles.

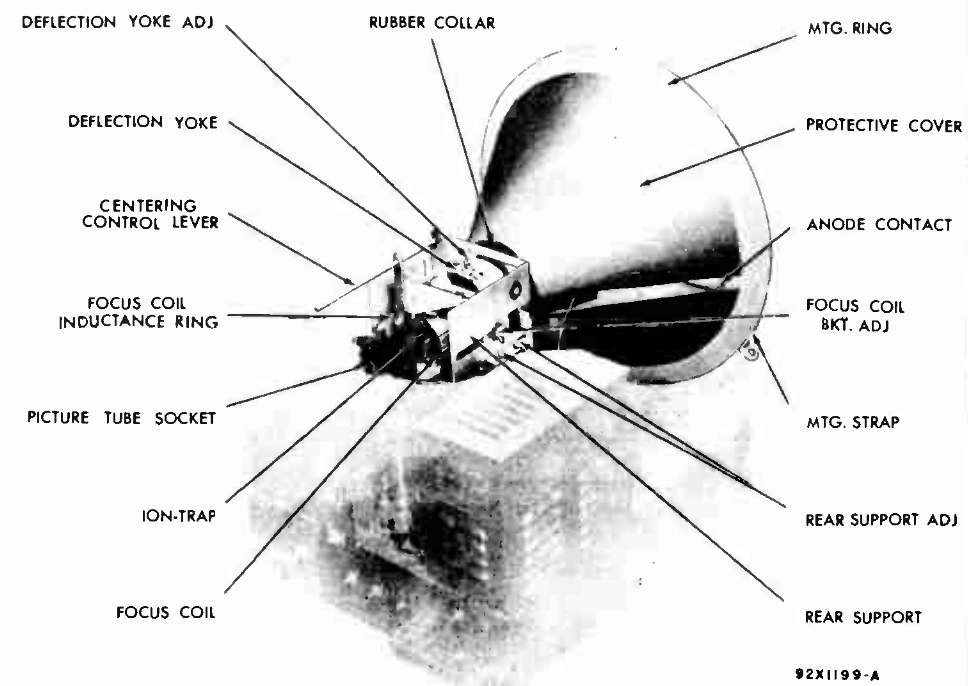

FIG. 10. PICTURE TUBE MOUNTING DETAIL

TO REMOVE THE CHASSIS FROM THE CABINET

1. Remove the knobs on the front panel by pulling in the forward direction.
2. Remove the slotted cover through which the centering lever protrudes on the cabinet back. This is accomplished by removing the two fastening screws from the cover.
3. Unscrew the fastening bolt located directly above the AC cord insert.
4. Remove the screws holding the cabinet back. The back cover may then be set aside.
5. Remove the speaker plug at the chassis. On table model remove the speaker mounting nuts and lift out the speaker.
6. Remove the leads from the built-in antenna at the terminals on the chassis.
7. Removal of the chassis may now be completed by removing the five chassis mounting bolts.

REMOVING THE PICTURE TUBE

1. Remove the chassis from the cabinet by following the above procedure.
2. Insure the discharge of the high voltage filter condenser by shorting the ANODE CONTACT (PL-104) to chassis through a well insulated wire or test lead.
3. Disconnect the ANODE CONTACT (PL-104).
4. Disconnect the TUBE SOCKET at the base of the tube.
5. Slip the ION TRAP from the neck of the tube.
6. Remove the MOUNTING STRAP at the front rim of the tube.
7. Loosen the four REAR SUPPORT ADJUSTMENT SCREWS and then, while holding the tube near the face, carefully slip the neck of the tube out of the DEFLECTION YOKE and FOCUS COIL. Use a slight twisting pull in order to break the cone of the tube away from the RUBBER COLLAR. If the tube fails to slip out smoothly, investigate and remove the cause of trouble. DO NOT USE FORCE.
8. If the tube is to be replaced, remove the rubber band from around the plastic MOUNTING RING. The PROTECTIVE COVER and the MOUNTING RING can now be removed.

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INSTALLING AND ADJUSTING THE PICTURE TUBE

1. Slip the PROTECTIVE COVER over the cone of the tube and fit the plastic MOUNTING RING over the edge of the PROTECTIVE COVER at the front rim of the tube. Make sure that the ANODE CONTACT makes a good electrical connection with the metal cone of the tube.

2. Adjust the MOUNTING RING and the PROTECTIVE COVER so that the ends of the MOUNTING RING come together approximately 90 degrees counterclockwise from the ANODE CONTACT on the PROTECTIVE COVER, when facing the front of the tube. Place the rubber band in the groove of the MOUNTING RING.

3. Slip the neck of the tube through the RUBBER COLLAR, DEFLECTION YOKE, and FOCUS COIL; seating the groove of the MOUNTING RING on the two rubber channels mounted on the two curved brackets at the front of the chassis. Position the tube so that the joint in the MOUNTING RING is centered at the bottom, next to the chassis.

4. Place the MOUNTING STRAP in the MOUNTING RING groove and tighten firmly.

5. Move the REAR SUPPORT so that the RUBBER COLLAR rests firmly against and supports the cone of the tube. Tighten the REAR SUPPORT ADJUSTMENT SCREWS.

6. Check the ION TRAP for any markings and slip it over the neck of the tube. If the TRAP is stamped with an arrow, the arrow should point towards the face of the tube.

7. Connect the PICTURE TUBE SOCKET and the ANODE CONNECTOR.

8. Turn the receiver on and allow a few minutes for warm up.

9. Turn up the BRIGHTNESS control and set the ION TRAP for maximum raster brilliance, backing off the BRIGHTNESS control as the maximum point is approached. The ION TRAP must be rotated about the axis of the tube as well as shifted along the neck in order to obtain proper setting. With the BRIGHTNESS control set for slightly above normal brilliance and the CONTRAST control full counterclockwise, adjust the FOCUS control until the raster is clearly visible. Readjust the ION TRAP for maximum raster brilliance and set the BRIGHTNESS control for normal reception.

10. Connect the antenna and tune in a test pattern.

11. Readjust the CONTRAST control until the different shades of the gray scale are clearly visible on the test pattern.

12. Check the position and appearance of the test pattern. If it is off center or shadowed at the corners (electron beam striking the neck of the tube) adjust the centering lever. Set the focus control at the center of its range and adjust the FOCUS COIL ADJUSTMENT, if one is provided, and FOCUS COIL INDUCTANCE RING as necessary so that a clear sharp picture may be obtained well within the range of the focus control.

CAUTION - It will not be necessary to turn the CENTERING LEVER excessively. Excessive force on the lever will snap the neck of the tube.

13. If the lines of the raster are not horizontal or square with the escutcheon loosen the DEFLECTION YOKE ADJ. screw and rotate the DEFLECTION YOKE until this condition is obtained. Tighten this adjustment.

14. Follow the procedure under the NON-OPERATING CONTROL ADJUSTMENTS and make any minor adjustment of the FOCUS COIL or DEFLECTION YOKE necessary to obtain the desired results.

ADJUSTMENT OF THE HIGH VOLTAGE ON THE PICTURE TUBE ANODE

The second anode potential should be slightly less than 14,000 volts on a receiver that is functioning properly. Since the high voltage is obtained from the horizontal output transformer, the service adjustments must be made, or known to be in proper adjustment, before a high voltage measurement will have any meaning.

Improper operation of the horizontal sweep circuit or circuit faults in the high voltage filter will generally account for an abnormal anode potential. If the anode potential is low, check the HORIZONTAL DRIVE adjustment outlined above.

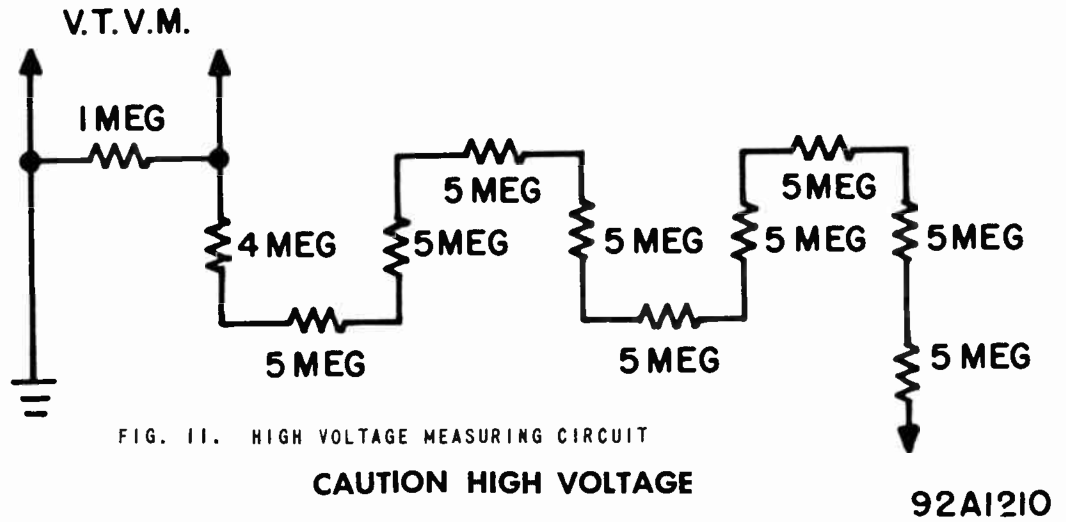

FIG. 11. HIGH VOLTAGE MEASURING CIRCUIT

CAUTION HIGH VOLTAGE

DO NOT USE HAND HELD FLEXIBLE TEST LEADS WHEN MAKING THE FOLLOWING MEASUREMENT. KEEP THE HANDS CLEAR OF THE CIRCUIT DURING MEASUREMENT. A 11 TO 14 KV. POTENTIAL EXISTS IN THIS CIRCUIT. EXERCISE ALL NORMAL HIGH VOLTAGE PRECAUTIONS.

To measure the second anode potential, set the CONTRAST and BRIGHTNESS controls at minimum. With the controls in this position, the resistance of the test circuit will simulate the load presented to the high voltage power supply of the picture tube. Connect a test circuit as shown in Fig. 11. Make the resistor string self-supporting and allow adequate clearance between the resistors and chassis parts to prevent high voltage breakdown. A meter scale of 0 to 300 volts or larger should be used. Observe the reading on the meter scale and multiply this reading by 50 to obtain the voltage across the circuit. As an example, if the V.T.V.M. reads 260 volts, the potential is 260 x 50 or 13,000 volts.

After it has been determined that the receiver is otherwise in good working order and properly adjusted, the High Voltage adjustment on the rear of the chassis (See Fig. 3) should be set for a potential slightly less than 14,000 volts. This adjustment has been provided mainly to compensate for variation in line voltage.

HORIZONTAL OSCILLATOR ALIGNMENT

If the Horizontal Hold control on the front panel fails to restore synchronization the Horizontal Range and Horizontal Lock adjustments should be reset.

1. Turn the Hold control to the full clockwise position. Adjust the Horizontal Range adjustment until a vertical bar appears in the pattern.

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2. Turn the Hold control to the full counter-clockwise position. Momentarily switch off the station. Three or four horizontal bars should then appear on the screen. If too many or too few bars appear, the number may be decreased by turning the Horizontal Lock adjustment in the clockwise direction, or increased by turning the Horizontal Lock adjustment in the counter-clockwise direction.

3. Repeat step #1.

4. Check the action of the front controls on on all active channels. Repeat the above steps if necessary to maintain stable synchronization.

If the above procedure fails to restore stable synchronization, a waveform adjustment may be made with the aid of an oscilloscope.

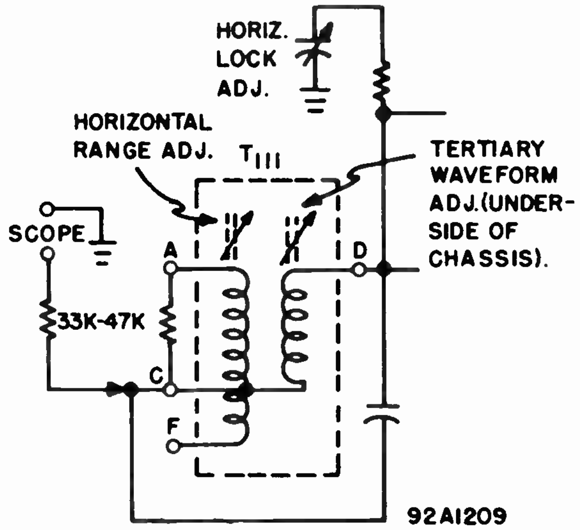

FIG. 12. OSCILLOSCOPE CONNECTION, FOR HORIZONTAL OSCILLATOR ALIGNMENT

5. Connect the oscilloscope as shown in Fig. 12. Adjust the Tertiary Waveform adjustment until the sine wave is equal in amplitude to the peak of the sawtooth (see Fig. 13), while maintaining the picture in synchronization with the Horizontal range adjustment.

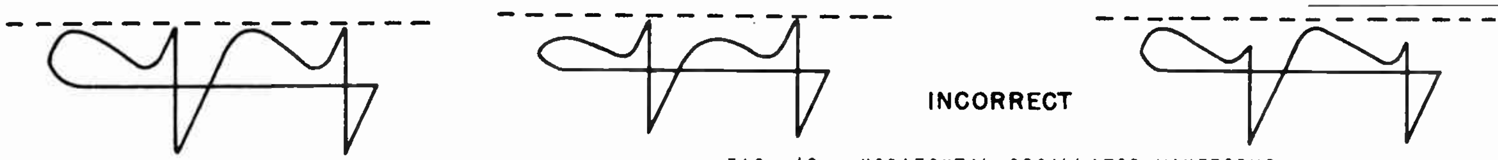

FIG. 13. HORIZONTAL OSCILLATOR WAVEFORMS

CARRIER vs. I-F FREQUENCY CHART

Channel No.	Channel Freq. (mc)	Picture Carrier Freq. (mc)	Sound Carrier Freq. (mc)	Receiver Osc. Freq. (mc)	Picture IF Freq. (mc)	Sound IF Freq. (mc)	Picture IF less Sound IF (mc)
2	54-60	55.25	59.75	81.5	26.25	21.75	4.5
3	60-66	61.25	65.75	87.5	26.25	21.75	4.5
4	66-72	67.25	71.75	93.5	26.25	21.75	4.5
5	76-82	77.25	81.75	103.5	26.25	21.75	4.5
6	82-88	83.25	87.75	109.5	26.25	21.75	4.5
7	174-180	175.25	179.75	201.5	26.25	21.75	4.5
8	180-186	181.25	185.75	207.5	26.25	21.75	4.5
9	186-192	187.25	191.75	213.5	26.25	21.75	4.5
10	192-198	193.25	197.75	219.5	26.25	21.75	4.5
11	198-204	199.25	203.75	225.5	26.25	.21.75	4.5
12	204-210	205.25	209.75	231.5	26.25	21.75	4.5
13	210-216	211.25	215.75	237.5	26.25	21.75	4.5

This adjustment is very important for correct operation of the circuit. If the broad peak of the wave on the oscilloscope is lower than the sharp peak, the noise immunity becomes poorer, the stabilizing effect of the tuned circuit is reduced and drift of the oscillator becomes more serious.

On the other hand, if the broad peak is higher than the sharp peak, the oscillator is overstabilized, the pull-in range becomes inadequate and the broad peak can cause double triggering of the oscillator when the hold control approaches the clockwise position.

6. Remove the oscilloscope and repeat step #1 and 2 if necessary.

7. Check the action of the front panel controls and repeat above steps as required to provide positive synchronization on all channels.

AM TUNER ALIGNMENT

Connect the VTVM across R-215 at the terminal strip on the under side of the chassis as shown in Fig. 15. Set the SELECTOR SWITCH to the AM position. Follow the steps in the chart below using just enough signal generator output to give a useful indication on the VTVM (approximately 2 volts).

Step	Dummy Ant.	Signal Generator Coupling To	Signal Generator Frequency (AM Modulated 30%)	Radio Dial Setting	Adjust	Remarks
1	.01 Mfd. capacitor	Pin No. 7 of the 6BE6 Converter tube	455 KC	1000 KC	A,B,C,D	Adjust for maximum indication on the VTVM
2	Same	Stator of C-202A	455 KC	1000 KC	C-207	Adjust for minimum indication on the VTVM
3	200 mmf. capacitor	Loop Antenna Primary	1600 KC	1600 KC	C-201B C-201A	Adjust for maximum indication on the VTVM

FM SOUND CHANNEL ALIGNMENT

EQUIPMENT REQUIRED

Signal generator covering 4 MC to 30 MC

Electronic voltmeter

IN34 crystal detector circuit as shown in Fig. 14.

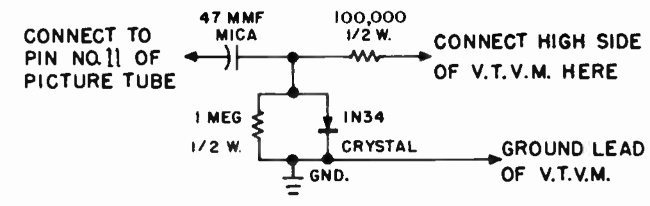

FIG. 14. SOUND ALIGNMENT TEST CIRCUIT

PROCEDURE

1. Connect the low frequency signal generator output, through a .005 capacitor, across the IF test terminals. (See Fig. 15).
2. Connect the detector circuit and VTVM as shown in Fig. 14.
3. Set the signal generator to 4.5 MC using just enough output to give approximately one volt reading at the electronic voltmeter.
4. Adjust the 4.5 MC TRAP ADJUSTMENT located on the under side of the chassis for minimum voltage as shown on the meter.
5. Disconnect the detector test circuit.
6. Connect the VTVM to pin #2 of the 6AL5 FM DETECTOR tube (V110).
7. Adjust the LIMITER GRID adjustment (L106) and the primary of T-108 (bottom adjustment) for maximum indication on the voltmeter.
8. Connect the electronic voltmeter across the 1000 mmf condenser (C130) (see Fig. 24.) at the output of the FM detector stage and adjust the FM DET. SEC. ADJ. of the FM detector transformer (T-108) for the null. If a null (0-volts) appears at more than one setting use the position nearest to the top limit of the tuning slug.
9. Shift the frequency of the signal generator either side of 4.5 MC and touch up the FM DETECTOR PRIMARY ADJUSTMENT (Bottom of T-108) for approximately equal peaks. Use just enough signal generator output to obtain one volt peaks for best results.
10. After completing the alignment procedure and placing the receiver in operation again, carefully tune in a TV test pattern and adjust the 4.5 MC TRAP ADJ. for maximum vertical wedge definition.

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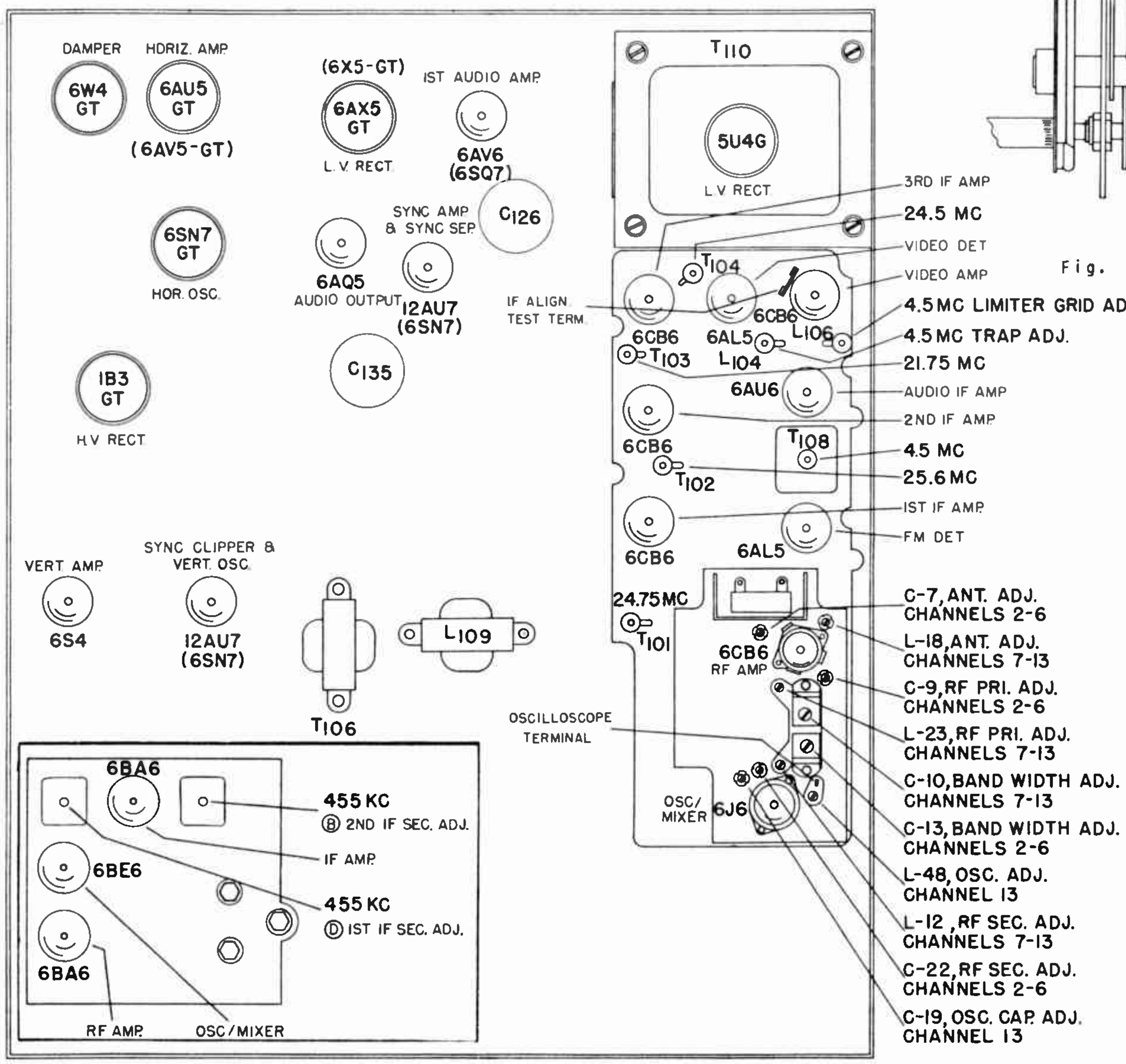

FIG. 15B. TOP VIEW ALIGNMENT LOCATIONS

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92A1182

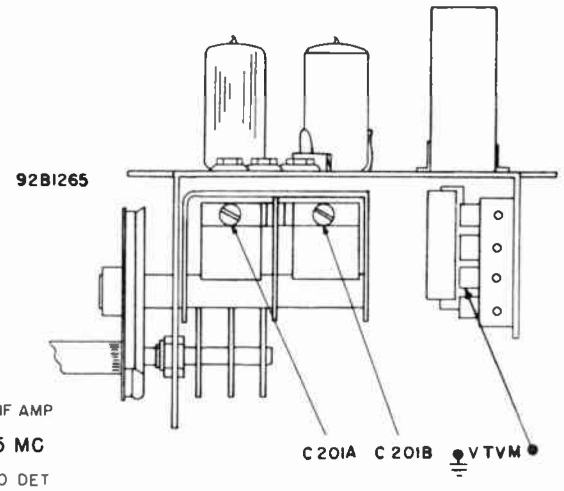

Fig. 15A. AM TUNER SIDE VIEW

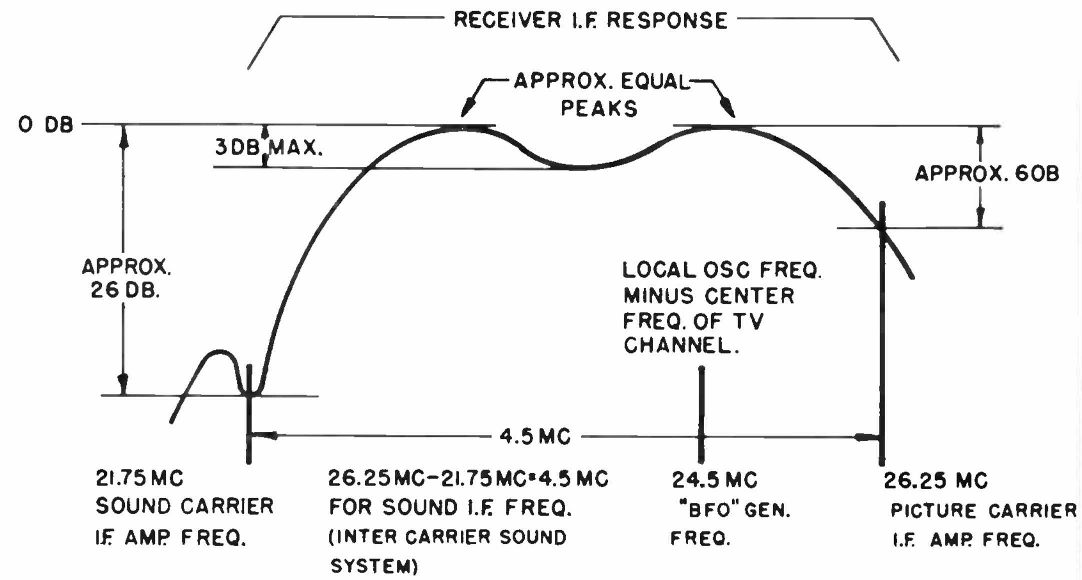

FIG. 16. IF AMPLIFIER RESPONSE.

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*NOTE - The 1st IF amp coil (T-101) has two iron cores and must be adjusted from both top and bottom for 24.75 MC response. Since this is an overcoupled transformer with a broad response, it will be necessary with this method of alignment to connect a 1000 ohm resistor across the primary winding (at the tuner terminals), when tuning the secondary (bottom core) and then connect the same resistor across the secondary winding when adjusting the primary (top) core.

IF AMPLIFIER ALIGNMENT

1. Connect the electronic voltmeter across the IF test terminals (see Fig. 15).

2. Couple the high side of the signal generator to the OSC/MIXER tube (V-2) by removing its shield and slipping a tight fitting tube shield or length of copper braid over the bulb of the tube and connecting the generator lead to it. Connect the ground side of the signal generator to the frame of the tuning unit.

3. Set the channel selector at channel 2.

4. Set the signal generator output (unmodulated) to develop one or two volts at the electronic voltmeter and adjust the four IF amplifier coils, according to the following chart, for maximum DC voltage as measured by the electronic voltmeter. Readjust the signal generator output as required to maintain the two-volt potential at the electronic voltmeter.

IF AMPLIFIER ALIGNMENT CHART

Signal Generator Frequency (No Modulation)	Adjustment (Refer to Fig. 15)	Stage Adjusted
24.75 MC	T101 24.75 MC IF Adj. (Top & Bottom)	1st IF amplifier
25.6 MC	T102 25.6 MC IF Adj.	2nd IF amplifier
23.1 MC	T103 23.1 MC IF Adj. Top	3rd IF amplifier
24.5 MC	T104 24.5 MC IF Adj.	Video Detector
21.75 MC	T103 21.75 MC Sound Bottom Trap Adj.	Sound Trap Adj. (Adj. for Min. Voltage)

Note: After adjusting the 21.75 MC Sound Trap recheck the setting of the 3rd IF Transformer (Top of T-103).

5. Check the i-f amplifier frequency response by tuning the signal generator from 21 mc through 26.25 mc and observing the change in d-c voltage at the electronic voltmeter. If the signal generator output is set for an electronic voltmeter reading of 1.5 volts at the peak i-f amplifier response, the d-c voltage should not drop below one volt between the two peaks normally obtained with this i-f amplifier. If the response is unsatisfactory, repeat the procedure or try slight modifications of the recommended settings to obtain the desired response. Avoid resonating the coils with the iron core at the bottom end of the coil form. (Adjustment screw near limit of its travel). If a sweep type signal generator and oscilliscope are available the problem of making the final adjustments will be much easier. Check the two carrier i-f responses, 21.75 mc and 26.25 mc. The 21.75 mc response will be approximately 20 db below the peak response (approx. 0.15 volt) and the 26.25 mc response will fall approximately 6 db below the peak (Approx. .75 volt). Refer to Fig. 16.

The average i-f amplifier sensitivity, when feeding the signal generator output through the receiver as described in step 2, will run approx. (800 to 1500 microvolts) for the one volt d-c peak measured at resistor R-116. (Receiver's oscillator operating on channel 2).

TUNER ALIGNMENT

The tuner is of the turret type employing printed-circuit coils and covering television channels 2 through 13. It has been carefully aligned and adjusted at the factory using precision equipment. Alignment or replacement of individual tuner components in the field is not recommended. If the tuner fails to operate properly by reason of part failure within the unit or in the event it should become badly misaligned, the complete unit should be replaced. The tuner may be exchanged for a new one, through the factory service department, at a very reasonable cost providing it has not been damaged or abused. In some cases the exchange can be effected without charge under the terms of the warranty.

Minor alignment adjustments may be desirable after tube replacement in the RF or oscillator-mixer stage. For those service engineers who are properly equipped, as specified below, the following alignment procedure is included.

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EQUIPMENT REQUIRED:

1. Sweep Generator - RCA-WR-59A or equivalent.
2. Marker Generator - RCA-WR-39A Television Calibrator or equivalent.
3. Cathode-Rav Oscilloscope - RCA-WO-60C or equivalent.
4. Electronic Voltmeter - RCA-195A Voltohmyst or equivalent.
5. Crvstal Diode Circuit as shown in Fig. 17.

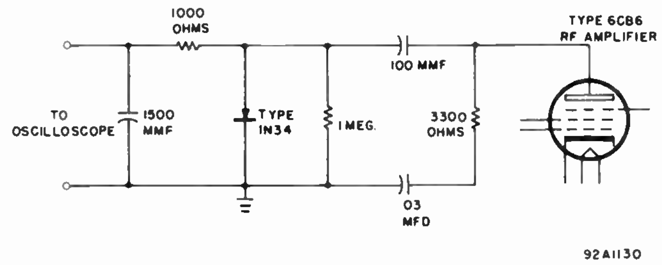

Fig. 17

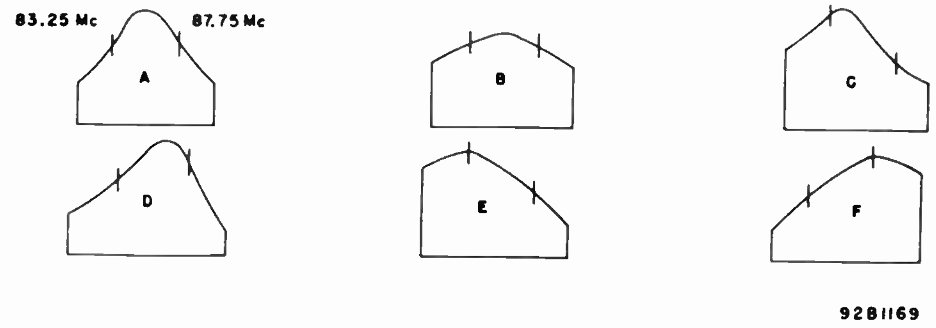

FIG. 19. ANTENNA CIRCUIT ALIGNMENT CURVES

SET-UP PROCEDURE:

1. Connect all test equipment and the television receiver to a common ground.
2. Connect the equipment as shown in Fig. 18.
3. Adjust the contrast control so that the tuner bias is 1.5 volts. This voltage is measured across terminal #1 and chassis ground.
4. Rotate C-10 and C-13 clockwise (fully in). See Fig. 15.

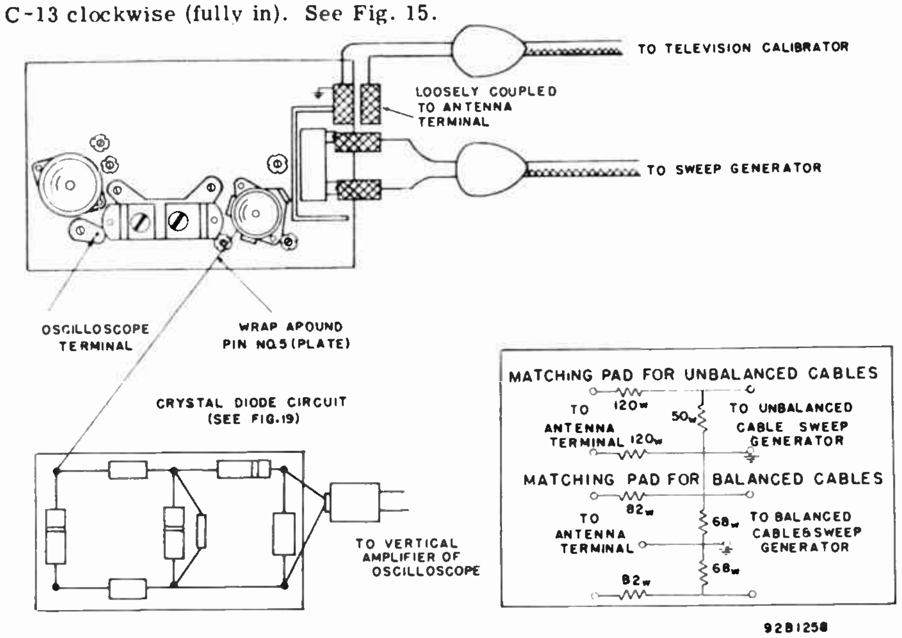

FIG. 18. TUNER ALIGNMENTS, TEST EQUIPMENT CONNECTIONS

ANTENNA CIRCUIT ALIGNMENT

See Figure 15 for location of all adjustment in this section.

5. Set test equipment and tuner to channel #6. (82-88 MC).
6. Adjust C-7 for required response curve on the cathode-ray oscilloscope (Fig. 19A). Peak in center with marker "pips" down equally on either side of curve.
7. Tune test equipment and tuner to channel #7.
8. Adjust L-18 for required response curve on the cathode-ray oscilloscope (Fig. 19B). Peak in center with marker "pips" down equally on either side of curve.
9. If L-18 requires a large adjustment, repeat steps 5 through 8 until the required response curves are obtained.
10. Check the response curves on channels #2, #3, #4, #5 and #6 and readjust C-7 for a compromise response curve for each channel. If the curves are more similar to 19C than they are to 19D, adjust C-7, counterclockwise. If the curves are more similar to 19D than they are to 19C, adjust C-7 clockwise. Curves for each of the channels #2 through #6 should be similar to Fig. 19A although alignment is complete if some curves are similar to Fig. 19C and some curves are similar to Fig. 19D. Adjustment is necessary only if all curves resemble Fig. 19C or Fig. 19D, rather than a compromise between Fig. 19C and Fig. 19D.
11. Check the response curves on channels #7, #8, #9, #10, #11, #12 and #13 and readjust L-18 for a compromise response curve for each channel. If the curves are more similar to Fig. 19E than they are to Fig. 19F, adjust L-18 clockwise. If the curves are more similar to Fig. 19F than they are to Fig. 19E, adjust L-18 counterclockwise. Curves for each of these channels should appear similar to that of Fig. 19B, although this portion of the alignment is complete if some curves are similar to Fig. 19E and some curves are similar to Fig. 19F. Adjustment is necessary only if all curves resemble Fig. 19E or Fig. 19F rather than a compromise between Fig. 19E and Fig. 19F.
12. Remove crystal diode circuit and connect oscilloscope directly to Oscilloscope Terminal.

RF ALIGNMENT

See Fig. 15 for location of all adjustments in this section.

13. Set tuner and test equipment to channel #6.
14. Adjust C-9, C-13 and C-22 to obtain a response curve on the oscilloscope similar to that shown on the normal curve in Fig. 20. This may be accomplished in the following manner:
    a. Rotate C-13 counterclockwise approximately one-half turn.
    b. Refer to Fig. 20 to determine the effects of tuning C-9, C-13 and C-22. C-9 primarily controls the center frequency of the response curve. C-22 primarily controls tilt of the curve and C-13 its bandwidth.
    c. It may be necessary to adjust C-22 after adjusting C-13.

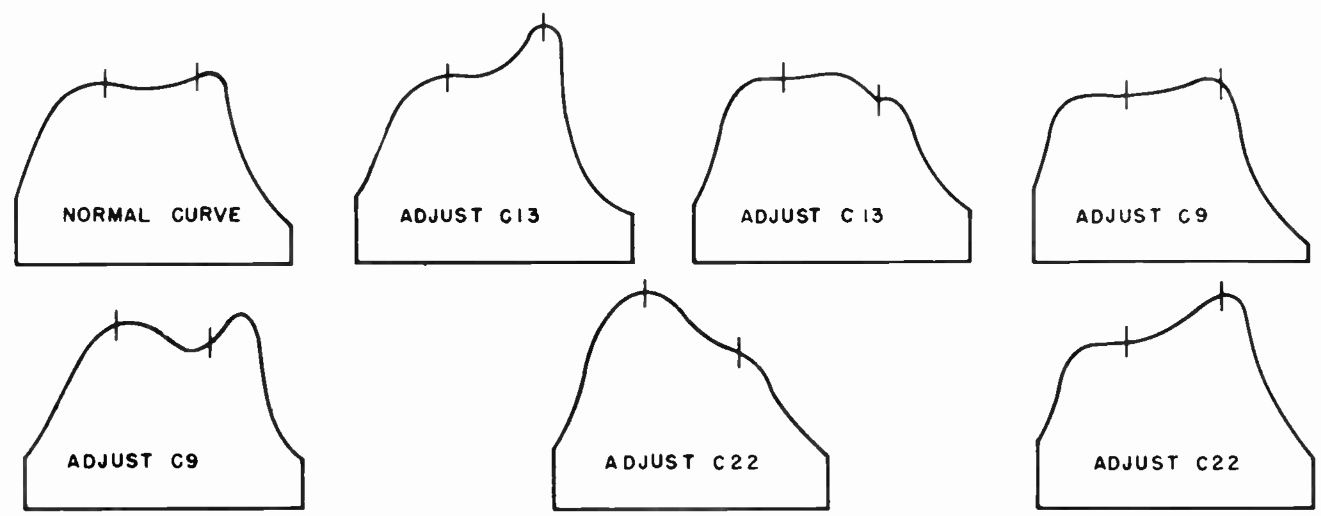

FIG. 20. RF ALIGNMENT CURVES

92B1167

C-9 and C-22 have an effect on the response of channel #7, #8, #9 and #10. It may be necessary to include adjustment of these capacitors in the adjustment of those channels. This should be done ONLY if two or more curves on the high channels slant in opposite directions. Care must be exercised so that curves of channels #2 through #6 will not be thrown far out of line. A recheck of channels #2 through #6 may be necessary.

15. Check the response curve for each of channels #2 through #6. Make compromise adjustments to C-9, C-13 and C-22 as is required so that i-f response curves for each channel will approximate those shown in Fig. 22.

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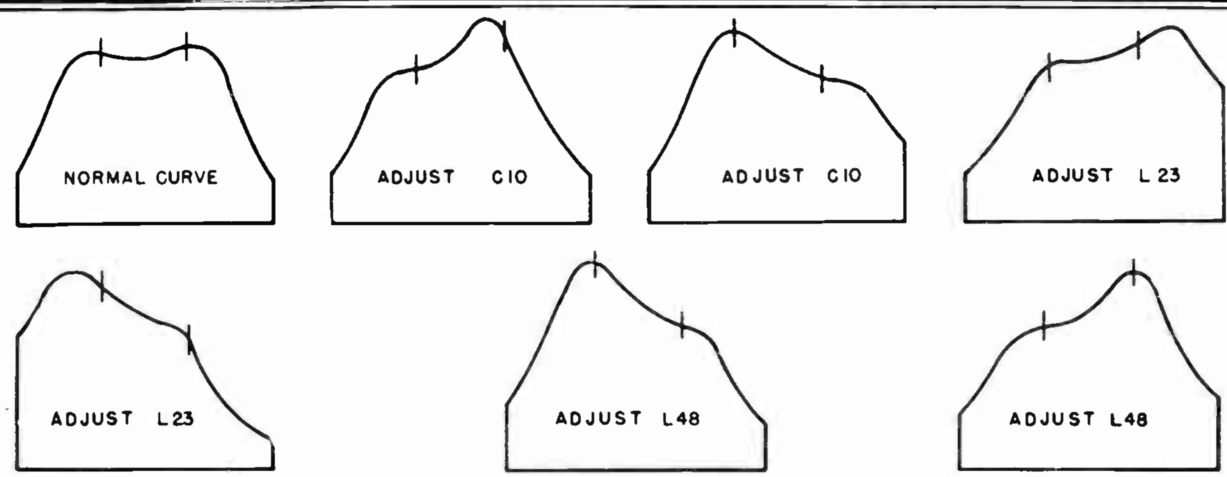

FIG. 21. RF RESPONSE CURVES

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16. Set tuner and test equipment to channel #12.

17. Adjust C-10, L-23 and L-48 to obtain a response curve on the oscilloscope similar to that shown as the normal curve in Fig. 21. This may be accomplished in the following manner:

   a. Rotate C-10 counterclockwise approximately one-half turn.

   b. Refer to Fig.21 to determine the effects of tuning C-10, L-23 and L-48. L-23 primarily controls the center frequency of the response curve. L-48 primarily controls tilt of the curve and C-10 its bandwidth.

   c. It may be necessary to adjust L-48 after adjusting C-10.

18. Check the response curve for each of channels #7 through #13. Make compromise adjustments to C-10, L-23 and L-48 as is required so that RF response curves for each channel will approximate those shown in Fig. 22.

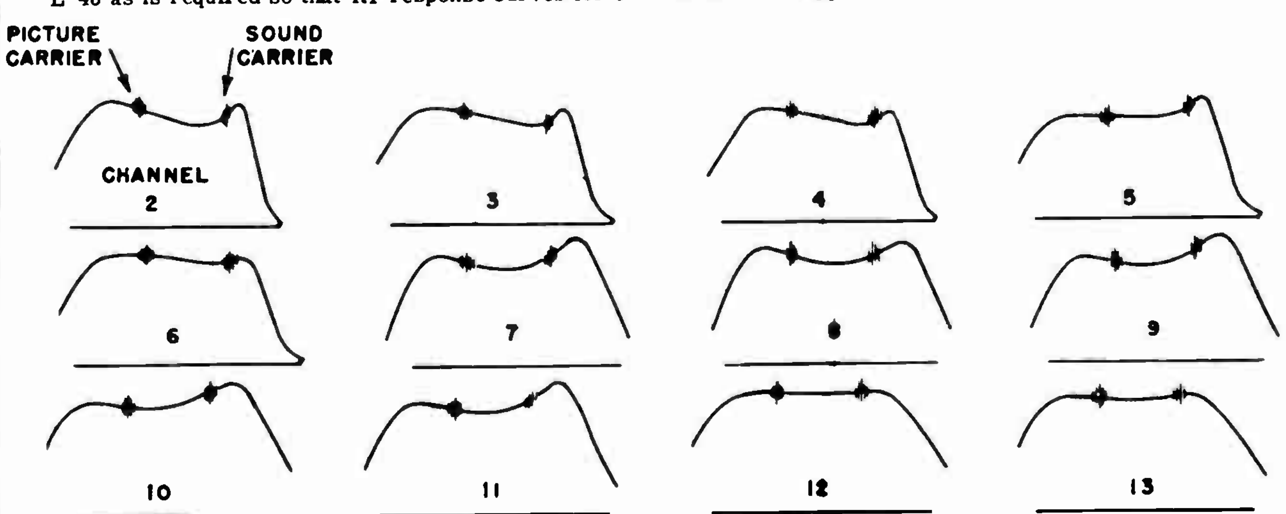

FIG. 22. CHANNEL RF RESPONSE CURVES

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OSCILLATOR ALIGNMENT

19. Connect the electronic voltmeter from pin #2 of the 6AL5 FM DET. TUBE to ground. Set the electronic voltmeter indicator at mid scale with no voltage.

20. Turn fine tuning control to mid-range.

21. Disconnect cathode-ray oscilloscope.

22. Connect television calibrator to antenna terminals.

23. Turn television calibrator to exactly 215.75 MC.

24. Adjust C-19 for zero-voltage. Rotating the tuner control should swing the needle either side of its center position.

25. Set television calibrator to exactly the sound carrier of each channel #12 to #2 in turn and adjust each individual oscillator coil for zero voltage as read on the electronic voltmeter. If one channel has insufficient range with individual oscillator adjustment, readjust C-19 to effect proper adjustment on this channel. Then readjust all other individual oscillator adjustments for zero voltage.

26. Recheck RF response curves as shown in Fig. 21.

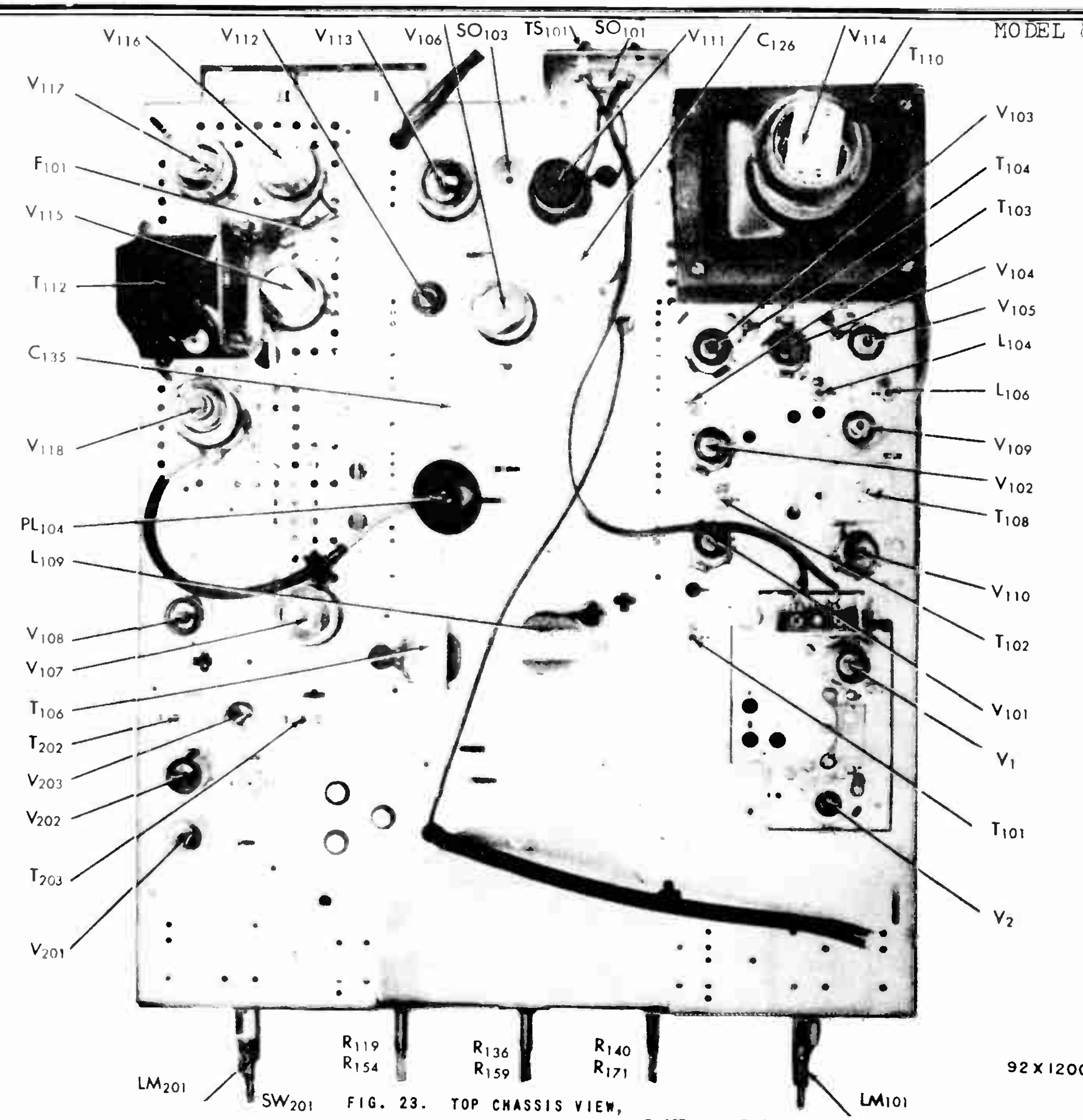

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FIG. 23. TOP CHASSIS VIEW, COMPONENT LOCATION.

SERVICE PARTS LIST

Ref. No.	Description	Part Number
	ELECTRICAL PARTS	
	TRANSFORMERS AND COILS	
T-101	Transformer, 1st i-f amplifier	50B471-C
T-102	Transformer, 2nd i-f amplifier	50A475
T-103	Transformer, 3rd i-f amplifier	50A476-E
T-104	Transformer, 4th i-f amplifier	50A477
T-106	Transformer, vertical oscillator	55C115
T-107	Transformer, vertical output	55B151-B
T-108	Transformer, ratio detector	50B473-D
T-109	Transformer, audio output	55B150
T-110	Transformer, power	52C204
T-111	Transformer, horizontal osc.	51B1242
T-112	Transformer, horizontal output	55C149
L-101	Coil, video peaking	51A1256
L-102	Coil, video peaking	51A1260
L-103	Coil, video peaking	51A1257
L-104,106	4.5 mc sound trap; Limiter grid adjustment	50A474-G
L-105	Coil, video peaking	51A1259
L-107	Coil, FOCUS	51B1246
L-108	Deflection yoke	53C197-B
L-109	Choke, filter	56C116
L-110	Coil, HORIZONTAL LINEARITY	51A1243-C
L-111	Coil, WIDTH control	51A1261-C
L-112	Choke, heater	53A200
L-202	Coil, 455 k-c trap	53A198
T-201	Coil, osc.	51A1245-E
T-202,203	Transformer, 1st i-f & 2nd i-f (AM)	50A472
	CONDENSERS	
CRL-101	Vertical integrating network	49A015
CRL-102	Audio coupling network	49A017
CRL-201	Audio filter network	49A016
C-101,102, 103,104, 106,107, 121,163, 164	5000 mmf. 450 V., ceramic	47A168
C-105,117	68 mmf. 500 V., ceramic	47B20680K5
C-108	10 mmf. 500 V., ceramic	47B20100K5
C-109,110	.5 mfd. 25 V., tubular	46A177
C-111	100 mfd. 10 V., electrolytic	45B170

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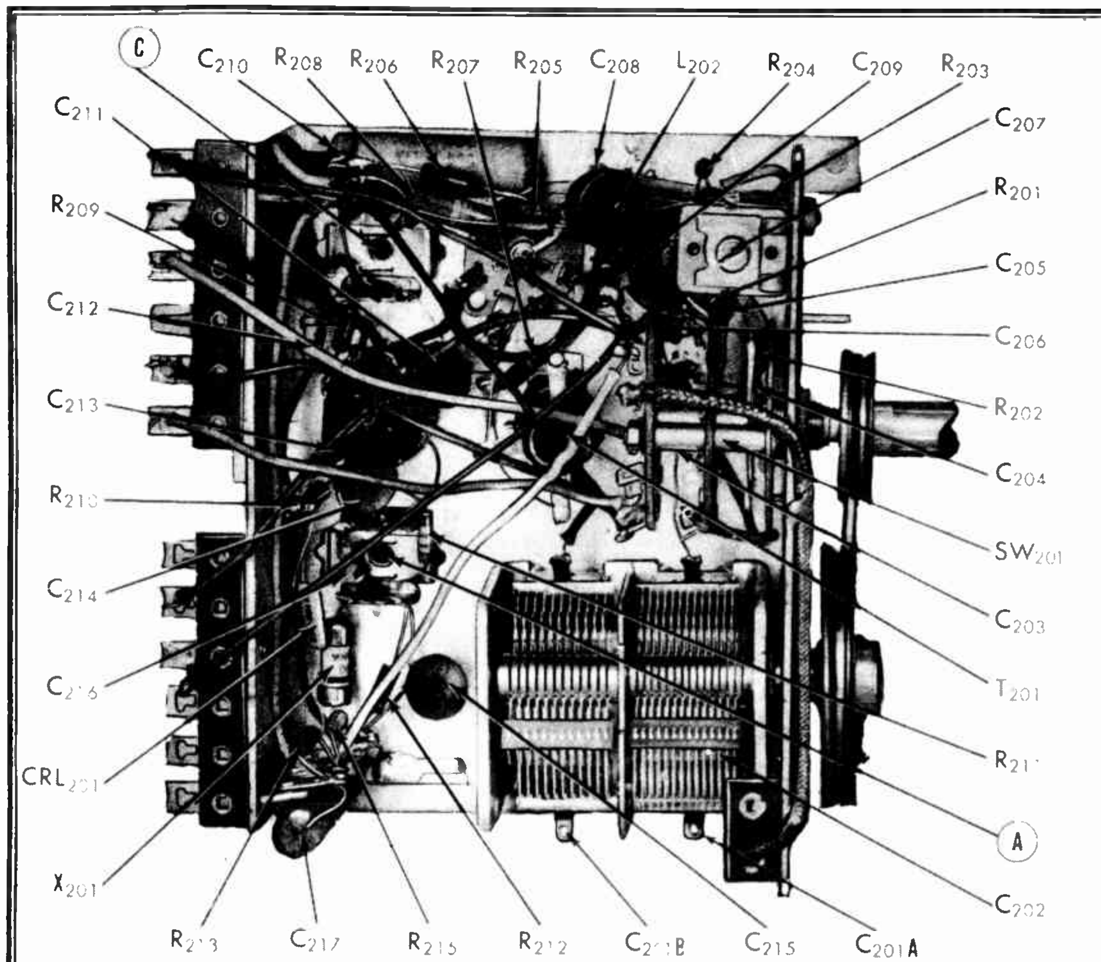

FIG. 24A. BOTTOM VIEW COMPONENT LOCATION (AM TUNER)

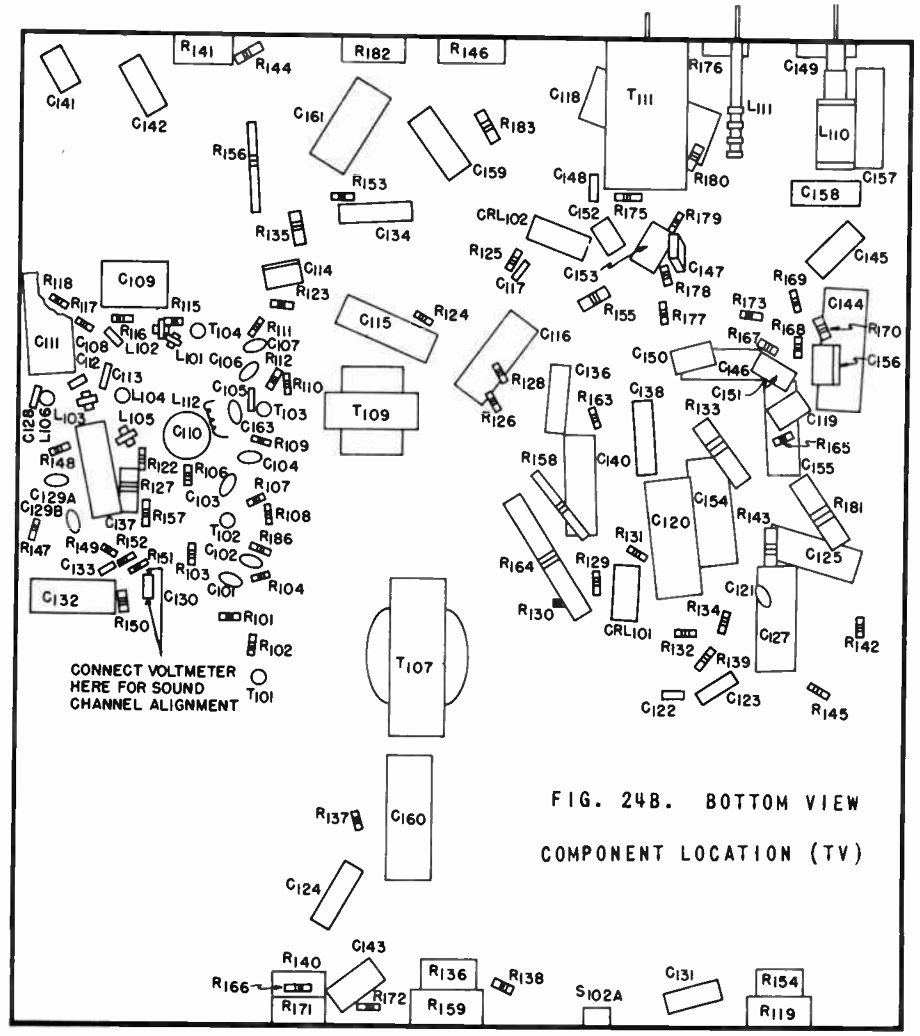

FIG. 24B. BOTTOM VIEW COMPONENT LOCATION (TV)

C-112	2.2 mmf. 500 V., ceramic	47A160-4
C-113,128	47 mmf. 500 V., ceramic	47X20SL470K
C-114	220 mmf. 500 V., mica	47X20B221K
C-115,116, 125,140, 143,146, 155	.05 mfd. 600 V., tubular	46AY503J
C-118	2X10 mfd. 450 V., electrolytic	45A172
C-119	120 mmf. 500 V., mica	47X20B121K
C-120,144	.5 mfd. 100 V., tubular	46AT504J
C-122,130	1000 mmf. 500 V., ceramic	47B20A102M5
C-123	6800 mmf. 500 V., mica	47X35B682K
C-124,131, 134,136, 138	.01 mfd. 600 V., tubular	46AY103J
C-126	60-40 mfd. 450 V., 75 mfd. 50 V., electrolytic	45B173
C-127,158, 161	.1 mfd. 600 V., tubular	46AX104J
C-129	2X.4000 mmf. 450 V., ceramic	47A218
C-132,154	5 mfd. 50 V., electrolytic	45B175
C-133	330 mmf. 500 V., ceramic	47B20331K5
C-135	40-40 mfd. 250 V., 40 mfd. 450 V., 20 mfd. 25 V., electrolytic	45B174
C-137	.1 mfd. 200 V., tubular	46AU104J
C-139	56 mmf. 500 V., mica	47X20A560M
C-141,142	.01 mfd. 600 V., tubular	46BR103J6
C-145	.02 mfd. 600 V., tubular	46AY203J
C-147,156	330 mmf. 500 V., mica	47X20B331K
C-148	.01 mfd. 400 V., tubular	46BR103E4
C-149	Trimmer, HORIZONTAL LOCK control	44A391
C-150,157	82 mmf. 500 V., mica	47X20B820K
C-152	820 mmf. 500 V., mica	47X25B821K
C-153	4700 mmf. 500 V., mica	47X35B472K
C-157,159	.03 mfd. 600 V., tubular	46AY303J
C-160	8 mfd. 475 V., electrolytic	45A103
C-162	500 mmf. 20,000 V., ceramic	47A223

* Use exact replacement part only

Ref. No.	Description	Part Number
	CONDENSERS (Cont.)	
C-201	Trimmer, adjustable (part of condenser C-202)	
C-202	Tuning condenser, 2 sections	48C241
C-203,208, 212	270 mmf. 500 V., ceramic	47B20A271K5
C-204,205, 206,211, 214,215	5000 mmf. 450 V., ceramic	47A168
C-207	Trimmer, adjustable, for Coil L-202	44A392
C-209	47 mmf. 500 V., ceramic	47B20A470K5
C-210	.02 mfd. 600 V., tubular	46AY203J
C-216	10 mmf. 500 V., ceramic	47B20A100K5
C-217	.05 mfd. 200 V., tubular	46AU503J
C-218,219	100 mmf. (part of CRL-201)	
C-220	.1 mfd. 600 V., tubular	46AY104J
	RESISTORS	
R-101,134, 163	4700 ohms 1/2 watt, carbon	23X20X472K
R-102,108, 110,111	100 ohms 1/2 watt, carbon	23X20X101K
R-103,106, 112,118, 147	150 ohms 1/2 watt, carbon	23X20X151K
R-104,107, 180	47 ohms 1/2 watt, carbon	23X20X470K
R-105,174	12,000 ohms 1/2 watt, carbon	23X20X123K
R-109,122, 137	10,000 ohms 1/2 watt, carbon	23X20X103K
R-113	6800 ohms 1/2 watt, carbon (Part of L-101)	23X20X682K
R-114,121	2200 ohms 1/2 watt, carbon (part of coils L-102, 105)	
R-115,139, 145	1 megohm 1/2 watt, carbon	23X20X105M
R-116	3300 ohms 1/2 watt, carbon	23X20X332K
R-117,123	220,000 ohms 1/2 watt, carbon	23X20X224M
R-119,154	1 megohm/2500 ohms, OFF-ON-VOLUME/CONTRAST control	25B898
R-120	15,000 ohms 1/2 watt, carbon (part of coil L-103)	
R-124	2.2 megohms 1/2 watt, carbon	23X20X225M
R-125	270,000 ohms 1/2 watt, carbon	23X20X274M
R-126,132, 138	47,000 ohms 1/2 watt, carbon	23X20X473K
R-127	5600 ohms 2 watts, carbon	23X40X562K
R-128	820,000 ohms 1/2 watt, carbon	23X20X824M
R-129,131	2200 ohms 1/2 watt, carbon	23X20X222K
R-130	6800 ohms 1/2 watt, carbon	23X20X682K
R-133	15,000 ohms 2 watts, carbon	23X40X153K
R-135	1500 ohms 1 watt, carbon	23X30X152K
R-136,159	2500/50,000 ohms, FOCUS-BRIGHTNESS control	25B895
R-140,171	1 megohm/50,000 ohms, VERTI-CAL-HORIZONTAL HOLD control	25B917
R-141	5000 ohms, VERTICAL LINEARITY control	25B712
R-142,175	8200 ohms 1/2 watt, carbon	23X20X822K
*R-143	1 megohm 1 watt, carbon	23X30BF105M
R-144	1000 ohms 1 watt, carbon	23X30X102K
R-146	2.5 megohms, HEIGHT control	25B711
R-148	22,000 ohms 1/2 watt, carbon	23X20X223K
R-149	270 ohms 1/2 watt, carbon	23X20X271K
R-150	33,000 ohms 1/2 watt, carbon	23X20X333K
R-151,152	10,000 ohms 1/2 watt, carbon	23X20X103J
R-153	10 megohms 1/2 watt, carbon	23X20X106M
R-155	270 ohms 1 watt, carbon	23X30X271K
R-156	15,000 ohms 10 watts, WW	24A922
R-157	100,000 ohms 1/2 watt, carbon	23X20X104M
R-158	1000 ohms 5 watts, WW	24A921

Ref. No.	Description	Part Number
	RESISTORS (Cont.)	
R-160,162	560 ohms 1/2 watt, carbon	23X20X561K
R-161	1000 ohms 1/2 watt, carbon	23X20X102K
R-164	750 ohms 10 watts, WW	24A920
R-165	3900 ohms 1/2 watt, carbon	23X20X392K
R-166	120,000 ohms 1/2 watt, carbon	23X20X124K
R-167,177	330,000 ohms 1/2 watt, carbon	23X20X334K
R-168	820,000 ohms 1/2 watt, carbon	23X20X824K
R-169	82,000 ohms 1 watt, carbon	23X30X823K
*R-170	330,000 ohms 1 watt, carbon	23X30BF334J
R-172	68,000 ohms 1/2 watt, carbon	23X20X683K
R-173	150,000 ohms 1/2 watt, carbon	23X20X154K
R-176	50,000 ohms, HORIZONTAL DRIVE control	25A858
R-178	47,000 ohms 1 watt, carbon	23X30X473K
R-179	470,000 ohms 1/2 watt, carbon	23X20X474M
R-181	220 ohms 3 watts, WW	24A925-B
R-182	200 ohms WW, HIGH VOLTAGE control	25B714
R-183	2200 ohms 1 watt, carbon	23X30X222K
R-184	3.3 ohms 1/2 watt, carbon	23X20X033K
R-185	1 megohm 1 watt, carbon	23X30X105M
R-186	150,000 ohms 1/2 watt, carbon	23X20X154M
R-187	680 ohms 1/2 watt, carbon	23X20X681M
R-201,209	2.2 megohms 1/2 watt, carbon	23X20X225M
R-202,210	68 ohms 1/2 watt, carbon	23X20X680K
R-203,211	56,000 ohms 1/2 watt, carbon	23X20X563K
R-204	8200 ohms 1/2 watt, carbon	23X20X822M
R-205,212	1000 ohms 1/2 watt, carbon	23X20X102M
R-206,213	1 megohm 1/2 watt, carbon	23X20X105M
R-207	22,000 ohms 1/2 watt, carbon	23X20X223K
R-208	27,000 ohms 1 watt, carbon	23X30X273K
R-214	47,000 ohms 1/2 watt, carbon (part of CRL-201)	
R-215	470,000 ohms 1/2 watt, carbon	23X20X474M
R-216	1000 ohms 5 watts, WW	24A921
	TUBES, RECTIFIERS AND DIAL LAMPS	
V-1	Type 6CB6: r-f amp.	90X6CB6
V-2	Type 6J6: osc./mixer	90X6J6
V-101,102, 103,105	Type 6CB6: 1st, 2nd, and 3rd i-f amplifiers; video amp	90X6CB6
V-104,110	Type 6AL5: video detector: f-m detector	90X6AL5
V-106,107	Type 12AU7: sync. amp. and sync. separator; sync. clipper and vertical osc. or	90X12AU7
	Type 6SN7: same as above	90X6SN7
V-108	Type 6S4: vertical amp.	90X6S4
V-109	Type 6AU6: audio i-f amp.	90X6AU6
V-111	Type 6AV6: audio amp. or	90X6AV6
	Type 6SQ7: audio amp.	90X6SQ7
V-112	Type 6AQ5: audio output	90X6AQ5
V-113	Type 6AX5-GT: low voltage rectifier	90X6AX5-GT
V-114	Type 5U4G: low voltage rectifier	90X5U4G
V-115	Type 6SN7-GT: horizontal osc.	90X6SN7-GT
V-116	Type 6AU5: horizontal amp. or	90X6AU5
	Type 6AV5-GT: horizontal amp.	90X6AV5-GT
V-117	Type 6W4-GT: damper	90X6W4-GT
V-118	Type 1B3-GT: high voltage rectifier	90X1B3-GT
V-119	Type 16GP4: picture tube	90X16GP4
V-201,203	Type 6BA6: r-f amp.; 1st i-f amp.	90X6BA6
V-202	Type 6BE6: Converter	90X6BE6
X-201	Crystal diode	19A1246
LM-101,201	Lamp, dial light: G.E. #47	39A004
	MISCELLANEOUS ELECTRICAL PARTS	
	Tuning unit assembly	1D961-X4
PL-104	Plug, 16GP4 anode (part of protective cover 8D1129)	
SW-201	Bandswitch assembly	60B401
F-101	Fuse, 1/4 amp. 250 V.	39A344
	Ion trap	21A101-B
	Polyethelene lead; 22 inch	87A1046

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Ref. No.	Description	Part Number
	MECHANICAL PARTS	
	CHASSIS PARTS	
	Bracket, deflection yoke and focus coil mtg.; bottom	67D1247
	Bracket, deflection yoke and focus coil mtg.; upper	67D1348
	*Use exact replacement part only	
	Bracket, deflection yoke mtg. (mounted on 67D1348)	67C1244
	Bracket, deflection yoke support (mounted on L-108)	67B1305
	Bracket, focus coil mtg. (mounted on focus coil assembly mtg. plate)	67C1251
	Bracket, mounting: for TS-101 and SO-101	67C1258
	Bracket, picture tube mtg.; front left	67D1260
	Bracket, picture tube mtg.; front right	67D1261
	Bracket, pilot light	67B1286
	Collar, picture tube mtg.; rubber (mounted near deflection yoke)	16C202
	Clamp, picture tube mtg.	76B597
	Cover, picture tube protective	8D1129
	Dial cord, 25 inch	38A001
	Lever, centering control	74B352
	Mounting ring; picture tube (plastic)	8C997-B
	Pilot light assembly	86A096
	Plate, focus coil assembly mtg. (mounted on 67D1348)	67C1386
	Pulley, assembly (drive shaft)	28A086-C
	Pulley and stop assembly (part of 28A086-C)	28A087
	Pulley, tuning shaft	28A084
	Ring, centering (part of focus coil assembly mtg. plate)	76B636
	Rubber channel, 2, (mounted under front of picture tube)	16A204
	Shield, light indicator (AM)	69A361
	Shield, light indicator (TV)	69A343-D
SO-101	Socket, a-c power	10A286
	Socket, miniature 7 pin tube	6A340
	Socket, miniature 7 pin (tubes V-201, 202, & 203)	6A308
	Socket, miniature 9 pin tube	6A334
	Socket, miniature 9 pin; molded mica filled (tube V-108)	6A360
	Socket, octal; molded (tube V-118)	6A355
	Socket, octal; molded mica filled (tube V-116)	6A364
	Socket, octal; molded (tubes V-113, 115 & 117)	6B296
SO-102	Socket, phono input	36A041
SO-104	Socket, phono motor	10A015
	Socket, picture tube	6B357-E
SO-103	Socket, speaker	10A373
	Spring, dial cord	75A012
	Spring, i-f transformer (AM)	76A385
TS-101	Terminal strip, antenna	88A020
	CABINET PARTS	
L-201	Antenna, loop	57C146
	Antenna, silver vortex built-in	57C147
	Cabinet	78F536
	Cabinet back	8E1151-E
	Escutcheon assembly; front controls	7D205
	Escutcheon, picture tube (metal)	7D196
	Glass, safety	22D292-D
	Knob; OFF-VOLUME, BRIGHTNESS, and VERTICAL HOLD control	15B234
	Knob; CONTRAST, FOCUS and HORIZONTAL HOLD control	15B269
	Knob; CHANNEL SELECTOR	15D293-C
	Knob; A-M TUNER	15D271
	Knob; FINE TUNING	15A299
	Knob; AM-TV-PHONO	15C295
PL-101	Line cord and plug PL-102	87B1668
	Mask, escutcheon	7D215
PL-103	Plug, speaker	10A372
	Retainer strip; safety glass	8B1203
LS-101	Speaker, 8 inch	85C104
	Spring, tube escutcheon ground	75B193
	Spring, knob escutcheon ground	75B194

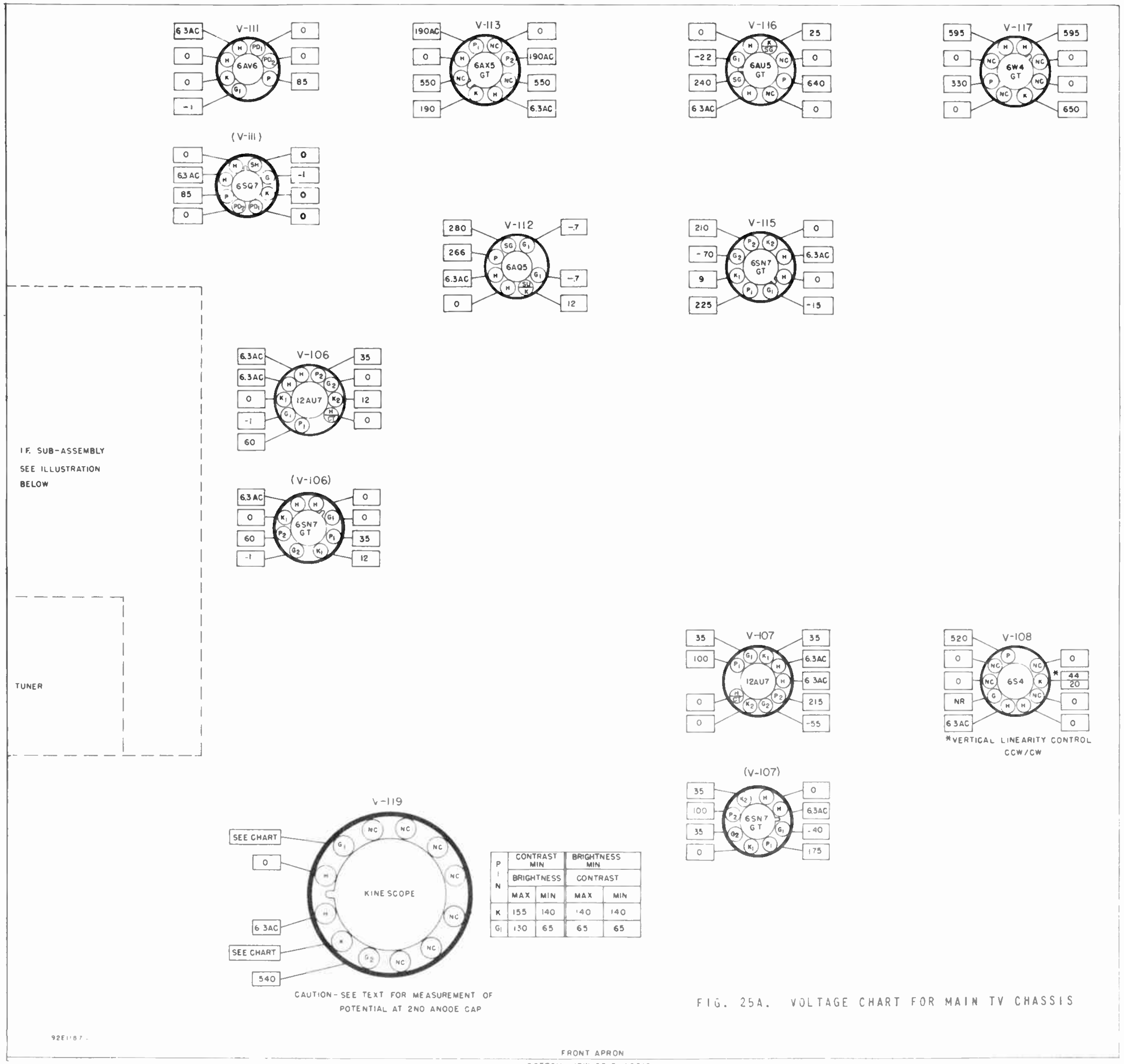

FIG. 25A. VOLTAGE CHART FOR MAIN TV CHASSIS

NOTES -

1 SOCKET VIEWS ARE BOTTOM VIEWS
2 ALL VOLTAGES ARE MEASURED BETWEEN TUBE SOCKET TERMINALS & CHASSIS WITH ZERO SIGNAL INPUT
3 LINE VOLTAGE — 117 V AC
4 ALL VOLTAGES SHOWN ARE DC UNLESS OTHERWISE SPECIFIED
5 DC VOLTAGES WERE MEASURED WITH AN ELECTRONIC VOLTMETER
6 "NC" - NO CONNECTION. VOLTAGE SHOWN FOR THIS TERMINAL ONLY WHEN TERMINAL IS USED AS A TIE LUG
7 "NR" - NOT READABLE. VOLTAGES MEASURED AT THESE TERMINALS GENERALLY MEANINGLESS
8 ALL VOLTAGES ON PICTURE TUBE WERE TAKEN AT TIE POINTS OF TUBE SOCKET LEADS
9 OPERATING CONTROLS SET FOR NORMAL PICTURE UNLESS OTHERWISE SPECIFIED.
10 NON-OPERATING CONTROLS SET FOR NORMAL OPERATION
11 MEASURMENT OF 2ND ANODE POTENTIAL AT PICTURE TUBE AS EXPLAINED IN TEXT IS RECOMMENDED FOR CHECK ON 1B3 RECTIFIER

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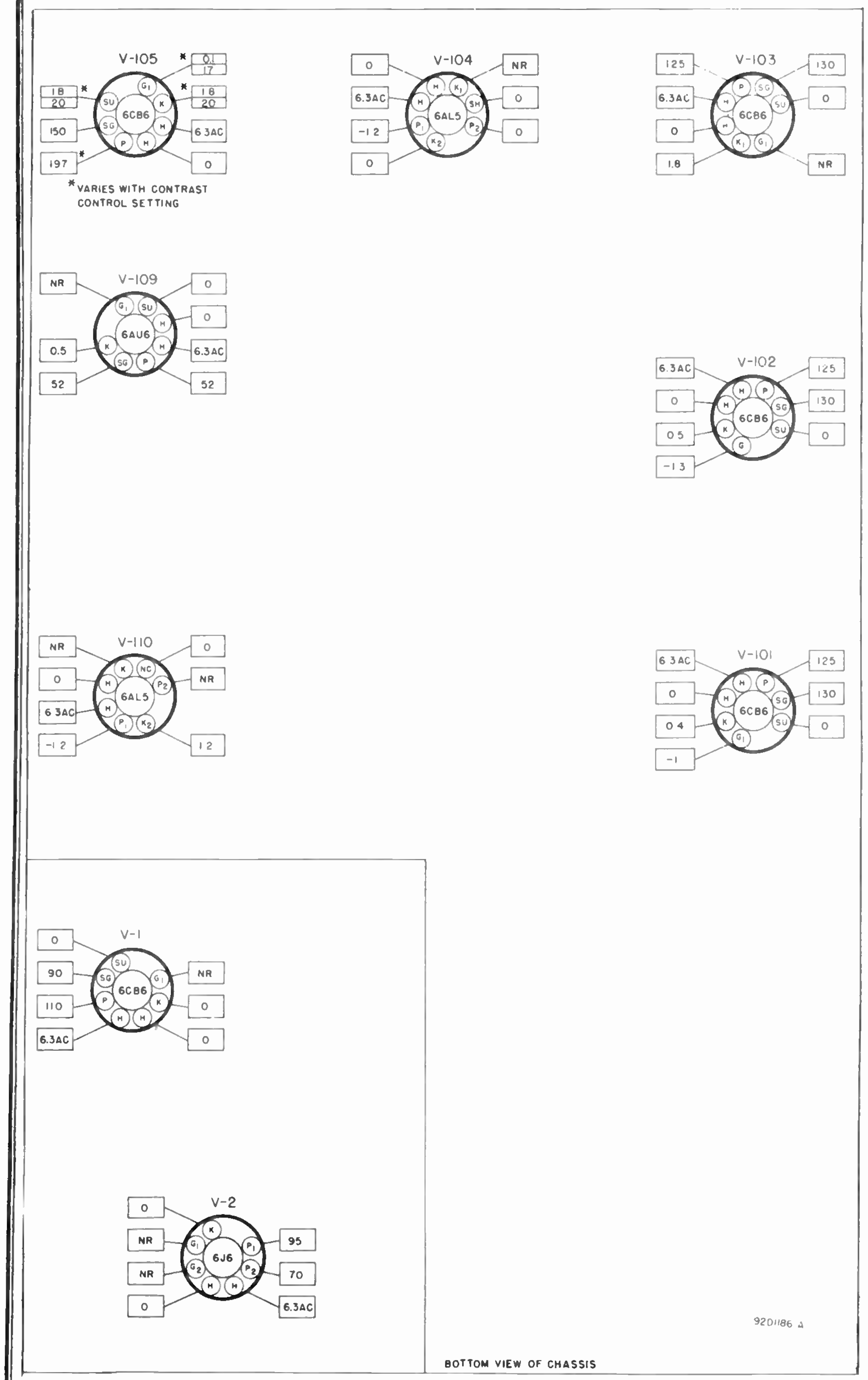


FIG. 25B. VOLTAGE CHART FOR IF ASSEMBLY.

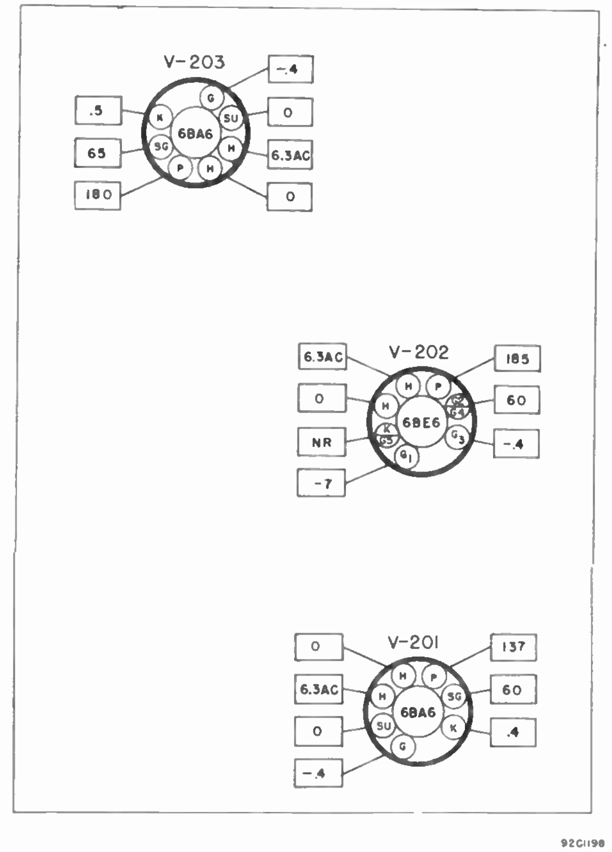
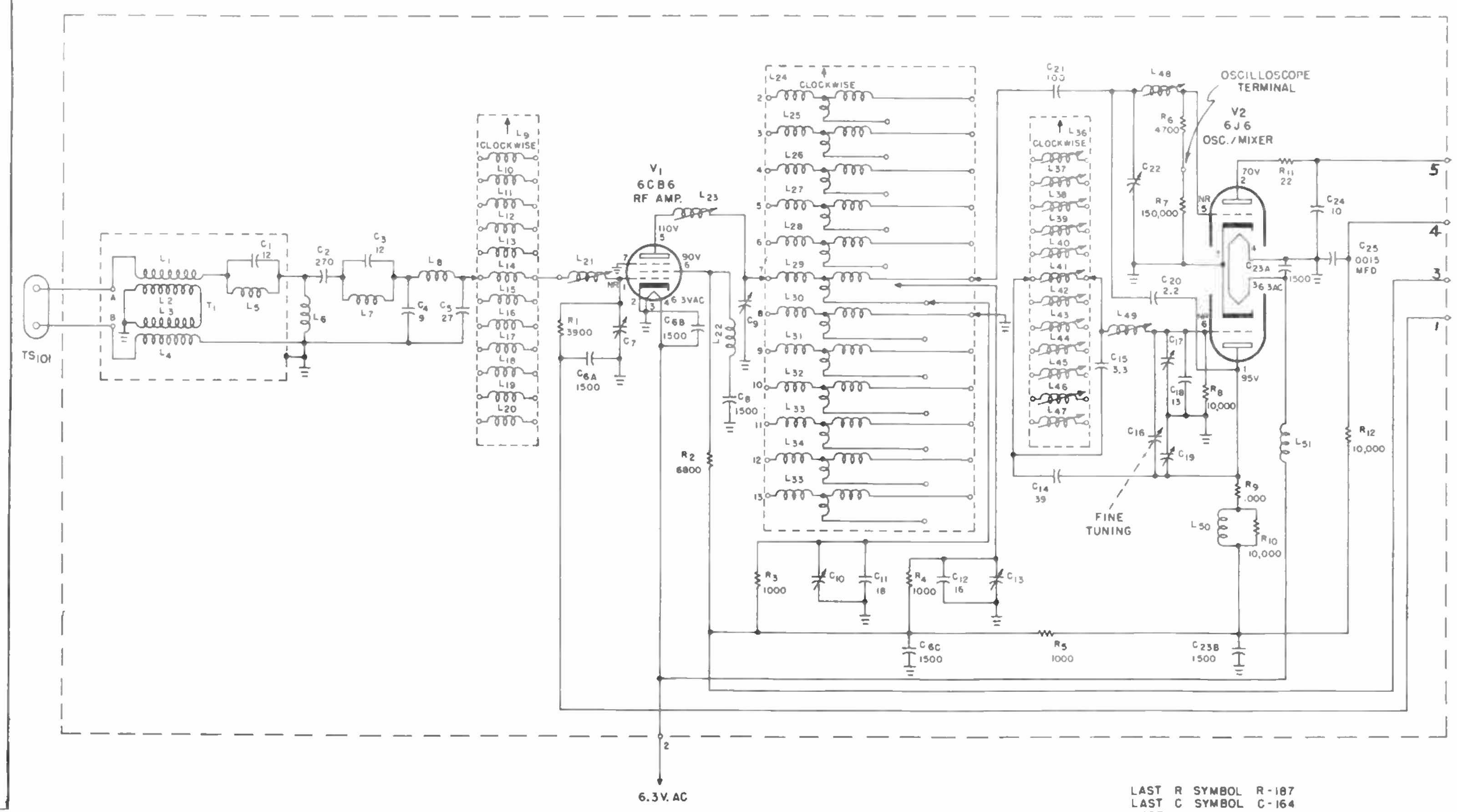


FIG. 25C. VOLTAGE CHART FOR AM TUNER

VALUES & TOLERENCES SHOWN ARE NOMINAL & VARIATIONS MAY BE FOUND. IT IS RECOMMENDED THAT THE VALUE OF ANY REPLACEMENT CORRESPOND TO THE NOMINAL VALUE OF THE PART BEING REPLACED.



LAST R SYMBOL R-187
LAST C SYMBOL C-164
LAST L SYMBOL L-112
LAST T SYMBOL T-112

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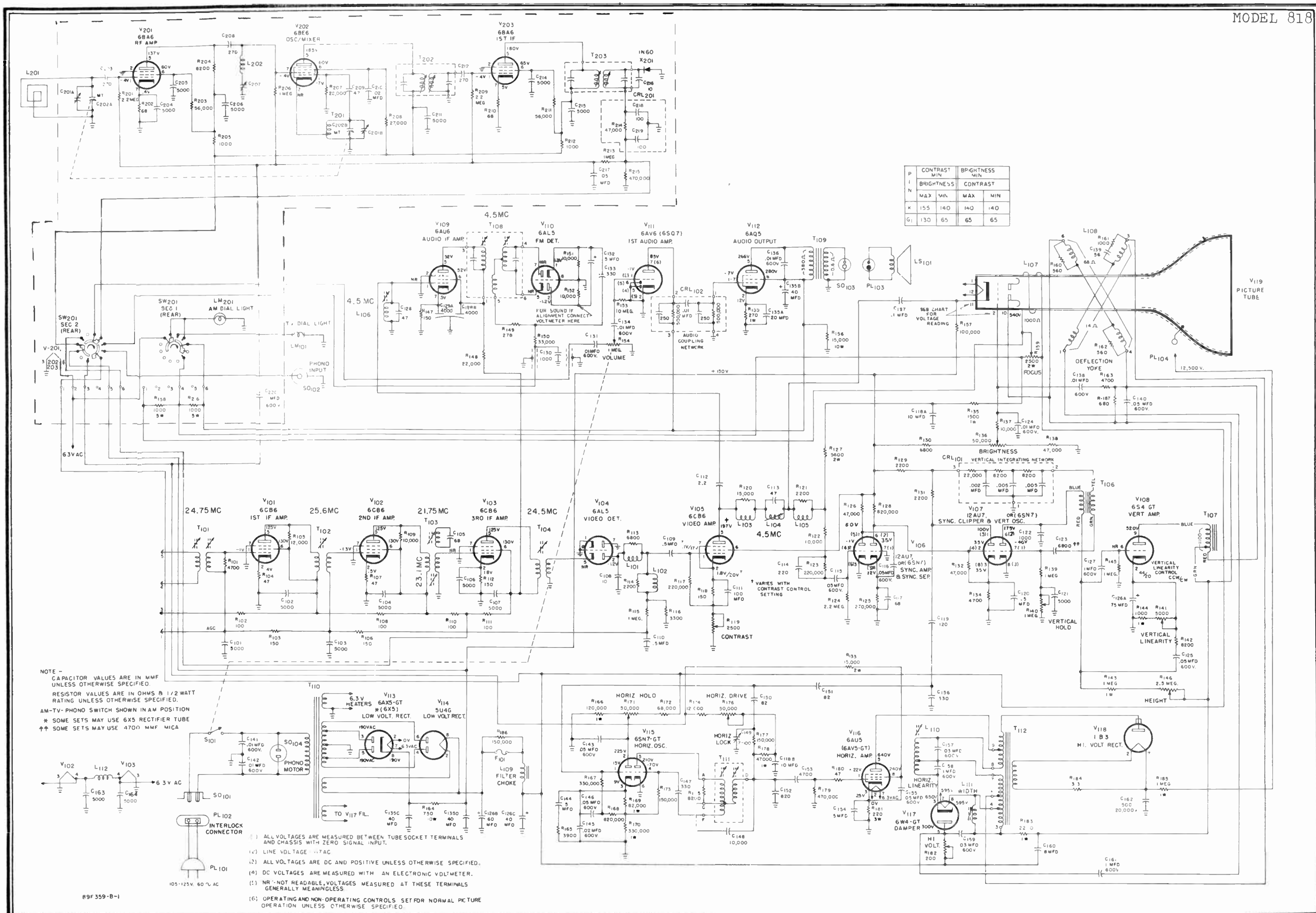

P I N	CONTRAST MIN		BRIGHTNESS MIN	
	BRIGHTNESS		CONTRAST	
	MAX	MIN	MAX	MIN
K	155	140	140	140
G_1	130	65	65	65

NOTE -
CAPACITOR VALUES ARE IN MMF UNLESS OTHERWISE SPECIFIED.
RESISTOR VALUES ARE IN OHMS & 1/2 WATT RATING UNLESS OTHERWISE SPECIFIED.

AM-TV-PHONO SWITCH SHOWN IN AM POSITION

* SOME SETS MAY USE 6X5 RECTIFIER TUBE
†† SOME SETS MAY USE 4700 MMF MICA

(1) ALL VOLTAGES ARE MEASURED BETWEEN TUBE SOCKET TERMINALS AND CHASSIS WITH ZERO SIGNAL INPUT.
(2) LINE VOLTAGE 117AC
(3) ALL VOLTAGES ARE DC AND POSITIVE UNLESS OTHERWISE SPECIFIED.
(4) DC VOLTAGES ARE MEASURED WITH AN ELECTRONIC VOLTMETER.
(5) NR - NOT READABLE, VOLTAGES MEASURED AT THESE TERMINALS GENERALLY MEANINGLESS
(6) OPERATING AND NON-OPERATING CONTROLS SET FOR NORMAL PICTURE OPERATION UNLESS OTHERWISE SPECIFIED

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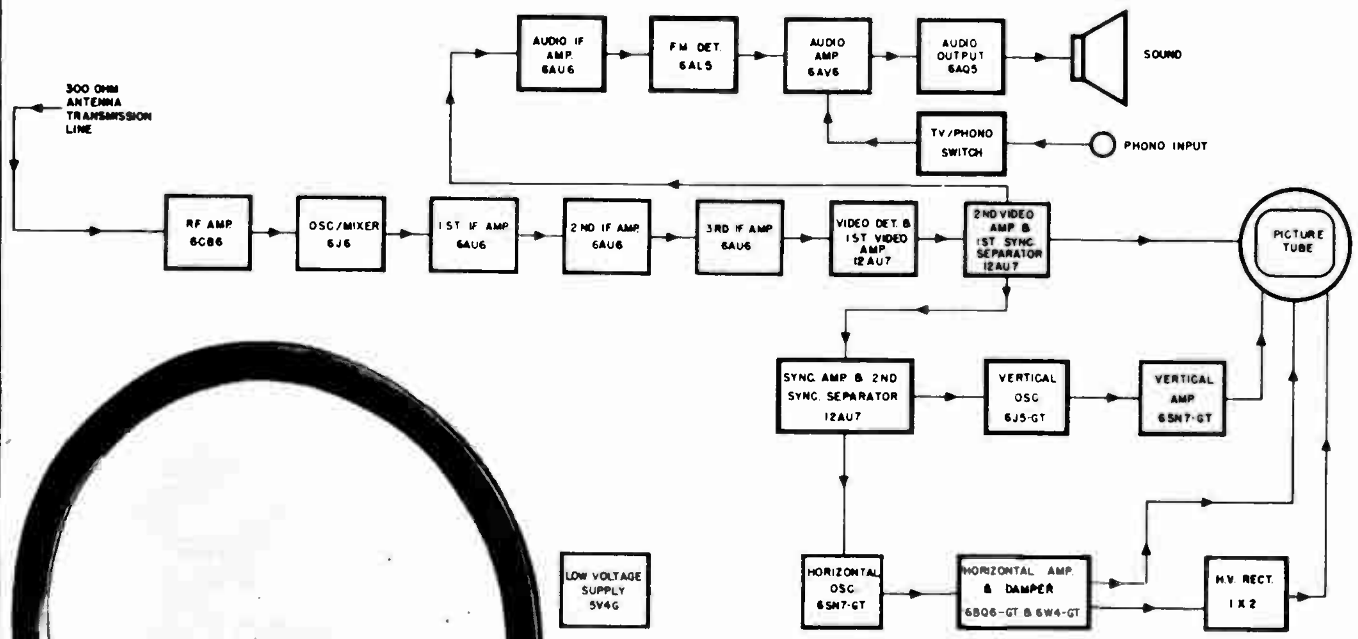
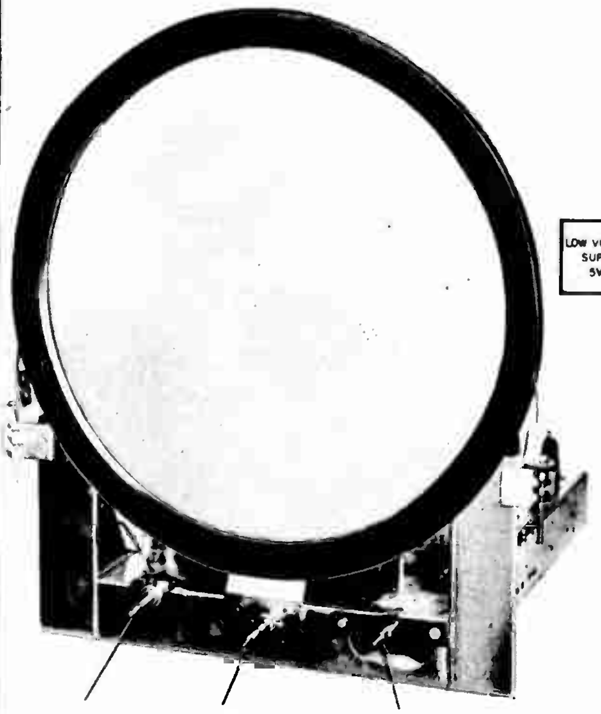


Fig. 1. Functional block diagram



GENERAL

Picture Area . . . 135 square inches

Tubes . . . . Eighteen plus two rectifiers

Speaker . . . . 8-inch P.M. (3.2 ohm V.C.)

Antenna . . . . Built-in cabinet antenna with provision for external antenna using 300-ohm transmission line.

Tuning . . . . 12 position channel selector plus fine tuning adjustment.

Tuning Range. . . . Twelve channels 2-13.

Channel No.	Frequency (mc)	Channel No.	Frequency (mc)
2	54-60	7	174-180
3	60-66	8	180-186
4	66-72	9	186-192
5	72-82	10	192-198
6	82-88	11	198-204
		12	204-210
		13	210-216

Intermediate Frequency
- Picture carrier . . . . 26.25 mc
- Sound carrier . . . . 21.75 mc
- Intercarrier sound system. . 4.5 mc

Power Supply. . . . . 105-125 V. 60 cycles AC

Power Consumption . . . . 200 Watts

Model Differences . . . . Model 832 - Wood consolette finished in mahogany.
Model 833 - Wood consolette finished in blonde.

CARE OF THE KINESCOPE WINDOW

The window in front of the picture tube is made of safety glass, hence may be cleaned by any of the conventional window cleaning processes. Abrasive or strong solvent type cleaning solutions that may scratch the glass or damage the cabinet finish, however, should be avoided.

HIGH VOLTAGE WARNING

Operation of the receiver chassis outside of the cabinet involves a shock hazard. An interlock in the line cord disconnects the power when the back cover is removed. The HIGH VOLTAGE supply, while of low current capacity, operates at a 11,000 volt potential. Exercise all normal HIGH VOLTAGE precautions while working this equipment.

KINESCOPE HANDLING PRECAUTIONS

The kinescope housing provides adequate protection against possible tube implosure while in the cabinet. Do not expose the kinescope or handle it in any way without providing personal protection in the form of shatterproof goggles and heavy gloves. The kinescope should be handled by qualified personnel only.

The kinescope envelope encloses a high vacuum and with the large surface area of glass involved, the stresses set up, particularly at the front rim of the tube, are considerable. An abnormal handling stress, accidental blow at a highly stressed surface, or even a scratch on the surface of the tube could cause it to implode or collapse with destructive violence.

NON-OPERATING CONTROLS ADJUSTMENTS

The "non-operating" or screw-driver adjustments normally will require an occasional minor adjustment if any circuit work or tube changing is required. A test pattern, generated either locally in the shop or obtained from a television station is recommended for best results. Normal picture contrast and brightness should be maintained during the following adjustments for best results.

HORIZONTAL HOLD, VERTICAL HOLD, HORIZONTAL OSC., BRIGHTNESS AND FOCUS ADJUSTMENTS

1. Set the HORIZONTAL and VERTICAL HOLD controls for a steady test pattern. Should the HORIZONTAL HOLD control fail to hold the test pattern in the normal manner, set the HORIZONTAL HOLD control in the center of its range and adjust the HORIZONTAL OSC. ADJ. screw on the under side of the chassis for horizontal sync. (See Fig. 12 for location). If the adjustment of the top slug has been tampered with, turn the top screw to its top limit and adjust the bottom slug for sync.

2. The focus adjustment may be made with or without the aid of a TV station. If a test pattern is available, adjust the receiver for best picture and set the FOCUS control for best picture detail, watching the wedges of the test pattern. If no signal is available, turn the picture control counter-clockwise, advance the brightness control until the scanning lines just begin to show distinctly and adjust the FOCUS control for sharp clean lines. Note that a misadjustment of the ion trap or focus coil positions may prevent even focusing over the entire raster.

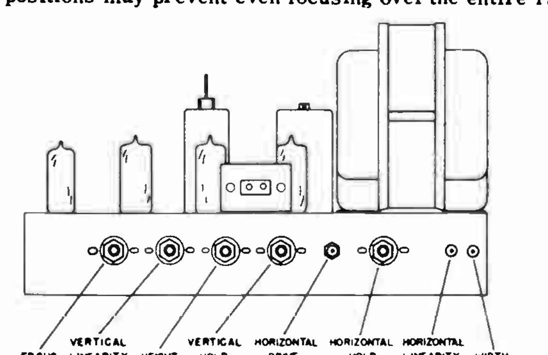


Fig. 2. Rear chassis view, location of "non-operating" controls.

HORIZONTAL — DRIVE, — LINEARITY, — CENTERING AND WIDTH ADJUSTMENTS

1. Advance the HORIZONTAL DRIVE control (clockwise) as far as possible without causing fold over of the test pattern. (Vertical white line.) Insufficient horizontal drive will cause low second anode voltage with consequent loss of picture brilliance.

HORIZONTAL DRIVE CONTROL MISADJUSTMENT

Figure 3.

2. Set the WIDTH control so that the test pattern fits the horizontal dimension of the kinescope escutcheon. A minor adjustment of the focus coil position may be required to recenter the pattern.

WIDTH CONTROL MISADJUSTMENT

Figure 4.

HORIZONTAL CENTERING MISADJUSTMENT

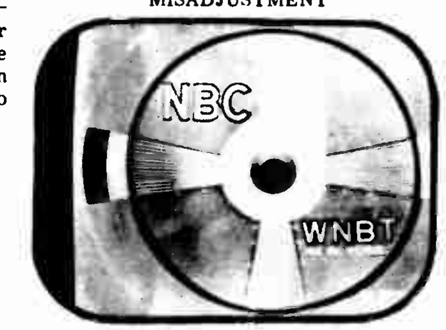


Figure 5.

3. Set the HORIZONTAL LINEARITY control so that the test pattern is symmetrical from left to right. A slight readjustment of the HORIZONTAL DRIVE control may be necessary when making this adjustment.

HORIZONTAL LINEARITY CONTROL MISADJUSTMENT

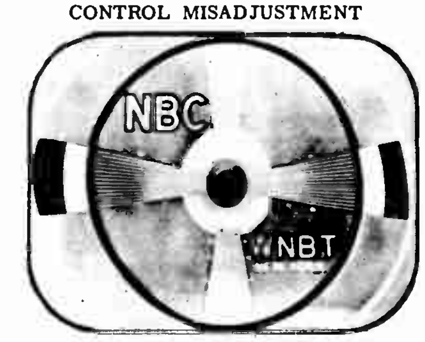


Figure 6.

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VERTICAL – CENTERING, – LINEARITY, AND HEIGHT ADJUSTMENTS

HEIGHT CONTROL MISADJUSTMENT

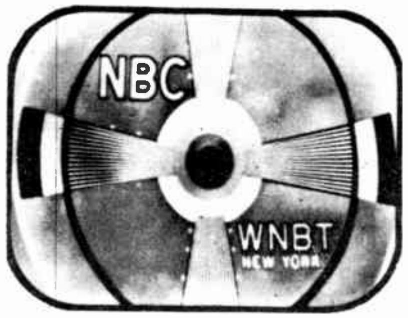


Figure 7.

1. Set the HEIGHT control so that the test pattern fits and centers in the vertical dimension of the kinescope escutcheon. A minor adjustment of the focus coil position may be required to recenter the pattern.

VERTICAL CENTERING MISADJUSTMENT

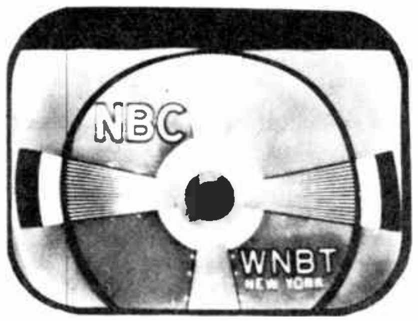


Figure 8.

VERTICAL LINEARITY CONTROL MISADJUSTMENT

Figure 9.

2. Set the VERTICAL LINEARITY control for a symmetrical test pattern in the vertical dimension. A slight readjustment of the HEIGHT control may be required when making this adjustment.

Note - The sequence of "non-operating" control adjustments outlined above is suggested as a convenient method of approach and not an arbitrary procedure. Variations of the procedure is permitted to obtain the final result.

DISMANTLING FOR KINESCOPE REPLACEMENT OR ALIGNMENT ADJUSTMENTS

1. Remove the three front panel control knobs by pulling them straight from their shafts. The dual control knob must be removed in two pieces, removing the center unit first.
2. Remove the back cover disconnecting the cable connector for the phono socket and switch mounted on the back cover. Note that the line cord and half of the interlock connector come along with the back cover.
3. Disconnect the speaker and remove the two wood screws holding the antenna terminal strip bracket to the cabinet. Note that for the table models the speaker will have to be removed to clear the picture tube.
4. Remove the five chassis bolts holding the receiver chassis in the cabinet and slide the entire assembly from the cabinet. The KINESCOPE is now accessible for replacement or adjustment.

REMOVING THE KINESCOPE

Refer to the warning KINESCOPE HANDLING PRECAUTIONS. Read all warning notices on both tube and carton. Follow the dismantling instructions above to expose the KINESCOPE and proceed as follows:

1. Disconnect the KINESCOPE SOCKET at the base of the kinescope.

2. Slip the ION TRAP from the neck of the tube past the kinescope base connector.

3. Measure the distance from the front edge of the steel band to the face of the tube. Keep this dimension handy for installation of a new tube.

4. Remove the steel band at the front rim of the kinescope and carefully slip the neck of the kinescope out of the FOCUS COIL and DEFLECTION YOKE. If the tube fails to slip out smoothly, investigate and remove the cause of the trouble. Do not use force.

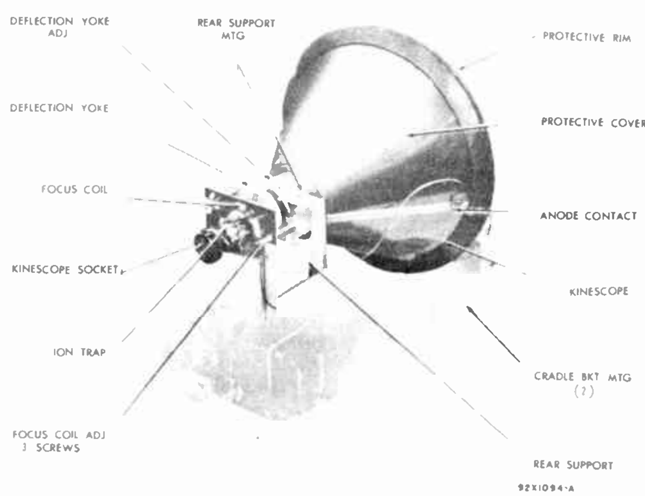


Fig. 10. Kinescope mounting detail.

INSTALLING AND ADJUSTING THE KINESCOPE

1. Wrap the RUBBER STRIP around the front rim of the kinescope and position the tube so that the anode contrast is located at the left side of the tube as viewed from the screen.

2. Slip the neck of the kinescope through the REAR SUPPORT, DEFLECTION YOKE and FOCUS COIL and seat the tube firmly against the REAR SUPPORT. If it fails to slip into place smoothly, investigate and remove the cause of the trouble. Do not force the tube. Check the distance from the face of the tube to the front edge of the steel band. Refer to the measurement made in step 3 above. If this dimension is off; loosen the two REAR SUPPORT MTG. screws, position the tube correctly and fasten the steel band firmly about the rim of the tube.

3. The REAR SUPPORT must seat firmly against the flare of the tube and be securely anchored in place by the two REAR SUPPORT MTG. screws. Check the SPRING CONTACT grounding the outer coating of the kinescope tube. A high potential is developed on the outer coating of the tube if this contact is faulty.

4. The DEFLECTION YOKE must seat firmly against the flare of the kinescope. Check by loosening the single DEFLECTION YOKE ADJ. screw and pushing the DEFLECTION YOKE forward as far as it will go. Take up the slack in the screw temporarily to hold the coil in place.

5. Slip the ION TRAP over the neck of the tube; the arrow points toward the face of the tube.

6. Reconnect the KINESCOPE SOCKET and anode connector and turn on the receiver.

7. After allowing a few minutes for warm up, turn up the BRIGHTNESS control and set the ION TRAP for maximum raster brilliance, backing off the brightness control adjustment as the maximum point is approached. The ION TRAP must be rotated about the axis of the tube as well as shifted along the neck of the tube to obtain the proper setting. The arrow on the ion trap will generally point at the HV anode connector when properly positioned as far as rotation is concerned, hence a rough setting may be obtained immediately with this type of trap.

With the BRIGHTNESS control set for slightly above average brilliance and the PICTURE control full counter-clockwise, adjust the FOCUS control until the line structure of the raster is clearly visible and readjust the ION TRAP for maximum raster brilliance. The final touches on this adjustment should be made with the BRIGHTNESS control at the maximum position with which good line focus can be maintained, then back off the setting of the BRIGHTNESS control until the retrace lines disappear.

8. Check the position and appearance of the test pattern. If the test pattern is off center or shadowed at the corners (Electron beam striking the neck of the tube), adjust the three FOCUS COIL ADJ. screws for a centered, evenly illuminated raster. Note that the three spring loaded adjustment screws tilt the focus coil to shift the position of the raster on the face of the kinescope. Do not turn all three screws up tight, use them to tilt the FOCUS COIL only.

CAUTION - It is not necessary to tilt the focus coil excessively. Excessive tilt may snap the neck of the kinescope if sufficient force is used.

The position of the test pattern may also be shifted by rotating the focus coil. To rotate the coil, loosen the two knurled nuts holding the coil to the mounting plate. Tighten the nuts after the adjustment has been made.

9. If the lines of the raster are not horizontal or square with the escutcheon, loosen the DEFLECTION YOKE ADJ. screw and rotate the DEFLECTION YOKE until this condition is obtained. Tighten the adjustment.

10. Follow the procedure under NON-OPERATING CONTROL ADJUSTMENTS and make any minor adjustments of the FOCUS COIL or DEFLECTION YOKE necessary to obtain the desired results. The final adjustment of the focus coil should leave the test pattern approximately centered.

MEASUREMENT OF H.V. POTENTIAL ON KINESCOPE ANODE

The second anode potential will be approx. 11,000 V. on a receiver that is functioning properly. Since the high potential for the kinescope anode is obtained from the horizontal output transformer, the "non-operating" control adjustments outlined above must be made or be known to be in proper adjustment before the H.V. measurement will have any meaning. Improper operation of the horizontal sweep circuit or circuit faults in the high voltage filter will generally account for an abnormal anode potential. If the anode potential is low, check the HORIZONTAL DRIVE adjustment outlined above.

CAUTION HIGH VOLTAGE

Do not use hand held flexible test leads when making the following measurement. Keep the hands clear of the circuit during measurement. A 11 KV. potential exists in this circuit. Exercise all normal high voltage precautions.

1. Connect a 50-megohm resistor string in series with a 300 microampere meter. Connect the free meter terminal to the chassis and the high side of the resistor string to the anode cap of the kinescope. The connection to the anode cap may be made with a fine wire slipped under the connector. Make up the resistor string with 5-megohm one or two watt resistors to provide a safety factor for voltage breakdown. If 5-megohm resistors are used, a total of ten will be required to obtain the 50 megohms. Make the setup self-supporting and allow adequate clearance between the resistor string and chassis parts to prevent high voltage breakdown.

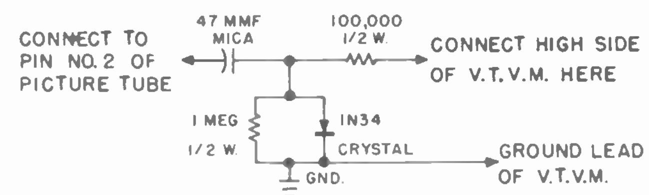
2. Turn on the receiver and set the BRIGHTNESS and PICTURE controls at minimum. The microammeter will read approx. 220 microamperes for 11,000 V. at the kinescope anode. The anode potential is measured in this manner (PICTURE and BRIGHTNESS control at minimum; meter current approx. 200 microamperes) to simulate the kinescope load on the high voltage power supply.

I-F AMP. ALIGNMENT PROCEDURE

Note - The following alignment adjustments do not require the use of the kinescope tube. It is recommended that the tube be removed if extensive alignment adjustments are to be made.

CAUTION - Removal of the kinescope tube exposes the HIGH VOLTAGE anode connector contact. Keep this lead and contact clear of personnel servicing equipment and grounded objects on the service bench. Exercise all normal high voltage precautions while working with the exposed units.

Fig. A.



EQUIPMENT REQUIRED

Signal generator covering 4 mc to 30 mc

Electronic voltmeter

IN-34 crystal detector circuit as shown in Fig. A.

F-M SOUND CHANNEL ALIGNMENT

1. Connect the low frequency signal generator output, through a .005 capacitor, across resistor (R-118) in the plate circuit of the 12AU7 VIDEO DETECTOR tube (V-104). This resistor is located at the terminal strip near the tube socket.

2. Connect the detector circuit and V.T.V.M. as shown in fig. A.

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3. Set the signal generator to 4.5 mc. using just enough output to give approximately one volt reading at the electronic voltmeter.

4. The LIMITER GRID adjustment on the top side of the chassis see fig. 12 should be set to its top limit. Adjust the 4.5 MC TRAP ADJUSTMENT located on the under side of the chassis for minimum voltage as shown on the meter.

5. Disconnect the detector test circuit.

6. Connect the V.T.V.M. to pin #7 of the 6AL5 FM DETECTOR tube (V-109).

7. Adjust the LIMITER GRID adjustment and the primary of T-108 for maximum indication on the voltmeter.

8. Connect the electronic voltmeter across the 1000 mmf condenser (C-135) at the output of the f-m detector stage and adjust the FM DET. SEC. ADJ. of the f-m detector transformer (T-108) for the null.

9. Shift the frequency of the signal generator either side of 4.5 mc and touch up the FM DET. PRI. ADJ. for approximately equal peaks. Use just enough signal generator output to obtain one volt peaks for the best results.

10. After completing the alignment procedure and placing the receiver in operation again, carefully tune in a TV test pattern and adjust the 4.5 MC TRAP ADJ. for maximum vertical wedge definition. This adjustment is located on the under side of the chassis and on the same coil form as the 4.5 MC LIMITER GRID ADJ. shown in fig. 12.

NOTE - The primary adjustment of T-108, the coarse frequency adjustment of T-111 and the 4.5 mc trap adjustment may all be made through the holes in the cabinet bottom or chassis mtg. board.

I-F AMPLIFIER ALIGNMENT

1. Connect the electronic voltmeter across resistor R-118 in the plate circuit of the 12AU7 VIDEO DET. tube (V-104). This resistor is located on the terminal strip near the tube socket.

2. Couple the high side of the signal generator to the OSC./MIXER tube (V-3) by removing its shield and slipping a tight fitting tube shield or length of copper braid over the bulb of the tube and connecting the generator lead to it. Connect the ground side of the signal generator to the frame of the tuning unit.

3. Set the channel selector at channel 2.

4. Set the signal generator output (unmodulated) to develop one or two volts at the electronic voltmeter and adjust the four i-f amplifier coils, according to the following chart, for maximum d-c voltage as measured by the electronic voltmeter. Readjust the signal generator output as required to maintain the two-volt potential at the electronic voltmeter.

I-F AMPLIFIER ALIGNMENT CHART

Signal Generator Frequency (No Modulation)	Adjustment (Refer to Fig. 11)	Stage Adjusted
24.5 Mc	*24.5 Mc IF Adj.	1st IF amp.
23.4 Mc	23.4 Mc IF Adj.	2nd IF amp.
24.6 Mc	24.6 Mc IF Adj.	3rd IF amp.
25.6 Mc	25.6 Mc IF Adj.	Video Detector
21.75 Mc	21.75 Mc Sound Trap Adj.	*Sound Trap Adj. Adj. for Min. Voltage

*Note: After adjusting the 21.75 Mc Sound Trap recheck the setting of the 1st IF Transformer (T101).

5. Check the i-f amplifier frequency response by tuning the signal generator from 21 mc through 26.25 mc and observing the change in d-c voltage at the electronic voltmeter. If the signal generator output is set for an electronic voltmeter reading of 1.5 volts at the peak i-f amplifier response, the d-c voltage should not drop below one volt between the two peaks normally obtained with this i-f amplifier. If the response is unsatisfactory, repeat the procedure or try slight modifications of the recommended settings to obtain the desired response. Avoid resonating the coils with the iron core at the bottom end of the coil form. (Adjustment screw near limit of its travel). If a sweep type signal generator and oscilliscope is available the problem of making the final adjustments will be much easier. Check the two carrier i-f responses, 21.75 mc and 26.25 mc. The 21.75 mc response will be approximately 20 db below the peak response (Approx. 0.15 volt) and the 26.25 mc response will fall approximately 6 db below the peak (Approx. 0.4 volt). Refer to Fig. 11.

The average i-f amplifier sensitivity, when feeding the signal generator output through the receiver as described in step 2, will run approx. 2000 to 5000 microvolts for the one volt d-c peak measured at resistor R-118. (Receiver's oscillator operating on channel 2).

*NOTE - The 1st IF amp coil (T-101) has two iron cores and must be adjusted from both top and bottom for 24.5 mc. response. Since this is an overcoupled transformer with a broad response, it will be necessary with this method of alignment to connect a 1000 ohm resistor across the primary winding (at the tuner terminals), when tuning the secondary (bottom core) and then connect the same resistor across the secondary winding when adjusting the primary (top) core.

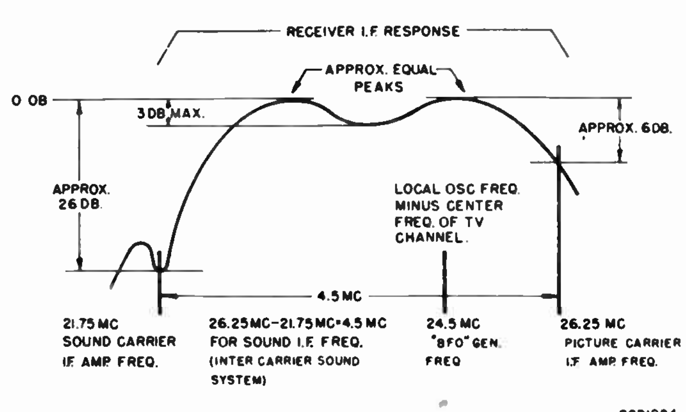

Fig. 11. I-F amplifier response.

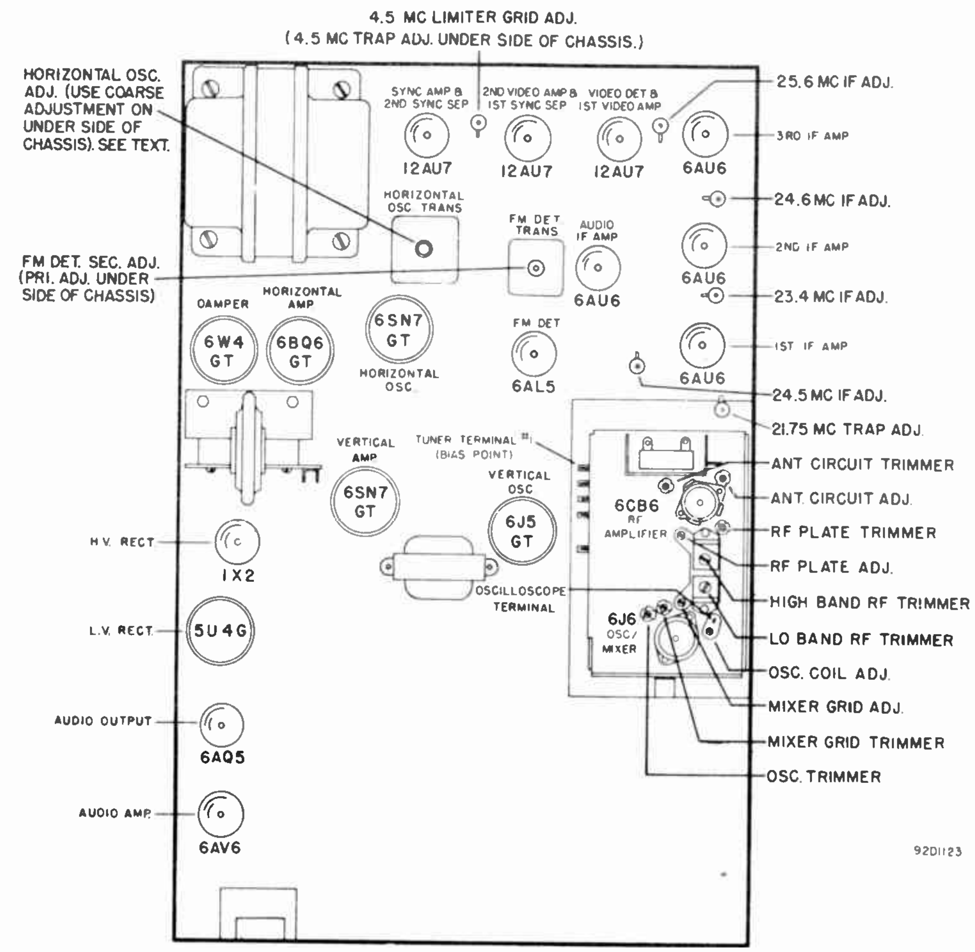

Fig. 12. Top view, i-f amplifier alignment points

CARRIER vs I-F FREQUENCY CHART

Channel No.	Channel Freq. (mc)	Picture Carrier Freq. (mc)	Sound Carrier Freq. (mc)	Receiver Osc. Freq. (mc)	Picture IF Freq. (mc)	Sound IF Freq. (mc)	Picture IF less Sound IF (mc)
2	54-60	55.25	59.75	81.5	26.25	21.75	4.5
3	60-66	61.25	65.75	87.5	26.25	21.75	4.5
4	66-72	67.25	71.75	93.5	26.25	21.75	4.5
5	76-82	77.25	81.75	103.5	26.25	21.75	4.5
6	82-88	83.25	87.75	109.5	26.25	21.75	4.5
7	174-180	175.25	179.75	201.5	26.25	21.75	4.5
8	180-186	181.25	185.75	207.5	26.25	21.75	4.5
9	186-192	187.25	191.75	213.5	26.25	21.75	4.5
10	192-198	193.25	197.75	219.5	26.25	21.75	4.5
11	198-204	199.25	203.75	225.5	26.25	21.75	4.5
12	204-210	205.25	209.75	231.5	26.25	21.75	4.5
13	210-216	211.25	215.75	237.5	26.25	21.75	4.5

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TUNER ALIGNMENT

The tuner is of the turret type employing printed-circuit coils and covering television channels 2 through 13. It has been carefully aligned and adjusted at the factory using precision equipment. Alignment or replacement of individual tuner components in the field is not recommended. If the tuner fails to operate properly by reason of part failure within the unit or in the event it should become badly misaligned, the complete unit should be replaced. The tuner may be exchanged for a new one, through the factory service department, at very reasonable cost providing it has not been damaged or abused. In some cases the exchange can be effected without charge under the terms of the warranty.

Minor alignment adjustments may be desirable after tube replacement in the RF or oscillator-mixer stage. For those service engineers who are properly equipped, as specified below, the following alignment procedure is included.

Equipment Required:

Sweep Generator - Similar to RCA type WR59A, covering frequencies of 54 to 88 Mc and 174 to 216 MC with a minimum sweep of 10 Mc in each channel, and a 300 ohm balanced output at least 0.1 volt line to line.

Cathode Ray Oscilloscope - equivalent to the RCA W060C.

Television Calibrator - equivalent to the RCA WR39A.

Electronic Voltmeter - equivalent to the RCA Voltohmyst 195A.

Crystal Diode Circuit - for coupling the oscilloscope to the RF amplifier. (See Fig. 13.)

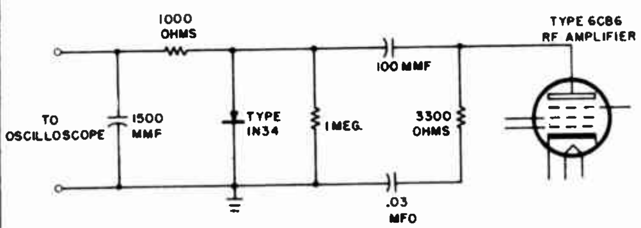


Fig. 13

NOTE: If equipment used is not calibrated by television channels, see CARRIER vs IF FREQUENCY CHART (column #1) for the correct frequencies to use for each channel.

For location of all adjustments see Fig. 12.

For response on each channel see Fig. 14.

ANTENNA CIRCUIT:

(1) Apply - 1.5 volts fixed bias to the tuner by connecting a 1.5 volt cell between tuner terminal number 1 (see Fig. 12.) and chassis ground.

(2) Connect the sweep generator to the antenna terminals, using a 300 ohm matching pad if necessary.

(3) Connect the oscilloscope to the plate of the 6CB6 RF amplifier tube (pin #5) through the crystal diode circuit (see Fig. 13.)

(4) Adjust the antenna circuit trimmer for maximum response on the oscilloscope between the picture and sound carriers of channel #6.

(5) Adjust the antenna circuit adjustment for maximum response on the oscilloscope between the picture and sound carriers of channel #7.

(6) Observe the response of all channels on the oscilloscope. Readjust the antenna circuit trimmer for channels #2 through #6, and the antenna circuit adjustment for channels #7 through #13 so that the best compromise is obtained in making the response of each channel look like that shown in Fig. 14.

(7) Remove the oscilloscope connection.

RF ALIGNMENT:

(8) Connect the oscilloscope to the oscilloscope terminal on top of the chassis (see Fig. 12.)

(9) Adjust the RF plate adjustment, the high band RF trimmer and the mixer grid adjustment for the proper curve shape of channel #13.

(10) Adjust the RF plate trimmer and mixer grid trimmer for the proper curve shape of channel #7.

(11) Adjust the Lo band RF trimmer for proper curve shape of channel #6.

(12) Observe the response of channels #2 through #6 on the oscilloscope. Readjust the RF plate trimmer, the Lo band RF trimmer and the mixer grid trimmer so that the best compromise is obtained in making the response of each channel look like that shown in Fig. 14.

(13) Observe the response of channels #7 through #13 on the oscilloscope. Readjust the high band RF trimmer, the RF plate adjustment and the mixer grid adjustment so that the best compromise is obtained in making the response of each channel look like that shown in Fig. 14.

(14) Remove oscilloscope and sweep generator.

OSCILLATOR ALIGNMENT:

(15) Connect the electronic voltmeter across C-135 at the output of the discriminator circuit. (see Fig. 16.)

(16) Connect the television calibrator to the antenna terminals.

(17) Tune the calibrator to 59.75 Mc and set the tuner to channel #2. Set the fine tuning control to mid range.

(18) Adjust the oscillator trimmer for zero voltage on the electronic voltmeter.

(19) Tune the television calibrator to 215.75 Mc and set the tuner to channel #13. Set the fine tuning adjustment to mid range.

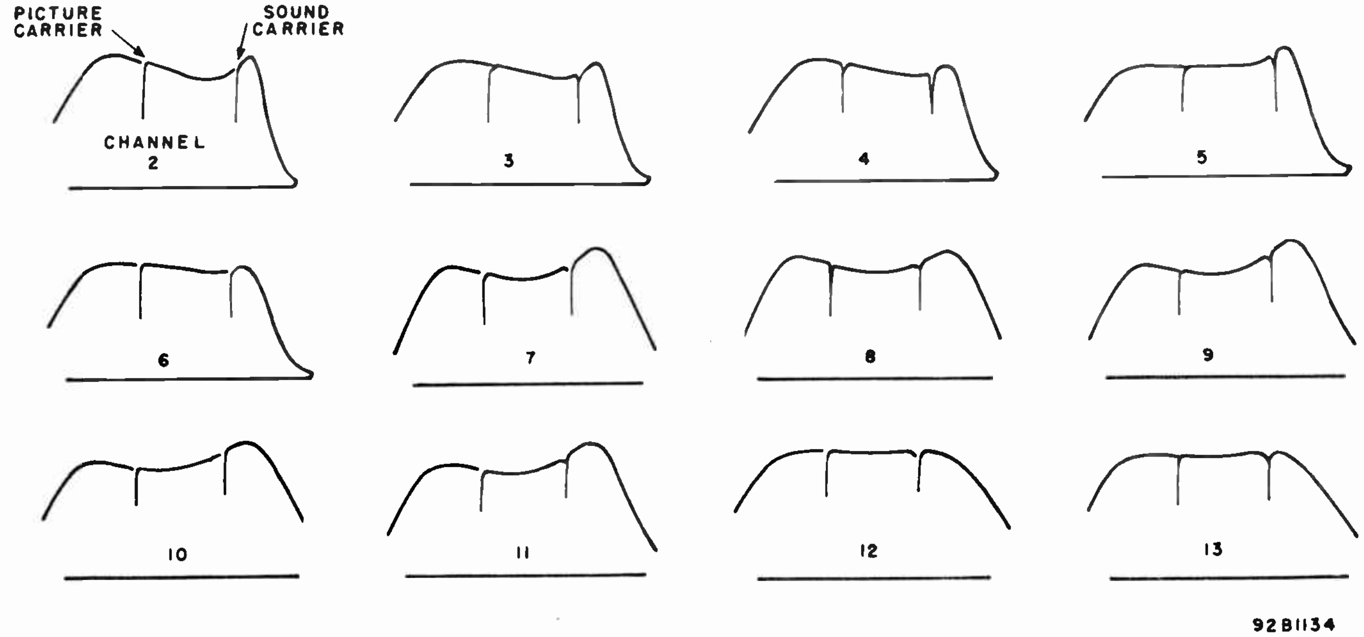
(20) Adjust the oscillator coil adjustment for zero voltage on the electronic voltmeter.

(21) Tune the television calibrator to the sound carrier of channels #3 through #12. (See CARRIER VS IF FREQUENCY CHART, column 3). With the fine tuning control set at mid range, adjust the oscillator adjustment of each band for zero voltage on the electronic voltmeter. These adjustments are accessible through the hole provided in the front of the tuner chassis.

Note: Oscillator adjustments for channels #2 and #13 have been set by the factory. Their positions have been chosen as reference points in the event that the tuner becomes completely misaligned.

(22) Recheck RF alignment and repeat procedure #9, #10, #11, #12 and #13 where necessary.

(23) Remove the electronic voltmeter, oscilloscope connections, and bias cell.



TYPICAL RF RESPONSE CURVES MEASURED AT THE OSCILLOSCOPE TERMINAL

Fig. 14

SERVICE PARTS LIST

Ref. No.	Description	Manufacturer's Part Number
	ELECTRICAL PARTS	
	TRANSFORMERS AND COILS	
L-101,102, 109	Coil, video peaking	51B1154
L-103,104	Coil, video peaking	51B1155
L-105	Coil, focus	51B1159
L-106	Deflection yoke	53C195
L-107	Coil, WIDTH control	51B1230
L-108	Coil, HORIZONTAL LINEARITY control	51B1232
L-112	Coil, 21.75 mc. trap	51B1231
T-101	Transformer, 1st i-f amplifier	50B478
T-102,103, 104	Transformer, i-f amplifier	50A431
T-105	Coil, 4.5 mc sound trap	50A432
T-106	Transformer, vertical oscillator	55B115
T-107	Transformer, vertical output	55B128
T-108	Transformer, ratio detector	50B406
T-109	Transformer, audio output	55C134
T-110	Transformer, power	52C199
T-111	Transformer, horizontal oscillator.	51B1153
T-112	Transformer, horizontal output	55C154
	CONDENSERS	
C-101	47 mf. 500 V., ceramic	47X20SL470K
C-102	3.3 mmf. 500 V., ceramic	47A160-5
C-103,104, 105,106, 107,108, 109,130, 132,190	5,000 mmf. 450 V., ceramic	47A168
C-110,168	5 mmf. 500 V., ceramic	47X20UJ050M
C-111,113, 149,160,	.25 mfd. 200 V., tubular	46AT254J
C-112	22 mmf. 500 V., mica	47X20A220K
C-114,116, 139,141	.01 mfd. 600 V., tubular	46AY103J
C-115,118, 161,165, 191	.05 mfd., 600 V., tubular	46AY503J
C-119,188, 166	.05 mfd. 200 V., tubular	46AU503J
C-120	270 mmf. 500 V., mica	47X20B271K
C-121	47 mmf. 500 V., mica	47X20B470M
C-123,152, 157	.002 mfd. 600 V., tubular	46AZ202J
C-124,125	.005 mfd. 200 V., tubular	46AU502J
C-126	4700 mmf. 500 V., mica	47X35A472M
C-127	50 mfd. 250 V., 75 mfd. 50 V., electrolytic	45B165
C-128,151	.1 mfd. 600 V., tubular	46AY104J
C-129	.25 mfd. 600 V., tubular	46AX254J
C-133	5 mfd. 50 V., electrolytic	45A109
C-134,169	330 mmf. 500 V., ceramic	47B20331K5
C-135,172 174,175, 184	1000 mmf. 500 V., ceramic	47B20A102M5
C-136,137	.01 mfd., 200 V., tubular	46AU103J
C-138	330 mmf. 500 V., mica	47X20A331M
C-142	50 mfd. 300 V., electrolytic	45B171
C-144	56 mmf. 500 V., mica	47X15D560K
*C-145,146	.01 mfd. 600 V., molded	46BR103L6
C-147	40-40 mfd. 450 V., electrolytic	45B159

* Use exact replacement part only

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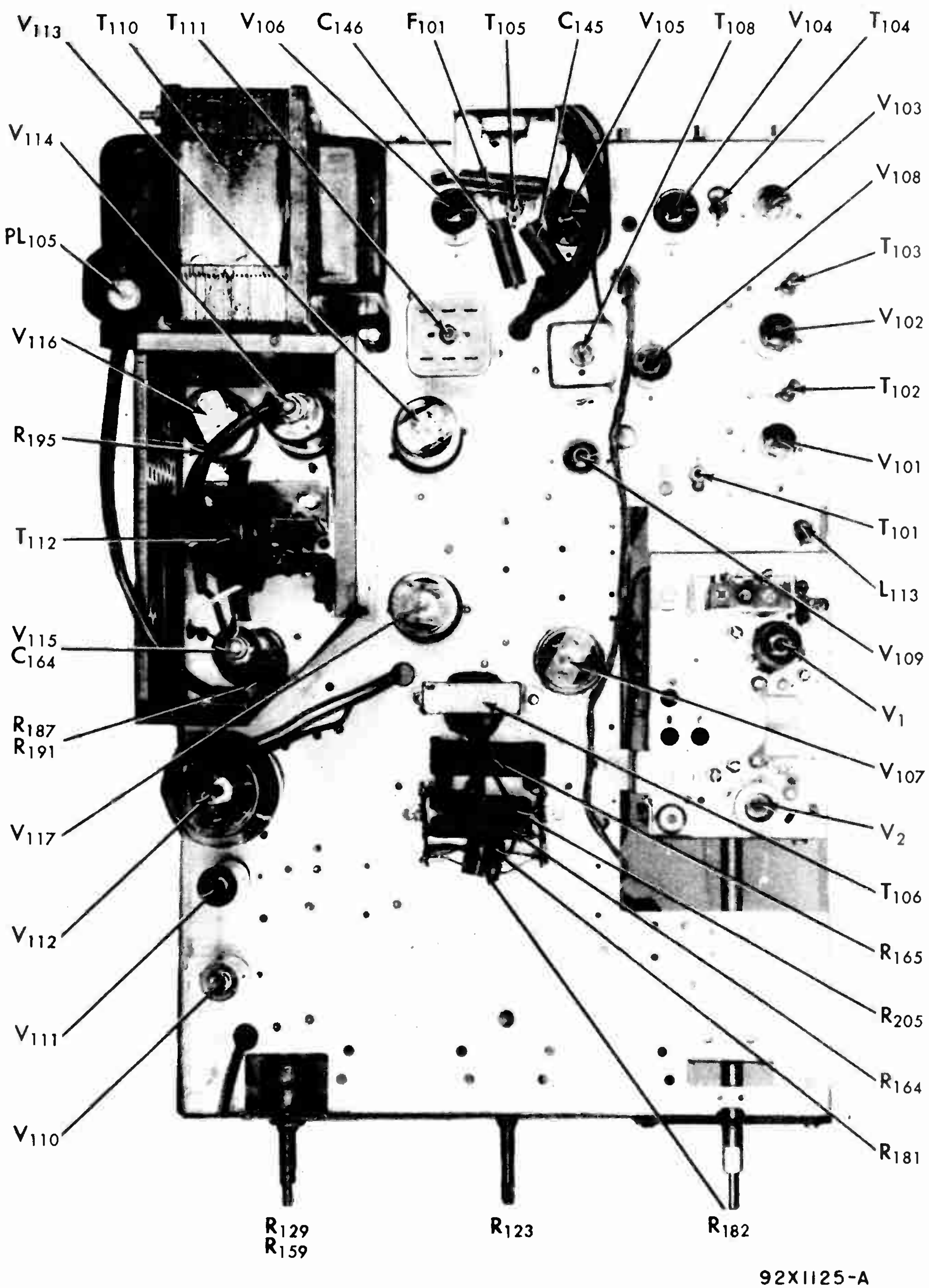

Fig. 15. Top view component locations.

Ref. No.	Description	Manufacturer's Part Number
	CONDENSERS (Cont.)	
C-148	60 mfd. 450 V., electrolytic	45B166
C-150	220 mmf. 500 V., mica	47X20B221M
C-153	.02 mfd. 600 V., tubular	46AY203J
C-154	390 mmf. 500 V., mica	47X20B391K
C-155	10,000 mmf. 500 V., ceramic	47A226
C-156	82 mmf. 500 V., mica	47X20B820M
C-158	1500 mmf. 500 V., mica	47X20B152M
C-159	HORIZONTAL DRIVE control	44A361
C-162,171	47 mmf. 500 V., ceramic	47B20470K5
C-164	500 mmf. 20,000 V., ceramic	47A216
C-167	.035 mfd. 600 V., tubular	46AY353J
C-178	1,000 mmf. 500 V., mica	47X20A102M
C-180	100 mfd. 10V., electrolytic	45B170
C-181	8 mfd. 475 V., electrolytic	45A103
C-183	390 mmf. 500 V., mica	47X20A391K
C-185	2.2 mmf. 500 V., ceramic	47A160-4
C-187	.1 mfd. 200 V., tubular	46AU104J
	RESISTORS	
R-104,126, 134,136, 149	4700 ohms 1/2 watt, carbon	23X20X472K
R-105,110, 180	47 ohms 1/2 watt, carbon	23X20X470K
R-106,109, 112,152	150 ohms 1/2 watt, carbon	23X20X151K
R-107	15,000 ohms 1/2 watt, carbon	23X20X153K
R-108,188	100 ohms 1/2 watt, carbon	23X20X101K
R-111	3300 ohms 1/2 watt, carbon	23X20X332K
R-114,124, 154,178	22,000 ohms 1/2 watt, carbon	23X20X223K
R-117,122, 143	1 megohm 1/2 watt, carbon	23X20X105K
R-118,137	10,000 ohms 1/2 watt, carbon	23X20X103K
R-119	2200 ohms 1 watt, carbon	23X30X222K
R-120	4700 ohms 2 watts, carbon	23X40X472K
R-123	7500 ohms WW, PICTURE control	25B791
R-125	27,000 ohms 1/2 watt, carbon	23X20X273K
R-127,131	2200 ohms 1/2 watt, carbon	23X20X222K
R-128	6800 ohms 1/2 watt, carbon	23X20X682M
R-129,159	50,000 ohms/1 meg., BRIGHTNESS/VOLUME control	25B897
R-130,161, 179,193	470,000 ohms 1/2 watt, carbon	23X20X474M
R-132,168	820,000 ohms 1/2 watt, carbon	23X20X824K
R-133,146	270,000 ohms 1/2 watt, carbon	23X20X274K
R-135,206, 171	47,000 ohms 1/2 watt, carbon	23X20X473K
R-138,139, 166,189	8200 ohms 1/2 watt, carbon	23X20X822K
R-140	2500 ohms 2 watts, WW, FOCUS	25B710
R-141,142	560 ohms 1/2 watt, carbon	23X20X561K
R-144,	1 megohm, VERTICAL control	25B857
R-145,147	2.2 megohms, 1/2 watt, carbon	23X20X225M
R-148	5,000 ohms, VERTICAL LINEARITY control	25B712
*R-150	1 megohm 1 watt, carbon	23X30BF105K
R-151	2.5 megohms 1/2 watt, HEIGHT control	25B711
*R-156,157	10,000 ohms 1/2 watt, carbon	23X20X103J
R-158,194	33,000 ohms 1/2 watt, carbon	23X20X333K
R-160	4.7 megohms 1/2 watt, carbon	23X20X475M

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VOLTAGE CHART

L919120

1. SOCKET VIEWS ARE BOTTOM VIEWS
2. ALL VOLTAGES ARE MEASURED BETWEEN TUBE SOCKET TERMINALS AND CHASSIS WITH ZERO SIGNAL INPUT
3. LINE VOLTAGE — 117 V AC.
4. ALL VOLTAGES SHOWN ARE DC UNLESS OTHERWISE SPECIFIED
5. DC VOLTAGES SHOWN WERE MEASURED WITH AN ELECTRONIC VOLTMETER
6. "NC" NO CONNECTION VOLTAGE SHOWN FOR THIS TERMINAL ONLY WHEN TERMINAL IS USED AS A TIE LUG
7. "NR" NOT READABLE VOLTAGE MEASURED AT THESE TERMINALS GENERALLY MEANINGLESS.
8. ALL VOLTAGES ON KINESCOPE WERE TAKEN AT TIE POINTS OF TUBE SOCKET LEADS.
9. OPERATING CONTROLS SET FOR NORMAL PICTURE UNLESS OTHERWISE SPECIFIED
10. NON-OPERATING CONTROLS SET FOR NORMAL PICTURE.
11. MEASUREMENT OF 2ND ANODE POTENTIAL AT KINESCOPE RECOMMENDED FOR CHECK ON 1X2 RECTIFIER
12. ▭ SPACE PROVIDED FOR SERVICE METER READINGS.

* FOR VOLTAGES ON V-1 & V-2 REFER TO INPUT TERMINALS ON SCHEMATIC MARKED 1,2,3,4 & 5

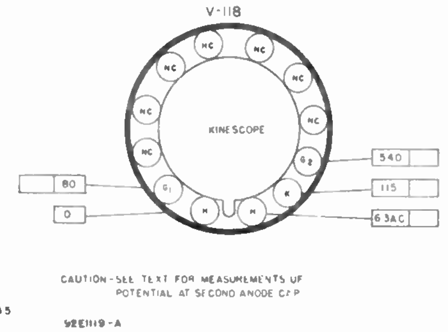
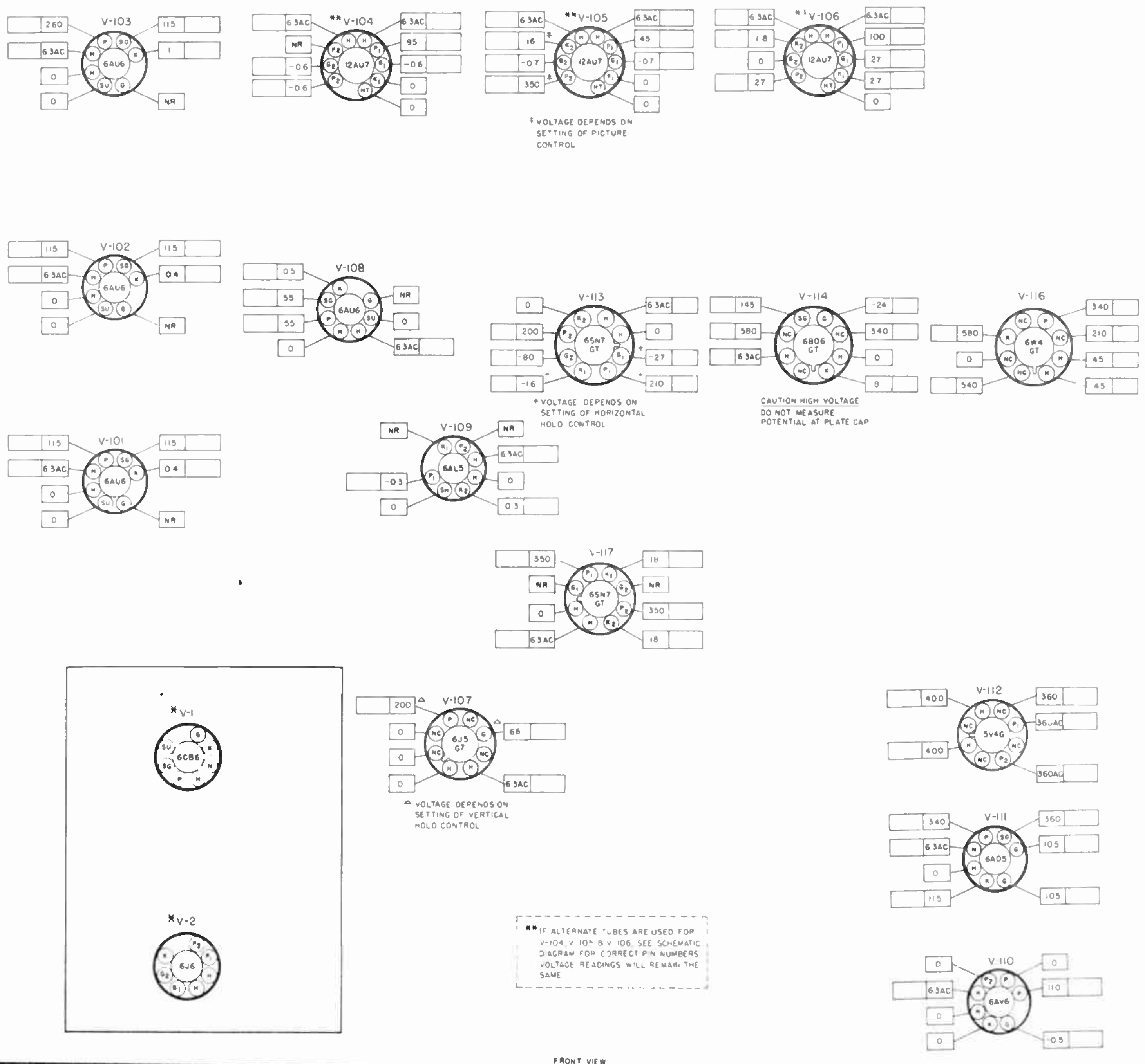


Fig. 17. Tube socket voltage chart.



BOTTOM VIEW OF RECEIVER CHASSIS

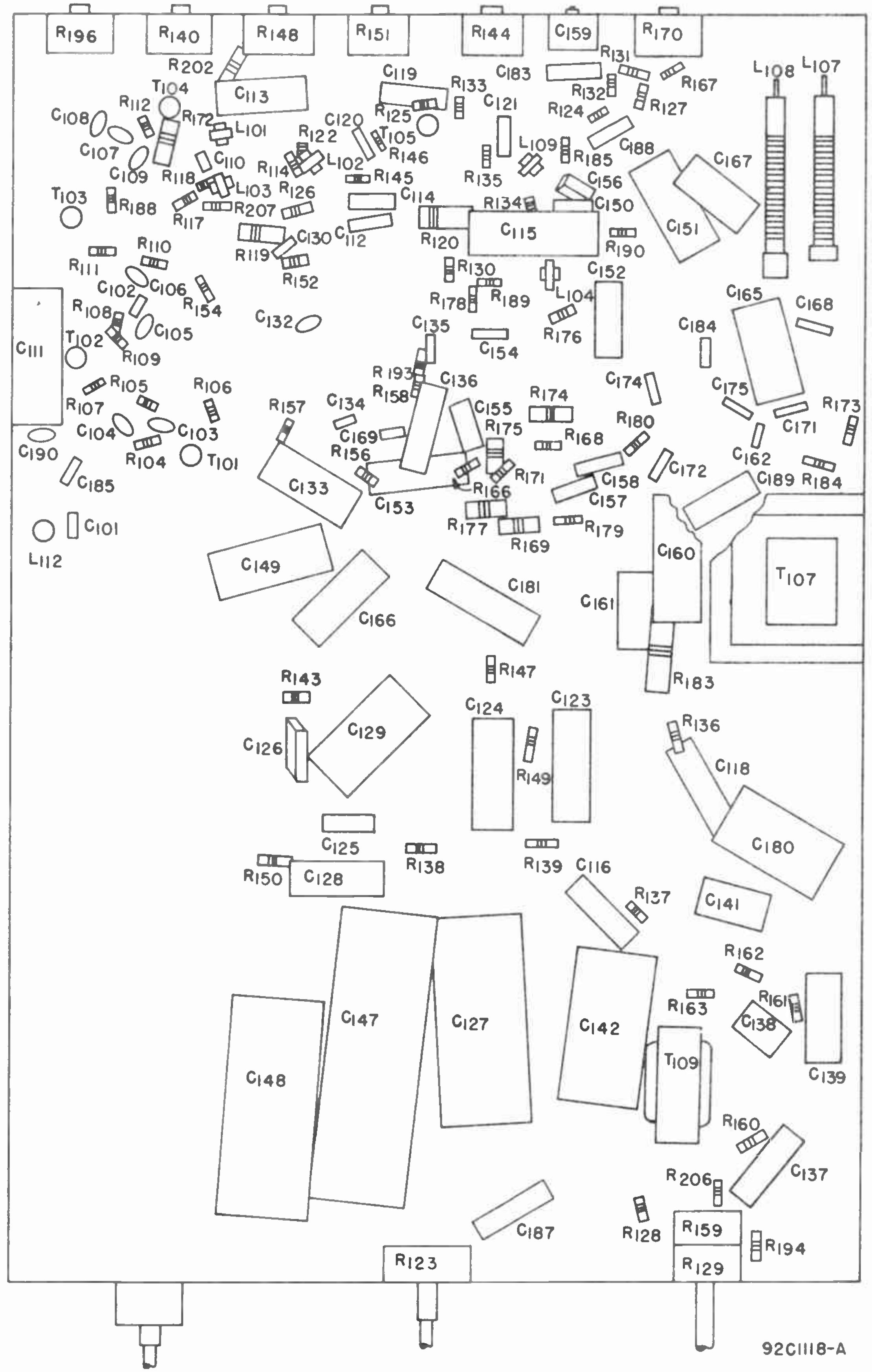


Fig. 16. Bottom view component locations

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SERVICE PARTS LIST (Cont.)

Ref. No.	Description	Manufacturer's Part Number
	RESISTORS (Cont.)	
*R-162	330,000 ohms 1/2 watt, carbon	23X20X334J
*R-163	4.7 megohms 1/2 watt, carbon	23X20X475J
R-164	10,000 ohms 10 watts, WW.	24BG103E
R-165	200 ohms 20 watts, WW	24BH201E
R-167,175	82,000 ohms 1/2 watt, carbon	23X20X823K
R-169	180.000 ohms 1/2 watt, carbon	23X20X184K
R-170	50,000 ohms, HORIZONTAL control	25A858
R-172	18,000 ohms 1 watt, carbon	23X30X183K
R-173	120,000 ohms 1/2 watt, carbon	23X20X124M
R-174,207	330,000 ohms 1/2 watt	23X20X334K
R-176	150,000 ohms 1/2 watt, carbon	23X20X154M
*R-177	120,000 ohms 1 watt, carbon	23X30BF124J
R-181,182	39,000 ohms 2 watts, carbon	23X40X393K
R-183	100 ohms 2 watts, carbon	23X40X101K
R-184	10,000 ohms 1 watt, carbon	23X30X103K
R-187	1 megohm 1 watt, carbon	23X30X105M
R-190	560,000 ohms 1/2 watt, carbon	23X20X564M
R-191	3.3 ohms 1/2 watt, carbon	23X20X033M
R-195	33 ohms 1 watt, carbon	23X30X330K
R-196	400 ohms 2 watts, WW, HORIZONTAL CENTERING	25B713
R-202	390 ohms 1 watt, carbon	23X30X391K
R-205	30,000 ohms 10 watts, WW	24BG303E

Tol. on carbon resistors - M-20%, K-10%, J-5%

TUBE COMPLEMENT

V-1	Type 6CB6: r-f amp.	90X6CB6
V-2	Type 6J6: osc./mixer	90X6J6
V-101,102, 103,108	Type 6AU6: 1st, 2nd and 3rd i-f amp. and audio i-f amp.	90X6AU6
V-104,105, 106	Type 12AU7: video detector and 1st video amp. 2nd video amp. and sync. separator: sync. amp. and 2nd sync. separator	90X12AU7
V-107	Type 6J5-GT: Vertical osc.	90X6J5-GT
V-109	Type 6AL5: f-m detector	90X6AL5
V-110	Type 6AV6: audio amp.	90X6AV6
V-111	Type 6AQ5: audio output	90X6AQ5
V-112	Type 5U4G: low voltage rectifier	90X5U4G
V-113,117	Type 6SN7-GT: horizontal osc.; and vertical amp.	90X6SN7-GT
V-114	Type 6BQ6-GT: horizontal amp.	90X6BQ6-GT
V-115	Type 1X2: high voltage rectifier	90X1X2
V-116	Type 6W4-GT: damper	90X6W4-GT
V-118	Type 16GP4: kinescope	90X16GP4

MISCELLANEOUS ELECTRICAL PARTS

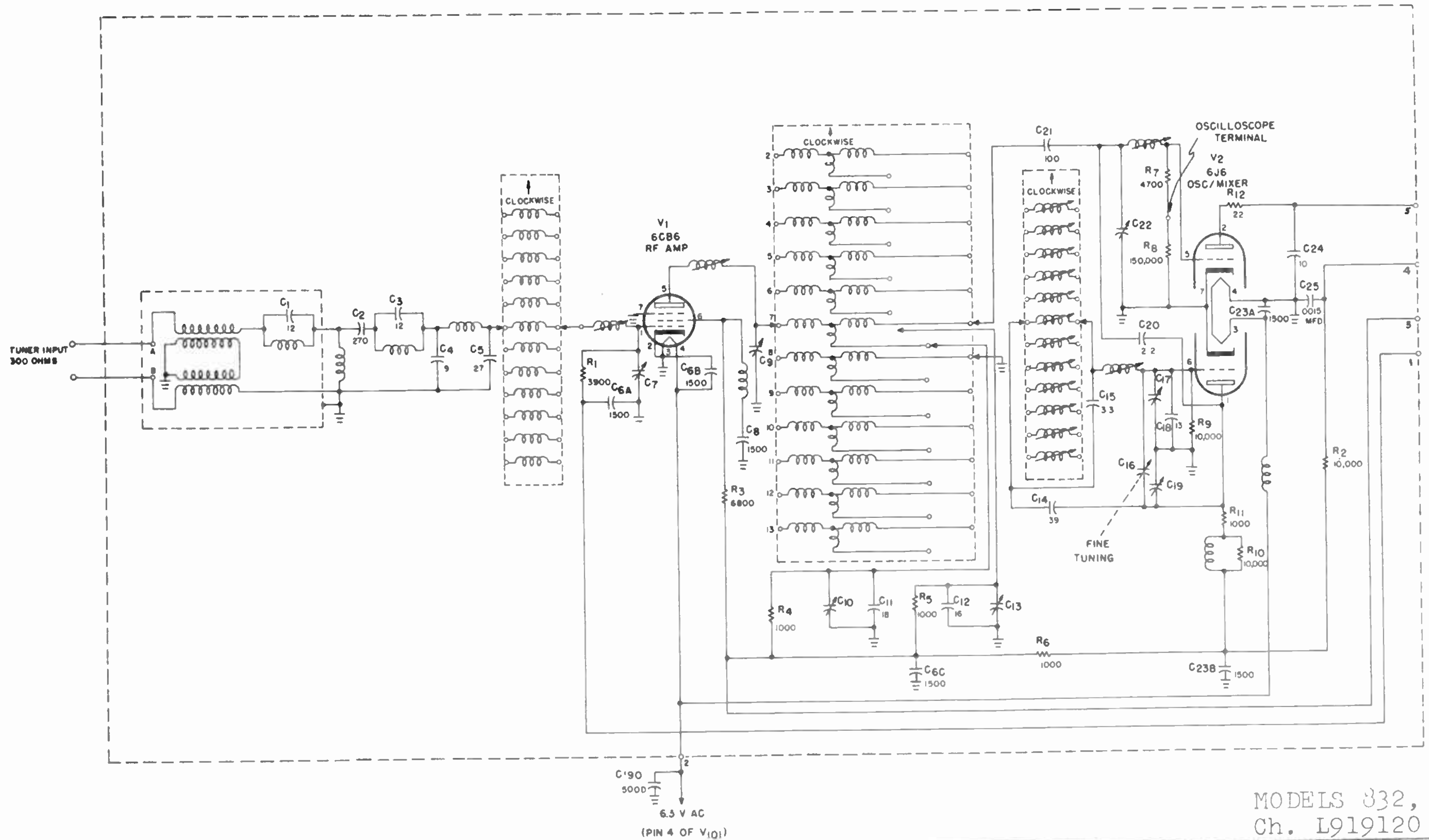
	Tuning unit assembly complete	1A986
LS-101	Speaker assembly	85A102
PL-101	Line cord and plug PL-102	87B1668
PL-103	Plug, speaker (Includes SO-102)	10A287
PL-105	Plug, 16GP4 anode (Part of protective cover 9D1129)	
PL-106	Plug, 4 prong (PHONO/ TELEVISION)	10A302
	Shell, plug (Used on PL-106)	10A305

* Use exact replacement part only.

Ref. No.	Description	Manufacturer's Part Number
	Socket, kinescope	6A348
F-101	Fuse, 5 amp. (with wire leads)	39A346
S-102	Switch, D.P.D.T.; (PHONO/ TELEVISION)	60A381
	MECHANICAL PARTS	
	CHASSIS PARTS	
SO-101	Socket, a-c power	10A286
SO-103	Socket, phono input	36A041
SO-104	Socket, 4 prong (PHONO/ TELEVISION)	10A296
	Shell, socket (Used on SO-104)	10A294
	Socket, octal (Tube)	6A339
	Socket, octal (Tube V-107)	6B296
	Socket, miniature 7 pin	6A340
	Socket, miniature 9 pin (Tube)	6A334
	Socket, miniature 9 pin (Tube V-115)	6A343
	Coil spring, focus coil adj.	75A170
	Clamp, kinescope mtg.	76B579

CABINET PARTS

TS-101	Terminal strip, antenna	88A020
	Bracket, antenna terminal strip mtg.	67B1060
	Mask, escutcheon	7D182
	Escutcheon, kinescope	7D181
	Glass, safety	22D302
	Knob, fine tuning (Model 732)	15D261
	Knob, fine tuning (Model 733)	15A273
	Knob, channel selector (Model 732)	15A280
	Knob, channel selector (Model 733)	15A282
	Knob, OFF-PICTURE (Model 732)	15C232
	Knob, OFF-PICTURE (Model 733)	15A241
	Knob, BRIGHTNESS (Model 732)	15A281
	Knob, BRIGHTNESS (Model 733)	15A283
	Knob, HORIZONTAL & VERTICAL HOLD	15A244
	Knob, VOLUME (Model 732)	15B234
	Knob, VOLUME (Model 733)	15A243
	Ion Trap	21A101
	Cabinet, back	8E1126
	Shield, kinescope protective cover	8D1129



MODELS 832, 833, Ch. L919120

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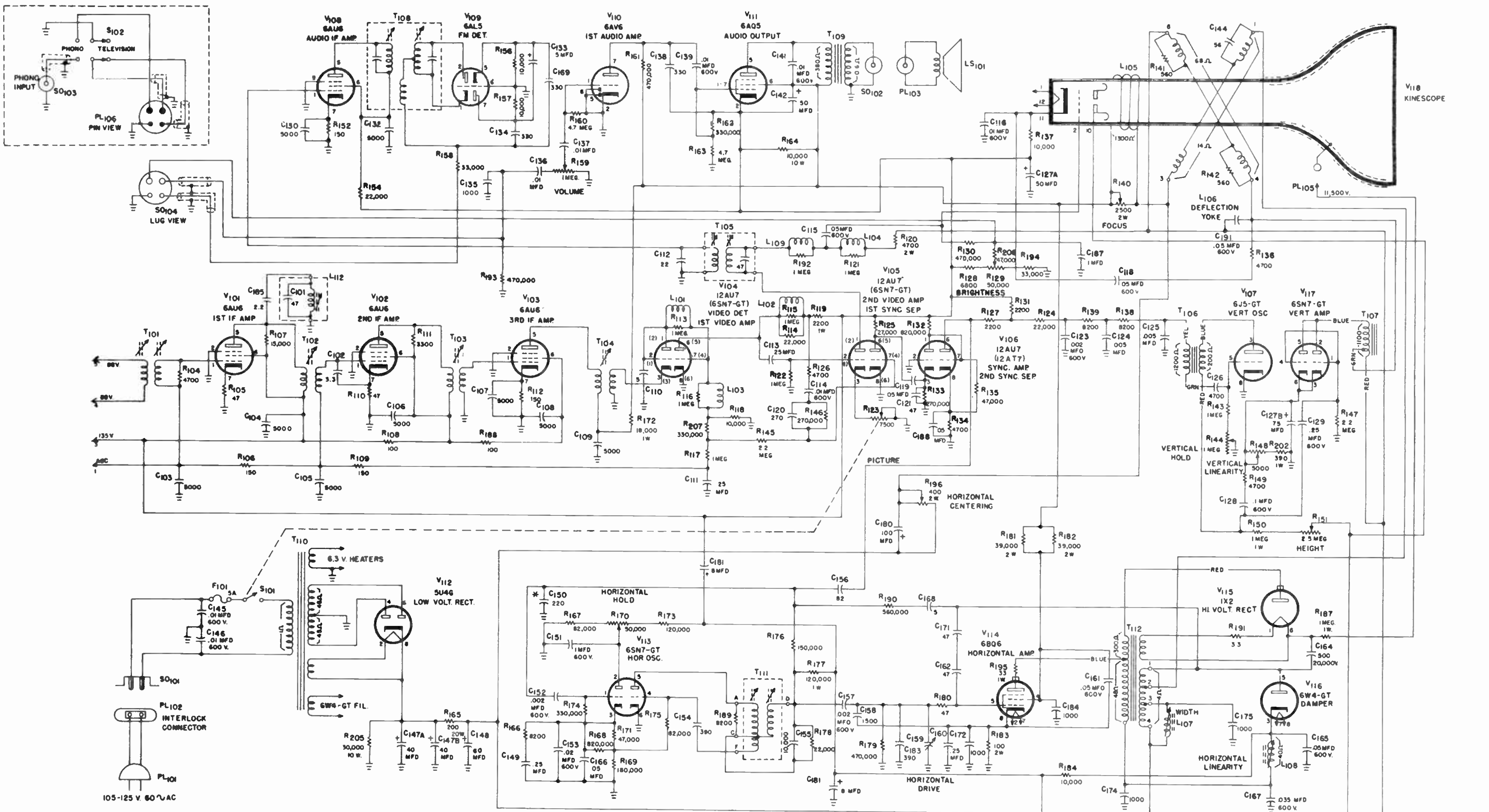

NOTE - CAPACITOR VALUES ARE IN MMF UNLESS OTHERWISE SPECIFIED.
RESISTOR VALUE ARE IN OHMS & 1/2 WATT RATING UNLESS OTHERWISE SPECIFIED.
S-102 SHOWN IN TELEVISION POSITION

* USE A 100 MMF VALUE FOR C150, WHEN V106 IS A 12AT7

LAST R SYMBOL R-207
LAST C SYMBOL C-191
LAST L SYMBOL L-112
LAST T SYMBOL T-112

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IDENTIFICATION

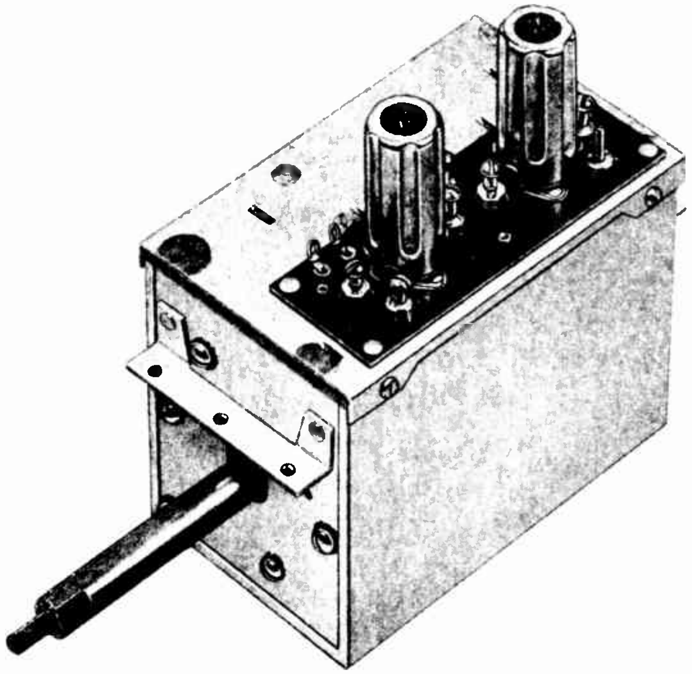


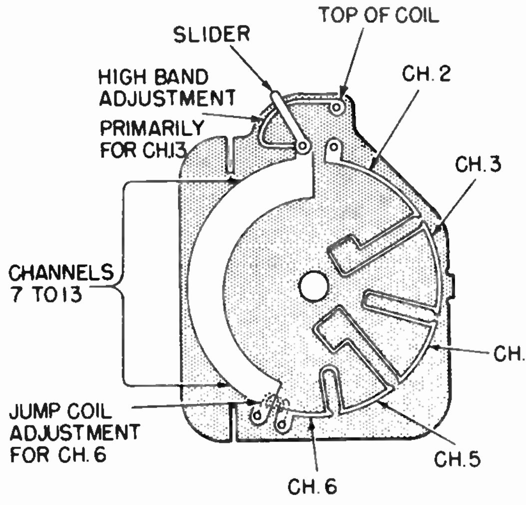
Figure 1. Hoffman Tuning Unit

CIRCUIT OPERATION

The Hoffman Tuning Unit is a continuous type tuner which covers television channels 2 through 13. The circuit employs a 6J6 as a push-pull RF amplifier, and a 6J6 as an oscillator and converter.

The tuned circuits are pairs of plates of specially prepared bakelite on which silver has been printed to form a tuned line resonant circuit. Variation of the electrical length of line is accomplished by shorting across the line with a shorting contactor. This variation in electrical length resonates the line to the proper frequency for each channel. Lumped inductance in the form of jump coils are connected between the distributed high and low band lines so that the tuning skips the frequencies between 88 mc and 174 mc. This skip is designed to eliminate all outside frequencies between channels 6 and 7.

The antenna input circuit has an impedance of 300 ohms, balanced, with center ground. The antenna line is printed on the same plates as the tuned grid circuit for the RF amplifier, which gives inductive coupling between the two circuits. The configuration of the tuned lines are such that the center neutral portion of the antenna line is adjacent to the high band lines of the RF amplifier grid circuit. As the shorting bar contactor is moved up the tuned grid line from channel 2 position, a shorted loop is developed in the low band circuit of the grid lines between the neutral center and



Oscillator Plate Showing
Resonant Line Tuned Circuits

Figure 2. Left Hand Plate

the shorting bar. This shorted loop has the effect of canceling a portion of the antenna lines which in turn reduces the amount of coupling between the antenna and grid lines. This system of varying coupling with frequency maintains a constant bandpass characteristic and input impedance for the tuner.

The RF amplifier grid circuit (Z1 in figure 11-schematic) is tuned by distributed capacity plus the trimmer, C1. The amplifier is a push-pull connected 6J6. Cross neutralization is accomplished through C2 and C3, the latter being adjustable to allow for exact neutralization. AGC voltage is applied to the RF amplifier grids through R1, and is fed into the neutral center of the tuned lines. The RF amplifier plate circuit (shown as Z_2) is a tuned line similar in configuration to the grid circuit, and tuned to the same frequency as the grid circuit. A metal shield is physically placed between the two sets of plates to prevent any coupling or feedback which would cause oscillation. Plate voltage for the RF stage is applied through the dropping resistor, R2, and associated by-pass capacitors, C19 and C20.

The converter grid circuit tuned line (shown as Z_3) is identical to the RF amplifier plate circuit. The circuits are coupled by a combination inductive, capacitive arrangement which provides slight over coupling at all frequencies. High band coupling is achieved through condensers C6 and C7, C7 being adjustable. Low band coupling is carried out through the coupling loop printed on the plates adjacent to the low band sections, plus mutual coupling between jump coils L8 and L9. It can be observed, as the shorting contactors are moved from the high band toward the low bands and down to the channel 2 position, increased inductive coupling circuits come into effect. The increased coupling is required to maintain constant bandwidth as the base frequency is decreased, and the pass band becomes a larger percentage of the base frequency.

The converter grid circuit (shown as Z3) is resonated by distributed capacity plus C9 and the variable trimmer, C10. Tuning for different channels is accomplished by changing the electrical length of the tuned lines with a shorting bar as in all other sections.

The resistor, R4, serves as a grid leak return for the converter. Condenser C8, 5 mmf, is used to balance the grid-cathode and grid-plate capacity of the 6J6 converter section. Balancing is necessary when going from the push-pull RF amplifier to the single ended converter stage. The resistor, R3, is inserted between the ends of the lines to prevent forming a completely shorted loop (as in the antenna-RF section) which would reduce the effectiveness of the coupling loop on the low bands. RF grounding of the neutral center of Z_3 is provided through C21.

The oscillator circuit is a modified form of the Pierce oscillator, with the tuned circuit forming the feedback path between plate and grid circuits. The tuned lines are resonated by C12 and the variable trimmer, C15. C12 is shown connected directly between grid and plate, and is located physically near the 6J6 tube base to reflect heating changes. This capacitor has a negative 750 parts/million temperature coefficient and compensates for variations of inductance in the oscillator line which result from temperature changes. The neutral ends of the oscillator line are not connected together. This is done to avoid leaving a complete loop which would be tuned to channel 2 at any time when the shorting bar is not making contact such as when crossing over jumps between channels. Plate voltage is supplied through R6, the plate dropping resistor.

C14 is used for blocking DC from the oscillator grid and R5 is the grid leak return for the oscillator section of the 6J6. The oscillator signal is coupled back to the converter through C11.

The converter output circuit forms a mutual inductance coupled circuit with the grid circuit of the 1st IF amplifier tube. The capacitor, C13, and coil, L17, are resonated at 23 mc. Adjustment of L17 is part of the alignment procedure. The coil, L18, and condenser, C16, and associated distributed capacities are resonant at about 16 mc, and present an inductive reactance of about 100 ohms to the intermediate frequencies. This inductive reactance forms the mutual circuit between C13-L17 and the input coil and tube capacities of the 1st IF amplifier. In addition, L18-C16 form a trap circuit which removes part of the adjacent channel signals. However, L18 cannot be adjusted for complete adjacent channel trapping because the mutual inductance would not be correct to provide mutual coupling in the IF pass band.

Converter plate voltage is supplied through R7. The converter output provides a composite video-sound IF signal of 26.1 mc video and 21.6 mc sound. This output is suitable for use directly in the intercarrier IF system of the Hoffman 21 tube TV receiver chassis.

FIELD SERVICE

Field service of the Hoffman Tuner is limited primarily to maintenance and sub-assembly replacement. If a tuner requires major servicing, it should be removed from the TV receiver and returned to the Hoffman distributor for replacement. The exploded view diagram is for the purpose of location of parts and explanation.

TUBE REPLACEMENT.

Replacement of tubes in the Hoffman Tuner will have an effect on the alignment or tracking characteristics. However, this effect can be minimized until the changes are negligible if replacement is made with a tube by the same manufacturer as the original tube, and with a tube designed for TV use. The RF amplifier, being cross neutralized, may oscillate if a tube with different interelectrode capacities is used.

Replacement of the oscillator tube may require retrimming of C15 to bring the tuning into the middle of the channel.

Selection of tubes may be made by trying several tubes until one is obtained which has approximately the same interelectrode capacity as the original tube.

SHORTING BAR CONTACT MAINTENANCE

The shorting bars for the tuned lines are in the form of solid silver leaf springs with a small detent on each tip which rides on the silver surface of the printed distributed line.

Smooth and silent operation of the tuner requires proper oiling of the contact surfaces. Contact noise usually shows up as black streaks across the raster during tuning.

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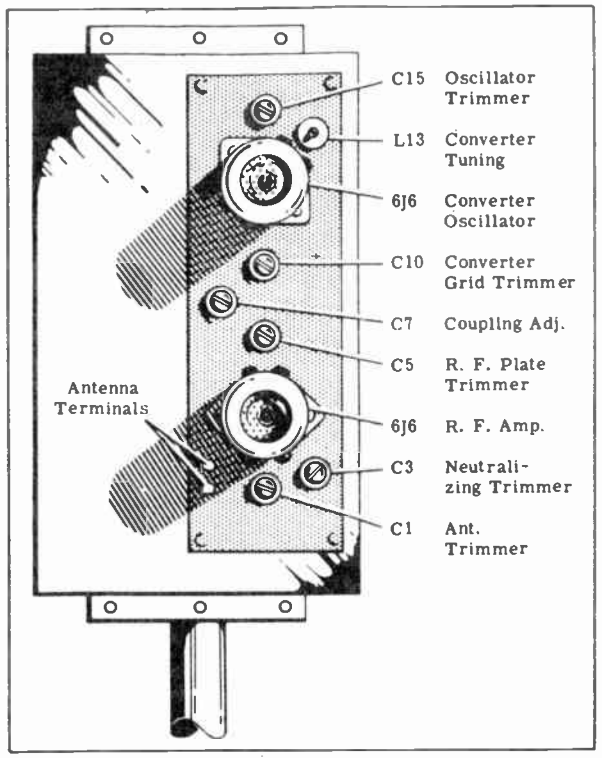

Figure 3. Top View

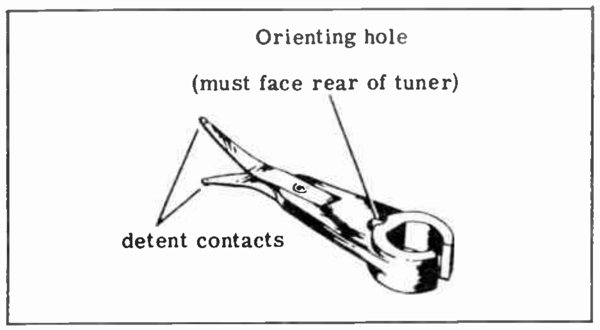

Figure 4. Shorting bar

A special oil for use in high frequency circuits which has no effect on the Q of the circuit or will not disturb the electrical properties of the tuned lines must be used. Factory production uses #7059 Solidified Switch Oil manufactured by the Viscosity Oil Co. of Chicago, Ill.

A soft, non-shedding brush, such as camel's hair, should be used to apply the oil to the outer surface of each tuned line around the entire circumference where the contactor shorting bar rides on the silver surface. Turn the contactor shorting bar to the opposite side of the plates being oiled to avoid bending or springing the contactor with the oil brush. Make sure that brush hairs or other particles are completely removed from the plates after oiling.

The small loop and slide bar used for high band inductance adjustment do not require oiling.

SHORTING BAR CONTACTOR REPLACEMENT

The detent contact of the shorting bar is subject to the greatest amount of wear of any portion of the tuner. If the contactor becomes noisy and cannot be corrected by oiling, the entire shorting bar should be replaced. Refer to the exploded view diagram, and follow these steps for replacement:

1. Loosen the shaft-holding setscrew. This is a 6-32 Allen head screw and uses a No. 6 Allen wrench.

2. Grasp the metal tuner shaft through the access hole in the back plate of the tuner and pull it straight out, or part way out until the desired shorting bar drops loose.

3. Replace the noisy contactors with new parts. The hole through which the shaft passes is flat on one side so that misalignment of the contactor is impossible. The hole size tolerance is +.00 - .001 so that the hole must be lined up squarely with the shaft before the shaft will pass through. The bakelite material forming the hole is split so that a snug fit will result when the shaft is pushed through.

A small hole is molded in the bakelite material just above the flat portion of the shaft assembly hole. (See drawing of shorting bar contactor.) Insert the contactor between the plates with the small hole facing toward the back of the tuner.

4. Slide the shaft into the oscillator section (rear plates), line up the contactor hole, and lightly force the shaft through the contactor. Proceed to each successive pair of plates, lining up the contactor and forcing the shaft through one at a time.

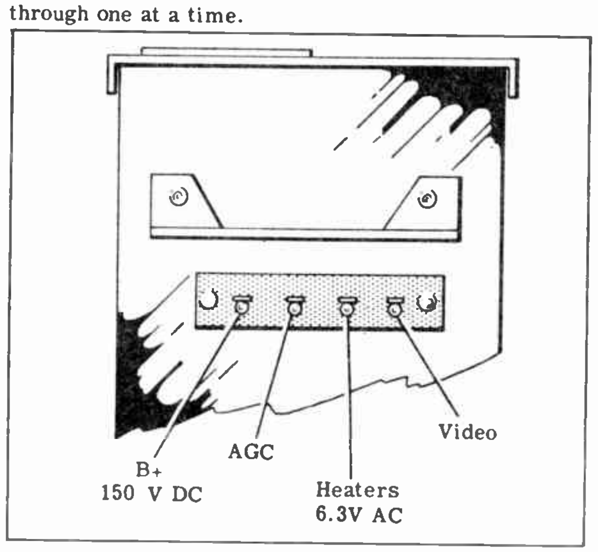

Figure 5. Rear View

5. Press the shaft into the brass drive collar. The setscrew must set against the flatted side of the shaft. The shaft will slide forward until the rear end of the shaft is approximately flush with the metal back plate of the tuner. Tighten the setscrew.

ALIGNMENT PROCEDURE

RF AMPLIFIER - CONVERTER INPUT ALIGNMENT.

SETUP.

Using a 300 ohm source, insert signal into the antenna terminals. Loop one wire lead of a 100 K isolating resistor around the screw adjustment of C10, converter tuning. Connect the other end of the resistor through a shielded lead to the vertical input terminals of a scope. Ground the shielded lead to the tuner chassis and scope ground.

Load L17 by soldering an 1800 ohm, 1/2 watt, composition resistor across the coil terminals.

Since the chassis has been removed from the cabinet, there is no index mark for the channel dial. A suitable index can be fashioned from a piece of stiff wire soldered to the main TV chassis, and set to a point directly above the tuning shaft center.

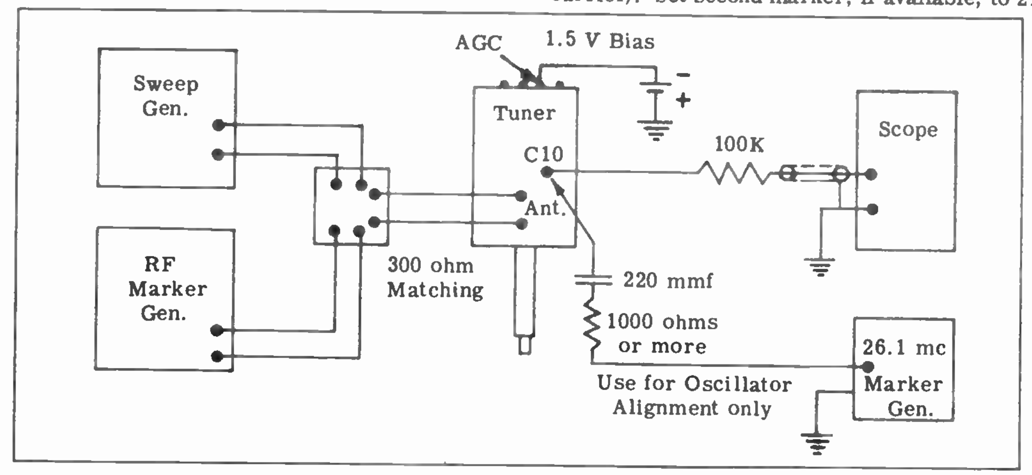

Figure 6. Connection Diagram

Solder a 1-1/2 volt battery in the main TV chassis between ground and the tie point near L101 which will provide bias for the tuning unit during alignment.

DETAILED PROCEDURE.

The alignment of the Hoffman continuous tuner is a process of compatibly adjusting the three variables of each section of tuned plates; i. e., trimmer capacitor, high-band loop sliders and low-band jump coils. Adjustment of coupling and neutralization are another important part of alignment. The general procedure to be followed is:

a. Preliminary adjustment of trimmers.
b. Adjustment of slide bars.
c. Final adjustment of trimmers.
d. Adjustment of jump coils.
e. Recheck of all channels and compromise retrimming of all adjustments.

Exact details of the alignment procedure are given below, and are outlined in a step by step process in the alignment chart. Alignment of the RF and converter input section is completed first; then alignment and tracking of the oscillator section is accomplished.

Set the sweep generator to Channel 6, 85.5 mc center, with 10 mc sweep width. The input signal level should be .02 to .05 volt. Insert a marker signal at 83.25 mc (picture carrier frequency). If a second marker signal is available, it should be set to 87.75 mc, sound carrier frequency. If only one marker is available, it can be swung back and forth to the two frequencies during alignment. Using the dial knob, set Channel 6 opposite the index. This should place the shorting bar contactor approximately in the center of the Channel 6 segment. Adjust C1 (antenna trimmer), C5 (RF amplifier plate), and C10 (converter grid circuit) to give maximum overall response with a symmetrical waveform. Do not tune for a maximum peaked response, but develop a symmetrical waveform. This is a preliminary adjustment of the trimmers; so, exact shaping of Channel 6 is not required at this point. Adjust C3 for proper neutralization. Extreme cases of improper neutralization will cause oscillation in the RF amplifier which shows as "grass" on the scope waveform. Lesser degrees of improper neutralization will produce a peak on one side or the other of the waveform. See figure 7 for example of improper neutralization.

Set the tuner to Channel 13. Set sweep generator at 213 mc., and marker generator at 211.25 mc (picture carrier). Set second marker, if available, to 215.75 mc. Adjust the high band loop slide bars to obtain a maximum symmetrical waveform. Adjustment order, although not critical, should be antenna section, RF plate section, and converter grid section, in that order. At final adjustment, both sliders of any one section should be in approximately the same position. Usually, the antenna section will be set for nearly maximum inductance, and the RF and converter sections will be at about 3/4 of maximum inductance. A band pass of 6 to 7 mc can be obtained. C7 (coupling) may be adjusted to obtain coupling to produce greater than the minimum of 6 mc. The picture carrier marker should appear on or just outside the maximum amplitude point of the high frequency side of the waveform. The band pass decreases as the frequency is reduced to Channel 7, so widest bandpass is required on Channel 13.

Set tuner to Channel 7. Set the sweep generator to 177.5 mc with 10 mc sweep. Set marker generators to 175.25 and 179.75 mc. It may occur that the markers do not lie on the most desirable portions of the pass band (on each side of the peak), when the knob is set with 7 exactly at the index. Reset the knob slightly to move the pass band to the proper position relative to the markers. The new knob position should be within 3 or 4 tenths of the exact position. The condition where this rotation is excessive will be taken up later.

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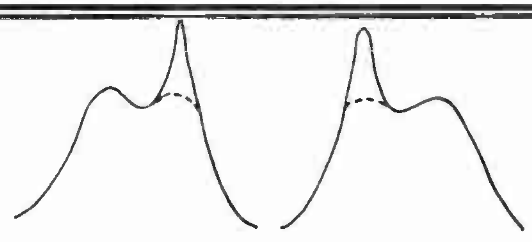


Adjust C3 To Bring Peak
Down To Dotted Line

Figure 7. Improper Neutralization

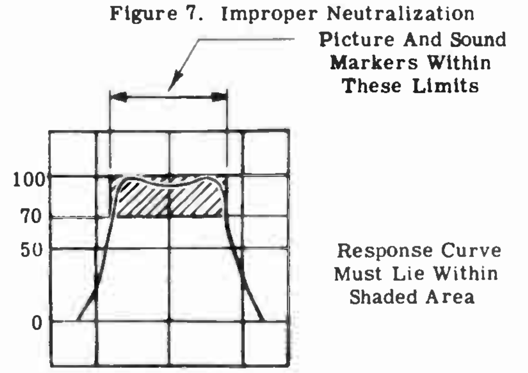


Figure 8. Ideal Band Pass Characteristic

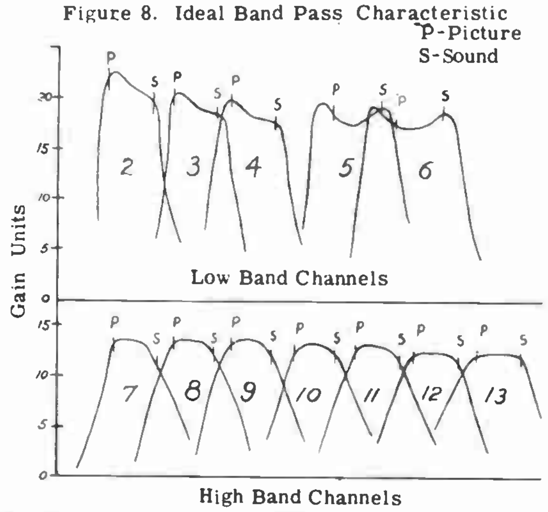


Figure 9. Typical Band Pass Characteristic

> The waveform and bandpass response curves shown in this manual are illustrated in the conventional manner, with amplitude upward and frequency from left to right, low frequency being on the left. In actual practice, depending on polarity of scope and signal generators, the waveforms may be inverted or reversed from right to left. Accurate location of marker indicators will quickly orient the waveforms for practical use.

With the markers in best position, adjust C1, C5 and C10 to produce a symmetrical waveform with greatest amplitude. It may be necessary to slightly retrim C7 to provide proper coupling. Adjustment of C7 influences the setting of C5 and C10, so that the three trimmers should be adjusted alternately. If considerable readjustment of the trimmers was required on Channel 7, then Channel 13 should be rechecked as described above. The adjustment of loop sliders and trimmers should be "rocked in" to obtain the best possible conditions for all the high band channels. If rotation of the channel knob for proper placement of the markers on Channel 7 as described above, was excessive, the knob should be set exactly at the index on Channel 7, and the trimmers C1, C5 and C10 adjusted to bring the waveform as close as possible to the best positioned symmetrical shape. It is then imperative to repeat slide bar adjustments on Channel 13, plus again returning to Channel 7 for final retrimming.

Set tuner to Channel 6. Set sweep generator to 85 mc, 10 mc sweep. Set markers to 83.25 mc (picture) and 87.75 mc (sound). Reset tuner knob until markers lie within the peaks of the curve. Again, it is not necessary that 6 be set exactly at the index, but should be within 3 or 4 tenths of the exact position. Inspection of the position of the shorting contactor will indicate its position which should be within approximately the center third of the Channel 6 segment. If the knob calibration is excessively in error, or the shorting contactor is near the edge of the segment, adjustment of the jump coils is required. The inductance of the coils can be decreased or increased by spreading or squeezing the coil. Use a nonmetalic alignment tool for spreading the turns, or a long nose pliers insulated with tape for squeezing the coils. Set the tuning knob to place Channel 6 opposite the index. Start with the antenna section coils L1 and L4. Next adjust the outside coils (L5 and L12) of the RF and converter sections. Adjust the coupling coils L8 and L9 for best band-width. Observing the curves of Figure 9, the coupling on Channel 6 provides a band-width of 7 to 8 mc. This wide pass band is necessary to give sufficient coupling on the lower channels. Overall adjustment of the jump coils should result in a smooth symmetrical double peaked curve.

Set tuner to Channel 2 (approximately). Set the sweep generator to 57.5 mc, 10 mc sweep. Set markers to 55.25 mc (picture) and 59.75 mc (sound). Check the waveform on Channel 2. The picture marker should be located just outside the maximum peak. The waveform will not be completely symmetrical, and the sound marker will fall at a lower point on the opposite side of the curve. The difference between amplitudes at marker points should not exceed 3 db. If the waveform is not acceptable, retrim C3 and C1 slightly. This is a compromise adjustment and it will be necessary to recheck Channels 13 and 6. Some deterioration of waveforms on the other channels may be tolerated to allow better performance on 2. The average overall performance should be considered in these cases.

OSCILLATOR SECTION ADJUSTMENT

SETUP

The oscillator adjustment should be made after the RF section is aligned. Tracking of the oscillator is accomplished by accurately marking the 26.1 mc picture IF output point, and then adjusting the oscillator to make a converted RF picture marker coincide with the reference 26.1 mc marker.

Input isolation must be used to avoid loading the converter grid circuit too heavily. A network consisting of a 1000 ohm composition resistor and a 220 mmf condenser in series with the signal lead will give sufficient isolation and transmit enough signal to produce a readily apparent marker. However, this loading of the converter grid circuit will distort the RF waveform, so it is desirable to use a larger resistor if sufficient signal amplitude is available from the 26.1 mc source. Distortion of the RF waveform is not serious, because the oscillator adjustment is for frequency only, and does not affect the waveform.

The 26.1 mc reference marker should be derived from a source which will allow the signal to be injected into the circuit separately from the sweep signal. Any unmodulated C.W. signal which can be accurately calibrated to 26.1 mc will be satisfactory. The output should be 0.1 volt or greater.

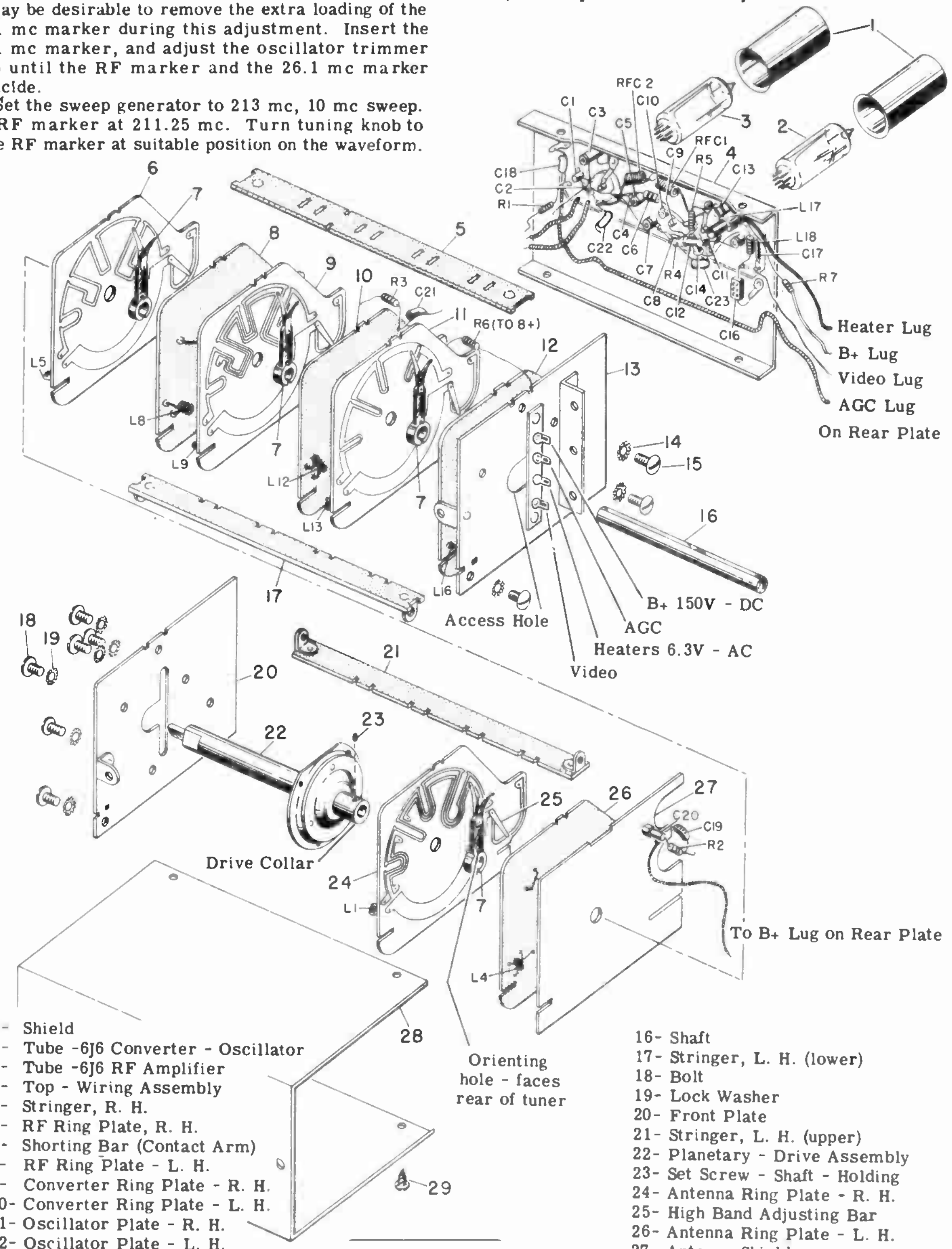
The sweep generator and scope are connected as in the RF alignment. Inject the 26.1 mc source into the circuit at the scope takeoff point by coupling to the metal screw of C10.

PROCEDURE

Set the sweep generator to 85 mc, 10 mc sweep. Set the RF marker to 83.25 mc. Turn the tuning knob to approximately the center of Channel 6 so that the RF marker is in a suitable position on the waveform. If may be desirable to remove the extra loading of the 26.1 mc marker during this adjustment. Insert the 26.1 mc marker, and adjust the oscillator trimmer C15 until the RF marker and the 26.1 mc marker coincide.

Set the sweep generator to 213 mc, 10 mc sweep. Set RF marker at 211.25 mc. Turn tuning knob to place RF marker at suitable position on the waveform. Adjust the oscillator section high band loop sliders to make markers coincide.

Set sweep generator to 177.5 mc, 10 mc sweep. Set RF marker to 175.25 mc. Turn tuning knob to Channel 7. If markers approximately coincide, no further adjustment is required. If necessary, readjust C15, then repeat Channel 13 adjustments.



1- Shield
2- Tube -6J6 Converter - Oscillator
3- Tube -6J6 RF Amplifier
4- Top - Wiring Assembly
5- Stringer, R. H.
6- RF Ring Plate, R. H.
7- Shorting Bar (Contact Arm)
8- RF Ring Plate - L. H.
9- Converter Ring Plate - R. H.
10- Converter Ring Plate - L. H.
11- Oscillator Plate - R. H.
12- Oscillator Plate - L. H.
13- Rear Plate
14- Lock Washer
15- Bolt
16- Shaft
17- Stringer, L. H. (lower)
18- Bolt
19- Lock Washer
20- Front Plate
21- Stringer, L. H. (upper)
22- Planetary - Drive Assembly
23- Set Screw - Shaft - Holding
24- Antenna Ring Plate - R. H.
25- High Band Adjusting Bar
26- Antenna Ring Plate - L. H.
27- Antenna Shield
28- Chassis Cover
29- Sheet Metal Screw

Figure 10. Tuner Exploded View

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Set sweep generator to 85 mc, 10 mc sweep and RF marker at 83.25 mc. Turn tuning knob to approximately Channel 6. If required, adjust the oscillator section jump coils L13 and L16 to make markers coincide.

Set sweep generator to 57.5 mc, 10 mc sweep. Set RF marker at 55.25 mc. Turn tuning knob within the range of Channel 2 segment and check for coincidence of markers. If coincidence occurs at edge of range, it will be necessary to compromise the Channel 6 setting and readjust the jump coils slightly.

The oscillator alignment is described as a separate step, but may be combined with the RF alignment after experience is gained in handling the adjustments and compromises required.

With a continuous type tuner, a considerable range is available for tuning on each channel. For this reason, there are no individual channel oscillator adjustments. Slight retuning of C15 will change the oscillator frequency on all channels.

CHANNEL FREQUENCIES

Channel No.	Limit Frequencies Mc.	Picture Carrier Mc.	Sound Carrier Mc.	Oscillator Frequency Mc.
2	54-60	55.25	59.75	81.35
3	60-66	61.25	65.75	87.35
4	66-72	67.25	71.75	93.35
5	76-82	77.25	81.75	103.35
6	82-88	83.25	87.75	109.35
7	174-180	175.25	179.75	201.35
8	180-186	181.25	185.75	207.35
9	186-192	187.25	191.75	213.35
10	192-198	193.25	197.75	219.35
11	198-204	199.25	203.75	225.35
12	204-210	205.25	209.75	231.35
13	210-216	211.25	215.75	237.35

ALIGNMENT TABLE

This alignment table is for quick reference during alignment. Detailed instructions beginning on page 4 should be studied before alignment by use of the table is attemped.

RF AND CONVERTER ALIGNMENT

Step No.	Sweep Gen. Freq.	Marker Gen. Freq.	Set Tuning Knob	Adjust	Instructions
1	85.5 mc	83.25 mc 87.75 mc	Channel 6 Index	C1, C5, C10	Symmetrical waveform maximum response.
2	85.5 mc	83.25 mc 87.75 mc	Channel 6 Index	C3 (Neut.)	See figure 7.
3	213 mc	211.25 mc 215.75 mc	Channel 13 Index	All high-band loop sliders	See figure 9.
4	213 mc	211.25 mc 215.75 mc	Channel 13 Index	C7	6 to 7 mc Bandwidth.
5	177.5 mc	175.25 mc 179.75 mc	Channel 7 approx.	C1, C5, C10	See figure 9.
6	85.5 mc	83.25 mc 87.75 mc	Channel 6 Index	L1, L4, L5, L12, L8, L9	See figure 9.
7	57.5 mc	55.25 mc 59.75 mc	Channel 2 approx.	C1 slightly, if required	Check waveform only.
8	All Channels	Sound and Picture	Each channel approx.		Check waveform.

Use 10 mc sweep width for all sweep signals.
Use 300 ohm balanced input for signal.

Load L17 with 1800 ohms.
Use 1.5v. fixed bias in place of AGC bias.

OSCILLATOR ALIGNMENT

Step No.	Sweep Gen. Freq.	Marker Gen. Freq.	Set Tuning Knob	Adjust	Instructions
9	85 mc	83.25 mc 26.1 mc	Channel 6 approx.	C15	Coincide markers.
10	213 mc	211.25 mc 26.1 mc	Channel 13 approx.	Loop slider	Coincide markers.
11	177.5 mc	175.25 mc 26.1 mc	Channel 7 approx.	C15, if required	Coincide markers.
12	85 mc	83.25 mc 26.1 mc	Channel 6 approx.	L13, L16	Coincide markers.
13	57.5 mc	55.25 mc 26.1 mc	Channel 2 approx.		Check markers.
14	All Channels	Picture RF 26.1	Each Channel		Check markers.

Remove all bias, resistor loading and signal connections after alignment.

TUNER PARTS LIST

SYMBOL	VALUE	TOL.	WATTS OR VOLTS	TYPE	PART NO.
C1, C3*, C5, C7, C10, C15	(.3-3) mmf			Trimmer (Muter)	4323
C2, C4*, C9, C11	1.5 mmf	10%		Ceramic fixed	4024
C6	.5 mmf	10%		Ceramic fixed	4054
C8	5 mmf	10%		Ceramic fixed N750	4028
C12	2 mmf	10%		Ceramic fixed N750	4052
C13, C14, C19, C21	10 mmf	10%		Ceramic fixed N750	4038
C16	135 mmf	3%		Silver mica	4059
C17	330 mmf	10%		Ceramic tubular NPO	4010
C18, C22, C23	1000 mmf			Ceramic fixed (GMV)	4060
C20	470 mmf			Ceramic stud mtg	4053
* In some tuners					
C5, C10	(2-5.5) mmf			Trimmer (Muter)	4324
C4, C9	Deleted from tuner				
R1	470K ohms	20%	1/2 W	Comp	4506
R2	2200 ohms	20%	1/2 W	Comp	4512
R3	220 ohms	20%	1/2 W	Comp	4530
R4, R5	47K ohms	10%	1/2 W	Comp	4559
R6	1500 ohms	20%	1/2 W	Comp	4534
R7	15K ohms	20%	1/2 W	Comp	4521

INDUCTORS

Z1	Antenna tuned line (consisting of)		
	L1, L4	Antenna jump coil	5307
	L2	Antenna ring (RH)	99566
	L3	Antenna ring (LH)	99565
Z2	RF Plate Tuned Line (consisting of)		
	L5	RF jump coil	5297
	L6	RF ring (RH)	99568
	L7	RF coupling ring (LH)	99569
	L8	RF jump coupling coil	5322
Z3	Converter Tuned Line (consisting of)		
	L9	RF jump coupling coil	5322
	L10	RF coupling ring (RH)	99570
	L11	RF ring (LH)	99567
	L12	RF jump coil	5297
Z4	Oscillator Tuned Line		
	L13, L16	Oscillator jump coil	5306
	L14	Oscillator ring (RH)	99572
	L15	Oscillator ring (LH)	99571
	L17	Coil Converter Plate	5320
	L18	Coil, Series Trap	5327
RFC1, RFC2		Filament Choke	5133

TUBE COMPLEMENT

6J6	Push-Pull RF amp., dual triode
6J6	Converter-Oscillator, dual triode

ELECTRICAL DIAGRAM

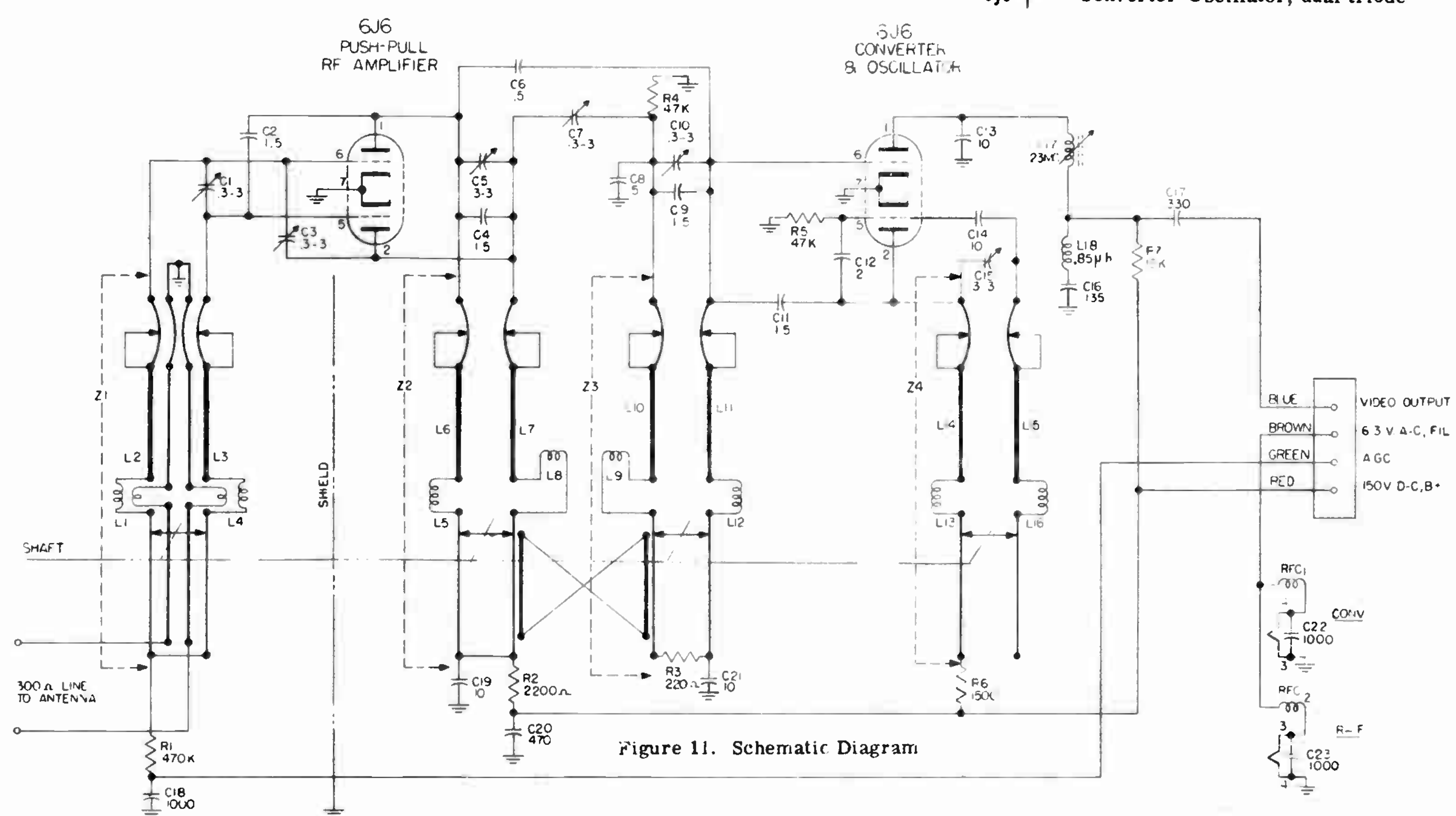

Figure 11. Schematic Diagram

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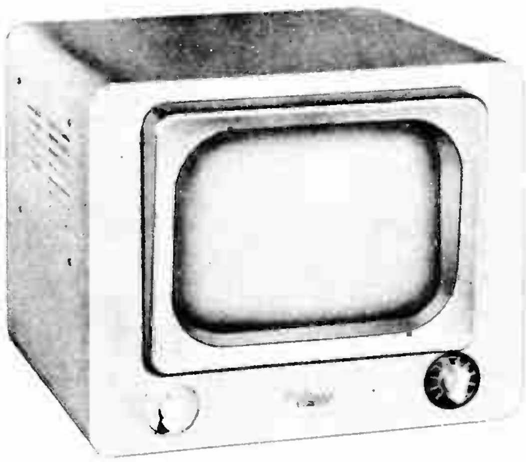


MODEL 632
Blonde Oak Cabinet

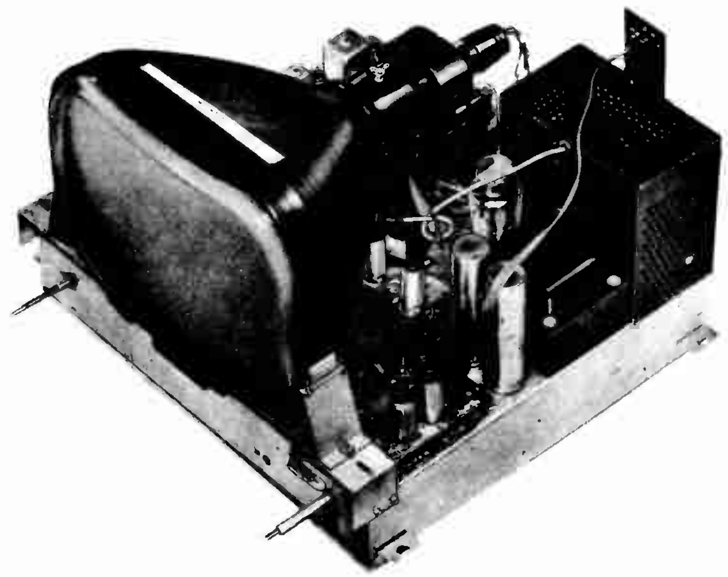


Figure 1. Chassis 159

MODEL 633
Mahogany Cabinet

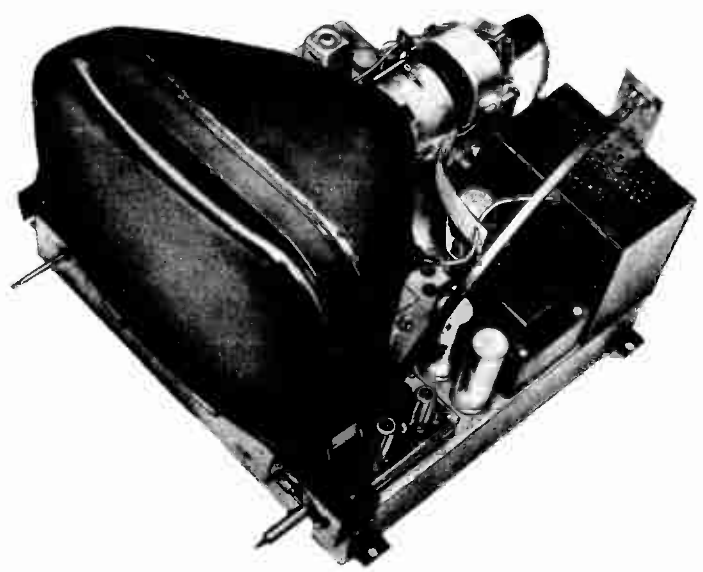


Figure 2. Chassis 160

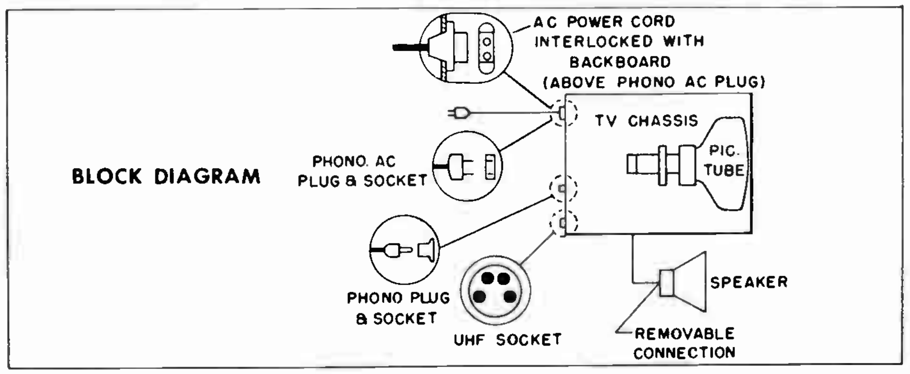
SPECIFICATIONS

Line Voltage	115V AC 60 cps
Number of Tubes	21
Picture Tube Size	16" Rect.
Power Consumption	205 Watts
TV Channels	2 through 13
Audio Power Ouput	3 Watts

Speaker Type	6" x 12" Oval PM
Cabinet Height	18 3/8"
Cabinet Width	22"
Cabinet Depth	18 1/2"

PHONOGRAPH CONNECTIONS

Circuit connections are built into these models for attaching an external phonograph. A crystal pickup type record player must be used. A 45 rpm 7" record changer, a Long Playing changer, or a standard changer will produce good results. The phono AC power cord may be conveniently plugged into a socket marked AC PHONO located directly below the AC line cord lock at the left rear portion of the chassis. The phono audio lead goes into an audio jack marked INPUT PHONO located at the right rear portion of the chassis. The audio amplifier system of the TV receiver is controlled by the slide switch located adjacent to the INPUT PHONO jack. When this switch is placed in the PHONO position, the output of the record player pickup is amplified through the TV audio system. The volume is controlled in the normal manner with the volume control at the left front of the chassis. The slide switch marked TV-PHONO has no effect on the picture circuits of the receiver. The CONTRAST control may be turned full off to remove the picture. (Brightness should have been previously set so that light just begins to appear at minimum contrast setting.) All power to the phonograph is turned off when the TV receiver is turned off.



MAJOR COMPONENTS

Cabinet	
Model 632	7580
Model 633	7581
TV Chassis	
Models 632, 633	160
Tube, Picture	16TP4
Glass, Window Protective	743
Frame, TV Glass	2387
Mask, Frame Liner	2388
Speaker	9074
Antenna Assembly	99609
Loop, Antenna	9667
Azimutrol	9658
Knob, Antenna Tuning	3691
Backboard	2436
Cord, AC	3176
Plate, Contrast-Off-On-Volume	2446
Plate, Channels-Tuning	2448
Knobs	
Turret Tuner	
Channel Selector	33502
Fine Tuning	3642
Off-On-Volume	SK341
Contrast	SK342
Brightness	3719
Vertical Hold	3719

ELECTRICAL AND MECHANICAL DATA

Power Requirements:	
Operating Voltage	115 V AC 60 cps
Watts	205
Tuning Range:	
TV	Channels 2 through 13
Audio Power Output	3 Watts
Output Impedance (Audio)	3.2 ohms at 400 cps
Video Bandpass	3 MC
Intermediate Frequencies:	
Video Carrier	26.1 MC
Intercarrier Sound	4.5 MC
Antenna Input Impedance	300 ohms, balanced
Picture Tube:	
Chassis 159	14BP4
Chassis 160	16TP4

Chassis 159 and 160 are 21 tube TV receivers. An intercarrier sound system is used with the 4.5 mc sound IF being taken off after the video second detector. Three stages of video IF and two stages of sound IF are used. The interstage IF transformers are double-tuned, over-coupled type. The high voltage and deflection circuits are designed to operate a 70° deflection system for a 14 inch or 16 inch rectangular tube. The picture tube is mounted directly on the chassis on specially designed support brackets.

Servicing of the receiver without removal from the cabinet is facilitated by the easily removable metal bottom plate. The metal plate forms the bottom of the receiver cabinet, and is held in place by four screws.

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Chassis 159 and 160 are identical except for the variations required to handle either the 14BP4 tube for chassis 159 or the 16TP4 tube for chassis 160. The parts which are different are the tube holddown strap, the focus coil mounting bracket, the deflection yoke mounting bracket, and the metal bracket for supporting the front of the picture tube. The screen resistor, R162, of the 6BG6G, is increased from 8.2 K to 15 K ohms to decrease the horizontal drive and high voltage for the 14 inch tube. Alternate part numbers are shown in the parts list. All other electrical and mechanical components are the same for both chassis.

TUNING UNITS

Two types of tuning units are used interchangeably in the chassis 159 and 160. The turret tuner, RF6, used in previous types of Hoffman receivers is used in early production of chassis 160. The Hoffman continuous type tuner is used in production of both 159 and 160 chassis, although the two tuners are operationally interchangeable and may be used alternately at any time.

Separate mounting plates are used in conjunction with each type tuner, so that direct mechanical interchangeability is possible.

The style of knobs for the front panel controls are different for the two types of tuners, and each tuner must be used with the set of knobs specifically designed for it.

TUBE COMPLEMENT

2	6AU6	Sound IF	V101, V102
1	6T8	Ratio Detector, 1st Audio	V103
1	6K6GT	Audio Output	V104
3	6CB6	Picture IF	V105, V106, V107
1	6CB6	Video Amplifier	V108
1	6AU6	AGC Keyer	V109
1	6SN7GT	Horizontal Oscillator Control & Sync Amplifier	V110
1	6SN7GT	Horizontal Oscillator	V111
1	6BG6G	Horizontal Output	V112
1	1X2	H. V. Rectifier	V113
1	6W4GT	Damping Diode	V114
1	6AU6	Sync Separator	V115
1	6J5	Vertical Oscillator	V116
1	6S4	Vertical Output	V117
1	5U4G	Low Voltage Rectifier	V118
1	16TP4 or	Picture Tube	
1	14BP4	Picture Tube	

TUNING UNIT

1	6J6	RF Amplifier
1	6J6	Oscillator, Converter

SUMMARY OF TUBE COMPLEMENT

1X2	1	6K6GT	1
5U4G	1	6S4	1
6AU6	4	6SN7GT	2
6BG6G	1	6T8	1
6CB6	4	6W4GT	1
6J5	1	14BP4 or 16TP4	1
6J6	2		

INSTALLATION AND OPERATING INSTRUCTIONS

FRONT PANEL CONTROLS

The front panel operating controls consist of the TUNING control, the OFF-VOLUME control, and the CONTRAST control. With the AGC system used for maintaining constant signal level, the contrast control becomes primarily useful in setting background level for best viewing under various room lighting levels or different average program contrast levels.

BEAM BENDER ADJUSTMENTS

The single magnet type beam bender is used with either the 14 inch or 16 inch tube. The rated flux density is 60 gauss, which is higher than previously used magnets. There is no indication to show a forward or back direction for the installation of the magnet on the tube neck. The direction of installation is immaterial, except that if the magnet is turned over, it must be rotated 180° on the neck of the tube.

The method of installation is to slip the beam bender on the neck of the tube and move it forward toward the tube face until it approaches a space over the "flags" of the first anode. Set the brightness control about midway of its range, never full on, to avoid damaging the tube's electron gun prior to proper adjustment of the beam bender. Rotate the magnet 180° or more on the tube neck until light appears on the screen. After initial light has been obtained, move the beam bender forward or back, and further rotate it to obtain the brightest raster. With the strong, 60 gauss magnet, there are two positions which will give screen illumination. One occurs near the tube base as the magnet approaches a position over the "flags" and the second occurs as the magnet is pushed beyond the "flags" and near the focus coil. The first position is preferred because it allows greater space for adjustment range. The strong magnet also allows a wider adjustment range and the setting will affect the centering and focus. A last check should be made on beam bender adjustment after focus and deflection adjustments have been made.

BRIGHTNESS CONTROL

The brightness control provides adjustment of control grid bias voltage. Automatic retrace elimination circuits are incorporated, so that retrace lines are visible only at maximum setting of the brightness control. Proper setting of the brightness is such that light is just visible on the screen when the contrast control is set at minimum with a signal tuned in.

HORIZONTAL CONTROLS

The HORIZONTAL HOLD and HORIZONTAL DRIVE controls are interdependent and should be adjusted simultaneously. Tune in a test pattern and set the tuning so that sound and picture are both present. Set the HORIZONTAL DRIVE to the middle of its range. Turn the HORIZONTAL HOLD until the picture is properly in sync. Approach from either clockwise or counter-clockwise direction is permissible. There will be a range of 2 or 3 turns of the L108 tuning slug which will hold the picture in sync. Adjust to approximately the center of this range. From these preliminary adjustments, final adjustments can be made, if required. One, or several picture discrepancies may appear which can be corrected by slight readjustment of the Drive control and retrimming of the Hold control. These symptoms are:

(1) a vertical white line or band through the center of the picture;

(2) thin vertical black lines on either left or right side of picture;

(3) vertical wedges of test pattern or vertical lines of picture are crooked or bent over at the top of the picture;

(4) sync at edge of range, evidenced by failure of picture to immediately come into sync horizontally when the tuner is turned away from and back on channel;

(5) horizontal non-linearity of test pattern.

All of these discrepancies can be corrected by simultaneous readjustment of the Drive and Hold controls.

The HORIZONTAL SIZE, or width control, L109, provides a wide range of linear width adjustment. Clockwise rotation (slug moving into coil) increases the width of the picture.

FOCUS CONTROL AND RASTER CENTERING ADJUSTMENTS

Electromagnetic focusing is used, with the focus coil being used as a choke in the B+ supply circuit. The Focus control, R195, shunts the focus coil. Adjust the Focus control until clear, well-defined horizontal sweep lines can be observed.

Vertical and Horizontal Centering controls are mechanical type which operate by positioning the focus coil. The vertical centering is operated by a spring-loaded screw on the right of the focus coil, and horizontal centering is operated by a similar screw on the left. If difficulty is encountered in focusing or centering, or neck shadows appear, a reversal of the leads to the focus coil will often remedy the situation.

VERTICAL CONTROLS

The VERTICAL HOLD control has a "hold-in" range of adjustment over which the picture will stay in sync. The control should be set in about the middle of the "hold-in" range.

The VERTICAL SIZE and VERTICAL LINEARITY operate together to aujust the vertical height and proportion of the picture. The Size control affects the vertical size of the entire picture, but not in a linear manner. The bottom portion of the picture is expanded and the picture center tends to move toward the top of the tube. The linearity control operates to expand the upper portions of the picture, and compensate for non-linearity created by the Size control.

ALIGNMENT

This alignment procedure describes alignment of the double-tuned IF system and intercarrier sound circuits only; the procedure for the RF tuning unit is described in separate bulletins on the tuning units. The general order of alignment should be as follows:

Sound Takeoff Coil
Sound IF and Ratio Detector Primary
Ratio Detector Secondary
4.5 MC Video Trap
Adjacent Channel IF Traps
Picture IF Transformers
Converter Output Coils

The detailed alignment procedure deals with methods used and precautions to be observed during alignment. For actual alignment, it is suggested that the alignment table be followed after reading the detailed procedure.

SOUND IF ALIGNMENT

Equipment Setup

Set the sweep generator at 4.5 mc center frequency with approximately 400 kc sweep width. Insert a marker signal of exactly 4.5 mc.

Connect the signal to the short wire leading to the grid, pin 1,of V108. This is shown as point "C" on the schematic diagram. Use shielded lead from the sweep generator, and connect a 50 ohm, composition resistor from point C to ground. This resistor is not required if the generator has a low impedance output.

Unsolder one end of C113.

Connect the scope from pin 2 of the 6T8 to ground. Use a 10 K ohm, isolating resistor between pin 2 and the scope lead, and use shielded lead for making the scope connection.

Procedure

Adjust L100, T101 primary (bottom), T101 secondary (top), and T102 primary (bottom) to obtain a flat-topped, symmetrical band pass with the 4.5 mc marker in the center of an approximately 75 kc bandwidth. See Figure 3. It is essential that the slugs be moved from the outer ends of the coil form toward the center, by turning the slugs clockwise. If the slug has been run past the center, so that resonance is reached with the slug coming out of the coil, then the slug must be backed out, counter-clockwise, completely through the coil and the tuning procedure started over again. If the slugs are run into the center of the double-tuned coils, the mutual coupling will be adversely affected and proper alignment will be impossible. This applies to all double-tuned transformers.

RATIO DETECTOR ALIGNMENT

Equipment Setup

The sweep and marker generators remain connected as above.

Reconnect C113.

Connect the scope, with isolating resistor, to the junction of R105, R106.

Procedure

Adjust the secondary (top) of T102 for an "S" curve which is symmetrical, and has the 4.5 mc marker in the center of the linear or straight line portion of the curve. Inasmuch as the center of the "S" curve is a zero or null point, very little 4.5 mc marker will come through. However, the marker does produce a series of irregular traces which appear on opposite sides of the linear portion of the curve. These traces may be evenly distributed about the center for proper adjustment of T102 secondary.

ALTERNATE SOUND ALIGNMENT

If no 4.5 mc sweep generator is available, the sound may be peak aligned using an unmodulated 4.5 mc source and a 20,000 ohm/volt DC meter. Connect the generator to pin 1, V108 as with the sweep generator. Leaving C113 in the circuit, connect the DC meter across R107. Tune all 4.5 mc sound coils as above to produce a peak reading on the meter.

Adjustment of the ratio detector secondary may be accomplished by connecting one terminal of the DC meter to the junction of R105, R106, and the other terminal to the junction of two 10 K ohm resistors connected in series and soldered in the circuit across R107. Adjust T102 secondary (top) until a zero or null is produced.

If no equipment is available, the sound may be aligned on a station signal without the use of a signal generator or scope. Tune in a station normally, and while listening to the sound output from the speaker, tune L100, T101 primary (bottom), T101 secondary (top) and T102 primary (bottom) to obtain maximum sound output. Tune T102 secondary (top) for maximum output, best quality, and minimum buzz. It may be necessary to go through the series twice to obtain the best performance.

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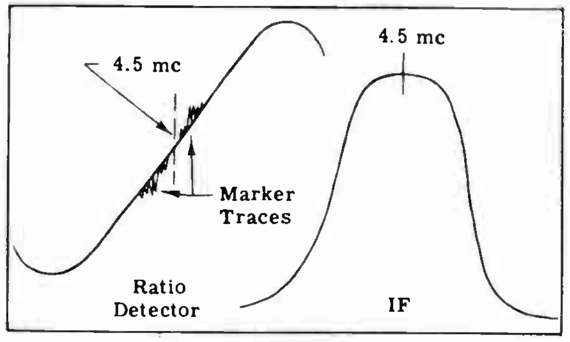

Figure 3. Sound Alignment Curves

TUNING 4.5 MC VIDEO TRAP

Equipment Setup

Connect an unmodulated 4.5 mc signal to pin 1, V108. Connections are the same as for sound alignment. Use a detector and isolating network as shown in Figure 4, connected to the output side of video peaking coil, L105. The 2.5 V scale of a volt-ohmmeter or a 50 microamp meter with a limiting resistor in series may be used for the indicator.

Procedure

Adjust the slug of L106 for minimum reading on the meter. Increase the input signal to produce greater output as the trap is tuned.

Alternate Procedure

If the service man is familiar with the appearance of 4.5 mc beat pattern as produced on the picture tube, then adjustment may be made without external signal generator or meters.

Tune in any channel, and then mis-tune to a point that would be equivalent to placing the sound IF carrier "up" on the IF response curve. This will produce and be indicated by a maximum 4.5 mc beat pattern in the picture. Tune L106 for minimum beat note. This will minimize the beat pattern when the station is properly tuned.

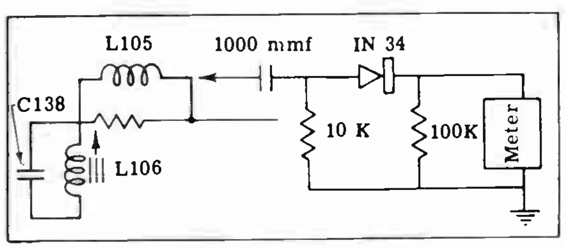

Figure 4. 4.5 MC Beat Pattern Detector Circuit

TUNING ADJACENT CHANNEL TRAPS

Equipment Setup

Connect a voltmeter to the short wire between the output of the picture 2nd detector circuits and pin 1 of V108. This is shown as point "C" on the schematic. Set meter to 10 V DC scale. The scale may be reduced later.

Connect a signal generator, through an isolation network, to the grid, pin 1, of V107. The isolation network is shown in Figure 5.

Use composition resistors and a disc type, ceramic condenser.

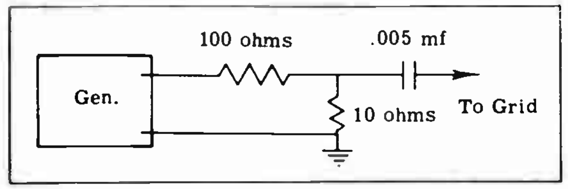

Figure 5. Input Isolation Network

Procedure

Apply an unmodulated, 28.1 mc signal to the grid of V107. Use sufficient output from the generator to produce an appreciable reading on the DC meter. Tune L103 to produce a minimum on the meter. This dip may be only a small change of reading if the IF amplifiers are misaligned, but will be located properly regardless of amplitude. It may be necessary to decrease the meter scale and increase signal as L103 is tuned.

Move the signal generator and isolation network to the grid, pin 1, of V106. Set the unmodulated signal to 28.5 mc. The tuning procedure for L102 is the same as described for L103.

PICTURE IF ALIGNMENT

The picture IF alignment procedure is a process of separately adjusting a series of double-tuned, over-coupled stages. Adjustment of each stage is complete in itself and provides a band pass of about 3 mc for each stage. The cascading of three amplifiers and the equivalent of four double-tuned transformers produces a high gain broad band amplifier. The band pass waveform is the conventional, double-humped characteristic of the over-coupled circuit.

Equipment Setup

Connect a scope between point "C" and ground through a 10 K series resistor as shown in Figure 6. The scope should have a sensitivity of .1 volt RMS/inch or better.

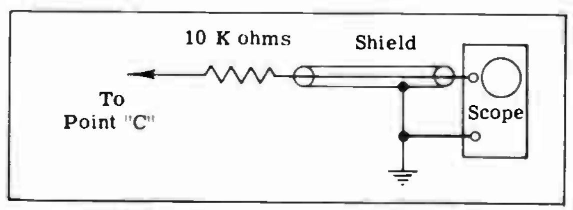

Figure 6. Scope Connection Network

Connect the negative terminal of a 3 V battery to the junction of R124 and C127, and connect the positive terminal to ground. This provides bias in place of the AGC voltage for alignment procedure.

For first stage alignment, connect the sweep generator through the network shown in Figure 5 to pin 1 of V107. For successive stages, move the generator and network to each grid in succession.

Procedure

Set the sweep generator to a center frequency of about 24 mc with 10 mc sweep.

Insert a marker signal set to 24.3 mc.

For alignment of the 3rd picture IF, adjust the primary (bottom) and secondary (top) of T106 to obtain a pass band whose flat top is symmetrical about the marker. Skirt positions and slopes will not be symmetrical. See Figure 7. Correct alignment of the overcoupled, double-tuned stages is indicated by a curve having a nearly flat top with equal amplitude peaks. The bandwidth of each stage is predetermined by design of the transformers and is not controlled by alignment. A dip may be noticed as indicated by a dotted line in Figure 7. This condition may be eliminated by shorting the primary of the transformer in the plate circuit of the stage preceding the stage under alignment. The sweep generator is connected to the secondary of the transformer whose primary will be shorted.

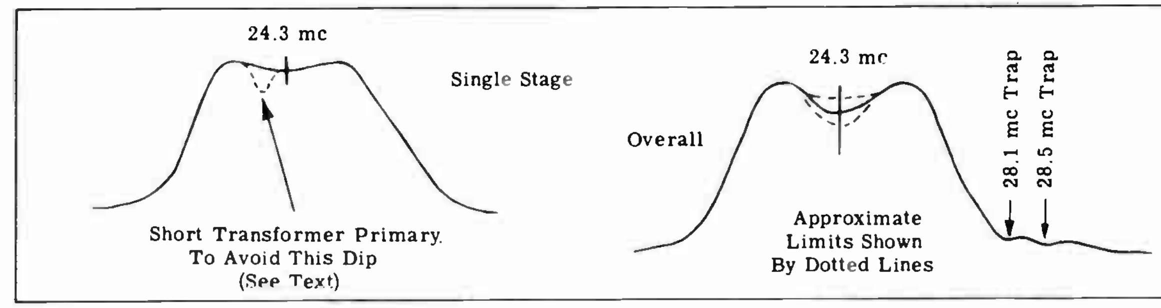

Figure 7. I.F. Alignment Wave Forms

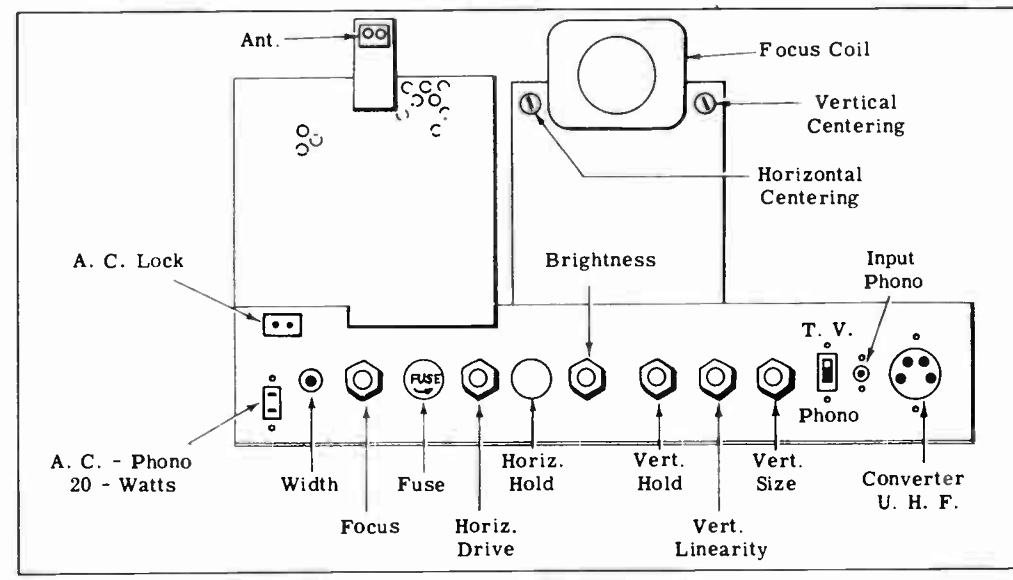

Figure 8. Rear Chassis Controls

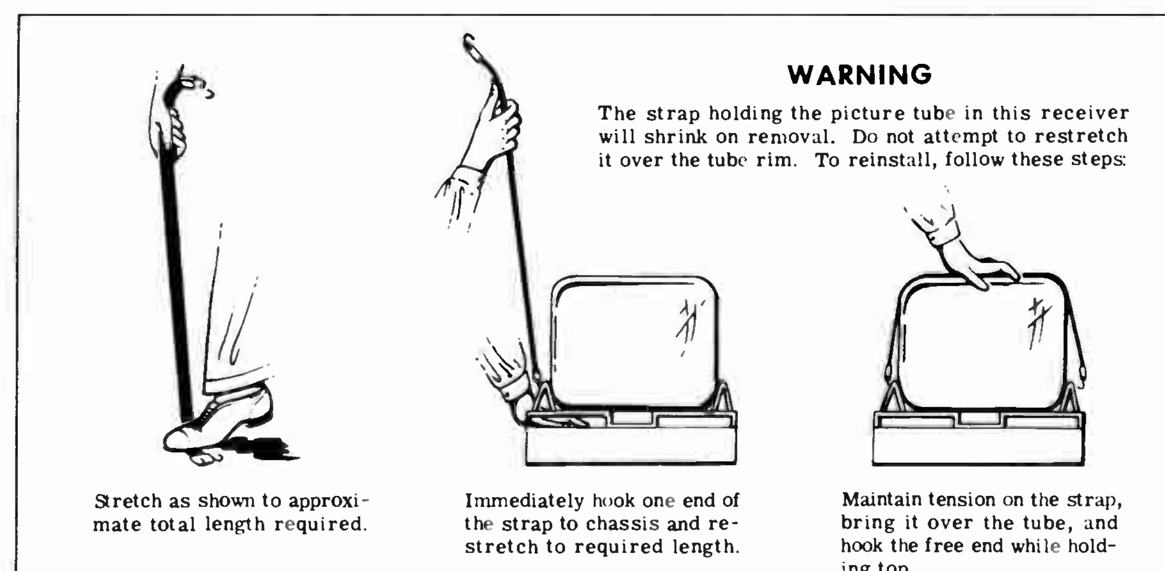

Figure 9. Strap Installation

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Move sweep generator and isolation network to pin 1 of V106, 2nd picture IF. Alignment of T105 is accomplished by tuning the primary and secondary to give a symmetrically topped curve as previously described. It is imperative that T105 only be adjusted. The previously aligned T106 must not be touched because a false alignment can be obtained even though the overall response may appear satisfactory. If the transformer primary was shorted for previous alignment, the short must be removed prior to alignment of this stage.

Move the sweep generator and isolation network to pin 1 of V105, 1st picture IF. Align T104 as was done in previous stages. Do not readjust T105 or T106. See Figure 7 for approximate shape of the overall band pass.

It can be noted that the center dip is greater, and the total band pass is slightly less than that of a single stage. Note also the position of the dips caused by the 28.1 and 28.5 mc traps.

Connect the signal generator and isolation network to the converter grid in the RF tuning unit. The converter output coil and the picture IF peaking coil, L101, form an over-coupled circuit comparable to the IF transformers. Using the converter output coil as the primary, and L101 as the secondary, align the IF input circuit to produce an overall response curve as shown in Figure 7. Again, it is emphasized that previously aligned stages must not be touched.

ALIGNMENT TABLE

This alignment table is for quick reference during alignment. Detailed instructions beginning on page 4. should be studied before alignment by use of the table is attempted.

Step No.	Connect Signal To	Sweep Gen. Freq.	Marker Gen. Freq.	Output Indicator	Adjust	Instructions
1	Point "C"	4.5 mc 400 kc sweep	4.5 mc	Scope to Pin 2 of 6T8	L100 T101 Pri, Sec T102 Pri	Disconnect C113. See Fig. 3 for waveform.
2	"	"	"	Scope to junction R105, R106	T102 Sec	Reconnect C113. Adjust for "S" curve.
3	"	None	"	Detector Network and Meter to L105	L106	Adjust for minimum reading on meter.
4	Pin 1 V107	None	28.1 mc	Meter to Pin 1 of V108	L103	Use isolation net on input. Adjust for dip on meter.
5	Pin 1 V106	None	28.5 mc	"	L102	Adjust for dip on meter.
6	Pin 1 V107	24.3 mc 10 mc sweep	24.3 mc	Scope to point "C"	T106 Pri, Sec	Adjust for symmetrical waveform. See Fig. 7.
7	Pin 1 V106	"	"	"	T105 Pri, Sec	"
8	Pin 1 V105	"	"	"	T104 Pri, Sec	"
9	Converter Grid	"	"	"	Converter Output and L101	"

Use −3 V battery connected to AGC line for alignment bias.
See text for isolation networks.

TOP VIEW PARTS LAYOUT
CHASSIS 160

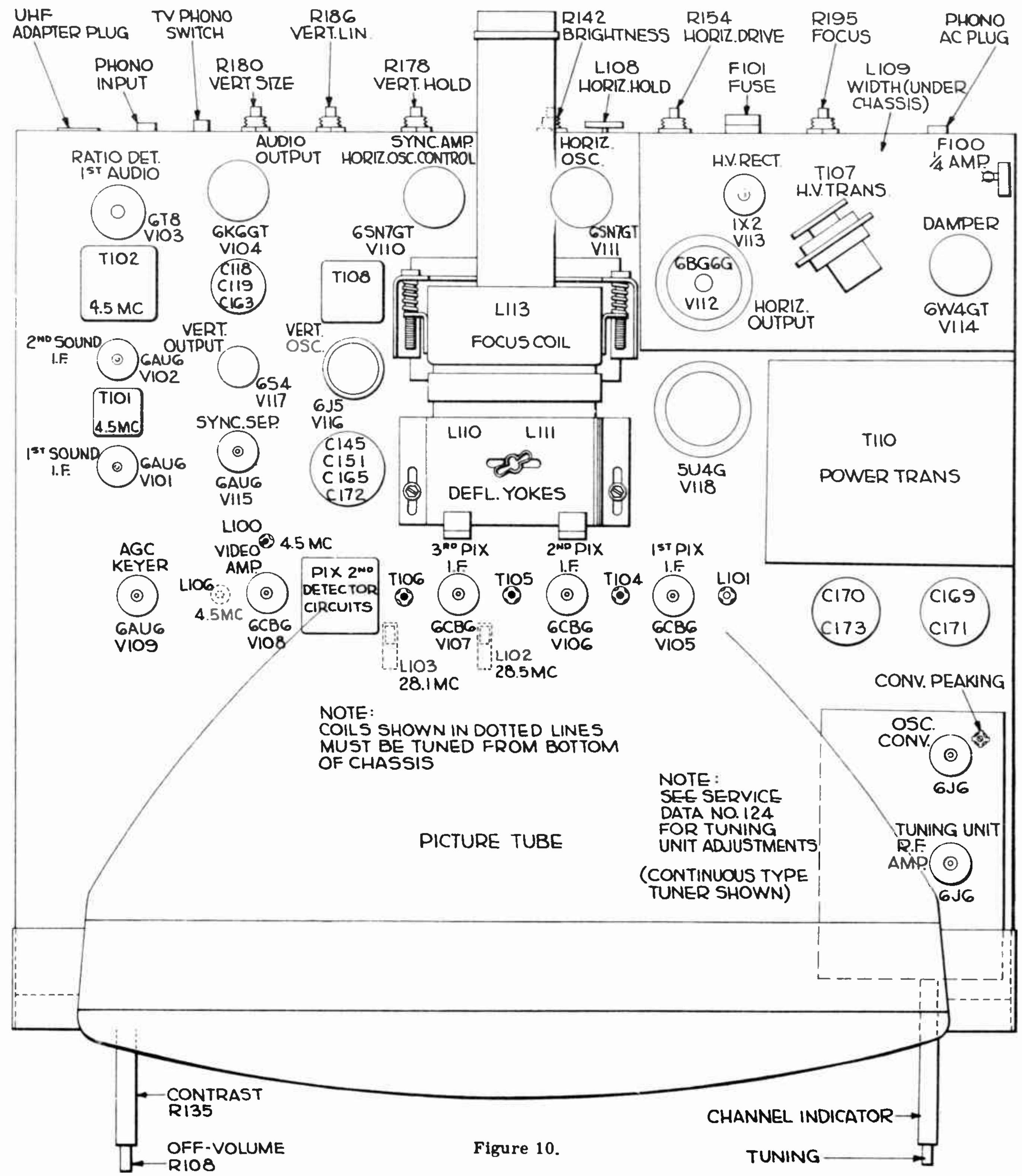

Figure 10.

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PARTS LIST

SYMBOL	VALUE	TOL.	WATTS OR VOLTS	TYPE	PART NO.
C100	22 mmf	10%		GA4	4069
C101	.005	GMV		Ceramic	4029
C102	.005	GMV		Ceramic	4029
C103	Part of T101				
C104	Part of T101				
C105	.005	GMV		Ceramic	4029
C106	.005	GMV		Ceramic	4029
C107	.005	GMV		Ceramic	4029
C108	Part of T102				
C109	.0047	20%	400V	Paper	4127
C110	Part of T102				
C111	180 mmf	20%		Ceramic	4070
C112	.005	GMV		Ceramic	4029
C113	5		50V	Electrolytic	4209
C114	.0005	20%		Ceramic	4017
C115	47 mmf	20%		Ceramic	4009
C116	.01	20%	600V	Paper	4105
C117	.0047	20%	600V	Paper	4128
C118	20		25V	Electrolytic	} 4230
C119	20		475V	Electrolytic	
C120	.005			Ceramic	4029
C121	.005			Ceramic	4029
C122	.005			Ceramic	4029
C123	.005			Ceramic	4029
C124	2 x .004			Ceramic	4036
C125	1.0 mmf	10%	500V	GA2	4063
C126	.005			Ceramic	4029
C127	.22	20%	200V	Paper	4131
C128	.005			Ceramic	4029
C129	1.2 mmf	10%	500V	GA	4074
C130	2 x .004			Ceramic	4036
C131	10 mmf	Part of L102			
C132	1.0 mmf	10%	500 V	GA2	4063
C133	2 x .004		500V	Ceramic	4036
C134	.005		500V	Ceramic	4029
C135	2.2 mmf	10%	500V	GA4	4069
C136	10 mmf	Part of L103			
C137	5 mmf	20%	500V	Ceramic	4064
C138	Part of L106 4.5 mc trap				
C139	.005		500V	Ceramic	4029
C140	330 mmf	10%	500V	Mica	4010
C141	.0047	10%	1000V	Paper	4140
C142	.0047	20%	400V	Paper	4127
C143	.0047	20%	400V	Paper	4127
C144	.1	20%	200V	Paper	4143
C145	10		475V	Electrolytic	Part of 4228
C146	.0039	10%		Mica	4037
C147	270 mmf	10%		Mica	4022
C148	.0047	20%	600V	Paper	4128
C149	220 mmf	20%	500V	Ceramic	4026
C150	220 mmf	20%	500V	Ceramic	4026
C151	5		50V	Electrolytic	Part of 4228
C152	.047	20%	600V	Paper	4133
C153	.25	20%	600V	Paper	4129
C154	47 mmf	10%	1500V	Mica	4067
C155	.001	20%	600V	Paper	4146

BOTTOM VIEW PARTS LAYOUT
CHASSIS 160

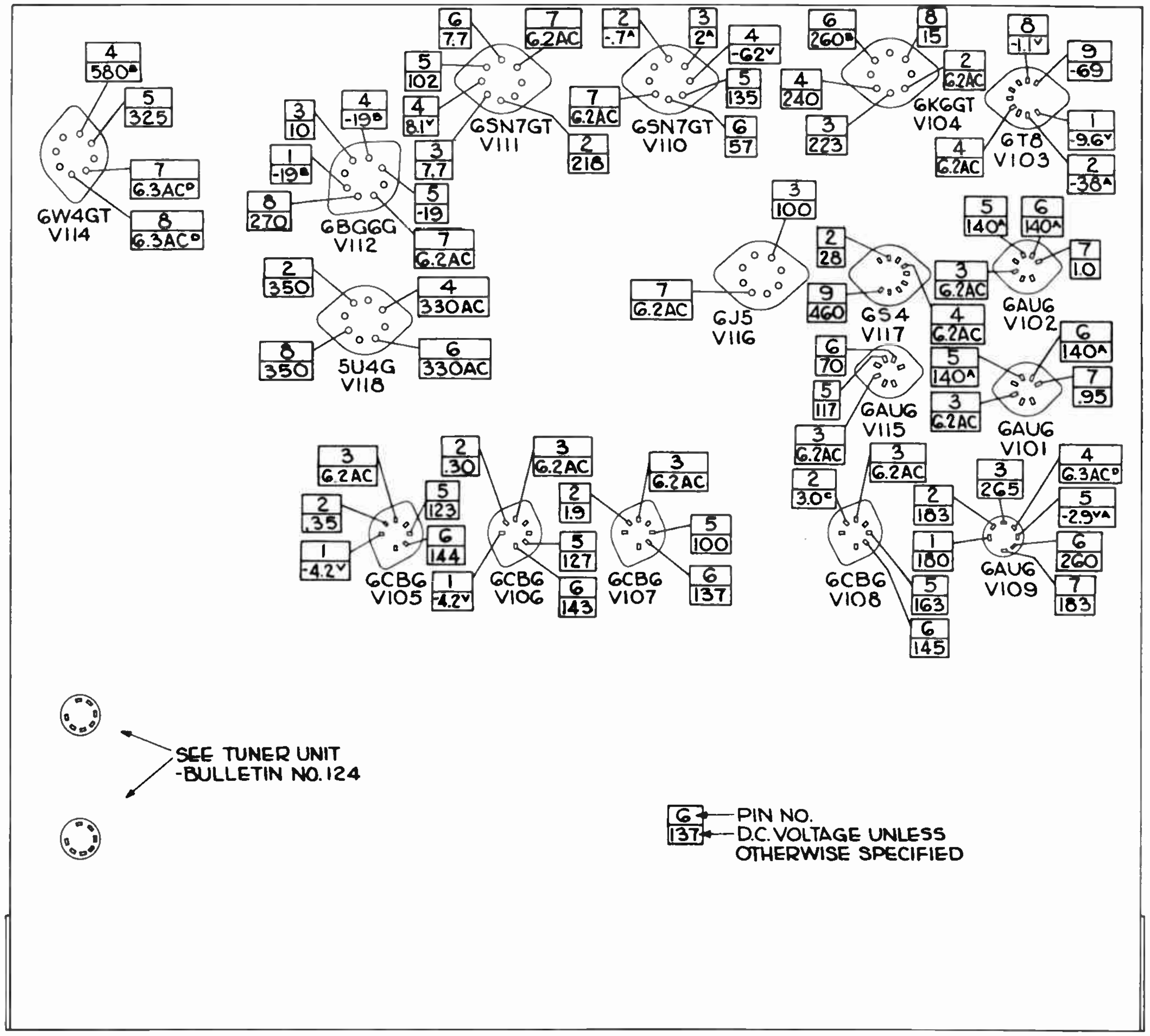

Figure 11. Voltage Chart

All voltages measured with set receiving picture and sound adjusted for normal operation, medium signal, medium volume and contrast level.

Line Voltage	=	115V AC	A - Varies with signal level.
265V Buss	=	260V DC	B - Pin used as tie point only.
180V Buss	=	180V DC	C - Contrast set at minimum.
140V Buss	=	145V DC	D - Measured to other heater pin.
			V - Measured with V.T.V.M.

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MODELS 630, 631, Ch. 159; 632, 633, Ch. 160

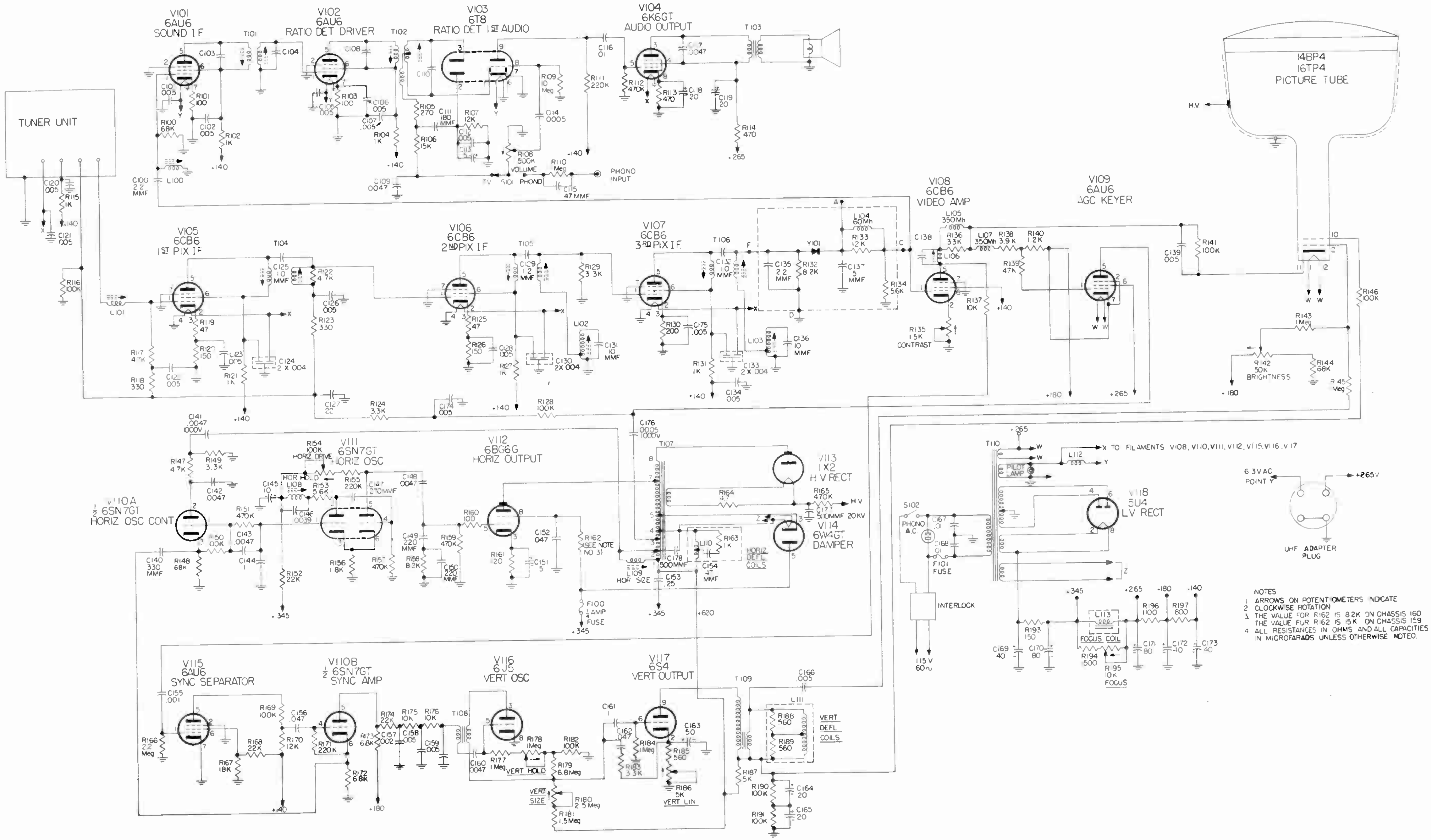

Figure 12. Schematic Diagram

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PARTS LIST

SYMBOL	VALUE	TOL.	WATTS OR VOLTS	TYPE	PART NO.
C156	.047	20%	600V	Paper	4133
C157	.002	20% }		Ceramic	4068
C158	.005	20% }			
C159	.005	20% }			
C160	.0047	5%		Mica	4035
C161	.1	20%	600V	Paper	4144
C162	.047	10%	600V	Paper	4141
C163	50		50V	Electrolytic	Part of 4230
C164	20		450V	Electrolytic	4227
C165	20		450V	Electrolytic	Part of 4228
C166	.005			Ceramic	4069
C167	.01		600V	Paper	4105
C168	.01		600V	Paper	4105
C169	40		475V	Electrolytic	Part of 4229
C170	80		475V	Electrolytic	Part of 4229
C171	80		475V	Electrolytic	Part of 4229
C172	40		475	Electrolytic	Part of 4228
C173	40		475	Electrolytic	Part of 4229
C174	.005			Ceramic	4029
C175	.005			Ceramic	4029
C176	.0005		1000V	Mica	4075
C177	500 mmf		20KV	Mica	4056
C178	500 mmf	20%	1500V		4076
R100	68K	20%	1/2 W	All resistors are composition type unless otherwise noted.	4661
R101	100	10%	1/2 W		4566
R102	1K	20%	1/2 W		4542
R103	100	10%	1/2 W		4566
R104	1K	20%	1/2 W		4542
R105	270	10%	1/2 W		4663
R106	15K	20%	1/2 W		4521
R107	12K	5%	1/2 W		4656
R108	500K	"Volume"		Dual Variable	Part of 4833
R109	10 Meg.	20%	1/2 W		4505
R110	1 Meg.	20%	1/2 W		4513
R111	220K	10%	1/2 W		4618
R112	470K	20%	1/2 W		4506
R113	470	10%	1 W		4531
R114	470	10%	1 W		4531
R115	1K	20%	1/2 W		4542
R116	100K	20%	1/2 W		4511
R117	(4.7K	5%	1/2 W	For continuous tuner	4649
	(6.8K	10%	1/2 W	For turret tuner	4557
R118	330	20%	1/2 W		4509
R119	47	10%	1/2 W		4639
R120	150	10%	1/2 W		4614
R121	1K	20%	1/2 W		4542
R122	4.7K	5%	1/2 W		4649
R123	330	20%	1/2 W		4509
R124	3.3K	10%	1/2 W		4607
R125	47	10%	1/2 W		4639
R126	150	10%	1/2 W		4616
R127	1K	20%	1/2 W		4542
R128	100K	20%	1/2 W		4511
R129	3.3K	5%	1/2 W		4648
R130	200	10%	1/2 W		4642
R131	1K	20%	1/2 W		4542
R132	8.2K	5%	1/2 W		4641
R133	12K	20%	1/2 W		Part of L104
R134	5.6K	5%	1/2 W		4603
R135	1.5K	"Contrast"		Dual Variable	Part of 4833
R136	33K	20%			Part of L105
R137	10K	20%	1/2 W		4515
R138	3.9K	5%	1/2 W		4654
R139	47K	20%	1/2 W		4504
R140	1.2K	10%	1/2 W		4553
R141	100K	20%	1/2 W		4511
R142	50K	"Brightness"		Variable	4831
R143	1 Meg.	20%	1/2 W		4513
R144	68K	20%	1/2 W		4661
R145	1 Meg.	20%	1/2 W		4513
R146	100K	20%	1/2 W		4511

SYMBOL	VALUE	TOL.	WATTS OR VOLTS	TYPE	PART NO.
R147	4.7K	20%	1/2 W		4543
R148	68K	20%	1/2 W		4661
R149	3.3K	10%	1/2 W		4607
R150	100K	10%	1/2 W		4571
R151	470K	20%	1/2 W		4506
R152	22K	10%	1/2 W		4628
R153	5.6K	10%	1/2 W		4629
R154	100K	Horiz. Drive		Variable	4835
R155	220K	10%	1/2 W		4618
R156	1.8K	10%	1/2 W		4640
R157	470K	20%	1/2 W		4506
R158	8.2K	10%	1/2 W		4651
R159	470K	20%	1/2 W		4506
R160	100	10%	1/2 W		4566
R161	120	10%	2 W		4657
R162	(8.2K	10%	1 W	Used in Chassis 160	4658
	(15K	20%	2 W	Used in Chassis 159	4665
R163	1K	10%	1/2 W		4659
R164	4.7 ohms	10%	1/2 W	Wire Wound	4719
R165	470K	20%	1/2 W		4506
R166	2.2 meg.	20%	1/2 W		4502
R167	18K	10%	1/2 W		4662
R168	22K	10%	1/2 W		4628
R169	100K	20%	1/2 W		4511
R170	12K	20%	1/2 W		4660
R171	220K	10%	1/2 W		4618
R172	6.8K	10%	1/2 W		4557
R173	6.8K	10%	1/2 W		4557
R174	22K	10%	1/2 W		4628
R175	10K	20%	1/2 W		4515
R176	10K	20%	1/2 W		4515
R177	1 meg.	10%			4614
R178	1 meg.	"Vertical Hold"		Variable	4832
R179	6.8 meg.	10%	1/2 W		4604
R180	2.5 meg.	"Vertical Size"			4821
R181	1.5 meg.	10%	1/2 W		4605
R182	100K	10%	1/2 W		4571
R183	3.3K	10%	1/2 W		4607
R184	1 meg.	20%	1/2 W		4513
R185	560	10%	1/2 W		4507
R186	5K	"Vertical Lin."		Variable	4820
R187	5K	10%	3W	Wire Wound	4724
R188	560	10%	1/2 W		4507
R189	560	10%	1/2 W		4507
R190	100K	20%	1/2 W		4511
R191	100K	20%	1/2 W		4511
R193	150	10%	10 W	Wire Wound	4730
R194	1500	10%	4 W	Wire Wound	4732
R195	10K	Focus		Variable	4834
R196	1100	10%	10 Watts	Tapped }	4731
R197	800	10%	Total	Wire Wound }	

SYMBOL	DESCRIPTION	PART NO.
L100	4.5 mc Sound IF Peaking	5332
L101	Picture IF Peaking	5334
L102	28.5 mc Trap	5344
L103	28.1 mc Trap	5342
L104	60 μh Video Peaking	5338
L105	350 μh Video Peaking (Series)	5339
L106	4.5 mc Trap	5376
L107	350 μh Video Peaking (Shunt)	5340
L108	Horizontal Hold	5300
L109	Horizontal Size (width)	5317
L110	Horizontal Defl. Coil }	5324
L111	Vertical Defl. Coils }	
L112	Filament Choke	5133
L113	Focus Coil	5341
T101	4.5 mc Sound IF	5331
T102	Ratio Detector Transformer	5330
T103	Audio Output Transformer	5131

T104	1st Picture IF	5335
T105	2nd Picture IF	5335
T106	3rd Picture IF	5336
T107	Horizontal Output Transformer	5144
T108	Vertical Output Transformer	5127
T109	Vertical Output Transformer	5140
T110	Power Transformer	5023
F100	1/4 Amp Fuse, High Voltage	9515
F101	Fuse, Line, 3 Amp Slo-Blo Type 3AG	9648
S101	TV or Phono Switch	6007
S102	A. C. Line Power Switch	Part of 4833
Y101	Type IN60 or Equivalent Crystal Detector	9075
	Strap, Tube Hold Down.	
	Chassis 159	9668
	Chassis 160	9663
	Pilot Lamp Type 51	
	TV Tuning Unit	
	Turret Type	9677
	Continuous Type	99532
	Beam Bender (Single Magnet) 60 gauss	9669
	Phono Input Receptacle	6121
	UHF Adapter Receptacle	6114
	Loud Speaker, 6" x 12", P. M., 3.2 ohm Voice Coil	9074
	Phono AC Power Plug	6139

SAFETY FACTOR CHANGE FOR PICTURE TUBE USED IN CHASSIS 159 AND 160

Field reports indicate that a number of Chassis 159 and Chassis 160 receivers are experiencing intermittent picture tube trouble as evidenced by loss of raster. This trouble occurs in receivers that use a picture tube that has an abnormally low heater to cathode breakdown potential characteristic. In order to provide a greater safety factor in the receiver the CR tube heater D.C. potential should be lowered from the 265 volts originally used to 180 volts. The figure indicates the necessary change in wiring.

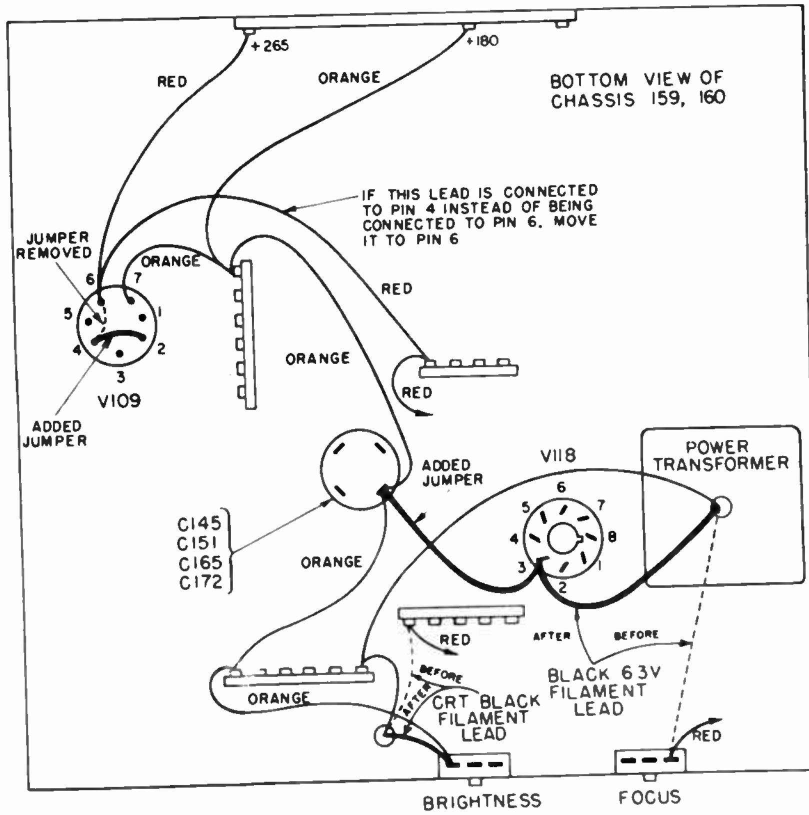

Figure 1. CR Tube Safety Factor Wiring Change

Dotted lines indicate wiring before change is made. Heavy black lines indicate wiring that is changed or added.

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REGENERATION IN I.F. AMPLIFIERS

SYMPTOMS: Regeneration in the I.F. amplifiers, particularly at low signal level where little AGC bias is developed, may result from feedback through the B+ lines on sets produced prior to Serial No. D035142. Two effects may be produced, one when a station is tuned in and another on unused channels when no signal is present.

The effect on a picture is production of a vertical, 1/8 to 1/4 inch wide band, spaced about 1/4 inch from the left edge of the raster. The band contains variable width diagonal stripes, alternate dark and light, which produce a "barber pole" effect.

The effect when no signal is present, is known as "Christmas tree". The white raster, with brightness turned up, will appear with several variable width sections, giving it an appearance of a Christmas tree. In severe cases, the raster disintegrates into "layers" of bright horizontal lines filling approximately the center 50% of the raster area. The lines are accompanied by a loud singing of the horizontal output transformer. This latter effect disappears when a station is tuned in.

The Christmas tree condition is associated with horizontal sync and is covered further in Service Bulletin No. 132.

REMEDY: The following changes can be made in the wiring layout of chassis 159 and 160 to aid in reducing regeneration. Schematically, no changes have been made in the circuit.

1. Remove the co-ax lead running from the Tuning Unit video output to coil L101.

2. Replace connection with wire, dressing wire against chassis.

3. Remove two red +265 V wires (in some sets these wires are orange) from the 80 mf, 475 V, electrolytic condenser (shown as present C171 on schematic).

4. Remove orange +345 V wire from the 80 mf, 475 V, electrolytic condenser (shown as present C170 on schematic). Remove one end of R193 (150 ohms) from same electrolytic.

5. Reconnect one +265 V red wire (from R195, focus control) to the electrolytic condenser formerly occupied by +345 V orange wire.

6. Reconnect orange +345 V wire to electrolytic formerly occupied by two red wires.

7. Reconnect free lead of R193 to new position of +345 V wire as in step 6 above.

The steps 3 through 7 are for the purpose of exchanging the physical locations of C170 and C171. Schematically, no changes have been made.

8. Disconnect one blue wire (going to R197 voltage divider) from the +140 V point at C173.

9. Reconnect blue wire to +140 V tie-point in sound I.F. strip (junction of R102, R104).

10. Reconnect red wire (+265 V lead from R196, previously disconnected in step 3) to junction of pins 4 and 6 at tube socket of V109, 6AU6, AGC keyer.

If heater leads of V109 are connected directly to the tube socket, the following change should be made.

11. Remove V109 heater wires (black, twisted leads from power transformer) from tube socket pins. Leave all other wires in place. Connect one wire to +265 V string at junction of R195, L113, on focus potentiometer. Connect other black wire to tie-point junction of brown wires running to heater of cathode-ray tube and heater of V109.

These changes have been made on all sets produced after Serial No. D035142.

On early production receivers, prior to Serial No. C023200, one additional change is required. A white wire, carrying AGC voltage, runs along the front of the I.F. strip, between the adjacent channel traps, L102, L103, and the I.F. amplifier tubes. This wire should be rerouted so that it lies outside the I.F. strip, and against the main chassis, under the lip of the I.F. strip subchassis.

An easy way to make the wiring changes is to obtain a recent production chassis and follow the new wiring layout.

To realize full benefit from the wiring changes to reduce regeneration, the chassis should be realigned after completion of the rewiring.

The metal bottom plate for the chassis may provide an additional feedback path in some cases, particularly in fringe areas where the signal is low and little AGC bias is developed. This condition will be characterized and aggravated by the 3rd I.F. stage being "hot" or regenerative. To alleviate this situation, a non-metallic bottom plate has been developed and is available on order from the Hoffman distributor under Part No. 3735.

ADJACENT CHANNEL TRAP ADJUSTMENTS

The adjacent channel traps, L102 and L103, may require adjustment to a different set of frequencies to give optimum operation in some locations. Alignment data in Service Data No. 125 shows 28.1 mc for L103 and 28.5 mc for L102. Factory production is aligning to 27.6 mc for L103 and 28.1 mc for L102. The frequency 27.6 mc represents the adjacent channel carrier and more efficient trapping is obtained, particularly in fringe areas.

Setting the traps to the lower frequencies tends to steepen the side of the I.F. bandpass characteristic and may result in a sharper sound tuning characteristic.

In setting the adjacent channel traps, two positions of the iron slug will produce resonance. The trap will be most effective if the slug is set in a position going into the electrical "bottom" of the coil. The electrical "bottom" is the grounded end of the winding. Physically, the "bottom" end is opposite from the end held in the chassis by the tinnerman nut. In practice, the slug may protrude out of the coil form by an amount of one or two threads. This slug position is most effective for either set of trap frequencies.

The trap settings materially affect the I.F. alignment, so it is suggested that no adjustments be made on the traps unless complete realignment can be completed.

ALTERNATE CRYSTAL TYPES

The crystal used as the picture second detector is shown as a Sylvania type 1N60 in Service Data No. 125. Several alternate types listed below may be used interchangeably for replacement.

Raytheon	CK703
	CK704
	CK705
Sylvania	1N34
G. E.	G5A

LETTERING SYSTEM ON SECOND DETECTOR COMPONENT CAN

The can in which the picture second detector crystal and components are housed has its bottom terminals identified by letters. On present production, the lettering on connections A and C is interchanged as compared to the lettering shown on the schematic diagram. If field replacement of the can is required, it is desirable to check the D.C. resistance to ground from each point before wiring the can in the circuit. The component connections and values are correct as shown on the schematic in Service Data No. 125.

HIGH VOLTAGE RECTIFIER FILAMENT

The chassis 159, with 14 inch picture tube, has a 4.7 ohm resistor in series with the 1X2, high voltage rectifier, filament. This resistor drops the filament operating temperature below the most desirable condition for long tube life. Reduce this resistor, R164, to 2.2 ohms, 10%, 1/2 watt, Part No. 4735.

The corresponding part in the 160 chassis should remain at 4.7 ohms. The reason for the difference between the two chassis is that the 14 inch tube requires less high voltage and horizontal sweep than the 16 inch tube. As a result, the 6BG6-G screen resistor, R162, is 15K ohms on chassis 159, which reduces the drive to the horizontal output transformer, T107, and in turn reduces the available 1X2 filament voltage.

NO CONTROL OF BRIGHTNESS

The failure of C166, .005 mf, Part No. 4069, causes the brightness control to have no effect. Shorting of C166 places a constant positive voltage on pin 2 of the picture tube, and the screen remains lighted at all times. Replacement of the condenser affords temporary correction, but the condenser may fail again due to voltage spikes in the vertical deflection circuit, temporary arcs in the picture tube, or shorting of R145 to ground. This condition can be permanently remedied by physically and schematically interchanging the positions of C166 and R145 (1 meg., 1/2 watt). The two components form a series circuit, so that the operation of the receiver is not affected. However, the 1 megohm R145 will protect C166 from voltage spikes. The two components should be interchanged whenever replacement of C166 is necessary. This change has been made on all sets produced after Serial No. D037401.

FOCUSING OF VARIOUS PICTURE TUBES

Rectangular picture tubes, 14" and 16", of various manufacturers require different focus coil field strengths. The present focus coil is suitable for use with all types, provided that circuit arrangements are made to give the proper amount of current flow through the focus coil.

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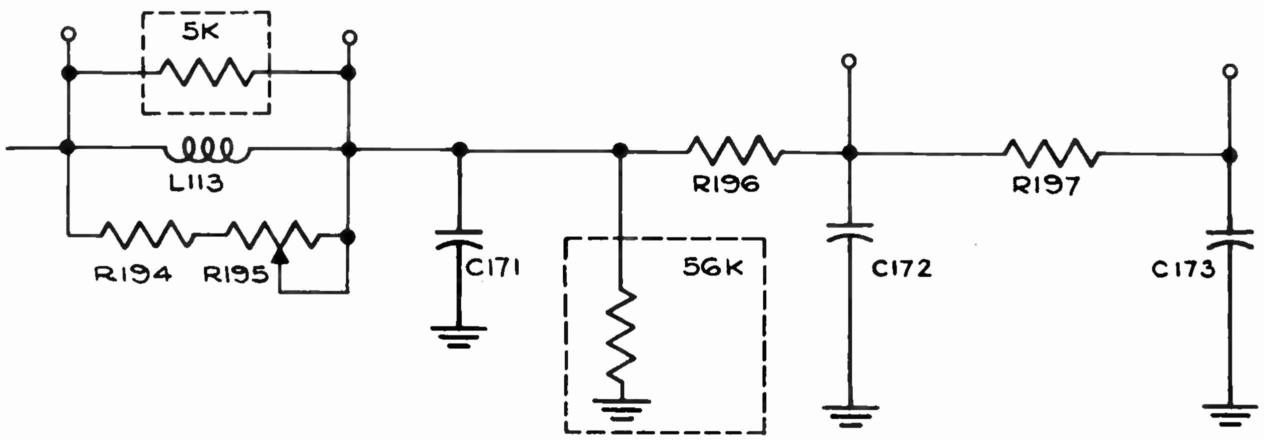
Hytron and G.E. tubes require less current and a 5K ohm, 5 watt resistor must be shunted across the focus coil, L113.

Sylvania tubes require more current, and a 56K ohm, 2 watt resistor should be shunted across C171 to increase the current through the focus coil. These changes are illustrated schematically below.



The appropriate circuit modification for the tube used is made in the factory. However, if a tube is changed in the field for any reason, circuit modifications may be necessary. These circuits apply in most cases. Occasionally a tube will require slightly different resistance values.

PICTURE TUBE COATING TO BE GROUNDED

On some picture tubes, the aqua-dag coating is not formed down far enough to contact the ground springs attached to the deflection yoke bracket. Most tubes are satisfactory. The Hoffman production department will paint extra coating on initial equipment tubes which require this treatment. However, the length of coating must be considered if tube replacement or change is made by the service man. The coating can be extended with a paint formed of graphite held in a lacquer vehicle suspension.

BUZZ IN SOUND

A buzz of basically 60 cycle frequency may appear on some stations and not on others in the same area. The buzz is different from a 60 cycle hum in that it is rough or raucous sounding. The cause of the buzz is in the transmitting station characteristics, and may result from excessive video amplitude modulation, or phase modulation of the video carrier in the final stages of the transmitter.

Three things may be done which will materially aid in eliminating buzz reception by the receiver.

1. Retrim the tuning of the ratio detector secondary. Tune the receiver to the station which gives the greatest buzz. Tune the top slug of T102 for minimum buzz. This slug may be reached from the top of the chassis. The results obtained by tuning the slug for minimum buzz while listening to an offending station will be better than those obtained when aligning to a 4.5 mc signal generator.

2. Change the value of R107, ratio detector load resistor, from 12K ohms to 6.8K ohms. This change affords a considerable improvement in the buzz rejection, and has been made on all sets produced after Serial No. E040192.

3. Increase the capacity of C109, from .0047 mf to .01 mf. A 200 V paper condenser is suitable for use. This change has been made on all sets produced after Serial No. C023200 and will aid the previously described changes in reducing buzz.

VERTICAL SIZE CONTROL RANGE

The vertical output is sufficient to more than fill the entire tube screen. In some cases, particularly on the 159 chassis, the vertical size control will not decrease the size of the picture sufficiently to have all of the picture appear on the tube. Increasing the value of R181 from 1.5 to 2.2 megohms will reduce the vertical output to within normal range of the vertical size control. In extreme cases it may be necessary to increase R181 to 3.3 megohms.

A convenient arrangement for changing to 2.2 megohms is to interchange the resistors, R181 and R166. This will result in values of 2.2 megohms for R181 and 1.5 megohms for R166. This change has been made on all sets produced after Serial No. E040192.

The horizontal synchronizing and sweep circuits are designed to be an integrated and controlled system, using a feedback circuit from the horizontal output to provide a comparison voltage for the horizontal oscillator control tube. Therefore, it is necessary when making any changes in the circuit, to consider an overall viewpoint and determine what effect the change will have on any other operating characteristic of the receiver.

The various conditions and changes will be discussed separately, but any interlocking effects will be pointed out.

HORIZONTAL SYNC INSTABILITY

Horizontal jitter, or sync instability is very often caused by noise upsetting the sync circuits, particularly in weak signal areas.

Several modifications of the original circuit, as shown in Service Data No. 125, have been made on different production runs of the chassis 159 and 160 to aid in stabilizing the horizontal sync.

The correct modified values are listed below, along with serial numbers indicating when the change was made. Sets produced after the listed serial number will have the modification included.

Symbol	Part	Serial No.
C144	.1 mf 20% 200 V paper	D034300
C144	Outside foil grounded (See below)	D034738
C179	47 mmf 20% 500 V ceramic or mica (In parallel with R166, pin 1 V115 to ground)	D033610
R148	68K ohms 20% 1/2 watt	C023576
C143	.01 mf 20% 200 V	D037401

Sync instability in sets with the proper constants, produced prior to Serial No. D034738, may be caused by the inversion of C144. This condenser is a molded phenolic, paper dielectric type. It is imperative that the outside foil be connected to ground. If this condenser is inverted, with the outside foil connected in the grid circuit, stray pulses will be picked up which cause severe instability. In construction of this condenser, one of the leads has a solder bump located just outside the phenolic case. This lead is connected to the outside foil and must be connected to ground. Careful control of the polarity of this condenser has been exercised in sets produced after Serial No. D034738. Leads should be kept short and the condenser mounted close to the chassis.

HORIZONTAL SYNC PULL-IN RANGE

When tuning from station to station, or when the receiver is first turned on, there may be a momentary delay before the picture will pull into horizontal sync. To increase the pull-in range and improve the pull-in characteristics of the receiver, a modification has been made on all receivers produced after Serial No. D037401. The changes are:

C143 changed from .0047 to .01 mf, 20%, 200 V, Part No. 4142

C141 changed from .0047 to .022 mf, 20%, 1000 V, Part No. 4135

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An additional result of changing C141 is that a different phasing relationship is obtained between the horizontal sweep voltage and the sync signals in the horizontal oscillator control tube. This causes the picture to start at a point further to the right and allows for easier centering without neck shadows. When this change is made, check the values of R147, R149, and C140 to make sure they are the correct values as shown on the schematic for chassis 159, 160.

The pull-in range is controlled by the setting of the horizontal hold control (L108). The pull-in range should be checked and the control adjusted according to the following sequence.

1. Set horizontal drive control (R154) at minimum resistance (full counterclockwise) or as close as possible. See instructions on setting drive under the section on "Christmas tree effect."

2. Turn hold control counterclockwise (slug coming out of coil) while turning channel selector on and off station until sync is lost.

3. Turn control clockwise (slug going in) and check the number of bars (picture segments) before pull-in. There should be a snap-in from at least one bar (60 cycles).

4. Continue turning control clockwise while turning channel selector until sync is lost as in step 2 above.

5. Turn control counterclockwise (slug coming out) and check number of bars before pull-in, as in step 3 above.

6. Turn slug an additional 1/4 turn counterclockwise if one-bar pull-in occurs, or approximately 1/2 turn if two-bar pull-in occurs. This setting provides best operating characteristics for sync pull-in and drift, and is approximately correct for the least amount of "hook."

The amplified AGC system used in this receiver is very positive in its action. When the receiver is first turned on and warming up, it may be possible for the AGC action to lock and hold the picture out of sync as well as in sync. In this case, all that is required is to turn the channel selector off and on station, momentarily releasing the AGC, and the picture will immediately lock into correct sync.

DRIFT

Coupled with pull-in range is long term frequency stability of the horizontal multivibrator, V111. Actually, the oscillator operates at a frequency of 15,750 cps at all times when in sync. However, as the natural, or uncontrolled frequency of the horizontal oscillator tends to drift due to component value changes as the parts heat up, more control voltage is required at the grid, pin 1, of V111. Eventually, if enough drift takes place, the available control voltage will be exceeded and the receiver will lose sync.

To aid in eliminating drift, the condenser C149, 250 mmf, Part No. 4086, must be a ceramic NPO (zero temperature coefficient). In sets produced prior to Serial No. E047496, C149 has been a GP type ceramic, with no rated temperature characteristic. In some instances, a 330 mmf condenser may be found as C149. The 330 mmf should be replaced with the proper 250 mmf NPO ceramic. The capacity 250 mmf is critical, and no other value should be used. If a ceramic NPO condenser is not available, a silver mica type with a low temperature characteristic is suitable.

The change of C149 will eliminate most drift problems. However, further stabilization may be obtained by changing C146, .0039 mf, from its present ordinary mica type to a silver mica type with low temperature characteristic.

CHRISTMAS TREE EFFECT (Improper Horizontal Multivibrator Operation)

The Christmas tree effect, with symptoms as described in Service Bulletin No. 128, will appear on unused channels, when no signal is present, such as when switching from channel to channel. In addition to evidences on the picture tube, the effect is characterized by loud frying or singing sound from the horizontal output transformer. Although this singing causes no apparent harm, it is annoying and sounds destructive.

The primary cause of Christmas tree effect is regeneration, and this should be eliminated on sets requiring wiring changes

A second cause is excessive resistance in the horizontal drive circuit. Set the drive control, R154, at minimum resistance (maximum counterclockwise rotation). This position can be used when setting up the horizontal controls unless a vertical white bar appears in the center of the picture. In this case, the control can be set to eliminate the white bar. In some receivers, the potentiometer may be 250K ohms instead of the rated 100K. Replace these 250K controls or shunt them with a fixed 220K ohm to bring the total resistance to the proper value.

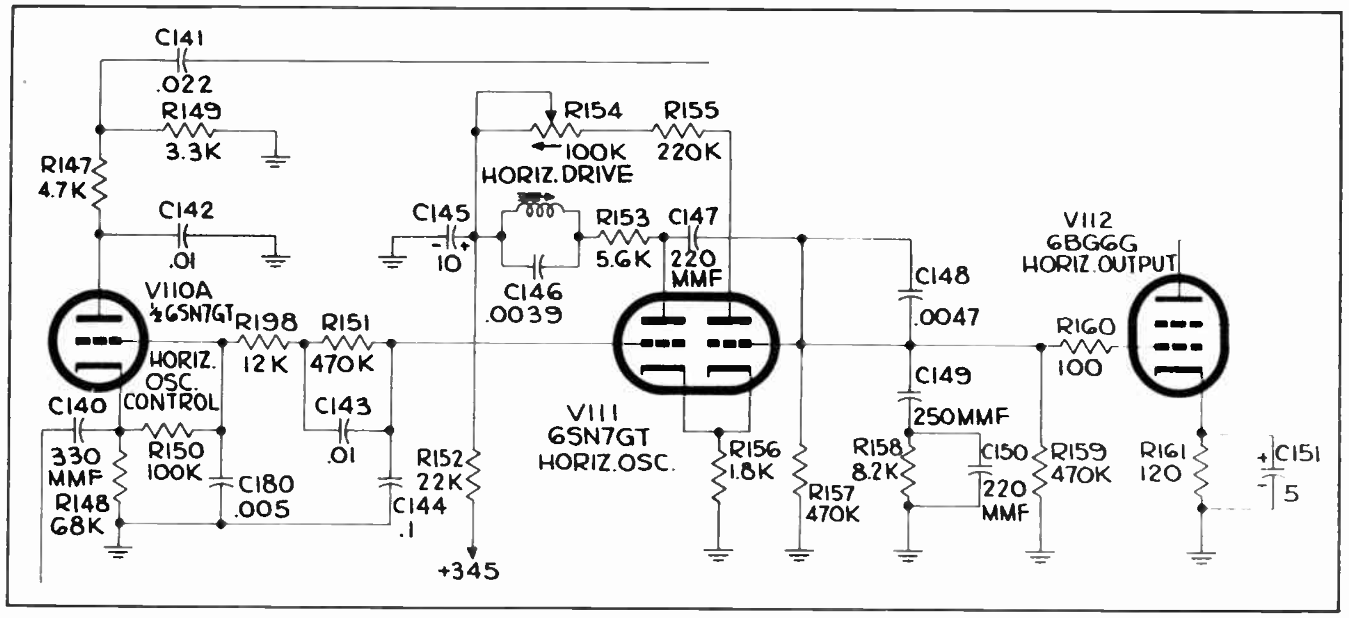
A third possible cause is too high capacity value of C149. Too much capacity in this component tends to cause Christmas tree effect and poor sync hold-in.

CURVATURE IN VERTICAL LINES (Hook)

Curvature in vertical lines in the top portion of the picture is commonly called "hook." This curvature is particularly apparent on a test pattern, or a picture with distinct vertical lines, such as the sides of a door or folds in a drapery. The curvature is normally in the form of a bow or a bend to the right in the top portion of the picture.

The hook can be materially decreased by addition of a 12K ohm, 20%, 1/2 watt, composition resistor (R198) and a .005 mf ceramic capacitor (C180) in the grid circuit of the horizontal oscillator control tube, V110A. Refer to the schematic diagram with this bulletin for location of these components. A further change which will improve the hook and Christmas tree condition is the change of C142 from .0047 mf to .01 mf, 400 V, paper type capacitor. However, this change reduces the horizontal sync hold-in range, and it is imperative that C146 and C149 be changed to a zero temperature coefficient type as described under "Drift", if the change of C142 is made.

REVISED HORIZONTAL CIRCUIT



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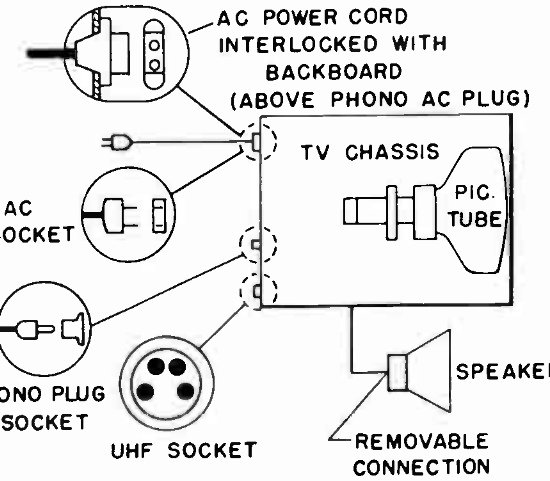
BLOCK DIAGRAM



MAJOR COMPONENT

Cabinet	
Model 870	7577
Model 871	7575
Model 872	7576
TV Chassis	159, 170
Tube, Picture	14CP4
Glass, Window Protective	745
Frame, TV Glass	2426
Mask, Frame Liner	2427
Speaker	9015 or 9070
Antenna Assembly	99609
Loop, Antenna	9667
Azimutrol	9658
Knob, Antenna Tuning	3691
Backboard	2443
Cord, AC	3176
Plate, Contrast-Off-On-Volume	2446
Plate, Channels - Tuning	2448
Knobs	
Turret Tuner	
Channel Selector	33502
Fine Tuning	3642
Off-On-Volume	SK341
Contrast	SK342
Continuous Tuner	
Channel Selector Assembly	33504
Contrast-Off-On-Volume Assembly	33505
Brightness	3719
Vertical Hold	3719

PHONOGRAPH CONNECTIONS

Circuit connections are built into these models for attaching an external phonograph. A crystal pickup type record player must be used. A 45 rpm 7" record changer, a Long Playing changer, or a standard changer will produce good results. The phono AC power cord may be conveniently plugged into a socket marked AC PHONO located directly below the AC line cord lock at the left rear portion of the chassis. The phono audio lead goes into an audio jack marked INPUT PHONO located at the right rear portion of the chassis. The audio amplifier system of the TV receiver is controlled by the slide switch located adjacent to the INPUT PHONO jack. When this switch is placed in the PHONO position, the output of the record player pickup is amplified through the TV audio system. The volume is controlled in the normal manner with the volume control at the left front of the chassis. The slide switch marked TV-PHONO has no effect on the picture circuits of the receiver. The CONTRAST control may be turned full off to remove the picture. (Brightness should have been previously set so that light just begins to appear at minimum contrast setting.) All power to the phonograph is turned off when the TV receiver is turned off.

SPECIFICATIONS

Receiver for television with provision for connection of external record player.

Line Voltage	115V AC 60 cps	Audio Power Output	3 Watts
Number of Tubes	21	Speaker Type	12" Round PM
Picture Tube Size	14" Rect.	Cabinet Height	35-1/2"
Power Consumption	205 Watts	Cabinet Width	22-1/2"
TV Channels	2 through 13	Cabinet Depth	20-15/16"

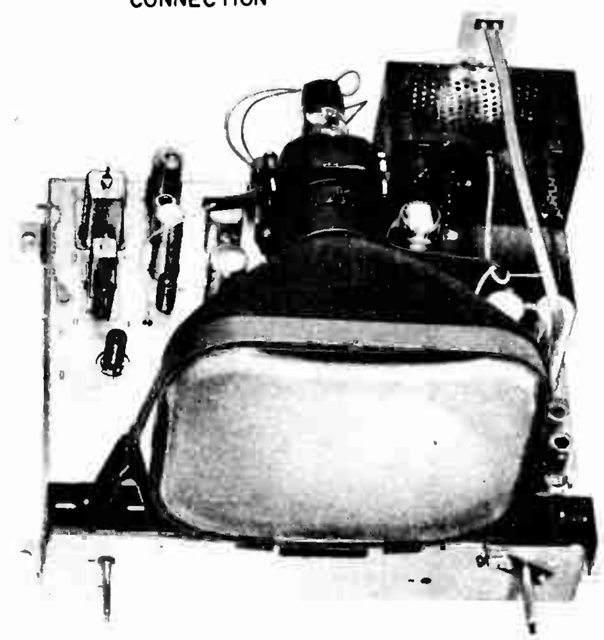
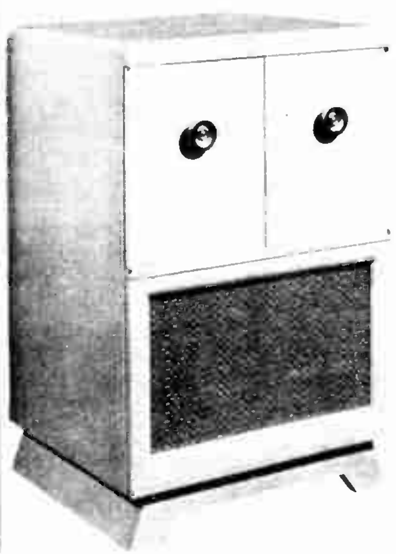


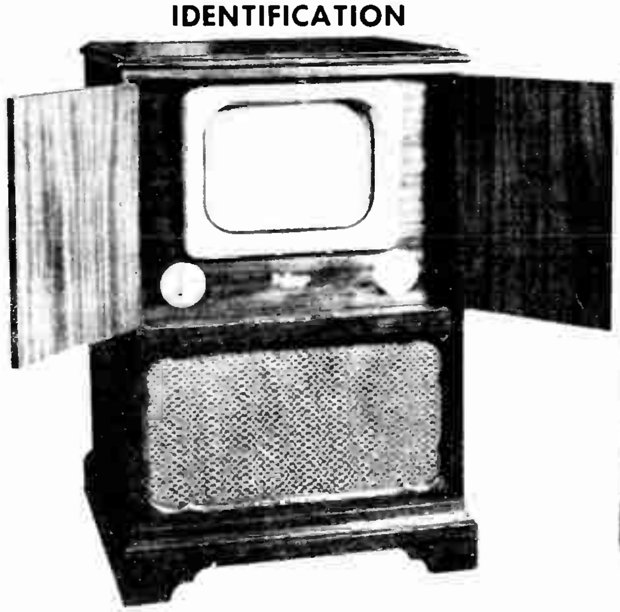
Figure 1. Chassis 170, 171, 173

Figure 2. Chassis 175

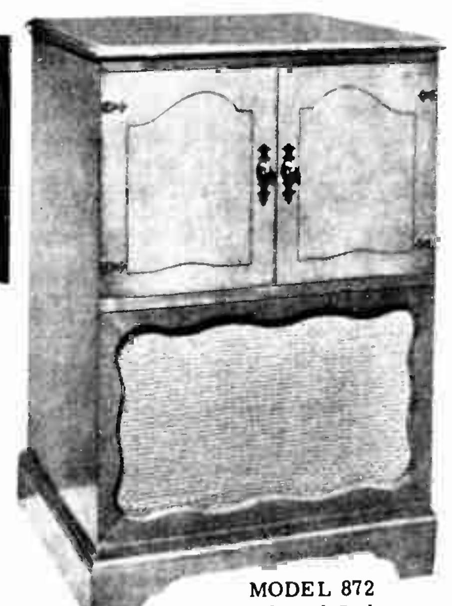
IDENTIFICATION



MODEL 870
Modern Style
Oak Cabinet



MODEL 871
Traditional Style
Mahogany Cabinet



MODEL 872
Colonial Style
Maple Cabinet

ELECTRICAL AND MECHANICAL DATA

Power Requirements:	
Operating Voltage	115 V AC 60 cps
Watts	205 watts
Tuning Range:	
TV	Channels 2 through 13
Audio Power Output	3 watts
Output Impedance (Audio)	3.2 ohms at 400 cps
Video Bandpass	3.8 MC
Intermediate Frequencies:	
Video Carrier	26.1 MC
Sound Carrier	21.6 MC
Antenna Input Impedance	300 ohms, balanced
Picture Tube:	
Chassis 170	14CP4
Chassis 171	16TP4,16RP4,or 16KP4
Chassis 173	17BP4
Chassis 175	19AP4

Chassis 170, 171, 173 and 175 are 21 tube TV receivers. Separate sound and video IF amplifiers are used, with the sound being taken off after the 2nd video IF amplifier. Three stages of video IF and two stages of sound IF are used. The interstage IF transformers are double-tuned, over-coupled type.

Chassis 170, 171, 173 and 175 are all electrically and mechanically similar except for slight variations as follows:

Chassis 170, 171 and 173 employ 14 inch, 16 inch and 17 inch rectangular picture tubes respectively. These picture tubes mount directly on their respective chassis on specially designed support brackets. Chassis 175 employs a 19 inch round picture tube which is mounted on a specially designed support frame that is separate from the chassis. The chassis 175, unlike the chassis 170, 171 and 173 which mount horizontally in the cabinet, is mounted in the vertical position that occupies the upper left-hand side of the cabinet as viewed from the back. The chassis is mounted so that it travels on a slide arrangement and it is held in place by bolts that fit through the chassis side brackets and thread into the upper slide. With this arrangement the

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bolts and front control knobs may be removed and the chassis pulled about two-thirds of its length out of the cabinet. In this position the chassis may be conveniently serviced throughout most of its entirety. Chassis 170, 171 and 173 side brackets run in horizontal slides on each side of the cabinet and are held in place by bolts which fit through the brackets and into the threaded slides. Chassis 170, 171 and 173 are covered by metal bottom plates which may be removed easily.

The deflection systems of the four chassis are the same with the exception that the 6BG6 G screen resistor is increased from 8.2K to 15K in the chassis 170. This change is made to decrease the horizontal drive and high voltage on the 14 inch tube. Otherwise the sweep requirements of the various size picture tubes are taken care of by adjustment of the horizontal and vertical size controls. In the case of the Chassis 175, the 6BG6 G horizontal output tube is mounted outside of the high voltage cage so that better ventilation is affected, and R 167, 470K resistor, is not used because the picture tube is of the metal type. Also a heat shield is placed between the power transformer and 5U4 low voltage rectifier.

TUNING UNITS

Two types of tuning units are used interchangeably in chassis 170, 171, 173 and 175. The turret tuner, RF6* used in previous types of Hoffman receivers and the Hoffman continuous type tuner are each being used in production of the above chassis. The two tuners are operationally inter-changeable and may be used alternately at any time. Separate mounting plates are used in conjunction with each type tuner, so that direct mechanical interchangeability is possible. The style of knobs for the front panel controls are different for the two types of tuners, and each tuner must be used with the set of knobs specifically designed for it.

* Present unit does have a modified converter output circuit and is known by Part No. 9684. The modification consists of eliminating L6, Part No. 5311 and changing values of L5 (.8µh) and C14 (135 mmf).

TUBE COMPLEMENT

2	6AU6	Sound IF	V101, V102
1	6AL5	Ratio Detector	V103
1	6AV6	Audio Amplifier	V104
1	6K6GT	Audio Output	V105
3	6CB6	Picture IF	V106, V107 V108
1	6CB6	Video Amplifier	V109
1	6AU6	AGC Keyer	V110
1	6SN7GT	Horizontal Oscillator Control & Sync Amplifier	V111
1	6SN7GT	Horizontal Oscillator	V112
1	6BG6G	Horizontal Output	V113
1	1 X 2	H.V. Rectifier	V114
1	6W4GT	Damping Diode	V115
1	5U4G	Low Voltage Rectifier	V116
1	6AU6	Sync Separator	V117
1	12BH7	Vertical Oscillator & Vertical Output	V118

HOFFMAN CONTINUOUS TUNER UNIT

1	6J6	RF Amplifier
1	6J6	Oscillator, Converter

TURRET TUNER, RF6

1	6AG5*	RF Amplifier
1	6J6	Oscillator Converter

SUMMARY OF TUBE COMPLEMENT

6AU6	4	6SNTGT	2
6AL5	1	6BG6G	1
6AV6	1	1 x 2	1
6K6	1	6W4GT	1
6AG5* or 6J6**	1	12BH7	1
6U6	1	5U4G	1
6CB6	4		

* 6BC5 or 6CB6 interchangeable in this application. Reference can be made to service bulletin No. 120.
** 6AG5 or equivalent used in turret type tuner, and 6J6 used in continuous type tuner.

OPERATING INSTRUCTIONS

FRONT PANEL CONTROLS

The front panel operating controls consist of the TUNING control, the OFF-VOLUME control, and the CONTRAST control. With the AGC system used for maintaining constant signal level, the contrast control becomes primarily useful in setting background level for best viewing under various room lighting levels or different average program contrast levels.

BEAM BENDER ADJUSTMENTS

The single magnet type beam bender is used with all the picture tubes. The rated flux density is 60 gauss. There is no indication to show a forward or back direction for the installation of the magnet on the tube neck. The direction of installation is immaterial, except that if the magnet is turned over, it must be rotated 180° on the neck of the tube.

The method of installation is to slip the beam bender on the neck of the tube and move it forward toward the tube face until it approaches a space over the "flags" of the first anode. Set the brightness control about midway of its range, never full on, to avoid damaging the tube's electron gun prior to proper adjustment of the beam bender. Rotate the magnet 180° or more on the tube neck until light appears on the screen. After initial light has been obtained, move the beam bender forward or back, and further rotate it to obtain the brightest raster. With the strong, 60 gauss magnet, there are two positions which will give screen illumination. One occurs near the tube base as the magnet approaches a position over the "flags" and the second occurs as the magnet is pushed beyond the "flags" and near the focus coil. The first position is preferred because it allows greater space for adjustment range. The strong magnet also allows a wider adjustment range and the setting will affect the centering and focus. A last check should be made on beam bender adjustments after focus and deflection adjustments have been made.

BRIGHTNESS CONTROL

The brightness control provides adjustment of picture tube control grid bias voltage. Automatic retrace elimination circuits are incorporated, so that retrace lines are visible only at maximum setting of the brightness control. Proper setting of the brightness is such that light is just visible on the screen when the contrast control is set at minimum with a signal tuned in.

HORIZONTAL CONTROLS

The design of the chassis covered in this bulletin is such that no horizontal linearity control is needed, and no horizontal linearity control will be found on the chassis.

When adjusting the horizontal and vertical controls, it is necessary to have a test pattern or program tuned in on the receiver. Set the tuning of the tuner unit so that sound and picture are both present.

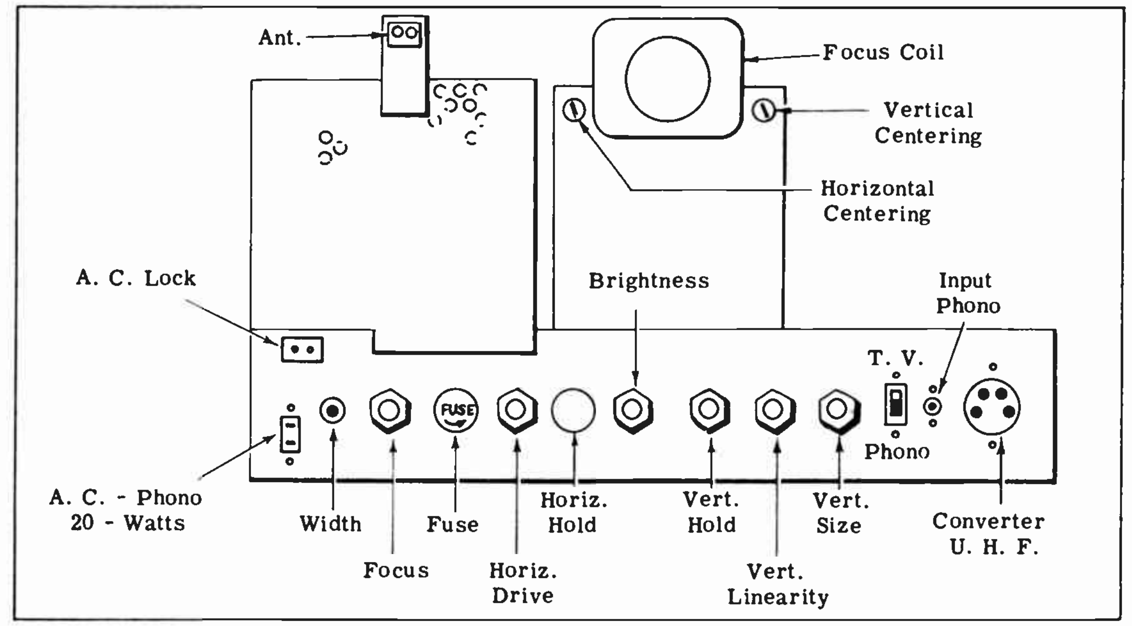
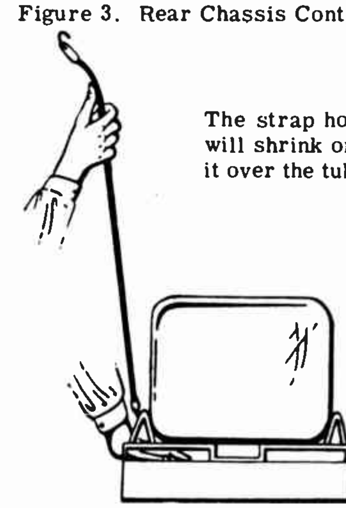


Figure 3. Rear Chassis Controls

WARNING

The strap holding the picture tube in this receiver will shrink on removal. Do not attempt to restretch it over the tube rim. To reinstall, follow these steps:

Stretch as shown to approximate total length required.



Immediately hook one end of the strap to chassis and re-stretch to required length.

Maintain tension on the strap, bring it over the tube, and hook the free end while holding top.

Figure 4. Strap Installation

The HORIZONTAL DRIVE control (R156) should be adjusted for minimum resistance (full counter-clockwise) or as close as possible. In some instances the minimum setting will permit a vertical white bar to appear in the center of the picture. In such cases the control must be rotated clockwise until the white bar disappears. Once the drive control is adjusted as described, it should not be changed in order to vary the horizontal width or frequency. The HORIZONTAL SIZE control (L110) has a large range of width control, and it should be used to vary the picture width. Minimum resistance of the drive control is recommended so that the tendency toward regeneration ("Christmas tree effect") will be reduced.

The HORIZONTAL HOLD control should be adjusted as follows: Turn the hold control (L109) counter-clockwise (slug coming out of coil) while switching the channel selector on and off channel until sync is lost. Turn the control clockwise (slug going into coil) and check the number of bars or picture segments which appear just before pull-in of the picture. There should be a pull-in from at least one segment for normal operation. Continue turning hold control clockwise while switching channel selector on and off channel until sync is lost again. Turn the hold control counter-clockwise (slug coming

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out) and check the number of segments that appear before pull-in. Turn the slug an additional 1/4 turn counter-clockwise if one-segment pull-in occurs, or turn slug approximately 1/2 turn counter-clockwise if two-segment pull-in occurs. This setting of the hold control provides best operating characteristics for sync pull-in and drift of the horizontal oscillator, and it is approximately correct for least amount of "hook".

The amplified AGC system used in the receivers covered in this bulletin is very positive in its action. When the receiver is first turned on and warming up, it may be that the AGC action will lock and hold the picture out of sync as well as holding it in sync. In this case, all that is required is to turn the channel selector off and on channel, momentarily releasing the AGC, and the picture will lock into correct sync.

The hold control should be adjusted as described above for best horizontal sync stability, and any horizontal centering of the picture should be taken care of with the HORIZONTAL CENTERING control.

VERTICAL CONTROLS

The VERTICAL HOLD control has a "hold-in" range of adjustment over which the picture will stay in sync. The control should be set in about the middle of the "hold-in" range.

The VERTICAL SIZE and VERTICAL LINEARITY operate together to adjust the vertical height and proportion of the picture. The Size control affects the vertical size of the entire picture, but not in a linear manner. The bottom portion of the picture is expanded and the picture center tends to move toward the top of the tube. Counter-clockwise rotation of the VERTICAL SIZE control increases the vertical size. The linearity control operates to expand the upper portions of the picture, and compensate for non-linearity created by the Size control. Clockwise rotation of VERTICAL LINEARITY control expands the upper portions of the picture.

FOCUS CONTROL AND RASTER CENTERING ADJUSTMENTS

Electromagnetic focusing is used, with the focus coil being used as a choke in the B+ supply circuit. The Focus control, R196, shunts the focus coil. Adjust the Focus control until clear, well-defined horizontal sweep lines can be observed.

Vertical and Horizontal Centering controls are mechanical type which operate by positioning the focus coil. The vertical centering is operated by a spring-loaded screw on the right of the focus coil, and horizontal centering is operated by a similar screw on the left. If difficulty is encountered in focusing or centering, or neck shadows appear, a reversal of the leads to the focus coil will often remedy the situation.

ALIGNMENT

The following alignment procedure describes alignment of the double-tuned video and sound IF circuits used in the chassis dealt with in this bulletin. The procedure for the RF tuning unit is described in separate bulletins, bulletin number 80 covering the turret type tuner unit and bulletin number 124 covering the continuous type tuner unit. The following discussion deals with recommended methods and equipment to be used and precautions to be observed during the alignment procedure. For actual alignment procedure, it is suggested that the alignment table be followed after reading the more detailed procedure.

For best results it is important that alignment be performed on a metal topped bench with all instruments and equipment securely bonded together and to ground. All leads should be as short as is practicable, particularly in the input grid circuits. Isolation circuits will be required for both the input and output connections. It is important that composition resistors, preferably the half watt size, and disc type ceramic condensers be used in making up these isolation networks, so that a minimum amount of external inductance is added to the tuned circuits being adjusted.

A sweep signal generator with a frequency range which includes 24.25 MC, and a sweep width of 10 MC will be required. A marker generator whose fixed frequencies include 4.5 MC, 20.1 MC, 21.6 MC, 24.25 MC, 26.1 MC and 27.6 MC will be needed if not already combined with the sweep generator. A voltmeter with sensitivity of 20,000 ohms per volt or higher and with voltage scale ranges from 50 volts on down as low as 2.5 volts or lower must be on hand. Also included in the instrument list is an oscilloscope with at least a moderately high vertical gain. In general the output signal level from the signal generator should be kept as low as the output indicator being used will permit if overdriving of the receiver stage (s) with its adverse results is to be avoided. In general, too, the RF tuner unit should be tuned to the vicinity of the channel 12 frequency range, but individual circumstances may require that the tuner be set on one of the low channels, depending upon what interfering frequencies are being radiated about the alignment bench. A 3 volt battery should be connected with negative terminal to the AGC bus and positive terminal to ground for the alignment procedure. This is done to establish a circuit gain reference standard which approaches the average value found in the field. It will also reduce any interference pick-up since the gain will be lower than the gain available without AGC. Where receivers are known to be operated in weak signals areas, a lower value of fixed bias voltage may prove more desirable.

ORDER OF ALIGNMENT

The general order of alignment should be as follows:

Sound IF and Ratio Detector Primary
Ratio Detector Secondary
4.5 MC Trap
Sound Takeoff Coil
27.6 MC Adjacent Channel Sound Traps
20.1 MC Adjacent Channel Video Trap
Picture IF Transformers
Converter Output Coil

SOUND IF ALIGNMENT

Equipment:

Set the signal generator to 21.6 MC. Connect the signal to the grid, pin 1 of V101. If the generator does not have a low impedance output, it is suggested that a 75 ohm resistor be shunted across the output terminals. Connect the voltmeter in series with a 10K ohm, isolating resistor to pin 7 of V103.

Procedure:

Adjust T101 primary (bottom), T101 secondary (top), and T102 primary (bottom) to obtain a maximum reading on the meter. The maximum voltage reading should be kept below 3 volts by decreasing the generator output as the windings are tuned to resonance. It is essential that the slugs be moved from the outer ends of the coil form toward the center, by turning the slugs clockwise. If the slug has been moved past the center so that resonance is reached with the slug coming out of the coil, then the slug must be moved out, counter-clock-wise, completely through the coil and the tuning procedure undertaken again. This is necessary because the mutual coupling will be adversely affected and proper alignment will be impossible if the slugs are run into the center of the double-tuned coils.

RATIO DETECTOR ALIGNMENT

Equipment:

Generator and input circuit remain as connected above. Meter should be switched to one of its higher scales, and in the case of a VTVM the zero point can be set up scale to the center position. No isolation resistor is used. Connect one voltmeter lead to the junction of R 107 and R 108 and the other lead to the junction of R 106 and C 114. Temporarily short the grid pin 1, of V 102 to ground.

Procedure:

Adjust the secondary of T 102 for a zero reading on the voltmeter. The polarity of the reading will depend upon which side of resonance the secondary winding is tuned. As the resonant position is approached, the voltmeter scale should be reduced so that a more sensitive zero indication is available. Do not increase the generator output beyond the level which produced the maximum reading above, however.

ALTERNATE RATIO DETECTOR ALIGNMENT

The following procedure is considered less desirable than the one described above because the zero point obtained is not always a true indication of balance due to slight production variations of ratio detector transformers.

The input equipment remains the same as in the first procedure with the addition of a sweep signal of 400 KC width and a 21.6 MC marker signal being added. The voltmeter is replaced by an oscilloscope and isolation network shown in Figure 8. Connect the

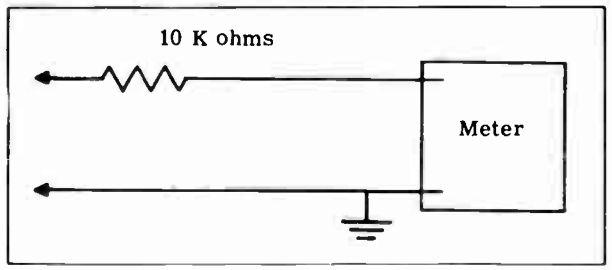

Figure 5.

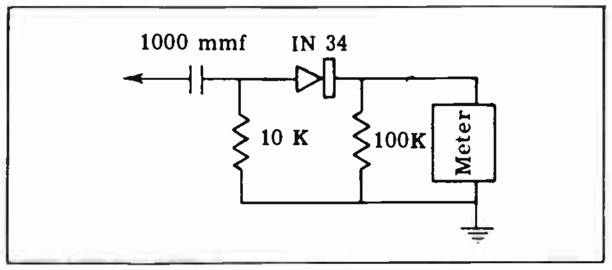

Figure 6.

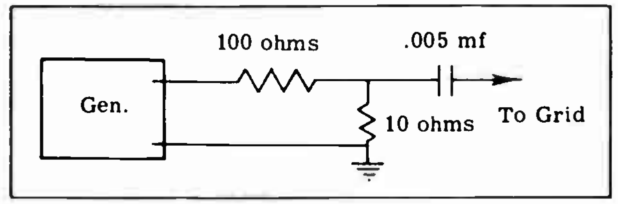

Figure 7.

isolating resistor to the junction of R 106 and C 114. Adjust the secondary (top) of T 102 for an "S" curve which is symmetrical, and has the 21.6 MC marker in the center of the linear or straight line portion of the curve as indicated in Figure 11. Because the center of the "S" curve is a zero or null point, very little 21.6MC marker will come through. However, the marker does produce a series of irregular traces which appear on opposite sides of the linear portion of the curve. These traces should be evenly distributed about the center for correct adjustment of T 102 secondary.

ALTERNATE SOUND IF AND RATIO DETECTOR ALIGNMENT

This alternate procedure offers the advantage of requiring less time to perform, and the results obtained from its employment are independent of whether or not R 107 and R 108 are identical in value. If this unbalance does exist, the zero adjustment determined by the meter method would be slightly in error.

SOUND IF

Equipment:

Connect the sweep generator to pin 1, V101, using the network shown in Figure 7. Set the generator center frequency at 21.6 MC and use a sweep of about 400 KC. The blanking control should be in the on position, so that a baseline is established as a reference. Connect a scope to the junction of R 106 and C 114, using the network shown in Figure 8.

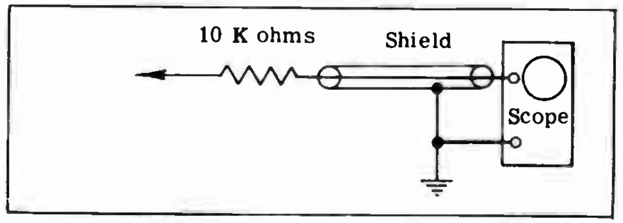

Figure 8.

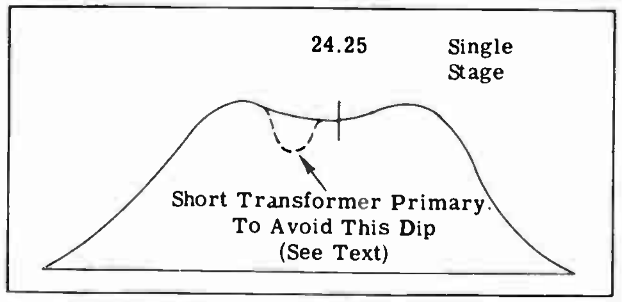

Figure 9.

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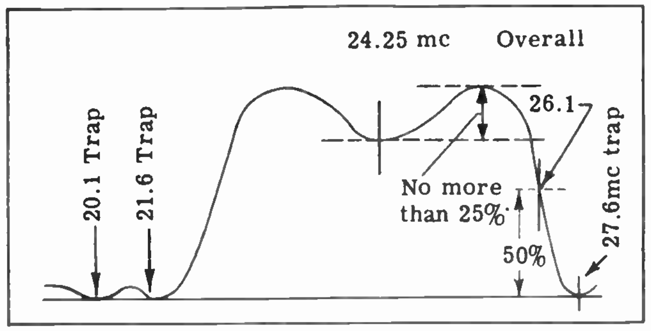

Figure 10.

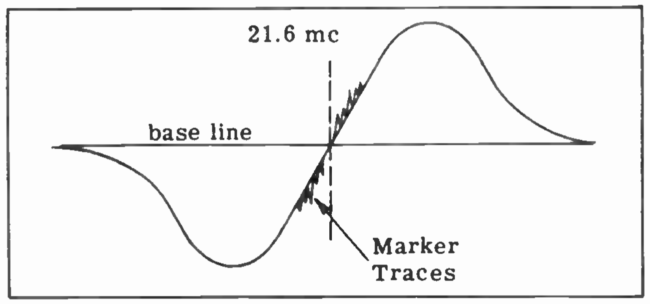

Figure 11.

Procedure:

With the equipment connected as described, some sort of "S" curve will be seen on the scope if the alignment is not too far off from the correct condition. Adjust the primary and secondary of T 101 and the primary of T 102, so that the "S" curve appears symmetrical on both sides of the baseline, so that it has maximum amplitude, and so that it has best linearity over the straight portion.

RATIO DETECTOR SECONDARY

Equipment:

Same as used in sound IF alignment but with the addition of injecting a 400 cycle modulated, 21.6 MC marker signal into the sweep signal.

Procedure:

Now a sine wave should appear along the baseline of the "S" curve as shown in Figure 12.

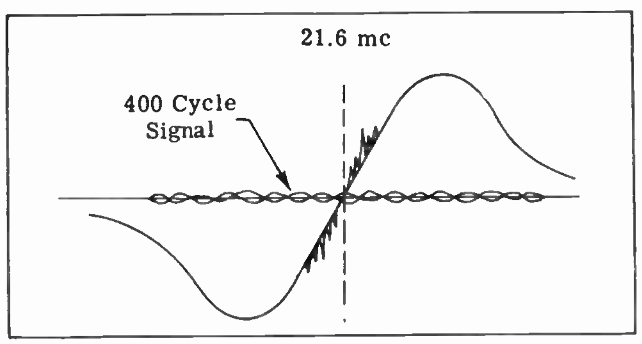

Figure 12.

The 400 cycle signal will not remain stationary, but will appear as a wiggle about the baseline. Adjust the secondary of T 102 until the 400 cycle signal decreases and finally disappears. When this is done, the ratio detector offers the maximum amount of AM rejection.

TUNING 4.5 MC VIDEO TRAP

Equipment:

Connect an unmodulated 4.5 MC signal to pin 1, V 109, using network shown in Figure 7. Use a detector and isolating network with the voltmeter as shown in Figure 6. Connect the detector to the junction of R 141, C 145, and the picture tube cathode lead.

Set the contrast control to mid-range. Adjust the slug of L 108 for minimum reading on the voltmeter. As the null reading is approached, the voltmeter range should be reduced and the input signal increased somewhat to produce a more sensitive indication. If the output level of the generator is less than .25 volts, it will be necessary to connect the 5000 mmf condenser shown in Figure 7 to the generator side of the 100 ohm resistor.

Alternate Procedure:

If the service man is familiar with the appearance of 4.5 MC beat pattern as produced on the picture tube, then adjustment may be made without external signal, generator or indicating device. Tune in a channel, and then mis-tune to a point that would be equivalent to placing the sound IF carrier "up" on the IF response curve. This will produce and be indicated by a relatively weak 4.5 MC beat pattern in the picture. Tune L 108 for minimum beat pattern. This will minimize the beat pattern when the station is properly tuned.

TUNING SOUND TAKEOFF COIL

Equipment:

The equipment complement remains the same as for the 4.5 MC trap procedure, but the signal generator is set at 21.6 MC and moved to pin 1, V 106. The detector-meter combination (see figure 6) is connected to pin 1, V 109.

Procedure:

Adjust the slug of L 104 for minimum reading on the voltmeter. Contrast control should be left at mid-range. The voltmeter range should be progressively reduced and the signal increased slightly as L 104 is tuned to resonance.

TUNING ADJACENT CHANNEL SOUND TRAPS

Equipment:

Equipment complement remains as above, the signal generator unmodulated frequency is set at 27.6 MC. Input and output connections are left undisturbed.

Procedure:

L 105 and L 103 are tuned to give a null indication as above. While tuning one trap, the other trap can be de-tuned by touching the winding with the fingers, giving a more sensitive null for either trap.

TUNING ADJACENT CHANNEL VIDEO TRAP

There are two alternate video input circuits which will be found in early production chassis. Figure 13 shows one circuit which excludes an adjacent channel video trap. Figure 14 shows the other alternate input circuit which includes an adjacent channel video trap.

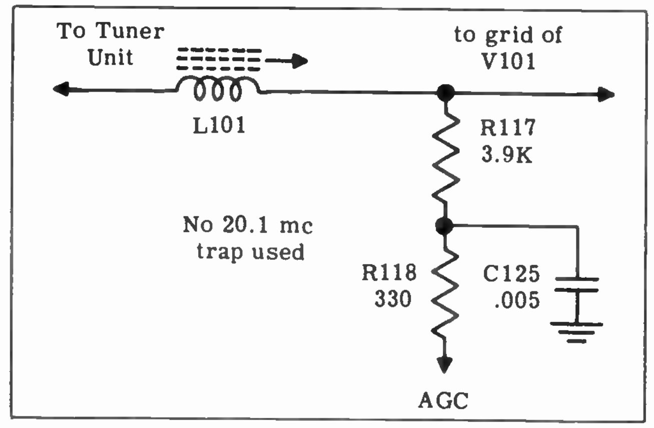

Figure 13.

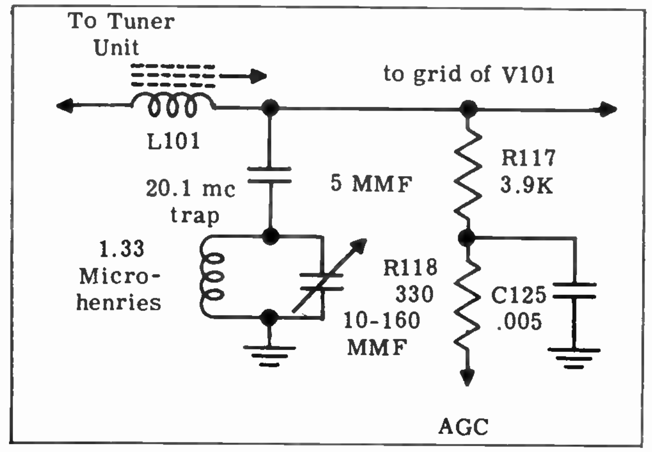

Figure 14.

Equipment:

Equipment complement remains unchanged, (see fig. 6&7). and the unmodulated signal frequency is set at 20.1 MC. The signal generator is moved to the grid of the converter tube, pin 5 of the 6J6 in the tuning unit.

Procedure:

L 102 is tuned for a minimum reading on the voltmeter.

PICTURE IF ALIGNMENT

The picture IF alignment procedure is a process of separately tuning a series of double-tuned, overcoupled stages. Adjustment of each stage is complete in itself and provides a band pass of about 3.8 MC for each stage. No attempt should be made to re-adjust the tuning of an IF transformer once it has been aligned and the signal generator has moved on to the next stage. An erroneous alignment can result even though the overall response may appear satisfactory.

Equipment:

Connect a scope between pin 1, V 109 and ground through the isolating network shown in Figure 8. For first stage alignment connect the sweep generator through the isolation network shown in Figure 7 to pin 1, V 108.

For successive stages, move the generator to each grid in succession. The input signal should be kept low enough so that the stage (s) are not overdriven, but the level should not be so low that the gain of the vertical amplifiers in the scope have to be increased to a point that gives a distorted waveform and overemphasis of any "hash" that may be present.

Procedure:

Set the sweep generator to a center frequency of about 24 MC with 10 MC sweep. Insert a marker signal at 24.25 MC.

For alignment of the 3rd picture IF, adjust the primary (bottom) and secondary (top) of T 106 to obtain a pass band whose top is symmetrical about the marker pip. Skirt positions and slopes will not be symmetrical. See Figure 9. Correct alignment of the stages is indicated by a curve having nearly flat top with equal amplitude peaks. The band-width of each stage is predetermined by design of the transformers and is not varied to any appreciable extent by alignment. A dip may be noticed as indicated by a dotted line in Figure 9. This condition may be eliminated by shorting the primary of the transformer in the plate circuit of the stage preceding the stage under alignment. The sweep generator is connected to the secondary of the transformer whose primary will be shorted. When alignment of a particular stage is completed, remove the short just mentioned.

Next, move sweep generator and isolation network to pin 1, V 107, 2nd picture IF. Alignment of T 105 is accomplished by tuning the primary and secondary to give a symmetrically topped curve as previously described.

Move the sweep generator and isolation network to pin 1, of V 106, 1st picture IF. Align T 104 as was done in previous stages. Response curve should begin to appear approximately as shown in Figure 10. It can be noted that the center dip is greater and the total band pass is slightly less than that of a single stage. Note also the effect of the dips caused by the 27.6 MC adjacent channel sound traps, 21.6 sound trap, and 20.1 MC adjacent channel picture trap.

Connect the signal generator and isolation network to the converter grid in the RF tuning unit. Insert a 26.1 marker. The converter output coil and the picture IF peaking coil, L 101, form a circuit comparable to the IF transformers. Using the converter output coil as the primary and L 101 as the secondary align the IF input circuit to produce an overall response curve as shown in Figure 10. At the same time, tuning of these two coils will position the 26.1 MC point near the 50% point on the response curve slope. The 26.1 MC point (picture carrier) should never be down the slope of the video pass band to more than the 40% point. If this condition is permitted to exist, the sound and picture will not tune to a maximum together, and the low frequency response will be adversely affected. Again, it is emphasized that previously aligned stages must not be touched.

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ALIGNMENT TABLE

Step No.	Signal Gen. Freq. Mc.	Modulation or Sweep	Connect Signal To	Signal Isolation	Output Indicator	Adjust	Instructions	Special Connections and Settings
SOUND IF AND RATIO DETECTOR								
1	21.6	None	Pin 1, V 101	Network, Fig. 5, Fig. 3	Voltmeter to pin 7, V 103	T 101 Pri., Sec. T 102 Pri.	Adjust for maximum meter reading, but keep input signal level low enough so that reading is less than 3 V.	Use - 3 V bias from battery on AGC bus. for all alignment.
2	"	"	"	Network Fig. 7	Voltmeter between junction R106, C114 and junction R107, R108	T 102 Sec.	Adjust for zero reading	Decrease voltmeter scale as zero reading is approached. Do not increase generator signal beyond maximum level used in step No. 1.
TRAPS								
3	4.5	None	Pin 1, V 109	Network, Fig. 6, Fig. 7	Detector and meter to junction R141, C145 CR tube cathode lead	L 108	Adjust for zero or null reading	If generator output is less than .25V, move condenser in Fig. 7 to gen. side of 100 ohm resistor.
4	21.6	"	Pin 1, V 106	Network, Fig. 6, Fig. 7	Detector and meter to pin 1, V 109	L 104	"	Lower meter scale as null is approached.
5	27.6	"	"	"	"	L 105	"	Lower meter scale as null is approached, and de-tune L 103, with fingers held on winding.
6	"	"	"	"	"	L 103	"	Lower meter scale as null is approached, and de-tune L 105, with fingers held on winding.
7	20.1	"	Grid of converter tube in RF tuner.	"	"	L 102	"	Lower meter scale as null is approached.
PICTURE IF TRANSFORMERS								
8	24.25	10 Mc.	Pin 1, V 108	Network, Fig. 6, Fig. 7	Scope to pin 1, V 109	T 106 Pri., Sec.	Adjust for symmetrical waveform. See Fig. 10	Insert 24.25 Marker freq.
9	"	"	Pin 1, V 107	"	"	T 105 Pri., Sec.	"	"
10	"	"	Pin 1, V 106	"	"	T 104 Pri., Sec.	Adjust for waveform approximately as shown in Fig. 10.	"
11	"	"	Converter grid in RF tuner.	"	"	Converter output and L 101.	Adjust for waveform shown in Fig. 10. 26.1 marker should be at 50% point of slope.	Insert 26.1 marker.

TOP VIEW PARTS LAYOUT CHASSIS 170, 171, 173, 175

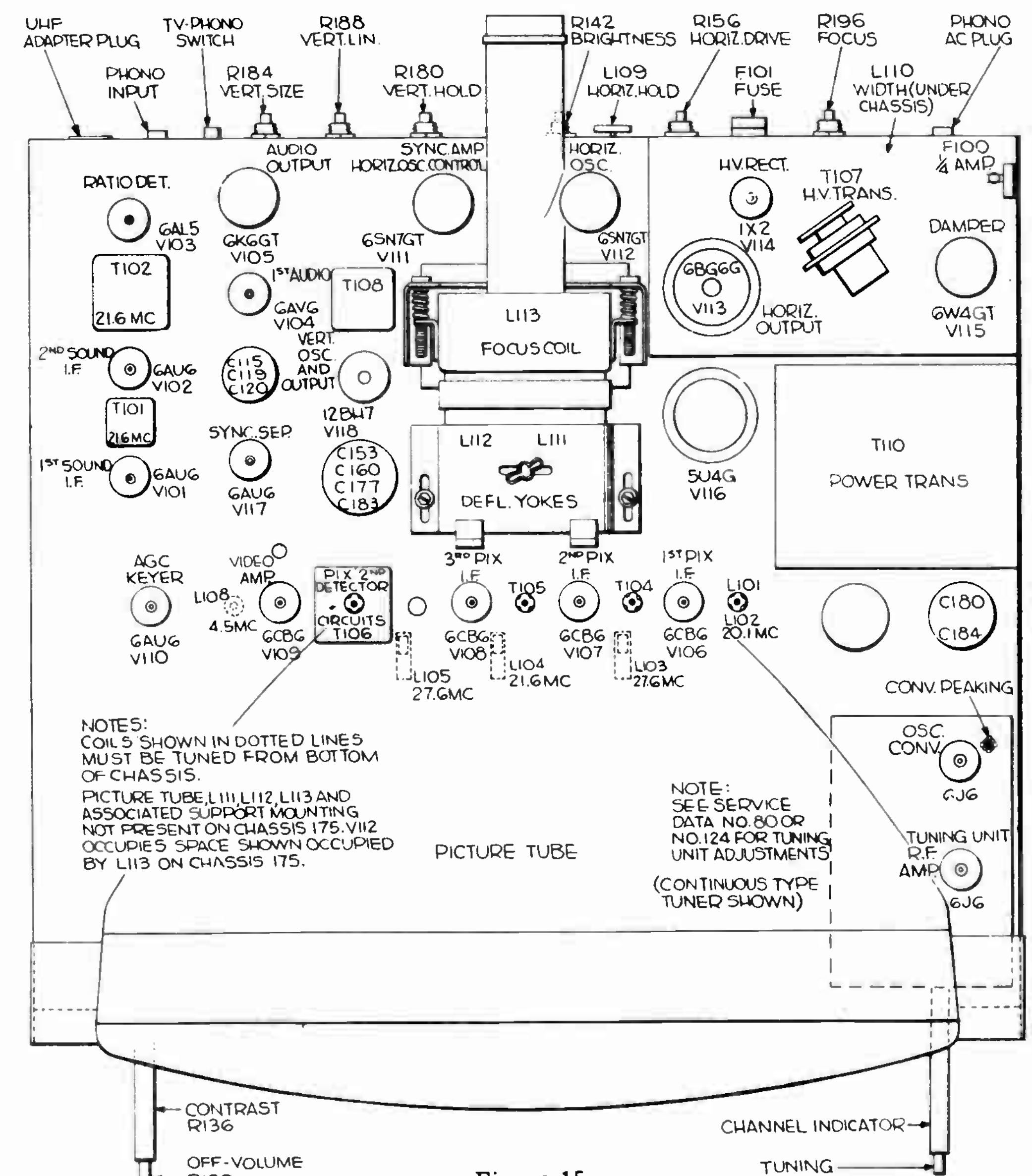

Figure 15.

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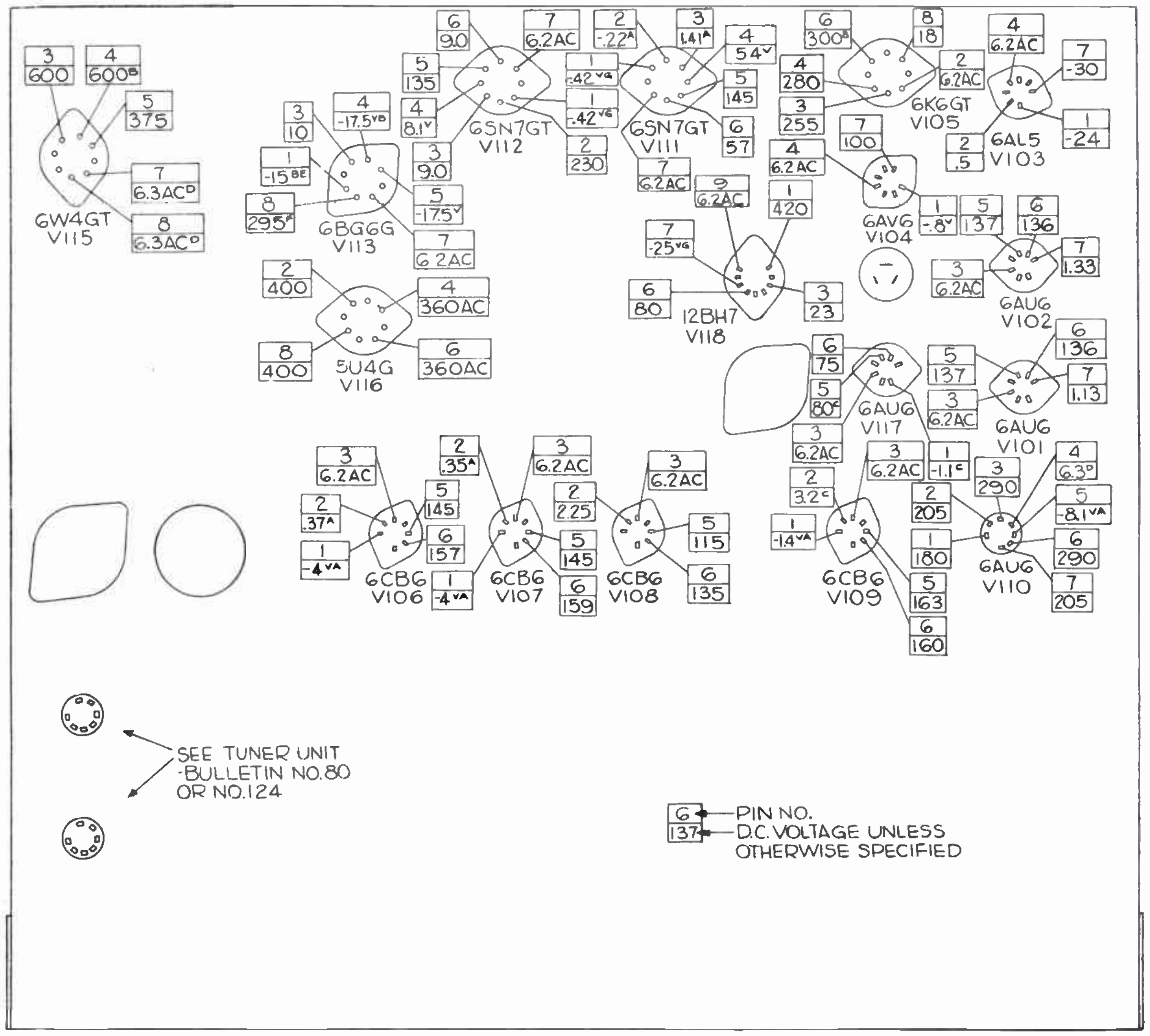
BOTTOM VIEW TUBE LAYOUT
CHASSIS 170, 171, 173, 175



All voltages measured with set receiving picture and sound adjusted for normal operation, medium signal, medium volume and contrast level.

Line Voltage = 115V AC

All bus voltages run about 10 to 20 volts higher than shown on circuit schematic.

Slight variations in voltage values are to be expected due to variations in line voltage and variations from component nominal values.

A - Varies with signal level.
B - Pin used as tie point only.
C - Contrast set at minimum.
D - Measured to other heater pin.
E - No connection on chassis 175.
F - About 40V. less on chassis 170.
G - Depends upon setting of hold control.
V - Measured with V.T.V.M.

Figure 16. Voltage Chart

MODEL 867
Traditional Style
Mahogany Cabinet

MODEL 868
Colonial Style
Maple Cabinet

Note: Models 866, 867, 868 are all similar except for cabinet style and finish, and Models 876, 877, 878 are all similar except for cabinet style and finish.

MODEL 877
Traditional Style
Mahogany Cabinet

MODEL 876
Modern Style
Oak Cabinet

MAJOR COMPONENTS

Cabinet	
Model 866	7604
Model 867	7605
Model 868	7606
Model 876	7598
Model 877	7599
Model 878	7600
TV Chassis	171
Tube, Picture	16RP4, 16TP4, 16KP4A
Glass, Window Protective	753
Frame, TV Glass	2387
Mask, Frame Liner	2388
Speaker	9015 or 9070
Antenna Assembly	99602
Loop, Antenna	9667
Azimutrol	9658
Knob, Antenna Tuning	3691
Backboard	2465
Cord, AC	3176
Plate	
Models 866, 867, 868	
Controls Escutcheon	2486A
Models 876, 877, 878	
Contrast-Off-On-Volume	2446
Channels - Tuning	2448
Knobs	
Channel Selector Assembly	33504
Contrast-Off-On-Volume Assembly	33505
Brightness	3719
Vertical Hold	3719

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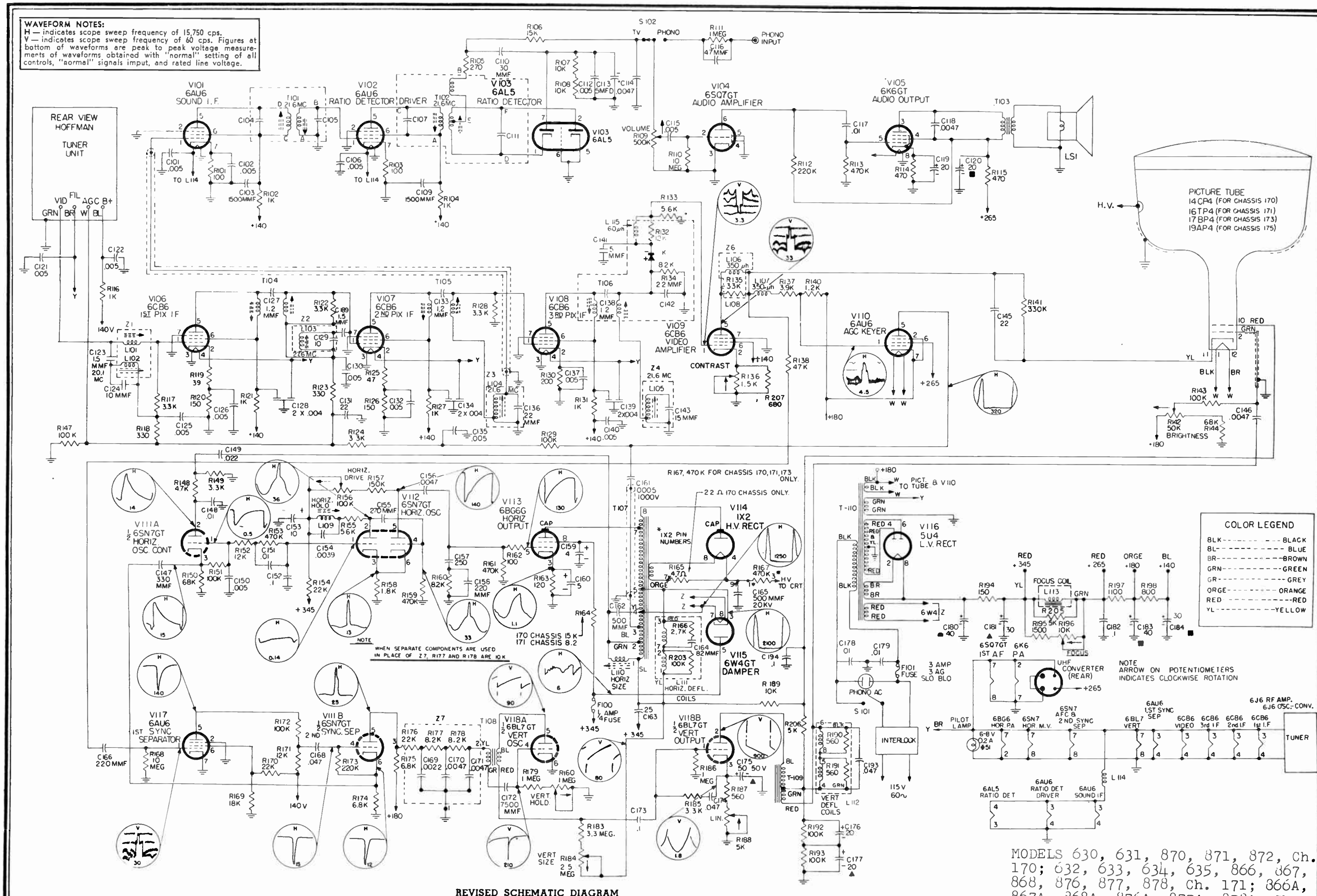
WAVEFORM NOTES:
H — indicates scope sweep frequency of 15,750 cps.
V — indicates scope sweep frequency of 60 cps. Figures at bottom of waveforms are peak to peak voltage measurements of waveforms obtained with "normal" setting of all controls, "normal" signals imput, and rated line voltage.



REVISED SCHEMATIC DIAGRAM
CHASSIS NOS. 170, 171, 173, 175

MODELS 630, 631, 870, 871, 872, Ch. 170; 632, 633, 634, 635, 866, 867, 868, 876, 877, 878, Ch. 171; 866A, 867A, 868A, 876A, 877A, 878A, Ch. 173; 890, 891, 892, Ch. 175

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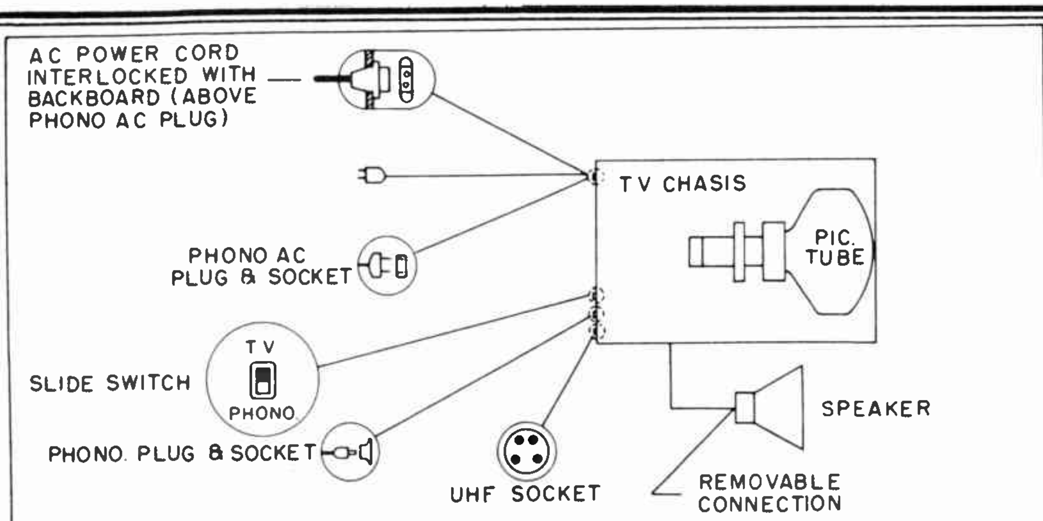

BLOCK DIAGRAM

IMPROVEMENT IN DEFLECTION CIRCUITS

A .047 mf capacitor has been added across the vertical deflection coils of the high impedance yoke only. The purpose of this addition was to reduce light vertical bars in the raster due to internal deflection yoke coupling. Since this internal coupling varies among deflection yokes, only a relatively few sets contain yokes that give noticeable indication of these bars. Only those sets in the field that give evidence of these light vertical bars need be serviced regarding this addition. The change was added to all current production as an insurance measure. The physical location of the capacitor is under the chassis. One side is connected to the black vertical deflection coil lead. The other side is connected to a red plastic-covered jumper wire that is in turn connected to the green vertical deflection coil lead.

Old Part	New Part	Difference
--	C193 (4148)	.047, 400V, 20% added across vertical deflection coils

This change has been made on all sets produced after Serial No. I089886

A recent change in the internal structure of some 6BG6G horizontal output tubes has brought about a condition of beam modulation in the 6BG6G. This condition shows up in the raster as a 120 cps horizontal wave of about a quarter inch peak to peak amplitude in extreme cases. This condition will be made negligible by changing the .047 mf screen by-pass capacitor for the 6BG6G to a 4 mf electrolytic or greater. Anything between 4 mf and 20 mf is recommended. Procurement difficulties have delayed the use of the 4 mf electrolytic, and an alternate modification is being used for a short time until the 4 mf electrolytics are delivered. This information is mentioned here in order to aid the service man in recognizing the modification at such time as he may be called upon to service a set that employs the modification. A brief description is as follows: R164 was replaced by two 3.3K, 2 watt in series. R154 was eliminated, and the junction of C153, L109, C154, and R156 was connected to the screen of the 6BG6G.

Old Part	New Part	Difference
C159 (4133)	C159 (4236)	6BG6G screen by-pass capacitor increased to 4 mf, 450V.

PRODUCTION CHANGES IN VERTICAL CIRCUIT

The following production change has been made in order that the vertical circuit be made more flexible for shifting to different types of vertical oscillator-vertical output amplifier tubes as procurement conditions demand.

Old Part	New Part	Difference
R181 (4571)	--	100K resistor between Vertical Hold potentiometer is deleted, potentiometer being connected directly to ground.
R182 (4604)	--	6.8 meg resistor between Vertical Hold potentiometer and plate circuit of blocking oscillator deleted.
--	R206 (4724)	A 5K, 3 watt wire-wound resistor added between vertical deflection coil and R189.
R146 (4511)		100K resistor in 1st anode circuit of CR tube deleted, and 1st anode connected to junction of R189 and R206.
	C194 (4144)	0.1 mf, 600V, 20% added between ground and junction of R189 and R206.

This change has been made on all sets produced after Serial No. J106134

Production is now using a single unit vertical integrator network when the units are available. Because the supply is sporadic, the single unit network will be used interchangeably with the previously used network.

Old Part	New Part	Difference
R176 (4628) R177 (4515) R178 (4515) C169 (4145) C170 (4128) C171 (4128)	Z7 (9695)	Single unit network with three leads replaces six individual components.

REVISED SCHEMATIC DIAGRAM

PARTS LIST

NOTE: All values of capacity are microfarads unless otherwise noted. All resistors are 1/2 watt composition type with values given in ohms unless otherwise noted.

SYMBOL	PART NO.	VALUE	TOL.	WATTS OR VOLTS	TYPE
C101	4029	.005	GMV		HI-K, Ceramic
C102	4029	.005	GMV		HI-K, Ceramic
C103	4090	1500 mmf	GMV		Ceramic
C104	Part of T101				
C105	Part of T101				
C106	4029	.005	GMV		HI-K, Ceramic
C107	Part of T102				
C108	Not Used				
C109	4090	1500 mmf	GMV		Ceramic
C110	4043	30 mmf	10%		Ceramic
C111	Part of T102				Ceramic
C112	4029	.005	GMV		HI-K, Ceramic
C113	4209	5		50V	Electrolytic
C114	4127	.0047	20%	400V	Paper
C115	4029	.005	GMV		HI-K, Ceramic
C116	4009	47 mmf	20%		Mica or ceramic
C117	4105	.01	20%	600V	Paper
C118	4128	.0047	20%	600V	Paper
C119	Part of 4230	20		25V	Electrolytic
C120	Part of 4230	20		475V	Electrolytic
C121	4029	.005	GMV		HI-K, Ceramic
C122	4029	.005	GMV		HI-K, Ceramic
C123	4082	1.5 mmf	10%	Stack pole	GA-3
C124	4027	10 mmf	10%		Ceramic NPO
C125	4029	.005	GMV		HI-K, Ceramic
C126	4029	.005	GMV		HI-K, Ceramic
C127	4074	1.2 mmf	10%	Stack pole	GA
C128	4036	2 x .004	GMV		HI-K, Ceramic
C129	Part of L103	10 mmf			

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SYMBOL	PART NO.	VALUE	TOL.	WATTS OR VOLTS	TYPE
C130	4029	.005	GMV		HI-K, Ceramic
C131	4131	.22	20%	200V	Paper
C132	4029	.005	GMV		HI-K, Ceramic
C133	4074	1.2 mmf	10%	Stack pole	GA-3
C134	4036	2 x .004	GMV		HI-K, Ceramic
C135	4029	.005	GMV		HI-K, Ceramic
C136	Part of Z3	22 mmf			
C137	4029	.005	GMV		HI-K, Ceramic
C138	4074	1.2 mmf	10%	Stack pole	GA
C139	4036	2 x .004	GMV		HI-K, Ceramic
C140	4029	.005	GMV		HI-K, Ceramic
C141	4028	5 mmf	10%		Ceramic N750
C142	4069	2.? mmf	10%	Stack pole	GA-4
C143	Part of L105	15 mmf			
C144	Not Used				
C145	4131	.22	20%	200V	Paper
C146	4149	.0047	20%	1000V	Paper
C147	4010	330 mmf	10%		Mica or G.P. Ceramic
C148	4142	.01	20%	200V	Paper
C149	4135	.022	20%	1000V	Paper
C150	4029	.005	GMV		HI-K, Ceramic
C151	4142	.01	20%	200V	Paper
C152	4143	.1	20%	200V	Paper
C153	Part of 4228	10		475V	Electrolytic
C154	4085	.0039	10%	500V	Silver Mica
C155	4022	270 mmf	10%		Mica
C156	4128	.0047	20%	600V	Paper
C157	4086	250 mmf	10%	500V	Ceramic NPO
C158	4026	220 mmf	20%	500V	Mica or ceramic
C159	4236	4		450V	Electrolytic
C160	Part of 4228	5		50V	Electrolytic
C161	4075	.0005	20%	1000V	Mica
C162	4076	500 mmf	20%	1500V	Mica
C163	4129	.25	20%	600V	Paper
C164	4087	82 mmf	20%	Part of Yoke Assembly	Mica or ceramic
C165	4056	500 mmf		20KV	Ceramic
C166	4026	220 mmf	20%		Ceramic
C167	Not Used				
C168	4133	.047	20%	600V	Paper
C169	4145	.0022	20%	600V	Paper
C170	4128 or Part of Z7	.0047	20%	600V	Paper
C171	4128	.0047	20%	600V	Paper
C172	4083	7500 mmf	5%		Mica
C173	4144	.1	20%	600V	Paper
C174	4141	.047	10%	600V	Paper
C175	Part of 4230	50		50V	Electrolytic
C176	4227	20		450V	Electrolytic
C177	4228	20		450V	Electrolytic
C178	4105	.01	20%	600V	Paper
C179	4105	.01	20%	600V	Paper
C180	Part of 4232	40		475V	Electrolytic
C181	Part of 4232	30		475V	Electrolytic
C182	4144	.1	20%	600V	Paper
C183	Part of 4228	40		475V	Electrolytic
C184	Part of 4232	30		475V	Electrolytic
C185	Not Used				
C186	Not Used				
C187	Not Used				
C188	Not Used				
C189	4082	1.5 mmf	10%	Stack pole	GA-3
C190	Not Used				
C191	Not Used				
C192	Not Used				
C193	4148	.047	20%	400V	
C194	4144	.1	20%	600V	
R101	4566	100	10%		
R102	4542	1K	20%		
R103	4566	100	10%		
R104	4542	1K	20%		
R105	4663	270	10%		
R106	4521	15K	20%		
R107	4597	10K	10%		
R108	4597	10K	10%		
R109	Part of 4833	500K	"Volume"	Dual Variable	
R110	4505	10 meg	20%		

SYMBOL	PART NO.	VALUE	TOL.	WATTS OR VOLTS	TYPE
R111	4513	1 meg	20%		
R112	4618	220K	10%		
R113	4506	470K	20%		
R114	4531	470	10%		
R115	4531	470	10%		
R116	4542	1K	20%		
R117	4648	3.3K	10%		
R118	4509	330	20%		
R119	4620	39	10%		
R120	4616	150	10%		
R121	4542	1K	20%		
R122	4648	3.3K	10%		
R123	4509	330	20%		
R124	4607	3.3K	10%		
R125	4639	47	10%		
R126	4616	150	10%		
R127	4542	1K	20%		
R128	4648	3.3K	5%		
R129	4511	100K	20%		
R130	4642	200	10%		
R131	4543	1K	20%		
R132	4660	12K	20%		
R133	4603	5.6K	5%		
R134	4641	8.2K	5%		
R135	Part of L106	33K	20%		
R136	Part of 4833	1.5K	"Contrast"		Dual Variable
R137	4654	3.9K	5%		
R138	4504	47K	20%		
R139	Not Used				
R140	4553	1.2K	10%		
R141	4677	330K	20%		
R142	4831	50K	"Brightness"		Variable
R143	4511	100K	20%		
R144	4661	68K	20%		
R145	Not Used				
R146	Not Used				
R147	4511	100K	20%		
R148	4543	4.7K	20%		
R149	4607	3.3K	10%		
R150	4661	68K	20%		
R151	4571	100K	10%		
R152	4660	12K	20%		
R153	4506	470K	20%		
R154	4628	22K	10%		
R155	4629	5.6K	10%		
R156	4835	100K	"Horiz. Drive"		Variable
R157	4589	150K	10%		
R158	4640	1.8K	10%		
R159	4622	470K	10%		
R160	4651	8.2K	10%		
R161	4506	470K	20%		
R162	4566	100	10%		
R163	4657	120	10%	2 W	
R164	4658	8.2K	10%	1 W-Used in Chassis 171 173, 175	
	4665	15K	20%	2 W-Used in Chassis 170	
R165	4735	2.2 ohms		1/2 W Used in Chassis 170	Wire Wound
	4719	4.7 ohms	10%	1/2 W Used in Chassis 171, 173, 175	Wire Wound
R166	4673	2.7K	20%	Part of Yoke Assembly Not Used in Chassis 175	
R167	4506	470K	20%		
R168	4505	10 meg	20%		
R169	4662	18K	10%		
R170	4628	22K	10%		
R171	4660	12K	20%		
R172	4511	100K	20%		
R173	4618	220K	10%		
R174	4557	6.8K	10%		
R175	4557	6.8K	10%		
R176	4628	22K	10%		
R177	4515 or Part of Z7	10K	20%		
R178	4515	10K	20%		
R179	4614	1 meg	10%		
R180	4832	1 meg	"Vertical Hold"		Variable

SYMBOL	PART NO.	VALUE	TOL.	WATTS OR VOLTS	TYPE
R181	Not Used				
R182	Not Used				
R183	34643	3.3 meg	10%	1 W	
R184	4821	2.5 meg	"Vertical Size"		Variable
R185	4607	3.3K	10%		
R186	4513	1 meg	20%		
R187	4507	560	10%		
R188	4820	5K	"Vertical Linearity"		Variable
R189	4737	10K		5 W	
R190	4507	560	10%	Part of Yoke Assembly	
R191	4507	560	10%	Part of Yoke Assembly	
R192	4511	100K	20%		
R193	4511	100K	20%		
R194	4730	150	10%	10 W	Wire Wound
R195	4732	1500	10%	4 W	Wire Wound
R196	4834	10K	"Focus"		Variable
R197	4731	1100	10%	10 W Total	Tapped Wire Wound
R198	4731	800	10%		
R199	Not Used				
R200	Not Used				
R201	Not Used				
R202	Not Used				
R203	4558	100K	20%	1 W	
R204	Not Used				
R205	4724	5K		3W	Wire Wound
R206	4724	5K		3W	Wire Wound

SYMBOL	PART NO.	DESCRIPTION
L101	5391	Picture IF Peaking
L102		20.1 mc Trap
L103	5344	27.6 mc Trap
L104	5386	21.6 mc Sound Take-off and Part of Trap
L105	5342	27.6 mc Trap
L106	5339	350 mh Vidio Peaking (Series)
L107	5340	350 mh Vidio Peaking (Shunt)
L108	Not Used	
L109	5300	Horizontal Hold
L110	5317	Horizontal Size (Width)
L111		Horizontal Deflection Coils, Part of Yoke Assembly
L112	5389	Vertical Deflection Coils, Part of Yoke Assembly
L113	5341	Focus Coil
L114	5133	RF Filament Choke
L115	5338	Detector Series Peaking Coil
T101	5304	21.6 Sound IF
T102	5305	Ratio Detector Transformer
T103	5147	Audio Output Transformer
T104	5335	1st Picture IF
T105	5335	2nd Picture IF
T106	5336	3rd Picture IF
T107	5144 or 5146	Horizontal Output Transformer (5144 for Chassis 170, 171, 173; 5146 for Chassis 175)
T108	5127	Vertical Blocking Transformer
T109	5140	Vertical Output Transformer
T110	5023	Power Transformer
Z7	9695	Vertical Integrator Network
F100	9515	1/4 Amp Fuse, High Voltage
F101	9648	Fuse, Line, 3 Amp Slo-Blo Type 3AG
S101	Part of 4833	A.C. Line Power Switch
S102	6007	T.V. or Phono Switch
CK705	9075	Crystal Vidio Detector
	9676	Pilot Lamp Type 51
		TV Tuning Unit
	9684	Turret Type
	99532	Continuous Type
	9702 or 9669	Beam Bender (Single Magnet) 60 gauss
	6121	Phono Input Receptacle
	6114	UHF Adapter Receptacle
	6126	Power Interlock Receptacle
	6108	Phono AC Power Plug

MODELS 630, 631, 870, 871, 872, Ch. 170; 632, 633, 634, 635, 366, 367, 868, 376, 877, 878, Ch. 171; 366A, 367A, 868A, 376A, 877A, 878A, Ch. 173; 890, 891, 892, Ch. 175

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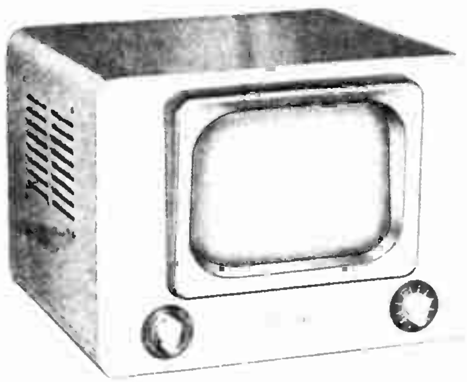
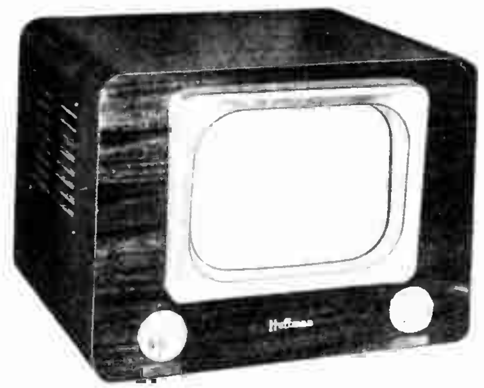
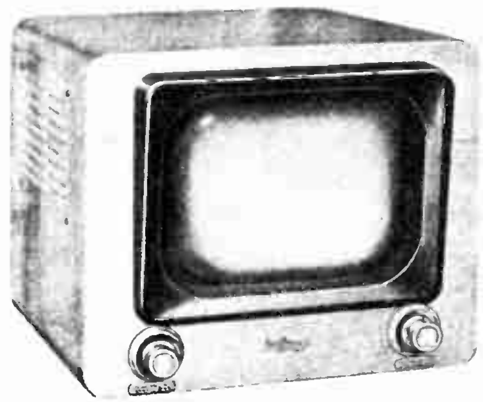


Model 630 - Blonde Oak Cabinet



Model 631 - Mahogany Cabinet



Model 634 - Blonde Oak Cabinet

Model 635 - Mahogany Cabinet

SPECIFICATIONS

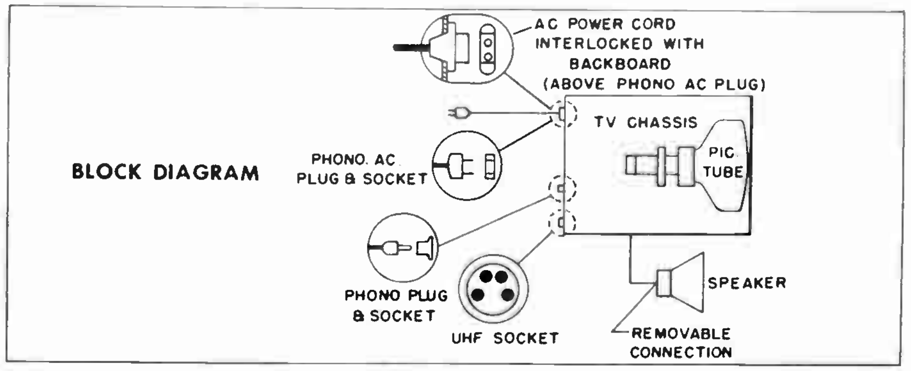
Line Voltage	115V AC 60 cps	Speaker Type	
		Models 630, 631	8" Round PM
		Models 634, 635	6" x 12" Oval PM
Number of Tubes	21		
Picture Tube Size		Cabinet Height	
Models 630, 631	14" Rect.	Models 630, 631	16 3/8"
Models 634, 635	16" Rect.	Models 634, 635	18 3/8"
Power Consumption	205 Watts		
TV Channels	2 through 13	Cabinet Width	22"
Audio Power Output	3 Watts	Cabinet Depth	18 1/2"

PHONOGRAPH CONNECTIONS

Circuit connections are built into these models for attaching an external phonograph. A crystal pickup type record player must be used. A 45 rpm 7" record changer, a Long Playing changer, or a standard changer will produce good results. The phono AC power cord may be conveniently plugged into a socket marked AC PHONO located directly below the AC line cord lock at the left rear portion of the chassis. The phono audio lead goes into an audio jack marked INPUT PHONO located at the right rear portion of the chassis. The audio amplifier system of the TV receiver is controlled by the slide switch located adjacent to the INPUT PHONO jack. When this switch is placed in the PHONO position, the output of the record player pickup is amplified through the TV audio system. The volume is controlled in the normal manner with the volume control at the left front of the chassis. The slide switch marked TV-PHONO has no effect on the picture circuits of the receiver. The CONTRAST control may be turned full off to remove the picture. (Brightness should have been previously set so that light just begins to appear at minimum contrast setting.) All power to the phonograph is turned off when the TV receiver is turned off.

MAJOR COMPONENTS

Cabinet	
Model 630	7578
Model 631	7579
Model 634	7580
Model 635	7581
TV Chassis	
Models 630, 631	170
Models 634, 635	171
Tube, Picture	
Models 630, 631	14CP4
Models 634, 635	16TP4
Glass, Window Protective	
Models 630, 631	745
Models 634, 635	743
Frame, TV Glass	
Models 630, 631	2426
Models 634, 635	2387
Mask, Frame Liner	
Models 630, 631	2427
Models 634, 635	2388
Speaker	
Models 630, 631	9076
Models 634, 635	9074
Antenna Assembly	99609
Loop, Antenna	9667
Azimutrol	9658
Knob, Antenna Tuning	3691
Backboard	
Models 630, 631	2435
Models 634, 635	2436
Cord, AC	3176
Plate, Contrast-Off-On-Volume	2446
Plate, Channels-Tuning	2448
Knobs	
Turret Tuner	
Channel Selector	33502
Fine Tuning	3642
Off-On-Volume	SK341
Contrast	SK342
Continuous Tuner	
Channel Selector Assembly	33504
Contrast-Off-On-Volume Assy.	33505
Brightness	3719
Vertical Hold	3719



Service information on chassis 170 and 171 is given in Service Data No. 136, and should be referred to when chassis servicing is required.

It may happen that chassis 173 with the 17" picture tube will be found in cabinets similar to those used with Models 634 and 635. Such sets will be designated as Models 634A and 635A, and are identical to Models 634 and 635 respectively except for picture tube and associated hardware.

PRODUCTION CHANGES

CHASSIS 170, 171, 173, 175

SAFETY FACTOR FOR CATHODE RAY TUBE

An additional safety factor on the cathode ray tube heater-cathode potential has been provided in the above listed chassis. This has been accomplished by tying the CR tube filament to a +180 v potential instead of the +265 v potential formerly used.

The following wiring changes have been made in production in order to achieve the above objective. At the AGC keyer tube, V110, the jumper between pins 4 and 6 has been removed. The red (orange in some chassis) wire that formerly was connected to pin 4 of V110 has been moved to pin 6 of V110 so

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that both red (and/or orange) wires are connected to the same pin. In some early receivers only the jumper need be removed since both wires are already connected to pin 6. A jumper has been run between pins 2 and 4 of V110. So far, then, the result has been to change the filament connection from the +265 v string to the +180 v string. This was necessary because the V110 filament shares its filament winding with the CR tube, and the B+ string leads included in the wiring change serve the dual function of completing the filament circuit of these two tubes and of providing the correct B+ potential to the filament. Continuing the wiring change detail, the transformer filament lead that formerly connected to the +265 v side of the focus control, R196, was moved to pin 3 of the 5U4, V116. Formerly, pin 3, had not been used. An additional orange wire 8 inches long was connected to this same pin 3 and to the tie lug on C183. The black CR tube filament lead was removed from the +265 v string tie lug and wired to the +180 v side of the brightness control (R142). The final result was to change the B+ leads that made up part of the filament circuit shared by the CR tube and AGC keyer tube so that the filament potential of the CR tube was brought closer to its cathode potential. In this manner the safety factor on the CR tube heater-cathode potential has been increased.

IMPROVED TUNING CHARACTERISTIC

A production change involving the audio IF section of the TV receiver has been made in order to make the point of optimum sound reproduction less critical when the head end is tuned. This objective has been accomplished by broadening the sound IF bandpass. Therefore, just as the broad bandpass of the video IF stages makes it possible for the RF oscillator to be detuned slightly, giving a higher or lower center IF frequency without serious changes in picture reproduction, so the broader bandpass of the sound IF stages permits a less critical tuning of the RF oscillator.

In order to increase the bandpass, the following circuit and part changes were made.

Old Part	New Part	Difference
C103, C109 (4029)	C103, C109 (4090)	V101, V102 Screen bypass condensers reduced from .005 mfd to 1500 mmfd.
C108 (4029)	---	Remove from circuit.

REDUCTION OF PICTURE SMEAR

A production change concerning the retrace line elimination circuit has been made in order to reduce picture smear present when the CR tube draws grid current. A study of the schematic diagram, of chassis 170, 171, 173 and 175 will reveal that the retrace line elimination circuit can act as a grid leak biasing circuit for the CR tube grid. When the grid draws grid current as it will when the cathode is driven by relatively high negative peaks (high contrast levels), a negative bias is produced which, tends to bring the CR grid to its cut-off potential. This negative bias remains on the grid until it has has time to leak off via the RC path of the circuits involved. By reducing the RC time constant of the effective grid leak, the grid is not held near cut-off for so long a time, relatively speaking, and the faster recovery makes it possible for the grid to follow the transmitted video information.

The RC time constant was reduced by making the following circuit and part changes.

Old Part	New Part	Difference
R145 (4513)	---	1 meg resistor deleted to reduce time constant.
C146 (4149)	C146 (4029)	Coupling capacitor value change from .0047 mfd to .005 mfd and voltage rating changed from 1000 V to 500 V.
---	C185 (4029)	.005 mfd capacitor added to complete capacity voltage divider.

The circuit changes are indicated in figure 1 below.

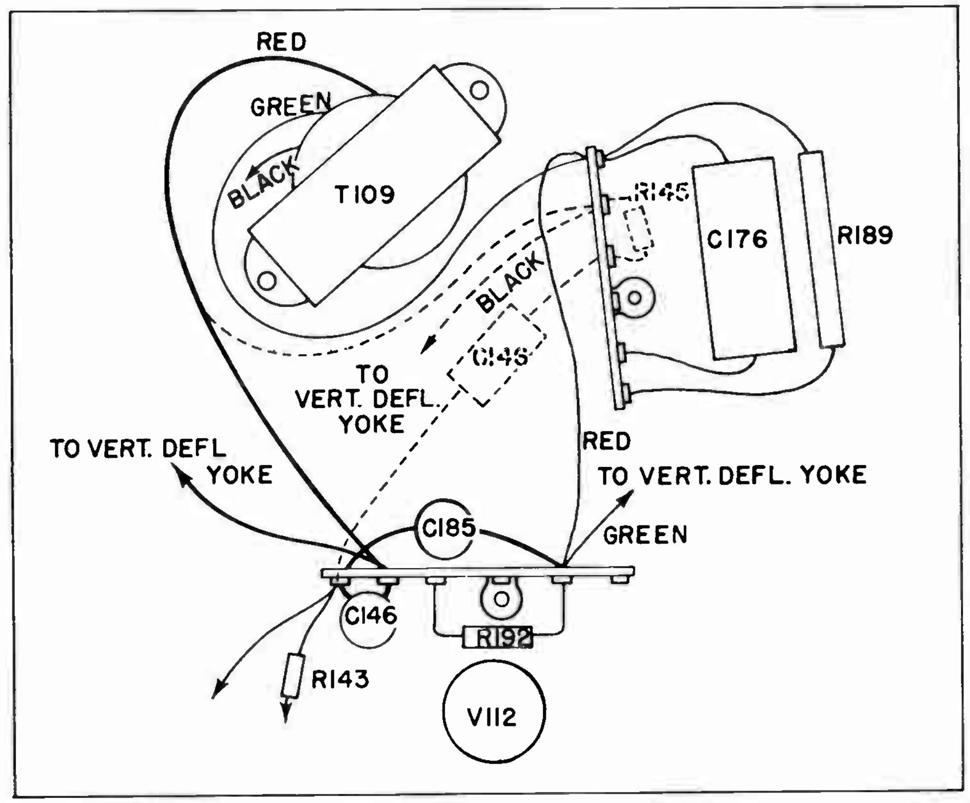


Figure 1

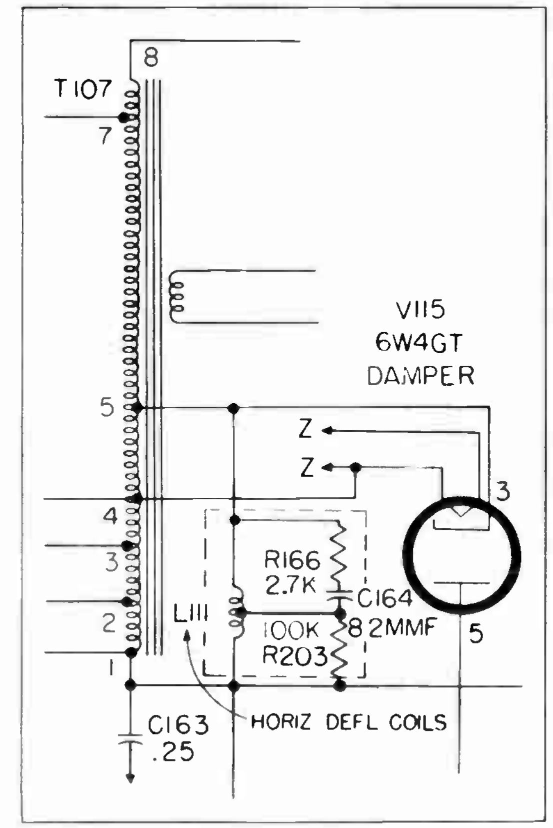
Note: Dotted lines indicate wiring and components before change was made. Heavy black lines indicate wiring and components changed.

PRODUCTION CHANGE
IN DEFLECTION YOKE
CHASSIS 170 SERIES*

A production change involving the deflection yoke assembly has been made in production. The horizontal windings in the yoke assembly used just prior to this change have an inductance of 10.3 millihenries. This value of inductance offered a higher resonant frequency than does the new 25 millihenry winding. The change provides a reduction in the vertical light bars seen on the screen of some early production chassis.

Figure 1 shows the revised portion of the circuit under discussion. Attention is directed to the error in Figure 8, Service Bulletin No. 139. The junction of, L111 and R166 should be shown connected to lug 5 of the horizontal output transformer. The only wiring change made, external to the yoke, is that of moving the connection of the red yoke lead from pin 7 to pin 3 on the 6W4, V115, tube socket. In effect, this change, places the horizontal deflection coils between lugs 1 and 5 instead of between lugs 1 and 4 of the horizontal, output transformer. The reason for moving the yoke lead from lug 4 to lug 5 lies in correct impedance, matching between output transformer and load (deflection coils).

The circuit changes require the change in deflection yoke (L111 and L112), R166, C164, and an addition of a resistor, R203.



Symbol	Value	Tol.	Watts or Volts	Type	Part No.
L111,L112	-	-	-	-	5389
R166	2.7 K	20%	1/2 W	Comp.	4673
R203	100 K	20%	1 W	Comp.	4558
C164	82 Mmfd	20%	1500 V	Mica	4087

The above change will appear on all sets produced after Serial No. H074558

NOTE

*The term "170 Series" includes Chassis 170, 171, 172, 173, 174, 175, 176, and any possible future chassis that are closely related to those listed here. The term will be used in all future bulletins dealing with these chassis.

MODELS 630, 631, 870, 871, 872, Ch. 170; 632, 633, 634, 635, 866, 867, 868, 876, 877, 878, Ch. 171; 866A, 867A, 868A, 876A, 877A, 878A, Ch. 173; 890, 891, 892, Ch. 175

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ALIGNMENT IMPROVEMENT

CHASSIS 170 SERIES

This service note deals with production changes which result in simplification of the alignment procedure and a more nearly ideal video IF bandpass characteristic.

Figure 1 shows identification of parts, and may be used in conjunction with previous schematic diagrams of chassis 170 series in order to accentuate what changes were made. The changes result in an approximately flat topped IF response curve by introducing more resistance loading into the first two video IF transformers and by decreasing the coupling in the second video IF transformer. The loss in gain brought about by these changes is more than balanced by eliminating the by-passed portion of the cathode resistance in the first two video IF stages. The resulting decrease in bias in no way causes the operating ratings of the tubes to be exceeded.

Old Part	New Part	Difference
*R117, R122 (4671)	R117, R122 (4648)	Decreased from 3.9K to 3.3K
R120, R126 (4616) C126, C132 (4029)	---	150 ohm portion of cathode resistance and associated by-pass capacitors not used.
R119 (4639)	R119 (4620)	Resistance reduced from 47 ohms to 39 ohms. No change in rating.
C133 (4082)	C133 (4074)	Capacitance reduced from 1.5 mmf to 1.2 mmf.

The wiring of the two 3.3K resistors and the 1.5 mmf capacitor should duplicate the old components, regarding position and lead length. However, the new R119 resistor and previous R125 resistor should be returned to the suppressor grid ground point rather than returning the resistors to the grounded tie lugs of the tie point strips. The latter connection would introduce unwanted inductance into the IF circuits.

These changes have been made on all sets produced after Serial No. G067626.

*R117 should be reduced to 1.8K (4640) in those chassis which employ the alternate adjacent channel sound trap shown in figure 14, Service Bulletin No. 136. This alternate trap may be easily identified by the ceramic trimmer capacitor mounted on the lip of the IF sub-chassis near the first video IF stage.

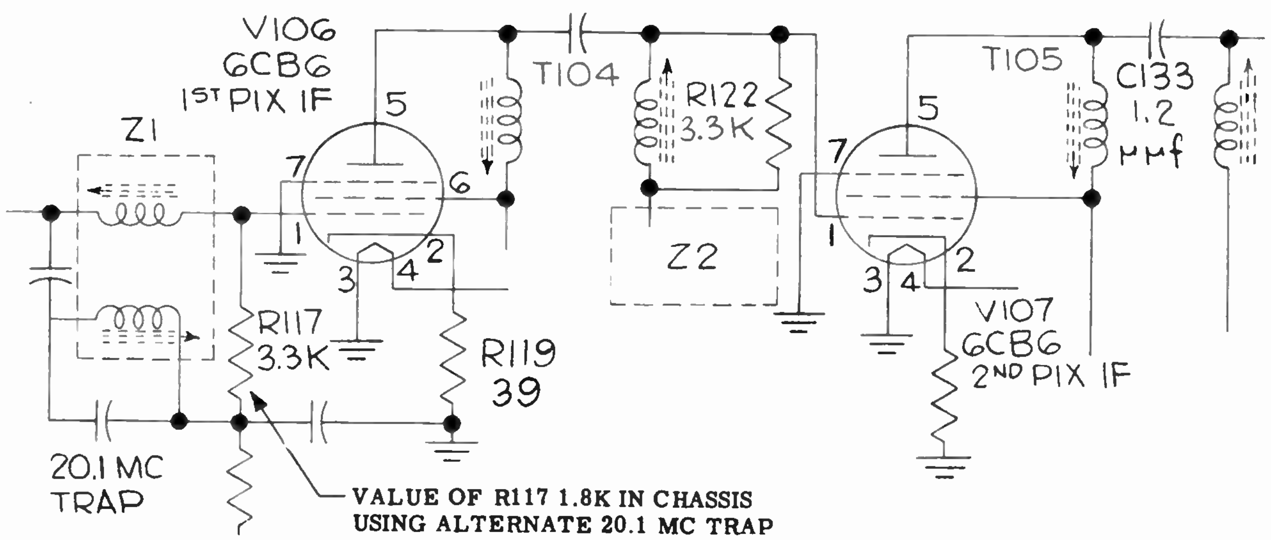

Figure 1. Portion of schematic diagram, TV chassis 170 series, showing component changes for improved alignment. Only changed components have been labeled with numerical values.

PRODUCTION CHANGES
ELIMINATION OF "CHRISTMAS TREE" EFFECT
SHADING AT TOP OF PICTURE
ELIMINATION OF SMEAR
CONTRAST IMPROVEMENT

CHASSIS 170 SERIES

ELIMINATION OF "CHRISTMAS TREE" EFFECT

There are some receivers in the field that are troubled by "Christmas tree" under certain operating conditions, such as occurs during between-channel tuning or tuning to one particular channel. This condition may be remedied by reducing the resistance value of R157, the 220K resistor that is in series with the HORIZONTAL DRIVE potentiometer.

Old Part	New Part	Difference
R157 (4618)	R157 (4589)	Value of R157 reduced from 220K to 150K. No change in rating.

This change has been made on all sets produced after Serial No. G067626.

SHADING AT TOP OF PICTURE

In order to eliminate the dark shading at the upper portion of the picture that occurs on some receivers at low contrast settings, the following changes are recommended:

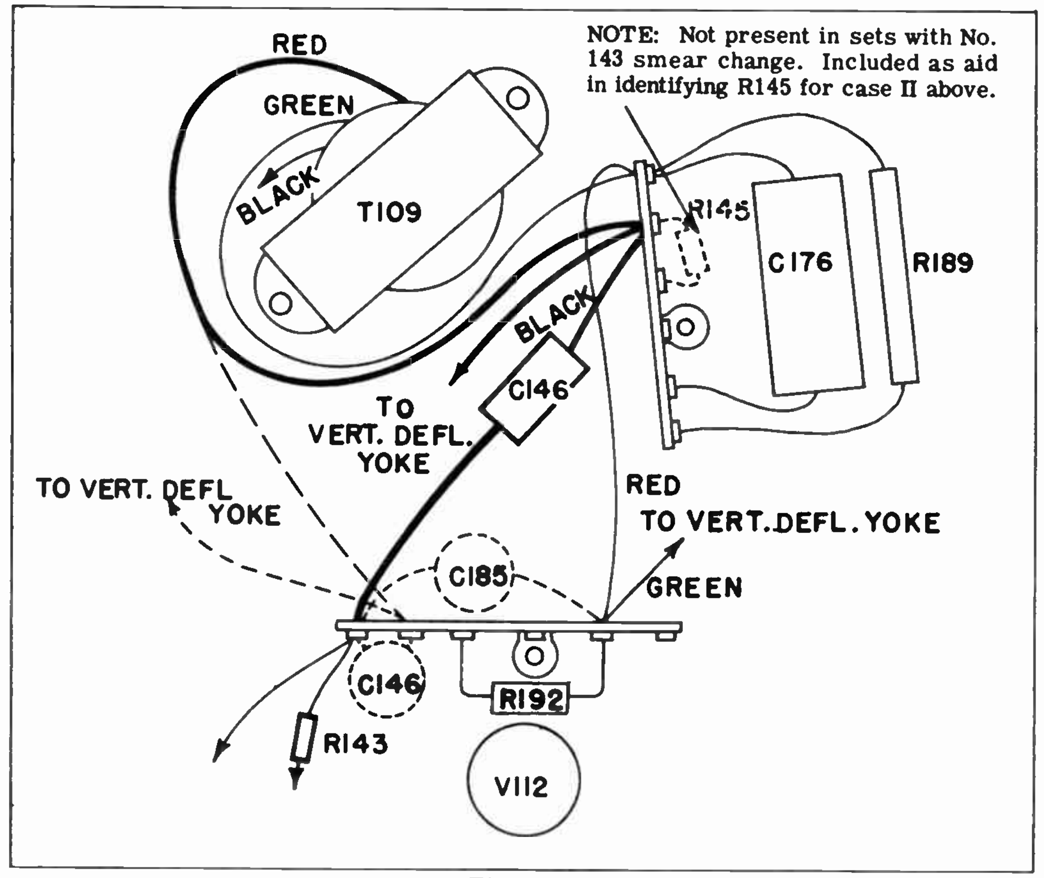

Figure 1

Dotted lines indicate wiring and components before shading change was made on those sets in which the smear change of Bulletin No. 143 was made. Heavy black lines indicate wiring and components changed.

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Case I - Sets containing smear change indicated in Figure 1.

Remove C185 and reduce the resistance value of R143 to 100K ohms. Change C146 to a higher voltage rating and rewire as indicated in figure 1.

Case II - Sets that do not contain smear change shown in Figure 1.

Move C146 lead to other side of R145, eliminating R145 from the circuit. Reduce resistance value of R143 to 100K ohms.

Old Part	New Part	Difference
C185 (4029)	---	C185, .005 mfd Hi-K removed from circuit.
R143 (4513)	R143 (4511)	R143 reduced from 1 meg to 100K. No rating change.
C146 (4029)	C146 (4149)	C146 change from .005 mfd, 500 v to .0047 mfd, 1000 v. (Case I only)

This change has been made on all sets produced after Serial No. G067626.

NOTE: C146 and C185 shown in Figure 1 have their "C" numbers erroneously interchanged in the circuit schematic, Figure 8, Service Bulletin No. 139. This must be kept in mind if reference is made to this schematic concerning the change described above.

ELIMINATION OF SMEAR

Smear, as exemplified on the screen by trailing shades from black toward white after large dark objects and white toward black after large white objects, and a general fuzzy appearance throughout the picture, is still present in some sets incorporating the smear change covered in Service Bulletin No. 143. The remaining smear is caused by insufficient low frequency response of the video amplifier, and it may be eliminated by an increase in low frequency response. To accomplish this, the coupling capacitor between the video amplifier and the CR tube should be increased in value.

Old Part	New Part	Difference
C145 (4029)	C145 (4131)	C145 increased from .005 mfd, 500 v to .22 mfd, 200 v.

This change has been made on all sets produced after Serial No. G067626.

CONTRAST IMPROVEMENT.

Field reports have indicated that more picture contrast is desirable at high level settings of the CONTRAST control. The condition shows up as a washed out appearance of the picture. The effect has been due to the linear relationship between increase in contrast and increase in brightness. In order to obtain a picture that appears to have more contrast at high contrast levels, the relationship can be made non-linear by the following change. Increase the resistance value of R141. When this has been done the picture brightness will increase at a slower rate than the rate of increase in picture contrast.

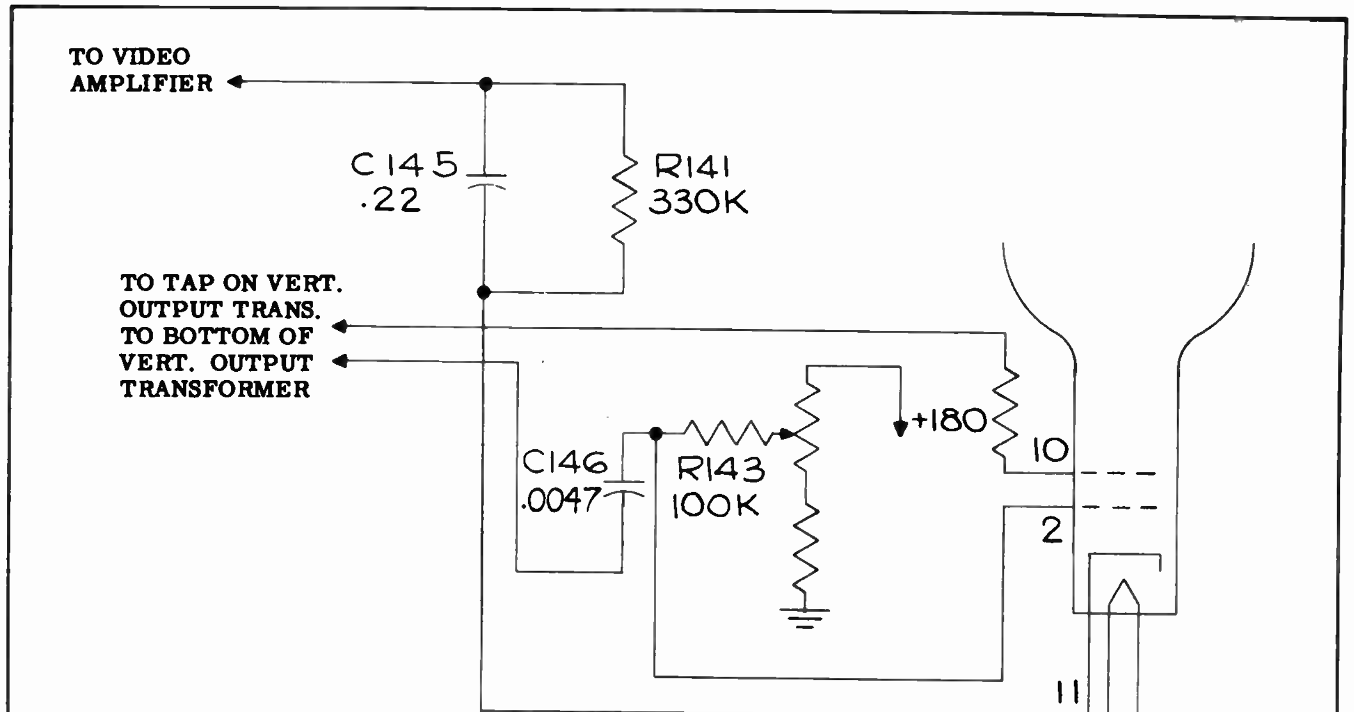
Old Part	New Part	Difference
R141 (4511)	R141 (4677)	R141 increased from 100K to 330K. No rating change.

This change has been made on all sets produced after Serial No. G067626.

CONTRAST CHANGE

All 170 Series chassis are being produced with a 680-ohm resistor connected in shunt across the contrast potentiometer. The physical location of the new resistor is from pin 2 of V109, the video amplifier, to ground. The maximum resistance in the cathode circuit of the video amplifier is lowered, and the minimum contrast level previously obtained is raised. This means that the seldom used lower third of the contrast range is dispensed with, and the more useful range that remains is spread out over a greater scale. It is important to note that the recommendations for setting the brightness control are now different. The recommended procedure for setting the brightness control is to set the control for medium brightness at minimum contrast setting. This will produce a picture with average background characteristics at about three-quarters contrast setting. For individual tastes that vary from this recommendation, the brightness control may be set so that it is most pleasing to the observer.

Old Part	New Part	Difference
-----	R207 (4514)	680 ohms, 1/2 watt, 20% resistor added in parallel with contrast potentiometer.



Portion of schematic diagram, TVchassis 170 series, showing component changes covered in this bulletin. Only changed components have been labeled with numerical values.

Figure 2.

DEFINITION IMPROVEMENT

CHASSIS 170 SERIES

Closely associated with the smear effect as far as picture appearance is concerned, is the general lack of contrast which shows up in the picture as a reduction of fine detail. This effect is caused by a falling off of the high frequency end of video response in the video amplifier circuit. The response may be improved by making the following changes which may be identified in Figure 1. Remove R139 and replace it with a short piece of hook-up wire. It is suggested that the leads of R139 be kept as long as possible during its removal so that it may be used to replace R138. Remove R138 and connect a 47K resistor between the junction of L106, L107 and the tie lug previously used for connecting R138 to C166. Change C166 to 220 mmf. Change R168 to 10 meg. Remove C167. These changes will introduce less loading on the video amplifier without changing the noise immunity going into the 1st sync separator.

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Old Part	New Part	Difference
R139 (4504)	---	R139 replaced by direct connection.
R138 (4515)	R138 (4504)	R138 increased from 10K to 47K. No rating change.
C166 (4146)	C166 (4026)	C166 decreased from .001 mfd. to 220 mmf, 20%, ceramic.
R168 (4605)	R168 (4505)	R168 increased from 1.5 meg. to 10 meg. No change in rating.
C167 (4009)	---	C167 removed from circuit.

These changes have been made on all sets produced after Serial No. H070169.

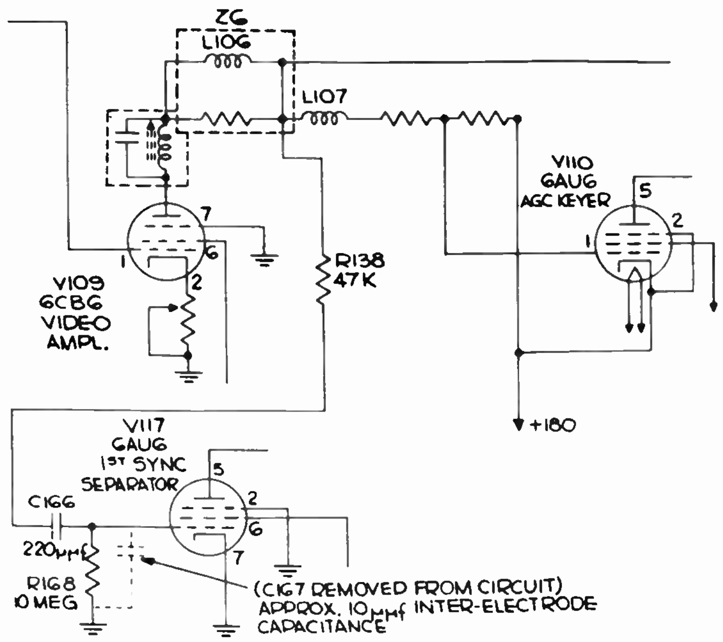

Figure 1
Portion of circuit schematic for chassis 170 series. Only those components affected in the changes are labled with numerical values.

INCREASE 21.6 MC TRAPPAGE

CHASSIS 170 SERIES

Some receivers are being troubled by excess 4.5 mc beat interference and sound in the picture. This unwanted situation makes it impossible to obtain a clear picture when the tuner is adjusted correctly for best sound. The difficulty may be eliminated by increasing the 21.6 mc trappage.

Figure 1 may be used as an aid in identifying the following changes. The additional 21.6 mc trap is obtained by converting Z4, at present one of the two 27.6 adjacent channel sound traps. Z4 is converted by increasing the capacitance in the parallel tuned circuit to 15 mmf. This is accomplished by shunting C143 with an additional 5 mmf condenser and peaking the converted trap to 21.6 mc. Conversion of Z4 to 21.6 mc results in less 27.6 mc trappage, so the connections on Z2, the other adjacent channel sound trap must be changed to provide the additional trappage. To alter Z2 disconnect the bare lead from the tap on the trap inductance. The tap connection is the one that is not connected to either side of the 10 mmf parallel condenser. Reconnect the bare lead to the trap lug that also has the 330 ohm resistor and .005 mfd condenser connected to it. Connect a 1.5 mmf condenser between pin 1 of the second video IF amplifier, V107, and the lug on the trap inductance to which only the parallel condenser C129 is connected, keeping the leads as short as possible. Peak Z2 for 27.6 mc.

Old Part	New Part	Difference
---	C190 (4081)	Shunts C143 with 5 mmf.
---	C189 (4082)	Add 1.5 mmf condenser between high side of trap and grid of V107.
Wiring change		Bare lead moved from tap on trap to low side of trap.

It is recommended that this change be made at the time the alignment change (bulletin No. 145) is made.

The additional 21.6 mc trappage has eliminated the need for the 4.5 mc trap, and factory production has eliminated its usage. It is recommended that the slug for the 4.5 mc trap be removed in all sets so that there will be no possibility of this trap causing a dip in high frequency response should it be misadjusted below 4.5 mc toward the high frequency end of the video response.

These changes have been made on all sets produced after Serial No. H069463

There are several hundred sets with serial numbers lower than the given number which also incorporate the change. However, in these sets the 4.5 mc trap is present, but the slug has been removed.

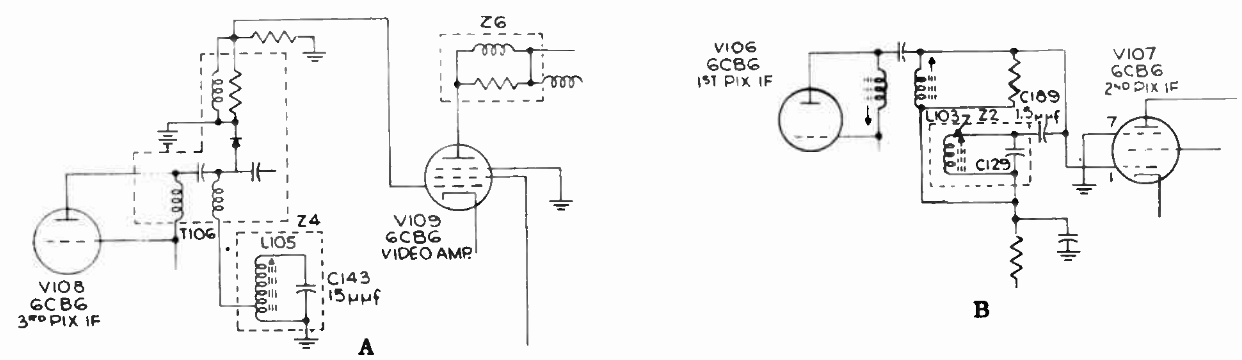

Figure 1.

Portions of circuit schematic for chassis 170 series showing trap changes. Only components included in change have been given numerical values.

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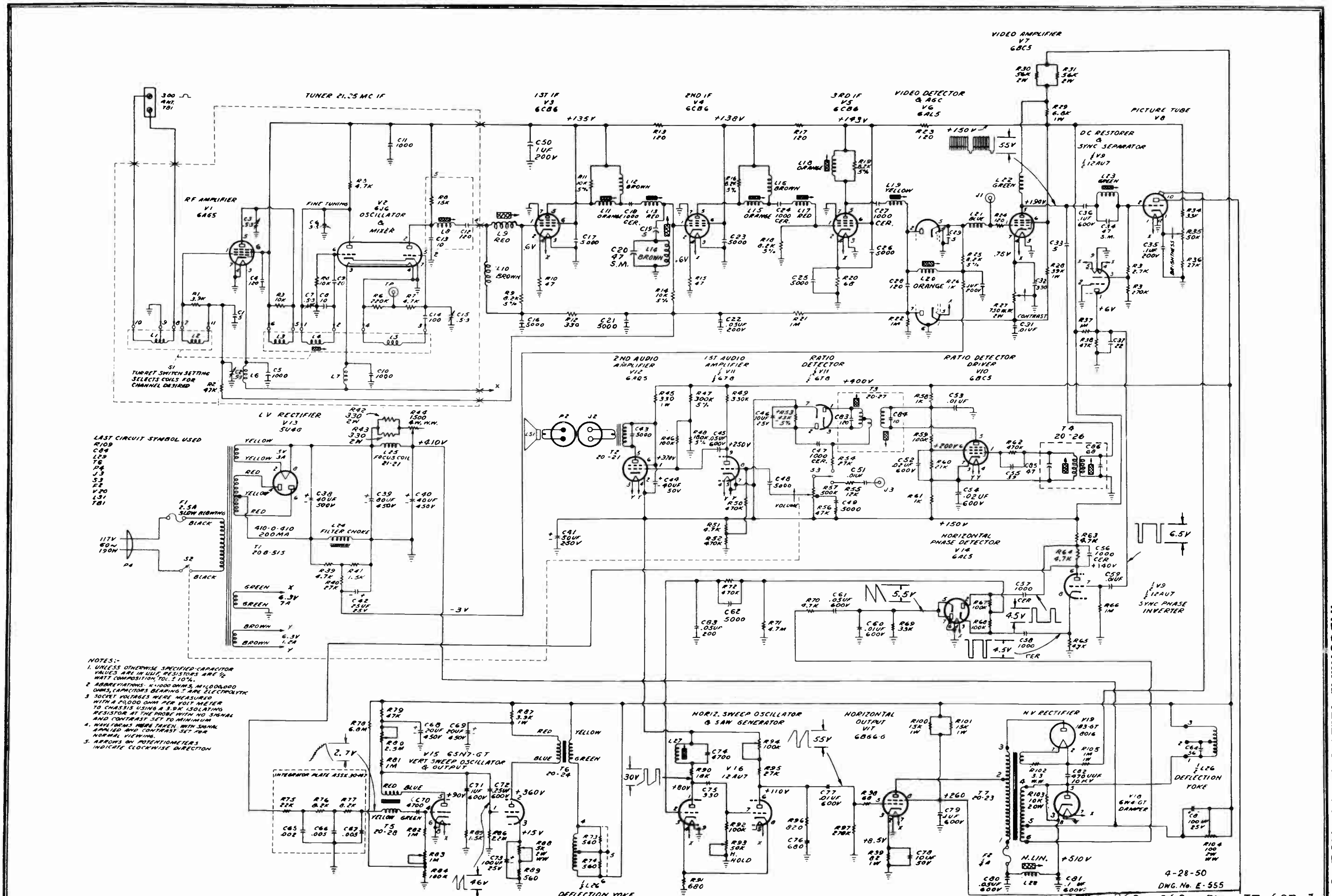

MODELS 860, 960, Ch. IT-60R-1;
760, 1160, 1260, Ch. IT-60R-2

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Issue 1
8/10/50

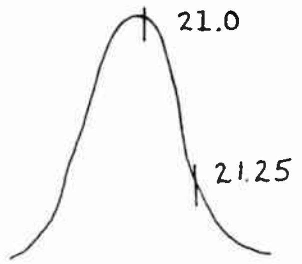
I.F. Alignment Procedure, IT-61R
Models 761, 1161, 1261, and 1361

REFERENCES: Circuit Diagram E-585
EQUIPMENT: Component Location Label 33D-583

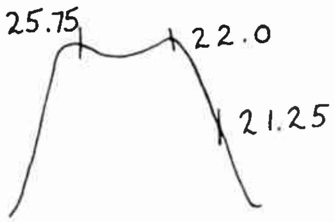
1. Sweep generator, 23.5 mc. center frequency, 10 mc. sweep width.
2. Marker generator, 21.25 mc., 22.0 mc., and 25.75 mc.
3. Crystal oscillator, variable output, 4.5 mc. unmodulated.
4. Oscilloscope.
5. 20,000 ohm per volt meter.

PROCEDURE, VIDEO I.F.:

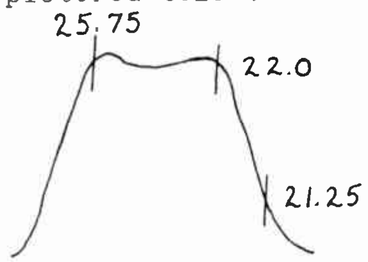
1. Connect oscilloscope to J1 test point.
2. Move tuner between channels to disconnect coils.
3. Short circuit the two component mounting lugs next to detector socket (V6) which are (1) the junction of R21 and C20, and (2) the junction of R26, C26, and R25. This places fixed bias on the A.G.C. line.
4. Connect sweep generator, decoupled with 1000 uuf., to pin 1 of V5. Turn the slug on L18 until it is centered in the coil. (This narrows the band pass of this stage.) Adjust L19 and L17 until the pass appears as below:



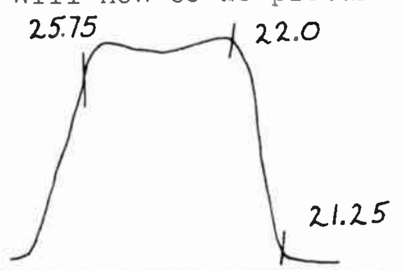
Now adjust L18 until pass is as pictured:

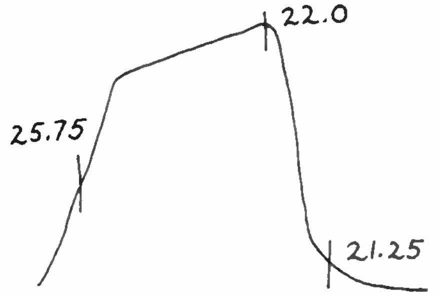


5. Move sweep generator to pin 1 of V4. Adjust L16 until pass balances, adjust L14 until pass balances. When properly adjusted, pass will look as pictured below:



6. Move sweep generator to pin 1 of V3. Adjust L13 and L11 as in above step. Pass will now be as pictured.





7. Move sweep generator to test point on tuner chassis); adjust L8 (square can on tuner) until the pass rocks through a tilt and leave adjusted with a 10% tilt in the pass, as pictured below:

The video I.F. is now correctly aligned.

INTERCARRIER SOUND SYSTEM:

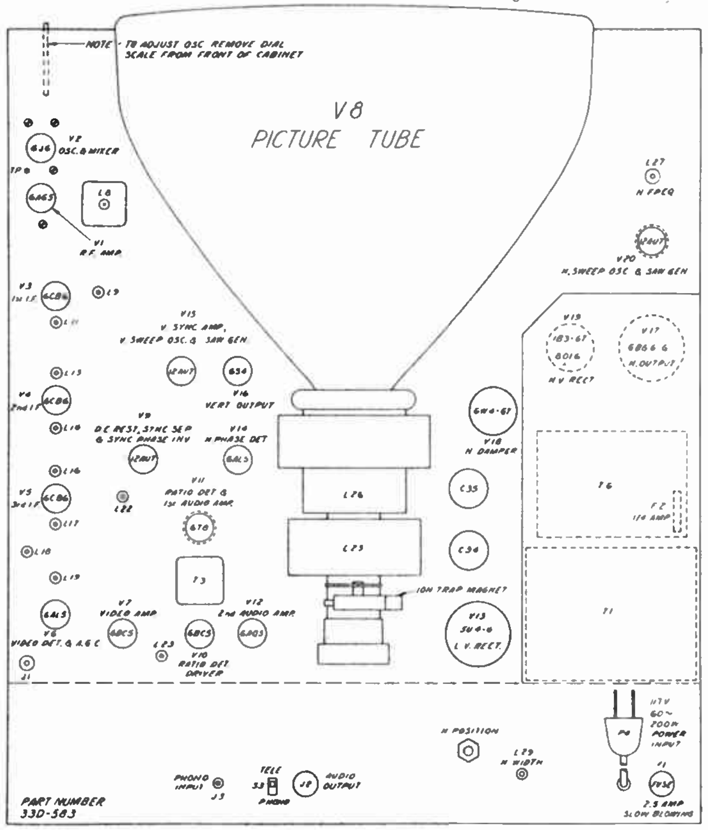
1. Connect voltmeter, set on 10 volt scale across C42, observing polarity.
2. Insert 4.5 mc. generator, capacity decoupled, in J1.
3. Reduce signal so that voltmeter reads a maximum of 3.0 volts, and continue to reduce as adjustments are made so as not to exceed this value.

Adjust in the order given, the following transformer slugs for maximum output:

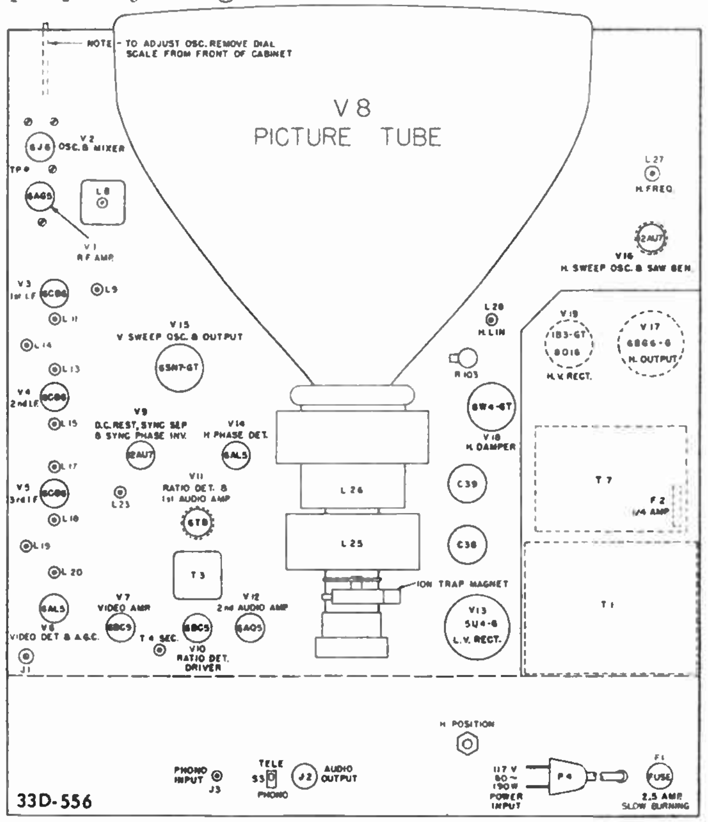
a. Bottom slug, T3.
b. L23.
c. Top slug, T3.

Repeat to insure accurate setting.

Intercarrier sound system is now properly aligned.



CHASSIS IT-60R-1,-2



CHASSIS IT-61R-1,-2,-3,-4,-5

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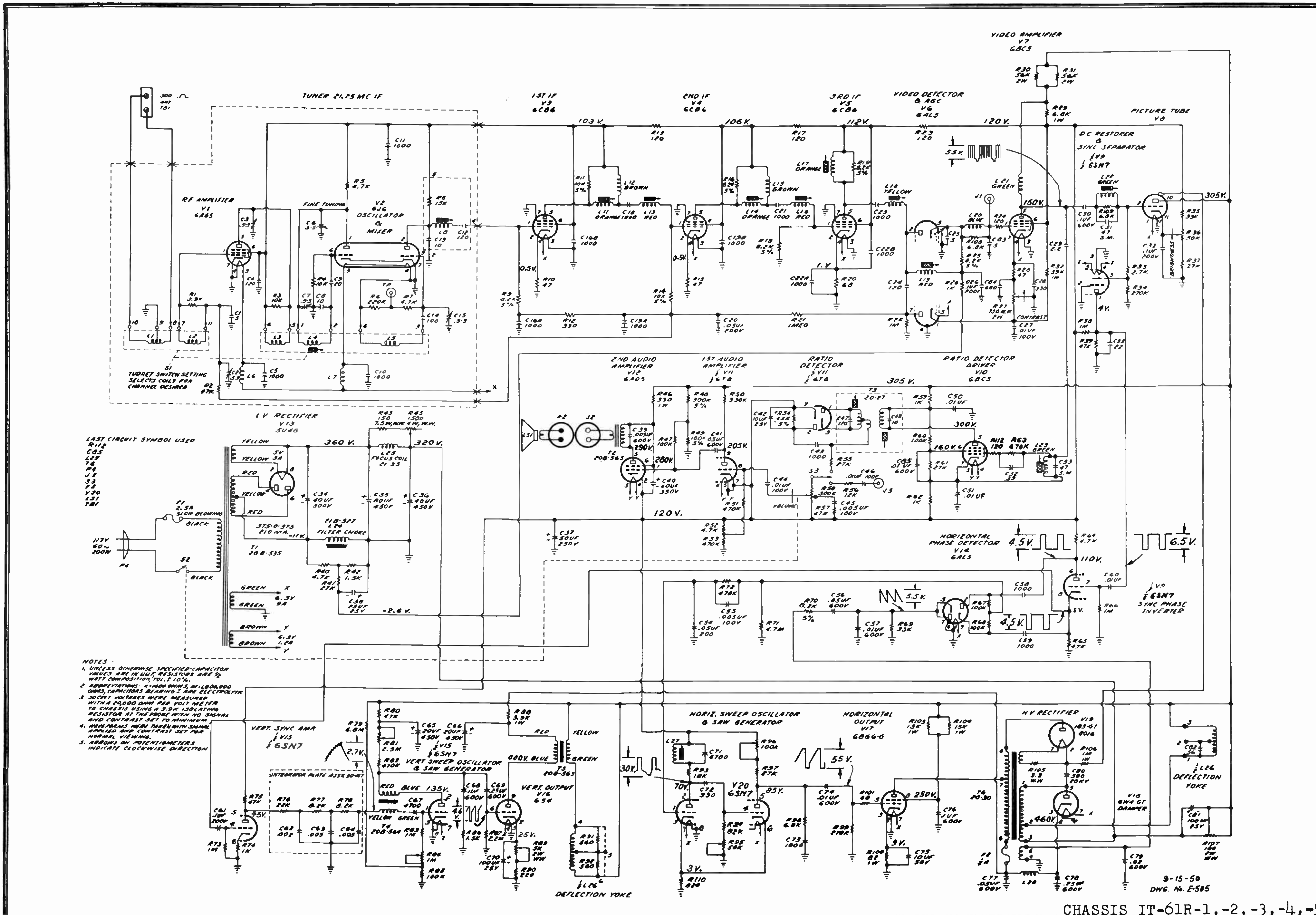

CHASSIS IT-61R-1,-2,-3,-4,-5

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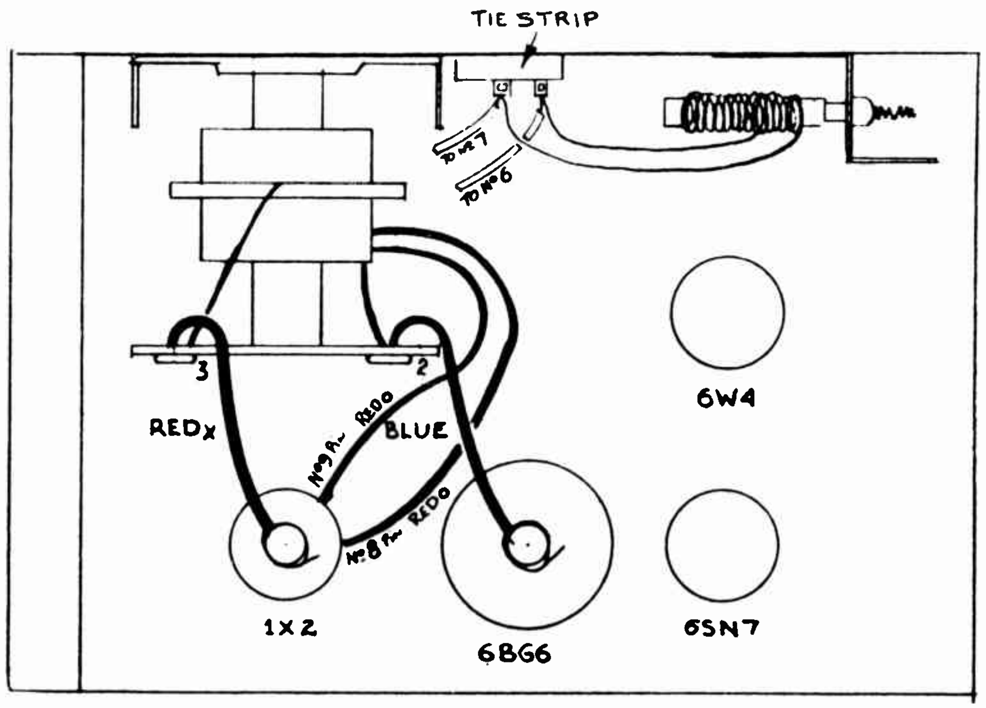
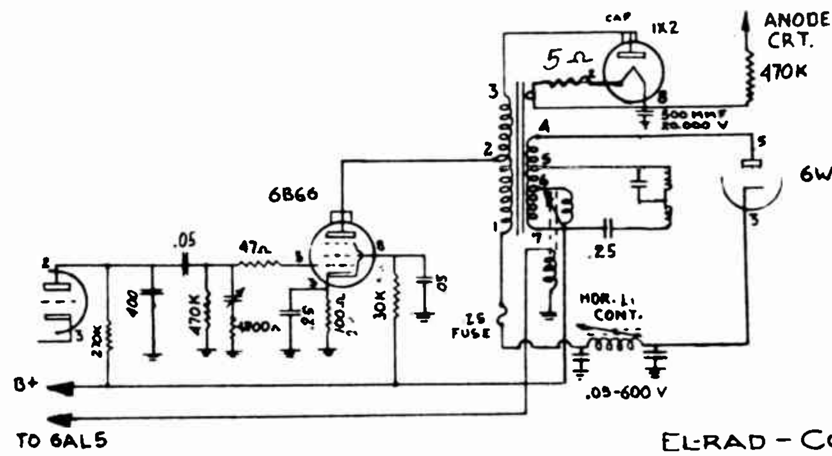
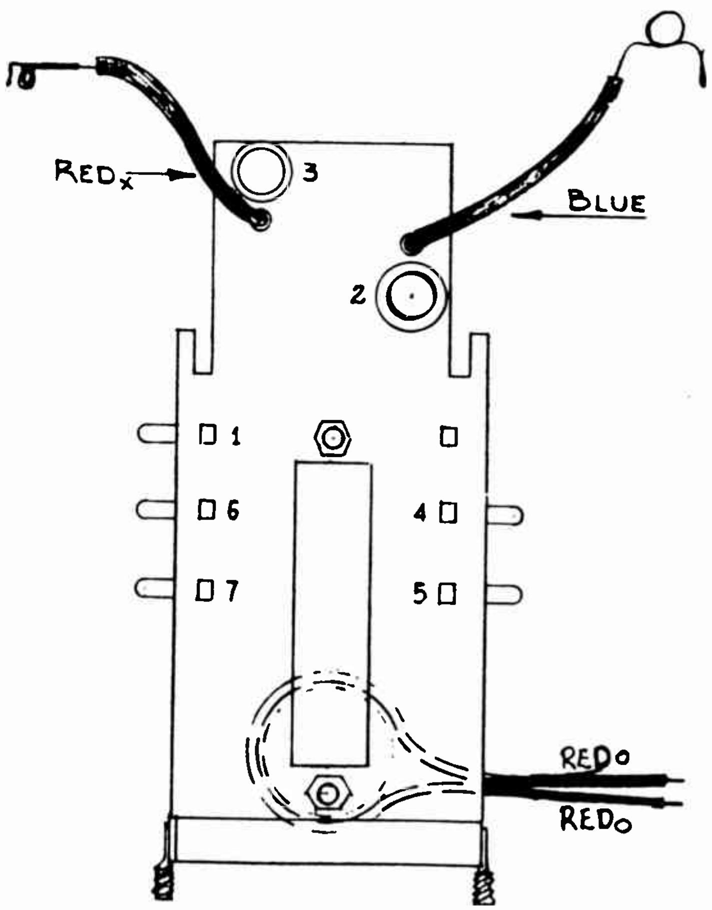


Top View Of High Voltage Can

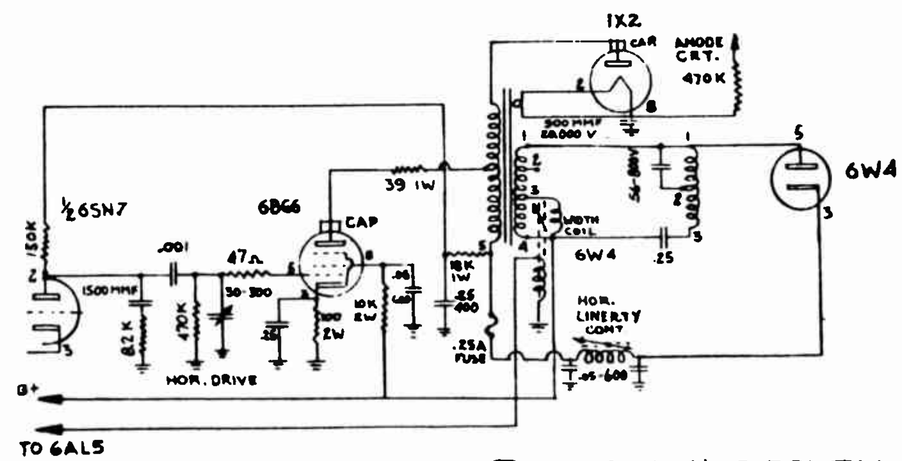
NEW CIRCUIT



EL-RAD - CONVERSION



OLD CIRCUIT



STEVENS HORIZONTAL OUTPUT

MODELS 14T, 16C,
16T, 26C, 26T, Code E

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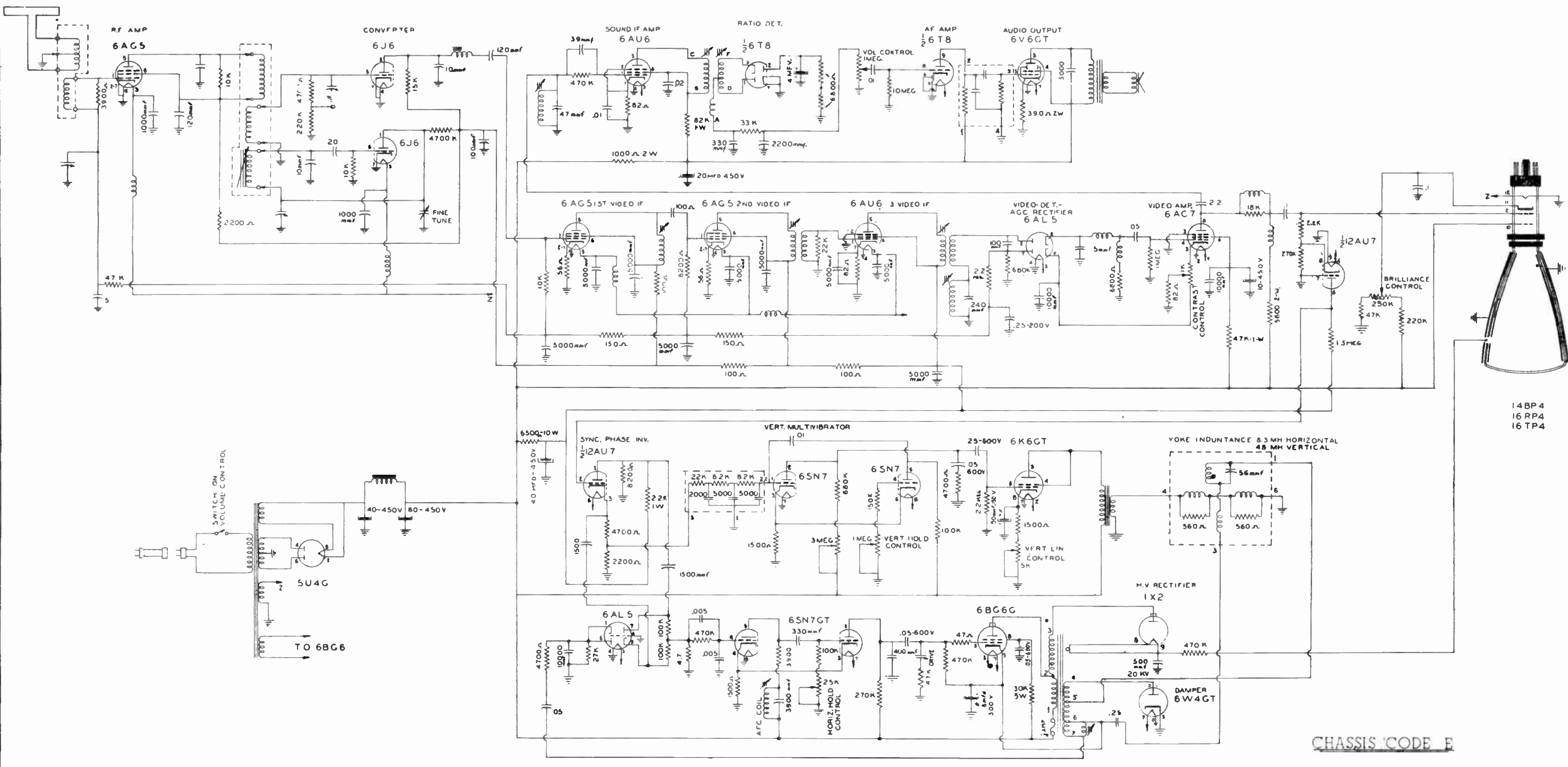
MODELS 14T, 16C, 16T, 26C, 26T, Code E



CHASSIS CODE E

14 & 16
SCHEMATIC DIAGRAM

All RESISTORS ½ WATT ±20%
UNLESS OTHERWISE NOTED

All CONDENSERS IN MMF- 600 V UNLESS
OTHERWISE NOTED

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GENERAL DESCRIPTION

Television chassis model 231 is a television receiver employing 19 tubes, plus 1 power rectifier, 2 high voltage rectifiers and a television picture tube. Television chassis model 242 has an additional tube for keyed AGC. Chassis model No. 231 is used in the following models:

231	Open Face Table Model	16" Rectangular Picture Tube
232	Table Model With Doors	16" Rectangular Picture Tube
233	Open Face Console	16" Round Picture Tube
234	"Hide-Away"	16" Round Picture Tube
235	"Windsor"	16" Round Picture Tube
236	"Normandy"	16" Round Picture Tube
237	"Cambridge"	16" Round Picture Tube
238	Open Face Console	19" Round Picture Tube
239	"Hide-away"	19" Round Picture Tube
240	"Windsor"	19" Round Picture Tube
241	"Normandy"	19" Round Picture Tube
731	Open Face Table Model	17" Rectangular Picture Tube
733	Open Face Console	17" Rectangular Picture Tube

SPECIFICATIONS

Overall Dimensions:

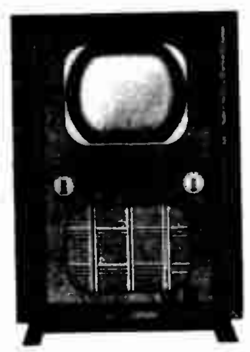
Model	Height	Width	Depth	Shipping Weight
231	19"	23¾"	21¼"	90 lbs.
232	21¾"	23"	23½"	104 lbs.
233	38⅛"	24"	21-9 16"	115 lbs.
234	38¼"	27"	24"	170 lbs.
235	38"	28½"	23½"	164 lbs.
236	40"	27"	24½"	165 lbs.
237	42½"	26"	24½"	134 lbs.
238	38⅛"	24"	21-9 10"	119 lbs.
239	38¼"	27"	24"	172 lbs.
240	38"	28½"	23½"	166 lbs.
241	40"	27"	24½"	160 lbs.
731	20"	23¾"	21¼"	90 lbs.
733	38⅛"	24"	21-9 16"	115 lbs.

Audio Power Output Rating:

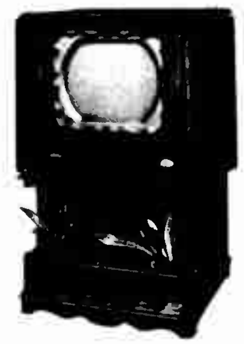
3 W. maximum

Tube Complement:

Tube	No. 1	Function
6AG5	V-1	Tuner, RF Amplifier
6J6	V-2	Tuner, Oscillator—Converter
6CB6	V-3	1st I-F
6CB6	V-4	2nd I-F
6CB6	V-5	3rd I-F
6AL5	V-6	Pict Det
12AU7	V-7	Video Amp
6AU6	V-8	Sound I-F
6AL5	V-9	Ratio Det
6AV6	V-10	Audio Amp
6K6	V-11	Audio Output
12AU7	V-12	Sync. Sep—Sync. Amp—D.C. Rest.
6AL5	V-13	Horiz Phase
6SN7	V-14	Horiz Osc
6AU5	V-15	Horiz Output
6AU5	V-16	Horiz Output
1V2	V-17	H. V. Rect.
1V2	V-18	H. V. Rect.
6J5	V-19	Vert Osc.
6S4	V-20	Vert Output
6W4	V-21	Damper
5U4	V-22	Rectifier
16" or 19" Pict. Tube	V-23	Pict. Tube
6AU6 (Model 242)	V-24	AGC keyer



THE HIDEAWAY



THE CAMBRIDGE

Tuning Frequency Range:
Television Channels 2 Through 13:
Intermediate Frequencies:

Video I-F Carrier	25 MC
Audio I-F Carrier	20.5 MC
Inter Carrier Sound	4.5 MC
Tuner I-F	24.2 MC
1st Video I-F	21.8 MC
2nd Video I-F	24.3 MC
3rd Video I-F	23.4 MC

Loudspeaker:

All models permanent magnet type: 3.2 ohm voice coil impedance at 400 cycles—Models 231-232 use 6" diameter speaker 2.18 oz. magnet. Models 233 through 241 use 12" diameter speaker—6.8 oz. magnet.

Power Supply Rating:

117 Volts—60 Cycles—211 Watts

Receiver Antenna Input Impedance:

300 Ohms Balanced

Video Response:

4 MC

Focus:

Electro-Magnetic

Sweep Deflection:

Electro-Magnetic

Scanning:

525 Lines Interlaced

Horizontal Scanning Frequency:

15,750 C.P.S.

Vertical Scanning Frequency:

60 C.P.S.

Picture Repetition Rate:

30 C.P.S.

Centering:

Electrical-Mechanical

OPERATION OF KAYE-HALBERT MODEL 231 TELEVISION CHASSIS

1. Turn the left inside bar knob slightly to the right to turn on the set. This knob also controls the volume. Allow a few minutes for the set to warm up. The sound will come on first, followed by the picture.
2. Turn the right inside bar knob until the number at the top of the dial indicates the channel desired. This is the channel selector.
3. Adjust the outside ring of the knob on the right until the picture is clearest and sharpest. Disregard any change in sound volume that may occur and tune for the best picture. This is the fine tuning control and adjusts the positions of the I.F. pass band and traps in relation to the sound and picture carriers. When adjusted so that the picture is clearest, the sound carrier will be centered on its trap at a very low part of the I.F. curve.
4. Adjust the outside ring of the left knob for contrast of the picture; if turned too high the whites may be saturated. It may be necessary to adjust this control before turning for best picture with the fine tuning control.
5. Adjust the sound volume.

No other adjustment is necessary while operating the receiver and in most cases the channel selector may be turned from station to station without touching any other control.

ADJUSTMENT OF SET WHEN PUTTING INTO SERVICE

All external rear controls should be checked by the dealer.

Brightness is set by turning the brightness control until the black areas of the picture are dark. If set too low, the picture will have an unpleasant dark and contrasty appearance. If too high, the blacks will appear gray and the picture will have a washed out appearance.

The vertical hold control is turned until the picture moves in from the bottom with a slight snap. The vertical hold, height, and linearity controls are slightly interactont so it is well to check the hold control if the others are moved.

Adjust the height and linearity by means of a test pattern. Make the distance from the center of the pattern to the top of the picture about the same as from the center to the bottom. Our circuits are capable of excellent horizontal and vertical linearity but a slight non-linearity will never show on the picture.

The horizontal frequency control is adjusted until the picture pulls in on a weak signal. Remove or short the antenna until the picture becomes faint, turn the tuner off channel to break the sync lock-in and return the tuner to a station. The horizontal should pull in. If it does not, adjust the horizontal frequency control until it does. This is usually all that is required. If there is a wide latitude between left and right pull-in, set the horiz-freq control in the center of these two positions.

Note that lock-in has a much greater range than pull-in. It is unlikely that any adjustment is necessary as the horizontal hold is set at the factory.

Focus is set by turning the focus control until the picture is sharpest. It is usually noted at a point off center of the tube so that edge focus is not deteriorated too much. In the absence of a picture the raster lines may be focused to as sharp a line as possible.

Horizontal drive is normally nearly full on (clockwise). If a predominant vertical white line appears, or in some cases horizontal picture instability, reduce the drive slightly. Too little drive will result in poor width and a dim picture.

Horizontal linearity adjustment is controlled by a screw located on top of the chassis near the 6W4 tube. Sometimes a vertical white line may occur with improper linearity adjustment. Turn until this line disappears.

The width adjustment is controlled by a screw on top of the chassis near the 6AU5 tubes. To increase width, turn clockwise.

CENTERING AND ION TRAP ADJUSTMENTS

Adjust the ion trap for brightest picture. Do not leave the ion trap out of adjustment any longer than necessary as it is possible to burn the tube aperture. The ion trap may be used to help center the picture if necessary, but do not move it appreciably from the brightest position.

Vertical centering is accomplished by the top and bottom elastic stop nuts on the focus coil mounting. Use a ⅜" spintite wrench. Horizontal centering is accomplished by the elastic stop nuts to the left and right of the focus coil. There is some interaction between these two adjustments.

70° deflection tubes tend to have a shadow on the screen if the focus coil is moved too far. Shadow may be caused by the yoke, focus coil or ion trap, usually the focus coil and ion trap. To help in centering, move the focus coil left or right by loosening the screw on top. This screw locks the yoke coil after adjusting the picture "level" on the screen. The yoke should be as far forward on the tube as possible. The focus coil should be up close to the back of the yoke and centered around the neck of the tube. It should also be parallel with the back of the yoke (not bent or tipped).

If the focus coil is angled and not close to the back of the yoke, picture weave may be noticed. To test for this effect, move the focus control back and forth. If the picture moves back and forth horizontally, weave will occur. One quarter inch of movement is satisfactory.

To help meet all of these conditions, electrical horizontal centering has been used in the set. Some sets have fixed electrical centering. This can be altered by putting, or changing, a resistor (less than 1000 ohm) across the selemium rectifier.

FRONT END OSCILLATOR ADJUSTMENT (Standard Tuner)

The front end is adjusted at the factory and ordinarily need never be changed. Once properly set it does not need to be adjusted. It will not be necessary to do so at the customer's installation, as handling or different antennas will not affect it. Any slight drift will be compensated for by the fine tuning control.

To adjust, pull straight forward on both double knobs on the right side of the set and remove. Set the inside shaft, using the knob if necessary, so that the tuner is on the right channel. (This is important as it is possible to tune channel 13 on channel 12.) Then set the fine tuning (outside shaft) to center position (flag pointing down). Using an insulated screw driver, turn the small brass slug through the hole in the tuner frame. One quarter turn will probably be sufficient. *Do Not Turn Too Far In*, as the slug will drop inside the coil, requiring a special tool or removal of the chassis to recover it. Turning too far out may cause the slug to come out. Turning the slug in will cause the picture to go negative. Back off from this position by unscrewing the slug until the picture is clear, as under operating instructions, fine tuning. Now note the sound. If the sound is extremely weak, not present, or fuzzy, you probably tuned on adjacent channel. (13 on 12 for example.)

Due to the extreme sensitivity of this receiver you may see a picture on an adjacent channel (such as 4 on 3). This is due to the slight remaining sideband not suppressed at the transmitter.

Do not be confused by it. No sound or very weak sound will be present in this case.

SERVICE SUGGESTIONS

1. No picture, no sound, no raster:

A. 5U4 filaments do not light:
   1) AC switch defective
   2) AC plug or leads open
   3) Make sure set is connected to 117 volt supply.

B. No (B+) voltage:
   1) 5U4 rectifier
   2) Open focus coil
   3) Shorted or leaky electrolytic filter condensers.

2. Picture ok, no sound:

Trouble lies in sound IF or audio section:
Speaker or speaker leads open, 6K6, 6AV6, 6AL5, 6AU6 sound IF, or open volume control.

3. Sound and raster ok, no picture:

Open peaking coil or open .1 mf condenser, both in series in picture tube grid circuit.

MODELS 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 731, 733, Chassis 231, 242

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4. Sound ok, no picture, no raster:
Indicates possible trouble in high voltage circuit:
1) Open .1 mf condenser from grid (pin 4) horiz osc to ground (in some cases).
2) One of two .22 mf condensers open (pin 8 to pin 3, and pin 3 to ground) of horizontal output tubes.
3) Open cathode resistor (100 ohm, pin 3 to ground) of horizontal output tubes.
4) Leaky coupling condenser (330 mmf, pin 5 to pin 1) of the horizontal oscillator.
5) Either of two 1 meg resistors in voltage doubling high voltage circuit may have changed values.
6) Either or several of these tubes: 6SN7 horiz osc, 6AU5 horizontal output, 1V2 HV rect, 6W4 damper, 6AL5 horiz phase, or the CR tube.

5. Raster ok, no picture, no sound:
Tuner, 12AU7 video out, any 6CB6 IF tube, open IF coils, shorted screen bypass condenser in IF stages.

6. Picture rolls vertically, horiz ok:
Leaky integrator, 12AU7 sync separator, leaky .05 sync coupler to pin 3 of 12AU7 sync separator open or leaky. .1 mf cond to pin 6 of 6S4 vert out, open or leaky .05 mf cond joining above mentioned .1 mf and 8200 ohm resistor connected to pin 2 of vert out 6S4.

7. Diagonal bars (horiz freq), vertical ok:
Adjust horiz hold control, replace 6SN7 horiz osc, 12AU7 sync sep, leaky .05 sync coupling cond connected to pin 3 of 12AU7 sync sep, 6AL5 horiz phase, leaky 1000 mmf cond from 12AU7 sync sep to pins 5 & 7 of horiz phase.

8. Vertical and horizontal roll:
Shorted integrator block, 12AU7 sync sep, shorted or open .05 connected to pin 3 of 12AU7 sync sep, leaky .1 mf connected to grid of CR tube, physical shorting at base pins of 12AU7 sync separator.

9. Sound bars:
A. Volume control at zero:
1) replace 6AU6 sound IF
2) check setting of 20.5 mc trap
3) check setting of ratio det null
4) check alignment.
B. Sound bars only with advance of vol control:
1) replace 6K6 audio output
2) replace 6AL5 ratio det tube and 6AV6 first audio tube
3) in extreme cases, remove all leads from screen grid of 6K6 audio out (pin 4) and reconnect these leads to the same grid through a 1000 ohm, 1 watt resistor, and place an 8 mf 450 volt electrolytic from pin 4 to ground.

10. Miscellaneous troubles:
A. Intermittent blowing of fuses—6W4 damper or 6AU5 horiz out.
B. Low IF screen voltage—shorted screen cond in tuner.
C. Can't cut down brightness in CR tube—short in CR tube, replace.
D. Tuner fine tuning changes horiz freq—trouble in horiz phase circuit. Suggest check for shorts, change 6AL5 horiz phase; or either of two 1000 mmf coupling cond to 6AL5 phase tube leaky.
E. Picture shakes in horiz motion when contrast control is advanced—cut out and remove 10 mmf condenser connected between pins 1 & 9 of 12AU7 sync sep, if cond is in circuit.
F. Sound and picture not together—may be weak antenna. Weak signal of any sort can exaggerate this condition. Realign sound IF and ratio detector. Check IF curve.
G. Focus pot and parallel 1200 ohm resistor burn—focus coil open.
H. "Pie Crust" effect—may be one of two types:
1) Change 6SN7 horiz osc.
2) Dress green lead from grid of CR tube away from 6SN7 horiz osc.
3) .1 mf cond between pin 4 and ground of 6SN7 horiz osc open.
I. Picture weave—electrolytic open. Also see modification sheet for weave (involves changing filter network from 40 mf input and 80 mf output to 80 mf input and 40 mf output).
J. Raster looks like an ancient "scroll"—electrolytic open.
K. Corona at HV trans—look for sharp pointed solder joints, especially near final 1V2 filament.

EFFECT OF CONDENSOR FAILURES IN DEFLECTION CIRCUIT

PART	OPEN	SHORTED
C-29 Sync. Coupling	Loss of Vert. & Horiz. Sync.	Loss of Vert. & Horiz. Sync.
C-31	Loss of Horiz. Sync.	Loss of H.V. Due to Inoperative Horiz. Osc.
C-32	Loss of Horiz. Sync.	Loss of H.V. Due to Inoperative Horiz. Osc.
C-33	Appearance of Ripple in Horiz. Deflection	Appearance of Ripple in Horiz. Deflection
C-39	Pict. remains in Sync. but is full of Streaks and has a Jitter. Wave form on grid of Horiz. output is thickened.	Loss of Horiz. Sync.
C-41	Lss of H.V. due to Inoperative Horiz. Osc.	
C-44	Loss of H.V. due to Inoperative Horiz. Osc.	Loss of H.V. due to Inoperative Horiz. Osc.
C-43	Multiple Pictures Horiz. due to incorrect Horiz. Osc. Freq.	Loss of Horiz. Sync.
C-42	Loss of H.V. due to D.C. on Horiz. output grids	
C-59a	Loss of Horiz. Sync.	
C-58a	Reduction in Vertical size—keystoning in raster.	
C-46	Loss of Hl. voltage due to inoperative Horiz. output stage.	No noticeable change in picture. Grid of V-16 rises to 20 volts. Cathode of V-16 falls to zero.
C-45	Loss of Hl. Volt. due to inoperative Horiz. output stage.	Loss of Hl. Volt. R-76 heats. 0.25 Amp fuse DOES NOT BLOW.
C-52	Slightly reduced Horiz. size.	Horiz. size reduced to about ½ normal.
C-47	Stretch in Horiz. Dir. of left side of pict.	Same as open.
C-48	Stretch in Horiz. Dir. of left side of pict.	Same as open.
S-1	Horiz. Centering control inoperative.	
C-50	Faint picture due to low H.V.-H.V. falls to 6000 V.	Very faint picture. H.V. falls to about 3000 V.
C-51	No loss of H.V. slight jitter.	Very faint picture H.V. falls to about 3000 V.
C-57		No H.V.
C-40	Loss of H.V. due to Horiz. Osc. Waveform at pins 1 & 2 of Horiz. phase tube jitters.	Loss of Horiz. Sync.
C-37	Reduced Vert. sweep roll	Extended Vert. sweep.
C-36	Vert. Osc. Changes Freq.	Vert. sweep reduced greatly.
C-34	Loss of vertical.	Same as open.
C-27	Vertical bright bands at left of picture.	Excessive brightness. No brightness control action.
C-28	No change.	

BEND

Bend can be caused by unbalance of the horizontal sync pulses to the 6AL5 Horizontal phase tube or the tube itself. To check balance, tune in a station and connect a VTVM across R-50 (4.7M).

Remove the sawtooth wave by connecting pins 1 and 2 of the 6AL5 Horizontal phase tube to ground. The VTVM will then read the sync unbalance voltage. It should be no more than plus or minus .5 volts. To balance temporarily, place approximately 33 K ohms across R-46 or R-43 (12AU7 phase inverter) whichever improves the balance.

After determining whether R-46 or R-43 needs correcting, select a value of resistor which brings the balance voltage within tolerance, then solder in place. Sometimes bend can be compensated by a little unbalance, but do not exceed the tolerance given.

BUZZ AND HUM

Buzz can be traced to many sources. Some of the most common will be mentioned. The first source of both buzz and hum may be the station. Station technique may not always be perfect. The station may also cause buzz in intercarrier sets by too much modulation of the video carrier. This results in the tips of the sync pulses cutting off or nearly cutting off the video carrier. The 4½ MC intercarrier is formed by the beat between the sound carrier and the picture carrier. If one becomes zero, the intercarrier also becomes zero. Sync occurs at a 60 cycle rate (frame) so the carrier may drop out 60 times a second, causing buzz. This buzz is characterized by a sharp wave front containing high frequency components, as compared to hum. This type of buzz may change as cameras are changed at the studio, due to the video level of one camera being set at a slightly different value than the others.

Buzz occurring in the receiver has been experienced by not having the IF curve and the cathode trap aligned to produce very low response at the 20.5 MC sound carrier; not having the ratio detector correctly tuned, especially by being on the wrong secondary null; and by having an unbalanced ratio detector coil. The latter can usually be corrected by connecting a 330 Mmfd condenser from the junction of C-4, R-5 and R-4 to ground. Re-peak the 4½ MC IF coil also. Be sure the fine tuning control is tuned correctly. A slight buzz can be obtained on strong station by turning the contrast full on, causing the video amplifier to overload and clipping sync with the same effect as previously described. This effect is normal and at normal contrast setting may not be noticed.

Another type of buzz is caused by the vertical sweep coupling into the audio. As the vertical has a sharp wave front and fairly high amplitude, a very slight coupling may pick it up. Test for it by turning the volume control completely off and listen. A shield installed between the 6J5 vertical oscillator and the 6AV6 (or 6SN7) will remove it.

Hum is usually power supply hum and requires an electrolytic filter on the 290V bus.

I. F. ALIGNMENT

Equipment Required:
1 VTVM.
1 Oscilloscope.
1 Sweep generator, 10 MC sweep centering about 23 MC. RF channels desirable but not necessary. The sweep generator should have very low harmonic content or it will produce signal in the RF while the IF is being aligned.
Markers, preferably crystal control, at 4.5 MC, 20.5 MC, 25 MC and 21.4 MC. It is desirable to be able to operate 25 MC and 21.4 MC markers at the same time to facilitate alignment. Additional frequencies of 23.4, 24.3, 21.8 and 24.2 may be obtained from a variable signal generator. If an accurate signal generator is available a 25 MC marker used with it will give good results.

Set Up:
Loosen the tube shield from ground of the 6J6 in the Standard tuner (front tube). Connect the output of the sweep generator to this tube shield and ground. Connect the horizontal terminals of the scope to the sweep sync. terminals. Connect the vertical terminals of the scope across ground and the picture detector load resistor (R-27). If the scope has a Z terminal, 110 VAC through a 2.2 M ohm resistor may be conected to it to blank out the return trace. Reverse the plug if necessary. Be sure the sweep generator is connected to the receiver chassis by a short ground wire. If at any time the curve shape changes due to touching the equipment or changing leads around, check all grounds and do not proceed until corrected. It is not necessary that the set-up be connected to an earth ground, but that it be connected together by short ground leads. In an extreme case it may be necessary to place the equipment on a sheet of metal.

Procedure:
Set the tuner on Channel 12 and obtain the IF response curve on the scope. Adjust scope height, width, centering and perhaps phase. Set the sweep amplitude for medium output. Turn the tuner on two or three adjacent channels; the curve should remain substantially the same. If it does not, pick a channel which has the same curve as two or three others. Note any superfluous response or extra markers. The tuner oscillator may produce a marker. Tune the fine tuning control to identify it and place in an inconspicuous place. Try to identify if not remove all other signals. The IF may be oscillating if improperly aligned. Place a finger on an IF coil or put in an iron or brass slug to identify or move. Do not try to align before stopping any oscillation. This can also be done by turning the coil slug but is not recommended for those aligning for the first time as the slug position may be lost. Turn the sweep generator amplitude down and then up and note how the curve follows. If a station is on the channel being used, try another channel or reduce the signal from the station. Remove the antenna to remove noise and other signals. Set the contrast control about one-half on. In receivers using keyed AGC, connect —3 volt of battery bias to the AGC bus and ground before sweeping. Connect the markers loosely to the receiver. This can usually be done by connecting to the receiver chassis, tuner chassis or between tuner chassis and receiver chassis.

Note how the markers appear on the scope IF curve. Run the marker attenuators up and down. Always use the minimum amount of marker signal possible as it will distort the curve. When it is necessary to use a large amount of marker in the first steps of alignment, reduce it later and check curve.

Alignment:
Introduce 23.4 MC marker and adjust last IF slug (3rd IF) for maximum. This can be done by watching the marker on the scope and adjusting for maximum excursion from zero axis. An alternate method is to shut off the sweep and use a VTVM at the picture detector load resistor. Change marker to 24.3 and peak 2nd IF. Set marker to 21.8 and peak 1st IF. Set marker to 24.2 and peak tuner converter. Set marker to 20.5 and null cathode trap. When the IF coils are set to frequency, a rough curve, approximating the IF curve, will appear on the scope. Then turn the IF slugs, watching the scope, to obtain the curve shape and marker position desired. (This curve is reproduced on the circuit diagram. It will result in a full resolution 350 line picture. Band width is measured at 50% points.) A considerable amount of skill is required to perform this operation quickly. Here are some hints to help. Never turn any one slug too far. Don't try to do it all on one IF coil but pick up a little bit on each one. Sometimes turning a slug to obtain a desired portion of the surve will apparently make the curve worse but it may be compensated for in another IF stage. If you get too far from the desired result, re-peak the IF's on marker frequencies and start over. While aligning, note the gain by the amplitude on the scope as it is possible to get a good looking curve with low gain. In this case one or more of the IF stages will have gain off to one side of the curve. This is sometimes evidenced by considerable "suck out" of the cathode trap. The 20.5 MC sound carrier (cathode trap frequency) should be very low and very little response will be noted on the other side of the trap. If the trap is incorrectly aligned or not working, buzz may occur in the sound and 4½ MC beat in the picture. Usually, but not always, the 3rd IF rocks the curve; the 2nd IF moves the 25 MC marker and broadens the curve; the 1st IF broadens the curve on the 21.4 MC side; and the tuner converter broadens the 21.4 MC side, moves 25 MC marker, and rocks the curve.

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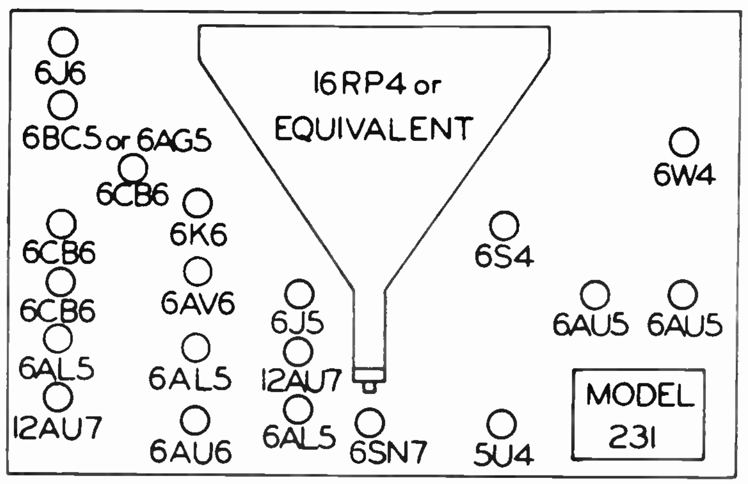
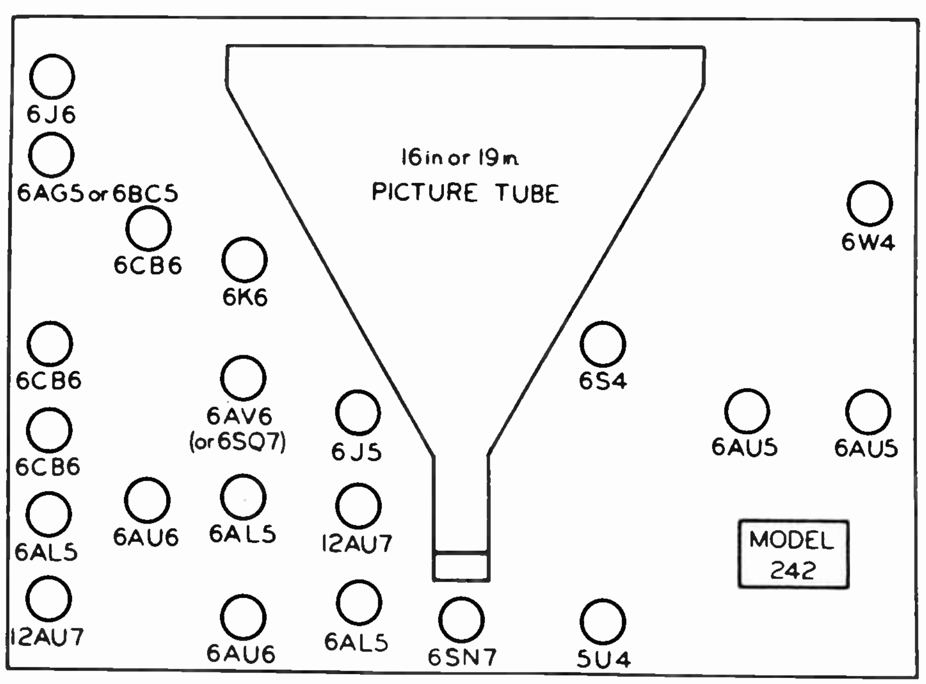
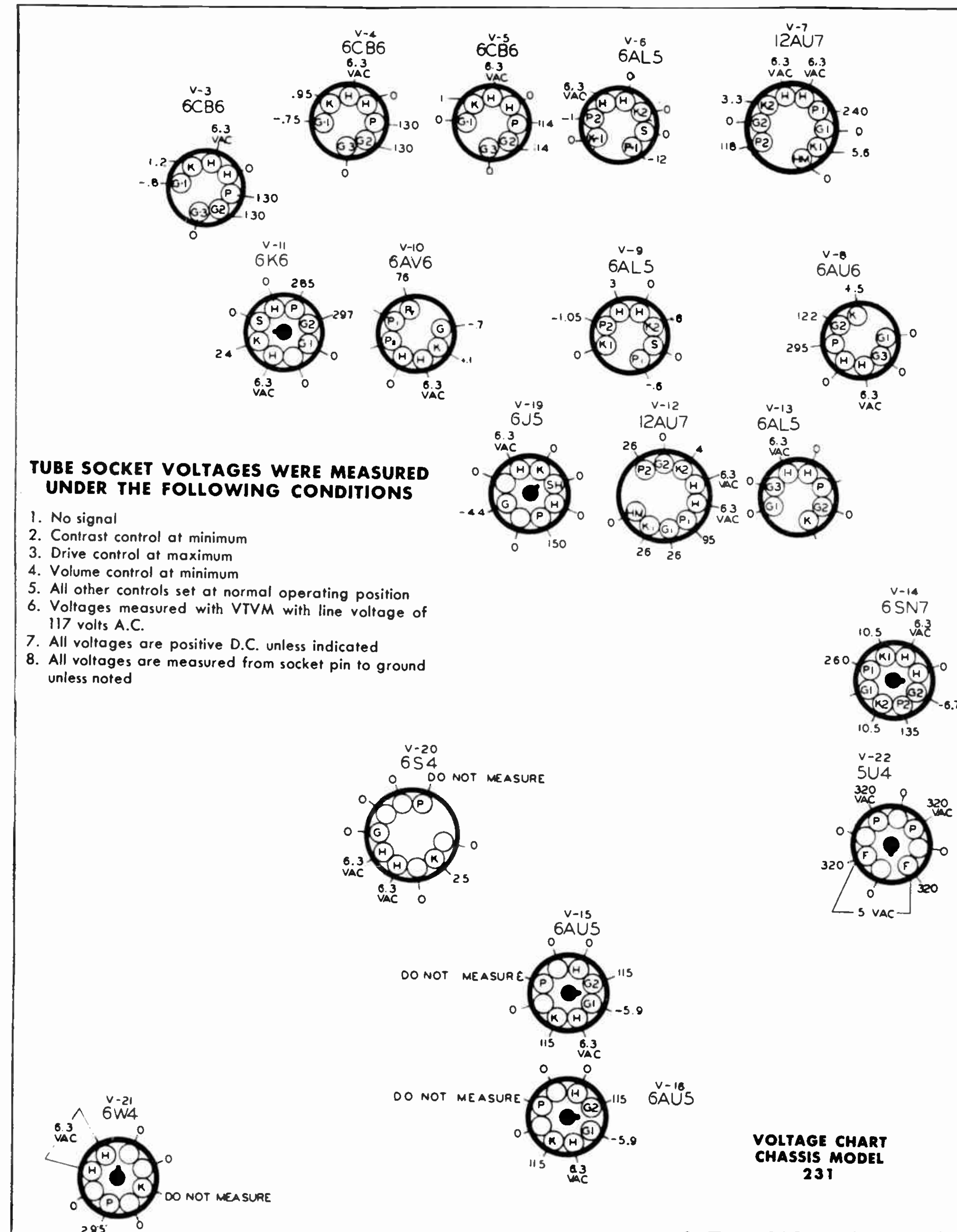
Sound Alignment:
Turn off the sweep and connect the VTVM to the ratio detector load (marked "maximum" on the circuit). Inject 4.5 MC and peak sound take off coil and primarily of ratio detector transformer (bottom). Null 4½ MC trap if one is used, by placing VTVM on picture tube grid and ground. Adjust the secondary of the ratio detector for zero. There are three responses to the ratio detector transformer. The correct one is in the middle. At the correct zero a slight turn of the slug will move the VTVM needle rapidly positive or negative. Reset to zero. If the secondary slug was moved appreciably, recheck the tuning of the primary slug.





TUBE LOCATION CHART



TUBE SOCKET VOLTAGES WERE MEASURED UNDER THE FOLLOWING CONDITIONS

1. No signal
2. Contrast control at minimum
3. Drive control at maximum
4. Volume control at minimum
5. All other controls set at normal operating position
6. Voltages measured with VTVM with line voltage of 117 volts A.C.
7. All voltages are positive D.C. unless indicated
8. All voltages are measured from socket pin to ground unless noted

VOLTAGE CHART CHASSIS MODEL 231

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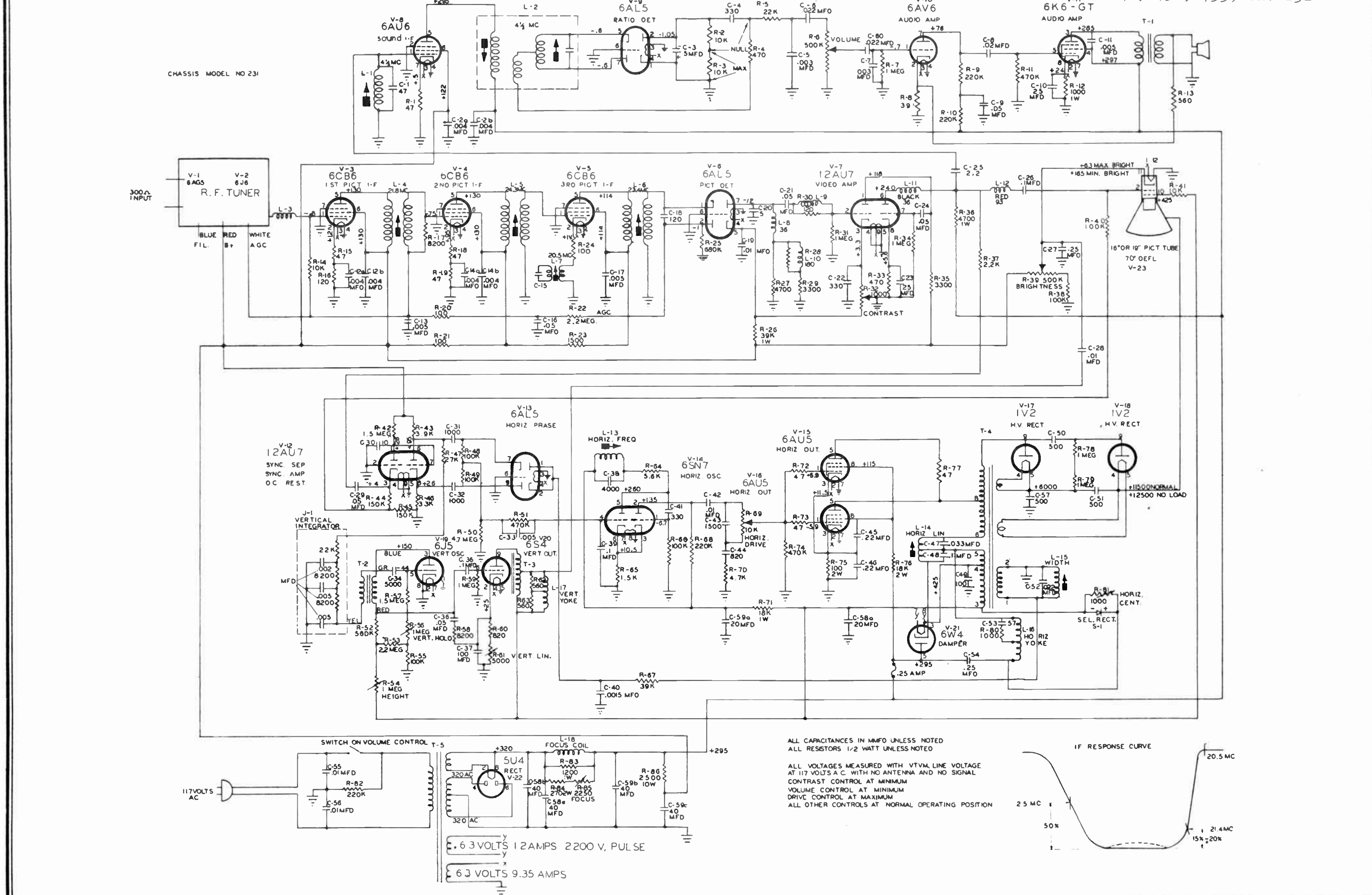

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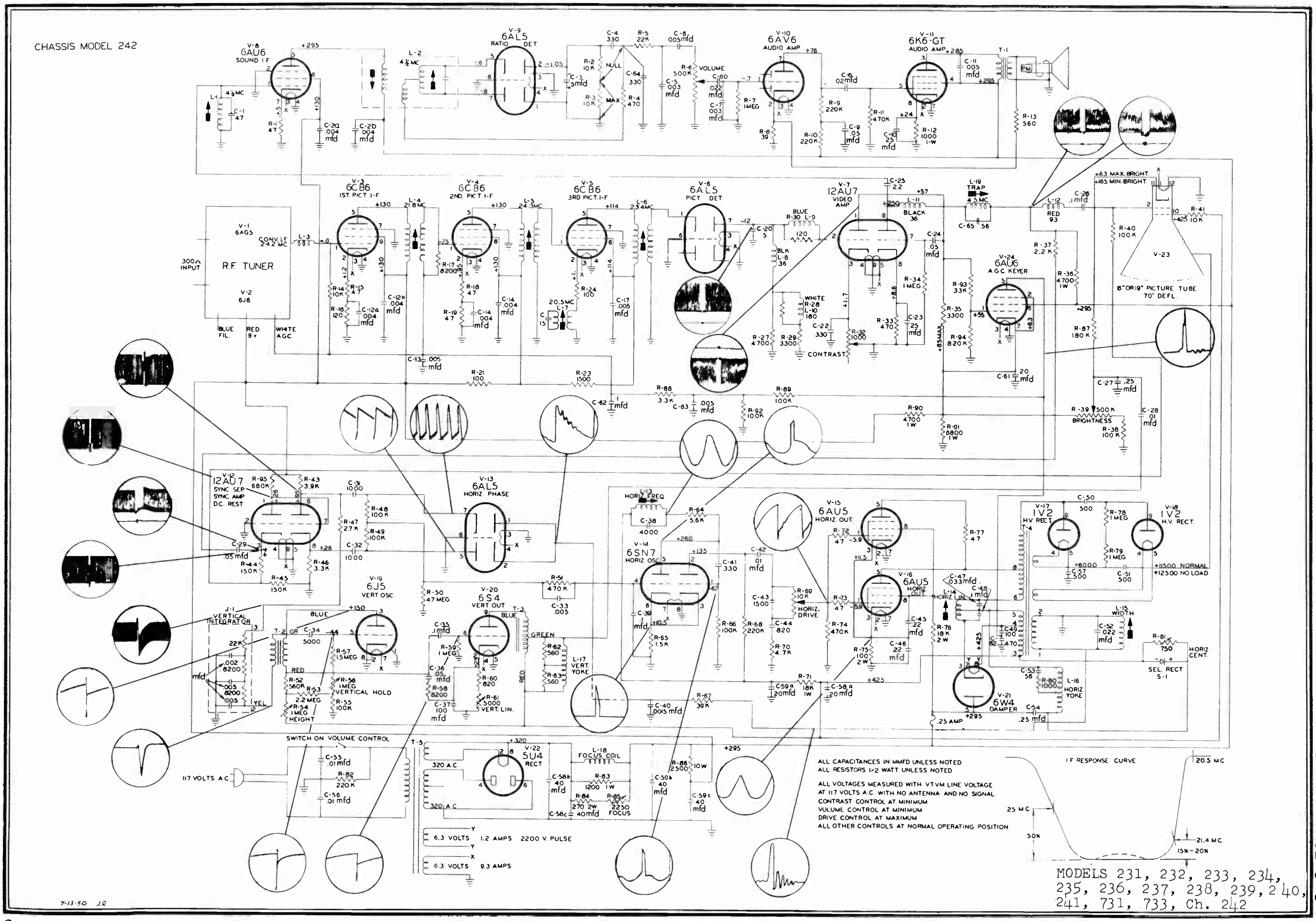

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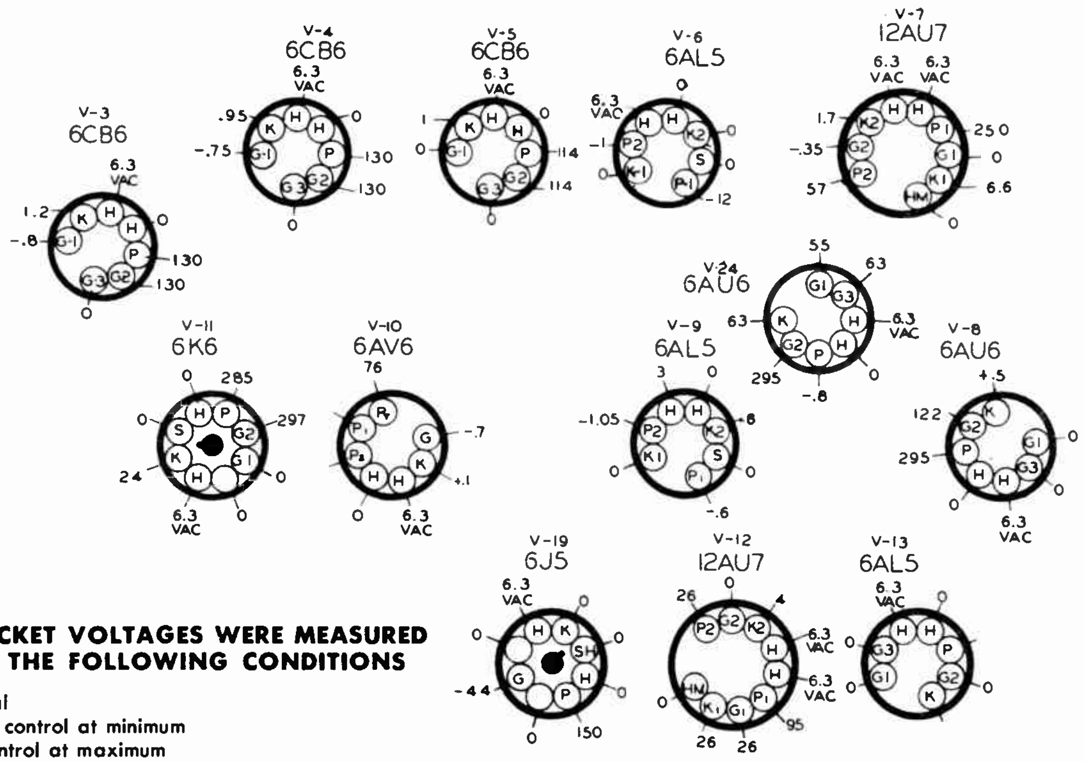

TUBE SOCKET VOLTAGES WERE MEASURED UNDER THE FOLLOWING CONDITIONS

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3. Drive control at maximum
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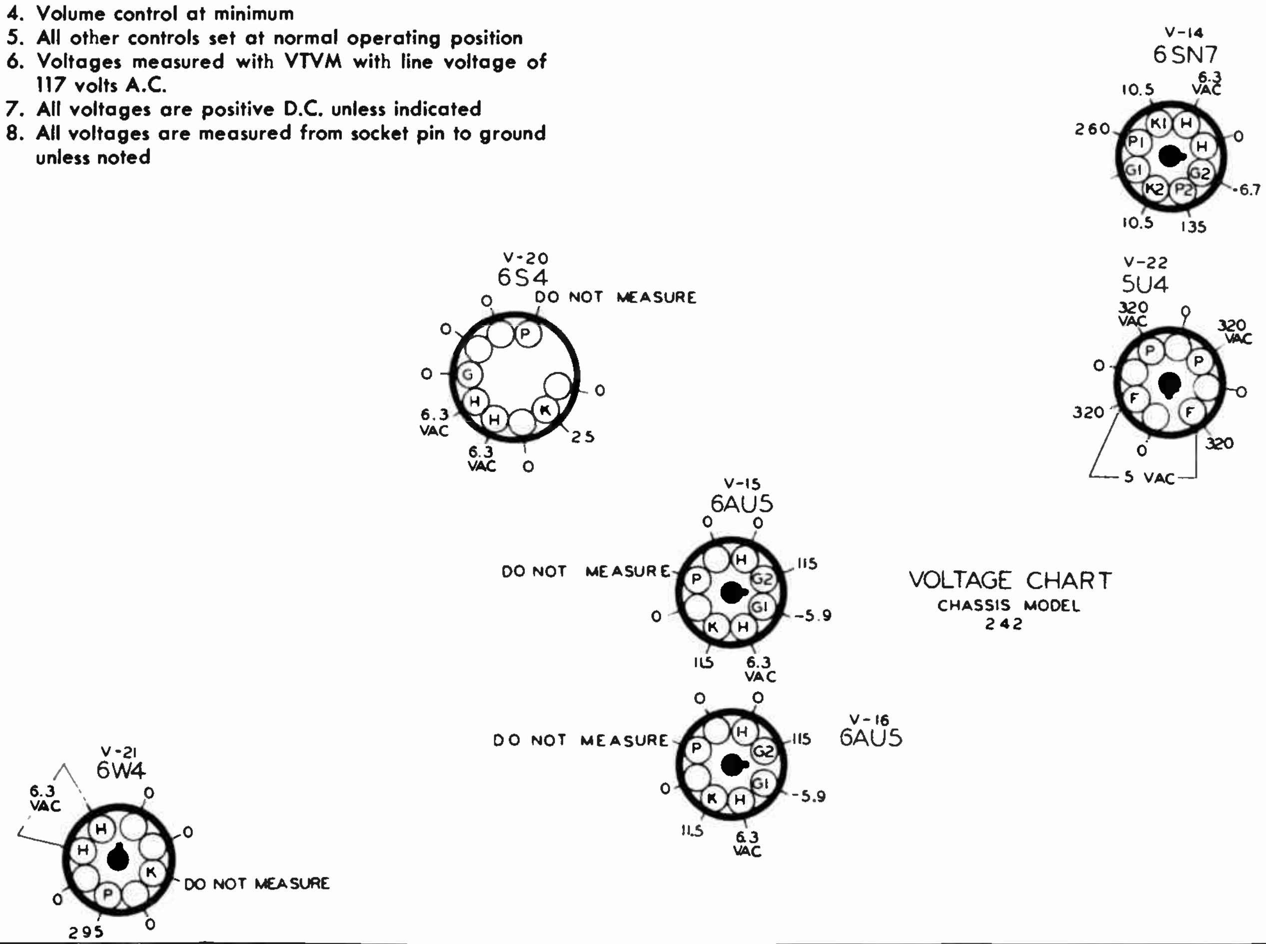
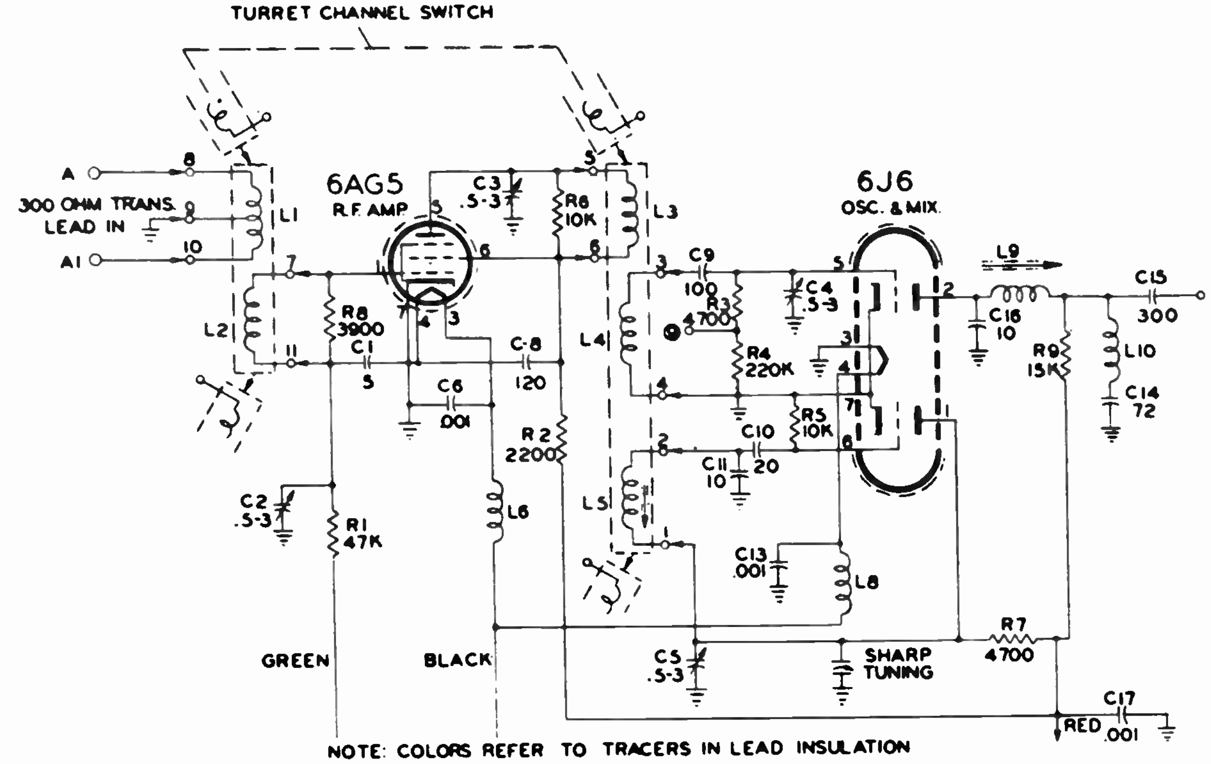
7. All voltages are positive D.C. unless indicated
8. All voltages are measured from socket pin to ground unless noted



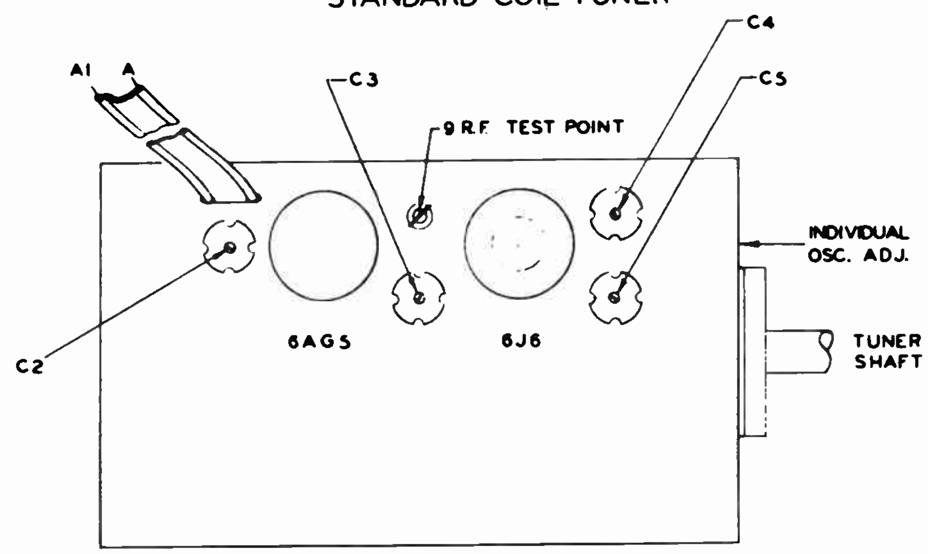
VOLTAGE CHART
CHASSIS MODEL 242



NOTE: COLORS REFER TO TRACERS IN LEAD INSULATION

C1 IS ELIMINATED ON SOME TUNERS BY THE USE OF A 3 TO 9 MMF TRIMMER AT C2

SCHEMATIC - STANDARD COIL TUNER



C2 ADJUST FOR MAX. PATTERN HEIGHT
C3,C4 ADJUST FOR MAX. HEIGHT, FLATNESS, & CORRECT FREQ.
C5 OSC. FREQ.-ADJUST LAST

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PARTS LIST

Res., Cap., Induct., Trans., Tubes
All plus or minus 10% except as noted

PART NO.	REF. SYMBOL	DESCRIPTION
	Resistors, Carbon	***½ Watt***
A335	R-1, 15, 18, 19, 72, 73, 77	47 ohms
A755	R-2, 3, 14, 41	10,000 ohms
A515	R-4, 33	470 ohms
A815	R-5	22,000 ohms
A1115	R-7, 31, 34, 59	1 megohm
A320	R-8	39 ohms
A1010	R-9, 10	270,000 ohms
A1055	R-11, 51, 74	470,000 ohms
A530	R-13, 62, 63	560 ohms (R62, R63 in Vert. Yoke Housing)
A410	R-16	120 ohms
A740	R-17, 58	8,200 ohms
A395	R-20, 21, 24	100 ohms
A1175	R-22, 53	2.2 megohms
A605	R-23, 65	1,500 ohms
A1085	R-25	680,000 ohms
A695	R-27, 70	4,700 ohms
H2108	R-28 Part of L-10	39,000 ohms
H2112	R-30 Part of L-9	22,000 ohms
A665	R-35, 46, 29	3,300 ohms
A635	R-37	2,200 ohms
A935	R-38, 40, 48, 49, 55, 66	100,000 ohms
A1145	R-42, 57	1.5 megohms
A680	R-43	3,900 ohms
A965	R-44, 45	150,000 ohms
A830	R-47	27,000 ohms
A1235	R-50	4.7 megohms
A1070	R-52	560,000 ohms
A560	R-60	820 ohms
A710	R-64	5,600 ohms
A860	R-67	39,000 ohms
A995	R-68, 82	220,000 ohms
A575	R-80	1,000 ohms (in Focus Coil Housing)
	Resistors, Carbon	***1 Watt***
A2575	R-12	1,000 ohms
A2695	R-36	4,700 ohms
A2590	R-83	1,200 ohms
A2800	R-71	18,000 ohms
	Resistors, Carbon	***2 Watt***
A4395	R-75	100 ohms
A4470	R-84	270 ohms
A4800	R-76	18,000 ohms
	Resistors, W. W.	***10 Watt***
A6280	R-86	2,500 ohms
	RESISTORS, SPECIAL PURPOSE	
A7150	R-78, 79	1 meg., 1 W, Type B.T.A.V
	Resistors, Variable	
M124	R-6 / R-32 Dual with A.C. Switch	500 K, Volume / 2000 Contrast
M120	R-39	500 K, Brightness
M106	R-54	1 Meg, Height
M106	R-56	1 Meg, Vert. Hold
M110	R-61	5000 Vert. Lin.
M122	R-69	10 K, Horiz. Drive
M126	R-81	1000 Horiz. Cent.
M112	R-85	2250 Focus Cont.
	USED ON MODEL 241	
A980	R-87	180 K, ½ W. Carbon
A665	R-88	3.3 K, ½ W. Carbon
A935	R-89, 92	100 K, ½ W. Carbon
A845	R-93	33 K, ½ W. Carbon
A1100	R-94	820 K, ½ W. Carbon
A1085	R-95	680 K, ½ W. Carbon
A2715 (5%)	R-90	6200 1 W. Carbon
A2720 (5%)	R-91	6800 1 W. Carbon
K220	J-1 Vertical Integrator CRL No. YA 002-010	Printed Circuit

PART NO.	REF. SYMBOL	DESCRIPTION
	Capacitor	***Tubular***
B2180	C-5	.003 Mfd. 600 V.
B2200	C-6, 11, 33, 7	.005 Mfd. 600 V.
B2340	C-8	.02 Mfd. 400 V.
B2420	C-9, 16, 21, 24, 29	.05 Mfd. 400 V.
B2300	C-19, 28, 42, 55, 56	.01 Mfd. 400 V.
B2560	C-26, 35	.1 Mfd. 600 V.
B2660	C-27	.25 Mfd. 200 V.
B2480	C-36	.05 Mfd. 600 V.
B2520	C-39	.1 Mfd. 200 V.
B3100	C-45, 46	.22 Mfd. 400 V.
B2960	C-47	.033 Mfd. 600 V.
B3060	C-48	.1 Mfd. 400 V.
B2950	C-52	.022 Mfd. 400 V.
B2620	C-54	.25 Mfd. 600 V.
	Capacitor	***Mica***
B530	C-15	10 Mmfd. Part of L-7
B1765	C-34	5000 Mmfd.
B1712	C-38	4000 Mmfd.
B1390	C-44	820 Mmfd.
B1190	C-41	330 Mmfd.
	Capacitor	***Ceramic***
B190	C-1	47 Mmf.
B470	C-2a, 2b, 12a, 12b, 14a, 14b	.004 x .004 Mfd.
B240	C-4, 22, 64	330 Mmf.
B455	C-13, 17	.005 Mfd.
B217	C-18	120 Mmf.
B145	C-20	5 Mmf.
B125	C-25	2.2 Mmf.
B150	C-30	10 Mmf.
B270	C-31, 32	1000 Mmf.
B280	C-40, 43	.0015 Mmf.
B8130	C-49	100 Mmf.
B197	C-53, 65	56 Mmf.
	Capacitor	***Electrolytic***
B5120	C-3	5 Mfd. 50 W.V.
B5150	C-10, 23	25 Mfd. 50 W.V.
B1580	C-37	100 Mfd. 50 W.V.
B6525	C-58a, b, c / C-59a, b, c	20 Mfd. 450 V. / 40 x 40 Mfd. 350 V.

HIGH VOLTAGE CONDENSORS

B8120	C-50, 51, 57	.00047 Mfd. 6000 Volts

USED ON MODEL 241

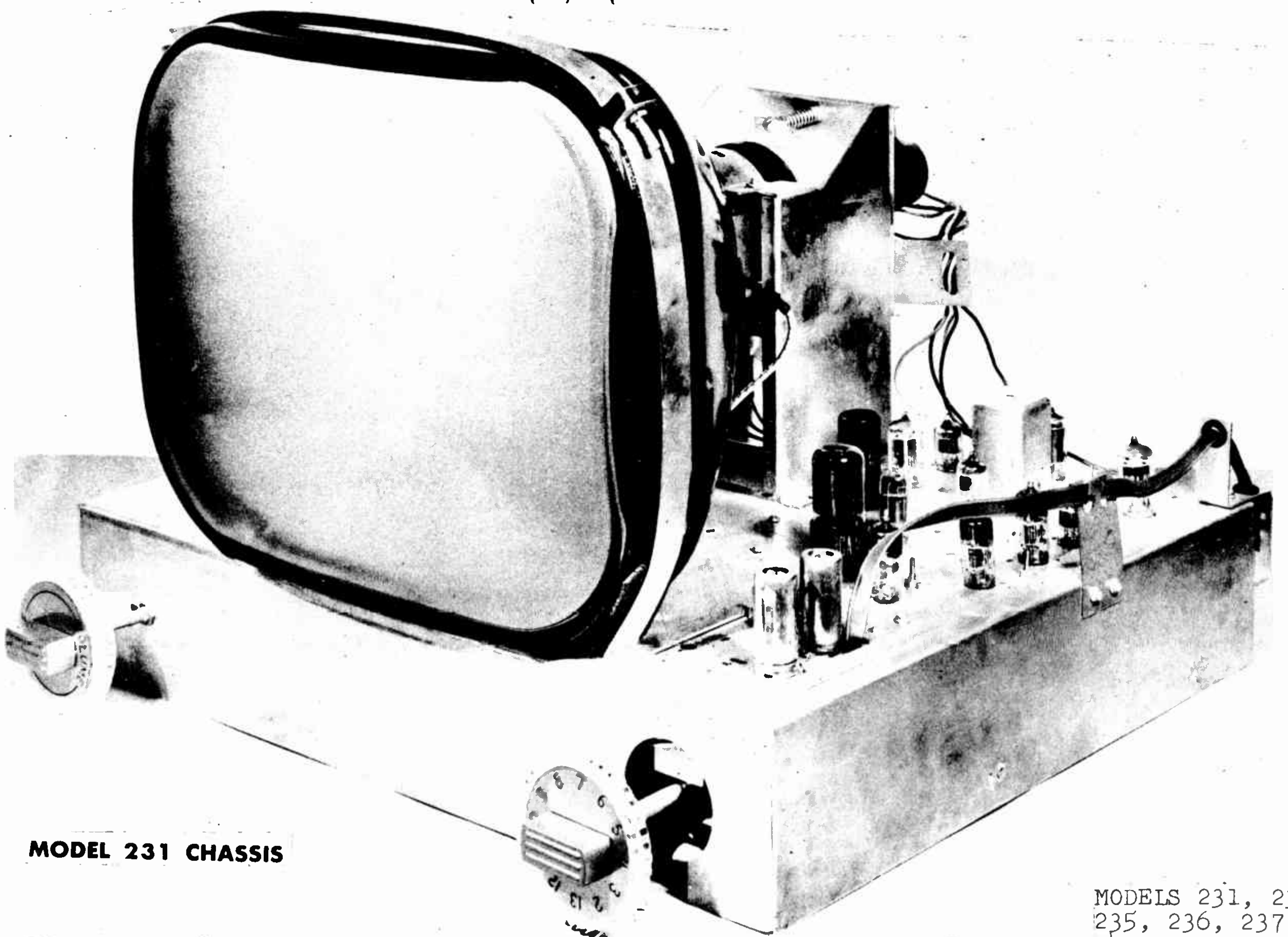
B5140	C-61	20 Mfd. Electrolytic
B2800	C-62	1 Mfd. 200 V. paper
B2200	C-63	0.005 Mfd. 200 V. paper

COILS

H116	L-1	I.F. Sound 4.5 Mc Takeoff
H110	L-2 / L-3	Ratio Detector Transformer / 4.3 uh Tuner Coupling
H112	L-4 / L-5	Video I.F. 1st & 2nd White
H114	L-6	Video I.F. 3rd Red
H6100	L-7	Sound Carrier Trap 20.5 Mc
H2106	L-8	Video Peaking Coil 36 uh Black
H2112	L-9	Video Peaking Coil 120 uh Blue
H2108	L-10	Video Peaking Coil 180 uh White
H2106	L-11	Video Peaking Coil 36 uh Black
H2110	L-12	Video Peaking Coil 93 uh Red
H5104	L-13	Horizontal Oscilator Coil
H4102	L-14	Horizontal Linearity Coil
H3602	L-15	Width Coil
H6604	L-16	Horizontal Yoke
H6604	L-17	Vert. Yoke
H3102	L-18	Focus Coil
H6102	L-19	Trap—4.5 Mc

TRANSFORMERS

C2020	T-1	Audio Output Transformer
C3102	T-2	Vertical Blocking Oscilator Transformer
C2304	T-3	Vertical Output Transformer
C2112	T-4	Horizontal Output Transformer
C101	T-5	Power Transformer



MODEL 231 CHASSIS

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PART I
DESCRIPTION AND SPECIFICATIONS

CIRCUIT INFORMATION

CHASSIS	HORIZ. DEFLECTION	R-F TUNER	AUDIO AMPL.
CT 232	As shown in full-size schematic uses only the 16AP4 tube	Type "S" untuned input	123 A
CT 236	Same as CT 232	Type "R"	123 A
CT 239	Same as CT 232	Same as CT 232	123 B
CT 240	Same as CT 232	Same as CT 236	123 B
CT 244	Two 6BG6G tubes, shown in excerpt of schematic. May use either the 16AP4 (long) or 16EP4 (short) picture tube	Type "S" tuned input, with 6AB4 oscillator	123 B
CT 245	Same as CT 244	Same as CT 244	123 A
CT 246	Same as CT 244	Same as CT 244	None
	Uses 6J5 for AGC gating diode which is a diode in the audio amplifier of chassis using an audio amplifier. Also uses 10 watt Bleeder resistor to provide current drain the same as though an audio amplifier were used, and so the same +B voltage. Connects an 11.7K 10 watt resistor from +B 250V, to ground.		
Audio Ampl. 123 A	is the same as 123 B except part No. of output transformer. 123 A uses transformer No. 320027-3 while 123 B uses No. 320027-4.		

- R-F tuner having tuned input; gives improved signal-noise ratio, sensitivity.
- 4 stages of video I-F amplification, stagger-tuned for reduced phase distortion and for increased stability and for ease of alignment.
- Three stages of high gain sound I-F amplification.
- Two stages of video amplification, two stages of audio amplification.
- Direct-coupled video amplifiers, eliminating necessity for DC reinsertion.
- Either self-contained audio system (except CT 246) or plug connection to use the audio amplifier and speaker system of a companion radio-chassis.
- MAGNALOK horizontal AFC circuit. Frequency control is by variable width of a converted sync pulse, rather than variable amplitude. Since interference is for the most part AM, this results in improved noise immunity in horizontal scanning.
- Amplified automatic gain control. Affords maximum uniformity of reproduction when switching between stations and reduces fading. Less necessity for adjusting picture and brightness controls.
- Non-hazardous high voltage supply.
- 16 inch picture tube—either short or long tube in the CT 244-45-46.

TUBE COMPLEMENT

R-F amplifier (untuned input)	6BH6	6SN7GT	1st video ampl., 1st sync ampl.
R-F amplifier (tuned input)	6AK5	6V6GT	2nd video ampl.
Mixer	6AG5	6SN7GT	AGC rect., 2nd sync ampl.
Oscillator (untuned input)	6C4 or 6AB4	6SN7GT	AGC ampl., vert. osc.
1st sound I-F	6BA6	6SN7GT	Sync leveler, clipper
2nd sound I-F	6BA6	6V6GT	Vert. output
3rd sound I-F	6AU6	6SN7GT	Hor. AFC, oscillator
Discriminator	6AL5	6BG6G	Hor. output (two in parallel), CT 244-45-46
1st A-F amplifier	6SF7		
Audio output	6V6GT	1B3GT(2)	H. V. rectifiers
1st Video I-F	6AG5	6W4GT	Damper
2nd Video I-F	6AG5	5U4G(2)	L. V. rectifiers
3rd Video I-F	6AG5	16AP4	Long picture tube
4th Video I-F	6AG5	or	
		16EP4	Short picture tube

TOTAL CT 232-36-39-40—27 tubes
CT 244-45-46 —28 tubes

TELEVISION FREQUENCIES, MC.

Picture I-F	25.75	21.25	Co-channel sound trap
Sound I-F	21.25	19.75	Adjacent channel picture trap
Adjacent channel sound trap	27.25	.30	Discriminator band width

Video Amplifier Compensation .... to 4 mc.

CHASSIS CT 232, CT 236, CT 239, CT 240, CT 244, CT 245, CT 246

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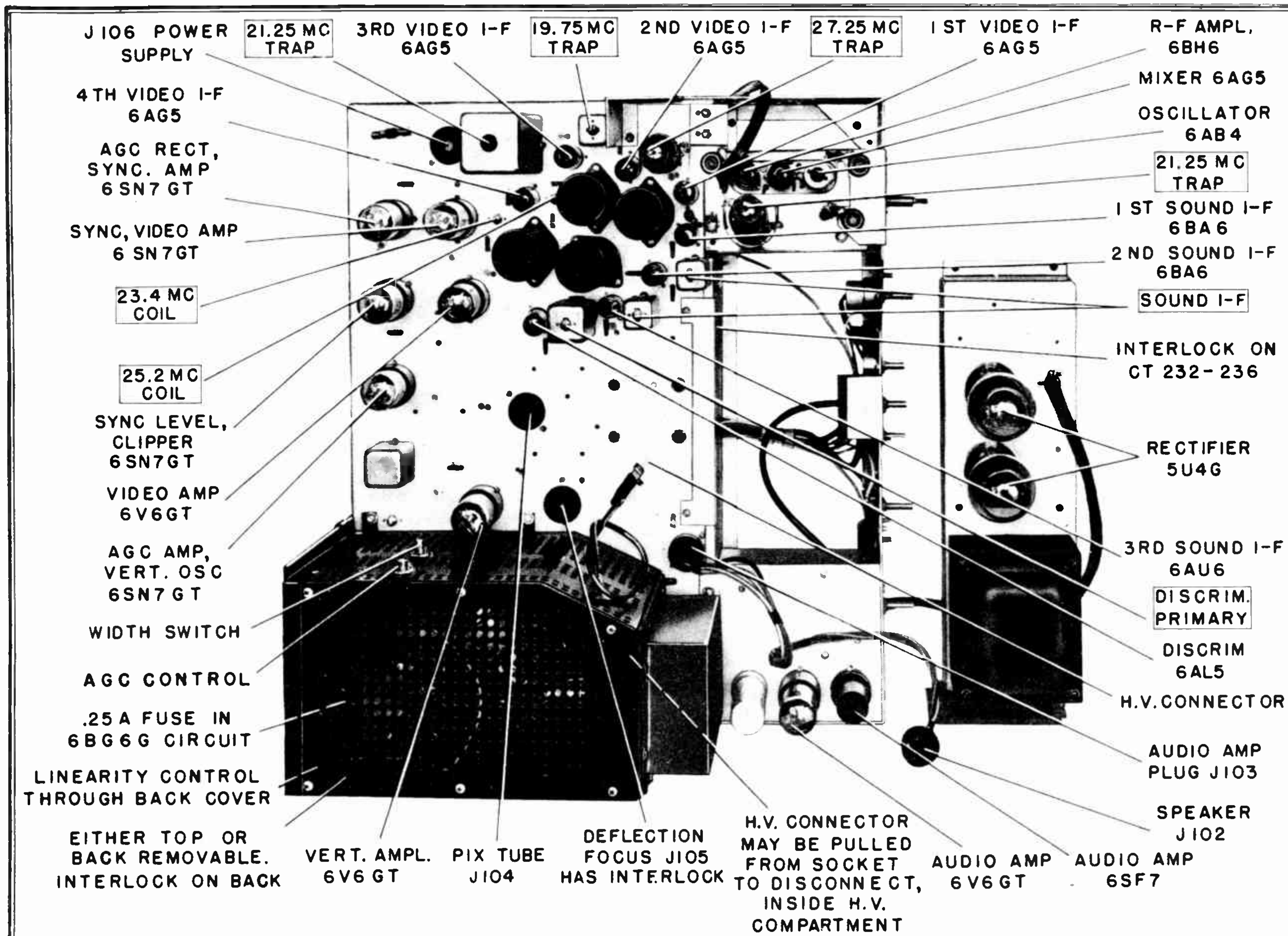
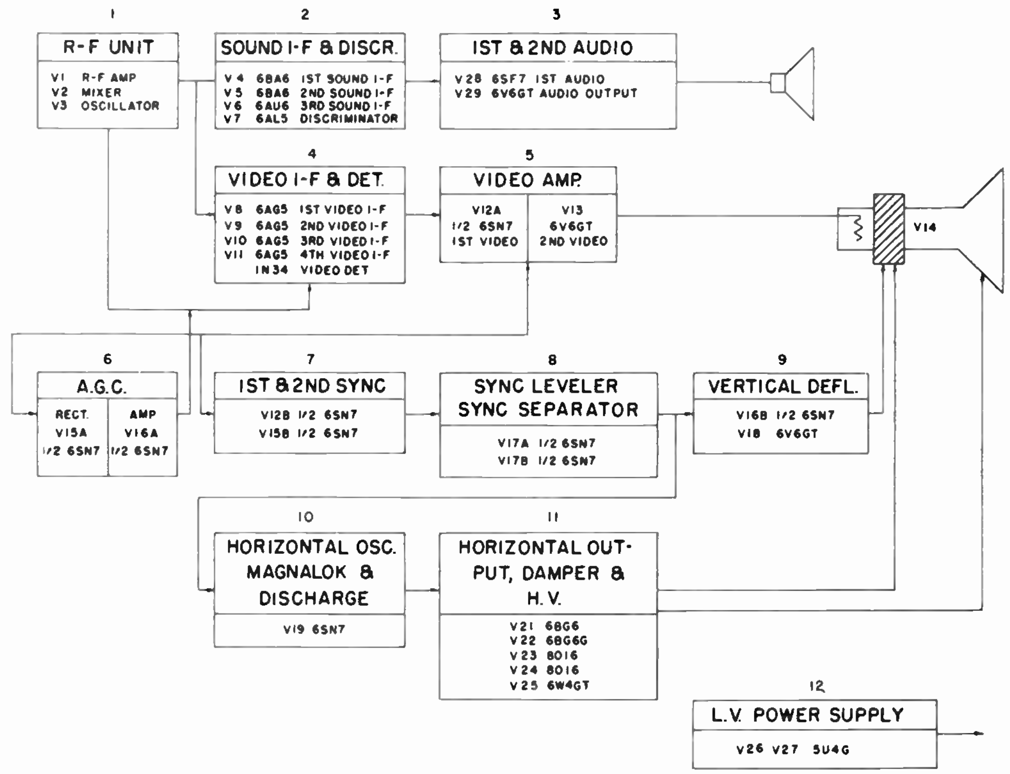


TOP VIEW OF THE CHASSIS

FUNCTIONAL DIAGRAM



RECEIVER OPERATING INSTRUCTIONS

1. Turn the CONTRAST OFF-ON control to the right ½ turn.
2. Set the STATION SELECTOR to the desired channel number.
3. Adjust the FINE TUNING control for best quality sound and the VOLUME control for suitable sound volume.
4. Adjust the BRIGHTNESS control for suitable picture brilliance. Adjust FOCUS for best detail.
5. Now adjust the PICTURE control until the picture has the proper degree of contrast.

6. If necessary adjust the BRIGHTNESS and SOUND control on radio chassis for best picture and sound quality.

The small control knobs marked VERTICAL and HORIZONTAL will rarely require adjustment after they are properly set. If the picture "roll" up or down, turn the VERTICAL knob to the left as far as possible—then advance to the right until the picture stops moving. If the picture is not centered horizontally or if it is broken up, adjust the HORIZONTAL control knob to frame the picture.

PART II

PARTS IDENTIFICATION

Channel No.	Limits	Picture Carrier	Sound Carrier	Local Osc.
2	54-60	55.25	59.75	81
3	60-66	61.25	65.75	87
4	66-72	67.25	71.75	93
5	76-82	77.25	81.75	103
6	82-88	83.25	87.75	109
7	174-180	175.25	179.75	201
8	180-186	181.25	185.75	207
9	186-192	187.25	191.75	213
10	192-198	193.25	197.75	219
11	198-204	199.25	203.75	225
12	204-210	205.25	209.75	231
13	210-216	211.25	215.75	237

300 ohm—Antenna input .... **IMPEDANCE** .... Speaker Coil 123A Amplifier 15 ohms
123B Amplifier 3.2 ohms
275 W. at 115 V., 60 c.p.s. .... **POWER** .... Audio—2.5 W. undistorted, 4 W. Max.
Chassis 19" wide, 17" deep, 10⅝" high .... **SIZE** .... Picture—14" x 10⅞"

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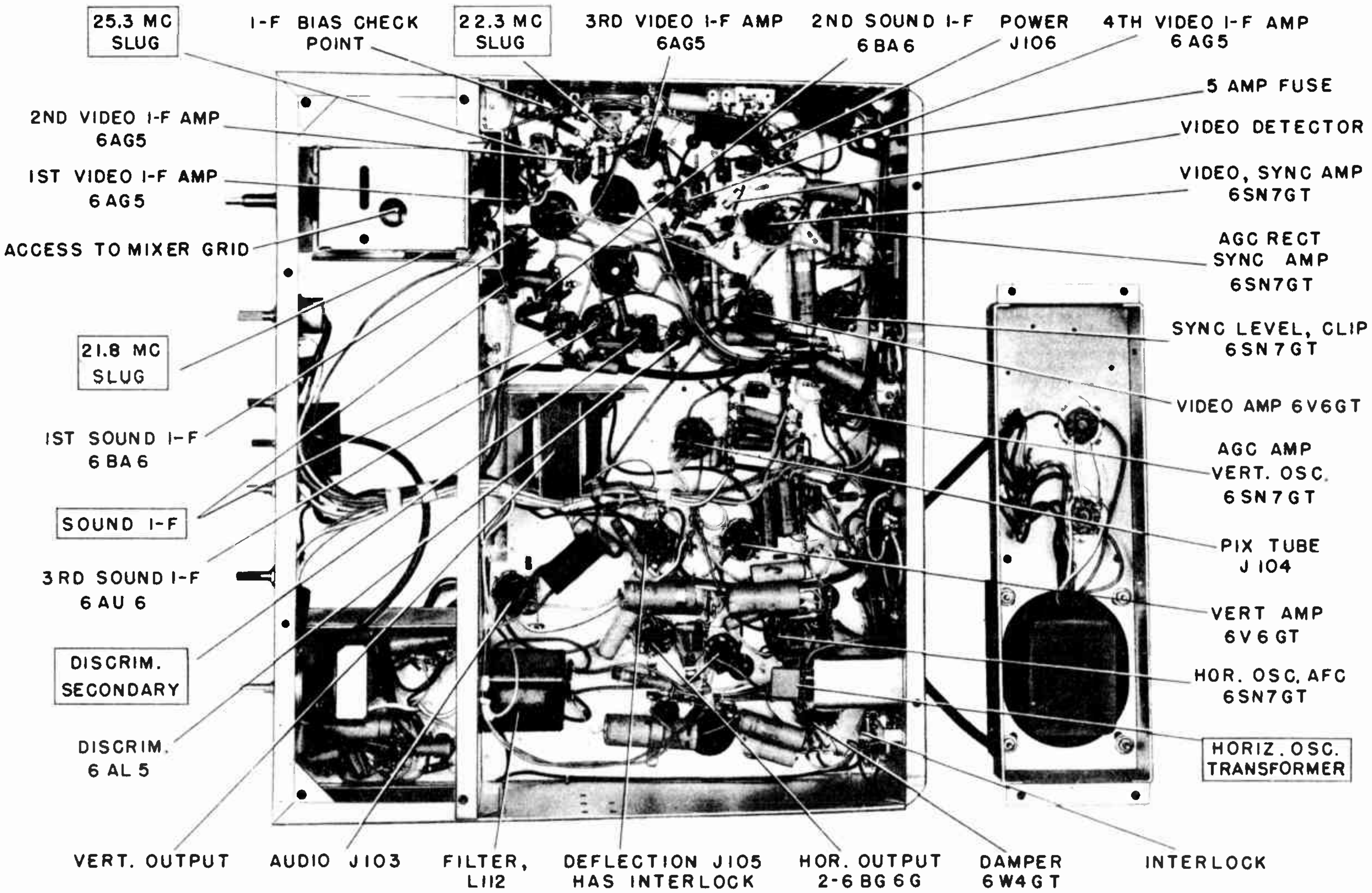

BOTTOM VIEW OF THE CHASSIS

PART III

PRELIMINARY ADJUSTMENTS

ALIGNMENT OF HORIZONTAL DEFLECTION CIRCUITS

a. Check of Horizontal Hold Control

(1) Allow a five minute warm up period before making this check.

(2) Rotate the Horizontal Hold Control from its extreme counterclockwise position. The picture should remain in synchronization. Return the control to its extreme counterclockwise position and momentarily interrupt the signal by switching to another channel and back again. The picture should fall out of synchronization and show from 4 to 5 bars slanting *upward to the right.*

(3) If this condition does not occur adjust the Horizontal Speed Control (rear chassis adjustment) until synchronization of the picture is obtained as described above.

b. Alignment of Horizontal Sync. Circuits

If the Horizontal Hold Control fails to perform as described above and it cannot be corrected by adjusting the Horizontal Speed Control it will be necessary to make the following adjustments:

(1) Set the Horizontal Hold Control to the full counterclockwise position.

(2) Adjust the Horizontal Lock Trimmer to at least two turns counterclockwise from maximum tightness. Do not force the tight adjustment to determine this setting.

(3) Short circuit the Horizontal Speed Coil which is mounted in metal can, terminal C and D. Access to this coil may be attained by removing the metal shield located on the bottom of the receiver cabinet.

(4) With the Horizontal Hold Control counterclockwise, adjust the iron core of the Magnalok transformer to frame the picture. This adjustment is located at the opposite end of the transformer from the horizontal speed coil.

(5) Remove the short from the Horizontal Speed Coil and adjust the Horizontal Speed Control for proper synchronization as described in check of Horizontal Hold Control.

PICTURE ADJUSTMENTS

a. Height and Vertical Linearity

Adjust the Height control until the picture just fills the mask vertically. Adjust VERTICAL LINEARITY control until the test pattern is symmetrical from top to bottom. Adjustment of either control will require a readjustment of the other. Adjust vertical centering control to align the picture with the mask.

b. Width Compensating Switch

The serviceman is provided with a switch which will compensate the horizontal width for different values of line voltage. It is a four position switch as follows:

Position 1	Low line voltage	(Approx. 105V)
Position 2	Nominal line voltage but weak horizontal sweep amp. tube	(Approx. 117V)
Position 3	Nominal line voltage	(Approx. 117V)
Position 4	High line voltage	(Approx. 125V)

When installing the receiver the serviceman should check the average line voltage at customer's home. The switch should then be set to position corresponding to his measurements.

In positions 3 and 4 the size control is operative and the picture can be adjusted to the exact width. In positions 1 and 2 the size control is inoperative and the picture may sometimes go slightly beyond the edges of the mask.

Positions 1 and 2 are provided for the location where the line voltage is low or the condition where the horizontal sweep amplifier tube is weak. They should only be used under these conditions.

Caution should be observed when adjusting the switch as improper position may result in the horizontal sweep amplifier tube operating with excessive screen dissipation. In all cases the serviceman can check his setting by observing if the picture width greatly exceeds the mask. If this happens the switch should be set to the next higher position.

Position 3 is recommended for most installations. The size control will then take care of normal variations encountered. If any doubt exists, the size control should be set for maximum size and starting with position 4, the switch should be turned until the picture size conforms with the mask or is slightly larger than the mask. The picture width (for positions 3 and 4) can then be reduced by the size control.

c. Width and Linearity

Adjust width control (recessed, upper right rear of H. V. compartment) for maximum width. Then, adjust Horizontal drive and linearity for proper width and linearity of picture.

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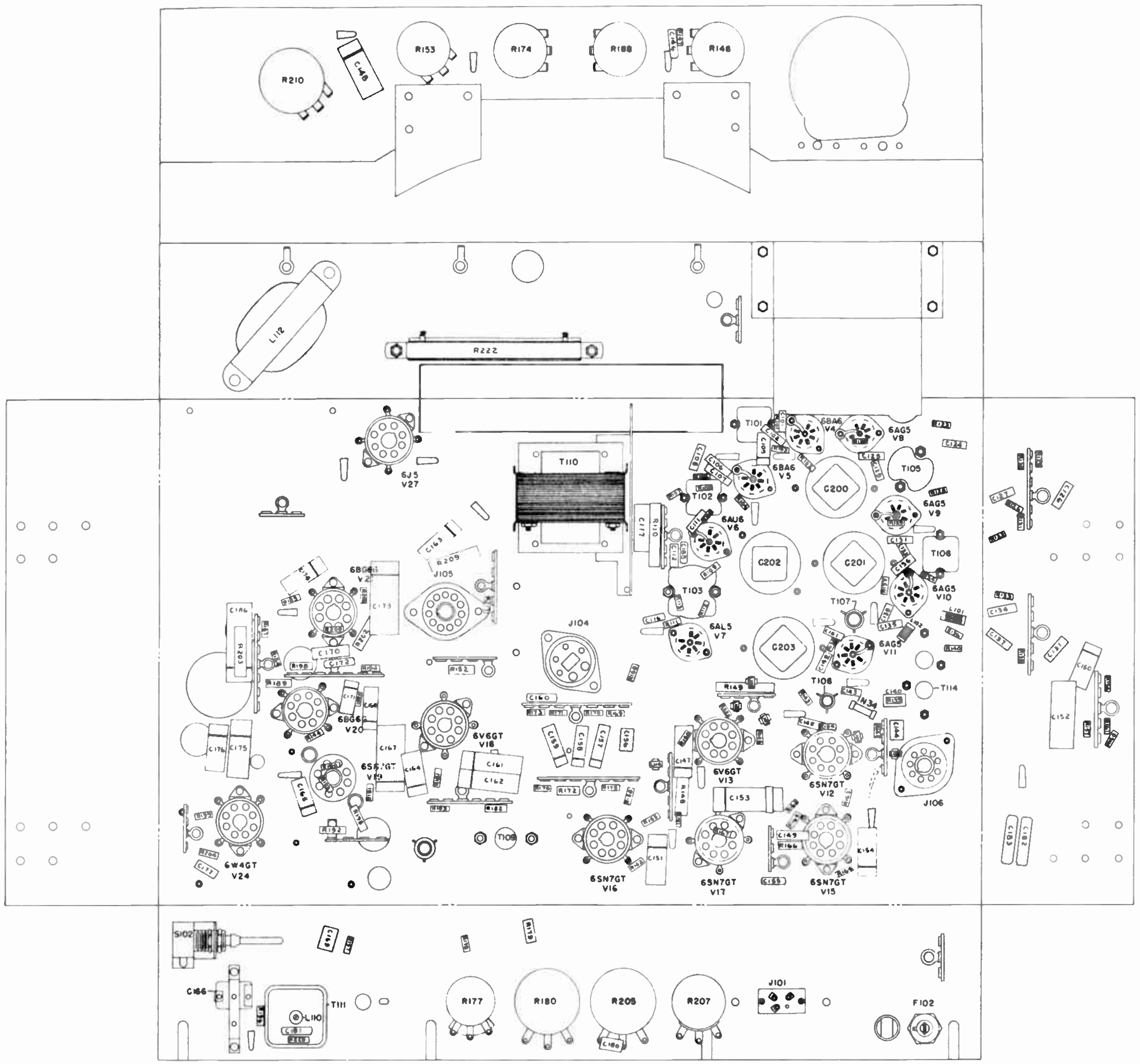
PARTS IDENTIFICATION



BOTTOM VIEW OF THE CHASSIS

CHECKING A. G. C. THRESHOLD CONTROL

1. Tune in a strong signal.

2. Sync the picture, then turn PICTURE control to maximum CW, and note that there is sufficient contrast.

3. Turn BRIGHTNESS until retrace lines are just invisible. Remove signal by switching momentarily to another channel.

4. If picture returns immediately, the control is properly set. If an appreciable part of a second is required for picture return the receiver is overloading and the threshold control should be readjusted.

ADJUSTING THE CONTROL

There are two methods of adjusting the AGC Control, and it is unnecessary to remove the receiver from the cabinet when using either.

1. WHEN AN OSCILLOSCOPE IS AVAILABLE.
   a. Connect the scope to the grid of the picture tube.
   b. Tune in a television signal for proper sound.
   c. Turn the contrast control clockwise to maximum.
   d. Adjust the AGC control for a 70 volt peak to peak video pattern on the scope.

   If a calibrated scope is not available, a convenient way to calibrate one is to connect the scope probe to a 6.3 volt filament pin, and set the vertical gain control so the sine wave pattern is ½ inch high. Without changing the vertical gain control, move the probe to the picture tube grid and set the AGC control to obtain a pattern 2 inches high. This is equal to 70 volts peak to peak. (Explanation: The peak voltage is 1.4 times the RMS voltage, therefore 1.4 x6.3=8.82 volts, the peak value of the filament voltage from zero to positive. The scope pattern shows both positive and negative half cycles, so 2x8.82=17.64 volts. Therefor 6.3 volts RMS = 17.65 volts peak to peak = ½ inch vertical deflection on the scope. A 70 volt calibration is required, so 4x17.65=70.6 volts p-p = 2 inches vertical deflection).

   e. As a precaution, turn the AGC control so the p-p voltage is higher than the required 70 volts, and examine the pattern for signs of overload. If overloading occurs at or very near the 70V. range, set the AGC control so the signal is slightly below that value.

2. WHEN NO OSCILLOSCOPE IS AVAILABLE.
   a. Tune in a television signal for maximum clarity.
   b. Turn the contrast control to mid-range, half way between maximum and minimum rotation.
   c. Without changing the contrast control, adjust the brilliance control and the AGC control for a medium brilliance and medium contrast picture.
   d. As a precaution, turn the AGC control farther than necessary in step c, and examine the picture for signs of overload. If overloading occurs at or very near the setting just established, advance the contrast control a quarter of an inch, and adjust the brilliance and AGC controls for the best obtainable picture.

ADJUSTING THE ANTENNA TRAPS

In some instances interference may be encountered from FM stations that are on the image frequency of a television station.

The CT 232-239-244-245-246 incorporates a series resonant trap across the R-F amplifier grid circuit to eliminate this type of interference.

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To adjust the trap, tune in the station on which the interference is observed, tune both cores of the trap for minimum interference in the picture. Keep both cores approximately the same by visual inspection, then turn one core ½ turn from the original position and repeak the second for maximum rejection. Repeat this process until the best rejection is obtained. The R-F unit of the CT 236 and 240 having greater selectivity, no traps are, as a rule, necessary.

PART IV

I-F, R-F ALIGNMENT

In aligning the amplifiers, it must be remembered that feedback between output and input circuits leads to regeneration and, if feedback be appreciable, to oscillation. It may be determined whether the amplifier is oscillating as follows:

Increasing signal generator output by a factor of (for example) two should result in a rise in output voltage in approximately the same degree. If, instead, a decrease in output with increased input is noted and if there be a steady output voltage as indicated on the V.T.V.M. even without input signal, the circuit is oscillating.

Regeneration insufficient to cause oscillation gives rise to distortion of the reproduced response curve, and proper alignment is not possible in such event.

Regeneration may be caused by poor bonding between the chassis of the receiver and of test equipment being used. Connection should be made by short, heavy leads. Many service organizations use a metallic sheet (galvanized iron is satisfactory) atop the bench which affords good R-F grounding between chassis, even though they are not conductively connected thereto.

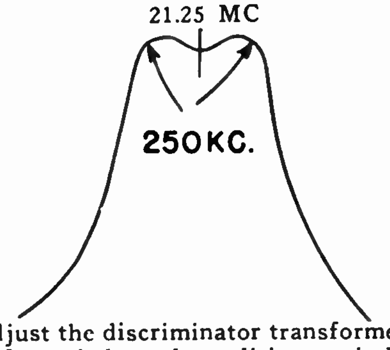
After the several connections of equipment are made and a pattern being reproduced, it must be possible to place the hand at various points of the equipment chassis and along the interconnecting cables, with no visible change in output potential or wave form. Failure to attain this probably means that regeneration is present, better grounding is necessary and subsequent alignment adjustments are questionable.

It may be necessary, to realize such a condition in the absence of a metal-topped bench, to employ two or more short bonding wires between chassis, connected at different points.

SOUND DISCRIMINATOR ALIGNMENT

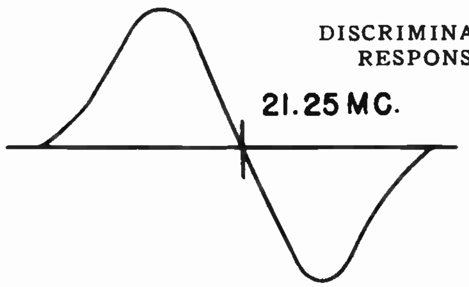
1. Connect the marker generator to the grid of the converter tube. Set the marker generator to exactly 21.25 MC.
2. Connect the Electronic Voltmeter to the discriminator output. Audio output terminal block may be used for this purpose. Set voltmeter to a low scale.
3. Detune the discriminator secondary (bottom adjustment transformer (3)) and then adjust discriminator primary (top adjustment) for maximum indication on the voltmeter. Adjust I-F transformer (2) and I-F transformer (1) top and bottom adjustment for maximum output.
4. Connect sweep generator to converter grid to a center frequency of 21.25 MC with a 1 MC sweep. Loosely couple marker generator at this point. Connect oscilloscope through 22K isolating resistor to high end of resistor (108) 3rd I-F grid. Retouch I-F adjustments so that output is maximum and symmetrical about the 21.25 MC marker as shown.

SOUND I-F AMPL. RESPONSE 21.25 MC



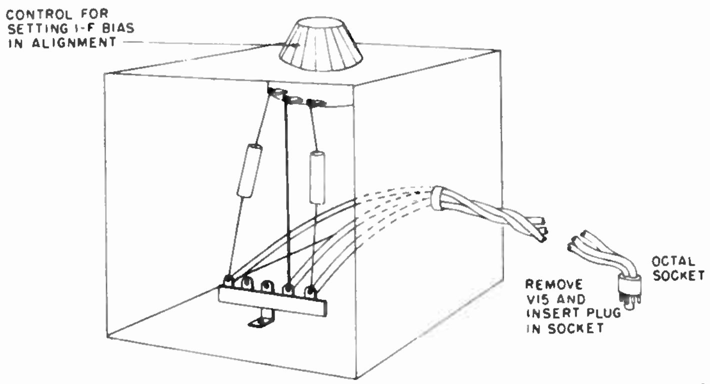
5. Adjust the discriminator transformer (3) secondary for a balanced condition as indicated by zero reading on the electronic voltmeter. When proper balance is obtained, positive and negative peaks will be observed as the marker generator is tuned to either side of the 21.25 MC sound I-F frequency. Keep P/P scope deflection at about one volt.
6. Observe the response curve at the output of the discriminator by connecting oscilloscope to the discriminator output. Connect the sweep generator to the converter grid and loosely couple the marker generator into the converter grid circuit. The marker generator 21.25 MC pip should occur at the midpoint of the linear portion of the discriminator response curve and will be attenuated at this point.

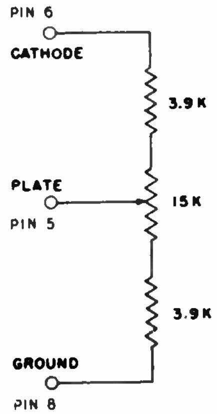
DISCRIMINATOR RESPONSE



VIDEO I-F ALIGNMENT

1. Remove the A. G. C. rectifier and sync amplifier tube (V15) and connect a variable resistor as shown in the accompanying sketch. Using this control set bias on I-F bus to approximately —3 volts.





Control for setting I-F bias. Use Plug Adaptor to plug into AGC tube socket.

2. Connect AM signal generator to mixer grid through a small capacitor. Connect oscilloscope between grid of 1st video amplifier tube (pin 1, V12A) and chassis ground. Set the signal generator to the 19.75 MC position with modulation and adjust the 2nd video I-F trap for minimum response (top adjustment). If the signal generator has no AM, use the VTVM across the detector load resistor as an indicating device.
3. Set the signal generator to the 21.25 MC position. Adjust the cathode trap (top adjustment) and then the converter trap on the R-F unit for minimum response (top adjustment).
4. Set the signal generator to the 27.25 MC position and adjust the trap to the 1st video I-F transformer (top adjustment) for minimum response. This completes the preliminary adjustments of the trap circuits.

Note: A VTVM may be used as an indicating device, when connected across the video detector load resistor. CAUTION—these points are approximately at minus 100 volts below ground.

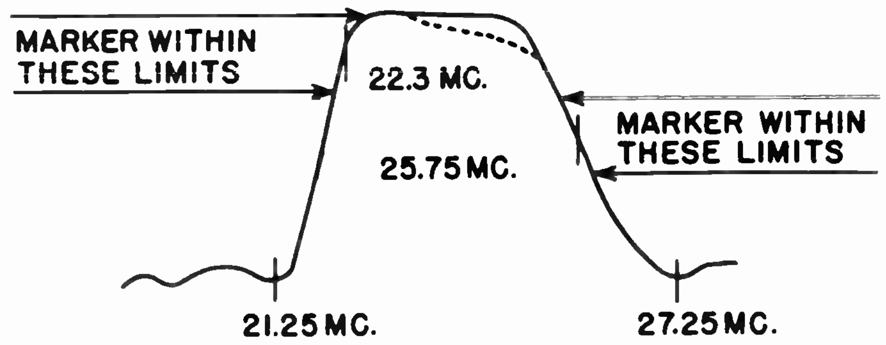
I-F TRANSFORMERS

1. Set the signal generator to the 21.8 MC position and adjust the converter transformer primary (bottom adjustment) for maximum output. Caution should be taken so that the signal does not overload the circuit. With the signal generator set up for the appropriate frequencies, tune the plate coils of the 1st video I-F transformer to 25.3 MC, 2nd video I-F transformer to 22.3 MC (after making this adjustment it will be necessary to realign the trap circuit to 19.75 MC) 3rd video I-F coil to 25.2 MC and 4th video I-F coil to 23.4 MC for maximum response.

RETOUCHING VIDEO I-F ALIGNMENT

1. Connect the sweep generator to the receiver antenna terminals. Set the channel selector and sweep generator to channel 13. Loosely couple the marker generator into the grid circuit of the converter stage. Sufficient coupling may be obtained by connecting the high side of the generator output to the R-F unit sub chassis to form a ground loop. Connect the oscilloscope between the plate of the 1st video amplifier (pin 2, V12A) and ground. The A. G. C. circuit should be inoperative as has been indicated and the I-F bus voltage set to —3 volts.
2. Observe the response curve obtained. The response will not be ideal and it will be necessary to retouch the I-F adjustments in order to obtain the desired curve as shown. The most important factor in the retouching procedure is that the video I-F carrier will fall within the limits as shown on the response curve. If the video carrier operates too low on the curve, loss of low frequency video response, of picture brilliance, of blanking and of sync may occur. If the video carrier operates too high on the response curve the picture definition is reduced by lack of high frequency video response. In making these adjustments care should be taken that no two I-F transformers are tuned to same frequency or I-F oscillation may occur.

OVERALL VIDEO RESPONSE



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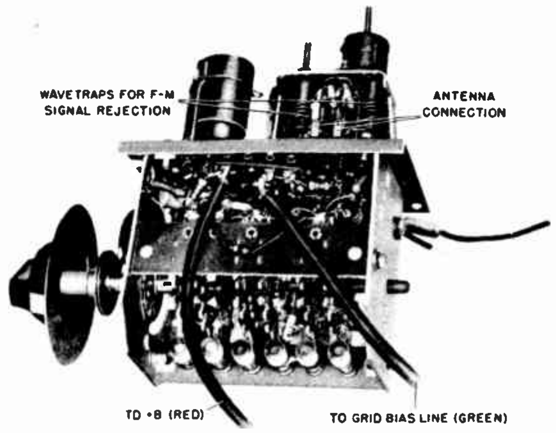
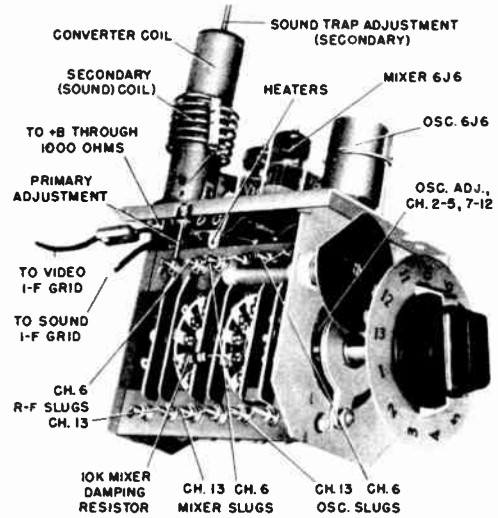
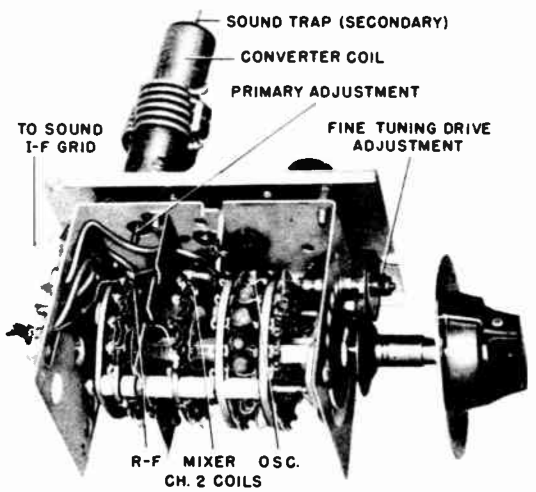
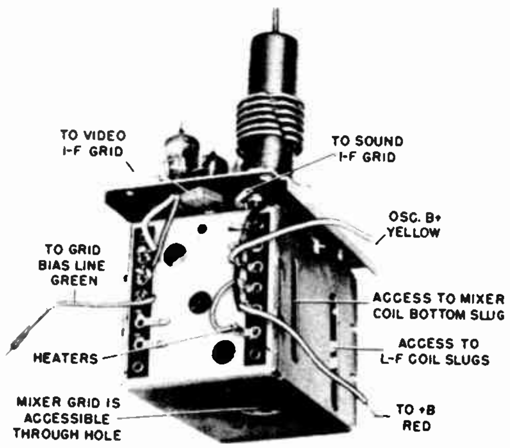
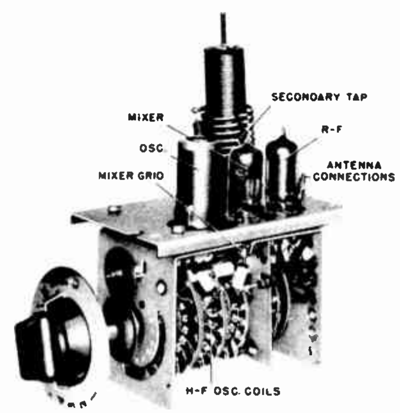




R-F UNIT OF THE CT 236-240 CHASSIS





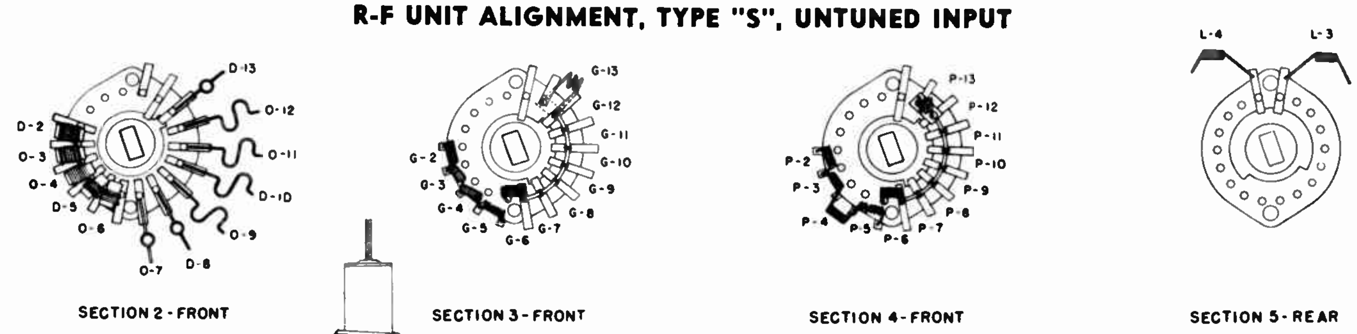


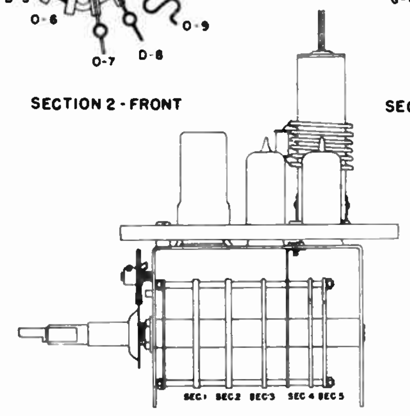
OSC 6C4, MIXER 6AG5, R-F AMP 6BH6

R-F UNIT OF THE CT 232-239 CHASSIS

R-F unit having tuned input physically similar to above, but oscillator is adjustable on all channels by means of slugs accessible from front of tuner. May be adjusted without removing chassis, by removing channel selector dial. Uses 6AB4 osc., 6AG5 mixer, 6AK5 R-F ampl.

R-F UNIT ALIGNMENT, TYPE "S", UNTUNED INPUT





R.F. UNIT ADJUSTMENT
ALL SECTIONS VIEWED FROM SHAFT END

OSCILLATOR ALIGNMENT

1. Oscillator adjustment should be made only when the fine tuning control tunes in the extreme clockwise or counterclockwise position from its center or if it will not tune at all within its tuning range. Such a condition may be brought about by changes in the inductance of the oscillator coils or changes in the circuit capacitance which might occur when the oscillator tube is replaced.

2. Method 1. (Adjustments to be made with R-F unit shield in place.)

a. The criteria of proper alignment using this method is that the combination of the assigned sound carrier and the local oscillator produce a signal that falls in the center of the sound discriminator characteristic. It is important that the sound I-F of the discriminator circuits have first been properly aligned.

b. To check the existing alignment of the local oscillator.

(1) Set the fine tuning control in the middle of its range.

(2) Turn the channel selector switch to channel 13. Connect signal generator to antenna terminals. If the generator has single ended output of low impedance a sufficiently accurate balance can be realized if two equal resistances are inserted between the generator output and the receiver antenna terminals and a terminating resistor equal in value to the generator cable impedance across the generator output. The value of the resistors is such that the sum of their resistance plus the terminating resistor equals approximately 300 ohms.

(3) Tune the signal generator to each side of the 215.75 MC Sound Carrier until its modulation is heard in the speaker. The signal generator should be tuned for a minimum signal located between two maximum points.

(4) Observe whether the signal generator reading obtained is above or below the 215.75 MC sound carrier. Repeat for the remaining high band channels tuning the signal generator about the corresponding sound carrier frequency in each case. See table page 4 for these sound carrier frequencies.

(5) If all of the high band oscillator coils or the majority of them are off in the same direction as shown by the signal generator dial reading they may usually be brought into alignment by adjusting the wheel which turns the fine tuning capacitor, or by changing oscillator tube.

3. Readjusting the Fine Tuning Wheel

a. Reset the channel selector switch to channel 13 and set the signal generator to the sound carrier for that channel. Tune the fine tuning control until the receiver is precisely tuned to the sound carrier.

b. Loosen the Allen set screws which fasten the wheel to the shaft of the fine tuning capacitor. Reset the wheel until it is mechanically in the center of its tuning range and tighten the set screw. When making this adjustment be sure that the fine tuning control does not move from its center position.

c. Recheck the settings of the channels as has been shown. Channels which are not

World Radio History

properly aligned must be adjusted individually. This procedure would also be followed in cases where the adjustments are off in random fashion and present no definite pattern to be followed in setting the fine tuning control.

4. Individual Adjustments of the Oscillator Coils, 12 Channel Unit

a. Having determined the direction in which the oscillator is misaligned on any high band channel remove the shield from the R-F unit and adjust the oscillator coil for that channel.

b. Coils having a one turn loop (Channels 13, 8 and 7) may be tuned higher by spreading the loop apart or making it smaller. They may be tuned lower by squeezing the loop closer, making the loop as large as possible and making the adjacent parts of the loop as parallel as possible.

c. Coils consisting of a single bent wire (Channels 12, 11, 10 and 9) may be adjusted from minimum to maximum inductance by adjusting them as shown below.

Care should be taken to prevent any coil from touching an adjacent one and to prevent a part of the coil from touching the switch stator contact in any place except where it is soldered to that contact.

d. To adjust the low band coils turn the brass slugs in and out as required with a small screwdriver, reheating the wax around them after the final adjustment.

e. In order to avoid repeated removal and replacement of the R-F unit shield during oscillator adjustment the fine tuning control may be set 120 degrees away from its mid point position in the direction of less capacity. (Corresponding to clockwise rotation of the fine tuning control). It will be found that when the coils are adjusted in this manner with the shield removed, the fine tuning control will be in the center of its range when the shield is in place.

SWITCH WAFER

MINIMUM INDUCTANCE

MEDIUM INDUCTANCE

MAXIMUM INDUCTANCE

R-F AMPLIFIER AND CONVERTER ALIGNMENT*

a. Set channel selector on channel 13. Connect sweep generator to the antenna terminals using a balanced resistor network for those generators having an unbalanced output. Set the sweep generator to sweep channel 13. Connect oscilloscope between the plate of the first video amplifier and chassis ground.

b. Loosely couple the marker generator to the antenna terminals. Set the generator to the channel 13 sound carrier and tune the receiver to that carrier. Adjust the sweep input in such a manner as to avoid overload in the R-F amplifier. Adjust the R-F amplifier plate coil (P13) and the converter grid coil (G13) for maximum response. Set the marker generator to the channel 13 video carrier frequency and adjust these coils for proper bandpass with optimum gain. The video carrier marker should be approximately at the 50% point on the response curve.

c. Set the R-F channel selector switch and sweep generator successively to channels 12 down to 7. If the channel 13 R-F amplifier plate coil (P13) and the converter grid coil (G13) are correctly tuned, channels 12 to 7 will give symmetrical bandpass patterns and the height of the pattern will not vary by more than 3 to 1 between channels 13 and 7.

LOW BAND

a. Connect the sweep generator and marker signal generator to the antenna terminals as has been shown for the high band alignment. Set the channel selector switch to channel 6. Set sweep generator to sweep channel 6 and the marker generator to the channel 6 sound carrier frequency.

b. Connect the oscilloscope between the plate of the first video amplifier and chassis ground.

c. Set the fine tuning control to the center of its range. Observe the response and adjust the R-F amplifier plate coil (P6) and the converter grid coil (G6) for maximum response. Set the marker generator to the channel 6 video carrier frequency and adjust these coils for proper bandpass with optimum gain. The video carrier marker should be at the 50% point on the response curve.

d. Align channels 5, 4, 3 and 2 in a similar fashion. The difference between peaks on any channel should be no more than 30% of the total height of the response curve.

e. It should be noted that maximum height and symmetry of the response curve should occur at the mid range of the fine tuning control where it will properly tune in the sound carrier frequency.

*The AGC circuit should be made inoperative as has previously been shown.

R-F UNIT ALIGNMENT, TYPE "S" WITH TUNED INPUT

OSCILLATOR ALIGNMENT

The oscillator coils in this R-F unit are all tunable by slug adjustments, and alignment of one does not appreciably effect the tuning of the other coils. The order of alignment is from channel 6-2, 13-7, 6-2 and 13-7. The repeated adjustment is necessary to correct any detuning caused by the capacity change due to slug adjustments of adjacent coils.

1. Set the sweep generator and channel switch to No. 6 channel. Adjust as outlined in instructions for untuned input tuner.
2. Proceed through channels 5-2 in the same manner.
3. Align channels 13-7.
4. Proceed as above through channels 6-2 and 13-7, and retouch if necessary.

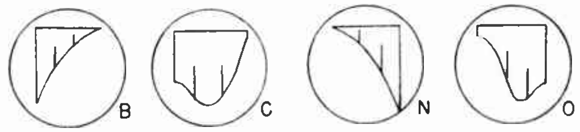
ANTENNA, R-F AMPLIFIER AND CONVERTER ALIGNMENT

There are three variables which will give the desired pattern. If the antenna coil (wafer nearest the rear of the tuner is first expanded, then the grid coil and finally the plate coil is expanded, the proper pattern will appear. These coils must be very carefully adjusted with only slight movement, particularly the plate coil. The final pattern is obtained by working back and forth between these three coils.

1. Remove the AGC rectifier-amplifier tube and connect bias control.
2. Connect sweep generator to antenna terminals, using a balanced resistor network if generator has unbalanced output cable. Connect 'scope to terminal provided on the tuner.
3. Set the sweep generator and channel switch to No. 13 channel. If the coils are very badly aligned, the pattern on the scope will probably be either of these:

The meaning of "A" is that some coils must be opened up. The meaning of "M" is that some coils should be closed or squeezed together.

4. When they are far off from their proper tuning, all three coil circuits have their main effect on pattern height, so tune for increasing height of the pattern.
5. As a coil is changed, one side of the picture will get higher and then a hump will start to move across the screen.

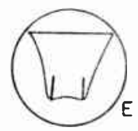


If the first pattern was like "A", the next will be "B" and then "C" as the coil is opened. If the first pattern was like "M", the next will be "N" and then "O" as the coil is closed. When the hump, due to the tuning of that coil, is between the markers, it indicates that this coil is very close to where it it should be. So leave it and immediately go to another coil.

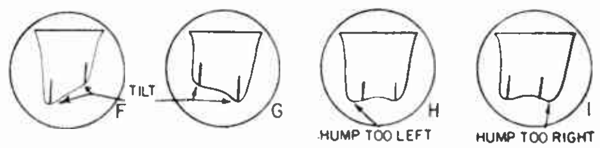
6. The side of the picture which is higher indicates what to do to the next coil. In "C", the left hand side is higher, which indicates that said coil should be opened. In "O", the right side is higher, indicating that said coil should be closed. A picture similar to "D" or "P" should be then obtained.

The fact that there are now two humps in the pattern shows that both converter wafer and R-F wafer are tuned nearly right. If picture height is near what it should be with the scope settings unchanged, the antenna wafer is near correct. It should be adjusted a bit to see if pattern height improves.

7. When all three coils are nearly tuned, the antenna wafer controls the tilt, the RF wafer controls the left hand hump, and the converter wafer controls the right hand hump. Adjust them for a perfect flat pattern on channel 13 as below.



8. Proceeding through channels 12, 11, 10, etc. The pattern will change slightly as shown below. In general, three things occur: (1) tilt (2) hump too far left or (3) hump too far right.



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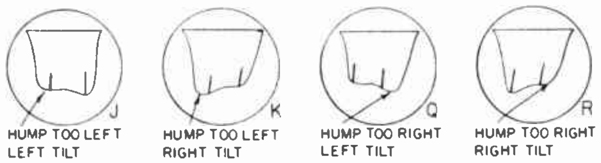
For right tilt as in "F", press down the loops on the antenna wafer. For left tilt as in "G", pull up the loops on the antenna wafer. For hump to left as in "H", push down on the loops on the R-F wafer. For hump to right as in "I", use iron and screwdriver and pull out channel 12 or channel 7 loops on converter wafer.

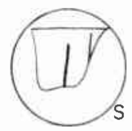
9. Combinations of detuning also occur.



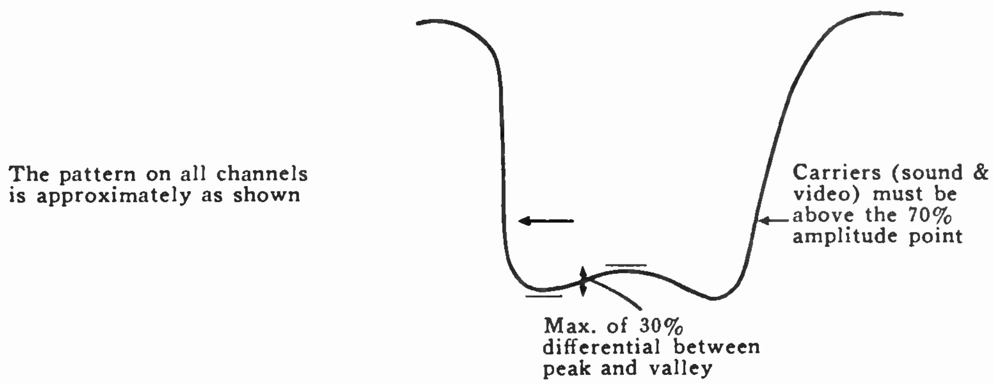
In these cases, two wafers must be adjusted to bring in the best picture. For a case like "J", R-F wafer must be adjusted to bring in the hump and antenna wafer to correct the tilt. In a case like "Q", the converter wafer should be adjusted to bring in the hump and the antenna wafer to correct the tilt. In combination cases like these where the antenna wafer and one of the other two must be adjusted, always adjust the antenna wafer for tilt correction after all adjustments have been made on the other two wafers.

10. It is best to prevent the left hump from going so far to the left that it cannot be brought back, or the tilt to become so bad that it cannot be corrected. If the best possible pattern is obtained on each successive channel, then proper adjustment of the next one will always be within its range.

11. When both coils are near to proper tuning, a slight adjustment of either R-F or converter wafer will give a flat pattern, with very little tilt, and the humps right on the markers; but only the correct coil will give this correct pattern shape plus best pattern height.



When the pattern is like "S" on a low band, opening a coil on either wafer will move the pattern to the right, but try both slightly and make the final adjustment by opening that coil which causes the pattern to become higher as it moves toward the right.



R-F UNIT ADJUSTMENT, TYPE "R" TUNER

1. Oscillator Alignment

   a. The criteria of proper alignment using this method is that the assigned sound carrier and the local oscillator produce a signal that falls in the center of the sound discriminator characteristic (21.25 MC), when the fine tuning control is in the center of its tuning range. The sound I-F and Discriminator circuits must be in alignment before making any adjustments to the oscillator circuit.

2. High Band Alignment

   a. Set the fine tuning control in the center of its tuning range. Set the selector switch to channel 13.

   b. Connect the signal generator to the antenna terminals and set to the channel 13 sound carrier frequency (215.75 MC). This signal should be amplitude modulated.

   c. Adjust L77 and L78 for a minimum signal located between two maximum points. Note: When making these adjustments allow for the change in circuit capacity which occurs when the alignment tool is brought into the vicinity of the oscillator tuning circuit.

   d. Switch the channel selector to channel 12 and set the signal generator to the channel 12 sound carrier frequency (209.75 MC). Tune the channel 12 oscillator tuning screw as has been indicated. Repeat for channels 11 to 7, in each case switching the channel selector to the correct channel and the signal generator to the corresponding sound carrier frequency.

3. Low Band Alignment

   a. Set the channel switch to channel 6. Adjust the signal generator to the channel 6 sound carrier frequency (87.75 MC). Adjust L63 and L64 as described in step (c) of the high band alignment. Set the signal generator to channel 5 and switch the channel selector to channel 5. Tune the channel 5 oscillator tuning slug as has been shown. Repeat for channels 4 to 2, in each case, changing the selector switch to the correct channel and the signal generator to the corresponding sound carrier frequency.

R-F AMPLIFIER AND CONVERTER ALIGNMENT

1. Set I-F bias line to —3V as previously outlined.

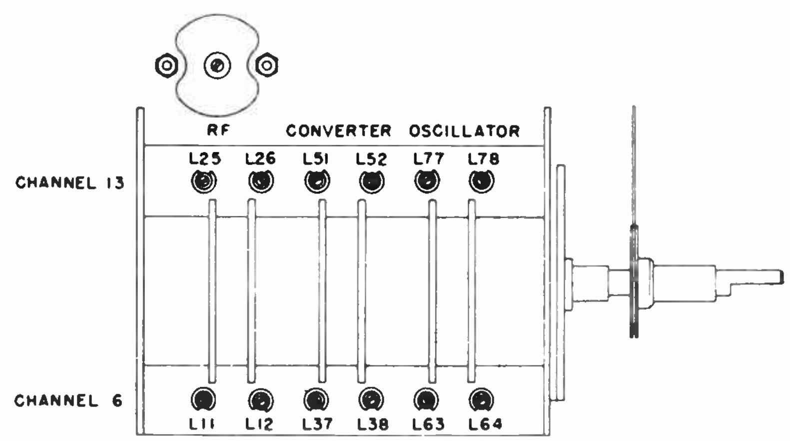
   (1) Set channel selector switch to channel 13. Connect sweep generator to the antenna terminals using a balanced resistor network for those generators having an unbalanced output. Set the sweep generator to sweep channel 13. Connect the oscilloscope between the plate of the 1st video amplifier and chassis ground. The marker generator should be loosely coupled into the grid circuit of the converter stage, this can best be done, without placing a load on the converter grid circuit, by connecting the high side of the generator output to the R-F unit chassis and increasing the output of the marker generator until the marker signal is visible on the response curve.

   (2) Set the fine tuning control in the center of its range where it will correctly tune in the sound carrier. Set the sweep generator to sweep channel 13. Observe the overall video response and adjust L25, L26, L51, and L52 for proper bandpass with optimum gain. The overall response should approximate the curve shown in figure 4. L25 and L26 are both primary of R-F amplifier plate coil adjustments and the stud extensions of these cores should be kept equal. The same applies to L51 and L52 which are the secondary or converter grid coil adjustments. When channel 13 is properly adjusted channels 12 to 7 inclusive should be checked for proper overall video response. It may be necessary to compromise between channels 7 and 13 to get the response within the desired limits.

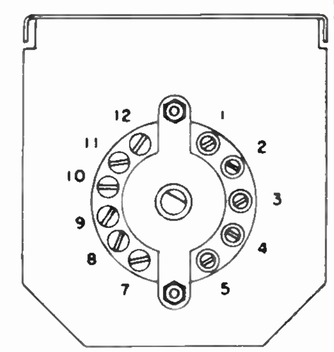
3. Low Band Alignment

   a. Channel 6 can now be aligned in the same manner as channel 13. Inductances L11 and L12 being the primary adjustments and L37 and L38 the secondary adjustment. Again the stud extensions of the adjustable cores are maintained equal. Channels 5 to 2 should now be checked for proper response, again it may be necessary to compromise between channels.

R-F UNIT ALIGNMENT, TYPE "R"



R F UNIT



OSCILLATOR ADJUSTMENTS

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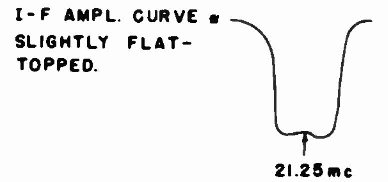
TABULATED ALIGNMENT

ALIGNMENT, SOUND I-F, DISCRIMINATOR

CONNECT SIG. GEN.	AM	CW	CONNECT SWEEP	GENERATOR FREQUENCY	CONNECT 'SCOPE	CONNECT V. T. METER	TUNE	FOR	COMMENTS
1. SOUND TAKEOFF, MIXER OUTPUT TRANS. (TAP)	✓			STEP (1) MAKES FREQUENCY SAME AS TRAPS THEREFORE, TRAPS SHOULD BE PROPERLY SET.	VIDEO DET. LOAD RESISTOR		GENERATOR	MIN. NEAR 21.25 mc	BOTH 'SCOPE AND METER SERVE AS INDICATOR. AVOID OVERLOAD IN I-F AMPLIFIERS AS SHOWN BY FLATTENING OF PEAKS.
2. SAME	✓				GRID RESISTOR, LAST I-F AMP. (LIMITER)	SAME AS 'SCOPE	SOUND I-F TRANSFORMERS	MAX.	
3.							RETOUCH I-F TRANSFORMERS	PROPER CURVE *	
4. SAME	✓		WITH GEN. AT SOUND TAKEOFF, MIXER TRANS.		AUDIO TAKEOFF, DISCRIMINATOR	SAME AS 'SCOPE	a. DETUNE SEC. (BOTTOM) SLUG OF DISC. TRANS. b. PRI. (TOP) SLUG. c. SEC. SLUG.	MAX. MIN.	
5. USE AS MARKER, LOOSELY COUPLED		✓	SAME				RETOUCH DISC. TRANS., PRI. AND SEC. AS REQUIRED.	SYMMETRY OF "S" CURVE MARKER AT CENTER	



DISCRIMINATOR CURVE

ALIGNMENT, VIDEO I-F

SET BIAS ON GRID RETURN BUS TO NEGATIVE 3 VOLTS

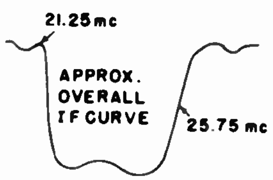
CONNECT SIG. GEN.	AM	CW	CONNECT SWEEP	GENERATOR FREQUENCY	CONNECT 'SCOPE	CONNECT V.T. METER	TUNE	FOR	COMMENTS
1. CONVERTER (MIXER) GRID	✓			21.25	VIDEO DET. LOAD RESISTOR	VIDEO DETECTOR LOAD RESISTOR	(a) DETUNE MIXER TRANS. TOP SLUG (b) 21.25 mc TRAP (4th. I F CATHODE)	MIN.	AVOID OVER LOAD AS SHOWN BY FLATTENING OF CURVE ON 'SCOPE. STEP 4 MAY FOLLOW STEP 1.
2.	✓			19.75			TRAP, 2nd. I F PLATE (TOP)	MIN.	
3.	✓			27.25		CONNECT ACROSS RESISTOR—NOT TO CHASSIS GROUND. METER WILL BE -100 VOLTS TO GROUND.	TRAP, 1st. I F PLATE (TOP)	MIN.	
4.	✓			21.25			MIXER OUTPUT TOP SLUG	MIN.	
5.	✓			21.8			MIXER OUTPUT (BOTTOM SLUG)	MAX.	
6.	✓			25.3			PLATE SLUG, 1st. I F AMPL.	MAX.	BOTTOM SLUG
7.	✓		REPEAT STEP 2 AFTER STEP 7 IS COMPLETED	22.3			PLATE SLUG, 2nd. I F AMPL. (BOTTOM SLUG)	MAX.	2 PEAKS PRESENT. USE PEAK WITH SLUG IN.
8.	✓			25.2			4th. I F AMPL. GRID.	MAX.	TOP-OF-CHASSIS SLUG.
9.	✓			23.4			4th. I F AMPL. PLATE	MAX.	TOP-OF-CHASSIS SLUG
10. USE AS MARKER IF NECESSARY		✓	MIXER GRID	AS NECESSARY			SLUGS AS REQUIRED, EXCEPT TRAPS (SEE NOTES)	PROPER CURVE	LOOSELY COUPLE MARKERS

NOTES

SLUG	TUNES	MOSTLY AFFECTS
21.8	SHARP	LOW FREQUENCY END OF CURVE
25.3	SHARP	HIGH FREQUENCY END OF CURVE
22.3	BROAD	LOW-CENTER END OF CURVE
25.2	BROAD	HIGH-CENTER END OF CURVE
23.4	VERY BROAD	MIDDLE OF CURVE

IN RETOUCHING, 23.4 SLUG IS USUALLY THE ONLY ONE REQUIRING ADJUSTMENT. THE 25.2 SLUG IS OF NEXT IMPORTANCE.

DO NOT RETOUCH 22.3mc SLUG!



ALIGNMENT, R-F UNITS

IF ALL STATIONS TUNE NEAR ONE END OF DIAL, CHANGE OSCILLATOR TUBE OR ADJUST FINE TUNE DRIVE OF TYPE "S"

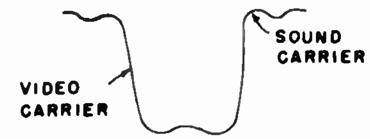
ADJUST BIAS LINE TO NEGATIVE 1½ VOLTS FOR R-F ALIGNMENT

CONNECT SIG. GEN.	AM	CW	CONNECT SWEEP	GENERATOR FREQUENCY	CONNECT 'SCOPE	CONNECT V.T. METER	TUNE	FOR	COMMENTS	
1. ANTENNA		✓		SOUND CARRIER CH. 13		AUDIO TAKEOFF DISCRIMINATOR	OSCILLATOR, * CH. 13 ADJUSTMENT	ZERO BETWEEN TWO PEAKS	OSCILLATOR ADJUSTMENT	COVER OF UNIT INFLUENCES FREQUENCY.
2.		✓		SAME, CH.12-7			SAME, CH.12-7 *	SAME		
3.		✓		SAME, CH. 6			SAME, CH. 6 *	SAME		
4.		✓		SAME, CH. 5-2			SAME, CH. 5-2 *	SAME		

* ADJUST OSC. OF TYPE "R" UNIT ON CH. 2 AND 7. OTHERS SHOULD FALL INTO LINE.

CONNECT SIG. GEN.	AM	CW	CONNECT SWEEP	GENERATOR FREQUENCY	CONNECT 'SCOPE	CONNECT V.T. METER	TUNE	FOR	COMMENTS	
5. USE AS MARKER IF NECESSARY			ANTENNA	AS REQUIRED FOR MARKER	VIDEO DET. LOAD RESISTOR.		R-F AMPL. ADJUSTMENTS, CH. 13	PROPER CURVE	R-F AMPL. ADJUSTMENT	R-F AMP. RARELY. NEEDS ADJUSTMENT
6.		✓					SAME, CH.12-7 +	SAME		
7.		✓					SAME, CH. 6	SAME		
8.		✓					SAME, CH. 5-2 +	SAME		

+ ADJUSTMENT FOR CHANNELS 5-2 IS ONLY ON TYPE "S" UNIT. ON OTHERS, COMPROMISE IF NECESSARY, TO KEEP SOUND, VIDEO CARRIERS WITHIN LIMITS.



PART V

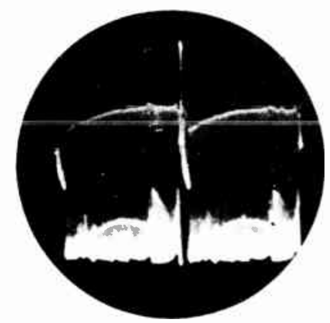
VOLTAGES AND WAVEFORMS

INPUT 1st VIDEO AMPL. PIN 1, V14A 'SCOPE AT 30 C.P.S. 2V. P-P

INPUT, 2nd VIDEO AMPL. PIN 5, V14 'SCOPE AT 30 C.P.S. 15V. P-P

CONTROL GRID, PICTURE TUBE 'SCOPE AT 30 C.P.S. 60V. P-P. VARIATION WITH PICTURE CONTROL.

INPUT OF SYNC. AMPL. PIN 1, V15B 'SCOPE AT 30 C.P.S. 14V. P-P



OUTPUT OF SYNC. AMPL. PIN 2, V15B 'SCOPE AT 30 C.P.S. 80V. P-P

INPUT OF SYNC. CLIPPER PIN 1, V17B 'SCOPE AT 30 C.P.S. 46V. P-P

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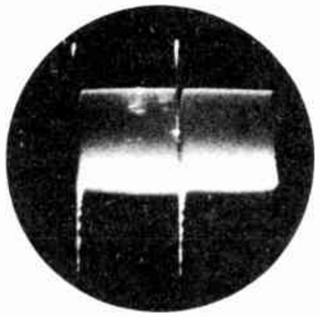
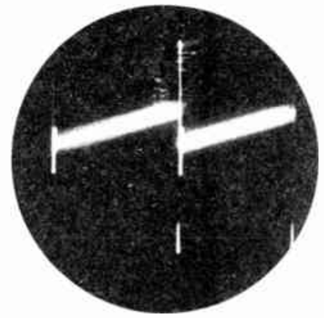
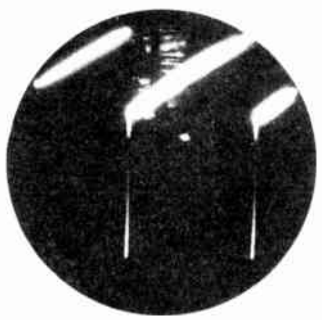


OUTPUT, SYNC. CLIPPER PIN 3, V17B 'SCOPE AT 30 C.P.S. 8V. P-P

GRID, VERT. OSCILLATOR PIN 1, V16B 'SCOPE AT 30 C.P.S. 300V. P-P

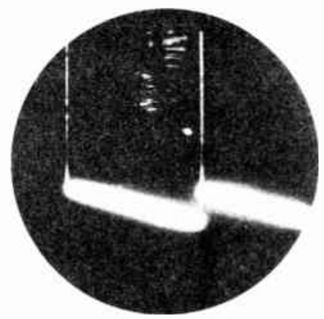


VERT. OSCILLATOR PLATE PIN 2 V16B 'SCOPE AT 30 C.P.S. 100V. P-P



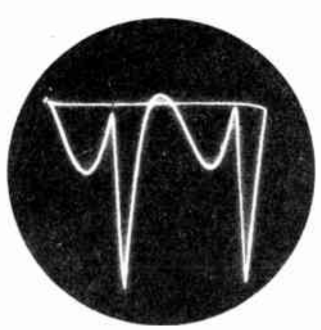
GRID, VERT. AMPL. PIN 5, V18 'SCOPE AT 30 C.P.S. 50V. P-P

PLATE OF VERT. AMPL., PIN 3, V18 'SCOPE AT 30 C.P.S. 400V. P-P



SECONDARY, VERT. OUTPUT TRANSFORMER GREEN WIRE 'SCOPE AT 30 C.P.S. 40V. P-P

ACROSS HORIZ. LOCK CONDENSER 'SCOPE AT 7875 C.P.S. 15V. P-P



CENTER TAP, HORIZ. SPEED COIL 'SCOPE AT 7875 C.P.S. 60V. P-P

ACROSS C172, .0018 MFD, HORIZ. OSCILLATOR OUTPUT 'SCOPE AT 5250 C.P.S. 75V. P-P

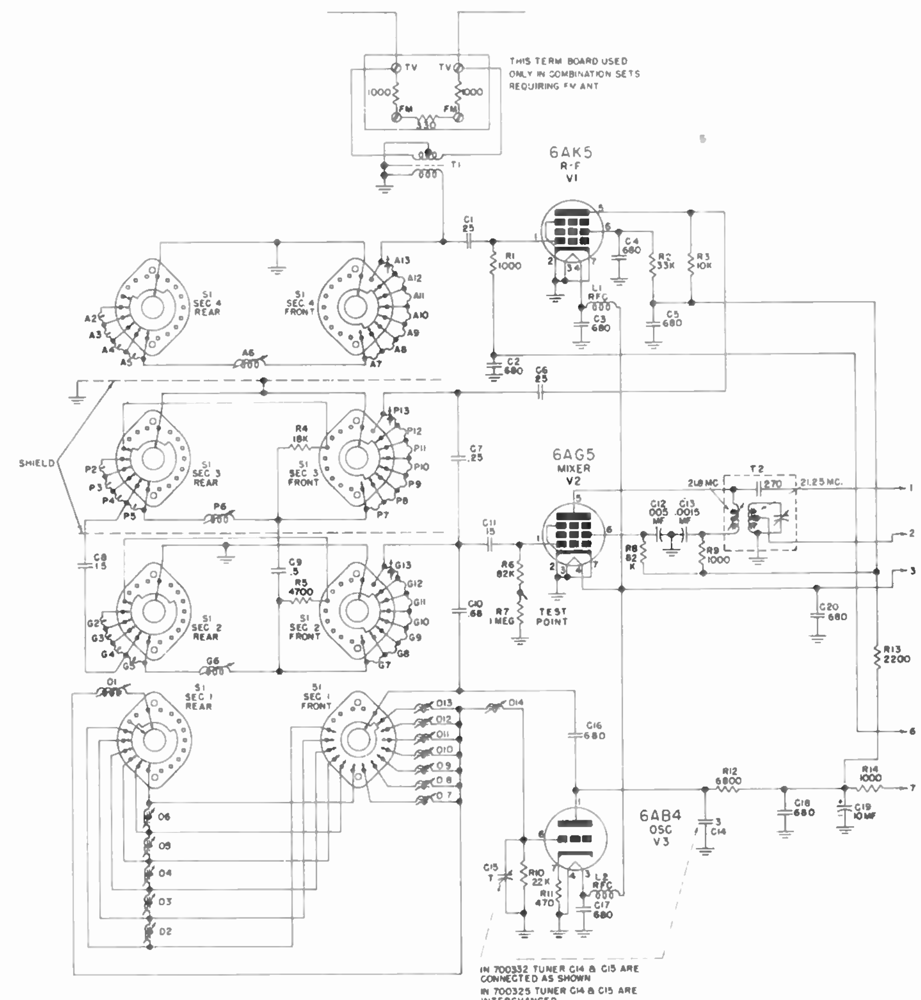
WHY THE VOLTAGES VARY

Assuming normal operation of the television receiver, voltage waveforms often do not appear as shown. This is a function of the type of oscilloscope used, and its input cable.

These waveforms are as reproduced on a Dumont 208B instrument but another, having greater or lesser frequency fidelity, may show a waveform quite different in shape and/or size. Therefore, the service technician must be familiar with his oscilloscope, must recognize its limitations and must make mental correction if waveforms do not appear to be "normal."

The same logic applies to the measure of D-C voltages. Measurements shown here are on an RCA Voltohmyst, Jr. and the use of a 20,000 ohm per volt movement will indicate some D-C voltages to differ greatly from those shown. Again, logic and reasoning must be applied, realizing that in a high impedance circuit, the indicated voltage will be less than the actual operating voltage.

Allowances for 'scope waveforms and D-C meter readings may be computed if all pertinent factors are known, but the experienced technician makes mental correction and allowances to the end that high fidelity instruments are not required.



TYPE "S" R-F UNIT WITH TUNED INPUT, CT 244-245-246

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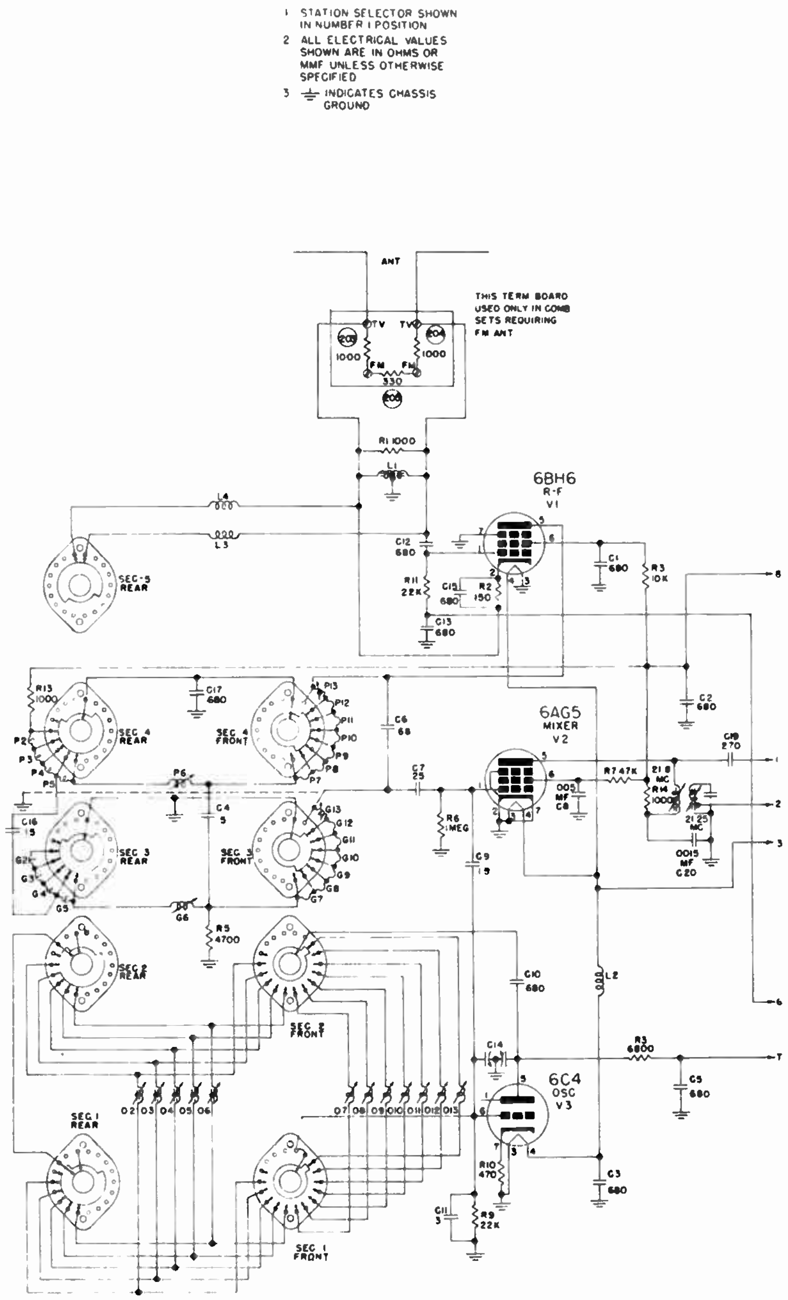
TUBE NO.	TUBE TYPE	FUNCTION	PLATE PIN NO.	PLATE VOLTS	SCREEN PIN NO.	SCREEN VOLTS	CATHODE PIN NO.	CATHODE VOLTS	GRID PIN NO.	GRID VOLTS	NOTES ON MEASUREMENT
		VOLTAGE CHART, 16" CHASSIS CT232, CT236, CT239, CT240, CT244, CT245, CT246									
4	6BA6	1st Sound I-F	5	100	6	100	7	.6	1	.0	Measurements made with receiver operating on 117 volts 60 cycles a-c and no signal input. Voltages between indicated terminal and chassis ground except where otherwise noted. Voltage and current readings are nominal values.
5	6BA6	2nd Sound I-F	5	120	6	105	7	.8	1	-.2	
6	6AU6	3rd Sound I-F	5	43	6	43	7	0	1	-.3	
7	6AL5	A-F Disc	7 2	-.5			1 5	0			
8	6AG5	1st Video I-F	5	125	6	120	7	.4	1	-1.7 to -4.4	Variation with threshold control
9	6AG5	2nd Video I-F	5	125	6	120	7	.4	1	-2.2 to -4.4	Variation with threshold control
10	6AG5	3rd Video I-F	5	110	6	120	7	.4	1	-2.8 to -4.4	Variation with threshold control
11	6AG5	4th Video I-F	5	100	6	140	7	1.2	1	0	
12A	6SN7GT	1st Video Ampl.	2	-25			3	-100	1	-100	
13	6V6GT	2nd Video Ampl.	3	190	4	200	8	0 to 3.6	5	-25	Variation with threshold control
12B	6SN7GT	1st sync Ampl.	5	88			6	-16	4	-23	
14	16AP4	Pix.Tube (Chassis Socket)	Shell	13.3KV	3	360	4	45 to 110			Variation with brightness control
									5	0 to 23	Variation with contrast control
		Pix.Tube (Tube Sock)	Shell	13.3KV	10	360	11	45 to 110			Variation with brightness control
									2	0 to 23	Variation with contrast control
15A	6SN7GT	AGC Rect.	5	86			6	-14	4	-23	
16A	6SN7GT	AGC Ampl.	5	-4 to -18			6	-49	4	-49	Variation with threshold control
15B	6SN7GT	2nd sync Ampl.	2	91			3	1.2	1	-.6 to -1.9	Variation with threshold control
17A	6SN7GT	Sync.leveler	5	-34to -67			6	gnd	4	tied to plate	Variation with threshold control
17B	6SN7GT	Sync.clipper	2	200			3	1.5	1	-34 to -67	Variation with threshold control
16B	6SN7GT	Vert.Osc.	2	28-115 -34-160			3	-100	1	-150	Variation with vertical speed control Variation with height control
18	6V6GT	Vert.Out.	3	190	4	190	8	-72	5	-86	
19A	6SN7GT	Hor.A.F.C.	2	15-50			3	-70 to -81	1	-66 to -76	Variation with horizontal hold control
19B	6SN7GT	Hor.Osc.	5	90			6	-100	4	-160	
21	6BG6G	Hor.Out.	cap	375	8	200	3	-87	5	-117	
22	6BG6	Hor.Out.	cap	375	8	200	3	-87	5	-117	V22 used only on chassis 244, 245 and 246
23	1B3GT	H.V.Rect.	cap	6.8KV			2-7	7.5KV			Measured with electrostatic voltmeter
24	1B3GT	H.V.Rect.	cap	Pulse			2-7	14.7KV			Measured with electrostatic voltmeter
25	6W4GT	Damper	5	280			3	380			
26	5U4G	Rectifier	4-6	375 AC			2-8	295			
27	5U4G	Rectifier	4-6	375 AC			2-8	295			



TYPE "S" R-F UNIT WITH UNTUNED INPUT CT 232-239

CHASSIS CT 232, CT 236, CT 239, CT 240, CT 244, CT 245, CT 246

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PARTS LIST FOR THE CT 244 AND CT 245 TELEVISION CHASSIS

Ref. No.	Part No.	Description
T101	360332-12	First Sound I-F Coil Assembly
T102	360332-12	Second Sound I-F Coil Assembly
T103	360332-13	Sound Discriminator Transformer
T104	320027-3	Output Transformer
T105	360332-3	First Video I-F Coil
T106	360332-5	Second Video I-F Coil Assembly
T107	360332-6	Third Video I-F Coil
T108	360332-6	Fourth Video I-F Coil
T109	320030-2	Vertical Blocking Oscillator Transformer
T110	320024-2	Vertical Output Transformer
T111	360402-1	Synchro-Guide Transformer
T112	320035-1	High Voltage Transformer
T113	300055-1	Power Transformer
T114	360332-4	Fourth Video Cathode Trap
L101	360332-11	Filament Choke Coil
L102	360332-11	Filament Choke Coil
L103	360332-10	Peaking Coil, Green
L104	360332-15	Peaking Coil, Orange
L105	360332-10	Peaking Coil, Green
L106	360332-9	Peaking Coil, White
L107	360332-16	Peaking Coil, Yellow
L108	360330-7	Deflection Yoke Assembly
L109	360401-1	Focus Coil
L111	360358-1	Horizontal Linearity Coil
L112	360340-1	Filter Choke, 60 ohms
L113	360357-1	Width Coil
L114	360332-14	Peaking Coil, Black
C101	250088-46	Capacitor, Ceramic, 1000 mmf, 350V
C102	250088-46	Capacitor, Ceramic, 1000 mmf, 350V
C105	250201-7	Capacitor, Paper, .01 mfd, 600V
C106	250088-46	Capacitor, Ceramic, 1000 mmf, 350V
C107	250088-46	Capacitor, Ceramic, 1000 mmf, 350V
C108	250088-46	Capacitor, Ceramic, 1000 mmf, 350V
C111	250088-43	Capacitor, Ceramic, 36 mmf, 500V
C112	250088-46	Capacitor, Ceramic, 1000 mmf, 350V
C113	250201-13	Capacitor, Paper, .1 mfd, 600V
C114	270023-10	Capacitor, Electrolytic, 25 mfd, 450V
C115	250201-7	Capacitor, Paper, .01 mfd, 600V
C116	250159-87	Capacitor, Mica, 270 mmf, 500V
C117	250201-7	Capacitor, Paper, .01 mfd, 600V
C118	250159-96	Capacitor, Mica, 47 mmf, 500V
C119	250201-13	Capacitor, Paper, .1 mfd, 600V
C120	250201-1	Capacitor, Paper, .001 mfd, 600V
C121	250201-4	Capacitor, Paper, .0033 mfd, 600V
C122	270027-8	Capacitor, Electrolytic, 20 mfd, 150V
C123	250201-5	Capacitor, Paper, .0047 mfd, 600V
C124	250088-46	Capacitor, Ceramic, 1000 mmf, 350V
C125	250088-46	Capacitor, Ceramic, 1000 mmf, 350V
C126	250088-46	Capacitor, Ceramic, 1000 mmf, 350V
C127	250088-46	Capacitor, Ceramic, 1000 mmf, 350V
C129	250088-45	Capacitor, Ceramic, 270 mmf, 500V
C130	250088-46	Capacitor, Ceramic, 1000 mmf, 350V
C131	250088-46	Capacitor, Ceramic, 1000 mmf, 350V
C132	250159-98	Capacitor, Mica, 100 mmf, 500V
C133	250088-45	Capacitor, Ceramic, 270 mmf, 500V
C134	250088-46	Capacitor, Ceramic, 1000 mmf, 350V
C135	250088-46	Capacitor, Ceramic, 1000 mmf, 350V
C136	250088-46	Capacitor, Ceramic, 1000 mmf, 350V
C137	250088-46	Capacitor, Ceramic, 1000 mmf, 350V
C138	250088-45	Capacitor, Ceramic, 270 mmf, 500V
C139	250175-3	Capacitor, Ceramic, .0015 mfd, 450V
C140	250159-44	Capacitor, Mica, 75 mmf, 500V
C141	250088-46	Capacitor, Ceramic, 1000 mmf, 350V
C142	250088-45	Capacitor, Ceramic, 270 mmf, 500V
C143	250088-44	Capacitor, Ceramic, 5 mmf, 500V
C144	250159-92	Capacitor, Mica, 10 mmf, 500V
C145	250088-46	Capacitor, Ceramic, 1000 mmf, 350V
C146	250160-61	Capacitor, Mica, 560 mmf, 500V
C147	250201-11	Capacitor, Paper, .047 mfd, 600V
C148	250201-13	Capacitor, Paper, .1 mfd, 600V
C150	250201-11	Capacitor, Paper, .047 mfd, 600V
C151	250201-11	Capacitor, Paper, .047 mfd, 600V
C152	270027-7	Capacitor, Electrolytic, 25 mfd, 50V
C153	250172-1	Capacitor, Paper, .25 mfd, 400V, With Strap
C154	250201-11	Capacitor, Paper, .047 mfd, 600V
C155	250159-98	Capacitor, Mica, 100 mmf, 500V
C156	250159-81	Capacitor, Mica, 180 mmf, 500V
C157	250201-3	Capacitor, Paper, .0022 mfd, 600V
C158	250201-5	Capacitor, Paper, .0047 mfd, 600V
C159	250201-5	Capacitor, Paper, .0047 mfd, 600V
C160	250161-24	Capacitor, Mica, 4700 mmf, 500V
C161	250201-13	Capacitor, Paper, .1 mfd, 600V
C162	250201-13	Capacitor, Paper, .1 mfd, 600V
C163	250201-10	Capacitor, Paper, .033 mfd, 600V
C164	250201-11	Capacitor, Paper, .047 mfd, 600V
C165	250201-3	Capacitor, Paper, .0022 mfd, 600V
C166	250106-1	Capacitor, Trimmer, Horizontal Lock
C167	250151-21	Capacitor, Paper, .25 mfd, 400V
C168	250201-9	Capacitor, Paper, .022 mfd, 600V
C170	250201-7	Capacitor, Paper, .01 mfd, 600V
C171	250201-7	Capacitor, Paper, .01 mfd, 600V
C172	250160-15	Capacitor, Mica, 1800 mmf, 500V
C173	250172-1	Capacitor, Paper, .25 mfd, 400V, With Strap
C174	250201-11	Capacitor, Paper, .047 mfd, 600V
C175	250201-13	Capacitor, Paper, .1 mfd, 600V
C176	250201-11	Capacitor, Paper, .047 mfd, 600V
C177	250088-44	Capacitor, Mica, 5 mmf, 500V
C178	250173-1	Capacitor, Ceramic, 500 mmf, 15,000V
C179	250201-9	Capacitor, Paper, .022 mfd, 600V
C180	250159-87	Capacitor, Mica, 270 mmf, 500V
C181	250161-53	Capacitor, Mica, .01 mfd, 300V
C182	250129-15	Capacitor, Paper, .05 mfd, 400V
C183	250129-15	Capacitor, Paper, .05 mfd, 400V
C184	250173-1	Capacitor, Ceramic, 500 mmf, 15,000V
C185	250173-1	Capacitor, Ceramic, 500 mmf, 15,000V
C186	250172-3	Capacitor, Paper, .25 mfd, 600V, With Strap
C188	250159-87	Capacitor, Mica, 270 mmf, 500V
C189	250201-11	Capacitor, Paper, .047 mfd, 600V
C200	270021-13	Capacitor, Electrolytic, 30-30-10 mfd, 475V
C201	270021-16	Capacitor, Electrolytic, 72 mfd, 475V—50 mfd, 50V
C202	270021-25	Capacitor, Electrolytic, 40-10-10-10 mfd, 475V
C203	270021-24	Capacitor, Electrolytic, 40-30-10 mfd, 475V
R101	230104-50	Resistor, Carbon, 100 ohms, ½W
R102	230104-6	Resistor, Carbon, 2200 ohms, ½W
R103	230104-94	Resistor, Carbon, 470,000 ohms, ½W
R104	230104-50	Resistor, Carbon, 100 ohms, ½W
R105	230104-72	Resistor, Carbon, 6800 ohms, ½W
R106	230104-78	Resistor, Carbon, 22,000 ohms, ½W
R107	230104-62	Resistor, Carbon, 1000 ohms, ½W
R108	230104-78	Resistor, Carbon, 22,000 ohms, ½W
R109	230105-74	Resistor, Carbon, 10,000 ohms, 1W
R110A	230105-77	Resistor, Carbon, 18,000 ohms, 1W
R110B	230105-78	Resistor, Carbon, 22,000 ohms, 1W
R111	230104-86	Resistor, Carbon, 100,000 ohms, ½W
R112	230104-86	Resistor, Carbon, 100,000 ohms, ½W
R113	230104-86	Resistor, Carbon, 100,000 ohms, ½W
R114	230104-91	Resistor, Carbon, 270,000 ohms, ½W
R115	230104-110	Resistor, Carbon, 10 megohm, ½W
R116	230105-60	Resistor, Carbon, 680 ohms, 1W
R117	230104-98	Resistor, Carbon, 1 megohm, ½W
R118	230104-90	Resistor, Carbon, 220,000 ohms, ½W
R119	230104-91	Resistor, Carbon, 270,000 ohms, ½W
R120	230104-98	Resistor, Carbon, 1 megohm, ½W
R121	230104-98	Resistor, Carbon, 1 megohm, ½W
R122	230105-60	Resistor, Carbon, 680 ohms, 1W
R123	230104-74	Resistor, Carbon, 10,000 ohms, ½W
R124	230084-45	Resistor, Carbon, 39 ohms, ½W
R125	230104-62	Resistor, Carbon, 1000 ohms, ½W
R126	230104-62	Resistor, Carbon, 1000 ohms, ½W
R128	230104-74	Resistor, Carbon, 10,000 ohms, ½W
R129	230084-45	Resistor, Carbon, 39 ohms, ½W
R130	230104-62	Resistor, Carbon, 1000 ohms, ½W
R131	230104-52	Resistor, Carbon, 150 ohms, ½W
R132	230104-62	Resistor, Carbon, 1000 ohms, ½W
R133	230104-70	Resistor, Carbon, 4700 ohms, ½W
R134	230084-45	Resistor, Carbon, 39 ohms, ½W

PARTS LIST FOR THE CT 244 AND CT 245 TELEVISION CHASSIS (Continued)

Ref. No.	Part No.	Description
R135	230104-52	Resistor, Carbon, 150 ohms, ½W
R136	230104-62	Resistor, Carbon, 1000 ohms, ½W
R137	230104-67	Resistor, Carbon, 2700 ohms, ½W
R138	230104-71	Resistor, Carbon, 5600 ohms, ½W
R139	230104-52	Resistor, Carbon, 150 ohms, ½W
R140	230104-62	Resistor, Carbon, 1000 ohms, ½W
R141	230104-67	Resistor, Carbon, 2700 ohms, ½W
R142	230104-91	Resistor, Carbon, 270,000 ohms, ½W
R143	230084-38	Resistor, Carbon, 10 ohms, ½W
R144	230104-45	Resistor, Carbon, 39 ohms, ½W
R145	230104-69	Resistor, Carbon, 3900 ohms, ½W
R146	220076-16	Control, Contrast
R147	230104-54	Resistor, Carbon, 220 ohms, ½W
R148A	230105-80	Resistor, Carbon, 33,000 ohms, 1W
R148B	230105-81	Resistor, Carbon, 39,000 ohms, 1W
R149A	230105-71	Resistor, Carbon, 5600 ohms, 1W
R149B	230105-71	Resistor, Carbon, 5600 ohms, 1W
R150	230104-102	Resistor, Carbon, 2.2 megohm, ½W
R151	230104-102	Resistor, Carbon, 2.2 megohm, ½W
R152	230105-85	Resistor, Carbon, 82,000 ohms, 1W
R153	220076-7	Control, Brilliance
R154	230104-74	Resistor, Carbon, 10,000 ohms, ½W
R155	230104-85	Resistor, Carbon, 560,000 ohms, ½W
R156	230104-102	Resistor, Carbon, 2.2 megohm, ½W
R157	230104-86	Resistor, Carbon, 100,000 ohms, ½W
R158	230104-94	Resistor, Carbon, 470,000 ohms, ½W
R159	220076-18	Control, AGC Threshold
R160	230104-77	Resistor, Carbon, 18,000 ohms, ½W
R161	230104-71	Resistor, Carbon, 5600 ohms, ½W
R162	230104-96	Resistor, Carbon, 680,000 ohms, ½W
R163	230104-79	Resistor, Carbon, 27,000 ohms, ½W
R164	230104-98	Resistor, Carbon, 1 megohm, ½W
R165	230104-54	Resistor, Carbon, 220 ohms, ½W
R166	230105-78	Resistor, Carbon, 22,000 ohms, 1W
R167	230104-105	Resistor, Carbon, 3.9 megohm, ½W
R168	230104-58	Resistor, Carbon, 470 ohms, ½W
R169	230104-78	Resistor, Carbon, 22,000 ohms, ½W
R170	230104-73	Resistor, Carbon, 8200 ohms, ½W
R171	230104-73	Resistor, Carbon, 8200 ohms, ½W
R172	230104-76	Resistor, Carbon, 4.7 megohm, ½W
R173	230104-98	Resistor, Carbon, 1 megohm, ½W
R174	220076-12	Control, Vertical Speed
R175	230104-86	Resistor, Carbon, 100,000 ohms, ½W
R176	230105-91	Resistor, Carbon, 270,000 ohms, ½W
R177	220076-5	Control, Height
R178	230104-83	Resistor, Carbon, 56,000 ohms, ½W
R179	230105-59	Resistor, Carbon, 560 ohms, 1W
R180	220076-20	Control, Vertical Linearity
R181	230104-102	Resistor, Carbon, 2.2 megohm, ½W
R182	230105-13	Resistor, Carbon, 1000 ohms, 1W
R183	230104-69	Resistor, Carbon, 3900 ohms, ½W
R184	230104-50	Resistor, Carbon, 100 ohms, ½W
R185	230104-50	Resistor, Carbon, 100 ohms, ½W
R186	230091-1	Resistor, Temperature Compensating, 380,000 ohms, ½W
R187	230104-87	Resistor, Carbon, 120,000 ohms, ½W
R188	220076-15	Control, Horizontal Hold
R189	230105-91	Resistor, Carbon, 270,000 ohms, 1W
R190	230094-225	Resistor, Carbon, 270,000 ohms, 1W
R191	230094-213	Resistor, Carbon, 180,000 ohms, ½W
R192	230095-211	Resistor, Carbon, 150,000 ohms, 1W
R193	230104-103	Resistor, Carbon, 2.7 megohm, ½W
R194	230104-73	Resistor, Carbon, 8200 ohms, ½W
R195	230092-1	Resistor, Temperature Compensating, 100,000 ohms, ½W
R196	230104-73	Resistor, Carbon, 8200 ohms, ½W
R197	230104-88	Resistor, Carbon, 150,000 ohms, ½W
R198A	230105-90	Resistor, Carbon, 220,000 ohms, 1W
R198B	230105-91	Resistor, Carbon, 270,000 ohms, 1W
R199	230104-74	Resistor, Carbon, 10,000 ohms, ½W
R200	230104-45	Resistor, Carbon, 39 ohms, ½W
R201	230104-89	Resistor, Carbon, 180,000 ohms, ½W
R202A	230105-54	Resistor, Carbon, 220 ohms, 1W
R202B	230105-54	Resistor, Carbon, 220 ohms, 1W
R203	240021-3	Resistor, Carbon, 10,000 ohms, 10W
R204	230104-95	Resistor, Carbon, 560,000 ohms, ½W
R205	220076-9	Control, Horizontal Centering
R206	230105-98	Resistor, Carbon, 1 megohm, 1W
R207	220076-10	Control, Vertical Centering
R208	230104-89	Resistor, Carbon, 180,000 ohms, ½W
R209A	230105-62	Resistor, Carbon, 1000 ohms, 1W
R209B	230105-62	Resistor, Carbon, 1000 ohms, 1W
R210	220076-17	Control, Focus
R211	240044-1	Resistor, Wire Wound, 520-520 ohms
R212	240046-1	Resistor, Wire Wound, 555-245 ohms
R213	230105-72	Resistor, Carbon, 6800 ohms, 1W
R214A	230105-77	Resistor, Carbon, 18,000 ohms, 1W
R214B	230105-78	Resistor, Carbon, 22,000 ohms, 1W
R215	240035-11	Resistor, Wire Wound, 260 ohms, 11W
R216	230105-50	Resistor, Carbon, 100 ohms, 1W
R217	230104-83	Resistor, Carbon, 56,000 ohms, ½W
R221	230104-79	Resistor, Carbon, 27,000 ohms, ½W
R223	230066-558	Resistor, Wire Wound, 4.7 ohms, ½W
R224	230066-558	Resistor, Wire Wound, 4.7 ohms, ½W
R225	240053-4	Resistor, Hi Voltage, 1.5 megohm
R226A	230105-74	Resistor, Carbon, 10,000 ohms, 1W
R226B	230105-74	Resistor, Carbon, 10,000 ohms, 1W
R227A	230105-74	Resistor, Carbon, 10,000 ohms, 1W
R227B	230105-74	Resistor, Carbon, 10,000 ohms, 1W
R228	230104-78	Resistor, Carbon, 22,000 ohms, ½W
R229	220076-19	Control, Volume
R230	230104-94	Resistor, Carbon, 470,000 ohms, ½W
R231	230104-70	Resistor, Carbon, 4700 ohms, ½W
J101	180060-1	Socket, External
J102	180382-8	Connector, Speaker
J103	180403-2	Socket, Octal Molded
J104	180393-7	Socket, 6 Pin Molded
J105	180393-10	Socket, 11 Pin Molded
J106	180393-9	Socket, 9 Pin Molded
P104	180508-11	Plug, 6 Prong Molded
P105	180508-16	Plug, 11 Prong Molded
P106	180508-15	Plug, 9 Prong Molded
S101	160206-1	Switch, 3 Position Wafer
S102	160192-1	Switch, Push Button
F101	18	Fuse, .25A, 250V
F102	180157-9	Fuse, 5A, 250V
1.	180463-2	Anode Connector Assembly
2.	700325-2	Tuner Unit Type "S"

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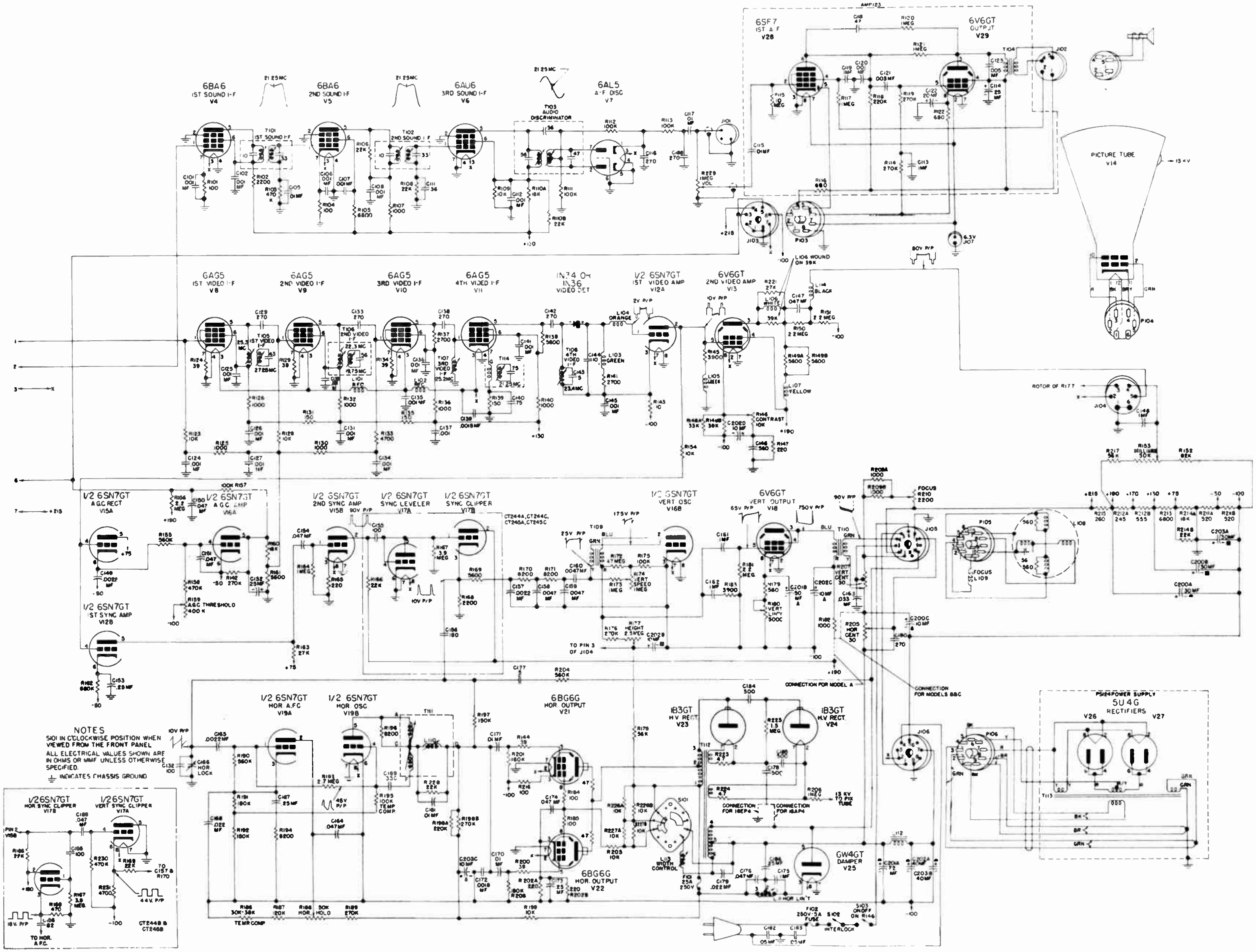

SCHEMATIC WIRING DIAGRAM, MAGNAVOX
CT 244-245 TELEVISION RECEIVER
MAIN SCHEMATIC (LESS R-F UNIT)

CHASSIS CT 244, CT 245

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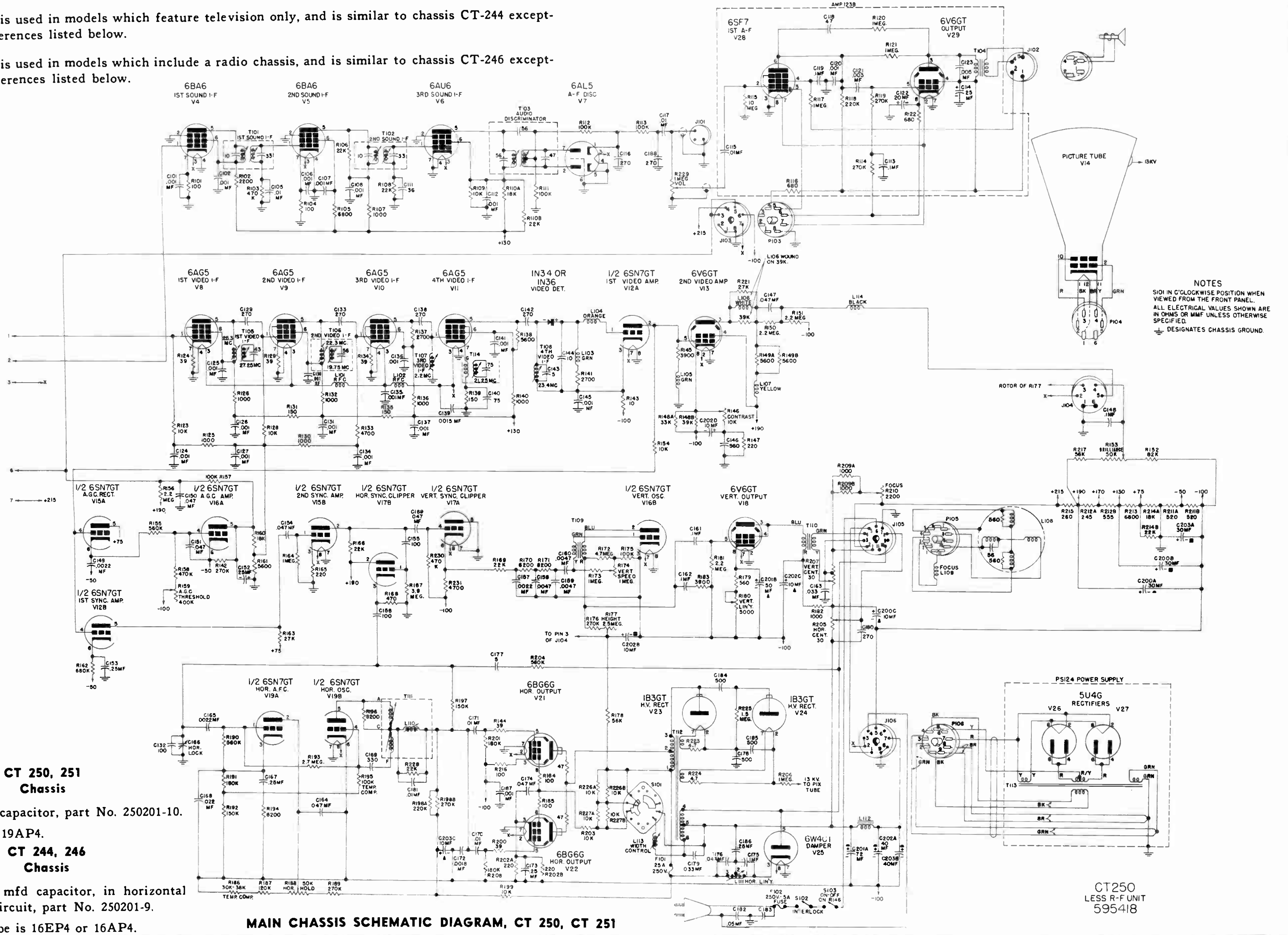
This maintenance information covers Magnavox television receiver chassis CT-250 and CT-251.

Chassis CT-250 is used in models which feature television only, and is similar to chassis CT-244 excepting for the differences listed below.

Chassis CT-251 is used in models which include a radio chassis, and is similar to chassis CT-246 excepting for the differences listed below.



CT 250, 251 Chassis

C179, .033 mfd capacitor, part No. 250201-10.

Picture tube is 19AP4.

CT 244, 246 Chassis

(1) C179, .022 mfd capacitor, in horizontal linearity circuit, part No. 250201-9.

(2) Picture tube is 16EP4 or 16AP4.

MAIN CHASSIS SCHEMATIC DIAGRAM, CT 250, CT 251

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PART I
DESCRIPTION

Magnavox Television chassis number CT 247, 248 and 249 are direct view chassis with self contained power supplies. All include an intercarrier I-F system. Their differences are outlined in Part III of this manual.

The advanced design of these receivers provides equivalent or better performance comparing to any existing television receiver regardless of the tube complements involved. Technical features include:

- Direct-coupled video amplifier, which eliminates the need for D-C reinsertion and provides better noise immunity.
- Intercarrier I-F amplifiers for ease of alignment, simplified tuning, increased stability, reduced phase discrepancies, and freedom from the effect of oscillator drift.
- Discriminator-type horizontal automatic frequency control.
- Ratio-detector type sound detector.
- Cathode modulation of the picture tube.
- Minimum number of operating controls.
- MAGNALOK horizontal AFC circuit. Frequency control is accomplished by comparing the sine wave oscillator frequency with the sync pulses. The result is applied to a reactance tube, which in turn controls the oscillator frequency.

TUBE COMPLEMENT

[a]R-F Amplifier	6AK5
[b]Converter	6AG5
Oscillator	6AB4
I-F Amplifier	6AG5
I-F Amplifier	6AG5
I-F Amplifier	6AG5
Video Det. and Sync Leveler	6AL5
Video Amplifier	6AU6
Sound I-F Amplifier	6AU6
Ratio Detector	6AL5
[c-d]1st Audio Ampl. and AGC Clamp	6AV6
[d]Audio Output	6K6GT/G
12AU7	AGC Det. and Pre Sync Sep.
12AU7	AGC Ampl. and Sync Ampl.
6AN7GT	Vert. Sync Clipper and Multi-Vib.
6SN7GT	Vert. Sync. Clipper and Multi-Vib.
6AL5	AFC Detector
6AU6	AFC Reactance
6SN7GT	Hor. Sine Wave Osc. and Disch.
6BG6G	Hor. Output
6W4GT	Damper
1B3GT	H. V. Rectifier
5U4G	L. V. Rectifier
[e]12LP4	Picture Tube
[f]12KP4	Picture Tube

Note A 6AK5 used in early models only. 6BC5 used in later models may not be used as replacement for 6AK5.

Note B 6AG5 used in early models only. 6BC5 used in later models may be used as replacement for 6AG5.

Note C 6C4 used in CT-248 as AGC clamp.

Note D 6AV6 and 6K6GT/G not used in CT-248.

Note E Used in CT-247 chassis only.

Note F Used in CT-248 and CT-249 chassis.

GENERAL DESCRIPTION

300 Ohm—Antenna Input	**IMPEDANCE**	Speaker Voice Coil 3.2 Ohms
195 W. at 117 V., 60 C. P. S.	**POWER**	Audio—2.5 W. Undistorted, 4 W Max.
Chassis 17"x13¾"x9½"	**SIZE**	Picture—8 29/32"x11¼"

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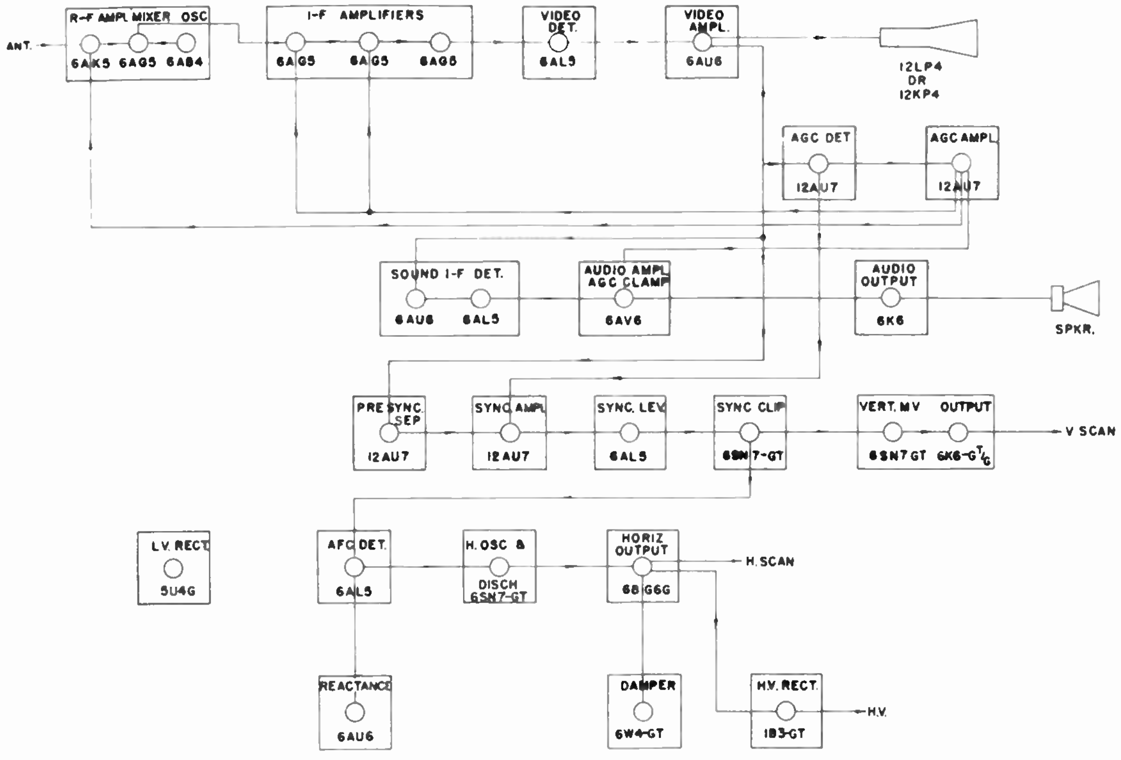
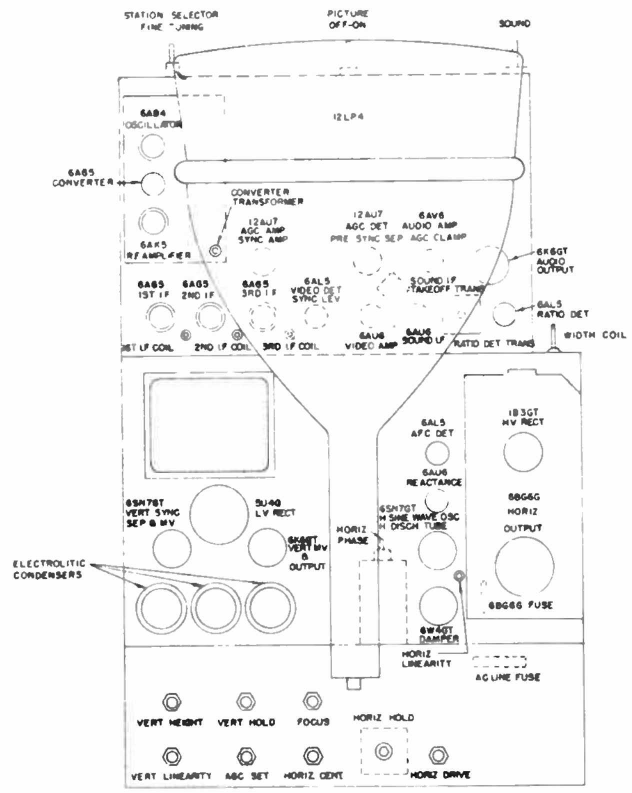
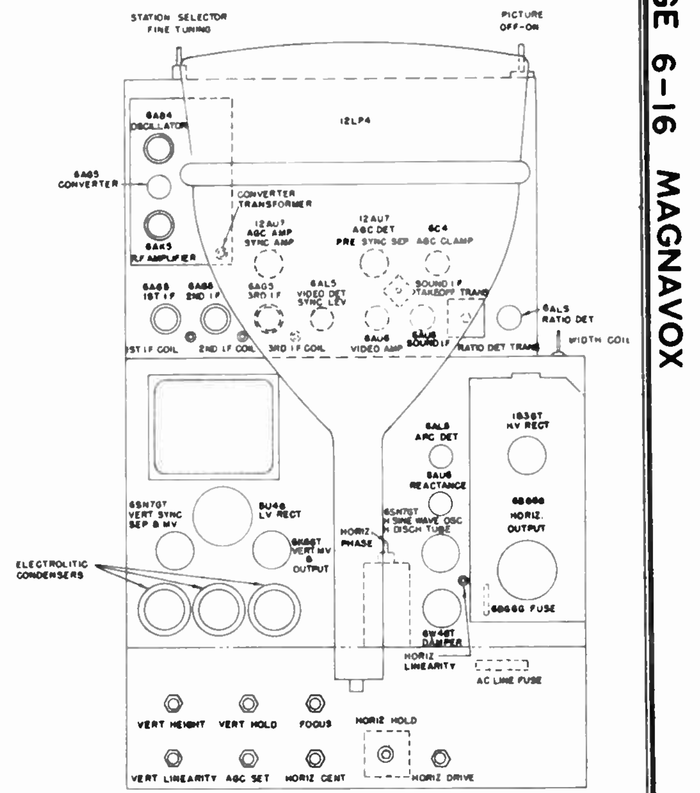


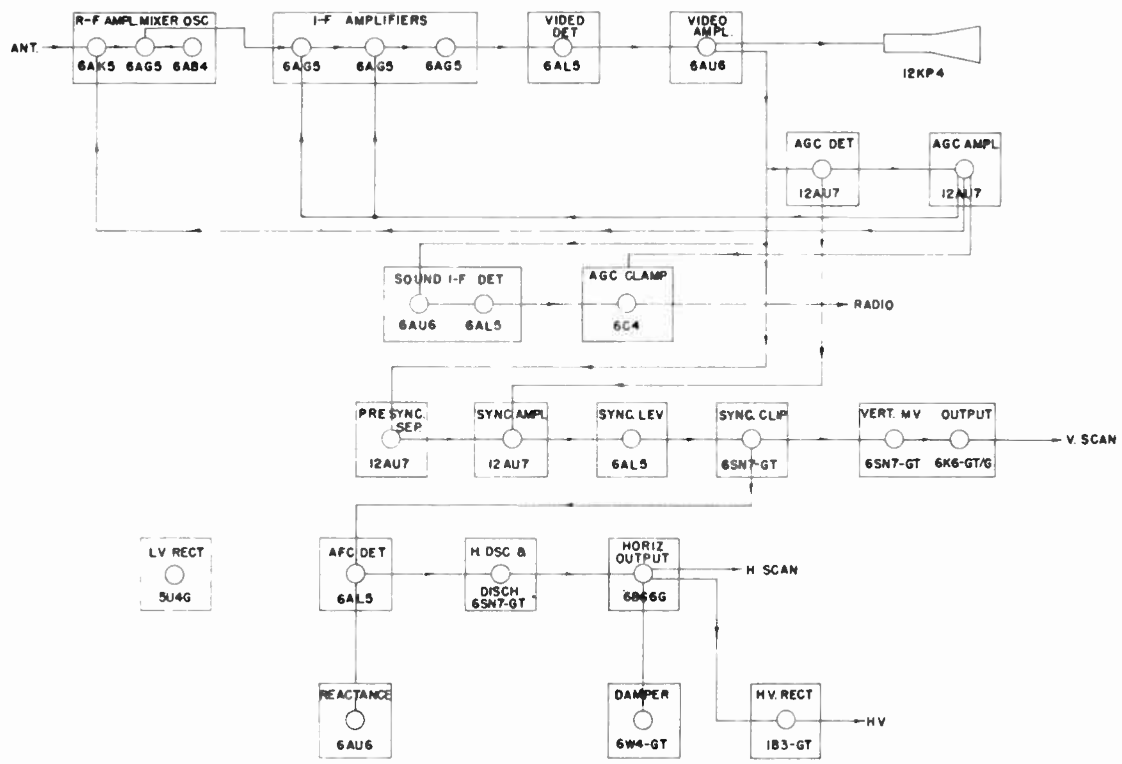
FUNCTIONAL DIAGRAM, CT 247-CT 249



LAYOUT DIAGRAM, CT 247-CT 249



LAYOUT DIAGRAM, CT 248



FUNCTIONAL DIAGRAM, CT 248

RECEIVER OPERATION INSTRUCTIONS

CT 247 AND 249

1. Turn the PICTURE OFF-ON control to the right, about one-half turn.
2. Adjust the CHANNEL SELECTOR to the desired channel number.
3. Adjust the FINE TUNING control for best picture quality.

   If the Fine Tuning Control is improperly adjusted, the picture may be blurred or streaked, or the sound reproduction may have a "buzzing" sound.
4. The PICTURE OFF-ON control adjusts the picture brightness. It should be set for the most pleasing picture.
5. The SOUND control adjusts the volume of sound reproduction.

A picture framing control is located at the rear of the instrument, and is identified by a small control knob. It may be necessary to reset this control should the picture roll. Turn it to the left so the roll is downward, then advance it to the right until the picture stops moving.

CT 248

1. Turn OFF-ON BASS control on the radio receiver to the right, about one-half turn.
2. Set the INPUT SELECTOR SWITCH on the radio to TV.
3. Turn the PICTURE OFF-ON control to the right about one-half turn.
4. Adjust the CHANNEL SELECTOR to the desired channel number.
5. Adjust the FINE TUNING control for best picture quality.
6. Adjust PICTURE OFF-ON control for most pleasing picture.
7. Adjust the VOLUME, BASS and TREBLE controls for the desired TV sound reproduction.

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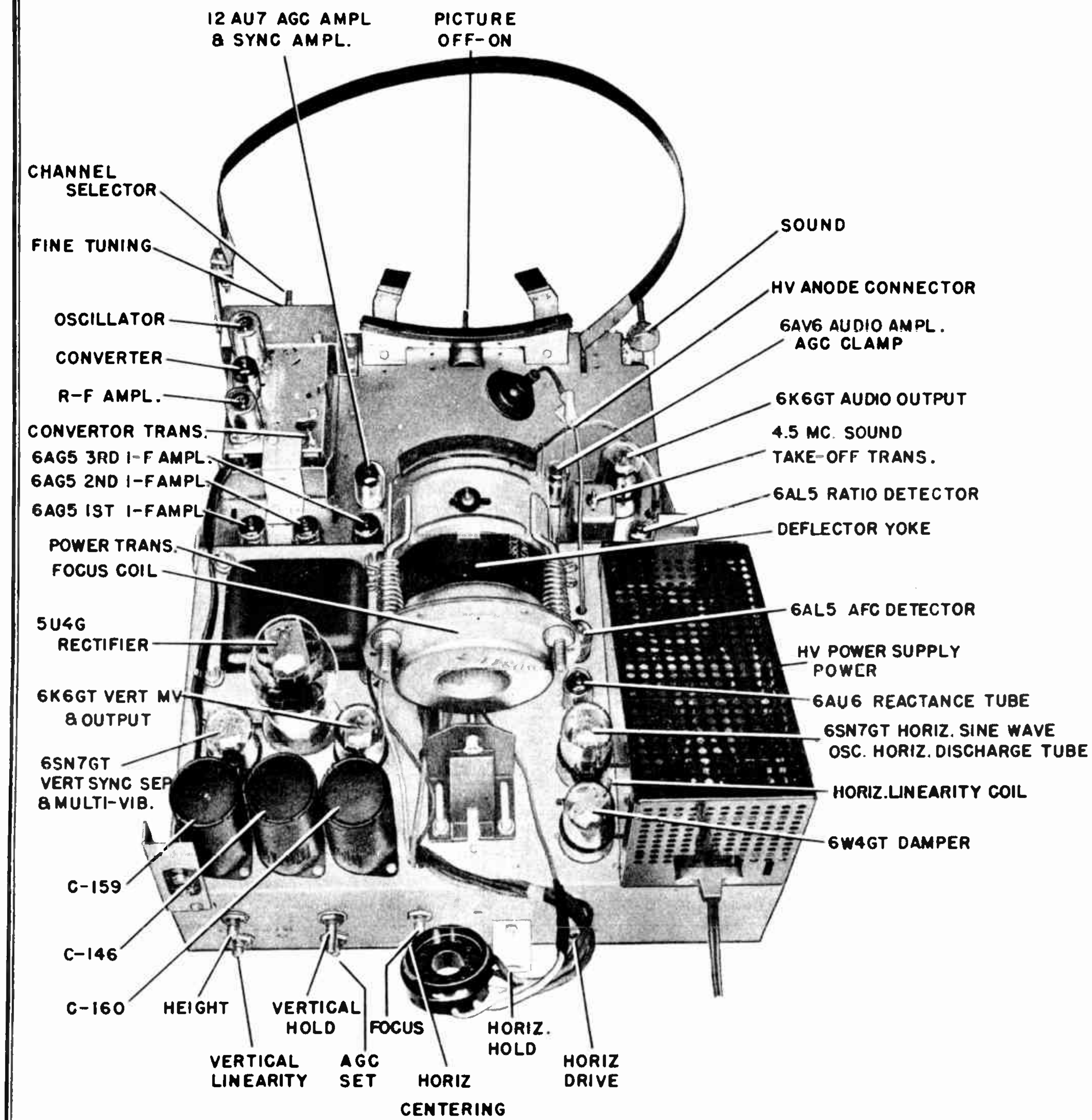
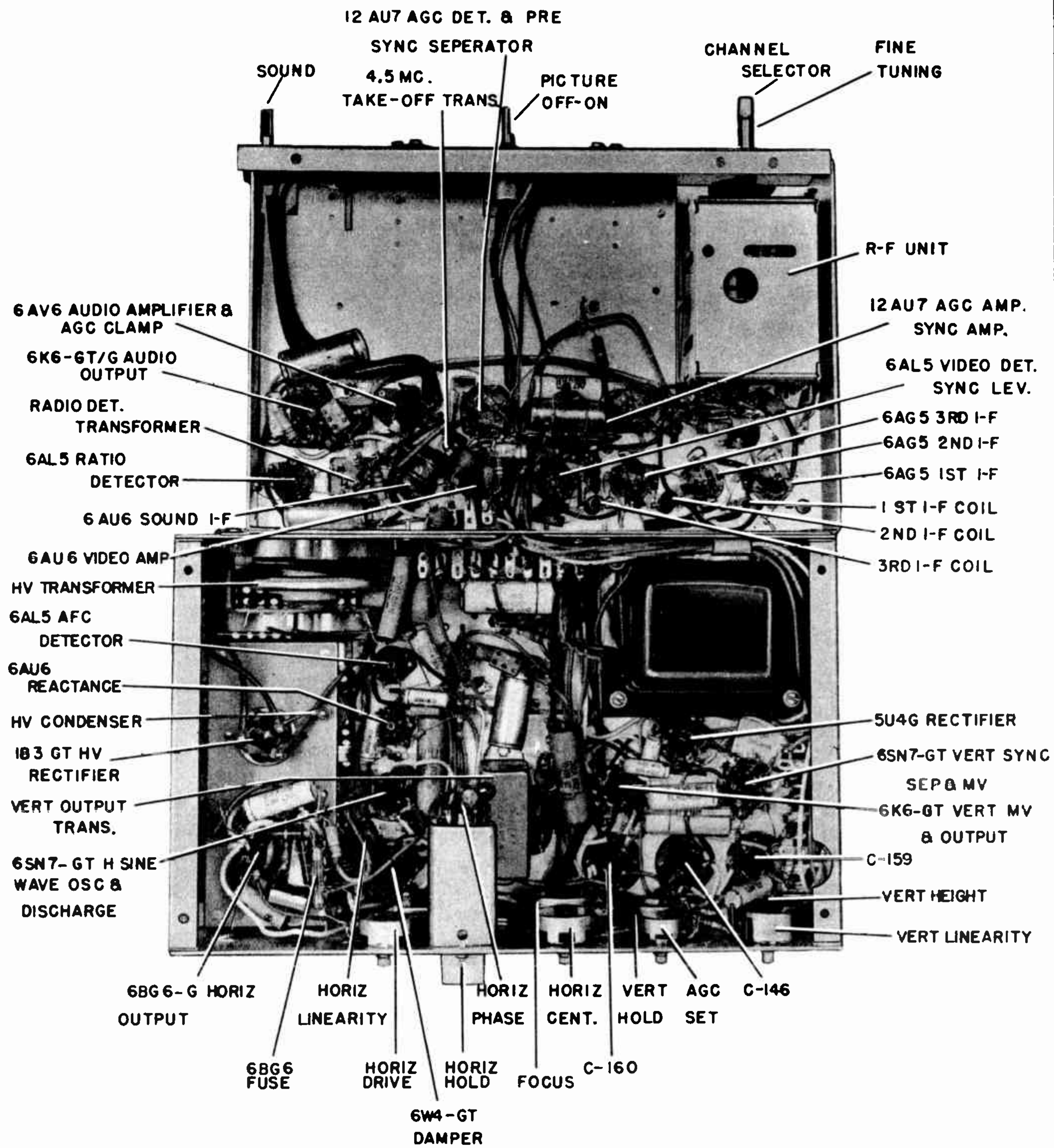
PART II
PARTS IDENTIFICATION



TOP VIEW OF CT 247-CT 249 CHASSIS



BOTTOM VIEW OF CT 247-CT 249 CHASSIS

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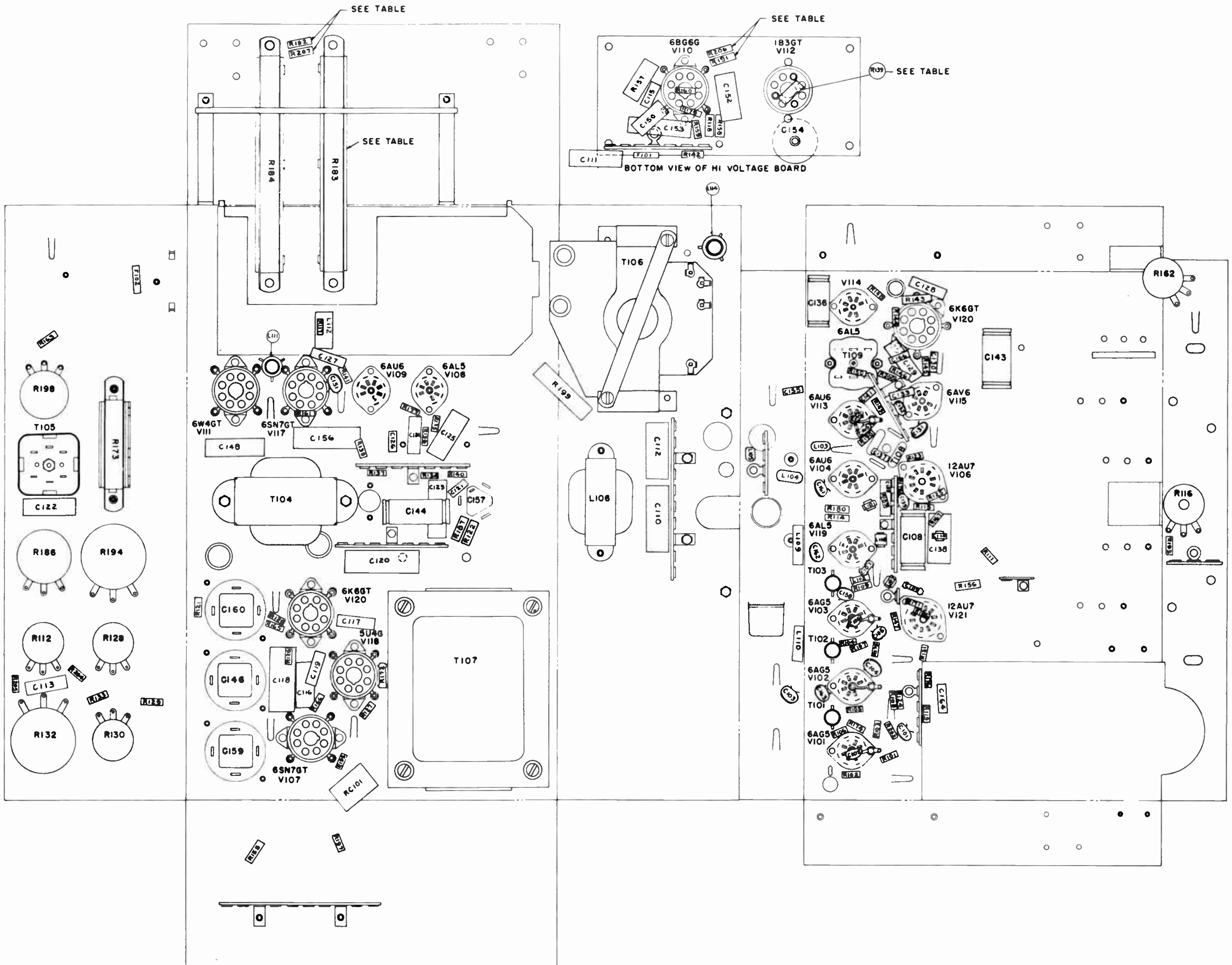

BOTTOM VIEW OF THE CHASSIS

PART III
TECHNICAL SPECIFICATIONS

CHASSIS DIFFERENCES

Chassis	Picture Tube	Ion Trap	Audio Amplifier
CT-247	12LP4	360404-2	On TV Chassis
CT-248	12KP4	None	Uses audio in radio chassis
CT-249	12KP4	None	On TV Chassis

These chassis are very similar, and differ only in the audio stages and the picture tubes used.

The CT-247 is used in models which feature television only, and is designed for a 12LP4 picture tube. It uses a 6K6GT/G audio power amplifier, and the triode section of a 6AV6 as an audio amplifier. It also uses the diode section of the 6AV6 as AGC Clamp.

The C-248 is used in models which include a radio chassis, and has no audio amplifier or speaker. AGC clamping is accomplished by a 6C4. The picture tube is a 12KP4.

The CT-249 is the same as the CT-247 except that it uses a 12KP4 picture tube.

R-F UNIT

The R-F Unit consists of an R-F Amplifier, an Oscillator and a Converter or Mixer. A 12-position switch selects the proper antenna, R-F amplifier, oscillator and converter tuned circuits for the desired television channel. The oscillator frequency may be further adjusted by means of the fine tuning control, which is a variable dielectric capacitor.

I-F AMPLIFIERS

The three I-F amplifiers are stagger turned for simplicity, for increased stability, and for ease of alignment. This last feature is further emphasized by the fact that there are no traps to adjust, or to affect the frequency of the other coils.

The first I-F plate coil and the second I-F grid coil are bi-filar wound, (in the same direction) on the same coil form, which is tuned with an adjustable iron core. Coupling between stages is by the capacity and inductive coupling between windings. The same conditions exist between the second I-F plate coil and third I-F grid coil, and the third I-F plate coil and detector primary coil.

The I-F passband is 3 Mc. wide. The audio carrier

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is approximately 25 db down on the curve, and the video carrier is 6 db down on the curve.

DETECTOR

The detector operates in the conventional manner, and also detects the 4.5 Mc. beat between the video I-F and sound I-F carriers. As these carriers result from crystal controlled carrier frequencies at the television transmitter, their resultant 4.5 Mc. beat is much more stable than if it were produced by beating the sound carrier with a local oscillator.

VIDEO AMPLIFIER

The video amplifier is direct coupled, and eliminates the necessity for DC reinsertion. As the output from the detector is negative, noise pulses drive the video amplifier tube beyond cut-off, so it also acts as a noise limiter. The output from the amplifier is in a positive direction, so the signal is applied to the picture tube cathode. This is identical to grid modulation with a negative signal. The DC bias on the picture tube governs the brightness of the tube, and is adusted by the PICTURE CONTROL.

SYNC CIRCUITS

The Pre Sync Separator provides a boost of vertical pulses, and the triode section of the AGC Detector provides a boost of horizontal pulses. The combined output from these stages is amplified by the Sync Amplifier, held at a predetermined level by the Sync Leveler, and the desired pulses are accepted by the Sync Clipper.

VERTICAL DEFLECTION

The vertical pulses are separated by the integrating network, and used to synchronize the Vertical Multivibrator and Output stages, which provides the necessary vertical deflection.

AUTOMATIC GAIN CONTROL

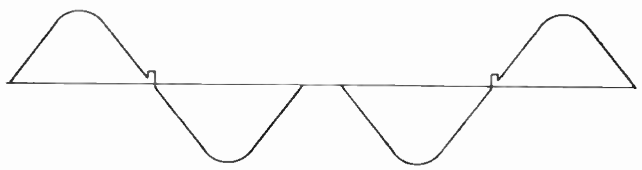
A rectified DC voltage is taken from the cathode of the AGC Detector, amplified by the AGC Amplifier, and used to bias the first and second I-F amplifiers and the R-F amplifier. The operating range of this bias is controlled by the AGC SET CONTROL.

AUTOMATIC FREQUENCY CONTROL

When "free running," the Horizontal Sine Wave Oscillator operates at a frequency approximately correct for horizontal scanning. The sine wave is applied through T105, to the plates of the AFC Detector 180° out of phase. The horizontal sync pulses are applied to the center tap of the plate winding of the transformer, and appear at the plates of the AFC Detector in phase. When the oscillator operates in synchronism with the transmitter, the pulses appear on the sine waves as one plate goes through zero voltage in the negative direction, and as the other plate goes through zero voltage in a positive direction. Because the sync pulses appear when both plates are at zero voltage, there is no change in the operation of the circuit. However, if the oscillator changes in frequency, the sync pulses at the detector plates do not appear when the oscillator voltage is zero, but at a point on each sine wave either before or after it goes through zero. As the sine wave on one plate is of opposite polarity from the other, and as the sync pulse on one plate is of the same polarity as the other, the sync pulse will add to the sine wave that is positive, and subtract from the one that is negative. This condition will produce a voltage unbalance in the cathode circuit of the AFC Detector. This voltage is applied to the grid of the Horizontal Reactance tube, thereby controlling the variable reactance in shunt with the horizontal oscillator tank circuit. This causes the Horizontal Sine Wave Oscillator to change frequency in such a direction so as to come back into exact synchronism.

PLATE 1 PLATE 2

OSCILLATOR SINE WAVE IN PHASE WITH SYNC PULSE



HORIZONTAL DEFLECTION

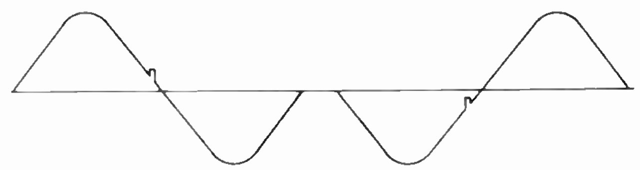
The horizontal sine wave oscillator has in its plate circuit an inductance that is shock excited. This inductance is damped so that its natural frequency of oscillation is damped out in considerably less than one horizontal line. The initial positive excursion is applied to the grid of the discharge tube. This tube then draws heavy current for a very short period. The plate potential decays very abruptly. Because of the peaking resistor in its plate circuit, the discharge condenser does not discharge as much as the plate potential decays. When the tube stops drawing current, its plate potential returns to the potential of the discharge condenser. This condenser then proceeds to charge at the rate determined by the circuit time constant. This saw-tooth wave, with its peaking, is then applied to the horizontal output grid.

SOUND

As previously mentioned, the Video Detector produces, in addition to its conventional function, a 4.5 mc. beat between the sound I-F and the video I-F carriers. This is amplified by the video amplifier and removed from its plate circuit by T108. It is again amplified by the Sound I-F, and its audio component removed by the Ratio Detector, which is essentially immune to amplitude modulation. The resultant audio frequencies are applied to the 1st Audio Amplifier in the CT-247 and CT-249, or to the audio amplifier of the associated radio receiver for the CT-248. The Audio Output stage of CT-247 and CT-249 is a conventional power pentode, operating into an output transformer and speaker.

PLATE 1 PLATE 2

OSCILLATOR SINE WAVE OUT OF PHASE WITH SYNC PULSE



PART IV

PRELIMINARY ADJUSTMENTS

The CT-247, CT-248 and CT-249 television instruments are shipped completely assembled, with the picture tube installed. All that is necessary for installation is the proper location, adjustment of the various controls, and removal of the back cover for adjustment of the ion trap on the 12LP4 (the 12KP4 requires none) and adjustment of the cabinet antenna. A check should be made that all tubes are properly seated, and the red shipping bracket removed from the focus coil and deflection yoke assembly.

The safety glass, mask, filter and frame constitute an assembly, which is easily removed for access to the picture tube by removal of the two angle brackets above the control panel.

The chassis is held in the cabinet by six mounting screws through the bottom.

SETTING UP FOR OPERATION

(a) Tune in a television station and adjust the fine tuning control for best picture quality. At this point, tuning should be for the best detail or clearest picture. It is possible to tune for maximum audio output, but such an adjustment is incorrect for this type of receiver.

(b) Adjust the AGC Set Control on the rear panel and the Picture Control on the front panel alternately for proper contrast. A standard test pattern is necessary for this adjustment in order to observe correctly the various degrees of black, grey, and white. It is also necessary to switch to all available channels in order to arrive at a good average contrast. Once set, only the front panel control need be used.

(c) If horizontal linearity is unsatisfactory, turn the Horizontal Drive Control as far as possible without causing crowding of the right side of the picture. This position provides maximum high voltage to the picture tube. Too much drive will cause a bright vertical line about 1/3 from the left side of the raster. Then adjust the Horizontal Linearity Coil to improve linearity.

(d) Height and Vertical Linearity Adjustment. Adjust the Height Control until the picture just fills the mask vertically. Adjust the Vertical Linearity Control until the test pattern is symmetrical from top to bottom. Adjustment of either control will require readjustment of the other.

(e) Rotate the Vertical Hold Control, located on the rear panel, until the picture slowly moves in a downward direction (A). Then reverse the rotation of the control slowly until the picture falls into sync (direction B). Switch off channel and then switch back on the channel. The picture should fall into sync immediately. It is possible that the picture may pull into sync slowly. If this occurs, rotate the Vertical Hold Control a bit more in direction (B) noted above. Switching from channel to channel should now produce immediate vertical synchronism.

(f) Functions of the Sound, Focus, and Horizontal Centering controls are conventional. Vertical centering is accomplished by tilting the focus coil. Earlier models had no Width Control, but it was later added, inside the high voltage compartment. It should be adjusted so that the picture just fills the mask horizontally.

(g) Horizontal Hold Adjustment. If the receiver does not snap into horizontal sync immediately on being switched to a picture channel, but instead it slowly pulls in as indicated by diagonal blanking bars which slowly reduce in frequency until the picture snaps into synchronism, the following adjustment should be made. Remove the horizontal AFC Discriminator tube (type 6AL5, V108) and adjust the Horizontal Hold Control until the picture slowly moves back and forth with the blanking bar vertical. Now replace the horizontal AFC Discriminator tube. The picture should then fall into horizontal sync immediately on switching from channel to channel.

(h) Horizontal Phasing. If step G does not provide immediate horizontal synchronism, it is possible that the horizontal phasing is incorrect. The bottom cover must be removed from the cabinet for this adjustment. Adjust the (phasing) core of the horizontal AFC and oscillator transformer, front of transformer, until there is ¼ inch of blanking visible on the right hand edge of the picture. This adjustment is located inside the chassis, at the opposite end of the coil from the Horizontal Hold Control.

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If the adustment (H) resulted in any great adjustment of the phasing core, repeat the procedure covered in (g).

(i) Cabinet Antenna Adjustment. An indoor antenna is built into the television cabinet for use in areas where receiving conditions are favorable. In some models the antenna is rotatable, and has a switch on the back cover. On some stations, reception will be better with the switch in one position, and on others it will be better in the other position, due to the direction of the television stations from the receiver.

The antenna can be rotated by the serviceman and should be set for best all around performance. The switch provides a shift in the main pickup lobe of as much as 30° on some channels, and is the only antenna adjustment to be used by the customer. The serviceman should so orient the antenna so that with one switch position or the other, all signals are received with maximum clarity. The customer should then be instructed, for example, to have the switch pushed to the left for channel 2, 7 and 9, and to the right for 5 and 11, or whatever the case may be.

The suggested procedure for antenna adjustment is as follows:

1. Tune in a station and rotate the antenna through 360° for maximum signal and minimum ghosts.

2. Snap the antenna switch and re-orient the antenna through 360° for best picture. Compare the results of each of these tests and make a mental note of antenna position and switch positions for best performance.

3. Repeat these tests for each of the other channels, making note of the antenna and switch positions for best results on each channel.

4. The final position for the antenna shall be that compromise which receives the majority of stations with best picture, regardless of switch position. The customer then can change the switch for various channels in order to get the best possible picture.

In other models, the cabinet antenna consists of a fixed antenna in the top of the cabinet and a power line antenna. The fixed portion is primarily designed for use on high channels, and the power line antenna is for low channels. However, they may be used separately or together, depending on local conditions. Each should be tried on all available channels, and that antenna or combination giving best results should be selected.

1. Connect the power line antenna lead (the grey wire extending from the rear of the chassis) to first one and then the other terminal on the antenna terminal board, tune for all local stations, and note which gives the better result.

2. Remove the power line antenna lead from the terminal board, connect the cabinet antenna lead to first one and then the other antenna terminal, tune for all stations, and note the results.

3. Connect the power line antenna and the cabinet antenna leads to the terminal board, tune for all stations, and note the results. It may be necessary to reverse the connections for the best compromise of pictures.

PICTURE TUBE REPLACEMENT

Should it become necessary to replace the picture tube, it should be done in the following manner. Remove the chassis from the cabinet. Then remove the tube socket and the ion trap from the rear of the tube. Loosen the lock nut that secures the support strap over the bell of the tube, and loosen the clamping screw. Remove the high voltage anode connector. Remove the tube supports at the bottom front of the tube, and lift out the tube.

Replace with another tube. Replace the tube supports at the bottom front of the tube. Loosen the wing nuts on the yoke mounting bracket and push this assembly as far forward on the picture tube as possible. The end result should have the tube up against the bottom front tube supports, the yoke against the bell of the tube, the grounding springs on the yoke assembly making contact with the grounding coating on the picture tube, and the neck of the tube parallel to the deck of the chassis. The wing nuts should now be tightened, as should the tube clamp. Replace the chassis in the cabinet.

PART V
ALIGNMENT
I-F ALIGNMENT

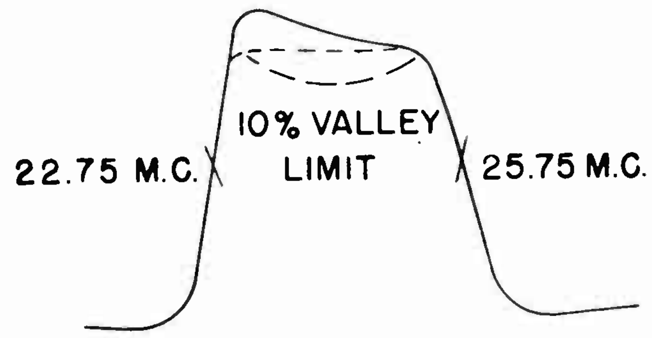
TEST EQUIPMENT

For proper television alignment, it is recommended that the following test equipment be available:

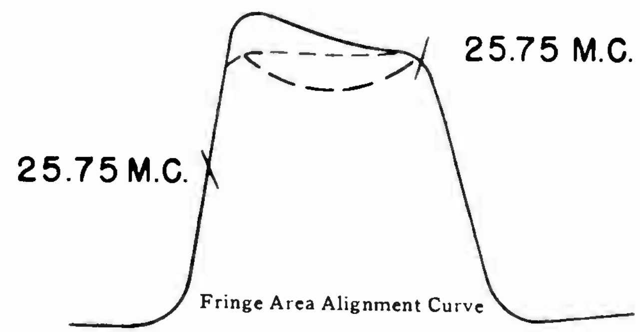
1. R-F Sweep Generator meeting the following requirements:
   a. Frequency range 18 to 30 Mc.
      40 to 90 Mc.
      170 to 225 Mc.
   b. Sweep width adjustable from 1 to 12 Mc.
   c. Output at least .1 volt maximum.
2. Cathode Ray Oscilloscope—wide band vertical deflection.
3. Electronic Voltmeter with high voltage probe.
4. 500K potentiometer with clip leads.
5. Signal generator to cover the following frequency ranges:
   I-F range from 19.75 Mc. to 27.75 Mc.
   R-F range from 45.25 Mc. to 215.75 Mc.

Channel No.	Band Width (Mc.)	Picture Carrier	Sound Carrier	Local Oscillator
2	54-60	55.25	59.75	81
3	60-66	61.25	65.75	87
4	66-72	67.25	71.75	93
5	76-82	77.25	81.75	103
6	82-88	83.25	87.75	109
7	174-180	175.25	179.75	201
8	180-186	181.25	185.75	207
9	186-192	187.25	191.75	213
10	192-198	193.25	197.75	219
11	198-204	199.25	203.75	225
12	204-210	205.25	209.75	231
13	210-216	211.25	215.75	237

10% TILT NOMINAL



Nominal Alignment Curve



Fringe Area Alignment Curve

VIDEO I-F ALIGNMENT

For proper alignment, the bias on the first and second I-F grids must be maintained at —4 volts. This may be accomplished by either of two approved methods.

(a) A battery with a potentiometer across it may be connected from the grid return of either tube to ground, and adjusted to —4 volts.

(b) A potentiometer of 500K ohms may be connected across the AGC amplifier tube V121 from plate (pin 6) to cathode (pin 8), and adjusted to give a —4 volt reading at the I-F grid return.

A convenient method for injection of the signals necessary for alignment is to place a tight-fitting ungrounded tube shield over the converter tube (middle tube on the R-F Unit), and connect the signal generator or sweep generator to it.

1. Connect oscilloscope to the high side of the detector load resistor R-109, 3300 ohms (junction of R-109 and L-102), and to chassis ground. A 10K resistor in series with the scope probe will prevent radiation and feedback.

2. Tune the converter plate transformer for maximum at 22.75 Mc., using a modulated signal.

3. Tune the first I-F transformer T-101 for maximum at 23.4 Mc.

4. Tune the second I-F transformer T-102 for maximum at 25.2 Mc.

5. Tune the third I-F transformer T-103 for maximum at 25.3 Mc.

6. Remove the I-F signal generator and tube shield and connect the R-F Sweep Generator to the antenna terminals.

7. Set the receiver and R-F Sweep Generator to a high channel, because those are more broad and flat topped.

8. The I-F transformers can now be retouched if necessary in order to obtain a standard response curve, with the picture carrier at 50% of maximum response, and the 3 Mc. marker (22.75 Mc.) also at 50%.

The converter coil will correct the low frequency side, as will T-103 correct the high frequency side when necessary. Proper position ing of the markers on the response curve is important since no traps are used. T-101 will control the tilt of the response curve.

9. All twelve channels should be checked for alignment. The nominal curve shall have a tilt of 10% with respect to the base line of sweep. The low limit of tilt is shown in the above curve.

SOUND I-F ALIGNMENT

Test equipment required:

4.5 Mc. Signal Generator, A-M Modulated
4.5 Mc. Sweep Generator
Oscilloscope
VTVM (Voltohmist type)
Crystal Detector (Assembly diagram shown below)
Tapped Resistor and Clip Assembly (two 22,000 ohm 5% resistors in series with a clip lead at each end)

1. Connect the signal generator to pin 1 of V-104 and chassis, and set frequency at 4.5 Mc.
2. Connect XTAL detector to the kinescope end of L-105 and chassis. Connect Scope or VTVM across output of XTAL detector. Adjust bottom slug of T-108 for minimum response.
3. Clip tapped resistor from pin 7 of V-114 to chassis. Connect VTVM minus lead to the resistor tap, and the probe to junction of R-149 and R-150. Align slugs top of T-108 and bottom of T-109 for maximum response.
4. Adjust top slug of T-109 for approximately —½ volt, then readjust bottom slug of T-109 for maximum reading.
5. Adjust top slug of T-109 for zero.
6. Remove signal generator and apply sweep generator to pin 1 of V-104 and ground. Remove tapped resistor and connect scope to junction of R-149 and R-150 and chassis

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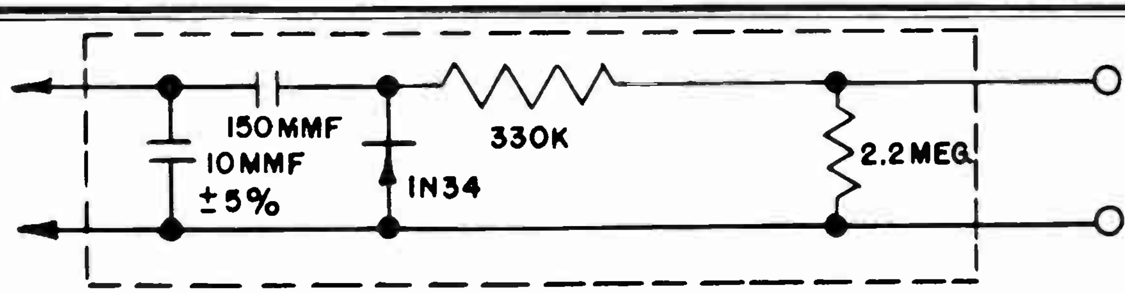
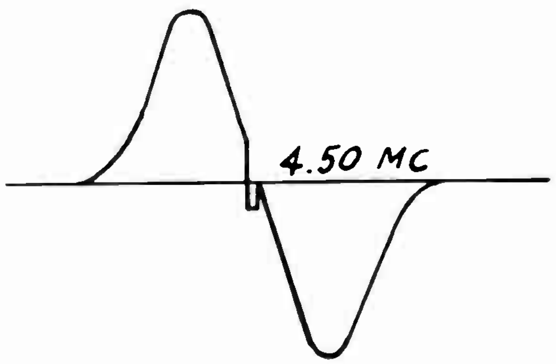


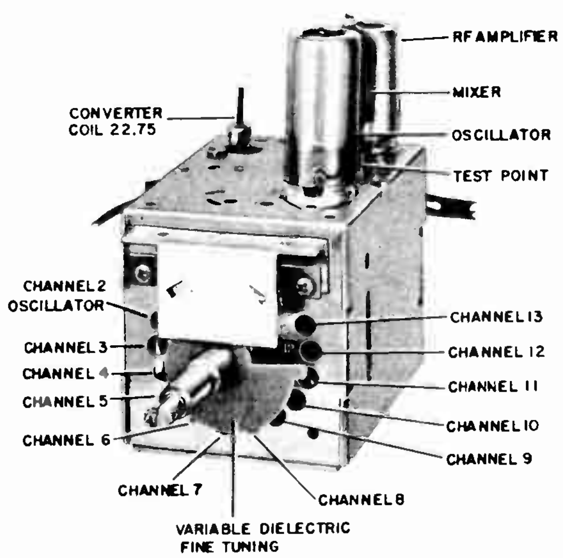
ground. Check the curve for symmetry as shown on the following curve:



7. Touch up only if necessary top slug of T-109 to obtain proper curve.

R-F UNIT ALIGNMENT, TYPE "S" TUNER

FRONT VIEW RF UNIT



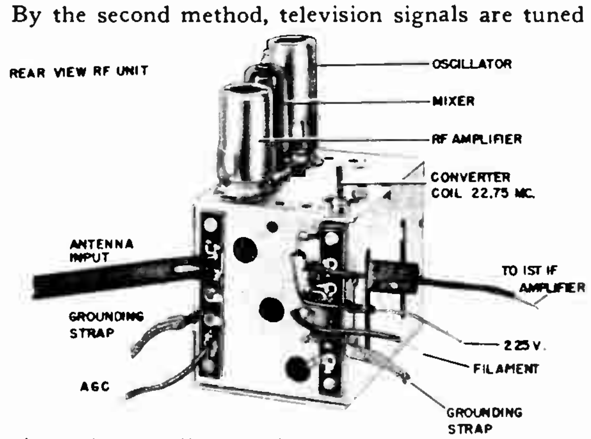
OSCILLATOR ALIGNMENT

The criteria of proper oscillator alignment is that the combination of the assigned video carrier and the local oscillator produce a signal that falls at the 25.75 Mc. marker point on the overall I-F curve.

Adjustment should be made only when the fine tuning control tunes in the extreme clockwise or counterclockwise position from its center, or if it will not tune at all within its tuning range. Such a condition may be brought about by changes in the inductance of the oscillator coils or changes in the circuit capacitance which might occur when the oscillator tube is replaced.

The oscillator coils are tunable by means of slug-adjustments, accessible from the front of the chassis. Alignment of one does not appreciably effect the tuning of the other coils.

Alignment may be accomplished by two approved methods. By the first, a video carrier frequency is coupled to the antenna, which produces an I-F signal, and another I-F signal is coupled to the first I-F tube. If the oscillator is properly aligned, the two will produce a zero beat visible at the video detector. By the second method, television signals are tuned



in, and the oscillator coil for each channel is adjusted so tuning occurs at mid-range of the tuning control. The detailed procedures follow:

FIRST METHOD

Remove the 1st I-F tube.

(1) Connect an oscilloscope across the video detector load resistor.

(2) Loosely couple an unmodulated signal to the first I-F, and set the frequency at 25.75 Mc.

(3) Connect another signal generator to the antenna leads, and tune it to the video carrier frequency of the channel to be aligned. Rotate the channel selector to the correct position. Rotate the fine tuning control until a zero beat is noticed. If the zero beat does not occur at the mid-range of the fine tuning control, adjust the oscillator tuning slug for that channel.

SECOND METHOD

(1) Connect the television antenna to the antenna terminals of the receiver.

(2) Tune in the signal on all available channels. If the best picture does not occur at mid-range of the fine tuning control, adjust the oscillator slug for that channel.

OSCILLATOR ALIGNMENT

The oscillator coils in this R-F unit are all tunable by slug adjustments. The order of alignment is from channel 6-2, 13-7, 6-2 and 13-7. The repeated adjustment is necessary to correct any detuning caused by the capacity change due to slug adjustments of adjacent coils.

1. Set the sweep generator and channel switch to No. 6 channel. Adjust as outlined in instructions for untuned input tuner.
2. Proceed through channels 5-2 in the same manner.
3. Align channels 13-7.
4. Proceed as above through channels 6-2 and 13-7, and retouch if necessary.

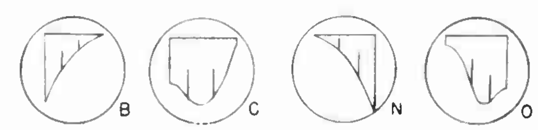
ANTENNA, R-F AMPLIFIER AND CONVERTER ALIGNMENT

There are three variables which will give the desired pattern. If the antenna coil (wafer nearest the rear of the tuner) is first expanded, then the grid coil and finally the plate coil is expanded, the proper pattern will appear. These coils must be very carefully adjusted with only slight movement, particularly the plate coil. The final pattern is obtained by working back and forth between these three coils.

1. Remove the AGC rectifier-amplifier tube and connect bias control.
2. Connect sweep generator to antenna terminals, using a balanced resistor network if generator has unbalanced output cable. Connect scope to terminal provided on the tuner.
3. Set the sweep generator and channel switch to No. 13 channel. If the coils are very badly aligned, the pattern on the scope will probably be either of these:

The meaning of "A" is that some coils must be opened up. The meaning of "M" is that some coils should be closed or squeezed together.

4. When they are far off from their proper tuning, all three coil circuits have their main affect on pattern height, so tune for increasing height of the pattern.
5. As a coil is changed, one side of the picture will get higher and then a hump will start to move across the screen.

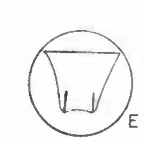


If the first pattern was like "A", the next will be "B" and then "C" as the coil is opened. If the first pattern was like "M", the next will be "N" and then "O" as the coil is closed. When the hump, due to the tuning of that coil, is between the markers, it indicates that this coil is very close to where it should be. So leave it and immediately go to another coil.

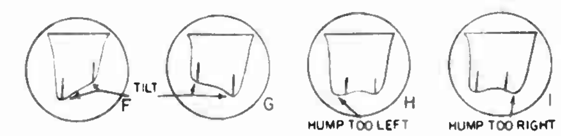
6. The side of the picture which is higher indicates what to do to the next coil. In "C", the left hand side is higher, which indicates that said coil should be opened. In "O", the right side is higher, indicating that said coil should be closed. A picture similar to "D" or "P" should be then obtained.

The fact that there are now two humps in the pattern shows that both converter wafer and R-F wafer are tuned nearly right. If picture height is near what it should be with the scope settings unchanged, the antenna wafer is near correct. It should be adjusted a bit to see if pattern height improves.

7. When all three coils are nearly tuned, the antenna wafer controls the tilt, the RF wafer controls the left hand hump, and the converter wafer controls the right hand hump. Adjust them for a perfect flat pattern on channel 13 as below.

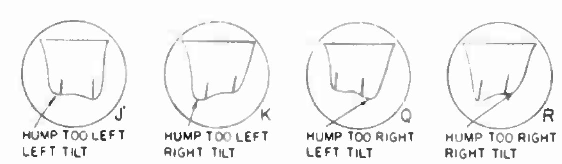


8. Proceeding through channels 12, 11, 10, etc., the pattern will change slightly as shown below. In general, three things occur: (1) tilt, (2) hump too far left, or (3) hump too far right.



For right tilt as in "F", press down the loops on the antenna wafer. For left tilt as in "G", pull up the loops on the antenna wafer. For hump to left as in "H", push down on the loops on the R-F wafer. For hump to right as in "I", use iron and screwdriver and pull out channel 12 or channel 7 loops on converter wafer.

9. Combinations of detuning also occur.



In these cases, two wafers must be adjusted to bring in the best picture. For a case like "J", R-F wafer must be adjusted to bring in the hump and antenna wafer to correct the tilt. In

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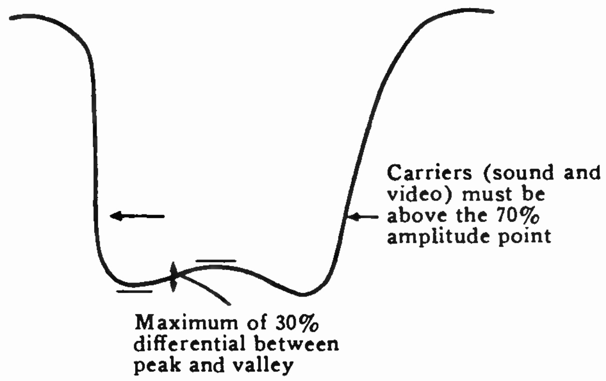
a case like "Q", the converter wafer should be adjusted to bring in the hump and the antenna wafer to correct the tilt. In combination cases like these, where the antenna wafer and one of the other two must be adjusted, always adjust the antenna wafer for tilt correction after all adjustments have been made on the other two wafers.

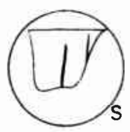
10. It is best to prevent the left hump from going so far to the left that it cannot be brought back, or the tilt to become so bad that it cannot be corrected. If the best possible pattern is obtained on each successive channel, then proper adjustment of the next one will always be within its range.

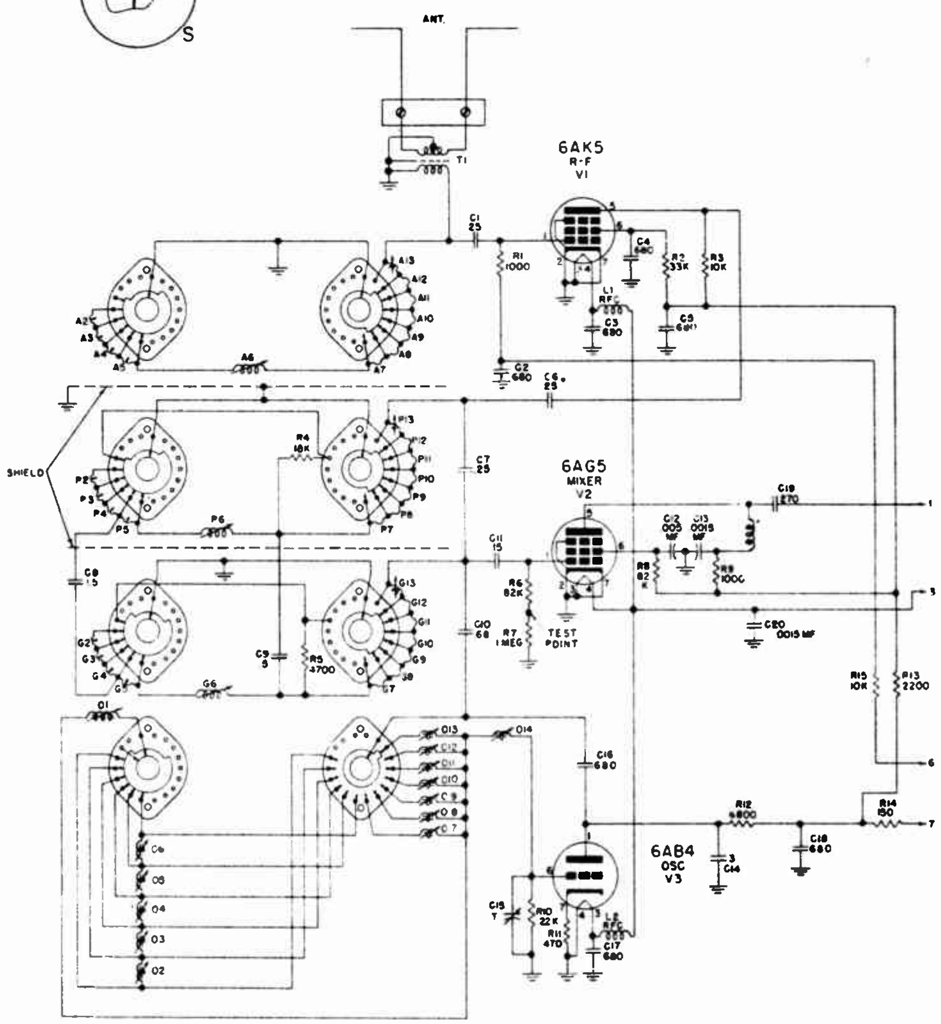
11. When both coils are near to proper tuning, a slight adjustment of either R-F or converter wafer will give a flat pattern, with very little tilt, and the humps right on the markers; but only the correct coil will give this correct pattern shape plus best pattern height.

When the pattern is like "S" on a low band, opening a coil on either wafer will move the pattern to the right, but try both slightly and make the final adjustment by opening that coil which causes the pattern to become higher as it moves toward the right.

The pattern on all channels is approximately as shown







TYPE "S" R-F UNIT, CT 247-248-249

PART VI

CT 247, 248, 249 VOLTAGE CHART NO SIGNAL INPUT

Measurements made with receiver operating on 117 volts, 60 cycles AC, with "Voltohmist" type VTVM, between indicated terminal and chassis ground, unless otherwise noted.

Tube No.	Tube Type	Function	Plate Pin No.	Plate Volts	Screen Pin No.	Screen Volts	Cathode Pin No.	Cathode Volts	Grid Pin No.	Grid Volts	Notes
1	6AK5	RF Ampl.	5	125	6	115	2-7	0	1	—.25	*1
2	6AG5	Mixer	5	185	6	107	2-7	0	1	—1.6	*2
3	6AB4	Oscillator	1	185			7	2	6	—4.3	*2
101	6AG5	1st IF Ampl.	5	124	6	124	7	.15	1	—.7	
102	6AG5	2nd IF Ampl.	5	123	6	123	7	.55	1	—.7	
103	6AG5	3rd IF Ampl.	5	122	6	122	7	1.25	1	0	
119A	6AL5	Video Det.	7	—105			1	—105			
104	6AU6	Video Ampl.	5	—37	6	34	7	—105	1	—105	*3
105	12L(K)P4	Kinescope	x	9.0 KV	10	235	11	—37	2	0 to —105	*4
106A	12AU7	AGC Det.	1	226			3	—14	2	—37	*5
121A	12AU7	AGC Ampl.	6	—3.6			8	—51	7	—73	
106B	12AU7	Pre Sync Sep.	6	221			8	—13.7	7	—37	*5
121B	12AU7	Sync Ampl.	1	100			3	1.9	2	0	
119B	6AL5	Sync Lev.	2	—26			5	0			
107B	6SN7	Sync Clip.	2	234			3	—18.5	1	—24	
107A	6SN7	Vert. MV.	5	15			6	—105	4	—130	
120	6K6	Vert. MV. & Output	3	218	4	218	8	—64	5	—84	
108	6AL5	AFC Det.	2 & 7	—19.5			1-5	0			
109	6AU6	Reactance	5	240	6	124	7	2.6	1	0	*6
117A	6SN7	Horiz. Osc.	2	222			3	.1	1	—14	
117B	6SN7	Horiz. Disch.	5	109			6	—109	4	—143	
110	6BG6	Horiz. Output	x	do not meas.	8	168	3	—96	5	—125	*7
111	6W4	Damper	5	do not meas.			3	390			*7
113	6AU6	Sound IF	5	124	6	124	7	—1.2	1	0	
114	6AL5	Ratio Det.	2 7	—.4 —.8			1 5	—.4 0			
115	6AV6	1st Audio	7	—97			2	0	1	—.6	*8
116	6K6	Audio Output	3	180	4	210	8	—80	5	—100	*8
115	6C4	AGC Clamp	5	.3			7	0	6	.3	*9
118	5U4	Rectifier	6-4	385 RMS			2-8	290			*10

Note *1 All voltages vary with AGC.
Note *2 All voltages vary with selector switch setting.
Note *3 Plate voltage varies with different tubes.
Note *4 Bias varies with picture control setting.
Note *5 Cathode varies with different video amplifier tubes.
Note *6 Cathode varies with horizontal oscillator tuning.
Note *7 Do not measure Horiz. Output plate or Damper plate with VTVM. Pulses cause grid rectification in meter so reading is meaningless. Pulses may damage meter.
Note *8 Used only in CT 248 and 249.
Note *9 Used only in CT 248.
Note *10 AC plate voltage measured from —100 volt tap.

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CT 247, 248, 249 VOLTAGE CHART NORMAL SIGNAL INPUT

Measurements made with receiver operating on 117 volts, 60 cycles AC, with "Voltohmist" type VTVM, between indicated terminal and chassis ground, unless otherwise noted.

Tube No.	Tube Type	Function	Plate		Screen		Cathode		Grid		Notes
			Pin No.	Volts	Pin No.	Volts	Pin No.	Volts	Pin No.	Volts	
1	6AK5	RF Ampl.	5	125	6	115	2-7	0	1	—9.3	*1
2	6AG5	Mixer	5	190	6	115	2-7	0	1	—1.6	*2
3	6AB4	Oscillator	1	190			7	2.6	6	—4.4	*2
101	6AG5	1st IF Ampl.	5	170	6	170	7	0	1	—5.3	
102	6AG5	2nd IF Ampl.	5	169	6	169	7	0	1	—5.3	
103	6AG5	3rd IF Ampl.	5	168	6	168	7	1.7	1	0	
119A	6AL5	Video Det.	7	—91			1	—90			
104	6AU6	Video Ampl.	5	—5	6	63	7	—90	1	—90	*3
105	12L(K)P4	Kinescope	x	9.0 KV	10	274	11	—5	2	10 to —90	*4
106A	12AU7	AGC Det.	1	259			3	41	2	—4.4	*5
121A	12AU7	AGC Ampl.	6	—27.5			8	—45	7	—45	
106B	12AU7	Pre Sync Sep.	6	250			8	40	7	—4.4	*5
121B	12AU7	Sync Ampl.	1	130			3	1.95	2	—2.8	
119B	6AL5	Sync Lev.	2	—83			5	0			
107B	6SN7	Sync Clip.	2	273			3	—40	1	—84	
107A	6SN7	Vert. MV.	5	36			6	—90	4	—115	
120	6K6	Vert. MV. & Output	3	230	4	230	8	—60	5	—90	
108	6AL5	AFC Det.	2 7	26.7 28.4			1 5	.15 0			
109	6AU6	Reactance	5	267	6	170	7	3.8	1	—.1	*6
117A	6SN7	Horiz. Osc.	2	252			3	.1	1	—16.5	
117B	6SN7	Horiz. Disch.	5	133			6	—90	4	—130	
110	6BG6	Horiz. Output	x	do not meas.	8	190	3	—80	5	—105	*7
111	6W4	Damper	5	do not meas.			3	420			*7
113	6AU6	Sound IF	5	170	6	170	7	1.65	1	0	
114	6AL5	Ratio Det.	2 7	—1 —1.9			1 5	—1.1 0			
115	6AV6	1st Audio	7	—93			2	0	1	—.6	*8
116	6K6	Audio Output	3	195	4	225	8	—68	5	—90	*8
115	6C4	AGC Clamp	5	—6.5			7	0	6	—6.5	*9
118	5U4	Rectifier	6-4	385 RMS			2-8	290			*10

Note *1 All voltages vary with AGC.
Note *2 All voltages vary with selector switch setting.
Note *3 Plate voltage varies with different tubes.
Note *4 Bias varies with picture control setting.
Note *5 Cathode varies with different video amplifier tubes.
Note *6 Cathode varies with horizontal oscillator tuning.
Note *7 Do not measure Horiz. Output plate or Damper plate with VTVM. Pulses cause grid rectification in meter so reading is meaningless. Pulses may damage meter.
Note *8 Used only in CT 248 and 249.
Note *9 Used only in CT 248.
Note *10 AC plate voltage measured from —100 volt tap.

PARTS LIST

Ref. No.	Part No.	DESCRIPTION
T 101	360461-1	Transformer, 1st video I-F
T 102	360461-1	Transformer, 2nd video I-F
T 103	360461-1	Transformer, 3rd video I-F
T 104	320040-1	Transformer, vertical output
T 105	360435-1	Transformer, horizontal oscillator
T 106	320048-1	Transformer, horizontal scanning
T 107	300057-1	Transformer, power
T 108	360440-1	Transformer, 4.5 mc. trap and take off
T 109	360434-1	Transformer, ratio det.
L 101	360332-9	Coil, peaking—white
L 102	360332-17	Coil, peaking—violet
L 103	360443-1	Coil, peaking—brown
L 104	360443-2	Coil, peaking—red
L 105	360443-3	Coil, peaking—orange
L 106	320041-1	Coil, filter reactor
L 107	360332-8	Coil, R-F choke
L 108	360443-4	Coil, peaking—yellow
L 109	360372-4	Coil, R-F choke insulated 6.8 uh
L 110	360455-1	Coil, R-F choke insulated .4 uh
L 111	360334-1	Coil, linearity
L 112	360451-1	Coil, peaking
L 113	360341-7&8	Focus coil assembly
L 114	360331-2	Horiz. size control
L 115	360330-9	Deflection yoke assembly
RC 101	250186-1	Printed circuit
	180157-9	Fuse, 5 A., 250 V.
	180475-1	Fuse, ¼ A., 250 V. (pigtail)
C 101	250175-3	Capacitor, ceramic, 1500 mmf., 450 V.
C 102	250175-3	Capacitor, ceramic, 1500 mmf., 450 V.
C 103	250175-3	Capacitor, ceramic, 1500 mmf., 450 V.
C 104	250175-3	Capacitor, ceramic, 1500 mmf., 450 V.
C 105	250175-3	Capacitor, ceramic, 1500 mmf., 450 V.
C 106	250175-3	Capacitor, ceramic, 1500 mmf., 450 V.
C 107	250176-12	Capacitor, ceramic, 10 mmf., 500 V.
C 108	270027-4	Capacitor, electrolytic, 10 mfd.
C 109	250176-17	Capacitor, ceramic, 100 mmf., 500 V.
C 110	250201-13	Capacitor, paper, .1 mfd., 600 V.
C 111	250201-10	Capacitor, paper, 0.33 mfd., 600 V.
C 112	250201-13	Capacitor, paper, .1 mfd., 600 V.
C 113	250201-7	Capacitor, ceramic, .01 mfd., 600 V.
C 114	250176-13	Capacitor, ceramic, .5 mmf., 500 V.
C 115	250160-62	Capacitor, mica, 680 mmf., 500 V.
C 116	250151-41	Capacitor, paper, .005 mfd., 600 V.
C 117	250201-11	Capacitor, paper, .047 mfd., 600 V.
C 118	250201-13	Capacitor, paper, .1 mfd., 600 V.
C 119	250201-3	Capacitor, paper, .002 mfd., 600 V.
C 120	250151-12	Capacitor, paper, .25 mfd., 200 V.
C 121	250159-82	Capacitor, mica, 100 mmf., 500 V.
C 122	250185-9	Capacitor, mica, .005 mfd., 600 V.
C 123	250185-10	Capacitor, paper, .015 mfd. 5%, 600 V.
C 124	250201-5	Capacitor, mica, .004 mfd., 600 V.
C 125	250201-11	Capacitor, paper, .047 mfd., 200 V.
C 126	250159-82	Capacitor, mica, 100 mmf., 500 V.
C 127	250201-5	Capacitor, paper, .004 mfd., 600 V.
C 128	250151-44	Capacitor, paper, .002 mfd., 600 V.
C 129	250151-38	Capacitor, paper, .01 mfd., 600 V.
C 130	250159-98	Capacitor, mica, 100 mmf., 500 V.
C 131	250175-2	Capacitor, ceramic, .01 mfd., 450 V.
C 132	250175-2	Capacitor, ceramic, .01 mfd., 450 V.
C 135	250201-1	Capacitor, paper, .001 mfd., 600 V.
C 133	250088-46	Capacitor, ceramic, 1000 mmf., 350 V.
C 136	270027-10	Capacitor, electrolytic, 4 mfd.
C 137	250176-13	Capacitor, ceramic. 5 mmf.
C 138	250201-11	Capacitor, paper, .047 mfd., 600 V.
C 139	250175-1	Capacitor, ceramic, 500 mmf., 450 V.
C 140	250175-1	Capacitor, paper, 5000 mmf., 450 V.
C 141	250176-13	Capacitor, ceramic, 5 mmf., 500 V.
C 143	270027-13	Capacitor, electrolytic, 20 mfd.
C 144	270027-12	Capacitor, electrolytic, 80 mfd.
C 145	270027-13	Capacitor, electrolytic, 20 mfd.
C 146	270021-33	Capacitor, electrolytic, 40-45 mfd.
C 148	250201-11	Capacitor, paper, .047 mfd., 600 V.
C 150	250201-1	Capacitor, paper, .001 mfd., 600 V.
C 151	250175-2	Capacitor, paper, .01 mfd., 450 V.
C 152	250201-11	Capacitor, paper, .047 mfd., 600 V.
C 153	250201-11	Capacitor, paper, .047 mfd., 600 V.
C 154	250173-2	Capacitor, ceramic, 500 mmf., 10 KV.
C 155	250088-31	Capacitor, ceramic, 500 mmf., 500 V.
C 156	250151-12	Capacitor, paper, .25 mfd., 200 V.
C 157	270023-11	Capacitor, electrolytic, 20 mfd.
C 158	250175-3	Capacitor, ceramic, 1500 mmf., 450 V.
C 159	270021-35	Capacitor, electrolytic 80, 40, 40, 50
C 160	270021-34	Capacitor, electrolytic 40-10-35
C 161	250175-3	Capacitor, ceramic, 1500 mmf., 450 V.
C 162	250175-3	Capacitor, ceramic, 1500 mmf., 450 V.
C 163	250175-3	Capacitor, ceramic, 1500 mmf., 450 V.
C 164	250175-3	Capacitor, ceramic, 1500 mmf., 450 V.
C 165	250175-1	Capacitor, ceramic, 5000 mmf., 450 V.
C 166	250159-102	Capacitor, mica, 470 mmf., 500 V.
R 101	230104-76	Resistor, carbon, 15K, ½ W.
R 102	230104-40	Resistor, carbon, 15K, ½ W.
R 103	230104-50	Resistor, carbon, 100 K, ½ W.
R 104	230104-73	Resistor, carbon. 82K, ½ W.
R 105	230104-48	Resistor, carbon, 68K, ½ W.
R 106	230104-71	Resistor, carbon, 5600K, ½ W.
R 107	230104-52	Resistor, carbon, 150K, ½ W.
R 108	230094-200	Resistor, carbon, 22K, 5%
R 109	230104-68	Resistor, carbon, 3300K, ½ W.
R 111	230104-82	Resistor, carbon, 47K, ½ W.
R 112	220076-26	Potentiometer, AGC setting
R 114	230105-76	Resistor, carbon, 15K, 1 W.
R 115	230104-77	Resistor, carbon, 18K
R 116	220076-31	Potentiometer, picture control
R 117	230104-78	Resistor, carbon, 22K, ½ W.
R 118	230105-54	Resistor, carbon, 220K, 1 W.
R 119	230094-241	Resistor, carbon, 2.7 megohm, 5%, ½ W.
R 120	230104-102	Resistor, carbon, 2.2 megohm, ½ W.
R 121	230104-62	Resistor, carbon, 1000K, ½ W.
R 122	230105-65	Resistor, carbon, 1800, 1 W.
R 123	230104-79	Resistor, carbon, 27K, ½ W.
R 124	230094-200	Resistor, carbon, 6800, 5%, ½ W.
R 125	230104-82	Resistor, carbon, 47K, ½ W.
R 126	230104-69	Resistor, carbon, 3900, ½ W.
R 127	230104-88	Resistor, carbon, 220K, ½ W.
R 128	220076-27	Potentiometer, vertical hold
R 129	230104-97	Resistor, carbon, 820K, ½ W.
R 130	220076-28	Potentiometer, vertical height
R 131	230104-71	Resistor, carbon, 5600, ½ W.

CHASSIS CT 247, CT 248, CT 249

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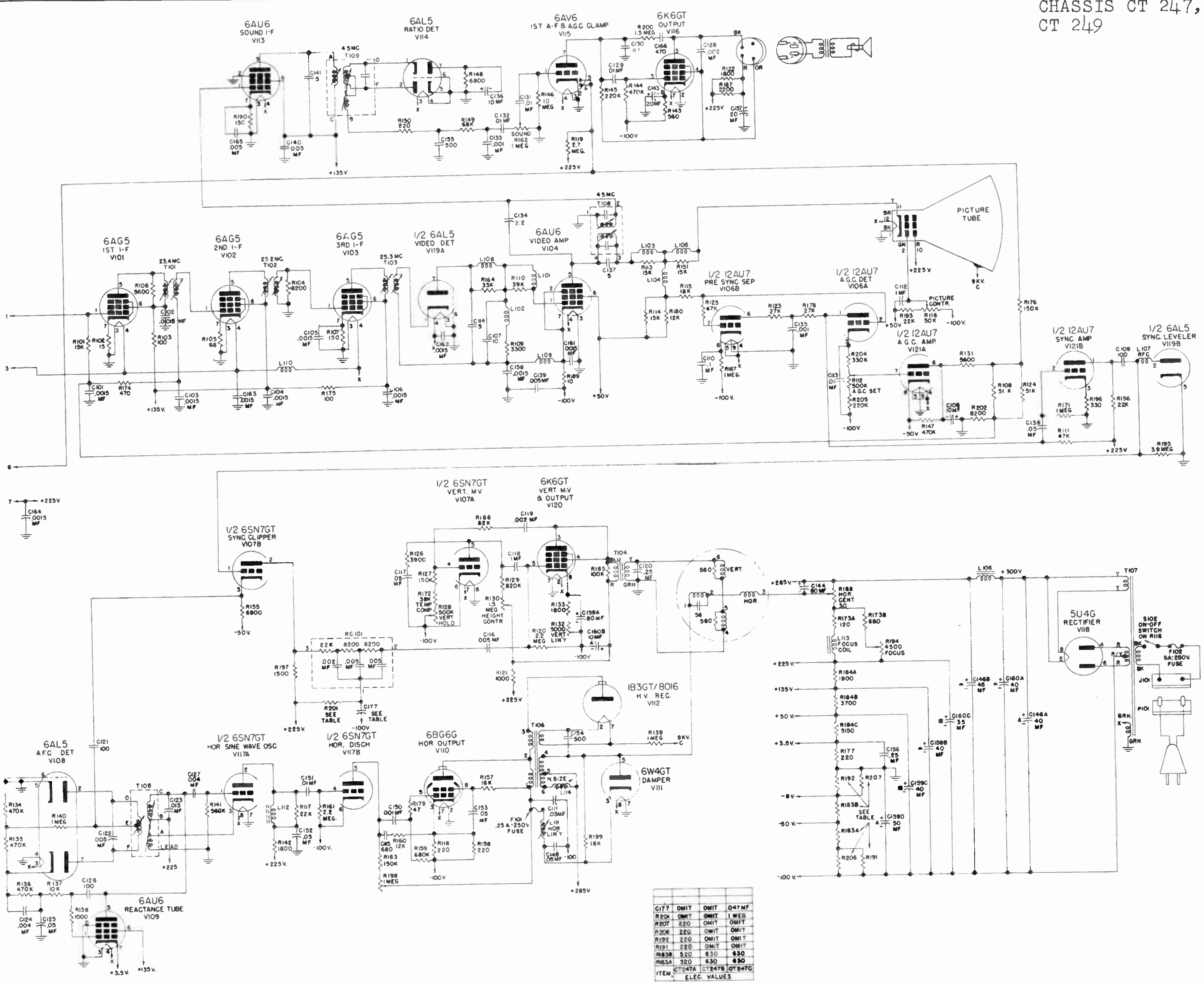
Ref. No.	Part No.	DESCRIPTION
R 132	220076-29	Potentiometer, vertical linearity
R 133	230105-65	Resistor, carbon, 1800, 1 W.
R 134	230104-94	Resistor, carbon, 470K, ½ W.
R 135	230104-94	Resistor, carbon, 470K, ½ W.
R 136	230104-94	Resistor, carbon, 470K, ½ W.
R 137	230104-74	Resistor, carbon, 10K, ½ W.
R 138	230104-62	Resistor, carbon, 1000, ½ W.
R 139	230105-98	Resistor, carbon, 1 megohm, 1 W.
R 140	230104-98	Resistor, carbon, 1 megohm, ½ W.
R 141	230104-95	Resistor, carbon, 560K, ½ W.
R 142	230105-65	Resistor, carbon, 1800, 1 W.
R 143	230105-59	Resistor, carbon, 560, 1 W.
R 144	230104-94	Resistor, carbon, 470K, ½ W.
R 145	230104-90	Resistor, carbon, 220K, ½ W.
R 146	230104-110	Resistor, carbon, 10 megohms, ½ W.
R 147	230104-94	Resistor, carbon, 470K, ½ W.
R 148	230104-72	Resistor, carbon, 6800, ½ W.
R 149	230104-84	Resistor, carbon, 68K, ½ W.
R 150	230104-54	Resistor, carbon, 220, ½ W.
R 155	230105-72	Resistor, carbon, 6800, 1 W.
R 156	230105-78	Resistor, carbon, 22K, 1 W.
R 157	240057-2	Resistor, carbon, 16K, 5 W.
R 158	230105-54	Resistor, carbon, 220, 1 W.
R 159	230104-96	Resistor, carbon, 680K, ½ W.
R 160	230104-75	Resistor, carbon, 12K, ½ W.
R 161	230104-102	Resistor, carbon, 2.2 megohm, ½ W.
R 162	220076-30	Potentiometer, volume
R 163	230104-88	Resistor, carbon, 150K, ½ W.
R 165	230104-86	Resistor, carbon, 100K, ½ W.
R 166	230104-85	Resistor, carbon, 82K, ½ W.
R 167	230104-98	Resistor, carbon, 1 megohm, ½ W.
R 171	230104-98	Resistor, carbon, 1 megohm, ½ W.
R 172	230091-1	Resistor, temperature compensating, .38K
R 173	240058-1	Strip resistor
R 174	230104-58	Resistor, carbon, 470, ½ W.
R 175	230104-50	Resistor, carbon, 100, ½ W.
R 176	230094-211	Resistor, carbon, 100K, 5%, ½ W.
R 177	230104-54	Resistor, carbon, 220, ½ W.
R 178	230104-79	Resistor, carbon, 27K, ½ W.
R 179	230104-46	Resistor, carbon, 47, ½ W.
R 180	230105-75	Resistor, carbon, 12K, 1 W.
R 183	240044-1	Strip resistor
R 184	240055-1	Strip resistor
R 187	230105-66	Resistor, carbon, 2200, 1 W.
R 188	220076-32	Potentiometer, horizontal centering
R 189	230104-38	Resistor, carbon, 10, ½ W.
R 190	230104-52	Resistor, carbon, 150 ohms, ½ W.
R 191	230105-54	Resistor, carbon, 220, 1 W.
R 192	230105-54	Resistor, carbon, 220, 1 W.
R 193	230104-78	Resistor, carbon, 22K, ½ W.
R 194	220076-34	Potentiometer, focus
R 195	230104-105	Resistor, carbon, 3.9 megohms, ½ W.
R 196	230104-56	Resistor, carbon, 330, ½ W.
R 197	230104-64	Resistor, carbon, 1500, ½ W.
R 198	220076-33	Potentiometer, horizontal drive
R 199	240057-1	Resistor, wire wound, 16K, 5%, 10 W.
R 200	230104-100	Resistor, carbon, 1.5M, ½ W.
R 202	230104-73	Resistor, carbon, 8200, ½ W.
R 204	230104-92	Resistor, carbon, 330K, ½ W.
R 205	230104-90	Resistor, carbon, 220, ½ W.
R 206	230105-54	Resistor, carbon, 220, 1 W.
R 207	230105-54	Resistor, carbon, 220, 1 W.



SCHEMATIC WIRING DIAGRAM, MAGNAVOX CT-247-249 TELEVISION RECEIVER

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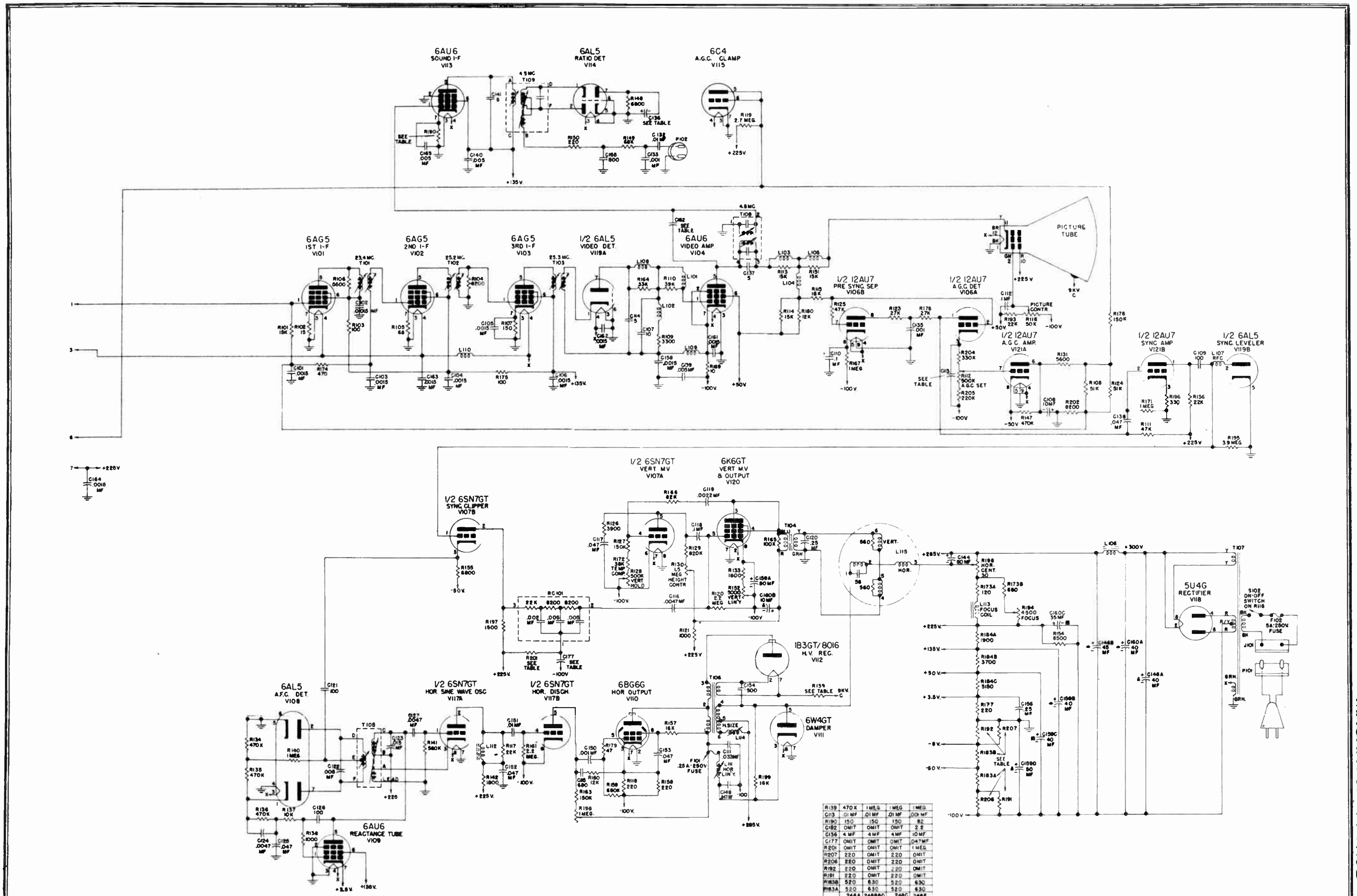

R139	470 K	1 MEG	1 MEG	1 MEG
C113	.01 MF	.01 MF	.01 MF	.001 MF
R190	150	150	150	82
C182	OMIT	OMIT	OMIT	2.2
C136	4 MF	4 MF	4 MF	10 MF
C177	OMIT	OMIT	OMIT	.047 MF
R201	OMIT	OMIT	OMIT	1 MEG
R207	220	OMIT	220	OMIT
R206	220	OMIT	220	OMIT
R192	220	OMIT	220	OMIT
R191	220	OMIT	220	OMIT
R183B	520	630	520	630
R183A	520	630	520	630
ITEM	248A	248B&D	248C	248E
	ELEC VALUES			

SCHEMATIC WIRING DIAGRAM, MAGNAVOX CT 248 TELEVISION RECEIVER

CHASSIS CT 248

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CHASSIS CT 247, CT 248, CT 249

ADDENDA

The vertical circuit was changed twice in order to improve linearity. The following paragraphs will indicate the original component values used, and the first and second changes in the order in which they were made. The chassis schematic includes these improvements:

1. Add R-120, 8200 ohms, 10%, ½ watt resistor (230104-73) in series with discharge condenser C-117. (See following paragraph, item 1.)
2. Add R-211, 27 K ohms, 10%, ½ watt resistor (230104-79) in series with C-178.
3. Replace R-129 (1 megohm) with one 820 K ohm, 10%, ½ watt resistor (230104-97).
4. Replace R-197 (1500 ohm) with one 2200 ohm, 10%, ½ watt resistor (230104-66).

1. Replace R-210 (8200 ohm) with one 10 K, 10%, ½ watt resistor (230104-74).
2. Replace R-120 (2.2 megohm) with one 3.9 megohm, 10%, ½ watt resistor (230104-105).
3. Add R-213, 100 K ohm, 10%, ½ watt resistor (230104-86).
4. Add C-183, .033 mfd., 20%, 600 v. capacitor (250201-10).
5. Replace C-118 (.047 mfd.) with one .1 mfd., 20%, 600 v. capacitor (250201-13).

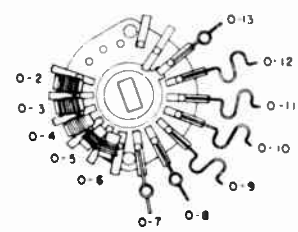
MAGNAVOX MODEL "M" TUNER

Most CT 247, 248 and 249 chassis use the Model "S" tuner No. 700333 as described herein. However some current production chassis use the Model "M" tuner No. 700340. This tuner is capable of increased sensitivity and selectivity, and has low noise factors. It uses a 6BC5 RF Amplifier and a 6J6 Oscillator and Converter. If all channels tune toward the same side of the fine tuning control, they may be brought in by adjusting the trimmer which extends through the front of the tuner. Individual channel oscillator alignment is accomplished by knifing the coils. The antenna, RF Amplifier and Converter coils are over-coupled for the necessary passband, and adjustment is different from that outlined for the type "S" tuner, and will be included in a subsequent service manual.

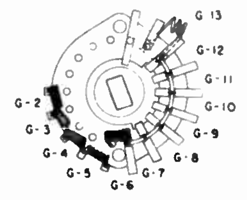
CHASSIS CT 255

This maintenance information covers Magnavox television receiver chassis model CT 255, and is supplementary to Manual No. 7206 covering the CT 247, 248 & 249 chassis. All data of 7206 is applicable to the CT 255 chassis excepting reference to the tuner. Tuner No. 700337 is used in CT 255, and is described below.

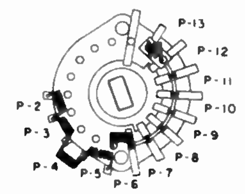
TUNER NO. 700337 ALIGNMENT INSTRUCTIONS



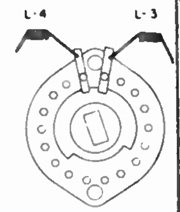
SECTION 2-FRONT



SECTION 3-FRONT



SECTION 4-FRONT



SECTION 5-REAR

OSCILLATOR ALIGNMENT

1. TOUCH-UP

a. If some low channels do not tune at all, or not near enough the center of the fine tuning range, adjust the oscillator tuning slug for those channels.

b. Check all other channels to determine if their tuning has been affected enough to warrant further touch-up.

c. If the tuning on some channels is unsatisfactory, proceed with complete oscillator alignment as follows:

2. COMPLETE OSCILLATOR ALIGNMENT

a. Connect an unmodulated signal generator to the antenna terminals and tune it to channel 13 video carrier frequency.

b. Connect a sweep generator to the antenna terminals and set it on channel 13.

c. Loosely couple an unmodulated signal generator to the 1st I-F grid and tune it to 25.75 mc.

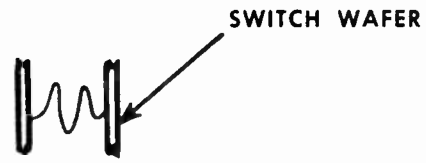
d. Connect an oscilloscope across the video detector load resistor.

e. Turn the receiver on and set the fine tuning control at mid range. After the receiver has warmed up, and if there are two markers on the scope, adjust the oscillator coil until the markers merge.

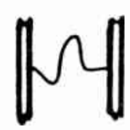
Coils having a 1 turn loop (channels 13, 8 and 7) may be tuned higher by spreading the loop apart or making it smaller. They may be tuned lower by squeezing the loop closer, making the loop as large as possible and making the adjacent sides of the loop as parallel as possible.

Coils consisting of a single bent wire (channels 12, 11, 10 and 9) may be adjusted by adjusting them as shown below.

Care should be taken to prevent any coil from touching the switch stator contact in any place except where it is soldered to that contact.



MINIMUM INDUCTANCE



MEDIUM INDUCTANCE

MAXIMUM INDUCTANCE

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R-F AMPLIFIER & CONVERTER ALIGNMENT

a. Set the channel selector on channel 13. Connect the sweep generator to the antenna terminals using a balanced resistor network for those generators having an unbalanced output. Set the sweep generator to sweep channel 13. Connect an oscilloscope across the video detector load resistor.

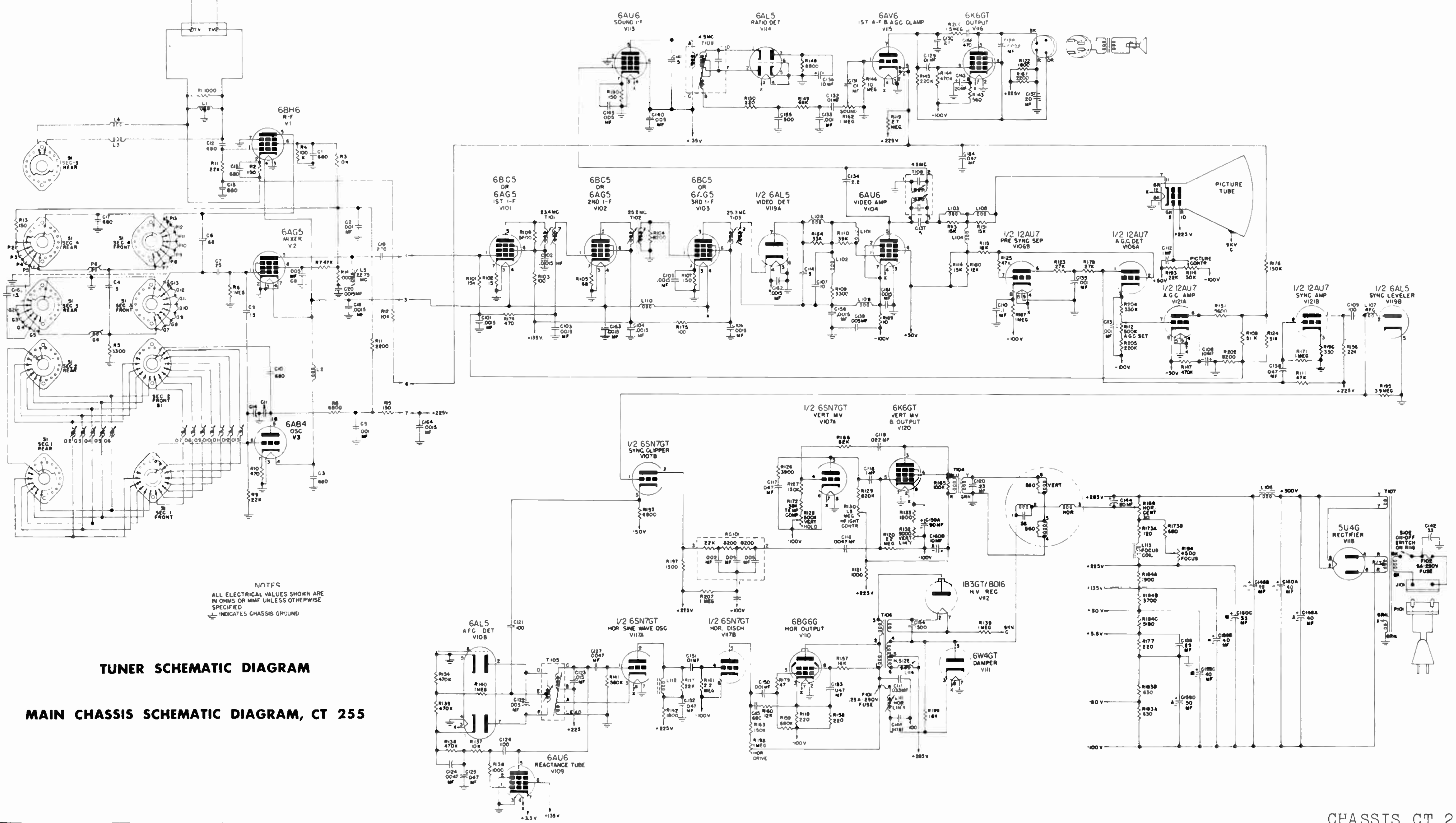
b. Set the fine tuning control to mid-range. Loosely couple a signal generator to the antenna terminals, and tune it to the channel 13 picture carrier frequency, and tune the receiver to that frequency. Adjust the sweep input in such a manner as to avoid overload in the R-F amplifier. Adjust the R-F amplifier plate coil (P13) and the converter grid coil (G13) for maximum response. Set the marker generator to the channel 13 sound carrier frequency and adjust these coils for proper bandpass with optimum gain.

c. Set the channel selector and sweep generator successively to channels 12 through 7. If the R-F amplifier plate coil and the converter grid coil are correctly tuned, channels 12 to 7 will give symmetrical bandpass patterns and the height of the pattern will not vary by more than 3 to 1 between channels 13 and 7.

d. Set the channel selector and the sweep generator to channel 6, and set the marker generator to the channel 6 picture carrier frequency.

e. Adjust the R-F amplifier plate coil (P6) and the converter grid coil (G6) for maximum response. Set the marker generator to the channel 6 sound carrier frequency and adjust these coils for proper bandpass with optimum gain.

f. Align channels 5, 4, 3 and 2 in a similar fashion. The difference between peaks on any channel should be no more than 30% of the total height of the response curve.



TUNER SCHEMATIC DIAGRAM

MAIN CHASSIS SCHEMATIC DIAGRAM, CT 255

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Component Differences

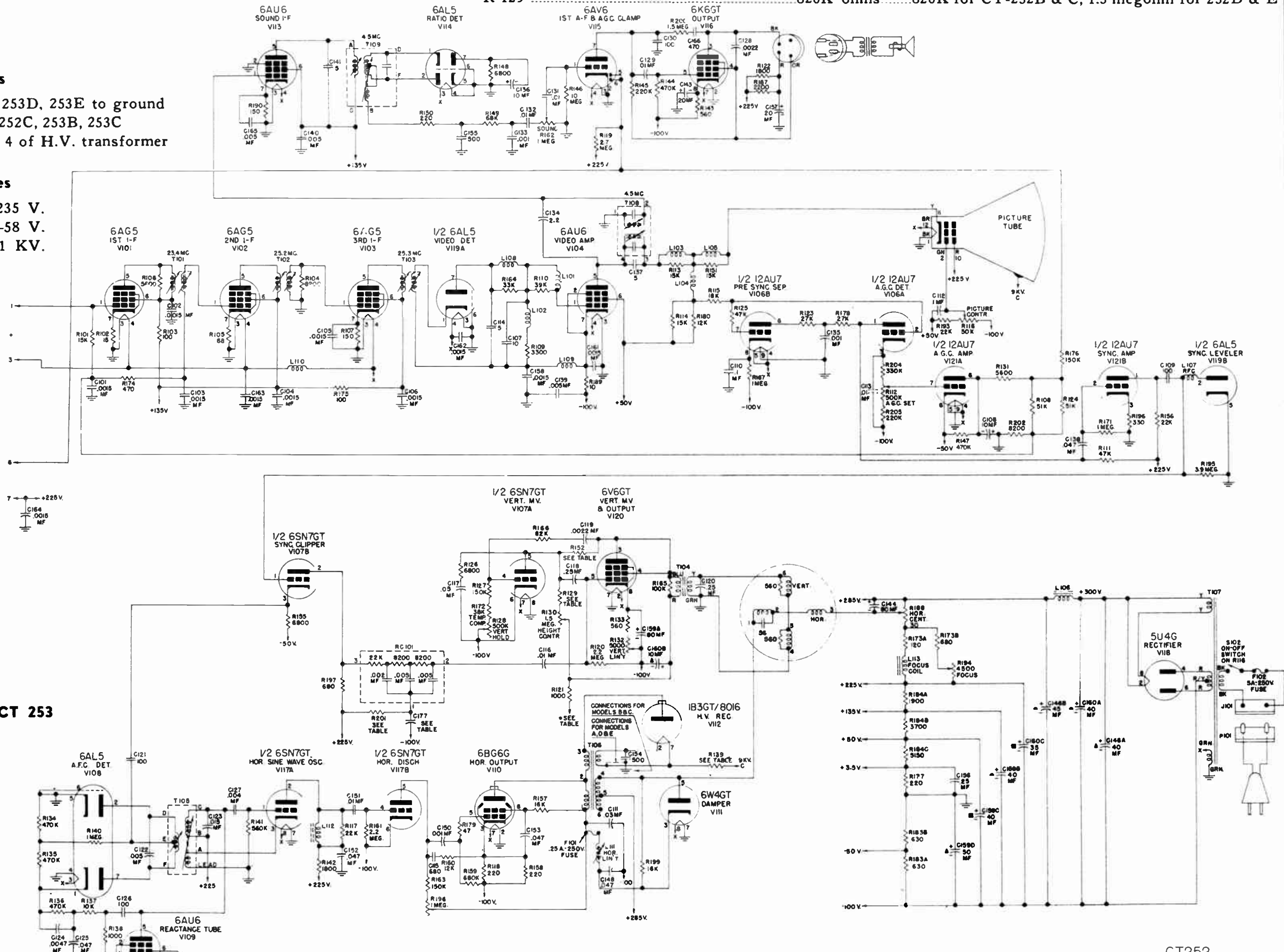
Description	CT-247,248,249	CT-252,253
Horizontal Output Transformer	320042	320048
Picture Tube	12LP4,12KP4	16EP4
Focus Coil	360341-7	360401-4
Deflection Yoke	360330-9	360464-1CT-252B & C, 360462-1CT-252D & E
Ion Trap	360404-2	360404-3
C-117	.01 mfd. ± 20%	.01 mfd. ± 5%
R-126	3900 ohms	6800 ohms
R-133	1800 ohms	560 ohms
C-118	.01 Mfd.	.25 Mfd.
V-120	6K6GT/G	6V6GT/G
R-129	820K ohms	820K for CT-252B & C, 1.5 megohm for 252D & E

Wiring Differences

High Voltage Condenser Return....to ground.. 252D, 253D, 253E to ground
252B, 252C, 253B, 253C
to pin 4 of H.V. transformer

Voltage Differences

V-120 (Vertical Output) plate	215 V.	235 V.
V-120 Cathode	-64 V.	-58 V.
High Voltage	9 KV.	10.1 KV.



MAIN CHASSIS SCHEMATIC DIAGRAM, CT 252, CT 253

C177	OMIT	OMIT	OMIT	OMIT	OMIT	.047MF
R201	OMIT	OMIT	OMIT	OMIT	OMIT	1 MEG.
●	+225V	+285V	+285V	+225V	+225V.	225V.
R152	OMIT	3.9MEG	3.9MEG	3.9MEG	3.9 MEG.	3.9MEG.
R139	470K	1MEG	1.MEG	1MEG	1MEG	1MEG
R129	820K	1.5MEG	1.5MEG	820K	820K	820K
ITEM	CT252A	CT252B	CT252C	CT252D	CT252E	CT252F
	ELECTRICAL VALUES					

This maintenance information covers Magnavox television receiver chassis CT 252 and CT 253, designed for round 16" picture tubes, and is supplementary to Manual 7206 covering the CT 247, CT 248 and CT 249 chassis. All data in 7206 is applicable to the CT 252 and CT 253 chassis excepting as noted below.

CT252
LESS R-F UNIT
595417

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SECTION I

FEATURES & SPECIFICATIONS

Magnavox Series 103 chassis are all direct view units with self contained power supplies. They provide a wide choice of picture tubes, and a selection of types for use in models which feature television only, or which include a radio chassis and record changer. Special features are:

* RF tuner having tuned input; gives improved signal to noise ratio, sensitivity.
* Four stages of video I-F amplification, stagger-tuned for reduced phase distortion, for increased stability and for ease of alignment.
* Four stages of high gain sound I-F amplification, including the 1st video IF which amplifies both the video IF and sound IF.
* Direct coupled video amplifiers, eliminating the necessity for DC re-insertion.
* Separate audio amplifier chassis, which may be omitted when TV chassis is used in combination with a radio, or used in models which feature TV only. In straight TV models, the audio amplifier may be operated alone, for use with a record player, etc.
* Magnalok horizontal AFC system. Frequency control is accomplished by comparing the sine wave oscillator frequency with the sync pulses. The result is applied to a reactance tube, which in turn controls the oscillator frequency.
* Amplified automatic gain control. Affords maximum uniformity of reproduction when switching between stations and reduces fading. Less necessity for adjusting picture and brightness controls.
* De-energizing circuit which eliminates a bright spot on the picture tube when the power is turned off.
* Facilities for connection of an external phonograph on models which feature TV only.

GENERAL DESCRIPTION

300 ohms, antenna input----IMPEDANCE---------------Speaker Coil, 127 Amp. 32 ohms

275 W at 117V, 60 cps. ----POWER----------Audio, 2½ W. undist., 4W. Max.

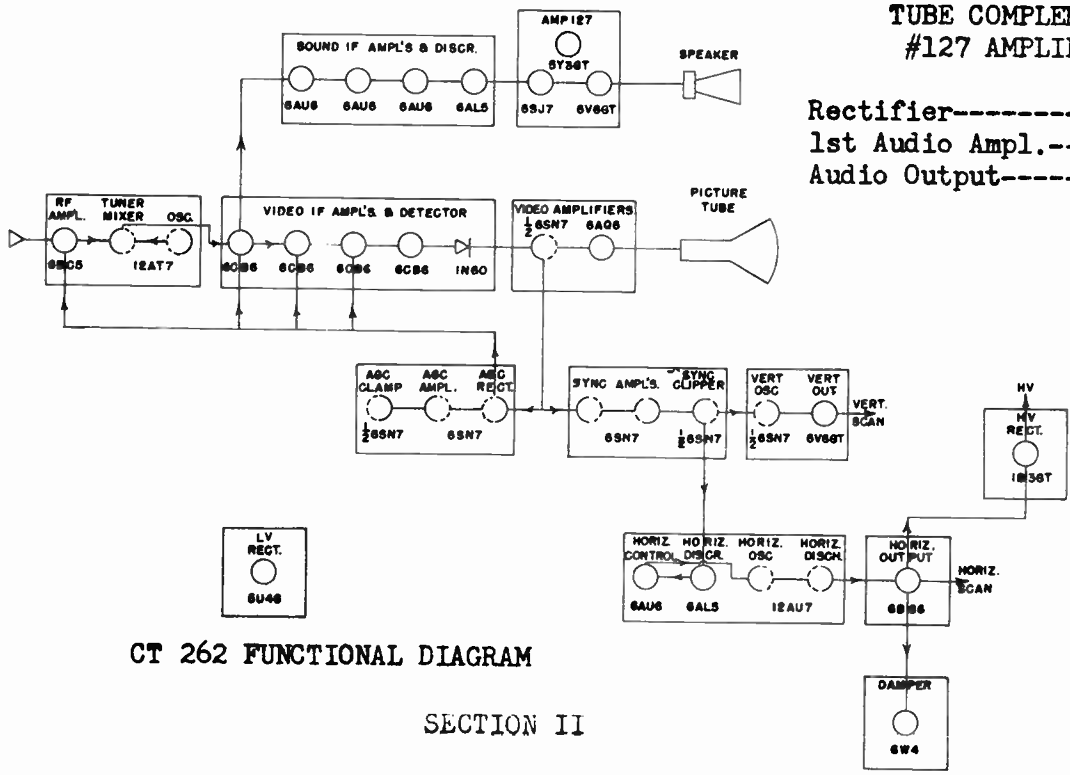
Chassis 15" wide, 17" deep, 11" high-----SIZE---------Five picture tube sizes

TUBE COMPLEMENT
TELEVISION CHASSIS

V1------RF Amplifier---------6BC5	V111----2nd Video Ampl.---------6AQ5
V2------Mixer---------------½12AT7	V112A---1st Sync Ampl.-------½6SN7GT
V2B-----Oscillator----------½12AT7	V112B---2nd Sync Ampl.-------½6SN7GT
V101----1st Sound IF Ampl.---6AU6	V113A---Sync Clipper---------½6SN7GT
V102----2nd Sound IF Ampl.---6AU6	V113B---Vertical Oscillator--½6SN7GT
V103----3rd Sound IF Ampl.---6AU6	V114----Vertical Output---------6V6GT
V104----Discriminator--------6AL5	V115----Horiz. Control----------6AU6
V105A---AGC Amplifier-----½6SN7GT	V116----Horiz. Discriminator-----6AL5
V105B---AGC Rectifier-----½6SN7GT	V117A---Horiz. Oscillator-----½12AU7
V106----1st Video IF Ampl.---6CB6	V117B---Horiz. Discharge------½12AU7
V107----2nd Video IF Ampl.---6CB6	V118----Horiz. Output----------6BG6G
V108----3rd Video IF Ampl.---6CB6	V119----H.V. Rectifier----------1B3GT
V109----4th Video IF Ampl.---6CB6	V120----Damper-------------------6W4GT
V110A---1st Video Ampl.---½6SN7GT	V121----L.V. Rectifier----------5U4G
V110B---AGC Clamp---------½6SN7GT	V122----Picture Tube-----(see chart)

TUBE COMPLEMENT
#127 AMPLIFIER

Rectifier----------5Y3GT
1st Audio Ampl.------6SJ7
Audio Output--------6V6GT



CT 262 FUNCTIONAL DIAGRAM

SECTION II

CHASSIS DIFFERENCES

All Series 103 chassis are identical, with the exception of the picture tube size, shape and mounting; and audio section. A round picture tube is identified in the following chart by a circle, and a rectangular one by a square. The audio amplifier section of the associated radio chassis is used in models which do not use the #127 amplifier.

CHASSIS CT 262, CT 263, CT 264, CT 265, CT 266, CT 267, CT 269, CT 283, CT 284, CT 285, CT 286, CT 287, CT 288, CT 289, CT 290, CT 293, CT 291, CT 294, CT 297

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CHASSIS	PICTURE TUBE	AUDIO AMPLIFIER	PICTURE TUBE CENTER	CHASSIS	PICTURE TUBE	AUDIO AMPLIFIER	PICTURE TUBE CENTER
262	16	#127	$9\frac{1}{2}$"	285	16	None	10 7/8
266	16	None	$9\frac{1}{2}$"	286	17	#127	10 1/8
263	16	#127	$11\frac{1}{4}$"	287	17	None	10 1/8
267	16	None	$11\frac{1}{4}$"	288	17	None	10 7/8
265	19	#127	12"	289	17	#127	$11\frac{1}{4}$
269	19	None	12"	290	17	None	$11\frac{1}{4}$
283	16	#127	$11\frac{1}{4}$"	293	20	#127	$11\frac{1}{4}$
284	16	None	$11\frac{1}{4}$"	294	20	None	$11\frac{1}{4}$

SECTION III

OPERATION AND INSTALLATION

All Series 103 television instruments are shipped completely assembled, with the picture tube installed. All that is necessary is the proper location, connection to a suitable antenna, adjustment of the various controls, and removel of the back cover for adjustment of the ion trap and focus magnet, and orientation of the cabinet antenna if an adjustable one is used. A check should be made that all tubes are properly seated.

The safety glass and mask constitute an assembly, which is easily removed for access to the picture tube by removal of the two screws securing the glass support bracket.

The chassis is held in the cabinet by six mounting screws through the bottom.

1. Plug the receiver power cord into the power outlet.
2. Set the TV-Phono switch on the rear panel of the chassis to TV.
3. Turn on the radio chassis and set the selector switch to TV in combination models. For TV, the AC switch on the PICTURE control. Turn it to the right.
4. Set the STATION SELECTOR to the desired channel number.
5. Adjust the FINE TUNING control for the best volume and quality sound. Select the desired sound volume by turning the VOLUME control.
6. Advance the BRIGHTNESS control until the picture tube screen is only slightly illuminated. If no light appears, it may be limited by incorrect adjustment of the ion trap magnet. Proper procedure for correct adjustment follows:

   Advance the brightness control and adjust the ion trap until light appears on the screen. Then reduce the brilliance to a point near extinction by turning the brightness control counter-clockwise. Then readjust the ion trap until maximum brilliance is obtained. It may be necessary to turn the brightness control still further counter-clockwise.

7. Adjust the PICTURE control for the proper degree of contrast.
8. If the picture "rolls" up or down, turn the VERTICAL control knob to the left so the "roll" is downward, then turn it to the right until the picture stops moving. Switching from channel to channel will not cause the picture to lose sync if the control is properly set.
9. If the picture does not snap into horizontal sync immediately on being switched to a picture channel, but instead it slowly pulls in as indicated by diagonal blanking bars which slowly reduce in frequency until the picture snaps into synchronism, the following adjustments should be made. Remove the Horizontal AFC Discriminator tube (type 6AL5, V116) and adjust the HORIZONTAL SPEED coil until the picture slowly moves back and forth with the blanking bar vertical. Now replace the AFC discriminator tube. The picture should then fall into horizontal sync immediately on switching from channel to channel.
10. If horizontal linearity is unsatisfactory, adjust the linearity coil so that 1/2 to 5/8 inch of the adjusting screw is above the tinerman clip. Adjust the drive control for maximum width and high voltage. Both occur simultaneously. Maximum high voltage can be detected by a minimum height. Adjust the linearity control for best linearity. A slight readjustment of the drive control may be necessary, but always use the maximum possible drive comparable with good linearity.
11. HEIGHT and VERTICAL LINEARITY adjustment. Adjust the height control until the picture just fills the mask vertically. Adjust the vertical linearity control until the test pattern is symmetrical from top to bottom. It is difficult to adjust linearity with a picture on the screen. Adjustment of either control will require readjustment of the other.
12. The FOCUS MAGNET has an adjustable shunt ring that governs the amount of magnetic flux which controls the size of the electron stream. Set the FOCUS CONTROL at about mid-range, and adjust the shunt ring so proper focus occurs at that point. Any subsequent focusing can then be accomplished with the focus control. It will probably be necessary to readjust the ion trap after the shunt ring has been moved.
13. To center the picture: Loosen the screw on each side of the focus coil and move the coil about the neck of the tube until proper centering is accomplished. If this adjustment does not provide proper centering, refer to PICTURE TUBE REPLACEMENT.

USING THE AUDIO AMPLIFIER FOR ANOTHER PURPOSE

1. Set the TV-PHONO switch to PHONO.
2. Plug the reproducer to be used into the PHONO JACK.
3. Turn the PICTURE, OFF-ON control to the right until a snap is heard. This applies power to the audio amplifier, but not to the TV chassis.
4. Put the reproducer into operation.
5. Adjust the VOLUME control for the desired sound volume.

PICTURE TUBE REPLACEMENT, HORIZONTAL CHASSIS

If it becomes necessary to replace the picture tube, it should be done in the following manner.

1. Remove the tube socket from the rear of the picture tube, then remove the ion trap.
2. Remove the safety glass assembly by taking out the screws which hold the glass rail in position.
3. Loosen the nuts that secure the tube strap over the rim of the tube, and remove the strap.

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4. Slip the high voltage anode connector from beneath the insulating ring and lift out the tube.
5. Transfer the insulating ring to the replacement tube.
6. Install the HV connector, replace the support strap, and fasten it down securely with the nuts removed in step 3.
7. Loosen the thumbscrew on top of the deflection yoke, so the yoke moves freely. Loosen the two hex-head screws on each side of the deflection yoke mounting bracket, and push the top section forward until the rubber bumper fits against the bell of the tube, all the way around. Then tighten the screws. If the screw heads on the left side are difficult to reach, use a right-angle spintite, an end wrench, or remove the HV compartment cover. Then press the deflection yoke forward as far as possible, and tighten the thumbscrew.
8. Tighten the three focus coil plate adjustment screws until the plate is near the deflection yoke, perpendicular to the neck of the tube.
9. Loosen the two screws which secure the focus coil, and move it so the neck of the tube is properly centered in it. Then tighten the screws and adjust the ion trap.
10. If centering is not satisfactory, move the focus coil around the neck of the tube until the picture is properly centered in the mask. It may be necessary to readjust the ion trap each time the focus coil is moved.

NOTICE: in the event that proper centering cannot be accomplished, remove the ion trap, turn the front edge to the rear, install and readjust it. Then proceed with the centering adjustment. If proper centering still cannot be accomplished, remove the focus coil and reverse the right and left sides on the chassis.

PICTURE TUBE REPLACEMENT, VERTICAL CHASSIS

In models wherein the chassis is mounted in a vertical position, the following procedure is recommended.

1. Remove the safety glass and mask assembly by taking out the screws which hold the glass rail in place.
2. Lay the cabinet on its side on a clean piece of felt or other soft material, with the chassis side down.
3. Remove the two metal wedges that brace the rim of the picture tube top and side. Two wood screws hold each in place.
4. Two 1/4-20 screws secure each side of the chassis to the mounting rails of the cabinet. Remove these screws, all connections to the amplifier, and pull the chassis out of the cabinet. Then proceed through steps 1 to 10 in the preceeding section. Then replace the chassis.

CABINET ANTENNA ADJUSTMENT

Two types of cabinet antennae may be used. One is fixed and the other may be adjusted.

The first consists of a power line antenna and one mounted in the cabinet top. They may be used separately or together, depending on local conditions. Each should be tried on all available channels, and that antenna or combination thereof giving the best results would be selected.

1. Connect the power line antenna lead (grey wire extending from the rear of the chassis) to first one and then the other terminal of the antenna terminal board, tune for all local television stations and note which gives the better results.
2. Remove the power line antenna lead from the terminal board, connect the cabinet antenna leads first one way and then reversed, tune for all available stations, and note the results.
3. Leave the cabinet antenna leads connected, then try the power line antenna to first one side of the terminal board and then the other. Reverse the cabinet antenna leads and repeat the two power line connections. Tune for all available stations in each condition (4) and note the results.
4. Select the one connection as described in 1, 2 or 3 that gives the best overall performance for all available stations.
5. Disconnect the power line antenna and cabinet antenna when an outside antenna is used.

The latter antenna can be rotated and should be set for best all around performance. The switch provides a shift in the main pickup lobe of as much as 30° on some channels and is the only antenna adjustment to be used by the customer.

1. Tune in a station and rotate the antenna through 360° for maximum signal and minimum ghosts.
2. Snap the antenna switch and re-orient the antenna through 360° for best picture. Compare the results of each of these tests and make a mental note of antenna position and switch positions for best performance.
3. Repeat these tests for each of the other channels, making note of the antenna and switch positions for best results on each channel.
4. The final position for the antenna shall be that compromise which receives the majority of stations with best picture, regardless of switch position.

SECTION IV

CIRCUIT DESCRIPTION

The Magnavox 700351 tuner consists basically of three tubes, four sets of coils, and a four section wafer switch having twelve active and six inactive positions.

The antenna input transformer T1 is provided to match a balanced 300 ohm antenna to the tuner. The ANTENNA COILS A-13 to A-2 are in the grid circuit of the RF Amplifier stage, and are grouped around the rear wafer of the unit. The RF Amplifier PLATE coils P-13 to P-2 are mounted on the second wafer from the rear. The converter GRID coils G-13 to G-2 are on the third wafer from the rear. The OSCILLATOR coils O-13 to O-2 are on the front wafer. In each, coil 13 is tuned for channel 13, coils 13 plus 12 are for channel 12, coils 13 plus 12 and 11 are for channel 11, etc. The following diagram outlines its design and operation.

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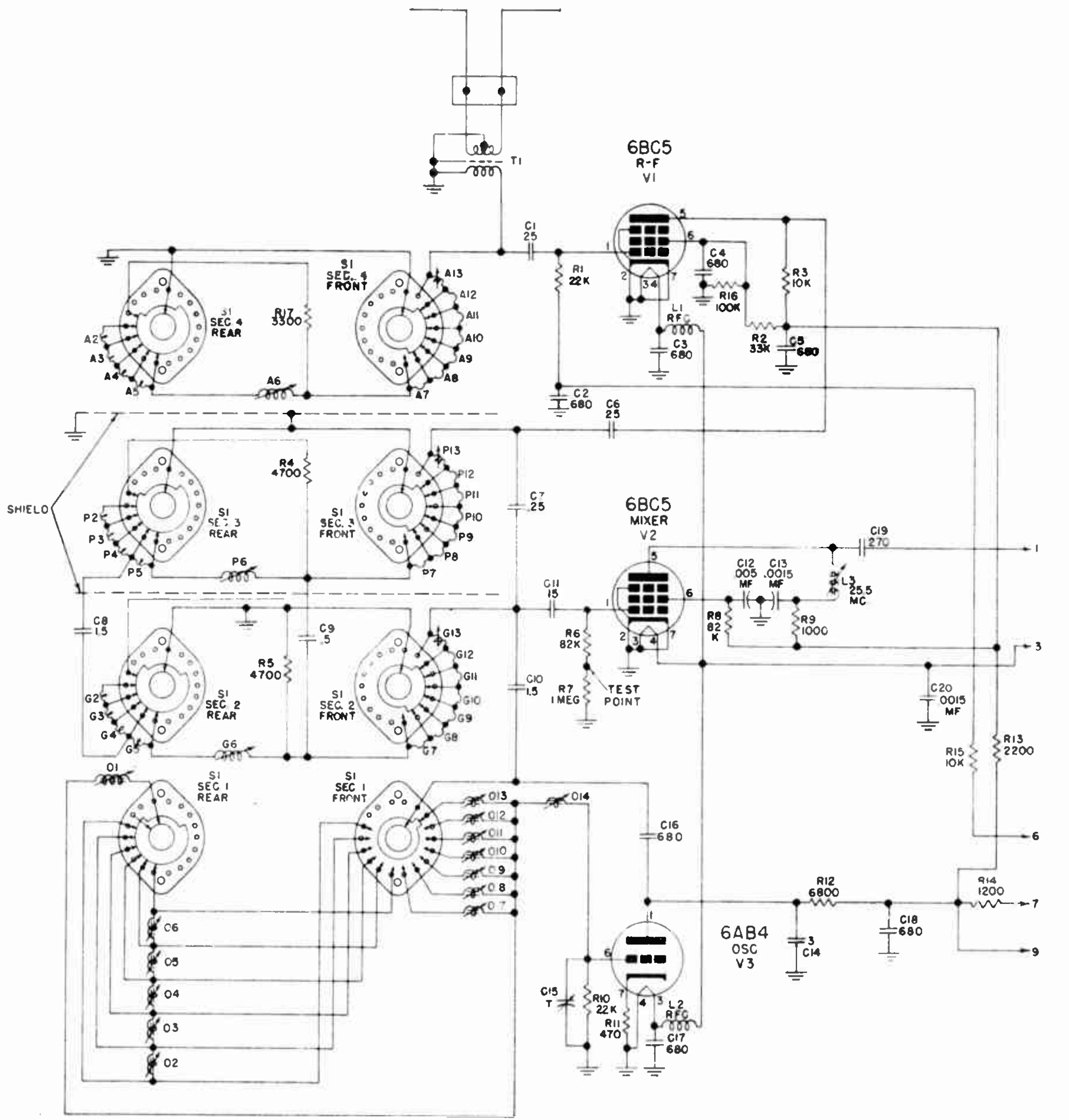


Antenna coils A-13 to A-2 are tuned to their respective channels, a band pass sufficiently wide to accept all the information therein, and with sides of the pattern sufficiently steep so as to reduce signals on adjacent channels. The same applies to P-13 to P-2. Under weak signal conditions, the RF amplifier stage is capable of a gain of 15 times its input. In the presence of a strong signal, the automatic gain control bias on the grid limits its output to a fraction of its input.

The oscillator is tuned to a frequency 25.75 mc. higher than the video carrier, and when hetrodyned with the carriers in the converter, produces a modulated video IF signal of 25.75 mc. and a modulated sound IF signal of 21.25 mc. These are applied to the first IF amplifier through C-19. L-3 in the converter plate circuit is the converter plate IF transformer.

The fine tuning control, a variable dielectric capacitor, shifts the oscillator frequency about 0.5 mc. on channel 2, and relatively more on the other channels up to 13, where it is about 2.0 mc. Individual oscillator adjustments for each channel, accessible from the front of the chassis by removal of the channel scale and fine tuning knob, are provided to compensate for any long time drift or for different tube capacities when the oscillator tube is replaced, although it is best to select a tube that provided tuning in the correct position of the fine tuning knob.

The oscillator signal is applied to the converter grid through C10. The amplified RF signal is applied to the converter grid coils through C7, C8 and C9 depending on the position of the channel selector switch. These capacitors are used to provide adequate bandpass coupling. The converter stage is capable of a gain of about 5 times its input.

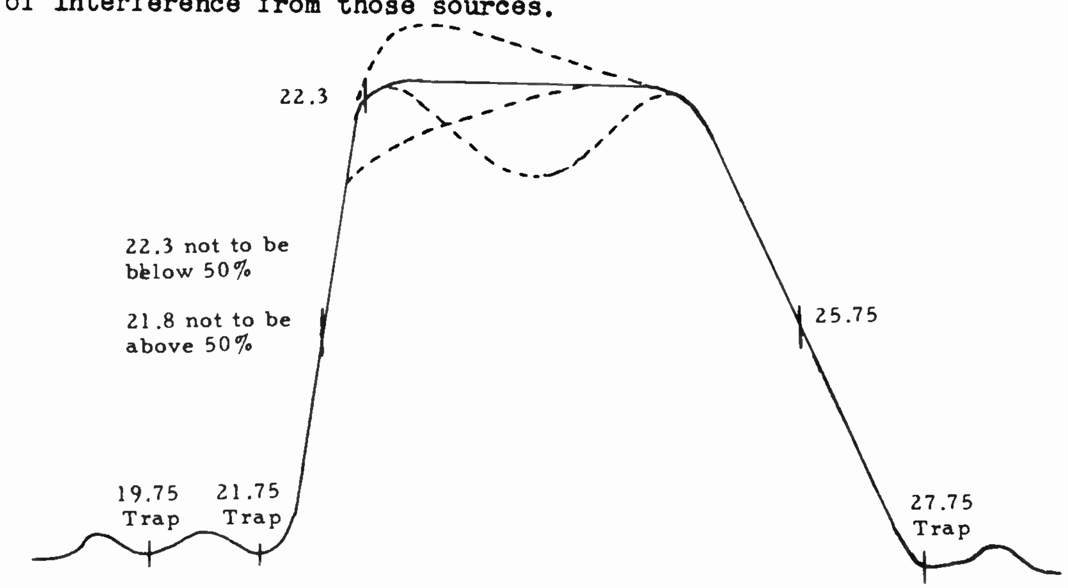
A test point is provided on the top of the tuner near the middle tube for connecting the oscilloscope used in alignment of the antenna, RF and converter coils. A complete schematic of the 700351 RF Unit, alignment procedure and service instructions are included in a later chapter.

The tuner is capable of a gain of about 75 times from the antenna to the first IF amplifier grid.

The video IF amplifier strip is of the latest design, and incorporates adequate gain and high fidelity. It consists of four 6CB6 tubes V106, V107, V108 and V109, coupled by IF transformers T104, T106, T108 and T109. The primary and secondary windings of the transformers are bifilar wound, and coupling between stages is by the capacitive and inductive coupling between windings. Each transformer is tuned by an adjustable iron core.

The IF passband is 3.75 mc. wide, with a response of 50% at 22.0 mc.

The converter coil and four transformers are stagger tuned. A 19.75 mc. adjacent channel picture trap is included in the first stage, a 27.25 mc. adjacent channel sound trap is included in the second stage and a 21.25 mc. sound trap is included in the third stage, to insure a minimum of interference from those sources.



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The first stage accomodates both the sound and video IF signals and the sound portion is then removed by T105.

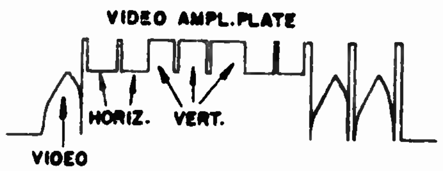
AGC bias is applied to V106, V107 and V108 and controls their gain inversely proportional to the applied signal strength. V109 operates at fixed bias. The output of the IF system is essentially constant despite variations of the input signal level.

Complete alignment instructions are included in a later chapter.

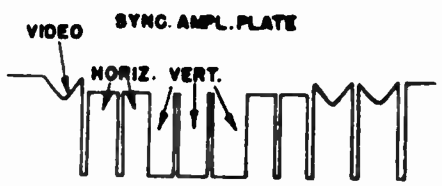
The 1N60 crystal detector conducts on negative cycles, and current flows through its load resistor. This develops a voltage which varies with modulation of the IF carrier. The high frequency IF component is by-passed to ground through a 10 mmf capacitor and C-137, .0015 mmf.

V-110A, the first video amplifier is conventional and has a gain of about 6.5 times. It is direct coupled to the next stage, and presents a posi-

The vertical and horizontal sync pulses appear on the video carrier, through the IF amplifiers, detector and video amplifiers, between scanning lines of video modulation. Their appearance at the picture tube grid is always during retrace time, and cuts the beam to blanking level at those intervals.



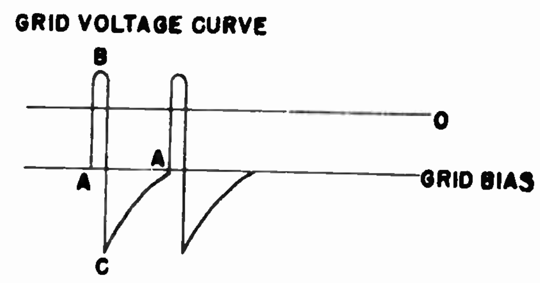
A portion of the positive going signal is removed from the plate of the first video amplifier, and applied to the grid of the first sync amplifier V-112A. This tube is biased so the video portion of the signal falls below the knee of its characteristic curve, and receives but little amplification, and the sync pulses appear on the linear portion of the curve, and are greatly accentuated.



The negative signal that is fed to the second sync amplifier grid V-112B is again amplified. This tube is also biased so that any noise on the crest of the pulses is removed, and any noise between the sync pulses is reduced to their amplitude.

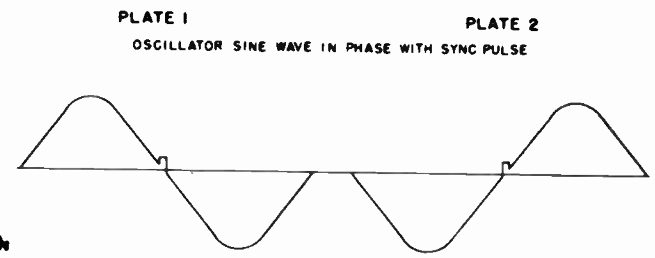
The signal is in a positive direction at the sync clipper grid V-113A, and in that stage the lower half of the signal is removed, leaving only clean, square sync pulses.

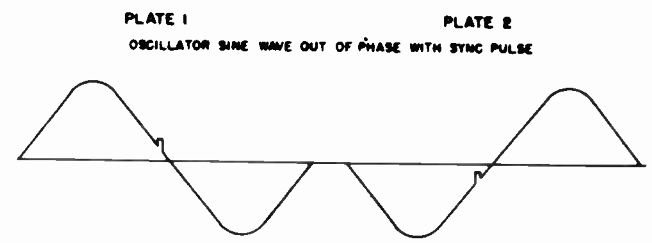
These are applied to the vertical oscillator stage V-113B, through RC-101, a filter network which passes only the low frequency vertical pulses. The vertical blocking oscillator and discharge stage, V-113B, is 1/2 of a 6SN7. During non-conduction, the grid voltage is negative with respect to the cathode. The plate draws current during discharge at a rate determined by the setting of the height control R-239. Due to the coupling of the oscillator transformer, there is a corresponding voltage rise on the grid, A to B on the following curve. When the grid becomes more positive than the cathode, it draws grid current. This quickly charges C-205, which drives the grid negative and cuts off the plate current, see B to C. Then the charge on C-205 is slowly discharged through the verticalspeed control, R-218 and R-216, which allows the grid voltage to slowly rise to its normal bias, see C to A. Then plate current begins to flow again and the cycle is repeated at a frequency depending on the rate of C-205 discharge, which is controlled by the setting of R-218.



The frequency is adjusted at slightly slower than 60 cps. During the charging period of C-205 (C to A), the vertical sync pulse is applied just before it would "trip" in its free-running cycle. The magnitude of the sync pulse is sufficient to drove the tube into conduction, and therefore controls the frequency of the blocking oscillation.

The sync clipper output signal is also used to synchronize horizontal scanning. When free running, the Horizontal Oscillator V-117A operates at a frequency approximately correct for horizontal scanning. The resultand sine wave output is applied through T-112 to the plates of the Horizontal Discriminator V-116 180° out of phase. The horizontal sync pulses are applied to the center tap of the plate winding of the transformer, and appears at the plates of the Discriminator in phase. When the oscillator operates in synchronism with the transmitter, the pulses appear on the sine waves as one plate goes through zero voltage in a negative direction and as the other plate goes through zero voltage in a positive direction.





Because the pulses appear when both plates are at zero voltage, there is no change in the operation of the circuit. However if the oscillator changes in frequency, the sync pulses at the detector plates do not appear when the oscillator voltage is zero, but at a point on each sine wave either before or after it goes through zero.

As the sine wave on one plate is of opposite polarity from the other, and as the sync pulse on one plate is of the same polarity as the other, the sync pulse will add to the sine wave that is positive, and subtract from the one that is negative. This condition will produce a voltage unbalance in the cathode circuit of the Discriminator.

This voltage difference, applied to the grid of V-115, the 6AU6 Horizontal Control stage, controls the variable reactance in shunt with the horizontal oscillator tank circuit, and causes the oscillator to change frequency in such a direction so as to come back into exact synchronism with the sync pulses.

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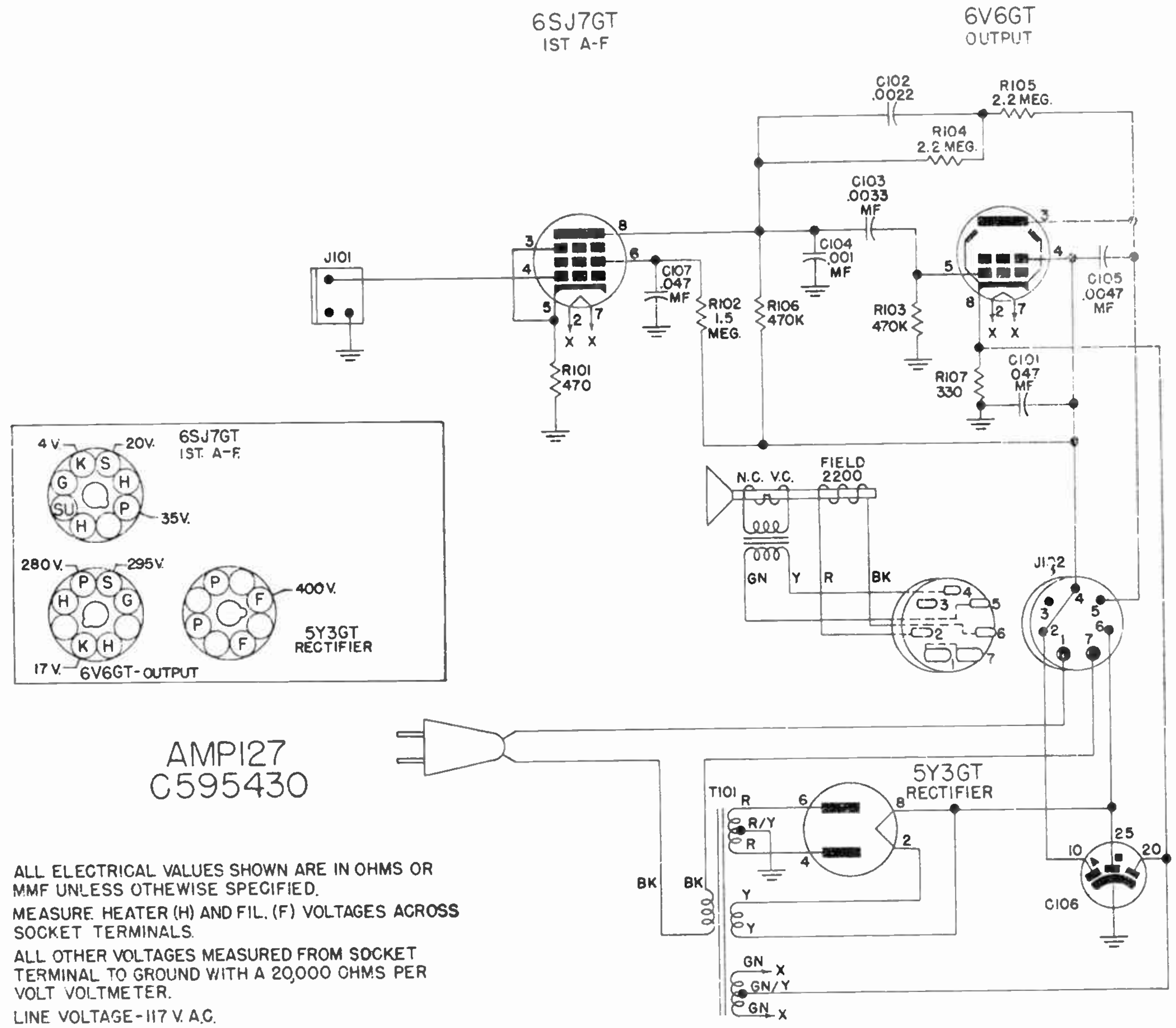


SECTION VI
ALIGNMENT

In aligning the IF amplifiers, it must be remembered that feedback between output and input circuits lead to regeneration and, if feedback be appreciable, to oscillation. It may be determined whether the amplifier is oscillating as follows:
Increasing signal generator output by a factor of (for example) two should result in a rise in output voltage in approximately the same degree. If, instead a decrease in output with increased input is noted, and if there be a steady output voltage as indicated on the VTVM even without input signal, the circuit is oscillating.

Regeneration insufficient to cause oscillation gives rise to distortion of the reproduced response curve, and proper alignment is not possible in such event.
While the distortion due to overload is not as important for the trap adjustments, it is very important for the tuning adjustments of the staggered toned IF system. The trap adjustments would normally need the maximum signal available since the trap circuit so greatly attenuates the signal there is very little danger of overload.

Regeneration may be caused by poor bonding between the chassis of the receiver and of test equipment being used. Connection should be made by short, heavy leads.
Before attempting to align the chassis it is advisable to measure voltages at the power supply bleeder. These voltages are nominally +280, +270, +200, +135, +90, +3.5, -50, and -100 but are subject to a wide variation, when the various circuits are not properly adjusted.

PICTURE IF ALIGNMENT PROCEDURE

For proper alignment, it is recommended that the following test equipment be available

Signal Generator covering the following frequency ranges:

4.5 mc.
19.75 to 27.25 mc.

Sweep Generator meeting the following requirements:

a. Frequency Range 19 - 28 mc.
40 - 90 mc.
170 - 225 mc.

b. Sweep Width, 0 - 12 mc.

c. Output, at least .1 volt maximum.

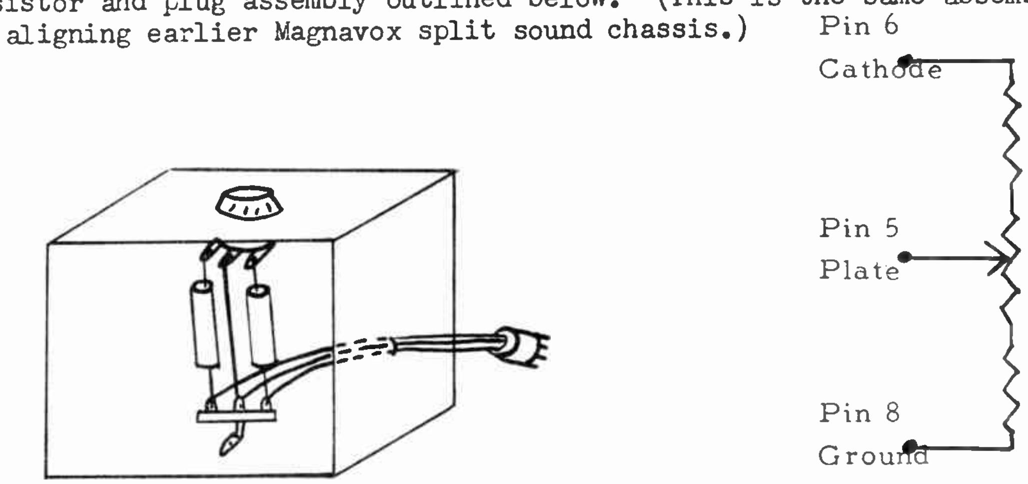
Electronic Voltmenter with HV probe.

Cathode ray oscilloscope-wide band vertical deflection.

Variable resistor - cable and plug assembly.

Crystal detector.

1. Adjust the bias on the tuner AGC lead to - volts by use of the variable resistor and plug assembly outlined below. (This is the same assembly used in aligning earlier Magnavox split sound chassis.)



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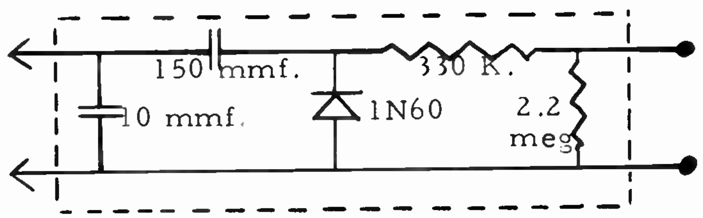
2. Connect the IF signal generator to the converter grid wafer (through the hole provided in the bottom of the tuner shield) and chassis ground. Short the primary of the first IF transformer, T101, to ground.



Crystal Detector

3. Connect the oscilloscope across the first video plate through an isolating resistor of 10K. Adjust the signal generator to 19.75 megacycles and adjust the trap coil L101 for minimum response. The purpose of the oscilloscope is to observe demodulated signal and to thus make sure that no overload condition develops because of too much signal input.

4. Adjust the signal generator to 21.25 megacycles. Adjust the trap L103 and then the sound pick-off coil T105 for minimum response.

5. Adjust the signal generator to 27.25 megacycles and adjust the trap L102 for minimum response.

6. Adjust the signal generator to 21.8 and adjust the first I.F. transformer T104 for maximum output. Again, caution should be observed that the signal does not overload the receiver.

7. Adjust the signal generator to 23.8 megacycles. Adjust transformer T106 for maximum response.

8. Adjust the signal generator to 22.3 megacycles. Adjust transformer T108 for maximum response.

9. Adjust the signal generator to 25.2 megacycles. Adjust transformer T109 for maximum response.

10. Adjust the signal generator to 21.25 megacycles and readjust the trap L103 and the sound pick-off coil T105 for maximum response.

SOUND IF ALIGNMENT PROCEDURE

1. Remove the short from T101 to ground. Adjust the bias on the tuner AGC lead to -2 volts by use of the variable resistor and plug assembly described in the Picture IF Alignment Procedure. Connect the signal generator to Pin 1 of V101 (grid of the 6AU6 1st sound IF), and ground. Connect oscilloscope to terminal 1 of T102 through a 470K resistor. Align both slugs of T1 and T2 for maximum output at 21.25 megacycles. Connect sweep generator to the converter grid wafer (through the hole provided in the bottom of the tuner shield) and chassis ground. Set the Channel Selector to channel 2, and check for symmetrical response about 21.25 megacycles.

2. Connect oscilloscope to C126. Align bottom slug of discriminator transformer for minimum output, at 21.25 megacycles. Connect sweep generator to the converter grid wafer and align top slug of discriminator transformer for symmetrical output. The alignment should produce, when limiting, a symmetrical discriminator characteristic with a peak separation of 300 ± 50 KC. The average slope sensitivity is .08 volts per KC.

OVERALL RESPONSE OF THE RECEIVER

A. Check the overall RF alignment with the sweep generator connected to the antenna terminals through a suitable balancing network. The picture intermediate-frequencies can now be retouched if necessary to obtain the standard overall frequency response curves with the picture carrier at approximately 50% of maximum response. In making the final touch-up adjustments, it should be remembered that the converter stage and the first picture intermediate stage use relatively high Q circuits and tend to control the response at the high and low frequency ends of the pass band. The third and fourth picture intermediate frequencies are relatively low Q circuits and they control the response over the center of the passband. The second intermediate frequency circuit controls the tilt. The limits shown represent the position of the markers which determine acceptable selectivity. All twelve channels should be checked for alignment.

1. After acceptable curves are obtained, each channel is to be checked for proper tuning. The null should occur more than 30 degrees rotation from either end of the tuning vernier.

2. Average Sensitivity Characteristics.

Input signal required at antenna terminals to produce one volt DC rise across Pins 1 & 3 of V110A first video amp.

Channel	Midband Input Microvolts
2	32
6	30
7	22
13	26

Input required at sound carrier frequency for one volt above contact potential across R107 (limiter grid return) shall be 30 microvolts.

4.5 Mc Trap Alignment

A 4.5 Mc Signal modulated approximately 400 cycles, 50% should be connected to the grid of the first video amplifier. Turn CONTRAST control maximum counter-clockwise. Connect a crystal detector to the picture tube grid lead. Observe the signal at the crystal detector load resistor on an oscilloscope and adjust the trap for minimum output at the scope.

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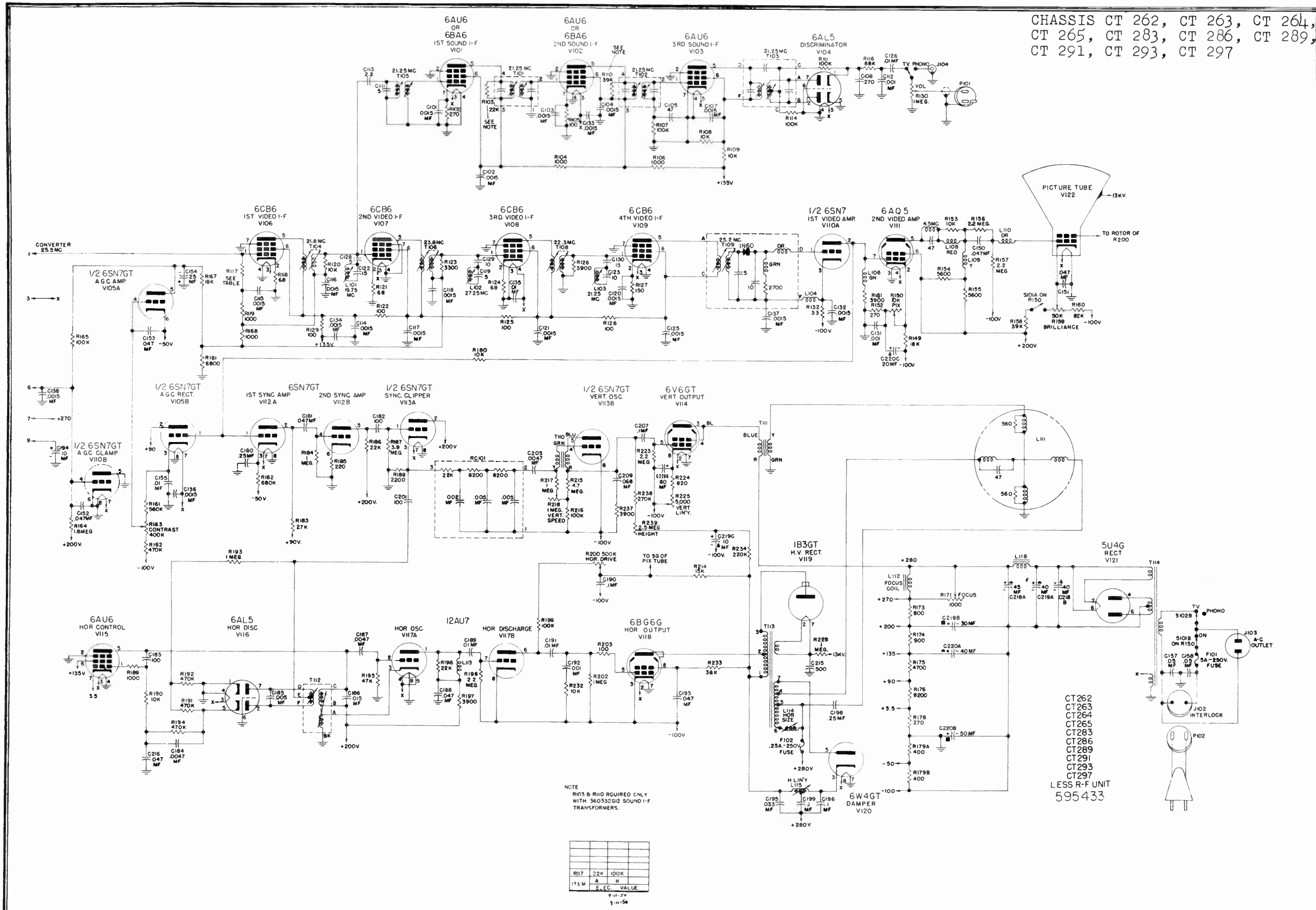

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SERIES 103 VOLTAGE CHART

Measurements made with receiver operating at 117 volts 60 cycles AC, with a strong signal input. Measurements made with Voltohmist type VTVM, between indicated terminal and chassis ground unless otherwise noted.

TUBE NO.	TUBE TYPE	FUNCTION	PLATE PIN NO.	PLATE VOLTS	SCREEN PIN NO.	SCREEN VOLTS	CATHODE PIN NO.	CATHODE VOLTS	GRID PIN NO.	GRID VOLTS
V-101	6AU6	1st Sound IF	5	121	6	121	7	1.5	1	0
V-102	6AU6	2nd Sound IF	5	120	6	120	7	1.6	1	0
V-103	6AU6	3rd Sound IF	5	61	6	61	7	0	1	-5.8
V-104	6AL5	Discriminator	7 2	-4.5 -3.5			1 5	1.42 0		
V-105A	½6SN7GT	AGC Ampl.	5	-18			6	-38	4	-39
V-105B	½6SN7GT	AGC Rect.	2	92			3	4.7	1	-3.7
V-106	6CB6	1st Video IF	5	139	6	139	2	.22	1	-4.8
V-107	6CB6	2nd Video IF	5	139	6	139	2	.22	1	-4.2
V-108	6CB6	3rd Video IF	5	139	6	139	2	.36	1	-4.2
V-109	6CB6	4th Video IF	5	139	6	139	2	2.3	1	0
V110A	½6SN7GT	1st Video Ampl.	2	-16			3	-80	1	-88
V-110B	½6SN7GT	AGC Clamp	5	0			6	0	4	-2.2
V-111	6AQ5	2nd Video Ampl.	5	170	6	200	2	2.7	7	-16
V-112A	½6SN7GT	1st sync. Ampl.	2	99			3	4.8	1	-3.7
V-112B	½6SN7GT	2nd Sync. Ampl.	5	96			6	1.12	4	-.9
V-113A	½6SN7GT	Sync.Clipper	2	+200			3	8.3	1	-17
V-113B	½6SN7GT	Vertical Osc.	5	+138			6	-80	4	-138
V-114	6V6GT	Vertical Output	3	+280	4	280	8	-47	5	-65
V-115	6AU6	Horiz.Control	5	+200	6	150	7	+3.6	1	.24
V-116	6AL5	Horiz.Discr.	1 5	0 .1			7 2	-27 -28		
V-117A	½12AU7	Horiz. Osc.	1	170			3	.1	2	-8.6
V-117B	½12AU7	Horiz. Disch.	6	142			8	-80	7	-110
V-118	6BG6G	Horiz. Output	Cap	Do not meas.	8	205	3	-80	5	-110
V-120	6W4GT	Damper	5	Do not meas.			3	.450		
V-121	5U4G	LV Rectifier	4/6	*365			8/2	'300		
V-122	(See Chart	Picture Tube		"13KV	10	400	11	70-120	2	-5 to +50

*AC voltage, measured from -100 volt tap.
'DC voltage, measured from -100 volt tap.
"Measured with electrostatic voltmeter.
Do not measure Horizontal Output plate or Damper plate with VTVM. Pulses cause grid rectification in meter so reading is meaningless, and HV pulses may damage meter.

REF. NO.	PART NO.	DESCRIPTION
T101	360332-12	Sound IF Transformer
T102	360332-12	Sound IF Transformer
T103	360332-13	Sound Discriminator Transformer
T104	360461-2	1st Video IF Transformer
T105	360461-2	2nd Video IF Transformer
T106	360461-2	3rd Video IF Transformer
T108	360461-2	4th Video IF Transformer
T109	360476-1	Video Detector Transformer
T110	320030-6	Vertical Blocking Oscillator Trans.
T111	320056-3B	Vertical Output Transformer
T112	360435-1	Magnalok Transformer
T113	320055-1	H. V. Transformer
T114	300060-1	Power Transformer
L101	360484-1	Video I.F. Trap
L102	360484-1	Video I.F. Trap
L103	360484-1	Video I.F. Trap
L104	360372-4	R. F. Choke
L106	360443-9	Peaking Coil, green
L107	360483-1	4.5 Mc. Trap
L108	360443-7	Peaking Coil, red
L109	360443-12	Peaking Coil, yellow
L110	360443-11	Peaking Coil, orange
L111	360462-5	Deflection Yoke Assembly
L112	360477-2	Focus Coil
L113	360451-1	Peaking Coil
L114	360357-1	Horiz. Size Coil
L115	360358-1	Horiz. Linearity Coil
L116	320041-2A	Filter Reactor
	180475-1	Fuse, 1/4 Amp.
	180475-2	Fuse, 5 Amp.
R101	230104-94	Res. Carb. 470K, 1/2W
R102	230104-50	Res, Carb, 100 Ohm, 1/2W
R103	230104-81	Res, Carb, 39K Ohm, 1/2W
R104	230104-62	Res, Carb, 1000 Ohm, 1/2W
R105	230104-50	Res, Carb, 100 Ohm, 1/2W
R106	230104-62	Res, Carb, 1000 Ohm, 1/2W
R107	230104-78	Res, Carb, 22K Ohm, 1/2W
R108	230105-74	Res, Carb, 10K, 1W
R109	230105-74	Res, Carb, 10K, 1W
R110	230104-81	Res, Carb, 39K Ohm, 1/2W
R111	230104-86	Res, Carb, 100K Ohm, 1/2W
R114	230104-86	Res, Carb, 100K Ohm, 1/2W
R116	230104-84	Res, Carb, 68K Ohm, 1/2W
R117	230104-76	Res, Carb, 15K Ohm, 1/2W

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REF. NO.	PART NO.	DESCRIPTION
R118	230104-48	Res, Carb. 68 Ohm, 1/2W
R119	230104-62	Res, Carb. 1000 Ohm, 1/2W
R120	230104-74	Res, Carb, 10K Ohm, 1/2W
R121	230104-48	Res, Carb, 68 Ohm, 1/2W
R122	230104-50	Res, Carb, 100 Ohm, 1/2W
R123	230104-68	Res, Carb, 3300 Ohm, 1/2W
R124	230104-48	Res, Carb, 68 Ohm, 1/2W
R125	230104-50	Res, Carb, 100 Ohm, 1/2W
R126	230104-69	Res, Carb, 3900 Ohm, 1/2W
R127	230104-52	Res, Carb, 150 Ohm, 1/2W
R128	230104-50	Res, Carb, 100 Ohm, 1/2W
R129	230104-50	Res, Carb, 100 Ohm, 1/2W
R130	220076-19	Control, Volume
R132	230104-44	Res, Carb, 33 Ohm, 1/2W
R149	230106-77	Res, Carb, 18K Ohm, 2W
R150	220076-43	Control, Picture
R151	230104-69	Res, Carb, 3900 Ohm, 1/2W
R152	230104-55	Res, Carb, 270 Ohm, 1/2W
R153	230104-74	Res, Carb, 10K Ohm, 1/2W
R154	230105-71	Res, Carb, 5600 Ohm, 1W
R155	230105-71	Res, Carb, 5600 Ohm, 1W
R156	230104-102	Res, Carb, 2.2 Meg, 1/2W
R158	230104-83	Res, Carb, 56K Ohm, 1/2W
R159	220076-44	Control, Brightness
R160	230105-85	Res, Carb, 100K, 1/2W
R161	230104-95	Res, Carb, 560K, 1/2W
R162	230104-94	Res, Carb, 470K, 1/2W
R163	220076-39	Control, AGC Set
R164	230104-101	Res, Carb, 1.8 Meg. 1/2W
R165	230104-86	Res, Carb, 100K ohm, 1/2W
R167	230104-77	Res, Carb, 18K Ohm, 1/2W
R168	230104-62	Res, Carb, 1000 Ohm, 1/2W
R171	220076-38	Control, Focus
R173	240035-8	Strip Resistor
R174	240035-13	Strip Resistor
R175	230105-70	Res, Carb, 4700 Ohm, 1W
R176	230166-73	Res, Carb, 3200 Ohm, 2W
R178	230104-54	Res, Carb, 220 Ohm, 1/2W
R179	240069-1	Strip Resistor
R180	230104-74	Res, Carb, 10K, 1/2W
R181	230104-72	Res, Carb, 6800 Ohm, 1/2W
R182	230104-96	Res, Carb, 680K, 1/2W
R184	230104-98	Res, Carb, 1 Meg, 1/2W
R185	230104-54	Res, Carb, 220 Ohm, 1/2W
R186	230105-78	Res, Carb, 22K Ohm, 1W
R187	230104-105	Res, Carb, 3.9 Meg. 1/2W
R188	230104-66	Res, Carb, 2200 Ohm, 1/2W
R189	230104-62	Res, Carb, 1000 Ohm, 1/2W

REF. NO.	PART NO.	DESCRIPTION
R190	230104-74	Res, Carb, 10K, 1/2W
R191	230104-94	Res, Carb, 470K, 1/2W
R192	230104-94	Res, Carb, 470K, 1/2W
R193	230104-98	Res, Carb, 1 Meg, 1/2W
R194	230104-94	Res, Carb, 470K, 1/2W
R195	230104-82	Res, Carb, 47K ohm, 1/2W
R196	230104-78	Res, Carb, 22K Ohm, 1/2W
R197	230105-69	Res, Carb, 3900 Ohm, 1W
R198	230104-102	Res, Carb, 2.2 Meg. 1/2W
R199	230104-86	Res, Carb, 100K Ohm, 1/2W
R200	220076-35	Control, Horiz. Disc
R202	230104-98	Res, Carb, 1 Meg, 1/2W
R203	230104-50	Res, Carb, 100 Ohm, 1/2W
R214	230104-76	Res, Carb, 15K ohm, 1/2W
R215	230104-106	Res, Carb, 4.7 Meg, 1/2W
R217	230104-98	Res, Carb, 1 Meg, 1/2W
R216	230104-86	Res, Carb, 100K Ohm, 1/2W
R218	220076-12	Control, Vertical Speed
R223	230104-102	Res, Carb, 2.2 Meg.
R224	230105-61	Res, Carb, 820 Ohm, 1W
R225	220076-20	Control, Vertical Linearity
R228	230105-98	Res, Carb, 1 Meg, 1W
R232	230104-74	Res, Carb, 10K Ohm, 1/2W
R233	240057-3	Res, Carb, 28.3 Ohm, 5%, 5W
R234	230104-90	Res, Carb, 220K Ohm, 1/2W
R237	230104-69	Res, Carb, 3900 Ohm, 1/2W
R238	230104-91	Res, Carb, 270K Ohm, 1/2W
R239	220076-5	Control Vertical
RC101	250186-1	Printed Circuit
C104	250175-3	Cap. ceramic, 1500 mmf. 450 V
C105	250207-11	Cap. ceramic, 47 mmf. 500 V
C107	250175-3	Cap. ceramic, 1500 mmf. 450 V
C108	250207-20	Cap. ceramic, 270 mmf. 500 V
C111	250206-1	Cap. ceramic 5 mmf. 500 V
C112	250201-1	Cap. paper .001 mfg. 600 V
C113	250164-13	Cap. ceramic, 2.2 mmf. 500 V
C114	250175-3	Cap. ceramic, 1500 mmf. 450 V
C115	250175-3	Cap. ceramic, 1500 mmf. 450 V
C116	250175-3	Cap. ceramic, 1500 mmf. 450 V
C117	250175-3	Cap. ceramic, 1500 mmf.. 450 V
C118	250175-3	Cap. ceramic, 1500 mmf. 450 V
C119	250206-1	Cap. ceramic, 5 mmf. 500 V
C120	250175-3	Cap. ceramic, 1500 mmf. 450 V
C121	250175-3	Cap. ceramic, 1500 mmf. 450 V
C122	250206-5	Cap. ceramic, 15 mmf. 500 V
C123	250206-3	Cap. ceramic, 10 mmf. 500 V
C125	250175-3	Cap. ceramic, 1500 mmf. 450 V

REF. NO.	PART NO.	DESCRIPTION
C126	250175-2	Cap. ceramic, .01 mfd. 450 V
C128	250206-1	Cap. ceramic, 5 mmf. 500 V
C129	250206-3	Cap. ceramic, 10 mmf. 500 V
C130	250206-5	Cap. ceramic, 15 mmf. 500 V
C131	250201-1	Cap. paper, .001 mfd. 600 V
C132	250175-3	Cap. ceramic, 1500 mmf. 450 V
C133	250175-3	Cap. ceramic, 1500 mmf. 450 V
C134	250175-3	Cap. ceramic, 1500 mmf. 450 V
C135	250175-2	Cap. ceramic, .01 mfd. 450 V
C136	250175-3	Cap. ceramic, 1500 mmf. 450 V
C137	250175-3	Cap. ceramic, 1500 mmf. 450 V
C150	250201-11	Cap. paper, .047 mfd. 600 V
C151	250201-11	Cap. paper, .047 mfd. 600 V
C152	250201-11	Cap. paper, .047 mfd. 600 V
C153	250201-11	Cap. paper, .047 mfd. 600 V
C154	270027-7	Cap. electrolytic
C155	250201-7	Cap. paper, .01 mfd. 600 V
C157	250129-15	Cap. paper, .05 mfd. 400 V
C158	250129-15	Cap. paper, .05 mfd. 400 V
C180	250151-21	Cap. paper, .25 mfd. 400 V
C181	250201-11	Cap. paper, .047 mfd. 600 V
C182	250159-98	Cap. mica, 100 mmf. 500 V
C183	250159-98	Cap. mica, 100 mmf. 500 V
C184	250201-5	Cap. paper, .0047 mfd. 600 V
C185	250185-9	Cap. paper, .005 mfd. 600 V
C186	250185-10	Cap. paper, .015 mfd. 600 V
C187	250201-5	Cap. paper, .0047 mfd. 600 V
C188	250201-11	Cap. paper, .047 mfd. 600 V
C189	250201-7	Cap. paper, .01 mfd. 600 V
C190	250201-13	Cap. paper, .1 mfd. 600 V
C191	250201-7	Cap. paper, .01 mfd. 600 V
C192	250160-64	Cap. mica, 1000 mmf. 500 V
C193	250201-11	Cap. paper, .047 mfd. 600 V
C194	270027-9	Cap. electrolytic
C195	250201-10	Cap. paper, .033 mfd. 600 V
C196	250201-13	Cap. paper, .1 mfd. 600 V
C198	250151-21	Cap. paper, .25 mfd. 400 V
C199	250201-13	Cap. paper, .1 mfd. 600 V
C201	250159-98	Cap. mica, 100 mmf. 500 V
C205	250161-24	Cap. mica, 4700 mmf. 5% 500 V
C207	250201-13	Cap. paper, .1 mfd. 600 V
C209	250201-12	Cap. paper, .068 mfd. 600 V
C216	250201-11	Cap. paper, .047 mfd. 600 V
C218	270021-33	Cap. electrolytic
C219	270021-24	Cap. electrolytic
C220	270021-40	Cap. electrolytic

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SERVICE ADJUSTMENTS

Below is given a description of the steps required in adjustment of the Beam Bender, Deflection Yoke, Focusing, Vertical and Horizontal Peaking and Horizontal A.F.C. However, it should be remembered that these adjustments are to be made only when picture quality is such that service adjustment is warranted. Use this description as a check-list and if a particular phase of quality is good, leave it alone and go on to the next operation. Refer to figure 1 for location of front panel controls, or to figure 2 for location of rear panel controls.

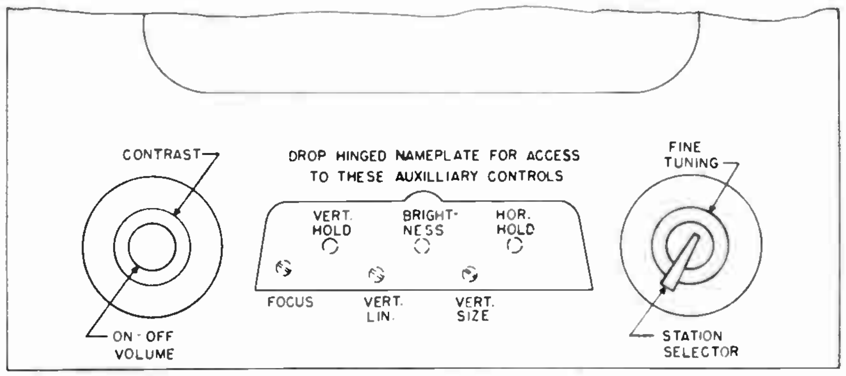


FIG. 1 — FRONT PANEL SERVICE ADJUSTMENTS

Before proceeding, tune in a station transmitting a test pattern.

A. BEAM BENDER (ION TRAP) ADJUSTMENT

1. Advance the BRIGHTNESS control almost fully clockwise.
2. Position the Beam Bender over the "flags" or kink in the gun structure. Starting from this position, adjust the Beam Bender by moving it fordward or backward, and at the same time rotating it slightly around the neck of the tube until the brightest raster appears on the screen. If two maximum brightness positions are found, the one nearest the tube base is the correct setting. This adjustment should be done quickly to avoid damaging the gun structure.
3. Adjust the BRIGHTNESS control setting until the raster is slightly above average brilliance.
4. Re-adjust the Beam Bender carefully for maximum raster brilliance.

B. DEFLECTION YOKE ADJUSTMENT

1. Loosen the wing thumb screw located at the top of the deflection yoke frame.
2. Rotate the yoke until the raster-lines are squared with the picture mask.
3. Make sure the yoke presses firmly against the flare of the tube and tighten the wing screw.

C. FOCUSING ADJUSTMENTS

1. Adjust BRIGHTNESS and CONTRAST controls so that the raster brilliance corresponds to that of an average picture.
2. If the corner of the raster is shadowed, loosen the Focus Coil Wing Nuts and screws slightly, and carefully twist the focus coil in such a direction that the shadow is eliminated. The focus coil should be positioned close to, but not necessarily touching the back of the deflection yoke. Tighten the wing nuts and screws while the focus coil is held in this position. The Beam Bender may now require slight readjustment.
3. Adjust the focus control (see fig. 1) so that the lines of the raster are sharp and distinct over the greatest screen area.

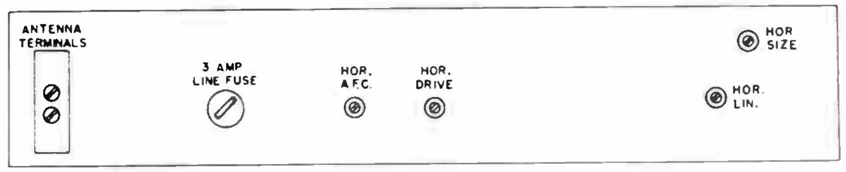


FIG. 2 — REAR PANEL ADJUSTMENTS

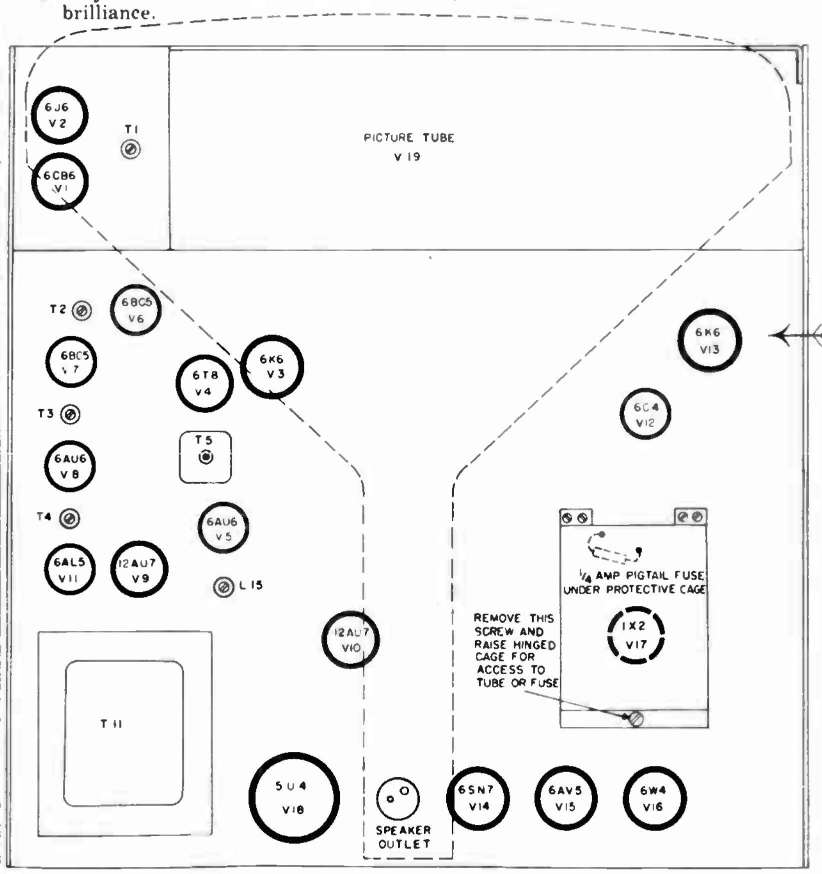
D. PICTURE CENTERING, SIZE, AND LINEARITY

1. Horizontal or Vertical Centering is accomplished mechanically. To center the picture, loosen the Focus Coil Wing Nuts sufficiently to twist the Focus Coil slightly about its horizontal or vertical axis. Make sure the corners of the rasters are not shadowed. See step C-2.
2. Adjust the VERTICAL SIZE and VERTICAL LINEARITY controls (see fig. 1) until the test pattern is vertically linear and symmetrical, and fills the mask. Adjustment of either control may require readjustment of the other. If vertical synchronization "falls out," re-adjust the VERTICAL HOLD control.
3. Adjust the HORIZONTAL SIZE control for correction of horizontal width.
4. Adjust the HORIZONTAL PEAKING control trimmer (see fig. 2) for a horizontally symmetrical pattern and for elimination of any existing vertical bars in left-center of picture.
5. Adjust the HORIZONTAL LINEARITY control (see fig. 2) for central alignment of the inner circles of the test pattern.

E. HORIZONTAL A.F.C. ADJUSTMENT

If difficulty is encountered in locking the picture horizontally, or if it locks-in only when the HORIZONTAL HOLD control is counterclockwise, adjust the HORIZONTAL A.F.C. control as follows:

1. Turn CONTRAST down about half way.
2. Turn HORIZONTAL HOLD control fully clockwise.
3. If the picture is not locked-in, turn the HORIZONTAL A.F.C. control till it does lock-in.
4. Turn the HORIZONTAL A.F.C. control counterclockwise till it just tends to fall out of sync. — This is the correct position of the HORIZONTAL A.F.C. control for optimum range of the HORIZONTAL HOLD control.



SEE NOTE ON SCHEMATIC

TUBE LOCATION DIAGRAM — TOP VIEW

MODELS

12½" Round	14" Rect.
120	141
	141B
121	142
	1400
121B	1400B

ELECTRICAL SPECIFICATIONS

Power Supply	117 Volts A.C. 60 Cycles Only
Power Consumption	175 Watts
Antenna Input Impedance	300 Ohms, Balanced
Tuning Range	Channels 2 to 13
I.F. System	Intercarrier
I.F. Frequencies	Picture—24.75 Mc Sound—20.25 Mc
Sound I.F. Aligned at 4.5 Mc	
Loud Speaker	5" P.M. or 10" P.M.
Voice Coil Impedance	3.2 Ohms @ 400 c.p.s.

TUBE COMPLEMENT AND VOLTAGE READINGS — SERIES 99 AND 100

Item No.	Function	Tube Type	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Pin 9
V1	R.F. AMPLIFIER	6CB6	—0.6	0.4	0	6.3 A.C.	110	110	0	—	—
V2	OSCILLATOR-CONVERTER	6J6	120	85	0	6.3 A.C.	—3	—5	0	—	—
V3	AUDIO OUTPUT	6K6	N.C.	0	263	275	0	N.C.	6.3 A.C.	19	—
V4	RATIO DET.—AUDIO AMP.	6T8	—0.8	—1.5	—0.8	6.3 A.C.	0	—0.8	0	—0.7	53
V5	RATIO DETECTOR DRIVER	6AU6	—0.1	0	0	6.3 A.C.	265	85	—0.6	—	—
V6	1st VIDEO I.F.	6BC5	—0.5	N.C.	0	6.3 A.C.	130	130	0.7	—	—
V7	2nd VIDEO I.F.	6BC5	—1	N.C.	0	6.3 A.C.	130	130	0.7	—	—
V8	3rd VIDEO I.F.	6AU6	0	0	0	6.3 A.C.	130	130	1.1	—	—
V9	VIDEO AMPLIFIER	12AU7	100	—0.7	0.2	6.3 A.C.	6.3 A.C.	150	—1	0	0
V10	SYNC. AMPLIFIER	12AU7	135	0	3.8	6.3 A.C.	6.3 A.C.	285	—23	4	0
V11	A.G.C.—SYNC. LEVELER	6AL5	2.6	—23	0	6.3 A.C.	0	—	—0.2	—	—
V12	VERT. OSCILLATOR	6C4	105	0	0	6.3 A.C.	105	—29	0	—	—
V13	VERT. OUTPUT	6K6	N.C.	0	270	270	0	270	6.3 A.C.	33	—
V14	HOR. OSCILLATOR	6SN7	—6	175	10	—65	170	0	0	6.3 A.C.	—
V15	HOR. OUTPUT	6AV5	5.8	6.3 A.C.	28	—	360	—	0	175	—
V16	HOR. DAMPER	6W4	230	N.C.	365	285	230	365	270 * 6.3 A.C.	270 * 6.3 A.C.	—
V17	H.V. RECTIFIER	† 1 X 2	9KV	9KV	—	9KV	9KV	9KV	—	9KV	9KV
V18	POWER RECTIFIER	5U4G	N.C.	290	N.C.	295 A.C.	270	295 A.C.	270	290	—
V19	PICTURE TUBE	See Diagram	270 * 6.3 A.C.	150	Pin 10 320			Pin 11 175		Pin 12:	270 * 6.3 A.C.

NOTES

1. Tune receiver to unused channel—no signal applied.
2. All front panel controls set at maximum clockwise positions.
3. Maintain line voltage at 117 volts A.C.
4. Values shown are D-C voltages, measured from socket pin to ground, unless otherwise stated.
5. D-C voltages measured with V.T.V.M. unless otherwise stated.

† Use high voltage insulated probe.

* Top value is D-C voltage to ground; bottom value measured across filament (Y-Y).

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ALIGNMENT INSTRUCTIONS

I-F and Sound Alignment Procedure

TV I-F ALIGNMENT

1. Tune receiver to quiet portion of TV High Band.
2. Set contrast control fully counterclockwise.
3. Connect TV I-F Signal Generator through a 1500 MMF condenser to Test Point (A) of tuner unit; (See Fig. 4) low side to ground.
4. Connect negative lead of V.T.V.M. (or meter of 20,000 ohms-per-volt, or better) to 8.2K diode load resister TEST POINT (B); positive lead to ground. See schematic diagram.
5. Feed 24.9 MC (±.05 MC) from Signal Generator, and adjust T4 for maximum deflection on meter. *Maintain Signal Generator output so low that meter reads no more than 1.5 volts at peak.*
6. Feed 24.1 MC (±.05 MC) from Signal Generator, and adjust T3 as above.
7. Feed 22.3 MC (±.05 MC) from Signal Generator, and adjust T2 as above.
8. Feed 23.0 MC (±.05 MC) from Signal Generator, and adjust T1 as above.
9. Replace the meter with the vertical input of an Oscilloscope; low side to ground.
10. Replace Signal Generator with a video I-F Sweep Generator.
11. Loosely couple high side of a TV I-F Marker Generator to the high Sweep Generator Lead; low side to ground.
12. Feed I-F Sweep, and observe response on 'scope.
13. If response does not approximate that shown in Fig. 5, repeat steps 3 to 8, making sure that frequencies are precise, and that the Signal Generator output voltage is kept low. Continue with steps 9 to 12. A slight touch-up of individual slugs may be required to approximate the recommended curve of Fig. 5.

SOUND ALIGNMENT

1. Connect a 4.5 MC Signal Generator (±.01 MC) through a 1500 MMF condenser to the 8.2K video diode load resistor—TEST POINT (B); low side to ground. See schematic diagram.
2. Obtain two resistors of approximately 100,000 ohms each, whose resistances have been matched accurately with an ohmmeter. Connect them in series across the 18K resistor (R19) at the 6T8 tube socket (V4).
3. Connect negative lead of V.T.V.M. to junction of matched resistors of step 2; positive lead to ground.
4. Feed 4.5 MC (±.01 MC) from Signal Generator, and adjust L15 and bottom slug of T5 for maximum deflection on V.T.V.M.
5. Connect positive lead of V.T.V.M. to junction of C25, C26, and R17—TEST POINT (C), leaving negative lead of V.T.V.M. connected as in step 4. See schematic diagram for TEST POINT (C).
6. Adjust top of T5 for zero output on V.T.V.M., between two opposite polarity peaks.

R.F. AND OSCILLATOR ALIGNMENT PROCEDURE

The oscillator adjustments are readily accessible from the front panel. If the picture is out of range of the Fine Tuning control, slight readjustment of L7 and/or L8 (see Fig. 4) can be accomplished without an elaborate test set-up.

The perforated bottom cover is removable, permitting access to the important alignment points. If proper test equipment is available, alignment may be performed, particularly on table model receivers, without taking the chassis out of the cabinet.

R.F. ALIGNMENT

1. Connect TV Sweep Generator to Antenna Terminals.
2. Couple R.F. Marker Generator loosely to Antenna Terminals.
3. Connect vertical amplifier of Oscilloscope through a 10,000 ohm ½W. resistor to TEST POINT (A), Figs. 3 and 4.
4. Short the A.G.C. Buss to ground on the TV chassis (across C34A 5000 MMF Single Section of Dual Discap condenser).
5. Set Station Selector to channel 13.
6. Feed 213 MC at 10 MC Sweep from Sweep Generator, and 211.25 MC and 215.75 MC fixed frequencies from R-F Marker Generator.
7. Observe response curve on 'scope. If necessary, adjust L1, L3, or L4 (see Fig. 3) so that curve approximates that shown in Fig 6. If curve is too wide or too narrow, the coupling between V1 and V2 can be adjusted by bringing the wire "gimmic" (see schematic diagram) either further from, or closer to the .25 MMF condenser, C4. Caution. DO NOT SHORT "GIMMIC" WIRES.
8. Set Station Selector, Sweep Generator and Marker Generator at frequencies which correspond to channel 12 (see Table I) and adjust wire-loop inductances on switch wafers 2 and 3 which tune to channel 12, so that observed curve approximates that in Fig. 6.

   To adjust these inductances, carefully bend the wire loops closer to, or further from the switch wafers. *Sequence of wafers 1 to 4 is from front to back of tuner.*
9. Repeat, as above, on channels 11, 10, 9, 8, and 7 (in that order) setting Station Selector, and test equipment at corresponding frequencies (see Table I). Adjust corresponding wire-loop inductances on switch wafers 2 and 3 as above.
10. If the tops of the response curves of channels 12 to 7 tilt in one direction, repeat steps 5 and 6 and adjust L1 so that the response curve tilts in a direction which will compensate for the tilt of the offending channels.

    A compromise must be reached where no channel is badly adjusted.

    NOTE: *If any individual channel is adjusted, all remaining high band channels which are lower in frequency must be re-adjusted.*
11. Set Station Selector, Sweep Generator and Marker Generator at frequencies which correspond to channel 6 (see Table I) and adjust inductances on switch wafers 2, 3, and 4 which tune channel 6, so that observed response curve approximates that shown in Fig. 6. Caution: ADJUST ONLY HEAVY-WIRE SECONDARY WINDING OF L2 on WAFER 4.
12. Set Station Selector, Sweep Generator and Marker Generator at frequencies which correspond to channels 5, 4, 3, and 2 (in that order—see Table I) and adjust corresponding inductances on switch wafers 2, 3, and 4 so that observed response curve approximate that shown in Fig. 6.

    NOTE: *If any individual low-band channel is adjusted, all remaining channels lower in frequency must be re-adjusted.*

OSCILLATOR ALIGNMENT

1. Connect TV Sweep Generator to Antenna Terminals.
2. Couple R-F Marker Generator loosely to Antenna Terminals.
3. Connect vertical amplifier of Oscilloscope across the video amplifier grid and ground (Pin 2 of 12AU7, V9).
4. Couple 24.75 mc. Video I.F. Marker Generator loosely to first I.F. grid (pin 1 of 6BC5, V6). This frequency remains fixed throughout oscillator alignment.
5. Rotate Fine Tuning Control to center of range.
6. Set Station Selector to channel 13.
7. Set Sweep Generator to 213 MC at 10 MC sweep and Marker Generator to 211.25 MC (Video Carrier).
8. Observe response curve, and adjust L8 (see Fig. 4) for zero-beat with 24.75 MC marker. The zero-beat is indicated by an unmistakable break-up of the observed response curve.

   NOTE: *Quality of response curve does not affect accuracy of oscillator alignment, so long as zero-beat is obtained.*
9. Set Station Selector, Sweep Generator, and Video Carrier R-F Marker Generator to channels 12, 11, 10, 9, 8, and 7 (in that order) adjusting at the same time the corresponding inductances on wafer 1 for zero-beat with 24.75 MC marker. If zero-beat is within central range of the Fine Tuning control, alignment is satisfactory.
10. Set Station Selector, Sweep Generator, and Video Carrier R-F Marker Generator at channel 6 frequencies (see Table I) and adjust L7 (see Fig. 4) for zero-beat as above.
11. Set Station Selector, Sweep Generator, and Video Carrier R-F Marker Generator at frequencies of channels 5, 4, 3 and 2 (in that order) and adjust corresponding inductances on switch wafer 1 for zero-beat as above.

R-F TUNER ADJUSTMENT POINTS

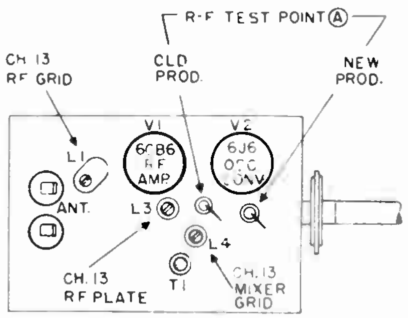

FIG 3 - TOP VIEW

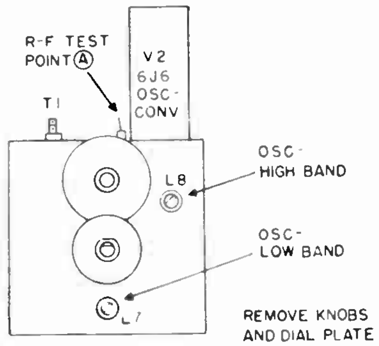

FIG.4 - FRONT VIEW

REMOVE KNOBS AND DIAL PLATE FOR ACCESS TO THESE ADJUSTMENTS.

NOTE: THE ADJUSTMENTS L1, L3, L4, AND THE ANTENNA TERMINALS ARE LOCATED AS SHOWN ONLY ON LATER PRODUCTION TUNERS.

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TABLE I - ALIGNMENT FREQUENCIES

CHANNEL NUMBER	SWEEP GEN. CENTER FREQ. (10 MC. SWEEP)	MARKER GENERATOR FREQUENCIES	
		VIDEO CARRIER	SOUND CARRIER
2	57 MC.	55.25 MC	59.75 MC.
3	63 MC	61.25 MC.	65.75 MC.
4	69 MC.	67.25 MC.	71.75 MC.
5	79 MC.	77.25 MC.	81 75 MC.
6	85 MC.	83.25 MC	87.75 MC
7	177 MC.	175.25 MC.	179.75 MC.
8	183 MC.	181.25 MC.	185.75 MC.
9	189 MC.	187.25 MC	191.75 MC.
10	195 MC.	193.25 MC.	197.75 MC.
11	201 MC.	199.25 MC.	203.75 MC.
12	207 MC	205.25 MC	209.75 MC.
13	213 MC.	211.25 MC	215.75 MC.

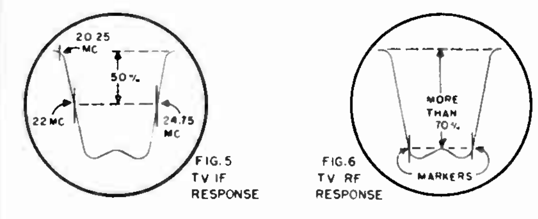

FIG. 5 TV IF RESPONSE

FIG. 6 TV RF RESPONSE

RECOMMENDED RESPONSE CURVES

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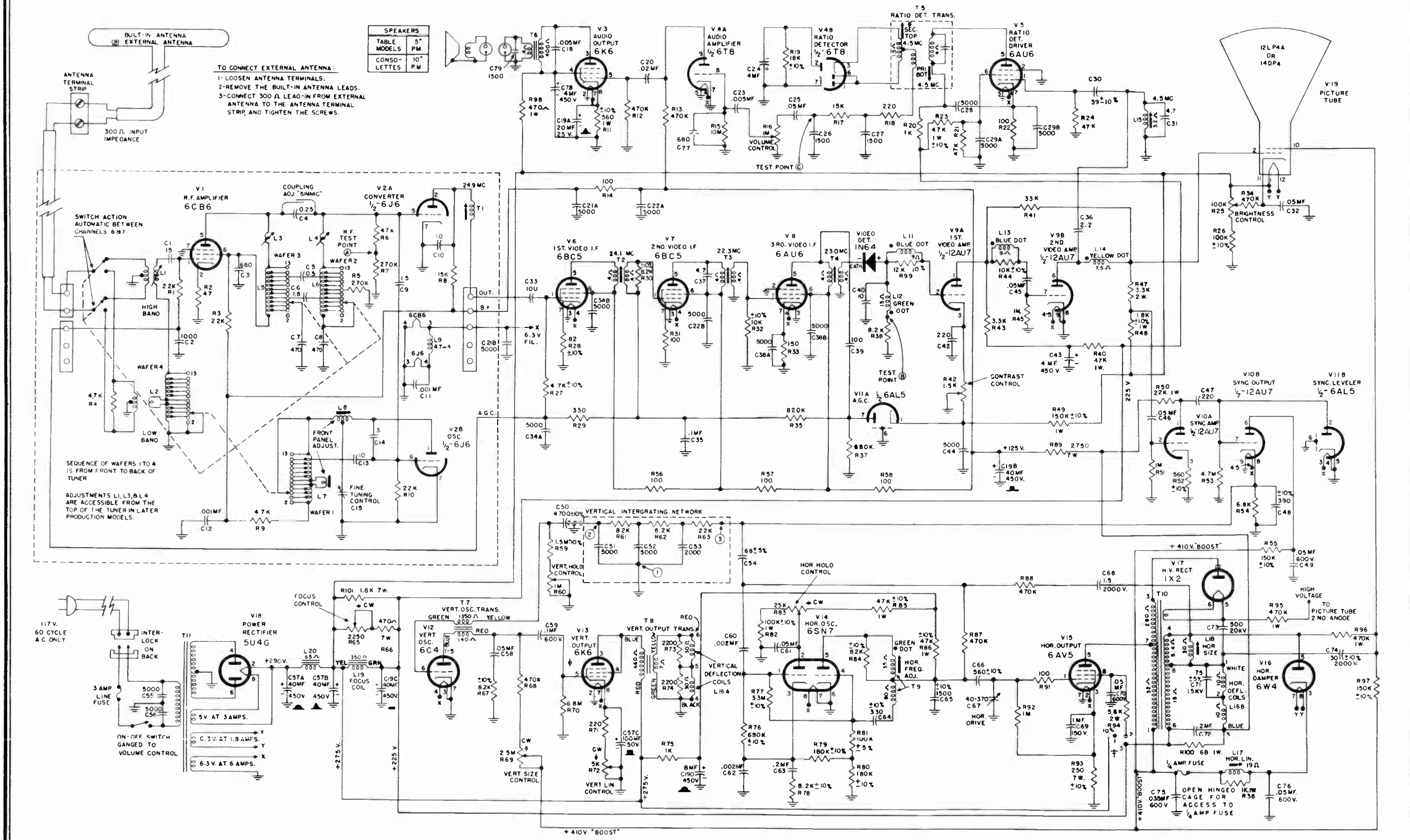

I.F. ALIGNMENT DATA
T1 – 24.9 MC
T2 – 24.1 MC
T3 – 22.3 MC
T4 – 23.0 MC
(T1–T4: VIDEO)
L15 – 4.5 MC – SOUND TAKE-OFF
* T5 – 4.5 MC – RATIO DETECTOR

* TO ALIGN PRI. OR SEC. OF T5, OBTAIN TWO RESISTORS OF APPROXIMATELY 100,000 OHMS EACH, WHICH HAVE BEEN MATCHED ACCURATELY WITH OHMMETER. CONNECT THEM IN SERIES, ACROSS 18K RATIO DETECTOR RESISTOR (R19). USE JUNCTION OF MATCHED RESISTORS AS TEST POINT.

6K6GT IS USED IN 99 SERIES; 6V6GT USED IN 100 SERIES

IN 99 SERIES CONNECTION IS FROM 2 TO 3
IN 100 SERIES CONNECTION IS FROM 1 TO 2

"K" = KILOHMS
"M" = MEGOHMS

ALL CERAMIC AND MICA CAPACITORS ARE IN MMFD. AND RATED 500W.V., UNLESS OTHERWISE SPECIFIED.

ALL RESISTORS ARE 1/2 WATT AND ALL PAPER CAPACITORS ARE 400W.V., UNLESS OTHERWISE SPECIFIED.

CIRCUIT SCHEMATIC DIAGRAM

99 SERIES 12 1/2" ROUND TUBE		100 SERIES 14" RECTANGULAR TUBE	
MODEL	CABINET	MODEL	CABINET
120	TABLE MODEL, LEATHERETTE	141	TABLE MODEL, MAHOGANY
121	TABLE MODEL, MAHOGANY	141B	TABLE MODEL, BLEACHED
121B	TABLE MODEL, BLEACHED	1400	CONSOLETTE, MAHOGANY
		1400B	CONSOLETTE, BLEACHED
		142	TABLE MODEL, MAHOGANY
		142B	TABLE MODEL, BLEACHED

MODELS 120, 121, 121B, Ch. 99; 141, 141B, 142, 1400, 1400B, Ch. 100

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SERVICE ADJUSTMENTS

MODELS 160, 160B, 162, 1600, 1600B, Ch. 101; 1605, 1605B, 1610, 1610B, Ch. 102

Below is given a description of the steps required in adjustment of the Beam Bender, Deflection Yoke, Focusing, Vertical and Horizontal Peaking and Horizontal A.F.C. However, it should be remembered that these adjustments are to be made only when picture quality is such that service adjustment is warranted. Use this description as a check-list and if a particular phase of quality is good, leave it alone and go on to the next operation. Refer to figure 1 for location of front panel controls, or to figure 2 for location of rear panel controls.

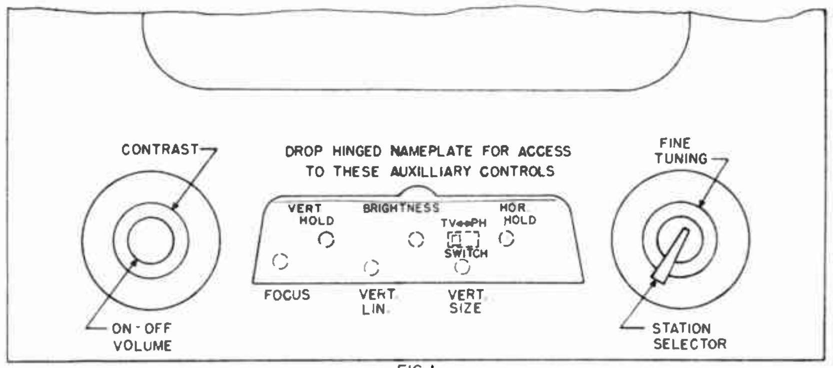


FIG. 1 — FRONT PANEL SERVICE ADJUSTMENTS

Before proceeding, tune in a station transmitting a test pattern.

A. BEAM BENDER (ION TRAP) ADJUSTMENT

1. Advance the BRIGHTNESS control almost fully clockwise.
2. Position the Beam Bender over the "flags" or kink in the gun structure. Starting from this position, adjust the Beam Bender by moving it forward or backward, and at the same time rotating it slightly around the neck of the tube until the brightest raster appears on the screen. If two maximum brightness positions are found, the one nearest the tube base is the correct setting. This adjustment should be done quickly to avoid damaging the gun structure.
3. Adjust the BRIGHTNESS control setting until the raster is slightly above average brilliance.
4. Re-adjust the Beam Bender carefully for maximum raster brilliance.

B. DEFLECTION YOKE ADJUSTMENT

1. Loosen the wing thumb screw located at the top of the deflection yoke frame.
2. Rotate the yoke until the raster-lines are squared with the picture mask.
3. Make sure the yoke presses firmly against the flare of the tube and tighten the wing screw.

C. FOCUSING ADJUSTMENTS

1. Adjust BRIGHTNESS and CONTRAST controls so that the raster brilliance corresponds to that of an average picture.
2. If the corner of the raster is shadowed, loosen the Focus Coil Wing Nuts and screws slightly, and carefully twist the focus coil in such a direction that the shadow is eliminated. The focus coil should be positioned close to, but not necessarily touching the back of the deflection yoke. Tighten the wing nuts and screws while the focus coil is held in this position. The Beam Bender may now require slight readjustment.
3. Adjust the focus control (see fig. 1) so that the lines of the raster are sharp and distinct over the greatest screen area.

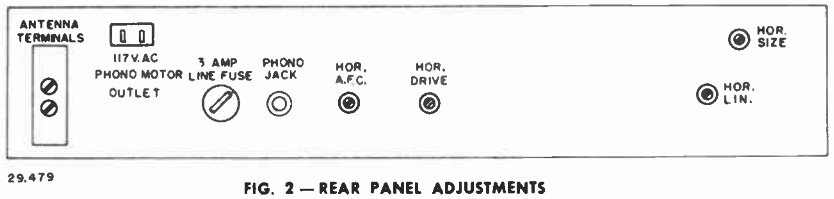


FIG. 2 — REAR PANEL ADJUSTMENTS

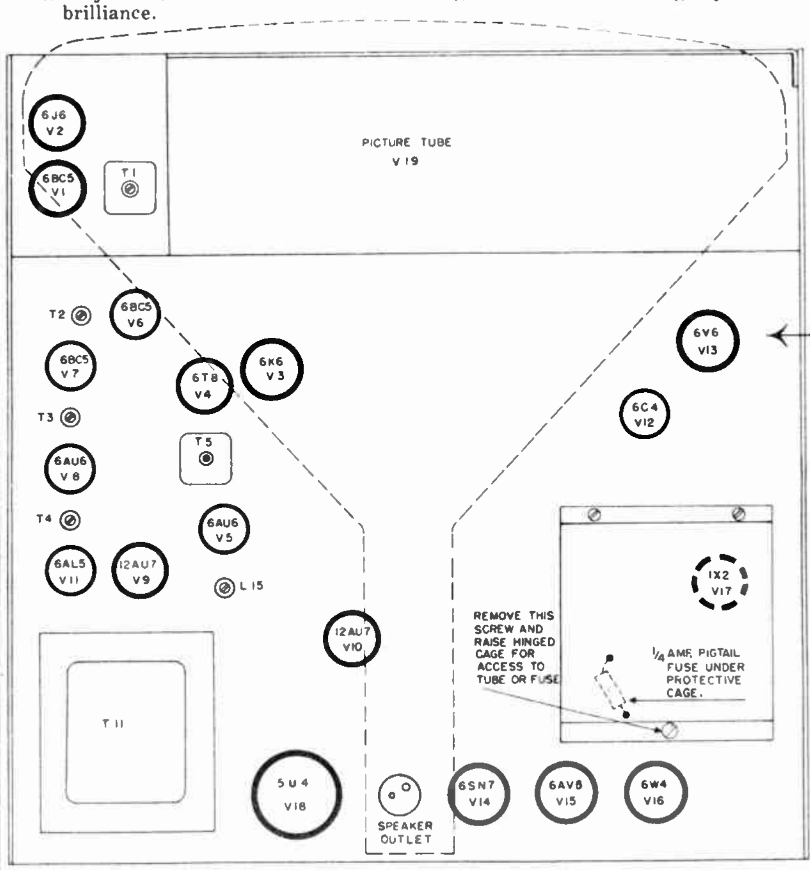
D. PICTURE CENTERING, SIZE, AND LINEARITY

1. Horizontal or Vertical Centering is accomplished mechanically. To center the picture, loosen the Focus Coil Wing Nuts sufficiently to twist the Focus Coil slightly about its horizontal or vertical axis. Make sure the corners of the rasters are not shadowed. See step C-2.
2. Adjust the VERTICAL SIZE and VERTICAL LINEARITY controls (see fig. 1) until the test pattern is vertically linear and symmetrical, and fills the mask. Adjustment of either control may require readjustment of the other. If vertical synchronization "falls out," re-adjust the VERTICAL HOLD control.
3. Adjust the HORIZONTAL SIZE control for correction of horizontal width.
4. Adjust the HORIZONTAL PEAKING control trimmer (see fig. 2) for a horizontally symmetrical pattern and for elimination of any existing vertical bars in left-center of picture.
5. Adjust the HORIZONTAL LINEARITY control (see fig. 2) for central alignment of the inner circles of the test pattern.

E. HORIZONTAL A.F.C. ADJUSTMENT

If difficulty is encountered in locking the picture horizontally, or if it locks-in only when the HORIZONTAL HOLD control is counterclockwise, adjust the HORIZONTAL A.F.C. control as follows:

1. Turn CONTRAST down about half way.
2. Turn HORIZONTAL HOLD control fully clockwise.
3. If the picture is not locked-in, turn the HORIZONTAL A.F.C. control till it does lock-in.
4. Turn the HORIZONTAL A.F.C. control counterclockwise till it just tends to fall out of sync. — This is the correct position of the HORIZONTAL A.F.C. control for optimum range of the HORIZONTAL HOLD control.



TUBE LOCATION DIAGRAM — TOP VIEW

MODELS

16" Rectangular	16" Round
160	1605
160B	1605B
162	1610
1600	1610B
1600B	

ELECTRICAL SPECIFICATIONS

Power Supply	117 Volts A.C. 60 Cycles Only
Power Consumption	175 Watts
Antenna Input Impedance	300 Ohms, Balanced
Tuning Range	Channels 2 to 13
I.F. System	Intercarrier
I.F. Frequencies	Picture—24.75 Mc Sound—20.25 Mc

Sound I.F. Aligned at 4.5 Mc

Loud Speaker	5" P.M. or 10" P.M.
Voice Coil Impedance	3.2 Ohms @ 400 c.p.s.

TUBE COMPLEMENT AND VOLTAGE READINGS—SERIES 101 AND 102

Item No.	Function	Tube Type	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Pin 9
V1	R.F. AMPLIFIER	6AG5/6BC5	– 0.7	0	6.3 AC	0	115	115	0	—	—
V2	OSCILLATOR-CONVERTER	6J6	103	75	6.3 AC	0	–3 to –4.5	–4 to –9	0	—	—
V3	AUDIO OUTPUT	6K6	N.C.	0	263	275	0	N.C.	6.3 A.C.	19	—
V4	RATIO DET.—AUDIO AMP.	6T8	–0.8	–1.5	–0.8	6.3 A.C.	0	–0.8	0	–0.7	53
V5	RATIO DETECTOR DRIVER	6AU6	–0.1	0	0	6.3 A.C.	265	85	–0.6	—	—
V6	1st VIDEO I.F.	6BC5	–0.5	N.C.	0	6.3 A.C.	130	130	0.7	—	—
V7	2nd VIDEO I.F.	6BC5	–1	N.C.	0	6.3 A.C.	130	130	0.7	—	—
V8	3rd VIDEO I.F.	6AU6	0	0	0	6.3 A.C.	130	130	1.1	—	—
V9	VIDEO AMPLIFIER	12AU7	100	–0.7	0.2	6.3 A.C.	6.3 A.C.	150	–1	0	0
V10	SYNC. AMPLIFIER	12AU7	135	0	3.8	6.3 A.C.	6.3 A.C.	285	–23	4	0
V11	A.G.C.—SYNC. LEVELER	6AL5	2.6	–23	0	6.3 A.C.	0	—	–0.2	—	—
V12	VERT. OSCILLATOR	6C4	105	0	0	6.3 A.C.	105	–29	0	—	—
V13	VERT. OUTPUT	6V6/6W6	N.C.	0	270	270	0	270	6.3 A.C.	33	—
V14	HOR. OSCILLATOR	6SN7	–6	175	10	–65	170	0	0	6.3 A.C.	—
V15	HOR. OUTPUT	6AV5	5.8	6.3 A.C.	28	—	360	—	0	175	—
V16	HOR. DAMPER	6W4	230	N.C.	365	285	230	365	270 * 6.3 A.C.	270	—
V17	H.V. RECTIFIER	† 1 X 2	11KV	11KV	—	11KV	11KV	11KV	—	11KV	11KV
V18	POWER RECTIFIER	5U4G	N.C.	290	N.C.	295 A.C.	270	295 A.C.	270	290	—
V19	PICTURE TUBE	See Diagram	270 * 6.3 A.C.	150	Pin 10 320			Pin 11 175		Pin 12:	270 * 6.3 A.C.

NOTES

1. Tune receiver to unused channel—no signal applied.
2. All front panel controls set at maximum clockwise positions.
3. Maintain line voltage at 117 volts A.C.
4. Values shown are D-C voltages, measured from socket pin to ground, unless otherwise stated.
5. D-C voltages measured with V.T.V.M. unless otherwise stated.

† Use high voltage insulated probe.

* Top value is D-C voltage to ground; bottom value measured across filament (Y-Y).

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ALIGNMENT INSTRUCTIONS

I-F and Sound Alignment Procedure

TV I-F ALIGNMENT

1. Tune receiver to quiet portion of TV High Band.
2. Set contrast control fully counterclockwise.
3. Connect TV I-F Signal Generator through a 1500 MMF condenser to Test Point (A) of tuner unit; (See Fig. 3) low side to ground.
4. Connect negative lead of V.T.V.M. (or meter of 20,000 ohms-per-volt, or better) to 8.2K diode load resister TEST POINT (B); positive lead to ground. See schematic diagram.
5. Feed 23.0 MC (±.05 MC) from Signal Generator, and adjust T4 for maximum deflection on meter. *Maintain Signal Generator output so low that meter reads no more than 1.5 volts at peak.*
6. Feed 22.3 MC (±.05 MC) from Signal Generator, and adjust T3 as above.
7. Feed 24.1 MC (±.05 MC) from Signal Generator, and adjust T2 as above.
8. Feed 24.9 MC (±.05 MC) from Signal Generator, and adjust T1 as above.
9. Replace the meter with the vertical input of an Oscilloscope; low side to ground.
10. Replace Signal Generator with a video I-F Sweep Generator.
11. Loosely couple high side of a TV I-F Marker Generator to the high Sweep Generator Lead; low side to ground.
12. Feed I-F Sweep, and observe response on 'scope.
13. If response does not approximate that shown in Fig. 5, repeat steps 3 to 8, making sure that frequencies are precise, and that the Signal Generator output voltage is kept low. Continue with steps 9 to 12. A slight touch-up of individual slugs may be required to approximate the recommended curve of Fig. 5.

SOUND ALIGNMENT

1. Connect a 4.5 MC Signal Generator (±.01 MC) through a 1500 MMF condenser to the 8.2K video diode load resistor—TEST POINT (B); low side to ground. See schematic diagram.
2. Obtain two resistors of approximately 100,000 ohms each, whose resistances have been matched accurately with an ohmmeter. Connect them in series across the 18K resistor (R19) at the 6T8 tube socket (V4).
3. Connect negative lead of V.T.V.M. to junction of matched resistors of step 2; positive lead to ground.
4. Feed 4.5 MC (±.01 MC) from Signal Generator, and adjust L15 and bottom slug of T5 for maximum deflection on V.T.V.M.
5. Connect positive lead of V.T.V.M. to junction of C25, C26, and R17—TEST POINT (C), leaving negative lead of V.T.V.M. connected as in step 4. See schematic diagram for TEST POINT (C).
6. Adjust top of T5 for zero output on V.T.V.M., between two opposite polarity peaks.

R.F. AND OSCILLATOR ALIGNMENT PROCEDURE

R.F. ALIGNMENT

1. Connect TV Sweep Generator to Antenna Terminals.
2. Connect R.F. Marker Generator loosely to Antenna Terminals.
3. Connect vertical amplifier of Oscilloscope through a 10,000 ohm ½w. resistor to Test Point (A) fig. 3.
4. Short A.G.C. Bus to ground on TV chassis (across C34A 5000 MMF Discap condenser).
5. Set Station Selector switch to Channel 12.
6. Feed 207 mc at 10 mc sweep from Sweep Generator, and 205.25 mc & 209.75 mc fixed frequencies from R.F. Marker Generator.
7. Observe response curve on Scope. If necessary adjust C2, C3, or C4 (See fig. 3) so that response curve corresponds approximately to that shown in fig. 6 and has maximum gain.
8. Check markers on response curve of all remaining channels, setting Sweep and Marker Generators at corresponding frequencies for each channel. See Table I for convenient tabulation of proper frequencies. If the R.F. Markers do not fall in automatically in their proper places on all channels, a compromise must be made by slight readjustment of C2, C3, or C4.

OSCILLATOR ALIGNMENT

1. Connect TV Sweep Generator to Antenna Terminals.
2. Couple R.F. Marker Generator loosely to Antenna Terminals.
3. Connect verticle amplifier of Oscilloscope across the video amplifier grid and ground (Pin 2 of 12AU7, V9).
4. Couple 24.75 mc video I.F. Marker Generator loosely to first I.F. grid (Pin 1 of 6BC5, V6).
5. Rotate Fine Tuning control to center of range.
6. Set Station Selector switch to Channel 12.
7. Set Sweep Generator to 207 mc at 10 mc sweep and Marker Generator to 205.25 mc (video carrier).
8. Observe response curve and adjust C5, (figs. 3 & 4) for Zero-beat with 24.75 mc marker.

NOTE: Quality of response curve does not affect accuracy of oscillator alignment, so long as a zero-beat is obtained.

9. Check for zero-beat on all channels in this manner, setting the Station Selector, Sweep Generator and Marker Generator at corresponding frequencies. (See Table I). It is not usually necessary to make any further adjustments. However, if the individual oscillator coils must be touched-up, the following procedure should be employed:

a) Rotate Fine Tuning control to center of range.

b) Set Station Selector to desired channel, Sweep Generator to its center frequency with 10 mc sweep, and Marker Generator to the corresponding video carrier frequency (See Table I).

c) Place a non-metallic screwdriver through the opening marked 'Recessed Individual Osc. Adjustment', fig. 4, and adjust oscillator coil zero-beat with 24.75 mc marker on response curve.

d) This adjustment can be repeated on any single channel, or, if necessary, on all channels.

e) If difficulty is encountered in tuning any particular channel well within limits of Fine Tuning control after these adjustments are made, readjust C5 slightly (as in Step 8) shifting the whole range of frequencies in the desired direction.

R.F. TUNER ADJUSTMENT POINTS

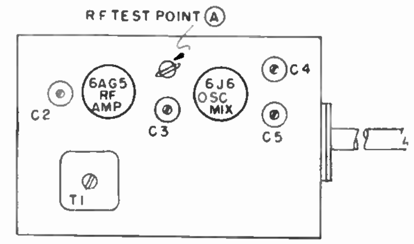

FIG.3— TOP VIEW

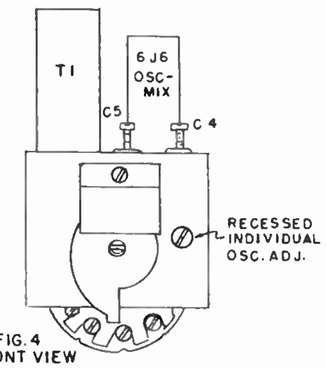

FIG. 4 FRONT VIEW

TABLE I - ALIGNMENT FREQUENCIES			
CHANNEL NUMBER	SWEEP GEN. CENTER FREQ. (10MC.SWEEP)	MARKER GENERATOR FREQUENCIES: VIDEO CARRIER	MARKER GENERATOR FREQUENCIES: SOUND CARRIER
2	57 MC.	55.25 MC.	59.75 MC.
3	63 MC.	61.25 MC.	65.75 MC.
4	69 MC.	67.25 MC.	71.75 MC.
5	79 MC.	77.25 MC.	81.75 MC.
6	85 MC.	83.25 MC.	87.75 MC.
7	177 MC.	175.25 MC.	179.75 MC.
8	183 MC.	181.25 MC.	185.75 MC.
9	189 MC.	187.25 MC.	191.75 MC.
10	195 MC.	193.25 MC.	197.75 MC.
11	201 MC.	199.25 MC.	203.75 MC.
12	207 MC	205.25 MC.	209.75 MC.
13	213 MC.	211.25 MC.	215.75 MC.

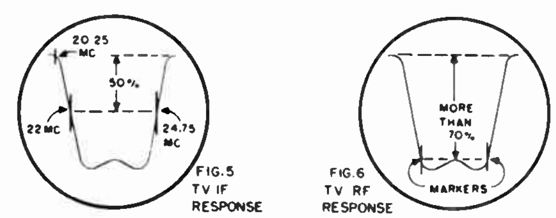

FIG.5 TV IF RESPONSE

FIG.6 TV RF RESPONSE

RECOMMENDED RESPONSE CURVES

29,491

RECORD-PLAYER OR CHANGER OPERATION

A Phono-Jack and a 117V. A.C. outlet are provided at the rear of the chassis (See fig. 2) for connection of a record-player or changer. A TV-Phono transfer switch is concealed behind the trap door on the front of the cabinet (See fig. I).

To operate phonograph, switch should be thrown to "phono" position. Sound volume is regulated by means of volume control as in the case of TV operation. (See main schematic diagram for circuit details).

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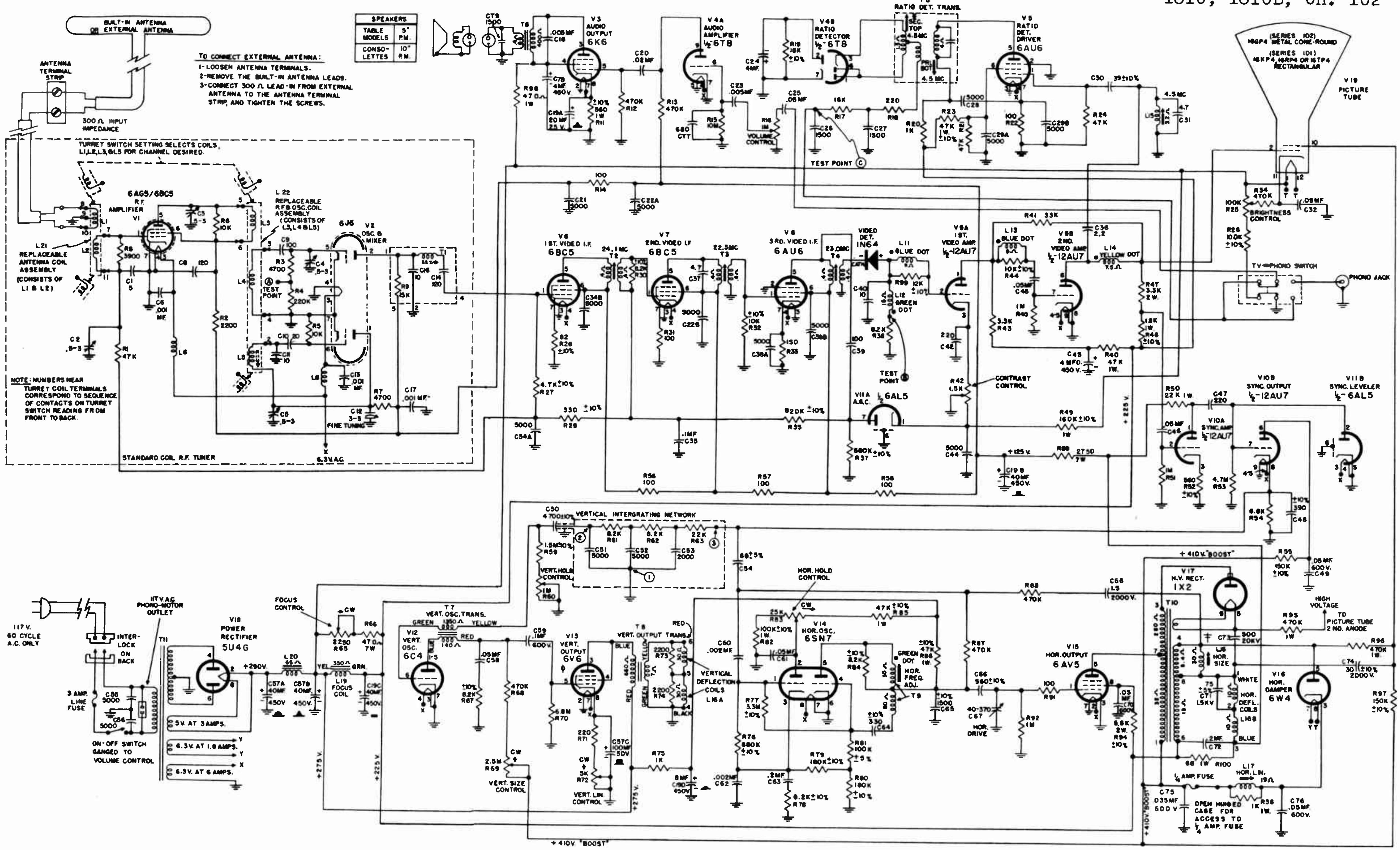
World Radio History

MODELS 160, 160B, 162, 1600, 1600B, Ch. 101; 1605, 1605B, 1610, 1610B, Ch. 102



I.F. ALIGNMENT DATA	
T1 – 24.9 MC	VIDEO
T2 – 24.1 MC	VIDEO
T3 – 22.3 MC	VIDEO
T4 – 23.0 MC	VIDEO
L15 – 4.5 MC – SOUND TAKE-OFF	
* T5 – 4.5 MC – RATIO DETECTOR	

* TO ALIGN PRI. OR SEC OF T5, OBTAIN TWO RESISTORS OF APPROXIMATELY 100,000 OHMS EACH, WHICH HAVE BEEN MATCHED ACCURATELY WITH OHMMETER. CONNECT THEM IN SERIES, ACROSS 18K RATIO DETECTOR RESISTOR (R19). USE JUNCTION OF MATCHED RESISTORS AS TEST POINT.

† C 73 AS SHOWN, IN SERIES 101 RECEIVERS
C 73 CONNECTED BETWEEN PINS OF V17 AND GROUND IN SERIES 102 RECEIVERS.

♦ 6V6 ON SERIES 101, 6W6 OR 6V6 ON SERIES 102

"K" = KILOHMS
"M" = MEGOHMS

ALL CERAMIC AND MICA CAPACITORS ARE IN MMFD. AND RATED 600W.V., UNLESS OTHERWISE SPECIFIED.

ALL RESISTORS ARE 1/2 WATT AND ALL PAPER CAPACITORS ARE 400W.V., UNLESS OTHERWISE SPECIFIED.

CIRCUIT SCHEMATIC DIAGRAM

101 SERIES 16" RECTANGULAR TUBE		102 SERIES 16" ROUND TUBE	
MODEL	CABINET	MODEL	CABINET
160	TABLE MODEL, MAHOGANY	1605	CONSOLETTE, MAHOGANY
160B	TABLE MODEL, BLEACHED	1605 B	CONSOLETTE, BLEACHED
162	TABLE MODEL, LEATHERETTE	1610	CONSOLE, MAHOGANY
1600	CONSOLETTE, MAHOGANT	1610 B	CONSOLE, BLEACHED
1600B	CONSOLETTE, BLEACHED		

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World Radio History

MM-512C

MM-516C

Model XQR

Model XOB

Model XTR

Model XTA

MM-516T

Model XRA

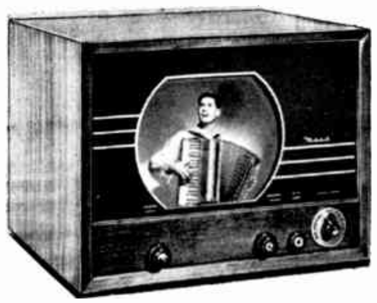
Model XRPS.

Model XQA

MM-510T

MODEL XSA

Model XSPS.



MM-512T

Alignment Procedure

MECK 10", 12", 16" and 19" Models

NECESSARY EQUIPMENT

Television Sweep Generator
Marker Freq. Generator
Vacuum Tube Voltmeter
4.5 MC fixed freq. Generator or equivalent

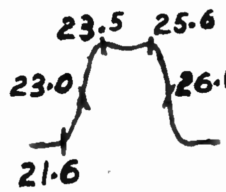


Fig. 1

I. F. ALIGNMENT

1. Connect VTVM and the input terminal of the oscilloscopes' vertical amplifier to the juncture of the 8200 ohm video detector load resistor and the 600 uh choke.

2. I. F. Signal should be introduced as follows:

   a. Models employing TT-10002A and TT-10005 tuners - connect signal generator to miniature tube shield floated over the 6AG5 mixer tube.
   b. Models employing TT-10003 tuner - connect signal generator to bare wire extending through top of tuner cover.
   c. Models employing TT-10004 tuner-connect signal generator to terminal lug #4 located on the side of tuner cover.

3. With the sweep off and the marker freq. set to 23.3MC, adjust the 1st and 3rd I. F. coils for maximum response, as indicated by VTVM. Generator should be attenuated so as not to provide more than threshold sensitivity (1 volt on VTVM at fixed freq., 1/2 volt on sweep).

4. Re-set marker frequency to 25.6MC and adjust 2nd and 4th I. F. transformers for maximum VTVM indication, as above

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World Radio History

MODELS MM-510T, MM-512C, MM-512T, MM-516C, MM-516C, XOB, XQA, XTA, XRA, XSA, XQR, XTR, XRPS, XRPT, XSPS, XSPT

5. With sweep turned on, observe the I. F. curve on the oscilloscope. See Fig. 1 for desired response curve. If original alignment did not produce a satisfactory curve, it may be modified by adjusting the I. F. tuning while observing the curve on the oscilloscope. Care must be taken that both peaks are approximately the same height and that the mid-portion of the curve is not down more than 3BD. The sound carrier, which is 21.6MC, should be at least 26DB below the flat top. The marker indicating the position of the video carrier (26 1MC) should be located at a point 6DB down (1/2 way down) on the curve. The curve should be about 3 1MC wide at 6DB down.

A convenient method, of checking this curve, is to observe markers at 23.0MC and 26.1MC. If these markers appear 6DB down on opposite sides of the curve as indicated in Fig. 1, the response curve can be considered normal.

I. F. ALIGNMENT (V. C. TUNER)

Note: The following instructions apply only to models employing the TT-10006 tuner.

1. Connect RF Generator to pin 1 of 1st 6AU6 through a .01 mfd. condenser. Connect ground side to chassis.
2. Connect V.T.V.M. to TB between 600 uh shunt coil and 8.2K resistor.
3. Set generator to 25.8MC and align 2nd I.F. to peak reading on V.T.V.M.
4. Set generator to 23.3MC and align 3rd I.F. to peak reading on V.T.V.M.
5. Set generator to 24.4MC and align 4th I.F. to peak reading on V.T.V.M.
6. Disconnect RF generator and V.T V.M.
7. Connect scope to same point as V.T.V.M. as above.
8. Apply RF sweep through antenna at channel 5 and adjust top slug in tuner for proper band width (3.1MC) markers at 23MC and 26.1MC to be at 6DB down point on curve.
   Slight readjustment of 2nd, 3rd, 4th I.F.'s may be necessary.

SOUND ALIGNMENT

1. Connect 4.5MC generator to the grid of the video amplifier tube (here again, low signal level is important, so that limiting action does not occur). Metering may be accomplished at the sound take-off point of the ratio detector (at the juncture of the 15,000 ohm resistor and the 3900 mmf capacitor) with meter ground connected to pin #8 of 6V6GT tube.
2. Adjust the top and bottom slugs on the sound transformer for maximum meter indication.
3. Adjust primary of ratio detector (top slug) for maximum reading.
4. Connect meter ground to the juncture of the two 6800 ohm resistors in the sound detector circuit, and adjust bottom slug on ratio detector to Zero voltage. Other meter lead remains connected as in step 1.

VOLTAGE MEASUREMENTS FOR 10", 12", and 16" MODELS
(No Signal)

TUBE	PIN 1	PIN 2	PIN 3	PIN 4	PIN 5	PIN 6	PIN 7	PIN 8	PIN 9	TUBE APPLICATION
6AU6	-1.2	0	0	6VAC	130	130	.5			1st I.F. Amp.
6AU6	-1.2	0	0	6VAC	130	130	.5			2nd I.F. Amp.
6AU6	0	0	0	6VAC	130	130	.8			3rd I.F. Amp.
6AL5	0	-2.7	0	6VAC	-2.7	0	.45			Video Detector
6AC7	0	6VAC	2.7	-2.7	2.7	170	0	165		Video Amp.
6AU6 *	5.5	6.1	0	6VAC	215	48	6.1			Sound IF
6T8 *	-.35	-.85	-.42	0	6VAC	0	0	-1.2	77	Ratio Det , Aud. Amp.
6V6 *	0	6VAC	210	215	-11.5	0	0	0		Audio Output
12AU7	125	0	6.2	6VAC	6VAC	7.0	0	1.5	0	Sync Amp., Sync. Clipper Sync. Splitter, D.C. Restorer
6AL5	2.5	-2.1	0	6VAC	0	0	0			Horz Phase Detector
6SN7	-40 -20	130 65	0		330	13 21	6VAC	0		Vert Sweep Osc. & Output
6SN7	.55	260	11	-9.1	105	11	6VAC	0		Horz. Sweep Osc.
6W4	0	0	450	0	360	0	130	130		Horz. Damper
6BG6 x	-13.5	0	7.2	0	-13.5	0	6VAC	280		Horz. Sweep Output
#	-11	0	7	0	-11	0	6VAC	255		
1B3	DoNot Measure									H V Rectifier
5U4	0	410	0	365AC	0	365AC		410		Power Rectifier
			PIN 10		PIN 11		PIN 12	Anode	No Load	
16 JP4	0	.8	370		130		6VAC	9,800		Kinescope
12LP4	0	.8	370		130		6VAC	8,800		Kinescope
10BP4	0	.8	370		130		6VAC	8,800		Kinescope

* Measured from Pin 8 of 6V6
# 10" and 12" chassis
x 16" chassis

B/ Voltage at tuner / 140 D.C.
A.G.C. at tuner -1V. DC

1. Voltage measurements obtained with VTVM, and are positive DC unless otherwise noted.
2. Readings are from socket pin to chassis ground unless otherwise noted
3. Line voltage maintained at 117 volts.
4. Front panel controls set at minimum. Where voltage readings vary according to the settings of the service controls, both minimum and maximum readings are given

R. F. ALIGNMENT

The R.F. Tuner in this receiver has been pre-aligned by the manufacturer, and it is not recommended that adjustment be made in the field. Elaborate test equipment and personnel having specialized knowledge are required to properly align the R.F. Tuner.

TROUBLE SHOOTING CHART - 10", 12" and 16" MODELS

SYMPTOMS	CHECK	REMARKS
No Raster; Sound O.K.	Ion Trap adjustment; H.V. Pwr. Sply; C.R.T. Voltages; 1/4 Amp. fuse in H.V. supply.	If no drive on 6BG6 grid, check 6SN7. If 6SN7 is not oscillating check associated components and voltages.
No Sound; Picture O.K.	Spkr. connections; 6V6 6T8; 6AU6; sound driver and ratio detector coils.	The Sound section of the receiver is used as a voltage regulator; all sound tubes must be in their sockets when set is on.
Weak Sound; Picture O.K.	6AU6; 6T8; 6V6; 4 mfd, 50 V cond. on 6T8 socket for short; alignment; voltages.	Negative return for sound strip is 140 V above ground. Alignment must be done only with accurate 4.5 mc. signal source and V.T.V.M.
Weak Video; Sound O.K.	6AC7 voltages; 12AU7 D.C. restorer; C.R.T. grid, cath. and anode voltages; peaking coils.	
No Sound or Picture	6AC7; 6A15; 6AU6 IF's; tuner power supply.	The difficulty can most easily be determined by starting at the 6AC7 video amp. and working toward the front end of the receiver. In tuner, first check osc. tube.
Insufficient Raster Brilliance	Ion Trap adjustment; 1B3 H.V. rectifier; 6BG6; C.R.T. voltages and C.R.T.	
Shadows or rounded corners on Raster	Deflection yoke too far back on neck of tube; ION trap adjustment; focus coil adjustment.	
Tilted Raster	Rotate deflection yoke.	
Picture not centered	Adjustment of focus coil.	
Insufficient Raster Height	Vertical heighth and linearity controls; 6SN7 and associated voltages; Vertical osc. and output transformers; yoke.	
Insufficient Raster Width	6BG6 by substitution; 6SN7; horz. size adjustment; horz. drive adjustment.	In extreme cases an .05 to .1 mfd. condenser may be added across the width control for additional horz. deflection.

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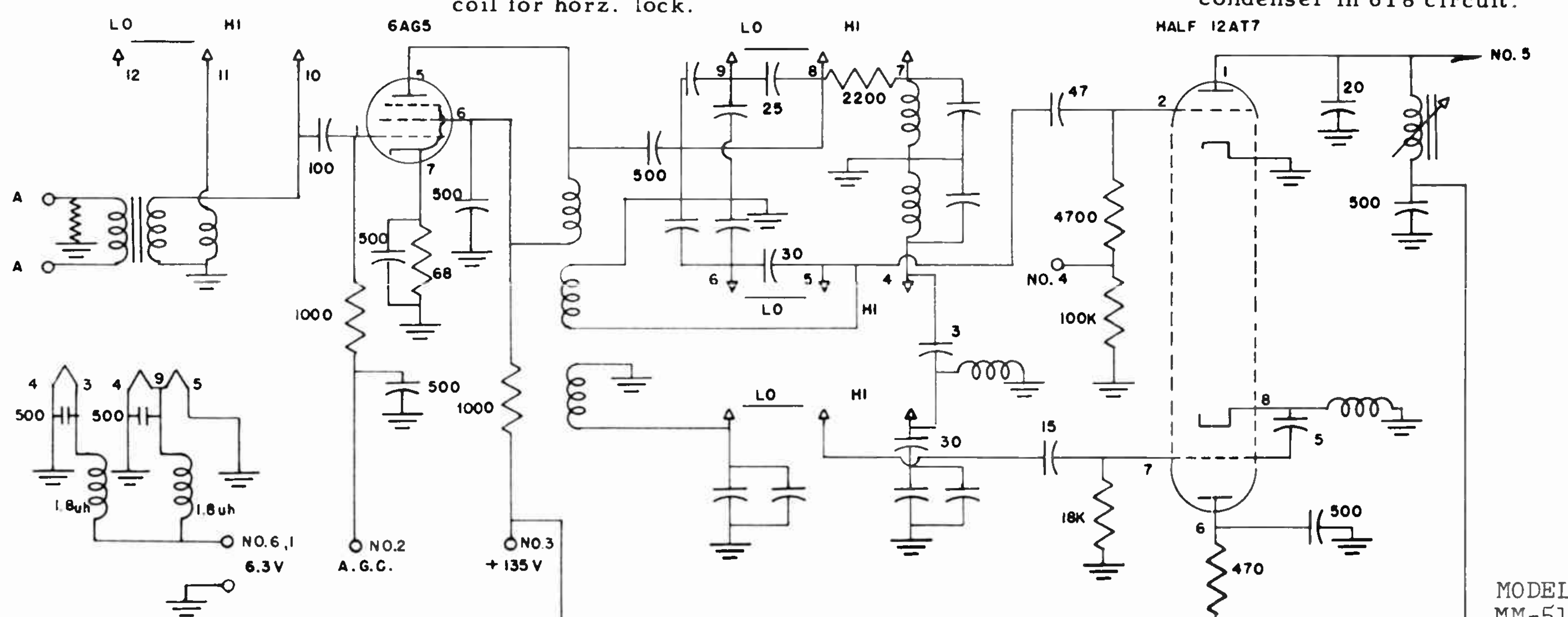
SYMPTOMS	CHECK	REMARKS
Excessive Raster Brilliance; Brill. Cont. has little or no effect.	Brill. cont. for short; C.R.T. cathode circuit; C.R.T.	
Trapezoidal Raster	Deflection Yoke.	
Light and Dark Vertical Bars Left Side of Raster	Horz. drive adjustment; Horz. damper tube, 6W4 and associated circuit.	
Light and Dark Vertical Bars Right Side of Picture	Last section of triple 40 mfd. input filter (CL 10039) for open or low capacity.	
Improper Focus or No Control of Focus	Focus coil; focus control circuit; picture tube; horz. drive setting.	Can be caused by too much or too little B+ current drain, shorted turns in focus coil, or gassy picture tube.
Smeared Effect in Picture	6AC7; Video peaking chokes for open.	
Sound Bars in Picture	Setting of fine tuning control; Incorrect slope on low freq. side of IF curve; 40 mfd. lytics in 140V. line.	
No Vertical Sync.	12AU7 and associated components; 6SN7 and associated components.	
No. Horz. Sync.	6AL5 and horz. phase detector circuit; horz. osc. control circuit.	For best results set horz. hold control in the center of its range and with weak signal input adjust A.F.C. coil for horz. lock.

SYMPTOMS	CHECK	REMARKS
No Horz. or Vertical Sync.	12AU7; .1 mfd. to C.R.T. grid for leakage; grid current in C.R.T.	C.R.T. may draw grid current if brilliance setting is too high, causing loss of sync.
Horiz. Syncs. in Center of Raster	6SN7; 6AL5; improperly connected Horizontal output transformer.	
Raster Very Rough on both Edges	Parasitics in 6BG6 horz. amp; 10 mmf. 1.5 KV from damper plate; horz. drive; Horz. output trans; 6W4.	
Horizontal Non-linearity.	Horz. drive and horz. linearity controls; 6SN7 horz. osc; 6W4 damper; damper resistor.	Too high a setting of the contrast control may cause the picture to distort.
Vertical Non-linearity.	Vert. size and linearity controls; 6SN7 and associated circuit and voltages.	Leaking .25 mfd. condenser on Pin #4 6SN7 will cause foldover at bottom of raster.
Weak Picture and Sound in Strong Signal Area	Weak RF, If, or video det. and amp. tubes; Check all voltages; Check for malfunctioning antenna system.	The R.F. and I.F. tuned circuits are precisely aligned at factory. Alignment should not be necessary except when components directly connected with these tuned circuits are replaced.
Sync. Buzz	Sound Alignment; IF Alignment; 4 mfd. Electrolytic condenser in 6T8 circuit.	Improper Setting of fine tuning and contrast controls will cause sync. buzz.



RCC TV10 TUNER
JMI TT-10004

MODELS MM-510T, MM-512C, MM-512T, MM-516C, MM-516C, XOB, XQA, XTA, XRA, XSA, XQR, XTR, XRPS, XRPT, XSPS, XSPT

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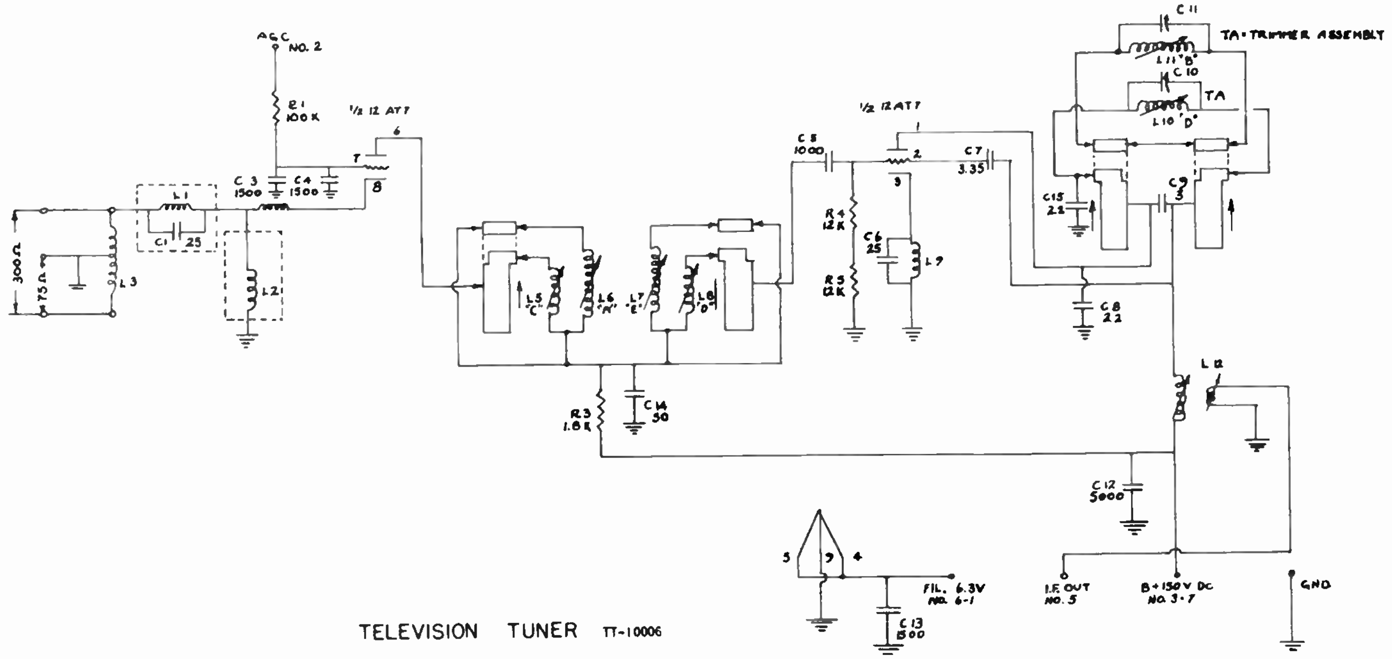
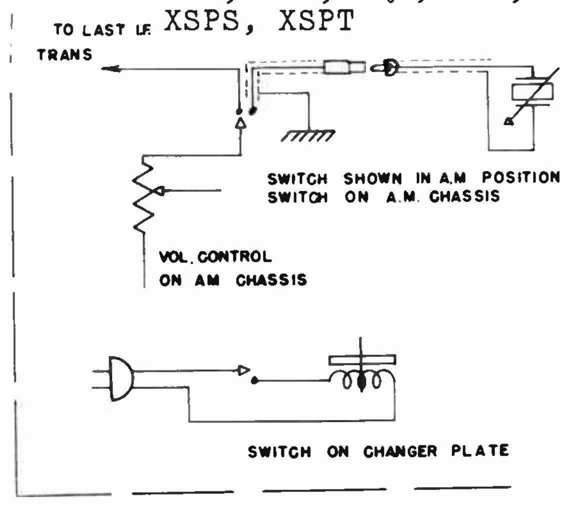


TELEVISION TUNER TT-10006

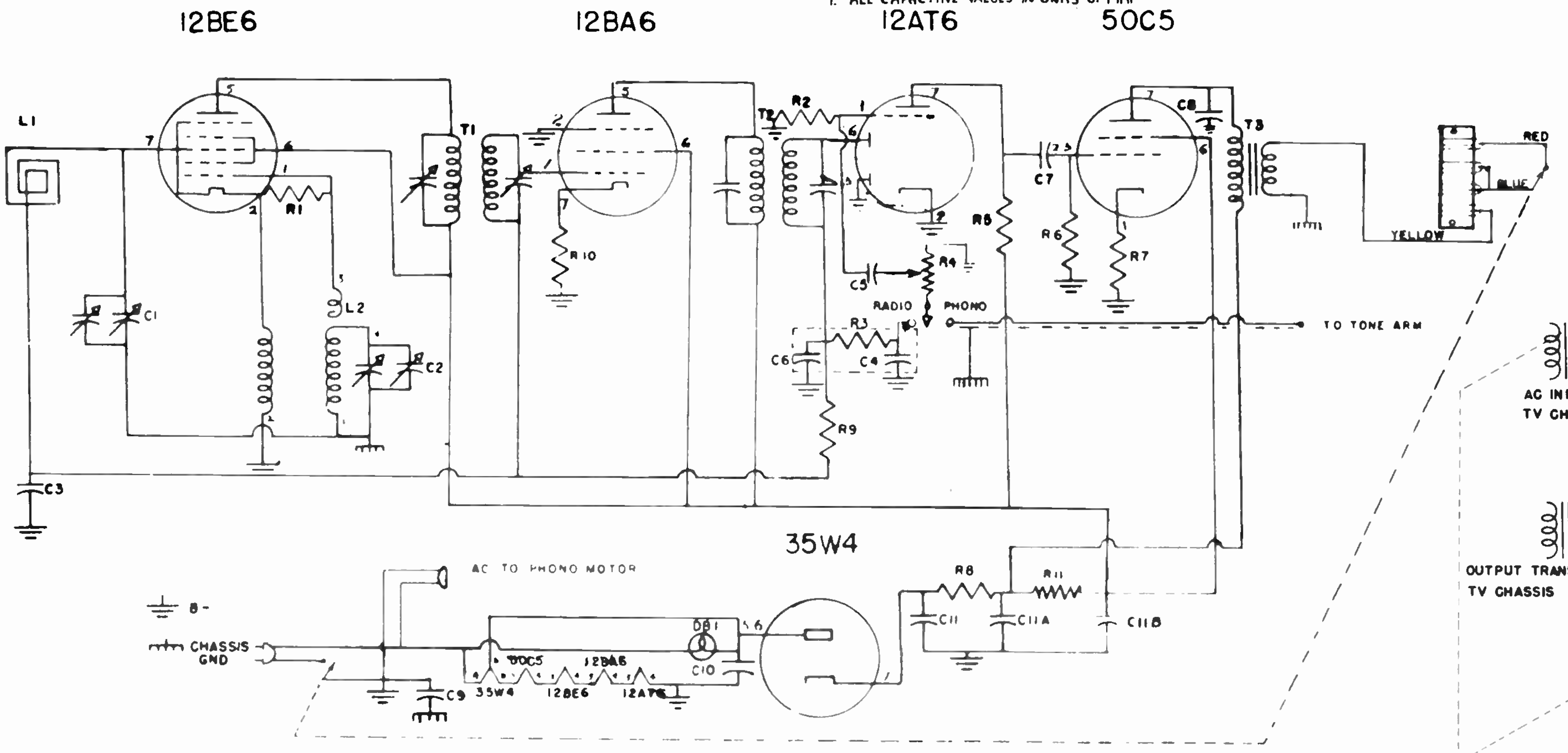
DRAWING NO. XX-10390

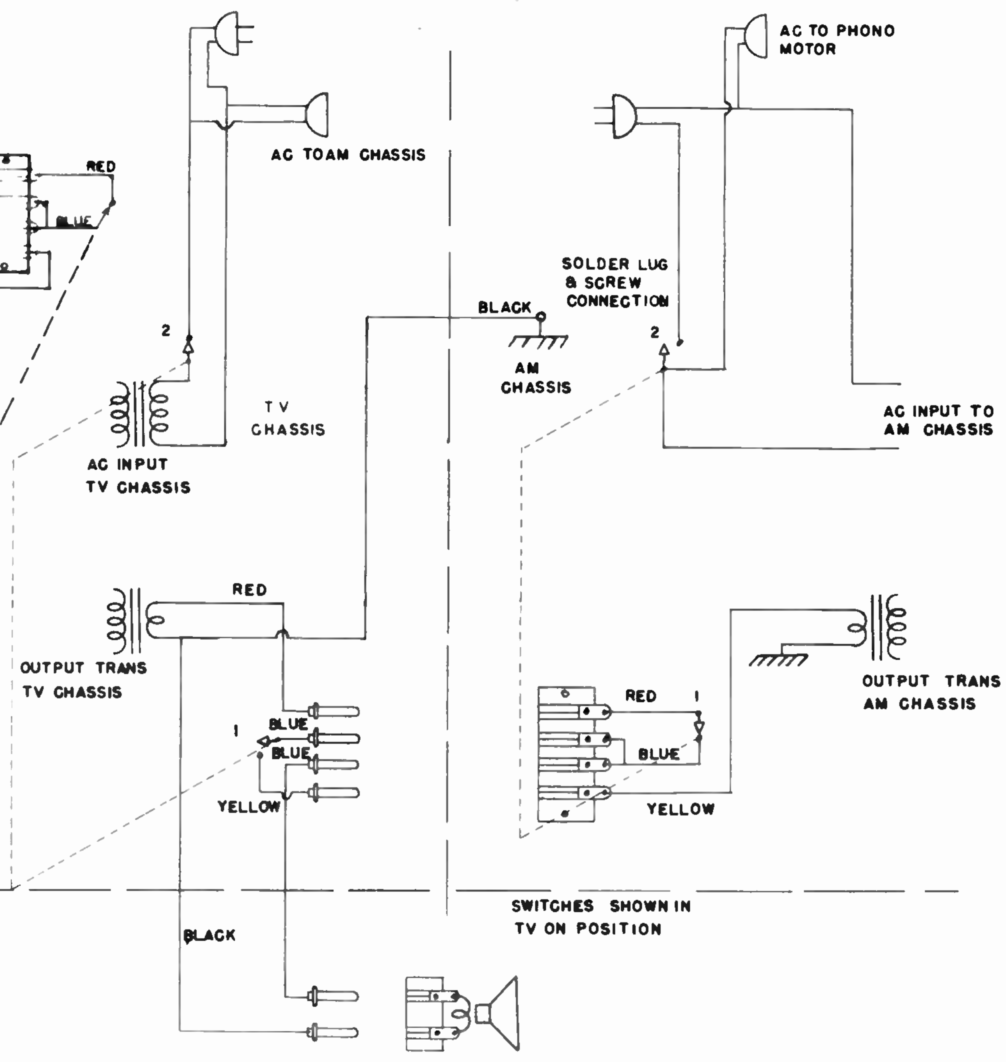


TV AM PHONO INTERCONNECTING DIAGRAM

DRAWING NO XX 10331

NOTES:
1. ALL CAPACITIVE VALUES IN UNITS OF MMF





CIR SYM	PART NO	DESCRIPTION
C1-2	CV-10025	CONDENSER VARIABLE
C4-6	CM-18281	" MICA 100 MMF
C5-7	CP-12802	" PAPER .005 MFD 200 VOLTS
C8	CP-12208	" " .02 MFD 600 VOLTS.
C9	CP-14154	" " .15 MFD 400 VOLTS.
C10-3	CP-14503	" " .05 MFD 400 VOLTS.
C11-11A-11B	CLC-00057A	" ELECT. 40-20-20 MFD 150 VOLTS.
DB1	DB-10000	DIAL LIGHT BULB NO. 47
L1	ALP-10026	ANTENNA LOOP
L2	TRC-10013-	OSCILLATOR COIL

CIR SYM	PART NO	DESCRIPTION
R1	RC-32202	RESISTOR CARBON 22,000 OHM 1/2 W.
R2	RC-31005	" " 10 MEG OHM 1/2 W
R3	RC-31003	" " 10,000 OHM 1/2 W
R4	VCP-112120A	VOLUME CONTROL 1 MEG
R5	RC-32203	RESISTOR CARBON 220,000 OHM 1/2 W
R6	RC-34703	" " 470,000 OHM 1/2 W
R7	RC-31500	" " 150 OHM 1/2 W
R8	RC-47700	" " 220 OHM 1 W
R9	RC-32204	" " 2.2 MEG OHM 1/2 W
T1	TS-10042	TRANSFORMER I.F. 1ST
T2	TS-10043	" I.F. 2ND
T3	TOC-10032	" OUTPUT
R10	RC-30680	RESISTOR CARBON 68 OHM 1/2 W.
R11	RC-44700	" " 470 OHM 1 W

CHASSIS MODEL 9015

DRAWING NO. XX 10334

SCHEMATIC 9015

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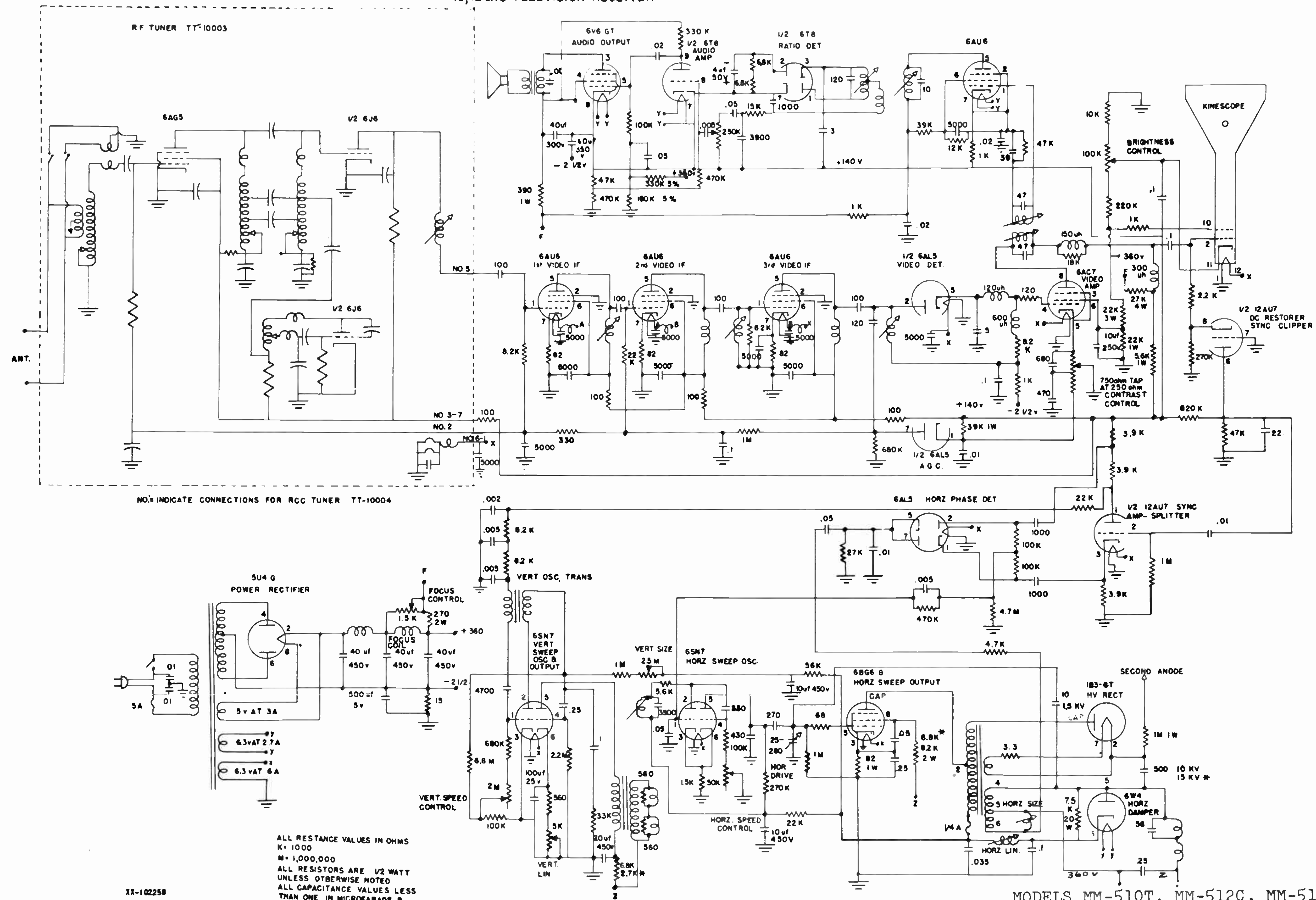
World Radio History

10", 12" & 16" TELEVISION RECEIVER



ALL RESTANCE VALUES IN OHMS
K= 1000
M= 1,000,000
ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE NOTED
ALL CAPACITANCE VALUES LESS THAN ONE IN MICROFARADS & GREATER THAN ONE IN MICRO-MICROFARADS UNLESS OTHERWISE NOTED
* 16" ONLY

MODELS MM-510T, MM-512C, MM-512T, MM-516C, MM-516T, XOB, XQA, XTA, XRA, XSA, XQR, XTR, XRPS, XRPT, XSPS, XSPT

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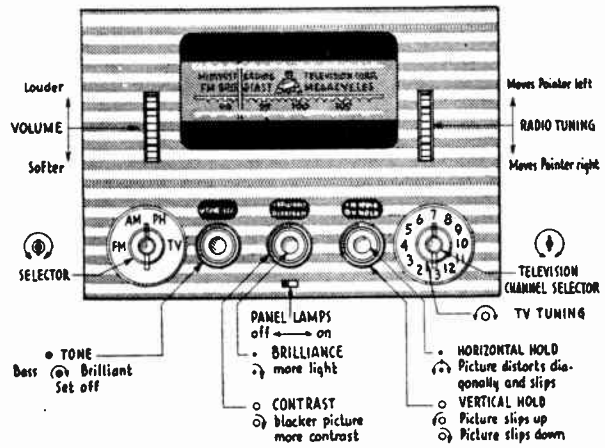
World Radio History

World Radio History

OPERATION



The controls on the panel are: two ivory plastic wheels whose rims extend out on either side of the dial, two pointer knobs, the one on the right being dual purpose, two dual purpose knobs, and one single purpose knob. This last knob has the same appearance as the dual knobs but is in one piece, being used to operate the **TONE** control and **OFF-ON** switch.

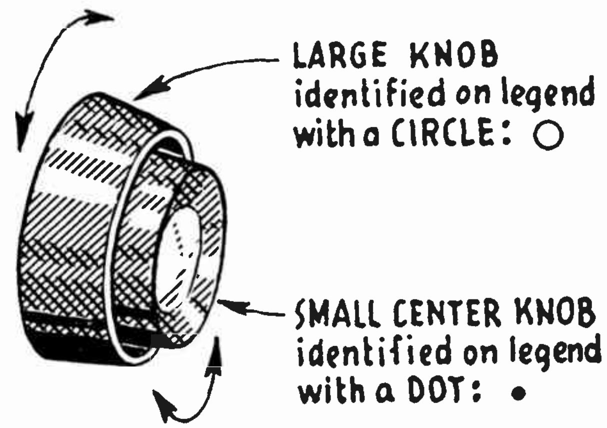
The **HOR HOLD & VERT HOLD** and the **BRILLIANCE & CONTRAST** controls are actually two knobs in one. There is a small knob in the center of the larger knob and these two can be turned separately. In the small window above each control is a legend describing the control, the dot before the name refers to the small center knob whereas the circle refers to the larger part of the knob.

Until you have used the receiver enough to know what each control does it will be best to follow a step by step procedure. This is given in skeleton form on the card which is attached to the receiver. These same steps are described here in greater detail, with suggestions and further information about the use of the controls.

Your Midwest Radio-Television receiver provides radio reception, phonograph reproduction and television programs. Radio reception includes the standard American Broadcast band and the FM Broadcast band.

The three speed automatic record changer will play twelve 10 inch records or ten 12 inch records or ten intermixed sizes, either all standard, all long play microgroove, or all 45 rpm 7 inch, and stops after the last record is played. The receiver, however, remains on and must be turned off manually.

The television programs may be chosen from any of the television stations in your area.



Dual control made of two concentric knobs which are rotated independently.

The first step to select the type of entertainment you wish is to turn the **SELECTOR** lever. This lever has four positions where the following letters appear: **TV**, **PH**, **AM** and **FM**. These letters represent television, phonograph, and radio bands AM–Standard American Broadcast and FM–FM Broadcast.

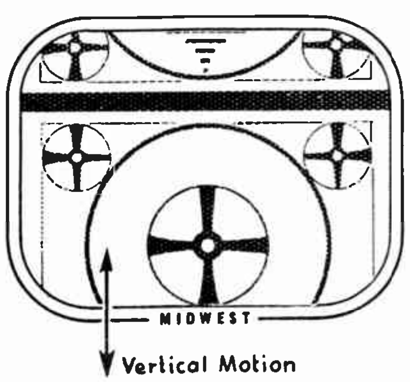
To turn the receiver **ON** rotate the **TONE** control knob clockwise. The **OFF-ON** switch is operated by the first few degrees of rotation of the **TONE** control after which it serves to change the tone, reducing bass and boosting high frequencies as it is rotated clockwise. Since the best fidelity is obtained when this control is at the intermediate point, it is best to leave it in this position until all adjustments are completed after which it may be returned to the setting most pleasing to you. This will depend somewhat upon the kind of program being received.

Having selected one of the radio bands, preferably the American Broadcast band A for first trial, roll the **VOLUME** control wheel up to increase volume until some sound or signal is heard.

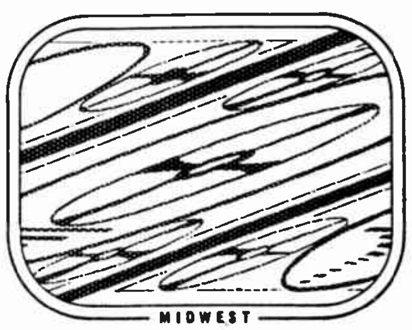
To tune to any station roll the radio **TUNING** control wheel up or down, upwards motion moves the dial pointer to the right and downwards rotation of the **TUNING** drum moves the pointer to the left.

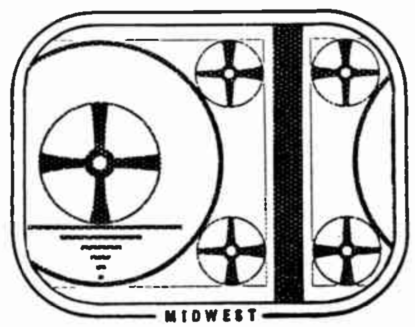
The dial calibration for the A band, Standard Broadcast, is from 55 to 160, if you add a zero to these numbers they will represent kilocycles. For example 700 kilocycles, WLW, appears on the dial as 70.

Your FM Broadcast band is calibrated in channel numbers, these channel numbers were assigned by the Federal Communications Commission for the convenience of the general public. However, in many parts of the country FM stations use a frequency designation so that we repeat the calibration in megacycles on the foil dial.



Vertical Motion





Horizontal Motion

Adjust **VOLUME** for a comfortable level. You should be able to hear the TV program at this point. If you do not hear it, turn the **TV TUNING** control full left and then slowly right until you do hear the program.

The **TV TUNING** control knob is the round, brown knob behind the **CHANNEL SELECTOR** pointer knob. The **CONTRAST** and **BRILLIANCE** controls are a dual concentric pair, the center knob is used to control picture brightness and the outer ring knob is used to adjust picture contrast. First turn the **CONTRAST** control full left, then turn **BRILLIANCE** control to the right only as much as is necessary to make a bright screen. The **BRILLIANCE** control should not be turned past the point at which the picture begins to grow larger, since detail is lost due to loss of focus.

Now advance the **CONTRAST** control, if necessary, to produce a visible pattern in black and white on the screen. It may be necessary to turn the **BRILLIANCE** control back so that the picture does not grow.

Too much contrast, even after everything is adjusted will cause the picture to be poor in detail and may cause flickering and distortion or complete loss of holding so that it moves sidewise. The pattern then will probably be unintelligible because of rapid motion up and down and sidewise, and there may be multiple patterns.

Before the **HOLD** controls are adjusted these motions are combined on the screen. The result is an appearance of violent motion. You must first stop the vertical motion with the **VERT HOLD** control. Beginning with it in the full counter clockwise position turn it slowly to the right until the horizontal black bar has slowed enough to be seen. Then proceed carefully to turn the control further until it stops altogether. At this setting you will notice that the bar has been pulled into the top of the screen, and slight movement of the **VERT HOLD** control does not set it in motion again.

The **HOR HOLD** may now be rotated towards the position where horizontal motion slows down. The first effect will be a reduction in the number of diagonal lines, nearer to correct setting results in an upright pattern which may still be sliding to left or right. As the proper setting is reached a vertical black bar, much larger than the one observed in adjustment of the **VERT HOLD**, may be seen. This black area will slip into the left or right side of the picture screen. Further adjustment should then stabilize the picture so that no flicker or bending occurs.

If there is trouble reaching a steady picture, reduce the **CONTRAST** control again until the screen is dim and advance the **BRILLIANCE** for visibility. During the first few minutes the **HOLD** controls may let loose of the picture and require readjustment but the new setting will be close and much more easily found. Once they are set and the receiver has been on for some time neither hold control should need further adjustment, since both the vertical and horizontal circuits lock in with the transmitter.

The **TV TUNING** Control is primarily for tuning the picture to the very best detail. Starting from full left the picture should be soft and lacking in sharp detail. As the control is turned right there is first a point, fairly critical, where a herringbone pattern begins to show over the entire picture. Turn slightly more and this pattern disappears. Further rotation to the right results in the herringbone pattern again. Past this second "pattern" point the picture rapidly becomes weak and streaked. The best position is right between the "pattern" points and at this point the picture is best. There may also be a buzz in the sound if the **TV TUNING** is not set at this critical point.

You have, of necessity, become familiar to some degree with the purpose of the **CONTRAST** and **BRILLIANCE** controls while setting the **HOLD** controls. When the **CONTRAST** is turned clockwise the **BRILLIANCE** control may need adjustment counter-clockwise, as this direction of adjustment is continued, in small steps, the picture becomes more black and white with less of the grey tones which give you details in shadow and highlight areas. Note again that if too much contrast is used the picture will bend and distort. You must choose, by repeated trial settings of the **BRILLIANCE** and **CONTRAST**, the best degree of contrast for your normal viewing distance, if you become lost or confused in this step start all over by turning the **CONTRAST** completely counter-clockwise.

This initial adjustment may seem involved at first. Actually it involves only these steps:

1. Turn receiver **ON** by turning the **TONE** control clockwise.
2. Select the **CHANNEL** on which the desired television program is being broadcast.
3. Turn **CONTRAST** full counterclockwise.
4. Advance the **VOLUME** control and tune in the sound with the **TV TUNING** control.
5. Advance the **BRILLIANCE** control clockwise until the picture screen glows, then advance the **CONTRAST** control until the picture appears.
6. Stop movement of the picture with the **HOLD** controls.
7. Tune **TV TUNING** for sharpest picture.
8. Adjust **CONTRAST** and **BRILLIANCE** for the desired shading.

After this, adjustments, necessary when the receiver is used again need only involve:

1. Turn the receiver **ON.**
2. Select the desired **CHANNEL.**
3. Adjust **VOLUME** and **TV TUNING** for sharpest picture since these may be slightly different on each channel.

The **HOLD** controls should not be touched unless necessary.

There is sufficient brightness available on the screen for comfortable viewing inside the home during daylight, unless in direct sun or skylight, and in the usual home illumination at night. If you desire to dim the room lights the picture will appear much brighter and in that case the panel lamps might be too noticeable, the **PANEL LAMP** switch is provided so that these may be turned **OFF.**

In the section following are described various controls not on the front panel which you can adjust to cure certain faults or failure.

NON-OPERATING ADJUSTMENTS

There are a number of seldom used adjustments for centering the picture, correcting distortion in the picture, changing the size of the picture and for rotating the picture to line up square on the screen. Some of these controls may never be needed but they must be available when aging of the parts, tube changes or some actual physical change is caused by violence (as may occur in shipment) makes it necessary to correct any of the things mentioned above.

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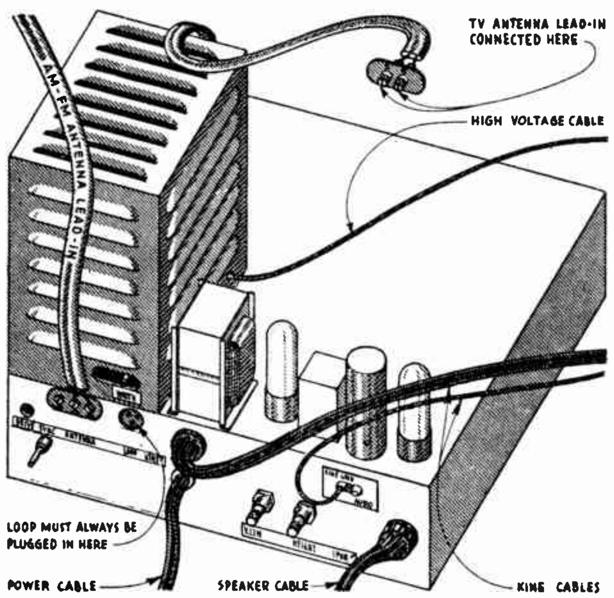
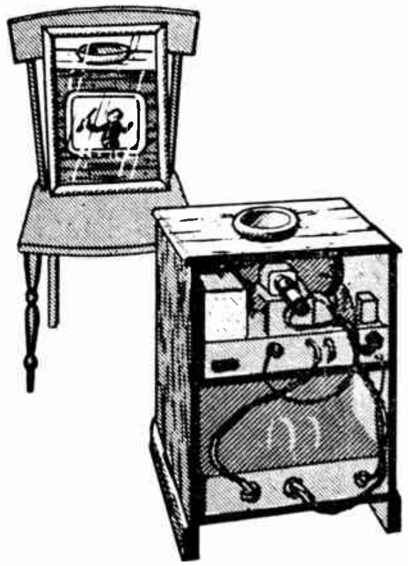
WARNING

It is here necessary to warn you against reaching into the receiver past the rear apron. It is necessary to use voltages which can be deadly if contacted and in any case would result in an unpleasant shock, every precaution has been taken for your safety by enclosing the high voltage, 14,000 volts, in a metal cage, using low regulation of voltage and by using high safety-factor wire for the lead to the kinescope. This is a bright red wire which is plugged into the side of the picture tube, if it has come loose the open end, although hooded by a rubber cup, may be dangerous. Other voltages do not exceed 400 volts but will supply considerable current and can also be dangerous, these voltages are carried in the cables connecting the two chassis together and in the speaker cable.



The metal chassis and the controls on the rear apron of the chassis may be adjusted in complete safety if you do not at the same time handle any of the cables or wiring connected to the chassis, or when the receiver is disconnected or turned off.

HORIZONTAL SYNC. The horizontal hold control on the front panel is a vernier control and is not too critical in adjustment. The **HOR SYNC** control on the rear apron of the chasis is critical and some care should be used in its adjustment. As long as the panel control, **HOR HOLD**, can be used, do not touch the **HOR SYNC** but when the panel control must be turned full left or right then, in small adjustments, rotate the **HOR HOLD** towards a center position and follow it with compensating adjustments of the **HOR SYNC** needed to keep the picture steady.



To observe the screen while adjusting the controls on the rear of the chassis you will find the use of a mirror is very helpful.

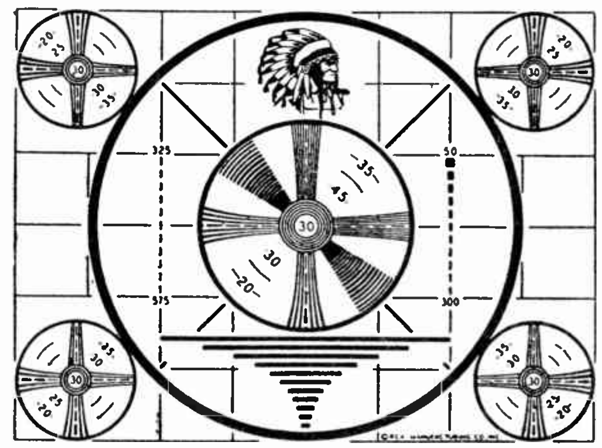
WIDTH. When the picture is too small or too large, both width and height can be adjusted within limits. When the picture is too small because of low line voltage, weak tubes or mechanical reasons there may not be enough adjustment. The **WIDTH** control is a threaded screw and as it is screwed out the picture will slowly increase in width.

HEIGHT. To increase or decrease the size of the picture vertically rotate the **HEIGHT** control. Although the width and height are adjusted separately the final adjustment must result in a ratio of 4 units wide to 3 units high, or there will be distortion of the picture.

LINEARITY. Distortion of the picture proportions may still occur even with the correct aspect ratio in use. This distortion may occur in either the transmitter or receiver, this you can check if there is more than one television transmitter in your locality by comparing the test patterns to see if the same sort of distortion occurs on both. When this distortion is determined to be in the receiver, and is pronounced, correction may be undertaken, the work must be done when there is a pattern being transmitted. Each station has a variation of the fundamental pattern, one of these is shown below but any pattern having a large circle will provide a picture where non-linearity is easily noticed in the distortion of the circle.

VERT LIN control interacts with the **HEIGHT** adjustment so that each control affects both height and linearity. You will find that with increased height caused by advancing the **HEIGHT** control the pattern is stretched slightly more at the bottom.

The **VERT LIN** control actually has most effect on the top half of the pattern, as this control is turned to increase the height, the top half of the pattern is stretched more than the bottom. This sort of adjustment can be done most easily by reducing one of these controls for minimum height and then setting the other for correct height. Now advance the first control in small steps, at each step reducing height with the second control, as the pattern approaches good vertical linearity the adjustments should be made in still smaller steps. You must use your judgment as to the best relative setting of **HEIGHT** and **VERT LIN.**

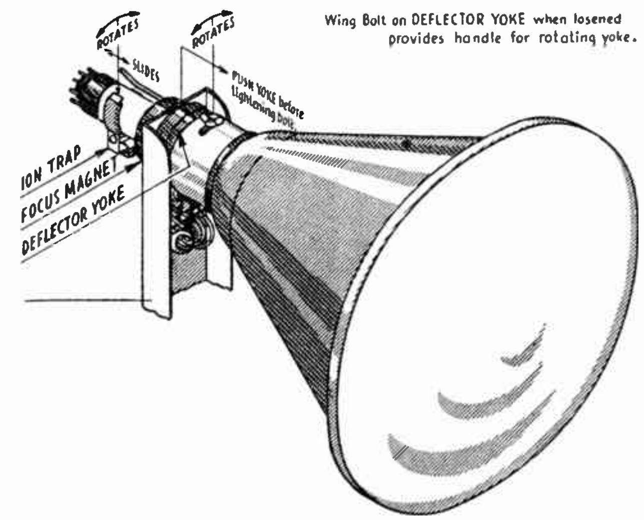


There is no adjustment of horizontal linearity. This is held to the commercial limits of plus or minus 10%, this being evenly distributed. There is also a commercial limit of plus or minus 2% on trapezoid, pin cushion and barrel effects.

The only control over rotation of the picture is a mechanical one, and as a corollary, if the picture is not square in the frame there has been a disturbance of the mechanical adjustments. Besides this mechanical control, ion trap adjustments are made with mechanically operated controls. To make these changes it is necessary to reach past the rear of the chassis, where an additional hazard is encountered in addition to the possibility of shock.

FURTHER WARNING

The kinescope (picture tube) being a large glass bottle with the inside evacuated, has a few tons of pressure over its surface because of atmospheric pressure. The face is thick but if a fracture of the glass is started by a blow or scratch so that a sudden collapse occurs, the force of the resulting implosion may throw all sizes of pieces of glass with dangerous violence and in every direction. The violence of the implosion can not be predicted and it may result merely in no more damage than would occur when a small lamp bulb is broken, further, the amount of abuse that the kinescope will withstand is likewise not predictable. Some of these large tubes have collapsed even when no visible or known force was used. To be safe, never hold the tube against the body or handle it without gloves and eyeglasses or goggles.



Here are the mechanical adjustments that can be used to rotate the picture in the frame, correct corner cutting and adjust the ion trap. To make them accessible when the receiver is in the cabinet, you may remove the wood strip holding the paper tube over the small end of the kinescope.

FOCUS: Midwest uses an all PM focus unit, to change the effect of this device, there are two **FOCUS ADJUSTMENT SCREWS** as shown in the illustration.

The screws are magnetic material so that they will provide a variable, alternate path for the magnetic field generated by the Alnico magnets in the unit. If an iron screw driver is used, it also distorts the magnetic field, so that you should use a copper penny or a non-ferrous screw driver to adjust these screws.

This aspect ratio is transmitted by all stations.

The same ratio must be used in the receiver.

Otherwise — *this occurs.*

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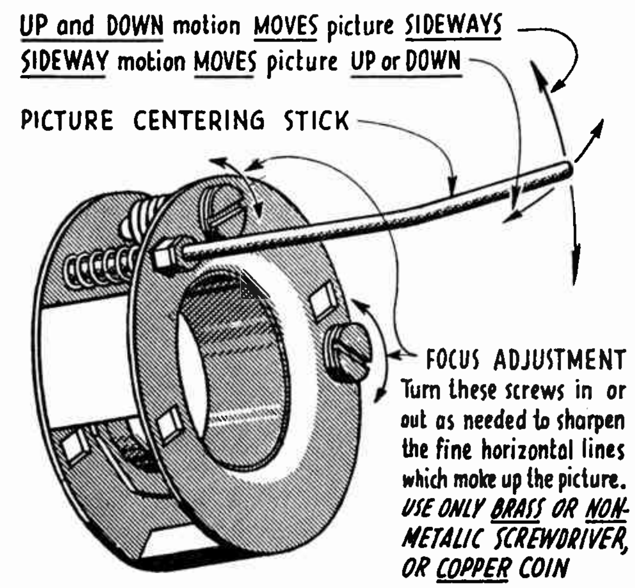
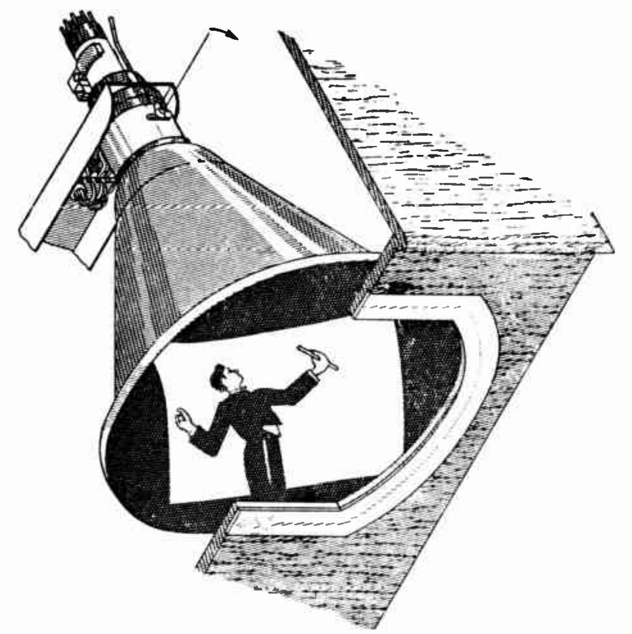
At one certain position there will appear very fine horizontal lines in the picture screen, at a viewing distance of several feet these would not be visible and this may be the best setting. If you prefer, however, a small amount of rotation in either direction will cause the picture to smooth out and appear slightly better if you are going to watch the screen from a distance of less than three feet.

CENTERING: To center the picture on the face of the kinescope, there is a sliding aperture plate in the focus unit, this plate is moved by the **CENTERING CONTROL STICK** so that the axis of the magnetic field in the gun



of the kinescope is tilted. Because of the way the plate is held, the movement of the **CENTERING STICK** combines the vertical and horizontal movement of the picture, if you set up a mirror in front of the receiver and watch the picture in the mirror while adjusting the **CENTERING**, this is not a diffcult adjustment. The illustration above shows roughly the relation between the motion of the picture and the motion of the **CENTERING STICK.**

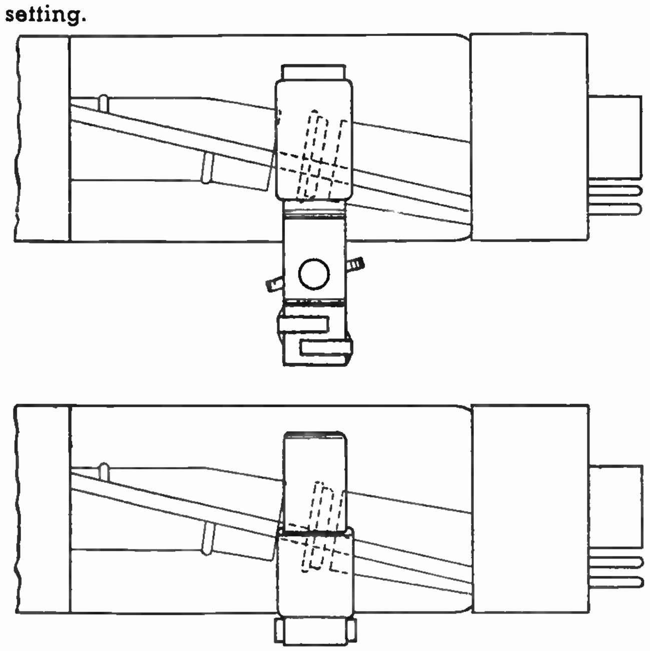


TO ROTATE the picture in the frame you simply loosen the **WING BOLT** one half turn and, using it as a handle, rotate the **DEFLECTION YOKE** in the metal tube to straighten up the picture. The receiver must be operating for you to observe the correction being made, otherwise you will need to make a number of trial adjustments. Each time the **WING BOLT** is loosened the yoke must be pushed forward, using the paper collar which is exposed between the metal yoke mounting tube and the **MOUNTING FOOT.** The relation between the rotation of the picture and the yoke is direct, being in the same direction and amount, be sure to tighten the bolt only after the yoke has been pushed forward against the kinescope.

THE ION TRAP is a device for removing ions from the electron beam generated in the gun of the kinescope. The ions removed are molecules of matter which have been excited by electron bombardment so as to have a negative charge and if allowed to remain in the electron beam will eventually cause a dark spot in the center of the kinescope tube face since they continually strike a small area, not being as easily bent from their path by the magnetic fields used to bend the electron beam. This function is not demonstrable but you may be sure it is operating if there is a picture on the screen, since wrong placement of the ion trap, or no trap, on tubes designed for them results in no picture or light on the screen or in a corner of the picture being cut off. The aluminized kinescope and hard vacuum kinescopes do not use ion traps.

There are numerous types of ion traps, all differing in appearance but identical in action. Two types are illustrated here, showing approximate location on the gun of the kinescope.

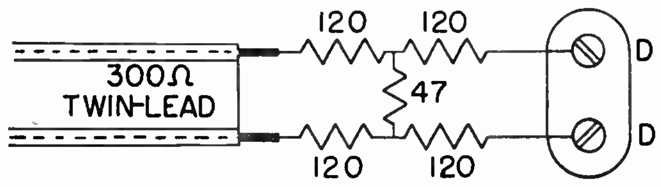
The principle involved is the same one used by the mass spectograph where isotopes are separated. If the ion trap is placed on the kinescope as shown here, only slight movement will be needed to give you the desired results. First, rotation will show that light intensity is peaked at one point and second, longitudinal movement will show a cutting of picture corners except at one point, by combining the back and forth motion with rotation side to side will quickly show you the optimum setting.



Note: If polarity of the magnets are reversed these traps would be up instead of down, as shown. Either position is OK.

There are no more corrective adjustments unless the chassis is removed from the cabinet and these adjustments must then be moved only when service equipment is used to make and check them. However, you will find some information of interest to you in the following section on service and we suggest that you should finish reading this manual.

of black areas, this is the result of loss of all low video frequency detail. To correct this trouble insert an attentuator pad in the 300 ohm line to the receiver antenna terminals. The values shown here are recommended, using only carbon resistors and adding sections until detail is obtained in the picture.



Interference from unwanted signals, such as the image of an FM station or high frequency diathermy and automatic control devices should be eliminated as far as possible with relocation of the antenna.

To reduce interference from shortwave stations, parallel tuned traps may be installed, one in each lead of the twin lead. A high-pass filter may also be used. For strong short wave interference additional RF filter may be necessary in the power line, your Midwest receiver has two .01 mfd. condensers from the lines to chassis.

Interference from VHF stations may be attenuated by an open stub wave trap. Cut a length of twin lead which is 1/4 the wave length of the interfering station (reduce length by the V. P. factor), connect one end across the antenna terminals and leave the other end open. This effectively shorts the lead-in at the interfering frequency only. If using 300 ohm twin lead with a V. P. of 82% divide 201 by the station frequency in MC for the answer in feet. In "fringe" areas a directional, narrow band antenna will discriminate against interference, a tuned "booster" would also increase the selective characteristics of the receiving set-up.

Adjustment of the controls, both operating and concealed non-operating is described in detail in the two sections of this manual immediately preceding. Failures ranging from complete lack of light on the screen to slight non-linearity in the picture can be caused by

Black dashes - caused by arcs or ignitions systems

Herringbone effect - caused by radio frequency only

Sound bars - caused by modulated carrier

loss of detail - caused by excessive signal

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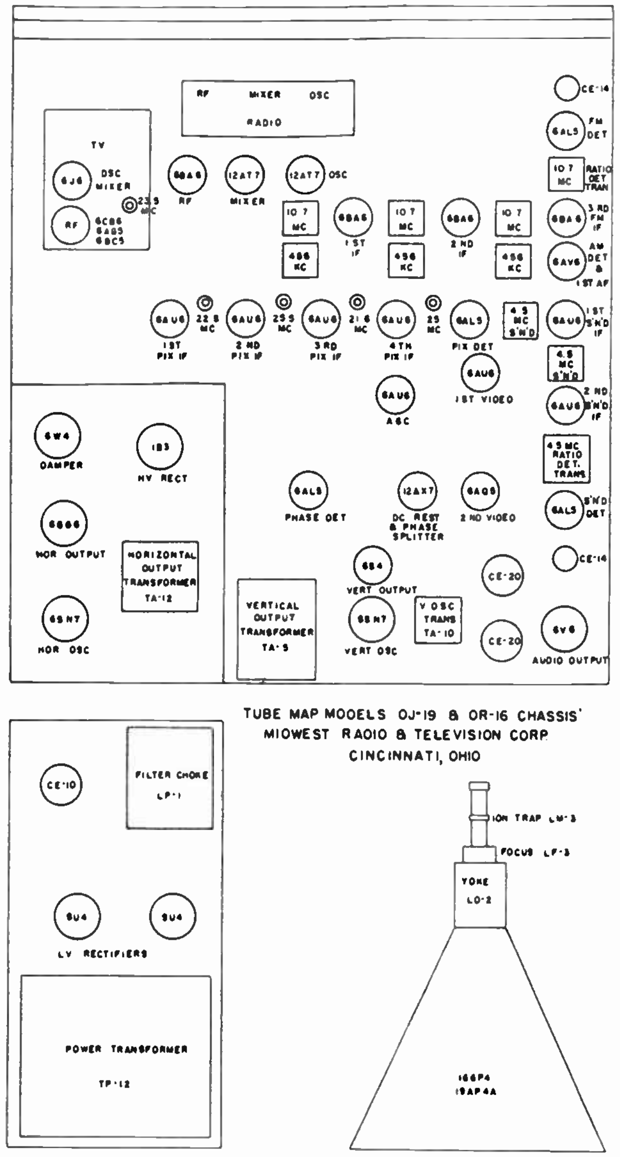
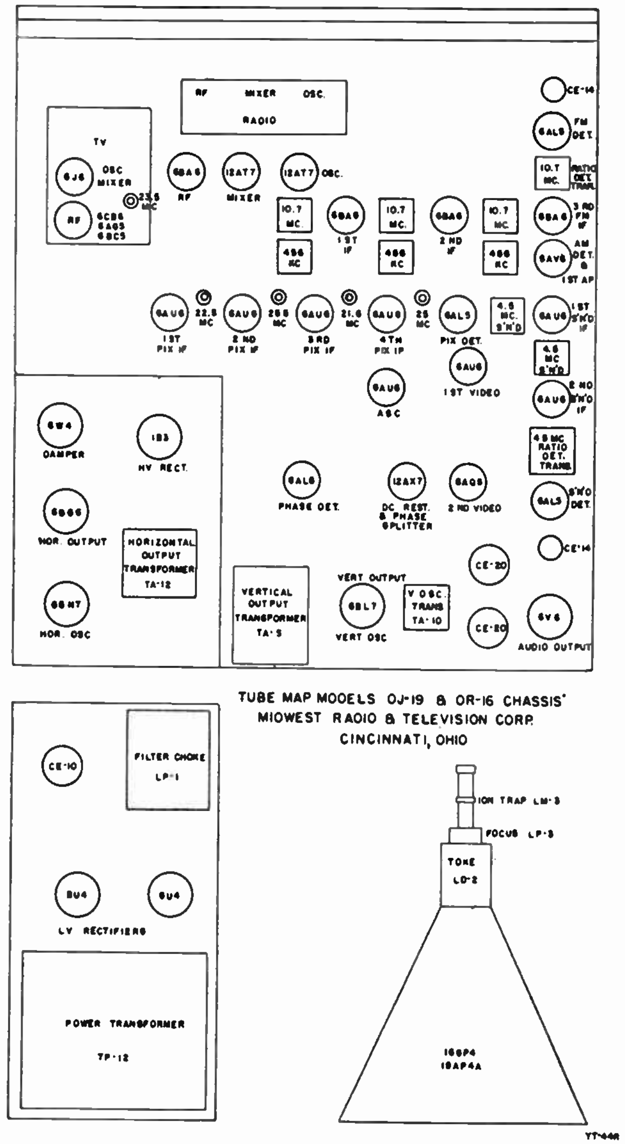


TUBE MAP MODELS OJ-19 & OR-16 CHASSIS'
MIDWEST RADIO & TELEVISION CORP
CINCINNATI, OHIO



TUBE MAP MODELS OJ-19 & OR-16 CHASSIS'
MIDWEST RADIO & TELEVISION CORP
CINCINNATI, OHIO

misadjustment of these controls, and it is worth the time required to check them before removing the receiver for shop service.

If failure is not due to improper installation or operation you will find tube trouble is the major cause for failure.

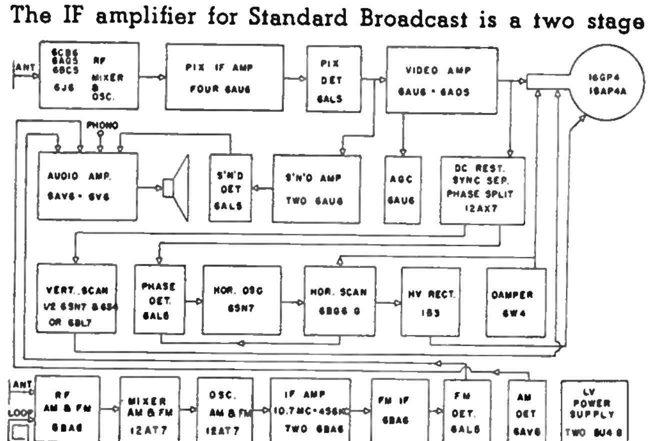
Depending upon the type of trouble encountered certain sections of the receiver can be suspected, so that you do not usually need to check all the tubes in the receiver.

This block diagram and the tube map provide the information necessary to locate physically the sections of the receiver where tube trouble can be, assuming that experience or previous instruction provides you the knowledge to interpret the symptoms. No attempt is made in this manual to duplicate the abundant and excellent literature on television circuit theory now available.

The following description will supplement the block diagram with some detail about the type of circuits used.

A tuned RF stage is used on both radio bands, a 6BA6 pentode is the RF amplifier. Separate triode mixers are used for AM and FM, a 12AT7 dual triode is the mixer. Another 12AT7 dual triode is used or separate AM and FM local oscillators.

The IF amplifier for Standard Broadcast is a two stage



amplifier using six tuned circuits and two 6BA6 remote cut-off pentodes. The AM detector uses the diodes of a 6AV6, which also generates automatic volume control voltage.

The IF amplifier for FM Broadcast reception has three stages, over coupled for band width and using eight tuned circuits. One additional 6BA6 is needed here for the extra IF amplifier stage. The detector is the accepted Ratio Detector using one 6AL5 duo-diode for the very best in fidelity and noise rejection.

The television carrier is amplitude modulated with the video signal and only one side band is transmitted, the sound carrier is frequency modulated and is always 4.5 megacycles higher. Our local oscillator is always 25.75 megacycles above the picture carrier and 21.25 megacycles above the sound carrier and thus produces two beats, one for the Pix intermediate frequency amplifier. The front end is a completely shielded unit containing a tuned balanced 300 ohm input to a 6AG5 pentode RF amplifier, with automatic contrast control voltage applied to its grid, the coupling from RF plate to mixer grid is made with tuned, over-coupled circuits for wide band flat top response, the mixer tube is ½ of a 6J6, the local oscillator is the other ½ of the 6J6. The sound IF amplifier has two transformer coupled, tuned stages using two 6AU6 adjacent cut-off pentodes followed by a ratio detector, which is a 6AL5 duo-diode. Automatic volume control voltage generated in the detector is applied to the first and second sound IF tubes. The audio system has two stages, with a continuously variable, double action tone control in the first stage for full control over both bass and treble. The first audio stage is the triode section of a 6AV6, followed by a class A single 6V6. The speaker is a 12 inch P.M.

The adaptor models omit the 6V6 audio output tube.

The Pix IF amplifier is a four stage stagger tuned wide band amplifier, substantially flat from 25.75 to 22 megacycles, two traps are used for attenuation of the sound IF carrier. Four 6AU6 sharp cut-off pentodes are used in the picture IF amplifier, fast automatic keyed picture contrast control voltage is applied to the control grids in the first three stages. The Pix detector is a 6AL5.

The video amplifier is a two stage wide band amplifier using series and parallel peaking coils to hold the response flat from 40 cycles to 4 megacycles. The first stage has a 6AU6 sharp cut-off pentode and the second stage uses a 6AQ5 beam power amplifier.

At this point the black level is automatically set (brightness level is thus automatically established for each scene) by the dc restorer circuit, ½ of a 12AX7 is used.

The 12AX7 is used to separate the sync tips from the complete modulation. The second section is a phase splitter, to provide 180° different horizontal sync tips for the 6AL5 phase detector. The vertical sync integrator is also fed from the plate of the second section. The 6AL5 phase detector compares the horizontal oscillator frequency with the transmitter sync frequency and develops a DC control voltage which is applied to the horizontal oscillator.

The vertical scanning generator consists of a triggered blocking oscillator, discharge and peaking circuit, followed by a power output stage, transformer coupled to the deflection yoke on the kinescope. The self blocking oscillator is ½ of a 6BL7 dual triode which is triggered by the vertical pulse formed by an integrating network directly from the transmitted sync pulses, the output tube is the other ½ of the 6BL7. Some models may use ½ of a 6SN7 for oscillator and a 6S4 for output. The horizontal scanning generator is a combined sine and multivibrator oscillator, cathode coupled, a 6SN7 dual triode is used. Frequency is controlled in most part by the tuned circuit. **AFC** and the **HOR HOLD** control correct the frequency within narrow limits. The horizontal scanning output stage uses a 6BG6G beam power amplifier. This is transformer coupled to the deflection yoke on the kinescope.

A 6W4 high-vacuum rectifier is used as a damper load in the output circuit to prevent shock excited oscillation after retrace, to partially shape the sawtooth scanning current and to salvage some power for reuse by the output tube.

For brilliance and definition the kinescope requires a mimimum of 13,000 volts at the anode. To provide this voltage the peak voltage produced in the output transformer during field collapse is rectified and filtered. A 1B3 half-wave high-vacuum rectifier is used.

The low voltage power supply is designed for continuous service at the rated current and 400 volts. Two 5U4G full-wave high-vacuum rectifiers are employed in a full-wave circuit. Filter capacitors total 100 microfarads in the hum filter circuit. Further details of the circuit are available by study of the schematic diagram.

When failure of the receiver occurs because of components or circuit alignment drift, shop service is indicated. Here again a knowledge of theory, or experience, is necessary to interpret the symptoms for approximate location of the faulty circuit. Further tests in that circuit will either confirm or refute your deduction. To make these tests we suggest that the following equipment is desirable:

(1) General purpose volt-ohmmeter, ac and dc.
(2) Vacuum tube voltmeter, with probe for 30 KV dc.
(3) Oscilloscope.

The oscilloscope need only to have 15 cycles to 22 KC sweep frequency and vertical amplifier response to 70 KC to observe response of the IF and Video amplifiers using RF sweep generators.

Drift in the tuned circuits should be minor, even over a long period of time and with tube changes. When the operation of the receiver is indicative of drift the alignment of the circuits should be first observed with appropriate sweep generators on an oscillograph, using accurate, preferably crystal controlled, markers to determine the limits of the bands covered. Experience and self confidence will not replace this necessary display equipment and attempts to align with step by step procedure always results in an inferior alignment. The equipment needed for service alignment, is shown here:

(4) a. 0-10 megacycles sweep, 1/10 volt minimum.
b. 19 to 29 megacycles sweep, 1/10 volt minimum.
c. 54 to 88 MC and 174-216 MC ± 6 megacycle.

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(5) a. Accurate CW marker signals at 21.25 and 25.75.
b. Accurate CW marker signals for RF alignment at

Channel	Video MC	Sound MC	Oscillator MC
2	55.25	59.75	81
3	61.25	65.75	87
4	67.25	71.75	93
5	77.25	81.75	103
6	83.25	87.75	109
7	175.25	179.75	201
8	181.25	185.75	207
9	187.25	191.75	213
10	193.25	197.75	219
11	199.25	203.75	225
12	205.25	209.75	231
13	211.25	215.75	237

(6) Crystal probe for detection of resonant response for display on the oscillograph.
(7) Accurate CW signal at 4.5 MC for Picture Sound IF.
(8) Accurate CW signals from 20 to 26 MC for Pix IF point alignment.
(9) 10.7 MC ± 250 KC deviation for FM IF.
(10) 456 KC AM modulated for AM IF.
(11) Accurate signals for Radio RF alignment.

Radio Band	Coil Adj.	Trimmer Adj.
AM	560 KC	1500 KC
FM	----	105 MC

Item (4) is combined in the **RCA WR-59A** sweep generator but there is no objection to separate generators and the **0-10 MC** video sweep is not necessary unless the components in the video amplifier are replaced with physically or electrically different components. Complications caused by this sort of repair are very difficult to clear.

Item (5), (7) and (8) is combined in the **RCA WR-39A** calibrator and in the Kay Electric megamarkers, but any calibrated generator or crystal calibrator which you have checked against some frequency standard may be used, the markers should provide 1 or 2 volts so that the coupling may be very loose, and ideally should be by radiation.

The television RF response is shown here, the frequency of the markers for Pix carrier and sound carrier were given previously with the list of marker frequencies needed.

The schematic shows the frequencies for the Pix IF alignment together with the procedure and final curve. The Pix Sound IF alignment is also given in the schematic.

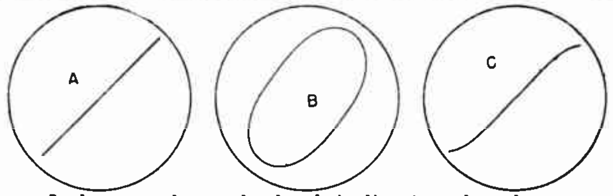
The television RF circuits are overcoupled and only appropriate alignment techniques may be used, unless you are sure of your equipment do not touch the RF circuits.

The alignment points are shown on the top and bottom views of the chassis as well as certain part numbers.

AM IF should be aligned at 456 KC. There are three transformers and six adjustments, the transformers are coupled with less than critical coupling and there is only one peak. Couple the generator into the mixer grid and use either AVC or audio for the output meter.

FM IF should be aligned at 10.7 MC. There are four transformers and eight adjustments, the transformers are over-coupled and must be aligned with a scope and sweep generator.

1. Connect generator to 3rd IF grid and vertical input of scope to the audio of the receiver at any point where sufficient signal is available and phasing can be properly adjusted.
2. Adjust the top screw for greatest length of straight line. This is the secondary winding, the bottom screw should give improvement in signal level.



A does not have the hook indicating that the sweep generator has a greater deviation than the detector capability.

B shows improper phasing of the horizontal sweep with the audio output of the receiver.

C is preferred because it shows the limits of deviation and you obtain it simply by adjusting the deviation (sweep width) control on the signal generator. Approximately 150 KC is normal.

3. Connect generator to 2nd IF grid and adjust the 2nd IF slugs for maximum signal **and** band width. This you can be sure of by the amount of hook at the ends of the line on the scope. Repeat this procedure for 1st IF grid and mixer grid. Adjust for greatest signal without appreciable loss of band width.

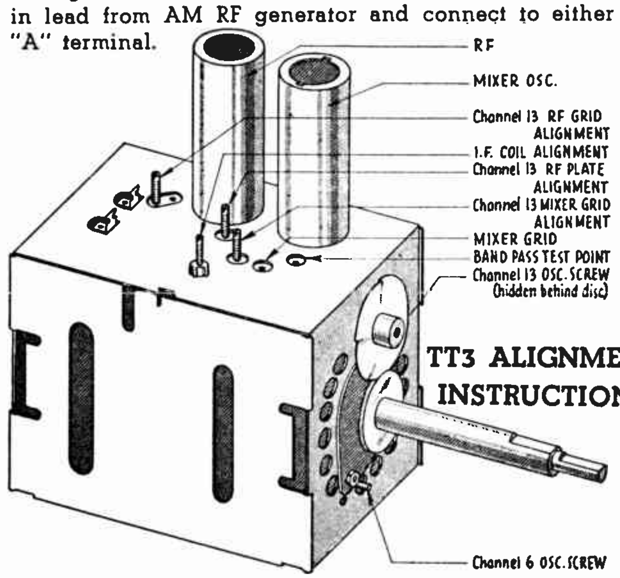
Alternate Method: The IF response of the 1st, 2nd and 3rd transformer may be observed more directly if you use a crystal detector at the plate of the tube following the transformer and feed the vertical plates of the scope from that point. Feed signal into grid of tube preceding transformer. Use a CW marker at 10.7 to be sure the double peaked response curve straddles the ratio detector response. Observe each stage separately.

Notice: Do not use AM or CM signal to peak the FM transformers. Regeneration may result and band-width and noise rejection will be poor, although signal strength will increase.

FM RF should be trimmed at 105 MC. There should not be any reason to adjust the low end but if this is necessary it can be done by distorting the FM coils on the tuning gang.

AM RF should be peaked at the high end with the trimmer and at the low end by core adjustment.

Notice: Use as low signal input as possible for readable output indication. Feed signal in from FM RF generator through 150 ohms in each lead to "A-A." Use 400 ohms in lead from AM RF generator and connect to either "A" terminal.



TT3 ALIGNMENT INSTRUCTIONS

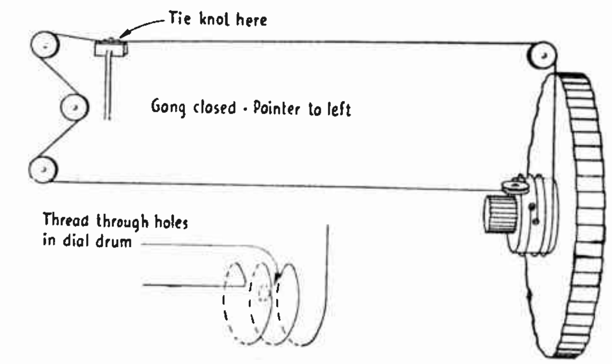
Oscillator Realignment Instructions

1. Set fine tuning ½ way.
2. Align channel 13 oscillator by means of screw.
3. Check frequency of channel 13 thru 7. They all should fall within ⅓ of the range of the **fine** tuning.
4. Align channel 6 oscillator by means of screw.
5. Check frequency of channel 6 thru 2. They all should fall within ⅓ of the range of the fine tuning.

Note: After replacement of parts, if the original L/C ratio in the oscillator has been altered, it may be necessary to re-align the incremental loops in the switch, to obtain correct frequency for every channel. Pushing the loops in increases the frequency. This must be done in order, from 12 to 7. For the lower channels, spreading the incremental coils will increase the frequency. This operation must be done in order from 5 to 2.

Band Pass Realignment Instructions

1. Use R.F. Sweep & Oscilloscope to the test point.
2. The oscillator must be operating at nearly the correct frequency for each channel.
3. Align channel 13 R.F. plate and mixer grid by spreading or pushing together the turns. **Use a** tuning wand to determine whether the inductance should be increased or decreased. The band pass should include both carriers and have steep sides. Align the antenna coil by spreading or pushing the last turn to obtain flat response, usually then the frequency of the antenna coil falls at the center channel frequency or nearly so.
4. Align the incremental loops of the plate and grid from 12 to 7 in that order. Pushing the loops in, increases the frequency.
5. Align channel 6 R.F plate, mixer grid and antenna to obtain a flat response, with maximum gain. Use tuning wand to determine what change is necesary. Band pass should include both carriers and have steep sides.
6. Align incremental coils of R.F. plate, mixer grid and antenna from 5 to 2, in that order. Spreading coils increases the frequency.



For dial stringing use a light weight dial cord such as Bevin-Wilcox 6-18 Imperial silk cord.

If replacement parts of identical manufacture and rating are not available for service repairs these should be ordered from Midwest Radio & Television Corporation, giving model number and serial number of the chassis and name of the part.

Repair data for the record changer mechanism is available separately, please specify Model.

REVISIONS -- October 25, 1950

1. The 1K 1W resistor in the 6AQ5 video tube plate should be changed to 1.5K 1W 10%; this will make a total of 3K in the plate load for better low frequency response.
2. To reduce regeneration on the FM band, .01 mfd ceramic condensers may be used to bypass heaters at the 2nd and 3rd 6BA6 IF tubes.
3. To make trimming less critical 10 or 15 mmfd may be added across the FM oscillator gang section. Use zero temperature co-efficient ceramic condensers.
4. Grid resistor of the 3rd Pix IF should be changed from 12K 10% to 22K, and Pix IF alignment frequencies revised as follows:

1st Stage	23.4 MC
2nd Stage	22.2 MC
3rd Stage	25.3 MC
4th Stage	21.0 MC
Detector	25.5 MC

The 1st Sound Trap should be adjusted to slightly less than 21.25 MC to reduce the response below that frequency. This will improve the tuning characteristics.

5. The tuning gang should be grounded at the division plate between RF and and Mixer sections to the mounting screw of the Mixer Coil Plate. A ground lug may be used under the Mixer Coil Plate mounting nuts and bent over to touch the gang division plate where it should be soldered. This will reduce FM RF regeneration.
6. To improve both sync and sensitivity a 5000 ohm 10 watt resistor should be put in parallel with the end section of the "Candohm," from the terminal supplying 215V to the 100V terminal. This will increase the "B" on the Pix IF tubes and on the tuner.

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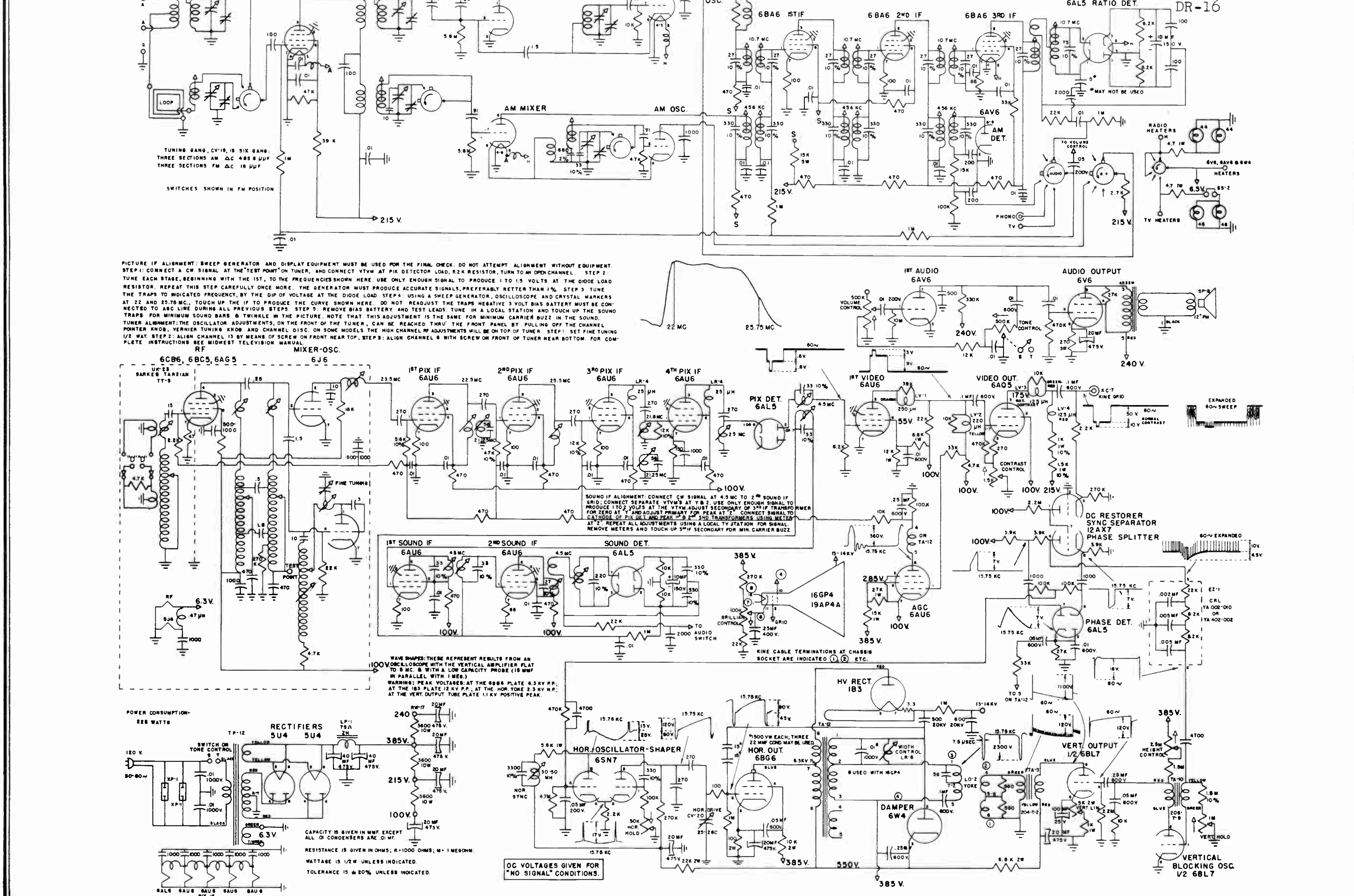
MODELS K-19, KR-19, Ch. DJ-19; P-16, PR-16, Ch. DR-16



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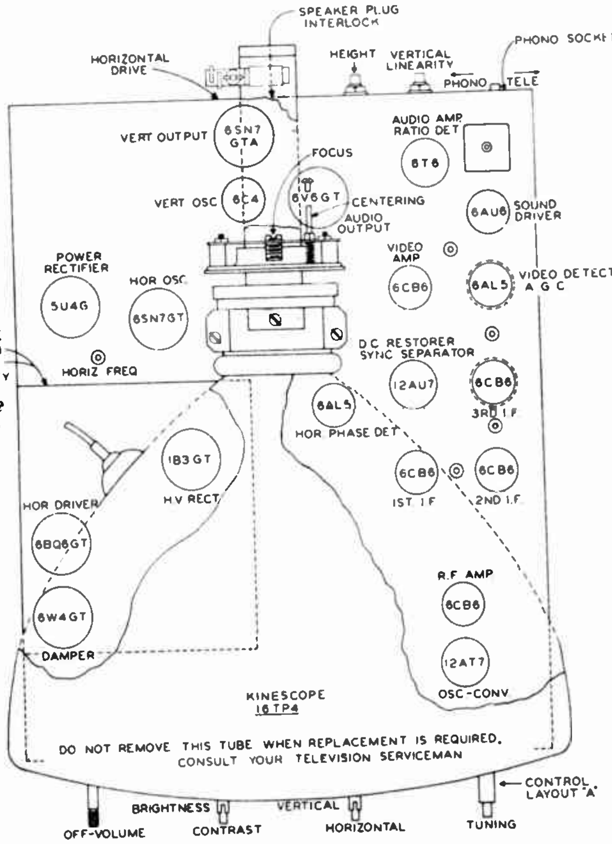
These models use 20 Tubes (Including Picture Tube and Rectifiers) and employ an inter-carrier sound circuit. The picture Tube in both receivers is the 16TP4. Both receivers use ratio detector for the sound.

SAFETY PRECAUTIONS: The kinescope should be handled with extreme care. The person handling this tube should wear gloves and protective goggles as an added precaution.

When the power is connected, care must be taken in servicing the High Voltage Supply of these receivers. The interlock opens one side of the line only leaving one side of the line connected when the back is removed. For servicing with chassis out of the cabinet the interlock-socket can be shorted.

VOLTAGE READINGS: The voltage readings to be obtained at various locations in the receiver have been indicated on the schematic diagram. These voltages will be very advantageous when "trouble shooting". Check voltages, tubes, fuse and inspect for damaged or burned parts before attempting to re-align receiver. A wired-in 1/4 amp fuse is used to protect the high voltage circuit of the receiver.

All voltages were taken with a 117.5 V. line and with no signal input. The contrast control set at the maximum clockwise position; the brightness control at 50% rotation and all other controls in normal operating position. The tuner set for Channel 2. All voltages are positive with respect to ground unless otherwise indicated.



FREQUENCY CHART

CHANNEL NO.	CHANNEL FREQ.MC.	PICTURE CARRIER M.C.	SOUND CARRIER M.C.	RECEIVER RF. OSC. M.C.	CHANNEL NO.	CHANNEL FREQ.MC.	PICTURE CARRIER M.C.	SOUND CARRIER M.C.	RECEIVER RF. OSC. M.C.
2	54-60	55.25	59.75	81.35	8	180-186	181.25	185.75	207.35
3	60-66	61.25	65.75	87.35	9	186-192	187.25	191.75	213.35
4	66-72	67.25	71.75	93.35	10	192-198	193.25	197.75	219.35
5	76-82	77.25	81.75	103.35	11	198-204	199.25	203.75	225.35
6	82-88	83.25	87.75	109.35	12	204-210	205.25	209.75	231.35
7	174-180	175.25	179.75	201.35	13	210-216	211.25	215.75	237.35

I.F. FREQ. M.C.

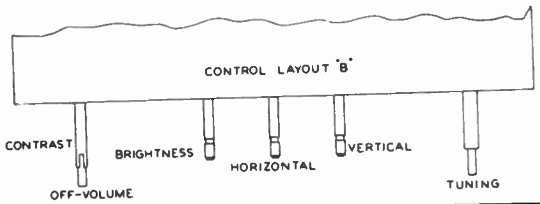
PICTURE CARRIER	26.1
SOUND CARRIER	21.6

FOCUS ADJUSTMENT AND CENTERING

These receivers use a permanent magnet (PM) type of focusing. This focalizer is attached to a plate which is mounted behind the Yoke.

CENTERING OF PICTURE: The picture may be centered in relationship with the opening of the glass panel at the face of the receiver by shifting the brass centering stud at the rear of the focalizer. (See top view of chassis on Page 2).

FOCUS ADJUSTMENT: (The focus adjustment must be made with a screw-driver of non-magnetic material.) The focus adjustment (the large slotted screw) is located at the rear of the focalizer. The picture focus is adjusted by either increasing or decreasing the amount of screw insertion to either decrease or increase the magnetic flux as required.



CONTROL OPERATION

HEIGHT CONTROL (Rear Apron of Chassis) To increase the vertical size of the picture, turn this control in a counter-clockwise rotation. To reduce the size of the picture vertically, turn this control clockwise.

VERTICAL LINEARITY: (Rear Apron of Chassis) As this knob is turned to the left (counter-clockwise) the size of the top half of the picture is increased vertically; as it is turned clockwise, it is reduced.

HORIZONTAL LINEARITY: (Top of Chassis - See Layout on page 2) moving the slug out of the coil increases the left hand side of the picture and moving the slug in decreases the left and increases the right hand side.

WIDTH CONTROL: (Top of Chassis - See Layout on page 2) Screw slug in to increase width and out to decrease width.

HORIZONTAL FREQUENCY: (Top of Chassis - See Layout on page 2) Locate the horizontal hold control (located on front apron) in the center of its rotation. Adjust horizontal frequency screw to lock in picture. When properly adjusted the horizontal hold control should hold in the picture when the picture is turned approximately equal amounts from the center position.

HORIZONTAL DRIVE: (Screw Driver Adjustment on rear apron of chassis) Turn counter-clockwise to increase drive and clockwise to decrease drive. Drive should be as high as possible without producing a bright vertical line on the raster.

CAUTION: INSUFFICIENT DRIVE WILL OVERLOAD HORIZONTAL DRIVER (6BQ6GT).

TUNER ASSEMBLY

SCHEMATIC LOCATION	NUMBER	DESCRIPTION
	CARBON RESISTORS	
R7		470 Ohms
R2,R3		1,000 Ohms
R4		2,200 Ohms
R6		18,000 Ohms
R1,R5		100,000 Ohms
	CERAMIC CONDENSERS	
C1		100 MMFD. 10%
(C2A,C2B),(C21A,C21B)		1000 MMFD. Dual Condenser
C3,C4		500 MMFD.
C11		25 MMFD.
C12		33 MMFD. 5% (N750 Temp. Coeff)
C13		30 MMFD. 5% (N750 Temp. Coeff)
C17		47 MMFD.
C18		15 MMFD. 5% (N-750 Temp. Coeff)
C20		20 MMFD.
C22		5 MMFD. 5% (N-750 Temp. Coeff)
	TRIMMER CONDENSERS	
C5		Low Band R.F. Trimmer
C6		Low Band Mixer Trimmer
C10		Low Band Oscillator Trimmer
C15		High Band R.F. Trimmer
C16		High Band Mixer Trimmer
C19		High Band Oscillator Trimmer
	TUNING CAPACITORS	
C7,C8,C9,C14		Main Gang Tuning Capacitors

SCHEMATIC LOCATION	PART NO.	DESCRIPTION
	COILS	
L1		Antenna Coil
L2		High Band R.F. Coil
L3		High Band Mixer Coil
L4		High Band Oscillator Coil
L5		I.F. Coil
L6,L7		R.F. Choke Coil - 1.8 Microhenries
	TRANSFORMERS	
T1		Antenna Transformer
T2		Low Band Coil Assembly

MAIN CHASSIS

SCHEMATIC LOCATION	PART NO.	DESCRIPTION
	CONTROLS (Control Layout "A")	
R35) R100)	N-8053	(Contrast Control-2500 Ohms) (Brightness Control - 50,000 Ohms)
R59) R87)	N-7338	(Vertical Hold Control-1.0 Megohm) (Horizontal Hold Control-50,000 Ohms)
R56	N-7172	Volume Control with On-Off Switch-0.5 Megohm
R61	N-7341	Height Control-2.5 Megohms
R66	N-8071	Vertical Linearity Control-3000 Ohms
	CONTROLS (Control Layout "B")	
R35) R56)	N-8158	(Contrast Control-2500 Ohms) (Volume Control with on-off switch-0.5 Megohm
R100	N-8160	Brightness Control - 50,000 Ohms
R87	N-8160	Horizontal Hold Control - 50,000 Ohms
R59	N-8159	Vertical Hold Control-1.0 Megohm
R61	N-7341	Height Control - 2.5 Megohm
R66	N-8071	Vertical Linearity Control-3000 Ohms
	WIREWOUND RESISTORS	
R68	N-8035	8,200 Ohms 5.0 Watts 10%
R21	N-8036	13,000 Ohms 4.0 Watts 7.5%
	CARBON RESISTORS	
R96	N-8126	4.3 Ohms 1/2 Watt 10%
R11,R16,R34	N-6237	47 Ohms 1/2 Watt 10%
R81	N-8155	56 Ohms 1.0 Watt 10%
R12,R17	N-5857	82 Ohms 1/2 Watt 10%
R31,R57,R91	N-1349	100 Ohms 1/2 Watt 20%
R92	N-8030	100 Ohms 2.0 Watts 10%
R23	N-3663	150 Ohms 1/2 Watt 10%
R32	N-4067	180 Ohms 1/2 Watt 10%
R49	N-4121	270 Ohms 1/2 Watt 10%
R24,R47,R69,R70	N-4280	560 Ohms 1/2 Watt 10%
R65	N-4279	820 Ohms 1/2 Watt 10%
R46,R95	N-3341	1,000 Ohms 1/2 Watt 10%
R10,R13,R18,R19	N-1694	1,000 Ohms 1/2 Watt 20%
R84	N-6793	1,200 Ohms 1/2 Watt 10%
R33,R75	N-7398	1,500 Ohms 1/2 Watt 10%
R42,R77	N-4896	2,200 Ohms 1/2 Watt 10%
R76	N-8103	2,700 Ohms 1/2 Watt 10%
R62	N-7399	3,900 Ohms 1/2 Watt 10%
R40	N-7154	4,700 Ohms 1.0 Watt 10%
R8	N-7000	4,700 Ohms 1/2 Watt 20%
R83	N-7406	5,600 Ohms 1.0 Watt 10%
R9,R22,R29,R89	N-4630	6,800 Ohms 1/2 Watt 10%
R45	N-8043	8,200 Ohms 1.0 Watt 10%
R71	N-4895	10,000 Ohms 1/2 Watt 10%
R97	N-4229	10,000 Ohms 2.0 Watts 10%
R50	N-5690	12,000 Ohms 1/2 Watt 10%
R15,R48,R101	N-6424	15,000 Ohms 1/2 Watt 10%
R14,R39	N-2970	15,000 Ohms 2.0 Watts 10%
R36	N-8031	18,000 Ohms 2.0 Watts 10%

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PARTS LIST (Cont'd)

CARBON RESISTORS (Cont.)

SCHEMATIC LOCATION	PART NO.	DESCRIPTION
R73	N-6012	22,000 Ohms 1/2 Watt 10%
R44	N-7012	27,000 Ohms 1.0 Watt 10%
R41	N-8044	33,000 Ohms 1.0 Watt 10%
R93	N-8032	33,000 Ohms 2.0 Watts 10%
R20	N-8033	47,000 Ohms 2.0 Watts 10%
R67	N-4823	56,000 Ohms 1/2 Watt 10%
R102	N-4120	68,000 Ohms 1/2 Watt 20%
R54,R78,R79,R85,R86	N-2973	100,000 Ohms 1/2 Watt 10%
R94	N-8028	100,000 Ohms 1.0 Watt 10%
R103	N-1778	100,000 Ohms 1/2 Watt 20%
R28,R43	N-4468	150,000 Ohms 1/2 Watt 10%
R55,R88	N-7003	180,000 Ohms 1/2 Watt 10%
R52	N-4899	220,000 Ohms 1/2 Watt 10%
R53	N-8025	300,000 Ohms 1/2 Watt 5%
R99	N-8026	390,000 Ohms 1/2 Watt 10%
R82,R90	N-5694	470,000 Ohms 1/2 Watt 10%
R98	N-8029	470,000 Ohms 1.0 Watt 10%
R72	N-7790	560,000 Ohms 1/2 Watt 10%
R26	N-7403	680,000 Ohms 1/2 Watt 10%
R25	N-4469	820,000 Ohms 1/2 Watt 10%
R30,R60,R74	N-2976	1.0 Megohm 1/2 Watt 10%
R58	N-4470	1.2 Megohm 1/2 Watt 10%
R63	N-4424	2.2 Megohm 1/2 Watt 10%
R80	N-4061	4.7 Megohm 1/2 Watt 20%
R51	N-4028	6.8 Megohm 1/2 Watt 20%

ELECTROLYTIC CONDENSERS

SCHEMATIC LOCATION	PART NO.	DESCRIPTION
C93	N-8054	4 MFD. 50 Volt
C60	N-6912	16 MFD. 50 Volt
C71	N-8037	100 MFD. 250 Volt
C75A)	N-8039	(10 MFD. 450 Volt
C75B)		(10 MFD. 450 Volt
C63A)	N-8038	(60 MFD. 450 Volt
C63B)		(40 MFD. 450 Volt
C48A)	N-8040	(10 MFD. 450 Volt
C48B)		(80 MFD. 200 Volt
C48C)		(100 MFD. 50 Volt
C48D)		(40 MFD. 200 Volt

TRIMMER CONDENSERS

SCHEMATIC LOCATION	PART NO.	DESCRIPTION
C91	N-7375	Horizontal Drive Control-20-270 MMFD

HIGH VOLTAGE CONDENSERS

SCHEMATIC LOCATION	PART NO.	DESCRIPTION
C99	N-8041	500 MMFD. 20,000 Volts

CERAMIC CONDENSERS

SCHEMATIC LOCATION	PART NO.	DESCRIPTION
C49	N-7776	5 MMFD. 500 V. 20%
C43	N-7843	10 MMFD. 500 V. 10%
C51	N-7844	68 MMFD. 500 V. 10%
C26,C31,C36,C39,C40,C66	N-6015	100 MMFD. 500 V. 20%
C27,C32	N-6887	.001 MFD. (Guar.Min.Value)
C23,C24,C28,C30,C33,C38,C42) C53,C54,C56,C59,C65,C73)	N-6272	.005 MFD. (Guar.Min.Value)
C29,C34	N-7371	.0015 MFD. (Guar. Min. Value)
(C35A,C35B), (C37A,C37B)	N-7774	(.004 MFD. 450 Volt) (.004 MFD. 450 Volt) DUAL COND.

SILVER MICA CONDENSERS

SCHEMATIC LOCATION	PART NO.	DESCRIPTION
C86	N-7777	330 MMFD. 500 Volt 10%
C88	N-7373	3,900 MMFD. 500 Volt 5%
C98	N-8073	1,500 MMFD. 1000 Volt 10%

MICA CONDENSERS

SCHEMATIC LOCATION	PART NUMBER	DESCRIPTION
C47,C52,C87	N-7836	47 MMFD. 500 Volt 10%
C97	N-7509	56 MMFD. 1000 Volt 5%
C46	N-8106	220 MMFD. 500 Volt 20%
C90	N-8074	270 MMFD. 500 Volt 10%
C89	N-7780	560 MMFD. 500 Volt 10%
C81,C82	N-7783	1,100 MMFD. 500 Volt 10%
C57	N-6891	2,200 MMFD. 500 Volt 10%
C58	N-6892	3,900 MMFD. 500 Volt 10%
C74	N-6893	4,700 MMFD. 500 Volt 10%

PAPER CONDENSERS

SCHEMATIC LOCATION	PART NUMBER	DESCRIPTION
C61,C62	N-6979	.01 MFD. 600 Volt (Bakelite Case)
C64,C72,C84	N-4894	.005 MFD. 600 Volt
C44	N-1344	.01 MFD. 400 Volt
C55,C68,C69	N-1376	.02 MFD. 400 Volt
C45,C70	N-1345	.05 MFD. 200 Volt
C79	N-1346	.05 MFD. 400 Volt
C94, C100	N-8105	.05 MFD. 800 Volt
C67	N-8092	.08 MFD. 200 Volt
C25,C85,C83,C103	N-1351	.1 MFD. 200 Volt
C50,C76,C101,C102	N-1623	.1 MFD. 400 Volt
C41,C96	N-1479	.25 MFD. 200 Volt
C78,C92	N-2579	.25 MFD. 400 Volt
C95	N-6895	.25 MFD. 600 Volt
C80	N-6896	.5 MFD. 200 Volt

INTEGRATING PLATE ASSEMBLY

SCHEMATIC LOCATION	PART NUMBER	DESCRIPTION
R64A)		(Resistor 8,200 Ohms 20%
R64B)		(Resistor 8,200 Ohms 20%
R64C)		(Resistor 22,000 Ohms 20%
C77A)	N-8042	(Condenser .005 MFD.
C77B)		(Condenser .005 MFD.
C77C)		(Condenser .002 MFD.

COILS

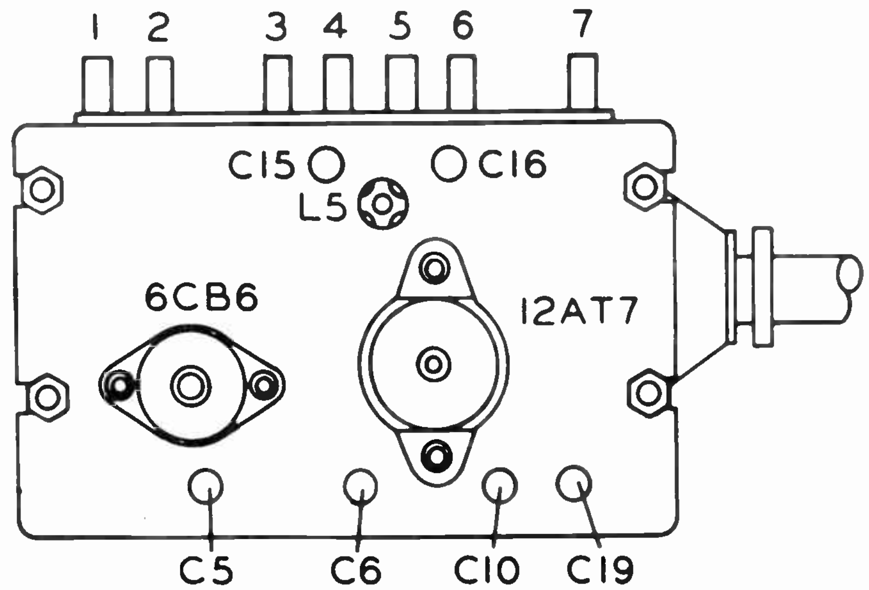
SCHEMATIC LOCATION	PART NUMBER	DESCRIPTION
L8,L10,L12	N-7745	Coil, I.F.
L9,L11	N-7321	R.F. Filter Choke Coil-10 Microhenries
L13	N-8060	Coil, Detector Series-174 Microhenries
L14	N-8059	Coil, Detector Shunt - 933 Micohenries
L15	N-8061	Coil, Amplifier Series-217 Microhenries
L16	N-8062	Coil, Amplifier Shunt - 578 Microhenries
L17	N-7746	Coil, 4.5 MC Sound Take-Off
L18	N-8064	Choke, Filter
L19	N-7748	Coil, Horizontal Frequency Control
L20	N-8134	Coil, Width Control
L21	N-8063	Coil, Horizontal Linearity Control
	N-8057	Coil, Deflection Yoke

TRANSFORMERS

SCHEMATIC LOCATION	PART NUMBER	DESCRIPTION
T3	N-7744	Ratio Detector Transformer
T4	N-8069	Power Transformer
T5	PART OF SPEAKER	Audio Output Transformer
T6	N-7764	Vertical Blocking Oscillator Transformer
T7	N-7717	Vertical Output Transformer
T8	N-8070	(Horizontal Output Transformer-Mounted on Wood Spacers)
T8	N-8104	(Horizontal Output Transformer-Mounted directly to shelf)

OTHER COMPONENTS

SCHEMATIC LOCATION	PART NUMBER	DESCRIPTION
TABLE MODEL ONLY	N-8170	Speaker, 5" PM with Output Transformer
CONSOLETTE ONLY	N-8055	Speaker, 8" PM with Output Transformer
	N-7949	Internal Antenna Assembly
	N-8100	Tube Socket with Corona Ring
	N-7929	Ion Trap
	N-8067	Focalizer Assembly
	N-8099	Switch, Television-Phono



TUNER ADJUSTMENTS

TUNER ALIGNMENT

The tuner should normally retain its alignment and need no realignment in the field. However, if it is tampered with or a condenser or resistor is replaced due to failure, realignment may be necessary but should not be attempted until the video I.F. is aligned. If a part is replaced be careful not to disturb any other parts and the replacement part should be placed in the same position as the previous part and with the same length of leads.

This tuner employs a gang condenser which retains its alignment. The adjusting is accomplished at the high and low ends of the two bands; channels 6 and 2, and 13 and 7.

The oscillator trimmers act independently, but the R.F. and mixer trimmers must be aligned first on the low channels as they are in parallel with high band trimmers.

Connect the antenna lead to the sweep generator which must terminate in 300 ohm. Connect signal generator to piece of wire and wrap around 300 ohm antenna lead. (If sweep generator has sound and picture markers the signal generator is not necessary.)

Adjust channel 6 first. Set the tuner to the center of channel 6 and set the signal generator to the picture carrier (83.25 MC). Adjust the low band oscillator trimmer (C10) to bring the marker approximately 60% up from the base of the curve. As this trimmer is increased in capacity the marker should move towards the top of the curve. If this is not the case, the marker is on the audio side of the curve. Reduce the trimmer until the marker is on the other side of the curve. Next adjust the low band R.F. (C5) and Mixer trimmers (C6) to give maximum sensitivity on the oscilloscope being careful to have sufficent width on the audio side of the curve. Check channel 2 with a marker frequency of 55.25 MC.

Adjust channel 13 in the same manner as for channel 6 except using the High Band trimmers (RF-C15, Mixer C16, and Oscillator C19) and the picture marker frequency which is 211.25 MC. Check channel 7 with a marker frequency of 175.25 MC.

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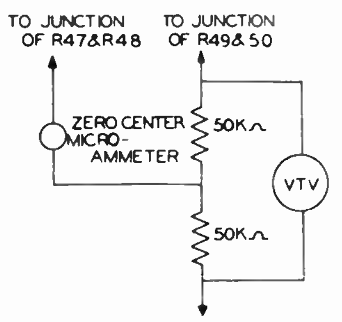
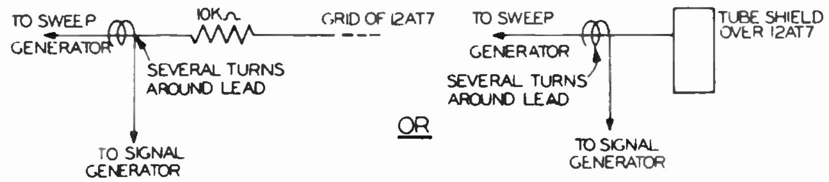
I.F. ALIGNMENT PROCEDURE

STEP NO.	Connect Signal Generator to	Signal Gerator Frequency MC	Connect Sweep Generator to	Sweep Generator Frequency	Connect Oscilloscope to	REMARKS	ADJUSTMENTS (Use peak obtained when screw is farthest out of can or coil.)
1. AUDIO IF ALIGNMENT	Grid of Video Amp. (6CB6) Pin #1. Contrast control at maximum.	4.5 MC. No Modulation. See Adjustments column.	NOT USED		NOT USED	Connect Vacuum Tube Voltmeter and zero center Microammeter as shown in note 1 (50,000 ohm resistors shown in note 1 must match within 5%)	Adjust L17 and T3 (Bottom) for maximum on Vacuum Tube Voltmeter. This adjustment should be made with voltage on Vacuum Tube Voltmeter under 12 Volts. Adjust T3 (Top) for zero on Microammeter. If the receiver is receiving a signal, the above adjustment can be made off a weak station keeping the reading on the Vacuum Tube Voltmeter under 12 Volts.
2. PRELIMINARY VIDEO IF ALIGNMENT	Grid (Pin 2) of 12AT7 through 10,000 ohm resistor or a tube shield and slip over 12AT7. Do Not Ground Shield	25.5 MC. No Modulation.	NOT USED		NOT USED	Connect Vacuum Tube Voltmeter to A.G.C. point. Junction of R19 and R25.	Adjust 2nd and 4th I.F. coils (L8 and L12) for maximum on Vacuum Tube Voltmeter. Adjust at approximately one volt.
3. PRELIMINARY VIDEO IF ALIGNMENT	Grid (Pin 2) of 12AT7 through 10,000 ohm resistor or a tube shield and slip over 12AT7. Do Not Ground Shield	23.0 MC. No Modulation.	NOT USED.		NOT USED	Connect Vacuum Tube Voltmeter to A.G.C. point. Junction of R19 and R25.	Adjust 1st and 3rd I.F. coils (L5 in Tuner and L10) for maximum on Vacuum Tube Voltmeter. Adjust at approximately one volt.
4. FINAL VIDEO IF ALIGNMENT	Signal Generator as shown in note 2.	26.1 and 22.8 MC MC. No Modulation. See Note 3.	Grid of 12AT7 through 10,000 ohm resistor, or a tube shield and slip over 12AT7. See Note 2.	24 MC Center Frequency and at least 6 MC wide.	Junction of R29 and L14.		With signal generator set at 26.1 MC adjust 2nd and 4th I.F. coils to give correct marker position as shown in note 3. Set signal generator at 22.8 MC and adjust 1st and 3rd I.F. coils for pattern shown in note 3. A slight readjustment of 2nd and 4th I.F. coils may be necessary. Curve shape should be between "A" and "C" on note 3 with maximum signal output for a low sweep input.

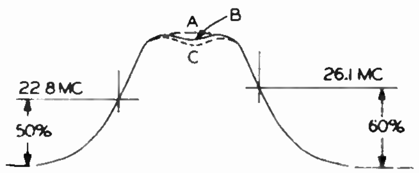
NOTE 1



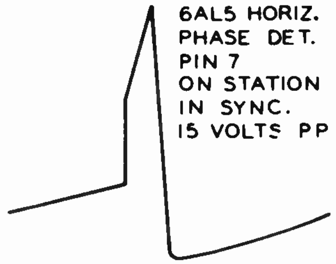
NOTE 2



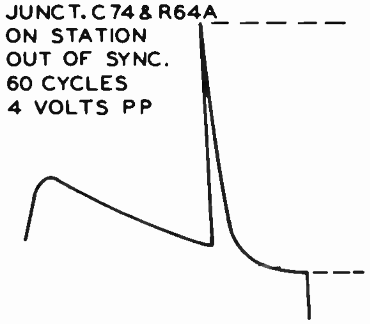
NOTE 3



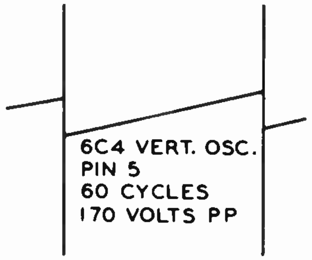
OSCILLOSCOPE PATTERNS



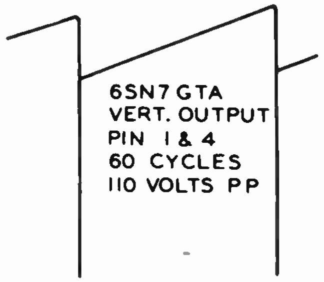
6AL5 HORIZ. PHASE DET. PIN 7 ON STATION IN SYNC. 15 VOLTS PP



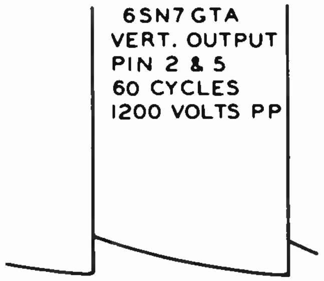
JUNCT. C74 & R64A ON STATION OUT OF SYNC. 60 CYCLES 4 VOLTS PP



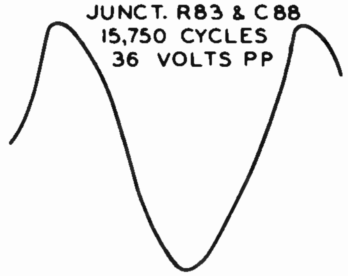
6C4 VERT. OSC. PIN 5 60 CYCLES 170 VOLTS PP



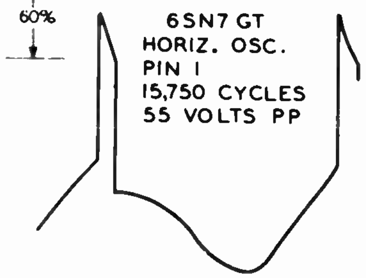
6SN7 GTA VERT. OUTPUT PIN 1 & 4 60 CYCLES 110 VOLTS PP



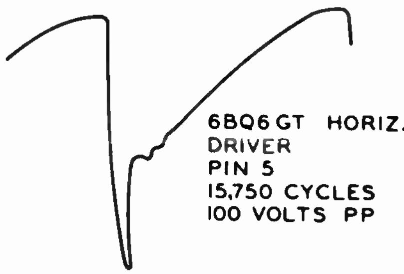
6SN7 GTA VERT. OUTPUT PIN 2 & 5 60 CYCLES 1200 VOLTS PP



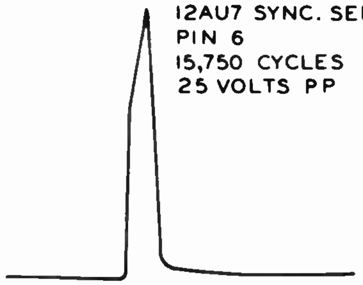
JUNCT. R83 & C88 15,750 CYCLES 36 VOLTS PP



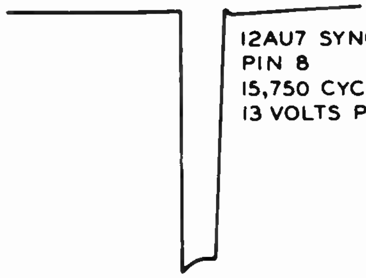
6SN7 GT HORIZ. OSC. PIN 1 15,750 CYCLES 55 VOLTS PP



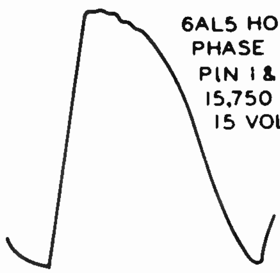
6BQ6 GT HORIZ. DRIVER PIN 5 15,750 CYCLES 100 VOLTS PP



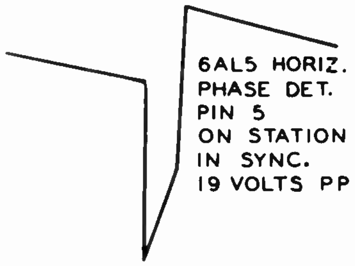
12AU7 SYNC. SEP. PIN 6 15,750 CYCLES 25 VOLTS PP



12AU7 SYNC. SEP. PIN 8 15,750 CYCLES 13 VOLTS PP



6AL5 HORIZ. PHASE DET. PIN 1 & 2 15,750 CYCLES 15 VOLTS PP



6AL5 HORIZ. PHASE DET. PIN 5 ON STATION IN SYNC. 19 VOLTS PP

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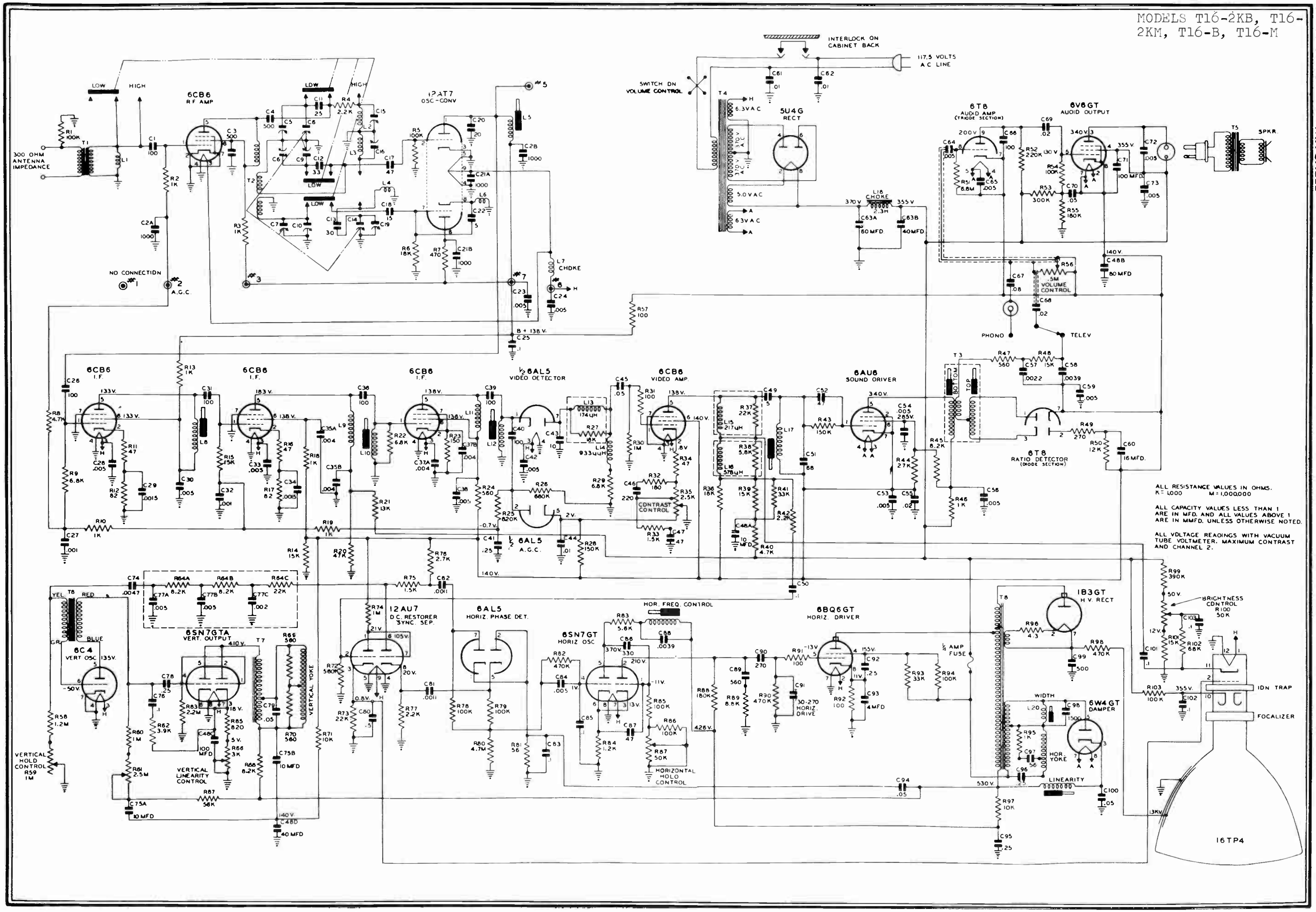
MODELS T16-2KB, T16-2KM, T16-B, T16-M



ALL RESISTANCE VALUES IN OHMS. K= 1,000 M=1,000,000

ALL CAPACITY VALUES LESS THAN 1 ARE IN MFD. AND ALL VALUES ABOVE 1 ARE IN MMFD. UNLESS OTHERWISE NOTED.

ALL VOLTAGE READINGS WITH VACUUM TUBE VOLTMETER. MAXIMUM CONTRAST AND CHANNEL 2.

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Receiver Installation

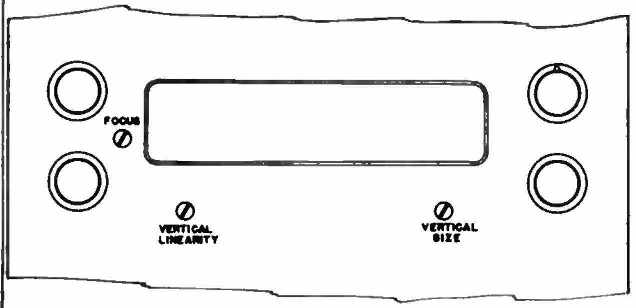

FIG. 1—Front Panel Adjustments For Receivers Using General Instrument R-F Tuner.

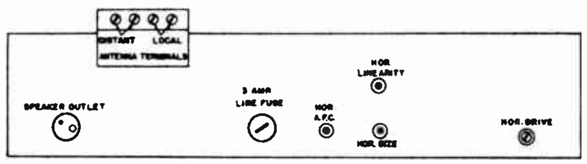

FIG. 3—Rear Panel Adjustments For Receivers Using General Instrument R-F Tuner. (Models 94GCB3023 A & B)

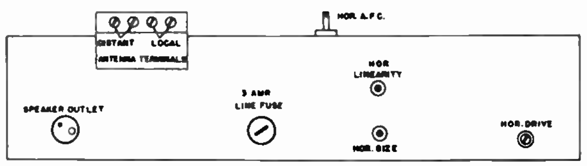

FIG. 4—Rear Panel Adjustments For Early Production Receivers Using Standard Coil R-F Tuner. (Model 94GCB3023C)

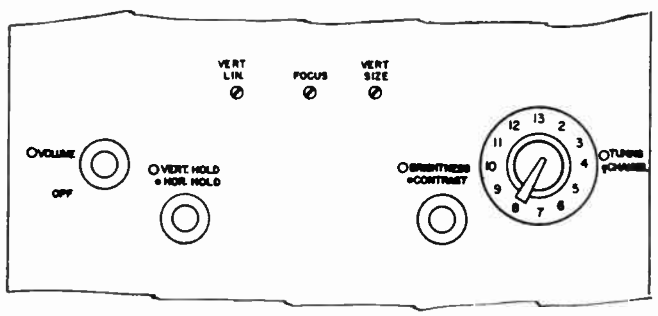

FIG. 2—Front Panel Adjustments For Receivers Using Standard Coil R-F Tuner.

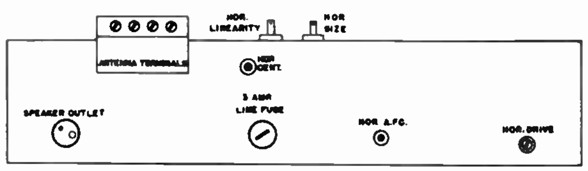

FIG. 5—Rear Panel Adjustments For Later Production Receivers Using Standard Coil R-F Tuner. (Models 16K1/63-3019 and 05GCB3019A)

SERVICE ADJUSTMENTS

Refer to figures 1 or 2 for location of front panel controls, or to figures 3, 4, or 5 for location of rear panel controls. Since these controls are located differently for several different production runs, select those diagrams which correspond to the receiver in question.

Antenna Installation

The installation and orientation of an antenna is one of the most important single factors in realizing optimum performance from a television receiver. An improperly oriented, or poorly matched, or unwisely chosen antenna can completely offset the good design engineered into this television receiver. For these reasons, choose, locate and install your antenna carefully, especially in poor signal areas. Models 16K1/63-3019 and O5GCB3019A are equipped with a built-in antenna which performs satisfactorily in locations where good signal strength is available, and where a minimum of noise is present.

When an outdoor antenna must be installed, use a standard, approved antenna, having a 300 ohm impedance, and match it with a balanced 300 ohm transmission line. Orient the antenna for maximum signal strength from the greatest number of stations, and for the minimum amount of interference and reflection. Where the receiver is to be installed beyond the range of good signal strength (about 30 miles) use a stacked array, being careful to match the impedance of the antenna, transmission line, and receiver (300 ohms). If additional gain is required, try a "booster" for improvement of signal-to-noise ratio.

In critical locations, where the receiver is surrounded by several stations, most of which are located beyond the 30 mile radius, a careful appraisal of the terrain and the measurement of field strength will usually yield acceptable television operation where a haphazard installation might have failed. To make full use of the directional and "gain" properties of a stacked array and booster, the following procedure is recommended:

1. Measure the field-strength of the transmittal signal from each of the desired stations on a calibrated field-strength meter.
2. Tabulate your results and conclude which stations are within reasonable quality distance. A field-strength of 300 microvolts-per-meter or higher will give acceptable results. A field-strength measurement of 100 microvolts-per-meter or lower is usually unsatisfactory.
3. Let the consumer decide which of the acceptable channels he desires, and orient the antenna to receive maximum signal from those desired stations.
4. Always twist the 300 ohm lead-in about once for every foot of length to minimize transmission line noise pick-up.

On receivers with no built-in antenna, provision has been made on the antenna terminal strip located at the rear of the chassis for a choice of two connections of the antenna lead-in. Terminals 1 and 2 are used for all normal operation. In some cases, however, where the receiver is located in close proximity to powerful local stations, some overload may result with consequent distortion. In that event, terminals 3 and 4 should be used.

BUILT-IN ANTENNA

Receiver Model 16K1/63-3019 and O5GCB3019A are shipped with the built-in antenna completely connected. The power line-cord functions as the low frequency element, while a folded dipole inside the cabinet forms the high-frequency element. A few precautions should be observed, upon installing this receiver, if optimum performance is to be obtained.

1. Try to locate the receiver in such a position so that it is not adjacent to a street having heavy automobile traffic which may cause ignition interference.
2. Unwind the line-cord which is shipped "hanked" in a spool, leaving no kinks and plug it into a power outlet. Make sure that the line-cord does not run close to grounded metallic objects.
3. After performing the Service Adjustments try a few stations and observe if their signals are received with acceptable quality.
4. If signal strength and noise conditions are known to be good and operation is not satisfactory, it may be best to try a new receiver location, choosing one where the receiver will be rotated 90 degrees relative to its former position.

If however, it is found that the receiver is not permitted to perform at its best because of limitations of the built-in antenna in a noisy or weak signal area, an outdoor antenna should be installed. To connect an outdoor antenna to this receiver:—

1. Loosen the four screws on the antenna terminal strip (see Fig. 5A).
2. Extend the shorting links to their open position (see Fig 5B).
3. Connect the 300 ohm lead-in from the external antenna to terminals 2 and 3 (see Fig. 5B).
4. Tighten all screws, leaving the built-in antenna wires connected to terminals 1 and 4. (See Fig. 5B).

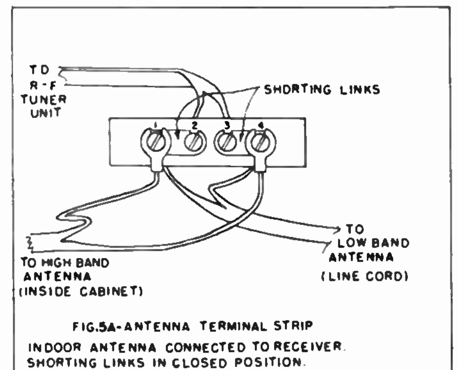

FIG.5A-ANTENNA TERMINAL STRIP
INDOOR ANTENNA CONNECTED TO RECEIVER. SHORTING LINKS IN CLOSED POSITION.

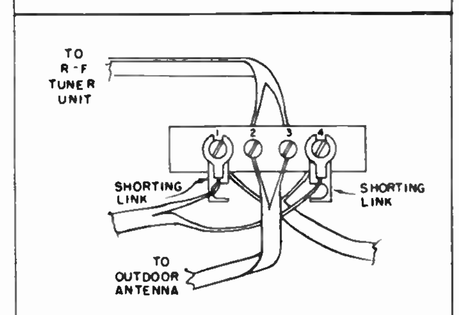

FIG.5B-ANTENNA TERMINAL STRIP
OUTDOOR ANTENNA CONNECTED TO RECEIVER SHORTING LINKS IN OPEN POSITION

FIG. 5—Antenna Terminal Strip Showing Built-In Antenna (Fig. 5A) and Outdoor Antenna (Fig. 5B) Connected to Receiver.

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Voltage Charts

TUBE COMPLEMENT AND VOLTAGE READINGS - FOR RECEIVERS USING ST'D. TUNER

ITEM NO	FUNCTION	TUBE TYPE	PIN 1	PIN 2	PIN 3	PIN 4	PIN 5	PIN 6	PIN 7	PIN 8	PIN 9
V1	PICTURE TUBE	SEE DIAGRAM	0	2	PIN 10: 245 V;		PIN 11: 16 V;		PIN 12: 6.3 AC		
V2	R.F. AMPLIFIER	6AG5	-0.7	0	6.3AC	0	118	118	0	—	—
V3	OSCILLATOR-CONVERTER	6J6	105	77	6.3AC	0	† -3 TO -4.5	† -4 TO -9	0	—	—
V4	AUDIO OUTPUT	* 6V6	N.C.	6.3AC	190	200	-9	0	0	0	—
V5	RATIO DET. - AUDIO AMP	* 6T8	-0.3	-0.7	-0.3	6.3 AC	0	0	0	-1.3	100
V6	RATIO DETECTOR DRIVER	* 6AU6	4	5	0	6.3 AC	200	35	4	—	—
V7	1ST VIDEO I.F.	6AU6	-1.5	0	0	6.3 AC	130	130	0.6	—	—
V8	2ND VIDEO I.F.	6AG5	-1.5	0.8	0	6.3AC	130	130	0.8	—	—
V9	3RD VIDEO I.F.	6AG5	0	1.2	0	6.3AC	130	130	1.2	—	—
V10	VIDEO DET. — A.G.C.	6AL5	2	-3	0	6.3AC	-3	0	-0.5	—	—
V11	VIDEO AMPLIFIER	6AC7	0	0	0.2	-3	0.2	130	6.3AC	120	—
V12	DC REST. - CLIP - SEP. - AMP.	6SN7	0	120	5	0	7	2	6.3AC	0	—
V13	HOR. PHASE DETECTOR	6AL5	3	-1.7	0	6.3 AC	0	0	0	—	—
V14	VERT. SWEEP OSCILLATOR-OUTPUT	6SN7	-35	125	0	0	340	15	6.3AC	0	—
V15	HOR. SWEEP OSCILLATOR	6SN7	0.4	250	10	-7	110	10	6.3 AC	0	—
V16	HOR. SWEEP OUTPUT	6BG6G	-7.5	0	0.5	N.C.	-7.5	N.C.	6.3AC	260	—
V17	HIGH VOLTAGE RECTIFIER	♦ 1B3	—	ϕ 10 KV. / 8.5 KV.	—	—	—	ϕ 10 KV. / 8.5 KV.	ϕ 10 KV / 8.5 KV.	—	—
V18	HORIZONTAL DAMPER	6W4	0.6	130	420	N.C.	350	N.C.	130	130	—
V19	POWER RECTIFIER	5U4G	N.C.	400	N.C.	385 AC	N.C.	385AC	N.C.	400	—

NOTES

1 - D.C. VOLTAGES MEASURED WITH V.T.V.M., UNLESS OTHERWISE STATED.
2 - VALUES SHOWN ARE D.C. VOLTAGES, MEASURED FROM SOCKET PIN TO GROUND, UNLESS OTHERWISE STATED.
3 - LINE VOLTAGE MAINTAINED AT 117 V.A.C.
4 - ALL FRONT PANEL CONTROLS SET AT MAXIMUM CLOCKWISE POSITION.
5 - NO SIGNAL APPLIED; TUNE RECEIVER TO UNUSED CHANNEL.
* - MEASURED TO LOW B+ BUS, MARKED "+140 V" ON DIAGRAM.
♦ - USE HIGH VOLTAGE INSULATED PROBE AND 20,000 OHM/VOLT METER.
ϕ - 10KV FOR FLY BACK TRANS. MARKED PART NO. 9.240-1; 8.5KV FOR FLY BACK TRANS. MARKED PART NO. 9.236-1
† - VARIES WITH CHANNEL SETTING

TUBE COMPLEMENT AND VOLTAGE READINGS - FOR RECEIVERS USING G.I. TUNER

ITEM NO	FUNCTION	TUBE TYPE	PIN 1	PIN 2	PIN 3	PIN 4	PIN 5	PIN 6	PIN 7	PIN 8	PIN 9
V1	RF AMPLIFIER	6J6	110	110	0	6.3AC	-1.5	-1.5	0	—	—
V2	CONVERTER	6J6	125	125	0	6.3AC	-1.75	-1.75	0	—	—
V3	OSCILLATOR	6J6	118	118	0	6.3AC	-4.8	-4.8	0	—	—
V4	AUDIO OUTPUT	ϕ 6V6	N.C.	6.3AC / 130	160 / 160	180 / 180	-7 / -7	180 / 180	0 / 130	0 / 0	—
V5	RATIO DET. - AUDIO AMP.	* 6T8	-0.3	-0.5	-0.3	6.3 AC	0	0	0	-1	75
V6	RATIO DETECTOR DRIVER	* 6AU6	3	4	† 130 / 0	† 130 / 6.3 AC	200	35	4	—	—
V7	1ST. VIDEO I.F.	6AU6	-0.8	0	0	6.3 AC.	130	130	0.6	—	—
V8	2ND VIDEO I.F.	6AG5	-0.8	0.8	0	6.3AC	130	130	0.8	—	—
V9	3RD VIDEO I.F.	6AG5	0	1.2	0	6.3AC	130	130	1.2	—	—
V10	VIDEO DET. — A.G.C.	6AL5	2	-3	0	6.3AC	-3	0	-0.5	—	—
V11	VIDEO AMPLIFIER	6AC7	0	0	0.9	-3	0.9	130	6.3AC	120	—
V12	DC REST. - CLIP - SEP. - AMP.	6SN7	0	120	5	0	7	2	6.3AC	0	—
V13	HOR. PHASE DETECTOR	6AL5	2	-1.2	0	6.3 AC	0	0	0	—	—
V14	VERT. SWEEP OSCILLATOR-OUTPUT	6SN7	-35	125	0	0	340	15	6.3AC	0	—
V15	HOR. SWEEP OSCILLATOR	6SN7	0.4	250	10	-7	110	10	6.3 AC	0	—
V16	HOR. SWEEP OUTPUT	6BG6G	-7.5	0	0.5	N.C.	-7.5	N.C.	6.3AC	260	—
V17	HIGH VOLTAGE RECTIFIER	♦ 1B3	—	8.5 KV	—	8.5KV	—	8.5 KV	8.5KV	—	—
V18	HORIZONTAL DAMPER	6W4 / 5V4	0.6 / 0.6	130 / 420	420 / 420	N.C. / 250	350 / 350	N.C. / 350	130 / 420	130 / 420	— / —
V19	POWER RECTIFIER	5U4G	N.C.	400	N.C.	385AC	N.C.	385AC	N.C.	400	—
V20	PICTURE TUBE	SEE DIAGRAM	0	2	PIN 10: 340V;		PIN 11: 16 V;		PIN 12: 6.3 AC.		

NOTES

1 - D.C. VOLTAGES MEASURED WITH V.T.V.M., UNLESS OTHERWISE STATED.
2 - VALUES SHOWN ARE D.C. VOLTAGES, MEASURED FROM SOCKET PIN TO GROUND, UNLESS OTHERWISE STATED.
3 - LINE VOLTAGE MAINTAINED AT 117 V.A.C.
4 - ALL FRONT PANEL CONTROLS SET AT MAXIMUM CLOCKWISE POSITION.
5 - NO SIGNAL APPLIED; TUNE RECEIVER TO UNUSED CHANNEL.
* - MEASURED TO LOW B+ BUS, MARKED "+140 V" ON DIAGRAM.
♦ - USE HIGH VOLTAGE INSULATED PROBE AND 20,000 OHM/VOLT METER
ϕ - TOP VALUE WHEN V18 IS 6W4, MEASURED TO "LOW B+ BUSS" MARKED "+140V" ON SCHEMATIC; BOTTOM VALUE WHEN V18 IS 5V4, MEASURED TO GROUND.
† - TOP VALUE WHEN V18 IS 6W4; BOTTOM VALUE WHEN V18 IS 5V4

Alignment Procedure

Although each receiver is correctly adjusted at the factory, rough handling during transit and aging of components may cause misalignment of the critical circuits. If picture and/or sound defects indicate that re-alignment is warranted, carefully follow the step-by-step procedure outlined below. Adjust only that portion of the receiver which is defective, avoiding for example, re-alignment of the r-f stages if "touching-up" the i-f section clears the trouble.

SERVICE EQUIPMENT—The quality of your test equipment is second in importance only to the manner in which it is used. To perform satisfactory alignment, the calibration of the r-f and i-f generating equipment should be within the limits specified below, for uniform resettability as well as for individual dial reading. The signals generated by these instruments, and shaped by the system under test, must be faithfully recorded on the V.T.V.M. or Scope to be properly interpreted. You can have confidence in equipment which meets the following specifications:

1. **R-F SWEEP GENERATOR:**
   a) Frequency Range: 18 to 30 mc., 50 to 90 mc., and 170 to 225 mc.
   b) Sweep Width: Variable up to 10 mc.
   c) Output: Constant over sweep width at any center frequency, and "flat" on all ranges and all attenuator positions, with maximum output of at least .1 volt.
   d) Output Impedance: 300 ohms balanced to ground.
2. **R-F MARKER GENERATOR:**
   a) Frequency Range: 18 to 30 mc., 50 to 90 mc., and 170 to 225 mc.
   b) Calibration: Accurate to within ±.05 mc. at any freqency.
   c) If marker generator output voltage is sufficient, it may also be used as a signal generator; if not, a separate signal generator is required whose frequency may be accurately checked with the marker generator.
3. **I.F. MARKER GENERATOR:**
   This piece of equipment is required in addition to the r-f marker generator for proper alignment of the H.F. Oscillator section of the R-F tuner unit.
   a) Frequency: 24.75 mc.
   b) Accuracy: Within ±.05 mc.
4. **4.5 MC SIGNAL SOURCE:**
   a) Accuracy: Within ±0.25%, or ±10,000 cps.
5. **CATHODE-RAY OSCILLOSCOPE:**
   a) Vertical Sensitivity: .07 volts-per-inch if r-f sweep generator provides .1 volt output.
   b) Vertical Response: A wide-band scope is not necessary for r-f, osc., or i-f alignment, so long as the low-frequency response is satisfactory and does not cause excessive phase shift.
6. **VACUUM TUBE VOLTMETER:**
   a) Response: To 4.5 mc with a detector probe.
   b) Range: As low as 3 volts d-c., zero-center scale.
   c) Accuracy: Extreme accuracy not essential for alignment.

TELEVISION RECEIVER ALIGNMENT CHART

CIRCUIT ALIGNED	STEP	SIGNAL GENERATOR CONNECTIONS	FREQ. ±.05 MC.	CONNECT D.C. V.T.V.M	ADJUST	REMARKS
	1	TUNE RECEIVER TO QUIET PORTION OF TV HIGH BAND. SET CONTRAST CONTROL AT MIN. (COUNTERCLOCKWISE) FOR TV I-F ALIGNMENT				
TV I.F.	2	THROUGH 1500 MMF. CONDENSER TO CONV. GRID AND GROUND. SEE NOTE *1	24.0 MC.	ACROSS VIDEO DIODE LOAD - HIGH SIDE TO JUNCTION OF L5, L6 & R104, - LOW SIDE TO GROUND. (IN LATEST MODELS, THE PEAKING COILS ARE DESIGNATED L15 AND L16 INSTEAD OF L5 & L6)	T4	ADJUST FOR MAXIMUM DEFLECTION ON V.T.V.M. MAINTAIN SIGNAL GENERATOR OUTPUT VOLTAGE AT A MINIMUM TO AVOID OVERLOAD.
	3	"	22.0 MC.	" " "	T3	" " "
	4	"	24.3 MC.	" " "	T2	" " "
	5	"	22.9 MC	" " "	T1	" " " VISUAL CHECK-UP DESIRABLE FOR TOUCH-UP OF BANDPASS CIRCUIT. SEE NOTE #2
SOUND TAKE-OFF	6	THRU 1500 MMFD. COND. ACROSS DIODE LOAD - HIGH SIDE TO JUNCTION OF L5, L6 & R104 (L15 & L16 IN SOME SETS) LOW SIDE TO GND.	4.5 MC.	NEGATIVE LEAD TO JUNCTION OF R22 & R23 (LOCATED AT 6T8 RATIO DET.) POSITIVE LEAD TO EITHER SIDE OF C41 4 MF. CONDENSER.	T5 TOP; T5 BOT.; T6 TOP OR BOT. SEE NOTE #3	ADJUST FOR MAXIMUM DEFLECTION ON V.T.V.M.
RATIO DETECTOR	7	"	4.5 MC.	NEGATIVE LEAD TO JUNCTION OF R22 & R23 (LOCATED AT 6T8 RATIO DET.) POSITIVE LEAD TO JUNCTION OF C43, C45 & R24 (OUTPUT OF DEEMPHASIS NETWORK)	T6 BOT. OR TOP. SEE NOTE #3	ADJUST FOR ZERO OUTPUT ON V.T.V.M. BETWEEN A PLUS AND A MINUS PEAK.

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Video I-F and Sound Alignment

NOTE #1—The following description will aid in locating the signal injection point for each of the two types of tuners used:

a. G.I. Tuner—Physically at Point (A) in Fig. 11; (across R5 and C27, see Fig. 10).

b. Standard Coil Tuner—Physically at Point (A) in Fig. 12; (across R4—220K resistor, see main schematic diagram).

Where the available signal generator output voltage is sufficient, it is preferable to couple directly around the converter tube. This method has the advantage of causing less loading, less de-tuning, and less wave-form distortion; and where the signal injection point is difficult to reach, it may be more convenient. To couple in this manner, slip a tight-fitting conductive shield over the converter tube, being careful not to ground the shield to the tuner chassis. Connect the signal generator high output end to the shield, the low end to ground.

NOTE #2—Due to differences in tube gain and component values, it is highly recommended that a visual alignment of the i-f response be performed after alignment has been completed by the signal generator—v.t.v.m. method. If, after the procedure given below is followed, it is found that the response curve differs greatly from that shown in Fig. 11, repeat alignment using the signal generator—v.t.v.m. method, making certain that the frequencies are precise, adjustments are accurate, and that signal generator output voltage is so low that the v.t.v.m. reads only about 1.5 v.d.c. at peak adjustment. During visual re-inspection, a slight touch-up of the individual slug adjustments may be necessary to approximate the recommended curve of Fig. 6.

For visual alignment proceed as follows:

a) Maintain the Contrast control at minimum setting.

b) Replace the v.t.v.m. with the vertical input of the oscilloscope; across the video diode load resistor. Keep the leads away from the receiver.

c) Replace the signal generator with a sweep generator which has been set to sweep the i-f frequencies over a range of about 8 mc. Use the preferred method of direct tube coupling described in Note #1.

d) Loosely couple the high side of the marker generator to the high sweep generator lead; low side to ground.

IMPORTANT: Keep the sweep generator and marker generator outputs at minimum to avoid curve distortion. Marker pips should be kept barely visible.

NOTE #3—The Ratio Detector Transformer, T6 is of three types, depending upon the period of production. In some receivers, transformer types "A" and "B" are used, having the primary slug (adjustment for maximum voltmeter deflection) on bottom, and the secondary slug (adjustment for zero output between plus and minus peaks) on top. In other receivers, transformer type "C" is used, having the slugs reversed; primary on top and secondary on bottom. Table 1 will aid in distinguishing between the three types.

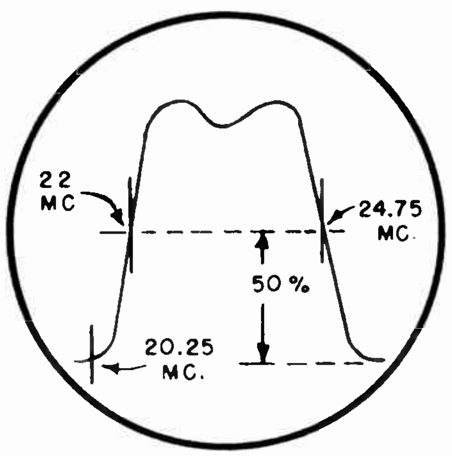

FIG. 6—Recommended I-F Response Curve

TABLE I—DISTINGUISHING FEATURES BETWEEN TYPES 'A', 'B' & 'C' RATIO DETECTOR TRANSFORMERS

		TYPE 'A'	TYPE 'B'	TYPE 'C'
ADJUSTMENT		PRI-BOTTOM SEC-TOP	PRI-BOTTOM SEC-TOP	PRI-TOP SEC-BOTTOM
CAN HEIGHT		1-15/16"	2½"	3"
TINNERMAN		NONE	⅝" DIA.	½" DIA. OR NONE
SOLDERING TERMINALS		STRAIGHT LUGS	STRAIGHT LUGS	WIRE LOOPS OR LUGS
CONNECTIONS	To Plate of 6AU6	3	A	F
	To B-Plus	4	C	D
	To R11, 220 ohm	5	E	E
	To Pin 1 of 6T8	1	D	C
	To Pin 3 of 6T8	2	F	A

R.F. and Oscillator Alignment

Alignment of the radio-frequency and oscillator stages involves adjustment of the "front end" tuner unit. This portion of the receiver is the most critical, hence re-alignment should be resorted to only after its need has been definitely determined.

I. R-F ALIGNMENT PROCEDURE (See Fig. 8)

Basically, the r-f alignment procedure is the same for each type of tuner used. A radio-frequency sweep voltage, whose center frequency corresponds to that of a particular TV channel, is injected into the antenna terminals of the receiver under test. This signal is amplified by the r-f stage (or stages), and detected at the converter grid, where it is taken-off through a 10,000 ohm isolating resistor and impressed upon the vertical input of the oscilloscope. The scope is swept horizontally by the same 60-cycle voltage which varies the r-f sweep frequency, tracing on the oscilloscope screen a pattern which represents the bandpass response of the r-f amplifier. The r-f marker generator, which is loosely coupled to the antenna terminals, serves to accurately locate a particular frequency (video carrier or sound carrier) represented on the scope. The r-f response curve should ideally look like that shown in Fig. 7 regardless of the type of tuner tested. Before proceeding with r-f alignment, the A.G.C. buss is shorted to ground at the low end of the 1st i-f grid resistor, R53. If the output impedance of the sweep generator is neither 300 ohms nor balanced to ground, a dummy antenna, consisting of two 150 ohm resistors is used, one in series with each lead of the output cable of the sweep generator.

II. OSCILLATOR ALIGNMENT PROCEDURE (See Fig. 9).

As in r-f alignment, the TV sweep generator and r-f marker generator are connected to the antenna terminals; the sweep generator set to the center frequency of a particular channel; and the r-f marker generator is carefully adjusted to the r-f video carrier frequency of that channel. Differing from the r-f set-up however, the oscilloscope is now connected directly across the video diode load impedance while an additional i-f marker generator is loosely coupled to the 1st i-f grid and accurately adjusted to 24.75 mc, the correct i-f frequency of the video carrier. On the scope, which is swept horizontally at the same rate as the r-f sweep generator, is seen the overall response curve of the receiver—from the antenna to the diode detector. If the oscillator is correctly adjusted, the "beat" between the oscillator voltage and the incoming video r-f signal will be exactly 24.75 mc. In turn, this 24.75 mc signal resulting from conversion will zero-beat with the 24.75 mc i-f marker, causing ripples and an unmistakable "break-up" in the observed response curve. If, on the other hand, the oscillator is incorrectly adjusted, the frequency of the converted video i-f signal will be something other than 24.75 mc, and there will be no zero-beat. Therefore, by adjusting the oscillator for zero-beat on the response curve, a simple and highly accurate means of alignment is achieved.

Note that the quality of the response curve does not affect the accuracy of the oscillator alignment so long as the zero-beat is obtained. If there is a Fine Tuning control, set it to the center of its range before proceeding with the alignment.

On the following pages are presented two sets of alignment information, giving special instructions for alignment of the r-f and oscillator stages of both types of tuners.

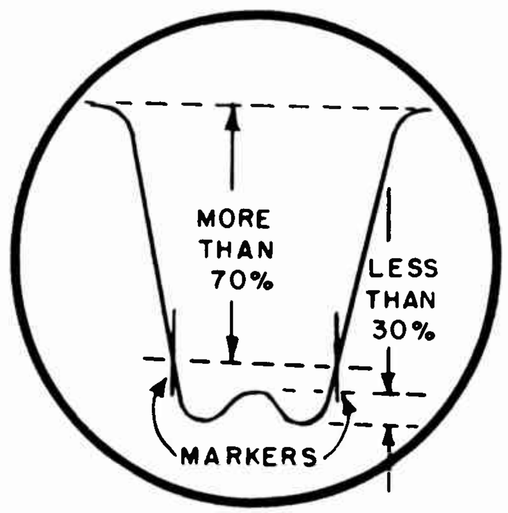

FIG. 7—Recommended R-F Response Curve

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R.F. and Oscillator Alignment Block Diagrams

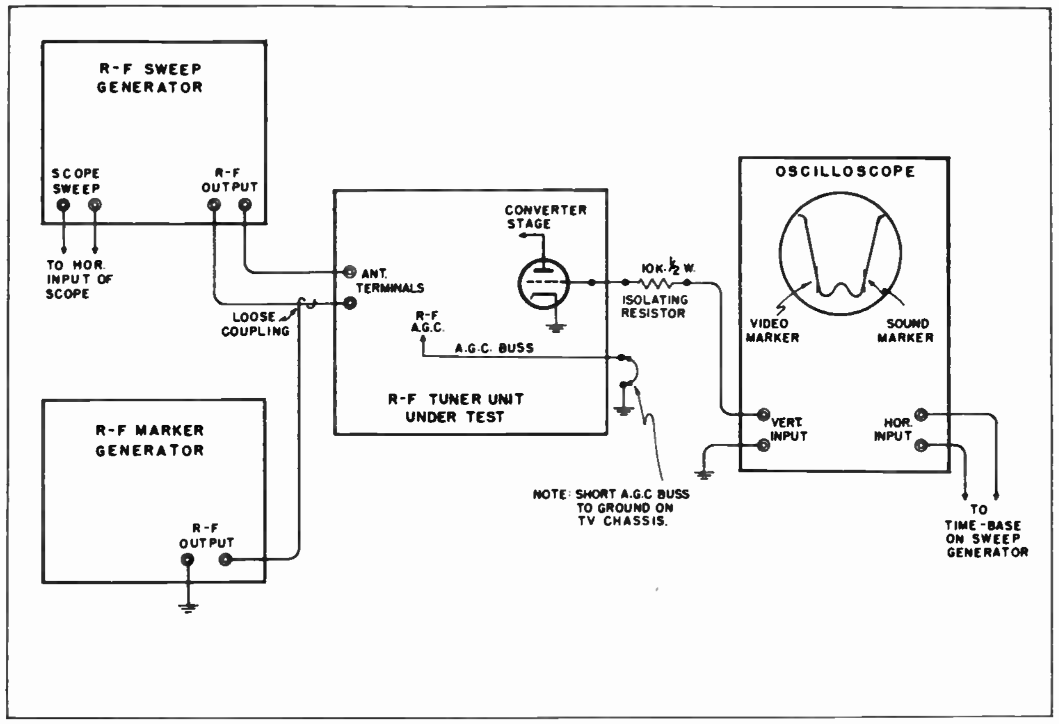

FIG. 8—R-F Alignment Block Diagram.

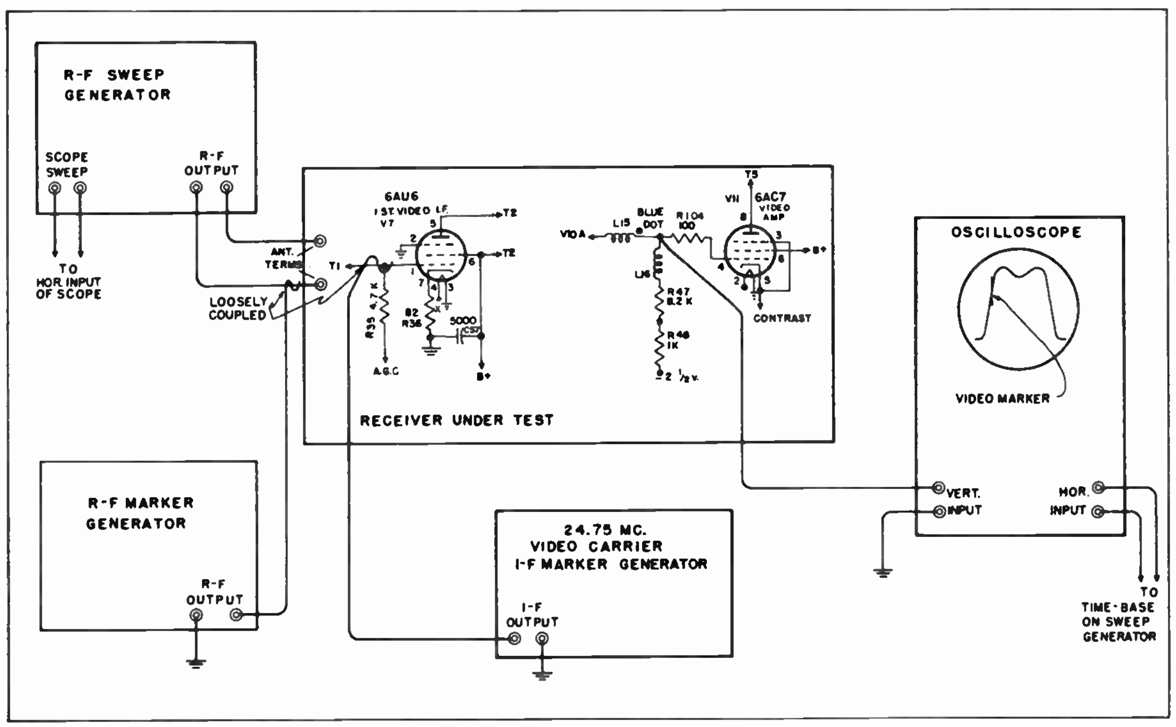

FIG. 9—Oscillator Alignment Block Diagram.

Alignment Diagrams—General Instrument Tuner

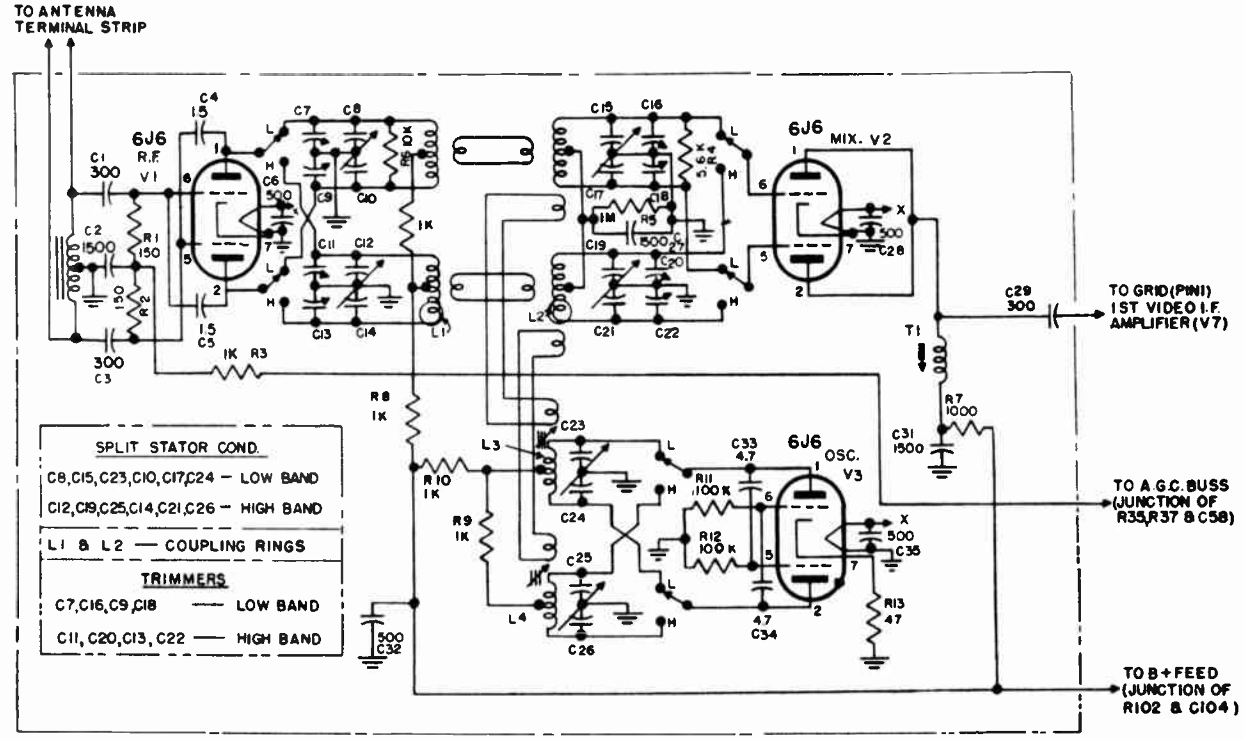

FIG. 10—Schematic Diagram of General Instrument R-F Tuner.

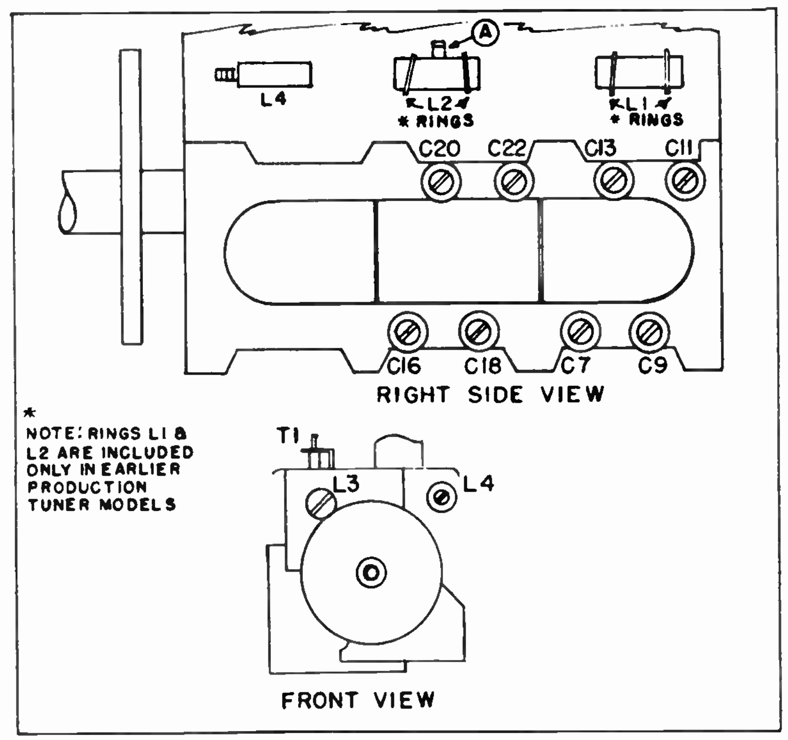

FIG. 11—Alignment Points of General Instrument R-F Tuner.

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Alignment Charts — General Instrument Tuner

TV RF ALIGNMENT

DUMMY ANTENNA	STEP	SIGNAL GENERATOR CONNECTIONS	SIGNAL GENERATOR FREQUENCY (10 MC SWEEP)	MARKER GENERATOR FREQUENCY	CHANNEL	CONNECT SCOPE	ADJUST	REMARKS
ONE 150 Ω CARBON RESISTOR IN SERIES WITH EACH LEAD.	1	ANTENNA TERMINALS	213 MC	211.25 MC & 215.75 MC	13	VERT. AMPLIFIER ACROSS CENTER TAP OF MIX. GRID COILS & GND. POINT (A) IN FIG. 11	C11, C20 C13, C22 (SEE FIG. 11)	ADJUST FOR RESPONSE APPROX. AS SHOWN ON FIG. 7, WITH MARKERS MORE THAN 70% OF PEAK AMPLITUDE. KEEP THE RF AND MIXER TRIMMER PAIRS IN APPROX. THE SAME RELATIVE POSITION.
"	2	"	177 MC	175.25 MC & 179.75 MC	7	"	L1 & L2 (SEE FIG. 11)	ADJUST RINGS FOR WAVEFORM AS SHOWN ON FIG. 7
"	3	"	183 MC	181.25 MC & 185.75 MC	8	"		CHECK RESPONSE ON ALL CHANNELS. SLIGHT ADJUSTMENT OF C11, C20, C13, OR C22 MAY BE REQUIRED TO OBTAIN OPTIMUM RESPONSE ON ALL CHANNELS.
"	4	"	189 MC	187.25 MC & 191.75 MC	9	"		
"	5	"	195 MC	193.25 MC & 197.75 MC	10	"		
"	6	"	201 MC	199.25 MC & 203.75 MC	11	"		
"	7	"	207 MC	205.25 MC & 209.75 MC	12	"		
"	8	"	85 MC	83.25 MC & 87.75 MC	6	"	C7, C16 C9, C18	ADJUST FOR RESPONSE APPROX. AS SHOWN ON FIG. 7
"	9	"	79 MC	77.25 MC & 81.75 MC	5	"		CHECK RESPONSE ON ALL CHANNELS. SLIGHT ADJUSTMENT OF C7, C16, C9, OR C18 MAY BE REQUIRED TO OBTAIN OPTIMUM RESPONSE ON ALL CHANNELS.
"	10	"	69 MC	67.25 MC & 71.75 MC	4	"		
"	11	"	63 MC	61.25 MC & 65.75 MC	3	"		
"	12	"	57 MC	55.25 MC & 59.75 MC	2	"		

TV OSCILLATOR ALIGNMENT

STEP	PROCEDURE
1	CONNECT TV SWEEP GENERATOR TO ANTENNA TERMINALS
2	COUPLE R-F MARKER GENERATOR LOOSELY TO ANTENNA TERMINALS
3	CONNECT VERTICAL AMPLIFIER OF SCOPE ACROSS VIDEO DIODE LOAD — HIGH SIDE TO JUNCTION OF L15, L16 & R104; LOW SIDE TO GROUND.
4	COUPLE 24.75 MC VIDEO I-F MARKER GENERATOR LOOSELY TO FIRST VIDEO I-F GRID — PIN 1 OF 6AU6, V7
5	ROTATE FINE TUNING CONTROL TO CENTER OF RANGE

STEP	DIAL CHANNEL NUMBER	SWEEP GEN. CENTER FREQ (10 MC. SWEEP)	R-F MARKER GENERATOR FREQUENCY	ADJUST	PROCEDURE
6	13	213 MC.	211.25 MC.	L4 SEE FIG. 11	ADJUST FOR ZERO-BEAT WITH I-F MARKER ON RESPONSE CURVE
7	6	85 MC.	83.25 MC.	L3 SEE FIG. 11	" " " " " " " " " "
8	5	79 MC.	77.25 MC.		CHECK TO SEE THAT ALL REMAINING CHANNELS PASS THROUGH ZERO-BEAT WELL WITHIN THE LIMITS OF THE FINE TUNING CONTROL. IF NOT, SOME COMPROMISE MAY BE MADE BY ADJUSTING L3 FOR THE LOW CHANNELS AND L4 FOR THE HIGH CHANNELS. NOTE: QUALITY OF RESPONSE CURVE DOES NOT AFFECT ACCURACY OF OSCILLATOR ALIGNMENT SO LONG AS A ZERO-BEAT IS OBTAINED.
	4	69 MC.	67.25 MC.		
	3	63 MC.	61.25 MC.		
	2	57 MC.	55.25 MC.		
	12	207 MC.	205.25 MC.		
	11	201 MC.	199.25 MC.		
	10	195 MC.	193.25 MC.		
	9	189 MC.	187.25 MC.		
	8	183 MC.	181.25 MC.		
	7	177 MC.	175.25 MC.		

Alignment Instructions — Standard Coil Tuner

R.F. ALIGNMENT

1. Connect TV Sweep Generator to Antenna Terminals.
2. Connect R.F. Marker Generator loosely to Antenna Terminals.
3. Connect vertical amplifier of Oscilloscope through a 10,000 ohm ½w. resistor to Test Point (A) Fig. 12.
4. Short A.G.C. Bus to ground on TV chassis (across C58, 5000 MMF Discap condenser).
5. Set Station Selector switch to Channel 12.
6. Feed 207 mc at 10 mc sweep from Sweep Generator, and 205.25 mc & 209.75 mc fixed frequencies from R.F. Marker Generator.
7. Observe response curve on Scope. If necessary adjust C2, C3, or C4 (see Fig. 12) so that response curve corresponds approximately to that shown in Fig. 7, and has maximum gain.
8. Check markers on response curve of all remaining channels, setting Sweep and Marker Generators at corresponding frequencies for each channel. See Table II for convenient tabulation of proper frequencies. If the R.F. Markers do not fall in automatically in their proper places on all channels, a compromise must be made by slight readjustment of C2, C3, or C4.

OSCILLATOR ALIGNMENT

1. Connect TV Sweep Generator to Antenna Terminals.
2. Couple R.F. Marker Generator loosely to Antenna Terminals.
3. Connect vertical amplifier of Oscilloscope across the video amplifier grid and ground (pin 4 of 6AC7, V11).
4. Couple 24.75 mc video I.F. Marker Generator loosely to first I.F. grid (pin 1 of 6AU6, V7).
5. Rotate Fine Tuning control to center of range.
6. Set Station Selector switch to Channel 12.
7. Set Sweep Generator to 207 mc at 10 mc sweep and Marker Generator to 205.25 mc (video carrier).
8. Observe response curve and adjust C5, (Fig. 12) for Zero-beat with 24.75 mc marker. **NOTE: Quality of response curve does not affect accuracy of oscillator alignment, so long as a zero-beat is obtained.**
9. Check for zero-beat on all channels in this manner, setting the Station Selector, Sweep Generator and Marker Generator at corresponding frequencies. (See Table II). It is not usually necessary to make any further adjustments. However, if the individual oscillator coils must be touched up, the following procedure should be employed:

a) Rotate Fine Tuning control to center of range.

b) Set Station Selector to desired channel, Sweep Generator to its center frequency with 10 mc sweep, and Marker Generator to the corresponding video carrier frequency (see Table II).

c) Place a non-metallic screwdriver through the opening marked "Recessed Individual Osc. Adjustment," Fig. 12, and adjust oscillator coil for zero-beat with 24.75 mc marker on response curve.

d) This adjustment can be repeated on any single channel, or if necessary, on all channels.

e) If difficulty is encountered in tuning any particular channel well within limits of Fine Tuning control after these adjustments are made, readjust C5 slightly (as in Step 8) shifting the whole range of frequencies in the desired direction.

TABLE II - ALIGNMENT FREQUENCIES

CHANNEL NUMBER	SWEEP GEN. CENTER FREQ. (10 MC. SWEEP)	MARKER GENERATOR FREQUENCIES VIDEO CARRIER	MARKER GENERATOR FREQUENCIES SOUND CARRIER
2	57 MC.	55.25 MC	59.75 MC.
3	63 MC.	61.25 MC.	65.75 MC.
4	69 MC.	67.25 MC.	71.75 MC.
5	79 MC.	77.25 MC.	81.75 MC.
6	85 MC.	83.25 MC.	87.75 MC.
7	177 MC.	175.25 MC.	179.75 MC.
8	183 MC.	181.25 MC.	185.75 MC.
9	189 MC.	187.25 MC.	191.75 MC.
10	195 MC.	193.25 MC.	197.75 MC.
11	201 MC.	199.25 MC.	203.75 MC.
12	207 MC	205.25 MC	209.75 MC.
13	213 MC.	211.25 MC	215.75 MC.

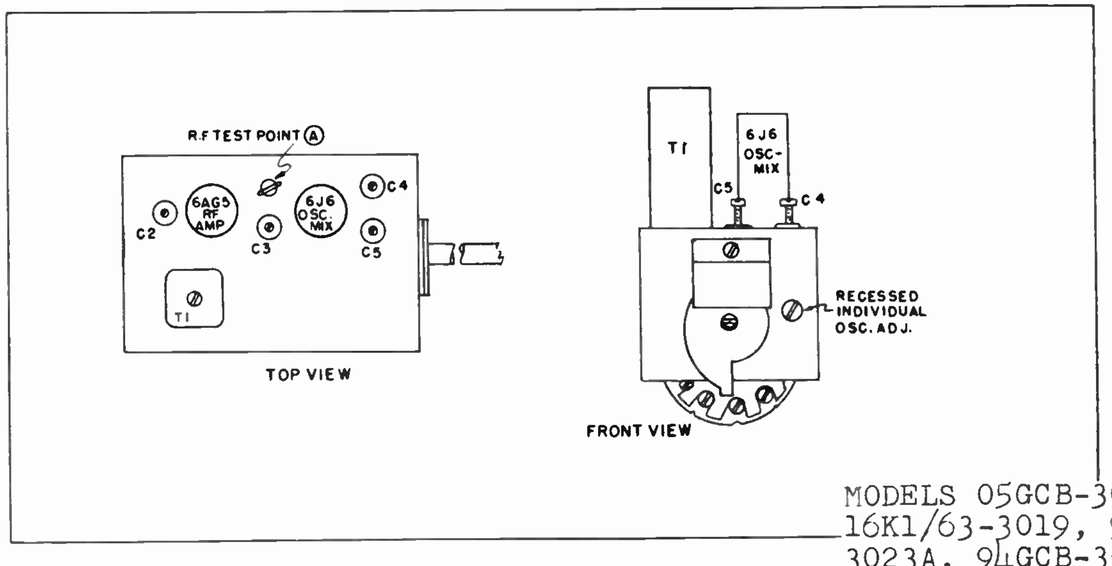

FIG. 12—Alignment Points of Standard Coil R-F Tuner.

MODELS 05GCB-3019A, 16K1/63-3019, 94GCB-3023A, 94GCB-3023B, 94GCB-3023C

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Service Notes

For additional information, be sure to see the section entitled "PRODUCTION CIRCUIT CHANGES" on pages 11, 12 and 13.

The Television Serviceman can usually save considerable time by combining his training and experience to deduce the origin of the trouble from the appearance of the defective picture on the screen. Detailed instruction of the application of this technique is beyond the scope of this manual. Rather than repeat this information, which can be found in most good general service literature, this section presents special service notes and hints which apply mainly to these receivers.

I ELIMINATION OF PICTURE TWIST

a) If twist occurs mainly upon advancing the brightness control, see (and perform if necessary) the production change entitled "Twist Due to Brightness."

b) If twist is apparent even at low settings of the brightness and Contrast controls, check:—

1. Proximity of 6.3 volt filament wires to Horizontal A.F.C. Coil. If wires run close, reroute the filament wires further from the A.F.C. circuit.

2. Wire from Horizontal Hold control to R77, 100K resistor at grid (pin 4) of 6SN7 Horizontal Sweep Oscillator. If unshielded, replace with shielded wire.

3. Horizontal Sweep Oscillator 1.5K Cathode Resistor (R76). Slight increase of resistance value may reduce twist.

4. See PRODUCTION CHANGE #6 entitled, "HORIZONTAL PARASITICS".

5. See PRODUCTION CHANGE #12 entitled, "A.F.C. BALANCE".

II STANDARD COIL R-F TUNER: The antenna, R-F and Oscillator Coils of the Standard Coil Tuner are retained by bronze spring clips. Defective coils may be removed and replaced by identical sections which are supplied by the manufacturer. Re-alignment of the particular channels will probably be necessary after this change is made. See the Parts List for identification numbers. Do not tamper with the main tuner assembly; replace as a complete unit.

III RATIO DETECTOR TRANSFORMER, T6: Three types of transformers are used. See Note #3 under Alignment Procedure (page 5) if identification is required. (See PRODUCTION CHANGE # 10).

IV INCREASE PICTURE SIZE IN LOW LINE-VOLTAGE AREA: If greater picture size is required, shunt the terminals of the Horizontal Deflection Yoke with a 470 mmfd, 2000 volt (or equivalent) condenser.

V SOUND-AND-PICTURE COINCIDENCE: See (and perform if necessary) PRODUCTION CHANGE #9 entitled "Sound-and-Picture Coincidence".

VI MINIMIZING "INTERCARRIER BUZZ": SEE PRODUCTION CHANGE #1. This type of buzz is usually more noticeable on a test pattern with a 400 or 1000 cycle tone modulation. If, however, it is determined that the buzz is objectionable on a live program, when contrast is not advanced too far clockwise, the following corrections are suggested:

1. Check filter condenser C38 (40 MF - 350V.) for leakage or an open condition.

2. If possible, align video I.F. visually (see Alignment Procedure), making sure that 24.75 MC and 22.0 MC markers are both at the 50% points.

Production Circuit Changes

1. "INTERCARRIER BUZZ." To minimize "intercarrier buzz" on earlier receivers, the circuit revision described below is recommended. This revision has been performed on Model O5GCB3019A.

Note: All reference to the 6AU6 Ratio Detector Driver (V6) will be indicated here as merely "6AU6" for simplicity. Refer to Fig. 13 for identification of components.

a) Remove the .02 MF 400V. paper condenser. (At junction of 1K (R34) and 47K (R25) located at a terminal of the Raito Detector Trans.)

b) Remove the 33K 6AU6 screen bleeder resistor. (Located at 6AU6 pins 6 and 7.)

c) Clip the small buss wire which connect 6AU6 pins 2 and 7.

d) Carefully unsolder the lead of the 5000 mmf disc condenser (C48) which connects to 6AU6 pin 7, and re-solder this lead to 6AU6 pin 2. Do not clip this lead or it will be too short.

e) Insert an 82 ohm ½w. resistor (R26) and a 5000 mmf disc condenser (C34) in parallel between 6AU6 terminals 2 and 7.

f) Insert a 5000 mmf disc condenser (C55) between junction of 1K (R34) and 47K (R25) located at the Ratio Det. Trans., and 6AU6 pin 7, keeping leads as short as possible.

g) Remove from 6AU6 pin 1 the leads of 47K (R28) and 39 mmf (C49) and insert from that junction (R28 and C49) a 100 ohm ½w. resistor (R10) to 6AU6 pin 1.

h) Remove from a terminal on the ratio det. trans. the lead of 15K (R24) and 1500 mmf (C42) and insert from that junction (R24 and C42) a 220 ohm ½w. resistor (R11) to the same terminal on the ratio det. trans.

i) Remove jumpers between terminals 5, 6, and 7 of the 6T8 (V5). Remove the 8.2K resistor (R22) from 6T8 pin 6 and re-connect to 6T8 pin 7. Insert jumper between 6T8 pins 5 and 7. Insert jumper (with spaghetti) between 6T8 pins 6 and 1.

j) Align the sound circuit. (See Alignment Procedure.)
Note: In absence of alignment equipment, the above adjustments can usually be performed with acceptable accuracy by tuning-in an offending TV channel and utilizing the 4.5MC difference frequency as the signal source. While tuning T5 and T6, listen for maximum audio signal with corresponding minimum buzz. An audio output meter across the speaker voice coil may be helpful.

k) Check sound on all channels. If, after careful alignment, instability is encountered, (tendency toward regeneration) insert a 47K (approx.) screen bleeder resistor between 6AU6 pins 2 and 6.

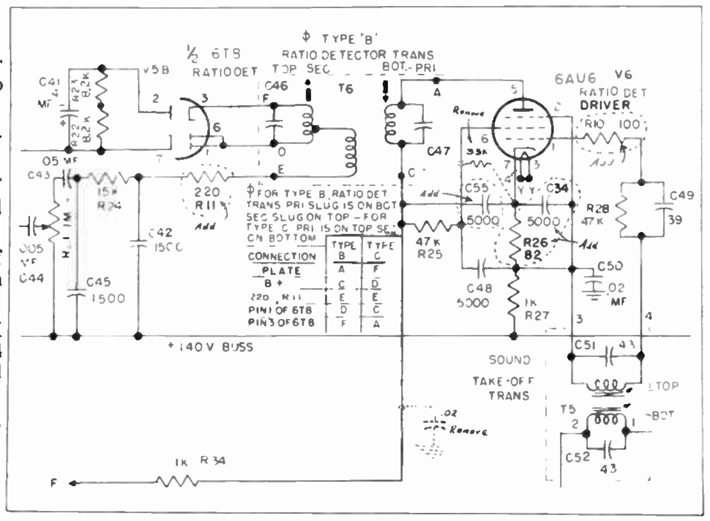

FIG. 13—Partial Schematic Diagram Showing Buzz Changes.

Production Circuit Changes

(CONTINUED)

2. ¼ AMP. FUSE: To provide additional protection to the fly-back transformer, the ¼ amp. fuse was removed from the 6BG6 cathode circuit and inserted, instead, in series with terminal #1 of the fly-back transformer on Model 05GCB3019A.

3. EARLY 16" CONSOLETTES: In Models 94GCB3023A and 94GCB3023B a 10" electrodynamic speaker is used and a separate selenium rectifier power supply is employed to furnish the 60 volts required for the speaker field winding. See Fig. 14 below. In addition, the following variations will be found in these receivers:

a) By-pass condenser (C36) across output transformer primary is .003 mfd.

b) Resistor (R58) across focus control is 1.8K 2 watt.

c) Model 94GCB3023A uses a 16" 60° Picture Tube, and in some cases a 52° Picture Tube.

d) Model 94GCB3023B uses a 16" 52° Picture Tube.

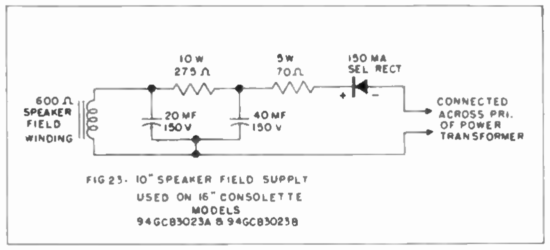

FIG. 14—10" Speaker Field Supply Used on 16" Consolette Models 94GCB3023A & 94GCB3023 B.

4. TWIST DUE TO BRIGHTNESS: If required, the D-C Restorer Circuit should be altered on Models 94GCB3023A and 94GCB3023B as follows: (See Fig. 15).

a) Change resistor at picture-tube grid (R55) to 1 meg.

b) Add .1 mfd 400V capacitor (C11) in series with an 8.2K ½w. resistor (R108) connected from the cathode (pin 6) of the D-C Restorer (V12A) to junction of L18 and R54.

Note: R108 is 7K in earlier production receivers.

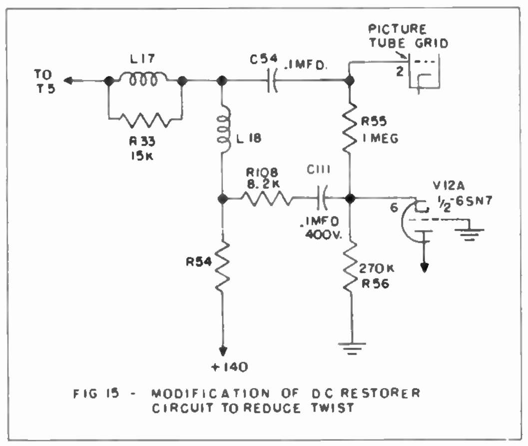

FIG. 15—Modification of D-C Restorer Circuit to Reduce Twist.

5. PICTURE "BLOOMING": To reduce picture "blooming" on Models 94GCB3023A and 94GCB3023B, drop the screen voltage on the picture-tube from 360 volts to 250 volts as follows: (Refer to main diagram).

a) Change resistor (R32) at picture-tube screen from 1K to 100K, ½w.

b) Add a 220K ½w. resistor (R115) from picture-tube screen to ground.

6. HORIZONTAL "PARASITICS": If "parasitics" is the horizontal sweep circuit are encountered in Models 94GCB3023A or 94GCB3023B, proceed as follows: (Refer to main diagram).

a) Change R75, located at pin 2 of the Horizontal Sweep Oscillator (V15) from 5.6K to 4.7K, ½w. (Some receivers may have a 3.9K resistor here).

b) Reverse the leads on the Horizontal A.F.C. Coil (L9).

c) If necessary, relocate the Horizontal A.F.C. Coil.

7. VARIATIONS IN VIDEO PEAKING COILS ARE AS FOLLOWS:

EARLY PRODUCTION

PART NUMBER	DOT COLOR CODE	ITEM NUMBER	INDUCTANCE
C-1.503-1	RED	L15	120 μh
C-1.503-2	GREEN	L16	419 μh
C-1.503-3	BLUE	L17, L18	169 μh

LATE PRODUCTION

PART NUMBER	DOT COLOR CODE	ITEM NUMBER	INDUCTANCE
C-1.522-1	GRAY	L16	760 μh
C-1.522-2	GREEN	L18	419 μh
C-1.522-3	BLUE	L15, L17	169 μh

8. 6BC5 TUBE: The 6BC5 Tube is an exact replacement for the 6AG5 which has been used in earlier receivers. When replacement of the 6AG5 is required, use the 6BC5, whos transconductance is held to closer tolerance. Slight realignment may be required when this change is made.

9. SOUND-AND-PICTURE COINCIDENCE: If sound-and-picture are not coincident on weak signals on early production receivers, change R26 screen voltage divider on 6AU6 Ratio Detector Drive tube from 10K to 33K, ½watt. See PRODUCTION CHANGE #1.

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World Radio History

Production Circuit Changes

(CONTINUED)

10. RATIO DETECTOR TRANSFORMERS: As a result of use of types "B" and "C" ratio detector transformers in later production receivers (employing Standard Coil Tuners), the Ratio Detector Driver Grid Resistor (R28) and by-pass condenser across the output transformer primary (C36) were changed from 470K to 47K and from .005 mfd to .01 mfd respectively. For identification of these transformers, see main schematic diagram and Note #3 in ALIGNMENT section.

11. FILTER CONDENSERS: For increased voltage safety factor, the triple-section 40-40-40 mfd; 450-450-450 Volt single-can electrolytic filter condenser was replaced by two units (C80 and C81) of higher voltage ratings (475 volts each section). See main schematic diagram.

12. A.F.C. BALANCE: To minimize picture twist due to unbalance of positive and negative sync voltage at 6AL5 A.F.C. diodes, the following revisions were made: (See main schematic diagram.)

a) Plate resistor (R98) of ½ 6SN7 Sync Amp.-Split. (V12B) changed from 3.9K to 6.8K.

b) Plate resistor (R99) of above tube changed from 3.9K to 2.2K.

c) Vert. integ. resistor (R97) changed from 22K to 33K.

d) Saw-tooth feedback resistor (R94) changed from 4.7K to 3.9K.

13. MISCELLANEOUS CHANGES: In addition to those changes given above, the following variations will be found in these receivers.

a) High Voltage Filter Condenser (C95) is rated at 10KV when used with Fly-Back Transformer #9.236-1; it is rated at 20KV when used with Fly-Back Transformer #9.240-1.

b) Integrating Network Condensers (C70 and C71) may be either 4700 mmfd or 5000 mmfd "discaps".

c) Picture Tube grid resistor (R55) may be either 2.2K, 18K, 22K, or 1 meg (depending upon period of production). See PRODUCTION CHANGE #4.

d) De-emphasis Condenser (C45) changed from 3900 mmfd to 1500 mmfd in later production receivers.

e) First Video I.F. Grid Resistor (R35) changed from 8.2K to 4.7K in receivers with Standard Coil Tuner.

f) Voice-Coil By-Pass Condenser (C35) may be either 1000 mmfd, 1500 mmfd, or omitted on earlier receivers.

g) Audio Output Transformer (T7) was #9.238 on earlier table model receivers and is #9.241 on all later production receivers.

h) A 10" Permanent Magnet Speaker is used in Models 94GCB3023C, 16K1/63-3019, and 05GCB3019A. See PRODUCTION CHANGE #3.

i) Indoor Antenna: An indoor antenna is used in Models 16K1/63-3019 and 05GCB3019A.

j) Video Amplifier Plate Load: Video Amplifier plate load resistors R52 and R53 as follows:

1. 56K, 2 watts each; connected in parallel in all receivers using the General Instrument Tuner.
2. R52 is 11K, 2 watt; R53 is 15K, 2 watts in early receivers using Standard Coil Tuner.
3. R52 is 12K, 2 watts; R53 is 15K, 2 watts in latest production receivers using Standard Coil Tuner.

PICTURE TUBE REPLACEMENT GUIDE

TUBE TYPE	RESIST. ACROSS FOCUS POT.	MFG. LIST FOCUS CURRENT, MA.	TUBE DEFL. ANGLE AND DEFL. YOKE PART NO.	H. V. CONTACT	BEAM BENDER	MAX. BULB DIA.	OVER-ALL LENGTH	DIRECT REPLACE-MENT
16CP4	TWO 1000 OHM RESISTORS IN PARALLEL (R58 & R59)	115	52° C-9.209	Recess	Single or Double	15⅞"	22¾"	None
16DP4		115	60° C-9.242	Recess	Single or Double	15⅞"	20¾"	THESE FOUR TYPES ARE INTERCHANGEABLE
16JP4		110	60° C-9.242	Recess	Single or Double	16⅛"	20¾"	
16LP4 Amer. Tel.		110	52° C-9.242	Recess	Single or Double	15⅞"	22¼"	
16HP4		110	60° C-9.242	Recess	Single or Double	15⅞"	21¼"	
16FP4 Dumont	None	140	62° C-9.242	Pin	Single	16⅛"	20¼"	None

TO REPLACE A TUBE NOT GIVEN ON THIS CHART, PROCEED AS FOLLOWS:

1. Check physical dimensions, socket connections, anode connector. Allow for physical variations.
2. Assemble tube in receiver, turn on receiver and observe picture.
3. If variation of focus control is not sufficient to focus tube—
   a) If more current is required, increase resistance of either or both R58 & R59. Try placing them in series.
   b) If less current is required, decrease resistance of either or both R58 & R59. Shunt them with other resistors.
4. If sweep is not sufficient on wide angle tubes, a change of deflection yoke or circuit values may be required.

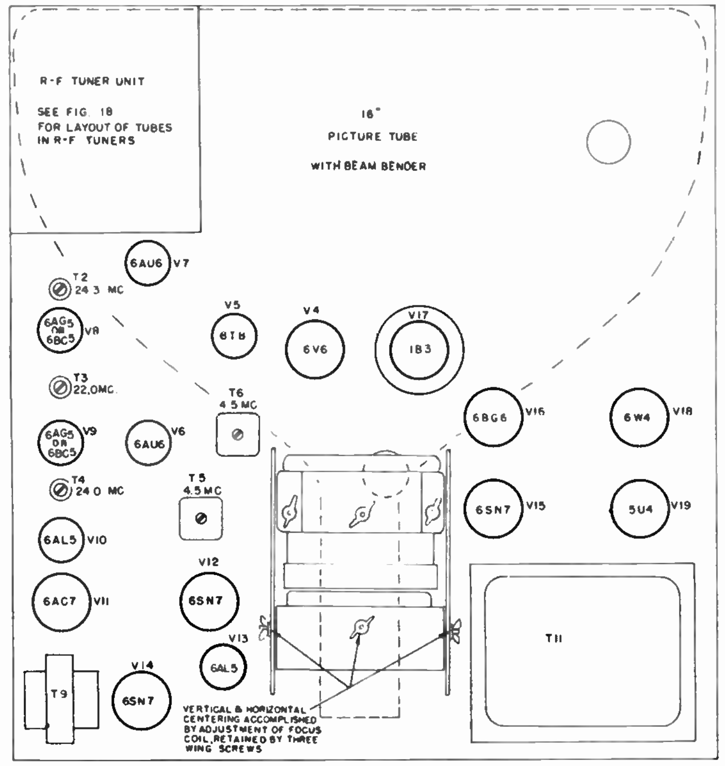
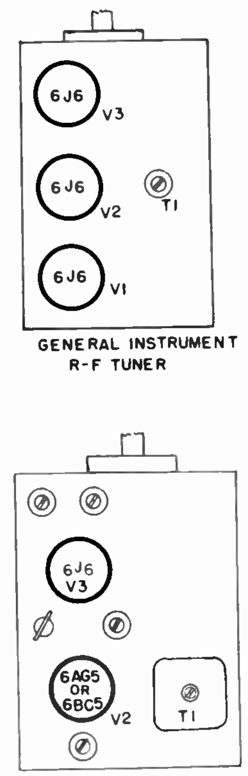


FIG. 16—Tube Placement Chart—Top View.



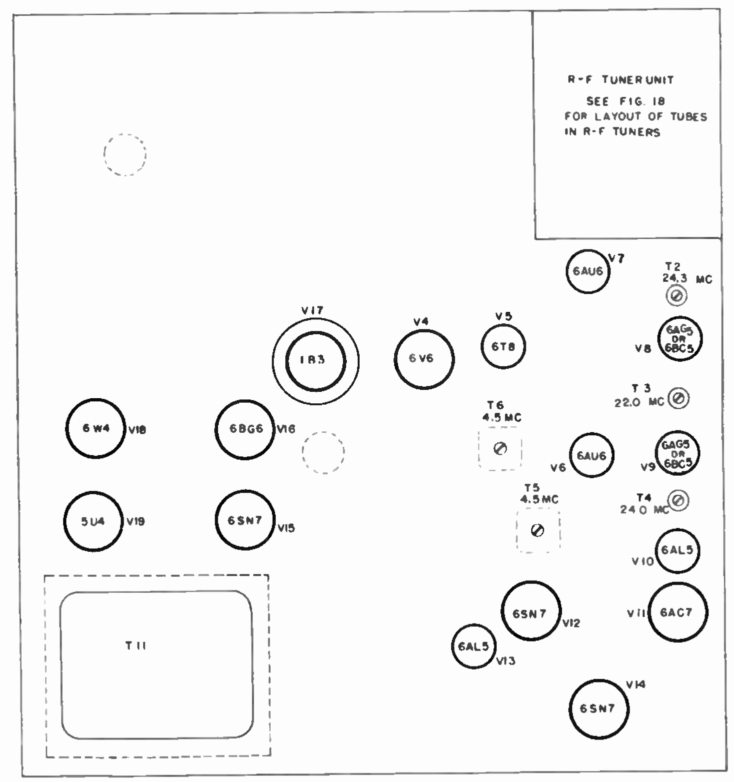


FIG. 17—Tube Placement Chart—Bottom View.

NOTE: V-NUMBER DESIGNATION OF TUBES CORRESPONDS TO THAT OF VOLTAGE CHARTS; PAGE 3.

FIG. 18—R-F Tuner Sub-Chassis—Top Views.

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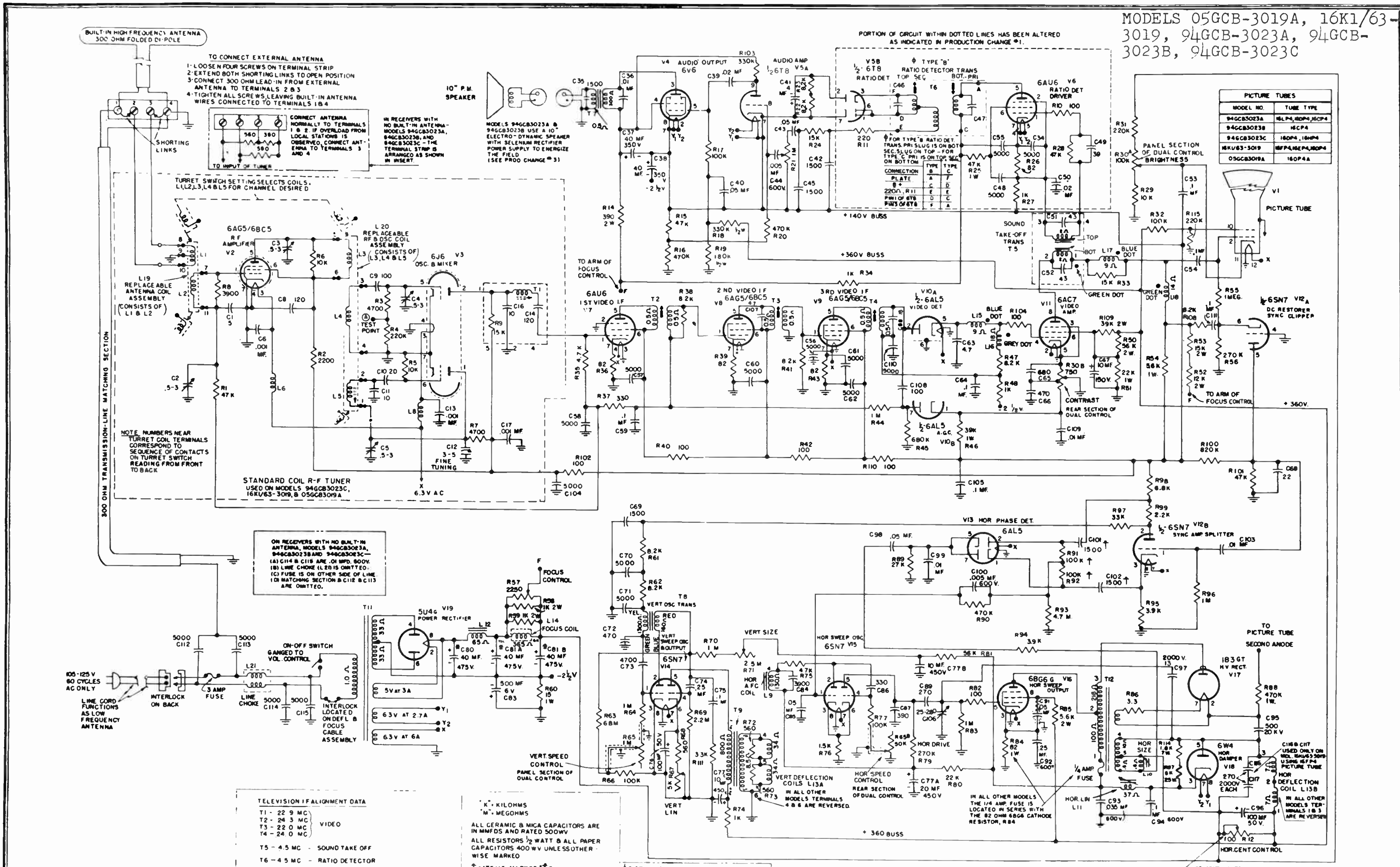
World Radio History

MODELS 05GCB-3019A, 16K1/63-3019, 94GCB-3023A, 94GCB-3023B, 94GCB-3023C



PICTURE TUBES	
MODEL NO.	TUBE TYPE
94GCB3023A	16LP4, 16DP4, 16CP4
94GCB3023B	16CP4
94GCB3023C	16DP4, 16HP4
16K1/63-3019	16FP4, 16EP4, 16DP4
05GCB3019A	16DP4A

TELEVISION IF ALIGNMENT DATA

T1 - 22.9 MC
T2 - 24.3 MC
T3 - 22.0 MC
T4 - 24.0 MC
} VIDEO

T5 - 4.5 MC - SOUND TAKE OFF

T6 - 4.5 MC - RATIO DETECTOR

THE 1/4 AMP FUSE USED IN SERIES WITH TERM #1 OF HOR OUT TRANS IS ACCESSIBLE FROM THE BOTTOM OF THE CHASSIS

THE 3 AMP LINE FUSE IS ACCESSIBLE FROM THE REAR OF THE CHASSIS

"K" = KILOHMS
"M" = MEGOHMS

ALL CERAMIC & MICA CAPACITORS ARE IN MMFDS AND RATED 500WV

ALL RESISTORS 1/2 WATT & ALL PAPER CAPACITORS 400 WV UNLESS OTHERWISE MARKED

† = ITEMS MARKED "†"; R91, R92, C101, C102 - ARE MATCHED PAIRS ± 1% REPLACE AS MATCHED PAIRS

✱ = C80 & C81 ARE RATED AT 450V IN MODELS 94GCB3023A & 94GCB3023B. IF REPLACEMENT IS REQUIRED, USE 475 V CONDENSERS, AS ABOVE

ϕ DISTINGUISHING FEATURES BETWEEN TYPES "B" & "C" RATIO DET TRANS, T6

	TYPE "B"	TYPE "C"
CAN HEIGHT	2 1/2"	3"
SOLDERING TERMINALS	STRAIGHT LUGS	WIRE LOOPS OR STRAIGHT LUGS

CIRCUIT SCHEMATIC DIAGRAM

MODEL 05GCB3019A 16" CONSOLETTE

THIS DIAGRAM REPRESENTS THE MOST RECENT OF THIS SERIES. INFORMATION ON ALL OTHER MODELS (WHERE VARIATIONS EXIST) IS GIVEN HERE IN NOTE FORM AND IS ALSO EXPLAINED IN THE SECTION ENTITLED "PRODUCTION CIRCUIT CHANGES"

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World Radio History

PARTS LIST

For convenience of tabulation, the model numbers will be designated in this listing as follows:

Model No.	Designation	Model No.	Designation
94GCB3023A	94A	16K1/63-3019	16K1
94GCB3023B	94B	05GCB3019A	05A
94GCB3023C	94C		

R-F Tuner Unit—Part No. D-36.134-1
Used In Models 94A and 94B (See Misc. Parts)
Part Numbers listed for identification only.

CAPACITORS

Symbol	Description	
C1	300 MMF	
C2	1500 MMF	
C3	300 MMF	
C4	1.5 MMF	
C5	1.5 MMF	
C6	500 MMF	
C7	Trimmer	Low Band
C8	Split Stator Cond.	Low Band
C9	Trimmer	Low Band
C10	Split Stator Cond.	Low Band
C11	Trimmer	High Band
C12	Split Stator Cond.	High Band
C13	Trimmer	High Band
C14	Split Stator Cond.	High Band
C15	Split Stator Cond.	Low Band
C16	Trimmer	Low Band
C17	Split Stator Cond.	Low Band
C18	Trimmer	Low Band
C19	Split Stator Cond.	High Band
C20	Trimmer	High Band
C21	Split Stator Cond.	High Band
C22	Trimmer	High Band
C23	Split Stator Cond.	Low Band
C24	Split Stator Cond.	Low Band
C25	Split Stator Cond.	High Band
C26	Split Stator Cond.	High Band
C27	1500 MMF	
C28	500 MMF	
C29	300 MMF	
C31	1500 MMF	
C32	500 MMF	
C33	4.7 MMF	
C34	4.7 MMF	
C35	500 MMF	

RESISTORS

Symbol	Description	
R1	150 ohm	½ w. Carbon
R2	150 ohm	½ w. Carbon
R3	1,000 ohm	½ w. Carbon
R4	5,600 ohm	½ w. Carbon
R5	1 megohm	½ w. Carbon
R6	10,000 ohm	½ w. Carbon
R7	1,000 ohm	½ w. Carbon
R8	1,000 ohm	½ w. Carbon
R9	1,000 ohm	½ w. Carbon
R10	1,000 ohm	½ w. Carbon
R11	100,000 ohm	½ w. Carbon
R12	100,000 ohm	½ w. Carbon
R13	47 ohm	½ w. Carbon
R108	1,000 ohm	½ w. Carbon

TRANSFORMERS

Symbol	Description
T1	Converter Plate 22.9 m.c.

COILS

Symbol	Description
L1	Coupling Ring
L2	Coupling Ring
L3	Osc. Coil, Low Band
L4	Osc. Coil, High Band

R-F Tuner Unit—Part No. D-36.137
Used in Models 94C, 16K1, and 05A (See Misc. Parts)

CAPACITORS

Symbol	Description
C1	5 MMF
C3	.5-3 MMF Trimmer
C2	.5-3 MMF Trimmer
C4	.5-3 MMF Trimmer
C5	.5-3 MMF Trimmer
C6	.001 MF, 400V, Tubular
C8	120 MMF
C9	100 MMF
C10	20 MMF
C12	3-5 MMF Fine Tuning
C13	.001 MF, 400V, Tubular
C14	120 MMF
C15	68 MMF
C16	10 MMF
C17	.001 MF, 400V, Tubular

RESISTORS

Symbol	Description	
R1	4,700 ohm	½ w. Carbon
R2	2,200 ohm	½ w. Carbon
R3	4,700 ohm	½ w. Carbon
R4	220,000 ohm	½ w. Carbon
R5	10,000 ohm	½ w. Carbon
R6	10,000 ohm	½ w. Carbon
R7	4,700 ohm	½ w. Carbon
R8	3,900 ohm	½ w. Carbon
R9	15,000 ohm	½ w. Carbon

TRANSFORMERS

Symbol	Description
T1	Converter Plate, 22.9 m.c.

REPLACEABLE TURRET COIL ASSEMBLIES

Symbol	Garod Part No.	Description
L19	B-36.141-2	Antenna Coil Assembly Chan. 2
	B-36.141-3	Antenna Coil Assembly Chan. 3
	B-36.141-4	Antenna Coil Assembly Chan. 4
	B-36.141-5	Antenna Coil Assembly Chan. 5
	B-36.141-6	Antenna Coil Assembly Chan. 6
	B-36.141-7	Antenna Coil Assembly Chan. 7
	B-36.141-8	Antenna Coil Assembly Chan. 8
	B-36.141-9	Antenna Coil Assembly Chan. 9
	B-36.141-10	Antenna Coil Assembly Chan. 10
	B-36.141-11	Antenna Coil Assembly Chan. 11
	B-36.141-12	Antenna Coil Assembly Chan. 12
	B-36.141-13	Antenna Coil Assembly Chan. 13
L20	B-36.141-102	RF & Osc. Coil Assem. Chan. 2
	B-36.141-103	RF & Osc. Coil Assem. Chan. 3
	B-36.141-104	RF & Osc. Coil Assem. Chan. 4
	B-36.141-105	RF & Osc. Coil Assem. Chan. 5
	B-36.141-106	RF & Osc. Coil Assem. Chan. 6
	B-36.141-107	RF & Osc. Coil Assem. Chan. 7
	B-36.141-108	RF & Osc. Coil Assem. Chan. 8
	B-36.141-109	RF & Osc. Coil Assem. Chan. 9
	B-36.141-110	RF & Osc. Coil Assem. Chan. 10
	B-36.141-111	RF & Osc. Coil Assem. Chan. 11
	B-36.141-112	RF & Osc. Coil Assem. Chan. 12
	B-36.141-113	RF & Osc. Coil Assem. Chan. 13

RESISTORS

Symbol	Part No.	Description	
R10	D-7.101-226	100 ohm	½ w. Carbon
R11	D-7.101-234	220 ohm	½ w. Carbon
		R10 and R11 Used on Model 05A	
R12	C-8.206-3	100 ohm, 2 w. Pot. Hor. Center. Used on Model 05A	
R14	D-7.103-69	390 ohm, ± 10%	2 w. Wire Wound
R15	D-7.101-45	4,700 ohm	½ w. Carbon
R16	D-7.101-129	470,000 ohm	½ w. Carbon
R17	D-7.101-101	100,000 ohm	½ w. Carbon
R18	D-7.101-120	330,000 ohm ± 5%	½ w. Carbon
R19	D-7.101-110	180,000 ohm ± 5%	½ w. Carbon
R20	D-7.101-129	470,000 ohm	½ w. Carbon
R21	C-8.227-1	1 meg. pot. vol. control with switch	
R22	D-7.101-55	8,200 ohm ± 10%	½ w. Carbon
R23	D-7.101-55	8,200 ohm ± 10%	½ w. Carbon
R24	D-7.101-66	15,000 ohm	½ w. Carbon
R25	D-7.102-95	47,000 ohm	1 w. Carbon
R26	D-7.101-59	10,000 ohm Used on Models 94A, 94B and 94C	½ w. Carbon
	D-7.101-80	33,000 ohm Used on Model 16K1	½ w. Carbon
	D-7.101-235	82 ± 10% Used on Model 05A	½ w. Carbon
R27	D-7.101-17	1,000 ohm	½ w. Carbon
R28	D-7.101-129	470,000 ohm Used on Models 94A, 94B, and 94C	½ w. Carbon
	D-7.101-87	47,000 ohm Used on Models 16K1 and 05A	½ w. Carbon
R29	D-7.101-59	10,000 ohm	½ w. Carbon
R30A	C-8.226-1	100,000 ohm pot. Brightness Control	
R30B		750 ohm pot. tap. @ 250, Contrast	
R31	D-7.101-115	220,000 ohm	½ w. Carbon
R32	D-7.101-17	1,000 ohm Used on Models 94A, 94B and 94C	½ w. Carbon
	D-7.101-101	100,000 ohm Used on Models 16K1 and 05A	½ w. Carbon
R33	D-7.101-66	15,000 ohm	½ w. Carbon
R34	D-7.101-17	1,000 ohm	½ w. Carbon
R35	D-7.101-55	8200 ohm ± 10% Used on Models 94A and 94B	½ w. Carbon
	D-7.101-45	4700 ohm ± 10% Used on Models 94C, 16K1 and 05A	½ w. Carbon
R36	D-7.101-235	82 ohm ± 10%	½ w. Carbon
R37	D-7.101-237	330 ohm	½ w. Carbon
R38	D-7.101-55	8,200 ohm	½ w. Carbon
R39	D-7.101-235	82 ohm ± 10%	½ w. Carbon
R40	D-7.101-226	100 ohm	½ w. Carbon
R41	D-7.101-55	8,200 ohm	½ w. Carbon
R42	D-7.101-226	100 ohm	½ w. Carbon
R43	D-7.101-235	82 ohm ± 10%	½ w. Carbon
R44	D-7.101-142	1 megohm	½ w. Carbon
R45	D-7.101-135	680,000 ohm	½ w. Carbon
R46	D-7.102-91	39,000 ohm ± 10%	1 w. Carbon
R47	D-7.101-55	8,200 ohm ± 10%	½ w. Carbon
R48	D-7.101-17	1,000 ohm	½ w. Carbon
R49	B-6.209-1	70 ohm Used on Models 94A & 94B	5 w. Wire Wound
R50	D-7.103-160	56,000 ohm ± 10%	2 w. Carbon
R51	D-7.102-81	22,000 ohm	1 w. Carbon
R52	D-7.103-160	56,000 ohm ± 10% Used on Models 94A and 94B	2 w. Carbon
	D-7.103-269	11,000 ohm ± 10% Used on Model 94C	2 w. Carbon
	D-7.103-132	12,000 ohm ± 10% Used on Models 16K1 and 05A	2 w. Carbon
R53	D-7.103-160	56,000 ohm ± 10% Used on Models 94A and 94B	2 w. Carbon
	D-7.103-135	15,000 ohm ± 10% Used on Models 94C, 16K1 and 05A	2 w. Carbon
R54	D-7.102-55	5,600 ohm ± 10%	1 w. Carbon
R55	D-7.101-31	2,200 ohm Used on Models 94A and 94B	½ w. Carbon
	D-7.101-142	1 megohm Used on Models 94C, 16K1 and 05A	½ w. Carbon
R56	D-7.101-118	270,000 ohm ± 10%	½ w. Carbon
R57	C-8.221	2250 ohm, 4 w. pot. focus control	
R58	D-7.103-87	1,000 ohm	2 w. Carbon
R59	D-7.103-87	1,000 ohm	2 w. Carbon
R60	C-6.212-3	15 ohm	1 w. wire wound
R61	D-7.101-55	8,200 ohm ± 10%	½ w. Carbon
R62	D-7.101-55	8,200 ohm ± 10%	½ w. Carbon
R63	D-7.108-185	6.8 megohm	½ w. Carbon
R64	D-7.101-142	1 megohm	½ w. Carbon
R65A	C-8.217-3	1 megohm pot. vert. hold	
R65B		50,000 ohm pot. horiz. hold	
R66	D-7.101-101	100,000 ohm	½ w. Carbon
R67	C-8.206-6	5,000 ohm vert. lin. control	
R68	D-7.101-6	560 ohm ± 10%	½ w. Carbon
R69	D-7.101-156	2.2 megohm	½ w. Carbon
R70	D-7.101-142	1 megohm	½ w. Carbon
R71	C-8.207-5	2.5 megohm pot. vert. size	
R72	D-7.101-6	560 ohm ± 10%	½ w. Carbon
R73	D-7.101-6	560 ohm ± 10%	½ w. Carbon
R74	D-7.101-17	1,000 ohm	½ w. Carbon
R75	D-7.101-48	5,600 ohm ± 10% Used on Models 94A and 94B	½ w. Carbon
	D-7.101-45	4,700 ohm ± 10% Used on Models 94C, 16K1 and 05A	½ w. Carbon
R76	D-7.101-24	1,500 ohm	½ w. Carbon
R77	D-7.101-101	100,000 ohm	½ w. Carbon
R78	B-6.211-2	275 ohm Used on Models 94A and 94B	10 w. wire wound
R79	D-7.102-126	270,000 ± 10%	1 w. Carbon
R80	D-7.101-73	22,000 ohm	½ w. Carbon
R81	D-7.101-90	56,000 ohm	½ w. Carbon
R82	D-7.101-226	100 ohm	½ w. Carbon
R83	D-7.101-142	1 megohm	½ w. Carbon
R84	D-7.102-213	82 ohm ± 10%	1 w. Carbon
R85	D-7.103-124	8,200 ohm	2 w. Carbon
R86	C-6.212-1	3.3 ohm	1 w. wire wound
R87	B-6.220	6,000 ohm	25 w. Wire Wound
R88	D-7.102-137	470,000 ohm	1 w. Carbon
R89	D-7.101-76	27,000 ohm ± 10%	½ w. Carbon
R90	D-7.101-129	470,000 ohm	½ w. Carbon
R91	D-7.101-101	100,000 ohm	½ w. Carbon
R92	D-7.101-101	100,000 ohm	½ w. Carbon
R93	D-7.101-179	4.7 megohm	½ w. Carbon
R94	D-7.101-45	4,700 ohm Used on Models 94A and 94B	½ w. Carbon
	D-7.101-41	3,900 ohm Used on Models 94C, 16K1, & 05A	½ w. Carbon
R95	D-7.101-41	3,900 ohm ± 10%	½ w. Carbon
R96	D-7.101-142	1 megohm	½ w. Carbon
R97, R98 & R99 Consecutively	D-7.101-73	22,000 ohm	½ w. Carbon
	D-7.101-41	3,900 ohm ± 10%	½ w. Carbon
	D-7.101-41	3,900 ohm ± 10% R97, R98, R99 used on Models 94A and 94B	½ w. Carbon
	D-7.101-80	33,000 ohm	½ w. Carbon
	D-7.101-51	6,800 ohm ± 10%	½ w. Carbon
	D-7.101-30	2,200 ohm ± 10% R97, R98, R99 used on Models 94C, 16K1 and 05A	½ w. Carbon
R100	D-7.101-138	820,000 ohm ± 10%	½ w. Carbon
R101	D-7.101-87	47,000 ohm	½ w. Carbon
R102	D-7.101-226	100 ohm	½ w. Carbon
R103	D-7.101-122	330,000 ohm	½ w. Carbon
R104	D-7.101-226	100 ohm	½ w. Carbon
R105	D-7.101-6	560 ohm ± 10%	½ w. Carbon
R106	D-7.101-239	390 ohm ± 10%	½ w. Carbon
R107	D-7.101-6	560 ohm ± 10%	½ w. Carbon
R108	D-7.101-237	7,000 ohm Used on Models 94C & 16K1	½ w. Carbon
	D-7.101-55	8,200 ohm ± 10% Used on Model 05A	½ w. Carbon

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World Radio History

PARTS LIST *(Continued)*

Symbol	Part No.	Description	
R109*	D-7.103-153	39,000 ohm ± 10%	2 w. Carbon
R110*	D-7.101-226	100 ohm	½ w. Carbon
R111	D-7.101-38	3,300 ohm	½ w. Carbon
R114	C-6.215-8	1,800 ohm	7 w. wire wound
R115	D-7.101-115	220,000 ohm	½ w. Carbon

R114 & R115 used on Models 94C, 16K1 & 05A

*R109 & R110 are interchanged on Models 94A & 94B

CAPACITORS

Symbol	Part No.	Description
C34	B-4.115-1	5000 MMF, 500V, Ceramic Used on Model 05A
C35	D-4.108-12	1500 MMF, 500V, Ceramic Used on Models 16K1 and 05A
C36	D-3.100-3	.003 MF, 600V, Paper Tubular Used on Models 94A, 94B & 94C
	D-3.100-7	.01 MF, 400V, Paper Tubular Used on Models 16K1 and 05A
C37	B-5.432	40 MF, 350V, Tubular Electrolytic
C38	B-5.432	40 MF, 350V, Tubular Electrolytic
C39	D-3.100-11	.02 MF, 400V, Paper Tubular
C40	D-3.100-19	.05 MF, 400V, Paper Tubular
C41	C-5.430-1	4 MF, 50V, Tubular Electrolytic
C42	D-4.108-12	1500 MMF, 500V, Ceramic
C43	D-3.100-19	.05 MF, 400V, Paper Tubular
C44	D-3.100-4	.005 MF, 400V, Paper Tubular
C45	C-4.109-21	3900 MMF, 500V, Ceramic Used on Models 94A, 94B & 94C
	C-4.108-12	1500 MMF, 500V, Ceramic Used on Models 16K1 & 05A
C48	B-4.115-1	5000 MMF, 500V, Disc, Ceramic
C49	D-4.104-21	39 MMF Mica
C50	D-3.100-11	.02 MF, 400V, Paper Tubular
C51	Part of T5	43 MMF
C52	#C-1.509-1	43 MMF
C53	D-3.100-23	.1 MF, 400V, Paper Tubular
C54	D-3.100-23	.1 MF, 400V, Paper Tubular
C55	D-3.100-11	.02 MF, 400V, Paper Tubular Used on All Except Model 05A
	B-4.115-1	5000 MMF, 500V, Disc, Ceramic Used on Model 05A
C56	B-4.115-1	5000 MMF, 500V, Disc, Ceramic
C57	B-4.115-1	5000 MMF, 500V, Disc, Ceramic
C58	B-4.115-1	5000 MMF, 500V, Disc, Ceramic
C59	D-3.100-23	.1 MF, 400V, Paper Tubular
C60	B-4.115-1	5000 MMF, 500V, Disc, Ceramic
C61	B-4.115-1	5000 MMF, 500V, Disc, Ceramic
C62	B-4.115-1	5000 MMF, 500V, Disc, Ceramic
C63	C-4.111-6	5 MMF, 500V, Ceramic
C64	D-3.100-23	.1 MF, 400V, Paper Tubular
C65	C-4-109-5	680 MMF, 500V, Ceramic
C66	C-4.109-2	470 MMF, 500V, Ceramic
C67	C-5.430-2	10 MF 150V, Tubular Electrolytic
C68	D-4.104-11	22 MMF Mica
C69	D-4.108-12	1500 MMF, 500V, Ceramic
C70	B-4.115-1	5000 MMF, 500V, Ceramic
C71	B-4.115-1	5000 MMF, 500V, Ceramic
C72	C-4.109-2	470 MMF, 500V, Ceramic
C73	D-1.105-24	4700 MMF Mica ± 10%
C74	D-3.100-32	.25 MF 600V, Paper Tubular
C75	D-3.100-23	.1 MF, 400V, Paper Tubular
C76	C-5.420-1	100 MF, 25V, Tubular Electrolytic Used on Models 94A, 94B and 94C
	C-5.420-2	100 MF, 50V, Tubular Electrolytic Used on Models 16K1 and 05A
C77A	C-5.421-5	20 MF, 450V, Electrolytic
C77B		10 MF, 450V, Electrolytic
C77C		10 MF, 450V, Electrolytic
C78	D-3.100-7	.01 MF, 400V, Paper Tubular
C79	D-3.100-7	.01 MF, 400V, Paper Tubular
C80A	C-5.421-6	10 MF, 450V, Elect. (Used on Models 94A and 94B)
C80B		40 MF, 450V, Elect. (Used on Models 94A and 94B)
C80C		40 MF, 450V, Elect. (Used on Models 94A and 94B)
C81B	C-5.400-7	40 MF, 150V, Elect. (Used on Models 94A and 94B)
C81C		20 MF, 150V, Elect. (Used on Models 94A and 94B)
C80	C-5.433-1	40 MF, 150V, Elect. (Used on Models 94C, 16K1 and 05A)
C81A	C-5.434-1	40 MF, 475V, Elect. (Used on Models 94C, 16K1 and 05A)
C81B		40 MF, 475V, Elect. (Used on Models 94C, 16K1 and 05A)
C83	B-5.431	500 MF, 6V, Tubular Electrolytic
C84	D-4.105-20	3900 MF, Mica ± 10%
C85	D-3.100-19	.05 MF, 400V, Paper Tubular
C86	D-4.104-60	330 MMF, Mica
C87	D-4.104-63	390 MMF, Mica ± 10%
C88	C-4.109-22	15 MMF, 400V, Ceramic
C89	D-4.104-56	270 MMF, Mica
C91	D-3.100-19	.05 MF, 400V, Paper Tubular
C92	D-3.100-32	.25 MF, 600V, Paper Tubular
C93	D-3.100-46	.035 MF, 600V, Paper Tubular
C94	D-3.100-24	.1 MF, 600V, Paper Tubular
C95	B-4.114	500 MMF, 10KV Ceramic Used on Models 94A and 94B
	B-4.122	500 MMF, 20KV Ceramic Used on Models 94C, 16K1 and 05A
C96	D-3.100-32	.25 MF, 600V, Paper Tubular Used on Models 94A and 94B
	C-5.420-1	100 MF, 25V, Tubular Elect. Used on Model 94C
	C-5.420-2	100 MF, 50V, Tubular Elect. Used on Models 16K1 and 05A
C97	B-4.121	13 MMF, 1500V, Ceramic
C98	D-3.100-19	.05 MF, 400V, Paper Tubular
C99	D-3.100-7	.01 MF, 400V, Paper Tubular
C100	D-3.100-4	.005 MF, 600V, Paper Tubular
C101	D-4.108-12	1500 MMF, 500V, Ceramic
C102	D-4.108-12	1500 MMF, 500V, Ceramic
C103	D-3.100-7	.01 MF, 400V, Paper Tubular
C104	B-4.115-1	5000 MMF, 500V, Disc, Ceramic
C105	D-3.100-23	.1 MF, 400V, Paper Tubular
C106	B-4.119	25 — 280 MMF, Ceramic Trimmer
C107	C-4.111-6	4.7 MMF, 500V, Ceramic
C108	C-4.109-10	100 MMF, 500V, Ceramic
C109	D-3.100-7	.01 MF, 400V, Paper Tubular
C110	B-4.115-1	5000 MMF, 500V, Disc, Ceramic
C111	D-3.100-23	.1 MF, 400V, Paper Tubular Used on Models 94C, 16K1 and 05A
C112, C113, C114, C115	B-4.115-1	5000 MMF, 500V, Disc, Ceramic Used on Models 16K1 and 05A

TRANSFORMERS AND COILS

Symbol	Part No.	Description
T2	C-1.476	1st Video I.F., 24.3 mc
T3	C-1.476	2nd Video I.F., 22.0 mc
T4	C-1.476	3rd Video I.F., 24.0 mc.
T5	C-1.509-1	Sound Take-Off, 4.5 mc
T6	C-1.510-1	Ratio Det. Trans., 4.5 mc Used on Models 94A and 94B
	C-1.521	Ratio Det. Trans., 4.5 mc Used on Models 94C, 16K1 and 05A
T7	C-9.241	Audio Output Transformer Used on Models 94C, 16K1 and 05A

Note. Audio Out. Trans. on Models 94A & 94B is part of Speaker #C-30.309-2

Symbol	Part No.	Description
T8	C-9.230-2	Vert. Block. Osc. Trans.
T9	C-9.228-3	Vert. Output Trans.
T11	D-9.235	Power Trans., 405 V. D.C.
T12	C-9.236	Hor. Output Transformer Used on Models 94A and 94B
	C-9.240-1	Hor. Output Transformer Used on Models 94C, 16K1, & 05A
L9	B-1.507	Hor. A.F.C. Coil Used on Models 94A, 94B and 94C
	B-1.519	Hor. A.F.C. Coil Used on Models 16K1 and 05A
L10	C-1.458	Horiz. Size
L11	C-1.459	Horiz. Linearity
L12	C-9.237	Filter Choke, 2.5 Hy.
L13	C-9.209	Deflection Yoke Used on Models 94A, 94B & 94C
	C-9.242	Deflection Yoke Used on Models 16K1 and 05A
L14	C-9.234-2	Focus Coil, 365 ohms
L15, L16, L17 & L18	C-1.503-1	Video Peaking, Red Dot, 120 µh
	C-1.503-2	Video Peaking, Green Dot, 419 µh
	C-1.503-3	Video Peaking, Blue Dot, 169 µh
	C-1.503-3	Video Peaking, Blue Dot, 169 µh L15, L16, L17 & L18 used on Models 94A & 94B
Con-secu-tively	C-1.522-3	Video Peaking, Blue Dot, 169 µh
	C-1.522-1	Video Peaking, Gray Dot, 760 µh
	C-1.522-3	Video Peaking, Blue Dot, 169 µh
	C-1.522-2	Video Peaking, Green Dot, 419 µh L15, L16, L17 & L18 used on Models 94C, 16K1, & 05A
L21	C-1.523	Line Choke Used on Models 16K1 & 05A

MISCELLANEOUS

ALL RECEIVERS, MODELS 94A, 94B, 94C, 16K1 & 05A

Part No.	DESCRIPTION
B-24.236	Min. Socket, with Center Shield
B-24.235	Min. Socket, no Center Shield
B-24.228	Min. Socket, 9 pin, with center shield
B-24.205	Octal Socket, Moulded
C-24.225-4	Picture Tube Socket with Leads
B-36.131	Line Fuse Holder
B-24.232	Line Cord Receptacle, Interlock
B-36.123	Beam Bender (Double)
B-36.126	Beam Bender (Single)
20.217	Line Cord 6 Feet
C-26.585	Safety Glass
D-29.309	Bottom Cover, Perforated Masonite
B-33.125	Service Adjustment Plug Button

MODELS 94A and 94B

Part No.	DESCRIPTION
C-30.309-2	Speaker, 10" E.D. with output trans.
B-20.209-1	Speaker, plug and cable
D-36.134-1	Tuner, G.I., with tubes, drum and strap
B-36.132	Selenium Rectifier, 150 ma
L-35.346	1B3 Tube Socket & Insulator Plate
C-24.241-1	Pilot Light Socket
E-12.341	Picture Tube Mask
D-29.326	Back Cover, Perforated Masonite
C-13.167	Bar Knob
B-33.138	Spring for Knob #C-13.167
C-13.168	Round Knob
B-13.198	Bar Knob for Volume Control
B-33.317	Spring for Knob #C-13.168 or #B-13.198
B-26.560-1	Dial Pointer
C-26.587	Dial Scale
B-26.570	Dial Escutcheon
B-31.101	Dial Spring

MODELS 94C, 16K1 & 05A

Part No.	DESCRIPTION
C-30.320	Speaker, 10" P.M.
D-36.137	Tuner Unit, S.C., with tubes
L-35.346	1B3 Socket & Plate (Model 94C)
L-35.366	1B3 Socket & Plate (Model 16K1)
E-12.341	Pix Tube Mask (Models 94C & 16K1)
D-12.378	Pix Tube Mask (Model 05A)
D-29.326	Back Cover (Models 94C & 16K1)
D-29.423	Back Cover (Model 05A)
B-13.201	Knob, Fine Tuning Only
B-13.202	Knob, Large Round
B-13.203	Contrast or Hor. Hold
B-13.204	Knob, Volume

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Loud Speaker . . . . 12 inch PM Dynamic
Voice Coil Impedance . . . . 3.2 Ohms 400 Cycles
Video Response . . . . To 3.5 MC
Picture Area . . . . 52 Square Inch
Focus . . . . Magnetic
Sweep Deflection . . . . Magnetic
Scanning . . . . Interlaced, 525 Line
Horizontal Scanning Frequency. 15,750 CPS
Vertical Scanning Frequency . . . 60 CPS
Frame Frequency . . . . 30 CPS
Record Changer . . . . See Manual 5073A

ELECTRICAL SPECIFICATIONS

Power Supply . . . . 105-125 Volts AC, 60 Cycles only
Power Consumption . . . . Television—300 Watts; Radio—80 Watts; Phonograph—100 Watts
Tuning Ranges . . . . TV—12 Channel; BC—540-1600 KC; FM—88-108 MC
Power Output . . . . 8.5 Watts (Max.); 6.0 Watts (10% Distortion)
Antenna Input Impedance . . . . . 300 Ohms Balanced
Intermediate Frequencies (Tel.). Picture 25.75 MC; Sound 21.25 MC
Intermediate Frequencies (Rad.). FM—10.7 MC; AM—455 KC
Selectivity . . . . AM—43 KC Broad at 1,000 Times Signal measured at 1,000 KC; I.F. FM—190 KC Broad at 2 Times down; I.F. FM—760 KC Broad at 200 times down
Sensitivity . . . . (For .5 Watt Output); AM—10 Microvolts Average; FM—30 Microvolts Average

TUBE COMPLEMENT

TV CHASSIS

Symbol	Type	Function
V1	1—6BH6	R-F Amplifier
V2	1—6AG5	Converter
V3	1—6C4	R-F Oscillator
V4	1—6BA6	1st Sound I-F Amp.
V5	1—6AU6	2nd Sound I-F Amp.
V6	1—6AL5	Sound Discriminator
V8	1—6AT6	1st Audio and Bias Clamp
V9	1—6AG5	1st Picture I-F Amp.
V10	1—6AG5	2nd Picture I-F Amp.
V11	1—6AG5	3rd Picture I-F Amp.
V12A-12B.	1—6AL5	Picture 2nd Det. and Sync Limiter
V13	1—12AU7	1st and 2nd Video Amp.
V14	1—6SN7-GT	Sync Amplifier and Separator
V15	1—6SN7-GT	Vertical Sweep Oscillator, Discharge and Output
V16	1—6SN7-GT	Horizontal Sweep Oscillator and Sync Guide
V17	1—6BG6-G	Horizontal Sweep Output
V18	1—1B3-GT/8016	High Voltage Rectifier
V19	1—5V4-G	Horizontal Damper
V20	1—5U4-G	Power Supply Rectifier
V21	1—10BP4	Kinescope (Picture Tube)

RADIO CHASSIS

1—6BA6 AM-FM R-F Amplifier
1—12AT7 FM & AM Osc. & Mixer
1—6BA6 FM-AM 1st I-F Amplifier
1—6BA6 FM 2nd I-F Amplifier
1—6AL5 FM Detector
1—6AV6 Audio Amplifier, AM 2nd Detector and AVC
2—6K6-GT Audio Output
1—5Y3-GT Rectifier
1—6AV6 Phase Inverter
2—No. 47 Dial Lamps

RADIO FREQUENCY RANGES

Channel Number	Channel Frequency Mc	Picture Carrier Frequency Mc	Sound Carrier Frequency Mc	Receiver R-F Osc. Frequency Mc
2	54-60	55.25	59.75	81
3	60-66	61.25	65.75	87
4	66-72	67.25	71.75	93
5	76-82	77.25	81.75	103
6	82-88	83.25	87.75	109
7	174-180	175.25	179.75	201
8	180-186	181.25	185.75	207
9	186-192	187.25	191.75	213
10	192-198	193.25	197.75	219
11	198-204	199.25	203.75	225
12	204-210	205.25	209.75	231
13	210-216	211.25	215.75	237

RECEIVER LOCATION—Advise the owner as to the proper location for the television receiver. The following may be used as a guide:

1. Choose an area in the home where sunlight or light from lamps do not strike the face of the picture tube and cause glare.
2. Remember the necessity of an electrical outlet and the location of the point at which the antenna leads enter the room.
3. The receiver should be placed a short distance from the wall to allow adequate ventilation.
4. The receiver should be placed to permit easy access for operation and comfortable viewing from all angles.

ANTENNA— This receiver has been designed to use an antenna with a 300 ohm balanced transmission line. This line must be as short as possible because the longer the line the greater the chances are for picking up electrical disturbances. Stand-off insulation should be used to keep the line away from the mast, metal or walls. Twist this line about one turn per foot throughout the line to cancel out direct signal and/or noise pickup by the transmission line. It should also be securely anchored in place so that a change in weather will not affect its position.

HIGH VOLTAGE WARNING

This television receiver contains high voltages which are dangerous to life. Never operate or service the receiver outside of the cabinet or with the covers removed until all the safety precautions necessary for working with high voltage equipment have been observed.

KINESCOPE (Picture Tube) HANDLING PRECAUTION

Shatterproof goggles and heavy gloves must be worn by individuals while handling the kinescope or installing the kinescope into the receiver.

The kinescope encloses a high vacuum and due to the large surface area, is subjected to excessive air pressure. Therefore, care should be taken not to bump or scratch the picture tube accidentally as it may cause the tube to implode resulting in damage to property or injury to an individual.

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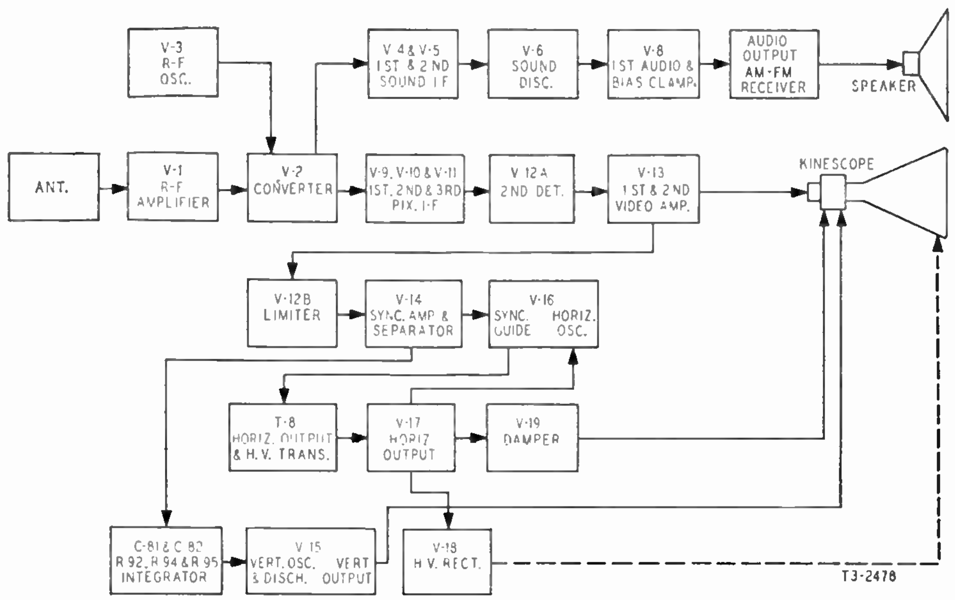

Fig. 2—Block Diagram

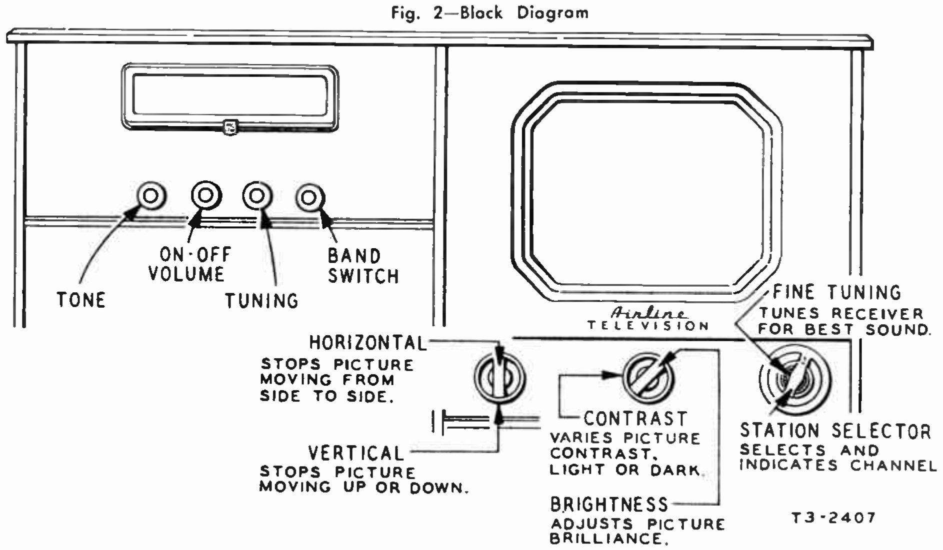

Fig. 3—Front Panel Controls

TUNING PROCEDURE

1. To turn the television receiver on, turn the ON-OFF VOLUME CONTROL on the radio panel until a click is heard. Allow approximately 30 seconds for the tubes to warm up.
2. Turn BAND SWITCH CONTROL on the radio panel fully counterclockwise to the TV position.
3. Turn the STATION SELECTOR CONTROL to the desired channel. This control may be turned in either direction.
4. Turn the CONTRAST CONTROL fully counterclockwise.
5. Turn the BRIGHTNESS CONTROL fully counterclockwise and then very slowly clockwise until light is readily visible on the screen.
6. Turn the CONTRAST CONTROL clockwise until activity or definite form is noted on the screen.
7. Adjust the FINE TUNING CONTROL for best tonal quality and the VOLUME CONTROL for desired volume.
8. Turn the VERTICAL CONTROL until the picture stops moving up or down.
9. Adjust the HORIZONTAL CONTROL until the picture is obtained and centered.
10. Adjust the CONTRAST CONTROL until the best picture is obtained and if necessary make a slight readjustment of the BRIGHTNESS CONTROL.
11. After the receiver has been on for a while it may be necessary to readjust the FINE TUNING CONTROL for best sound quality.
12. When switching from one channel to another, it may be necessary to repeat steps number 7 and 10.
13. To turn off the receiver, turn the ON - OFF VOLUME CONTROL counterclockwise until a click is heard.
14. When the receiver is turned on again and the positions of the controls have not been changed, no further adjustments will be necessary except for the FINE TUNING CONTROL and VOLUME CONTROL for the desired volume.
15. If the positions have been disturbed since the last time the receiver has been used it may be necessary to follow steps 1 to 11.

KINESCOPE—The receiver is shipped with the kinescope in place, however some of the kinescope adjustments may have been jarred loose in shipment. If adjustments are necessary, the following should be used as a guide:

1. After the receiver has been unpacked and the cradle removed, take off the cabinet back and make sure all the tubes are properly mounted in their respective sockets.
2. Remove the tape from the kinescope socket base and the corrugated cardboard lock holding the focus coil in place.
3. Connect an antenna to the antenna terminals at the rear of the radio chassis and insert the line cord plug into a convenient outlet.
4. Turn on the receiver and wait about 60 seconds for the receiver to warm up. Turn the channel selector to a station that is transmitting and check the picture. If the picture is not centered on the screen, or visible at all, make the adjustments on the deflection yoke, focus coil and ion trap magnet assemblies as outlined

KINESCOPE REPLACEMENT—Should the kinescope have to be replaced, remove the defective kinescope in the following manner:

1. Remove the front panel control knobs by pulling them straight from their shafts.
2. Remove two ornamental screws holding the front panel to the cabinet (see figure 5) and lift out panel.
3. Remove the cabinet back.
4. Disconnect the kinescope socket connector at the base of the tube and the high voltage anode lead from the front of the kinescope.
   WARNING—REMOVE STATIC CHARGE FROM THE ANODE LEAD BY GROUNDING IT AGAINST THE CHASSIS.
5. Remove the ion trap magnet, slipping it from the neck of the kinescope past the socket.
6. Loosen the wing nuts and wing screws on the deflection yoke and focus coil.
7. Loosen the strap holding the front of kinescope in place and withdraw the kinescope toward the front of the chassis.
8. To install a new kinescope, reverse the above procedure making sure that the kinescope is fitted closely against the kinescope cushion and that the high voltage well connector is at the top of the kinescope. If the kinescope sticks or fails to slip into place smoothly, investigate and remove the source of the trouble. Never force the tube.

KINESCOPE WINDOW — Clean the kinescope window with a dampened cloth or a soft lint-free cloth if dust or finger marks are present.

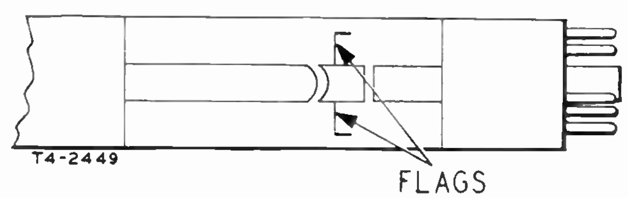

Fig. 4—Ion Trap Flags

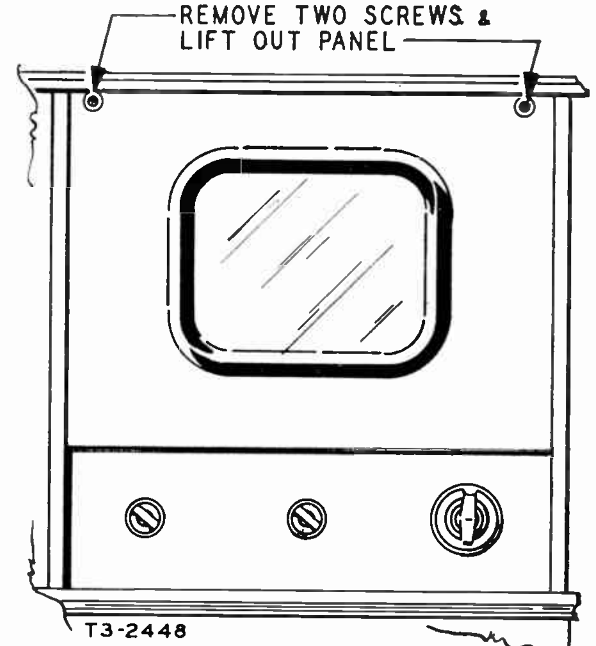

Fig. 5—Front Panel Removal

NON-OPERATING CONTROLS (Rear Of Chassis)

Horizontal Centering	R-106
Vertical Centering	R-105
Width	L-15
Height	R-86
Horizontal Linearity	L-16
Vertical Linearity	R-93
Horizontal Drive	C-55C
Horizontal Frequency (Fine)	C-55B
Horizontal Oscillator Frequency (Bottom Chassis)	L-14
Horizontal Locking Range	C-55A
Focus	R-104
Focus Coil	Wing Screw Adjustment
Ion Trap Magnet	Top Chassis Adjustment
Deflection Coil	Wing Nut Adjustment

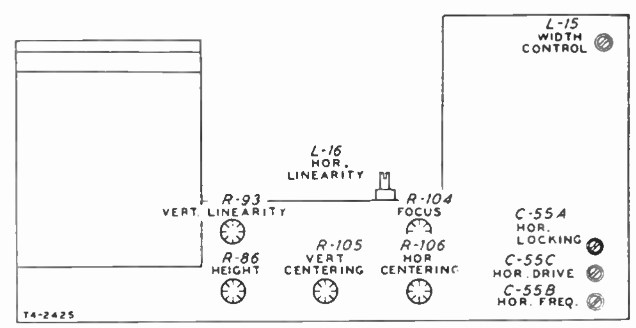

Fig. 6—Rear Chassis Adjustments

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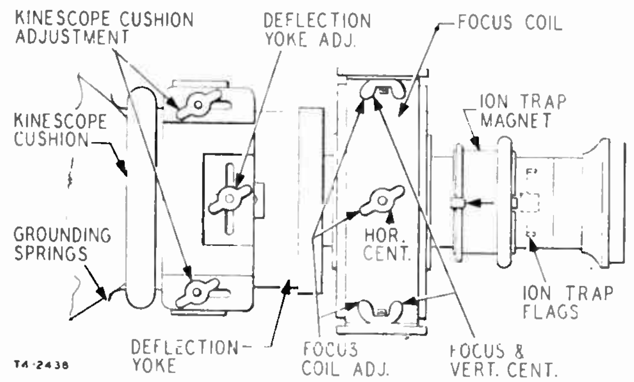

Fig. 7—Yoke, Focus and Ion Trap Magnet Adjustment

DEFLECTION YOKE ADJUSTMENT — If the lines of the raster are not horizontal or squared with the picture mask, rotate the deflection yoke until this condition is obtained. Tighten the yoke adjustment wing screw.

FOCUS COIL ADJUSTMENT — Turn the HORIZONTAL CENTERING (R-106) and VERTICAL CENTERING (R-105) CONTROLS to the halfway position. (See Figure 6). If a corner of the raster is shadowed, it indicates that the electron beam is striking the neck of the tube. Loosen the focus coil adjustment wing nuts and rotate the coil about its vertical and horizontal axes until the entire raster is visible, approximately centered and with no shadowed corners. Tighten the focus coil adjustment wing nuts with the coil in this position.

ION TRAP MAGNET ADJUSTMENT—The ion trap magnet should be positioned exactly as shown in Figure 7. Adjust the magnet by moving it back and forth and at the same time rotating it slightly around the neck of the kinescope until the brightest raster is obtained on the picture screen. Reduce the brightness control setting until the raster is slightly above average brilliance. Adjust the Focus Control R-104 (see Figure 6) until the line structure of the raster is clearly visible. Readjust the ion trap magnet for maximum raster brilliance. The final touches on this adjustment should be made with the brightness control at the maximum position with which good line focus can be maintained.

PICTURE ADJUSTMENT —For further adjustments, obtain a test pattern on the receiver. Turn on receiver and follow tuning procedure

CHECK OF HORIZONTAL OSCILLATOR ALIGNMENT—Turn the horizontal hold control to the extreme counter-clockwise position. The picture should remain in horizontal sync. Momentarily remove the signal by switching off channel and then back. Normally the picture will be out of sync. Turn the control clockwise slowly. The number of diagonal bars will be gradually reduced and when only 3-1/2 to 4-1/2 bars sloping downward to the left are obtained, the picture will pull into sync upon slight additional clockwise rotation of the control. The pull-in should occur when the control is approximately 90 degrees from the extreme counter-clockwise position. The picture should remain in sync for approximately 90 degrees of additional clockwise rotation of the control. At the extreme clockwise position, the picture should be out of sync and should show from 3-1/2 to 4-1/2 bars sloping downward to the right.

If the receiver passes the above checks and the picture is normal and stable, the horizontal oscillator is properly aligned. Skip "Alignment of Horizontal Oscillator" and proceed with "Focus" adjustment.

ALIGNMENT OF HORIZONTAL OSCILLATOR — If in the above check the receiver failed to hold sync with the hold control at the extreme counter-clockwise position or failed to hold sync for at least 60 degrees of clockwise rotation of the control from the pull in point, it will be necessary to make the following adjustments.

HORIZONTAL FREQUENCY ADJUSTMENT—Turn the horizontal hold control to the extreme clockwise position. Tune in a television station and adjust the rear apron horizontal frequency trimmer C-55B (see Figure 6) until the picture is out of sync and shows 3-1/2 to 4-1/2 bars sloping downward to the right. If the trimmer has insufficient range, set the trimmer to mid-position (1 turn out from maximum capacity) and adjust the L-14 horizontal frequency adjustment until this condition is obtained. See Figure 9 for the location of L-14.

HORIZONTAL LOCKING RANGE ADJUSTMENT —Set the horizontal hold control to the extreme counter-clockwise position. Momentarily remove the signal by switching off channel and then back. Slowly turn the horizontal hold control clockwise and note the least number of diagonal bars obtained just before the picture pulls into sync. If more than 4-1/2 bars are present just before the picture pulls into sync, adjust the horizontal locking range trimmer C-55A (See Figure 6) slightly clockwise. If less than 3-1/2 bars are present, adjust trimmer C-55A slightly counter-clockwise. Turn the horizontal hold control counter-clockwise, momentarily remove the signal and recheck the number of bars present at the pull-in point. Repeat this procedure until 3-1/2 to 4-1/2 bars are present. Repeat the adjustments under "Horizontal Frequency Adjustment" and "Horizontal Locking Range Adjustment" until the condition specified under each are fulfilled. When the horizontal hold operates as outlined under "Check of Horizontal Oscillator Alignment" the oscillator is properly adjusted.

HEIGHT AND VERTICAL LINEARITY ADJUSTMENTS — Adjust the height control R-86 (See Figure 6) until the picture fills the mask vertically. Adjust the vertical linearity control R-93 (See Figure 6) until the picture is symmetrical from top to bottom. Adjustment of either control will require a readjustment of the other. Adjust vertical centering control R-105 (See Figure 6) to align the picture with the mask.

WIDTH, DRIVE AND HORIZONTAL LINEARITY ADJUSTMENTS —Turn the width control L-15 (at top of power supply cover) to the maximum clockwise position. Vary the horizontal drive trimmer C-55C (See Figure 6) to yield the best compromise between brightness and linearity. Adjust the horizontal linearity control L-16 (See Figure 6) for best linearity of the right half of the picture. Readjust the width control L-15, until the picture just fills the mask. Adjust horizontal centering control R-106 (See Figure 6) to align the picture with the mask.

FOCUS —Adjust the focus control R-104 (see Fig. 6) for maximum definition of the vertical wedge of the picture. Check to see that all cushion, yoke and focus coil thumb screws are tight. Replace the cabinet back making sure that the back is on tight, otherwise it may rattle at high volume.

CHECK OF R-F OSCILLATOR ADJUSTMENTS-With a crystal calibrated test oscillator or heterodyne frequency meter, check to see if the receiver R-F oscillator is adjusted to the proper frequency on all channels. The adjustments for all channels are available from the front of the cabinet by removing the front panel as shown in Figure 5. Tune in all available television stations.

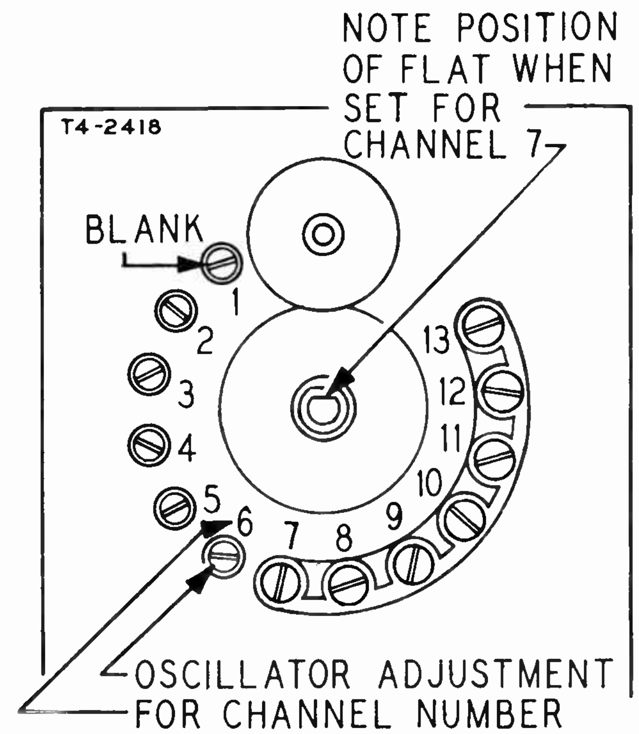

Fig. 8—R-F Oscillator Adjustments

VIDEO PEAKING LINK—A video peaking link is provided to permit changing the video response. This link is connected at the factory with the peaking in. However, if transients are produced on high contrast pictures, or picture is smeared or fuzzy, or if the receiver is operated in areas where the signal strength is weak, open the video peaking link connecting L-13 and R-52.

VENTILATION CAUTION—The receiver is provided with adequate ventilation holes in the bottom and back of the cabinet. Care should be taken not to allow these holes to be covered or ventilation to be impeded in any way.

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SERVICE SUGGESTIONS

NO RASTER ON KINESCOPE —If raster cannot be obtained check below for the possible causes.

1. Ion trap magnet adjustment is incorrect.
2. No high voltage, check V-17 (6BG6-G) and V-18 (1B3-GT/8016) tubes and circuits. If the horizontal deflection circuits are operating, as evidenced by the correct wave form measured on terminal 4 of horizontal output transformer (T-8), the trouble can be isolated to the high voltage rectifier (V-18) circuit. Either the high voltage winding (points 2 to 3 on T-8) is open, tube V-18 is defective, its filament circuit is open, or the high voltage filter capacitor (C-76) is shorted.
3. Damper tube V-19 (5V4-G) defective. Plate voltage supply for V-17 (6BG6-G) horizontal output tube is obtained through the damper tube. Check tube and heater winding on power transformer (T-9). If the tube is alright, check the horizontal linearity coil (L-16) for continuity and check capacitors C-69 and C-75 for short circuit.
4. Defective kinescope. Heater open, cathode return circuit open.
5. No plate voltage. Electrolytic capacitor shorted. All +B measurements are accessible for measurement by removing cover from bleeder box.
6. Horizontal oscillator and control tube V-16 (6SN7-GT) defective. Check for sawtooth on grid of horizontal output tube V-17 (6BG6-G). If not present, check voltages and components in the V-16 (6SN7-GT) circuits.

HORIZONTAL DEFLECTION ONLY —If only horizontal deflection is obtained as evidenced by a straight line across the face of the kinescope, it can be caused by the following:

1. Vertical oscillator and output tube V-15 (6SN7-GT) inoperative. Check voltages on grid and plate.
2. Vertical output transformer (T-7) open.
3. Yoke vertical coils open.

POOR VERTICAL LINEARITY—If adjustment of the vertical, height and linearity controls will not correct this condition, any of the following may be the cause:

1. Vertical output transformer (T-7) defective.
2. Capacitors C-80A or C-78A defective.
3. V-15 (6SN7-GT) defective, check voltages.
4. Excess leakage or incorrect value in capacitor C-82.
5. Low plate and bias voltages. Check rectifier tube and capacitors in +B supply circuits.
6. Capacitor C-81 defective.

POOR HORIZONTAL LINEARITY—If adjustment of controls does not correct this condition, check the following:

1. Check or replace horizontal output tube V-17 (6BG6-G).
2. Check or replace damper tube V-19 (5V4-G).
3. Check linearity coil L-16 for short circuit.
4. Check capacitors C-69 and C-75 for defects.

TRAPEZOIDAL OR NONSYMMETRICAL RASTER —

1. Improper adjustment of focus coil or ion trap magnet.
2. Defective yoke.

WRINKLES ON LEFT SIDE OF RASTER—This condition can be caused by:

Defective yoke due to R-97, R-98 or C-86 (internal in yoke assembly) being wrong value or open. These components are mounted in rear of yoke assembly.

SMALL RASTER —This condition can be caused by:

1. Low +B or line voltage.
2. Insufficient output from horizontal output tube V-17 (6BG6-G). Replace tube.
3. Insufficient output from vertical output tube V-15 (6SN7-GT). Replace tube.

SERVICE SUGGESTIONS (Continued)

RASTER; NO IMAGE, BUT ACCOMPANYING SOUND—This condition can be caused by:

1. No signal on kinescope grid. Check picture I-F amplifier tubes V-9, 10 and 11 (6AG5's), second detector V-12 (6AL5) and video amplifier V-13 (12AU7).
2. Bad contact to kinescope grid (lead to socket broken).

SIGNAL APPEARS ON KINESCOPE GRID BUT IMPOSSIBLE TO SYNCHRONIZE THE PICTURE VERTICALLY AND HORIZONTALLY —A condition of this nature can be caused by:

1. Defective sync amplifier and separator V-14 (6SN7-GT).
2. If tube is O.K. check voltages, and associated circuits.

SIGNAL ON KINESCOPE GRID AND HORIZONTAL SYNC ONLY —If this condition is encountered, check:

1. Vertical integrating network capacitors C-71, C-72, C-73 and C-74; and resistors R-79, R-80 and R-81.

PICTURE STABLE BUT WITH POOR RESOLUTION —If the picture resolution is not up to standard, it may be caused by any of the following:

1. Defective picture detector V-12 (6AL5) or video amplifier V-13 (12AU7).
2. Open video peaking coil. Check all peaking coils L-8, L-9, L-10, L-11 for continuity. Note that L-9 and L-11 have shunting resistors.
3. Leakage in V-13 (12AU7) grid capacitor C-42. If the above components are not found to be defective, check the following:

1. Check all potentials in video circuits.
2. Check kinescope grid circuit for poor or dirty contact.
3. Check adjustment of focus control R-104. It should be effective on either side of proper focus.
4. Check and realign, if necessary, the picture I-F and R-F circuits.

PICTURE SMEAR:

1. Normally, smear can be attributed to phase shift at the low frequency end of the video characteristic. This can be caused by improper values of resistors and capacitors in the video circuits. Check for grid current on video amplifier tube V-13 (12AU7).
2. This trouble can also originate at the transmitter. Check reception from another station.

PICTURE JITTER:

1. If regular sections at left of the picture are displaced, replace the horizontal output tube V-17 (6BG6-G).
2. Vertical instability may be due to loose connections or noise received with the signal.
3. Horizontal instability may be due to unstable transmitted sync or to noise.

ALIGNMENT PROCEDURE

TEST EQUIPMENT —To service this receiver properly, it is recommended that the following test equipment be available:

R-F SWEEP GENERATOR meeting the following requirements:

(a) Frequency ranges:

18 to 30 mc, 1 mc sweep width
40 to 90 mc, 10 mc sweep width
170 to 225 mc, 10 mc sweep width

(b) Output adjustable with at least .1 volt maximum.
(c) Output constant on all ranges.
(d) Flat output in all attenuator positions.

CATHODE-RAY OSCILLOSCOPE preferably one with a wide band vertical deflection and an input calibrating source.

SIGNAL GENERATOR to provide the following frequencies: (Output on these ranges should be adjustable and at least .1 volt maximum.)

(a) Intermediate frequencies:

21.25 mc sound i-f and sound traps
22.8 mc converter transformer
23.9 mc first picture i-f coil
24.5 mc third picture i-f coil
26.0 mc second picture i-f coil
27.5 mc adjacent picture trap

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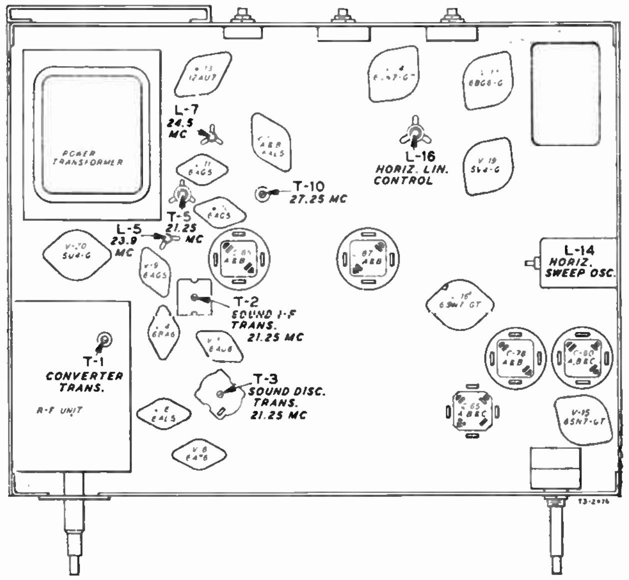

Fig. 9—Bottom Chassis Components

ALIGNMENT TABLE

DISCRIMINATOR AND SOUND I-F ALIGNMENT

Step No.	Connect Signal Generator to	Signal Gen. Freq. Mc.	Connect Sweep Generator to	Sweep Gen. Freq. Mc.	Connect Oscilloscope to	Connect Voltmeter to	Miscellaneous Connections and Instructions	Adjust	Refer to
1	2nd sound i-f grid (pin 1, V-5)	21.25 .1 volt output	Not used		Not used	In series with 1 meg. to junction of R-14 and R-13	Meter on 10 volt scale	Detune T-3 (bottom) Adjust T-3 (top) for max. on meter.	Fig. 11 Fig. 12
2	2nd sound i-f grid (pin 1, V-5)	21.25 .1 volt output	Not used		Not used	Discriminator output (pin 1 of V-6)	Meter on 3 volt scale	T-3 (bottom) for zero on meter.	Fig. 12
3	2nd sound i-f grid (pin 1, V-5)	21.25 .1 volt output	2nd sound i-f grid (pin 1, V-5)	21.25 center 1 mc .1 volt output	Discriminator output (pin 1 of V-6)	Not used	Check for symmetrical response waveform (positive and negative). If not equal adjust T-3 (top) until they are equal. See Note 1.		Fig. 11 Fig. 12 A
4	Trap winding on T-1 (top of chassis)	21.25 reduced output	Trap winding on T-1	21.25 reduced output	Terminal A, T-2 in series with 33,000 ohms. See Note 2.	Not used	Sweep output reduced to provide .3 volt p-to-p on scope. See Note 3.	T-2 (top and bottom) for max. gain and symmetry at 21.25 mc.	Fig. 11 Fig. 12 B

NOTE: 1: The peak to peak bandwidth of the discriminator should be approximately 350 kc. and should be linear from 21.175 mc. to 21.325 mc.

NOTE 2: If a 60 cycle sweep rate is used, it will be necessary to reduce the time constant in the 2nd sound i-f grid circuit in order to reproduce the desired response curve. To do this, shunt R-10 (Terminal "A" of T-2 to chassis) with 5600 ohms.

NOTE 3: The sweep generator output should be set to produce approximately 0.3 volt peak-to-peak at the second sound i-f grid return (Terminal "A" of T-2) for final touch-up on this adjustment. Signal voltage in excess of 0.3 volt will tend to broaden the response curve—permitting misadjustment to pass unnoticed.

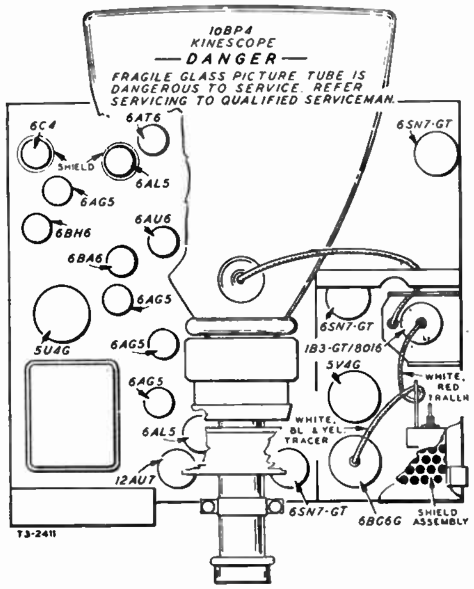

Fig. 10—Tube Layout Diagram

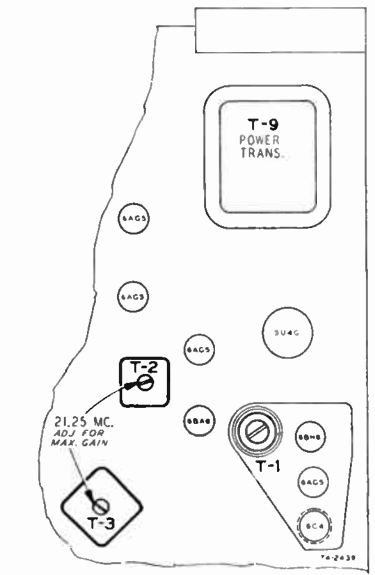

Fig. 11—Top Chassis Audio I-F Adjustments

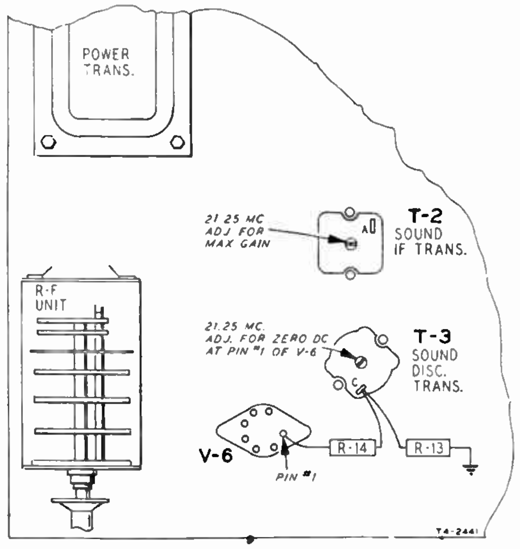

Fig. 12—Bottom Chassis Audio I- and Discriminator Adjustmen s

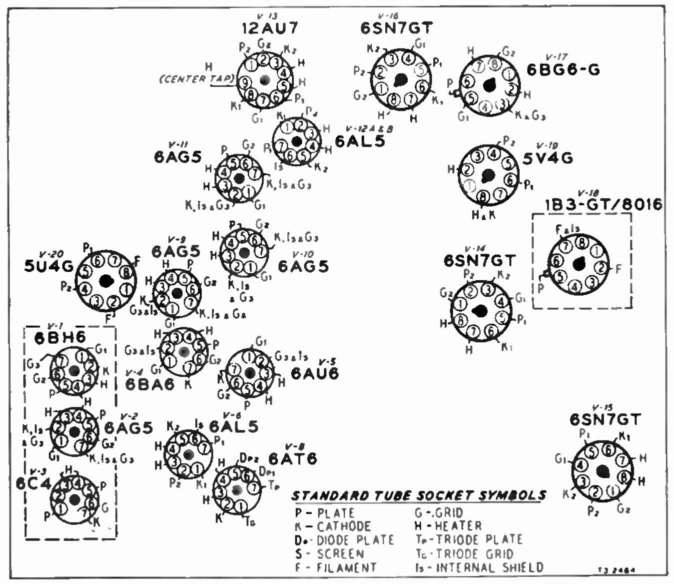

Fig. 13—Bottom Socket View

ALIGNMENT PROCEDURE (Continued)

(b) Radio frequencies:

Channel Number	Picture Carrier Freq. Mc	Sound Carrier Freq. Mc
2	55.25	59.75
3	61.25	65.75
4	67.25	71.75
5	77.25	81.75
6	83.25	87.75
7	175.25	179.75
8	181.25	185.75
9	187.25	191.75
10	193.25	197.75
11	199.25	203.75
12	205.25	209.75
13	211.25	215.75

HETERODYNE FREQUENCY METER with crystal calibrator if the signal generator is not crystal controlled.

ELECTRONIC VOLTMETER and a high voltage probe for use with this meter to permit measurements up to 10 kilovolts.

SERVICE PRECAUTIONS—To service the receiver remove the chassis from the cabinet. To do so, remove the knobs, the front panel, the cabinet back, disconnect all leads to the radio chassis and then the 5 chassis mounting bolts. The chassis normally should be serviced without the kinescope. However, if it is necessary to view the raster during servicing, the kinescope should be inserted only after the chassis is turned on end. The kinescope should never be allowed to support its weight by resting in the deflection yoke. A bracket should be used to support the tube at its viewing screen. By turning the chassis on end with the power transformer up, all adjustments will be conveniently available. Since this is the only safe position in which the chassis will rest and still leave adjustment accessible, the trimmer location drawings are oriented similarly for ease of use.

CAUTION: Do not permit the kinescope second-anode lead to become shorted to the chassis. To do so will cause a considerable overload on the high-voltage filter resistor R-82.

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ALIGNMENT TABLE (Continued)

PICTURE I-F AND TRAP ADJUSTMENT

Step No.	Connect Signal Generator to	Signal Gen. Freq. Mc.	Connect Sweep Generator to	Sweep Gen. Freq. Mc.	Connect Oscilloscope to	Connect Voltmeter to	Miscellaneous Connections and Instructions	Adjust	Refer to
5	Not used		Not used		Not used	Junction R-41 and R-43	Set "Station Selector" switch to channel 13	Adjust "Picture" control for —3 volts reading on Voltmeter	Fig. 15
6	Junction C-31 and R-23	21.25	Not used		Not used	Junction of L-8 and R-51	Meter on 3 volt scale	T-1 (top) for min. on meter	Fig. 14 Fig. 15
7	Junction C-31 and R-23	21.25	Not used		Not used	Junction of L-8 and R-51	Meter on 3 volt scale	T-5 for min.	Fig. 14
8	Junction C-31 and R-23	27.25	Not used		Not used	Junction of L-8 and R-51	Meter on 3 volt scale	T-10 (bottom) for min.	Fig. 9
9	Junction C-31 and R-23	22.8	Not used		Not used	Junction of L-8 and R-51		T-1 (bottom) for max.	Fig. 15
10	Junction C-31 and R-23	23.9	Not used		Not used	Junction of L-8 and R-51		L-5 (top chassis) for max.	Fig. 14
11	Junction C-31 and R-23	26.0	Not used		Not used	Junction of L-8 and R-51		T-10 (top chassis) for max.	Fig. 14
12	Junction C-31 and R-23	24.5	Not used		Not used	Junction of L-8 and R-51		L-7 (top chassis) for max.	Fig. 14

NOTE: Oscillation may occur if the i-f section is badly out of alignment. This will be evidenced by a meter reading in excess of 3 volts and is caused by the "staggered" i-f stages being tuned to approximately the same frequency. If this condition is encountered, adjust the core studs of T-1 (bottom) L-5, T-10 and L-7 until oscillation ceases. Oscillation may not be encountered until proceeding with steps 9, 10, or 11.

RETOUCHING OF PICTURE I-F ADJUSTMENTS —The picture i-f response curve varies somewhat with change of bias and for this reason it should be aligned with approximately the same signal input as it will receive in operation.

If the receiver is located at the edge of the service area, it should be aligned with approximately —1 volt i-f grid bias. However, for normal conditions, (signals of 1000 microvolts or greater), it is recommended that the picture i-f be aligned with a grid bias of —3 volts. Set the picture control for —3 volts at the junction of R-41 and R-43.

Connect the r-f sweep generator to the receiver antenna terminals.

Connect the signal generator to the antenna terminals and feed in the 25.75 megacycles i-f picture carrier marker and a 23 megacycles marker.

Connect the oscilloscope across the picture detector load resistor R-51.

Set the channel switch to channel (between 1 and 6) found to have the best response.

Set the sweep output to produce approximately .3 volt peak to peak across the picture detector load resistor.

Observe and analyze the response curve obtained. The response will not be ideal and the i-f adjustments must be retouched in order to obtain the desired curve. In making these adjustments, care should be taken that no two transformers are tuned to the same frequency as i-f oscillation may result.

On final adjustment the picture carrier marker must be at approximately 45% response. The curve must be approximately flat topped and with the 23 mc marker at 90% response.

The most important consideration in making the i-f adjustments is to get the picture carrier at the 45% response point. If the picture carrier operates too low on the response curve, loss of low frequency video response, of picture brilliance, of blanking, and of sync may occur. If the picture carrier operates too high on the response curve, the picture definition is impaired by loss of high frequency video response.

SENSITIVITY CHECK —A comparative sensitivity check can be made by operating the receiver on a weak signal from a television station and comparing the picture and sound obtained to that obtained on other receivers under the same conditions.

This weak signal can be obtained by connecting the shop antenna to the receiver through an attenuator pad of the type shown in Figure 17. The number of stages in the pad depends upon the signal strength available at the antenna. A sufficient number of stages should be inserted so that a somewhat less than normal contrast picture is obtained when the picture control is at the maximum clockwise position.

Only carbon type resistors should be used to construct the attenuator pad. Since many of the low value molded resistors generally available are of wire wound construction, it is advisable to break and examine one of each type of resistor used in order to determine its construction.

RESPONSE CURVES — The response curves shown in Figure 18 were taken from a production set. Although these curves are typical, some variations can be expected.

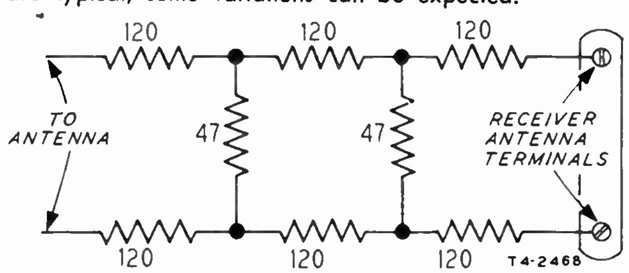

Fig. 17—Attenuator Pad

The response curves are shown in the classical manner of presentation, that is with response up and low frequency to the left. The manner in which they will be seen in a given test set-up will depend upon the characteristics of the oscilloscope and the sweep generator. The curves may be seen inverted and/or switched from left to right depending on the deflection polarity of the oscilloscope and the phasing of the sweep generator.

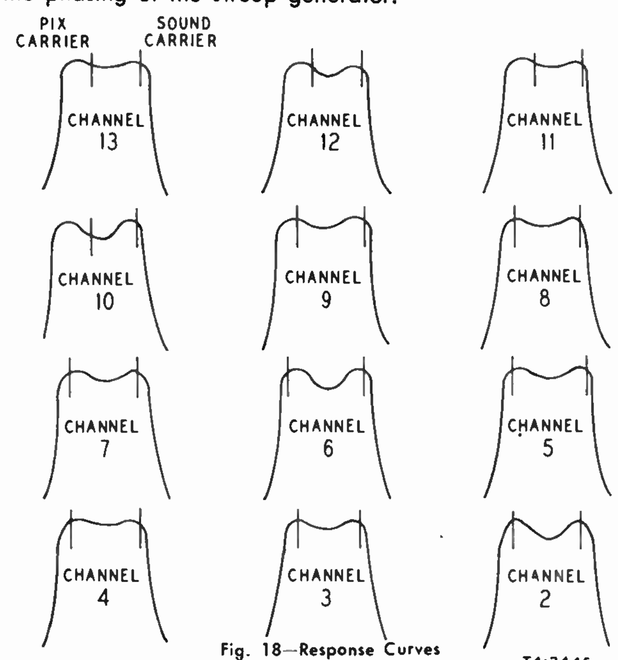

Fig. 18—Response Curves

CRITICAL LEAD DRESS—

1. Do not permit any strains to be placed on the leads of R-68, R-59, R-63, R-62, R-58, R-61, R-67 and R-64. Do not permit these resistors to be exposed to the heat of a soldering iron any more than is absolutely necessary.
2. Dress the temperature compensating resistor R-64 approximately one quarter inch from the power transformer and the chassis.
3. Dress all video coupling capacitors and peaking coils up and away from the chassis.
4. Contact between the R-F oscillator frequency adjustment screws and the oscillator coils on channel switch outlets must be avoided.
5. Dress T-8 winding leads as shown in Figure 16.

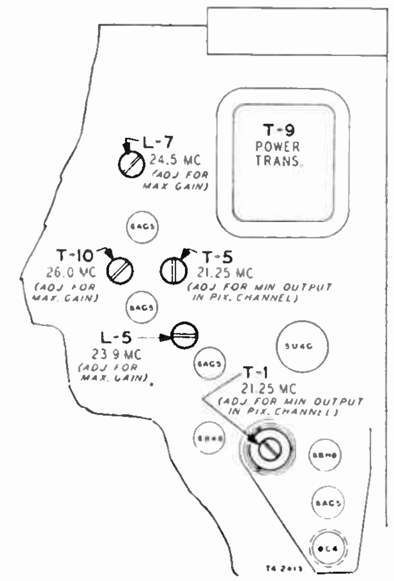

Fig. 14—Top Chassis Video I-F Adjustments

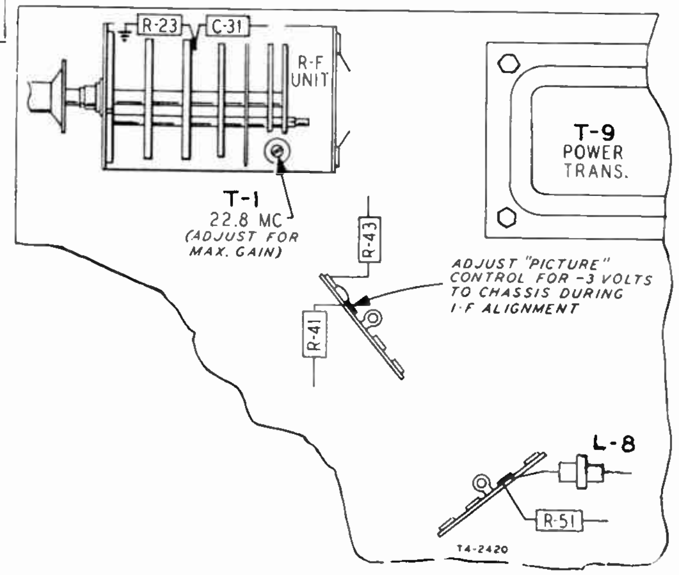

Fig. 15—Bottom Chassis Video I F Adjustments

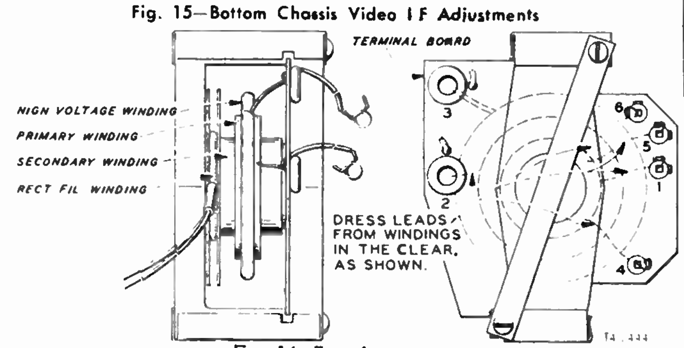

Fig. 16—Transformer Winding Leads

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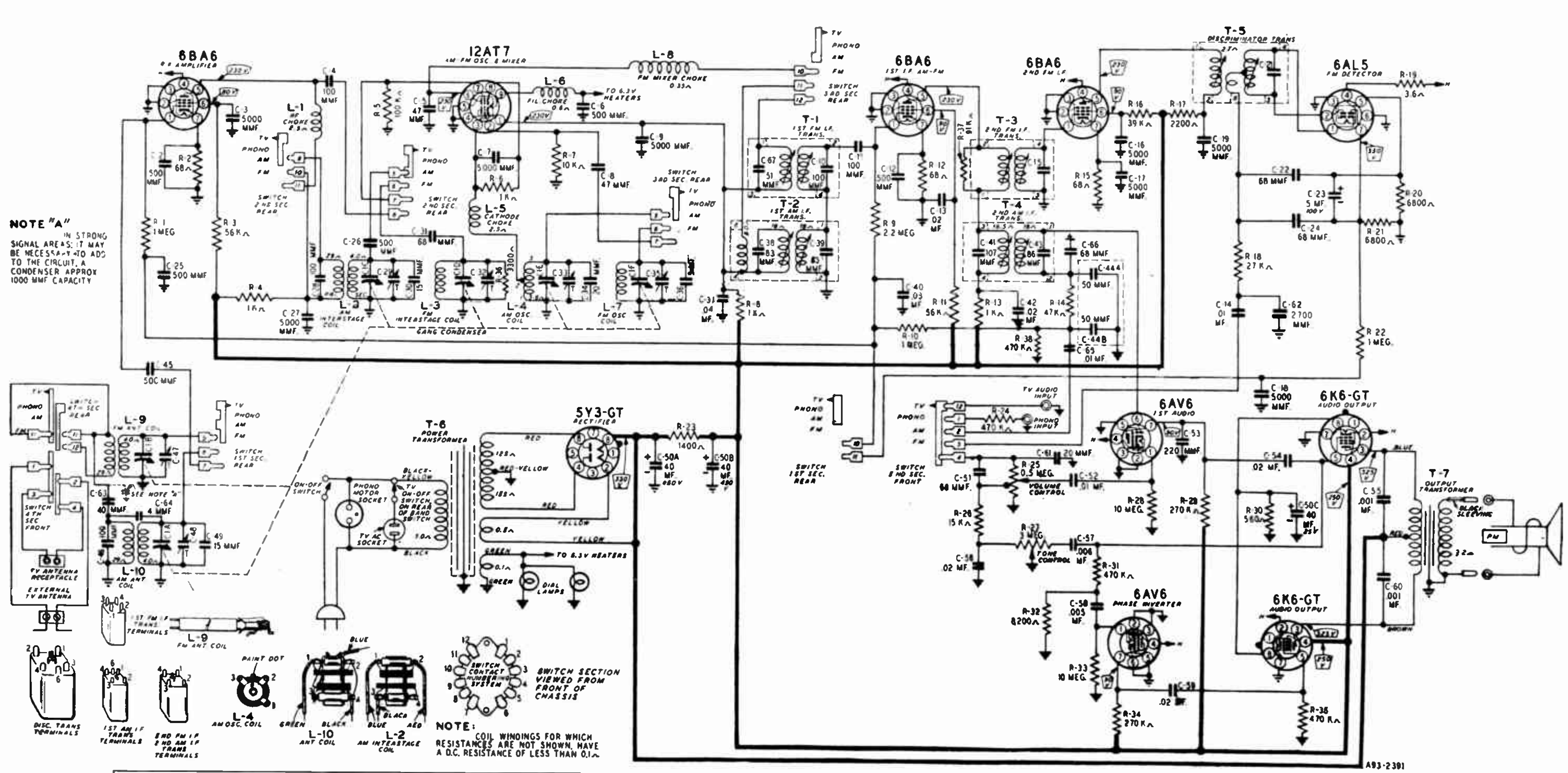
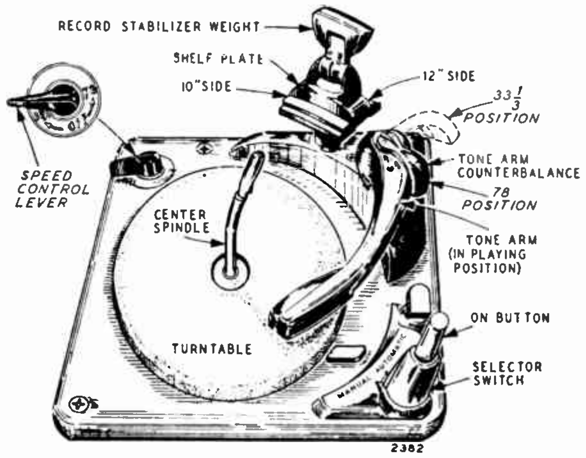
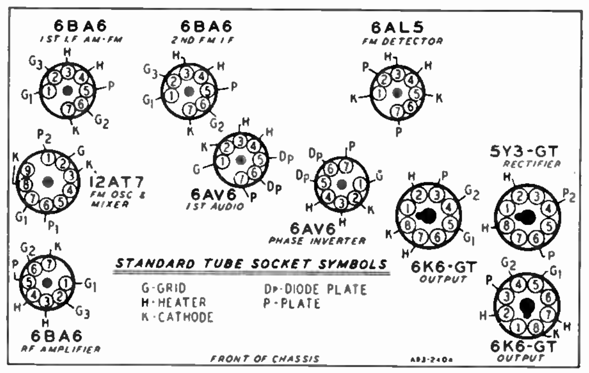
RADIO SCHEMATIC DIAGRAM





WEBSTER No. 256 DUAL SPEED RECORD CHANGER



TUBE SOCKET VOLTAGES

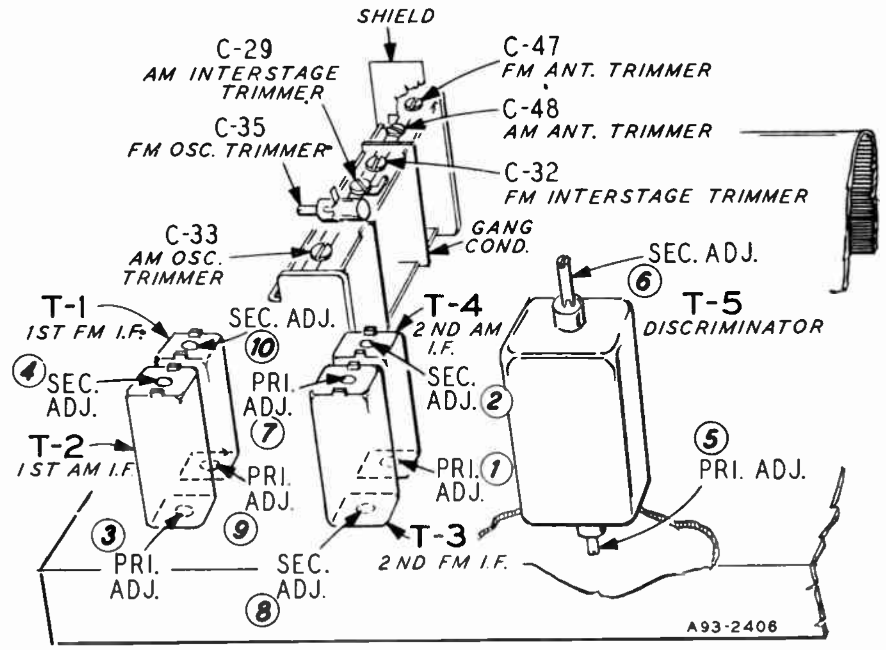
Socket voltages are shown on the schematic diagram at the tube socket terminals. All voltages are between the socket terminal and chassis ground. Plate, screen and cathode voltages were taken with a 1000 ohm-per-volt meter with a 300 volt scale used for plate and screen voltages. Audio grid voltages were read with a vacuum tube volt-meter. Conditions of measurement are:

Line voltage ....117 Volts AC

Signal Input ....None

A variation of ±10% is usually permissible.

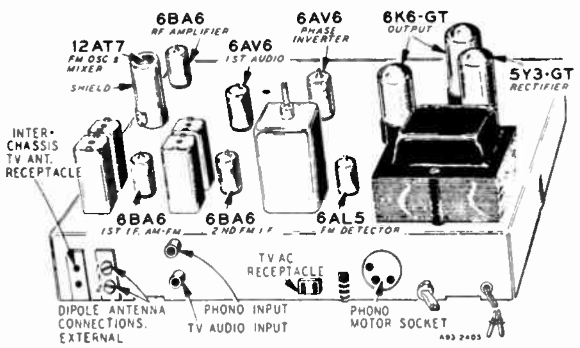
RADIO MISCELLANEOUS DATA



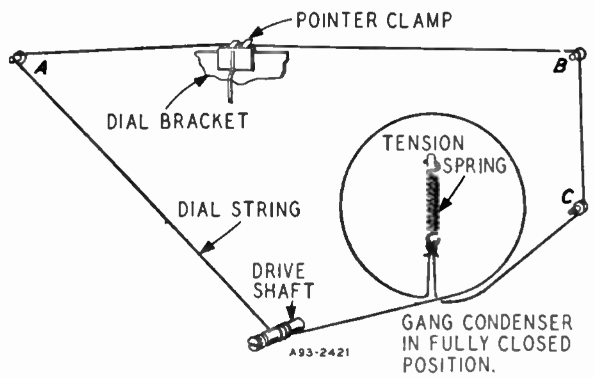
TRIMMER POSITIONS

DRIVE CORD REPLACEMENT

Replacement of the drive cord may be accomplished as shown in the illustration. For this purpose use the new drive cord assembly listed in the Replacement Parts List. Turn the gang condenser until the plates are fully meshed. Then install the string as shown, winding three turns clockwise around the tuning shaft with the turns progressing away from the chassis. After the cord is installed, rotate the tuning shaft several times in order to take up any slack in the cord.



TUBE LAYOUT



DRIVE CORD STRINGING

MODEL 94WG-3008A

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RADIO ALIGNMENT PROCEDURE

AM STAGES

The following is required for aligning:
An All Wave Signal Generator Which Will Provide an Accurately Calibrated Signal at the Test Frequencies as Listed.
Output Indicating Meter, Non-Metallic Screwdriver, Dummy Antennas —.1 mf, 200 mmf.

Volume Control—Maximum all Adjustments.
Connect Radio Chassis to Ground Post of Signal Generator with a Short Heavy Lead.
Allow Chassis and Signal Generator to "Heat Up" for Several Minutes.

SIGNAL GENERATOR	FREQUENCY SETTING	CONNECT GENERATOR OUTPUT TO	THROUGH DUMMY ANTENNA	BAND SWITCH SETTING	GANG CONDENSER SETTING	ADJUST	ADJUST FOR
I-F	455 kc	12AT7 Pin 7 and Chassis	.1 mf	Broadcast	Rotor Fully Open	2nd I-F Pri. & Sec. 1 & 2 1st I-F Pri. & Sec. 3 & 4	Maximum Output
Broadcast	1620 kc	Dipole Antenna Terminal and Ground	200 mmf	Broadcast	Rotor Fully Open	Broadcast Oscillator C-33	
	1400 kc	Dipole Antenna Terminal and Ground	200 mmf	Broadcast	Turn Rotor to Max. Output Set pointer to 1400 kc See Note A	Broadcast Interstage C-29	
	1400 kc	Dipole Antenna Terminal and Ground	200 mmf	Broadcast		AM Trimmer C-48	

Note A—If the pointer is not at 1400 KC on dial, reset pointer at the 1400 KC mark on the dial scale.

FM STAGES

The following equipment is required for aligning:
An accurately calibrated signal generator providing unmodulated signals at the test frequencies listed below.
Non-metallic screwdriver.
Dummy Antennas and I-F Loading Resistor—.01 mf, 300 ohms and 1000 ohms.

Zero center scale DC vacuum tube voltmeter having a range of approximately 3 volts.
(If a zero center scale meter is not available, a standard scale vacuum tube voltmeter may be used by reversing the meter connections for negative readings.)
Allow chassis and signal generator to warm up for several minutes.

	SIGNAL GENERATOR FREQUENCY SETTING	SIGNAL GENERATOR CONNECT GENERATOR OUTPUT TO	THROUGH DUMMY ANTENNA	BAND SWITCH SETTING	GANG CONDENSER SETTING	ADJUST	ADJUST FOR
Discriminator	10.7 MC Note B	6BA6 2nd I-F Pin 1 and Chassis	.01 mf	FM	Rotor Fully Open	Disc. Pri. 5 Note A	Maximum Deflection
	10.7 MC Note B	6BA6 2nd I-F Pin 1 and Chassis	.01 mf	FM	Rotor Fully Open	Disc. Sec. 6 Note C	Zero Center
I-F	10.7 MC Note F	6BA6 1st I-F Pin 1 and Chassis	.01 mf	FM	Rotor Fully Open	2nd I-F Pri. Note A and D 7 2nd I-F Sec. Note A and E 8	Maximum Deflection
Discriminator	10.7 MC Note F	6BA6 1st I-F Pin 1 and Chassis	.01 mf	FM	Rotor Fully Open	Disc. Pri. 5 Note A	Maximum Deflection
	10.7 MC Note F	6BA6 1st I-F Pin 1 and Chassis	.01 mf	FM	Rotor Fully Open	Disc. Sec. 6 Note C	Zero Center
	10.7 MC Note F	FM-RF Gang Condenser terminal	.01 mf	FM	Rotor Fully Open	1st I-F Pri. 9 1st I-F Sec. 10 Notes A, D & E	Maximum Deflection
Recheck I-F Adjustments in order given							
R-F & Osc.	108.4 Note H	Disconnect dipole and connect generator to dipole terminals with resistor in series connected to terminal No. 1.	300 ohms	FM	Rotor Fully Open	Oscillator C-35 Note G	Maximum Deflection
	104.5		300 ohms	FM	Tune Rotor for Max. AVC voltage	FM Interstage C-32	Maximum Deflection
	104.5		300 ohms	FM	Tune Rotor for Max. AVC voltage	Ant. C-47	Maximum Deflection
Recheck R-F and Osc. Adjustments in order given							

NOTE A—Test Equipment connections are as given in the table. The zero center scale DC vacuum tube voltmeter is to be connected between chassis ground and the AVC line at the junction of resistor R-22 and condenser C-18 for all adjustments except the discriminator secondary adjustment, for which See Note C.

NOTE B—A signal of .1 volt must be fed into the receiver for this adjustment.

NOTE C—Disconnect zero center DC vacuum tube voltmeter from AVC and connect to junction of R-18 c–d C-62. Adjust for zero voltage indication.

NOTE D—Before adjusting Pri. core connect 1000 ohm load resistor across the 2nd I.F. secondary terminals. Input may have to be increased to .1 volt if receiver is *badly* mis-aligned.

NOTE E—Disconnect 1000 ohm load resistor from secondary terminals and connect across the 2nd I.F. primary terminals. Input may have to be increased to .1 volt if receiver is *badly* mis-aligned.

NOTE F—Input can be reduced to 10,000 microvolts.

NOTE G—Oscillator frequency above signal frequency.

NOTE H—Remove the 1000 ohm load resistor before attempting to check the R-F and oscillator adjustments.

REPLACEMENT PARTS LIST

S-25A1 R. F. TUNER ASSEMBLY

Ref. No.	Part No.	Description		Qty. Used in Set
C-1, C-2, C-3, C-4, C-5, C-30, C-34, C-35, C-44	47X554	680 mmf	Ceramic	9
C-6	47X517	50 mmf	Ceramic	1
*C-7		0.68 mmf	Ceramic	1
C-8	47X487	25 mmf	Ceramic	1
*C-9		1.5 mmf	Ceramic	1
C-10	47X5O7	5000 mmf	Ceramic	1
C-11	47X534	270 mmf	Molded Mica	1
*C-12		62 mmf	Ceramic	1
*C-31		0.47 mmf	Ceramic	1
*C-32		1.5 mmf	Ceramic	1
*C-33A, *C-33B		1.2 mmf	Trimmer	1
C-36	47X545	1500 mmf	Ceramic	1
C-45	47X556	3 mmf	Ceramic	1
R-1, R-2, R-3, R-25	B85102	1000 ohms 0.5 W	Carbon	4
R-4	B85151	150 ohms 0.5 W	Carbon	1
R-5, R-38	B85223	22 K ohms 0.5 W	Carbon	2
R-6	B85105	1 megohm 0.5 W	Carbon	1
R-7	B85B23	B2 K ohms 0.5 W	Carbon	1
R-21	B85333	33 K ohms 0.5 W	Carbon	1
R-22	C85103	10 K ohms 1.0 W	Carbon	1
R-23	B85472	4.7 K ohms 0.5 W	Carban	1
R-24	B85471	470 ohms 0.5 W	Carbon	1
R-107	C85682	6800 ohms 1.0 W	Carbon	1
*L-1, *L-2, *L-3, *L-4		RF Tuner Coils		
L-12	9A2033	Filament Choke		1
T-1	9A2032	R-F Trap Trans.		1

*PARTS ARE NOT INTERCHANGEABLE—COMPLETE TUNER ASSEMBLY MUST BE ORDERED. (SEE MISCELLANEOUS).

TELEVISION PARTS

CAPACITORS

Ref. No.	Part No.	Description			Qty. Used in Set
C-13, C-16, C-18, C-22, C-47, C-48, C-49, C-50, C-52	47X545	1500 mmf.		Ceramic	9
C-14, C-15		Part of T-2 (Sound I-F Trans)			
C-17	D67103	.01 mf	400 V	Tubular	1
C-19, C-20, C-21		Part of T-3 (Sound Disc. Trans.)			
C-23, C-37, C-38, C-40	47X534	270 mmf	1000 V	Molded Mica	4
C-39		Part of T-5 (Cathode Trap)			
C-41, C-42, C-60, C-70	D67503	.05 mf	400 V	Tubular	4
C-43, C-46, C-58, C-66, C-81	D65254	.25 mf	400 V	Tubular	5
C-51	47X546	100 mmf		Ceramic	1
C-53	47X542	10 mmf	500 V	Molded Mica	1
C-54, C-56	47X532	120 mmf	1000 V	Molded Mica	2
C-55A, C-55B, C-55C	17A259	10-160 mmf, 40-370 mmf, 40-370 mmf		Trimmer	1
C-57, C-72	F66202	.002 mf	600 V	Tubular	2
C-59	D65203	.02 mf	400 V	Tubular	1
C-61	47X536	180 mmf	1000 V	Molded Mica	1
C-62	47X531	2200 mmf	1000 V	Molded Mica	1
C-63, C-71	47X535	390 mmf	1000 V	Molded Mica	2
C-64	47X541	47 mmf	500 V	Molded Mica	1
C-65A, C-65B, C-65C	45X371	10 mf, 30 mf, 30 mf	450 V, 300 V, 400 V	Dry Electrolytic	1
C-67	47X544	100 mmf	1000 V	Molded Mica	1
C-68	F67503	.05 mf	600 V	Tubular	1
C-69	46X408	.035 mf	1000 V	Tubular	1
C-73, C-74	D65502	.005 mf	400 V	Tubular	2
C-75, C-82	46X409	.1 mf	1000 V	Tubular	2
C-76	47X530	500 mmf		High Voltage Ceramic	1
C-77	47X533	5 mmf	1500 V	Molded Mica	1
C-78A, C-78B	45X369	10 mf, 80 mf	450 V, 450 V	Dry Electrolytic	1
C-79	47X543	4700 mmf	500 V	Molded Mica	1
C-80A, C-80B, C-80C	45X370	130 mf, 40 mf, 40 mf	50 V, 450 V, 150 V	Dry Electrolytic	1
C-83, C-84	46X410	.01 mf	400 V	Molded Paper	2
C-85A, C-85B	45X367	10 mf, 40 mf	350 V, 450 V	Dry Electrolytic	1
C-86		Part of Deflection Yoke Assembly			
C-87A, C-87B	45X368	1000 mf, 250 mf	6 V, 10 V	Dry Electrolytic	1

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World Radio History

REPLACEMENT PARTS LIST (Continued)
TELEVISION PARTS

RESISTORS

Ref. No.	Part No.	Ohms	Watts	Description	Qty. Used in Set
R-8	32B4820	82	0.5	Carbon	1
R-9	3284122	1200	0.5	Carbon	1
R-10	3285474	470 K	.C5	Carbon	1
R-11, R-79	3285223	22 K	0.5	Carbon	2
R-12, R-44, R-45, R-48, R-50, R-96	32B5102	1000	0.5	Carbon	6
R-13, R-14	32B3104	100 K	0.5	Carbon	2
R-15	43X239	5.1	0.5	Wirewound	1
R-26, R-28	32B4390	39	0.5	Carbon	2
R-27, R-29	3283562	5600	0.5	Carbon	2
R-30, R-78	3283682	6800	0.5	Carbon	2
R-31		Part of L-9			
R-32, R-54, R-71, R-74	3285105	1 meg.	0.5	Carbon	4
R-33	32C4332	3300	1.0	Carbon	1
R-34, R-46	32B4102	1000	0.5	Carbon	2
R-35		Part of L-11			
R-36, R-47	78X1	500 K, 10 K		Brightness and Contrast Control	1
R-37	32B5104	100 K	0.5	Carbon	1
R-39	32B4685	6.8 meg.	0.5	Carbon	1
R-40	3284823	82 K	0.5	Carbon	1
R-41, R-67, R-83	3284103	10 K	0.5	Carbon	3
R-42	32B3153	15 K	0.5	Carbon	1
R-43	3284123	12 K	0.5	Carbon	1
R-49	32B4151	150	0.5	Carbon	1
R-51	3284472	4700	0.5	Carbon	1
R-52		Part of L-13			
R-53, R-55	32B4332	3300	0.5	Carbon	2
R-56, R-72	3285470	47	0.5	Carbon	2
R-57	32B4154	150 K	0.5	Carbon	1
R-58	32C3335	3.3 meg	1.0	Carbon	1
R-59	32B3564	560 K	0.5	Carbon	1
R-60, R-80, R-81	3284822	8200	0.5	Carbon	3
R-61	3181104	100 K	0.5	Carbon	1
R-62	32C3104	100 K	1.0	Carbon	1
R-63	3284184	180 K	0.5	Carbon	1
R-64	34A1	30 K	0.25	Temp. Comp.	1
R-65	32B4124	120 K	0.5	Carbon	1
R-66, R-90	78X2	50 K, 1 meg		Horizontal and Vertical Hold Control	1
R-68	32C4274	270 K	1.0	Carbon	1
R-69	32C4124	120 K	1.0	Carbon	1
R-70	32C4820	82	1.0	Carbon	1
R-73	32C5153	15 K	1.0	Carbon	1
R-75	32C4472	4700	1.0	Carbon	1
R-76	43X238	3.3	0.5	Wirewound	1
R-77	3284395	3.9 meg	0.5	Carbon	1
R 82	32C5105	1 meg	1.0	Carbon	1
R-84	32B4564	560 K	0.5	Carbon	1
R-85	32B4563	56 K	0.5	Carbon	1
R-86	77X3	2.5 meg		Height Control	1
R-87	32B4155	1.5 meg.	0.5	Carbon	1
R-88	32B5685	6.8 meg.	0.5	Carbon	1
R-89	3283105	1 meg	0.5	Carbon	1
R-91	32B4104	100 K	0.5	Carbon	1
R-92	3284561	560	0.5	Carbon	1
R-93	77X4	5000		Vertical Lin. Control	1
R-94	32B5225	2.2 meg	0.5	Carbon	1
R-95	3284392	3900	0.5	Carbon	1
R-97, R-98		Part of Vertical Yoke			
R-99A, R-99B	43X244	700, 510	20, 20	Wirewound	1
R-100A, R-1008, R-100C	43X243	2830, 30, 85	1.0, 0.8, 2.0	Wirewound	1
R-101	32C4390	39	1.0	Carbon	1
R-102, R-103	32C5681	680	1.0	Carbon	2
R-104	77X1	2250		Focus Control	1
R-105	77X2	20		Vertical Centering	1
R-106	77X5	20		Horizontal Centering	1

TRANSFORMERS AND COILS

Ref. No.	Part No.	Description	Qty. Used in Set
L-5, L-7	9A1980	1st and 3rd Pix I.F. Coil	2
L-8, L-10	9A1979	Peaking Coil	2
L-9, L-11	9A1978	Peaking Coil	2
L-13	9A1977	Peaking Coil	1
L-14	9A1984	Transformer (Synchronization Guide)	1
L-15	9A1976	Width Control Coil	1
L-16	9A1981	Coil (Horizontal Linearity)	1
L-17, L-18, L-19, L-20		Part of 9A1987 Deflection Yoke Assembly (See Miscelloneous)	
L-21	9A1974	Focus Coil	1
L 22	52X87	Filter Choke	1
T-2	9A1986	Sound I-F Transformer	1
T-3	9A1983	Sound Disc. Transformer	1
T 5	9A1985	Cathode Trap Transformer	1
T-6	54X4	Vertical Oscillator Transformer	1
T-7	51X140	Vertical Output Transformer	1
T-8	53X296	Horizontal Output & H. V. Trans.	1
T-9	53X297	Power Transformer	1
T-10	9A1982	2nd Pix I-F Transformer	1

MISCELLANEOUS

Ref. No.	Part No.	Description		Qty. Used in Set
	S-25A1	R-F Tuner Assembly		1
	9A1987	Deflection Yoke Assembly		1
	6A306	Anode Connector		1
	28X560	Spring (Anode Connector)		1
	2A382	Ion Trap Magnet		1
	3A445	Tube Socket (Octal)		5
	3A443	Tube Socket (9 pin)		1
	3A444	Tube Socket (Ceramic)		1
	3A445	Tube Socket (Octal)		5
	3A448	Socket (Hi-Voltage Capacitor)		1
	13X614	Tube Socket (Kinescope)		1
	4X1026	Screen Escutchean		1
	17X101	Pix Crystal		1
	4X1028	Escutcheon (Channel)		1
	4X1029	Escutcheon (Vertical & Horizontal)		1
	10A717	Knob (Fine Tuning)		1
	10A714	Knob (Brightness and Horizontal)		2
	10A716	Knob (Contrast & Vertical)		2
	10A718	Knob (Channel Tuning)		1
	32X396	Tube Shield (6C4—R.F.OSC.)		1
	32X221	Tube Shield (6AL5 Sound Disc.)		1
	14X449	Ventilator Grille (Metal)		1
	14X450	Ventilator Grille (Back of Cabinet)		1
	S-3A1	Socket Assembly (H. V. Rectifier)		1
	S-32X4	Line Cord and Shield Assembly		1
	S-25X36	Rubber Strip and Bracket Assembly		1
	S-8X1	Hood Assembly	Def. Yoke	1
	20X1558	Wing Screw	Def. Yoke	3
	25X1597	Support Bracket	Def. Yoke	1
	25X1595	Top Bracket	Focus Coil	1
	25X1598	Middle Bracket	Focus Coil	1
	25A1047	Support Assembly	Focus Coil	1
	25A1049	Stud Assembly	Focus Coil	1
	20X1557	Wing Nut	Focus Coil	3
	8X191	Mask	Focus Coil	1
	16X132	Fuse (3 amperes 250 volts)		1
	16X133	Fuse (¼ ampere 250 volts)		1
	16X131	Fuse Holder		1

CAPACITORS

Ref. No.	Part No.	Description	Qty. Used in Set
C-1	14A207	Gang Condenser	1
C-2, C-6, C-12, C-25, C-26, C-45	47X496	500 mmf Ceramic	6
C-3, C-7, C-9, C-16, C-17, C-18, C-19, C-27	47X507	5000 mmf Ceramic	8
C-4	47X497	100 mmf Ceramic	1
C-5	47X499	47 mmf Ceramic	1
C-8	47X498	47 mmf Ceramic	1
C-10, C-67		Part of T-1 1st I.F. Trans. (FM)	
C-11, C-28, C-46	47X550	100 mmf Ceramic	3
C-13, C-42, C-54, C-59	F66203	.02 mf 600 V Tubular	4
C-15		Part of T-3 2nd I.F. Trans. (FM)	
C-21		Part of T-5 Discriminator Trans.	
C-22, C-24, C-31, C-51	47X501	68 mmf Ceramic	4
C-23	45X361	5 mf 100 V Dry Electrolytic	1
C-29, C-32, C-33, C-47, C-48		Part of Gang Condenser	
C-30, C-49	47X552	15 mmf Ceramic	2
C-34, C-61	47X516	20 mmf Ceramic	2
C-35	26A489	1-8 mmf Trimmer Assembly	1
C-36	47X549	5 mmf Ceramic	1
C-37	F66403	.04 mf 600 V Tubular	1
C-38, C-39		Part of T-2 1st I-F Trans. (AM)	
C-40	866503	.05 mf 200 V	1
C-41, C-43		Part of T-4 2nd I-F Trans. (AM)	
C-44A, C-448	47X112	50-50 mmf Dual Mica	1
C-50A, C-50 8, C-50C	45X374	40 mf 450 V, 40 mf 450 V, 40 mf 25 V Dry Electrolytic	1

REPLACEMENT PARTS LIST
RADIO PARTS

TRANSFORMERS AND COILS

Ref. No.	Part No.	Description	Qty. Used in Set
L-1, L-5	35A5	R. F. Choke	2
L-2	9A2025	Interstage Coil (AM)	1
L-3	9A2024	Interstage Coil (FM)	1
L-4	9A2022	Oscillator Coil (AM)	1
L-6	9A1881	Filament Choke	1
L-7	9A2023	Oscillator Coil (FM)	1
L-8	35A7	Mixer Choke (FM)	1
L-9	9A2027	Antenna Coil (FM)	1
L-10	9A2026	Antenna Coil (AM)	1
T-1	9A2034	1st I-F Trans. (FM)	1
T-2	9A2029	Ist I-F Trans. (AM)	1
T-3	9A2030	2nd I-F Trans. (FM)	1
T-4	9A1963	2nd I-F Trans. (AM)	1
T-5	9A1970	Discriminator Coil	1
T-6	53X286	Power Transformer	1
T-7	51X142	Output Transformer	1

DIAL AND DRIVE ASSEMBLY

Ref. No.	Part No.	Description	Qty. Used in Set
	S-25X34	Dial Bracket Assembly	1
	S-58X25	Dial Assembly	1
	58X718	Dial Glass	1
	28X113	Tension Spring (Drive Cord)	1
	10X38	Drive Cord Assembly	1
	15X246	Pointer	1
	26X486	Drive Shaft	1
	7A103	No. 47 Pilot Light	2
	7A199	Pilot Light Socket Assembly	1

MISCELLANEOUS

Ref. No.	Part No.	Description	Qty. Used in Set
	12A490	12" PM Speaker	1
	3A304	Phono Motor Socket	1
	3A305	Socket — Single Pin	2
	3A435	Tube Socket — Octal (8 prong) molded	3
	3A436	Tube Socket (for 12AT7)	1
	32X388	Tube Shield (for 12AT7)	1
	32X390	Tube Shield (miniature)	1
	3A441	Tube Socket (miniature)	6
	2A386	Band Switch	1
	13X546	Line Cord and Plug Assembly	1
	4X1027	Escutchean	1
	10A713	Knob	4
	6X21	Rubber Grommets	4
	30X547	Line Cord Clamp	1
	6A307	TV AC Receptacle	1
	6A308	TV Antenna Receptacle	1

TYPE W-28A1S3 RECORD CHANGER PARTS

Ref. No.	Part No.	Description	Qty. Used in Set
	W-15X097-1	Motor Assembly, 60 cycles 115-120 V.	1
	W-21P247	Crystal Cartridge	
	W-21P515	Semi-Permanent Twin Point Needle Assembly	1
	W-11X368	Rubber Drive Wheel (33-1/3 R.P.M.)	1
	W-11X366	Rubber Drive Wheel (78 R.P.M.)	1

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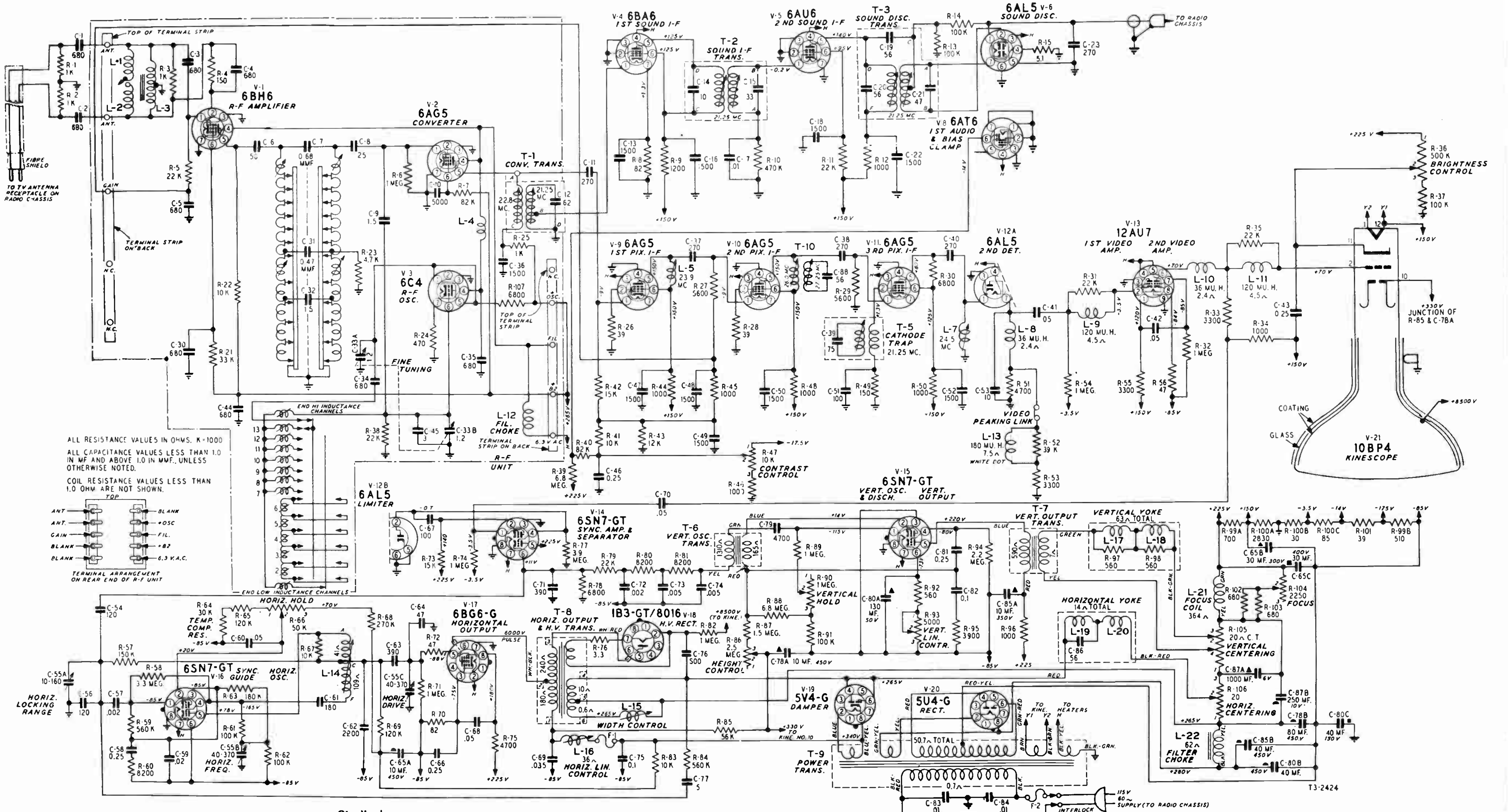
MODEL 94WG-3008A



Ref. No.	Part No.	Description			Qty. Used in Set
C-52	F66103	.01 mf	600 V	Tubular	1
C-53	47X468	220 mmf		Ceramic	1
C-55, C-60	F66102	.001 mf	600 V	Tubular	2
C-56	B66203	.02 mf	200 V	Tubular	1
C-57	F66602	.006 mf	600 V	Tubular	1
C-58	B66502	.005 mf	200 V	Tubular	1
C-62	47X492	2700 mmf		Molded Mica	1
C-63	47X472	40 mmf		Ceramic	1
C-64	47X553	4 mmf		Ceramic	1
C-65	46X328	.01 mf	120 V	Tubular	1
C-66	47X471	68 mmf		Ceramic	1

REPLACEMENT PARTS LIST (Continued)

RADIO PARTS

RESISTORS

Ref. No.	Part No.	Ohms	Watts	Description	Qty.
R-1, R-10, R-22	B85105	1 meg.	0.5	Carbon	3
R-2, R-12, R-15	B83680	68	0.5	Carbon	3
R-3, R-11	B84563	56K	0.5	Carbon	2
R-4, R-6, R-8, R-13	B84102	1000	0.5	Carbon	4
R-5	B85104	100K	0.5	Carbon	1
R-7	B84103	10K	0.5	Carbon	1
R-9	B85225	2.2 meg.	0.5	Carbon	1
R-14	B85473	47K	0.5	Carbon	1
R-16	C84393	39K	1.0	Carbon	1
R-17	B85222	2200	0.5	Carbon	1
R-18	B84273	27K	0.5	Carbon	1
R-19	43X233	3.6	0.5	Wire Wound	1
R-20, R-21	B83682	6800	0.5	Carbon	2
R-23	43X242	1400	5.0	Wire Wound	1
R-24, R-31, R-35, R-38	B85474	470K	0.5	Carbon	4
R-25	36X380	.5 meg.		Volume Control	1
R-26	B85153	15K	0.5	Carbon	1
R-27	40X285	3 meg.		Tone Control	1
R-28, R-33	B85106	10 meg.	0.5	Carbon	2
R-29, R-34	B85274	270K	0.5	Carbon	2
R-30	D83561	560	2.0	Carbon	1
R-32	B84822	8200	0.5	Carbon	1
R-36	B84332	3300	0.5	Carbon	1
R-37	B84913	91K	0.5	Carbon	1

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SUPPLEMENTARY MANUAL

All service information applicable to models 94WG-3016A, B and C is contained in service manual 3008A, and this Supplementary Service Manual. The differences between the models are as follows:

1. Models 94WG-3016A and 94WG-3016B are identical to model 94WG-3008A, except for the use of a 12½" picture tube and minor resistor, condenser, and mechanical part changes that are required for a larger tube. A new schematic diagram and a new replacement parts list is incorporated in this Supplementary manual. For all other service and replacement parts information, refer to manual 3008A.

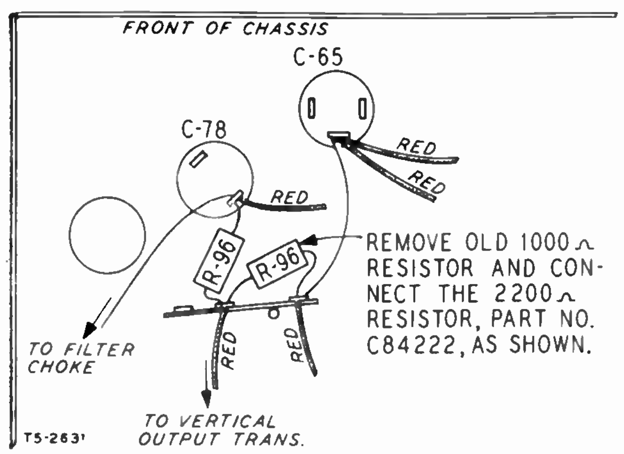
2. Model 94WG-3016C is a Model 94WG-3008A converted by a field modification to use a 12½" picture tube. This was accomplished by the use of a kit, part number 26A503, now no longer available. An illustration of the few circuit changes is in this manual. For a complete parts list and other service information, refer to manual 3008A.

CIRCUIT CHANGES

MODEL 94WG-3016C

The changes shown in the illustration applies +265 volts to the primary of the vertical deflection transformer instead of +225 volts as shown in Manual No. 3008A.

In addition, a .05 mf 400V condenser (part no. D67503) was installed between pin No. 6 of the 6BG6 horizontal output socket and the yellow wire connected to the upper end of the horizontal size control. Then a black wire (9½") was connected between pin No. 6 of the 6BG6 horizontal output socket and terminal No. 6 of the horizontal output transformer. This procedure connected the .05 mf 400V condenser across the width control L-15.



PARTS LIST

MODELS 94WG-3016A&B

The partial parts list shown below constitute the changes that were made on the 94WG-3008A so that a 12½" picture tube could be used. This necessitated the changing of the model number to 94WG-3016A&B. For all other service and replacement parts information refer to manual 3008A.

CAPACITORS

Removed	C-67	47X544	100 mmf	1000 V	Molded Mica.
Removed	C-70	D67503	.05 mf	400 V	Tubular.....
Added	C-70	47X534	270 mmf	1000 V	Molded Mica.
Removed	C-71	47X535	390 mmf	1000 V	Molded Mica.
Added	C-88		Part of T-10		
Added	C-89	D66104	.1 mf	400 V	Tubular.....
Added	C-90	47X516	20 mmf		Ceramic.....

RESISTORS

			Ohms	Watts	
Removed	R-33	32B4332	3300	0.5	Carbon.....
Added	R-33	B84392	3900	0.5	Carbon.....
Removed	R-34	32B4102	1000	0.5	Carbon.....
Added	R-34	B84471	470	0.5	Carbon....
Removed	R-37	32B5104	100 K	0.5	Carbon.....
Added	R-37	B85223	22 K	0.5	Carbon.....
Removed	R-39	32B4685	6.8 meg.	0.5	Carbon.....
Removed	R-40	32B4823	82 K	0.5	Carbon.....
Removed	R-56	32B5470	47	0.5	Carbon.....
Removed	R-73	32C5153	15K	1.0	Carbon...
Added	R-73	B84155	1.5 meg.	0.5	Carbon...
Removed	R-74	32B5105	1 meg.	0.5	Carbon...
Added	R-74	B84473	47 K	0.5	Carbon....
Removed	R-77	32B4395	3.9 meg.	0.5	Carbon....
Added	R-77	B85225	2.2 meg.	0.5	Carbon....
Removed	R-78	32B3682	6800	0.5	Carbon....
Added	R-78	C84103	10 K	1.0	Carbon....
Added	R-108	B85103	10 K	0.5	Carbon....
Added	R-109	B85474	470 K	0.5	Carbon....
Added	R-110	B85222	2200	0.5	Carbon....

MISCELLANEOUS

Added	3A428	Tube Socket (miniature) ....
Added	3A447	Tube Socket (Octal) ....
Removed	4X1026	Screen Escutcheon ....
Added	4X1047	Screen Escutcheon ....
Removed	S-25X36	Rubber Strip & Bracket Assembly ....
Added	S-25X38	Rubber Strip & Bracket Assembly.........
Removed	25X1597	Support Bracket ....
Added	25X1630	Support Bracket ....
Removed	S-25A1	R-F Tuner Assembly ....
Added	S-25A3	R-F Tuner Assembly ....
*Removed	2A382	Ion Trap Magnet ....
Removed	10BP4	10" Pix Tube ....
Added	12KP4	12½" Pix Tube ....

*Ion Trap Magnet not used with 12KP4 Pix Tube.

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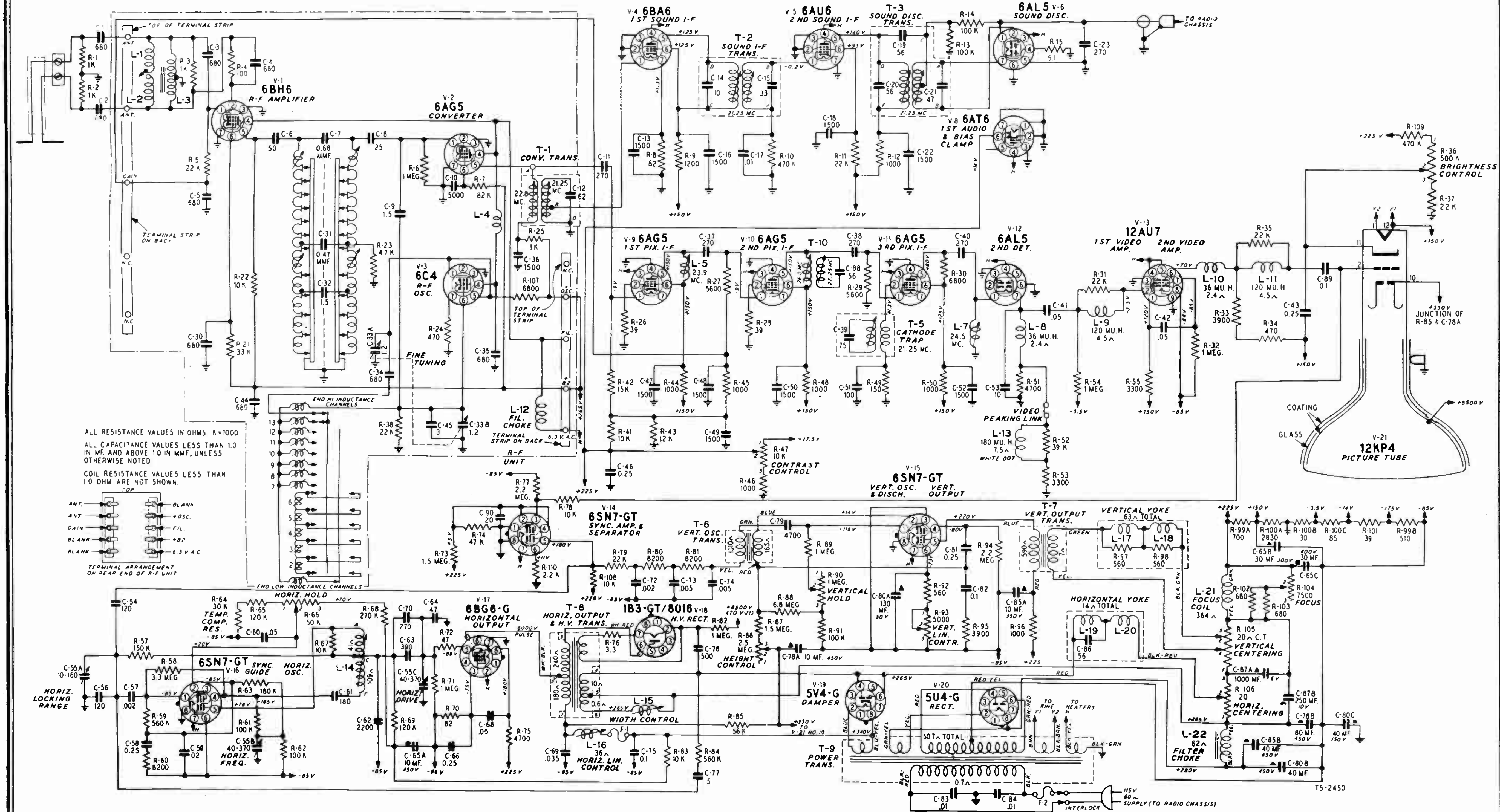
MODEL 05WG-3016A & B



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ELECTRICAL SPECIFICATIONS

Power Supply	105-125 Volts AC, 60 Cycles only
Power Consumption	Television—300 Watts Radio—80 Watts Phonograph—100 Watts
Tuning Ranges	TV—12 Channel BC—540-1600 KC FM—88-108 MC
Power Output	8.5 Watts (Max.) 6.0 Watts (10% Distortion)
Tel. Antenna Input Impedance	300 Ohms Balanced
Intermediate Frequencies (Tel.)	Picture 25.75 MC Sound 21.25 MC
Intermediate Frequencies (Rad.)	FM—10.7 MC AM—455 KC
Selectivity	AM—43 KC Broad at 1,000 Times Signal measured at 1,000 KC I.F. FM—190 KC Broad at 2 Times down I.F. FM—760 KC Broad at 200 times down
Sensitivity	(For .5 Watt Output) AM—10 Microvolts Average FM—30 Microvolts Average

Loud Speaker	12 inch PM Dynamic
Voice Coil Impedance	3.2 Ohms 400 Cycles
Video Response	To 3.5 MC
Picture Area	90 Square Inch
Focus	Magnetic
Sweep Deflection	Magnetic
Scanning	Interlaced, 525 Line
Horizontal Scanning Frequency	15,750 CPS
Vertical Scanning Frequency	60 CPS
Frame Frequency	30 CPS
Record Changer	See Manual 5081A

TUBE COMPLEMENT

TV CHASSIS

Symbol	Type	Function
V1	1—6AG5	R-F Amplifier
V2	1—6AG5	Converter
V3	1—6AB4	R-F Oscillator
V4	1—6BA6	1st Sound I-F Amp.
V5	1—6AU6	2nd Sound I-F Amp.
V6	1—6AL5	Sound Discriminator
V9	1—6AG5	1st Picture I-F Amp.
V10	1—6AG5	2nd Picture I-F Amp.
V11	1—6AG5	3rd Picture I-F Amp.
V12A-12B	1—6AL5	Picture Det. and Sync Limiter
V13	1—12AU7	1st and 2nd Video Amp.
V14	1—6SN7-GT	Sync Amplifier and Separator
V15	1—6SN7-GT	Vertical Sweep Oscillator, Discharge and Output
V16	1—6SN7-GT	Horizontal Sweep Oscillator and Sync Guide
V17	1—6BG6-G	Horizontal Sweep Output
V18	1—1B3-GT/8016	High Voltage Rectifier
V19	1—5V4-G	Horizontal Damper
V20	1—5U4-G	Power Supply Rectifier
V21	1—12KP4	Picture Tube (12½ Inch)

(Ion Trap Magnets Not Used With 12KP4 Tubes)

RADIO CHASSIS

1—6BA6 AM-FM R-F Amplifier
1—12AT7 FM & AM Osc. & Mixer
1—6BA6 FM-AM 1st I-F Amplifier
1—6BA6 FM 2nd I-F Amplifier
1—6AL5 FM Detector
1—6AV6 Audio Amplifier, AM 2nd Detector and AVC
2—6K6-GT Audio Output
1—5Y3-GT Rectifier
1—6AV6 Phase Inverter
2—No. 47 Dial Lamps

RADIO FREQUENCY RANGES

Channel Number	Channel Frequency Mc	Picture Carrier Frequency Mc	Sound Carrier Frequency Mc	Receiver R-F Osc. Frequency Mc
2	54-60	55.25	59.75	81
3	60-66	61.25	65.75	87
4	66-72	67.25	71.75	93
5	76-82	77.25	81.75	103
6	82-88	83.25	87.75	109
7	174-180	175.25	179.75	201
8	180-186	181.25	185.75	207
9	186-192	187.25	191.75	213
10	192-198	193.25	197.75	219
11	198-204	199.25	203.75	225
12	204-210	205.25	209.75	231
13	210-216	211.25	215.75	237

RECEIVER LOCATION—Advise the owner as to the proper location for the television receiver. The following may be used as a guide:

1. Choose an area in the home where sunlight or light from lamps do not strike the face of the picture tube and cause glare.
2. Remember the necessity of an electrical outlet and the location of the point at which the antenna leads enter the room.
3. The receiver should be placed a short distance from the wall to allow adequate ventilation.
4. The receiver should be placed to permit easy access for operation and comfortable viewing from all angles.

NATENNA—This receiver has been designed to use an antenna with a 300 ohm balanced transmission line. This line must be as short as possible because the longer the line the greater the chances are for picking up electrical disturbances. Stand-off insulation should be used to keep the line away from the mast, metal or walls. Twist this line about one turn per foot throughout the line to cancel out direct signal and/or noise pickup by the transmission line. It should also be securely anchored in place so that a change in weather will not affect its position.

HIGH VOLTAGE WARNING

This television receiver contains high voltages which are dangerous to life. Never operate or service the receiver outside of the cabinet or with the covers removed until all the safety precautions necessary for working with high voltage equipment have been observed.

PICTURE TUBE HANDLING PRECAUTION

Shatterproof goggles and heavy gloves must be worn by individuals while handling the picture tube or installing the picture tube into the receiver.

The picture tube encloses a high vacuum and due to the large surface area, is subjected to excessive air pressure. Therefore, care should be taken not to bump or scratch the picture tube accidentally as it may cause the tube to implode resulting in damage to property or injury to an individual.

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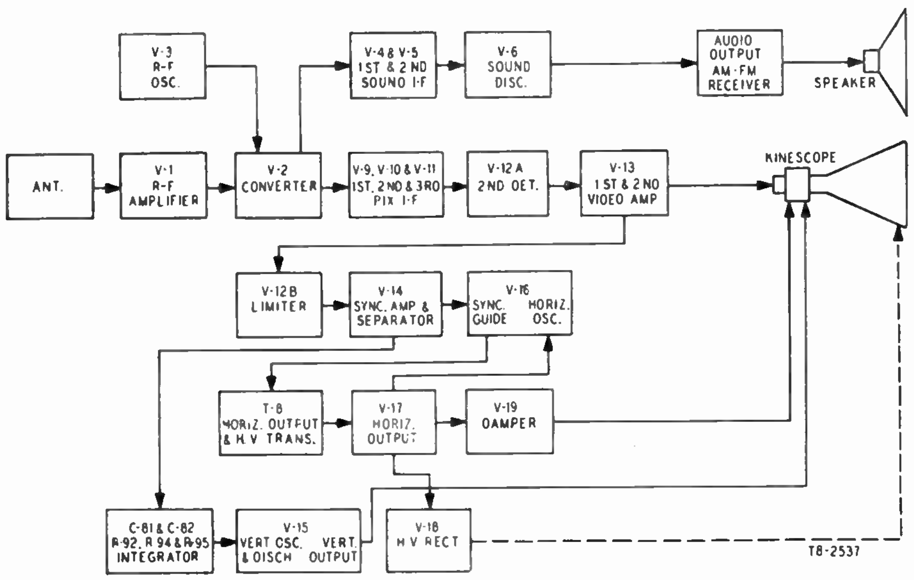

Fig. 2—Block Diagram

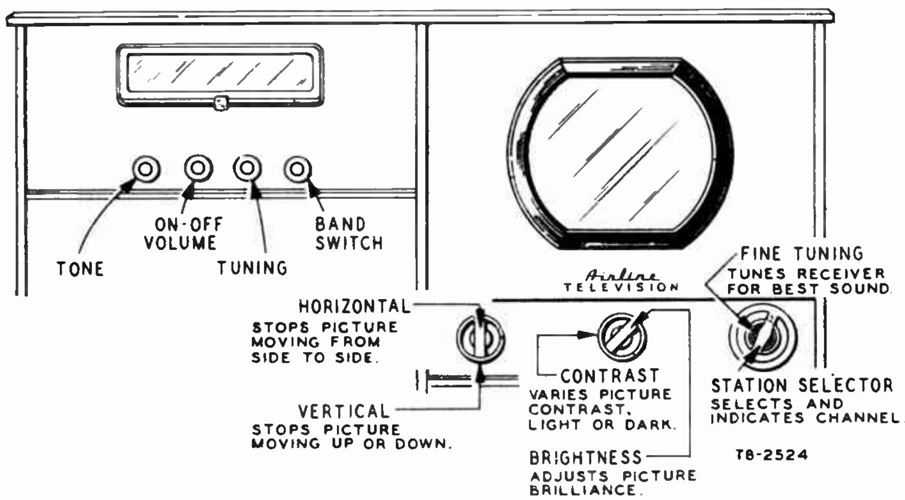

Fig. 3—Front Panel Controls

TUNING PROCEDURE

1. To turn the television receiver on, turn the ON-OFF VOLUME CONTROL on the radio panel until a click is heard. Allow approximately 30 seconds for the tubes to warm up.
2. Turn BAND SWITCH CONTROL on the radio panel fully counterclockwise to the TV position.
3. Turn the STATION SELECTOR CONTROL to the desired channel. This control may be turned in either direction.
4. Turn the CONTRAST CONTROL fully counterclockwise.
5. Turn the BRIGHTNESS CONTROL fully counterclockwise and then very slowly clockwise until light is readily visible on the screen.
6. Turn the CONTRAST CONTROL clockwise until activity or definite form is noted on the screen.
7. Adjust the FINE TUNING CONTROL for best tonal quality and the VOLUME CONTROL for desired volume.
8. Adjust the HORIZONTAL CONTROL until the picture is obtained and centered.
9. Turn VERTICAL CONTROL clockwise until the picture rolls slowly downward, then turn control counter clockwise until picture stops moving up.
10. Adjust the CONTRAST CONTROL until the best picture is obtained and if necessary make a slight readjustment of the BRIGHTNESS CONTROL.
11. After the receiver has been on for a while it may be necessary to readjust the FINE TUNING CONTROL for best sound quality.
12. When switching from one channel to another, it may be necessary to repeat steps number 7 and 10.
13. To turn off the receiver, turn the ON - OFF VOLUME CONTROL counterclockwise until a click is heard.
14. When the receiver is turned on again and the positions of the controls have not been changed, no further adjustments will be necessary except for the FINE TUNING CONTROL and VOLUME CONTROL for the desired volume.
15. If the positions have been disturbed since the last time the receiver has been used it may be necessary to follow steps 1 to 11.

PICTURE TUBE — Some receivers are shipped with the picture tube in place. However, some of the picture tube adjustments may have been jarred loose in shipment. If adjustments are necessary, the following should be used as a guide:

1. After the receiver has been unpacked and the cradle removed, take off the cabinet back and make sure all the tubes are properly mounted in their respective sockets.
2. Connect an antenna to the antenna terminals at the rear of the radio chassis and insert the line cord plug into a convenience outlet.
3. Turn on the receiver and wait about 60 seconds for the receiver to warm up. Turn the channel selector to a station that is transmitting and check the picture. If the picture is not centered on the screen, or visible at all, make the adjustments on the deflection yoke, focus coil and ion trap magnet assemblies as outlined on page 5.

PICTURE TUBE REPLACEMENT — Should the picture tube have to be replaced, remove the defective picture tube in the following manner:

1. Remove the front panel control knobs by pulling them straight from their shafts.
2. Remove two ornamental screws holding front panel to the Cabinet (see figure 5) and lift out panel.
3. Remove the cabinet back.
4. Disconnect the picture tube socket connector at the base of the tube and the high voltage anode lead from the front of the picture tube.

   WARNING—REMOVE STATIC CHARGE FROM THE ANODE LEAD BY GROUNDING IT AGAINST THE CHASSIS.
5. Remove the ion trap magnet, slipping it from the neck of the picture tube past the socket.
   NOTE: Ion trap magnets not used with 12KP4 Tubes.
6. Loosen the wing nuts and wing screws on the deflection yoke and focus coil.
7. Loosen the strap holding the front of the picture tube in place and withdraw the picture tube toward the front of the chassis.
8. To install a new picture tube, reverse the above procedure making sure that the picture tube is fitted closely against the picture tube cushion and that the high voltage well connector is at the top of the picture tube. If the picture tube sticks or fails to slip into place smoothly, investigate and remove the source of the trouble. Never force the tube.

PICTURE TUBE WINDOW — Clean the picture tube window with a dampened cloth or a soft lint-free cloth if dust or finger marks are present.

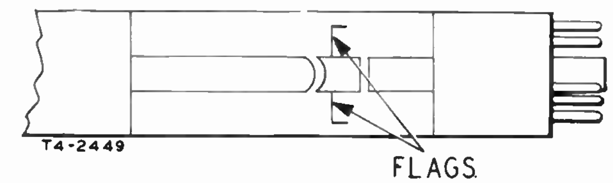

Fig. 4—Ion Trap Flags

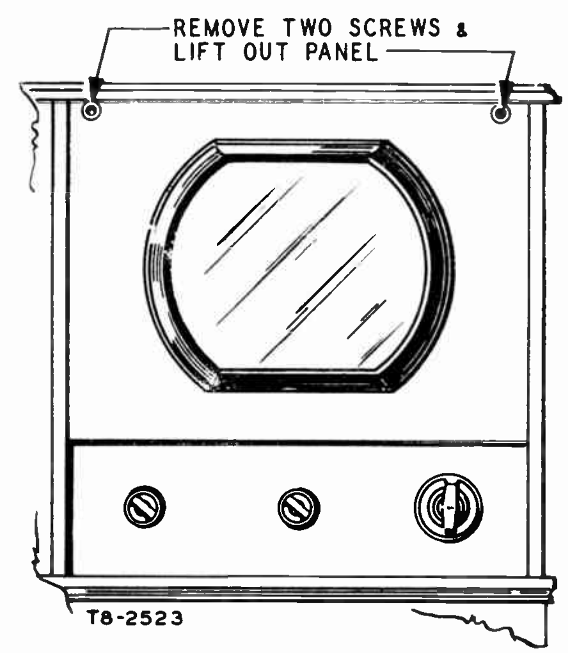

Fig. 5—Front Panel Removal

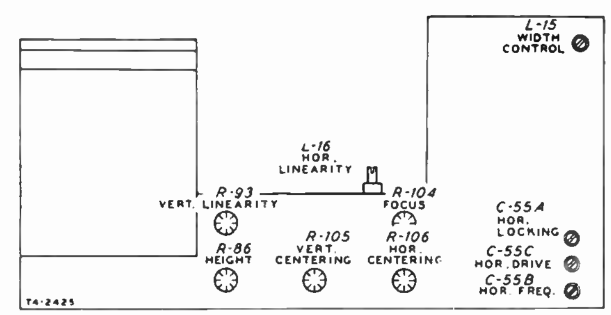

Fig. 6—Rear Chassis Adjustments

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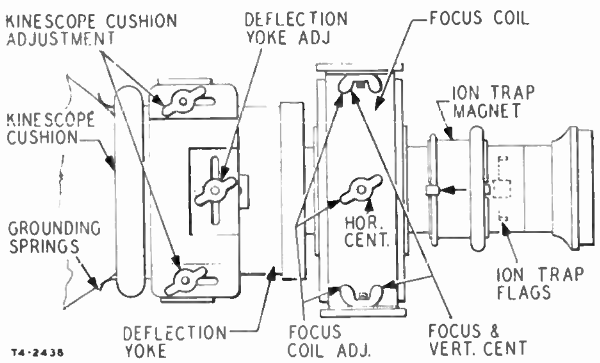

Fig. 7—Yoke, Focus and Ion Trap Magnet Adjustment

NON-OPERATING CONTROLS
(Rear Of Chassis)

Horizontal Centering	R-106
Vertical Centering	R-105
Width	L-15
Height	R-86
Horizontal Linearity	L-16
Vertical Linearity	R-93
Horizontal Drive	C-55C
Horizontal Frequency (Fine)	C-55B
Horizontal Oscillator Frequency (Bottom Chassis)	L-14
Horizontal Locking Range	C-55A
Focus	R-104
Focus Coil	Wing Nut Adjustment
Ion Trap Magnet	Wing Nut Adjustment
Deflection Coil	Wing Screw Adjustment

DEFLECTION YOKE ADJUSTMENT — If the lines of the raster are not horizontal or squared with the picture mask, rotate the deflection yoke until this condition is obtained. Tighten the yoke adjustment wing screw.

FOCUS COIL ADJUSTMENT — Turn the HORIZONTAL CENTERING (R-106) and VERTICAL CENTERING (R-105) CONTROLS to the halfway position. (See Figure 6). If a corner of the raster is shadowed, it indicates that the electron beam is striking the neck of the tube. Loosen the focus coil adjustment wing nuts and rotate the coil about its vertical and horizontal axes until the entire raster is visible, approximately centered and with no shadowed corners. Tighten the focus coil adjustment wing nuts with the coil in this position.

ION TRAP MAGNET ADJUSTMENT—The ion trap magnet should be positioned exactly as shown in Figure 7. Adjust the magnet by moving it back and forth and at the same time rotating it slightly around the neck of the picture tube until the brightest raster is obtained on the picture screen. Reduce the brightness control setting until the raster is slightly above average brilliance. Adjust the Focus Control R-104 (see Figure 6) until the line structure of the raster is clearly visible. Readjust the ion trap magnet for maximum raster brilliance. The final touches on this adjustment should be made with the brightness control at the maximum position with which good line focus can be maintained.

PICTURE ADJUSTMENT—For further adjustments, obtain a test pattern on the receiver. Turn on receiver and follow tuning procedure on page 24.

CHECK OF HORIZONTAL OSCILLATOR ALIGNMENT—Turn the horizontal hold control to the extreme counter-clockwise position. The picture should remain in horizontal sync. Momentarily remove the signal by switching off channel and then back. Normally the picture will be out of sync. Turn the control clockwise slowly. The number of diagonal bars will be gradually reduced and when only 3-1/2 to 4-1/2 bars sloping downward to the left are obtained, the picture will pull into sync upon slight additional clockwise rotation of the control. The pull-in should occur when the control is approximately 90 degrees from the extreme counter-clockwise position. The picture should remain in sync for approximately 90 degrees of additional clockwise rotation of the control. At the extreme clockwise position, the picture should be out of sync and should show from 3-1/2 to 4-1/2 bars sloping downward to the right.

If the receiver passes the above checks and the picture is normal and stable, the horizontal oscillator is properly aligned. Skip "Alignment of Horizontal Oscillator" and proceed with "Focus" adjustment.

ALIGNMENT OF HORIZONTAL OSCILLATOR — If in the above check the receiver failed to hold sync with the hold control at the extreme counter-clockwise position or failed to hold sync for at least 60 degrees of clockwise rotation of the control from the pull in point, it will be necessary to make the following adjustments.

HORIZONTAL FREQUENCY ADJUSTMENT—Turn the horizontal hold control to the extreme clockwise position. Tune in a television station and adjust the rear apron horizontal frequency trimmer C-55B (see Figure 6) until the picture is out of sync and shows 3-1/2 to 4-1/2 bars sloping downward to the right. If the trimmer has insufficient range, set the trimmer to mid-position (1 turn out from maximum capacity) and adjust the L-14 horizontal frequency adjustment until this condition is obtained. See Figure 9 for the location of L-14.

HORIZONTAL LOCKING RANGE ADJUSTMENT—Set the horizontal hold control to the extreme counter-clockwise position. Momentarily remove the signal by switching off channel and then back. Slowly turn the horizontal hold control clockwise and note the least number of diagonal bars obtained just before the picture pulls into sync. If more than 4-1/2 bars are present just before the picture pulls into sync, adjust the horizontal locking range trimmer C-55A (See Figure 6) slightly clockwise. If less than 3-1/2 bars are present, adjust trimmer C-55A slightly counter-clockwise. Turn the horizontal hold control counter-clockwise, momentarily remove the signal and recheck the number of bars present at the pull-in point. Repeat this procedure until 3-1/2 to 4-1/2 bars are present. Repeat the adjustments under "Horizontal Frequency Adjustment" and "Horizontal Locking Range Adjustment" until the condition specified under each are fulfilled. When the horizontal hold operates as outlined ender "Check of Horizontal Oscillator Alignment" the oscillator is properly adjusted.

HEIGHT AND VERTICAL LINEARITY ADJUSTMENTS — Adjust the height control R-86 (See Figure 6) until the picture fills the mask vertically. Adjust the vertical linearity control R-93 (See Figure 6) until the picture is symmetrical from top to bottom. Adjustment of either control will require a readjustment of the other. Adjust vertical centering control R-105 (See Figure 6) to align the picture with the mask. See note on page 13.

WIDTH, DRIVE AND HORIZONTAL LINEARITY ADJUSTMENTS—Turn the width control L-15 (at top of power supply cover) to the maximum clockwise position. Vary the horizontal drive trimmer C-55C (See Figure 6) to yield the best compromise between brightness and linearity. Adjust the horizontal linearity control L-16 (See Figure 6) for best linearity of the right half of the picture. Readjust the width control L-15, until the picture just fills the mask. Adjust horizontal centering control R-106 (See Figure 6) to align the picture with the mask.

FOCUS—Adjust the focus control R-104 (see Fig. 6) for maximum definition of the vertical wedge of the picture. Check to see that all cushion, yoke and focus coil thumb screws are tight. Replace the cabinet back making sure that the back is on tight, otherwise it may rattle at high volume.

CHECK OF R-F OSCILLATOR ADJUSTMENTS—With an accurately calibrated signal generator (crystal calibrated type preferred), check to see if the receiver R-F oscillator is adjusted to the proper frequency on all channels. The adjustments for all channels are available from the front of the cabinet by removing the front panel as shown in Figure 5. Tune in all available television stations.

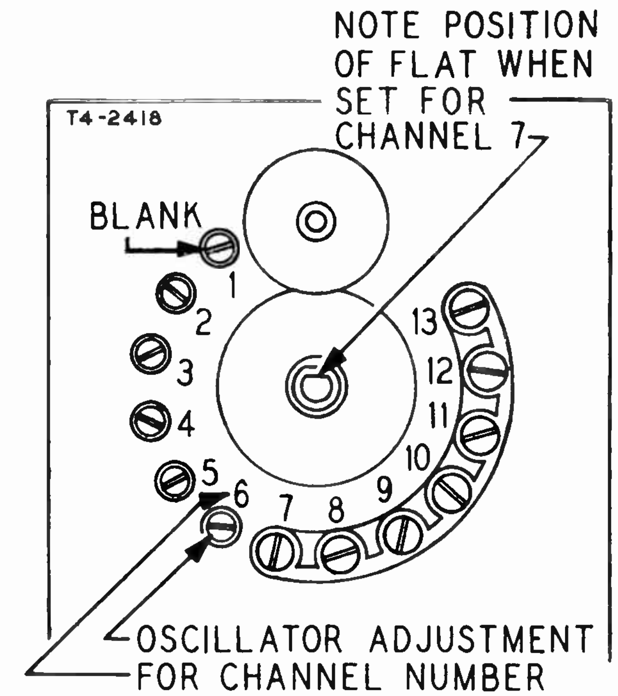

Fig. 8—R-F Oscillator Adjustments

VIDEO PEAKING LINK—A video peaking link is provided to permit changing the video response. This link is connected at the factory with the peaking in. However, if transients are produced on high contrast pictures, or picture is smeared or fuzzy, or if the receiver is operated in areas where the signal strength is weak, open the video peaking link connecting L-13 and R-52. See the television schematic diagram for the location of the video peaking link.

UHF CONNECTION—When UHF (Ultra High Frequency) television programs become available, this receiver may be used in conjunction with a converter to reproduce the UHF programs. After the converter is connected to the antenna terminals on the receiver, the station selector switch must be turned one position clockwise past channel 2 to permit reception of the UHF signals.

VENTILATION CAUTION—The receiver is provided with adequate ventilation holes in the bottom and back of the cabinet. Care should be taken not to allow these holes to be covered or ventilation to be impeded in any way.

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SERVICE SUGGESTIONS

NO RASTER ON PICTURE TUBE—If raster cannot be obtained check below for the possible causes.

1. Ion trap magnet adjustment is incorrect.
2. No high voltage, check V-17 (6BG6-G) and V-18 (1B3-GT/8016) tubes and circuits. If the horizontal deflection circuits are operating, as evidenced by the correct voltage measured on terminal 2 of horizontal output transformer (T-8), the trouble can be isolated to the high voltage rectifier (V-18) circuit. Either the high voltage winding (points 2 to 3 on T-8) is open, tube V-18 is defective, its filament circuit is open, or the high voltage filter capacitor (C-76) is shorted.
3. Damper tube V-19 (5V4-G) defective. Plate voltage supply for V-17 (6BG6-G) horizontal output tube is obtained through the damper tube. Check tube and heater winding on power transformer (T-9). If the tube is alright, check the horizontal linearity coil (L-16) for continuity and check capacitors C-69 and C-75 for short circuit.
4. Defective picture tube. Heater open, cathode return circuit open.
5. No plate voltage. Electrolytic capacitor shorted. All +B measurements are accessible for measurement by removing cover from bleeder box.
6. Horizontal oscillator and control tube V-16 (6SN7-GT) defective. Check voltages and components in the V-16 (6SN7-GT) circuits.

HORIZONTAL DEFLECTION ONLY—If only horizontal deflection is obtained as evidenced by a straight line across the face of the picture tube, it can be caused by the following:

1. Vertical oscillator and output tube V-15 (6SN7-GT) inoperative. Check voltages on grid and plate.
2. Vertical output transformer (T-7) open.
3. Yoke vertical coils open.

POOR VERTICAL LINEARITY—If adjustment of the vertical, height and linearity controls will not correct this condition, any of the following may be the cause:

1. Vertical output transformer (T-7) defective.
2. Capacitors C-80A or C-78A defective.
3. V-15 (6SN7-GT) defective, check voltages.
4. Excess leakage or incorrect value in capacitor C-82
5. Low plate and bias voltages. Check rectifier tube and capacitors in +B supply circuits.
6. Capacitor C-81 defective.

POOR HORIZONTAL LINEARITY—If adjustment of controls does not correct this condition, check the following:

1. Check or replace horizontal output tube V-17 (6BG6-G).
2. Check or replace damper tube V-19 (5V4-G).
3. Check linearity coil L-16 for short circuit.
4. Check capacitors C-69 and C-75 for defects.

TRAPEZOIDAL OR NONSYMMETRICAL RASTER—

1. Improper adjustment of focus coil or ion trap magnet.
2. Defective yoke.
3. Open condenser C-86 on horizontal yoke coil L-19.

WRINKLES ON LEFT SIDE OF RASTER—This condition can be caused by:

Defective yoke due to R-97, R-98 or C-86 (internal in yoke assembly) being wrong value or open. These components are mounted in rear of yoke assembly.

SMALL RASTER—This condition can be caused by:

1. Low +B or line voltage.
2. Insufficient output from horizontal output tube V-17 (6BG6-G). Replace tube.
3. Insufficient output from vertical output tube V-15 (6SN7-GT). Replace tube.

SERVICE SUGGESTIONS (Continued)

RASTER; NO IMAGE, BUT ACCOMPANYING SOUND—This condition can be caused by:

1. No signal on picture tube grid. Check picture I-F amplifier tubes V-9, 10 and 11 (6AG5's), second detector V-12 (6AL5) and video amplifier V-13 (12AU7).
2. Bad contact to picture tube grid (lead to socket broken).
3. Leakage in V-13 (12AU7) grid capacitor C-42. If the above components are not found to be defective check the following:

1. Check all potentials in video circuits.
2. Check picture tube grid circuit for poor or dirty contact.
3. Check adjustment of focus control R-104. It should be effective on either side of proper focus.
4. Check and realign, if necessary, the picture I-F and R-F circuits.

SIGNAL APPEARS ON PICTURE TUBE GRID BUT IMPOSSIBLE TO SYNCHRONIZE THE PICTURE VERTICALLY AND HORIZONTALLY—A condition of this nature can be caused by:

1. Defective sync amplifier and separator V-14 (6SN7-GT).
2. If tube is O.K. check voltages, and associated circuits.

SIGNAL ON PICTURE TUBE GRID AND HORIZONTAL SYNC ONLY—If this condition is encountered, check:

1. Vertical integrating network capacitors C-71, C-72, C-73 and C-74; and resistors R-79, R-80 and R-81.

PICTURE STABLE BUT WITH POOR RESOLUTION—If the picture resolution is not up to standard, it may be caused by any of the following:

1. Defective picture detector V-12 (6AL5) or video amplifier V-13 (12AU7).
2. Open video peaking coil. Check all peaking coils L-8, L-9, L-10, L-11 for continuity. Note that L-9 and L-11 have shunting resistors.

PICTURE SMEAR:

1. Normally, smear can be attributed to phase shift at the low frequency end of the video characteristic. This can be caused by improper values of resistors and capacitors in the video circuits. Check for grid current on video amplifier tube V-13 (12AU7).
2. This trouble can also originate at the transmitter. Check reception from another station.

PICTURE JITTER:

1. If regular sections at left of the picture are displaced, replace the horizontal output tube V-17 (6BG6-G).
2. Vertical instability may be due to loose connections or noise received with the signal.
3. Horizontal instability may be due to unstable transmitted sync or to noise.

ALIGNMENT PROCEDURE

TEST EQUIPMENT—To service this receiver properly, it is recommended that the following test equipment be available:

R-F SWEEP GENERATOR meeting the following requirements:

(a) Frequency ranges:

18 to 30 mc, 1 mc sweep width
40 to 90 mc, 10 mc sweep width
170 to 225 mc, 10 mc sweep width

(b) Output adjustable with at least .1 volt maximum.
(c) Output constant on all ranges.
(d) Flat output in all attenuator positions.

CATHODE-RAY OSCILLOSCOPE preferably one with a wide band vertical deflection and an input calibrating source.

SIGNAL GENERATOR to provide the following frequencies: (Output on these ranges should be adjustable and at least .1 volt maximum.)

(a) Intermediate frequencies:

21.25 mc sound i-f and sound traps
22.8 mc converter transformer
23.9 mc first picture i-f coil
24.5 mc third picture i-f coil
26.0 mc second picture i-f coil
27.5 mc adjacent channel trap

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ALIGNMENT PROCEDURE (Continued)

(b) Radio frequencies:

Channel Number	Picture Carrier Freq. Mc	Sound Carrier Freq. Mc
2	55.25	59.75
3	61.25	65.75
4	67.25	71.75
5	77.25	81.75
6	83.25	87.75
7	175.25	179.75
8	181.25	185.75
9	187.25	191.75
10	193.25	197.75
11	199.25	203.75
12	205.25	209.75
13	211.25	215.75

HETERODYNE FREQUENCY METER with crystal calibrator if the signal generator is not crystal calibrated.

ELECTRONIC VOLTMETER and a high voltage probe for use with this meter to permit measurements up to 10 kilovolts.

SERVICE PRECAUTIONS —To service the receiver remove the chassis from the cabinet. To do so, remove the knobs, the front panel, the cabinet back, disconnect all leads to the radio chassis and then the 5 chassis mounting bolts. The chassis normally should be serviced without the picture tube. However, if it is necessary to view the raster during servicing, the picture tube should be inserted only after the chassis is turned on end. The picture tube should never be allowed to support its weight by resting in the deflection yoke. A bracket should be used to support the tube at its viewing screen. By turning the chassis on end with the power transformer up, all adjustments will be conveniently available. Since this is the only safe position in which the chassis will rest and still leave adjustments accessible, the trimmer location drawings are oriented similarly for ease of use.

CAUTION: Do not permit the picture tube second-anode lead to become shorted to the chassis. To do so will cause a considerable overload on the high-voltage filter resistor R-82.

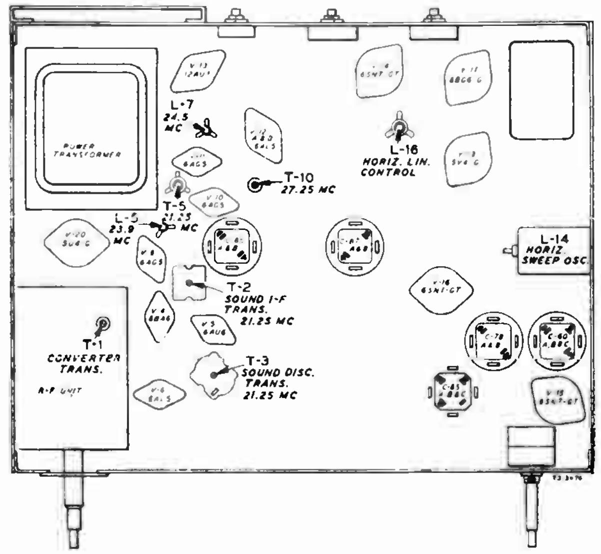

Fig. 9—Bottom Chassis Components

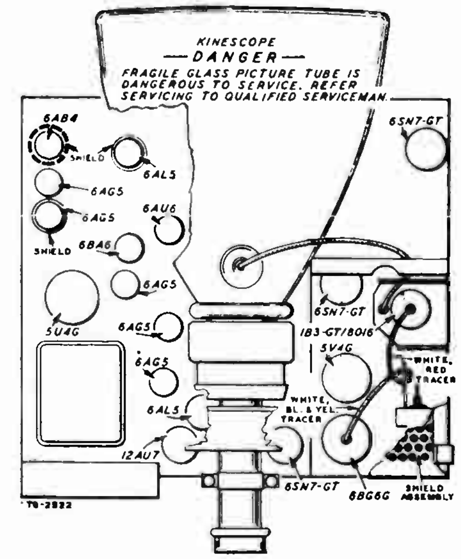

Fig. 10—Tube Layout Diagram

ALIGNMENT TABLE

DISCRIMINATOR AND SOUND I-F ALIGNMENT

Step No.	Connect Signal Generator to	Signal Gen. Freq. Mc.	Connect Sweep Generator to	Sweep Gen. Freq. Mc.	Connect Oscilloscope to	Connect Voltmeter to	Miscellaneous Connections and Instructions	Adjust	Refer to
1	2nd sound i-f grid (pin 1, V-5)	21.25 .1 volt output	Not used		Not used	In series with 1 meg. to junction of R-14 and R-13	Meter on 10 volt scale	Detune T-3 (bottom) Adjust T-3 (top) for max. on meter.	Fig. 11 Fig. 12 Fig. 13
2	2nd sound i-f grid (pin 1, V-5)	21.25 .1 volt output	Not used		Not used	Discriminator output (pin 1 of V-6)	Meter on 3 volt scale	T-3 (bottom) for zero on meter.	Fig. 12 Fig. 13
3	2nd sound i-f grid (pin 1, V-5)	21.25 .1 volt output	2nd sound i-f grid (pin 1, V-5)	21.25 center 1 mc .1 volt output	Discriminator output (pin 1 of V-6)	Not used	Check for symmetrical response waveform (positive and negative). If not equal adjust T-3 (top) until they are equal. See Note 1.		Fig. 11 Fig. 12 Fig. 13
4	Trap winding on T-1 (top of chassis)	21.25 reduced output	Trap winding on T-1	21.25 reduced output	Terminal A, T-2 in series with 33,000 ohms. See Note 2.	Not used	Sweep output reduced to provide .3 volt p-to-p on scope. See Note 3.	T-2 (top and bottom) for max. gain and symmetry at 21.25 mc.	Fig. 11 Fig. 12 Fig. 13

NOTE: 1: The peak to peak bandwidth of the discriminator should be approximately 350 kc. and should be linear from 21.175 mc. to 21.325 mc.

NOTE 2: If a 60 cycle sweep rate is used, it will be necessary to reduce the time constant in the 2nd sound i-f grid circuit in order to reproduce the desired response curve. To do this, shunt R-10 (Terminal "A" of T-2 to chassis) with 5600 ohms.

NOTE 3: The sweep generator output should be set to produce approximately 0.3 volt peak-to-peak on the oscilloscope at the second sound i-f grid return (Terminal "A" of T-2) for final touch-up on this adjustment. Signal voltage in excess of 0.3 volt will tend to broaden the responsive curve—permitting misadjustment to pass unnoticed.

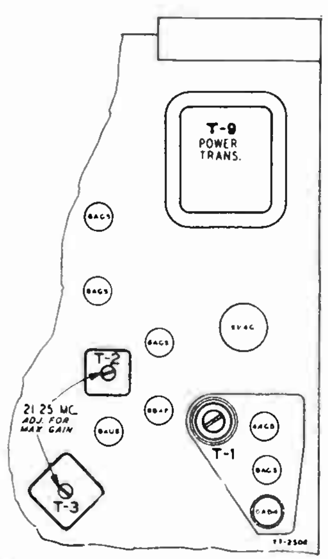

Fig. 11—Top Chassis Audio I-F Adjustments

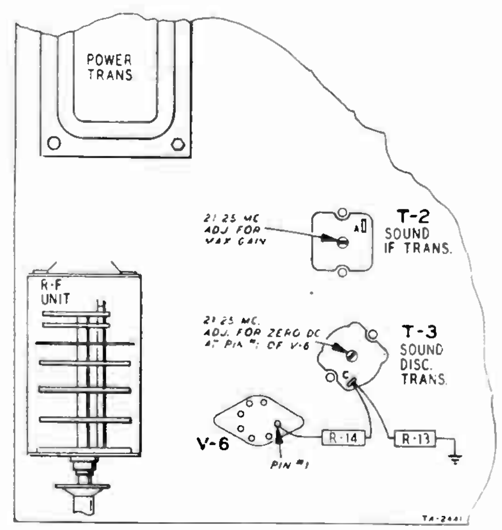

Fig. 12—Bottom Chassis Audio I-F and Discriminator Adjustments

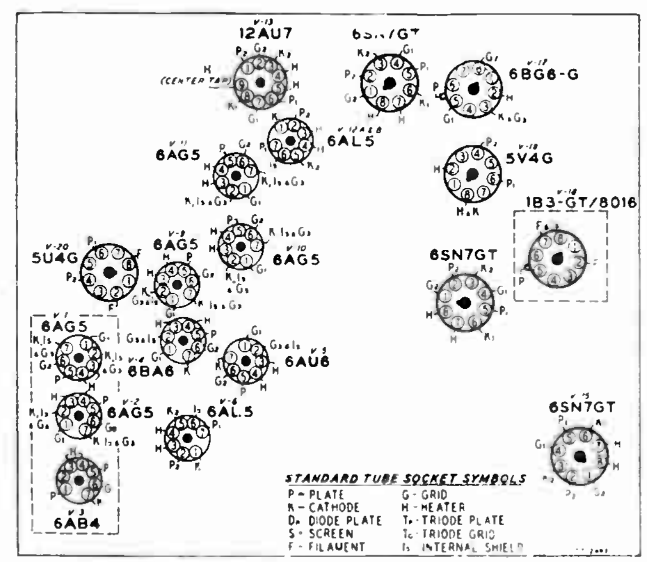

Fig. 13—Bottom Socket View

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ALIGNMENT TABLE (Continued)

PICTURE I-F AND TRAP ADJUSTMENT

Step No.	Connect Signal Generator to	Signal Gen. Freq. Mc.	Connect Sweep Generator to	Sweep Gen. Freq. Mc.	Connect Oscilloscope to	Connect Voltmeter to	Miscellaneous Connections and Instructions	Adjust	Refer to
5	Not used		Not used		Not used	Junction R-41 and R-43	Set "Station Selector" switch to channel 13	Adjust "Picture" control for —3 volts reading on Voltmeter	Fig. 15
6	Junction R-6 and R-7	21.25	Not used		Not used	Junction of L-8 and R-51	Meter on 3 volt scale	T-1 (top) for min. on meter	Fig. 14 Fig. 15
7	Junction R-6 and R-7	21.25	Not used		Not used	Junction of L-8 and R-51	Meter on 3 volt scale	T-5 for min.	Fig. 14 Fig. 15
8	Junction R-6 and R-7	27.25	Not used		Not used	Junction of L-8 and R-51	Meter on 3 volt scale	T-10 (bottom) for min.	Fig. 9 Figs. 14-15
9	Junction R-6 and R-7	22.8	Not used		Not used	Junction of L-8 and R-51		T-1 (bottom) for max.	Fig. 15
10	Junction R-6 and R-7	23.9	Not used		Not used	Junction of L-8 and R-51		L-5 (top chassis) for max.	Fig. 14 Fig. 15
11	Junction R-6 and R-7	26.0	Not used		Not used	Junction of L-8 and R-51		T-10 (top chassis) for max.	Fig. 14 Fig. 15
12	Junction R-6 and R-7	24.5	Not used		Not used	Junction of L-8 and R-51		L-7 (top chassis) for max.	Fig. 14 Fig. 15

NOTE: Oscillation may occur if the i-f section is badly out of alignment. This will be evidenced by a meter reading in excess of 3 volts and is caused by the "staggered" i-f stages being tuned to approximately the same frequency. If this condition is encountered, adjust the core studs of T-1 (bottom) L-5, T-10 and L-7 until oscillation ceases. Oscillation may not be encountered until proceeding with steps 9, 10, or 11.

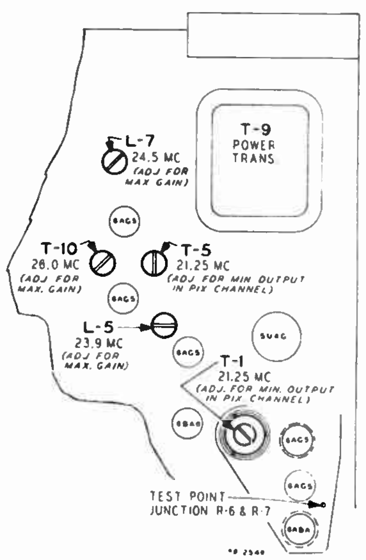


Fig. 14—Top Chassis Video I-F Adjustments

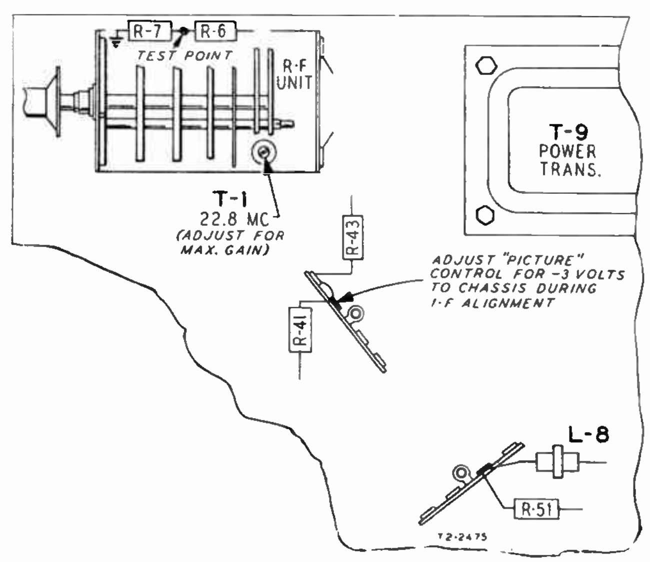


Fig. 15—Bottom Chassis Video I-F Adjustments

RETOUCHING OF PICTURE I-F ADJUSTMENTS—The picture i-f response curve varies somewhat with change of bias and for this reason it should be aligned with approximately the same signal input as it will receive in operation.

If the receiver is located at the edge of the service area, it should be aligned with approximately —1 volt i-f grid bias. However, for normal conditions, (signals of 1000 microvolts or greater), it is recommended that the picture i-f be aligned with a grid bias of —3 volts. Set the picture control for —3 volts at the junction of R-41 and R-43.

Connect the r-f sweep generator to the junction of R-6 and R-7. See Figure 14.

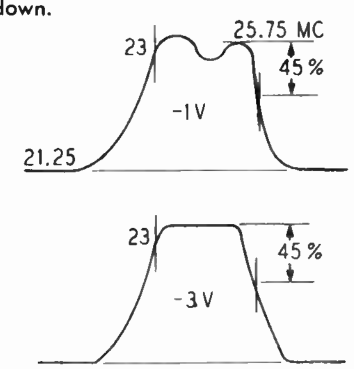
Loosely couple the signal generator to the sweep generator leads and feed in the 25.75 megacycles i-f picture carrier marker and a 23 megacycles marker.

Connect the oscilloscope across the picture detector load resistor R-51.

Set the channel switch to channel (between 1 and 6) found to have the best response.

Set the sweep output to produce approximately .3 volt peak to peak across the picture detector load resistor.

On final adjustment the picture carrier marker must be at approximately 45% down. The curve must be approximately flat topped and with the 23 mc marker at 10% down.



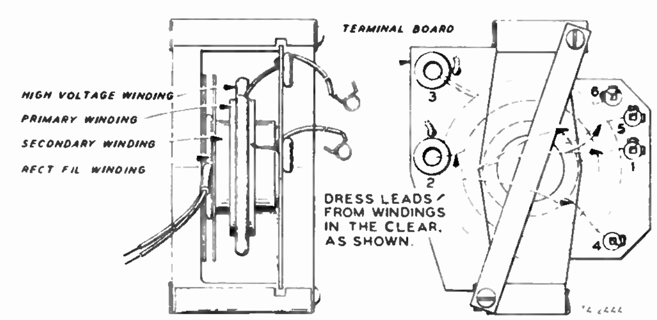


Fig. 16—Transformer Winding Leads

SENSITIVITY CHECK—A comparative sensitivity check can be made by operating the receiver on a weak signal from a television station and comparing the picture and sound obtained to that obtained on other receivers under the same conditions.

This weak signal can be obtained by connecting the shop antenna to the receiver through an attenuator pad of the type shown in Figure 17. The number of stages in the pad depends upon the signal strength available at the antenna. A sufficient number of stages should be inserted so that a somewhat less than normal contrast picture is obtained when the picture control is at the maximum clockwise position.

Only carbon type resistors should be used to construct the attenuator pad. Since many of the low value molded resistors generally available are of wire wound construction, it is advisable to break and examine one of each type of resistor used in order to determine its construction.

RESPONSE CURVES—The R-F response curves shown in Figure 18 were taken from a production set. Although these curves are typical, some variations can be expected.

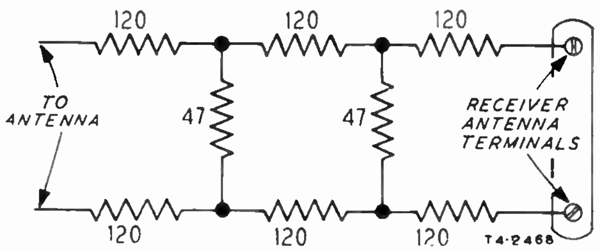


Fig. 17—Attenuator Pad

The response curves are shown in the classical manner of presentation, that is with response up and low frequency to the left. The manner in which they will be seen in a given test set-up will depend upon the characteristics of the oscilloscope and the sweep generator. These curves may be observed by connecting the sweep and marker generators to the antenna input and connecting the oscilloscope between the test point (see figure 14) and chassis.

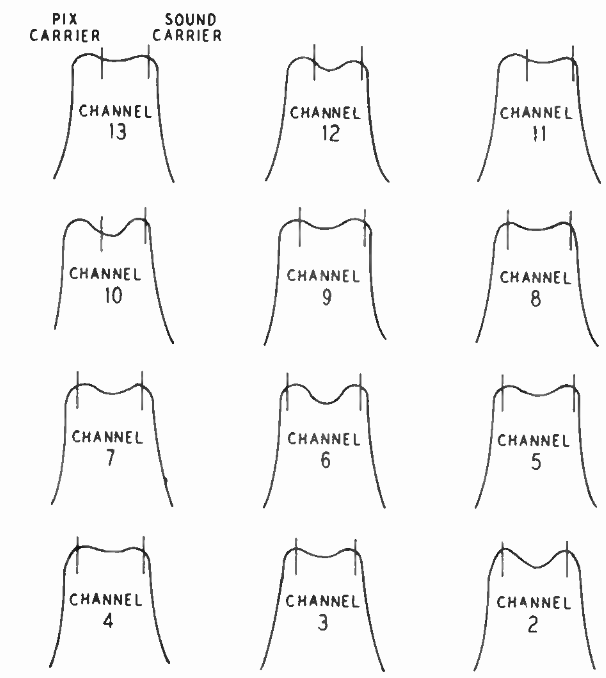


Fig. 18—Response Curves

CRITICAL LEAD DRESS—

1. Do not permit any strains to be placed on the leads of R-68, R-59, R-63, R-62, R-58, R-61, R-67 and R-64. Do not permit these resistors to be exposed to the heat of a soldering iron any more than is absolutely necessary.
2. Dress the temperature compensating resistor R-64 approximately one quarter inch from the power transformer and the chassis.
3. Dress all video coupling capacitors and peaking coils up and away from the chassis.
4. Contact between the R-F oscillator frequency adjustment screws and the oscillator coils on channel switch outlets must be avoided.
5. Dress T-8 winding leads as shown in Figure 16.

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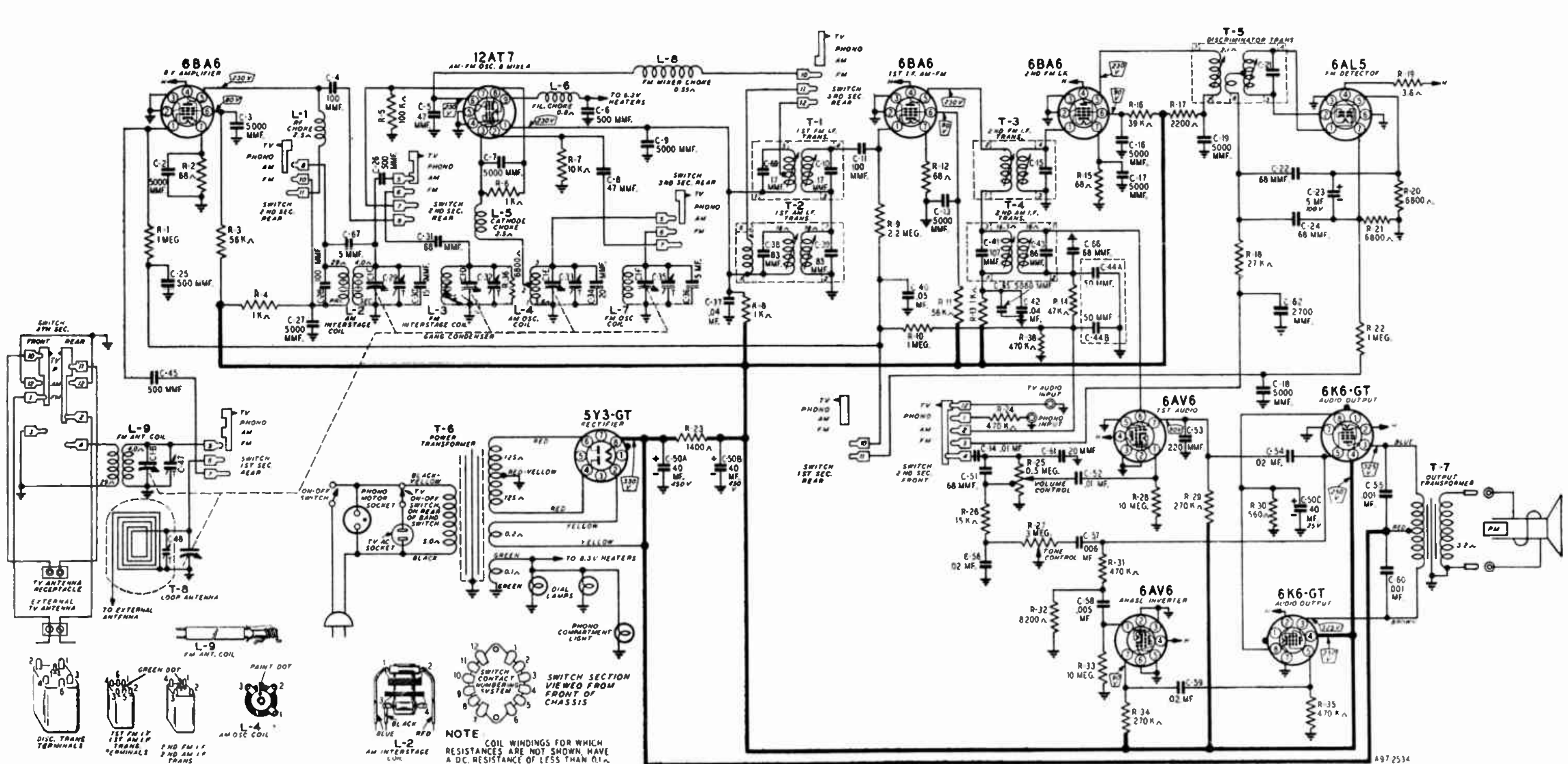
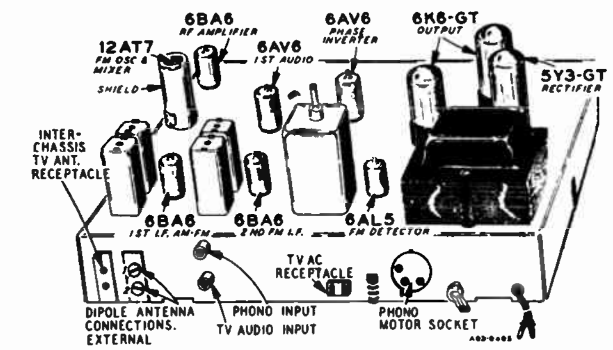
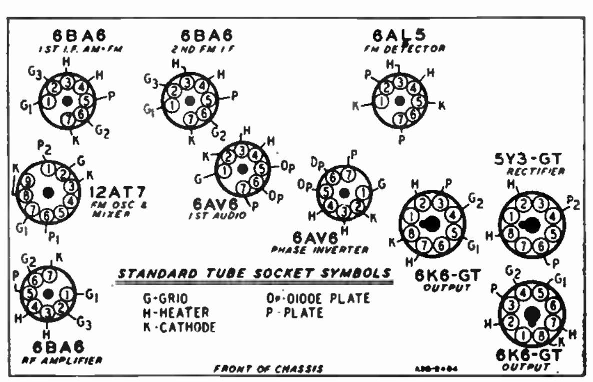




TUBE LAYOUT

RADIO MISCELLANEOUS DATA



TUBE SOCKET VOLTAGES

Socket voltages are shown on the schematic diagram at the tube socket terminals. All voltages are between the socket terminal and chassis ground. Plate, screen and cathode voltages were taken with a 1000 ohm-per-volt meter with a 300 volt scale used for plate and screen voltages. Audio grid voltages were read with a vacuum tube volt-meter. Conditions of measurement are:

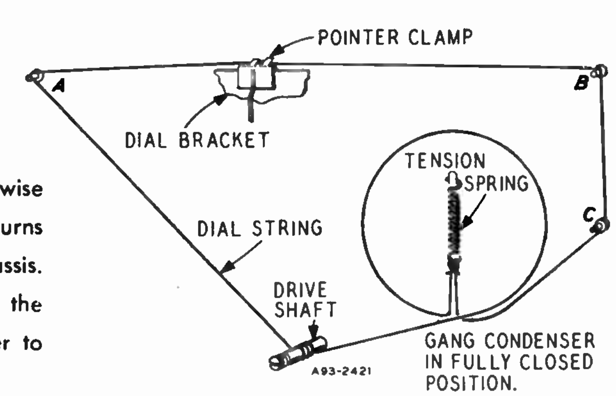
Line voltage .... 117 Volts AC

Signal Input .... None

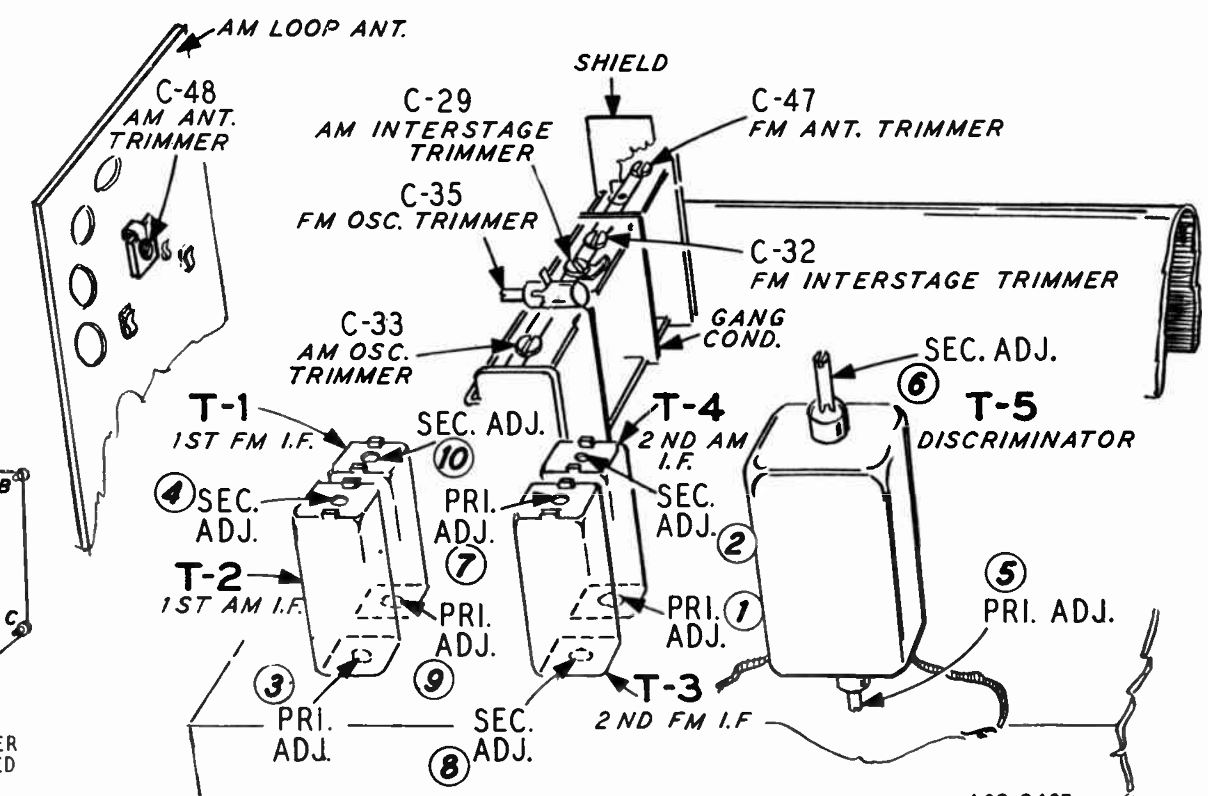
A variation of ±10% is usually permissible.

DRIVE CORD REPLACEMENT

Replacement of the drive cord may be accomplished as shown in the illustration. For this purpose use the new drive cord assembly listed in the Replacement Parts List. Turn the gang condenser until the plates are fully meshed. Then install the string as shown, winding three turns clockwise around the tuning shaft with the turns progressing away from the chassis. After the cord is installed, rotate the tuning shaft several times in order to take up any slack in the cord.



DRIVE CORD STRINGING



TRIMMER POSITIONS

MODEL 94WG-3028A

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RADIO ALIGNMENT PROCEDURE

AM STAGES

The following is required for aligning:

An All Wave Signal Generator Which Will Provide an Accurately Calibrated Signal at the Test Frequencies as Listed.

Output Indicating Meter, Non-Metallic Screwdriver, Dummy Antennas —.1 mf, 200 mmf.

Volume Control—Maximum all Adjustments.

Connect Radio Chassis to Ground Post of Signal Generator with a Short Heavy Lead.

Allow Chassis and Signal Generator to "Heat Up" for Several Minutes.

SIGNAL GENERATOR	FREQUENCY SETTING	CONNECT GENERATOR OUTPUT TO	THROUGH DUMMY ANTENNA	BAND SWITCH SETTING	GANG CONDENSER SETTING	ADJUST	ADJUST FOR
I-F	455 kc	12AT7 Pin 7 and Chassis	.1 mf	Broadcast	Rotor Fully Open	2nd I-F Pri. & Sec. 1 & 2 1st I-F Pri. & Sec. 3 & 4	Maximum Output
Broadcast	1620 kc	Antenna Lead and Ground	200 mmf	Broadcast	Rotor Fully Open	Broadcast Osciliator C-33	
	1400 kc	Antenna Lead and Ground	200 mmf	Broadcast	Turn Rotor to Max. Output Set pointer to 1400 kc See Note A	Broadcost Interstage C-29	
	1400 kc	Antenna Lead and Ground	200 mmf	Broadcast		Loop Trimmer C-48	

Note A—If the pointer is not at 1400 KC on dial, reset pointer at the 1400 KC mark on the dial scale.

FM STAGES

The following equipment is required for aligning:

An accurately calibrated signal generator providing unmodulated signals at the test frequencies listed below.

Non-metallic screwdriver.

Dummy Antennas and I-F Loading Resistor—.01 mf, 300 ohms and 1000 ohms.

Zero center scale DC vacuum tube voltmeter having a range of approximotely 3 volts.

(If a zero center scale meter is not available, a standard scale vacuum tube voltmeter may be used by reversing the meter connections for negative readings.)

Allow chossis and signal generator to warm up for several minutes.

	SIGNAL GENERATOR: FREQUENCY SETTING	SIGNAL GENERATOR: CONNECT GENERATOR OUTPUT TO	THROUGH DUMMY ANTENNA	BAND SWITCH SETTING	GANG CONDENSER SETTING	ADJUST	ADJUST FOR
Discrim-inatar	10.7 MC Note B	6BA6 2nd I-F Pin 1 and Chassis	.01 mf	FM	Rotor Fully Open	Disc. Pri. 5 Note A	Maximum Deflection
	10.7 MC Note B	6BA6 2nd I-F Pin 1 and Chassis	.01 mf	FM	Rotor Fully Open	Disc. Sec. 6 Note C	Zero Center
I-F	10.7 MC Note F	6BA6 1st I-F Pin 1 and Chassis	.01 mf	FM	Rotor Fully Open	2nd I-F Pri. Note A and D 7 2nd I-F Sec. Note A and E 8	Maximum Deflection
Discrim-inator	10.7 MC Note F	6BA6 1st I-F Pin 1 and Chassis	.01 mf	FM	Rotor Fully Open	Disc. Pri. 5 Note A	Maximum Deflection
	10.7 MC Note F	6BA6 1st I-F Pin 1 and Chassis	.01 mf	FM	Rotor Fully Open	Disc. Sec. 6 Note C	Zero Center
	10.7 MC Note F	FM-RF Gang Condenser terminal	.01 mf	FM	Rotor Fully Open	1st I-F Pri. 9 1st I-F Sec. 10 Notes A, D & E	Maximum Deflection
Recheck I-F Adjustments in order given							
R-F & Osc.	108.4 Note H	Disconnect dipole and connect generator to dipole terminals with resistor in series connected to terminal No. 1.	300 ohms	FM	Rotor Fully Open	Oscillator C-35 Note G	Maximum Deflection
	104.5		300 ohms	FM	Tune Rotor for Max. AVC voltage	FM Interstage C-32	Maximum Deflection
	104.5		300 ohms	FM	Tune Rotor for Max. AVC voltage	Ant. C-47	Maximum Deflection
Recheck R-F and Osc. Adjustments in order given							

NOTE A—Test Equipment connections are as given in the table. The zero center scale DC vacuum tube voltmeter is to be connected between chassis ground and the AVC line at the junction of resistor R-22 and condenser C-18 for all adjustments except the discriminator secondary adjustment, for which See Note C.

NOTE B—A signal of .1 volt must be fed into the receiver for this adjustment.

NOTE C—Disconnect zero center DC vacuum tube voltmeter from AVC and connect to junction of R-18 and C-62. Adjust for zero voltage indication.

NOTE D—Before adjusting Pri. core connect 1000 ohm load resistor across the 2nd I.F. secondary terminals. Input may have to be increased to .1 volt if receiver is *badly* mis-aligned.

NOTE E—Disconnect 1000 ohm load resistor from secondary terminals and connect across the 2nd I.F. primary terminals. Input may have to be increased to .1 volt if receiver is *badly* mis-aligned.

NOTE F—Input can be reduced to 10,000 microvolts.

NOTE G—Oscillotor frequency above signal frequency.

NOTE H—Remove the 1000 ohm load resistor before attempting to check the R-F and oscillator adjustments.

REPLACEMENT PARTS INFORMATION

HOW TO ORDER PARTS — Should it be necessary to write us or to order any repair parts, it is important that the complete model number which appears on the label attached to the rear of the chassis be specified.

REPLACEMENT PARTS LIST

S-25AS R-F TUNER ASSEMBLY

Ref. No.	Part No.	Description			Qty. Used in Set
C-1, C-2, C-4, C-9, C-11, C-31, C-35, C-36, C-88	47X554	680 mmf		Ceramic	9
C-3, C-5	47X487	25 mmf		Ceramic	2
*C-6		0.25 mmf		Ceramic	1
C-7	47X552	15 mmf		Ceramic	1
*C-8		3 mmf		Ceramic	1
C-10, C-89, C-90	47X507	5000 mmf		Ceramic	3
*C-12		62 mmf		Ceramic	1
*C-32		0.5 mmf		Ceramic	1
*C-33		1.5 mmf		Ceramic	1
*C-34		0.68 mmf		Ceramic	1
C-44	47X534	270 mmf		Molded Mica	1
C-91	47X545	1500 mmf		Ceramic	1
*C-92				Fine Tuning	1
R-1, R-2, R-3, R-38	B85102	1000 Ohm	0.5 W	Carbon	4
R-4	B85333	33 K Ohm	0.5 W	Carbon	1
R-5	B85103	10 K Ohm	0.5 W	Carbon	1
R-6	B85823	82 K Ohm	0.5 W	Carbon	1
R-7	B85105	1 meg.	0.5 W	Carbon	1
R-21	B85471	470 Ohm	0.5 W	Carbon	1
R-22	B85223	22 K Ohm	0.5 W	Carbon	1
R-23	B85823	82 K Ohm	0.5 W	Carbon	1
R-24	B85183	18 K Ohm	0.5 W	Carbon	1
R-25	B85472	4.7 K Ohm	0.5 W	Carbon	1
R-107	C85682	6800 Ohm	1.0 W	Corban	1
L-1	9A2033			Filament Choke	1
T-1	9A2035			Converter Transformer	1
*T-11		Part of R-F Tuner			

*PARTS ARE NOT INTERCHANGEABLE — COMPLETE TUNER ASSEMBLY MUST BE ORDERED.

CAPACITORS

Ref. No.	Part No.	Description			Qty. Used in Set
C-13, C-16, C-18, C-22, C-47, C-48, C-49, C-50, C-52	47X545	1500 mmf.		Ceramic	9
C-14, C-15		Part of T-2 (Sound I-F Trans)			
C-17	D57103	.01	400 V	Tubular	1
C-19, C-20, C-21		Part of T-3 (Sound Disc. Trans.)			
C-23, C-37, C-38, C-40	47X534	270 mmf	1000 V	Molded Mica	4
C-39		Part of T-5 (Cathode Trap)			
C-41, C-42, C-60, C-70	D67503	.05 mf	400 V	Tubular	4
C-43, C-46, C-58, C-66, C-81	D65254	.25 mf	400 V	Tubular	5
C-51	47X546	100 mmf		Ceramic	1
C-53	47X542	10 mmf	500 V	Molded Mica	1
C-54, C-56	47X532	120 mmf	1000 V	Molded Mica	2
C-55A, C-55B, C-55C	17A259	10-160 mmf 40-370 mmf 40-370 mmf		Trimmer	1
C-57, C-72	F66202	.002 mf	600 V	Tubular	2
C-59	D65203	.02 mf	400 V	Tubular	1
C-61	47X536	180 mmf	1000 V	Molded Mica	1
C-62	47X531	2200 mmf	1000 V	Molded Mica	1
C-63, C-71	47X535	390 mmf	1000 V	Molded Mica	2
C-64	47X541	47 mmf	500 V	Molded Mica	1
C-65A, C-65B, C-65C	45X371	10 mf 30 mf 30 mf	450 V 300 V 400 V	Dry Electrolytic	1
C-67	47X544	100 mmf	1000 V	Molded Mica	1
C-68, C-94	F67503	.05 mf	600 V	Tubular	2
C-69	46X408	.035 mf	1000 V	Tubular	1
C-73, C-74	D65502	.005 mf	400 V	Tubular	2
C-75, C-82	46X409	.1 mf	1000 V	Tubular	2
C-76	47X530	500 mmf		High Voltage Ceramic	1
C-77	47X533	5 mmf	1500 V	Molded Mica	1
C-78A, C-78B	45X369	10 mf 80 mf	450 V 450 V	Dry Electrolytic	1
C-79	47X543	4700 mmf	500 V	Molded Mica	1
C-80A, C-80B, C-80C	45X370	130 mf 40 mf 40 mf	50 V 450 V 150 V	Dry Electrolytic	1
C-83, C-84	46X410	.01 mf	400 V	Molded Paper	2
C-85A, C-85B	45X367	10 mf 40 mf	350 V 450 V	Dry Electrolytic	1
C-86		Part of Deflection Yoke Assembly			
C-87A, C-87B	45X368	1000 mf 250 mf	6 V 10 V	Dry Electrolytic	1
C-93		Part of T-10			

RESISTORS

Ref. No.	Part No.	Ohms	Watts		Qty. Used in Set
R-8	884820	82	0.5	Carbon	1
R-9	8B4122	1200	0.5	Carbon	1
R-10	B85474	470 K	0.5	Carbon	1
R-11, R-79	B85223	22 K	0.5	Carbon	2
R-12, R-44, R-45, R-48, R-50, R-108	B85102	1000	0.5	Carbon	6
R-13, R-14	883104	100 K	0.5	Carbon	2
R-15	43X239	5.1	0.5	Wirewound	1
R-26, R-28	B84390	39	0.5	Carbon	2

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REPLACEMENT PARTS LIST (Continued)

TELEVISION PARTS

Ref. No.	Part No.	Description			Qty. Used in Set
R-27, R-29	BB3562	5600	0.5	Carbon	2
R-30, R-78	BB3682	6800	0.5	Carbon	2
R-31		Part of L-9			
R-32, R-54, R-71, R-74	BB5105	1 meg.	0.5	Carbon	4
R-33	CB4332	3300	1.0	Carbon	1
R-34	BB4471	470	0.5	Carbon	1
R-35		Part of L-11			
R-36, R-47	78X1	500 K 10 K		Brightness and Contrast Control	1
R-37	BB5104	100 K	0.5	Carbon	1
R-41, R-67, R-83	BB4103	10 K	0.5	Carbon	3
R-42	BB3153	15 K	0.5	Carbon	1
R-43	BB4123	12 K	0.5	Carbon	1
R-46	BB4102	1000	0.5	Carbon	1
R-49	BB4151	150	0.5	Carbon	1
R-51	BB3472	4700	0.5	Carbon	1
R-52		Part of L-13			
R-53, R-55	BB3332	3300	0.5	Carbon	2
R-56, R-72	BB5470	47	0.5	Carbon	2
R-57	BB4154	150 K	0.5	Carbon	1
R-58	CB3335	3.3 Meg.	1.0	Carbon	1
R-59	BB3564	560 K	0.5	Carbon	1
R-60, R-80, R-81	BB4822	8200	0.5	Carbon	3
R-61	31B1104	100 K	0.5	Carbon	1
R-62	CB3104	100 K	1.0	Carbon	1
R-63	BB4184	180 K	0.5	Carbon	1
R-64	34A1	30 K	0.25	Temp. Comp.	1
R-65	BB3124	120 K	0.5	Carbon	1
R-66, R-90	78X2	50 K 1 meg.		Horizontal and Vertical Hold Control	1
R-68	CB4274	270 K	1.0	Carbon	1
R-69	CB4124	120 K	1.0	Carbon	1
R-70	CB4820	82	1.0	Carbon	1
R-73	CB5473	47 K	1.0	Carbon	1
R-75	CB4472	4700	1.0	Carbon	1
R-76	43X233	3.6	0.5	Wirewound	1
R-77	BB4395	3.9 meg.	0.5	Carbon	1
R-82	CB5105	1 meg.	1.0	Carbon	1
R-84	BB4564	560 K	0.5	Carbon	1
R-85	BB4563	56 K	0.5	Carbon	1
R-86	77X3	2.5 meg.		Height Control	1
R-87	BB4155	1.5 meg.	0.5	Carbon	1
R-88	BB5685	6.8 meg.	0.5	Carbon	1
R-89	BB3105	1 meg.	0.5	Carbon	1
R-91	BB4104	100 K	0.5	Carbon	1
R-92	BB4561	560	0.5	Carbon	1
R-93	77X4	5000		Vertical Lin. Control	1
R-94	BB5225	2.2 meg.	0.5	Carbon	1
R-95	BB4392	3900	0.5	Carbon	1
R-96	CB5222	2200	1.0	Carbon	1
R-97, R-98		Part of Vertical Yoke			
R-99A, R-99B	43X244	700 510	20 20	Wirewound	1
R-100A, R-100B, R-100C	43X243	2830 30 85	10 0.8 2.0	Voltage Divider	1
R-101	CB4390	39	1.0	Carbon	1
R-103	CB5681	680	1.0	Carbon	1
R-104	77X7	7500		Focus Control	1

TELEVISION PARTS

Ref. No.	Part No.	Description	Qty. Used in Set
R-105	77X2	20 Vertical Centering	1
R-106	77X5	20 Horizontal Centering	1

TRANSFORMERS AND COILS

Ref. No.	Part No.	Description	Qty. Used in Set
L-5, L-7	9A1980	1st and 3rd Pix I.F. Coil	2
L-8, L-10	9A1979	Peaking Coil	2
L-9, L-11	9A1978	Peaking Coil	2
L-13	9A1977	Peaking Coil	1
L-14	9A1984	Transformer (Synchronization Guide)	1
L-15	9A1976	Width Control Coil	1
L-16	9A1981	Coil (Horizontal Linearity)	1
L-17, L-18, L-19, L-20		Part of 9A2048 Deflection Yoke Assembly (See Miscellaneous)	
L-21	9A2050	Focus Coil	1
L-22	52X87	Filter Choke	1
T-2	9A1986	Sound I-F Transformer	1
T-3	9A2049	Sound Disc. Transformer	1
T-5	9A1985	Cathode Trap Transformer	1
T-6	54X4	Vertical Oscillator Transformer	1
T-7	51X140	Vertical Output Transformer	1
T-8	53X296	Horizontal Output & H. V. Trans.	1
T-9	53X297	Power Transformer	1
T-10	9A1982	2nd Pix I-F Transformer	1

MISCELLANEOUS

Part No.	Description	Qty. Used in Set
S-25A5	R-F Tuner Assembly	1
9A2048	Deflection Yoke Assembly	1
6A306	Anode Connector	1
2BX560	Spring (Anode Connector)	1
3A428	Tube Socket (Miniature)	7
3A443	Tube Socket (9 pin)	1
3A444	Tube Socket (Ceramic)	1
3A445	Tube Socket (Octal)	5
3A448	Socket (Hi-Voltage Capacitor)	1
13X614	Tube Socket (Kinescope)	1
4X1063	Screen Escutcheon	1
17X104	Pix Crystal	1
4X1028	Escutcheon (Channel)	1
4X1029	Escutcheon (Plain)	2
10A717	Knob (Fine Tuning)	1
10A714	Knob (Brightness & Horizontal)	2
10A716	Knob (Contrast & Vertical)	2
10A718	Knob (Channel Tuning)	1
32X379	Tube Shield	4
14X449	Ventilator Grille (Metal)	1
14X450	Ventilator Grille (Back)	1
S-3A1	Socket Assembly (H. V. Rectifier)	1
S-32X4	Line Cord and Shield Assembly	1
S-25X42	Rubber Strip and Bracket Assembly	1
S-13X644	R. F. Cable and Terminal Assembly	1

Ref. No.	Part No.	Description		Qty. Used in Set
	25A1056	Hood Assembly	Def. Yoke	1
	20X155B	Wing Screw	Def. Yoke	3
	25X1630	Support Bracket	Def. Yoke	1
	25X1595	Top Bracket	Focus Coil	1
	25X159B	Middle Bracket	Focus Coil	1
	25A1047	Support Assembly	Focus Coil	1
	25A1049	Stud Assembly	Focus Coil	1
	20X1557	Wing Nut	Focus Coil	3
	8X191	Mask	Focus Coil	1
	16X132	Fuse (3 amperes 250 volts)		1
	16X133	Fuse (1/4 ampere 250 volts)		1
	16X131	Fuse Holder		1

REPLACEMENT PARTS LIST

RADIO PARTS

CAPACITORS

Ref. No.	Part No.	Description			Qty. Used in Set
C-1	14A207	Gang Condenser			1
C-6, C-25, C-26, C-45	47X496	500 mmf		Ceramic	4
C-2, C-3, C-7, C-9, C-13, C-16, C-17, C-18, C-19, C-27, C-65	47X507	5000 mmf		Ceramic	11
C-4	47X497	100 mmf		Ceramic	1
C-5	47X499	47 mmf		Ceramic	1
C-8	47X498	47 mmf		Ceramic	1
C-10, C-69		Part of T-1 1st I.F. Trans. (FM)			
C-11, C-28	47X550	100 mmf		Ceramic	2
C-14	46X328	.01 mf	120 V	Tubular	1
C-15		Part of T-3 2nd I.F. Trans. (FM)			
C-21		Part of T-5 Discriminator Trans.			
C-22, C-24, C-31, C-51, C-66	47X501	68 mmf		Ceramic	5
C-23	45X361	5 mf	100 V	Dry Electrolytic	1
C-29, C-32, C-33, C-47		Part of Gang Condenser			
C-30	47X552	15 mmf		Ceramic	1
C-34, C-61	47X516	20 mmf		Ceramic	2
C-35	26A489	1-8 mmf		Trimmer Assembly	1
C-36, C-67	47X549	5 mmf		Ceramic	2
C-37, C-42	F66403	.04 mf	600 V	Tubular	2

REPLACEMENT PARTS LIST (Continued)

RADIO PARTS

Ref. No.	Part No.	Description			Qty. Used in Set
C-38, C-39		Part of T-2 1st I-F Trans. (AM)			
C-40	B66503	.05 mf	200 V	Tubular	1
C-41, C-43		Part of T-4 2nd I-F Trans. (AM)			
C-44A, C-44B	47X112	50-50 mmf		Dual Mica	1
C-48	17A235	2-24 mmf		Trimmer	1
C-50A, C-50B, C-50C	45X374	40 mf 40 mf 40 mf	450 V 450 V 25 V	Dry Electrolytic	1
C-52	F66103	.01 mf	600 V	Tubular	1
C-53	47X468	220 mmf		Ceramic	1
C-54, C-59	F66203	.02 mf	600 V	Tubular	2
C-55, C-60	F66102	.001 mf	600 V	Tubular	2
C-56	B66203	.02 mf	200 V	Tubular	1
C-57	F66602	.006 mf	600 V	Tubular	1
C-58	B66502	.005 mf	200 V	Tubular	1
C-62	47X492	2700 mmf		Molded Mica	1

RESISTORS

Ref. No.	Part No.	Ohms	Watts		Qty. Used in Set
R-1, R-10, R-22	BB5105	1 meg.	0.5	Carbon	3
R-2, R-12, R-15	BB3680	68	0.5	Carbon	3
R-3, R-11	BB4563	56K	0.5	Carbon	2
R-4, R-6, R-8, R-13	BB4102	1000	0.5	Carbon	4
R-5	BB5104	100K	0.5	Carbon	1
R-7	BB4103	10K	0.5	Carbon	1
R-9	BB5225	2.2 meg.	0.5	Carbon	1
R-14	BB5473	47K	0.5	Carbon	1
R-16	CB4393	39K	1.0	Carbon	1
R-17	BB5222	2200	0.5	Carbon	1
R-18	BB4273	27K	0.5	Carbon	1
R-19	43X233	3.6	0.5	Wire Wound	1
R-20, R-21, R-36	BB3682	6800	0.5	Carbon	3
R-23	43X242	1400	5.0	Wire Wound	1
R-24, R-31, R-35, R-38	BB5474	470K	0.5	Carbon	4
R-25	36X380	.5 meg.		Volume Control	1
R-26	BB5153	15K	0.5	Carbon	1
R-27	40X285	3 meg.		Tone Control	1
R-28, R-33	BB5106	10 meg.	0.5	Carbon	2
R-29, R-34	BB5274	270K	0.5	Carbon	2
R-30	DB3561	560	2.0	Carbon	1
R-32	BB4822	8200	0.5	Carbon	1

TRANSFORMERS AND COILS

Ref. No.	Part No.	Description	Qty. Used in Set
L-1, L-5	35A5	R. F. Choke	2
L-2	9A2025	Interstage Coil (AM)	1
L-3	9A2024	Interstage Coil (FM)	1
L-4	9A2022	Oscillator Coil (AM)	1
L-6	9A1881	Filament Choke	1
L-7	9A2023	Oscillator Coil (FM)	1
L-8	35A7	Mixer Choke (FM)	1
L-9	9A2027	Antenna Coil (FM)	1
T-1	9A2043	1st I-F Trans. (FM)	1
T-2	9A2029	1st I-F Trans. (AM)	1
T-3	9A2030	2nd I-F Trans. (FM)	1
T-4	9A2042	2nd I-F Trans. (AM)	1
T-5	9A1970	Discriminator Coil	1
T-6	53X286	Power Transformer	1
T-7	51X142	Output Transformer	1
T-8	9A1972	"B" Range Loop Antenna	1

DIAL AND DRIVE ASSEMBLY

Part No.	Description	Qty. Used in Set
S-25X39	Dial Bracket Assembly	1
S-58X27	Dial Assembly	1
58X723	Dial Glass	1
28X113	Tension Spring (Drive Cord)	1
10X54	Drive Cord Assembly	1
15X246	Pointer	1
26X512	Drive Shaft	1
7A103	No. 47 Pilot Light	3
7A199	Pilot Light Socket Assembly	1

MISCELLANEOUS

Part No.	Description	Qty. Used in Set
12A490	12" PM Speaker	1
3A304	Phono Motor Socket	1
3A305	Socket — Single Pin	2
3A435	Tube Socket — Octal (8 prong) molded	3
3A436	Tube Socket (for 12AT7)	1
32X388	Tube Shield (for 12AT7)	1
32X390	Tube Shield (6AV6)	1
3A441	Tube Socket (miniature)	6
2A392	Band Switch	1
13X546	Line Cord and Plug Assembly	1
4X1049	Escutcheon	1
10A713	Knob	4
6X67	Rubber Grommets	4
30X547	Line Cord Clamp	1
6A307	TV AC Receptacle	1
6A308	TV Antenna Receptacle	1
7A185	Socket Assembly (Record Comp.)	1

TYPE V-28A163 RECORD CHANGER PARTS

Part No.	Description	Qty. Used in Set
V-2727B	Motor Assembly, 60 Cycles 105-125 Volts AC	1
Shure P-77	Crystal Cartridge	1
	Needle, Microgroove (Red)	1
	Needle, Regular	1

(When ordering needles, specify part number and letter stamped on cartridge)

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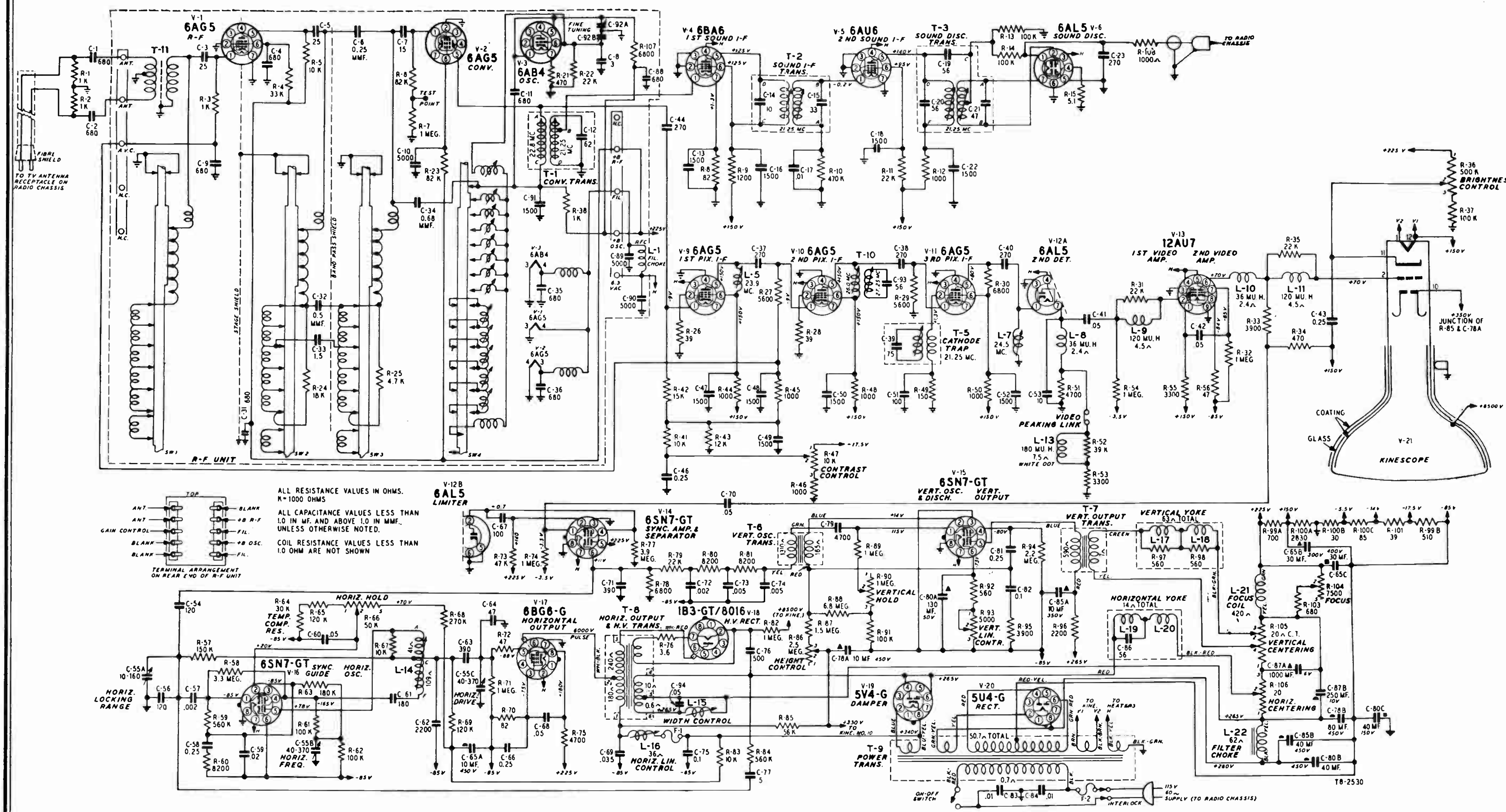
MODEL 94WG-3028A



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12T1

12T3

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12K1

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12K2

GENERAL INFORMATION

RECEIVER MODEL BREAKDOWN CHART

Model	Type of Set	TV Chassis Used
12T1	Table-red-brn mahogany	TS-53
12T1B	Table-limed oak	"
12T2	Table-red-brn mahogany	"
12T3	Table-red-brn mahogany	"
12K1	Console-red-brn mahogany	"
12K1B	Console-limed oak	"
12K2	Console-red-brn mahogany	"
12K2B	Console-limed oak	"
12K3	Console-red-brn mahogany	"
12K3B	Console-limed oak	"

TV CHASSIS - Television chassis TS-53 contains 19 tubes plus a 12-1/2" picture tube. The picture, sound, and scanning circuits, together with a selenium rectifier, voltage doubler "B" supply, are contained on a single chassis.

TV TUNING RANGE - Channels 2 through 13

TV IF FREQ - Channels 2 to 6: sound: 21.9 mc
picture: 26.4 mc
Channels 7 to 13: sound: 27.3 mc
picture: 22.8 mc

NOTE: In late chassis, using TT-13 tuner channels 11, 12, and 13: sound 21.9 mc, picture 26.4 mc.

ANTENNAS - TV: table model; TA-6 "Bilt-In-Tenna"
TV: console; TA-4 "Bilt-In-Tenna". Provision for connection of an external antenna in both cases.

TV ANTENNA IMPEDANCE - 300 ohms

POWER SUPPLY - 117 volts, 60 cycle AC current only

POWER CONSUMPTION - TV: 160 watts

TV AUDIO OUTPUT - 4 watts

TV CHASSIS TUBE COMPLEMENT -

Ref. No.	Tube	Function
V-1	6CB6	RF Amplifier
V-2	12AT7	Mixer-Oscillator
V-3	6AU6	1st IF Amplifier
V-4	6AU6	2nd IF Amplifier
V-5	6AG5	3rd IF Amplifier
V-6	6AL5	Video Detector
V-7	6AH6	Video Amplifier
V-8	6AU6	Audio Driver-Limiter
V-9	6AL5	Ratio Detector
V-10	6J5GT	Audio Amplifier
V-11	6V6GT	Audio Output
V-12	6SN7GT	1st & 2nd Clippers
V-13	6J5GT	Vertical Sweep Generator
V-14	25L6GT	Vertical Sweep Output
V-15	6AL5	Phase Detector
V-16	6SN7GT	Horizontal Oscillator
V-17	6BQ6GT	Horizontal Output & High Voltage Generator
V-18	6W4GT	Damping Diode
V-19	1B3GT	High Voltage Rectifier
V-20	12LP4	Picture Tube

HIGH VOLTAGE WARNING

Operation of this receiver, outside its cabinet or with covers removed, involves a shock hazard from the power supplies. No work should be attempted on this receiver by anyone not thoroughly familiar with the precautions necessary when working on high voltage equipment.

CATHODE RAY PICTURE TUBE HANDLING PRECAUTIONS

Extreme care must be used in handling the picture tube. The tube is highly evacuated and, due to its large size, is subjected to a considerable atmospheric pressure. The handler should wear safety goggles and gloves for protection. Avoid nicking or scratching the glass by rough contact with other objects.

Before removing glass tubes, discharge the capacity formed by the inner and outer aquadag coatings on the tube by shorting the anode contact on the side of the tube to the outer surface with a well insulated piece of wire.

INSTALLATION AND OPERATING INSTRUCTIONS

RECEIVER LOCATION

The receiver may be placed anywhere in the room, but for greatest satisfaction it should be located:

1. Away from any bright light that may fall directly on the screen or be reflected from it; this includes windows and lamps. Some illumination in the room, off to one side, is desirable, however, to prevent eye-strain.

2. To provide comfortable viewing and ease of operation.

3. At least one-inch away from a wall to allow for cabinet ventilation. This is very important.

ANTENNAS

The choice of television antenna depends entirely on the location of the receiver with respect to all television station transmitting antennas in the area. Maximum pick-up is obtained when the receiving antenna is directly in line of sight with the transmitting antenna.

"Bilt-In-Tenna". All receivers using the TS-53 series television chassis are equipped with the Motorola "Bilt-In-Tenna", mounted inside the cabinet, for use in good signal areas.

When this antenna is used, the following precautions should be observed for best reception:

1. In order to get maximum performance and satisfactory pictures from the "Bilt-In-Tenna", ample signals from the television station must be present at the location of the receivers. Normally, the strength of the signals will vary throughout the room in which the receiver is located. For this reason, better pictures will be obtained if the receiver is tried in all possible locations in the viewing room and is then placed where the clearest pictures are received from all stations. Avoid large metallic objects, such as radiators, metal panels, etc.

2. Lamps, vases and metallic objects, when placed on top of the receiver, may affect the efficiency of the "Bilt-In-Tenna".

Indoor Antenna. If additional pick-up is necessary, an indoor antenna, placed on or near the receiver, may be used. The antenna should be rotated and the arms should be adjusted for best signal, with no ghosts or reflections. Normally, the arms should be extended on the low channels (2-6) and telescoped on the high channels (7-13).

Outdoor Antenna. The Motorola "Bilt-In-Tenna" or the indoor type antenna will give satisfactory reception in strong signal areas; but, if the receiver is located in a fringe or weak signal area, an outdoor antenna is recommended.

In areas free of obstructions and reflections, within reasonable proximity to television transmitters, a dipole and reflector will prove satisfactory. Since such an antenna has a relatively small band coverage, a special antenna covering all twelve television channels should be used if it is desired to receive stations on channels of widely separated frequencies.

Location of the antenna should be decided from the standpoint of maximum signal pick-up. In general, the antenna should be broadside to the transmitting antenna and should be as high as possible. If a reflector is used, the antenna should be oriented so that the driver element is closest to the station and the reflector farthest away.

Locating the antenna and lead-in as far away as possible from highways, hospitals, doctors' offices, electrical machinery, etc., will help to reduce noise pick-up from such sources. Also, it is desirable to keep the antenna at least six feet away from other antennas, metal roofs, gutters, or other metal objects to prevent unwanted reflections and shielding.

Lead-in. Since the TS-53 chassis is designed for 300 ohms input, the standard 300 ohm twin lead line should be used for connecting the outside antenna to the receiver. Twisting the line one complete turn per foot of running length helps to reduce noise pick-up on the line. The lead-in should be supported on stand-off insulators and kept tight enough to prevent mechanical damage through swaying. Avoid running the lead-in close to metal gutters, iron standpipes, etc.

In areas of very strong signals, or where severe local electrical interference is encountered, 300 ohm shielded twin lead is recommended. The shield braid should be grounded.

An approved lightning arrestor should be used.

RECEIVER ANTENNA CONNECTION

The antenna lead-in to the television receiver is connected to the two screws of the terminal strip on the rear of the cabinet. Disconnect the "Bilt-In-Tenna" leads from the terminal strip before attaching an external antenna lead-in. Sometimes reversing the lead-in connections at the receiver may improve picture quality and overall performance.

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OPERATING CONTROLS

There are two dual controls, consisting of a small and a large knob each, on the front panel of the receiver. The function of each control is marked on the front panel; the "circle" indicating the large knob, and the "dot" indicating the small knob. See Figure 1 for front panel control functions.

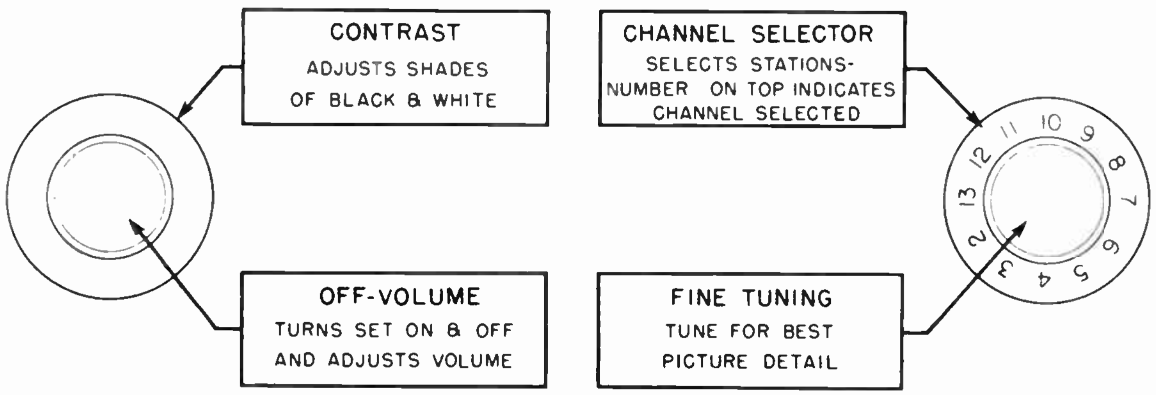


FIGURE 1. OPERATING CONTROLS

SERVICE ADJUSTMENT CONTROLS

The receiver is completely adjusted at the factory, so normally none other than the front panel control operating instructions need be followed in putting the receiver in operation. However, to provide for any misadjustment of the service controls, due to handling, the following instructions are in order. See Figure 2 for location of the service adjustment controls.

FOCUS CONTROL

The FOCUS control should be adjusted until the fine horizontal line structure of the raster is clearly visible over the picture area. The control should be tuned through the correct point several times so that optimum focus is obtained.

CENTERING

By means of a lever extending from the focus coil, thru the rear screen, the focus coil can be shifted to center the picture in its mask.

VERTICAL SIZE AND VERTICAL LINEARITY

Adjust the VERTICAL SIZE control until the picture fills the mask vertically. Adjust the VERTICAL LINEARITY control for best overall vertical linearity. Adjustment of the VERTICAL SIZE control will require a readjustment of the VERTICAL LINEARITY control and possibly of the vertical hold control. Center picture with the centering lever on the focus coil.

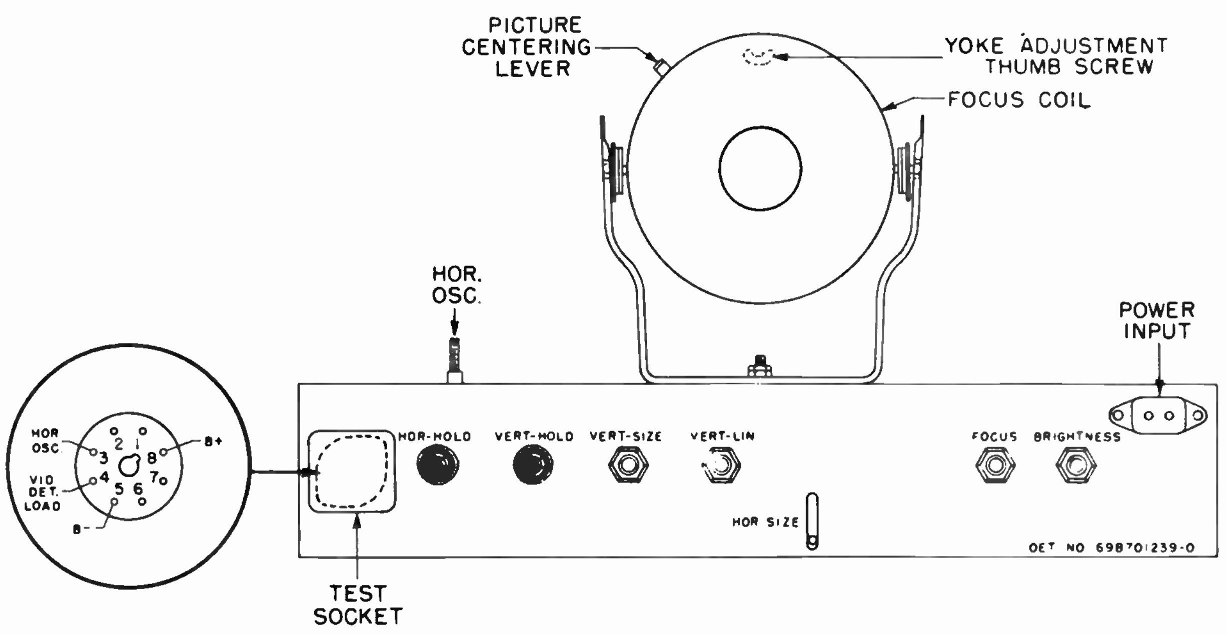
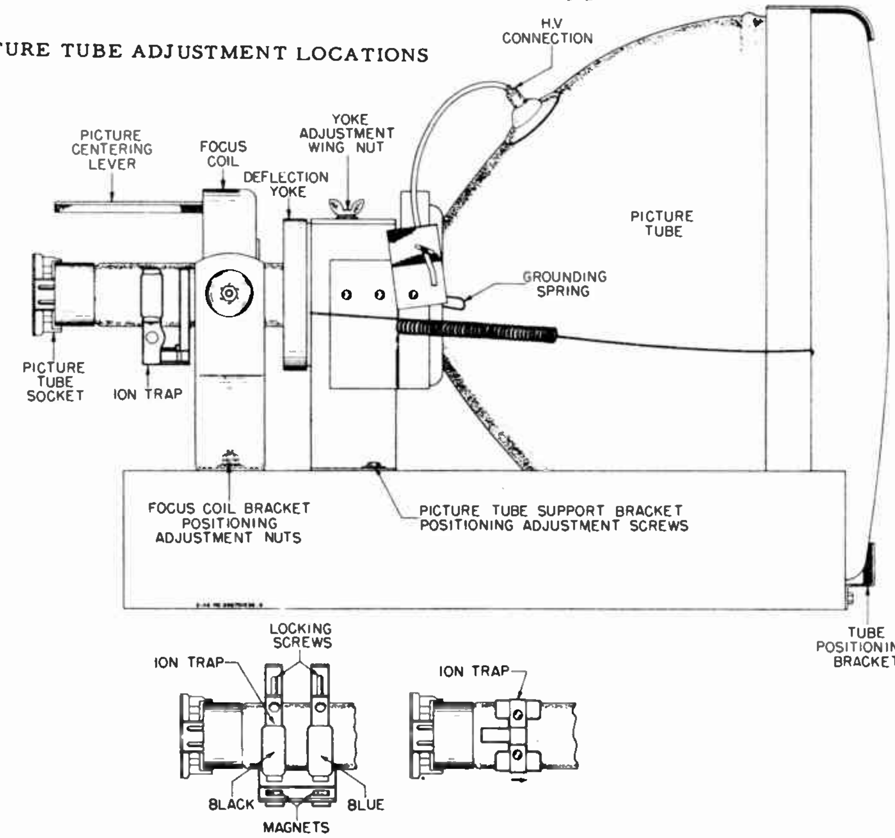


FIGURE 2. SERVICE ADJUSTMENT CONTROLS

FIGURE 3. PICTURE TUBE ADJUSTMENT LOCATIONS



HORIZONTAL SIZE

Adjust the HORIZONTAL SIZE lever until the picture fills the mask horizontally. Center picture with the centering lever.

HORIZONTAL HOLD ADJUSTMENT

The HORIZONTAL HOLD control should have a sync range of approximately 180 degrees. If the control is too critical, adjust as follows:

1. Short out HORIZONTAL OSCILLATOR coil L-25. This may be done with the chassis in the cabinet by shorting pins 3 & 8 of the test socket on chassis rear.

2. With the centering lever, move the picture to the left so that the right edge of the raster can be seen. Adjust the HORIZONTAL HOLD control to about the middle of its range and note the width of the blanking pulse. (The blanking pulse appears as a gray bar at the right edge of the picture).

3. Remove short from HORIZONTAL OSCILLATOR coil.

4. Adjust HORIZONTAL OSCILLATOR coil until the same amount of blanking pulse can be seen as was noted in step 2.

VERTICAL HOLD ADJUSTMENT

Adjust the VERTICAL HOLD control for the center of the vertical sync lock-in range.

BRIGHTNESS

Adjust the BRIGHTNESS control, in combination with the CONTRAST control for the most pleasing picture. Keep the brilliance slightly below maximum, however, in order to protect the fluorescent screen of the picture tube and to prevent poor picture detail.

ADJUSTMENT OF ION TRAP

Under conditions of rough shipment, it is possible for the ion trap to become misaligned. To prevent serious damage to the picture tube, the following method of adjustment should be used. See Figure 3.

The magnet should be placed on the neck of the tube in the direction indicated by the marking on the magnet (usually an arrow which points toward the picture tube screen) so that the stronger magnet of the double magnet type or the only magnet in the single magnet type is positioned over the internal pole pieces which are mounted on the gun structure. Adjust the brightness control for low intensity and move the magnet a short distance forward and backward at the same time rotating it to obtain the brightest raster. If, in obtaining the brightest raster, the ion trap magnet has to be moved more than 1/4" from the gun pole pieces the magnet is probably weak and a new magnet should be tried. Never correct for a shadowed raster with the ion trap magnet if such correction results in decreased brightness. The ion trap magnet must always be adjusted for maximum brightness and if shadows occur at this setting they should be eliminated by adjusting the focus and deflection coils as explained under "Focus Coil and Deflection Yoke Adjustment"

CAUTION: Keep brightness control at low intensity until ion trap is properly set.

A mirror placed in front of the receiver will aid in making this adjustment.

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DEFLECTION YOKE ADJUSTMENT

If the deflection yoke shifts, the picture will be tilted. To correct, loosen the thumb screw on top of the deflection yoke and rotate yoke until the picture is straight. Before tightening the thumb screw, make certain that the deflection yoke is as far forward as possible.

If the yoke support and the picture tube have shifted in transit, or if for any reason these parts have been removed and replaced, it is best to do a complete job of repositioning. See Figure 3. The starting point is the position of the picture tube. It should be adjusted so that the tube fits snugly up against the tube positioning bracket on the front edge of the chassis. The clamp on the front of the tube should then be tightened. The picture tube support bracket positioning adjustment screws should be loose enough to permit sliding the bracket forward until the rubber cushion fits snugly up against the flare of the tube. Loosen the yoke adjustment thumb screw and push the yoke up against the flare of the tube. CAUTION: Do not use force in sliding the bracket up. If too much force is used, a strain will be placed on the neck of the tube when the support bracket positioning adjustment screws are tightened. Also the yoke may be forced out of position. The opening in the yoke should be concentric with the neck of the tube.

FOCUS COIL

The focus coil bracket positioning screw nuts should now be loosened and the focus coil bracket moved up so that when the focus coil is parallel with the deflection yoke the space between them is 1/4". In tightening the focus coil bracket positioning screw nuts, tighten the first one so that the spring washers will have enough tension to hold the bracket firmly, but not so tightly as to cause difficulty in making picture centering adjustment. Then tighten the second nut to act as a lock to prevent loosening of the tension.

TEST SOCKET

A test socket is provided on the rear of the chassis which allows adjustment of the horizontal oscillator and checking of sensitivity without removing chassis from cabinet. See Figure 2 for socket connections.

ALIGNMENT

GENERAL

The chassis should be mounted on angle iron brackets (Motorola Part No. 7X700210) so that all connections and adjustments may be made easily.

Since the power cord circuit is broken by the interlock when the cabinet back is removed, it will be necessary to obtain an extra power cord with the female interlock receptacle in order to make a power connection to the receiver. Order Motorola Part No. 30B470756.

It is recommended that an isolation transformer be used between the receiver and the AC line whenever any test equipment is attached to the chassis. This precaution is especially important if grounded test equipment is used. NEVER GROUND THE RECEIVER CHASSIS DURING TESTING OPERATIONS OR INSTALLATION UNLESS AN ISOLATION TRANSFORMER IS USED.

ORDER OF ALIGNMENT

A complete receiver alignment can be most conveniently performed in the following order:

1. Audio Take-Off & Ratio Detector
2. 4.5 Mc Trap
3. IF coils & Mixer Transformer
4. Osc & RF Sections

AUDIO TAKE-OFF & RATIO DETECTOR ALIGNMENT

Equipment Required:

AM Signal Generator: (Optional)	Accurately calibrated at 4.5 mc
	Adjustable output
DC Meter:	Low range electronic meter

Procedure:

Refer to Figure 4 for location of adjustments.

1. If possible, it is desirable to align the audio section from an actual station signal, since the 4.5 mc alignment frequency will be exact. The fine tuning trimmer should be turned off the station slightly, to prevent overloading the ratio detector.
2. If a signal generator is used, tune it accurately to 4.5 mc, and adjust the output to approximately 10,000 microvolts. Connect the high side of the signal generator through a 1000 mmf capacitor to the grid (pin 1) of the video amplifier tube V-7 (6AH6), and the low side to B-. The following applies whether the station signal or signal generator is used.
3. From either side of capacitor C-60 (10 mf), connect an electronic voltmeter to B- decoupled thru 10K ohms.
4. Set the contrast control for maximum gain (fully clockwise).
5. Peak L-23 for maximum reading on meter.
6. Peak T-3 primary (top core) for maximum reading on meter.
7. Move the meter and decoupling resistor from C-60 to junction of R-42 (33K) and lead to volume control.
8. Adjust T-3 secondary (bottom core) for zero response on 2.5V scale of meter. This corresponds to the cross-over point on the FM detector curve. If desired, the symmetry of the curve may be checked by tuning the signal generator 25 Kc above and below 4.5 mc and noting the plus and minus voltage produced, reversing the meter connections as necessary. For proper balance of the ratio detector system, the voltage in each direction should be approximately equal. If not, check the tuning of L-23 and the primary and secondary of T-3, the ratio detector. If necessary, replace the ratio detector tube V-9 (6AL5). It is desirable to calibrate the generator on a station signal. This may be done by nulling the secondary on a station signal and then connecting the generator and tuning it to produce the same null without touching the trimmers in the set.

NOTE: As the adjustments are brought to resonance, it is advisable to reduce signal generator output to prevent overloading.

With a 10,000 microvolt signal into the grid of the video amplifier tube, with the contrast control turned fully clockwise, and the focus control at center of its range, the voltage read from one side of capacitor C-60 to B- should be greater than 5.0V.

4.5 MC TRAP ALIGNMENT

1. Connect the high side of the signal generator through a 1000 mmf capacitor to the grid (pin 1) of the video amplifier tube V-7 (6AH6), and the low side to B-.
2. Connect the voltmeter and germanium crystal rectifier, as shown in Figure 5, between the cathode of the picture tube (yellow lead) and B-. Use the lowest voltage scale on the meter.
3. With the signal generator accurately set at 4.5 mc and maximum output, adjust trap L-21 for minimum reading on the meter.

IF AMPLIFIER ALIGNMENT

Equipment Required:

IF Sweep Generator meeting the following requirements:

18 to 30 mc, approximately 12 mc sweep width. Output constant and adjustable to at least .1 volt maximum with accurately calibrated, adjustable markers.

Cathode Ray Oscilloscope: preferably one with a calibrated input attenuator.

NOTE: If there is no built-in marker in the sweep generator, loosely couple the output of an accurately calibrated AM signal generator to the IF strip. At all times, keep the marker output low enough to prevent the marker from distorting the response curve.

If a wide band scope is used, the marker will be more distinct if a capacitor of 100 to 1000 mmf is placed across the scope input. Use the smallest size possible, since too large a value will affect the shape of the curve.

Procedure:

1. Remove high voltage generator tube V-17 (6BQ6GT) from its socket to eliminate horizontal pick-up in the oscilloscope.
2. By means of an external battery, apply a negative 3.0 volt bias from the bottom of the 1st IF tube grid resistor R-11 (6800) to B-.
3. Using leads as short as possible, connect the hot side of the sweep generator to the grid (pin 1) of the 1st IF tube V-3 (6AU6) through a 5000 mmf capacitor (do not use the loose or "spraying" method of coupling). The low side is connected to B-. Set the center frequency of the sweep to about 24.6 mc and adjust initially for a sweep deviation of approximately 12 mc. However, a sweep of from 8 to 10 mc may be found better for overall alignment.
4. Using R-27 (100K) as a decoupling resistor, connect the scope to pin 4 of test socket. If a stronger output is desired, connect the scope between the picture tube cathode and B-. The curve seen at this position will be the reverse of the polarity shown in Figure 6.
5. Set the contrast control at minimum.

NOTE: If a distorted or unstable picture is seen on the oscilloscope during alignment, it may be necessary to stop the oscillator by disconnecting resistor R-10 (1000) from the plate (pin 6) of the oscillator tube V-2B (12AT7), or by substituting another tube with pin 6 removed.

CAUTION:

1. Do not reduce the oscilloscope gain and increase signal input so that the top of the curve is flattened due to limiting in the video or scope amplifiers.
2. The dress of plate and grid components in the IF affects tuning. Do not move indiscriminately.
3. On the IF coils and on the traps the resonance point will be found at two settings of the slug. The correct setting is the one which is found with the greater part of the adjusting screw out of the coil.

NOTE: The 1st & 2nd IF traps are tuned from bottom of chassis, while IF cores are adjusted from the top.

6. Tune the low frequency trap L-17, located on the 2nd IF coil, for maximum attenuation on the curve at 21.9 mc.
7. Tune the high frequency trap L-13, located on the 1st IF coil, for maximum attenuation on the curve at 27.3 mc.
8. Adjust the 1st IF coil, L-12, to place a 26.6 mc marker on the high side of the response curve 60% down from maximum response. See Figure 6.
9. Adjust the 2nd IF coil, L-16, to place a 22.7 mc marker on the low side of the response curve 60% down from maximum response.
10. Adjust the 3rd IF plate transformer T-2 to provide a flat top or symmetrical response curve.
11. Reset the traps (steps 6 & 7) and again check the IF for proper response.

NOTE: It is suggested that the bias be removed for accurate resetting of the traps.

12. With bias applied, connect the sweep between the grid (pin 2) of the mixer tube V-2A (12AT7) and B-.
13. Disconnect the trimmer, C-16, in LC circuit in the grid of the mixer tube, or short the trimmer through a 10,000 mmf ceramic disc type to B-.

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NO.	TYPE	FUNCTION
V-1	6CB6	RF AMP.
V-2	12AT7	MIXER-OSC.
V-3	6AU6	IST. IF AMP.
V-4	6AU6	2ND. IF AMP.
V-5	6AG5	3RD. IF AMP.
V-6	6AL5	VIDEO DET.
V-7	6AH6	VIDEO AMP.
V-8	6AU6	AUDIO DRIVER-LIMITER
V-9	6AL5	RATIO DET.
V-10	6J5GT	AUDIO AMP.
V-11	6V6GT	AUDIO OUTPUT
V-12	6SN7GT	IST. & 2ND. CLIPPER
V-13	6J5GT	VERT. SWEEP GEN.
V-14	25L6GT	VERT. SWEEP OUTPUT
V-15	6AL5	PHASE DET.
V-16	6SN7GT	HORIZ. OSC.
V-17	6BQ6GT	HORIZ. OUTPUT & H.V. GEN
V-18	6W4GT	DAMPING DIODE
V-19	1B3GT	H.V. RECT.

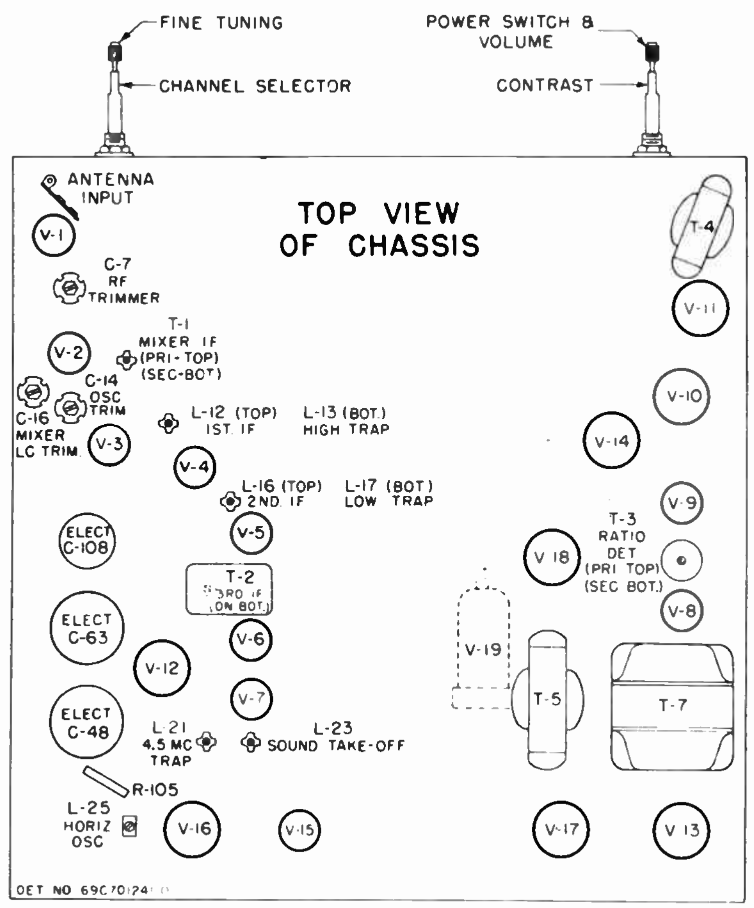

FIGURE 4. TUBE AND ALIGNMENT ADJUSTMENT LOCATIONS

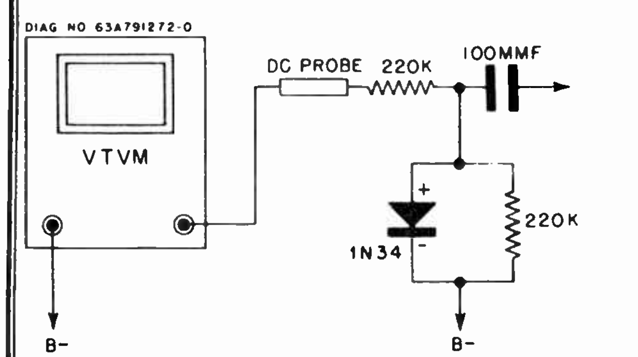

FIGURE 5. ELECTRONIC VOLTMETER CONNECTIONS

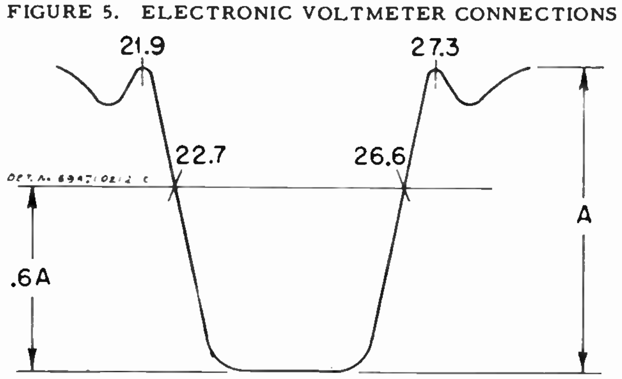

FIGURE 6. IF RESPONSE CURVE

14. Bring both cores of the mixer transformer, T-1, simultaneously from the outside towards the center. The half-way markers should be 26.4 mc and 22.9 mc. See Figure 7.

NOTE: In aligning the three IF coils, each coil is adjusted individually, but when adjusting the primary and secondary of the mixer transformer, the adjustments should be made simultaneously. The important point to keep in mind is to obtain a flat response curve with as much gain as possible. The sides of the curve should be straight and as steep as possible. Simultaneous adjusting of the primary and secondary is the easiest way to obtain this result. The transformer by itself is, in effect, tuned for the same pass band as the three staggered circuits. See Figure 7. The only difference in the overall waveform should be that the sides of the overall wave are steeper. Constant use of the 50% markers (22.9 mc & 26.4 mc) should be resorted to, since it is absolutely necessary to obtain the proper curve. A slight dip (not exceeding 10%) is permissible in the mixer transformer response curve.

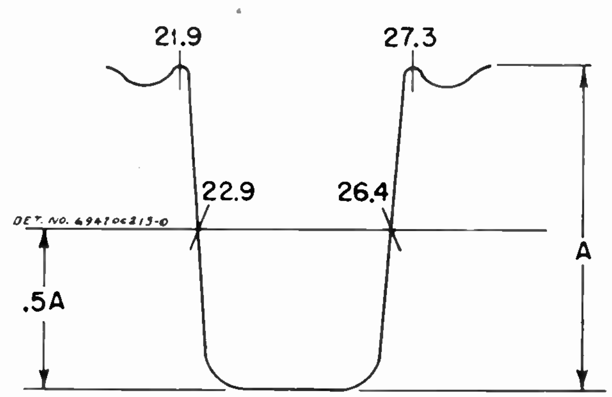

FIGURE 7. OVERALL RESPONSE CURVE FROM MIXER

BANDWIDTH

The bandwidth may be determined by connecting an AM generator to the mixer grid. With the generator frequency at 24.6 mc, adjust the output for 1 volt reading on a VTVM connected at the plate (pin 2) of the video detector tube V-6 (6AL5) and B-. Double the output of the generator. Now by tuning either side of 24.6 mc and noting the frequencies at which the VTVM again reads 1 volt, the 6 db bandwidth points are indicated.

REGENERATION CHECK

After the above IF and mixer transformer alignment has been made, a check for regeneration in the IF amplifier strip should be made. This is done by removing the battery bias and observing the output response curve on the oscilloscope, as taken between the picture tube cathode and B-. The bandwidth may change with the bias removed but should not change more than 0.2 mc. Set the contrast control to maximum gain. Decrease the input until the output signal shows a marked decrease. Any regeneration present will be indicated by sharp peaks on the overall response curve. The oscillator should be stopped, as described above, during this procedure.

CAUTION: Do not inject too much marker signal.

MIXER LC ADJUSTMENT

Reconnect bias removed for regeneration check. Replace trimmer C-16 in LC circuit of mixer grid or remove 10,000 mmf ceramic between trimmer and B-. Adjust the trimmer so it is tuned to the center of the mixer response curve. This is indicated by observing the effect of the LC circuit on the mixer response. Increasing the capacity of the trimmer and bringing the LC circuit from above the IF range into the IF range, it will be noted that the mixer curve will pull down on the high side, then straighten out as the LC circuit approaches the middle of the range, and pull down on the low side as the LC circuit approaches the low end of the IF range. The proper tuning point is that point at which the mixer curve straightens out. In effect, the LC circuit is similar to a jack coil when it is within the IF range

CAUTION: Tuning the LC circuit very low will cause oscillation.

IF SENSITIVITY MEASUREMENTS

IF Stages Only

1. Remove the battery bias from 1st IF tube grid.

2. Connect an AM signal generator, set at 24.6 mc, through a blocking capacitor of 5000 mmf, between B- and the grid (pin 1) of the 1st IF tube V-3 (6AU6).

3. Connect an electronic voltmeter across the video detector load resistor R-26 (5600). Both leads from the meter should be decoupled with 100K ohm resistors.

4. Set the contrast control for maximum sensitivity.

5. Stop the oscillator tube by disconnecting resistor R-10 (1000) from the plate (pin 6) of tube V-2B (12AT7) or by substituting another tube with pin 6 removed.

6. The signal required to produce 1 volt (negative) above contact potential on the meter should be less than 700 microvolts.

Mixer & IF Stages

The preliminary preparations are the same as for checking the sensitivity of the IF stages except:

1. Connect the AM signal generator, set at 24.6 mc through a 5000 mmf capacitor, between B- and the grid (pin 2) of the mixer tube V-2A (12AT7).

2. The signal required to produce 1 volt (negative) above contact potential on the meter should be less than 125 microvolts.

OSCILLATOR, ANTENNA AND RF ALIGNMENT

NOTE: The IF must be aligned before the RF section can be properly phased.

Equipment Required:

Sweep Generator: Frequency range 40-220 mc; 10 mc sweep width
Output constant and adjustable
Adjustable markers (markers should be calibrated occasionally by checking against an accurate signal generator).

Oscilloscope: Preferably one with a calibrated input attenuator

Signal Generator: Frequency range 40 to 220 mc
Accurately calibrated
AM modulated, 400 cycle

FREQUENCY CHART

Chan	Frequency	Picture	Sound	Oscillator
2	54-60	55.25	59.75	81.65
3	60-66	61.25	65.75	87.65
4	66-72	67.25	71.75	93.65
5	76-82	77.25	81.75	103.65
6	82-88	83.25	87.75	109.65
7	174-180	175.25	179.75	152.45
8	180-186	181.25	185.75	158.45
9	186-192	187.25	191.75	164.45
10	192-198	193.25	197.75	170.45
11	198-204	199.25	203.75	176.45(225.65*)
12	204-210	205.25	209.75	182.45(231.65*)
13	210-216	211.25	215.75	188.45(237.65*)

(* in later sets)

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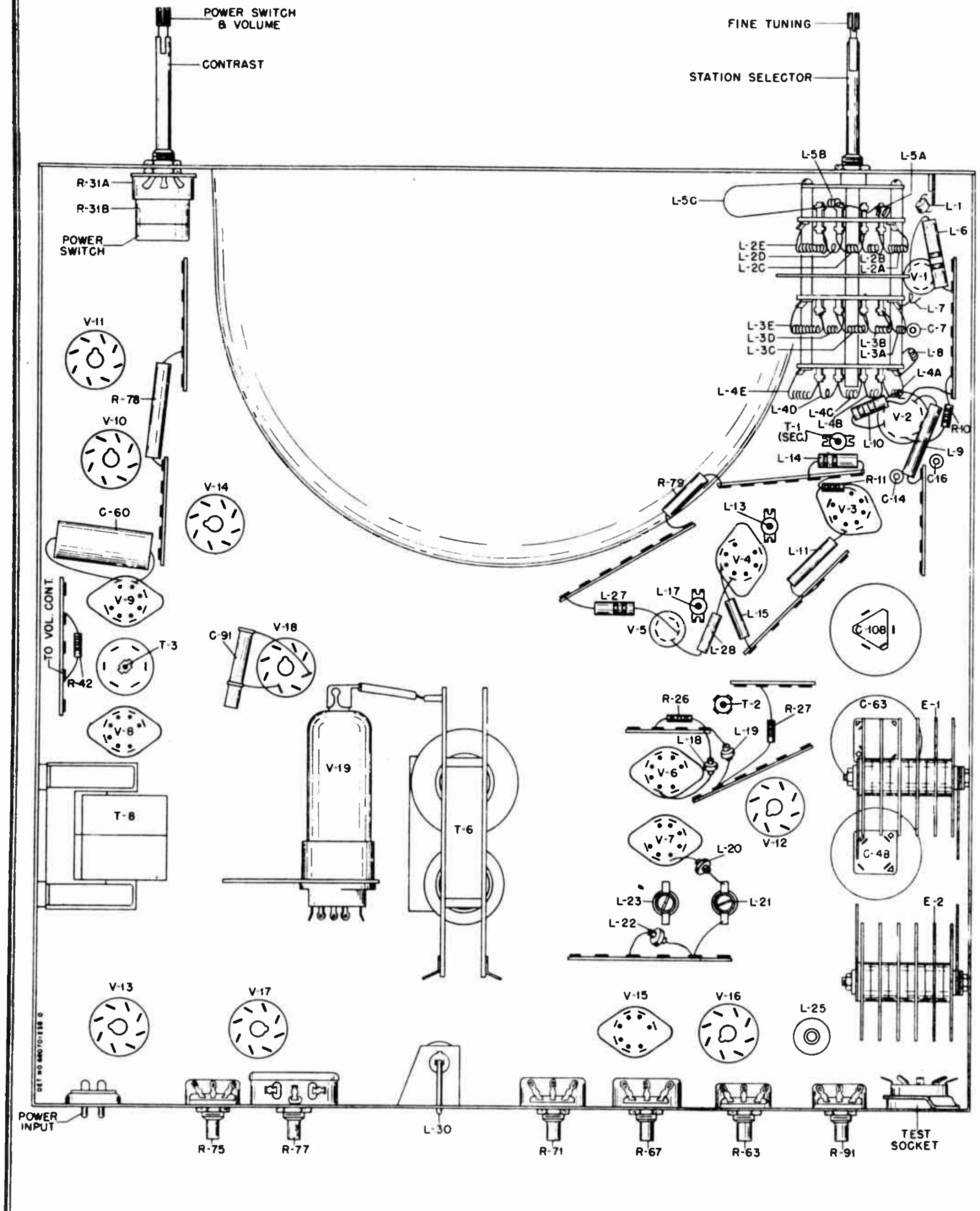

FIGURE 8. BOTTOM VIEW OF CHASSIS

ANTENNA & RF ALIGNMENT PROCEDURE

1. Remove high voltage generator tube V-17 (6BQ6GT) from its socket and stop the oscillator by disconnecting R-10 (1000) from plate (pin 6) of V-2B (12AT7).

2. Connect the sweep generator across the antenna terminals on the chassis with the antenna lead-in removed. The line from the sweep generator should be as short as possible.

3. Connect the oscilloscope through a decoupling resistor of 150,000 ohms, between the cathode (pin 3) of the mixer tube V-2 (12AT7) and B-.

4. Short out the AGC circuit with a clip lead from the AGC bus to B-.

5. Refer to Figure 4 for the RF trimmer location and to Figure 9 for the locations of the antenna and RF coils. The frequency chart listed previously gives the channel and alignment frequencies.

6. The antenna coils are tuned to the video carrier frequency and the RF coils are tuned to the sound carriers. Figure 10 shows the shape of the curve which should appear on the scope for channels 2-6 and Figure 11 the curves for channels 7-13.

7. Turn the station selector switch to channel 10. Set the center frequency of the sweep generator to the center frequency of channel 10 (195 mc).

8. Adjust ceramic trimmer, C-7, so that picture and sound markers are as in Figure 11.

9. Check channels 7 to 13 for proper response and, if necessary, tune the coil L-7. These coils may be tuned by spreading them to decrease inductance or compressing them to increase their inductance. See Figure 9 for location of coils. This will have more effect on channels 10 to 13 than 7 to 9. If L-7 is adjusted, it may be necessary to readjust RF trimmer C-7, and recheck the high channels.

10. Move bandswitch to channel 6.

11. With center frequency of sweep generator at the ter frequency of channel 6 (85 mc) introduce markers corresponding to sound and picture carriers and compare with curve of Figure 10.

NOTE: A convenient method of determining whether a coil is tuned correctly is to insert a brass or iron slug into the coil. Brass decreases and iron increases the inductance.

12. After channel 6 has been aligned, progress downward through channel 2.

CAUTION: Make certain the station selector switch is on the correct channel before checking band pass.

OSCILLATOR ADJUSTMENT

1. Put oscillator back in circuit.

2. Remove the short from the AGC circuit and apply -3 volt battery bias to AGC.

3. Move the oscilloscope to the video detector output. To provide decoupling, it is best to connect to the low side of R-27 (100K) which is connected through chokes L-19 and L-18 to the plate (pin 2) of the detector tube V-6 (6AL5).

4. Turn station selector switch to channel 10.

5. Set the contrast control at minimum (counterclockwise).

6. Set the center frequency of the sweep generator to 195 mc and keep the output low enough to show no evidence of limiting in the overall response curve.

7. Introduce a marker corresponding to the sound carrier of channel 10 (197.75).

8. With the fine tuning trimmer at mid-capacity, adjust the oscillator trimmer, C-14, to move the response to the point where the sound marker drops into the trap on the high side of the curve

9. Check channels 7 to 13 to note whether the sound marker will drop into the trap on the low side of the response with the fine tuning trimmer within plus or minus 22-1/2 degrees of mid-capacity. If this is not possible, adjust L-8. This coil has more effect on channels 10 to 13 than 7 to 9. It may have to be adjusted to obtain proper tracking on the high channels.

10. Move to channel 6 and progress downward through channel 2, spreading or compressing the coil sections to make the sound marker drop into the trap on the low side with the fine tuning trimmer within 22-1/2 degrees of mid-setting (each number on the station selector switch knob represents 30 degrees).

NOTE: Overall response should be substantially flat and of proper bandwidth.

REVISED OSCILLATOR ADJUSTMENT

Following is the oscillator alignment procedure for the revised tuners appearing in later production TS-53 chassis. Where formerly the oscillator was tuned beneath the carrier on all high channels, it has been raised above the carrier on channels 11, 12, and 13. This places the oscillator outside the TV spectrum on all high channels and, therefore, eliminates the possibility of its interfering with neighboring television receivers.

The new tuner may be identified by the additional coil in the oscillator section. The new coil is across the cut-out section of the stamped plate on the oscillator deck (see Figure 9). In addition, the switch shaft is color coded (green for the TS-53 chassis).

OSCILLATOR ADJUSTMENT

NOTE: The Antenna & RF Alignment Procedure is the same as in previous TS-53 chassis. The oscillator adjustment is revised as follows:

1. Put oscillator back in circuit.

2. Remove the short from the AGC circuit and apply a -3 volt battery bias to the AGC bus.

3. Move the scope to the test socket on the chassis rear with the high side connected to pin 4 and the low side to pin 5 (B-).

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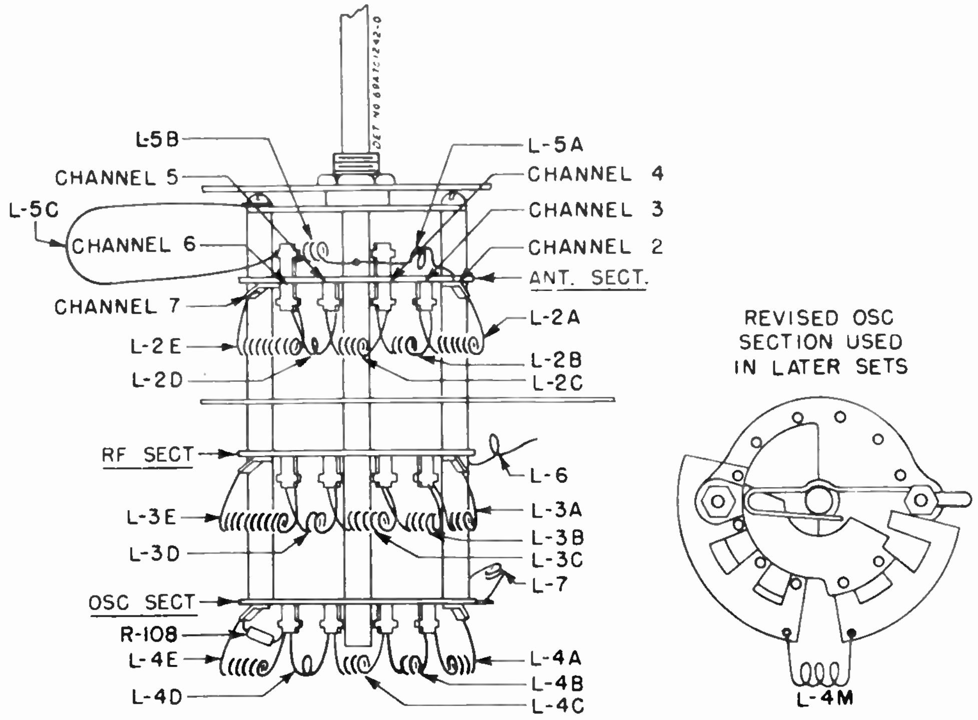

FIGURE 9. ANTENNA, RF AND OSCILLATOR COIL LOCATIONS

4. Set the contrast control at minimum (counterclockwise).

5. Remove the fine tuning knob and turn shaft until the slot is in a horizontal position. This represents the mid-capacity position.

6. Turn station selector switch to channel 12.

7. Set the sweep generator on channel 12 with a center frequency of 207 mc and at least a 12 mc sweep. Keep the output low enough to show no evidence of limiting in the overall response curve.

NOTE: Before aligning the oscillator section, make certain the 3.3 microhenry choke (L-9) in the mixer grid is dressed away from the 3 mmf capacitor (C-17) tied to the same grid.

8. Introduce a marker corresponding to the sound carrier of channel 12 (209.75 mc).

9. Adjust oscillator ceramic trimmer (C-14) so that the sound marker falls into the 21.9 mc trap dip in the response curve.

10. Turn generator and station selector to channel 9 with the fine tuning shaft slot still in the horizontal position.

11. Spread or compress the 3-turn coil located in the center of the oscillator plate (L-4M, Figure 9) so that the sound marker for channel 9 falls into the 27.3 mc trap dip in the response curve. As the oscillator is tuned below the carrier on channels 7, 8, 9, and 10, the 27.3 mc trap will be in the same position as the 21.9 mc trap in step 9.

12. Repeat steps 6, 7, 8 and 9.

13. Turn generator and station selector to channel 13.

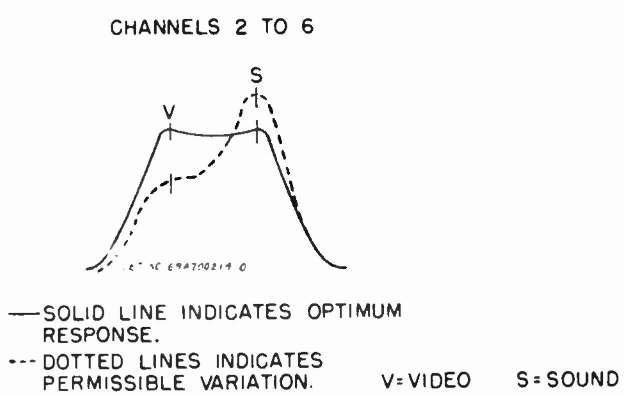

FIGURE 10. RF RESPONSE CURVES CHANNELS 2-6

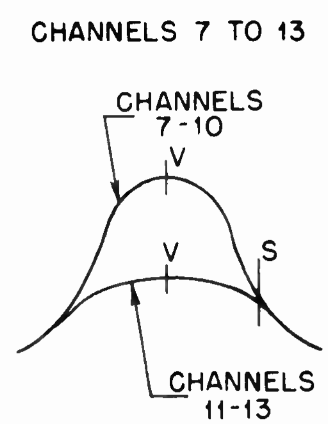

FIGURE 11. RF RESPONSE CURVES CHANNELS 7-13

14. Turn fine tuning trimmer so that the sound marker for channel 13 falls into the 21.9 mc trap dip of response curve. The slot in the fine tuning shaft should not have moved more than 30 degrees from the horizontal position to accomplish this (each number on the station selector knob represents 30 degrees).

15. If more than a 30 degree change in fine tuning trimmer was needed in step 14, adjust channel 13 oscillator coil (L-8) by spreading or compressing until the 30 degree requirement is met.

NOTE: Each adjustment of channel 13 oscillator coil (L-8) will necessitate a rechecking of the oscillator trimmer (C-14) on channel 12 as per steps 6, 7, 8, and 9.

16. Check channels 12, 11, 10, 9, 8, and 7, by noting whether the fine tuning trimmer can drop the sound marker for each channel in the trap dip by a 30 degree rotation. If one of the channels does not meet the 30 degree requirement, a compromise must be made by resetting channel 9 or 12, whichever is closer to the channel in question.

Example: 1) If channel 11 does not meet the 30 degree requirement, return station selector and and generator to channel 12 and tune ceramic trimmer (C-14) toward channel 11 (trimmer frequencies lowered by tightening screw). This will tend to move channel 12 sound marker out of the trap dip, but this can be compensated for by the fine tuning trimmer. Do not adjust trimmer any more then is necessary to get the channel in question back within the 30 degree requirement.

Example: 2) If channel 10 does not meet the 30 degree requirement, move station selector and generator to channel 9 and tune the 3-turn coil (L-4M, Figure 9) toward channel 10 (coil freq raised by spreading turns). This will also tend to move channel 9 sound marker out of the trap dip, but this can be compensated for by the fine tuning trimmer. Again, do not adjust the coil any more than is necessary to bring the channel in question back within the 30 degree requirement.

17. Turn sweep generator and station selector switch to channel 6.

18. Adjust channel 6 oscillator coil (L-4E, Figure 9) so that the sound marker for channel 6 falls into the 21.9 mc trap dip with the fine tuning trimmer at mid-capacity (shaft slot in horizontal position). Always spread or compress channel #6 oscillator coil in units of 3 turns. Compressing turns will move curve toward sound marker, while spreading will move curve toward video marker.

IMPORTANT: Since the coils are in series, the proper alignment of channel 6 will simplify the phasing of the channels to follow.

19. Adjust channels 5 and 4 so that the sound marker for each channel falls into the 21.9 mc trap dip in the curve with the fine tuning trimmer set no more than 15 degrees from mid-capacity.

20. Channels 3 and 2 should be adjusted so that the sound marker falls into the 21.9 mc trap dip with the fine tuning trimmer within 15 degrees of maximum capacity.

OVERALL RECEIVER SENSITIVITY MEASUREMENT

An overall measurement of sensitivity is made as follows:

1. Connect an AM signal generator to the input terminals of the receiver chassis after removing the short 300 ohm lead which connects to the antenna input strip on the back of the cabinet. To match the generator to the receiver input, a resistor matching network should be used. In the case of a generator with a 50 ohm output impedance, for example, place a 100 ohm resistor in series with the output terminal of the generator and a 150 ohm resistor in series with the ground terminal.

2. From cathode of picture tube to B- connect a calibrated oscilloscope.

NOTE: To calibrate scope, connect it across 6.3 volt filament supply. The peak-to-peak amplitude on the screen will then be approximately 18V (6.3 x 2.8).

3. Set contrast control for maximum sensitivity.

4. Tune signal generator to the video carrier frequency of the channel being checked. Generator signal should be 30% modulated at 400 cycles. The signal from the generator to produce 20 volts peak-to-peak at picture tube cathode should be less than 25 microvolts on channels 2 to 6 and less than 75 microvolts on channels 7 to 13.

CIRCUIT DESCRIPTION

LOW VOLTAGE POWER SUPPLY

The low voltage power supply (Figure 12) provides plate voltage for all tubes except the high voltage applied to the second anode of the picture tube. The heater transformers supply heater voltage to all tubes except the HV rectifier. which is energized by horizontal sweep current.

One low voltage secondary of T-7, the step-down filament transformer, supplies filament voltage to all tubes except the audio driver-limiter (V-8), the vertical output tube (V-14), the picture tube (V-20), and the horizontal damping diode (V-18). Since the damping diode (V-18) develops a high voltage pulse at its cathode, and its cathode is tied to the filament to prevent breakdown in the tube, it is necessary to provide a separate, low-capacity, well-insulated transformer (T-8) to heat this filament. The vertical output tube V-14 (25L6GT) requires a 25 volt filament supply and, hence is provided with a separate 25 volt tap on the transformer. V-8 and V-20 are supplied by an additional winding which, in later sets, is connected series opposing with the primary to increase the 6.3V filament supply voltage slightly to insure that the RF oscillator will operate on low line voltage.

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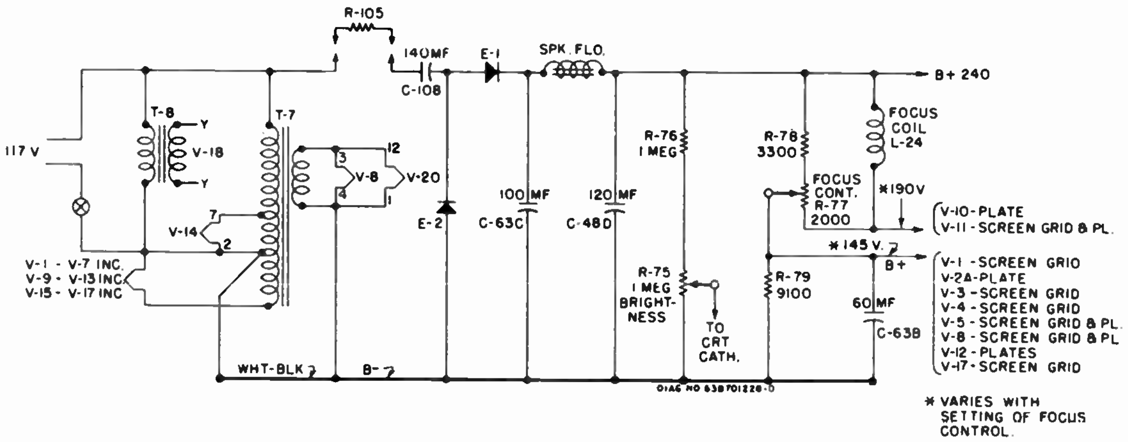

FIGURE 12. SIMPLIFIED SCHEMATIC OF LOW VOLTAGE POWER SUPPLY

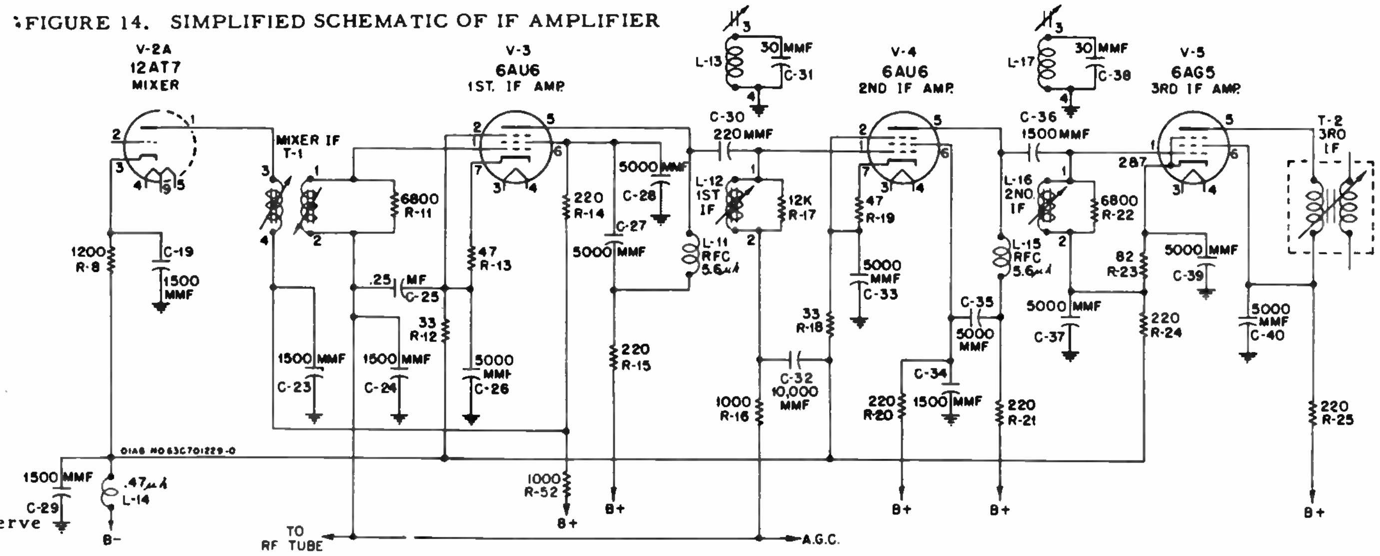

FIGURE 14. SIMPLIFIED SCHEMATIC OF IF AMPLIFIER

The B plus plate supply uses a voltage doubler. R-105 is a limiting resistor to protect the rectifiers from initial current surges and also serves as a fuse in case of B plus shorts. When the polarity of the applied 117 volt AC is such as to make the side of the line connected to R-105 negative, E-2 will conduct and charge C-108 (140 mf) to peak line voltage. On the next alternation, E-1 will conduct and the voltage applied to it is now the peak line voltage plus the peak charge stored in C-108. This results in a charge of about 260 volts on C-63C (100 mf). The speaker field is used as a filter choke. The focus coil and the resistor network, which controls the current thru it, act also as a voltage divider to supply plate and screen voltages to several tubes, as shown in Figure 12.

Another voltage divider from B plus to B-, consisting of R-76 (1 meg) and the potentiometer, R-75 (1 meg) provides a variable bias on the cathode of the picture tube, to serve as a brightness control.

THE RF TUNER

Antenna Input

Figure 13 is a simplified schematic of the tuner.

The antenna input coil, L-1, couples the balanced line to the single ended input circuit for the RF tube, V-1. Optimum antenna coupling for all channels is obtained by the coupling coils L-5A, L-5B, L-5C, and the coupling leads on channel positions 8, 10 and 12 of switch wafer S-1A. These can be considered the primary of the antenna transformer. The secondary, or tuned grid circuit, includes also the continuous, tapped coil mounted on wafer S-1B for the low channels (2-6) and the stamped metal plate in series with the coil for the high channels (7-13). The purpose of the antenna coil, coupling leads, and the secondary circuit, is to match the 300 ohm impedance of the transmission line from the antenna to the input impedance of the RF amplifier grid circuit and to tune this circuit for the channel selected. Referring to Figure 13, it will be seen that the switch in progressing from channel 2 to channel 13, shorts out the unused portion of the secondary winding or stamped metal plate. The bandwidth of channels 7 thru 13 is about 8 mc. The stamped metal plate is carefully designed so that with this bandwidth no alignment adjustment is needed on the high channels. The individual coil sections on the low channels, however, may be tuned by spreading or compressing them as outlined in the alignment procedure.

RF Amplifier

The grid of the RF amplifier V-1 (6CB6) is returned to the AGC bus thru L-6 and a bypass capacity (C-5). The plate load of this tube consists of another tapped coil for the low channels and a stamped metal plate for the high channels mounted, in this case, on switch wafer S-1C. Here again, the switch progressively shorts out the unused sections of the inductance in tuning from channel 2 to 13. In this case, however, a trimmer C-7 and a choke L-7 are provided to center the high channel response while the low channel coils may be tuned by expansion or compression.

The Mixer

The mixer uses 1/2 of V-2 (12AT7). C-15 (8 mmf) couples the RF amplifier output to the mixer grid. Oscillator injection is accomplished by C-17 (2 mmf). L-9 and C-16 form a series resonant circuit tuned to the center of the IF response, to prevent interaction between the IF and the mixer input.

The Oscillator

The oscillator uses the other half of V-2 (12AT7) in a Colpitts circuit. Here again, the tuning inductance consists of the tapped coil for the low channels and the stamped metal plate for the high channels mounted on wafer S-1E. L-8 and C-14 are provided to set the center frequency on the high channels while the low channels are aligned by spreading or compressing the individual coil sections. C-13 is provided as a fine tuning control for customer use. The oscillator operates above the RF on the low channels and below the RF on the high channels except that in later production the circuit was modified to avoid interference by operating the oscillator on the high side for channels 11, 12 and 13.

THE IF AMPLIFIER

The IF amplifier uses two 6AU6 tubes and one 6AG5 tube. Figure 14 is the schematic of the IF amplifier. T-1 couples the mixer plate to the first IF grid. Coupling between primary and secondary, which are individually slug-tuned, is fixed and is designed for proper bandwidth. The plate choke L-11, of the 1st IF tube V-3 (6AU6), is coupled to the grid coil, L-12, of the 2nd IF tube V-4 (6AU6) thru C-30 (220 mmf). At IF frequencies, the impedance of C-30 is negligible and for all practical purposes, L-11 and L-12 can be considered as being in parallel, L-12 being slug-tuned. A similar method is used between the 2nd and 3rd IF tubes. The 3rd IF plate is coupled to the detector by T-2, a unity coupled transformer. The IF circuits are stagger-tuned for proper bandwidth as explained in the Alignment Instructions. L-13 and L-17 are separately tuned trap windings on IF coil forms L-12 and L-16, respectively. Together with C-31 and C-38, they form absorption type trap circuits which steepen the high and low skirts of the IF response for better picture quality and to stabilize the audio response with intercarrier sound.

Decoupling has been used not only in the plate supply and AGC circuits, but also in the filament circuits to prevent regeneration.

THE VIDEO DETECTOR

One-half of V-6 (6AL5) is used as the video detector. Figure 15 is a schematic of the video detector. Since for noise limiting purposes it is desirable to apply a signal with negative going sync pulses to the grid of the video amplifier, the detector load R-26 (5600) is placed in the plate circuit of the diode. L-18, L-19, and C-42, form a low pass filter to keep IF frequencies off the grid of the video amplifier.

Since this chassis operates on the intercarrier sound system, the detector heterodynes the video and sound IF frequencies, and produces the 4.5 mc beat frequency which becomes the new audio IF frequency. The negative DC voltage developed at the high side of the detector load R-26

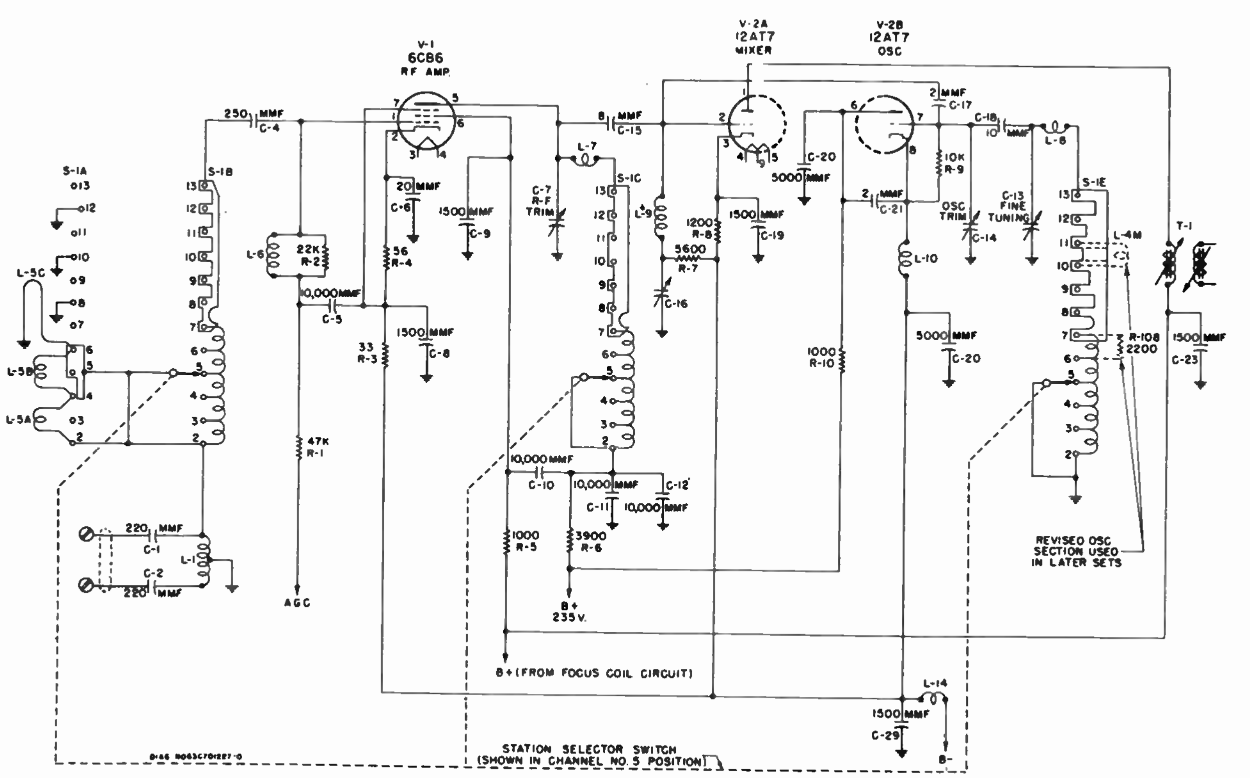

FIGURE 13. SIMPLIFIED SCHEMATIC OF RF TUNER

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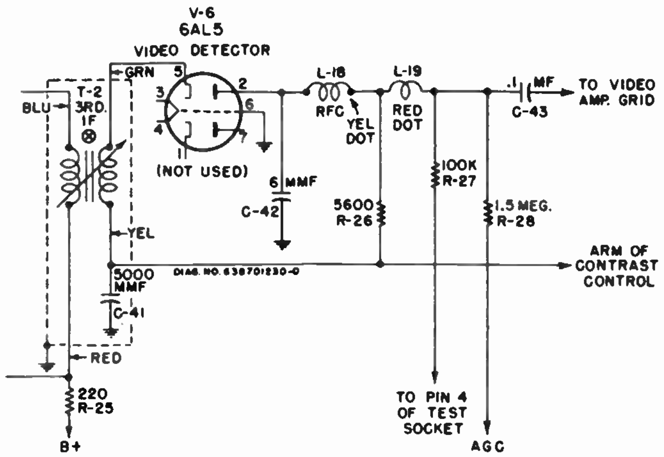

FIGURE 15.
SIMPLIFIED SCHEMATIC OF VIDEO DETECTOR

(5600) will be a function of carrier level. This voltage is fed to the AGC bus thru R-28 (1.5 meg) and controls the gain of the RF and 1st and 2nd IF amplifiers.

THE VIDEO AMPLIFIER

The video amplifier V-7 (6AH6) not only amplifies the video signal but also the 4.5 megacycle audio IF beat. Figure 16 is a schematic of the video amplifier. In its plate circuit, this beat is separated from the video signal and fed to the grid circuit of the audio driver-limiter tube V-8 (6AU6) by C-49 (2.2 mmf) and L-23, the sound take-off coil. The 4.5 mc trap, L-21 and C-50, is a parallel resonant circuit which, when properly tuned, offers a high impedance to this frequency, to prevent its reaching the picture tube.

By applying a negative signal to the grid of the video amplifier, a noise limiting action is achieved because noise pulses of amplitude greater than the sync level will drive the tube to cut off and, therefore, will not be present in the plate circuit. Since a single video amplifier tube is used, the signal at its plate will be positive and, as might be expected, is used to modulate the cathode of the picture tube rather than the grid, because the blanking pulses must cut the picture tube off and the polarity of the video information must be such that dark picture elements result in making the grid more negative with respect to the cathode.

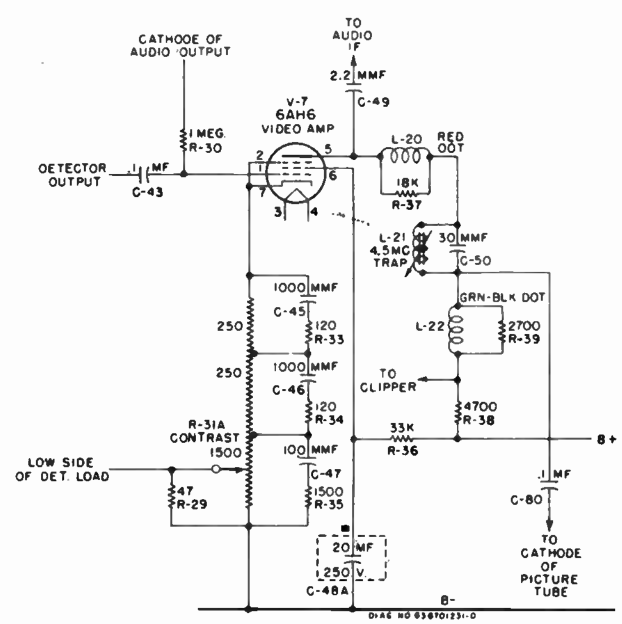

FIGURE 16.
SIMPLIFIED SCHEMATIC OF THE VIDEO AMPLIFIER

L-20 and L-22 are peaking coils to extend the high frequency response of the amplifier. The contrast control, R-31A, is placed in the cathode circuit of the video amplifier and controls the bias and, therefore, the gain of this tube. The network of resistors and condensers across taps on the contrast control decreases degeneration at the higher frequencies and, therefore, helps to extend the high frequency response. The composite video signal is fed to the picture tube cathode thru coupling condenser C-80 (.1).

THE AGC

The negative DC voltage developed across the detector load resistor, R-26 (5600), is the AGC voltage. It will be noted that the low side of this resistor is connected to the arm of the contrast control potentiometer, R-31A. R-29 (47) is shunted across the arm of the contrast control and B-. In weak signal areas, this arrangement results in delay in the AGC action. For a weak signal, minimum bias is desired on the video amplifier, therefore, the arm of the contrast control will be closest to the cathode end of the potentiometer. Because R-29 is then shunted across the entire contrast control, most of the plate current will flow thru it and develop a positive voltage of approximately one volt at the arm with respect to B-. Since the low side of the detector load is tied to this positive voltage, no AGC voltage will develop until the signal is strong enough to overcome this positive voltage and, therefore, no AGC bias is applied to the controlled tubes under weak signal conditions. In a strong signal area, however, where the arm of the contrast control approaches the B- end of the control, R-29 is shorted out and full AGC voltage is developed.

THE AUDIO SYSTEM

The audio system employs a driver-limiter. V-8 (6AU6); a ratio detector V-9 (6AL5); a first audio amplifier, V-10 (6J5), and an audio output tube, V-11 (6V6). Figure 17 is a schematic of the audio system. The driver-limiter is operated at low plate and screen voltages to act as a partial limiter to minimize any amplitude modulation. A conventional ratio detector and audio amplifier are used.

THE CLIPPER

The clipper uses a 6SN7GT tube. The clipper schematic is shown in Figure 18. The composite video signal with positive going sync is applied thru R-55 (10K) and C-66 (.005) to the grid of the first clipper from the plate circuit of the video amplifier. Under no signal conditions, the tube is unbiased. The positive signal, however, will cause the tube to draw grid current and the voltage drop across R-54 (1 meg), negative at the grid, will charge C-66 to such a value that only the most positive part of the signal, which is the sync pulse, will cause plate current to flow. Therefore, the video information and the blanking pulses are clipped off and only the sync pulses, now negative in polarity, appear in the plate circuit. The second clipper is so biased that the peaks of the sync pulses will drive the tube to cut-off, which results in squared pulses of positive polarity in the plate circuit of this tube. A slight increase in sync pulse amplitude is obtained by a small positive voltage applied to the grid of the second clipper by R-107 (330K).

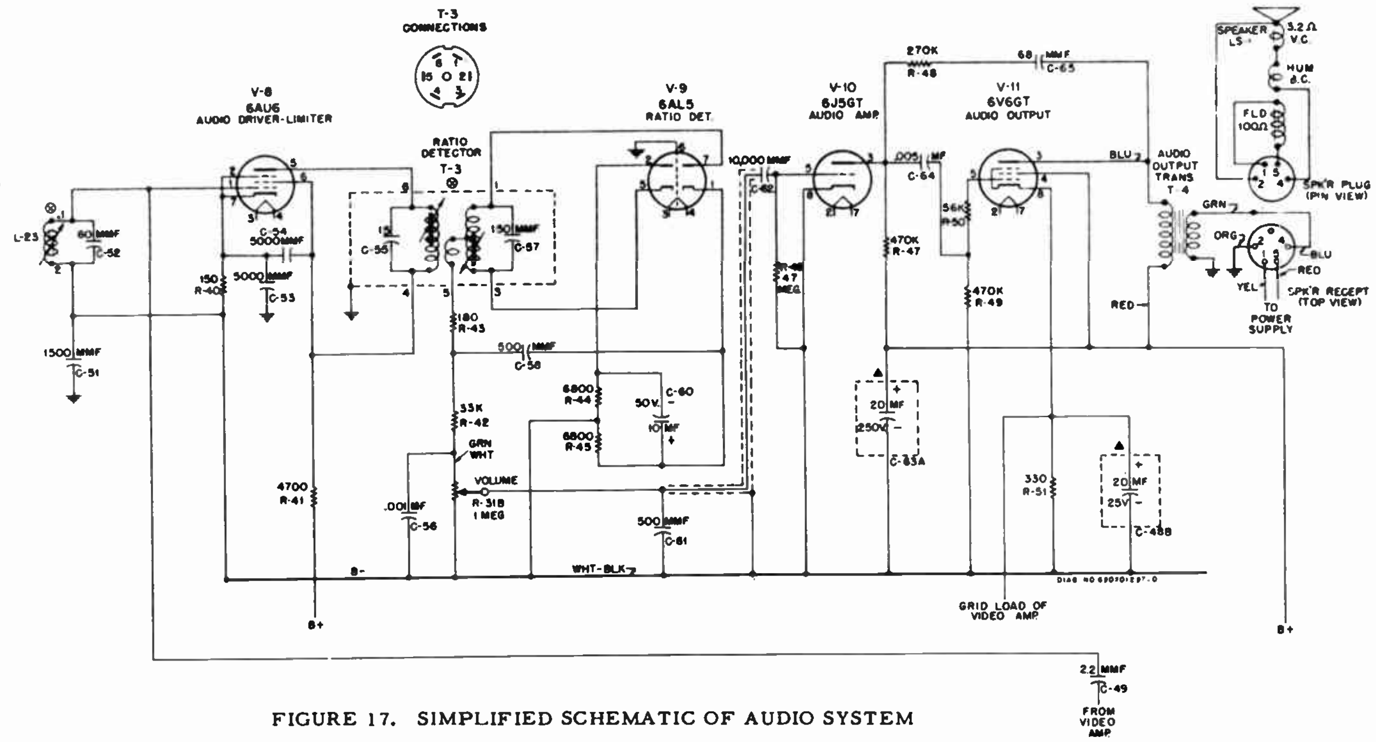

FIGURE 17. SIMPLIFIED SCHEMATIC OF AUDIO SYSTEM

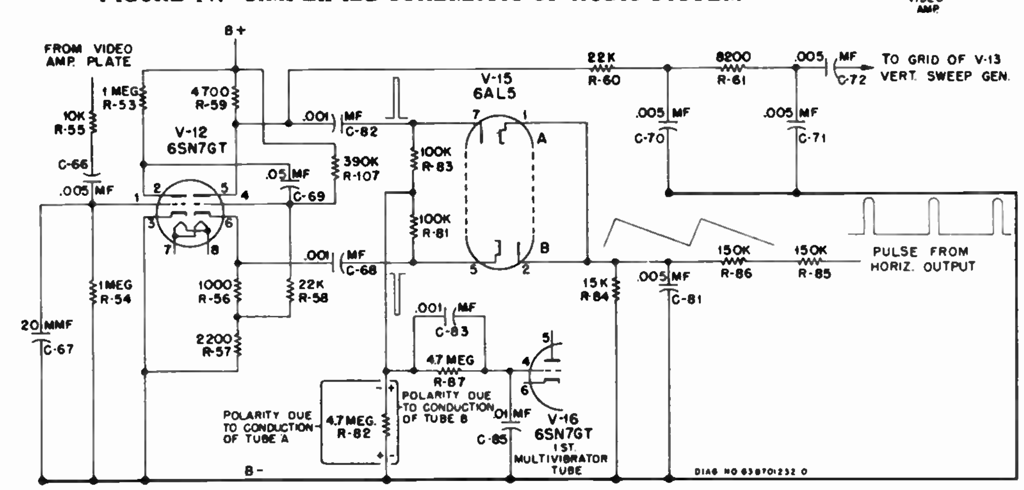

FIGURE 18. SIMPLIFIED SCHEMATIC OF CLIPPERS AND PHASE DETECTOR

THE VERTICAL SCANNING SYSTEM

Figure 19 is a schematic of the Vertical Scanning System.

The integrating network, shown in Figure 18, composed of R-60, C-70, R-61, and C-71, changes the vertical group of sync pulses into a single pulse of suitable amplitude to trigger the vertical oscillator. The vertical oscillator is an asymmetrical multivibrator using two tubes V-13 (6J5) and V-14 (25L6). V-14 also serves as the output tube.

A multivibrator can be considered as a resistance coupled amplifier in which the output of the second tube is coupled back to the input of the first tube. V-13 is the automatic switch which charges and discharges the sawtooth forming condenser C-74 (.05), connected in its plate circuit. The circuit components of the multivibrator are chosen so that V-13's conductance period is about 7% of the entire cycle, to insure that retrace time of the scan will have the proper relationship with the trace time. This circuit is modified from the conventional resistance coupled multivibrator in that the plate of the output stage, which is also the second multivibrator tube, has a fairly large value of inductance, introduced by the output transformer stepping up the yoke inductance. When the tube is cut off, a positive pulse of several hundred volts is developed across this inductance. A portion of this pulse, obtained by means of the feedback network, R-72, R-73, R-74 and C-76, C-77 and C-78, is used to cause the discharge tube V-13 to go into heavy conduction.

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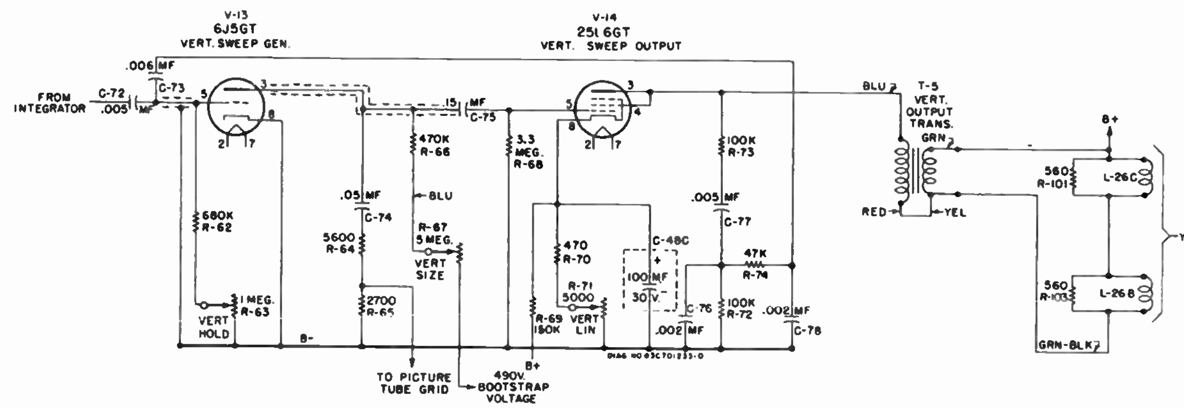

FIGURE 19. SIMPLIFIED SCHEMATIC OF VERTICAL SCANNING SYSTEM

For purposes of explaining the circuit action, assume a time has been reached in the cycle when the trace period is almost completed. During this trace period, V-13 is cut off and V-14 is conducting. C-73 has been discharging thru the grid resistors of V-13, R-62 (680K) and R-63 (the vertical hold control) and resistors R-74 and R-72. This discharge circuit makes the grid end of R-62 negative and biases the tube beyond cut-off. When the energy stored in the condenser has decreased sufficiently, the grid of V-13 reaches the threshold of conductance and the tube begins to draw current. Condenser C-75, which has been charged to nearly the B plus voltage, now starts to discharge thru V-13 and R-68 (3.3 meg) and this discharge current makes the grid end of R-68 negative tending to cut off V-14, and initiates the retrace. With the sudden change of plate current in V-14 developed across the plate inductance, a positive pulse is applied to the grid of V-13 through the feedback network driving this tube into heavy conduction. C-74 will then discharge thru V-13. The voltage developed at the plate of V-13 will be the combination sawtooth and pulse voltage shown in Figure 22(1). The pulse is formed by the peaking resistors R-64 and R-65. When V-13 goes into conduction, the voltage at the plate of V-13 drops suddenly to a value determined by the relationship of the plate resistance of V-13 to the total resistance in the discharge circuit of C-74, which consists of R-64, R-65 and the plate resistance of V-13. After this initial instant, the charge on C-74 decreases, causing the voltage decrease at the plate shown between points "c" and "d" of Figure 22(1). When the positive pulse on the grid of V-13 has decreased to the value where the negative charge on C-73 becomes operative and cuts off V-13, the voltage on the plate of V-13 and correspondingly on the grid of V-14, rises quickly to point "a" on the curve, the start of the trace.

The negative pulse shown between points "b" and "a" of Figure 22(1) acting on the grid of V-14, tends to cut the tube off and raises its plate resistance to the larger value required to dissipate the energy in the plate circuit inductance during the short retrace period.

Since the plate circuit of the vertical output stage V-14 has inductance, and as the time constant of an inductive circuit decreases with an increase of resistance, just the opposite of an RC circuit, the increase in plate resistance of the tube is used to obtain the short time constant circuit required for proper retrace time.

By returning the grid of the picture tube to the junction of the two peaking resistors, R-64 and R-65, a negative pulse of suitable amplitude to cut the picture tube off during retrace is obtained, resulting in elimination of retrace lines on the screen.

The feedback network to the grid of V-13 also serves to filter out horizontal pulses which are present in the plate of V-14 due to coupling in the yoke and which are coupled to the plate thru the output transformer. The windings of the vertical output transformer are connected series opposing, which reduces the step-down ratio and, hence, the inductance in the plate of V-14 in order to shorten the retrace time.

The controls found in this circuit are:

1. The Vertical Hold Control R-63 (1 meg). This control varies the resistance in the discharge circuit of C-73 (.006) and, hence, provides a means of varying the frequency of the multivibrator. In practice, this control is adjusted so that the incoming positive sync pulses, which are of constant amplitude, will fire the tube in exact synchronization with the transmitting station's vertical scan.

2. The Vertical Size Control R-67 (5 meg). This control varies the charging current into C-74 (.05) and, hence, the amplitude of the voltage developed across it. Variation of this voltage varies the drive on the grid of V-14 and controls vertical size.

3. Vertical Linearity R-71 (5000). This control, by bleeder action thru resistor R-69 (150K) and the output tube's plate current, sets the bias and determines the tube's operating point on its plate current curve. Since this curve is not linear, some distortion can be introduced to counteract any non-linearity in the sawtooth grid voltage.

Since all of these controls are also in the multivibrator circuit and have an effect also on its frequency, there will be some interaction between them. Usually readjustment of size or linearity will require readjustment of the hold control.

HORIZONTAL SCANNING SYSTEM

The horizontal scanning system comprises a phase detector V-15 (6AL5), and a cathode coupled multivibrator V-16 (6SN7), the output tube V-17 (6BQ6) and a damping diode V-18 (6W4). Figure 20 is a simplified schematic of this system.

Horizontal Oscillator

In order to see how the phase detector automatically corrects for multivibrator frequency change, it will be necessary to understand how the correction voltage affects the multivibrator. It will be noted that this circuit differs from the vertical multivibrator in that only one coupling condenser is used but that the two tubes have a common cathode resistor. This arrangement is known as a cathode coupled multivibrator.

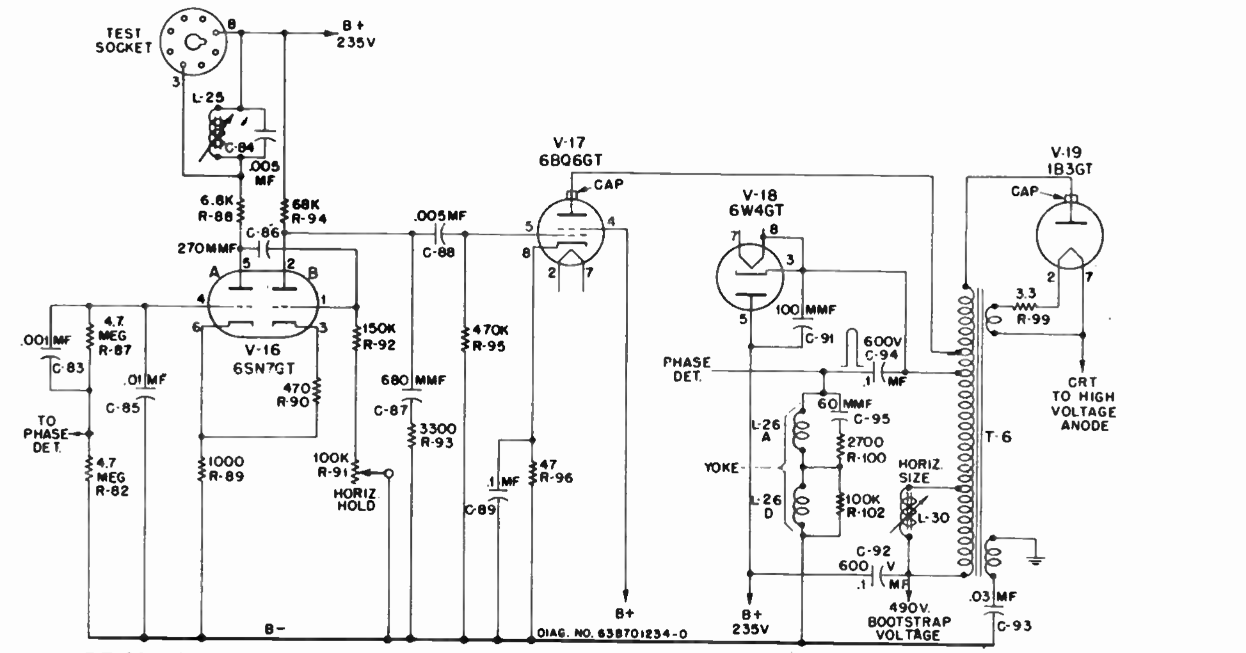

FIGURE 20. SIMPLIFIED SCHEMATIC OF HORIZONTAL SCANNING AND HIGH VOLTAGE SYSTEM

The operation is as follows. Assume that the trace period is almost completed. At this time, tube "A" is conducting, tube "B" is cut off. C-86 is discharging thru tube "A", R-92 (150K) and R-91 (the hold control). The discharge current of C-86 is still high enough to keep the grid of tube "B" negative and cut off. Bias is being applied to both tubes by current flow thru R-89 (1000) the common cathode resistor. When the energy stored in C-86 is reduced to the point where its discharge current no longer holds the grid of tube "B" below conductance, tube "B" starts to pass current and this current causes a greater voltage drop across R-89, the common cathode resistor, which increases the bias on tube "A" reducing its plate current. The resulting increase in voltage at the plate of tube "A" begins to charge C-86 and this charging current applies positive voltage to the grid of tube "B". The resulting heavier conduction of tube "B" develops a pulse of voltage across R-89 which cuts tube "A" off and results in a positive pulse at the plate of tube "A" which throws tube "B" into heavy conduction. This allows C-87, the saw-forming condenser to discharge thru tube "B" and R-93. When C-86 becomes charged the charging current thru R-92 and R-91 decreases and the positive voltage on the grid, which has far exceeded the bias developed across R-89, is reduced. This results in reducing the plate current thru tube "B" and, therefore, the bias applied to tube "A" by the voltage drop across R-89. Tube "A" starts to conduct and condenser C-86 starts to discharge, cutting tube "B" off. C-87 begins to charge, starting the next trace.

L-25 and C-84 in the plate circuit of tube "A", form a resonant circuit which is tuned to the horizontal frequency (15,750 cps). The 15,750 cycle sine wave generated by this circuit, if properly phased, will insure that the positive pulse at the plate of tube "A", which throws tube "B" into conduction, will be more frequency stable.

C-87 and R-93, the peaking resistor, will produce the same combination pulse and sawtooth voltage shown in Figure 22(1). This action was explained in the vertical circuit.

The Phase Detector

The foregoing explanation is based on the assumption that tube "A's" grid is returned to a fixed potential point. It can be seen that if this grid is returned to a point which varies in potential with frequency of the multivibrator, it would be possible to make this variation a means of frequency control. Assume that the grid of "A" in Figure 20 is made more positive. This causes the bias of "B" to increase because of the increased drop across the common cathode resistor R-89. Capacitor C-86 will then discharge for a longer time before "B" conducts, thereby decreasing the frequency of oscillation. If the grid were made more negative, the bias across the common cathode resistor would be less and C-86 would discharge for less time before "B" started to conduct, thereby increasing the frequency.

Figure 18 is a simplified schematic of the clipper and phase detector circuits. The phase detector V-15 (6AL5) is so connected that a comparison of the phase of the incoming sync pulses and a sawtooth derived from the horizontal output system is made. A positive sync pulse from the plate of the 2nd clipper V-12 (6SN7) is fed thru C-82 (.001) to the plate of diode "A" of V-15. A negative sync pulse from the cathode of V-12 is applied thru C-68 (.001) to the cathode of diode "B" of V-15. A sawtooth, derived from the integration of a pulse in the horizontal output circuit, at the yoke, by the integrating network, composed of R-86 (150K), R-85 (150K), and C-81 (.005) is applied to the cathode of diode "A" and the plate of diode "B", which are tied together and returned to B- thru R-84 (15K). The load for diodes "A" and "B" consists of resistors R-83 (100K) and R-81 (100K) whose junction returns to the high side of the grid resistor R-82 of the first horizontal multivibrator tube V-16 (6SN7). The voltage applied to the two diodes will be a function of the amplitude of the sawtooth, the amplitude of the sync pulses and the phase relationship between the pulses and the sawtooth.

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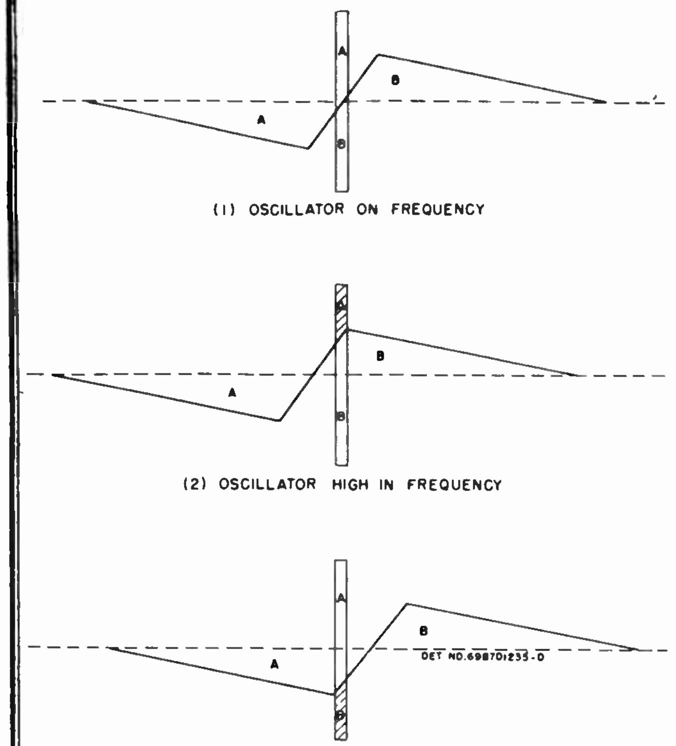

FIGURE 21. WAVEFORMS AT PHASE DETECTOR

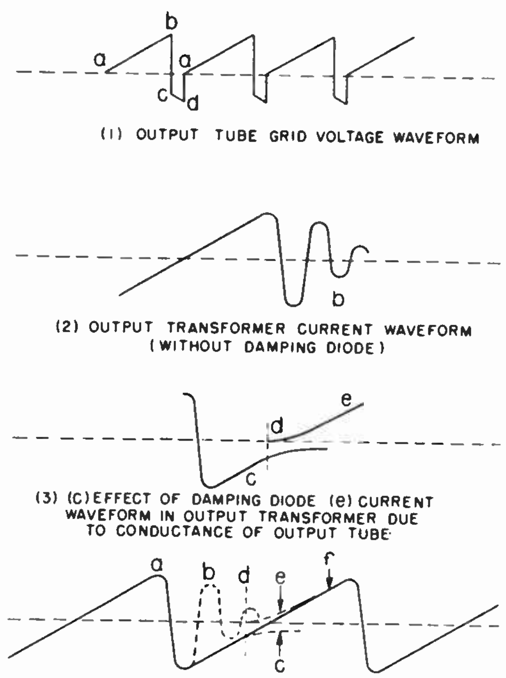

FIGURE 22. WAVEFORMS IN HORIZONTAL SCANNING SYSTEM

If the sawtooth, whose phase and frequency are a function of the multivibrator's phase and frequency, is operating in the middle of the lock-in range, the sync pulse will occur in the center of the retrace time. See Figure 21(1). The sync pulses have an amplitude of from 6 to 8 volts while the sawtooth amplitude is about two volts. The RC time constant in the pulse input circuit to the diodes is long enough to maintain an average pulse voltage of 6 to 8 volts for two or three horizontal lines, which means that in the "on" frequency condition shown in Figure 21(1), the diodes conduct only on the pulses and since these are equal in amplitude and develop voltages of opposite polarity across R-82 in the first multivibrator grid circuit as shown in Figure 18, no control voltage is applied to the grid of V-16.

If the oscillator tends to increase in frequency, with respect to the sync pulses, the phase relationship shown in Figure 21(2) exists at the diodes. The phase of the sawtooth has now shifted so that at the same instant that the pulse is applied to the plate of diode "A" the positive saw is also applied to its cathode, so that only the shaded portion of the pulse causes conduction of diode "A". Diode "B", however, still conducts on the total amplitude of the negative pulse applied to its cathode aided by the positive saw applied to its plate at the same time. Since current flow thru diode "A" makes the grid end of R-82 negative, with respect to B-, the decreased current flow caused by the sawtooth voltage bucking the pulse voltage at diode "A" results in a more positive voltage across R-82 applying a more positive voltage to the grid of V-16 which, as we have seen, results in decreasing the oscillator's frequency.

If the oscillator tends to decrease in frequency, with respect to the sync pulses, the phase relationship shown in Figure 21(3) exists at the diodes. At the same instant that the negative pulse is applied to the cathode of diode "B", the negative saw is applied to its plate so that only the shaded portion of the pulse causes conduction. Diode "A", however, conducts on the full amplitude of the positive pulse applied to its plate aided by the negative saw applied to its cathode at the same time. Since current flow thru diode "B" makes the grid end of R-82 positive, with respect to B-, the decreased current thru diode "B" results in applying a more negative voltage to the grid of V-16 which, as we have seen, results in increasing the oscillator frequency. C-83, R-87 and C-85 provide two time constant filters which are necessary to obtain "fly-wheel" action of this AFC sync circuit.

The Horizontal Output System

The combination sawtooth and pulse waveform developed across C-87 (680) and R-93 (3300) by the multivibrator circuit, is fed to the grid of the horizontal output tube V-17 (6BQ6). Figure 20 is a simplified schematic of the horizontal output system. It will be noted that in this system an auto-transformer is used. In the horizontal scan it is necessary that retrace be completed in about 7 microseconds. In order to accomplish reversal of current in the inductance of the output transformer and the yoke in this short a time, it is necessary to make this circuit resonant at such a frequency that the half cycle time will equal 7 microseconds, because only by shock exciting such a circuit into oscillation will retrace be accomplished in the time allowed. The circuit is made resonant by the inductance of the output transformer and yoke, the distributed capacity and the tube capacity. Bearing this in mind, the operation can be explained as follows. Referring to Figure 22(1), assume that the voltage on the grid of the output tube is increasing, point "a". The grid is now being made less negative and the output tube starts to draw current which is supplied from B plus thru the damping diode. When point "b" is reached on the grid voltage waveform, the output tube is suddenly cut off because its grid has been made highly negative, (point "c" on the grid voltage waveform). With the tube cut off, the resonant plate load is undamped and the circuit is shocked into oscillation. The reversal of current through the output inductance produces a positive voltage pulse which makes the cathode of the damping diode (V-18) positive, with respect to its plate; therefore, it cannot conduct. C-91 (100) is placed across the diode to provide a low impedance for the oscillatory current. If the damping diode V-18 were not present, this oscillation would continue and current would flow in the output transformer as shown in Figure 22(2). In order to insure a linear trace, however, this oscillation must be stopped and the damping diode serves this purpose. When the current nears its maximum negative value, the polarity and amplitude of the voltage pulse on the damping diode is such that its plate becomes positive, with respect to its cathode, so that the tube conducts heavily and loads the circuit sufficiently to prevent continuation of the oscillation. The current then follows the decay curve shown at "c" in Figure 22(3). At the time ["d" in Figure 22(3)] the voltage at the grid of the output tube has become less then cut off [point "a" in Figure 22(1)] and the tube again demands current. The rising current in the tube results in superimposing the waveform "e" of Figure 22(3) on the current flow already in the output transformer due to the decaying current which resulted from the damped oscillation. Combination of these two currents results in the linear trace current indicated at "f" in Figure 22(4), which is a composite waveform of the entire action. During the peak conduction of the damping diode, C-92 (.1) charges and its polarity is such that when the output tube calls for current the charge on the condenser will be in series with the B plus supply so that the voltage at the output tube plate is raised from the 250 volt B plus supply to about 475 volts by this so-called "bootstrap" voltage. When the grid voltage waveform of the output tube again reaches point "b" of Figure 22(1), the tube is cut off and another cycle starts.

In order to properly match the yoke inductance to the required output inductance for the tube, the yoke is connected to a tap on the winding which effectively makes an auto-transformer of this section. The positive pulse of voltage at this tap is coupled to the yoke thru C-94 (.1) and results in a sawtooth of current thru the yoke. It will be remembered that a portion of this pulse is also fed to the phase detector for the AFC action thru R-86 and R-85.

The small additional winding, one terminal of which is connected to chassis while the other terminal is connected to B- thru C-93 (.03) is used to cancel the pulse of voltage which is placed on the chassis by induction from the output transformer. By connecting this winding in such a way as to place a pulse of suitable amplitude on the chassis 180 degrees out of phase with the induced voltage, cancellation of the induced voltage will take place.

High Voltage

To take advantage of the large voltage pulse developed across the output inductance by the heavy current flow caused by the retrace oscillation, the plate winding is made the primary of an auto-transformer whose step-up ratio is such as to develop pulses of about 12 Kv at its high end. These pulses are rectified by V-19 (1B3) and the resulting DC is applied to the second anode of the picture tube. The filament voltage for the 1B3 rectifier is obtained from an additional winding on the output transformer.

Controls

L-25 is the coil of the sine wave generating circuit in the horizontal multivibrator circuit and should be tuned to 15,750 cycles as explained in the service instructions.

R-91 is the horizontal hold control which can be adjusted for correct frequency operation of the multivibrator.

L-30, paralleling a small portion of the output choke controls, to a small degree, the inductance of the choke and acts as a size control.

REPLACEMENT PARTS LIST

Ref. No.	Part No.	Description
CHASSIS PARTS - ELECTRICAL		
Capacitors		
C-1	21K77375	Ceramic tubular: 220 mmf 500V......
C-2	21K77375	Ceramic tubular: 220 mmf 500V......
C-3		(See tuning unit parts list)
C-4	21K77375	Ceramic tubular: 220 mmf 500V......
C-5	21K482726	Ceramic disc: 10,000 mmf 450V......
C-6	21K490799	Ceramic tubular: 20 mmf 500V.......
C-7	1X790189	Trimmer, ceramic: .5-3 mmf; includes screw and mtg nut........
C-8	21A470790	Ceramic disc: 1500 mmf 500V........
C-9	21A470790	Ceramic disc: 1500 mmf 500V........
C-10	21K482726	Ceramic disc: 10,000 mmf 450V......
C-11		(See tuning unit parts list)
C-12		(See tuning unit parts list)
C-13		Fine Tuning trimmer (part of station selector switch)..........
C-14	1X790189	Trimmer, ceramic: .5-3 mmf; includes screw and mtg nut........
C-15	21K478234	Molded: 8 mmf 500V.................
C-16	1X792784	Trimmer, ceramic: 3-13 mmf; includes screw and mtg nut........
C-17	21K478280	Molded: 2 mmf 500V temp comp.......
C-18		(See TT-11 & TT-13 parts list)
C-19	21A470790	Ceramic disc: 1500 mmf 500V........
C-20	21A470789	Ceramic disc: 5000 mmf 450V........
C-21	21K478280	Molded: 2 mmf 500V temp comp.......
C-22	21A470789	Ceramic disc: 5000 mmf 450V........
C-23	21A470790	Ceramic disc: 1500 mmf 500V........
C-24	21A470790	Ceramic disc: 1500 mmf 500V........
C-25	8R9810	Paper: .25 mf 100V.................
C-26	21A470789	Ceramic disc: 5000 mmf 450V........
C-27	21A470789	Ceramic disc: 5000 mmf 450V........
C-28	21A470789	Ceramic disc: 5000 mmf 450V........
C-29	21A470789	Ceramic disc: 5000 mmf 450V........
C-30	21K77375	Ceramic tubular: 220 mmf 500V......
C-31	21K470329	Molded: 30 mmf 500V temp comp......
C-32	21K482726	Ceramic disc: 10,000 mmf 450V......
C-33	21A470789	Ceramic disc: 5000 mmf 450V........
C-34	21A470790	Ceramic disc: 1500 mmf 500V........
C-35	21A470789	Ceramic disc: 5000 mmf 450V........
C-36	21A470790	Ceramic disc: 1500 mmf 500V........
C-37	21A470790	Ceramic disc: 1500 mmf 500V........
	21A470789	Ceramic disc: 5000 mmf 450V (suggested replacement value).....
C-38	21K470329	Molded: 30 mmf 500V temp comp......
C-39	21A470789	Ceramic disc: 5000 mmf 450V........
C-40	21A470789	Ceramic disc: 5000 mmf 450V........
C-41	21A470789	Ceramic disc: 5000 mmf 450V........
C-42	21K470324	Molded: 6 mmf 500V.................
C-43	8R9854	Paper: .1 mf 200V..................
C-45	21K780599	Ceramic tubular: 1000 mmf 500V.....
C-46	21K780599	Ceramic tubular: 1000 mmf 500V.....
C-47	21B77286	Ceramic tubular: 100 mmf 500V......
C-48 A,B, C&D	23B790148	Electrolytic: 4-section; A-20 mf/250V, B-20 mf/25V, C-100 mf/30V, D-120 mf/300V..........................
C-49	21A478274	Molded: 2.2 mmf 500V...............
C-50	21K470329	Molded: 30 mmf 500V................
C-51	21A470790	Ceramic disc: 1500 mmf 500V........
C-52	21K790683	Molded: 60 mmf 500V................
C-53	21A470789	Ceramic disc: 5000 mmf 450V........
C-54	21A470789	Ceramic disc: 5000 mmf 450V........
C-55	21K790439	Silver mica: 15 mmf (part of T-3 base)...........................
C-56	8R9866	Paper: .001 mf 600V................
C-57	21A790131	Ceramic tubular: 150 mmf (in T-3 can)............................
C-58	21R6590	Mica: 500 mmf 500V.................
C-59	21A470790	Ceramic disc: 1500 mmf 500V........
C-60	23A90205	Electrolytic: 10 mf 50V............
C-61	21R6590	Mica: 500 mmf 500V.................
C-62	21K482726	Ceramic disc: 10,000 mmf 450V......

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Ref. No.	Part No.	Description
C-63 A,B, &C	23B790147	Electrolytic: 3-section; A-20 mf/250V, B-60 mf/250V, C-100 mf/300V
C-64	21A470789	Ceramic disc: 5000 mmf 450V
C-65	21R6642	Mica: 68 mmf 500V
C-66	8R9869	Paper: .005 mf 600V
C-67	21K470322	Molded: 20 mmf 500V
C-68	8R9866	Paper: .001 mf 600V
C-69	8R9873	Paper: .05 mf 600V
C-70	8R9869	Paper: .005 mf 600V
C-71	8R9869	Paper: .005 mf 600V
C-72	8R9869	Paper: .005 mf 600V
C-73	8K790026	Paper: .006 mf 600V
C-74	8R9873	Paper: .05 mf 600V
C-75	8R9875	Paper: .15 mf 600V
C-76	8R9866	Paper: .001 mf 600V
	8R9867	Paper: .002 mf 600V (suggested replacement value)
C-77	8R9869	Paper: .005 mf 600V
C-78	8R9867	Paper: .002 mf 600V
C-79	21A470789	Ceramic disc: 5000 mmf 450V
C-80	8R9874	Paper: .1 mf 600V
C-81	8R9869	Paper: .005 mf 600V
C-82	8R9866	Paper: .001 mf 600V
C-83	8R9866	Paper: .001 mf 600V
C-84	8R9869	Paper: .005 mf 600V
C-85	8R9870	Paper: .01 mf 600V
C-86	21K400037	Ceramic tubular: 270 mmf 500V
C-87	21R2741	Mica: 680 mmf 500V
C-88	21A470789	Ceramic disc: 5000 mmf 450V
C-89	8R9854	Paper: .1 mf 200V
C-91	21K792438	Ceramic tubular: 100 mmf 3000V
C-92	8R9874	Paper: .1 mf 600V
C-93	8R9872	Paper: .03 mf 600V
C-94	8R9875	Paper: .15 mf 600V
	8R9874	Paper: .1 mf 600V (suggested replacement value)
C-95	21K790574	Ceramic tubular: 60 mmf 1500V (in deflection yoke)
C-96	21A470790	Ceramic disc: 1500 mmf 500V
C-97	21A470790	Ceramic disc: 1500 mmf 500V
C-98	21A470790	Ceramic disc: 1500 mmf 500V
C-99	21A470790	Ceramic disc: 1500 mmf 500V
C-100	21A470790	Ceramic disc: 1500 mmf 500V
C-101	21A470790	Ceramic disc: 1500 mmf 500V
C-102	21A470790	Ceramic disc: 1500 mmf 500V
C-103	21K77375	Ceramic tubular: 220 mmf 500V
C-104	21K77375	Ceramic tubular: 220 mmf 500V
C-105	21B482295	Ceramic tubular: 250 mmf 500V
C-106	21B482295	Ceramic tubular: 250 mmf 500V
C-107	21A470790	Ceramic disc: 1500 mmf 500V
C-108	23B484097	Electrolytic: 1-section; 140 mf 150V

Rectifiers

E1,2	48B700555	Rectifier, selenium: 300 ma

Coils

Ref. No.	Part No.	Description
L-1	24A790033	Antenna impedance Matching Coil
L-2		(See TT-11 & TT-13 parts list)
L-3		(See TT-11 & TT-13 parts list)
L-4		(See TT-11 & TT-13 parts list)
L-4M		(See TT-11 & TT-13 parts list)
L-5		(See TT-11 & TT-13 parts list)
L-6	24K791446	RF Choke: molded; 10 microhenries
L-7	24K792825	RF Coil: channel 13
L-8		(See TT-11 & TT-13 parts list)
L-9	24K792577	RF Choke: molded; 3.3 microhenries.
L-10	24K780128	RF Choke: molded; 2.2 microhenries.
L-11	24K790035	RF Choke: molded; 5.6 microhenries
L-12	24B792586	1st IF: complete with trap L-13 & C-31, cores, and mtg nuts
L-13		27.3 mc trap (part of L-12)
L-14	24K790145	RF Choke: molded; 0.47 microhenries
L-15	24K790035	RF Choke: molded; 5.6 microhenries.
L-16	24K792587	2nd IF: complete with trap L-17 and C-38, cores, & mtg nuts
L-17		21.9 mc trap (part of L-16)
L-18	24K792771	RF Choke: yellow dot
L-19	24K792772	RF Choke: red dot
L-20	24A790579	Compensating coil: red dot (wound on R-37)
L-21	24B792735	4.5 mc trap: less core & clip
L-22	24A792588	Compensating coil: grn-blk dot (wound on R-39)
L-23	24A470159	Sound take-off: less core & mtg nut
L-24	24K700655	Focus Coil
L-25	24K790059	Horizontal Oscillator: less core and clip
L-26	24K792758	Deflection yoke: complete
	or 24K792759	Deflection yoke: complete
L-27	24K790145	RF Choke: molded; 0.47 microhenries
L-28	24K790145	RF Choke: molded; 0.47 microhenries
L-29	24K790145	RF Choke: molded; 0.47 microhenries
L-30	24K700089	Horizontal size: less core & mtg nut

Speakers

LS-1	50C790154	
	or 50C791779	5" electrodynamic: 3.2 ohm voice coil; 100 ohm field coil (hot): 12T2, 12T3
	50K791483	
	or 50K791867	6" electrodynamic: 3.2 ohm voice coil; 100 ohm field coil (hot); 12T1
	50C791118	8" electrodynamic: 3.2 ohm voice coil; 100 ohm field coil (hot); 12K1, 12K2, 12K3

Resistors

Note: All resistors are insulated carbon type unless otherwise specified.

Ref. No.	Part No.	Description
R-1	6R6048	47,000 10% 1/2W
R-2	6R6397	22,000 10% 1/2W
R-3	6R2036	33 10% 1/2W
R-4	6R5614	56 10% 1/2W
R-5	6R6229	1000 10% 1/2W
R-6	6R5659	3900 10% 1/2W
R-7	6R6117	5600 10% 1/2W
R-8	6R6393	1200 10% 1/2W
R-9	6R6320	10,000 10% 1/2W
R-10	6R6229	1000 10% 1/2W
R-11	6R6428	6800 10% 1/2W
R-12	6R2036	33 10% 1/2W
R-13	6R5550	47 10% 1/2W
R-14	6R6270	220 10% 1/2W
R-15	6R6270	220 10% 1/2W
R-16	6R6229	1000 10% 1/2W
R-17	6R6394	12,000 10% 1/2W
R-18	6R2036	33 10% 1/2W
R-19	6R5550	47 10% 1/2W
R-20	6R6270	220 10% 1/2W
R-21	6R6270	220 10% 1/2W
R-22	6R6428	6800 10% 1/2W
R-23	6R2035	82 10% 1/2W
R-24	6R6270	220 10% 1/2W
R-25	6R6270	220 10% 1/2W
R-26	6R6117	5600 10% 1/2W
R-27	6R6031	100,000 10% 1/2W
R-28	6R6460	1.5 meg 10% 1/2W
R-29	6R5550	47 10% 1/2W
R-30	6R6004	1 meg 20% 1/2W
R-31 A & B	18A792009	Contrast & Volume Control, dual: 2000 & 1 meg respectively; with power switch
R-33	6R5551	120 10% 1/2W
R-34	6R5551	120 10% 1/2W
R-35	6R6038	1500 10% 1/2W
R-36	6R6400	33,000 10% 1W
R-37		18,000 10% 1/2W (not replaceable-part of L-20)
R-38	6R5671	4700 10% 2W
R-39		2700 10% 1/2W (not replaceable part of L-22)
R-40	6R6373	150 10% 1/2W
R-41	6R6080	4700 10% 1/2W
R-42	6R6410	33,000 10% 1/2W
R-43	6R5660	180 10% 1/2W
R-44	6R6428	6800 10% 1/2W
R-45	6R6428	6800 10% 1/2W
R-46	6R6446	4.7 meg 10% 1/2W
R-47	6R6377	470,000 10% 1/2W
R-48	6R6414	270,000 10% 1/2W
R-49	6R6377	470,000 10% 1/2W
R-50	6R6378	56,000 10% 1/2W
R-51	6R6022	330 10% 1/2W
R-52	6R6229	1000 10% 1/2W
R-53	6R6004	1 meg 20% 1/2W
R-54	6R6004	1 meg 20% 1/2W
R-55	6R6320	10,000 10% 1/2W
R-56	6R6229	1000 10% 1/2W
R-57	6R6069	2200 10% 1/2W
R-58	6R6397	22,000 10% 1/2W
R-59	6R6117	5600 10% 1/2W
	6R6080	4700 10% 1/2W (suggested replacement value)
R-60	6R6397	22,000 10% 1/2W
R-61	6R2004	8200 10% 1/2W
R-62	6R6475	680,000 10% 1/2W
	6R6377	470,000 10% 1/2W (suggested replacement value)
R-63	18A90147	Vertical Hold Control: 1 meg
R-64	6R6117	5600 10% 1/2W
R-65	6R5577	2700 10% 1/2W
R-66	6R6377	470,000 10% 1/2W
R-67	18A90145	Vertical Size Control: 5 meg
R-68	6R6497	3.3 meg 10% 1/2W
R-69	6R6398	150,000 10% 1/2W
R-70	6R6090	470 10% 1/2W
R-71	18A791132	Vertical Linearity Control: 5000
R-72	6R6031	100,000 10% 1/2W
R-73	6R6031	100,000 10% 1/2W
R-74	6R6048	47,000 10% 1/2W
R-75	18A90147	Brightness Control: 1 meg
R-76	6R6004	1 meg 20% 1/2W
R-77	18A790162	Focus control: 2000
R-78	17A791717	Wire wound: 3300 10% 7W
R-79	6R490753	9100 10% 3W (non-insulated)
R-80	6R6048	47,000 10% 1/2W
R-81	6R6031	100,000 10% 1/2W
R-82	6R6446	4.7 meg 10% 1/2W
R-83	6R6031	100,000 10% 1/2W
R-84	6R6477	15,000 10% 1/2W
R-85	6R5721	150,000 10% 1W
R-86	6R5721	150,000 10% 1W
R-87	6R6446	4.7 meg 10% 1/2W
R-88	6R6428	6800 10% 1/2W
R-89	6R6229	1000 10% 1/2W
R-90	6R6090	470 10% 1/2W
R-91	18A791574	Horizontal Hold Control: 100,000
R-92	6R6398	150,000 10% 1/2W
R-93	6R5581	3300 10% 1/2W
R-94	6R6074	68,000 10% 1/2W
R-95	6R6377	470,000 10% 1/2W
R-96	6R5550	47 10% 1/2W
R-97	6R5646	390,000 10% 1/2W
R-98		(See TT-13 parts list)
R-99	17K485412	Wire wound: molded; 3.3 10% 1/2W.
R-100	6R5577	2700 10% 1/2W (in deflection yoke)
R-101	6R6291	560 10% 1/2W (in deflection yoke)
R-102	6R6328	100,000 10% 1W (in deflection yoke)
R-103	6R6291	560 10% 1/2W (in deflection yoke)
R-104	6R6377	470,000 10% 1/2W
R-105	17A791166	Wire wound: 7.5 10% 5W (does not include mounting strip)

Transformers

Ref. No.	Part No.	Description
T-1	24K792578	Mixer IF: less cores & mounting nuts
T-2	24B792585	3rd IF: less core & clip
T-3	24B790125	Ratio Detector: complete less shield can
T-4	25B790686	Audio Output Transformer
T-5	25K791804	
	or 25B792545	Vertical Output Transformer
T-6	24C792596	High Voltage Transformer: complete.
T-7	25B791793	
	or 25B700137	Filament Transformer
T-8	25B790140	Filament Transformer: isolating (for V-18)

Tubes

Ref. No.	Part No.	Description
V-1	6CB6	RF Amplifier
V-2	12AT7	Mixer-Oscillator
V-3	6AU6	1st IF Amplifier
V-4	6AU6	2nd IF Amplifier
V-5	6AG5	3rd IF Amplifier
V-6	6AL5	Video Detector
V-7	6AH6	Video Amplifier
V-8	6AU6	Audio Driver-Limiter
V-9	6AL5	Ratio Detector
V-10	6J5GT	Audio Amplifier
V-11	6V6GT	Audio Output
V-12	6SN7GT	1st & 2nd Clippers
V-13	6J5GT	Vertical Sweep Generator
V-14	25L6GT	Vertical Sweep Output
V-15	6AL5	Phase Detector
V-16	6SN7GT	Horizontal Oscillator
V-17	6BQ6GT	Horizontal Output & HV Generator
V-18	6W4GT	Damping Diode
V-19	1B3GT	High Voltage Rectifier
V-20	12LP4	Picture tube
	12LP4A	Picture tube black

TUNERS

Model TT-11 Tuning Unit

Ref. No.	Part No.	Description
S-1	1X792780	TT-11 tuning unit: includes station selector switch, fine tuning trimmer and the following components:
C-3	21K478234	Capacitor, molded: 8 mmf 500V
C-10	21K482726	Capacitor, ceramic disc: 10,000 mmf 450V
C-11	21K482726	Capacitor, ceramic disc: 10,000 mmf 450V
C-12	21K482726	Capacitor, ceramic disc: 10,000 mmf 450V
C-17	21K478280	Capacitor, molded: 2 mmf 500V
C-18	21K470322	Capacitor, molded: 20 mmf 500V
L-2	24C792764	Coil, antenna: channels 2 through 6; includes L-2A through L-2E (L-2F through L-2L are part of switch)
L-3	24K790536	Coil, RF: Channels 2 through 6; includes L-3A through L-3E (L-3F through L-3L are part of switch)
L-4	24K790537	Coil, oscillator: Channels 2 through 6; includes L-4A through L-4E (L-4F through L-4L are part of switch)
L-5	24K792765	Coil, antenna primary: low frequency; includes L-5A, 5B & 5C
L-8	24K790606	Coil, oscillator: Channel 13
R-6	6R5659	Resistor: 3900 10% 1/2W
	43K790136	Clip, spring: phosphor bronze (on collar)

MODELS 12K1, 12K1B, 12K2, 12K2B, 12K3, 12K3B, 12T1, 12T1B, 12T2, 12T3, Ch. TS-53

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Ref. No.	Part No.	Description
S-1	1X700100	TT-13 tuning unit: includes station selector switch, fine tuning trimmer and the following components:
C-3	21K478234	Capacitor, molded: 8 mmf 500V
C-11	21K482726	Capacitor, ceramic disc: 10,000 mmf 450V
C-12	21K482726	Capacitor, ceramic disc: 10,000 mmf 450V
C-18	21K400173	Capacitor, molded: 10 mmf 500V temp comp
	43K700725	Collar, spring (on rear end of fine tuning shaft)
	47K700726	Shaft, fine tuning

Model TT-13 tuning unit

Note: The TT-13 tuning unit is the revised TT-11 which places the oscillator above the carrier on the three high channels instead of below as in the TT-11. It can be distinguished from the TT-11 by the extra coil across the cut-out section of the plate on the oscillator deck.

L-2	24C792764	Coil, antenna: channels 2 through 6; includes L-2A through L-2E; L-2F through L-2L are part of switch).
L-3	24K790536	Coil, R.F.: channels 2 through 6; includes L-3A through L-3E (L-3F through L-3L are part of switch).
L-4	24C700114	Coil, oscillator: channels 2 through 6; includes L-4A through L-4E (L-4F through L-4L are part of switch)
L-4M	24K700115	Coil, oscillator: channel 10
L-5	24K792765	Coil, antenna primary: low freq; includes L-5A, 5B & 5C
L-8	24K700116	Coil, oscillator: channel 13
R-98	6R6069	Resistor: 2200 10% 1/2W
	42K790136	Clip, spring: phosphor bronze (on collar)
	43K700725	Collar, spring (on rear end of fine tuning shaft)
	47K700726	Shaft, fine tuning

CHASSIS PARTS - MECHANICAL

Part Number	Description
7K485464	Bracket, chassis mtg
7A791168	Bracket, coil mtg (horizontal size coil mtg)
1X792798	Bracket, deflection coil mtg: with yoke bumper mtg brkt, grounding spring & anode lead strip
7B792583	Bracket, focus coil (supports focus coil)
7A791965	Bracket, interlock safety (on chassis rear)
	Bracket, tube positioning (varies with cabinet - see particular cabinet parts list)
7C792737	Bracket, yoke bumper mtg: cad pl (on deflection coil bracket)
35A792454	Bumper, rubber (on each side of picture tube front)
38B792486	Button, plug: 1/2" dia (plugs hole next to focus control)
42K471342	Cap, plate (for high voltage rectifier)
42A5480	Cap, plate (for 6BQ6)
42A700147	Clamp, lead retainer (dresses V-19 filament leads)
42B70721	Clip, coil mtg (T-3 secondary mtg)
42A76244	Clip, coil retainer (L-25)
42A72609	Clip, tube shield grounding (V-10)
42K791405	Connector, 2nd anode: with rubber cap & leads
39K17396	Contact, pin terminal (on speaker leads)
46A478242	Core, brass, & screw (T-2)
46K791756	Core, brass, & screw (L-12 & L-16)
46K480256	Core, iron, & screw (L-13 & T-1 secondary)
46K471143	Core, iron, & screw (L-25)
46A470310	Core, iron, & screw (T-1 primary, L-21 & L-23)
46A70023	Core, iron, & screw (T-3 primary & L-17).
46A470302	Core, iron, & screw (T-3 secondary)
46A700090	Core, iron: with slide adjustment (L-30)
15B791111	Cover, test socket
35A792756	Cushion, focus coil: rubber
35B792739	Cushion, yoke mtg: rubber (circular pad on yoke bumper brkt)
5K470916	Grommet, insulating: 3/16" hole (for V-17 plate cap lead)
5K792031	Grommet, insulating: 9/32" hole (for 2nd anode lead)
5A790684	Grommet, rubber (V-14 & V-16 socket mtg)
14A780184	Insulator, antenna lead (beneath antenna terminal strip)
14K87179	Insulator, coil (in ratio detector can)
14A700081	Insulator, contact strip (wrapped around plug-in resistor receptacle)
9A484098	Insulator, electrolytic mtg: 3-lug; impregnated
9K471267	Insulator, electrolytic mtg: 4-lug; impregnated
14K791892	Insulator, shield (in T-2 shield)
4S7655	Lockwasher, internal: 3/8; cad pl (contrast control & station selector mtg)
4S7666	Lockwasher, external: #6; cad pl (plug-in resistor receptacle mtg).
4S7650	Lockwasher, internal: #6; cad pl (48B700138, 48B700139 & 48B700555 selenium rect mtg)
4S7657	Lockwasher, external: #8; cad pl (48B791694 selenium rectifier mtg)
4S9751	Lockwasher, internal-external: #8; cad pl (deflection yoke adj screw)
29R5239	Lug, soldering: #8 H.T.
2K791404	Nut, coil & core mtg (L-30)
2A470049	Nut, coil & core mtg (T-1, T-2, L-12, L-13, L-16, L-17, L-21 & L-23)
2S7004	Nut, hex: 3/8-32 x 9/16 (contrast control & station selector mtg)
2S7005	Nut, hex: 6-32 x 1/4 stl; cad pl (48B700138, 48B700139 & 48B700555 selenium rect mtg)
2S7003	Nut, hex: 8-32 x 5/16 stl; cad pl (48B791694 selenium rectifier mtg)
2S7051	Nut, hex palnut: 3/8-32 x 9/16; cad pl (rear controls mtg)
2S7050	Nut, hex palnut: 6-32 (T-2 shield mtg)
2B70703	Nut, palnut: special (T-3 primary core mtg)
2A790191	Nut, special: cad pl (mounts trimmers C-7, C-14 & C-16)
35K790637	Pad, cushion: sponge rubber (large pad on tube retainer strap)
35K790169	Pad, cushion: sponge rubber (small pad on tube retainer strap)
35A790110	Pad, cushion: sponge rubber (under picture tube front)
64A700185	Plate, cover (on top rear of chassis)
64K791818	Plate, chassis cover (removable plate on chassis side)
64K792464	Plate, socket cover (covers unused socket hole next to V-17)
28K471323	Plug, line cord: 2-pin (power input)
9A22367	Receptacle: 5-prong (on speaker leads)
5S8497	Rivet: .088 x 1/8 stl; nkl pl (mounts V-1, V-2 & V-5 sockets)
5S7770	Rivet: .088 x 5/32 stl; nkl pl (antenna lead insulator mtg)
5S2815	Rivet: .088 x 7/32 stl; nkl pl (mounts 9K780442 & 9K484167 sockets)
5S7707	Rivet: .122 x 5/32 stl; nkl pl (mounts all octal sockets except V-14, V-16 & V-19)
5S7701	Rivet: .122 x 3/16 stl; nkl pl (mounts plug-in resistor receptacle)
5S7703	Rivet: .122 x 7/32 stl; nkl pl (electrolytic insulator mtg)
5S7700	Rivet: .122 x 1/4 stl; nkl pl (power plug mtg)
5S7728	Rivet: .122 x 5/16 stl; nkl pl (V-19 socket mtg)
5K71246	Rivet, shoulder: nkl pl (V-14 & V-16 socket mtg)
5S6846	Rivet: .145 x 5/32 stl; nkl pl (audio and vertical output trans mtg)
5S6842	Rivet: .145 x 7/32 stl; nkl pl (cover plate mtg)
3S490354	Screw, machine: 6-32 x 5/8 slotted hex head; cad pl (C-7 & C-14 trimmer adj)
3S490822	Screw, machine: 6-32 x 1" slotted hex head; cad pl (C-16 trimmer adj)
3S490459	Screw, machine: 6-32 x 1-1/8 slotted round head; brass (secures HV transformer plates)
3S488195	Screw, machine: 6-32 x 2 plain hex head; cad pl (48B700138 selenium rectifier mtg)
3S400051	Screw, machine: 6-32 x 2-1/2 plain hex head; cad pl (48B700555 & 48B700139 selenium rect mtg)
3S7163	Screw, machine: 8-32 x 1/4 plain hex head; cad pl (mounts high volt rectifier tube mtg plate)
3S7257	Screw, machine: 8-32 x 5/8 plain hex head; cad pl (focus coil bracket adjustment)
3S7454	Screw, sheet metal: #8 x 1/4 PKZ plain hex head; cad pl (filament transformer mtg)
3S3397	Screw, sheet metal: #8 x 5/16 PKZ plain hex head; cad pl (deflection coil support brkt mtg)
3S7467	Screw, sheet metal: #8 x 3/8 PKZ plain hex head; cad pl (T-8 mtg)
3S7512	Screw, sheet metal: #8 x 1/2 PKZ plain hex head; cad pl (tube retainer strap mtg)
3S7453	Screw, sheet metal: #8 x 1" PKA plain hex head; cad pl (tube retainer strap mtg)
3K790107	Screw, thumb: 8-32; cad pl (defl yoke adj)
26K485936	Shield, coil (ratio detector)
1X792785	Shield, coil: with spade bolts (T-2 shield)
26A26283	Shield, tube (for glass 6J5 audio amp)
26A90301	Shield, tube: miniature
26A790508	Shield, video: cad pl (shields video amp from HV transformer)
9A792167	Socket, tube: miniature; 7-prong (V-1)
9K780442	Socket, tube: miniature; 7-prong (V-3, V-4 & V-6)
9K484167	Socket, tube: miniature; 7-prong (V-7, V-8, V-9 & V-15)
9A471343	Socket, tube: miniature; tan molded (V-5)
9K484816	Socket, tube: noval; molded (V-2)
9K471270	Socket, tube: octal (all octal sockets except V-14, V-16 & V-19)
9A790685	Socket, tube: octal (V-14 & V-16)
9A480274	Socket, tube: octal; (V-19)
9K700039	Socket, picture tube: 5-pin; with leads
9K700036	Socket, picture tube: 12-pin; with leads.
41A700143	Spring, coil (L-30)
41A70705	Spring, coil (T-3)
41A790182	Spring, grounding (grounds picture tube outer coating)
41A471379	Spring, tension (picture tube support)
1X792061	Strap, tube retainer: with cushions (picture tube front support for 12T3 & 12K3)
1X790634	Strap, tube retainer: with cushions (picture tube front support for 12T1, 12T2, 12K1 & 12K2)
35A791581	Strip, anode lead (dresses 2nd anode lead from chassis)
31A700082	Strip, contact (receptacle for plug-in resistor)
1K700078	Strip, terminal: 2-pin (mounts plug-in resistor)
31A21990	Strip, terminal: 2-screw (antenna terminal)
31K76184	Strip, terminal: 2 ins, #1 gnd; 3/8" spacing
31A700148	Strip, terminal: 2 ins, #2 mtg; 3/8" spacing
31A792450	Strip, terminal: 2 ins, #3 mtg; 3/8" spacing
31K471564	Strip, terminal: 3 ins, #2 gnd; 3/8" spacing
31K51511	Strip, terminal: 3 ins, #3 gnd; 3/8" spacing
31K471565	Strip, terminal: 3 ins, #4 gnd; 3/8" spacing
31K37494	Strip, terminal: 4 ins, #3 gnd; 3/8" spacing
31A790122	Strip, terminal: 4 ins, #3 gnd; 1/2" spacing
31K22174	Strip, terminal: 4 ins, #4 mtg; 3/8" spacing
31A780089	Strip, terminal: 4 ins, #5 gnd; 3/8" spacing
31K26658	Strip, terminal: 5 ins, #3 gnd; 3/8" spacing
31K90046	Strip, terminal: 5 ins, #4 gnd; 3/8" spacing
31A791402	Strip, terminal: 6 ins, #4 gnd; 3/8" spacing
31A780091	Strip, terminal: 6 ins, #5 gnd
24A790646	Trap, ion
1X780165	Tube mounting plate: with mounting bracket & tube socket (high-voltage rectifier mounting plate)
4A77577	Washer, insulating (on chassis side of horizontal size coil)
4K470939	Washer, insulating: 3/8 x .136 x .062 (electrolytic insulator mtg)
4A791447	Washer, insulating (T-8 mtg)
4A790132	Washer, spring (focus coil bracket adj screw)
4S7569	Washer, flat; 5/16 x .145 x .027; cad pl (V-14 & V-16 socket mtg)
4S490366	Washer, flat: 3/8 x .156 x .125 stl; cad pl (48B700138, 48B700139 & 48B700555 selenium rectifier mtg).
4A7562	Washer, flat: 7/16 x .187 x .033 stl; cad pl (focus coil bracket mtg)
4S7596	Washer, flat: 1/2 x .195 x .067 stl; cad pl (deflection yoke support bracket mtg)
4S7631	Washer, flat: 1 x .187 x .042; cad pl (cover plate mtg)

INSULATING COMPOUNDS

Part Number	Description
11M490423	Coating, high voltage insulating: red-brn (on high volt rectifier socket)
11M490387	Wax, biwax (on high volt transformer)

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MODEL 12K1 CABINET PARTS

Part Number	Description
1X792153	Back Cover: complete with centering adjustment cover, picture tube rear cover & line cord (specify diameter of tube rear cover - 2-1/2" or 4")
13D790489	Bezel, picture tube (window frame)
1X792768	Bracket, picture tube positioning: with pad (on chassis front)
1X792484	Bracket, window mtg: with pad
16F792064	Cabinet, console: red-brown mahogany; less bezel, window and gasket
13K792066	Cloth, grille (cabinet front)
30B470756	Cord, line: with plug & receptacle
15B791076	Cover, centering adjustment: rubber
1X792546	Cover, chassis bottom: with hi-volt insulator
15A790586	Cover, picture tube rear: 2-1/2" cup diameter (on back cover)
15K700162	Cover, picture tube rear: 4" cup diameter (on back cover)
5S3139	Eyelet: .202 x .475 brass; ant cop (on back cover)
32D790654	Gasket, picture tube: rubber
14A791829	Insulator, threaded (bezel mtg)
14B792069	Insulator, high voltage (on bottom cover)
14A791827	Insulator, tube base: round (in 2-1/2" picture tube rear cover)
14K791828	Insulator, tube base: rectangular (in 2-1/2" picture tube rear cover)
14B700565	Insulator, tube base (in 4" picture tube rear cover)
14K700567	Insulator, tube base: disc (in 4" picture tube rear cover)
36A485457	Knob, control (hold controls on chassis rear)
36B790505	Knob, control (contrast)
36B790506	Knob, control (station selector)
36C790507	Knob, control: wal-mahog (volume & fine tuning)
62K70581	Logotype: "Motorola" gold enamel
4S7650	Lockwasher, Int: #6; cad pl (line cord mtg)
4S9751	Lockwasher, Int-Ext: #8; cad pl (spkr mtg)
4S7657	Lockwasher, Ext: #8; cad pl (spkr mtg)
13A790824	Medallion ("M" on grille cloth)
2S7007	Nut, hex: 8-32 x 1/4; cad pl (spkr mtg)
2S7003	Nut, hex: 8-32 x 5/16 stl; cad pl (spkr mtg)
2S490424	Nut, teenut: 6-32 (bezel mtg)
35K792459	Pad, cushion (window mtg brkts)
35K792740	Pad, cushion (on tube positioning brkt)
5K791856	Rivet, shoulder: annealed (line cord mtg)
5S7706	Rivet: .122 x 1/8 stl; pol nkl (hi-volt insulator mtg)
5S7751	Rivet: .122 x 1/4 stl; ant cop pl (picture tube rear cover mtg)
3S2991	Screw, machine: 6-32 x 1/2 plain hex head; cad pl (window mtg brkts)
3K653	Screw, machine: 8-32 x 1-1/4 (spkr mtg)
3S476115	Screw, sheet metal: #6 x 1/4 PKZ plain hex head; cad pl
3S7536	Screw, sheet metal: #6 x 3/8 PKA slotted acorn head; ant cop pl (back cover mtg)
3S7509	Screw, sheet metal: #6 x 5/8 PKA slotted acorn head; ant cop pl (back cover mtg)
3S490819	Screw, sheet metal: #6 x 7/8 slotted acorn head; statuary bronze pl (back cover mtg)
3S7454	Screw, sheet metal: #8 x 1/4 PKZ plain hex head; cad pl (tube positioning brkt mtg)
3S8153	Screw, sheet metal: #8 x 3/4 PKA plain hex head; cad pl (bottom cover mtg)
3S3359	Screw, sheet metal: #8 x 1-5/8 PKA plain hex head; cad pl (chassis mtg)
56B791612	Strap, antenna support (for lower loop antenna)
4K780040	Washer, felt (under control knobs)
4K470786	Washer, fibre: 1/2 x 3/16 x 1/16 (bezel mtg)
4S7646	Washer, flat: 11/16 x 3/16 x .067; wrought iron; cop pl (chassis mtg).
4S7629	Washer, flat: 1/2 x 3/16 x .048 stl; (bottom cover mtg)
61K790653	Window, picture tube: 12"; safety glass

MODEL 12K1B CABINET PARTS - Same as 12K1 except:

Part Number	Description
16K792065	Cabinet, console: limed oak; less bezel, window, and gasket
13K792067	Cloth, grille: egg-shell (cabinet front).
36K791431	Knob, control: tan (volume & fine tuning)

MODEL 12K2 CABINET PARTS

Part Number	Description
1X792485	Back Cover: complete with centering adjustment cover, picture tube rear cover, and line cord
13D790489	Bezel, picture tube (window frame)
1X792484	Bracket, picture tube window mtg: with pad
1X792769	Bracket, picture tube positioning: with pad
16F792455	Cabinet, console: red-brown mahogany; less window, bezel & gasket
55K791116	Cloth, grille: red mahogany; 13-5/16 x 19-7/8
30B470756	Cord, line: with plug & receptacle
15B791076	Cover, centering adjustment: rubber (on back cover)
1X792546	Cover, chassis bottom: with hi-volt insulator
15A790586	Cover, picture tube rear: 2-1/2" cup diameter (on back cover)
15K700162	Cover, picture tube rear: 4" cup diameter (on back cover)
5S3139	Eyelet: .202 x .475 brass; ant cop
32D790654	Gasket, picture tube: rubber
55K791113	Grille, metal: brushed brass (on grille cloth)
14B792069	Insulator, high voltage (on bottom cover)
14A791829	Insulator, threaded (bezel mtg)
14A791827	Insulator, tube base: round; (inside 2-1/2" tube rear cover)
14K791828	Insulator, tube base: rectangular (inside 2-1/2" tube rear cover)
14B700565	Insulator, tube base (inside 4" tube rear cover)
14K700567	Insulator, disc (inside 4" tube rear cover)
36A485457	Knob, control: black (hold controls on chassis rear)
36B790505	Knob, control (contrast)
36B790506	Knob, control (station selector)
36C790507	Knob, control: wal-mahog (volume & fine tuning)
62K70581	Logotype: "Motorola"; gold enamel
4S7650	Lockwasher, Int: #6; cad pl (line cord mtg)
4S9751	Lockwasher, Int-Ext: #8; cad pl (spkr mtg)
4S7657	Lockwasher, Ext: #8; cad pl (spkr mtg)
2S7007	Nut, hex: 8-32 x 1/4; cad pl (spkr mtg)
2S7003	Nut, hex: 8-32 x 5/16; stl; cad pl (spkr mtg)
2S490424	Nut, teenut: 6-32 (bezel mtg)
35K792740	Pad, cushion (picture tube positioning brkt)
35K792459	Pad, cushion (on window mtg brkt)
5K791856	Rivet, shoulder: annealed (line cord mtg)
5S7706	Rivet: .122 x 1/8 stl; pol nkl (hi-volt insulator mtg)
5S7751	Rivet: .122 x 1/4 stl; ant cop (picture tube rear cover mtg)
3S2991	Screw, machine: 6-32 x 1/2 plain hex head; cad pl (window mtg brkts)
3K653	Screw, machine: 8-32 x 1-1/4 (spkr mtg)
3S476115	Screw, sheet metal: #6 x 1/4 PKA plain hex head; cad pl (bottom cover mtg)
3S7536	Screw, sheet metal: #6 x 3/8 PKA slotted acorn head; ant cop (back cover mtg)
3S7509	Screw, sheet metal: #6 x 5/8 PKA slotted acorn head; ant cop (back cover mtg)
3S490819	Screw, sheet metal: #6 x 7/8 PKA slotted acorn head; statuary bronze (back cover mtg)
3S7454	Screw, sheet metal: #8 x 1/4 PKZ plain hex head; cad pl (tube positioning brkt)
3S8153	Screw, sheet metal: #8 x 3/4 PKA plain hex head; cad pl (bottom cover mtg).
3S3359	Screw, sheet metal: #8 x 1-5/8 PKA plain hex head; cad pl (chassis mtg)
56B791612	Strap, antenna support (for lower loop antenna)
35A791581	Strip, lead (dresses spkr leads)
4K780040	Washer, felt (under control knobs)
4K470786	Washer, fibre: 1/2 x 3/16 x 1/16 (bezel mtg)
4S7646	Washer, flat: 11/16 x 3/16 x .067; wrought cop pl (chassis mtg)
4S7629	Washer, flat: 1/2 x 3/16 x .048 stl; cad pl (bottom cover mtg)
61K790653	Window, picture tube: 12"; safety glass

MODEL 12K2B CABINET PARTS - Same as 12K2 except:

Part Number	Description
16K792456	Cabinet, console: limed oak; less window, bexel, and gasket
13K791115	Cloth, grille: blonde; 14-1/8 x 19-7/8
36K791431	Knob, control: tan (volume & fine tuning)

MODEL 12K3 CABINET PARTS

Part Number	Description
1X700654	Back Cover: with picture tube rear cover, centering adjustment cover & line cord.
13D790489	Bezel, picture tube (window frame)
1X700653	Bracket, picture tube positioning: with pad (on chassis front)
1X792484	Bracket, window mtg: with cushion
16F700122	Cabinet, console: red-brn mahogany; less window, gasket & bezel
13K700151	Cloth, grille: 19-1/4 x 12-1/4; "S" Mahogany
30B470756	Cord, line: with plug & receptacle
15B791076	Cover, centering adjustment; rubber (on back cover)
1X792546	Cover, chassis bottom: with high voltage insulator
15B790987	Cover, picture tube rear (on back cover)
5S3139	Eyelet: .202 x .475 brass; ant cop (on back cover)
32D790654	Gasket, picture tube: rubber
14B792069	Insulator, high-voltage (on bottom cover)
14A791829	Insulator, threaded (bezel mtg)
14B700174	Insulator, tube base (in picture tube rear cover)
36B790505	Knob, control (contrast)
36B790506	Knob, control (station selector)
36K780522	Knob, control: ivory (hold controls on chassis rear)
36C790507	Knob, control: wal-mahog (off-volume & fine tuning)
4S7657	Lockwasher, external: #8 (spkr mtg)
4S7650	Lockwasher, internal: #6; cad pl (hi-volt insulator & line cord mtg)
4S9751	Lockwasher, internal-external: #8; cad pl (spkr mtg)
62K70581	Logotype: "Motorola"; gold enamel
13A790824	Medallion: brass pl ("M" on grille cloth)
2S7007	Nut, hex: 8-32 x 1/4; cad pl (spkr mtg)
2S7003	Nut, hex: 8-32 x 5/16 stl; cad pl (spkr mtg)
2S490424	Nut, teenut: 6-32 (bezel mtg)
35K792740	Pad, cushion (on tube positioning bracket)
35K792459	Pad, cushion (on window mtg bracket)
5K791856	Rivet, shoulder: annealed (line cord mtg)
5S7706	Rivet: .122 x 1/8 stl; pol nkl (hi-volt insulator mtg)
5S7751	Rivet: .122 x 1/4 stl; ant cop fin (picture tube rear cover mtg)
3S2991	Screw, machine: 6-32 x 1/2 plain hex head; cad pl (window mtg brackets)
3K27913	Screw, machine: 8-32 x 1 (spkr mtg)
3S7536	Screw, sheet metal: #6 x 3/8 PKA slotted acorn head; ant cop fin (back cover mtg)
3S7509	Screw, sheet metal: #6 x 5/8 PKA slotted acorn head; ant cop (back cover mtg)
3S490819	Screw, sheet metal: #6 x 7/8 PKA slotted acorn head; sta brz (back cover mtg)
3S7454	Screw, sheet metal: #8 x 1/4 PKZ plain hex head; cad pl (tube positioning brkt mtg)
3S8153	Screw, sheet metal: #8 x 3/4 PKA plain hex head; cad pl (bottom cover mtg).
3S3359	Screw, sheet metal: #8 x 1-5/8 PKA plain hex head; cad pl (chassis mtg)
56K700009	Strap, antenna support (for lower loop antenna)
35A791581	Strip, lead (dresses spkr leads)
64A700112	Strip, trim: brass (across cabinet front)
4K780040	Washer, felt (under control knobs)
4K470786	Washer, fibre: 1/2 x 3/16 x 1/16 (bezel mtg)
4S7629	Washer, flat: 1/2 x 3/16 x .048 stl; cad pl (bottom cover mtg)
61K790653	Window, picture tube: 12"

MODEL 12K3B CABINET PARTS - Same as 12K3 except:

Part Number	Description
16K700135	Cabinet, console: limed oak; less window, gasket, & bezel
13K700136	Cloth, grille: 19-1/4 x 12-1/4; eggshell
36K791431	Knob, control: tan (off-volume & fine tuning)

MODEL 12T1 CABINET PARTS

Part Number	Description
1X791078	Back Cover: with centering adjustment cover, picture tube rear cover, & line cord (specify diameter of tube rear cover 2-1/2" or 4")
13D790489	Bezel, picture tube (window frame)
3S488134	Bolt, chassis mtg: 1/4-20 x 1-1/2 hex head; cad pl
1X792484	Bracket, window mtg: with pad
1X792767	Bracket, tube positioning: with pad (on chassis front)
37A12748	Bumper, recess: rubber (cabinet feet)
16E792106	Cabinet, table model: red-brown mahog; less window, bezel & gasket
13K791038	Cloth, grille: 7 x 8; mahogany (spkr grille)
13K792108	Cloth, grille: 13-1/2 x 18-1/2; negre (cabinet front)
30B470756	Cord, line: with plug & receptacle
15B791076	Cover, centering adjustment: rubber (on back cover)

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World Radio History

Part Number	Description
1X792546	Cover, chassis bottom: with high voltage insulator
15K791052	Cover, picture tube rear: 2-1/2" cup diameter (on back cover)
15B790987	Cover, picture tube rear: 4" cup diameter (on back cover)
5S3139	Eyelet: .202 x .475 brass; ant cop (on back cover)
32D790654	Gasket, picture tube: rubber
14B792069	Insulator, high voltage (on bottom cover)
14A791827	Insulator, tube base: round (in 2-1/2" picture tube rear cover)
14K791858	Insulator, tube base (in 2-1/2" picture tube rear cover)
14B700174	Insulator, picture tube base (in 4" picture tube rear cover)
14A791829	Insulator, threaded (bezel mtg)
36A485457	Knob, control: black (hold controls on chassis rear)
36B790505	Knob, control (contrast)
36B790506	Knob, control (station selector)
36B790507	Knob, control: wal-mahog (volume & fine tuning)
62K70581	Logotype: "Motorola"; gold enamel
4S7650	Lockwasher, Int: #6; cad pl (high volt insulator & line cord mtg)
4S9751	Lockwasher, Int-Ext: #8; cad pl (spkr mtg)
2A484897	Nut, chassis mtg: 5/8 x 1/2 x 3/16
2S7007	Nut, hex: 8-32 x 1/4; cad pl (spkr mtg)
2S7003	Nut, hex: 8-32 x 5/16 stl; cad pl (spkr mtg)
2S490424	Nut, teenut: 6-32 (bezel mtg)
35K792740	Pad, cushion (on tube positioning bracket)
35K792459	Pad, cushion (on window mtg brkts)
5S7706	Rivet: .122 x 1/8 stl; pol nkl (high volt insulator mtg)
5S7751	Rivet: .122 x 1/4 stl; cad pl (picture tube rear cover mtg)
5K791856	Rivet, shoulder (line cord mtg)
3S2991	Screw, machine: 6-32 x 1/2 plain hex head; cad pl (window mtg brkts)
3S7536	Screw, sheet metal: #6 x 3/8 PKA slotted acorn head; ant cop (antenna strip & back cover mtg)
3S476115	Screw, sheet metal: #6 x 1/4 PKZ plain hex head; cad pl
3S7509	Screw, sheet metal: #6 x 5/8 PKA slotted acorn head; ant cop (back cover mtg)doz
3S490819	Screw, sheet metal: #6 x 7/8 PKA slotted acorn head; statuary bronze (back cover mtg)
3S7454	Screw, sheet metal: #8 x 1/4 PKZ plain hex head; cad pl (tube positioning brkt mtg)
3S3397	Screw, sheet metal: #8 x 5/16 PKZ plain hex head; cad pl (chassis mtg brkt)
3S8153	Screw, sheet metal: #8 x 3/4 PKA plain hex head; cad pl (bottom cover mtg)
3K791825	Screw, spkr mtg: 8-32 x 1; statuary bronze
35A791581	Strip, lead (dresses spkr leads)
4A484894	Washer, cut: cad pl (bottom cover mtg)
4K780040	Washer, felt (under control knobs)
4K470786	Washer, fibre: 1/2 x 3/16 x 1/16 (bezel mtg)
4S7629	Washer, flat: 1/2 x 3/16 x .048; stl; cad pl (bottom cover mtg)
61K790653	Window, picture tube: 12"; safety glass.

MODEL 12T1B CABINET PARTS - Same as 12T1 except:

Part Number	Description
16K792107	Cabinet, table model: limed oak; less window, bezel, and gasket
13K791037	Cloth, grille: 7 x 8; blonde (spkr grille)
36K791431	Knob, control: tan (volume & fine tuning)
3A791324	Screw, spkr mtg: 8-32 x 1; brass pl.

MODEL 12T2 CABINET PARTS

Part Number	Description
1X700045	Back Cover Assembly: with picture tube rear cover, centering adj cover, and line cord (specify diameter of tube rear cover 2-1/2" or 4")
1X700068	Bracket, picture tube positioning: with cushion (on chassis front)
35A790097	Bumper, recess: rubber (cabinet feet)
16F700064	Cabinet, table model: red-brn mahogany; less window & gasket
13K792045	Cloth, grille: mahogany; 5-1/4 x 6-3/8 (spkr grille)
30B470756	Cord, line: with plug and receptacle
15B791076	Cover, centering adjustment: rubber (on back cover)
1X792495	Cover, chassis bottom: with hi-volt insulator
15K791052	Cover, picture tube rear: 2-1/2" cup diameter (on back cover)
15B790987	Cover, picture tube rear: 4" cup diameter (on back cover)
5S3139	Eyelet: .202 x .475 brass; ant cop fin (on back cover)
32D791602	Gasket, picture tube: rubber (on picture window)
14B792069	Insulator, high voltage (on bottom cover)
14K791858	Insulator, tube base: rectangular (inside 2-1/2" picture tube rear cover)
14A791827	Insulator, tube base: round (inside 2-1/2" picture tube rear cover)
14B700174	Insulator, tube base: inside 4" picture tube rear cover)
36B790505	Knob, control: contrast
36A485457	Knob, control: plastic (hold controls on chassis rear)
36B790506	Knob, control: station selector
36C790507	Knob, control: wal-mahog (fine tuning & off-volume)
4S7650	Lockwasher, Int: #6; cad pl (line cord mtg)
4S9751	Lockwasher, Int-Ext: #8; cad pl (spkr mtg)
2S7003	Nut, hex: 8-32 x 5/16 stl; cad pl (spkr mtg)
2S490359	Nut, speednut (spkr mtg)
35K792740	Pad, cushion: sponge rubber (on picture tube positioning bracket)
5K791856	Rivet, shoulder: annealed (line cord mtg)
5S7706	Rivet: .122 x 1/8 stl; pol nkl (hi-volt insulator mtg)
5S7751	Rivet: .122 x 1/4 stl; cad pl (picture tube rear cover mtg)
3K791825	Screw, machine: 8-32 x 1 insulated head: statuary bronze (spkr mtg)
3S7536	Screw, sheet metal: #6 x 3/8" PKA slotted acorn head; ant cop finish (bottom & back cover mtg)
3S7509	Screw, sheet metal: #6 x 5/8 PKA slotted acorn head; ant cop finish (back cover mtg)
3S490508	Screw, sheet metal: #6 x 3/4 PKA plain acorn head; cad pl (window mtg strips)
3S490819	Screw, sheet metal: #6 x 7/8 PKA slotted acorn head; statuary bronze (back cover mtg)
3S7454	Screw, sheet metal: #8 x 1/4 PKZ plain hex head; cad pl (mounts picture tube positioning bracket)
3S8126	Screw, sheet metal: #8 x 1-1/4" PKA plain hex head; cad pl (chassis mtg)
35A791581	Strip, lead (dresses antenna leads and speaker leads)
35K790463	Strip, rubber (on bottom of picture window)
35A790461	Strip, rubber (on sides of picture window)
16B791508	Strip, window mtg (bottom of picture window)
16K700060	Strip, window mtg (sides of picture window)
4K780040	Washer, felt (under control knobs)
4S7614	Washer: 11/16 x 11/64 x .036 stl; cad pl (chassis mtg)
1X700044	Window, picture tube: with gasket and rubber strips

MODEL 12T3 CABINET PARTS

Part Number	Description
1X700045	Back Cover: with picture tube rear cover, centering adjustment cover, and line cord
13D790489	Bezel, picture tube (window frame)
1X792767	Bracket, picture tube positioning: with pad (on chassis front)
1X792484	Bracket, window mtg: with pad
35A790097	Bumper, recess: rubber (cabinet feet)
16F700545	Cabinet, table model: red-brn mahogany; less window, gasket & bezel
13K700546	Cloth, grille: eggshell & brown; 17-1/2 x 13
13K792045	Cloth, grille: mahogany; 5-1/4 x 6-3/8 (spkr grille)
30B470756	Cord, line: with plug & receptacle
15B791076	Cover, centering adjustment: rubber (on back cover)
1X792495	Cover, chassis bottom: with high-voltage insulator
15B790987	Cover, picture tube rear (on back cover).
5S3139	Eyelet: .202 x .475 brass; ant cop fin (on back cover)
32D790654	Gasket, picture tube: rubber
14B792069	Insulator, high-voltage (on bottom cover)
14A791829	Insulator, threaded (bezel mtg)
14B700174	Insulator, tube base (in picture tube rear cover)
36A485457	Knob, control: black (hold controls on chassis rear)
36B790505	Knob, control (contrast)
36B790506	Knob, control (station selector)
36C790507	Knob, control: wal-mahog (off-volume & fine tuning)
4S7650	Lockwasher, internal: #6; H.T. (hi-volt. insulator mtg)
4S9751	Lockwasher, internal-external; #8; cad pl (spkr mtg)
62K70581	Logotype: "Motorola"; gold enamel
2S7003	Nut, hex: 8-32 x 5/16 stl; cad pl (spkr mtg)
2S490359	Nut, speednut (spkr mtg)
2S490424	Nut, teenut: 6-32 (bezel mtg)
35K792740	Pad, cushion (on tube positioning brkt)
35K792459	Pad, cushion (on window mtg brkt)
5K791856	Rivet, shoulder: annealed (line cord mtg)
5S7706	Rivet: .122 x 1/8 stl; pol nkl (hi-volt insulator mtg)
5S7751	Rivet: .122 x 1/4 stl; cad pl (picture tube rear cover mtg)
3S2991	Screw, machine: 6-32 x 1/2" plain hex head; cad pl (window mtg brkts)
3K791825	Screw, machine: 8-32 x 1 insulated head; statuary bronze fin (spkr mtg)
3S7536	Screw, sheet metal: #6 x 3/8 PKA slotted acorn head; ant. cop (back cover mtg)
3S7509	Screw, sheet metal: #6 x 5/8 PKA slotted acorn head; ant cop (back cover mtg)
3S490819	Screw, sheet metal: #6 x 7/8 PKA slotted acorn head; statuary bronze (back cover mtg)
3S7454	Screw, sheet metal: #8 x 1/4 PKZ plain hex head; cad pl (mounts tube positioning brkt)
3S8126	Screw, sheet metal: #8 x 1-1/4 PKA plain hex head; cad pl (chassis mtg)
35A791581	Strip, antenna lead (dresses loop antenna & spkr leads from RF)
4K470786	Washer, fibre: 1/2 x 3/16 x 1/16 (bezel mtg)
4S7614	Washer, flat: 11/16 x 11/64 x .036 stl; cad pl (chassis mtg)
61K790653	Window, picture tube: 12"

BILT-IN-TENNAS

Model TA-4 (12K1, 12K2 & 12K3)

Part Number	Description
1X791759	TA-4 Double Loop Antenna: complete
21R6593	Capacitor, mica: 15 mmf 300V
21K70720	Capacitor, molded: 5 mmf
24A791771	Coil, antenna loading
29A791608	Lug, spade
31K471564	Strip, terminal: 3 ins #2 gnd; 3/8" spacing

Model TA-6 (12T1, 12T2 & 12T3)

Part Number	Description
1X791900	TA-6 Single Loop Antenna: complete
21R2763	Capacitor, mica: 6 mmf 300V
21R2764	Capacitor, mica: 18 mmf 300V
24A791748	Coil, antenna loading (on terminal strip)
24A791989	Coil, high frequency compensating
35A791581	Strip, antenna lead
31K34326	Strip, terminal: 2 ins, #3 gnd; 3/8" spacing

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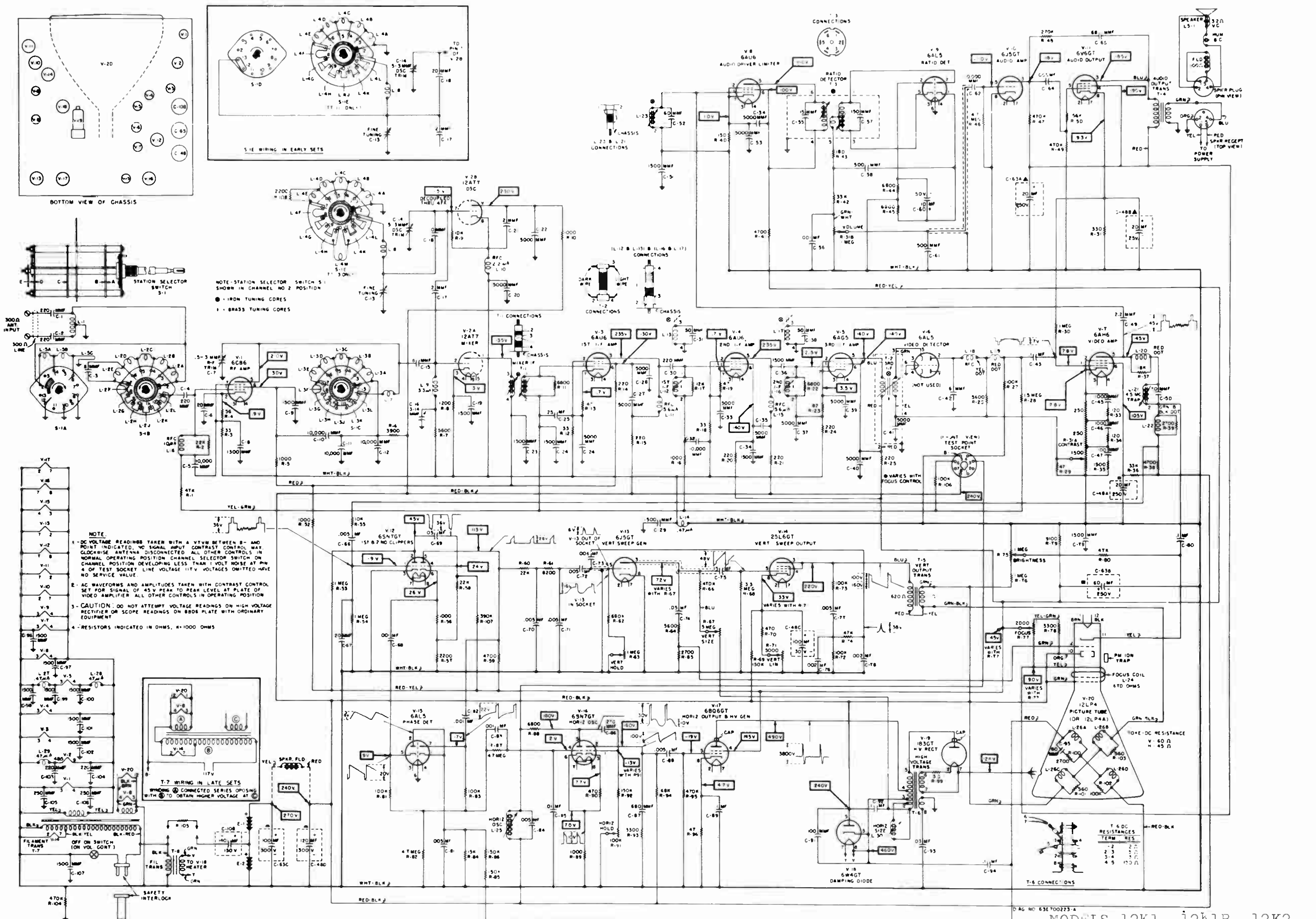

TELEVISION CHASSIS TS-53

Date: 24 May 1950
Draw. No. 63E700223-A

MODELS 12K1, 12K1B, 12K2, 12K2B, 12K3, 12K3B, 12T1, 12T1B, 12T2, 12T3, Ch. TS-53

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GENERAL INFORMATION

RECEIVER MODEL BREAKDOWN

Model	Type of Set	Chassis Used
14K1H	Console, red-brn mahogany	TS-115
14K1BH	Console, limed-oak	TS-115

CHASSIS - Television chassis TS-115 contains 20 tubes plus a 14" rectangular picture tube. The picture, sound, and scanning circuits, together with a full-wave rectifier, are contained on a single chassis.

TUNING RANGE - Channels 2 through 13

IF FREQUENCY -

Channels 2, 3, 4, 5, 6, 11, 12 & 13: sound - 21.9 mc
picture - 26.4 mc
Channels 7, 8, 9 & 10: sound - 27.3 mc
picture - 22.8 mc

ANTENNA - TA-4 "Bilt-In-Tenna". Provision for connection of an external antenna.

ANTENNA IMPEDANCE - 300 ohms

POWER SUPPLY - 117 volts, 60 cycle AC current only

POWER CONSUMPTION - 205 watts

AUDIO OUTPUT - 4 watts

CHASSIS TUBE COMPLEMENT

Ref. No.	Tube	Function
V-1	6CB6	RF Amplifier
V-2	12AT7	Mixer-Oscillator
V-3	6AU6	1st IF Amplifier
V-4	6AU6	2nd IF Amplifier
V-5	6AG5	3rd IF Amplifier
V-6	6AL5	Video Detector
V-7	6AH6	Video Amplifier
V-8	6AU6	Audio Driver-Limiter
V-9	6AL5	Ratio Detector
V-10	6J5GT	Audio Amplifier
V-11	6V6GT	Audio Output
V-12	6SN7GT	1st & 2nd Clippers
V-13	12AU7	Vertical Sweep Generator
V-14	6W6GT	Vertical Sweep Output
V-15	6AL5	Phase Detector
V-16	6SN7GT	Horizontal Oscillator
V-17	6BQ6GT	Horizontal Output & High Voltage Generator
V-18	6W4GT	Damping Diode
V-19	1B3GT	High Voltage Rectifier
V-20	14BP4 or 14CP4	Picture Tube: rectangular
V-21	5U4G	Low Voltage Rectifier

HIGH VOLTAGE WARNING

Operation of this receiver, outside its cabinet or with covers removed, involves a shock hazard from the power supplies. No work should be attempted on this receiver by anyone not thoroughly familiar with the precautions necessary when working on high voltage equipment.

CATHODE RAY PICTURE TUBE HANDLING PRECAUTIONS

Extreme care must be used in handling the picture tube. This tube is highly evacuated and, due to its large size, is subjected to a considerable atmospheric pressure. The handler should wear safety goggles and gloves for protection. Avoid nicking or scratching the glass by rough contact with other objects.

Before removing glass tubes, discharge the capacitor formed by the inner and outer aquadag coatings on the tube by shorting the anode contact on the side of the tube to the outer surface with a well insulated piece of wire.

INSTALLATION AND OPERATING INSTRUCTIONS

RECEIVER LOCATION

The receiver may be placed anywhere in the room, but for greatest satisfaction it should be located:

1. Away from any bright light that may fall directly on the screen or be reflected from it; this includes windows and lamps. Some illumination in the room, off to one side, is desirable, however, to prevent eyestrain.

2. To provide comfortable viewing and ease of operation.

3. At lease one-inch away from a wall to allow for cabinet ventilation. This is very important.

ANTENNAS

The choice of a television antenna depends entirely on the location of the receiver with respect to all television station transmitting antennas in the area. Maximum pick-up is obtained when the receiving antenna is directly in line of sight with the transmitting antenna.

"Bilt-In-Tenna." All receivers using the TS-115 series television chassis are equipped with the Motorola "Bilt-In-Tenna", mounted inside the cabinet, for use in good signal areas.

When this antenna is used, the following precautions should be observed for best reception:

1. In order to get maximum performance and satisfactory pictures from the "Bilt-In-Tenna", ample signals from the television station must be present at the location of the receiver. Normally, the strength of the signals will vary throughout the room in which the receiver is located. For this reason, better pictures will be obtained if the receiver is tried in all possible locations in the viewing room and is then placed where the clearest pictures are received from all stations. Avoid large metallic objects, such as radiators, metal panels, etc.

2. Lamps, vases and metallic objects, when placed on top of the receiver, may affect the efficiency of the "Bilt-In-Tenna".

Indoor Antenna. If additional pick-up is necessary an indoor antenna, placed on or near the receiver, may be used. The antenna should be rotated and the arms should be adjusted for the best signal, with no ghosts or reflections. Normally, the arms should be extended on the low channels (2-6) and telescoped on the high channels (7-13).

Outdoor Antenna. The Motorola "Bilt-In-Tenna" or the indoor type antenna will give satisfactory reception in strong signal areas; but, if the receiver is located in a fringe or weak signal area, an outdoor antenna is recommended.

In areas free of obstructions and reflections, within reasonable proximity to television transmitters, a dipole and reflector will prove satisfactory. Since such an antenna has a relatively small band coverage, a special antenna covering all twelve television channels should be used if it is desired to receive stations on channels of widely separated frequencies.

Location of the antenna should be decided from the standpoint of maximum signal pick-up. In general, the antenna should be broadside to the transmitting antenna and should be as high as possible. If a reflector is used, the antenna should be oriented so that the driven element is closest to the station and the reflector farthest away.

Locating the antenna and lead-in as far away as possible from highways, hospitals, doctors' offices, electrical machinery, etc., will help to reduce noise pick-up from such sources. Also, it is desirable to keep the antenna at least six feet away from other antennas, metal roofs, gutters, or other metal objects to prevent unwanted reflections and shielding.

Lead-In. Since the TS-115 chassis is designed for 300 ohm input, the standard 300 ohm twin lead line should be used for connecting the outside antenna to the receiver. Twisting the line one complete turn per foot of running length helps to reduce noise pick-up on the line. The lead-in should be supported on stand-off insulators and kept tight enough to prevent mechanical damage through swaying. Avoid running the lead-in close to metal gutters, iron standpipes, etc.

In areas of very strong signals, or where severe local electrical interference is encountered, 300 ohm shielded twin lead is recommended. The shield braid should be grounded.

An approved lightning arrestor should be used.

RECEIVER ANTENNA CONNECTION

The antenna lead-in to the receiver is connected to the two screws of the terminal strip on the rear of the cabinet. Disconnect the "Bilt-In-Tenna" leads from the terminal strip before attaching an external antenna lead-in. Sometimes, reversing the lead-in connections at the receiver may improve picture quality and overall performance.

OPERATING CONTROLS

There are two dual controls, consisting of a small and a large knob each, on the front panel of the receiver. The function of each control is marked on the front panel, the "circle" indicating the large knob, and the "dot" indicating the small knob. See Figure 1 for front panel control functions.

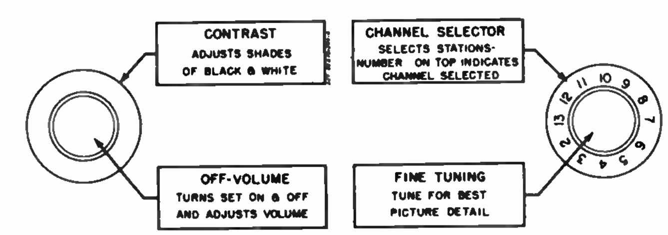

FIGURE 1. OPERATING CONTROLS

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SERVICE ADJUSTMENT CONTROLS

The receiver is completely adjusted at the factory, so normally none other than the front panel control operating instructions need be followed in putting the receiver in operation. However, to provide for any misadjustment of the service controls, due to handling, the following instructions are in order. See Figure 2 for location of the service adjustment controls.

FOCUS CONTROL

The FOCUS control should be adjusted until the fine horizontal line structure of the raster is clearly visible over the picture area. The control should be tuned through the correct point several times so that optimum focus is obtained.

CENTERING

By means of a lever extending from the focus coil, thru the rear screen, the focus coil can be shifted to center the picture in its mask.

VERTICAL SIZE AND VERTICAL LINEARITY

Adjust the VERTICAL SIZE control until the picture fills the mask vertically. Adjust the VERTICAL LINEARITY control for best overall vertical linearity. Adjustment of the VERTICAL SIZE control will require a readjustment of the VERTICAL LINEARITY control and possibly of the vertical hold control. Center picture with the centering lever on the focus coil.

HORIZONTAL SIZE

Adjust the HORIZONTAL SIZE lever until the picture fills the mask horizontally. Center picture with the centering lever.

HORIZONTAL HOLD ADJUSTMENT

The HORIZONTAL HOLD control should have a sync range of approximately 180°. If the control is too critical, adjust as follows:

1. Short out HORIZONTAL OSCILLATOR coil L-23. This may be done with the chassis in the cabinet by shorting pins 3 and 8 of the test socket on chassis rear.
2. With the centering lever, move the picture to the left so that the right edge of the raster can be seen. Adjust the HORIZONTAL HOLD control to about the middle of its range and note the width of the blanking pulse. (The blanking pulse appears as a gray bar at the right edge of the picture).
3. Remove short from HORIZONTAL OSCILLATOR coil.
4. Adjust HORIZONTAL OSCILLATOR coil until the same amount of blanking pulse can be seen as was noted in step 2.

VERTICAL HOLD ADJUSTMENT

Adjust the VERTICAL HOLD control for the center of the vertical sync lock-in range.

BRIGHTNESS

Adjust the BRIGHTNESS control, in combination with the CONTRAST control for the most pleasing picture. Keep the brilliance slightly below maximum, however, in order to protect the fluorescent screen of the picture tube and to prevent poor picture detail.

ADJUSTMENT OF ION TRAP

Under conditions of rough shipment, it is possible for the ion trap to become misaligned. To prevent serious damage to the picture tube, the following method of adjustment should be used. See Figure 3.

The magnet should be placed on the neck of the tube in the direction indicated by the marking on the magnet (usually an arrow which points toward the picture tube screen) so that the stronger magnet of the double magnet type or the only magnet in the single magnet type, is positioned over the internal pole pieces which are mounted on the gun structure. Adjust the brightness control for low intensity and move the magnet a short distance forward and backward at the same time rotating it to obtain the brightest raster. If, in obtaining the brightest raster, the ion trap magnet has to be moved more than 1/4" from the gun pole pieces, the magnet is probably weak and a new magnet should be tried. Never correct for a shadowed raster with the ion trap magnet if such correction results in decreased brightness. The ion trap magnet must always be adjusted for maximum brightness and, if shadows occur at this setting, they should be eliminated by adjusting the focus and deflection coils as explained under "Focus Coil and Deflection Yoke Adjustment".

CAUTION: Keep brightness control at low intensity until ion trap is properly set.

A mirror placed in front of the receiver will aid in making this adjustment.

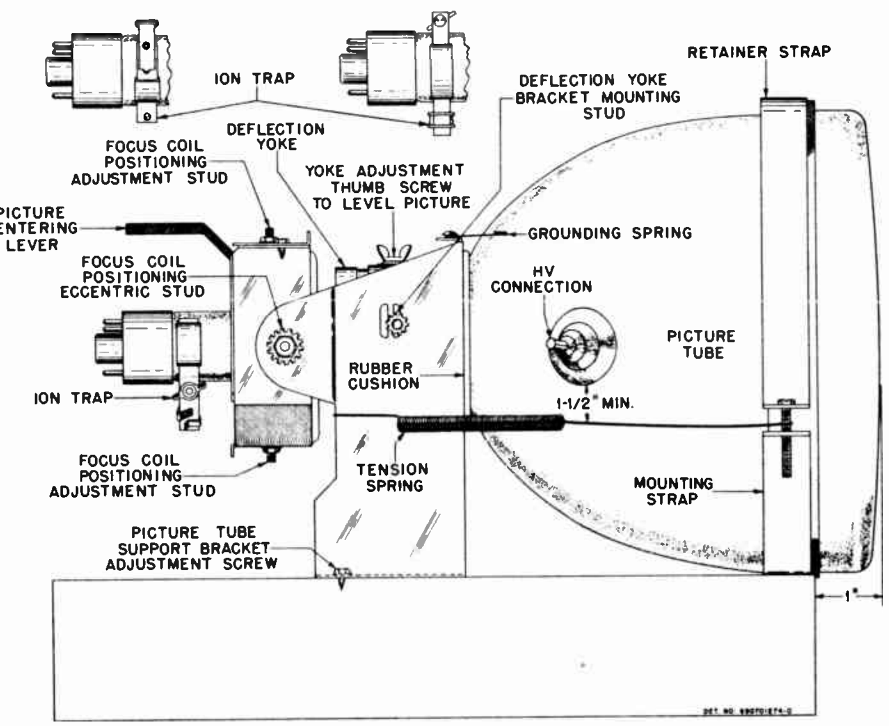

FIGURE 3. PICTURE TUBE ADJUSTMENT LOCATIONS

DEFLECTION YOKE ADJUSTMENT

If the deflection yoke shifts, the picture will be tilted. To correct, loosen the thumbscrew on top of the deflection yoke and rotate yoke until the picture is straight. Before tightening the thumbscrew, make certain that the deflection yoke is as far forward as possible.

If the yoke support and the picture tube have shifted in transit or, if for any reason, these parts have been removed and replaced, it is best to do a complete job of repositioning. See Figure 3. The starting point is the position of the picture tube. It should be adjusted so that the distance from the center of the tube face to the front edge of the chassis is 1". The clamp on the front of the tube should then be tightened. The picture tube rear support bracket positioning adjustment screws should be loose enough to permit sliding the bracket forward until the rubber cushion fits snugly up against the flare of the tube. Loosen the yoke adjustment thumbscrew and push the yoke up against the flare of the tube. CAUTION: Do not use force in sliding the bracket up. If too much force is used, a strain will be placed on the neck of the tube when the support bracket positioning adjustment screws are tightened. Also, the yoke may be forced out of position. The opening in the yoke should be concentric with the neck of the tube.

FOCUS COIL ADJUSTMENT

The focus coil should be positioned so that it is spaced 1/4" from the deflection yoke when parallel with the yoke. The opening in the yoke should be concentric with the neck of the tube. The spacing should be adjusted before the front of the picture tube is clamped down, because it is necessary to remove the tube to change the position of the focus coil. Its position is changed by choice of location of the coil mounting studs in the scalloped holes on the top and bottom of the coil mounting bracket. The opening in the coil can be made concentric with the neck of the tube by loosening the nuts on the studs which support the focus coil bracket and turning the studs with a screwdriver in the slots provided. The studs are eccentric and move the coil both vertically and horizontally. They should be used only to center the neck of the tube in the opening of the coil.

TEST SOCKET

A test socket is provided on the rear of the chassis which allows adjustment of the horizontal oscillator and checking of sensitivity without removing chassis from cabinet. See Figure 2 for socket connections.

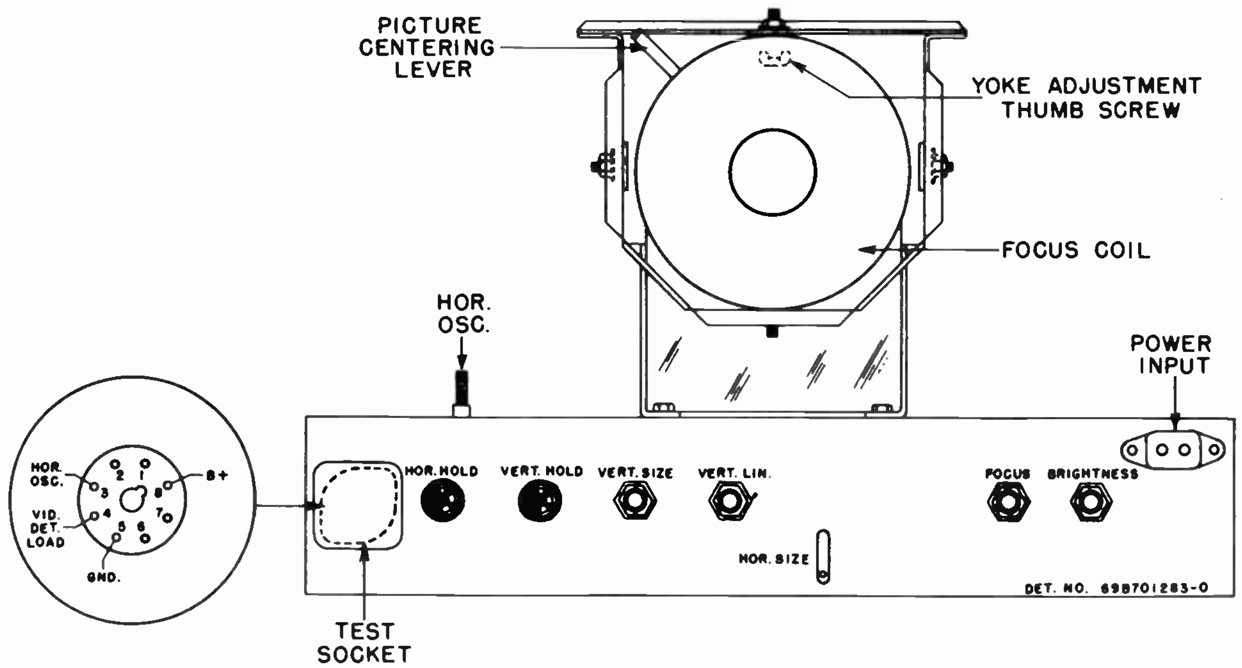

FIGURE 2. SERVICE ADJUSTMENT CONTROLS

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ALIGNMENT

GENERAL

The chassis should be mounted on angle iron brackets (Motorola Part No. 7X700210) so that all connections and adjustments may be made easily.

Since the power cord circuit is broken by the interlock when the cabinet back is removed, it will be necessary to obtain an extra power cord with the female interlock receptacle in order to make a power connection to the receiver. Order Motorola Part No. 30B470756.

ORDER OF ALIGNMENT

A complete receiver alignment can be most conveniently performed in the following order:

1. Audio Take-Off & Ratio Detector
2. 4.5 Mc Trap
3. IF Coils & Mixer Transformer
4. Osc & RF Sections

AUDIO TAKE-OFF & RATIO DETECTOR ALIGNMENT

Equipment Required:

AM Signal Generator: (Optional) Accurately calibrated at 4.5 mc

Adjustable output

DC Meter: Low range electronic voltmeter

Procedure:

Refer to Figure 4 for location of adjustments.

1. If possible, it is desirable to align the audio section from an actual station signal, since the 4.5 mc alignment frequency will be exact. The fine tuning trimmer should be turned off the station slightly, to prevent overloading the ratio detector.

2. If a signal generator is used, tune it accurately to 4.5 mc, and adjust the output to approximately 10,000 microvolts. Connect the high side of the signal generator through a 1000 mmf capacitor to the grid (pin 1) of the video amplifier tube V-7 (6AH6), and the low side to chassis. The following applies whether the station signal or signal generator is used.

3. From either side of capacitor C-52 (10 mf), connect an electronic voltmeter to chassis decoupled thru 10K ohms.

4. Set the contrast control for maximum gain (fully clockwise).

5. Peak L-20 for maximum reading on meter.

6. Peak T-3 primary (top core) for maximum reading on meter.

7. Move the meter and decoupling resistor from C-52 to junction of R-41 (33K) and lead to volume control.

8. Adjust T-3 secondary (bottom core) for zero response on 2.5V scale of meter. This corresponds to the cross-over point on the FM detector curve.

If desired, the symmetry of the curve may be checked by tuning the signal generator 25 kc above and below 4.5 mc and noting the plus and minus voltage produced, reversing the meter connections as necessary. For proper balance of the ratio detector system, the voltage in each direction should be approximately equal. If not, check the tuning of L-20 and the primary and secondary of T-3, the ratio detector. If necessary, replace the ratio detector tube V-9 (6AL5). It is desirable to calibrate the generator on a station signal. This may be done by nulling the secondary on a station signal and then connecting the generator and tuning it to produce the same null without touching the trimmers in the set.

NOTE: As the adjustments are brought to resonance, it is advisable to reduce signal generator output to prevent overloading.

With a 10,000 microvolt signal into the grid of the video amplifier tube, with the contrast control turned fully clockwise, and the focus control at center of its range, the voltage read from one side of capacitor C-52 should be greater than 5.0V.

4.5 MC TRAP ALIGNMENT

1. Connect the high side of the signal generator through a 1000 mmf capacitor to the grid (pin 1) of the video amplifier tube V-7 (6AH6), and the low side to chassis.

2. Connect the voltmeter and germanium crystal rectifier, as shown in Figure 5, between the cathode of the picture tube (yellow lead) and chassis. Use the lowest voltage scale on the meter.

3. With the signal generator accurately set at 4.5 mc and maximum output, adjust trap L-18 for minimum reading on the meter.

IF AMPLIFIER ALIGNMENT

Equipment Required:

IF Sweep Generator meeting the following requirements:

18 to 30 mc, approximately 12 mc sweep width. Output constant and adjustable to at least .1 volt maximum with accurately calibrated, adjustable markers.

Cathode Ray Oscilloscope: preferably one with a calibrated input attenuator.

NOTE: If there is no built-in marker in the sweep generator, loosely couple the output of an accurately calibrated AM signal generator to the IF strip. At all times, keep the marker output low enough to prevent the marker from distorting the response curve.

If a wide band scope is used, the marker will be more distinct if a capacitor of 100 to 1000 mmf is placed across the scope input. Use the smallest size possible, since too large a value will affect the shape of the curve.

Procedure:

1. Remove high voltage generator tube V-17 (6BQ6GT) from its socket to eliminate horizontal pick-up in the oscilloscope. Replace 6BQ6 tube with dummy load of 2500 ohms 25 watts connected from B plus side of fuse to chassis.

2. By means of an external battery, apply a negative 3.0 volt bias from the bottom of the 1st IF tube grid resistor R-13 (6800) to chassis.

3. Using leads as short as possible, connect the hot side of the sweep generator to the grid (pin 1) of the 1st IF tube V-3 (6AU6) through a 5000 mmf capacitor (do not use the loose or "spraying" method of coupling). The low side is connected to chassis. Set the center frequency of the sweep to about 24.6 mc and adjust initially for a sweep deviation of approximately 12 mc. However, a sweep of from 8 to 10 mc may be found better for overall alignment.

4. Using R-26 (100K) as a decoupling resistor, connect the scope to pin 4 of test socket. If a stronger output is desired, connect the scope between the picture tube cathode and chassis. The curve seen at this position will be the reverse of the polarity shown in Figure 6.

5. Set the contrast control at minimum.

NOTE: If a distorted or unstable picture is seen on the the oscilloscope during alignment, it may be necessary to stop the oscillator by disconnecting resistor R-9 (1500) from the plate (pin 6) of the oscillator tube V-2B (12AT7), or by substituting another tube with pin 6 removed.

CAUTION: 1. Do not reduce the oscilloscope gain and increase signal input so that the top of the curve is flattened, due to limiting in the video or scope amplifiers.

2. The dress of plate & grid components in the IF affects tuning. Do not move indiscriminately.

3. On the IF coils and on the traps, the resonance point will be found at two settings of the slug. The correct setting is the one which is found with the greater part of the adjusting screw out of the coil.

NOTE: The 1st & 2nd IF traps are tuned from bottom of chassis, while IF cores are adjusted from the top.

6. Tune the low frequency trap L-14, located on the 2nd IF coil, for maximum attenuation on the curve at 21.9 mc.

7. Tune the high frequency trap L-12 located on the 1st IF coil for maximum attenuation on the curve at 27.3 mc.

8. Adjust the 1st IF coil, L-11, to place a 26.6 mc marker on the high side of the response curve 60% down

NO.	TYPE	FUNCTION
V-1	6CB6	R-F AMP.
V-2	12AT7	MIXER-OSC.
V-3	6AU6	1ST. I-F AMP.
V-4	6AU6	2ND. I-F AMP.
V-5	6AG5	3RD. I-F AMP.
V-6	6AL5	VIDEO DET.
V-7	6AH6	VIDEO AMP.
V-8	6AU6	AUDIO DRIVER-LIMITER
V-9	6AL5	RATIO DET.
V-10	6J5GT	AUDIO AMP.
V-11	6V6GT	AUDIO OUTPUT
V-12	6SN7GT	1ST. & 2ND. CLIPPER
V-13	12AU7	VERT. SWEEP GEN.
V-14	6W6GT	VERT. SWEEP OUTPUT
V-15	6AL5	PHASE DET.
V-16	6SN7GT	HORIZ. OSC.
V-17	6BQ6GT	HORIZ. OUTPUT & H.V. GEN.
V-18	6W4GT	DAMPING DIODE
V-19	1B3GT	H.V. RECT.
V-21	5U4G	L.V. RECT.

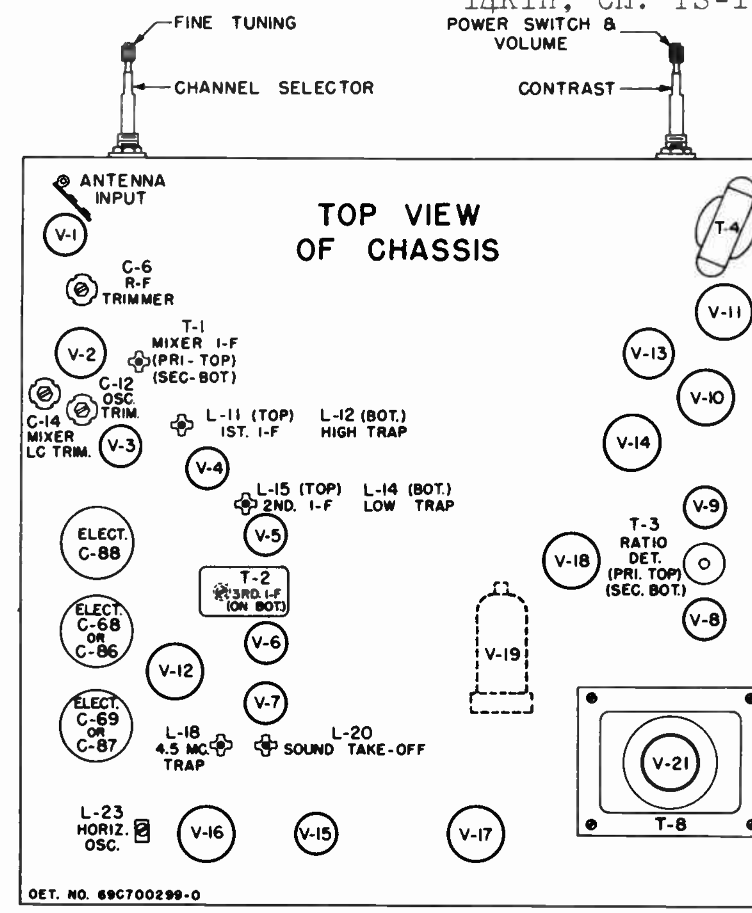

FIGURE 4. TUBE AND ALIGNMENT ADJUSTMENT LOCATIONS

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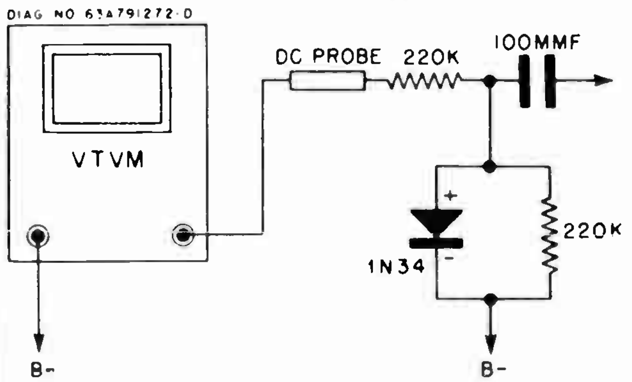

FIGURE 5.
ELECTRONIC VOLTMETER CONNECTIONS

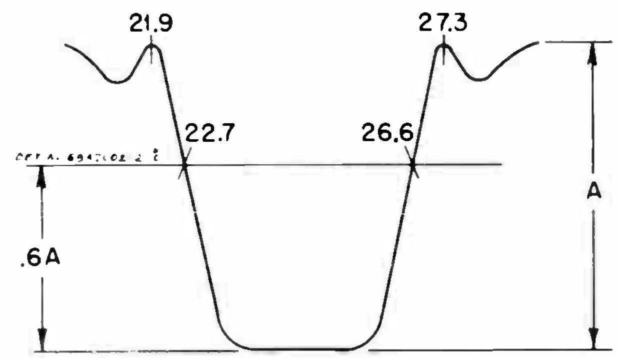

FIGURE 6. IF RESPONSE CURVE

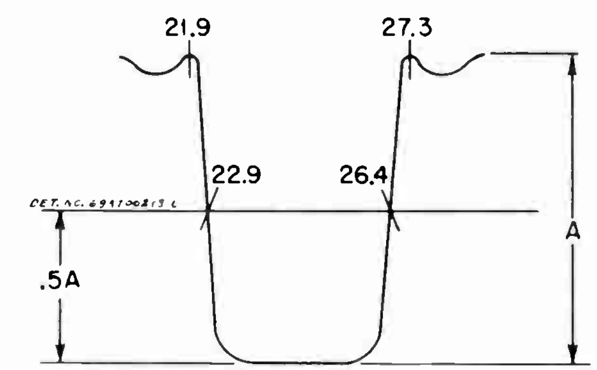

FIGURE 7. OVERALL RESPONSE CURVE FROM MIXER

from maximum response. See Figure 6.

9. Adjust the 2nd IF coil, L-15, to place a 22.7 mc marker on the low side of the response curve 60% down from maximum response.

10. Adjust the 3rd IF plate transformer, T-2, to provide a flat top or symmetrical response curve.

11. Reset the traps (steps 6 & 7) and again check the IF for proper response.

NOTE: It is suggested that the bias be removed for accurate resetting of the traps.

12. With bias applied, connect the sweep between the grid (pin 2) of the mixer tube V-2A (12AT7) and chassis.

13. Disconnect the trimmer, C-14, in LC circuit in the grid of the mixer tube, or short the trimmer through a 10,000 mmf ceramic disc type to chassis.

14. Bring both cores of the mixer transformer, T-1, simultaneously from the outside towards the center. The half-way markers should be 26.4 mc and 22.9 mc. (Figure 7).

NOTE: In aligning the three IF coils, each coil is adjusted individually, but when adjusting the primary and secondary of the mixer transformer, the adjustments should be made simultaneously. The important point to keep in mind is to obtain a flat response curve with as much gain as possible. The sides of the curve should be straight and as steep as possible. Simultaneous adjusting of the primary and secondary is the easiest way to obtain this result. The transformer by itself is, in effect, tuned for the same pass band as the three staggered circuits. See Figure 7. The only difference in the overall waveform should be that the sides of the overall wave are steeper. Constant use of the 50% markers (22.9 mc and 26.4 mc) should be resorted to, since it is absolutely necessary to obtain the proper curve. A slight dip (not exceeding 10%) is permissible in the mixer transformer response curve.

BANDWIDTH

The bandwidth may be determined by connecting an AM generator to the mixer grid. With the generator frequency at 24.6 mc, adjust the output for 1 volt reading on a VTVM connected at the plate (pin 2) of the video detector tube V-6 (6AL5) and chassis. Double the output of the generator. Now, by tuning either side of 24.6 mc and noting the frequencies at which the VTVM again reads 1 volt, the 6 db bandwidth points are indicated.

REGENERATION CHECK

After the above IF and mixer transformer alignment has been made, a check for regeneration in the IF amplifier should be made. This is done by removing the battery bias and observing the output response curve on the oscilloscope, as taken between the picture tube cathode and chassis. The bandwidth may change with the bias removed but should not change more than 0.2 mc. Set the contrast control to maximum gain. Decrease the input until the output signal shows a marked decrease. Any regeneration present will be indicated by sharp peaks on the overall response curve. The oscillator should be stopped, as described above, during this procedure.

CAUTION: Do not inject too much marker signal.

MIXER LC ADJUSTMENT

Reconnect bias removed for regeneration check. Replace trimmer C-14 in LC circuit of mixer grid or remove 10,000 mmf ceramic between trimmer and chassis. Adjust the trimmer so it is tuned to the center of the mixer response curve. This is indicated by observing the effect of the LC circuit on the mixer response. Increasing the capacity of the trimmer and bringing the LC circuit from above the IF range into the IF range, it will be noted that the mixer

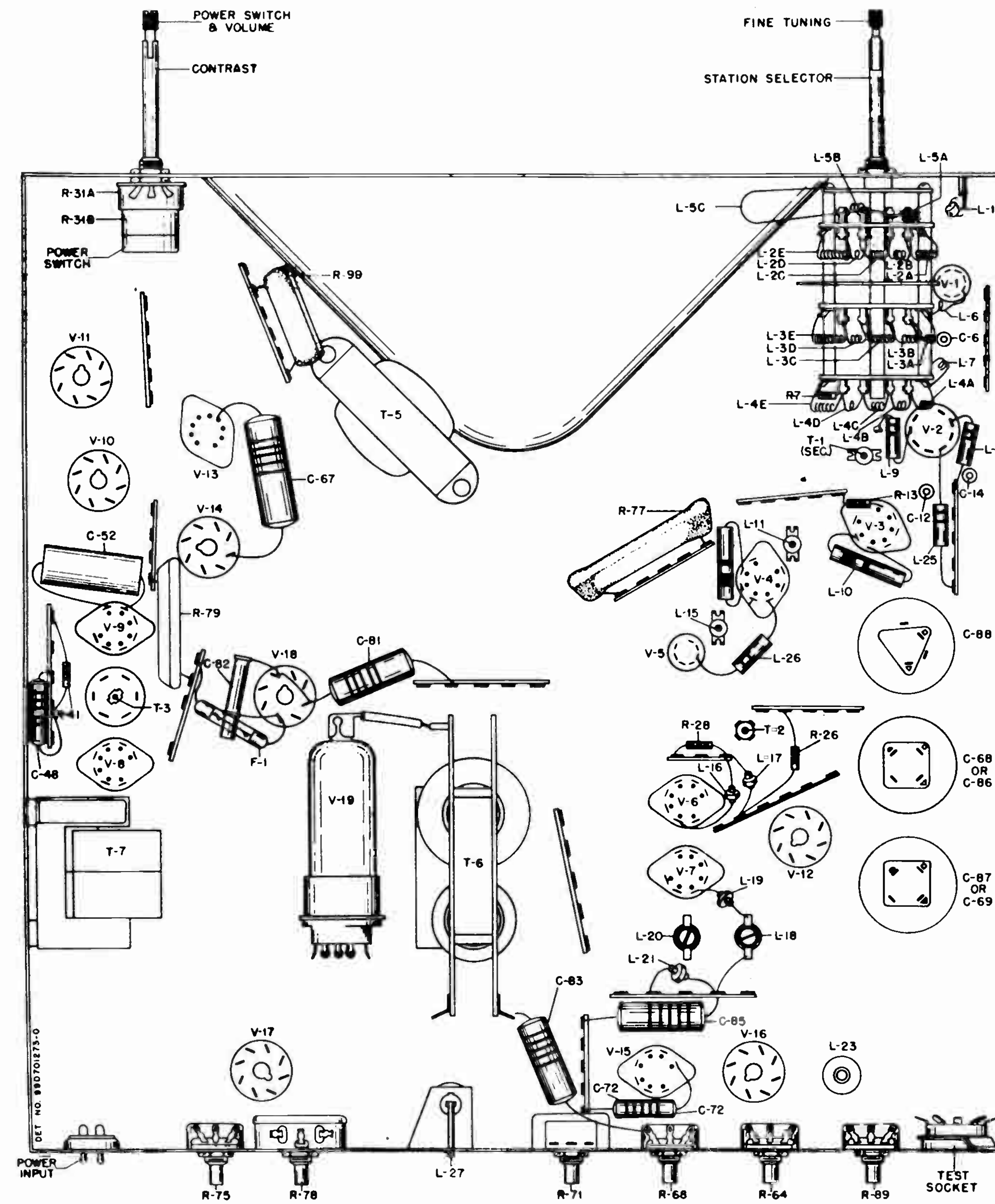

FIGURE 8. BOTTOM VIEW OF CHASSIS

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curve will pull down on the high side, then straighten out as the LC circuit approaches the middle of the range, and pull down on the low side as the LC circuit approaches the low end of the IF range. The proper tuning point is that point at which the mixer curve straightens out. In effect, the LC circuit is similar to a jack coil when it is within the IF range.

CAUTION: Tuning the LC circuit very low will cause oscillation.

IF SENSITIVITY MEASUREMENTS

IF Stages Only

1. Remove the battery bias from the 1st IF tube grid.
2. Connect an AM signal generator, set at 24.6 mc thru a blocking capacitor of 5000 mmf, between grid (pin 1) of the 1st IF tube V-3 (6AU6) and chassis.
3. Connect an electronic voltmeter across the video detector load resistor R-28 (5600). Both leads from the meter should be decoupled with 100K ohm resistors.
4. Set the contrast control for maximum sensitivity.
5. Stop the oscillator tube by disconnecting resistor R-9 (1500) from the plate (pin 6) of the tube V-2B (12AT7) or by substituting another tube with pin 6 removed.
6. The signal required to produce 1 volt (negative) above contact potential on the meter should be less than 700 microvolts.

Mixer & IF Stages

The preliminary preparations are the same as for checking the sensitivity of the IF stages except:

1. Connect the AM signal generator, set at 24.6 mc, through a 5000 mmf capacitor, between the grid (pin 2) of the mixer tube V-2A (12AT7) and chassis.
2. The signal required to produce 1 volt (negative) above contact potential on the meter should be less than 125 microvolts.

OSCILLATOR, ANTENNA AND RF ALIGNMENT

NOTE: The IF must be aligned before the RF section can be properly phased.

Equipment Required:

Sweep Generator: Frequency range 40-220 mc; 10 mc sweep width
Output constant and adjustable
Adjustable markers (markers should be calibrated occasionally by checking against an accurate signal generator).

Oscilloscope: Preferably one with a calibrated input attenuator.

Signal Generator: Frequency range 40 to 220 mc
Accurately calibrated
AM modulated 400 cycle

FREQUENCY CHART

Chan	Frequency	Picture	Sound	Oscillator
2	54-60	55.25	59.75	81.65
3	60-66	61.25	65.75	87.65
4	66-72	67.25	71.75	93.65
5	76-82	77.25	81.75	103.65
6	82-88	83.25	87.75	109.65
7	174-180	175.25	179.75	152.45
8	180-186	181.25	185.75	158.45
9	186-192	187.25	191.75	164.45
10	192-198	193.25	197.75	170.45
11	198-204	199.25	203.75	225.65
12	204-210	205.25	209.75	231.65
13	210-216	211.25	215.75	237.65

ANTENNA & RF ALIGNMENT PROCEDURE

1. Remove high voltage generator tube V-17 (6BQ6GT) from its socket and replace with a dummy load of 2500 ohms 25 watts connected from B plus side of fuse to chassis. Stop the oscillator by disconnecting R-9 (1500) from plate (pin 6) of V-2B (12AT7).
2. Connect the sweep generator across the antenna terminals on the chassis with the antenna lead-in removed. The line from the sweep generator should be as short as possible.
3. Connect the oscilloscope through a decoupling resistor of 150,000 ohms, between the cathode (pin 3) of the mixer tube V-2 (12AT7) and chassis.
4. Short out the AGC circuit with a clip lead from the AGC bus to chassis.
5. Refer to Figure 4 for the RF trimmer location and to Figure 9 for the locations of the antenna and RF coils. The frequency chart listed previously gives the channel and alignment frequencies.
6. The antenna coils are tuned to the video carrier frequency and the RF coils are tuned to the sound carriers. Figure 10 shows the shape of the curve which should appear on the scope for channels 2-6 and Figure 11 the curves for channels 7-13.
7. Turn the station selector switch to channel 10. Set the center frequency of the sweep generator to the center frequency of channel 10 (195 mc).
8. Adjust ceramic trimmer, C-6, so that picture and sound markers are as in Figure 11.
9. Check channels 7 to 13 for proper response and, if necessary, tune the coil L-6. These coils may be tuned by spreading them to decrease inductance or compressing them to increase their inductance. See Figure 9 for location of coils. This will have more effect on channels 10 to 13 than 7 to 9. If L-6 is adjusted, it may be necessary to readjust RF trimmer C-6, and recheck the high channels.

NOTE: As the bandwidth of the high channels is very broad, a slight variation is permissible.

10. Move bandswitch to channel 6.
11. With the center frequency of sweep generator at the center frequency of channel 6 (85 mc), introduce markers corresponding to sound and picture carriers and compare with curve of Figure 10.

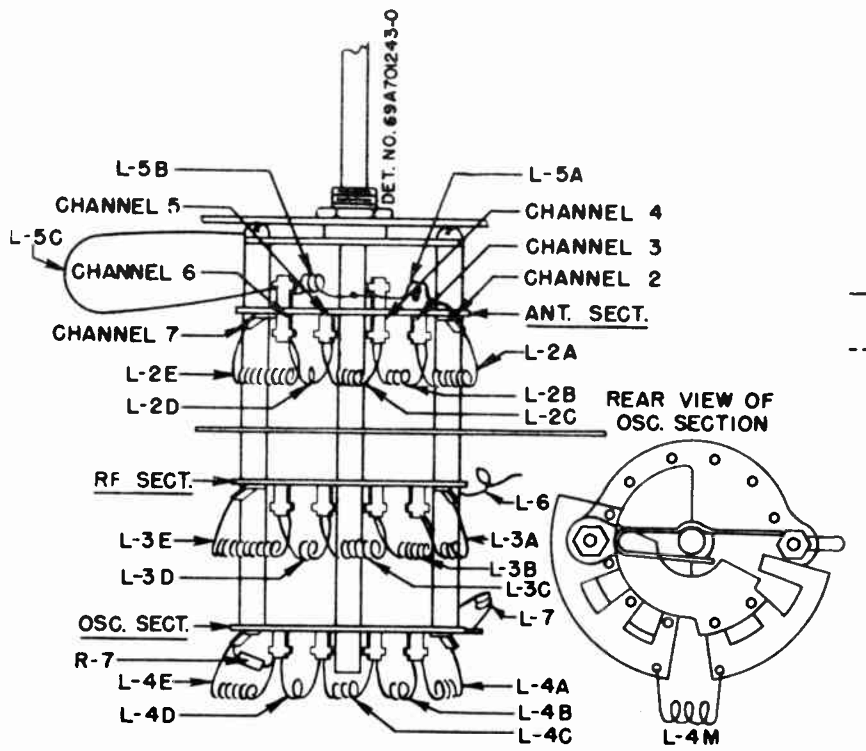


FIGURE 9. ANTENNA, RF AND OSCILLATOR COIL LOCATIONS

NOTE: A convenient method of determining whether a coil is tuned correctly is to insert a brass or iron slug into the coil. Brass decreases and iron increases the inductance.

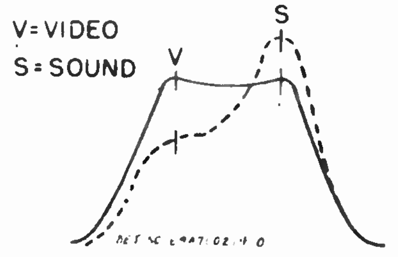
12. After channel 6 has been aligned, progress downward through channel 2.

CAUTION: Make certain the station selector switch is on the correct channel before checking bandpass.

OSCILLATOR ADJUSTMENT

1. Put oscillator back in circuit.
2. Remove the short from the AGC circuit and apply a -3 volt battery bias to the AGC bus.
3. Move the scope to the test socket on the chassis rear with the high side connected to pin 4 and the low side to pin 5 (chassis).
4. Set the contrast control at minimum (counterclockwise).
5. Remove the fine tuning knob and turn shaft until the slot is in a horizontal position. This represents the mid-capacity position.
6. Turn station selector switch to channel 12.
7. Set the sweep generator on channel 12 with a center frequency of 207 mc and at least a 12 mc sweep. Keep the output low enough to show no evidence of limiting in the overall response curve.

NOTE: Before aligning the oscillator section, make



—SOLID LINE INDICATES OPTIMUM RESPONSE.
--- DOTTED LINES INDICATES PERMISSIBLE VARIATION.

FIGURE 10.
RF RESPONSE CURVES CHANNELS 2-6

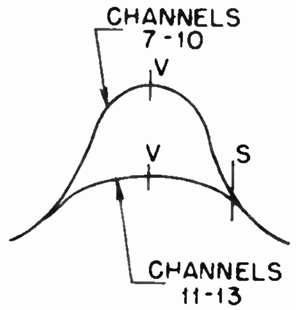


FIGURE 11.
RF RESPONSE CURVES CHANNELS 7-13

certain the 3.3 microhenry choke (L-8) in the mixer grid is dressed away from the 2 mmf capacitor (C-16) tied to the same grid.

8. Introduce a marker corresponding to the sound carrier of channel 12 (209.75 mc).
9. Adjust oscillator ceramic trimmer so that the sound marker falls into the 21.9 mc trap dip in the response curve.
10. Turn generator and station selector to channel 9 with the fine tuning shaft slot still in the horizontal position.
11. Spread or compress the 3-turn coil located in the center of the oscillator plate (L-4M, Figure 9) so that the sound marker for channel 9 falls into the 27.3 mc trap dip in the response curve. As the oscillator is tuned below the carrier on channels 7, 8, 9 & 10, the 27.3 mc trap will be in the same position as the 21.9 mc trap in step 9.
12. Repeat steps 6, 7, 8 & 9.
13. Turn generator and station selector to channel 13.
14. Turn fine tuning trimmer so that the sound marker for channel 13 falls into the 21.9 mc trap dip of response curve. The slot in the fine tuning shaft should not have moved more than 30° from the horizontal position to accomplish this (each number on the station selector knob represents 30°).
15. If more than a 30° change in fine tuning trimmer was needed in step 14, adjust channel 13 oscillator coil

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(L-7) by spreading or compressing until the 30° requirement is met.

NOTE: Each adjustment of channel 13 oscillator coil (L-7) will necessitate a rechecking of the oscillator trimmer on channel 12 as per steps 6, 7, 8 & 9.

16. Check channels 12, 11, 10, 9, 8, and 7 by noting whether the fine tuning trimmer can drop the sound marker for each channel in the trap dip by a 30° rotation. If one of the channels does not meet the 30° requirement, a compromise must be made by resetting channel 9 or 12, whichever is closer to the channel in question.

Example: 1) If channel 11 does not meet the 30° requirement, return station selector and generator to channel 12 and tune ceramic trimmer toward channel 11 (trimmer frequencies lowered by tightening screw). This will tend to move channel 12 sound marker out of the trap dip, but this can be compensated for by the fine tuning trimmer. Do not adjust trimmer any more than is necessary to get the channel in question back within the 30° requirement.

Example: 2) If channel 10 does not meet the 30° requirement, move station selector and generator to channel 9 and tune the 3-turn coil (L-4M, Figure 9) toward channel 10 (coil freq raised by spreading turns.) This will also tend to move channel 9 sound marker out of the trap dip, but this can be compensated for by the fine tuning trimmer. Again, do not adjust the coil any more than is necessary to bring the channel in question back within the 30° requirement.

17. Turn sweep generator and station selector switch to channel 6.

18. Adjust channel 6 oscillator coil (L-4E, Figure 9) so that the sound marker for channel 6 falls into the 21.9 mc trap dip with the fine tuning trimmer at mid-capacity (shaft slot in horizontal position). Always spread or compress channel 6 oscillator coil in units of 3 turns. Compressing turns will move curve toward sound marker, while spreading will move curve toward video marker.

IMPORTANT: Since the coils are in series, the proper alignment of channel 6 will simplify the phasing of the channels to follow.

19. Adjust channels 5 and 4 so that the sound marker for each channel falls into the 21.9 mc trap dip in the curve with the fine tuning trimmer set no more than 15° from mid-capacity.

20. Channels 3 and 2 should be adjusted so that the sound marker falls into the 21.9 mc trap dip with the fine tuning trimmer within 15° of maximum capacity.

OVERALL RECEIVER SENSITIVITY MEASUREMENT

An overall measurement of sensitivity is made as follows:

1. Connect an AM signal generator to the input terminals of the receiver chassis after removing the short 300 ohm lead which connects to the antenna input strip on the back of the cabinet. To match the generator to the receiver input, a resistor matching network should be used. In the case of a generator with a 50 ohm output impedance, for example, place a 100 ohm resistor in series with the output terminal of the generator and a 150 ohm resistor in series with the ground terminal.

2. From cathode of picture tube to chassis, connect a calibrated oscilloscope.

NOTE: To calibrate scope, connect it across 6.3 volt filament supply. The peak-to-peak amplitude on the screen will then be approximately 18V (6.3 x 2.8).

3. Set contrast control for maximum sensitivity.

4. Tune signal generator to the video carrier frequency of the channel being checked. Generator signal should be 30% modulated at 400 cycles. The signal from the generator to produce 20 volts peak-to-peak at picture tube cathode should be less than 25 microvolts on channels 2 to 6 and less than 75 microvolts on channels 7 to 13.

CIRCUIT DESCRIPTION

LOW VOLTAGE POWER SUPPLY

The low voltage power supply (Figure 12) provides plate voltage for all tubes except the high voltage applied to the second anode of the picture tube and heater voltage to all tubes except the HV rectifier, which is energized by horizontal sweep current.

Since the damping diode (V-18) develops a high voltage pulse at its cathode, and its cathode is tied to the filament to prevent breakdown in the tube, it is necessary to provide a separate, low-capacity, well-insulated transformer (T-7), to heat this filament.

The plate supply is a conventional full wave rectifier using a 5U4 tube (V-21). The speaker field serves as the filter choke. The focus coil, and its current adjusting resistor network, is used also as a voltage divider to supply plate current to several tubes as shown in Figure 12.

Another voltage divider from this network to chassis consisting of R-76 (1 meg) and the potentiometer R-75 (1 meg) provides a variable bias on the cathode of the picture tube, to serve as a brightness control.

THE RF TUNER

Antenna Input

Figure 13 is a simplified schematic of the tuner.

The antenna input coil, L-1, couples the balanced line to the single ended input circuit for the RF tube, V-1. Optimum antenna coupling for all channels is obtained by the coupling coils L-5A, L-5B, L-5C, and the coupling leads on channel positions 8, 10, and 12 of switch wafer S-1A. These can be considered the primary of the antenna transformer. The secondary, or tuned grid circuit, includes also the continuous, tapped coil mounted on wafer S-1B for the low channels (2-6) and the stamped metal plate in series with the coil for the high channels (7-13). The purpose of the antenna coil, coupling leads, and secondary circuit, is to match the 300 ohm impedance of the transmission line from the antenna to the input impedance of the RF amplifier grid circuit and to tune this circuit for the channel selected. Referring to Figure 13, it will be seen that the switch, in progressing from channel 2 to channel 13, shorts out the unused portion of the secondary winding or stamped metal plate. The bandwidth of channels 7 thru 13 is about 8 mc. The stamped metal plate is carefully designed so that with this bandwidth no alignment adjustment is needed on the high channels. The individual coil sections on the low channels, however, may be tuned by spreading or compressing them, as outlined in the alignment procedure.

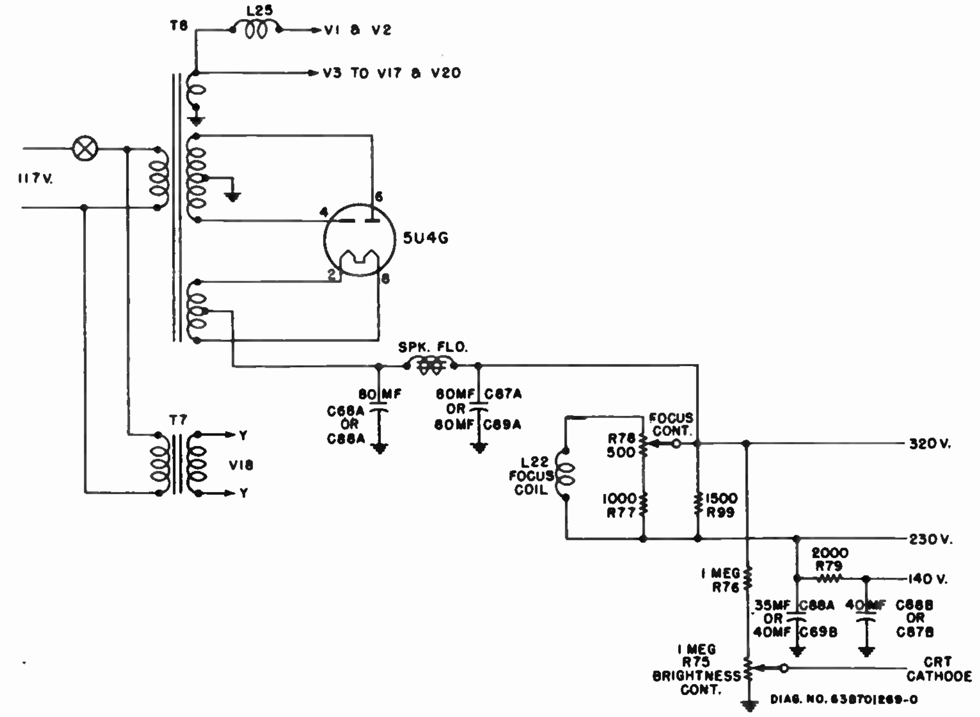

FIGURE 12. SIMPLIFIED SCHEMATIC OF LOW VOLTAGE POWER SUPPLY

RF Amplifier

The grid of the RF amplifier V-1 (6CB6) is returned to the AGC bus thru R-1 (22K) and the decoupling resistor R-2 (47K) is bypassed by capacitor C-3. The plate load of this tube consists of another tapped coil for the low channels and a stamped metal plate for the high channels mounted, in this case, on switch wafer S-1C. Here again, the switch progressively shorts out the unused sections of the inductance in tuning from channel 2 to 13. In this case, however, a trimmer C-6 and a choke L-6 are provided to center the high channel response while the low channel coils may be tuned by expansion or compression.

The Mixer

The mixer uses 1/2 of V-2 (12AT7). C-17 (8 mmf) couples the RF amplifier output to the mixer grid. Oscillator injection is accomplished by C-16 (2 mmf). L-8 and C-14 form a series resonant circuit tuned to the center of the IF response, to prevent interaction between the IF and the mixer input.

The Oscillator

The oscillator uses the other half of V-2 (12AT7) in a Colpitts circuit. Here again, the tuning inductance consists of the tapped coil for the low channels and the stamped plate for the high channels mounted on wafer S-1D. L-7 and C-12 are provided to set the center frequency on the high channels while the low channels are aligned by spreading or compressing the individual coil sections. C-11 is provided as a fine tuning control for customer use. The oscillator operates above the RF on channels 2, 3, 4, 5, 6, 11, 12 & 13 and below the RF on channels 7, 8, 9 & 10. This choice of oscillator frequencies eliminates interference due to oscillator radiation on the high channels.

THE IF AMPLIFIER

The IF amplifier uses two 6AU6 tubes and one 6AG5 tube. Figure 14 is the schematic of the IF amplifier. T-1 couples the mixer plate to the first IF grid. Coupling between primary and secondary, which are individually slug-tuned, is fixed and is designed for proper bandwidth. The plate choke L-10, of the 1st IF tube V-3 (6AU6), is coupled to the grid coil, L-11, of the 2nd IF tube V-4 (6AU6) thru C-27 (220 mmf). At IF frequencies, the impedance of C-27 is negligible and for all practical purposes, L-10 and L-11 can be considered as being in parallel, L-11 being slug-tuned. A similar method is used between the 2nd and 3rd IF tubes. The 3rd IF plate is coupled to the detector by T-2, a unity coupled transformer. The IF circuits are stagger-tuned for proper bandwidth as explained in the Alignment Instructions. L-12 and L-14 are separately tuned trap windings on IF coil forms L-11 and L-15, respectively. Together with C-28 and C-36, they form absorption type trap circuits which steepen the high and low skirts of the IF response for better picture quality and stabilize the audio response with intercarrier sound.

Decoupling is used in the plate supply and AGC circuits to prevent regeneration.

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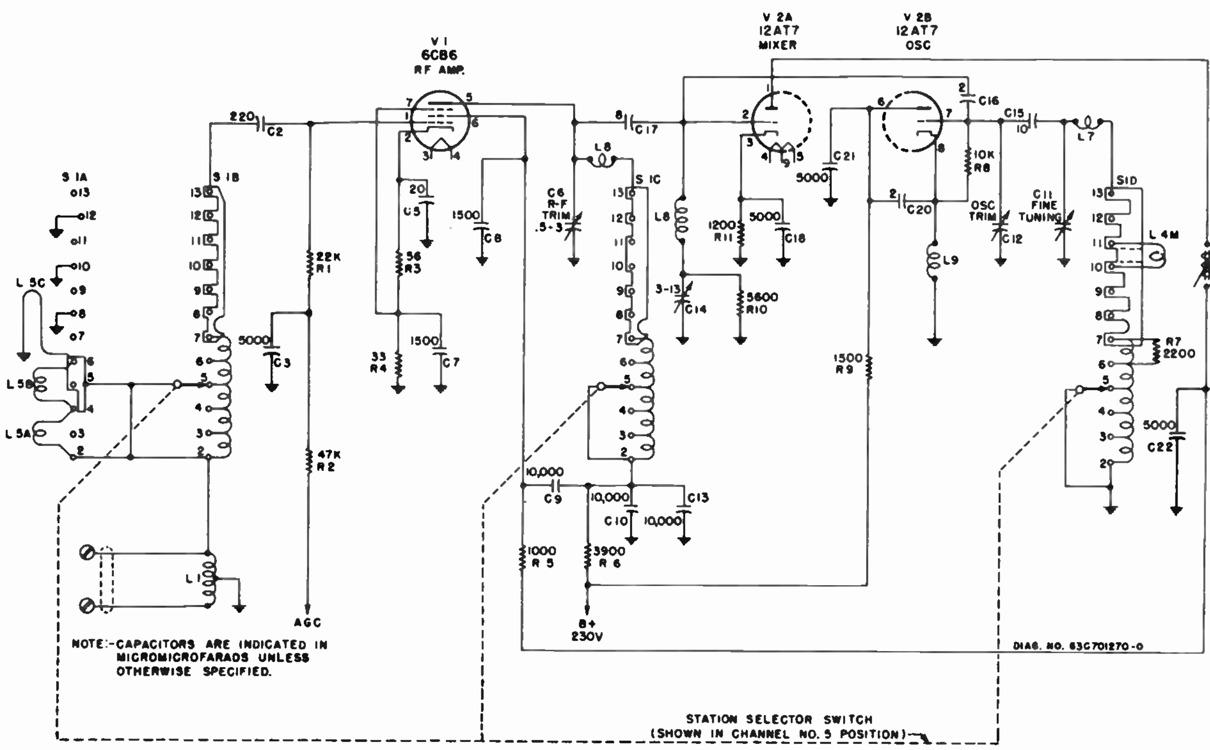

FIGURE 13. SIMPLIFIED SCHEMATIC OF RF TUNER

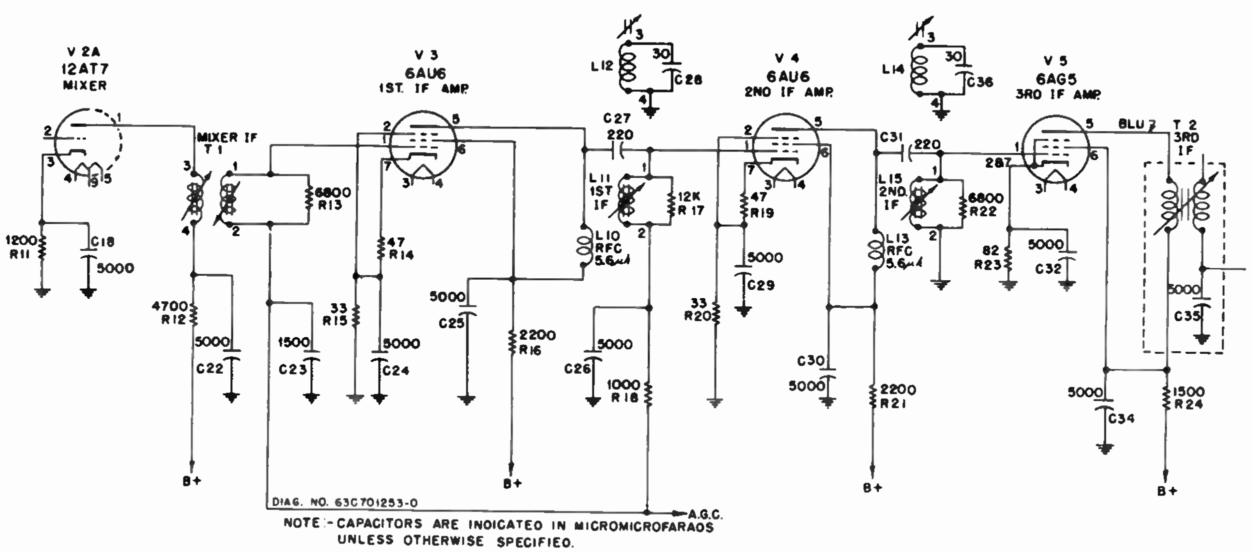

FIGURE 14. SIMPLIFIED SCHEMATIC OF IF AMPLIFIER

THE VIDEO DETECTOR

One-half of V-6 (6AL5) is used as the video detector. Figure 15 is a schematic of the video detector. Since for noise limiting purposes it is desirable to apply a signal with negative going sync pulses to the grid of the video amplifier, the detector load R-28 (5600) is placed in the plate circuit of the diode. L-16, L-17 and C-37, form a low pass filter to keep IF frequencies off the grid of the video amplifier.

Since this chassis operates on the intercarrier sound system, the detector heterodynes the video and sound IF frequencies and produces the 4.5 mc beat frequency which becomes the new audio IF frequency. The negative DC voltage is fed to the AGC bus thru R-27 (1.5 meg) and controls the gain of the RF and 1st and 2nd IF amplifiers.

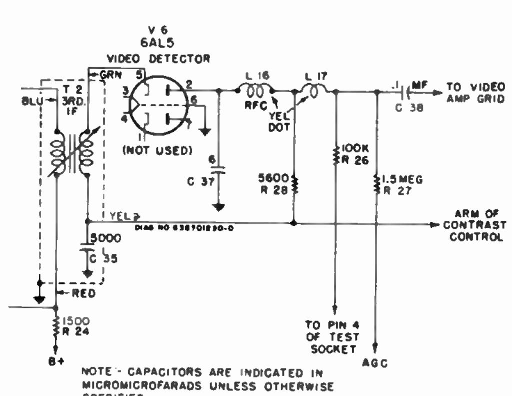

FIGURE 15. SIMPLIFIED SCHEMATIC OF VIDEO DETECTOR

THE VIDEO AMPLIFIER

The video amplifier V-7 (6AH6) not only amplifies the video signal but also the 4.5 megacycle audio IF beat. Figure 16 is a schematic of the video amplifier. In its plate circuit, this beat is separated from the video signal and fed to the grid circuit of the audio driver-limiter tube V-8 (6AU6) by C-43 (2.2 mmf) and L-20, the sound take-off coil. The 4.5 mc trap, L-18 and C-42 is a parallel resonant circuit which, when properly tuned, offers a high impedance to this frequency, to prevent its reaching the picture tube.

By applying a negative signal to the grid of the video amplifier, a noise limiting action is achieved because noise pulses of amplitude greater than the sync level will drive the tube to cut off and, therefore, will not be present in the plate circuit. Since a single video amplifier tube is used, the signal at its plate will be positive and, as might be expected, is used to modulate the cathode of the picture tube rather than the grid, because the blanking pulses must cut the picture tube off and the polarity of the video information must be such that dark picture elements result in making the grid more negative with respect to the cathode.

L-19 and L-21 are peaking coils to extend the high frequency response of the amplifier. The contrast control, R-31A, is placed in the cathode circuit of the video amplifier and controls the bias and, therefore, the gain of this tube. The composite video signal is fed to the picture tube thru coupling condenser C-85 (.1).

THE AGC

The negative DC voltage developed across the detector load resistor, R-28 (5600), is the AGC voltage. It will be noted that the low side of this resistor is connected to the arm of the contrast control potentiometer, R-31A. R-30 (47) is shunted across the arm of the contrast control and chassis. In weak signal areas, this arrangement results in a delay in the AGC action. For a weak signal, minimum bias is desired on the video amplifier and, therefore, the arm of the contrast control will be closest to the cathode end of the potentiometer. Because R-30 is then shunted across the entire contrast control, most of the plate current will flow thru it and develop a positive voltage of approximately one volt at the arm with respect to chassis. Since the low

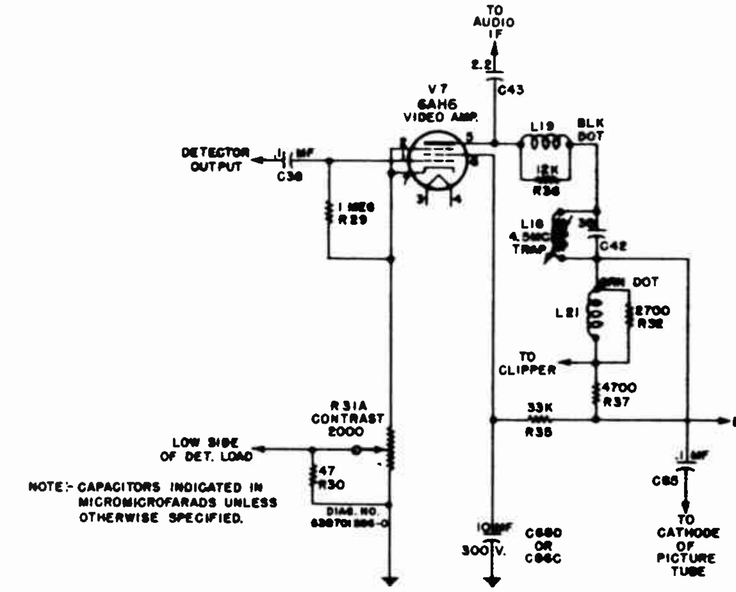

FIGURE 16. SIMPLIFIED SCHEMATIC OF VIDEO AMPLIFIER

side of the detector load is tied to this positive voltage, no AGC voltage will develop until the signal is strong enough to overcome this positive voltage and, therefore, no AGC bias is applied to the controlled tubes under weak signal conditions. In a strong signal area, however, where the arm of the contrast control approaches the chassis end of the control, R-30 is shorted out and full AGC voltage is developed.

THE AUDIO SYSTEM

The audio system employs a driver-limiter, V-8 (6AU6); a ratio detector, V-9 (6AL5); a first audio amplifier, V-10 (6J5) and an audio output tube, V-11 (6V6). Figure 17 is a schematic of the audio system. The driver-limiter is operated at low plate and screen voltages to act as a partial limiter to minimize any amplitude modulation. A conventional ratio detector and audio amplifier are used.

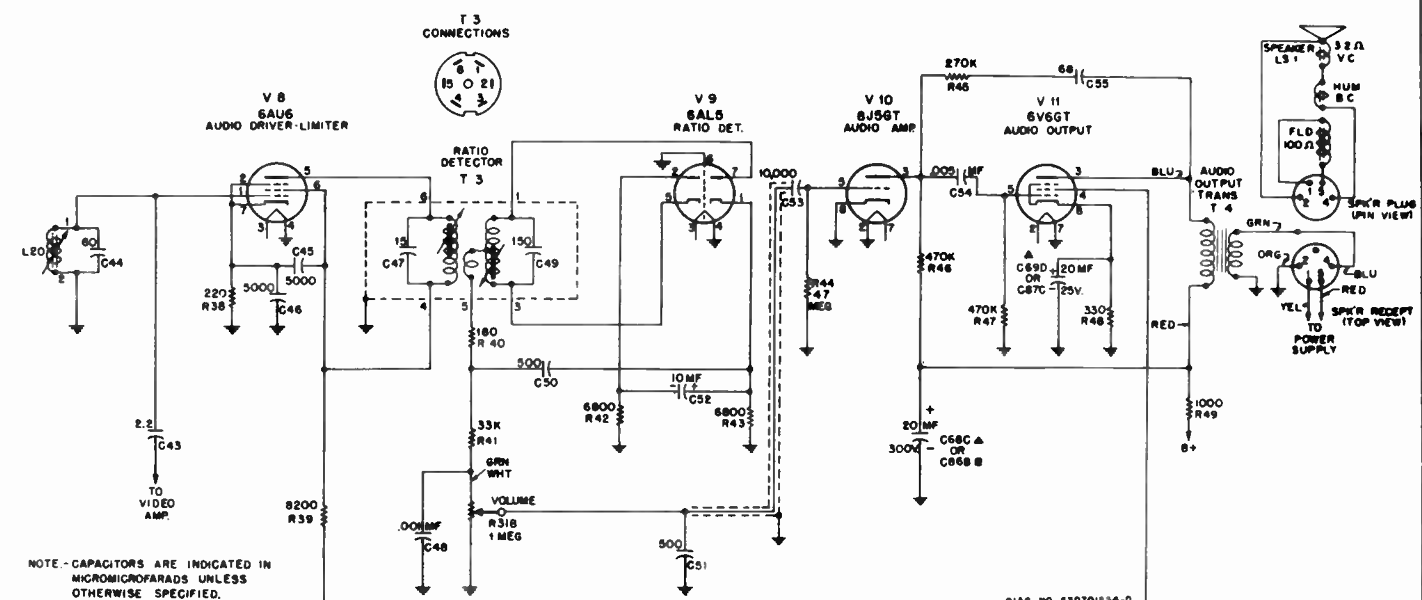

FIGURE 17. SIMPLIFIED SCHEMATIC OF AUDIO SYSTEM

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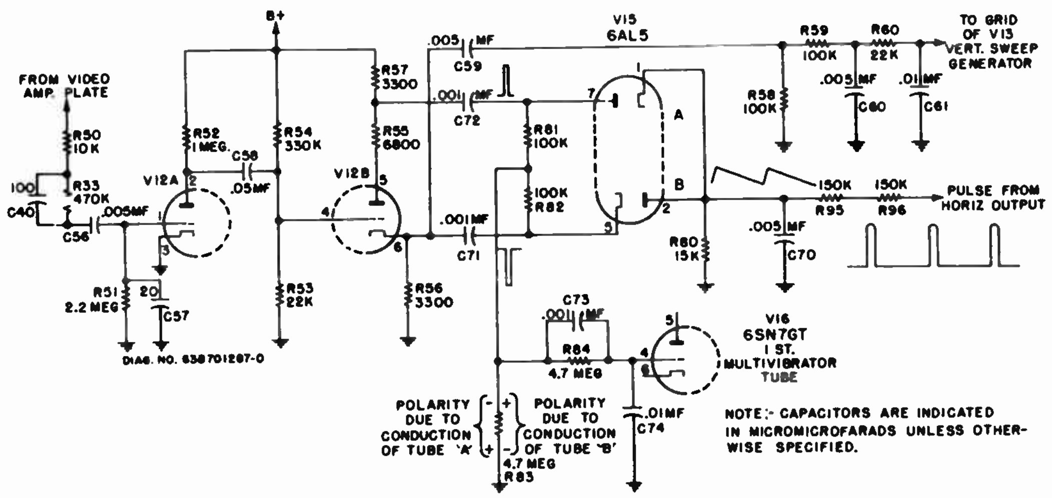

FIGURE 18. SIMPLIFIED SCHEMATIC OF CLIPPERS AND PHASE DETECTOR

THE CLIPPER

The clipper uses a 6SN7GT tube. The clipper schematic is shown in Figure 18. The composite video signal with positive going sync is applied thru R-50 and C-56 (.005) to the grid of the first clipper from the plate circuit of the video amplifier. R-33 (470K) and C-40 (100) provide a short time constant circuit to minimize noise at the clipper grid. Under no signal conditions, the tube is unbiased. The positive signal, however, will cause the tube to draw grid current and the voltage drop across R-51 (2.2 meg), negative at the grid, will charge C-56 to such a value that only the most positive part of the signal, which is the sync pulse, will cause plate current to flow. Therefore, the video information and the blanking pulses are clipped off and only the sync pulses, now negative in polarity, appear in the plate circuit. The second clipper is so biased that the peaks of the sync pulses will drive the tube to cut-off, which results in squared pulses of positive polarity in the plate circuit of this tube. A slight increase in sync pulse amplitude is obtained by a small positive voltage applied to the grid of the second clipper by R-54 (330K).

THE VERTICAL SCANNING SYSTEM

Figure 19 is a schematic of the Vertical Scanning System.

The negative sync pulses are fed from the cathode circuit of the second clipper, V-12B, to the integrating network composed of R-59, C-60, R-60 and C-61 where the serrations of the vertical group are changed to a single negative pulse to trigger the vertical scanning oscillator. C-59 (.005) and R-58 (100K) form a differentiating network which helps to stabilize the vertical scanning system by eliminating low frequency disturbances such as line fluctuations, etc.

The vertical scanning oscillator is an asymmetrical, cathode coupled multivibrator using the dual triode V-13 (12AU7). The circuit component values are chosen so that V-13B's conductance time is about 7% of the entire cycle to insure that retrace of the scan will have the proper relationship to the trace time. The saw-forming condenser, C-66 (.05) is placed in the plate circuit of V-13B while the sync pulses are applied to the grid of V-13A. For the purpose of explaining the free-running action of the circuit, assume that the end of the trace period has almost been reached. At this time, V-13A is conducting, C-63 (.01) is discharging thru V-13A, R-63 (330K) and R-64 (the vertical hold control). This discharge current makes the grid end of R-63 negative and, together with the plate current of V-13A thru R-62 (2700), the common cathode resistor, biases V-13B beyond cut-off. The energy stored in C-63 is finally reduced to the point where the voltage drop across R-63 and R-64, due to the discharge current of C-63, is no longer sufficient to keep the grid of V-13B below cut-off and the tube begins to conduct current. The increased current thru the common cathode resistor R-62, increases the bias on V-13A and reduces its plate current. The rise in voltage at the plate of V-13A starts to charge C-63, and this charging current applies a positive voltage to the grid of V-13B. This pulse of voltage throws V-13B into heavy conduction and develops a pulse of voltage across the common cathode resistor R-62, which drives V-13A beyond cut-off. C-66, the saw-forming condenser, discharges suddenly thru the virtual short circuit caused by the heavy conduction of V-13B. This corresponds to the retrace time in the scanning cycle. As C-63 approaches full charge, the charging current thru the grid circuit of V-13B decreases and the positive voltage applied to the grid of V-13B is reduced, which results in a reduction of plate current and, therefore, a reduction of bias on the grid of V-13A. Eventually, this tube starts to conduct and C-63 begins to discharge and again this discharge current thru R-63 and R-64 cuts V-13B off. C-66 begins to charge from B plus, initiating the trace time of the scan and the beginning of another cycle.

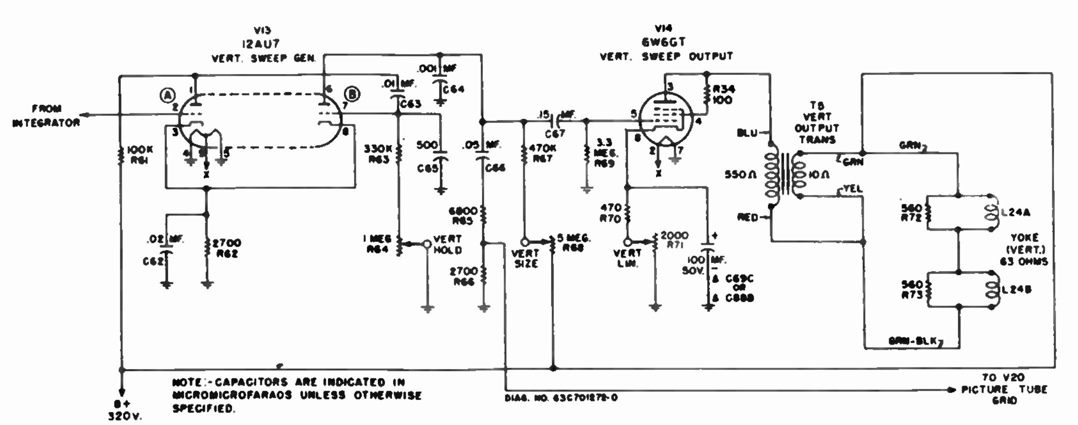

FIGURE 19. SIMPLIFIED SCHEMATIC OF VERTICAL SCANNING SYSTEM

The frequency of the multivibrator is adjusted by means of the hold control R-64, so that the sync pulse from the transmitting station, negative in polarity, arrives at the time when V-13B is beginning to conduct which, as we have seen, causes the grid of V-13A to go negative. The added negative voltage of the sync pulse insures that V-13A will be driven to cut-off at sync pulse rate for each cycle, thus initiating the retrace in exact step with the transmitting station's vertical scan. The voltage developed at the plate of V-13B will be the combination sawtooth and pulse voltage shown in Figure 22(1). The pulse is formed by the peaking resistors R-65 and R-66. When V-13B goes into conduction, the voltage at the plate of V-13B drops suddenly to a value determined by the relationship of the plate resistance of V-13B to the total resistance in the discharge circuit of C-66 which consists of R-65, R-66 and the plate resistance of V-13B. After this initial instant, the charge on C-66 decreases, causing the voltage decrease at the plate shown between points "c" and "d" of Figure 22(1). When the positive pulse on the grid of V-13B has decreased to the value where the negative charge on C-63 becomes operative and cuts off V-13B, the voltage on the plate of V-13B and, correspondingly, on the grid of V-14, rises quickly to point "a" on the curve, the start of the trace.

By returning the grid of the picture tube to the junction of the two peaking resistors R-65 and R-66, a negative pulse of suitable amplitude to cut the picture tube off during retrace is obtained, resulting in elimination of retrace lines on the screen.

The negative pulse shown between point "b" and "a" of Figure 22(1), acting on the grid of V-14, tends to cut the tube off and raises its plate resistance to the larger value required to dissipate the energy in the plate circuit inductance during the short retrace period.

Since the plate circuit of the vertical output stage V-14 has inductance and, as the time constant of an inductive circuit decreases with an increase of resistance, just the opposite of an RC circuit, the increase in plate resistance of the tube is used to obtain the short time constant circuit required for proper retrace time. The windings on the vertical output transformer are connected series opposing which reduces the step-down ratio and, hence, the inductance in the plate of V-14 in order to shorten the retrace time.

The controls found in this circuit are:

1. The Vertical Hold Control R-64 (1 meg). This control varies the resistance in the discharge circuit of C-63 (.01) and, hence, provides a means of varying the frequency of the multivibrator. In practice, this control is adjusted so that the incoming negative sync pulses, on the grid of V-13A, which are of constant amplitude, will cut V-13A off and throw V-13B into conduction in exact synchronization with the transmitting station's vertical scan.

2. The Vertical Size Control R-68 (5 meg). This control varies the charging current into C-66 (.05) and, hence, the amplitude of the voltage developed across it. Variation of this voltage varies the drive on the grid of V-14 and controls vertical size

3. Vertical Linearity R-71 (2000). This control, thru resistor R-70 (470), sets the bias on the grid of the vertical output tube and determines the tube's operating point on its plate current curve. Since this curve is not linear, some distortion can be introduced to counteract any non-linearity in the sawtooth grid voltage.

Since the size control is part of the multivibrator circuit and has an effect also on its frequency, there will be some interaction between the size and hold controls. Usually, readjustment of size will require readjustment of the hold control.

HORIZONTAL SCANNING SYSTEM

The horizontal scanning system comprises a phase detector V-15 (6AL5), a cathode coupled multivibrator V-16 (6SN7), the output tube V-17 (6BQ6) and a damping diode V-18 (6W4). Figure 20 is a simplified schematic of this system.

The Horizontal Oscillator

In order to see how the phase detector automatically corrects for multivibrator frequency change, it will be necessary to understand how the correction voltage affects the multivibrator. The horizontal oscillator is also an asymmetrical cathode coupled multivibrator.

The operation is as follows. Assume that the trace period is almost completed. At this time, tube "A" is conducting, tube "B" is cut off. C-76 is discharging thru tube "A" R-88 (120K), and R-89 (the hold control). The discharge current of C-76 is still high enough to keep the grid of tube "B" negative and cut off. Bias is being applied to both tubes by current flow thru the common cathode resistor R-86 (1000). When the energy stored in C-76 is reduced to the point where its discharge current no longer holds the grid of tube "B" below conductance, tube "B" starts to pass current and this current causes a greater voltage drop across R-86, the common cathode resistor, which increases the bias on tube "A" reducing its plate current. The resulting increase in voltage at the plate of tube "A" begins to charge C-76 and this charging current applies positive voltage to the grid of tube "B". The resulting heavier conduction of tube "B" develops a pulse of voltage across R-86 which cuts tube "A" off and results in a positive pulse at the plate of tube "A" which throws tube "B" into heavy conduction. This allows C-77, the saw-forming condenser, to discharge thru tube "B" and R-91. When C-76 becomes charged, the charging current thru the grid circuit of tube "B" decreases and the positive voltage on the grid, which has far exceeded the bias developed across R-86, is reduced. This results in reducing the plate current thru tube "B" and, therefore, the bias applied to tube "A" by the voltage drop across R-86. Tube "A" starts to conduct and condenser C-76 starts to discharge, cutting tube "B" off. C-77 begins to charge, starting the next trace.

L-23 and C-75 in the plate circuit of tube "A", form a resonant circuit which is tuned to the horizontal frequency (15,750 cps). The 15,750 cycle sine wave generated by this circuit, if properly phased, will insure that the positive pulse at the plate of tube "A", which throws tube "B" into conduction, will be more frequency stable.

C-77 and R-91, the peaking resistor, will produce the

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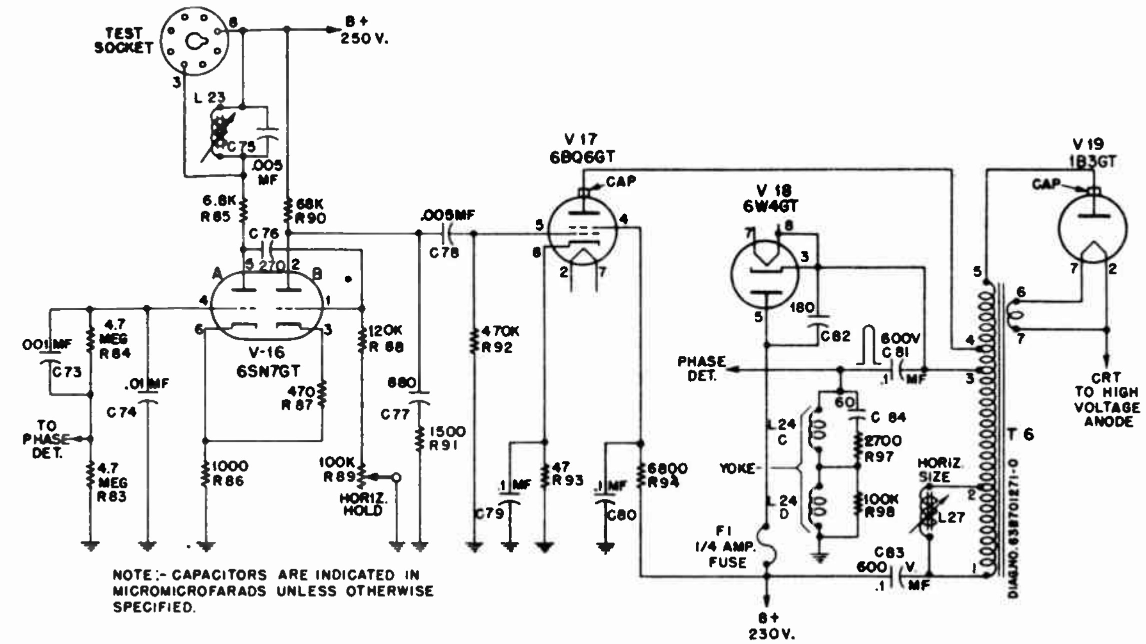

FIGURE 20. SIMPLIFIED SCHEMATIC OF HORIZONTAL SCANNING AND HIGH VOLTAGE SYSTEM

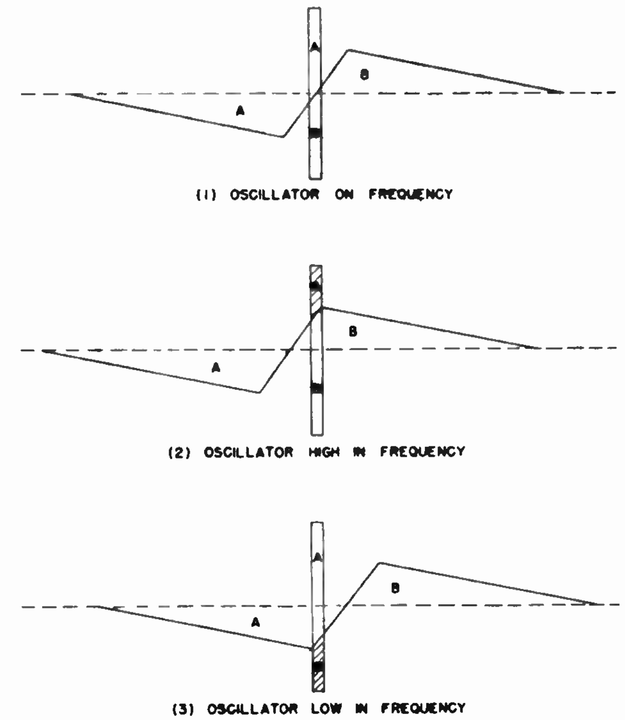

FIGURE 21. WAVEFORMS AT PHASE DETECTOR

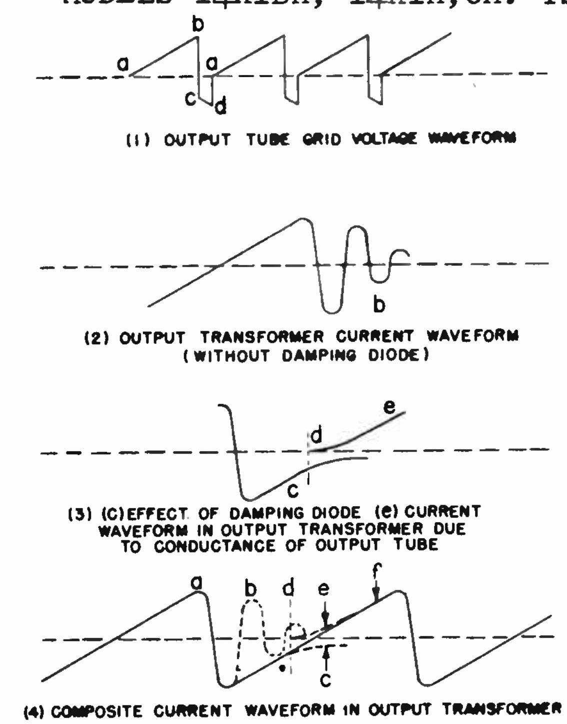

FIGURE 22. WAVEFORMS IN HORIZONTAL SCANNING SYSTEM

same combination pulse and sawtooth voltage shown in Figure 22(1). This action was explained in the vertical circuit.

The Phase Detector

The foregoing explanation is based on the assumption that tube "A's" grid is returned to a fixed potential point. It can be seen that if this grid is returned to a point which varies in potential with frequency of the multivibrator, it would be possible to make this variation a means of frequency control. Assume that the grid of "A" in Figure 20 is made more positive. This causes the bias of "B" to increase because of the increased drop across the common cathode resistor R-86. Capacitor C-76 will then discharge for a longer time before "B" conducts, thereby decreasing the frequency of oscillation. If the grid were made more negative, the bias across the common cathode resistor would be less and C-76 would discharge for less time before "B" started to conduct, thereby increasing the frequency.

Figure 18 is a simplified schematic of the clipper and phase detector circuits. The phase detector V-15 (6AL5) is so connected that a comparison of the phase of the incoming sync pulses and a sawtooth derived from the horizontal output system is made. A positive sync pulse from the plate of the 2nd clipper V-12 (6SN7) is fed thru C-72 (.001) to the plate of diode "A" of V-15. A negative sync pulse from the cathode of V-12 is applied thru C-71 (.001), to the cathode of diode "B" of V-15. A sawtooth, derived from the integration of a pulse in the horizontal output circuit, at the yoke, by the integrating network, composed of R-95 (150K), R-96 (150K), and C-70 (.005), is applied to the cathode of diode "A" and the plate of diode "B", which are tied together and returned to chassis thru R-80 (15K). The load for diodes "A" and "B" consists of resistors R-81 (100K) and R-82 (100K) whose junction returns to the high side of the grid resistor R-83 (4.7 meg) of the first horizontal multivibrator tube V-16 (6SN7). The voltage applied to the two diodes will be a function of the amplitude of the sawtooth, the amplitude of the sync pulses and the phase relationship between the pulses and the sawtooth.

If the sawtooth, whose phase and frequency are a function of the multivibrator's phase and frequency, is operating in the middle of the lock-in range, the sync pulse will occur in the center of the retrace time. See Figure 21(1). The sync pulses have an amplitude of from 6 to 8 volts while the sawtooth amplitude is about two volts. The RC time constant in the pulse input circuit to the diodes is long enough to maintain an average pulse voltage of 6 to 8 volts for two or three horizontal lines, which means that in the "on" frequency condition shown in Figure 21(1), the diodes conduct only on the pulses and since these are equal in amplitude and develop voltages of opposite polarity across R-83 in the first multivibrator grid circuit, as shown in Figure 18, no control voltage is applied to the grid of V-16.

If the oscillator tends to increase in frequency, with respect to the sync pulses, the phase relationship shown in Figure 21(2) exists at the diodes. The phase of the sawtooth has now shifted so that at the same instant that the pulse is applied to the plate of diode "A", the positive saw is also applied to its cathode, so that only the shaded portion of the pulse causes conduction of diode "A". Diode "B", however, still conducts on the total amplitude of the negative pulse applied to its cathode aided by the positive saw applied to its plate at the same time. Since current flow thru diode "A" makes the grid end of R-83 negative, with respect to chassis, the decreased current flow, caused by the sawtooth voltage bucking the pulse voltage at diode "A", results in a more positive voltage across R-83, applying a more positive voltage to the grid of V-16 which, as we have seen, results in decreasing the oscillator's frequency.

If the oscillator tends to decrease in frequency, with respect to the sync pulses, the phase relationship shown in Figure 21(3) exists at the diodes. At the same instant that the negative pulse is applied to the cathode of diode "B", the negative saw is applied to its plate so that only the shaded portion of the pulse causes conduction. Diode "A", however, conducts on the full amplitude of the positive pulse applied to its plate, aided by the negative saw applied to its cathode at the same time. Since current flow thru diode "B" makes the grid end of R-83 positive, with respect to chassis, the decreased current thru diode "B" results in applying a more negative voltage to the grid of V-16 which, as we have seen, results in increasing the oscillator frequency. C-73, R-84 and C-74 provide two time constant filters which are necessary to obtain "fly-wheel" action of this AFC sync circuit.

The Horizontal Output System

The combination sawtooth and pulse waveform developed across C-77 (680) and R-91 (1500) by the multivibrator circuit, is fed to the grid of the horizontal output tube V-17 (6BQ6). Figure 20 is a simplified schematic of the horizontal output system. It will be noted that in this system an auto-transformer is used. In the horizontal scan, it is necessary that retrace be completed in about 7 microseconds. In order to accomplish reversal of current in the inductance of the output transformer and the yoke in this short a time, it is necessary to make this circuit resonant at such a frequency that the half cycle time will equal 7 microseconds, because only by shock exciting such a circuit into oscillation will retrace be accomplished in the time allowed. This circuit is made resonant by the inductance of the output transformer and yoke, the distributed capacity and the tube capacity. Bearing this in mind, the operation can be explained as follows. Referring to Figure 22(1), assume that the voltage on the grid of the output tube is increasing, point "a". The grid is now being made less negative and the output tube starts to draw current which is supplied from B plus thru the damping diode. When point "b" is reached on the grid voltage waveform, the output tube is suddenly cut off because its grid has been made highly negative, (point "c" on the grid voltage waveform). With the tube cut off, the resonant plate load is undamped and the circuit is shocked into oscillation. The reversal of current through the output inductance produces a positive voltage pulse which makes the cathode of the damping diode (V-18) positive, with respect to its plate; therefore, it cannot conduct. C-82 (180) is placed across the diode to provide a low impedance for the oscillatory current. If the damping diode V-18 were not present, this oscillation would continue and current would flow in the output transformer as shown in Figure 22(2). In order to insure a linear trace, however, this oscillation must be stopped and the damping diode serves this purpose.

When the current nears its maximum negative value, the polarity and amplitude of the voltage pulse on the damping diode is such that its plate becomes positive, with respect to its cathode so that the tube conducts heavily and loads the circuit sufficiently to prevent continuation of the oscillation. The current then follows the decay curve shown at "c" in Figure 22(3). At the time ["d" in Figure 22(3)] the voltage at the grid of the output tube has become less than cut off point[" " in Figure 22(1)], the tube again demands current. The rising current in the tube results in superimposing the waveform "e" of Figure 22(3) on the current flow already in the output transformer due to the decaying current which resulted from the damped oscillation. Combination of these two currents results in the linear trace current indicated at "f" in Figure 22(4), which is a composite waveform of the entire action. During the peak conduction of the damped diode, C-83 (.1) charges and its polarity is such that when the output tube calls for current the charge on the condenser will be in series with the B plus supply so that the voltage at the output tube plate is raised from the 250 volt B plus supply to about 475 volts by this so-called "bootstrap" voltage. When the grid voltage waveform of the output tube again reaches point "b" of Figure 22(1), the tube is cut off and another cycle starts.

In order to properly match the yoke inductance to the required output inductance for the tube, the yoke is connected to a tap on the winding which effectively makes an auto-transformer of this section. The positive pulse of voltage at this tap is coupled to the yoke thru C-81 (.1) and results in a sawtooth of current thru the yoke. It will be remembered that a portion of this pulse is also fed to the phase detector for the AFC action thru R-95 and R-96.

High Voltage

To take advantage of the large voltage pulse developed across the output inductance by the heavy current flow caused by the retrace oscillation, the plate winding is made the primary of an auto-transformer whose step-up ratio is

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such as to develop pulses of about 14 kv at its high end. These pulses are rectified by V-19 (1B3) and the resulting DC is applied to the second anode of the picture tube. The filament voltage for the 1B3 rectifier is obtained from an additional winding on the output transformer.

Controls

1. Horizontal Oscillator Adjustment. L-23 is the coil of the sine wave generating circuit in the horizontal multivibrator circuit and should be tuned to 15,750 cycles as explained in the service instructions.

2. Horizontal Hold Control. R-89 is the horizontal hold control which can be adjusted for correct frequency operation of the multivibrator.

3. Horizontal Size Control. L-27, paralleling a small portion of the output choke controls, to a small degree, the inductance of the choke and acts as a size control.

REPLACEMENT PARTS LIST

NOTE: When ordering parts specify model number of set in addition to part number and description of part.

CHASSIS PARTS - ELECTRICAL

Capacitors

Ref. No.	Part Number	Description
C-1	-	See Tuning Unit Parts List........
C-2	21K77375	Ceramic tubular: 220 mmf 500V......
C-3	21A470789	Ceramic disc: 5000 mmf 450V.......
C-4	21K77375	Ceramic tubular: 220 mmf 500V......
C-5	21K470322	Molded: 20 mmf 500V................
C-6	1X790189	Trimmer, ceramic: .5-3 mmf; complete with screw & mtg. nut....
C-7	21A470790	Ceramic disc: 1500 mmf 500V.......
C-8	21A470790	Ceramic disc: 1500 mmf 500V.......
C-9	21K482726	Ceramic disc: 10,000 mmf 450V......
C-10	-	See Tuning Unit Parts List........
C-11	-	Fine Tuning Trimmer (part of station selector)................
C-12	1X790189	Trimmer, ceramic: .5-3 mmf; complete with screw & mtg. nut....
C-13	-	See Tuning Unit Parts List........
C-14	1X792784	Trimmer, ceramic: 3-13 mmf; complete with screw & mtg. nut....
C-15	-	See Tuning Unit Parts List........
C-16	21K478280	Molded: 2 mmf (temp comp)..........
C-17	21K478234	Molded: 8 mmf 500V.................
C-18	21A470789	Ceramic disc: 5000 mmf 450V.......
C-19	21K77375	Ceramic tubular: 220 mmf 500V......
C-20	21K478280	Molded: 2 mmf 500V................
C-21	21A470789	Ceramic disc: 5000 mmf 450V.......
C-22	21A470789	Ceramic disc: 5000 mmf 450V.......
C-23	21A470790	Ceramic disc: 1500 mmf 500V.......
C-24	21A470789	Ceramic disc: 5000 mmf 450V.......
C-25	21A470789	Ceramic disc: 5000 mmf 450V.......
C-26	21A470789	Ceramic disc: 5000 mmf 450V.......
C-27	21K77375	Ceramic tubular: 220 mmf 500V......
C-28	21K470329	Molded: 30 mmf 500V (temp. comp.)..
C-29	21A470789	Ceramic disc: 5000 mmf 450V.......
C-30	21A470789	Ceramic disc: 5000 mmf 450V.......
C-31	21K77375	Ceramic tubular: 220 mmf 500V......
C-32	21A470789	Ceramic disc: 5000 mmf 450V.......
C-33	21A470789	Ceramic disc: 5000 mmf 450V.......
C-34	21A470789	Ceramic disc: 5000 mmf 450V.......
C-35	21A470789	Ceramic disc: 5000 mmf 450V.......
C-36	21K470329	Molded: 30 mmf 500V (temp. comp.)..
C-37	21K470324	Molded: 6 mmf 500V.................
C-38	8R9854	Paper: .1 mf 200V..................
C-39	8R9854	Paper: .1 mf 200V..................
C-40	21R6554	Mica: 100 mmf 500V.................
C-42	21K470329	Molded: 30 mmf 500V................
C-43	21A478274	Molded: 2.2 mmf 500V...............
C-44	21K790683	Molded: 60 mmf 500V................
C-45	21A470789	Ceramic disc: 5000 mmf 450V.......
C-46	21A470789	Ceramic disc: 5000 mmf 450V.......
C-47	21K790439	Silver mica: 15 mmf (part of T-3 base)............................
C-48	8R9866	Paper: .001 mf 600V................
C-49	21A790131	Ceramic tubular: 150 mmf 500V......
C-50	21R6590	Mica: 500 mmf 500V.................
C-51	21R6590	Mica: 500 mmf 500V.................
C-52	23A90205	Electrolytic: 10 mf 50V ....
C-53	21K482726	Ceramic disc: 10,000 mmf 450V......
C-54	8R9869	Paper: .005 mf 600V................
C-55	21R6650	Mica: 68 mmf 500V..................
C-56	8R9869	Paper: .005 mf 600V................
C-57	21K470322	Molded: 20 mmf 500V................
C-58	8R9873	Paper: .05 mf 600V.................
C-59	8R9869	Paper: .005 mf 600V................
C-60	8R9869	Paper: .005 mf 600V................
C-61	8R9870	Paper: .01 mf 600V.................
C-62	8R9851	Paper: .02 mf 200V.................
C-63	8R9870	Paper: .01 mf 600V.................
C-64	8R9866	Paper: .001 mf 600V................
C-65	21R6590	Mica: 500 mmf 500V.................
C-66	8R9873	Paper: .05 mf 600V.................
C-67	8R9875	Paper: .15 mf 600V.................
C-68	23B700160	Electrolytic: 4-section; 80 mf/400V, 40 mf/300V, 20 mf/300V, 10 mf/300..........................
C-69	23B700159	Electrolytic: 4-section; 80 mf/400V, 40 mf/400V, 100 mf/50V, 20 mf/25V.........................
C-70	8R9869	Paper: .005 mf 600V................
C-71	8R9866	Paper: .001 mf 600V................
C-72	8R9866	Paper: .001 mf 600V................
C-73	8R9866	Paper: .001 mf 600V................
C-74	8R9870	Paper: .01 mf 600V.................
C-75	8R9869	Paper: .005 mf 600V................
C-76	21K400037	Ceramic tubular: 270 mmf 500V......
C-77	21R2741	Mica: 680 mmf 500V.................
C-78	8R9869	Paper: .005 mf 600V................
C-79	8R9854	Paper: .1 mf 200V..................
C-80	8R9874	Paper: .1 mf 600V..................
C-81	8R490263	Molded paper: .1 mf 600V...........
C-82	21K700883	Ceramic tubular: 180 mmf 3000V.....
C-83	8R9874	Paper: .1 mf 600V..................
C-84	21K790574	Ceramic tubular: 60 mmf 1500 V (in deflection yoke)..............
C-85	8R9874	Paper: .1 mf 600V..................
C-86 A,B&C	23B700613	Electrolytic: 3-section; 80 mf/400 V, 20 mf/300 V, 10 mf/300 V...
C-87 A,B&C	23B700614	Electrolytic: 3-section; 60 mf/400 V, 40 mf/300 V, 20 mf/25 V....
C-88	23B700615	Electrolytic: 2-section; 35 mf/400 V, 100 mf/50 V................
C-89	8R9810	Paper: .25 mf 100V.................

Fuses

Ref. No.	Part Number	Description
F-1	65A700851	Fuse, 1/4 amp: glass; with leads...

Coils

Ref. No.	Part Number	Description
L-1	24A790033	Antenna Impedance Matching Coil....
L-2	-	See Tuning Unit Parts List.........
L-3	-	See Tuning Unit Parts List.........
L-4	-	See Tuning Unit Parts List.........
L-5	-	See Tuning Unit Parts List.........
L-6	24K792825	RF Coil: channel 13................
L-7	-	See Tuning Unit Parts List.........
L-8	24K792577	RF Choke: 3.3 microhenries.........
L-9	24K780128	RF Choke: 2.2 microhenries.........
L-10	24K790035	RF Choke: 5.6 microhenries.........
L-11	24B792586	1st IF: complete with LC trap, cores & mtg nuts..................
L-12	-	27.3 mc trap (part of L-11)........
L-13	24K790035	RF Choke: 5.6 microhenries.........
L-14	-	21.9 mc trap (part of L-15)........
L-15	24K792587	2nd IF: complete with LC trap, cores & mtg nuts..................
L-16	24K792771	RF Choke: yellow dot...............
L-17	24K792771	RF choke: yellow dot ....
L-18	24B792735	4.5 mc trap: less core & mtg nut...
L-19	24K701652	Compensating coil: black dot ......
L-20	24A470159	Sound Take-Off: less core & mtg nut...............................
L-21	24K701651	Compensating coil: green-black dot.
L-22	24K701321	Focus coil.........................
L-23	24K790059	Horizontal Oscillator: less core & clip..........................
L-24	24C792171 or 24K700776 or 24K792173 or 24K700778 or 24C792506 or 24K700694 or 24K792508 or 24K700714 or 24C700050 or 24K700774	Deflection yoke: complete..........
L-25	24K790145	RF Choke: 0.47 microhenries........
L-26	24K790145	RF Choke: 0.47 microhenries........
L-27	24K700089	Horizontal Size: less core & clip..

Speakers

Ref. No.	Part Number	Description
LS-1	50C791913	Speaker: 8" electrodynamic 3.2 ohm voice coil; 100 ohm field (hot)...

Resistors

Note: All resistors are insulated carbon type unless otherwise specified.

Ref. No.	Part Number	Description
R-1	6R6397	22,000 10% 1/2W..............
R-2	6R6056	47,000 20% 1/2W..............
R-3	6R5614	56 10% 1/2W..................
R-4	6R2036	33 10% 1/2W..................
R-5	6R6229	1000 10% 1/2W................
R-6	6R5659	3900 10% 1/2W................
R-7	-	See Tuning Unit Parts List.....
R-8	6R6320	10,000 10% 1/2W..............
R-9	6R6038	1500 10% 1/2W................
R-10	6R6117	5600 10% 1/2W................
R-11	6R6393	1200 10% 1/2W................
R-12	6R6080	4700 10% 1/2W................
R-13	6R6428	6800 10% 1/2W................
R-14	6R5550	47 10% 1/2W..................
R-15	6R2036	33 10% 1/2W..................
R-16	6R6069	2200 10% 1/2W................
R-17	6R6394	12,000 10% 1/2W..............
R-18	6R6229	1000 10% 1/2W................
R-19	6R5550	47 10% 1/2W..................
R-20	6R2036	33 10% 1/2W..................
R-21	6R6069	2200 10% 1/2W................
R-22	6R6428	6800 10% 1/2W................
R-23	6R2035	82 10% 1/2W..................
R-24	6R6038	1500 10% 1/2W................
R-25	6R6031	100,000 10% 1/2W.............
R-26	6R6031	100,000 10% 1/2W.............
R-27	6R3966	1.5 meg 20% 1/2W.............
R-28	6R6117	5600 10% 1/2W................
R-29	6R6004	1 meg 20% 1/2W...............
R-30	6R5550	47 10% 1/2W..................
R-31 A & B	18A792009	Contrast & Volume Control, dual: 2000 tapped & 1 meg respectively; includes power switch............
R-32	-	2700 (not replaceable; part of L-21)
R-33	6R6032	470,000 20% 1/2W.............
R-34	6R6018	100 20% 1/2W.................
R-35	6R6400 or 6R6341	33,000 10% 1W (for 6AB6 video amp)......................... or 22,000 10% 1W (for 6CB6 video amp).........................
R-36	-	12,000 (not replaceable; part of L-19)........................
R-37	6R5671	4700 10% 2W..................
R-38	6R3933	220 20% 1/2W.................
R-39	6R2004	8200 10% 1/2W................
R-40	6R5660	180 10% 1/2W.................
R-41	6R6012	33,000 20% 1/2W..............
R-42	6R6428	6800 10% 1/2W................
R-43	6R6428	6800 10% 1/2W................
R-44	6R2122	4.7 meg 20% 1/2W.............
R-45	6R6414	270,000 10% 1/2W.............
R-46	6R6032	470,000 20% 1/2W.............
R-47	6R6032	470,000 20% 1/2W.............
R-48	6R6022	330 10% 1/2W.................
R-49	6R476004	1000 20% 2W..................
R-50	6R6320	10,000 10% 1/2W..............
R-51	6R3927	2.2 meg 20% 1/2W.............
R-52	6R6004	1 meg 20% 1/2W...............
R-53	6R6397	22,000 10% 1/2W..............
R-54	6R2096	330,000 10% 1/2W.............
R-55	6R6428	6800 10% 1/2W................
R-56	6R5581	3300 10% 1/2W................
R-57	6R5581	3300 10% 1/2W................
R-58	6R6031	100,000 10% 1/2W.............
R-59	6R6031	100,000 10% 1/2W.............
R-60	6R6397	22,000 10% 1/2W..............
R-61	6R6031	100,000 10% 1/2W.............
R-62	6R5577	2700 10% 1/2W................
R-63	6R2096	330,000 10% 1/2W.............
R-64	18A90147	Vertical Hold Control: 1 meg....
R-65	6R6428	6800 10% 1/2W................
R-66	6R5577	2700 10% 1/2W................
R-67	6R6032	470,000 20% 1/2W.............
R-68	18A90145	Vertical Size Control: 5 meg....
R-69	6R2118	3.3 meg 20% 1/2W.............
R-70	6R3949	470 20% 1/2W.................
R-71	18A790146	Vertical Linearity Control: 2000
R-72	6R6291	560 10% 1/2W (in deflection yoke).........................
R-73	6R6291	560 10% 1/2W (in deflection yoke).........................
R-74	6R6056	47,000 20% 1/2W..............
R-75	18A90147	Brightness control: 1 meg......
R-76	6R6004	1 meg 20% 1/2W...............
R-77	17K790840	Wire wound: 1000 10% 10W.....
R-78	18K701114	Focus control: 500............
R-79	17K792705	Wire wound: 2000 10% 10W.....
R-80	6R6477	15,000 10% 1/2W..............
R-81	6R6031	100,000 10% 1/2W.............
R-82	6R6031	100,000 10% 1/2W.............
R-83	6R2122	4.7 meg 20% 1/2W.............
R-84	6R2122	4.7 meg 20% 1/2W.............
R-85	6R6428	6800 10% 1/2W................
R-86	6R6229	1000 10% 1/2W................
R-87	6R3949	470 20% 1/2W.................
R-88	6R5631	120,000 10% 1/2W.............
R-89	18A791574	Horizontal Hold: 100,000.......
R-90	6R6074	68,000 10% 1/2W..............
R-91	6R6038	1500 10% 1/2W................
R-92	6R6032	470,000 20% 1/2W.............
R-93	6R5583	47 10% 1W....................
R-94	6R5690	6800 10% 2W..................
R-95	6R5721	150,000 10% 1W...............
R-96	6R5721	150,000 10% 1W.....
R-96	6R5721	150,000 10% 1W...............
R-97	6R5577	2700 10% 1/2W................
R-98	6R6328	100,000 10% 1W...............
R-99	17K701353	Wire wound: 1500 10% 5W......
R-100	6R6032	470,000 20% 1/2W.............
R-101	6R6018	100 20% 1/2W.................
R-102		2700 (not replaceable; part of L-21)........................

Transformers

Ref. No.	Part No.	Description
T-1	24K792578	Mixer IF: less cores & Mtg nuts....
T-2	24B792585	3rd IF: less core, mtg nut, & colored leads.................
T-3	24B790125	Ratio Detector: complete less shield can..........................
T-4	25B790686	Audio output.......................
T-5	25K701619	Vertical output....................
T-6	24K700588	High Voltage Transformer...........
T-7	25B790140	Filament Transformer: isolating....
T-8	25C700161 or 25C700169 or 25C701025 or 25K700882	Power Transformer..................

Tubes

Ref. No.	Part No.	Description
V-1	6CB6	RF Amplifier.......................
V-2	12AT7	Mixer-Oscillator...................
V-3	6AU6	1st IF Amplifier...................
V-4	6AU6	2nd IF Amplifier...................
V-5	6AG5	3rd IF Amplifier...................
V-6	6AL5	Video Detector.....................
V-7	6AB6 or 6CB6	Video Amplifier....................
V-8	6AU6	Audio Driver-Limiter...............
V-9	6AL5	Ratio detector.....................
V-10	6J5GT	Audio Amplifier....................
V-11	6V6GT	Audio Output.......................
V-12	6SN7GT	1st & 2nd Clippers.................
V-13	12AU7	Vertical Sweep Generator...........
V-14	6W6	Vertical Sweep Output..............
V-15	6AL5	Phase Detector.....................
V-16	6SN7GT	Horizontal Oscillator..............
V-17	6BQ6GT	Horizontal Output & High Voltage Generator..........................
V-18	6W4GT	Damping Diode......................
V-19	1B3GT	High Voltage Rectifier.............
V-20	14BP4 or 14CP4	Picture Tube: 14" rectangular......
V-21	5U4G	Low Voltage Rectifier..............

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World Radio History

TUNER

Model TT-13 Tuning Unit

Ref. No.	Part Number	Description
	1X700100	TT-13 Tuning Unit: includes station selector switch, fine tuning trimmer, and the following components:
C-1	21K478234	Capacitor, molded: 8 mmf 500V
C-10	21K482726	Capacitor, ceramic disc: 10,000 mmf 450V
C-13	21K482726	Capacitor, ceramic disc: 10,000 mmf 450V
C-15	21K400173	Capacitor, molded: 10 mmf 500V (temp. comp.)
L-2	24C792764	Coil, antenna: channels 2 thru 6; includes L-2A thru L-2E (L-2F thru L-2L are part of switch)
L-3	24K790536	Coil, RF: channels 2 thru 6; includes L-3A thru L-3E (L-3F thru L-3L are part of switch)
L-4	24C700114	Coil, oscillator: channels 2 thru 6; includes L-4A thru L-4E (L-4F thru L-4L are part of switch)
L-4M	24K700115	Coil, oscillator: channel 10
L-5	24K792765	Coil, antenna primary: low frequency; includes L-5A, 5B & 5C
L-7	24K700116	Coil, oscillator: channel 13
R-7	6R6069	Resistor: 2200 10% 1/2W
	42K790136	Clip, spring (on collar)
	43K700725	Collar, spring (on rear end of fine tuning shaft)
	47K700726	Shaft, fine tuning

CHASSIS PARTS - MECHANICAL

Part Number	Description
7K700153	Bracket, coil mtg (L-27)
7B700194	Bracket, focus coil mtg: bottom ("U" bracket around focus coil)
7A700196	Bracket, focus coil mtg: top (across top of focus coil)
7A791965	Bracket; interlock safety
7B700515	Bracket, mask mounting
1X700504	Bracket, rear tube support: with tube grounding spring & 2nd anode insulator (large support brkt)
7A792568	Bracket, yoke adj (across top of deflection yoke)
35K700532	Bumper, rubber (circular bumper in rear support brkt)
30A790948	Cable, high voltage (6BQ6 plate cap lead) ... ft
42K471342	Cap, plate (for hi-volt rectifier)
42A701441	Cap, plate (for 6BQ6)
42A700147	Clamp, lead retainer (on hi-volt rect filament leads)
42B70721	Clip, coil mtg (T-3 secondary)
42A76244	Clip, coil retainer (L-23)
42A72609	Clip, grounding (grounds V-10 shield)
42A780193	Connector, 2nd anode: with lead
39K17396	Contact, pin terminal (in spkr receptacle) ... per/c
46A478242	Core, brass & screw (T-3)
46K791756	Core, brass & screw (L-11 & L-15)
46A470310	Core, iron & screw (T-1 primary, L-18 & L-20)
46K480256	Core, iron & screw (T-1 secondary, & L-12)
46A70023	Core, iron & screw (T-3 primary & L-14)
46A470302	Core, iron & screw (T-3 secondary)
46K471143	Core, iron & screw (L-23)
46A700090	Core, iron & slide adjustment (L-27)
15B791111	Cover, test socket
35K792757	Cushion, focus coil (between coil & tube)
5K792031	Grommet, insulating: 9/32" hole
5A790684	Grommet, tube socket (V-14 & V-16 socket mtg)
14A780184	Insulator, antenna lead (dresses antenna input from chassis)
14K791892	Insulator, coil (in T-2 can)
14K87179	Insulator, coil (in T-3 can)
14A791787	Insulator, 2nd anode lead: armite (dresses 2nd anode lead from chassis)
4S7655	Lockwasher, internal: 3/8; cad pl (front controls mtg)
4S2640	Lockwasher, internal: 1/2 thin; cad pl (mounts bottom focus coil mtg brkt)
4S7688	Lockwasher, internal-external: 1/4; cad pl (mounts bottom focus coil mtg brkt)
4S9751	Lockwasher, internal-external: #8; cad pl (T-8 mtg)
29R5220	Lug, formed (on T-8 mtg screw)
29R5239	Lug, soldering: #8 H.T.
2A470049	Nut, coil & core mtg (T-1, T-2, L-11, L-12, L-14, L-15, L-18 & L-20)
2K791404	Nut, coil & core mtg (L-27)
2S7022	Nut, hex: 1/4-20 x 7/16; cad pl (mounts bottom focus coil mtg brkt)
2S7004	Nut, hex: 3/8-32 x 9/16; cad pl (front controls mtg)
2S7003	Nut, hex: 8-32 x 5/16 stl; cad pl (T-8 mtg)
2S7051	Nut, hex: palnut; 3/8-32 x 9/16; cad pl (rear controls mtg)
2S7050	Nut, hex: palnut: 6-32 x 5/16; cad pl (T-2 shield mtg)
2B70703	Nut, palnut: special (T-3 primary coil mtg)
2A790191	Nut: special (ceramic trimmer mtg)
35K792182	Pad, cushion (at bottom of picture tube front)
35K700167	Pad, cushion (small pads on lower picture tube strap)
35K700166	Pad, cushion (on top picture tube strap)
64K791818	Plate, chassis cover (removable plate on chassis side)
64A90034	Plate, electrolytic mtg (mounts 2 electrolytics)
64A700690	Plate, electrolytic mtg (mounts 3 electrolytics)
64K700748	Plate, socket cover (covers unused hole when 2 electrolytics used)
64A700745	Plate, transformer cover (for 25C700161 power trans. only)
28K471323	Plug, line cord: 2-pin; waxed
9A22367	Receptacle: 5-prong (spkr receptacle)
5S8497	Rivet: .088 x 1/8 stl; pol nkl (V-1, V-2, & V-5 socket mtg)
5S7770	Rivet: .088 x 5/32 stl; pol nkl (antenna ins. mtg)
5S2815	Rivet: .088 x 7/32 stl; pol nkl (9A485495, 9K780442 & 9K484167 socket mtg)
5S7707	Rivet: .122 x 5/32 stl; pol nkl (9K471270 socket & terminal strip mtg)
5S7701	Rivet: .122 x 3/16 stl; pol nkl (2nd anode lead insulator mtg)
5S7703	Rivet: .122 x 7/32 stl; pol nkl (tube grounding spring mtg)
5S7700	Rivet: .122 x 1/4 stl; pol nkl (line cord plug mtg)
5S7728	Rivet: .122 x 5/16 stl; pol nkl (V-19 socket mtg)
5S6842	Rivet: .145 x 7/32 stl; pol nkl (T-4 & T-5 mtg)
5K71246	Rivet, shoulder: nkl pl (V-14 & V-16 socket mtg)
3A700198	Screw, eccentric: cad.pl (mounts bottom focus coil mtg brkt)
3S490354	Screw, machine: 6-32 x 5/8 slotted hex head; cad pl (C-6 & C-12 trimmer adj)
3S490822	Screw, machine: 6-32 x 1 slotted hex head; cad pl (C-14 trimmer adj.)
3S490459	Screw, machine: 6-32 x 1-1/8 slotted round head; brass (secures HV trans plates)
3S7163	Screw, machine: 8-32 x 1/4 plain hex head; cad pl (mounts V-19 mtg plate)
3S490642	Screw, machine: 10-32 x 1-1/2 plain hex head; cad pl (picture tube retainer strap mtg)
3S7454	Screw, sheet metal: #8 x 1/4 PKZ plain hex head; cad pl (chassis side plate mtg)
3S7467	Screw, sheet metal: #8 x 3/8 PKZ plain hex head; cad pl (T-7 mtg)
3A470369	Screw, thumb: cad pl (yoke adj screw)
26K485936	Shield, coil (T-3)
1X792785	Shield, coil: with spade bolts (T-2)
26A26283	Shield, tube (for glass V-10)
26A90301	Shield, tube: miniature
26A700717	Shield, video (shields video amp from hi-volt trans)
9K701447	Socket, picture tube: 5-pin; with leads
9K701448	Socket, picture tube: 12-pin; with leads
9A792167	Socket, tube: miniature 7-prong (V-1)
9K780442	Socket, tube: miniature 7-prong (V-3, V-4, & V-6)
9K484167	Socket, tube: miniature 7-prong (V-7, V-8, V-9 & V-15)
9A471343	Socket, tube: miniature; tan molded (V-5)
9A485495	Socket, tube: noval; laminated; less adaptor (V-13)
9K484816	Socket, tube: noval; molded (V-2)
9K471270	Socket, tube: octal (all octal sockets except V-14, V-16 & V-19)
9A790685	Socket, tube: octal (V-14 & V-16)
9A480274	Socket, tube: octal; molded (hi-volt rectifier)
41A70705	Spring, coil (T-3)
41A700143	Spring, compression (L-27)
41A700563	Spring, grounding (grounds picture tube outer coating)
41A471379	Spring, tension (picture tube support)
1X700520	Strap, picture tube mtg: with pads (lower strap around tube front)
1X700521	Strap, picture tube retainer: with pad (upper strap around tube front)
31K31217	Strip, terminal: 1 ins #2 gnd; 3/8" spacing
31K90044	Strip, terminal: 2 ins #2 gnd; 3/8" spacing
31A700148	Strip, terminal: 2 ins #2 mtg; 3/8" spacing
31K471564	Strip, terminal: 3 ins #2 gnd; 3/8" spacing
31K51511	Strip, terminal: 3 ins #3 gnd; 3/8" spacing
31A700697	Strip, terminal: 3 ins #3 gnd #4 large; 3/8" spacing
31K471565	Strip, terminal: 3 ins #4 gnd; 3/8" spacing
31K37494	Strip, terminal: 4 ins #3 gnd; 3/8" spacing
31A790122	Strip, terminal: 4 ins #3 gnd; 1/2" spacing
31K471569	Strip, terminal: 4 ins #4 gnd; 3/8" spacing
51K26658	Strip, terminal: 5 ins #3 gnd; 3/8" spacing
31K90046	Strip, terminal: 5 ins #4 gnd; 3/8" spacing
31A791613	Strip, terminal: special (on hi-volt transformer)
31A21990	Strip, terminal: 2-screw (antenna terminal)
24K700585	Trap, ion
or 24K700586	Trap, ion
or 24K700587	Trap, ion: PM
1X700523	Tube mtg plate: with mtg bracket & socket (hi-volt rectifier mtg plate)
4S7569	Washer, flat: 5/16 x .145 x .027; cad pl (V-14 & V-16 socket mtg)
4S1719	Washer, flat: 3/8 x .140 x .030; cad pl (tube grounding spring mtg)
4S1720	Washer, flat: 3/8 x .156 x .030 stl; cad pl (rear tube support brkt mtg)
4S1706	Washer, flat: 3/8 x .203 x .033 stl; cad pl (tube retainer strap mtg)
4A77577	Washer, insulating (L-27 mtg)
4A791447	Washer, insulating (T-7 mtg)

INSULATING COMPOUNDS

Part Number	Description
11M490423	Coating, hi-volt. insulating: red-brn (on hi-volt rect. socket)
11M490387	Wax, bivax (on hi-volt transformer)

MODEL 14K1H CABINET PARTS

Part Number	Description
1X701541	Back cover: complete with picture tube rear cover, centering adjustment cover, and line cored
13C700627	Base, metallic: brass pl (between cabinet legs)
13D700086	Bezel, picture tube (window frame)
1X792494	Bracket, window mtg: with pads
16F700629	Cabinet, console: red-brn mahogany; less window & bezel
42A792502	Clip, mask retainer
13K700631	Cloth, grille: mahogany
30B470756	Cord, line: with plug & receptacle
15K792068	Cover, centering adjustment: rubber (on back cover)
1X792546	Cover, chassis bottom: with hi-volt insulator
15K700596	Cover, picture tube rear (on back cover)
5S3139	Eyelet: .202 x .475 brass; ant cop (on back cover)
14B792069	Insulator, hi-volt (on bottom cover)
36B790505	Knob, control (contrast)
36B790506	Knob, control (station selector)
36A485457	Knob, control: black (hold controls on chassis rear)
36K792078	Knob, control: wal-mahog (fine tuning & off-volume)
4S7657	Lockwasher, external: #8; cad pl (spkr mtg)
4S7650	Lockwasher, internal: #6; cad pl (hi-volt insulator mtg)
62K70581	Logotype: "Motorola"; gold enamel
1X700594	Mask, picture tube: with retainer clips
13A700601	Medallion: brass pl ("M" on grille cloth)
2S7007	Nut, hex: 8-32 x 1/4; cad pl (spkr mtg)
2S7003	Nut, hex: 8-32 x 5/16 stl; cad pl (spkr mtg)
35K700168	Pad, cushion (window mtg)
35K792501	Pad, cushion (on window mtg brkts)
5S7706	Rivet: .122 x 1/8 stl; pol nkl (hi-volt insulator mtg)
5S1683	Rivet: .122 x 3/16 brs; pol nkl (mask clip mtg)
5S7703	Rivet: .122 x 7/32 stl; ant cop (picture tube rear cover mtg)
5K791856	Rivet, shoulder: annealed (line cord mtg)
3S7374	Screw, machine: 8-32 x 5/16 plain hex head; cad pl (bezel mtg)
4S7629	Washer, flat: 1/2 x 3/16 x .048 stl; cad pl (bottom cover mtg)
4S8214	Washer, flat: 7/8 x .203 x .067 stl; cad pl (chassis mtg)
61C700134	Window, picture tube: 14" rectangular.

MODEL 14K1BH CABINET PARTS - Same as 14K1H except:

Part Number	Description
16K700630	Cabinet, console: limed oak; less window & bezel
13K700632	Cloth, grille: eggshell
36K792079	Knob, control: tan (fine tuning & off-volume)

BILT-IN-TENNAS

BILT-IN-TENNA

Part Number	Description
1X791759	TA-4 Double Loop Antenna: complete
21R6593	Capacitor, mica: 15 mmf 300V
21K70720	Capacitor, molded: 5 mmf 500V
24A791771	Coil, antenna loading
29A791608	Lug, spade
31K471564	Strip, terminal: 3 ins #2 gnd; 3/8" spacing
3K653	Screw, machine: 8-32 x 1-1/4; cop oxd (spkr mtg)
3S7536	Screw, sheet metal: #6 x 3/8 PKA slotted acorn head; ant cop (window & back cover mtg)
3S7509	Screw, sheet metal: #6 x 5/8 PKA slotted acorn head; ant cop (back cover mtg)
3S490819	Screw, sheet metal: #6 x 7/8 PKA slotted acorn head; ant cop (back cover mtg)
3S7467	Screw, sheet metal: #8 x 3/8 PKZ plain hex head; cad pl (mask mtg)
3S400220	Screw, sheet metal: #10 x 3/4 PKA plain hex head; cad pl (bottom cover mtg)
3S400221	Screw, sheet metal: #10 x 1-1/2 PKA plain hex head; cad pl (chassis mtg)
56K700009	Strap, antenna support (supports lower loop antenna)
35A791581	Strip, lead (dresses leads to cabinet side)
13K700628	Strip, metallic: brass (across cabinet front)
4A792497	Washer, cut: cad pl (bezel mtg)
4S1767	Washer, flat: 5/16 x .130 x .025 brs; pol nkl (mask clip mtg)
4S1720	Washer, flat: 3/8 x 11/64 x .030 stl; cad pl (mask & line cord mtg)
4S7562	Washer, flat: 7/16 x .187 x .033 stl; cad pl (spkr mtg)

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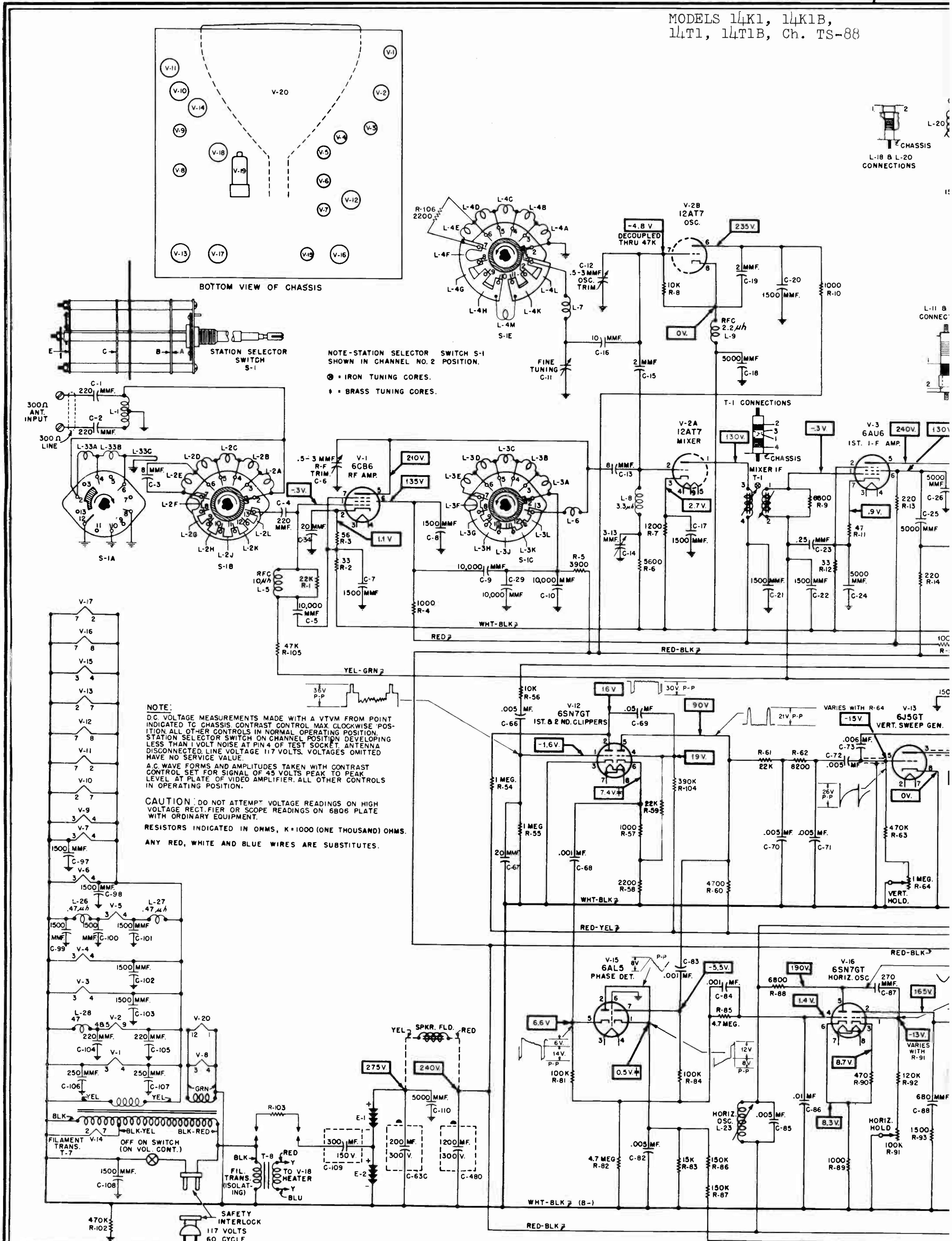
MODELS 14K1, 14K1B, 14T1, 14T1B, Ch. TS-88



NOTE:
D.C. VOLTAGE MEASUREMENTS MADE WITH A VTVM FROM POINT INDICATED TO CHASSIS. CONTRAST CONTROL MAX. CLOCKWISE POSITION. ALL OTHER CONTROLS IN NORMAL OPERATING POSITION. STATION SELECTOR SWITCH ON CHANNEL POSITION DEVELOPING LESS THAN 1 VOLT NOISE AT PIN 4 OF TEST SOCKET. ANTENNA DISCONNECTED. LINE VOLTAGE 117 VOLTS. VOLTAGES OMITTED HAVE NO SERVICE VALUE.

A.C. WAVE FORMS AND AMPLITUDES TAKEN WITH CONTRAST CONTROL SET FOR SIGNAL OF 45 VOLTS PEAK TO PEAK LEVEL AT PLATE OF VIDEO AMPLIFIER. ALL OTHER CONTROLS IN OPERATING POSITION.

CAUTION: DO NOT ATTEMPT VOLTAGE READINGS ON HIGH VOLTAGE RECTIFIER OR SCOPE READINGS ON 6BQ6 PLATE WITH ORDINARY EQUIPMENT.

RESISTORS INDICATED IN OHMS, K=1000 (ONE THOUSAND) OHMS.

ANY RED, WHITE AND BLUE WIRES ARE SUBSTITUTES.

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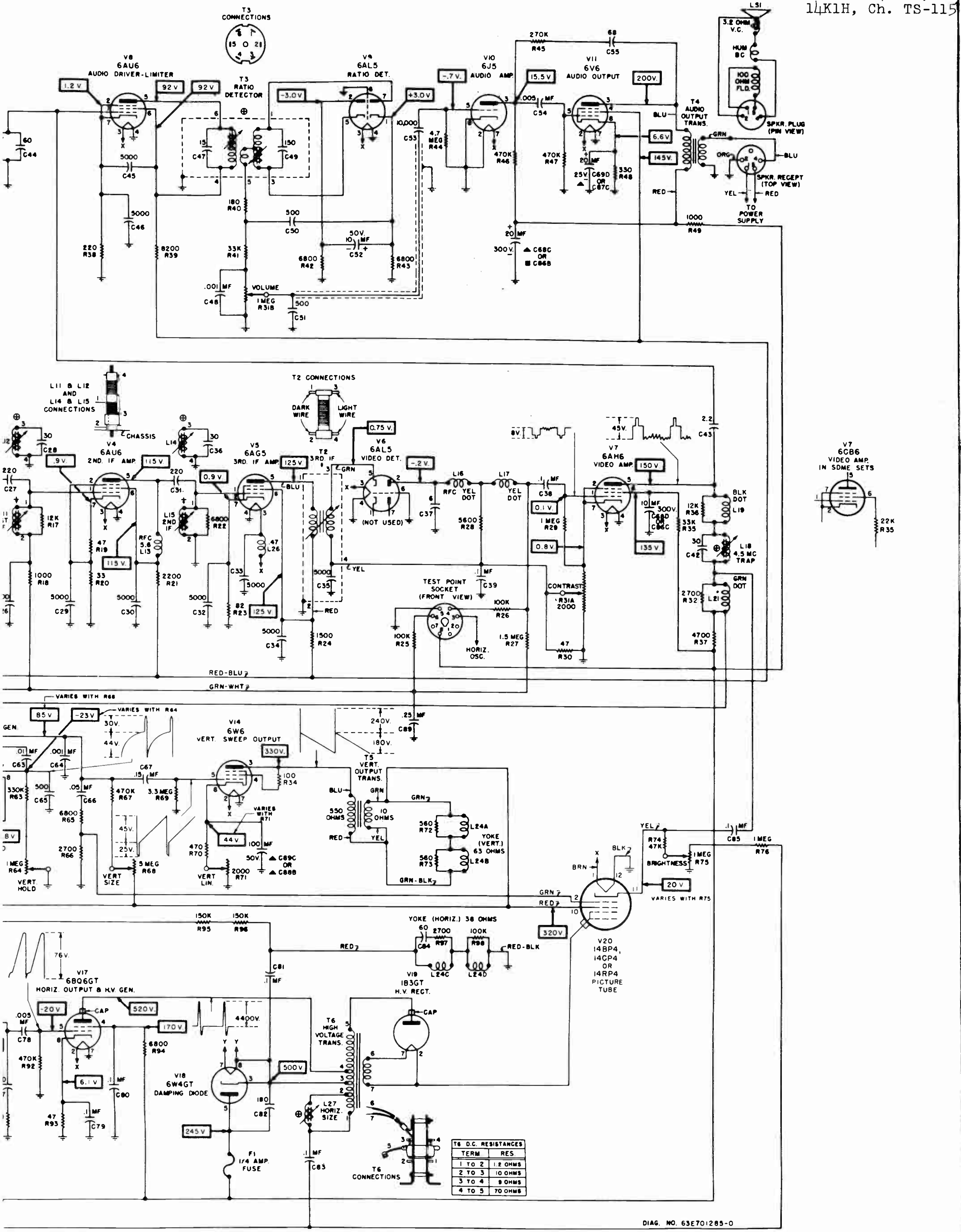
MODELS 14K1BH, 14K1H, Ch. TS-115



T6 D.C. RESISTANCES	
TERM	RES
1 TO 2	1.2 OHMS
2 TO 3	10 OHMS
3 TO 4	9 OHMS
4 TO 5	70 OHMS

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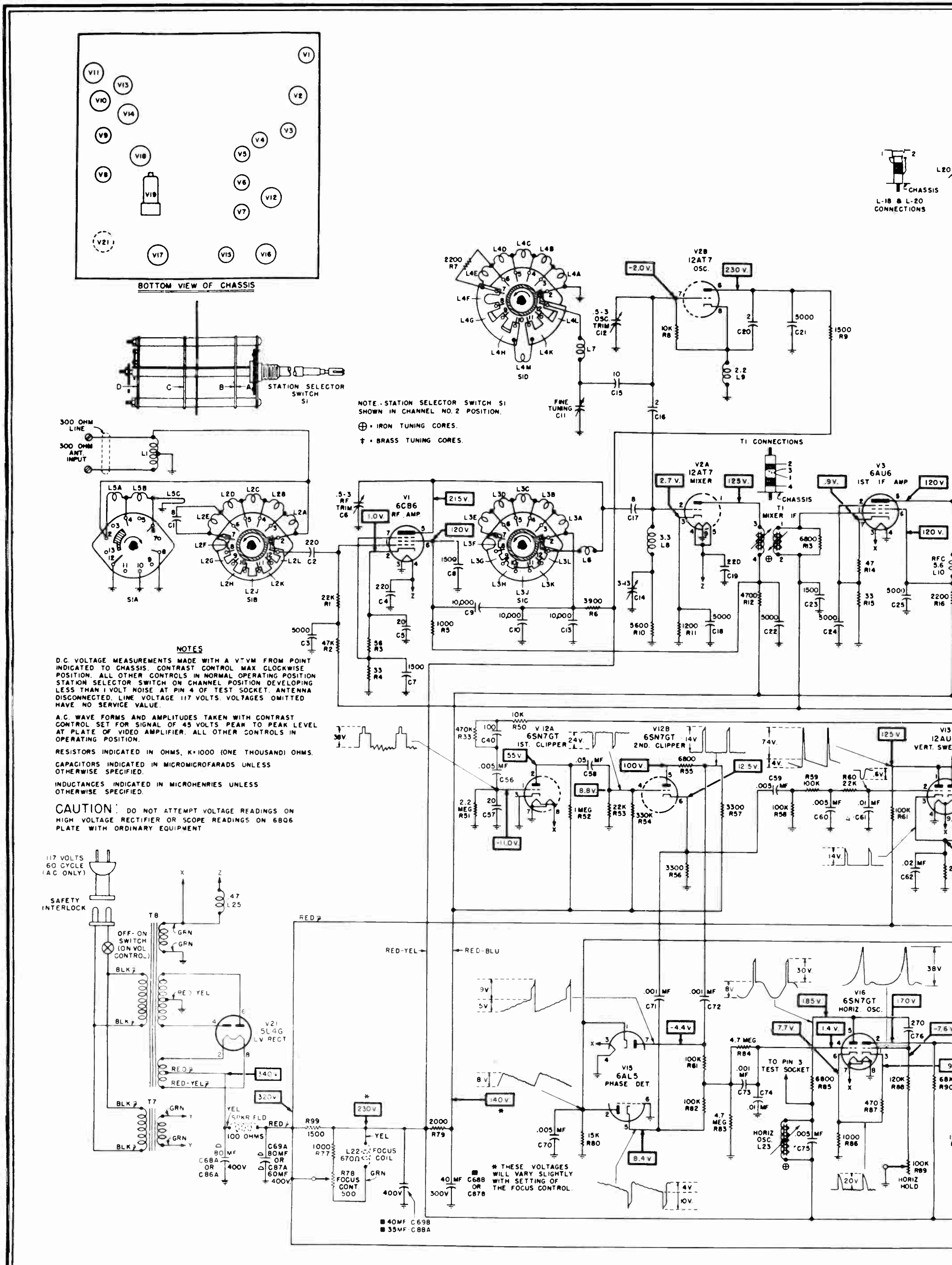

NOTES

D.C. VOLTAGE MEASUREMENTS MADE WITH A VTVM FROM POINT INDICATED TO CHASSIS. CONTRAST CONTROL MAX CLOCKWISE POSITION. ALL OTHER CONTROLS IN NORMAL OPERATING POSITION STATION SELECTOR SWITCH ON CHANNEL POSITION DEVELOPING LESS THAN 1 VOLT NOISE AT PIN 4 OF TEST SOCKET. ANTENNA DISCONNECTED. LINE VOLTAGE 117 VOLTS. VOLTAGES OMITTED HAVE NO SERVICE VALUE.

A.C. WAVE FORMS AND AMPLITUDES TAKEN WITH CONTRAST CONTROL SET FOR SIGNAL OF 45 VOLTS PEAK TO PEAK LEVEL AT PLATE OF VIDEO AMPLIFIER. ALL OTHER CONTROLS IN OPERATING POSITION.

RESISTORS INDICATED IN OHMS, K=1000 (ONE THOUSAND) OHMS.

CAPACITORS INDICATED IN MICROMICROFARADS UNLESS OTHERWISE SPECIFIED.

INDUCTANCES INDICATED IN MICROHENRIES UNLESS OTHERWISE SPECIFIED.

CAUTION: DO NOT ATTEMPT VOLTAGE READINGS ON HIGH VOLTAGE RECTIFIER OR SCOPE READINGS ON 6BQ6 PLATE WITH ORDINARY EQUIPMENT

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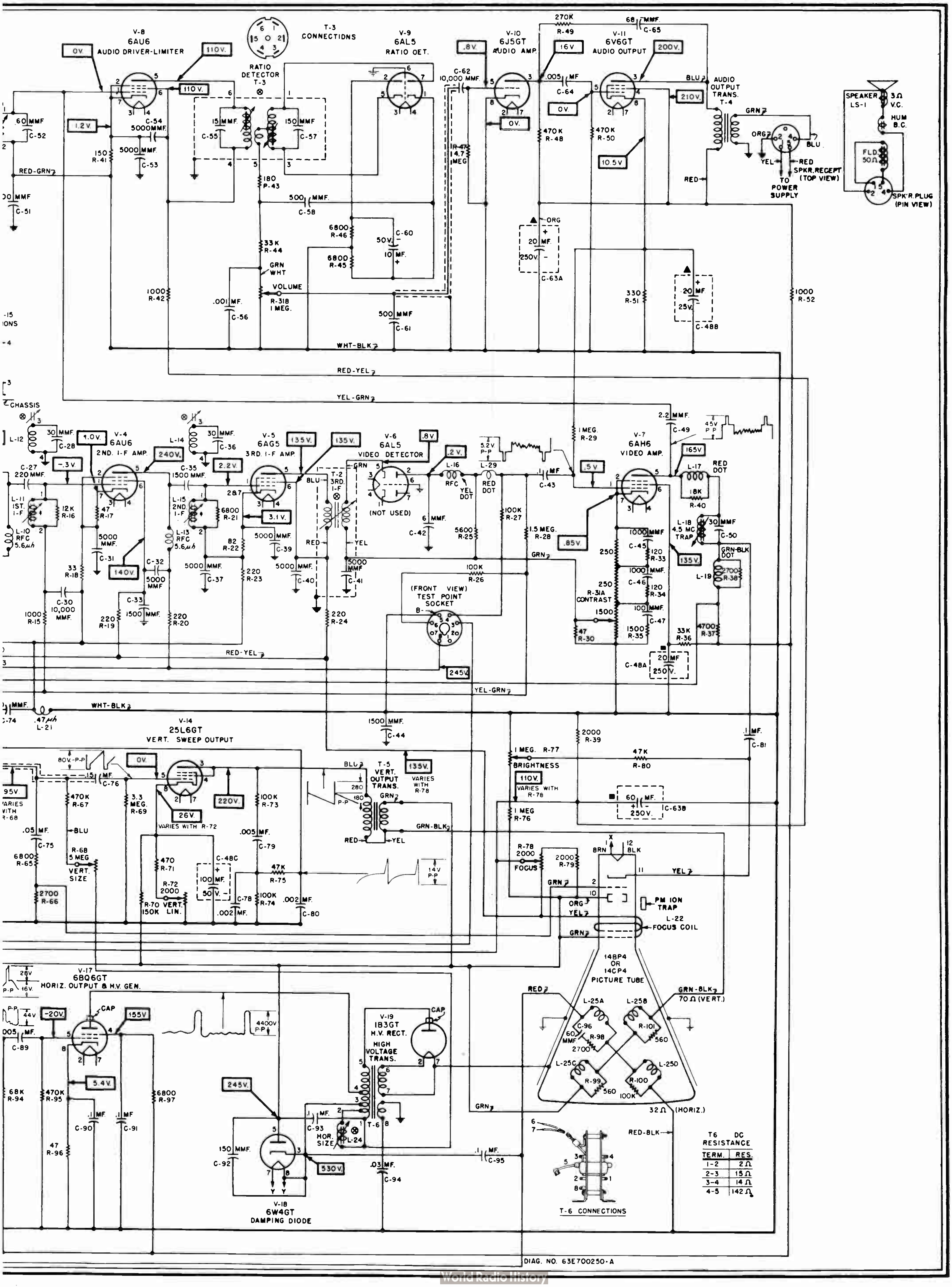

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INDEX

14T1

14K1

GENERAL INFORMATION

RECEIVER MODEL BREAKDOWN CHART

Model	Type of Set	TV Chassis Used
14T1	Table, red-brn mahogany	TS-88
14T1B	Table, limed oak	TS-88
14K1	Console, red-brn mahogany	TS-88
14K1B	Console, limed oak	TS-88

TV CHASSIS - Television chassis TS-88 contains 19 tubes plus a 14" rectangular picture tube. The picture, sound, and scanning circuits, together with a selenium rectifier voltage doubler "B" supply are contained on a single chassis.

TV TUNING RANGE - Channels 2 through 13

TV IF FREQUENCY -

Channels 2, 3, 4, 5, 6, 11, 12 & 13: sound - 21.9 mc
picture - 26.4 mc
Channels 7, 8, 9 & 10: sound - 27.3 mc
picture - 22.8 mc

ANTENNAS - table model; TA-6 "Bilt-In-Tenna" console; TA-4 "Bilt-In-Tenna". Provision for connection of an external antenna in both cases.

TV ANTENNA IMPEDANCE - 300 ohms

POWER SUPPLY - 117 volts, 60 cycle AC current only

POWER CONSUMPTION - TV: 170 watts

TV AUDIO OUTPUT - 4 watts

TV CHASSIS TUBE COMPLEMENT

Ref. No.	Tube	Function
V-1	6CB6	RF Amplifier
V-2	12AT7	Mixer-Oscillator
V-3	6AU6	1st IF Amplifier
V-4	6AU6	2nd IF Amplifier
V-5	6AG5	3rd IF Amplifier
V-6	6AL5	Video Detector
V-7	6AH6	Video Amplifier
V-8	6AU6	Audio Driver-Limiter
V-9	6AL5	Ratio Detector
V-10	6J5GT	Audio Amplifier
V-11	6V6GT	Audio Output
V-12	6SN7GT	1st & 2nd Clippers
V-13	6J5GT	Vertical Sweep Generator
V-14	25L6GT	Vertical Sweep Output
V-15	6AL5	Phase Detector
V-16	6SN7GT	Horizontal Oscillator
V-17	6BQ6GT	Horizontal Output & High Voltage Generator
V-18	6W4GT	Damping Diode
V-19	1B3GT	High Voltage Rectifier
V-20	14BP4 or 14CP4	Picture tube: rectangular

HIGH VOLTAGE WARNING

Operation of this receiver, outside its cabinet or with covers removed, involves a shock hazard from the power supplies. No work should be attempted on this receiver by anyone not thoroughly familiar with the precautions necessary when working on high voltage equipment.

CATHODE RAY PICTURE TUBE HANDLING PRECAUTIONS

Extreme care must be used in handling the picture tube. This tube is highly evacuated and, due to its large size, is subjected to a considerable atmospheric pressure. The handler should wear safety goggles and gloves for protection. Avoid nicking or scratching the glass by rough contact with other objects.

Before removing glass tubes, discharge the capacitor formed by the inner and outer aquadag coatings on the tube by shorting the anode contact on the side of the tube to the outer surface with a well insulated piece of wire.

INSTALLATION AND OPERATING INSTRUCTIONS

RECEIVER LOCATION

The receiver may be placed anywhere in the room, but for greatest satisfaction it should be located:

1. Away from any bright light that may fall directly on the screen or be reflected from it; this includes windows and lamps. Some illumination in the room, off to one side, is desirable, however, to prevent eyestrain.

2. To provide comfortable viewing and ease of operation.

3. At least one-inch away from a wall to allow for cabinet ventilation. This is very important.

ANTENNAS

The choice of a television antenna depends entirely on the location of the receiver with respect to all television station transmitting antennas in the area. Maximum pick-up is obtained when the receiving antenna is directly in line of sight with the transmitting antenna.

"Bilt-In-Tenna". All receivers using the TS-88 series television chassis are equipped with the Motorola "Bilt-In-Tenna", mounted inside the cabinet, for use in good signal areas.

When this antenna is used, the following precautions should be observed for best reception:

1. In order to get maximum performance and satisfactory pictures from the "Bilt-In-Tenna", ample signals from the television station must be present at the location of the receiver. Normally, the strength of the signals will vary throughout the room in which the receiver is located. For this reason, better pictures will be obtained if the receiver is tried in all possible locations in the viewing room and is then placed where the clearest pictures are received from all stations. Avoid large metallic objects such as, radiators, metal panels, etc.

2. Lamps, vases and metallic objects, when placed on top of the receiver, may affect the efficiency of the "Bilt-In-Tenna".

Indoor Antenna. If additional pick-up is nececessary, an indoor antenna, placed on or near the receiver, may be used. The antenna should be rotated and the arms should be extended on the low channels (2-6) and telescoped on the high channels (7-13).

Outdoor Antenna. The Motorola "Bilt-In-Tenna", or the indoor type antenna will give satisfactory reception in strong signal areas; but, if the receiver is located in a fringe or weak signal area, an outdoor antenna is recommended.

In areas free of obstructions and reflections, within reasonable proximity to television transmitters, a dipole and reflector will prove satisfactory. Since such an antenna has a relatively small band coverage, a special antenna covering all twelve television channels should be used if it is desired to receive stations on channels of widely separated frequencies.

Location of the antenna should be decided from the standpoint of maximum signal pickup. In general, the antenna should be broadside to the transmitting antenna and should be as high as possible. If a reflector is used, the antenna should be oriented so that the driven element is closest to the station and the reflector farthest away.

Locating the antenna and lead-in as far away as possible from highways, hospitals, doctors' offices, electrical machinery, etc., will help to reduce noise pick-up from such sources. Also, it is desirable to keep the antenna at least six feet away from other antennas, metal roofs, gutters, or other metal objects to prevent unwanted reflections and shielding.

Lead-In. Since the TS-88 chassis is designed for 300 ohms input, the standard 300 ohm twin lead line should be used for connecting the outside antenna to the receiver. Twisting the line one complete turn per foot of running length helps to reduce noise pick-up on the line. The lead-in should be supported on stand-off insulators and kept tight enough to prevent mechanical damage through swaying. Avoid running the lead-in close to metal gutters, iron standpipes, etc.

In areas of very strong signals, or where severe local electrical interference is encountered, 300 ohm shielded twin lead is recommended. The shield braid should be grounded.

An approved lightning arrestor should be used.

RECEIVER ANTENNA CONNECTION

The antenna lead-in to the television receiver is connected to the two screws of the terminal strip on the rear of the cabinet. Disconnect the "Bilt-In-Tenna" leads from the terminal strip before attaching an external antenna lead-in. Sometimes, reversing the lead-in connections at the receiver may improve picture quality and overall performance.

OPERATING CONTROLS

There are two dual controls, consisting of a small and a large knob each, on the front panel of the receiver. The function of each control is marked on the front panel, the "circle" indicating the large knob, and the "dot" indicating small knob. See Figure 1 for front panel control functions.

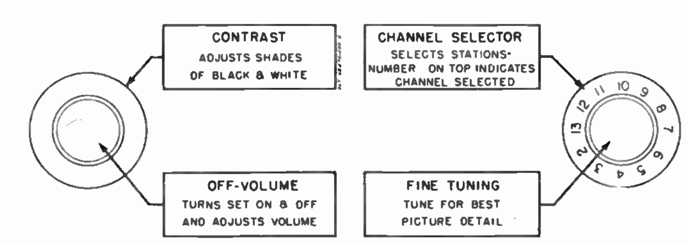

FIGURE 1. OPERATING CONTROLS

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SERVICE ADJUSTMENTS

The receiver is completely adjusted at the factory, so normally none other than the front panel control operating instructions need be followed in putting the receiver in operation. However, to provide for any misadjustment of the service controls, due to handling, the following instructions are in order. See Figure 2 for location of the service adjustment controls.

FOCUS CONTROL

The FOCUS control should be adjusted until the fine horizontal line structure of the raster is clearly visible over the picture area. The control should be tuned through the correct point several times so that optimum focus is obtained.

CENTERING

By means of a lever extending from the focus coil, thru the rear screen, the focus coil can be shifted to center the picture in its mask.

VERTICAL SIZE AND VERTICAL LINEARITY

Adjust the VERTICAL SIZE control until the picture fills the mask vertically. Adjust the VERTICAL LINEARITY control for best overall vertical linearity. Adjustment of the VERTICAL SIZE control will require a readjustment of the VERTICAL LINEARITY control and possibly of the VERTICAL HOLD control. Center picture with the centering lever on the focus coil.

HORIZONTAL SIZE

Adjust the HORIZONTAL SIZE lever until the picture fills the mask horizontally. Center picture with the centering lever.

HORIZONTAL HOLD ADJUSTMENT

The HORIZONTAL HOLD control should have a sync range of approximately 180°. If the control is too critical, adjust as follows:

1. Short out HORIZONTAL OSCILLATOR coil L-23. This may be done with the chassis in the cabinet by shorting pins 3 and 8 of the test socket on chassis rear.

2. With the centering lever, move the picture to the left so that the right edge of the raster can be seen. Adjust the HORIZONTAL HOLD control to about the middle of its range and note the width of the blanking pulse. (The blanking pulse appears as a gray bar at the right edge of the picture).

3. Remove short from HORIZONTAL OSCILLATOR coil.

4. Adjust HORIZONTAL OSCILLATOR coil until the same amount of blanking pulse can be seen as was noted in step 2.

VERTICAL HOLD ADJUSTMENT

Adjust the VERTICAL HOLD control for the center of the vertical sync lock-in range.

BRIGHTNESS

Adjust the BRIGHTNESS control, in combination with the CONTRAST control for the most pleasing picture. Keep the brilliance slightly below maximum, however, in order to protect the fluorescent screen of the picture tube and to prevent poor picture detail.

ADJUSTMENT OF ION TRAP

Under conditions of rough shipment, it is possible for the ion trap to become misaligned. To prevent serious damage to the picture tube, the following method of adjustment should be used. See Figure 3.

The magnet should be placed on the neck of the tube in the direction indicated by the marking on the magnet (usually an arrow which points toward the picture tube screen) so that the stronger magnet of the double magnet type or the only magnet in the single magnet type is positioned over the internal pole pieces which are mounted on the gun structure. Adjust the BRIGHTNESS control for low intensity and move the magnet a short distance forward and backward at the same time rotating it to obtain the brightest raster. If, in obtaining the brightest raster, the ion trap magnet has to be moved more than 1/4" from the gun pole pieces the magnet is probably weak and a new magnet should be tried. Never correct for a shadowed raster with the ion trap magnet if such correction results in decreased brightness. The ion trap magnet must always be adjusted for maximum brightness and, if shadows occur at this setting, they should be eliminated by adjusting the focus and deflection coils as explained under "Focus Coil and Deflection Yoke Adjustment".

CAUTION: Keep brightness control at low intensity until ion trap is properly set.

A mirror placed in front of the receiver will aid in making this adjustment.

DEFLECTION YOKE ADJUSTMENT

If the deflection yoke shifts, the picture will be tilted. To correct, loosen the thumbscrew on top of the deflection yoke and rotate yoke until the picture is straight. Before tightening the thumbscrew, make certain that the deflection yoke is as far forward as possible.

If the yoke support and the picture tube have shifted in transit or, if for any reason, these parts have been removed and replaced, it is best to do a complete job of repositioning. See Figure 3. The starting point is the position of the picture tube. It should be adjusted so that the distance from the center of the tube face to the front edge of the chassis is 1". The clamp on the front of the tube should then be tightened. The picture tube rear support bracket positioning adjustment screws should be loose enough to permit sliding the bracket forward until the rubber cushion fits snugly up against the flare of the tube. Loosen the yoke adjustment thumbscrew and push the yoke up against the flare of the tube. CAUTION: Do not use force in sliding the bracket up. If too much force is used, a strain will be placed on the neck of the tube when the support bracket positioning adjustment screws are tightened. Also the yoke may be forced out of position. The opening in the yoke should be concentric with the neck of the tube.

FOCUS COIL

The focus coil should be positioned so that it is spaced 1/4" from the deflection yoke when parallel with the yoke. The opening in the focus coil should be concentric with the neck of the tube. The spacing should be adjusted before the front of the picture tube is clamped down because it is necessary to remove the tube to change the position of the focus coil. Its position is changed by choice of location of the coil mounting studs in the scalloped holes on the top and bottom of the coil mounting bracket. The opening in the focus coil can be made concentric with the neck of the tube by loosening the nuts on the studs which support the focus coil bracket and turning the studs with a screwdriver in the slots provided. The studs are eccentric and move the coil both vertically and horizontally. They should be used only to center the neck of the tube in the opening of the coil.

TEST SOCKET

A test socket is provided on the rear of the chassis which allows adjustment of the horizontal oscillator and checking of sensitivity without removing chassis from cabinet. See Figure 2 for socket connections.

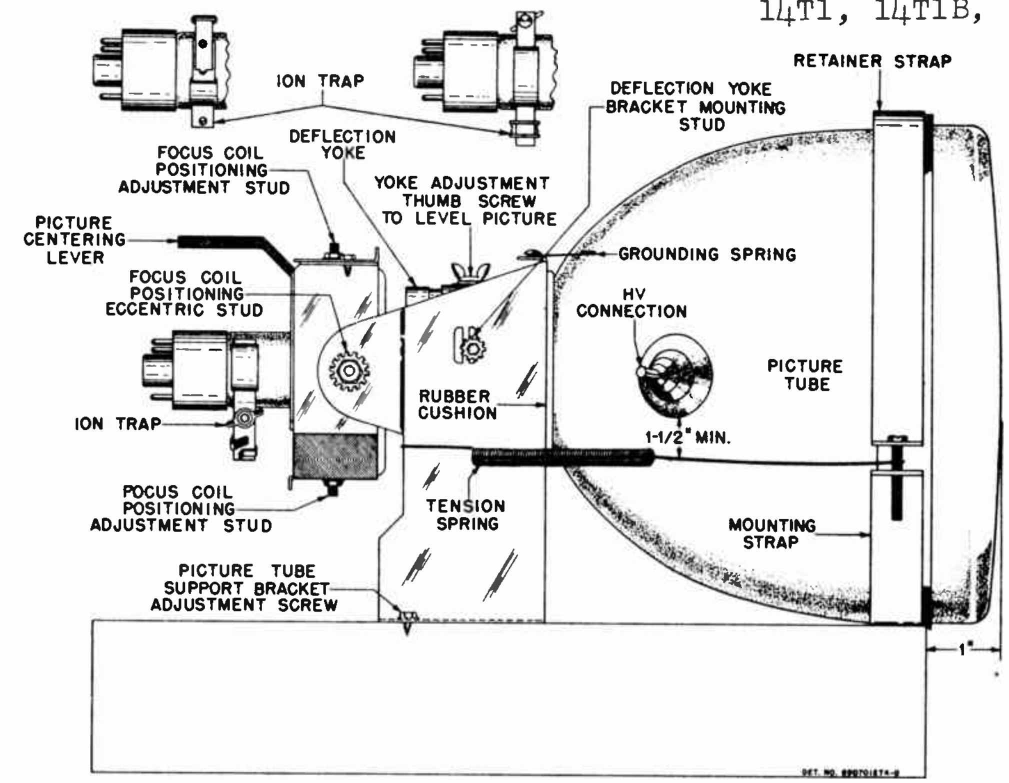

FIGURE 3. PICTURE TUBE ADJUSTMENT LOCATIONS

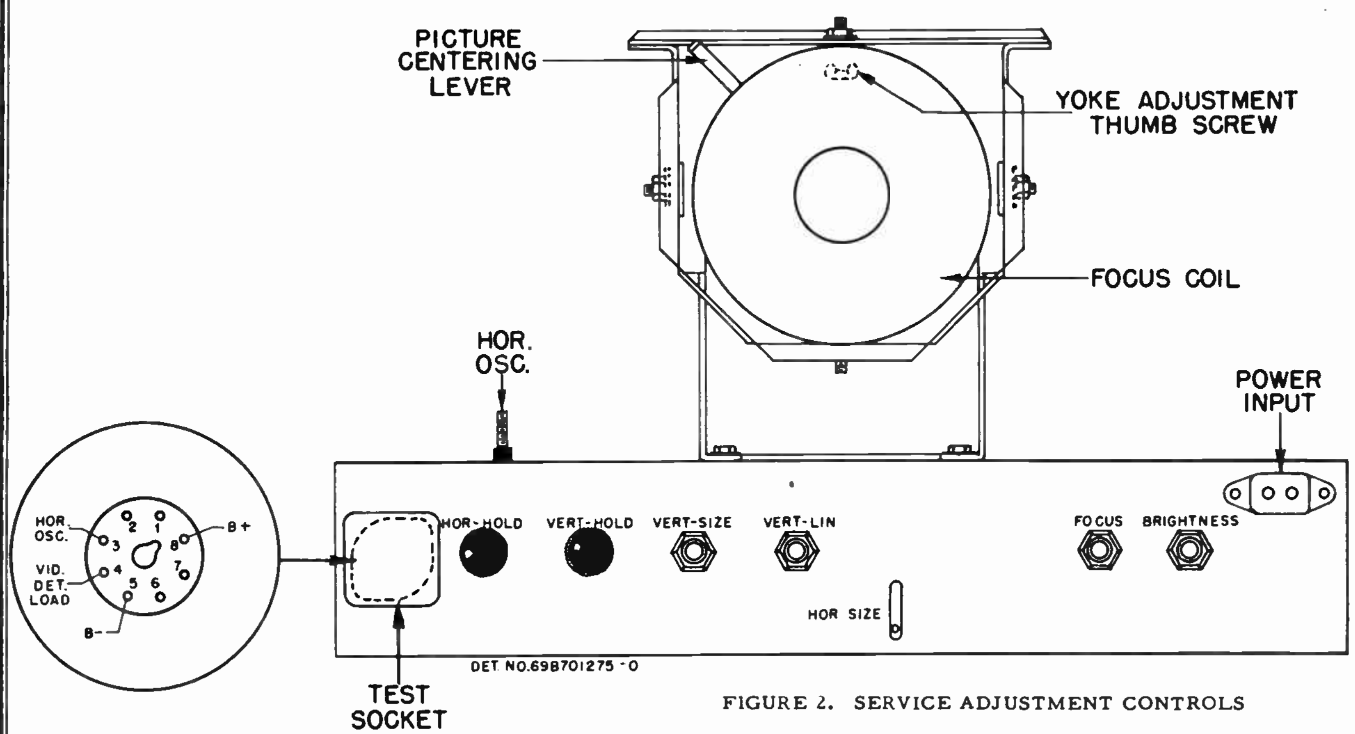

FIGURE 2. SERVICE ADJUSTMENT CONTROLS

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ALIGNMENT

GENERAL

The chassis should be mounted on angle iron brackets (Motorola Part No. 7X700210) so that all connections and adjustments may be made easily.

Since the power cord circuit is broken by the interlock when the cabinet back is removed, it will be necessary to obtain an extra power cord with the female interlock receptacle in order to make a power connection to the receiver. Order Motorola Part No. 30B470756.

It is recommended that an isolation transformer be used between the receiver and the AC line whenever any test equipment is attached to the chassis. This precaution is especially important if grounded test equipment is used. NEVER GROUND THE RECEIVER CHASSIS DURING TESTING OPERATIONS OR INSTALLATION UNLESS AN ISOLATION TRANSFORMER IS USED.

ORDER OF ALIGNMENT

A complete receiver alignment can be most conveniently performed in the following order:

1. Audio Take-Off & Ratio Detector
2. 4.5 Mc Trap
3. IF Coils & Mixer Transformer
4. Osc & RF Sections

AUDIO TAKE-OFF & RATIO DETECTOR ALIGNMENT

Equipment Required:

AM Signal Generator: (Optional)	Accurately calibrated at 4.5 mc
	Adjustable output
DC Meter:	Low range electronic voltmeter

Procedure:

Refer to Figure 4 for location of adjustments.

1. If possible, it is desirable to align the audio section from an actual station signal, since the 4.5 mc alignment frequency will be exact. The fine tuning trimmer should be turned off the station slightly, to prevent overloading the ratio detector.

2. If a signal generator is used, tune it accurately to 4.5 mc, and adjust the output to approximately 10,000 microvolts. Connect the high side of the signal generator through a 1000 mmf capacitor to the grid (pin 1) of the video amplifier tube V-7 (6AH6), and the low side to B-. The following applies whether the station signal or signal generator is used.

3. From either side of capacitor C-60 (10 mf), connect an electronic voltmeter to B- decoupled thru 10K ohms.

4. Set the contrast control for maximum gain (fully clockwise).

5. Peak L-20 for maximum reading on meter.

6. Peak T-3 primary (top core) for maximum reading on meter.

7. Move the meter and decoupling resistor from C-60 to junction of R-44 (33K) and lead to volume control.

8. Adjust T-3 secondary (bottom core) for zero response on 2.5V scale of meter. This corresponds to the cross-over point on the FM detector curve. If desired, the symmetry of the curve may be checked by tuning the signal generator 25 kc above and below 4.5 mc and noting the plus and minus voltage produced, reversing the meter connections as necessary. For proper balance of the ratio detector system, the voltage in each direction should be approximately equal. If not, check the tuning of L-20 and the primary & secondary of T-3, the ratio detector. If necessary, replace the ratio detector tube V-9 (6AL5). It is desirable to calibrate the generator on a station signal. This may be done by nulling the secondary on a station signal and then connecting the generator and tuning it to produce the same null without touching the trimmers in the set.

NOTE: As the adjustments are brought to resonance, it is advisable to reduce signal generator output to prevent overloading.

With a 10,000 microvolt signal into the grid of the video amplifier tube, with the contrast control turned fully clockwise, and the focus control at center of its range, the voltage read from one side of capacitor C-60 should be greater than 5.0V.

4.5 MC TRAP ALIGNMENT

1. Connect the high side of the signal generator through a 1000 mmf capacitor to the grid (pin 1) of the video amplifier tube V-7 (6AH6), and the low side to B-.

2. Connect the voltmeter and germanium crystal rectifier, as shown in Figure 5, between the cathode of the picture tube (yellow lead) and B-. Use the lowest voltage scale on the meter.

3. With the signal generator accurately set at 4.5 mc and maximum output, adjust trap L-18 for minimum reading on the meter.

IF AMPLIFIER ALIGNMENT

Equipment Required:

IF Sweep Generator meeting the following requirements:

18 to 30 mc, approximately 12 mc sweep width. Output constant and adjustable to at least .1 volt maximum with accurately calibrated, adjustable markers.

Cathode Ray Oscilloscope: preferably one with a calibrated input attenuator.

NOTE: If there is no built-in marker in the sweep generator, loosely couple the output of an accurately calibrated AM signal generator to the IF strip. At all times, keep the marker output low enough to prevent the marker from distorting the response curve.

If a wide band scope is used, the marker will be more distinct if a capacitor of 100 to 1000 mmf is placed across the scope input. Use the smallest size possible, since too large a value will affect the shape of the curve.

Procedure:

1. Remove high voltage generator tube V-17 (6BQ6GT) from its socket to eliminate horizontal pick-up in the oscilloscope.

2. By means of an external battery, apply a negative 3.0 volt bias from the bottom of the 1st IF tube grid resistor R-9 (6800) to B-.

3. Using leads as short as possible, connect the hot side of the sweep generator to the grid (pin 1) of the 1st IF tube V-3 (6AU6) through a 5000 mmf capacitor (do not use the loose or "spraying" method of coupling). The low side is connected to B-. Set the center frequency of the sweep to about 24.6 mc and adjust initially for a sweep deviation of approximately 12 mc. However, a sweep of from 8 to 10 mc may be found better for overall alignment.

4. Using R-27 (100K) as a decoupling resistor, connect the scope to pin 4 of test socket. If a stronger output is desired, connect the scope between the picture tube cathode and B-. The curve seen at this position will be the reverse of the polarity shown in Figure 6.

5. Set the contrast control at minimum.

NOTE: If a distorted or unstable picture is seen on the oscilloscope during alignment, it may be necessary to stop the oscillator by disconnecting resistor R-10 (1000) from the plate (pin 6) of the oscillator tube V-2B (12AT7), or by substituting another tube with pin 6 removed.

CAUTION:

1. Do not reduce the oscilloscope gain and increase signal input so that the top of the curve is flattened due to limiting in the video or scope amplifiers.

2. The dress of plate & grid components in the IF affects tuning. Do not move indiscriminately.

3. On the IF coils and on the traps the resonance point will be found at two settings of the slug. The correct setting is the one which is found with the greater part of the adjusting screw out of the coil.

NOTE: The 1st & 2nd IF traps are tuned from bottom of chassis, while IF cores are adjusted from the top.

6. Tune the low frequency trap L-14, located on the 2nd IF coil, for maximum attenuation on the curve at 21.9 mc.

7. Tune the high frequency trap L-12, located on the 1st IF coil, for maximum attenuation on the curve at 27.3 mc.

8. Adjust the 1st IF coil, L-11, to place a 26.6 mc marker on the high side of the response curve 60% down from maximum response. See Figure 6.

9. Adjust the 2nd IF coil, L-15, to place a 22.7 mc marker on the low side of the response curve 60% down from maximum response.

10. Adjust the 3rd IF plate transformer, T-2, to provide a flat top or symmetrical response curve.

11. Reset the traps (steps 6 & 7) and again check the IF for proper response.

NOTE: It is suggested that the bias be removed for accurate resetting of the traps.

12. With bias applied, connect the sweep between the grid (pin 2) of the mixer tube V-2A (12AT7) and B-.

13. Disconnect the trimmer, C-14, in LC circuit in the grid of the mixer tube, or short the trimmer through a 10,000 mmf ceramic disc type to B-.

14. Bring both cores of the mixer transformer, T-1, simultaneously from the outside towards the center. The half-way markers should be 26.4 mc and 22.9 mc (Figure 7).

NOTE: In aligning the three IF coils, each coil is adjusted individually, but when adjusting the primary and secondary of the mixer transformer, the adjustments should be made simultaneously. The important point to keep in mind is to obtain a flat response curve with as much gain as possible. The sides of the curve should be straight and as steep as possible. Simultaneous adjusting of the primary and secondary is the easiest way to obtain this result. The transformer by itself, is in effect, tuned for the same pass band as the three staggered circuits. See Figure 7. The only difference in the overall waveform should be that the sides of the overall wave are steeper. Constant use of the 50% markers (22.9 mc and 26.4 mc) should be resorted to, since it is absolutely necessary to obtain the proper curve. A slight dip (not exceeding 10%) is permissible in the mixer transformer response curve.

BANDWIDTH

The bandwidth may be determined by connecting an AM generator to the mixer grid. With the generator frequency at 24.6 mc, adjust the output for 1 volt reading on a VTVM connected at the plate (pin 2) of the video detector tube V-6 (6AL5) and B-. Double the output of the generator. Now, by tuning either side of 24.6 mc and noting the frequencies at which the VTVM again reads 1 volt, the 6 db bandwidth points are indicated.

REGENERATION CHECK

After the above IF and mixer transformer alignment has been made, a check for regeneration in the IF amplifier strip should be made. This is done by removing the battery bias and observing the output response curve on the oscilloscope as taken between the picture tube cathode and B-. The bandwidth may change with the bias removed but should not change more than 0.2 mc. Set the contrast control to maximum gain. Decrease the input until the output signal shows a marked decrease. Any regeneration present will be indicated by sharp peaks on the overall response curve. The oscillator should be stopped, as described above, during this procedure.

CAUTION: Do not inject too much marker signal.

MIXER LC ADJUSTMENT

Reconnect bias removed for regeneration check. Re-

MODELS 14K1, 14K1B, 14T1, 14T1B, Ch. TS-88

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NO.	TYPE	FUNCTION
V-1	6CB6	R-F AMP.
V-2	12AT7	MIXER-OSC.
V-3	6AU6	IST. I-F AMP.
V-4	6AU6	2ND. I-F AMP.
V-5	6AG5	3RD. I-F AMP.
V-6	6AL5	VIDEO DET.
V-7	6AH6	VIDEO AMP.
V-8	6AU6	AUDIO DRIVER-LIMITER
V-9	6AL5	RATIO DET.
V-10	6J5GT	AUDIO AMP.
V-11	6V6GT	AUDIO OUTPUT
V-12	6SN7GT	IST. & 2ND. CLIPPER
V-13	6J5GT	VERT. SWEEP GEN.
V-14	25L6GT	VERT. SWEEP OUTPUT
V-15	6AL5	PHASE DET.
V-16	6SN7GT	HORIZ. OSC.
V-17	6BQ6GT	HORIZ. OUTPUT & H.V. GEN.
V-18	6W4GT	DAMPING DIODE
V-19	1B3GT	H.V. RECT.

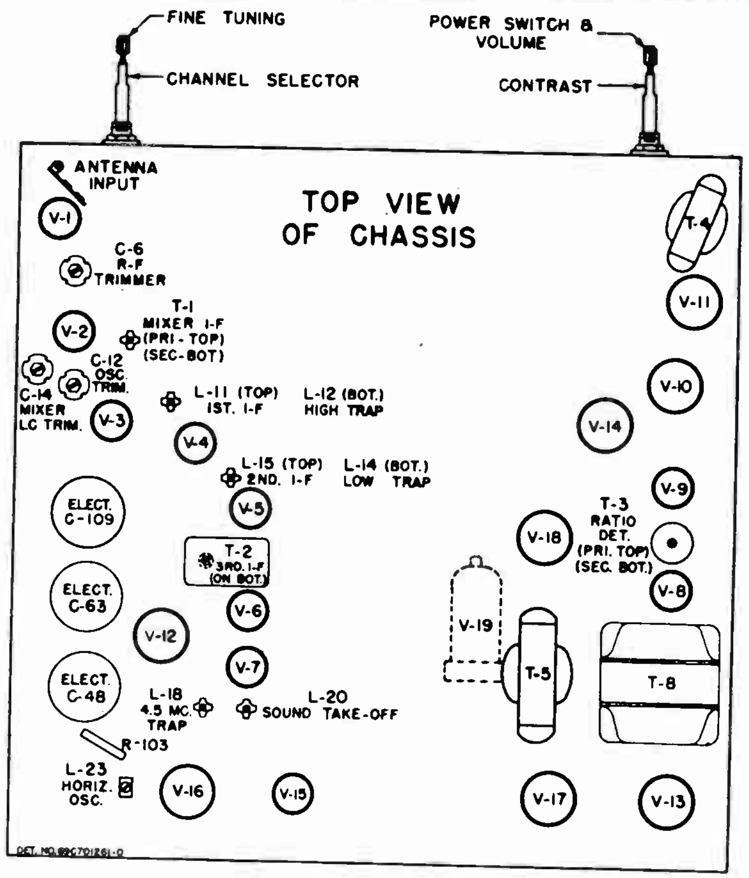

FIGURE 4. TUBE & ALIGNMENT ADJUSTMENT LOCATIONS

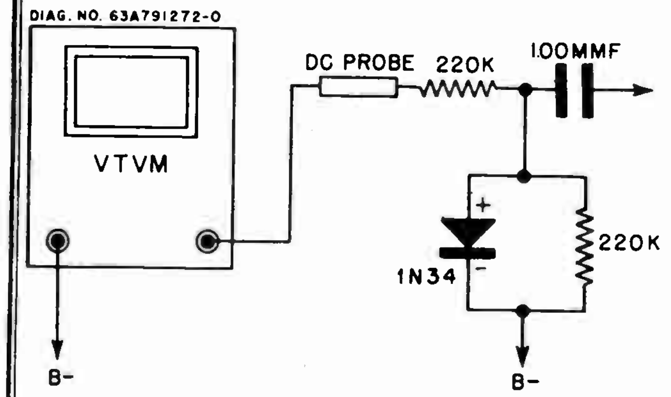

FIGURE 5. ELECTRONIC VOLTMETER CONNECTIONS

place trimmer C-14 in LC circuit of mixer grid or remove 10,000 mmf ceramic between trimmer and B-. Adjust the trimmer so it is tuned to the center of the mixer response curve. This is indicated by observing the effect of the LC circuit on the mixer response. Increasing the capacity of the trimmer and bringing the LC circuit from above the IF range into the IF range, it will be noted that the mixer curve will pull down on the high side, then straighten out as the LC circuit approaches the middle of the range, and pull down on the low side as the LC circuit approaches the low end of the IF range. The proper tuning point is that point at which the mixer curve straightens out. In effect, the LC circuit is similar to a jack coil when it is within the IF range.

CAUTION: Tuning the LC circuit very low will cause oscillation.

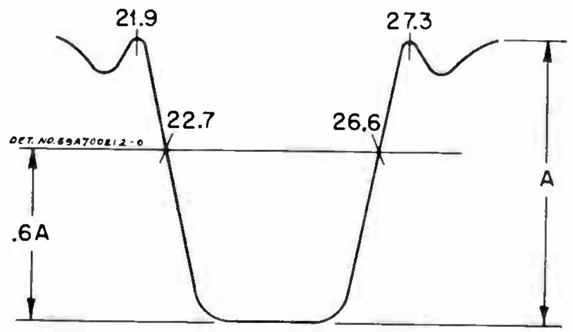

FIGURE 6. IF RESPONSE CURVE

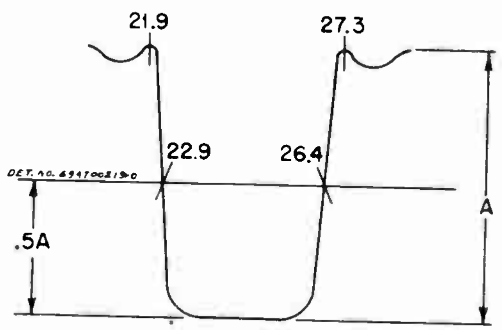

FIGURE 7. OVERALL RESPONSE CURVE FROM MIXER

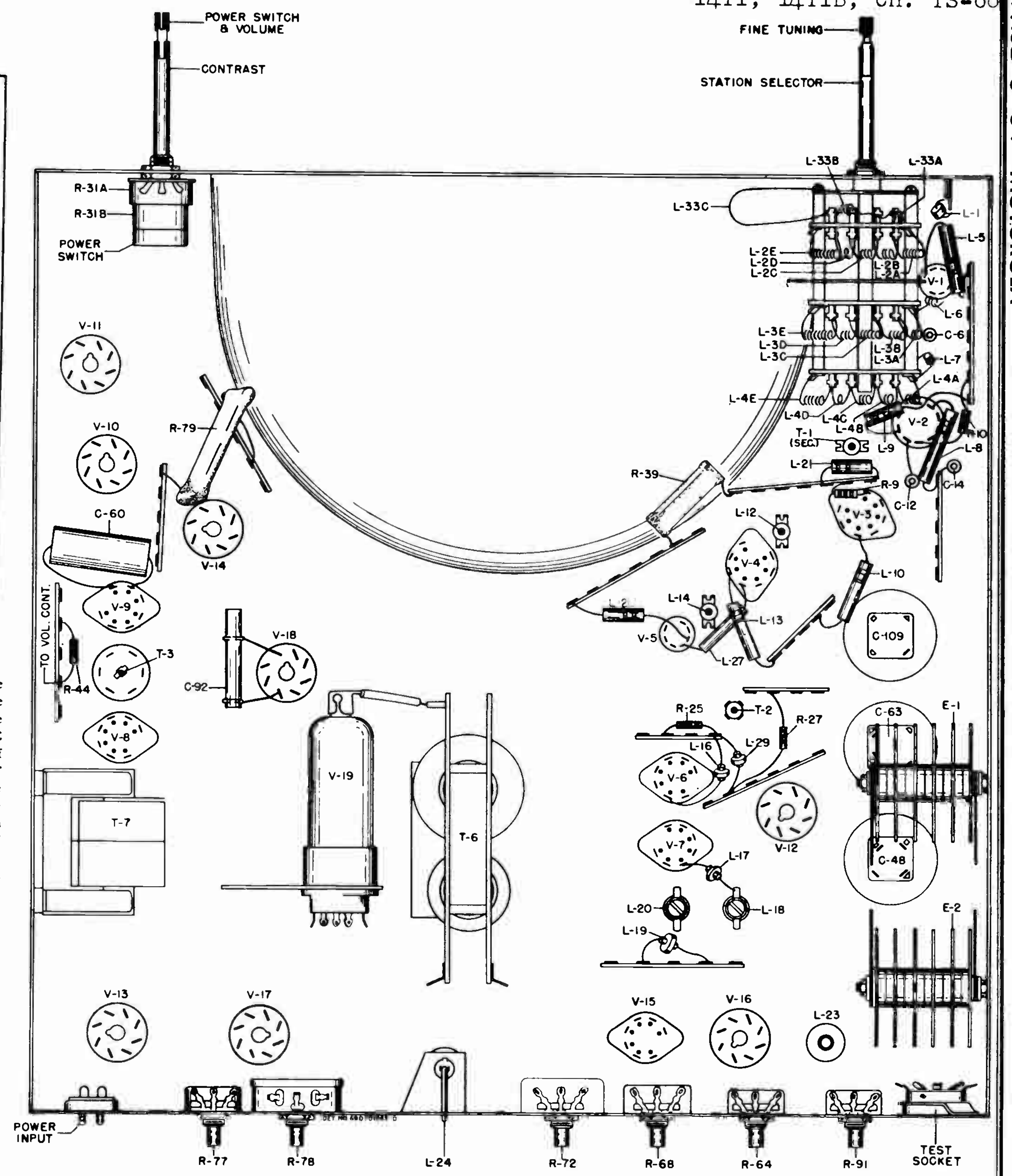

FIGURE 8. BOTTOM VIEW OF CHASSIS

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IF SENSITIVITY MEASUREMENTS

IF Stages Only

1. Remove the battery bias from 1st IF tube grid.

2. Connect an AM signal generator, set at 24.6 mc, through a blocking capacitor of 5000 mmf, between B- and the grid (pin 1) of the 1st IF tube V-3 (6AU6).

3. Connect an electronic voltmeter across the video detector load resistor R-26 (5600). Both leads from the meter should be decoupled with 100K ohm resistors.

4. Set the contrast control for maximum sensitivity.

5. Stop the oscillator tube by disconnecting resistor R-10 (1000) from the plate (pin 6) of tube V-2B (12AT7) or by substituting another tube with pin 6 removed.

6. The signal required to produce 1 volt (negative) above contact potential on the meter should be less than 125 microvolts.

Mixer & IF Stages

The preliminary preparations are the same as for checking the sensitivity of the IF stages except:

1. Connect the AM signal generator, set at 24.6 mc, through a 5000 mmf capacitor, between B- and the grid (pin 2) of the mixer tube V-2A (12AT7).

2. The signal required to produce 1 volt (negative) above contact potential on the meter should be less than 125 microvolts.

OSCILLATOR, ANTENNA AND RF ALIGNMENT

NOTE: The IF must be aligned before the RF section can be properly phased.

Equipment Required:

Sweep Generator: Frequency range 40-220 mc; 10 mc sweep width
Output constant and adjustable
Adjustable markers (markers should be calibrated occasionally by checking against an accurate signal generator).

Oscilloscope: Preferably one with a calibrated input attenuator.

Signal Generator: Frequency range 40 to 220 mc
Accurately calibrated
AM modulated, 400 cycle

FREQUENCY CHART

Channel	Frequency	Picture	Sound	Oscillator
2	54-60	55.25	59.75	81.65
3	60-66	61.25	65.75	87.65
4	66-72	67.25	71.75	93.65
5	76-82	77.25	81.75	103.65
6	82-88	83.25	87.75	109.65
7	174-180	175.25	179.75	152.45
8	180-186	181.25	185.75	158.45
9	186-192	187.25	191.75	164.45
10	192-198	193.25	197.75	170.45
11	198-204	199.25	203.75	225.65
12	204-210	205.25	209.75	231.65
13	210-216	211.25	215.75	237.65

ANTENNA & RF ALIGNMENT PROCEDURE

1. Remove high voltage generator tube V-17 (6BQ6GT) from its socket and stop the oscillator by disconnecting R-10 (1000) from plate (pin 6) of V-2B (12AT7).

2. Connect the sweep generator across the antenna terminals on the chassis with the antenna lead-in removed. The line from the sweep generator should be as short as possible.

3. Connect the oscilloscope through a decoupling resistor of 150,000 ohms, between the cathode (pin 3) of the mixer tube V-2 (12AT7) and B-.

4. Short out the AGC circuit with a clip lead from the AGC bus to B-.

5. Refer to Figure 4 for the RF trimmer location and to Figure 9 for the locations of the antenna and RF coils. The frequency chart listed previously gives the channel and alignment frequencies.

6. The antenna coils are tuned to the video carrier and the RF coils are tuned to the sound carrier. Figure 10 shows the shape of the curve which should appear on the scope for channels 2-6 and Figure 11 the curves for channels 7-13.

7. Turn the station selector switch to channel 10. Set the center frequency of the sweep generator to the center frequency of channel 10 (195 mc).

8. Adjust ceramic trimmer, C-6, so that picture and sound markers are as in Figure 11.

9. Check channels 7 to 13 for proper response and, if necessary, tune the coil L-6. These coils may be tuned by spreading them to decrease inductance or compressing them to increase their inductance. See Figure 9 for location of coils. This will have more effect on channels 10 to 13 than 7 to 9. If L-6 is adjusted, it may be necessary to readjust RF trimmer C-6, and recheck the high channels.

NOTE: As the bandwidth of the high channels is very broad, a slight variation is permissible.

10. Move bandswitch to channel 6.

11. With the center frequency of sweep generator at the center frequency of channel 6 (85 mc) introduce markers corresponding to sound and picture carriers and compare with curve of Figure 10.

NOTE: A convenient method of determining whether a coil is tuned correctly is to insert a brass or iron slug into the coil. Brass decreases and iron increases the inductance.

12. After channel 6 has been aligned, progress downward through channel 2.

CAUTION: Make certain the station selector switch is on the correct channel before checking bandpass.

OSCILLATOR ADJUSTMENT

1. Put oscillator back in circuit.

2. Remove the short from the AGC circuit and apply a -3 volt battery bias to the AGC bus.

3. Move the scope to the test socket on the chassis rear with the high side connected to pin 4 and the low side to pin 5 (B-).

4. Set the contrast control at minimum (counterclockwise).

5. Remove the fine tuning knob and turn shaft until the slot is in a horizontal position. This represents the mid-capacity position.

6. Turn station selector switch to channel 12.

7. Set the sweep generator on channel 12 with a center frequency of 207 mc and at least a 12 mc sweep. Keep the output low enough to show no evidence of limiting in the overall response curve.

NOTE: Before aligning the oscillator section, make certain the 3.3 microhenry choke in the mixer grid is dressed away from the 2 mmf capacitor tied to the same grid.

8. Introduce a marker corresponding to the sound carrier of channel 12 (209.75 mc).

9. Adjust oscillator ceramic trimmer so that the sound marker falls into the 21.9 mc trap dip in the response curve.

10. Turn generator and station selector to channel 9 with the fine tuning shaft slot still in the horizontal position.

11. Spread or compress the 3-turn coil located in the center of the oscillator plate (L-4M, Figure 9) so that the sound marker for channel 9 falls into the 27.3 mc trap dip in the response curve. As the oscillator is tuned below the carrier on channels 7, 8, & 10 the 27.3 mc trap will be in the same position as the 21.9 mc trap in step 9.

12. Repeat steps 6, 7, 8, & 9.

13. Turn generator and station selector to channel 13.

14. Turn fine tuning trimmer so that the sound marker for channel 13 falls into the 21.9 mc trap dip of response curve. The slot in the fine tuning shaft should not have moved more than 30 degrees from the horizontal position to accomplish this (each number on the station selector knob represents 30 degrees).

15. If more than a 30 degree change in fine tuning trimmer was needed in step 14, adjust channel 13 oscillator coil (L-7) by spreading or compressing until the 30 degree requirement is met.

NOTE: Each adjustment of channel 13 oscillator coil (L-7) will necessitate a rechecking of the oscillator trimmer on channel 12 as per steps 6, 7, 8 & 9.

16. Check channels 12, 11, 10, 9, 8, and 7 by noting whether the fine tuning trimmer can drop the sound marker for each channel in the trap dip by a 30 degree rotation. If one of the channels does not meet the 30 degree requirement, a compromise must be made by resetting channel 9 or 12, whichever is closer to the channel in question.

Example: 1) If channel 11 does not meet the 30 degree requirement, return station selector and generator to channel 12 and tune ceramic trimmer toward channel 11 (trimmer frequencies lowered by tightening screw). This will tend to move channel 12 sound marker out of the trap dip, but this can be compensated for by the fine tuning trimmer. Do not adjust trimmer any more than is necessary to get the channel in question back within the 30 degree requirement.

2) If channel 10 does not meet the 30 degree requirement, move station selector and generator to channel 9 and tune the 3-turn coil (L-4M, Figure 9) toward channel 10 (coil freq raised by spreading turns). This will also tend to move channel 9 sound marker out of the trap dip, but this can be compensated for by the fine tuning trimmer. Again, do not adjust the coil any more than is necessary to bring the channel in question back within the 30 degree requirement.

17. Turn sweep generator and station selector switch to channel 6.

18. Adjust channel 6 oscillator coil (L-4E, Figure 9) so that the sound marker for channel 6 falls into the 21.9 mc trap dip with the fine tuning trimmer at mid-capacity (shaft slot in horizontal position). Always spread or compress channel #6 oscillator coil in units of 3 turns. Compressing turns will move curve toward sound marker, while spreading will move curve toward video marker.

IMPORTANT: Since the coils are in series, the proper alignment of channel 6 will simplify the phasing of the channels to follow.

19. Adjust channels 5 and 4 so that the sound marker for each channel falls into the 21.9 mc trap dip in the curve with the fine tuning trimmer set no more than 15° from mid-capacity.

20. Channels 3 and 2 should be adjusted so that the sound marker falls into the 21.9 mc trap dip with the fine tuning trimmer within 15° of maximum capacity.

OVERALL RECEIVER SENSITIVITY MEASUREMENT

An overall measurement of sensitivity is made as follows:

1. Connect an AM signal generator to the input terminals of the receiver chassis after removing the short 300 ohm lead which connects to the antenna input strip on the back of the cabinet. To match the generator to the receiver input, a resistor matching network should be used. In the case of a generator with a 50 ohm output impedance, for example, place a 100 ohm resistor in series with the output terminal of the generator and a 150 ohm resistor in series with the ground terminal.

2. From cathode of picture tube to B- connect a calibrated oscilloscope.

NOTE: To calibrate scope, connect it across 6.3 volt filament supply. The peak-to-peak amplitude on the screen will then be approximately 18V (6.3 x 2.8).

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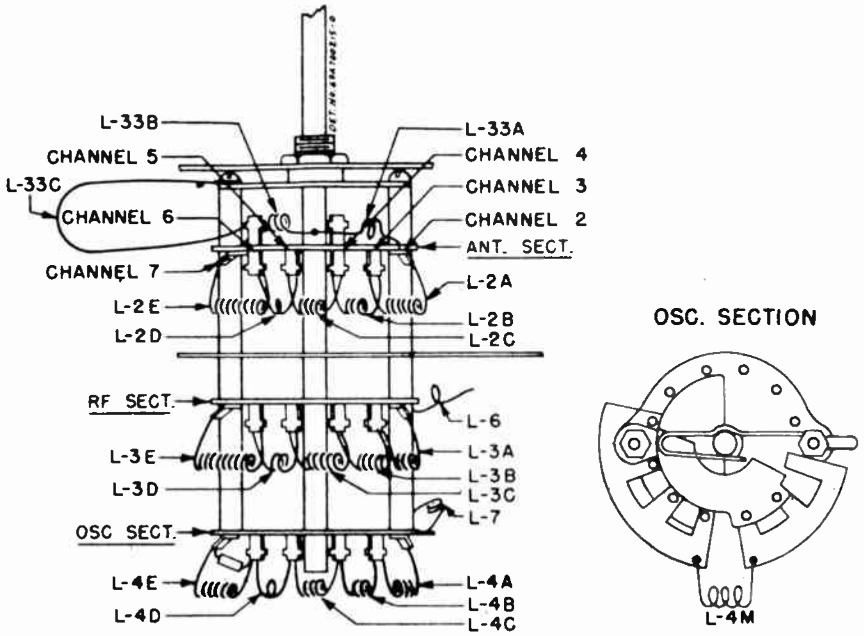

FIGURE 9. ANTENNA, RF AND OSCILLATOR COIL LOCATIONS

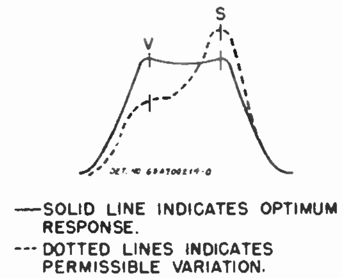

FIGURE 10. RF RESPONSE CURVE - CHANNELS 2-6

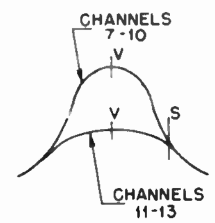

FIGURE 11. RF RESPONSE CURVES - CHANNELS 7-10 & 11-13

3. Set contrast control for maximum sensitivity.

4. Tune signal generator to the video carrier frequency of the channel being checked. Generator signal should be 30% modulated at 400 cycles. The signal from the generator to produce 20 volts peak-to-peak at picture tube cathode should be less than 25 microvolts on channels 2 to 6 and less than 75 microvolts on channels 7 to 13.

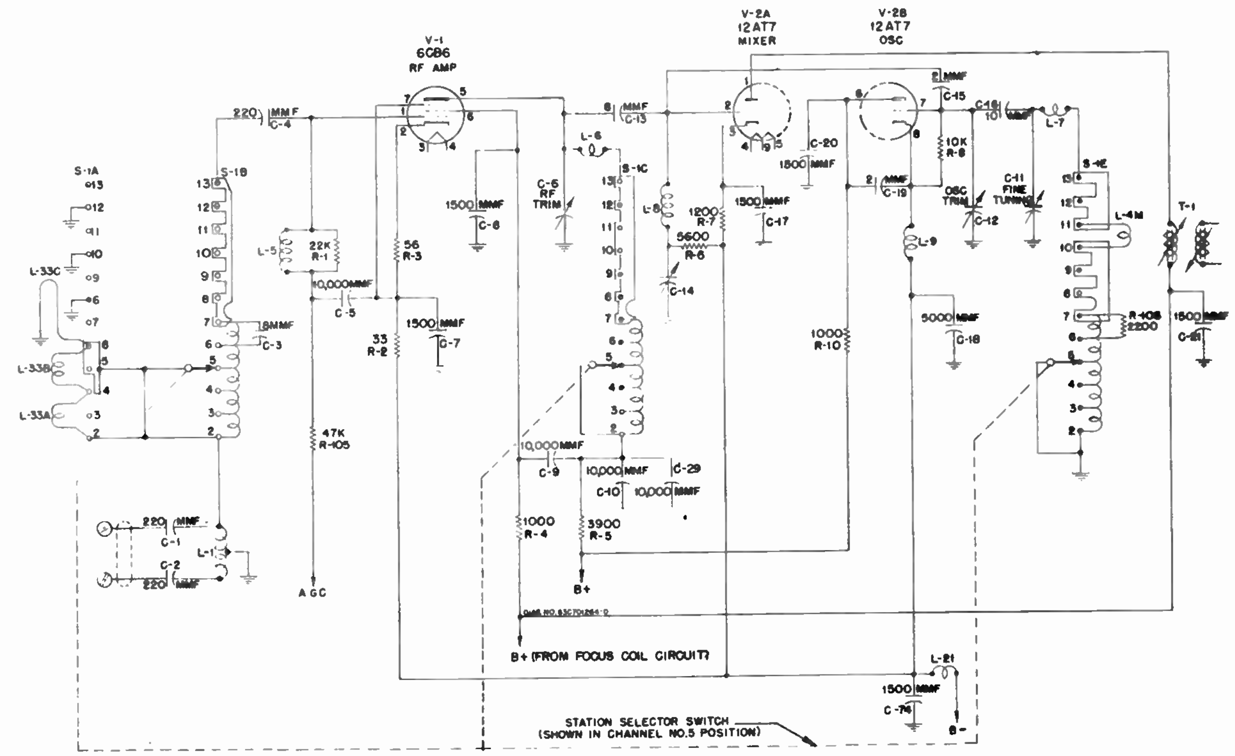

FIGURE 13. SIMPLIFIED SCHEMATIC OF RF TUNER

CIRCUIT DESCRIPTION

LOW VOLTAGE POWER SUPPLY

The low voltage power supply (Figure 12) provides plate voltage for all tubes except the high voltage applied to the second anode of the picture tube. The heater transformers supply heater voltage to all tubes except the HV rectifier, which is energized by horizontal sweep current.

One low voltage secondary of T-7, the step-down filament transformer, supplies filament voltage to all tubes except the audio driver-limiter (V-8), the vertical output tube (V-14), and the horizontal damping diode (V-18). Since the damping diode (V-18) develops a high voltage pulse at its cathode, and its cathode is tied to the filament to prevent breakdown in the tube, it is necessary to provide a separate low-capacity, well-insulated transformer (T-8) to heat this filament. The vertical output tube V-14 (25L6GT) requires a 25 volt filament supply and, hence, is provided with a separate 25 volt tap on the transformer. In earlier production chassis, the audio driver-limiter (V-8) had its cathode connected to a B plus point of about 120 volts. In order to keep the heater to cathode difference of potential low, it was necessary to provide a separate filament winding for this tube. This tube's cathode is now returned to B- but, since the separate winding is still supplied on present production transformers, it is still used for V-8 and in late sets also for V-20.

The B plus plate supply uses a voltage doubler. R-103 is a limiting resistor to protect the rectifiers from initial current surges and also serves as a fuse in case of B plus shorts. When the polarity of the applied 117 volt AC is such as to make the side of the line connected to R-103 negative, E-2 will conduct and charge C-109 (300 mf) to peak line voltage. On the next alternation, E-1 will conduct and the voltage applied to it is now the peak line voltage plus the peak charge stored in C-109. This results in a charge of about 270 volts on C-63C (200 mf). The speaker field is used as a filter choke. The focus coil and the resistor network, which controls the current thru it, act also as a voltage divider to supply plate and screen voltages to several tubes, as shown in Figure 12.

Another voltage divider from B plus to B-, consisting of R-76 (1 meg) and the potentiometer, R-77 (1 meg) provides a variable bias on the cathode of the picture tube, to serve as a brightness control.

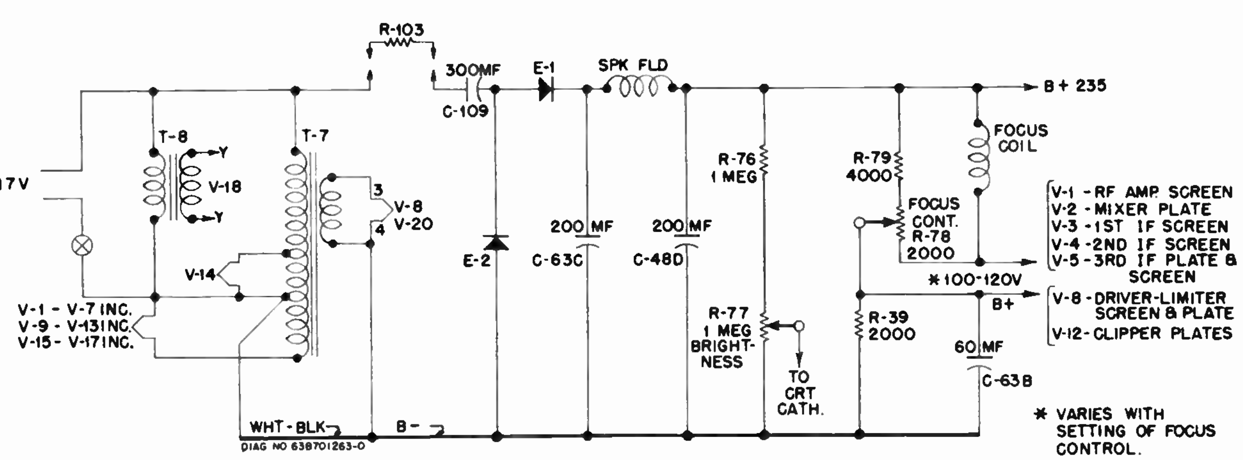

FIGURE 12. SIMPLIFIED SCHEMATIC OF HEATER AND LOW VOLTAGE POWER SUPPLY

THE RF TUNER

Antenna Input

Figure 13 is a simplified schematic of the tuner.

The antenna input coil, L-1, couples the balanced line to the single ended input circuit for the RF tube, V-1. Optimum antenna coupling for all channels is obtained by the coupling coils L-33A, L-33B, L-33C, and the coupling leads on channel positions 8, 10, and 12 of switch wafer S-1A. These can be considered the primary of the antenna transformer. The secondary, or tuned grid circuit, includes also the continuous, tapped coil mounted on wafer S-1B for the low channels (2-6) and the stamped metal plate in series with the coil for the high channels (7-13). The purpose of the antenna coil, coupling leads, and secondary circuit, is to match the 300 ohm impedance of the transmission line from the antenna to the input impedance of the RF amplifier grid circuit and to tune this circuit for the channel selected. Referring to Figure 13, it will be seen that the switch, in progressing from channel 2 to channel 13, shorts out the unused portion of the secondary winding or stamped metal plate. The bandwidth of channels 7 thru 13 is about 8 mc. The stamped metal plate is carefully designed so that with this bandwidth no alignment adjustment is needed on the high channels. The individual coil sections on the low channels, however, may be tuned by spreading or compressing them, as outlined in the alignment procedure.

RF Amplifier

The grid of the RF amplifier V-1 (6CB6) is returned to the AGC bus thru L-5 and a bypass capacitor (C-5). The plate load of this tube consists of another tapped coil for the high channels mounted, in this case, on switch wafer S-1C. Here again, the switch progressively shorts out the unused sections of the inductance in tuning from channel 2 to 13. In this case, however, a trimmer C-6 and a choke L-6 are provided to center the high channel response while the low channel coils may be tuned by expansion or compression.

The Mixer

The mixer uses 1/2 of V-2 (12AT7). C-13 (8 mmf) couples the RF amplifier output to the mixer grid. Oscillator injection is accomplished by C-15 (2 mmf). L-8 and C-14 form a series resonant circuit tuned to the center of the IF response, to prevent interaction between the IF and the mixer input.

The Oscillator

The oscillator uses the other half of V-2 (12AT7) in a Colpitts circuit. Here again, the tuning inductance consists of the tapped coil for the low channels and the stamped metal plate for the high channels mounted on wafer S-1E. L-7 and C-12 are provided to set the center frequency on the high channels while the low channels are aligned by spreading or

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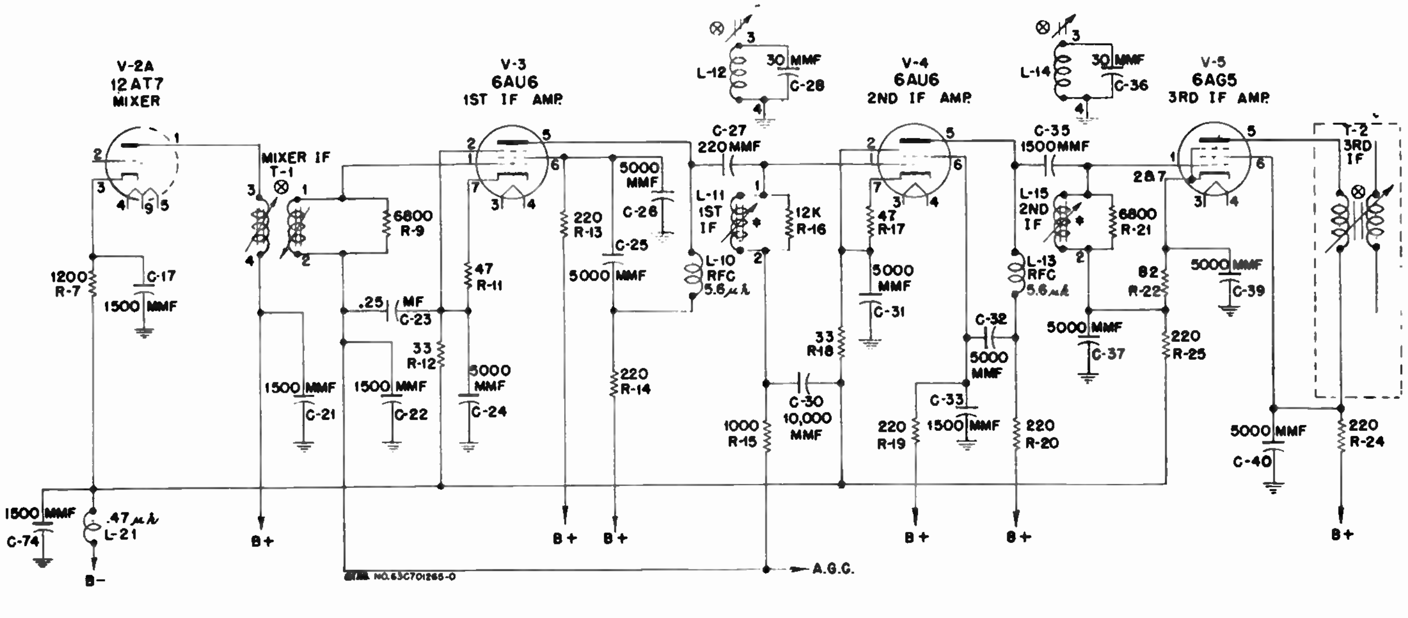

FIGURE 14. SIMPLIFIED SCHEMATIC OF IF AMPLIFIER

compressing the individual coil sections. C-11 is provided as a fine tuning control for customer use. The oscillator operates above the RF on the low channels and below the RF on the high channels except that in later production the circuit was modified to avoid interference by operating the oscillator on the high side for channels 11, 12 and 13.

IF AMPLIFIER

The IF amplifier uses two 6AU6 tubes and one 6AG5 tube. Figure 14 is the schematic of the IF amplifier. T-1 couples the mixer plate to the first IF grid. Coupling between primary and secondary, which are individually slug-tuned, is fixed and is designed for proper bandwidth. The plate choke L-10, of the 1st IF tube V-3 (6AU6), is coupled to the grid coil, L-11, of the 2nd IF tube V-4 (6AU6) thru C-27 (220 mmf). At IF frequencies, the impedance of C-27 is negligible and for all practical purposes, L-10 and L-11 can be considered as being in parallel, L-11 being slug-tuned. A similar method is used between the 2nd and 3rd IF tubes. The 3rd IF plate is coupled to the detector by T-2, a unity coupled transformer. The IF circuits are stagger-tuned for proper bandwidth as explained in the Alignment Instructions. L-12 and L-14 are separately tuned trap windings on IF coil forms L-11 and L-15, respectively. Together with C-28 and C-36, they form absorption type trap circuits which steepen the high and low skirts of the IF response for better picture quality and stabilize the audio response with intercarrier sound.

Decoupling has been used not only in the plate supply and AGC circuits, but also in the filament circuits to prevent regeneration.

THE VIDEO DETECTOR

One-half of V-6 (6AL5) is used as the video detector. Figure 15 is a schematic of the video detector. Since for noise limiting purposes it is desirable to apply a signal with negative going sync pulses to the grid of the video amplifier, the detector load R-26 (5600) is placed in the plate circuit of the diode. L-16, L-29 and C-42, form a low pass filter to keep IF frequencies off the grid of the video amplifier.

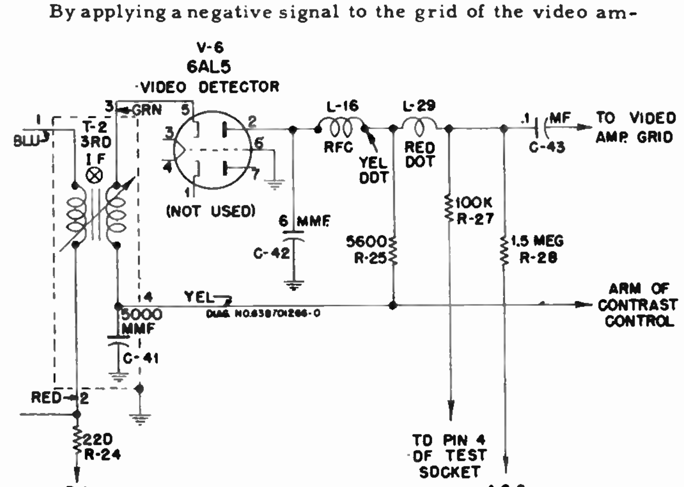

FIGURE 15.
SIMPLIFIED SCHEMATIC OF VIDEO DETECTOR

Since this chassis operates on the intercarrier sound system, the detector heterodynes the video and sound IF frequencies, and produces the 4.5 mc beat frequency which becomes the new audio IF frequency. The negative DC voltage developed at the high side of the detector load R-26 (5600) will be a function of carrier level. This voltage is fed to the AGC bus thru R-28 (1.5 meg) and controls the gain of the RF and 1st and 2nd IF amplifiers.

THE VIDEO AMPLIFIER

The video amplifier V-7 (6AH6) not only amplifies the video signal but also the 4.5 megacycle audio IF beat. Figure 16 is a schematic of the video amplifier. In its plate circuit, this beat is separated from the video signal and fed to the grid circuit of the audio driver-limiter tube V-8 (6AU6) by C-49 (2.2 mmf) and L-20, the sound take-off coil. The 4.5 mc trap, L-18 and C-50, is a parallel resonant circuit which, when properly tuned, offers a high impedance to this frequency, to prevent its reaching the picture tube.

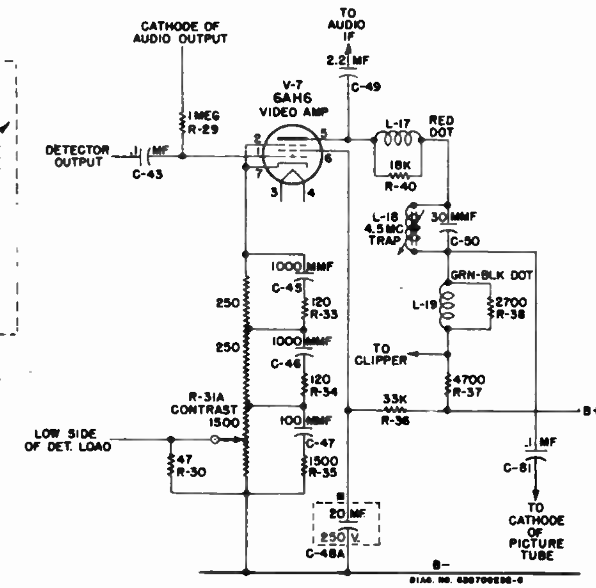

FIGURE 16.
SIMPLIFIED SCHEMATIC OF VIDEO AMPLIFIER

By applying a negative signal to the grid of the video amplifier, a noise limiting action is achieved because noise pulses of amplitude greater than the sync level will drive the tube to cut off and, therefore, will not be present in the plate circuit. Since a single video amplifier tube is used, the signal at its plate will be positive and, as might be expected, is used to modulate the cathode of the picture tube rather than the grid, because the blanking pulses must cut the picture tube off and the polarity of the video information must be such that dark picture elements result in making the grid more negative with respect to the cathode.

L-17 and L-19 are peaking coils to extend the high frequency response of the amplifier. The contrast control, R-31A, is placed in the cathode circuit of the video amplifier and controls the bias and, therefore, the gain of this tube. The network of resistors and condensers across taps on the contrast control decreases degeneration at higher frequencies and, therefore, helps to extend the high frequency response. The composite video signal is fed to the picture tube cathode thru coupling condenser C-81 (.1).

THE AGC

The negative DC voltage developed across the detector load resistor, R-26 (5600), is the AGC voltage. It will be noted that the low side of this resistor is connected to the arm of the contrast control potentiometer, R-31A. R-30 (47) is shunted across the arm of the contrast control and B-. In weak signal areas, this arrangement results in a delay in the AGC action. For a weak signal, minimum bias is desired on the video amplifier and, therefore, the arm of the contrast control will be closest to the cathode end of the potentiometer. Because R-30 is then shunted across the entire contrast control, most of the plate current will flow thru it and develop a positive voltage of approximately one volt at the arm with respect to B-. Since the low side of the detector load is tied to this positive voltage, no AGC voltage will develop until the signal is strong enough to overcome this positive voltage and, therefore, no AGC bias is applied to the controlled tubes under weak signal conditions. In a strong signal area, however, where the arm of the contrast control approaches the B- end of the control, R-30 is shorted out and full AGC voltage is developed.

THE AUDIO SYSTEM

The audio system employs a driver-limiter, V-8 (6AU6); a ratio detector, V-9 (6AL5); a first audio amplifier, V-10 (6J5) and an audio output tube, V-11 (6V6). Figure 17 is a schematic of the audio system. The driver-limiter is operated at low plate and screen voltages to act as a partial limiter to minimize any amplitude modulation. A conventional ratio detector and audio amplifier are used.

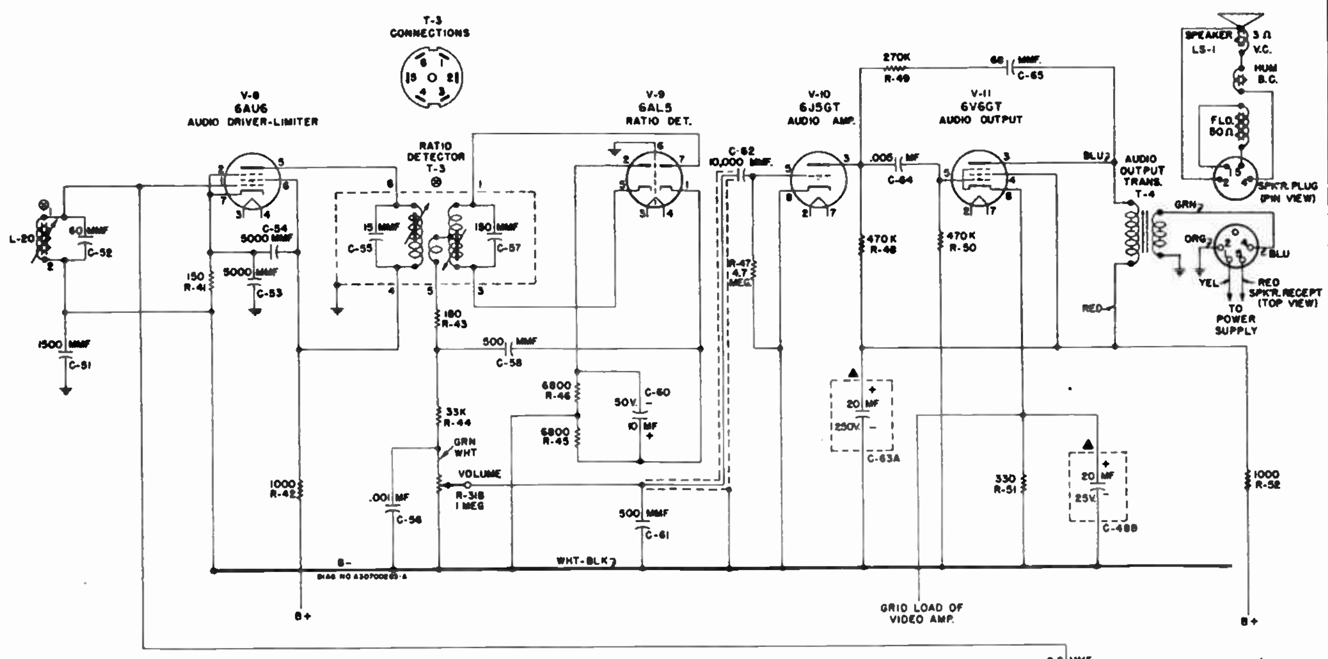

FIGURE 17. SIMPLIFIED SCHEMATIC OF AUDIO SYSTEM

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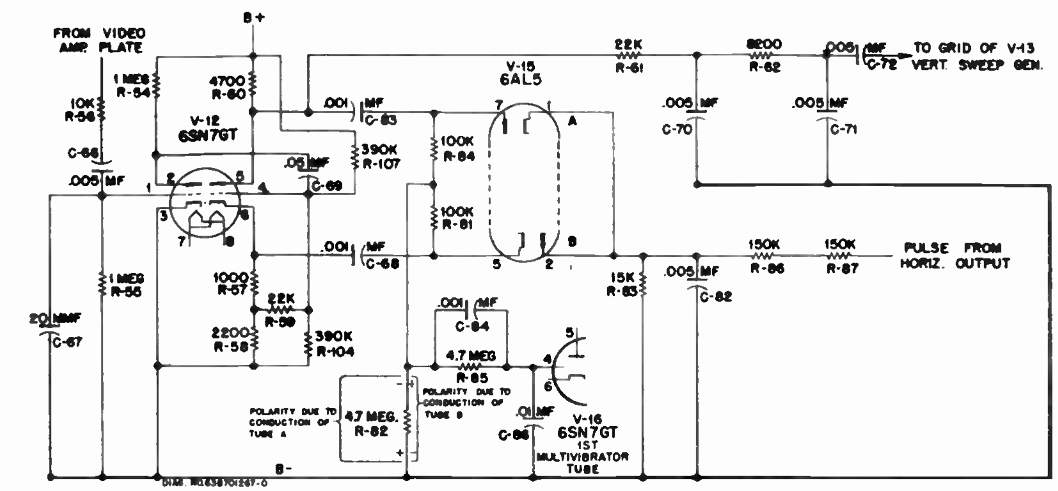


FIGURE 18. SIMPLIFIED SCHEMATIC OF CLIPPERS & PHASE DETECTOR

THE CLIPPER

The clipper uses a 6SN7GT tube. The clipper schematic is shown in Figure 18. The composite video signal with positive going sync is applied thru R-56 (10K) and C-66 (.005) to the grid of the first clipper from the plate circuit of the video amplifier. Under no signal conditions, the tube is unbiased. The positive signal, however, will cause the tube to draw grid current and the voltage drop across R-55 (1 meg), negative at the grid, will charge C-66 to such a value that only the most positive part of the signal, which is the sync pulse, will cause plate current to flow. Therefore, the video information and the blanking pulses are clipped off and only the sync pulses, now negative in polarity, appear in the plate circuit. The second clipper is so biased that the peaks of the sync pulses will drive the tube to cut-off, which results in squared pulses of positive polarity in the plate circuit of this tube. A slight increase in sync pulse amplitude is obtained by a small positive voltage applied to the grid of the second clipper by R-104 (390K).

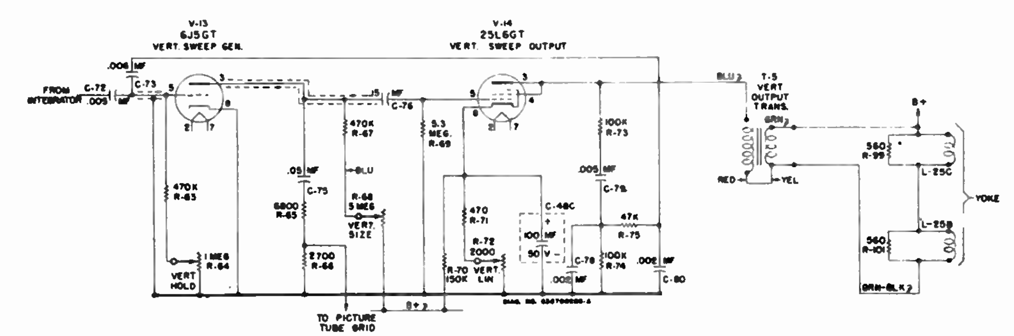
THE VERTICAL SCANNING SYSTEM

Figure 19 is a schematic of the Vertical Scanning System.

The integrating network, shown in Figure 18, composed of R-61, C-70, R-62, and C-71, changes the vertical group of sync pulses into a single pulse of suitable amplitude to trigger the vertical oscillator. The vertical oscillator is an asymmetrical multivibrator using two tubes V-13 (6J5), and V-14 (25L6). V-14 also serves as the output tube.

A multivibrator can be considered as a resistance coupled amplifier in which the output of the second tube is coupled back to the input of the first tube. V-13 is the automatic switch which charges and discharges the sawtooth forming condenser C-75 (.05), connected in its plate circuit. The circuit components of the multivibrator are chosen so that V-13's conductance period is about 7% of the entire cycle, to insure that retrace time of the scan will have the proper relationship with the trace time. This circuit is modified from the conventional resistance coupled multivibrator in that the plate of the output stage, which is also the second multivibrator tube, has a fairly large value of inductance, introduced by the output transformer stepping up the yoke inductance. When the tube is cut off, a positive pulse of several hundred volts is developed across this inductance. A portion of this pulse, obtained by means of the feedback network R-73, R-74, R-75 and C-78, C-79 and C-80, is used to cause the discharge tube V-13 to go into heavy conduction.

For purposes of explaining the circuit action, assume that a time has been reached in the cycle when the trace period is almost completed. During this trace period V-13 is cut off and V-14 is conducting. C-73 has been discharging thru the grid resistors of V-13, R-63 (470K) and R-64 (the vertical hold control) and resistors R-75 and R-74. This discharge circuit makes the grid end of R-63 negative and biases the tube beyond cut-off. When the energy stored in



NOTE - L-24B AND L-24C IN TS-60 ARE L-25B AND L-25C IN TS-88

FIGURE 19. SIMPLIFIED SCHEMATIC OF VERTICAL SCANNING SYSTEM

the condenser has decreased sufficiently, the grid of V-13 reaches the threshold of conductance and the tube begins to draw current. Condenser C-76, which has been charged to nearly the B plus voltage, now starts to discharge thru V-13 and R-69 (3.3 meg) and this discharge current makes the grid end of R-69 negative tending to cut off V-14, and initiates the retrace. With the sudden change of plate current in V-14 developed across the plate inductance, a positive pulse is applied to the grid of V-13 thru the feedback network driving this tube into heavy conduction. C-75 will then discharge thru V-13. The voltage developed at the plate of V-13 will be the combination sawtooth and pulse voltage shown in Figure 22(1). The pulse is formed by the peaking resistors R-65 and R-66. When V-13 goes into conduction, the voltage at the plate of V-13 drops suddenly to a value determined by the relationship of the plate resistance of V-13 to the total resistance in the discharge circuit of C-75, which consists of R-65, R-66 and the plate resistance of V-13. After this initial instant, the charge on C-75 decreases, causing the voltage decrease at the plate shown between points "c" and "d" of Figure 22(1). When the positive pulse on the grid of V-13 has decreased to the value where the negative charge on C-73 becomes operative and cuts off V-13, the voltage on the plate of V-13 and, correspondingly, on the grid of V-14, rises quickly to point "a" on the curve, the start of the trace.

The negative pulse shown between point "b" and "a" of Figure 22(1), acting on the grid of V-14, tends to cut the tube off and raises its plate resistance to the larger value required to dissipate the energy in the plate circuit inductance during the short retrace period.

Since the plate circuit of the vertical output stage V-14 has inductance, and as the time constant of an inductive circuit decreases with an increase of resistance, just the opposite of an RC circuit, the increase in plate resistance of the tube is used to obtain the short time constant circuit required for proper retrace time.

By returning the grid of the picture tube to the junction of the two peaking resistors, R-65 and R-66, a negative pulse of suitable amplitude to cut the picture tube off during retrace is obtained, resulting in elimination of retrace lines on the screen.

The feedback network to the grid of V-13 also serves to filter out horizontal pulses which are present in the plate of V-14 due to coupling in the yoke and which are coupled to the plate thru the output transformer. The windings of the vertical output transformer are connected series opposing, which reduces the step-down ratio and, hence, the inductance in the plate of V-14 in order to shorten the retrace time.

The controls found in this circuit are:

1. The Vertical Hold Control R-64 (1 meg). This control varies the resistance in the discharge circuit of C-73 (.006) and, hence, provides a means of varying the frequency of the multivibrator. In practice, this control is adjusted so that the incoming positive sync pulses, which are of constant amplitude, will fire the tube in exact synchronization with the transmitting station's vertical scan.

2. The Vertical Size Control R-68 (5 meg). This control varies the charging current into C-75 (.05) and, hence, the amplitude of the voltage developed across it. Variation of this voltage varies the drive on the grid of V-14 and controls vertical size.

3. Vertical Linearity R-72 (2000). This control, by bleeder action thru resistor R-70 (150K) and the output tube's plate current, sets the bias and determines the tube's operating point on its plate current curve. Since this curve is not linear, some distortion can be introduced to counteract any non-linearity in the sawtooth grid voltage.

Since all of these controls are also in the multivibrator circuit and have an effect also on its frequency, there will be some interaction between them. Usually, readjustment of size or linearity will require readjustment of the hold control.

HORIZONTAL SCANNING SYSTEM

The horizontal scanning system comprises a phase detector V-15 (6AL5), a cathode coupled multivibrator V-16 (6SN7), the output tube V-17 (6BQ6) and a damping diode V-18 (6W4). Figure 20 is a simplified schematic of this system.

The Horizontal Oscillator

In order to see how the phase detector automatically corrects for multivibrator frequency change, it will be necessary to understand how the correction voltage affects the multivibrator. It will be noted that this circuit differs from the vertical multivibrator in that only one coupling condenser is used but that the two tubes have a common cathode resistor. This arrangement is known as a cathode coupled multivibrator.

The operation is as follows. Assume that the trace period is almost completed. At this time, tube "A" is conducting, tube "B" is cut off. C-87 is discharging thru tube "A", R-92 (150K) and R-91 (the hold control). The discharge current of C-87 is still high enough to keep the grid of tube "B" negative and cut off. Bias is being applied to both tubes by current flow thru R-89 (1000), the common cathode resistor. When the energy stored in C-87 is reduced to the point where its discharge current no longer holds the grid of tube "B" below conductance, tube "B" starts to pass current and this current causes a greater voltage drop across R-89, the common cathode resistor, which increases the bias on tube "A" reducing its plate current. The resulting increase in voltage at the plate of tube "A" begins to charge C-87 and this charging current applies positive voltage to the grid of tube "B". The resulting heavier conduction of tube "B" develops a pulse of voltage across R-89 which cuts tube "A" off and results in a positive pulse at the plate of tube "A" which throws tube "B" into heavy conduction. This allows C-88, the saw-forming condenser, to discharge thru tube "B" and R-93. When C-87 becomes charged, the charging current thru R-92 and R-91 decreases, and the positive voltage on the grid, which has far exceeded the bias developed across R-89, is reduced. This results in reducing the plate current thru tube "B" and, therefore, the bias applied to tube "A" by the voltage drop across R-89. Tube "A" starts to conduct and condenser C-87 starts to discharge, cutting tube "B" off. C-88 begins to charge, starting the next trace.

L-23 and C-85 in the plate circuit of tube "A", form a resonant circuit which is tuned to the horizontal frequency (15,750 cps). The 15,750 cycle sine wave generated by this circuit, if properly phased, will insure that the positive pulse at the plate of tube A", which throws tube "B" into conduction, will be more frequency stable.

C-88 and R-93, the peaking resistor, will produce the same combination pulse and sawtooth voltage shown in Figure 22(1). This action was explained in the vertical circuit.

The Phase Detector

The foregoing explanation is based on the assumption that tube "A's" grid is returned to a fixed potential point.

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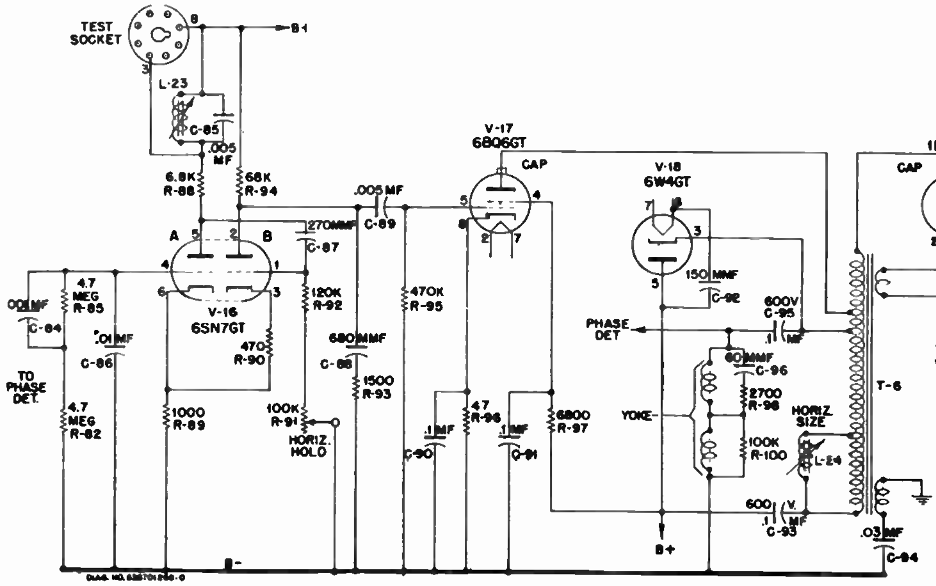

FIGURE 20. SIMPLIFIED SCHEMATIC OF HORIZONTAL SCANNING & HV SYSTEM

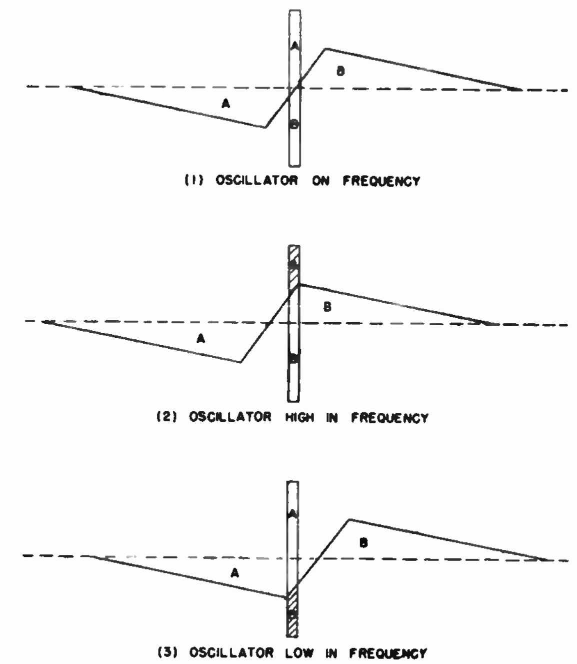

FIGURE 21. WAVEFORMS AT PHASE DETECTOR

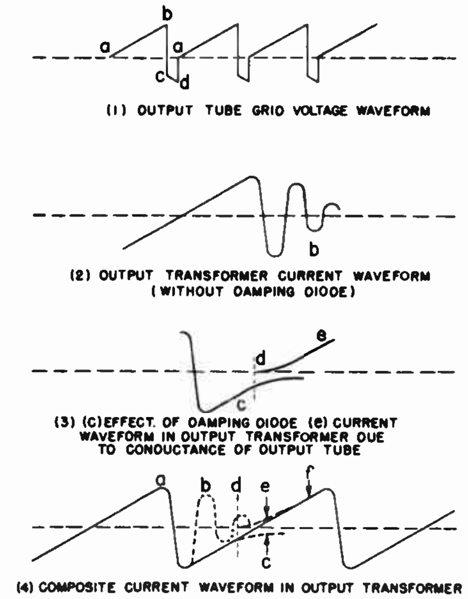

FIGURE 22. WAVEFORMS IN HORIZONTAL SCANNING SYSTEM

It can be seen that if this grid is returned to a point which varies in potential with frequency of the multivibrator, it would be possible to make this variation a means of frequency control. Assume that the grid of "A" in Figure 20 is made more positive. This causes the bias of "B" to increase because of the increased drop across the common cathode resistor R-89. Capacitor C-87 will then discharge for a longer time before "B" conducts, thereby decreasing the frequency of oscillation. If the grid were made more negative, the bias across the common cathode resistor would be less and C-87 would discharge for less time before "B" started to conduct, thereby increasing the frequency.

Figure 18 is a simplified schematic of the clipper and phase detector circuits. The phase detector V-15 (6AL5) is so connected that a comparison of the phase of the incoming sync pulses and a sawtooth derived from the horizontal output system is made. A positive sync pulse from the plate of the 2nd clipper V-12 (6SN7) is fed thru C-83 (.001) to the plate of diode "A" of V-15. A negative sync pulse from the cathode of V-12 is applied thru C-68 (.001) to the cathode of diode "B" of V-15. A sawtooth, derived from the integration of a pulse in the horizontal output circuit, at the yoke by the integrating network, composed of R-86 (150K), R-87 (150K), and C-82 (.005), is applied to the cathode of diode "A" and the plate of diode "B", which are tied together and returned to B- thru R-83 (15K). The load for diodes "A" and "B" consists of resistors R-84 (100K) and R-81 (100K) whose junction returns to the high side of the grid resistor R-82 of the first horizontal multivibrator tube V-16 (6SN7). The voltage applied to the two diodes will be a function of the amplitude of the sawtooth, the amplitude of the sync pulses and the phase relationship between the pulses and the sawtooth.

If the sawtooth, whose phase and frequency are a function of the multivibrator's phase and frequency, is operating in the middle of the lock-in range, the sync pulse will occur in the center of the retrace time. See Figure 21(1). The sync pulses have an amplitude of from 6 to 8 volts while the sawtooth amplitude is about two volts. The RC time constant in the pulse input circuit to the diodes is long enough to maintain an average pulse voltage of 6 to 8 volts for two or three horizontal lines, which means that in the "on" frequency condition shown in Figure 21(1), the diodes conduct only on the pulses and since these are equal in amplitude and develop voltages of opposite polarity across R-82 in the first multivibrator grid circuit, as shown in Figure 18, no control voltage is applied to the grid of V-16.

If the oscillator tends to increase in frequency, with respect to the sync pulses, the phase relationship shown in Figure 21(2) exists at the diodes. The phase of the sawtooth has now shifted so that at the same instant that the pulse is applied to the plate of diode "A" the positive saw is also applied to its cathode, so that only the shaded portion of the pulse causes conduction of diode "A". Diode "B", however, still conducts on the total amplitude of the negative pulse applied to its cathode aided by the positive saw applied to its plate at the same time. Since current flow thru diode "A" makes the grid end of R-82 negative, with respect to B-, the decreased current flow, caused by the sawtooth voltage bucking the pulse voltage at diode "A", results in a more positive voltage across R-82, applying a more positive voltage to the grid of V-16 which, as we have seen, results in decreasing the oscillator's frequency.

If the oscillator tends to decrease in frequency, with respect to the sync pulses, the phase relationship shown in Figure 21(3) exists at the diodes. At the same instant that the negative pulse is applied to the cathode of diode "B", the negative saw is applied to its plate so that only the shaded portion of the pulse causes conduction. Diode "A", however, conducts on the full amplitude of the positive pulse applied to its plate, aided by the negative saw applied to its cathode at the same time. Since current flow thru diode "B" makes the grid end of R-82 positive, with respect to B-, the decreased current thru diode "B" results in applying a more negative voltage to the grid of V-16 which, as we have seen, results in increasing the oscillator frequency. C-84, R-85 and C-86 provide two time constant filters which are necessary to obtain "fly-wheel" action of this AFC sync circuit.

The Horizontal Output System

The combination sawtooth and pulse waveform developed across C-88 (680) and R-93 (1500) by the multivibrator circuit, is fed to the grid of the horizontal output tube V-17 (6BQ6). Figure 20 is a simplified schematic of the horizontal output system. It will be noted that in this system an auto-transformer is used. In the horizontal scan, it is necessary that retrace be completed in about 7 microseconds. In order to accomplish reversal of current in the inductance of the output transformer and the yoke in this short a time, it is necessary to make this circuit resonant at such a frequency that the half cycle time will equal 7 microseconds because only by shock exciting such a circuit into oscillation will retrace be accomplished in the time allowed. This circuit is made resonant by the inductance of the output transformer and yoke, the distributed capacity and the tube capacity. Bearing this in mind, the operation can be explained as follows. Referring to Figure 22(1), assume that the voltage on the grid of the output tube is increasing, point "a". The grid is now being made less negative and the output tube starts to draw current which is supplied from B plus thru the damping diode. When point "b" is reached on the grid voltage waveform, the output tube is suddenly cut off because its grid has been made highly negative (point "c" on the grid voltage waveform). With the tube cut off, the resonant plate load is undamped and the circuit is shocked into oscillation. The reversal of current through the output inductance produces a positive voltage pulse which makes the cathode of the damping diode (V-18) positive, with respect to its plate; therefore, it cannot conduct. C-92 (100) is placed across the diode to provide a low impedance for the oscillatory current. If the damping diode V-18 were not present, this oscillation would continue and current would flow in the output transformer as shown in Figure 22(2). In order to insure a linear trace, however, this oscillation must be stopped and the damping diode serves this purpose. When the current nears its maximum negative value, the polarity and amplitude of the voltage pulse on the damping diode is such that its plate becomes positive, with respect to its cathode, so that the tube conducts heavily and loads the circuit sufficiently to prevent continuation of the oscillation. The current then follows the decay curve shown at "c" in Figure 22(3). At the time ["d" in Figure 22(3)] the voltage at the grid of the output tube has become less than cut off [point "a" in Figure 22(1)], the tube again demands current. The rising current in the tube results in superimposing the waveform "e" of Figure 22(3) on the current flow already in the output transformer due to the decaying current which resulted from the damped oscillation. Combination of these two currents results in the linear trace current indicated at "f" in Figure 22(4), which is a composite waveform of the entire action. During the peak conduction of the damping diode, C-93 (.1) charges and its polarity is such that when the output tube calls for current the charge on the condenser will be in series with the B plus supply so that the voltage at the output tube plate is raised from the 250 volt B plus supply to about 475 volts by this so-called "bootstrap" voltage. When the grid voltage waveform of the output tube again reaches point "b" of Figure 22(1), the tube is cut off and another cycle starts.

In order to properly match the yoke inductance to the required output inductance for the tube, the yoke is connected to a tap on the winding which effectively makes an auto-transformer of this section. The positive pulse of voltage at this tap is coupled to the yoke thru C-95 (.1) and results in a sawtooth of current thru the yoke. It will be remembered that a portion of this pulse is also fed to the phase detector for the AFC action thru R-86 and R-87.

The small additional winding, one terminal of which is connected to chassis while the other terminal is connected to B- thru C-94 (.03) is used to cancel the pulse of voltage which is placed on the chassis by induction from the output transformer. By connecting this winding in such a way as to place a pulse of suitable amplitude on the chassis 180° out of phase with the induced voltage, cancellation of the induced voltage will take place.

High Voltage

To take advantage of the large voltage pulse developed across the output inductance by the heavy current flow caused by the retrace oscillation, the plate winding is made the primary of an auto-transformer whose step-up ratio is such as to develop pulses of about 14 kv at its high end. These pulses are rectified by V-19 (1B3) and the resulting DC is applied to the second anode of the picture tube. The filament voltage for the 1B3 rectifier is obtained from an additional winding on the output transformer.

Controls

L-23 is the coil of the sine wave generating circuit in the horizontal multivibrator circuit and should be tuned to 15,750 cycles as explained in the service instructions.

R-91 is the horizontal hold control which can be adjusted for correct frequency operation of the multivibrator.

L-24, paralleling a small portion of the output choke controls, to a small degree, the inductance of the choke and acts as a size control.

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REPLACEMENT PARTS LIST

NOTE: When ordering parts, specify model number of set in addition to part number and description of part.

CHASSIS TS-88 ELECTRICAL PARTS

Capacitors

Ref. No.	Part Number	Description
C-1	21K77375	Ceramic, tubular: 220 mmf 500V
C-2	21K77375	Ceramic, tubular: 220 mmf 500V
C-3	-	See Tuning Units Parts List
C-4	21K77375	Ceramic, tubular: 220 mmf 500V
C-5	21K482726	Ceramic disc: 10,000 mmf 450V
C-6	1X790189	Ceramic trimmer: .5-3 mmf; complete with screw and mounting nut
C-7	21A470790	Ceramic disc: 1500 mmf 500V
C-8	21A470790	Ceramic disc: 1500 mmf 500V
C-9	21K482726	Ceramic disc: 10,000 mmf 450V
C-10	-	See Tuning Units Parts List
C-11		Fine Tuning Trimmer: part of station selector switch
C-12	1X790189	Ceramic trimmer: .5-3 mmf; complete with screw and mounting nut.
C-13	21K478234	Molded: 8 mmf 500V
C-14	1X792784	Ceramic trimmer: 3-13 mmf; complete with screw and mounting nut.
C-15	21K478280	Molded: 2 mmf 500V (temperature compensating)
C-16	-	See Tuning Units Parts List
C-17	21A470790	Ceramic disc: 1500 mmf 500V
C-18	21A470789	Ceramic disc: 5000 mmf 450V
C-19	21K478280	Molded: 2 mmf 500V (temperature compensating)
C-20	21A470789	Ceramic disc: 5000 mmf 450V
	21A470790	Ceramic disc: 1500 mmf 500V (suggested replacement value)
C-21	21A470790	Ceramic disc: 1500 mmf 500V
C-22	21A470790	Ceramic disc: 1500 mmf 500V
C-23	8R9810	Paper: .25 mf 100V
C-24	21A470789	Ceramic disc: 5000 mmf 450V
C-25	21A470789	Ceramic disc: 5000 mmf 450V
C-26	21A470789	Ceramic disc: 5000 mmf 450V
C-27	21K77375	Ceramic, tubular: 220 mmf 500V
C-28	21K470329	Molded: 30 mmf 500V (temperature compensating)
C-29	-	See Tuning Units Parts List
C-30	21K482726	Ceramic disc: 10,000 mmf 450V
C-31	21A470789	Ceramic disc: 5000 mmf 450V
C-32	21A470789	Ceramic disc: 5000 mmf 450V
C-33	21A470790	Ceramic disc: 1500 mmf 500V
C-34	21K470322	Molded: 20 mmf 500V
C-35	21A470790	Ceramic disc: 1500 mmf 500V
C-36	21K470329	Molded: 30 mmf 500V (temperature compensating)
C-37	21A470789	Ceramic disc: 5000 mmf 450V
C-39	21A470789	Ceramic disc: 5000 mmf 450V
C-40	21A470789	Ceramic disc: 5000 mmf 450V
C-41	21A470789	Ceramic disc: 5000 mmf 450V (in T-2 shield can)
C-42	21K470324	Molded: 6 mmf 500V
C-43	8R9854	Paper: .1 mf 200V
C-44	21A470790	Ceramic disc: 1500 mmf 500V
C-45	21K780599	Ceramic, tubular: 1000 mmf 500V
C-46	21K780599	Ceramic, tubular: 1000 mmf 500V
C-47	21B77286	Ceramic, tubular: 100 mmf 500V
C-48A, B,C&D	23B791741	Electrolytic: 4-section; A-20 mf/250V; B-20 mf/25V; C-100 mf/50V; D-200 mf/300V
C-49	21A478274	Molded: 2.2 mmf 500V
C-50	21K470329	Molded: 30 mmf 500V
C-51	21A470790	Ceramic disc: 1500 mmf 500V
C-52	21K790683	Molded: 60 mmf 500V
C-53	21A470789	Ceramic disc: 5000 mmf 450V
C-54	21A470789	Ceramic disc: 5000 mmf 450V
C-55	21K790439	Silver mica: 15 mmf (part of T-3 base)
C-56	8R9866	Paper: .001 mf 600V
C-57	21A790131	Ceramic, tubular: 150 mmf (in T-3 shield can)
C-58	21R6590	Mica: 500 mmf 500V
C-60	23A90205	Electrolytic: 10 mf 50V
C-61	21R6590	Mica: 500 mmf 500V
C-62	21K482726	Ceramic disc: 10,000 mmf 450V
C-63A, B & C	23B791721	Electrolytic: 3-section; A-20 mf/250V; B-60 mf/250V; C-200 mf/300V
C-64	8R9869	Paper: .005 mf 600V
C-65	21R6650	Mica: 68 mmf 500V
C-66	8R9869	Paper: .005 mf 600V
C-67	21K470322	Molded: 20 mmf 500V
C-68	8R9866	Paper: .001 mf 600V
C-69	8R9873	Paper: .05 mf 600V
C-70	8R9869	Paper: .005 mf 600V
C-71	8R9869	Paper: .005 mf 600V
C-72	8R9869	Paper: .005 mf 600V
C-73	8R790026	Paper: .006 mf 600V
C-74	21A470790	Ceramic disc: 1500 mmf 500V
C-75	8R9873	Paper: .05 mf 600V
C-76	8R9875	Paper: .15 mf 600V
C-78	8R9867	Paper: .002 mf 600V
C-79	8R9869	Paper: .005 mf 600V
C-80	8R9867	Paper: .002 mf 600V
C-81	8R9874	Paper: .1 mf 600V
C-82	8R9869	Paper: .005 mf 600V
C-83	8R9866	Paper: .001 mf 600V
C-84	8R9866	Paper: .001 mf 600V
C-85	8R9869	Paper: .005 mf 600V
C-86	8R9870	Paper: .01 mf 600V
C-87	21K400037	Ceramic, tubular: 270 mmf 500V
C-88	21R2741	Mica: 680 mmf 500V
C-89	8R9869	Paper: .005 mf 600V
C-90	8R9854	Paper: .1 mf 200V
C-91	8R9874	Paper: .1 mf 600V
C-92	21K792438	Ceramic, tubular: 100 mmf 3000V.
	21K700620	Ceramic, tubular: 150 mmf 3000V (suggested replacement value)
C-93	8R9874	Paper: .1 mf 600V
C-94	8R9872	Paper: .03 mf 600V
C-95	8R9874	Paper: .1 mf 600V
C-96	21K790574	Ceramic, tubular: 60 mmf 1500V (in deflection yoke)
C-97	21A470790	Ceramic disc: 1500 mmf 500V
C-98	21A470790	Ceramic disc: 1500 mmf 500V
C-99	21A470790	Ceramic disc: 1500 mmf 500V
C-100	21A470790	Ceramic disc: 1500 mmf 500V
C-101	21A470790	Ceramic disc: 1500 mmf 500V
C-102	21A470790	Ceramic disc: 1500 mmf 500V
C-103	21A470790	Ceramic disc: 1500 mmf 500V
C-104	21K77375	Ceramic, tubular: 220 mmf 500V
C-105	21K77375	Ceramic, tubular: 220 mmf 500V
C-106	21B482295	Ceramic, tubular: 250 mmf 500V
C-107	21B482295	Ceramic, tubular: 250 mmf 500V
C-108	21A470790	Ceramic disc: 1500 mmf 500V
C-109	23B791692	Electrolytic: 1-section; 300 mf/150V
C-110	21A470789	Ceramic disc: 5000 mmf 450V

Rectifiers

Ref. No.	Part Number	Description
E-1 & E-2	48B700074 or 48B791694 or 48B700139	Selenium Rectifier

Coils

Ref. No.	Part Number	Description
L-1	24A790033	Antenna Impedance Matching Coil
L-2	-	See Tuning Unit Parts List
L-3	-	See Tuning Unit Parts List
L-4	-	See Tuning Unit Parts List
L-4M	-	See Tuning Unit Parts List
L-5	24K791446	RF Choke: molded; 10 microhenries
L-6	24K792825	RF Coil: channel 13
L-7	-	See Tuning Unit Parts List
L-8	24K792577	RF Choke: molded; 3.3 microhenries
L-9	24K780128	RF Choke: molded; 2.2 microhenries
L-10	24K790035	RF Choke: molded; 5.6 microhenries.
L-11	24B792586	1st IF: with trap coil L-12, cores, & mtg nuts
L-12		Trap: part of L-11
L-13	24K790035	RF Choke: molded; 5.6 microhenries.
L-14		Trap: part of L-15
L-15	24K792587	2nd IF: with trap coil L-14, cores, & mtg nuts
L-16	24K792771	RF Choke: yellow dot
L-17	24A790579	Compensating coil: red dot (wound on R-40)
L-18	24B792735	4.5 Mc Trap: less core & mtg nut
L-19	24A792588	Compensating coil: green-blk dot (wound on R-38)
L-20	24A470159	Sound Take-off: less core & mtg nut
L-21	24K790145	RF Choke: molded; 0.47 microhenries
L-22	24B700514	Focus coil
L-23	24K790059	Horizontal Oscillator: less core and clip
L-24	24K700089	Horizontal Size: less core and clip
L-25	24K700776 or 24K792173 or 24K700778 or 24C792506 or 24K700694 or 24K792508 or 24K700714 or 24C700050 or 24K700774 or 24C792171	Deflection Yoke: complete
L-26	24K790145	RF Choke: molded; 0.47 microhenries
L-27	24K790145	RF Choke: molded; 0.47 microhenries
L-28	24K790145	RF Choke: molded; 0.47 microhenries
L-29	24K792772	RF Choke: red dot
L-33	-	See Tuning Unit Parts List

Speakers

Ref. No.	Part Number	Description
LS-1	50K700636 or 50K700669 or 50K701616	Speaker: 6" electrodynamic; 3.2 ohm voice coil; 50 ohm field(14T1) Exch
	50C791913	Speaker: 8" electrodynamic; 3.2 ohm voice coil, 50 ohm field(14K1)

Resistors

Note: All resistors are insulated carbon type unless otherwise specified.

Ref. No.	Part Number	Description
R-1	6R6397	22,000 10% 1/2W
R-2	6R2036	33 10% 1/2W
R-3	6R5614	56 10% 1/2W
R-4	6R6229	1000 10% 1/2W
R-5	6R5659	3900 10% 1/2W
R-6	6R6117	5600 10% 1/2W
R-7	6R6393	1200 10% 1/2W
R-8	6R6320	10,000 10% 1/2W
R-9	6R6428	6800 10% 1/2W
R-10	6R6229	1000 10% 1/2W
R-11	6R5550	47 10% 1/2W
R-12	6R2036	33 10% 1/2W
R-13	6R6270	220 10% 1/2W
R-14	6R6270	220 10% 1/2W
R-15	6R6229	1000 10% 1/2W
R-16	6R6394	12,000 10% 1/2W
R-17	6R5550	47 10% 1/2W
R-18	6R2036	33 10% 1/2W
R-19	6R6270	220 10% 1/2W
R-20	6R6270	220 10% 1/2W
R-21	6R6428	6800 10% 1/2W
R-22	6R2035	82 10% 1/2W
R-23	6R6270	220 10% 1/2W
R-24	6R6270	220 10% 1/2W
R-25	6R6117	5600 10% 1/2W
R-26	6R6031	100,000 10% 1/2W
R-27	6R6031	100,000 10% 1/2W
R-28	6R6460	1.5 meg 10% 1/2W
R-29	6R6004	1 meg 20% 1/2W
R-30	6R5550	47 10% 1/2W
R-31 A & B	18A792009	Contrast & Volume Control: dual; 2000 tapped & 1 meg respectively; includes power switch
R-33	6R5551	120 10% 1/2W
R-34	6R5551	120 10% 1/2W
R-35	6R6038	1500 10% 1/2W
R-36	6R6400	33,000 10% 1W
R-37	6R5671	4700 10% 2W
R-38		2700 (not replaceable-part of L-19)
R-39	17K792705	Wirewound: 2000 10% 10W
R-40		18,000 (not replaceable-part of L-17)
R-41	6R6373	150 10% 1/2W
R-42	6R6229	1000 10% 1/2W
R-43	6R5660	180 10% 1/2W
R-44	6R6410	33,000 10% 1/2W
R-45	6R6428	6800 10% 1/2W
R-46	6R6428	6800 10% 1/2W
R-47	6R6446	4.7 meg 10% 1/2W
R-48	6R6377	470,000 10% 1/2W
R-49	6R6414	270,000 10% 1/2W
R-50	6R6377	470,000 10% 1/2W
R-51	6R6022	330 10% 1/2W
R-52	6R3922	1000 10% 2W
R-53	6R6229	1000 10% 1/2W
R-54	6R6004	1 meg 20% 1/2W
R-55	6R6004	1 meg 20% 1/2W
R-56	6R6320	10,000 10% 1/2W
R-57	6R6229	1000 10% 1/2W
R-58	6R6069	2200 10% 1/2W
R-59	6R6397	22,000 10% 1/2W
R-60	6R6080	4700 10% 1/2W
R-61	6R6397	22,000 10% 1/2W
R-62	6R2004	8200 10% 1/2W
R-63	6R6377	470,000 10% 1/2W
R-64	18A90147	Vertical hold control: 1 meg
R-65	6R6428	6800 10% 1/2W
R-66	6R5577	2700 10% 1/2W
R-67	6R6377	470,000 10% 1/2W
R-68	18A90145	Vertical size control: 5 meg
R-69	6R6497	3.3 meg 10% 1/2W
R-70	6R6398	150,000 10% 1/2W
R-71	6R6090	470 10% 1/2W
R-72	18A790146	Vertical linearity control: 2000
R-73	6R6031	100,000 10% 1/2W
R-74	6R6031	100,000 10% 1/2W
R-75	6R6048	47,000 10% 1/2W
R-76	6R6004	1 meg 20% 1/2W
R-77	18A90147	Brightness control: 1 meg
R-78	18A790162	Focus control: 2000
R-79	17K792705	Wirewound: 2000 10% 10W
R-80	6R6048	47,000 10% 1/2W
R-81	6R6031	100,000 10% 1/2W
R-82	6R6446	4.7 meg 10% 1/2W
R-83	6R6477	15,000 10% 1/2W
R-84	6R6031	100,000 10% 1/2W
R-85	6R6446	4.7 meg 10% 1/2W
R-86	6R5721	150,000 10% 1W
R-87	6R5721	150,000 10% 1W
R-88	6R6428	6800 10% 1/2W
R-89	6R6229	1000 10% 1/2W
R-90	6R6090	470 10% 1/2W
R-91	18A791574	Horizontal hold control: 100,000
R-92	6R6398	150,000 10% 1/2W
	6R5631	120,000 10% 1/2W
R-93	6R6038	1500 10% 1/2W
R-94	6R6074	68,000 10% 1/2W
R-95	6R6377	470,000 10% 1/2W
R-96	6R5583	47 10% 1W
R-97	6R5690	6800 10% 2W
R-98	6R5577	2700 10% 1/2W (in deflection yoke)
R-99	6R6291	560 10% 1/2W (in deflection yoke)
R-100	6R6328	100,000 10% 1W (in deflection yoke)
R-101	6R6291	560 10% 1/2W (in deflection yoke)
R-102	6R6377	470,000 10% 1/2W
R-103	17A791696	Wire wound: special 5 10% 5W
R-104	6R5646	390,000 10% 1/2W
R-105	6R6048	47,000 10% 1/2W
R-106	-	See Tuning Unit Parts List

Transformers

Ref. No.	Part Number	Description
T-1	24K792578	Mixer IF: less cores & mtg nuts
T-2	24B792585	3rd IF: less core, clip, & colored leads
T-3	24B790125	Ratio Detector: includes cores & clips; less shield can
T-4	25B790686	Audio output
T-5	25B792168	Vertical output
T-6	24K700588	High voltage transformer: complete.
T-7	25B700137 or 25B791793	Filament transformer
T-8	25B790140	Filament isolating transformer (for V-18)

Tubes

Ref. No.	Part Number	Description
V-1	6CB6	RF Amplifier
V-2	12AT7	Mixer-Oscillator
V-3	6AU6	1st IF Amplifier
V-4	6AU6	2nd IF Amplifier
V-5	6AG5	3rd IF Amplifier
V-6	6AL5	Video Detector
V-7	6AH6	Video Amplifier
V-8	6AU6	Audio Driver-Limiter
V-9	6AL5	Ratio Detector
V-10	6J5GT	Audio Amplifier
V-11	6V6GT	Audio Output
V-12	6SN7GT	1st & 2nd Clippers
V-13	6J5GT	Vertical Sweep Generator
V-14	25L6GT	Vertical Sweep Generator
V-15	6AL5	Phase Detector
V-16	6SN7GT	Horizontal Oscillator
V-17	6BQ6GT	Horizontal Output & HV Generator
V-18	6W4GT	Damping Diode
V-19	1B3GT	High Voltage Rectifier
V-20	14BP4 or 14CP4	Picture Tube: 14" rectangular

TUNING UNIT - TT-13

Ref. No.	Part Number	Description
	1X700100	TT-13 Tuning Unit: complete with station selector switch, fine tuning trimmer, and the following components:
C-3	21K478234	Capacitor, molded: 8 mmf 500V
C-10	21K482726	Capacitor, ceramic disc: 10,000 mmf 450V
C-16	21K400173	Capacitor, molded: 10 mmf 500V (temperature compensating)
C-29	21K482726	Capacitor, ceramic disc: 10,000 mmf 450V
L-2	24C792764	Coil, antenna: channels 2 thru 6; includes L-2A thru L-2E (L-2F thru L-2L are part of switch)
L-3	24K790536	Coil, RF: channels 2 thru 6; includes L-3A thru L-3E (L-3F thru L-3L are part of switch)
L-4	24C700114	Coil, oscillator: channels 2 thru 6; includes L-4A thru L-4E (L-4F thru L-4L are part of switch)
L-4M	24K700115	Coil, oscillator: channel 10
L-7	24K700116	Coil, oscillator: channel 13
L-33	24K792765	Coil, antenna primary: low frequency (includes L-33A, L-33B & L-33C)
R-106	6R6069	Resistor: 2200 10% 1/2W
	42K790136	Clip, spring (on collar)
	43K700725	Collar, spring (on end of fine tuning shaft)
	47K700726	Shaft, fine tuning

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CHASSIS PARTS - MECHANICAL

Part No.	Description
7K700153	Bracket, coil mtg (Horizontal size) .....
7A700196	Bracket, focus coil mtg (straight bracket across top of focus coil) ....
7B700194	Bracket, focus coil mtg (forked bracket housing focus coil) ....
7A791965	Bracket, interlock safety (on chassis rear)
7B700515	Bracket, mask mounting ....
1X700504	Bracket, picture tube rear support: with grounding spring & anode lead insulator (large rear support bracket) ....
7A792568	Bracket, yoke adjustment (adjustable bracket housing yoke) ....
35K700532	Bumper, rubber (between picture tube & rear support bracket) ....
35A700603	Bumper, rubber (used only on 24C792171 deflection coil) ....
38B792486	Button, plug (for hole next to focus control) ....
42K471342	Cap, plate (for high voltage rectifier).
42A701441	Cap, plate (for 6BQ6) ....
42A700147	Clamp, lead retainer (on high volt rect filament leads) ....
42B70721	Clip, coil mtg (T-3 secondary) .....
42A76244	Clip, coil retainer (L-23) ....
42A72609	Clip, grounding (V-10 tube shield grounding) ....
42K792034	Connector, 2nd anode: complete with lead
39K17396	Contact, pin terminal (on spkr leads)
46A478242	Core, brass, & screw (T-2) ....
46K791756	Core, brass, & screw (L-11 & L-15)......
46A470310	Core, iron, & screw (T-1 primary, L-18 & L-20) ....
46K480256	Core, iron, & screw (T-1 secondary, L-12)
46A70023	Core, iron, & screw (T-3 primary & L-14)
46A470302	Core, iron, & screw (T-3 secondary).....
46K471143	Core, iron, & screw (L-23) ....
46A700090	Core, iron: with slide adjustment (L-24)
15B791111	Cover, test socket ....
35K792757	Cushion, focus coil: rubber (around tube neck) ....
5K470916	Grommet, insulating: 3/16" hole .....
5K792031	Grommet, insulating: 9/32" hole (for 2nd anode lead) ....
5A790684	Grommet, rubber (V-14 & V-16 socket mtg) ....
14A791787	Insulator, anode lead: armite (dresses 2nd anode lead from chassis) ....
14A780184	Insulator, antenna lead (under antenna lead terminal strip) ....
14K87179	Insulator, coil (in ratio detector can) ....
9K471267	Insulator, electrolytic mtg: 4-lug; impregnated ....
14K791892	Insulator, shield (in T-2 can) ......
4S7666	Lockwasher, external: #6; cad pl (R-103 receptacle mtg).................
4S7657	Lockwasher, external: #8; cad pl (48B791694 selenium rect mtg) ...
4S7655	Lockwasher, internal: 3/8; cad pl (contrast & station selector switch mtg) ....
4S2640	Lockwasher, internal: 1/2"; thin; cad pl (mounts lower focus coil mtg bracket) ....
4S7650	Lockwasher, internal: #6; cad pl (48B700074 & 48B700139 selenium rect mtg) ....
4S7688	Lockwasher, int-ext: 1/4"; cad pl (on eccentric screw) ....
4S9751	Lockwasher, int-ext: #8; cad pl (yoke adj bracket mtg) ....
29R5239	Lug, soldering: #8 HT ....
2A470049	Nut, coil & core mtg (T-1, T-2, L-11, L-12, L-14, L-15, L-18 & L-20) ......
2K791404	Nut, coil & core mtg (L-24) ....
4S7022	Nut, hex: 1/4-20 x 7/16; cad pl (on eccentric screw) ....
2S7004	Nut, hex: 3/8-32 x 9/16; cad pl (contrast & station selector switch mtg) ......
2S7005	Nut, hex: 6-32 x 1/4 stl; cad pl (48B700074 & 48B700139 selenium rect mtg) ....
2S7003	Nut, hex: 8-32 x 5/16 stl; cad pl (48B791694 selenium rectifier mtg)
2S7050	Nut, hex: palnut; 6-32 (T-2 shield mtg) ....
2S7051	Nut, hex: palnut; 3/8-32 x 9/16; cad pl (rear control mtg) ....
2A790191	Nut, special: cad pl (mounts three ceramic trimmers) ....
2S70703	Nut, palnut: special; (T-3 primary)..
35K792182	Pad, cushion: sponge rubber (long pad at bottom of picture tube) ....
35K700166	Pad, cushion: sponge rubber (pad on top of picture tube) ....
64K791818	Plate, chassis cover: cop pl (removable plate on chassis side) ....
64A700185	Plate, cover
64K792464	Plate, socket cover (covers unused socket hole next to 6BQ6) ....
28K471323	Plug, line cord: 2-pin; waxe' (power plug on chassis rear) ....
9A22367	Receptacle: 5-prong (speaker receptacle).
5S8497	Rivet: .088 x 1/8 stl; pol nkl (V-1, V-2, & V-5 socket mtg) ....
5S7770	Rivet: .088 x 5/32 stl; pol nkl (mounts ant terminal strip & insulator)...
5S2815	Rivet: .088 x 7/32 stl; pol nkl (9K780442 & 9K484167 socket mtg) ....
5S7707	Rivet: .122 x 5/32 stl; pol nkl (9K471270 socket & terminal strip mtg) .....
5S7701	Rivet: .122 x 3/16 stl; pol nkl (R-103 receptacle mtg) ....
5S7703	Rivet: .122 x 7/32 stl; pol nkl (electrolytic insulator mtg) ....
5S7700	Rivet: .122 x 1/4 stl; pol nkl (power plug mtg) ....
5S7728	Rivet: .122 x 5/16 stl; pol nkl (V-19 socket mtg) ....
5S6846	Rivet: .145 x 5/32 stl; pol nkl (cover plate mtg) ....
5S6842	Rivet: .145 x 7/32 stl; pol nkl (audio & vertical output transformer mtg) .
5K71246	Rivet: shoulder; nkl pl (V-14 & V-16 socket mtg) ....
3A700198	Screw, eccentric: cad pl (lower focus coil mtg bracket) ....
3S490354	Screw, machine: 6-32 x 5/8 slotted hex head; cad pl (adjustment screw for C-6 & C-12 trimmers) ....
3S490822	Screw, machine: 6-32 x 1; slotted hex head; cad pl (adjustment screw for C-14 trimmer) ....
3S490459	Screw, machine: 6-32 x 1-1/8 slotted round head; brass (secures HV transformer plates) ....
3S488195	Screw, machine: 6-32 x 2 plain hex head; cad pl (48B700074 selenium rectifier mtg) ....
3S400051	Screw, machine: 6-32 x 2-1/2 plain hex head; cad pl (48B700139 selenium rectifier mtg) ....
3S7163	Screw, machine: 8-32 x 1/4 plain hex head; cad pl (mounts bracket for V-19 mtg plate) ....
3S490642	Screw, machine: 10-32 x 1-1/2 plain hex head; cad pl (mounts top picture tube retainer strap) ....
3S7454	Screw, sheet metal: #8 x 1/4 PKZ plain hex head; cad pl (T-7 transformer mtg) ....
3S7467	Screw, sheet metal: #8 x 3/8 PKZ plain hex head; cad pl (T-8 transformer mtg) ....
3A470369	Screw, thumb: cad pl (deflection yoke adj) ....
26K485936	Shield, coil (ratio detector) ....
1X792785	Shield, coil: with spade bolts (T-2 can).
26A26283	Shield, tube (for glass 6J5 audio amp)..
26A90301	Shield, tube; miniature (V-5) ....
26A790508	Shield, video: cad pl (shields video amp from HV transformer) ....
9A792167	Socket, tube: miniature; 7-prong (V-1)...
9K780442	Socket, tube: miniature; 7-prong (V-3, V-4 & V-6) ....
9K484167	Socket, tube: miniature; 7-prong (V-7, V-8, V-9 & V-15) ....
9A471343	Socket, tube: miniature; tan molded (V-5)
9K484816	Socket, tube: noval; molded (V-2) ....
9K471270	Socket, tube: octal (all octal sockets except V-14, V-16 & V-19) ....
9A790685	Socket, tube: octal (V-14 & V-16) ....
9A480274	Socket, tube: octal; molded (V-19) ......
9K700510 or	Socket, picture tube: 5-pin; with leads..
9K700512	Socket, picture tube: 12 pin; with leads.
41A70705	Spring, coil (ratio detector) ....
41A700143	Spring, compression (horizontal size)
41A700563	Spring, grounding: cad pl (grounds picture tube outer coating) ....
41A471379	Spring, tension (picture tube support)...
1X700520	Strap, tube mtg: with pads (lower strap around picture tube front) ....
1X700521	Strap, tube retainer: with pad (upper strap around picture tube front) ....
31A700082	Strip, contact (plug in resistor receptacle) ....
31A700077	Strip, terminal: 2-pin (mounts plug-in resistor) ....
31A21990	Strip, terminal: 2-screw (antenna terminal)
31K76184	Strip, terminal: 2 ins, #1 gnd; 3/8" spacing ....
31A700148	Strip, terminal: 2 ins, #2 mtg; 3/8" spacing ....
31K471564	Strip, terminal: 3 ins, #2 gnd; 3/8" spacing ....
31K51511	Strip, terminal: 3 ins, #3 gnd; 3/8" spacing ....
31K471565	Strip, terminal: 3 ins, #4 gnd; 3/8" spacing ....
31K37494	Strip, terminal: 4 ins, #3 gnd; 3/8" spacing ....
31A790122	Strip, terminal: 4 ins, #3 gnd; 1/2" spacing ....
31K22174	Strip, terminal: 4 ins, #4 mtg; 3/8" spacing..............................
31A780089	Strip, terminal: 4 ins, #5 gnd; 3/8" spacing ....
31K26658	Strip, terminal: 5 ins, #3 gnd; 3/8" spacing ....
31K90046	Strip, terminal: 5 ins, #4 gnd; 3/8" spacing ....
31A791402	Strip, terminal: 6 ins, #4 gnd; 3/8" spacing ....
31A791613	Strip, terminal: special (on HV trans)...
24K700587 or	Trap, Ion: PM; with collar ....
24K700586	Trap, Ion: PM; with collar ....
24K700585	Trap, Ion: PM; with collar ....
1X791850	Tube mtg plate: with mtg bracket & socket (high voltage rectifier mtg) ....
4A77577	Washer, insulating (horizontal size coil mtg) ....
4A791447	Washer, insulating (T-8 transformer mtg) ....
4K470939	Washer, insulating: 3/8 x .136 x .062; armite (electrolytic insulator mtg)
4S1767	Washer, flat: 5/16 x .130 x .025; pol nkl (grounding spring mtg)........
4S7569	Washer, flat: 5/16 x .145 x .027; cad pl (V-14 & V-16 socket mtg) ......
4S490366	Washer, flat: 3/8 x .156 x .125 stl; cad pl (48B700074 & 48B700139 selenium rectifier mtg) ....
4S1706	Washer, flat: 3/8 x .203 x .033 stl; cad pl (mounts top picture tube retainer strap) ....
4S7631	Washer, flat: 1 x 3/16 x .042; cad pl (cover plate mtg) ....

INSULATING COMPOUNDS

Part No.	Description
11M490423	Coating, hi-voltage insulating: red-brn (on hi-volt rectifier socket)...........
11M490387	Wax, bivax (on HV transformer) ....

MODEL 14K1 CABINET PARTS

Part No.	Description
1X700722	Back Cover: with picture tube rear cover, centering adjustment cover, and line cord ....
13C700627	Base, metallic: brs pl (between cabinet legs) ....
13D700086	Bezel, picture tube (window frame) ......
1X792494	Bracket, window mtg: with pad ....
16F700629	Cabinet, console: red-brn mahogany; less window & bezel ....
42A792502	Clip, mask retainer: HT ....
13K700631	Cloth, grille: mahogany; 19-1/2 x 11-15/16
30B470756	Cord, line: with plug & receptacle.......
15K792068	Cover, centering adjustment: rubber (on back cover) ....
1X792546	Cover, chassis bottom: with hi-volt insulator ....
15K700596	Cover, picture tube rear (on back cover).
5S3139	Eyelet: .202 x .475 brs; ant cop (on back cover) ....
14B792069	Insulator, high voltage (on bottom cover)
14K700567	Insulator, picture tube: disc (in picture tube rear cover) ....
14K700566	Insulator, picture tube: rectangular (in picture tube rear cover) ....
36B790505	Knob, control (contrast) ....
36B790506	Knob, control (station selector) ....
36K780522	Knob, control: ivory (hold controls on chassis rear) ....
36C790507	Knob, control: val-mahog (fine tuning & off-volume) ....
4S7657	Lockwasher, external: #8; cad pl (spkr mtg) ....
4S7650	Lockwasher, internal: #6; cad pl (hi-volt insulator mtg) ....
62K70581	Logotype: "Motorola"; gold enamel .....
1X700594	Mask, picture tube: with retainer clips
13A700601	Medallion: brs pl ("M" on grille cloth)
2S7007	Nut, hex: 8-32 x 1/4 stl; cad pl (spkr mtg) ....
2S7003	Nut, hex: 8-32 x 5/16 stl; cad pl (spkr mtg) ....
35K700168	Pad, cushion (window mtg) ....
35K792501	Pad, cushion (on window mtg brkt)....
5K791856	Rivet, shoulder: annealed (line cord mtg) ....
5S7706	Rivet: .122 x 1/8 stl; pol nkl (hi-volt insulator mtg) ....
5S1683	Rivet: .122 x 3/16 brs; pol nkl (mask clip mtg) ....
5S7751	Rivet: .122 x 1/4 stl; ant cop (picture tube rear cover mtg) ....
3S7374	Screw, machine: 8-32 x 5/16 plain hex head; cad pl (bezel mtg) ....
3K653	Screw, machine: 8-32 x 1-1/4; cop oxide (spkr mtg) ....
3S7536	Screw, sheet metal: #6 x 3/8 PKA slotted acorn head; ant cop (window & back cover mtg) ....
3S7509	Screw, sheet metal: #6 x 5/8 PKA slotted acorn head; ant cop (back cover mtg).
3S490819	Screw, sheet metal: #6 x 7/8 PKA slotted acorn head; ant cop (back cover mtg).
3S7467	Screw, sheet metal: #8 x 3/8 PKZ plain hex head; cad pl (mask mtg) ....
3S8153	Screw, sheet metal: #8 x 3/4 PKZ plain hex head; cad pl (bottom cover mtg)..
3S8104	Screw, sheet metal: #8 x 1-1/2 PKA plain hex head; cad pl (chassis mtg) ......
56K700009	Strap, antenna support (supports lower loop antenna) ....
35A791581	Strip, lead (dresses leads to side of cabinet) ....
13K700628	Strip, trim: brass (metal strip across cabinet front) ....
4A792497	Washer, cut: cad pl (bezel mtg) .....
4S1767	Washer, flat: 5/16 x .130 x .025 brs; pol nkl (mask clip mtg) ....
4S1720	Washer, flat: 3/8 x 11/64 x .030 stl; cad pl (line cord & mask mtg) .....
4S7562	Washer, flat: 7/16 x .187 x .033 stl; cad pl (speaker mtg) ....
4S7629	Washer, flat: 1/2 x 3/16 x .048 stl; cad pl (bottom cover mtg) ....
4S7646	Washer, flat: 11/16 x 3/16 x .067 wrought iron; cop pl (chassis mtg) ....

MODEL 14K1B CABINET PARTS - Same as 14K1 except:

Part No.	Description
16K700630	Cabinet, console: limed oak; less window & bezel ....
13K700632	Cloth, grille: eggshell; 19-1/2 x 11-15/16 ....
36K791431	Knob, control: tan (fine tuning & off-volume) ....

MODEL 14T1 CABINET PARTS

Part No.	Description
1X700595	Back Cover: with picture tube rear cover, centering adjustment cover, and line cord ....
13D700086	Bezel, picture tube (window frame) ......
	Board, baffle (speaker baffle) ....
3S488134	Bolt, chassis mtg: 1/4-20 x 1-1/2 hex head; cad pl ....
1X792494	Bracket, window mtg: with pad ....
16E700121	Cabinet, table model: red-brn mahogany; less window & bezel ....
42A792502	Clip, mask retainer: HT ....
13K700124	Cloth, grille: 7 x 8; mahogany ....
30B470756	Cord, line: with plug & receptacle ......
15K792068	Cover, centering adjustment: rubber (on back cover) ....
1X792546	Cover, chassis bottom: with hi-volt insulator ....
15K700596	Cover, picture tube rear (on back cover).
5S3139	Eyelet: .202 x .475 brass; ant cop finish (on back cover) ....
14B792069	Insulator, high voltage (on chassis bottom cover) ....
14K700567	Insulator, picture tube: disc (in picture tube rear cover) ....
14K700566	Insulator, picture tube:rect (in picture tube rear cover).... ....
36B790505	Knob, control (contrast) ....
36B790506	Knob, control (station selector) ....
36A485457	Knob, control: plastic (hold controls on chassis rear) ....
36C790507	Knob, control: val-mahog (fine tuning & off-volume) ....
4S7650	Lockwasher: int; #6; cad pl (high volt insulator mtg) ....
4S7657	Lockwasher: ext; #8; cad pl (spkr mtg) ....
13K700118	Logotype: "Motorola"; gold enamel .....
1X700594	Mask, picture tube: with retainer clips
2A484897	Nut, hex: 5/8 x 1/2 x 3/16; cop finish (chassis mtg) ....
2S7007	Nut, hex: 8-32 x 1/4; cad pl (spkr mtg) ....
2S7003	Nut, hex: 8-32 x 5/16 stl; cad pl (spkr mtg) ....
35K700168	Pad, cushion (window mtg) ....
35K792501	Pad, cushion (on window mtg brkt) ...
5S1683	Rivet: .122 x 3/16 brass; pol nkl (mask retainer clip mtg) ....
5S7751	Rivet: .122 x 1/4 stl; ant cop finish (picture tube rear cover mtg) .....
5S7706	Rivet: .122 x 1/8 stl; pol nkl (hi-volt insulator mtg) ....
5K791856	Rivet, shoulder: annealed (line cord mtg) ....

MODEL 14T1B CABINET PARTS - Same as 14T1 except:

Part No.	Description
16K700125	Cabinet, table model: limed oak; less window & bezel ....
13K700126	Cloth, grille: 7 x 8; blonde ....
36K791431	Knob, control: tan (fine tuning & off-volume) ....
3A791824	Screw, machine: 8-32 x 1 insulated head; brushed brass finish (speaker mtg)..

BILT-IN-TENNAS

Model TA-4 (14K1)

Part No.	Description
1X791759	TA-4 Double Loop Antenna: complete...
21R6593	Capacitor, mica: 15 mmf 300V ....
21K70720	Capacitor, molded: 5 mmf 500V ....
24A791771	Coil, antenna loading ....
29A791608	Lug, spade ....
31K471564	Strip, terminal: 3 ins, #2 gnd; 3/8" spacing ....

Model TA-6 (14T1)

Part No.	Description
1X791900	TA-6 Single Loop Antenna: complete ..
21R2763	Capacitor, molded mica: 6 mmf 300V .
21R2764	Capacitor, molded mica: 18 mmf 300V
24A791748	Coil, antenna loading ....
24A791989	Coil, high frequency compensating ...
31K34326	Strip, terminal: 2 ins, #3 gnd; 3/8" spacing ....
3S7374	Screw, machine: 8-32 x 5/16 plain hex head; cad pl (bezel mtg) ....
3K791825	Screw, machine: 8-32 x 1 insulated head; statuary bronze (speaker mtg) ....
3S7536	Screw, sheet metal: #6 x 3/8 PKA slotted acorn head; (window & back cover mtg) ....
3S7509	Screw, sheet metal: #6 x 5/8 PKA slotted acorn head; antique copper finish (back cover mtg) ....
3S490819	Screw, sheet metal: #6 x 7/8 PKA slotted acorn head; antique copper finish (back cover mtg)............................
3S7467	Screw, sheet metal: #8 x 3/8 PKZ plain hex head; cad pl (mask mtg) ....
3S8153	Screw, sheet metal: #8 x 3/4 PKA plain hex head; cad pl (bottom cover & chassis mtg) ....
35A791581	Strip, lead (dresses leads to side of cabinet) ....
4A792497	Washer, cut: cad pl (bezel mtg)......
4A484894	Washer, cut: cad pl (chassis mtg)....
4K780040	Washer, felt (under control knobs)...
4S1767	Washer: 5/16 x .130 x .025 brass; pol nkl (mounts mask retainer clips)...
4S1720	Washer: 3/8 x .156 x .030 stl; cad pl (mask and line cord mtg) ....
4S7562	Washer: 7/16 x .187 x .033 stl; cad pl (speaker mtg) ....
4S7629	Washer: 1/2 x 3/16 x .048 stl; cad pl (bottom cover mtg) ....
4S8224	Washer: 1" x 17/64 x .067 stl; cad pl (chassis mtg) ....
61C700134	Window, picture tube: rectangular; 14"

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GENERAL INFORMATION

RECEIVER MODEL BREAKDOWN

Model	Type of Set	Chassis Used
14T3	Table, molded plastic: walnut	TS-114

CHASSIS - Television chassis TS-114 contains 20 tubes plus a 14" rectangular picture tube. The picture, sound, and scanning circuits, together with a full-wave rectifier, are contained on a single chassis.

TUNING RANGE - Channels 2 through 13

IF FREQUENCY -

Channels 2, 3, 4, 5, 6, 11, 12 & 13: sound - 21.9 mc
picture - 26.4 mc

Channels 7, 8, 9 & 10: sound - 27.3 mc
picture - 22.8 mc

ANTENNA - TA-6 "Bilt-In-Tenna". Provision for connection of an external antenna.

ANTENNA IMPEDANCE - 300 ohms

POWER SUPPLY - 117 volts, 60 cycle AC current only

POWER CONSUMPTION - 205 watts

AUDIO OUTPUT - 4 watts

CHASSIS TUBE COMPLEMENT

Ref. No.	Tube	Function
V-1	6CB6	RF Amplifier
V-2	12AT7	Mixer-Oscillator
V-3	6AU6	1st IF Amplifier
V-4	6AU6	2nd IF Amplifier
V-5	6AG5	3rd IF Amplifier
V-6	6AL5	Video Detector
V-7	6AH6	Video Amplifier
V-8	6AU6	Audio Driver-Limiter
V-9	6AL5	Ratio Detector
V-10	6J5GT	Audio Amplifier
V-11	6V6GT	Audio Output
V-12	6SN7GT	1st & 2nd Clippers
V-13	6SN7GT	Vertical Sweep Generator
V-14	6W6GT	Vertical Sweep Output
V-15	6AL5	Phase Detector
V-16	6SN7GT	Horizontal Oscillator
V-17	6BQ6GT	Horizontal Output & High Voltage Generator
V-18	6W4GT	Damping Diode
V-19	1B3GT	High Voltage Rectifier
V-20	14BP4 or 14CP4	Picture Tube: rectangular
V-21	5U4G	Low Voltage Rectifier

HIGH VOLTAGE WARNING

Operation of this receiver, outside its cabinet or with covers removed, involves a shock hazard from the power supplies. No work should be attempted on this receiver by anyone not thoroughly familiar with the precautions necessary when working on high voltage equipment.

CATHODE RAY PICTURE TUBE HANDLING PRECAUTIONS

Extreme care must be used in handling the picture tube. This tube is highly evacuated and, due to its large size, is subjected to a considerable atmospheric pressure. The handler should wear safety goggles and gloves for protection. Avoid nicking or scratching the glass by rough contact with other objects.

Before removing glass tubes, discharge the capacitor formed by the inner and outer aquadag coatings on the tube by shorting the anode contact on the side of the tube to the outer surface with a well insulated piece of wire.

INSTALLATION AND OPERATING INSTRUCTIONS

RECEIVER LOCATION

The receiver may be placed anywhere in the room, but for greatest satisfaction it should be located:

1. Away from any bright light that may fall directly on the screen or be reflected from it; this includes windows and lamps. Some illumination in the room, off to one side, is desirable, however, to prevent eyestrain.

2. To provide comfortable viewing and ease of operation.

3. At lease one-inch away from a wall to allow for cabinet ventilation. This is very important.

ANTENNAS

The choice of a television antenna depends entirely on the location of the receiver with respect to all television station transmitting antennas in the area. Maximum pick-up is obtained when the receiving antenna is directly in line of sight with the transmitting antenna.

"Bilt-In-Tenna." All receivers using the TS-114 series television chassis are equipped with the Motorola "Bilt-In-Tenna", mounted inside the cabinet, for use in good signal areas.

When this antenna is used, the following precautions should be observed for best reception:

1. In order to get maximum performance and satisfactory pictures from the "Bilt-In-Tenna", ample signals from the television station must be present at the location of the receiver. Normally, the strength of the signals will vary throughout the room in which the receiver is located. For this reason, better pictures will be obtained if the receiver is tried in all possible locations in the viewing room and is then placed where the clearest pictures are received from all stations. Avoid large metallic objects, such as radiators, metal panels, etc.

2. Lamps, vases and metallic objects, when placed on top of the receiver, may affect the efficiency of the "Bilt-In-Tenna".

Indoor Antenna. If additional pick-up is necessary an indoor antenna, placed on or near the receiver, may be used. The antenna should be rotated and the arms should be adjusted for the best signal, with no ghosts or reflections. Normally, the arms should be extended on the low channels (2-6) and telescoped on the high channels (7-13).

Outdoor Antenna. The Motorola "Bilt-In-Tenna" or the indoor type antenna will give satisfactory reception in strong signal areas; but, if the receiver is located in a fringe or weak signal area, an outdoor antenna is recommended.

In areas free of obstructions and reflections, within reasonable proximity to television transmitters, a dipole and reflector will prove satisfactory. Since such an antenna has a relatively small band coverage, a special antenna covering all twelve television channels should be used if it is desired to receive stations on channels of widely separated frequencies.

Location of the antenna should be decided from the standpoint of maximum signal pick-up. In general, the antenna should be broadside to the transmitting antenna and should be as high as possible. If a reflector is used, the antenna should be oriented so that the driven element is closest to the station and the reflector farthest away.

Locating the antenna and lead-in as far away as possible from highways, hospitals, doctors' offices, electrical machinery, etc., will help to reduce noise pick-up from such sources. Also, it is desirable to keep the antenna at least six feet away from other antennas, metal roofs, gutters, or other metal objects to prevent unwanted reflections and shielding.

Lead-In. Since the TS-114 chassis is designed for 300 ohm input, the standard 300 ohm twin lead line should be used for connecting the outside antenna to the receiver. Twisting the line one complete turn per foot of running length helps to reduce noise pick-up on the line. The lead-in should be supported on stand-off insulators and kept tight enough to prevent mechanical damage through swaying. Avoid running the lead-in close to metal gutters, iron standpipes, etc.

In areas of very strong signals, or where severe local electrical interference is encountered, 300 ohm shielded twin lead is recommended. The shield braid should be grounded.

An approved lightning arrestor should be used.

RECEIVER ANTENNA CONNECTION

The antenna lead-in to the receiver is connected to the two screws of the terminal strip on the rear of the cabinet. Disconnect the "Bilt-In-Tenna" leads from the terminal strip before attaching an external antenna lead-in. Sometimes, reversing the lead-in connections at the receiver may improve picture quality and overall performance.

OPERATING CONTROLS

There are two dual controls, consisting of a small and a large knob each, on the front panel of the receiver. The function of each control is marked on the front panel, the "circle" indicating the large knob, and the "dot" indicating the small knob. See Figure 1 for front panel control functions.

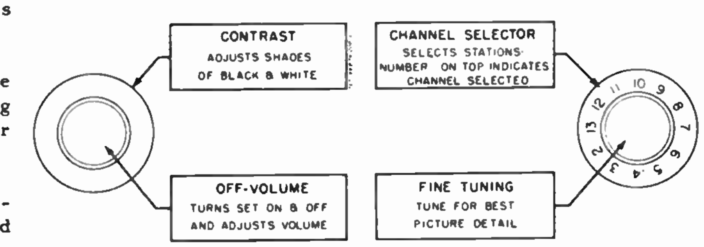

FIGURE 1. OPERATING CONTROLS

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SERVICE ADJUSTMENT CONTROLS

The receiver is completely adjusted at the factory, so normally none other than the front panel control operating instructions need be followed in putting the receiver in operation. However, to provide for any misadjustment of the service controls, due to handling, the following instructions are in order. See Figure 2 for location of the service adjustment controls.

FOCUS CONTROL

The FOCUS control should be adjusted until the fine horizontal line structure of the raster is clearly visible over the picture area. The control should be tuned through the correct point several times so that optimum focus is obtained.

CENTERING

By means of a lever extending from the focus coil, thru the rear screen, the focus coil can be shifted to center the picture in its mask.

VERTICAL SIZE AND VERTICAL LINEARITY

Adjust the VERTICAL SIZE control until the picture fills the mask vertically. Adjust the VERTICAL LINEARITY control for best overall vertical linearity. Adjustment of the VERTICAL SIZE control will require a readjustment of the VERTICAL LINEARITY control and possibly of the vertical hold control. Center picture with the centering lever on the focus coil.

HORIZONTAL SIZE

Adjust the HORIZONTAL SIZE lever until the picture fills the mask horizontally. Center picture with the centering lever.

HORIZONTAL HOLD ADJUSTMENT

The HORIZONTAL HOLD control should have a sync range of approximately 180°. If the control is too critical, adjust as follows:

1. Short out HORIZONTAL OSCILLATOR coil L-23. This may be done with the chassis in the cabinet by shorting pins 3 and 8 of the test socket on chassis rear.
2. With the centering lever, move the picture to the left so that the right edge of the raster can be seen. Adjust the HORIZONTAL HOLD control to about the middle of its range and note the width of the blanking pulse. (The blanking pulse appears as a gray bar at the right edge of the picture).
3. Remove short from HORIZONTAL OSCILLATOR coil.
4. Adjust HORIZONTAL OSCILLATOR coil until the same amount of blanking pulse can be seen as was noted in step 2.

VERTICAL HOLD ADJUSTMENT

Adjust the VERTICAL HOLD control for the center of the vertical sync lock-in range.

BRIGHTNESS

Adjust the BRIGHTNESS control, in combination with the CONTRAST control for the most pleasing picture. Keep the brilliance slightly below maximum, however, in order to protect the fluorescent screen of the picture tube and to prevent poor picture detail.

ADJUSTMENT OF ION TRAP

Under conditions of rough shipment, it is possible for the ion trap to become misaligned. To prevent serious damage to the picture tube, the following method of adjustment should be used. See Figure 3.

The magnet should be placed on the neck of the tube in the direction indicated by the marking on the magnet (usually an arrow which points toward the picture tube screen) so that the stronger magnet of the double magnet type or the only magnet in the single magnet type, is positioned over the internal pole pieces which are mounted on the gun structure. Adjust the brightness control for low intensity and move the magnet a short distance forward and backward at the same time rotating it to obtain the brightest raster. If, in obtaining the brightest raster, the ion trap magnet has to be moved more than 1/4" from the gun pole pieces, the magnet is probably weak and a new magnet should be tried. Never correct for a shadowed raster with the ion trap magnet if such correction results in decreased brightness. The ion trap magnet must always be adjusted for maximum brightness and, if shadows occur at this setting, they should be eliminated by adjusting the focus and deflection coils as explained under "Focus Coil and Deflection Yoke Adjustment".

CAUTION: Keep brightness control at low intensity until ion trap is properly set.

A mirror placed in front of the receiver will aid in making this adjustment.

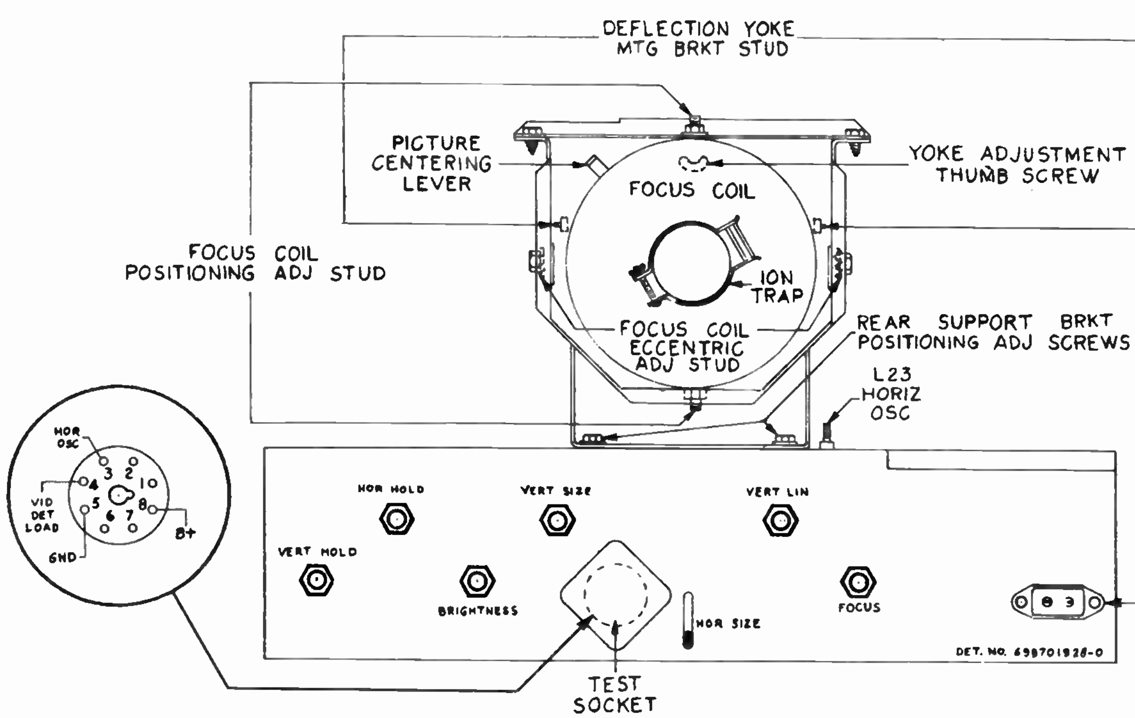

FIGURE 2. SERVICE ADJUSTMENT CONTROLS

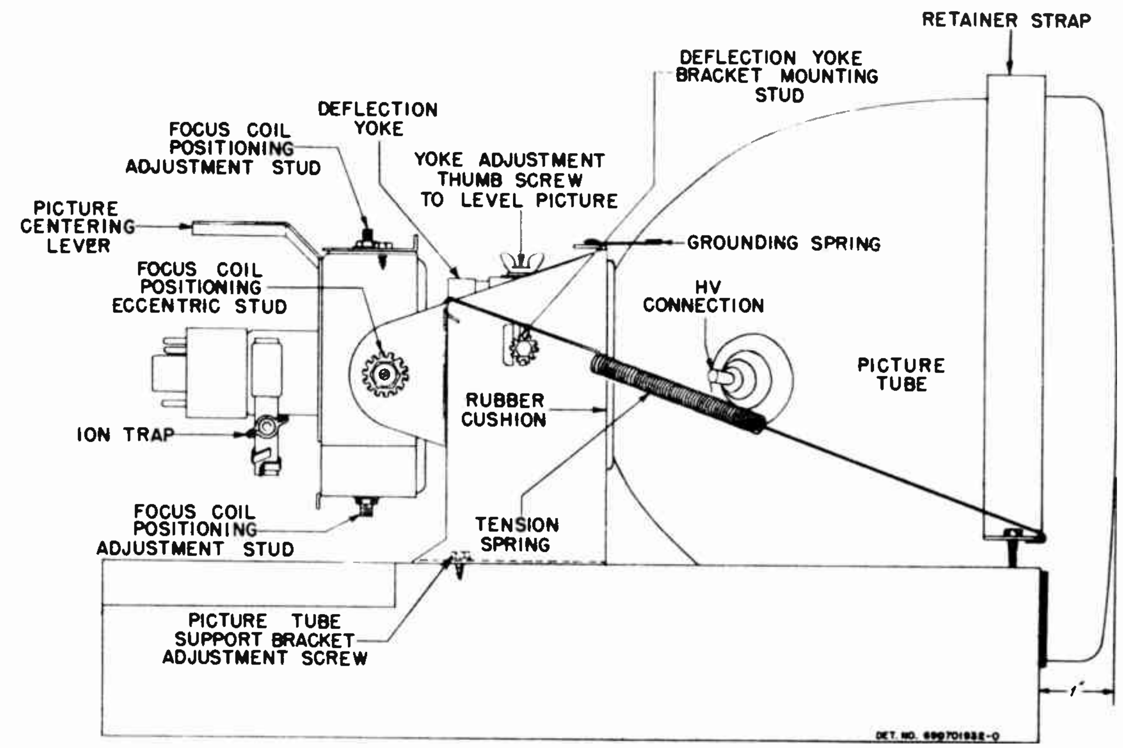

FIGURE 3. PICTURE TUBE ADJUSTMENT LOCATIONS

DEFLECTION YOKE ADJUSTMENT

If the deflection yoke shifts, the picture will be tilted. To correct, loosen the thumbscrew on top of the deflection yoke and rotate yoke until the picture is straight. Before tightening the thumbscrew, make certain that the deflection yoke is as far forward as possible.

If the yoke support and the picture tube have shifted in transit or, if for any reason, these parts have been removed and replaced, it is best to do a complete job of repositioning. See Figure 3. The starting point is the position of the picture tube. It should be adjusted so that the distance from the center of the tube face to the front edge of the chassis is 1". The clamp on the front of the tube should then be tightened. The picture tube rear support bracket positioning adjustment screws should be loose enough to permit sliding the bracket forward until the rubber cushion fits snugly up against the flare of the tube. Loosen the yoke adjustment thumbscrew and push the yoke up against the flare of the tube. CAUTION: Do not use force in sliding the bracket up. If too much force is used, a strain will be placed on the neck of the tube when the support bracket positioning adjustment screws are tightened. Also, the yoke may be forced out of position. The opening in the yoke should be concentric with the neck of the tube.

FOCUS COIL ADJUSTMENT

The focus coil should be positioned so that it is spaced 1/4" from the deflection yoke when parallel with the yoke. The opening in the yoke should be concentric with the neck of the tube. The spacing should be adjusted before the front of the picture tube is clamped down, because it is necessary to remove the tube to change the position of the focus coil. Its position is changed by choice of location of the coil mounting studs in the scalloped holes on the top and bottom of the coil mounting bracket. The opening in the coil can be made concentric with the neck of the tube by loosening the nuts on the studs which support the focus coil bracket and turning the studs with a screwdriver in the slots provided. The studs are eccentric and move the coil both vertically and horizontally. They should be used only to center the neck of the tube in the opening of the coil.

TEST SOCKET

A test socket is provided on the rear of the chassis which allows adjustment of the horizontal oscillator and checking of sensitivity without removing chassis from cabinet. See Figure 2 for socket connections.

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ALIGNMENT

GENERAL

The chassis should be mounted on angle iron brackets (Motorola Part No. 7X700210) so that all connections and adjustments may be made easily.

Since the power cord circuit is broken by the interlock when the cabinet back is removed, it will be necessary to obtain an extra power cord with the female interlock receptacle in order to make a power connection to the receiver. Order Motorola Part No. 30B470756.

ORDER OF ALIGNMENT

A complete receiver alignment can be most conveniently performed in the following order:

1. Audio Take-Off & Ratio Detector
2. 4.5 Mc Trap
3. IF Coils & Mixer Transformer
4. Osc & RF Sections

AUDIO TAKE-OFF & RATIO DETECTOR ALIGNMENT

Equipment Required:

AM Signal Generator: (Optional) Accurately calibrated at 4.5 mc

Adjustable output

DC Meter: Low range electronic voltmeter

Procedure:

Refer to Figure 4 for location of adjustments.

1. If possible, it is desirable to align the audio section from an actual station signal, since the 4.5 mc alignment frequency will be exact. The fine tuning trimmer should be turned off the station slightly, to prevent overloading the ratio detector.
2. If a signal generator is used, tune it accurately to 4.5 mc, and adjust the output to approximately 10,000 microvolts. Connect the high side of the signal generator through a 1000 mmf capacitor to the grid (pin 1) of the video amplifier tube V-7 (6AH6), and the low side to chassis. The following applies whether the station signal or signal generator is used.
3. From either side of capacitor C-52 (10 mf), connect an electronic voltmeter to chassis decoupled thru 10K ohms.
4. Set the contrast control for maximum gain (fully clockwise).
5. Peak L-20 for maximum reading on meter.
6. Peak T-3 primary (top core) for maximum reading on meter.
7. Move the meter and decoupling resistor from C-52 to junction of R-41 (33K) and lead to volume control.
8. Adjust T-3 secondary (bottom core) for zero response on 2.5V scale of meter. This corresponds to the cross-over point on the FM detector curve.

If desired, the symmetry of the curve may be checked by tuning the signal generator 25 kc above and below 4.5 mc and noting the plus and minus voltage produced, reversing the meter connections as necessary. For proper balance of the ratio detector system, the voltage in each direction should be approximately equal. If not, check the tuning of L-20 and the primary and secondary of T-3, the ratio detector. If necessary, replace the ratio detector tube V-9 (6AL5). It is desirable to calibrate the generator on a station signal. This may be done by nulling the secondary on a station signal and then connecting the generator and tuning it to produce the same null without touching the trimmers in the set.

NOTE: As the adjustments are brought to resonance, it is advisable to reduce signal generator output to prevent overloading.

With a 10,000 microvolt signal into the grid of the video amplifier tube, with the contrast control turned fully clockwise, and the focus control at center of its range, the voltage read from one side of capacitor C-52 should be greater than 5.0V.

4.5 MC TRAP ALIGNMENT

1. Connect the high side of the signal generator through a 1000 mmf capacitor to the grid (pin 1) of the video amplifier tube V-7 (6AH6), and the low side to chassis.
2. Connect the voltmeter and germanium crystal rectifier, as shown in Figure 5, between the cathode of the picture tube (yellow lead) and chassis. Use the lowest voltage scale on the meter.
3. With the signal generator accurately set at 4.5 mc and maximum output, adjust trap L-18 for minimum reading on the meter.

IF AMPLIFIER ALIGNMENT

Equipment Required:

IF Sweep Generator meeting the following requirements:

18 to 30 mc, approximately 12 mc sweep width. Output constant and adjustable to at least .1 volt maximum with accurately calibrated, adjustable markers.

Cathode Ray Oscilloscope: preferably one with a calibrated input attenuator.

NOTE: If there is no built-in marker in the sweep generator, loosely couple the output of an accurately calibrated AM signal generator to the IF strip. At all times, keep the marker output low enough to prevent the marker from distorting the response curve.

If a wide band scope is used, the marker will be more distinct if a capacitor of 100 to 1000 mmf is placed across the scope input. Use the smallest size possible, since too large a value will affect the shape of the curve.

Procedure:

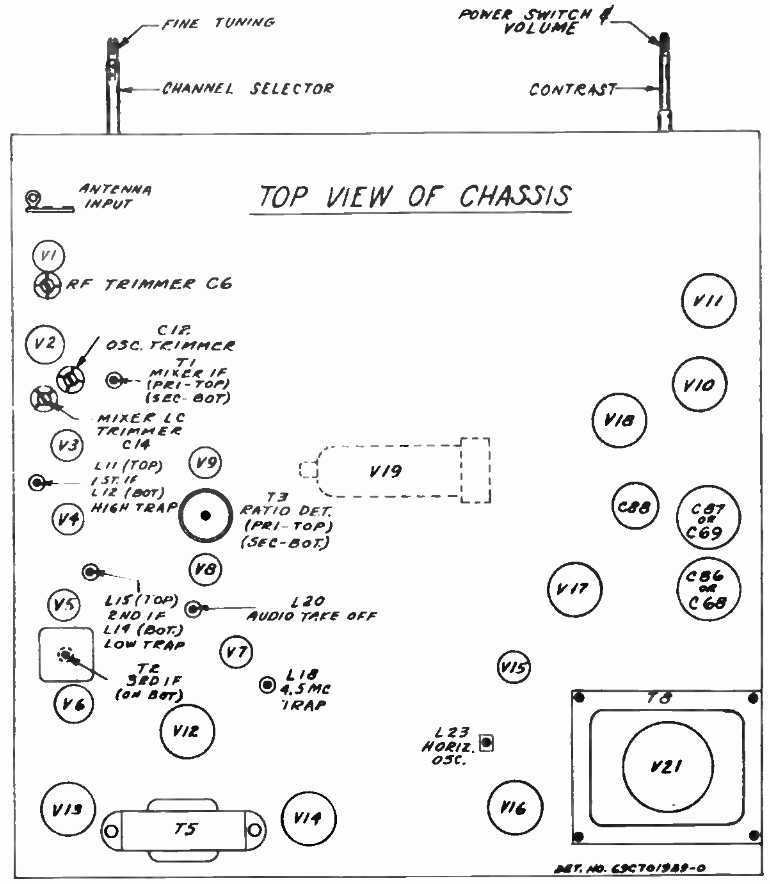
1. Remove high voltage generator tube V-17 (6BQ6GT) from its socket to eliminate horizontal pick-up in the oscilloscope. Replace 6BQ6 tube with dummy load of 2500 ohms 25 watts connected from B plus side of fuse to chassis.
2. By means of an external battery, apply a negative 3.0 volt bias from the bottom of the 1st IF tube grid resistor R-13 (6800) to chassis.
3. Using leads as short as possible, connect the hot side of the sweep generator to the grid (pin 1) of the 1st IF tube V-3 (6AU6) through a 5000 mmf capacitor (do not use the loose or "spraying" method of coupling). The low side is connected to chassis. Set the center frequency of the sweep to about 24.6 mc and adjust initially for a sweep deviation of approximately 12 mc. However, a sweep of from 8 to 10 mc may be found better for overall alignment.
4. Using R-26 (100K) as a decoupling resistor, connect the scope to pin 4 of test socket. If a stronger output is desired, connect the scope between the picture tube cathode and chassis. The curve seen at this position will be the reverse of the polarity shown in Figure 6.
5. Set the contrast control at minimum.

NOTE: If a distorted or unstable picture is seen on the the oscilloscope during alignment, it may be necessary to stop the oscillator by disconnecting resistor R-9 (1500) from the plate (pin 6) of the oscillator tube V-2B (12AT7), or by substituting another tube with pin 6 removed.

CAUTION:
1. Do not reduce the oscilloscope gain and increase signal input so that the top of the curve is flattened, due to limiting in the video or scope amplifiers.
2. The dress of plate & grid components in the IF affects tuning. Do not move indiscriminately.
3. On the IF coils and on the traps, the resonance point will be found at two settings of the slug. The correct setting is the one which is found with the greater part of the adjusting screw out of the coil.

NOTE: The 1st & 2nd IF traps are tuned from bottom of chassis, while IF cores are adjusted from the top.

6. Tune the low frequency trap L-14, located on the 2nd IF coil, for maximum attenuation on the curve at 21.9 mc.
7. Tune the high frequency trap L-12 located on the 1st IF coil for maximum attenuation on the curve at 27.3 mc.
8. Adjust the 1st IF coil, L-11, to place a 26.6 mc marker on the high side of the response curve 60% down



NO.	TYPE	FUNCTION
V1	6CB6	RF AMP.
V2	12AT7	MIXER-OSC.
V3	6AU6	1ST. IF AMP.
V4	6AU6	2ND IF AMP.
V5	6AG5	3RD. IF AMP.
V6	6AL5	VIDEO DET.
V7	6AH6	VIDEO AMP.
V8	6AU6	AUDIO DRIVER-LIMITER
V9	6AL5	RATIO DET.
V10	6U5GT	AUDIO AMP.
V11	6V6GT	AUDIO OUTPUT
V12	6SN7GT	1ST. & 2ND. CLIPPERS
V13	6SN7GT	VERT. SWEEP GEN.
V14	6W6GT	VERT. SWEEP OUTPUT
V15	6AL5	PHASE DET.
V16	6SN7GT	HORIZ. OSC.
V17	6BQ6GT	HORIZ. OUTPUT & H.V. GEN.
V18	6W4GT	DAMPING DIODE
V19	1B3GT	H.V. RECT.
V21	5U4G	L.V. RECT

FIGURE 4. TUBE AND ALIGNMENT ADJUSTMENT LOCATIONS

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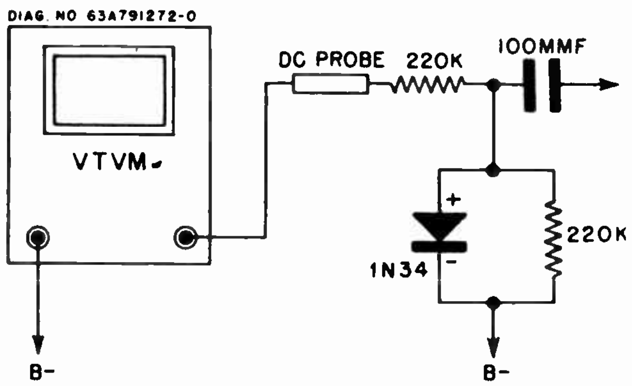

FIGURE 5.
ELECTRONIC VOLTMETER CONNECTIONS

from maximum response. See Figure 6.

9. Adjust the 2nd IF coil, L-15, to place a 22.7 mc marker on the low side of the response curve 60% down from maximum response.

10. Adjust the 3rd IF plate transformer, T-2, to provide a flat top or symmetrical response curve.

11. Reset the traps (steps 6 & 7) and again check the IF for proper response.

NOTE: It is suggested that the bias be removed for accurate resetting of the traps.

12. With bias applied, connect the sweep between the grid (pin 2) of the mixer tube V-2A (12AT7) and chassis.

13. Disconnect the trimmer, C-14, in LC circuit in the grid of the mixer tube, or short the trimmer through a 10,000 mmf ceramic disc type to chassis.

14. Bring both cores of the mixer transformer, T-1, simultaneously from the outside towards the center. The half-way markers should be 26.4 mc and 22.9 mc. (Figure 7).

NOTE: In aligning the three IF coils, each coil is adjusted individually, but when adjusting the primary and secondary of the mixer transformer, the adjustments should be made simultaneously. The important point to keep in mind is to obtain a flat response curve with as much gain as possible. The sides of the curve should be straight and as steep as possible. Simultaneous adjusting of the primary and secondary is the easiest way to obtain this result. The transformer by itself is, in effect, tuned for the same pass band as the three staggered circuits. See Figure 7. The only difference in the overall waveform should be that the sides of the overall wave are steeper. Constant use of the 50% markers (22.9 mc and 26.4 mc) should be resorted to, since it is absolutely necessary to obtain the proper curve. A slight dip (not exceeding 10%) is permissible in the mixer transformer response curve.

BANDWIDTH

The bandwidth may be determined by connecting an AM generator to the mixer grid. With the generator frequency at 24.6 mc, adjust the output for 1 volt reading on a VTVM

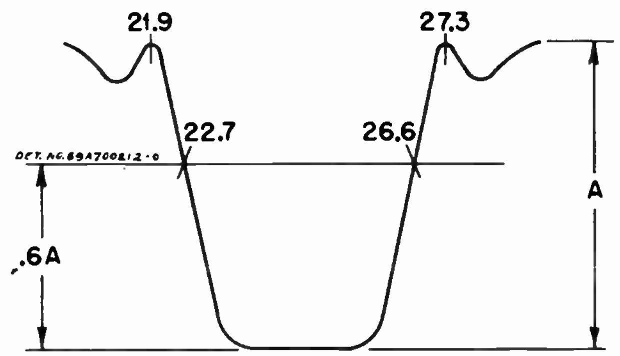

FIGURE 6. IF RESPONSE CURVE

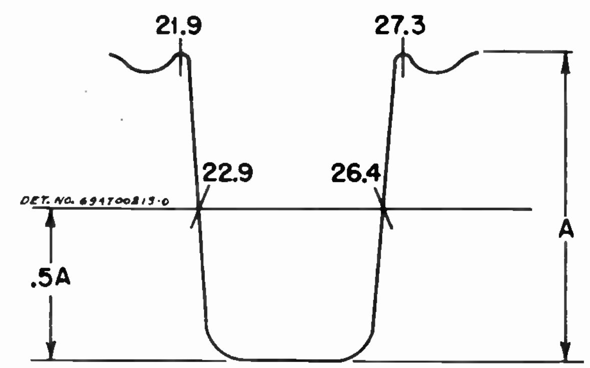

FIGURE 7. OVERALL RESPONSE CURVE FROM MIXER

connected at the plate (pin 2) of the video detector tube V-6 (6AL5) and chassis. Double the output of the generator. Now, by tuning either side of 24.6 mc and noting the frequencies at which the VTVM again reads 1 volt, the 6 db bandwidth points are indicated.

REGENERATION CHECK

After the above IF and mixer transformer alignment has been made, a check for regeneration in the IF amplifier should be made. This is done by removing the battery bias and observing the output response curve on the oscilloscope, as taken between the picture tube cathode and chassis. The bandwidth may change with the bias removed but should not change more than 0.2 mc. Set the contrast control to maximum gain. Decrease the input until the output signal shows a marked decrease. Any regeneration present will be indicated by sharp peaks on the overall response curve. The oscillator should be stopped, as described above, during this procedure.

CAUTION: Do not inject too much marker signal.

MIXER LC ADJUSTMENT

Reconnect bias removed for regeneration check. Replace trimmer C-14 in LC circuit of mixer grid or remove 10,000 mmf ceramic between trimmer and chassis. Adjust the trimmer so it is tuned to the center of the mixer response curve. This is indicated by observing the effect of the LC circuit on the mixer response. Increasing the capacity of the trimmer and bringing the LC circuit from above the IF range into the IF range, it will be noted that the mixer curve will pull down on the high side, then straighten out as the LC circuit approaches the middle of the range, and pull down on the low side as the LC circuit approaches the low end of the IF range. The proper tuning point is that point at which the mixer curve straightens out. In effect, the LC circuit is similar to a jack coil when it is within the IF range.

CAUTION: Tuning the LC circuit very low will cause oscillation.

IF SENSITIVITY MEASUREMENTS

IF Stages Only

1. Remove the battery bias from the 1st IF tube grid.

2. Connect an AM signal generator, set at 24.6 mc thru a blocking capacitor of 5000 mmf, between grid (pin 1) of the 1st IF tube V-3 (6AU6) and chassis.

3. Connect an electronic voltmeter across the video detector load resistor R-28 (5600). Both leads from the meter should be decoupled with 100K ohm resistors.

4. Set the contrast control for maximum sensitivity.

5. Stop the oscillator tube by disconnecting resistor R-9 (1500) from the plate (pin 6) of the tube V-2B (12AT7) or by substituting another tube with pin 6 removed.

6. The signal required to produce 1 volt (negative) above contact potential on the meter should be less than 700 microvolts.

Mixer & IF Stages

The preliminary preparations are the same as for checking the sensitivity of the IF stages except:

1. Connect the AM signal generator, set at 24.6 mc, through a 5000 mmf capacitor, between the grid (pin 2) of the mixer tube V-2A (12AT7) and chassis.

2. The signal required to produce 1 volt (negative) above contact potential on the meter should be less than 125 microvolts.

OSCILLATOR, ANTENNA AND RF ALIGNMENT

NOTE: The IF must be aligned before the RF section can be properly phased.

Equipment Required:

Sweep Generator: Frequency range 40-220 mc; 10 mc sweep width
Output constant and adjustable
Adjustable markers (markers should be calibrated occasionally by checking against an accurate signal generator).

Oscilloscope: Preferably one with a calibrated input attenuator.

Signal Generator: Frequency range 40 to 220 mc
Accurately calibrated
AM modulated, 400 cycle

FREQUENCY CHART

Chan	Frequency	Picture	Sound	Oscillator
2	54-60	55.25	59.75	81.65
3	60-66	61.25	65.75	87.65
4	66-72	67.25	71.75	93.65
5	76-82	77.25	81.75	103.65
6	82-88	83.25	87.75	109.65
7	174-180	175.25	179.75	152.45
8	180-186	181.25	185.75	158.45
9	186-192	187.25	191.75	164.45
10	192-198	193.25	197.75	170.45
11	198-204	199.25	203.75	225.65
12	204-210	205.25	209.75	231.65
13	210-216	211.25	215.75	237.65

ANTENNA & RF ALIGNMENT PROCEDURE

1. Remove high voltage generator tube V-17 (6BQ6GT) from its socket and replace with a dummy load of 2500 ohms 25 watts connected from B plus side of fuse to chassis. Stop the oscillator by disconnecting R-9 (1500) from plate (pin 6) of V-2B (12AT7).

2. Connect the sweep generator across the antenna terminals on the chassis with the antenna lead-in removed. The line from the sweep generator should be as short as possible.

3. Connect the oscilloscope through a decoupling resistor of 150,000 ohms, between the cathode (pin 3) of the mixer tube V-2 (12AT7) and chassis.

4. Short out the AGC circuit with a clip lead from the AGC bus to chassis.

5. Refer to Figure 4 for the RF trimmer location and to Figure 9 for the locations of the antenna and RF coils. The frequency chart listed previously gives the channel and alignment frequencies.

6. The antenna coils are tuned to the video carrier frequency and the RF coils are tuned to the sound carriers. Figure 10 shows the shape of the curve which should appear on the scope for channels 2-6 and Figure 11 the curves for channels 7-13.

7. Turn the station selector switch to channel 10. Set the center frequency of the sweep generator to the center frequency of channel 10 (195 mc).

8. Adjust ceramic trimmer, C-6, so that picture and sound markers are as in Figure 11.

9. Check channels 7 to 13 for proper response and, if necessary, tune the coil L-6. These coils may be tuned by spreading them to decrease inductance or compressing them to increase their inductance. See Figure 9 for location of coils. This will have more effect on channels 10 to 13 than 7 to 9. If L-6 is adjusted, it may be necessary to readjust RF trimmer C-6, and recheck the high channels.

NOTE: As the bandwidth of the high channels is very broad, a slight variation is permissible.

10. Move bandswitch to channel 6.

11. With the center frequency of sweep generator at the center frequency of channel 6 (85 mc), introduce markers corresponding to sound and picture carriers and compare with curve of Figure 10.

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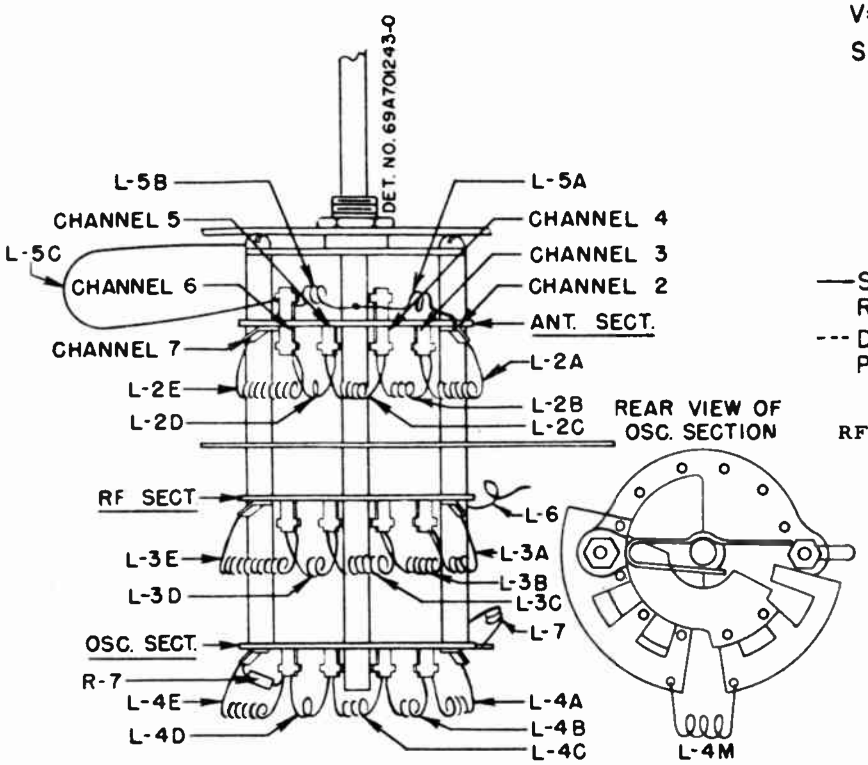

FIGURE 9. ANTENNA, RF AND OSCILLATOR COIL LOCATIONS

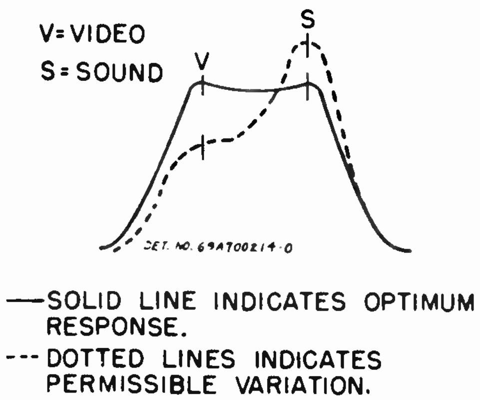

FIGURE 10.
RF RESPONSE CURVES CHANNELS 2-6

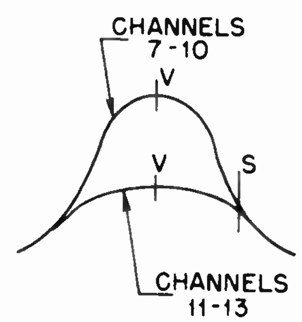

FIGURE 11.
RF RESPONSE CURVES CHANNELS 7-13

NOTE: A convenient method of determining whether a coil is tuned correctly is to insert a brass or iron slug into the coil. Brass decreases and iron increases the inductance.

12. After channel 6 has been aligned, progress downward through channel 2.

CAUTION: Make certain the station selector switch is on the correct channel before checking bandpass.

OSCILLATOR ADJUSTMENT

1. Put oscillator back in circuit.

2. Remove the short from the AGC circuit and apply a -3 volt battery bias to the AGC bus.

3. Move the scope to the test socket on the chassis rear with the high side connected to pin 4 and the low side to pin 5 (chassis).

4. Set the contrast control at minimum (counterclockwise).

5. Remove the fine tuning knob and turn shaft until the slot is in a horizontal position. This represents the mid-capacity position.

6. Turn station selector switch to channel 12.

7. Set the sweep generator on channel 12 with a center frequency of 207 mc and at least a 12 mc sweep. Keep the output low enough to show no evidence of limiting in the overall response curve.

NOTE: Before aligning the oscillator section, make certain the 3.3 microhenry choke (L-8) in the mixer grid is dressed away from the 2 mmf capacitor (C-16) tied to the same grid.

8. Introduce a marker corresponding to the sound carrier of channel 12 (209.75 mc).

9. Adjust oscillator ceramic trimmer so that the sound marker falls into the 21.9 mc trap dip in the response curve.

10. Turn generator and station selector to channel 9 with the fine tuning shaft slot still in the horizontal position.

11. Spread or compress the 3-turn coil located in the center of the oscillator plate (L-4M, Figure 9) so that the sound marker for channel 9 falls into the 27.3 mc trap dip in the response curve. As the oscillator is tuned below the carrier on channels 7, 8, 9 & 10, the 27.3 mc trap will be in the same position as the 21.9 mc trap in step 9.

12. Repeat steps 6, 7, 8 & 9.

13. Turn generator and station selector to channel 13.

14. Turn fine tuning trimmer so that the sound marker for channel 13 falls into the 21.9 mc trap dip of response curve. The slot in the fine tuning shaft should not have moved more than 30° from the horizontal position to accomplish this (each number on the station selector knob represents 30°).

15. If more than a 30° change in fine tuning trimmer was needed in step 14, adjust channel 13 oscillator coil (L-7) by spreading or compressing until the 30° requirement is met.

NOTE: Each adjustment of channel 13 oscillator coil (L-7) will necessitate a rechecking of the oscillator trimmer on channel 12 as per steps 6, 7, 8 & 9.

16. Check channels 12, 11, 10, 9, 8, and 7 by noting whether the fine tuning trimmer can drop the sound marker for each channel in the trap dip by a 30° rotation. If one of the channels does not meet the 30° requirement, a compromise must be made by resetting channel 9 or 12, whichever is closer to the channel in question.

Example: 1) If channel 11 does not meet the 30° requirement, return station selector and generator to channel 12 and tune ceramic trimmer toward channel 11 (trimmer frequencies lowered by tightening screw). This will tend to move channel 12 sound marker out of the trap dip, but this can be compensated for by the fine tuning trimmer. Do not adjust trimmer any more than is necessary to get the channel in question back within the 30° requirement.

Example: 2) If channel 10 does not meet the 30° requirement, move station selector and generator to channel 9 and tune the 3-turn coil (L-4M, Figure 9) toward channel 10 (coil freq raised by spreading turns.) This will also tend to move channel 9 sound marker out of the trap dip, but this can be compensated for by the fine tuning trimmer. Again, do not adjust the coil any more than is necessary to bring the channel in question back within the 30° requirement.

17. Turn sweep generator and station selector switch to channel 6.

18. Adjust channel 6 oscillator coil (L-4E, Figure 9) so that the sound marker for channel 6 falls into the 21.9 mc trap dip with the fine tuning trimmer at mid-capacity (shaft slot in horizontal position). Always spread or compress channel 6 oscillator coil in units of 3 turns. Compressing turns will move curve toward sound marker, while spreading will move curve toward video marker.

IMPORTANT: Since the coils are in series, the proper alignment of channel 6 will simplify the phasing of the channels to follow.

19. Adjust channels 5 and 4 so that the sound marker for each channel falls into the 21.9 mc trap dip in the curve with the fine tuning trimmer set no more than 15° from mid-capacity.

20. Channels 3 and 2 should be adjusted so that the sound marker falls into the 21.9 mc trap dip with the fine tuning trimmer within 15° of maximum capacity.

OVERALL RECEIVER SENSITIVITY MEASUREMENT

An overall measurement of sensitivity is made as follows:

1. Connect an AM signal generator to the input terminals of the receiver chassis after removing the short 300 ohm lead which connects to the antenna input strip on the back of the cabinet. To match the generator to the receiver input, a resistor matching network should be used. In the case of a generator with a 50 ohm output impedance, for example, place a 100 ohm resistor in series with the output terminal of the generator and a 150 ohm resistor in series with the ground terminal.

2. From cathode of picture tube to chassis, connect a calibrated oscilloscope.

NOTE: To calibrate scope, connect it across 6.3 volt filament supply. The peak-to-peak amplitude on the screen will then be approximately 18V (6.3 x 2.8).

3. Set contrast control for maximum sensitivity.

4. Tune signal generator to the video carrier frequency of the channel being checked. Generator signal should be 30% modulated at 400 cycles. The signal from the generator to produce 20 volts peak-to-peak at picture tube cathode should be less than 25 microvolts on channels 2 to 6 and less than 75 microvolts on channels 7 to 13.

CIRCUIT DESCRIPTION

Chassis TS-114 and TS-115 are electrically identical except for the Vertical Sweep Generator (V-13). The TS-114 uses a 6SN7GT instead of the 12AU7 of the TS-115. This change necessitated changing grid resistor R-63 from 330K to 100K. The circuit description of the TS-115, as found in the TS-115 Service Manual will, therefore, apply also to the TS-114 except for the differences noted above.

REPLACEMENT PARTS LIST

NOTE: When ordering parts, specify model number of set in addition to part number and description of part.

Ref. No.	Part No.	Description
CHASSIS TS-114 ELECTRICAL PARTS		
Capacitors		
C-1 thru C-22	-	See Tuner Parts List................
C-23	21A470790	Ceramic disc: 1500 mmf 500V......
C-24	21A470789	Ceramic disc: 5000 mmf 450V......
C-25	21A470789	Ceramic disc: 5000 mmf 450V......
C-26	21A470789	Ceramic disc: 5000 mmf 450V......
C-27	21K77375	Ceramic tubular: 220 mmf 500V....
C-28	21K470329	Molded: 30 mmf 500V (temperature compensated)......................

Ref. No.	Part No.	Description
C-29	21A470789	Ceramic disc: 5000 mmf 450V......
C-30	21A470789	Ceramic disc: 5000 mmf 450V......
C-31	21K77375	Ceramic tubular: 220 mmf 500V....
C-32	21A470789	Ceramic disc: 5000 mmf 450V......
C-33	21A470789	Ceramic disc: 5000 mmf 450V......
C-34	21A470789	Ceramic disc: 5000 mmf 450V......
C-35	21A470789	Ceramic disc: 5000 mmf 450V......
C-36	21K470329	Molded: 30 mmf 500V (temperature compensated)......................

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Ref. No.	Part No.	Description
C-37	21K470324	Molded: 6 mmf 500V
C-38	8R9854	Paper: .1 mf 200V
C-39	8R9854	Paper: .1 mf 200V
C-40	21R6554	Mica: 100 mmf 500V
C-42	21K470329	Molded: 30 mmf
C-43	21A478274	Molded: 2.2 mmf
C-44	21K490806	Molded: 60 mmf
C-45	21A470789	Ceramic disc: 5000 mmf 450V
C-46	21A470789	Ceramic disc: 5000 mmf 450V
C-47	21K790439	Silver mica: 15 mmf (part of T-3 base)
C-48	8R9866	Paper: .001 mf 600V
C-49	21A790131	Ceramic tubular: 150 mmf
C-50	21R6590	Mica: 500 mmf 500V
C-51	21R6590	Mica: 500 mmf 500V
C-52	23A90205	Electrolytic: 10 mf 50V
C-53	21K482726	Ceramic disc: 10,000 mmf 450V
C-54	8R9869	Paper: .005 mf 600V
C-55	21R6650	Mica: 68 mmf 500V
C-56	8R9869	Paper: .005 mf 600V
C-57	21K470322	Molded: 20 mmf
C-58	8R9873	Paper: .05 mf 600V
C-59	8R9869	Paper: .005 mf 600V
C-60	8R9869	Paper: .005 mf 600V
C-61	8R9870	Paper: .01 mf 600V
C-62	8R9871	Paper: .02 mf 600V
C-63	8R9870	Paper: .01 mf 600V
C-64	8R9866	Paper: .001 mf 600V
C-65	21R6590	Mica: 500 mmf 500V
C-66	8R9873	Paper: .05 mf 600V
C-67	8R9875	Paper: .15 mf 600V
C-68	23B700160	Electrolytic: 4-section; 80 mf/450V; 40 mf/300V; 20 mf/300V; 10 mf/300V
C-69	23B700159	Electrolytic: 4-section; 80 mf/400V; 40 mf/400V; 100 mf/50V; 20 mf/25V
C-70	8R9869	Paper: .005 mf 600V
C-71	8R9866	Paper: .001 mf 600V
C-72	8R9866	Paper: .001 mf 600V
C-73	8R9866	Paper: .001 mf 600V
C-74	8R9870	Paper: .01 mf 600V
C-75	8R9869	Paper: .005 mf 600V
C-76	21K400037	Ceramic tubular: 270 mmf 500V
C-77	21R2741	Mica: 680 mmf 500V
C-78	8R9869	Paper: .005 mf 600V
C-79	8R9854	Paper: .1 mf 200V
C-80	8R9874	Paper: .1 mf 600V
C-81	8R9874	Paper: .1 mf 600V
C-82	21K700883	Ceramic tubular: 180 mmf 3000V
C-83	8R9874	Paper: .1 mf 600V
C-84	21K790574	Ceramic tubular: 60 mmf 1500V (in deflection yoke)
C-85	8R9874	Paper: .1 mf 600V
C-86	23B700613	Electrolytic: 3-section; 80 mf/400V; 20 mf/300V; 10 mf/300V
C-87	23B700614	Electrolytic: 3-section; 60 mf/400V; 40 mf/300V; 20 mf/25V
C-88	23B700615	Electrolytic: 2-section; 35 mf/400V; 100 mf/50V
C-89	8R9810	Paper: .25 mf 100V

Fuses

Ref. No.	Part No.	Description
F-1	65A700851	Fuse, 1/4 amp: glass tubular; with leads

Coils

Ref. No.	Part No.	Description
L-1 thru L-9	-	See Tuner Parts List
L-10	24K790035	RF choke: molded; 5.6 microhenries
L-11	24B701343	1st IF: complete with LC trap, core, & mtg nut
L-12		Trap (part of L-11)
L-13	24K790035	RF choke: molded: 5.6 microhenries
L-14		Trap (part of L-15)
L-15	24K701344	2nd IF: complete with LC trap, core, & mtg nut
L-16	24K792771	RF choke: yellow dot
L-17	24K792771	RF choke: yellow dot
L-18	24B792735	4.5 mc trap: less core & mtg nut
L-19	24K701652	Compensating coil: blk dot (wound on R-36)
L-20	24A470159	Audio take-off: less core and mtg nut
L-21	24K701651	Compensating coil: grn dot (wound on R-32)
L-22	24K701512	Focus coil
L-23	24K790059	Horizontal Oscillator: less core & clip
L-24	24K701139 or 24K701136 or 24K701141 or 24K701138 or 24K701142	Deflection yoke: complete
L-25	-	See Tuner Parts List
L-26	24K790145	RF choke: molded; 0.47 microhenries
L-27	24K701349	Horizontal size coil: less core & mtg nut

Speakers

Ref. No.	Part No.	Description
LS-1	50C701808	Speaker: 5" electrodynamic; 3.2 ohm voice coil; 100 ohm field (hot)

Resistors

Ref. No.	Part No.	Description
R-1 thru R-12	-	See Tuner Parts List
R-13	6R6428	6800 10% 1/2W
R-14	6R5550	47 10% 1/2W
R-15	6R2036	33 10% 1/2W
R-16	6R6069	2200 10% 1/2W
R-17	6R6394	12,000 10% 1/2W
R-18	6R6229	1000 10% 1/2W
R-19	6R5550	47 10% 1/2W
R-20	6R2036	33 10% 1/2W
R-21	6R6069	2200 10% 1/2W
R-22	6R6428	6800 10% 1/2W
R-23	6R2035	82 10% 1/2W
R-24	6R6038	1500 10% 1/2W
R-25	6R6075	100,000 20% 1/2W
R-26	6R6075	100,000 20% 1/2W
R-27	6R3966	1.5 meg 20% 1/2W
R-28	6R6117	5600 10% 1/2W
R-29	6R6004	1 meg 20% 1/2W
R-30	6R5550	47 10% 1/2W
R-31 A & B	18A792009	Contrast volume control: dual; carbon; 2000 1/2W & 1 meg 1/4W respectively (with power switch)
R-32		2700 (not replaceable; part of L-21)
R-33	6R6032	470,000 20% 1/2W
R-34	6R6018	100 20% 1/2W
R-35	6R6400	33,000 10% 1W (in 6AH6 video amp)
	or 6R6341	22,000 10% 1W (in 6CB6 video amp)
R-36		12,000 (not replaceable; part of L-19)
R-37	6R5671	4700 10% 2W
R-38	6R3933	220 20% 1/2W
R-39	6R2004	8200 10% 1/2W
R-40	6R5660	180 10% 1/2W
R-41	6R6012	33,000 20% 1/2W
R-42	6R6428	6800 10% 1/2W
R-43	6R6428	6800 10% 1/2W
R-44	6R2122	4.7 meg 20% 1/2W
R-45	6R6414	270,000 10% 1/2W
R-46	6R6032	470,000 20% 1/2W
R-47	6R6032	470,000 20% 1/2W
R-48	6R6022	330 10% 1/2W
R-49	6R476004	1000 20% 2W
R-50	6R6320	10,000 10% 1/2W
R-51	6R3927	2.2 meg 20% 1/2W
R-52	6R6004	1 meg 20% 1/2W
R-53	6R6397	22,000 10% 1/2W
R-54	6R2096	330,000 10% 1/2W
R-55	6R6428	6800 10% 1/2W
R-56	6R5581	3300 10% 1/2W
R-57	6R5581	3300 10% 1/2W
R-58	6R6031	100,000 10% 1/2W
R-59	6R6031	100,000 10% 1/2W
R-60	6R6397	22,000 10% 1/2W
R-61	6R6031	100,000 10% 1/2W
R-62	6R5577	2700 10% 1/2W
R-63	6R6031	100,000 10% 1/2W
R-64	18A90147	Vertical hold control: carbon; 1 meg 1/4W
R-65	6R6428	6800 10% 1/2W
R-66	6R5577	2700 10% 1/2W
R-67	6R6032	470,000 20% 1/2W
R-68	18A90145	Vertical size control: carbon; 5 meg 1/4W
R-69	6R2118	3.3 meg 20% 1/2W
R-70	6R3949	470 20% 1/2W
R-71	18A790146	Vertical linearity control: wire wound; 2000 2W
R-72	6R6291	560 10% 1/2W (in deflection yoke)
R-73	6R6291	560 10% 1/2W (in deflection yoke)
R-74	6R6056	47,000 20% 1/2W
R-75	18A90147	Brightness control: carbon; 1 meg 1/4W
R-76	6R6004	1 meg 20% 1/2W
R-77	17K790840	Wire wound: 1000 10% 15W
R-78	18K701114	Focus control: wire wound; 500 4W
R-79	17K792705	Wire wound: 2000 10% 10W
R-80	6R6477	15,000 10% 1/2W
R-81	6R6031	100,000 10% 1/2W
R-82	6R6031	100,000 10% 1/2W
R-83	6R2122	4.7 meg 20% 1/2W
R-84	6R2122	4.7 meg 20% 1/2W
R-85	6R6428	6800 10% 1/2W
R-86	6R6229	1000 10% 1/2W
R-87	6R3949	470 20% 1/2W
R-88	6R5631	120,000 10% 1/2W
R-89	18A791574	Horizontal hold control: carbon; 100,000 1/4W
R-90	6R6074	68,000 10% 1/2W
R-91	6R6038	1500 10% 1/2W
R-92	6R6032	470,000 20% 1/2W
R-93	6R5583	47 10% 1W
R-94	6R5690	6800 10% 2W
R-95	6R5721	150,000 10% 1W
R-96	6R5721	150,000 10% 1W
R-97	6R5577	2700 10% 1/2W (in deflection yoke)
R-98	6R6328	100,000 10% 1W (in deflection yoke)
R-99	17K701353	Wire wound: 1500 10% 15W

Transformers

Ref. No.	Part No.	Description
T-1	-	See Tuner Parts List
T-2	24B792585	3rd IF: less core, mtg nut, & colored leads
T-3	24B790125	Ratio detector: complete less shield can
T-4	25B790686	Audio output
T-5	25K701143	Vertical output
T-6	24C701134	High voltage transformer
T-7	25B790140	Filament isolation transformer (for V-18)
T-8	25C700161 or 25K700882 or 25C700169 or 25C701025	Power transformer

Tubes

Ref. No.	Part No.	Description
V-1	6CB6	RF Amplifier
V-2	12AT7	Mixer-Oscillator
V-3	6AU6	1st IF Amplifier
V-4	6AU6	2nd IF Amplifier
V-5	6AG5	3rd IF Amplifier
V-6	6AL5	Video Detector
V-7	6AH6 or 6CB6	Video Amplifier
V-8	6AU6	Audio Driver-Limiter
V-9	6AL5	Ratio Detector
V-10	6J5	Audio Amplifier
V-11	6V6	Audio Output
V-12	6SN7GT	1st & 2nd Clipper
V-13	6SN7GT	Vertical Sweep Generator
V-14	6W6	Vertical Sweep Output
V-15	6AL5	Phase Detector
V-16	6SN7GT	Horizontal Oscillator
V-17	6BQ6GT	Horizontal Output & Hi-Voltage Generator
V-18	6W4GT	Damping Diode
V-19	1B3GT	Hi-Voltage Rectifier
V-20	14BP4 or 14CP4	Picture Tube: 14" Rectangular
V-21	5U4G	Low Voltage Rectifier

TUNER - MODEL TT-16

Ref. No.	Part No.	Description
	1X701444	TT-16 Tuner: complete with tubes
C-1	21K478234	Molded: 8 mmf
C-2	21K77375	Ceramic tubular: 220 mmf 500V
C-3	21A470789	Ceramic disc: 5000 mmf 450V
C-4	21K77375	Ceramic tubular: 220 mmf 500V
C-5	21K470322	Molded: 20 mmf 500V
C-6	1X701662	Trimmer, ceramic: .5-3 mmf; with screw & mtg nut
C-7	21A701029	Ceramic disc: 1500 mmf
C-8	21A701029	Ceramic disc: 1500 mmf
C-9	21K482726	Ceramic disc: 10,000 mmf 450V
C-10	21K482726	Ceramic disc: 10,000 mmf 450V
C-11		Fine Tuning Trimmer (part of switch)
C-12	1X701662	Trimmer, ceramic: .5-3 mmf; with screw & mtg nut
C-13	21K482726	Ceramic disc: 10,000 mmf 450V
C-14	1X792784	Trimmer, ceramic: 3-13 mmf; with screw and mtg nut
C-15	21K400050	Molded: 10 mmf 500V
C-16	21K478280	Molded: 2 mmf 500V
C-17	21K478234	Molded: 8 mmf 500V
C-18	21A470789	Ceramic disc: 5000 mmf 450V
C-19	21K77375	Ceramic tubular: 220 mmf 500V
C-20	21K478280	Molded: 2 mmf 500V
C-21	21A470789	Ceramic disc: 5000 mmf 450V
C-22	21A470789	Ceramic disc: 5000 mmf 450V
L-1	24A790033	Antenna impedance matching coil
L-2	24C792764	Antenna coil: channels 2 thru 6; includes L-2A thru L-2E (high channel coils are part of switch).
L-3	24K790536	RF coil: channels 2 thru 6; includes L-3A thru L-3E (high channel coils are part of switch).
L-4	24C700114	Oscillator coil: channels 2 thru 6; includes L-4A thru L-4E (high channel coils are part of switch)
L-4M	24K700115	Oscillator coil: channel 10
L-5	24K792765	Antenna primary: low frequency includes L-5A, L-5B, & L-5C
L-6	24K701839	RF coil: channel 13
L-7	24K700116	Oscillator coil: channel 13
L-8	24K792577	RF choke: molded; 3.3 microhenries.
L-9	24K780128	RF choke: molded; 2.2 microhenries.
L-25	24K790145	RF choke: molded; 0.47 microhenries
R-1	6R6397	22,000
R-2	6R6048	47,000 10% 1/2W
R-3	6R5614	56 10% 1/2W
R-4	6R2036	33 10% 1/2W
R-5	6R6229	1000 10% 1/2W
R-6	6R5659	3900 10% 1/2W
R-7	6R6069	2200 10% 1/2W
R-8	6R6320	10,000 10% 1/2W
R-9	6R6038	1500 10% 1/2W
R-10	6R6117	5600 10% 1/2W
R-11	6R6393	1200 10% 1/2W
R-12	6R6080	4700 10% 1/2W
T-1	24K701135	Mixer IF: less cores & mtg nuts

NOTE: Tuner mechanical parts are included in following list.

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CHASSIS TS-114 MECHANICAL PARTS

Part No.	Description
7A791965	Bracket, interlock safety
7A701393	Bracket, transformer cut-out: large (beneath 25C700161 or 25K700882 power trans)
7A701396	Bracket, transformer cut-out: small (beneath 25C700169 or 25C701025 power trans)
1X701407	Bracket, rear tube support: with tube grounding spring
7A792568	Bracket, yoke adjustment (across top of defl yoke)
7B700194	Bracket, focus coil mtg: bottom ("U" bracket around focus coil)
35K700532	Bumper, rubber (circular bumper in large rear support brkt)
7A700196	Bracket, focus coil mtg: top (across top of focus coil)
7K700153	Bracket, coil mtg (L-27 mtg)
42A72609	Clip, grounding (V-10 tube shield)
35K792757	Cushion, focus coil (between coil & tube)
39K17396	Contact, pin terminal (in spkr receptacle
42K701443	Cap, plate: with lead (for 6BQ6)
15B791111	Cover, test socket
42A700147	Clamp, lead retainer (on hi-volt rect filament leads)
42K471342	Cap, plate (hi-volt rect)
46A470302	Core, iron, & screw (T-3 secondary)
42B70721	Clip, coil mtg (T-3 secondary)
46A70023	Core, iron, & screw (T-3 primary, L-14)
46A478242	Core, brass, & screw (T-2)
46K791756	Core, brass, & screw (L-11 & L-15)
46K480256	Core, iron & screw (L-12 & T-1 secondary)
46A470310	Core, iron, & screw (L-18, L-20, & T-1 primary)
46K471143	Core, iron, & screw (L-23)
42A76244	Clip, coil retainer (L-23)
46A700090	Core, iron, & screw (L-27)
5A790684	Grommet, tube socket (V-14 & V-16 socket mtg)
14A780184	Insulator, antenna lead (insulates 300 ohms line from chassis)
14K791892	Insulator, coil (in T-2 can)
14K87179	Insulator, coil (in T-3 can)
4S7655	Lockwasher, internal: 3/8; cad pl (front controls mtg)
4S9751	Lockwasher, int-ext: #8; cad pl (T-8 & focus coil mtg)
4S2640	Lockwasher, internal: 1/2 thin; cad pl (mounts bottom focus coil mtg brkt).
4S7688	Lockwasher, int-ext: 1/4; cad pl (mounts bottom focus coil mtg brkt).
2A790191	Nut: special: cad pl (mounts ceramic trimmers)
2A791404	Nut, coil & core mtg (L-27)
2A470049	Nut, coil & core mtg (T-1, T-2, L-11, L-12, L-14, L-15, L-18, & L-20)
2B70703	Nut, palnut; special (T-3 primary coil mtg)
2S7093	Nut, hex: palnut; 6-32 x 1/4 cad pl (T-2 shield mtg)
2S7022	Nut, hex: 1/4-20 x 7/16; cad pl (mounts bottom focus coil mtg brkt
2S7003	Nut, hex: 8-32 x 5/16 stl; cad pl (T-8 & focus coil mtg)
2S7051	Nut, hex: palnut; 3/8-32 x 9/16; cad pl (rear controls mtg)
2S7004	Nut, hex: 3/8-32 x 9/16; cad pl (front controls mtg)
64A700690	Plate, electrolytic mtg (when 3 electrolytics used)
28K471323	Plug, line cord: 2-pin; waxed
64K700748	Plate, socket cover (covers unused hole when only two electrolytics are used)
64A700745	Plate, transformer cover (beneath 24C700161 & 25K700882 power trans)
35K701379	Pad, cushion (under picture tube)
35K700166	Pad, cushion (on picture tube retainer strap)
64B701162	Plate, chassis cover (removable plate on chassis side)
9a54664	Receptacle, female (test jack)
5S7770	Rivet: .088 x 5/32 stl; pol nkl (V-2 socket mtg)
5S7728	Rivet: .122 x 5/16 stl; pol nkl (V-19 socket mtg)
9A22367	Receptacle: 5-prong (spkr receptacle)
5S7703	Rivet: .122 x 7/32 stl; pol nkl (pix tube grounding spring mtg)
5S6842	Rivet: .145 x 5/32 stl; pol nkl (mounts T-4 & T-5)
5S7700	Rivet: .122 x 1/4 stl; pol nkl (line cord mtg)
5K71246	Rivet, shoulder: nkl pl (V-14 & V-16 socket mtg)
5S2815	Rivet: .088 x 7/32 stl; pol nkl (9K780442 & 9K484167 socket mtg)
5S8497	Rivet: .088 x 1/8 stl; pol nkl (V-1 & V-5 socket mtg)
5S7707	Rivet: .122 x 5/32 stl; pol nkl (mounts 9K471270 socket & terminal strips)
3S490822	Screw, machine: 6-32 x 1 slotted hex head; cad pl (ceramic trimmer adj)
3S490508	Screw, sheet metal: #6 x 3/4 PKA plain hex head; cad pl
3S7467	Screw, sheet metal: #8 x 3/8 PKA plain hex head; cad pl (T-7 mtg)
3S7163	Screw, machine: 8-32 x 1/4 plain hex head; cad pl (yoke adj. bracket mtg)
3A700198	Screw, eccentric: cad pl (mounts bottom focus coil mtg brkt)
3A470369	Screw, thumb: cad pl (yoke adjustment)
3S7467	Screw, sheet metal: #8 x 3/8 PKZ plain hex head; cad pl (mounts top focus coil mtg brkt)
3S7454	Screw, sheet metal: #8 x 1/4 PKZ plain hex head; cad pl (test socket cover mtg)
3S8146	Screw, sheet metal: #8 x 1 PKZ plain hex head; cad pl (tube retainer strap mtg)
3S490459	Screw, machine: 6-32 x 1 1/8 slotted round hex head; brass (secures hi-volt trans plates)
26A26283	Shield, tube (for glass 6J5 audio amp)
26A90301	Shield, tube: miniature
42C701181	Strap, tube retainer: with pl (around picture tube front)
41A471379	Spring, tension (picture tube support)
26B700835	Shield, IF (between audio & video IF strips)
26C701345	Shield, tuner chassis
31K4573	Strip, terminal: 3 ins #3 gnd; 1/2" spacing
9A480274	Socket, tube: octal; molded (hi-volt rect)
31A791613	Strip, terminal: special (on hi-volt trans)
41A70705	Spring, coil (T-3)
26K485936	Shield, coil (T-3)
9K471270	Socket, tube: octal (all octal sockets except V-14, V-16, & V-19)
9A471343	Socket, tube: miniature; tan molded (V-5)
9K780442	Socket, tube: miniature 7-prong (V-3, V-4, & V-6)
9K484167	Socket, tube: miniature 7-prong (V-7, V-8, V-9, & V-15)
9A790685	Socket, tube: octal (V-14 & V-16)
31K90046	Strip, terminal: 5 ins #4 gnd; 3/8" spacing
31K37494	Strip, terminal: 4 ins #3 gnd; 3/8" spacing
31K471568	Strip, terminal: 4 ins #2 gnd; 3/8" spacing
31K51511	Strip, terminal: 3 ins #3 gnd; 3/8" spacing
31K471564	Strip, terminal: 3 ins #2 gnd; 3/8" spacing
31A791402	Strip, terminal: 6 ins #4 gnd; 3/8" spacing
31K4602	Strip, terminal: 5 ins #3 gnd; 1/2" spacing
31A470164	Strip, terminal: 8 ins #2 & 7 gnd; 3/8" spacing
41A700563	Spring, tube grounding (grounds outer picture tube coating)
1X701157	Shield, coil: with spade bolts (T-2)
31A21990	Strip, terminal: 2-screw (antenna terminal)
9K701449	Socket, picture tube: 5-pin; with leads.
or	
9K701451	Socket, picture tube: 12-pin; with leads
41A700143	Spring, compression (L-27)
9K701324	Socket, tube: noval (V-2)
9K701456	Socket, tube: miniature (V-1)
31A792459	Strip, terminal: 2 ins #3 mtg: 3/8" spacing
31A701497	Strip, terminal: 3 ins #2 mtg; 1/4" spacing
31A102619	Strip terminal: 2 ins #2 mtg; 1/4" spacing
24K700585	Trap, ion: PM
or	
24K700586	Trap, ion: PM
or	
24K700587	Trap, ion: PM
1X701482	Tube mtg plate: with bracket & socket (hi-volt rect)
11M490387	Wax, bi-wax (on hi-volt transformer)
4S7596	Washer; flat: 1/2 x .203 x .033 stl; cad pl (retainer strip)
4A77577	Washer, insulating (L-27 mtg)
4S1720	Washer, flat: 3/8 x .156 x .030 stl; cad pl (pix tube rear support brkt mtg)
4S1719	Washer, flat: 3/8 x .40 x .030; cad (pix tube grounding spring mtg)
4A791447	Washer, insulating (T-7 mtg)
4S7569	Washer, flat: 5/16 x .145 x .027; cad pl (V-14 & V-16 socket mtg)

MODEL 14T3 CABINET PARTS

Part No.	Description
1X792494	Bracket, window mtg: with pad
16B700099	Board, baffle: with grille cloth
35A790097	Bumper, rubber: with bushing (cabinet feet)
1X701529	Back cover: complete with picture tube rear cover, antenna recept mtg plage, antenna support bracket, centering adjustment cover, and line cord
7A701358	Bracket, antenna support
16F701061	Cabinet, table model: molded plastic; walnut; less window & grille cloth
42A792502	Clip, mask retainer
1X701527	Cover, chassis bottom with hi-volt insulator
15K700596	Cover, picture tube rear (on back cover).
30B470756	Cord, line: with plug & receptacle
15K792068	Cover, centering adjustment: rubber (on back cover)
5S3139	Eyelet: .202 x .475 brs; ant cap (on back cover)
14B792069	Insulator, high voltage (on bottom cover)
36A485457	Knob, control (hold controls on chassis rear)
36C700732	Knob, control: brn (fine tuning & off-volume)
36K700734	Knob, control (contrast)
36C700733	Knob, control (station selector)
4S7651	Lockwasher, internal: #8; cad pl (spkr mtg)
4S7650	Lockwasher, internal: #6; cad pl (hi-volt insulator mtg)
1X701526	Mask, picture tube: with retainer clips.
2S7003	Nut, hex: 8-32 x 5/16 (spkr mtg)
35K700799	Pad, cushion (window mtg)
35K792501	Pad, cushion (on window mtg brkt)
35K471282	Pad, asbestos
64A792052	Plate, antenna receptacle mtg
5K791856	Rivet, shoulder: annealed (line cord mtg)
5S7751	Rivet: .122 x 1/4 stl; ant cop (mounts ant recept mtg plate)
5S7703	Rivet: .122 x 7/32 stl; ant cop (picture tube rear cover mtg)
5S1683	Rivet: .122 x 3/16 brs; pol nkl (mask clip mtg)
5S7706	Rivet: .122 x 1/8 stl; pol nkl (hi-volt insulator mtg)
3S488098	Screw, sheet metal: #8 x 3/8 type 25 plain hex head; cad pl (window mtg)
3K791825	Screw, insulated head: statuary bronze (spkr mtg)
3S7467	Screw, sheet metal: #8 x 3/8 PKZ plain hex head; cad pl (mask mtg)
3S400220	Screw, sheet metal: #10 x 3/4 PKA plain hex head; cad pl (bottom cover mtg)
3S8126	Screw, sheet metal: #8 x 1 1/4 PKA plain hex head; cad pl (cabinet feet mtg)
3S7536	Screw, sheet metal: #6 x 3/8 PKA slotted acron head; ant cop (back cover mtg)
3S490819	Screw, sheet metal: #6 x 7/8 PKA slotted acron head; ant cop (back cover mtg)
35A701524	Strip, antenna support: chip board (supports"Bilt-in-Tenna")
3S2957	Screw, machine: 8-32 x 1/2 plain hex
4K780040	Washer, felt (under control knobs)
4S7566	Washer, flat (3/8 x 5/32 x .033 stl; cad pl
4S7629	Washer, flat: 1/2 x 3/16 x .048 stl; cad pl (bottom cover mtg)
4S1720	Washer, flat: 3/8 x .156 x .030 stl; cad pl (mask mtg)
4S1767	Washer, flat: 5/16 x .130 x .025 brs; pol nkl (mask clip mtg)
61C701152	Window, picture tube: rectangular.

BILT-IN-TENNA MODEL TA-6

Part No.	Description
1X791900	TA-6 Single Loop Antenna: complete
21R2763	Capacitor, mica: 6 mmf 300V
21R2764	Capacitor, mica: 18 mmf 300V
24A791748	Coil, antenna loading (on terminal strip)
24A791989	Coil, high frequency compensating
29A791608	Lug, spade
31K34326	Strip, terminal: 2 ins, #3 gnd; 3/8" spacing

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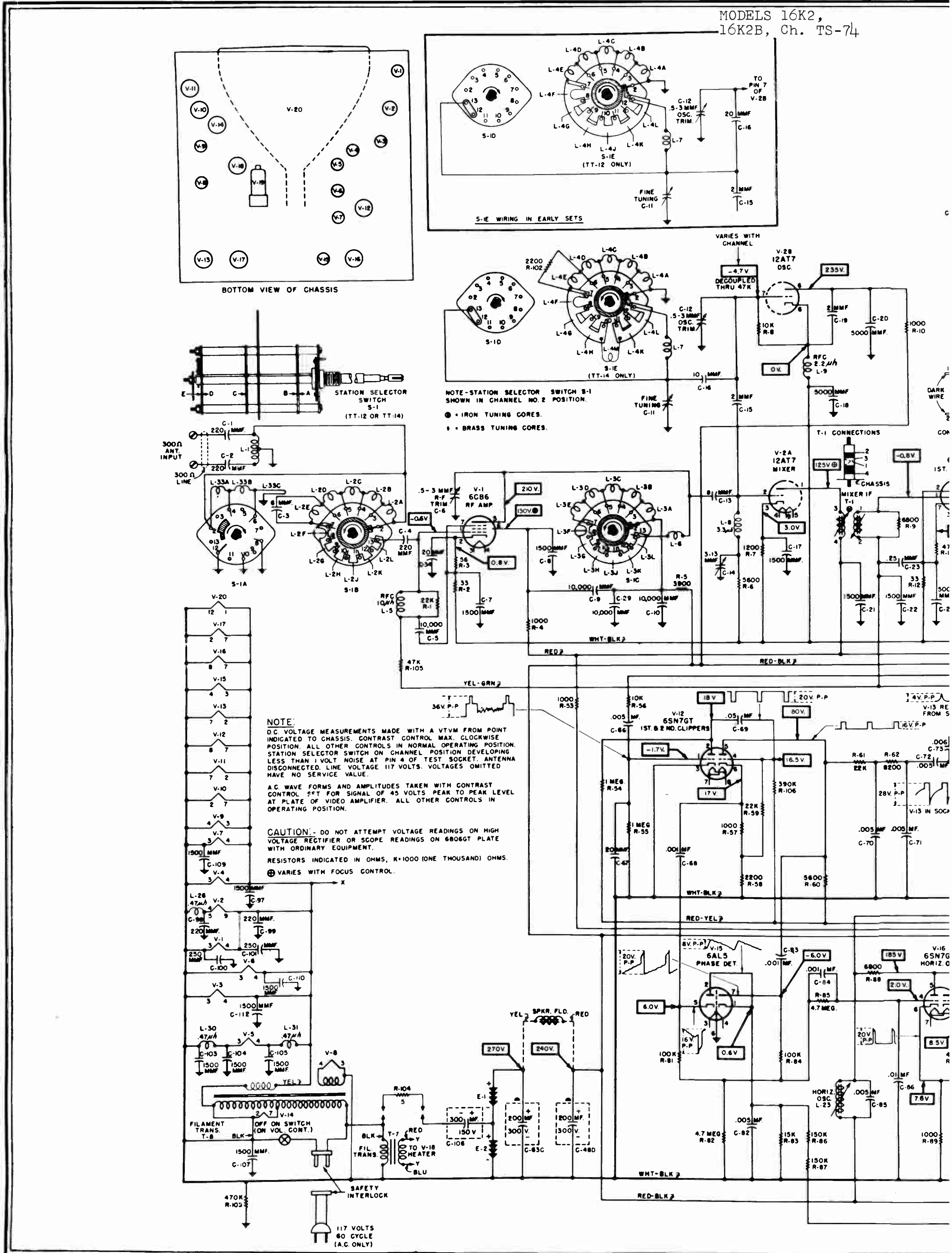
MODELS 16K2, 16K2B, Ch. TS-74



NOTE:
D.C. VOLTAGE MEASUREMENTS MADE WITH A VTVM FROM POINT INDICATED TO CHASSIS. CONTRAST CONTROL MAX. CLOCKWISE POSITION. ALL OTHER CONTROLS IN NORMAL OPERATING POSITION. STATION SELECTOR SWITCH ON CHANNEL POSITION DEVELOPING LESS THAN 1 VOLT NOISE AT PIN 4 OF TEST SOCKET. ANTENNA DISCONNECTED. LINE VOLTAGE 117 VOLTS. VOLTAGES OMITTED HAVE NO SERVICE VALUE.

A.C. WAVE FORMS AND AMPLITUDES TAKEN WITH CONTRAST CONTROL SET FOR SIGNAL OF 45 VOLTS PEAK TO PEAK LEVEL AT PLATE OF VIDEO AMPLIFIER. ALL OTHER CONTROLS IN OPERATING POSITION.

CAUTION:- DO NOT ATTEMPT VOLTAGE READINGS ON HIGH VOLTAGE RECTIFIER OR SCOPE READINGS ON 6BQ6GT PLATE WITH ORDINARY EQUIPMENT.

RESISTORS INDICATED IN OHMS, K=1000 (ONE THOUSAND) OHMS.

⊕ VARIES WITH FOCUS CONTROL.

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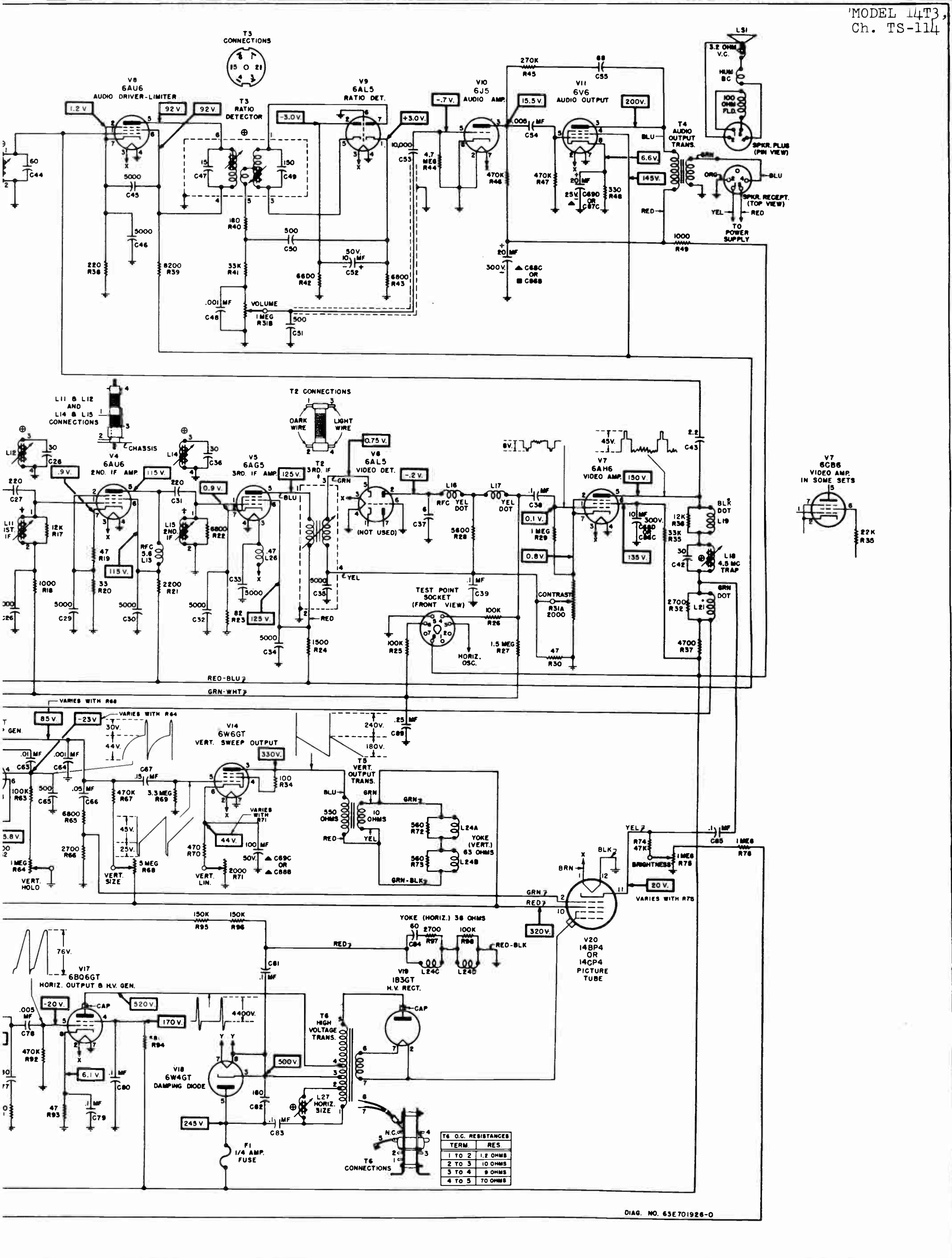
MODEL 14T3, Ch. TS-114



T6 O.C. RESISTANCES	
TERM.	RES.
1 TO 2	1.2 OHMS
2 TO 3	10 OHMS
3 TO 4	9 OHMS
4 TO 5	70 OHMS

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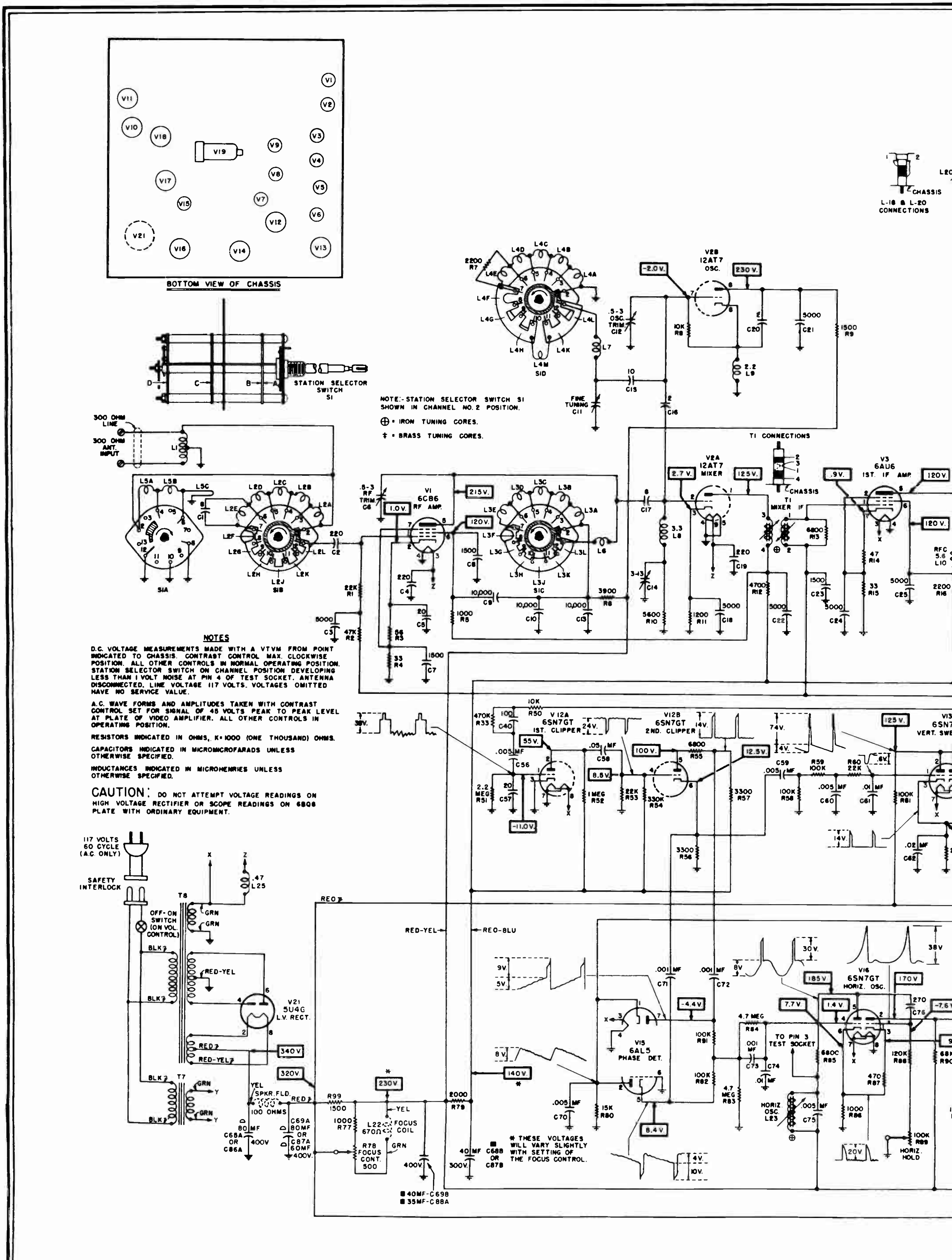

NOTES

D.C. VOLTAGE MEASUREMENTS MADE WITH A VTVM FROM POINT INDICATED TO CHASSIS. CONTRAST CONTROL MAX. CLOCKWISE POSITION. ALL OTHER CONTROLS IN NORMAL OPERATING POSITION. STATION SELECTOR SWITCH ON CHANNEL POSITION DEVELOPING LESS THAN 1 VOLT NOISE AT PIN 4 OF TEST SOCKET. ANTENNA DISCONNECTED. LINE VOLTAGE 117 VOLTS. VOLTAGES OMITTED HAVE NO SERVICE VALUE.

A.C. WAVE FORMS AND AMPLITUDES TAKEN WITH CONTRAST CONTROL SET FOR SIGNAL OF 45 VOLTS PEAK TO PEAK LEVEL AT PLATE OF VIDEO AMPLIFIER. ALL OTHER CONTROLS IN OPERATING POSITION.

RESISTORS INDICATED IN OHMS, K=1000 (ONE THOUSAND) OHMS.

CAPACITORS INDICATED IN MICROMICROFARADS UNLESS OTHERWISE SPECIFIED.

INDUCTANCES INDICATED IN MICROHENRIES UNLESS OTHERWISE SPECIFIED.

CAUTION: DO NOT ATTEMPT VOLTAGE READINGS ON HIGH VOLTAGE RECTIFIER OR SCOPE READINGS ON 6BQ6 PLATE WITH ORDINARY EQUIPMENT.

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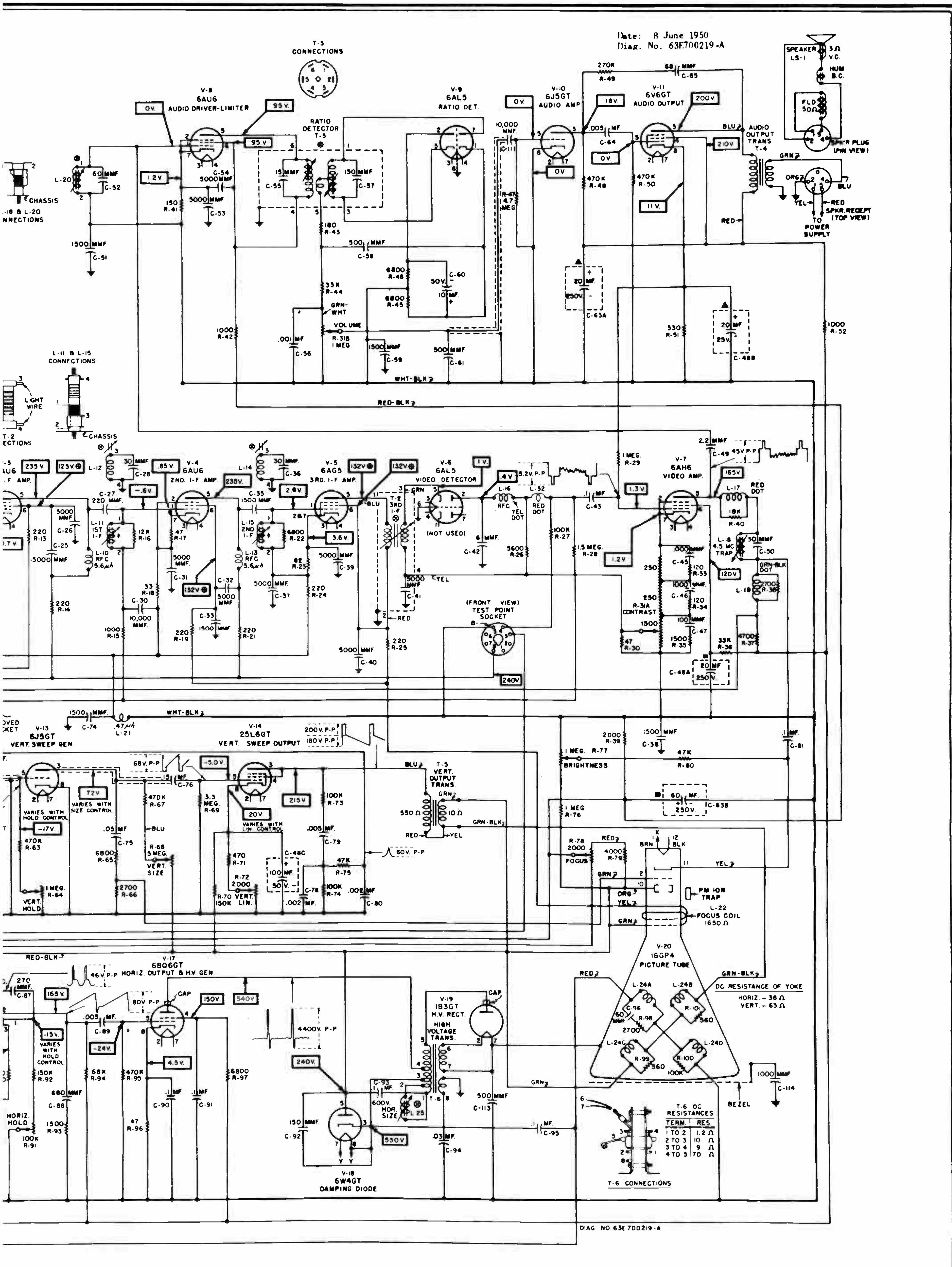

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GENERAL INFORMATION

RECEIVER MODEL BREAKDOWN CHART

Model	Type of Set	TV Chassis Used
16K2	Console, red-brn mahogany	TS-74
16K2B	Console, limed oak	TS-74

TV CHASSIS - Television chassis TS-74 contains 19 tubes plus a 16" picture tube. The picture, sound, and scanning circuits, together with a selenium rectifier, voltage doubler "B" supply, are contained on a single chassis.

TV TUNING RANGE - Channels 2 through 13

TV IF FREQ - Channels 2 to 6: sound - 21.9 mc
picture - 26.4 mc
Channels 7 to 13: sound - 27.3 mc
picture - 22.8 mc

NOTE: In late chassis, using TT-14 tuner, channels 11, 12, and 13: sound 21.9 mc, picture 26.4 mc

ANTENNAS - TV: console; TA-4 "Bilt-In-Tenna". Provision for connection of an external antenna

TV ANTENNA IMPEDANCE - 300 ohms

POWER SUPPLY - 117 volts, 60 cycle AC current only

POWER CONSUMPTION - TV: 170 watts

TV AUDIO OUTPUT - 4 watts

TV CHASSIS TUBE COMPLEMENT

Ref. No.	Tube	Function
V-1	6CB6	RF Amplifier
V-2	12AT7	Mixer-Oscillator
V-3	6AU6	1st IF Amplifier
V-4	6AU6	2nd IF Amplifier
V-5	6AG5	3rd IF Amplifier
V-6	6AL5	Video Detector
V-7	6AH6	Video Amplifier
V-8	6AU6	Audio Driver-Limiter
V-9	6AL5	Ratio Detector
V-10	6J5GT	Audio Amplifier
V-11	6V6GT	Audio Output

(TV Chassis Tube Complement - cont'd)

Ref. No.	Tube	Function
V-12	6SN7GT	1st & 2nd Clippers
V-13	6J5GT	Vertical Sweep Generator
V-14	25L6GT	Vertical Sweep Output
V-15	6AL5	Phase Detector
V-16	6SN7GT	Horizontal Oscillator
V-17	6BQ6GT	Horizontal Output & High Voltage Generator
V-18	6W4GT	Damping Diode
V-19	1B3GT	High Voltage Rectifier
V-20	16GP4	Picture Tube

HIGH VOLTAGE WARNING

Operation of this receiver, outside its cabinet or with covers removed, involves a shock hazard from the power supplies. No work should be attempted on this receiver by anyone not thoroughly familiar with the precautions necessary when working on high voltage equipment.

CATHODE RAY PICTURE TUBE HANDLING PRECAUTIONS

Extreme care must be used in handling the picture tube. The tube is highly evacuated and, due to its large size, is subjected to a considerable atmospheric pressure. The handler should wear safety goggles and gloves for protection. Avoid nicking or scratching the glass by rough contact with other objects.

INSTALLATION AND OPERATING INSTRUCTIONS

RECEIVER LOCATION

The receiver may be placed anywhere in the room, but for greatest satisfaction it should be located:

1. Away from any bright light that may fall directly on the screen or be reflected from it; this includes windows and lamps. Some illumination in the room, off to one side is desirable, however, to prevent eyestrain.

2. To provide comfortable viewing and ease of operation.

3. At least one-inch away from a wall to allow for cabinet ventilation. This is very important.

ANTENNAS

The choice of television antenna depends entirely on the location of the receiver with respect to all television station transmitting antennas in the area. Maximum pick-up is obtained when the receiving antenna is directly in line of sight with the transmitting antenna.

"Bilt-In-Tenna". All receivers using the TS-74 series television chassis are equipped with the Motorola "Bilt-In-Tenna", mounted inside the cabinet, for use in good signal areas.

When this antenna is used, the following precautions should be observed for best reception:

1. In order to get maximum performance and satisfactory pictures from the "Bilt-In-Tenna", ample signals from the television station must be present at the location of the receivers. Normally, the strength of the signals will vary throughout the room in which the receiver is located. For this reason, better pictures will be obtained if the receiver is tried in all possible locations in the viewing room and is then placed where the clearest pictures are received from all stations. Avoid large metallic objects, such as radiators, metal panels, etc.

2. Lamps, vases and metallic objects, when placed on top of the receiver, may affect the efficiency of the "Bilt-In-Tenna".

Indoor Antenna. If additional pick-up is necessary, an indoor antenna, placed on or near the receiver, may be used. The antenna should be rotated and the arms should be adjusted for the best signal, with no ghosts or reflections. Normally, the arms should be extended on the low channels (2-6) and telescoped on the high channels (7-13).

Outdoor Antenna. The Motorola "Bilt-In-Tenna" or the indoor type antenna will give satisfactory reception in strong signal areas; but, if the receiver is located in a fringe or weak signal area, an outdoor antenna is recommended.

In areas free of obstructions and reflections, within reasonable proximity to television transmitters, a dipole and reflector will prove satisfactory. Since such an antenna has a relatively small band coverage, a special antenna covering all twelve television channels should be used if it is desired to receive stations on channels of widely separated frequencies.

Location of the antenna should be decided from the standpoint of maximum signal pick-up. In general, the antenna should be broadside to the transmitting antenna and should be as high as possible. If a reflector is used, the antenna should be oriented so that the driver element is closest to the station and the reflector farthest away.

Locating the antenna and lead-in as far away as possible from highways, hospitals, doctors' offices, electrical machinery, etc., will help to reduce noise pick-up from such sources. Also, it is desirable to keep the antenna at least six feet away from other antennas, metal roofs, gutters, or other metal objects to prevent unwanted reflections and shielding.

Lead-In. Since the TS-74 chassis is designed for 300 ohm input, the standard 300 ohm twin lead line should be used for connecting the outside antenna to the receiver. Twisting the line one complete turn per foot of running length helps to reduce noise pick-up on the line. The lead-in should be supported on stand-off insulators and kept tight enough to prevent mechanical damage through swaying. Avoid running the lead-in close to metal gutters, iron standpipes, etc.

In areas of very strong signals, or where severe local electrical interference is encountered, 300 ohm shielded twin lead is recommended. The shield braid should be grounded.

An approved lightning arrestor should be used.

RECEIVER ANTENNA CONNECTION

The antenna lead-in to the television receiver is connected to the two screws of the terminal strip on the rear of the cabinet. Disconnect the "Bilt-In-Tenna" leads from the terminal strip before attaching an external antenna lead-in. Sometimes reversing the lead-in connections at the receiver may improve picture quality and overall performance.

OPERATING CONTROLS

There are two dual controls, consisting of a small and a large knob each, on the front panel of the receiver. The function of each control is marked on the front panel; the "circle" indicating the large knob, and the "dot" indicating the small knob. See Figure 1 for front panel control functions.

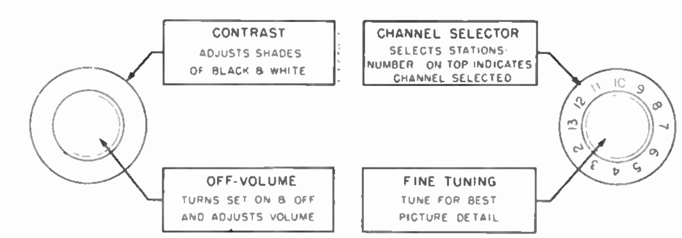

FIGURE 1. OPERATING CONTROLS

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SERVICE ADJUSTMENT CONTROLS

The receiver is completely adjusted at the factory, so normally none other than the front panel control operating instructions need be followed in putting the receiver in operation. However, to provide for any misadjustment of the service controls, due to handling, the following instructions are in order. See Figure 2 for location of the service adjustment controls.

FOCUS CONTROL

The FOCUS control should be adjusted until the fine horizontal line structure of the raster is clearly visible over the picture area. The control should be tuned through the correct point several times so that optimum focus is obtained.

CENTERING

By means of a lever extending from the focus coil, thru the rear screen, the focus coil can be shifted to center the picture in its mask.

VERTICAL SIZE AND VERTICAL LINEARITY

Adjust the VERTICAL SIZE control until the picture fills the mask vertically. Adjust the VERTICAL LINEARITY control for best overall vertical linearity. Adjustment of the VERTICAL SIZE control will require a readjustment of the VERTICAL LINEARITY control and possibly of the VERTICAL HOLD control. Center picture with the centering lever on the focus coil.

HORIZONTAL SIZE

Adjust the HORIZONTAL SIZE lever until the picture fills the mask horizontally. Center picture with the centering lever.

HORIZONTAL HOLD ADJUSTMENT

The HORIZONTAL HOLD control should have a sync range of approximately 180°. If the control is too critical, adjust as follows:

1. Short out HORIZONTAL OSCILLATOR coil L-23. This may be done with the chassis in the cabinet by shorting pins 3 & 8 of the test socket on chassis rear.
2. With the centering lever, move the picture to the left so that the right edge of the raster can be seen. Adjust the HORIZONTAL HOLD control to about the middle of its range and note the width of the blanking pulse. (The blanking pulse appears as a gray bar at the right edge of the picture).
3. Remove short from HORIZONTAL OSCILLATOR coil.
4. Adjust HORIZONTAL OSCILLATOR coil until the same amount of blanking pulse can be seen as was noted in step 2.

VERTICAL HOLD ADJUSTMENT

Adjust the VERTICAL HOLD control for the center of the vertical sync lock-in range.

BRIGHTNESS

Adjust the BRIGHTNESS control, in combination with the CONTRAST control for the most pleasing picture. Keep the brilliance slightly below maximum, however, in order to protect the fluorescent screen of the picture tube and to prevent poor picture detail.

ADJUSTMENT OF ION TRAP

Under conditions of rough shipment, it is possible for the ion trap to become misaligned. To prevent serious damage to the picture tube, the following method of adjustment should be used. See Figure 3.

The magnet should be placed on the neck of the tube in the direction indicated by the marking on the magnet (usually an arrow which points toward the picture tube screen) so that the stronger magnet of the double magnet type or the only magnet in the single magnet type is positioned over the internal pole pieces which are mounted on the gun structure. Adjust the BRIGHTNESS control for low intensity and move the magnet a short distance forward and backward at the same time rotating it to obtain the brightest raster. If, in obtaining the brightest raster, the ion trap magnet has to be moved more than 1/4" from the gun pole pieces, the magnet is probably weak and a new magnet should be tried. Never correct for a shadowed raster with the ion trap magnet if such correction results in decreased brightness. The ion trap magnet must always be adjusted for maximum brightness and if shadows occur at this setting, they should be eliminated by adjusting the focus and deflection coils as explained under "Focus Coil and Deflection Yoke Adjustment".

CAUTION: Keep brightness control at low intensity until ion trap is properly set.

A mirror placed in front of the receiver will aid in making this adjustment.

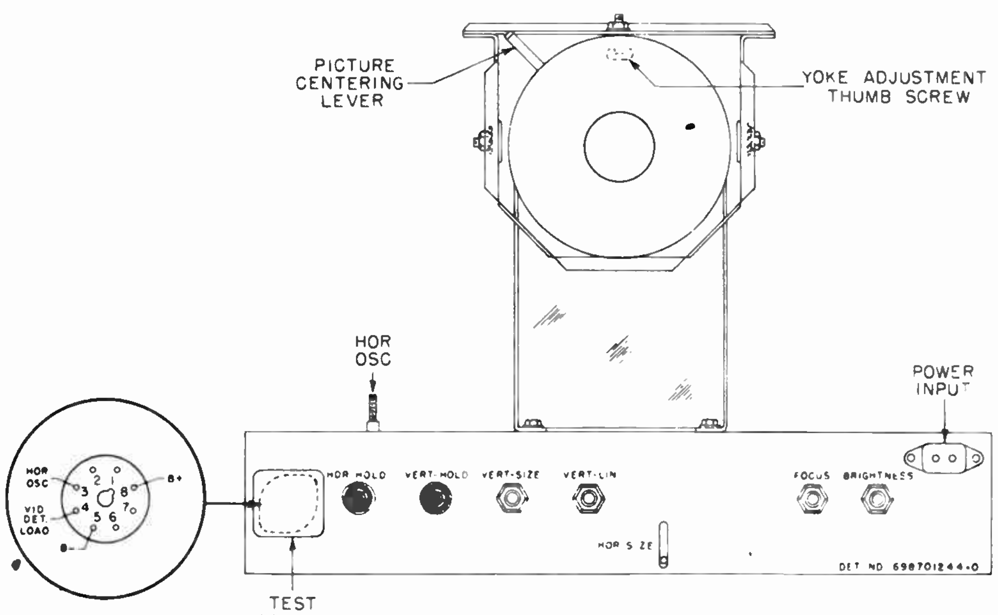

FIGURE 2. SERVICE ADJUSTMENT CONTROLS

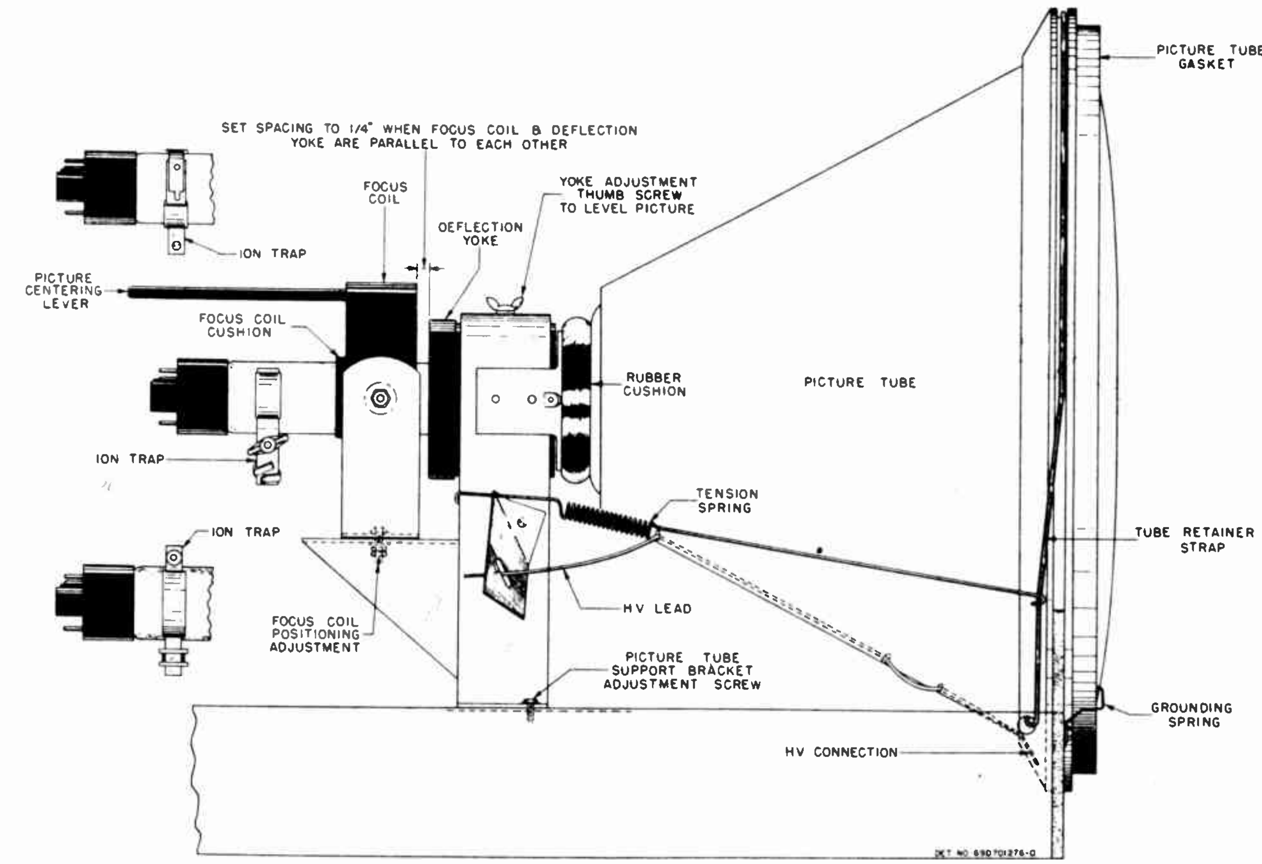

FIGURE 3. PICTURE TUBE ADJUSTMENT LOCATIONS

DEFLECTION YOKE ADJUSTMENT

If the deflection yoke shifts, the picture will be tilted. To correct, loosen the thumbscrew on top of the deflection yoke and rotate yoke until the picture is straight. Before tightening the thumbscrew, make certain that the deflection yoke is as far forward as possible.

If the yoke support and the picture tube have shifted in transit or, if for any reason these parts have been removed and replaced, it is best to do a complete job of repositioning. See Figure 3. The starting point is the position of the picture tube. This is fixed by the front tube mounting. The picture tube rear support bracket positioning adjustment screws should be loose enough to permit sliding the bracket forward until the rubber cushion fits snugly up against the flare of the tube. CAUTION: Do not use force in sliding the bracket up. If too much force is used, a strain will be placed on the neck of the tube when the support bracket positioning adjustment screws are tightened. Also the yoke may be forced out of position. The opening in the yoke should be concentric with the neck of the tube.

FOCUS COIL

The focus coil bracket positioning screw nuts should now be loosened and the focus coil bracket moved up so that when the focus coil is parallel with the deflection yoke the space between them is 1/4". In tightening the focus coil bracket positioning screw nuts, tighten the first one so that the spring washers will have enough tension to hold the bracket firmly, but not so tightly as to cause difficulty in making picture centering adjustment. Then tighten the second nut to act as a lock to prevent loosening of the tension.

TEST SOCKET

A test socket is provided on the rear of the chassis which allows adjustment of the horizontal oscillator and checking of sensitivity without removing chassis from cabinet. See Figure 2 for socket connections.

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ALIGNMENT

GENERAL

The chassis should be mounted on angle iron brackets (Motorola Part No. 7X700210) so that all connections and adjustments may be made easily.

Since the power cord circuit is broken by the interlock when the cabinet back is removed, it will be necessary to obtain an extra power cord with the female interlock receptacle in order to make a power connection to the receiver. Order Motorola Part No. 30B470756.

It is recommended that an isolation transformer be used between the receiver and the AC line whenever any test equipment is attached to the chassis. This precaution is especially important if grounded test equipment is used. NEVER GROUND THE RECEIVER CHASSIS DURING TESTING OPERATIONS OR INSTALLATION UNLESS AN ISOLATION TRANSFORMER IS USED.

ORDER OF ALIGNMENT

A complete receiver alignment can be most conveniently performed in the following order:

1. Audio Take-Off & Ratio Detector
2. 4.5 Mc Trap
3. IF Coils & Mixer Transformer
4. Osc & RF Sections

AUDIO TAKE-OFF & RATIO DETECTOR ALIGNMENT

Equipment Required:

AM Signal Generator: (Optional)	Accurately calibrated at 4.5 mc Adjustable output
DC Meter:	Low range electronic voltmeter

Procedure:

Refer to Figure 4 for location of adjustments.

1. If possible, it is desirable to align the audio section from an actual station signal, since the 4.5 mc alignment frequency will be exact. The fine tuning trimmer should be turned off the station slightly, to prevent overloading the ratio detector.

2. If a signal generator is used, tune it accurately to 4.5 mc, and adjust the output to approximately 10,000 microvolts. Connect the high side of the signal generator through a 1000 mmf capacitor to the grid (pin 1) of the video amplifier tube V-7 (6AH6), and the low side to B-. The following applies whether the station signal or signal generator is used.

3. From either side of capacitor C-60 (10 mf), connect an electronic voltmeter to B- decoupled thru 10K ohms.

4. Set the contrast control for maximum gain (fully clockwise).

5. Peak L-20 for maximum reading on meter.

6. Peak T-3 primary (top core) for maximum reading on meter.

7. Move the meter and decoupling resistor from C-60 to junction of R-44 (33K) and lead to volume control.

8. Adjust T-3 secondary (bottom core) for zero response on 2.5V scale of meter. This corresponds to the cross-over point on the FM detector curve. If desired, the symmetry of the curve may be checked by tuning the signal generator 25 Kc above and below 4.5 mc and noting the plus and minus voltage produced, reversing the meter connections as necessary. For proper balance of the ratio detector system, the voltage in each direction should be approximately equal. If not, check the tuning of L-20 and the primary & secondary of T-3, the ratio detector. If necessary, replace the ratio detector tube V-9 (6AL5). It is desirable to calibrate the generator on a station signal. This may be done by nulling the secondary on a station signal and then connecting the generator and tuning it to produce the same null without touching the trimmers in the set.

NOTE: As the adjustments are brought to resonance, it is advisable to reduce signal generator output to prevent overloading.

With a 10,000 microvolt signal into the grid of the video amplifier tube, with the contrast control turned fully clockwise, and the focus control at center of its range, the voltage read from one side of capacitor C-60 should be greater than 5.0V.

4.5 MC TRAP ALIGNMENT

1. Connect the high side of the signal generator through a 1000 mmf capacitor to the grid (pin 1) of the video amplifier tube V-7 (6AH6), and the low side to B-.

2. Connect the voltmeter and germanium crystal rectifier, as shown in Figure 5, between the cathode of the picture tube (yellow lead) and B-. Use the lowest voltage scale on the meter.

3. With the signal generator accurately set at 4.5 mc and maximum output, adjust trap L-18 for minimum reading on the meter.

IF AMPLIFIER ALIGNMENT

Equipment Required:

IF Sweep Generator meeting the following requirements:

18 to 30 mc, approximately 12 mc sweep width. Output constant and adjustable to at least .1 volt maximum with accurately calibrated, adjustable markers.

Cathode Ray Oscilloscope: preferably one with a calibrated input attenuator.

NOTE: If there is no built-in marker in the sweep generator, loosely couple the output of an accurately calibrated AM signal generator to the IF strip. At all times, keep the marker output low enough to prevent the marker from distorting the response curve.

If a wide band scope is used, the marker will be more distinct if a capacitor of 100 to 1000 mmf is placed across the scope input. Use the smallest size possible, since too large a value will affect the shape of the curve.

Procedure:

1. Remove high voltage generator tube V-17 (6BQ6GT) from its socket to eliminate horizontal pick-up in the oscilloscope.

2. By means of an external battery, apply a negative 3.0 volt bias from the bottom of the 1st IF tube grid resistor R-9 (6800) to B-.

3. Using leads as short as possible, connect the hot side of the sweep generator to the grid (pin 1) of the 1st IF tube V-3 (6AU6) through a 5000 mmf capacitor (do not use the loose or "spraying" method of coupling). The low side is connected to B-. Set the center frequency of the sweep to about 24.6 mc and adjust initially for a sweep deviation of approximately 12 mc. However, a sweep of from 8 to 10 mc may be found better for overall alignment.

4. Using R-27 (100K) as a decoupling resistor, connect the scope between the top of the detector load resistor R-26 (5600) and B-. If a stronger output is required, connect the scope between the picture tube cathode and B-. The curve seen at this position will be the reverse of the polarity shown in Figure 6.

5. Set the contrast control at minimum.

NOTE: If a distorted or unstable picture is seen on the oscilloscope during alignment, it may be necessary to stop the oscillator by disconnecting resistor R-10 (1000) from the plate (pin 6) of the oscillator tube V-2B (12AT7), or by substituting another tube with pin 6 removed.

CAUTION:

1. Do not reduce the oscilloscope gain and increase signal input so that the top of the curve is flattened, due to limiting in the video or scope amplifiers.

2. The dress of plate & grid components in the IF affects tuning. Do not move indiscriminately.

3. On the IF coils and on the traps, the resonance point will be found at two settings of the slug. The correct setting is the one which is found with the greater part of the adjusting screw out of the coil.

NOTE: The 1st & 2nd IF traps are tuned from bottom of chassis, while IF cores are adjusted from the top.

6. Tune the low frequency trap L-14, located on the 2nd IF coil, for maximum attenuation on the curve at 21.9 mc.

7. Tune the high frequency trap L-12, located on the 1st IF coil, for maximum attenuation on the curve at 27.3 mc.

8. Adjust the 1st IF coil, L-11, to place a 26.6 mc marker on the high side of the response curve 60% down from maximum response. See Figure 6.

9. Adjust the 2nd IF coil, L-15, to place a 22.7 mc marker on the low side of the response curve 60% down from maximum response.

10. Adjust the 3rd IF plate transformer T-2 to provide a flat top or symmetrical response curve.

11. Reset the traps (steps 6 & 7) and again check the IF for proper response.

NOTE: It is suggested that the bias be removed for accurate resetting of the traps.

12. With bias applied, connect the sweep between the grid (pin 2) of the mixer tube V-2A (12AT7) and B-.

13. Disconnect the trimmer, C-14, in LC circuit in the grid of the mixer tube, or short the trimmer through a 10,000 mmf ceramic disc type to B-.

14. Bring both cores of the mixer transformer, T-1, simultaneously from the outside towards the center. The half-way markers should be 26.4 mc and 22.9 mc. See Figure 7.

NOTE: In aligning the three IF coils, each coil is adjusted individually, but when adjusting the primary and secondary of the mixer transformer, the adjustments should be made simultaneously. The important point to keep in mind is to obtain a flat response curve with as much gain as possible. The sides of the curve should be straight and as steep as possible. Simultaneous adjusting of the primary and secondary is the easiest way to obtain this result. The transformer by itself is, in effect, tuned for the same pass band as the three staggered circuits. See Figure 7. The only difference in the overall waveform should be that the sides of overall wave are steeper. Constant use of the 50% markers (22.9 mc & 26.4 mc) should be resorted to, since it is absolutely necessary to obtain the proper curve. A slight dip (not exceeding 10%) is permissible in the mixer transformer response curve.

BANDWIDTH

The bandwidth may be determined by connecting an AM generator to the mixer grid. With the generator frequency at 24.6 mc, adjust the output for 1 volt reading on a VTVM connected at the plate (pin 2) of the video detector tube V-6 (6AL5) and B-. Double the output of the generator. Now by tuning either side of 24.6 mc and noting the frequencies at which the VTVM again reads 1 volt, the 6 db bandwidth points are indicated.

REGENERATION CHECK

After the above IF and mixer transformer alignment has been made, a check for regeneration in the IF amplifier strip should be made. This is done by removing the battery bias and observing the output response curve on the oscilloscope, as taken between the picture tube cathode and B-. The bandwidth may change with the bias removed but should not change more than 0.2 mc. Set the contrast control to maximum gain. Decrease the input until the output signal shows a marked decrease. Any regeneration present will be indicated by sharp peaks on the overall response curve. The oscillator should be stopped, as described above, during this procedure.

CAUTION: Do not inject too much marker signal.

MIXER LC ADJUSTMENT

Reconnect bias removed for regeneration check. Re-

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NO.	TYPE	FUNCTION
V-1	6CB6	R-F AMP.
V-2	12AT7	MIXER-OSC.
V-3	6AU6	1ST. I-F AMP.
V-4	6AU6	2ND. I-F AMP.
V-5	6AG5	3RD. I-F AMP.
V-6	6AL5	VIDEO DET.
V-7	6AH6	VIDEO AMP.
V-8	6AU6	AUDIO DRIVER-LIMITER
V-9	6AL5	RATIO DET.
V-10	6J5GT	AUDIO AMP.
V-11	6V6GT	AUDIO OUTPUT
V-12	6SN7GT	1ST. & 2ND. CLIPPER
V-13	6J5GT	VERT. SWEEP GEN.
V-14	25L6GT	VERT. SWEEP OUTPUT
V-15	6AL5	PHASE DET.
V-16	6SN7GT	HORIZ. OSC.
V-17	6BQ6GT	HORIZ. OUTPUT & H.V. GEN.
V-18	6W4GT	DAMPING DIODE
V-19	1B3GT	H.V. RECT.

NOTE:- IN EARLY CHASSIS R-104 WAS NOT A PLUG-IN TYPE RESISTOR AND WAS LOCATED ON BOTTOM OF CHASSIS.

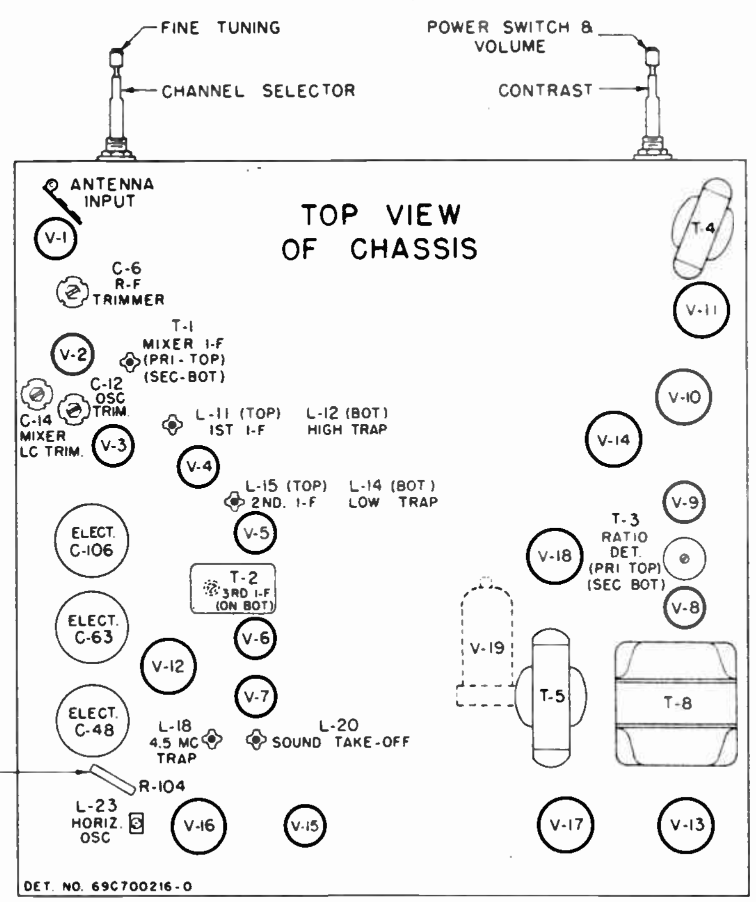

FIGURE 4. TUBE & ALIGNMENT ADJUSTMENT LOCATIONS

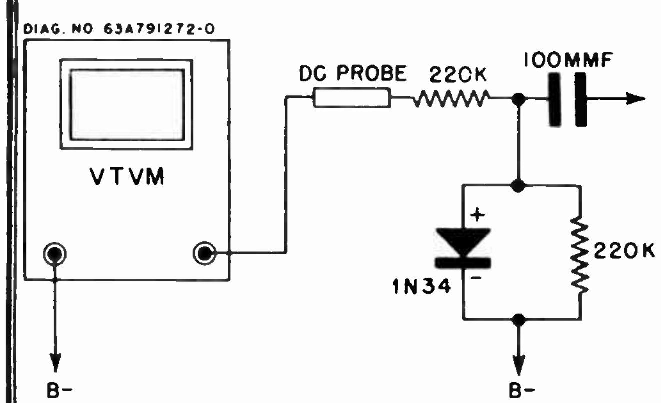

FIGURE 5. ELECTRONIC VOLTMETER CONNECTIONS

place trimmer C-14 in LC circuit of mixer grid or remove 10,000 mmf ceramic between trimmer and B-. Adjust the trimmer so it is tuned to the center of the mixer response curve. This is indicated by observing the effect of the LC circuit on the mixer response. Increasing the capacity of the trimmer and bringing the LC circuit from above the IF range into the IF range, it will be noted that the mixer curve will pull down on the high side, then straighten out as the LC circuit approaches the middle of the range, and pull down on the low side as the LC circuit approaches the low end of the IF range. The proper tuning point is that point at which the mixer curve straightens out. In effect, the LC circuit is similar to a jack coil when it is within the IF range.

CAUTION: Tuning the LC circuit very low will cause oscillation.

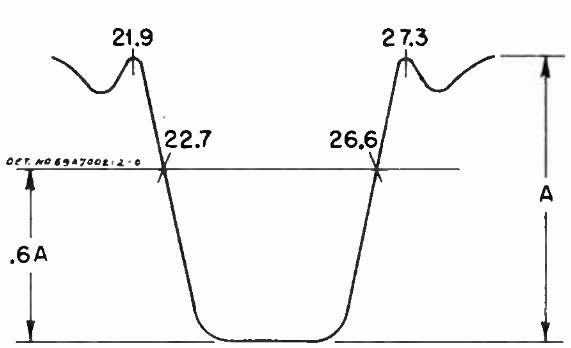

FIGURE 6. IF RESPONSE CURVE

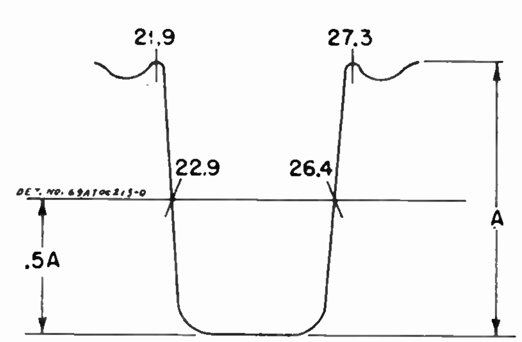

FIGURE 7. OVERALL RESPONSE CURVE FROM MIXER

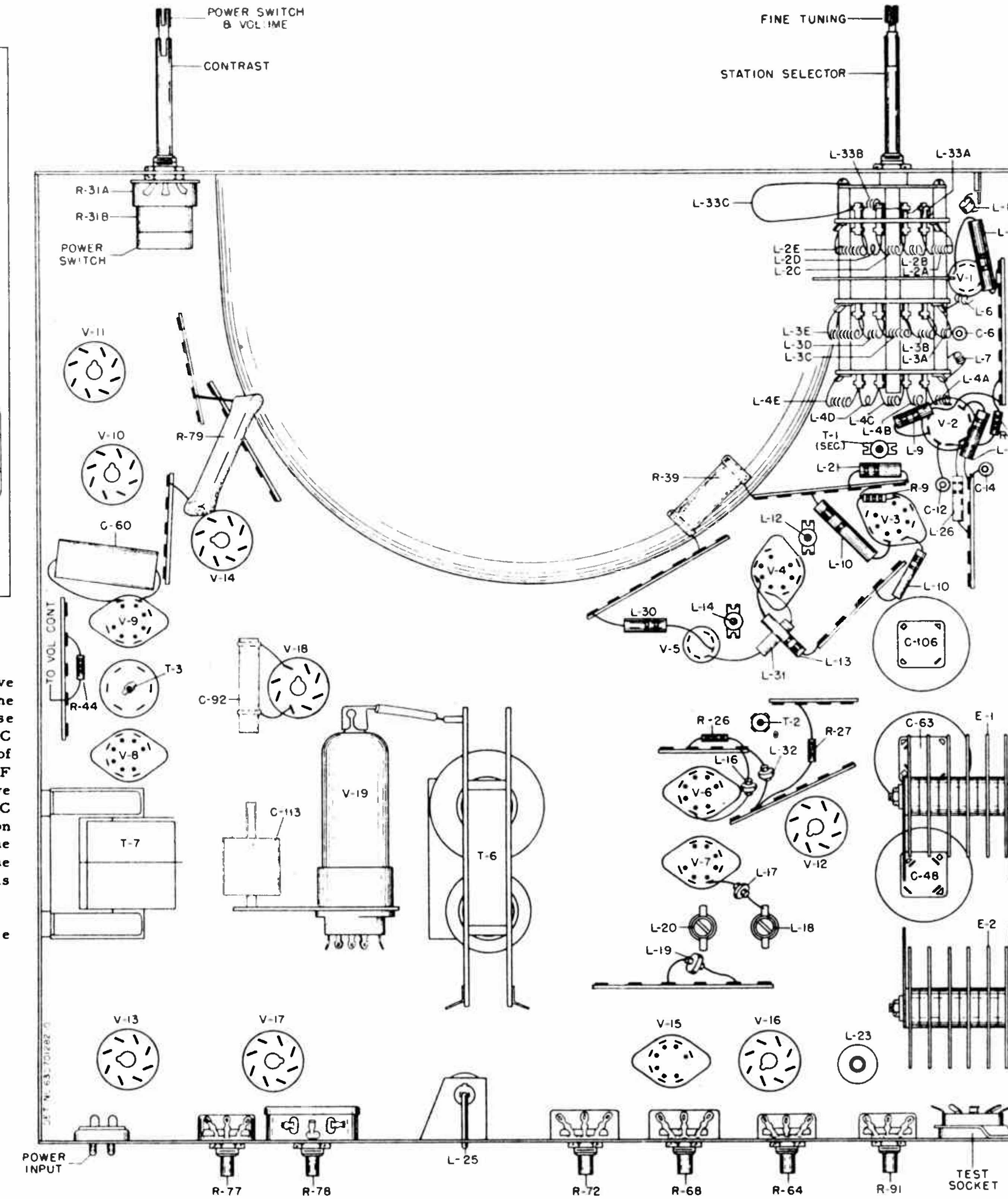

FIGURE 8. BOTTOM VIEW OF CHASSIS

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IF SENSITIVITY MEASUREMENTS

IF Stages Only

1. Remove the battery bias from 1st IF tube grid.

2. Connect an AM signal generator, set at 24.6 mc, through a blocking capacitor of 5000 mmf, between B- and the grid (pin 1) of the 1st IF tube V-3 (6AU6).

3. Connect an electronic voltmeter across the video detector load resistor R-26 (5600). Both leads from the meter should be decoupled with 100K ohm resistors.

4. Set the contrast control for maximum sensitivity.

5. Stop the oscillator tube by disconnecting resistor R-10 (1000) from the plate (pin 6) of tube V-2B (12AT7) or by substituting another tube with pin 6 removed.

6. The signal required to produce 1 volt (negative) above contact potential on the meter should be less than 700 microvolts.

Mixer & IF Stages

The preliminary preparations are the same as for checking the sensitivity of the IF stages except:

1. Connect the AM signal generator, set at 24.6 mc, through a 5000 mmf capacitor, between B- and the grid (pin 2) of the mixer tube V-2A (12AT7).

2. The signal required to produce 1 volt (negative) above contact potential on the meter should be less than 125 microvolts.

OSCILLATOR, ANTENNA AND RF ALIGNMENT

NOTE: The IF must be aligned before the RF section can be properly phased.

Equipment Required:

Sweep Generator: Frequency range 40-220 mc; 10 mc sweep width
Output constant and adjustable
Adjustable markers (markers should be calibrated occasionally by checking against an accurate signal generator).

Oscilloscope: Preferably one with a calibrated input attenuator.

Signal Generator: Frequency range 40 to 220 mc
Accurately calibrated
AM modulated, 400 cycle

FREQUENCY CHART

Chan	Frequency	Picture	Sound	Oscillator
2	54-60	55.25	59.75	81.65
3	60-66	61.25	65.75	87.65
4	66-72	67.25	71.75	93.65
5	76-82	77.25	81.75	103.65
6	82-88	83.25	87.75	109.65
7	174-180	175.25	179.75	152.45
8	180-186	181.25	185.75	158.45
9	186-192	187.25	191.75	164.45
10	192-198	193.25	197.75	170.45
11	198-204	199.25	203.75	176.45(225.65*)
12	204-210	205.25	209.75	182.45(231.65*)
13	210-216	211.25	215.75	188.45(237.65*)

(* in later sets)

ANTENNA & RF ALIGNMENT PROCEDURE

1. Remove high voltage generator tube V-17 (6BQ6GT) from its socket and stop the oscillator by disconnecting R-10 (1000) from plate (pin 6) of V-2B (12AT7).

2. Connect the sweep generator across the antenna terminals on the chassis with the antenna lead-in removed. The line from the sweep generator should be as short as possible.

3. Connect the oscilloscope through a decoupling resistor of 150,000 ohms, between the cathode (pin 3) of the mixer tube V-2 (12AT7) and B-.

4. Short out the AGC circuit with a clip lead from the AGC bus to B-.

5. Refer to Figure 4 for the RF trimmer location and to Figure 9 for the locations of the antenna and RF coils. The frequency chart listed previously gives the channel and alignment frequencies.

6. The antenna coils are tuned to the video carrier frequency and the RF coils are tuned to the sound carriers. Figure 10 shows the shape of the curve which should appear on the scope for channels 2-6 and Figure 11 the curves for channels 7-13.

7. Turn the station selector switch to channel 10. Set the center frequency of the sweep generator to the center frequency of channel 10 (195 mc).

8. Adjust ceramic trimmer, C-6, so that picture and sound markers are as in Figure 11.

9. Check channels 7 to 13 for proper response and, if necessary, tune the coil L-6. These coils may be tuned by spreading them to decrease inductance or compressing them to increase their inductance. See Figure 9 for location of coils. This will have more effect on channels 10 to 13 than 7 to 9. If L-6 is adjusted, it may be necessary to readjust RF trimmer C-6, and recheck the high channels.

NOTE: As the bandwidth of the high channels is very broad, a slight variation is permissible as shown in Figure 11.

10. Move bandswitch to channel 6.

11. With center frequency of sweep generator at the center frequency of channel 6 (85 mc) introduce markers corresponding to sound and picture carriers and compare with curve of Figure 10.

NOTE: A convenient method of determining whether a coil is tuned correctly is to insert a brass or iron slug into the coil. Brass decreases and iron increases the inductance.

12. After channel 6 has been aligned, progress downward through channel 2.

CAUTION: Make certain the station selector switch is on the correct channel before checking band pass.

OSCILLATOR ADJUSTMENT

1. Put oscillator back in circuit.

2. Remove the short from the AGC circuit and apply -3 volt battery bias to AGC.

3. Move the oscilloscope to the video detector output. To provide decoupling, it is best to connect to the low side of R-27 (100K) which is connected thru chokes L-32 and L-16 to the plate (pin 2) of the detector tube V-6 (6AL5).

4. Turn station selector switch to channel 10.

5. Set the contrast control at minimum (counterclockwise).

6. Set the center frequency of the sweep generator to 195 mc and keep the output low enough to show no evidence of limiting in the overall response curve.

7. Introduce a marker corresponding to the sound carrier of channel 10 (197.75 mc).

8. With the fine tuning trimmer at mid-capacity, adjust the oscillator trimmer, C-12, to move the response to the point where the sound marker drops into the trap on the high side of the curve.

9. Check channels 7 to 13 to note whether the sound marker will drop into the trap on the sound side of the response with the fine tuning trimmer within plus or minus 22-1/2 degrees of mid-capacity. If this is not possible, adjust L-7. This coil has more effect on channels 10 to 13 than 7 to 9. It may have to be adjusted to obtain proper tracking on the high channels.

10. Move to channel 6 and progress downward through channel 2, spreading or compressing the coil sections to make the sound marker drop into the trap on the low side with the fine tuning trimmer within 22-1/2 degrees of mid-setting (each number on the station selector switch knob represents 30 degrees).

NOTE: Overall response should be substantially flat and of proper bandwidth.

REVISED OSCILLATOR ADJUSTMENT

Following is the oscillator alignment procedure for the revised tuners appearing in later production TS-74 chassis. Where formerly the oscillator was tuned beneath the carrier on all high channels, it has been raised above the carrier on channels 11, 12, and 13. This places the oscillator outside the TV spectrum on all high channels and, therefore, eliminates the possibility of its interfering with neighboring television receivers.

The new tuner may be identified by the additional coil in the oscillator section. The new coil is across the cut-out section of the stamped plate on the oscillator deck (see Figure 9). In addition, the switch shaft is color coded (red for TS-74 chassis).

OSCILLATOR ADJUSTMENT

NOTE: The Antenna & RF Alignment Procedure is the same as in previous TS-74 chassis. The oscillator adjustment is revised as follows.

1. Put oscillator back in circuit.

2. Remove the short from the AGC circuit and apply a -3 volt battery bias to the AGC bus.

3. Move the scope to the test socket on the chassis rear with the high side connected to pin 4 and the low side to pin 5 (B-).

4. Set the contrast control at minimum (counterclockwise).

5. Remove the fine tuning knob and turn shaft until the slot is in a horizontal position. This represents the mid-capacity position.

6. Turn station selector switch to channel 12.

7. Set the sweep generator on channel 12 with a center frequency of 207 mc and at least a 12 mc sweep. Keep the output low enough to show no evidence of limiting in the overall response curve.

NOTE: Before aligning the oscillator section, make certain the 3.3 microhenry choke in the mixer grid is dressed away from the 2 mmf capacitor tied to the same grid.

8. Introduce a marker corresponding to the sound carrier of channel 12 (209.75 mc).

9. Adjust oscillator ceramic trimmer so that the sound marker falls into the 21.9 mc trap dip in the response curve.

10. Turn generator and station selector to channel 9 with the fine tuning shaft slot still in the horizontal position.

11. Spread or compress the 3-turn coil located in the center of the oscillator plate (L-4M, Figure 9) so that the sound marker for channel 9 falls into the 27.3 mc trap dip in the response curve. As the oscillator is tuned below the carrier on channels 7, 8, 9 & 10, the 27.3 mc trap will be in the same position as the 21.9 mc trap in step 9.

12. Repeat steps 6, 7, 8 & 9.

13. Turn generator and station selector to channel 13.

14. Turn fine tuning trimmer so that the sound marker for channel 13 falls into the 21.9 mc trap dip of response curve. The slot in the fine tuning shaft should not have moved more than 30 degrees from the horizontal position to accomplish this (each number on the station selector knob represents 30 degrees).

15. If more than a 30 degree change in fine tuning trimmer was needed in step 14, adjust channel 13 oscillator coil (L-7) by spreading or compressing until the 30 degree requirement is met.

NOTE: Each adjustment of channel 13 oscillator coil (L-7) will necessitate a rechecking of the oscillator trimmer on channel 12 as per steps 6, 7, 8 & 9.

16. Check channels 12, 11, 10, 9, 8, and 7 by noting whether the fine tuning trimmer can drop the sound marker for each channel in the trap dip by a 30 degree rotation. If one of the channels does not meet the 30 degree requirements, a compromise must be made by resetting channel 9 or 12, whichever is closer to the channel in question.

Example: 1) If channel 11 does not meet the 30 degree requirement, return station selector and generator to channel 12 and tune ceramic trimmer toward channel 11 (trimmer fre-

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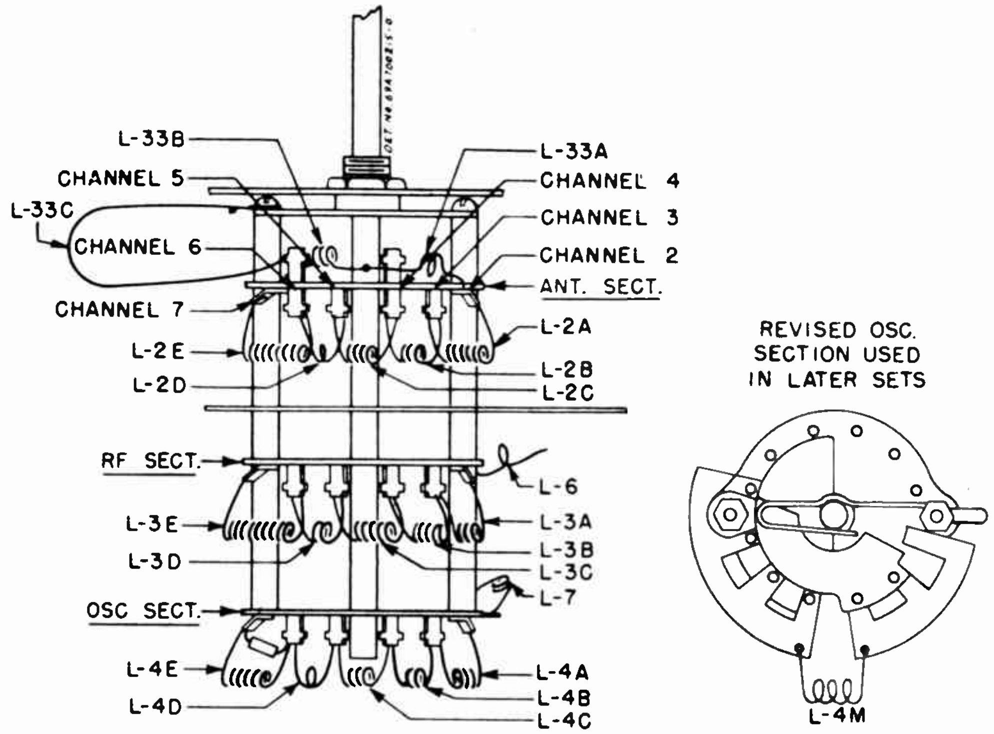


FIGURE 9. ANTENNA, RF AND OSCILLATOR COIL LOCATIONS

quencies lowered by tightening screw). This will tend to move channel 12 sound marker out of the trap dip, but this can be compensated for by the fine tuning trimmer. Do not adjust trimmer any more than is necessary to get the channel in question back within the 30 degree requirement.

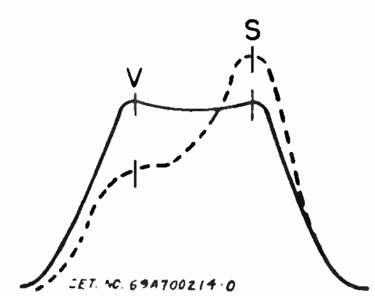
2) If channel 10 does not meet the 30 degree requirement, move station selector and generator to channel 9 and tune the 3-turn coil (L-4M, Figure 9) toward channel 10 (coil frequency raised by spreading turns). This will also tend to move channel 9 sound marker out of the trap dip, but this can be compensated for by the fine tuning trimmer. Again, do not adjust the coil any more than is necessary to bring the channel in question back within the 30 degree requirement.

17. Turn sweep generator and station selector switch to channel 6.

18. Adjust channel 6 oscillator coil (L-4E, Figure 9) so that the sound marker for channel 6 falls into the 21.9 mc trap dip with the fine tuning trimmer at mid-capacity (shaft slot in horizontal position). Always spread or compress channel #6 oscillator coil in units of 3 turns. Compressing turns will move curve toward sound marker, while spreading will move curve toward video marker.

IMPORTANT: Since the coils are in series, the proper alignment of channel 6 will simplify the phasing of the channels to follow.

19. Adjust channels 5 and 4 so that the sound marker for each channel falls into the 21.9 mc trap dip in the



—SOLID LINE INDICATES OPTIMUM RESPONSE.

--- DOTTED LINES INDICATES PERMISSIBLE VARIATION.

FIGURE 10. RF RESPONSE CURVES - CHANNELS 2-6

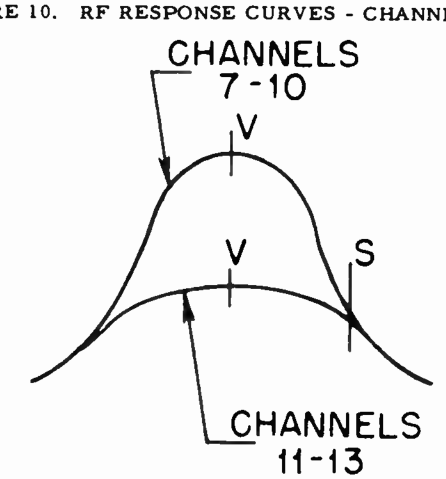


FIGURE 11.
RF RESPONSE CURVES - CHANNELS 7-10 & 11-13

curve with the fine tuning trimmer set no more than 15° from mid-capacity.

20. Channels 3 and 2 should be adjusted so that the sound marker falls into the 21.9 mc trap dip with the fine tuning trimmer within 15° of maximum capacity.

OVERALL RECEIVER SENSITIVITY MEASUREMENT

An overall measurement of sensitivity is made as follows:

1. Connect an AM signal generator to the input terminals of the receiver chassis after removing the short 300 ohm lead which connects to the antenna input strip on the back of the cabinet. To match the generator to the receiver input, a resistor matching network should be used. In the case of a generator with a 50 ohm output impedance, for example, place a 100 ohm resistor in series with the output terminal of the generator and a 150 ohm resistor in series with the ground terminal.

2. From cathode of picture tube to B-, connect a calibrated oscilloscope.

NOTE: To calibrate scope, connect it across 6.3 volt filament supply. The peak-to-peak amplitude on the screen will then be approximately 18V (6.3 x 2.8).

3. Set contrast control for maximum sensitivity.

4. Tune signal generator to the video carrier frequency of the channel being checked. Generator signal should be 30% modulated at 400 cycles. The signal from the generator to produce 20 volts peak-to-peak at picture tube cathode should be less than 25 microvolts on channels 2 to 6 and less than 75 microvolts on channels 7 to 13.

CIRCUIT DESCRIPTION

LOW VOLTAGE POWER SUPPLY

The low voltage power supply (Figure 12) provides plate voltage for all tubes except the high voltage applied to the second anode of the picture tube. The heater transformers supply heater voltage to all tubes except the HV rectifier, which is energized by the horizontal sweep current.

One low voltage secondary of T-8, the step-down filament transformer, supplies filament voltage to all tubes except the audio driver-limiter (V-8), the vertical output tube (V-14), and the horizontal damping diode (V-18). Since the damping diode (V-18) develops a high voltage pulse at its cathode, and its cathode is tied to the filament to prevent breakdown in the tube, it is necessary to provide a separate, low capacity, well-insulated transformer (T-7) to heat this filament. The vertical output tube V-14 (25L6GT) requires a 25 volt filament supply and, hence, is provided with a separate 25 volt tap on the transformer. In earlier production chassis, the audio driver-limiter (V-8) had its cathode connected to a B plus point of about 120 volts. In order to keep the heater to cathode difference of potential low, it was necessary to provide a separate filament winding for this tube. This tube's cathode is now returned to B- but, since the separate winding is still supplied on present production transformers, it is still used for V-8.

The B plus plate supply uses a voltage doubler. R-104 is a limiting resistor to protect the rectifiers from initial current surges and also serves as a fuse in case of B plus shorts. When the polarity of the applied 117 volt AC is such as to make the side of the line connected to R-104 negative, E-2 will conduct and charge C-106 (300 mmf) to peak line voltage. On the next alternation, E-1 will conduct and the voltage applied to it is now the peak line voltage plus the peak charge stored in C-106. This results in a charge of about 260 volts on C-63C (200 mf). The speaker field is used as a filter choke. The focus coil and the resistor network, which controls the current thru it, act also as a voltage divider to supply plate and screen voltages to several tubes, as shown in Figure 12.

Another voltage divider from B plus to B-, consisting of R-76 (1 meg) and the potentiometer, R-77 (1 meg) provides a variable bias on the cathode of the picture tube, to serve as a brightness control.

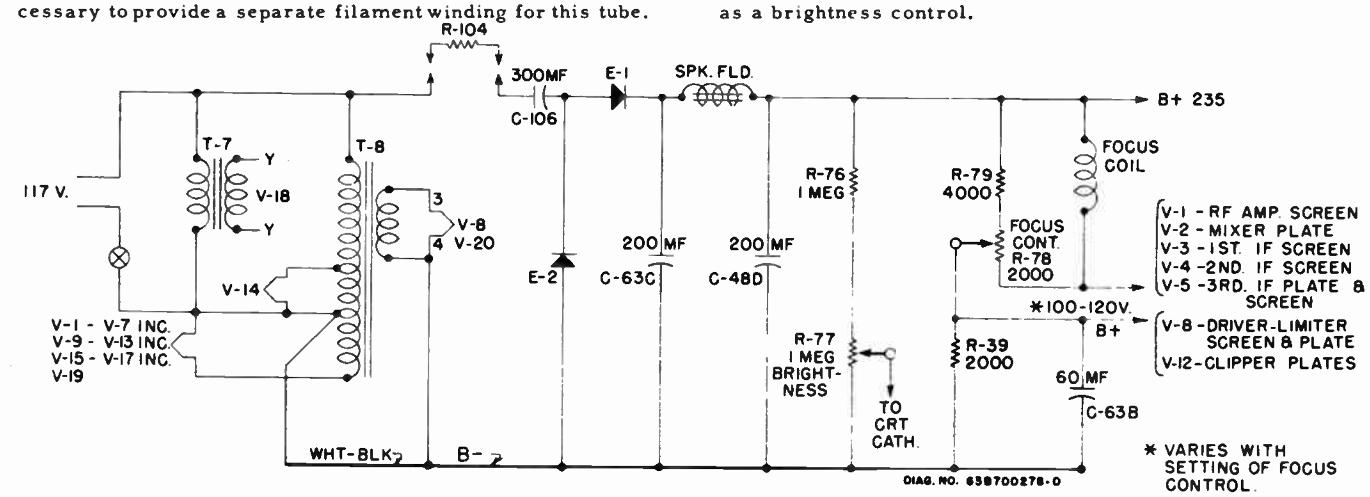


FIGURE 12. SIMPLIFIED SCHEMATIC OF HEATER AND LOW VOLTAGE POWER SUPPLY

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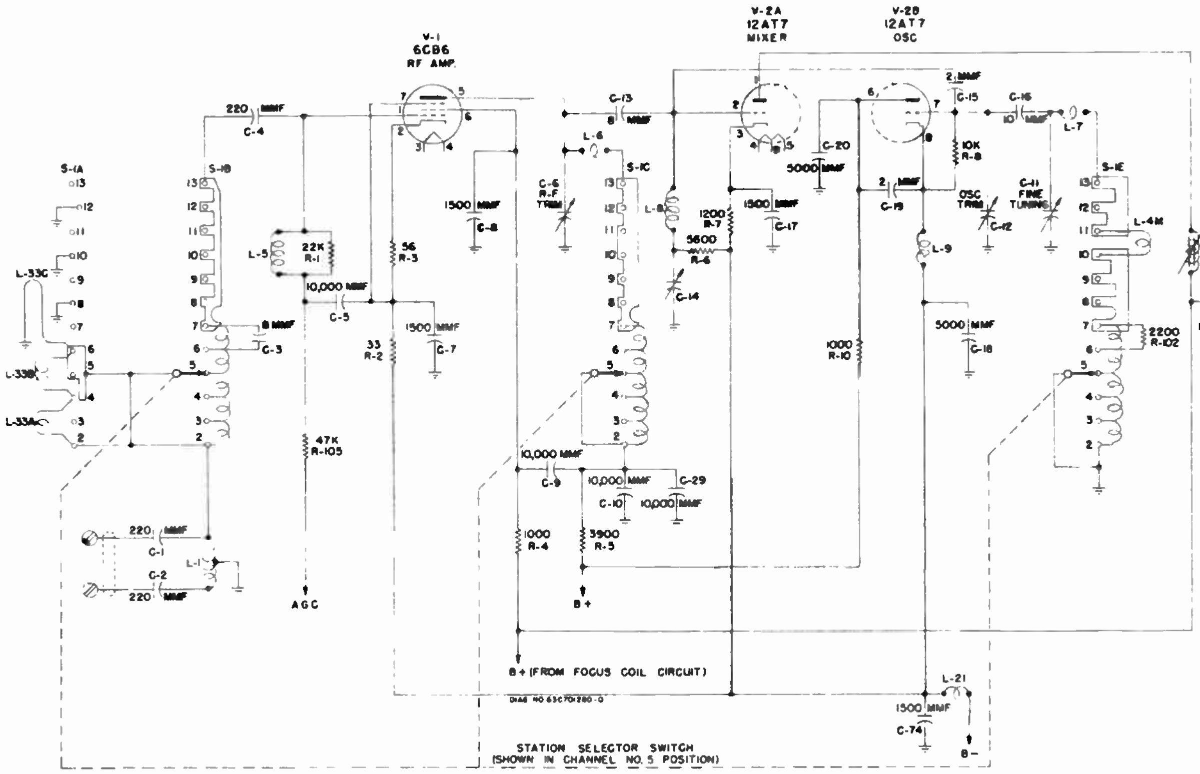

FIGURE 13. SIMPLIFIED SCHEMATIC OF RF TUNER

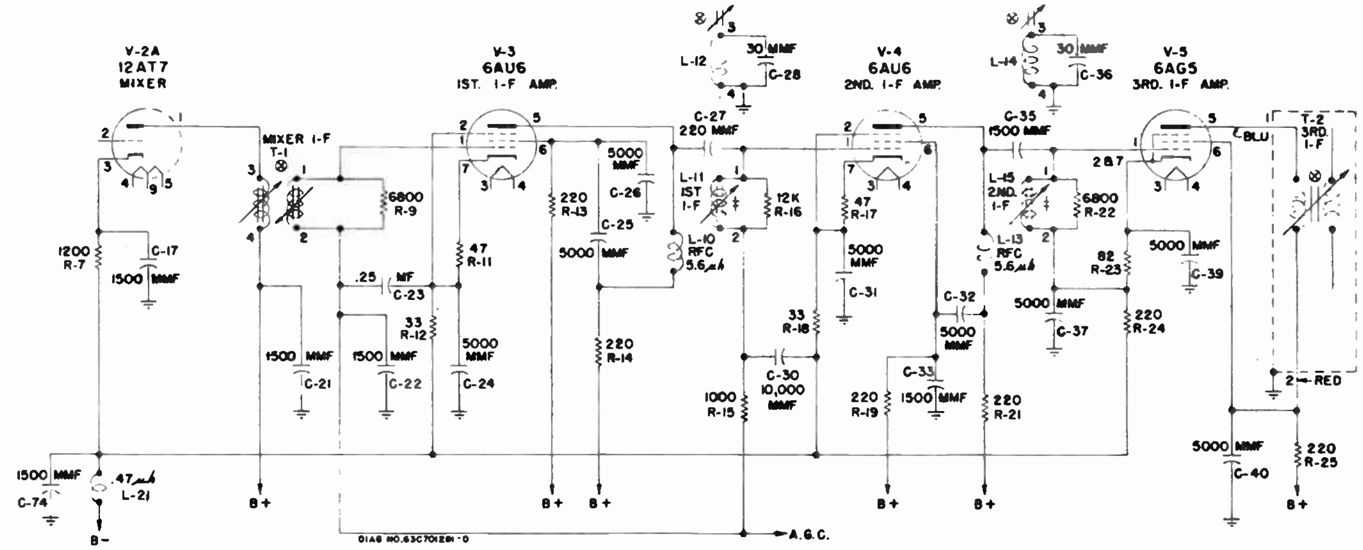

FIGURE 14. SIMPLIFIED SCHEMATIC OF IF AMPLIFIER

THE RF TUNER

Antenna Input

Figure 13 is a simplified schematic of the tuner.

The antenna input coil, L-1, couples the balanced line to the single ended input circuit for the RF tube, V-1. Optimum antenna coupling for all channels is obtained by the coupling coils L-33A, L-33B, L-33C, and the coupling leads on channel positions 8, 10 and 12 of switch wafer S-1A. These can be considered the primary of the antenna transformer. The secondary, or tuned grid circuit, includes also the continuous, tapped coil mounted on wafer S-1B for the low channels (2-6) and the stamped metal plate in series with the coil for the high channels (7-13). The purpose of the antenna coil, coupling leads, and the secondary circuit, is to match the 300 ohm impedance of the transmission line from the antenna to the input impedance of the RF amplifier grid circuit and to tune this circuit for the channel selected. Referring to Figure 13, it will be seen that the switch, in progressing from channel 2 to channel 13, shorts out the unused portion of the secondary winding or stamped metal plate. The bandwidth of channels 7 thru 13 is about 8 mc. The stamped metal plate is carefully designed so that with this bandwidth no adjustment is needed on the high channels. The individual coil sections on the low channels, however, may be tuned by spreading or compressing them as outlined in the alignment procedure.

RF Amplifier

The grid of the RF amplifier V-1 (6CB6) is returned to the AGC bus thru L-5 and a bypass capacity (C-5). The plate load of this tube consists of another tapped coil for the low channels and a stamped metal plate for the high channels mounted, in this case, on switch wafer S-1C. Here again, the switch progressively shorts out the unused sections of the inductance in tuning from channel 2 to 13. In this case, however, a trimmer C-6 and a choke L-6 are provided to center the high channel response while the low channel coils may be tuned by expansion or compression.

The Mixer

The mixer uses 1/2 of V-2 (12AT7). C-13 (8 mmf) couples the RF amplifier output to the mixer grid. Oscillator injection is accomplished by C-15 (2 mmf). L-8 and C-14 form a series resonant circuit tuned to the center of the IF response, to prevent interaction between the IF and the mixer input.

The Oscillator

The oscillator uses the other half of V-2 (12AT7) in a Colpitts circuit. Here again, the tuning inductance consists of the tapped coil for the low channels and the stamped metal plate for the high channels mounted on wafer S-1E. L-7 and C-12 are provided to set the center frequency on the high channels while the low channels are aligned by spreading or compressing the individual coil sections. C-11 is provided as a fine tuning control for customer use. The oscillator operates above the RF on the low channels and below the RF on the high channels except that in later production the circuit was modified to avoid interference by operating the oscillator on the high side for channels 11, 12 and 13.

THE IF AMPLIFIER

The IF amplifier uses two 6AU6 tubes and one 6AG5 tube. Figure 14 is the schematic of the IF amplifier. T-1 couples the mixer plate to the first IF grid. Coupling between primary and secondary, which are individually slug-tuned, is fixed and is designed for proper bandwidth. The plate choke L-10, of the 1st IF tube V-3 (6AU6), is coupled to the grid coil, L-11, of the 2nd IF tube V-4 (6AU6) thru C-27 (220 mmf). At IF frequencies, the impedance of C-27 is negligible and for all practical purposes, L-10 and L-11 can be considered as being in parallel, L-11 being slug tuned. A similar method is used between the 2nd and 3rd IF tubes. The 3rd IF plate is coupled to the detector by T-2, a unity coupled transformer. The IF circuits are stagger-tuned for proper bandwidth as explained in the Alignment Instructions. L-12 and L-14 are separately tuned trap windings on IF coil forms L-11 and L-15, respectively. Together with C-28 and C-36, they form absorption type trap circuits which steepen the high and low skirts of the IF response for better picture quality and to stabilize the audio response with intercarrier sound.

Decoupling has been used not only in the plate supply and AGC circuits, but also in the filament circuits to prevent regeneration.

THE VIDEO DETECTOR

One-half of V-6 (6AL5) is used as the video detector. Figure 15 is a schematic of the video detector. Since for noise limiting purposes it is desirable to apply a signal with negative going sync pulses to the grid of the video amplifier, the detector load R-26 (5600) is placed in the plate circuit of the diode. L-16, L-32 and C-42, form a low pass filter to keep IF frequencies off the grid of the video amplifier.

Since this chassis operates on the intercarrier sound system, the detector heterodynes the video and sound IF frequencies, and produces the 4.5 mc beat frequency which becomes the new audio IF frequency. The negative DC voltage developed at the high side of the detector load R-26 (5600) will be a function of carrier level. This voltage is fed to the AGC bus thru R-28 (1.5 meg) and controls the gain of the RF and 1st and 2nd IF amplifiers.

THE VIDEO AMPLIFIER

The video amplifier V-7 (6AH6) not only amplifies the video signal but also the 4.5 megacycle audio IF beat. Figure 16 is a schematic of the video amplifier. In its plate circuit, this beat is separated from the video signal and fed to the grid circuit of the audio driver-limiter tube V-8 (6AU6) by C-49 (2.2 mmf) and L-20, the sound take-off coil. The 4.5 mc trap, L-18 and C-50, is a parallel resonant circuit which, when properly tuned, offers a high impedance to this frequency, to prevent its reaching the picture tube.

By applying a negative signal to the grid of the video amplifier, a noise limiting action is achieved because noise pulses of amplitude greater than the sync level will drive the tube to cut off and, therefore, will not be present in the plate circuit. Since a single video amplifier tube is used, the signal at its plate will be positive and, as might be expected, is used to modulate the cathode of the picture tube rather than the grid, because the blanking pulses must cut the picture tube off and the polarity of the video information must be such that dark picture elements result in making the grid more negative with respect to the cathode.

L-17 and L-19 are peaking coils to extend the high frequency response of the amplifier. The contrast control, R-31A, is placed in the cathode circuit of the video amplifier and controls the bias and, therefore, the gain of this tube. The network of resistors and condensers across taps on the contrast control decreases degeneration at the higher fre-

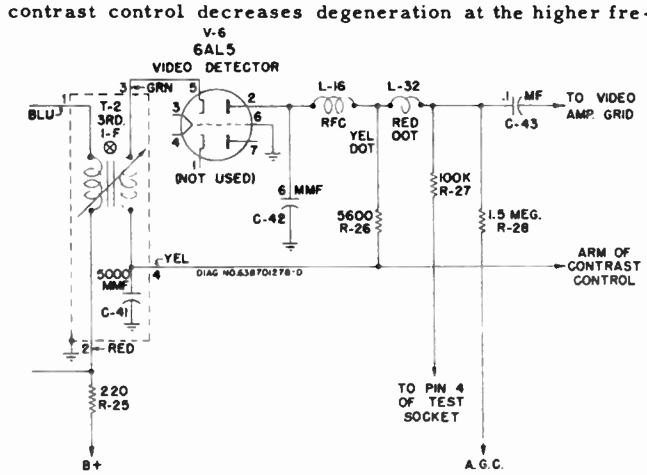

FIGURE 15.
SIMPLIFIED SCHEMATIC OF VIDEO DETECTOR

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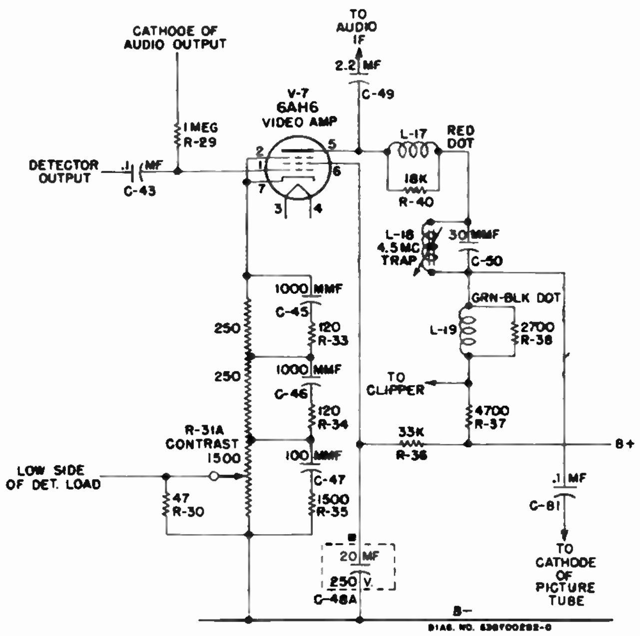

FIGURE 16.
SIMPLIFIED SCHEMATIC OF VIDEO AMPLIFIER

quencies and, therefore, helps to extend the high frequency response. The composite video signal is fed to the picture tube cathode thru coupling condenser C-81 (.1).

THE AGC

The negative DC voltage developed across the detector load resistor, R-26 (5600), is the AGC voltage. It will be noted that the low side of this resistor is connected to the arm of the contrast control potentiometer, R-31A. R-30 (47) is shunted across the arm of the contrast control and B-. In weak signal areas, this arrangement results in a delay in the AGC action. For a weak signal, minimum bias is desired on the video amplifier, therefore, the arm of the contrast control will be closest to the cathode end of the potentiometer. Because R-30 is then shunted across the entire contrast control, most of the plate current will flow thru it and develop a positive voltage of approximately one volt at the arm with respect to B-. Since the low side of the detector load is tied to this positive voltage, no AGC voltage will develop until the signal is strong enough to overcome this positive voltage and, therefore, no AGC bias is applied to the controlled tubes under weak signal conditions. In a strong signal area, however, where the arm of the contrast control approaches the B- end of the control, R-30 is shorted out and full AGC voltage is developed.

THE AUDIO SYSTEM

The audio system employs a driver-limiter, V-8 (6AU6); a ratio detector V-9 (6AL5); a first audio amplifier, V-10 (6J5), and an audio output tube, V-11 (6V6). Figure 17 is a schematic of the audio system. The driver-limiter is operated at low plate and screen voltages to act as a partial limiter to minimize any amplitude modulation. A conventional ratio detector and audio amplifier are used.

THE CLIPPER

The clipper uses a 6SN7GT tube. The clipper schematic is shown in Figure 18. The composite video signal with positive going sync is applied thru R-56 (10K) and C-66 (.005) to the grid of the first clipper from the plate circuit of the video amplifier. Under no signal conditions, the tube is unbiased. The positive signal, however, will cause the tube to draw grid current and the voltage drop across R-55 (1 meg), negative at the grid, will charge C-66 to such a value that only the most positive part of the signal, which is the sync pulse, will cause plate current to flow. Therefore, the video information and the blanking pulses are clipped off and only the sync pulses, now negative in polarity, appear in the plate circuit. The second clipper is so biased that the peaks of the sync pulses will drive the tube to cut off, which results in squared pulses of positive polarity in the plate circuit of this tube. A slight increase in sync pulse amplitude is obtained by a small positive voltage applied to the grid of the 2nd clipper by R-106 (390K).

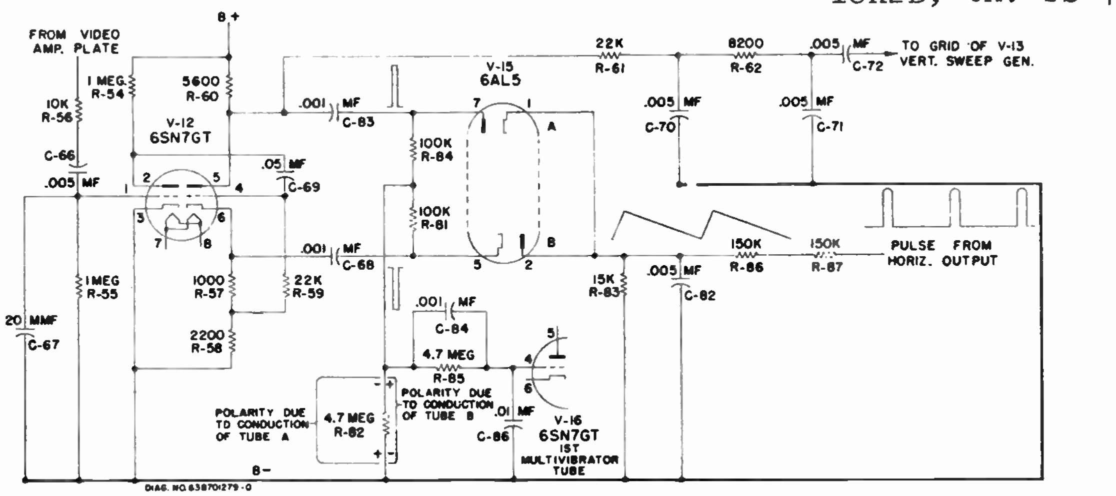

FIGURE 18. SIMPLIFIED SCHEMATIC OF CLIPPERS & PHASE DETECTOR

THE VERTICAL SCANNING SYSTEM

Figure 19 is a schematic of the Vertical Scanning System.

The integrating network, shown in Figure 18, composed of R-61, C-70, R-62, and C-71, changes the vertical group of sync pulses into a single pulse of suitable amplitude to trigger the vertical oscillator. The vertical oscillator is an asymmetrical multivibrator using two tubes V-13 (6J5) and V-14 (25L6). V-14 also serves as the output tube.

A multivibrator can be considered as a resistance coupled amplifier in which the output of the second tube is coupled back to the input of the first tube. V-13 is the automatic switch which charges and discharges the sawtooth forming condenser C-75 (.05), connected in its plate circuit. The circuit components of the multivibrator are chosen so that V-13's conductance period is about 7% of the entire cycle, to insure that retrace time of the scan will have the proper relationship with the trace time. This circuit is modified from the conventional resistance coupled multivibrator in that the plate of the output stage, which is also the second multivibrator tube, has a fairly large value of inductance, introduced by the output transformer stepping up the yoke inductance. When the tube is cut off, a positive pulse of several hundred volts is developed across this inductance. A portion of this pulse, obtained by means of the feedback network R-73, R-74, R-75 and C-78, C-79 and C-80, is used to cause the discharge tube V-13 to go into heavy conduction.

For the purposes of explaining the circuit action, assume that a time has been reached in the cycle when the trace period is almost completed. During this trace period V-13 is cut off and V-14 is conducting. C-73 has been discharging thru the grid resistors of V-13, R-63 (680K) and R-64 (the vertical hold control) and resistors R-75 and R-74. This discharge circuit makes the grid end of R-63 negative and biases the tube beyond cut-off. When the energy stored in the condenser has decreased sufficiently, the grid of V-13 reaches the threshold of conductance and the tube begins to draw current. Condenser C-76, which has been charged to nearly the B plus voltage, now starts to discharge thru V-13 and R-69 (3.3 meg) and this discharge current makes the grid end of R-69 negative tending to cut off V-14, and initiates the retrace. With the sudden change of plate current in V-14 developed across the plate inductance, a positive pulse is applied to the grid of V-13 through the feedback network,

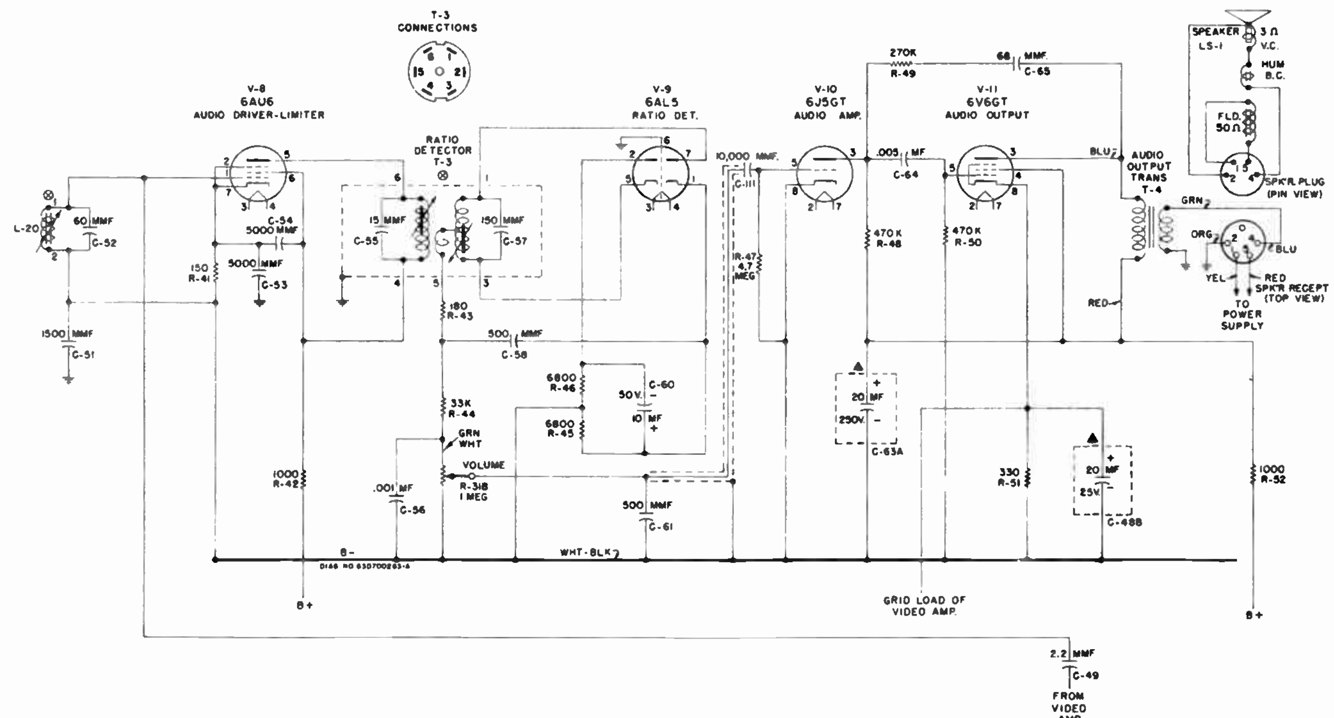

FIGURE 17. SIMPLIFIED SCHEMATIC OF AUDIO SYSTEM

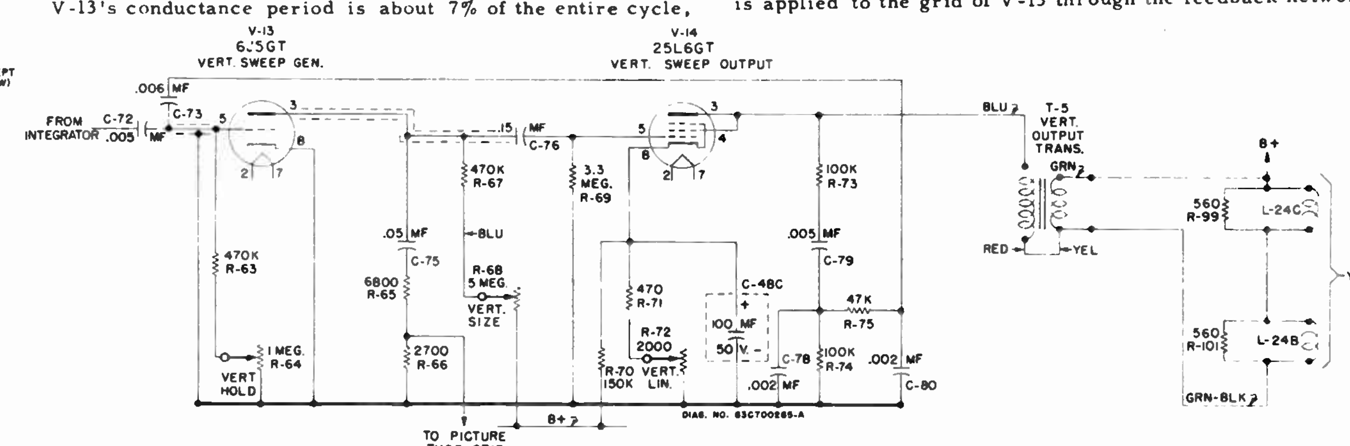

FIGURE 19. SIMPLIFIED SCHEMATIC OF VERTICAL SCANNING SYSTEM

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driving this tube into heavy conduction. C-75 will then discharge thru V-13. The voltage developed at the plate of V-13 will be the combination sawtooth and pulse voltage shown in Figure 22(1). The pulse is formed by the peaking resistors R-65 and R-66. When V-13 goes into conduction, the voltage at the plate of V-13 drops suddenly to a value determined by the relationship of the plate resistance of V-13 to the total resistance in the discharge circuit of C-75, which consists of R-65, R-66 and the plate resistance of V-13. After this initial instant, the charge on C-75 decreases, causing the voltage decrease at the plate shown between points "c" and "d" of Figure 22(1). When the positive pulse on the grid of V-13 has decreased to the value where the negative charge on C-73 becomes operative and cuts off V-13, the voltage on the plate of V-13 and, correspondingly, on the grid of V-14, rises quickly to point "a" on the curve, the start of the trace.

The negative pulse shown between point "b" and "a" of Figure 22(1) acting on the grid of V-14, tends to cut the tube off and raises its plate resistance to the larger value required to dissipate the energy in the plate circuit inductance during the short retrace period.

Since the plate circuit of the vertical output stage V-14 has inductance, and as the time constant of an inductive circuit decreases with an increase of resistance, just the opposite of an RC circuit, the increase in plate resistance of the tube is used to obtain the short time constant circuit required for proper retrace time.

By returning the grid of the picture tube to the junction of the two peaking resistors, R-65 and R-66, a negative pulse of suitable amplitude to cut the picture tube off during retrace is obtained, resulting in elimination of retrace lines on the screen.

The feedback network to the grid of V-13 also serves to filter out horizontal pulses which are present in the plate of V-14 due to coupling in the yoke and which are coupled to the plate thru the output transformer. The windings of the vertical output transformer are connected series opposing, which reduces the step-down ratio and, hence, the inductance in the plate of V-14 in order to shorten the retrace time.

The controls found in this circuit are:

1. The Vertical Hold Control R-64 (1 meg). This control varies the resistance in the discharge circuit of C-73 (.006) and, hence, provides a means of varying the frequency of the multivibrator. In practice, this control is adjusted so that the incoming positive sync pulses, which are of constant amplitude, will fire the tube in exact synchronization with the transmitting station's vertical scan.

2. The Vertical Size Control R-68 (5 meg). This control varies the charging current into C-75 (.05) and, hence, the amplitude of the voltage developed across it. Variation of this voltage varies the drive on the grid of V-14 and controls vertical size.

3. Vertical Linearity R-72 (2000). This control, by bleeder action thru resistor R-70 (150K) and the output tube's plate current, sets the bias and determines the tube's operating point on its plate current curve. Since this curve is not linear, some distortion can be introduced to counteract any non-linearity in the sawtooth grid voltage.

Since all of these controls are also in the multivibrator circuit and have an effect also on its frequency, there will be some interaction between them. Usually readjustment of size or linearity will require readjustment of the hold control.

HORIZONTAL SCANNING SYSTEM

The horizontal scanning system comprises a phase detector V-15 (6AL5), a cathode coupled multivibrator V-16 (6SN7), the output tube V-17 (6BQ6) and a damping diode V-18 (6W4). Figure 20 is a simplified schematic of this system.

The Horizontal Oscillator

In order to see how the phase detector automatically corrects for multivibrator frequency change, it will be necessary to understand how the correction voltage affects the multivibrator. It will be noted that this circuit differs from the vertical multivibrator in that only one coupling condenser is used but that the two tubes have a common cathode resistor. This arrangement is known as a cathode coupled multivibrator.

The operation is as follows. Assume that the trace period is almost completed. At this time, tube "A" is conducting, tube "B" is cut off. C-87 is discharging thru tube "A", R-92 (150K) and R-91 (the hold control). The discharge current of C-87 is still high enough to keep the grid of tube "B" negative and cut off. Bias is being applied to both tubes by current flow thru R-89 (1000) the common cathode resistor. When the energy stored in C-87 is reduced to the point where its discharge current no longer holds the grid of tube "B" below conductance, tube "B" starts to pass current and this current causes a greater voltage drop across R-89, the common cathode resistor, which increases the bias on tube "A" reducing its plate current. The resulting increase in voltage at the plate of tube "A" begins to charge C-87 and this charging current applies positive voltage to the grid of tube "B". The resulting heavier conduction of tube "B" develops a pulse of voltage across R-89 which cuts tube "A" off and results in a positive pulse at the plate of tube "A" which throws tube "B" into heavy conduction. This allows C-88, the saw-forming condenser to discharge thru tube "B" and R-93. When C-87 becomes charged, the charging current thru R-92 and R-91 decreases and the positive voltage on the grid, which has far exceeded the bias developed across R-89, is reduced. This results in reducing the plate current thru tube "B" and, therefore, the bias applied to tube "A" by the voltage drop across R-89. Tube "A" starts to conduct and condenser C-87 starts to discharge, cutting tube "B" off. C-88 begins to charge, starting the next trace.

L-23 and C-85 in the plate circuit of tube "A", form a resonant circuit which is tuned to the horizontal frequency (15, 750 cps). The 15, 750 cycle sine wave generated by this circuit, if properly phased, will insure that the positive pulse at the plate of tube "A", which throws tube "B" into conduction, will be more frequency stable.

C-88 and R-93, the peaking resistor, will produce the same combination pulse and sawtooth voltage shown in Figure 22(1). This action was explained in the vertical circuit.

The Phase Detector

The foregoing explanation is based on the assumption that tube "A's" grid is returned to a fixed potential point. It can be seen that if this grid is returned to a point which varies in potential with frequency of the multivibrator, it would be possible to make this variation a means of frequency control. Assume that the grid of "A" in Figure 20 is made more positive. This causes the bias of "B" to increase because of the increased drop across the common cathode resistor R-89. Capacitor C-87 will then discharge for a longer time before "B" conducts, thereby decreasing the frequency of oscillation. If the grid were made more negative, the bias across the common cathode resistor would be less and C-87 would discharge for less time before "B" started to conduct,

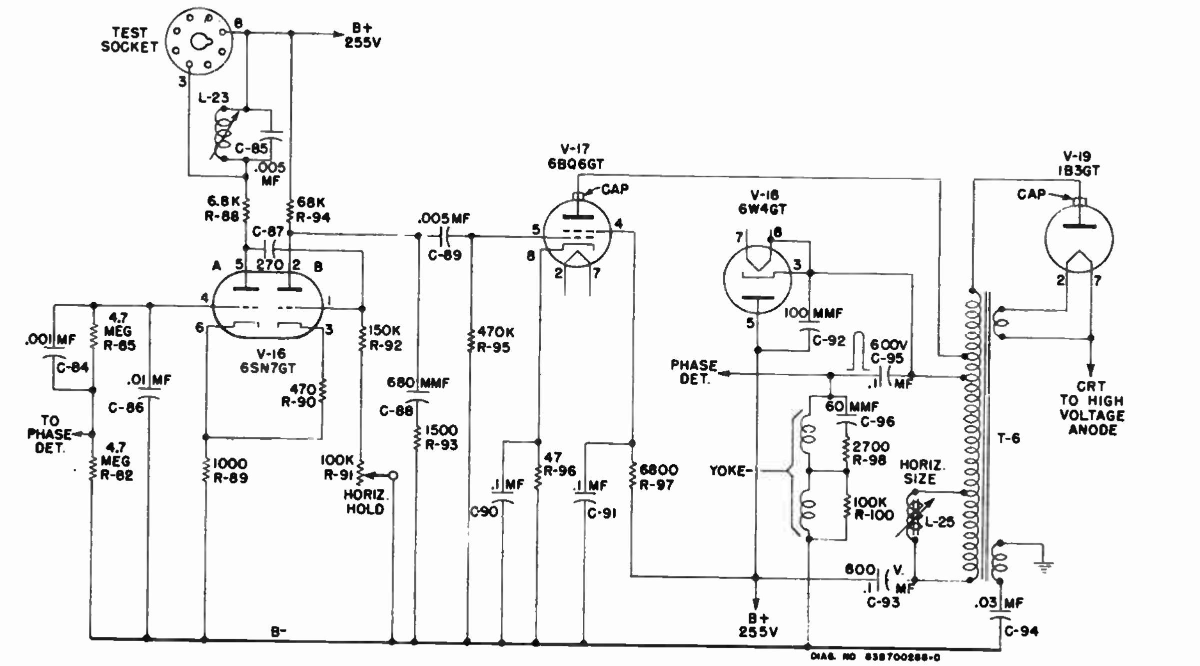

FIGURE 20. SIMPLIFIED SCHEMATIC OF HORIZONTAL SCANNING & HV SYSTEM

thereby increasing the frequency.

Figure 18 is a simplified schematic of the clipper and phase detector circuits. The phase detector V-15 (6AL5) is so connected that a comparison of the phase of the incoming sync pulses and a sawtooth derived from the horizontal output system is made. A positive sync pulse from the plate of the 2nd clipper V-12 (6SN7) is fed thru C-83 (.001) to the plate of diode "A" of V-15. A negative sync pulse from the cathode of V-12 is applied thru C-68 (.001) to the cathode of diode "B" of V-15. A sawtooth, derived from the integration of a pulse in the horizontal output circuit, at the yoke, by the integrating network, composed of R-86 (150K), R-87 (150K), and C-82 (.005) is applied to the cathode of diode "A" and the plate of diode "B", which are tied together and returned to B- thru R-83 (15K). The load for diodes "A" and "B" consists of resistors R-84 (100K) and R-81 (100K) whose junction returns to the high side of the grid resistor R-82 of the first horizontal multivibrator tube V-16 (6SN7). The voltage applied to the two diodes will be a function of the amplitude of the sawtooth, the amplitude of the sync pulses and the phase relationship between the pulses and the sawtooth.

If the sawtooth, whose phase and frequency are a function of the multivibrator's phase and frequency, is operating in the middle of the lock-in range, the sync pulse will occur in the center of the retrace time. See Figure 21(1). The sync pulses have an amplitude of from 6 to 8 volts while the sawtooth amplitude is about two volts. The RC time constant in the pulse input circuit to the diodes is long enough to maintain an average pulse voltage of 6 to 8 volts for two or three horizontal lines, which means that in the "on frequency" condition shown in Figure 21(1), the diodes conduct only on the pulses and since these are equal in amplitude and develop voltages of opposite polarity across R-82 in the first multivibrator grid circuit as shown in Figure 18, no control voltage is applied to the grid of V-16.

If the oscillator tends to increase in frequency, with respect to the sync pulses, the phase relationship shown in Figure 21(2) exists at the diodes. The phase of the sawtooth has now shifted so that at the same instant that the pulse is applied to the plate of diode "A" the positive saw is also applied to its cathode, so that only the shaded portion of the pulse causes conduction of diode "A". Diode "B", however, still conducts on the total amplitude of the negative pulse applied to its cathode aided by the positive saw applied to its plate at the same time. Since current flow thru diode "A" makes the grid end of R-82 negative, with respect to B-, the decreased current flow caused by the sawtooth voltage bucking the pulse voltage at diode "A" results in a more positive voltage across R-82 applying a more positive voltage to the grid of V-16 which, as we have seen, results in decreasing the oscillator's frequency.

If the oscillator tends to decrease in frequency, with respect to the sync pulses, the phase relationship shown in Figure 21(3) exists at the diodes. At the same instant that the negative pulse is applied to the cathode of diode "B", the negative saw is applied to its plate so that only the shaded portion of the pulse causes conduction. Diode "A", however, conducts on the full amplitude of the positive pulse applied to its plate aided by the negative saw applied to its cathode at the same time. Since current flow thru diode "B" makes the grid end of R-82 positive, with respect to B-, the decreased current thru diode "B" results in applying a more negative voltage to the grid of V-16 which, as we have seen, results in increasing the oscillator frequency. C-84, R-85 and C-86 provide two time constant filters which are necessary to obtain "fly-wheel" action of this AFC sync circuit.

The Horizontal Output System

The combination sawtooth and pulse waveform developed across C-88 (680) and R-93 (1500) by the multivibrator circuit, is fed to the grid of the horizontal output tube V-17 (6BQ6). Figure 20 is a simplified schematic of the horizontal output system. It will be noted that in this system an auto-transformer is used. In the horizontal scan, it is necessary that retrace be completed in about 7 microseconds. In order to accomplish reversal of current in the inductance of the output transformer and the yoke in this short a time, it is necessary to make this circuit resonant at such a frequency that the half-cycle time will equal 7 microseconds, because only by shock exciting such a circuit into oscillation will retrace be accomplished in the time allowed. The cir-

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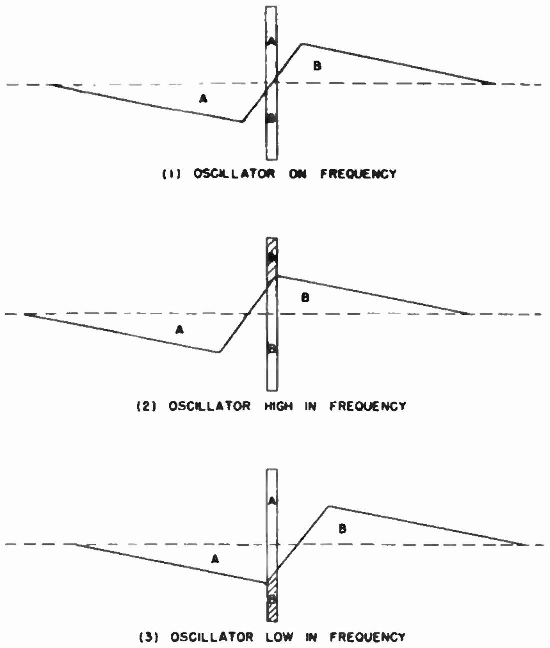

FIGURE 21. WAVEFORMS AT PHASE DETECTOR

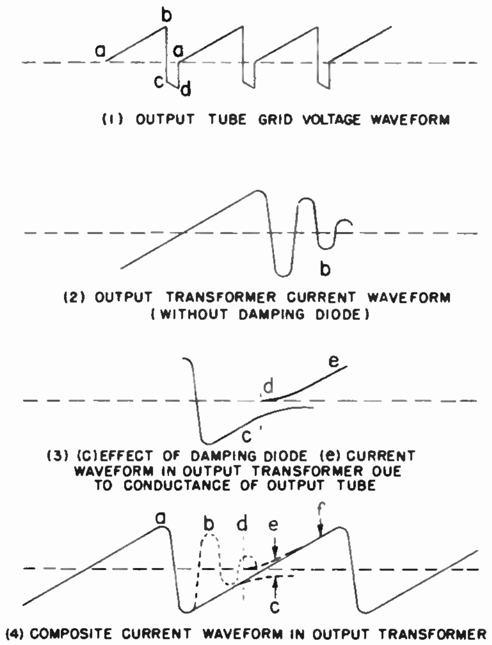

FIGURE 22. WAVEFORMS IN HORIZONTAL SCANNING SYSTEM

cuit is made resonant by the inductance of the output transformer and yoke, the distributed capacity and the tube capacity. Bearing this in mind, the operation can be explained as follows. Referring to Figure 22(1), assume that the voltage on the grid of the output tube is increasing, point "a". The grid is now being made less negative and the output tube starts to draw current which is supplied from B plus thru the damping diode. When point "b" is reached on the grid voltage waveform, the output tube is suddenly cut off because its grid has been made highly negative, (point "c" on the grid voltage waveform). With the tube cut off, the resonant plate load is undamped and the circuit is shocked into oscillation. The reversal of current through the output inductance produces a positive voltage pulse which makes the cathode of the damping diode (V-18) positive, with respect to its plate; therefore, it cannot conduct. C-92 (100 mmf) is placed across the diode to provide a low impedance for the oscillatory current. If the damping diode V-18 were not present, this oscillation would continue and current would flow in the output transformer as shown in Figure 22(2). In order to insure a linear trace, however, this oscillation must be stopped and the damping diode serves this purpose. When the current nears its maximum negative value, the polarity and amplitude of the voltage pulse on the damping diode is such that its plate becomes positive, with respect to its cathode, so that the tube conducts heavily and loads the circuit sufficiently to prevent continuation of the oscillation. The current then follows the decay curve shown at "c" in Figure 22(3). At the time "d" in Figure 22(3) the voltage at the grid of the output tube has become less than cut off [point "a" in Figure 22(1)] and the tube again demands current. The rising current in the tube results in superimposing the waveform "e" of Figure 22(3) on the current flow already in the output transformer due to the decaying current which resulted from the damped oscillation. Combination of these two currents results in the linear trace current indicated at "f" in Figure 22(4), which is a composite waveform of the entire action. During the peak conduction of the damping diode, C-93 (.1) charges and its polarity is such that when the output tube calls for current the charge on the condenser will be in series with the B plus supply so that the voltage at the output tube plate is raised from the 250 volt B plus supply to about 475 volts by this so-called "bootstrap" voltage. When the grid voltage waveform of the output tube again reaches point "b" of Figure 22(1), the tube is cut off and another cycle starts.

In order to properly match the yoke inductance to the required output inductance for the tube, the yoke is connected to a tap on the winding which effectively makes an auto-transformer of this section. The positive pulse of voltage at this tap is coupled to the yoke thru C-95 (.1) and results in a sawtooth of current thru the yoke. It will be remembered that a portion of this pulse is also fed to the phase detector for the AFC action thru R-86 and R-87.

The small additional winding, one terminal of which is connected to chassis while the other terminal is connected to B- thru C-94 (.03), is used to cancel the pulse of voltage which is placed on the chassis by induction from the output transformer. By connecting this winding in such a way as to place a pulse of suitable amplitude on the chassis 180 degrees out of phase with the induced voltage, cancellation of the induced voltage will take place.

High Voltage

To take advantage of the large voltage pulse developed across the output inductance by the heavy current flow caused by the retrace oscillation, the plate winding is made the primary of an auto-transformer whose step-up ratio is such as to develop pulses of about 14 Kv at its high end. These pulses are rectified by V-19 (1B3) and the resulting DC is applied to the second anode of the picture tube. The filament voltage for the 1B3 rectifier is obtained from an additional winding on the output transformer.

Controls

L-23 is the coil of the sine wave generating circuit in the horizontal multivibrator circuit and should be tuned to 15,750 cycles as explained in the service instructions.

R-91 is the horizontal hold control which can be adjusted for correct frequency operation of the multivibrator.

L-25, paralleling a small portion of the output choke controls, to a small degree, the inductance of the choke and acts as a size control.

REPLACEMENT PARTS LIST

NOTE: When ordering parts, specify model number of set in addition to part number and description of part.

CHASSIS PARTS - ELECTRICAL

Capacitors

Ref. No.	Part No.	Description
C-1	21K77375	Ceramic tubular: 220 mmf 500V......
C-2	21K77375	Ceramic tubular: 220 mmf 500V......
C-3	-	See tuning units parts list........
C-4	21K77375	Ceramic tubular: 220 mmf 500V......
C-5	21K482726	Ceramic disc: 10,000 mmf 450V......
C-6	1X790189	Trimmer, ceramic: .5-3 mmf (complete with screw & mtg nut)...
C-7	21A470790	Ceramic disc: 1500 mmf 500V........
C-8	21A470790	Ceramic disc: 1500 mmf 500V........
C-9	-	See TT-12 tuning unit parts list...
C-10	-	See tuning units parts list........
C-11	-	Fine tuning trimmer (part of station selector switch)..........
C-12	1X790189	Trimmer, ceramic: .5-3 mmf (complete with screw & mtg nut)...
C-13	21K478234	Molded: 8 mmf 500V.................
C-14	1X792784	Trimmer, ceramic: 3-13 mmf (complete with screw & mtg nut)...
C-15	-	See TT-12 tuning unit parts list...
C-16	-	See TT-12 & TT-14 tuning unit parts list..............................
C-17	21A470790	Ceramic disc: 1500 mmf 500V........
C-18	21A470789	Ceramic disc: 5000 mmf 450V........
C-19	21K478280	Molded: 2 mmf temperature compensating......................
C-20	21A470789	Ceramic disc: 5000 mmf 450V........
C-21	21A470790	Ceramic disc: 1500 mmf 500V........
C-22	21A470790	Ceramic disc: 1500 mmf 500V........
C-23	8R9810	Paper: .25 mf 100V.................
C-24	21A470789	Ceramic disc: 5000 mmf 450V........
C-25	21A470789	Ceramic disc: 5000 mmf 450V........
C-26	21A470789	Ceramic disc: 5000 mmf 450V........
C-27	21K77375	Ceramic tubular: 220 mmf 500V......
C-28	21K470329	Molded: 30 mmf temperature compensating......................
C-29	-	See tuning units parts list........
C-30	21K482726	Ceramic disc: 10,000 mmf 450V......
C-31	21A470789	Ceramic disc: 5000 mmf 450V........
C-32	21A470789	Ceramic disc: 5000 mmf 450V........
C-33	21A470790	Ceramic disc: 1500 mmf 500V........
C-34	21K490799	Ceramic tubular: 20 mmf 500V.......
C-35	21A470790	Ceramic disc: 1500 mmf 500V........
C-36	21K470329	Molded: 30 mmf temperature compensating......................
C-37	21A470789	Ceramic disc: 5000 mmf 450V........
C-38	21A470790	Ceramic disc: 1500 mmf 500V........
C-39	21A470789	Ceramic disc: 5000 mmf 450V........
C-40	21A470789	Ceramic disc: 5000 mmf 450V........
C-41	21A470789	Ceramic disc: 5000 mmf 450V (in T-2 can).........................
C-42	21K470324	Molded: 6 mmf 500V.................
C-43	8R9854	Paper: .1 mf 200V..................
C-45	21K780599	Ceramic tubular: 1000 mmf 500V.....
C-46	21K780599	Ceramic tubular: 1000 mmf 500V.....
C-47	21B77286	Ceramic tubular: 100 mmf 500V......
C-48, A,B, C & D	23B791741	Electrolytic: 4-section; 20 mf/250V, 20 mf/25V, 100 mf/50V, 200 mf/300V
C-49	21K478274	Molded: 2.2 mmf 500V...............
C-50	21K470329	Molded: 30 mmf 500V................
C-51	21A470790	Ceramic disc: 1500 mmf 500V........
C-52	21K790683	Molded: 60 mmf 500V................
C-53	21A470789	Ceramic disc: 5000 mmf 450V........
C-54	21A470789	Ceramic disc: 5000 mmf 450V........
C-55	21K790439	Silver mica: 15 mmf (part of T-3 base)...........................
C-56	8R9866	Paper: .001 mf 600V................
C-57	21A790131	Ceramic tubular: 150 mmf 500V (in T-3 can).........................
C-58	21R6590	Mica: 500 mmf 500V.................
C-59	21A470790	Ceramic disc: 1500 mmf 500V........
C-60	23A90205	Electrolytic: 10 mf 50V............
C-61	6R6590	Mica: 500 mmf 500V.................
C-63A, B & C	23B791721	Electrolytic: 3-section; 20 mf/250V, 60 mf/250V, 200 mf/300V...........
C-64	8R9869	Paper: .005 mf 600V................
C-65	21R6650	Mica: 68 mmf 500V..................
C-66	8R9869	Paper: .005 mf 600V................
C-67	21K470322	Molded: 20 mmf 500V................
C-68	8R9866	Paper: .001 mf 600V................
C-69	8R9873	Paper: .05 mf 600V.................
C-70	8R9869	Paper: .005 mf 600V................
C-71	8R9869	Paper: .005 mf 600V................
C-72	8R9869	Paper: .005 mf 600V................
C-73	8K790026	Paper: .006 mf 600V................
C-74	21A470790	Ceramic disc: 1500 mmf 500V........
C-75	8R9873	Paper: .05 mf 600V.................
C-76	8R9875	Paper: .15 mf 600V.................
C-78	8R9867	Paper: .002 mf 600V................
C-79	8R9869	Paper: .005 mf 600V................
C-80	8R9867	Paper: .002 mf 600V................
C-81	8R9874	Paper: .1 mf 600V..................
C-82	8R9869	Paper: .005 mf 600V................
C-83	8R9866	Paper: .001 mf 600V................
C-84	8R9866	Paper: .001 mf 600V................
C-85	8R9869	Paper: .005 mf 600V................
C-86	8R9870	Paper: .01 mf 600V.................
C-87	21K77375	Ceramic tubular: 220 mmf 500V......
	21K400037	Ceramic tubular: 270 mmf 500V (suggested replacement value).....
C-88	21R2741	Mica: 680 mmf 500V.................
C-89	8R9869	Paper: .005 mf 600V................
C-90	8R9854	Paper: .1 mf 200V..................
C-91	8R9874	Paper: .1 mf 600V..................
C-92	21K792438	Ceramic tubular: 100 mmf 3000V.....
	21K700620	Ceramic tubular: 150 mmf 3000V (suggested replacement value).....
C-93	8R9874	Paper: .1 mf 600V..................
C-94	8R9872	Paper: .03 mf 600V.................
C-95	8R9874	Paper: .1 mf 600V..................
C-96	21K790574	Ceramic tubular: 60 mmf (in defl yoke).....................
C-97	21A470790	Ceramic disc: 1500 mmf 500V........
C-98	21K77375	Ceramic tubular: 220 mmf 500V......
C-99	21K77375	Ceramic tubular: 220 mmf 500V......
C-100	21B482295	Ceramic tubular: 250 mmf 500V......
C-101	21B482295	Ceramic tubular: 250 mmf 500V......
C-103	21A470790	Ceramic disc: 1500 mmf 500V........
C-104	21A470790	Ceramic disc: 1500 mmf 500V........
C-105	21A470790	Ceramic disc: 1500 mmf 500V........
C-106	23B791692	Electrolytic: 1-section; 300 mf/150V..............................
C-107	21A470790	Ceramic disc: 1500 mmf 500V........
C-109	21A470790	Ceramic disc: 1500 mmf 500V........
C-110	21A470790	Ceramic disc: 1500 mmf 500V........
C-111	21K482726	Ceramic disc: 10,000 mmf 450V......
C-112	21A470790	Ceramic disc: 1500 mmf 500V........
C-113	21A790833	High voltage: 500 mmf 20,000V (on V-19 mtg plate).................
C-114	21R400099	Mica: 1000 mmf 1500V (between bezel mtg and chassis).................

Rectifiers

Ref. No.	Part No.	Description
E1,2	48B700074 or 48B791694 or 48B700139	Selenium rectifier.................

Coils

Ref. No.	Part No.	Description
L-1	24A790033	Antenna impedance matching coil....
L-2	-	See tuning unit parts list.........
L-3	-	See tuning unit parts list.........
L-4	-	See TT-12 & TT-14 tuning unit parts list..............................
L-4M	-	See TT-14 tuning unit parts list...
L-5	24K791446	RF choke: molded; 10 microhenries..

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Ref. No.	Part No.	Description
L-6	24K792825	RF coil (channel 13)
L-7	-	See TT-12 & TT-14 tuning unit parts list
L-8	24K792577	RF choke: 3.3 microhenries
L-9	24K780128	RF choke: molded; 2.2 microhenries.
L-10	24K790035	RF choke: molded; 5.6 microhenries.
L-11	24B792586	1st IF: complete with LC trap, cores & mtg nuts
L-12		Trap: part of L-11

Speakers

Ref. No.	Part No.	Description
LS-1	50C791689 or 50C791913	Speaker: 8" electrodynamic; 50 ohm field (hot); 3.2 ohm voice coil

Resistors

Note: All resistors are insulated carbon type unless otherwise specified.

Ref. No.	Part No.	Description
R-1	6R6397	22,000 10% 1/2W
R-2	6R2036	33 10% 1/2W
R-3	6R5614	56 10% 1/2W
R-4	6R6229	1000 10% 1/2W
R-5		See TT-12 tuning unit parts list
R-6	6R6117	5600 10% 1/2W
R-7	6R6393	1200 10% 1/2W
R-8	6R6320	10,000 10% 1/2W
R-9	6R6428	6800 10% 1/2W
R-10	6R6229	1000 10% 1/2W
R-11	6R5550	47 10% 1/2W
R-12	6R2036	33 10% 1/2W
R-13	6R6270	220 10% 1/2W
R-14	6R6270	220 10% 1/2W
R-15	6R6229	1000 10% 1/2W
R-16	6R6394	12,000 10% 1/2W
R-17	6R5550	47 10% 1/2W
R-18	6R2036	33 10% 1/2W
R-19	6R6270	220 10% 1/2W
R-21	6R6270	220 10% 1/2W
R-22	6R6428	6800 10% 1/2W
R-23	6R2035	82 10% 1/2W
R-24	6R6270	220 10% 1/2W
R-25	6R6270	220 10% 1/2W
R-26	6R6117	5600 10% 1/2W
R-27	6R6031	100,000 10% 1/2W
R-28	6R6460	1.5 meg 10% 1/2W
R-29	6R6004	1 meg 20% 1/2W
R-30	6R5550	47 10% 1/2W
R-31 A, B	18A791705	Contrast & volume control, dual: 2000 & 1 meg; with power switch
L-13	24K790035	RF choke: molded; 5.6 microhenries
L-14		Trap: part of L-15
L-15	24K792587	2nd IF: complete with LC trap, cores & mtg nuts
L-16	24K792771	RF choke: yellow dot
L-17	24A790579	Compensating coil: red dot (wound on R-40)
L-18	24B792735	4.5 mc trap: less core & clip
L-19	24A792588	Compensating coil: grn-black dot (wound on R-38)
L-20	24A470159	Sound take-off: less core & clip
L-21	24K790145	RF choke: molded; 0.47 microhenries
L-22	24K700656	Focus coil
L-23	24K790059	Horizontal oscillator: less core & clip
L-24	24C792171 or 24K792173 or 24C792506 or 24K792508	Deflection yoke: complete
L-25	24K700089	Horizontal size: less core & clip
L-26	24K790145	RF choke: molded; 0.47 microhenries
L-30	24K790145	RF choke: molded; 0.47 microhenries
L-31	24K790145	RF choke: molded; 0.47 microhenries
L-32	24K792772	RF choke: red dot
L-33	-	See tuning unit parts list

Ref. No.	Part No.	Description
R-33	6R5551	120 10% 1/2W
R-34	6R5551	120 10% 1/2W
R-35	6R6038	1500 10% 1/2W
R-36	6R6400	33,000 10% 1W
R-37	6R5671	4700 10% 2W
R-38	-	2700 (not replaceable; part of compensating coil L-19)
R-39	17K792705	Wire wound: 2000 10% 10W
R-40	-	18,000 (not replaceable; part of compensating coil, L-17)
R-41	6R6373	150 10% 1/2W
R-42	6R6229	1000 10% 1/2W
R-43	6R5660	180 10% 1/2W
R-44	6R6410	33,000 10% 1/2W
R-45	6R6428	6800 10% 1/2W
R-46	6R6428	6800 10% 1/2W
R-47	6R6446	4.7 meg 10% 1/2W
R-48	6R6377	470,000 10% 1/2W
R-49	6R6414	270,000 10% 1/2W
R-50	6R6377	470,000 10% 1/2W
R-51	6R6022	330 10% 1/2W
R-52	6R3922	1000 10% 2W
R-53	6R6229	1000 10% 1/2W
R-54	6R6004	1 meg 20% 1/2W
R-55	6R6004	1 meg 20% 1/2W
R-56	6R6320	10,000 10% 1/2W
R-57	6R6229	1000 10% 1/2W
R-58	6R6069	2200 10% 1/2W
R-59	6R6397	22,000 10% 1/2W
R-60	6R6117	5600 10% 1/2W
R-61	6R6397	22,000 10% 1/2W
R-62	6R2004	8200 10% 1/2W
R-63	6R6377	470,000 10% 1/2W
R-64	18A90147	Vertical hold control: 1 meg
R-65	6R6428	6800 10% 1/2W
R-66	6R5577	2700 10% 1/2W
R-67	6R6377	470,000 10% 1/2W
R-68	18A90145	Vertical size control: 5 meg
R-69	6R6497	3.3 meg 10% 1/2W
R-70	6R6398	150,000 10% 1/2W
R-71	6R6090	470 10% 1/2W
R-72	18A790146	Vertical linearity control: 2000
R-73	6R6031	100,000 10% 1/2W
R-74	6R6031	100,000 10% 1/2W
R-75	6R6048	47,000 10% 1/2W
R-76	6R6004	1 meg 20% 1/2W
R-77	18A90147	Brightness control: 1 meg
R-78	18A790162	Focus control: 2000
R-79	17K790902	Wire wound: 4000 10% 10W
R-80	6R6048	47,000 10% 1/2W
R-81	6R6031	100,000 10% 1/2W
R-82	6R6446	4.7 meg 10% 1/2W
R-83	6R6477	15,000 10% 1/2W
R-84	6R6031	100,000 10% 1/2W
R-85	6R6446	4.7 meg 10% 1/2W
R-86	6R5721	150,000 10% 1W
R-87	6R5721	150,000 10% 1W
R-88	6R6428	6800 10% 1/2W
R-89	6R6229	1000 10% 1/2W
R-90	6R6090	470 10% 1/2W
R-91	18A791574	Horizontal hold control: 100,000
R-92	6R6398	150,000 10% 1/2W
R-93	6R6038	1500 10% 1/2W
R-94	6R6074	68,000 10% 1/2W
R-95	6R6377	470,000 10% 1/2W
R-96	6R5583	47 10% 1W
R-97	6R5690	6800 10% 2W
R-98	6R5577	2700 10% 1/2W (in defl yoke)
R-99	6R6291	560 10% 1/2W (in defl yoke)
R-100	6R6328	100,000 10% 1W (in defl yoke)
R-101	6R6291	560 10% 1/2W (in defl yoke)
R-102	-	See TT-14 parts list
R-103	6R6377	470,000 10% 1/2W
R-104	17A791696	Wire wound: 5 10% 5W
R-105	6R6048	47,000 10% 1/2W
R-106	6R5646	390,000 10% 1/2W

Transformers

Ref. No.	Part No.	Description
T-1	24K792578	Mixer IF: less cores & mtg nuts
T-2	24B792585	3rd IF: less core, clip & colored leads
T-3	24B790125	Ratio Detector: complete less shield can
T-4	25B790686	Audio output
T-5	25B792168	Vertical output
T-6	24K792753	High voltage transformer: complete.
T-7	25B790140	Filament transformer: isolating (for V-18)
T-8	25B791793 or 25B700137	Filament transformer

Tubes

Ref. No.	Part No.	Description
V-1	6CB6	RF Amplifier
V-2	12AT7	Mixer-Oscillator
V-3	6AU6	1st IF Amplifier
V-4	6AU6	2nd IF Amplifier
V-5	6AG5	3rd IF Amplifier
V-6	6AL5	Video detector
V-7	6AH6	Video amplifier
V-8	6AU6	Audio-Driver-Limiter
V-9	6AL5	Ratio Detector
V-10	6J5GT	Audio Amplifier
V-11	6V6GT	Audio output
V-12	6SN7GT	1st & 2nd Clippers
V-13	6J5GT	Vertical Sweep Generator
V-14	25L6GT	Vertical Sweep Output
V-15	6AL5	Phase Detector
V-16	6SN7GT	Horizontal Oscillator
V-17	6BQ6GT	Horizontal Output & High Voltage Generator
V-18	6W4GT	Damping Diode
V-19	1B3GT	High Voltage Rectifier
V-20	16GP4	Picture Tube

TUNERS

Model TT-12 Tuning Unit

Ref. No.	Part No.	Description
	1X792770	TT-12 Tuning Unit: complete with station selector switch, fine tuning trimmer, and the following components:
C-3	21K478234	Capacitor, molded: 8 mmf 500V
C-9	21K482726	Capacitor, ceramic disc: 10,000 mmf 450V
C-10	21K482726	Capacitor, ceramic disc: 10,000 mmf 450V
C-15	21K478280	Capacitor, molded: 2 mmf 500V (temp. comp.)
C-16	21K470322	Capacitor, molded: 20 mmf 500V (temp. comp.)
C-29	21K482726	Capacitor, ceramic disc: 10,000 mmf 450V
L-2	24C792764	Coil, antenna: channels 2 thru 6; includes L-2A thru L-2E; L-2F thru L-2L are part of switch
L-3	24K790536	Coil, RF: channels 2 thru 6; includes L-3A thru L-3E
L-4	24K790537	Coil, oscillator: channels 2 thru 6; includes L-4A thru L-4E; L-4F thru L-4L are part of switch
L-7	24K790606	Coil, oscillator: channel 13
L-33	24K792765	Coil, antenna primary: low freq; includes L-33A, L-33B & L-33C
R-5	6R5659	Resistor: 3900 10% 1/2W
	43K700725	Collar, spring (on end of fine tuning shaft)
	42K790136	Clip, spring (on collar)
	42K700726	Shaft, fine tuning

Model TT-14 Tuning Unit

(The TT-14 is the revised tuning unit which places the oscillator above the carrier on the three high channels instead of below as in the TT-12. It can be distinguished from the TT-12 by the extra coil across the cut-out on the oscillator deck of the switch.)

Ref. No.	Part No.	Description
	1X700132	TT-14 tuning unit: complete with station selector switch, fine tuning trimmer, and the following components:
C-3	21K478234	Capacitor, molded: 8 mmf 500V
C-10	21K482726	Capacitor, ceramic disc: 10,000 mmf 450V
C-16	21K400173	Capacitor, molded: 10 mmf 500V (temp. comp.)
C-29	21K482726	Capacitor, ceramic disc: 10,000 mmf 450V
L-2	24C792764	Coil, antenna: channels 2 thru 6; includes L-2A thru L-2E; L-2F thru L-2L are part of switch
L-3	24K790536	Coil, RF: channels 2 thru 6; includes L-3A thru L-3E; L-3F thru L-3L are part of switch
L-4	24C700114	Coil, oscillator: channels 2 thru 6; includes L-4A thru L-4E; L-4F thru L-4L are part of switch
L-4M	24K700115	Coil, oscillator: channel 10
L-7	24K700116	Coil, oscillator: channel 13
L-33	24K792765	Coil, antenna primary: low frequency; includes L-33A, L-33B & L-33C
R-102	6R6069	Resistor: 2200 10% 1/2W
	43K700725	Collar, spring (on end of fine tuning shaft)
	42K790136	Clip, spring (on collar)
	42K700726	Shaft, fine tuning

CHASSIS PARTS - MECHANICAL

Part Number	Description
37K790951	Band, rubber (around picture tube gasket)
7K485464	Bracket, chassis mtg (on sides of chassis)
7K700153	Bracket, coil mtg: cad pl (horizontal size coil)
7A792468	Bracket, deflection coil mtg: cop pl ("L" brackets at base of deflection coil assembly)
7B792807	Bracket, deflection coil mtg (arched bracket housing defl yoke)
7B792191	Bracket, focus coil: cop pl (focus coil retainer)
7B791707	Bracket, focus coil mtg: cad pl (supports focus coil bracket)
7A791965	Bracket, interlock safety; cad pl
7A791967	Bracket, reinforcing: cad pl (brace between legs of 7B792807 brkt)
7C792737	Bracket, yoke cushion mtg: cad pl
7A791956	Bracket, strap mtg (mounts retainer strap tightening screw)
38B792486	Button, plug (for 25/64" hole next to focus control)
30A790948	Cable, high voltage (2nd anode lead).
42K471342	Cap, plate (high-volt rectifier)
42A5480	Cap, plate (6BQ6)
42A700147	Clamp, lead retainer (on V-19 fil leads)
42B70721	Clip, coil mounting (T-3 secondary)
42A76244	Clip, coil retainer (L-23)
42A72609	Clip, tube shield grounding (V-10)
39A790979	Contact, high voltage lead (connects high voltage lead to picture tube)
39K17396	Contact, pin terminal (speaker receptacle)

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Part Number	Description
46K791756	Core, brass & screw (L-11 & L-15)
46A478242	Core, brass & screw (T-2)
46A470310	Core, iron & screw (T-1 primary, L-18 & L-20)
46K480256	Core, iron & screw (T-1 secondary, L-12).
46A70023	Core, iron & screw (T-3 primary, L-14)
46A470302	Core, iron & screw (T-3 secondary)
46K471143	Core, iron & screw (L-23)
46A700090	Core, iron: with slide adjustment (L-25).
15B791111	Cover, test socket
35A792756	Cushion, focus coil
35B792739	Cushion, yoke mtg
32D790946	Gasket, picture tube mtg: plastic (around picture tube front)
5K470916	Grommet, insulating: 3/16" hole
5A790684	Grommet, rubber (V-14 & V-16 socket mtg)
14A791787	Insulator, anode lead (dresses high voltage lead from chassis)
14A780184	Insulator, antenna lead (under input terminal strip)
14K87179	Insulator, coil (in ratio detector can)
9K471267	Insulator, electrolytic mtg: 4-lug; impregnated
13K791892	Insulator, shield (in T-2 can)
4S7657	Lockwasher, external: #8; cad pl (48B791694 selenium rectifier mtg).
4S7652	Lockwasher, external: #10; cad pl (picture tube retainer strap mtg)..
4S7655	Lockwasher, internal: 3/8; cad pl (mounts front controls)
4S7650	Lockwasher, internal: #6; cad pl (48B700074 & 48B700139 selenium rect mtg)
4S9751	Lockwasher, internal-external: #8; cad pl (focus coil mtg)
29R5242	Lug, soldering: #6L; HT (on hi-voltage capacitor)
29R5239	Lug, soldering: #8 HT
13D790936	Mask, picture tube
2A470049	Nut, coil & core mtg (L-11, L-12, L-14, L-15, T-2, T-1, L-20 & L-18)
2A791404	Nut, coil & core mtg (L-25)
2S7005	Nut, hex: 6-32 x 1/4; cad pl (Hi-Volt capacitor mtg)
2S7003	Nut, hex: 8-32 x 5/16 stl; cad pl (focus coil mtg)
2S7004	Nut, hex: 3/8-32 x 9/16 stl; cad pl (station selector & cont-vol mtg)
2S7051	Nut, hex palnut: 3/8-32 x 9/16; cad pl (rear controls mtg)
2S7050	Nut, hex palnut: 6-32 (T-2 can mtg).
2B70703	Nut, palnut: special (T-3 primary core mtg)
2A790191	Nut, special: cad pl (mounts ceramic trimmers)
35K700799	Pad, cushion (inside mask when Rauland picture tube used)
64K791818	Plate, chassis cover: cop pl (removable plate on chassis side)
64D791722	Plate, front tube support: fibre (supports picture tube front)
64K792464	Plate, socket cover (covers unused socket hole next to V-17)
28A790978	Plug, high voltage lead (plugs in high voltage receptacle)
28K471323	Plug, line cord: 2-pin (power input)
9A22367	Receptacle, 5-prong (on spkr leads)
9A790977	Receptacle, HV lead: plastic (insulates hi-volt lead from chassis)
5S8497	Rivet: .088 x 1/8 stl; white nkl (V-1, V-2, V-5 socket mtg)
5S7770	Rivet: .088 x 5/32 stl; pol nkl (ant terminal strip mtg)
5S2815	Rivet: .088 x 7/32 stl; pol nkl (mounts 9K780442 and 9K484167 socket)
5S7707	Rivet: .122 x 5/32 stl; pol nkl (mounts 9K471270 socket)
5S7701	Rivet: .122 x 3/16 stl; pol nkl (R-104 receptacle mtg)

Part Number	Description
5S7700	Rivet: .122 x 1/4 stl; pol nkl (line cord plug mtg)
5S7703	Rivet: .122 x 7/32 stl; pol nkl (electrolytic wafer mtg)
5S7728	Rivet: .122 x 5/16 stl; pol nkl (HV rect socket mtg)
5S6846	Rivet: .145 x 5/32 stl; pol nkl (vert & audio output transformer mtg)
5K71246	Rivet, shoulder: nkl pl (V-14 & V-16 socket mtg)
3S490354	Screw, machine: 6-32 x 5/8 slotted hex head; cad pl (C-6 & C-12 trimmer adj)
3S490822	Screw, machine: 6-32 x 1" slotted hex head; cad pl (C-14 trimmer adj)
3S490459	Screw, machine: 6-32 x 1-1/8 slotted round head; brass (fastens high volt transformer plates together)
3S488195	Screw, machine: 6-32 x 2 plain hex head; cad pl (48B700074 selenium rect. mtg)
3S7163	Screw, machine: 8-32 x 1/4 plain hex head (high volt rect mtg plate & T-6 mtg)
3S7257	Screw, machine: 8-32 x 5/8 plain Hex head (mounts focus coil bracket)
3S490642	Screw, machine: 10-32 x 1-1/2 plain hex head; cad pl (picture tube retainer strap mtg)
3S7454	Screw, sheet metal: #8 x 1/4 PKZ plain hex head: cad pl (fil trans mtg)
3S3397	Screw, sheet metal: #8 x 5/16 PKZ plain hex head; cad pl (chassis mtg brkts)
3S7467	Screw, sheet metal: #8 x 3/8 PKZ plain hex head; cad pl (isolating trans mtg)
3S7512	Screw, sheet metal: #8 x 1/2 PKZ plain hex head; cad pl (picture tube front support plate mtg)
3S8153	Screw, sheet metal: #8 x 3/4 PKA plain hex head; cad pl (mounts strap mtg brkt)
3K790107	Screw, thumb: 8-32; cad pl (defl yoke adj)
1X792785	Shield, coil: with spade bolts (T-2 shield)
26K485936	Shield, coil (ratio detector)
26K700067	Shield, picture tube: plastic (around metal cone)
26A26283	Shield, tube (for V-10 when glass 6J5 used)
26A90301	Shield, tube: miniature (V-5)
26A790508	Shield, video: cad pl (shields video amp from HV trans)
9K700040	Socket, picture tube: 5-pin; with leads..
9K780442	Socket, tube: miniature (V-3, V-4 & V-6).
9K484167	Socket, tube: miniature 7-prong (V-7, V-8, V-9, & V-15)
9A792167	Socket, tube: miniature: 7-prong (V-1)...
9A471343	Socket, tube: miniature; tan molded (V-5)
9K484816	Socket, tube: noval; molded (V-2)
9A790685	Socket, tube: octal (V-14 & V-16)
9A480274	Socket, tube: octal; molded (high volt rectifier)
9K471270	Socket, tube: octal; molded (all octal sockets but V-14, V-16 & V-19)
41A70705	Spring, coil (ratio det)
41A700143	Spring, compression (L-25)
41A791727	Spring, grounding (grounds window to chassis)
41A790942	Spring, insert (receptacle for high voltage plug)
41K791768	Spring, tension (picture tube support)
42A791958	Strap, tube retainer: cop pl (secures picture tube front)
31A700082	Strip, contact (receptacle for plug-in resistor)
31A700077	Strip, terminal (R-104 mtg)
31A791613	Strip, terminal: special (on HV transformer)
31A21990	Strip, terminal: 2-screw (on antenna cable)

Part Number	Description
24A792821	Trap, ion: PM; with collar
or	
24A792827	Trap, ion: PM; with collar
1X791850	Tube mtg plate: with mounting bracket and socket (HV rectifier mtg plate)
4S7569	Washer, flat: 5/16 x .145 x .027; cad pl (V-14 & V-16 socket mtg)
4S490366	Washer, flat: 3/8 x .156 x .125 stl; cad pl (48B700074 & 48B700139 selenium rect mtg)
4S7562	Washer, flat: 7/16 x .187 x .033 stl; cad pl (focus coil brkt mtg)
4S1722	Washer, flat: 7/16 x .187 x .048 stl; cad pl (picture tube front support plate mtg)
4S7596	Washer, flat: 1/2 x .195 x .067 stl; (defl yoke mtg brkts)
4K470939	Washer, insulating: 3/8 x .136 x .062 (electrolytic mtg)
4A77577	Washer, insulating (horizontal size coil mtg)
4A791447	Washer, insulating (isolating fil trans mtg)
4K790132	Washer, spring (focus coil mtg)
61C790865	Window, picture tube: 16"; safety glass

INSULATING COMPOUNDS

Part Number	Description
11M490423	Coating, hi-volt insulating: red-brn (on hi-volt rectifier socket)
11M490387	Wax, biwax (on hi-volt trans.)
31K76184	Strip, terminal: 2 ins #1 gnd; 3/8" spacing
31A21990	Strip, terminal: 2-screw (on antenna cable)
31A792450	Strip, terminal: 2 ins #3 mtg 3/8" spacing
31K471564	Strip, terminal: 3 ins #2 gnd; 3/8" spacing
31K51511	Strip, terminal: 3 ins #3 gnd; 3/8" spacing
31K471565	Strip, terminal 3 ins #4 gnd; 3/8" spacing
31K37494	Strip, terminal: 4 ins #3 gnd; 3/8" spacing
31A790122	Strip, terminal: 4 ins #3 gnd; 1/2" spacing
31K22174	Strip, terminal: 4 ins #4 mtg; 3/8" spacing
31A780089	Strip, terminal: 4 ins #5 gnd; 3/8" spacing
31K26658	Strip, terminal: 5 ins #3 gnd; 3/8" spacing
31K90046	Strip, terminal: 5 ins #4 gnd; 3/8" spacing
31A791402	Strip, terminal: 6 ins #4 gnd; 3/8" spacing
31A780091	Strip, terminal: 6 ins #5 gnd; 3/8" spacing

MODEL 16K2 CABINET PARTS

Part Number	Description
1X700172	Back Cover Assembly: complete with line cord, picture tube rear cover, and centering adjustment cover
13K792792	Bezel, picture tube (window frame)
16F700006	Cabinet, console: red-brn mahog; less bezel
13K700008	Cloth, grille: negre
30B470756	Cord, line: with plug & receptacle
15K792068	Cover, centering adjustment: rubber (on back cover)
1X792546	Cover, chassis bottom: with high voltage insulator
15B790987	Cover, picture tube rear (on back cover).
5S3139	Eyelet: .202 x .475 brass (on back cover)
14B792069	Insulator, high voltage (on chassis bottom cover)

Part Number	Description
14B700174	Insulator, picture tube base (in picture tube rear cover)
36B790505	Knob, control (contrast)
36B790506	Knob, control (station selector)
36K792078	Knob, control: wal-mahog (fine tuning & off-volume)
36A485457	Knob, control: black (hold controls on chassis rear)
4S7650	Lockwasher: #6 int; cad pl (hi-volt insulator mtg)
4S7657	Lockwasher: #8 ext; cad pl (spkr mtg)
4S2639	Lockwasher, internal-external: 5/16; cad pl (chassis mtg)
62K790672	Logotype: "Motorola"; brass pl
13A790824	Medallion ("M" on grille cloth)
2S7003	Nut, hex: 8-32 x 5/16 steel; cad pl (spkr mtg)
2S7007	Nut, hex: 8-32 x 1/4; cad pl (spkr mtg)
2S7022	Nut, hex: 1/4-20 x 7/16 steel; cad pl (chassis mtg)
5S7751	Rivet: .122 x 1/8 stl; pol nkl (hi-volt insulator mtg)
5S7706	Rivet: .122 x 1/4 stl; ant cop (picture tube rear cover mtg)
5K790011	Rivet, shoulder: annealed (line cord plug)
3S2226	Screw, machine: 1/4-20 x 1-1/4 plain hex head; stl; cad pl (chassis mtg)
3S7205	Screw, machine: 8-32 x 1/4 slotted lock hex head; cad pl
3S7374	Screw, machine: 8-32 x 5/16 plain hex head; cad pl (Bezel mtg)
3S7536	Screw, sheet metal: #6 x 3/8 PKA slotted acorn head; ant cop finish (back cover mtg)
3S7509	Screw, sheet metal: #6 x 5/8 PKA slotted acorn head; ant cop finish (back cover mtg)
3S490819	Screw, sheet metal: #6 x 7/8 PKA slotted acorn head; ant cop (back cover mtg).
3S488298	Screw, sheet metal: #8 x 1/4 PKZ slotted hex head; cad pl (back cover mtg)
3S8153	Screw, sheet metal: #8 x 3/4 PKA plain hex head; cad pl (bottom cover mtg)..
3K653	Screw, speaker mtg
35A791581	Strip, lead (dresses leads to side of cabinet)
4K780040	Washer, felt (under control knobs)
4S1720	Washer, flat: 3/8 x .156 x .030 steel; cad pl (line cord mtg)
4S488234	Washer, flat: 7/8 x 3/8 x .060 stl; cad pl (chassis mtg)
4S7562	Washer, flat: 7/16 x .187 x .033 steel; cad pl (speaker mtg)
4S7629	Washer, flat: 1/2 x 3/16 x .048 stl; cad pl (bottom cover mtg)
4S7563	Washer, flat: 5/8 x .203 x .033 stl; cad pl (bezel mtg)

MODEL 16K2B CABINET PARTS - Same as 16K2 except:

Part Number	Description
16K700007	Cabinet, console: limed oak
13K791084	Cloth, grille: blonde
36K792079	Knob, control: tan (fine tuning & off-volume)

BILT-IN-TENNAS

MODEL TA-4 TELEVISION DOUBLE LOOP BILT-IN-TENNA

Part Number	Description
1X791759	TA-4 Television Double Loop Antenna: complete (Bilt-In-Tenna)
21K70720	Capacitor, molded: 5 mmf 500V
21R6593	Capacitor, mica: 15 mmf 300V
24A791771	Coil, antenna loading
31K471564	Strip, terminal: 3 ins #2 gnd; 3/8" spacing

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M31

MODEL NO.	CHASSIS NO.	PICTURE TUBE	CABINET STYLE
M31	TV17A2	16" Rect.	Table Model
M31R	TV17A3	16" Round	Table Model
M32	TV17A3	16" Rect.	Consolette
M32R	TV17A3	16" Round	Consolette
M41	TV17A3A	17" Rect.	Table Model
M42	TV17A3A	17" Rect.	Consolette
M33	TV17A4	19" Round	Cons olette
M34	TV17A4	19" Round	Console Combination
M46	TV17A7	20" Rect.	Consolette
M49	TV17A7	20" Rect.	Consolette

M33

SPECIFICATIONS

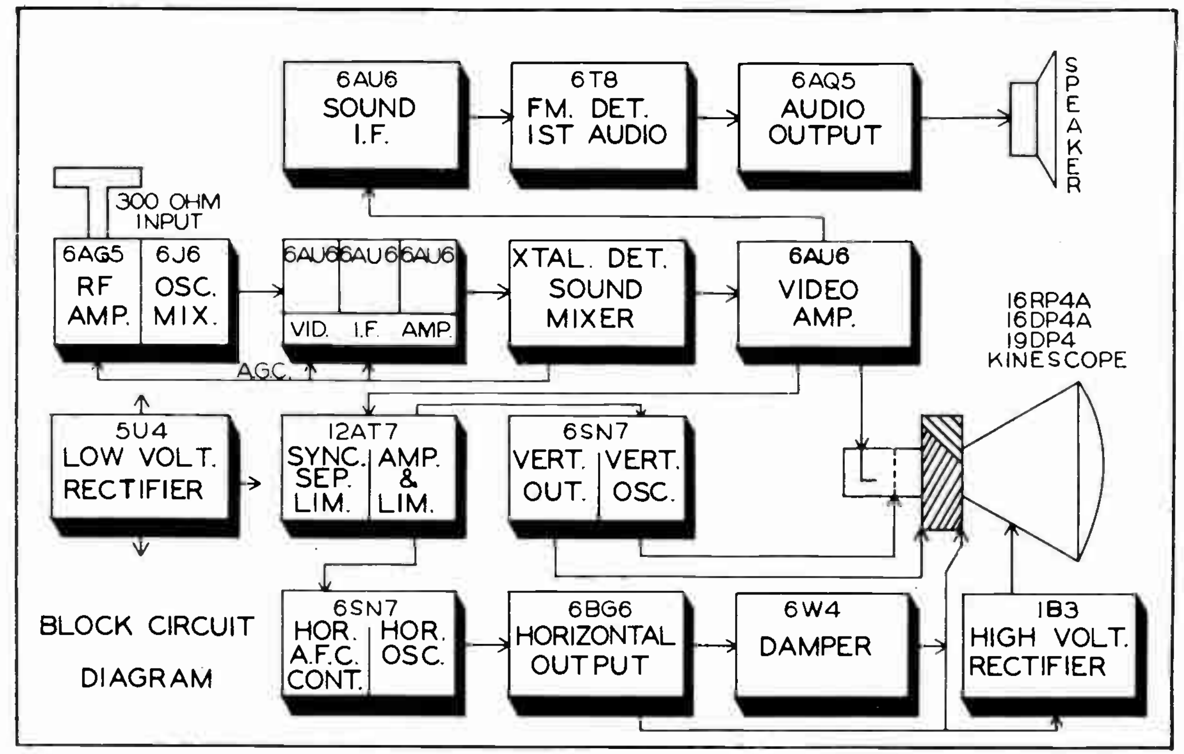
OPERATING VOLTAGE - 105 to 125 Volts - 60 Cycles.
CHANNEL COVERAGE - 2 to 13 inclusive.
POWER CONSUMPTION - 160 Watts.
AUDIO POWER OUTPUT - 1.5 Watts undistorted - Maximum 2.5 Watts.
LOUDSPEAKER - 5" - 8" - 10" - depending on cabinet.
VOICE COIL - 3.2 ohms - 400 cycles.
RECEIVER INPUT - 300 ohms balanced - 72 ohms unbalanced.

OTHER ADVANTAGES ARE - One-knob picture control - Very High Frequency tuner assembly - R.F. stage on all bands - Snap-in antenna and oscillator coils - Electronic coupled oscillator and mixer - Built-in all-channel antenna - Synchroguide type of AFC - "EYE SAVER" picture tube - Alnico Five P.M. speaker - Inter-carrier picture and sound - High fidelity FM sound - Improved fly-back high voltage supply for picture tube - Four I.F. coils - Isolated filament winding for important audio tubes - I.F. plate voltage regulation - Very moderate temperature rise - Convenient service adjustments - All wood cabinets Anti-glare picture mask - Safety glass protection.

HIGH VOLTAGE WARNING

The danger accompanying shock is always present when the receiver is operated outside the cabinet or when the rear cover is removed from the cabinet. Only a person familiar with the precautions to be observed when working with high-voltage equipment should service this receiver.

BLOCK CIRCUIT DIAGRAM



INSTALLATION INSTRUCTIONS

UNPACKING THE TV

1. Place the carton on the floor in an upside down position with the large red arrows downward.

2. Break the carton seals and fold back all flaps over the sides.

3. Give the carton a 1/4 turn, resting it on the MUNTZ side.

4. Support the TV set with one hand on the open end and 1/4 roll the carton, preventing the flaps from moving beneath the set.

5. Lift the carton free from the television set. It will then be resting on the filler and in perfect condition without damage to the knobs or cabinet.

TO PREPARE THE RECEIVER FOR OPERATION

MUNTZ Television sets leave the factory with the chassis bolted tight to the cabinet, but not in proper position. This is done to prevent breakage of the picture tube in transit.

1. Remove the back of the cabinet.

2. Inspect the face of the CRT and the glass window for dust or smudges. If the face of the CRT or the inside of the glass window is smudged, it will be necessary to remove the chassis to clean the smudged surface.

3. Loosen the 4 chassis mounting bolts (table model, beneath the set; consolette style, beneath the shelf) and push the chassis forward in the cabinet until the picture tube rests snugly against the mask.

4. Tighten the mounting bolts securely.

5. Check the adjusting screws of the deflection yoke. The rubber cushion at the front of the yoke must rest tight against the curved surface of the picture tube. If the cushion is not tight against the tube loosen the 4 bolts at the base of the yoke and push the entire yoke assembly forward until the rubber cushion is tight against the CRT. See Fig. No. 1, Point B.

CABINET TV ANTENNAS

Coming forth from the side of the chassis near the rear antenna terminals are red and blue wires tipped with spade lugs. A third wire runs across the inside top of the cabinet and down the cabinet side, terminating near the red and blue wires. It also is tipped with a spade lug. These three wires can be connected in various two-wire combinations to the two antenna terminals. Fasten in a combination that will give the best picture reception on all channels.

If the built-in antenna provides good reception no outside antenna is required, but never hesitate to recommend an outside aerial wherever necessary.

If an outside antenna is desirable, disconnect the built-in antenna wires. Cover the ends with tape and dress in such a position that they do not touch the chassis.

MODELS M31, Ch. TV17A2; M31R, M32, M32R, Ch. TV17A3; M33, M34, Ch. TV17A4; M41, M42, Ch. TV17A3A; M46, M49, Ch. TV17A7

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TO CHECK OPERATION OF RECEIVER

All MUNTZ TV sets are adjusted during the final test procedure at the factory, but will

require an adjusting and touch-up job in the customer's home at the time of installation.

1. Connect the AC plug (105 - 125 volts) to a 60 cycle wall socket. Turn the TV set on and allow a 10 minute warm-up period.
2. Advance the volume control 1/2 turn to the right.
3. Turn the channel selector knob to a local station.
4. Turn the picture control to the right until the screen of the picture tube is illuminated. The set should now operate, picture and sound, with the following provisions: (a) a station operating on the air, (b) the oscillator adjustment tuned to the station, (see paragraph "Oscillator Alignment") and (c) tube and service adjustments are not too far out of alignment.

PICTURE TUBE ADJUSTMENTS

The picture tube adjustments are on the neck of the picture tube. They work in conjunction with the service controls and need a touch-up job in the customer's home at time of installation. Function of these controls is as follows:

ION TRAP

Before giving the proper instructions for Ion Trap adjustment, we must call to your attention the seriousness of a mis-adjusted trap.

Improper positioning of the magnet may result in circular areas of discoloration developing on the screen of the tube, thus injuring the picture screen, even though the ions developed in the cathode section of the tube have been properly "trapped." When the magnet is not in the correct position, the electron beam, instead of going through the aperture in the anode disc, bombards the edge of the opening. The heat thus produced vaporizes the metal of the 2nd anode disc, releasing gases which have a harmful effect on the operation of the tube. Some of this vaporized material is deposited on the screen of the tube, causing darkened areas in the center of the screen.

Since it is possible to destroy a picture tube with a mis-adjusted ion trap in a matter of seconds, it should be the first adjustment when the set is turned on and the last adjustment before restoring the back of the cabinet.

TO PROPERLY ADJUST AN ION TRAP DO THE FOLLOWING:

Move the trap assembly back and forth with a slight rotary motion; adjust for maximum brightness of the screen. Reduce the brilliance control until the pattern is barely visible and again adjust ion trap for maximum brightness - at all times keeping the trap as far back on the neck of the picture tube as possible (over or behind flags). Fig. No. 1, Point A.

The ion-adjustment MUST BE RESET AFTER EVERY MOVEMENT OF THE FOCUS COIL OR FOCUS ADJUSTMENT.

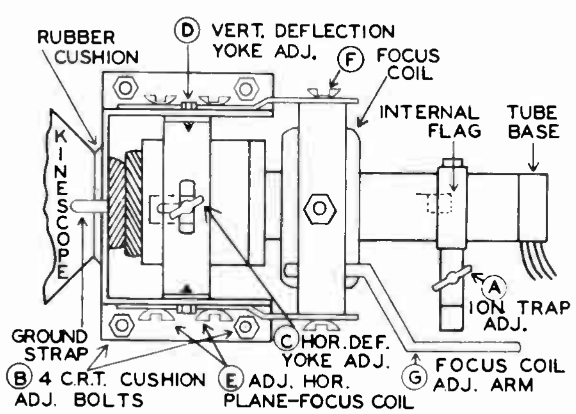
Never move the ION TRAP to remove a SHADOW from the edge of the raster as by so doing the intensity of the raster is decreased. In such a case the shadow should have been eliminated by moving the deflection coil forward and then re-adjusting the focus coil, focus adjustments, and finally the ion trap. The ion trap should always be in the position to give MAXIMUM raster brilliance.

Too much care cannot be taken in making the ion trap magnet adjustment. Remember the picture tube is still the most expensive part of the TV receiver. Take a little extra time and check the ion trap setting carefully.

CATHODE RAY TUBE CUSHION

The rubber cushion must fit snugly against the flare of the cathode ray tube in order that the rear of the tube will be supported firmly. Loosen the 4 cushion adjusting bolts and press the entire assembly forward. Fig. No. 1, Point B.

VIEW OF C.R.T.-PICTURE TUBE ADJUSTMENTS



NOTE: The 4 nuts "E" on Fig. No. 1 are welded positions on the 19" model and not adjustable.

FIG. NO. 1

CATHODE RAY TUBE HANDLING PRECAUTIONS

Shatterproof goggles and heavy gloves should be worn at all times when handling the cathode ray tube. The tube should not be handled in the vicinity of any person not so equipped. When handling the cathode ray tube, always keep it away from the body.

The cathode ray tube bulb, due to its large surface area and high vacuum contained within, is subjected to high air pressure. More than ordinary care is required to prevent shattering the tube. The large end of the bulb, particularly the rim of the viewing surface, must not be struck, scratched, or subjected to more than moderate pressure at any time. If the tube sticks or fails to slip smoothly into place during replacement, remove the tube and determine the cause of the trouble - - DO NOT FORCE THE TUBE.

VERTICAL DEFLECTION YOKE ADJUSTMENT. The vertical deflection yoke adjustment is made by raising or lowering the metal strap which supports the horizontal deflection yoke. To raise or lower this assembly loosen the two P.K.screws and float the yoke coils around the neck of the picture tube. Adjust in a way to avoid all binding action. Fig. No. 1, Point D.

THE HORIZONTAL DEFLECTION YOKE ADJUSTMENT controls the angle of the picture with respect to the horizontal. If the picture is not squared in the picture mask, loosen the wing nut and move it to the left or right so as to rotate the deflection yoke. The picture will tilt to the left or right with the deflection yoke rotation. After the picture is square in the mask and before tightening the wing nut, press the entire coil forward as far as possible to the flare of the picture tube. Fig. No. 1, Point C.

FOCUS COIL: To protect the neck of the picture tube during transit, a cardboard band is put inside the focus coil. The purpose of the focus coil is to center the picture on the screen in its entirety with the best possible line detail. Adjust the 4 wing bolts (Fig. No.1 - Point E) to centralize the focus coil on the neck of the picture tube. To properly position the coil along the neck of the picture tube, adjustments as shown in Fig. No. 1 - Point F are provided. Before adjusting these, set the focus control Fig. No. 3 at midpoint. Now move the coil back and forth along the neck of the tube for best line detail at the edges of the picture. Reset the focus control for best line detail in center of picture. In general, the focus coil should be positioned as far forward as consistent with good line detail. The focus coil adjusting arm "G" extends through the back of the cabinet. It has a universal joint action for a final touch-up of picture centering. A final setting of all the focus coil adjustments will deliver a picture with straight horizontal and vertical lines and have good over-all detail. Reset Ion Trap.

PICTURE CENTERING LEVER. If the picture is not centered in the mask or shadows appear at one corner, it will be necessary to adjust the focus coil by moving the "picture centering lever" which extends through the backboard of the set. See Fig. No. 1A. The picture centering lever is welded to the focus coil. It has a universal joint action capable of easily centering the picture to the proper position. ALWAYS RESET THE FOCUS CONTROL AFTER MOVING THE CENTERING LEVER.

BACK OF CABINET

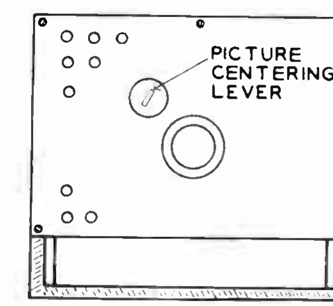


FIG. NO. 1A

DESCRIPTIVE OPERATION OF SERVICE CONTROLS

FRONT CHASSIS SERVICE ADJUSTMENTS

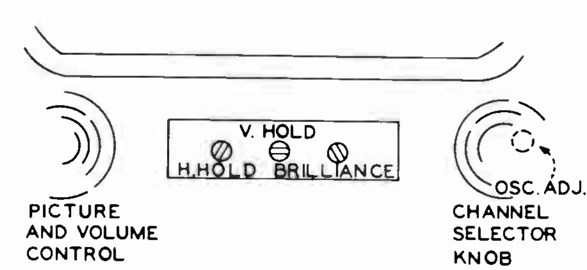


FIG. NO. 2

The most necessary service controls are conveniently located under the MUNTZ TV name plate on the front of the set between the two knobs. To remove this panel place the fingertips on both ends and pull gently toward you. On the back of the panel you have just removed is a diagram naming the controls in their order.

V. HOLD: The vertical hold control locks the picture into position on the surface of the picture tube so that it no longer moves up or down. Fig. No. 2.

BRILLIANCE: The brilliance control must be adjusted simultaneously with the front panel picture control. Too much brilliance will have the same effect as too little contrast, making it advisable to strike a proper balance between the picture control and the brilliance control. They are to be adjusted when the set is installed and should receive consideration on every service call. See Fig. No. 2.

H. HOLD: This control locks the circuits of the receiver in horizontal synchronization with the transmitting station. If heavy diagonal lines run across the picture, moving the control will snap the picture into view. Fig. No. 2.

Like photography, the final setting of the brilliance control should be left at a point where the picture displays a really dark black, a very brilliant white, and many shades of grey. Fig. No. 2.

OSCILLATOR ALIGNMENT

An important adjustment that must be made in the customer's home at time of installation, is the oscillator alignment tuning slug adjustment. While they are accurately set at the factory, a touch-up job is necessary to bring the TV set exactly in tune with the local stations.

The tuning slugs may be reached through an opening located behind the channel selector knob. Fig. No. 2.

(a) Turn the TV set on and allow a 10 minute warm-up period.

(b) Set the channel selector to the desired station on the air in your locale.

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(c) Turn up the volume control and picture control to a normal operating position.

(d) The TV station on the air is better suited for making the oscillator adjustment than a signal generator.

(e) Use a non-metallic screw driver so the coil inductance will not be affected.

(f) Tune adjusting slug for most efficient COMPROMISE of both sound and picture.

CAUTION: Take care that the oscillator slug is not screwed in beyond its thread limitations as it will drop into the oscillator coil, which will necessitate the removal of the coil from the drum assembly so that the threads may again be engaged. This amounts to a good deal of work. To prevent this, always start by turning the adjusting screw in a counterclockwise direction.

REAR CHASSIS SERVICE ADJUSTMENTS

The remainder of the service controls are found on the back of the chassis and can be seen just below the back plate of the cabinet. See Fig. No. 3.

REAR VIEW OF CHASSIS

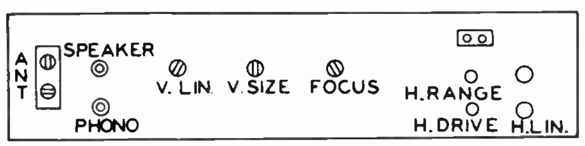

FIG. NO. 3

V. LINEARITY: The vertical linearity control gives the proper vertical proportions to the picture. Movement of the control affects the top half of the picture much more than the lower half. For this reason the V. Linearity and the V. Size must be adjusted simultaneously for proper proportions of picture height. Fig. No. 3.

V. SIZE: This control changes the overall picture height. When adjusted to correct height, the picture should extend for approximately 1/4 inch beyond the edge of the picture tube mask so that the top and bottom edges of the picture are not visible. Fig. No. 3.

FOCUS: The focus control clarifies line detail throughout the entire picture. It works in conjunction with the focus coil. Watch the center of the test pattern for sharp detail when moving this adjustment. Stop movement of control at point of optimum. Readjust Ion Trap.

H. DRIVE: (C65B) Adjustment expands and contracts the picture from midpoint to the left. CAUTION: Trimmer screw will fall out if turned too far to the left.

H. LINEARITY: (L13) Adjustment expands and contracts the picture from midpoint to the right. Alternate readjustment of C65B and L13 will obtain good horizontal linearity. When good horizontal linearity is accomplished and the proper setting of controls V. LIN. and V. SIZE is completed the test pattern circle should appear round. NOTE: If a white vertical line appears on the left side of the picture, it can generally be eliminated by adjustment of the horizontal drive. In some cases a compromise adjustment for linearity must be made to eliminate the white line.

All the stations do not send perfect linear pictures at all times. It is suggested, when making the linearity size and centering adjustments, to check the stations on the air and make your adjustments to fit all stations as well as possible.

H. RANGE: For particulars, read the HORIZONTAL OSC. SET-UP PROCEDURE.

PHONO JACK

When using a phono attachment the picture control must be turned completely counterclockwise. Move the station selector to an unused channel. The volume control of the receiver now acts as the volume control for the phono unit.

During the history of production on the TV17A chassis the phono jacks were not always connected. If you desire to use this part follow the wiring as given on the schematic diagram. The phono wire must be shielded with Part No. PR-0174.

HORIZONTAL OSC. SET-UP PROCEDURE - SYNCHROGUIDE CIRCUIT

CHECKING NEED FOR HORIZ. OSC. ADJUSTMENT

Tune in a good signal (preferably a test pattern) and allow receiver to warm up for a few minutes. When the Horiz. Osc. adjustments are properly set, the horiz. hold control will act as per the following: Rotate the horiz. hold control (beneath MUNTZ name plate) fully counterclockwise. The picture should remain in horiz. sync., but fall out of sync. if the channel selector is moved off channel, then back to channel. This action is correct with the H. HOLD fully counterclockwise.

Slowly rotate H. HOLD control in a clockwise direction. The number of diagonal blanking bars will gradually decrease, until only 3 or 4 diagonal blanking bars can be seen. At this point slight additional rotation will snap the picture into sync. The point where the picture falls into sync. should occur when the H. HOLD control is approximately 45 degrees from full counterclockwise position.

Further rotation of control should find the picture falling out of sync. in the opposite direction at about 45 degrees from the extreme CLOCKWISE position. In this position it should fall out of sync. without rotation of selector control.

If the horiz. osc. does not fill the above requirements, readjustment of these circuits is in order and can usually be done in the customer's home by re-adjustment of the H. HOLD control, the TOP HORIZ. SLUG, H. RANGE, and H. DRIVE TRIMMERS set to positions that fill the above requirements. If these conditions cannot be obtained the slug beneath the chassis needs adjustment. Follow procedure listed under "Complete Alignment of Horizontal Oscillator".

COMPLETE ALIGNMENT OF HORIZONTAL OSCILLATOR (AFC)

1. Tune in known good signal (test pattern) and adjust contrast control well below an over-contrast condition.

2. Turn both HORIZ. OSC. SLUGS out of coil can #LO-0035 (T6) as far as possible.

CAUTION: For manufacturing convenience both of the osc. adjustments are within the can #LO-0035. If slugs are turned too far in, then a coupled condition is reached which is undesirable.

3. Pre-set H. RANGE trimmer 1/8 turn out from full "in" position. Through adjustment of the H. HOLD, H. RANGE, and TOP H. OSC. SLUG cause picture to sync.

4. Connect scope having a 10 mmf. condenser in series with the vertical lead to Point C (Fig. No. 4). Adjust bottom H. OSC. SLUG, KEEPING PICTURE SYNCED AT ALL TIMES, until broad and sharp peaks are of equal height. (Fig. No. 4A). Remove scope.

5. Set H. HOLD to extreme clockwise position - adjust TOP H. OSC. SLUG until complete raster starts to move across screen.

BENEATH CHASSIS

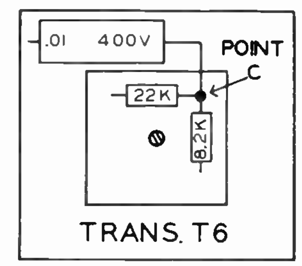

FIG. NO. 4

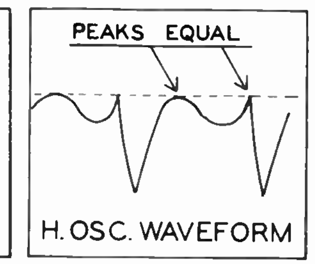

FIG. NO. 4A

6. Re-set H. HOLD to extreme counterclockwise position. Then force picture to drop out of sync. by snapping channel selector off, then on, station.

7. Slowly rotate H. HOLD control clockwise until the point is reached where it will snap into sync.

8. While repeating step No. 6 as required, re-adjust the H. RANGE trimmer and the TOP H. OSC. SLUG until a condition is reached wherein there appears 3 or 4 diagonal bars just before the picture snaps into sync.

CAUTION: The H. RANGE trimmer and the TOP H. OSC. SLUG are interactive and there are numerous combinations of adjustments where the picture will sync. but only ONE combination where the 3 or 4 diagonal bars appear just before snapping into sync.

9. Now recheck the clockwise position of H.HOLD control. Picture should fall out of sync. during the last 45 degrees of rotation. If not, slightly readjust the TOP H. HOLD SLUG only until this condition is reached.

10. Repeat any of the above steps as necessary until Horiz. Hold Control conforms to specifications as required in paragraph, "Checking need for H. Osc. Adjustment".

PARTS LIST

Give Part Number, Description and Chassis Number which is located on the rear of the chassis you are working on.

CABINET PARTS

CABINETS

Part No.	Description		Chassis No.
CW-0023-1	Table Model	Walnut	(M31 TV17A2)
-3	Table Model	Mahog.	(M31 TV17A2)
-4	Table Model	Blond	(M31 TV17A2)
CW-0023R-1	Table Model	Walnut	(M31R TV17A3)
-3	Table Model	Mahog.	(M31R TV17A3)
-4	Table Model	Blond	(M31R TV17A3)
CW-0024-1A	Consolette	Walnut	(M32 TV17A3)
-3A	Consolette	Mahog.	(M32 TV17A3)
-4A	Consolette	Blond	(M32 TV17A3)
	or chassis TV17A2 (rectangular)		
CW-0026-1	Consolette	Walnut	(M33 TV17A4)
-3	Consolette	Mahog.	(M33 TV17A4)
-4	Consolette	Blond	(M33 TV17A4)

CABINET ACCESSORIES

Part No.	Description
ES-0016-1B	Cover Plate MUNTZ - bronze
ES-0017	Dial Plate (Pic. Control) - bronze
ES-0018-A	Dial Plate (Selector) - bronze
ES-0021	Mask 16" rectangular - alum.
ES-0023	Escutcheon Bezel 16" - bronze
ES-0024	Mask 16" round - alum.
ES-0025	Mask 19" round - alum.
ES-0026	Escutcheon Bezel 19" - bronze
BP-0120A	Back Board (14-7/16"x20-5/16")
BP-0121A	Back Board (15-9/16"x22-9/16")
BP-0122C	Back Board (19" cabinet)
GW-0008	Grille M32 - brass
GW-0009	Grille M33 - brass
KB-0029	Knob (On/Off Vol.) - brass
KB-0030	Knob (Selector) - brass
KB-0031	Knob (Selector) - molded
KB-0032	Knob (Vol. Control - molded
KB-0033	Knob (Pic. Control - molded
MP-0442	Strip - Glass Retainer - 19"
PR-0162	Spring Catch - Holds MUNTZ Name Plate
PR-0170	Compression Ring for Knob
PR-0171	Spacer Sleeve for Knob
WF-0028	Washer Knob 2" Felt
WF-0029	Washer Knob 1-1/4" Felt
WG-0009A	Glass 16" - Safety
WG-0010	Glass 19" - Safety

SPEAKERS

SK-0012	Speaker 5" P.M. (LS1)
SK-0014	Speaker 10" P.M. (LS1)

MODELS M31, Ch. TV17A2; M31R, M32, M32R, Ch. TV17A3; M33, M34, Ch. TV17A4; M41, M42, Ch. TV17A3A; M46, M49, Ch. TV17A7

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World Radio History

TUNERS

The following list of parts can be identified from the schematic diagram, Tuner Section Z1.

TUNERS

Sym.	Description	Part No.
Z1	Tuner Intercarrier, 1-15/16" shaft	PR-0166-1
Z1	Tuner Intercarrier, 2-27/32" shaft	PR-0166-2

CONDENSERS

Sym.	Description	Part No.
C1	.5 to 3 mmfd., Ceramic Trimmer	CT-0011
C2	5 mmfd., ±.5 mmfd, Zero Temp. Coeff	CC-0081
C3	.001 mfd., min., Ceramic	CC-0082
C4	120 mmfd., 5%, Ceramic, -750 Temp. Coeff.	CC-0083
C5	.5 to 3 mmfd., Ceramic Trimmer	CT-0011
C6	100 mmfd., Cer, -750 Temp. Coeff.	CC-0084
C7	10 mmfd., 5%, Cer, -750 Temp. Coeff	CC-0085
C8	20 mmfd., Cer, Zero Temp. Coeff	CC-0086
C9	.5 to 3 mmfd., Ceramic Trimmer	CT-0011
C10	.5 to 3 mmfd., Tuning	CC-0087
C11	.5 to 3 mmfd., Ceramic Trimmer	CT-0011
C12	.001 mfd. min., Ceramic	CC-0082
C13	10 mmfd., 5%, Cer, Zero Temp. Coeff	CC-0089
C14	120 mmfd., 10%, Silver Mica	CM-0042
C15	.001 mfd. min., Ceramic	CC-0082

COILS

Sym.	Description	Part No.
L1	Antenna Coil - Channel #2 (2F)	LR-0042
L1	Antenna Coil - Channel #3 (3F)	LR-0043
L1	Antenna Coil - Channel #4 (4F)	LR-0044
L1	Antenna Coil - Channel #5 (5F)	LR-0045
L1	Antenna Coil - Channel #6 (6F)	LR-0046
L1	Antenna Coil - Channel #7 (7F)	LR-0047
L1	Antenna Coil - Channel #8 (8F)	LR-0048
L1	Antenna Coil - Channel #9 (9F)	LR-0049
L1	Antenna Coil - Channel #10 (10F)	LR-0050
L1	Antenna Coil - Channel #11 (11F)	LR-0051
L1	Antenna Coil - Channel #12 (12F)	LR-0052
L1	Antenna Coil - Channel #13 (13F)	LR-0053

COILS--Continued

Sym.	Description	Part No.
L2	Mixer Osc. Coil - Channel #2 (2F)	LO-0062
L2	Mixer Osc. Coil - Channel #3 (3F)	LO-0063
L2	Mixer Osc. Coil - Channel #4 (4F)	LO-0064
L2	Mixer Osc. Coil - Channel #5 (5F)	LO-0065
L2	Mixer Osc. Coil - Channel #6 (6F)	LO-0066
L2	Mixer Osc. Coil - Channel #7 (7F)	LO-0067
L2	Mixer Osc. Coil - Channel #8 (8F)	LO-0068
L2	Mixer Osc. Coil - Channel #9 (9F)	LO-0069
L2	Mixer Osc. Coil - Channel #10 (10F)	LO-0070
L2	Mixer Osc. Coil - Channel #11 (11F)	LO-0071
L2	Mixer Osc. Coil - Channel #12 (12F)	LO-0072
L2	Mixer Osc. Coil - Channel #13 (13F)	LO-0073

INDUCTANCES

Sym.	Description	Part No.
L3	Choke, Filament RF	LR-0020
L4	Choke, Filament Oscillator	LO-0037
L5	I.F. Load Coil	LI-0045

RESISTORS

Sym.	Description	Part No.
*R1	3,900 ohms, 1/2 watt, 10%	RC-3901-18
R2	47,000 ohms, 1/2 watt, 10%	RC-4702-18
R3	10,000 ohms, 1/2 watt, 10%	RC-1002-18
R4	2,200 ohms, 1/2 watt, 20%	RC-2201-28
R5	4,700 ohms, 1/2 watt, 10%	RC-4701-18
R6	220,000 ohms, 1/2 watt, 20%	RC-2203-28
R7	10,000 ohms, 1/2 watt, 10%	RC-1002-18
*R8	4,700 ohms, 1/2 watt, 10%	RC-4701-18
R9	15,000 ohms, 1/2 watt, 10%	RC-1502-18

* To secure proper high frequency characteristics, use IRC metalized resistor only.

CHASSIS PARTS (Excluding Tuner Z1)

The following parts are the electrical components of the chassis and can be located on the schematic diagram by symbol number. Capacitor percentages are 20% unless otherwise stated.

CAPACITORS

Sym.	Description		%	Part No.
C18	Ceramic - Tub.	30 mmf. 500 V.	10	CC-0068
C19	L'ytic	2 x 40 mfd. 500 V. / 100 mfd. 200 V.		CE-0026A
C20	L'ytic	2 x 40 mfd. 500 V. / 100 mfd. 50 V.		CE-0033A
C21, C22	Silver Mica furnished on 4.5 MC Trap Coil			
C23	Ceramic - HiKap	5,000 mmf. 500 V.		CC-0060
C24	Ceramic - HiKap	5,000 mmf. 500 V.		CC-0060
C25	Ceramic - Tub.	5 mmf. 500 V.	10	CC-0067
C26	Ceramic - HiKap	5,000 mmf. 500 V.		CC-0060
C27	Ceramic - Tub.	500 mmf. 500 V.		CC-0065
C28	Ceramic - Tub.	1,000 mmf. 350 V.		CC-0061A
C29	Ceramic - HiKap	5,000 mmf. 500 V.		CC-0060
C30	L'ytic	4 mfd. 50 V.		CE-0031
C31	Ceramic - HiKap	5,000 mmf. 500 V.		CC-0060
C32	Tub. Paper	.01 mfd. 400 V.		CP-0041
C33	Tub. Paper	.01 mfd. 600 V.		CP-0019
C34	Ceramic - HiKap	5,000 mmf. 500 V.		CC-0060
C35	Ceramic - HiKap	5,000 mmf. 500 V.		CC-0060
C36	Ceramic - HiKap	5,000 mmf. 500 V.		CC-0060
C37	Ceramic - HiKap	5,000 mmf. 500 V.		CC-0060
C38	Ceramic - HiKap	5,000 mmf. 500 V.		CC-0060

CAPACITORS--Continued

Sym.	Description		%	Part No.
C39	Tub. Paper	.2 mfd. 400 V.		CP-0033
C40	Ceramic - HiKap	5,000 mmf. 500 V.		CC-0060
C41	Ceramic - HiKap	5,000 mmf. 500 V.		CC-0060
C42	Ceramic - HiKap	5,000 mmf. 500 V.		CC-0060
C43	Ceramic - HiKap	5,000 mmf. 500 V.		CC-0060
C44	Ceramic - HiKap	5,000 mmf. 500 V.		CC-0060
C45	Ceramic - Tub.	10 mmf. 500 V.		CC-0059A
C46	Tub. Paper	.05 mfd. 400 V.		CP-0010
C47	Tub. Paper	.2 mfd. 400 V.		CP-0033
C48	Tub. Paper	.001 mfd. 600 V.		CP-0030
C49	Tub. Paper	.05 mfd. 400 V.		CP-0010
C50	Tub. Paper	.05 mfd. 600 V.		CP-0007A
C51	Tub. Paper	.1 mfd. 600 V.		CP-0013
C52	Tub. Paper	.05 mfd. 600 V.		CP-0007A
C53	Mol. Paper	.005 mfd. 600 V.		CP-0038
C54	Mol. Paper	.005 mfd. 600 V.		CP-0038
C55	Mol. Paper	.002 mfd. 600 V.		CP-0037
C56	Mol. Paper	.002 mfd. 600 V.		CP-0037
C57	Tub. Paper	.05 mfd. 600 V.		CP-0007A
C58	Tub. Paper	.02 mfd. 200 V.		CP-0040
C59	Tub. Paper	.2 mfd. 200 V.		CP-0039
C60	Ceramic - Tub.	200 mmf. 500 V.	5	CC-0080
C61	Mol. Paper	.002 mfd. 600 V.		CP-0037
C62	Tub. Paper	.01 mfd. 400 V.	10	CP-0043
C63	Mol. Paper	.002 mfd. 600 V.	10	CP-0036
C64	Ceramic - Tub.	180 mmf. 500 V.	10	CC-0074
C65	Double Trimmer	10-160 mmf. / 40-370 mmf.		CT-0010B
C66	Ceramic - Tub.	470 mmf. 500 V.		CC-0078
C67	Ceramic - Tub.	7.5 mmf. 1500 V.		CC-0076
C68	Tub. Paper	.05 mfd. 600 V.		CP-0007A
C69	Tub. Paper	.05 mfd. 600 V.		CP-0007A
C70	Tub. Paper	.1 mfd. 600 V.		CP-0013
C71	Tub. Paper (16")	.04 mfd. 400 V.		CP-0042
C71	Tub. Paper (19")	.1 mfd. 400 V.		CP-0034
C72	L'ytic	500 mfd. 6 V.		CE-0032
C73	Ceramic - Tub.	56 mmf. 500 V.		CC-0079

FUSE

Sym.	Description	Part No.
F1	3 amp. - 250 V. with pigtails	FU-0004

JACK

Sym.	Description	Part No.
J1	Speaker	SO-0010

COILS

Sym.	Description	Part No.
L7	Antenna Choke	LC-0043A
L8	Focus 385 ohm 16"	LC-0050
L8	Focus 400 ohm 19"	LC-0052A
L9	Peaking 170 uh blue	LC-0038B
L10	Peaking 400 uh yellow	LC-0041B
L11	Peaking 280 uh green	LC-0044B
L12	Peaking 400 uh yellow	LC-0041B
L13	Horz. Linearity	LR-0019

LINE CORD

Sym.	Description	Part No.
P1	with plug	CA-0103

RESISTORS

Sym.	Description	ohm	watts	%	Part No.
R12	Carbon	820	2	10	RC- 820-12
R13	Focus Control	ww 2,250	2		VC-0024A
R14	Carbon	82	1/2	10	RC- 82-18
R15	Carbon	680	1/2		RC- 680-28
R16	Carbon	4,700	2	10	RC-4701-12
R17	Carbon	220	1/2		RC- 220-28
R18	Carbon	47,000	1/2		RC-4702-28
R19	Carbon	6,800	1/2	10	RC-6801-18
R20	Dual Control 1-1/2" Shaft	.5 meg / 1,500			VC-0033C
R20	Dual Control 2-13/32" Shaft	.5 meg / 1,500			VC-0040A
R21	Carbon	4.7 meg	1/2		RC-4704-28
R22	Carbon	270,000	1/2	10	RC-2703-18
R23	Carbon	470,000	1/2	5	RC-4703-58
R24	Carbon	820,000	1/2	5	RC-8203-58
R25	Carbon	10,000	1/2	10	RC-1002-18
R26	Carbon	100	1/2		RC- 100-28
R27	Carbon	680	1/2	10	RC- 680-28
R28	Carbon	82	1/2	10	RC- 82-18
R29	Carbon	8,200	1/2	10	RC-8201-18
R30	Carbon	680	1/2	10	RC- 680-28
R31	Carbon	82	1/2	10	RC- 82-18
R32	Carbon	560	1/2	10	RC- 560-18
R33	Carbon	8,200	1/2	10	RC-8201-18
R34	Carbon	100	1/2		RC- 100-28
R35	Carbon	560	1/2	10	RC- 560-18
R36	Carbon	4,700	1/2	10	RC-4701-18

RESISTORS--Continued

Sym.	Description	ohm	watts	%	Part No.
R37	Carbon	1.5 meg	1/2		RC-1504-28
R38	Carbon	18,000	1/2	10	RC-1802-18
R39	Carbon	1.2 meg	1/2	10	RC-1204-18
R40	Carbon	6,800	1	10	RC-6801-11
R41	Carbon	10,000	1/2	10	RC-1002-18
R42	Carbon	100,000	1/2		RC-1003-28
R43	Carbon	2.2 meg	1/2	10	RC-2204-18
R44	Brightness Control	50,000	1/2		VC-0036B
R45	Carbon	2,700	1/2	10	RC-2701-18
R46	Carbon	22,000	1/2	10	RC-2202-18
R47	Carbon	470,000	1/2	10	RC-4703-18
R48	Carbon	12,000	1/2	10	RC-1202-18
R49	Carbon	560	1/2	10	RC- 560-18
R50	Carbon	560	1/2	10	RC- 560-18
R51	Carbon	680	1/2	10	RC- 680-28
R52	Vert.Lin.Control	2,500	1/2		VC-0037A
R53	Carbon	1.5 meg	1/2	10	RC-1504-18
R54	Vert.Hold Control	1. meg	1/2		VC-0038A
R55	Carbon	3.9 meg	1/2	10	RC-3904-18
R56	Carbon	3.9 meg	1/2	10	RC-3904-18
R57	Vert.Size Control	2. meg	1/4		VC-0034C
R58	Carbon	2.2 meg	1/2	10	RC-2204-18
R59	Carbon	10,000	2	10	RC-1002-12
R60	Carbon	8,200	1/2	10	RC-8201-18
R61	Carbon	8,200	1/2	10	RC-8201-18
R62	Carbon	8,200	1/2	10	RC-8201-18
R63	Carbon	22,000	1/2	10	RC-2202-18
R64	Carbon	68,000	1/2	10	RC-6802-18
R65	Horz.Hold Control	50,000	1/2		VC-0039A
R66	Carbon	100,000	1	10	RC-1003-11
R67	Carbon	820,000	1/2	10	RC-8203-18
R68	Carbon	8,200	1/2	10	RC-8201-18
R69	Carbon	150,000	1/2	10	RC-1503-18
R70	Carbon	100,000	1	10	RC-1003-11
R71	Carbon	220,000	1/2	10	RC- 203-18
R72	Carbon	2.7 meg	1/2	10	RC-2704-18
R73	Carbon	8,200	1/2	10	RC-8201-18
R74	Carbon	22,000	1/2	10	RC-2202-18
R75	Carbon	120,000	1/2	10	RC-1203-18
R76	Carbon	75,000	2	10	RC-7502-12
R77	Carbon	470,000	1/2	10	RC-4703-18
R78	Carbon	100	1/2		RC- 100-28
R79	Carbon	560,000	1/2	10	RC-5603-18
R80	Carbon	8,200	2	10	RC-8201-12
R81	Carbon	2,200	1	10	RC-2201-11
R82	Carbon	500,000	1		RC-5003-21

SOCKET

Sym.	Description	Part No.
S1	Interlock	SO-0034

TRANSFORMERS

Sym.	Description	Part No.
T1	Power	TP-0018
T2	Audio Output	TO-0019
T3	Vertical Output	TO-0018B
T4	Deflection Yoke Coil 16" & 19"	LC-0048
T4	Deflection Yoke Coil 16" Round	LC-0051
T5	Vert. Blocking Oscillator	TO-0022A
T6	Horiz. Oscillator Coil (AFC)	LO-0035B
T7	Horiz. Output 16" Rect.	TO-0020
T7	Horiz. Output 16" Round	TO-0021
T7	Horiz. Output 19"	TO-0024

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World Radio History

ANTENNA STRIP

TB1 Antenna Terminal - 2 Term. TB-0027

TUBES

V1	R.F. Amp.	6AG5
V2	Osc. & Mixer.	6J6
V3	Low Voltage Rectifier	5U4G
V4	Sound I.F.	6AU6
V5	FM Detector & 1st Audio	6T8
V6	Audio Output	6AQ5
V7	1st I.F. Amp.	6AU6
V8	2nd I.F. Amp.	6AU6
V9	3rd I.F. Amp.	6AU6
V10	Video Amp.	6AU6
V11	Sync. Separator	12AT7
V12	Vert. Osc. & Output	6SN7GT
V13	Horz. AFC & Osc.	6SN7GT
V14	Horz. Output	6BG6G
V15	High Voltage Rectifier	1B3GT
V16	Damper	6W4
Y1	Germanium Crystal Detector.(IN-34)	CX-0027

KINESCOPE TUBES

V17 Rect.	16"	16RP4A
V17 Round	16"	16DP4A
V17 Round	19"	19DP4A

CRYSTAL DETECTOR

Y1 Germanium (IN-34). CX-0027

COILS

Z1	See Parts List for RF Tuner. (Page 7)	
Z2	Trap 4.5 MC.	LO-0036A
Z3	Ratio Detector	LI-0044
Z4	2nd I.F. blue	LI-0042A
Z5	3rd I.F. white	LI-0041A
Z6	4th I.F. red	LI-0040A

MISCELLANEOUS CHASSIS PARTS

The remainder of these parts have no symbol numbers as they are not located on the schematic diagram.

SOCKETS & ACCESSORIES

Kinescope Socket & Wire Assy. 16"	CA-0106-2
Kinescope Socket & Wire Assy. 19"	CA-0106-3
Wafer 7 pin min. 2/shield	SO-0035
Wafer 7 pin min. less shield	SO-0039
Wafer 9 pin min. less shield	SO-0040
HiV. Socket & Corona Ring	SO-0042B
Octal 1-5/16" mtg. center - Moulded	SO-0043
Insulator Mtg. HiV. Socket - Ceramic	IN-0096
Kinescope HiV. Cable 18"	CA-0107-B
Kinescope HiV. Cable 21"	CA-0107-1

ION TRAPS

33-39 Gauss	16" Round	PR-0163
47-53 Gauss	16" Rect.	PR-0165
48 ± 3 Gauss	19" Round	PR-0172

RUBBER BUMPERS

Tube Stop 1/16" sponge - adhesive back.	RB-0028
Tube Stop 3" Long - Neoprene (X-397)	RB-0034
Tube Stop 3" Long - Neoprene (X-407)	RB-0035

TERMINAL TIE POINTS

4 Term. (LTTTT)	TB-0022
3 Term. (TTTL)	TB-0024
2 Term. (TLT)	TB-0030
9 Term. (LTTTTTTTTL)	TB-0033

MISCELLANEOUS

Solder 5 lb. roll (rosin)	JS-0001
Phone Plug, Speaker	PL-0005
Spiral Shield (Vol. Control)	PR-0173
Spiral Shield (Phono)	PR-0174
Web Strapping 43" Long	PR-0161
Web Strapping 56" Long	PR-0167
Ground Clip (min. tube)	PR-0168
Shield (min. tube)	PR-0169

ELIMINATION OF AUDIO BUZZ

Hum or buzz and interference should be given consideration when the set is first installed, and the proper antenna system used to minimize interference effects.

The following is a list of causes which determine a 60 cycle buzz or hum in TV sets that use the popular intercarrier sound system. Reduce the buzz or hum to a minimum by doing the following steps in succession, when a complaint is encountered.

1. Buzz is most commonly due to improper tuning of the receiver controls. CORRECTION: Properly instruct customer in operation of picture control knob. It must be kept well below an over-contrast position.

2. Buzz may be the result of improperly adjusted oscillator coil slug (beneath the channel selector knob). CORRECTION: Properly follow instructions given in Service Manual under the topic "Oscillator Alignment" on page 5.

2a. If it is evidenced in the picture that the oscillator slug will not properly tune in the station, then the oscillator pad C9 in the tuner is out of alignment. Instructions for re-setting the pad C9 trimmer "K" are given in this Manual page 9 under "Oscillator Alignment" chart.

2b. There are times when the TV stations are responsible for Buzz since they transmit it with the picture in the form of over-modulation or phase shift. This can be determined by comparison (after adjustment of oscillator slugs) simply by turning to another transmitting station with a pure signal.

3. Hum may be due to mis-alignment of the ratio detector secondary tuning slug (adjust "G"). CORRECTION: Tune in a well known good station, with picture control normal, and volume control turned down to where station can just be heard and hum is evident. Use a non-metallic screwdriver and adjust slug to best fidelity in audio signal, which will reduce hum to a minimum. The primary ratio detector slug is beneath the chassis. It can be adjusted in the same manner as the top slug but must be tuned to maximum signal. However, the primary slug is not critical and hum should not be as apparent in slight misadjustment.

4. Buzz is also caused by overloading of the video stages due to a very strong television signal. Insertion of an attenuation pad between the transmission line and the receiver should decrease the incoming signal to normal level.

5. Other faults in the receiver which may cause buzz or hum are mis-alignment of the video I.F. stages and changes in component values such as resistors and electrolytic condensers.

6. In early production of the 17A series a BLUE covered mfd. 50 Volt condenser was used beneath the 6T8 socket. Some BLUE condensers have two faults; one is an open condition, the other a high power factor. Hold a good condenser across the BLUE one in the TV. If the hum is reduced by all means put in the good condenser and take out the offender.

7. A caution to all repairmen. Here we wish to seriously call to the attention of all repairmen that all connecting wires are routed by the Engineering and Production departments for the best possible over-all results. When probing for trouble do not reposition wires beneath a TV set. When so doing, you bring inferior reception to the home of the customer, often without realizing it, causing repeated service calls and sometimes the trouble is never found. The practice of moving wires ruins the product we so proudly represent.

8. Some people will continue to over-contrast a picture regardless of consequences and have hum as the result. This will cause repeated service calls. Place a resistor in series with the contrast control and eliminate the complaint. The value should be somewhere between 100 and 400 ohms, depending on the amount of pick-up in antenna. Do this work only under unusual circumstances.

ALIGNMENT INSTRUCTIONS

A 22,000 ohm isolation resistor, for scope or VT meter, is provided beneath the chassis at point "E" Figure No. 5.

VIDEO I.F. ALIGNMENT CHART

	DUMMY ANTENNA	SIGNAL GENERATOR COUPLING	SIGNAL GENERATOR FREQUENCY	CHANNEL	CONNECT V.T.V.M.	FIG. NO. 5 ADJUST	REMARKS
#1	.001	Pin #1 of V8	25.7 MC	2	DC probe to Test Point "E"	D (Z6)	Short antenna connections. To avoid distortion in the response curve which may be caused by AGC action, keep the attenuator of the signal generator to a minimum, below 2 volts on the vacuum tube voltmeter. Adjust for maximum reading.
#2	.001	Pin #1 of V8	24.7 MC	2	DC probe to Test Point "E"	C (Z5)	
#3	.001	High side to ungrounded tube shield floating over converter tube (V2). Low side to chassis.	22.7 MC	2	DC probe to Test Point "E"	B (Z4)	
#4	.001	High side to ungrounded tube shield floating over converter tube (V2). Low side to chassis.	21.8 MC	2	DC probe to Test Point "E"	A (L5)	
#5	Repeat above operations until no further improvement can be made.						

OVERALL VIDEO I.F. RESPONSE EMPLOYING I.F. CURVE

	DUMMY ANTENNA	SWEEP GENERATOR COUPLING	SWEEP GENERATOR FREQUENCY	MARKER GEN. FREQ.	CHANNEL	CONNECT SCOPE	FIG. NO. 5 TOUCH-UP	REMARKS
#6	.001	High side to ungrounded tube shield floating over converter tube (V2). Low side to chassis.	24 MC 10 MC Sweep	20.6 MC 22.6 MC 24.3 MC 25.1 MC	2	Point "E"	A B C D	Short antenna connections. Check response curve to Fig. No. 6 and touch up where necessary.

MODELS M31, Ch. TV17A2; M31R, M32, M32R, Ch. TV17A3; M33, M34, Ch. TV17A4; M41, M42, Ch. TV17A3A; M46, M49, Ch. TV17A7

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DISCRIMINATOR AND SOUND I.F. ALIGNMENT

Connect two matched 100K ohm resistors in series from Pin #2 of the 6T8 to chassis ground. Fig. No. 7.

	DUMMY ANTENNA	SIGNAL GENERATOR COUPLING	SIGNAL GENERATOR FREQUENCY	CHANNEL	CONNECT V.T.V.M.	FIG. NO. 5 ADJUST	REMARKS
#7	.001	Pin #1 of 6AU6 V10	4.5 MC (unmod.)	2	Pin #2 of 6T8 and Chassis Ground (Fig. No. 7)	F, H, I	Turn picture control (contrast) all the way counterclockwise. Maximum reading. Use non-metallic screwdriver.
#8	.001	Pin #1 of 6AU6 V10	4.5 MC (unmod.)	2	Move to Point S and T, Fig. No. 7	G	The correct setting is when the VTVM pointer is at zero "cross over point." Use non-metallic screwdriver.

R.F. ALIGNMENT

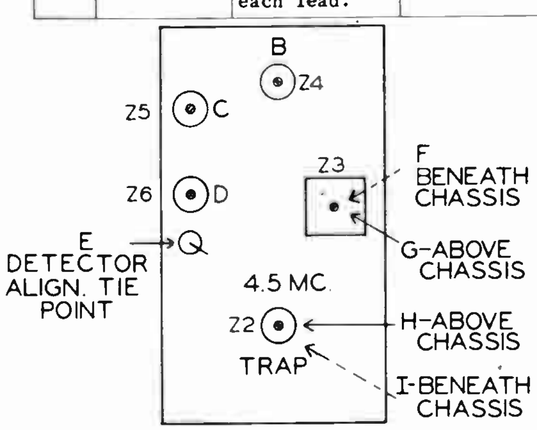
Remove 1st I.F. Amplifier tube V7 before making adjustments L, J, M.

	DUMMY ANTENNA	SWEEP GENERATOR COUPLING	MASTER OSC. (MC)	MARKER GEN. FREQ.(MC)	CHANNEL	CONNECT SCOPE	FIG. NO. 5 ADJUST	REMARKS
#9	Two 120 ohm carbon res.	Across ant. term. with 120 ohms in each lead.	207.50 (10MC sweep)	205.25 209.75	12	R.F. Test Point "N", Fig. No. 5	Points L, J, M	Adjust to response curve Fig. No. 8 with markers as shown.
#10	Two 120 ohm carbon res.	Across ant. term. with 120 ohms in each lead.	213.50	211.25 215.75	13	R.F. Test Point "N", Fig. No. 5		Check all channels to see that they have not been seriously affected.
			201.50	199.25 203.75	11			
			195.50	193.25 197.75	10			
			189.50	187.25 191.75	9			
			183.50	181.25 185.75	8			
			177.50	175.25 179.75	7			
			85.50	83.25 87.75	6			
			79.50	77.25 81.75	5			
			69.50	67.25 71.75	4			
#10 Continued	Two 120 ohm carbon res.	Across ant. term. with 120 ohms in each lead.	63.50	61.25 65.75	3	R.F. Test Point "N", Fig. No. 5		Check all channels to see that they have not been seriously affected.
			57.50	55.25 59.75	2			

OSCILLATOR ALIGNMENT

Restore 1st I.F. tube V7 to its socket. If the oscillator seems to be off frequency approximately the same amount for a majority of the channels, it is possible to correct them in one step, using adjustment "K" Fig. No. 5. Before adjusting "K" move each individual channel oscillator slug (they are reached through a hole at the right of the channel switch shaft), and observe the curve. It should be noted that this is an all-channel oscillator circuit adjustment and should not be adjusted for any individual channel.

	DUMMY ANTENNA	SWEEP GENERATOR COUPLING	MASTER OSC. (MC)	MARKER GEN. FREQ.(MC)	CHANNEL	CONNECT SCOPE	ADJUST OSC. SLUG	REMARKS
#11	Two 120 ohm carbon res.	Across Ant. Terminals with 120 ohm in each lead.	(Use Table in above R.F. Alignment Chart)			Point "E" Fig. No. 5	13 to 2 incl.	Adjust to place the sound marker as per Fig. No. 9. The Video marker should fall above 50%.



ALIGNMENT POINTS FRONT OF CHASSIS TOP VIEW

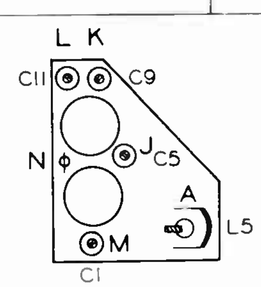


FIG. NO. 5

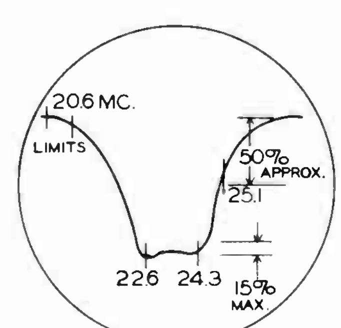


FIG. NO. 6

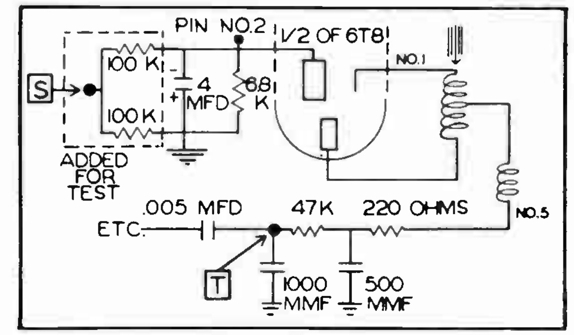


FIG. NO. 7

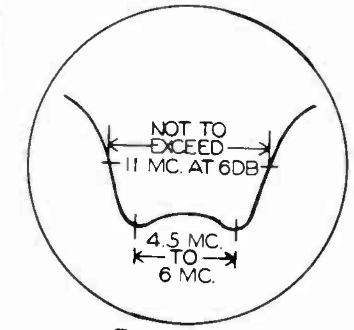


FIG NO. 8

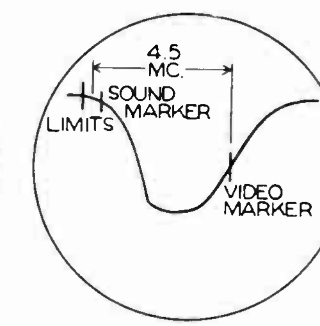


FIG. NO. 9

VOLTAGE SOCKET CHART

The following voltages were taken with the line voltage set at 117V. and it must be remembered that they are subject to a + or - 20% consideration. The meter used is an RCA VoltOhmyst. All voltages were taken from chassis ground to the socket pin contacts.

	FUNCTION	TUBE TYPE	SCREEN Pin	SCREEN Volts	CATHODE Pin	CATHODE Volts	GRID Pin	GRID Volts	PLATE Pin	PLATE Volts
V1	R.F. AMP	6AG5	6	115	7	0	1	-2	5	105
V2	OSC. MIXER	6J6			7 7	0 0	6 5	-3 -2	1 2	105 70
V7 V8 V9	1st I.F. AMP . . . . 2nd I.F. AMP . . . . 3rd I.F. AMP	6AU6 6AU6 6AU6	6 6 6	150 150 150	7 7 7	0 .4 1.2	1 1 1	-2.6 -2.6 0	5 5 5	150 150 150
Y1	XTAL. DET.	End of XTAL will be approximately -1. to -3.5 volts.								
V10	VIDEO AMP.	6AU6	6	150	7 7	pic 0 n.pic 16	1 1	pic -1 n.pic 12	5	100
V4	I.F. SOUND	6AU6	6	300	7	155	1 2	155 155	5	300
V5	FM DET. 1st AUDIO.	6T8			3 7	-16 0	8	-.75	1 2 6 9	-18 -22 -2 60
V11	SYNC. SEPARATOR.	12AT7			3 8	0 4	2 7	pic-25 n.pic -4 0	1 6	65 130
V6	AUDIO OUTPUT	6AQ5	6	380	2	150	1 7	130 130	5	400
V12	VERTICAL OSC. AND VERTICAL OUTPUT.	6SN7			3 6	0 16	1	V.Hold -20 to -30	2 5	Height 60 to 120 390
V16	DAMPER	6W4			3	480			5	370
V14	HORZ. OUTPUT	6BG6	8	240	3	0	5	-20		
V13	HORZ. AFC AND OSC.	6SN7			3 6	8 0	1 4	-22 -80	2 5	130 225
V3	RECTIFIER LOW VOLT	5U4			8	395		Measure at C19A		
V15	HIGH VOLTAGE RECTIFIER . . .	1B3	Cap	16" 8,500 volts			19" 12,500 volts			

1B3 cap Voltage is taken with the Anode wire disconnected from the picture tube, and employing a kilovolt-meter.

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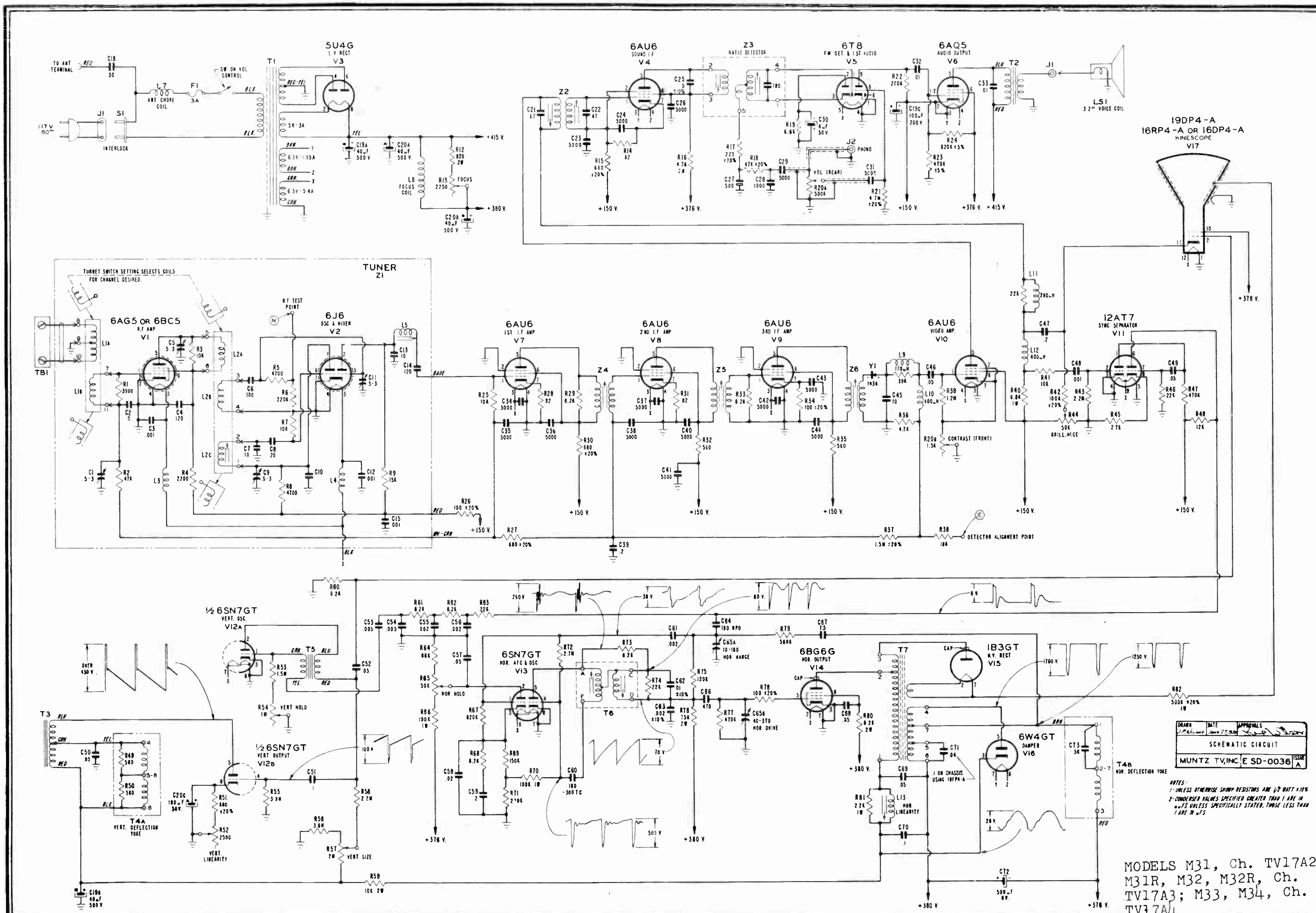

MODELS M31, Ch. TV17A2; M31R, M32, M32R, Ch. TV17A3; M33, M34, Ch. TV17A4

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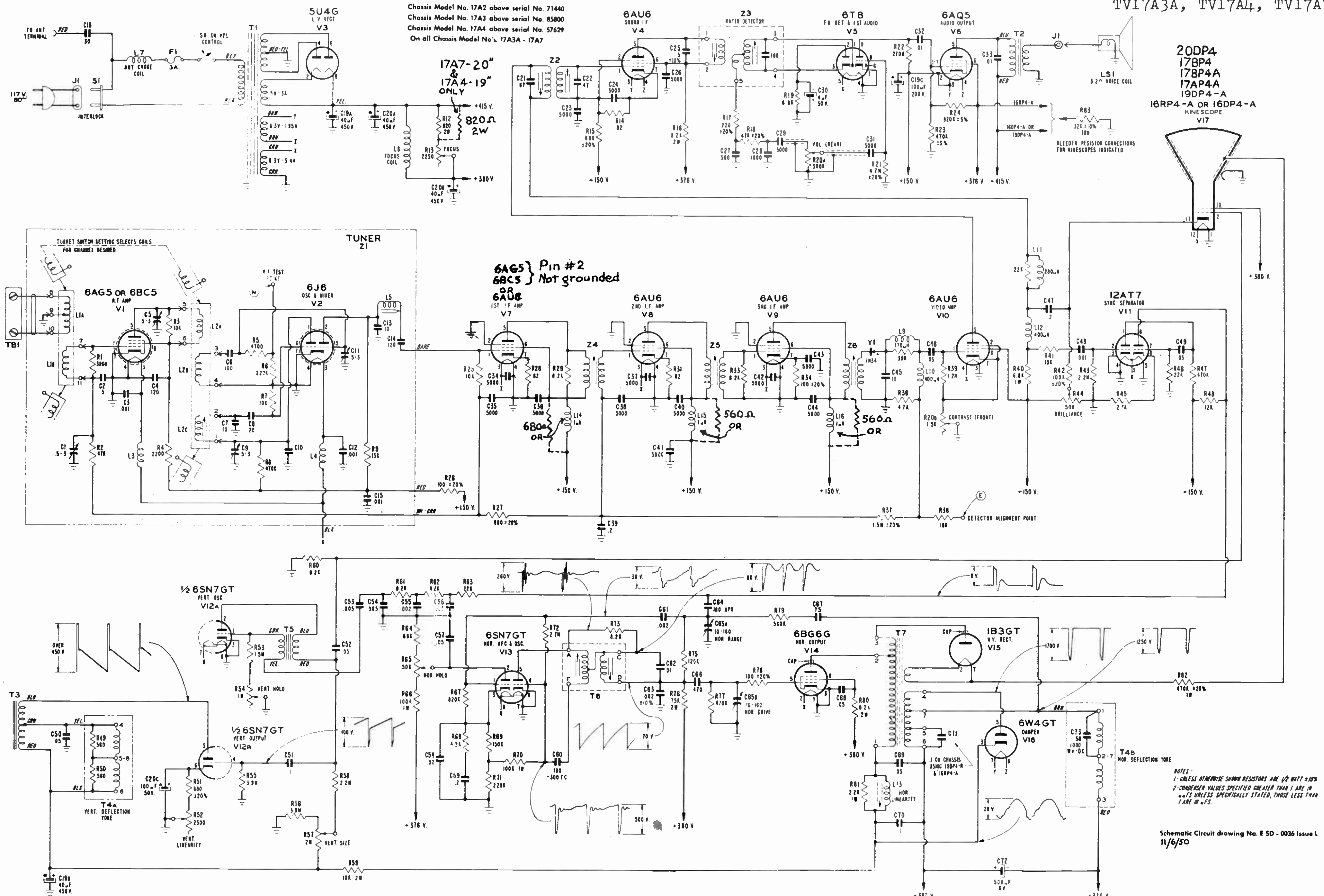
CHASSIS TV17A2, TV17A3, TV17A3A, TV17A4, TV17A7

This print applies to the following MUNTZ chassis:
Chassis Model No. 17A2 above serial No. 71440
Chassis Model No. 17A3 above serial No. 85800
Chassis Model No. 17A4 above serial No. 57629
On all Chassis Model No's. 17A3A - 17A7



NOTES:-
1 - UNLESS OTHERWISE SHOWN RESISTORS ARE 1/2 WATT ±10%
2 - CONDENSER VALUES SPECIFIED GREATER THAN 1 ARE IN μμFS UNLESS SPECIFICALLY STATED, THOSE LESS THAN 1 ARE IN μFS.

Schematic Circuit drawing No. E SD - 0036 Issue L
11/6/50

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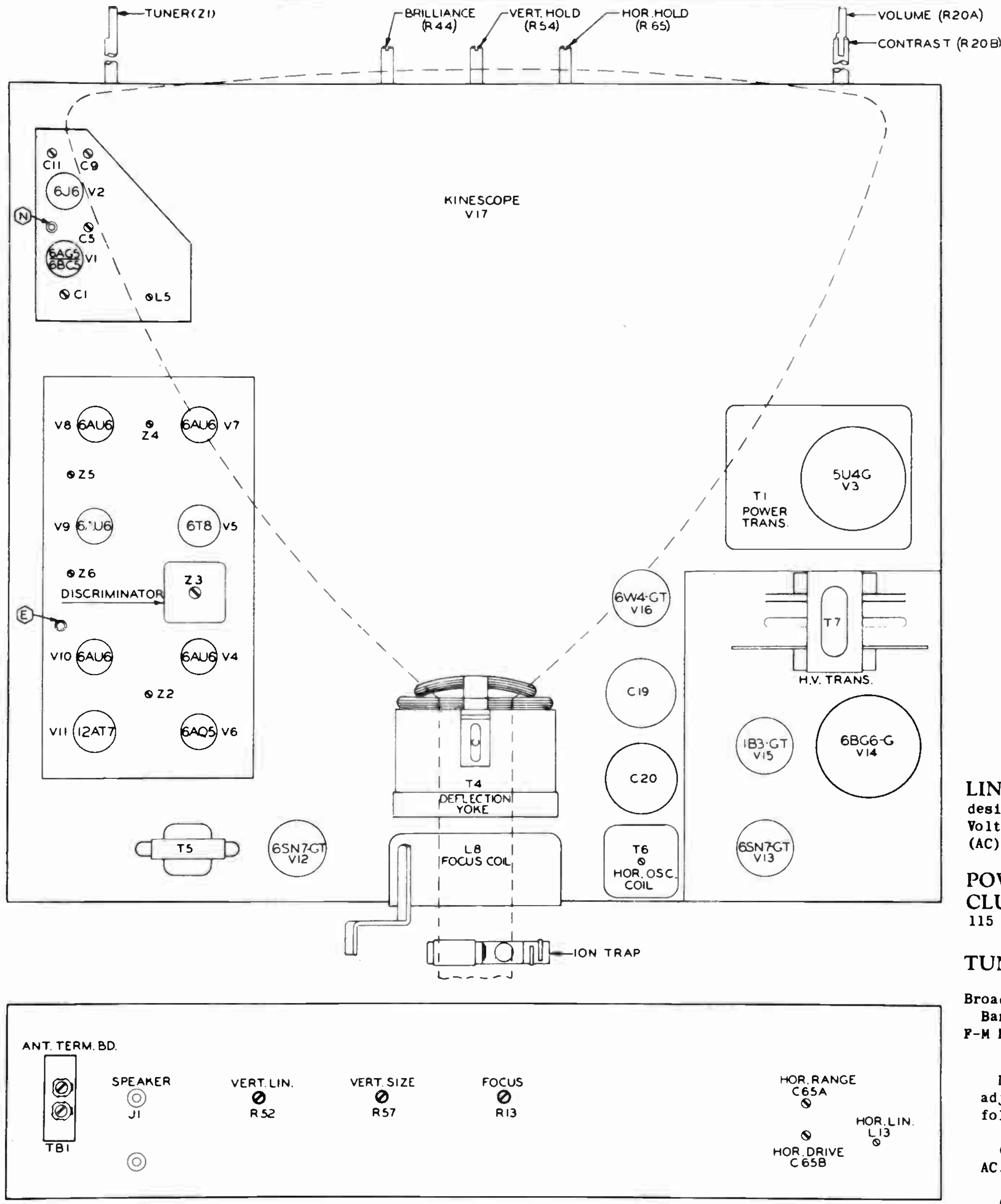


RESISTANCE OF VARIOUS COMPONENTS NOT GIVEN ON DIAGRAM

Focus Coil (L8) LC-0050
16" 385 ohms
19" 400 ohms

Peaking Coil (L9) LC-0038B
Blue 170 Mil-H. 9. ohms

Peaking Coil (L10) LC-0041B
Yellow 400 Mil-H. 15. ohms

Peaking Coil (L11) LC-0044B
Green 280 Mil-H. 12. ohms

Horizontal Linearity Control (L13) LR-0019
18. ohms

Power transformer (T1) TP-0018
Primary 1.2 ohms
H.V.S. 75. ohms

Audio Output transformer (T2) TO-0019
Primary 600. ohms
Secondary .6 ohms

Vertical Output transformer (T3) TO-0018B
16"
Primary 750. ohms
Secondary 10. ohms

Vertical Output transformer (T3) TO-0023
19"
Primary 900. ohms
Secondary 7. ohms

Yoke Coil (T4) LC-0048
Horiz. Term. (1 - 3) 8.5 ohms (T4B)
Vert. Term. (4 - 6) 50. ohms (T4A)

Vert. Blocking transformer (T5) TO-0022
Primary 170. ohms
Secondary 1000. ohms

Horiz. Osc. Coil (T6) LO-0035A
Terminals
A - F 80. ohms
C - D 45. ohms
A - C 22. ohms

Horiz. Output transformer (T7) TO-0020 — 16" rect.

Terminals	
1 - 2	140. ohms
2 - 3	200. ohms
4 - 5	8.5 ohms
5 - 6	.5 ohms
1B3 Filament	1 turn

Horiz. Output transformer (T7) TO-0021 — 16" round

Terminals	
1 - 2	180. ohms
2 - 3	180. ohms
4 - 5	9.5 ohms
5 - 6	.5 ohms
1B3 Filament	1 turn

Horiz. Output transformer (T7) TO-0024 — 19"

Terminals	
1 - 2	130. ohms
2 - 3	400. ohms
4 - 5	11. ohms
5 - 6	.5 ohms
1B3 Filament	1 turn

Crystal Detector (Y1) CX-0027
forward Resistance: Reject if below 30 ohms and above 250 ohms.
backward Resistance: Reject if below 200 K ohms, above 2.5 megohms.

Trap 4.5 MC (Z2) LO-0036A
Primary 1.5 ohms
Secondary 1.5 ohms

Discriminator Coil (Z3) LI-0044
Terminals
1 - 2 4. ohms
3 - 4 .8 ohms
4 - 5 .8 ohms
3 - 5 .8 ohms

I.F. Coil (Z4) LI-0040A
Primary .3 ohms
Secondary .3 ohms

I.F. Coil (Z5) LI-0041A
Primary .3 ohms
Secondary .3 ohms

I.F. Coil (Z6) LI-0042A
Primary .3 ohms
Secondary .3 ohms

INSTALLATION, OPERATION AND SERVICE DATA

Model M34 Cabinet Style Console
TV Chassis—TV17A4
Radio Chassis—8FM34
Record Player Chassis—100

LINE VOLTAGE: This receiver is designed for operation on 105-125 Volts; 60 Cycles, Alternating Current (AC) only.

POWER CONSUMPTION INCLUDING RECORD CHANGER: 115 Watts.

TUNING RANGE:

Broadcast Band: 540 to 1650 Kilocycles (182 to 555 Meters)
F-M Band: 87.5 to 108.5 Megacycles (2.7 to 3.4 Meters)

During the alignment procedure all adjustments should be made under the following conditions:

(A) Line voltage set at 117 Volts AC.

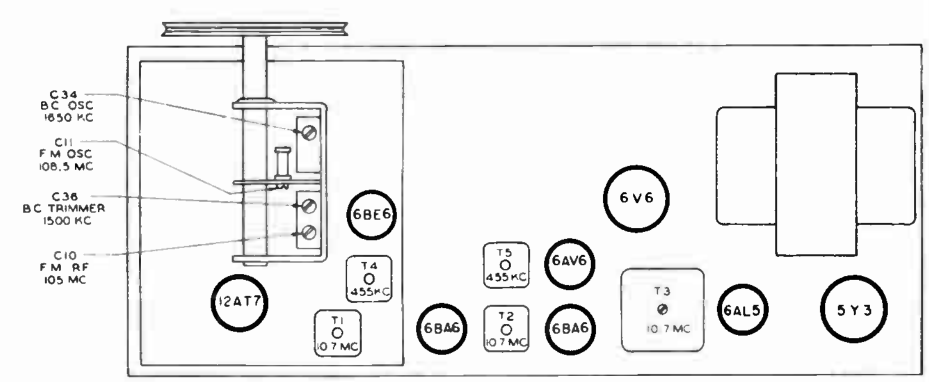
(B) Volume control at maximum position.

(C) Tone control set at extreme left position (Treble).

(D) Minimum input from the signal generator. This procedure should be adhered to, otherwise adjustments will be broad, due to the action of the automatic volume control.

TUBES: The Tubes used, and their functions, are as follows:

12AT7	R-F Amplifier and Mixer (F-M)
6BE6	A-M Converter and F-M Oscillator
6BA6	1st I-F Amplifier (A-M & F-M)
6BA6	2nd I-F Amplifier (F-M)
6AL5	F-M Detector
6AV6	A-M Detector, A.V.C. and Audio Amp.
6V6GT	Beam Power Amplifier
5Y3GT	Rectifier



TUBE AND ADJUSTMENT LOCATION DIAGRAM

MODELS M31, Ch. TV17A2; M31R, M32, M32R, Ch. TV17A3; M33, M34, Radio Ch. 8FM34, Ch. TV17A4; M41, M42, Ch. TV17A3A; M46, M49, Ch. TV17A7

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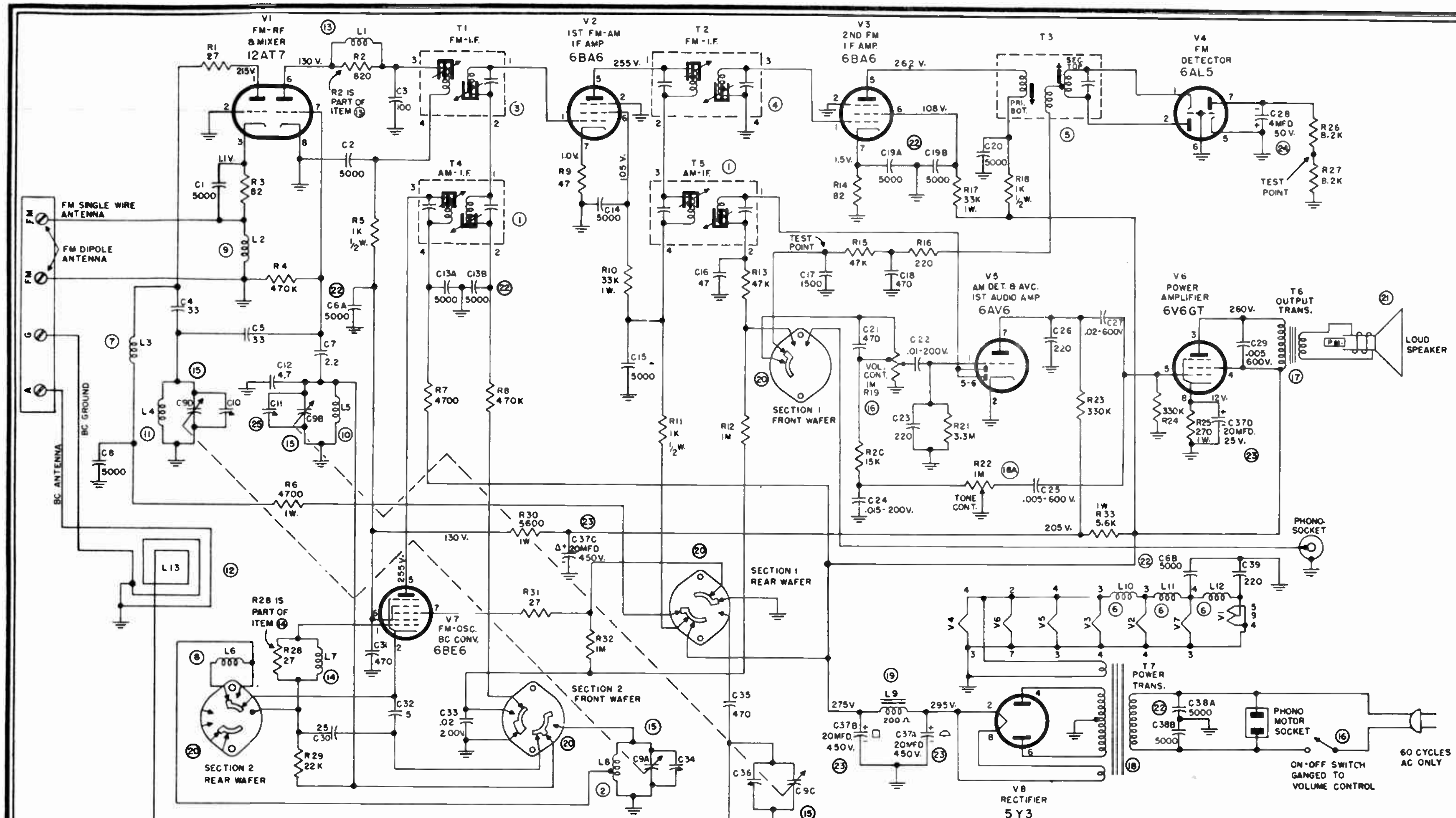
MODEL M34, Ch. TV17A4,
Radio Ch. 8FM34



MODEL M34—8FM34 SCHEMATIC DIAGRAM

K=Kilohms
M=Megohms

FM-I.F.=10.7MC
AM-I.F.=455KC

All Condensers Shown In MMF.
All Condensers 500V. Except As Shown.
All Resistors 1/4 Watt Except As Shown

BAND-SWITCH POSITIONS

Counter Clockwise. . .FM (87.5-108.5MC)
Center . . . . .AM (540 -1650KC)
Clockwise. . . . . . .Phono.

BAND-SWITCH IN FM POSITION.

PARTS LIST

1	LI-9001	AM - I.F. Transformer.	(C-1.445-3)
2	LO-9001	BC - Oscillator Coil	(C-1.436-2)
3	LI-9002	FM - I.F. Transformer.	(C-1.446-2)
4	LI-9003	FM - I.F. Transformer.	(C-1.446-3)
5	LI-9004	Ratio Detector Transformer Can Height 2½".	(C-1.524)
	LI-9004	Ratio Detector Transformer Can Height 1-15/16"	(C-1.542-1)
6	LC-9001	Filament Choke	(B-1.501)
7	LC-9002	RF Choke - RF Plate.	(B-1.512)
8	LC-9003	RF Choke - Osc. Cathode.	(B-1.535-1)
9	LC-9004	RF Choke - RF Cathode.	(B-1.535-2)
10	LO-9002	FM Oscillator Coil	(B-1.538)
11	LR-9001	FM - RF Grid Coil.	(B-1.539)
12	AN-9001	BC Loop Antenna.	(D-1.540)
13	LC-9005	Modulator Plate Choke.	(B-1.536-1)
14	LC-9006	Parasitic Suppressor	(B-1.536-2)
15	CV-9001	Variable Condenser	(C-2.222)
16	VC-9001	Volume Control & Switch. . .	(C-8.201-11)
16A	VC-9002	Tone Control	(C-8.201-12)
17	TO-9001	Output Transformer	(C-9.241-3)
18	TP-9001	Power Transformer.	(D-9.248)
19	LC-9007	Filter Choke.	(C-9.255)
20	SW-9001	Band-Switch	(C-8.228)
21	SK-0014	10" Speaker	
22	CC-9001	Dual Shielde. Ceramic Capacitor.	(B-4.125-1)
23	CE-9001	Dry Electrolytic Capacitor Unit	(C-5.421-7)
24	CE-9002	Electrolytic Capacitor.	(C-5.430)
25	CT-9001	Ceramic Trimmer .7 to 3.5 mmf.	(B-4.118)
26	AN-9002	Cabinet Antenna for FM.	

ALIGNMENT CHART

STEP	CIRCUIT ALIGNED	RECEIVER DIAL AT	SIGNAL GENERATOR			METER		ADJUST	METER INDICATION
			TYPE	FREQ.	CONNECTIONS	TYPE	CONNECTIONS		
1	B.C.I.F.	B.C. Band Max. Freq.	A.M.	455 KC 30% Mod.	Rear B.C. Section Of Variable Condenser	Output	Across Voice Coil	Top & Bot. Of T4 & T5	Max. Output
Preferred Method 2	F.M. I.F.	F.M. Band Max. Freq.	F.M.	10.7 MC. 30% Mod.	High Side Through .005 MF. (Approx.) Cap To Pin 7 Of 12AT7	Output	Across Voice Coil	Top & Bot. Of T1 & T2; Bot. of T3	Max. Output
Alternate Method 2			R.F. or A.M.	10.7 MC. Unmod.		D.C. V.T.V.M.	Negative To Pin 7 Of 6AL5; Positive To Ground		Max. Deflection
Preferred Method 3	F.M. Det.	F.M. Band Max. Freq.	F.M.	10.7 MC. 30% Mod.		Output	Across Voice Coil	Top Of T3	Max. Output
Alternate Method 3			R.F. or A.M.	10.7 MC. Unmod.		D.C. V.T.V.M.	Neg. To Junction Of 8.2K Resistor At 6AL5; Pos. To Junction Of R15 & C17.		Zero Between Two Opposite Polarity Peaks
Preferred Method 4	F.M. OSC.	F.M. Band Max. Freq.	F.M.	108.5 MC. 30% Mod.	Each Side Of Gen. Output Through 150 OHM Resistor To F.M. Ant. Terminals	Output	Across Voice Coil	Trimmer On Top Center Of Var. Cond. (C11)	Max. Output
Alternate Method 4			R.F. or A.M.	108.5 MC. Unmod.		D.C. V.T.V.M.	Negative To Pin 7 Of 6AL5; Positive To Ground		Max. Deflection
Preferred Method 5	F.M. R.F.	F.M. Band 105 MC.	F.M.	105 MC. 30% Mod.		Output	Across Voice Coil	Trimmer At Rear Of Var. Cond. (C10)	Max. Output
Alternate Method 5			R.F. or A.M.	105 MC. Unmod.		D.C. V.T.V.M.	Negative To Pin 7 Of 6AL5; Positive To Ground		Max. Deflection
6	B.C. OSC.	B.C. Band Max. Freq.	A.M.	1650 KC. 30% Mod.	Rear B.C. Section Of Variable Condenser	Output	Across Voice Coil	Trimmer At Front Of Var. Cond. (C34).	Max.
7	B.C. R.F.	B.C. Band 1500 KC.	A.M.	1500 KC. 30% Mod.	Each Side Of Gen. Output To 2 Or 3-Turn Loop (1 Foot Dia.) Several Feet From Ant.	Output	Across Voice Coil	B.C. Trim. At Rear Of Var. Cond. (C36).	Output

RECORD CHANGER: Webster Chicago Model 100, See Pages RCD.CH.21-1 through RCD.CH.21-10.

Notes:
1 - Turn Volume Control Fully Clockwise.
2 - Maintain Signal Input Low Enough To Have Less Than 2 Volts Across Meters.
3 - Unless Otherwise Noted, Connect Low Side Of Signal Generator To Chassis.
4 - Unless Otherwise Noted, Set Variable Condenser To Minimum Capacity (Max. Freq.)
5 - Use Proper Tool For Small I.F. Trans. Adjustments - I.E., .150 Dia. Bakelite With Blade .075 Thick.
6 - Maintain 60 Cycle Line Voltage At Approx. 117 Volts.

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The position of the fuse from beneath the chassis is being moved to up inside the high voltage compartment. The fuse may now be reached by simply removing the inter-lock assembly.

The practice of holding a screw driver close to the high voltage winding of the high voltage transformer should be discontinued. This was done by men in the field to see if the high voltage winding was working, but this is what takes place. A light corona condition exists between the high voltage winding and the screw driver blade. The corona breaks down the insulation on the high voltage winding (although it cannot be seen by eye) and a week or two later the transformer must be changed. TO TEST THIS PART, USE A CONTINUITY METER AND CHECK BETWEEN TERMINALS 1-2 AND 2-3.

The following parts are to be used only in the #TV17A7 chassis, all other parts are the same as in the main parts list:

SYMBOL	DESCRIPTION	PART NO.
	Backboard for M43, M44, M46	BP-0122-1
	Spacer Bracket - Tube Mtg. 20" rect.	BR-0127
	Bracket for Pix Tube Band	BR-0128
	Bracket Tube stop	BR-0129
	Kinescope Cable Assy. H.V.	CA-0107-1
C73	Capacitor - 56μμfd. - 1000 V.	CC-0079
C2	Capacitor - 5μμfd. - .5μμfd. Zero Temp. Coeff.	CC-0081
C3	Capacitor - .001 μfd., min. Ceramic	CC-0082
C4	Capacitor - 120 μμfd., 5% Ceramic -750 Temp. Coef.	CC-0083
C6	Capacitor - 100 μμfd., Ceramic -750 Temp. Coeff.	CC-0084
C7	Capacitor - 10 μμfd., 5% Ceramic -750 Temp. Coeff.	CC-0085
C8	Capacitor - 20μμfd., Ceramic Zero Temp. Coeff.	CC-0086
C10	Capacitor - .5 to 3 μμfd., Tuning	CC-0087
C13	Capacitor - 10 μμfd., 5% Ceramic Zero Temp. Coeff.	CC-0089
C74	Capacitor - 500 μμfd., Ceramic - HiV. 20KV - DC	CC-0090
C14	Capacitor - Mica - 120 μfd. 10%	CM-0042
C50	Capacitor - Paper - .05 μfd. 1000V. DC	CP-0044
	Cabinet - Consolette - 20" Walnut	CW-0030-1
	Cabinet - Consolette - 20" Mahog.	CW-0030-3
	Cabinet - Consolette -20" Blonde	CW-0030-4
	Cabinet - Console 19" Walnut	CW-0027-1A
	Cabinet - Console 19" Mahog.	CW-0027-3A
	Cabinet - Console 19" Blonde	CW-0027-4A
	Crystal, Germanium (1N60)	CX-0028
	Bezel - 19" Rd. Fixed M44, M45	ES-0028
	Mask - 16" Rd. use with 19" Rd. Bezel Fixed M45	ES-0031
	Mask, Plastic - 19" Rd. Fixed - M44	ES-0032
	Mask 20" rect. M46	ES-0033
	Bezel - 20" rect. M46	ES-0034
	Felt Strip - 16" rect. or 16" round	FB-0007
	Felt Strip - 17" rect. or 19" round	FB-0007-1
	Felt Strip - 20" rect.	FB-0007-2
	Insulator - Mtg. HiV. Socket	IN-0098
L14, L15, L16	Choke Coil - 1μH	LC-0054-1
L8	Focus Coil - 17A7 20" rect.	LC-0052
	Band - Pix Tube - 20" rect.	MP-0448
	Nut - #10-32x3/8 - 20" rect.	NT-0034
	Packing Carton - Console	PC-0026
	Packing Carton - Chassis TV17A4	P6-0027
	Knob, Ring, Compression	PR-0170
	Knob, Spacer Sleeve	PR-0171
	Strip - Pix Tube Band - 20"	RB-0043
R76	Resistor - 68,000Ω 2 W	RC-6802-12
R82	Resistor - 470,000Ω 1/2 W.	RC-4703-21
R83	Resistor - Candohm, 32,000Ω 10 W.	RW-0037
	Screw - #10-32x3/8" Hex Hd.	SC-7503
	Screw - #10-32x1" Rd. Hd.	SC-2039
	Spring - Tube Mtg. 20"	SP-0049

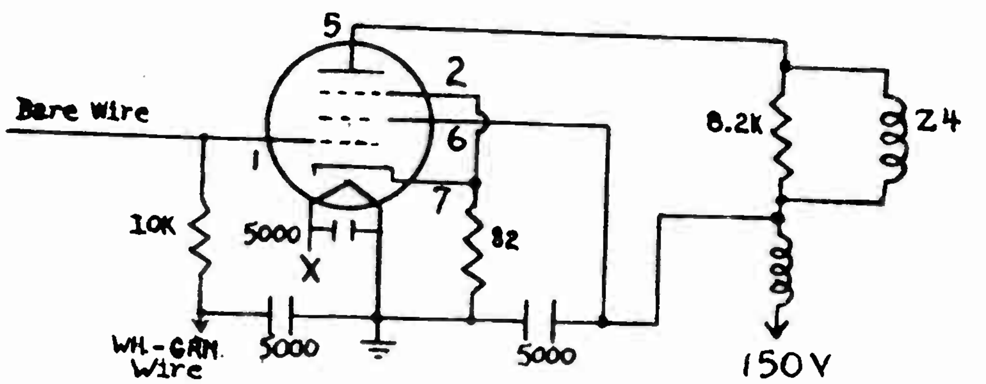
SYMBOL	DESCRIPTION	PART NO.
T7	Transformer - Horiz. Output 19", 20"	TO-0024
	Tube, Kinescope - 17" rect.	17BP4A
	Tube, Kinescope - 17" rect.	17AP4A
	Tube, Kinescope - 20" rect.	20DP4
	Mounting Block - 20" rect.	WE-0148
	Mounting Block - 17" rect.	WE-0144
	Glass Front - 20"	WG-0011

THE FOLLOWING CHANGES MAY BE FOUND IN CHASSIS MODELS #17A2 - #17A3 - #17A4 - #17A7. THEY BRING THE ATTACHED DIAGRAM UP-TO-DATE.

On Chassis Models #17A4 - #17A7, an 820 ohm resistor 2 watt is in parallel with R12 focus circuit; in other words, only used on the 19" and 20" tubes.

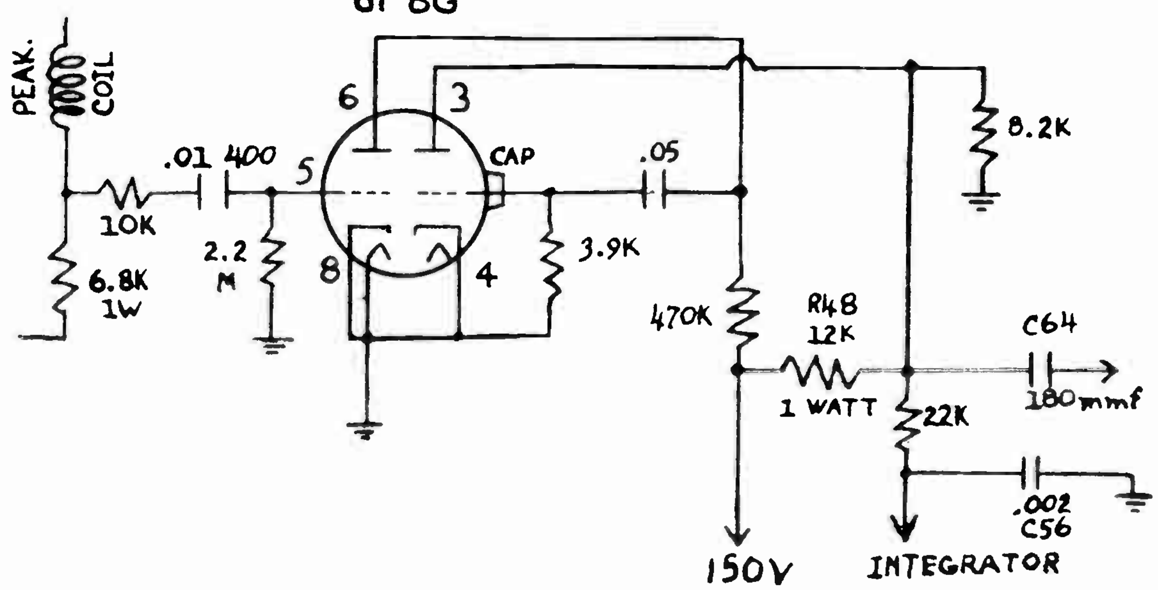
This schematic pertains to the chassis employing a 6AG5, 6BC5, 6CB6, instead of a 6AU6 as the 1st I.F. Amp.

1ST I.F. AMP.



This schematic pertains to the chassis employing a 6F8G tube instead of a 12AT7 Sync. Separator.

6F8G



MODELS M31, Ch. TV17A2; M31R, M32, M32R, Ch. TV17A3; M33, M34, Radio Ch. 8FM34, Ch. TV17A4; M41, M42, Ch. TV17A3A; M46, M49, Ch. TV17A7

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MODELS M30, Ch. TV16A1; M31, Ch. TV16A2; M31R, M32, Ch. TV16A3, Early: M31, Ch. TV17A2; M31R, M32, M32R, Ch. TV17A3; M33, M34, Ch. TV17A4; Ch. TV17A4A

With reference to MUNTZ chassis models 16A or 17A early series.

COMPLAINT No. 1: Fold over at bottom of raster.
" No. 2: Lack of vertical height.
" No. 3: Pear shaped test pattern.

Any one of these three conditions can exist in the wax impregnated transformer. In getting the feel of doing the following work, we suggest you use a TV with a waxed transformer.

PARTS AFFECTED - Vertical output transformers part numbers TO-0018 A, B, or TO-0023, A, B, C.

TOOLS NECESSARY - Pair of Vise gripping pliers of the type generally used in garage work having unusual squeezing power.

TECHNICAL - The technical reason for these difficulties is the variations in the tiny air gap between the I & E section of the laminated core, and you may adjust this gap by doing the following. Late chassis models 17A have a fixed gap.

OPERATION: Tune in a test pattern, use a crayon pencil and mark a reference line at the top and bottom of the test pattern. The results of your work can then be easily observed.
To correct complaints No. 1 and No. 2, squeeze and compress the laminations very tightly, particularly at the sides of the channel shell container to permanently hold the laminations a little closer together. (tight stack) See Fig. A. Squeeze at positions A and B. After every adjustment, observe the test pattern and correct V. Height and V. Linearity control settings. Repeat above until best results are obtained.

To correct complaint No. 3, it will be necessary to unsolder the wires and remove the transformer from the chassis. Place a heavy weight beneath the transformer and rap the transformer with a hammer as shown in Fig. B, position C. This will reduce the air gap between the I & E lamination stack.

Another way, is to place the transformer in a bench vise and squeeze it. Fig. D. Restore the transformer to the chassis by means of 6-32 by 1-4" nuts and bolts and lock washers. Before tightening, place a piece of light stiff cardboard (such as used on back of a paper tablet) between the transformer and the chassis pan. When tightening the bolts, the little piece of cardboard will act as a buttress and permanently hold the I & E stack tightly together.

#1. Adding resistor R83 to the circuit permits us to use filter condensers with a working voltage of 450 volts instead of 500 volts. The 450 volt condensers are more commonly used in the industry and therefore easier to produce.

IMPORTANT: When you have an occasion to use a 450 volt filter condenser for repair purposes on a chassis that previously had 500 volt filter condenser, be sure to add the resistor R83.

#2. As a temporary deviation due to the scarcity of No. 6AU6 tubes on the market, for the next 5000 chassis the factory will use a No. 6AG5 tube in place of a No. 6AU6 at the 1st I.F. Amplifier stage. When they are in the chassis, the tube layout sticker will be changed accordingly. The I.F. curve will maintain its usual shape in marker positions. A slight improvement will be noticeable in I.F. sensitivity amounting to about 2db. Otherwise everything is equal. We have drawn an (x) on the wire necessary to eliminate when the No. 6AG5 tube is present. In other words, we have removed the buss ground wire from pin #2 to ground when installing the 6AG5 tube. You will remember, the 6AG5 tube has pin #2 & pin #7 connected internally.

#3. This pertains only to chassis Models 17A4 and 17A4A which are the 19" round glass picture tube chassis. Across resistor R12 (820 ohm 2 watts) is soldered a 2nd (820 ohm 2 watts) resistor R84 in parallel. So doing improves the focus on the 19" model.

#4. Isolation resistors R30-R32 & R35 (old schematic) will be replaced with choke coils L14-L15 and L16 and in production in the near future. Please watch for them. The new choke coil looks like a resistor as it is housed in the resistor type of coating. The DC resistance will measure .3 ohms. The part number for this choke is LC-0054-1 and is a 1 microhenry choke.

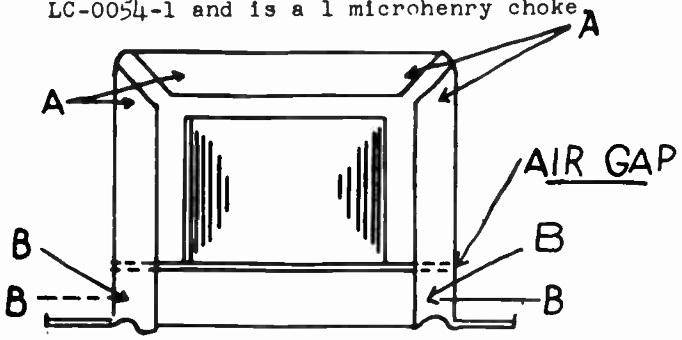
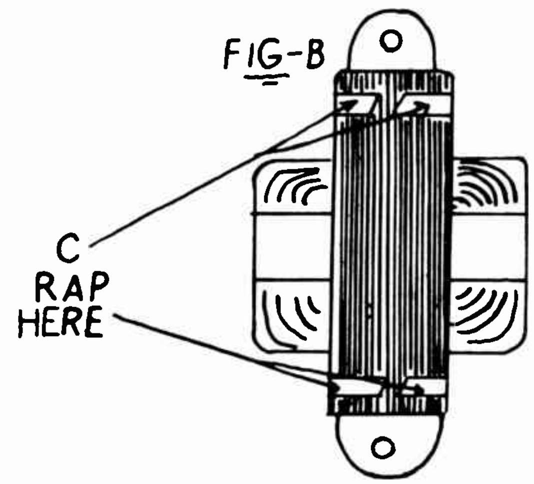
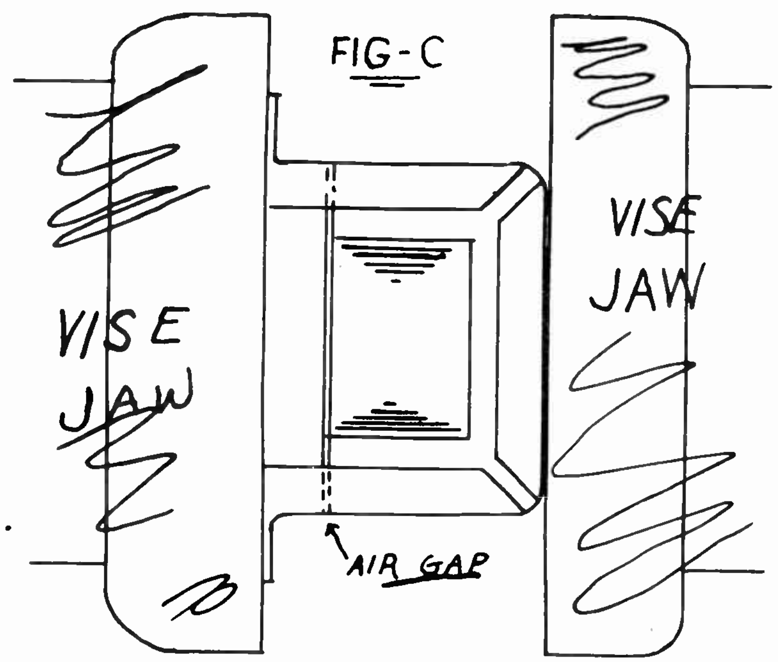


FIG-A

FIG-B



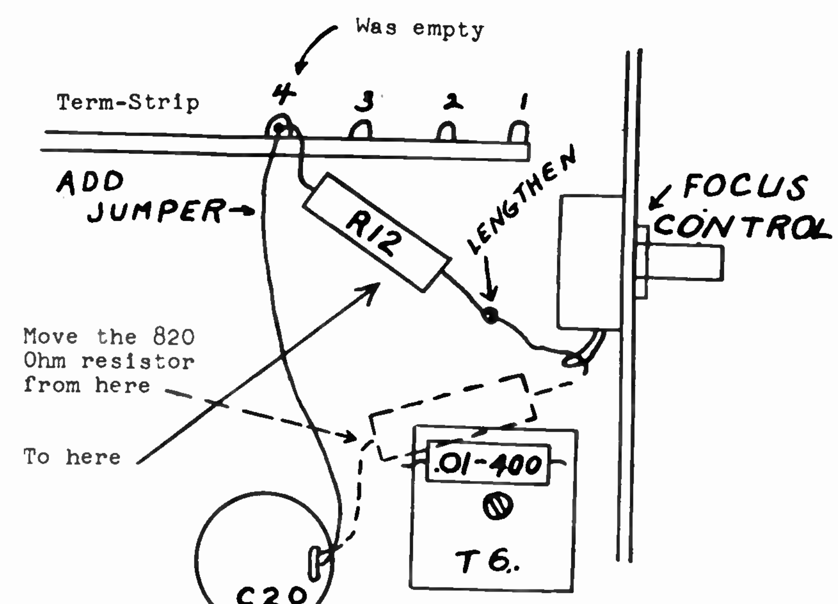


IMPROVED HORIZONTAL STABILITY

A change in parts placement took place in chassis models
17A2 above serial number 41,369
17A3 above serial number 52,256
17A4 above serial number 57,135

The 2 Watt resistor R12 in series with the focus control has been moved away from beneath the transformer T6 (Horiz. Osc. AFC) and away from the .01 mfd. condenser C62. Heat radiated from the resistor was rising into the condenser and Horizontal oscillator coil - affecting the stability of those parts.

Early production receivers may be modified by moving the resistor as shown in the following sketch.



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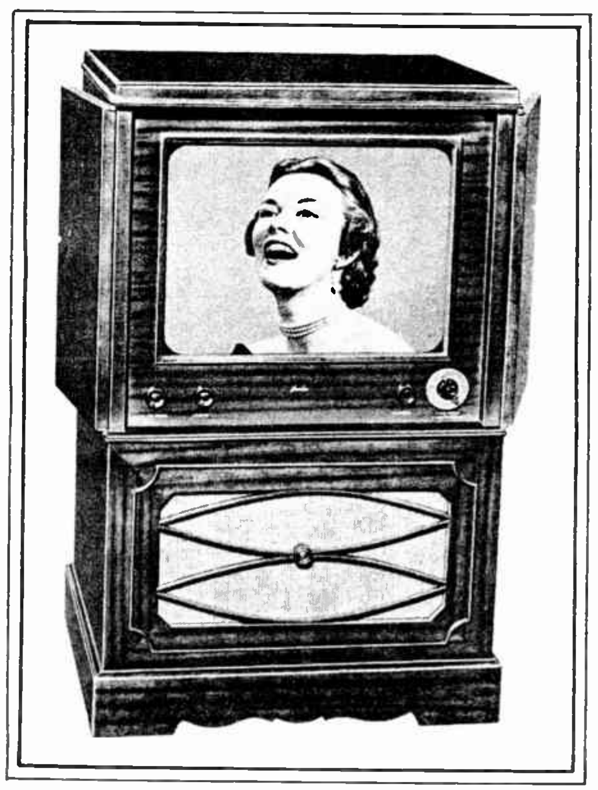
CONTENTS

MODEL PT 200



MODEL PT 300

SERVICE NOTES

MODEL PT200 "THE IRVINGTON" — CHASSIS PT200 — MODEL PT300 "THE MT. VERNON"

The NORELCO console television receivers MODEL PT200 and MODEL PT300 employ a television chassis of the most advanced design, in conjunction with the new MODEL 170 NORELCO PROTELGRAM TELEVISION SYSTEM. 19 tubes, 3 rectifiers, 1 picture tube and 1 germanium diode are used.

SPECIFICATIONS

PICTURE	13½" x 18" (235 Square inches) with rounded corners, on a flat, translucent screen.
INPUT IMPEDANCE	300 ohm - balanced.
FREQUENCIES	IF-21.25 Mc., Intercarrier sound - 4.5 Mc.
POWER SUPPLY	The High Voltage for the anode of the 3NP4 picture tube is obtained from a Norelco H.V. Unit Model 170B.
PROTECTION CIRCUIT	To prevent accidental damage to the screen of the 3NP4 picture tube in the event of deflection circuit failure, a special protection circuit is incorporated in the chassis. (See sheet 3)
OPERATING VOLTAGE	110-120 volts, 60 cycles
MAX. POWER CONSUMPTION	225 Watts
MAX. AUDIO POWER	3.0 Watts
SPEAKER	8" PM
TUNING RANGE	Commercial television channels 2-13, inclusive.

TUBE COMPLEMENT

V1	RF Amplifier	6AG5
V2	Oscillator - Mixer	6J6
V3	1st IF	6CB6
V4	2nd IF	6CB6
V5	3rd IF	6CB6
V6	Video Detector & AGC	6AL5
V7	Vidéo Amplifier	6AG7
V8	Picture Tube	3NP4
½ V9	DC Restorer & Sync. Separator	12AU7 or
½ V9	Sync. Phase Inverter	6SN7
½V10	Horizontal Sweep Failure Protector	12AU7 or
½V10	Vertical Sweep Failure Protector	6SN7

MODELS PT200, The Irvington: PT300, The Mt. Vernon; Ch. PT200

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	V11	Ratio Detector Driver	6BC5 or 6AG5
	½ V12	Ratio Detector	6T8 or 6S8
	½ V12	1st Audio Amplifier	
	V13	2nd Audio Amplifier	6AQ5 or 6V6GT
	V14	Low Voltage Rectifier	5U4G
	V15	Horizontal Phase Detector	6AL5
	V16	Vertical Sweep Oscillator & Output	6SN7
	V17	Horizontal Sweep Oscillator & Saw Generator	12AU7 or 6SN7
	V18	Horizontal Output	6BG6-G
	V19	Horizontal Damper	6W4-GT
PROTELGRAM H.V. POWER SUPPLY	(V20	Rectifier	1B3-GT
	(V21	Rectifier	1B3-GT
	(V22	Oscillator	6L6G
	(V23	Regulator	6V6-GT/G
GERMANIUM DIODE	CR1	Vertical Sweep Failure Detector	1N34
FUSES	F1	Line Fuse, slow blowing, 2.5 amp.	
	F2	Horizontal Deflection Protection, .25 amp.	

CIRCUIT DESCRIPTION

The PT200 television receiver chassis employs a balanced 300 ohm antenna input circuit. The 6AG5 RF stage is inductively coupled to the 6J6 mixer. Tuning of the RF amplifier and mixer grid circuit is accomplished be means of capacitor and coil switching using a turret-type tuner. (for RF alignment see sheet)

A three-stage network IF amplifier using 6CB6 tubes amplifies both sound and video signals. The video detector is a 6AL5 diode with the other section used as an automatic gain control (AGC) rectifier. The AGC voltage is applied to the RF amplifier and to the first two IF stages. The video amplifier uses a 6AG7 with a variable cathode resistor serving as a contrast control. The contrast control setting also determines the amount of automatic gain control voltage applied to the preceeding stages.

The 4.5 Mc. intercarrier sound signal is taken off the plate of the 6AG7 video amplifier and applied to a 6BC5 ratio detector driver. The triode section of this tube is used as the first audio amplifier and a 6AQ5 tube is used as the audio output amplifier.

DC restoration and sync clipping is accomplished in the picture tube grid by means of one diode- connected section of a 6SN7. The other triode section of this tube is used as a sync signal phase inverter which supplies the two phases of sync signal requires to operate a 6AL5 horizontal phase detector. This horizontal phase detector compares the horizontal sync signal with a pulse obtained from the horizontal output transformer and produces a suitable DC control voltage to provide automatic frequency . . . . control of the Potter type horizontal oscillator which uses a 12AU7 or 6SN7 tube. The horizontal oscillator uses a 12AU7 or 6SN7 tube. The horizontal oscillator and saw generator is coupled to a 6BG6 horizontal output stage and an output transformer. A 6W4 horizontal damper tube is employed. A 6SN7 serves as a vertical oscillator and amplifier in a stabilized blocking tube oscillator.

The low-voltage power supply uses a 5U4 rectifier tube. The focus coil is in series with the low-voltage power supply with a suitable shunting resistor as a focus control. The power supply transformer primary is fused and interlocked.

PROTECTION CIRCUIT

Incorporated in the chassis is a protection circuit to prevent line or spot burns on the face of the 3NP4 tube caused by failure of the horizontal or vertical deflection circuits. One half of V10-6SN7 or 12AU7 is used as a horizontal sweep failure protector and the other half is used as a vertical sweep failure protector .

The horizontal protection circuit uses the same pulse employed for horizontal comparison in the horizontal phase detector 6AL5. This pulse is driven into the grid of the triode sections of a 12AU7 or 6SN7 (V10). The pulse time constant is so arranged that as long as the driving pulse is present, the tube conducts.

The plate circuit is connected to the low side of a brightness potentiometer (R39) which, while the tube conducts, acts as a series resistor of approximately 12,000 ohms. When the pulse is removed (horizontal oscillator failure) the tube fails to conduct and presents an infinite resistance, allowing the brightness voltage to go up to 150 volts thus biasing the tube resulting in no beam current.

A 1N34 germanium diode acts as a peak rectifier on the secondary side of the vertical output transformer producing approximately 25 volts used to bias beyond cutoff the other triode section of V 10.

The plate section of this tube is connected in parallel with the 2nd section of the horizontal sweep oscillator tube V17 - 6SN7. When a vertical signal is present, the protection tube presents an infinite impedance across the horizontal sweep oscillator and has no effect on its oscillation. It the event of a vertical failure, there is no negative voltage on the grid of the protection tube. The tube then conducts and acts as a shunt resistor of approximately 5,000 ohms connected in parallel with the horizontal sweep oscillator. This stops the horizontal sweep oscillator and thus throws the horizontal sweep failure protector tube into operation as explained above.

DESCRIPTION OF THE PROTELGRAM UNITS

HIGH VOLTAGE POWER SUPPLY (170B)

This unit supplies the 25 Kv required for the anode of the 3NP4 tube. Overall outer dimensions are: 7-1/8" x 5-3/4" x 9" high, except for the flat mounting feet. The weight of the unit is 5 lbs. The unit is very stable and has regulation characteristics matched to the requirements of the 3NP4. It is shielded.

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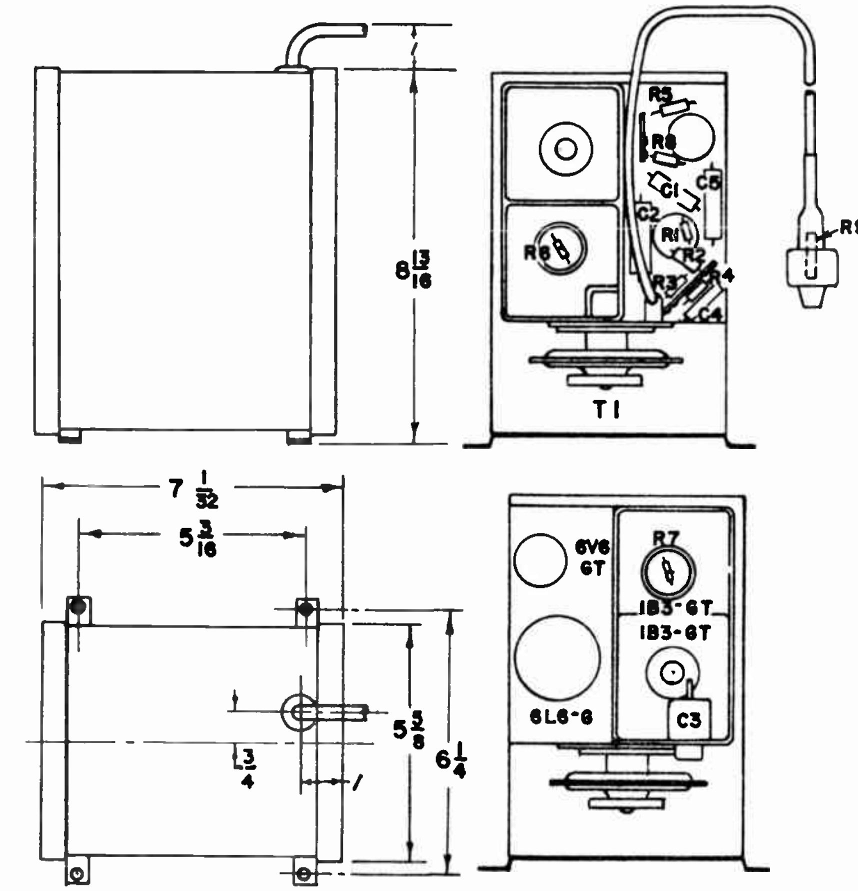
DESCRIPTION OF THE CIRCUIT

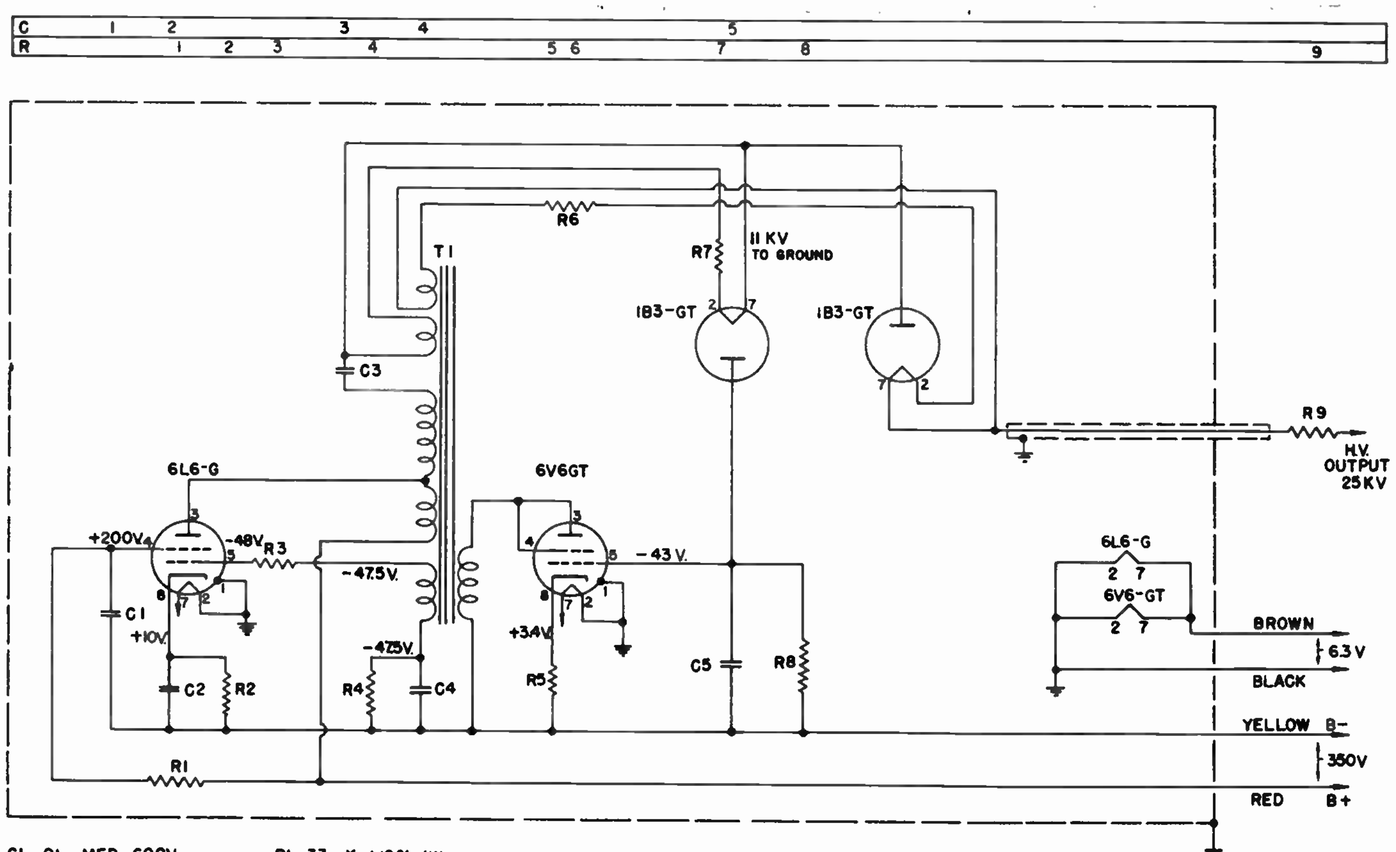
The tubes employed are:

1) 1 - 6L6G Oscillator
2) 2 - 1B3GT Rectifiers
3) 1 - 6V6GT Regulator

The 6L6G operates as a normal continuous oscillator at a frequency of approximately 28 kc. The plate winding of the oscillator forms a section of an auto-transformer winding which steps up the oscillator output voltage to the order of 12.5 Kv peak. The two 1B3GT rectifiers are used in a voltage-doubling arrangement so that the output voltage at no load with the regulator tube in operation is about 24.5 Kv and drops to 23.5 Kv at 200 Microamperes.

The output voltage regulator tube is a type 6V6GT. Its plate and screen are electrically connected, and are supplied from an additional winding on the high voltage transformer. Bias on its grid is dependent on the amount of beam current drawn by the 3NP4, since it is developed across a 300,000 ohm resistor in series with the plate of one of the 1B3GT tubes. The regulator operates as a variable load on the oscillator. Higher beam current generates higher negative bias on the regulator tube. Therefore it absorbs less power, so that the output voltage of the oscillator/voltage doubler system tends to remain more nearly constant.





C1 .01 MFD 600V.
C2 .1 MFD 400V.
C3 500 MMF 20KV.
C4 .01 MFD 400V.
C5 .1 MFD 400V.

R1 33 K ±10% 1W
R2 220 ±10% 2W
R3 560 ±10% .5W
R4 47 K ±10% .5W
R5 820 ±5% 1W
R6 3.3 ±10% .5W
R7 3.3 ±10% .5W
R8 300 K ±5% .5W
R9 1.5 M ±20% 1W

VOLTAGES MEASURED WITH V.T.V.M. WITH RESPECT TO B- AT NORMAL PICTURE CURRENT OF (90 μ AMPS.)

PROTELGRAM
HIGH VOLTAGE POWER SUPPLY
170-B

As the regulator tube approaches cutoff, its effect continues to decrease until the output voltage of the system begins to follow an unregulated curve, and the output voltage starts to fall. This arrangement provides a safety device for the 3NP4 which prevents injury due to severe overloads at high voltage, forms a protection against external short circuit, and also reduces the shock hazard to personnel. There is also a protective resistor in series with the anode lead at the connector. This has a value of 1.5 megohm.

Extreme care, however, must be exercised when working on the high voltage circuits. A good practice when working with such circuits is to keep one hand in a pocket while working only with the other.

3NP4 CATHODE-RAY TUBE

GENERAL CHARACTERISTICS **SPECIFICATIONS**

ELECTRICAL

Heater Voltage:	6.3 volts
Heater Current:	0.30 amperes
Focusing Method:	Electromagnetic
Deflecting Method:	Electromagnetic
Maximum Deflection Angle	42°
Gun:	Triode
Phosphor:	No. 4 aluminized
Fluorescence:	White 6000° - 8000° Kelvin
Persistence:	Medium

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INTERELECTRODE CAPACITIES

Cathode to all others:	6 mmf
Grid to all others:	9 mmf
Anode to external coating:	450 mmf

MAXIMUM DESIGN RATINGS

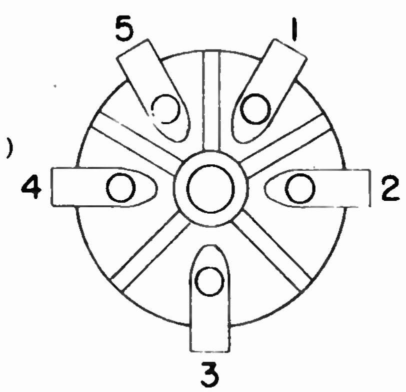
Anode Voltage:	25,000 volts D.C.
Grid Voltage Negative Bias	150 volts D.C.
Grid Voltage Positive Peak:	2 volts D.C.
Maximum Heater to Cathode Voltage: (heater positive or negative)	125 volts D.C.
Grid Circuit Resistance:	Not to exceed 1.5 megohms
Heater/Cathode Resistance:	Not over 20,000 ohms.

TYPICAL OPERATING CONDITIONS

Anode Voltage:	24,000 volts D.C. ± 1 Kv.
Anode Current Normal:	90 Microamperes
Normal Anode Current Peaks	150 Microamperes
Grid Voltage for Visual Extinction of Undeflected Focused Spot:	40-90 volts negative
Focusing Current:	290 ohm Coil-125 milliamperes nominal 11,000 ohm coil-21 milliamperes nominal

Base Connections

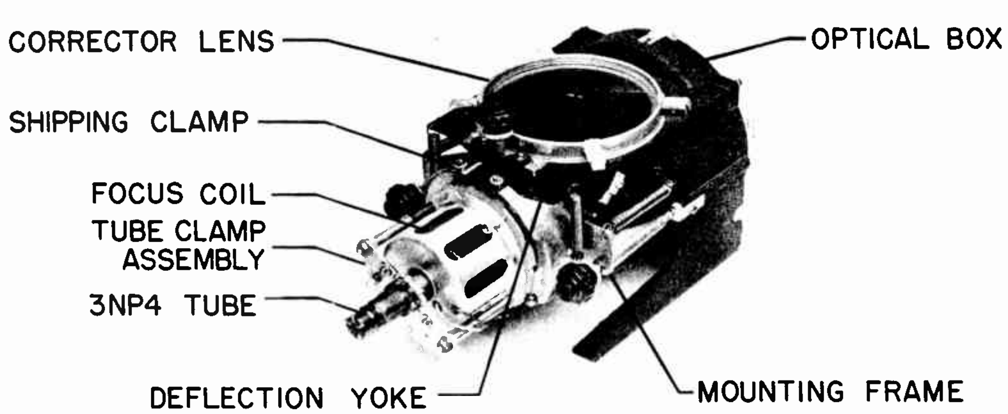
Pin No.	
1	Grid
2	Heater
3	Spark Trap (Must be grounded)
4	Heater
5	Cathode
	Anode: Cup contact



OPTICAL UNIT AND TUBE MOUNT

TUBE MOUNT

The Tube Mount includes the Focus Coil, the Deflection Yoke and the Tube Clamp Assembly.



The Focus Coil used in the PT200 receiver has a DC resistance of 290 ohms ± 10% and a nominal current of 125 milliamperes. The Tube Mount is assembled to the Optical Box by means of the Mounting Frame which contains the 3 adjustments used for mechanical focusing. These adjustments should be made when the set is installed and when the 3NP4 Picture Tube is replaced. They are described under "Installation Instructions" on sheet 8.

OPTICAL UNIT

This unit contains a concave mirror, a flat mirror and a corrector lens. These elements are precisely assembled at the factory and no attempt should be made to adjust or replace them in the field. The corrector lens should be cleaned with a soft rag.

PROTELGRAM CONNECTIONS

The following socket and plug and jack connections are provided for easy connection of the Protelgram units to the chassis:

J2 - 3NP4 Picture Tube Socket.

1.	Red	Grid	
2.	Yellow	Heater	6.3 volts, 0.30 amps.
3.	Blue	Spark Trap	ground
4.	Black	Heater	ground
5.	Green	Cathode	

J5 - 170B H. V. Power Supply Connections

1-5	Jumper		
2.	Black	Ground	
3.	Yellow	B minus	
4.	Red	B plus	350 V.
5.	Brown	Filament	6.3 V.A.C.

J6 - Deflection Yoke and Focus Coil

1.	Yellow	Focus Coil
2.	Red	Focus Coil
3.	Orange-Black	Horiz. Deflection Yoke
4-6	Jumper	
5.	Orange-White	Horiz. Deflection Yoke
7.	Blue-White	Vert. Deflection Yoke-ground
8.	Blue-Black	Vert. Deflection Yoke

INSTALLATION INSTRUCTIONS

HIGH VOLTAGE WARNING: The back of the receiver is equipped with an interlocking power cord which removes power from the set when the back is removed. Operation of the receiver outside its cabinet or with the back removed involves a shock hazard. Therefore no work should be attempted on the receiver by anyone who is not familiar with the precautions necessary when working on high-voltage equipment.

1. SERVICE ADJUSTMENTS: The service adjustments are readily accessible by removing the grillecloth panel, which is held in place by bullet catches. The panel can be easily removed by a slight pull at the top.

2. REMOVAL OF SHIPPING CLAMP AND OPTICAL ADJUSTMENTS:

a) Remove the speaker baffle. This is held in place by 2 wing nuts which can be reached through the back of the cabinet.
b) The Optical Box is located directly behind the speaker baffle. To prevent accidental damage during transit a red shipping clamp is attached to the optical box. Remove this shipping clamp by unscrewing 4 screws holding it. Keep the clamp and screws for possible future use in shipment.
c) Connect AC line to outlet.

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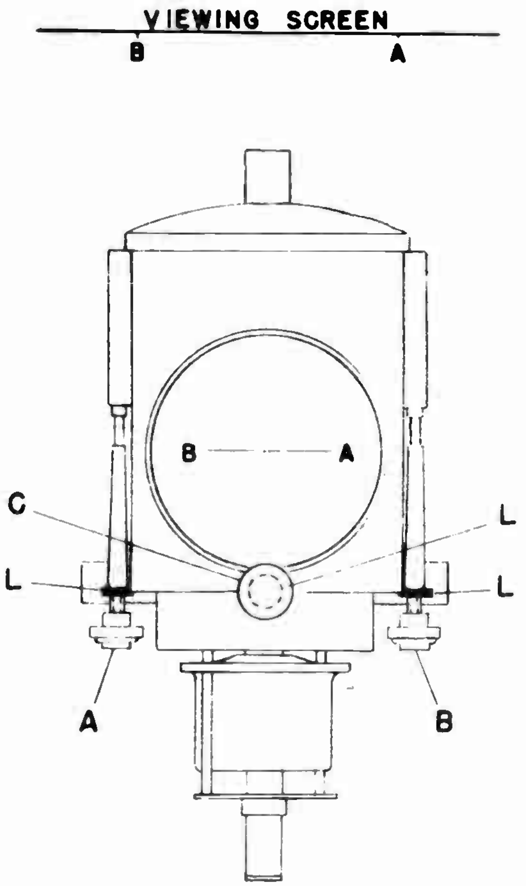


DIAGRAM 1

WARNING: This receiver is designed for use on 105 to 125 volt 60 cycles, alternating current (A.C.) only. Do not connect to direct current (D.C.). If in doubt about the type of current available check with your local Electric Power Company.

d) Connect antenna leads to antenna binding posts.
e) Tune in a signal.
f) Turn contrast control on the front of the cabinet to the extreme left position.
g) Turn brightness control on the service panel to the extreme right.
h) Adjust focus control on the front of the cabinet.
i) Examine retrace lines and raster for sharpness of focus. If the entire area of the screen is not sharply in focus, proceed as follows:

1) Loosen 3 locking nuts "L" (Diagram 1)
2) Focus the raster lines on the right side of the screen by adjusting the knob on the left side of the Optical Box - marked "A" on diagram.
3) Focus the raster lines on the left side of the screen by adjusting the knob on the right side of the optical box marked "B" on the diagram.
4) Repeat operation (b) and (c) if necessary until each side of the picture is sharply in focus.
5) Focus the raster lines on the top and bottom of the screen by adjusting the knob on the top of the optical box - marked "C" on the diagram.

j) Tighten 3 locking nuts "L" (If picture cannot be centered on the screen see further detailed information regarding adjustment of the Protelgram System sheet 14).

3. Make any necessary linearity and size adjustments by means of the service controls.

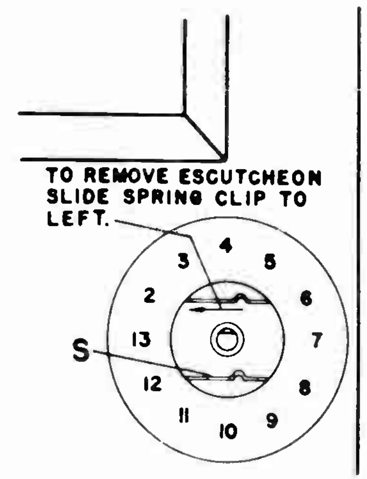
4. BRIGHTNESS LEVEL SETTING:

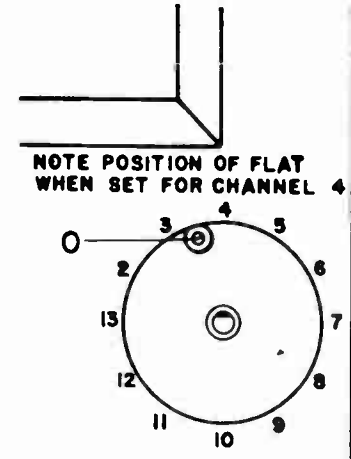
a) Set channel selector between channel.
b) Turn contrast control on the front of the cabinet to the extreme left position.
c) Turn brightness control on service panel to extreme left position and gradually turn to the right until the raster lines are just visible on the screen.

5. CHANNEL SELECTOR ADJUSTMENTS:

After allowing 15 minutes for the receiver to warm-up, adjust the tuner oscillator as follows:

a) Remove the channel selector and fine tuning knobs and the channel indicator plate.
b) Leave the fine tuner at mid-position.
c) Turn the channel selector to each channel and adjust the oscillator "O" using a non-metallic alignment screw driver with a 1/8" blade. Turn this screw to the right until the 4.5 Mc. interference is seen on the screen (a fine herringbone pattern). Then gradually turn back the screw until this interference disappears.
d) After the tuner oscillator has been adjusted for each channel, replace the channel indicator plate and the channel selector knob and fine tuning knob.





ALIGNMENT PROCEDURE

REFERENCES: Circuit Diagram
Component Parts Location Label

EQUIPMENT:
1. Sweep generator, 23.5 mc. center frequency, 10 mc. sweep width.
2. Marker generator, 21.25 mc., 22.0 mc, and 25.75 mc.
3. Crystal oscillator, variable output, 4.5 mc. unmodulated.
4. Oscilloscope.
5. 20,000 ohm per volt meter.

NOTE: Follow the instructions in these Service Notes regarding location of test points for alignment, for taking voltage measurements, or in making oscilloscope waveform analysis. Do not connect test equipment across other points unless you are thoroughly familiar with the circuit wiring and points at which high voltages are present.

REMOVAL OF CHASSIS:
To remove chassis from cabinet proceed as follows:

1) Remove lower back cover.
2) Remove 2 screws holding chassis slides in place.
IMPORTANT 3) Remove 2 screws near volume control which hold the control mounting strip to the cabinet front panel.
4) Remove 6BG6 tube (V18).
5) Disconnect plugs from J5 and J6 which connect the Protelgram HV unit and Deflection Yoke and Focus Coil to the chassis.
6) Remove tube socket from the 3NP4 (V8) tube.
7) Slide out the chassis on the mounting rails provided.

PROCEDURE VIDEO IF
1. Connect oscilloscope to J1 (test point).
2. Move turner between channels to disconnect coils.
3. Connect a 3 volt bias battery between ground and junction of R21 and C20.

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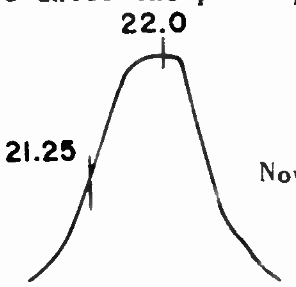
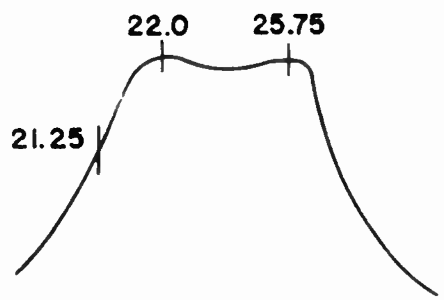
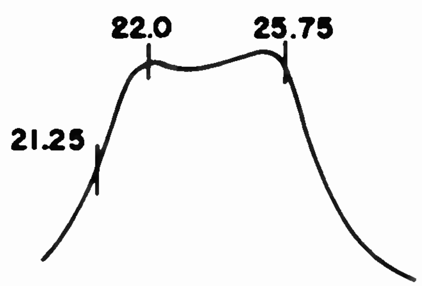
4. Connect sweep generator, capacitively decoupled with 1000 uuf., to Pin 1 of V5. Turn the slug on L17 until it is centered in the coil (this narrows the band pass of this stage). Adjust L16 and L12 until the pass appears as below.



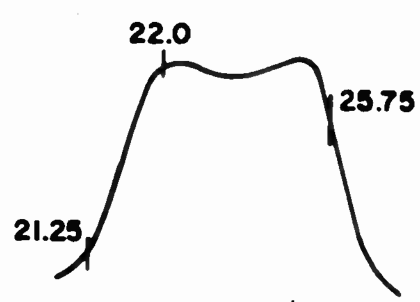
Now adjust L17 until pass is as pictured.



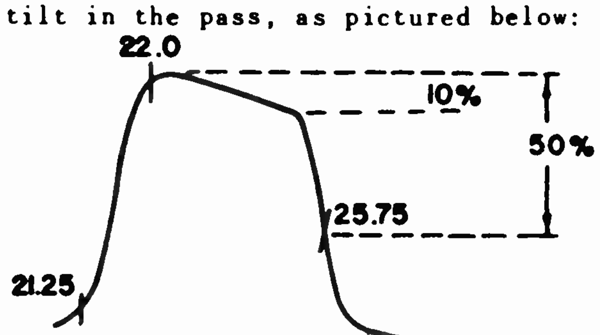
5. Move sweep generator to Pin 1 of V4. Adjust L13 until pass balances, adjust L15 until pass balances. When properly adjusted, pass will look as pictured below.



6. Move sweep generator to Pin 1 of V3. Adjust L9 and L11 as in above step. Pass will now be as pictured.



7. Move sweep generator to test point on tuner (can be located as a loop of wire between V1 and V2 on top of tuner chassis.) Adjust L8 (square can on tuner) until the pass rocks through a tilt and leave adjusted with a 10% tilt in the pass, as pictured below:



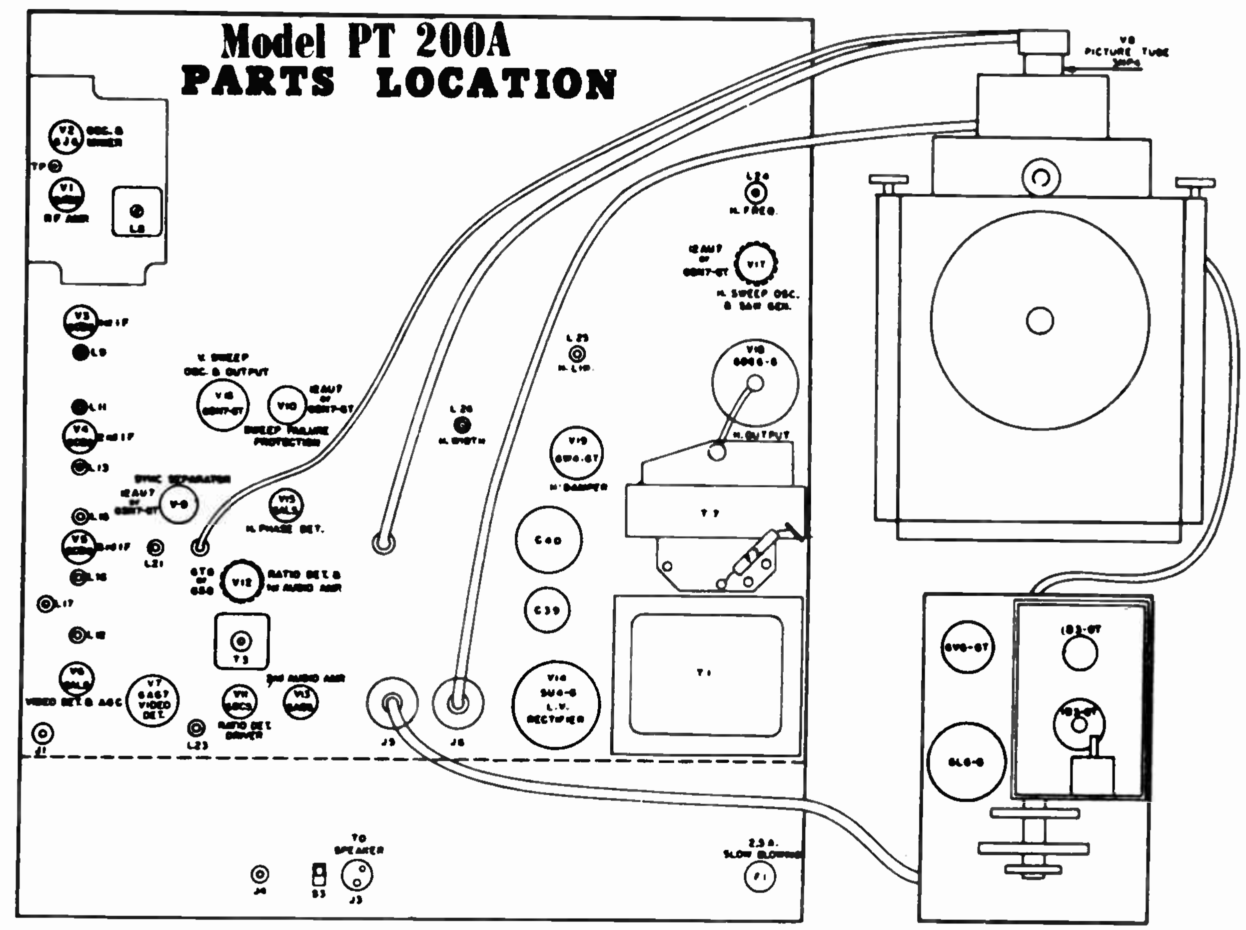
The video I.F. is now correctly aligned.

PROCEDURE INTERCARRIER SOUND SYSTEM

1. Connect voltmeter set on 10 volt scale across C46, observing polarity.
2. Insert 4.5 mc. generator, capacitively decoupled, in J1.
3. Reduce signal so that voltmeter reads a maximum of 3.0 volts, and continue to reduce as adjustments are made so as not to exceed this value.
4. Adjust in the order given, the following transformer slugs for maximum output:
   a) Bottom slug T3.
   b) L23
   c) Top slug T3.
5. Repeat to insure accurate setting.

Intercarrier sound system is now properly aligned.

RMA-No.541 117v.60cy.,200w



NOTICE: - THIS APPARATUS USES INVENTIONS OF UNITED STATES PATENTS LICENSED BY RADIO CORPORATION OF AMERICA. PATENT NUMBERS SUPPLIED UPON REQUEST.

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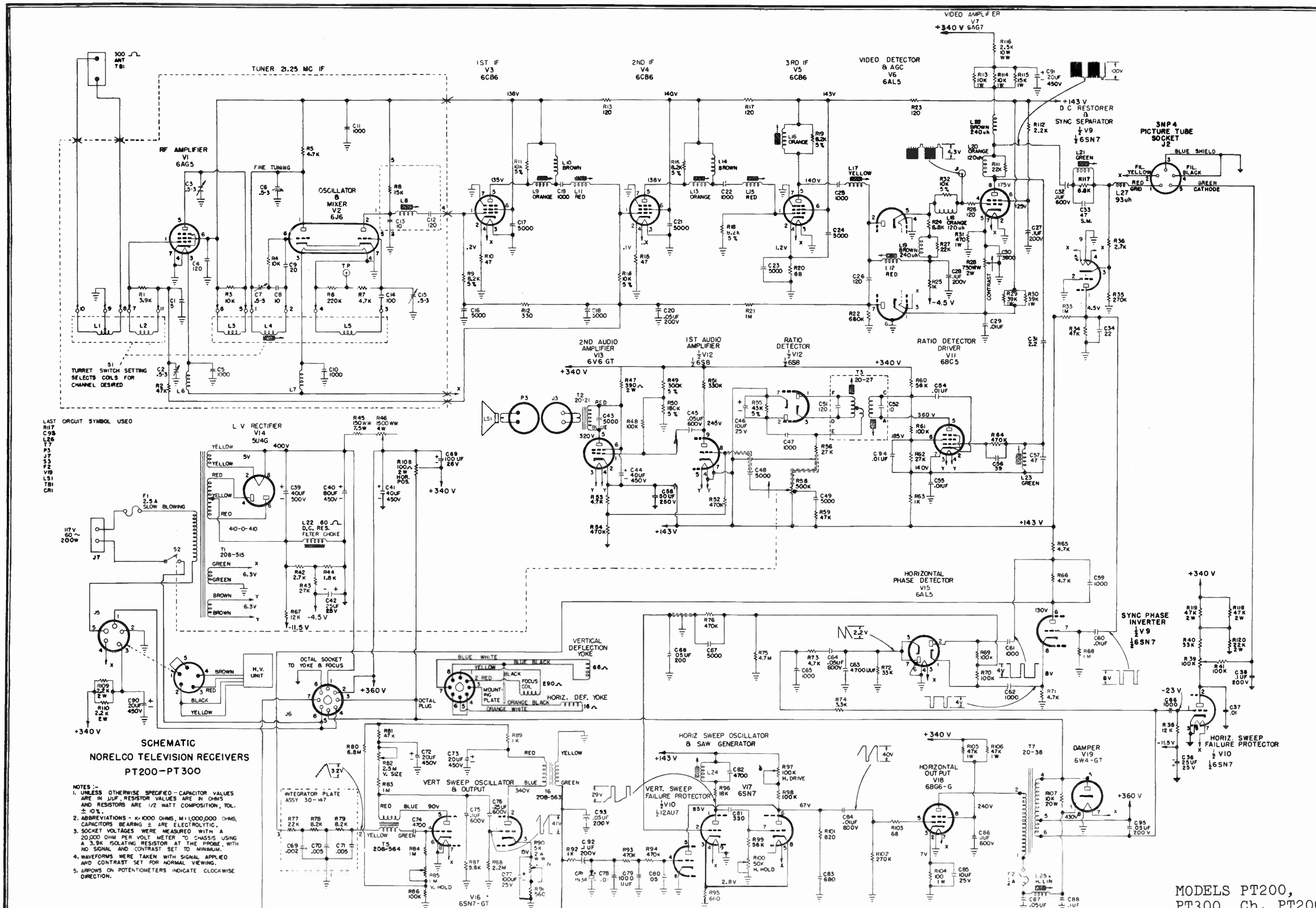

SCHEMATIC
NORELCO TELEVISION RECEIVERS
PT200-PT300

NOTES :-

1. UNLESS OTHERWISE SPECIFIED - CAPACITOR VALUES ARE IN µµF, RESISTOR VALUES ARE IN OHMS AND RESISTORS ARE 1/2 WATT COMPOSITION, TOL. ± 10%.
2. ABBREVIATIONS - K=1000 OHMS, M=1,000,000 OHMS, CAPACITORS BEARING ± ARE ELECTROLYTIC.
3. SOCKET VOLTAGES WERE MEASURED WITH A 20,000 OHM PER VOLT METER TO CHASSIS USING A 3.9K ISOLATING RESISTOR AT THE PROBE, WITH NO SIGNAL AND CONTRAST SET TO MINIMUM.
4. WAVEFORMS WERE TAKEN WITH SIGNAL APPLIED AND CONTRAST SET FOR NORMAL VIEWING.
5. ARROWS ON POTENTIOMETERS INDICATE CLOCKWISE DIRECTION.

MODELS PT200, PT300, Ch. PT200

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ELIMINATION OF AUDIO BUZZ

Under certain conditions a buzz may be heard in the sound. This may be caused by:

a) Mis-adjustment of the fine tuning control. This control should be tuned for most clearly defined picture with best sound. If no definite sound peak is obtainable with rotation of the fine tuning control, it may be necessary to adjust the tuner oscillator (See Channel Selector Adjustments - sheet 9)

b) Contrast Control too far clockwise thus overloading the Video Amplifier.

c) Misalignment of the Intercarrier Sound System. If this condition exists it may be corrected by the following procedure:

1) Connect VTVM across R55. Observe polarity.
2) Set VTVM on 10 volts scale and tune in channel.
3) Make the following adjustments for maximum voltage in the order stated:

a) Adjust slug L23 for maximum voltage.
b) Adjust bottom slug of T3 for maximum voltage.
c) Adjust top slug of T3 for maximum.
d) Repeat these adjustments.

d) Overloading of the video stages due to a very strong television signal. Such a strong signal can be attenuated by shunting a 10-100 ohm resistor across the secondary of the tuner antenna coil. This is the snap-in type and can be easily removed.

NOTE: Station buzz may be due to the transmission of a non-standard picture signal by the station. This condition is usually momentary.

DRESSING GRID LEAD TO 3NP4 PICTURE TUBE SOCKET

When attaching the socket to the 3NP4 Picture Tube, the Red-Grid lead should be dressed at least 1 inch away from the other leads in the J2 cable.

3NP4 TUBE INSTALLATION AND POSITIONING ADJUSTMENTS

(A) 1.- Loosen the 3 screws "M" which hold the Tube Mount to the Optical Box (Diagram A).
2.- Turn the Tube Mount clockwise until the 3 cutouts clear the screws "M".
3.- Pull out the Tube Mount.

NOTE: This operation should be done with care to prevent the tube from hitting the 45-degree Plane Mirror.

(B) 1.- Loosen the Tube Clamp Screw "J" (Diagram A).
2.- Insert the 3NP4 tube through the Deflection Yoke keeping the glass Anode Cup down (opposite the word "top" on the Tube Mount).

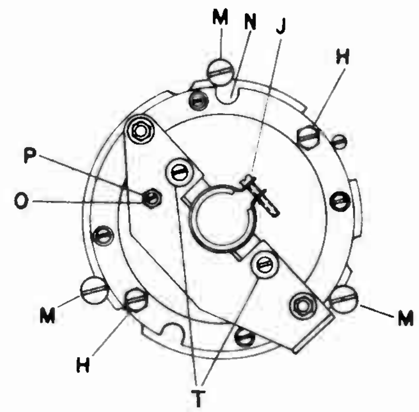

DIAGRAM A

NOTE: The fiber light shield and neoprene band packed with the 3NP4 tube should not be used with the Model 170 Tube Mount described here.

3.- Push the tube as far as it will go into the Deflection Yoke and tighten the screw "J" in the Tube Clamp. The Clamp should be tight enough to prevent the Tube from moving out of the Deflection Yoke. Be sure that the 2 spring clips from the Deflection Yoke make firm contact with the aquadag coating on the 3NP4 Tube.
4.- If the Tube neck is not centered in the Focus Coil, loosen the 2 screws "T", center the neck in the Focus Coil and retighten 2 screws "T",

CAUTION: In this operation or in any subsequent operation, do not hold the Tube Mount assembly by grasping the Deflection Yoke. This can result in breaking the cantilever-supported yoke form.

(C) 1.- Insert the H.V. Cable Connector in the glass Anode Cup on the tube. Be sure that the Connector is making good contact with the metal button in the Anode Cup.
2.- Tighten the plastic clamp around the neoprene Cable Connector. Carefully insert the Tube Mount in the Optical Box. Be sure that the Tube correctly enters the dust shield and clears the opening in the 45-degree Plane Mirror. It is essential that the position of the Tube in the Tube Mount is not disturbed. The Tube must remain firmly seated in the Deflection Yoke.
3.- Turn the Tube Mount counter-clockwise until the slot "N" is on line with the top screw "M" (Diagram A). (Be sure that the bottom edge of the Tube Mount is seated in the milled sections at the bottom of the Optical Box.)
4.- Tighten the 3 screws "M".
5.- Connect the Tube Socket to the Tube. While doing this, hold the neck so as to avoid pushing the Tube out of its position in the Deflection Yoke.
6.- If the edges of the projected picture are not in line with the edges of the viewing screen, loosen 3 "M" screws and rotate the Tube Mount slightly to the right or to the left of the above-mentioned position. Retighten 3 "M" screws.

NOTE: Be sure to dress the red (grid) lead in the J2 Cable to the 3NP4 Tube Socket at least 1" away from the rest of the leads in this cable.

(D) ELECTRICAL ADJUSTMENTS

1.- Properly tune receiver to transmitted test pattern. Look down into Optical Box at pattern reflected from 45-degree mirror.
2.- Adjust electrical controls of receiver to obtain normal and properly focused pattern on tube face as described under Installation Instructions.
3.- Adjust size of pattern and center so that each corner just touches edge of tube face as shown on Diagram C
4.- If the picture cannot be centered by means of the receiver centering controls, proceed as follows: (see Diagram A)

a) Loosen the locking nut "O" and loosen the screw "P" which locks the Focus Coil in position.
b) Adjust the 2 screws "H" until the pattern is properly centered on the tube face.

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c) Tighten the screw "P" and the locking nut "O".

To make the following adjustments, look at the projected pattern on the viewing screen. When the screen is in a cabinet it may be more convenient to cover the outside of the screen with a piece of dark paper or cardboard so that the pattern can be seen from the inside of the cabinet.

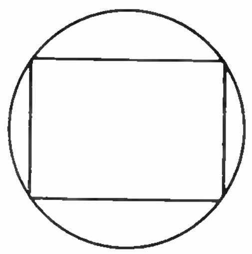


DIAGRAM C

(E) CENTERING PATTERN ON VIEWING SCREEN

1.- Loosen 3 bolts "R" (Diagram B).
2.- Center the projected picture on the viewing screen by adjusting the 3 screws "S".
3.- Tighten 3 bolts "R".

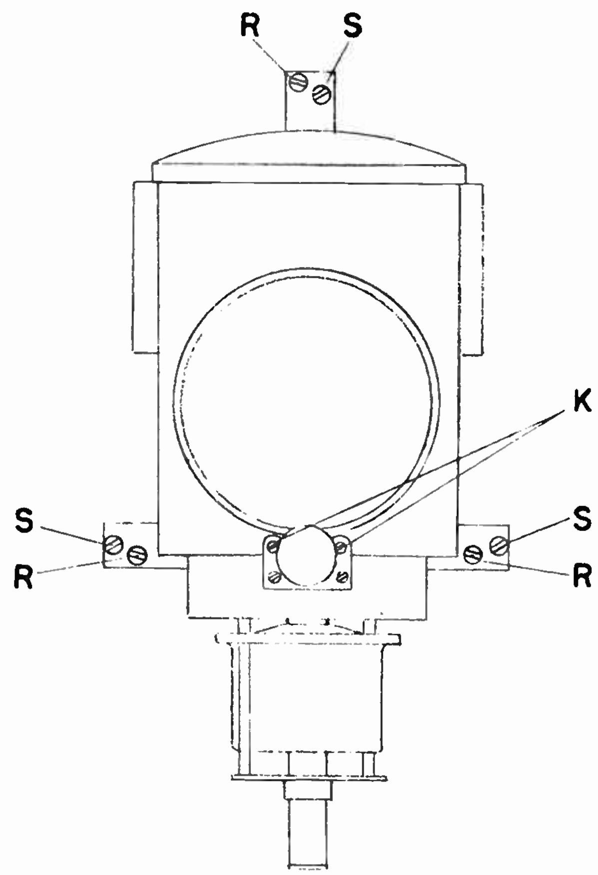
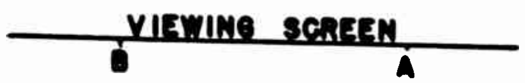


DIAGRAM B



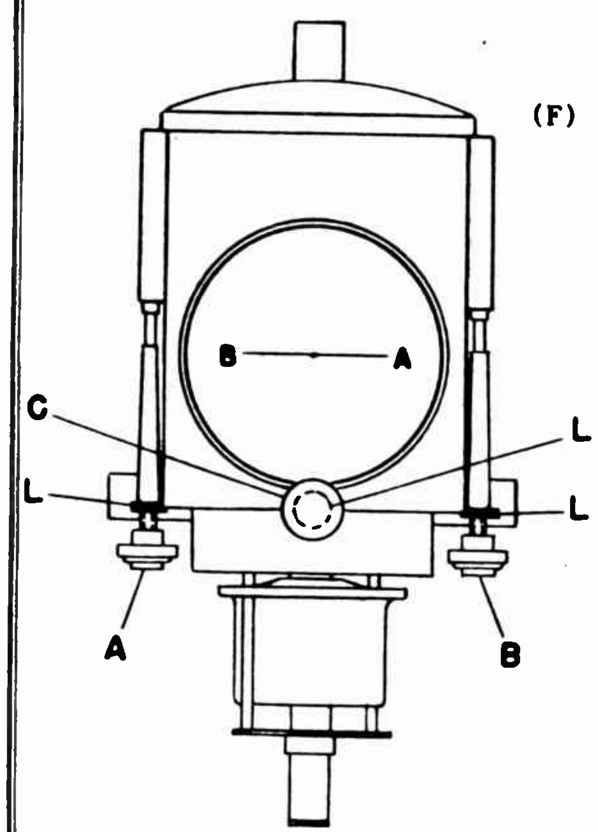


DIAGRAM D

(F) FOCUSING

Before making these adjustments, be sure to remove the 4 screws "K" (Diagram B) which secure the red shipping clamp to the Optical Box.

1.- DIAGRAM D

a) Loosen the 3 locking nuts "L".
b) Adjust the electrical focus on the receiver.
c) Focus a point "A" on the right side of a horizontal line through the center of the pattern on the viewing screen - by adjusting the knob "A".
d) Focus a point "B" on the left side of a horizontal line through the center of the pattern on the viewing screen - by adjusting the knob "B".
e) Repeat operations c, d alternately until points A and B are both in focus.
f) Focus a vertical line through the center of the pattern on the viewing screen - by adjusting the knob "C".
g) Hand-tighten the 3 locking nuts "L".

(G) 1.- If necessary, clear the top of the Corrector Lens with a soft cloth.
2.- When a black shroud is provided, tie it around the Corrector Lens being sure that it does not encroach the light path.

SERVICE HINTS

TROUBLE	CHECK
Dead Receiver	a) Be sure that power is being delivered to the receiver. b) Check interlock. c) Check fuse F1 d) Check V13 e) Check low-voltage rectifier tube 5U4G f) Check filter capacitors C39, 40, 41
Low B Plus Voltage	a) Check low-voltage rectifier tube 5U4G b) Check filter capacitors C39, 40, 41
No Raster	a) Check V17, V18, V19 b) Check plate lead dress on V18 c) Check fuse F2 d) Check T7 e) Check C81 f) Check L24, 25 g) Check Protelgram H.V. Supply 170B h) Defective focus control i) C89 open j) Check jack J6 and plug k) Check leads to Protelgram tailpiece l) Check V16, T5, T6, C72, C73, R90
No Sync	a) Check V9, V60, R28 and associated circuit components. b) Check V1 and V3 for gassy condition
No Vertical Sync	a) Check V16, C72, C74 and associated circuit components. b) Check V1 and V3 for gassy condition
No Horizontal Sync	a) Check V15, V17, V18, V9, and associated circuit components.
No Sound or Picture	a) Make complete check of tuner and IF circuits b) Check V1, V2, V3, V4, V5, V6, V7.
Sound But No Picture	a) Check 3NP4 picture tube, V7, V9, V10 and associated circuit components. b) Protelgram H.V. Unit

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Picture But No Sound	**a) V11, V12, V13, and associated circuit components.** **b) Loudspeaker**
Poor Horizontal Linearity	**a) V17, V18, V19 and adjustment of L25.**
Poor Vertical Linearity	**a) Check V16, C77, R89, R90**
Insufficient Horizontal Size	**a) Check for low line voltage** **b) Check for low B plus voltage** **c) Check V14, V17, V18, V19, C68, C84 and associated circuit components.**
Insufficient Vertical Size	**a) Check V16 and associated circuit components** **b) Check Protelgram Deflection Yoke**

PARTS LIST

When ordering parts, give the model number of the receiver, the description of the parts and their code number.

RESISTORS

PART NO.	DESCRIPTION	CIRCUIT SYMBOL
2-5	Resistor, 1.8K, ± 10% tolerance, ½ W, composition	R44
2-6	Resistor, 2.2K, ± 10% tolerance, ½ W, composition	R112
2-9	Resistor, 6.8K, ± 10% tolerance, ½ W, composition	R24, R117
2-11	Resistor, 47K, ± 10% tolerance, ½ W, composition	R34, R59, R81
2-12	Resistor, 100K, ± 10% tolerance, ½ W, composition	R41, R48, R61, R69, R70, R86, R98
2-13	Resistor, 3.3K, ± 10% tolerance, ½ W, composition	R74
2-14	Resistor, 470K, ± 10% tolerance, ½ W, composition	R52, R54, R64, R76, R93, R94
2-16	Resistor, 1 meg. ± 10% tolerance, ½ W, composition	R21, R33, R68, R83, R84
2-18	Resistor, 2.2meg. ± 10% tolerance, ½ W, composition	R88
2-20	Resistor, 27K, ± 10% tolerance, ½ W, composition	R43, R56, R62
2-21	Resistor, 47 ohm, ± 10% tolerance, ½ W, composition	R10, R15
2-24	Resistor, 1.5K, ± 10% tolerance, ½ W. composition	R87
2-29	Resistor, 270K, ± 10% tolerance, ½ W, composition	R35, R102
2-31	Resistor, 18K, ± 10% tolerance, ½ W, composition	R96
2-34	Resistor, 1K, ± 10% tolerance, ½ W, composition	R25, R63, R89, R92
2-36	Resistor, 33K, ± 10% tolerance, ½ W, composition	R40, R72
2-37	Resistor, 22K, ± 10% tolerance, ½ W, composition	R27, R111
2-38	Resistor, 56K, ± 10% tolerance, ½ W, composition	R60, R99
2-39	Resistor, 6.8 meg. ± 10% tolerance, ½ W, composition	R80
2-40	Resistor, 330 ohm. ± 10% tolerance, ½ W, composition	R12
2-47	Resistor, 2.7K, ± 10% tolerance, ½ W, composition	R36, R42
2-48	Resistor, 4.7K, ± 10% tolerance, ½ W, composition	R53, R65, R66, R71, R73

RESISTORS (con't.)

PART NO.	DESCRIPTION	CIRCUITS SYMBOL
2-49	Resistor, 680 ohm. ± 10% tolerance, ½ W, composition	R95
2-53	Resistor, 470 ohm. ± 10% tolerance, 1 W, composition	R31, R47
2-60	Resistor, 10K, ± 10% tolerance, 1 W, composition	R113, R114
2-61	Resistor, 15K, ± 10% tolerance, 1 W, composition	R115
2-65	Resistor, 47K, ± 10% tolerance, 1 W, composition	R105, R106
2-86	Resistor, 39K, ± 10% tolerance, 1 W, composition	R29, R30
2-103	Resistor, 22K, ± 10% tolerance, 2 W, composition	R120
2-108	Resistor, 2.2K, ± 10% tolerance, 2 W, composition	R109, R110
2-118	Resistor, 47K, ± 10% tolerance, 2 W, composition	R118, R119
2-126	Resistor, 8.2K, ± 5% tolerance, ½ W, composition	R9, R16, R18, R19
2-127	Resistor, 150 ohm. ± 10% tolerance, 7.5W, W.W. with wire leads	R45
2-133	Resistor, 120 ohm, ± 10% tolerance, ½ W, composition	R13, R17, R23, R26
2-134	Resistor, 68 ohm, ± 10% tolerance, ½ W, composition	R20, R103
2-135	Resistor, 560, ± 10% tolerance, ½ W, composition	R91
2-136	Resistor, 10K, ± 5% tolerance, ½ W, composition	R11, R14, R32
2-137	Resistor, 12K, ± 10% tolerance, ½ W, composition	R38, R67
2-138	Resistor, 180K, ± 5% tolerance, ½ W, composition	R50
2-141	Resistor, 330K, ± 10% tolerance, ½ W, composition	R51
2-145	Resistor, 820 ohm, ± 10% tolerance, ½ W, composition	R101
2-144	Resistor, 4.7 meg., ± 10% tolerance, ½ W, composition	R75
2-152	Resistor, 2.5K ± 10% tolerance, 10W, W.W.	R116
2-158	Resistor, 10K, ± 10% tolerance, 20W, W.W.	R107
2-171	Resistor, 300K, ± 5% tolerance, ½ W, composition	R49
2-175	Resistor, 43K ± 5% tolerance, ½ W, composition	R55
2-214	Resistor, 680K, ± 10% tolerance, ½ W, composition	R22
2-215	Resistor, 100 ohm ± 10% tolerance, 1 W, composition	R104
2-222	Resistor, 390 ohm ± 10% tolerance, 2 W, composition	R47
1-39	Potentiometer, 5 K, 2 W, W.W., linear	R90
1-44	Potentiometer, 2.5 meg., 1/2 W, linear, composition	R82
1-46	Potentiometer, 500 K tapped, 1/2 W, audio taper, with AC switch	R58, S2
1-48	Potentiometer, 1 meg., 1/2 W, linear, composition	R85
1-49	Potentiometer, 50 K, 1/2 W, linear	R100
1-54	Potentiometer, 100 K, 1/2 W, linear	R39, R97
1-68	Potentiometer, 750 ohm, 2 W, W.W., linear	R28
1-69	Potentiometer, 100 ohm, 2 W, W.W.	R108
1-78	Potentiometer, 1500 ohm, linear, 4 W, W.W.	R46

CAPACITORS

PART NO.	DESCRIPTION	CIRCUITS SYMBOL
3-2	Capacitor, 47 uuf., ± 5% tolerance, 500 WV, silver mica	C33, C57
3-5	Capacitor, 330 uuf., ± 10% tolerance, 500 WV, mica	C81
3-7	Capacitor, 1000 uuf. ± 10% tolerance, 500 WV, insulated, ceramicon	C19, C22, C25, C47, C59, C61, C62, C65, C66, C79

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CAPACITORS (con't.)

PART NO.	DESCRIPTION	CIRCUIT SYMBOL
3-8	Capacitor, 4700 uuf. ± 10% tolerance, 500 WV mica	C63, C74, C82
3-28	Capacitor, 100 uf., 25 WV, tubular electrolytic	C77, C69
3-33	Capacitor, 120 uuf., ± 10% tolerance, 500 WV, mica	C26
3-36	Capacitor, 22 uuf., ± 10% tolerance, 500 WV, mica	C34
3-43	Capacitor, 39 uuf., ± 5% tolerance, 500 WV, silver mica	C56
3-48	Capacitor, 5000 uuf., ± 450 WV, disc type	C16, C17, C18, C21, C23, C24, C43, C48, C49, C-67
3-81	Capacitor, 2.2 uuf. ± 20% tolerance, 500 WV	C31
3-82	Capacitor, 0.1 uf., 200 WV, paper tubular	C28, C38, C27, C92
3-83	Capacitor, 0.01 uf., ± 450 WV, disc type	C29, C37, C54, C55, C60, C78
3-84	Capacitor, 0.05 uf., 200 WV, paper tubular	C20, C68, C80, C93 C94, C95
3-85	Capacitor, 0.05 uf., 600 WC, paper tubular	C45, C64, C87
3-86	Capacitor, 0.1 uf., 600 WV, paper tubular	C32, C75, C86, C88
3-94	Capacitor, 0.25 uf., 600 WV, paper tubular	C76
3-95	Capacitor, 3900 uuf., 500 WV, mica	C30
3-103	Capacitor, 10 uf., 25 WV, tubular electrolytic	C46, C85
3-110	Capacitor, 50 uf., 250 WV, tubular electrolytic	C58
3-117	Capacitor, 0.01 uf., 600 WV, paper tubular	C84
3-132	Capacitor, 80 uf., 450 WV, twist-prong can type, 1 3/8" dia., electrolytic	C40
3-133	Capacitor, 25 uf., 25 WV, tubular electrolytic	C36, C42
3-134	Capacitor, 40 uf., 450 WV, tubular electrolytic with mounting clamp	C41, C44
3-135	Capacitor, 20 uf., 450 WV, tubular electrolytic	C72, C73, C90, C91
3-136	Capacitor, 680 uuf., ± 10% tolerance, mica	C83
3-137	Capacitor, 40 uf., 500 WV, twist-prong can type, 1" dia., electrolytic	C39

TRANSFORMERS

20-21	Audio output transformer	T2
20-27	Ratio detector transformer	T3
20-38	Horizontal output transformer without h.v. or filament winding	T7
20B-515	Power transformer	T1
20B-563	Vertical output transformer	T6
20B-564	Vertical blocking oscillator transformer	T5

COILS

21-6	Horizontal Linearity coil	L25
21-28	Horizontal oscillator coil	L24
21A-260-1	Inductor, video peaking, 240 uh.	L19, L28
21A-260-3	Inductor, video peaking, 120 uh.	L18, L20
21A-260-6	Inductor, video peaking, 93 uh.	L27
21A-517-2	Inductor, variable	L11, L15, L12
21A-517-3	Inductor, variable	L9, L13, L16
21A-517-4	Inductor, variable	L17
21A-517-5	Inductor, variable	L21, L23
21A-518-1	Inductor, fixed	L10, L14
21B-527	Filter choke	L22

FUSES

11-4	Fuse holder	
11-9	Fuse, 1/4 amp., with wire leads	F2
11-10	Fuse, 2½ amp., slow blowing	F1

MISCELLANEOUS

38-9	Speaker, 8" PM, 3.2 ohm VC	LS1
39-9	Tuner with tubes	V1, V2
30-147	Vertical integrator plate	R77, R78, R79, C69, C70, C71

PROTELGRAM PARTS

HIGH VOLTAGE POWER SUPPLY (170B)

PART NO.	DESCRIPTION	CIRCUIT SYMBOL SCHEMATIC 170-B
	CAPACITORS	
G8.381.23	Capacitor, .01 uf. 600V	C1
G8.381.09	Capacitor, .1 uf. 400V	C2, C5
P8.000.18*	Capacitor, 500 uuf. 20KV	C3
G8.381.01	Capacitor, .01 uf. 400V	C4

*NOTE: When ordering this part also order push-on nut Part No. G5.399.97.

RESISTORS

G8.317.43	Resistor, 33K, - 10% tolerance, 1W, composition	R1
G8.346.17	Resistor, 220 ohm, - 10% tolerance, 2W, composition	R2
G8.305.22	Resistor, 560 ohm, - 20% tolerance, ½W, WW	R3
G8.312.45	Resistor, 47K, - 10% tolerance, ½ W, composition	R4
G8.315.46	Resistor, 820 ohm, - 5% tolerance, 1W, composition	R5
G8.324.03	Resistor, 3.3 ohm, - 10% tolerance, ½ W, WW	R6, R7
G8.311.12	Resistor, 300K, - 5% tolerance, ½ W	R8

MISCELLANEOUS

P9.001.81	Transformer	T1
P9.001.64	High Voltage Cable	

OPTICAL UNIT

P9.001.82	Top Adjusting Screw Assembly
P9.001.83	Side Adjusting Screw Assembly

TUBE MOUNT

P9.205.12M	Focus Coil and Housing Assembly
P9.000.22	Deflection Yoke Assembly

MODELS PT200, PT300, Ch. PT200

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SERVICE DATA

OLYMPIC TELEVISION RECEIVERS MODELS 752, 753, 755, 764, 766, 767 & 769

These models are twenty tube direct viewing television receivers differing essentially in size of speaker and styling of cabinet.

Models 764 and 767 are provided with a sensitivity switch and a phono-TV switch with phonojack.

Models 766 and 769 in addition to the TV chassis, have a three speed record changer and a separately powered FM-AM chassis. For circuit diagram and alignment data on the FM-AM chassis refer to Olympic's instruction manual IB-2354.

NOTE: Both 16" and 17" rectangular glass picture tubes are used on the above models. They require different mechanical mountings and mask and therefore are not interchangeable. When replacing tubes in service use identical tube sizes.

Electrical and Mechanical Specifications

Radio Frequency Ranges

Channel Number	Channel Freq. MC	Picture Carrier Freq. MC	Sound Carrier Freq. MC	Receiver RF Osc Freq. MC
2	54-60	55.25	59.75	81
3	60-66	61.25	65.75	87
4	66-72	67.25	71.75	93
5	76-82	77.25	81.75	103
6	82-88	83.25	87.75	109
7	174-180	175.25	179.75	201
8	180-186	181.25	185.75	207
9	186-192	187.25	191.75	213
10	192-198	193.25	197.75	219
11	198-204	199.25	203.75	225
12	204-210	205.25	209.75	231
13	210-216	211.25	215.75	237

Power Supply - - - - - - - - - - - - - - - - - 105-125 volts 60 cycles 240 watts
Speaker, Models 752 & 755 - - - - - - - - - - 5" PM 1.0 oz. Alnico 5
Speaker, Models 753, 764 & 767 - - - - - - - - 10" PM 3.16 oz. Alnico 5
Speaker, Models 766 & 769 - - - - - - - - - - 12" PM 4.64 oz. Alnico 5
Voice Coil Impedance - - - - - - - - - - - - - 3.2 ohms at 400 cycles
Receiver Antenna Input Impedance - - - - - - - 300 ohms balanced

Tube Complement		Function
1) 6AG5 or 6BC5	(V1)	RF Amplifier
2) 6J6	(V2)	RF Oscillator and Converter
3) 6AU6 or 6BA6**	(V3)	1st Sound IF Amplifier
4) 6AU6	(V4)	2nd Sound IF Amplifier and Driver
5) 6AL5	(V5)	Sound Discriminator
6) 6AV6	(V6)	1st Audio Amplifier
7) 6V6GT	(V7)	Audio Output
8) 6AG5 or 6BC5	(V8)	1st Pix and Sound IF
9) 6AG5 or 6BC5	(V9)	2nd Pix IF Amplifier
10) 6AG5 or 6BC5	(V10)	3rd Pix IF Amplifier
11) 6AL5	(V11)	Video Detector, Automatic Gain Control and Sync Limiter
12) 12AU7	(V12)	1st and 2nd Video Amplifier
13)*16KP4/16RP4	(V13)	Kinescope (Picture Tube)
14) 6SN7GT	(V14)	Sync Amplifier and Separator
15) 12BH7	(V15)	Vertical Oscillator and Vertical Output

* On 17" Models use 17BP4/17BP4A

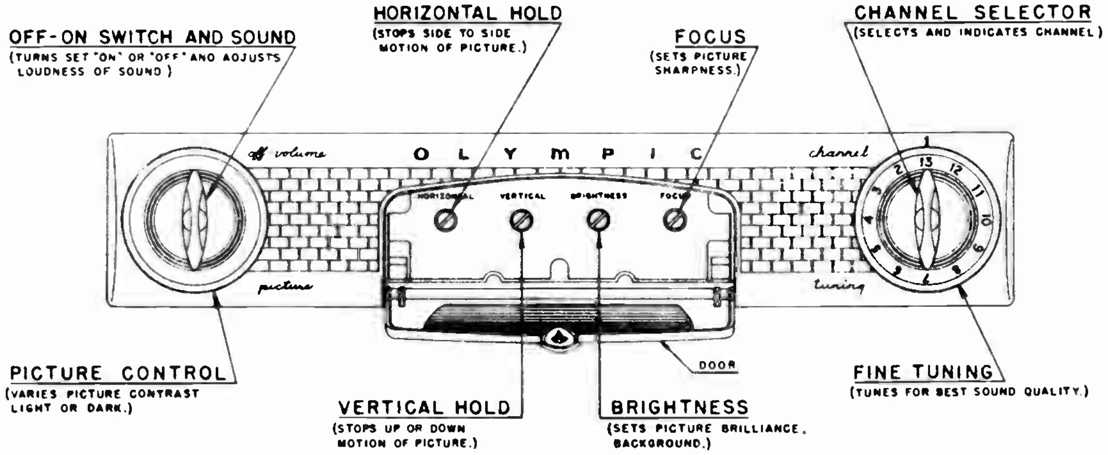
** When a 6BA6 is used in V3 position R1 (cathode bias resistor) is bypassed with a 1500 mmf condenser.

Tube Complement (Continued)		Function
16) 6SN7GT	(V16)	Horizontal Oscillator and AFC
17) 6BQ6GT	(V17)	Horizontal Output
18) 1B3GT	(V18)	High Voltage Rectifier
19) 6W4GT	(V19)	Damper
20) 5U4G	(V20)	Power Supply Rectifier

Picture Intermediate Frequencies
Picture Carrier Frequency - - - - - - - - - - - - 25.75 MC
Accompanying Sound Traps - - - - - - - - - - - - 21.25 MC

Sound Intermediate Frequencies
Sound Carrier Frequency - - - - - - - - - - - - - 21.25 MC
Sound discriminator band width (between peaks) - - - 350 KC

Operating Controls (front panel)
Channel Selector / Fine Tuning — Dual Control Knobs
Power Switch and Volume / Contrast (Picture) Control — Dual Control Knobs
Horizontal Hold - - - - - - - - - - - - - - - - - - Single Control
Vertical Hold - - - - - - - - - - - - - - - - - - - Single Control
Brightness - Single Control
Focus - Single Control



Non-Operating Controls
Width - - - - - - - - - - - - - - - - Rear screwdriver adjustment.
Height - - - - - - - - - - - - - - - Front chassis screwdriver adjustment.
Horizontal Linearity - - - - - - - - Rear chassis screwdriver adjustment.
Vertical Linearity - - - - - - - - - Front chassis screwdriver adjustment.
Horizontal Drive - - - - - - - - - - Rear chassis screwdriver adjustment.
Horizontal Oscillator Frequency
(Fine) - - - - - - - - - - - - Rear chassis screwdriver adjustment (L16).
Horizontal Oscillator Frequency
(Wave Shape) - - - - - - - - Bottom chassis screwdriver adjustment (L17).

MODELS 752,-U, 753,-U, 755,-U, 764,-U, 766-U, 767, 769

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Horizontal Locking Range - - - - Rear Chassis screwdriver adjustment.
Focus Coil - - - - - - - - - - - - - (Top chassis) lever adjustment for centering of raster.
Ion Trap Magnet - - - - - - - - - On neck of picture tube.
Deflection Coil - - - - - - - - - - - Top chassis wing screw adjustment.

ALIGNMENT

Equipment Required

1) RF signal generator to provide the following accurate frequencies. If the accuracy of the generator frequencies is not known, some type of crystal calibrator should be utilized to check the correct settings of the RF generator for each particular frequency.

(a) 4.5 MC Video Amplifier Trap

(b) IF Frequencies

21.25 MC	Sound IF, Sound Discriminator and Sound Traps
22.25 MC	Converter Coil
22.5 MC	Marker Frequency
23.0 MC	First Pix IF Coil
26.5 MC	Second Pix IF Coil
25.0 MC	Third Pix IF Coil
25.75 MC	Picture Carrier Marker

(c) RF Frequencies

Channel Number	Picture Carrier Freq. MC	Sound Carrier Freq. MC
2	55.25	59.75
3	61.25	65.75
4	67.25	71.75
5	77.25	81.75
6	83.25	87.75
7	175.25	179.75
8	181.25	185.75
9	187.25	191.75
10	193.25	197.75
11	199.25	203.75
12	205.25	209.75
13	211.25	215.75

(d) Output on these ranges should be adjustable and capable of providing at least .1 volt.

2) Electronic Voltmeter
3) Cathode Ray Oscilloscope, 3" minimum screen
4) RF Sweep Generator, meeting the following requirements:

(a) Frequency Ranges
18 to 30 MC., 1 MC. sweep width
40 to 90 MC., 10 MC. sweep width
170 to225 MC., 10 MC. sweep width

(b) Output adjustable to .1 volt.

The chassis may be removed from the cabinet with the kinescope tube in place and servicing and alignment work can be accomplished without removing the kinescope tube. This work is most conveniently performed by placing the chassis on its left side (power supply cage resting on work bench) and the controls facing the operator.

To remove chassis from cabinet remove
(1) Line cord from power outlet
(2) Masonite back
(3) Antenna Lead-in from terminal posts
(4) Speaker plug from rear of chassis
(5) Knobs from front of cabinet
(6) Four mounting screws and washers from bottom of cabinet

In sliding chassis out of cabinet be careful that the kinescope tube does not strike against cabinet or any other obstruction.

Order of Alignment

When complete receiver alignment is necessary it should be performed in the following sequence.

(1) Pix IF Traps
(2) Sound IF Transformers
(3) Sound Discriminator
(4) Pix IF Coils
(5) Retouch Pix IF Transformers
(6) 4.5 MC Trap

After removing chassis from cabinet, connect power and speaker plugs.

If a local station is not operating on channel #9 set the tuner to this channel, turn on power switch and proceed as follows: (If #9 is a local station channel use channel #8 or #10).

Picture I-F Trap Adjustment

Insert 100,000 ohm resistor in series with hot lead of electronic voltmeter and connect to Pin #7 of V11 with meter range switch set to lowest scale and observing polarity for negative readings.

Couple hot lead of RF SignalGenerator to converter tube V2 by means of a loop consisting of two turns of insulated hook-up wire. Connect ground lead of RF Signal Generator to chassis.

Note: If the converter tube V2 is shielded - remove shield.

Set the generator frequency accurately to 21.25 MC, and adjust L7 cathode sound trap (see tube and trimmer layout drawing) for minimum reading on voltmeter.

By means of a clip lead, short circuit condenser C26 on cathode trap.

Increase generator output to maximum (recheck 21.25 MC generator setting) and adjust L5 for minimum reading of voltmeter.

Sound IF Transformer Adjustment

Change hot lead connection of electronic voltmeter (with 100,000 ohm resistor connected in series) to terminal marked "C" of sound discriminator transformer. Reduce output of the signal generator to give approximately 2 volts reading on voltmeter scale.

Adjust L1 and L2 for maximum reading.

Sound Discriminator Adjustment

Change hot lead connection of voltmeter to pin #1 of V5 and adjust L3 for zero reading on voltmeter. This zero setting is very critical and the adjustment must be made with extreme care.

Repeat adjustments for L2 and L3 in the same manner indicated above.

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Pix IF Coil Adjustment

Connect hot lead of voltmeter to pin #7 of V11 and adjust the following slugs for maximum output at frequencies indicated:

L301	22.25 MC
L4 (Bottom of can)	23.0 MC
L6	26.5 MC
L8	25.0 MC

If oscillation occurs during alignment, temporarily lower frequency of L8 by turning screw clockwise until screw projects approximately ¼". After properly adjusting L301, L4 & L6 then set L8 to proper frequency. Oscillation is evidenced by high reading on voltmeter (-10v to -20v) with signal generator OFF and no signal coming in through the antenna terminals.

Retouch Pix IF Transformer Adjustment

Disconnect RF signal generator leads and connect hot lead of sweep generator to coupling loop on converter tube and ground lead to chassis.

Connect vertical input terminal of oscilloscope to pin #7 of V11 (Pix Dectector) and connect ground lead of scope to chassis.

Connect 1½ V flashlight battery with positive terminal to chassis and negative terminal to #2 pin of V11.

Set tuner to channel 9 unless local station is operating on this frequency, in which case an adjacent channel should be used.

Set sweep generator frequency to IF sweep on the 20 to 30 MC range.

Adjust sweep generator output to produce a curve on the scope which is approximately 2/3 of the screen diameter.

Loosely couple output of RF signal generator to hot lead of sweep generator and set frequency of RF signal generator to 25.75 MC (marker).

Curve shown on scope should be similar to the standard response curve shown below. For proper setting of the pix carrier the 25.75 MC marker should appear on the curve at a point approximately 50% to 60% of the vertical height of the curve.

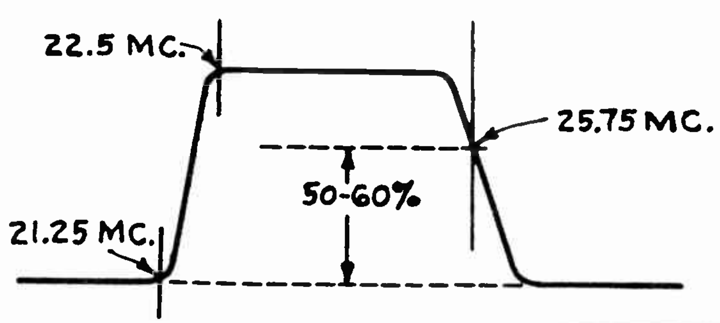
To obtain this setting retouch L6 and L8.

Reset RF signal generator frequency to 22.5 MC and retouch L301 and L4 for correct positioning of marker on shoulder of curve.

The curve may now be flat topped by retouching L8 & L4.

Recheck setting of 25.75 MC marker to make sure that position has not shifted on curve.

Disconnect bias battery.



Note: If the curve cannot be made to appear as above due to a local station or other interference, or multiple markers appear, remove (V1) 6BC5 RF tube from tuner.

Tuner Adjustments for Models using Tuner Part #CL-2262

Note: Before making a complete tuner adjustment it is essential that the Sound I.F. and discriminator circuits be aligned at their proper frequencies as described above. WHEN CHANGING THE CONVERTER TUBE IT IS NECESSARY TO REALIGN THE OSCILLATOR ADJUSTMENT ON ALL CHANNELS WITH THE V2 TUBE SHIELD IN PLACE.

RF and Converter Alignment

1) Set channel selector switch to #12
2) Connect oscilloscope through 10,000 ohms to test point on tuner (bare tinned copper loop wire located between V1 and V2)
3) Set fine tuning control at approximate mid-point of its tuning range. Temporarily connect jumper wire from pin #7 of V11 to chassis.
4) Feed Sweep generator into antenna terminals, sweeping channel 12.
5) Adjust C301, C302, and C304 for flat top response curve. Check picture and sound carrier markers corresponding to frequencies shown on Page 2 for all respective channels.
6) Remove jumper from pin #7 of V11 to chassis.

Oscillator Alignment

1) Set channel selector switch to #12
2) Connect signal generator to one antenna terminal and ground. Set to sound carrier frequency 209.75 MC.
3) Connect electronic voltmeter to pin #1 of V5 (6AL5) sound discriminator.
4) Adjust C303 for zero reading on electronic voltmeter between a positive and negative peak.
5) Check all channels for zero reading on voltmeter. It is usually not necessary to make any further adjustments. If it is found necessary to touch up the oscillator coils, the following procedure should be observed.

Oscillator Coil Touch-up

(a) Center fine tuning control, as described in Note A below.
(b) Place a non-metallic screwdriver through opening, and adjust oscillator coil on channel 12 (L312)
(c) Turn channel selector switch to channel 13 and adjust L313.
(d) This adjustment can be repeated for all channels or if necessary on any single channel.

ADJUSTMENTS

Ion Trap Magnet Adjustment:

Turn the brightness control fully clockwise and the contrast control fully counter-clockwise. Adjust the ion trap magnet by moving it forward or backward and at the same time rotating it slightly around the neck of the kinescope until the raster on the screen is brightest. Reduce the brightness control setting until the raster is slightly above average brilliance. Adjust focus control until the line structure of the raster is clearly visible (sharp). Readjust the ion trap magnet again for maximum raster brilliance. The final touches on this adjustment should be made with the brightness control at the maximum position with which good line focus can be maintained.

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Focus Coil Adjustments:

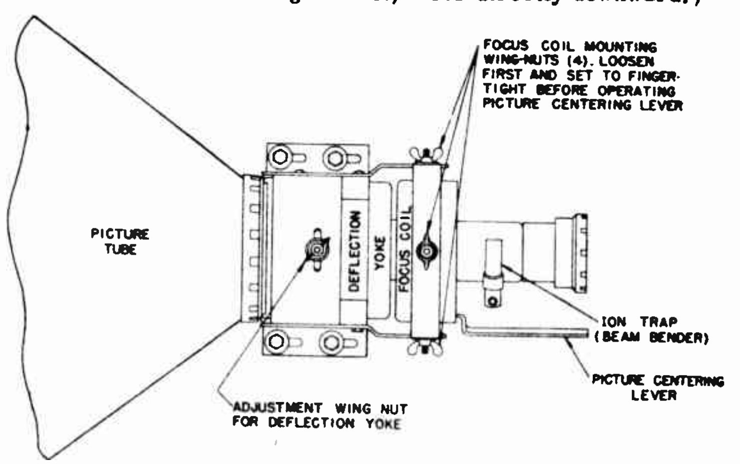
The focus coil is mounted within a frame to permit movement about its horizontal and vertical axis. The four wing nuts holding the focus coil to the frame are tightened at the factory to prevent movement during shipment. Upon installation of the receiver these wing nuts should be loosened and then adjusted finger tight. Centering of the picture within the mask is accomplished by gently moving the lever welded to the focus coil up and down or from left to right until the entire raster or picture is visible on the screen.

Deflection Yoke Adjustment:

If the lines of the raster are not horizontal or squared with the picture mask, loosen the deflection yoke adjustment screw and rotate the deflection yoke until this condition is obtained, and retighten the yoke adjustment screw.

If neck shadow is evident or the corners of the raster are dark, the deflection yoke must be moved forward as far as possible and the wing screw retightened. After observing that the picture tube is brought forward as far as possible to rest against the two tube stop brackets, loosen the four screws holding the rear tube support bracket to the chassis and move the entire bracket forward so that the rubber cup presses firmly against the cone of the picture tube. Where an additional reinforcing bracket is used to hold the rear tube support to the high voltage power supply cage it will be necessary to remove the power supply cover and remove the mounting screws in the bracket prior to making the above adjustment. After the rear tube support bracket has been properly adjusted and the screws retightened the reinforcing bracket can be reassembled using another set of mounting holes on the side of the power supply cage which will maintain a firm pressure of the rubber cup against the cone of the picture tube.

Note A - The mid-point of the fine tuning range is attained when the point of the bakelite cam (which is attached to the fine tuning control) faces directly downward.)



Check of Horizontal Oscillator Alignment

(Any adjustments or check of horizontal oscillator alignment should be made after a fifteen to thirty minute chassis warm-up period.)

Obtain a test pattern and turn the horizontal hold control to the extreme clockwise position. The picture should remain in synchronization or shift slightly to the right with the blanking bar becoming visible. The blanking bar may be unstable and move from side to side. Turn hold control counter-clockwise and the picture should remain in synchronization unless the signal is weak and in which case 3 or 4 bars may be seen sloping downward to the left.

If the receiver behaves in this manner and the test pattern is normal and stable, the horizontal oscillator is properly adjusted. Skip the "Adjustment of Horizontal Oscillator" and proceed with Height and Vertical Linearity adjustments.

Horizontal Oscillator

The horizontal oscillator is adjusted at the factory to provide the wave shape shown on the following page and normally can be adjusted by means of the horizontal frequency threaded brass screw (L16) at rear of chassis, and by means of the horizontal lock trimmer (C57).

(a) Turning the horizontal lock trimmer (C57) clockwise decreases the range of the horizontal hold control, and turning the trimmer counter-clockwise increases the range of the hold control. Normal setting is about one turn counter-clockwise from the tight position. In "Fringe" or weak signal areas the trimmer may be set two turns counter-clockwise from the tight position resulting in somewhat better range on the hold control.

(b) Turning the horizontal frequency screw (L16) clockwise lowers the frequency, (bars sloping downward to left). Turning the screw counter-clockwise increases frequency (bars sloping downward to right).

Adjustment of Horizontal Oscillator (with the use of an oscilloscope)

1) Allow set to warm up to operating temperature. Select station operating normally.
2) Connect vertical input lead of oscilloscope to terminal "C" of horizontal oscillator transformer (TR-2294) and ground oscilloscope to chassis. Set frequency of scope to approximately 5 KC.
3) Set horizontal lock trimmer (C57) one turn from tight.
4) Short terminals "C" & "D" on TR-2294 by means of clip lead.
5) **Set horizontal hold control at maximum clockwise rotation.**
6) **Adjust horizontal frequency screw (L16) until picture falls into sync. Then turn screw slightly counter-clockwise until blanking bar shows, or three or four bars show sloping downward to right.**
7) **Remove short from terminals "C" & "D" of TR-2294 and adjust screw (L17) at terminal end of TR-2294 (under chassis) until wave shape as observed on scope is like that shown in sketch.**

NOTE: Due to variations in oscilloscope input characteristics it may be necessary to insert a 50,000 ohm resistor in the vertical input lead. This will prevent the loading of the scope from affecting the frequency of the horizontal circuit.

8) Some further adjustment of horizontal frequency screw (L16) may be necessary to keep picture in sync while L17 is being adjusted for proper wave shape.
9) Remove scope from terminal "C".
10) Turn horizontal hold control through entire range. Picture should remain in sync except in clockwise position when "blanking bar" will appear, or two or three bars will show sloping downward to the right.
11) If picture falls out at left or condition described in "10" is not obtained, adjust horizontal frequency screw (L16) slightly. Observe paragraphs "a" & "b" under "Horizontal Oscillator"

NOTE: Some manufacturers types of 6SN7GT may perform better than others in the horizontal oscillator socket and excessive drift of the horizontal oscillator circuit may be caused by a weak or defective 6SN7GT tube.

After the horizontal oscillator circuit has been adjusted in the manner outlined above, any subsequent touch-up may be made with the horizontal frequency screw L16.

Caution: It is important that the picture be centered in the mask properly with the horizontal hold control in the mid-position, otherwise the set user may attempt to center the picture by means of the hold control. Under this condition the control may be on "edge" and impulse noise or change of camera will cause the picture to fall out of synchronization.

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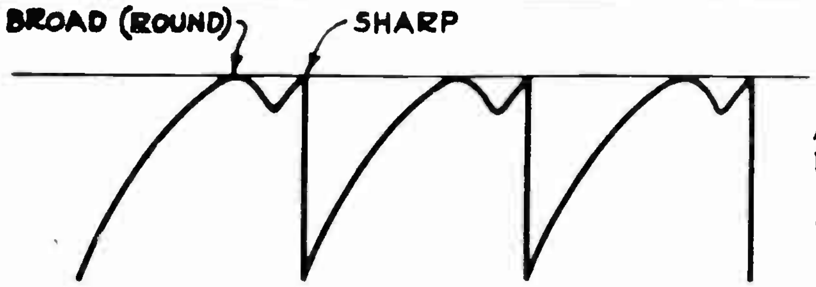


ADJUST L17 FOR EQUAL HEIGHTS OF ROUND AND SHARP PORTIONS OF PULSE.

Height and Vertical Linearity Adjustments:

Adjust the height control until the picture fills the mask vertically. Adjust vertical linearity until the test pattern is symmetrical from top to bottom.

Adjustment of one control will require readjustment of the other. Then adjust focus coil lever to align the picture within the mask.

Width, Drive and Horizontal Linearity:

Turn the width control L19 (accessible through a hole in the rear of chassis) clockwise until the picture fills the entire width of the tube. Adjust the trimmer "horizontal drive" C67 (rear of chassis) to give the best degree of brightness and linearity. Adjust the horizontal linearity control L18 (rear of chassis) for best linearity of the right half of the picture. Readjust the width control until the picture fills the mask and again adjust the focus coil lever to align the picture within the mask.

NOTE: It is advisable to adjust both the height and width of the picture to a size slightly larger than the mask opening so that during periods of low line voltage or subsequent aging of tubes adequate deflection to fill the mask opening is obtained.

IMPORTANT:

The horizontal oscillator frequency must be checked for proper range of horizontal hold control after any adjustment of horizontal drive (C67) and horizontal lock (C57) trimmers. Some interaction is present between these trimmers and any adjustment of either one will usually require resetting of the horizontal frequency adjustment screw (L16).

FOCUS:

Adjust the focus control for maximum definition of the vertical wedge of the test pattern and uniform focus over face of picture tube.

Sensitivity Switch (Used only on Models 764 & 767) 762,

A two-position switch is provided at the rear of the chassis for increasing the gain of the receiver which may be required for proper operation in fringe areas. Where sound and picture reception is weak with the sensitivity switch set in LOCAL position, switching to "FRINGE" position will improve the performance of the receiver.

Phono-Television Switch (Used only on Models 764 & 767)

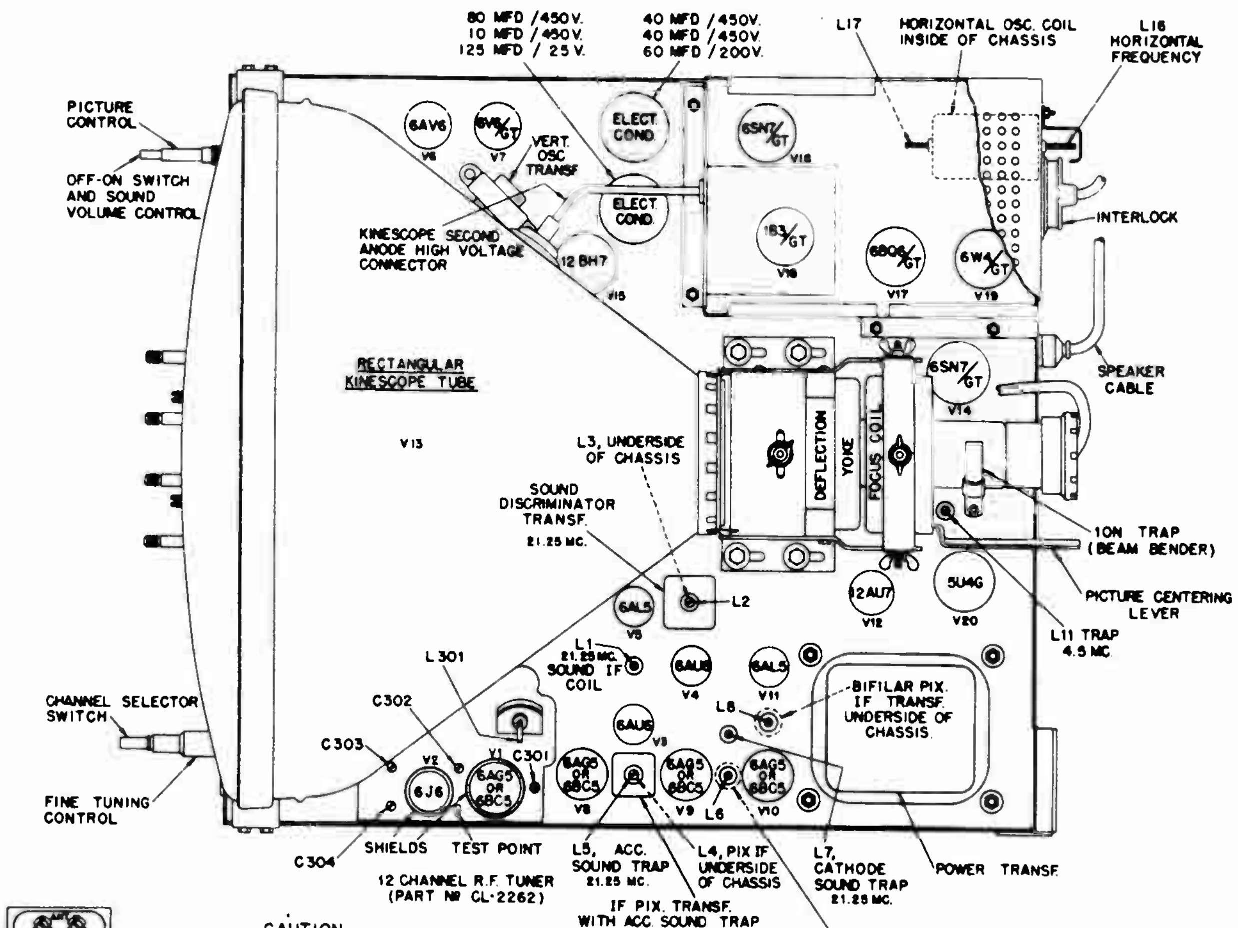
A two-position slide switch is provided at the rear of the chassis together with a pick-up socket for plug-in of an external record changer.

Built-In Antenna

All models are equipped with a built-in antenna which will provide satisfactory reception in many locations. In areas of weak reception an outside antenna will substantially improve the performance of the receiver. An antenna post is provided at the rear of the chassis and is accessible through the opening in the masonite back to permit the connection of an outside aerial. The built-in antenna is normally connected to the antenna posts and must be disconnected when attaching the outside aerial. To prevent the lead-in wires of the built-in antenna from contacting chassis parts and tubes it is recommended that the lead-in wire be folded and held in place by tape or a rubber band. In some cases reception can be improved by changing the location of the receiver in the room.

Note: The text in this manual applies to television receivers wired in accordance with enclosed schematic diagram DG-2346-1.

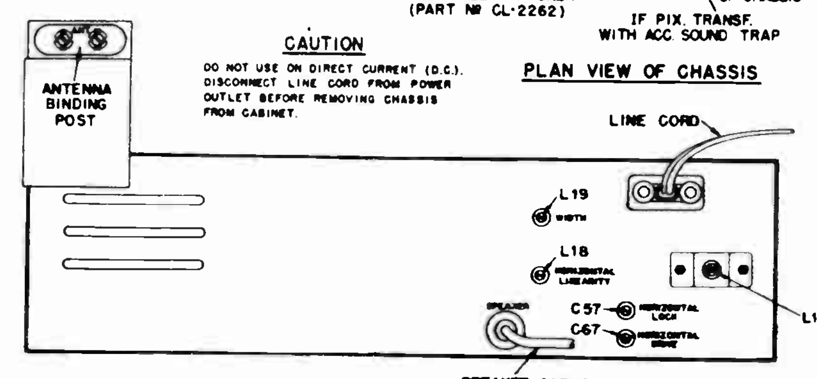
TUBE AND TRIMMER LAYOUT



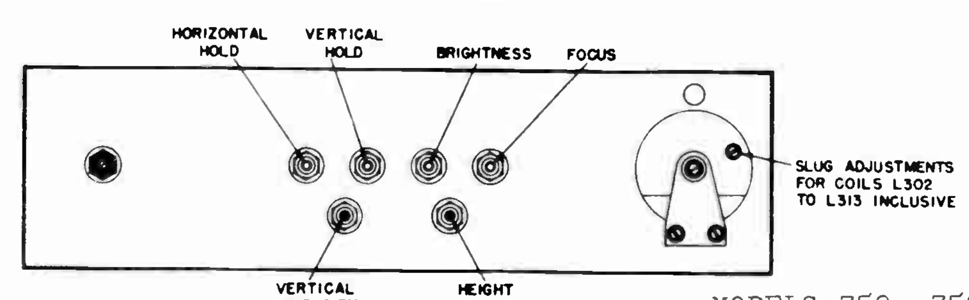
CAUTION

DO NOT USE ON DIRECT CURRENT (D.C.). DISCONNECT LINE CORD FROM POWER OUTLET BEFORE REMOVING CHASSIS FROM CABINET.

PLAN VIEW OF CHASSIS



REAR VIEW OF CHASSIS



L8-2327

FRONT VIEW OF CHASSIS

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ALL 700 SERIES RECEIVERS

MODELS 752, 752U, 753, 753U, 755, 755U, 764, 764U, 766, 766U, 767, 769

Trouble: Fuse blows on line voltage surge, etc. resulting in small picture, fold over on both sides and damping bars.
Remedy: Remove fuse from present circuit and then remove green lead from terminal #1 on TR-2293 horizontal output transformer and connect to #8. Connect fuse between #8 and #1. Remove yellow wire from #8 and connect to #7. Dress fuse away from high voltage terminals.

Trouble: Insufficient width.
Remedy: Connect an .05-400 volt condenser across width control (terminals #5 and #6 on transformer). In severe cases of low line voltage, etc. a .1-400 condenser may be used. Change 6BQ6GT.

Trouble: Vertical retrace lines visible at low contrast. May be due to low transmitter sync level, or variations in picture tube characteristics.
Remedy: Connect .05-600 volt condenser from green lead of vertical output transformer (TR-2189) to yellow lead (pin #11 V13 Kinescope). These leads run to adjacent tie points on terminal strip near vertical output transformer.

Trouble: Beat interference, hash in picture or sound, or separation of sound and picture on high band. Oscillation in sound I.F.
Remedy: Ground cathode resistor (R1 150 ohms) directly to center shield of V3 socket 1st sound IF amplifier, instead of terminal strip ground. Connect 1500 mmf ceramic condenser between pin #7 cathode and socket center shield. Check alignment of sound IF, sound traps, and distriminator.

SUBJECT: Modifications and Notes Applying to Models 752, 753, 755, 764, 766 and 767. Refer to schematic drawing DG-2346-1. All references to changes and symbol numbers in this service bulletin are with respect to Olympic's schematic wiring diagrams supplied with Instruction Manual IB-2405.

1. Tube Changes
Due to the critical shortage of 12AU7 tubes, the first and second video amplifier V12 will at times be replaced by a 6SN7GT tube. Due to inability to obtain adequate supplies of 12BH7 tubes, the vertical oscillator tube V15 is now being replaced by a 6SN7GT and all further production will use the latter type of tube.

2. Circuit Change
Condenser No. C18 .01/600 volts is being returned to the 6V6 screen, pin #4 instead of ground to reduce possibility of voltage breakdown.
Resistor No. R50, 6.8 Meg. going to the vertical hold control is not being used in all sets. It is often eliminated for better range of the vertical hold control.

3. Horizontal Tearing (Defective Parts)
If tearing occurs, especially in fringe areas resulting in a distorted picture, when contrast control is advanced, check for a short, leaky or open .05 condenser (C37) and low capacity in 220 MMF mica condenser (C38).

4. Color Converter
A color converter socket is now being wired in on the rear of the chassis for use with color converters -- when available.

5. Underwriters' Changes
In accordance with U/L requirements, a 120,000 ohm 1 watt resistor is being placed across condenser C48 in the primary of the power transformer -- connecting one side of the A.C. line to ground.

6. Picture Width
To increase picture width for low line voltage areas, a .05/600 W.V. paper condenser is now used on all models across terminals 5 and 6 of the flyback transformer TR-2293.

7. Vertical Height
To improve vertical height, try replacing the vertical output tube V15 which may be either a 6SN7GT or a 12BH7. As noted in paragraph one, both 6SN7GT and 12BH7 have been used in V15 socket.
Due to resistor shortages, R55 and R56, 3300 ohms each respectively in series have been replaced on some receivers by one 6500 ohm 5 watt wire wound resistor. To obtain increased height where R55 and R56 are used, short out either one of them. Where a 6500 ohm resistor is used, shunt another 6500 ohm 2 to 5 watt resistor across the present one or replace it by a 3300 ohm 2 watt resistor.

8. Width Control
Due to the scarcity of power transformers, Olympic Part No. TR-1966, it has been necessary to substitute another specification TR-1688 giving slightly lower B+ voltages. On all models where TR-1688 have been substituted and to secure sufficient width, the width control has been removed from the circuit by connecting both width control leads to terminal #1 of the 6BQ6GT tube. (V17 socket).
If it is necessary to reduce the width of the picture, restore connections of the width control by re-wiring to terminals 5 and 6 of the flyback transformer.

9. Vacuum Tubes
It appears that component parts manufacturers standards have been appreciably lowered lately. Therefore -- always check tubes first in case of performance and operation troubles. Some manufacturers types are better than others especially in 6BQ6 and 6SN7 types.

10. Resistors
Because of the critical shortage of this item, we and other manufacturers are compelled to develop new sources of supply even using resistors of foreign manufacture. While foreign resistors are properly rated as to wattage and resistance, the majority of them are of the un-insulated type. In production, these resistors are dressed away from contact with other parts. Transportation shock may cause them to shift, causing shorts. In case of trouble, check for short circuits and re-dress resistors so that they do not touch adjacent parts or components.

11. Horizontal Tearing (Modification)
When tearing of picture occurs at high or medium contrast control setting, R36 1000 ohm should be reduced to 700 or 800 ohms. When tearing or distortion occurs at low contrast setting R36 is too low and should be increased to 1200 ohms.

BULLETIN NO. 51-4

SUBJECT: Insufficient height and width in areas of low line voltage. Models 752, 753, 755, 764, 766 and 767.

Production Changes Starting November 24, 1950

Pix Width: R76 56,000 ohm 1 watt resistor changed to 22,000 ohm ±20% 1 watt.

Pix Height: R55 and R56 3,300 ohm 2 watt, (actually 6500 ohm 10 watt in production) replaced by one 3300 ohm 2 watt. A parallel resistor combination may be used as an equivalent of a 3300 ohm 2 watt resistor.

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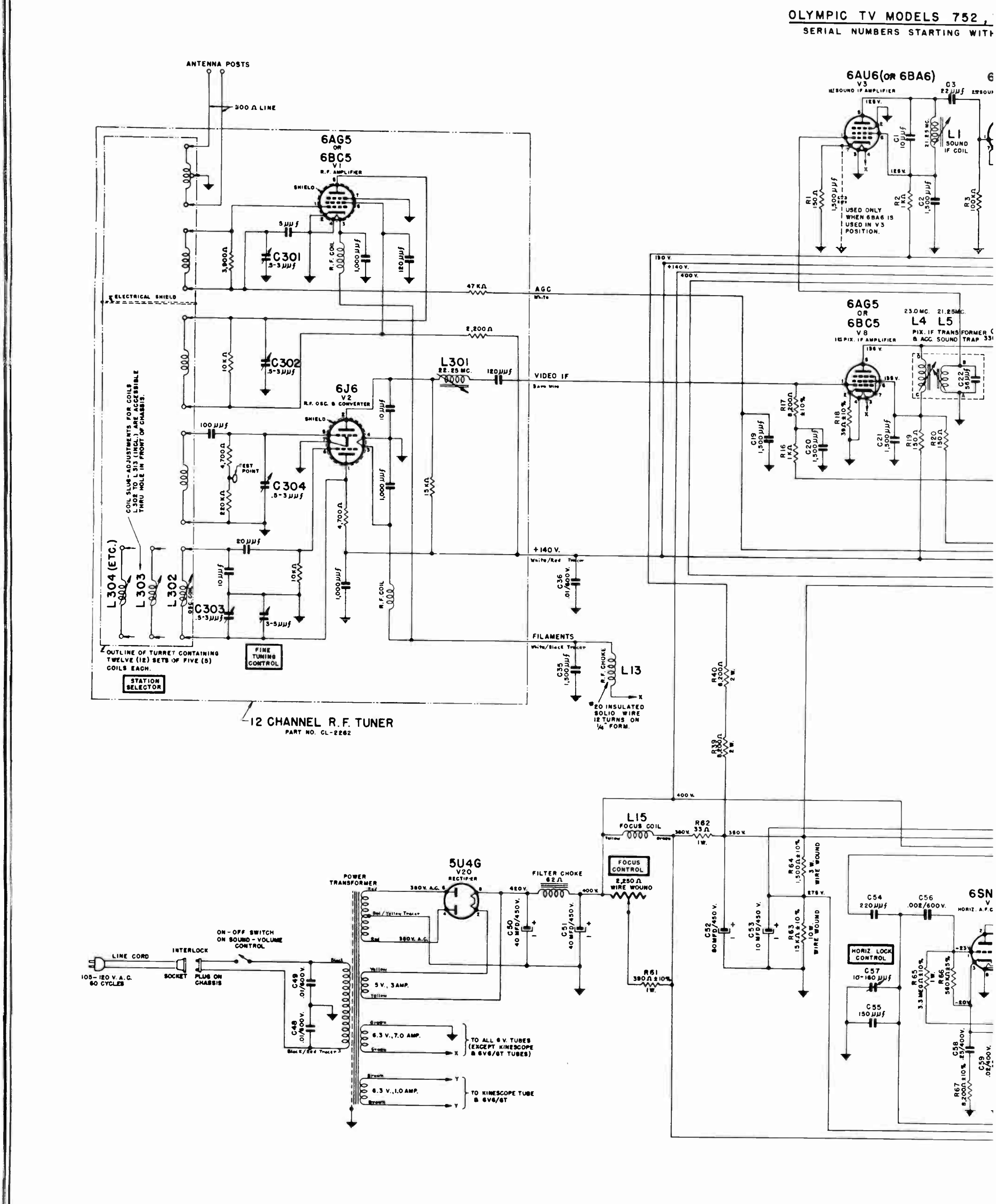
World Radio History

MODELS 752, 753, 755, 764, 766, 767, 769, Starting with R-500,001 and S-600,001



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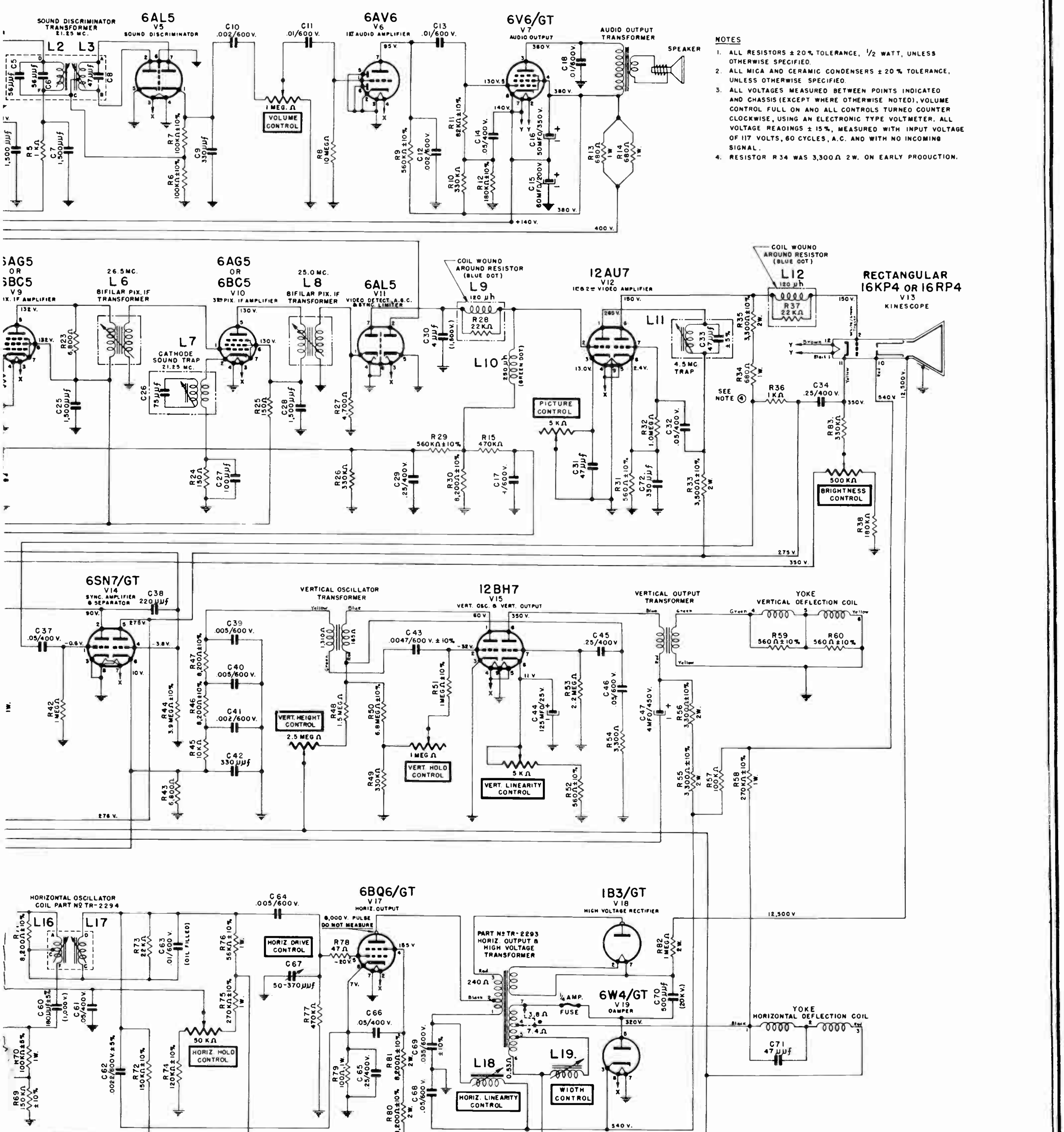
World Radio History

MODELS 752, 753, 755, 766, 769, Starting with R-500,001



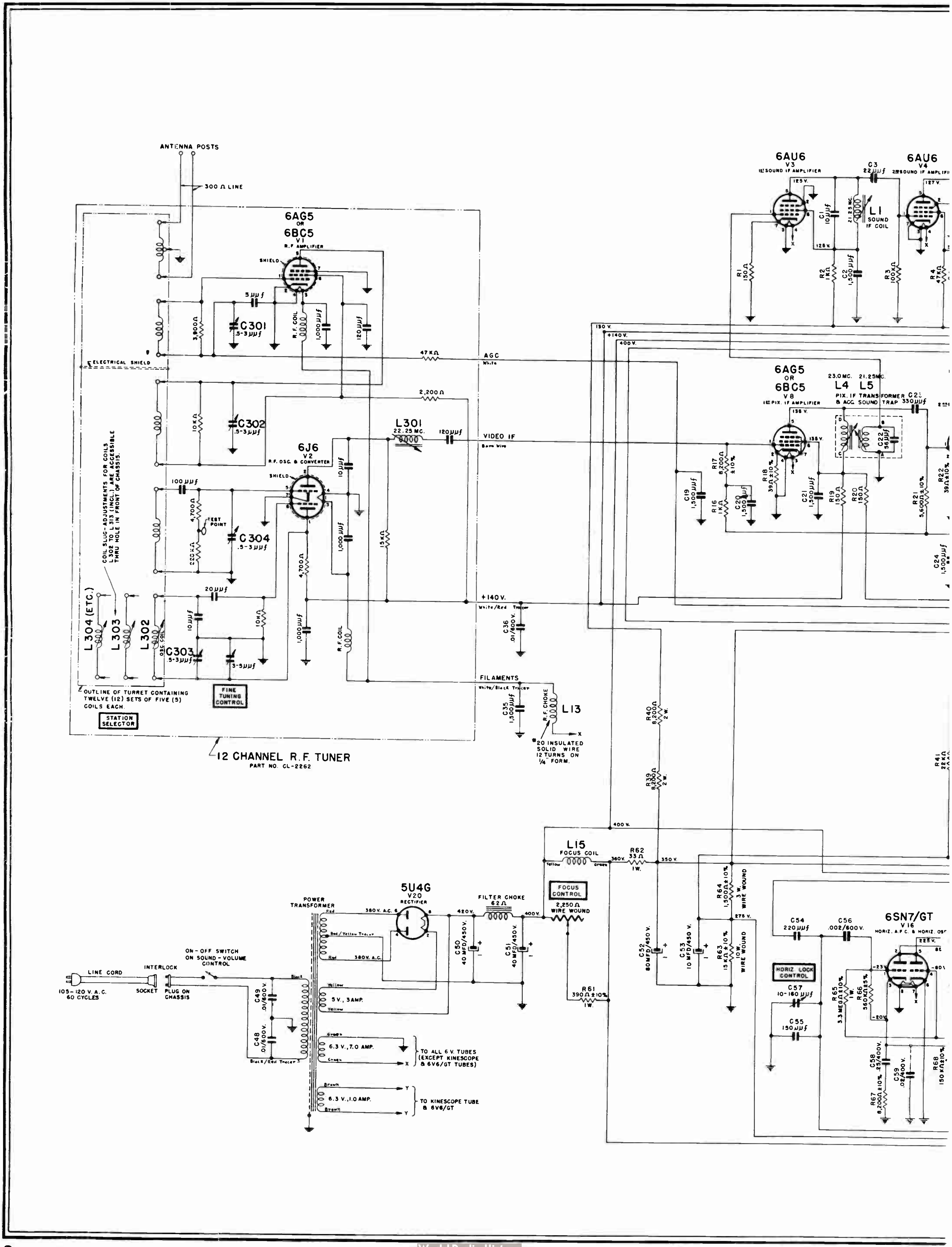
NOTES

1. ALL RESISTORS ± 20% TOLERANCE, 1/2 WATT, UNLESS OTHERWISE SPECIFIED.
2. ALL MICA AND CERAMIC CONDENSERS ± 20% TOLERANCE, UNLESS OTHERWISE SPECIFIED.
3. ALL VOLTAGES MEASURED BETWEEN POINTS INDICATED AND CHASSIS (EXCEPT WHERE OTHERWISE NOTED), VOLUME CONTROL FULL ON AND ALL CONTROLS TURNED COUNTER CLOCKWISE, USING AN ELECTRONIC TYPE VOLTMETER. ALL VOLTAGE READINGS ± 15%, MEASURED WITH INPUT VOLTAGE OF 117 VOLTS, 60 CYCLES, A.C. AND WITH NO INCOMING SIGNAL.
4. RESISTOR R34 WAS 3,300Ω 2W. ON EARLY PRODUCTION.

* WITH DEFLECTION YOKE PART NO. CL-2087 & CL-2087-1 #1 TERMINAL (BLACK LEAD) OF DEFLECTION YOKE (HORIZONTAL WINDING) IS CONNECTED TO TERMINAL #4 OF HIGH VOLTAGE TRANSFORMER.
WITH DEFLECTION YOKE PART NO. CL-2368 #1 TERMINAL (BLACK LEAD) OF DEFLECTION YOKE (HORIZONTAL WINDING) IS CONNECTED TO TERMINAL #7 OF HIGH VOLTAGE TRANSFORMER.

DG-2346

World Radio History



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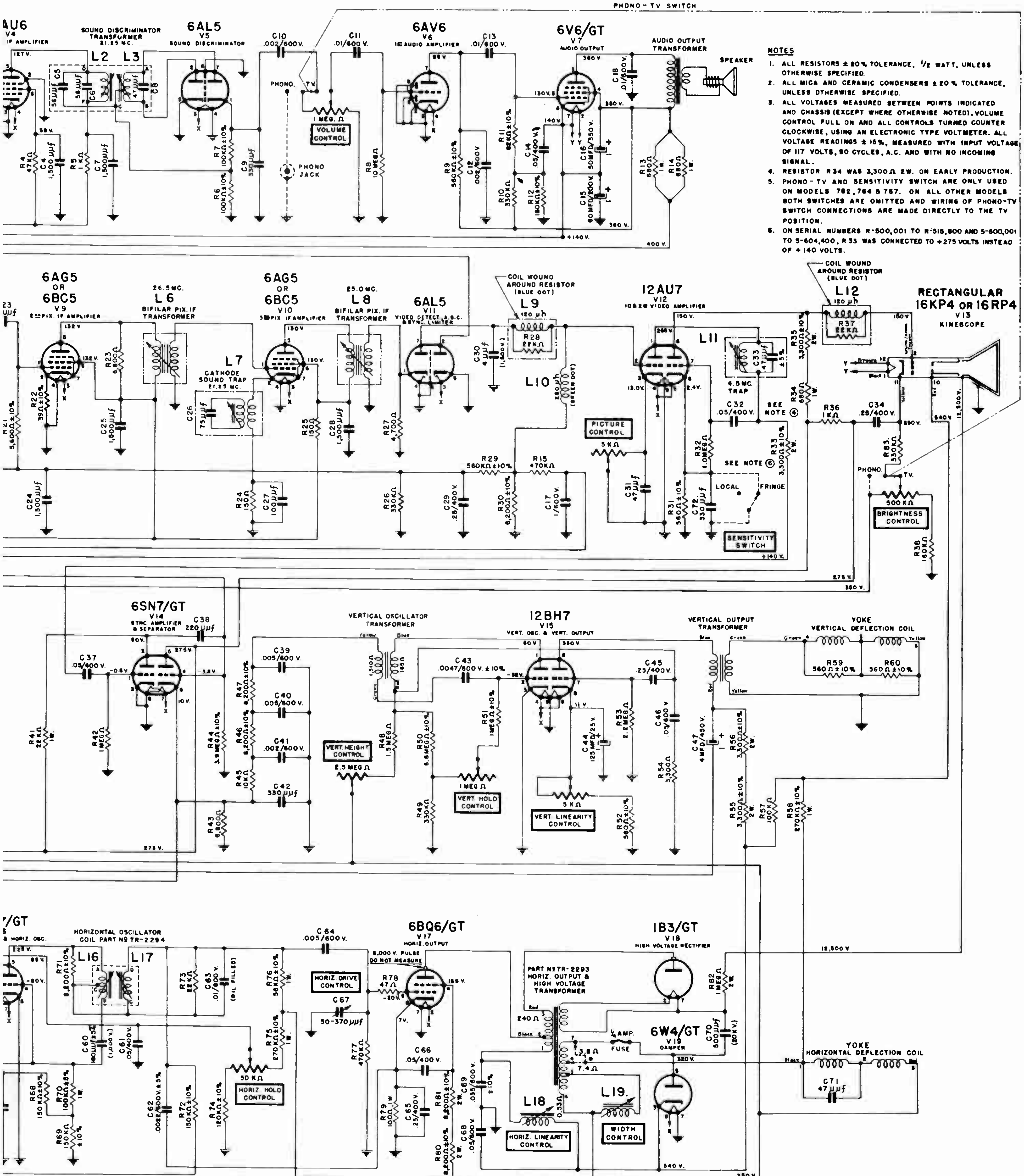
World Radio History

'53, 755, 764, 766, 767 & 769

R-500,001 & S-600,001



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4. RESISTOR R34 WAS 3,300 Ω 2W. ON EARLY PRODUCTION.
5. PHONO - TV AND SENSITIVITY SWITCH ARE ONLY USED ON MODELS 762, 764 & 767. ON ALL OTHER MODELS BOTH SWITCHES ARE OMITTED AND WIRING OF PHONO-TV SWITCH CONNECTIONS ARE MADE DIRECTLY TO THE TV POSITION.
6. ON SERIAL NUMBERS R-500,001 TO R-518,800 AND S-600,001 TO S-604,400, R 33 WAS CONNECTED TO +275 VOLTS INSTEAD OF +140 VOLTS.

● WITH DEFLECTION YOKE PART NO. CL-2087 & CL-2087-1 #1 TERMINAL (BLACK LEAD) OF DEFLECTION YOKE (HORIZONTAL WINDING) IS CONNECTED TO TERMINAL #4 OF HIGH VOLTAGE TRANSFORMER.
WITH DEFLECTION YOKE PART NO. CL-2368 #1 TERMINAL (BLACK LEAD) OF DEFLECTION YOKE (HORIZONTAL WINDING) IS CONNECTED TO TERMINAL #7 OF HIGH VOLTAGE TRANSFORMER.

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NOTE:-For Service Data of Television Ch. for Model DX-621, See Volume 5, Pages 5-1 through 5-7.

Frequency Range: A.M. 535-1700 kc. and F.M. 88-108 mc.

Power Requirement: 105-125 Volts a-c 60 cycles

Power Consumption: Receiver on a-m: 95 watts. Receiver with Record Changer: 115 watts

IMPORTANT NOTICE:

This AM-FM-TV receiver and automatic 3-speed record changer console is for use on alternating current ONLY and should never be used on direct current.

Before operating the radio receiver and record changer it will be necessary to remove the two shipping screws (which are identified with tags) holding radio receiver to its mounting board and loosen the three record changer mounting screws completely as described in separate accompanying Record Changer Instruction Sheet.

This instrument is equipped with two separate chassis; one a 10 tube (including rectifier) AM-FM chassis and another a 20 tube (including rectifiers) television chassis. Built-in antennas are provided for both the AM and FM-TV sections of the receiver which will provide satisfactory reception under normal operating conditions. For AM reception an outside antenna will seldom be required whereas on FM-TV the use of an outside antenna will generally improve the quality of reception.

AM-FM RECEIVER CONTROLS: (see separate folder for television controls and operation)

The AM-FM receiver has four control knobs marked according to their function, and reading from left to right as follows:

1. VOLUME 2. OFF-ON-TONE 3. FM-AM-PH-TV 4. TUNING

NOTE: The power switches for operating the television and radio sections of this instrument are interconnected and therefore it is necessary that the power switch of the unit which is not in operation be turned to the "OFF" position.

TUNING:

To place receiver in operation turn the OFF-ON knob clockwise until a click is heard. The tubes require a warm-up period of about one-half minute before the set is ready to function.

A.M.

For AM reception turn FM-AM-PH-TV knob to the position where AM faces the indicator dot. The tuning knob should now be turned until the dial pointer is at the frequency of the desired station. Use part of dial calibrated from 55 to 170. Dial numbers are converted to kilocycles by adding one zero. For example, 70 on the dial is 700 kilocycles. With volume control set to LOW volume level turn the station selector knob until the desired station is received loudest. Now adjust volume to the desired level and the tone control to the desired tone. DO NOT USE TUNING KNOB TO ADJUST VOLUME BY TUNING OFF STATION AS THIS WILL RESULT IN POOR TONE QUALITY.

F.M.

As supplied, the built-in television antenna is connected to both the TV and FM section of the receiver. Where no outside television aerial is used this arrangement will in most cases assure satisfactory FM reception. Where an outside television aerial is used, this internal connection will automatically connect the FM section to the outside aerial and no additional FM antenna should be required. Where an independent FM aerial is desired the connecting line between the television receiver and the radio receiver should be disconnected on both ends and the aerial connected to the post on the rear of the radio receiver marked "FM-Dipole."

For FM reception turn FM-AM-PH-TV knob to the position FM facing indicator dot. Use the part of the dial calibrated in megacycles and channel numbers and tune carefully at medium volume level to the desired station. The tuning is done by the same knob as on AM. It is important to tune accurately to the center of the station as incorrect tuning will result in poor tone quality. The correct tuning point is the position of loudest response.

Tone and volume may be adjusted by the same two knobs as for AM reception.

NOTE: When operating this console as a Radio Receiver be sure that the motor switch on the record changer is in the OFF position.

RECORD CHANGER OPERATION:

To operate the record changer, turn the FM-AM-PH-TV knob so that PH faces indicator dot, leave the "OFF-ON" knob in the "ON" position and adjust volume and tone with the same knob as used in receiver operation.

TELEVISION RECEPTION:

To use the television receiver on this instrument it is IMPORTANT that the FM-AM-PH-TV knob be set in the position where TV faces indicator dot. If this is not observed the sound section of the television receiver will be inoperative. For instructions how to use television receiver read the separate instructions accompanying this instrument.

SERVICE AND ALIGNMENT INSTRUCTIONS

To remove the chassis from the console, it is first necessary to disconnect all plugs and sockets between the rear of the receiver chassis, the speaker, the television set and the record changer, respectively. Then remove the four knobs and the four screws holding the chassis to its mounting panel. (On Model 766 it will also be necessary to remove the wood screw holding the broadcast loop to the side of the cabinet.)

CAUTION: WHEN REMOVING THE CHANGER BE SURE TO PLACE IT IN A POSITION IN WHICH THE CHANGER MECHANISM WILL NOT BE DAMAGED.

ALIGNMENT:

Equipment Required: Modulated a-m, r-f signal generator; modulated f-m signal generator covering the range from 88 to 108 megacycles; vacuum tube voltmeter; output meter; insulated screw driver; radiation loop (1 turn of about 6" to 8" diameter of #12 or #14 wire connected across output of signal generator and placed parallel to receiver loop about 8" or 10" away); one .1 mfd 400 volt condenser; two 150 ohm resistors.

With the receiver removed from the cabinet, connect output meter, or vacuum tube voltmeter and signal generator as indicated in the alignment procedure chart and keeping the output of the generator as low as possible, proceed exactly in the sequence as shown on the chart.

Before aligning, close the variable condenser fully counter-clockwise (plates fully closed) and check that pointer coincides with the reference line on the dial.

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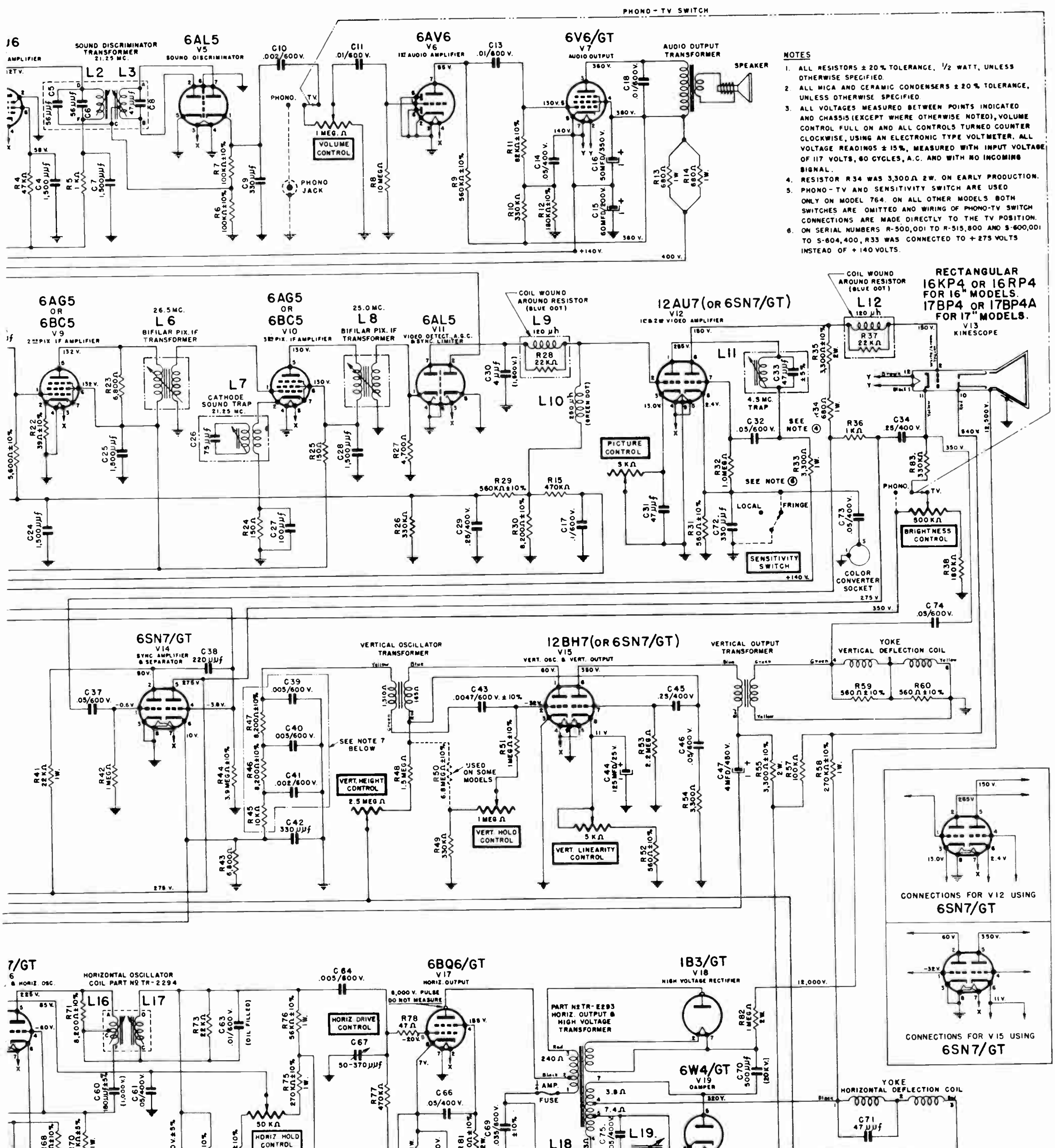
MODELS 752U, 753U, 755U, 764U, 766U, 769, Starting with R-500,001 and S-600,001

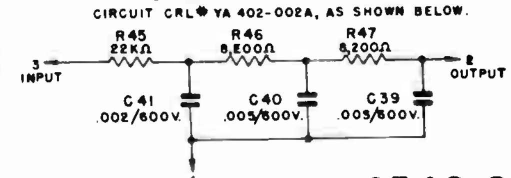
53U, 755U, 764U, 766U & 769
-500,001 & S-600,001



NOTES

1. ALL RESISTORS ± 20% TOLERANCE, 1/2 WATT, UNLESS OTHERWISE SPECIFIED.
2. ALL MICA AND CERAMIC CONDENSERS ± 20% TOLERANCE, UNLESS OTHERWISE SPECIFIED.
3. ALL VOLTAGES MEASURED BETWEEN POINTS INDICATED AND CHASSIS (EXCEPT WHERE OTHERWISE NOTED), VOLUME CONTROL FULL ON AND ALL CONTROLS TURNED COUNTER CLOCKWISE, USING AN ELECTRONIC TYPE VOLTMETER. ALL VOLTAGE READINGS ± 15%, MEASURED WITH INPUT VOLTAGE OF 117 VOLTS, 60 CYCLES, A.C. AND WITH NO INCOMING SIGNAL.
4. RESISTOR R34 WAS 3,300Ω 2W. ON EARLY PRODUCTION.
5. PHONO-TV AND SENSITIVITY SWITCH ARE USED ONLY ON MODEL 764. ON ALL OTHER MODELS BOTH SWITCHES ARE OMITTED AND WIRING OF PHONO-TV SWITCH CONNECTIONS ARE MADE DIRECTLY TO THE TV POSITION.
6. ON SERIAL NUMBERS R-500,001 TO R-515,800 AND S-600,001 TO S-604,400, R33 WAS CONNECTED TO +275 VOLTS INSTEAD OF +140 VOLTS.

NOTE 7: ON SOME MODELS THE VERTICAL INTEGRATOR NETWORK WITHIN DOTTED AREA IS REPLACED BY A PRINTED CIRCUIT CRL# YA 402-002A, AS SHOWN BELOW.



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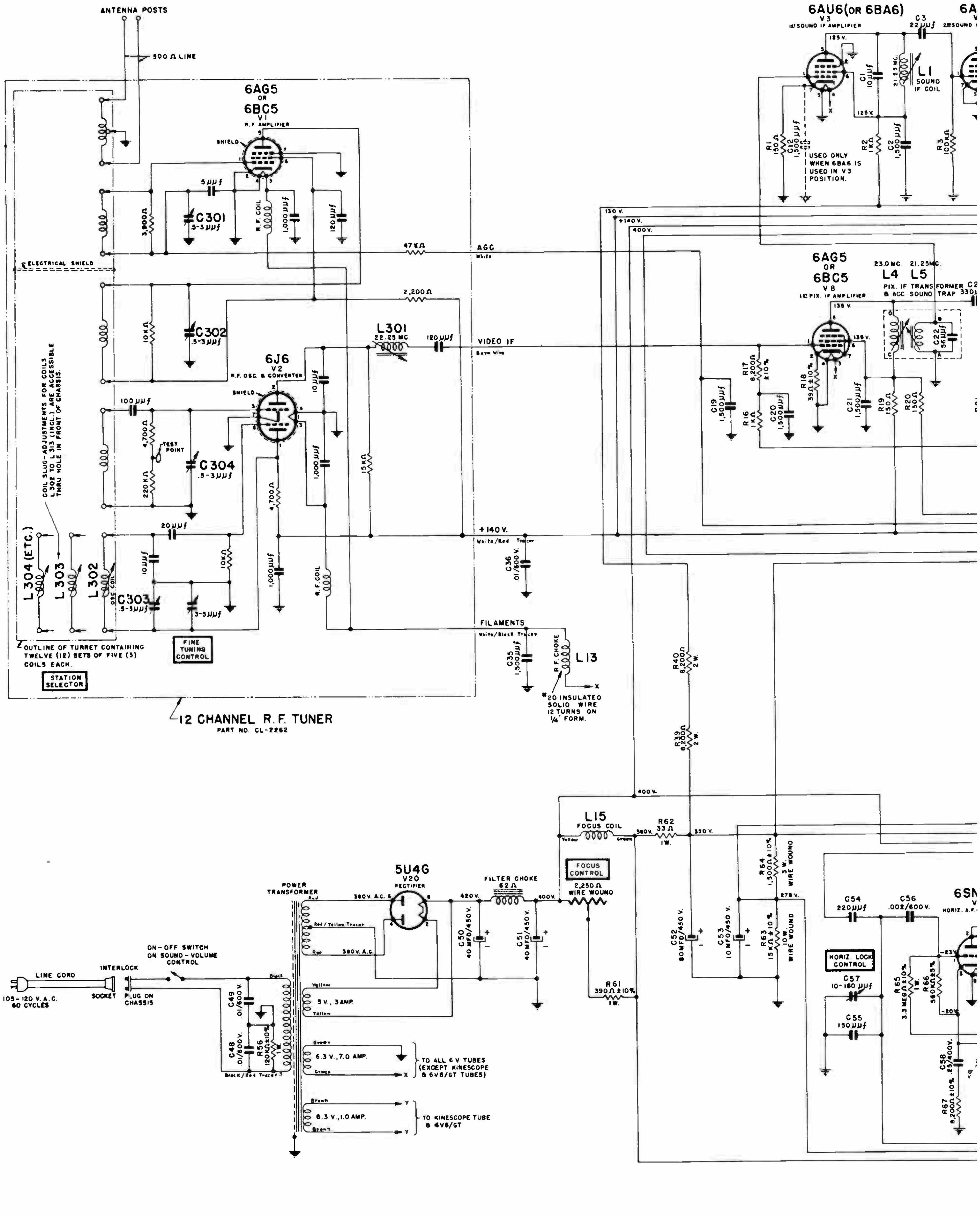
OLYMPIC TV MODELS 752U, 7

SERIAL NUMBERS STARTING WITH



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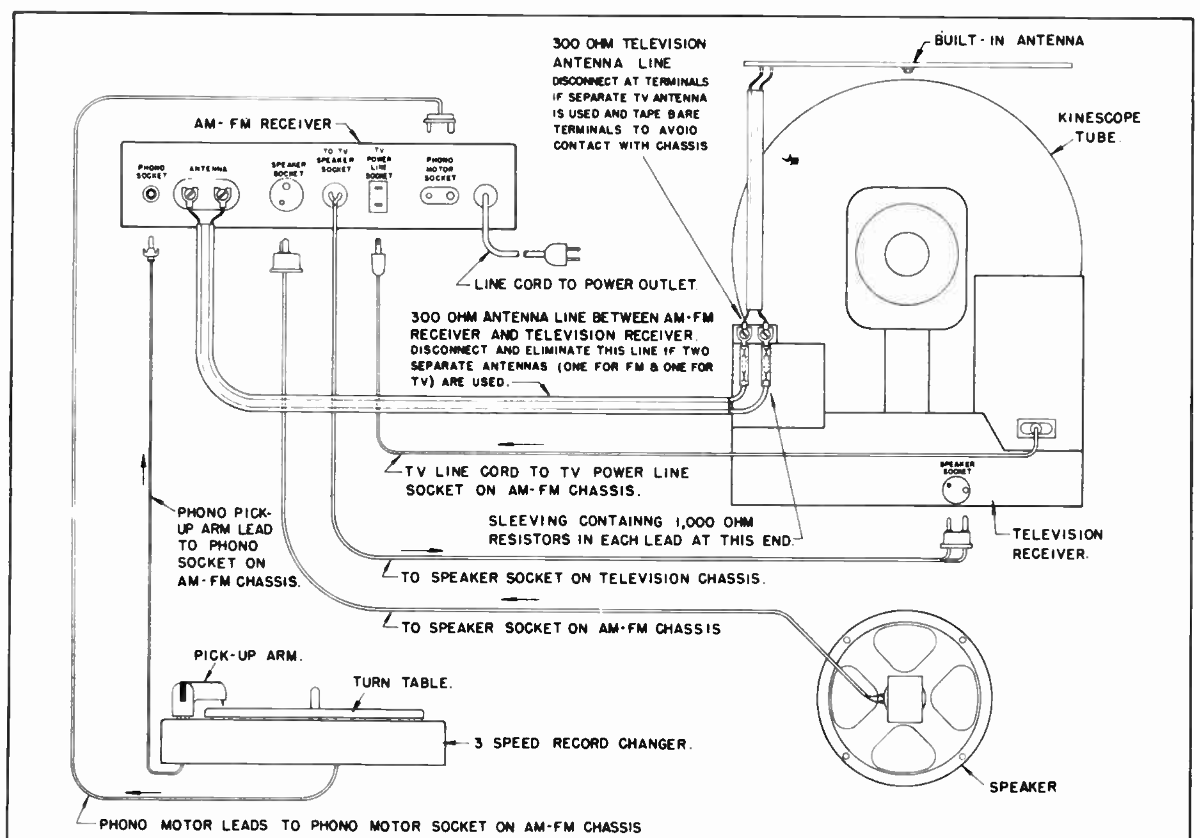
ALIGNMENT PROCEDURE CHART

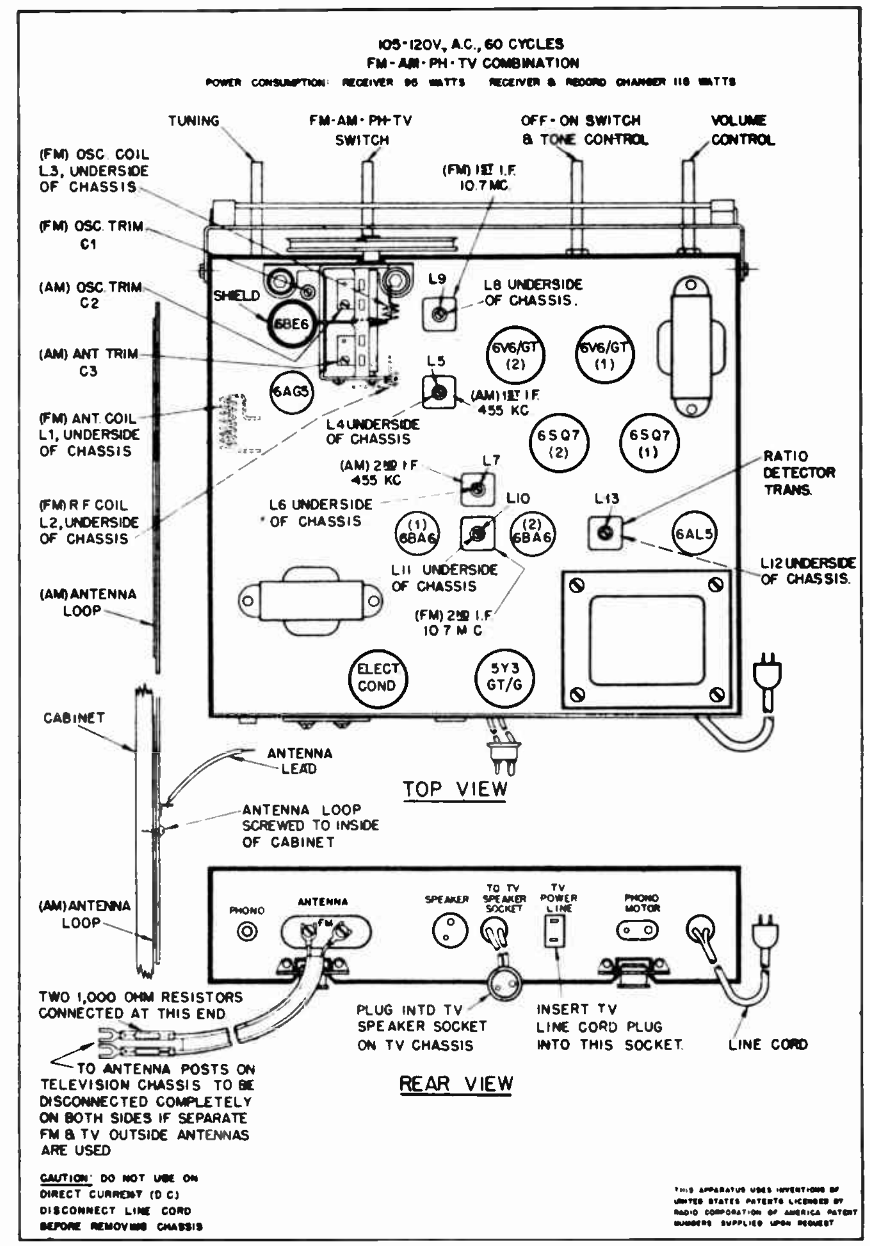
STEP	SET BAND SWITCH ON-	CONNECT HIGH SIDE OF SIGNAL GENERATOR TO-	SET SIGNAL GENERATOR TO-	TURN POINTER TO-	READ OUTPUT ON-	ADJUST THE FOLLOWING- (KEEP SIGNAL FROM SIGNAL GENERATOR AS LOW AS POSSIBLE).
BEFORE ALIGNING CLOSE VARIABLE CONDENSER FULLY COUNTER-CLOCKWISE (PLATES FULLY CLOSED) AND ADJUST POINTER TD COINCIDE WITH THE BEGINNING DF DIAL SCALE.						
1	F.M.	PIN 1 OF 6BA6 (2) TUBE FOR .1 VOLT SIGNAL.	10.7 MC. UNMODULATED SIGNAL.	EXTREME RIGHT HAND POSITION (CONDENSER PLATES FULLY OPEN)	VACUUM TUBE VOLTMETER ACROSS 10,000 OHM RESISTOR (SEE "A" ON CIRCUIT DIAGRAM).	L12 (RATIO DETECTOR PRIMARY, SLUG ON UNDERSIDE OF CHASSIS) FOR MAXIMUM READING.
2	F.M.				VACUUM TUBE VOLTMETER ACROSS "B" ON CIRCUIT DIAGRAM.	L13 (RATIO DETECTOR SECONDARY; SLUG ON TOP OF CHASSIS) FOR ZERO READING.
3	F.M.	6BE6 THRU A TWO TURN LOOP AROUND TUBE ENVELOPE (LOOSELY COUPLED).			VACUUM TUBE VOLTMETER ACROSS 10,000 OHM RESISTOR (SEE "A" ON CIRCUIT DIAGRAM).	L8 (SLUG ON UNDERSIDE OF CHASSIS) L9 (SLUG ON TDP OF CHASSIS) FOR MAXIMUM READING.
4	F.M.					L10 (SLUG ON TOP OF CHASSIS) L11 (SLUG ON UNDERSIDE OF CHASSIS) FOR MAXIMUM READING.
5	A.M.	R.F. SECTION OF VARIABLE CONDENSER OR PIN 7 OF THE 6BE6 TUBE IN SERIES WITH A .1MFD., 400 VOLT CONDENSER.	455 KC.		OUTPUT METER ACROSS SPEAKER VDICE-COIL.	L4 (SLUG ON UNDERSIDE OF CHASSIS) L5 (SLUG ON TDP OF CHASSIS) FOR MAXIMUM READING.
6	A.M.					L6 (SLUG ON UNDERSIDE OF CHASSIS) L7 (SLUG ON TOP OF CHASSIS) FOR MAXIMUM READING.
7	F.M.	REPEAT STEPS 3 AND 4.				
8	F.M.	CONNECT F.M. SIGNAL GENERATOR TO DIPOLE TERMINAL POSTS USING A 150 OHM RESISTOR IN SERIES WITH THE HIGH SIDE AND A 150 OHM RESISTOR IN SERIES WITH THE GROUND SIDE OF SIGNAL GENERATOR. USE 30% FREQUENCY MODULATED SIGNAL.	88 MC	88 MC. ON DIAL.	DUTPUT METER ACROSS SPEAKER VOICE-COIL.	*L3 (OSCILLATOR COIL, ON UNDERSIDE OF CHASSIS ADJUST BY COMPRESSING OR EXPANDING COIL SLIGHTLY FOR MAXIMUM OUTPUT COINCIDING WITH 88 MC. ON DIAL.
9	F.M.		108 MC.	108 MC. ON DIAL.		C1 (OSCILLATOR TRIMMER) FOR MAXIMUM OUTPUT.
10	F.M.		REPEAT STEPS 8 AND 9 UNTIL OSCILLATOR RANGE IS 88MC TO 108MC. ON DIAL			
11	F.M.		98 MC.	RESONANCE APPROXIMATELY 98 MC ON DIAL.	OUTPUT METER ACROSS SPEAKER VOICE-COIL.	*L1 *L2, (ON UNDERSIDE OF CHASSIS) ADJUST BY COMPRESSING OR EXPANDING COIL SLIGHTLY FOR MAXIMUM OUTPUT.
12	A.M.	USE RADIATED SIGNAL. (CONNECT BOTH SIDES OF SIGNAL GENERATOR TO RADIATION LOOP).	1500 KC	1500 KC ON DIAL		C2 (OSCILLATOR TRIMMER) FOR MAXIMUM OUTPUT
✦ 13	A.M.					C3 (ANTENNA TRIMMER) FOR MAXIMUM OUTPUT.
14	A.M.		600 KC.	RESONANCE APPROXIMATELY 600 KC. ON DIAL		CHECK THAT 600 KC. RESONANCE CORRESPONDS WITH 600 KC. POINT ON DIAL.
* THESE ADJUSTMENTS ARE PERMANENTLY SET AT THE FACTORY AND NORMALLY DO NOT REQUIRE READJUSTMENT UNLESS THEY ARE DISPLACED OR REPLACED IN SERVICING.						

✦ On Model 766 Repeat Step 13 with Chassis and Loop Mounted in Cabinet

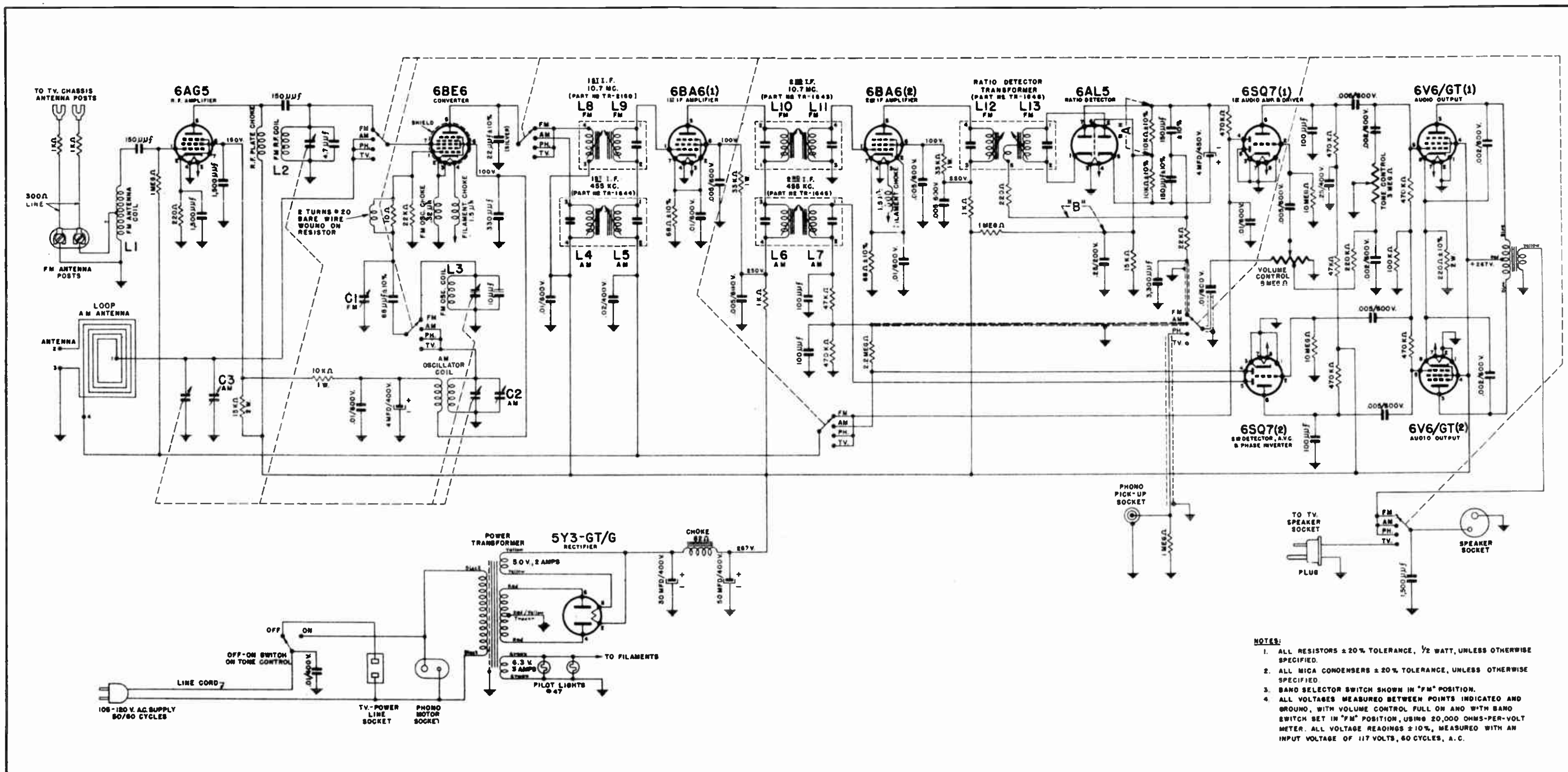
BLOCK DIAGRAM OF INTERCONNECTIONS



TUBE & TRIMMER LAYOUT



World Radio History



REPLACEMENT PARTS LIST

Part No	Description
BU 187	Pilot Light Bulb—6.3 V.
CK 1127	Choke—R. F. Plate Choke
CK 1058	Choke—1.5 Microhenry Filament Choke
CK 1346	Choke—Filter Choke
CK 1452	Choke—F. M. Oscillator Cathode Choke
CL 1466	Coil—Oscillator Coil (B. C.)
CL 2178	Coil—Antenna Coil (FM)
CL 2179	Coil—R. F. & Oscillator Coil (FM)
CO 1056	Condenser—4 MFD. — 450 W. V. Elect. Condenser
CO 1083	Condenser—4.7 MMF ± 20% Fixed Condenser
CO 2350	Condenser—30/400 W.V. + 50/400 W.V. + 4/400 Elect. Cond.
CT 1036-1	Trimmer—1-8 MMF. Oscillator Trimmer (FM)
CV 2165	Condenser—2 Gang Var. Condenser (AM/FM)
DL 2187	Dial—Glass Dial Scale "OLYMPIC"
KN 422	Knob—Walnut "Volume" Knob
KN 423	Knob—Walnut "Off-On Tone" Knob
KN 425	Knob-Walnut "Tuning" Knob

Part No	Description
KN 2154	Knob—Walnut "FM-AM-PH-TV" Knob
LP 2176	Loop (Used on Model 769)
LP 2356	Loop (Used on Model 766)
PO 1011	Pointer
PT 567	Control—2 Meg. Tapped Vol. Control
PT 2160	Control—3 Meg. Tone Control (SPDT Switch)
RX 2181-1	Changer—Auto. Record Changer (Webster 100)
SH 238	Shaft—Drive Shaft
SP 191	Spring—Lock Spring (For Dial Drive)
SP 218	Spring—7/8" Lg. Pointer Drive Spring
SW 2159	Switch—Band Switch
TR 1643	Transformer—2nd FM I. F. Transformer
TR 1644	Transformer—AM I. F. Transformer
TR 1645	Transformer—AM I. F. Transformer
TR 1646	Transformer—Ratio Detector Transformer
TR 2155	Transformer—Power Transformer
TR 2156	Transformer—Output Transformer
TR 2180	Transformer—1st FM I. F. Transformer

MODELS 766, 769, DX-621

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LIST OF ILLUSTRATIONS

Figure 1

Model 2801-TV

Model 2801-TV, shown in figure 1, is a console television — AM-FM radio — phonograph combination. It employs 23 tubes plus 4 rectifiers and a 16-inch rectangular picture tube using electro-magnetic deflection.

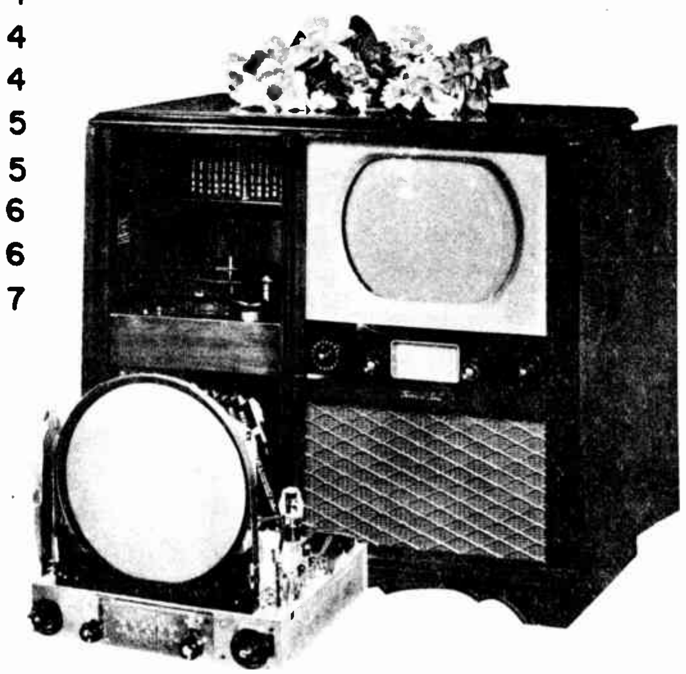

Figure 2

Model 2801A-TV

Model 2801A-TV, shown in Figure 2, is the same as the 2801-TV with the exception that it employs a 16-inch round picture tube.

Cabinet styling is in walnut, mohogany, blonde oak, and maple.

GENERAL INFORMATION

Two chassis comprise the overall chassis assembly: the television chassis and the AM-FM chassis. The audio amplifier and power supply contained in the television chassis, serves both chassis.

Both models feature the Webster Model 100-11 three-speed automatic record changer. Service Instructions pertaining to this unit will accompany this service manual.

SPECIFICATIONS

OVERALL DIMENSIONS:

Height	38¼"
Width	40⅛"
Depth	23⅜"
Shipping Weight	250 Lbs.

TUNING FREQUENCY RANGE:

Television	All 12 channels currently alloted to the Pacific Coast Area; channels 2 to 13 inclusive (54 to 88 MC and 176 to 216 MC).
FM	88 to 108 MC
AM	540 to 1620 KC

INTERMEDIATE FREQUENCIES:

Television Sound Carrier	20.5 MC
Television Picture Carrier	25.0 MC
Frequency Modulation	10.7 MC
Standard Broadcast	455 KC

ELECTRICAL RATING:

Line Voltage	110-120 volts
Power Consumption @ 115 volts	
Radio — Phono	98 watts
Television	210 watts

ELECTRICAL POWER OUTPUT: (Maximum)

Television	2.0 watts
FM	3.0 watts
AM	2.5 watts
Phonograph	2.5 watts

LOUDSPEAKER:

Type	Permanent Magnet
Outside Cone Diameter	12"
Voice Coil Impedance	3.2 ohms @ 400 C.P.S.
Magnet Rating	6.8 Oz. Alnico V

RECEIVING ANTENNA INPUT IMPEDANCE:
300 ohms balanced

VIDEO RESPONSE:
3.5 MC band width

FOCUS:
Electro-Magnetic

SWEEP DEFLECTION:
Electro-Magnetic (70 degree)

SCANNING:
525 lines interlaced

HORIZONTAL SCANNING FREQUENCY:
15,750 C.P.S.

VERTICAL SCANNING FREQUENCY:
60 C.P.S.

PICTURE REPETITION RATE:
30 C.P.S.

PICTURE SIZE:

	Rectangular	Round
Width	13 27/32"	14½"
Height	10 7/16"	11"

TUBE COMPLEMENT:

Television

No.	Tube	Function
V-1	6AU6	Sound I-F Driver
V-2	6AL5	Television Ratio Detector
V-3	6AV6	1st Audio Amplifier
V-4	6V6-GT	Power Amplifier
V-5	6AU6	1st Pix I-F Amplifier
V-6	6AU6	2nd Pix I-F Amplifier
V-7	6AU6	3rd Pix I-F Amplifier
V-8	6AL5	Pix Detector, A.G.C.
V-9	12AU7	1st & 2nd Video Amplifier
V-10	12AU7	Sync. Amplifier, Sync. Separator & D.C. Restorer
V-11	6AL5	A.F.C. Discriminator
V-12	6SN7-GT	Horizontal Oscillator
V-13	6J5	Horizontal Discharge
V-14	6CD6-G	Horizontal Output
V-15	1B3-GT	High Voltage Rectifier
V-16	1B3-GT	High Voltage Rectifier
V-17	6SN7-GT	Vertical Oscillator & Discharge
V-18	6S4	Vertical Output
V-19	6U4-GT	Damper
V-20	5U4-G	Low Voltage Rectifier
V-21	16TP4	16" Rectangular Picture Tube (2801-TV)
V-21	16GP4	16" Round Picture Tube (2801A-TV)
*V-22	6AG5	R-F Amplifier
*V-23	6J6	R-F Oscillator, Converter

AM—FM RADIO

No.	Tube	Function
V-24	6BE6	AM Converter, FM Oscillator
V-25	6BA6	I-F Amplifier
V-26	6AU6	FM Driver, AM Detector
V-27	6AL5	FM Ratio Detector
V-28	12AT7	FM R-F Converter

*V-22 and V-23 are contained in the television R-F tuner.

When replacing tubes, refer to tube layout label on rear of cabinet.

INSTALLATION INSTRUCTIONS

The usual installation adjustments may be accomplished quite conveniently without removing the chassis or the cabinet back.

CAUTION!!

The metal shell of the picture tube contained in Model 2801A-TV carries the second anode voltage which is in excess of 13,000 volts. Unless it is absolutely necessary, it is recommended that the high voltage lead be disconnected and temporarily insulated during alignment or servicing procedure. WHEN THE TUBE IS CONNECTED, MAKE CERTAIN THAT ANY PORTION OF THE BODY, METAL OBJECTS, TEST LEADS, ETC., ARE AT LEAST ONE INCH AWAY FROM THE SHELL AT ALL TIMES.

When disconnecting the high voltage clip, remove the remaining charge by shorting it to the chassis.

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PICTURE TUBE ADJUSTMENTS:

The following picture tube adjustments should be checked upon installation or whenever the receiver is serviced. *(See Figure 3.)*

Focus Coil, Horizontal and Vertical Centering and Ion Trap Adjustments:

1. Set Brightness Control at its approximate mid-point and slowly adjust ion trap backward and forward and rotate around neck of tube until maximum brightness is noted. *MAKE CERTAIN BRIGHTNESS CONTROL IS NOT SET BEYOND MID-POSITION UNTIL ION TRAP IS PROPERLY ADJUSTED. CONTRARY PROCEDURE MAY RESULT IN SERIOUS DAMAGE TO PICTURE TUBE.*
2. Adjust Focus Control for proper picture focus.
3. Adjust Focus Coil centering screws until raster is centered vertically and horizontally.
4. Recheck ion trap adjustment.

If, for any reason, it becomes necessary to remove the focus coil, it must be replaced so that the center hole is mechanically centered with respect to the neck of the picture tube. Then adjust it backward and forward so that picture focus is reached with the focus control at its approximate mid-point. Following this, center the raster as previously outlined.

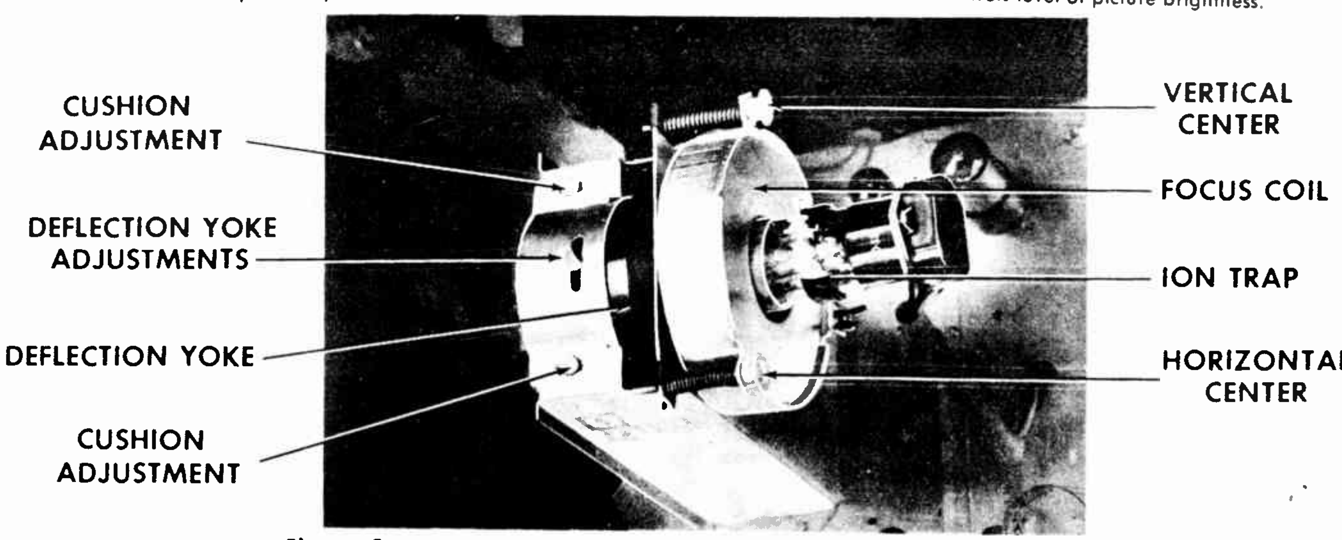

Figure 3
Picture Tube Yoke Assembly

Deflection Yoke Adjustment:

1. Loosen deflection yoke thumb screw adjustment and adjust until the raster is square with the picture tube frame.
2. Tighten screw.

INSTRUCTIONS FOR REPLACING PICTURE TUBE:

The round (2801A-TV) and rectangular (2801-TV) picture tubes employ different mounting methods, consequently, the manner of replacement varies:

RECTANGULAR (2801-TV)

1. Loosen tube protecting strap bolts.
2. Remove tube socket, ion trap and polyvinyl sleeve.
3. Disconnect high voltage lead.
4. Carefully slide tube forward out of yoke assembly and place it on a bench face down. A soft cloth or felt should be used to protect the face of the tube.
5. Replace tube by reversing the foregoing procedure.

ROUND (2801A-TV)

1. Disconnect picture tube socket.
2. Remove ion trap and polyvinyl sleeve.
3. Remove four screws securing picture tube cradle to chassis.
4. Loosen tube protecting strap.
5. Disconnect high voltage lead by sliding connecting clip downward on protecting strap.
6. Remove picture tube by sliding it forward out of yoke assembly. AVOID NECK OF TUBE STRIKING YOKE ASSEMBLY.
7. Place tube on bench face down. Tube face should be protected by a felt or soft cloth.
8. Replace tube by reversing the foregoing procedure.

CAUTION!!

USE GOGGLES OR A MASK AND GLOVES TO HANDLE TUBE. DO NOT SCRATCH, STRIKE OR EXERT MORE THAN MODERATE PRESSURE ON TUBE.

NOTE: It is suggested the picture tube plexiglas lens be cleaned with a soft, damp cloth or chamois whenever the chassis is removed from the cabinet.

NON-OPERATING CONTROLS AND ADJUSTMENTS:

CONTROL	ACTION
Focus	Adjust sharpness of raster lines.
Brightness	Controls level of picture brightness.
Vertical Hold	Pulls picture into vertical sync.
Height	Control top to bottom dimensions of raster.
Vertical Linearity	Controls relative proporations of upper, central and lower portions of raster.

ADJUSTMENT	ACTION
Horizontal Hold	Adjusts horizontal oscillator to pull picture into horizontal sync.
Horizontal Drive	Adjusts maximum raster width without crowding right side of raster.
Width	Adjusts width of raster.
Horizontal Linearity	Adjusts relative proporations of horizontal scan to central portions of raster.

For obvious reasons, it is preferable that these controls be adjusted while observing a station test pattern.

Prior to undertaking the following adjustments, the Focus, Brightness, Contrast and Fine Tuning Controls should be set at their normal operating position.

Height, Vertical Linearity and Vertical Hold Adjustments:

1. Set Vertical Hold Control to sync. picture vertically.
2. Adjust Height Control until pattern fills frame from top to bottom.
3. Adjust Vertical Linearity Control until top, central and lower portions of the picture are symmetrical.

Width, Horizontal Linearity, Horizontal Hold and Horizontal Drive Adjustments:

1. Set Horizontal Hold Adjustment to sync. picture horizontally.
2. Momentarily remove signal by switching off channel then back.
3. Repeat Step 1 if picture does not hold sync.
4. Repeat Steps 1, 2 and 3 until picture remains in constant sync.
5. Turn Horizontal Linearity and Horizontal Drive Adjustments alternately until left, central and right portions of picture are in proportion.
6. Turn Width Adjustment until picture fills frame horizontally.
7. Recheck Steps 1, 2, 3 and 4.

FINAL INSTALLATION INSTRUCTIONS:

When the receiver is ready for actual operation in the customer's home the following should be observed.

1. If at all possible, the instrument should be located so that excessive light does not fall on the picture tube face and cause annoying reflections from the plexiglas mask.
2. To insure adequate ventilation, place instrument at least two inches from the wall.
3. Extreme care should be taken in the type, location and orientation of the antenna so that the best possible reception is obtained. All Packard-Bell television receivers are equipped with Packard-Bell's exclusive "Teletenna." This built-in antenna system will deliver satisfactory results in areas where a strong signal prevails. In locations, however, where reflections are usually encountered and the signal is down, an outside antenna should be installed.

SPECIAL SERVICING INFORMATION TELEVISION

BLOCK CIRCUIT DIAGRAM (TELEVISION):

The block circuit diagram as shown in Figure 15 will enable service personnel to follow the signal through the receiver in a logival manner, thereby assisting in isolating circuit deficiencies.

CRITICAL LEAD DRESS:

In the event parts are replaced, refer to Figure 20 for proper lead dress. Particular attention should be accorded the following:

1. Do not displace components in the Pix I-F Circuit. Should it become necessary to replace parts in this section of the circuit it is strongly advised that alignment be checked following the changes.
2. Dress high voltage leads up and away from the chassis.
3. If replacement of parts in the high voltage circuit becomes necessary, solder joints must be rounded and free from sharp corners.

PRODUCTION MODIFICATIONS:

The following production modifications, effected after early production runs, do not appear on the schematic diagram.

1. Two changes should be noted on all 2801A-TV receivers:
   a. C-50 (.01 Mfd. 600 volt capacitor) becomes a .003 Mfd. 600 volt capacitor.
   b. Add 200 Mmf. ceramic, 2500 volt capacitor in parallel with C-49.
2. A 470 ohm, 2 watt carbon resistor was added in parallel with L-15, Width Coil.
3. In later production runs, the above was changed to a 500 ohm, 5 watt wire wound resistor.

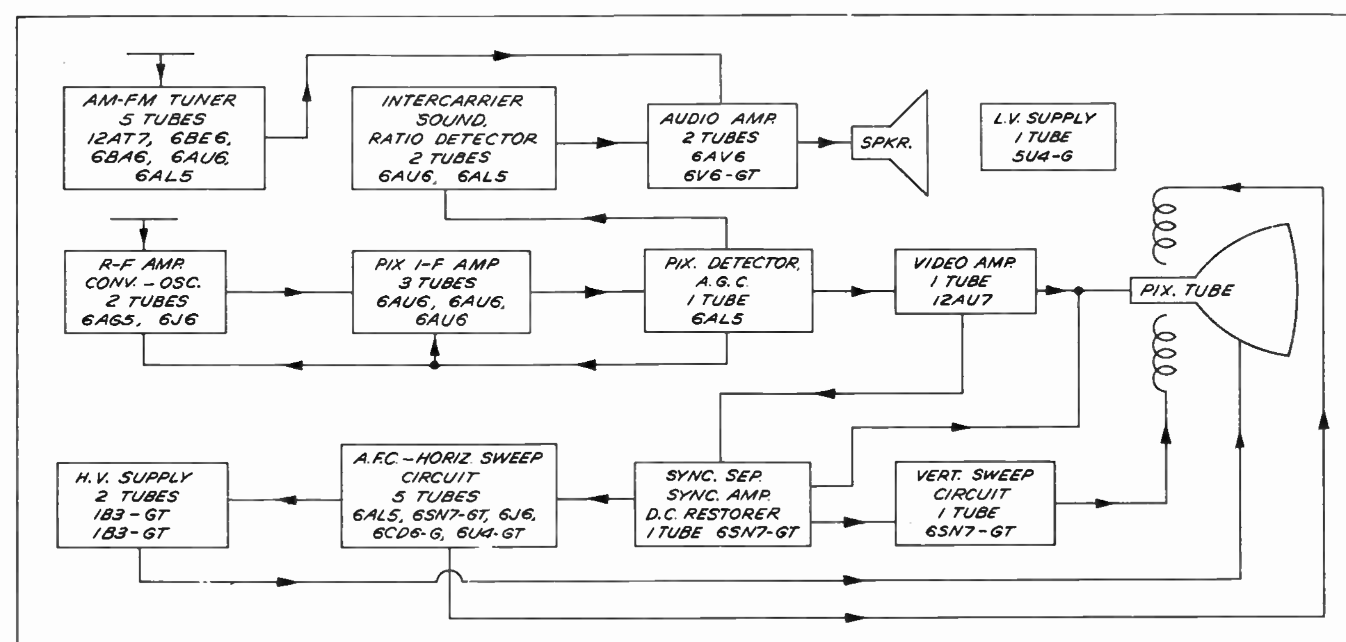

Figure 15
Block Circuit Diagram

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SOCKET VOLTAGES — TELEVISION:

The socket voltages as shown in Figure 16 were measured under the following conditions:

1. Selector Switch in TV position.
2. No Signal.
3. Brightness and Contrast Controls minimum.
4. All voltages shown are positive D.C. and were measured from socket contacts to chassis unless otherwise noted.
5. Voltage readings are subject to a 10% variation.
6. ~~D.C. voltages measured with a vacuum tube voltmeter.~~
7. Voltage readings on the following tubes are subject to a wide variation since they are dependent on the setting of closely related controls.

V-17 (6SN7-GT)	. .	Vertical Hold
V-9 (12AU7)	. . .	Contrast
V-17 (6SN7-GT)	. .	Height
V-18 (6S4)	. . .	Vertical Linearity

8. A.C. Voltages measured with a 1,000 ohms per volt A.C. meter.
9. The voltages shown on V-1 (6AU6) and V-4 (6V6-GT) are readings taken from socket contacts to chassis. However, since V-4 functions as a voltage divider as well as a power amplifier, the cathode and filament are tied directly to the B plus. Hence, in order to measure the true operating voltages of these tubes, connect the common terminal of the voltmeter to the cathode pin of V-4.

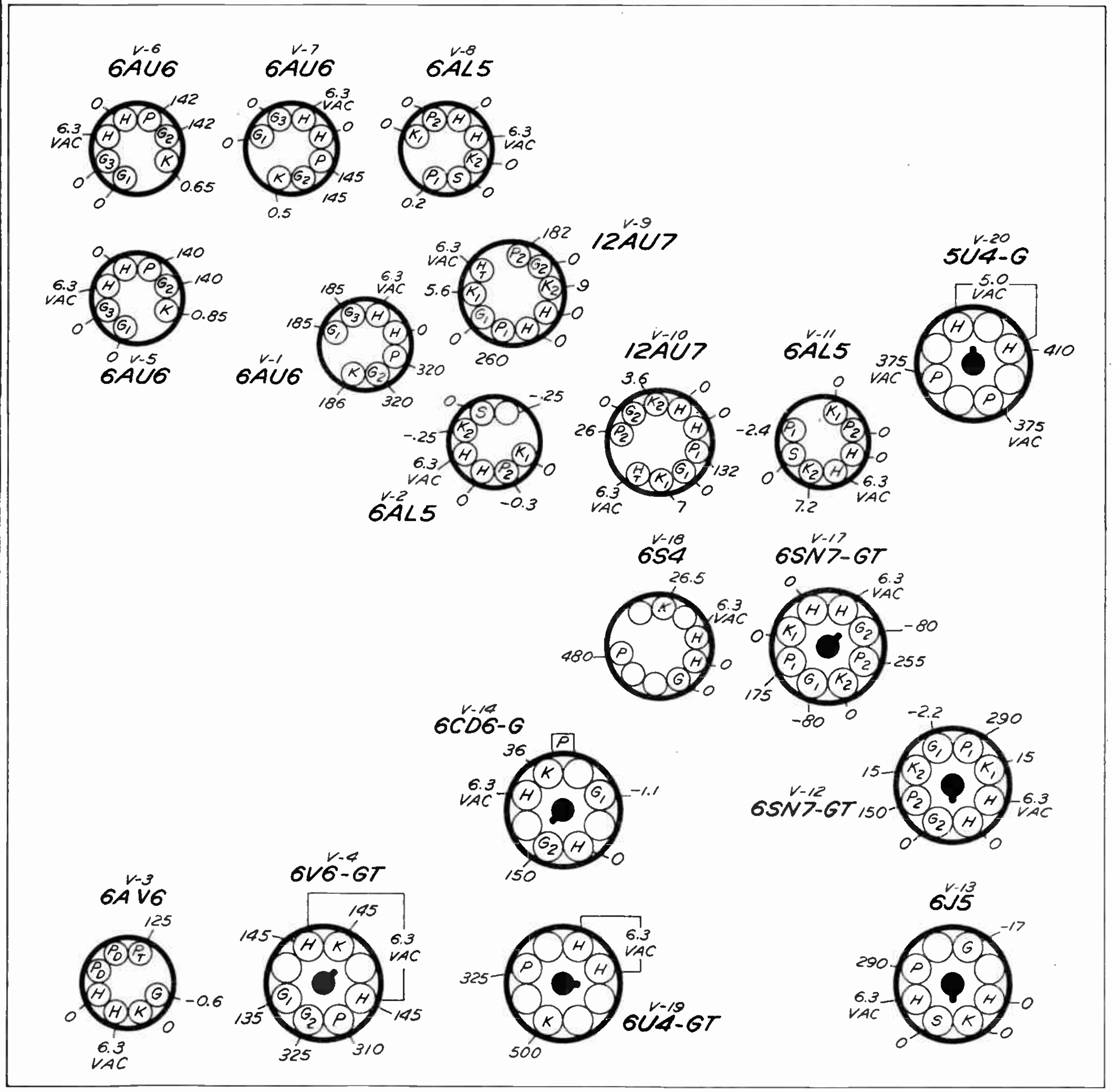

Figure 16
Socket Voltages—Television

HIGH VOLTAGF WARNING

The Pix tube second anode voltage is in excess of 13 KV. Only personnel familiar with high voltage handling procedure should undertake servicing the chassis once it has been removed from the cabinet. DO NOT, AT ANY TIME, WORK ON THE CHASSIS WITH THE RECEIVER CURRENT ON AND THE HIGH VOLTAGE COVER REMOVED.

ISOLATING TROUBLE BY PICTURE TUBE OBSERVATION:

Very often, circuit deficiencies may be isolated by observing certain visible characteristics present on the picture tube. The following are hypothetical cases of trouble and the probable source.

No Raster on Picture Tube:

1. Incorrect adjustment of ion trap magnet. (See "*Picture Tube Adjustments.*")
2. V-14, V-15, V-16 defective; check voltages and associated circuit components.
3. No high voltage; check high voltage winding of T-3.
4. V-12, V-13 defective; check voltages and associated circuit components.
5. V-19 defective; check voltages and associated circuit components.
6. Defective picture tube or picture tube socket.

Sound and Raster but no Picture:

1. Open video peaking coils.

Picture Stable but Poor Resolution:

1. V-8, V-9, V-10 defective; check voltages and associated circuit components.
2. Check Focus Control for proper adjustment.
3. R-F or I-F circuits improperly aligned.

Picture Jitter:

1. If regular sections of the left of picture are displaced, V-14 may be defective: check voltages.
2. Check for loose connections or noise.

Weak Raster:

1. Low B plus or line voltage.
2. V-14, V-15, V-16 defective; check voltages.
3. Check filter capacitors. Check value of R-74, R-75.

Picture Will Not Hold Horizontal Sync:

1. V-11 defective; check voltages and associated circuit components.
2. L-12 improperly aligned. (See "*Non-Operating Control Adjustments.*")
3. L-12 defective.

Poor Horizontal Linearity:

1. Horizontal Linearity Control improperly adjusted.
2. T-4 defective.
3. V-14, V-19 defective; check voltages.

Poor Vertical Linearity:

1. Incorrect adjustment of R-70 (Vertical Linearity Control.)
2. T-4 defective.

No Horizontal Deflection:

1. Horizontal Deflection Coils open (L-16).

No Vertical Deflection:

1. V-18 inoperative; check voltages and associated circuit components.
2. Vertical Deflection Coils open (L-13).

Non-Symmetrical Raster:

1. Check Focus Coil and Ion Trap adjustments.
2. Defective yoke assembly.
3. Check Vertical and Horizontal Linearity adjustments.

Picture but no Sound:

1. V-1, V-2, V-3, V-4 defective; check voltages and associated circuit components.
2. T-1 or speaker voice coil open.

TELEVISION ALIGNMENT PROCEDURE

GENERAL INSTRUCTIONS:

Television alignment is divided into five sections.

1. Picture I-F Alignment (Preliminary).
2. Inter-Carrier Sound and Ratio Detector Alignment.
3. Picture I-F Alignment (Final).
4. R-F Oscillator Alignment.
5. R-F Tuner Alignment — Oscillator, Converter and R-F Amplifier.

In the event complete alignment is necessary, it should be done in the foregoing order.

Location of trimmers and test points called out in the step by step alignment instructions that follow are shown in Figures 19 & 20. They are also shown in the schematic diagram.

Alignment of the 4.5 MC trap at the input of the video amplifier requires an R-F vacuum tube voltmeter. If such is not available, a Germanium *Diode Detector (Crystal)* may be connected in series with the positive probe of a conventional D.C. vacuum tube voltmeter. This type crystal is available at all radio supply houses at a nominal cost.

In several instances, alignment instructions call for a "loose coupling" to the converter or R-F oscillator tube by a marker or sweep generator. This is accomplished by wrapping several turns of fairly heavy wire (#14 or #16 insulated copper) around the glass envelope of the tube and connecting the generators to one end.

The service technician must bear in mind that the alignment as herein outlined is somewhat similar to the original factory alignment which is done with the receiver almost completely out of adjustment. Generally speaking, such a condition would rarely be encountered in the field. Field adjustments are usually confined to "touch-up" adjustments.

This is particlarly true in the case of the picture I-F alignment. It will be noted in the instructions that follow, that the picture I-F alignment is divided into two sections: one (preliminary) utilizes the conventional "meter alignment"; the other (final) an oscilloscope alignment. The meter alignment, principally because of its speed advantages, is used where the circuit is completely out of adjustment. It brings the I-F response curve reasonably close to its desired proportions. It cannot, however, as experience has proven, deliver the proper curve with the required accuracy (See Figure 17.) Thus, to attain the desired curve, it is necessary to use an oscilloscope for final detailed adjustments.

Normally, the service technician will find that oscilloscope alignment will prove sufficient where picture I-F alignment is indicated. In any case, it is strongly recommended that the I-F response curve be carefully analyzed before proceeding with adjustments of any nature.

R-F FREQUENCY RANGES:

Channel Number	Channel Freq. MC	Pix Carrier Freq. MC	Sound Carrier Freq. MC	Receiver R-F Osc. Freq. MC
2	54-60	55.25	59.75	80.25
3	60-66	61.25	65.75	86.25
4	66-72	67.25	71.75	92.25
5	76-82	77.25	81.75	102.25
6	82-88	83.25	87.75	108.25
7	174-180	175.25	179.75	200.25
8	180-186	181.25	185.75	206.25
9	186-192	187.25	191.75	212.25
10	192-198	193.25	197.75	218.25
11	198-204	199.25	203.75	224.25
12	204-210	205.25	209.75	230.25
13	210-216	211.25	215.75	236.25

1. PICTURE I-F ALIGNMENT (PRELIMINARY):

a. Connect marker generator to antenna terminals. Set VTVM to minus 3 volt scale and connect to "Point D" and ground.

b. Set marker generator to 21.8 MC and adjust S-5 to 21.8 MC observing VTVM for maximum output. It may be necessary to set the marker generator output at maximum in order to detect any reading on the VTVM. However, once it is evident that the correct signal is present, reduce the output accordingly.

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c. Set marker generator to 24.0 MC and, following the procedure outlined in the preceeding step, adjust S-20 1st Pix I-F.

d. Set marker generator to 23.0 MC and adjust S-21, 2nd Pix I-F, as above.

e. Set marker generator to 21.8 MC and adjust S-22, 3rd Pix I-F, as above.

2. INTER-CARRIER SOUND, RATIO DETECTOR AND 4.5 MC TRAP ALIGNMENT:

a. Connect marker generator to "Point D" and ground and set to 4.5 MC (exact) maximum output.

b. Connect R-F vacuum tube voltmeter to "Point E" and ground. If such a meter is not available, connect Germanium Diode Detector (Crystal) in series with positive probe of D.C. vacuum tube voltmeter. Connect negative probe to ground.

c. Adjust S-23 for minimum reading on VTVM.

d. Connect VTVM to "Point A" and ground.

e. Adjust S-1, Sound I-F Driver, to 4.5 MC observing VTVM for maximum output.

f. Adjust S-2, Ratio Detector Primary, to 4.5 MC, observing VTVM for maximum output.

g. Connect VTVM to "Points A & B" (negative probe to "Point A").

h. Adjust S-3, Ratio Detector Secondary to zero, between positive and negative peaks.

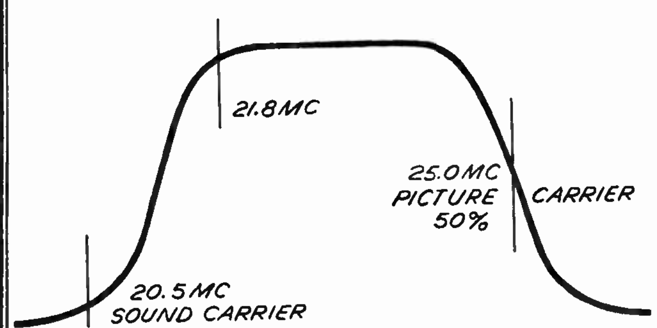

Figure 17
I-F Response Curve

3. PICTURE I-F ALIGNMENT (FINAL):

a. Remove converter tube shield and loosely couple sweep generator to converter tube. Connect marker generator to antenna terminals. Connect oscilloscope to "Point D".

*b. Set sweep generator to center picture I-F frequency, sweep 10 MC. Set marker generators to provide markers at 21.8 MC and 25.0 MC.

c. Observe and analyze the response curve obtained on the oscilloscope; compare it with the curve as shown in Figure 17. In all probability, the two will not be alike. This indicates that the Picture I-F adjustments must be retouched. Careful study of the curve and the position of the markers thereon will indicate which adjustments are in need of attention.

1. The curve should be essentially flat-topped.
2. The picture carrier, 25.0 MC, should be at the 50% response point.
3. The 21.8 MC marker should be at approximately 100% response.

The most important point to consider in making final I-F adjustments is to get the picture carrier at the 50% response point. If the picture carrier operates too high on the curve, there will be a loss of picture detail.

If the picture carrier operates too low on the curve, loss of low frequency video response will result and loss of picture brightness, of blanking and of sync will occur.

* *NOTE—To provide two markers simultaneously would require two marker generators. If two are not available, one is sufficient. Simply observe the position of the markers one at a time.*

SPECIAL PIX I-F ALIGNMENT FOR WEAK SIGNALS OR "FRINGE AREAS."

In order to gain added sensitivity, necessary in some "fringe areas", it is recommended that the Picture I-F be aligned as shown in Figure 18.

It will be noted that the band width has been reduced to approximately 2.5 MC. This reduction in band width will result in some loss of horizontal resolution, which with inadequate signal strength, would be lacking in any case. Consequently, the resultant loss in resolution is more than compensated by the increased sensitivity.

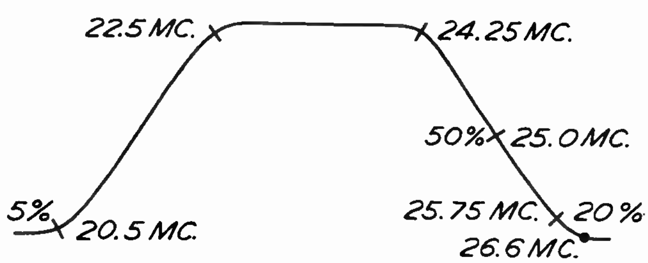

Figure 18
"Fringe Area"
I-F Response Curve

4. R-F OSCILLATOR ALIGNMENT:

It has been noted that the majority of service technicians prefer to align the channel oscillator slugs by ear and observing the picture quality thereby eliminating the use of a marker generator and a vacuum tube voltmeter. While it is true, this method is not 100% accurate, it has proven to be more than satisfactory.

Since this receiver employs inter-carrier sound, the oscillator slug is not tuned to the maximum sound level. It is tuned for maximum picture quality. The sound will be slightly below maximum at this point.

Make certain Fine Tuning Control is set at its approximate mid-point during these adjustments.

In the event it is desired, for example, if the receiver is being aligned at such a time when all stations are off the air, the following method which employs a heterodyne frequency meter may be used.

a. Turn Selector to channel 13 and set Fine Tuning Control at its approximate mid-point.

b. Loosely couple heterodyne frequency meter to the R-F oscillator tube. Set meter to 236.25 MC (receiver R-F oscillator frequency, channel 13).

c. Adjust channel 13 oscillator slug observing heterodyne frequency meter for zero beat.

d. Follow the above procedure on all channels, making certain the heterodyne frequency meter is set to the receiver R-F oscillator frequency corresponding to the channel being adjusted. (See *"R-F Frequency Ranges."*)

5. R-F TUNER ALIGNMENT (CONVERTER, OSCILLATOR & R-F AMPLIFIER):

With the exception of S-5, converter I-F trimmer, no field adjustments should be necessary where the R-F Tuner is concerned. However, in the remote event these trimmers, S-4A, S-4B, S-18 and S-19, should be found out of adjustment, the following is the correct procedure for readjusting them.

a. Oscillator Alignment:

Align the oscillator by adjusting S-19 in the manner prescribed for adjusting the channel oscillator slugs (.See *"R-F Oscillator Alignment — heterodyne frequency meter"*.)

b. R-F and Mixer Alignment:

1. Turn Selector to Channel 12 and set Fine Tuning Control at its approximate mid-point.
2. Connect oscilloscope to "Point C."
3. Feed sweep generator into antenna terminals sweeping channel 12.
4. Adjust S-4A, S-4B and S-18 alternately, observing oscilloscope for the following.
   a. Response curve should be essentially flat-topped.
   b. Check position of sound and picture carrier markers on all channels; they should not be more than 3 DB down from the top of the curve
   c. At 6 DB down, the band width should not be more than 11 MC.

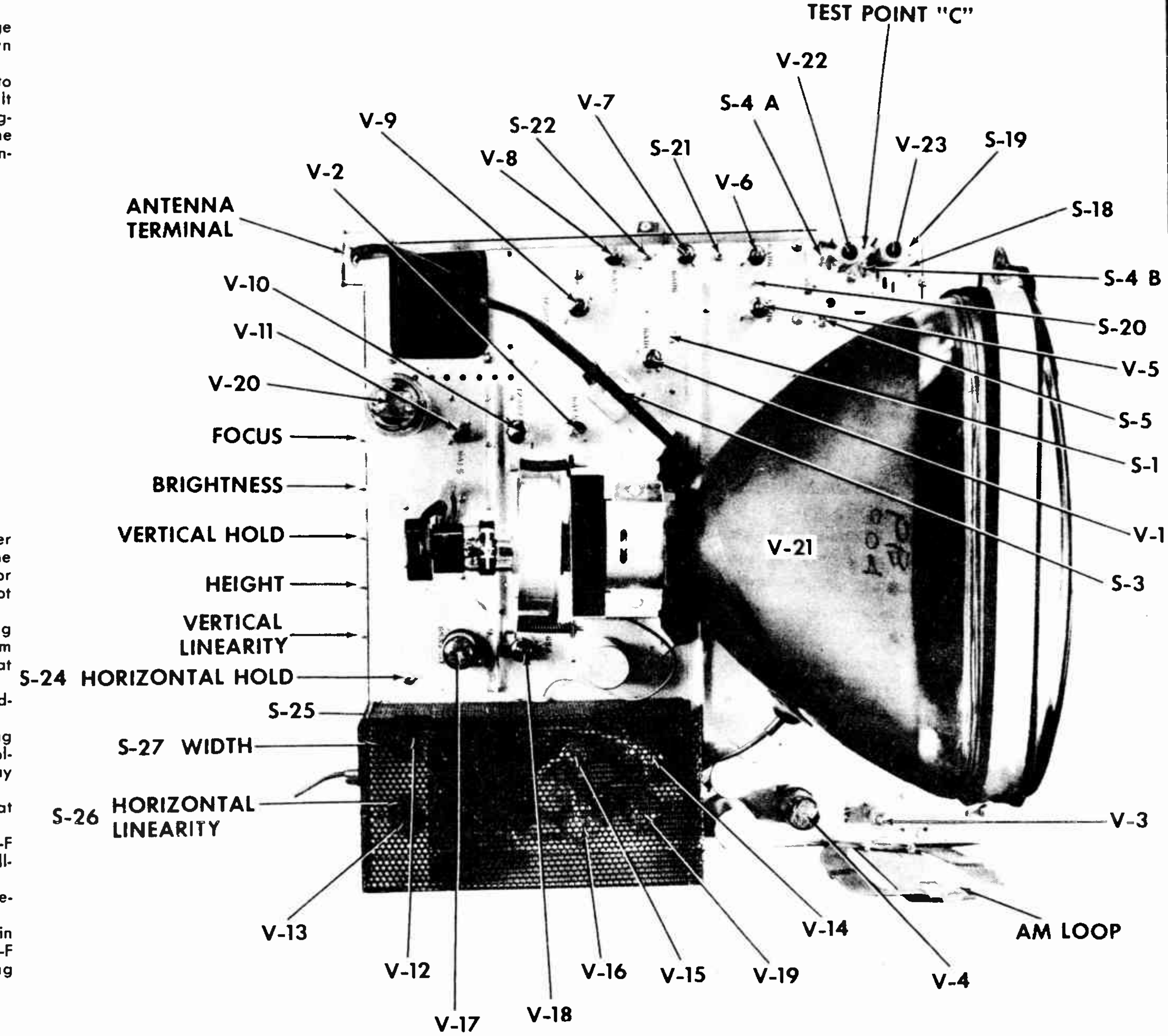

Figure 19
Top View of Television Chassis

SPECIAL SERVICING INFORMATION
AM — FM — PHONO

D. C. RESISTANCE MEASUREMENTS:

I-F COILS

1st FM I-F:	
Primary (Terminals 1 & 2)	.6 ohms
Secondary (Terminals 3 & 4)	1.2 ohms
2nd FM I-F:	
Primary (Terminals 1 & 2)	.47 ohms
Secondary (Terminals 3 & 4)	1.2 ohms
1st AM I-F:	
Primary (Terminals 1 & 2)	17.4 ohms
Secondary (Terminals 3 & 4)	16.2 ohms
2nd AM I-F:	
Primary (Terminals 1 & 2)	16.0 ohms
Secondary (Terminals 3 & 4)	14.7 ohms
Ratio Detector:	
Primary (Terminals A & E) .	2.0 ohms
Secondary (Terminals B & D)	.1 ohms
Each side to tertiary (Terminal F)	.05 ohms
Oscillator Coil AM:	
Start to Finish	8.0 ohms
Start to Tap	7.0 ohms

SOCKET VOLTAGES FM:

6BE6 (V-24) FM Oscillator

Pin	Element	Voltage
1	Grid 1	0
2	Cathode-Grid 5 . . .	0
3	Heater	6.3 VAC
4	Heater	0
5	Plate	95
6	Grids 2 & 4 (Screen) .	95
7	Grid 3	0

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6BA6 (V-25) I-F Amplifier

Pin	Element	Voltage
1	Grid 1	0
2	Grid 3	0
3	Heater	6.3 VAC
4	Heater	0
5	Plate	130
6	Grid 2 (Screen)	130
7	Cathode	1.35

6AU6 (V-26) Driver

Pin	Element	Voltage
1	Grid 1	0
2	Grid 3	0
3	Heater	6.3 VAC
4	Heater	0
5	Plate	150
6	Grid 2 (Screen)	150
7	Cathode	1.0

6AL5 Ratio Detector

Pin	Element	Voltage
1	Cathode-1st Diode	-.2
2	Plate-2nd Diode	0
3	Heater	0
4	Heater	6.3 VAC
5	Cathode-2nd Diode	0
6	Shield	0
7	Plate-1st Diode	.2

12AT7 (V-28) R-F Converter

Pin	Element	Voltage
1	Plate-2nd Triode	95
2	Grid-2nd Triode	-.85
3	Cathode-2nd Triode	0
4	Heater	0
5	Heater	0
6	Plate-1st Triode	165
7	Grid-1st Triode	0
8	Cathode-1st Triode	1.8
9	Heater Tap	6.3 VAC

AM SOCKET VOLTAGES:

6BE6 (V-24) AM Converter

Pin	Element	Voltage
1	Grid 1	-.8
2	Cathode-Grid 5	0
3	Heater	6.3 VAC
4	Heater	0
5	Plate	90
6	Grids 2 & 4 (Screen)	90
7	Grid 3	0

6BA6 (V-25) I-F Amplifier

Pin	Element	Voltage
1	Grid 1	-.25
2	Grid 3	0
3	Heater	6.3 VAC
4	Heater	0
5	Plate	140
6	Grid 2 (Screen)	140
7	Cathode	0

6AU6 (V-26) AM Detector

Pin	Element	Voltage
1	Grid 1	0
2	Grid 3	0
3	Heater	6.3 VAC
4	Heater	0
5	Plate	-1.1
6	Grid 2 (Screen)	-1.1
7	Cathode	0

PHONO SOCKET VOLTAGES:

6AV6 (V-3) 1st Audio Amplifier

Pin	Element	Voltage
1	Grid	-.6
2	Cathode	0
3	Heater	6.3 VAC
4	Heater	0
5	Diode Plate	Not Used
6	Diode Plate	Not Used
7	Plate-Triode	145

TELEVISION TRIMMERS & ADJUSTMENTS

S-2	Ratio Detector Primary
S-6 thru S-17	Channel Oscillator Adjustments
S-23	4.5 MC Trap
S-1	Inter-Carrier Sound
S-3	Ratio Detector Secondary
S-4A	Antenna (R-F Tuner)
S-4B	R-F (R-F Tuner)
S-5	Converter I-F, 21.8 MC (R-F Tuner)
S-18	Mixer (R-F Tuner)
S-19	Oscillator (R-F Tuner)
S-20	1st Pix I-F
S-21	2nd Pix I-F
S-22	3rd Pix I-F
S-24	Horizontal Oscillator (Horizontal Hold)
S-25	Horizontal Drive
S-26	Horizontal Linearity
S-27	Width

6V6-GT (V-4) Power Amplifier

Pin	Element	Voltage
1	No Connection	
2	Heater	190 (6.3 VAC to pin 7)
3	Plate	400 (Operating voltage 210 when measured from 190 volt reference point.)
4	Grid 2 (Screen)	420 (Measures 230 volts from 190 volt reference point.)
5	Grid 1	180 (10 volts bias)
6	No Connection	
7	Heater	190 (6.3 VAC to pin 2)
8	Cathode	190

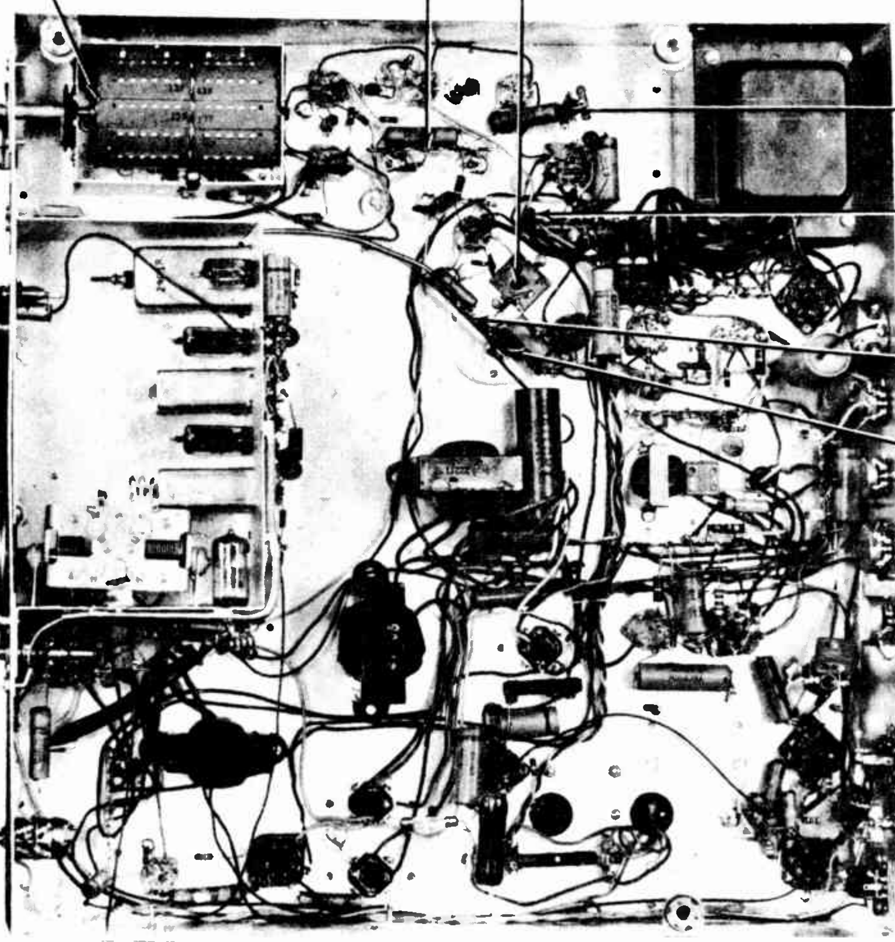
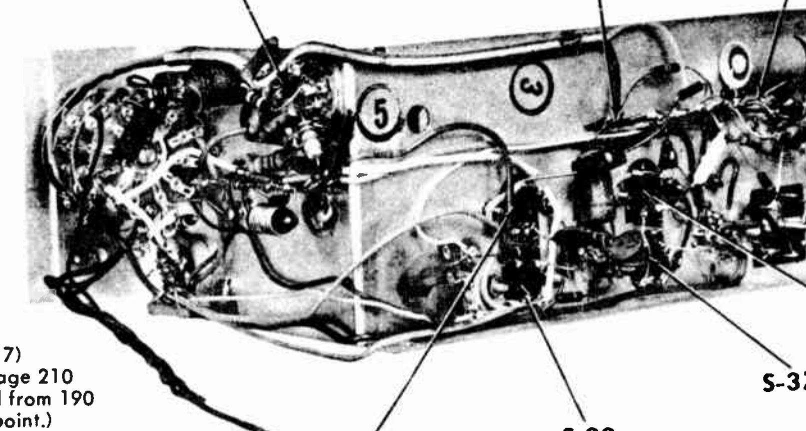


Figure 20
Bottom View of Television Chassis

AM & FM TRIMMERS & ADJUSTMENTS



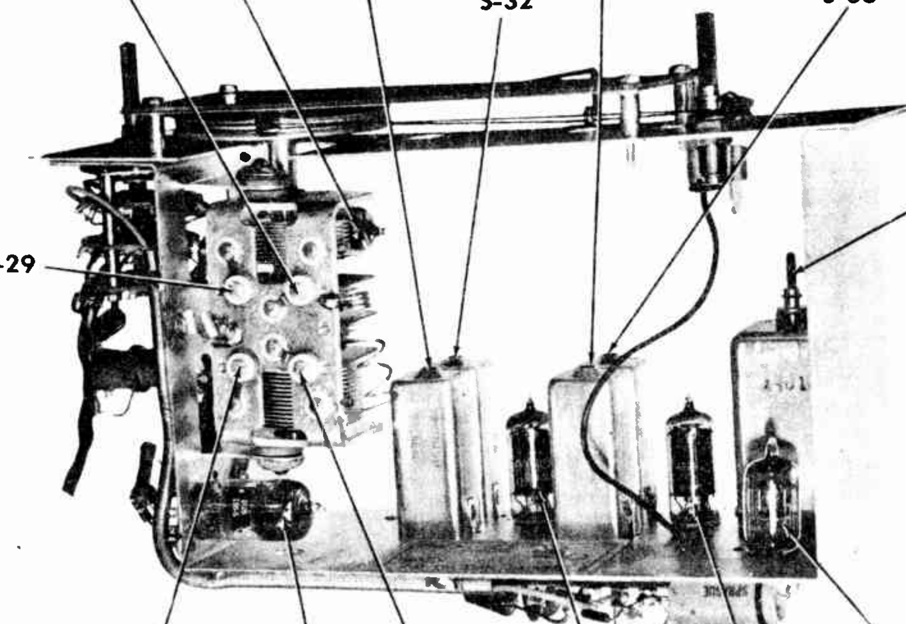


Figure 21
AM-FM Tuner Chassis

S-28 — AM Antenna
S-29 — AM Oscillator
S-30 — FM R-F
S-31 — FM Oscillator
S-32 — 1st FM I-F Primary
S-34 — 1st AM I-F Primary
S-36 — 2nd FM I-F Primary
S-38 — 2nd AM I-F Primary
S-40 — FM Ratio Detector Primary
S-33 — 1st FM I-F Secondary
S-35 — 1st AM I-F Secondary
S-37 — 2nd FM I-F Secondary
S-39 — 2nd AM I-F Secondary
S-41 — FM Ratio Detector Secondary

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ALIGNMENT PROCEDURE AM & FM

AM ALIGNMENT — consists of the steps outlined in the AM Alignment Chart. Make certain each step is done with a minimum input signal. Connect AC voltmeter to speaker voice coil.

STEP	CONNECT TEST OSC. TO	TEST OSC. SETTING	POINTER SETTING	ADJUST FOR MAX. OUTPUT
1	Mixer grid & ground	455 KC	540 KC	S-34, 35, 38 & 39
2	Mixer grid & ground	1620 KC	1620 KC	S-29 to 1620 KC
3	Test Loop	1500 KC	1500 KC	S-28
4	Repeat Steps 2 & 3			
5	Check Stationizing. Slide pointer on string if stations are uniformly off in one direction.			

FM ALIGNMENT — consists of the steps outlined in the FM Alignment Chart.

STEP	CONNECT TEST OSC. TO	TEST OSC. SETTING	POINTER SETTING	CONNECT VOLTMETER TO	ADJUST FOR MAX. OUTPUT
1	FM Conv. grid	10.7 MC	88 MC	Point F	* S-40, 41 36, 37 33, 32
2	Adjust S-11 for zero center			Points F & G	
3	Repeat Steps 1 & 2				
*4	FM Ant. terminals	108 MC	108 MC	Point F	S-30, 31

*NOTE — If the dial does not "track" properly after adjusting S-30 and S-31, it is quite probable that the turns on the R-F and oscillator coils have been disturbed. These turns are spaced properly at the factory and, normally, will require no further adjustment. However, should the occasion arise, spread the turns to increase the frequency and collapse the turns to decrease the frequency. Naturally, S-30 and S-31 must be rechecked should this be found necessary.

*Adjust trimmers in sequence shown.

RECORD CHANGER: Webster Model 100, See Pgs. RCD.CH.21-1 to RCD.CH.21-10.

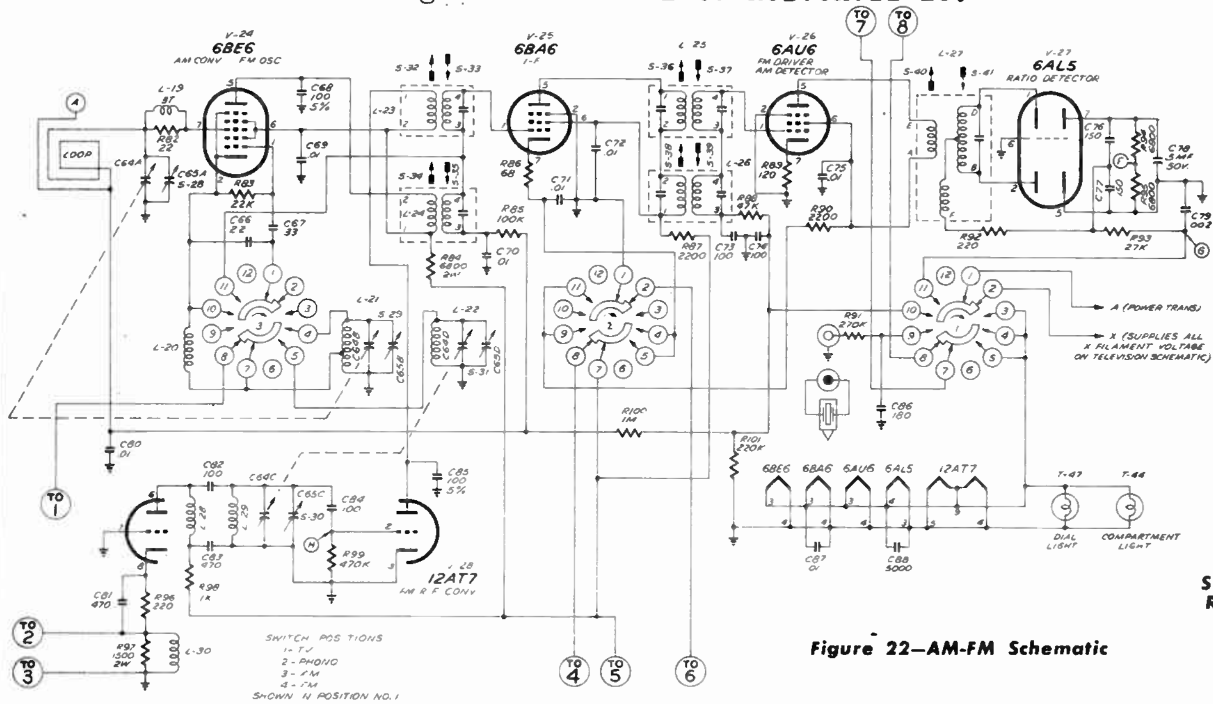

Figure 22—AM-FM Schematic

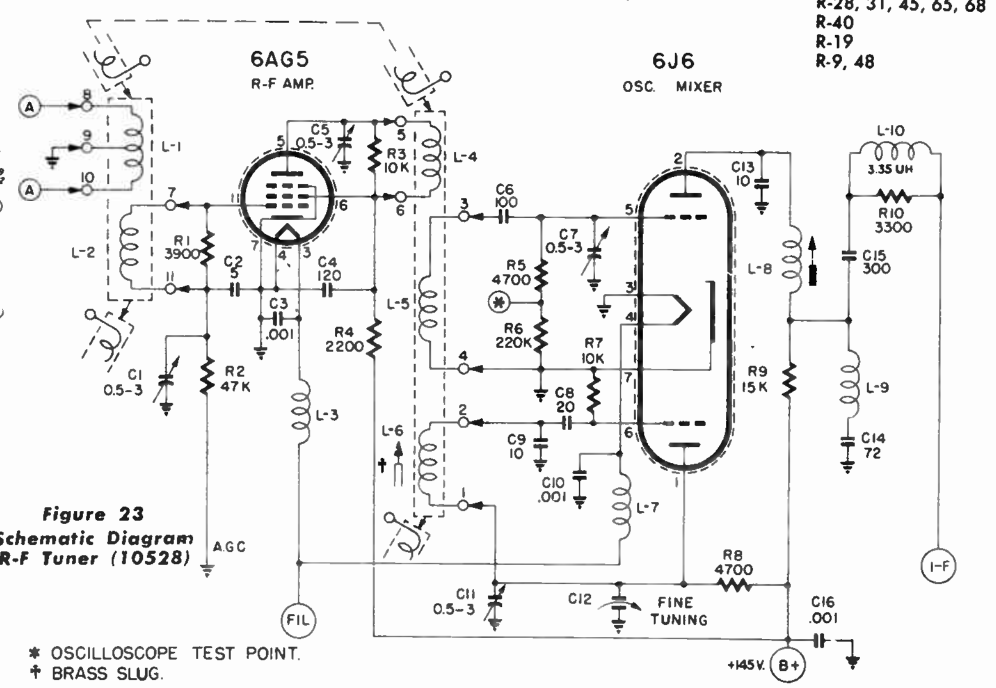

Figure 23
Schematic Diagram
R-F Tuner (10528)

✱ OSCILLOSCOPE TEST POINT.
† BRASS SLUG.

TABLE OF PARTS

TELEVISION

REF. SYMBOL	DESCRIPTION	PB PART NO.
	CAPACITOR, TUBULAR.	
C-35	.001 Mfd. 600 volt	23001
C-4, 12	.005 Mfd. 600 volt	23004
C-8, 9, 10	.02 Mfd. 600 volt	23007
C-16, 22, 45	.05 Mfd. 600 volt	23010
C-24, 25, 41	.1 Mfd. 600 volt	23012
C-7	.003 Mfd. 600 volt	23016
C-19, 27	.05 Mfd. 200 volt	23017
C-32, 46, 55, 56	.1 Mfd. 600 volt	23019
C-34, 36, 50, 57	.01 Mfd. 600 volt	23023
C-38, 44	.2 Mfd. 600 volt	23037
C-40	.033 Mfd. 600 volt	23031
	CAPACITOR, MICA,	
C-43	4900 Mmf. 10%	23207
C-31	4000 Mmf. 10%	23208
C-33	1200 Mmf. 10%	23219
	CAPACITOR, TRIMMER,	
C-37	300-800 Mmf.	23420
	CAPACITOR, CERAMIC,	
C-20	56 Mmf. 500 volt	23922
C-14, 15, 17, 18, 26	.005 Mfd. Hy-Kap	23931
C-62, 63	.01 Mfd. 125 VAC	23932
C-28, 29	1500 Mmf. 500 volt GP	23936
C-51, 52	500 Mmf. 10 KV	23938
C-6	330 Mmf. 500 volt GP	23944
C-42	Integrator Network	23951
C-2	2.2 Mmf. 500 valt GP	23952
C-3A & B	Dual-,.004 Mfd. 500 Volt GP	23955
C-54	47 Mmf. 2 KV	23956
C-49	200 Mmf. 2500 volt, 10%	23958
C-53	500 Mmf. 20 KV	23959
C-30	Capristor	23960
	CAPACITOR, ELECTROLYTIC,	
C-21	25 Mfd. 25 volt	24006
C-5, 39	5 Mfd. 50 volt	24038
C-58, 59, 11	40-40/450 volt, 100/200 volt	24055
C-60, 61, 48	40-40/450 volt, 10/500 volt	24061
C-23, 47	10/450 volt, 100/50 volt	24062
C-13	40 Mfd. 350 volt	24063
	CONTROLS,	
R-66	Height, 3 Megohms	25805D
R-70	Vertical Linearity, 5,000 ohms	25807B
R-80	Focus, 1,500 ohms	25812
R-37	Brightness, 500,000 ohms	25832
R-64	Vertical Hold, 1 megohm	25833
R-29 & R-8	Dual W/AC switch, Contrast, 5,000 ohms Volume, 500,000 ohms	25835
	COILS,	
L-31	Filter choke, 1 Hy, @ 320 MA, 37 ohms D.C.	27005
L-1	Sound I-F, 4.5 MC	29053
L-2	Ratio Detector	29054
L-4, 5	1st & 2nd Pix I-F	29055
L-6	3rd Pix I-F	29056
L-8	Video, 120 uh (blue)	29506
L-11	Video 93 uh (red)	29507
L-9	Video, 180 uh (white)	29508
L 17	Focus	29519
L-10, 18	Video, 36 uh (black)	29520
L-3	TV Tuner Coupling	29523
L-12	Horizontal Oscillator	29527
L-7	4.5 MC Trap	29529
L-13, 16	Yoke	29530
L-14	Horizontal Linearity	29531
L-15	Width	29532
	RESISTORS, ½ WATT, 10%	
R-22	47 ohms	73009
R-T, 8	82 ohms	73012
R-20, 23, 57	100 ohms	73013
R-16	120 ohms	73014
R-6, 30	470 ohms	73021
R-71, 72	560 ohms	73022
R-3, 77	1,000 ohms	73025
R-35	2,200 ohms	73029
R-26, 32, 42, 43, 44	3,300 ohms	73031
R-2, 50	3,900 ohms	73032
R-24	4,700 ohms	73033
R-4, 5, 61, 67	10,000 ohms	73037
R-17, 49, 51	12,000 ohms	73038
R-7, 15, 21	22,000 ahms	73041
R-36	33,000 ohms	73043
R-55	39,000 ohms	73044
R-52	150,000 ohms	73051
R-13	180,000 ohms	73052
R-12	270,000 ohms	73054
R-54	390,000 ohms	73056
	RESISTORS, ½ WATT, 20%	
R-11, 38, 46, 47	100,000 ohms	73149
R-62, 79	150,000 ohms	73151
R-10, 53, 56	220,000 ohms	73153
R-39, 41	330,000 ohms	73155
R-63	470,000 ohms	73157
R-28, 31, 45, 65, 68	1 megohm	73161
R-40	1.5 megohm	73163
R-19	2.2 megohm	73165
R-9, 48	4.7 megohm	73169
	RESISTORS, 1 WATT, 10%	
R-78	10 ohms	73201
R-69	820 ohms	73224
R-60	1,000 ohms	73225
R-33	56,000 ohms	73246
R-74, 75	1 megohm, BTAV (20%)	73398
	RESISTORS, 2 WATT, 10%	
R-34	4,700 ohms	73433
	RESISTORS, WIRE WOUND	
R-73, 76	.68 ohms, 1 watt	73602
R-58	300 ohms, 10 watt	73615
R-81	500 ohms, 5 watt	73617
R-59	10,000 ohms, 5 watt	73642
	TRANSFORMERS,	
T-2	Vertical Oscillator	89031
T-5	Power—Plate winding 235 MA	89036
T-1	Audio Output, 8500 to 3.2 ohms	89426
T-3	Horizontal Output	89429
T-4	Vertical Output	89430
	CAPACITORS, TUBULAR,	
C-79	.002 Mfd. 600 volt	23002

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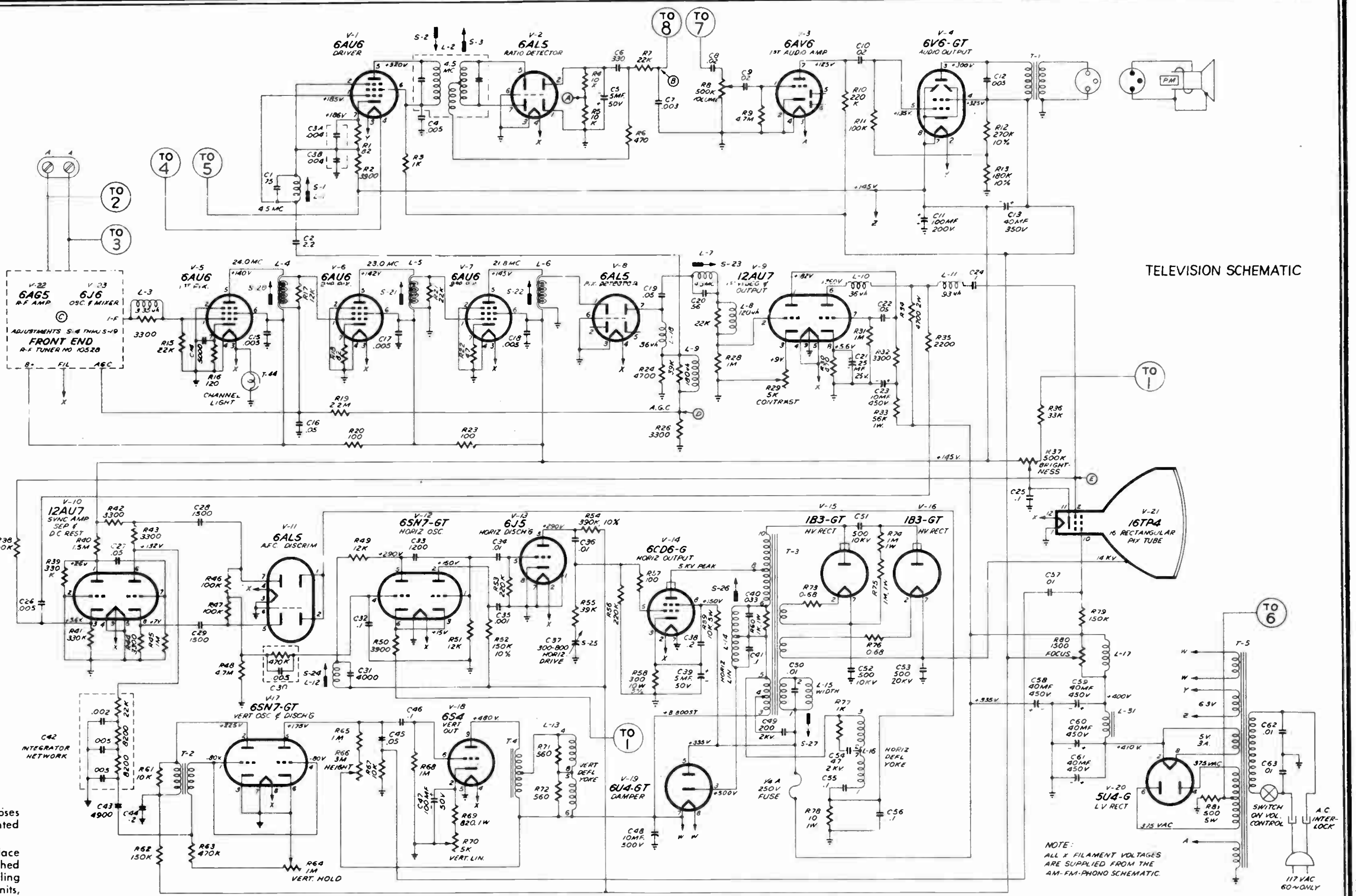
AM — FM PARTS

	CAPACITORS, MICA,	
C-86	180 Mmf. 500 volt	23216
	CAPACITOR, VARIABLE,	
C-64A & B C-65A & B	2 gang	23506
	CAPACITORS, CERAMIC,	
C-73, 74, 77	100 Mmf. 500 volt, 20%	23914
C-83	470 Mmf. 500 volt, 20%	23916
	Tweet Filter	23930
C-88	.005 Mfd. Hy-Kap	23931
C-69, 70, 71, 72, 80, 81	.01 Mfd. 500 volt, 10%	23939
C-67	33 Mmf. 500 volt, 10%	23940
C-68, 82	100 Mmf. 500 volt, 5%	23941
C-76, 85	150 Mmf. 500 volt, 10%	23942
	CAPACITOR, ELECTROLYTIC,	
C-78	5 Mfd. 50 volt	24038
	COILS,	
L-27	FM Ratio Detector	29018
L-24	1st AM I-F	29050
L-26	2nd AM I-F	29051
L-23	1st FM I-F	29052
L-25	2nd FM I-F	29057
L-20, 28	R-F Choke	29104
L-29	FM R-F	29118
L-21	AM Oscillator	29202A
L-22	FM Oscillator	29221
	AM Loop	29334
L-30	FM Antenna	29441
	RESISTORS, ½ WATT, 10%	
R-86	68 ohms	73011
R-82 & L-19	22 ohms	73005
R-89	120 ohms	73014
R-92, 96	220 ohms	73017
R-98	1,000 ohms	73025
R-87, 90	2,200 ohms	73029
R-94, 95	6,800 ohms	73035
R-83	22,000 ohms	73041
R-93	27,000 ohms	73042
R-91	270,000 ohms	73054
	RESISTORS, ½ WATT, 20%	
R-85	100,000 ohms	73149
R-101	220,000 ohms	73153
R-99	470,000 ohms	73157
R-100	1 megohm	73161
	RESISTORS, 2 WATT, 10%	
R-97	1,500 ohms	73427
R-84	6,800 ohms	73435



TELEVISION SCHEMATIC

R-F TUNER PARTS LIST:

The following R-F Tuner parts are listed for reference purposes only. With the exception of the channel coil assemblies mounted in the turret, the tuner is usually replaceable as a unit.

It will be noted that in the event it becomes necessary to replace any one of the channel coil assemblies, it may be accomplished by merely removing the defective assembly by hand and installing the replacement in the same manner. When ordering these units, state number of channel and coil desired (Antenna and R-F or Oscillator).

	CAPACITORS,
C-12, 16, 18, 22	Trimmer, .5 to 3 Mmf.
C-13	Ceramic, 5 Mmf.
C-14	Tubular, .01 Mfd. 600 volt
C-15	Ceramic, 120 Mmf.
C-17	Ceramic, 100 Mmf.
C-19	Ceramic, 20 Mmf.
C-20, 24	Ceramic, 10 Mmf.
C-21, 27	Tubular, .001 Mfd. 600 volt
C-23	Fine Tuning Capacitor
C-25	Ceramic, 300 Mmf.
C-26	Ceramic, 72 Mmf.
	COILS
L-3	Antenna, channels 2 to 13
L-4	Antenna, channels 2 to 13
L-6	R-F, channels 2 to 13
L-7	Oscillator, channels 2 to 13
L-8	Converter, channels 2 to 13
L-9	R-F choke
L-10	I-F, 21.8 MC
L-11	R-F choke

RESISTORS, CARBON, ½ WATT, 10%

R-1	3,900 ohms
R-15	47,000 ohms
R-16	10,000 ohms
R-17	2,200 ohms
R-18, 21	4,700 ohms
R-19	220,000 ohms
R-20	10,000 ohms
R-22	15,000 ohms

MISC. PARTS LIST

PB PART NO.	DESCRIPTION
10528	TV Tuner
21098	Cabinet (Specify Finish)
32021	AC Cord
38117	Dial, Stationized
45004	Fuse, ¼ Amp. 250 volt
54001	Lamp, dial, compartment light, channel selector
	KNOBS,
52067-1	Selector
52068	Fine Tuning
52069-1	Volume
52070	Contrast
52071	Tuning and Band switch
55020	Pix Tube Lens (2801-TV)
55024	Pix Tube Lens (2801A-TV)
58036	3-Speed Automatic Record Changer (Webster 100-11)
	PLUGS,
66004	Compartment Light
66013	Speaker
66021	AC (Interlock)
66023	AC (Phono Motor)
	SOCKETS,
79002	Tube, octal—1 5/16" Mtg. centers
79004	Speaker
79007	AC
79018	2-Prong, Comp. Light—Phono
79061	Tube, 7 pin miniature, mica filled
79066	Tube, 9 pin miniature
79067	Tube, 7 pin miniature
79070	Duo-Decal
79072	Tube, Octal—1½" Mtg. centers
79074	Pilot Light
79075	Tube, octal—1 5/16" Mtg. centers, mica-filled
79077	Electrolytic Mtg.
83802	12" speaker
86028	Selector Switch

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INTRODUCTION

The Philco 12-Position Turret Tuner consists of a turret having 12 aerial-r-f snap-in coils and 12 mixer-oscillator snap-in coils. As the turret is rotated, the terminals of the appropriate aerial-r-f and mixer-oscillator coils are brought into contact with the two contact panels which provide connections to the aerial, r-f, mixer, and oscillator circuits.

This type of channel switch insures the low contact resistance and inductance which is so essential to high-frequency reception. A 6AG5 tube is used as an r-f amplifier, and a 6J6 is used as an oscillator-mixer. The tuner is built into a well-shielded subchassis, thereby providing high gain with stability.

The aerial input circuit is designed for 300-ohm line, balanced to ground, or unbalanced 72-ohm line.

SERVICING

The majority of the electrical parts of the 12-Position Turret Tuner can be replaced with the Tuner in the receiver chassis. The parts are made accessible by removing the component cover plate.

REMOVING THE TURRET

Refer to figure 1, exploded view of Turret Tuner.

1. Remove the bracket holding the rotor of the fine-tuning condenser.
2. Remove the rotor of the fine-tuning condenser.
3. Remove the pressure spring and fiber washer.
4. Remove the two turret-securing springs.
5. Remove the turret.

When replacing the turret, reverse the procedure given below, then index the turret as directed under TURRET INDEX ADJUSTMENT.

REMOVING THE 12-POSITION TURRET TUNER FROM THE CHASSIS

1. Unsolder the connecting wires, recording their connections.
2. Remove the four screws holding the turret-tuner mounting bracket.
3. Remove the three screws securing the turret tuner to the mounting bracket, then remove the tuner from the mounting bracket.

The turret tuner should be replaced in the chassis by reversing the procedure given above.

REPLACING THE CONTACT-PANEL ASSEMBLY

1. Carefully unsolder all the connections to the contact panels, recording their connections.
2. Remove the two screws holding the contact panel.
3. Using a heavy-duty soldering iron, unsolder the solder bonding between the contact-panel assembly and the tuner.
4. Remove the contact-panel assembly by spreading the end of the tuner slightly, and pulling the assembly outward.
5. Install the new contact-panel assembly by reversing the procedure given above.

TURRET INDEX ADJUSTMENT

The position of the turret index spring (item 8 in figure 1) determines the indexing of the turret, and should be adjusted to obtain proper indexing. To adjust, loosen the index-spring holding screw, and move the spring upward or downward until the snap-in coils are making maximum contact with the contacts on the contact-panel assembly. Tighten the holding screw.

LUBRICATION

Proper lubrication of the Philco 12-Position Turret Tuner is an important part of the servicing of the unit. Remember that too much lubrication can be as detrimental as too little. It is very important that only the points shown in figure 1 be lubricated.

Use a good grade of light grease, such as Philco Special Lubricant, Part No. 45-8611.

TUBE REPLACEMENT

Whenever a tube is replaced, it is suggested that several be tried, to obtain a tube which has interelectrode capacitance similar to the original tube, to avoid changing the tuner alignment. The picture quality and oscillator fine-tuning range should be observed while selecting tubes.

If a tube having similar interelectrode capacitance cannot be obtained, the Turret Tuner should be aligned.

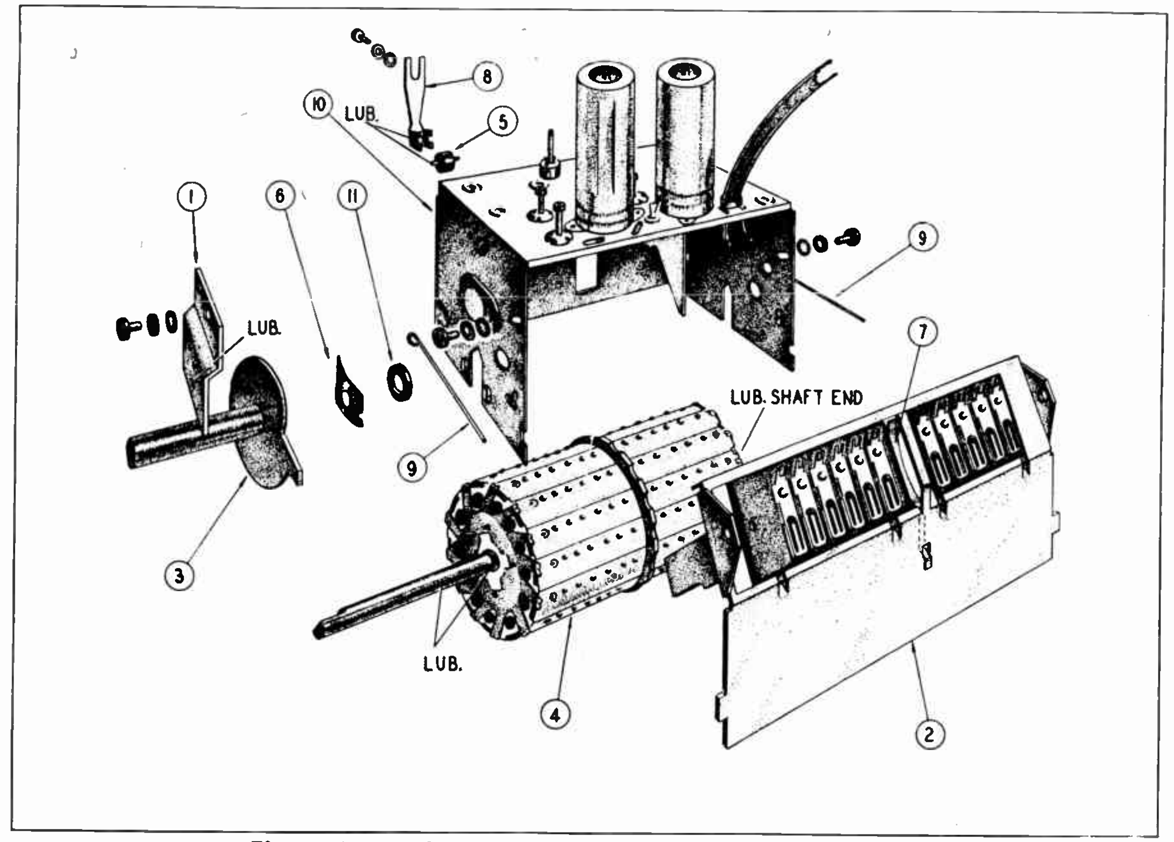

Figure 1. Exploded View of 12-Position Turret Tuner TP9-512C

1. Bracket, fine-tuning condenser
2. Contact-panel assembly
3. Rotor, fine-tuning condenser
4. Turret
5. Roller, turret indexing
6. Spring, fine-tuning pressure
7. Spring, turret grounding
8. Spring, turret indexing
9. Spring, turret securing (2 used)
10. Stator plate, fine-tuning condenser
11. Washer, rotor pressure

TURRET TUNER ALIGNMENT

When the Tuner has been serviced, or when a suitable replacement tube cannot be obtained, as described under TUBE REPLACEMENT, the Turret Tuner should be aligned according to the procedure given below.

Equipment Required

1. Philco Precision Visual Alignment Generator for Television and FM, Model 7008, or the equivalent equipment.
2. Aerial-matching dummy; see figure 2. These resistors should be of carbon-composition construction, and should be chosen from a group, to obtain values close to those indicated.

Procedure

1. Remove the Channel 10 aerial-r-f coil, and turn the Channel Selector to Channel 10.
2. Short the v-i-f output lead of the tuner to ground.
3. Connect the vertical input of the oscilloscope to the tuner test jack, J1-T; refer to figure 4.
4. Remove the component cover plate, and connect the alignment generator to the grid of the r-f tube, pin 1 (terminal 7 of the contact-panel assembly).
5. Set the FM generator to the frequency of Channel 10 (195 mc.), ± 6 mc. deviation.
6. Set the AM generator (unmodulated) to 192 mc. and 198 mc., respectively, and observe the marker pips on the response curve.
7. Tune C8-T and C3-T (see figure 4) to obtain maximum and symmetrical response.
8. Disconnect the alignment generator, then replace the Channel 10 aerial-r-f coil and the component cover plate.

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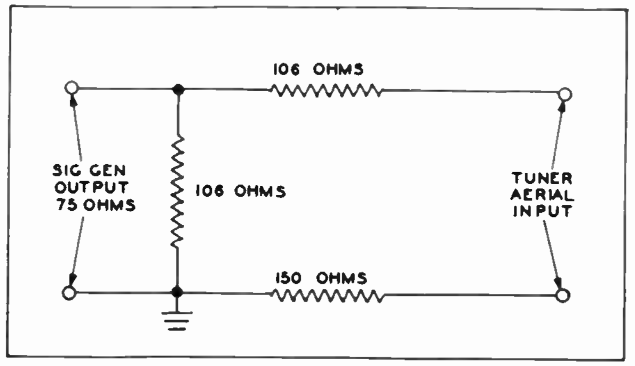

Figure 2. Aerial-Matching Dummy

9. Connect the alignment generator to the aerial input terminal board through the aerial-matching dummy.

10. Tune C2-T (see figure 4) for maximum and symmetrical response within the limits shown in figure 3.

NOTE: The tuner response on any one of the 12 channels should fall within the limits shown in figure 3.

11. Remove the short from the tuner v-i-f output lead.

12. Remove the input of the oscilloscope from J1-T, and connect it to pin 3 of the FM TEST jack. Set the AM marker generator (unmodulated) to 197.75 mc. Use low signal-generator output, and high oscilloscope gain, and adjust C11-T for minimum indication on the oscilloscope.

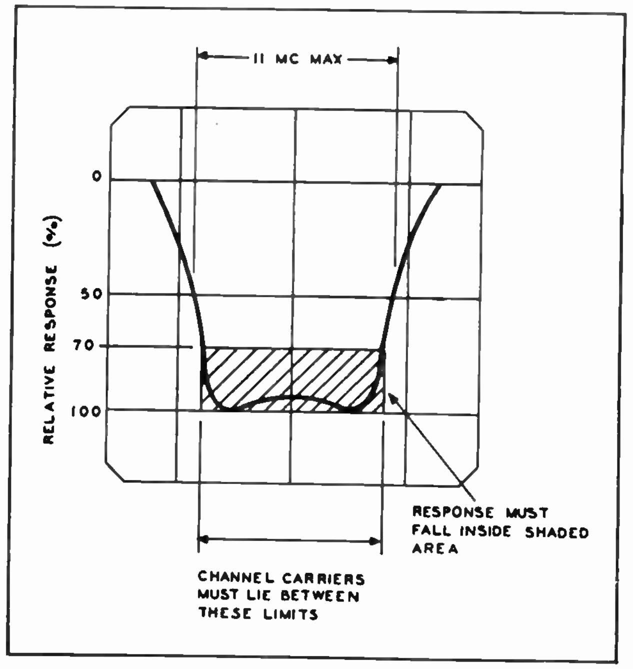

Figure 3. Turret-Tuner Response Limits for the Twelve Television Channels

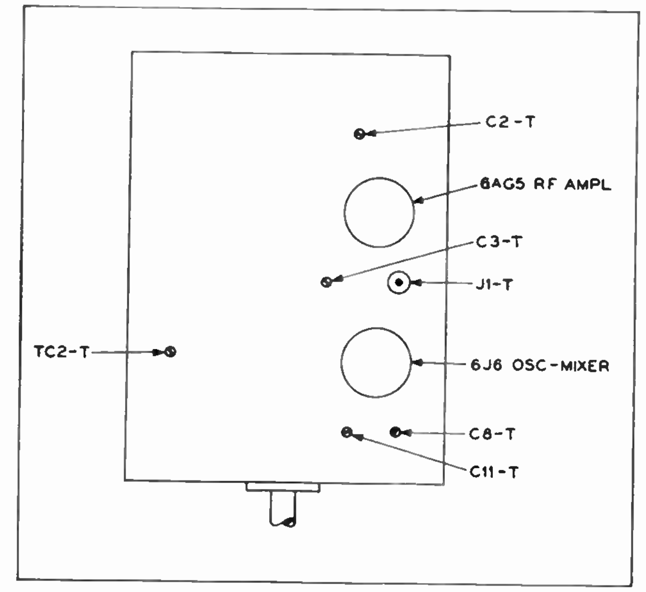

Figure 4. Top View of 12-Position Turret Tuner, Showing Trimmer Locations

TELEVISION CARRIER FREQUENCIES

CHANNEL	CHANNEL LIMITS (mc.)	VIDEO CARRIER FREQUENCY (mc.)	SOUND CARRIER FREQUENCY (mc.)
2	54—60	55.25	59.75
3	60—66	61.25	65.75
4	66—72	67.25	71.75
5	76—82	77.25	81.75
6	82—88	83.25	87.75
7	174—180	175.25	179.75
8	180—186	181.25	185.75
9	186—192	187.25	191.75
10	192—198	193.25	197.75
11	198—204	199.25	203.75
12	204—210	205.25	209.75
13	210—216	211.25	215.75

REPLACEMENT PARTS LIST

The 12-Position Turret Tuner is repairable in the field. Only the individual replaceable components will be accepted under warranty.

At present, there are two types of 12-Position Turret Tuners used in production.

Type 1 has the channel numbers stamped on the snap-in coils in black and red. Part numbers 76-5411 or 76-5411-2 may be stamped on the assembly.

Type 2 has the channel numbers stamped on the snap-in coils in green, with the letter "F" following the number. The contacts on the snap-in coil are on a raised section, and the contacts on the contact panel are kidney-shaped. Part numbers 76-5411-1, 76-5411-3, or 76-5411-4 may be stamped on the assembly.

Parts carrying the same part numbers under type 1 and 2 in the following list are directly interchangeable.

NOTE: Part numbers identified by an asterisk (*) are general replacement items. These numbers may not be identical with those on factory parts. Also, the electrical values of some replacement items may differ from the values indicated in the schematic diagram and parts list. The values substituted in any case are so chosen that the operation will either be unchanged or improved. When ordering replacements, use only the "Service Part No."

ELECTRICAL PARTS

Reference Symbol	Description	Service Part No.	
		Type 1 Tuner	Type 2 Tuner
C1-T	Condenser, fixed padder, 5 $\mu\mu f$.	30-1224-5	30-1224-5
C2-T	Condenser, trimmer, .5 $\mu\mu f$. to 3 $\mu\mu f$.	45-1696	45-1696
C3-T	Condenser, trimmer, r-f amplifier plate	45-1696	45-1696
C4-T	Condenser, filament by-pass, .001 μf.	62-210001011	62-210001011
C5-T	Condenser, screen by-pass, 120 $\mu\mu f$.	30-1224-69	30-1224-69
C6-T	Condenser, decoupling, .001 μf.	62-210001011	62-210001011
C7-T	Condenser, r-f by-pass, 100 $\mu\mu f$.	30-1224-1	30-1224-1
C8-T	Condenser, trimmer, mixer grid	45-1696	45-1696
C9-T	Condenser, fixed trimmer, 10 $\mu\mu f$.	30-1224-51	30-1224-51
C10-T	Condenser, d-c blocking, 20 $\mu\mu f$.	30-1224-43	30-1224-43
C11-T	Condenser, trimmer, oscillator grid	45-1697	45-1697
C12-T	Condenser, filament by-pass, .001 μf.	62-210001011	62-210001011
C13-T	Condenser, fixed trimmer, 10 $\mu\mu f$.	30-1224-51	30-1224-51
C14-T	Condenser, FINE TUNING control	See rotor, fine-tuning condenser	See rotor, fine-tuning condenser
C15-T	Condenser, d-c blocking, 120 $\mu\mu f$.	30-1224-69	30-1224-69
J1-T	Jack, TUNER TEST	Part of 76-5411-3†	Part of 76-5411-3†
L1A-T	Coil, aerial	Part of Z1-T	Part of Z1-T
L1B-T	Coil, r-f amplifier grid	Part of Z1-T	Part of Z1-T
L2-T	Coil, filament choke	45-6579	45-6579

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REPLACEMENT PARTS LIST (Cont'd)

ELECTRICAL PARTS (Cont'd)

Reference Symbol	Description	Service Part No. Type 1 Tuner	Service Part No. Type 2 Tuner
L3A-T	Coil, r-f amplifier plate	Part of Z2-T	Part of Z2-T
L3B-T	Coil, mixer grid	Part of Z2-T	Part of Z2-T
L3C-T	Coil, oscillator	Part of Z2-T	Part of Z2-T
L4-T	Coil, filament choke	45-6580	45-6580
L5-T	Coil, mixer plate	45-1695	45-1695
R1-T	Resistor, grid return, 3900 ohms	66-2398340*	66-2398340*
R2-T	Resistor, a-v-c filter, 47,000 ohms	66-3478340*	66-3478340*
R3-T	Resistor, plate load, 10,000 ohms	66-3108340*	66-3108340*
R4-T	Resistor, decoupling, 2200 ohms	66-2228340*	66-2228340*
R5-T	Resistor, grid, 4700 ohms	66-2478340*	66-2478340*
R6-T	Resistor, grid return, 220,000 ohms	66-4228340*	66-4228340*
R7-T	Resistor, grid return, 10,000 ohms	66-3108340*	66-3108340*
R8-T	Resistor, damping, 15,000 ohms	66-3158340*	66-3158340*
R9-T	Resistor, decoupling, 4700 ohms	66-2478340*	66-2478340*
TC1-T	Tuning core, oscillator	Part of Z2-T	Part of Z2-T
TC2-T	Tuning core, mixer plate coil	Part of L5-T	Part of L5-T
Z1-T	Coil assembly, aerial and r-f		
	Channel 2	32-4428-2	32-4436-2
	Channel 3	32-4428-3	32-4436-3
	Channel 4	32-4428-4	32-4436-4
	Channel 5	32-4428-5	32-4436-5
	Channel 6	32-4428-6	32-4436-6
	Channel 7	32-4428-7	32-4436-7
	Channel 8	32-4428-8	32-4436-8
	Channel 9	32-4428-9	32-4436-9
	Channel 10	32-4428-10	32-4436-10
	Channel 11	32-4428-11	32-4436-11
	Channel 12	32-4428-12	32-4436-12
	Channel 13	32-4428-13	32-4436-13
Z2-T	Coil assembly, mixer and oscillator		
	Channel 2	32-4429-2	32-4437-2
	Channel 3	32-4429-3	32-4437-3
	Channel 4	32-4429-4	32-4437-4
	Channel 5	32-4429-5	32-4437-5
	Channel 6	32-4429-6	32-4437-6
	Channel 7	32-4429-7	32-4437-7
	Channel 8	32-4429-8	32-4437-8
	Channel 9	32-4429-9	32-4437-9
	Channel 10	32-4429-10	32-4437-10
	Channel 11	32-4429-11	32-4437-11
	Channel 12	32-4429-12	32-4437-12
	Channel 13	32-4429-13	32-4437-13

† Turret tuner assembly, with coils

MECHANICAL PARTS

Description	Service Part No. Type 1 Tuner	Service Part No. Type 2 Tuner
Contact-panel assembly (stator)	45-1693	45-1694
Roller, turret indexing	45-6570	45-6571
Rotor, fine-tuning condenser	45-1690	45-1690
Spring, fine-tuning pressure	45-6573	45-6574
Spring, turret grounding	45-6581	45-6582
Spring, turret indexing	45-6577	45-6578
Spring, turret securing (2 used)	45-6575	45-6576
Tube shield (6J6)	56-3979-7	56-3979-7
Tube shield (6AG5)	56-3979	56-3979
Turret (rotor) and shaft assembly, less coils	45-1691	45-1692
**Turret tuner assembly, with coils	76-5411-3*	76-5411-3*
Washer (fiber), rotor pressure	45-6572	45-6572

**NOTE: Turret tuner assembly, Part No. 76-5411-3, is to be used as a replacement for both types of tuners whenever a complete tuner is replaced.

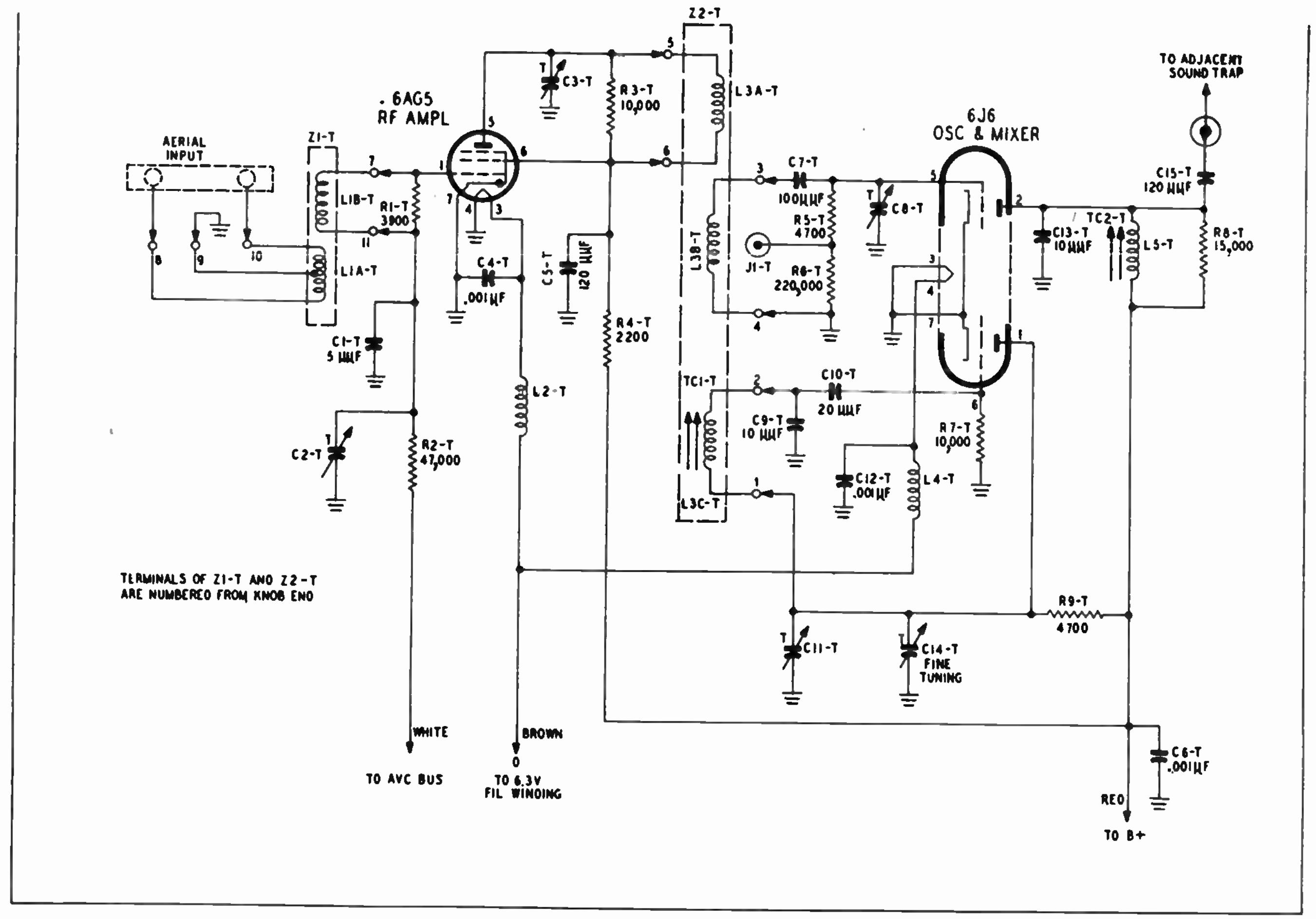

Figure 5. Schematic Diagram of 12-Position Turret Tuner TP9-512

TUBE REPLACEMENT

Whenever a tube is replaced, it is suggested that, if possible, several be tried, to obtain a tube which has interelectrode capacitance similar to the original tube, to avoid changing the tuner alignment. The picture quality and oscillator fine-tuning range should be observed while selecting tubes.

CHECKING OSCILLATOR INJECTION VOLTAGE

After a tuner has been serviced, the performance of the oscillator should be determined by checking the level of the oscillator voltage that is injected into the mixer. The procedure is as follows:

1. Connect a vacuum-tube voltmeter to the grid of the mixer tube, with a 1-megohm resistor in series with the probe.
2. Tuning through Channels 2 to 6, the voltage should be at least –2 volts.
3. Tuning through Channels 7 to 13, the voltage should be at least –1 volt.

If the voltage indications are below the minimum values given above, the oscillator and mixer stages should be checked.

TURRET TUNER, PART NO. 76-5411-SERIES

The detailed service information given in manual PR-1803 applies to this tuner, together with the information contained in this manual.

Since the printing of PR-1803, the following changes have been made in this tuner:

1. To prevent the oscillator voltage from appearing in the first v-i-f grid circuit, the mixer plate coil was tapped, as shown in figure 1.

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The part number of the mixer coil, L5-T, given in PR-1803, is for the tapped type. The part number of the earlier type is 45-1711. These coils are not interchangeable, because of the effect of the mixer plate load on the mixer grid tuning; therefore, before procuring a replacement coil, it should be determined by inspection which type is used. In conjunction with the change in the mixer plate coil, an additional decoupling network was installed in the plate circuit of the mixer. This is also shown in figure 1.

2. An additional 100-$\mu\mu f$. filament by-pass condenser was added, between ground and the junction of L2-7 and L4-7. The part number is 30-1224-1.

3. In later production of some turret tuners, C1-T fixed trimmer and C2-T trimmer were replaced by a single trimmer having a capacitance equal to these two in parallel. The part number of this new trimmer is 45-1710. Tuners having this change are identified by the absence of the fixed trimmer across C2-T.

4. The use of the turret tuner in new models necessitated different shaft lengths for the turret and fine-tuning rotor. The part numbers of the turrets and rotors for various models are given below, along with the part numbers of the complete replacement turret tuners.

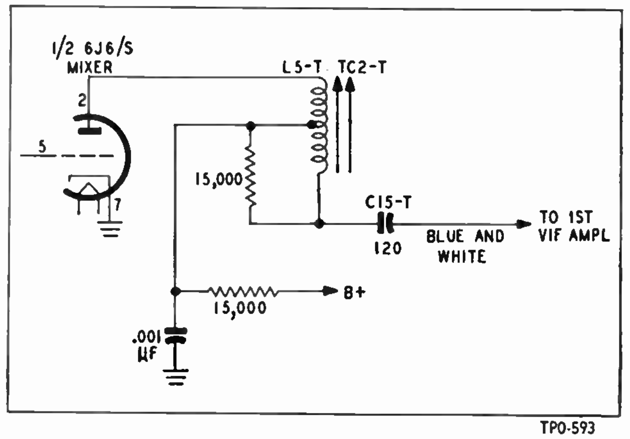

Figure 1. Changes in Mixer Plate Circuit, Turret Tuner, Part No. 76-5411-Series

Turret Tuner Part No.	Used in Models	Fine-Tuning Rotor Part No.	Turret (drum ass'y.) Part No.	Replacement Turret Tuner (complete) Part No.
76-5411	50-T1476 through 50-T1482; 50-T1484, and 50-T1630	45-1690	45-1691	76-5411-3
76-5411-1	50-T1402, 50-T1406, and 50-T1432, all Code 122	45-1690-1	45-1692-1	76-5411-1
76-5411-2	50-T1476 through 50-T1482; 50-T1484, and 50-T1630	45-1690	45-1691	76-5411-3
76-5411-3	50-T1476 through 50-T1482; 50-T1484, and 50-T1630	45-1690	45-1692	76-5411-3
76-5411-4	50-T1476 through 50-T1482; 50-T1484, and 50-T1630	45-1690	45-1692	76-5411-3
76-5411-5	50-T1600, 50-T1632, and 50-T1633	45-1690-2	45-1692-2	76-5411-5

WAFER-SWITCH TUNERS

The table below gives the part numbers of the Wafer-Switch Tuners used in various Philco Television Receivers, and also the part numbers of the complete replacement tuners.

Wafer-Switch Tuner Part No.	Used in Models	Replacement Tuner (complete)
76-4402	49-702	76-4402-7
76-4402-5	50-T1443, Code 122	76-4402-7
76-4402-6	50-T1400, 50-T1401, 50-T1402, 50-T1403, 50-T1404, 50-T1406, 50-T1430, and 50-T1104, Code 123	*76-5433-1
76-4402-7	50-T702, Code 122	76-4402-7
76-5433	50-T1400, 50-T1401, 50-T1402, 50-T1403, 50-T1404, 50-T1406, and 50-T1430	*76-5433-1
76-5433-1	50-T1400, 50-T1401, 50-T1402, 50-T1403, 50-T1404, 50-T1406, and 50-T1432	76-5433-1

*Used in conjunction with mounting bracket kit, Part No. 45-9591, when substituted for 76-4402-6 or 76-5433.

WAFER-SWITCH TUNER, PART NO. 76-4402-SERIES

The components of this tuner are made accessible by removing the tuner from the chassis, and then removing the perforated cover.

CLEANING AND LUBRICATION

Erratic operation or noise may be caused by dirty wafer-switch contacts, in which case, the contacts should be cleaned and lubricated. Clean the contacts carefully with a contact cleaning fluid, and lubricate with a contact lubricant, such as Philco All Purpose Lubricator, Part No. 45-2806. Remember that too much lubrication can be as detrimental as too little. Lubricate only the switch contacts.

PARTS REPLACEMENT

The parts given in the following list are those which are readily accessible, and which may be replaced without disturbing the tuning of any individual channels; however, the over-all alignment should be checked after servicing.

IMPORTANT! The lead dress and lead lengths of some components are critical. When replacing components, duplicate the original wiring as closely as possible.

PARTS REPLACEABLE IN WAFER-SWITCH TUNER, PART NO. 76-4402-SERIES

Reference Symbol	Description	Service Part No.
C3	Condenser, trimmer, mixer grid	31-6511-9
C6	Condenser, d-c blocking, 470 $\mu\mu f$.	Part of L36
C7	Condenser, cathode by-pass, 220 $\mu\mu f$.	30-1225-15
C10	Condenser, oscillator injection, 4.7 $\mu\mu f$.	**
C10	Condenser, oscillator injection, 2.2 $\mu\mu f$.	30-1224-66
C12	Condenser, d-c blocking, 220 $\mu\mu f$.	30-1225-15
C13	Condenser, fixed padder, 10 $\mu\mu f$.	30-1224-26
C15	Condenser, d-c blocking, 10 $\mu\mu f$.	30-1224-26
C16	Condenser, filament by-pass, 220 $\mu\mu f$. (L36 must be removed)	30-1225-15
C19	Condenser, fixed padder, 27 $\mu\mu f$.	62-027409011
C20	Condenser, trimmer, r-f plate	31-6511-6
C21	Condenser, d-c blocking, 39 $\mu\mu f$.	62-039409011
C22	Condenser, d-c blocking, 220 $\mu\mu f$.	30-1225-11
C24	Condenser, cathode by-pass, 220 $\mu\mu f$.	30-1225-11
C25	Condenser, screen by-pass, 220 $\mu\mu f$. (clipped free and replaced from pin 6 to ground, pin 3)	30-1225-11
C26	Condenser, a-g-c decoupling, 220 $\mu\mu f$.	30-1225-11
C27	Condenser, filament by-pass, 220 $\mu\mu f$.	30-1225-11
L23	Coil, oscillator, Channel 2	32-4357-2
L24	Coil, oscillator, Channel 3	32-4357-3
L25	Coil, oscillator, Channel 4	32-4357-4
L26	Coil, oscillator, Channel 5	32-4357-5
L27	Coil, oscillator, Channel 6	32-4357-6
L28	Coil, oscillator, Channel 7	32-4357-7
L29	Coil, oscillator, Channel 8	32-4357-8
L30	Coil, oscillator, Channel 9	32-4357-8
L31	Coil, oscillator, Channel 10	32-4357-10
L32	Coil, oscillator, Channel 11	32-4357-11
L33	Coil, oscillator, Channel 12	32-4357-12
L34	Coil, oscillator, Channel 13	32-4357-11
L35	Coil, choke, r-f plate	32-4112-2
L36	Coil, 1st v-i-f	32-4359-6
R1	Resistor, cathode bias, 330 ohms	66-1338340*
R2	Resistor, plate decoupling, 3300 ohms	66-2338240*
R3	Resistor, grid return, 100,000 ohms	66-4108340*
R4	Resistor, grid return, 10,000 ohms	66-3108340*
R6	Resistor, grid return, 10,000 ohms	66-3103340*
R6†	Resistor, grid return, 1 megohm	66-5108340*
R7	Resistor, a-g-c decoupling, 330 ohms	66-1338340*
R9	Resistor, plate feed, 4700 ohms	66-2478240*
R9†	Resistor, plate feed, 3300 ohms	66-2338240

†Changed in later production to the value indicated.

**Replace with 2.2-$\mu\mu f$. condenser, and rewire from pin 6 to pin 1.

WAFER-SWITCH TUNER, PART NO. 76-5433-SERIES

The components of this tuner are made accessible by removing the tuner from the chassis, and then removing the perforated cover.

CLEANING AND LUBRICATION

Refer to the information given above for the Part No. 77-4402-series tuner.

PARTS REPLACEMENT

The parts given in the following list are those which are readily accessible, and which may be replaced without disturbing the tuning of any individual channels; however, the over-all alignment should be checked after servicing. All parts are interchangeable in these tuners, except as noted.

IMPORTANT! The lead dress and lead lengths of some components are critical. When replacing components, duplicate the original wiring as closely as possible.

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PARTS REPLACEABLE IN WAFER-SWITCH TUNERS, PART NOS. 76-5433 AND 76-5433-1

Reference Symbol	Description	Service Part No.
C1-T	Condenser, fixed trimmer, 5 μμf. (76-5433)	30-1224-28
C1-T	Condenser, fixed trimmer, 20 μμf. (76-5433-1)	62-02030901
C3-T	Condenser, a-g-c by-pass, 220 μμf.	30-1225-11
C4-T	Condenser, filament by-pass, 220 μμf.	30-1225-11
C6-T	Condenser, B plus by-pass, 220 μμf.	30-1225-11
C12-T	Condenser, r-f by-pass, 15 μμf.	62-01509011
C14-T	Condenser, r-f by-pass, 1500 μμf.	30-1225-19
C18-T	Condenser, r-f by-pass, 220 μμf.	30-1225-11
C20-T	Condenser, d-c blocking, 20 μμf.	30-1224-67
L2-T	Coil, FM trap (76-5433)	32-4438
L2-T	Coil, FM trap (76-5433-1)	32-4438-1
L36-T	Coil, 1st v-i-f tank	32-4359-8
L37-T	Coil, choke, r-f-plate feed	32-4112-2
L38-T	Coil, oscillator, Channel 2	32-4357-2
L39-T	Coil, oscillator, Channel 3	32-4357-3
L40-T	Coil, oscillator, Channel 4	32-4357-4
L41-T	Coil, oscillator, Channel 5	32-4357-5
L42-T	Coil, oscillator, Channel 6	32-4357-6
L43-T	Coil, oscillator, Channel 7	32-4357-7
L44-T	Coil, oscillator, Channel 8	32-4357-8
L45-T	Coil, oscillator, Channel 9	32-4357-8
L46-T	Coil, oscillator, Channel 10	32-4357-10
L47-T	Coil, oscillator, Channel 11	32-4357-11
L48-T	Coil, oscillator, Channel 12	32-4357-12
L49-T	Coil, oscillator, Channel 13	32-4357-11
L50-T	Coil, tapered line	32-4432
L51-T	Coil, tapered line	32-4432
R1-T	Resistor, input loading, 1200 ohms	66-2128340*
R2-T	Resistor, grid return, 1 megohm	66-5108340*
R3-T	Resistor, a-g-c decoupling, 330 ohms	66-1338340*
R4-T†	Resistor, plate feed, 10,000 ohms	66-3108340*
R5-T	Resistor, screen dropping, 39,000 ohms	66-3398340*
R6-T	Resistor, B plus decoupling, 330 ohms	66-1338340*
R8-T	Resistor, loading, 15,000 ohms	66-3158340*
R9-T	Resistor, B plus decoupling, 330 ohms	66-1338340*
R10-T	Resistor, grid return, 100,000 ohms	66-4108340*
R11-T	Resistor, grid return, 10,000 ohms	66-3108340*

†In later production tuners, this resistor was replaced by an r-f choke, Part No. 32-4112-22. At the same time, a 6800-ohm resistor was added, across L31-T, the mixer grid coil for Channel 5, and a 10,000-ohm resistor was added, across L29-T, the mixer grid coil for Channel 6.

TELEVISION CARRIER AND OSCILLATOR FREQUENCIES

CHANNEL	CHANNEL LIMITS (mc.)	VIDEO CARRIER FREQUENCY (mc.)	SOUND CARRIER FREQUENCY (mc.)	LOCAL OSCILLATOR FREQUENCY (mc.)
2	54—60	55.25	59.75	81.85
3	60—66	61.25	65.75	87.85
4	66—72	67.25	71.75	93.85
5	76—82	77.25	81.75	103.85
6	82—88	83.25	87.75	109.85
7	174—180	175.25	179.75	201.85
8	180—186	181.25	185.75	207.85
9	186—192	187.25	191.75	213.85
10	192—198	193.25	197.75	219.85
11	198—204	199.25	203.75	225.85
12	204—210	205.25	209.75	221.85
13	210—216	211.25	215.75	237.85

TUNER ALIGNMENT

After the tuner has been serviced, or if it is necessary to use a replacement tube that does not exactly meet the requirements described under TUBE REPLACEMENT, the tuner alignment should be checked. If realignment is necessary, it should be done according to the procedure given below.

The alignment may be made satisfactorily with the tuner out of the receiver chassis, by using an external power supply. This power-supply circuit may be similar to that shown in figure 2. If desired, B batteries and a 6.3-volt filament transformer may be used, or a television receiver may be conveniently set up to supply power to the tuner. In all cases, there should be good bonding between the alignment generator and the tuner. This may be done by placing the generator and tuner on a metal plate.

EQUIPMENT REQUIRED

1. Philco Precision Visual Alignment Generator for Television and FM, Model 7008, or the equivalent equipment.

2. Aerial-matching dummy; see figure 3. These resistors should be of carbon-composition construction, and should be chosen from a group to obtain values close to those indicated.

3. A power supply, as described above.

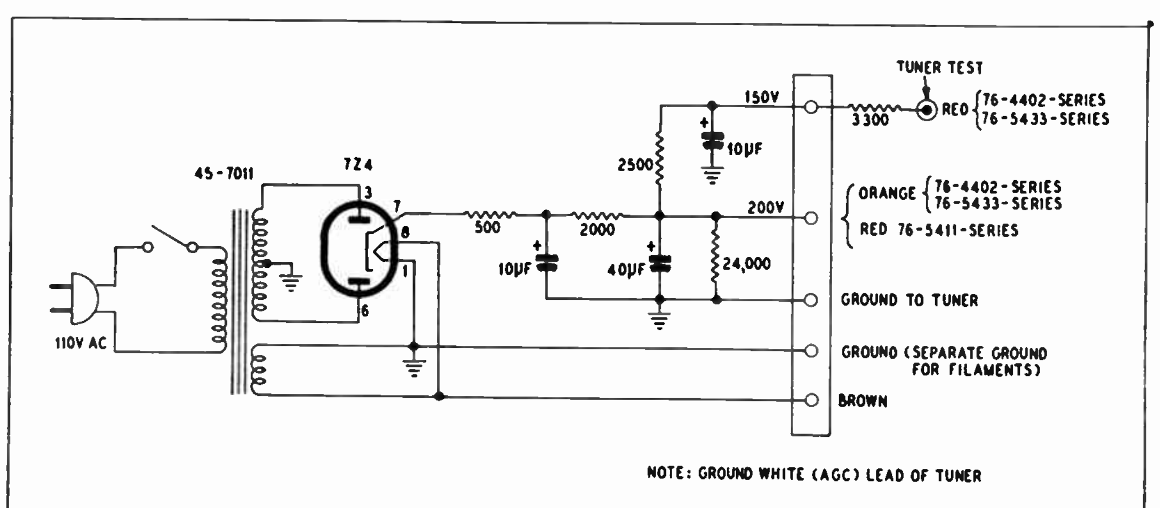

Figure 2. Power Supply for Tuner Alignment with Tuner Removed from Receiver Chassis

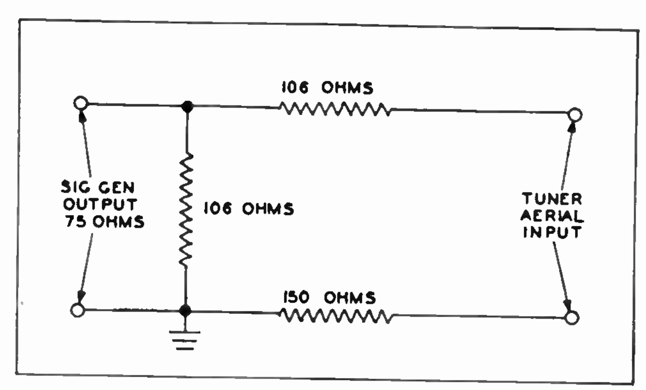

Figure 3. Aerial-Input Matching Network

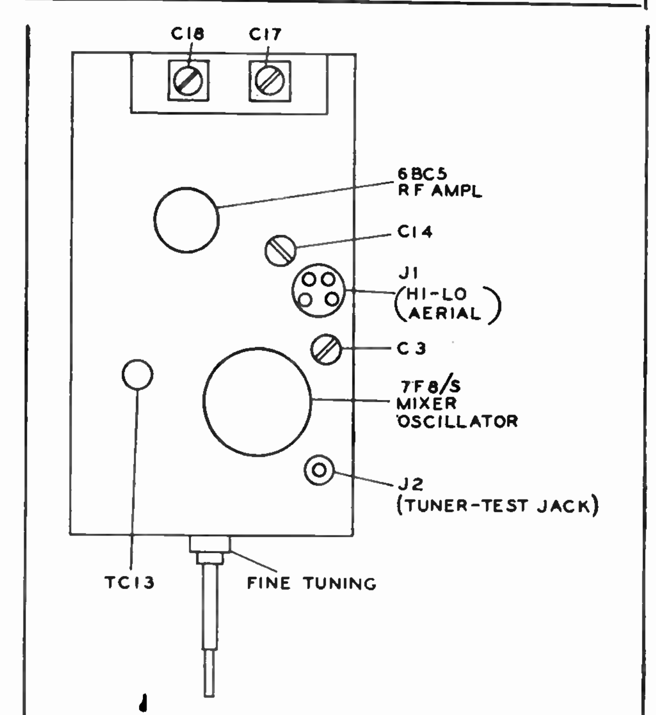

Figure 4. Wafer-Switch Tuner, Part No. 76-4402-Series, Top View, Showing Trimmer Locations

MODELS 76-5411, 76-4402, 76-5433, Series Tuners

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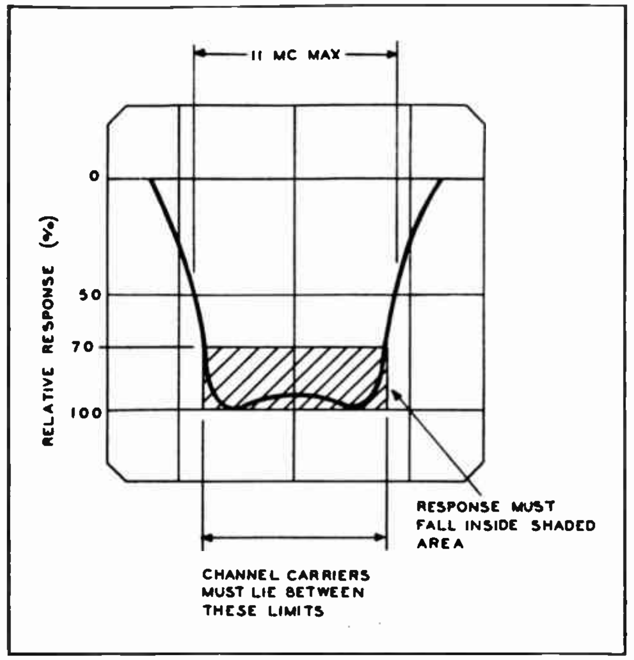

TP9-512B

Figure 5. Tuner Response Limits for the Twelve Television Channels

TURRET TUNER, PART NO. 76-5411-SERIES

For the detailed alignment procedure, refer to manual PR-1803, and include corrections and additions as follows:

1. All references to figure 3 should read "figure 2."
2. All references to figure 4 should read "figure 3."
3. All references to figure 5 should read "figure 4."
4. In step 2 of the alignment procedure, the v-i-f output lead should be connected to ground through a 470-ohm resistor.
5. Delete step 12, and replace by the following: C11-T is used to compensate for differences in the inter-electrode capacitance of 6J6/S tubes. If the range of the FINE TUNING control is incorrect on all channels, due to replacement of the 6J6/S tube, C11-T should be adjusted for best sound while receiving a high channel station. If the tuner is out of the chassis, or if repairs have been made, C11-T should be set midway in its range, and each oscillator core should be adjusted.
6. In reference to the adjustment of C8-T, C3-T, and C2-T on Channel 10, if there is one station in the local area which is weak, these adjustments may be made on that channel, to improve the response, provided that the response on the other channels is not sacrificed too much.

Local-Oscillator Adjustments

When making the tuner alignment with the tuner in the receiver chassis, the local oscillator tuning cores should be adjusted as follows:

1. Remove the chassis from the cabinet.
2. Connect a 20,000-ohms-per-volt voltmeter to the FM TEST jack, J3, using the FM TEST jack adapter shown in figure 6.

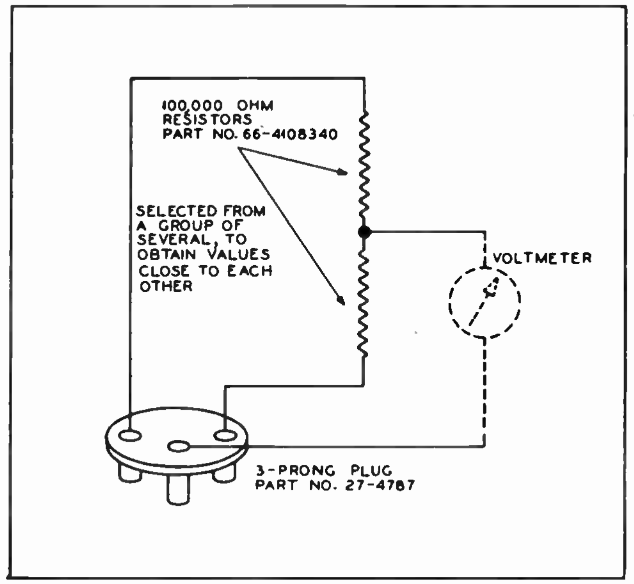

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Figure 6. FM TEST Jack Adapter

3. Turn the CHANNEL SELECTOR to Channel 2.
4. Set the FINE TUNING control to the middle of its range.
5. Connect an accurately calibrated AM signal generator (unmodulated) to the aerial input of the receiver, and set the generator to the sound-carrier frequency of Channel 2. See table of TELEVISION CARRIER AND OSCILLATOR FREQUENCIES.
6. Adjust the oscillator tuning core for a zero reading on the voltmeter.
7. Repeat the above steps for Channels 3 through 13, in order.

When making the tuner alignment with the tuner out of the receiver chassis (using a separate power supply, as described previously), the local oscillator tuning cores should be adjusted as follows:

1. Connect the oscilloscope to J1-T. If the signal-generator output or the scope gain is insufficient, a larger beat indication may be had by connecting a 3300-ohm resistor in series with the red lead, then connecting the oscilloscope to the junction of the red lead and the 3300-ohm resistor.
2. Set the CHANNEL SELECTOR to Channel 2.
3. Set the FINE TUNING control to the center of its range.
4. Connect an accurately calibrated AM signal generator (unmodulated) to the aerial input.
5. Set the signal-generator to the oscillator frequency for Channel 2. See table of TELEVISION CARRIER AND OSCILLATOR FREQUENCIES.
6. Adjust the Channel 2 oscillator tuning core for zero-beat indication on the oscilloscope.
7. Repeat the above steps for Channels 3 through 13. In each case, use the appropriate signal-generator setting and CHANNEL SELECTOR setting, and adjust the proper oscillator tuning core for the channel.

WAFER-SWITCH TUNER, PART NO. 76-4402-SERIES

Local-Oscillator Adjustments

When making the tuner alignment with the tuner in the receiver chassis, adjust the local oscillator tuning cores according to the first procedure given under LOCAL-OSCILLATOR ADJUSTMENTS for the Turret Tuner, Part No. 76-5411-Series.

When making the tuner alignment with the tuner out of the receiver chassis (using a separate power supply, as described previously), the local oscillator tuning cores should be adjusted as follows:

1. Connect the oscilloscope to the tuner test point at the 150-volt output of the power supply (see figure 2).
2. Follow steps 2 through 7 of the second procedure given under LOCAL-OSCILLATOR ADJUSTMENTS for the Turret Tuner, Part No. 76-5411-Series.

Bandwidth and R-F Response Adjustments

This information supersedes the procedures given in manuals PR-1672, PR-1771, and PR-1793. Trimmer locations are shown in figure 7. The alignment procedure for bandwidth and r-f response is as follows:

1. Turn the CHANNEL SELECTOR to Channel 2, and remove the 1st v-i-f tube. Connect a 470-ohm resistor from the green (v-i-f output) lead to ground. If the alignment is being made with the tuner out of the receiver chassis (using a separate power supply, as described previously), ground the white (a-g-c) wire.
2. Connect the vertical input of the oscilloscope to the tuner test jack, J2, or if using a separate power supply, to the red lead on the tuner side of a 3300-ohm resistor, as shown in figure 2.
3. Connect the outputs of the AM and FM signal generators to the aerial input leadin through the aerial-matching network; see figure 3.

NOTE: In cases where an installation uses two aerials, and the single leadin has been clipped off, it is necessary to connect the signal generator to the appropriate aerial-input terminals of J1.

4. Set the FM signal generator for Channel 2 (55 mc.), with sufficient sweep to give the complete response curve.
5. Establish the channel limits by using the AM signal generator (unmodulated) to produce marker pips on the response curve; set the generator first to 54 mc., then to 60 mc.
6. Adjust C3 and C20 for symmetrical response within the channel limits. See figure 5.
7. Check the response on Channels 3 through 13, using the appropriate sweep and marker frequencies. See table of TELEVISION CARRIER AND OSCILLATOR FREQUENCIES. If the response is consistently out of the proper bandpass in one direction, C3

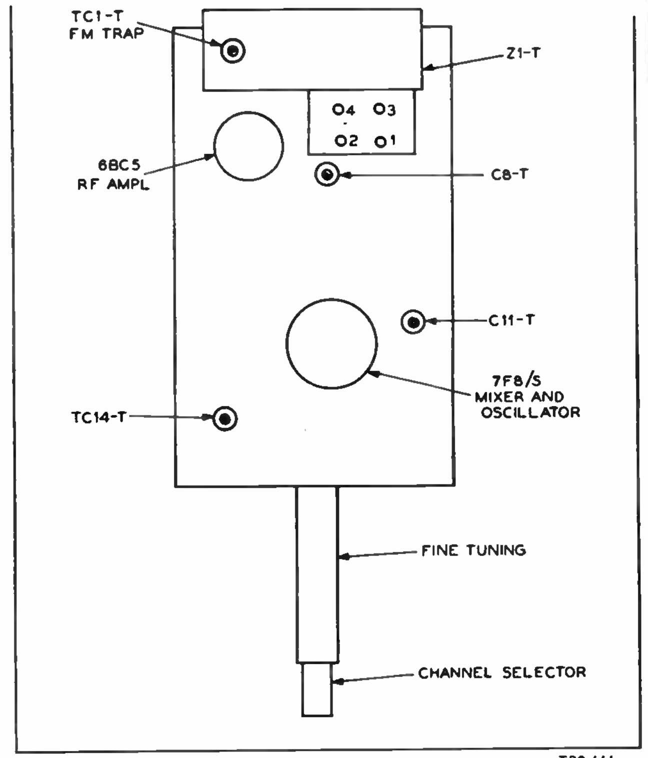

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Figure 7. Wafer-Switch Tuner, Part No. 76-5433-Series, Top View, Showing Trimmer Locations

and C20 should be readjusted to obtain the best compromise response on all of the channels used in the local area; these adjustments may be made to accommodate the weakest station, provided that the performance on the other channels is not sacrificed too much.

8. Turn the CHANNEL SELECTOR to Channel 6.
9. Set the FM signal generator to 85 mc., with sufficient sweep to give the complete response curve. Establish the channel limits by means of appropriate marker signals from the AM signal generator.
10. Adjust C17 for maximum output and symmetry of curve.
11. Check the response on Channel 2, and readjust C17 to obtain the best response on low channel stations in the local area.
12. Turn the CHANNEL SELECTOR to Channel 13.
13. Set the FM signal generator to 213 mc., with sufficient sweep to give the complete response curve. Establish the channel limits by means of appropriate marker signals from the AM signal generator.
14. Adjust C18 for maximum output and symmetry of curve.
15. Check the response on Channel 7, and readjust C18 to obtain the best response on high channel stations in the local area.
16. Recheck the local-oscillator adjustments.

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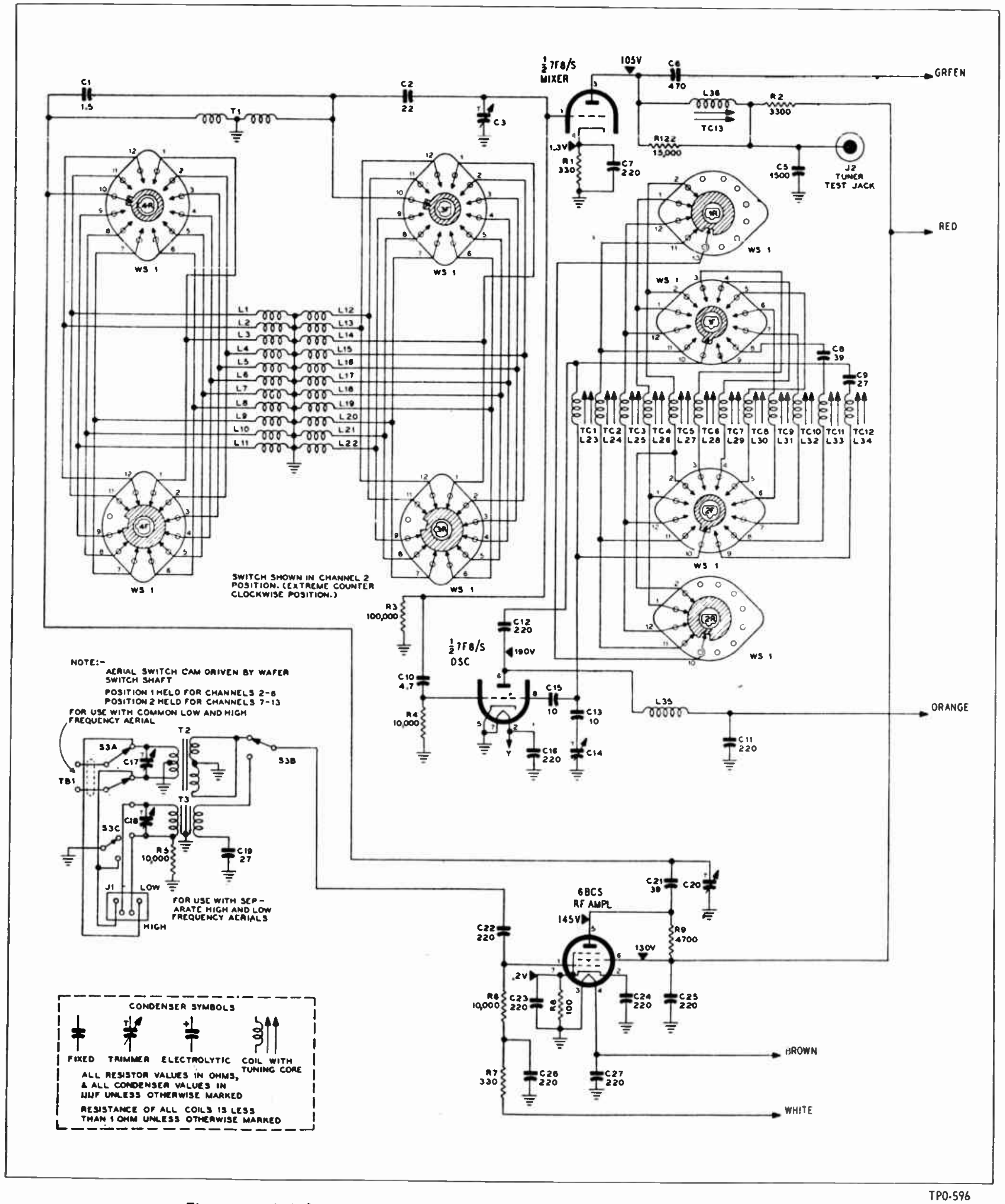

Figure 8. Wafer-Switch Tuner, Part No. 76-4402-Series, Schematic Diagram

WAFER-SWITCH TUNER PART NO. 76-5433-SERIES

Local-Oscillator Adjustments

When making the tuner alignment with the tuner in the receiver chassis, adjust the local oscillator tuning cores according to the first procedure given under LOCAL-OSCILLATOR ADJUSTMENTS for the Turret Tuner, Part No. 76-5411-Series.

When making the tuner alignment with the tuner out of the receiver chassis (using a separate power supply, as described previously), the local oscillator tuning cores should be adjusted as follows:

1. Connect the oscilloscope to the tuner test point at the 150-volt output of the power supply (see figure 2).

2. Follow steps 2 through 7 of the second procedure given under LOCAL-OSCILLATOR ADJUSTMENTS for the Turret Tuner, Part No. 76-5411-Series.

Bandwidth and R-F Response Adjustments

This information supersedes the procedures given in manuals PR-1823 and PR-1844. Trimmer locations are shown in figure 7. The alignment procedure for bandwidth and r-f response is as follows:

1. Connect the outputs of the AM and FM signal generators through the aerial-matching network (figure 3) to terminals 1 and 2 of Z1-T. Terminals 3 and 4 of Z1-T should be connected together, for a 300-ohm input.

2. Connect a 3300-ohm resistor in series with the 150-volt (red) B+ lead to R9-T. Connect the vertical input of the oscilloscope to the junction of the 3300-ohm resistor and R9-T. When making the tuner alignment with the tuner out of the receiver chassis (using a separate power supply), connect the oscilloscope to the tuner test point at the 150-volt output of the power supply (see figure 2).

3. Turn the CHANNEL SELECTOR to Channel 10, and remove the 1st v-i-f tube. If the alignment is being made with the tuner out of the receiver chassis, ground the white (a-g-c) wire. Connect a 470-ohm resistor from the green (v-i-f output) lead to ground.

4. Set the FM signal generator to 195 mc., with sufficient sweep to give the complete response curve.

5. Set the AM signal generator (unmodulated) to produce marker pips at the video and sound carriers for Channel 10.

6. Adjust C8-T and C11-T for maximum symmetrical response within Channel 10. If there is one weak station in the local area, the adjustment of C8-T and C11-T may be made on that channel, to improve the response provided that the response on other channels is not sacrificed too much.

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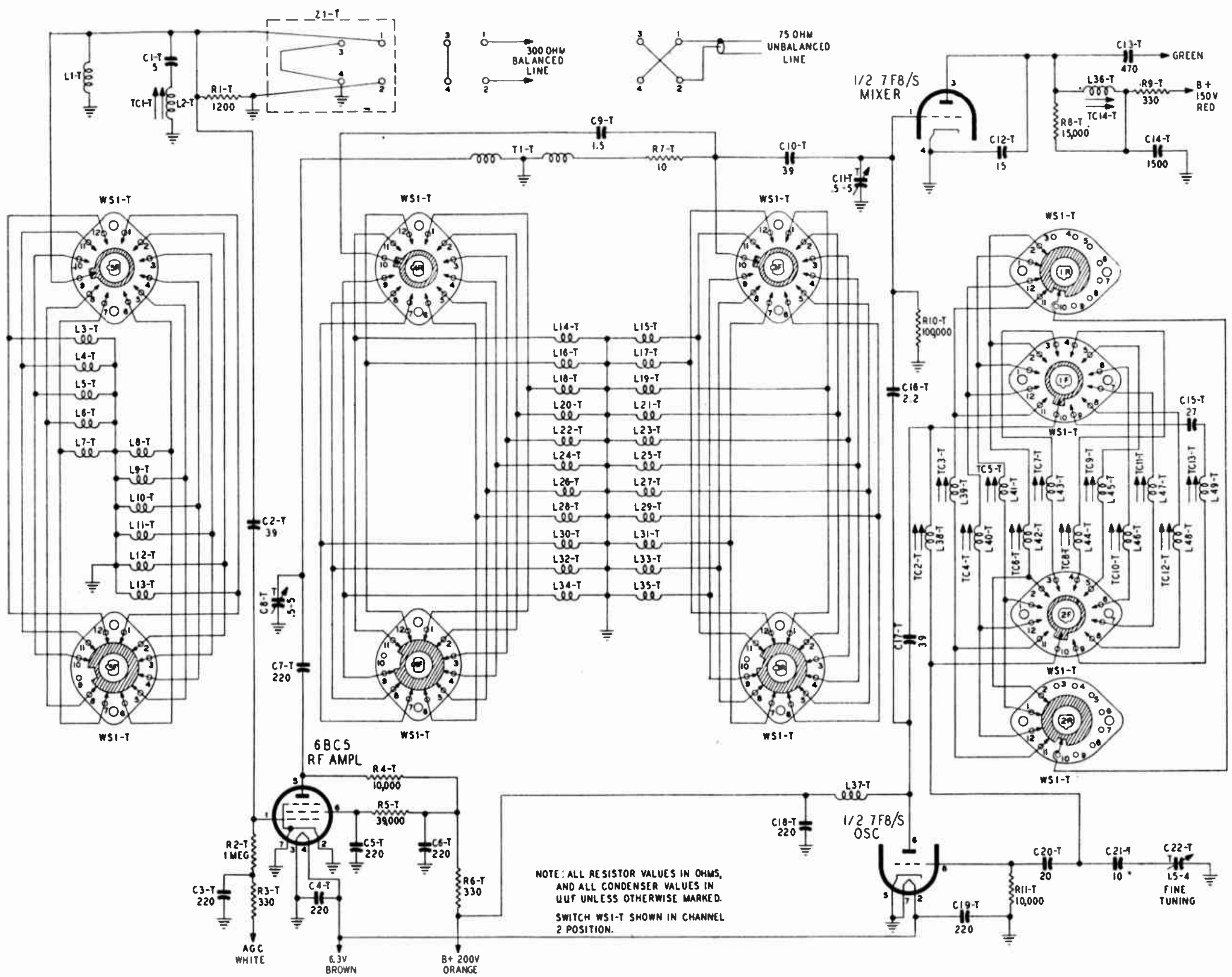

Figure 9. Wafer-Switch Tuner, Part No. 76-5433-Series, Schematic Diagram

ALL MODELS USING 76-5411 SERIES TURRET TUNER

Reduction of Modulation Hum

Modulation hum in the reception of high-frequency channels may be reduced by adding an additional 100-$\mu\mu$f. filament by-pass condenser (Part No. 30-1224-1). This condenser should be wired from the junction of L2-T and L4-T to ground. Physically, the condenser should be connected between the terminal holding the filament feed wire and the adjacent ground knock-out.

With the tuner in the chassis, the parts are made accessible by simply removing about half of the snap-in coils.

Part No. 76-5433 — Series Tuner — Additional Replacement Part

The FINE TUNING condenser for the above tuners is available for replacement purposes. The part number is 31-6517-1. This condenser is made accessible by first moving L38-T (Channel 2) and L39-T (Channel 3) oscillator coils. This may be done by compressing the coil mounting clips, then carefully pushing the coil back into the tuner, out of the way.

SUBSTITUTING PART NO. 76-5433-1 TUNERS FOR PART NO. 76-4402-6 AND PART NO. 76-5433 TUNERS

Tuner Part No. 76-5433-1 is built only to be shock-mounted; therefore, when using it to replace other tuners, mounting brackets are required. These brackets, including installation instructions, may be ordered by Part No. 45-9591.

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SPECIFICATIONS

Philco Television Receiver Model 50-702, Code 122, is an 18-tube superheterodyne table model with a mahogany-finished cabinet.

CHANNEL TUNING

The channel selector is the 12-position type, with provision for fine tuning on each of the 12 television channels.

AERIALS

Provisions are made for connecting a common aerial for high-band and low-band or for connecting separate high-band and low-band aerials.

AUDIO

Audio output, 2.5 watts; 5-inch electrodynamic speaker, with 3.2-ohm voice-coil impedance at 400 cycles.

INTERMEDIATE FREQUENCIES

Video Carrier: 26.6 megacycles.
Sound carrier: 22.1 megacycles.

ELECTRICAL

Operating voltage, 110—120 volts, 60 cycles, a.c.; power consumption, 125 watts. Power supplies (two): 300 volts d.c. at 200 ma.; 5000 volts d.c. at 2 ma.

VACUUM TUBES (18)

LOKTAL	OCTAL	MINIATURE	CRT
2-7F7	1-6V6GT	4-6AG5	1-7JP4
1-7X7	1-1B3GT	1-6BA6	
1-7F8		1-6AU6	
1-7B5		3-12AU7	
1-7N7			

TP-7008

MODEL 50-702, CODE 122

CIRCUIT DESCRIPTION

GENERAL

Philco Model 50-702, Code 122, is a seven-inch table model television receiver. The channel selector is a twelve-position selector, with fine tuning effective on each channel. Provisions are made for connecting either a common high-frequency and low-frequency aerial or separate high-frequency and low-frequency aerials.

POWER-SUPPLY SECTION

The power-supply section contains two power supplies; one is a low-voltage supply, which employs two dry-disc rectifiers connected as voltage doublers, and the other is a high-voltage supply, which employs an oscillator type of high-voltage source.

SOUND SECTION

The sound signal is taken off the third video-i-f stage and fed to the sound-i-f stages, which employ one 6BA6 tube and one 6AU6 tube. The diode section of a 7X7 tube is used as an FM sound detector; the triode section of the 7X7 functions as an audio amplifier. A 7B5 tube is used as an audio output tube.

VIDEO SECTION

The video section employs three 6AG5 tubes as i-f amplifiers, one half of a 12AU7 tube as a video detector and a-g-c rectifier, the other half of the tube as a video amplifier, and one half of another 12AU7 as a video output tube.

RADIO-FREQUENCY SECTION

The radio-frequency section employs one 6AG5 tube as a radio-frequency amplifier; one half of a 7F8 tube is used as an oscillator, and the other one half as a mixer.

SWEEP SECTION

The sync section employs one half of a 7F7 tube as a sync separator, and the other half as a sync amplifier. The vertical-sweep section comprises a conventional vertical-sweep circuit using one half of a 12AU7 as an oscillator and discharge tube, and one 7F7 as a push-pull output tube.

The horizontal-sweep circuit consists basically of a free-running blocking-oscillator sweep generator and incorporates automatic frequency control to lock in the circuit.

Figure 1 shows a simplified diagram. The sweep-generating circuit consists of L63 with C93 and C94 in series. These condensers are charged from B plus through L63, and are discharged, at the end of the sweep, by the conduction of the blocking-oscillator tube.

The repetition rate of the oscillator is determined by the time required to discharge C92 to the value at which the grid will conduct. It is possible to control the frequency of this oscillator by changing the time constants of the grid circuit (consisting of R94, R95, and C92) or by applying a small voltage to the grid circuit, thus changing the time required for C92 to discharge to a given value.

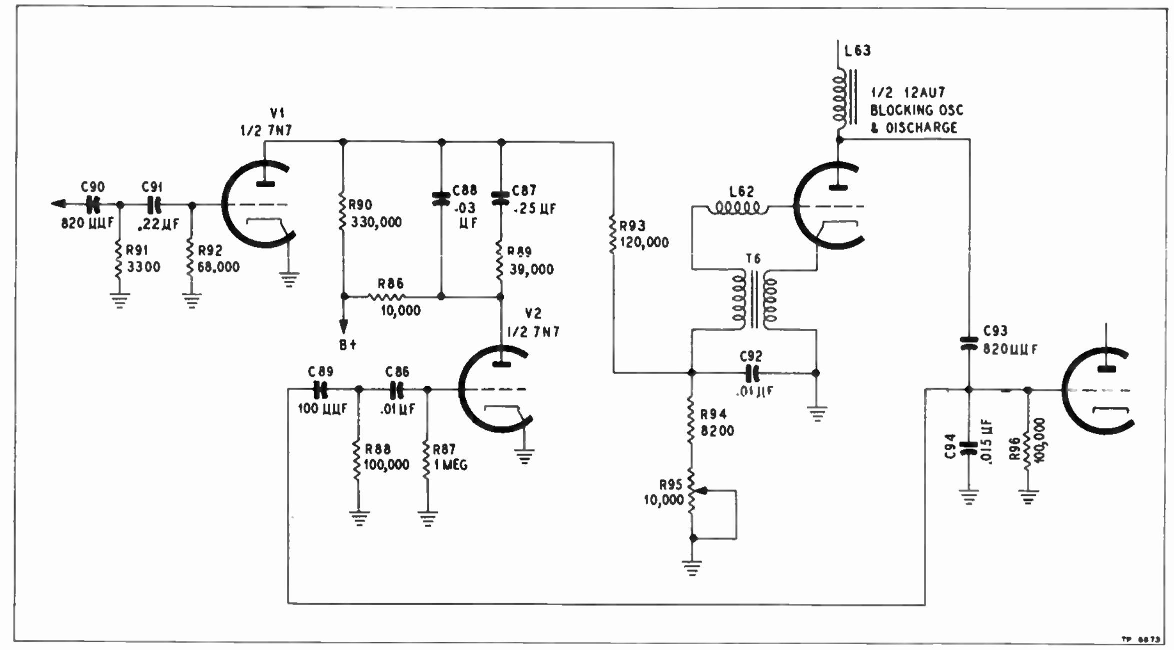

Figure 1. Simplified Schematic Diagram, Horizontal Sweep Control Circuit

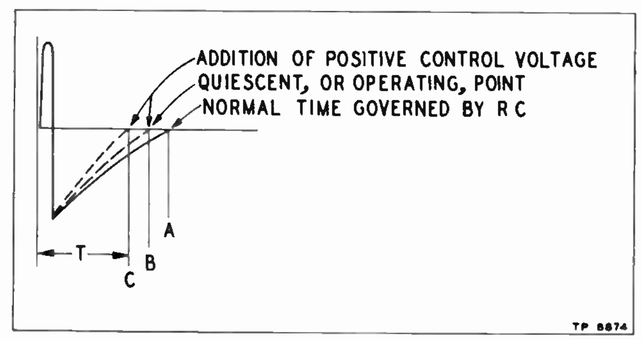

Figure 2. Blocking Oscillator Waveforms, Showing Effects of Control Voltage

Figure 2 shows waveforms at the grid of the blocking oscillator tube. The solid curve (A) shows how the waveform would appear if no control voltage were used. Curve B shows how the introduction of positive control voltage reduces the time required for the discharge of C92, thereby increasing the repetition rate. If an operating point is chosen so as to utilize an intermediate value of control voltage (Curve C), an *increase* in the control voltage will *increase* the repetition rate, and a *decrease* in the voltage will *decrease* the repetition rate. By making the level of the control voltage dependent upon the phase relationship between the incoming sync pulses and the horizontal sawtooth voltages, the oscillator circuit can be made to fall into sync, and to remain substantially independent of noise impulses.

To obtain the control voltage, the incoming positive sync pulses are applied, through a differentiating network (C90 and R91), to V1 and a portion of the horizontal sweep output, taken from the junction of C93 and C94, is passed through a differentiating network (C89 and R88) and applied to V2. C86 and R87 are used to maintain grid-leak bias for V2.

C91 and R92 are used to obtain grid-leak bias for V1, and the values are chosen to maintain grid cutoff between sync pulses.

Referring to figure 3, it can be seen that, the larger the plate current drawn by V1, the greater the drop across R90, and the lower the voltage at X, hence, the lower the voltage at Vc. Conversely, if the current drawn by V1 is decreased, the lower the voltage drop across R90, and higher the voltage at X and Vc.

The plate voltage of V1 contains d.c. with the differentiated sawtooth superimposed upon it. The average value of the plate current is determined by the phase relationship between the sync pulse and the sawtooth voltage. If the repetition rate of the blocking oscillator tends to become lower, a phase relationship similar to that shown in figure 4A appears. The sync pulses drive the grid positive at the instants when the plate voltage is low, resulting in low average plate current. This low plate current reduces the voltage drop across R90, increasing the positive voltage at points X and Vc, and increasing the repetition rate of the oscillator. Conversely, if the repetition rate tends to become higher, a phase relationship similar to that shown in figure 4B appears. The sync pulses drive the grid positive at the instants when the plate voltage is high, resulting in a higher average plate current. This increase in the plate current causes an increased drop across R90, lowering the voltage at points X and Vc, and causing the repetition rate to decrease.

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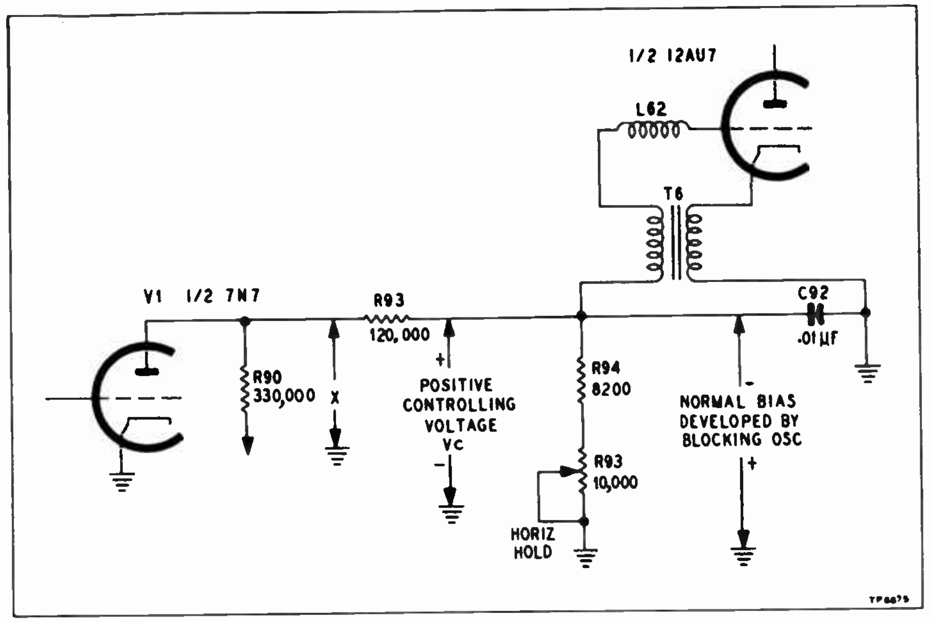

Figure 3. Breakdown Diagram of Control Circuit

Figure 4C shows the quiescent, or operating, condition. A tendency to change frequency in either direction will develop a change in the correcting voltage, to keep the oscillator in sync.

Two filter networks, as shown in figure 5, are used to filter out noise that might be present along with the sync voltages.

AERIAL CONNECTIONS

The aerial-input circuit has provisions for either single-aerial or dual-aerial installation. The receiver is normally wired for single-aerial installation; in this case, the aerial leadin is connected to the two-terminal board, TB1, which is mounted at the left-hand rear corner of the chassis (facing the rear of the chassis).

To adapt the receiver for dual-aerial operation, it is only necessary to clip the parallel conductor extending from TB1 into the tuner chassis (cut as close to the tuner chassis as possible); this prevents the length of parallel conductor from acting as a trap on the higher-frequency channels. Using plug Part No. 27-4788, connect the low-frequency aerial leadin to the two widely spaced pins, and the high-frequency aerial leadin to the two closely spaced pins. Insert the plug into the aerial-input receptacle, J1, which is located near the 7F8 tube.

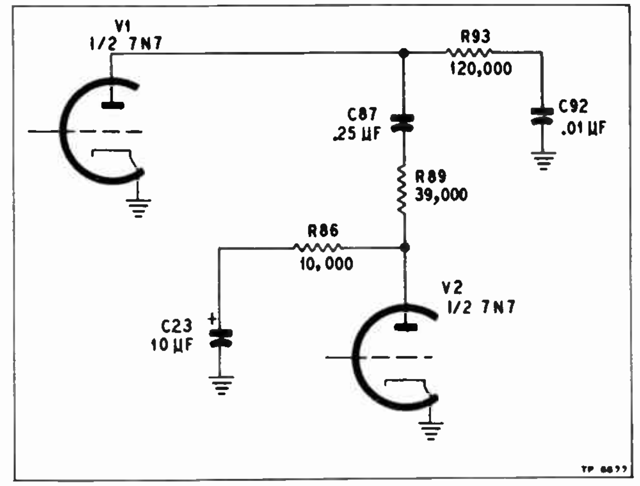

Figure 5. Filter Circuits

The aerial-input circuit is switched by means of a cam-operated switch, S2. The cam is operated by the shaft of the station-selector switch, and is so constructed that it places the switch in one position for Channels 2 through 6, and in another position for Channels 7 through 13. The action of S2 is as follows:

SINGLE-AERIAL OPERATION

1. Connects the aerial to the primary of the low-frequency aerial-input transformer, T3, or the high-frequency aerial-input transformer, T4, depending upon the channel selected.
2. Connects the control grid of the r-f amplifier to the proper secondary of either aerial-input transformer, depending upon the channel selected.
3. Grounds the primary winding of low-frequency aerial-input transformer when the high-frequency aerial input transformer is in use.

DUAL-AERIAL OPERATION

1. Connects the control grid of the r-f amplifier to the proper secondary of either aerial-input transformer, depending upon the channel selected.
2. Grounds the primary winding of the low-frequency aerial-input transformer when the high-frequency aerial-input transformer is in use.
3. The separate aerial leadins are permanently connected to the primaries of their respective transformers; therefore, no switching of the primaries is required.

ALIGNMENT PROCEDURE

TEST EQUIPMENT REQUIRED FOR ALIGNMENT

The following test equipment is recommended for aligning the receiver:

1. Philco Precision Visual Alignment Generator for Television and FM, Model 7008; this instrument has the following features:

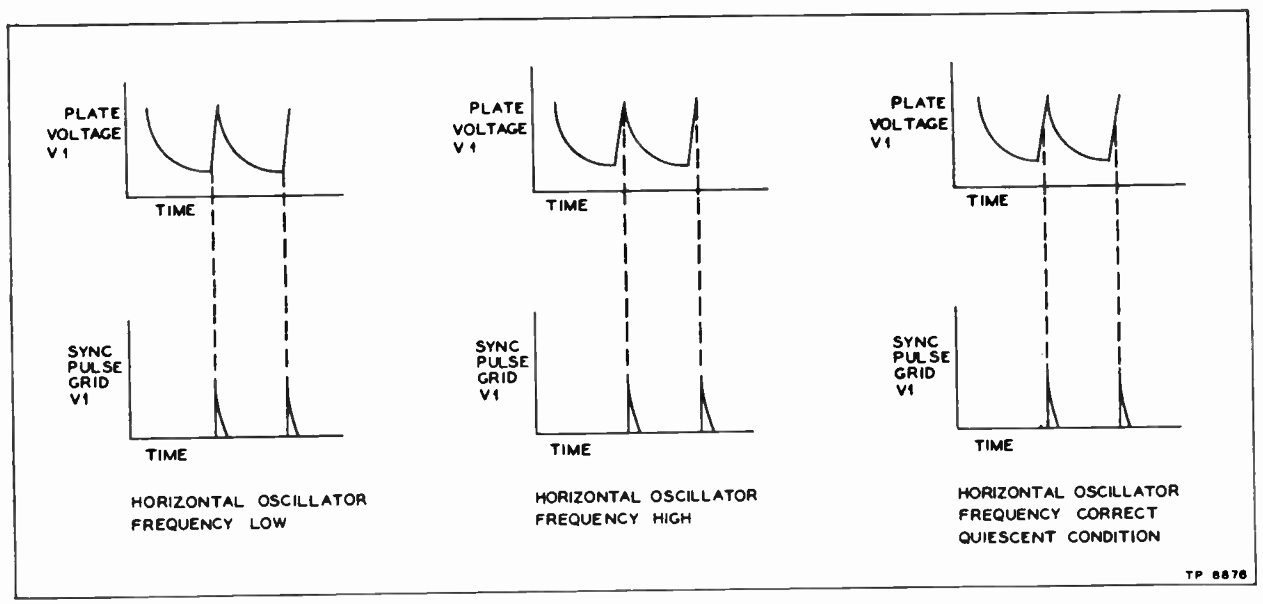

Figure 4. Sawtooth and Sync Relationships

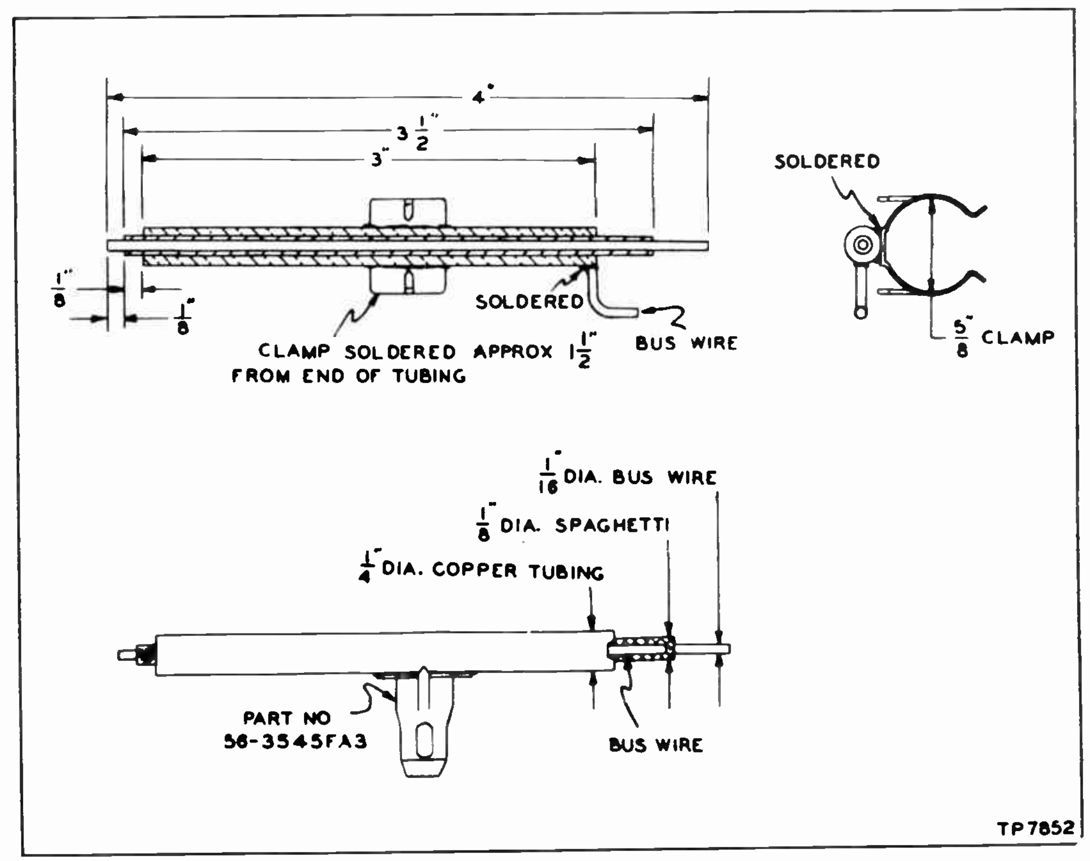

Figure 6. I-F Jig

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a. FM signal generator with ranges of 4—120 mc. and 144—260 mc., with a maximum deviation of 15 mc.
b. AM (marker) signal generator with ranges of 3.2—7.5 Mc., 6.4—15 mc., 14.5—36 mc., 69—125 mc., and 138—250 mc.
c. Built-in oscilloscope with sensitivity of 25 millivolts, 3-inch cathode-ray tube, and crosshatch screen.

2. D-c vacuum-tube voltmeter or 20,000-ohms-per-volt voltmeter.
3. If separate signal generators and oscilloscope are used, these instruments should have the following characteristics:
   a. FM signal generator—Deviation: ±4 mc.; center-frequency range: 20 mc. to 30 mc.; sweep-sync output with either built-in or separate phase corrector.
   b. AM signal generator—Carrier-frequency range, 20 mc. to 30 mc.; dial should be suitable for setting and resetting accurately to frequencies specified in ALIGNMENT CHART.
   c. Oscilloscope—Calibrated; vertical sensitivity of 1 volt (peak-to-peak) per inch, or better.

NOTE: When using a separate AM r-f signal generator to obtain a marker "pip," couple the output lead of this generator to the output lead of the FM generator, using just sufficient coupling to obtain a suitable pip.

ALIGNMENT JIGS

The following jigs are recommended for correctly coupling the signal generators to the various circuits where input signals are required for alignment.

I-F JIG

Figure 6 shows a jig which is recommended for coupling the signal generator to the various i-f grids. The following parts are necessary for the construction of this jig.

1. 3-inch length of 1/4-inch-diameter tubing.
2. 3½-inch length of 1/8-inch-diameter spaghetti.
3. 4-inch length of #12 or #14 bus wire.
4. Clamp, Philco Part No. 56-3545FA3.

To construct this jig, follow the procedure given below:

1. Insert the spaghetti into the tubing. Allow 1/8 inch to extend from one end of the tubing.
2. Insert the bus wire into the spaghetti. Allow 1/8 inch to extend from one end of the spaghetti.
3. Crimp one end of the tubing, to secure the spaghetti and bus wire.
4. Solder the clamp to the middle of the tubing.
5. If Model 7008 Visual Alignment Generator is used, solder a short piece of bus wire to the tubing, to provide a convenient ground connection for the output-cable terminating box.

The connections to the video-i-f amplifier grids are accessible from the top of the chassis through small holes near the tube shields. To use the jig, slide the clamp over the tube shield, and insert the probe end of the jig into the hole; adjust the height to insure good contact with the grid connection.

MIXER JIG (See figure 7)

Parts required

1 piece of 1/4-inch-diameter copper tubing, 1½ inches long.
1 piece of 1/8-inch-diameter spaghetti, 1¾ inches long.
1 piece of heavy bus wire, 2½ inches long.
1 piece of flat metal, ¾ inch wide, 2 inches long, and 1/32 inch thick.

Procedure:

Drill a 1/4 inch hole in one end of the metal piece. With a grindstone or file, taper the other end. Insert the copper tubing into the hole drilled in the metal piece, and solder the tubing so that one end is flush with the surface of the metal strip. Insert the spaghetti into the tubing, and fasten with glue. Allow some spaghetti to extend from each end. Insert the bus wire into the spaghetti. Solder the ground connection to the side of the tubing.

How to Use the Mixer Alignment Jig

Looking at the chassis from the side with the operating controls to the left, two holes will be seen on the side of the r-f tuner. The top hole is opposite the plate of C3, which connects directly to the mixer grid. Scratch an

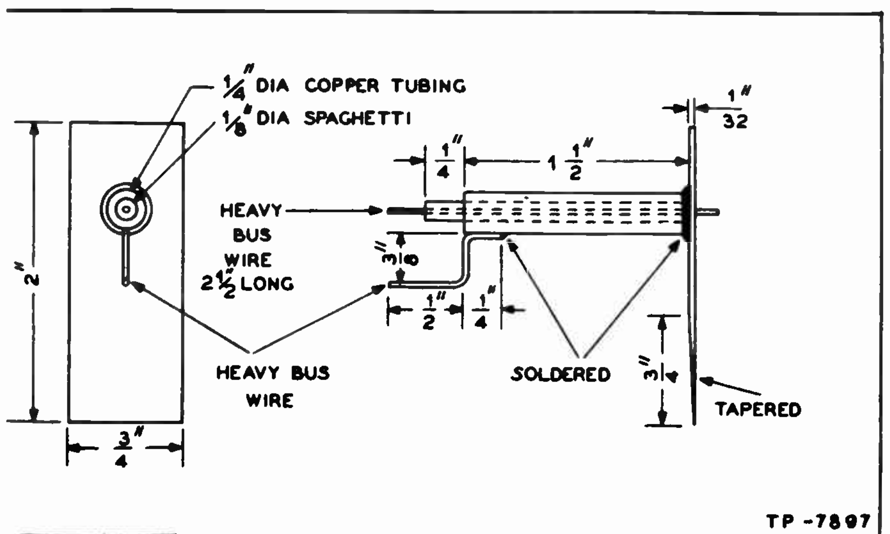

Figure 7. Mixer Jig

ALIGNMENT CHART

STEP	OUTPUT-INDICATOR CONNECTION	SIGNAL-GENERATOR CONNECTION	SIGNAL-GENERATOR SETTING	ADJUST
1	Connect vertical input of scope to ALIGN TEST jack J4.	Connect output of AM generator through i-f jig to grid (pin 1) of 3rd v-i-f amplifier.	22.1 mc. (modulated).	TC13 and TC22 for minimum indication.
2	Connect vertical input of scope to FM detector jack J3 (see Note 1).	Connect outputs of AM and FM generators through i-f jig to grid (pin 1) of 3rd v-i-f amplifier.	FM generator to 22.1 mc., with ± 4 mc. deviation; AM generator (modulated) to 22.1 mc.	TC15 for minimum amount of AM indication (see Note 2). TC14 for symmetrical pattern within limits shown by curves in figure 8.
3	Same as step 2.	Same as step 2.	FM generator to 22.1 mc., with ± 4 mc. deviation; AM generator off.	C27A and C27B for maximum peaks and symmetrical pattern.
4	Same as step 1.	Same as step 2.	FM generator to 25 mc., with ± 4 mc. AM generator (unmodulated) to 26.6 mc., to produce marker pip on response curve.	TC21 for curve 1.
5	Same as step 1.	Connect outputs of AM and FM generators through i-f jig to grid (pin 1) of 2nd v-i-f amplifier.	FM generator to 25 mc., with ± 4 mc. deviation. AM generator (unmodulated) to 24.5 mc., to produce marker pip on response curve.	TC20 for curve 2.
6	Same as step 1.	Connect outputs of AM and FM generators through i-f jig to grid (pin 1) of 1st v-i-f amplifier.	FM generator to 25 mc., with ± 4 mc. deviation. AM generator (unmodulated) to 24.5 mc., to produce marker pip on response curve.	TC 19 for curve 3.
7	Same as step 1.	Connect output of AM generator through mixer jig to grid (pin 1) of mixer tube.	AM generator (modulated) to 28.1 mc.	TC17 for minimum indication.
8	Same as step 1.	Connect outputs of AM and FM generators through mixer jig to grid (pin 1) of mixer tube.	FM generator to 25 mc. with ± 4 mc. deviation. AM generator (unmodulated) to 23.6 mc., 24.25 mc., 26.25 mc., and 26.6 mc., to produce marker pips on response curve.	Channel selector to Channel 2. TC16 and TC18 for curve 4. It may be necessary to readjust TC21, TC20, and TC19 to obtain this curve.

FINAL I-F CHECK

STEP	OUTPUT-INDICATOR CONNECTION	SIGNAL-GENERATOR CONNECTION	SIGNAL-GENERATOR SETTING	ADJUST
9	Connect vertical input of scope to ALIGN TEST jack J4. Connect a v.t.v.m. (0-10v. scale) to FM detector jack J3. Use adapter shown in figure 12.	Same as step 1.	AM generator (modulated) to 22.1 mc.	When indication on scope is minimum, the v.t.v.m. should read zero. If this reading is not zero, adjust TC15. If this reading requires more than one-half turn, repeat step 2.

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index mark on the chassis at the center of the top hole, and scratch an index mark on the metal piece at the center of the tubing. Insert the tapered end of the metal strip between the r-f tuner and the chassis, and push down until the index marks coincide. Push the bus wire in gently until it makes contact with the plate of C3. Connect the "hot" lead of the signal generator to the center bus wire, and connect the ground lead of the signal generator to the outside bus wire.

GENERAL

WARNING—Dangerous potentials are present in the receiver when it is operating, and for a short time after it has been turned off.

The intermediate frequencies are 22.1 mc. for the sound channel and 26.6 mc. for the video channel. Alignment of circuits operating at these high frequencies requires careful workmanship and good equipment. The following precautions must be observed:

1. The top of the work bench must be metallic, and the test equipment and television-receiver chassis must make good metal-to-metal contact with the bench top.
2. In order to gain access to the i-f adjustments, it is necessary to remove the picture tube from its holder, as follows:
   a. Remove the chassis from the cabinet.
   b. Disconnect the tube socket.
   c. Remove the screw that tightens the clamp around the front of the tube.
   d. Slide the tube out of the holder.

NOTE: The tube socket should be reconnected before the receiver is turned on.

3. During the alignment, the signal-generator output should be attenuated to keep the output indication below 2 volts, peak-to-peak.
4. Allow the receiver and test equipment to warm up for 15 minutes before starting the alignment.
5. Set the receiver controls as follows:
   a. OFF-ON-VOLUME control fully clockwise.
   b. CONTRAST control fully clockwise. (When starting the alignment, it may be necessary to retard the CONTRAST control slightly, to prevent regeneration.)
   c. BRIGHTNESS control to give a dim raster.

NOTES

1. The scope should be connected to pin 1 of J3.
2. The AM signal will appear as a series of sine waves superimposed on the discriminator curve.

ALIGNMENT OF TUNER

The r-f tuner is aligned at the factory and normally needs no adjustment other than the fine tuning. However, under certain conditions such as the replacement of tubes, it may be necessary to touch up the adjustments. The procedure for making these adjustments is as follows:

EQUIPMENT

1. 7008 Philco Visual Alignment Generator, or equivalent.

PROCEDURE

1. Set the tuner to Channel 2.
2. Connect the outputs of the AM and FM generators to the aerial terminal board, TB1 (see NOTE below).

2A. Connect the vertical input of the oscilloscope to the tuner test jack, J2.

3. Set the FM output for Channel 2—55 mc., with ± 4 mc. deviation.
4. Set the AM (unmodulated) output to 54 mc. and 60 mc., to produce marker pips on the response curve.
5. Short out the 1st i-f coil; this can be done from the top of the tuner, by inserting a piece of solder into the hole that is adjacent to the i-f adjusting trimmer TC16. Allow the solder to make contact with the chassis and the lug located under the hole.
6. Adjust C10 for band width, as shown in figure 10. (The permissible limits of the band pass lie between 6 mc. and 14 mc., at 70% amplitude.)
7. Set the tuner to Channel 6.
8. Set the FM output to 85 mc., with ± 4 mc. deviation.
9. Adjust C4 for maximum output and symmetry of curve.
10. Set the tuner to Channel 13.
11. Set the FM output to 213 mc., with ± 4 mc. deviation.
12. Adjust C5 and C3 for maximum output and symmetry of curve.

NOTE: The generator should be connected to the aerial-input terminals through a matching network, shown in figure 11. These resistors should be chosen from a group to obtain values close to those indicated. In cases where an installation uses two aerials, it will be necessary to connect the generator to the low-frequency aerial-input terminals of J1.

ADJUSTING LOCAL OSCILLATOR

1. Remove the chassis from the cabinet.
2. Connect a 20,000-ohms-per-volt voltmeter to the FM detector jack, J3, using the adapter shown in figure 12.
3. Turn the channel selector to Channel 2.
4. Adjust the FINE TUNING control to the middle of its range.
5. Connect an accurately calibrated AM signal generator to the aerial-input terminals of the receiver, and tune the generator to the sound-carrier frequency of Channel 2.
6. Tune the oscillator core for zero reading on the voltmeter.
7. Repeat the above steps for Channels 3 through 13, in order.

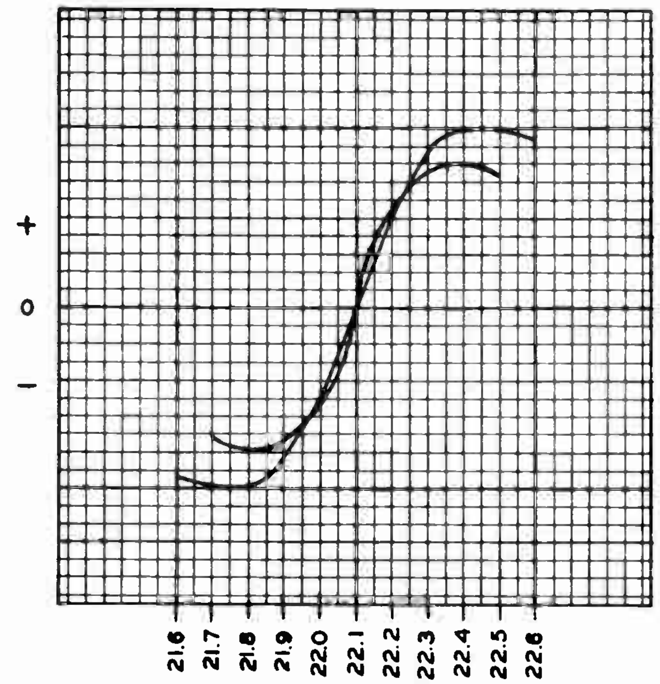

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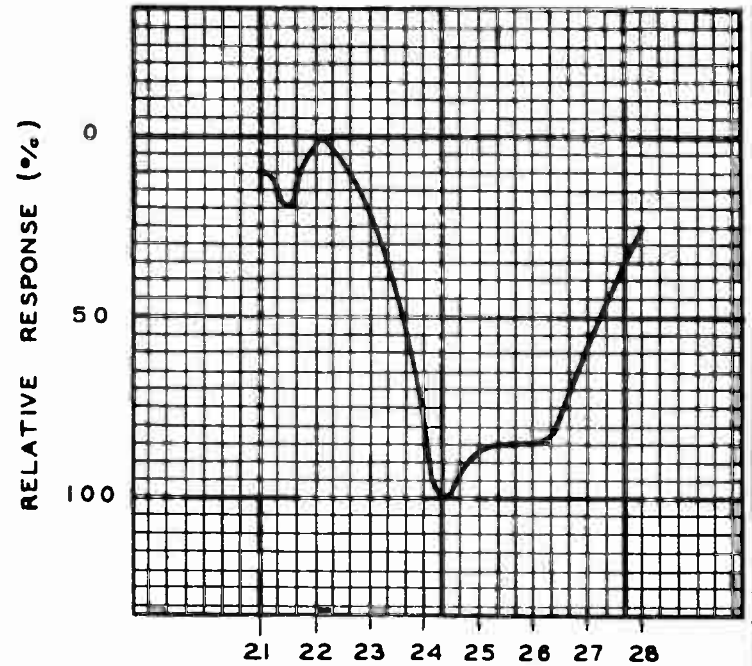
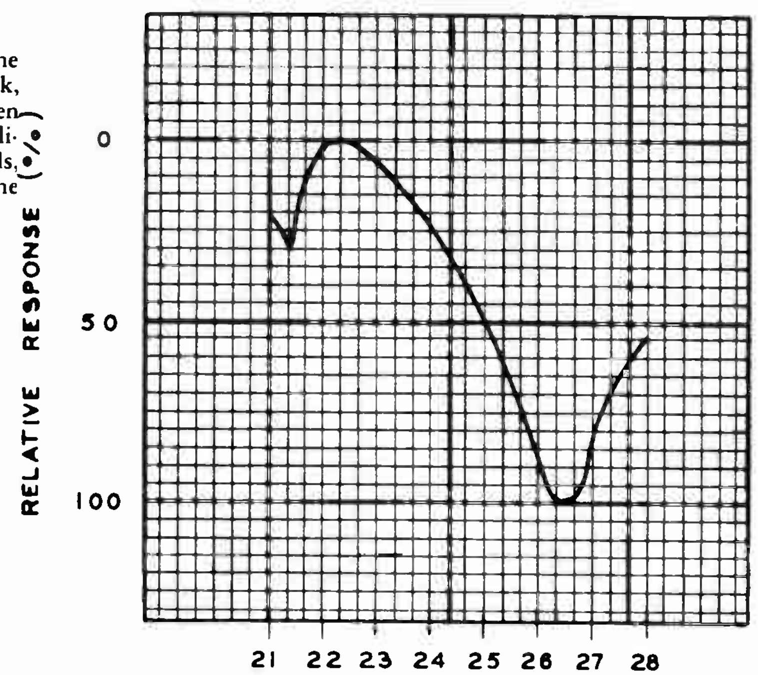
Figure 8. FM-Detector Curve



TP 8841 B

CURVE 2

Figure 9. Alignment Curves (Cont.)



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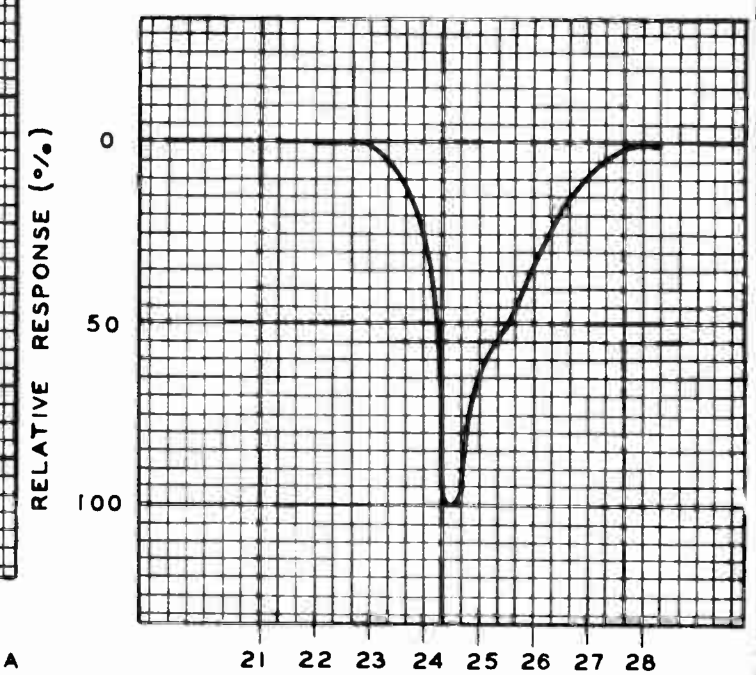
CURVE 1

Figure 9. Alignment Curves



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CURVE 3

Figure 9. Alignment Curves (Cont.)

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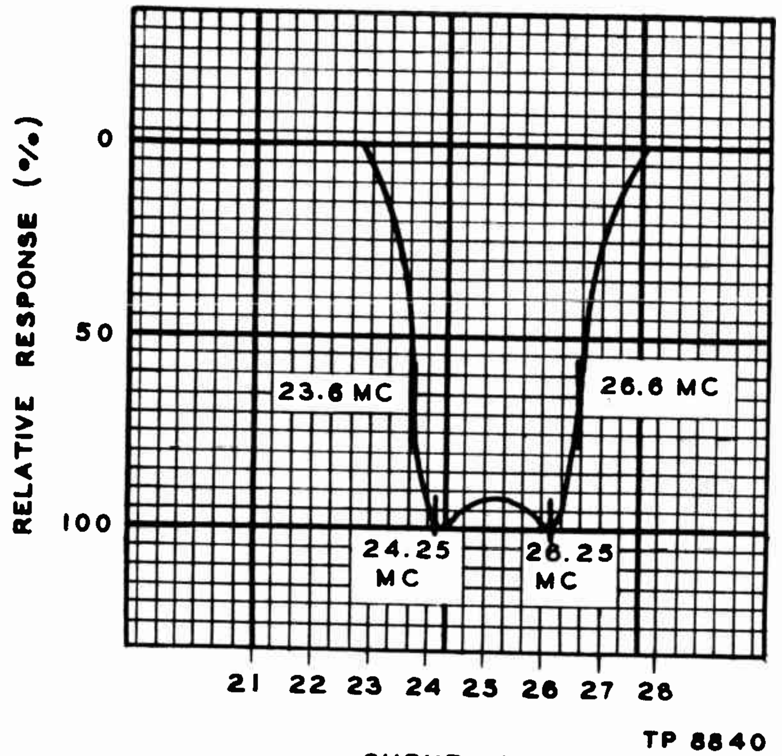

CURVE 4

Figure 9. Alignment Curves (Cont.)

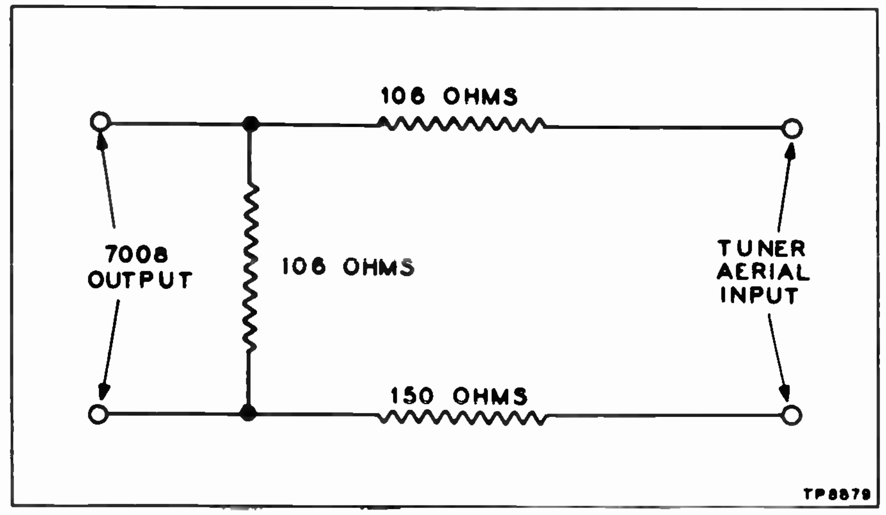

Figure 11. Aerial-Input-Matching Networks

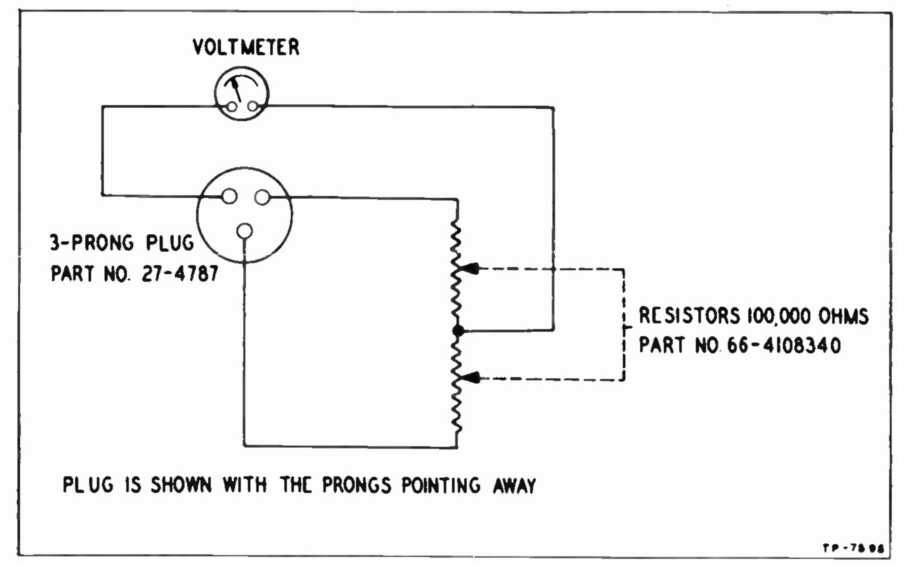

Figure 12. Oscillator Alignment Adapter

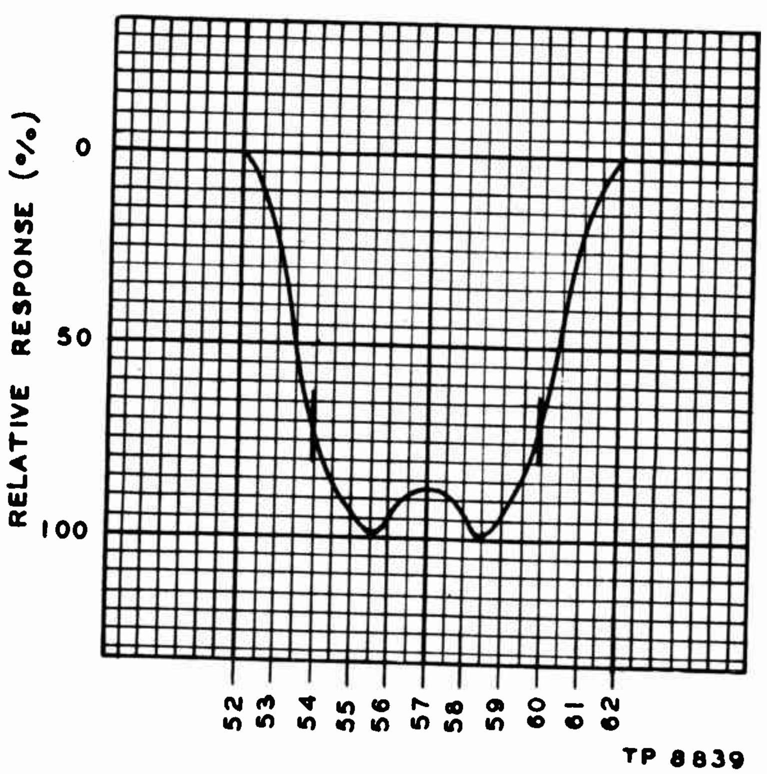

Figure 10. R-F Curve

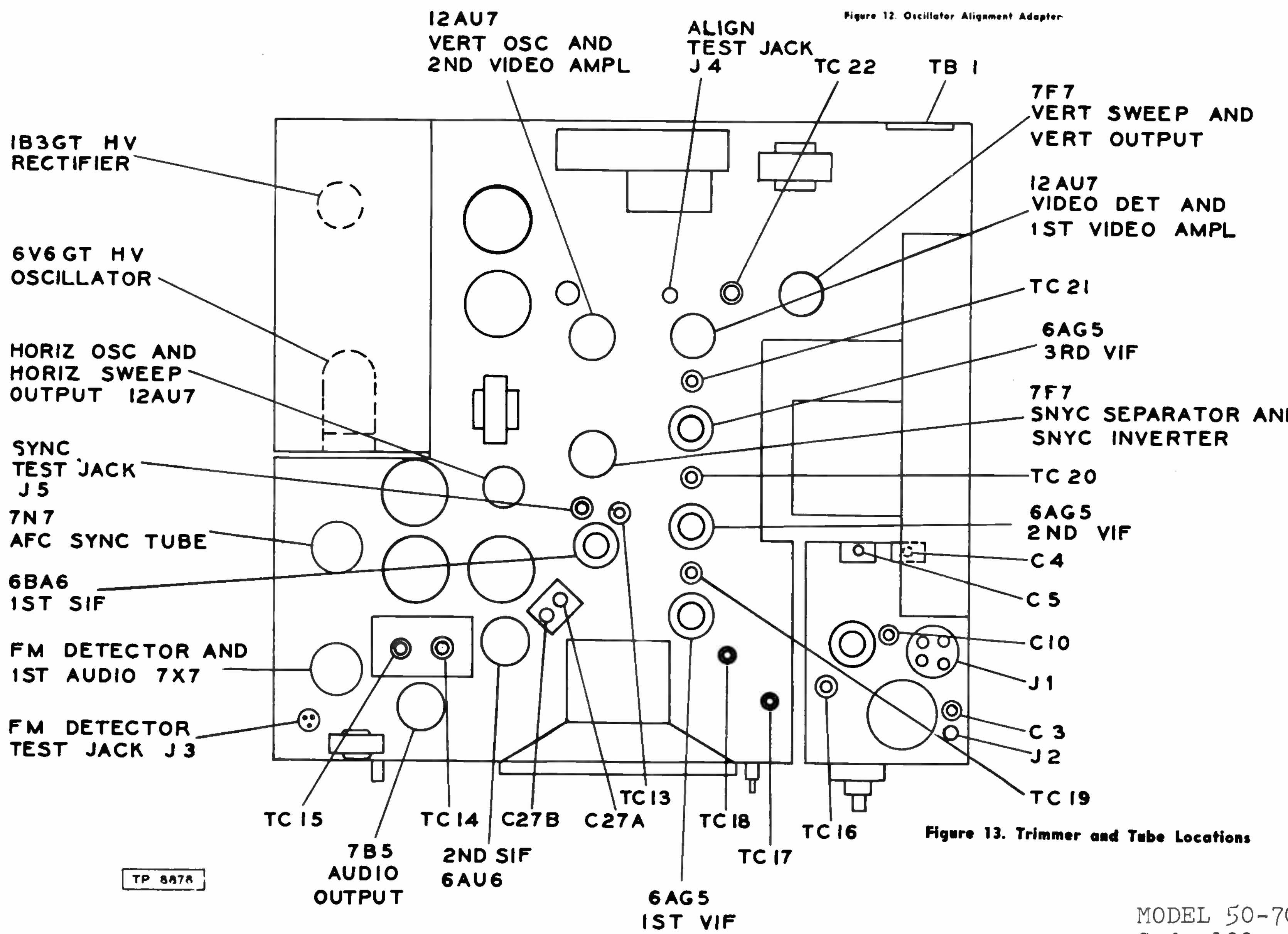

Figure 13. Trimmer and Tube Locations

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WAVEFORMS AND VOLTAGES

A calibrated test oscilloscope is required for viewing and measuring the waveforms.

For viewing the waveforms in the vertical sync and sweep circuits, adjust the oscilloscope sweep for 30 c.p.s. (half the vertical-sweep rate). For viewing the waveforms in the horizontal sync and sweep circuits, adjust the oscilloscope sweep for 7875 c.p.s. (half the horizontal-sweep rate).

The waveforms in the chart are sized for clarity and are not intended to illustrate relative amplitudes. Approximate peak-to-peak voltages are given for each waveform. The peak-to-peak voltages in the sync circuits are the values obtained with approximately one volt, peak-to-peak, at the VIDEO TEST jack, J4, when the controls are set to give a normal picture.

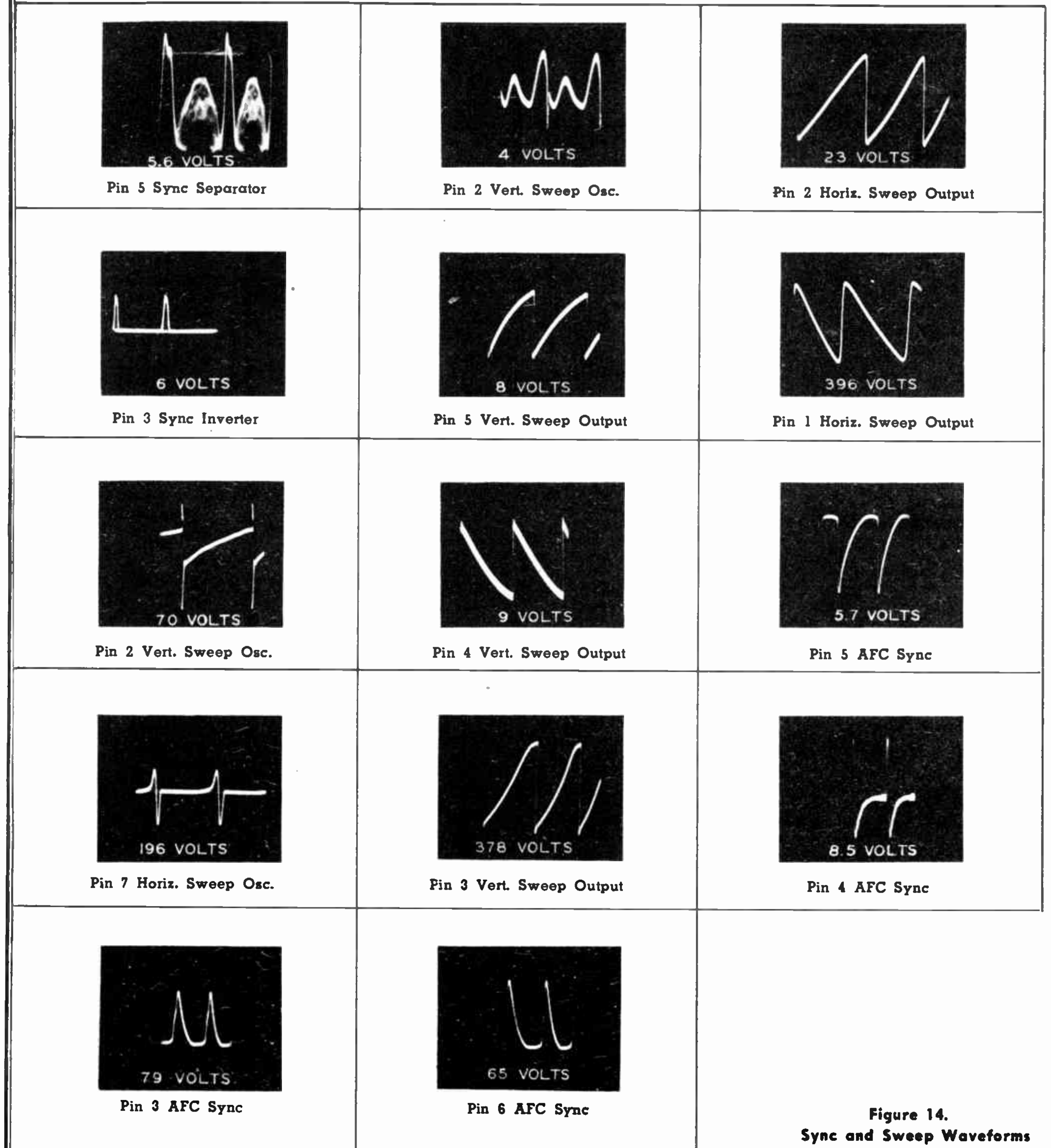

Figure 14.
Sync and Sweep Waveforms

REPLACEMENT PARTS LIST

NOTE: Part numbers identified by an asterisk (*) are general replacement items. These numbers may not be identical with those on factory parts; also, the electrical values of some replacement items may differ from the values indicated in the schematic diagram and parts list. The values substituted in any case are so chosen that the operation of the receiver will be either unchanged or improved. When ordering replacements, use only the "Service Part No."

In the event of failure of any component in the tuner, other than tubes, the entire tuner is to be exchanged through your Philco Distributor. Only tuners found to be defective by the Philco Distributor will be accepted for exchange.

The part number of the r-f tuner assembly is 76-4402-7.

Reference Symbol	Description	Service Part No.
C1	Condenser, d-c blocking, 1.5 μμf.	Part of 76-4402-7
C2	Condenser, d-c blocking, 22 μμf.	Part of 76-4402-7
C3	Condenser, mixer trimmer, .5—5 μμf.	Part of 76-4402-7
C4	Condenser, l-f aerial input	Part of 76-4402-7
C5	Condenser, h-f aerial input	Part of 76-4402-7
C6	Condenser, h-f aerial, 27 μμf.	Part of 76-4402-7
C7	Condenser, d-c blocking, 220 μμf.	Part of 76-4402-7
C8	Condenser, r-f by-pass, 220 μμf.	Part of 76-4402-7
C9	Condenser, cathode by-pass, 220 μμf.	Part of 76-4402-7
C10	Condenser, r-f plate trimmer, .5—5 μμf.	Part of 76-4402-7
C11	Condenser, cathode by-pass, 220 μμf.	Part of 76-4402-7
C12	Condenser, d-c blocking, 39 μμf.	Part of 76-4402-7
C13	Condenser, screen by-pass, 220 μμf.	Part of 76-4402-7
C14	Condenser, oscillator injection, 5 μμf.	Part of 76-4402-7
C15	Condenser, r-f by-pass, 220 μμf.	Part of 76-4402-7
C16	Condenser, d-c blocking, 220 μμf.	Part of 76-4402-7
C17	Condenser, d-c blocking, 10 μμf.	Part of 76-4402-7
C18	Condenser, r-f by-pass, 220 μμf.	Part of 76-4402-7
C19	Condenser, fixed padder, 10 μμf.	Part of 76-4402-7
C20	Condenser, trimmer, fine tuning	Part of 76-4402-7
C21	Condenser, fixed padder, 27 μμf.	Part of 76-4402-7
C22	Condenser, fixed padder, 39 μμf.	Part of 76-4402-7
C23	Condenser, filter, 10 μf.	30-2417-6
C24	Condenser, r-f by-pass, 220 μμf.	Part of 76-4402-7
C25	Condenser, fixed trimmer, 56 μμf.	62-056409001*
C26	Condenser, d-c blocking, .01 μf.	61-0120*
C27A	Condenser, trimmer	Part of Z1
C27B	Condenser, trimmer	Part of Z1
C28	Condenser, r-f by-pass, 1500 μμf.	62-215001011*
C29	Condenser, grid, 56 μμf.	60-056409001*
C30	Condenser, d-c blocking, 3.3 μμf.	30-1224-30*
C31	Condenser, r-f by-pass, 1500 μμf.	62-215001011*
C32	Condenser, balancing, 2.2 μμf.	30-1221-4*
C33	Condenser, r-f by-pass, 1500 μμf.	62-215001011*
C34	Condenser, r-f by-pass, 1500 μμf.	62-215001011*
C35	Condenser, r-f by-pass, 1500 μμf.	62-215001011*
C36	Condenser, detector filter, 2 μf., 50v	30-2417-7
C37	Condenser, d-c blocking, .02 μf., 200v	61-0108*
C38	Condenser, d-c blocking, .01 μf., 400v	61-0120*
C39	Condenser, r-f by-pass, 1500 μμf.	62-215001011*
C40	Condenser, d-c blocking, .047 μf.	61-0122*
C41	Condenser, r-f by-pass, 470 μμf.	62-147001001*
C42	Condenser, cathode by-pass, 40 μf., 50v	Part of C106
C43	Condenser, filter, 10 μf., 450v	Part of C106
C44	Condenser, tone compensator, .0068 μf.	61-0174*
C45	Condenser, r-f by-pass, 1500 μμf.	62-215001011*
C46	Condenser, d-c blocking, 470 μμf.	62-147001001
C47	Condenser, fixed trimmer, 22 μμf.	62-022009001*
C48	Condenser, fixed trimmer, 22 μμf.	62-022009001*
C49	Condenser, r-f by-pass, 1500 μμf.	62-215001011*
C50	Condenser, screen by-pass, 1500 μμf.	62-215001011*
C51	Condenser, d-c blocking, 470 μμf.	62-147001001*
C52	Condenser, r-f by-pass, 1500 μμf.	62-215001011*
C53	Condenser, screen by-pass, 1500 μμf.	62-215001011*
C54	Condenser, d-c blocking, 470 μμf.	62-147001001*
C55	Condenser, r-f by-pass, 1500 μμf.	62-215001011*
C56	Condenser, screen by-pass, 1500 μμf.	62-215001011*
C57	Condenser, d-c blocking, 470 μμf.	62-147001001*
C58	Condenser, cathode by-pass, 2 μf.	30-2417-7
C59	Condenser, r-f by-pass, 47 μμf.	30-1224-2*
C60	Condenser, d-c blocking, 10 μμf.	62-010009001*
C61	Condenser, fixed trimmer, 56 μμf.	62-056409001
C62	Condenser, d-c blocking, .05 μf.	61-0122*
C63	Condenser, h-f compensation, 100 μμf.	62-110009001*
C64	Condenser, l-f compensation, 10 μf.	Part of C107
C65	Condenser, d-c blocking, .22 μf.	45-3500-9*
C66	Condenser, l-f compensation, 10 μf.	Part of C107
C67	Condenser, d-c blocking, .01 μf.	61-0120*
C68	Condenser, a-g-c filter, .5 μf.	61-0133
C69	Condenser, d-c blocking, .002 μf.	61-0062*
C70	Condenser, d-c blocking, .05 μf.	61-0170
C71	Condenser, 3-section filter	30-2570-37*
C71A	Condenser, filter, 10 μf.	Part of C71
C71B	Condenser, cathode by-pass, 10 μf.	Part of C71
C72	Condenser, d-c blocking, .01 μf.	61-0120*
C73	Condenser, integrating, .001 μf.	45-3500-5
C74	Condenser, integrating, .0015 μf.	62-215001011*
C75	Condenser, integrating, .0015 μf.	62-215001011*
C76	Condenser, feedback, .1 μf.	45-3500-8*
C77	Condenser, charging, .25 μf.	61-0122*
C78	Condenser, shaping, .0068 μf.	61-0127*
C79	Condenser, d-c blocking, .1 μf.	61-0113*
C80	Condenser, filter, .0068 μf.	61-0127*
C81	Condenser, voltage divider, 100 μμf.	62-110009001*
C82	Condenser, voltage divider, .004 μf.	45-3500-17*
C83	Condenser, d-c blocking, .0047 μf.	30-4661-2*
C84	Condenser, d-c blocking, .0047 μf.	30-4661-2*
C85	Condenser, cathode by-pass, .25 μf.	61-0125*
C86	Condenser, d-c blocking, .01 μf.	61-0120*
C87	Condenser, filter, .25 μf.	61-0125*
C88	Condenser, d-c blocking, .03 μf.	61-0119*
C89	Condenser, differentiating, 100 μμf.	62-110009001*
C90	Condenser, differentiating, 820 μμf.	60-10825401*
C91	Condenser, d-c blocking, .22 μf.	61-0125*
C92	Condenser, charging, .01 μf.	61-0120*
C93	Condenser, sweep charging, 820 μμf.	60-10825401*
C94	Condenser, sweep charging, .015 μf.	
C95	Condenser, d-c blocking, .0047 μf.	30-4661-2*
C96	Condenser, d-c blocking, .0047 μf.	30-4661-2*
C97	Condenser, d-c blocking, .001 μf.	45-3500-5*
C98	Condenser, screen by-pass, .15 μf.	61-0193*
C99	Condenser, fixed trimmer, .02 μf.	61-0118*
C100	Condenser, filter, .0047 μf.	30-4661-2*
C101	Condenser, filter, .0047 μμf.	30-4661-2*
C102	Condenser, filter, 50 μf., 250v	30-2568-32*
C103	Condenser, filter, 50 μf., 250v	30-2568-32*
C104	Condenser, filter, 80 μf., 250v	Part of C71

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REPLACEMENT PARTS LIST (Cont.)

Reference Symbol	Description	Service Part No.
C105	Condenser, filter, 2 µf., 50v	30-2417-7*
C106	Condenser, 1 section of a 3-section filter, 40 µf., 250v	30-2570-36
C107	Condenser, 1 section of a 3-section filter, 40 µf., 250v	30-2570-36
C108	Condenser, line filter, .01 µf.	61-0120*
C109	Condenser, line filter, .01 µf.	61-0120*
CR1	Rectifier, selenium	34-8003-5
CR2	Rectifier, selenium	34-8003-4
J1	Socket, aerial	Part of 76-4402-7
J2	Jack, tuner test	Part of 76-4402-7
J3	Socket FM test	27-6126
J4	Jack, align test	27-6180
J5	Jack, sync test	27-6180
J6	Socket, power	27-6240
L1 to L34	Tuning coils	Part of 76-4402-7
L35	Choke, plate	Part of 76-4402-7
L36	Choke, plate	Part of 76-4402-7
L37	Autotransformer, sound	32-4303
L38	Coil, primary	Part of Z1
L39	Coil, secondary	Part of Z1
L40	Coil, primary	Part of Z2
L41	Coil, secondary	Part of Z2
L42	Coil, coupling	Part of Z2
L43	Choke, filament	32-4112-11
L44	Choke, filament	32-4112-11
L45	Coil, plate tank	32-4359
L46	Coil, adjacent-sound trap	32-4234-4
L47	Coil, grid tank	32-4233-2
L48	Coil, plate tank	32-4234-1
L49	Choke, filament	32-4112-11
L50	Choke, r-f	32-4112-11
L51	Coil, plate tank	32-4234-1
L52	Coil, plate tank	32-4234-1
L53	Choke, cathode	32-4143-1
L54	Choke, filament	32-4112-11
L55	Coil, accompanying-sound trap	32-4303
L56	Coil, series compensation	32-4143
L57	Coil, shunt compensation	32-4143-7
L58	Coil, series compensation	32-4143-7
L59	Coil, shunt compensation	32-4143-7
L60	Coil, series compensation	32-4143-5
L61	Coil, shunt compensation	32-4143-7
L62	Choke, shaping	32-4143-7
L63	Choke, plate load	32-9618
L64	Choke, plate load	32-9618
L65	Choke, r-f	32-4112-15
L66	Choke, filament	32-4112-11
L67	Field Coil	Part of LS1
LS1	Speaker	36-1625-7
PL1	Plug, power	Part of W1
R1	Resistor, loading, 3300 ohms	Part of 76-4402-7
R2	Resistor, grid return, 100,000 ohms	Part of 76-4402-7
R3	Resistor, loading, 10,000 ohms	Part of 76-4402-7
R4	Resistor, grid return, 330 ohms	Part of 76-4402-7
R5	Resistor, a-v-c filter, 10,000 ohms	Part of 76-4402-7
R6	Resistor, cathode bias, 100 ohms	Part of 76-4402-7
R7	Resistor, shunt feed, 3300 ohms	Part of 76-4402-7
R8	Resistor, grid bias, 10,000 ohms	Part of 76-4402-7
R9	Resistor, plate dropping, 12,000 ohms	Part of 76-4402-7
R10	Resistor, loading, 22,000 ohms	66-3228340*
R11	Resistor, grid return, 470,000 ohms	66-4478340*
R12	Resistor, cathode bias, 150 ohms	66-1158340*
R13	Resistor, plate decoupling, 3300 ohms	66-2334340*
R14	Resistor, grid return, 68,000 ohms	66-3688340*
R15	Resistor, plate decoupling, 8200 ohms	66-2828340*
R16	Resistor, voltage divider, 22,000 ohms	66-3228340*
R17	Resistor, FM detector, 47 ohms	66-0478340*
R18	Resistor, diode return, 47,000 ohms	66-3478340*

Reference Symbol	Description	Service Part No.
R19	Resistor, load, 100,000 ohms	66-4108340*
R20	Resistor, potentiometer, VOLUME control, 2 megohms	33-5566
R21	Resistor, grid return, 4.7 megohms	66-5478340*
R22	Resistor, plate load, 330,000 oms	66-4338340*
R23	Resistor, plate dropping, 1000 ohms	66-2104340*
R24	Resistor, grid return, 1 megohm	66-5108340*
R25	Resistor, cathode bias, 680 ohms	66-1684340*
R26	Resistor, plate dropping, 10,000 ohms	66-3108340*
R27	Resistor, plate load, 15,000 ohms	66-3158340*
R28	Resistor, plate decoupling, 3300 ohms	66-2338340*
R29	Resistor, decoupling, 22,000 ohms	66-3228340*
R30	Resistor, grid return, 15,000 ohms	66-3158340*
R31	Resistor, bias decoupling, 3300 ohms	66-2338340*
R32	Resistor, plate decoupling, 330 ohms	66-1338340*
R33	Resistor, cathode bias, 68 ohms	66-0688340*
R34	Resistor, plate decoupling, 330 ohms	66-1338340*
R35	Resistor, plate decoupling, 330 ohms	66-1338340*
R36	Resistor, grid return, 10,000 ohms	66-3108340*
R37	Resistor, bias filter, 3300 ohms	66-2338340*
R38	Resistor, cathode bias, 68 ohms	66-0688340*
R39	Resistor, grid return, 22,000 ohms	66-3228340*
R40	Resistor, cathode bias, 100 ohms	66-1108340*
R41	Resistor, screen dropping, 330 ohms	66-1338340*
R42	Resistor, cathode dropping, 470,000 ohms	66-4478340*
R43	Resistor, a-g-c filter, 470,000 ohms	66-4478340*
R44	Resistor, a-g-c load, 330,000 ohms	66-4338340*
R45	Resistor, loading, 47,000 ohms	66-3478340*
R46	Resistor, diode load, 4700 ohms	66-2478340*
R47	Resistor, grid return, 1 megohm	66-5108340*
R48	Resistor, loading, 47,000 ohms	66-3478340*
R49	Resistor, compensation, 3300 ohms	66-2338340*
R50	Resistor, plate load, 3900 ohms	66-2394340*
R51	Resistor, compensation, 4700 ohms	66-2474340*
R52	Resistor, grid return, 330,000 ohms	66-4338340*
R53	Resistor, potentiometer CONTRAST control, 5000 ohms	Part of R85
R54	Resistor, plate load, 5600 ohms	66-2564340*
R55	Resistor, compensation, 2200 ohms	66-2224340*
R56	Resistor, grid return, 2.2 megohms	66-5228340*
R57	Resistor, filter, 8200 ohms	66-2828340*
R58	Resistor, grid return, 1 megohm	66-5108340*
R59	Resistor, grid return, 1.2 megohms	66-5128340*
R60	Resistor, voltage divider, 15,000 ohms	66-3154340*
R61	Resistor, plate load, 15,000 ohms	66-3154340*
R62	Resistor, plate dropping, 10,000 ohms	66-3104340*
R63	Resistor, potentiometer VERT. HOLD control, 100,000 ohms	35-5563-2
R64	Resistor, limiting, 68,000 ohms	66-3688340*
R65	Resistor, integrating, 22,000 ohms	66-3228340*
R66	Resistor, integrating, 22,000 ohms	66-3228340*
R67	Resistor, integrating, 33,000 ohms	66-3338340*
R68	Resistor, plate loading, 10,000 ohms	66-3108340*
R69	Resistor, limiting, 150,000 ohms	66-4158340*
R70	Resistor, potentiometer HEIGHT control, 500,000 ohms	33-5565-2
R71	Resistor, vertical charging, 150,000 ohms	66-4158340*
R72	Resistor, voltage divider, 3.9 megohms	66-5398340*
R73	Resistor, voltage divider, 220,000 ohms	66-4224340*
R74	Resistor, potentiometer WIDTH control, 20,000 ohms	33-5546-18

REPLACEMENT PARTS LIST (Cont.)

Reference Symbol	Description	Service Part No.
R75	Resistor, grid return, 2.2 megohms	66-5228340*
R76	Resistor, cathode bias, 47,000 ohms	66-3478340*
R77	Resistor, dropping, 2.2 megohms	66-5228340*
R78	Resistor, dropping, 2.2 megohms	66-5228340*
R79	Resistor, dropping, 2.2 megohms	66-5228340*
R80	Resistor, dropping, 2.2 megohms	66-5220340*
R81	Resistor, grid return, 10 megohms	66-6108340*
R82	Resistor, plate return, 4.7 megohms	66-5474340*
R83	Resistor, plate return, 4.7 megohms	66-5474340*
R84	Resistor, cathode limiting, 470,000 ohms	66-4478340*
R85	Resistor, potentiometer BRIGHTNESS control, 100,000 ohms	33-5546-11
R86	Resistor, plate load, 10,000 ohms	66-3104340*
R87	Resistor, grid return, 1 megohm	66-5108340*
R88	Resistor, differentiating, 100,000 ohms	66-4108340*
R89	Resistor, filter, 39,000 ohms	66-3398340*
R90	Resistor, plate load, 330,000 ohms	66-4334340*
R91	Resistor, differentiating, 3300 ohms	66-2338340*
R92	Resistor, grid return, 68,000 ohms	66-3688340*
R93	Resistor, filter, 120,000 ohms	66-4128340*
R94	Resistor, limiting, 8200 ohms	66-2828340*
R95	Resistor, potentiometer HORIZONTAL HOLD control, 10,000 ohms	Part of R63
R96	Resistor, grid return, 100,000 ohms	66-4108340*
R97	Resistor, plate return, 4.7 megohms	66-5478340*
R98	Resistor, plate return, 4.7 megohms	66-5478340*
R99	Resistor, potentiometer VERTICAL CENTER control	33-5565-3
R100	Resistor, potentiometer HORIZONTAL CENTER control	33-5565-3
R101	Resistor, voltage divider, 1 megohm	66-5108340*
R102	Resistor, voltage divider, 1 megohm	66-5108340*
R103	Resistor, high-voltage bleeder, 1.5 megohms	66-5158340*
R104	Resistor, high-voltage bleeder, 1.5 megohms	66-5158340*
R105	Resistor, high-voltage bleeder, 1.5 megohms	66-5158340*
R106	Resistor, high-voltage bleeder, 1.5 megohms	66-5158340*
R107	Resistor, high-voltage bleeder, 1.5 megohms	66-5158340*
R108	Resistor, high-voltage bleeder, 1.5 megohms	66-5158340*
R109	Resistor, high-voltage bleeder, 4.7 megohms	66-5478340*
R110	Resistor, high-voltage bleeder, 4.7 megohms	66-5478340*
R111	Resistor, high-voltage bleeder, 4.7 megohms	66-5478340*
R112	Resistor, grid return, 150,000 ohms	66-4158340*
R113	Resistor, screen dropping, 680 ohms	66-1684340*
R114	Resistor, filter, 100,000 ohms	66-4108340*
R115	Resistor, 2-section	33-1344
R115A	Resistor, current limiting, 5 ohms	Part of R115
R115B	Resistor, current limiting, 20 ohms	Part of R115
R116	Resistor, bias, 22 ohms	66-0228340*
R117	Resistor, bias filter, 100,000 ohms	66-4108340*
R118	Resistor, 2-section	33-3435-21
R118A	Resistor, filter, 150 ohms	Part of R118

Reference Symbol	Description	Service Part No.
R118B	Resistor, filter, 150 ohms	Part of R118
S1	Switch, power	Part of R20
S2	Switch, aerial	Part of 76-4402-7
T1	Transformer, r-f	Part of 76-4402-7
T2	Transformer, l-f aerial	Part of 76-4402-7
T3	Transformer, h-f aerial	Part of 76-4402-7
T4	Transformer, audio output	32-8356-1
T5	Transformer, vertical oscillator	
T6	Transformer, horizontal oscillator	
T7	Transformer, high-voltage	32-9619
T8	Transformer, low-voltage	32-8381
TC1 to TC12	Tuning cores	Part of 76-4402-7
TC13	Tuning core	Part of L37
TC14	Tuning core	Part of Z2
TC15	Tuning core	Part of Z2
TC16	Tuning core	Part of L45
TC17	Tuning core	Part of L46
TC18	Tuning core	Part of L47
TC19	Tuning core	Part of L48
TC20	Tuning core	Part of L51
TC21	Tuning core	Part of L52
TC22	Tuning core	Part of L55
W1	Cord and plug, power line	41-3865
Z1	Transformer, sound i-f	32-4236
Z2	Transformer, FM detector	30-4317

MISCELLANEOUS

Description	Service Part No.
Band-and-bracket assembly, picture tube	76-4394
Base, miniature tube shield	56-3978FA3
Cabinet, 49-702	10733
Back-and-cup assembly	76-4413
Mask	56-6535
Window	54-7595-2
Cable assembly, picture tube	41-3892-1
Cord, drive (25-foot spool)	45-8750*
Eyelets, panel and a-c cord assembly	2W35731
Knobs	
VOLUME ON-OFF	54-4661-1
BRIGHTNESS	54-4659-1
SELECTOR TUNING	54-4662-1
VERT. HOLD	54-4659-3
HORIZ. HOLD	54-4664-3
CONTRAST	54-4664-1
CHANNEL SELECTOR	56-6596
Panel assembly, high-voltage wiring	76-4385
Panel, tube mounting	54-7703
Screen and high-voltage-shield assembly	76-4396
Shaft, hollow	56-6528
Shield, miniature tube	56-5629FA3
Shield, picture tube	56-6480FA3
Sockets	
Loktal	27-6207
Miniature	27-6226
Octal	27-6174-6
Octal (1B3GT)	27-6174-5
Nine-pin (12AU7)	27-6203-5
Spring, shield-centering, picture tube	56-6476
Spring, drive cord	56-6549FA1
Spring, fine tuning, hairpin type	56-6552
Support, tube shield	76-4386FA3

MODEL 50-702, Code 122

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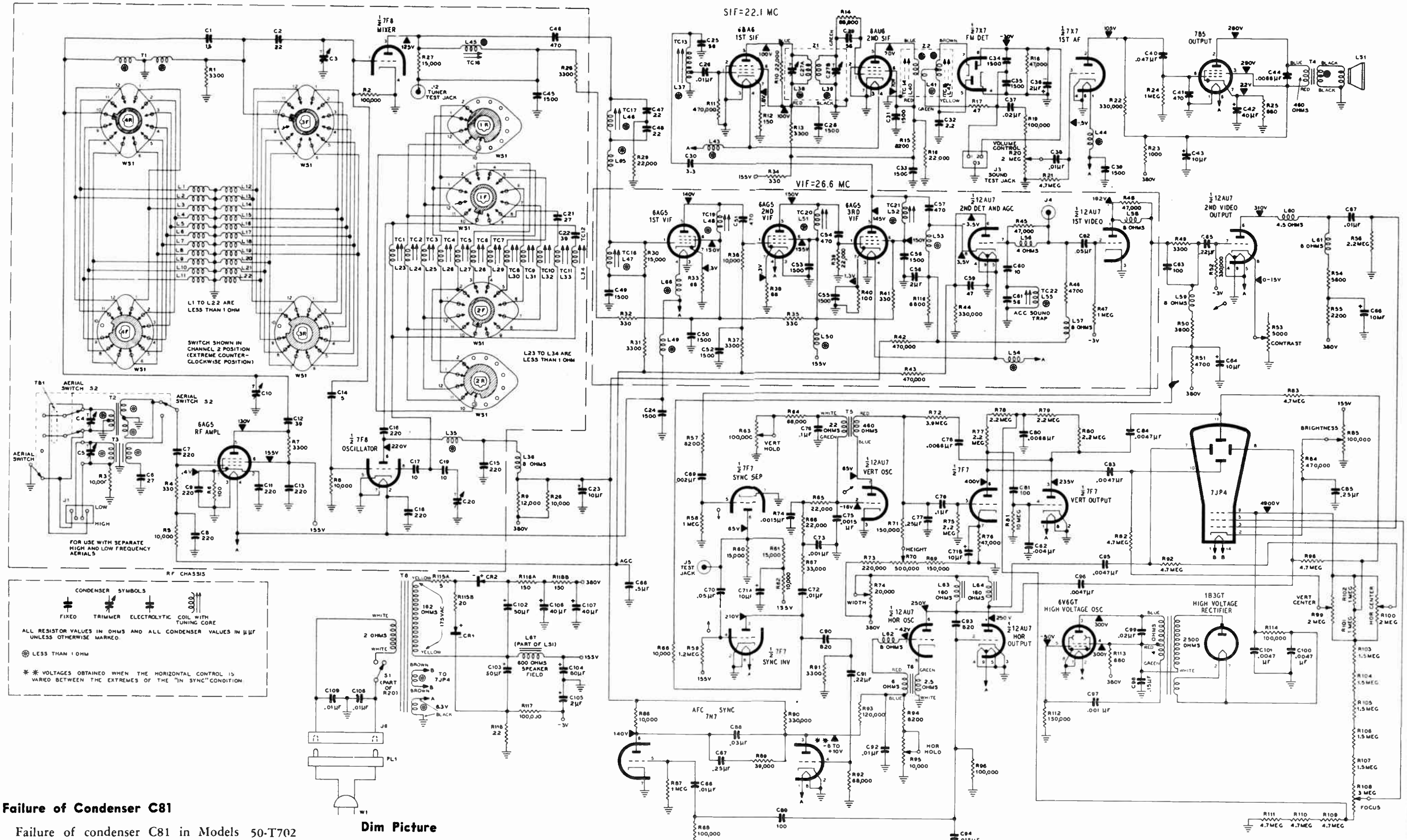

Failure of Condenser C81

Failure of condenser C81 in Models 50-T702 may be caused by operating these receivers when the vertical-output tube is removed. When this tube is removed, there is no voltage drop across resistors R77 and R78. This causes the voltage applied to condenser C81 to exceed the normal value and may result in the failure of this condenser.

Dim Picture

A dim picture in Models 50-T702 may result from leaky d-c blocking condensers to the deflection plates of the picture tube or by faulty high-voltage filter condensers. Whenever a dim picture is encountered, condensers C83, C84, C95, C96, C100 and C101 should be checked for leakage.

Figure 15. Philco Television Receiver Model 50-702, Code 122, Schematic Diagram

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PRE-PRODUCTION CHANGES

These changes were made between the time the manual was printed and the time the first production started. A 330-ohm resistor and a 220-$\mu\mu f$. by-pass condenser connected in parallel were added between the cathode (pin 4) of the 7F8 mixer and ground.

R1 was changed to 10,000 ohms.

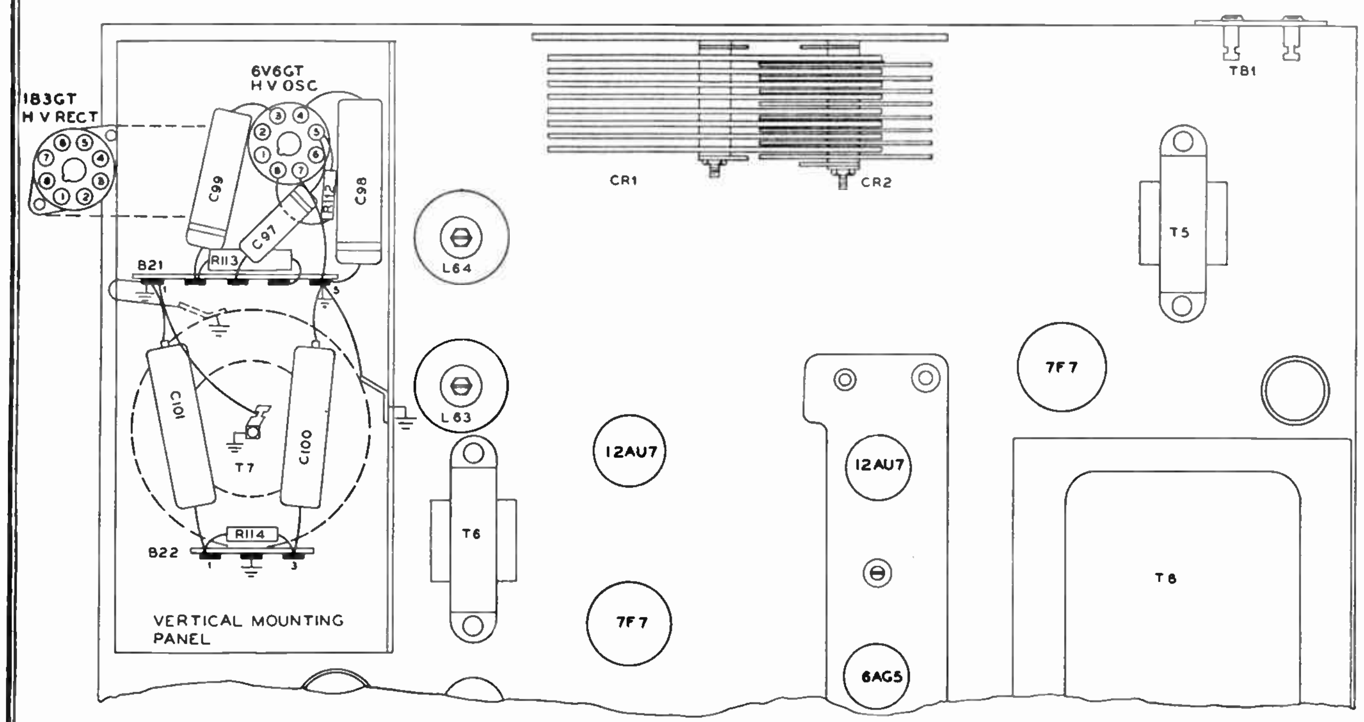
R7 was changed to 4700 ohms.

A 220-$\mu\mu f$. condenser was added between the cathode (pin 4) of the 6AG5 r-f tube and ground.

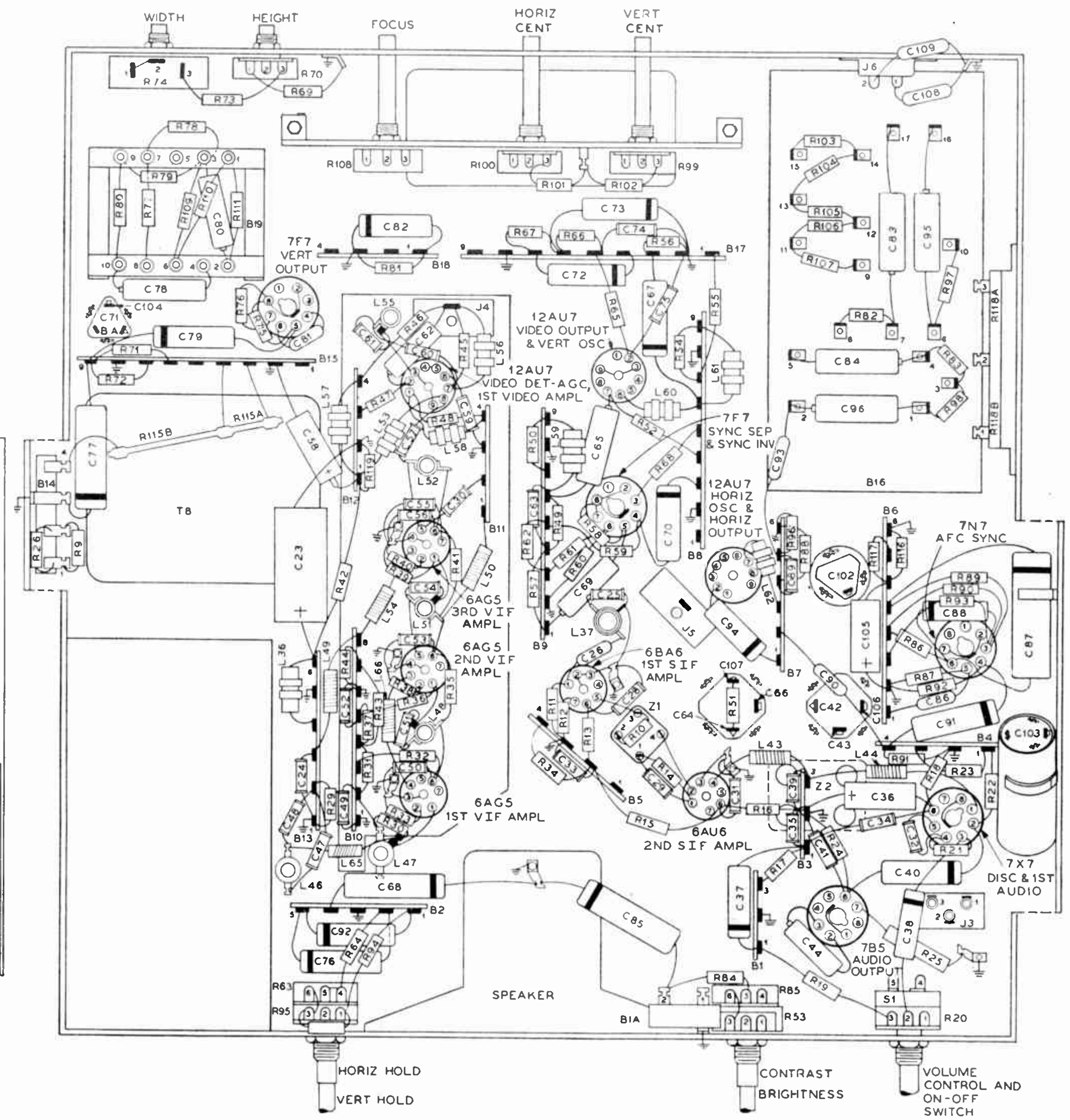
L35 was removed.

PRODUCTION CHANGES

RUN NO.	DESCRIPTION OF CHANGE	NEW OR ADDED PART NO.	OLD OR REMOVED PART NO.	REASON FOR CHANGE
2	R54 changed to a 2-watt resistor.	66-2565340*	66-2564340	To provide for high line voltages.
2	R51 changed to a 1-watt resistor.	66-2474340*	66-2478340	To provide for high line voltages.
2	R26 and R9 replaced with a 5100-ohm, 5-watt resistor.	33-1335-18	66-3108340 and 66-3128340	To provide for high line voltages.
2	C82 changed to .0047 μf.	30-4661-2	45-3500-17	To use a low-leakage condenser.
2	C87 changed to .22 μf.	30-4650-49	61-0120	To use a low-leakage condenser.



Model 50-702, Code 122, Partial Top View, Showing Vertical Mounting Panel TP-9243



Model 50-702, Code 122, Bottom View TP-9242

CORRECTION IN ALIGNMENT PROCEDURE

The last sentence of the note should read:

In cases where an installation uses two aerials, it will be necessary to connect the generator to the appropriate aerial-input terminals of J1.

CORRECTIONS AND ADDITIONS TO REPLACEMENT PARTS LIST

C24 should be: Condenser, r-f by-pass, 1500 $\mu\mu f$., Part No. 62-215001011

L36 should be: Choke, plate, Part No. 33-5565-4

R63 should be: Resistor, potentiometer, VERT. HOLD control, 100,000 ohms, Part No. 33-5563-2

R108 should be: Resistor, potentiometer, FOCUS control, 3 megohms, Part No. 33-5565-4

T5 should be: Transformer, vertical oscillator, Part No. 32-8304-3

T6 should be: Transformer, horizontal oscillator, Part No. 32-8307-3

Z2 should be: Transformer, FM detector, Part No. 32-4317

Cabinet should be: 50-702, Part No. 10733

Hollow shaft is part of tuner, and is not replaceable. Should be part of 76-4402-7

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NOTE:- For additional information, See Model 50-T1105, Pages 5-1 to 5-6.

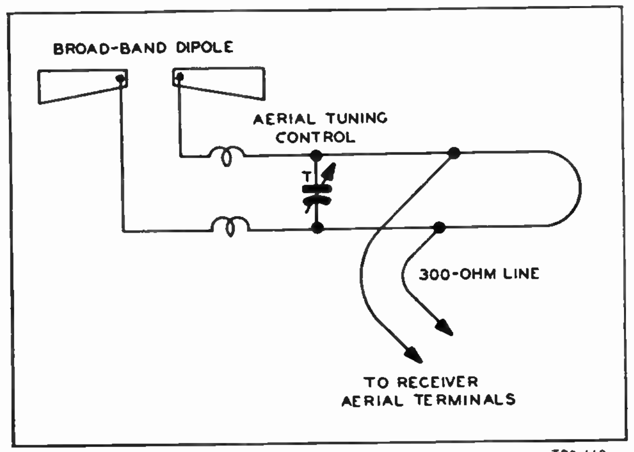

Figure 1. Built-In Aerial and Aerial Tuning Network

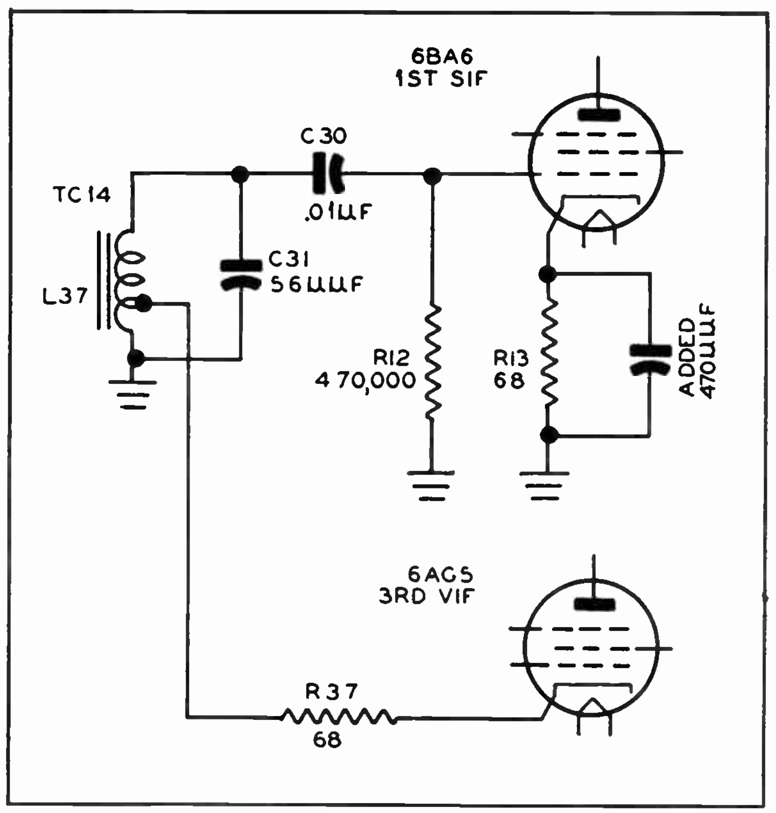

Figure 2. Change in Sound-I-F Take-off

MODEL 50-T1104, CODE 121, and MODEL 50-T1104, CODE 122

Philco Models 50-T1104, Code 121, and 50-T1104, Code 122, are table-type television receivers in plastic cabinets. Model 50-T1104, Code 122, incorporates a built-in aerial, and also has provisions for the connection of an external aerial, if necessary. The chassis of both codes are identical to the chassis of Philco Model 50-T1105, Code 121.

The built-in aerial of Model 50-T1104, Code 122, consists of a broad-band dipole of metal foil, mounted inside the cabinet on the top, and a tuning and impedance-matching network. This aerial covers all channels, and is tuned for each channel by adjusting the AERIAL TUNING control, which is located on the front of the Receiver near the top of the cabinet. Figure 1 shows the schematic diagram of the new aerial and aerial-tuning network.

A 300-ohm line couples the tuning network to the aerial terminals of the Receiver. This line is disconnected from the aerial terminals when an external aerial is used.

For additional service information pertaining to Models 50-T1104, Code 121, and 50-T1104, Code 122, refer to Philco Service Manual PR-1771, which covers Models 50-T1105 and 50-T1106, and to the information in this manual, which supplements PR-1771. However, the Miscellaneous section of the Replacement Parts List in PR-1771 does not apply to Models 50-T1104, Code 121, and 50-T1104, Code 122. The following list of miscellaneous items should be used.

WARNING: Before removing the chassis, it will be necessary to remove the built-in dipole aerial, to prevent it from being damaged. Proceed as follows:

1. Loosen the setscrew in the AERIAL TUNING knob, using a 1/16" hex wrench, Philco Part No. 45-9270.
2. Remove the two nuts holding the rear of the aerial in place.
3. Free the two brackets from the screws, and draw the aerial toward the rear until the shaft is free of the hole.
4. Loosen the two screws holding the aerial transmission line to the aerial terminal.
5. Remove the chassis in the usual manner.

MISCELLANEOUS PARTS LIST
MODEL 50-T1104, CODE 121, AND MODEL 50-T1104, CODE 122

Description	Service Part No.
Bolt, wing, adjusting bracket	W2547FA3
Bracket assembly, picture-tube support (rear)	76-5190FA3
Cabinet (50-T1104-M, Code 121)	10748
Cabinet (50-T1104-M, Code 122)	10748-7
Cabinet Hardware and Parts	
Back-and-cup assembly	76-4605
Condenser, AERIAL TUNING control (50-T1104, Code 122)	31-6518
Coupler, rubber, AERIAL TUNING shaft (50-T1104, Code 122)	54-4748
Dipole foil (50-T1104, Code 122) two used	56-7635
Knob, AERIAL TUNING control (50-T1104, Code 122)	54-4750
Knob, BRIGHTNESS control (50-T1104-M)	54-4659-1
Knob, BRIGHTNESS control (50-T1104-E)	54-4659
Knob, CHANNEL SELECTOR (50-T1104-M)	56-6596-1
Knob, CHANNEL SELECTOR (50-T1104-E)	56-6596-2
Knob, CONTRAST control (50-T1104-M)	54-4664-1
Knob, CONTRAST control (50-T1104-E)	54-4664
Knob, FINE TUNING control (50-T1104-M)	54-4662-1
Knob, FINE TUNING control (50-T1104-E)	54-4662
Knob, HORIZ. HOLD control (50-T1104-M)	54-4664-3
Knob, HORIZ. HOLD control (50-T1104-E)	54-4664-2
Knob, VERT. HOLD control (50-T1104-M)	54-4659-3
Knob, VERT. HOLD control (50-T1104-E)	54-4659-2
Knob, VOLUME control (50-T1104-M)	54-4661-1
Knob, VOLUME control (50-T1104-E)	54-4661
Loop assembly, AERIAL tuning (50-T1104, Code 122)	76-5413
Mask	56-7143
Panel assembly, AERIAL TUNING control (50-T1104, Code 122)	75-5399
Shaft, AERIAL TUNING control (50-T1104, Code 122)	54-4747
Strap, mask	56-6848-1
Window	54-7595-5
Cable assembly, high-voltage	41-3771-7
Cord, drive, 25-foot spool	45-8750
Insulator, high-voltage	54-7573-5
Shield, Loktal tube	56-2731
Shield, miniature tube	56-5629FA3
Socket, Loktal tube	27-6207
Socket, miniature tube	27-6226
Socket, octal tube	27-6174-6
Socket, octal tube, 1B3GT	27-6174-5
Socket, 9-pin, 12AU7	27-6203-5
Spring, fine tuning, hairpin type	56-6552
Strap assembly, picture-tube support (front)	76-5191
Support, picture tube	76-5192

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PRE-PRODUCTION and PRODUCTION CHANGES

PRE-PRODUCTION CHANGES

NOTE: The following changes should be considered when referring to Philco Service Manual PR-1771. These changes which were made in the design of the sets were effective beginning with first production.

DESCRIPTION OF CHANGE	REMOVED PART NO.	ADDED PART NO.
Tone circuit, consisting of 47,000-ohm resistor (R127) and .0047-μf. condenser (C110), added in series between tap of VOLUME control and ground.		66-3478340 45-3505-56
Sound i-f take-off point moved from plate of third video-i-f amplifier to cathode of same stage. C29 removed. First sound-i-f autotransformer changed. 470-$\mu\mu f$. condenser (C111) added in parallel with R13. See figure 2. (This change was incorporated into first production of Model 50-T1105 only.)	C29, 30-1224-30 L37, 32-4373-1	62-147001001 32-4303-1
22,000-ohm resistor (R128) added across primary of Z1 in Model 50-T1106 only.		66-3228340
130-volt B+ lead from pin 8 of audio-output tube disconnected from junction of S2A, R14, and R11, and connected to junction of L45, C54, and R11.		
R10 disconnected from junction of L45, C54, and R11, and connected to screen (pin 6) of first video-i-f amplifier.		
Lead between junction of R30 and R7 and junction of C59 and R23 removed. Junction of R30 and R7 connected to junction of R33 and R34.		
1500-$\mu\mu f$. condenser (C112) added between junction of R30 and R7 and ground.		62-215001011
Resistor R39 changed to 15,000 ohms.	66-3478340	66-3158340
1500-$\mu\mu f$. condenser (C113) added in parallel with C4.		62-215001011
1500-$\mu\mu f$. condenser (C114) added in parallel with C27.		62-215001011
1500-$\mu\mu f$. condenser (C115) added in parallel with C11.		62-215001011
Condenser C28 disconnected from junction of L35 and R67, and ungrounded end connected to junction of R67 and R68.		
Connections to 7N7 sync preamplifier and sync separator changed so that pin numbers are as follows: Plate, sync preamplifier 3 Plate, sync separator 6 Grid, sync preamplifier 4 Grid, sync separator 5 Cathode, sync preamplifier 2 Cathode, sync separator 7		
Resistor R96 changed to 82,000 ohms.	66-4108340	66-3828340
Resistor R101 changed to 120,000 ohms.	66-4108340	66-4128340
Condenser C104 removed. TELEVISION terminal of S2B disconnected from junction of R82 and R109, and connected to pin 3 of horizontal-output tube.	30-2417-1	
Additional section of S2 connected so that, in PHONO position, the junction of C40 and C41 is connected to the ungrounded end of C45. The TELEVISION terminal of this section of the switch is left open.		
Connection to FM TEST jack J3 changed so that: 1. Pin 1 is grounded 2. Pin 2 is connected to ungrounded (negative) end of C42. 3. Pin 3 is connected to junction of C40 and C41.		
This change necessitates a corresponding change to the connections of the FM TEST jack adaptor shown in figure 4 of PR-1771. The FM TEST jack adaptor should be constructed as shown in figure 3 of this bulletin. The 100,000-ohm resistors used for this adaptor should be selected from a group, to obtain values as close to each other as possible. In the I-F ALIGNMENT CHART, all references to connecting the oscilloscope to pin 1 of J3 should be disregarded, and the oscilloscope should be connected to pin 3 instead.		

PRODUCTION CHANGES

RUN NO.	DESCRIPTION OF CHANGE	REMOVED PART NO.	ADDED PART NO.	REASON FOR CHANGE
2	FM detector (7X7) shielded.		Shield-mounting clip, 56-1567-1. Tube shield, 56-2731.	To eliminate harmonic beat.
2	R-f choke added in series with ungrounded lead to filament of FM detector (7X7).		32-4112-15	To eliminate harmonic beat.
2*	Sound-i-f take-off point moved from plate of third video-i-f amplifier to cathode of same stage. C29 removed. First sound-i-f autotransformer changed. 470-$\mu\mu f$. condenser added in parallel with R13. R128 removed. See figure 2.	C29, 30-1224-30 L37, 32-4373-1 R128, 66-3228340	62-147001001 32-4303-1	To improve padding.
3	R118 changed to 15,000 ohms.	66-3188340	66-3158340	To improve adjacent-sound attenuation.
4	Ground connection of C31 is changed to same ground connection that grounds L37.			Improve sound-i-f stability.

* This change was incorporated in first production of Model 50-T1105 and Run 2 of Model 50-T1106.

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CORRECTION TO SERVICE MANUAL PR-1771

On page 11 of Service Manual PR-1771, the trimmer symbolized C14 in figure 9 should be symbolized C20.

The following corrections should be made to the Replacement Parts List:

Reference Symbol	Published Part No.	Correct Part No.
C29	62-056409001	30-1224-30
L37	32-4302	32-4373-1
R119	66-21518340	66-2508340

In the Miscellaneous Section of the Replacement Parts List, "Nut, wing, adjusting bracket" should be "Bolt, wing, adjusting bracket, Part No. W2547FA3".

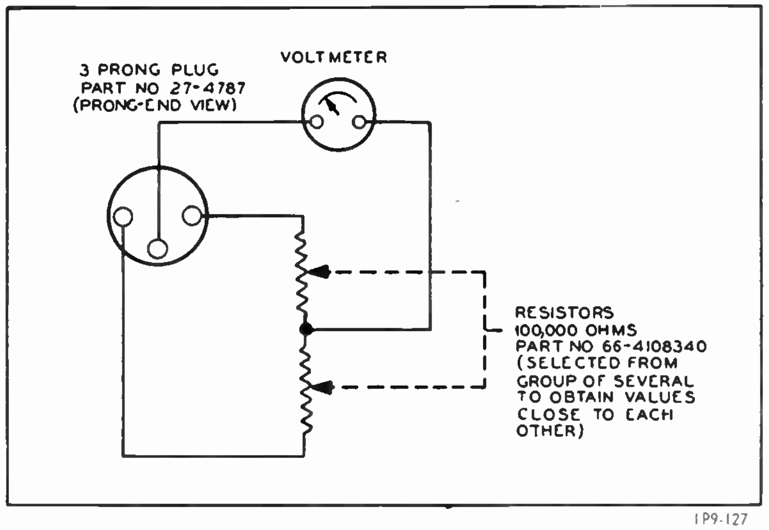

Figure 3. FM TEST Jack Adaptor

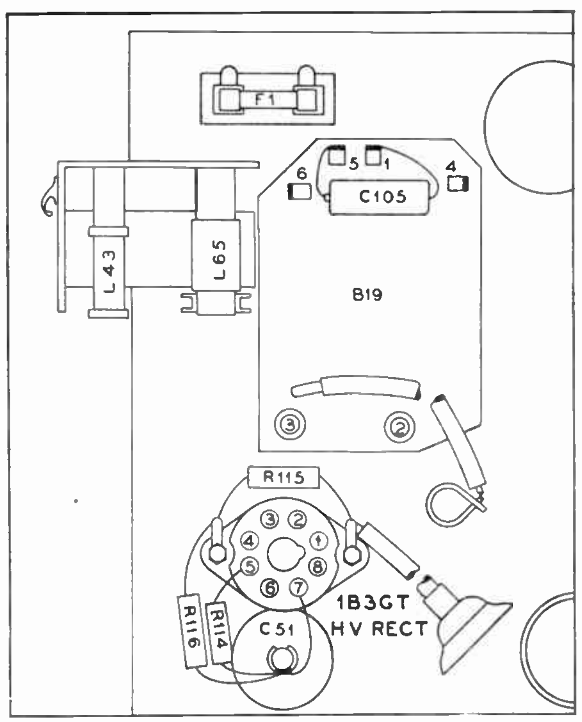

Figure 4. Partial Top View, Models 50-T1104, Code 121, 50-T1104, Code 122, 50-T1105, and 50-T1106, Showing Components Mounted on Top of Chassis

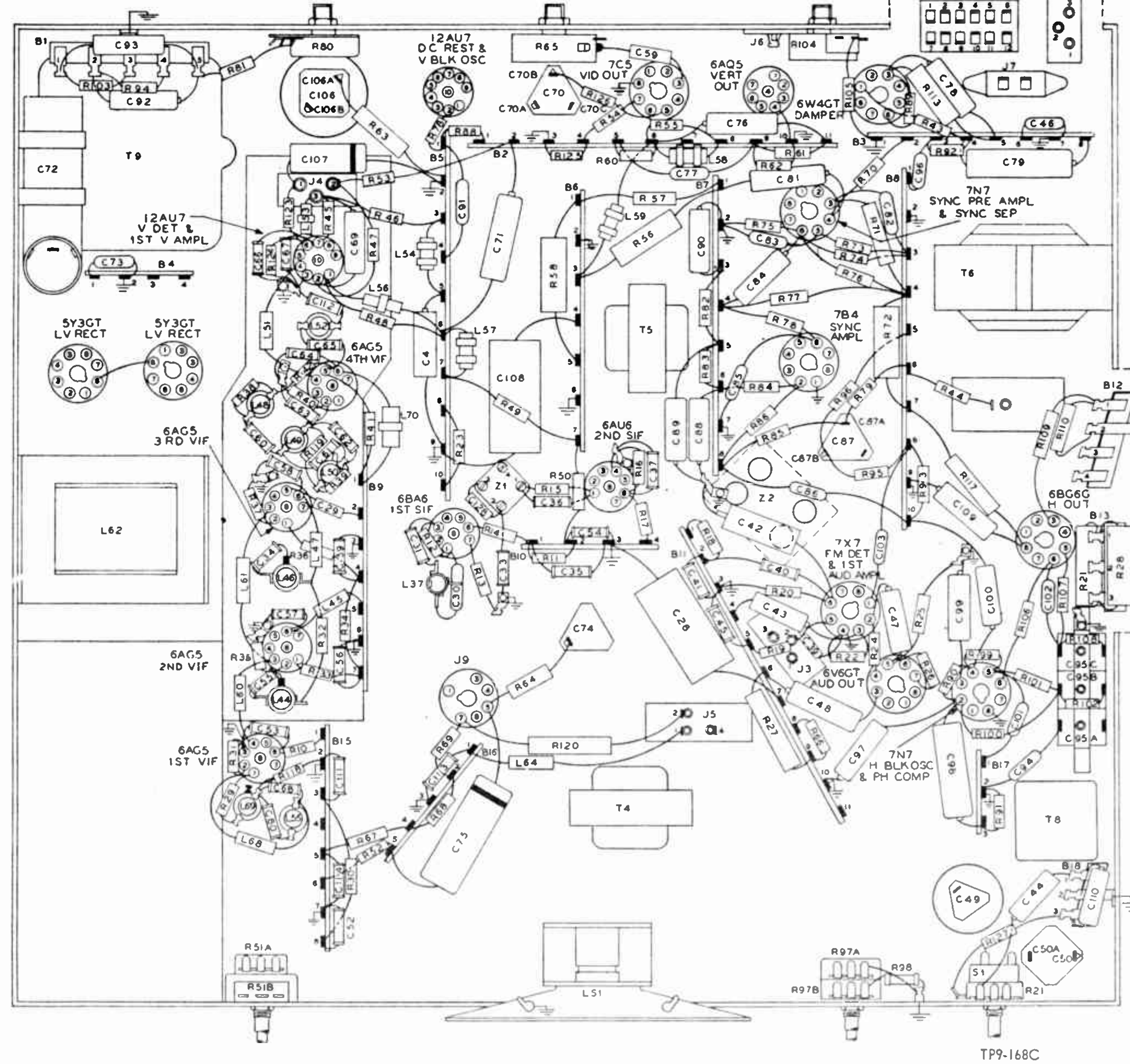

Figure 5. Bottom View, Models 50-T1104, Code 121, 50-T1104, Code 122, 50-T1105, and 50-T1106, Showing Locations of Components

MODELS 50-T1104; 50-T1105; 50-T1106

Connecting Television Booster TB2

In the above models, the cathode and filament circuits of the 6V6GT audio-output tube are 130 volts above ground. Therefore, the octal-power adapter for Television Booster TB2 is not applicable to these models. A special 3-prong socket is incorporated into the top of the chassis, near the speaker, to supply booster power. Plug and Cable Assembly, Part No. 41-3942, should be used to connect the booster to this socket.

MODELS 50-T1104, CODE 122, AND 50-T1105, CODE 122 — BUILT-IN AERIAL LEAD DRESS

In some cases, improper performance of the built-in aerial may be traced to the way the lead from the built-in aerial to the aerial-input terminals is dressed. This lead should be kept away from the end of the dipole element nearest the power transformer, and dressed so that it is entirely in the clear.

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CORRECTIONS TO SERVICE MANUAL PR-1793

1. FM TEST jack J3 should be wired as shown in figure 1.
2. In the schematic diagram, the video-output screen by-pass condenser, C108, should be deleted.
3. In figure 2 of PR-1793, the wording "PLUG IS SHOWN WITH PRONGS POINTING AWAY" should read "PRONG-END VIEW."
4. The PHONO switch, S2, should be wired as shown in figure 2.
5. The caption for figure 10 should read "Philco Television Receiver Models 50-T1400; 50-T1402; 50-T1104, Code 123; Complete Schematic Diagram."
6. Pins 2 and 7 of the high-voltage rectifier tube should be reversed.
7. The following changes should be made in the part numbers in the Replacement Parts List:

Reference Symbol or Description	Published Part No.	New or Correct Part No.
C43	30-4650-56	45-3505-56
C48	30-4650-91	45-3505-91
C71	30-4650-49	45-3505-49
C78	30-4650-49	45-3505-49
C104	62-215001001	62-215001011
C108	62-215001001	62-215001011
L37	32-4302-3	32-4303-2
R21	33-5586-16	33-5564-4
R51	33-5563-22	33-5563-10
R97	33-5563-23	33-5563-6
R119	66-2518340	66-2508340

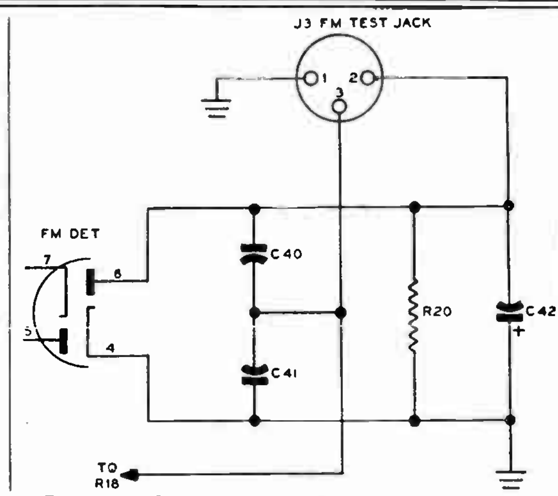

Figure 1. Connections to FM TEST Jack, Models 50-T1400; 50-T1402; 50-T1104, Code 123

Reference Symbol or Description	Published Part No.	New or Correct Part No.
Bolt, wing, deflection yoke		W2547FA3
Cabinet (50-T1402)	10776-1	10776
Cable assembly, high voltage	41-3771-9	41-3771-2
Knob, BRIGHTNESS control (50-T1400)	54-4999-3	54-4699-3
Knob, CHANNEL SELECTOR (50-T1400)	56-6596-3FCP	56-6596-3
Screw, window rail	1W25201FA3	1W25201

All references to 76-4402-9 (the tuner unit) should read 76-4402-6.

PREPRODUCTION CHANGES IN MODELS 50-T1400 AND 50-T1402

The following changes were made in Models 50-T1400 and 50-T1402 between the time of printing of Service Manual PR-1793 and the time of first production of Models 50-T1400 and 50-T1402:

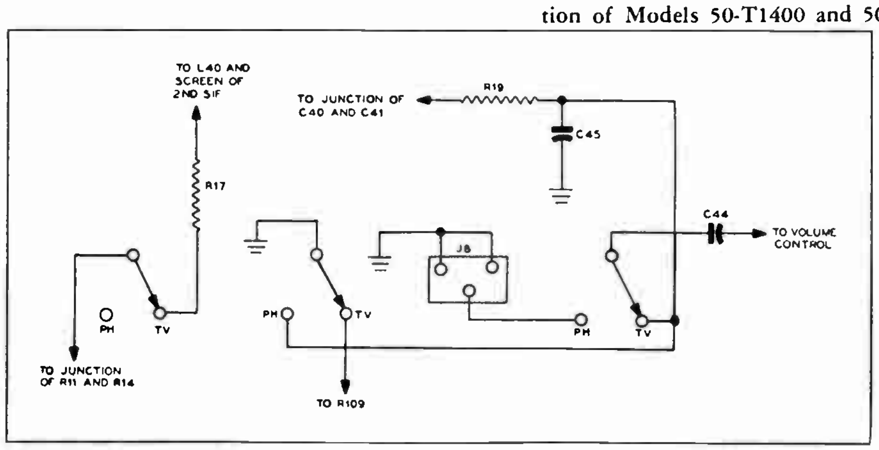

Figure 2. Preproduction Connections to Phono Switch, Models 50-T1400; 50-T1402; 50-T1104, Code 123

DESCRIPTION OF CHANGE	REMOVED PART NO.	ADDED PART NO.
L55 changed to different coil.	32-4234-4	32-4234-8
R118 changed from 5100 ohms to 5600 ohms.	66-2518340	66-2568340
C68 and C80 changed from 18 $\mu\mu f$. to 51 $\mu\mu f$.	60-00185317	30-1224-62
100-$\mu\mu f$. condenser (C115) added between screen (pin 8) of horizontal-output tube and secondary tap of T7.		60-10105407
Lead to screen (pin 8) of horizontal-output tube removed. Pin 8 reconnected to pin 8 of T7 through a 250-microhenry choke (L72) and a 4700-ohm resistor (R127) in series.		32-4143-7 66-2475340

NOTE:- For additional information, See Philco Model 50-T1400, Pgs. 4-27 to 4-34

DESCRIPTION OF CHANGE	REMOVED PART NO.	ADDED PART NO.
R121 removed. R28 changed from 10,000 ohms to 5000 ohms.	33-1335-47	33-3435-30
R94 changed from 6800 ohms to 5100 ohms.	66-2688340	66-2518240
L68 removed; L69 connected across R29.	32-4112-15	
470-ohm resistor, R128, added in series with lead between C6 and junction of L55 and C68.		66-1478340
R116 removed. R115 connected to junction of R114 and C51.	66-4685340	
J8 and S2 removed. Leads to S2 rewired so that connections are same as when S2 was switched to TELEVISION position. R109 removed. Cathode (pin 3) of horizontal-output tube grounded.	27-6126 42-1893-1 66-2105340	
Ungrounded end of C28 disconnected and reconnected to junction of R67 and R68.		
1500-$\mu\mu f$. condenser (C117) added in parallel with C27.		62-215001011

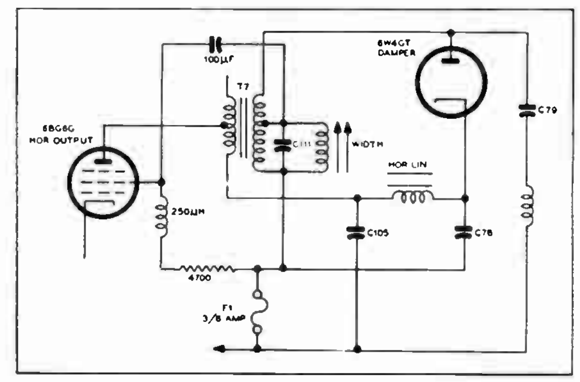

Figure 3. Location of Fuse, Runs 1F, 2F, and 3F of Models 50-T1400 and 50-T1402

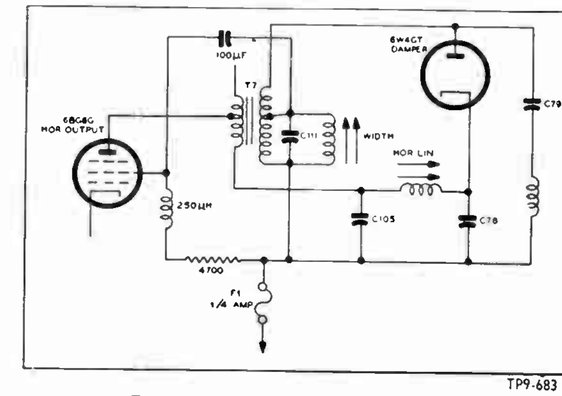

Figure 4. Location of Fuse, Run 4 of Models 50-T1400 and 50-T1402

PREPRODUCTION CHANGES IN MODEL 50-T1104, CODE 123

The following changes were made in Model 50-T1104, Code 123, between the time of printing of Service Manual PR-1793 and the time of first production of Model 50-T1104, Code 123:

DESCRIPTION OF CHANGE	REMOVED PART NO.	ADDED PART NO.
470-ohm resistor (R128) added in series with lead between C6 and junction of L55 and C68.		66-1478340
2.2-$\mu\mu f$. condenser (C116) added between ground and junction of C6 and R128.		30-1221-4
C111 removed.	45-3505-60	
C79 changed from .15 μf. to .47 μf.	45-3505-48	61-0133
R121 removed. R28 changed from 10,000 ohms to 5000 ohms.	33-1335-47	33-3435-30
R108 changed from 270,000 ohms to 390,000 ohms.	66-4278340	66-4398340
R72 changed from 5100 ohms to 1500 ohms.	33-5546-28	66-2155340
1500-$\mu\mu f$. condenser (C117) added in parallel with C27.		62-215001011

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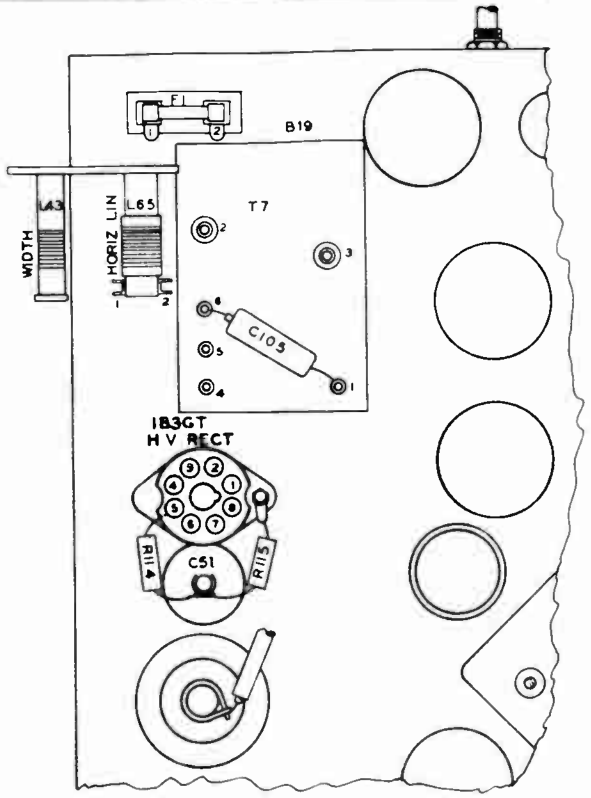

Figure 5. Partial Top View of Models 50-T1400, 50-T1401, 50-T1402, and 50-T1430, Showing Components Located in High-Voltage Cage

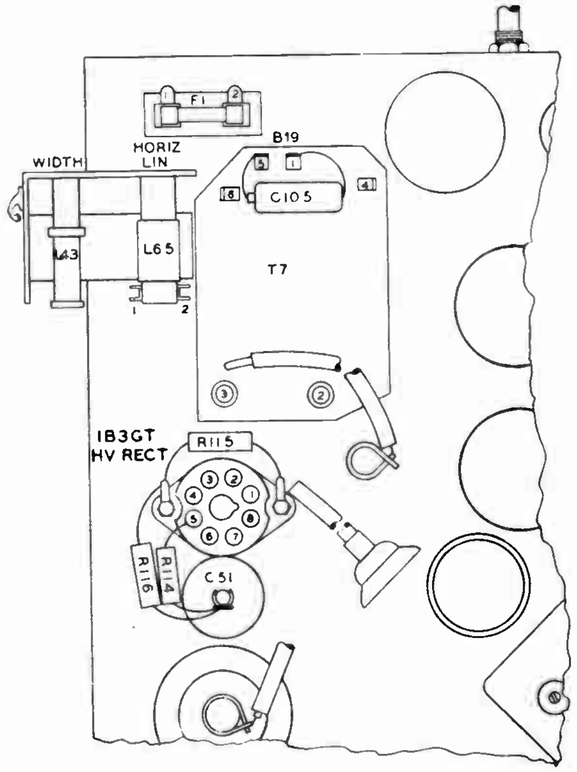

Figure 6. Partial Top View of Models 50-T1104, Code 123, Showing Components Located in High-Voltage Cage

PRODUCTION CHANGES IN MODELS 50-T1400 AND 50-T1402

RUN NO.	DESCRIPTION OF CHANGE	REMOVED PART NO.	ADDED PART NO.	REASON FOR CHANGE
2	2.2-µµf. condenser added between ground and junction of C6 and R128.		30-1221-4	To center tuning of first video-i-f transformer.
2Z and 3	Arm of HEIGHT control disconnected and re-wired to junction of R89 and R96.			To improve vertical linearity.
1F	F1 removed from position shown in service manual, and rewired as shown in figure 3. This run does not include the changes made in runs 2, 2Z, or 3.			To provide increased protection.
2F	F1 removed from position shown in service manual, and rewired as shown in figure 3. This run includes the changes made in run 2, but does not include the change made in runs 2Z and 3.			To provide increased protection.
3F	F1 removed from position shown in service manual, and rewired as shown in figure 3. This run includes the changes made in runs 2, 2Z, and 3.			To provide increased protection.
4	F1 rewired as shown in figure 4. Value changed from 3/8 ampere to 1/4 ampere.	45-2656-10	45-2656-8	To reduce a-c current through fuse.
5	330-ohm resistor added in series with lead between ungrounded (negative end) of C42 and junction of R20 and pin 2.		66-1338340	To reduce harmonic beat.
5	Lead from junction of R19 and pin 3 of J3 disconnected from junction of C40 and C41. C41 removed. C40 connected across R20.	62-215001011		To reduce harmonic beat.

PRODUCTION CHANGES IN MODELS 50-T1400 AND 50-T1402 (Cont.)

RUN NO.	DESCRIPTION OF CHANGE	REMOVED PART NO.	ADDED PART NO.	REASON FOR CHANGE
5	150-µµf. condenser added between ground and junction of R18 and R19.		60-10155407	To reduce harmonic beat.
5	10,000-ohm resistor added across R56 and R57.		66-3104340	To improve video response.
5	R49 changed from 4700 ohms to 3900 ohms.	66-2478340	66-2398340	To improve video response.
5	R54 changed from 100 ohms to 10 ohms.	66-1108340	66-0108340	To improve video response.
5	R44 changed from 5600 ohms to 2200 ohms.	66-2568340	66-2228340	To improve video response.
5	L53 changed from 150 microhenries to 40 microhenries.	32-4143	32-4143-1	To improve video response.
5	R46 changed from 3300 ohms to 2400 ohms.	66-2338340	66-2258340'	To improve video response.
5	R58 changed from 1500 ohms to 1000 ohms.	66-2158340	66-2108340	To improve video response.

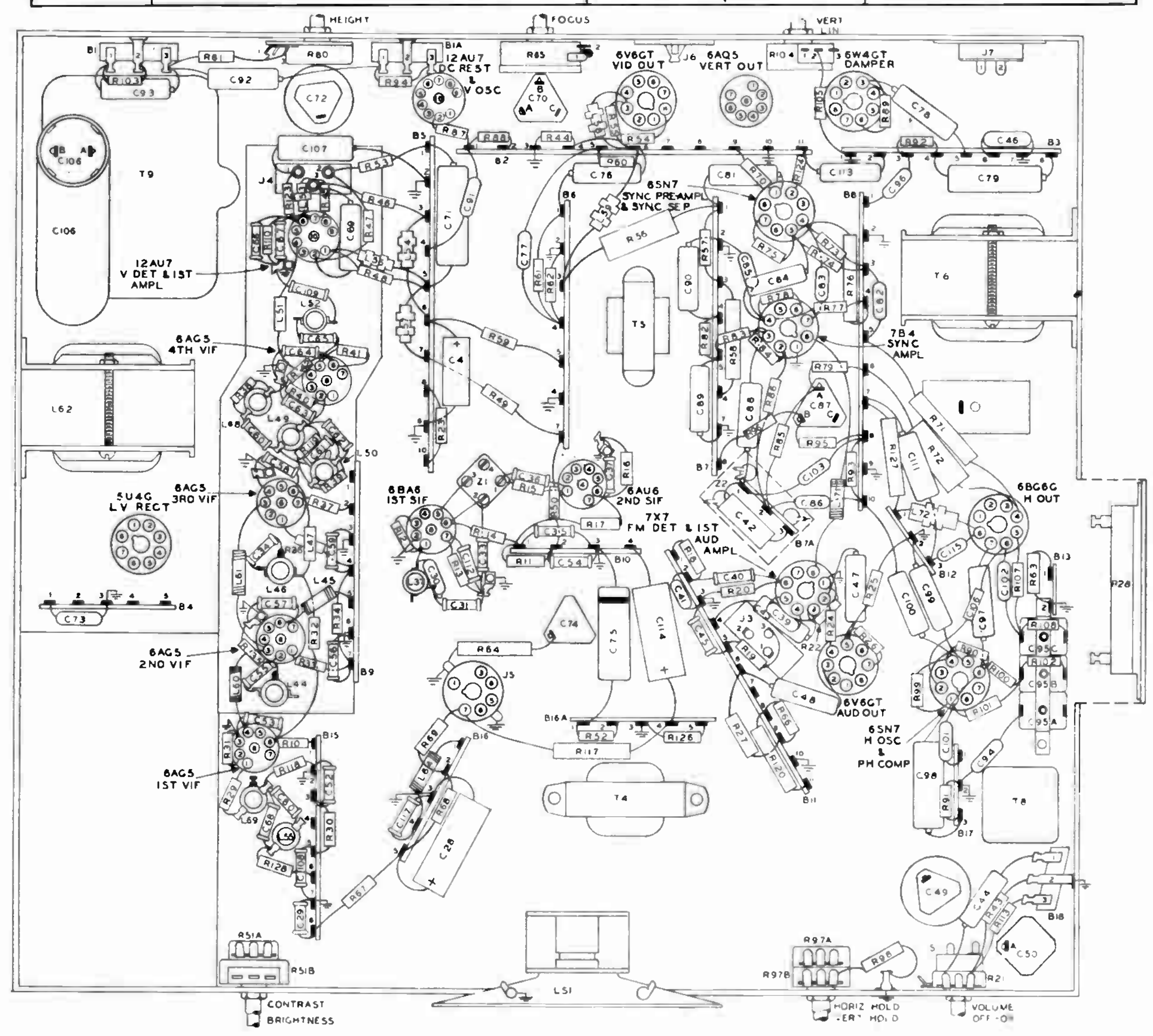

Figure 7. Bottom View of Models 50-T1400, 50-T1401, 50-T1402, and 50-T1430, Showing Locations of Components

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PRODUCTION CHANGES IN MODEL 50-T1104, CODE 123

RUN NO.	DESCRIPTION OF CHANGE	REMOVED PART NO.	ADDED PART NO.	REASON FOR CHANGE
2	J8 and S2 removed. Leads to S2 rewired so that connections are same as when S2 was switched to TELEVISION position. R109 removed. Cathode (pin 3) of horizontal output tube grounded.	27-6126 42-1893-1 66-2105340		
3	.0022-μf. condenser, 470-ohm resistor, and 600-microhenry choke connected in parallel, and added in series with lead between pin 4 of T7 and pin 5 of damper tube.		45-3505-54 66-1475340 32-4264-1	To eliminate Barkhausen oscillations.
4	L55 changed to different coil.	32-4234-4	32-4234-8	To improve picture quality.
4	R118 changed from 5100 ohms to 5600 ohms.	66-2518340	66-2568340	To improve picture quality.
4	C68 and C80 changed from 18 $\mu\mu f$. to 51 $\mu\mu f$.	60-00185317	30-1224-62	To improve picture quality.

RUN NO.	DESCRIPTION OF CHANGE	REMOVED PART NO.	REASON FOR CHANGE
4	L70 removed. R41 connected between plate (pin 5) and screen (pin 8) of 4th v-i-f tube.	32-4143-1	To improve lead dress.

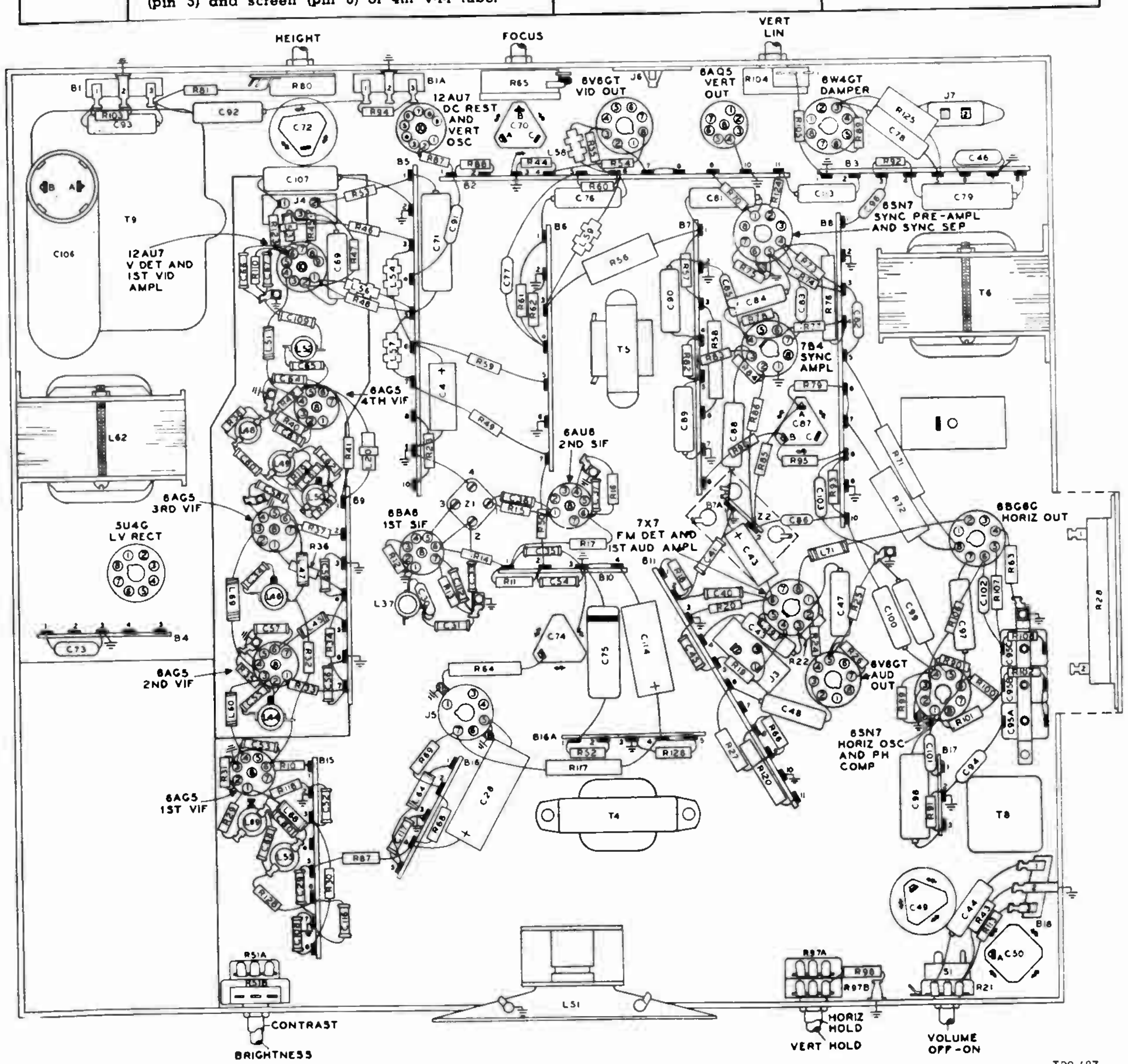

Figure 8. Bottom View of Model 50-T1104, Code 123, Showing Locations of Components

PHILCO TELEVISION RECEIVER MODELS 50-T1401 AND 50-T1430

The chassis of Philco Models 50-T1401 and 50-T1430 are the same as that used in Model 50-T1400. Model 50-T1401 is a table model with a wrap-around mahogany cabinet. Model 50-T1430 is a console model with a modern-style mahogany cabinet. Both models incorporate a 12-inch picture tube, a wide mask, and a built-in aerial.

For service information pertaining to Models 50-T1401 and 50-T1430, refer to Philco Service Manual PR-1793, which covers Models 50-T1400, 50-T1402, and 50-T1104, Code 123, and to the supplementary information in this bulletin. However, the miscellaneous section of the Replacement Parts List in PR-1793 does not apply to Models 50-T1401 and 50-T1430 because of the difference in the cabinets. For miscellaneous parts, therefore, refer to the miscellaneous section of the following Replacement Parts List for Models 50-T1400, 50-T1401, 50-T1402, and 50-T1430 (All Run 5).

REPLACEMENT PARTS LIST

MODELS 50-T1400; 50-T1401; 50-T1402; 50-T1430 (ALL RUN 5)

Reference Symbol	Description	Service Part No.
C1	Condenser, d-c blocking, 1.5 $\mu\mu f$.	Part of 76-4402-6
C2	Condenser, d-c blocking, 22 $\mu\mu f$.	Part of 76-4402-6
C3	Condenser, mixer tuning, .5 to 2 $\mu\mu f$.	Part of 76-4402-6
C4	Condenser, filter, 2 μf.	30-2417-7
C5	Condenser, r-f by-pass, 1500 $\mu\mu f$.	Part of 76-4402-6
C6	Condenser, d-c blocking, 470 $\mu\mu f$.	Part of 76-4402-6
C7	Condenser, cathode by-pass, 220 $\mu\mu f$.	Part of 76-4402-6
C8	Condenser, fixed padder, 39 $\mu\mu f$.	Part of 76-4402-6
C9	Condenser, fixed padder, 27 $\mu\mu f$.	Part of 76-4402-6
C10	Condenser, oscillator injection, 4.7 $\mu\mu f$.	Part of 76-4402-6
C11	Condenser, r-f by-pass, 220 $\mu\mu f$.	Part of 76-4402-6
C12	Condenser, d-c blocking, 220 $\mu\mu f$.	Part of 76-4402-6
C13	Condenser, fixed padder, 10 $\mu\mu f$.	Part of 76-4402-6
C14	Condenser, trimmer, fine tuning, 4 to 7 $\mu\mu f$.	Part of 76-4402-6
C15	Condenser, d-c blocking, 10 $\mu\mu f$.	Part of 76-4402-6
C16	Condenser, r-f by-pass, 220 $\mu\mu f$.	Part of 76-4402-6
C17	Condenser, trimmer, l-f aerial, 5 to 50 $\mu\mu f$.	Part of 76-4402-6
C18	Condenser, trimmer, h-f aerial, 5 to 50 $\mu\mu f$.	Part of 76-4402-6
C19	Condenser, fixed padder, 27 $\mu\mu f$.	Part of 76-4402-6
C20	Condenser, trimmer, r-f plate, .5 to 5 $\mu\mu f$.	Part of 76-4402-6
C21	Condenser, d-c blocking, 39 $\mu\mu f$.	Part of 76-4402-6
C22	Condenser, d-c blocking, 220 $\mu\mu f$.	Part of 76-4402-6
C23	Condenser, cathode by-pass, 220 $\mu\mu f$.	Part of 76-4402-6
C24	Condenser, cathode by-pass, 220 $\mu\mu f$.	Part of 76-4402-6
C25	Condenser, screen by-pass, 220 $\mu\mu f$.	Part of 76-4402-6
C26	Condenser, r-f by-pass, 220 $\mu\mu f$.	Part of 76-4402-6
C27	Condenser, r-f by-pass, 220 $\mu\mu f$.	Part of 76-4402-6
C43	Condenser, d-c blocking, .0047 μf.	45-3505-58*
C44	Condenser, d-c blocking .01 μf.	61-0120*
C48	Condenser, tone compensation, .0068 μf.	45-3505-91*
C50	Condenser, 2-section, 80-10 μf.	30-2570-39
C50A	Condenser, filter 80 μf. 450v	Part of C50
C68	Condenser, fixed trimmer, 51 $\mu\mu f$.	30-1224-62*
C71	Condenser, d-c blocking, .22 μf.	45-3505-49*
C78	Condenser, horizontal shaping, .22 μf. (50-T1400, 50-T1402)	45-3505-49*
C80	Condenser, fixed trimmer, 51 $\mu\mu f$.	30-1224-62
C104	Condenser, r-f filter, 1500 $\mu\mu f$.	62-215001011*
C108	Condenser, a-v-c filter, 1500 $\mu\mu f$.	62-215001011*
C115	Condenser, feedback, 1500 $\mu\mu f$.	60-10105407*
C116	Condenser, r-f filter, 2.2 $\mu\mu f$.	30-1221-4
C117	Condenser, r-f by-pass, 1500 $\mu\mu f$.	60-215001011*
C118	Condenser, r-f by-pass, 150 $\mu\mu f$.	60-10155407*
F1	Fuse, B+ protective, ¼ ampere	45-2656-8
J1	Socket, aerial input	Part of 76-4402-6
J2	Jack, TUNER TEST	Part of 76-4402-6
J3	Jack, FM TEST	27-6126
J4	Jack, ALIGN TEST	27-6126
L1 to L11	Coils, r-f plate	Part of 76-4402-6
L12 to L22	Coils, mixer grid	Part of 76-4402-6
L23 to L34	Coils, oscillator	Part of 76-4402-6
L35	Coil, plate choke	Part of 76-4402-6
L36	Coil, mixer plate tank	Part of 76-4402-6
L37	Coil, 1st sound i-f autotransformer	32-4303-2
L53	Coil, series peaking, 40 microhenries	32-4143-1
L55	Coil, adjacent-channel trap	32-4[illegible]
L54	Coil, shunt peaking, 250 microhenries	32-4143-7
R1	Resistor, cathode bias, 330 ohms	Part of 76-4402-6
R2	Resistor, loading, 3300 ohms	Part of 76-4402-6
R3	Resistor, grid return, 100,000 ohms	Part of 76-4402-6
R4	Resistor, grid return, 10,000 ohms	Part of 76-4402-6
R5	Resistor, loading, 10,000 ohms	Part of 76-4402-6
R6	Resistor, grid return, 330 ohms	Part of 76-4402-6
R7	Resistor, a-v-c filter, 10,000 ohms	Part of 76-4402-6
R8	Resistor, cathode bias, 100 ohms	Part of 76-4402-6
R3	Resistor, plate load, 4700 ohms	Part of 76-4402-6
R20	Resistor, bleeder, 5000 ohms	33-3435-30
R44	Resistor, voltage divider, 2200 ohms	66-2228340*
R46	Resistor, video-detector load, 2400 ohms	66-2248340*
R49	Resistor, plate load, 3900 ohms	66-2398340*
R51	Potentiometer assembly, dual, 5000 ohms-100,000 ohms	33-5533-10
R51A	Potentiometer, BRIGHTNESS control, 100,000 ohms	Part of R51
R51B	Potentiometer, CONTRAST control, 5,000 ohms	Part of R51
R54	Resistor, cathode bias, 10 ohms	66-0108340*
R58	Resistor, l-f compensation, 1000 ohms	66-2108340*
R94	Resistor, vertical shaping, 5100 ohms	66-2519240*
R97	Potentiometer assembly, dual, 50,000 ohms-1 megohm	33-5563-6
R97A	Potentiometer, VERT. HOLD control, 1 megohm	Part of R97
R97B	Potentiometer, HORIZ. HOLD control, 50,000 ohms	Part of R97
R118	Resistor, terminating, 5600 ohms	66-2568340*
R119	Resistor, terminating, 5100 ohms	66-2508340*
R127	Resistor, screen dropping, 4700 ohms	66-2475340*
R128	Resistor, r-f filter, 470 ohms	66-1478340*
R129	Resistor, beat suppressor, 330 ohms	66-1338340*
R130	Resistor, plate-load shunt, 10,000 ohms	66-3104340*
S3	Switch, band	Part of 76-4402-6
S3A	Switch, aerial	Part of S3
S3B	Switch, aerial transformer	Part of S3
S3C	Switch aerial grounding	Part of S3
T1	Transformer, r-f	Part of 76-4402-6
T2	Transformer, l-f aerial	Part of 76-4402-6
T3	Transformer, h-f aerial	Part of 76-4402-6
TC1 to TC13	Tuning cores	Part of 76-4402-6
WS1	Wafer-switch-and plate assembly	Part of 76-4402-6
Z2	Transformer, FM detector	32-4217-2

MODEL 50-T1104, CODE 123 (RUN 4)

C79	Condenser, d-c blocking, .47 μf.	61-0133
L73	Coil, filter, 600 μh.	32-4264-1
R72	Resistor, decoupling, 1,500 ohms, 5w	66-2155340*
R119	Resistor, terminating, 5800 ohms	66-2568340*
R131	Resistor, damping	66-1475340*

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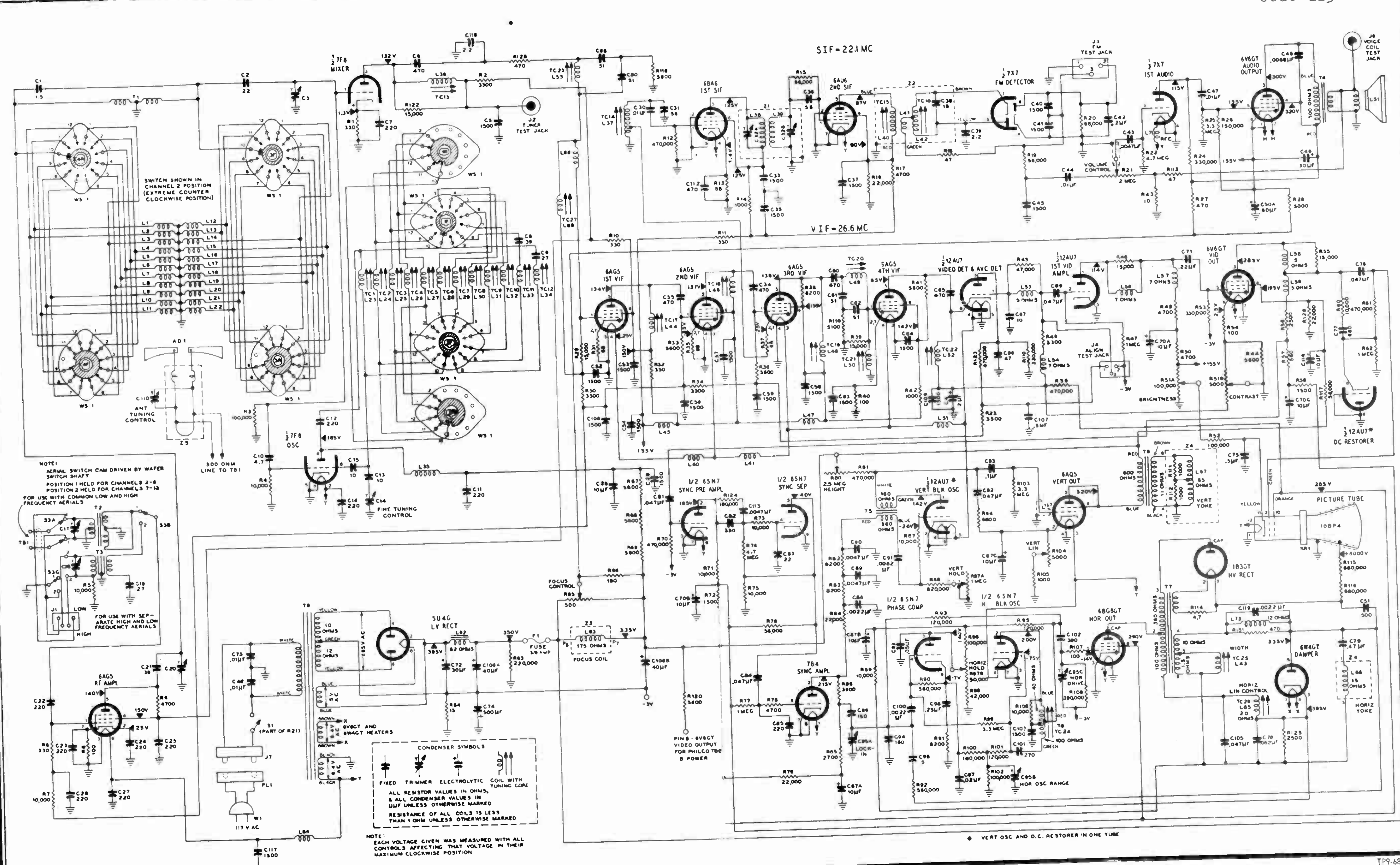

Figure 10. Philco Television Receiver Model 50-T1104, Code 123 (Run 4), Complete Schematic Diagram

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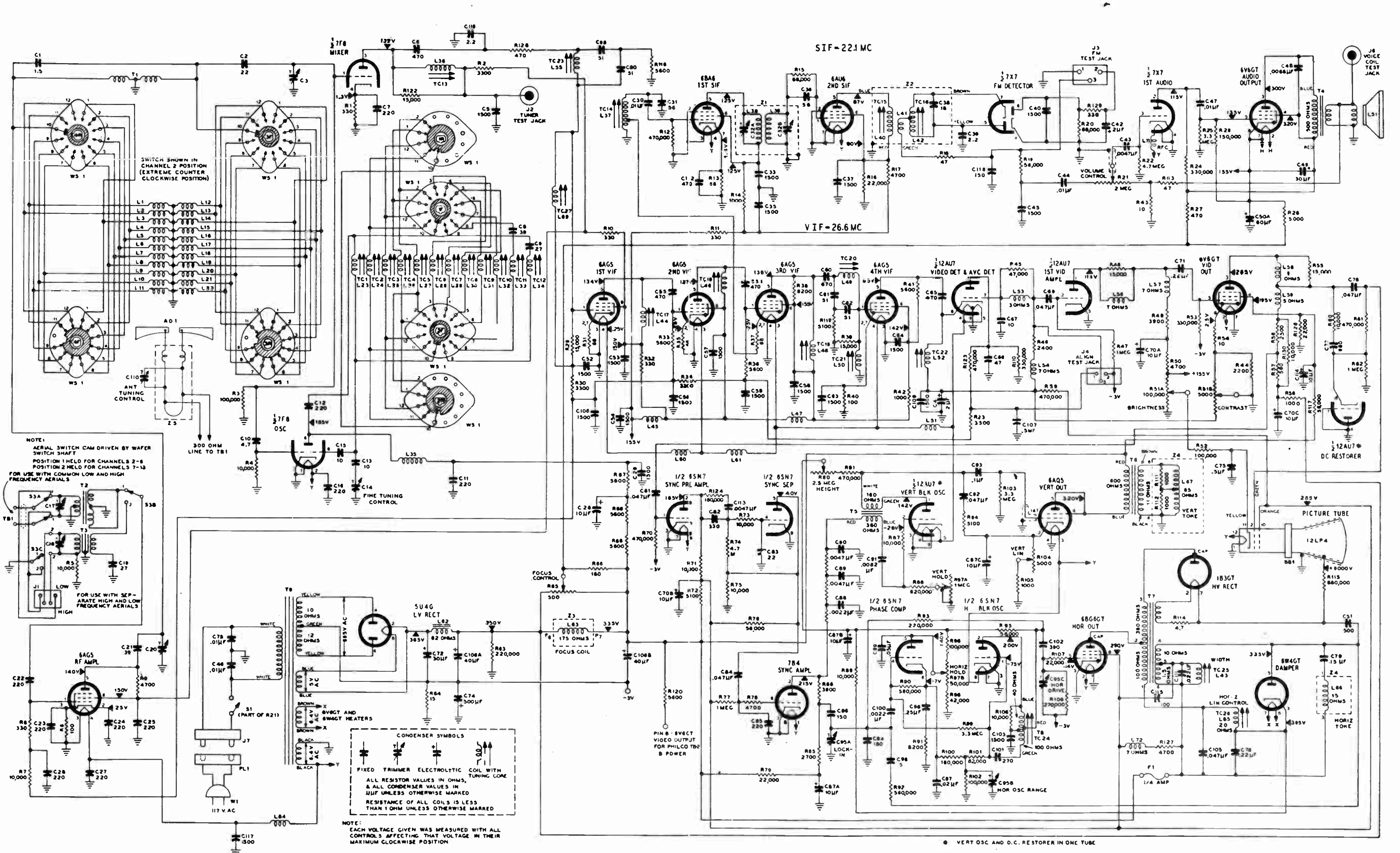

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Figure 9. Philco Television Receiver Models 50-T1400, 50-T1401, 50-T1402, and 50-T1430 (All Run 5), Complete Schematic Diagram

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PRODUCTION CHANGES IN MODELS 50-T1400; 50-T1401; 50-T1402; 50-T1430

RUN NO.	DESCRIPTION OF CHANGE	REMOVED PART NO.	ADDED PART NO.	REASON FOR CHANGE
6	R94 changed from 5100 ohms to 5600 ohms.	66-2518340	66-2568340	To reduce vertical foldover.
6	R66 changed from 180 ohms to 100 ohms.	66-1184340	66-1104340	To center range of FOCUS control.
7*	L72, C111, and C115 removed. Screen (pin 8) of horizontal-output tube connected through R127 to secondary tap of T7. L43 changed to improved type width coil.	32-4143-7 45-3505-60 60-10105407 32-4419	32-4419-2	To improve horizontal deflection.
7*	R108 changed from 270,000 ohms to 180,000 ohms.	66-4278340	66-4188340	To improve horizontal deflection.

* Other runs incorporating this change have "Y" stamped after the run number.

MODELS 50-T1400, 50-T1401, 50-T1402, 50-T1430

RUN NO.	DESCRIPTION OF CHANGE	REMOVED PART NO.	ADDED PART NO.	REASON FOR CHANGE
X	"X" after run numbers 1 through 7 indicates that a short wire jumper is connected across R67.			To improve performance with low line voltage.
8	R67 removed. R68 connected to junction 66-2564340 of L35 and C11.			To improve performance with low line voltage.
7A or 9	Tuner No. 76-4402-6 replaced with Tapered-Line Tuner No. 76-5433. R29 changed from 15,000 ohms to 10,000 ohms. R68 changed from 56,000 ohms to 1000 ohms. R69 changed from 56,000 ohms to 6200 ohms.	76-4402-6 66-3158340 (2) 66-2568340	76-5433 66-3108340 66-2108340 33-1335-19	To incorporate new tuner.
10	C91 changed from .0082 μf. to .015 μf.. R87 removed. Pin 2 of vertical-blocking-oscillator tube connected to junction of C91 and R88. R88 changed from 820,000 ohms to 470,000 ohms. R94 changed from 5100 ohms to 6800 ohms.	61-0174 66-3108340 66-4828340 66-2518340	30-4651-8 66-4478340 66-2688340	To reduce vertical foldover.

PHILCO TELEVISION RECEIVER MODELS 50-T1403, 50-T1404, AND 50-T1406

The chassis of Philco Models 50-T1403, 50-T1404, and 50-T1406 are similar to that used in Model 50-T1400. All are table models with different type cabinets. Model 50-T1403 has a functional-style walnut cabinet; Model 50-T1404 has a modern-style mahogany cabinet; and Model 50-T1406 is housed in a Georgian-style cabinet with mahogany finish. All three models incorporate a 12-inch picture tube, a wide mask, and a built-in aerial.

For service information pertaining to the above models, refer to Philco Service Manual PR-1793, which covers Models 50-T1400, 50-T1402, and 50-T1104, Code 123. The production changes for Model 50-T1400 also apply to Models 50-T1403, 50-T1404, and 50-T1406. However, the Miscellaneous section of the Replacement Parts List in PR-1793 does not apply to these models, because of the difference in cabinets. Therefore, the following list of miscellaneous items should be used.

MISCELLANEOUS

Description	Service Part No.
Cabinet (50-T1403)	10785-4
Cabinet (50-T1404)	10795
Cabinet (50-T1406)	10783-1
Cabinet Hardware and Parts	
Back-and-cup assembly (50-T1403)	76-5406-2
Back-and-cup assembly (50-T1404)	76-5406-6
Back-and-cup assembly (50-T1406)	76-5406-4
Brace, picture tube, 1 15/16" x 5 15/16" (50-T1403, 50-T1404, 50-T1406)	56-5581-33FA3
Brace, picture tube, 2½" x 2⅜" (50-T1403)	56-5581-39FA3
Brace, picture tube, 2" x 4⅛" (50-T1404)	56-5581-40FA3
Brace, picture tube, 1 13/16" x 4⅜" (50-T1406)	56-5581-26FA3
Coupler, aerial shaft, rubber	54-4748
Escutcheon (50-T1404)	56-7854FCP
Knob, AERIAL TUNING control	54-4750
Knob, BRIGHTNESS control (50-T1403, 50-T1404)	54-4699-3
Knob, BRIGHTNESS control (50-T1406)	54-4699
Knob, CHANNEL SELECTOR (50-T1403, 50-T1404)	56-6596-3
Knob, CHANNEL SELECTOR (50-T1406)	56-6596-6
Knob, CONTRAST control (50-T1403, 50-T1404)	54-4703-2
Knob, CONTRAST control (50-T1406)	54-4707
Knob, FINE TUNING control (50-T1403, 50-T1404)	54-4662-1

MISCELLANEOUS (Cont.)

Description	Service Part No.
Knob, FINE TUNING control (50-T1406)	54-4662-2
Knob, HORIZ. HOLD control (50-T1403, 50-T1404)	54-4707-2
Knob, HORIZ. HOLD control (50-T1406)	54-4707
Knob, VERT. HOLD control (50-T1403, 50-T1404)	54-4699-3
Knob, VERT. HOLD control (50-T1406)	54-4699
Knob, VOLUME control (50-T1403, 50-T1404)	54-4703-2
Knob, VOLUME control (50-T1406)	54-4703
Shaft, AERIAL TUNING control	54-4747-9
Window (50-T1403, 50-T1404)	54-4755-1
Window (50-T1406)	54-8068
Cable assembly, high voltage	41-3771-2
Cable assembly, picture tube	41-3772-2
Insulator, high voltage	54-7573-5
Insulator, standoff	54-7309-6
Mounting-frame assembly, picture tube	76-3938
Shield, Loktal tube	56-2731
Shield, miniature tube	56-5629FA3
Socket, Loktal tube	27-6207
Socket, miniature tube	27-6226
Socket, octal tube	27-6174-6
Socket, octal tube (1B3GT)	27-6174-5
Socket, 9-pin (12AU7)	27-6203-5
Tuner assembly, complete	76-5433

PHILCO TELEVISION RECEIVER MODELS 50-T1402, 50-T1406, 50-T1432, ALL CODE 122

The chassis of the above models are similar to that used in Model 50-T1400, Code 121, Run 13, except that these models use Philco 12-position turret tuner, Part No. 76-5411-3, and have minor circuit changes, as follows:

1. The B+ line from the tuner is connected through a 10,000-ohm resistor, Part No. 66-3104340, instead of through R67, R68, and R69.
2. C28 is connected between ground and the junction of the tuner B+ lead and the added 10,000-ohm resistor.
3. An r-f choke, Part No. 32-4112-11, is added, in series with the filament lead to the tuner.
4. A 1500-$\mu\mu f$. condenser, Part No. 62-215001011, is connected between ground and the junction of the tuner filament lead and the added r-f choke.

Model 50-T1402, Code 122, and 50-T1406, Code 122, are table models. Model 50-T1432, Code 122, is a console model. Model 50-T1432, Code 122, uses a 10-inch speaker, Part No. 36-1610-6, which is mounted in the cabinet.

Models 50-T1402, Code 122, and 50-T1432, Code 122, have modern-style mahogany-finish cabinets. Model 50-T1406, Code 122, has a Georgian-style cabinet with mahogany finish.

For service information pertaining to the above models, refer to Philco Service Manual PR-1793, which covers Models 50-T1400, 50-T1402, and 50-T1104, Code 123. For service information pertaining to the tuner, refer to Service Manual PR-1803. A list of replacement parts covering the miscellaneous items used in these models is given below.

Description	Service Part No.
Cabinet (50-T1402, Code 122)	10776-3
Cabinet (50-T1406, Code 122)	10783-1
Cabinet (50-T1432, Code 122)	10794
Cabinet Hardware and Parts	
Back-and-cup assembly (50-T1402, Code 122)	76-5406
Back-and-cup assembly (50-T1406, Code 122)	76-5406-4
Back assembly (50-T1432, Code 122)	76-5717
Brace, picture tube, 1 13/16" x 4⅜" (50-T1402, Code 122, and 50-T1406, Code 122)	56-5581-26FA3
Brace, picture tube, 1 13/16" x 6¼" (50-T1402, Code 122)	56-5581-27FA3
Brace, picture tube, 1 15/16" x 5 15/16" (50-T1406, Code 122)	56-5581-33FA3
Brace, picture tube, 2⅛" x 6½" (50-T1432, Code 122)	56-5581-41FA3
Brace, picture tube, 2" x 7 13/16" (50-T1432, Code 122)	56-7754FA3
Cup, back (50-T1432, Code 122)	56-5171-6FJ31
Escutcheon (50-T1402, Code 122, 50-T1432, Code 122)	56-7854
Knob, AERIAL TUNING control	54-4750
Knob, BRIGHTNESS control (50-T1402, Code 122)	54-4699-3
Knob, BRIGHTNESS control (50-T1406, Code 122, 50-T1432, Code 122)	54-4699
Knob, CHANNEL SELECTOR (50-T1402, Code 122)	56-6596-3FCP
Knob, CHANNEL SELECTOR (50-T1406, Code 122, 50-T1432, Code 122)	56-6596-6FCP
Knob, CONTRAST control (50-T1402, Code 122)	54-4703-2
Knob, CONTRAST control (50-T1406, Code 122, 50-T1432, Code 122)	54-4707
Knob, FINE TUNING control (50-T1402, Code 122)	54-4662-1
Knob, FINE TUNING control (50-T1406, Code 122, 50-T1432, Code 122)	54-4662-2
Knob, HORIZ. HOLD control (50-T1402, Code 122)	54-4707-2
Knob, HORIZ. HOLD control (50-T-1406, Code 122, 50-T1432, Code 122)	54-4707
Knob, VERT. HOLD control (50-T1402, Code 122)	54-4699-3
Knob, VERT. HOLD control (50-T1406, Code 122, 50-T1432, Code 122)	54-4699
Knob, VOLUME control (50-T1402, Code 122)	54-4703-2
Knob, VOLUME control (50-T1406, Code 122, 50-T1432, Code 122)	54-4703
Shaft, aerial-tuning control (50-T1402, Code 122)	54-4747-6
Shaft, aerial-tuning control (50-T1406, Code 122, 50-T1432, Code 122)	54-4747-9
Window (50-T1402, Code 122)	54-7983
Window (50-T1406, Code 122)	54-8068
Window (50-T1432, Code 122)	54-7943-8
Cable assembly, high voltage	41-3771-2
Cable assembly, picture tube	41-3772-2
Insulator, high voltage	54-7573-5
Insulator, standoff	54-7309-6
Mounting-frame assembly, picture tube	76-3938
Shield, Loktal tube	56-2731
Shield, miniature tube	56-5629FA3
Socket, Loktal tube	27-6207
Socket, miniature tube	27-6226
Socket, octal tube	27-6174-6
Socket, octal tube (1B3GT)	27-6174-5
Socket, 9-pin (12AU7)	27-6203-5
Tuner assembly, complete	76-5411-3

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MODELS 50-T1400, 50-T1401, 50-T1402, 50-T1403, 50-T1404, 50-T1406, AND 50-T1430, ALL CODE 121

RUN NO.	DESCRIPTION OF CHANGE	REMOVED PART NO.	ADDED PART NO.	REASON FOR CHANGE
W	"W" stamped after run number indicates that R101 is changed from 82,000 ohms to 68,000 ohms.	66-3828340	66-3688340	To extend range of horizontal-oscillator tank circuit.
V	"V" stamped after run number indicates that R101 is 82,000 ohms, and that an 860,000-ohm resistor is added, across it.		66-4828340	To extend range of horizontal-oscillator tank circuit.
11	Tuner unit shock-mounted.			To reduce microphonics.
11	R69 changed from 6200 ohms to 5100 ohms.	33-1335-19	33-1335-18	To increase tuner B+ voltage.
12	C83 changed from 22 μμf. to 12 μμf.	62-022009001	30-1223-2	To improve interlace and reduce jitters.
13	T9 changed to transformer with hum shield.	32-8411-1	32-8423-2	To reduce picture weave.

PRODUCTION CHANGES

MODELS 50-T1400, 50-T1401, 50-T1402, 50-T1403, 50-T1404, 50-T1406, AND 50-T1430, ALL CODE 121

RUN NO.	DESCRIPTION OF CHANGE	REMOVED PART NO.	ADDED PART NO.	REASON FOR CHANGE
14	C101, 270 μμf., changed to 220 μμf.	60-10275407*	60-10225317*	To center range of horiz. osc. coil slug.
15	L43 (width coil) changed.	32-4419-2	32-4419-3	To increase width.
16	1B3 socket and wiring changed. Wiring removed from pin 5 and placed on pin 4.	27-6174-5	27-6174-7	To prevent shorting of components due to internal connections on pins 1, 3, and 5 of some 1B3GT tubes.
17	Extensive changes were made in physical location of sound detector parts.			To reduce harmonic beat.
18	R130 removed. R56, 2500 ohms, changed to 1800 ohms.	66-3108340* *33-1335-87	66-2185340*	
19	Vertical-output transformer (T6) changed to smaller size.	32-8405	32-8425-1 (For replacement purposes, use 32-8405*.)	
20	Fuse added, in series with ground lead of filament winding of power transformer.		Length of #26 copper wire.	To provide protection against filament shorts.
21	820-μμf. condenser added, to screen of horizontal output tube (6BG6G).		60-10825001*	To reduce parasitic oscillation in 6BG6G tube.
22	B supply fuse changed to 1/2-amp. delayed-action type, and wired in series with B-lead of power transformer.	45-2656-8	45-2656-17 (1/2 amp. delayed action.)	To provide additional protection.

*The part number given for R56 (2500-ohm plate load resistor) in the Service Manual is incorrect. The correct part number is 33-1335-87.

MODELS 50-T1400, 50-T1402, 50-T1403, 50-T1404, AND 50-T1406, ALL CODE 122

RUN NO.	DESCRIPTION OF CHANGE	REMOVED PART NO.	ADDED PART NO.	REASON FOR CHANGE
2	1B3 socket and wiring changed. Wiring removed from pin 5 and placed on pin 4.	27-6174-5	27-6174-7	To prevent shorting of components due to internal connection on pins 1, 3, and 5 of some 1B3GT tubes.
3	R130 removed. R56, 2500 ohms, changed to 1800 ohms.	66-3108340* *33-1335-87	66-2185340*	
4	Vertical-output transformer (T6) changed to smaller size.	32-8405	32-8425-1 (For replacement purposes, use 32-8405*.)	
5	Fuse added, in series with ground lead of filament winding of power transformer.		Length of #26 copper wire.	To provide protection against filament shorts.
6	820-μμf. condenser added, to screen of horizontal output tube (6BG6G).		60-10825001*	To reduce parasitic oscillation in 6BG6G tube.

*The part number given for R56 (2500-ohm plate load resistor) in the Service Manual is incorrect. The correct part number is 33-1335-87.

MODEL 50-T1432, CODE 122

RUN NO.	DESCRIPTION OF CHANGE	REMOVED PART NO.	ADDED PART NO.	REASON FOR CHANGE
6	Fuse added, in series with ground lead of filament winding of power transformer.		Length of #26 copper wire.	To provide protection against filament shorts.

MODEL 50-T1104, CODE 123

Correction to Parts List

The correct part number of the back-and-cup assembly used in the above model is 76-4605.

Model	Cabinet Part No.	Window Part No.
50-T1400	10785-3	54-4755
50-T1401	10784-3	54-4755

MODEL 50-T1400

Tables

To make the 50-T1400 cabinet fit properly into the table, either the front or rear cabinet feet should be removed.

MODELS 50-T1104, CODE 123; 50-T1400 SERIES

Horizontal Sync and Drive Padder Identification

Future production of the above models will not have the horizontal sync and drive padder function stamped adjacent to the padder.

The relative position of the padders will remain the same, and the applicable service manual should be referred to for the specific location.

MODELS 50-T1400, 50-T1401

New Cabinets

The cabinets for the above models have been changed so that the oscillator tuning cores may be adjusted with the chassis in the cabinet. This may now be done by simply removing the CHANNEL SELECTOR and FINE TUNING knobs. A physical change was also made in the windows.

CORRECTIONS TO MODELS 50-T1400, 50-T1402, AND 50-T1104, CODE 123

The corrections given below should be made to the Replacement Parts List.

Reference Symbol	Published Part No.	New or Correct Part No.
R56	66-2254340*	33-1335-87
R72	33-5546-28	33-1335-18
Z5	54-4661	76-5413

MISCELLANEOUS

Description	Published Part No.	New or Correct Part No.
Mask (50-T1104-M)	56-7144-2	56-7143

MODELS 50-T1400, 50-T1401, 50-T1402, 50-T1403, 50-T1404, 50-T1406, Codes 121, 122; 50-T1430, Code 121; 50-T1432, Code 122; 50-T1104, Code 123; 50-T1400, 50-T1402, 50-T1404, Code 123

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MODELS 50-T1104, CODE 123, 50-T1400, 50-T1401, 50-T1402, 50-T1403, 50-T1404, 50-T1406, 50-T1430, 50-T1432; —NEW HORIZONTAL-OUTPUT TRANSFORMER

The horizontal-output transformer for the above models has been changed. The new part numbers are given below:

Model	New Transformer Part No.
50-T1104 through 50-T1432	32-8437
50-T1476 through 50-T1482; 50-T1484	32-8421-2

The above transformer should be used for all replacements in these models.

CORRECTIONS

The corrections given below should be made to the Replacement Parts List for Models 50-T1400, 50-T1401, 50-T1402, and 50-T1430 (all Run 5).

Reference Symbol	Published Part No.	New or Correct Part No.
C109	62-245001001*	62-215001011*
C110	31-6518	45-9570*
R46	66-2248340*	66-2248240*
R54	66-0108340*	66-0103340*
R56	66-2254340*	33-1335-87
R72	33-5546-28	33-1335-18
R94	66-2519240	66-2518240*
T9	32-8411-1	32-8423-2
R119	66-2508340*	66-2518240*
TB1	38-8688	38-8689

MISCELLANEOUS

Description	Published Part No.	New or Correct Part No.
Item 9—Bolt, mask (50-T1401)	1W8038FE11	1W18038FA3
Item 11—Brace, picture tube	56-5581-39FA3	56-5581-34FA3
Item 23—Knob, CHANNEL SELECTOR (50-T1400, 50-T1401)	56-6596-1	56-6596-3

The corrections given below should be made to the Replacement Parts List for Model 50-T1104, Code 123 (Run 4).

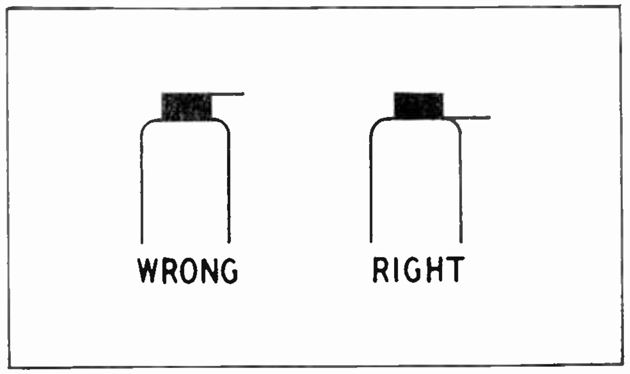
Reference Symbol	Published Part No.	New or Correct Part No.
C43	30-4650-56	45-3505-56*
C48	30-4650-91	45-3505-91*
C71	30-4650-49	45-3505-49*
C104	62-215001001*	62-215001011*
C108	62-215001001*	62-215001011*
C109	62-245001001*	62-215001011*
C110	31-6518	45-9570*
L37	32-4302-3	32-4303-2
R113	66-0473340*	66-1478340*
R125	66-2258340*	66-2253340*
T9	32-8411-1	32-8423-2*
TB1	38-8688	38-8689

MISCELLANEOUS

Description	Published Part No.	New or Correct Part No.
Item 9—Knob, CHANNEL SELECTOR	56-6596-1	56-6596-3

MODELS 50-T1104, CODE 123, 50-T1400, 50-T1401, 50-T1402, 50-T1403, 50-T1404, 50-T1406, 50-T1430, AND 50-T1432—PLACEMENT OF 1B3GT ANODE CAP

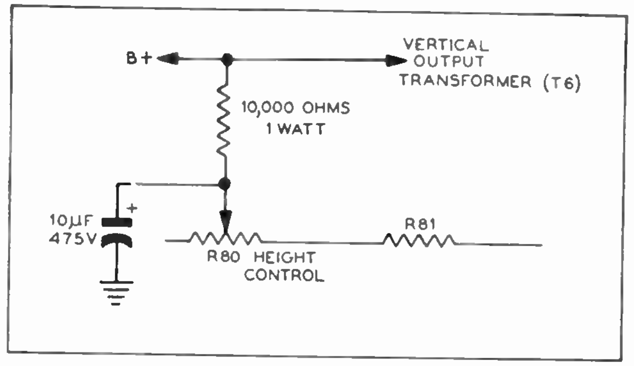
It is possible to place the anode cap on the 1B3GT tube, in the above Receivers, so that it is too close to the top of the high-voltage cage. When placing the anode cap on the tube, make sure that it is placed as illustrated below.



Placement of 1B3GT Anode Cap

MODEL 50-T1400 SERIES, RUNS 1 AND 2 — REDUCTION OF VERTICAL JITTER

Vertical jitter in the picture due to line voltage fluctuations in the above models may be greatly reduced or eliminated, in the special cases where necessary, by adding an extra filter network to the B supply feeding the vertical oscillator and discharge tube. This network consists of a 10,000-ohm resistor and a 10-μf. condenser.



Addition of Filter Network, Model 50-T1400 Series, Runs 1 and 2

MODEL 50-T1400 SERIES PREVENTING HORIZONTAL-SYNC TEAR AT MINIMUM CONTRAST CONTROL SETTING

Horizontal tear at the top of the picture may be caused by a horizontal damper lead radiating energy into the sync separator circuit.

The effect of this radiation may be reduced by redressing these leads (refer to figure 7, page 5, of Service Bulletin 49T3, PR-1822) as follows:

Redress the blue lead on B3-3 to the mounting jack of the high-voltage condenser, under C46, and under T6 to the condenser mounting jack. This wire connects C51 to C79, and radiates some horizontal output signal to the lead connected from B3-2 to B8-3, which is in the sync separator grid circuit. Also redress this wire (from B3-2 to B8-3) on the 6SN7GT side of B8, under R76 to B8-3.

Model 50-T1400 Series, 50-T1404 and 50-T1105 Correction of Part Number

The correct part number of C74, the 500-$\mu\mu f$., 25-volt filter condenser across the 15-ohm resistor in the negative return of the low-voltage power supply, is 30-2570-40.

Model 50-T1403 Additional Replacement Part

A securing clip for the oscillator adjustment cover escutcheon plate is now available for replacement purposes. The part number is 1W57058FA22. It is referred to as a speed clip.

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NOTE:- For additional information, See Model 50-T1404, Code 1403, Pages 5-7 to 5-16.

PRODUCTION CHANGES IN MODELS 50-T1404, CODE 123, AND 50-T1406, CODE 123; 50-T1404, 50-T1406, AND 50-T1432, ALL CODE 124

Corrections to Service Manual

1. Figure 5, page 6, caption should read, "Top View of Chassis (without Tuner), etc."

2. Figure 6, page 7, caption should read, "Top View of Chassis, Showing Locations of Adjustments."

3. The Bandpass and R-F Response Adjustment Procedure for Tapered Line Tuner (Code 123), page 12, is superseded by the following procedure (refer to PR-1858 for complete tuner information):

1. Connect the outputs of the AM and FM signal generators through the aerial-matching network (figure 1) to terminals 1 and 2 of Z1-T. Terminals 3 and 4 of Z1-T should be connected together, for a 300-ohm input.

2. Connect a 3300-ohm resistor in series with the 150-volt (red) B+ lead to R9-T. Connect the vertical input of the oscilloscope to the junction of the 3300-ohm resistor and R9-T.

3. Turn the CHANNEL SELECTOR to Channel 10, and remove the 1st v-i-f tube. Connect a 470-ohm resistor from the v-i-f output (green) lead to ground.

4. Set the FM signal generator to 195 mc., with sufficient sweep to give the complete response curve.

5. Set the AM signal generator (unmodulated) to produce marker pips at the video and sound carriers for Channel 10.

6. Adjust C8-T and C11-T for maximum symmetrical response within Channel 10. If there is one weak station in the local area, the adjustment of C8-T and C11-T may be made on that channel, to improve its performance, provided that the response on other channels is not sacrificed too much.

4. The Bandpass and R-F Response Adjustment Procedure for 12-Position Turret Tuner (Code 124), page 13, step 2, should read, "Short the v-i-f output lead of the tuner to ground through a 470-ohm resistor."

5. The connection of C15-T and L17-T, R10-T should be interchanged in figure 13, page 13.

6. In figure 14, pages 16 and 17, terminal 4 of the tapered line input terminals should be grounded.

7. In figure 14, pages 16 and 17, the connections to pins 1 and 3 of the 6T8 (Code 124) should be reversed.

8. In figure 14, pages 16 and 17, the value of R94 should be 82,000 ohms.

9. In figure 14, pages 16 and 17, and in the Replacement Parts List, the values of R3-T and R2-T should be interchanged.

10. In figure 14, the peak-to-peak voltage on the grid of the 6BG6G tube should be 35v.

11. The correct part number of C24 is 62-01049001.

12. The correct part number of R26 is 33-5563-22.

PRODUCTION CHANGES IN MODELS 50-T1404, CODE 123, AND 50-T1406, CODE 123

RUN NO.	DESCRIPTION OF CHANGE	REMOVED PART NO.	NEW OR ADDED PART NO.	REASON FOR CHANGE
2	R85 changed to 1.5 megohms.	66-5108340	66-5158340	To center range of VERT. HOLD control.
3	R68 removed. Pin 6 of video output tube was connected directly to the 135-volt source.	66-2565340		To simplify wiring.
4	L17 and R24 removed. Plate of 1st video amplifier was connected directly to L18.	32-4143-14 66-3158340		To improve video response.

PRODUCTION CHANGES IN MODELS 50-T1404, 50-T1406, 50-T1432, ALL CODE 124

RUN NO.	DESCRIPTION OF CHANGE	REMOVED PART NO.	NEW OR ADDED PART NO.	REASON FOR CHANGE
2	R85 changed to 1.5 megohms.	66-5108340	66-5158340	To center range of VERT. HOLD control.
3	R68 removed. Pin 6 of video output tube was connected directly to the 135-volt source.	66-2565340		To simplify wiring.
4	L17 and R24 removed. Plate of 1st video amplifier was connected directly to L18.	32-4143-14 66-3158340		To improve video response.
4	A 3.3-$\mu\mu f$. condenser was added, from pin 1 of FM detector, 6T8, to ground.		30-1224-30	To improve FM detector AM rejection.

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MODEL 50-T1403

The chassis used in the above models is similar to the chassis used in Models 50-T1404 and 50-T1406, Code 123. The differences are as follows:

1. A 7N7 tube is used in place of a 6SN7GT in the vertical-sweep-output stage.
2. A 7N7 tube is used in place of a 6SN7GT as a phase comparer and horizontal oscillator.
3. The 7N7 phase comparer and horizontal-oscillator tube is shock-mounted.
4. The phase comparer and horizontal-oscillator circuits are changed, as shown in figure 3.
5. The 47,000-ohm loading resistor (R116) across the video detector series peaking coil (L15) is removed.
6. The series peaking coil (L17) in the plate circuit of the 1st video amplifier is removed, and the plate is connected directly to the shunt peaking coil (L18).
7. The 1-megohm resistor (R85) shunting the VERT. HOLD control is changed to 1.5 megohms.
8. The B supply for Philco Television Booster Model TB-2, on pin 6 of the video-output tube, is obtained directly from the 135-volt bus.

For complete service information on Models 50-T1403, 50-T1404, and 50-T1406, all Code 125, refer to this supplement, and to Service Manual PR-1844, covering Models 50-T1404, Code 123, and 50-T1406, Code 123; Models 50-T1404, 50-T1406, and 50-T1432, all Code 124.

HORIZONTAL-SWEEP ADJUSTMENTS

The changes made in the horizontal-sweep circuit necessitate a new adjustment procedure, which is given below.

The range of the horizontal-hold control potentiometer is sufficient to compensate for normal variations in the frequency of the horizontal oscillator, and no other adjustments are ordinarily required. However, if the tube or other components are replaced in the horizontal-oscillator circuit, it may be necessary to make the following adjustments, to obtain proper synchronism and deflection:

1. Preset the adjustments as follows:
   a. Lockin trimmer, C65A, one turn counterclockwise from the maximum clockwise position. See figure 1.
   b. Stabilizing core, TC-15, maximum counterclockwise.
   c. Drive trimmer, C65C, 1 turn counterclockwise from the maximum clockwise position.
   d. HORIZ. HOLD control, center of its range.
2. Tune in a station, and adjust TC12 until the picture is brought into sync.
3. Connect an oscilloscope to pin 3 of the HOR. OSC. TEST socket, J6, and adjust the scope sweep until two complete cycles of the pattern are stationary.

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4. Adjust the stabilizing core, TC15, until the two peaks (see figure 2) are of equal amplitude, readjusting TC12, if necessary, to keep the picture in sync.
5. Connect the oscilloscope to pin 1 of J6.
6. Adjust the drive trimmer, C65C, to obtain 8600 volts on the picture-tube second anode, with the BRIGHTNESS control fully counterclockwise, or the picture-tube second-anode lead disconnected. The second-anode voltage should be measured with a Philco Electronic Circuit Master, Model 7001, or an equivalent instrument which has 100-megohm input resistance. Readjust TC15, if necessary, to keep the picture in sync. If a meter capable of reading high voltage is not available, the horizontal drive may be adjusted as follows: Starting with C65C in the preset position, turn counterclockwise until variation of the BRIGHTNESS control just affects the horizontal linearity of the picture.
7. Turn the HORIZ. HOLD control maximum clockwise. Adjust TC12 so that the blanking bar appears at the left edge of the picture.
8. Turn the HORIZ. HOLD control counterclockwise until the picture comes in, then goes out of sync. Then turn the HORIZ. HOLD control slowly clockwise again, counting the number of black bars sloping down to the left before the picture pulls into sync. If there are more than 3½ bars, turn the lockin trimmer, C65A, slightly clockwise; if there are less than 2½ bars, turn C65A slightly counterclockwise. If the Receiver does not lose sync when the HORIZ. HOLD control is maximum counterclockwise, remove the signal momentarily.
9. Repeat steps 7 and 8 until the picture pulls into sync when from 2½ to 3½ bars appear, sloping down to the left.
10. Turn the HORIZ. HOLD control maximum clockwise. Adjust TC12 to obtain between 4 and 6 bars, sloping down to the right.
11. Turn the HORIZ. HOLD control slowly counterclockwise, and note whether the picture goes in and out of sync again. Now, turn the HORIZ. HOLD control slowly clockwise until the picture comes into sync. If this sequence is not obtained, repeat steps 7, 8, 9, and 10.

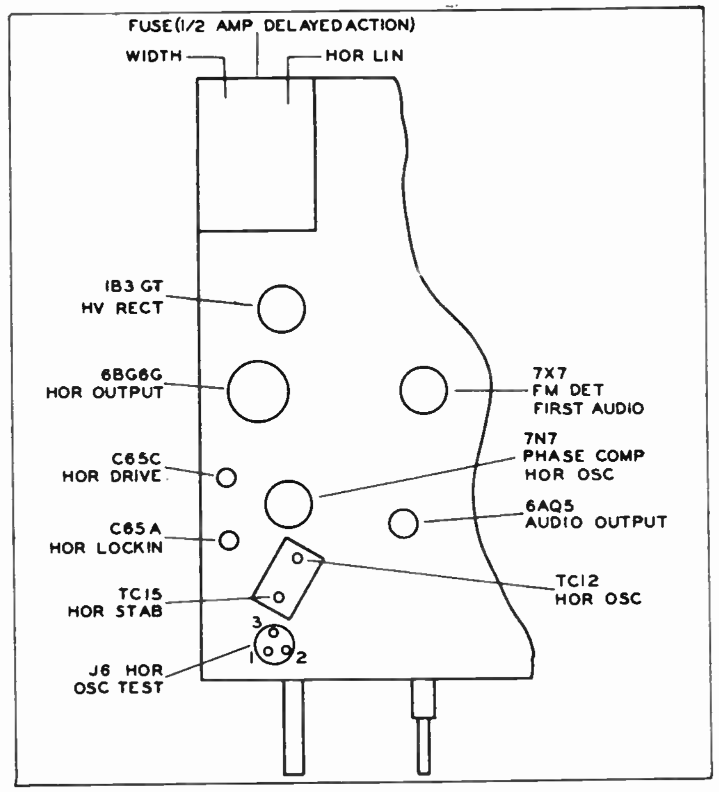

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Figure 1. Locations of Horizontal-Sweep Adjustments

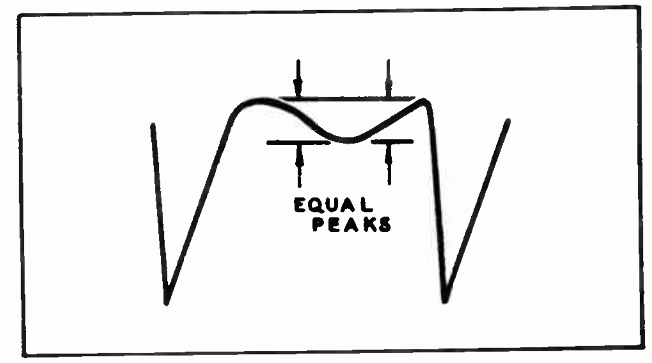

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Figure 2. Horizontal-Sync Pulses—Horizontal Stabilizing Core Properly Adjusted

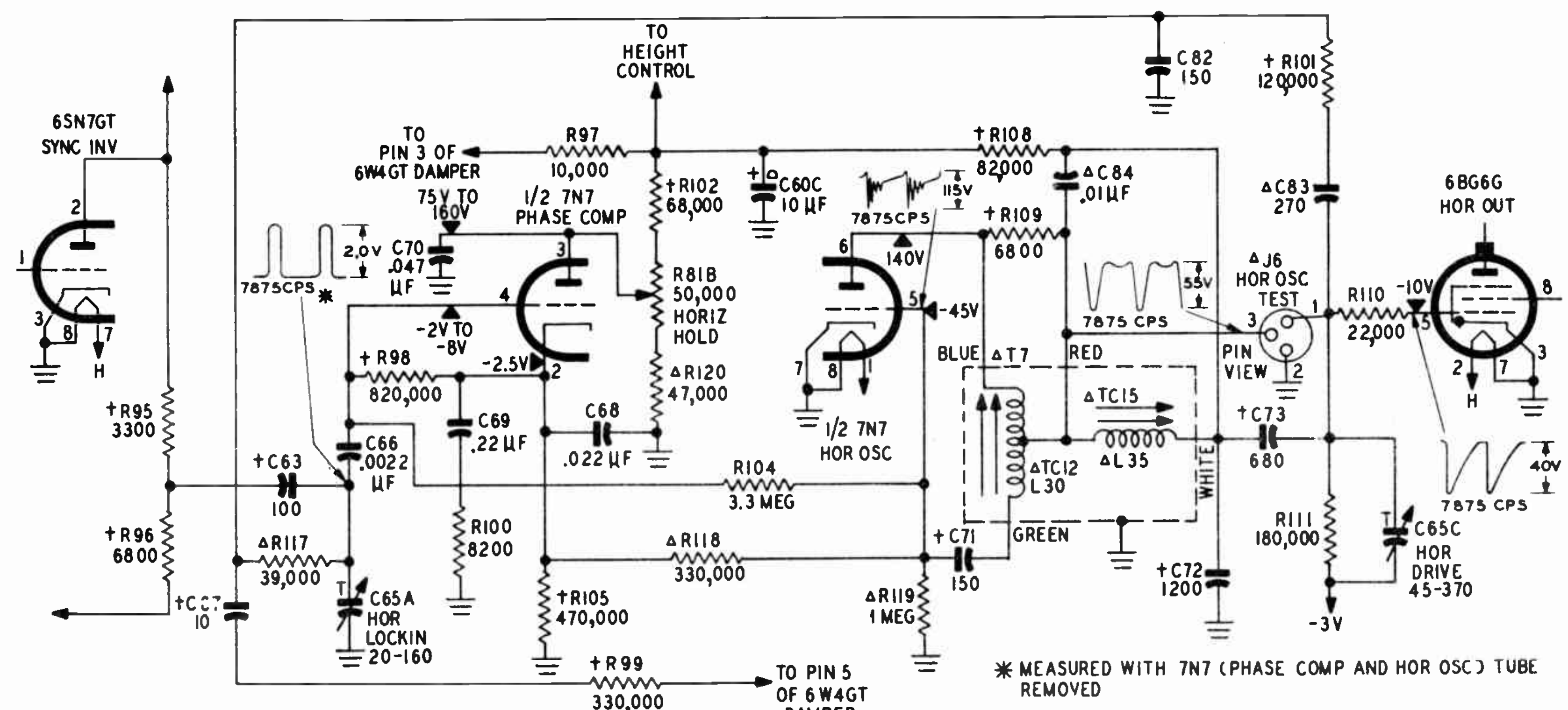

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Figure 3. Circuit Variations in Code 125 of Models 50-T1403, 50-T1404, and 50-T1406

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REPLACEMENT PARTS LIST

A supplementary parts list for Models 50-T1403, 50-T1404, and 50-T1406, all Code 125, is given below. A part identified by † has the same function as in Code 123, but its value is different.

A part that has been added in Code 125 is identified by Δ, and has a new symbol. All other parts have the same symbols, values, and functions as in Code 123, and are repeated in this list for convenience in the use of the supplementary schematic diagram.

In any case where a part is not used in Code 125, or where its function is changed, the original symbol is not used, and, therefore, is not listed.

NOTE: Part numbers identified by an asterisk (*) are general replacement items. These numbers may not be identical with those on factory parts. Also, the electrical values of some replacement items may differ from the values indicated in the schematic diagram and parts list. The values substituted in any case are so chosen that the operation will be either unchanged or improved. When ordering replacements, use only the "Service Part No."

Reference Symbol	Description	Service Part No.
C60C	Condenser, decoupling, 10μf., 475v	Part of C60
†C63	Condenser, d-c blocking, 100 μμf.	60-10105407
C65	Condenser, 2-section trimmer	31-6476-21
C65A	Condenser, HORIZ. LOCKIN	Part of C65
C65C	Condenser, HORIZ. DRIVE	Part of C65
C66	Condenser, d-c blocking, .0022 μf.	45-3505-54*
†C67	Condenser, sweep feedback, 10 μμf.	60-00105407
C68	Condenser, cathode by-pass, .022 μf.	45-3505-43*
C69	Condenser, cathode filter, .22 μf.	45-3505-49*
C70	Condenser, plate by-pass, .047 μf.	45-3505-62*
†C71	Condenser, d-c blocking, 150 μμf.	60-10155407
†C72	Condenser, sweep charging, 1200 μμf.	60-20125404
†C73	Condenser, d-c blocking, 680 μμf.	60-10685401
ΔC82	Condenser, feedback delay, 150 μμf.	60-10155407
ΔC83	Condenser, d-c blocking, 270 μμf.	60-10275407
ΔC84	Condenser, fixed trimmer, .01 μf.	45-3505-58*
ΔJ6	Socket, HOR. OSC. TEST	27-6126
ΔL30	Coil, horiz. oscillator	Part of T7
ΔL35	Coil, horiz. stabilizing	Part of T7
†R85	Resistor, shunt, 1.5 megohms	66-5158340*
†R95	Resistor, plate load, 3300 ohms	66-2338340*
†R96	Resistor, plate load, 6800 ohms	66-2688340*
R97	Resistor, decoupling, 10,000 ohms	66-3104340*
†R98	Resistor, grid return, 820,000 ohms	66-4828340*
†R99	Resistor, sweep feedback, 330,000 ohms, ±5%	66-4338240*
R100	Resistor, cathode filter, 8200 ohms	66-2828340*
†R101	Resistor, sweep feedback, 120,000 ohms	66-4128340*
†R102	Resistor, voltage divider, 68,000 ohms, ±5%	66-3684240*
R104	Resistor, grid return, 3.3 megohms, ±5%	66-5334240*
†R105	Resistor, cathode return, 470,000 ohms, ±5%	66-4478240*
†R108	Resistor, sweep charging, 82,000 ohms, ±5%	66-3824240
†R109	Resistor, loading, 6800 ohms	66-2688340*
R110	Resistor, suppressor, 22,000 ohms	66-3228340*
R111	Resistor, grid return, 180,000 ohms	66-4188340*
ΔR117	Resistor, sweep feedback delay, 39,000 ohms	66-3398340*
ΔR118	Resistor, coupling, 330,000 ohms, ±5%	66-4334240*
ΔR119	Resistor, grid return, 1 megohm, ±5%	66-5104240*
ΔR120	Resistor, voltage divider, 47,000 ohms	66-3474340*
ΔT7	Transformer, horiz. blocking	32-4367*
ΔTC12	Tuning core, horiz. oscillator	Part of T7
ΔTC15	Tuning core, horiz. stabilizing	Part of T7

MISCELLANEOUS

Description	Service Part No.
Δ Grommet, 7N7 shock mtg.	27-4099-3
Δ Socket, 7N7 shock mtg.	27-6207

PREPRODUCTION AND PRODUCTION CHANGES IN MODELS 50-T1403, 50-T1404, AND 50-T1406, ALL CODE 125

Corrections to Service Manual (PR-1846)

1. Delete step 5 of Horizontal-Sweep Adjustment.
2. The correct part number of the horizontal-blocking-oscillator transformer, T7, is 32-4470-3.
3. For corrections to Tuner Alignment Procedure, see Corrections to Service Manual (PR-1844).

PREPRODUCTION CHANGES

The following changes were made between the printing of PR-1846 and first production.

1. Resistor R118 was changed to 390,000 ohms, Part No. 66-4394240*.
2. Condenser C83 was changed to .001 μf., Part No. 45-3505-52.
3. The blocking condenser (C71) in the horizontal-output circuit was rewired as shown in figure 1.

PRODUCTION CHANGES

RUN NO.	DESCRIPTION OF CHANGE	REMOVED PART NO.	NEW OR ADDED PART NO.	REASON FOR CHANGE
2	R108 changed to 56,000 ohms. C73 changed to 390 μμf.	66-3824240 60-10685401	66-3564240 30-1220-35	To increase width and reduce interaction between width and linearity controls.
3	C67 increased in voltage rating.	60-00105407	30-1224	To reduce possibility of breakdown.
4	Video amplifier, sync take-off point, and sync separator changed as shown in figure 2.	Refer to following Parts List.	Refer to following Parts List.	To improve sync performance, and to improve picture quality with weak signal input.
4Z	A 33-μμf. condenser was added, across R32, and L19 was shorted out.		62-033009001	An inductive resistor was used for R32 (see note below.)
5 and 4X	R32 changed to 2000 ohms, non-inductive. The 33-μμf. condenser and the short across L19 were removed.	62-03330001		Circuit changed to use non-inductive resistor.
6	C74 changed to .0047 μf.	60-01825401	45-3505-90	To reduce parasitic oscillations in the 6BG6G.
7	A 680,000-ohm resistor was added, in series with R113.		66-4684340*	To increase width, and reduce squeeze on right side.

NOTE: When Part No. 33-1335-94 (220 ohms, non-inductive) is used as a replacement, the circuit should be wired as shown in figure 2.

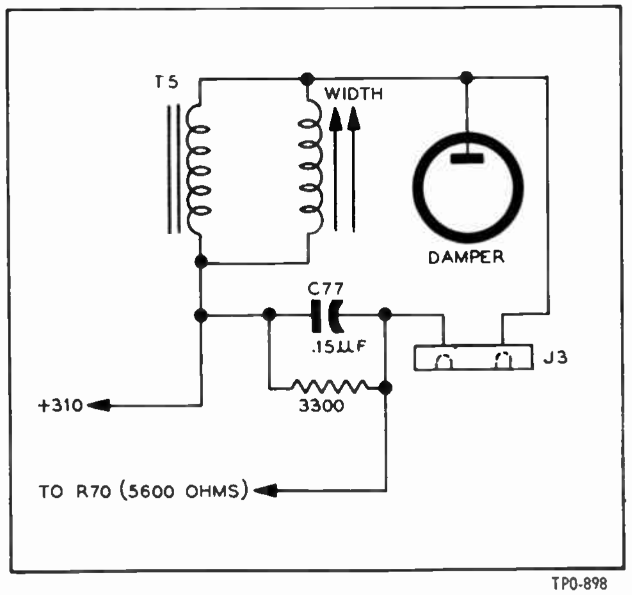

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Figure 1. Change in Horizontal-Output Circuit, Models 50-T1403, 50-T1404, and 50-T1406, All Code 125

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MODELS 50-T1403, 50-T1404, 50-T1406, Code 125

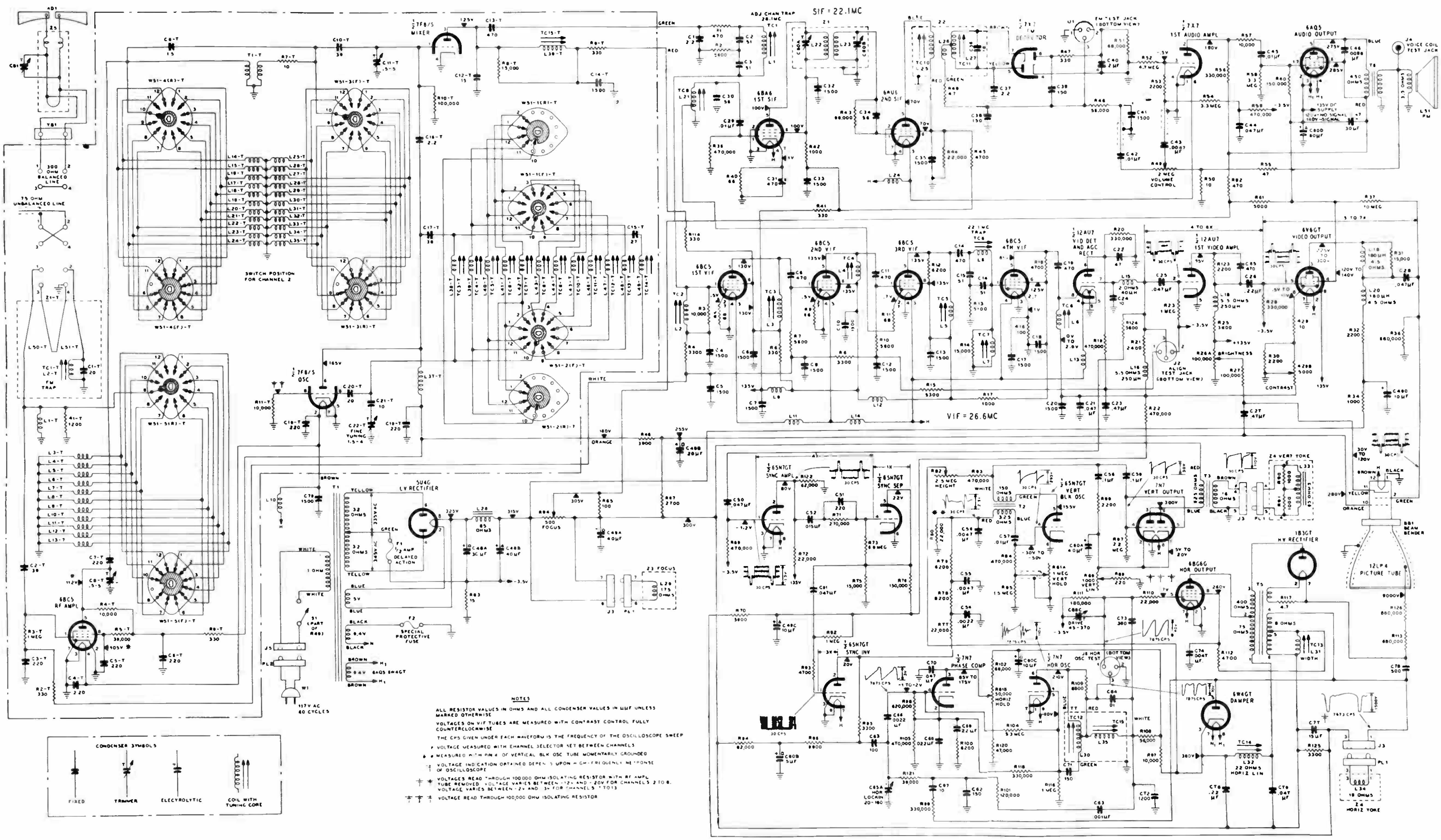

Figure 2. Schematic Diagram, Models 50-T1403, 50-T1404, and 50-T1406, All Code 125 Run 7

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SPECIFICATIONS

CABINET—Modern style, consolette type, mahogany or blonde finish

CIRCUIT—26-tube superheterodyne

TUNING—12-position manual tuner; fine-tuning control for local oscillator

AUDIO OUTPUT—2.5 watts

FREQUENCY RANGE—Television Channels 2 through 13

INTERMEDIATE FREQUENCY
Video Carrier—26.6 mc.
Sound Carrier—22.1 mc.

AERIAL—Built-in broad-band dipole and provisions for external single-aerial or dual-aerial installations

TRANSMISSION LINE—300-ohm, twin-wire leadin (balanced), or 72-ohm coaxial cable (unbalanced) in areas of high interference

OPERATING VOLTAGE—110—120 volts, 60 cycles, a.c.

POWER CONSUMPTION—250 watts

TUBE COMPLEMENT

LOKTAL	OCTAL	MINIATURE	C.R.T.
1—7Z4	2—1B3GT	5—6AG5	1—12LP4
1—7F8	1—6BG6G	2—6AL5	
3—7N7	2—6K6GT	3—6AU6	
1—7F7	1—5U4G	1—6BA6	
1—7C5	1—6W4GT		

CIRCUIT DESCRIPTION

Philco Model 50-T1443, Code 122, is a consolette-type television receiver employing a 12-inch picture tube and a built-in aerial. Provision is made for the connection of an external record player.

The built-in aerial is mounted inside the cabinet, on the top. This aerial consists of a broad-band dipole of metal foil and a tuning and impedance-matching network. The aerial covers all channels, and is tuned for each channel by adjusting the AERIAL TUNING control located on the front of the receiver, near the top of the cabinet.

A 300-ohm line couples the tuning network to the aerial input terminals of TB1. This line may be disconnected from the aerial terminals so that an external aerial may be used, if required.

The radio-frequency section is built on a sub-chassis, and incorporates a 6AG5 tube as an r-f amplifier and a 7F8 tube as a mixer and oscillator.

Four 6AG5 tubes are used as video-i-f amplifiers, and a 6AL5 tube is used as a video detector and a-v-c rectifier. The rectified video signal is amplified by a 6AU6 video-amplifier stage and a 7C5 video-output stage.

The sound-i-f signal is taken from the cathode of the third video-i-f stage, and further amplification is obtained with a 6BA6 and a 6AU6. A 6AL5 tube is used as an FM detector, and a 6AU6 tube is employed as an audio amplifier, which drives a 6K6GT audio-output stage. Pin 6 of the socket for the audio-output tube supplies 160 volts which may be used for Philco Television Booster TB-2.

A portion of the composite video signal is taken from the video-output stage and is amplified by a sync pre-amplifier. A sync separator separates the sync pulses from the rest of the composite video signal. Another amplifier inverts these pulses to a positive polarity. The vertical-sync pulses are separated from the horizontal-sync pulses in an integrating network, and are applied to the grid of the vertical-blocking oscillator to control its frequency. The horizontal-sync pulses are applied to the grid of the phase comparer.

The vertical-sweep circuit consists of a conventional blocking oscillator and vertical output stage.

Horizontal-sweep voltage is generated by a blocking oscillator, the frequency of which is determined by the phase relationships of the horizontal-sync pulses and the horizontal sawtooth at the phase-comparer grid. A 6BG6G amplifies the horizontal sweep voltage, which is applied across a 6W4GT damper tube to the horizontal deflection coils.

Two 1B3GT rectifier tubes are used as a voltage doubler, to supply high voltage for the second anode of the picture tube. A 5U4G and a 7Z4 are employed as full-wave rectifiers, to supply plate and screen voltages for the entire chassis.

A 5-ampere fuse in the a-c power input and a 3.8-ampere B+ protective fuse are located in the high-voltage cage.

EXTERNAL-AERIAL CONNECTIONS

The external-aerial input circuit has provisions for either a single-aerial or a dual-aerial installation. For single external aerial installations, the aerial leadin is connected to the two-terminal terminal board, TB1, which is mounted at the left-hand rear corner of the chassis (facing the rear of the chassis).

To adapt the receiver for external dual-aerial operation, it is only necessary to clip the parallel conductor extending from TB1 into the tuner chassis (cut as close to the tuner chassis as possible); this prevents the length of parallel conductor from acting as a trap on the higher frequency channels. Using plug Part No. 27-4788, connect the low-frequency-aerial leadin to the two widely spaced pins, and the high-frequency-aerial leadin to the two closely spaced pins. Insert the plug into the aerial input receptacle, J1, which is located near the 7F8 tube.

The aerial input circuit is switched by means of a cam-operated switch, S2. The cam is operated by the shaft of the station-selector switch, and is so constructed that it places the switch in one position for Channels 2 through 6, and in another position for channels 7 through 13.

HORIZONTAL HOLD ADJUSTMENT

Ordinarily, the range of the HORIZ. HOLD control potentiometer is sufficient to compensate for normal variations and provide horizontal hold control. If, for some reason, such as replacement of tubes or components, it becomes necessary to make further hold adjustments, the following procedure is recommended:

1. Preset the adjustments as follows:
   a. Lockin trimmer C98A ½ turn counterclockwise from the maximum clockwise position.
   b. Range trimmer C98B 1½ turns counterclockwise from the maximum clockwise position.
   c. HORIZ. HOLD control to approximate center of its range.
2. Tune in a station, and adjust TC26 until the picture is brought into sync.
3. Adjust the CONTRAST control for normal contrast.
4. Turn the HORIZ. HOLD control fully clockwise.
5. Adjust TC26 until 8 to 10 stationary bars appear, sloping downward from the left side of the picture tube. If this cannot be accomplished, turn C98B another full turn counterclockwise, and repeat this step.
6. Turn the HORIZ. HOLD control counterclockwise until the picture is brought into sync; continue to rotate this control until the picture falls out of sync. In some cases, the picture will not go out of sync, even though the HORIZ. HOLD control is turned to its extreme counterclockwise position. If this is the case, momentarily short the aerial terminals. When the picture reappears, it will be out of sync.
7. Slowly turn the HORIZ. HOLD control clockwise, and note the change in the number of blanking bars appearing on the picture tube. The number of bars should decrease as sync is approached. Just before the picture falls into sync, there should be 3½ to 4½ bars sloping upward from the left side of the picture tube. If there are more than 4½ bars, turn C98A another ¼ turn clockwise, and repeat steps 4, 5, 6, and 7. If there are less than 3½ bars, turn C98A another ¼ turn counterclockwise, and repeat steps 4, 5, 6 and 7.

DEFLECT. CONTROL ADJUSTMENT

The DEFLECT. control, R128, is adjusted for optimum performance of the horizontal-sweep circuits, and normally requires no adjustment. If tubes or components in the horizontal-sweep circuit are replaced, however, it may be necessary to adjust the DEFLECT. control to obtain sufficient width.

REPLACEMENT OF 7F8 MIXER-OSCILLATOR TUBE

Whenever it becomes necessary to replace the 7F8 mixer-oscillator tube, several different tubes should be tried until one is found that will permit the FINE TUNING control to be set near the center of its range when the high-frequency channels are properly tuned. Otherwise it will be necessary to remove the chassis, whenever the tube is replaced, and adjust the oscillator tuning cores as directed in the R-F-TUNER ALIGNMENT procedure.

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WAVEFORMS OF SYNC and SWEEP CIRCUITS

The waveforms in figure 1 are sized for clarity, and are not intended to illustrate relative amplitudes. Approximate peak-to-peak voltages are given in each case. These voltages are the approximate values when the CONTRAST control is adjusted to give 35 volts peak-to-peak, at the grid of the picture tube, and when all other controls are in their normal positions.

For viewing waveforms in the vertical sync and sweep circuits, adjust the oscilloscope sweep to 30 c.p.s. (one-half the vertical-sweep rate).

For viewing waveforms in the horizontal sync and sweep circuits, adjust the oscilloscope sweep to 7875 c.p.s. (one-half the horizontal sweep rate).

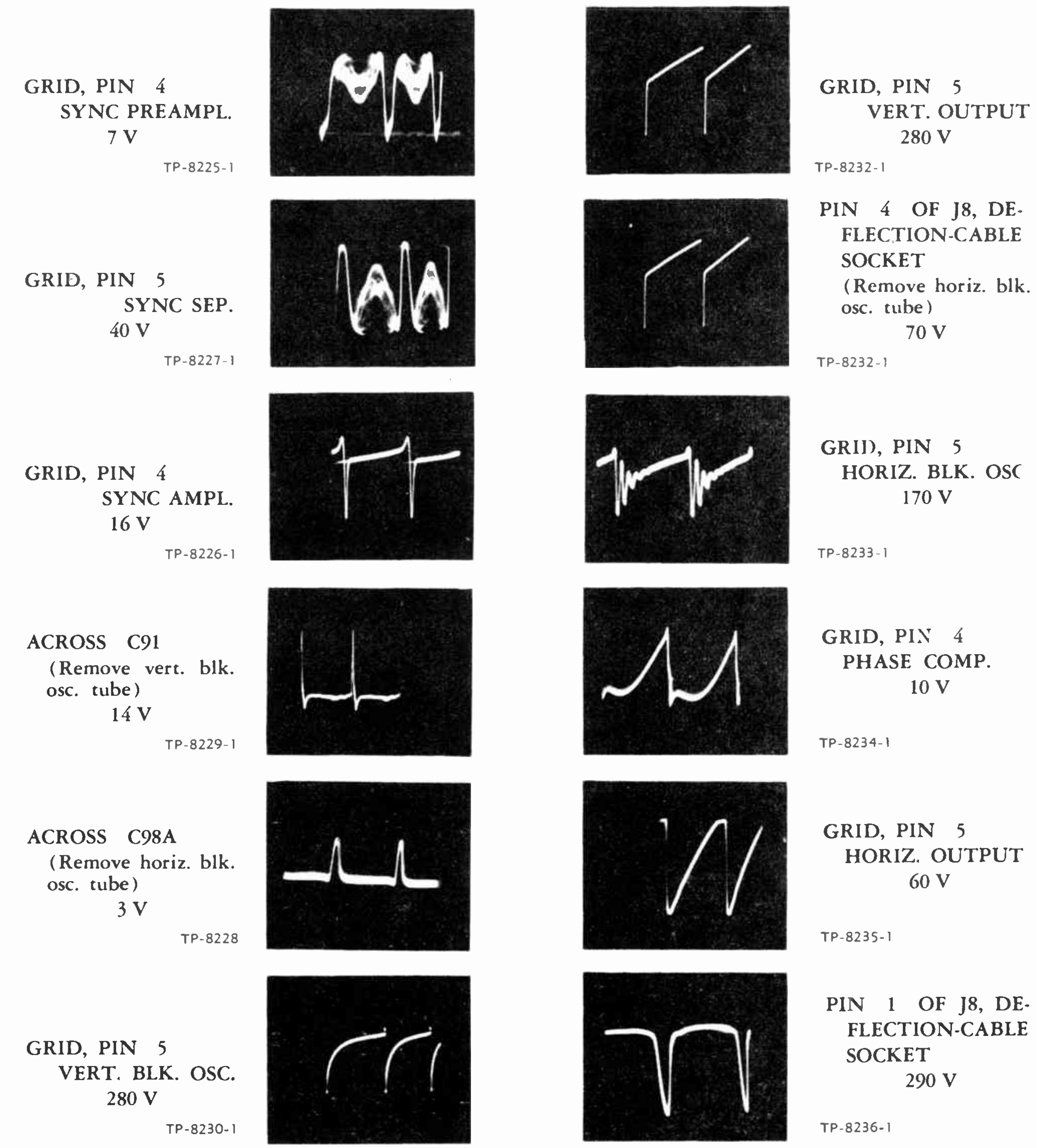

Figure 1. Sync and Sweep Waveforms

ALIGNMENT

WARNING! Dangerous potentials are present in the receiver when it is operating and for a short time after it has been turned off.

I-F ALIGNMENT

GENERAL

The intermediate frequencies for the receiver are 22.1 mc. for the sound channel and 26.6 mc. for the video channel. Alignment of circuits operating at these high frequencies requires careful workmanship and good equipment. The following precautions must be observed:

1. The top of the work bench must be metallic, and the test equipment and receiver chassis must make a good metal-to-metal contact with the bench top.

2. Never disconnect the picture tube, picture-tube yoke, or speaker while the receiver is turned on.

3. Allow the receiver and test equipment to warm up for 15 minutes before starting the alignment.

4. When aligning the receiver, it is possible to achieve optimum adjustment of all tuning cores when the tops of the adjusting screws are approximately ¼ inch above the coil mounts, and also when the tops of the adjusting screws are approximately ¾ inch above the coil mounts. The tuning cores should be adjusted so that the tops of the adjusting screws are approximately ¾ inch above the coil mounts.

TEST EQUIPMENT REQUIRED

The following test equipment is recommended for aligning the i-f stages of the receiver:

1. Philco Precision Visual Alignment Generator for Television and FM, Model 7008, or equivalent.

2. A vacuum-tube voltmeter or a 20,000-ohms-per-volt voltmeter.

If separate signal generators and oscilloscope are used in place of Model 7008, these instruments should have the following characteristics:

FM Signal Generator
Deviation: ± 4 mc.
Center-frequency range: 20 mc. to 30 mc.
Sweep-sync output with either built-in or separate phase corrector.

AM Signal Generator
Carrier-frequency ranges: 4.5 mc. and 20 mc. to 30 mc.
Dial: Suitable for setting and resetting accurately to the frequencies specified in the I-F ALIGNMENT CHART.

Oscilloscope
Calibrated.
Vertical sensitivity: 1 volt (peak-to-peak) per inch, or better.

When using a separate AM r-f signal generator to obtain marker pips, couple the output lead of this generator to the output lead of the FM signal generator, using just sufficient coupling to obtain a suitable marker pip.

JIGS REQUIRED

Mixer Jig

Figure 2 shows a jig that is recommended for coupling the signal generator to the mixer grid, to provide short connections and good grounding. The following parts are necessary for the construction of this jig:

1. Hairpin (commonly called "bobby pin"), straight type, approximately 1¾ inches long.

2. 1-inch length of ⅛-inch-diameter spaghetti.

3. 2-inch length of No. 12 or No. 13 bus wire.

Referring to figure 2, construct the jig as follows:

1. File the enamel from the inside of the prongs of the hairpin (point B).

2. Bend the tips of the prongs (point A) out at a slight angle.

3. Form the prongs at a point ⅜ inch from the tips as shown at point B.

4. Slightly pinch the end of the hairpin at point C.

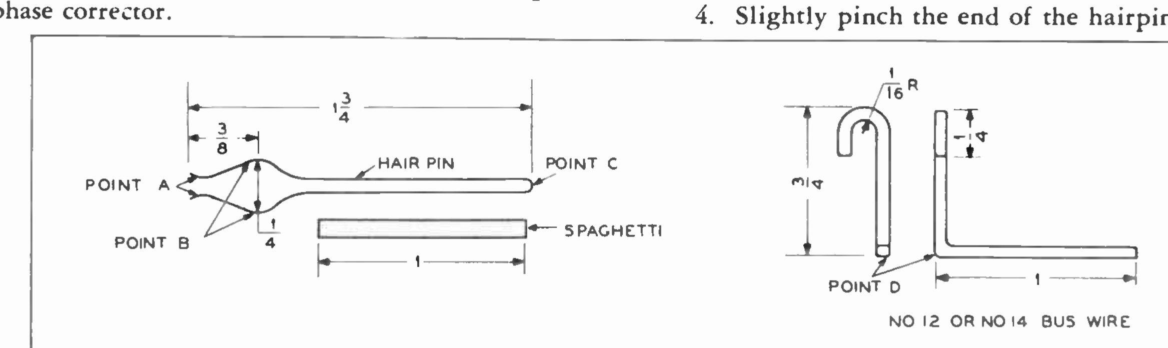

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Figure 2. Mixer Jig

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I-F ALIGNMENT CHART

STEP	SIGNAL-GENERATOR CONNECTION	OUTPUT-INDICATOR CONNECTION	SIGNAL-GENERATOR SETTING	ADJUSTMENT INSTRUCTIONS
1	Connect output of AM signal generator through i-f jig to grid (pin 1) of 4th video-i-f tube.	Connect vertical input of oscilloscope through ALIGN TEST jack adaptor (figure 4) to ALIGN TEST jack J4.	Set AM signal generator (modulated) to 25.5 mc.	Adjust TC21 for maximum indication on oscilloscope.
2	Connect output of AM signal generator through i-f jig to grid (pin 1) of 3rd video-i-f tube.	Same as step 1.	Set AM signal generator (modulated) to 24.5 mc.	Adjust TC20 for maximum indication on oscilloscope.
3	Same as step 2.	Same as step 1.	Set AM signal generator (modulated) to 25 mc.	Adjust TC18 for maximum indication on oscilloscope.
4	Connect output of AM signal generator through i-f jig to grid (pin 1) of 2nd video-i-f tube.	Same as step 1.	Set AM signal generator (modulated) to 26.6 mc.	Adjust TC17 for maximum indication on oscilloscope.
5	Connect output of AM signal generator through i-f jig to grid (pin 1) of 1st video-i-f tube.	Same as step 1.	Set AM signal generator (modulated) to 23.25 mc.	Adjust TC16 for maximum indication on oscilloscope.
6	Connect output of AM signal generator through mixer jig to grid (pin 1) of mixer tube.	Same as step 1.	Set AM signal generator (modulated) to 28.1 mc. (See Note 1.)	Turn CHANNEL SELECTOR to Channel 3. Adjust TC14 for minimum indication on oscilloscope.
7	Same as step 6.	Same as step 1.	Set AM signal generator (modulated) to 22.1 mc. (See Note 1.)	Turn CHANNEL SELECTOR to Channel 3. Adjust TC23 for minimum indication on oscilloscope. If no minimum is apparent, turn TC23 counterclockwise until the response increases rapidly. Turn TC23 clockwise to the point just before the response increases; then adjust TC19 for minimum indication on oscilloscope.
8	Same as step 6.	Same as step 1.	Set AM signal generator (modulated) to 24.25 mc.	Adjust TC13 for maximum indication on oscilloscope
9	Connect outputs of AM and FM signal generators through mixer jig to grid (pin 1) of mixer tube.	Same as step 1.	Set FM signal generator to 25 mc., ± 4 mc. deviation. Set AM signal generator (unmodulated) to 23.25 mc., 23.5 mc., 25.75 mc., and 26.6 mc., as required, to produce marker pips.	Turn CHANNEL SELECTOR to Channel 3. Adjust TC15 for response curve within limits of curve in figure 5. It may be necessary to readjust TC13, TC15, TC16, TC17, TC20, TC18, and TC21 in order to obtain this curve. (See Note 2.)

5. File the enamel from the end of the hairpin at point C.

6. Slip the spaghetti over the hairpin.

7. Bend the bus wire as shown at point D.

Looking at the chassis from the side, with the operating controls to the left, two holes will be seen on the side of the r-f tuner. The top hole is opposite the plate of C13, which connects directly to the mixer grid.

To use the jig, insert the prong end into the hole opposite C13 until it snaps over the trimmer plate.

Loosen the self-tapping screw which holds the front end of the tuner shield. Slip the hook end of the bus wire under the screw head and retighten screw. Connect the ground lead of the signal generator to the short length of bus wire, and the hot lead to the end of the hairpin.

I-F Jig

It is recommended that Philco I-F Alignment Jig, Part No. 45-1670, be used to couple the signal generator to the various video-i-f grids. The connections to these grids are accessible from the top of the chassis through small holes near the tube shields. To use the jig, slip the clamp over the tube shield, and insert the probe end into the hole. Slide the jig downward until good contact is made with the grid connection. Philco Cable, Part No. 45-1635, provides a convenient method of connecting the signal generator to the i-f jig.

I-F ALIGNMENT PROCEDURE

Before proceeding with the i-f alignment, the following preliminary instructions should be observed:

1. Insert a 10,000-ohm resistor in series with the oscilloscope lead.

2. If additional attenuation of the marker signal is required when using Visual Alignment Generator Model 7008, insert a 10,000-ohm resistor in series with the output lead.

3. Preset the television-receiver controls as follows:
   a. CONTRAST control fully counterclockwise.
   b. VOLUME control for an audible signal.
   c. BRIGHTNESS control to give a dim raster.
   d. FINE TUNING control to the center of its range.

4. Preset the television-receiver tuning cores and trimmer condensers as follows:
   a. C115A and C115B fully clockwise.
   b. TC15 fully counterclockwise.
   c. TC19, TC18, and TC23 until the top of the adjusting screw is approximately ⅝ inch from the top of the coil mount.

5. During alignment, attenuate the signal-generator output to keep the output at the ALIGN TEST jack below 2 volts, peak-to-peak, and the output at the FM TEST jack below .5 volt, peak-to-peak.

The i-f stages of the receiver should be aligned according to the instructions given in the I-F ALIGNMENT CHART.

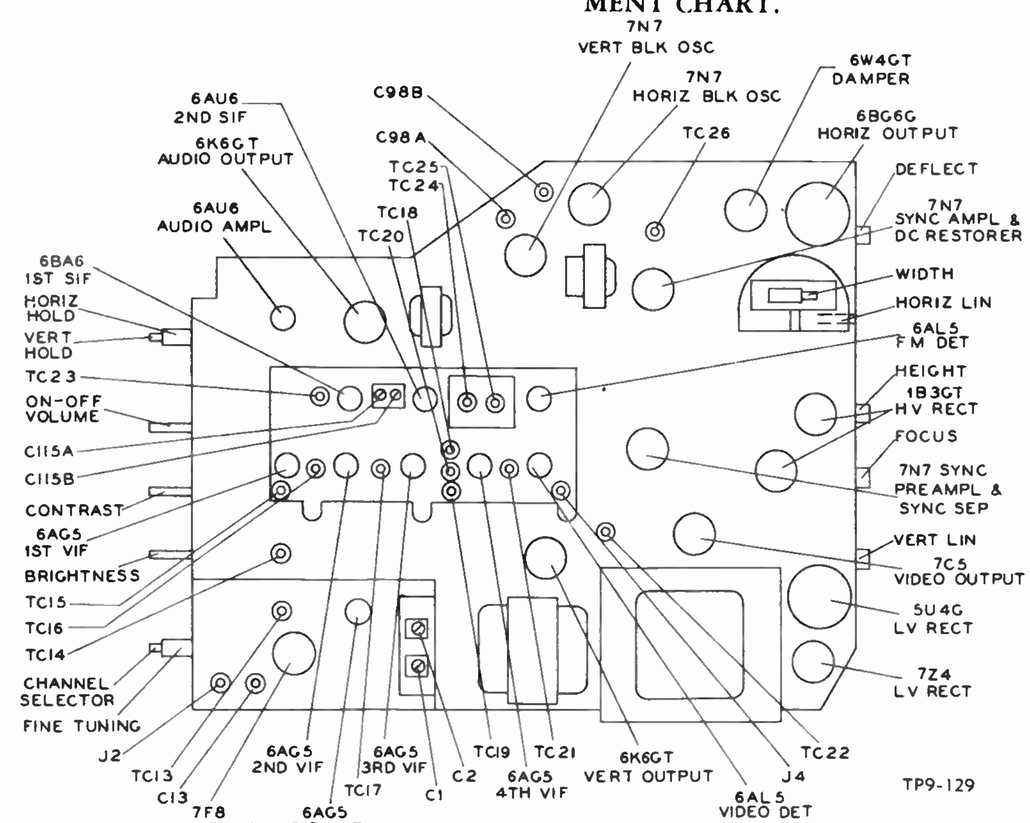

Figure 3. Top View of Chassis, Showing Tuning Core, Trimmer, and Tube Locations

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I-F ALIGNMENT CHART (Cont.)

STEP	SIGNAL-GENERATOR CONNECTION	OUTPUT-INDICATOR CONNECTION	SIGNAL-GENERATOR SETTING	ADJUSTMENT INSTRUCTIONS
10	Same as step 9.	Connect vertical input of oscilloscope to pin 3 of FM TEST jack J3.	Set FM signal generator to 22.1 mc., ± 1 mc. deviation. Set AM signal generator (modulated) to 22.1 mc.	Adjust C115A and C115B slightly counterclockwise until indication is observed on oscilloscope.
11	Same as step 9.	Same as step 10.	Same as step 10.	Adjust TC25 for minimum amount of AM indication. (See Note 3.) Adjust TC24 for symmetrical pattern (equal peaks) within limits of curve in figure 6.
12	Connect output of FM signal generator through mixer jig to grid (pin 1) of mixer tube.	Same as step 10.	Set FM signal generator to 22.1 mc., ± 1 mc. deviation.	Adjust C115A and C115B for maximum peaks and symmetry of pattern
13	Connect output of AM signal generator through mixer jig to grid (pin 1) of mixer tube.	Connect vertical input of oscilloscope through ALIGN TEST jack adaptor (figure 4) to ALIGN TEST jack J4. Connect v.t.v.m. (0—10-volt range) through FM TEST jack adaptor (figure 7) to FM TEST jack J3.	Set AM signal generator (modulated) to 22.1 mc. (minimum indication on oscilloscope).	When indication on oscilloscope is minimum, v.t.v.m reading should be zero. If reading is not zero, adjust TC25. If adjustment requires more than one-half turn, repeat step 11.
14	Connect output of AM signal generator to pin 3 of ALIGN TEST jack J4.	Connect vertical input of oscilloscope across the d-c-restorer load resistor R47.	Set AM signal generator (modulated) for a strong 4.5-mc. output.	Adjust TC22 for minimum indication on oscilloscope.

NOTE 1: When adjusting TC14, TC23, and TC19, the vertical gain control of the oscilloscope should be set at maximum, and the input signal should be as low as possible.

NOTE 2: If readjustment of the tuning cores is necessary to obtain a response curve within the limits of figure 5, the following information may be used to find the adjustment required:
- TC15 affects the position of the carrier and the high-frequency slope.
- TC13 affects the low-frequency slope.
- TC16 affects the amplitude and low-frequency slope.
- TC17 affects the band width and carrier setting.
- TC20 affects the flat-top response.
- TC18 affects the amplitude of the high-frequency slope.
- TC21 affects the high-frequency slope.
- TC14, TC19, and TC23 should not be readjusted.

NOTE 3: The AM signal will appear as a series of sine waves superimposed on the FM-detector curve.

R-F TUNER ALIGNMENT

GENERAL

The r-f tuner is aligned at the factory and normally needs no adjustment other than fine tuning. However, under certain conditions, such as the replacement of tubes, it may be necessary to touch up the adjustments.

TEST EQUIPMENT REQUIRED

The following test equipment is recommended for aligning the tuner:

1. Philco Precision Visual Alignment Generator for Television and FM, Model 7008, or equivalent.
2. A vacuum-tube voltmeter o- a 20,000-ohms-per-volt voltmeter.

If separate signal generators and oscilloscope are used in place of Model 7008, these instruments should have the following characteristics:

FM Signal Generator
- Deviation: ± 7 mc.
- Center-frequency ranges: 50 mc. to 64 mc. and 206 mc. to 220 mc.
- Sweep-sync output with either built-in or separate phase corrector.

AM Signal Generator
- Carrier-frequency range: 50 mc. to 220 mc.
- Dial: Suitable for setting and resetting accurately to frequencies between 50 mc. and 220 mc.

Oscilloscope
- Calibrated
- Vertical sensitivity: 1 volt (peak-to-peak) per inch, or better.

TUNER ALIGNMENT PROCEDURE

For aligning the tuner, the outputs of the signal generators should be connected to the aerial input terminals, through the matching network shown in figure 8. The resistors should be chosen carefully to obtain values close to those indicated. In cases where an installation uses two aerials, it will be necessary to connect the signal generators to the appropriate aerial input terminals of J1.

To adjust the band width and r-f response of the tuner, proceed as follows:

1. Connect the outputs of the AM and FM signal generators through the aerial-matching network (figure 8) to the appropriate aerial input terminals for Channel 2.
2. Connect the oscilloscope to the TUNER TEST jack, J2.
3. Turn the CHANNEL SELECTOR to Channel 2.
4. Insert a piece of solder into the hole that is adjacent to tuning core TC13. Allow the solder to make contact with the chassis and the lug located under the hole.
5. Set the FM signal generator to 55 mc., ± 7 mc. deviation.
6. Set the AM signal generator (unmodulated) to 54 mc. and 60 mc., as required, to produce marker pips on the response curve.
7. Adjust C114 for a band width of 6 mc. to 14 mc. between the two points that are 70% of the maximum amplitude of the response curve. (See figure 9.)
8. Turn the CHANNEL SELECTOR to Channel 6.
9. Set the FM signal generator to 85 mc., ± 7 mc. deviation.
10. Adjust C1 for maximum output and symmetry of curve.
11. Turn the CHANNEL SELECTOR to Channel 13.
12. Set the FM signal generator to 213 mc., ± 7 mc. deviation.
13. Adjust C2 and C13 for maximum output and symmetry of curve.

The local oscillator should be adjusted as follows:

1. Connect the voltmeter through the FM TEST jack adaptor (figure 7) to the FM TEST jack.
2. Set the CHANNEL SELECTOR to Channel 2.
3. Set the FINE TUNING control to the center of its range.
4. Connect an accurately-calibrated AM signal generator through the aerial-matching network (figure 8) to the aerial input terminals, and set the signal generator to the sound-carrier frequency of Channel 2.
5. Adjust the oscillator tuning core for Channel 2 until a zero reading is obtained on the voltmeter.
6. Repeat the above steps for Channels 3 through 13. In each case use the appropriate signal-generator setting and CHANNEL SELECTOR setting, and adjust the oscillator tuning core for the proper channel.

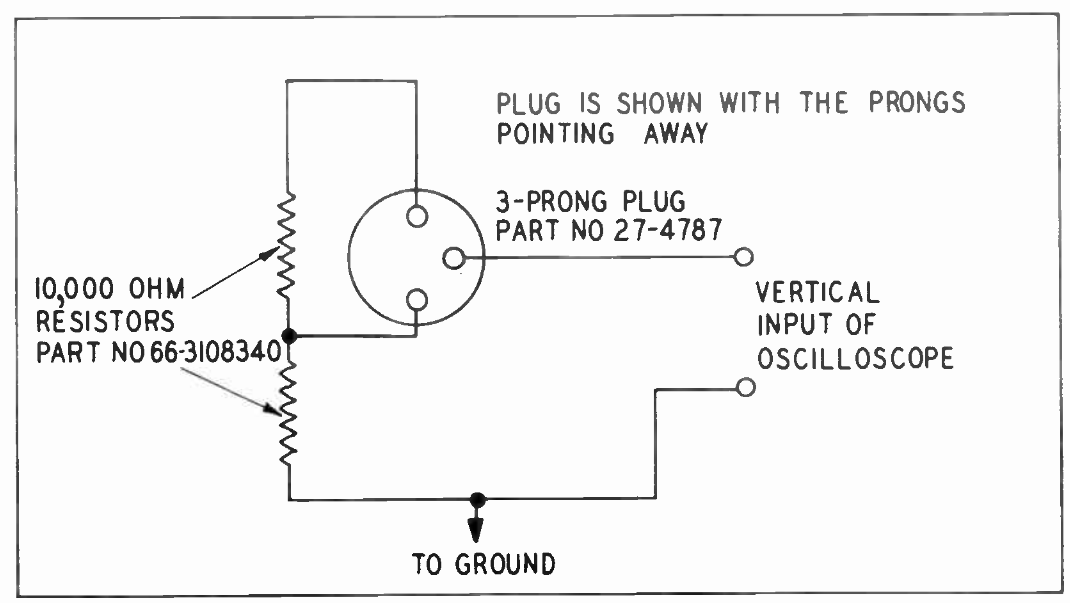

Figure 4. ALIGN TEST Jack Adaptor

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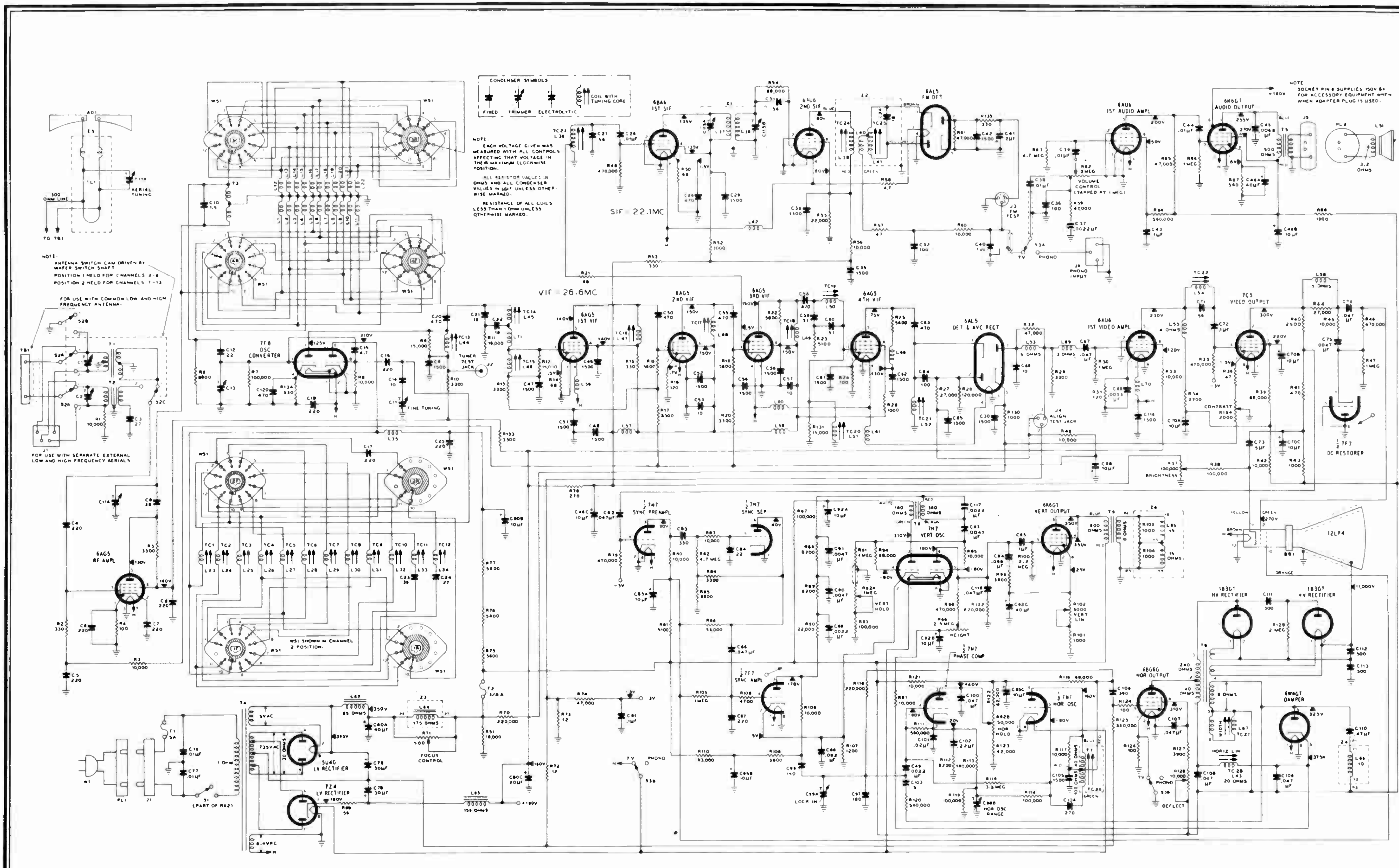

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Figure 10. Philco Television Receiver Model 50-T1443, Code 122, Complete Schematic Diagram

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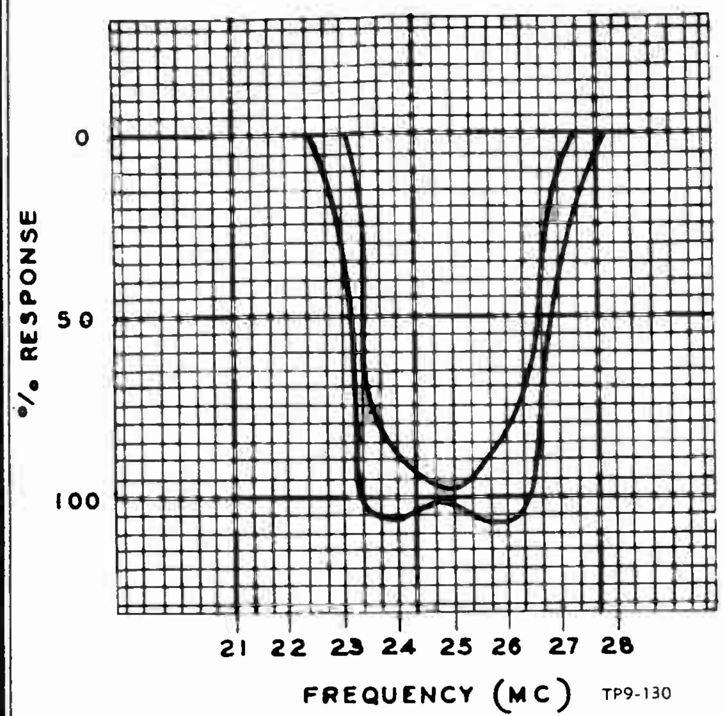

Figure 5. Over-all Video-I-F Response Curve

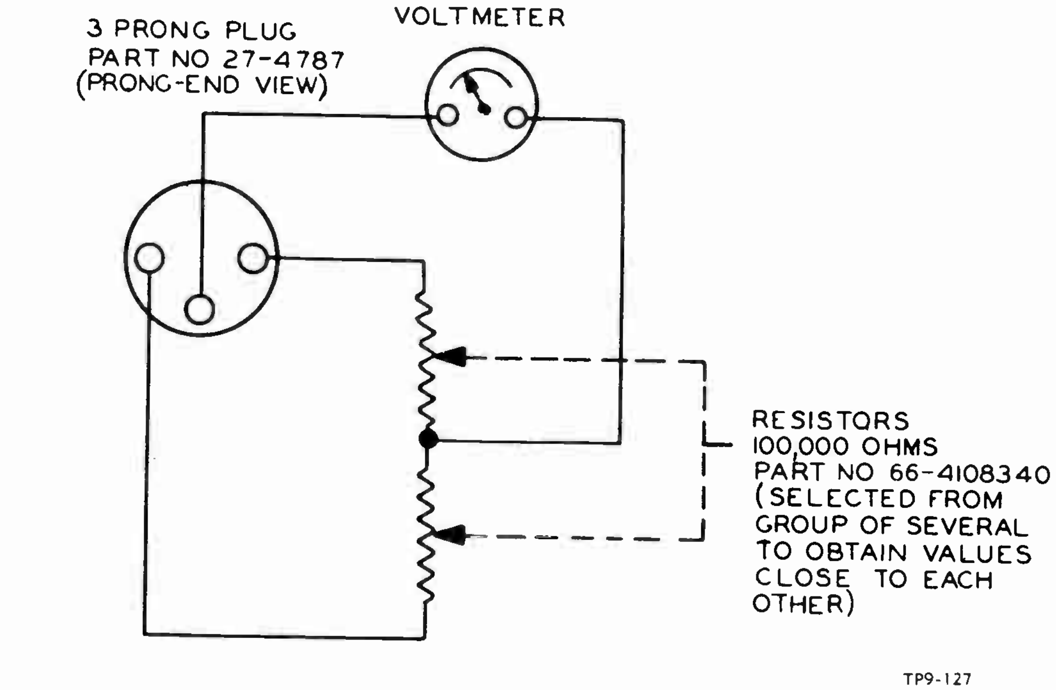

Figure 7. FM TEST Jack Adaptor

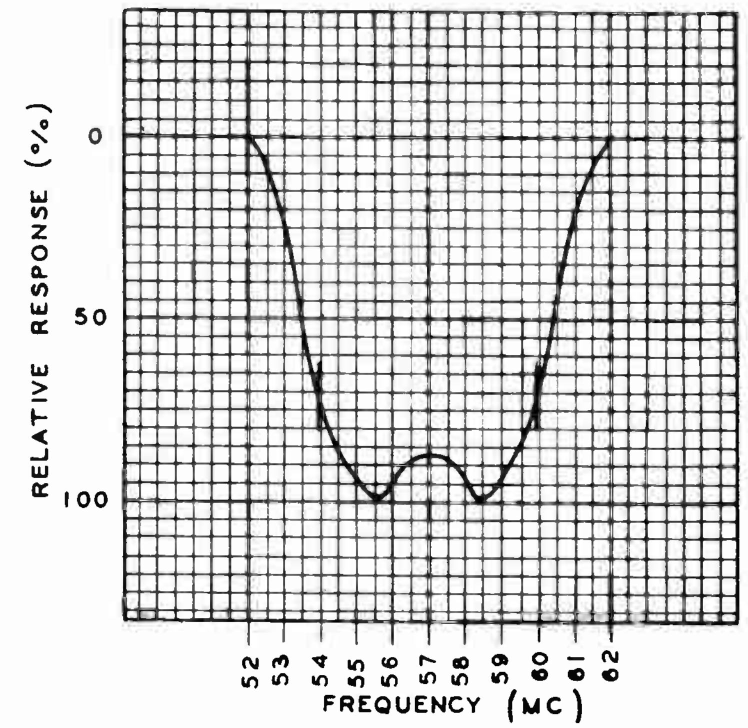

Figure 9. R-F Response Curve

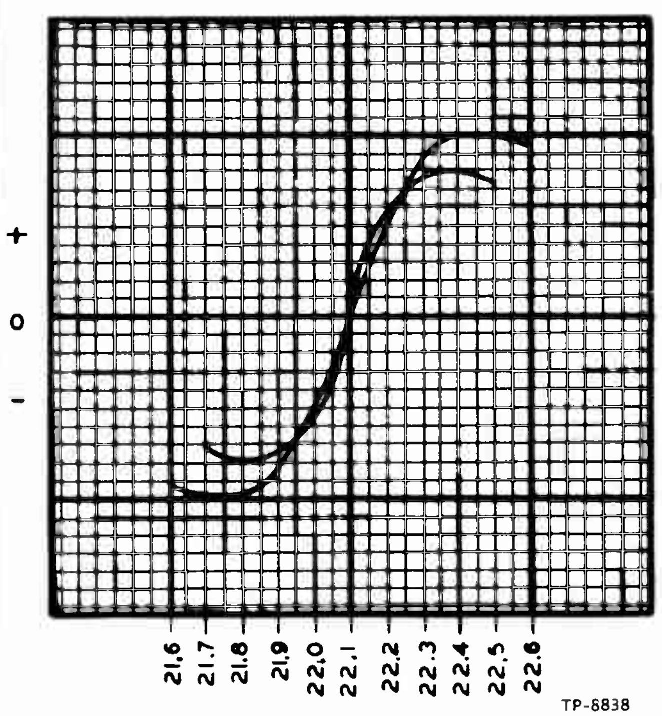

Figure 6. FM-DETECTOR CURVE

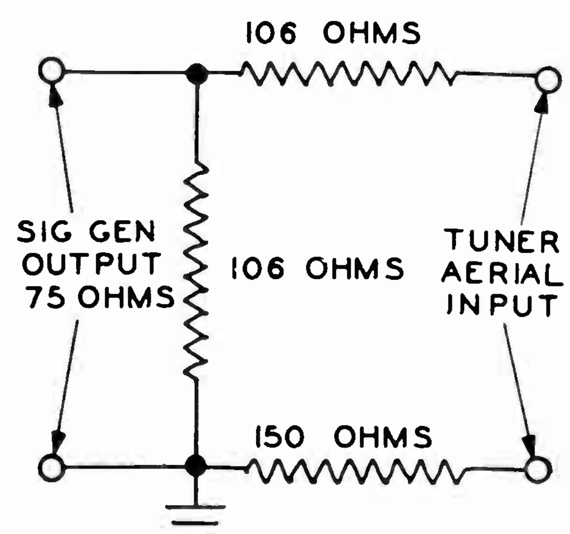

Figure 8. Aerial-Input Matching Network

REPLACEMENT PARTS LIST

Reference Symbol	Description	Service Part No.
AD1	Aerial, broad-band dipole, foil (2 used)	56-7635
BB1	Beam bender, p-m	76-3913-2
C1	Condenser, trimmer, 1-f aerial	Part of 76-4402-5
C2	Condenser, trimmer, h-f aerial	Part of 76-4402-5
C3	Condenser, fixed padder, 27 μμf.	Part of 76-4402-5
C4	Condenser, d-c blocking, 220 μμf.	Part of 76-4402-5
C5	Condenser, r-f by-pass, 220 μμf.	Part of 76-4402-5
C6	Condenser, cathode by-pass, 220 μμf.	Part of 76-4402-5
C7	Condenser, cathode by-pass, 220 μμf.	Part of 76-4402-5
C8	Condenser, screen by-pass, 220 μμf.	Part of 76-4402-5
C9	Condenser, d-c blocking, 39 μμf.	Part of 76-4402-5
C10	Condenser, d-c blocking, 1.5 μμf.	Part of 76-4402-5
C11	Condenser, trimmer, fine tuning	Part of 76-4402-5
C12	Condenser, d-c blocking, 22 μμf.	Part of 76-4402-5
C13	Condenser, trimmer, mixer grid	Part of 76-4402-5
C14	Condenser, fixed padder, 10 μμf.	Part of 76-4402-5
C15	Condenser, oscillator injection, 4.7 μμf.	Part of 76-4402-5
C16	Condenser, d-c blocking, 10 μμf.	Part of 76-4402-5
C17	Condenser, d-c blocking, 220 μμf.	Part of 76-4402-5
C18	Condenser, r-f by-pass, 220 μμf.	Part of 76-4402-5
C19	Condenser, r-f by-pass, 1500 μμf.	Part of 76-4402-5
C20	Condenser, d-c blocking, 470 μμf.	Part of 76-4402-5
C21	Condenser, fixed trimmer, 18 μμf.	60-00185317*
C22	Condenser, fixed trimmer, 18 μμf.	60-00185317*
C23	Condenser, fixed padder, 39 μμf.	Part of 76-4402-5
C24	Condenser, fixed padder, 27 μμf.	Part of 76-4402-5
C25	Condenser, r-f by-pass, 220 μμf.	Part of 76-4402-5
C26	Condenser, d-c blocking, .01 μf.	45-3505-41*
C27	Condenser, fixed trimmer, 56 μμf.	62-056409001*
C28	Condenser, cathode by-pass, 470 μμf.	62-147001001*
C29	Condenser, r-f by-pass, 1500 μμf.	62-215001011*
C30	Condenser, r-f by-pass, 1500 μμf.	62-215001011*
C31	Condenser, d-c blocking, 56 μμf.	62-056409001*
C32	Condenser, r-f by-pass, 1500 μμf.	62-215001011*
C33	Condenser, r-f by-pass, 1500 μμf.	62-215001011*
C34	Condenser, fixed trimmer, 18 μμf.	Part of Z2
C35	Condenser, r-f by-pass, 100 μμf.	62-110009001*
C36	Condenser, r-f by-pass, 100 μμf.	62-110009001*
C37	Condenser, l-f compensation, .0022 μf.	45-3505-54*
C38	Condenser, d-c blocking, .01 μf.	45-3505-41*
C39	Condenser, d-c blocking, .01 μf.	45-3505-41*
C40	Condenser, r-f by-pass, 100 μμf.	62-110009001*
C41	Condenser, filter, 2 μf., 50v	30-2417-7
C42	Condenser, r-f by-pass, 1500 μμf.	62-215001011*

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REPLACEMENT PARTS LIST (Cont.)

Reference Symbol	Description	Service Part No.
C43	Condenser, screen by-pass, .1 µf.	45-3505-47*
C44	Condenser, d-c blocking, .01 µf.	45-3505-41*
C45	Condenser, tone compensation, .0068 µf.	45-3505-57*
C46	Condenser, electrolytic, 3-section	30-2570-16*
C46A	Condenser, cathode by-pass, 40 µf., 50v	Part of C46
C46B	Condenser, decoupling, 10 µf., 450v	Part of C46
C46C	Condenser, filter, 10 µf., 450v	Part of C46
C47	Condenser, a-v-c by-pass, 1500 µµf.	62-215001011*
C48	Condenser, r-f by-pass, 1500 µµf.	62-215001011*
C49	Condenser, screen by-pass, 1500 µµf.	62-215001011*
C50	Condenser, d-c blocking, 470 µµf.	62-147001001*
C51	Condenser, a-v-c by-pass, 1500 µµf.	62-215001011*
C52	Condenser, screen by-pass, 1500 µµf.	62-215001011*
C53	Condenser, screen by-pass, 10 µµf.	62-010009001*
C54	Condenser, a-v-c by-pass, 1500 µµf.	62-215001011*
C55	Condenser, d-c blocking, 470 µµf.	62-147001001*
C56	Condenser, screen by-pass, 1500 µµf.	62-215001011*
C57	Condenser, screen by-pass, 10 µµf.	62-010009001*
C58	Condenser, d-c blocking, 470 µµf.	62-147001001*
C59	Condenser, fixed trimmer, 51 µµf.	30-1224-2*
C60	Condenser, fixed trimmer, 51 µµf.	30-1224-2*
C61	Condenser, cathode by-pass, 1500 µµf.	62-215001011*
C62	Condenser, screen by-pass, 1500 µµf.	62-215001011*
C63	Condenser, d-c blocking 470 µµf.	62-147001001*
C64	Condenser, d-c blocking, 100 µµf.	62-110009001*
C65	Condenser, r-f by-pass, 1500 µµf.	62-215001011*
C66	Condenser, r-f by-pass, 10 µµf.	62-010009001*
C67	Condenser, d-c blocking, .047 µf.	45-3505-28*
C68	Condenser, a-v-c filter, 10 µf., 50v	30-2417-1*
C69	Condenser, cathode by-pass, .0033 µf.	45-3505-55*
C70	Condenser, electrolytic, 4-section	30-2570-10
C70A	Condenser, decoupling, 10 µf., 475v	Part of C70
C70B	Condenser, screen by-pass, 10 µf., 475v	Part of C70
C70C	Condenser, l-f compensating, 10 µf., 475v	Part of C70
C71	Condenser, fixed trimmer, 56 µµf.	62-056409001*
C72	Condenser, d-c blocking, .1 µf.	45-3505-47*
C73	Condenser, cathode by-pass, .5 µf.	61-0137*
C74	Condenser, d-c blocking, .047 µf.	45-3505-28*
C75	Condenser, d-c blocking, .0047 µf.	45-3505-56*
C76	Condenser, line filter, .01 µf.	45-3505-41*
C77	Condenser, line filter, .01 µf.	45-3505-41*
C78	Condenser, electrolytic, input filter, 30 µf., 475v	30-2568-19
C79	Condenser, electrolytic, input filter, 30 µf., 475v	30-2568-19
C80	Condenser, electrolytic 4-section	30-2570-8*
C80A	Condenser, filter, 40 µf., 475v	Part of C80
C80B	Condenser, decoupling, 10 µf., 475v	Part of C80
C80C	Condenser, filter, 20 µf., 475v	Part of C80
C81	Condenser, bias filter, .1 µf.	45-3505-36*
C82	Condenser, d-c blocking, .047 µf.	45-3505-45*
C83	Condenser, d-c blocking, 330 µµf.	60-10335407*
C84	Condenser, video filter, 22 µµf.	62-022009001*
C85	Condenser, electrolytic, 3-section	30-2570-13
C85A	Condenser, decoupling, 10 µf., 475v	Part of C85
C85B	Condenser, decoupling, 10 µf., 475v	Part of C85
C85C	Condenser, decoupling, 10 µf., 475v	Part of C85
C86	Condenser, d-c blocking .047 µf.	61-0122*
C87	Condenser, video filter, 220 µµf.	62-122001001*
C88	Condenser, cathode by-pass, .082 µf.	30-4651-3
C89	Condenser, integrating, .0022 µf.	45-3505-54*
C90	Condenser, integrating, .0047 µf.	45-3505-56*
C91	Condenser, integrating, .0047 µf.	45-3505-56*
C92	Condenser, electrolytic, 3-section	30-2570-16*
C92A	Condenser, decoupling, 10 µf., 450v	Part of C92
C92B	Condenser, decoupling, 10 µf., 450v	Part of C92
C92C	Condenser, cathode by-pass, 40 µf., 50v	Part of C92
C93	Condenser, d-c blocking .0047 µf.	45-3505-56*
C94	Condenser, sweep charging, .068 µf.	45-3501*
C95	Condenser, d-c blocking, .1 µf.	45-3505-47*

Reference Symbol	Description	Service Part No.
C96	Condenser, d-c blocking, 150 µµf.	60-10155407*
C97	Condenser, voltage divider, 180 µµf.	30-1220-30*
C98	Condenser, 3-section trimmer	31-6477-2
C98A	Condenser, horizontal lock-in	Part of C98
C98B	Condenser, horizontal-oscillator range	Part of C98
C99	Condenser, d-c blocking, .0022 µf.	45-3505-54*
C100	Condenser, plate by-pass, .047 µf.	45-3505-45*
C101	Condenser, cathode by-pass, .02 µf.	61-6108*
C102	Condenser, filter, .22 µf.	45-3505-49*
C103	Condenser, horizontal feedback, 5 µµf.	60-90505007*
C104	Condenser, d-c blocking, 270 µµf.	60-10275407*
C105	Condenser, sweep charging, 1500 µµf.	60-20155314*
C106	Condenser, d-c blocking, 390 µµf.	60-10395407*
C107	Condenser, screen by-pass, .047 µf.	45-3505-62*
C108	Condenser, horizontal shaping, .047 µf.	45-3505-62*
C109	Condenser, horizontal shaping, .047 µf.	45-3505-62*
C110	Condenser, d-c blocking, .47 µf.	61-0133*
C111	Condenser, d-c blocking, 500 µµf.	30-1229-2
C112	Condenser, voltage doubling, 500 µµf.	30-1229-2
C113	Condenser, voltage doubling, 500 µµf.	30-1229-2
C114	Condenser, r-f plate trimmer	Part of 76-4402-5
C115A	Condenser, primary trimmer	Part of Z1
C115B	Condenser, secondary trimmer	Part of Z1
C116	Condenser, filament by-pass, 1500 µµf.	62-215001011*
C117	Condenser, filter, .0022 µf.	45-3505-54*
C118	Condenser, shaping, .047 µf.	45-3505-62*
C119	Condenser, AERIAL TUNING control	31-6518
C120	Condenser, cathode by-pass, 470 µµf.	Part of 76-4402-5
F1	Fuse, a-c line, 5 amperes	45-2656-11
F2	Fuse, B+ protective, 5/8 ampere	45-2656-10
J1	Socket, aerial input	Part of 76-4402-5
J2	Jack, TUNER TEST	Part of 76-4402-5
J3	Jack, FM TEST	27-6126
J4	Jack, ALIGN TEST	27-3772-6
J5	Socket, speaker	27-6214-1
J6	Jack, phono input	27-6126
J7	Socket, power	27-6240
J8	Socket, deflection cable	27-6180
J9	Socket and cable ass'y, picture tube	41-3860-1
L1 through L11	Coil, r-f plate	Part of 76-4402-5
L12 through L22	Coil, mixer grid	Part of 76-4402-5
L23 through L34	Coil, oscillator tank	Part of 76-4402-5
L35	Coil, r-f choke	Part of 76-4402-5
L36	Coil, 1st sound-i-f autotransformer	32-4303
L37	Coil, primary	Part of Z1
L38	Coil, secondary	Part of Z1
L39	Coil, primary	Part of Z2
L40	Coil, tertiary	Part of Z2
L41	Coil, secondary	Part of Z2
L42	Coil, r-f choke	32-4112-15
L43	Coil, HORIZ. LIN.	32-4211
L44	Coil, mixer-plate tank	Part of 76-4402-5
L45	Coil, adjacent-sound trap	32-4234-4
L46	Coil, 1st v-i-f grid tank	32-4233-4
L47	Coil, 1st v-i-f plate tank	32-4359
L48	Coil, 2nd v-i-f plate tank	32-4359
L49	Coil, 3rd v-i-f plate tank	32-4234-1
L50	Coil, accompanying-sound trap	32-4233-7
L51	Coil, 4th v-i-f grid tank	32-4233-2
L52	Coil, 4th v-i-f tank	32-4234-1
L53	Coil, series peaking	32-4143
L54	Coil, 4.5-mc. trap	32-4155
L55	Coil, shunt peaking	32-4143-2
L56	Coil, series peaking	32-4143
L57	Coil, B+ isolating	32-4112-11
L58	Coil, B+ isolating	32-4112-11

Reference Symbol	Description	Service Part No.
L59	Coil, r-f choke	32-4112-15
L60	Coil, r-f choke	32-4112-15
L61	Coil, r-f choke	32-4112-15
L62	Coil, filter choke	32-8399
L63	Coil, filter choke	32-8355-1
L64	Coil, focus	Part of Z3
L65	Coil, vertical deflection	Part of Z4
L66	Coil, horizontal deflection	Part of Z4
L67	Coil, WIDTH	32-4419-1
L68	Coil, r-f choke	32-4112-11
L69	Coil, series peaking, 40 µh.	32-4143
L70	Coil, r-f choke	32-4112-15
L71	Coil, r-f choke	32-4112-11
LS1	Speaker, p-m	36-1629-2
PL1	Plug, power	27-6240
PL2	Plug, speaker	27-4788
PL3	Plug-and-cable assembly, deflection	41-3860
R1	Resistor, aerial loading, 10,000 ohms	Part of 76-4402-5
R2	Resistor, grid return, 330 ohms	Part of 76-4402-5
R3	Resistor, a-v-c decoupling, 10,000 ohms	Part of 76-4402-5
R4	Resistor, cathode bias, 100 ohms	Part of 76-4402-5
R5	Resistor, plate feeding, 3300 ohms	Part of 76-4402-5
R6	Resistor, loading, 6800 ohms	Part of 76-4402-5
R7	Resistor, grid return, 100,000 ohms	Part of 76-4402-5
R8	Resistor, grid return, 10,000 ohms	Part of 76-4402-5
R9	Resistor, damping, 15,000 ohms	Part of 76-4402-5
R10	Resistor, decoupling, 3300 ohms	Part of 76-4402-5
R11	Resistor, terminating, 15,000 ohms	66-3158340*
R12	Resistor, damping, 15,000 ohms	66-3158340*
R13	Resistor, a-v-c decoupling, 3300 ohms	66-2338340*
R14	Resistor, cathode bias, 68 ohms	66-0688340*
R15	Resistor, B+ decoupling, 330 ohms	66-1338340*
R16	Resistor, grid return, 5600 ohms	66-2568340*
R17	Resistor, a-v-c decoupling, 3300 ohms	66-2338340*
R18	Resistor, cathode bias, 120 ohms	66-1128340*
R19	Resistor, grid return, 5600 ohms	66-2568340*
R20	Resistor, a-v-c decoupling, 3300 ohms	66-2338340*
R21	Resistor, cathode bias, 68 ohms	66-0688340*
R22	Resistor, damping, 5600 ohms	66-2568340*
R23	Resistor, terminating, 5100 ohms	66-2518340*
R24	Resistor, cathode bias, 100 ohms	66-1108340*
R25	Resistor, plate feed, 5600 ohms	66-2568340*
R26	Resistor, B+ decoupling, 1000 ohms	66-2108340*
R27	Resistor, r-f decoupling, 27,000 ohms	66-3278340*
R28	Resistor, a-v-c load, 120,000 ohms	66-4128340*
R29	Resistor, video-detector load, 3300 ohms	66-2338340*
R30	Resistor, grid return, 1 megohm	66-5108340*
R31	Resistor, cathode bias, 120 ohms	66-1124340*
R32	Resistor, damping, 47,000 ohms	66-3478340*
R33	Resistor, screen dropping, 10,000 ohms	66-3104340*
R34	Resistor, plate load, 2700 ohms	66-2274340*
R35	Resistor, grid return, 470,000 ohms	66-4478340*
R36	Resistor, limiting, 47 ohms	66-0478340*
R37	Potentiometer, BRIGHTNESS control, 100,000 ohms	33-5539-43
R38	Resistor, limiting, 100,000 ohms	66-4108340*
R39	Resistor, screen dropping, 68,000 ohms	66-3684340*
R40	Resistor, plate load, 2500 ohms	33-1335-87
R41	Resistor, plate load, 470 ohms	66-1474340*
R42	Resistor, B+ decoupling, 10,000 ohms	66-3105340*
R43	Resistor, l-f compensation, 1000 ohms	66-2104340*
R44	Resistor, damping, 27,000 ohms	66-3278340*
R45	Resistor, isolating, 10,000 ohms	66-3108340*
R46	Resistor, grid return, 470,000 ohms	66-4478340*
R47	Resistor, d-c restorer load, 1 megohm	66-5108340*
R48	Resistor, a-v-c filter, 10,000 ohms	66-3108340*
R49	Resistor, grid return, 470,000 ohms	66-4478340*
R50	Resistor, cathode bias, 68 ohms	66-0688340*
R51	Resistor, bleeder, 18,000 ohms, 10 watts	33-1335-85

Reference Symbol	Description	Service Part No.
R52	Resistor, B+ decoupling, 1000 ohms	66-2108340*
R53	Resistor, B+ decoupling, 330 ohms	66-1338340*
R54	Resistor, grid return, 68,000 ohms	66-3688340*
R55	Resistor, voltage divider, 22,000 ohms	66-3228340*
R56	Resistor, B+ dropping, 10,000 ohms	66-3108340*
R57	Resistor, decoupling, 47 ohms	66-0478340*
R58	Resistor, filament dropping, 4.7 ohms	66-9478340*
R59	Resistor, bass compensating, 47,000 ohms	66-3478340*
R60	Resistor, decoupling, 10,000 ohms	66-3108340*
R61	Resistor, detector load, 47,000 ohms	66-3478340*
R62	Potentiometer, VOLUME control, 2 megohms, tapped at 1 megohm	33-5564-1
R63	Resistor, grid return, 4.7 megohms	66-5478340*
R64	Resistor, screen dropping, 560,000 ohms	66-4564340*
R65	Resistor, plate load, 47,000 ohms	66-3474340*
R66	Resistor, grid return, 1 megohm	66-5108340*
R67	Resistor, cathode bias, 560 ohms	66-1564340*
R68	Resistor, B+ decoupling, 1900 ohms	33-3435-15
R69	Resistor, limiting, 56 ohms	66-0568340*
R70	Resistor, voltage divider, 220,000 ohms	66-4224340*
R71	Potentiometer, FOCUS control, 500 ohms	33-5547-5
R72	Resistor, bias divider, 12 ohms	66-0125340*
R73	Resistor, bias divider, 12 ohms	66-0125340*
R74	Resistor, bias filter, 47,000 ohms	66-3478340*
R75	Resistor, B+ dropping, 5600 ohms	66-2564340*
R76	Resistor, B+ dropping, 5600 ohms	66-2564340*
R77	Resistor, B+ dropping, 5600 ohms	66-2564340*
R78	Resistor, B+ decoupling, 270 ohms	66-1274340*
R79	Resistor, grid return, 470,000 ohms	66-4478340*
R80	Resistor, plate load, 10,000 ohms	66-3104340*
R81	Resistor, B+ decoupling, 5100 ohms	33-1335-18
R82	Resistor, grid return, 4.7 megohms	66-5478340
R83	Resistor, video filter, 10,000 ohms	66-3108340*
R84	Resistor, voltage divider, 3300 ohms	66-2338340*
R85	Resistor, voltage divider, 6800 ohms	66-2688340*
R86	Resistor, plate load, 56,000 ohms	66-3564340
R87	Resistor, decoupling, 100,000 ohms	66-4108340*
R88	Resistor, integrating, 8200 ohms	66-2828340*
R89	Resistor, integrating, 8200 ohms	66-2828340*
R90	Resistor, integrating, 22,000 ohms	66-3228340*
R91	Resistor, limiting, 1 megohm	66-5108340*
R92	Potentiometer assembly, dual	33-5563-3
R92A	Potentiometer, VERT. HOLD control, 1 megohm	
R92B	Potentiometer, HORIZ. HOLD. control, 50,000 ohms	
R93	Resistor, limiting, 100,000 ohms	66-4108340*
R94	Resistor, grid limiting, 68,000 ohms	66-3688340*
R95	Resistor, grid limiting, 10,000 ohms	66-3108340*
R96	Potentiometer, HEIGHT control, 2.5 megohms	33-5565-10
R97	Resistor, limiting, 10,000 ohms	66-3108340*
R98	Resistor, sweep charging, 470,000 ohms	66-4474340*
R99	Resistor, sweep shaping, 3900 ohms	66-2398340*
R100	Resistor, grid return, 2.2 megohms	66-4228340*
R101	Resistor, limiting, 1000 ohms	66-2108340*
R102	Potentiometer, VERT. LIN. control, 5000 ohms	33-5546-10
R103	Resistor, damping, 1000 ohms	Part of Z4
R104	Resistor, damping, 1000 ohms	Part of Z4
R105	Resistor, grid return, 1 megohm	66-5108340*
R106	Resistor, video filter, 4700 ohms	66-2478340*
R107	Resistor, cathode bias, 1200 ohms	66-2124340*
R108	Resistor, plate load, 10,000 ohms	66-3108340*
R109	Resistor, plate load, 3900 ohms	66-2398340*
R110	Resistor, B+ decoupling, 33,000 ohms	66-3334340*
R111	Resistor, grid return, 560,000 ohms	66-4568340*
R112	Resistor, filter, 8200 ohms	66-2828340*
R113	Resistor, filter, 180,000 ohms	66-4188340*
R114	Resistor, grid return, 100,000 ohms	66-4108340*
R115	Resistor, cathode return, 100,000 ohms	66-4108340*
R116	Resistor, grid filter, 3.3 megohms	66-5338340

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REPLACEMENT PARTS LIST (Cont.)

Reference Symbol	Description	Service Part No.
R117	Resistor, damping, 10,000 ohms	66-3108340*
R118	Resistor, sweep charging, 68,000 ohms	66-3688340*
R119	Resistor, sweep feedback, 220,000 ohms	66-4228340*
R12C	Resistor, sweep feedback, 560,000 ohms	66-4568340*
R121	Resistor, B+ decoupling, 10,000 ohms	66-3108340*
R122	Resistor, voltage divider, 82,000 ohms	66-3824340*
R123	Resistor, tempeiature compensating, 42,000 ohms	33-1342-2
R124	Resistor, parasitic suppressor, 100 ohms	66-1108340*
R125	Resistor, grid return, 330,000 ohms	66-4334340*
R126	Resistor, cathode bias, 100 ohms	66-1105340*
R127	Resistor, screen dropping, 3900 ohms	66-2395340*
R128	Potentiometer, DEFLECT. control, 10,000 ohms	33-5546-18
R129	Resistor, diode return, 2 megohms	33-1338
R130	Resistor, isolating, 1000 ohms	66-2108340*
R131	Resistor, damping, 15,000 ohms	66-3158340*
R132	Resistor, shaping, 820,000 ohms	66-4828340*
R133	Resistor, decoupling, 3300 ohms	66-2338340*
R134	Resistor, cathode bias, 330 ohms	Part of 76-4402-5
R135	Resistor, beat suppressor, 330 ohms	66-1338340*
R136	Potentiometer, CONTRAST control 2000 ohms	33-5546-33
S1	Switch, power OFF-ON	Part of R62
S2	Switch, aerial	Part of 76-4402-5
S2A	Switch, aerial primary	Part of S2
S2B	Switch, aerial grounding	Part of S2
S2C	Switch, aerial secondary	Part of S2
S3	Switch, PHONO-TELEVISION	42-1893-1
S3A	Switch, audio switching	Part of S3
S3B	Switch, sweep disabling	Part of S3
T1	Transformer, l-f aerial input	Part of 76-4402-5
T2	Transformer, h-f aerial input	Part of 76-4402-5
T3	Transformer, r-f	Part of 76-4402-5
T4	Transformer, power	32-8391
T5	Transformer, audio output	32-8356
T6	Transformer, vertical blocking oscillator	32-8304-3
T7	Transformer, horizontal blocking oscillator	32-4367
T8	Transformer, horizontal-sweep output	32-8398-1
T9	Transformer, vertical-sweep output	32-8405-1
TB1	Terminal board, aerial input	Part of 76-4402-5
TC1 through TC12	Tuning core, oscillator	Part of 76-4402-5
TC13	Tuning core	Part of L44
TC14	Tuning core	Part of L45
TC15	Tuning core	Part of L46
TC16	Tuning core	Part of L47
TC17	Tuning core	Part of L48
TC18	Tuning core	Part of L49
TC19	Tuning core	Part of L50
TC20	Tuning core	Part of L51
TC21	Tuning core	Part of L52
TC22	Tuning core	Part of L54
TC23	Tuning core	Part of L36
TC24	Tuning core	Part of L39
TC25	Tuning core	Part of L41
TC26	Tuning core	Part of T7
TC27	Tuning core	Part of L67
TC28	Tuning core	Part of L43
TL1	Transformer assembly, line	Part of Z5
W1	Line-cord-and-plug assembly	41-3865
WS1	Wafer-switch-and-plate assembly	Part of 76-4402-5
Z1	Transformer assembly, 2nd sound-i-f	32-4236
Z2	Transformer assembly, FM detector	32-4317
Z3	Focus-coil assembly	76-2622-3
Z4	Deflection-coil assembly	32-9622
Z5	Loop assembly, aerial tuning	76-5413

MISCELLANEOUS

Description	Service Part No.
Cabinet, mahogany	10766-2
Cabinet, blonde	10766-3
Cabinet Hardware and Parts	
Back	54-7712-2
Baffle, masonite, speakei	219190
Brace, picture tube	56-5581-15FA3
Catch, bullet, blonde	45-6002-1
Catch, bullet, mahogany	45-6002
Chain, bead, back	76-3527
Coupler, AERIAL TUNING shaft	54-4748
Cup, back	56-5171-5FJ31
Door, drop, blonde	45-6545
Door, drop, mahogany	45-6536
Frame, picture, blonde	45-6547
Frame, picture, mahogany	45-6538
Hinges, knife (one pair)	56-5765-1
Knob, AERIAL TUNING	54-4750
Knob, BRIGHTNESS control	54-4703
Knob, CHANNEL SELECTOR	54-4706
Knob, CONTRAST control	54-4703
Knob, FINE TUNING control	54-4701
Knob, HORIZ. HOLD control	54-4707
Knob, VERT. HOLD control	54-4699
Knob, VOLUME control	54-4703
Panel assembly, AERIAL TUNING	76-5399
Panel, instrument, blonde	45-6546
Punel, instrument, mahogany	45-6537
Plate, strike, blonde	45-6003-1
Plate, strike, mahogany	45-6003
Pull, door, blonde	56-7210-1
Pull, door, mahogany	56-7210
Shaft, AERIAL TUNING control	54-4747
Window	54-7595-1
Cable assembly, high voltage	41-3771-3
Cable assembly, picture tube	41-3772
Cord, drive (25-foot spool)	45-8750
Frame assembly, picture-tube mounting	76-3938
Holder, fuse	76-4519
Nut, mounting-frame assembly	56-4633
Plate, high-voltage insulator base	54-4578
Shield assembly, high voltage	76-3841
Shield, miniature tube	56-5629FA3
Socket, Loktal tube	27-6138
Socket 7-pin miniature tube	27-6226
Socket, 9-pin miniature tube	27-6203-5
Socket, octal tube	27-6174
Socket, 1B3GT octal tube	27-6174-5

Philco Model 50-T1443, Code 123, is a consolette-type television receiver with a 12-inch picture tube, a wide mask, and a built-in aerial. Provision is made for the connection of an external aerial, if required. For service information on this model, use Philco Service Manual PR-1774 in conjunction with this supplement.

The cabinet, built-in aerial, and aerial-tuning network of Model 50-T1443, Code 123, are identical to those of Model 50-T1443, Code 122. The chassis is similar to the chassis of Model 50-T1443, Code 122, but has a different tuner unit and minor circuit changes. The schematic diagram of the new tuner unit is shown in figure 2. Other circuit differences between the two codes are as follows:

1. R133 is changed from 3300 ohms to 330 ohms, Part No. 66-1338340.

2. A 470-$\mu\mu f$. condenser, Part No. 62-147001001, is added between the a-v-c lead to the tuner and ground.

3. C80B, R75, R76, and R77 are removed.

4. Pin 6 of the audio-output tube is connected to pin 4 instead of the 150-volt B+ supply. This connection supplies a higher voltage at pin 6 for Philco Booster TB-2.

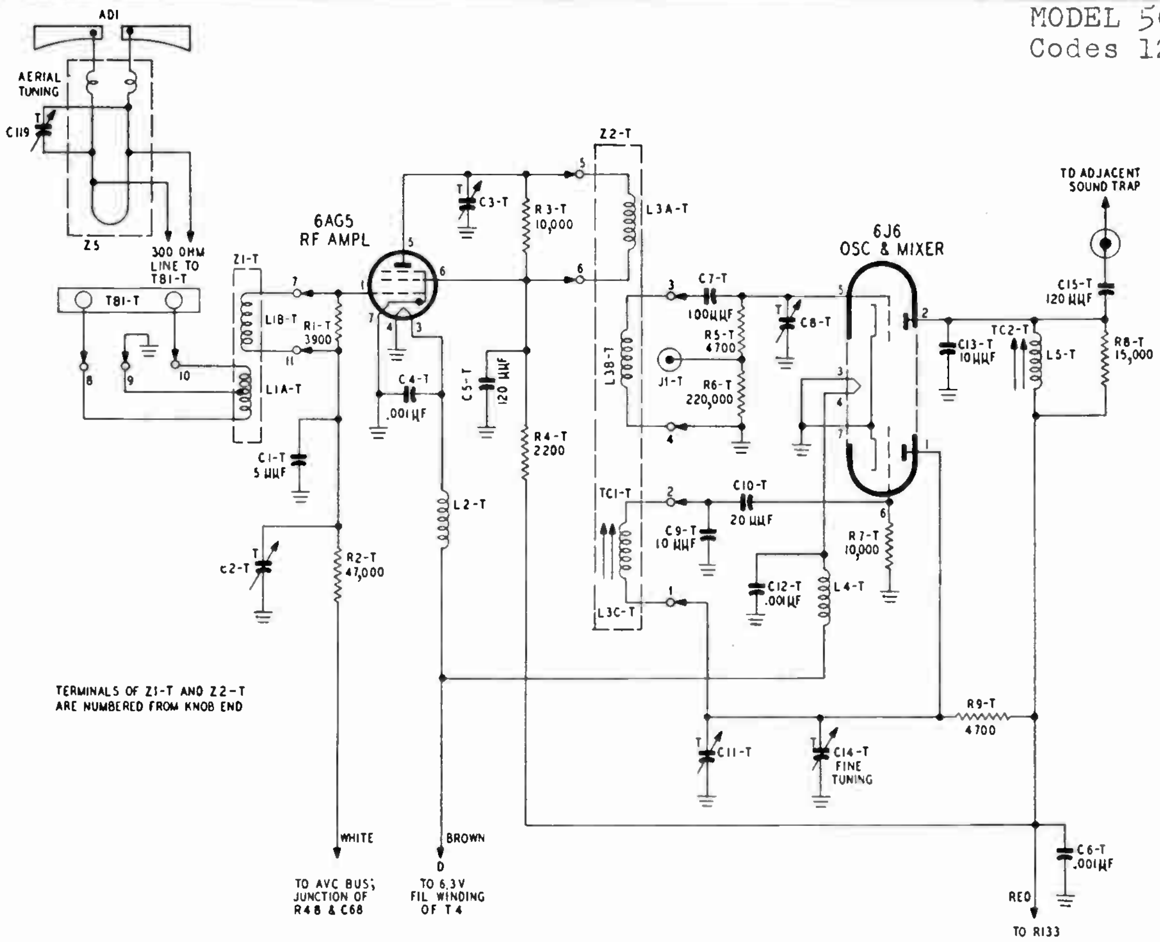

Figure 2. Tuner Unit for Model 50-T1443, Code 123, Schematic Diagram

CHECKING AND ADJUSTING THE BUILT-IN-AERIAL TUNING NETWORK

By rotating the AERIAL TUNING control, it should be possible to tune the built-in aerial system to resonance with the video carrier frequency of each channel except Channel 6. For Channel 6 a resonant condition should be approached.

To check the built-in aerial system, use the following procedure:

1. Connect a dipole through a 72-ohm coaxial cable to the output of an AM signal generator having a band range that covers the television channels.

2. Connect a 20,000-ohms-per-volt voltmeter to pin 3 of the ALIGN TEST jack, J4.

3. Set the CHANNEL SELECTOR to Channel 2, and the FINE TUNING control to the middle of its range.

4. Place the dipole near the back of the receiver, and set the signal generator for a modulated output at the video carrier frequency of Channel 2. Adjust the signal-generator attenuator for an output that will just give an indication on the meter.

5. Turn the AERIAL TUNING control for a maximum reading on the voltmeter. When maximum reading is obtained, the AERIAL TUNING control should not be in either its maximum clockwise position or maximum counterclockwise position.

6. Repeat the above steps for Channels 3 through 13. For all channels, except Channel 6, peak readings should be obtained on the meter when the AERIAL TUNING control is set at positions other than its maximum clockwise or maximum counterclockwise position. For Channel 6, a peak reading should be approached.

If a peak reading cannot be obtained on each channel (except Channel 6) in the low-frequency band, the long section of the loop assembly, to which the 300-ohm line is attached, may be pushed together or bowed out to obtain peaking.

If a peak reading cannot be obtained on each channel in the high-frequency band, the two loops adjacent to the AERIAL TUNING condenser may be pushed toward each other or fanned out to obtain peaking.

After the above adjustments have been made, it still may not be possible to obtain peak meter readings when the AERIAL TUNING control is set at positions other than its maximum clockwise or maximum counterclockwise position. If this is the case, it is suggested that the AERIAL TUNING condenser be replaced.

LOCAL-OSCILLATOR ADJUSTMENT

The procedure for adjusting the local oscillator is as follows:

1. Turn the CHANNEL SELECTOR to Channel 2, and set the FINE TUNING control to the middle of its range.

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2. Connect a 20,000-ohms-per-volt voltmeter, through the FM TEST jack adaptor (figure 7), to the FM TEST jack.

3. Connect an accurately calibrated AM signal generator to the aerial-input terminals of the receiver. Set the signal generator for a modulated signal at the frequency of the sound carrier of Channel 2.

4. Adjust the oscillator tuning core for zero reading on the voltmeter. The tuning cores may be adjusted, with the chassis in the cabinet, by removing the CHANNEL SELECTOR and FINE TUNING knobs and inserting a long thin screwdriver, such as Philco Part No. 45-6354-2, through the slot in the cabinet. DO NOT TURN THE TUNING CORE IN TOO FAR or it will be turned beyond the limit of the threads of the coil form and be lost.

5. Repeat steps 1 through 4 for Channels 3 through 13, in order.

REPLACING TUBES IN THE TUNER UNIT

Whenever it becomes necessary to replace a tube in the tuner unit, it is suggested that several be tried in order to obtain one which has similar interelectrode capacity, to prevent a change in tuner alignment. The picture quality and oscillator fine tuning range should be observed while selecting the tube.

ALIGNMENT

The tuner alignment procedure in PR-1774 is not applicable to Model 50-T1443, Code 123.

The i-f alignment procedure in PR-1774 is applicable to Model 50-T1443, Code 123, except for the following changes:

1. TC2-T should be adjusted wherever TC13 is mentioned.

2. The grid of the 6J6 mixer tube is pin 5 instead of pin 1.

3. C8-T connects directly to the mixer grid of Model 50-T1443, Code 123, and the mixer jig snaps over this trimmer. Shape the mixer jig, described in PR-1774, so that it fits C8-T, which is smaller in diameter than C13 in Model 50-T1443, Code 122.

TELEVISION CARRIER FREQUENCIES

CHANNEL	BAND WIDTH (mc.)	VIDEO CARRIER FREQUENCY (mc.)	SOUND CARRIER FREQUENCY (mc.)
2	54—60	55.25	59.75
3	60—66	61.25	65.75
4	66—72	67.25	71.75
5	76—82	77.25	81.75
6	82—88	83.25	87.75
7	174—180	175.25	179.75
8	180—186	181.25	185.75
9	186—192	187.25	191.75
10	192—198	193.25	197.75
11	198—204	199.25	203.75
12	204—210	205.25	209.75
13	210—216	211.25	215.75

REPLACEMENT PARTS LIST

Reference Symbol	Description	Service Part No.
C1-T	Condenser, fixed padder, 5 $\mu\mu f$.	30-1224-5
C2-T	Condenser, trimmer, .5 $\mu\mu f$. to 3 $\mu\mu f$.	Part of 76-5411-3
C3-T	Condenser, trimmer, r-f amplifier plate	Part of 76-5411-3
C4-T	Condenser, filament by-pass, .001 μf.	45-3505-52*
C5-T	Condenser, screen by-pass, 120 $\mu\mu f$.	60-10125237*
C6-T	Condenser, decoupling, .001 μf.	45-3505-52*
C7-T	Condenser, r-f by-pass, 100 $\mu\mu f$.	62-215001011*
C8-T	Condenser, trimmer, mixer grid	Part of 76-5411-3
C9-T	Condenser, fixed trimmer, 10 $\mu\mu f$.	62-010009001*
C10-T	Condenser, d-c blocking, 20 $\mu\mu f$.	60-00205307
C11-T	Condenser, trimmer, oscillator grid	Part of 76-5411-3
C12-T	Condenser, filament by-pass, .001 μf.	45-3505-52*
C13-T	Condenser, fixed trimmer, 10 $\mu\mu f$.	62-010009001*
C14-T	Condenser, FINE TUNING control	Part of 76-5411-3
C15-T	Condenser, d-c blocking, 120 $\mu\mu f$.	60-10125237*
J1-T	Jack, TUNER TEST	Part of 76-5411-3
L1A-T	Coil, aerial	Part of Z1-T
L1B-T	Coil, r-f amplifier grid	Part of Z1-T
L2-T	Coil, filament choke	32-4112-15
L3A-T	Coil, r-f amplifier plate	Part of Z2-T
L3B-T	Coil, mixer grid	Part of Z2-T
L3C-T	Coil, oscillator	Part of Z2-T
L4-T	Coil, filament choke	32-4112-15
L5-T	Coil, mixer plate	Part of 76-5411-3
R1-T	Resistor, grid return, 3900 ohms	66-2398340*
R2-T	Resistor, a-v-c filter, 47,000 ohms	66-3478340*
R3-T	Resistor, plate load, 10,000 ohms	66-3108340*
R4-T	Resistor, decoupling, 2200 ohms	66-2228340*
R5-T	Resistor, grid, 4700 ohms	66-2478340*
R6-T	Resistor, grid return, 220,000 ohms	66-4228340*
R7-T	Resistor, grid return, 10,000 ohms	66-3108340*
R8-T	Resistor, damping, 15,000 ohms	66-3158340*
R9-T	Resistor, decoupling, 4700 ohms	66-2478340*
TC1-T	Tuning core, oscillator	Part of Z2-T
TC2-T	Tuning core, mixer-plate coil	Part of L5-T
Z1-T	Coil assembly, aerial and r-f	
	Channel 2	32-4428-2
	Channel 3	32-4428-3
	Channel 4	32-4428-4
	Channel 5	32-4428-5
	Channel 6	32-4428-6
	Channel 7	32-4428-7
	Channel 8	32-4428-8
	Channel 9	32-4428-9
	Channel 10	32-4428-10
	Channel 11	32-4428-11
	Channel 12	32-4428-12
	Channel 13	32-4428-13
Z2-T	Coil assembly, mixer and oscillator	
	Channel 2	32-4429-2
	Channel 3	32-4429-3
	Channel 4	32-4429-4
	Channel 5	32-4429-5
	Channel 6	32-4429-6
	Channel 7	32-4429-7
	Channel 8	32-4429-8
	Channel 9	32-4429-9
	Channel 10	32-4429-10
	Channel 11	32-4429-11
	Channel 12	32-4429-12
	Channel 13	32-4429-13
	Tuner assembly, with coils	76-5411-3

PREPRODUCTION AND PRODUCTION CHANGES IN PHILCO MODELS 50-T1443, CODE 122; 50-T1443, CODE 123

CORRECTIONS TO SERVICE MANUAL PR-1774

1. In figure 4 of Service Manual PR-1774, the wording "PLUG IS SHOWN WITH THE PRONGS POINTING AWAY" should read "PRONG-END VIEW."

2. In the Replacement Parts List, the description for C85 should read "Condenser, electrolytic, 4-section." The Service Part No. should be 30-2570-10.

3. In the schematic diagram, the following changes should be made:

   a. R61 should be connected across C41 instead of between pins 5 and 7 of the FM detector.

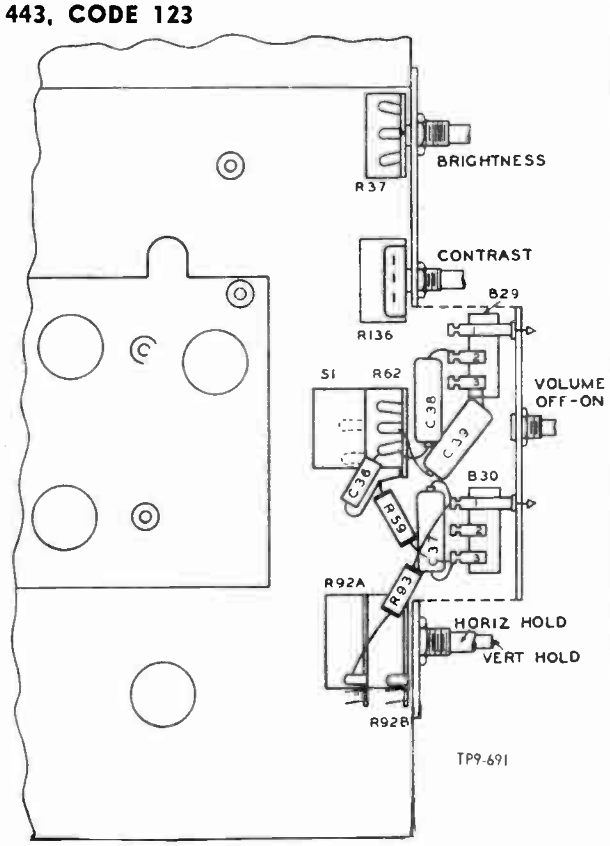
   b. The reference symbol for the CONTRAST control should be R136 instead of R134.

   c. The power socket should be J7 instead of J1.

   d. The reference symbols for C32 and C35 should be reversed.

PREPRODUCTION CHANGE IN MODEL 50-T1443, CODE 123

Between the time of the printing of Service Manual PR-1800 and the time of first production of Model 50-T1443, Code 123, L71 was removed and reconnected in series with the lead between C15T and the junction of C21 and L45. The junction of C22 and L45 was then connected directly to pin 1 of the first video-i-f amplifier.



Partial Top View of Models 50-T1443, Code 122, and 50-T1443, Code 123, Showing Components Located on Control Panel

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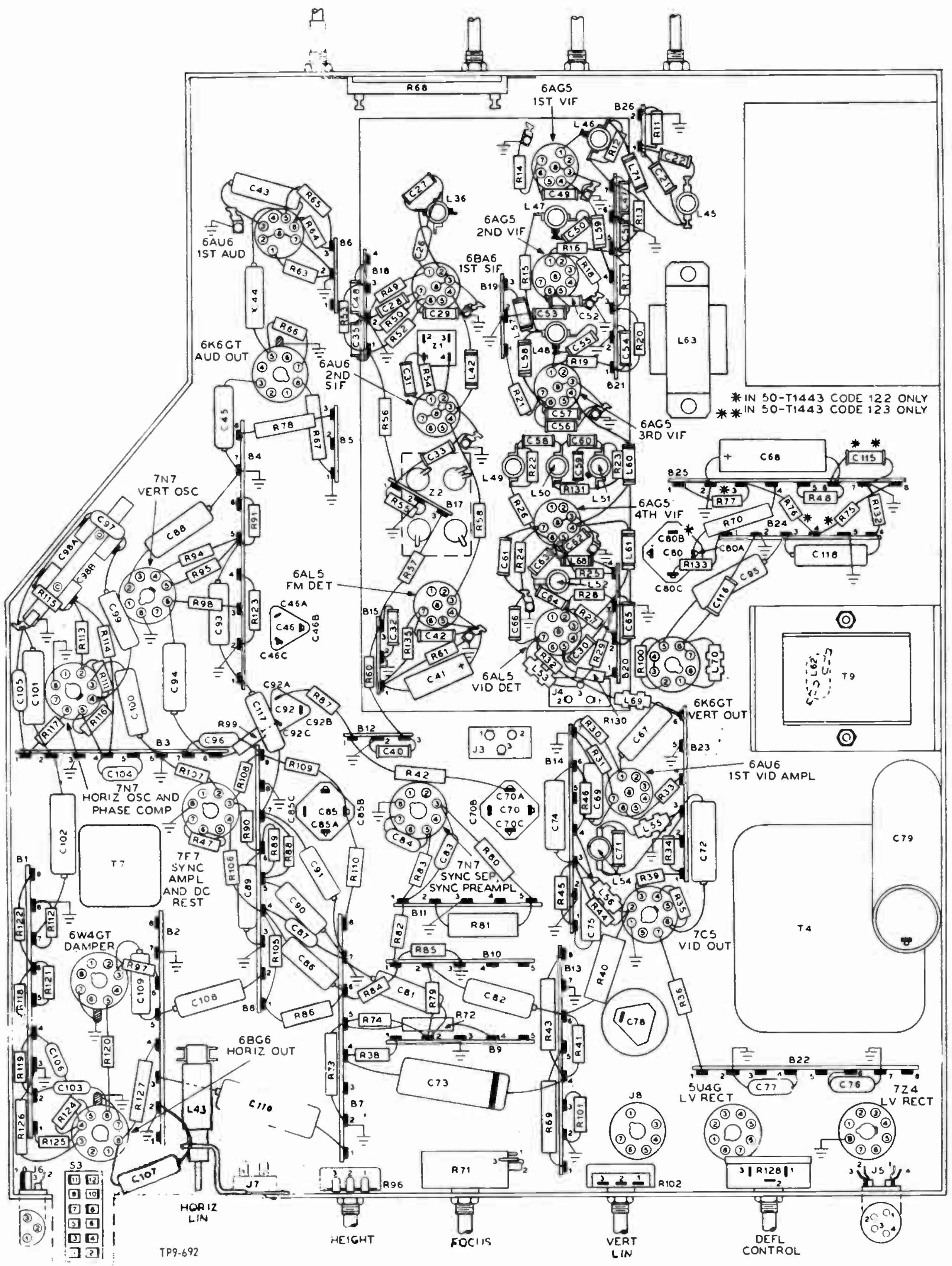
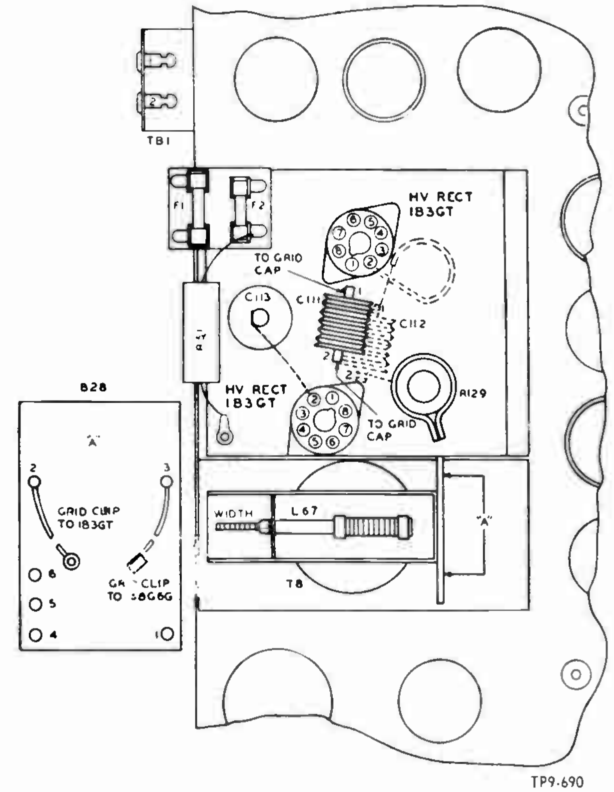


Bottom View of Models 50-T1443, Code 122, and 50-T1443, Code 123, Showing Locations of Components



Partial Top View of Models 50-T1443, Code 122, and 50-T1443, Code 123, Showing Components Located in High-Voltage Cage

MODEL 50-T1443
Correction to Service Manual

TC19 and TC20, in the top view of the drawing on page 5, should be reversed.

MODELS 50-T1443, CODE 122; 50-T1443, CODE 123

Microphonics Due to Improper Unpacking

The above models may be microphonic if their chassis do not float freely on the chassis shock mounts. When the receiver is placed in operation, the chassis-mounting bolts should be loosened, and all chassis-packing strips should be removed.

PRODUCTION CHANGE IN MODEL 50-T1443, CODE 122

RUN NO.	DESCRIPTION OF CHANGE	REASON FOR CHANGE
1Z	In early production of run 1Z, the unused (triangle) section of C80 and the unused (half-moon) section of C85 were added in parallel across R51. In later production of run 1Z, the unused (triangle) section of C80 and the unused (square) section of C70 were added in parallel across R51.	To reduce vertical-sweep-generator feedback into B+ supply.

PRODUCTION CHANGES IN MODEL 50-T1443, CODE 123

RUN NO.	DESCRIPTION OF CHANGE	REASON FOR CHANGE
2	Pin 6 of audio-output tube disconnected from 160-volt B+ supply and reconnected to pin 4 of audio-output tube.	To supply higher B+ voltage for Philco Booster TB-2.
1Z 2Z 3	Two unused (triangle and plain) sections of C80 were connected in parallel across R51. Runs 2Z and 3 also incorporate the change made in run 2. Run 1Z does not incorporate the change made in run 2.	To reduce vertical-sweep-generator feedback into B+ supply.
4	C92B disconnected and replaced with unused (half-moon) section of C85.	To provide condenser with higher voltage rating in HEIGHT-control circuit.

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PRODUCTION CHANGES IN I-F STRIP FOR MODELS 50-T1443, CODE 122; 50-T1443, CODE 123

RUN NO.	DESCRIPTION OF CHANGE	REMOVED PART NO.	ADDED PART NO.	REASON FOR CHANGE
2	2200-ohm resistor (R135*) added in series with lead between junction of C41 and pin 2 of J3 and junction of C42 and pin 7 of FM-detector tube.		66-2228340	To reduce harmonic beat.
2Z 3	R135* changed from 2200 ohms to 330 ohms.	66-2228340	66-1338340	To facilitate sound-i-f alignment.

* The schematic diagram in Service Manual PR-1774 shows R135 as 330 ohms (the value used in runs 2Z and 3), rather than 2200 ohms (the original value used in run 1).

PRODUCTION CHANGES IN MODEL 50-T1443, CODE 123

RUN NO.	DESCRIPTION OF CHANGE	REMOVED PART NO.	ADDED PART NO.	REASON FOR CHANGE
5	180-microhenry peaking coil added in series with lead between R40 and junction of L56 and R44.		32-4143-5	To improve picture quality.
5	6800-ohm resistor added between ground and junction of R136 and R36.		66-2688340	To improve picture quality.
5	R36 changed from 47 ohms to 10 ohms.	66-0478340	66-0108340	To improve picture quality.
5	82,000-ohm resistor added between screen (pin 3) of video-output tube and ground.		66-3824340	To improve picture quality.
5	15,000-ohm resistor added across R40 and R41.		66-3154340	To improve picture quality.

PRODUCTION CHANGES IN MODEL 50-T1443, CODE 123 (Cont.)

RUN NO.	DESCRIPTION OF CHANGE	REMOVED PART NO.	ADDED PART NO.	REASON FOR CHANGE
5	C69 changed from .0033 $\mu f.$ to 680 $\mu\mu f.$	45-3505-55	60-10685401	To improve picture quality.
6	R-f choke added in series with lead between R60 and junction of R47 and C32.		32-4061-2	To reduce beat interference.
6	R32 removed. L53 removed and replaced with 10-microhenry choke. L53 connected in series with lead to ungrounded end of R29, between R29 and junction of L69 and pin 3 of J4. 100-$\mu\mu f.$ condenser added between pin 2 of J4 and ground. These changes were incorporated by replacing the entire i-f strip with another strip.	66-3478340	62-110009001 32-4143-10	To reduce beat interference.
6	470-$\mu\mu f.$ condenser added between ground and junction of R136 and R130.		62-147001001	To reduce beat interference.

MODEL 50-T1443, CODE 123

RUN NO.	DESCRIPTION OF CHANGE	REMOVED PART NO.	ADDED PART NO.	REASON FOR CHANGE
6Z and 7	R114 changed from 100,000 ohms to 82,000 ohms.	66-4108340	66-3828340	To center HORIZ. HOLD control.

CORRECTIONS AND CHANGES IN REPLACEMENT PART NUMBERS

MODEL 50-T1443, CODE 122

The following changes should be made in the Replacement Parts List

REFERENCE SYMBOL OR DESCRIPTION	PUBLISHED PART NO.	NEW OR CORRECT PART NO.
C81	45-3505-36	45-3505-30
C101	61-6108	61-0108
C105	60-20155314	60-20155014
J4	27-3772-6	27-6180
J8	27-6180	27-6174-4
J9	41-3860-1	41-3860
R23	66-2518340	66-2518240
R123	33-1342-2	33-1343-2
Frame, picture, blond	45-6547	45-6549
Hinges, knife (one pair)	56-5765-1	56-5765

50-T1443, CODE 122 AND 123
Correction of Part Number

Four-section electrolytic condenser, 40-20-10-10 $\mu f.$, all 475 working volts, used in the above models, should have the part number of 30-2570-41 instead of 30-2570-8.

MODEL 50-T1443, CODE 123
TB2 Booster Connections

Early production receivers of the above model did not have the audio-tube socket wired to supply B voltage to 41-3963 booster adaptor. If a booster is required in one of these receivers, pin 6 and pin 4 of the audio-output (6K6GT) tube should be wired together. It may be determined whether this jumper is necessary by taking a voltage reading from pin 6 to ground.

MODELS 50-T1443, ALL CODES
A-C Line Fuse Failure

Under certain operating conditions, the 5-ampere line fuse may blow, due to line surges, although the receiver may be operating normally.

Investigation has revealed that a 3.2-ampere, delayed-action fuse will provide the required protection, and will not blow when surges occur.

If the receiver blows the 3.2-ampere, delayed-action fuse, trouble-shoot the receiver before trying another fuse.

The Philco Part No. of the delayed-action fuse is 45-2656-14.

SUPPLEMENTARY ALIGNMENT INFORMATION FOR MODELS 50-T1443, CODE 123

When the video-i-f stages of the above models are being aligned, better results may be obtained if bias is applied to the a-v-c bus only during the adjustment of the tuning core of the mixer-plate coil and during the adjustments that affect the over-all video-response curve.

During alignment, the ALIGN TEST jack adapter, shown in the service manuals should not be used. The vertical input of the oscilloscope should be connected directly to pin 3 of the ALIGN TEST jack. When adjusting the tuning core of the mixer-plate coil and when making adjustments to obtain the over-all response curve, connect a short piece of wire between pins 1 and 2 of the ALIGN TEST jack. Such a jumper applies a bias of -3 volts to the a-v-c bus.

To facilitate connections to the ALIGN TEST jack, a 3-prong plug, Philco Part No. 27-4787, with a short wire soldered in each prong, may be used.

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SPECIFICATIONS

CABINET

Model 50-T1477—Modern style, console type, matched-crotch mahogany finish

Model 50-T1478—Modern style, console type, walnut finish

Model 50-T1479—Modern style, console type, broken-stripe mahogany finish

Model 50-T1481—Modern style, console type, blonde finish

Model 50-T1482—Hepplewhite style, console type, mahogany finish

CIRCUIT—Combination AM-FM radio superheterodyne and television superheterodyne

RECORD PLAYER

Model 50-T1477—M-12C (provision for external 45 r.p.m. record player)
Model 50T1478—M-20
Model 50-T1479—M-20
Model 50-T1481—M-20
Model 50-T1482—M-20

TELEVISION TUNING—12-position turret tuner; fine-tuning control of local oscillator

AUDIO OUTPUT—5 watts

FREQUENCY RANGE

Television—Channels 2 to 13
AM radio—540 kc. to 1620 kc.
FM radio—88 mc. to 108 mc.

INTERMEDIATE FREQUENCY

Television video carrier—26.6 mc.
Television sound carrier—22.1 mc.
AM radio—455 kc.
FM radio—22.1 mc.

AERIAL

Television—Built-in broad-band dipole, and provisions for external aerial, if necessary
AM radio—Built-in loop aerial
FM radio—Uses television aerial

TELEVISION TRANSMISSION LINE (for external aerial)—300-ohm twin-wire leadin (balanced) or 72-ohm coaxial cable (unbalanced) in areas of high interference

OPERATING VOLTAGE—110 volts to 120 volts, 60 cycles, a.c.

POWER CONSUMPTION

Television—250 watts
Radio—220 watts

TUBE COMPLEMENT

LOKTAL	OCTAL	MINIATURE	C.R.T.
2—7N7	1—1B3GT	5—6BC5	1—12LP4
1—7F7	1—6BG6G	2—6AL5	
1—7C5	1—6Y6G	1—12AU7	
1—7R7	1—6V6GT	3—6AU6	
	1—5Y3GT	1—6BA6	
	1—5U4G	1—6BE6	
	1—6W4GT	1—12AT7	
		1—6J6	

CIRCUIT DESCRIPTION

Philco Models 50-T1477, 50-T1478, 50-T1479, 50-T1481, and 50-T1482 are combination television receivers, AM-FM radios, and phonographs in console cabinets. The radio-television chassis of these models are similar. The cabinets differ from each other in styling and finish.

The phonograph section of Model 50-T1477 uses an M-12C Automatic Record Player designed with two tone arms and two turntable speeds, for use with long-playing and standard records. Refer to PR-1600 for complete service information on the M-12C Automatic Record Player. Provision is also made for the connection of an external phonograph having a turntable speed of 45 r.p.m. The phonograph section of the other four models employs an M-20 Automatic Record Player, which has three turntable speeds and accommodates all types of records. Refer to PR-1731 for complete service information on the M-20 Automatic Record Player.

All models feature a built-in television and FM-radio aerial, a built-in AM-radio aerial, a 12-inch picture tube, and a wide mask.

The television radio-frequency section is built on a subchassis, and incorporates a 6BC5 or 6AG5/S tube as an r-f amplifier and a 6J6 tube as a mixer and local oscillator. Refer to PR-1803 for complete service information on the 12-position turret tuner.

Four 6BC5 tubes are used as video-i-f amplifiers, and a 6AL5 tube is used as a video detector and a-v-c rectifier. The rectified video signal is amplified by a video amplifier using one section of a 12AU7, and a 7C5 video-output stage.

The television sound-i-f signal is taken from the cathode of the third video-i-f tube, and further amplification is obtained with a 6BA6 and 6AU6. A 6AL5 tube is used as an FM detector, and a 6AU6 tube is employed as an audio amplifier which drives a 6Y6G audio-output stage.

The television aerial also serves as an FM-radio aerial. A 6AU6 is used an an r-f amplifier for the FM-radio section, and a 12AT7 is used as a mixer and oscillator. The FM intermediate frequency is 22.1 mc.

The AM-radio aerial consists of a built-in loop. For the AM-radio section, a 6BE6 tube functions as a mixer and oscillator. The AM intermediate frequency is 455 kc.

A 7R7 is used as a detector and a-v-c rectifier for the AM signals, and as an i-f amplifier for both the AM and FM-radio sections. The FM i-f signal from this stage is coupled to the television first sound i-f amplifier, and the television sound section completes the FM-radio circuit. The detected AM signal from the detector section of the 7R7 is fed to the television first audio amplifier. This stage, together with the audio-output stage, completes the AM-radio circuit.

A portion of the composite video signal is taken from the video-output stage and is amplified by a sync preamplifier. A sync separator separates the sync pulses from the rest of the composite video signal. Another amplifier inverts these pulses to a positive polarity. The vertical-sync pulses are separated from the horizontal-sync pulses in an integrating network, and are applied to the grid of the vertical-blocking oscillator to control its frequency. The horizontal-sync pulses are applied to the grid of the phase comparer.

The vertical-sweep circuit consists of a conventional blocking oscillator and vertical-output stage.

Horizontal-sweep voltage is generated by a blocking oscillator, the frequency of which is determined by the phase relationships of the horizontal-sync pulses and the horizontal sawtooth at the phase comparer grid. A 6BG6G amplifies the horizontal sweep which is applied across a 6W4GT damper tube to the horizontal deflection coils.

A 1B3GT tube is used as a high-voltage rectifier to supply high voltage for the second anode of the picture tube. A 5U4G and a 5Y3GT supply plate and screen voltages for the entire chassis.

CONNECTING PHILCO BOOSTER TB-2

Provisions are made for connecting Philco Television Booster, Model TB-2.

Plug the booster power adapter (Philco Part No. 41-3963) into the audio output tube socket. Then plug the 6Y6G into the adapter. Pin 6 of the audio output socket is used as a tie point to supply the B-plus voltage to the booster. Pins 2 and 7 furnish the filament power and B-minus connection.

BUILT-IN TELEVISION AERIAL

The built-in television aerial consists of a broad-band dipole of metal foil, mounted inside the cabinet on the top, and a tuning and impedance-matching network. This aerial covers all channels, and is tuned for each channel by adjusting the AERIAL TUNING control located on the front of the receiver, near the top of the cabinet.

A 300-ohm line couples the tuning network to the aerial-input terminals of TB1. This line should be disconnected from the aerial terminals so that an external aerial may be used if required.

HORIZONTAL HOLD ADJUSTMENT

Ordinarily, the range of the HORIZ. HOLD control potentiometer is sufficient to compensate for normal variations and provide horizontal hold control. If, for some reason, such as replacement of tubes or components, it becomes necessary to make further hold adjustments, the following procedure is recommended:

1. Preset the adjustments as follows:
   a. Lockin trimmer C80A—½ turn counterclockwise from the maximum clockwise position.
   b. Range trimmer C80B—1½ turns counterclockwise from the maximum clockwise position.
   c. Drive trimmer C80C two turns counterclockwise from the maximum clockwise position.
   d. HORIZ. HOLD control to approximate center of its range.

2. Tune in a station, and adjust TC14 until the picture is brought into sync.

3. Adjust the CONTRAST control for normal contrast.

4. Turn the HORIZ. HOLD control fully clockwise.

5. Adjust TC14 until 8 to 10 stationary bars appear, sloping downward from the left side of the picture tube. If this cannot be accomplished, turn C80B another full turn counterclockwise, and repeat this step.

6. Turn the HORIZ. HOLD control counterclockwise until the picture is brought into sync; continue to rotate this control until the picture falls out of

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sync. In some cases, the picture will not go out of sync, even though the HORIZ. HOLD control is turned to its extreme counterclockwise position. If this is the case, momentarily short the aerial terminals. When the picture reappears, it will be out of sync.

7. Slowly turn the HORIZ. HOLD control clockwise, and note the change in the number of blanking bars appearing on the picture tube. The number of bars should decrease as sync is approached. Just before the picture falls into sync, there should be 3½ to 4½ bars sloping upward from the left side of the picture tube. If there are more than 4½ bars, turn C80A another ¼ turn clockwise, and repeat steps 4, 5, 6, and 7. If there are less than 3½ bars, turn C80A another ¼ turn counterclockwise, and repeat steps 4, 5, 6, and 7.

CHECKING AND ADJUSTING THE BUILT-IN-AERIAL TUNING NETWORK

By rotating the AERIAL TUNING control, it should be possible to tune the built-in aerial system to resonance with the video carrier frequency of each channel except Channel 6. For Channel 6 a resonant condition should be approached.

To check the built-in aerial system follow the procedure given below:

1. Connect a dipole through a 72-ohm coaxial cable to the output of an AM signal generator which has a band range covering the television channels.

2. Connect a 20,000-ohms-per-volt voltmeter to pin 3 of the ALIGN TEST jack, J5.

3. Set the CHANNEL SELECTOR to Channel 2, and the FINE TUNING control to the middle of its range.

4. Place the dipole near the back of the receiver, and set the signal generator for a modulated output at the video carrier frequency of Channel 2. Adjust the signal-generator attenuator for an output that will just give an indication on the meter.

5. Turn the AERIAL TUNING control for a maximum reading on the voltmeter. When maximum reading is obtained, the AERIAL TUNING control should not be in either its maximum clockwise or maximum counterclockwise position.

6. Repeat the above steps for Channels 3 through 13. For all channels, except Channel 6, maximum readings should be obtained on the meter when the AERIAL TUNING control is set at positions other than its maximum clockwise or maximum counterclockwise position. For Channel 6, a peak reading should be approached.

If a peak reading cannot be obtained on each channel (except Channel 6) in the low-frequency band, the long section of the loop assembly, to which the 300-ohm line is attached, may be pushed together or bowed out to obtain peaking.

If a peak reading cannot be obtained on each channel in the high-frequency band, the two loops adjacent to the AERIAL TUNING condenser may be pushed toward each other or fanned out to obtain peaking.

After the above adjustments have been made, it still may not be possible to obtain maximum meter readings when the AERIAL TUNING control is set at positions other than its maximum clockwise or maximum counterclockwise position. If this is the case, it is suggested that the AERIAL TUNING condenser be replaced.

TELEVISION CARRIER FREQUENCIES

CHANNEL	CHANNEL LIMITS (mc.)	VIDEO CARRIER FREQUENCY (mc.)	SOUND CARRIER FREQUENCY (mc.)
2	54—60	55.25	59.75
3	60—66	61.25	65.75
4	66—72	67.25	71.75
5	76—82	77.25	81.75
6	82—88	83.25	87.75
7	174—180	175.25	179.75
8	180—186	181.25	185.75
9	186—192	187.25	191.75
10	192—198	193.25	197.75
11	198—204	199.25	203.75
12	204—210	205.25	209.75
13	210—216	211.25	215.75

TELEVISION ALIGNMENT

WARNING! Dangerous potentials are present in the receiver when it is operating and for a short time after it has been turned off.

TELEVISION I-F ALIGNMENT

GENERAL

The intermediate frequencies for the television receiver are 22.1 mc. for the sound channel and 26.6 mc. for the video channel. Alignment of circuits operating at these high frequencies requires careful workmanship and good equipment. The following precautions must be observed:

1. The top of the work bench must be metallic, and the test equipment and television-receiver chassis must make a good metal-to-metal contact with the bench top.

2. Never disconnect the picture tube, picture-tube yoke, or speaker while the receiver is turned on.

3. Allow the receiver and test equipment to warm up for 15 minutes before starting the alignment.

4. When aligning the receiver, it is possible to achieve optimum adjustment of all tuning cores when the tops of the adjusting screws are approximately ¼ inch above the coil mounts, and also when the tops of the adjusting screws are approximately ¾ inch above the coil mounts. The tuning cores should be adjusted so that the tops of the adjusting screws are approximately ¾ inch above the coil mounts.

TEST EQUIPMENT REQUIRED FOR TELEVISION I-F ALIGNMENT

The following test equipment is recommended for aligning the television i-f stages of the receiver:

1. Philco Precision Visual Alignment Generator for Television and FM, Model 7008, or equivalent equipment.

2. A vacuum-tube voltmeter or a 20,000-ohms-per-volt voltmeter.

If separate signal generators and oscilloscope are used in place of Model 7008, these instruments should have the following characteristics:

FM signal generator
- Deviation: ± 4 mc.
- Center-frequency range: 20 mc. to 30 mc.
- Sweep-sync output with either built-in or separate phase corrector.

AM signal generator
- Carrier-frequency range: 20 mc. to 30 mc.
- Dial: Suitable for setting and resetting accurately to the frequencies specified in the TELEVISION I-F ALIGNMENT CHART.

Oscilloscope
- Calibrated.
- Vertical sensitivity: 1 volt (peak-to-peak) per inch, or better.

When using a separate AM r-f signal generator to obtain marker pips, couple the output lead of this generator to the output lead of the FM signal generator, using just sufficient coupling to obtain a suitable marker pip.

JIGS REQUIRED FOR TELEVISION I-F ALIGNMENT

I-F Jig

It is recommended that Philco I-F Alignment Jig, Part No. 45-1670, be used to couple the signal generator to the various video-i-f grids. The connections to these grids are available from the top of the chassis through small holes near the tube shields. To use this jig, slip the clamp over the shield, insert the probe end into the hole, and slide the jig downward until a good contact is made with the grid connection.

In order to use the jig on the first video-i-f tube, it is necessary to remove the dial-light shield plate. Philco Cable, Part No. 45-1635, provides a convenient method of connecting the signal generator to the jig.

Mixer Jig

Figure 1 shows a jig that is recommended for coupling the signal generator to the mixer grid to provide short connections and good grounding. This jig is simply constructed from a straight-type hairpin (commonly called "bobbie pin"), a 1-inch length of ⅛-inch diameter spaghetti, and a short length of No. 14 bus wire.

Referring to figure 1, construct this jig as follows:

1. File the enamel from the inside of the prongs and from the end of the hairpin.

2. Bend the tips of the hairpin out at a slight angle and form the prongs at a point ⅜ inch from the tips as shown in figure 1.

3. Slightly pinch the end together and slip the spaghetti over the hairpin.

4. Bend the bus wire as shown in figure 1.

When the chassis is viewed from the side with the operating controls to the left, two holes will be seen on the side of the r-f tuner. The top hole is opposite the plate of C7 which connects directly to the mixer grid.

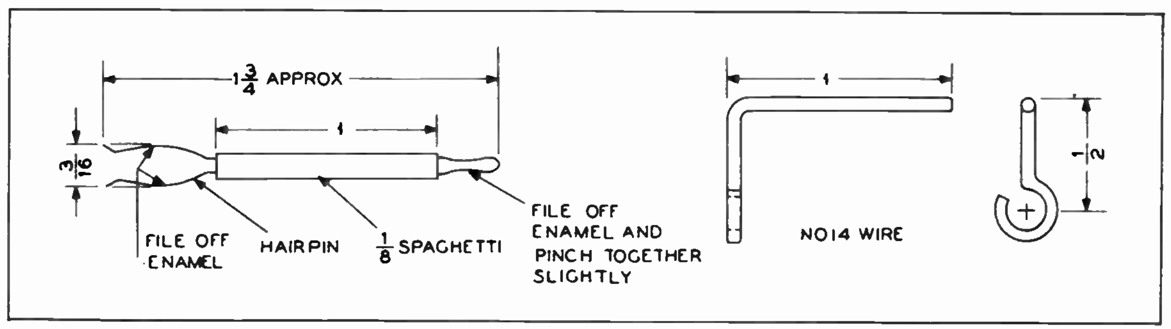

Figure 1. Mixer Jig

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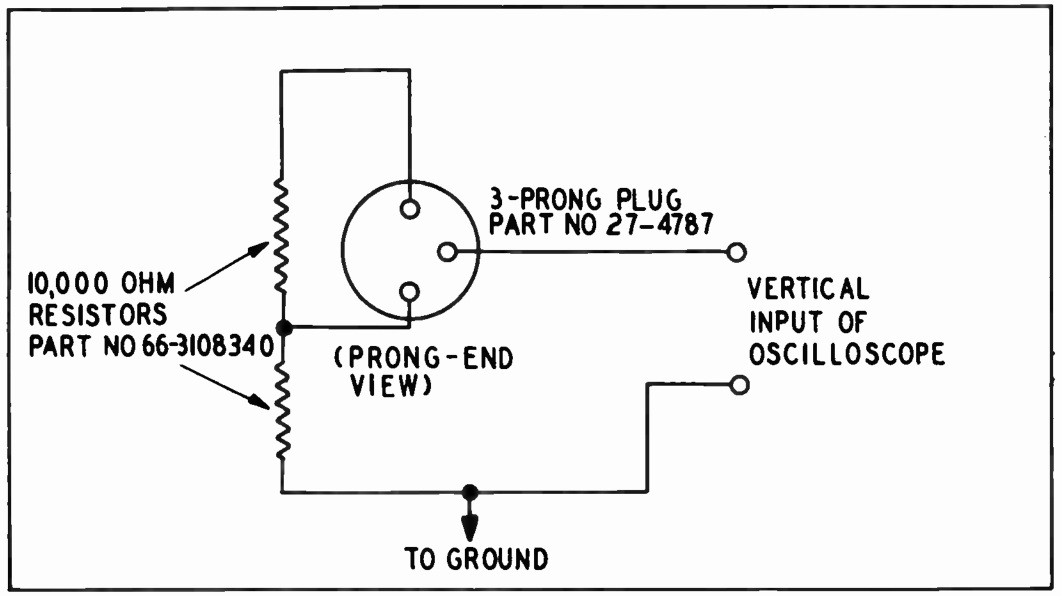

Figure 2. ALIGN TEST Jack Adaptor

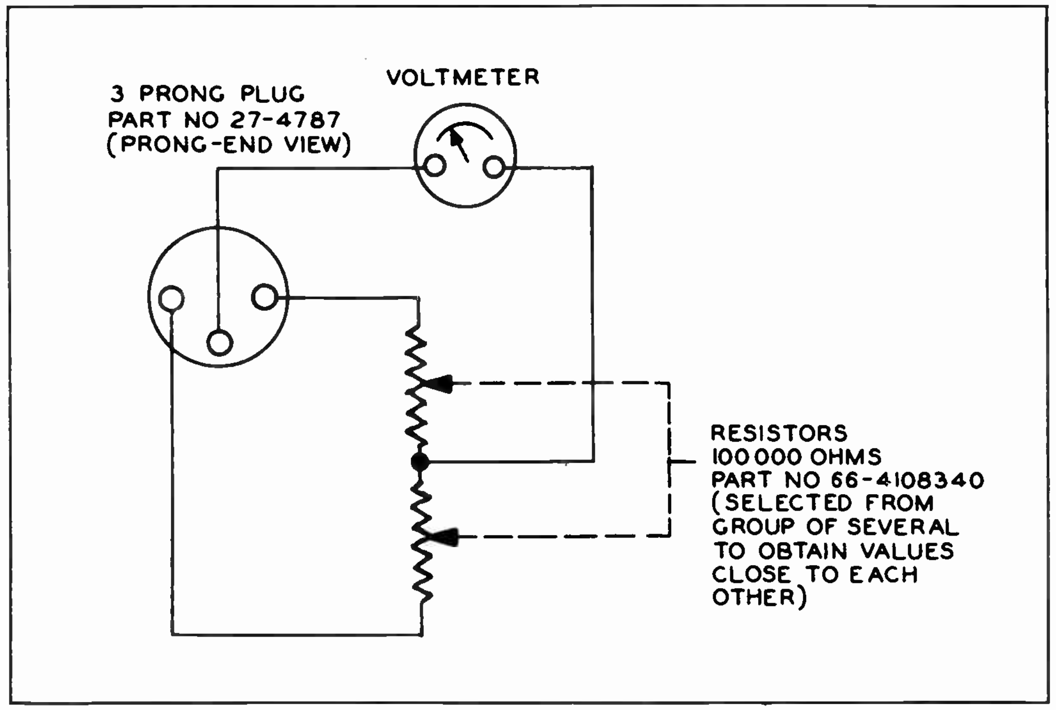

Figure 3. FM TEST Jack Adaptor

To use this jig, insert the prong end into the hole opposite C7 until it snaps over the trimmer plate. Loosen the self-tapping screw which holds the front end of the tuner component cover plate. Slip the hook end of the bus wire under the screw head, and tighten the screw. Connect the ground lead of the signal generator to the bus wire, and the "hot" lead to the end of the hairpin.

TELEVISION I-F ALIGNMENT PROCEDURE

Before proceeding with the television i-f alignment, the following preliminary instructions should be observed.

1. Insert a 10,000-ohm resistor in series with the oscilloscope lead.

2. If additional attenuation of the marker signal is required when using Visual Alignment Generator Model 7008, insert a 10,000-ohm resistor in series with the output lead.

3. Preset the television controls as follows:
   a. CONTRAST control fully counterclockwise.
   b. VOLUME control for an audible signal.
   c. BRIGHTNESS control to give a dim raster.
   d. FINE TUNING control to the center of its range.

4. Preset the tuning cores and trimmer condensers as follows:
   a. C21A and C21B fully clockwise.
   b. TC4 fully counterclockwise.
   c. TC7, TC8, and TC3 so that the top of the adjusting screw is approximately ⅝ inch from the top of the coil mount.

5. During alignment, attenuate the signal-generator output to keep the output at the ALIGN TEST jack below 2 volts, peak-to-peak, and the output at the FM TEST jack below .5 volt, peak-to-peak.

6. During the v-i-f and s-i-f alignment, index the turret tuner between channels.

The television i-f stages of the receiver should be aligned according to the instructions given in the TELEVISION I-F ALIGNMENT CHART.

TELEVISION I-F ALIGNMENT CHART

STEP	SIGNAL-GENERATOR CONNECTION	OUTPUT-INDICATOR CONNECTION	SIGNAL-GENERATOR SETTING	ADJUSTMENT INSTRUCTIONS
1	Connect output of AM signal generator through i-f jig to grid (pin 1) of 4th video-i-f tube.	Connect vertical input of oscilloscope through ALIGN TEST jack adapter (figure 2) to ALIGN TEST jack J5.	Set AM signal generator (modulated) to 25.5 mc.	Adjust TC10 for maximum indication on oscilloscope.
2	Connect output of AM signal generator through i-f jig to grid (pin 1) of 3rd video-i-f tube.	Same as step 1.	Set AM signal generator (modulated) to 24.5 mc.	Adjust TC9 for maximum indication on oscilloscope.
3	Same as step 2.	Same as step 1.	Set AM signal generator (modulated) to 25 mc.	Adjust TC7 for maximum indication on oscilloscope.
4	Connect output of AM signal generator through i-f jig to grid (pin 1) of 2nd video-i-f tube.	Same as step 1.	Set AM signal generator (modulated) to 26.6 mc.	Adjust TC6 for maximum indication on oscilloscope.
5	Connect output of AM signal generator through i-f jig to grid (pin 1) of 1st video-i-f tube.	Same as step 1.	Set AM signal generator (modulated) to 23.25 mc.	Adjust TC5 for maximum indication on oscilloscope.
6	Connect output of AM signal generator through mixer jig to grid (pin 5) of mixer tube.	Same as step 1.	Set AM signal generator (modulated) to 28.1 mc. (See Note 1.)	Adjust TC3 for minimum indication on oscilloscope.
7	Same as step 6.	Same as step 1.	Set AM signal generator (modulated) to 22.1 mc. (See Note 1.)	Adjust TC11 for minimum indication on oscilloscope. If no minimum is apparent, turn TC11 counterclockwise until the response increases rapidly. Turn TC11 clockwise to the point just before the response increases; then adjust TC8 for minimum indication on oscilloscope.
8	Same as step 6.	Same as step 1.	Set AM signal generator (modulated) to 24.25 mc.	Adjust TC2 for maximum indication on oscilloscope.

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TELEVISION I-F ALIGNMENT (Cont.)

STEP	SIGNAL-GENERATOR CONNECTION	OUTPUT-INDICATOR CONNECTION	SIGNAL-GENERATOR SETTING	ADJUSTMENT INSTRUCTIONS
9	Connect outputs of AM and FM signal generators through mixer jig to grid (pin 5) of mixer tube.	Same as step 1.	Set FM signal generator to 25 mc., ±4-mc. deviation. Set AM signal generator (unmodulated) to 23.25 mc., 23.5 mc., 25.75 mc., and 26.6 mc., as required to produce marker pips.	Adjust TC4 for response curve within limits of curve in figure 4. It may be necessary to readjust TC2, TC4, TC5, TC6, TC7, TC9, and TC10 in order to obtain this curve. (See Note 2.)
10	Same as step 9.	Connect vertical input of oscilloscope to pin 1 of FM TEST jack J3.	Set FM signal generator to 22.1 mc., ±1-mc. deviation. Set AM signal generator (modulated) to 22.1 mc.	Adjust C21A and C21B slightly counterclockwise until indication is observed on oscilloscope.
11	Same as step 9.	Same as step 10.	Same as step 10.	Adjust TC13 for minimum amount of AM indication. (See Note 3.) Adjust TC12 for symmetrical pattern (equal peaks) within limits of curve in figure 5.
12	Connect output of FM signal generator through mixer jig to grid (pin 5) of mixer tube.	Same as step 10.	Set FM signal generator to 22.1 mc., ±1-mc. deviation.	Adjust C21A and C21B for maximum peaks and symmetry of pattern.
13	Connect output of AM signal generator through mixer jig to grid (pin 5) of mixer tube.	Connect vertical input of oscilloscope through ALIGN TEST jack adapter (figure 2) to ALIGN TEST jack J5. Connect v.t.v.m. (0—10-volt range) through FM TEST jack adapter (figure 3) to FM TEST jack J3.	Set AM signal generator (modulated) to 22.1 mc. (minimum indication on oscilloscope).	When indication on oscilloscope is minimum, v-t-v-m reading should be zero. If reading is not zero, adjust TC12. If adjustment requires more than one half turn, repeat step 11.

NOTE 1: When adjusting TC3, TC11, and TC8, the vertical gain of the oscilloscope should be high and the input signal should be as weak as possible.

NOTE 2: If readjustment of the tuning cores is necessary to obtain a response curve within the limits of figure 4, the following information may be used to find the adjustment required:

- TC2 affects the low-frequency slope.
- TC4 affects the high-frequency slope.
- TC5 affects the amplitude and low-frequency slope.
- TC6 affects the bandwidth and carrier position.
- TC7 affects the amplitude of the high-frequency slope.
- TC9 affects the flat-top response.
- TC10 affects the high-frequency slope.
- TC3, TC11, and TC8 should not be readjusted.

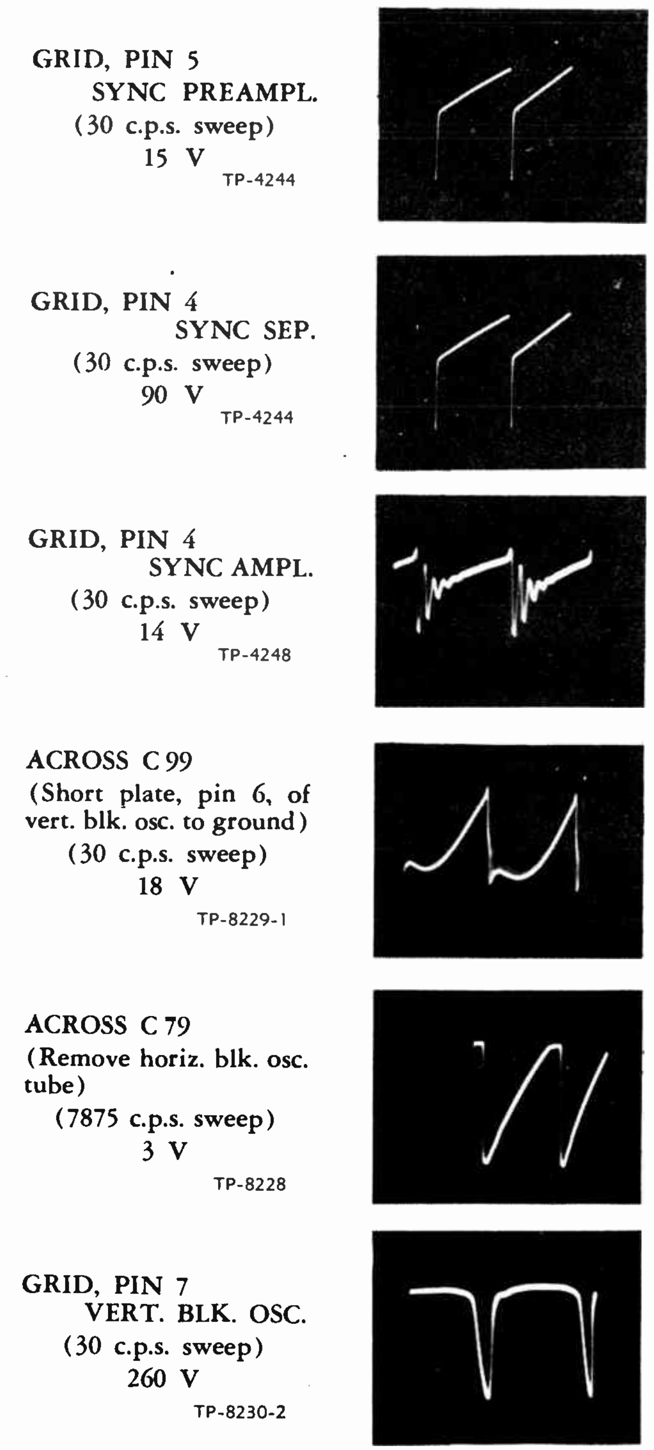
NOTE 3: The AM signal will appear as a series of sine waves superimposed on the FM-detector curve.

WAVEFORMS OF SYNC AND SWEEP CIRCUITS

The waveforms in figure 7 are sized for clarity, and are not intended to illustrate relative amplitudes. Approximate peak-to-peak voltages are given under the waveforms in each case. These voltages are the approximate values when the CONTRAST control is adjusted to give 30 volts, peak-to-peak, at the grid of the picture tube, and when all other controls are in their normal positions.

For viewing waveforms in the vertical sync and sweep circuits, adjust the oscilloscope sweep to 30 c.p.s. (one-half the vertical-sweep rate).

For viewing waveforms in the horizontal sync and sweep circuits, adjust the oscilloscope sweep to 7875 c.p.s. (one-half the horizontal sweep rate).



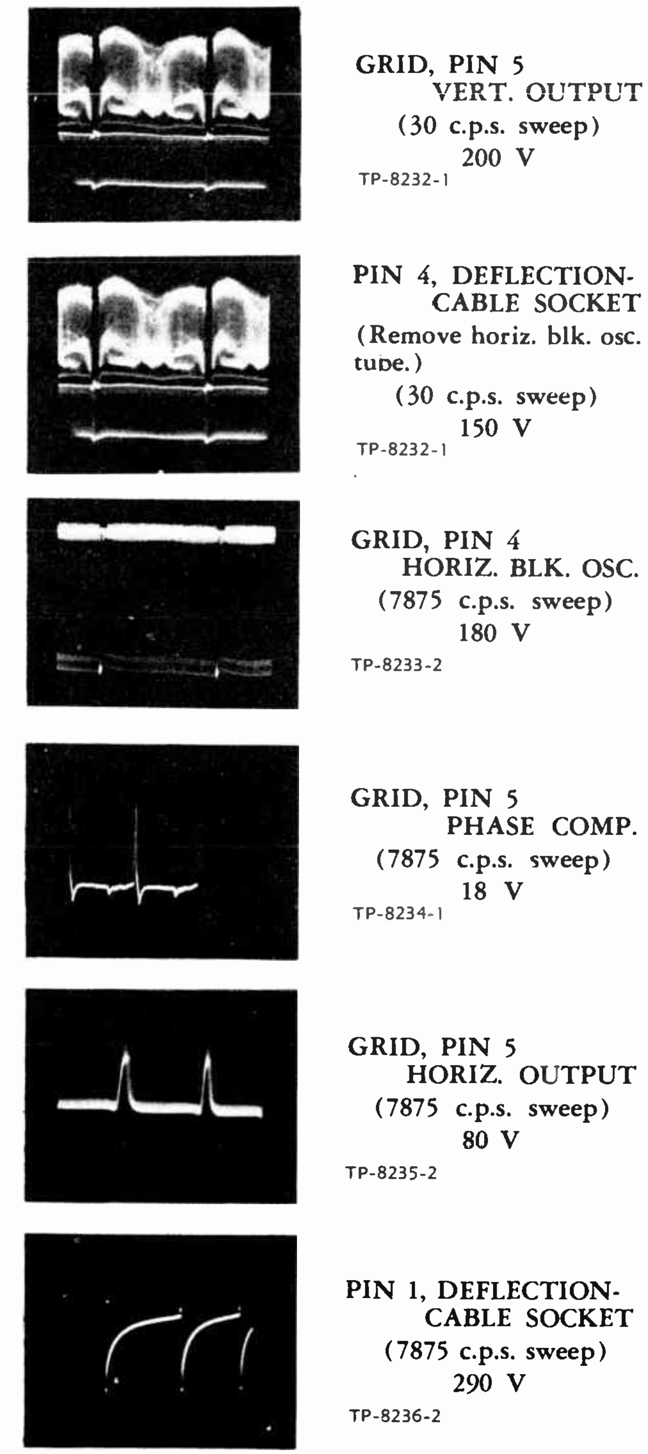


Figure 7. Sync and Sweep Waveforms

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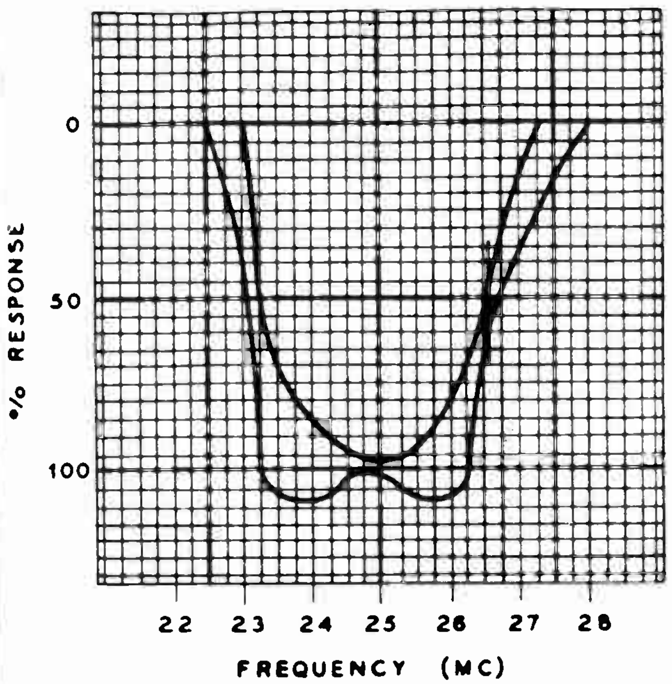


Figure 4. Over-all Video-I-F Response Curve

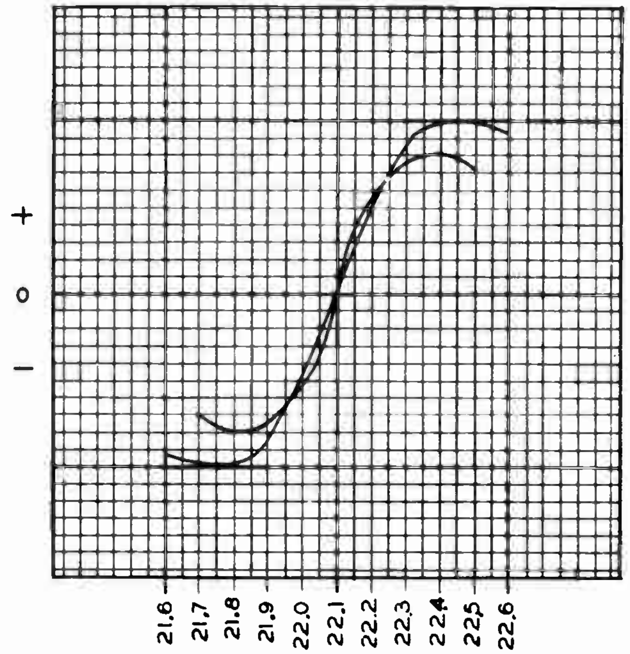
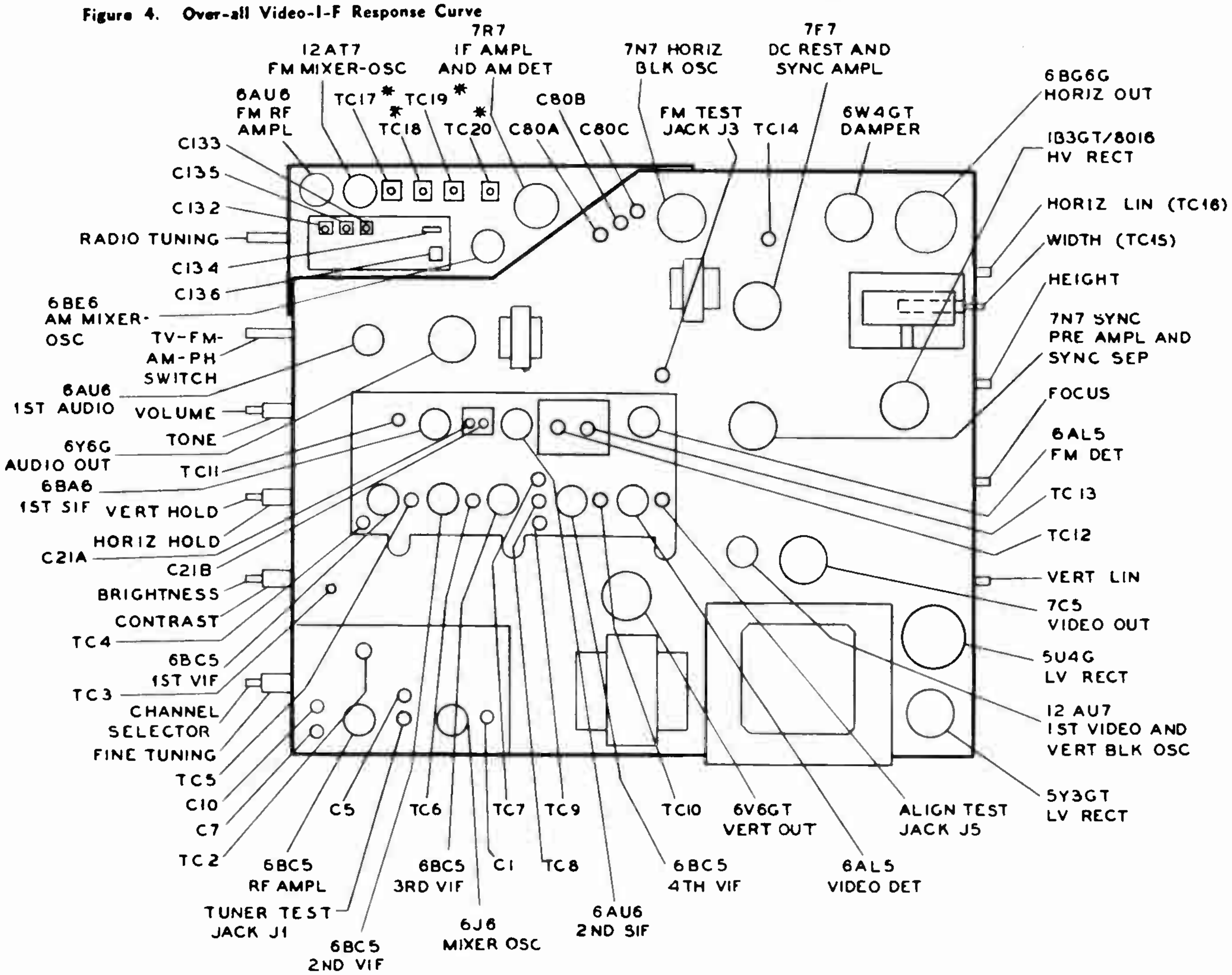


Figure 5. FM-Detector Curve



* TC17, TC18, TC19 AND TC20 CONSIST OF TWO TUNING CORES EACH. ADJUSTMENTS SHOULD BE MADE FROM BOTH TOP AND BOTTOM OF CHASSIS.

Figure 6. Tuning Core, Trimmer, and Tube Locations

RADIO ALIGNMENT

GENERAL

The television section should be properly aligned before the radio alignment is made. When complete AM and FM alignment of the radio is necessary, the AM section should be aligned first. If AM alignment is not required, FM alignment alone may be made after the television-i-f stages have been aligned.

Before starting the radio alignment, allow the receiver and test equipment to warm up for 15 minutes.

TEST EQUIPMENT REQUIRED FOR RADIO ALIGNMENT

The following equipment is recommended for aligning the AM-FM radio section:

1. Philco Precision Visual Alignment Generator, Model 7008, or equivalent equipment.

2. A vacuum-tube voltmeter or a 20,000-ohms-per-volt voltmeter.

RADIO ALIGNMENT PROCEDURE

Before proceeding with the radio alignment, the following preliminary instructions should be observed.

1. Insert a .1-µf. condenser in series with the signal-generator lead.

2. Preset the VOLUME control fully clockwise. Set switch WS1 to AM during AM-radio alignment, and to FM during FM-radio alignment.

3. During alignment of the AM radio, attenuate the signal generator to keep the output indication below 5.0 volts, peak-to-peak. During alignment of the FM radio, attenuate the signal generator to keep the output at the FM TEST jack below .5 volt, peak-to-peak.

4. For radio alignment use a non-metallic alignment tool.

The radio section should be aligned according to the instructions given in the AM-RADIO ALIGNMENT CHART and the FM-RADIO ALIGNMENT CHART.

AM-RADIO ALIGNMENT CHART

STEP	SIGNAL-GENERATOR CONNECTION	OUTPUT-INDICATOR CONNECTION	SIGNAL-GENERATOR SETTING	RADIO-DIAL SETTING	ADJUSTMENT INSTRUCTIONS
1	Connect AM signal generator through .1-µf. condenser to grid (pin 1) of AM mixer tube.	Connect vertical input of oscilloscope to widely spaced terminals of speaker socket J4.	Set AM signal generator (modulated) to 455 kc.	540 kc.	Adjust TC20* and TC18* for maximum indication on oscilloscope.
2	Connect AM signal generator through .1-µf. condenser to primary winding of T7.	Same as step 1.	Set AM signal generator (modulated) to 1620 kc.	1620 kc. (See figure 9.)	Adjust C136 for maximum indication on oscilloscope.
3	Same as step 2. (See Note below.)	Same as step 1.	Set AM signal generator (modulated) to 1500 kc.	Tune receiver to signal.	Adjust C135 for maximum indication on oscilloscope.

NOTE: The final adjustment of C135 should be made with the chassis in the cabinet and the loop connected. The signal from the signal generator should be coupled by means of a radiating loop. This radiating loop should be made up of six to eight turns of insulated wire in approximately a 6-inch-diameter loop. Connect the signal-generator output to the loop and place this loop near the receiver loop.

* TC18 and TC20 consist of two tuning cores each. Make adjustments from both top and bottom of chassis.

FM-RADIO ALIGNMENT CHART

STEP	SIGNAL-GENERATOR CONNECTION	OUTPUT-INDICATOR CONNECTION	SIGNAL-GENERATOR SETTING	RADIO-DIAL SETTING	ADJUSTMENT INSTRUCTIONS
1	Connect FM signal generator through .1-µf. condenser across C105B.	Connect vertical input of oscilloscope to pin 1 of FM TEST jack J3.	Set FM signal generator to 22.1 mc., ± 1-mc. deviation.	Gang fully closed.	Adjust TC19* and TC17* for maximum peaks and symmetry of pattern.
2	Connect FM signal generator through .1-µf. condenser to aerial input terminals of TB1.	Same as step 1.	Set FM signal generator to 105 mc., ± 1-mc. deviation.	105 mc. (See figure 9.)	Adjust C133, C132, and C134 for maximum peaks and symmetry of pattern.

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FM-RADIO ALIGNMENT CHART (Cont.)

STEP	SIGNAL-GENERATOR CONNECTION	OUTPUT-INDICATOR CONNECTION	SIGNAL-GENERATOR SETTING	RADIO-DIAL SETTING	ADJUSTMENT INSTRUCTIONS
3	Same as step 2.	Same as step 1.	Set FM signal generator for 92 mc., ± 1-mc. deviation.	92 mc. (See figure 9.)	Check resonance of L48, L47, and L45 by placing each end of a tuning core, such as Philco Part No. 56-6100, near the coils. If the output increases when the iron end is placed near the coil, compress the turns slightly. If the output increases when the brass end is placed near the coil, spread the turns slightly. If output decreases when either end is placed near the coil, no adjustment is necessary.
4	Repeat steps 2 and 3 until no further improvement is obtained.				

* TC17 and TC19 consist of two tuning cores each. Make adjustments from both top and bottom of chassis.

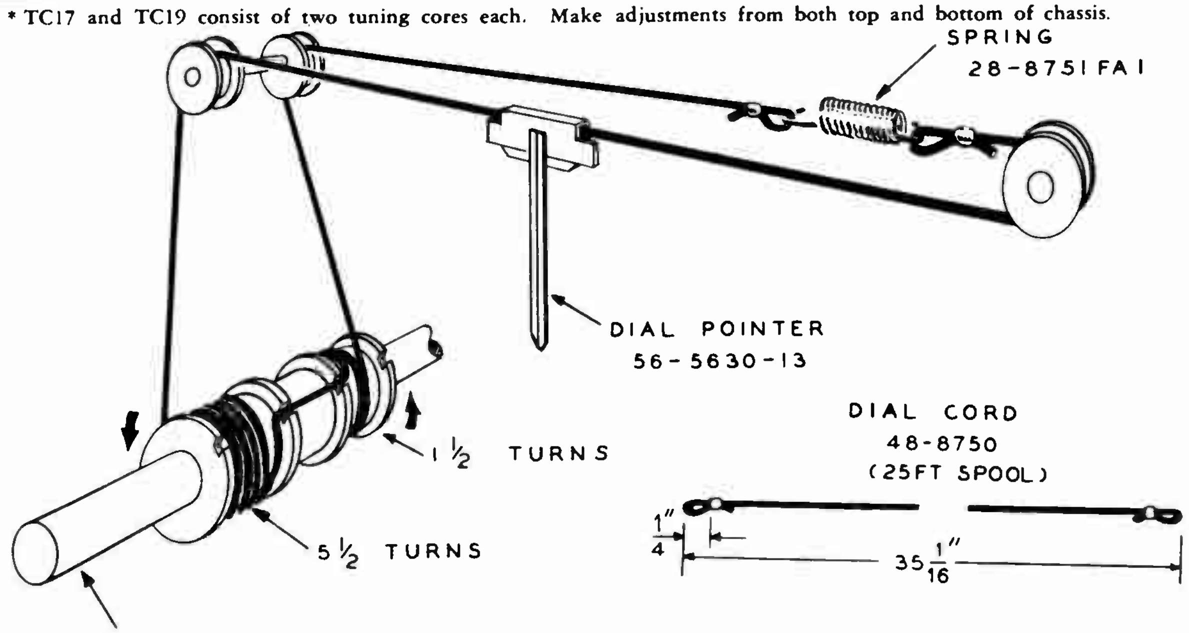

Figure 8. Drive-Cord Installation Details

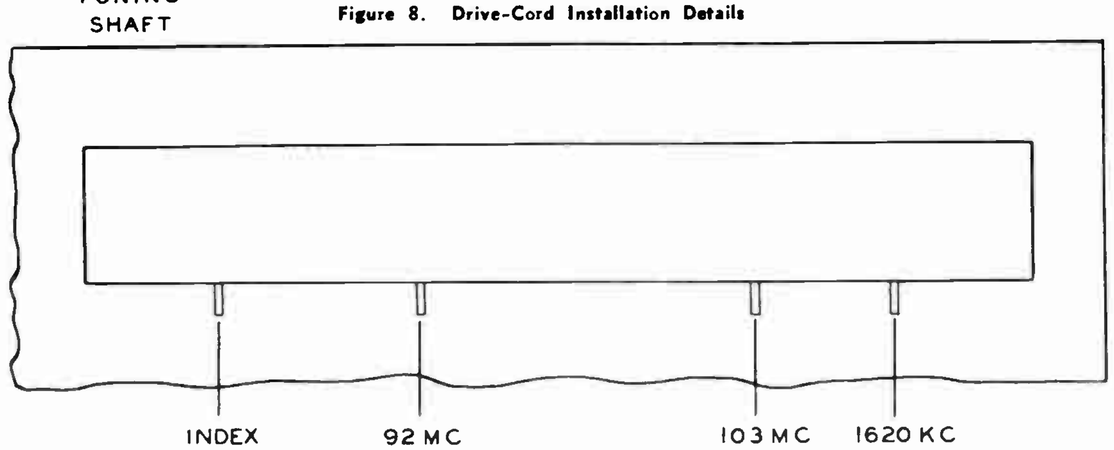

Figure 9. Dial-Scale Calibration

REPLACEMENT PARTS LIST

NOTE: Part numbers marked with an asterisk (*) are general replacement items. These numbers may not be identical with those on factory assemblies; also, the electrical values of some replacement items may differ from the values indicated in the schematic diagram and parts list. The values substituted in any case are so chosen that the operation will be either unchanged or improved. When ordering replacements, use only the "Service Part No."

Reference Symbol	Description	Service Part No.
AD1	Aerial, broad-band dipole, foil (2 used)	56-7635
BB1	Beam bender, permanent magnet	76-3913-4
C1	Condenser, aerial trimmer, .5 to 3 μμf.	Part of 76-5411-3
C2	Condenser, fixed padder, 5 μμf.	30-1224-5
C3	Condenser, r-f by-pass, .001 μf.	45-3505-52*
C4	Condenser, r-f by-pass, 120 μμf.	60-10125237*
C5	Condenser, r-f plate trimmer, .5 to 3 μμf.	Part of 76-5411-3
C6	Condenser, d-c blocking, 100 μμf.	62-215001011*
C7	Condenser, mixer grid trimmer, .5 to 3 μμf.	Part of 76-5411-3
C8	Condenser, d-c blocking, 20 μμf.	60-00205307*
C9	Condenser, fixed trimmer, 10 μμf.	62-010009001*
C10	Condenser, oscillator trimmer, .5 to 3 μμf.	Part of 76-5411-3
C11	Condenser, fine tuning	Part of 76-5411-3
C12	Condenser, r-f by-pass, .001 μf.	45-3505-52*
C13	Condenser, fixed trimmer, 10 μμf.	62-010009001*
C14	Condenser, r-f by-pass, .001 μf.	45-3505-52*
C15	Condenser, d-c blocking, 120 μμf.	60-10125237*
C16	Condenser, fixed trimmer, 51 μμf.	30-1224-62*
C17	Condenser, fixed trimmer, 51 μμf.	30-1224-62*
C18	Condenser, d-c blocking, .01 μf.	45-3505-41*
C19	Condenser, fixed trimmer, 56 μμf.	62-056409001*
C20	Condenser, cathode by-pass, 470 μμf.	62-147001001*
C21A	Condenser, trimmer	Part of Z3
C21B	Condenser, trimmer	Part of Z3
C22	Condenser, r-f by-pass, 1500 μμf.	62-215001011*
C23	Condenser, d-c blocking, 56 μμf.	62-056409001*
C24	Condenser, r-f by-pass, 1500 μμf.	62-215001011*
C25	Condenser, r-f by-pass, 1500 μμf.	62-215001011*
C26	Condenser, fixed trimmer, 18 μμf.	62-018300001*
C27	Condenser, r-f by-pass, 100 μμf.	62-110009001*
C28	Condenser, r-f by-pass, 1500 μμf.	62-215001011*
C29	Condenser, filter, 2 μf., 50v	30-2417-7
C30	Condenser, d-c blocking, .0033 μf.	45-3505-55*
C31	Condenser, r-f by-pass, 47 μμf.	30-1224-2*
C32	Condenser, tone compensation, 47 μμf.	30-1224-2*
C33	Condenser, tone compensation, .0068 μf.	45-3505-57*
C34	Condenser, d-c blocking, .047 μf.	45-3505-62*
C35	Condenser, screen by-pass, .22 μf.	45-3505-49*
C36	Condenser, tone compensation, .0068 μf.	45-3505-57*
C37	Condenser, d-c blocking, .047 μf.	45-3505-62*
C38	Condenser, 3-section filter	30-2570-16
C38A	Condenser, screen by-pass, 10 μf., 450v	Part of C38
C38B	Condenser, cathode by-pass, 40 μf., 50v	Part of C38
C38C	Condenser, filter, 10 μf., 450v	Part of C38
C39	Condenser, tone compensation, .015 μf.	45-3505-93*
C40	Condenser, a-v-c by-pass, 1500 μμf.	62-215001011*
C41	Condenser, r-f by-pass, 1500 μμf.	62-215001011*
C42	Condenser, r-f by-pass, 1500 μμf.	62-215001011*
C43	Condenser, r-f by-pass, 1500 μμf.	62-215001011*
C44	Condenser, d-c blocking, 470 μμf.	62-147001001*
C45	Condenser, a-v-c by-pass, 1500 μμf.	62-215001011*
C46	Condenser, r-f by-pass, 1500 μμf.	62-215001011*
C47	Condenser, r-f by-pass, 10 μμf.	62-010409001*
C48	Condenser, d-c blocking, 470 μμf.	62-147001001*
C49	Condenser, a-v-c by-pass, 1500 μμf.	62-215001011*
C50	Condenser, r-f by-pass, 1500 μμf.	62-215001011*
C51	Condenser, d-c blocking, 470 μμf.	62-147001001*
C52	Condenser, fixed trimmer, 51 μμf.	30-1224-2*
C53	Condenser, fixed trimmer, 51 μμf.	30-1224-2*
C54	Condenser, r-f by-pass, 10 μμf.	62-010409001*
C55	Condenser, cathode by-pass, 1500 μμf.	62-215001011*
C56	Condenser, r-f by-pass, 1500 μμf.	62-215001011*
C57	Condenser, d-c blocking, 470 μμf.	62-147001001*
C58	Condenser, d-c blocking, 100 μμf.	62-110009001*
C59	Condenser, a-v-c by-pass, 1500 μμf.	62-215001011*
C60	Condenser, r-f by-pass, 1500 μμf.	62-215001011*
C61	Condenser, r-f by-pass, 10 μμf.	62-010409001*
C62	Condenser, d-c blocking, .047 μf.	45-3505-45*
C63	Condenser, r-f by-pass, 1500 μμf.	62-215001011*
C64	Condenser, d-c blocking, .22 μf.	45-3505-49*
C65	Condenser, 4-section filter	30-2570-10
C65A	Condenser, l-f compensation, 10 μf., 475v	Part of C65
C65B	Condenser, decoupling, 10 μf., 475v	Part of C65
C65C	Condenser, decoupling, 10 μf., 475v	Part of C65
C65D	Condenser, decoupling, 10 μf., 475v	Part of C65
C66	Condenser, cathode by-pass, .5 μf.	45-3500-4*
C67	Condenser, 3-section filter	30-2570-16
C67A	Condenser, screen by-pass, 10 μf., 475v	Part of C67
C67B	Condenser, l-f compensation, 10 μf., 475v	Part of C67
C68	Condenser, d-c blocking, .047 μf.	45-3505-62*
C69	Condenser, d-c blocking, 680 μμf.	60-10685401*
C70	Condenser, line filter, .01 μf.	45-3505-58*
C71	Condenser, line filter, .01 μf.	45-3505-58*
C72	Condenser, input filter, 30 μf., 475v	30-2568-19
C73	Condenser, input filter, 30 μf., 475v	30-2568-19
C74	Condenser, 4-section filter	30-2570-8
C74A	Condenser, filter, 40 μf., 475v	Part of C74
C74B	Condenser, filter, 10 μf., 475v	Part of C74
C74C	Condenser, filter, 20 μf., 475v	Part of C74
C74D	Condenser, cathode by-pass, 10 μf.	Part of C74
C75	Condenser, bias filter, .1 μf.	45-3505-47*
C76	Condenser, video filter, 220 μμf.	62-122001001*
C77	Condenser, d-c blocking, .047 μf.	45-3505-62*
C78	Condenser, d-c blocking, 150 μμf.	60-10155407*
C79	Condenser, voltage divider, 180 μμf.	30-1220-30*
C80	Condenser, 3-section trimmer	31-6477-2
C80A	Condenser, lock-in trimmer	Part of C80
C80B	Condenser, horizontal-oscillator-range trimmer	Part of C80
C80C	Condenser, drive trimmer	Part of C80
C81	Condenser, d-c blocking, .0022 μf.	45-3505-54*
C82	Condenser, cathode by-pass, .022 μf.	45-3505-43*
C83	Condenser, filter, .22 μf.	45-3505-49*
C84	Condenser, plate by-pass, .047 μf.	45-3505-45*
C85	Condenser, d-c blocking, 270 μμf.	60-10275407*
C86	Condenser, sweep charging, 1500 μμf.	62-215001011*
C87	Condenser, d-c blocking, 390 μμf.	60-10395407*
C88	Condenser, screen by-pass, .047 μf.	45-3505-62*
C89	Condenser, horizontal shaping, .047 μf.	45-3505-62*
C90	Condenser, horizontal shaping, .082 μf.	61-0174*
C91	Condenser, d-c blocking, .15 μf.	45-3505-31*
C92	Condenser, high-voltage filter, 500 μμf.	30-1229-2*
C93	Condenser, d-c blocking, .047 μf.	45-3505-62*
C94	Condenser, d-c blocking, 330 μμf.	62-133001001*
C95	Condenser, d-c blocking, .0047 μf.	45-3505-56*
C96	Condenser, video filter, 22 μμf.	62-022009001*
C97	Condenser, integrating, .0022 μf.	45-3505-54*
C98	Condenser, integrating, .0047 μf.	45-3505-56*
C99	Condenser, integrating, .0047 μf.	45-3505-56*
C100	Condenser, a-v-c filter, 10 μf.	30-2417-1
C101	Condenser, d-c blocking, .015 μf.	45-3505-42*
C102	Condenser, sweep charging, .047 μf.	45-3505-62*
C103	Condenser, d-c blocking, .1 μf.	45-3505-47*
C104	Condenser, a-v-c filter, .05 μf.	61-0170*
C105	Condenser, 5-section tuning condenser	31-2743
C105A	Condenser, FM aerial tuning	Part of C105
C105B	Condenser, FM mixer tuning	Part of C105
C105C	Condenser, FM oscillator tuning	Part of C105
C105D	Condenser, AM aerial tuning	Part of C105
C105E	Condenser, AM oscillator tuning	Part of C105
C106	Condenser, d-c blocking, 100 μμf.	62-110009001*
C107	Condenser, r-f by-pass, 220 μμf.	62-122001001*

MODELS 50-T1477, 50-T1478, 50-T1479, 50-T1481, 50-T1482

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RECORD CHANGER: Model M-20, Pages RCD.CH.20-1 through RCD.CH.20-16.

MODELS 50-T1477, 50-T1478, 50-T1479, 50-T1481, 50-T1482

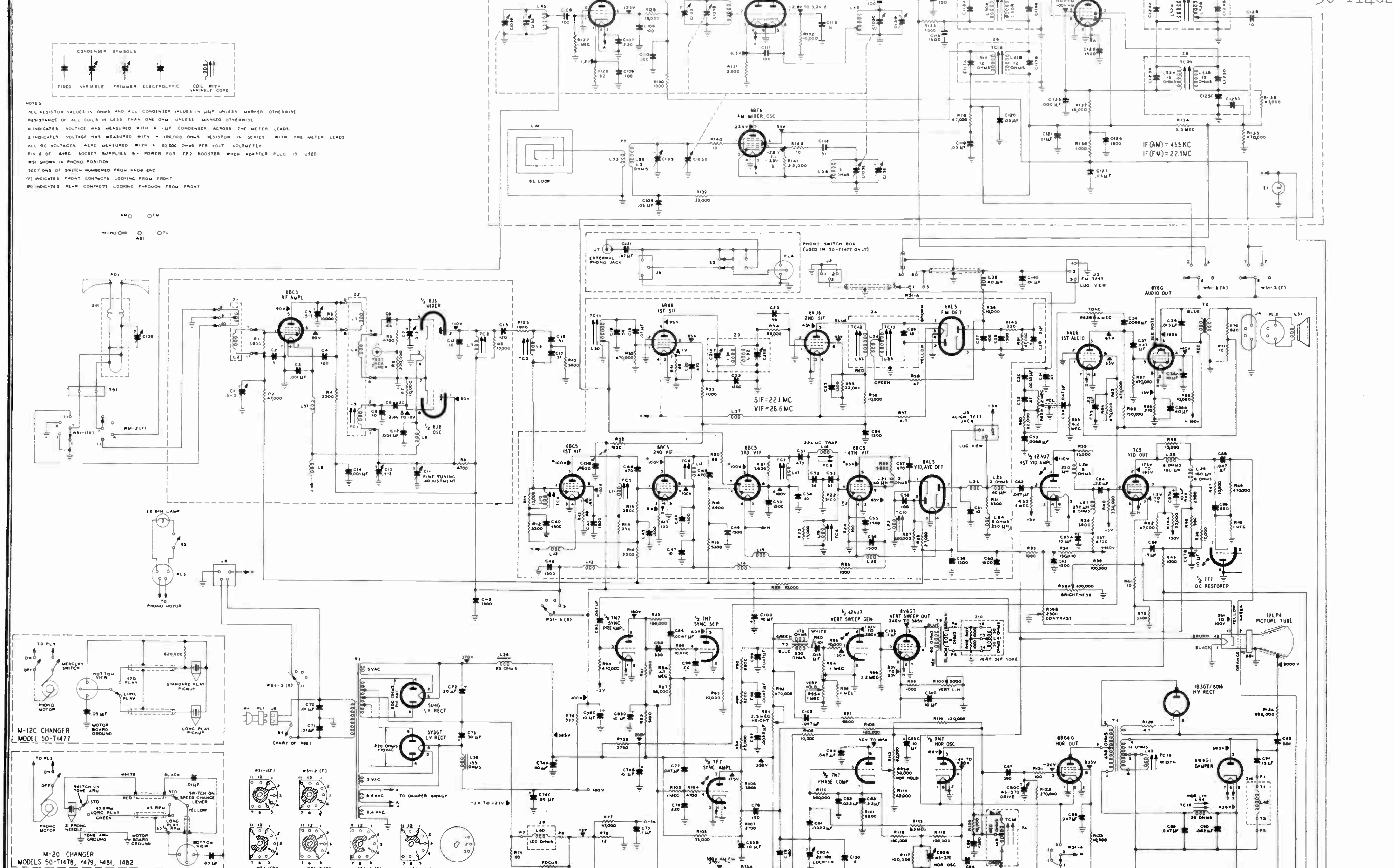

Figure 10. Philco Television-Radio-Phonograph Models 50-T1477, 50-T1478, 50-T1479, 50-T1481, and 50-T1482, Schematic Diagram

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REPLACEMENT PARTS LIST (Cont.)

Reference Symbol	Description	Service Part No.
C108	Condenser, cathode by-pass, 100 μμf.	62-110009001*
C109	Condenser, screen by-pass, 100 μμf.	62-110009001*
C110	Condenser, r-f by-pass, 100 μμf.	62-110009001*
C111	Condenser, FM oscillator injection, 100 μμf.	62-110009001*
C112	Condenser, r-f by-pass, 51 μμf.	30-1224-2*
C113	Condenser, d-c blocking, 100 μμf.	62-110009001*
C114	Condenser, r-f by-pass, 100 μμf.	62-110009001*
C115	Condenser, r-f by-pass, 1500 μμf.	62-215001011*
C116A	Condenser, fixed trimmer	Part of Z5
C116B	Condenser, fixed trimmer	Part of Z5
C117A	Condenser, fixed trimmer	Part of Z6
C117B	Condenser, fixed trimmer	Part of Z6
C118	Condenser, d-c blocking, 51 μμf.	30-1224-2*
C119	Condenser, screen by-pass, .05 μf.	61-0170*
C120	Condenser, r-f by-pass, .05 μf.	61-0170*
C121	Condenser, a-v-c filter, .01 μf.	45-3505-41*
C122	Condenser, r-f by-pass, 1500 μμf.	62-215001011*
C123	Condenser, screen by-pass, .006 μf.	45-3500-7*
C124A	Condenser, fixed trimmer	Part of Z7
C124B	Condenser, fixed trimmer	Part of Z7
C125A	Condenser, fixed trimmer	Part of Z8
C125B	Condenser, fixed trimmer	Part of Z8
C125C	Condenser, r-f by-pass	Part of Z8
C125D	Condenser, r-f by-pass	Part of Z8
C126	Condenser, r-f by-pass, 1500 μμf.	60-215001011*
C127	Condenser, r-f by-pass, .05 μf.	61-0170*
C128	Condenser, d-c blocking, 10 μμf.	62-010009011*
C129	Condenser, AERIAL TUNING	31-6518
C130	Condenser, horizontal-sweep feedback, 5 μμf.	60-90505007*
C131	Condenser, blocking, .47 μf. (49-1477)	45-3500-4
C132	Condenser, FM aerial trimmer	Part of C105
C133	Condenser, FM mixer trimmer	Part of C105
C134	Condenser, FM oscillator trimmer	31-6511
C135	Condenser, AM aerial trimmer	Part of C105
C136	Condenser, AM oscillator trimmer	Part of C105
C137	Condenser, d-c blocking, 100 μμf.	62-110009001*
C138	Condenser, r-f by-pass, 1500 μμf.	60-215001011*
C139	Condenser, r-f by-pass, 1500 μμf.	60-215001011*
C140	Condenser, audio developing, .01 μf.	45-3505-41*
F1	Fuse, B-plus protective, ¼ ampere	45-2656-8
I1	Lamp, dial	34-2039
I2	Lamp, bin	27-6233-47
J1	Socket, TUNER TEST	Part of 76-5411-3
J2	Socket, PHONO	27-6126
J3	Jack, FM TEST	27-6126
J4	Socket, speaker	27-6214-1
J5	Jack, ALIGN TEST	27-6126
J6	Socket, bin lamp and phono motor power (50-T1478, 50-T1479, 50-T1481, 50-T1482)	27-6233-47
J7	Jack, external phono (50-T1477)	27-6186
J8	Jack, M-12C phono (50-T1477)	27-6126
J9	Socket, a-c interlock	27-6240
L1	Coil, aerial input	Part of Z1
L2	Coil, r-f grid	Part of Z1
L3	Coil, r-f plate	Part of Z2
L4	Coil, mixer grid	Part of Z2
L5	Coil, oscillator	Part of Z2
L6	Coil, r-f choke	Part of 76-5411-3
L7	Coil, mixer plate tank	Part of 76-5411-3
L8	Coil, r-f choke	32-4112-11
L9	Coil, adjacent sound trap	32-4234-8
L10	Coil, 1st v-i-f grid tank	32-4233-4
L11	Coil, 1st v-i-f plate tank	32-4359
L12	Coil, r-f choke	32-4112-11
L13	Coil, r-f choke	32-4112-11
L14	Coil, r-f choke	32-4112-11
L15	Coil, r-f choke	32-4112-11
L16	Coil, 2nd v-i-f plate tank	32-4359
L17	Coil, 3rd v-i-f plate tank	32-4234-1
L18	Coil, accompanying sound trap	32-4233-7
L19	Coil, 4th v-i-f grid tank	32-4233-2
L20	Coil, r-f choke	32-4112-11
L21	Coil, r-f choke	32-4112-11

Reference Symbol	Description	Service Part No.
L22	Coil, 4th v-i-f tank	32-4234-1
L23	Coil, r-f choke	32-4112-11
L24	Coil, shunt peaking, 250 microhenries	32-4143-7
L25	Coil, series peaking, 40 microhenries	32-4143-1
L26	Coil, series peaking, 250 microhenries	32-4143-7
L27	Coil, shunt peaking, 250 microhenries	32-4143-7
L28	Coil, series peaking, 180 microhenries	32-4143-5
L29	Coil, shunt peaking, 180 microhenries	32-4143-5
L30	Coil, 1st sound autotransformer	32-4303
L31	Coil, 2nd sound primary	Part of Z3
L32	Coil, 2nd sound secondary	Part of Z3
L33	Coil, FM-detector primary	Part of Z4
L34	Coil, FM-detector tertiary	Part of Z4
L35	Coil, FM detector secondary	Part of Z4
L36	Coil, isolating, 40 microhenries	32-4143-1
L37	Coil, r-f choke	32-4112-11
L38	Coil, filter choke	32-8399
L39	Coil, filter choke	32-8355-1
L40	Coil, focus	Part of Z9
L41	Coil, vertical deflection	Part of Z10
L42	Coil, horizontal deflection	Part of Z10
L43	Coil, width	32-4419
L44	Coil, HORIZ. LIN.	32-4211-1
L45	Coil, FM aerial	32-4382
L46	Coil, r-f choke	32-4112-11
L47	Coil, FM-mixer grid tank	32-4383
L48	Coil, FM oscillator	32-4384
L49	Coil, r-f choke	32-4061-2
L50A	Coil, 1st FM i-f primary	Part of Z5
L50B	Coil, 1st FM i-f secondary	Part of Z5
L51A	Coil, 1st AM i-f primary	Part of Z6
L51B	Coil, 1st AM i-f secondary	Part of Z6
L52A	Coil, 2nd FM i-f primary	Part of Z7
L52B	Coil, 2nd FM i-f secondary	Part of Z7
L53A	Coil, 2nd AM i-f primary	Part of Z8
L53B	Coil, 2nd AM i-f secondary	Part of Z8
L54	Coil, AM oscillator	32-4153-2
L55	Coil, AM-aerial primary	Part of T7
L56	Coil, AM-aerial secondary	Part of T7
L57	Coil, r-f choke	32-4112-11
LA1	Loop, AM aerial (50-T1477)	32-4394-7
LA1	Loop, AM aerial (50-T1478, 50-T1479, 50-T1481, 50-T1482)	32-4394-6
LS1	Speaker, p.m., 10-inch	36-1610-5
PL1	Plug, a-c interlock	Part of W1
PL2	Plug, speaker	27-4788
PL3	Plug, bin-lamp and phono-motor power (50-T1478, 50-T1479, 50-T1481, 50-T1482)	27-4785-10
PL4	Plug and cable assembly, phono-switch box (50-T1477)	41-3868-5
R1	Resistor, aerial damping, 3900 ohms	66-2398340*
R2	Resistor, a-v-c decoupling, 47,000 ohms	66-3478340*
R3	Resistor, damping, 10,000 ohms	66-3108340*
R4	Resistor, decoupling, 2200 ohms	66-2228340*
R5	Resistor, grid return, 4700 ohms	66-2478340*
R6	Resistor, grid return, 220,000 ohms	66-4228340*
R7	Resistor, grid bias, 10,000 ohms	66-3108340*
R8	Resistor, plate feed, 4700 ohms	66-2478340*
R9	Resistor, damping, 15,000 ohms	66-3158340*
R10	Resistor, terminating, 5600 ohms	66-2568340*
R11	Resistor, damping, 15,000 ohms	66-3158340*
R12	Resistor, a-v-c decoupling, 3300 ohms	66-2338340*
R13	Resistor, cathode bias, 68 ohms	66-0688340*
R14	Resistor, decoupling, 330 ohms	66-1338340*
R15	Resistor, grid return, 5600 ohms	66-2568340*
R16	Resistor, a-v-c decoupling, 3300 ohms	66-2338340*
R17	Resistor, cathode bias, 120 ohms	66-1128340*
R18	Resistor, grid return, 5600 ohms	66-2568340*
R19	Resistor, a-v-c decoupling, 3300 ohms	66-2338340*
R20	Resistor, cathode bias, 68 ohms	66-0688340*
R21	Resistor, damping, 5600 ohms	66-2568340*
R22	Resistor, terminating, 5100 ohms	66-2508340*
R23	Resistor, damping, 15,000 ohms	66-3158340*
R24	Resistor, cathode bias, 100 ohms	66-1108340*
R25	Resistor, decoupling, 1000 ohms	66-2108340*
R26	Resistor, plate feed, 5600 ohms	66-2568340*
R27	Resistor, a-v-c load, 120,000 ohms	66-4128340*

Reference Symbol	Description	Service Part No.
R28	Resistor, r-f filter, 27,000 ohms	66-3278340*
R29	Resistor, a-v-c filter, 10,000 ohms	66-3108340*
R30	Resistor, load, 10,000 ohms	66-3108340*
R31	Resistor, diode load, 3300 ohms	66-2338340*
R32	Resistor, grid return, 1 megohm	66-5108340*
R33	Resistor, decoupling, 1000 ohms	66-2108340*
R34	Resistor, voltage divider, 150,000 ohms	66-4158340*
R35	Resistor, damping, 15,000 ohms	66-3158340*
R36	Resistor, plate load, 3900 ohms	66-2394340*
R37	Resistor, l-f compensation, 4700 ohms	66-2474340
R38	Potentiometer ass'y., dual, 100,000 ohms and 2500 ohms	33-5563-19
R38A	Potentiometer, BRIGHTNESS control, 100,000 ohms	Part of R38
R38B	Potentiometer, CONTRAST control, 2500 ohms	Part of R38
R39	Resistor, limiting, 100,000 ohms	66-4108340*
R40	Resistor, grid return, 330,000 ohms	66-4338340*
R41	Resistor, limiting, 10 ohms	66-0108340*
R42	Resistor, voltage divider, 47,000 ohms	66-3478340*
R43	Resistor, l-f compensation, 1000 ohms	66-2104340*
R44	Resistor, damping, 15,000 ohms	66-3158340*
R45	Resistor, plate load, 2500 ohms	33-1335-87
R46	Resistor, plate load, 560 ohms	66-1565340*
R47	Resistor, isolating, 10,000 ohms	66-3108340*
R48	Resistor, grid return, 470,000 ohms	66-4478340*
R49	Resistor, diode load, 1 megohm	66-5108340*
R50	Resistor, grid return, 470,000 ohms	66-4478340*
R51	Resistor, cathode bias, 68 ohms	66-0688340*
R52	Resistor, decoupling, 330 ohms	66-1334340*
R53	Resistor, dropping, 1000 ohms	66-2104340*
R54	Resistor, grid return, 68,000 ohms	66-3688340*
R55	Resistor, voltage divider, 22,000 ohms	66-3224340*
R56	Resistor, dropping, 10,000 ohms	66-3104340*
R57	Resistor, filament dropping, 4.7 ohms	66-9478340*
R58	Resistor, isolating, 47 ohms	66-0478340*
R59	Resistor, tone compensating, 10,000 ohms	66-3108340*
R60	Resistor, tone compensating, 82,000 ohms	66-3828340*
R61	Resistor, detector load, 47,000 ohms	66-3478340*
R62	Potentiometer and switch assembly, dual, 2 megohms and 4 megohms	33-5563-21
R62A	Potentiometer, VOLUME control, 2 megohms (tapped 1 megohm)	Part of R62
R62B	Potentiometer, TONE control, 4 megohms	Part of R62
R63	Resistor, grid return, 8.2 megohms	66-5828340*
R64	Resistor, voltage divider, 470,000 ohms	66-4474340*
R65	Resistor, screen dropping, 470,000 ohms	66-4474340*
R66	Resistor, plate load, 150,000 ohms	66-4154340*
R67	Resistor, grid return, 470,000 ohms	66-4478340*
R68	Resistor, cathode bias, 270 ohms	66-1275340*
R69	Resistor, screen dropping, 10,000 ohms	66-3108340*
R70	Resistor, voltage divider, 820 ohms	66-1824340*
R71	Resistor, voltgae divider, 10 ohms	66-0104340*
R72	Resistor, bleeder, 3300 ohms	66-2338340*
R73	Resistor, 2-section, 5000 ohms and 2750 ohms	33-3435-25
R73A	Resistor, filter, 5000 ohms	Part of R73
R73B	Resistor, decoupling, 2750 ohms	Part of R73
R74	Resistor, limiting, 65 ohms	33-1335-92
R75	Potentiometer, FOCUS control, 200 ohms	33-5546-13
R76	Resistor, decoupling, 330 ohms	66-1334340*
R77	Resistor, bias filter, 47,000 ohms	66-3478340*
R78	Resistor, bias, 12 ohms	66-0125340*
R79	Resistor, dropping, 47,000 ohms	66-3474340*
R80	Resistor, grid return, 470,000 ohms	66-4478340*
R81	Resistor, plate load, 10,000 ohms	66-3104340*
R82	Resistor, decoupling, 5100 ohms	33-1335-18
R83	Resistor, compensating, 180,000 ohms	66-4188340*
R84	Resistor, grid return, 4.7 megohms	66-5478340*
R85	Resistor, voltage divider, 10,000 ohms	66-3104340*
R86	Resistor, video filter, 10,000 ohms	66-3108340*
R87	Resistor, plate load, 56,000 ohms	66-3564340*
R88	Resistor, integrating, 22,000 ohms	66-3228340*
R89	Resistor, integrating, 8200 ohms	66-2828340*
R90	Resistor, integrating, 8200 ohms	66-2828340*
R91	Potentiometer, HEIGHT control, 2.5 megohms	33-5565-10

Reference Symbol	Description	Service Part No.
R92	Resistor, sweep charging, 470,000 ohms	66-4474340*
R93	Resistor, limiting, 10,000 ohms	66-3108340*
R94	Resistor, limiting, 1 megohm	66-5108340*
R95	Potentiometer ass'y., dual, 1 megohm and 50,000 ohms	33-5563-20
R95A	Potentiometer, VERTICAL HOLD control, 1 megohm	Part of R95
R95B	Potentiometer, HORIZONTAL HOLD control, 50,000 ohms	Part of R95
R96	Resistor, shunt, 1 megohm	66-5108340*
R97	Resistor, sweep shaping, 6800 ohms	66-2688340*
R98	Resistor, grid return, 2.2 megohms	66-5228340*
R99	Resistor, limiting, 1000 ohms	66-2104340*
R100	Potentiometer, VERTICAL LIN. control, 5000 ohms	33-5546-10
R101	Resistor, damping, 1000 ohms	66-2108340*
R102	Resistor, damping, 1000 ohms	66-2108340*
R103	Resistor, grid return, 1 megohm	66-5108340*
R104	Resistor, video filter, 4700 ohms	66-2478340*
R105	Resistor, decoupling, 33,000 ohms	66-3334340*
R106	Resistor, plate load, 3900 ohms	66-2394340*
R107	Resistor, plate load, 2700 ohms	66-2274340*
R108	Resistor, decoupling, 10,000 ohms	66-3104340*
R109	Resistor, horizontal-sweep feedback, 120,000 ohms	66-4124340*
R110	Resistor, grid return, 560,000 ohms	66-4568340*
R111	Resistor, filter, 8200 ohms	66-2828340*
R112	Resistor, horizontal-sweep feedback, 560,000 ohms	66-4568340*
R113	Resistor, voltage divider, 82,000 ohms	66-3824340
R114	Resistor, temperature compensating, 42,000 ohms	33-1343-2
R115	Resistor, filter, 3.3 megohms	66-5338340*
R116	Resistor, filter, 180,000 ohms	66-4188340*
R117	Resistor, cathode return, 100,000 ohms	66-4108340*
R118	Resistor, grid return, 100,000 ohms	66-4108340*
R119	Resistor, horizontal-sweep charging, 120,000 ohms	66-4124340*
R120	Resistor, damping, 10,000 ohms	66-3108340*
R121	Resistor suppressor, 100 ohms	66-1108340*
R122	Resistor, grid return, 270,000 ohms	66-4278340*
R123	Resistor, screen dropping, 10,000 ohms	66-3105340*
R124	Resistor, limiting, 680,000 ohms	66-4684340*
R125	Resistor, grid, 1000- ohms	66-2108340*
R126	Resistor, filament dropping, 4.7 ohms	66-9474360*
R127	Resistor, grid return, 1 megohm	66-5108340*
R128	Resistor, cathode bias, 82 ohms	66-0824340*
R129	Resistor, screen dropping, 18,000 ohms	66-3184340*
R130	Resistor, decoupling, 1000 ohms	66-2104340*
R131	Resistor, cathode bias, 2200 ohms	66-2228340*
R132	Resistor, grid return, 10,000 ohms	66-3108340*
R133	Resistor, decoupling, 1000 ohms	66-2104340*
R134	Resistor, a-v-c filter, 3.3 megohms	66-5338340*
R135	Resistor, a-v-c diode load, 470,000 ohms	66-4478340*
R136	Resistor, r-f filter, 47,000 ohms	66-3478340*
R137	Resistor, dropping, 18,000 ohms	66-3184340*
R138	Resistor, decoupling, 1000 ohms	66-2108340*
R139	Resistor, a-v-c decoupling, 33,000 ohms	66-3338340*
R140	Resistor, suppressor, 10 ohms	66-0108340*
R141	Resistor, grid bias, 22,000 ohms	66-3228340*
R142	Resistor, suppressor, 10 ohms	66-0108340*
R143	Resistor, beat suppressor, 330 ohms	66-1338340*
R144	Resistor, voltage divider, 22,000 ohms	66-3228340*
S1	Switch, power, OFF-ON	Part of R62
S2	Switch, phono-switch box (50-T1477)	42-1795-1
S3	Switch, door, (bin-light and phono-motor power)	42-1914
T1	Transformer, power	32-8417
T2	Transformer, audio output	32-8356

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REPLACEMENT PARTS LIST (Cont.)

Reference Symbol	Description	Service Part No.
T3	Transformer, vertical blocking oscillator	32-8304-3
T4	Transformer, horizontal blocking oscillator	32-4367
T5	Transformer, horizontal-sweep output	32-8421
T6	Transformer, vertical-sweep output	32-8405-1
T7	Transformer, AM aerial	32-4408-1
TB1	Terminal-board-and-bracket assembly, aerial input	76-5318
TC1	Tuning core, oscillator	Part of Z2
TC2	Tuning core, mixer plate tank	Part of L7
TC3	Tuning core, adjacent sound trap	Part of L9
TC4	Tuning core, 1st v-i-f grid tank	Part of L10
TC5	Tuning core, 1st v-i-f plate tank	Part of L11
TC6	Tuning core, 2nd v-i-f plate tank	Part of L16
TC7	Tuning core, 3rd v-i-f plate tank	Part of L17
TC8	Tuning core, accompanying sound trap	Part of L18
TC9	Tuning core, 4th v-i-f grid tank	Part of L19
TC10	Tuning core, 4th v-i-f tank	Part of L22
TC11	Tuning core, 1st sound autotrans-former	Part of L30
TC12	Tuning core, FM-detector primary	Part of L33
TC13	Tuning core, FM-detector secondary	Part of L35
TC14	Tuning core, horizontal oscillator	Part of T4
TC15	Tuning core, WIDTH	Part of L43
TC16	Tuning core, HORIZ. LIN.	Part of L44
TC17	Tuning core, 1st FM i-f	Part of Z5
TC18	Tuning core, 1st AM i-f	Part of Z6
TC19	Tuning core, 2nd FM i-f	Part of Z7
TC20	Tuning core, 2nd AM i-f	Part of Z8
W1	Line-cord-and-plug ass'y.	41-3865
WS1	Wafer switch, AM-FM TELEVISION-PHONO	42-1915
WS1-1 (F)	Wafer-switch section	Part of WS1
WS1-1 (R)	Wafer-switch section	Part of WS1
WS1-2 (F)	Wafer-switch section	Part of WS1
WS1-2 (R)	Wafer-switch section	Part of WS1
WS1-3 (F)	Wafer-switch section	Part of WS1
WS1-3 (R)	Wafer-switch section	Part of WS1
WS1-4	Wafer-switch section	Part of WS1
Z1	Coil ass'y., aerial	
	Channel 2	32-4428-2
	Channel 3	32-4428-3
	Channel 4	32-4428-4
	Channel 5	32-4428-5
	Channel 6	32-4428-6
	Channel 7	32-4428-7
	Channel 8	32-4428-8
	Channel 9	32-4428-9
	Channel 10	32-4428-10
	Channel 11	32-4428-11
	Channel 12	32-4428-12
	Channel 13	32-4428-13
Z2	Coil ass'y., mixer-oscillator	
	Channel 2	32-4429-2
	Channel 3	32-4429-3
	Channel 4	32-4429-4
	Channel 5	32-4429-5
	Channel 6	32-4429-6
	Channel 7	32-4429-7
	Channel 8	32-4429-8
	Channel 9	32-4429-9
	Channel 10	32-4429-10
	Channel 11	32-4429-11
	Channel 12	32-4429-12
	Channel 13	32-4429-13
Z3	Transformer assembly, 1st sound i-f	32-4236
Z4	Transformer assembly, FM detector	32-4317
Z5	Transformer assembly, 1st FM i-f	32-4396A
Z6	Transformer assembly, 1st AM i-f	32-4160A
Z7	Transformer assembly, 2nd AM i-f	32-4381A
Z8	Transformer assembly, 2nd AM i-f	32-4240-3A
Z9	Focus-coil assembly	76-2622-1
Z10	Deflection-coil assembly	32-9622
Z11	Loop assembly, aerial tuning	76-5413

MISCELLANEOUS

Description	Service Part No.
Cabinet (50-T1477)	10762
Cabinet (50-T1478)	10773-4
Cabinet (50-T1479)	10773-9
Cabinet (50-T1481)	10773-5
Cabinet (50-T1482)	10774-3
Cabinet Hardware and Parts	
Back, album, mahogany	54-7963
Back, album, blonde	54-7963-1
Back-and-cup assembly, televison (50-T1477)	76-4397-16
Back-and-cup assembly, television (50-T1478, 50-T1479, 50-T1481)	76-5412
Back-and-cup assembly, television (50-T1482)	76-5412-1
Back, phonograph (50-T1478)	54-7944-1
Back, phonograph (50-T1479)	54-7944
Back, phonograph (50-T1481)	54-7944-2
Back, phonograph (50-T1482)	54-7968-1
Baffle-and-cloth assembly (50-T1478)	40-7810-1
Baffle-and-cloth assembly (50-T1479)	40-7810
Baffle-and-cloth assembly (50-T1481)	40-7810-2
Baffle-and-cloth assembly (50-T1482)	40-7799-1
Bezel	56-5367
Bottom, record changer (50-T1479, 50-T1481)	54-7945
Bottom, record changer (50-T1482)	54-7969
Brace, picture tube, 3¾" x 4¾" (50-T1477)	56-5581-12FA3
Brace, picture tube, 6" x 5½" (50-T1477)	56-7754-2FA3
Brace, picture tube, 4¼" x 5⅞" (50-T1478)	56-5581-6FA3
Brace, picture tube, 4⅛" x 4¹³⁄₁₆" (50-T1478)	56-5581-32FA3
Brace, picture tube, 3¼" x 5⁹⁄₁₆" (50-T1479, 50-T1481)	56-5581-30FA3
Brace, picture tube, 3¹¹⁄₁₆" x 5⅞" (50-T1479, 50-T1481)	56-5581-31FA3
Brace, picture tube, 2¹³⁄₁₆" x 5⅝" (50-T1482)	56-5581-28FA3
Brace, picture tube, 3⁹⁄₁₆" x 5¹³⁄₁₆" (50-T1482)	56-5581-29FA3
Channel, rubber, window (50-T1478, 50-T1479, 50-T1481)	54-4698-1
Channel, rubber, window (50-T1482)	54-4698-2
Coupler, rubber, AERIAL TUNING shaft	54-4748
Dome	45-6190
Door, left-hand (50-T1481)	45-6554
Door, left-hand (50-T1482)	45-6556
Door, right-hand (50-T1481)	45-6553
Door, right-hand (50-T1482)	45-6555
Doors, matched set (50-T1478)	45-6550
Doors, matched set (50-T1479)	45-6551
Grille (50-T1481)	44-1664
Hinge (50-T1478, 50-T1479, 50-T1482)	56-7015
Hinge (50-T1481)	56-7015-1
Knob, AERIAL TUNING control	54-4750
Knob, BRIGHTNESS control	54-4699
Knob, CHANNEL SELECTOR	54-4706
Knob, CONTRAST control	54-4707
Knob, FINE TUNING control	54-4701
Knob, HORIZONTAL HOLD control	54-4707
Knob, PHONO-AM-FM-TV switch	54-4720
Knob, RADIO TUNING control	54-4703
Knob, TONE control	54-4707
Knob, VERT. HOLD control	54-4699
Knob, VOLUME control	54-4699
Panel assembly, AERIAL TUNING	76-5399
Pull, door (50-T1478)	56-7463
Pull, door (50-T1479)	56-7583
Pull, door (50-T1481)	56-7700
Pull, door (50-T1482)	56-7588
Scale, dial (50-T1477)	54-5064
Scale, dial (50-T1478, 50-T1479, 50-T1481)	54-5076
Scale, dial (50-T1482)	54-5078
Screw, strike, blonde	56-7655-1
Screw, strike, mahogany	56-7655
Shaft, AERIAL TUNING control (50-T1477, 50-T1478, 50-T1479)	54-4747-8
Shaft, AERIAL TUNING control (50-T1481, 50-T1482)	54-4747-3
Strap, scale (50-T1477)	56-5155FA3
Strap, scale (50-T1478, 50-T1479, 50-T1481)	56-4756
Strap, scale (50-T1482)	56-4756FE11
Window (50-T1477)	54-8008
Window (50-T1478, 50-T1479, 50-T1481)	54-7943-4
Window (50-T1482)	54-7943-2
Cable assembly, deflection	41-3860-6
Cable assembly, high voltage	41-3771-3
Cable assembly, picture tube	41-3772-7
Cord, drive (25-foot spool)	45-8750
Frame assembly, picture-tube mounting	76-3938
Holder, fuse	76-4519
Nut, focus-coil mounting	56-4633
Panel, diffusing	54-7781
Pointer, dial	56-5630-13
Shield assembly, high voltage	76-3867-7
Shield, light	54-7296-2
Shield, miniature tube	56-5629FA3
Shield, 6J6 tube	56-3979FA5
Shield, pilot light	56-6307-7FA3
Socket assembly, pilot lamp	27-6233-6
Socket, deflection cable	27-6174-4
Socket, Loktal tube	27-6138
Socket, 7-pin miniature tube	27-6226
Socket, 9-pin miniature tube	27-6203-5
Socket, 6J6 miniature tube	27-6203-1
Socket, octal tube	27-6174
Socket, 1B3GT octal tube	27-6174-5
Spring, dial cord	28-8751FA1
Strap, AM-FM tuner subchassis grounding	76-5472-1
Tuner-unit assembly	76-5411-3**

** Refer to PR-1803 for complete service information on Philco 12-position tuner.

Inoperative FM

In some cases, failure of FM reception is caused by blocking of the FM oscillator. One cause of oscillator blocking is improper lead dress. If this condition is encountered, the following components should be checked:

Model	Component	Dress
50-T1477 to 50-T1482	C4	Down against the chassis.
50-T1477 to 50-T1482	Green lead between L5 and pin 2 of the 12AT7.	Down against the chassis.

MODELS 50-T1478, 50-T1482
AM-FM Television Phono Switch

At present, there are two types of the above switch used in these models. Electrically, they are the same. The difference is in their mechanical structure. One has a three-section wafer, and the other has a four-section wafer. The part number of the three-section-wafer switch is 42-1915, which is given in the service manuals. The part number for the four-section-wafer switch is 42-1891.

Whenever replacement of this switch is necessary, use the type of switch that was originally in the receiver.

New Channel Selector Knob

An improved channel selector knob, made of die-cast metal, is available for replacement purposes. The part number of this knob is 56-7807FCP. This improved knob will be used in future production

MODELS 50-T1477 TO 50-T1482

The following changes should be made in the Replacement Parts List:

Reference Symbol	Description	Published Part No.	Correct Part No.
C128	Condenser, 10 μμf.	62-010009011	62-010009001
I2	Lamp, bin	27-6233-47	34-2064
R22	Resistor, 5100 ohms	66-2508340	66-2503340*
R41	Resistor, 10 ohms	66-0108340	66-0103340*
R63	Resistor, 8.2 megohms	66-5828340	66-5823340*
R140	Resistor, 10 ohms	66-0108340	66-0103340*
R142	Resistor, 10 ohms	66-0108340	66-0103340*

On page 10, the right-hand and left-hand column of waveform photographs should be interchanged.

In step 10 of the Television I-F Alignment Chart, the OUTPUT INDICATOR CONNECTION should read: "Connect vertical input of oscilloscope to pin 3 of FM TEST jack J3."

MODELS 50-T1477, 50-T1478, 50-T1479, 50-T1481, AND 50-T1482

RUN NO.	DESCRIPTION OF CHANGE	REMOVED PART NO.	ADDED PART NO.	REASON FOR CHANGE
1Z and 2	R118 changed from 120,000 ohms to 100,000 ohms.	66-4128340	66-4108340	To center HORIZ. HOLD control.
3	C88 removed.	45-3505-62		To increase width.
	R123 changed from 10,000 ohms to 4700 ohms.	66-3105340	66-2475340	
	R119 changed from 120,000 ohms to 56,000 ohms.	66-4124340	66-3564340	
	R121 changed from 100 ohms to 10,000 ohms.	66-1108340	66-3568340	
	L43 changed.	32-4419	32-4419-2	
	.022-μf. condenser added, across L43.		45-3505-60	
3Y and 4	R118 changed from 100,000 ohms to 82,000 ohms.	66-4108340	66-3828340	To center HORIZ. HOLD control.

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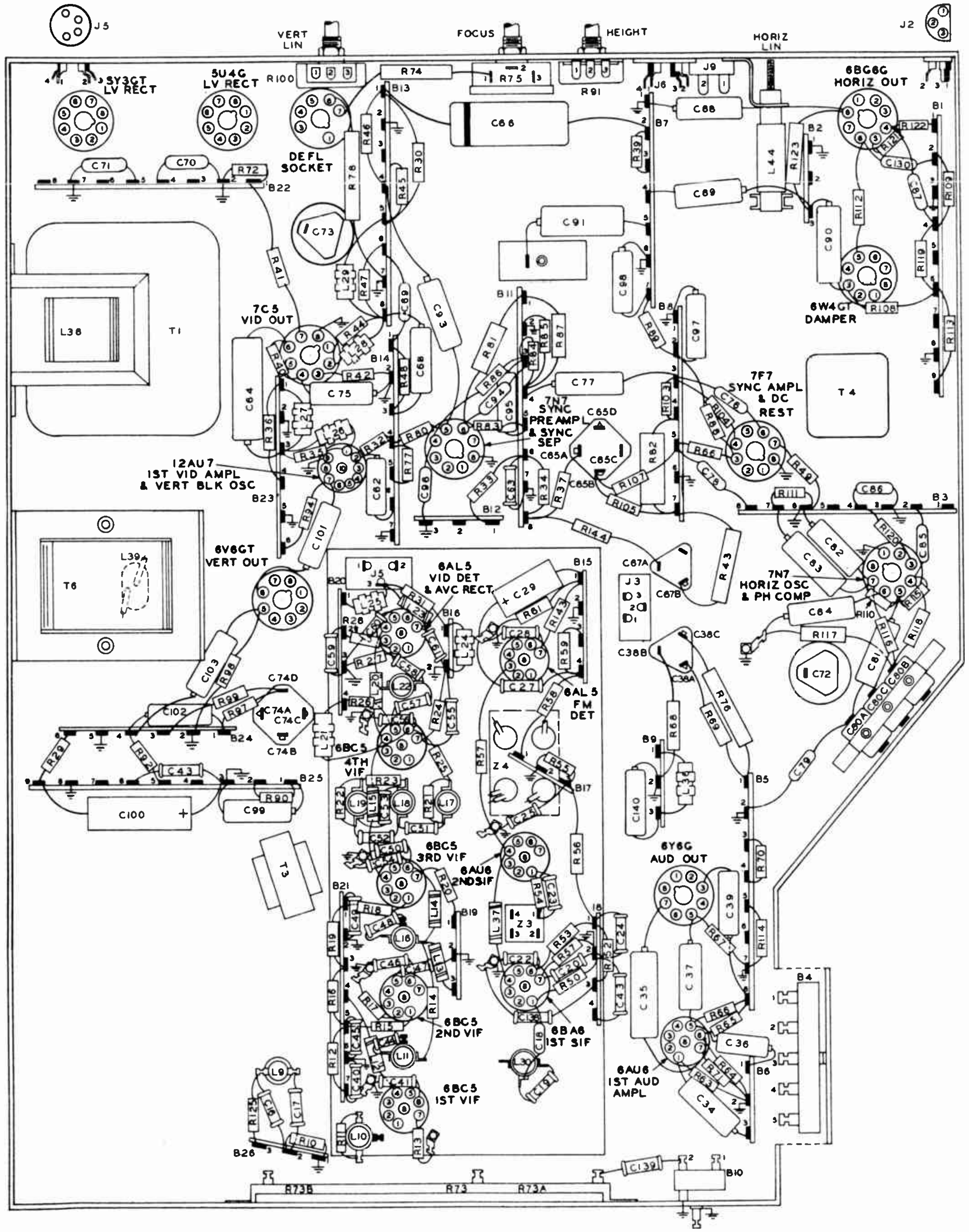
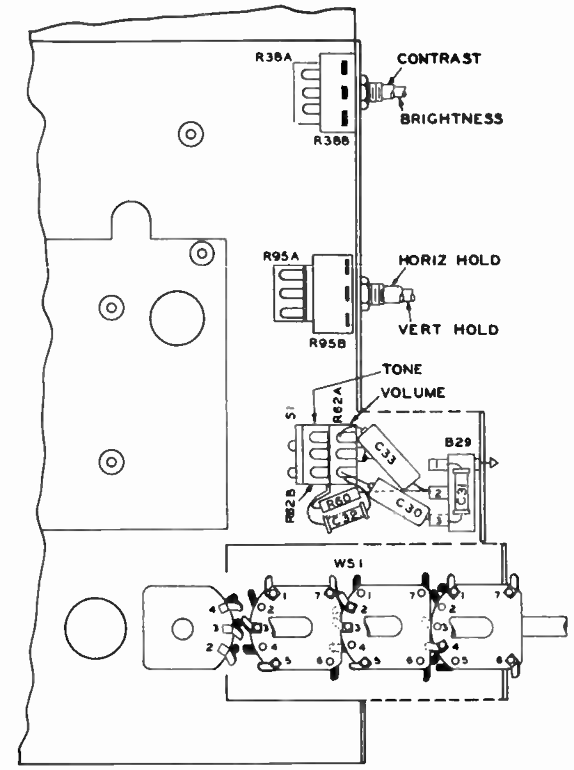
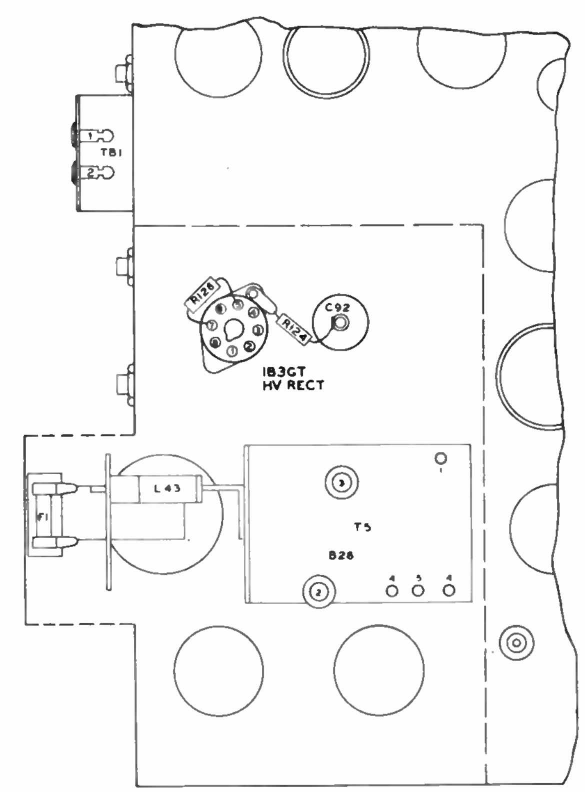


Bottom View of Chassis (TV), Models 50-T1477 to 50-T1482



Top View of Chassis (Controls), Models 50-T1477 to 50-T1482



Top View of Chassis (High Voltage), Models 50-T1477 to 50-T1482

MODELS 50-T1477, 50-T1478, 50-T1479, 50-T1481, 50-T1482

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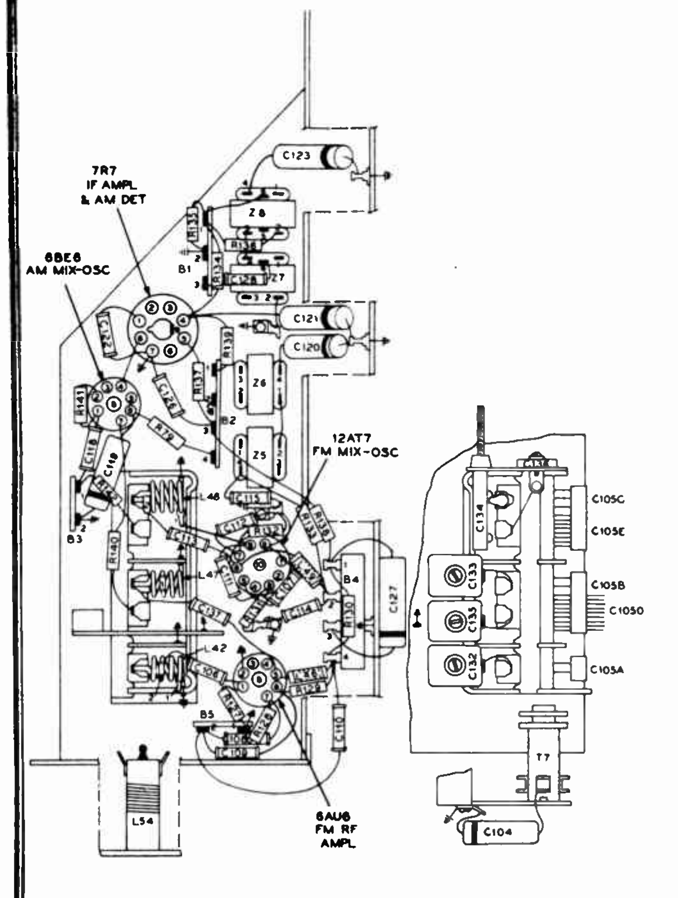

Bottom View of Subchassis (AM-FM Radio), Models 50-T1477 to 50-T1482

ADDITIONAL REPLACEMENT PART FOR MODELS 50-T1477 THROUGH 50-T1482 (PR-1787)

Dial backplate and rivet assembly 76-4858

Model 50-T1481 — New Part

A new fiberboard baffle-and-cloth assembly is available for the above model. Its part number is 40-7860-1, and it may be used as a direct replacement for the old type baffle and cloth.

MODELS 50-T1476 THROUGH 50-T1482; 50-T1484—NEW HORIZONTAL-OUTPUT TRANSFORMER

The horizontal-output transformer for the above models has been changed. The new part numbers are given below:

Model	New Transformer Part No.
50-T1104 through 50-T1432	32-8437
50-T1476 through 50-T1482; 50-T1484	32-8421-2

The above transformer should be used for all replacements in these models.

MODELS 50-T1476, 50-T1477, 50-T1478, 50-T1479, 50-T1481, 50-T1482, AND 50-T1484

RUN NO.	DESCRIPTION OF CHANGE	REMOVED PART NO.	ADDED PART NO.	REASON FOR CHANGE
5	L43 (width coil) changed.	32-4419-2	32-4419-3	To increase width.
6	1B3 socket and wiring changed. Wiring removed from pin 5 and placed on pin 4.	27-6174-5	27-6174-7	To prevent shorting of components due to internal connections on pins 1, 3, and 5 of some 1B3GT tubes.
7	Fuse added in series with ground lead of filament winding of power transformer.		Length of #26 copper wire.	To provide protection against filament shorts.
8	Vertical-output transformer changed to smaller size.	32-8405-1	32-8425 (For replacement purposes, use 32-8405*.)	

PHILCO TELEVISION-RADIO-PHONOGRAPH

MODELS 50-T1476 AND 50-T1484

The chassis of Philco Models 50-T1476 and 50-T1484 are similar to the one used in Models 50-T1477, 50-T1478, 50-T1479, 50-T1481, and 50-T1482, the difference being in the cabinet style.

All of the above models incorporate a 12-inch picture tube, a wide mask, a built-in aerial, and an M-20 automatic record changer which has three turntable speeds, for playing 33-1/3, 45, and 78 r.p.m. records.

For service information pertaining to Models 50-T1476 and 50-T1484, refer to Philco Service Manual PR-1787 and to the supplementary information in this bulletin. All of the production changes given for Models 50-T1477, 50-T1478, 50-T1479, 50-T1481, and 50-T1482 also apply to Models 50-T1476 and 50-T1484. However, the miscellaneous section of the Replacement Parts List in PR-1787 does not apply to Models 50-T1476 and 50-T1484, because of the difference in cabinets. For miscellaneous parts, therefore, refer to the following miscellaneous Replacement Parts List.

MISCELLANEOUS REPLACEMENT PARTS LIST

Description	Service Part No.
Bracket, tuner mounting	56-7680
Bumper, rubber, changer	54-4181
Cabinet (M) 50-T1476	10801-1
Cabinet (M) 50-T1484	10774-5
Cabinet (W) 50-T1476	10801
Cabinet (L) 50-T1476	10801-2
Cabinet Hardware and Parts	
Back, phono, 50-T1476	54-7944-1
Back, phono, 50-T1484	54-7968-1
Back-and-cup assembly, 50-T1476	54-5412-3
Back-and-cup assembly, 50-T1484	54-5412-2
Back, album	54-7963
Baffle-and-cloth assembly (M), 50-T1476	40-7886
Baffle-and-cloth assembly (W), 50-T1476	40-7886-1
Baffle-and-cloth assembly (L), 50-T1476	40-7886-2
Baffle-and-cloth assembly (M), 50-T1484	40-7799-1
Bezel and scale, 50-T1476	54-4765
Bezel, 50-T1484	56-5367FCP
Bolt, speaker mtg., 50-T1476	W-700-2
Bolt, speaker mtg., 50-T1484	W-700-1
Bottom, changer, 50-T1476	54-7945
Bottom, changer, 50-T1484	54-7969
Brace, picture tube, 4-1/4" x 5-7/8", 50-T1476	56-5581-6FA3
Brace, picture tube, 4-1/8" x 4-5/16", 50-T1476	56-5581-32FA3
Brace, picture tube, 2-13/16" x 5-5/8", 50-T1484	56-5581-28FA3
Brace, picture tube, 3-3/16" x 5-13/16"	56-5581-29FA3
Bullet catch (M, W), 50-T1476, 50-T1484	45-6002
Channel, rubber, window, 50-T1484	54-4698-2
Clip, bin-light mtg.	56-3545-6
Clip, spring, door catch (M, W), 50-T1476	56-7654
Clip, spring, door catch (L), 50-T1476	56-7654-1
Coupler, rubber, AERIAL TUNING shaft	54-4748
Dial backplate and rivet assembly	76-4858
Dome	45-6190
Door, matched pair (M), 50-T1476	45-6609
Door, matched pair (M), 50-T1484	45-6552
Door, matched pair (W), 50-T1476	45-6610
Door, matched pair (L), 50-T1476	45-6613
Grille, speaker, metal	56-7462-1
Hinge, knife stop (M, W) (2 used), 50-T1476	56-7873
Hinge, knife stop (L) (2 used), 50-T1476	56-7873-4
Hinge (M, W) (2 used), 50-T1476	56-7873-1
Hinge (L) (2 used), 50-T1476	56-7873-5
Hinge (r.h.), 50-T1484	56-5713-3
Hinge (l.h.), 50-T1484	56-5713-2
Knob, AERIAL TUNING	54-4750
Knob, BRIGHTNESS	54-4699
Knob, CHANNEL SELECTOR, 50-T1476	56-7807-2FCP
Knob, CHANNEL SELECTOR, 50-T1484	56-7807FCP
Knob, CONTRAST	54-4707
Knob, FINE TUNING	54-4701
Knob, HORIZ. HOLD	54-4707
Knob, PHONO-AM-FM-TV switch	54-4720
Knob, RADIO TUNING	54-4703
Knob, TONE	54-4707
Knob, VERT. HOLD	54-4699
Knob, VOLUME	54-4699
Panel assembly, AERIAL TUNING (includes condenser)	31-6519
Plate, scuff, 50-T1476	56-7989FCP
Pull, door (M, L), 50-T1476	56-7998
Pull, door (M), 50-T1484	56-7138-1
Pull, door (W), 50-T1476	56-7967
Pull, plate (M, L)	56-7999
Scale, dial, 50-T1484	54-5078
Screw, ball head, door catch (M, W)	56-7655
Screw, ball head, door catch (L)	56-7655-1
Screw, bezel and scale, 50-T1476	2W25478FC91
Screw, scale strap	1W25328FE11
Screw, scuff plate	2W25476FC91
Shaft, AERIAL TUNING, 50-T1476	54-4747-3
Shaft, AERIAL TUNING, 50-T1484	54-4747-4
Strap, scale, 50-T1484	56-4756FE11
Strike plate (M, W), 50-T1476, 50-T1484	45-6003
Window, 50-T1476	54-4755-1*
Window, 50-T1484	54-7943-2
Cable assembly, deflection	41-3860-6
Cable assembly, high voltage	41-3771-3
Cable assembly, picture tube	41-3772-7
Cord, dial drive (25-foot spool)	45-8750
Cover plate, tuner	56-7693
Frame assembly, picture-tube mtg.	76-3938
Holder, fuse	76-4519
Nut, focus-coil mtg.	56-4633
Panel, diffusing	54-7781
Plug, button (S3)	42-1919-1
Pointer, dial, 50-T1476	56-5925
Pointer, dial, 50-T1484	56-5630-13
Shield, phono power connector (PL-3)	56-2071
Shield assembly, high voltage	76-3867-7
Shield, light	54-7296-2
Shield, miniature tube	56-5629FA3
Shield, 6J6/S tube	56-3979FA5
Shield, pilot light	56-6307-7FA3
Socket assembly, pilot light	27-6233-6
Socket, deflection cable	27-6174-4
Socket, Loktal tube	27-6138
Socket, 7-pin miniature tube	27-6226
Socket, 9-pin miniature tube	27-6203-5
Socket, 6J6/S miniature tube	27-6203-1
Socket, octal tube	27-6174
Socket, 1B3GT octal tube	27-6174-5
Speednut, changer mtg.	W2554FCP
Spring, changer mtg. (heavy)	56-7059FA9
Spring, changer mtg. (light)	56-7059-1FJ47
Spring, dial cord	28-8751FA1
Spring, diffusion-panel mtg.	56-3841
Strap, AM-FM tuner subchassis grounding	76-5472-1
Tuner unit assembly	76-5411-3**

**Refer to PR-1803 for complete service information on Philco 12-Position Turret Tuner.

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MODELS TV-127, 164, 167A, 191
12 1/2, 16 and 19 Inch Television and
Complete FM Radio

ELECTRICAL SPECIFICATIONS

POWER SUPPLY RATING
TV-127 - 185 watts on TV and 85 watts on FM
TV-164, TV-167A and TV-191 - 230 watts on TV and 105 watts on FM

AUDIO POWER OUTPUT RATING
TV-127 - 2.2 watts
TV-164, TV-167A and TV-191 - 2.5 watts

LOUDSPEAKER
TV-127 - 6"
TV-164 - 8", TV-167A and TV-191 - 12"
Voice Coil Impedance - 3.2 ohms at 400 cycles

RECEIVER ANTENNA INPUT IMPEDANCE
300 ohms balanced

TUBE COMPLEMENT See Figure 1.

TUNING RANGE
FM - 88-108 mc.
TV - Channels 2 - 6 (54-88 mc.)
Channels 7 -13 (174-216 mc.)

ALIGNMENT DATA

Picture Carrier Frequency	25.75 mc.
Accompanying Sound Trap	21.25 mc.
Adjacent Sound Trap	27.25 mc.
Sound I.F. Frequency	4.5 mc.
FM First I.F. Frequency	10.7 mc.
FM Second I.F. Frequency	4.5 mc.
FM Second Oscillator Frequency	15.2 mc.
Sound Ratio Detector Band Width	225 kc. (between peaks)
Video Response	to 4.0 mc.

FOCUS - Permanent Magnet

SWEEP DEFLECTION - Electromagnetic

OPERATING CONTROLS - See Figure 1

NON-OPERATING CONTROLS - See Figure 1

PHONO INPUT
High Impedance
Plug - Type PL55 or equivalent

TV FRONT END

The TV front end is a separate sub-chassis of the receiver. Mounted on this chassis are the RF amplifier, converter and oscillator, bandswitch, all RF and oscillator coils and the converter plate. Referring to the schematic diagram, it will be noticed that there are three double triodes available in the front end. One section of each triode is used for high band tuning, and the other section of each triode is used for low band tuning. The switching comprises a changeover in the B+ and antenna coils. The two bands are otherwise completely independent.

With the chassis inverted and the tuning dials facing the operator, all components on the left side of the front end are associated with the low band and all components associated with the high band are located on the right side WITH THE EXCEPTION OF THE LOW AND HIGH BAND ANTENNA COILS WHICH ARE INVERTED IN THEIR LOCATION. The antenna terminates in a band-pass transformer for the low or high band respectively and is switched to the proper transformer when the bandswitch is set to the desired band. The trimmer T3 adjusts the high band circuit. Tuning in the plate circuit of the RF amplifier and grid circuit of the converter is accomplished through a band-pass transformer which is continuously tuned by means of the 3-gang variable condensers located on the top of the chassis directly above their respective coils. The low band interstage transformer is aligned by iron slug S2. The high band interstage transformer is aligned by iron slug S4 and trimmers T4 and T5. The RF oscillators are of the tickler feedback type, tuned over the bands by means of the rear sections of the variable condensers. The low band oscillator is adjusted by brass slug S1 and trimmer T2 and the high band oscillator by brass slug S3 and trimmer T6. The converter plate circuit, common to the low and high band, consists of an RF choke in parallel with the converter coil S5 which is mounted at the rear of the front end sub-chassis.

PICTURE I.F. AMPLIFIER AND DETECTOR

The picture I.F. amplifier is of the conventional stagger tuned type, with four stages of I.F. amplification. In order to obtain proper band-pass characteristics, the picture I.F. coils are tuned as follows:

1. Converter coil - 23.8 Mc (iron slug S5)
2. First picture I.F. coil - 25.6 Mc (iron slug S6)
3. Second picture I.F. coil - 22.2 Mc (iron slug S7)
4. Third picture I.F. coil - 22.0 Mc (iron slug S8)
5. Fourth picture I.F. coil - 25.4 Mc (iron slug S9)

To align the I.F. system, the coils are peaked to the specified frequency with an unmodulated signal generator, The over-all I.F. response is then observed by use of the sweep generator and oscilloscope.

TRAP CIRCUIT

In order to avoid sound carrier interference in the picture, 2 sound traps are incorporated. They are tuned by iron slug S10 to a frequency of 21.25 Mc and by iron slug S21 to a frequency of 27.25 Mc to absorb excessive sound energy.

PICTURE SOUND DETECTOR

The detector is a germanium crystal rectifier (1N60) and is obtained in Video Detector Can Assembly 279-63.

SOUND SYSTEM

The sound channel operates on the intercarrier principle. The output of the second detector contains a 4.5 Mc component which is frequency modul-

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ated with the sound, and is amplified by the 6CB6 Video amplifier and the 6AU6 Ratio detector driver. A 6AL5 Ratio detector demodulates the 4.5 Mc F.M. sound signal and feeds the two stage audio amplifier. A 4.5 Mc trap (79-85) is placed in the plate circuit of the video amplifier to prevent FM interference in the picture, and to raise the gain of the Video amplifier for 4.5 Mc. Provision is made for the connection of a record player for phonograph reproduction.

VIDEO AMPLIFIER, CONTRAST CONTROL AND A.G.C.

The single stage video amplifier uses a 6CB6 tube which provides a video amplification of approximately 25 times and has a flat frequency response up to 4 mc.

The contrast control is part of the A.G.C. system. It provides either a positive or a negative voltage which is placed in series with the developed A.G.C. voltage. When rotated in a clockwise direction, the series potential becomes more positive and tends to increase the signal output of the second detector. This action is particularly beneficial for weak signals because it counteracts the contact potential of the I.F. tubes.

DC RESTORER

Since the video amplifier is an AC amplifier, the DC component of the video signal that represents the average illumination of the original scene will not be passed. Unless this DC component is restored, difficulty will be experienced in maintaining proper scene illumination. For any given scene, this average illumination could be set properly by the brightness control. However, a change of scene would probably necessitate resetting this control. The DC restorer accomplishes this setting automatically, thus assuring proper picture illumination at all time.

SYNC. AMPLIFIER AND CLIPPER

The single stage sync. clipper amplifier separates the synchronizing information from the composite video signal signal and delivers well limited, amplified sync. pulses. The composite signal from the video amplifier is fed into a 6AU6 amplifier with the sync. pulses going in the positive direction. The grid and cathode of the 6AU6 act as peak rectifier. Thus a peak DC voltage equal to the composite video signal appears across the grid resistor keeping this tube biased off between sync. pulses. As soon as a new sync. pulse arrives, the grid will conduct and the sync pulse will appear amplified in the plate circuit. The video signal which follows the sync. pulse does not appear in the plate circuit since the sync. pulse has moved the grid potential to cut off again. Thus the video and blanking pulses are removed and only the sync. pulses appear at the sync. clipper plate.

VERTICAL SYNC. AMPLIFIER

The sync. pulses appearing at the sync. clipper plate are negative in polarity. One half of a 12AU7 acting as an amplifier and in conjunction with an integrating network effectively extracts the vertical synchronizing signal and feeds vertical sync. pulses of positive polarity to the vertical oscillator.

VERTICAL OSCILLATOR AND AMPLIFIER

The function of these circuits is to provide a sawtooth of current of the proper frequency and phase to perform the vertical scanning for the picture tube.

1. In models TV-164, TV-167A, and TV-191 a 6C4 tube with its associated components form a blocking oscillator and discharge circuit. The voltage present at the plate of this tube is of the shape required to produce a sawtooth of current in the vertical deflection coil. This voltage is coupled to a 6S4 tube which amplifies it and supplies a sufficient amount of power to the vertical deflection coil.

2. In the Model TV-127 one-half of a 6SN7 tube with its associated components form a blocking oscillator and discharge circuit. The other half of the 6SN7 is used in the same manner as the 6S4 in the 16" and 19" models.

PHASE INVERTER AND HORIZONTAL DETECTOR

The horizontal phase detector (6AL5) is a dual diode in a circuit which produces a DC output voltage which is proportional to the phase displacement between two input voltages.

The composite sync. signal is split in phase by the 12AU7 phase inverter and the resultant signals (nearly equal and 180° out of phase) comprise one of the input voltages to the phase detector. The other input voltage is taken from a tap on the horizontal output transformer. This peaked sawtooth voltage is shifted in phase and properly shaped by an RC network before being applied as the other input voltage to the phase detector.

The DC output voltage which is proportional to the phase displacement between the two input voltages, namely, the sync. pulses and the output sawtooth voltage, appears at the junction of the two 100K ohm resistors. A 4.7 megohm resistor is connected from this point to ground to provide a DC return for the horizontal sweep oscillator grid circuit. A conventional AFC filter consisting of the 470K ohm resistor in parallel with an 0.005 mfd. condenser in series with an 0.05 mfd. condenser is used. The voltage appearing across the 0.05 mfd. condenser is then the filtered control voltage which is applied to the horizontal sweep oscillator.

HORIZONTAL SWEEP OSCILLOSCOPE

The horizontal sweep oscillator has been developed to realize the characteristics which are most desirable for this purpose. The circuit shown is a stabilized cathode coupled miltivibrator, which combines the sensitivity of the multivibrator with the stability of the sine wave oscillator. The circuit is essentially a sine wave oscillator with good stability, but the resistor in series with the tuned circuit adds an impulse component which provides the desired rapid return time, and in conjunction with the other circuit constants, provides the proper control sensitivity both for the DC applied to the first grid for AFC, and with change in resistance in the second grid circuit for the manual control. Figure 4 shows the wave shape appearing at the plate of the first section of the oscillator.

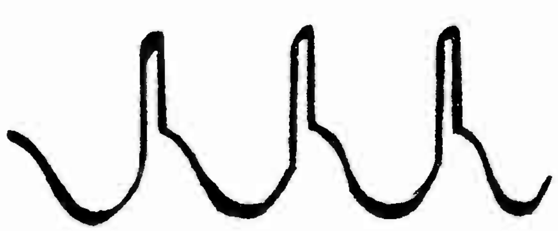

Figure 4 - Wave Shape at Plate of Horizontal Oscillator.

To place the circuit in operation, the 50K ohm horizontal hold control should be set in the center of its range and the variable inductor (part #72-66) adjusted until the picture is properly synchronized.

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HORIZONTAL OUTPUT AND HIGH VOLTAGE SUPPLY

The horizontal output amplifier (6CD6G) and "flyback" type power supply uses standard components and is conventional except that no electrical centering means is provided. Centering of the raster is accomplished by manipulating the mechanical adjustments of the focus magnet and ion magnet. The correct centering procedure is outlined in the OPERATING INSTRUCTIONS booklet.

The function of the output tube (6CD6G) is to supply sufficient current of the proper waveform to the horizontal deflection coil in order to provide horizontal scanning for the cathode ray tube. The function of the damper tube (6W4GT) is to stop oscillation and thus help provide a linear trace. It also recovers some of the energy from the yoke kickback and uses it to help supply additional power to the horizontal and vertical sweep circuits.

The width of the picture is controlled by adjusting slug S22 which varies the amount of inductance shunted across a portion of the secondary of the horizontal output transformer. Clockwise rotation of the adjustment increases picture width.

Adjustment of the horizontal drive control located on the rear apron of the chassis determines otpimum linearity and maximum high voltage and, therefore, crispness of picture. Before setting Horizontal Size, advance Drive Control until white vertical lines appear near the center of picture. Then turn back slightly to make lines disappear. The Horizontal Size of the picture should now be set by use of the Horizontal Size Control.

After changing tubes or re-locating the receiver in different location, the Horizontal Size may have to be readjusted due to change in tube characteristics or line voltage, it is always advisable to readjust the Drive Control as mentioned above to maintain maximum high voltage.

Rotation of the horizontal linearity control, S20, will affect the center portion of the picture and should be adjusted for best horizontal linearity as follows:

A.) Rotate slug in counter-clockwise direction until it is completely out of the coil.
B.) Slowly rotate slug in clockwise direction until good linearity is indicated by observation of the test pattern.

NOTE: If this operation is carried too far, a second point will be noticed where, apparently, good linearity is obtained. With this setting however, the center of the picture is distorted and therefore the adjustment should not be left in this position. The correct setting is the one where good linearity is obtained with the slug in the "out" position.

The high voltage power supply is a "kickback" type where the power is obtained from the energy stored in the deflection inductances during each horizontal scan. When the 6CD6G plate current is cut off by the incoming pulse, a pulse appears on the primary of the output transformer due to the collapsing field in the deflection coil. This pulse of voltage is stepped up, rectified by a voltage doubler, filtered, and applied to the second anode of the picture tube.

LOW VOLTAGE POWER SUPPLY

Although the low voltage power supply is a conventional circuit delivering about 360 volts at 200 ma. in Models TV-164, TV-167A, and TV-191 and 300 volts at 190 ma. on Model TV-127, the voltage distribution circuit through the receiver is unique. Those circuits which operate at lower voltages are connected in series with each other and placed across the higher voltage required for other circuits. The RF-IF cathodes return to chassis and the plates and screens are at +140 volts. The cathode of the audio power amplifier is returned to +140 volts. This tube then operates on the difference between +140 and +360 volts or +220 volts on Models TV-164, TV-167A and TV-191. On Model TV-127, the tube operates on the difference between +140 and +300 volts or plus 160 volts. Resistance is added in series with the audio output tube plate circuit which, together with the 20 mfd. condenser returned to the cathode, acts as a filter to keep its current variations from modulating the B supply voltage.

The audio output tube also operates as a series regulator tube to maintain the +140 volts relatively constant. Because its grid is connected to a divider running from +360 volts (300 volts for Model TV-127) to ground, any change in the +140 volts, due to current variations in the RF-IF circuits, changes the effective grid - cathode voltage of the audio output tube thereby providing a substantial amount of automatic voltage regulation.

FM TUNER

The FM tuner section of this receiver consists of a 6BA6 RF amplifier, a 6BE6 first converter and a 12AT7 second converter. The RF and first converter stages are conventional and produce an intermediate frequency of 10.7 mc. at the output of the first converter. The second converter is a dual triode, one section operating as a mixer and the other section operating as an oscillator. The 10.7 mc. IF tube of the first converter is heterodyned with a fixed oscillator operating at 15.2 mc. in the mixer triode section. The 15.2 mc. signal is generated in the oscillator section of the 12AT7 tube. The difference frequency of 4.5 mc. appears in the mixer plate and is coupled into the video detector. From this point the signal is handled in the same manner as the sound component.of the TV signal.

ALIGNMENT PROCEDURE

TEST EQUIPMENT

To properly service this receiver, it is necessary that the following test equipment be available:

1. RF Sweep Generator - Frequency ranges:
   a) 20 to 27 Mc. b) 50 to 90 Mc. (at least 10 Mc. sweep width)
   c) 170 to 225 Mc. (at least 10 Mc. sweep width)
   Output must be adjustable to a maximum of 1 volt.

2. Cathode Ray Oscilloscope
   Preferably one with a wide band vertical deflection, an input calibrating source and a low capacity probe.

3. Signal Generator to provide frequencies in the following ranges:
   a) 4.4 to 4.5 Mc. b) 10.7 Mc c) 20 to 27 Mc.
   d) 52 to 90 Mc. e) 88 to 108 Mc. f) 172 to 219 Mc.

4. Vacuum Tube Voltmeter and High Voltage Multiplier Probe for use with this meter to permit measurements up to 15,000 volts.

ADJUSTMENTS REQUIRED (Refer to Figure 1 for location of alignment adjustments)

Front end - Normally only the RF oscillator coils will require the attention of the service technician. All other circuits are very broad and will therefore only rarely require readjustment. If a realignment should

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be needed, only those thoroughly familiar with very high frequencies and sweep generators should attempt it. The oscillator coil adjustments are critical and may be affected by a tube change. Low band, as well as high band oscillator, are aligned by a trimmer and padder like a normal AM receiver.

A.) Low Band

Switch band selector to the low band, engage variable condenser completely. Then, tune slug S1 until the frequency of the oscillator equals 80 Mc. Disengage variable condenser completely and adjust trimmer T2 for an oscillator frequency of 110 Mc. Repeat this procedure several times to check accuracy.

B.) High Band

Throw the band selector switch to high band. Engage the variable condenser fully and adjust slug S3 until the oscillator frequency equals 200 Mc. Disengage condenser completely and adjust trimmer T6 to an oscillator frequency of 239 Mc. Repeat procedure several times.

The detailed alignment procedure which follows is intended primarily as a discussion of the method used, precautions to be taken and the reasons for these precautions. Then, for more convenient reference during alignment, a tabulation of the method is given. All the information necessary for alignment is given in the table. However, alignment by the table should not be attempted before reading the detailed instructions.

ORDER OF ALIGNMENT

When a complete receiver alignment is necessary, it should be performed in the following order:

A.) Align ratio detector as indicated in alignment table at 4.5 Mc.
B.) Set 4.5 Mc. trap with slug S11.
C.) Align all I.F. transformers following procedure and table.
D.) Set sound traps to 21.25 Mc. with slug S10 and to 27.25 with slug S21.
E.) Retouch picture I.F. transformers for full band width as per alignment procedure in table.
F.) Align FM section as per alignment procedure in table.
G.) Connect receiver to an antenna and tune for a test pattern if possible.
H.) Pay special attention to the proper setting of the HORIZONTAL HOLD CONTROL. It is not enough to set the HORIZONTAL HOLD CONTROL at the time of instellation to "hold" a picture. The setting should be checked for "pull-in". To make this check, the TUNING CONTROL should be tuned rapidly on and off a station. Find the point of adjustment for the HORIZONTAL HOLD CONTROL, where the picture will fall into frame, without hesitation.
I.) Adjust other size and hold controls as outlined in OPERATING INSTRUCTIONS booklet.
J.) Adjust FM trap slug S11 for minimum FM interference in picture.

PICTURE I.F. OSCILLATION

If the receiver is badly misaligned and two or more of the I.F. coils are tuned to the same frequency, or if the sound traps are not set properly, the receiver may fall into I.F. oscillatorn. I.F. oscillation shows up as a voltage in excess of a few tenths of a volt at the picture detector load resistor. If such a condition is encountered, it is sometimes possible to stop oscillation by adjusting the coils approximately by setting the adjustment screws to be nearly equal to those of another receiver known to be in proper alignment.

There is little likelihood of any oscillation occurring if the 21.25 Mc. trap (adjusted by slug S10) is at its proper frequency, and the third picture I.F. (slug S3) is set at 21.6 Mc. or lower. If oscillation persists, check for open by-pass condenser in I.F. strip.

RATIO DETECTOR ALIGNMENT

Set the signal generator for approximately 1 volt output at 4.5 Mc. and connect it to the grid of the ratio detector driver. To align the primary of the Ratio Detector, connect the vacuum tube voltmeter to pin No. 2 of the 6AL5 and tune S13 for maximum negative voltage. To balance the secondary of the ratio detector, connect the vacuum tube voltmeter from the phono input jack to ground. Adjust S14. It will be found that it is possible to produce a positive or negative voltage depending on this adjustment. Obviously, to pass from a positive to a negative voltage, the voltage must go through zero. S14 should be adjusted for zero output. It is possible to use any television station for this alignment since the difference between the frequency of the picture and the sound carrier is 4.5 mc.

SOUND I.F. ALIGNMENT

Connect the signal generator to terminal #4 of the video detector assembly and maintain it at 4.5 Mc. Connect the vacuum tube voltmeter to pin No. 2 of the 6AL5 Ratio Detector and adjust slug S12 for maximum DC reading. Reduce output of signal generator to a very low lev 1 and readjust S12.

ALIGNMENT CHART

FUNCTION	NOTES	CONNECT R.F. SIGNAL GENERATOR To:	CONNECT OUTPUT INDICATOR (V.T.V.M.) TO:	SET SIGNAL GENERATOR TO: (MC.)	ADJUST	OUTPUT INDICATIONS
1) Video I.F. Spot Frequency Alignment	Switch to TV Channels 2-6 --- Contrast Control to Maximum --- Remove 12AT7 Oscillator Tube	Low Band Mixer Grid (Pin #7)	Terminal #4 of Video Detector Coil Assembly	23.8	S5	Maximum on V.T.V.M.
				25.6	S6	" " "
				22.2	S7	" " "
				22.0	S8	" " "
				25.4	S9	" " "
				21.25	S10	Minimum on V.T.V.M.
				27.25	S21	" " "
2) FM & TV SOUND I.F. and Ratio Detector Alignment	Switch to FM (Close Gang) ---- Contrast Control to Maximum	Terminal #4 of Video Detector Coil Assembly	Pin #2 of 6AL5 Ratio Detector	4.5 Mc. (Use Weak Signal)	S13 and S12	Maximum on V.T.V.M.
		Pin #7 of 12AT7 FM 2nd Converter	Same	4.5 Mc. (Use Weak Signal)	S18	Maximum on V.T.V.M.
		Same	Phono Input Jack	4.5 Mc. (Use Weak Signal)	S14	Accurately for Zero Balance
		Pin #1 of 6BE6 FM 1st Converter	Same	10.7 Mc. (Use Weak Signal)	S17	Readjust for Zero Balance
		Same	Pin #2 of 6AL5 Ratio Detector	10.7 Mc. (Use Weak Signal	S16 and S15	Maximum on V.T.V.M.
			Repeak Slugs S13, S12, S18, S16 and S15 for Maximum Output Indication			

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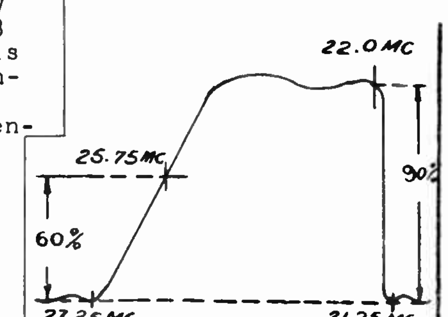
FUNCTION	NOTES	CONNECT R.F. SIGNAL GENERATOR TO:	CONNECT OUTPUT INDICATOR (V.T.V.M.) TO:	SET R.F. SIGNAL GENERATOR and DIAL POINTER TO:	ADJUST	OUTPUT INDICATION
3) FM RF Alignment	Switch to FM ---- Contrast Control to Maximum ---- Before Aligning Check Zero Set of FM Dial Pointer	Antenna Terminals Through 2 150 ohm Resistors (Dummy)	Pin #2 of 6AL5 Ratio Detector	90 MC.	Oscillator Disc (P1) and R.F. Padder P2	Maximum on V.T.V.M
				Set Generator to 106MC. and locate Signal on FM Dial. Note amount of error.	Set Tuner Pointer to the other side of 106 MC. by 1/2 the Error Found. Then Adjust T8.	Maximum to V.T.V.M.
			106 MC.	Oscillator Disc (P1)	Oscillator Disc (P1) and Antenna Trimmer (T7)	Maximum on V.T.V.M.
				Recheck Calibration at 90 MC. If Necessary, Repeat.		

FUNCTION	CONNECT SWEEP GENERATOR TO:	CONNECT R.F. SIGNAL GENERATOR TO:	SET R.F. SIGNAL GENERATOR TO:	CONNECT SCOPE TO:	ADJUSTMENTS
4) VIDEO I.F. SWEEP ALIGNMENT	Loosely coupled to 12AT7 mixer tube by means of a metal sleeve 1" wide. A miniature tube shield may be used. NOTE: Switch to Channels 2-6	Loosely coupled to Sweep Generator Output Cable.	Signal Generator is used as marker. Set from 20-28 Mc. as needed for markers.	Terminal #4 of Video Detector Coil Assembly 279-63 (Scope is synchronized to Sweep Generator.)	Adjust S5, S6, S7, S8 and S9 (as needed) to give following response curve:



NOTE: Keep input signal at low level to avoid overloading. Keep contrast control at center setting.

SERVICE SUGGESTIONS

I. NO RASTER ON C.R.T. - SOUND NORMAL

A.) IF ALSO NO HIGH VOLTAGE

1. Check 1/4 amp. fuse. Before replacing blown fuse check the following:-

a.) Deflection yoke coils - check for grounded windings and shorts between Vertical and Horizontal windings.
b.) Defective horizontal output transformer.
c.) Defective 6CD6G, 1B3GT's or 6W4GT.
d.) Shorted yoke series condenser.
e.) Shorted Boost filter electrolytic

2. Check 6SN7GT horizontal oscillator tube and associated circuit components. No horizontal drive.
3. Check 500 mmfd. high voltage filter capacitors.
4. Open high voltage filter resistor.

B.) IF HIGH VOLTAGE IS NORMAL

1. Ion trap magnet set incorrectly or reversed.
2. Defective C.R.T.
3. Wrong operating voltages at C.R.T. socket.
4. Check setting of brightness control.

II. NO VERTICAL DEFLECTION

1.) Check 6C4 (6SN7 in TV-127) vertical oscillator and associated circuit components.
2.) Check 6S4 (6SN7 in TV-127) vertical amplifier and associated circuit components.
3.) Check vertical deflection coils.
4.) Check vertical output transformer.
5.) Check for B+ supply voltage.

III. POOR VERTICAL LINEARITY

1.) If adjustments do not correct, change 6C4 and/or 6S4 vertical sweep tubes. (6SN7 in TV-127)
2.) Low B+ supply voltage.
3.) Defective vertical output transformer.

IV. UNSTABLE VERTICAL HOLD (JITTER)

1.) If adjustments do not correct, change 6C4 and/or 6S4 vertical sweep tubes. (6SN7 in TV-127)
2.) Check as in sections II and III for intermittent operation.
3.) Check 4700 mmfd. vertical oscillator grid capacitor.
4.) Excessive external noise conditions combined with weak signals due to poor reception or misalignment.
5.) Contrast control operated at excessive level.
6.) Excessive input signal causing overload. Attenuate antenna input.
7.) Check for loose connections or noisy tubes.

V. NO VERTICAL SYNC. (ROLLING)

1.) Check 1/2 12AU7 vertical sync. amplifier, and associated components.
2.) Check components associated with timer grid (pin 4) of 6SN7 vert. oscillator.

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VI. TRAPEZOIDAL OR NON-SYMMETRICAL RASTER

1.) Improper setting of focus magnet or ion trap magnet. This will also cause shading at the sides or corners of the raster.
2.) Defective yoke.
3.) Defective C.R.T.
4.) Defective focus magnet.

VII. POOR HORIZONTAL LINEARITY

1.) If adjustments do not correct, change 6SN7GT, 6CD6G or 6W4GT tubes in horizontal sweep circuit.
2.) Horizontal output transformer defective.
3.) Defective deflection yoke.
4.) Check horizontal linearity control associated components.
5.) Broken slug inside linearity coil.
6.) Check circuit components coupling 6SN7GT horizontal oscillator tube to 6CD6G.
7.) Check D.C. operating voltages at tube sockets.
8.) Raster may be off center due to:
   a.) Focus magnet set wrong.
   b.) Shorted or leaky .25 mfd. capacitor returning horizontal deflection coil to B+.

VIII. NO HORIZONTAL SYNC. (PICTURE TEARING)

1.) S19 improperly adjusted - readjust for sync. with horizontal hold control at center of rotation.
2.) Check 1/2 12AU7 phase inverter and 6AL5 phase detector tubes and associated circuit components.
3.) Horizontal output transformer defective.
4.) Check horizontal oscillator coil, part #72-66.
5.) Check tubes and components in horizontal oscillator circuit. Check D.C. operating voltages.
6.) Dress C.R.T. cathode lead (yellow) away from deflection yoke cable. If too near, will cause horizontal jitter.

IX. NO HORIZONTAL OR VERTICAL SYNC. (SIGNAL NORMAL AT C.R.T.)

1.) Check 6AU6 sync. clipper and associated circuit components.
2.) Check 1/2 6AL5 D.C. restorer.
3.) Check 1N60 germanium crystal video detector.
4.) Defective deflection yoke.
5.) Defective 100 mfd., 25 V. cathode by-pass capacitor on 6S4. (6SN7 in TV-127)

X. RASTER AND SIGNAL ON C.R.T. BUT NO SOUND

1.) Check 6AU6 ratio detector driver, 6AL5 ratio detector and audio amplifier tubes and circuit components.
2.) Check shielded audio leads for grounds.
3.) Defective loudspeaker.
4.) Check phono input jack for bad contacts.

XI. SOUND DISTORTED

1.) Sheck alignment and balance of ratio detector.
2.) Check operating bias on 6AQ5 tube (at 117 volt A.C. line and with no signal, should be between 6 and 10 volts).
3.) Defective audio tubes.
4.) Defective loudspeaker.

XII. HUM OR BUZZ IN SOUND-VOLUME CONTROL MINIMUM

1.) Dress .05 mfd. coupling condenser to 6AT6 grid away from high band oscillator coil.
2.) Check main power supply filter capacitors.
3.) Check 80 mfd., 150V., 6AQ5 cathode by-pass capacitors.

XIII. PICTURE STABLE - POOR RESOLUTION

1.) Check video detector coil assembly and 1N60 germanium crystal.
2.) Check 6CB6 Video Amplifier tube.
3.) Check peaking coils in video amplifier.
4.) Check alignment of 4.5 Mc. trap.
5.) Check setting of focus magnet.
6.) Defective C.R.T.
7.) R.F. - I.F. circuits improperly aligned.

XIV. PICTURE SMEARY, TRAILERS

1.) Video amplifier overloaded by excessive input. Reduce contrast control setting.
   NOTE: In strong signal areas, excessive input at the antenna terminals will produce smear, picture jitter, etc. An attenuator network at the antenna terminals will remedy this condition.
2.) Check for open 500 microhenry choke (75-26) in video detector can.
3.) Check video coupling capacitors and grid resistors.

XV. RASTER BUT NO SOUND, PICTURE OR SYNC.

1.) Defective antenna or transmission line.
2.) R.F. oscillator not operating or off frequency.
3.) R.F. unit completely inoperative. Check tubes and voltages.
4.) I.F. section inoperative. Check tubes and voltages.
5.) Check video detector coil assembly and crystal.
6.) Video amplifier inoperative. Check tubes and voltages.

XVI. PICTURE AND SOUND NOT TUNING TOGETHER

1.) Complete realignment.
2.) Extremely weak signal conditions due to location or poor antenna.
3.) Set being tuned improperly.

XVII. DIFFICULTY IN TUNING ACCOMPANIED BY BUZZ

1.) Check alignment of 21.25 mc. trap (S10)
2.) Check ratio detector alignment.
3.) Complete realignment.
4.) Weak or poor signal conditions due to location or antenna.
5.) Everything normal, but set is being tuned improperly.
6.) Contrast control turned up too far, overloading video amplifier.

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VOLTAGE CHART TV-164, TV-167A, TV-191

Measurements made with receiver operating on 117 volt 60 cycle line, no signal input.
Volume control, brightness control, and contrast control set at minimum (counter clockwise position) except where noted.
Band Switch in Channel 2-6 position except where noted. Measurements made at low freq. end of bands (gang closed).
Voltages measured with vacuum tube voltmeter.
Grid voltages measured between grid and cathode. Other voltages measured to chassis.

TUBE TYPE	FUNCTION	PLATE PIN	PLATE VOLTS	SCREEN PIN	SCREEN VOLTS	CATHODE PIN	CATHODE VOLTS	GRID PIN	GRID VOLTS	NOTES ON MEASUREMENTS
12AT7	High Band R.F.	1	140	-	-	3	0	2	-3.0	Band Switch Sent on TV Ch. 7 to 13 Gang Closed
12AT7	High Band Mixer	1	140	-	-	3	2.5	2	-2.5	
12AT7	High Band Osc.	1	140	-	-	3	0	2	-3.0	
12AT7	Low Band R.F.	6	140	-	-	8	0	7	-3.25	Band Switch Set on TV Ch. 2 to 6 Gang Closed
12AT7	Low Band Mixer	6	140	-	-	8	0	7	-1.5	
12AT7	Low Band Osc.	6	140	-	-	8	0	7	-1.0	
6AU6	1st I.F.	5	140	6	140	7	.1	1	-3.5	
6AU6	2nd I.F.	5	140	6	140	7	.1	1	-3.5	
6AU6	3rd I.F.	5	140	6	140	7	.1	1	-3.5	
6AH6	4th I.F.	5	256	6	140	7	1.5	1	-1.5	
6AU6	Ratio Det. Driver	5	140	6	140	7	1.25	1	-1.25	
6AL5	Ratio Det.	7	-.1	-	-	1	0	-	-	These voltages vary with sig nal and noise
		2	0	-	-	5	-.1	-	-	
6AT6	1st Audio	7	80	-	-	2	0	1	-1	
6AQ5	Audio Output	5	340	6	350	2	140	7	-10	Cont. Grid to Grid - 130V varies with signal.
6CB6	Video Amp.	5	190	6	140	2	0	1	-1.7	Contrast Min.
		5	210	6	130	2	0	1	-1.9	Contrast Max.
6AL5	D.C. Rest.	7	-.25	-	-	1	.75	-	-	
"	A.G.C.	2	-3.5	-	-	5	-2.75	-	-	Contrast Min
		2	2.25	-	-	5	4.0	-	-	Contrast Max
6C4	Vert.Osc.	1	115	-	-	7	0	6	-40	Vert Controls set for normal picture
6S4	Vert.Out-put	9	440	-	-	2	25	6	-25	
6SN7	Hor.Osc.	2	260	-	-	3	10	1	-8	Hor. controls set for normal picture
"		5	180	-	-	6	10	4	-20	
6CD6G	Hor.Out-put	Cap	See Note 1	8	140	3	12	5	-30	
6W4GT	Damper	5	360	-	-	3	550	-	-	
1B3GT	HV Rect.	-	-	-	-	2	7.2 KV	-	-	
1B3GT	HV Rect.	-	-	-	-	2	14 KC	-	-	

TUBE	FUNCTION	PLATE PIN	PLATE VOLTS	SCREEN PIN	SCREEN VOLTS	CATHODE PIN	CATHODE VOLTS	GRID PIN	GRID VOLTS	NOTES ON MEASUREMENTS
16TP4) 16KP4) 19AP4)	Picture tube	Cap	14 KV	10	360	11	140	2	-100	Min.Brightness
		Cap	12.8KV	10	360	11	30	2	-25	Max.Brightness
6BA6	FM - RF Amp.	5	135	6	95	7	1	1	-1	Band Switch in FM-Phono Position
6BE6	FM - 1st Conv.	5	140	6	90	2	0	1	-2	
12AT7	FM - 2nd Osc.	1	140	-	-	3	0	2	-5	
12AT7	FM - 2nd Mix.	6	140	-	-	8	0	7	-4	
5U4G	Rect.	4	370 AC			2	360			Band switch in FM-Phono posit.
5U4G	Rect.	6	370 AC							
5U4G	Rect.	4	380 AC			2	360			Band Switch in TV Ch. 2-6 Pos.
5U4G	Rect.	6	380 AC							

Note 1 +520 V. at + end of 20 mf 250 V. Booster Electrolytic, 5500V. Pulses at 6CD6G Plate. Do Not Measure at this Point.

VOLTAGE CHART TV-127

MEASUREMENTS MADE WITH RECEIVER OPERATING ON 117 volt 60 cycle line, no signal input.
Volume control, brightness control, and contrast control set at minimum (counter clockwise position) except where noted.
Band Switch in Channel 2-6 position except where noted. Measurements made at low freq. end of bands (gang closed).
Voltages measured with vacuum tube voltmeter.
Grid voltages measured between grid and cathode. Other voltages measured to chassis

TUBE TYPE	FUNCTION	PLATE PIN	PLATE VOLTS	SCREEN PIN	SCREEN VOLTS	CATHODE PIN	CATHODE VOLTS	*GRID PIN	*GRID VOLTS	NOTES ON MEASUREMENTS
12AT7 (a)	High Band R.F.	1	145	-	-	3	0	2	-4	Band switch
12AT7 (b)	High Band Mixer	1	145	-	-	3	2.5	2	-2.5	set on TV Ch. 7-13
12AT7 (c)	High Band Osc.	1	145	-	-	3	0	2	-4	Gang closed
12AT7 (a)	Low Band R.F.	6	145	-	-	8	0	7	-4	Band switch
12AT7 (b)	Low Band Mixer	6	145	--	-	8	0	7	-1.5	set on TV Ch. 2-6
12AT7 (c)	Low Band Osc.	6	145	-	-	8	0	7	-1.5	Gang closed
6AU6	1st I.F.	5	145	6	145	7	.1	1	-4	
6AU6	2nd I.F.	5	290	6	145	7	.1	1	-4	Band switch to
6AU6	3rd I.F.	5	290	6	145	7	.1	1	-4	
6AH6	4th I.F.	5	290	6	145	7	2	1	-2	
6AU6	Ratio Det. Driver	5	145	6	145	7	1.5	1	-1.5	Ch. 2-6

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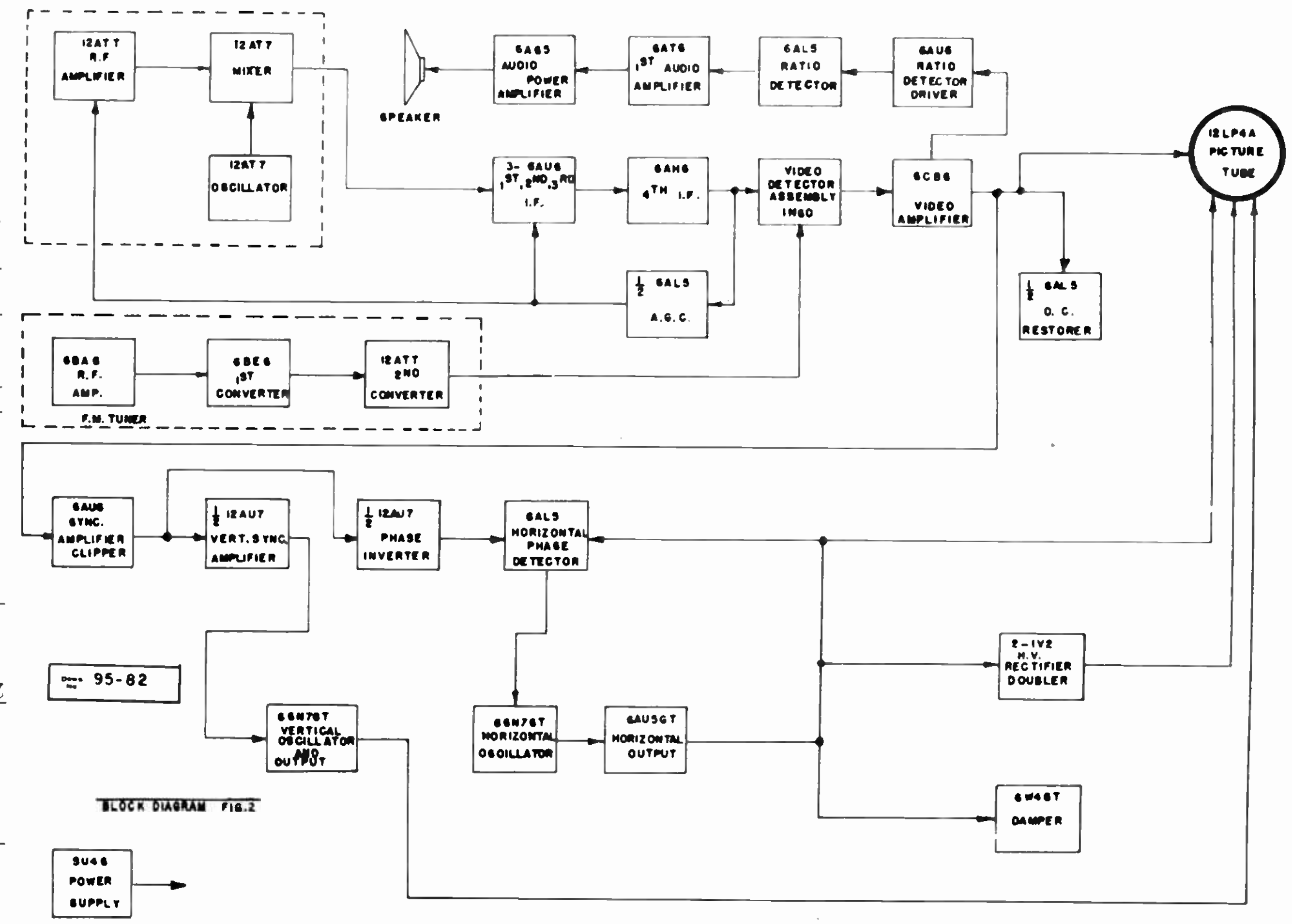
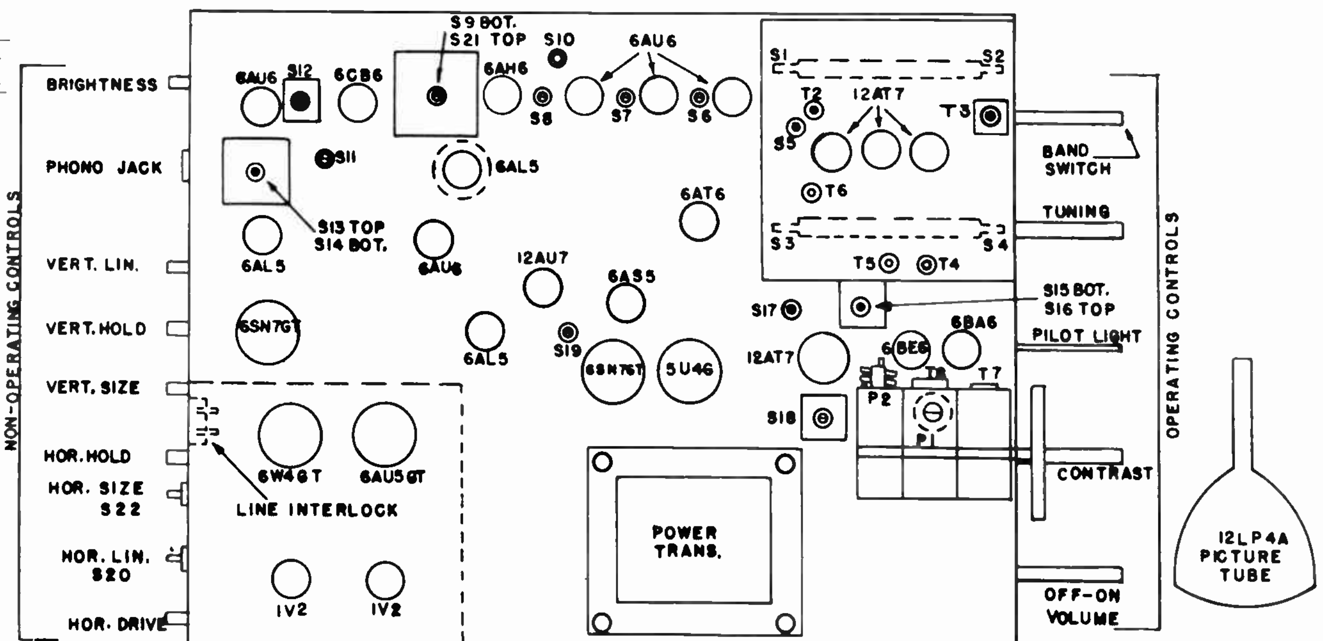
TUBE TYPE	FUNCTION	PLATE PIN	PLATE VOLTS	SCREEN PIN	SCREEN VOLTS	CATHODE PIN	CATHODE VOLTS	*GRID PIN	*GRID VOLTS	NOTES ON MEASUREMENTS
6AL5	Ratio Detector	7 2	0 -.1	- -	- -	1 5	.1 0	- -	- -	These voltages will vary with different signal or noise conditions.
6AT6	1st audio amplifier	7	75	-	-	2	0	1	-.7	
6AS5	Audio power amp.	7	280	6	275	1	145	2.5	-13	
6CB6	Video amplifier	5 5	190 210	6 6	145 135	2 2	0 0	1 1	-1.7 -1.9	Contrast Min Contrast Max
1/2 6AL5	D.C. Restorer	7	-.3	-	-	1	.4	-	-	
*	A.G.C.	2	-4	-	-	5	-3.5	-	-	Contrast Min.
		2	2	-	-	5	5	-	-	Contrast Max.
6AU6	Sync.clipper amp.	5	55	6	35	7	0	1	-1	
1/2 12AU7	Vertical sync.amp.	6	100	-	-	8	55	7	-1	
1/2 12AU7	Phase inverter	1	110	-	-	3	55	2	1	
6AL5	Horizontal Phase det.	2 7	-15 .1	- -	- -	5 1	.1 20	- -	- -	
1/2 6SN7	Vert. osc.	5	120	-	-	6	0	4	-50	All vertical controls set
1/2 6SN7	Vert. output	2	410	-	-	3	15	1	-15	at normal picture setting
1/2 6SN7	Hor. osc.	2	270	-	-	3	12	1	-10	All horizontal
1/2 6SN7		5	140	-	-	6	12	4	-25	controls set at normal pic-
6AU5	Horiz. output	5	See Note 1	8	200	3	7	1	-30	ture setting
6W4GT	Damper	5	300	-	-	3	440	-	-	
1V2	H.V. Rect. (a)	-	-	-	-	4	12 KV	-	-	
1V2	H.V. Rect. (b)	-	-	-	-	4	6 KV	-	-	
12LP4A	Picture tube	Cap Cap	12 KV 10.1KV	10 10	400 390	11 11	150 40	2 2	-110 -30	Brightness min Brightness max
6BA6	FM - RF Amplifier	5	145	6	100	7	1.2	1	-1.2	Band switch
6BE6	FM - 1st Converter	5	145	6	100	2	0	1 7	-3 0	to
1/2 12AT7	FM - 2nd Mixer	6	145	-	-	3	0	7	-2.5	FM position
1/2 12AT7	FM - 2nd Osc.	1	145	-	-	3	0	2	-2	(gang closed)
5U4G	Rect.	4	290 AC	-	-	2	300	-	-	
5U4G	Rect.	6	290 AC	-	-			-	-	
5U4G	Rect.	4	290 AC	-	-	2	315	-	-	Band switch
5U4G	Rect.	6	290 AC	-	-			-	-	to TV Ch. 2-6 position

Note 1 --- +440 V. at + end of 20 mf 250 V. Booster Electrolytic, 4000 V. Pulses at 6AU5 Plate. Do not measure at this point.



BLOCK DIAGRAM FIG.2



95-81 TUBE LAYOUT & ALIGNMENT CHART TV-127

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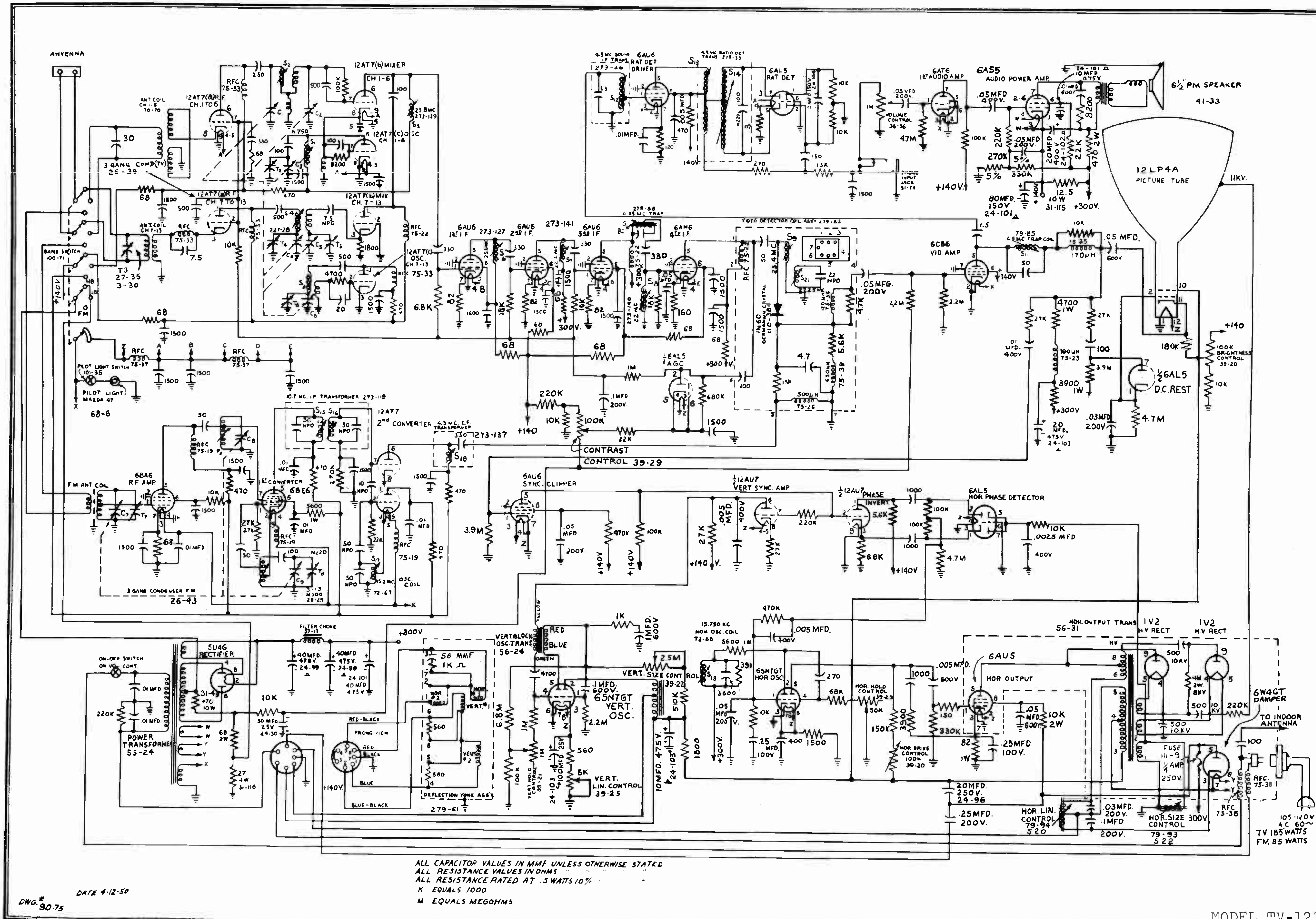

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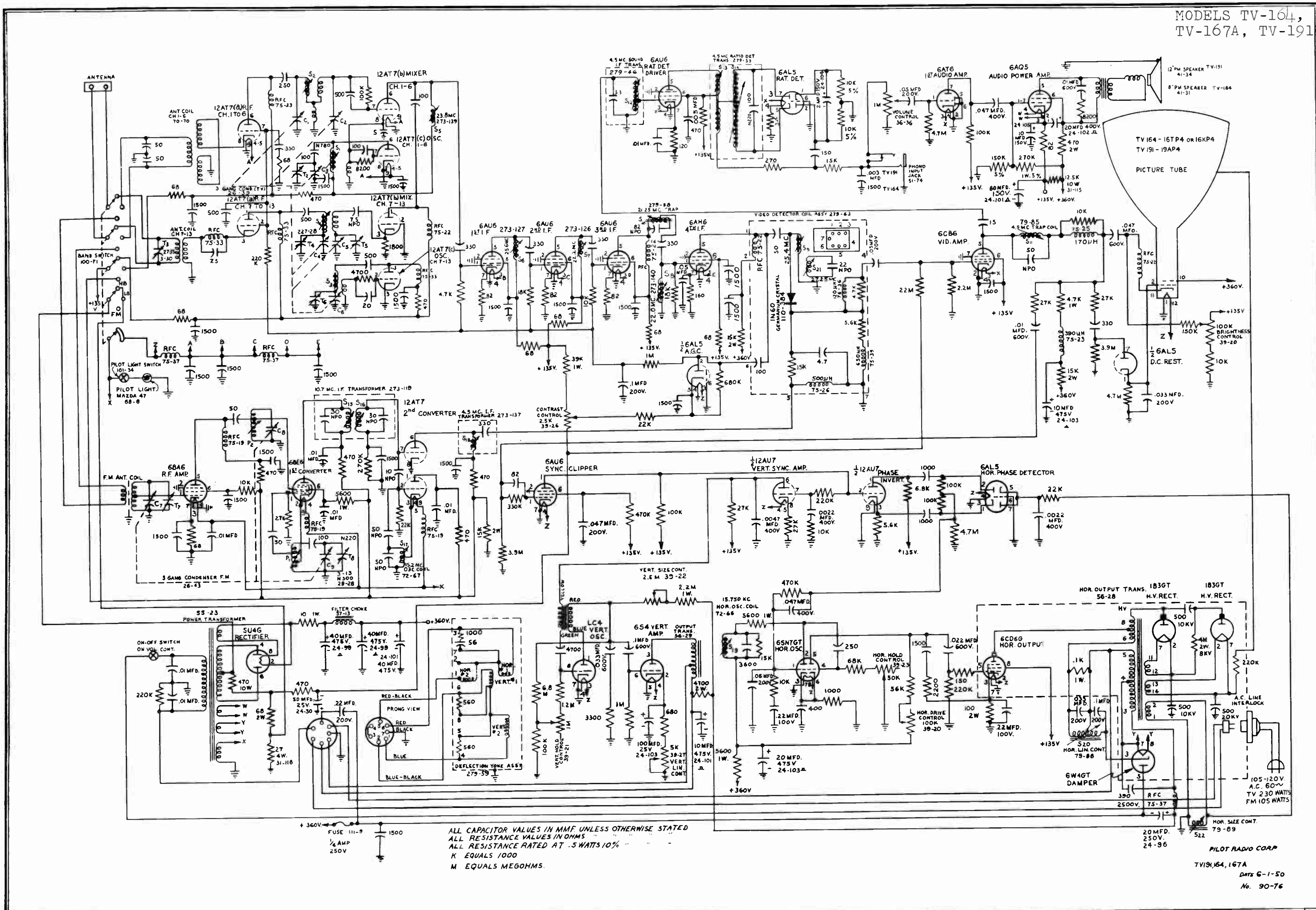
MODELS TV-164, TV-167A, TV-191



ALL CAPACITOR VALUES IN MMF. UNLESS OTHERWISE STATED
ALL RESISTANCE VALUES IN OHMS " " "
ALL RESISTANCE RATED AT .5 WATTS 10% " " "
K EQUALS 1000
M EQUALS MEGOHMS.

PILOT RADIO CORP

TV191, 164, 167A
DATE 6-1-50
No. 90-76

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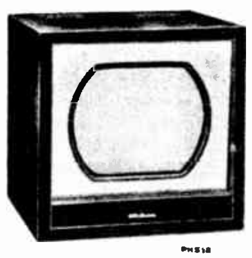
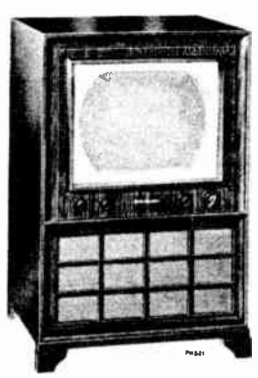
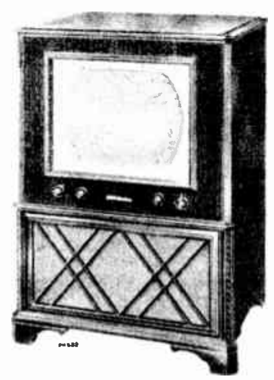


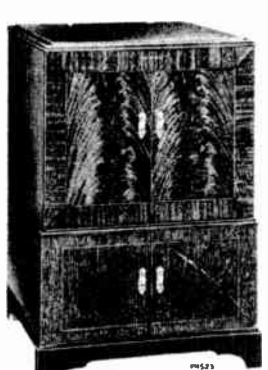
Model T164
Walnut, Mahogany or Oak



Model TC165
Walnut, Mahogany or Oak



Model TC166
Walnut, Mahogany or Oak



Model TC167
Walnut, Mahogany or Oak

Model TC168
Walnut, Mahogany or Oak

GENERAL DESCRIPTION

Models T164, TC165, TC166, TC167 and TC168 receivers employ twenty-one tubes plus two rectifiers and a 16GP4 kinescope. The receivers are identical except for cabinets, jewel lights and speakers. A phono input jack is provided to permit the use of an external record player.

ELECTRICAL AND MECHANICAL SPECIFICATIONS

PICTURE SIZE ...... 146 square inches on a 16GP4 kinescope

R-F FREQUENCY RANGES
All 12 television channels, 54 mc. to 88 mc., 174 mc. to 216 mc.
Fine Tuning Range..±250 kc. on chan. 2, ±650 kc. on chan. 13
Picture Carrier Frequency .... 25.75 mc.
Sound Carrier Frequency .... 21.25 mc.

CHASSIS DESIGNATIONS
KCS40 .... In Model T164
KCS40A .... In Models TC165, TC166, TC167, TC168

LOUDSPEAKERS
KCS40 .... (92580-3W) 8" PM Dynamic, 3.2 ohms
KCS40A .... (92569-10W) 12" PM Dynamic, 3.2 ohms

POWER SUPPLY RATING ...... 115 volts, 60 cycles, 250 watts

AUDIO POWER OUTPUT RATING .... 3.5 watts max.

RECEIVER ANTENNA INPUT IMPEDANCE
Choice: 300 ohms balanced or 72 ohms unbalanced.

RCA TUBE COMPLEMENT

	Tube Used	Function
(1)	RCA 6AG5	R-F Amplifier
(2)	RCA 6AG5	Converter
(3)	RCA 6J6	R-F Oscillator
(4)	RCA 6AU6	1st Sound I-F Amplifier
(5)	RCA 6AU6	2nd Sound I-F Amplifier
(6)	RCA 6AL5	Sound Discriminator
(7)	RCA 6AV6	1st Audio Amplifier
(8)	RCA 6K6GT	Audio Output
(9)	RCA 6BA6	1st Picture I-F Amplifier
(10)	RCA 6AG5	2nd Picture I-F Amplifier
(11)	RCA 6BA6	3rd Picture I-F Amplifier
(12)	RCA 6AG5	4th Picture I-F Amplifier
(13)	RCA 6AL5	Picture 2nd Detector and Sync Limiter
(14)	RCA 12AU7	1st and 2nd Video Amplifier
(15)	RCA 6SN7GT	AGC Amplifier and Vertical Sweep Osc.
(16)	RCA 6SN7GT	AGC Rectifier and 1st Sync Separator
(17)	RCA 6SN7GT	Sync Amplifier and 2nd Sync Separator
(18)	RCA 6K6GT	Vertical Sweep Output
(19)	RCA 6SN7GT	Horizontal Sweep Oscillator and Control
(20)	RCA 6BG6G	Horizontal Sweep Output
(21)	RCA 6W4GT	Damper
(22)	RCA 1B3-GT/8016	High Voltage Rectifier
(23)	RCA 5U4G	Power Supply Rectifier
(24)	RCA 16GP4	Kinescope

DIMENSIONS (inches)	Width	Height	Depth
Cabinet (outside), T164	23	21¼	21⅜
Cabinet (outside), TC165	27⅞	38¼	20⅝
Cabinet (outside), TC166	27⅝	38¾	22¾
Cabinet (outside), TC167	25¾	38¾	22¾
Cabinet (outside), TC168	26⅝	37⅞	22⅞
Chassis (overall)	19¼	11	18½

WEIGHT Model	Chassis with Tubes in Cabinet	Shipping Weight
T164	96	115
TC165	101	123
TC166	106	130
TC167	123	148
TC168	117	141

PICTURE INTERMEDIATE FREQUENCIES
Picture Carrier Frequency .... 25.75 Mc.
Adjacent Channel Sound Trap .... 27.25 Mc.
Accompanying Sound Traps .... 21.25 Mc.
Adjacent Channel Picture Carrier Trap .... 19.75 Mc.

SOUND INTERMEDIATE FREQUENCIES
Sound Carrier Frequency .... 21.25 Mc.
Sound Discriminator Band Width between peaks .... 350 kc

VIDEO RESPONSE .... To 4 Mc.

FOCUS .... Magnetic

SWEEP DEFLECTION .... Magnetic

SCANNING .... Interlaced, 525 line

HORIZONTAL SWEEP FREQUENCY .... 15,750 cps

VERTICAL SWEEP FREQUENCY .... 60 cps

FRAME FREQUENCY (Picture Repetition Rate) .... 30 cps

OPERATING CONTROLS (front panel)
Channel Selector / Fine Tuning .... Dual Control Knobs
Picture / Brightness .... Dual Control Knobs
Picture Horizontal Hold / Picture Vertical Hold .... Dual Control Knobs
Sound Volume and On-Off Switch / Tone .... Dual Control Knobs

NON-OPERATING CONTROLS (not including r-f and i-f adjustments)
Horizontal Centering .... cabinet adjustment
Vertical Centering .... cabinet adjustment
Width .... rear chassis adjustment
Height .... rear chassis adjustment
Horizontal Linearity .... rear chassis screwdriver adjustment
Vertical Linearity .... rear chassis adjustment
Horizontal Drive .... rear chassis screwdriver adjustment
Horizontal Oscillator Frequency ..... bottom chassis adjustment
Horizontal Oscillator Waveform .... side chassis adjustment
Horizontal Locking Range .... rear chassis adjustment
Focus .... rear chassis adjustment
Ion Trap Magnet .... cabinet adjustment
Deflection Coil .... cabinet adjustment
AGC Threshold Control .... rear chassis adjustment

HIGH VOLTAGE WARNING

OPERATION OF THIS RECEIVER OUTSIDE THE CABINET OR WITH THE COVERS REMOVED INVOLVES A SHOCK HAZARD FROM THE RECEIVER POWER SUPPLIES. WORK ON THE RECEIVER SHOULD NOT BE ATTEMPTED BY ANYONE WHO IS NOT THOROUGHLY FAMILIAR WITH THE PRECAUTIONS NECESSARY WHEN WORKING ON HIGH-VOLTAGE EQUIPMENT. DO NOT OPERATE THE RECEIVER WITH THE HIGH-VOLTAGE COMPARTMENT SHIELD REMOVED.

KINESCOPE HANDLING PRECAUTIONS

DO NOT REMOVE OR HANDLE THE KINESCOPE IN ANY MANNER UNLESS SHATTERPROOF GOGGLES AND HEAVY GLOVES ARE WORN. PEOPLE NOT SO EQUIPPED SHOULD BE KEPT AWAY WHILE HANDLING KINESCOPES. KEEP THE KINESCOPE AWAY FROM THE BODY WHILE HANDLING.

The kinescope bulb encloses a high vacuum and, due to its large surface area, is subjected to considerable air pressure. For this reason, kinescopes must be handled with more care than ordinary receiving tubes.

The large end of the kinescope bulb — particularly that part at the rim of the viewing surface — must not be struck, scratched or subjected to more than moderate pressure at any time. In installation, if the tube sticks or fails to slip smoothly into its socket, or deflecting yoke, investigate and remove the cause of the trouble. Do not force the tube. Refer to the Receiver Installation section for detailed instructions on kinescope installation. All RCA replacement kinescopes are shipped in special cartons and should be left in the cartons until ready for installation in the receiver. Keep the carton for possible future use.

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OPERATING INSTRUCTIONS

The following adjustments are necessary when turning the receiver on for the first time:

1. See that the TV-PH switch on the rear apron is in the "TV" position.

2. Turn the receiver "ON" and advance the SOUND VOLUME control to approximately mid-position.

3. Set the STATION SELECTOR to the desired channel.

4. Adjust the FINE TUNING control for best sound fidelity and the SOUND VOLUME control for suitable volume.

5. Turn the BRIGHTNESS control fully counter-clockwise, then clockwise until a light pattern appears on the screen.

6. Adjust the VERTICAL hold control until the pattern stops vertical movement.

7. Adjust the HORIZONTAL hold control until a picture is obtained and centered.

8. Turn the BRIGHTNESS control counter-clockwise until the retrace lines just disappear.

9. Adjust the PICTURE control for suitable picture contrast.

10. After the receiver has been on for some time, it may be necessary to readjust the FINE TUNING control slightly for improved sound fidelity.

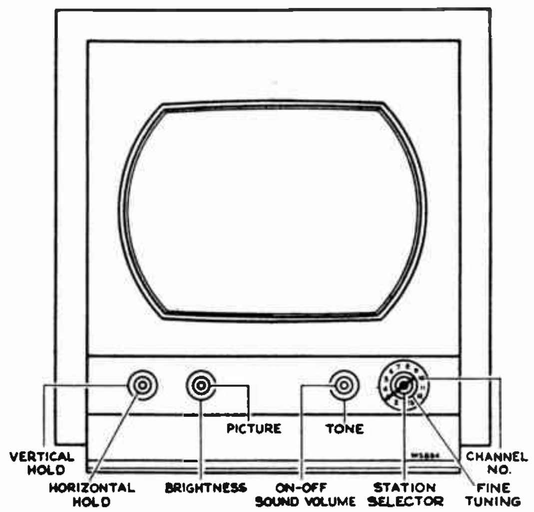

Figure 1—Receiver Operating Controls

11. In switching from one station to another, it may be necessary to repeat steps 4, 8 and 9.

12. When the set is turned on again after an idle period, it should not be necessary to repeat the adjustments if the positions of the controls have not been changed. If any adjustment is necessary, step number 4 is generally sufficient.

13. If the positions of the controls have been changed, it may be necessary to repeat steps 2 through 9.

14. To use the instrument with a record player, plug the record-player output cable into the PHONO jack on the rear apron, and set the TV-PH switch on "PH." Set the TV-PH switch back to TV on completion of the record program.

INSTALLATION INSTRUCTIONS

These receivers are shipped complete in cardboard cartons. The kinescope is shipped in place in the receiver.

UNPACKING.—To unpack the T164, tear open the carton flaps, pick up the receiver from under the bottom of the cabinet, and lift it out of the shipping carton.

The receiver may now be placed on a stand, table or other appropriate support. If a table or piece of furniture other than the regular stand is used for support, care must be taken to see that the receiver is sitting on the cabinet feet. If the bottom of the cabinet is permitted to touch a table top, the table could become badly scratched.

To unpack the console receivers, turn the shipping carton on its side and tear open the carton bottom flaps. Fold the flaps up along the side of the carton and turn the carton back up. Lift the carton up and off the cabinet.

To remove the skid attached to the bottom of the console cabinets, take off the nuts from the two bolts that hold the cabinet on the skid. With a man at each end of the cabinet, lift the cabinet off the skid.

Take off the cabinet back. The operating control knobs are packed in a bag which is tied on top of the chassis. Remove the bag and install the knobs on the proper control shafts.

Make sure that all tubes are in place and are firmly seated in their sockets.

Check to see that the high voltage lead clip is in place between the rim of the kinescope and the kinescope mask.

Connect the antenna transmission line to the receiver antenna terminals. Plug the receiver power cord into a 115 volt a-c power source. Turn the receiver power switch to the "on" position, the brightness control fully clockwise, and the picture control counter-clockwise.

WARNING. — The high voltage supply in this receiver delivers 12,000 volts! A.C. interlocks are provided at the back of the set so that when the back is removed — so is the power.

ION TRAP MAGNET ADJUSTMENT.—Set the ion trap magnet approximately in the position shown in Figure 2, and with the part number on magnet towards the rear of the chassis. Starting from this position immediately adjust the magnet by moving it forward or backward at the same time rotating it slightly around the neck of the kinescope for the brightest

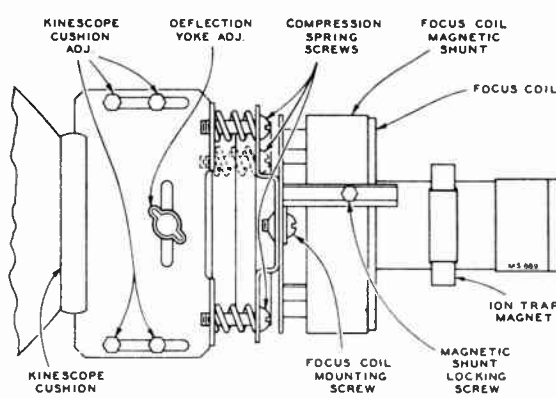

Figure 2—Yoke and Focus Coil Adjustments

raster on the screen. Reduce the brightness control setting until the raster is slightly above average brilliance. Adjust the focus control (R191 on the chassis rear apron) until the line structure of the raster is clearly visible. Readjust the ion trap magnet for maximum raster brilliance. The final touches of this adjustment should be made with the brightness control at the maximum position with which good line focus can be maintained.

DEFLECTION YOKE ADJUSTMENT.—If the lines of the raster are not horizontal or squared with the picture mask, rotate the deflection yoke until this condition is obtained. Tighten the yoke adjustment wing screw.

PICTURE ADJUSTMENTS.—It will now be necessary to obtain a test pattern picture in order to make further adjustments. See steps 3 through 9 of the receiver operating instructions.

If the Horizontal Oscillator and AGC System are operating properly, it should be possible to sync the picture at this point. However, if the AGC threshold control is misadjusted, and the receiver is overloading, it may be impossible to sync the picture.

If the receiver is overloading, turn R138 on the rear apron (see Figure 3) clockwise until the set operates normally and the picture can be synced.

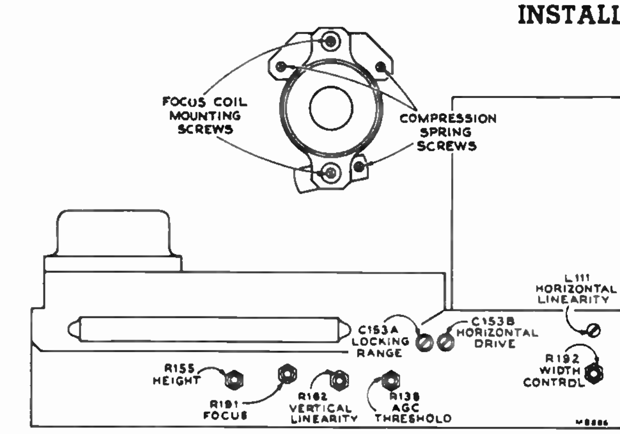

Figure 3—Rear Chassis Adjustments

CHECK OF HORIZONTAL OSCILLATOR ALIGNMENT.—Turn the horizontal hold control to the extreme counter-clockwise position. The picture should remain in horizontal sync. Momentarily remove the signal by switching off channel then back. Usually the picture will remain in sync. Turn the control clockwise slowly. If the picture did fall out of sync upon removal of the signal, the number of diagonal black bars will be gradually reduced and when only 2 bars sloping downward to the left are obtained, the picture will pull into sync upon slight additional clockwise rotation of the control. The picture should remain in sync for approximately 180 degrees of additional clockwise rotation of the control. At the extreme clockwise position, the picture should be out of sync and should show 1 vertical or diagonal black bar in the raster.

If the receiver passes the foregoing checks and the picture is normal and stable, the horizontal oscillator is properly aligned. Skip "Alignment of Horizontal Oscillator" and proceed with "Focus Coil Adjustment."

ALIGNMENT OF HORIZONTAL OSCILLATOR. — If in the above check the receiver failed to hold sync with the hold control at the extreme counter-clockwise position or failed to hold sync over 180 degrees of clockwise rotation of the control from the pull-in point, it will be necessary to make the following adjustments:

Horizontal Frequency Adjustment.—Turn the T109 sine wave core (on the outside of the apron) all the way out of the coil.

Set the locking range trimmer C153A one-half turn out from maximum capacity.

Turn the horizontal hold control to the extreme clockwise position. Tune in a television station and turn the frequency wave core of T109 under the chassis until the picture syncs and the sync bar just begins to move into the picture.

Note.—Occasionally, a tube may be found which does not respond to this alignment procedure since it may not be possible to sync the picture by means of the frequency core when the sine wave core is all the way out of the coil. Yet, the tube may work perfectly well when the circuit is properly aligned. In such a case, it may be necessary to turn the sine wave core in slightly, and readjust the frequency core to obtain sync.

Turn the sine wave core of T109 in until the blanking bar begins to move off to the left of the picture. Alternately turn the sine wave core in and the frequency out, keeping the picture in sync and the blanking bar showing in the picture.

Continue alternate adjustments until the picture falls from sync into a parasitic oscillation as indicated by a non-synchronized pattern which flickers in width and centering with possibly a light ragged vertical bar through the center of the screen.

Turn the sine wave core out ½ turn. Adjust the frequency core in until the picture is in sync and horizontal blanking appears as a vertical bar in the picture.

Check of Pull-in Range.—Turn the horizontal hold control fully counter-clockwise. Connect a 270K ohm resistor across C156. Momentarily switch off channel and back; the picture will then be out of sync. Turn the hold control clockwise slowly and observe the minimum number of bars obtained just before the picture pulls into sync.

The picture should snap in from two complete blanking bars. If two bars are not obtained, turn the locking range trimmer C153A in to obtain less bars or out to obtain more bars.

If C153A was adjusted, remove the 270K resistor, turn the horizontal hold control fully clockwise and adjust the T109 frequency core until horizontal blanking appears as a vertical bar in the synced picture. Then repeat the entire check of pull-in range to this point.

Repeat the adjustments under "Check of Pull-in Range" until the conditions specified are fulfilled. When the horizontal hold operates as outlined under "Check of Horizontal Oscillator Alignment" the oscillator is properly adjusted.

If the oscillator does not hold sync properly at this point and the AGC system is in proper adjustment it will be necessary to adjust the Horizontal Oscillator by the method outlined in the alignment procedure on page 11.

FOCUS COIL ADJUSTMENTS.—The focus coil should be adjusted so that there is approximately one-quarter inch of space between the rear cardboard shell of the yoke and the flat of the front face of the focus coil. This spacing gives best average focus over the face of the tube. The axis of the hole through the focus coil should be parallel with the axis of the kinescope neck.

The focus coil is provided with a magnetic shunt in the form of a metal sleeve as shown in Figure 2. If the receiver focuses with the focus control near the end of its range, loosen the shunt locking screw and slide the shunt backward or forward until focus occurs in the center range of the focus control.

CENTERING ADJUSTMENT. — No electrical centering controls are provided. Centering is obtained by loosening the two focus coil mounting screws and sliding the coil up or down or from side to side. If the focus coil was appreciably changed in position or if a corner of the raster is shadowed, check the position of the ion trap magnet. Reposition the magnet within the range of maximum raster brightness to eliminate the shadow and recenter the picture by sliding the coil. In no case should the magnet be adjusted to cause any loss of brightness since such operation may cause immediate or eventual damage to the tube. In extreme cases it may be necessary to adjust one or more of the three focus coil compression spring screws to eliminate a corner shadow.

WIDTH, DRIVE AND HORIZONTAL LINEARITY ADJUSTMENTS.—Adjustment of the horizontal drive control affects the high voltage applied to the kinescope. In order to obtain the highest possible voltage hence the brightest and best focused picture, adjust horizontal drive counter-clockwise as far as possible without losing tension on trimmer.

Set the width control to minimum picture width.

Turn the horizontal linearity coil out until appreciable loss in width occurs, then in until nearly maximum width and the best linearity is obtained. Do not run the core in beyond the point of maximum linearity change, as the current drawn by the 6BG6G then becomes excessive.

Adjust the width control for the proper picture width.

Readjust linearity, but again not beyond the point of maximum linearity change. If necessary adjust the drive control for best linearity.

If at very high line voltage, the picture width is excessive even with the width control set at minimum, turn the linearity coil out to obtain the proper width. On high line voltage, excessive width generally will be accompanied by good linearity, without retouching the drive.

Adjustments of the horizontal drive control affect horizontal oscillator hold and locking range. If the drive control was adjusted, recheck the oscillator alignment.

FOCUS.—Adjust the focus control (R191 on chassis rear apron) for maximum definition in the test pattern vertical "wedge" and best focus in the white areas of the pattern.

HEIGHT AND VERTICAL LINEARITY ADJUSTMENTS.—Adjust the height control (R155 on chassis rear apron) until the picture fills the mask vertically. Adjust vertical linearity (R162 on rear apron) until the test pattern is symmetrical from top to bottom. Adjustment of either control will require a readjustment of the other. Adjust the focus coil to align the picture with the mask.

Check to see that the cushion and yoke thumbscrews and the focus coil mounting screws are tight.

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INSTALLATION INSTRUCTIONS

AGC THRESHOLD CONTROL.—The AGC threshold control R138 is adjusted at the factory and normally should not require readjustment in the field.

To check the adjustment of the AGC threshold control, tune in a strong signal, sync the picture and turn the picture control to the maximum clockwise position. Turn the brightness control counter-clockwise until the vertical retrace lines are just invisible. Momentarily remove the signal by switching off channel and then back. If the picture reappears immediately, the receiver is not overloading due to improper setting of R138. If the picture requires an appreciable portion of a second to reappear, R138 should be readjusted.

Set the picture control at the maximum clockwise position. Turn R138 fully clockwise. The top one-half inch of the picture may be bent slightly. This should be disregarded. Turn R138 counter clockwise until there is a very, very slight bend or change of bend in the top one-half inch of the picture. Then turn R138 clockwise just sufficiently to remove this bend or change of bend.

If the signal is very weak, the above method may not work as it may be impossible to get the picture to bend. In this case, turn R138 counter-clockwise until the snow in the picture becomes more pronounced, then clockwise until the best signal to noise ratio is obtained.

The AGC control adjustment should be made on a strong signal if possible. If the control is set too far counter-clockwise on a weak signal, then the receiver may overload when a strong signal is received.

CHECK OF R-F OSCILLATOR ADJUSTMENTS.—Tune in all available stations to see if the receiver r-f oscillator is adjusted to the proper frequency on all channels. If adjustments are required, these should be made by the method outlined in the alignment procedure on page 10. The adjustments for channels 2 through 5 and 7 through 12 are available from the front of the cabinet by removing the station selector escutcheon as shown in Figure 4. Adjustment for channel 13 is on top of the chassis and channel 6 adjustment is in the kinescope well. See Figures 8 and 9 for their location.

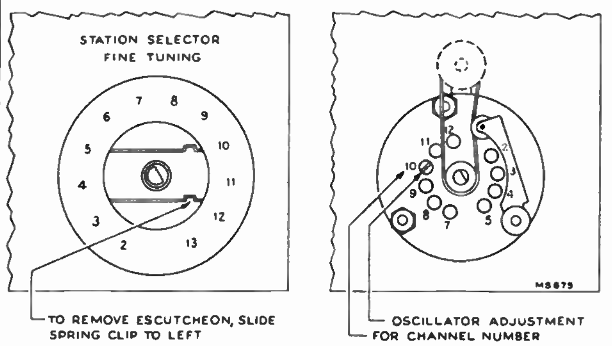

Figure 1—R-F Oscillator Adjustments

Replace the cabinet back and make sure that the screws are tight in order to prevent rattling at high volume.

WEAK SIGNAL AREA OPERATION.—Since the vast majority of receivers are sold in strong signal areas, the chassis are aligned to produce the cleanest pictures in those areas. However, if the receiver is to be operated in a weak signal area, better performance can be obtained by "peaking" the r-f unit.

To peak the r-f unit in these receivers, disconnect the 390-ohm resistor R14 which is on top of the r-f unit chassis. Adjust L66 to obtain the best possible picture on the weakest low channel station received.

If the peaked receiver is subsequently taken to a strong signal area, the resistor R14 should be connected in place and L66 adjusted for "flat" response on the low channels.

CHASSIS REMOVAL.—To remove the chassis from the cabinet for repair or installation of a new kinescope, remove the control knobs, the cabinet back, unplug the speaker cable, the kinescope socket, the antenna cable, the pilot light cable, the yoke and focus coil cable. Remove the yoke frame grounding strap and the interlock switch. Take out the six chassis bolts under the cabinet. Withdraw the chassis from the back of the cabinet.

KINESCOPE HANDLING PRECAUTION.—Do not install, remove, or handle the kinescope in any manner, unless shatterproof goggles and heavy gloves are worn. People not so equipped should be kept away while handling the kinescope. Keep the kinescope away from the body while handling.

To remove the kinescope from the cabinet, take out the four screws and one wing screw which hold the yoke frame to the cabinet. Remove the kinescope, the yoke frame with yoke and focus coil as an assembly.

INSTALLATION OF KINESCOPE.—Handle this tube by the metal rim at the edge of the screen. Do not cover the glass bell of the tube with fingermarks as it will produce leakage paths which may interfere with reception. If this portion of the tube has inadvertently been handled, wipe it clean with a soft cloth moistened with "dry" carbon tetrachloride.

Wipe the kinescope screen surface and front panel safety glass clean of all dust and fingermarks with a soft cloth moistened with "Windex" or similar cleaning agent.

Turn the tube so that the key on the base of the tube will be down and insert the neck of the kinescope through the deflection and focus coils. If the tube sticks, or fails to slip into place smoothly, investigate and remove the cause of the trouble. Do not force the tube.

Replace the kinescope and yoke frame assembly in the cabinet. Insert the four screws and wing screw and tighten.

Slip the kinescope as far forward as possible. Slide the kinescope cushion firmly up against the flare of the tube and tighten the adjustment wing screws. Slide the deflection yoke as far forward as possible. If this is not done, difficulty will be encountered in adjusting the ion trap magnet and focus coil because of shadows on the corner of the raster.

Slide the chassis into the cabinet, then insert and tighten the six chassis bolts.

Slip the ion trap magnet over the neck of the kinescope.

Connect the kinescope socket to the tube base and slip the high voltage lead clip between the rim of the kinescope and the mask.

Reconnect all other cables. Do not forget to replace the yoke frame grounding strap. Perform the entire set-up procedure beginning with Ion Trap Magnet Adjustment.

ANTENNAS.—The finest television receiver built may be said to be only as good as the antenna design and installation. It is therefore important to select the proper antenna to suit local conditions, to install it properly and orient it correctly.

RCA Television Antenna, type No. 225A1 is designed for reception of all twelve television channels. The antenna uses the 300-ohm RCA "Bright Picture" television transmission line. The antenna, a dipole with reflector, is unidirectional on channels two through six. When used on these channels the maximum signal is obtained when the antenna rods are broadside toward the transmitting antenna, with the antenna element between the reflector and the transmitting antenna.

When operated on channels seven through thirteen (174 to 216 Mc), the antenna has side lobes. On these channels, the maximum signal will be obtained when the antenna is rotated approximately 35 degrees in either direction from its broadside position toward the transmitting antenna. In many instances this effect may not cause any difficulties and it may be possible to make a compromise orientation which will permit satisfactory reception on all high and low channels. In some instances, however, this will not be the case due to reflections or to insufficient signal strength from one or more stations.

RCA antenna type 204A1 is available for use in locations in which it is desirable to eliminate side lobes and to have the antennas 7-13 directivity the same as its 2-6 directivity.

For use in cases where it is desirable to have adjustable 7-13 directivity different from 2-6, RCA antenna type 206A1 is provided.

In weak signal areas it is possible to "stack" the type 204A1 antenna to obtain increased signal strength by employing one type 204A1 antenna and one type 208A1 stacking kit.

CABINET ANTENNA.—A cabinet antenna is provided which may be employed in strong signal areas in which no reflections are experienced. The antenna leads are brought out near the receiver antenna terminal board.

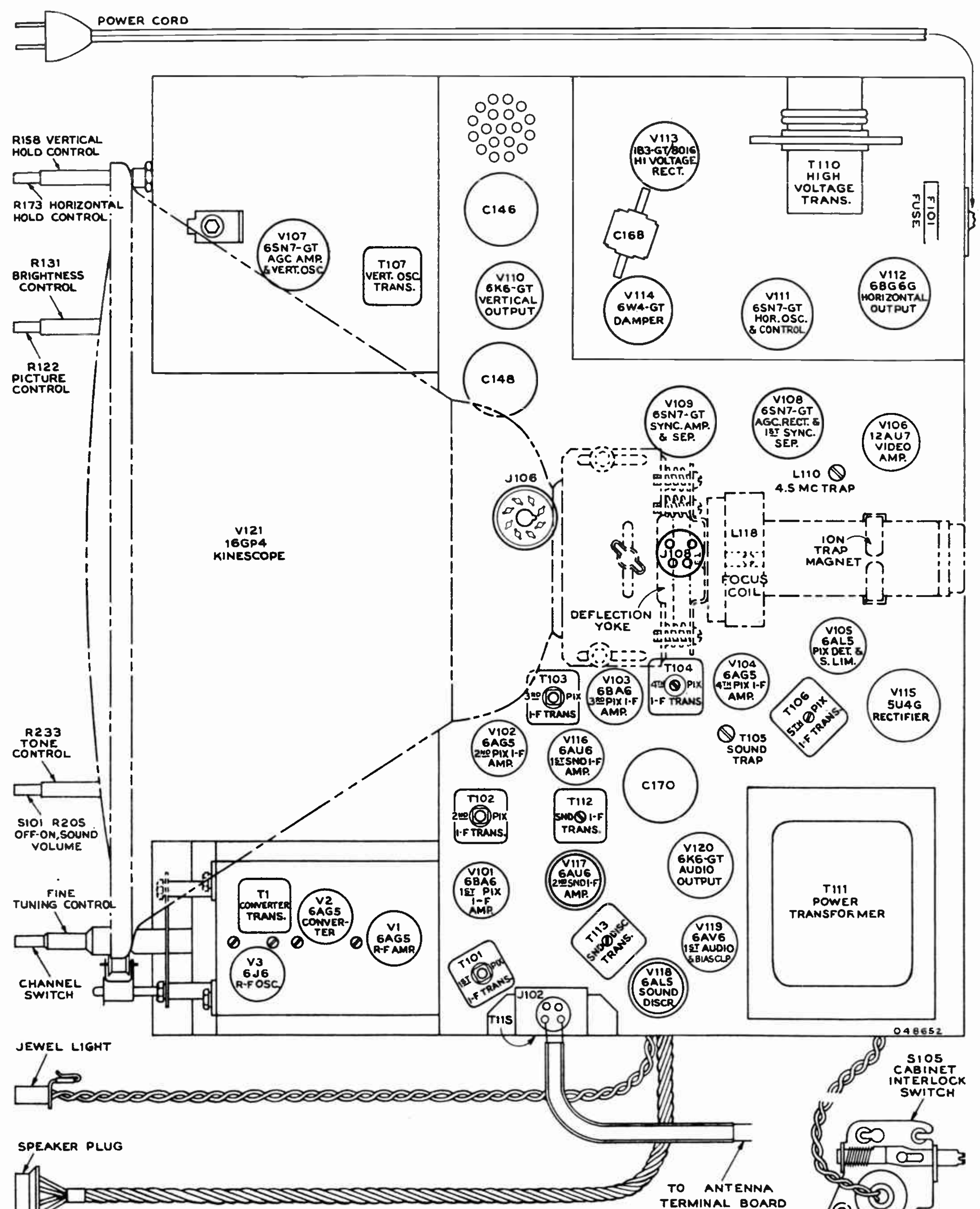

Figure 5—Chassis Top View

MODELS T164, Ch. KCS40; TC165, TC166, TC167, TC168, Ch. KCS40A

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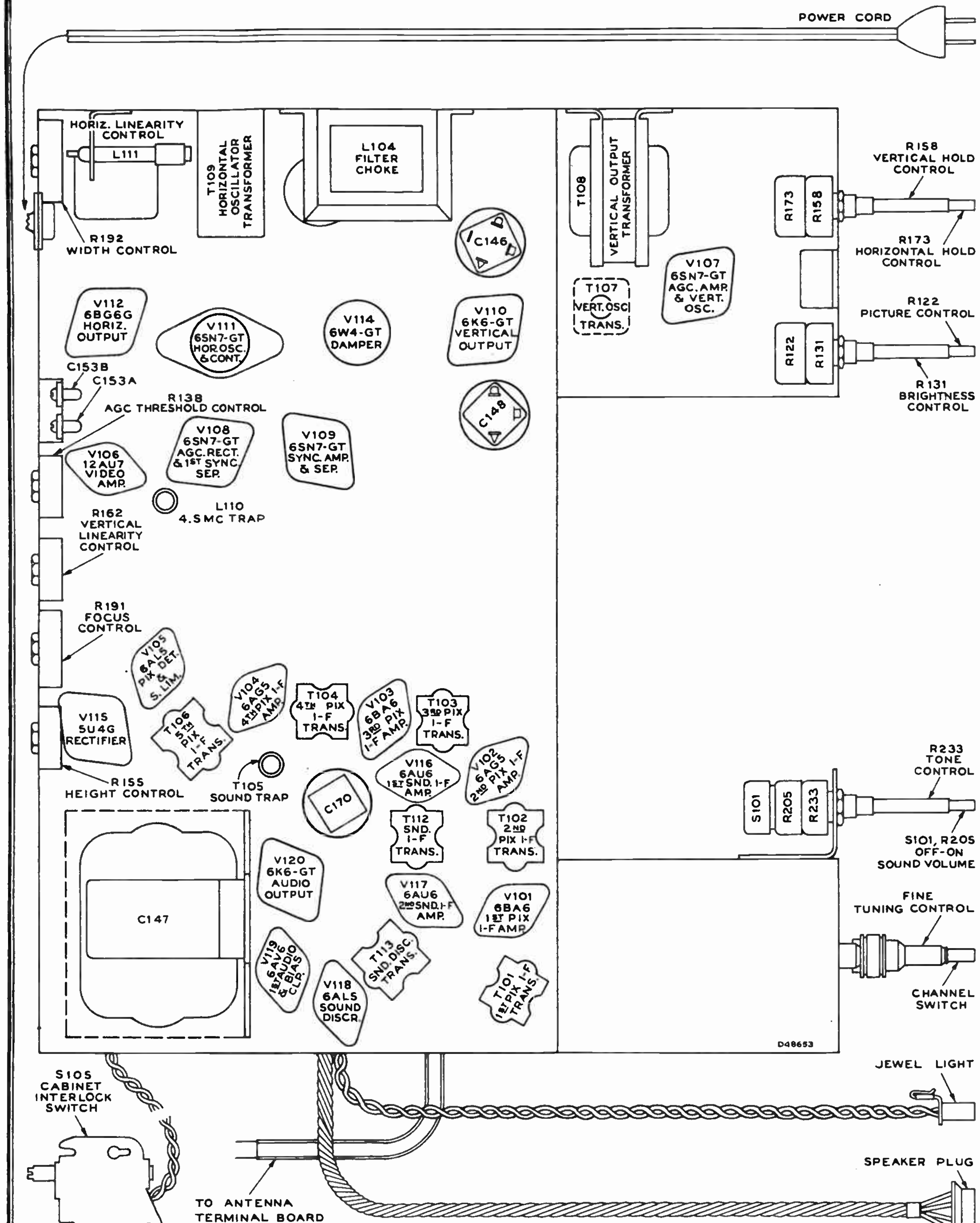

Figure 6—Chassis Bottom View

ALIGNMENT PROCEDURE

TEST EQUIPMENT. — To service properly the television chassis of this receiver, it is recommended that the following test equipment be available:

R-F Sweep Generator meeting the following requirements:

(a) Frequency Ranges
20 to 30 mc., 1 mc. and 10 mc. sweep width
50 to 90 mc., 10 mc. sweep width
170 to 225 mc., 10 mc. sweep width

(b) Output adjustable with at least .1 volt maximum.

(c) Output constant on all ranges.

(d) "Flat" output on all attenuator positions.

Cathode-Ray Oscilloscope. — For alignment purposes, the oscilloscope employed must have excellent low frequency and phase response, and should be capable of passing a 60-cycle square wave without appreciable distortion. While this requirement is not met by many commercial instruments, RCA Oscilloscopes, types WO-55A, WO-58A, WO-79A, and WO-60C fill the requirement and any of these may be employed.

For video and sync waveform observations, the oscilloscope must have excellent frequency and phase response from 10 cycles to at least two megacycles in all positions of the gain control. The RCA types WO-58A and WO-79A are ideally suited for this purpose.

Signal Generator to provide the following frequencies with crystal accuracy.

(a) Intermediate frequencies
19.75 mc. adjacent channel picture trap
21.25 mc. sound i-f and sound traps
22.05 and 24.75 mc. conv. and first pix i-f trans.
25.9 mc. second picture i-f transformer
24.6 mc. fourth picture i-f transformer
22.0 mc. third picture i-f transformer
22.5 mc. fifth picture i-f transformer
25.75 mc. picture carrier
27.25 mc. adjacent channel sound trap

(b) Radio frequencies

Channel Number	Picture Carrier Freq. Mc.	Sound Carrier Freq. Mc.
2	55.25	59.75
3	61.25	65.75
4	67.25	71.75
5	77.25	81.75
6	83.25	87.75
7	175.25	179.75
8	181.25	185.75
9	187.25	191.75
10	193.25	197.75
11	199.25	203.75
12	205.25	209.75
13	211.25	215.75

(c) Output on these ranges should be adjustable and at least .1 volt maximum.

Heterodyne Frequency Meter with crystal calibrator if the signal generator is not crystal controlled.

Electronic Voltmeter of Junior "VoltOhmyst" type and a high voltage multiplier probe for use with this meter to permit measurements up to 15 kv.

Service Precautions. — If possible, the chassis should be serviced without the kinescope. However, if it is necessary to view the raster during servicing, it would be a great convenience to have a set of yoke, focus coil, kinescope socket, high voltage and speaker extension cables.

CAUTION: Do not short the kinescope second-anode lead. Its short circuit current represents a considerable overload on the high voltage rectifier V113.

Adjustments Required. — Normally, only the r-f oscillator line will require the attention of the service technician. All other circuits are either broad or very stable and hence will seldom require readjustment.

The oscillator line is relatively non-critical. When oscillator tubes are changed, in all probability it will be necessary to adjust only C6 in order to bring the entire line into adjustment.

ORDER OF ALIGNMENT. — When a complete receiver alignment is necessary, it can be most conveniently performed in the following order:

(1) Sound discriminator
(2) Sound i-f transformers
(3) Picture i-f traps
(4) Picture i-f transformers
(5) R-F and converter lines
(6) R-F oscillator line
(7) 4.5 mc. video trap
(8) Sensitivity check

SOUND DISCRIMINATOR ALIGNMENT. — Set the signal generator for approximately .1 volt output at 21.25 mc. and connect it to the second sound i-f grid.

Detune T113 secondary (bottom).

Set the "VoltOhmyst" on the 3-volt scale.

Connect the meter, in series with a 1-megohm resistor, to the junction of diode resistors R203 and R204.

Adjust the primary of T113 (top) for maximum output on the meter.

Connect the "VoltOhmyst" to the junction of C183 and R203. Adjust T113 secondary (bottom). It will be found that it is possible to produce a positive or negative voltage on the meter dependent upon this adjustment. Obviously to pass from a positive to a negative voltage, the voltage must go through zero. T113 (bottom) should be adjusted so that the meter indicates zero output as the voltage swings from positive to negative. This point will be called discriminator zero output.

Connect the sweep oscillator to the grid of the second sound i-f amplifier.

Adjust the sweep band width to approximately 1 mc. with the center frequency at approximately 21.25 mc. and with an output of approximately .1 volt.

Connect the oscilloscope to the junction of C183 and R203. The pattern obtained should be similar to that shown in Figure 12. If it is not, adjust T113 (top) until the waveform is symmetrical.

The peak-to-peak band width of the discriminator should be approximately 350 kc. and the trace should be linear from 21.175 mc. to 21.325 mc.

SOUND I-F ALIGNMENT. — Connect the sweep oscillator to the first sound i-f amplifier grid.

Connect the oscilloscope to the second sound i-f grid return (terminal A of T112) in series with a 33,000-ohm isolating resistor.

Insert a 21.25 mc. marker signal from the signal generator into the first sound i-f grid.

Adjust T112 (top and bottom) for maximum gain and symmetry about the 21.25 mc. marker. The pattern obtained should be similar to that shown in Figure 13.

The output level from the sweep should be set to produce approximately .3 volt peak-to-peak at the second sound i-f grid return when the final touches on the above adjustment are made. It is necessary that the sweep output voltage should not exceed the specified values otherwise the response curve will be broadened, permitting slight misadjustment to pass unnoticed and possibly causing distortion on weak signals.

The band width at 70% response from the first sound i-f grid to the second i-f grid should be approximately 200 kc.

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PICTURE I-F TRAP ADJUSTMENT. — Connect the "VoltOhmyst" to the junction of R135 and C190.

Remove the 6SN7GT AGC Amplifier tube V107. Connect a 250,000-ohm potentiometer between pins 5 and 6 of the V107 socket. Adjust the potentiometer until the "VoltOhmyst" reads approximately −12 volts.

Set the channel switch to the blank position between channels number 2 and 13.

Connect the "VoltOhmyst" across the picture detector load resistor R119. Under this condition, both leads of the meter are at approximately −120 volts. In making this connection, care should be taken not to touch the case of the meter or to permit the meter case to become grounded.

Connect the output of the signal generator to the grid of the converter tube V2. To do this, remove the tube from the socket and fashion a clip by twisting one end of a small piece of wire around pin number 1. Replace the tube in the socket leaving the end of the wire protruding from under the tube. Connect the signal generator to this wire through a 1,500 mmf capacitor keeping the leads as short as possible.

Set the generator to each of the following frequencies and with a thin fiber screwdriver tune the specified adjustment for minimum indication on the "VoltOhmyst." In each instance the generator should be checked against a crystal calibrator to insure that the generator is exactly on frequency.

(1) 21.25 mc.—T103 (top)
(2) 21.25 mc.—T105 (top)
(3) 27.25 mc.—T102 (top)
(4) 27.25 mc.—T104 (top)
(5) 19.75 mc.—T106 (top)
(6) 19.75 mc.—T101 (top)

In the above transformers using threaded cores, it is possible to run the cores completely through the coils and secure two peaks or nulls. The correct position is with the cores in the outside ends of the coils. If the cores are not in the correct position, the coupling will be incorrect and it will be impossible to secure the correct response.

PICTURE I-F TRANSFORMER ADJUSTMENTS. — Set the signal generator to each of the following frequencies and peak the specified adjustment for maximum indication on the "VoltOhmyst." During alignment, reduce the input signal if necessary to prevent overloading.

22.5 mc.—T106 (bottom)
24.6 mc.—T104 (bottom)
22.0 mc.—T103 (bottom)
25.9 mc.—T102 (bottom)

T1 and T101 are coupled by a link and in combination constitute an overcoupled transformer. The characteristics of such a transformer are such that it is impossible to adjust it to a single frequency.

To sweep align T1 and T101, connect a 330-ohm composition resistor across the primary coils of T102, T103, T104 and T106.

Connect the "VoltOhmyst" to the junction of R135 and C190. Adjust the 250,000-ohm variable resistor for −2.0 volts on the meter.

Connect the oscilloscope to the plate of the first video amplifier, pin 1 of V106.

Connect a sweep generator to the converter grid through a 1,500 mmf capacitor. Set the generator to sweep from 20.0 mc. to 30.0 mc. and adjust the output to provide a 4-volt peak-to-peak signal on the scope.

Connect the signal generator loosely to the converter grid and tune it to provide markers at 22.05 mc. and 24.75 mc.

Adjust T1 (top) and T101 (bottom) to obtain the response shown in Figure 14. The T1 core must penetrate to the terminal-board end of the coil in order to obtain the correct response.

Remove the 330-ohm resistors from across T102, T103, T104 and T106.

Adjust the 250,000-ohm potentiometer for a 15-volt peak-to-peak signal at the plate of the first video amplifier. The bias as measured by the "VoltOhmyst" should be −12 volts or less.

Observe and analyze the response curve obtained. The response will not be ideal and the i-f adjustments must be retouched in order to obtain the desired curve. See Figure 15.

On final adjustment the picture carrier marker must be at approximately 45% response. The curve must be approximately flat topped, with the 22.1 mc. marker at approximately 95% response and the 25.0 mc. marker below 90% response. A 26.5 mc. marker must fall between 5 and 10% response.

The most important consideration in making the i-f adjustments is to get the picture carrier at the 45% response point. If the picture carrier operates too low on the response curve, loss of low frequency video response, of picture brilliance, of blanking, and of sync may occur. If the picture carrier operates too high on the response curve, the picture becomes smeared. In making these adjustments, care should be taken to see that no two transformers are tuned to the same frequency as i-f oscillation may result.

Remove the converter tube and take off the clip to pin number 1. Replace the tube in the socket.

Picture I-F Oscillation. — If the receiver will operate without oscillating with the test equipment disconnected but breaks into oscillation or becomes unstable with the equipment connected, it may become necessary to establish a ground plane. Cover the test bench with a sheet of copper and set the chassis on the sheet. Set all the test equipment except the "VoltOhmyst" on the sheet and bond or bypass them to it. A Junior "VoltOhmyst" should not be bonded to the sheet since the negative test probe is not always connected to ground during alignment. If the receiver is badly misaligned and two or more of the i-f transformers are tuned to the same frequency, the receiver may fall into i-f oscillation. I-F oscillation shows up as a voltage across the picture detector load resistor that is unaffected by r-f signal input. If such a condition is encountered, it is sometimes possible to stop oscillation by adjusting the transformers approximately to frequency by setting the adjustment cores of T101, T102, T103, T104, T105 and T106 to be approximately equal to those of another receiver known to be in proper alignment. If this does not have the desired effect, it may now be possible to stop oscillation by increasing the grid bias. If so, it should then be possible to align the transformers by the usual method. Once aligned in this manner, the i-f amplifier should be stable with reduced bias.

If the oscillation cannot be stopped in the above manner, shunt the grids of the first three pix i-f amplifiers to ground with 1,000 mmf. capacitors. Connect the signal generator to the fourth pix i-f grid and align T106 to frequency. Progressively remove the shunt from each grid and align the plate coil of that stage to frequency.

If this does not stop the oscillation, the difficulty is not due to i-f misalignment as the i-f section is stable when properly aligned. Check all i-f by-pass condensers, transformer shunting resistors, tubes, socket voltages, etc.

ANTENNA, R-F AND CONVERTER LINE ADJUSTMENT. — In order to align the r-f tuner, it will first be necessary to set the channel-13 oscillator to frequency. The shield over the bottom of the r-f unit must be in place when making any adjustments.

The channel-13 oscillator may be aligned by adjusting it to beat with a crystal-calibrated heterodyne frequency meter, or by feeding a signal into the receiver at the r-f sound carrier frequency and adjusting the oscillator for zero output from the sound discriminator. In this latter case the sound discriminator must first have been aligned to exact frequency. Either method of adjustment will produce the same results. The method used will depend upon the type of test equipment available. Regardless of which method of oscillator alignment is used, the frequency standard must be crystal controlled or calibrated.

If the receiver oscillator is to be adjusted by the heterodyne frequency meter method, couple the meter probe loosely to the receiver oscillator.

If the receiver oscillator is adjusted by feeding in the r-f sound carrier signal, connect the signal generator to the receiver antenna terminals. Connect the "VoltOhmyst" to the sound discriminator output (junction of C183 and R203).

Set the receiver switch to 13.

Adjust the frequency standard to the correct frequency (237 mc. for heterodyne frequency meter or 215.75 mc. for the signal generator).

Set the fine tuning control to the middle of its range.

Adjust C6 for an audible beat on the heterodyne frequency meter or zero voltage from sound discriminator.

Now that the channel-13 oscillator is set to frequency, we may proceed with the r-f alignment.

Connect the "VoltOhmyst" to the junction of R135 and L117. Adjust the 250K pot. for −3.5 volts on the meter.

Remove the first pix i-f amplifier tube V101.

Connect the oscilloscope to the test connection at R13 in the r-f tuning unit.

Connect the r-f sweep oscillator to the receiver antenna terminals. The method of connection depends upon the output impedance of the sweep. The P102 connections for 300-ohm balanced or 72-ohm single-ended input are shown in the circuit diagrams in Figure 78. If the sweep oscillator has a 50-ohm single-ended output, 300-ohm balanced output can be obtained by connecting as shown in Figure 7.

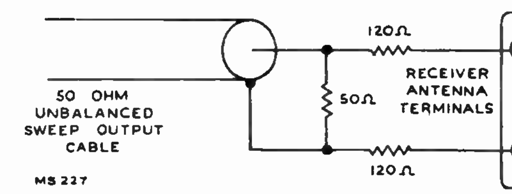

Figure 7—Unbalanced Sweep Cable Termination

Connect the signal generator loosely to the receiver antenna terminals.

Since channel 7 has the narrowest response of any of the high frequency channels, it should be adjusted first.

Set the receiver channel switch to channel 7.

Set the sweep oscillator to cover channel 7.

Insert markers of channel 7 picture carrier and sound carrier, 175.25 mc. and 179.75 mc.

Adjust C10 and C14 until the curve falls symmetrically between the sound and picture carrier markers. Adjust C11 to give the proper band width. Roughly peak L6 in conjunction with slight adjustments of C10 and C14 for a flat-topped response curve with the sound and picture carriers at 90% to 95% response points on this curve. See Figure 16, channel 7.

Switch to channel 12 and adjust L6 for maximum response and minimum top slope of the curve.

Check the response of channels 7 through 13 by switching the receiver channel switch, sweep oscillator and marker oscillator to each of these channels and observing the response obtained. See Figure 16 for typical response curves. It should be found that all these channels have the proper shaped response with the markers above 80% response. If the markers do not fall within this requirement on one or more high frequency channels, since there are no individual channel adjustments, it will be necessary to readjust L6, C10, C11 and C14, and possibly compromise some channel slightly in order to get the markers up on other channels. Normally, however, no difficulty of this type should be experienced since the higher frequency channels are comparatively broad and the markers easily fall within the required range.

Channel 6 is next aligned in the same manner.

Set the receiver to channel 6.

Set the sweep oscillator to cover channel 6.

Set the marker oscillator to channel 6 picture and sound carrier frequencies.

Adjust L9, L13, L66, and C12 for an approximately flat-topped response curve located symmetrically between the markers. L9, L13 and L66 are the center frequency adjustments. C12 is the band-width adjustment

Check channels 5 down through channel 2 by switching the receiver, sweep oscillator and marker oscillator to each channel and observing the response obtained. In all cases, the markers should be above the 80% response point. If this is not the case, L9, L13, L66 and C12 should be retouched. On final adjustment, all channels must be within the 80% specification.

Disconnect the 250K pot., and replace V107 and V101.

Following an r-f alignment, the oscillator alignment must be checked.

R-F OSCILLATOR LINE ADJUSTMENT. — The r-f oscillator line may be aligned by adjusting it to beat with a crystal calibrated heterodyne frequency meter, or by feeding a signal into the receiver at the r-f sound carrier frequency and adjusting the oscillator for zero output from the sound discriminator. In this latter case the sound discriminator must first have been aligned to exact frequency. Either method of adjustment will produce the same results. The method used will depend upon the type of test equipment available.

Regardless of which method of oscillator alignment is used, the frequency standard must be crystal controlled or calibrated. If the receiver oscillator is to be adjusted by the heterodyne frequency meter method, the calibration frequency listed under R-F Osc. Freq. must be available.

If the receiver oscillator is adjusted by feeding in the r-f sound carrier frequency, the frequencies listed under Sound Carrier Freq. must be available.

Channel Number	Receiver R-F Osc. Freq. Mc.	R-F Sound Carrier Freq. Mc.	Channel Oscillator Adjustment
2	81	59.75	L24
3	87	65.75	L23
4	93	71.75	L22
5	103	81.75	L21
6	109	87.75	L31
7	201	179.75	L19
8	207	185.75	L18
9	213	191.75	L17
10	219	197.75	L16
11	225	203.75	L15
12	231	209.75	L14
13	237	215.75	C6

If the heterodyne frequency meter method is used, couple the meter probe loosely to the receiver oscillator.

If the r-f sound carrier method is used, connect the "VoltOhmyst" to the sound discriminator output (junction of C183 and R203) and connect the signal generator to the receiver antenna terminals. The order of alignment remains the same regardless of which method is used.

If the r-f unit is removed from the receiver for service and is aligned separately, the shield over the bottom of the r-f unit must be in place when making adjustments.

Since the lower frequencies are obtained by adding steps of inductance, it is necessary to align channel 13 first and continue in reverse numerical order.

Set the receiver channel switch to 13.

Adjust the frequency standard to the correct frequency (237 mc. for heterodyne frequency meter or 215.75 mc. for the signal generator).

Set the fine tuning control to the middle of its range while making the adjustment.

Adjust C6 for an audible beat on the heterodyne frequency meter or zero voltage from sound discriminator. Oscillator adjustments L1 and L2 shown on the schematic are factory control adjustments and should not be touched in the field.

Switch the receiver to channel 12.

Set the frequency standard to the proper frequency as listed in the alignment table.

Adjust L14 for indications as above.

Adjust the oscillator to frequency on all channels by switching the receiver and the frequency standard to each channel and adjusting the appropriate oscillator trimmer for the speci-

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ALIGNMENT PROCEDURE

fied indication. It should be possible to adjust the oscillator to the correct frequency on all channels with the fine tuning control in the middle third of its range.

After the oscillator has been set on all channels, start back at channel 13 and recheck to make sure that all adjustments are correct.

AGC THRESHOLD ADJUSTMENT. — The AGC threshold adjustment can be made by the method outlined in the Installation Instructions. However, a more accurate adjustment can be obtained by the use of an oscilloscope.

Tune in a station and advance the picture control to the maximum clockwise position. Connect the low capacity probe from the oscilloscope to the plate of the first video amplifier, pin 1 of V106. Adjust the oscilloscope to observe the horizontal sync pulse.

Turn the AGC threshold control R138 fully clockwise, then slowly counter-clockwise. As the control is turned counter-clockwise, the receiver gain will increase slowly, increasing the size of the pattern on the oscilloscope. R138 should be turned counter-clockwise until the receiver begins to overload as indicated by clipping of the sync. The control should be left in the maximum gain position in which no clipping of sync is observed. See Figure 17 for proper waveforms.

HORIZONTAL OSCILLATOR ADJUSTMENT. — Normally the adjustment of the horizontal oscillator is not considered to be a part of the alignment procedure, but since the oscillator waveform adjustment requires the use of an oscilloscope, it can not be done conveniently in the field. The waveform adjustment is made at the factory and normally should not require readjustment in the field. However, the waveform adjustment should be checked whenever the receiver is aligned or whenever the horizontal oscillator operation is improper.

Horizontal Frequency Adjustment.—Set the locking range trimmer one half turn out from maximum capacity. With a clip lead, short circuit the coil between terminals C and D of the horizontal oscillator transformer T109. Tune in a television station and sync the picture if possible.

A. — Turn the horizontal hold control R173 to the extreme clockwise position. Adjust the T109 Frequency Adjustment (under the chassis) so that the picture is just out of sync and the horizontal blanking appears in the picture as a vertical bar. The position of the bar is unimportant.

Note.—Occasionally a tube may be found which does not respond to step "A" above, since it may not be possible to sync the picture by means of the frequency core when the sine wave coil is shorted out. Yet, the tube may work perfectly well when the circuit is properly aligned. In such a case it may be necessary to remove the short then turn the sine wave core out then in until it is possible to obtain sync by adjustment of the frequency core.

B. — Turn the hold control approximately one-quarter of a turn from the extreme clockwise position and examine the width and linearity of the picture. If picture width or linearity is incorrect, adjust the horizontal drive control C153B, the width control R192 and the linearity control L111 until the picture is correct. If C153B was adjusted, repeat step "A" and note above.

Horizontal Oscillator Waveform Adjustment. — Remove the shorting clip from terminals C and D of T109. Turn the horizontal hold control to the extreme clockwise position. With a thin fibre screwdriver, if necessary, adjust the Oscillator Waveform Adjustment Core of T109 (on the outside of the chassis) until the horizontal blanking bar appears in the raster. The waveform adjustment core will sync the picture in two positions. The core should be in the position nearest the outside of the chassis.

A. — Connect the low capacity probe of an oscilloscope to terminal C of T109. Alternately adjust the waveform and frequency cores of T109 until the peak of the sine wave is equal in amplitude to the peak of the saw tooth, on the oscilloscope as shown in Figure 18, while maintaining the picture in synchronization. Then adjust the frequency core until horizontal blanking shows as a vertical bar in the picture.

This adjustment is very important for correct operation of the circuit. If the broad peak of the wave on the oscilloscope is lower than the sharp peak, the noise immunity becomes poorer, the stabilizing effect of the tuned circuit is reduced and drift of the oscillator becomes more serious. On the other hand, if the broad peak is higher than the sharp peak, the oscillator is overstabilized, the pull-in range becomes inadequate and the broad peak can cause double triggering of the oscillator when the hold control approaches the clockwise position.

Remove the oscilloscope upon completion of this adjustment.

Check of Oscillator Pull-in Range.—Set the horizontal hold control to the full counter-clockwise position.

Connect a 270K ohm resistor across C156.

Momentarily switch off channel and back. The picture will then be out of sync.

Turn the hold control clockwise slowly and observe the minimum number of bars obtained just before the picture pulls into sync. The picture should snap in from two complete blanking bars. If two bars are not obtained turn the locking range trimmer C153A in to obtain less bars or out to obtain more bars.

After adjustment of C153A, remove the 270K resistor, turn the horizontal hold control fully clockwise and readjust the frequency core of T109 until the picture is in sync and the horizontal blanking bar begins to move in the picture. Then repeat the entire "Check of Pull-in Range" procedure to this point. Repeat this procedure until two bar pull-in is obtained.

Turn the horizontal hold control to the maximum clockwise position. The picture should be just out of sync to the extent that the horizontal blanking bar appears as a single vertical or diagonal bar in the picture. Adjust the T109 Frequency Adjustment until this condition is fulfilled.

4.5 MC. VIDEO TRAP. — With a strong input from a station, detune the receiver from the correct fine tuning point. With a very short clip lead, short the trap winding of T103. Observe the picture for the appearance of a 4.5 mc. beat. If the beat appears in the picture, adjust L110 until the beat is eliminated.

SENSITIVITY CHECK. — A comparative sensitivity check can be made by operating the receiver on a weak signal from a television station and comparing the picture and sound obtained to that obtained on other receivers under the same conditions.

This weak signal can be obtained by connecting the shop antenna to the receiver through a ladder type attenuator pad. The number of stages in the pad depends upon the signal strength available at the antenna. A sufficient number of stages should be inserted so that a somewhat less than normal contrast picture is obtained when the picture control is at the maximum clockwise position. Only carbon type resistors should be used to construct the pad.

RESPONSE CURVES. — The response curves shown on page 14 and referred to throughout the alignment procedure were taken from a production set. Although these curves are typical, variations can be expected.

The response curves are shown in the classical manner of presentation, that is with "response up" and low frequency to the left. The manner in which they will be seen in a given test set-up will depend upon the characteristics of the oscilloscope and the sweep generator. The curves may be seen inverted and/or switched from left to right depending on the deflection polarity of the oscilloscope and the phasing of the sweep generator.

ALIGNMENT TABLE. — Both methods of oscillator alignment are presented in the alignment table. The service technician may thereby choose the method to suit his test equipment.

ALIGNMENT TABLE

THE DETAILED ALIGNMENT PROCEDURE BEGINNING ON PAGE 8 SHOULD BE READ BEFORE ALIGNMENT BY USE OF THE TABLE IS ATTEMPTED.

STEP No.	CONNECT SIGNAL GENERATOR TO	SIGNAL GEN. FREQ. MC.	CONNECT SWEEP GENERATOR TO	SWEEP GEN. FREQ. MC.	CONNECT OSCILLOSCOPE TO	CONNECT "VOLTOHMYST" TO	MISCELLANEOUS CONNECTIONS AND INSTRUCTIONS	ADJUST	REFER TO
				DISCRIMINATOR AND SOUND I-F ALIGNMENT					
1	2nd sound i-f grid (pin 1, V117)	21.25 .1 volt output	Not used		Not used	In series with 1 meg. to junction of R203 & R204		Detune T113(bot.) Adjust T113 (top) for max. on meter	Fig. 8 Fig. 9 Fig. 10
2	"	"	"		"	Junct. of C183 & R203	Meter on 3 volt scale	T113 (bottom) for zero on meter	Fig. 9 Fig. 10
3	"	"	2nd sound i-f grid (pin 1, V117)	21.25 center 1 mc. wide .1 v. out	Junction of C183 & R203	Not used	Check for symmetrical response waveform (positive & negative). If not equal adjust T113 (top) until they are equal		Fig. 10 Fig. 12
4	1st sound i-f grid (pin 1, V116)	21.25 reduced output	1st sound i-f grid	21.25 reduced output	Terminal A, T112 in series with a 33,000 ohm resistor	"	Sweep output reduced to provide .3 volt p-to-p on scope	T112 (top & bot.) for max. gain and symmetry at 21.25 mc.	Fig. 8 Fig. 9 Fig. 10 Fig. 13
				PICTURE I-F AND TRAP ADJUSTMENT					
5	Not used		Not used		Not used	Junction of R135 & C190	Remove V107. Connect potentiometer between pins 5 & 6 of V107 socket	Adjust pot. for meter reading of −12 volts	Fig. 10
6	Converter grid (pin 1, V2)	21.25	"		"	Across R119	Meter on 3 volt scale. Receiver between 2 and 13	T103 (top) for min. on meter	Fig. 8
7	"	21.25	"		"	"	"	T105 (top) for min.	"
8	"	27.25	"		"	"	"	T102 (top) for min.	"
9	"	27.25	"		"	"	"	T104 (top) for min.	"
10	"	19.75	"		"	"	"	T106 (top) for min.	"
11	"	19.75	"		"	"	"	T101 (top) for min.	"
12	"	22.5	"		"	"	"	T106 (bottom) for max. on meter	Fig. 9
13	"	24.6	"		"	"	"	T104 (bottom) for max.	"
14	"	22.0	"		"	"	"	T103 (bottom) for max.	"
15	"	25.9	"		"	"	"	T102 (bottom) for max.	"
16	"	22.05 24.75	Converter grid (pin 1, V2)	Sweeping 20 to 30 mc.	Pin 1, V106	Junction of R135 & C190	Shunt 330 ohms across pri. T102, T103, T104, T106. Set bias −2 V. Set swp. gen. for 4 V. P-P on scope.	Adjust T1 (top) and T101 (bottom) for proper response	Fig. 8 Fig. 9 Fig. 14
17	"		"	"	"	"	Remove shunt resistors. Set bias to give 15 volts P to P on scope.	Adjust T1 (top), T101, T102, T103, T104, T106 (bot.) for proper resp.	Fig. 8 Fig. 9 Fig. 15
				ANTENNA, R-F AND CONVERTER LINE ALIGNMENT					
18	Antenna terminals	215.75	Not used		Not used	Junction of C183 & R203 for signal gen. method only	Fine tuning centered. Receiver on channel 13. Heterodyne meter coupled to oscillator if used.	C6 for zero on meter or beat on het. freq. meter	Fig. 8 Fig. 10
19						Junction of R135 & L117	Remove V101	Potentiometer for −3.5 volts on meter	Fig. 8 Fig. 10
20	Antenna terminal (loosely)	175.25 & 179.75	Antenna terminals (see text for precaution)	Sweeping channel 7	Test Connection R13	Not used	Receiver on channel 7	L6, C10, C11 & C14 for flat top response between markers. Markers above 90%.	Fig. 8 Fig. 9 Fig. 16 (7)
21	"	205.25 209.75	"	channel 12	"	"	Receiver on channel 12	L6 for max. response and min. slope of top of curve	Fig. 8 Fig. 16 (12)
22	"	175.25 179.75	"	channel 7	"	"	Receiver on channel 7	Check to see that response is as above	Fig. 16 (7)
23	"	181.25 185.75	"	channel 8	"	"	Receiver on channel 8	"	Fig. 16 (8)
24	"	187.25 191.75	"	channel 9	"	"	Receiver on channel 9	"	Fig. 16 (9)
25	"	193.25 197.75	"	channel 10	"	"	Receiver on channel 10	"	Fig. 16 (10)

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ALIGNMENT PROCEDURE

STEP No.	CONNECT SIGNAL GENERATOR TO	SIGNAL GEN. FREQ. MC.	CONNECT SWEEP GENERATOR TO	SWEEP GEN. FREQ. MC.	CONNECT OSCILLOSCOPE TO	CONNECT "VOLTOHMYST" TO	MISCELLANEOUS CONNECTIONS AND INSTRUCTIONS	ADJUST	REFER TO
				ANTENNA, R-F AND CONVERTER LINE ALIGNMENT (Continued)					
26	"	199.25 203.75	"	channel 11	"	"	Receiver on channel 11	"	Fig. 16 (11)
27	"	205.25 209.75	"	channel 12	"	"	Receiver on channel 12	"	Fig. 16 (12)
28	"	211.25 215.75	"	channel 13	"	"	Receiver on channel 13	"	Fig. 16 (13)
29	If the response on any channel (steps 22 through 28) is below 80% at either marker, switch to that channel and adjust L6, C10, C11 & C14 to pull response up on that channel. Then recheck steps 22 through 28.								
30	Antenna terminals (loosely)	83.25 87.75	Ant. terminals (see text for precaution)	Sweeping chan. 6	Test Connection R13	Not used	Receiver on channel 6	L9, L13, L66 & C12 for response as above	Fig. 16 (6)
31	"	77.25 81.75	"	channel 5	"	"	Receiver on channel 5	Check to see that response is as above	Fig. 16 (5)
32	"	67.25 71.75	"	channel 4	"	"	Receiver on channel 4	"	Fig. 16 (4)
33	"	61.25 65.75	"	channel 3	"	"	Receiver on channel 3	"	Fig. 16 (3)
34	"	55.25 59.75	"	channel 2	"	"	Receiver on channel 2	"	Fig. 16 (2)
35	If the response on any channel (steps 31 through 34) is below 80% at either marker, switch to that channel and adjust L9, L13, L66 & C12 to pull response up on that channel. Then recheck steps 30 through 34. Disconnect the bias pot. and replace V101 and V107.								

R-F OSCILLATOR ALIGNMENT

STEP No.	CONNECT SIGNAL GENERATOR TO	SIGNAL GEN. FREQ. MC.	CONNECT HETERODYNE FREQ. METER TO	HET. METER FREQ. MC.	CONNECT OSCILLOSCOPE TO	CONNECT "VOLTOHMYST" TO	MISCELLANEOUS CONNECTIONS AND INSTRUCTIONS	ADJUST	REFER TO
36	Antenna terminals	215.75	Loosely coupled to r-f osc.	237	Not used	Junction of C183 & R203 for sig. gen. method only	Fine tuning centered. Receiver on channel 13	C6 for zero on meter or beat on het. freq. meter	Fig. 8 Fig. 10
37	"	209.75	"	231	"	"	Rec. on chan. 12	L14 as above	Fig. 11
38	"	203.75	"	225	"	"	Rec. on chan. 11	L15 as above	"
39	"	197.75	"	219	"	"	Rec. on chan. 10	L16 as above	"
40	"	191.75	"	213	"	"	Rec. on chan. 9	L17 as above	"
41	"	185.75	"	207	"	"	Rec. on chan. 8	L18 as above	"
42	"	179.75	"	201	"	"	Rec. on chan. 7	L19 as above	"
43	"	87.75	"	109	"	"	Rec. on chan. 6	L31 as above	Fig. 9
44	"	81.75	"	103	"	"	Rec. on chan. 5	L21 as above	Fig. 11
45	"	71.75	"	93	"	"	Rec. on chan. 4	L22 as above	"
46	"	65.75	"	87	"	"	Rec. on chan. 3	L23 as above	"
47	"	59.75	"	81	"	"	Rec. on chan. 2	L24 as above	"
48	Repeat steps 36 through 47 as a check.								
				AGC THRESHOLD ADJUSTMENT					
49	Not used		Not used		Pin 1, V106	Not used	Tune in station, turn pix control clockwise. Adjust R138 for max. gain without clipping sync on scope		Fig. 10 Fig. 17
				HORIZONTAL OSCILLATOR ADJUSTMENT					
50	Short circuit terminals C and D of T109. Tune in a station. Set locking range trimmer C153A ½ turn out from maximum.								
51	Turn hold control fully clockwise. Adjust T109 Frequency Adjustment until horizontal blanking bar appears in the picture.								
52	Turn hold control ¼ turn from clockwise to sync picture. Adjust width (R192), linearity (L111) and drive (C153B) controls until picture is correct. Repeat step 51, then proceed with step 53.								
53	Remove clip from terminals C and D of T109. Turn hold control fully clockwise. Adjust T109 Oscillator Waveform Adjustment until horizontal blanking bar appears in picture with core in outer of two possible positions.								
54	Connect low capacity probe of oscilloscope to terminal C of T109. Alternately adjust T109 Oscillator Waveform Adjustment and frequency adjustment until broad and sharp peaks of wave on oscilloscope are same height while keeping picture in sync. Remove oscilloscope.								
55	Connect a 270K resistor across C156. Turn hold control fully counter-clockwise. Momentarily remove signal. Turn hold control slowly clockwise. Note least number of bars before pull-in. Adjust Locking Range Control (C153A) for 2 bar pull-in.								
56	Turn hold control fully clockwise. Adjust T109 Freq. Adjustment until horizontal blanking appears as single vertical or diagonal bar in pix.								
				4.5 MC VIDEO TRAP ADJUSTMENT					
57	Tune in a strong station. Short T103 trap. If a 4.5 mc. beat appears in picture adjust 4.5 mc. trap (L110) until beat is eliminated.								
				SENSITIVITY CHECK					
58	Connect antenna to receiver through attenuator pad to provide weak signal. Compare the picture and sound obtained to that obtained on other receivers under the same conditions.								

ALIGNMENT DATA

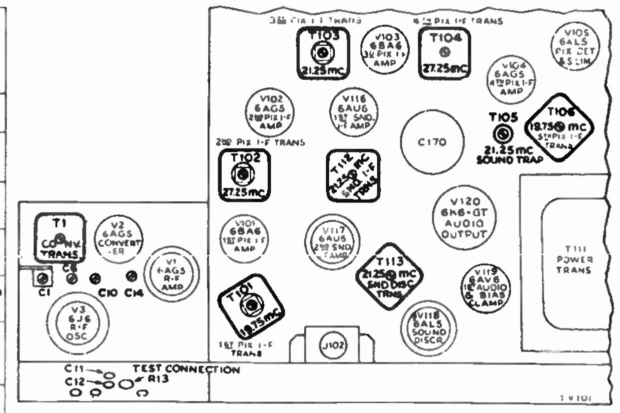


Figure 8—Top Chassis Adjustments

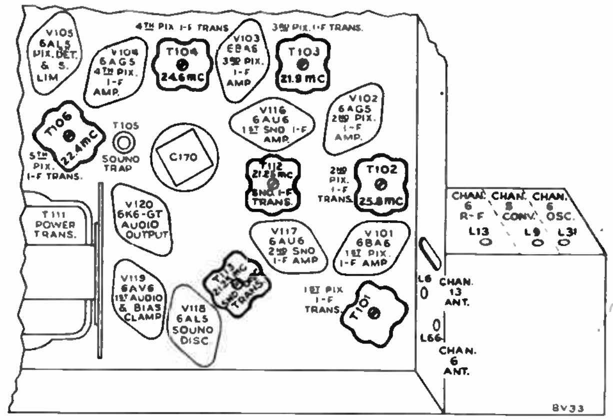


Figure 9—Bottom Chassis Adjustments

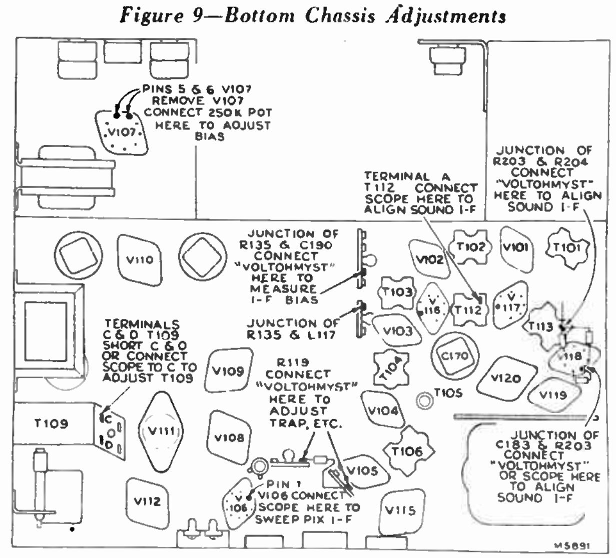
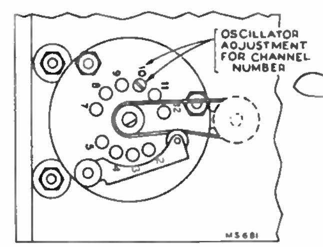


Figure 10—Test Connection Points



OSCILLATOR ADJUSTMENT FOR CHANNEL 13 IS ON TOP OF R F UNIT AND CHANNEL 6 IS ON SIDE.

Figure 11—R-F Oscillator Adjustments

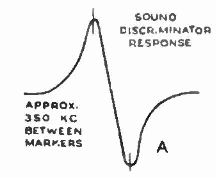


Figure 12 Discriminator Response

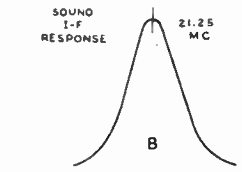


Figure 13 Sound I-F Response

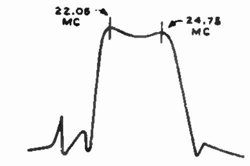


Figure 14 T1 and T101 Response

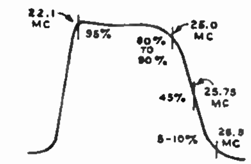


Figure 15 Overall I-F R-F Response

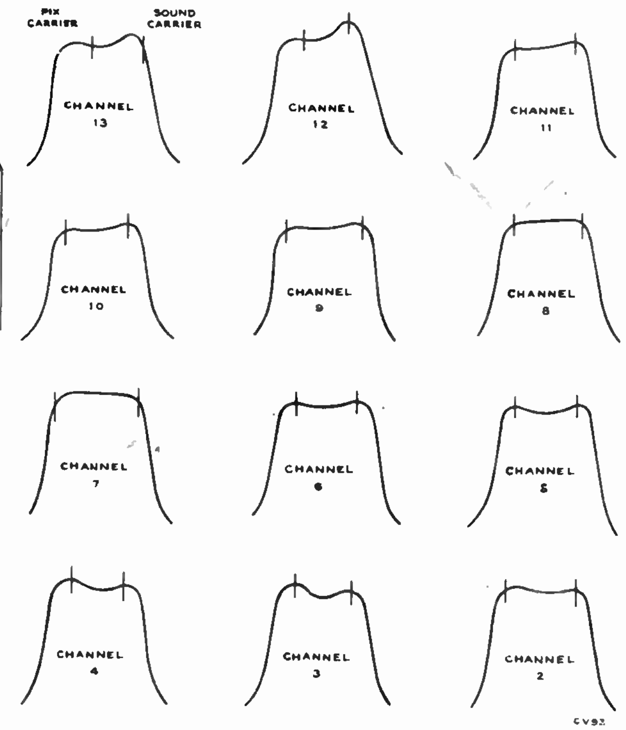


Figure 16—R-F Response

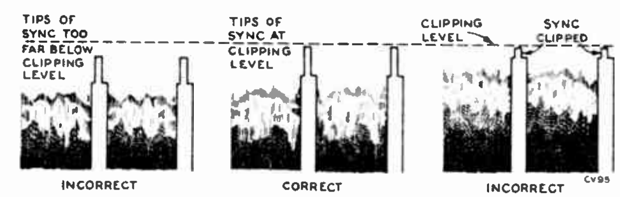


Figure 17—AGC Threshold Adjustment Waveforms

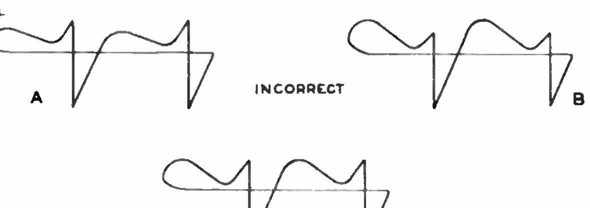


Figure 18—Horizontal Oscillator Waveforms

CHASSIS KCS40, KCS40A

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SERVICE SUGGESTIONS

Following is a list of symptoms of possible failures and an indication of some of the possible faults:

NO RASTER ON KINESCOPE:

(1) Incorrect adjustment of ion trap magnet. Magnet reversed either front to back or top to bottom.

(2) V112 or V113 inoperative. Check waveforms on grids and plates.

(3) No high voltage — If horizontal deflection is operating as evidenced by the correct waveform on terminal 4 of J106, the trouble can be isolated to the 8016 circuit. Either the T110 high voltage winding is open, the 8016 tube is defective, its filament circuit is open, or C168 is shorted.

(4) V111 circuit inoperative — Refer to schematic and waveform chart.

(5) Damper tube (V114) inoperative.

(6) Defective kinescope.

(7) R131 open.

(8) No receiver plate voltage—filter capacitor shorted—bleeder or filter choke open.

NO VERTICAL DEFLECTION:

(1) V107B or V110 inoperative. Check voltage and waveforms on grids and plates.

(2) T107 or T108 open.

(3) Vertical deflection coils open.

SMALL RASTER:

(1) Low Plus B or low line voltage.

(2) V112 defective.

(3) Defective yoke.

POOR VERTICAL LINEARITY:

(1) If adjustments cannot correct, change V110.

(2) T107 or T108 transformer defective.

(3) V107B defective — check voltage and waveforms on grid and plate.

(4) C150, R164, C146B, C147C, C148-C or C166 defective.

(5) Low bias or plate voltage — check rectifiers and capacitors in supply circuits.

POOR HORIZONTAL LINEARITY:

(1) If adjustments do not correct, change V112 or V114.

(2) T110 or L111 defective.

(3) C164 or C165 defective.

WRINKLES ON LEFT SIDE OF RASTER:

(1) C169 defective or incorrectly connected.

(2) C141 or C191 defective.

(3) Defective yoke.

PICTURE OUT OF SYNC HORIZONTALLY:

(1) T109 incorrectly tuned.

(2) R172, R173 or R174 defective.

TRAPEZOIDAL OR NON-SYMMETRICAL RASTER:

(1) Improper adjustment of focus coil or ion trap magnet.

(2) Defective yoke.

RASTER AND SIGNAL ON KINESCOPE BUT NO SOUND:

(1) R-F oscillator off frequency.

(2) Sound i-f, discriminator or audio amplifier inoperative — check V116, V117, V118, V119, V120 and their socket voltages.

(3) T114 or C186 defective.

(4) Speaker defective.

SIGNAL AT KINESCOPE GRID BUT NO SYNC:

(1) AGC threshold control R138 misadjusted.

(2) V105B, V107A, V108 or V109 inoperative. Check voltage and waveforms at their grids and plates.

SIGNAL ON KINESCOPE GRID BUT NO VERTICAL SYNC:

(1) Check V107B and associated circuits—C145, T107, etc.

(2) Integrating network inoperative—Check.

(3) R154, R155, R157, R158 or R159 defective.

SIGNAL ON KINESCOPE GRID BUT NO HORIZONTAL SYNC:

(1) T109 misadjusted—readjust as instructed on page 11.

(2) V111 inoperative—check socket voltages and waveforms.

(3) T109 defective.

(4) C134, C140, C146C, C153A, C154, C155, C156 or C157 defective.

(5) If horizontal speed is completely off and cannot be adjusted check C158, C159, R172, R173, R174, R179 and R182.

SOUND AND RASTER BUT NO PICTURE OR SYNC:

(1) Picture i-f, detector or video amplifier inoperative — check V103, V104, V105 and V106 — check socket voltages.

(2) Bad contact to kinescope grid.

PICTURE STABLE BUT POOR RESOLUTION:

(1) V105A or V106 defective.

(2) Peaking coils defective — check for specified resistance.

(3) Make sure that the focus control operates on both sides of proper focus.

(4) R-F and I-F circuits misaligned.

PICTURE SMEAR:

(1) R-F or I-F circuits misaligned.

(2) Open peaking coil.

(3) This trouble can originate at the transmitter — check on another station.

PICTURE JITTER:

(1) AGC threshold control R138 misadjusted.

(2) If regular sections at the left picture are displaced change V112.

SERVICE SUGGESTIONS

(3) Vertical instability may be due to loose connections or noise.

(4) Horizontal instability may be due to unstable transmitted sync.

RASTER BUT NO SOUND, PICTURE OR SYNC:

(1) Defective antenna or transmission line.

(2) R-F oscillator off frequency.

(3) R-F unit inoperative — check V1, V2, V3.

DARK VERTICAL LINE ON LEFT OF PICTURE:

(1) Reduce horizontal drive and readjust width and horizontal linearity.

(2) Replace V112.

LIGHT VERTICAL LINE ON LEFT OF PICTURE:

(1) C169 defective.

(2) V114 defective.

PICTURE I-F RESPONSE. — At times it may be desirable to observe the individual i-f stage response. This can be achieved by the following method:

Shunt all i-f transformers and coils with a 330-ohm carbon resistor except the one whose response is to be observed.

Connect a wide band sweep generator to the converter grid and adjust it to sweep from 18 mc. to 30 mc.

Connect the oscilloscope across the picture detector load resistor and observe the overall response. The response obtained will be essentially that of the unshunted stage. The effects of the various traps are also visible on the stage response.

Figures 27 through 31 show the responses of the various stages obtained in the above manner. The curves shown are typical although some variation between receivers can be expected. Relative stage gain is not shown.

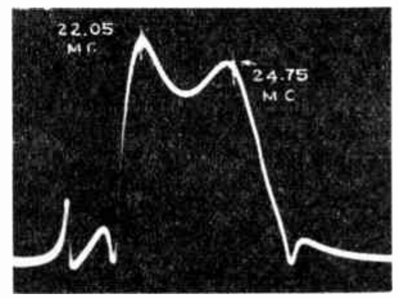

Figure 27—Response of Converter and First Pix I-F Transformer

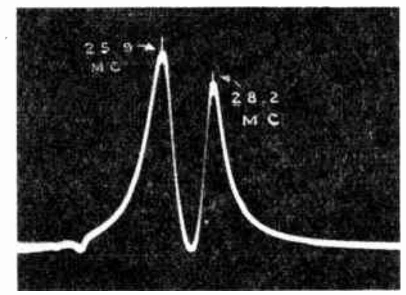

Figure 28—Response of Second Pix I-F Transformer

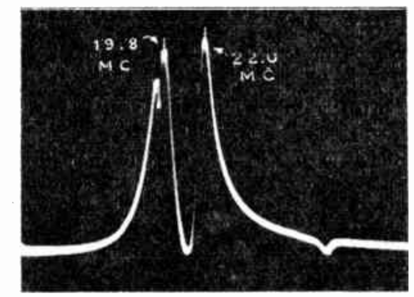

Figure 29—Response of Third Pix I-F Transformer

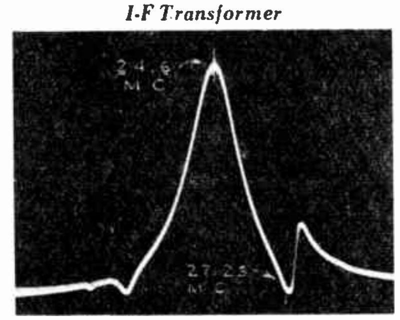

Figure 30—Response of Fourth Pix I-F Transformer

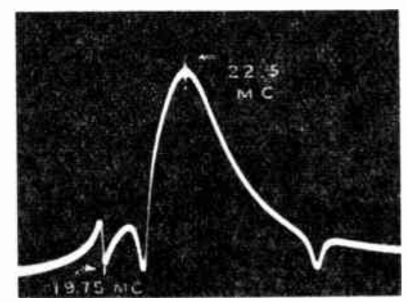

Figure 31—Response of Fifth Pix I-F Transformer

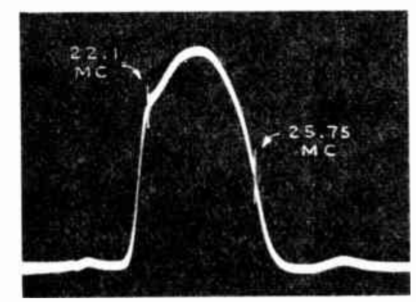

Figure 32—Response from First Pix I-F Grid to Pix Det.

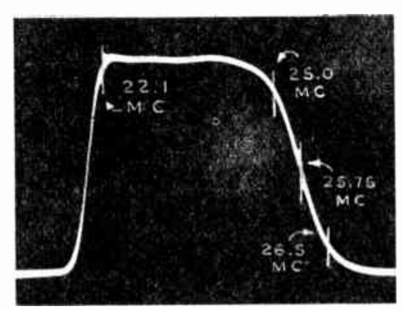

Figure 33—Overall Pix I-F Response

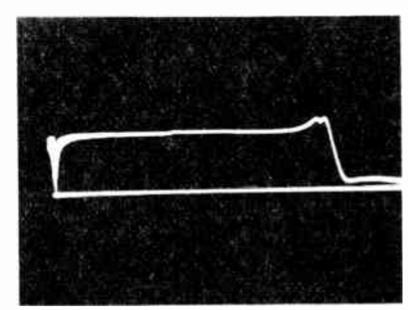

Figure 34—Video Response at Average Contrast

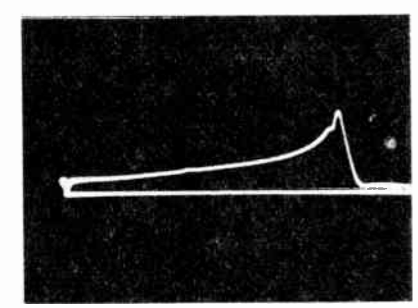

Figure 35—Video Response at Minimum Contrast

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WAVEFORM PHOTOGRAPHS

Video Signal Input to 1st Video Amplifier (Pin 2 of V106) (12AU7)

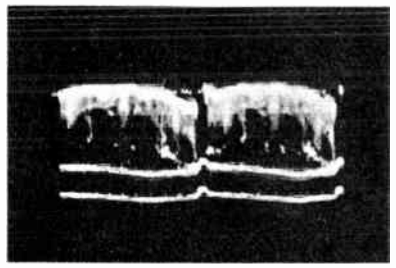

Figure 36- Vertical (Oscilloscope Synced to ½ of Vertical Sweep Rate) (5.4 Volts PP) ◄◄◄

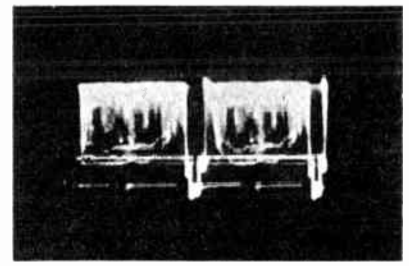

Figure 37—Horizontal (Oscilloscope Synced to ½ of Horizontal Sweep Rate) (5.4 Volts PP) ►►►

Sync Feed (Junction of L104, R219 and C194)

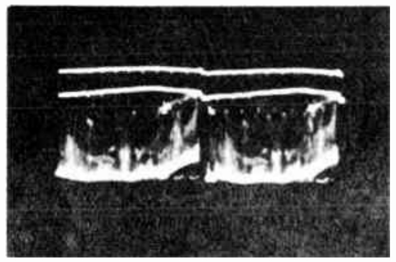

Figure 38—Vertical (28 Volts PP) ◄◄◄

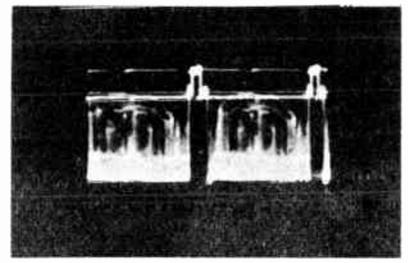

Figure 39—Horizontal (28 Volts PP) ►►►

Input to 2nd Video Amplifier (Pin 7 of V106) (12AU7)

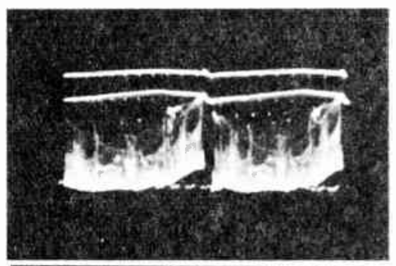

Figure 40—Vertical (17 Volts PP) ◄◄◄

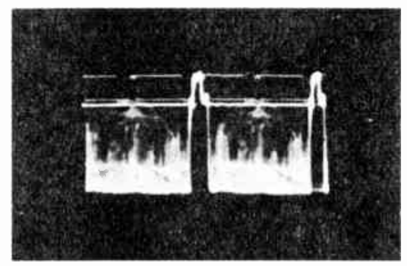

Figure 41—Horizontal (17 Volts PP) ►►►

Output of 2nd Video Amplifier (Junction of L105 and R127) (Picture Max.)

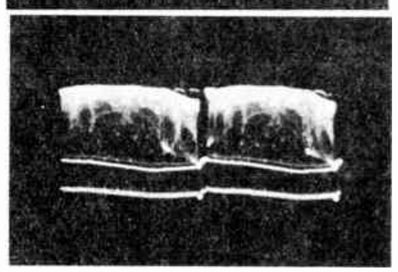

Figure 42—Vertical (96 Volts PP) ◄◄◄

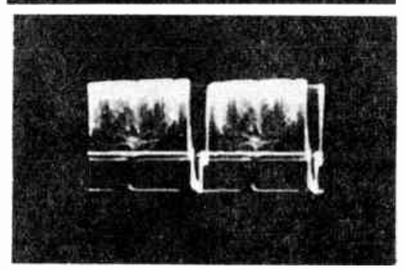

Figure 43—Horizontal (96 Volts PP) ►►►

Input to Kinescope (Junction of R127 and R128) (Picture Max.)

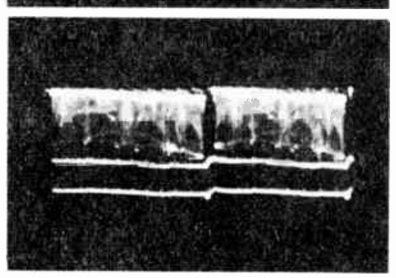

Figure 44—Vertical (65 Volts PP) ◄◄◄

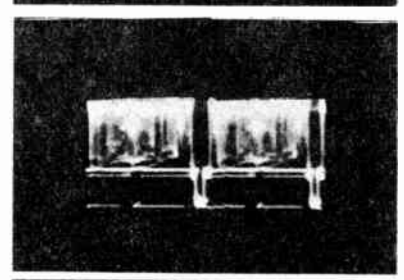

Figure 45—Horizontal (65 Volts PP) ►►►

Input to 1st Sync Separator (Pin 1 of V108) (6SN7GT)

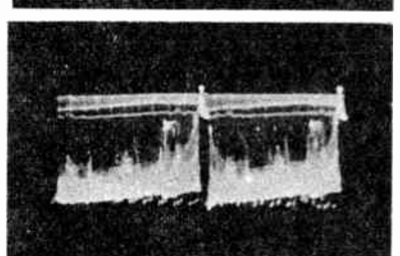

Figure 46—Vertical (25 Volts PP) ◄◄◄

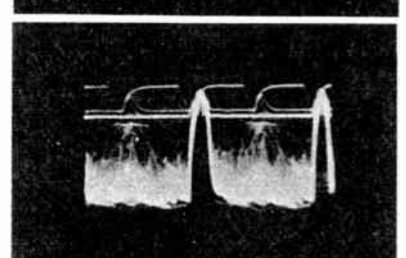

Figure 47—Horizontal (23 Volts PP) ►►►

AGC Rectifier Cathode (Pin 6 of V108) (6SN7GT)

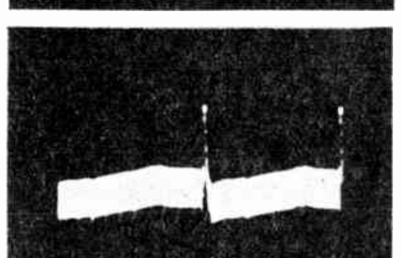

Figure 48—Vertical (4.7 Volts PP) ◄◄◄

Figure 49—Horizontal (1.5 Volts PP) ►►►

Output of AGC Rectifier (Pin 5 of V108) (6SN7GT)

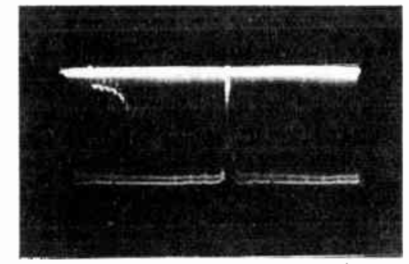

Figure 50—Vertical (24 Volts PP) ◄◄◄

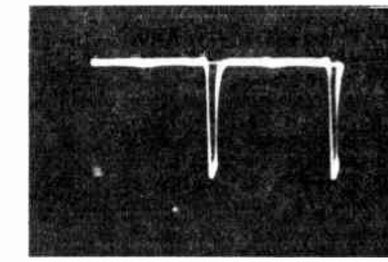

Figure 51—Horizontal (24 Volts PP) ►►►

Output of 1st Sync Separator (Pin 2 of V108) (6SN7GT)

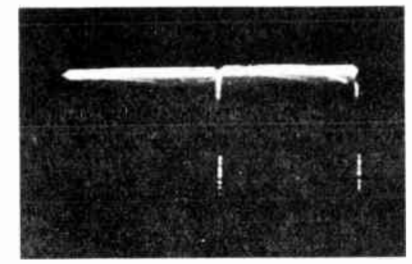

Figure 52—Vertical (26 Volts PP) ◄◄◄

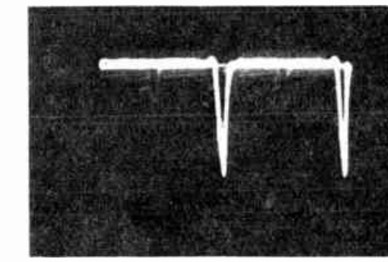

Figure 53—Horizontal (25.5 Volts PP) ►►►

Input to Sync Amplifier (Junction of C137, C139 and R145)

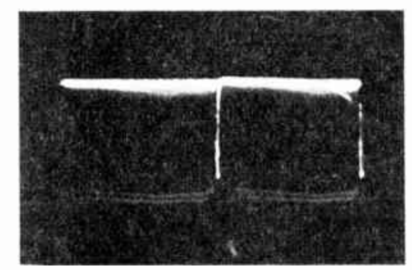

Figure 54—Vertical (21 Volts PP) ◄◄◄

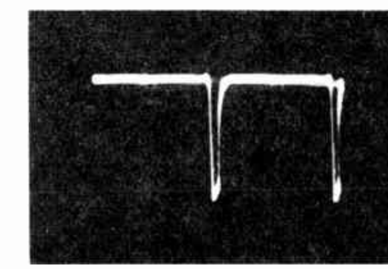

Figure 55—Horizontal (21 Volts PP) ►►►

Output of Sync Amplifier (Pin 2 of V109) (6SN7GT)

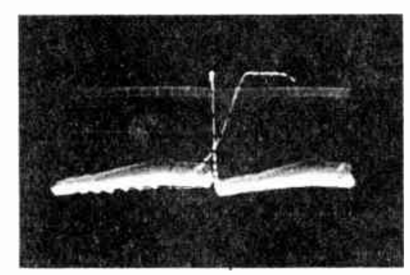

Figure 56—Vertical (115 Volts PP) ◄◄◄

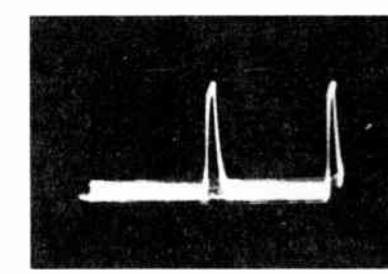

Figure 57—Horizontal (105 Volts PP) ►►►

Cathode of 2nd Sync Separator (Pin 6 of V109) (6SN7GT)

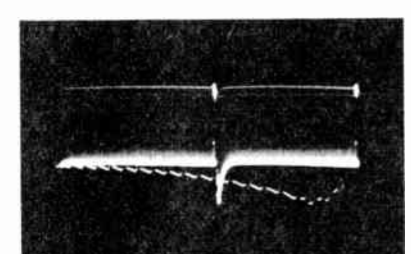

Figure 58—Vertical (17 Volts PP) ◄◄◄

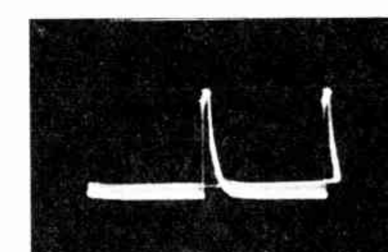

Figure 59—Horizontal (11 Volts PP) ►►►

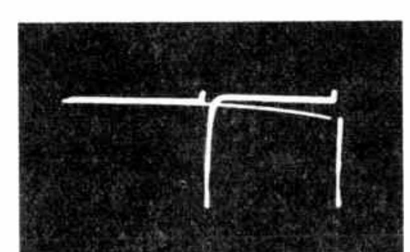

Figure 60—Output of Integrating Network (Junction of C144, C145 and R153) (45 Volts PP) ◄◄◄

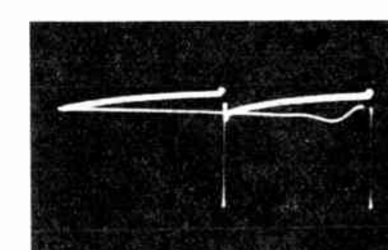

Figure 61—Grid of Vertical Oscillator (720 Volts PP) (Pin 1 of V107) (6SN7GT) ►►►

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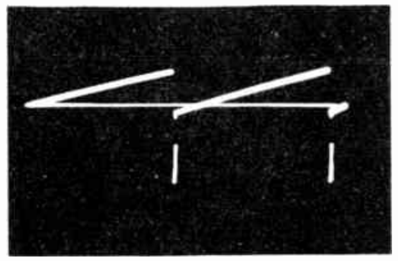

Figure 62—Grid of Vertical Output (160 Volts PP) (Pin 5 of V110) (6K6GT)

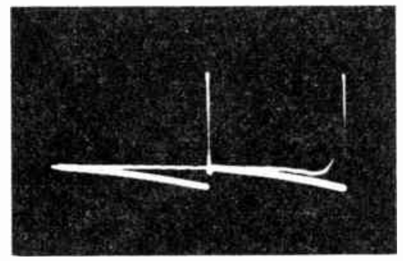

Figure 63—Plate of Vertical Output (750 Volts PP) (Pin 3 of V110) (6K6GT)

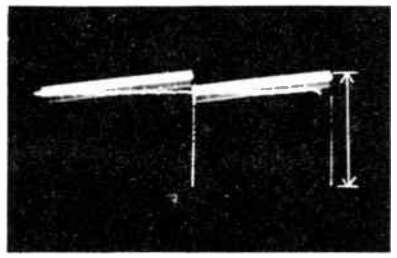

Figure 64—Input of Vertical Deflection Coils (75 Volts PP) (Junction of Green Lead of T108 and Green Lead of Yoke)

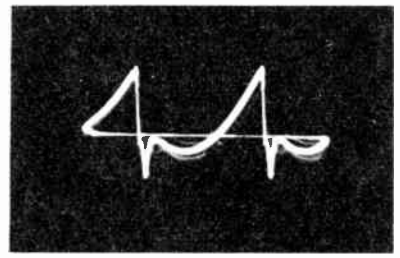

Figure 65—Input to Horizontal Oscillator (17.5 Volts PP) (Junction of C153A and C154)

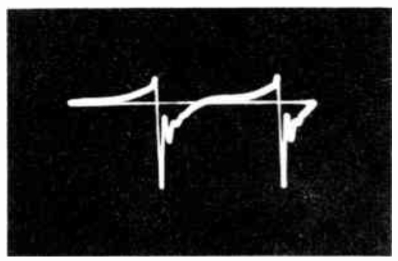

Figure 66—Junction of R168, R176 and R178 (150 Volts PP)

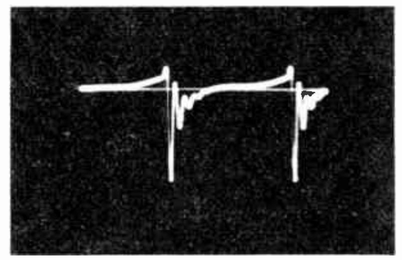

Figure 67—Grid of Horizontal Oscillator (480 Volts PP) (Pin 4 of V111) (6SN7GT)

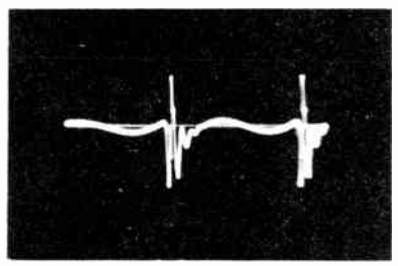

Figure 68—Plate of Horizontal Oscillator (270 Volts PP) (Pin 5 of V111) (6SN7GT)

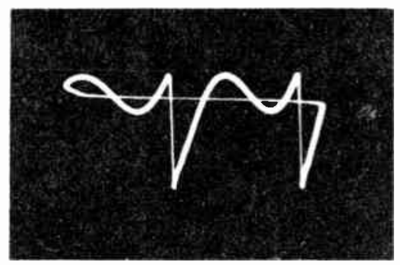

Figure 69—Terminal "C" of T109 (70 Volts PP)

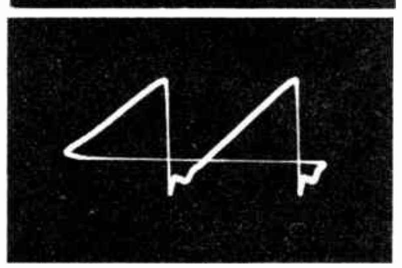

Figure 70—Input to Horizontal Output Tube (42 Volts PP) (Junction of C160, R183 and C153B)

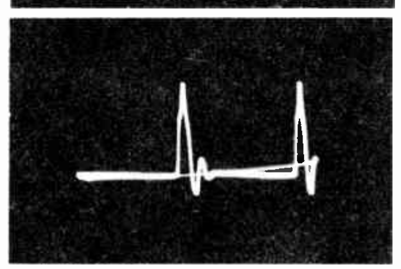

Figure 71—Plate of Horizontal Output (Approx. 6,500 Volts PP) (Measured Through a Capacity Voltage Divider Connected from Top Cap of V112 to Ground)

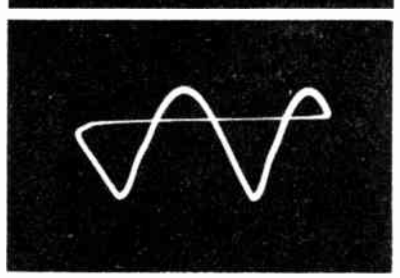

Figure 72—Terminal 1 of T110 (200 Volts PP)

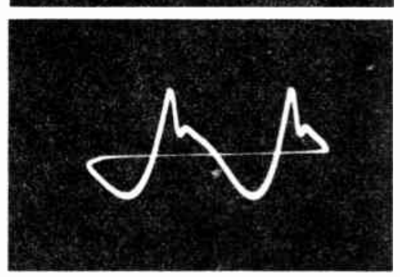

Figure 73—Plate of Damper (250 Volts PP) (Pin 5 of V114) (6W4GT)

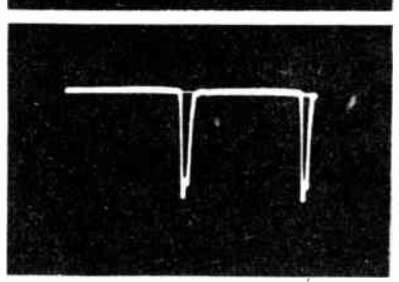

Figure 74—Input to Horizontal Deflection Coils (3,000 Volts PP)

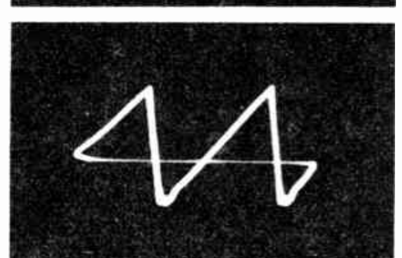

Figure 75—Horizontal Deflection Coil Current (0.5 Amp. PP) Measured by Inserting a 5-ohm Resistor in series with the yoke and observing the waveform across the resistor.

R-F UNIT WIRING DIAGRAM

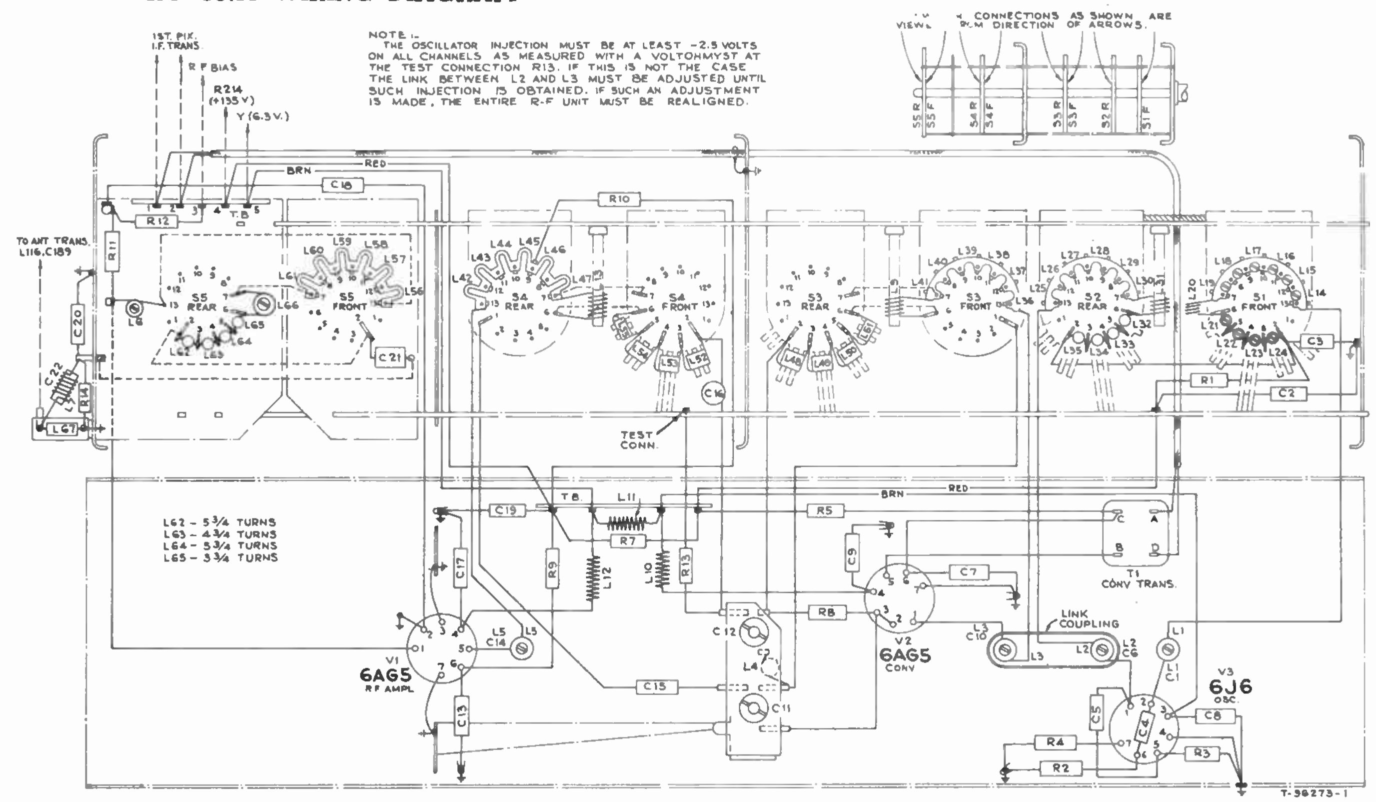

Figure 76—R-F Unit Wiring Diagram

CRITICAL LEAD DRESS:

1. The ground bus from pin 2 and the center shield of V117 socket should not be shortened or rerouted.
2. Do not change the dress of the filament leads or the by-pass capacitors in the picture or sound i-f circuits. The filament leads between V117, V118 and V119 should be down against the chassis and away from grid or plate leads.
3. If it is necessary to replace any of the 1500 mmf capacitors in the picture i-f circuit, the lead length must be kept as short as possible.
4. Picture i-f coupling capacitors C106, C111, C115 and C121 should be up and away from the chassis and should be clear of the pix i-f transformer adjustments by at least ¼ inch. If the dress of any of these capacitors is changed, the i-f alignment should be rechecked.
5. Dress black lead from terminal C of T106 down next to chassis.
6. Leads to L102 and L103 must be as short as possible.
7. Dress peaking coils L105, L106, L107 and L114 up and away from the chassis.
8. Dress C183 across tube pins 5 and 6 with leads not exceeding ⅜ inch.
9. Dress body of R215 as close to tube pin as possible.
10. Dress C129 and C130 up and away from the chassis.
11. Dress the yellow lead from the picture control away from the chassis and away from the volume-control leads. Dress the yellow lead from pin 8 of V106 away from the chassis.
12. Dress the green lead from pin 2 of V106 away from the chassis.
13. Dress R168, R176 and R178 up and away from the chassis.
14. The leads to the volume control should be dressed down against the chassis and away from V117 and V118.
15. Contact between the r-f oscillator frequency adjustment screws and the oscillator coils or channel switch eyelets must be avoided.
16. Dress three a-c leads to S101 under clamp and away from R211.
17. Dress black lead from power transformer and red lead from S102 to terminal board, on top side of four potentiometers.
18. Dress all leads from V115 to V122 on power transformer side of terminal board.
19. All solder joints in the high voltage section should be free of sharp edges.
20. The lead side of the V113 plate cap should be turned away from the fixed high voltage shield and the lead should be dressed away from all objects.
21. All leads under the horizontal plate in the high voltage section should be kept reasonably short and dressed away from the V113 corona ring.
22. The red-black lead from terminal 2 of the deflection yoke should be dressed around the green and yellow leads and away from the red lead. The loose end of the red-black wire should be heavily taped.

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VOLTAGE CHART

The following measurements represent two sets of conditions. In the first condition a 2200 microvolt test pattern signal was fed into the receiver, the picture was synced and the AGC threshold control was properly adjusted. The second condition was obtained by removing the antenna leads and short-circuiting the receiver antenna terminals. Voltages shown are as read with "Jr. VoltOhmyst" between the indicated terminal and chassis ground and with the receiver operating on 117 volts, 60 cycles a-c. Symbol < means less than.

Tube No.	Tube Type	Function	Operating Condition	E. Plate		E. Screen		E. Cathode		E. Grid		I Plate (ma.)	I Screen (ma.)	Notes on Measurements
				Pin No.	Volts	Pin No.	Volts	Pin No.	Volts	Pin No.	Volts			
V1	6AG5	R-F Amplifier	2200 Mu. V. Signal	5	130	6	132	2 & 7	0	1	-2.2	5	2	
			No Signal	5	67	6	111	2 & 7	0	1	0.0	14.0	5.0	
V2	6AG5	Converter	2200 Mu. V. Signal	5	*130 to 140	6	*130 to 140	2 & 7	0	1	*-3.0 to -7.0	*7.1 to 7.7	*2.3 to 2.7	*Depending upon channel
			No Signal	5	*107 to 109	6	*107 to 109	2 & 7	0	1	*-2.0 to -6.0	*5.3 to 5.9	*.8 to 1.0	
V3	6J6	R-F Oscillator	2200 Mu. V. Signal	1 & 2	*88 to 95	—	—	7	.19	5 & 6	*-5.1 to -7.3	*1.9 to 2.7	—	*Depending upon channel
			No Signal	1 & 2	*68 to 81	—	—	7	.16	5 & 6	*-4.5 to -6.6	*1.8 to 2.1	—	
V101	6BA6	1st Pix. I-F Amplifier	2200 Mu. V. Signal	5	128	6	128	7	.4	1	-11.0	1.9	.8	
			No Signal	5	95	6	95	7	1.73	1	+.2	8.1	3.4	
V102	6AG5	2d Pix. I-F Amplifier	2200 Mu. V. Signal	5	119	6	119	2 & 7	.78	1	0	8.8	2.4	
			No Signal	5	100	6	100	2 & 7	.62	1	0	7.4	1.6	
V103	6BA6	3d Pix. I-F Amplifier	2200 Mu. V. Signal	5	81	6	119	7	.52	1	-2.2	11.1	.3	
			No Signal	5	55	6	96	7	.62	1	+0.2	13.2	.3	
V104	6AG5	4th pix. I-F Amplifier	2200 Mu. V. Signal	5	159	6	135	2 & 7	1.5	1	0	7.2	2.2	
			No Signal	5	165	6	118	2 & 7	1.35	1	0	6.8	2.4	
V105 A	6AL5	Picture 2d Det.	2200 Mu. V. Signal	7	-116	—	—	1	-127	—	—	.3	—	
			No Signal	7	-131	—	—	1	-135	—	—	<0.1	—	
V105 B	6AL5	Sync Limiter	2200 Mu. V. Signal	2	-117	—	—	5	-58	—	—	—	—	
			No Signal	2	-63	—	—	5	-60	—	—	—	—	
V106	12AU7	1st Video Amplifier	2200 Mu. V. Signal	1	-18.7	—	—	3	-125	2	-129	2.6	—	
			No Signal	1	-28.0	—	—	3	-133	2	-135	6.6	—	
V106	12AU7	2d Video Amplifier	2200 Mu. V. Signal	6	*120	—	—	8	*-11.0	7	*-13.2	9.2	—	*At minimum contrast
			No Signal	6	*127	—	—	8	*-17.0	7	*-21.0	8.5	—	
			2200 Mu. V. Signal	6	*193	—	—	8	*-0.6	7	*-13.1	3.2	—	*At maximum contrast
			No Signal	6	*228	—	—	8	*-0.8	7	*-20.0	0.2	—	
V107 A	6SN7 GT	ACG Amplifier	2200 Mu. V. Signal	5	-11	—	—	6	-58	4	-61	.12	—	
			No Signal	5	+ 0.2	—	—	6	-60	4	-66	0	—	
V107 B	6SN7 GT	Vertical Oscillator	2200 Mu. V. Signal	2	125	—	—	3	-127	1	-170	.31	—	
			No Signal	2	120	—	—	3	-135	1	-175	.30	—	
V108	6SN7 GT	AGC Rectifier	2200 Mu. V. Signal	5	87	—	—	6	-2	4	-19.5	.3	—	
			No Signal	5	75	—	—	6	-22	4	-28.0	<.1	—	
V108	6SN7 GT	1st Sync Separator	2200 Mu. V. Signal	2	87	—	—	3	-3	1	-18.5	<.1	—	
			No Signal	2	73	—	—	3	-22	1	-28.0	<.1	—	
V109	6SN7 GT	Sync Amplifier	2200 Mu. V. Signal	2	153	—	—	3	0	1	-5.0	5.8	—	
			No Signal	2	160	—	—	3	0	1	-5.6	5.4	—	
V109	6SN7 GT	Sync Separator	2200 Mu. V. Signal	5	241	—	—	6	-58	4	-117	.22	—	
			No Signal	5	240	—	—	6	-57	4	-65	.71	—	
V110	6K6-GT	Vertical Output	2200 Mu. V. Signal	3	240	4	240	8	-78	5	-107	10	2.0	*Screen connected to plate
			No Signal	3	235	4	235	8	-83	5	-111	10	1.9	
V111	6SN7 GT	Horizontal Osc. Control	2200 Mu. V. Signal	2	50	—	—	3	-136	1	-127	.11	—	
			No Signal	2	*14	—	—	3	*-155	1	*-147	.10	—	Hold control counterclockwise
			No Signal	2	*78	—	—	3	*-140	1	*-142	.11	—	Hold control clockwise
V111	6SN7 GT	Horizontal Oscillator	2200 Mu. V. Signal	5	86	—	—	6	-127	4	-193	2.0	—	
			No Signal	5	80	—	—	6	-135	4	-205	1.7	—	
V112	6BG6G	Horizontal Output	2200 Mu. V. Signal	Cap	Do Not Meas.	8	152	3	-117	5	-145	67.9	8.1	
			No Signal	Cap	Do Not Meas.	8	150	3	-126	5	-157	66.0	8.0	
V113	1B3GT /8016	H. V. Rectifier	Brightness Min.	Cap	Do Not Meas.	—	—	2 & 7	12,300	—	—	0	—	
			Brightness Average	Cap	Do Not Meas.	—	—	2 & 7	11,700	—	—	.1	—	
V114	6W4GT	Damper	2200 Mu. V. Signal	5	Do Not Meas.	—	—	3	498	—	—	86	—	
			No Signal	5	Do Not Meas.	—	—	3	496	—	—	70	—	
V115	5U4G	Rectifier	2200 Mu. V. Signal	4 & 6	*385	—	—	2 & 8	267	—	—	225	—	*AC measured from plate to trans. center tap
			No Signal	4 & 6	*385	—	—	2 & 8	260	—	—	226	—	
V116	6AU6	1st Sound I-F Amplifier	2200 Mu. V. Signal	5	124	6	124	7	.87	1	-0.1	7.0	3.0	
			No Signal	5	107	6	107	7	.75	1	-0.15	6.4	2.3	
V117	6AU6	2nd Sound I-F Amplifier	2200 Mu. V. Signal	5	130	6	67	7	0	1	-9	4.3	1.5	
			No Signal	5	120	6	60	7	0	1	-0.37	3.7	1.6	
V118	6AL5	Sound Discrim.	2200 Mu. V. Signal	2	-8.4	—	—	5	5.8	—	—	—	—	
			No Signal	2	-0.4	—	—	5	0	—	—	—	—	
			2200 Mu. V. Signal	7	-3.7	—	—	1	0	—	—	—	—	
			No Signal	7	-0.4	—	—	1	0	—	—	—	—	
V119	6AV6	1st Audio Amplifier	2200 Mu. V. Signal	7	80	—	—	2	0	1	-.89	.48	—	
			No Signal	7	77	—	—	2	0	1	-.89	.47	—	
V120	6K6-GT	Audio Output	2200 Mu. V. Signal	3	193	4	135	8	-101	5	-127	12.4	2.1	
			No Signal	3	193	4	121	8	-109	5	-135	11.9	2.1	
V121	16GP4	Kinescope	2200 Mu. V. Signal	Cap	12,300	10	370	11	77	2	35	.06	—	Avg. Bright. Avg. Contrast
			2200 Mu. V. Signal	Cap	12,700	10	378	11	110	2	36	0	—	Min. Bright. Avg. Contrast
			2200 Mu. V. Signal	Cap	12,700	10	368	11	105	2	-2	0	—	Low Bright. Min. Contrast
			No Signal	Cap	11,700	10	366	11	73	2	48	.18	—	Avg. Bright. Avg. Contrast

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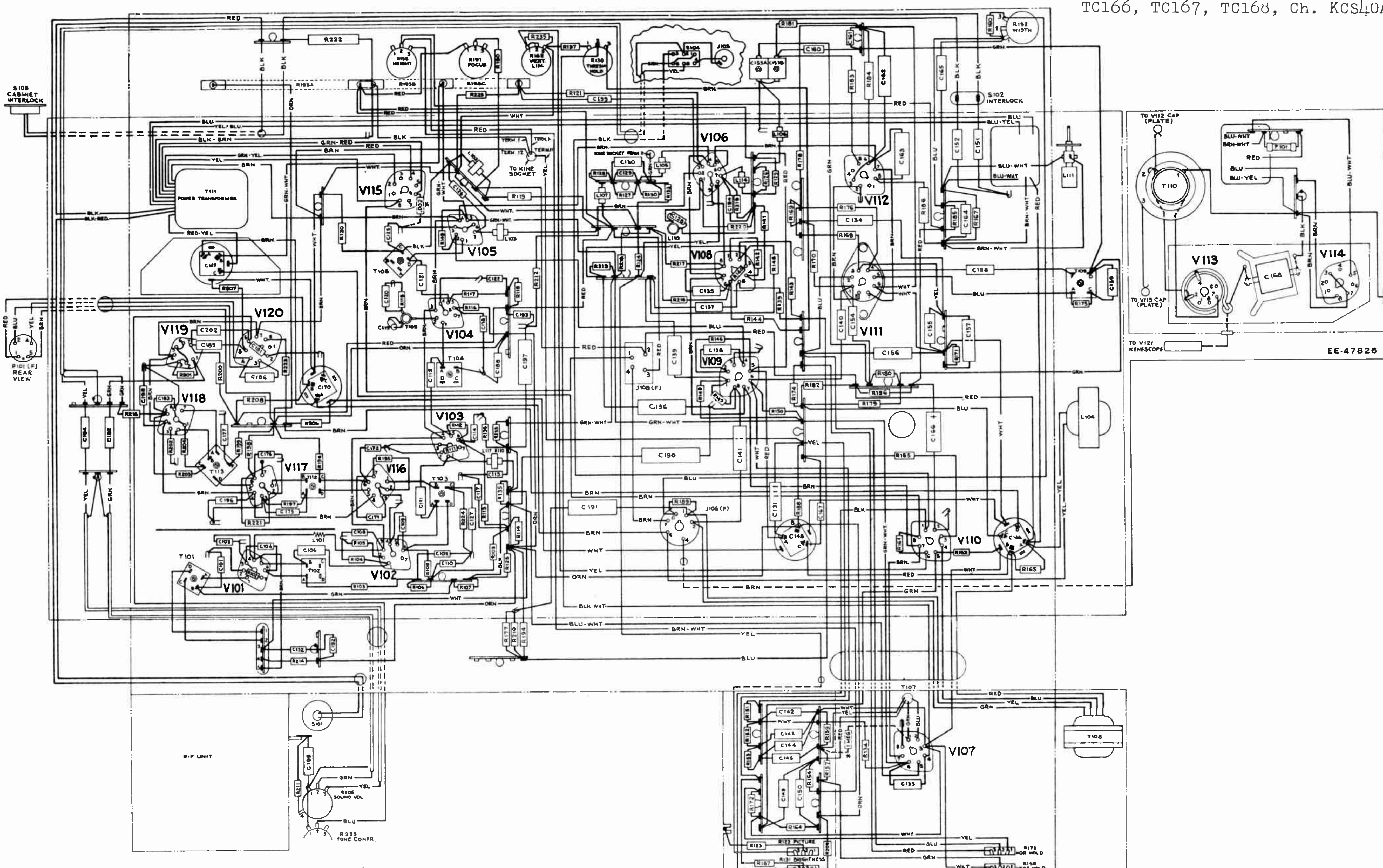
MODELS T164, Ch. KCS40; TC165, TC166, TC167, TC168, Ch. KCS40A



In some receivers, a four color ceramic capacitor color code is employed. It reads the same as the RMA color code except that the tolerance stripe is omitted.

If the coefficient stripe is silver, it indicates that the capacitor has a very large temperature coefficient and is to be employed for by-pass or other usages where a wide variation of capacity is unimportant. Silver striped capacitors are rated at 350 volts unless otherwise marked.

Figure 77—Chassis Wiring Diagram

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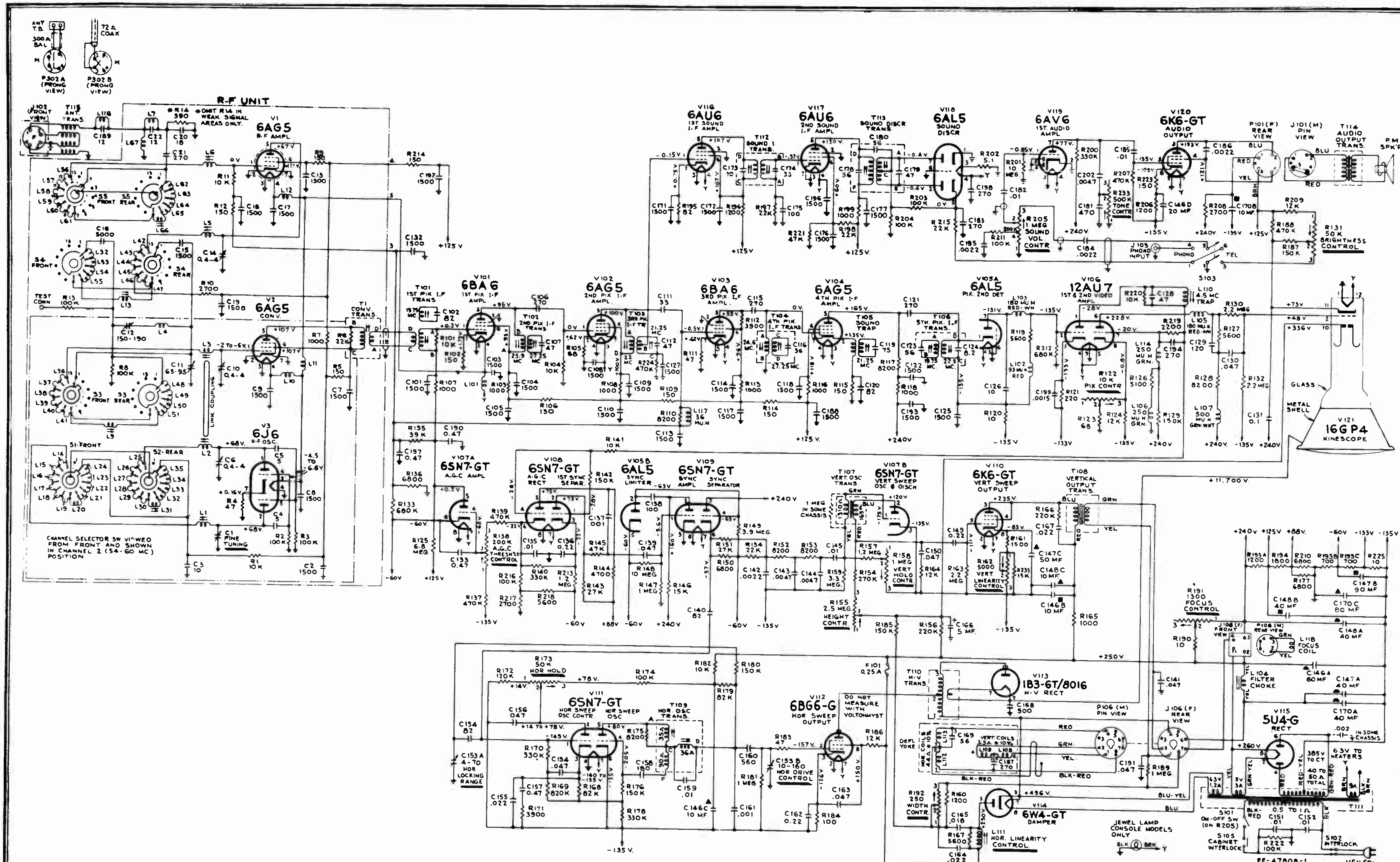

All resistance values in ohms. K = 1000.
All capacitance values less than 1 in MF and above 1 in MMF unless otherwise noted.

Coil resistance values less than 1 ohm are not shown.
Direction of arrows at controls indicates clockwise rotation.

All voltages measured with "Volt-Ohmyst" and with no signal input. Voltages should hold within ±20% with 117 v. a-c supply.

In some receivers, C141 was omitted.
In some receivers, R206 and R223 were 820 ohms.
In some receivers, R220 was 12K.

In some receivers, R121 was 39, R225 was 18, R128 was 6,800, R129 was 220K, L107 was 250 Muh and C199 was omitted.

In some receivers, R161 was 1,000 and R235 was omitted.
In some receivers, R160 and R167 were omitted.

Figure 78—Circuit Schematic Diagram

MODELS T164, Ch. KCS40; TC165, TC166, TC167, TC168, Ch. KCS40A

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REPLACEMENT PARTS

STOCK No.	DESCRIPTION
	R-F UNIT ASSEMBLIES KRK 5B
73465	Belt—Drive belt
75069	Board—R-F unit power connection terminal board
75067	Bracket—Vertical bracket for holding r-f oscillator tube shield
73478	Cable—I-F transmission cable (W1)
73441	Cam—Fine tuning adjustment
74035	Capacitor—Ceramic, 5 mmf. (C4, C5)
53511	Capacitor—Ceramic, 10 mmf. (C3)
54207	Capacitor—Ceramic, 18 mmf. (C20)
73449	Capacitor—Ceramic trimmer comprising 1 section of 150-190 mmf. and 1 section of 65-95 mmf. (C11, C12)
73091	Capacitor—Ceramic, 270 mmf. (C21)
71501	Capacitor—Ceramic, 1,500 mmf. (C2, C7, C8, C9, C13, C15, C17, C18, C19)
73473	Capacitor—Ceramic, 5,000 mmf. (C16)
73460	Coil—R-F plate coil for channel 6 (L13)
73461	Coil—Rear section—Oscillator plate coil for channel 6 (L20)
73462	Coil—Coupling inductance coil (L4)
73475	Coil—Antenna filter shunt coil (C67)
73476	Coil—I-F trap (L7, C22)
73477	Coil—Choke coil (L10, L11, L12)
73874	Coil—Front section—Oscillator plate coil for channel 6 (L31)
74108	Coil—Fine tuning coil (1½ turns) with adjustable inductance core and capacitor stud (plunger adjustment) (L1, C1)
74109	Coil—Trimmer coil (1½ turns) with adjustable inductance core and capacitor stud (screw adjustment for oscillator section or converter section) (L2, L3, C6, C10)
74110	Coil—Trimmer coil (3 turns) with adjustable inductance core and capacitor stud (screw adjustment) for r-f amplifier section (L5, C14)
73455	Core—Sliding core for fine tuning control trimmer
74187	Core—Adjustable core for coil L9
71493	Connector—Oscillator segment connector
73440	Detent—R-F unit detent mechanism and fibre shaft
71487	Form—Coil form for coil L31
73453	Form—Coil form assembly for L9, L13
73442	Link—Link assembly for fine tuning
71462	Loop—Oscillator to converter trimmer loop connector
73634	Nut—Speed nut for drive belt shield
73436	Plate—Front plate and bushing
73464	Pulley—Idler pulley
	Resistor—Fixed, composition: 47 ohms, ±20%, ½ watt (R4) 150 ohms, ±20%, ½ watt (R5, R9, R12) 390 ohms, ±10%, ½ watt (R14) 1,000 ohms, ±20%, ½ watt (R7) 2,700 ohms, ±10%, ½ watt (R10) 10,000 ohms, ±20%, ½ watt (R1, R11) 100,000 ohms, ±20%, ½ watt (R2, R3, R8, R13)
14343	Retainer—Channel selector shaft retaining ring
30340	Retainer—Retainer ring for fine tuning stud
70881	Screw—No. 4-40 x ¼" binder head screw for adjusting coils L14, L15, L16, L17, L18, L19
73640	Screw—No. 4-40 x ⅝" adjusting screw for L66

STOCK No.	DESCRIPTION
71475	Screw—No. 4-40 x 15/32" adjusting screw for coils L21, L22, L23, L24
74575	Screw—No. 4-40 x 17/32" adjusting screw for L6
73437	Shaft—Channel selector shaft complete with pawl and stud
73438	Shaft—Fine tuning control shaft and pulley
73439	Shaft—Actuating shaft for fine tuning control
75443	Shield—"U" shaped shield for bottom of r-f unit
72951	Shield—Metal tube shield for V3
73454	Shield—Metal shield for drive belt
73632	Shield—Metal tube shield for V1
71494	Socket—Tube socket, moulded, 7 prong, saddle mounted
73450	Socket—Tube socket, ceramic, 7 prong, bottom mounted
74576	Spacer—Insulating spacer for front plate (4 required)
75068	Spring—Retaining spring for r-f oscillator tube shield
73457	Spring—Return spring for fine tuning control core
74188	Spring—Retaining spring for adjustable core RCA 74187
74578	Spring—Retaining spring for adjusting screws RCA 73640 and RCA 74575
73468	Stator—Front oscillator section stator complete with rotor, segment, coils and adjusting screws (S1, L14, L15, L16, L17, L18, L19, L21, L22, L23, L24)
73469	Stator—Rear oscillator section stator complete with rotor, segment and coils (S2, L25, L26, L27, L28, L29, L30, L32, L33, L34, L35)
73633	Stator—Antenna stator complete with rotor and coils (S5, L6, L56, L57, L58, L59, L60, L61, L62, L63, L64, L65, L66, C21)
73470	Stator—Converter stator complete with rotor and coils (S3, L9, L36, L37, L38, L39, L40, L41, L48, L49, L50, L51)
73471	Stator—R-F amplifier stator complete with rotor and coils (S4, L13, L42, L43, L44, L45, L46, L47, L52, L53, L54, L55, C15, C16, R10)
73448	Transformer—Converter transformer (T1, R6)
73466	Washer—Insulating washer for front shield (1 set)
2917	Washer—"C" washer for channel selector shaft or fine tuning shaft and cam
	CHASSIS ASSEMBLIES KCS40 - T164 KCS40A - TC165, TC166, TC167, TC168
74946	Capacitor—Mica trimmer comprising 1 section of 4-70 mmf. and 1 section of 10-160 mmf. (C153A, C153B)
39604	Capacitor—Mica, 10 mmf. (C126)
74105	Capacitor—Mica, 33 mmf. (C111)
64062	Capacitor—Ceramic, 82 mmf. (C120)
73090	Capacitor—Mica, 82 mmf. (C140, C154)
39396	Capacitor—Ceramic, 100 mmf. (C175)
75060	Capacitor—Mica, 100 mmf. (C138)
73921	Capacitor—Ceramic, 120 mmf. (C129)
73102	Capacitor—Mica, 180 mmf. (C158)
73922	Capacitor—Ceramic, 270 mmf. (C183, C194, C198)
73091	Capacitor—Mica, 270 mmf. (C106, C115, C121)
39644	Capacitor—Mica, 470 mmf. (C181)

STOCK No.	DESCRIPTION
74947	Capacitor—Ceramic, 500 mmf., 20,000 volts (C168)
74250	Capacitor—Mica, 560 mmf. (C160)
71501	Capacitor—Ceramic, 1,500 mmf. (C101, C103, C104, C105, C108, C109, C110, C113, C114, C117, C118, C122, C125, C127, C132, C171, C172, C176, C177, C188, C192, C193, C196)
28417	Capacitor—Electrolytic, 5 mfd. 450 volts (C166)
71432	Capacitor—Electrolytic, comprising 2 sections of 40 mfd, 450 volts and 1 section of 10 mfd, 450 volts (C148A, C148B, C148C)
73582	Capacitor—Electrolytic, comprising 1 section of 40 mfd, 450 volts, 1 section of 10 mfd, 450 volts, and 1 section of 80 mfd, 200 volts (C170A, C170B, C170C)
73583	Capacitor—Electrolytic, comprising 1 section of 40 mfd, 450 volts, 1 section of 90 mfd, 150 volts and 1 section of 50 mfd, 150 volts (C147A, C147B, C147C)
73581	Capacitor—Electrolytic, comprising 1 section of 60 mfd, 450 volts, 2 sections of 10 mfd, 450 volts and 1 section of 20 mfd, 150 volts (C146A, C146B, C146C, C146D)
73801	Capacitor—Tubular, moulded paper, oil impregnated, .001 mfd, 1,000 volts (C137, C161)
73802	Capacitor—Tubular, paper, oil impregnated, .0015 mfd, 600 volts (C199)
73595	Capacitor—Tubular, paper, oil impregnated, .0022 mfd, 600 volts (C142, C184, C186, C195)
73920	Capacitor—Tubular, paper, oil impregnated, .0047 mfd, 600 volts (C143, C144, C202)
73561	Capacitor—Tubular, paper, oil impregnated, .01 mfd, 400 volts (C135, C182)
73594	Capacitor—Tubular, moulded paper, oil impregnated, .01 mfd, 600 volts (C145, C159)
73565	Capacitor—Tubular, paper, oil impregnated, .01 mfd, 1,000 volts (C151, C152, C185)
74727	Capacitor—Tubular, paper, oil impregnated, .018 mfd, 1,000 volts (C165)
73562	Capacitor—Tubular, paper, oil impregnated, .022 mfd, 400 volts (C155, C167)
73810	Capacitor—Tubular, paper, oil impregnated, .022 mfd, 1,000 volts (C164)
73553	Capacitor—Tubular, paper, oil impregnated, .047 mfd, 400 volts (C130, C134)
73592	Capacitor—Tubular, paper, oil impregnated, .047 mfd, 600 volts (C139, C156)
73597	Capacitor—Tubular, paper, oil impregnated, .047 mfd, 1,000 volts (C141, C150, C163, C191)
73557	Capacitor—Tubular, paper, oil impregnated, 0.1 mfd, 600 volts (C131)
73794	Capacitor—Tubular, paper, oil impregnated, 0.22 mfd, 400 volts (C136, C162)
74957	Capacitor—Tubular, paper, oil impregnated, 0.22 mfd, 600 volts (C149)
73787	Capacitor—Tubular, paper, oil impregnated, 0.47 mfd, 200 volts (C133, C157, C190, C197)
73154	Choke—Filter choke (L104)
71449	Coil—Horizontal linearity control coil (L111)
74983	Coil—Focus coil (L118, P108)
73477	Coil—Filament choke coil (L101)
74170	Coil—Peaking coil (36 muh) (L117, R110)
71527	Coil—Peaking coil (93 muh) (L102)
74214	Coil—Peaking coil (180 muh) (L103, L105)

STOCK No.	DESCRIPTION
71526	Coil—Peaking coil (250 muh) (L106, L114)
75252	Coil—Peaking coil (500 muh) (L107)
31027	Connector—4 contact female connector for focus coil (J108)
60942	Connector—8 contact female connector for deflection yoke (J106)
74594	Connector—Male connector for power cable
5040	Connector—4 contact female connector for speaker cable (P101)
74967	Connector—Anode connector
72734	Control—Horizontal and vertical hold control (R158, R173)
74047	Control—Brightness and picture control (R122, R131)
74048	Control—Volume control, tone control and power switch (R205, R233, S101)
71441	Control—Vertical linearity control (R162)
71440	Control—Height control (R155)
74597	Control—Focus control (R191)
74475	Control—AGC threshold control (R138)
74945	Control—Width control (R192)
71457	Cord—Power cord and plug
71437	Cover—Insulating cover for electrolytics Nos. 71432, 73581 and 73582
74956	Cushion—Rubber cushion for deflection yoke hood (2 required)
73600	Fuse—0.25 amps., 250 volts (F101)
71799	Grommet—Rubber grommet for horizontal yoke lead exit or 2nd anode lead exit
37396	Grommet—Rubber grommet for mounting ceramic tube socket
75445	Hood—Deflection yoke hood less rubber cushions
35787	Jack—Phono input jack (J103)
74953	Magnet—Ion trap magnet (P.M.)
18469	Plate—Bakelite mounting plate for electrolytics
75444	Plate—Bakelite plate complete with tube socket for high voltage rectifier
72067	Resistor—Wire wound, 5.1 ohms, ½ watt (R202)
18471	Resistor—Wire wound, 10 ohms, ½ watt (R190)
74955	Resistor—Voltage divider comprising 1 section of 1,200 ohms, 16 watts, and 2 sections of 700 ohms, 5½ watts (R193A, R193B, R193C)
	Resistor—Fixed, composition— 10 ohms, ±20%, ½ watt (R120) 10 ohms, ±10%, ½ watt (R225) 47 ohms, ±5%, ½ watt (R111) 47 ohms, ±20%, ½ watt (R183) 68 ohms, ±10%, ½ watt (R105) 68 ohms, ±20%, ½ watt (R123) 82 ohms, ±10%, ½ watt (R195) 100 ohms, ±10%, 2 watts (R184) 150 ohms, ±5%, ½ watt (R102) 150 ohms, ±10%, ½ watt (R115, R223) 150 ohms, ±20%, ½ watt (R106, R109, R114, R214) 220 ohms, ±10%, ½ watt (R121) 1,000 ohms, ±20%, ½ watt (R103, R107, R108, R113, R116, R118, R165, R199) 1,200 ohms, ±10%, ½ watt (R196) 1,200 ohms, ±10%, 1 watt (R160, R206) 1,500 ohms, ±10%, ½ watt (R161) 1,800 ohms, ±10%, 2 watts (R194) 2,200 ohms, ±10%, ½ watt (R219) 2,700 ohms, ±10%, ½ watt (R217) 2,700 ohms, ±10%, 2 watts (R208)

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REPLACEMENT PARTS (Continued)

STOCK No.	DESCRIPTION
	3,900 ohms, ±5%, ½ watt (R112)
	3,900 ohms, ±10%, ½ watt (R171)
	4,700 ohms, ±10%, ½ watt (R144)
	5,100 ohms, ±5%, ½ watt (R126)
	5,600 ohms, ±5%, ½ watt (R119)
	5,600 ohms, ±10%, ½ watt (R218)
	5,600 ohms, ±10%, 1 watt (R127, R167)
	6,800 ohms, ±5%, ½ watt (R136)
	6,800 ohms, ±10%, ½ watt (R150)
	6,800 ohms, ±10%, 2 watts (R177, R210)
	8,200 ohms, ±5%, ½ watt (R175)
	8,200 ohms, ±10%, ½ watt (R152, R153)
	8,200 ohms, ±5%, 1 watt (R117, R128)
	10,000 ohms, ±5%, ½ watt (R104)
	10,000 ohms, ±10%, ½ watt (R141, R182, R220)
	12,000 ohms, ±5%, ½ watt (R164)
	12,000 ohms, ±10%, ½ watt (R209)
	12,000 ohms, ±10%, 1 watt (R186)
	12,000 ohms, ±10%, 2 watts (R124)
	15,000 ohms, ±10%, ½ watt (R235)
	15,000 ohms, ±10%, 1 watt (R146)
	22,000 ohms, ±10%, ½ watt (R134, R197)
	22,000 ohms, ±20%, ½ watt (R198, R215)
	27,000 ohms, ±10%, ½ watt (R143, R151)
	39,000 ohms, ±5%, ½ watt (R135)
	47,000 ohms, ±10%, ½ watt (R145)
	47,000 ohms, ±20%, ½ watt (R221)
	82,000 ohms, ±5%, 1 watt (R179)
	82,000 ohms, ±10%, 1 watt (R168)
	100,000 ohms, ±5%, ½ watt (R203, R204)
	100,000 ohms, ±10%, ½ watt (R211, R216)
	100,000 ohms, ±10%, 1 watt (R174)
	100,000 ohms, ±20%, 2 watts (R222)
	120,000 ohms, ±10%, 1 watt (R172)
	150,000 ohms, ±10%, ½ watt (R129, R180, R185, R187)
	150,000 ohms, ±20%, ½ watt (R142)
	150,000 ohms, ±5%, 1 watt (R176)
	220,000 ohms, ±10%, ½ watt (R156, R166)
	270,000 ohms, ±10%, ½ watt (R154)
	330,000 ohms, ±10%, ½ watt (R140, R170, R200)
	330,000 ohms, ±5%, 1 watt (R178)
	470,000 ohms, ±10%, ½ watt (R137, R139, R188, R224)
	470,000 ohms, ±20%, ½ watt (R207)
	680,000 ohms, ±10%, ½ watt (R133, R212)
	820,000 ohms, ±10%, ½ watt (R169)
	1 megohm, ±10%, ½ watt (R147, R181)
	1 megohm, ±20%, ½ watt (R189)
	1.2 megohm, ±5%, ½ watt (R157, R213)
	2.2 megohm, ±10%, ½ watt (R130, R132, R163)
	3.3 megohm, ±5%, ½ watt (R159)
	3.9 megohm, ±10%, ½ watt (R149)
	6.8 megohm, ±10%, ½ watt (R125)
	10 megohm, ±10%, ½ watt (R148)
	10 megohm, ±20%, ½ watt (R201)
74602	Screw—No. 10-32 x 1¾" cross recessed round head screw for focus coil adjustments (3 required)
74601	Screw—No. 8-32 x ⅜" cross recessed pan head screw for focus coil mounting (2 required)
71456	Screw—No. 8-32 x 7/16" wing screw for fastening support and bracket
75083	Screw—No. 8-32 wing screw for mounting deflection yoke
73584	Shield—Tube shield
74937	Sleeve—Rubber sleeve for focus coil
73117	Socket—Tube socket, 7 pin, miniature
72927	Socket—Tube socket, 9 pin, miniature.

STOCK No.	DESCRIPTION
31251	Socket—Tube socket, octal, wafer
73249	Socket—Tube socket, octal, ceramic
71508	Socket—Tube socket for 1B3GT/8016
74834	Socket—Kinescope socket
31364	Socket—Pilot lamp socket for KCS40A
74936	Spring—Suspension spring (coil type) for kinescope socket leads
74954	Spring—Compression spring for hood and yoke assembly (3 required)
74944	Support—Rubber support for 2nd anode lead
74948	Support—Bakelite supports (1 set) for mounting hi-voltage plate
46760	Switch—"TV - Phono" switch (S103)
74157	Switch—Cabinet interlock switch (S105)
73569	Transformer—Vertical oscillator transformer (T107)
74589	Transformer—First pix I-F transformer (T101, C102, R101)
74590	Transformer—Second pix I-F transformer (T102, C107)
74591	Transformer—Third pix I-F transformer (T103, C112)
74592	Transformer—Fourth pix I-F transformer (T104, C116)
73575	Transformer—Fifth pix I-F transformer (T106, C123, C124)
71424	Transformer—Sound I-F transformer (T112, C173, C174)
71427	Transformer—Sound discriminator transformer (T113, C178, C179, C180)
73576	Transformer—Horizontal ocscillator transformer (T109)
73578	Transformer—Antenna transformer complete with socket (T115, J102)
74949	Transformer—Power transformer, 115 volts, 60 cycles (T111)
74951	Transformer—High voltage transformer (T110)
74950	Transformer—Vertical output transformer (T108)
73577	Trap—4.5 mc trap (L110, C128)
71778	Trap—Sound trap (T105, C119)
73476	Trap—I-F trap (L116, C189)
74952	Yoke—Deflection yoke (L108, L109, L112, L113, C169, C187, P106)
	SPEAKER ASSEMBLIES FOR MODEL T164 92580-3 W RMA - 274 RL105C5
75023	Cap—Dust cap
75024	Cone—Cone and voice coil assembly
5039	Connector—4 contact male connector for speaker (J101)
75025	Gasket—Speaker cone gasket
75022	Speaker—8" P.M. speaker complete with cone and voice coil (3.2 ohms) less output transformer and connector
75034	Transformer—Output transformer (T114)
	SPEAKER ASSEMBLIES FOR MODELS TC165, TC166, TC167, TC168 Stamped 92569-10W RL 111-16 RMA 274
13867	Cap—Dust cap
74901	Cone—Cone and voice coil assembly (3.2 ohms)

STOCK No.	DESCRIPTION
5039	Connector—4 contact male connector for speaker (J101)
75035	Speaker—12" P.M. speaker complete with cone and voice coil less output transformer and plug
75036	Transformer—Output transformer
	NOTE: If stamping on speaker in instrument does not agree with above speaker number, order replacement parts by referring to model number of instrument, number stamped on speaker and full description of part required.
	MISCELLANEOUS
74958	Back—Cabinet back for Model T164
75019	Back—Cabinet back for Model TC165
75026	Back—Cabinet back for Model TC166
74972	Back—Cabinet back for Model TC167
75020	Back—Cabinet back for Model TC168
72857	Board—"Ant" terminal board
71599	Bracket—Pilot lamp bracket for Models TC165, TC166, TC167, TC168
13103	Cap—Pilot lamp cap for Models TC165, TC166, TC167, TC168
71892	Catch—Bullet catch and strike for doors (1 set) (4 required for Model TC167 and 2 required for Model TC168)
X1917	Cloth—Grille cloth for mahogany or walnut instruments for Model T164
X1918	Cloth—Grille cloth for oak instruments for Model T164
X3074	Cloth—Grille cloth for mahogany or walnut instruments for Models TC165, and TC168, and maple instruments for Model TC168
X3089	Cloth—Grille cloth for oak instruments for Model TC165
X3088	Cloth—Grille cloth for mahogany or walnut instruments for Model TC167
X3101	Cloth—Grille cloth for mahogany and walnut instruments for Model TC166
X3090	Cloth—Grille cloth for oak instruments for Models TC166 and TC167
39153	Connector—4 contact male connector for antenna cable (P102)
30566	Connector—4 contact male connector, part of focus coil (P108)
35383	Connector—8 contact male connector, part of deflection yoke (P106)
74607	Decal—Control panel function decal for mahogany or walnut instruments
74608	Decal—Control panel function decal for oak or maple instruments
71984	Decal—Trade mark decal (RCA Victor) for Model T164
71768	Decal—Trade mark decal (RCA Victor) for Models TC167 and TC168
74809	Emblem—"RCA Victor" emblem

STOCK No.	DESCRIPTION
73642	Escutcheon—Channel marker escutcheon for mahogany or walnut instruments
73740	Escutcheon—Channel marker escutcheon for oak or maple instruments
72113	Foot—Rubber foot (4 required) for Model T164
74975	Glass—Safety glass for Model T164
74606	Glass—Safety glass for Models TC165, TC166, TC167 and TC168
37396	Grommet—Rubber grommet to mount speaker (4 required) for Models TC165, TC167 and TC168
73200	Hinge—Drop panel hinge (2 required) for Model T164
74308	Hinge—Cabinet door hinge (1 set) (4 required for Model TC167 and 2 required for Model TC168)
74959	Knob—Fine tuning knob—dark—for mahogany or walnut instruments (outer)
73995	Knob—Fine tuning knob—tan—for oak or maple instruments (outer)
74960	Knob—Channel selector knob—dark—for mahogany or walnut instruments (inner)
74961	Knob—Channel selector knob—tan—for oak or maple instruments (inner)
74962	Knob—Tone control, brightness control or vertical hold control knob—dark—for walnut or mahogany instruments (outer)
73999	Knob—Tone control, brightness control, or vertical hold control—tan—for oak or maple instruments (outer)
74963	Knob—Picture control, horizontal hold control or volume control and power switch knob—dark—for mahogany or walnut instruments (inner)
74001	Knob—Picture control, horizontal hold control or volume control and power switch knob—tan—for oak or maple instruments (inner)
11765	Lamp—Pilot lamp—Mazda 51—for Models TC165, TC166, TC167 and TC168
74162	Plate—Mounting plate for interlock switch
74450	Plate—Back plate for door pull (4 required) for Model TC167
74451	Pull—Door pull (4 required) for Model TC167
75021	Pull—Door pull (2 required) for Model TC168
74113	Screw—No. 8-32 x 1" trimit head screw for door pulls for Model TC167
74269	Screw—No. 8-32 x ¾" trimit head screw for door pull for Model TC168
73643	Spring—Spring clip for channel marker escutcheons
72845	Spring—Retaining spring for knobs Nos. 73995 and 74959
14270	Spring—Retaining spring for knobs Nos. 73999, 74960, 74961 and 74962
30330	Spring—Retaining spring for knobs Nos. 74001 and 74963
74966	Spring—Formed spring for kinescope masking panel (8 required)
72936	Stop—Door stop (2 required for Model TC167 and 1 required for Model TC168)
74161	Stud—Locating stud for back (2 required)

To obtain resistors for which no stock number is given, order by stating type, value of resistance, tolerance and wattage.

The system of employing an asterisk before the stock number of new items has been discontinued.

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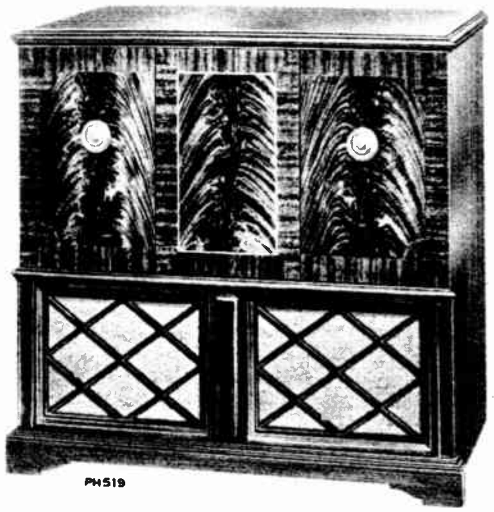

Model TA128 — Walnut, Mahogany or Oak

GENERAL DESCRIPTION

Model TA128 television, AM-FM radio, phonograph combination employs twenty-six tubes plus two rectifiers and a 12LP4 kinescope. The radio tuner unit which feeds through the television audio system covers the AM and the FM broadcast bands. Two record changers are provided to play 33⅓, 45 and 78 RPM records.

Features of the television unit are full twelve channel coverage; FM sound system; improved picture brilliance; picture A-G-C; A-F-C horizontal hold; stabilized vertical hold; two stages of video amplification; noise saturation circuits; improved sync separator and clipper; four mc. band width for picture channel and reduced hazard high voltage supply.

ELECTRICAL AND MECHANICAL SPECIFICATIONS

PICTURE SIZE.........87 square inches on a 12LP4 kinescope

TELEVISION R-F FREQUENCY RANGE

All 12 television channels, 54 mc. to 88 mc., 174 mc. to 216 mc.
Fine Tuning Range..±250 kc. on chan. 2, ±650 kc. on chan. 13
Picture Carrier Frequency ....25.75 mc.
Sound Carrier Frequency ....21.25 mc.

RADIO TUNING RANGE

Broadcast ....540-1,600 kc.
Frequency Modulation ....88-108 mc.
Intermediate Frequency—AM ....455 kc.
Intermediate Frequency—FM ....10.7 mc.

POWER SUPPLY RATING......115 volts, 60 cycles, 230 watts

AUDIO POWER OUTPUT RATING..............6 watts max.

CHASSIS DESIGNATIONS

Television Chassis KCS42A
Radio Chassis RK135D
33⅓/78 RPM Record Changer 960282
45 RPM Record Changer..............................RP168

Refer to Service Data 960282 or RP168 for information on the record changers.

LOUDSPEAKER 92569-8.................12 inch PM Dynamic
Voice Coil Impedance ....3.2 ohms at 400 cycles

WEIGHT

Chassis with Tubes in Cabinet.......................180 lbs.
Shipping Weight..................................207 lbs.

DIMENSIONS (inches)	Width	Height	Depth
Cabinet (outside)	36¼	34½	23½
Chassis (overall)	18⅝	17	18½

RECEIVER ANTENNA INPUT IMPEDANCE. 300 ohms balanced

If necessary, the television chassis may be fed separately from either a 300 ohm balanced line or a 72 ohm co-ax.

RCA TUBE COMPLEMENT

Tube Used	(Television Chassis)	Function
(1) RCA 6AG5		R-F Amplifier
(2) RCA 6AG5		Converter
(3) RCA 6J6		R-F Oscillator
(4) RCA 6AU6		1st Sound I-F Amplifier
(5) RCA 6AU6		2nd Sound I-F Amplifier
(6) RCA 6AL5		Sound Discriminator
(7) RCA 6AV6		1st Audio Amplifier
(8) RCA 6V6GT		Audio Output
(9) RCA 6BA6		1st Picture I-F Amplifier
(10) RCA 6AG5		2nd Picture I-F Amplifier
(11) RCA 6BA6		3rd Picture I-F Amplifier
(12) RCA 6AG5		4th Picture I-F Amplifier
(13) RCA 6AL5		Picture 2nd Detector & Sync Limiter
(14) RCA 12AU7		1st and 2nd Video Amplifier
(15) RCA 6SN7GT		AGC Amplifier & Vertical Sweep Osc.
(16) RCA 6SN7GT		AGC Rectifier & 1st Sync Separator
(17) RCA 6SN7GT		Sync Amplifier & 2nd Sync Separator
(18) RCA 6K6GT		Vertical Sweep Output
(19) RCA 6SN7GT		Horizontal Sweep Oscillator and Control
(20) RCA 6BG6G		Horizontal Sweep Output
(21) RCA 6W4GT		Damper
(22) RCA 1B3-GT/8016		High Voltage Rectifier
(23) RCA 5U4G		Power Supply Rectifier
(24) RCA 12LP4		Kinescope
	(Radio Tuner Chassis)	
(1) RCA 6J6		Mixer and Oscillator
(2) RCA 6BA6		I-F Amplifier
(3) RCA 6AU6		F-M Driver
(4) RCA 6AL5		Ratio Detector
(5) RCA 6BF6		AM Detector AVC and Phone Preamp.

ELECTRICAL AND MECHANICAL SPECIFICATIONS
(Continued)

PICTURE I-F FREQUENCIES

Picture Carrier Frequency ....25.75 mc.
Adjacent Channel Sound Trap ....27.25 mc.
Accompanying Sound Traps ....21.25 mc.
Adjacent Channel Picture Carrier Trap ....19.75 mc.

SOUND I-F FREQUENCIES

Sound Carrier Frequency ....21.25 mc.
Sound Discriminator Band Width between peaks........350 kc.

VIDEO RESPONSE ....To 4 mc.

FOCUS ....Magnetic

SWEEP DEFLECTION ....Magnetic

SCANNING ....Interlaced, 525 line

HORIZONTAL SCANNING FREQUENCY ....15,750 cps

VERTICAL SCANNING FREQUENCY ....60 cps

FRAME FREQUENCY (Picture Repetition Rate) ....30 cps

OPERATING CONTROLS (front panel)

Channel Selector }
Fine Tuning } ....Dual Control Knobs
Tone }
Sound Volume and On-Off Switch } ....Dual Control Knobs
Picture Horizontal Hold }
Picture Vertical Hold } ....Dual Control Knobs
Picture }
Brightness } ....Dual Control Knobs
Function Switch ....Single Control Knob
Radio Tuning ....Single Control Knob

NON-OPERATING CONTROLS

Horizontal Centering ....rear chassis adjustment
Vertical Centering ....rear chassis adjustment
Width ....rear chassis screwdriver adjustment
Width Selector Switch .....rear chassis screwdriver adjustment
Height ....rear chassis adjustment
Horizontal Linearity ....rear chassis screwdriver adjustment
Vertical Linearity ....rear chassis adjustment
Horizontal Drive ....rear chassis screwdriver adjustment
Horizontal Oscillator Frequency .....bottom chassis adjustment
Horizontal Oscillator Waveform ....side chassis adjustment
Focus ....rear chassis adjustment
Ion Trap Magnet ....top chassis adjustment
Deflection Coil ....top chassis wing nut adjustment
Focus Coil ....top chassis screwdriver adjustment

HIGH VOLTAGE WARNING

OPERATION OF THIS RECEIVER OUTSIDE THE CABINET OR WITH THE COVERS REMOVED, INVOLVES A SHOCK HAZARD FROM THE RECEIVER POWER SUPPLIES. WORK ON THE RECEIVER SHOULD NOT BE ATTEMPTED BY ANYONE WHO IS NOT THOROUGHLY FAMILIAR WITH THE PRECAUTIONS NECESSARY WHEN WORKING ON HIGH VOLTAGE EQUIPMENT. DO NOT OPERATE THE RECEIVER WITH THE HIGH VOLTAGE COMPARTMENT SHIELD REMOVED.

KINESCOPE HANDLING PRECAUTIONS

DO NOT OPEN THE KINESCOPE SHIPPING CARTON, INSTALL, REMOVE OR HANDLE THE KINESCOPE IN ANY MANNER UNLESS SHATTERPROOF GOGGLES AND HEAVY GLOVES ARE WORN. PEOPLE NOT SO EQUIPPED SHOULD BE KEPT AWAY WHILE HANDLING KINESCOPES. KEEP THE KINESCOPE AWAY FROM THE BODY WHILE HANDLING.

The kinescope bulb encloses a high vacuum and, due to its large surface area, is subjected to considerable air pressure. For these reasons, kinescopes must be handled with more care than ordinary receiving tubes.

The large end of the kinescope bulb—particularly that part at the rim of the viewing surface—must not be struck, scratched or subjected to more than moderate pressure at any time. In installation, if the tube sticks or fails to slip smoothly into its socket, or deflecting yoke, investigate and remove the cause of the trouble. Do not force the tube. Refer to the Receiver Installation section for detailed instructions on kinescope installation. All RCA kinescopes are shipped in special cartons and should be left in the cartons until ready for installation in the receiver. Keep the carton for possible future use.

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OPERATING INSTRUCTIONS

The following adjustments are necessary when turning the receiver on for the first time.

1. Turn the radio FUNCTION switch to Tel.

2. Turn the receiver "ON" and advance the SOUND VOLUME control to approximately mid-position.

3. Set the STATION SELECTOR to the desired channel.

4. Adjust the FINE TUNING control for best sound fidelity and SOUND VOLUME for suitable volume.

5. Turn the BRIGHTNESS control fully counter-clockwise, then clockwise until a light pattern appears on the screen.

6. Adjust the VERTICAL hold control until the pattern stops vertical movement.

7. Adjust the HORIZONTAL hold control until a picture is obtained and centered.

8. Turn the BRIGHTNESS control counter-clockwise until the retrace lines just disappear.

9. Adjust the PICTURE control for suitable picture contrast.

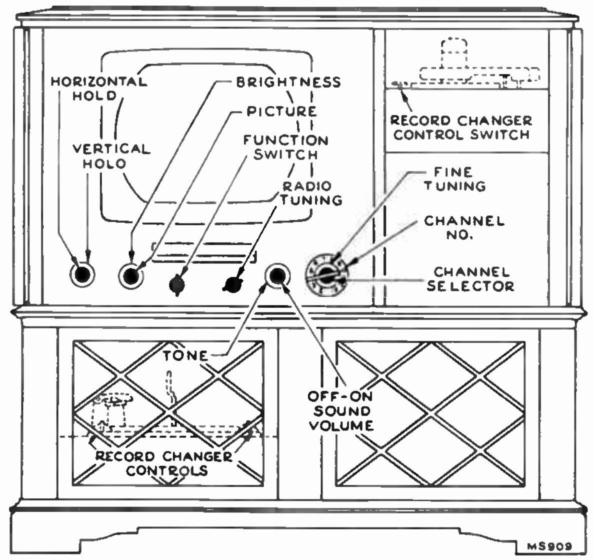

Figure 1—Receiver Operating Controls

10. After the receiver has been on for some time, it may be necessary to readjust the FINE TUNING control slightly for improved sound fidelity.

11. In switching from one station to another, it may be necessary to repeat steps numbers 4 and 9.

12. When the set is turned on again after an idle period, it should not be necessary to repeat the adjustments if the positions of the controls have not been changed. If any adjustment is necessary, step number 4 is generally sufficient.

13. If the positions of the controls have been changed, it may be necessary to repeat steps numbers 1 through 9.

14. For radio operation turn the FUNCTION switch to AM or FM and tune in station with the radio TUNING control.

15. For phono operation, turn the FUNCTION switch to PH for operation of the 33⅓/78 rpm record changer, or to XPH for operation of the 45 rpm record changer.

INSTALLATION INSTRUCTIONS

UNPACKING.—The TA128 receiver is packed complete with kinescope in a cardboard carton. To unpack, turn the shipping carton on its side and tear open the carton bottom flaps. Fold the flaps up along the side of the carton and turn the carton back up. Lift the carton up and off the cabinet.

A flat skid is attached to the bottom of the receiver cabinet which will permit the cabinet to be moved about without stressing the cabinet joints. To remove the skid, take off the nuts from the two bolts that hold the cabinet on the skid. With a man at each end of the cabinet, lift the cabinet off the skid.

The operating control knobs are packed in a bag and tied to a cabinet back rail. Remove the bag and install the knobs on the proper control shafts.

From the rear of the cabinet remove the single wood screw which holds the RP168 record changer drawer in the closed position. Slide the drawer out. From the top of the changer, remove the three filler plugs from over the motorboard mounting screws. Loosen these three screws to permit removal of two wooden shipping strips under the edge of the motorboard. Tighten the screws just enough to keep the motorboard springs from rattling and replace the filler plugs.

Remove the bracket which holds the 960282 changer drawer in the closed position. Open the drawer and from the front of the cabinet remove all of the changer packing material. Take out the two shipping screws from the changer motorboard. Insert two plugs from the bag with knobs into the holes in the motorboard.

Make sure that all tubes are in place and are firmly seated in their sockets.

Check to see that the high voltage lead is attached to the kinescope second anode connector socket on the bell of the tube.

Connect the antenna transmission line to the receiver antenna terminals.

Plug the receiver power cord into a 115 volt a-c power source. Turn the receiver power switch to the "on" position, the function switch to "tel," the brightness control three-quarters clockwise, and the picture control counter-clockwise.

ION TRAP MAGNET ADJUSTMENT.—Set the ion trap magnet approximately in the position shown in Figure 2. Starting from

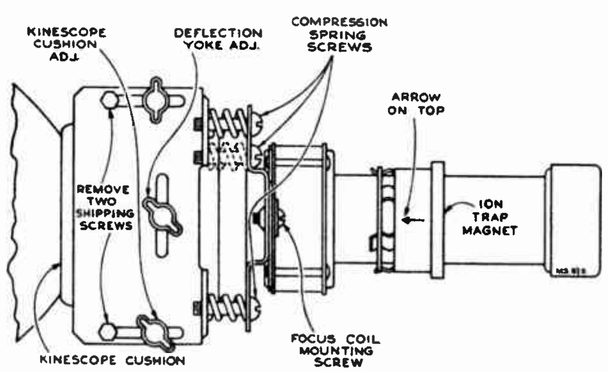

Figure 2—Yoke and Focus Coil Adjustments

this position adjust the magnet by moving it forward or backward at the same time rotating it slightly around the neck of the kinescope for the brightest raster on the screen. Reduce the brightness control setting until the raster is slightly above average brilliance. Adjust the focus control (R191 on the chassis rear apron) until the line structure of the raster is clearly visible. Readjust the ion trap magnet for maximum raster brilliance. The final touches on this adjustment should be made with the brightness control at the maximum position with which good line focus can be maintained.

INSTALLATION INSTRUCTIONS

DEFLECTION YOKE ADJUSTMENT.—If the lines of the raster are not horizontal or squared with the picture mask, rotate the deflection yoke until this condition is obtained. Tighten the yoke adjustment wing screw.

PICTURE ADJUSTMENTS.—It will now be necessary to obtain a test pattern picture in order to make further adjustments. See steps 3 through 9 of the receiver operating instructions.

If the Horizontal Oscillator and AGC System are operating properly, it should be possible to sync the picture at this point. However, if the AGC threshold control is misadjusted, and the receiver is overloading, it may be impossible to sync the picture.

If the receiver is overloading, turn R138 on the rear apron (see Figure 3) clockwise until the set operates normally and the picture can be synced.

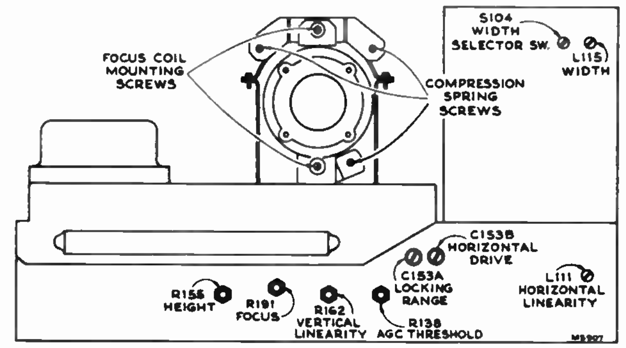

Figure 3—Rear Chassis Adjustments

CHECK OF HORIZONTAL OSCILLATOR ALIGNMENT.—Turn the horizontal hold control to the extreme counter-clockwise position. The picture should remain in horizontal sync. Momentarily remove the signal by switching off channel then back. Normally the picture will be out of sync. Turn the control clockwise slowly. The number of diagonal black bars will be gradually reduced and when only 3 bars sloping downward to the left are obtained, the picture will pull into sync upon slight additional clockwise rotation of the control. Pull in should occur when the control is approximately 90 degrees from the extreme counter-clockwise position. The picture should remain in sync for approximately 90 degrees of additional clockwise rotation of the control. At the extreme clockwise position, the picture should be out of sync and should show 1 vertical or diagonal black bar in the raster.

If the receiver passes the foregoing checks and the picture is normal and stable, the horizontal oscillator is properly aligned. Skip "Alignment of Horizontal Oscillator" and proceed with "Focus Coil Adjustments."

ALIGNMENT OF HORIZONTAL OSCILLATOR.—If in the above check the receiver failed to hold sync with the hold control at the extreme counter-clockwise position or failed to hold sync over 90 degrees of clockwise rotation of the control from the pull-in point, it will be necessary to make the following adjustments:

Horizontal Frequency Adjustment.—Turn the horizontal hold control to the extreme clockwise position. Tune in a television station and adjust the T109 horizontal frequency adjustment (under the chassis) until the picture is just out of sync and the horizontal blanking appears as a vertical or diagonal black bar in the raster.

Horizontal Lock in Range Adjustment.—Set the horizontal hold control to the full counter-clockwise position. Momentarily remove the signal by switching off channel then back. Slowly turn the horizontal hold control clockwise and note the least number of diagonal bars obtained just before the picture pulls into sync.

If more than 3 bars are present just before the picture pulls into sync, adjust the horizontal locking range trimmer C153A slightly clockwise. If less than 3 bars are present, adjust C153A slightly counter-clockwise. Turn the picture control counter-clockwise, momentarily remove the signal and recheck the number of bars present at the pull-in point. Repeat this procedure until 3 bars are present.

Repeat the adjustments under "Horizontal Frequency Adjustment" and "Horizontal Locking Range Adjustment" until the conditions specified under each are fulfilled. When the horizontal hold operates as outlined under "Check of Horizontal Oscillator Alignment" the oscillator is properly adjusted.

If it is impossible to sync the picture at this point and the AGC system is in proper adjustment it will be necessary to adjust the Horizontal Oscillator by the method outlined in the alignment procedure on page 11. For field purposes paragraph "A" under Horizontal Oscillator Waveform Adjustment may be omitted.

FOCUS COIL ADJUSTMENTS.—The focus coil should be adjusted so that there is approximately ¼ inch of space between the rear cardboard shell of the yoke and the flat of the front face of the focus coil. This spacing gives best average focus over the face of the tube. However, it may be necessary to change this distance slightly in order to compensate for small differences in strength of the permanent magnets in the coil. If the receiver focuses with the focus control towards the clockwise end of its range, the focus coil should be moved toward the yoke and if focus is obtained towards the counter-clockwise end of the control, the coil should be moved away from the yoke. In order to prevent the beam from striking the neck of the kinescope, it is important that the axis of the hole through the focus coil should be kept in accurate alignment with the axis of the neck of the kinescope.

CENTERING ADJUSTMENTS.—Centering is obtained by loosening the two focus coil mounting screws and sliding the coil up or down or from side to side. If a corner of the raster is shadowed, check the position of the ion trap magnet. In extreme cases it may be necessary to adjust one or more of the focus coil compression screws to eliminate a corner shadow.

Recheck the position of the ion trap magnet to insure that maximum brilliance is obtained.

WIDTH, DRIVE AND HORIZONTAL LINEARITY ADJUSTMENTS.—Adjustment of the horizontal drive control affects the high voltage applied to the kinescope. In order to obtain the highest possible voltage, hence the brightest and best focused picture, turn the horizontal drive control counter-clockwise until the left side of the picture begins to stretch.

Adjust the horizontal linearity control L111 to provide best linearity. Adjust the width control until the picture just fills the mask.

Adjustments of the horizontal drive control affect horizontal oscillator hold and locking range. If the drive control was adjusted, recheck the oscillator alignment.

FOCUS.—Adjust the focus control (R191 on chassis rear apron) for maximum definition in the test pattern vertical "wedge" and best focus in the white areas of the pattern.

HEIGHT AND VERTICAL LINEARITY ADJUSTMENTS.—Adjust the height control (R155 on chassis rear apron) until the picture fills the mask vertically. Adjust vertical linearity (R162 on rear apron), until the test pattern is symmetrical from top to bottom. Adjustment of either control will require a readjustment of the other. Adjust centering to align the picture with the mask.

CHECK TO SEE THAT THE CUSHION AND YOKE THUMB-SCREWS AND THE FOCUS COIL MOUNTING SCREWS ARE TIGHT.

AGC THRESHOLD CONTROL.—The AGC threshold control R138 is adjusted at the factory and normally should not require readjustment in the field.

To check the adjustment of the AGC Threshold Control, tune in a strong signal, sync the picture and turn the picture control to the maximum clockwise position. Turn the brightness control counter-clockwise until the vertical retrace lines are just invisible. Momentarily remove the signal by switching off channel and then back. If the picture reappears immediately, the receiver is not overloading due to improper setting of R138. If the picture requires an appreciable portion of a second to reappear, R138 should be readjusted.

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INSTALLATION INSTRUCTIONS

Set the picture control at the maximum clockwise position. Turn R138 fully clockwise. The top one-half inch of the picture may be bent slightly. This should be disregarded. Turn R138 counter-clockwise until there is a very, very slight bend or change of bend in the top one-half inch of the picture. Then turn R138 clockwise just sufficiently to remove this bend or change of bend.

If the signal is very weak, the above method may not work as it may be impossible to get the picture to bend. In this case, turn R138 counter-clockwise until the snow in the picture becomes more pronounced, then clockwise until the best signal to noise ratio is obtained.

The AGC control adjustment should be made on a strong signal if possible. If the control is set too far counter-clockwise on a weak signal, then the receiver may overload when a strong signal is received.

CHECK OF R-F OSCILLATOR ADJUSTMENTS.—Tune in all available stations to see if the receiver r-f oscillator is adjusted to the proper frequency on all channels. If adjustments are required, these should be made by the method outlined in the alignment procedure on page 10. The adjustments for channels 2 through 5 and 7 through 12 are available from the front of the cabinet by removing the station selector escutcheon as shown in Figure 4. Adjustment for channel 13 is on top of the chassis and channel 6 adjustment is in the kinescope well. See Figures 9 and 10 for their location.

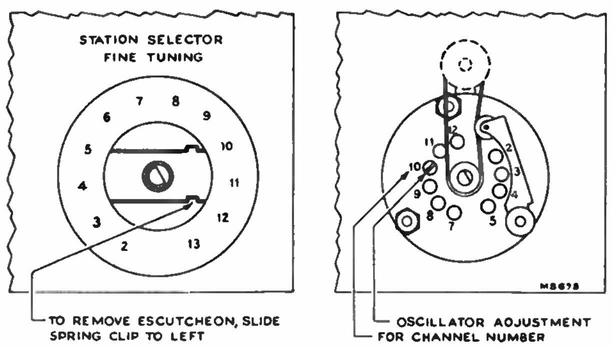

Figure 4—R-F Oscillator Adjustments

RECORD CHANGER OPERATION.—Turn the receiver function switch to each phono position and check each record player for proper operation.

RADIO OPERATION.—Turn the receiver function switch to AM and FM positions and check the radio for proper operation. Tune in a station of known frequency. If the dial pointer does not point to the correct spot on the dial, slip the dial pointer on the dial cord until the proper indication is obtained.

Replace the cabinet back and make sure that the screws are tight in order to prevent rattling at high volume.

WEAK SIGNAL AREA OPERATION.—Since the vast majority of receivers are sold in strong signal areas, the chassis are aligned to produce the cleanest pictures in those areas. However, if the receiver is to be operated in a weak signal area, better performance can be obtained by "peaking" the r-f unit.

To peak the r-f unit in these receivers, disconnect the 390 ohm resistor which is on top of the r-f unit chassis. Adjust L66 to obtain the best possible picture on the weakest low channel station received. By this action, the r-f gain is increased 50% at the expense of r-f bandwidth and an improvement in the weak signal picture results.

If the peaked receiver is subsequently taken to a strong signal area, the resistor R14 should be connected in place and L66 adjusted for "flat" response on the low channels.

CHASSIS REMOVAL.—To remove the chassis from the cabinet for repair or installation of a new kinescope, remove the back and the knobs, unplug all cables and remove the chassis bolts under the cabinet. Withdraw the chassis from the back of the cabinet. The kinescope is held on the chassis by means of a special strap, so that the chassis and the kinescope can be handled together, as a unit.

KINESCOPE HANDLING PRECAUTION.—Do not install, remove, or handle the kinescope in any manner, unless shatter-proof goggles and heavy gloves are worn. People not so equipped should be kept away while handling the kinescope. Keep the kinescope away from the body while handling.

To remove the kinescope, remove the kinescope socket, the ion-trap magnet, and the second-anode connector. Loosen the cross-recessed head screw on the kinescope strap, as shown in Figure 6. Withdraw the kinescope toward the front of the chassis.

INSTALLATION OF KINESCOPE.—Slide the kinescope cushion toward the rear of the chassis. Loosen the deflection yoke adjustment, slide the yoke toward the rear of the chassis and tighten.

The kinescope second anode contact is a recessed metal well in the side of the bulb. The tube must be installed so that this contact is up but rotated approximately 30 degrees toward the high-voltage compartment.

Insert the neck of the kinescope through the deflection and focus coils. If the tube sticks, or fails to slip into place smoothly, investigate and remove the cause of the trouble. Do not force the tube.

Slip the ion trap magnet assembly over the neck of the kinescope.

Connect the kinescope socket to the tube base.

Connect the high voltage lead to the kinescope second anode socket.

Wipe the kinescope screen surface and front panel safety glass clean of all dust and finger marks.

Tighten the cross-recessed head screw on the kinescope strap.

As may be seen by inspection, the radio dial lights and dial pointer are attached to the cabinet front panel. The dial cord is attached to the receiver chassis. The method of attachment may be seen in Figure 5.

Slide the dial pointer to the stop on the high frequency end of the dial. Turn the radio tuning shaft until the gang is completely unmeshed.

Slide the chassis into the cabinet until there is sufficient slack in the pilot light cable, then attach the pilot light sockets to the pilot light bracket.

Insert the chassis to its proper position, then install the six chassis bolts and tighten. Loosen the kinescope strap from the rear of the chassis. Push the kinescope forward until the face of the tube is against the mask. Push the yoke cushion forward against the kinescope flare, then tighten the cushion adjusting screws. Push the yoke forward and tighten. Tighten the kinescope strap. Replace the control knobs.

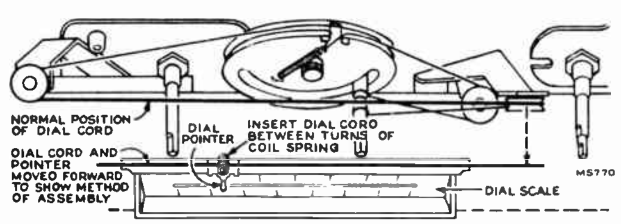

Figure 5—Dial Cord and Pointer Assembly

To hook up the dial pointer, reach over the television chassis to the radio and press the dial cord well into the coil spring.

Turn the set on and to radio position to see that the dial lighting is correct. If it is not, adjust the dial lights and shields. Tune in a station of known calibration and check the dial calibration.

Perform the entire television set-up procedure beginning with Ion Trap Magnet Adjustment.

CABINET ANTENNA.—A cabinet antenna is provided which may be employed in strong signal areas in which no reflections are experienced. The antenna leads are brought out near the receiver antenna terminals.

The link on the antenna terminal board on the back of the cabinet is for use in case it is desirable to connect a separate "A" band antenna.

CHASSIS TOP VIEW

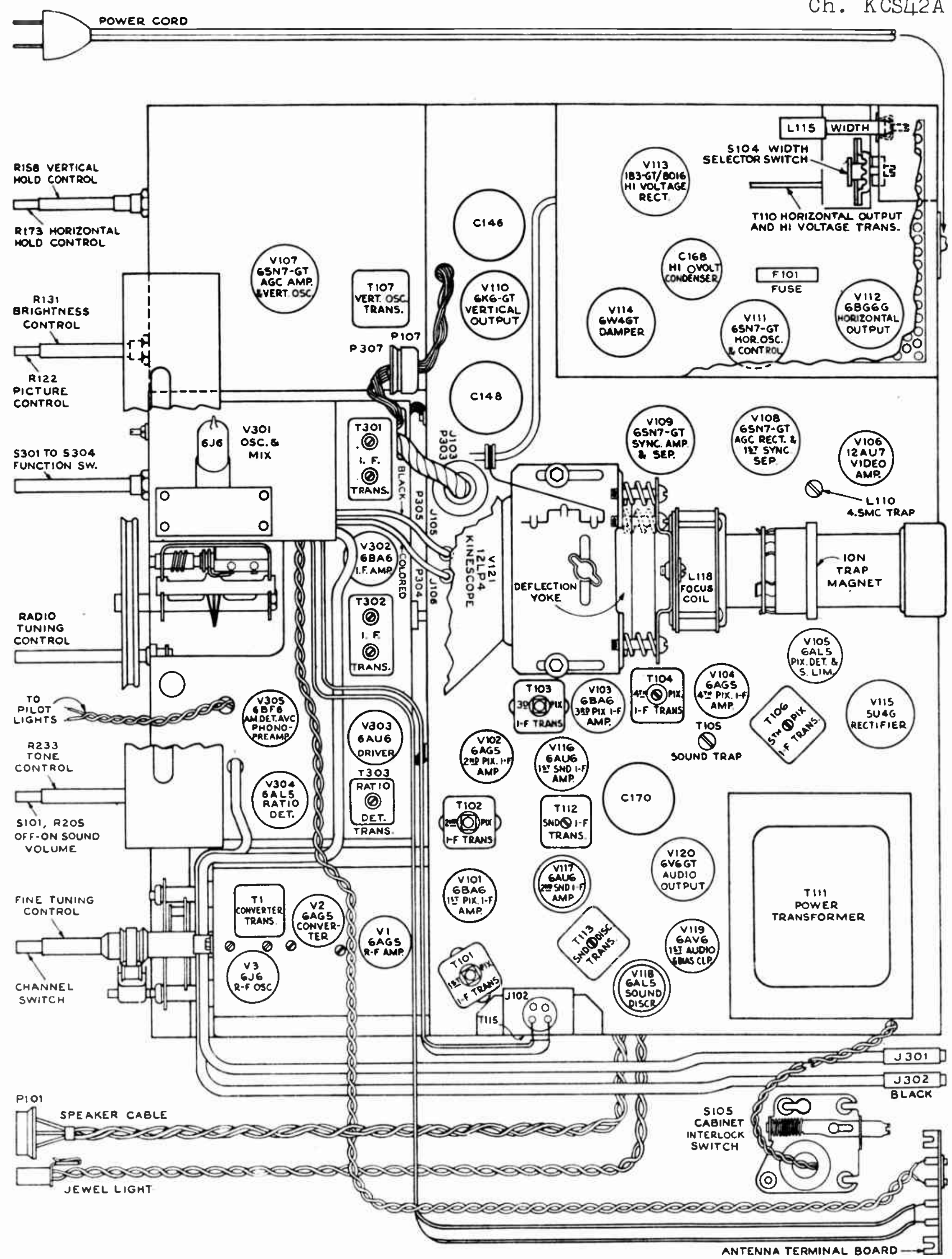

Figure 6—Chassis Top View

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CHASSIS BOTTOM VIEW

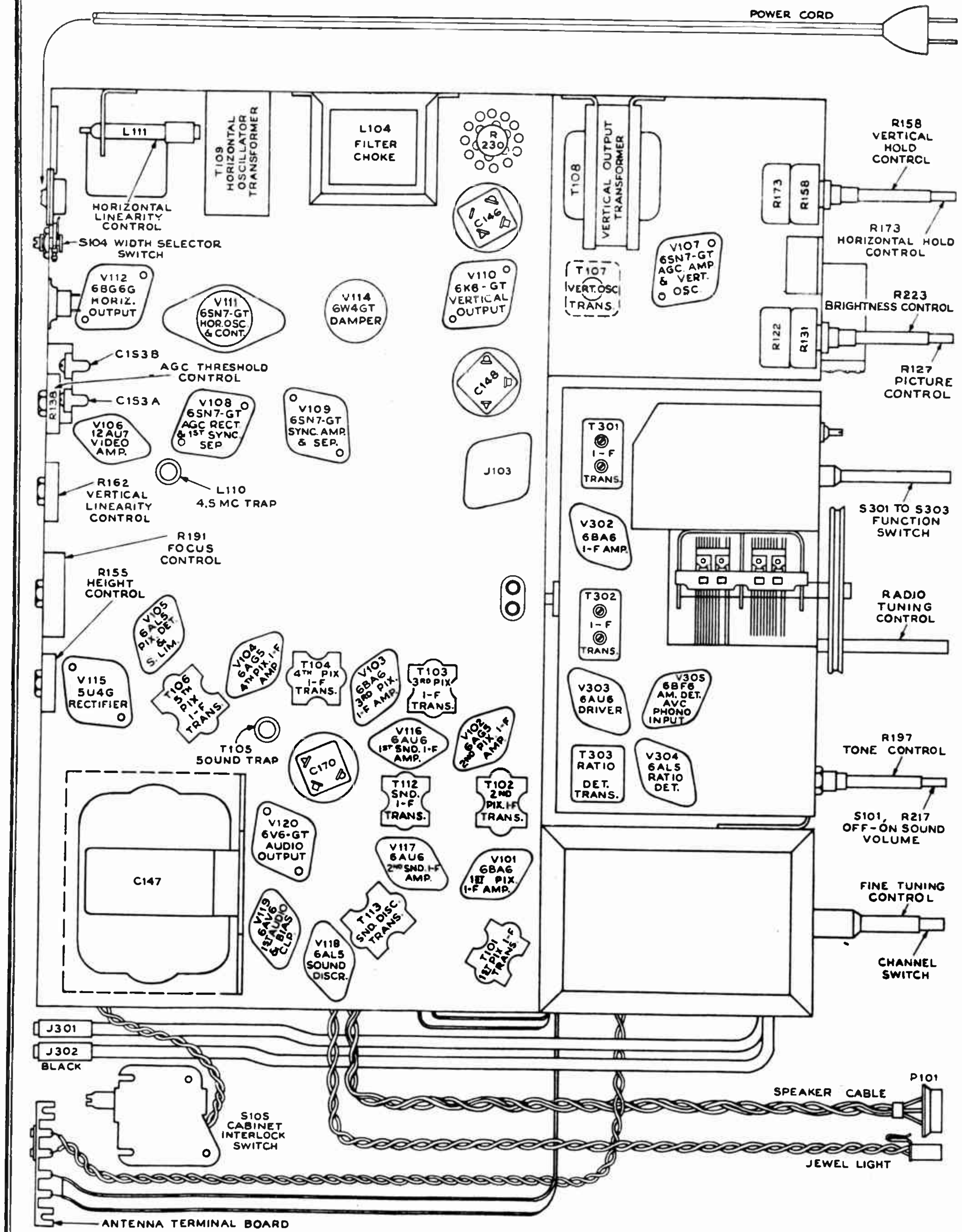

Figure 7—Chassis Bottom View

ALIGNMENT PROCEDURE

TEST EQUIPMENT.—To service properly the television chassis of this receiver, it is recommended that the following test equipment be available:

R-F Sweep Generator meeting the following requirements:

(a) Frequency Ranges

20 to 30 mc., 1 mc. and 10 mc. sweep width
50 to 90 mc., 10 mc. sweep width
170 to 225 mc., 10 mc. sweep width

(b) Output adjustable with at least .1 volt maximum.

(c) Output constant on all ranges.

(d) "Flat" output on all attenuator positions.

Cathode-Ray Oscilloscope.—For alignment purposes, the oscilloscope employed must have excellent low frequency and phase response and should be capable of passing a 60-cycle square wave without appreciable distortion. While this requirement is not met by many commercial instruments, RCA Oscilloscopes, types WO-55A, WO-58A, WO-79A, and WO-60C fill the requirement and any of these may be employed.

For video and sync waveform observations, the oscilloscope must have excellent frequency and phase response from 10 cycles to at least two megacycles in all positions of the gain control. The RCA types WO-58A and WO-79A are ideally suited for this purpose.

Signal Generator to provide the following frequencies with crystal accuracy.

(a) Intermediate frequencies

19.75 mc. adjacent channel picture trap
21.25 mc. sound i-f and sound traps
22.05 and 24.75 mc. conv. and first pix i-f trans.
25.9 mc. second picture i-f transformer
24.6 mc. fourth picture i-f transformer
22.0 mc. third picture i-f transformer
22.5 mc. fifth picture i-f transformer
25.75 mc. picture carrier
27.25 mc. adjacent channel sound trap

(b) Radio frequencies

Channel Number	Picture Carrier Freq. Mc.	Sound Carrier Freq. Mc.
2	55.25	59.75
3	61.25	65.75
4	67.25	71.75
5	77.25	81.75
6	83.25	87.75
7	175.25	179.75
8	181.25	185.75
9	187.25	191.75
10	193.25	197.75
11	199.25	203.75
12	205.25	209.75
13	211.25	215.75

(c) Output on these ranges should be adjustable and at least .1 volt maximum.

Heterodyne Frequency Meter with crystal calibrator if the signal generator is not crystal controlled.

Electronic Voltmeter of Junior "VoltOhmyst" type and a high voltage multiplier probe for use with this meter to permit measurements up to 10 kv.

Service Precautions.—If possible, the chassis should be serviced without the kinescope. However, if it is necessary to view the raster during servicing, make sure the kinescope retaining strap is secure, and the yoke cushion is up firmly against the flare of the tube.

CAUTION: Do not short the kinescope second-anode lead. Its short circuit current is approximately 3 ma. This represents approximately 9 watts dissipation and a considerable overload on the high-voltage filter resistor R189.

Adjustments Required.—Normally, only the r-f oscillator line will require the attention of the service technician. All other circuits are either broad or very stable and hence will seldom require re-adjustment.

The oscillator line is relatively non-critical. When oscillator tubes are changed, in all probability it will be necessary to adjust only C6 in order to bring the entire line into adjustment.

ORDER OF ALIGNMENT.—When a complete receiver alignment is necessary, it can be most conveniently performed in the following order:

(1) Sound discriminator
(2) Sound i-f transformers
(3) Picture i-f traps
(4) Picture i-f transformers
(5) R-F and converter lines
(6) R-F oscillator line
(7) 4.5 mc. video trap
(8) Sensitivity check

SOUND DISCRIMINATOR ALIGNMENT.—Set the signal generator for approximately .1 volt output at 21.25 mc. and connect it to the second sound i-f grid.

Detune T113 secondary (bottom).

Set the "VoltOhmyst" on the 3-volt scale.

Connect the meter, in series with a one-megohm resistor, to the junction of diode resistors R203 and R204.

Adjust the primary of T113 (top) for maximum output on the meter.

Connect the "VoltOhmyst" to the junction of C183 and R203. Adjust T113 secondary (bottom). It will be found that it is possible to produce a positive or negative voltage on the meter dependent upon this adjustment. Obviously to pass from a positive to a negative voltage, the voltage must go through zero. T113 (bottom) should be adjusted so that the meter indicates zero output as the voltage swings from positive to negative. This point will be called discriminator zero output.

Connect the sweep oscillator to the grid of the second sound i-f amplifier.

Adjust the sweep band width to approximately 1 mc. with the center frequency at approximately 21.25 mc. and with an output of approximately .1 volt.

Connect the oscilloscope to the junction of C183 and R203. The pattern obtained should be similar to that shown in Figure 13. If it is not, adjust T113 (top) until the wave form is symmetrical.

The peak to peak band width of the discriminator should be approximately 350 kc. and the trace should be linear from 21.175 mc. to 21.325 mc.

SOUND I-F ALIGNMENT.—Connect the sweep oscillator to the first sound i-f amplifier grid.

Connect the oscilloscope to the second sound i-f grid return (terminal A of T112) in series with a 33,000-ohm isolating resistor.

Insert a 21.25 mc. marker signal from the signal generator into the first sound i-f grid.

Adjust T112 (top and bottom) for maximum gain and symmetry about the 21.25 mc. marker. The pattern obtained should be similar to that shown in Figure 14.

The output level from the sweep should be set to produce approximately .3 volt peak-to-peak at the second sound i-f grid return when the final touches on the above adjustment are made. It is necessary that the sweep output voltage should not exceed the specified values otherwise the response curve will be broadened, permitting slight misadjustment to pass unnoticed and possibly causing distortion on weak signals.

The band width at 70% response from the first sound i-f grid to the second i-f grid should be approx. 200 kc.

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PICTURE I-F TRAP ADJUSTMENT.—Connect the "VoltOhmyst" to the junction of R135 and C190.

Remove the 6SN7GT AGC Amplifier tube V107. Connect a 250,000-ohm potentiometer between pins 5 and 6 of the V107 socket. Adjust the potentiometer until the "VoltOhmyst" reads approximately –12 volts.

Set the channel switch to the blank position between channels numbers 2 and 13.

Connect the "VoltOhmyst" across the picture detector load resistor R119. Under this condition, both leads of the meter are at approximately –12C volts. In making this connection, care should be taken not to touch the case of the meter or to permit the meter case to become grounded.

Connect the output of the signal generator to the grid of the converter tube V2. To do this, remove the tube from the socket and fashion a clip by twisting one end of a small piece of wire around pin number 1. Replace the tube in the socket leaving the end of the wire protruding from under the tube. Connect the signal generator to this wire through a 1,500 mmf capacitor keeping the leads as short as possible.

Set the generator to each of the following frequencies and with a thin fiber screwdriver tune the specified adjustment for minimum indication on the "VoltOhmyst." In each instance the generator should be checked against a crystal calibrator to insure that the generator is exactly on frequency.

(1) 21.25 mc.—T103 (top)	(4) 27.25 mc.—T104 (top)
(2) 21.25 mc.—T105 (top)	(5) 19.75 mc.—T106 (top)
(3) 27.25 mc.—T102 (top)	(6) 19.75 mc.—T101 (top)

In the above transformers using threaded cores, it is possible to run the cores completely through the coils and secure two peaks or nulls. The correct position is with the cores in the outside ends of the coils. If the cores are not in the correct position, the coupling will be incorrect and it will be impossible to secure the correct response.

PICTURE I-F TRANSFORMER ADJUSTMENTS.—Set the signal generator to each of the following frequencies and peak the specified adjustment for maximum indication on the "VoltOhmyst." During alignment, reduce the input signal if necessary to prevent overloading.

22.5 mc.—T106 (bottom)
24.6 mc.—T104 (bottom)
22.0 mc.—T103 (bottom)
25.9 mc.—T102 (bottom)

T1 and T101 are coupled by a link and in combination constitute an overcoupled transformer. The characteristics of such a transformer are such that it is impossible to adjust it to a single frequency.

To sweep align T1 and T101, connect a 330-ohm composition resistor across the primary coils of T102, T103, T104 and T106.

Connect the "VoltOhmyst" to the junction of R135 and C190. Adjust the 250,000-ohm variable resistor for 2.0 volts on the meter.

Connect the oscilloscope to the plate of the first video amplifier, pin 1 of V106.

Connect a sweep generator to the converter grid through a 1,500 mmf capacitor. Set the generator to sweep from 20.0 mc. to 30.0 mc. and adjust the output to provide a 4-volt peak-to-peak signal on the scope.

Connect the signal generator loosely to the converter grid and tune it to provide markers at 22.05 mc. and 24.75 mc.

Adjust T1 (top) and T101 (bottom) to obtain the response shown in Figure 15. The T1 core must penetrate to the terminal-board end of the coil in order to obtain the correct response.

Remove the 330 ohm resistors from across T102, T103, T104 and T106.

Adjust the 250,000 ohm potentiometer for a 15-volt peak-to-peak signal at the plate of the first video amplifier. The bias as measured by the "VoltOhmyst" should be 12 volts or less.

Observe and analyze the response curve obtained. The response will not be ideal and the i-f adjustments must be retouched in order to obtain the desired curve. See Figure 16.

On final adjustment the picture carrier marker must be at approximately 45% response. The curve must be approximately flat topped, with the 22.1 mc. marker at approximately 95% response and the 25.0 mc. marker below 90% response. A 26.5 mc. marker must fall between 5 and 10% response.

The most important consideration in making the i-f adjustments is to get the picture carrier at the 45% response point. If the picture carrier operates too low on the response curve, loss of low frequency video response, of picture brilliance, of blanking, and of sync may occur. If the picture carrier operates too high on the response curve, the picture becomes smeared. In making these adjustments, care should be taken to see that no two transformers are tuned to the same frequency as i-f oscillation may result.

Remove the converter tube and take off the clip to pin number 1. Replace the tube in the socket.

Picture I-F Oscillation. If the receiver will operate without oscillating with the test equipment disconnected but breaks into oscillation or becomes unstable with the equipment connected, it may become necessary to establish a ground plane. Cover the test bench with a sheet of copper and set the chassis on the sheet. Set all the test equipment except the "VoltOhmyst" on the sheet and bond or bypass them to it. A Junior "VoltOhmyst" should not be bonded to the sheet since the negative test probe is not always connected to ground during alignment. If the receiver is badly misaligned and two or more of the i-f transformers are tuned to the same frequency, the receiver may fall into i-f oscillation. I-F oscillation shows up as a voltage across the picture detector load resistor that is unaffected by r-f signal input. If such a condition is encountered, it is sometimes possible to stop oscillation by adjusting the transformers approximately to frequency by setting the adjustment cores of T101, T102, T103, T104, T105 and T106 to be approximately equal to those of another receiver known to be in proper alignment. If this does not have the desired effect, it may now be possible to stop oscillation by increasing the grid bias. If so, it should then be possible to align the transformers by the usual method. Once aligned in this manner, the i-f amplifier should be stable with reduced bias.

If the oscillation cannot be stopped in the above manner, shunt the grids of the first three pix i-f amplifiers to ground with 1,000 mmf capacitors. Connect the signal generator to the fourth pix i-f grid and align T106 to frequency. Progressively remove the shunt from each grid and align the plate coil of that stage to frequency.

If this does not stop the oscillation, the difficulty is not due to i-f misalignment as the i-f section is stable when properly aligned. Check all i-f by-pass condensers, transformer shunting resistors, tubes, socket voltages, etc.

ANTENNA, R-F AND CONVERTER LINE ADJUSTMENT.—In order to align the r-f tuner, it will first be necessary to set the channel-13 oscillator to frequency. The shield over the bottom of the r-f unit must be in place when making any adjustments.

The channel-13 oscillator may be aligned by adjusting it to beat with a crystal-calibrated heterodyne frequency meter, or by feeding a signal into the receiver at the r-f sound carrier frequency and adjusting the oscillator for zero output from the sound discriminator. In this latter case the sound discriminator must first have been aligned to exact frequency. Either method of adjustment will produce the same results. The method used will depend upon the type of test equipment available. Regardless of which method of oscillator alignment is used, the frequency standard must be crystal controlled or calibrated.

If the receiver oscillator is to be adjusted by the heterodyne frequency meter method, couple the meter probe loosely to the receiver oscillator.

If the receiver oscillator is adjusted by feeding in the r-f sound carrier signal, connect the signal generator to the receiver antenna terminals. Connect the "VoltOhmyst" to the sound discriminator output (junction of C183 and R203).

Set the receiver switch to 13.

Adjust the frequency standard to the correct frequency (237 mc. for heterodyne frequency meter or 215.75 mc. for the signal generator).

Set the fine tuning control to the middle of its range.

Adjust C6 for an audible beat on the heterodyne frequency meter or zero voltage from sound discriminator.

Now that the channel-13 oscillator is set to frequency, we may proceed with the r-f alignment.

Connect the "VoltOhmyst" to the junction of R135 and C197. Adjust the 250K pot. for –3.5 volts on the meter.

Remove the first pix i-f amplifier tube V101.

Connect the oscilloscope to the test connection at R13 in the r-f tuning unit.

Connect the r-f sweep oscillator to the receiver antenna terminals. The method of connection depends upon the output impedance of the sweep. The P102 connections for 300-ohm balanced or 72-ohm single-ended input are shown in the circuit diagram in Figure 74. If the sweep oscillator has a 50-ohm single-ended output, 300-ohm balanced output can be obtained by connecting as shown in Figure 8.

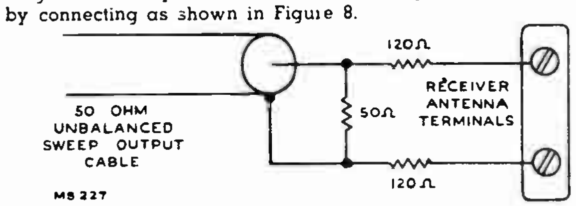

Figure 8—Unbalanced Sweep Cable Termination

Connect the signal generator loosely to the receiver antenna terminals.

Since channel 7 has the narrowest response of any of the high frequency channels, it should be adjusted first.

Set the receiver channel switch to channel 7.

Set the sweep oscillator to cover channel 7.

Insert markers of channel 7 picture carrier and sound carrier, 175.25 mc. and 179.75 mc.

Adjust C10 and C14 until the curve falls symmetrically between the sound and picture carrier markers. Adjust C11 to give the proper bandwidth. Roughly peak L6 in conjunction with slight adjustments of C10 and C14 for a flat-topped response curve with the sound and picture carriers at 90% to 95% response points on this curve. See Figure 17, channel 7.

Switch to channel 12 and adjust L6 for maximum response and minimum top slope of the curve.

Check the response of channels 7 through 13 by switching the receiver channel switch, sweep oscillator and marker oscillator to each of these channels and observing the response obtained. See Figure 17 for typical response curves. It should be found that all these channels have the proper shaped response with the markers above 80% response. If the markers do not fall within this requirement on one or more high frequency channels, since there are no individual channel adjustments, it will be necessary to readjust L6, C10, C11 and C14, and possibly compromise some channel slightly in order to get the markers up on other channels. Normally, however, no difficulty of this type should be experienced since the higher frequency channels are comparatively broad and the markers easily fall within the required range.

Channel 6 is next aligned in the same manner.

Set the receiver to channel 6.

Set the sweep oscillator to cover channel 6.

Set the marker oscillator to channel 6 picture and sound carrier frequencies.

Adjust L9, L13, L66, and C12 for an approximately flat-topped response curve located symmetrically between the markers. L9, L13 and L66 are the center frequency adjustments. C12 is the band-width adjustment.

Check channels 5 down through channel 2 by switching the receiver, sweep oscillator and marker oscillator to each channel and observing the response obtained. In all cases, the markers should be above the 80% response point. If this is not the case, L9, L13, L66 and C12 should be retouched. On final adjustment, all channels must be within the 80% specification.

Disconnect the 250K pot., and replace V107 and V101.

Following an r-f alignment, the oscillator alignment must be checked.

R-F OSCILLATOR LINE ADJUSTMENT.—The r-f oscillator line may be aligned by adjusting it to beat with a crystal calibrated heterodyne frequency meter, or by feeding a signal into the receiver at the r-f sound carrier frequency and adjusting the oscillator for zero output from the sound discriminator. In this latter case the sound discriminator must first have been aligned to exact frequency. Either method of adjustment will produce the same results. The method used will depend upon the type of test equipment available.

Regardless of which method of oscillator alignment is used, the frequency standard must be crystal controlled or calibrated. If the receiver oscillator is to be adjusted by the heterodyne frequency meter method, the calibration frequency listed under R-F Osc. Freq. must be available.

If the receiver oscillator is adjusted by feeding in the r-f sound carrier frequency, the frequencies listed under Sound Carrier Freq. must be available.

Channel Number	Receiver R-F Osc. Freq. Mc.	R-F Sound Carrier Freq. Mc.	Channel Oscillator Adjustment
2	81	59.75	L24
3	87	65.75	L23
4	93	71.75	L22
5	103	81.75	L21
6	109	87.75	L31
7	201	179.75	L19
8	207	185.75	L18
9	213	191.75	L17
10	219	197.75	L16
11	225	203.75	L15
12	231	209.75	L14
13	237	215.75	C6

If the heterodyne frequency meter method is used, couple the meter probe loosely to the receiver oscillator.

If the r-f sound carrier method is used, connect the "VoltOhmyst" to the sound discriminator output (junction of C183 and R203) and connect the signal generator to the receiver antenna terminals. The order of alignment remains the same regardless of which method is used.

If the r-f unit is removed from the receiver for service and is aligned separately, the shield over the bottom of the r-f unit must be in place when making adjustments.

Since lower frequencies are obtained by adding steps of inductance, it is necessary to align channel 13 first and continue in reverse numerical order.

Set the receiver channel switch to 13.

Adjust the frequency standard to the correct frequency (237 mc. for heterodyne frequency meter or 215.75 mc. for the signal generator).

Set the fine tuning control to the middle of its range while making the adjustment.

Adjust C6 for an audible beat on the heterodyne frequency meter or zero voltage from sound discriminator. Oscillator adjustments L1 and L2 shown on the schematic are factory control adjustments and should not be touched in the field.

Switch the receiver to channel 12.

Set the frequency standard to the proper frequency as listed in the alignment table.

Adjust L14 for indications as above.

Adjust the oscillator to frequency on all channels by switching the receiver and the frequency standard to each channel and adjusting the appropriate oscillator trimmer for the speci-

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ALIGNMENT PROCEDURE

fied indication. It should be possible to adjust the oscillator to the correct frequency on all channels with the fine tuning control in the middle third of its range.

After the oscillator has been set on all channels, start back at channel 13 and recheck to make sure that all adjustments are correct.

AGC THRESHOLD ADJUSTMENT.—The AGC threshold adjustment can be made by the method outlined in the Installation Instructions. However, a more accurate adjustment can be obtained by the use of an oscilloscope.

Tune in a station and advance the picture control to the maximum clockwise position. Connect the low capacity probe from the oscilloscope to the plate of the first video amplifier, pin 1 of V106. Adjust the oscilloscope to observe the horizontal sync pulse.

Turn the AGC threshold control R138 fully clockwise, then slowly counter-clockwise. As the control is turned counter-clockwise, the receiver gain will increase slowly, increasing the size of the pattern on the oscilloscope. R138 should be turned counter-clockwise until the receiver begins to overload as indicated by clipping of the sync. The control should be left in the maximum gain position in which no clipping of sync is observed. See Figure 18 for proper waveforms.

HORIZONTAL OSCILLATOR ADJUSTMENT.—Normally the adjustment of the horizontal oscillator is not considered to be a part of the alignment procedure, but since the oscillator waveform adjustment requires the use of an oscilloscope, it can not be done conveniently in the field. The waveform adjustment is made at the factory and normally should not require readjustment in the field. However, the waveform adjustment should be checked whenever the receiver is aligned or whenever the horizontal oscillator operation is improper.

Horizontal Frequency Adjustment.—With a clip lead, short circuit the coil between terminals C and D of the horizontal oscillator transformer T109. Tune in a television station and sync the picture if possible.

A.—Turn the horizontal hold control R173 to the extreme clockwise position. Adjust the T109 Frequency Adjustment (under the chassis) so that the picture is just out of sync and the horizontal blanking appears in the picture as a vertical bar. The position of the bar is unimportant.

B.—Turn the hold control approximately one quarter of a turn from the extreme clockwise position and examine the width and linearity of the picture. If picture width or linearity is incorrect, adjust the horizontal drive control C153B, the width control L115 and the linearity control L111 until the picture is correct. If C153B was adjusted, repeat step A above.

Horizontal Locking Range Adjustment.—Turn the horizontal hold control fully counter-clockwise. Momentarily remove the signal by switching off channel then back. Slowly turn the horizontal hold clockwise and note the least number of diagonal bars obtained just before the picture pulls into sync.

If more than 9 bars are present just before the picture pulls into sync, adjust the horizontal locking range trimmer C153A slightly clockwise. If less than 7 bars are present, adjust C153A slightly counter-clockwise. Turn the horizontal hold control counter-clockwise, momentarily remove the signal and recheck the number of bars present at the pull-in point. Repeat the procedure until 7 to 9 bars are present.

Horizontal Oscillator Waveform Adjustment.—Remove the shorting clip from terminals C and D of T109. Turn the horizontal hold control to the extreme clockwise position. With a thin fibre screwdriver, adjust the Oscillator Waveform Adjustment Core of T109 (on the outside of the chassis) until the horizontal blanking bar appears in the raster.

A.—Connect the low capacity probe of an oscilloscope to terminal C of T109. Turn the horizontal hold control one quarter turn from the clockwise position so that the picture is in sync. The pattern on the oscilloscope should be as shown in Figure 19. Adjust the Oscillator Waveform Adjustment Core of T109 until the two peaks are at the same height. During this adjustment, the picture must be kept in sync by readjusting the hold control if necessary.

This adjustment is very important for correct operation of the circuit. If the broad peak of the wave on the oscilloscope is lower than the sharp peak, the noise immunity becomes poorer, the stabilizing effect of the tuned circuit is reduced and drift of the oscillator becomes more serious. On the other hand, if the broad peak is higher than the sharp peak, the oscillator is overstabilized, the pull-in range becomes inadequate and the broad peak can cause double triggering of the oscillator when the hold control approaches the clockwise position.

Remove the oscilloscope upon completion of this adjustment.

Check of Horizontal Oscillator Adjustments.—Set the horizontal hold control to the full counter-clockwise position. Momentarily remove the signal by switching off channel then back. Slowly turn the horizontal hold control clockwise and note the least number of diagonal bars obtained just before the picture pulls into sync.

If more than 3 bars are present just before the picture pulls into sync, adjust the horizontal locking range trimmer C153A slightly clockwise. If less than 3 bars are present, adjust C153A slightly counter-clockwise. Turn the horizontal hold control counter-clockwise, momentarily remove the signal and recheck the number of bars present at the pull-in point. Repeat this procedure until 3 bars are present.

Turn the horizontal hold control to the maximum clockwise position. The picture should be just out of sync to the extent that the horizontal blanking bar appears as a single vertical or diagonal bar in the picture. Adjust the T109 Frequency Adjustment until this condition is fulfilled.

4.5 MC VIDEO TRAP.—With a strong input from a station, detune the receiver from the correct fine tuning point. With a very short clip lead, short the trap winding of T103. Observe the picture for the appearance of a 4.5 mc. beat. If the beat appears in the picture, adjust L110 until the beat is eliminated.

SENSITIVITY CHECK.—A comparative sensitivity check can be made by operating the receiver on a weak signal from a television station and comparing the picture and sound obtained to that obtained on other receivers under the same conditions.

This weak signal can be obtained by connecting the shop antenna to the receiver through a ladder type attenuator pad. The number of stages in the pad depends upon the signal strength available at the antenna. A sufficient number of stages should be inserted so that a somewhat less than normal contrast picture is obtained when the picture control is at the maximum clockwise position. Only carbon type resistors should be used to construct the pad.

RESPONSE CURVES.—The response curves shown on page 14 and referred to throughout the alignment procedure were taken from a production set. Although these curves are typical, variations can be expected.

The response curves are shown in the classical manner of presentation, that is with "response up" and low frequency to the left. The manner in which they will be seen in a given test set-up will depend upon the characteristics of the oscilloscope and the sweep generator. The curves may be seen inverted and/or switched from left to right depending on the deflection polarity of the oscilloscope and the phasing of the sweep generator.

ALIGNMENT TABLE.—Both methods of oscillator alignment are presented in the alignment table. The service technician may thereby choose the method to suit his test equipment.

ALIGNMENT TABLE

THE DETAILED ALIGNMENT PROCEDURE BEGINNING ON PAGE 8 SHOULD BE READ BEFORE ALIGNMENT BY USE OF THE TABLE IS ATTEMPTED

STEP No.	CONNECT SIGNAL GENERATOR TO	SIGNAL GEN. FREQ. MC.	CONNECT SWEEP GENERATOR TO	SWEEP GEN. FREQ. MC.	CONNECT OSCILLOSCOPE TO	CONNECT "VOLTOHMYST" TO	MISCELLANEOUS CONNECTIONS AND INSTRUCTIONS	ADJUST	REFER TO
				DISCRIMINATOR AND SOUND I F ALIGNMENT					
1	2nd sound i-f grid (pin 1, V117)	21.25 .1 volt output	Not used		Not used	In series with 1 meg. to junction of R203 & R204		Detune T113 (bot.) Adjust T113 (top) for max. on meter	Fig. 9 Fig. 10 Fig. 11
2	"	"	"		"	Junct. of C183 & R203	Meter on 3 volt scale	T113 (bottom) for zero on meter	Fig. 10 Fig. 11
3	"	"	2nd sound i-f grid (pin 1, V117)	21.25 center 1 mc. wide .1 v. out	Junction of C183 & R203	Not used	Check for symmetrical response waveform (positive & negative). If not equal adjust T113 (top) until they are equal		Fig. 11 Fig. 13
4	1st sound i-f grid (pin 1, V116)	21.25 reduced output	1st sound i-f grid	21.25 reduced output	Terminal A, T112 in series with a 33,000 ohm resistor	"	Sweep output reduced to provide .3 volt p-to-p on scope	T112 (top & bot.) for max. gain and symmetry at 21.25 mc.	Fig. 9 Fig. 10 Fig. 11 Fig. 14
				PICTURE I-F AND TRAP ADJUSTMENT					
5	Not used		Not used		Not used	Junction of R135 & C190	Remove V107. Connect potentiometer between pins 5 & 6 of V107 socket	Adjust pot. for meter reading of −12 volts	Fig. 11
6	Converter grid (pin 1, V2)	21.25	"		"	Across R119	Meter on 3 volt scale. Receiver between 2 and 13	T103 (top) for min. on meter	Fig. 9
7	"	21.25	"		"	"	"	T105 (top) for min.	"
8	"	27.25	"		"	"	"	T102 (top) for min.	"
9	"	27,25	"		"	"	"	T104 (top) for min.	"
10	"	19.75	"		"	"	"	T106 (top) for min.	"
11	"	19.75	"		"	"	"	T101 (top) for min.	"
12	"	22.5	"		"	"	"	T106 (bottom) for max. on meter	Fig. 10
13	"	24.6	"		"	"	"	T104 (bottom) for max.	"
14	"	22.0	"		"	"	"	T103 (bottom) for max.	"
15	"	25.9	"		"	"	"	T102 (bottom) for max.	"
16	"	22.05 24.75	Converter grid (Pin 1, V2)	Sweeping 20 to 30 mc.	Pin 1, V106	Junction of R135 & C190	Shunt 330 ohms across pri. T102, T103, T104, T106. Set bias −2 V. Set swp. gen. for 4 V. P-P on scope.	Adjust T1 (top) and T101 (bottom) for proper response	Fig. 9 Fig. 10 Fig. 15
17	"		"	"	"	"	Remove shunt resistors. Set bias to give 15 volts P to P on scope.	Adjust T1 (top), T101, T102, T103, T104, T106 (bot.) for proper resp.	Fig. 9 Fig. 10 Fig. 16
				ANTENNA, R-F AND CONVERTER LINE ALIGNMENT					
18	Antenna terminals	215.75	Not used		Not used	Junction of C183 & R203 for signal gen. method only	Fine tuning centered. Receiver on channel 13. Heterodyne meter coupled to oscillator if used.	C6 for zero on meter or beat on het. freq. meter	Fig. 9 Fig. 11
19						Junction of R135 & C197	Remove V101	Potentiometer for −3.5 volts on meter	Fig. 9 Fig. 11
20	Antenna terminal (loosely)	175.25 & 179.75	Antenna terminals (see text for precaution)	Sweeping channel 7	Test Connection R13	Not used	Receiver on channel 7	L6, C10, C11 & C14 for flat top response between markers. Markers above 90%.	Fig. 9 Fig. 10 Fig. 17 (7)
21	"	205.25 209.75	"	channel 12	"	"	Receiver on channel 12	L6 for max. response and min. slope of top of curve	Fig. 9 Fig. 17 (12)
22	"	175.25 179.75	"	channel 7	"	"	Receiver on channel 7	Check to see that response is as above	Fig. 17 (7)
23	"	181.25 185.75	"	channel 8	"	"	Receiver on channel 8	"	Fig. 17 (8)
24	"	187.25 191.75	"	channel 9	"	"	Receiver on channel 9	"	Fig. 17 (9)
25	"	193.25 197.75	"	channel 10	"	"	Receiver on channel 10	"	Fig. 17 (10)

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ALIGNMENT PROCEDURE

STEP No.	CONNECT SIGNAL GENERATOR TO	SIGNAL GEN. FREQ. MC.	CONNECT SWEEP GENERATOR TO	SWEEP GEN. FREQ. MC.	CONNECT OSCILLOSCOPE TO	CONNECT "VOLTOHMYST" TO	MISCELLANEOUS CONNECTIONS AND INSTRUCTIONS	ADJUST	REFER TO
	ANTENNA, R-F AND CONVERTER LINE ALIGNMENT (Cont'd)								
26	"	199.25 203.75	"	channel 11	"	"	Receiver on channel 11	"	Fig. 17 (11)
27	"	205.25 209.75	"	channel 12	"	"	Receiver on channel 12	"	Fig. 17 (12)
28	"	211.25 215.75	"	channel 13	"	"	Receiver on channel 13	"	Fig. 17 (13)
29	If the response on any channel (steps 22 through 28) is below 80% at either marker, switch to that channel and adjust L6, C10, C11 & C14 to pull response up on that channel. Then recheck steps 22 through 28.								
30	Antenna terminals (loosely)	83.25 87.75	Ant. terminals (see text for precaution)	Sweeping chan. 6	Test Connection R13	Not used	Receiver on channel 6	L9, L13, L66 & C12 for response as above	Fig. 17 (6)
31	"	77.25 81.75	"	channel 5	"	"	Receiver on channel 5	Check to see that response is as above	Fig. 17 (5)
32	"	67.25 71.75	"	channel 4	"	"	Receiver on channel 4	"	Fig. 17 (4)
33	"	61.25 65.75	"	channel 3	"	"	Receiver on channel 3	"	Fig. 17 (3)
34	"	55.25 59.75	"	channel 2	"	"	Receiver on channel 2	"	Fig. 17 (2)
35	If the response on any channel (steps 31 through 34) is below 80% at either marker, switch to that channel and adjust L9, L13, L66 & C12 to pull response up on that channel. Then recheck steps 30 through 34. Disconnect the bias pot. and replace V101 and V107.								
	R-F OSCILLATOR ALIGNMENT								
STEP No.	**CONNECT SIGNAL GENERATOR TO**	**SIGNAL GEN. FREQ. MC.**	**CONNECT HETERODYNE FREQ. METER TO**	**HET. METER FREQ. MC.**	**CONNECT OSCILLOSCOPE TO**	**CONNECT "VOLTOHMYST" TO**	**MISCELLANEOUS CONNECTIONS AND INSTRUCTIONS**	**ADJUST**	**REFER TO**
36	Antenna terminals	215.75	Loosely coupled to r-f osc.	237	Not used	Junction of C183 & R203 for sig. gen. method only	Fine tuning centered. Receiver on channel 13	C6 for zero on meter or beat on het. freq. meter	Fig. 9 Fig. 11
37	"	209.75	"	231	"	"	Rec. on chan. 12	L14 as above	Fig. 12
38	"	203.75	"	225	"	"	Rec. on chan. 11	L15 as above	"
39	"	197.75	"	219	"	"	Rec. on chan. 10	L16 as above	"
40	"	191.75	"	213	"	"	Rec. on chan. 9	L17 as above	"
41	"	185.75	"	207	"	"	Rec. on chan. 8	L18 as above	"
42	"	179.75	"	201	"	"	Rec. on chan. 7	L19 as above	"
43	"	87.75	"	109	"	"	Rec. on chan. 6	L31 as above	Fig. 10
44	"	81.75	"	103	"	"	Rec. on chan. 5	L21 as above	Fig. 12
45	"	71.75	"	93	"	"	Rec. on chan. 4	L22 as above	"
46	"	65.75	"	87	"	"	Rec. on chan. 3	L23 as above	"
47	"	59.75	"	81	"	"	Rec. on chan. 2	L24 as above	"
48	Repeat steps 36 through 47 as a check.								
	AGC THRESHOLD ADJUSTMENT								
49	Not used		Not used		Pin 1, V106	Not used	Tune in station, turn pix control clockwise. Adjust R138 for max. gain without clipping sync on scope.		Fig. 11 Fig. 18
	HORIZONTAL OSCILLATOR ADJUSTMENT								
50	Short circuit terminals C and D of T109. Tune in a station.								
51	Turn hold control fully clockwise. Adjust T109 Frequency Adjustment until horizontal blanking bar appears in the picture.								
52	Turn hold control 1/4 turn from clockwise to sync picture. Adjust width (L115), linearity (L111) and drive (C153B) controls until picture is correct. Repeat step 51.								
53	Turn hold control fully counter-clockwise. Momentarily remove signal. Turn hold control slowly clockwise. Note least number of bars before pull-in. Adjust Locking Range Control (C153A) for 7 to 9 bar pull-in.								
54	Remove clip from terminals C and D of T109. Turn hold control fully clockwise. Adjust T109 Oscillator Waveform Adjustment until horizontal blanking bar appears in picture.								
55	Connect low capacity probe of oscilloscope to terminal C of T109. Turn hold control 1/4 turn from clockwise. Adjust T109 Oscillator Waveform Adjustment until broad and sharp peaks of wave on oscilloscope are same height. Keep picture in sync with hold control during adjustment. Remove oscilloscope.								
56	Turn hold control fully counter-clockwise. Momentarily remove signal. Turn hold control slowly clockwise. Note least number of bars before pull-in. Adjust Locking Range Control (C153A) for 3 bar pull-in.								
57	Turn hold control fully clockwise. Adjust T109 Freq. Adjustment until horizontal blanking appears as single vertical or diagonal bar in pix.								
	4.5 MC VIDEO TRAP ADJUSTMENT								
58	Tune in a strong station. Short T103 trap. If a 4.5 mc. beat appears in picture adjust 4.5 mc. trap (L110) until beat is eliminated.								
	SENSITIVITY CHECK								
59	Connect antenna to receiver through attenuator pad to provide weak signal. Compare the picture and sound obtained to that obtained on other receivers under the same conditions.								

ALIGNMENT DATA

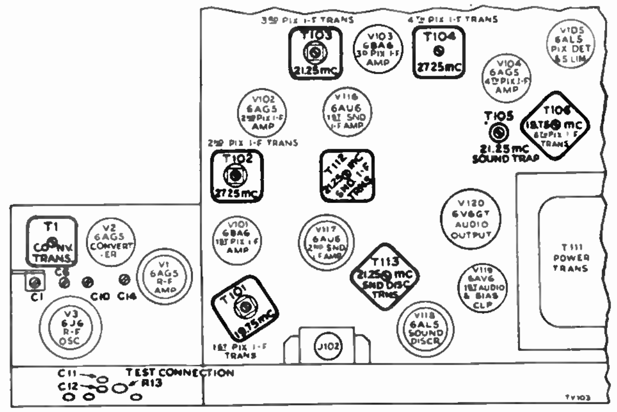


Figure 9—Top Chassis Adjustments

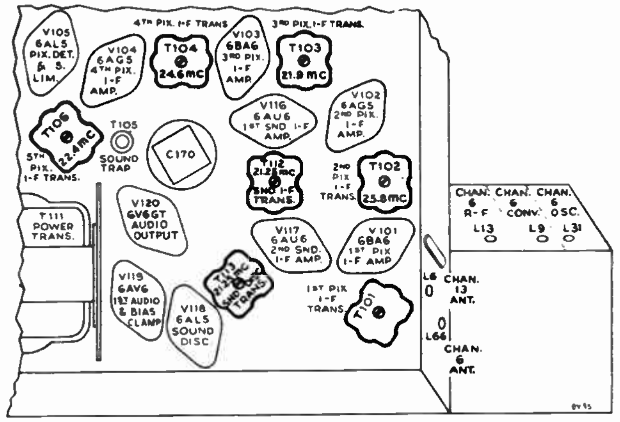


Figure 10—Bottom Chassis Adjustments

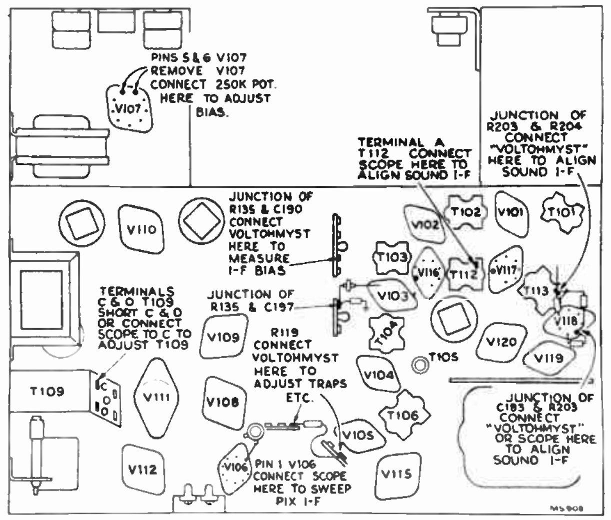
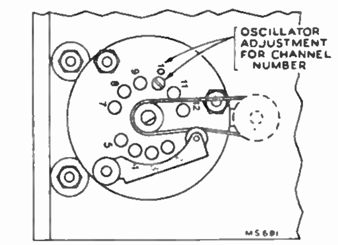


Figure 11—Test Connection Points



OSCILLATOR ADJUSTMENT FOR CHANNEL 13 IS ON TOP OF R-F UNIT AND CHANNEL 6 IS ON SIDE.

Figure 12—R-F Oscillator Adjustments

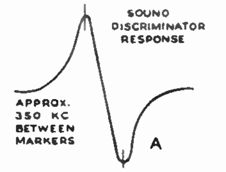


Figure 13
Discriminator
Response

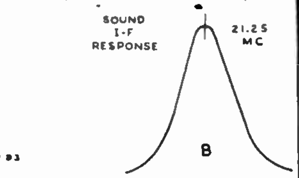


Figure 14
Sound I-F
Response

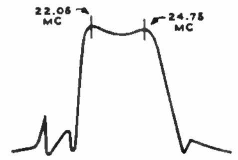


Figure 15
T1 and T101
Response

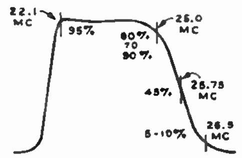


Figure 16
Overall I-F
R-F Response

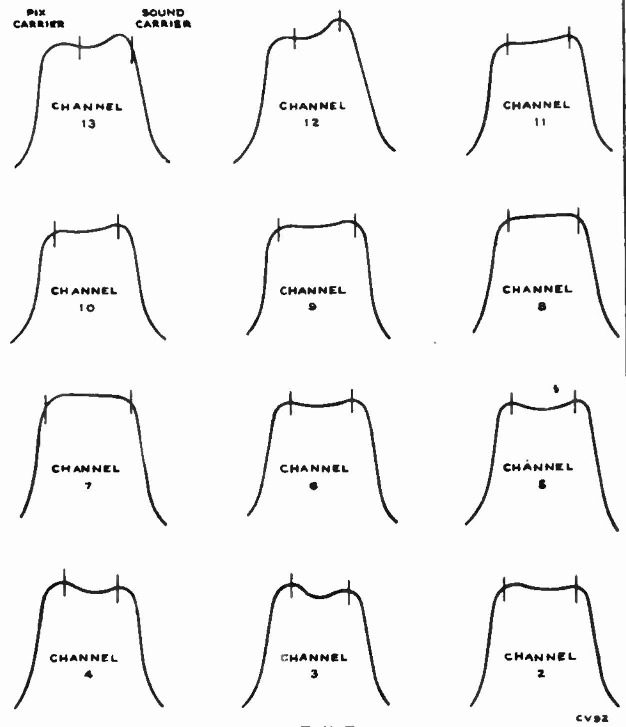


Figure 17—R-F Response

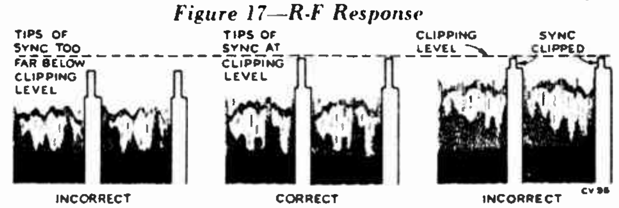


Figure 18—AGC Threshold Adjustment Waveforms

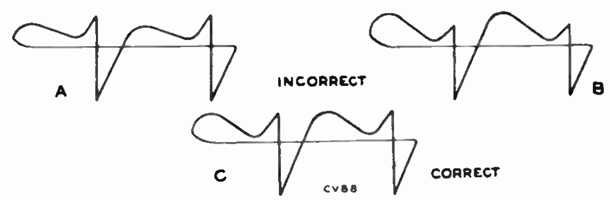


Figure 19—Horizontal Oscillator Waveforms

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RADIO ALIGNMENT PROCEDURE

If any lead dressing is necessary, it should be done before aligning the receiver. When making a complete alignment follow the table below in sequence. If only a portion of the circuit is to be aligned select the portion required and follow with the remaining steps in the section. Any adjustments made on the 455 kc. I-F's make it necessary to adjust the 10.7 mc. I-F's.

"AM" R-F—I-F ALIGNMENT

Test-Oscillator.—For all alignment operations, connect low side of the test-osc. to the receiver chassis, and keep the osc. output as low as possible to avoid a-v-c action. Output Meter.—Connect the meter across the speaker voice coil, and turn the receiver volume control to max.

Steps	Connect the High Side of the Test Osc. to—	Tune Test Osc. to—	Function Switch	Turn Radio Dial to—	Adjust the following
1	Antenna terminal in series with .01 mfd.	455 kc. Modulated	AM	Low Freq. end of Dial	†Top and bot. cores of T301 and T302. (For max. voltage across voice coil.)
2	Ant. terminal through dummy ant. of 200 mmfs.	1,620 kc.	AM	Min. capacity	Osc. C308 for maximum output.
3		1,400 kc.	AM	Tune to signal	Ant. C304 for maximum output.
4		600 kc.	AM	600 kc.	Osc. L306 and Ant. L303.
5	Repeat steps 2, 3 and 4 for maximum output.				

† Use alternate loading. Connect an 18,000-ohm resistor across the primary to load the plate winding while the grid winding of the same transformer is being peaked. Then load the grid winding with the 18,000-ohm resistor while the plate winding is being peaked.

RATIO DETECTOR ALIGNMENT

Connect probe of "VoltOhmyst" to negative side of C328 and low side to chassis. Connect output meter across speaker voice coil.

Steps	Connect the High Side of the Test Osc. to—	Tune Test Osc. to—	Function Switch	Radio Dial Tuned to—	Adjust
6	Pin No. 1 of 6AU6 (V303) in series with .01 mfd.	10.7 mc. 30% AM Modulated	FM	———	Top of T303 for maximum DC on "VoltOhmyst."
7	Pin No. 1 of 6AU6 (V303) in series with .01 mfd.		FM	———	Bottom of T303 for minimum audio output on meter.
8	Repeat steps 6 and 7 as necessary making final adjustment with r-f input level set to give approximately 3.0 volts d-c on "VoltOhmyst."				

"FM" R-F—I-F ALIGNMENT

Steps	Connect the High Side of the Test Osc. to—	Tune Test Osc. to—	Function Switch	Radio Dial Tuned to—	Adjust
9	Terminal 3 of S301-2 rear through 270 ohms.	10.7 mc.	FM	88 mc.	*T301 and T302 for max. with r-f input set to give −3 volts on "VoltOhmyst."
10	Terminal 3 of S301-2 rear through 270 ohms.	106 mc.	FM	106 mc.	Set C302 to max. capacity. Squeeze L307 and adjust C302 for maximum.
11	Terminal 3 of S301-2 rear through 270 ohms.	90 mc.	FM	Tune to signal	Squeeze L301 and rock gang for maximum output.
12	Repeat steps 10 and 11 as required.				

* Use a 680-ohm resistor to load the plate winding while the grid winding of the same transformer is being peaked. Then the grid winding is loaded with 680-ohm resistor while the plate winding is being peaked.

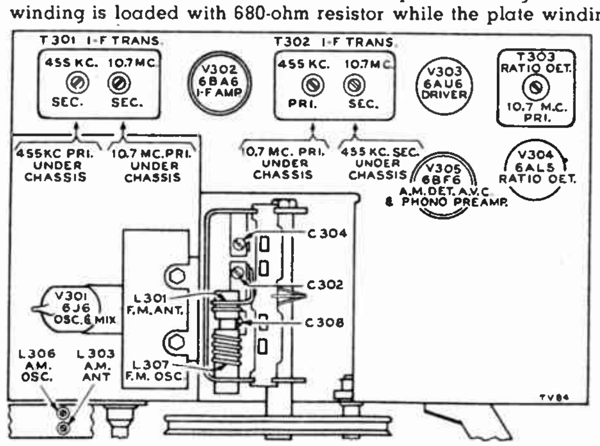

Figure 20—Chassis, Top View, Showing Adjustments

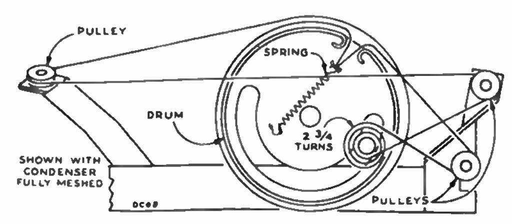

Figure 21—Dial and Drive Cord Assembly

CRITICAL LEAD DRESS:

1. Ground lead on pin 2 of V302 and V303 should be dressed down flat on chassis.
2. Dual .005 mfd. capacitors and diode filter should be dressed to clear the bottom of the cabinet.
3. Dress C329 across V302 sockets with short and direct leads.
4. Dress V302 plate lead from pin 5 down to the chassis.
5. Dress AVC lead from R321 to switch down to chassis and against back of gang mounting plate.
6. Dress lead from pin 6 of V305 down to chassis and against back of gang mounting plate.
7. Dress AVC lead from 1st I-F to switch against chassis and against gang mounting plate.
8. Dress lead from switch to pin 1 of V301 against plate supporting gang.
9. Dress all insulated F-M leads down to chassis.
10. Connect C309 with short lead to pin 6 of V301 keeping body of cap away from plate lead and switch terminals.
11. The coupling between L301 and L307 should be adjusted to give proper injection voltage to the mixer grid. This has been found to be correct when the distance between adjacent end turns is 3/4" to 7/16" measured at top of the form.
12. Dress cabled leads away from antenna transmission lines.
13. Dress all uninsulated bus wire so as to avoid short circuits.

SERVICE SUGGESTIONS

Following is a list of symptoms of possible failures and an indication of some of the possible faults:

NO RASTER ON KINESCOPE:

(1) Incorrect adjustment of ion trap magnet. Magnets reversed either front to back or top to bottom; front magnet incorrectly oriented.

(2) V112 or V113 inoperative. Check waveforms on grids and plates.

(3) No high voltage—If horizontal deflection is operating as evidenced by the correct waveform on terminal 4 of horizontal output transformer, the trouble can be isolated to the 8016 circuit. Either the T110 high voltage winding is open, the 8016 tube is defective, its filament circuit is open, C168 is shorted, or R187 or R189 are open.

(4) V111 circuit inoperative—Refer to schematic and waveform chart.

(5) Damper tube (V114) inoperative.

(6) Defective kinescope.

(7) R131 open.

(8) No receiver plate voltage—filter capacitor shorted—bleeder or filter choke open.

NO VERTICAL DEFLECTION:

(1) V107B or V110 inoperative. Check voltage and waveforms on grids and plates.

(2) T107 or T108 open.

(3) Vertical deflection coils open.

SMALL RASTER:

(1) Low Plus B or low line voltage.

(2) V112 defective.

POOR VERTICAL LINEARITY:

(1) If adjustments cannot correct, change V110.

(2) Vertical output transformer defective.

(3) V107B defective—check voltage and waveforms on grid and plate.

(4) C150, R164, C147B or C148C defective.

(5) Low bias or plate voltage—check rectifiers and capacitors in supply circuits.

POOR HORIZONTAL LINEARITY:

(1) If adjustments do not correct, change V112 or V114.

(2) T110 or L111 defective.

(3) C164 or C165 defective.

WRINKLES ON LEFT SIDE OF RASTER:

(1) R166, R167 or C169 defective.

(2) Defective yoke.

PICTURE OUT OF SYNC HORIZONTALLY:

(1) T109 incorrectly tuned.

(2) R172, R173 or R174 defective.

TRAPEZOIDAL OR NON-SYMMETRICAL RASTER:

(1) Improper adjustment of focus coil or ion trap magnet.

(2) Defective yoke.

RASTER AND SIGNAL ON KINESCOPE BUT NO SOUND:

(1) R-F oscillator off frequency.

(2) Sound i-f, discriminator or audio amplifier inoperative—check V116, V117, V118, V119, V120 and their socket voltages.

(3) T114 or C186 defective.

(4) Speaker defective.

SIGNAL AT KINESCOPE GRID BUT NO SYNC:

(1) AGC threshold control R138 misadjusted.

(2) V105B, V107A, V108 or V109 inoperative. Check voltage and waveforms at their grids and plates.

SIGNAL ON KINESCOPE GRID BUT NO VERTICAL SYNC:

(1) Check V107B and associated circuit—C145, T107, etc.

(2) Integrating network inoperative—Check.

(3) R154, R155, R157, R158 or R159 defective.

SIGNAL ON KINESCOPE GRID BUT NO HORIZONTAL SYNC:

(1) T109 misadjusted—readjust as instructed on page 11.

(2) V111 inoperative—check socket voltages and waveforms.

(3) T109 defective.

(4) C140, C153A, C154, C155, C156, C157 or C166 defective.

(5) If horizontal speed is completely off and cannot be adjusted check C158, C159, R172, R173, R174, R179 and R182.

SOUND AND RASTER BUT NO PICTURE OR SYNC:

(1) Picture i-f, detector or video amplifier inoperative—check V103, V104, V105 and V106—check socket voltages.

(2) Bad contact to kinescope grid.

PICTURE STABLE BUT POOR RESOLUTION:

(1) V105A or V106 defective.

(2) Peaking coils defective—check for specified resistance.

(3) Make sure that the focus control operates on both sides of proper focus.

(4) R-F and I-F circuits misaligned.

PICTURE SMEAR:

(1) R-F or I-F circuits misaligned.

(2) Open peaking coil.

(3) This trouble can originate at the transmitter—check on another station.

PICTURE JITTER:

(1) AGC threshold control R138 misadjusted.

(2) If regular sections at the left picture are displaced change V112.

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World Radio History

SERVICE SUGGESTIONS

(3) Vertical instability may be due to loose connections or noise.

(4) Horizontal instability may be due to unstable transmitted sync.

RASTER BUT NO SOUND, PICTURE OR SYNC:

(1) Defective antenna or transmission line.

(2) R-F oscillator off frequency.

(3) R-F unit inoperative—check V1, V2, V3.

DARK VERTICAL LINE ON LEFT OF PICTURE:

(1) Reduce horizontal drive and readjust width and horizontal linearity.

(2) Replace V112.

LIGHT VERTICAL LINE ON LEFT OF PICTURE:

(1) C169 defective.

(2) V114 defective.

PICTURE I-F RESPONSE.—At times it may be desirable to observe the individual i-f stage response. This can be achieved by the following method:

Shunt all i-f transformers and coils with a 330-ohm carbon resistor except the one whose response is to be observed.

Connect a wide band sweep generator to the converter grid and adjust it to sweep from 18 mc. to 30 mc.

Connect the oscilloscope across the picture detector load resistor and observe the overall response. The response obtained will be essentially that of the unshunted stage. The effects of the various traps are also visible on the stage response.

Figures 22 through 26 show the responses of the various stages obtained in the above manner. The curves shown are typical although some variation between receivers can be expected. Relative stage gain is not shown.

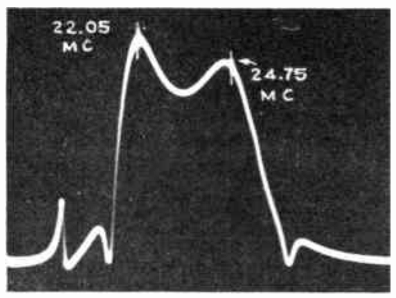

Figure 22—Response of Converter and First Pix I-F Transformer

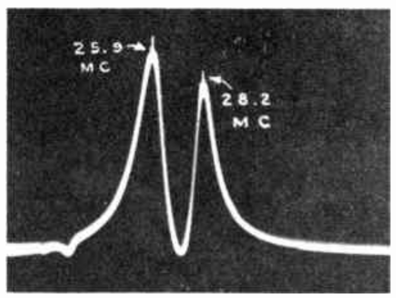

Figure 23—Response of Second Pix I-F Transformer

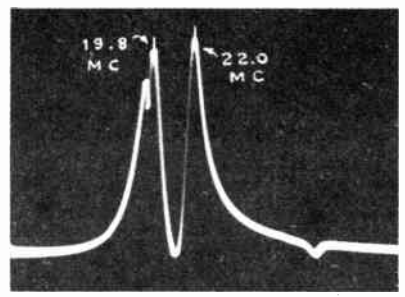

Figure 24—Response of Third Pix I-F Transformer

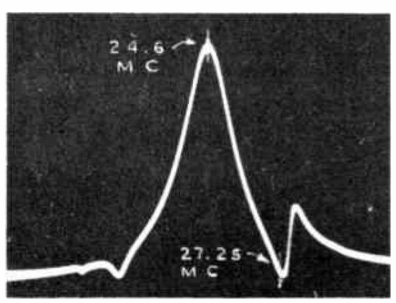

Figure 25—Response of Fourth Pix I-F Transformer

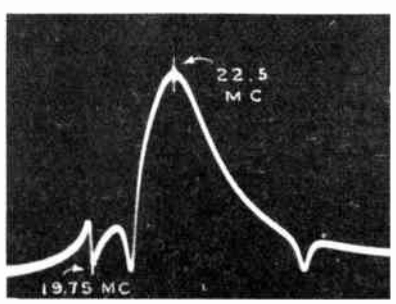

Figure 26—Response of Fifth Pix I-F Transformer

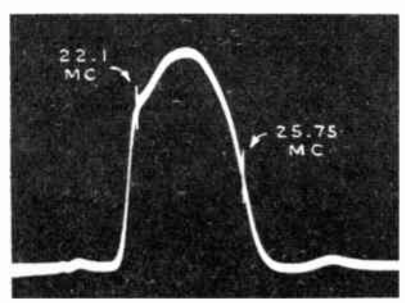

Figure 27—Response from First Pix I-F grid to Pix Det.

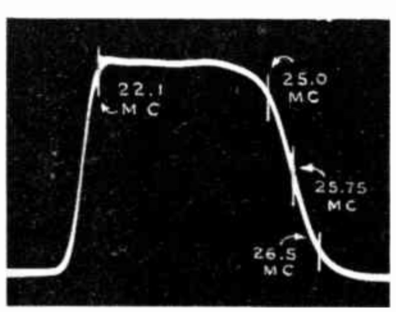

Figure 28—Overall Pix I-F Response

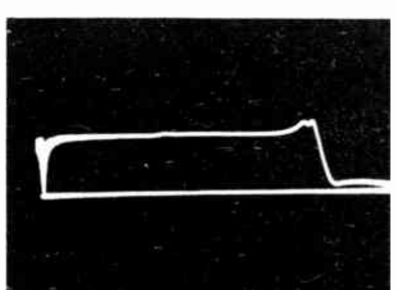

Figure 29—Video Response at Average Contrast

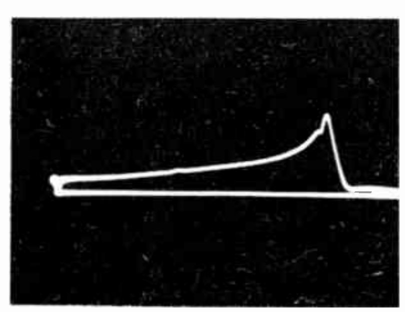

Figure 30—Video Response at Minimum Contrast

WAVEFORM PHOTOGRAPHS

Video Signal Input to 1st Video Amplifier (Pin 2 of V106) (12AU7)

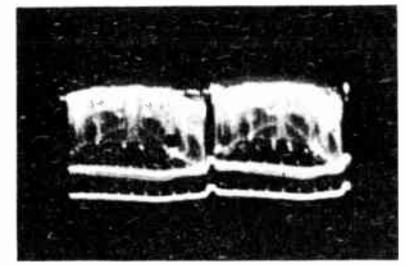

Figure 31—Vertical (Oscilloscope Synced to ½ of Vertical Sweep Rate) (5.4 Volts PP) ←

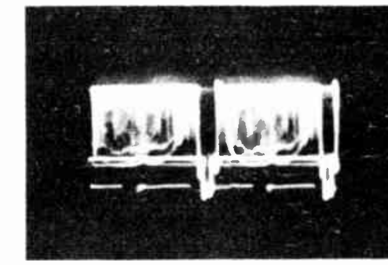

Figure 32—Horizontal (Oscilloscope Synced to ½ of Horizontal Sweep Rate) (5.4 Volts PP) →

Sync Feed (Junction of L104, R219 and C194)

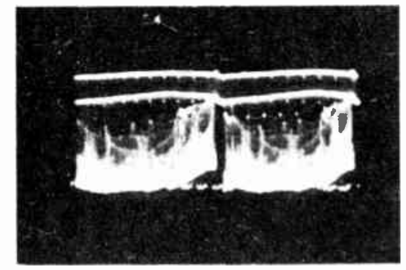

Figure 33—Vertical (28 Volts PP) ←

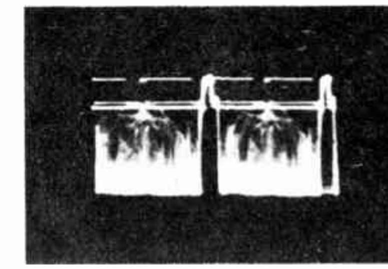

Figure 34—Horizontal (28 Volts PP) →

Input to 2nd Video Amplifier (Pin 7 of V106) (12AU7)

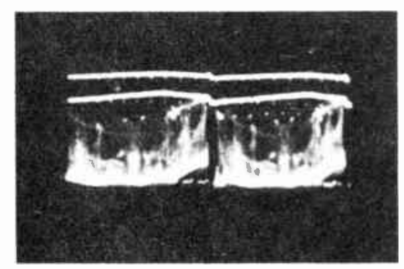

Figure 35—Vertical (17 Volts PP) ←

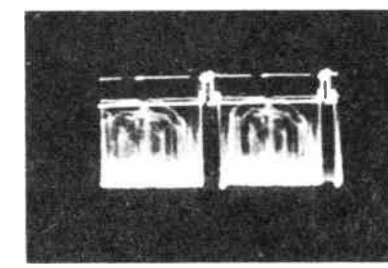

Figure 36—Horizontal (17 Volts PP) →

Output of 2nd Video Amplifier (Junction of L105 and R127) (Picture Max.)

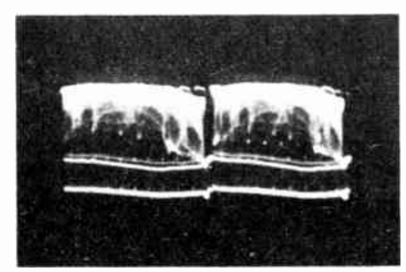

Figure 37—Vertical (96 Volts PP) ←

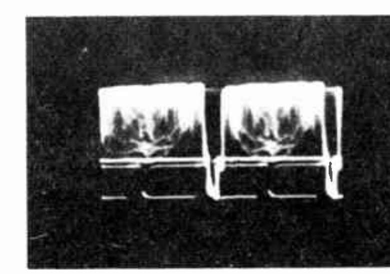

Figure 38—Horizontal (96 Volts PP) →

Input to Kinescope (Junction of R127 and R128) (Picture Max.)

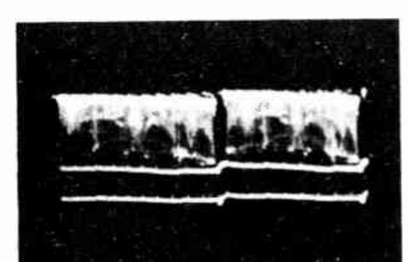

Figure 39—Vertical (65 Volts PP) ←

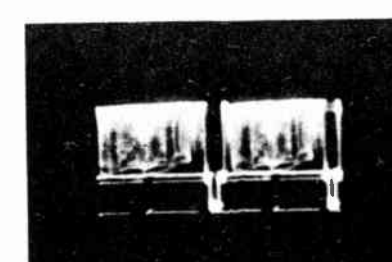

Figure 40—Horizontal (65 Volts PP) →

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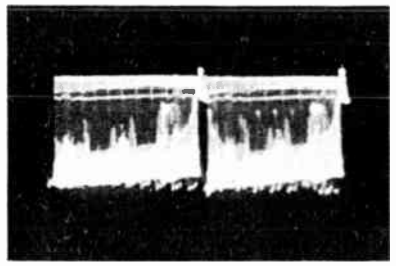
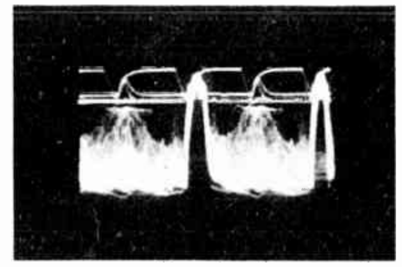
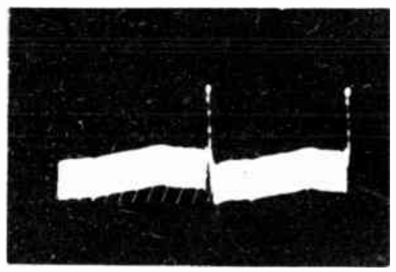


Input to 1st Sync Separator (Pin 1 of V108) (6SN7GT)

Figure 41—Vertical (25 Volts PP)

Figure 42—Horizontal (23 Volts PP)

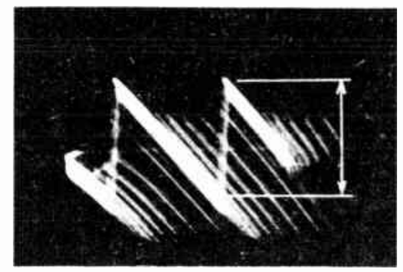


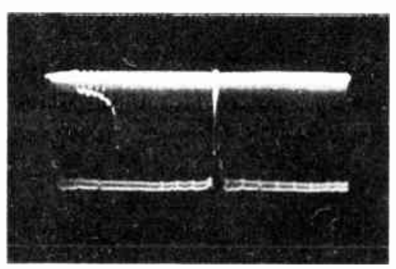


AGC Rectifier Cathode (Pin 6 of V108) (6SN7GT)

Figure 43—Vertical (4.7 Volts PP)

Figure 44—Horizontal (1.5 Volts PP)

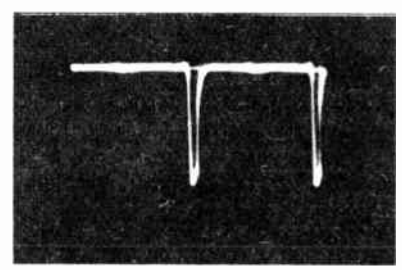


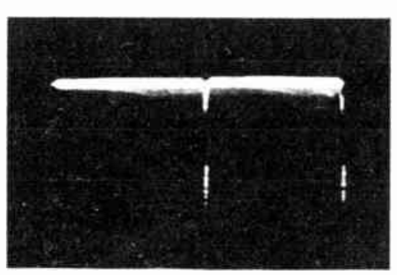


Output of AGC Rectifier (Pin 5 of V108) (6SN7GT)

Figure 45—Vertical (24 Volts PP)

Figure 46—Horizontal (24 Volts PP)

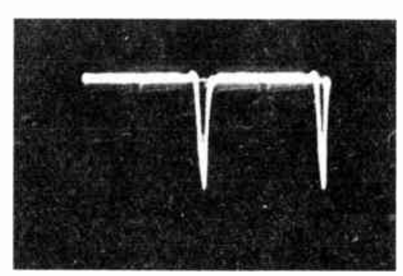


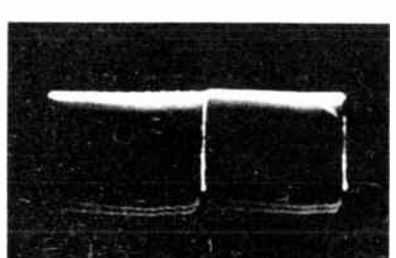


Output of 1st Sync Separator (Pin 2 of V108) (6SN7GT)

Figure 47—Vertical (26 Volts PP)

Figure 48—Horizontal (25.5 Volts PP)

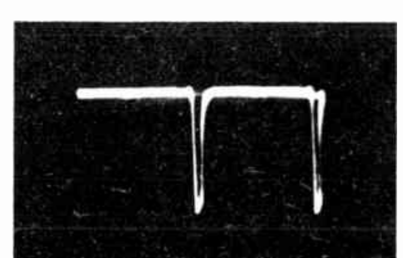


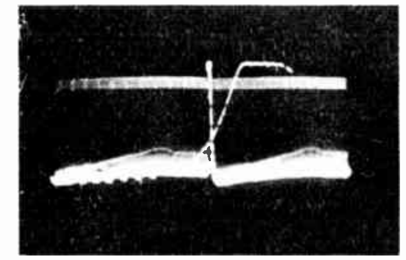


Input to Sync Amplifier (Junction of C137, C139 and R145)

Figure 49—Vertical (21 Volts PP)

Figure 50—Horizontal (21 Volts PP)

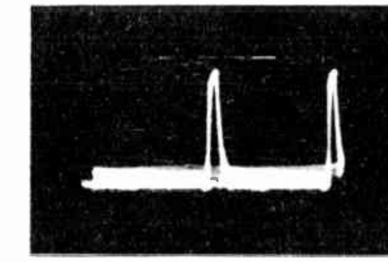


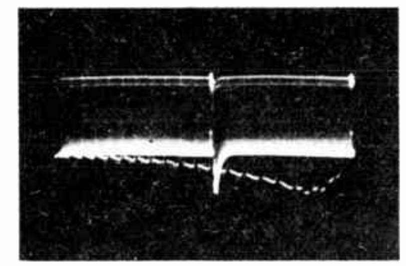


Output of Sync Amplifier (Pin 2 of V109) (6SN7GT)

Figure 51—Vertical (115 Volts PP)

Figure 52—Horizontal (105 Volts PP)

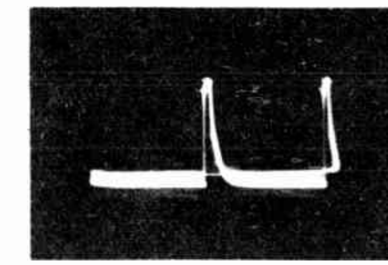




Cathode of 2nd Sync Separator (Pin 6 of V109) (6SN7GT)

Figure 53—Vertical (17 Volts PP)

Figure 54—Horizontal (11 Volts PP)



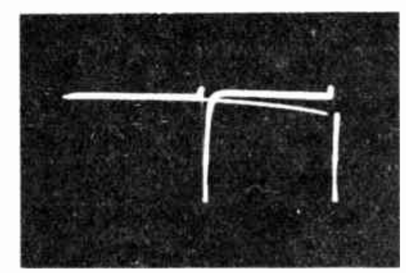
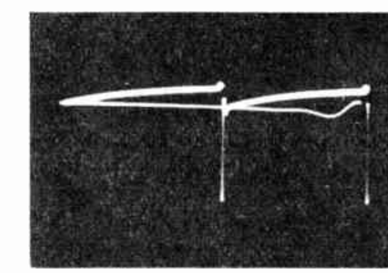


Figure 55—Output of Integrating Network (Junction of C144, C145 and R153) (45 Volts PP)

Figure 56—Grid of Vertical Oscillator (720 Volts PP) (Pin 1 of V107) (6SN7GT)



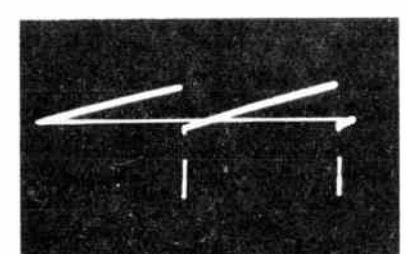
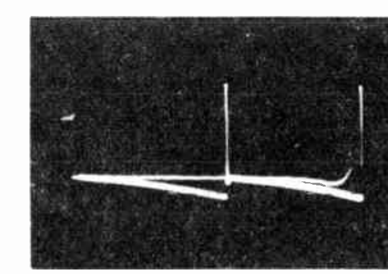


Figure 57—Grid of Vertical Output (160 Volts PP) (Pin 5 of V110) (6K6GT)

Figure 58—Plate of Vertical Output (750 Volts PP) (Pin 3 of V110) (6K6GT)



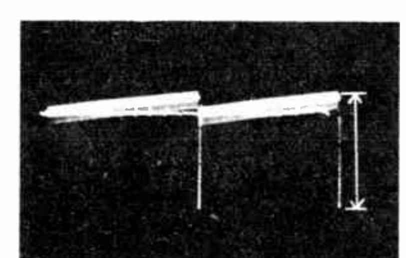


Figure 59—Input of Vertical Deflection Coils (75 Volts PP) (Junction of Green Lead of T108 and Green Lead of Yoke)

Figure 60—Input to Horizontal Oscillator (17.5 Volts PP) (Junction of C153A and C154)

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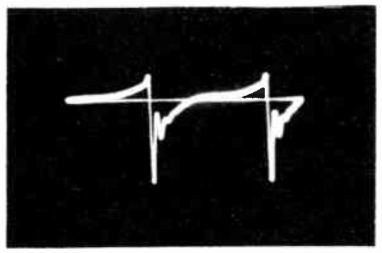
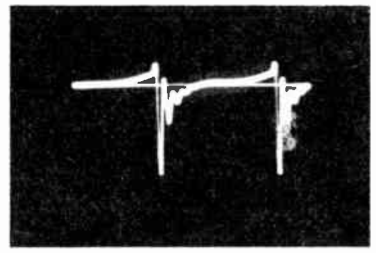


Figure 61—Junction of R168, R176 and R178 (150 Volts PP)

Figure 62—Grid of Horizontal Oscillator (480 Volts PP) (Pin 4 of V111) (6SN7GT)



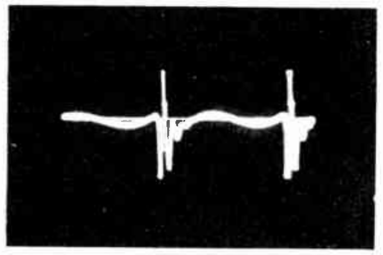
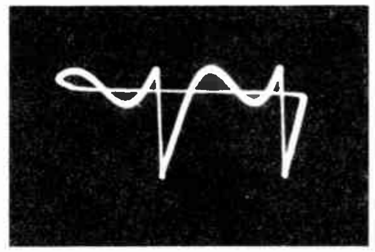


Figure 63—Plate of Horizontal Oscillator (270 Volts PP) (Pin 5 of V111) (6SN7GT)

Figure 64—Terminal "C" of T109 (70 Volts PP)



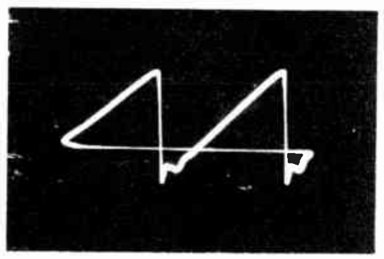
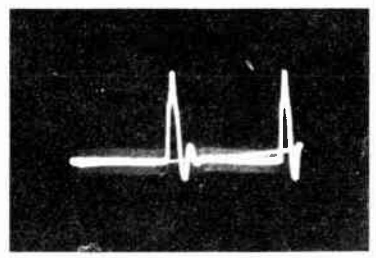


Figure 65—Input to Horizontal Output Tube (42 Volts PP) (Junction of C160, R183 and C153B)

Figure 66—Plate of Horizontal Output (Approx. 5,500 Volts PP) (Measured Through a Capacity Voltage Divider Connected from Top Cap of V112 to Ground)



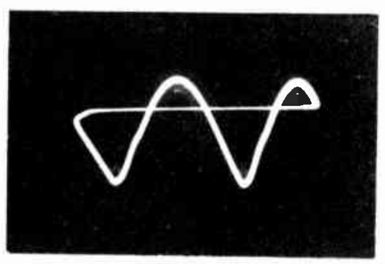
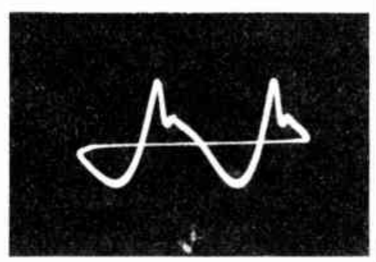


Figure 67—Junction of C164 and Terminal 1 of T110 (165 Volts PP)

Figure 68—Plate of Damper (125 Volts PP) (Pin 5 of V114) (6W4GT)



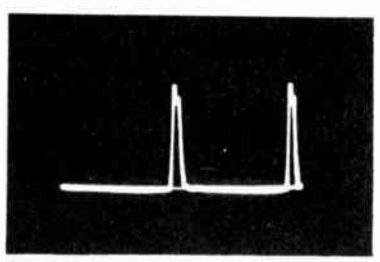
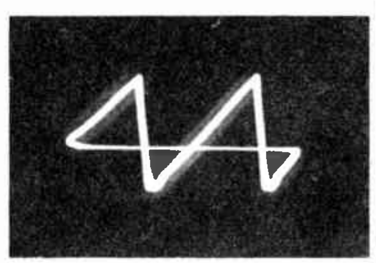


Figure 69—Input to Horizontal Deflection Coils (1,150 Volts PP)

Figure 70—Horizontal Deflection Coil Current (0.6 amp. PP) Measured by inserting a 5-ohm Resistor in series with the yoke and observing the waveform across the resistor



VOLTAGE CHART

The following measurements represent two sets of conditions. In the first condition a 2200 microvolt test pattern signal was fed into the receiver, the picture was synced and the AGC threshold control was properly adjusted. The second condition was obtained by removing the antenna leads and short-circuiting the receiver antenna terminals. Voltages shown are as read with "Jr. VoltOhmyst" between the indicated terminal and chassis ground and with the receiver operating on 117 volts, 60 cycles a-c.

Tube No.	Tube Type	Function	Operating Condition	E. Plate		E. Screen		E. Cathode		E. Grid		I Plate (ma.)	I Screen (ma.)	Notes on Measurements
				Pin No.	Volts	Pin No.	Volts	Pin No.	Volts	Pin No.	Volts			
V1	6AG5	R-F Amplifier	2200 Mu. V. Signal	5	140	6	142	2 & 7	0	1	–2.4	5	2	
			No Signal	5	67	6	111	2 & 7	0	1	–.4	14.0	5.0	
V2	6AG5	Converter	2200 Mu. V. Signal	5	*130 to 140	6	*130 to 140	2 & 7	0	1	*–3.0 to –7.0	*7.1 to 7.7	*2.3 to 2.7	*Depending upon channel
			No Signal	5	*104 to 109	6	*104 to 109	2 & 7	0	1	*–2.0 to –6.0	*5.3 to 5.9	*.8 to 1.0	
V3	6J6	R-F Oscillator	2200 Mu. V. Signal	1 & 2	*88 to 95	—	—	7	.19	5 & 6	*–5.1 to –7.3	*1.9 to 2.7	—	*Depending upon channel
			No Signal	1 & 2	*68 to 81	—	—	7	.16	5 & 6	*–4.5 to –6.6	*1.8 to 2.1	—	
V101	6BA6	1st Pix. I-F Amplifier	2200 Mu. V. Signal	5	125	6	125	7	.4	1	–12.5	2.8	1.3	
			No Signal	5	95	6	95	7	1.1	1	+.3	7.5	3.5	
V102	6AG5	2nd Pix. I-F Amplifier	2200 Mu. V. Signal	5	115	6	115	2 & 7	.75	1	0	8.2	2.5	
			No Signal	5	100	6	100	2 & 7	.65	1	0	6.8	2.1	
V103	6BA6	3d Pix. I-F Amplifier	2200 Mu. V. Signal	5	110	6	135	7	.25	1	–2.4	4.0	3.8	
			No Signal	5	60	6	100	2 & 7	.75	1	–.4	11.0	4.8	
V104	6AG5	4th Pix. I-F Amplifier	2200 Mu. V. Signal	5	170	6	135	2 & 7	1.35	1	0	6.5	2.0	
			No Signal	5	175	6	120	2 & 7	1.2	1	0	5.9	1.8	
V105 A	6AL5	Picture 2d Det.	2200 Mu. V. Signal	7	–113	—	—	1	–112	—	—	.48	—	
			No Signal	7	–120	—	—	1	–120	—	—	—	—	
V105 B	6AL5	Sync Limiter	2200 Mu. V. Signal	2	–107	—	—	5	–56	—	—	—	—	
			No Signal	2	–80	—	—	5	–60	—	—	—	—	
V106	12AU7	1st Video Amplifier	2200 Mu. V. Signal	1	–23.2	—	—	3	–111	2	–113	4.38	—	
			No Signal	1	–19.2	—	—	3	–117	2	–120	3.82	—	
V106	12AU7	2d Video Amplifier	2200 Mu. V. Signal	6	*166	—	—	8	*–5.3	7	*–12.2	6.2	—	*At average contrast
			No Signal	6	*134	—	—	8	*–5.6	7	*–10.3	6.9	—	
V107 A	6SN7 GT	AGC Amplifier	2200 Mu. V. Signal	5	–12.6	—	—	6	–55.5	4	–56.5	.9	—	
			No Signal	5	+.3	—	—	6	–60	4	–64	.3	—	
V107 B	6SN7 GT	Vertical Oscillator	2200 Mu. V. Signal	2	76	—	—	3	–111	1	–158	.2	—	
			No Signal	2	62	—	—	3	–120	1	–169	.2	—	
V108	6SN7 GT	AGC Rectifier	2200 Mu. V. Signal	5	97	—	—	6	–3.4	4	–19.3	.3	—	
			No Signal	5	81	—	—	6	–8.7	4	–19.3	.28	—	
V108	6SN7 GT	1st Sync Separator	2200 Mu. V. Signal	2	96	—		3	–1.8	1	–19.5	.1	—	
			No Signal	2	81	—	—	3	–9.7	1	19.3	.1	—	
V109	6SN7 GT	Sync Amplifier	2200 Mu. V. Signal	2	158	—	—	3	0	1	–4.7	5.25	—	
			No Signal	2	154	—	—	3	0	1	–5.2	3.75	—	

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VOLTAGE CHART

Tube No.	Tube Type	Function	Operating Condition	E. Plate Pin No.	E. Plate Volts	E. Screen Pin No.	E. Screen Volts	E. Cathode Pin No.	E. Cathode Volts	E. Grid Pin No.	E. Grid Volts	I Plate (ma.)	I Screen (ma.)	Notes on Measurements
V109	6SN7 GT	Sync Separator	2200 Mu. V. Signal	5	230	—	—	6	-51	4	-106	.4	—	
			No Signal	5	215	—	—	6	-59	4	-80	.35	—	
V110	6K6-GT	Vertical Output	2200 Mu. V. Signal	3	223	4	223	8	-67	5	-91		*7.85	*Screen connected to plate
			No Signal	3	208	4	208	8	-79	5	-101		*7.7	
V111	6SN7 GT	Horizontal Osc. Control	2200 Mu. V. Signal	2	*48	—	—	3	-110	1	-92	.2	—	*Variation of hold gives -21.9 to +56 volts on plate
			No Signal	2	*33	—	—	3	-120	1	-108	.2	—	
V111	6SN7 GT	Horizontal Oscillator	2200 Mu. V. Signal	5	70	—	—	6	-111	4	-185	2.4	—	
			No Signal	5	54	—	—	6	-120	4	-192	2.4	—	
V112	6BG6G	Horizontal Output	2200 Mu. V. Signal	Cap	Do Not Meas.	8	180	3	-90	5	-110	72	9.4	
			No Signal	Cap	Do Not Meas.	8	170	3	-100	5	-115	70	9.2	
V113	1B3GT /8016	H. V. Rectifier	Brightness Min.	Cap	Do Not Meas.	—	—	2 & 7	10,500	--	—	0	—	
			Brightness Average	Cap	Do Not Meas.	—	—	2 & 7	10,000	—	—	.1	—	
V114	6W4GT	Damper	2200 Mu. V. Signal	5	Do Not Meas.	—	—	3	290	—	—	66	—	
			No Signal	5	Do Not Meas.	—	—	3	280	—	—	65	—	
V115	5U4G	Rectifier	2200 Mu. V. Signal	4 & 6	335			2 & 8	250	—	—	210	—	*A-C measured from plate to trans. center tap
			No Signal	4 & 6	335			2 & 8	245	—	—	215	—	
V116	6AU6	1st Sound I-F Amplifier	2200 Mu. V. Signal	5	134	6	134	7	.9	1	-.5	8.2	3.3	
			No Signal	5	110	6	110	7	.7	1	-.5	5.7	2.6	
V117	6AU6	2nd Sound I-F Amplifier	2200 Mu. V. Signal	5	148	6	90	7	0	1	-9	1.6	.8	
			No Signal	5	115	6	60	7	0	1	-.65	3.35	1.15	
V118	6AL5	Sound Discrim.	2200 Mu. V. Signal	2	-8.4	—	—	5	5.8	—	—	—	—	
			No Signal	2	-2.0	—	—	5	.41	—	—	—	—	
			2200 Mu. V. Signal	7	-3.7	—	—	1	0	—	—	—	—	
			No Signal	7	-1.08	—	—	1	0	—	—	—	—	
V119	6AV6	1st Audio Amplifier	2200 Mu. V. Signal	7	85	—	—	2	0	1	-.89	.49	—	
			No Signal	7	83	—	—	2	0	1	-.89	.4	—	
V120	6V6-GT	Audio Output	2200 Mu. V. Signal	3	102	4	113	8	-99	5	-108	19.3	3.3	
			No Signal	3	72	4	80	8	-110	5	-120	18	3	
V121	12LP4	Kinescope	2200 Mu. V. Signal	Cap	*10,000	10	330	11	51	2	20	.1	—	*Average Brightness
			No Signal	Cap	*10,000	10	285	11	42	2	14	—	—	*Average Brightness
V301	6J6	Mixer and Oscillator	No Signal	1 2	110 95	— —	— —	7	0	6 5	-2.0 -5.0	— —	— —	
V302	6BA6	Radio I-F Amplifier	No Signal	5	210	6	105	7	.8	1	-0.2	—	—	Function switch in F-M position
V303	6AV6	Radio F-M Driver	No Signal	5	205	6	135	7	1.5	1	0	—	—	
V304	6AL5	Radio Ratio Det.	No Signal	2	-0.2 -0.2	—	—	5 1	-0.2 -0.1	— —	— —	— —	— —	
V305	6BF6	A-M Det. and Phono Preamp.	No Signal	7	-0.2	—	—	2	0	—	—	—	—	

RADIO CHASSIS WIRING DIAGRAM

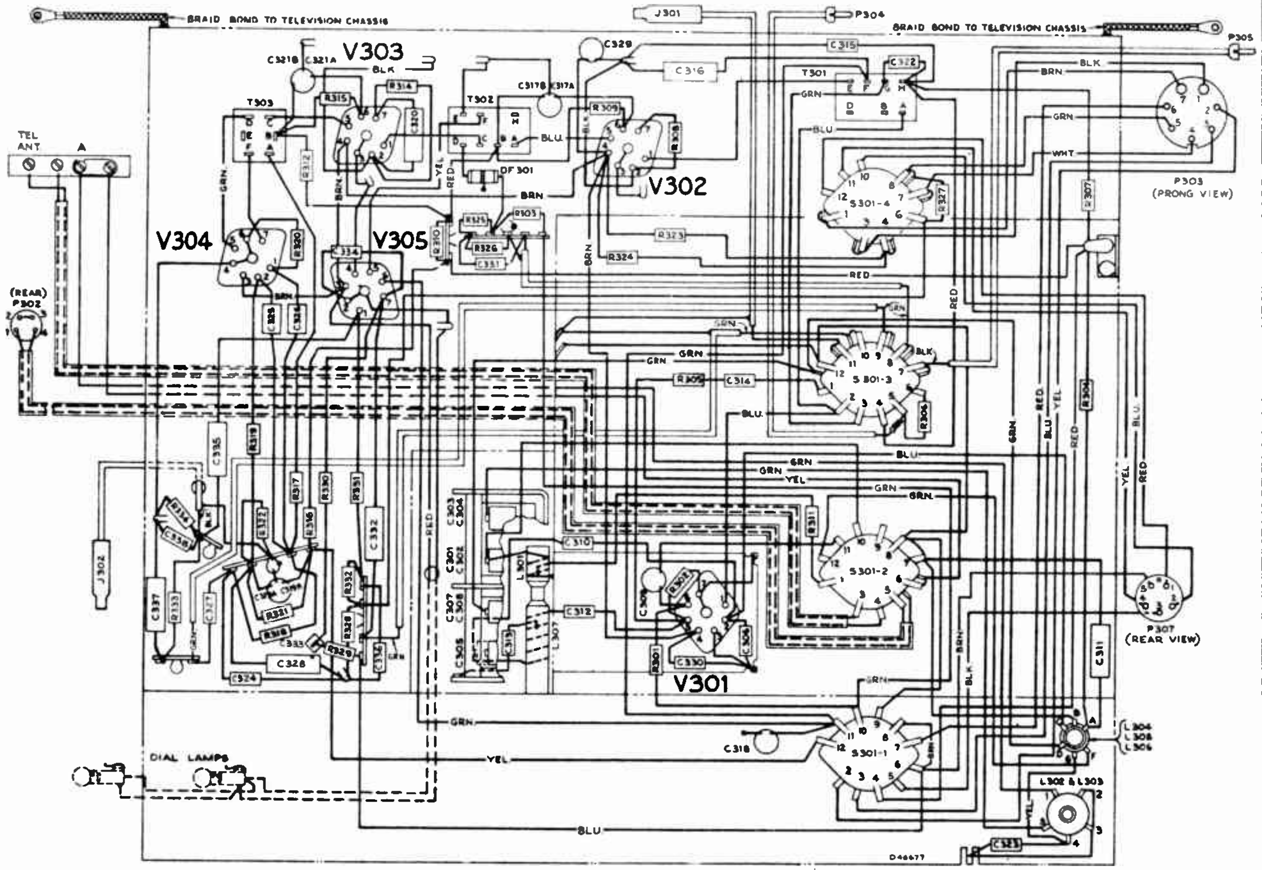

Figure 71—Radio Chassis Wiring Diagram (RK135D)

TELEVISION CRITICAL LEAD DRESS

1. The ground bus from pin 2 and the center shield of V117 socket should not be shortened or rerouted.
2. Do not change the dress of the filament leads or the by-pass capacitors in the picture or sound i-f circuits. The filament leads between V117, V118 and V119 should be down against the chassis and away from grid or plate leads.
3. If it is necessary to replace any of the 1500 mmf capacitors in the picture i-f circuit, the lead length must be kept as short as possible.
4. Picture i-f coupling capacitors C106, C111, C115 and C121 should be up and away from the chassis and should be clear of the pix i-f transformer adjustments by at least ¼ inch. If the dress of any of these capacitors is changed, the i-f alignment should be rechecked.
5. Leads to L102 and L103 must be as short as possible.
6. Dress peaking coils L105, L106 and L107 up and away from the chassis.
7. Dress C183 across tube pins 5 and 6 with leads not exceeding ⅜ inch.
8. Dress C129 and C130 up and away from the chassis.
9. Dress the yellow lead from the picture control away from the chassis and away from the volume-control leads. Dress the yellow lead from pin 8 of V106 away from the chassis.
10. Dress the green lead from pin 2 of V106 away from the chassis.
11. Dress R168, R169, R170, R176 and R178 up and away from the chassis.
12. The leads to the volume control should be dressed down against the chassis and away from V117 and V118.
13. Contact between the r-f oscillator frequency adjustment screws and the oscillator coils or channel switch eyelets must be avoided.
14. Dress leads from L115 (width control coil) away from the transformer frame.
15. Dress T110 winding leads as shown in Figure 72.

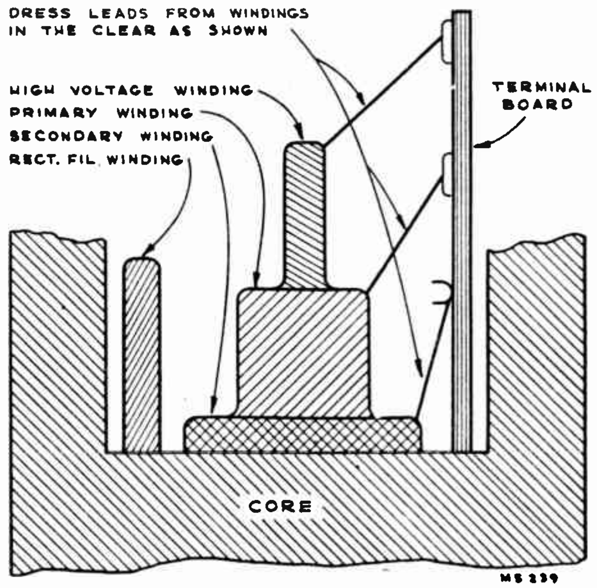

Figure 72—T110 Lead Dress

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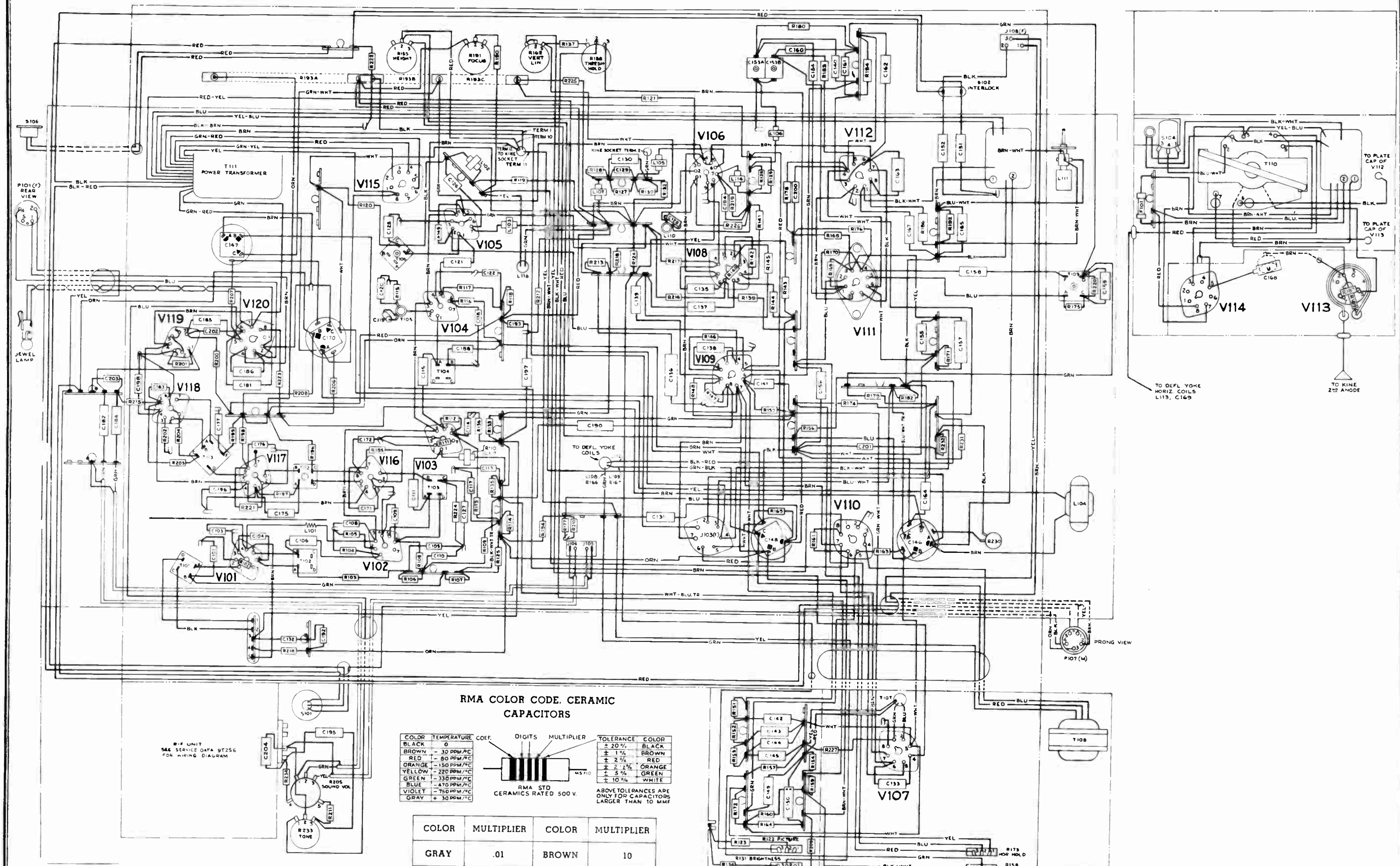
TELEVISION CHASSIS WIRING DIAGRAM

MODEL TA128, Ch. KCS42A



RMA COLOR CODE. CERAMIC CAPACITORS

COLOR	TEMPERATURE COEF.
BLACK	0
BROWN	- 30 PPM/°C
RED	- 80 PPM/°C
ORANGE	-150 PPM/°C
YELLOW	- 220 PPM/°C
GREEN	- 330 PPM/°C
BLUE	- 470 PPM/°C
VIOLET	- 750 PPM/°C
GRAY	+ 30 PPM/°C

DIGITS MULTIPLIER

RMA STD
CERAMICS RATED 500 V.

TOLERANCE	COLOR
± 20 %	BLACK
± 1 %	BROWN
± 2 %	RED
± 2 ½ %	ORANGE
± 5 %	GREEN
± 10 %	WHITE

ABOVE TOLERANCES ARE ONLY FOR CAPACITORS LARGER THAN 10 MMF

COLOR	MULTIPLIER	COLOR	MULTIPLIER
GRAY	.01	BROWN	10
WHITE	.1	RED	100
BLACK	1.	ORANGE	1,000

In some receivers, a four color ceramic capacitor color code is employed. It reads the same as the RMA color code except that the tolerance stripe is omitted.

If the coefficient stripe is silver, it indicates that the capacitor has a very large temperature coefficient and is to be employed for by-pass or other usages where a wide variation of capacity is unimportant. Silver striped capacitors are rated at 350 volts unless otherwise marked.

Figure 73—Chassis Wiring Diagram

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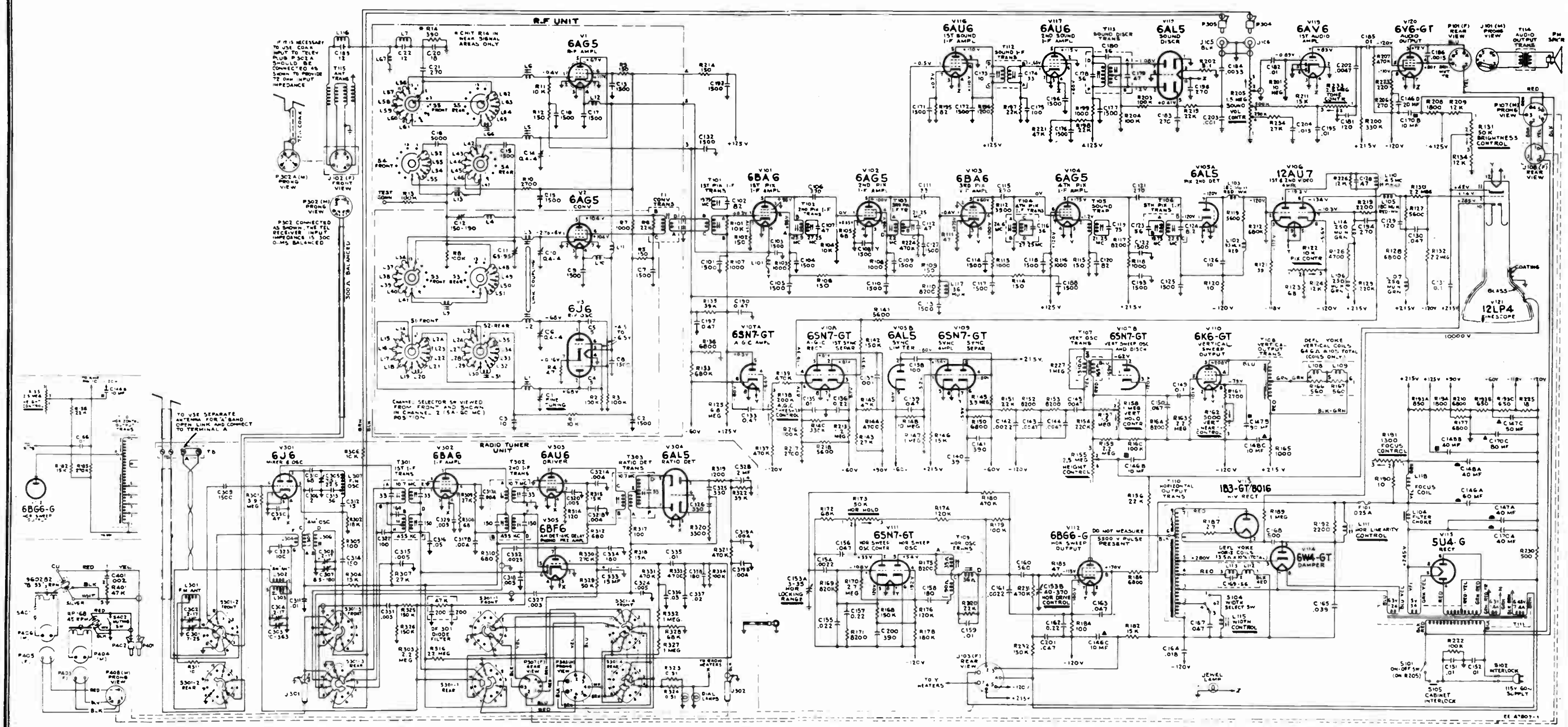
CIRCUIT SCHEMATIC DIAGRAM



Function switch S301 viewed from front and shown in Number 1 (maximum counterclockwise position).
Switch position 1—Television.

Switch position 2—AM.
Switch position 3—FM.
Switch position 4—Phono 45 RPM.
Switch position 5—Phono 78 RPM.

All resistance values in ohms. K = 1,000
All capacitance values less than 1 in MF and above 1 in MMF unless noted

Coil resistance values less than 1 ohm are not shown.
Direction of arrows at controls indicates clockwise rotation.

In some receivers, substitutions have caused changes in component lead color codes, in electrolytic capacitor values and their lug identification markings.

All voltages measured with "VoltOhmyst," no signal input with 117 v. a-c supply with the pix control fully clockwise and the brightness control set for average brightness.

The deflection circuits must be connected as shown above for powdered iron core yokes. The partial schematic insert shows the method of connection employed in early production receivers which employed an iron wire wrap yoke.

Figure 74—Circuit Schematic Diagram

RECORD CHANGER: Model RP168C, See pages RCD.CH.19-1 through RCD.CH.19-8.

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REPLACEMENT PARTS

STOCK No.	DESCRIPTION
	RF UNIT ASSEMBLIES KRK5
73465	Belt—Drive belt
75069	Board—R-F unit power connection terminal board
75067	Bracket—Vertical bracket for holding r-f oscillator tube shield
73478	Cable—I-F transmission cable (W1)
73441	Cam—Fine tuning adjustment
74035	Capacitor—Ceramic, 5 mmf. (C4, C5)
53511	Capacitor—Ceramic, 10 mmf. (C3)
54207	Capacitor—Ceramic, 18 mmf. (C20)
73449	Capacitor—Ceramic trimmer comprising 1 section of 150-190 mmf. and 1 section of 65-95 mmf. (C11, C12)
73091	Capacitor—Ceramic, 270 mmf. (C21)
71501	Capacitor—Ceramic, 1500 mmf. (C2, C7, C8, C9, C13, C15, C17, C18, C19)
73473	Capacitor—Ceramic, 5000 mmf. (C16)
73460	Coil—R-F plate coil for channel 6 (L13)
73461	Coil—Rear section—Oscillator plate coil for channel 6 (L20)
73462	Coil—Coupling inductance coil (L4)
73475	Coil—Antenna filter shunt coil (C67)
73476	Coil—I-F trap (L7, C22)
73477	Coil—Choke coil (L10, L11, L12)
73874	Coil—Front section—Oscillator plate coil for channel 6 (L31)
74108	Coil—Fine tuning coil (1½ turns) with adjustable inductance core and capacitor stud (plunger adjustment) (L1, C1)
74109	Coil—Trimmer coil (1½ turns) with adjustable inductance core and capacitor stud (screw adjustment for oscillator section or converter section) (L2, L3, C6, C10)
74110	Coil—Trimmer coil (3 turns) with adjustable inductance core and capacitor stud (screw adjustment) for r-f amplifier section (L5, C14)
73455	Core—Sliding core for fine tuning control trimmer
74187	Core—Adjustable core for coil L9
71493	Connector—Oscillator segment connector
73440	Detent—R-F unit detent mechanism and fibre shaft
71487	Form—Coil form for coil L31
73453	Form—Coil form assembly for L9, L13
73442	Link—Link assembly for fine tuning
71462	Loop—Oscillator to converter trimmer loop connector
73634	Nut—Speed nut for drive belt shield
73436	Plate—Front plate and bushing
73464	Pulley—Idler pulley
	Resistor—Fixed, composition:
	47 ohms, ±20%, ½ watt (R4)
	150 ohms, ±20%, ½ watt (R5, R9, R12)
	390 ohms, ±10%, ½ watt (R14)
	1000 ohms, ±20%, ½ watt (R7)
	2700 ohms, ±10%, ½ watt (R10)
	10,000 ohms, ±20%, ½ watt (R1, R11)
	100,000 ohms, ±20%, ½ watt (R2, R3, R8, R13)
14343	Retainer—Channel selector shaft retaining ring
30340	Retainer—Retainer ring for fine tuning stud
70881	Screw—No. 4-40 x ¼" binder head screw for adjusting coils L14, L15, L16, L17, L18, L19
73640	Screw—No. 4-40 x ⅝" adjusting screw for L66
71475	Screw—No. 4-40 x 15/32" adjusting screw for coils L21, L22, L23, L24
74575	Screw—No. 4-40 x 17/32" adjusting screw for L6
73437	Shaft—Channel selector shaft complete with pawl and stud
73438	Shaft—Fine tuning control shaft and pulley
73439	Shaft—Actuating shaft for fine tuning control
75443	Shield—"U" shape shield for bottom of r-f unit
72951	Shield—Metal tube shield for V3
73454	Shield—Metal shield for drive belt
73632	Shield—Metal tube shield for V1
71494	Socket—Tube socket, moulded, 7 prong, saddle mounted
73450	Socket—Tube socket, ceramic, 7 prong, bottom mounted
74576	Spacer—Insulating spacer for front plate (4 required)
73457	Spring—Return spring for fine tuning control core
74188	Spring—Retaining spring for adjustable core RCA 74187
75058	Spring—Retaining spring for r-f oscillator tube shield
74578	Spring—Retaining spring for adjusting screws RCA 73640 and RCA 74575
73468	Stator—Front oscillator section stator complete with rotor, segment, coils and adjusting screws (S1, L14, L15, L16, L17, L18, L19, L21, L22, L23, L24)
73469	Stator—Rear oscillator section stator complete with rotor, segment, coils (S2, L25, L26, L27, L28, L29, L30, L32, L33, L34, L35)
73633	Stator—Antenna stator complete with rotor and coils (S5, L6, L56, L57, L58, L59, L60, L61, L62, L63, L64, L65, L66, C21)
73470	Stator—Converter stator complete with rotor and coils (S3, L9, L36, L37, L38, L39, L40, L41, L48, L49, L50, L51)
73471	Stator—R-F amplifier stator complete with rotor and coils (S4, L13, L42, L43, L44, L45, L46, L47, L52, L53, L54, L55, C15, C16, R10)
75446	Stud—Capacitor stud—brass No. 4-40 x 13/16" with 3/64" screw driver slot for trimmer coils 74109 and 74110 uncoded or coded "ER"
75447	Stud—Capacitor stud—brass No. 4-40 x 13/16" with 3/64" screw driver slot for trimmer coils 74109 and 74110 coded numerically or "Hi Q"
73448	Transformer—Converter transformer (T1, R6)
73466	Washer—Insulating washer for front shield (1 set)
2917	Washer—"C" washer for channel selector shaft or fine tuning shaft and cam
	TELEVISION CHASSIS ASSEMBLIES KCS 42A
74593	Capacitor—Mica trimmer comprising 1 section of 3-35 mmf. and 1 section of 40-370 mmf. (C153A, C153B)
72615	Capacitor—Mica, 10 mmf. (C126)
74105	Capacitor—Mica, 33 mmf. (C111)
74726	Capacitor—Mica, 39 mmf. (C140)
64062	Capacitor—Ceramic, 82 mmf. (C120)
39396	Capacitor—Ceramic, 100 mmf. (C175)
75060	Capacitor—Mica, 100 mmf. (C138)
73921	Capacitor—Ceramic, 120 mmf. (C129)
39630	Capacitor—Mica, 120 mmf. (C181)
73102	Capacitor—Mica, 180 mmf. (C158)
73922	Capacitor—Ceramic, 270 mmf. (C183, C194, C198)
73091	Capacitor—Mica, 270 mmf. (C106, C115, C121)
68542	Capacitor—Mica, 390 mmf. (C141, C200)
74153	Capacitor—Ceramic, 500 mmf. 15,000 volts (C168)
74250	Capacitor—Mica, 560 mmf. (C160)
71501	Capacitor—Ceramic, 1500 mmf. (C101, C103, C104, C105, C108, C109, C110, C113, C114, C117, C118, C122, C125, C127, C132, C171, C172, C176, C177, C188, C192, C193, C196)
71432	Capacitor—Electrolytic, comprising 2 sections of 40 mfd., 450 volts and 1 section of 10 mfd., 450 volts (C148A, C148B, C148C)
73582	Capacitor—Electrolytic, comprising 1 section of 40 mfd., 450 volts, 1 section of 10 mfd., 450 volts and 1 section of 80 mfd., 200 volts (C170A, C170B, C170C)
73583	Capacitor—Electrolytic, comprising 1 section of 40 mfd., 450 volts, 1 section of 90 mfd., 150 volts and 1 section of 50 mfd., 150 volts (C147A, C147B, C147C)
73581	Capacitor—Electrolytic, comprising 1 section of 60 mfd., 450 volts, 2 sections of 10 mfd., 450 volts and 1 section of 20 mfd., 150 volts (C146A, C146B, C146C, C146D)
73801	Capacitor—Tubular, paper, oil impregnated, .001 mfd., 600 volts (C137, C203)
73802	Capacitor—Tubular, paper, oil impregnated, .0015 mfd., 1000 volts (C186)
73595	Capacitor—Tubular, paper, oil impregnated, .0022 mfd., 600 volts (C142, C161)
73803	Capacitor—Tubular, moulded paper, .0022 mfd., 600 volts (C154)
73795	Capacitor—Tubular, paper, oil impregnated, .0033 mfd., 600 volts (C184)
73920	Capacitor—Tubular, paper, oil impregnated, .0047 mfd., 600 volts (C143, C144, C145, C202)
73561	Capacitor—Tubular, paper, oil impregnated, .01 mfd., 400 volts (C135, C182, C195)
73594	Capacitor—Tubular, moulded paper, oil impregnated, .01 mfd., 600 volts (C159)
73565	Capacitor—Tubular, moulded paper, .01 mfd., 1000 volts (C151, C152, C185)
73797	Capacitor—Tubular, paper, oil impregnated, .015 mfd., 600 volts (C204)
74727	Capacitor—Tubular, moulded paper, oil impregnated, .018 mfd., 1000 volts (C164)
73562	Capacitor—Tubular, paper, oil impregnated, .022 mfd., 400 volts (C155)
74728	Capacitor—Tubular, moulded paper, oil impregnated, .039 mfd., 1000 volts (C165)
73553	Capacitor—Tubular, paper, oil impregnated, .047 mfd., 400 volts (C130, C139, C201, C167)
73592	Capacitor—Tubular, paper, oil impregnated, .047 mfd., 600 volts (C150, C156)
73597	Capacitor—Tubular, paper, oil impregnated, .047 mfd., 1000 volts (C163)
73551	Capacitor—Tubular, paper, oil impregnated, 0.1 mfd., 400 volts (C149)
73557	Capacitor—Tubular, paper, oil impregnated, 0.1 mfd., 600 volts (C131)
73794	Capacitor—Tubular, paper, oil impregnated, 0.22 mfd., 200 volts (C136, C157, C162)
73787	Capacitor—Tubular, paper, oil impregnated, 0.47 mfd., 200 volts (C133, C190, C197)
73154	Choke—Filter choke (L104)
74585	Coil—Focus coil (L118)
71449	Coil—Horizontal linearity control coil (L111)
71429	Coil—Width control coil (L115)
74170	Coil—Peaking coil (36 muh) (L117, R110)
71527	Coil—Peaking coil (93 muh) (L102)
74214	Coil—Peaking coil (180 muh) (L103, L105)
71526	Coil—Peaking coil (250 muh) (L106, L107, L114)
73477	Coil—Filament choke coil (L101)
72108	Connector—7 contact female connector (J103)
74594	Connector—2 contact male connector for power cord
72172	Connector—3 contact female connector for changers cable (J108)
5040	Connector—4 contact female connector for speaker cable (P101)
71789	Connector—Anode connector
71521	Connector—Hi-voltage capacitor connector
14786	Connector—5 contact male connector (P107)
72734	Control—Horizontal hold and vertical hold control (R158, R173)
74047	Control—Picture and brightness control (R122, R131)
74359	Control—Tone control, volume control and power switch (R205, R233, S101)
71441	Control—Vertical linearity control (R162)
71440	Control—Height control (R155)
74597	Control—Focus control (R191)
74475	Control—AGC threshold control (R138)
71457	Cord—Power cord and plug
71437	Cover—Insulating cover for electrolytics Nos. 71432, 73581 and 73582
73590	Cushion—Rubber cushion for deflection yoke hood (2 required)
74811	Cushion—Rubber cushion for kinescope mounting
73600	Fuse—0.25 amp. 250 volts (F101)
71799	Grommet—Rubber grommet for yoke horizontal lead exit
37396	Grommet—Rubber grommet for mounting ceramic tube socket (2 required)
74030	Grommet—Rubber grommet for mounting radio chassis (3 required)
74823	Magnet—Ion trap magnet
73587	Nut—Speed nut for mounting hi-voltage capacitor
18469	Plate—Bakelite mounting plate for electrolytics
33514	Receptacle—2 contact female receptacle for audio cable and switching cable (J105, J106)
74598	Resistor—Wire wound, 2.7 ohms, 1/3 watt (R187)
72067	Resistor—Wire wound, 5.1 ohms, ½ watt (R202)
18471	Resistor—Wire wound, 10 ohms, ½ watt (R190)
74043	Resistor—Wire wound, 500 ohms, 20 watts (R230)
73588	Resistor—Voltage divider, comprising 1 section of 850 ohms, 12 watts and 2 sections of 650 ohms, 6 watts (R193A, R193B, R193C)
	Resistor—Fixed, composition:
	10 ohms, ±20%, ½ watt (R120)
	18 ohms, ±10%, ½ watt (R225)
	39 ohms, ±10%, ½ watt (R120)
	47 ohms, ±5%, ½ watt (R111)
	47 ohms, ±20%, ½ watt (R183)
	68 ohms, ±10%, ½ watt (R105)
	68 ohms, ±20%, ½ watt (R123)
	82 ohms, ±10%, ½ watt (R195)
	100 ohms, ±10%, 2 watts (R184)
	150 ohms, ±5%, ½ watt (R102)
	150 ohms, ±10%, ½ watt (R115)
	150 ohms, ±20%, ½ watt (R106, R109, R114, R214)
	220 ohms, ±10%, 1 watt (R223)
	270 ohms, ±10%, 1 watt (R206)
	1000 ohms, ±20%, ½ watt (R103, R107, R108, R113, R116, R118, R165, R199)
	1200 ohms, ±10%, ½ watt (R196)
	1800 ohms, ±10%, 2 watts (R194, R208)
	2200 ohms, ±10%, ½ watt (R219)
	2200 ohms, ±10%, 1 watt (R192)
	2700 ohms, ±10%, ½ watt (R161, R217)
	3900 ohms, ±5%, ½ watt (R112)
	4700 ohms, ±5%, ½ watt (R126)
	4700 ohms, ±10%, ½ watt (R144)
	5600 ohms, ±5%, ½ watt (R119)
	5600 ohms, ±10%, ½ watt (R141, R218)
	5600 ohms, ±10%, 1 watt (R127)
	6800 ohms, ±5%, ½ watt (R136)
	6800 ohms, ±10%, ½ watt (R150)
	6800 ohms, ±5%, 1 watt (R128)
	6800 ohms, ±10%, 2 watts (R177, R186, R210)
	8200 ohms, ±5%, ½ watt (R164, R175)
	8200 ohms, ±10%, ½ watt (R152, R153, R171)
	8200 ohms, ±5%, 1 watt (R117)
	10,000 ohms, ±5%, ½ watt (R104)
	12,000 ohms, ±10%, ½ watt (R134, R209, R226)
	12,000 ohms, ±10%, 2 watts (R124)
	15,000 ohms, ±10%, ½ watt (R182, R211)
	15,000 ohms, ±10%, 1 watt (R146)
	22,000 ohms, ±10%, ½ watt (R151, R156, R197, R220)
	22,000 ohms, ±20%, ½ watt (R198, R215)
	27,000 ohms, ±10%, ½ watt (R143, R234)
	39,000 ohms, ±5%, ½ watt (R135)
	47,000 ohms, ±10%, ½ watt (R145)
	47,000 ohms, ±20%, ½ watt (R221)
	68,000 ohms, ±10%, ½ watt (R172)
	100,000 ohms, ±5%, ½ watt (R203, R204)
	100,000 ohms, ±10%, ½ watt (R160, R216)
	100,000 ohms, ±10%, 1 watt (R179)
	100,000 ohms, ±20%, 1 watt (R222)

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REPLACEMENT PARTS (Continued)

STOCK No.	DESCRIPTION
	120,000 ohms, ±5%, 1 watt (R176)
	120,000 ohms, ±10%, 1 watt (R174)
	150,000 ohms, ±10%, ½ watt (R168)
	150,000 ohms, ±20%, ½ watt (R142)
	180,000 ohms, ±10%, ½ watt (R232)
	180,000 ohms, ±5%, 1 watt (R178)
	220,000 ohms, ±10%, ½ watt (R129, R154)
	330,000 ohms, ±10%, ½ watt (R140, R200)
	470,000 ohms, ±10%, ½ watt (R137, R139, R180, R224, R231)
	470,000 ohms, ±20%, ½ watt (R207)
	680,000 ohms, ±10%, ½ watt (R133, R212)
	820,000 ohms, ±5%, ½ watt (R169)
	1 megohm, ±10%, ½ watt (R147)
	1 megohm, ±20%, 1 watt (R189, R227)
	1.2 megohm, ±5%, ½ watt (R213)
	1.5 megohm, ±5%, ½ watt (R157)
	2.2 megohm, ±10%, ½ watt (R130, R132, R159, R163)
	2.7 megohm, ±5%, 1 watt (R170)
	3.9 megohm, ±10%, ½ watt (R149)
	6.8 megohm, ±10%, ½ watt (R125)
	10 megohm, ±10%, ½ watt (R148)
	10 megohm, ±20%, ½ watt (R201)
74416	Screw—No. 10-32 x 1¾" cross recessed round head screw for kinescope retaining strap
71456	Screw—No. 8-32 wing screw for deflection yoke
74601	Screw—No. 8-32 x ⅜" cross recessed binder head screw for focus coil mounting (2 required)
74602	Screw—No. 10-32 x 1¼" cross recessed binder head screw for focus coil adjustment (3 required)
73584	Shield—Tube shield
74937	Sleeve—Rubber sleeve for focus coil
73117	Socket—Tube socket, 7 pin, miniature
72927	Socket—Tube socket, 9 pin, miniature
31251	Socket—Tube socket, octal, wafer
73249	Socket—Tube socket, octal, ceramic, plate mounted
71508	Socket—Tube socket for 1B3GT/8016
31364	Socket—Pilot lamp socket
74834	Socket—Kinescope tube socket
73586	Spring—Compression spring used under centering control screws (3 required)
74936	Spring—Suspension spring (coil type) for kinescope tube socket leads
74595	Spring—Anode lead spring
74893	Strap—Kinescope retaining strap
74596	Supports—Bakelite supports (1 set) for mounting hi-voltage rectifier tube mounting plate
74147	Switch—Width selector switch (S104)
74157	Switch—Cabinet interlock switch (S105)
74981	Transformer—Power transformer, 115 volt, 60 cycles (T111)
74587	Transformer—Vertical output transformer (T108)
73569	Transformer—Vertical oscillator transformer (T107)
74588	Transformer—Horizontal output and hi-voltage transformer (T110)
74589	Transformer—First pix, i-f transformer (T101, C102, R101)
74590	Transformer—Second pix, i-f transformer (T102, C107)
74591	Transformer—Third pix, i-f transformer (T103, C112)
74592	Transformer—Fourth pix, i-f transformer (T104, C116)
73575	Transformer—Fifth pix, i-f transformer (T106, C123, C124)
71424	Transformer—Sound i-f transformer (T112, C173, C174)
71427	Transformer—Sound discriminator transformer (T113, C178, C179, C180)
73576	Transformer—Horizontal oscillator transformer (T109)
73578	Transformer—Antenna transformer complete with socket and bracket (T115, J102)
73577	Trap—4.5 mc trap (L110, C128)
71778	Trap—Sound trap (T105, C119)

STOCK No.	DESCRIPTION
73476	Trap—I-F trap (L116, C189)
74262	Yoke—Deflection yoke (L108, L109, L112, L113, C169, R166, R167)
	RADIO CHASSIS ASSEMBLIES RK 135D
74039	Board—"Telv-Ant" terminal board (TB301)
74026	Bracket—Drive cord bracket complete with two pulleys —R.H.
74027	Bracket—Drive cord bracket complete with pulley—L.H.
74911	Cable—Shielded cable complete with female connector (W307, W311)
71105	Cable—Shielded cable complete with pin plug (W301, W302)
74017	Capacitor—Variable tuning capacitor (C301, C302, C303, C304, C305, C307, C308)
73866	Capacitor—Ceramic, 2 mmf. (C306)
39044	Capacitor—Ceramic, 15 mmf. (C312)
39042	Capacitor—Ceramic, 47 mmf. (C330)
73867	Capacitor—Ceramic, 56 mmf. (C313)
33379	Capacitor—Ceramic, 68 mmf. (C310)
39396	Capacitor—Ceramic, 100 mmf. (C322, C323)
48125	Capacitor—Ceramic, 150 mmf. (C314)
71922	Capacitor—Ceramic, 180 mmf. (C334, C338)
39640	Capacitor—Mica, 330 mmf. (C325, C326)
73748	Capacitor—Ceramic, 1500 mmf. (C309)
74009	Capacitor—Ceramic, dual, 4000 mmf. (C317, C319, C321)
73473	Capacitor—Ceramic, 5000 mmf. (C318, C329)
73747	Capacitor—Electrolytic, 2 mfd., 50 volts (C328)
32223	Capacitor—Electrolytic, 15 mfd., 300 volts (C333)
70602	Capacitor—Tubular, paper, .0025 mfd., 400 volts (C332)
73961	Capacitor—Tubular, paper, .003 mfd., 200 volts (C327, C331)
71553	Capacitor—Tubular, paper, .005 mfd., 400 volts (C315, C320, C324)
71923	Capacitor—Tubular, paper, .01 mfd., 200 volts (C335)
71925	Capacitor—Tubular, paper, .01 mfd., 400 volts (C311)
71928	Capacitor—Tubular, paper, .02 mfd., 200 volts (C337)
72596	Capacitor—Tubular, paper, .05 mfd., 200 volts (C336)
74455	Capacitor—Tubular, paper, .05 mfd., 400 volts (C316)
74020	Coil—Antenna coil—AM (L302, L303)
73744	Coil—Oscillator coil—AM (L304, L305, L306)
74024	Coil—Antenna coil—FM (L301)
74025	Coil—Oscillator coil—FM (L307)
36395	Connector—7 contact male connector (P103)
12493	Connector—5 contact female connector (P107B)
39153	Connector—4 prong male connector (P102)
72953	Cord—Drive cord (approx. 42" overall)
74011	Filter—Diode filter, dual 200 mmf. and 47,000 ohms (DF301)
74023	Resistor—Wire wound, 0.51 ohms, 1 watt (R323, R324)
	Resistor—Fixed, composition:
	10 ohms, ±20%, ½ watt (R311)
	68 ohms, ±20%, ½ watt (R308)
	100 ohms, ±20%, ½ watt (R305, R317)
	120 ohms, ±10%, ½ watt (R314)
	680 ohms, ±20%, ½ watt (R310, R312)
	1200 ohms, ±5%, ½ watt (R319)
	3300 ohms, ±5%, ½ watt (R320)
	4700 ohms, ±10%, ½ watt (R333)
	10,000 ohms, ±20%, ½ watt (R306)
	15,000 ohms, ±10%, ½ watt (R304)
	15,000 ohms, ±20%, ½ watt (R315, R318)
	18,000 ohms, ±10%, ½ watt (R302)
	27,000 ohms, ±10%, ½ watt (R307, R309)
	39,000 ohms, ±10%, ½ watt (R322)
	68,000 ohms, ±10%, ½ watt (R328)

STOCK No.	DESCRIPTION
	100,000 ohms, ±10%, ½ watt (R334)
	150,000 ohms, ±10%, ½ watt (R325, R326, R329)
	270,000 ohms, ±10%, ½ watt (R330)
	470,000 ohms, ±10%, ½ watt (R331)
	470,000 ohms, ±20%, ½ watt (R321)
	1 megohm, ±10%, ½ watt (R327, R332)
	2.2 megohm, ±20%, ½ watt (R303)
	3.9 megohm, ±10%, ½ watt (R301)
	22 megohm, ±20%, ½ watt (R316)
74028	Shaft—Tuning knob shaft
73632	Shield—Tube shield
73117	Socket—Tube socket, 7 pin, miniature for V301, V304, V305
74179	Socket—Tube socket, 7 pin, miniature for V302, V303
31364	Socket—Dial lamp socket
74038	Spring—Drive cord spring
74894	Switch—Selector switch (S301)
73745	Transformer—First i-f transformer, dual (T301)
74019	Transformer—Second i-f transformer, dual (T302)
73743	Transformer—Ratio detector transformer (T303)
33726	Washer—"C" washer for tuning shaft (rear)
34457	Washer—Spring washer for tuning shaft (front)
74172	Washer—Fibre washer to prevent drive cord slippage
	SPEAKER ASSEMBLIES 92569-8W RL-111-10 RMA-#274
13867	Cap—Dust cap
74901	Cone—Cone complete with voice coil (3.2 ohms)
5039	Connector—4 prong male connector (J101)
74900	Speaker—12" P.M. speaker complete with cone and voice coil (3.2 ohms) less transformer and plug
74902	Transformer—Output transformer (T114)
	NOTE: If stamping in instruments does not agree with above speaker number, order replacement parts by referring to model number of instruments, number stamped on speaker and full description of part required.
	MISCELLANEOUS
74977	Back—Cabinet back
74054	Bracket—Dial lamp bracket (2 required)
71599	Bracket—Pilot lamp bracket
75041	Button—Plug button for shipping bolts holes in 33/78 changer motorboard (2 required)
72437	Cable—Shielded pickup cable complete with pin plug
13103	Cap—Pilot lamp cap
73803	Capacitor—Tubular, paper, .002 mfd., 400 volts (C402)
71892	Catch—Bullet catch and strike
X3074	Cloth—Grille cloth for mahogany or walnut instruments
X3090	Cloth—Grille cloth for oak instruments
14782	Connector—3 contact male connector for record changer power cable
30868	Connector—2 contact female connector for record changer power cable
74581	Cover—Mounting screw cover for 45 RPM changer (3 required)
71984	Decal—Trade mark decal (RCA Victor)
74273	Decal—Trade mark decal (Victrola)
74898	Decal—Control panel function decal for mahogany or walnut instruments
74899	Decal—Control panel function decal for oak instruments
74052	Dial—Dial scale and bezel
74891	Edging—Vinylite edging for metal mask

STOCK No.	DESCRIPTION
74674	Emblem—"RCA Victor" emblem
73642	Escutcheon—Channel marker escutcheon for mahogany or walnut instruments
73740	Escutcheon—Channel marker escutcheon for oak instruments
74755	Glass—Safety glass
37396	Grommet—Rubber grommet for speaker
74206	Grommet—Rubber grommet for mounting 33/78 record changer (4 required)
74308	Hinge—Door hinge (1 set) for L.H. or R.H. doors
73200	Hinge—Lower hinge for center door
70166	Hinge—Upper hinge for center door
74051	Indicator—Station selector indicator
74959	Knob—Fine tuning knob—dark—for mahogany or walnut instruments (outer)
73995	Knob—Fine tuning knob—tan—for oak instruments (outer)
74960	Knob—Channel selector knob—dark—for mahogany or walnut instruments (inner)
74961	Knob—Channel selector knob—tan—for oak instruments (inner)
74962	Knob—Vertical hold control, brightness control or tone control knob—dark—for mahogany or walnut instruments (outer)
73999	Knob—Vertical hold control, brightness control or tone control knob—tan—for oak instruments (outer)
74978	Knob—Tuning or selector switch knob—dark—for mahogany or walnut instruments
74979	Knob—Tuning or selector switch knob—tan—for oak instruments
74963	Knob—Horizontal hold control, picture control or volume control and power switch knob—dark—for mahogany instruments (inner)
74001	Knob—Horizontal hold control, picture control or volume control and power switch knob—tan—for oak instruments (inner)
11765	Lamp—Dial or pilot lamp—Mazda 51
74208	Nut—Tee nut to mount 45 RPM changer (3 required)
74162	Plate—Mounting plate for interlock switch
75037	Pull—Door pull
	Resistor—Fixed, composition, 47,000 ohms, ±10%, ½ watt (R402)
74582	Screw—No. 8-32 x 1¾" special head screw to mount 45 RPM changer (3 required)
75038	Screw—No. 8-32 x ½" trimit head cross-recessed screw for door pull
74736	Slide—Record changer tray slide mechanism
74050	Slide—Station indicator slide
73643	Spring—Spring clip for channel marker escutcheon
72845	Spring—Retaining spring for knobs No. 73995 and No. 74959
14270	Spring—Retaining spring for knobs Nos. 73999, 74960, 74961, 74962
30330	Spring—Retaining spring for knobs Nos. 74001 and 74963
74055	Spring—Spring clip for dial and bezel assembly (2 required)
74421	Spring—Conical spring to mount 45 RPM changer—upper —R.H. (1 required)
74422	Spring—Conical spring to mount 45 RPM changer—upper —L.H. (2 required)
74423	Spring—Conical spring to mount 45 RPM changer—lower —(3 required)
75040	Spring—Mounting spring for 33/78 RPM record changer (4 required)
72936	Stop—Door stop
74161	Stud—Locating stud for back cover (2 required)

To obtain resistors for which no stock number is given, order by stating type, value of resistance, tolerance and wattage.

The system of employing an asterisk before the stock number of new items has been discontinued.

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GENERAL DESCRIPTION

Model TA129 receiver employs twenty-six tubes plus three rectifiers and a 12LP4 kinescope.

The television receiver is provided with Electronic Magnifier deflection circuits by which the center portion of the picture may be enlarged to fill the screen. Choice of picture coverage is made by operation of a remote switch.

The radio tuner unit which feeds through the television audio system covers the AM and the FM broadcast bands.

Two record changers are provided to play 45 and 78/33⅓ RPM records.

ELECTRICAL AND MECHANICAL SPECIFICATIONS

PICTURE SIZE............... 87 square inches on a 12LP4 kinescope

TELEVISION R-F FREQUENCY RANGE

All 12 television channels, 54 mc. to 88 mc., 174 mc. to 216 mc.
Fine Tuning Range....±250 kc. on chan. 2, ±650 kc. on chan. 13
Picture Carrier Frequency ....25.75 mc.
Sound Carrier Frequency ....21.25 mc.

RADIO TUNING RANGE

Broadcast ....540-1,600 kc.
Frequency Modulation ....88-108 mc.
Intermediate Frequency—AM ....455 kc.
Intermediate Frequency—FM ....10.7 mc.

POWER SUPPLY RATING ....115 volts, 60 cycles, 300 watts

AUDIO POWER OUTPUT RATING ....6 watts max.

CHASSIS DESIGNATIONS

Television Chassis KCS41A-1
Radio Chassis RK135D
78/33⅓ RPM Record Changer 960282
45 RPM Record Changer RP168C
Refer to Service Data 960282 or RP168 for information on the record changers.

LOUDSPEAKER—92569-8 (RL111-10) ....12 inch PM Dynamic

Voice Coil Impedance ....3.2 ohms at 400 cycles

WEIGHT

Chassis with Tubes in Cabinet ....183 lbs.
Shipping Weight ....221 lbs.

DIMENSIONS (inches)	Width	Height	Depth
Cabinet (outside)	37	38¾	22¾
Chassis (Overall)	19⅜	12¼	20¼

RECEIVER ANTENNA INPUT IMPEDANCE....300 ohms balanced

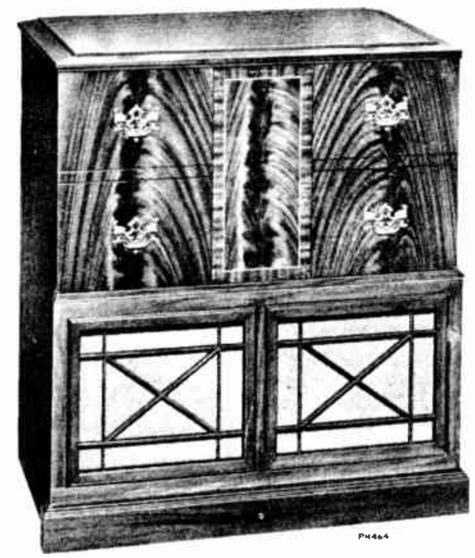
If necessary, the television chassis may be fed separately from either a 300 ohm balanced line or a 72 ohm co-ax.

RCA TUBE COMPLEMENT

	Tube Used	Function
(1)	RCA 6AG5	R-F Amplifier
(2)	RCA 6AG5	Converter
(3)	RCA 6J6	R-F Oscillator
(4)	RCA 6AU6	1st Sound I-F Amplifier
(5)	RCA 6AU6	2nd Sound I-F Amplifier
(6)	RCA 6AL5	Sound Discriminator
(7)	RCA 6AV6	1st Audio Amplifier
(8)	RCA 6V6GT	Audio Output
(9)	RCA 6BA6	1st Picture I-F Amplifier
(10)	RCA 6AG5	2nd Picture I-F Amplifier
(11)	RCA 6BA6	3rd Picture I-F Amplifier
(12)	RCA 6AG5	4th Picture I-F Amplifier
(13)	RCA 6AL5	Picture 2nd Detector & Sync Limiter
(14)	RCA 12AU7	1st and 2nd Video Amplifier
(15)	RCA 6SN7GT	AGC Amplifier & Vertical Sweep Osc.
(16)	RCA 6SN7GT	AGC Rectifier & 1st Sync Separator
(17)	RCA 6SN7GT	Sync Amplifier & 2nd Sync Separator
(18)	RCA 6K6GT	Vertical Sweep Output
(19)	RCA 6SN7GT	Horizontal Sweep Oscillator and Control
(20)	RCA 6BG6G	Horizontal Sweep Output
(21)	RCA 6W4GT	Damper
(22)	RCA 1B3-GT/8016	High Voltage Rectifier
(23)	RCA 5U4G	Power Supply Rectifier (2 tubes)
(24)	RCA 12LP4	Kinescope

(Radio Tuner Chassis)

	Tube Used	Function
(1)	RCA 6J6	Mixer and Oscillator
(2)	RCA 6BA6	I-F Amplifier
(3)	RCA 6AU6	F-M Driver
(4)	RCA 6AL5	Ratio Detector
(5)	RCA 6BF6	AM Detector AVC



Model TA129 Walnut, Mahogany or Oak

PICTURE I-F FREQUENCIES

Picture Carrier Frequency ....25.75 mc.
Adjacent Channel Sound Trap ....27.25 mc.
Accompanying Sound Traps ....21.25 mc.
Adjacent Channel Picture Carrier Trap ....19.75 mc.

SOUND I-F FREQUENCIES

Sound Carrier Frequency ....21.25 mc.
Sound Discriminator Band Width between peaks ....350 kc.

VIDEO RESPONSE..To 4 mc.

FOCUS..Magnetic

SWEEP DEFLECTION ....Magnetic

SCANNING..Interlaced, 525 line

HORIZONTAL SCANNING FREQUENCY.....................15,750 cps

VERTICAL SCANNING FREQUENCY ....60 cps

FRAME FREQUENCY (Picture Repetition Rate)...................30 cps

OPERATING CONTROLS (front panel)

Channel Selector / Fine Tuning ....Dual Control Knobs
Tone / Sound Volume and On-Off Switch ....Dual Control Knobs
Picture Horizontal Hold / Picture Vertical Hold ....Dual Control Knobs
Picture / Brightness ....Dual Control Knobs
Function Switch ....Single Control Knob
Radio Tuning ....Single Control Knob

NON-OPERATING CONTROLS

Horizontal Centering ....rear chassis adjustment
Vertical Centering ....rear chassis adjustment
Shunt Width Coil ....rear chassis screwdriver adjustments
Series Width Coil ....rear chassis screwdriver adjustment
Expanded Width Coil ....rear chassis screwdriver adjustment
Width Selector Switch ....rear chassis screwdriver adjustment
Height ....rear chassis adjustment
Horizontal Linearity ....rear chassis screwdriver adjustment
Vertical Linearity ....rear chassis adjustment
Horizontal Drive ....rear chassis screwdriver adjustment
Horizontal Oscillator Frequency ....bottom chassis adjustment
Horizontal Oscillator Waveform ....side chassis adjustment
Focus ....rear chassis adjustment
Ion Trap Magnet ....top chassis adjustment
Deflection Coil ....top chassis wing nut adjustment
Focus Coil ....top chassis screwdriver adjustment

HIGH VOLTAGE WARNING

OPERATION OF THIS RECEIVER OUTSIDE THE CABINET OR WITH THE COVERS REMOVED, INVOLVES A SHOCK HAZARD FROM THE RECEIVER POWER SUPPLIES. WORK ON THE RECEIVER SHOULD NOT BE ATTEMPTED BY ANYONE WHO IS NOT THOROUGHLY FAMILIAR WITH THE PRECAUTIONS NECESSARY WHEN WORKING ON HIGH VOLTAGE EQUIPMENT. DO NOT OPERATE THE RECEIVER WITH THE HIGH VOLTAGE COMPARTMENT SHIELD REMOVED.

KINESCOPE HANDLING PRECAUTIONS

DO NOT OPEN THE KINESCOPE SHIPPING CARTON, INSTALL, REMOVE OR HANDLE THE KINESCOPE IN ANY MANNER UNLESS SHATTERPROOF GOGGLES, AND HEAVY GLOVES ARE WORN. PEOPLE NOT SO EQUIPPED SHOULD BE KEPT AWAY WHILE HANDLING KINESCOPES. KEEP THE KINESCOPE AWAY FROM THE BODY WHILE HANDLING.

The kinescope bulb encloses a high vacuum and, due to its large surface area, is subjected to considerable air pressure. For these reasons, kinescopes must be handled with more care than ordinary receiving tubes.

The large end of the kinescope bulb—particularly that part at the rim of the viewing surface—must not be struck, scratched or subjected to more than moderate pressure at any time. In installation, if the tube sticks or fails to slip smoothly into its socket, or deflecting yoke, investigate and remove the cause of the trouble. Do not force the tube. Refer to the Receiver Installation section for detailed instructions on kinescope installation. All RCA kinescopes are shipped in special cartons and should be left in the cartons until ready for installation in the receiver. Keep the carton for possible future use.

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OPERATING INSTRUCTIONS

The following adjustments are necessary when turning the receiver on for the first time.

1. Turn the radio FUNCTION switch to Tel.

2. Turn the receiver "ON" and advance the SOUND VOLUME control to approximately mid-position.

3. Set the STATION SELECTOR to the desired channel.

4. Adjust the FINE TUNING control for best sound fidelity and SOUND VOLUME for suitable volume

5. Turn the BRIGHTNESS control fully counterclockwise, then clockwise until a light pattern appears on the screen.

6. Adjust the VERTICAL hold control until the pattern stops vertical movement.

7. Adjust the HORIZONTAL hold control until a picture is obtained and centered.

8. Turn the BRIGHTNESS control counterclockwise until the retrace lines just disappear.

9. Adjust the PICTURE control for suitable picture contrast.

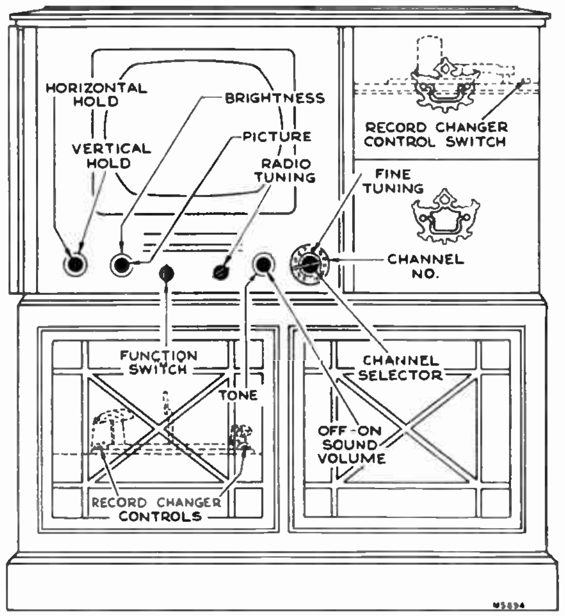

Figure 1—Receiver Operating Controls

10. After the receiver has been on for some time, it may be necessary to readjust the FINE TUNING control slightly for improved sound fidelity.

11. In switching from one station to another, it may be necessary to repeat steps numbers 4 and 9.

12. To operate the Electric Magnifier, push the button on the remote cable.

13. When the set is turned on again after an idle period, it should not be necessary to repeat adjustments if the positions of the controls have not been changed. If any adjustment is necessary, step number 4 is generally sufficient.

14. If the positions of the controls have been changed, it may be necessary to repeat steps numbers 1 through 9.

15. For radio operation turn the FUNCTION switch to AM or FM and tune in station with the radio TUNING control.

16. For phono. operation, turn the function switch to PH for operation of the 78 rpm changer or to XPH for operation of the 45 rpm changer.

INSTALLATION INSTRUCTIONS

UNPACKING.—The TA129 receiver is packed complete with kinescope in a cardboard carton. To unpack, turn the shipping carton on its side and tear open the carton bottom flaps. Fold the flaps up along the side of the carton and turn the carton back up. Lift the carton up and off the cabinet.

A flat skid is attached to the bottom of the receiver cabinet which will permit the cabinet to be moved about without stressing the cabinet joints. To remove the skid, take off the nuts from the two bolts that hold the cabinet on the skid. With a man at each end of the cabinet, lift the cabinet off the skid.

The operating control knobs are packed in a paper bag and tied to a crossmember in back of the cabinet. Remove the bag and install the knobs on the proper control shafts.

From the rear of the cabinet remove the red bracket which holds the RP168C record changer drawer in the closed position. Slide the drawer out. From the top of the changer, remove the three filler plugs from over the motorboard mounting screws. Loosen these three screws just enough to permit removal of two wooden shipping strips under the edge of the motorboard. Tighten the screws just enough to keep the motorboard springs from rattling and replace the filler plugs.

Remove the red bracket which holds the 960282 changer drawer in the closed position. Open the drawer and from the top of the changer. Remove the two shipping screws from the record changer motorboard. Insert two plugs from the bag of knobs into the holes in the motorboard.

Remove the television compartment back.

Make sure that all tubes are in place and are firmly seated in their sockets.

Check to see that the high voltage lead is attached to the kinescope second anode connector socket on the bell of the tube.

Connect the antenna transmission line to the receiver antenna terminals.

Plug the receiver power cord into a 115 volt a-c power source. Turn the power switch to the "on" position, the function switch to Tel, the brightness control three-quarters clockwise, and picture control counterclockwise.

ION TRAP MAGNET ADJUSTMENT.—Set the ion trap magnet approximately in the position shown in Figure 2. Starting from this position immediately adjust the magnet by moving

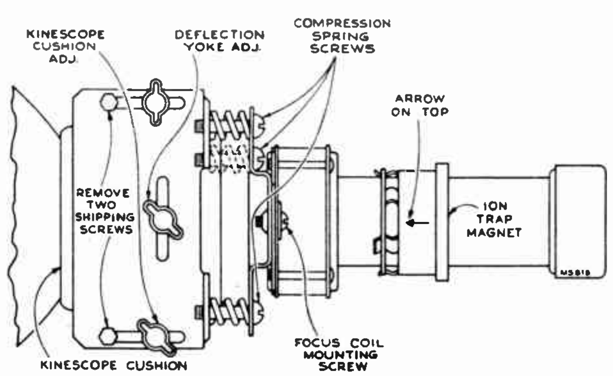

Figure 2—Yoke and Focus Coil Adjustments

it forward or backward at the same time rotating it slightly around the neck of the kinescope for the brightest raster on the screen. Reduce the brightness control setting until the raster is slightly above average brilliance. Adjust the focus control (R191 on the chassis rear apron) until the line structure of the raster is clearly visible. Readjust the ion trap magnet for maximum raster brilliance. The final touches on this adjustment should be made with the brightness control at the maximum position with which good line focus can be maintained.

DEFLECTION YOKE ADJUSTMENT.—If the lines of the raster are not horizontal or squared with the picture mask, rotate the deflection yoke until this condition is obtained. Tighten the yoke adjustment wing screw.

PICTURE ADJUSTMENTS.—It will now be necessary to obtain a test pattern picture in order to make further adjustments. See steps 3 through 9 of the receiver operating instructions.

If the Horizontal Oscillator and AGC System are operating properly, it should be possible to sync the picture at this point. However, if the AGC threshold control is misadjusted, and the receiver is overloading, it may be impossible to sync the picture.

If the receiver is overloading, turn R138 on the rear apron (see Figure 3) clockwise until the set operates normally and the picture can be synced.

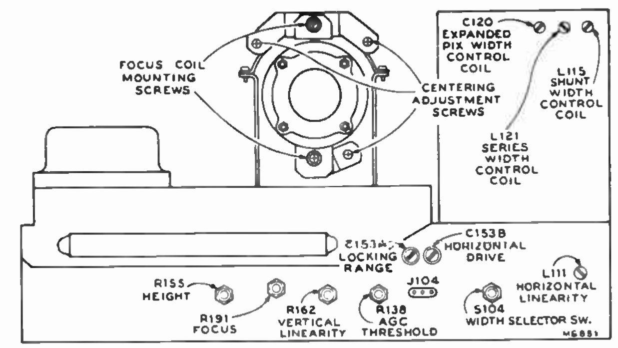

Figure 3—Rear Chassis Adjustments

CHECK OF HORIZONTAL OSCILLATOR ALIGNMENT.—Turn the horizontal hold control to the extreme counter-clockwise position. The picture should remain in horizontal sync. Momentarily remove the signal by switching off channel then back. Normally the picture will be out of sync. Turn the control clockwise slowly. The number of diagonal black bars will be gradually reduced and when only 3 bars sloping downward to the left are obtained, the picture will pull into sync upon slight additional clockwise rotation of the control. Pull in should occur when the control is approximately 90 degrees from the extreme counter-clockwise position. The picture should remain in sync for approximately 90 degrees of additional clockwise rotation of the control. At the extreme clockwise position, the picture should be out of sync and should show 1 vertical or diagonal black bar in the raster.

If the receiver passes the foregoing checks and the picture is normal and stable, the horizontal oscillator is properly aligned. Skip "Alignment of Horizontal Oscillator" and proceed with "Focus Coil Adjustments."

ALIGNMENT OF HORIZONTAL OSCILLATOR.—If in the above check the receiver failed to hold sync with the hold control at the extreme counter-clockwise position or failed to hold sync over 90 degrees of clockwise rotation of the control from the pull-in point, it will be necessary to make the following adjustments:

Horizontal Frequency Adjustment.—Turn the horizontal hold control to the extreme clockwise position. Tune in a television station and adjust the T109 horizontal frequency adjustment (under the chassis) until the picture is just out of sync and the horizontal blanking appears as a vertical or disagonal black bar in the raster.

Horizontal Lock in Range Adjustment.—Set the horizontal hold control to the full counter-clockwise position. Momentarily remove the signal by switching off channel then back. Slowly turn the horizontal hold control clockwise and note the least number of diagonal bars obtained just before the picture pulls into sync.

If more than 3 bars are present just before the picture pulls into sync, adjust the horizontal locking range trimmer C153A slightly clockwise. If less than 3 bars are present, adjust C153A slightly counter-clockwise. Turn the picture control counter-clockwise, momentarily remove the signal and recheck the number of bars present at the pull in point. Repeat this procedure until 3 bars are present.

Repeat the adjustments under "Horizontal Frequency Adjustment" and "Horizontal Locking Range Adjustment" until the conditions specified under each are fulfilled. When the horizontal hold operates as outlined under "Check of Horizontal Oscillator Alignment" the oscillator is properly adjusted.

If it is impossible to sync the picture at this point and the AGC system is in proper adjustment it will be necessary to adjust the Horizontal Oscillator by the method outlined in the alignment procedure on page 11. For field purposes paragraph "A" under Horizontal Oscillator Waveform Adjustment may be omitted.

FOCUS COIL ADJUSTMENTS.—The focus coil should be adjusted so that there is approximately ¼ inch of space between the rear cardboard shell of the yoke and the flat of the front face of the focus coil. This spacing gives best average focus over the face of the tube. However, it may be necessary to change this distance slightly in order to compensate for small differences in strength of the permanent magnets in the coil. In order to prevent the beam from striking the neck of the kinescope, it is important that the axis of the hole through the focus coil should be kept in accurate alignment with the axis of the neck of the kinescope.

CENTERING ADJUSTMENTS.—Centering is obtained by loosening the two focus coil mounting screws and sliding the coil up or down or from side to side. If a corner of the raster is shadowed, check the position of the ion trap magnet. Slightly reposition it to eliminate the shadow and recenter the picture by sliding the coil. In extreme cases it may be necessary to adjust one or more of the focus coil compression screws to eliminate a corner shadow.

Recheck the position of the ion trap magnet to insure that maximum brilliance is obtained. It is important that the kinescope not be operated with the ion trap magnet adjusted for less than maximum brightness. To do so may cause injury to the tube.

PICTURE SIZE AND LINEARITY.—Connect the "Electronic Magnifier" switch to its socket on the rear apron of the chassis. Set the switch to the large (expanded) picture position. Set the Expanded Width Selector Switch S104 to the counter-clockwise position and adjust the Expanded Width Control L120 so that the test pattern outer circle normally tangent to the top of the picture is now tangent to the side of the picture. (If the width is not sufficient, set the Expanded Width Selector Switch to the center or the clockwise end position.) Adjust the Horizontal Drive and the Horizontal Linearity Control until the pattern is symmetrical from left to right. In general, the core of the Linearity Control Coil should be between ½ to all the way out of the coil.

Set the "Electronic Magnifier" switch to the normal size position. Observe to see if the picture width is correct. If it is not, adjust either the Series Width Control Coil L121, or the Shunt Width Control Coil L115 until the picture is the correct width. If the Series Width Coil core is out too far, the picture will "ring" on the left half. This ring will be shown as one or more faint light or dark vertical bars somewhere on the left half of the picture with resulting poor horizontal linearity.

When the proper width is obtained, switch to the expanded picture position, wait for a few seconds then switch back to the normal position. Observe if the top of the picture immediately assumes its final position or if it takes several seconds to come to a stop. If the picture requires more than a second to become still, adjust the core of L115 or L121 in and the other out while maintaining the proper width. Repeat the above test and observe if the picture immediately comes to rest when switched to the normal size position. Continue to adjust L115 and L121 until this condition is satisfied and the picture is the proper width. Observe the picture horizontal linearity and if necessary retouch Horizontal Drive, Linearity and Width Controls L115 and L121.

With the "Electronic Magnifier" switch in normal position, adjust the Height (R155) and the Vertical Linearity control (R162) as usual in order to obtain good vertical linearity. In addition, if difficulty is experienced in obtaining good vertical linearity at the top one-half inch of the picture, slightly adjust the Vertical Peaking Control L119.

Switch to the expanded picture position and note if the proper aspect ratio is obtained. If not, adjust L112 and/or S104.

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INSTALLATION INSTRUCTIONS

Adjustments of the horizontal drive control affect horizontal oscillator hold and locking range. If the drive control was adjusted, recheck the oscillator alignment.

FOCUS.—Adjust the focus control (R191 on chassis rear apron) for maximum definition in the test pattern vertical "wedge" and best focus in the white areas of the pattern.

AGC THRESHOLD CONTROL. The AGC threshold control R138 is adjusted at the factory and normally should not require readjustment in the field.

To check the adjustment of the AGC Threshold Control, tune in a strong signal, sync the picture and turn the picture control to the maximum clockwise position. Turn the brightness control counter-clockwise until the vertical retrace lines are just invisible. Momentarily remove the signal by switching off channel and then back. If the picture reappears immediately, the receiver is not overloading due to improper setting of R138. If the picture requires an appreciable portion of a second to reappear, R138 should be readjusted.

Set the picture control at the maximum clockwise position. Turn R138 fully clockwise. The top one-half inch of the picture may be bent slightly. This should be disregarded. Turn R138 counter-clockwise until there is a very, very slight bend or change of bend in the top one-half inch of the picture. Then turn R138 clockwise just sufficiently to remove this bend or change of bend.

If the signal is very weak, the above method may not work as it may be impossible to get the picture to bend. In this case, turn R138 counter-clockwise until the snow in the picture becomes more pronounced, then clockwise until the best signal to noise ratio is obtained.

The AGC control adjustment should be made on a strong signal if possible. If the control is set too far counter-clockwise on a weak signal, then the receiver may overload when a strong signal is received.

CHECK OF R-F OSCILLATOR ADJUSTMENTS. Tune in all available stations to see if the receiver r-f oscillator is adjusted to the proper frequency on all channels. If adjustments are required, these should be made by the method outlined in the alignment procedure on page 10. The adjustments for channels 2 through 5 and 7 through 12 are available from the front of the cabinet by removing the station selector escutcheon as shown in Figure 4. Adjustment for channel 13 is on top of the chassis and channel 6 adjustment is in the kinescope well. See Figures 9 and 10 for their location.

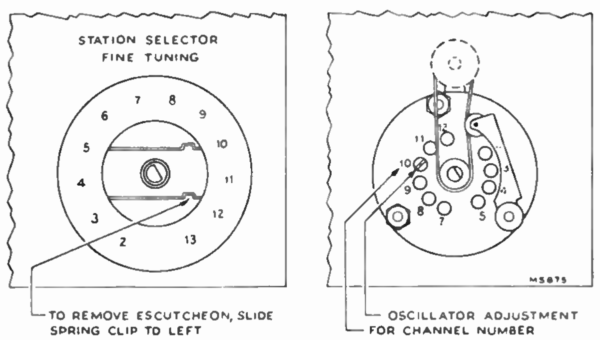

Figure 4—R-F Oscillator Adjustments

Replace the cabinet back and make sure that the screws are tight in order to prevent rattling at high volume.

WEAK SIGNAL AREA OPERATION.—Since the vast majority of receivers are sold in strong signal areas, the chassis are aligned to produce the cleanest pictures in those areas. However, if the receiver is to be operated in a weak signal area, better performance can be obtained by "peaking" the r-f unit.

To peak the r-f unit in these receivers, disconnect the 390 ohm resistor which is on top of the r-f unit chassis. Adjust L66 to obtain the best possible picture on the weakest low channel station received.

If the peaked receiver is subsequently taken to a strong signal area, the resistor R14 should be connected in place and L66 adjusted for "flat" response on the low channels.

CHASSIS REMOVAL. To remove the chassis from the cabinet for repair or installation of a new kinescope, remove the back and the knobs, unplug all cables and remove the chassis bolts under the cabinet. Withdraw the chassis from the back of the cabinet. The kinescope is held on the chassis by means of a special strap, so that the chassis and the kinescope can be handled together, as a unit.

KINESCOPE HANDLING PRECAUTION.—Do not install, remove, or handle the kinescope in any manner, unless shatterproof goggles and heavy gloves are worn. People not so equipped should be kept away while handling the kinescope. Keep the kinescope away from the body while handling.

To remove the kinescope, remove the kinescope socket, the ion-trap magnet, and the second-anode connector. Loosen the cross-recessed head screw on the kinescope strap. Withdraw the kinescope toward the front of the chassis.

INSTALLATION OF KINESCOPE.—Slide the kinescope cushion toward the rear of the chassis. Loosen the deflection yoke adjustment, slide the yoke toward the rear of the chassis and tighten.

The kinescope second anode contact is a recessed metal well in the side of the bulb. The tube must be installed so that this contact is up but rotated approximately 30 degrees toward the high-voltage compartment.

Insert the neck of the kinescope through the deflection and focus coils. If the tube sticks, or fails to slip into place smoothly, investigate and remove the cause of the trouble. Do not force the tube.

Slip the ion trap magnet assembly over the neck of the kinescope.

Connect the kinescope socket to the tube base.

Connect the high voltage lead to the kinescope second anode socket.

Wipe the kinescope screen surface and front panel safety glass clean of all dust and finger marks.

As may be seen by inspection, the radio dial lights and dial pointer are attached to the cabinet front panel. The dial cord is attached to the receiver chassis. The method of attachment may be seen in Figure 5.

Slide the dial pointer to the stop on the high frequency end of the dial. Turn the radio tuning shaft until the gang is completely unmeshed.

To replace the chassis in the cabinet, first tighten the cross recessed head screw on the kinescope strap. Slide the chassis into the cabinet until there is sufficient slack in the pilot light cable then attach the pilot light sockets to the pilot light bracket.

Insert the chassis to its proper position, then install the six chassis bolts and tighten. Loosen the kinescope strap from the rear of the chassis. Push the kinescope forward until the face of the tube is against the mask. Push the yoke cushion forward against the kinescope flare then tighten the cushion adjusting screws. Push the yoke forward and tighten Tighten the kinescope strap. Replace the control knobs.

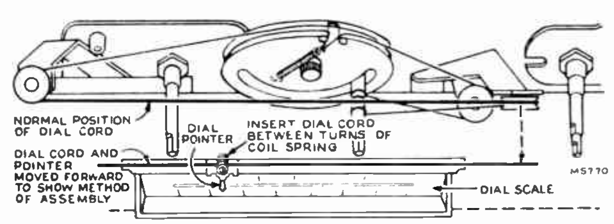

Figure 5—Dial Cord and Pointer Assembly

To hook up the dial pointer, reach over the television chassis to the radio and press the dial cord well into the coil spring.

Turn the set on and to radio position to see that the dial lighting is correct. If it is not, adjust the dial lights and shields. Tune in a station of known frequency and check the dial calibration.

CABINET ANTENNA. A cabinet antenna is provided which may be employed in strong signal areas in which no reflections are experienced. The antenna leads are brought out near the receiver antenna terminal board.

The link on the antenna terminal board is for use in case it is desirable to connect a separate "A" band antenna.

CHASSIS TOP VIEW

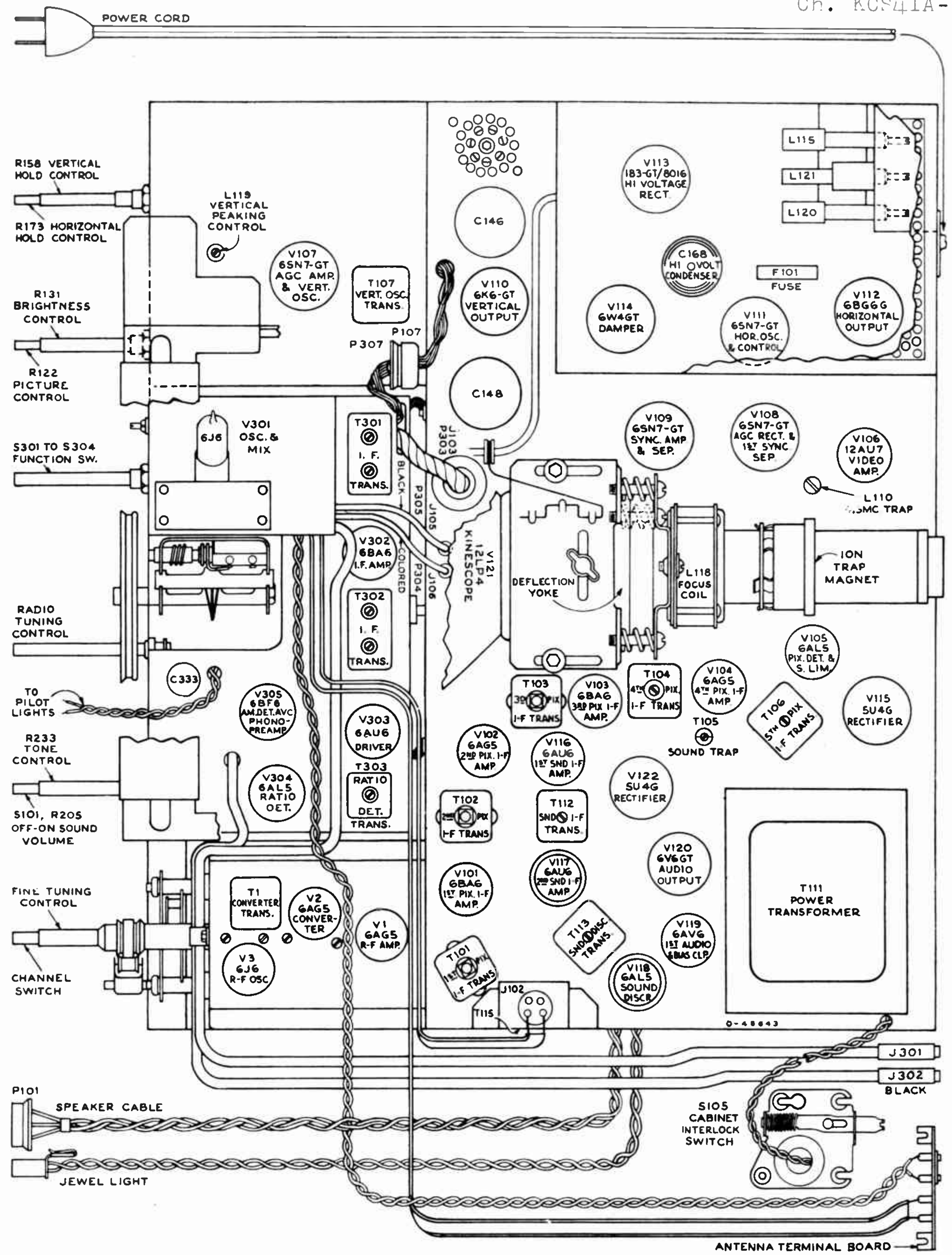

Figure 6—Chassis Top View

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CHASSIS BOTTOM VIEW

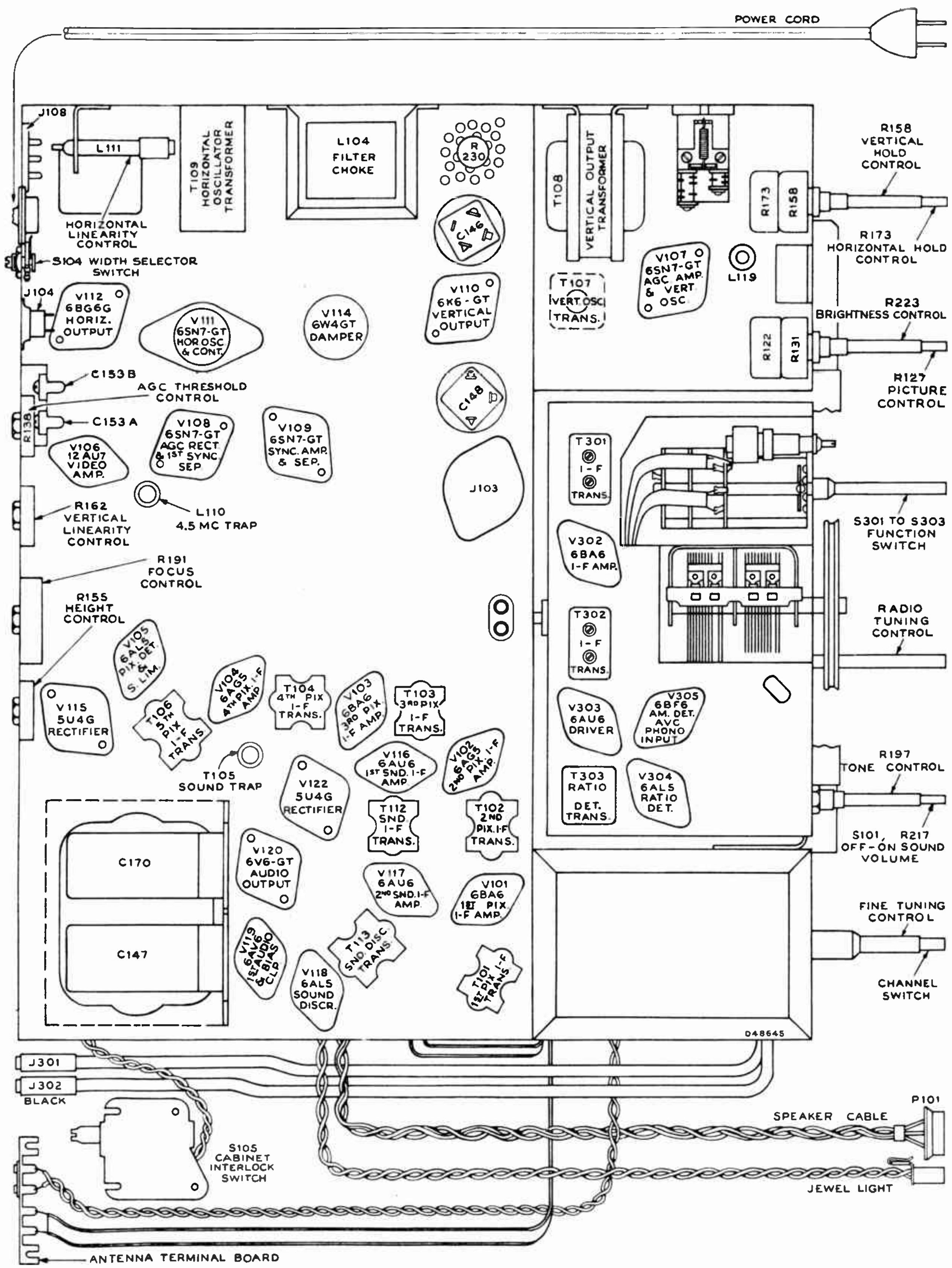

Figure 7—Chassis Bottom View

ALIGNMENT PROCEDURE

TEST EQUIPMENT.—To service properly the television chassis of this receiver, it is recommended that the following test equipment be available.

R-F Sweep Generator meeting the following requirements:

(a) Frequency Ranges

20 to 30 mc., 1 mc. and 10 mc. sweep width
50 to 90 mc., 10 mc. sweep width
170 to 225 mc., 10 mc. sweep width

(b) Output adjustable with at least .1 volt maximum.

(c) Output constant on all ranges.

(d) "Flat" output on all attenuator positions.

Cathode-Ray Oscilloscope.—For alignment purposes, the oscilloscope employed must have excellent low frequency and phase response, and should be capable of passing a 60-cycle square wave without appreciable distortion. While this requirement is not met by many commercial instruments, RCA Oscilloscopes, types WO-55A, WO-58A, WO-79A, and WO-60C fill the requirement and any of these may be employed.

For video and sync waveform observations, the oscilloscope must have excellent frequency and phase response from 10 cycles to at least two megacycles in all positions of the gain control. The RCA types WO-58A and WO-79A are ideally suited for this purpose.

Signal Generator to provide the following frequencies with crystal accuracy.

(a) Intermediate frequencies

19.75 mc. adjacent channel picture trap
21.25 mc. sound i-f and sound traps
22.05 and 24.75 mc. conv. and first pix i-f trans.
25.9 mc. second picture i-f transformer
24.6 mc. fourth picture i-f transformer
22.0 mc. third picture i-f transformer
22.5 mc. fifth picture i-f transformer
25.75 mc. picture carrier
27.25 mc. adjacent channel sound trap

(b) Radio frequencies

Channel Number	Picture Carrier Freq. Mc.	Sound Carrier Freq. Mc.
2	55.25	59.75
3	61.25	65.75
4	67.25	71.75
5	77.25	81.75
6	83.25	87.75
7	175.25	179.75
8	181.25	185.75
9	187.25	191.75
10	193.25	197.75
11	199.25	203.75
12	205.25	209.75
13	211.25	215.75

(c) Output on these ranges should be adjustable and at least .1 volt maximum.

Heterodyne Frequency Meter with crystal calibrator if the signal generator is not crystal controlled.

Electronic Voltmeter of Junior "VoltOhmyst" type and a high voltage multiplier probe for use with this meter to permit measurements up to 10 kv.

Service Precautions.—If possible, the chassis should be serviced without the kinescope. However, if it is necessary to view the raster during servicing, make sure the kinescope retaining strap is secure, and the yoke cushion is up firmly against the flare of the tube.

CAUTION: Do not short the kinescope second-anode lead. Its short circuit current is approximately 3 ma. This represents approximately 9 watts dissipation and a considerable overload on the high-voltage filter resistor R189.

Adjustments Required.—Normally, only the r-f oscillator line will require the attention of the service technician. All other circuits are either broad or very stable and hence will seldom require re-adjustment.

The oscillator line is relatively non-critical. When oscillator tubes are changed, in all probability it will be necessary to adjust only C6 in order to bring the entire line into adjustment.

ORDER OF ALIGNMENT.—When a complete receiver alignment is necessary, it can be most conveniently performed in the following order:

(1) Sound discriminator
(2) Sound i-f transformers
(3) Picture i-f traps
(4) Picture i-f transformers
(5) R-F and converter lines
(6) R-F oscillator line
(7) 4.5 mc. video trap
(8) Sensitivity check

SOUND DISCRIMINATOR ALIGNMENT.—Set the signal generator for approximately .1 volt output at 21.25 mc. and connect it to the second sound i-f grid.

Detune T113 secondary (bottom).

Set the "VoltOhmyst" on the 3-volt scale.

Connect the meter, in series with a one-megohm resistor, to the junction of diode resistors R203 and R204.

Adjust the primary of T113 (top) for maximum output on the meter.

Connect the "VoltOhmyst" to the junction of C183 and R203. Adjust T113 secondary (bottom). It will be found that it is possible to produce a positive or negative voltage on the meter dependent upon this adjustment. Obviously to pass from a positive to a negative voltage, the voltage must go through zero. T113 (bottom) should be adjusted so that the meter indicates zero output as the voltage swings from positive to negative. This point will be called discriminator zero output.

Connect the sweep oscillator to the grid of the second sound i-f amplifier.

Adjust the sweep band width to approximately 1 mc. with the center frequency at approximately 21.25 mc. and with an output of approximately .1 volt.

Connect the oscilloscope to the junction of C183 and R203. The pattern obtained should be similar to that shown in Figure 13. If it is not, adjust T113 (top) until the wave form is symmetrical.

The peak to peak band width of the discriminator should be approximately 350 kc. and the trace should be linear from 21.175 mc. to 21.325 mc.

SOUND I-F ALIGNMENT.—Connect the sweep oscillator to the first sound i-f amplifier grid.

Connect the oscilloscope to the second sound i-f grid return (terminal A of T112) in series with a 33,000-ohm isolating resistor.

Insert a 21.25 mc. marker signal from the signal generator into the first sound i-f grid.

Adjust T112 (top and bottom) for maximum gain and symmetry about the 21.25 mc. marker. The pattern obtained should be similar to that shown in Figure 14.

The output level from the sweep should be set to produce approximately .3 volt peak-to-peak at the second sound i-f grid return when the final touches on the above adjustment are made. It is necessary that the sweep output voltage should not exceed the specified values otherwise the response curve will be broadened, permitting slight misadjustment to pass unnoticed and possibly causing distortion on weak signals.

The band width at 70% response from the first sound i-f grid to the second i-f grid should be approximately 200 kc.

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ALIGNMENT PROCEDURE

PICTURE I-F TRAP ADJUSTMENT.—Connect the "VoltOhmyst" to the junction of R135 and C190.

Remove the 6SN7GT AGC Amplifier tube V107. Connect a 250,000 ohm potentiometer between pins 5 and 6 of the V107 socket. Adjust the potentiometer until the "VoltOhmyst" reads approximately −12 volts.

Set the channel switch to the blank position between channels number 2 and 13.

Connect the "VoltOhmyst" across the picture detector load resistor R119. Under this condition, both leads of the meter are at approximately −120 volts. In making this connection, care should be taken not to touch the case of the meter or to permit the meter case to become grounded.

Connect the output of the signal generator to the grid of the converter tube V2. To do this, remove the tube from the socket and fashion a clip by twisting one end of a small piece of wire around pin number 1. Replace the tube in the socket leaving the end of the wire protruding from under the tube. Connect the signal generator to this wire through a 1,500 mmf capacitor keeping the leads as short as possible.

Set the generator to each of the following frequencies and with a thin fiber screwdriver tune the specified adjustment for minimum indication on the "VoltOhmyst." In each instance the generator should be checked against a crystal calibrator to insure that the generator is exactly on frequency.

(1) 21.25 mc.—T103 (top)
(2) 21.25 mc.—T105 (top)
(3) 27.25 mc.—T102 (top)
(4) 27.25 mc.—T104 (top)
(5) 19.75 mc.—T106 (top)
(6) 19.75 mc.—T101 (top)

In the above transformers using threaded cores, it is possible to run the cores completely through the coils and secure two peaks or nulls. The correct position is with the cores in the outside ends of the coils. If the cores are not in the correct position, the coupling will be incorrect and it will be impossible to secure the correct response.

PICTURE I-F TRANSFORMER ADJUSTMENTS.—Set the signal generator to each of the following frequencies and peak the specified adjustment for maximum indication on the "VoltOhmyst." During alignment, reduce the input signal if necessary to prevent overloading.

22.5 mc.—T106 (bottom)
24.6 mc.—T104 (bottom)
22.0 mc.—T103 (bottom)
25.9 mc.—T102 (bottom)

T1 and T101 are coupled by a link and in combination constitute an overcoupled transformer. The characteristics of such a transformer are such that it is impossible to adjust it to a single frequency.

To sweep align T1 and T101, connect a 330-ohm composition resistor across the primary coils of T102, T103, T104 and T106.

Connect the "VoltOhmyst" to the junction of R135 and C190. Adjust the 250,000-ohm variable resistor for −2.0 volts on the meter.

Connect the oscilloscope to the plate of the first video amplifier, pin 1 of V106.

Connect a sweep generator to the converter grid through a 1,500 mmf capacitor. Set the generator to sweep from 20.0 mc. to 30.0 mc. and adjust the output to provide a 4-volt peak-to-peak signal on the scope.

Connect the signal generator loosely to the converter grid and tune it to provide markers at 22.05 mc. and 24.75 mc.

Adjust T1 (top) and T101 (bottom) to obtain the response shown in Figure 15. The T1 core must penetrate to the terminal-board end of the coil in order to obtain the correct response.

Remove the 330-ohm resistors from across T102, T103, T104 and T106.

Adjust the 250,000-ohm potentiometer for a 15-volt peak-to-peak signal at the plate of the first video amplifier. The bias as measured by the "VoltOhmyst" should be −12.0 volts or less.

Observe and analyze the response curve obtained. The response will not be ideal and the i-f adjustments must be retouched in order to obtain the desired curve. See Figure 16.

On final adjustment the picture carrier marker must be at approximately 45% response. The curve must be approximately flat topped, with the 22.1 mc. marker at approximately 95% response and the 25.0 mc. marker below 90% response. A 26.5 mc. marker must fall between 5 and 10% response.

The most important consideration in making the i-f adjustments is to get the picture carrier at the 45% response point. If the picture carrier operates too low on the response curve, loss of low frequency video response, of picture brilliance, of blanking, and of sync may occur. If the picture carrier operates too high on the response curve, the picture becomes smeared. In making these adjustments, care should be taken to see that no two transformers are tuned to the same frequency as i-f oscillation may result.

Remove the converter tube and take off the clip to pin number 1. Replace the tube in the socket.

Picture I-F Oscillation. If the receiver will operate without oscillating with the test equipment disconnected but breaks into oscillation or becomes unstable with the equipment connected, it may become necessary to establish a ground plane. Cover the test bench with a sheet of copper and set the chassis on the sheet. Set all the test equipment except the "VoltOhmyst" on the sheet and bond or bypass them to it. A Junior "VoltOhmyst" should not be bonded to the sheet since the negative test probe is not always connected to ground during alignment. If the receiver is badly misaligned and two or more of the i-f transformers are tuned to the same frequency, the receiver may fall into i-f oscillation. I-F oscillation shows up as a voltage across the picture detector load resistor that is unaffected by r-f signal input. If such a condition is encountered, it is sometimes possible to stop oscillation by adjusting the transformers approximately to frequency by setting the adjustment cores of T101, T102, T103, T104, T105 and T106 to be approximately equal to those of another receiver known to be in proper alignment. If this does not have the desired effect, it may now be possible to stop oscillation by increasing the grid bias. If so, it should then be possible to align the transformers by the usual method. Once aligned in this manner, the i-f amplifier should be stable with reduced bias.

If the oscillation cannot be stopped in the above manner, shunt the grids of the first three pix i-f amplifiers to ground with 1,000 mmf. capacitors. Connect the signal generator to the fourth pix i-f grid and align T106 to frequency. Progressively remove the shunt from each grid and align the plate coil of that stage to frequency.

If this does not stop the oscillation, the difficulty is not due to i-f misalignment as the i-f section is stable when properly aligned. Check all i-f by-pass condensers, transformer shunting resistors, tubes, socket voltages, etc.

ANTENNA, R-F AND CONVERTER LINE ADJUSTMENT.—In order to align the r-f tuner, it will first be necessary to set the channel-13 oscillator to frequency. The shield over the bottom of the r-f unit must be in place when making any adjustments.

The channel-13 oscillator may be aligned by adjusting it to beat with a crystal-calibrated heterodyne frequency meter, or by feeding a signal into the receiver at the r-f sound carrier frequency and adjusting the oscillator for zero output from the sound discriminator. In this latter case the sound discriminator must first have been aligned to exact frequency. Either method of adjustment will produce the same results. The method used will depend upon the type of test equipment available. Regardless of which method of oscillator alignment is used, the frequency standard must be crystal controlled or calibrated.

If the receiver oscillator is to be adjusted by the heterodyne frequency meter method, couple the meter probe loosely to the receiver oscillator.

If the receiver oscillator is adjusted by feeding in the r-f sound carrier signal, connect the signal generator to the receiver antenna terminals. Connect the "VoltOhmyst" to the sound discriminator output (junction of C183 and R203).

Set the receiver switch to 13.

Adjust the frequency standard to the correct frequency (237 mc. for heterodyne frequency meter or 215.75 mc. for the signal generator).

Set the fine tuning control to the middle of its range.

Adjust C6 for an audible beat on the heterodyne frequency meter or zero voltage from sound discriminator.

Now that the channel-13 oscillator is set to frequency, we may proceed with the r-f alignment.

Connect the "VoltOhmyst" to the junction of R135 and C197. Adjust the 250K pot. for −3.5 volts on the meter.

Remove the first pix i-f amplifier tube V101.

Connect the oscilloscope to the test connection at R13 in the r-f tuning unit.

Connect the r-f sweep oscillator to the receiver antenna terminals. The method of connection depends upon the output impedance of the sweep. The P102 connections for 300-ohm balanced or 72-ohm single-ended input are shown in the circuit diagram in Figure 74. If the sweep oscillator has a 50-ohm single-ended output, 300-ohm balanced output can be obtained by connecting as shown in Figure 8.

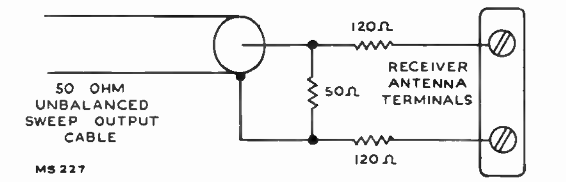

Figure 8—Unbalanced Sweep Cable Termination

Connect the signal generator loosely to the receiver antenna terminals.

Since channel 7 has the narrowest response of any of the high frequency channels, it should be adjusted first.

Set the receiver channel switch to channel 7.

Set the sweep oscillator to cover channel 7.

Insert markers of channel 7 picture carrier and sound carrier, 175.25 mc. and 179.75 mc.

Adjust C10 and C14 until the curve falls symmetrically between the sound and picture carrier markers. Adjust C11 to give the proper bandwidth. Roughly peak L6 in conjunction with slight adjustments of C10 and C14 for a flat-topped response curve with the sound and picture carriers at 90% to 95% response points on this curve. See Figure 17, channel 7.

Switch to channel 12 and adjust L6 for maximum response and minimum top slope of the curve.

Check the response of channels 7 through 13 by switching the receiver channel switch, sweep oscillator and marker oscillator to each of these channels and observing the response obtained. See Figure 17 for typical response curves. It should be found that all these channels have the proper shaped response with the markers above 80% response. If the markers do not fall within this requirement on one or more high frequency channels, since there are no individual channel adjustments, it will be necessary to readjust L6, C10, C11 and C14, and possibly compromise some channel slightly in order to get the markers up on other channels. Normally, however, no difficulty of this type should be experienced since the higher frequency channels are comparatively broad and the markers easily fall within the required range.

Channel 6 is next aligned in the same manner.

Set the receiver to channel 6.

Set the sweep oscillator to cover channel 6.

Set the marker oscillator to channel 6 picture and sound carrier frequencies.

Adjust L9, L13, L66, and C12 for an approximately flat-topped response curve located symmetrically between the markers. L9, L13 and L66 are the center frequency adjustments. C12 is the band-width adjustment.

Check channels 5 down through channel 2 by switching the receiver, sweep oscillator and marker oscillator to each channel and observing the response obtained. In all cases, the markers should be above the 80% response point. If this is not the case, L9, L13, L66 and C12 should be retouched. On final adjustment, all channels must be within the 80% specification.

Disconnect the 250K pot., and replace V107 and V101.

Following an r-f alignment, the oscillator alignment must be checked.

R-F OSCILLATOR LINE ADJUSTMENT. The r-f oscillator line may be aligned by adjusting it to beat with a crystal calibrated heterodyne frequency meter, or by feeding a signal into the receiver at the r-f sound carrier frequency and adjusting the oscillator for zero output from the sound discriminator. In this latter case the sound discriminator must first have been aligned to exact frequency. Either method of adjustment will produce the same results. The method used will depend upon the type of test equipment available.

Regardless of which method of oscillator alignment is used, the frequency standard must be crystal controlled or calibrated. If the receiver oscillator is to be adjusted by the heterodyne frequency meter method, the calibration frequency listed under R-F Osc. Freq. must be available.

If the receiver oscillator is adjusted by feeding in the r-f sound carrier frequency, the frequencies listed under Sound Carrier Freq. must be available.

Channel Number	Receiver R-F Osc. Freq. Mc.	R-F Sound Carrier Freq. Mc.	Channel Oscillator Adjustment
2	81	59.75	L24
3	87	65.75	L23
4	93	71.75	L22
5	103	81.75	L21
6	109	87.75	L31
7	201	179.75	L19
8	207	185.75	L18
9	213	191.75	L17
10	219	197.75	L16
11	225	203.75	L15
12	231	209.75	L14
13	237	215.75	C6

If the heterodyne frequency meter method is used, couple the meter probe loosely to the receiver oscillator.

If the r-f sound carrier method is used, connect the "VoltOhmyst" to the sound discriminator output (junction of C183 and R203) and connect the signal generator to the receiver antenna terminals. The order of alignment remains the same regardless of which method is used.

If the r-f unit is removed from the receiver for service and is aligned separately, the shield over the bottom of the r-f unit must be in place when making adjustments.

Since lower frequencies are obtained by adding steps of inductance, it is necessary to align channel 13 first and continue in reverse numerical order.

Set the receiver channel switch to 13.

Adjust the frequency standard to the correct frequency (237 mc. for heterodyne frequency meter or 215.75 mc. for the signal generator).

Set the fine tuning control to the middle of its range while making the adjustment.

Adjust C6 for an audible beat on the heterodyne frequency meter or zero voltage from sound discriminator. Oscillator adjustments L1 and L2 shown on the schematic are factory control adjustments and should not be touched in the field.

Switch the receiver to channel 12.

Set the frequency standard to the proper frequency as listed in the alignment table.

Adjust L14 for indications as above.

Adjust the oscillator to frequency on all channels by switching the receiver and the frequency standard to each channel and adjusting the appropriate oscillator trimmer for the speci-

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fied indication. It should be possible to adjust the oscillator to the correct frequency on all channels with the fine tuning control in the middle third of its range.

After the oscillator has been set on all channels, start back at channel 13 and recheck to make sure that all adjustments are correct.

AGC THRESHOLD ADJUSTMENT.—The AGC threshold adjustment can be made by the method outlined in the Installation Instructions. However, a more accurate adjustment can be obtained by the use of an oscilloscope.

Tune in a station and advance the picture control to the maximum clockwise position. Connect the low capacity probe from the oscilloscope to the plate of the first video amplifier, pin 1 of V106. Adjust the oscilloscope to observe the horizontal sync pulse.

Turn the AGC threshold control R138 fully clockwise, then slowly counter-clockwise. As the control is turned counter-clockwise, the receiver gain will increase slowly, increasing the size of the pattern on the oscilloscope. R138 should be turned counter-clockwise until the receiver begins to overload as indicated by clipping of the sync. The control should be left in the maximum gain position in which no clipping of sync is observed. See Figure 18 for proper waveforms.

HORIZONTAL OSCILLATOR ADJUSTMENT.—Normally, the adjustment of the horizontal oscillator is not considered to be a part of the alignment procedure, but since the oscillator waveform adjustment requires the use of an oscilloscope, it can not be done conveniently in the field. The waveform adjustment is made at the factory and normally should not require readjustment in the field. However, the waveform adjustment should be checked whenever the receiver is aligned or whenever the horizontal oscillator operation is improper.

Horizontal Frequency Adjustment.—With a clip lead, short circuit the coil between terminals C and D of the horizontal oscillator transformer T109. Tune in a television station and sync the picture if possible.

A.—Turn the horizontal hold control R173 to the extreme clockwise position. Adjust the T109 Frequency Adjustment (under the chassis) so that the picture is just out of sync and the horizontal blanking appears in the picture as a vertical bar. The position of the bar is unimportant.

B.—Turn the hold control approximately one quarter of a turn from the extreme clockwise position and examine the width and linearity of the picture. If picture width or linearity is incorrect, adjust the horizontal drive control C153B, the width controls, and the linearity control L111 as outlined on page 4 until the picture is correct. If C153B was adjusted, repeat step A above.

Horizontal Locking Range Adjustment.—Turn the horizontal hold control fully counter-clockwise. Momentarily remove the signal by switching off channel then back. Slowly turn the horizontal hold control clockwise and note the least number of diagonal bars obtained just before the picture pulls into sync.

If more than 9 bars are present just before the picture pulls into sync, adjust the horizontal locking range trimmer C153A slightly clockwise. If less than 7 bars are present, adjust C153A slightly counter-clockwise. Turn the horizontal hold control counter-clockwise, momentarily remove the signal and recheck the number of bars present at the pull-in point. Repeat the procedure until 7 to 9 bars are present.

Horizontal Oscillator Waveform Adjustment.—Remove the shorting clip from terminals C and D of T109. Turn the horizontal hold control to the extreme clockwise position. With a thin fibre screwdriver, adjust the Oscillator Waveform Adjustment Core of T109 (on the outside of the chassis) until the horizontal blanking bar appears in the raster.

ALIGNMENT PROCEDURE

A.—Connect the low capacity probe of an oscilloscope to terminal C of T109. Turn the horizontal hold control one quarter turn from the clockwise position so that the picture is in sync. The pattern on the oscilloscope should be as shown in Figure 19. Adjust the Oscillator Waveform Adjustment Core of T109 until the two peaks are at the same height. During this adjustment, the picture must be kept in sync by readjusting the hold control if necessary.

This adjustment is very important for correct operation of the circuit. If the broad peak of the wave on the oscilloscope is lower than the sharp peak, the noise immunity becomes poorer, the stabilizing effect of the tuned circuit is reduced and drift of the oscillator becomes more serious. On the other hand, if the broad peak is higher than the sharp peak, the oscillator is overstabilized, the pull-in range becomes inadequate and the broad peak can cause double triggering of the oscillator when the hold control approaches the clockwise position.

Remove the oscilloscope upon completion of this adjustment.

Check of Horizontal Oscillator Adjustments.—Set the horizontal hold control to the full counter-clockwise position. Momentarily remove the signal by switching off channel then back. Slowly turn the horizontal hold control clockwise and note the least number of diagonal bars obtained just before the picture pulls into sync.

If more than 3 bars are present just before the picture pulls into sync, adjust the horizontal locking range trimmer C153A slightly clockwise. If less than 3 bars are present, adjust C153A slightly counter-clockwise. Turn the horizontal hold control counter-clockwise, momentarily remove the signal and recheck the number of bars present at the pull-in point. Repeat this procedure until 3 bars are present.

Turn the horizontal hold control to the maximum clockwise position. The picture should be just out of sync to the extent that the horizontal blanking bar appears as a single vertical or diagonal bar in the picture. Adjust the T109 Frequency Adjustment until this condition is fulfilled.

4.5 MC VIDEO TRAP.—With a strong input from a station, detune the receiver from the correct fine tuning point. With a very short clip lead, short the trap winding of T103. Observe the picture for the appearance of a 4.5 mc. beat. If the beat appears in the picture, adjust L110 until the beat is eliminated.

SENSITIVITY CHECK.—A comparative sensitivity check can be made by operating the receiver on a weak signal from a television station and comparing the picture and sound obtained to that obtained on other receivers under the same conditions.

This weak signal can be obtained by connecting the shop antenna to the receiver through a ladder type attenuator pad. The number of stages in the pad depends upon the signal strength available at the antenna. A sufficient number of stages should be inserted so that a somewhat less than normal contrast picture is obtained when the picture control is at the maximum clockwise position. Only carbon type resistors should be used to construct the pad.

RESPONSE CURVES.—The response curves shown on page 14 and referred to throughout the alignment procedure were taken from a production set. Although these curves are typical, variations can be expected.

The response curves are shown in the classical manner of presentation, that is with "response up" and low frequency to the left. The manner in which they will be seen in a given test set-up will depend upon the characteristics of the oscilloscope and the sweep generator. The curves may be seen inverted and/or switched from left to right depending on the deflection polarity of the oscilloscope and the phasing of the sweep generator.

ALIGNMENT TABLE.—Both methods of oscillator alignment are presented in the alignment table. The service technician may thereby choose the method to suit his test equipment.

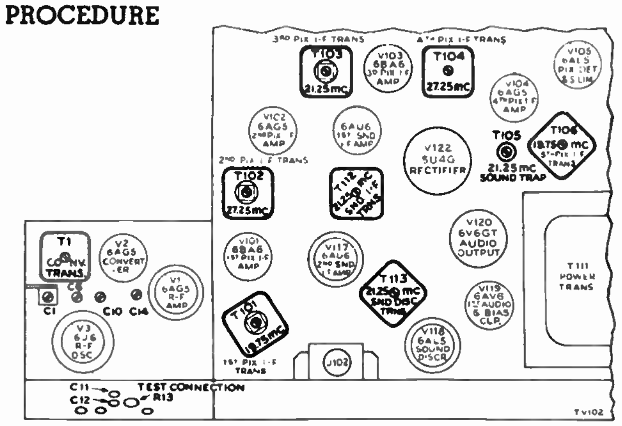


Figure 9—Top Chassis Adjustments

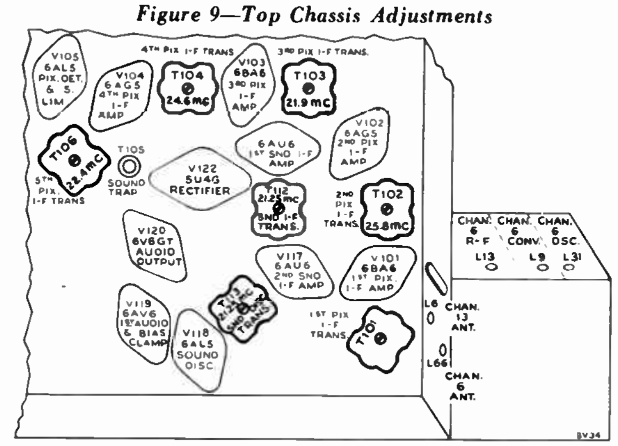


Figure 10—Bottom Chassis Adjustments

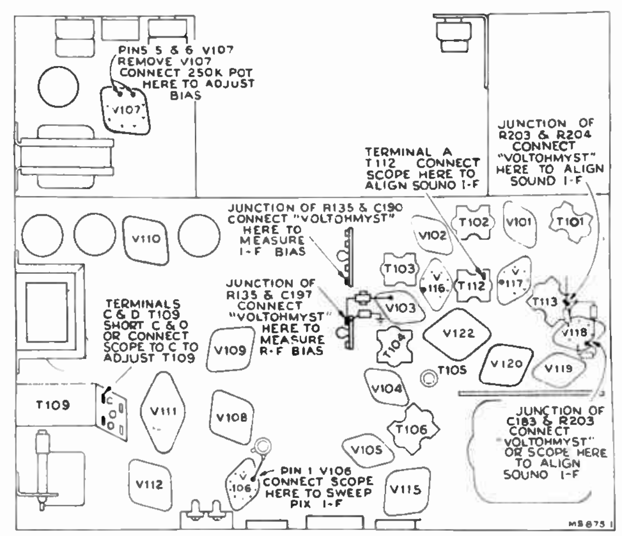
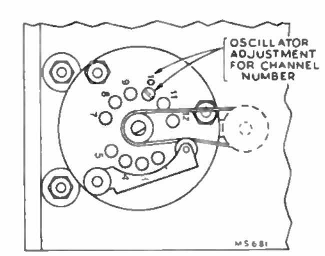


Figure 11—Test Connection Points



OSCILLATOR ADJUSTMENT FOR CHANNEL 13 IS ON TOP OF R-F UNIT AND CHANNEL 6 IS ON SIDE.

Figure 12—R-F Oscillator Adjustments

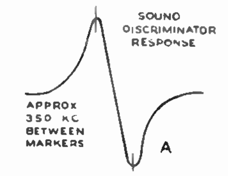


Figure 13 Discriminator Response

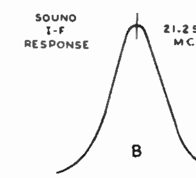


Figure 14 Sound I-F Response

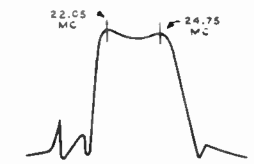


Figure 15 T1 and T101 Response

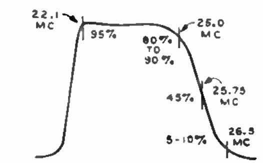


Figure 16 Overall I-F R-F Response

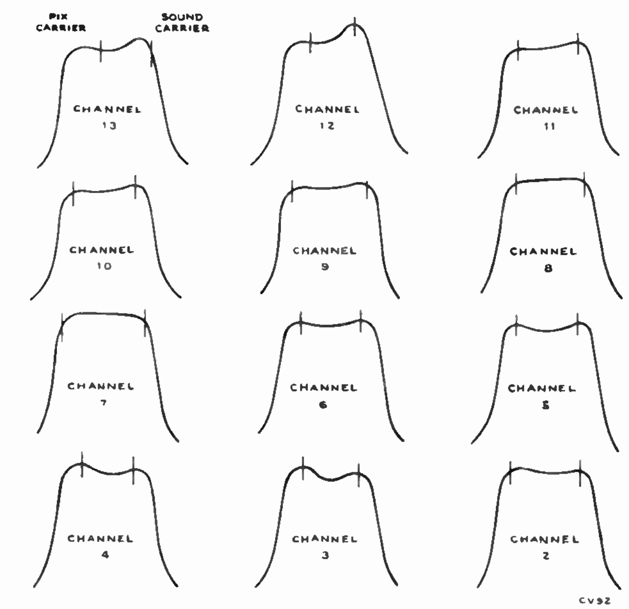


Figure 17—R-F Response

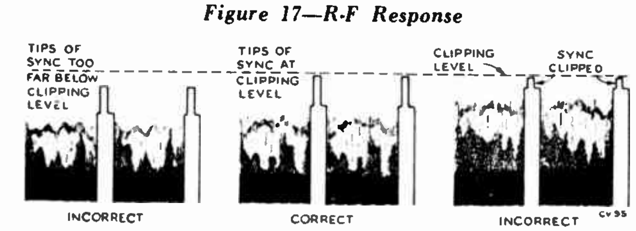


Figure 18—AGC Threshold Adjustment Waveforms

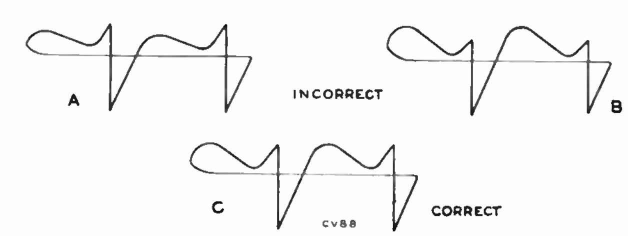


Figure 19—Horizontal Oscillator Waveforms

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ALIGNMENT TABLE

THE DETAILED ALIGNMENT PROCEDURE BEGINNING ON PAGE 8 SHOULD BE READ BEFORE ALIGNMENT BY USE OF THE TABLE IS ATTEMPTED

STEP No.	CONNECT SIGNAL GENERATOR TO	SIGNAL GEN. FREQ. MC.	CONNECT SWEEP GENERATOR TO	SWEEP GEN. FREQ. MC.	CONNECT OSCILLOSCOPE TO	CONNECT "VOLTOHMYST" TO	MISCELLANEOUS CONNECTIONS AND INSTRUCTIONS	ADJUST	REFER TO
	DISCRIMINATOR AND SOUND I-F ALIGNMENT								
1	2nd sound i-f grid (pin 1, V117)	21.25 .1 volt output	Not used		Not used	In series with 1 meg. to junction of R203 & R204		Detune T113 (bot.) Adjust T113 (top) for max. on meter	Fig. 9 Fig. 10 Fig. 11
2	"	"	"		"	Junct. of C183 & R203	Meter on 3 volt scale	T113 (bottom) for zero on meter	Fig. 10 Fig. 11
3	"	"	2nd sound i-f grid (pin 1, V117)	21.25 center 1 mc. wide .1 v. out	Junction of C183 & R203	Not used	Check for symmetrical response waveform (positive & negative). If not equal, adjust T113 (top) until they are equal.		Fig. 11 Fig. 13
4	1st sound i-f grid (pin 1, V116)	21.25 reduced output	1st sound i-f grid	21.25 reduced output	Terminal A, T112 in series with a 33,000 ohm resistor	"	Sweep output reduced to provide .3 volt p-to-p on scope	T112 (top & bot.) for max. gain and symmetry at 21.25 mc.	Fig. 9 Fig. 10 Fig. 11 Fig. 14
	PICTURE I-F AND TRAP ADJUSTMENT								
5	Not used		Not used		Not used	Junction of R135 & C190	Remove V107. Connect potentiometer between pins 5 & 6 of V107 socket	Adjust pot. for meter reading of −12.0 volts	Fig. 11
6	Converter grid (pin 1, V2)	21.25	"		"	Across R119	Meter on 3 volt scale. Receiver between 2 and 13	T103 (top) for min. on meter	Fig. 9
7	"	21.25	"		"	"	"	T105 (top) for min.	"
8	"	27.25	"		"	"	"	T102 (top) for min.	"
9	"	27.25	"		"	"	"	T104 (top) for min.	"
10	"	19.75	"		"	"	"	T103 (top) for min.	"
11	"	19.75	"		"	"	"	T101 (top) for min.	"
12	"	22.5	"		"	"	"	T106 (bottom) for max. on meter	Fig. 10
13	"	24.6	"		"	"	"	T104 (bottom) for max.	"
14	"	22.0	"		"	"	"	T103 (bottom) for max.	"
15	"	25.9	"		"	"	"	T102 (bottom) for max.	"
16	"	22.05 24.75	Converter grid (Pin 1, V2)	Sweeping 20 to 30 mc.	Pin 1, V106	Junction of R135 & C190	Shunt 330 ohms across pri. T102, T103, T104, T106. Set bias −2 V. Set swp. gen. for 4 V. P-P on scope.	Adjust T1 (top) and T101 (bottom) for proper response	Fig. 9 Fig. 10 Fig. 15
17	"		"	"	"	"	Remove shunt resistors. Set bias to give 15 volts P to P on scope.	Adjust T1 (top), T101, T102, T103, T104, T108 (bot.) for proper resp.	Fig. 9 Fig. 10 Fig. 16
	ANTENNA, R-F AND CONVERTER LINE ALIGNMENT								
18	Antenna terminals	215.75	Not used		Not used	Junction of C183 & R203 for signal gen. method only	Fine tuning centered. Receiver on channel 13. Heterodyne meter coupled to oscillator if used.	C6 for zero on meter or beat on het. freq. meter	Fig. 9 Fig. 11
19						Junction of R135 & C197	Remove V101	Potentiometer for −3.5 volts on meter	Fig. 9 Fig. 11
20	Antenna terminal (loosely)	175.25 & 179.75	Antenna terminals (see text for precaution)	Sweeping channel 7	Test Connection R13	Not used	Receiver on channel 7	L6, C10, C11 & C14 for flat top response between markers. Markers above 90%.	Fig. 9 Fig. 10 Fig. 17 (7)
21	"	205.25 209.75	"	channel 12	"	"	Receiver on channel 12	L6 for max. response and min. slope of top of curve.	Fig. 9 Fig. 17 (12)
22	"	175.25 179.75	"	channel 7	"	"	Receiver on channel 7	Check to see that response is as above	Fig. 17 (7)
23	"	181.25 185.75	"	channel 8	"	"	Receiver on channel 8	"	Fig. 17 (8)
24	"	187.25 191.75	"	channel 9	"	"	Receiver on channel 9	"	Fig. 17 (9)
25	"	193.25 197.75	"	channel 10	"	"	Receiver on channel 10	"	Fig. 17 (10)

STEP No.	CONNECT SIGNAL GENERATOR TO	SIGNAL GEN. FREQ. MC.	CONNECT SWEEP GENERATOR TO	SWEEP GEN. FREQ. MC.	CONNECT OSCILLOSCOPE TO	CONNECT "VOLTOHMYST" TO	MISCELLANEOUS CONNECTIONS AND INSTRUCTIONS	ADJUST	REFER TO
	ANTENNA, R-F AND CONVERTER LINE ALIGNMENT (Cont'd)								
26	"	199.25 203.75	"	channel 11	"	"	Receiver on channel 11	"	Fig. 17 (11)
27	"	205.25 209.75	"	channel 12	"	"	Receiver on channel 12	"	Fig. 17 (12)
28	"	211.25 215.75	"	channel 13	"	"	Receiver on channel 13	"	Fig. 17 (13)
29	If the response on any channel (steps 22 through 28) is below 80% at either marker, switch to that channel and adjust L6, C10, C11 & C14 to pull response up on that channel. Then recheck steps 22 through 28.								
30	Antenna terminals (loosely)	83.25 87.75	Ant. terminals (see text for precaution)	Sweeping chan. 6	Test Connection R13	Not used	Receiver on channel 6	L9, L13, L66 & C12 for response as above	Fig. 17 (6)
31	"	77.25 81.75	"	channel 5	"	"	Receiver on channel 5	Check to see that response is as above	Fig. 17 (5)
32	"	67.25 71.75	"	channel 4	"	"	Receiver on channel 4	"	Fig. 17 (4)
33	"	61.25 65.75	"	channel 3	"	"	Receiver on channel 3	"	Fig. 17 (3)
34	"	55.25 59.75	"	channel 2	"	"	Receiver on channel 2	"	Fig. 17 (2)
35	If the response on any channel (steps 31 through 34) is below 80% at either marker, switch to that channel and adjust L9, L13, L66 & C12 to pull response up on that channel. Then recheck steps 30 through 34. Disconnect the bias pot. and replace V101 and V107.								

R-F OSCILLATOR ALIGNMENT

STEP No.	CONNECT SIGNAL GENERATOR TO	SIGNAL GEN. FREQ. MC.	CONNECT HETERODYNE FREQ. METER TO	HET. METER FREQ. MC.	CONNECT OSCILLOSCOPE TO	CONNECT "VOLTOHMYST" TO	MISCELLANEOUS CONNECTIONS AND INSTRUCTIONS	ADJUST	REFER TO
36	Antenna terminals	215.75	Loosely coupled to r-f osc.	237	Not used	Junction of C183 & R203 for sig. gen. method only	Fine tuning centered. Receiver on channel 13	C6 for zero on meter or beat on het. freq. meter	Fig. 9 Fig. 11
37	"	209.75	"	231	"	"	Rec. on chan. 12	L14 as above	Fig. 12
38	"	203.75	"	225	"	"	Rec. on chan. 11	L15 as above	"
39	"	197.75	"	219	"	"	Rec. on chan. 10	L16 as above	"
40	"	191.75	"	213	"	"	Rec. on chan. 9	L17 as above	"
41	"	185.75	"	207	"	"	Rec. on chan. 8	L18 as above	"
42	"	179.75	"	201	"	"	Rec. on chan. 7	L19 as above	"
43	"	87.75	"	109	"	"	Rec. on chan. 6	L31 as above	Fig. 10
44	"	81.75	"	103	"	"	Rec. on chan. 5	L21 as above	Fig. 12
45	"	71.75	"	93	"	"	Rec. on chan. 4	L22 as above	"
46	"	65.75	"	87	"	"	Rec. on chan. 3	L23 as above	"
47	"	59.75	"	81	"	"	Rec. on chan. 2	L24 as above	"
48	Repeat steps 36 through 47 as a check.								
	AGC THRESHOLD ADJUSTMENT								
49	Not used		Not used		Pin 1, V106	Not used	Tune in station, turn pix control clockwise. Adjust R138 for max. gain without clipping sync on scope.		Fig. 11 Fig. 18
	HORIZONTAL OSCILLATOR ADJUSTMENT								
50	Short circuit terminals C and D of T109. Tune in a station.								
51	Turn hold control fully clockwise. Adjust T109 Frequency Adjustment until horizontal blanking bar appears in the picture.								
52	Turn hold control ¼ turn from clockwise to sync picture. Adjust width controls as outlined on page 4, linearity (L111) and drive (C153B) controls until picture is correct. Repeat step 51.								
53	Turn hold control fully counter-clockwise. Momentarily remove signal. Turn hold control slowly clockwise. Note least number of bars before pull-in. Adjust Locking Control (C153A) for 7 to 9 bar pull-in.								
54	Remove clip from terminals C and D of T109. Turn hold control fully clockwise. Adjust T109 Oscillator Waveform Adjustment until horizontal blanking bar appears in picture.								
55	Connect low capacity probe of oscilloscope to terminal C of T109. Turn hold control ¼ turn from clockwise. Adjust T109 Oscillator Waveform Adjustment until broad and sharp peaks of wave on oscilloscope are same height. Keep picture in sync with hold control during adjustment. Remove oscilloscope.								
56	Turn hold control fully counter-clockwise. Momentarily remove signal. Turn hold control slowly clockwise. Note least number of bars before pull-in. Adjust Locking Range Control (C153A) for 3 bar pull-in.								
57	Turn hold control fully clockwise. Adjust T109 Freq. Adjustment until horizontal blanking appears as single vertical or diagonal bar in pix.								
	4.5 MC VIDEO TRAP ADJUSTMENT								
58	Tune in a strong station. Short T103 trap. If a 4.5 mc. beat appears in picture adjust 4.5 mc. trap (L110) until beat is eliminated.								
	SENSITIVITY CHECK								
59	Connect antenna to receiver through attenuator pad to provide weak signal. Compare the picture and sound obtained to that obtained on other receivers under the same conditions.								

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RADIO ALIGNMENT PROCEDURE

If any lead dressing is necessary, it should be done before aligning the receiver. When making a complete alignment follow the table below in sequence. If only a portion of the circuit is to be aligned select the portion required and follow with the remaining steps in the section. Any adjustments made on the 455 kc. I-F's make it necessary to adjust the 10.7 mc. I-F's.

"AM" R-F—I-F ALIGNMENT

Test-Oscillator.—For all alignment operations, connect low side of the test-osc. to the receiver chassis, and keep the osc. output as low as possible to avoid a-v-c action. **Output Meter.**—Connect the meter across the speaker voice coil, and turn the receiver volume control to max.

Steps	Connect the High Side of the Test. Osc. to—	Tune Test Osc. to—	Function Switch	Turn Radio Dial to—	Adjust the following
1	Antenna terminal in series with .01 mfd.	455 kc. Modulated	AM	Low Freq. end of Dial	†Top and bot. cores of T301 and T302. (For max. voltage across voice coil.)
2	Ant. terminal through dummy ant. of 200 mmfs.	1,620 kc.	AM	Min. capacity	Osc. C308 for maximum output.
3		1,400 kc.	AM	Tune to signal	Ant. C304 for maximum output.
4		600 kc.	AM	600 kc.	Osc. L306 and Ant. L303.
5	Repeat steps 2, 3 and 4 for maximum output.				

† Use alternate loading. Connect an 18,000-ohm resistor across the primary to load the plate winding while the grid winding of the same transformer is being peaked. Then load the grid winding with the 18,000-ohm resistor while the plate winding is being peaked.

RATIO DETECTOR ALIGNMENT

Connect probe of "VoltOhmyst" to negative side of C328 and low side to chassis. Connect output meter across speaker voice coil.

Steps	Connect the High side of the Test. Osc. to—	Tune Test Osc. to—	Function Switch	Radio Dial Tuned to—	Adjust
6	Pin No. 1 of 6AU6 (V303) in series with .01 mfd.	10.7 mc. 30% AM Modulated	FM	———	Top of T303 for maximum DC on "VoltOhmyst."
7	Pin No. 1 of 6AU6 (V303) in series with .01 mfd.		FM	———	Bottom of T303 for minimum audio output on meter.
8	Repeat steps 6 and 7 as necessary making final adjustment with r-f input level set to give approximately −3.0 volts d-c on "VoltOhmyst."				

"FM" R-F—I-F ALIGNMENT

Steps	Connect the High Side of the Test. Osc. to—	Tune Test Osc. to—	Function Switch	Radio Dial Tuned to—	Adjust
9	Terminal 3 of S301-2 rear through 270 ohms.	10.7 mc.	FM	88 mc.	*T301 and T302 for max. with r-f input set to give −3 volts on "VoltOhmyst."
10	Terminal 3 of S301-2 rear through 270 ohms.	106 mc	FM	106 mc.	Set C302 to max. capacity. Squeeze L307 and adjust C302 for maximum.
11	Terminal 3 of S301-2 rear through 270 ohms.	90 mc.	FM	Tune to signal	Squeeze L301 and rock gang for maximum output.
12	Repeat steps 10 and 11 as required.				

* Use a 680-ohm resistor to load the plate winding while the grid winding of the same transformer is being peaked. Then the grid winding is loaded with 680-ohm resistor while the plate winding is being peaked.

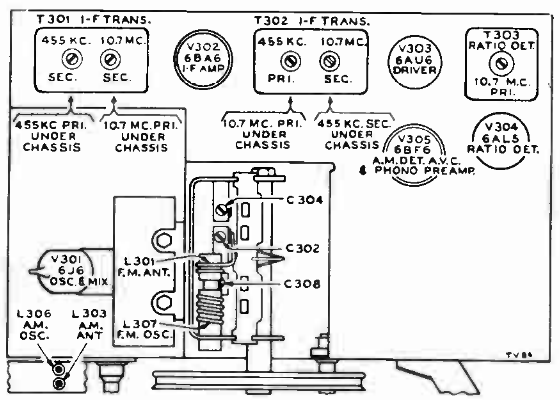

Figure 20—Chassis, Top View, Showing Adjustments

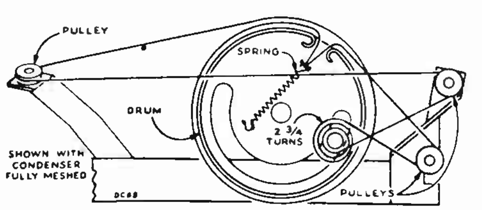

Figure 21—Dial and Drive Cord Assembly

CRITICAL LEAD DRESS:

1. Ground lead on pin 2 of V302 and V303 should be dressed down flat on chassis.
2. Dual .005 mfd. capacitors and diode filter should be dressed to clear the bottom of the cabinet.
3. Dress C329 across V302 sockets with short and direct leads.
4. Dress V302 plate lead from pin 5 down to the chassis.
5. Dress AVC lead from R321 to switch down to chassis and against back of gang mounting plate.
6. Dress lead from pin 6 of V305 down to chassis and against back of gang mounting plate.
7. Dress AVC lead from 1st I-F to switch against chassis and against gang mounting plate.
8. Dress lead from switch to pin 1 of V301 against plate supporting gang.
9. Dress all insulated F-M leads down to chassis.
10. Connect C309 with short lead to pin 6 of V301 keeping body of cap away from plate lead and switch terminals.
11. The coupling between L301 and L307 should be adjusted to give proper injection voltage to the mixer grid. This has been found to be correct when the distance between adjacent end turns is 3/8" to 7/16" measured at top of the form.
12. Dress cabled leads away from antenna transmission lines.
13. Dress all uninsulated bus wire so as to avoid short circuits.

SERVICE SUGGESTIONS

Following is a list of symptoms of possible failures and an indication of some of the possible faults:

NO RASTER ON KINESCOPE:

(1) Incorrect adjustment of ion trap magnet. Magnets reversed either front to back or top to bottom; front magnet incorrectly oriented.

(2) V112 or V113 inoperative. Check waveforms on grids and plates.

(3) No high voltage—If horizontal deflection is operating as evidenced by the correct waveform on terminal 4 of horizontal output transformer, the trouble can be isolated to the 8016 circuit. Either the T110 high voltage winding is open, the 8016 tube is defective, its filament circuit is open, C168 is shorted, or R187 or R189 are open.

(4) V111 circuit inoperative—Refer to schematic and waveform chart.

(5) Damper tube (V114) inoperative.

(6) Defective kinescope.

(7) R131 open.

(8) No receiver plate voltage—filter capacitor shorted—bleeder or filter choke open.

NO VERTICAL DEFLECTION:

(1) V107B or V110 inoperative. Check voltage and waveforms on grids and plates.

(2) T107 or T108 open.

(3) Vertical deflection coils open.

SMALL RASTER:

(1) Low Plus B or low line voltage.

(2) V112 defective.

POOR VERTICAL LINEARITY:

(1) If adjustments cannot correct, change V110.

(2) Vertical output transformer defective.

(3) V107B defective—check voltage and waveforms on grid and plate.

(4) C150, R164, C147B or C148-C defective.

(5) Low bias or plate voltage—check rectifiers and capacitors in supply circuits.

POOR HORIZONTAL LINEARITY:

(1) If adjustments do not correct, change V112 or V114.

(2) T110 or L111 defective.

(3) C164 or C165 defective.

WRINKLES ON LEFT SIDE OF RASTER:

(1) R166, R167 or C169 defective.

(2) Defective yoke.

PICTURE OUT OF SYNC HORIZONTALLY:

(1) T109 incorrectly tuned.

(2) R172, R173 or R174 defective.

TRAPEZOIDAL OR NON-SYMMETRICAL RASTER:

(1) Improper adjustment of focus coil or ion trap magnet.

(2) Defective yoke.

RASTER AND SIGNAL ON KINESCOPE BUT NO SOUND:

(1) R-F oscillator off frequency.

(2) Sound i-f, discriminator or audio amplifier inoperative—check V116, V117, V118, V119, V120 and their socket voltages.

(3) T114 or C186 defective.

(4) Speaker defective.

SIGNAL AT KINESCOPE GRID BUT NO SYNC:

(1) AGC threshold control R138 misadjusted.

(2) V105B, V107A, V108 or V109 inoperative. Check voltage and waveforms at their grids and plates.

SIGNAL ON KINESCOPE GRID BUT NO VERTICAL SYNC:

(1) Check V107B and associated circuit—C145, T107, etc.

(2) Integrating network inoperative—Check.

(3) R154, R155, R157, R158 or R159 defective.

SIGNAL ON KINESCOPE GRID BUT NO HORIZONTAL SYNC:

(1) T109 misadjusted—readjust as instructed on page 11.

(2) V111 inoperative—check socket voltage and waveforms.

(3) T109 defective.

(4) C140, C153A, C154, C155, C156, C157 or C166 defective.

(5) If horizontal speed is completely off and cannot be adjusted check C158, C159, R172, R173, R174, R179 and R182.

SOUND AND RASTER BUT NO PICTURE OR SYNC:

(1) Picture i-f, detector or video amplifier inoperative—check V103, V104, V105 and V106—check socket voltages.

(2) Bad contact to kinescope grid.

PICTURE STABLE BUT POOR RESOLUTION:

(1) V105A or V106 defective.

(2) Peaking coils defective—check for specified resistance.

(3) Make sure that the focus control operates on both sides of proper focus.

(4) R-F and I-F circuits misaligned.

PICTURE SMEAR:

(1) R-F or I-F circuits misaligned.

(2) Open peaking coil.

(3) This trouble can originate at the transmitter—check on another station.

PICTURE JITTER:

(1) AGC threshold control R138 misadjusted.

(2) If regular sections at the left picture are displaced change V112.

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SERVICE SUGGESTIONS

(3) Vertical instability may be due to loose connections or noise.

(4) Horizontal instability may be due to unstable transmitted sync.

RASTER BUT NO SOUND, PICTURE OR SYNC:

(1) Defective antenna or transmission line.

(2) R-F oscillator off frequency.

(3) R-F unit inoperative—check V1, V2, V3.

DARK VERTICAL LINE ON LEFT OF PICTURE:

(1) Reduce horizontal drive and readjust width and horizontal linearity.

(2) Replace V112.

LIGHT VERTICAL LINE ON LEFT OF PICTURE:

(1) C169 defective.

(2) V114 defective.

PICTURE I-F RESPONSE.—At times it may be desirable to observe the individual i-f stage response. This can be achieved by the following method:

Shunt all i-f transformers and coils with a 330-ohm carbon resistor except the one whose response is to be observed.

Connect a wide band sweep generator to the converter grid and adjust it to sweep from 18 mc. to 30 mc.

Connect the oscilloscope across the picture detector load resistor and observe the overall response. The response obtained will be essentially that of the unshunted stage. The effects of the various traps are also visible on the stage response.

Figures 22 through 26 show the responses of the various stages obtained in the above manner. The curves shown are typical although some variation between receivers can be expected. Relative stage gain is not shown.

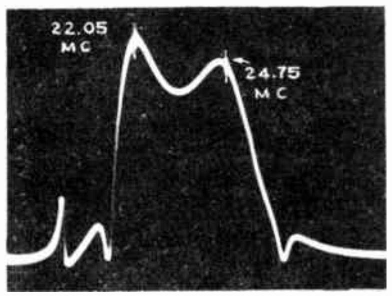

Figure 22—Response of Converter and First Pix I-F Transformer

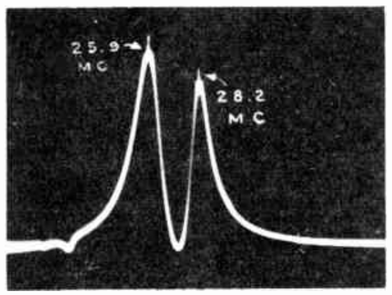

Figure 23—Response of Second Pix I-F Transformer

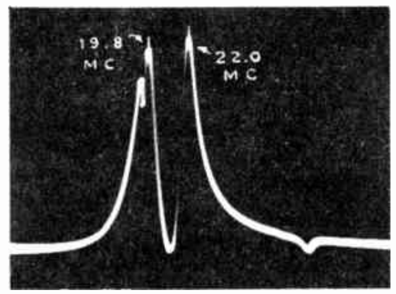

Figure 24—Response of Third Pix I-F Transformer

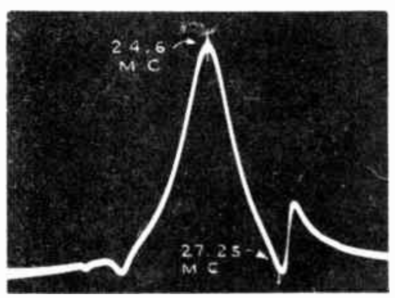

Figure 25—Response of Fourth Pix I-F Transformer

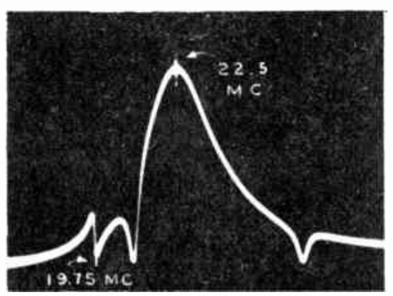

Figure 26—Response of Fifth Pix I-F Transformer

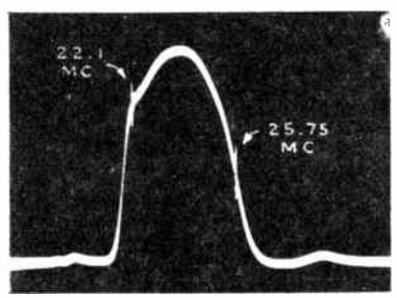

Figure 27—Response from First Pix I-F grid to Pix Det.

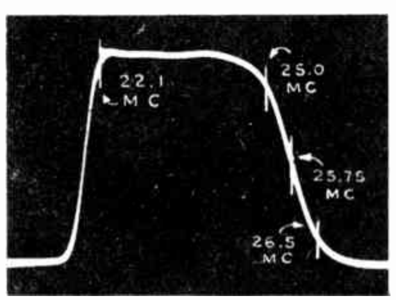

Figure 28—Overall Pix I-F Response

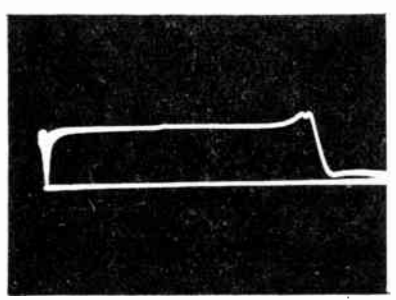
Figure 29—Video Response at Average Contrast

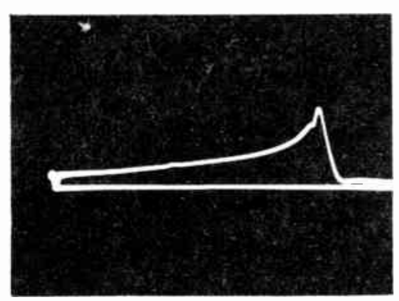
Figure 30—Video Response at Minimum Contrast

WAVEFORM PHOTOGRAPHS

Video Signal Input to 1st Video Amplifier (Pin 2 of V106) (12AU7)

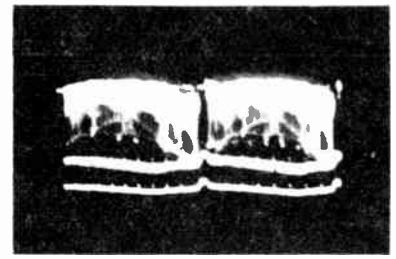
Figure 31—Vertical (Oscilloscope Synced to ½ of Vertical Sweep Rate) (5.4 Volts PP)

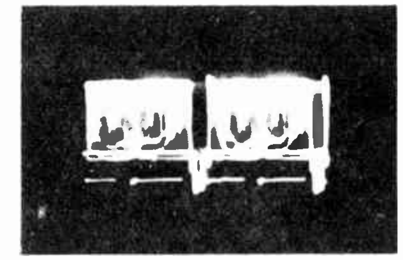
Figure 32—Horizontal (Oscilloscope Synced to ½ of Horizontal Sweep Rate) (5.4 Volts PP)

Sync Feed (Junction of L104, R219 and C194)

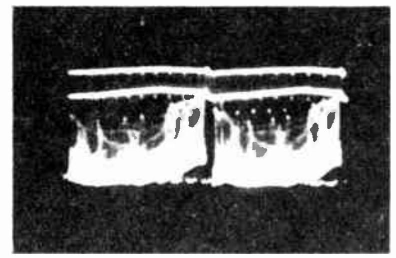
Figure 33—Vertical (28 Volts PP)

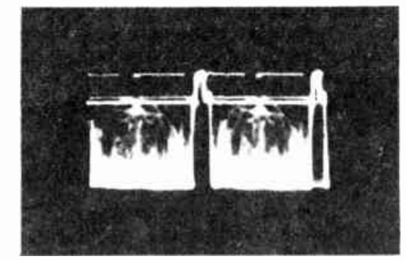
Figure 34—Horizontal (28 Volts PP)

Input to 2nd Video Amplifier (Pin 7 of V106) (12AU7)

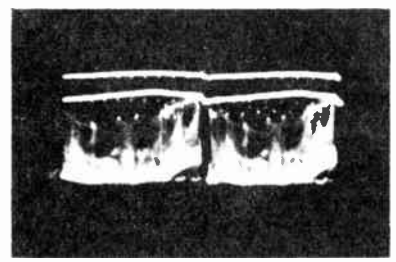
Figure 35—Vertical (17 Volts PP)

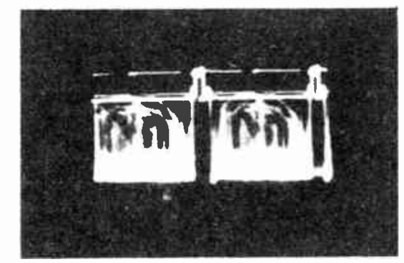
Figure 36—Horizontal (17 Volts PP)

Output of 2nd Video Amplifier (Junction of L105 and R127) (Picture Max.)

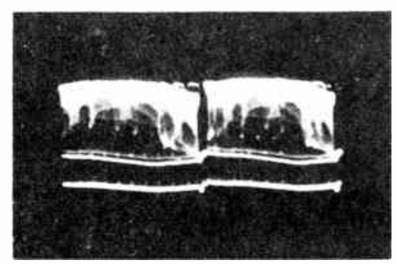
Figure 37—Vertical (96 Volts PP)

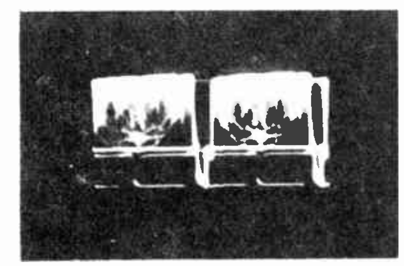
Figure 38—Horizontal (96 Volts PP)

Input to Kinescope (Junction of R127 and R128) (Picture Max.)

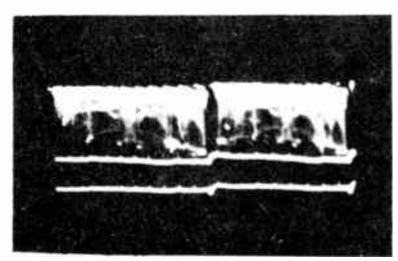
Figure 39—Vertical (65 Volts PP)

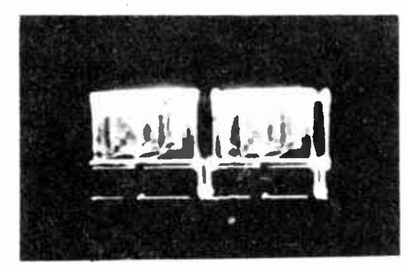
Figure 40—Horizontal (65 Volts PP)

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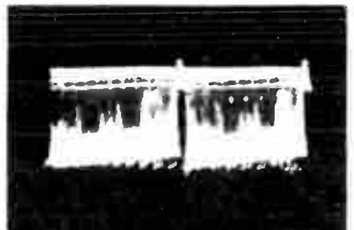
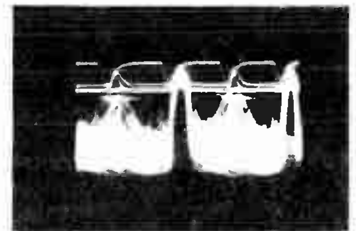
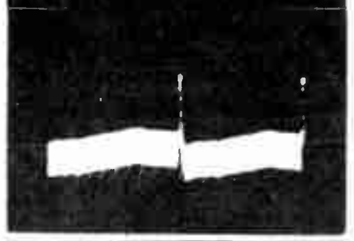


Input to 1st Sync Separator (Pin 1 of V108) (6SN7GT)

Figure 41—Vertical (25 Volts PP)

Figure 42—Horizontal (23 Volts PP)

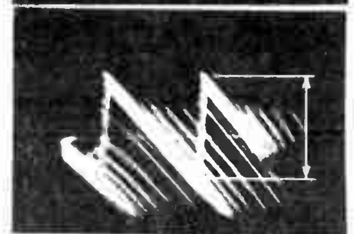


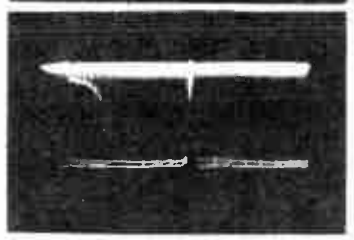


AGC Rectifier Cathode (Pin 6 of V108) (6SN7GT)

Figure 43—Vertical (4.7 Volts PP)

Figure 44—Horizontal (1.5 Volts PP)

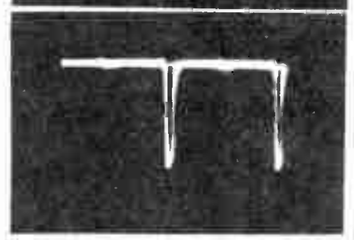


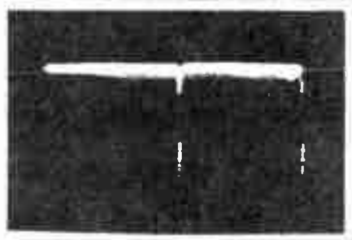


Output of AGC Rectifier (Pin 5 of V108) (6SN7GT)

Figure 45—Vertical (24 Volts PP)

Figure 46—Horizontal (24 Volts PP)

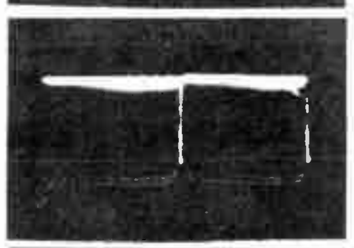




Output of 1st Sync Separator (Pin 2 of V108) (6SN7GT)

Figure 47—Vertical (26 Volts PP)

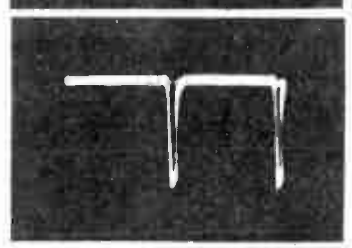
Figure 48—Horizontal (25.5 Volts PP)

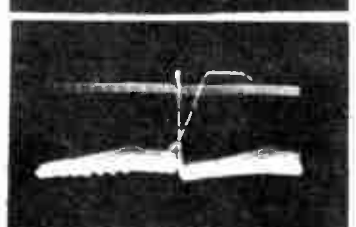


Input to Sync Amplifier (Junction of C137, C139 and R145)

Figure 49—Vertical (21 Volts PP)

Figure 50—Horizontal (21 Volts PP)

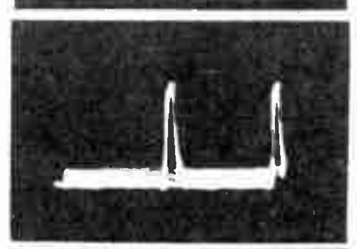


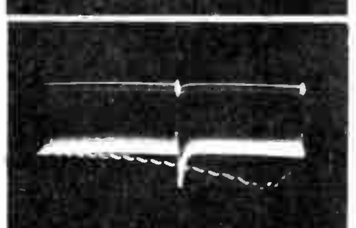


Output of Sync Amplifier (Pin 2 of V109) (6SN7GT)

Figure 51—Vertical (115 Volts PP)

Figure 52—Horizontal (105 Volts PP)

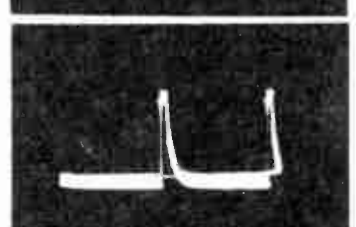




Cathode of 2nd Sync Separator (Pin 6 of V109 (6SN7GT)

Figure 53—Vertical (17 Volts PP)

Figure 54—Horizontal (11 Volts PP)



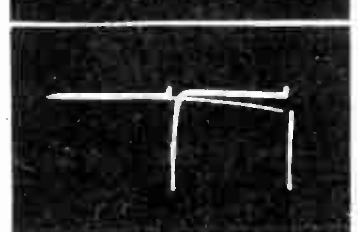
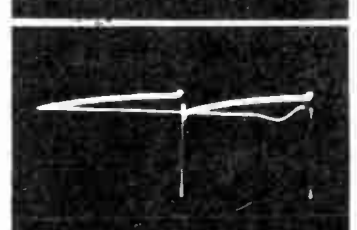


Figure 55—Output of Integrating Network (Junction of C144, C145 and R153) (45 Volts PP)

Figure 56—Grid of Vertical Oscillator (720 Volts PP) (Pin 1 of V107) (6SN7GT)



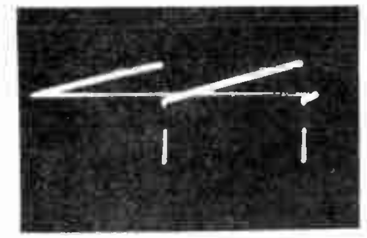
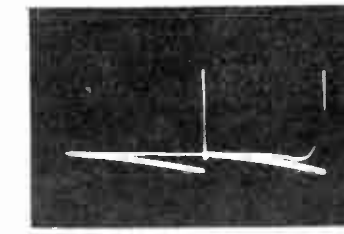


Figure 57—Grid of Vertical Output (160 Volts PP) (Pin 5 of V110) (6K6GT)

Figure 58—Plate of Vertical Output (750 Volts PP) (Pin 3 of V110) (6K6GT)



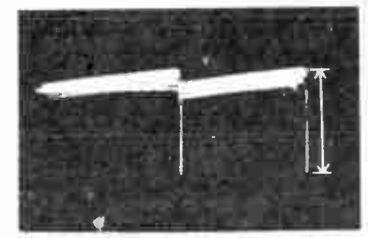
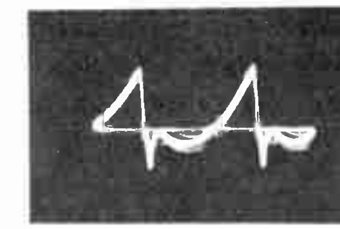


Figure 59—Input of Vertical Deflection Coils (75 Volts PP) (Junction of Green Lead of T108 and Green Lead of Yoke)

Figure 60—Input to Horizontal Oscillator (17.5 Volts PP) (Junction of C153A and C154)



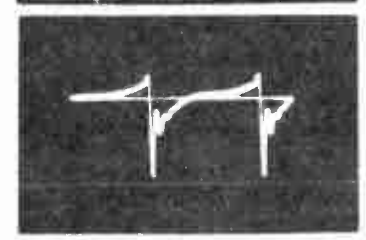
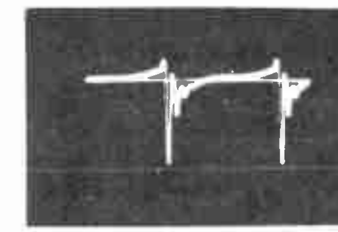


Figure 61—Junction of R168, R176 and R178 (150 Volts PP)

Figure 62—Grid of Horizontal Oscillator (480 Volts PP) (Pin 4 of V111) (6SN7GT)



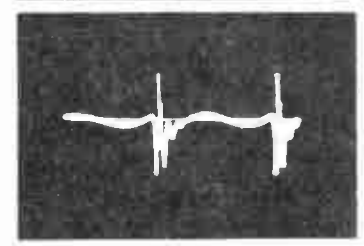
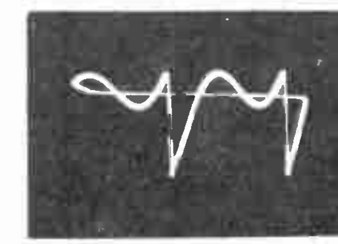


Figure 63—Plate of Horizontal Oscillator (270 Volts PP) (Pin 5 of V111) (6SN7GT)

Figure 64—Terminal "C" of T109 (70 Volts PP)



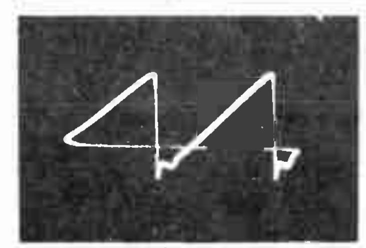
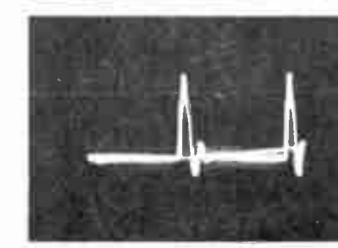


Figure 65—Input to Horizontal Output Tube (42 Volts PP) (Junction of C160, R183 and C153B)

Figure 66—Plate of Horizontal Output (Approx. 5,200 Volts PP) (Measured Through a Capacity Voltage Divider Connected from Top Cap of V112 to Ground)



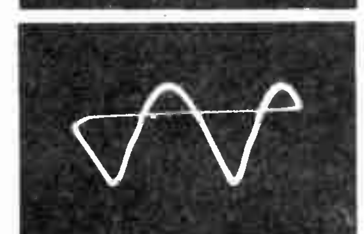
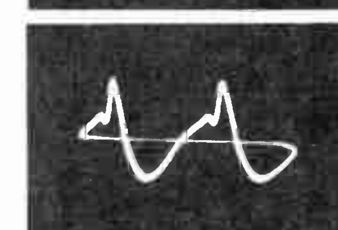


Figure 67—Junction of C164 and Terminal 1 of T110 (165 Volts PP)

Figure 68—Plate of Damper (125 Volts PP) (Pin 5 of V114) (6W4GT)



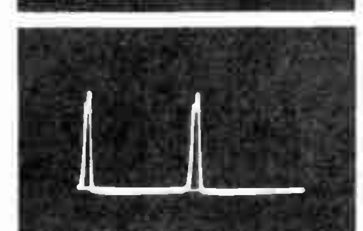
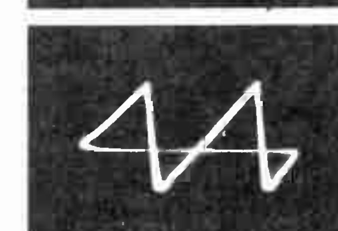


Figure 69—Input to Horizontal Deflection Coils (1,150 Volts PP)

Figure 70—Horizontal Deflection Coil Current (0.6 amp. PP) Measured by Inserting a 5-ohm Resistor in series with the yoke and observing the waveform across the resistor.



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VOLTAGE CHART

The following measurements represent two sets of conditions. In the first condition a 2200 microvolt test pattern signal was fed into the receiver, the picture was synced and the AGC threshold control was properly adjusted. The second condition was obtained by removing the antenna leads and short-circuiting the receiver antenna terminals. Voltages shown are as read with "Jr. VoltOhmyst" between the indicated terminal and chassis ground and with the receiver operating on 117 volts, 60 cycles a-c.

Tube No.	Tube Type	Function	Operating Condition	E. Plate		E. Screen		E. Cathode		E. Grid		I Plate (ma.)	I Screen (ma.)	Notes on Measurements
				Pin No.	Volts	Pin No.	Volts	Pin No.	Volts	Pin No.	Volts			
V1	6AG5	R-F Amplifier	2200 Mu. V. Signal	5	140	6	142	2 & 7	0	1	–2.4	.72	.33	
			No Signal	5	67	6	111	2 & 7	0	1	–.4	14.0	5.0	
V2	6AG5	Converter	2200 Mu. V. Signal	5	*130 to 140	6	*130 to 140	2 & 7	0	1	*–3.0 to –7.0	*7.1 to 7.7	*2.3 to 2.7	*Depending upon channel
			No Signal	5	*104 to 109	6	*104 to 109	2 & 7	0	1	*–2.0 to –6.0	*5.3 to 5.9	*.8 to 1.0	
V3	6J6	R-F Oscillator	2200 Mu. V. Signal	1 & 2	*88 to 95	—	—	7	.19	5 & 6	*–5.1 to –7.3	*1.9 to 2.7	—	*Depending upon channel
			No Signal	1 & 2	*68 to 81	—	—	7	.16	5 & 6	*–4.5 to –6.6	*1.8 to 2.1	—	
V101	6BA6	1st Pix. I-F Amplifier	2200 Mu. V. Signal	5	125	6	125	7	.4	1	–12.5	2.8	1.3	
			No Signal	5	95	6	95	7	1.1	1	+.3	7.5	3.5	
V102	6AG5	2d Pix. I-F Amplifier	2200 Mu. V. Signal	5	115	6	115	2 & 7	.75	1	0	8.2	2.5	
			No Signal	5	100	6	100	2 & 7	.65	1	0	6.8	2.1	
V103	6BA6	3d Pix I-F Amplifier	2200 Mu. V. Signal	5	110	6	135	7	.25	1	–2.4	4.0	3.8	
			No Signal	5	60	6	100	2 & 7	.75	1	–.4	11.0	4.8	
V104	6AG5	4th Pix. I-F Amplifier	2200 Mu. V. Signal	5	170	6	135	2 & 7	1.35	1	0	6.5	2.0	
			No Signal	5	175	6	120	2 & 7	1.2	1	0	5.9	1.8	
V105 A	6AL5	Picture 2d Det.	2200 Mu. V. Signal	7	–113	—	—	1	–112	—	—	.48	—	
			No Signal	7	–120	—	—	1	–120	—	—	—	—	
V105 B	6AL5	Sync Limiter	2200 Mu. V. Signal	2	–107	—	—	5	–56	—	—	—	—	
			No Signal	2	–80	—	—	5	–60	—	—	—	—	
V106	12AU7	1st Video Amplifier	2200 Mu. V. Signal	1	–23.2	—	—	3	–111	2	–113	4.38	—	
			No Signal	1	–19.2	—	—	3	–117	2	–120	3.82	—	
V106	12AU7	2d Video Amplifier	2200 Mu. V. Signal	6	*166	—	—	8	*–5.3	7	*–12.2	6.2	—	*At average contrast
			No Signal	6	*134	—	—	8	*–5.6	7	*–10.3	6.9	—	
V107 A	6SN7 GT	ACG Amplifier	2200 Mu. V. Signal	5	–12.6	—	—	6	–55.5	4	–56.5	.9	—	
			No Signal	5	+.3	—	—	6	–60	4	–64	.3	—	
V107 B	6SN7 GT	Vertical Oscillator	2200 Mu. V. Signal	2	76	—	—	3	–111	1	–158	.2	—	
			No Signal	2	62	—	—	3	–120	1	–169	.2	—	
V108	6SN7 GT	AGC Rectifier	2200 Mu. V. Signal	5	97	—	—	6	–3.4	4	–19.3	.3	—	
			No Signal	5	81	—	—	6	–8.7	4	–19.3	.28	—	
V108	6SN7 GT	1st Sync Separator	2200 Mu. V. Signal	2	96	—	—	3	–1.8	1	–19.5	.1	—	
			No Signal	2	81	—	—		–9.7	1	–19.3	.1	—	
V109	6SN7 GT	Sync Amplifier	2200 Mu. V. Signal	2	158	—	—	3	0	1	–4.7	5.25	—	
			No Signal	2	154	—	—	3	0	1	–5.2	3.75	—	

Tube No.	Tube Type	Function	Operating Condition	E. Plate		E. Cathode		E. Screen		E. Grid		I Plate (ma.)	I Screen (ma.)	Notes on Measurements
				Pin No.	Volts	Pin No.	Volts	Pin No.	Volts	Pin No.	Volts			
V109	6SN7 GT	Sync Separator	2200 Mu. V. Signal	5	230	—	—	6	–51	4	–106	.4	—	
			No Signal	5	215	—	—	6	–59	4	–80	.35	—	
V110	6K6–GT	Vertical Output	2200 Mu. V. Signal	3	223	4	223	8	–67	5	–91		*7.85	*Screen connected to plate
			No Signal	3	208	4	208	8	–79	5	–101		*7.7	
V111	6SN7 GT	Horizontal Osc. Control	2200 Mu. V. Signal	2	*48	—	—	3	–110	1	–92	.2	—	*Variation of hold gives –21.9 to +56 volts on plate
			No Signal	2	*33	—	—	3	–120	1	–108	.2	—	
V111	6SN7 GT	Horizontal Oscillator	2200 Mu. V. Signal	5	70	—	—	6	–111	4	–185	2.4	—	
			No Signal	5	54	—	—	6	–120	4	–192	2.4	—	
V112	6BG6G	Horizontal Output	2200 Mu. V. Signal	Cap	Do Not Meas.	8	180	3	–90	5	–110	68	–	
			No Signal	Cap	Do Not Meas.	8	170	3	–100	5	–115	67	—	
V113	1B3GT /8016	H. V. Rectifier	Brightness Min.	Cap	Do Not Meas.	—	—	2 & 7	9500	—	—	0	—	
			Brightness Average	Cap	Do Not Meas.	—	—	2 & 7	9000	—	—	.1	—	
V114	6W4GT	Damper	2200 Mu. V. Signal	5	Do Not Meas.	—	—	3	290	—	—	66	—	
			No Signal	5	Do Not Meas.	—	—	3	280	—	—	65	—	
V115 V122	5U4G	Rectifier	2200 Mu. V. Signal	4 & 6	335			2 & 6	250	—	—	210	—	*A-C measured from plate to trans. center tap
			No Signal	4 & 6	335			2 & 8	245	—	—	215	—	
V116	6AU6	1st Sound I-F Amplifier	2200 Mu. V. Signal	5	134	6	134	7	.9	1	0	8.2	3.3	
			No Signal	5	110	6	110	7	.7	1	0	5.7	2.6	
V117	6AU6	2nd Sound I-F Amplifier	2200 Mu. V. Signal	5	148	6	90	7	0	1	–9	1.6	.8	
			No Signal	5	115	6	60	7	0	1	–.65	3.35	1.15	
V118	6AL5	Sound Discrim.	2200 Mu. V Signal	2	–8.4	—	—	5	5.8	—	—	—	—	
			No Signal	2	–2.0	—	—	5	.41	—	—	—	—	
			2200 Mu. V. Signal	7	–3.7	—	—	1	0	—	—	—	—	
			No Signal	7	–1.08	—	—	1	0	—	—	—	—	
V119	6AV6	1st Audio Amplifier	2200 Mu. V. Signal	7	85	—	—	2	0	1	–.89	.49	—	
			No Signal	7	83	—	—	2	0	1	–.89	.4	—	
V120	6K6–GT	Audio Output	2200 Mu. V. Signal	3	102	4	113	8	–99	5	–108	19.3	3.3	
			No Signal	3	72	4	80	8	–111	5	–114	18	3	
V121	12LP4	Kinescope	2200 Mu. V. Signal	Cap	9000	10	339	11	51	2	20	.1	—	*Average Brightness
			No Signal	Cap	—	10	322	11	42	2	14	—	—	Average Brightness
V301	6J6	Mixer and Oscillator	No Signal	1 2	110 95	— —	— —	7	0	6 5	–2.0 –5.0	— —	—	Function switch in F-M position
V302	6BA6	Radio I-F Amplifier	No Signal	5	210	6	105	7	.8	1	–0.2	—	—	
V303	6AV6	Radio F-M Driver	No Signal	5	205	6	135	7	1.5	1	0	—	—	
V304	6AL5	Radio Radio Det.	No Signal	2 7	–0.2 –0.2	—	—	5 1	–0.2 –0.1	— —	— —	— —	— —	
V305	6BF6	Radio A-M Det.	No Signal	6 Diode	–0.2	—	—	2	0	—	—	—	—	

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TELEVISION CHASSIS WIRING DIAGRAM

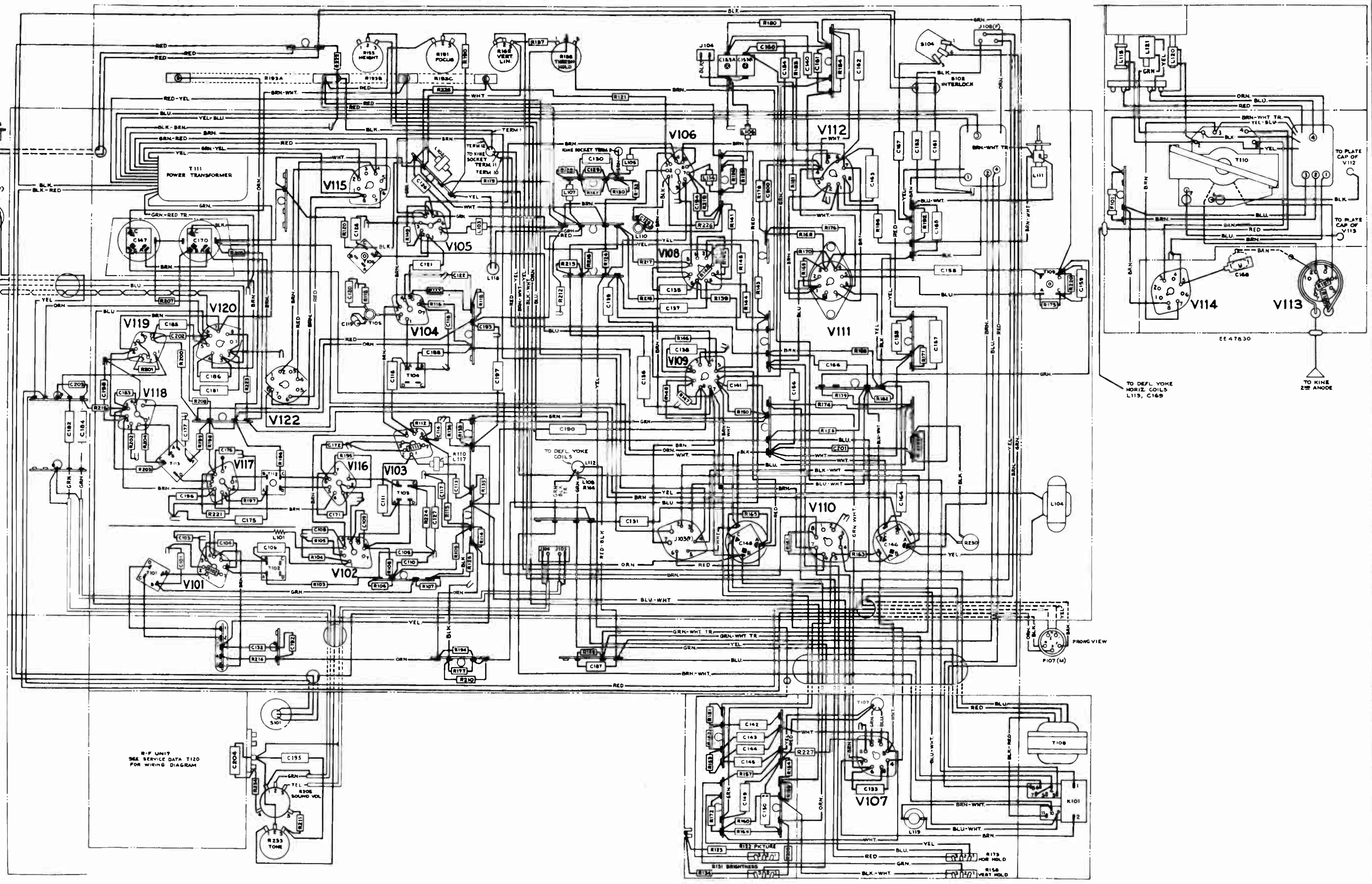

Figure 73—Chassis Wiring Diagram

MODEL TA129,
Ch. KCS41A-1

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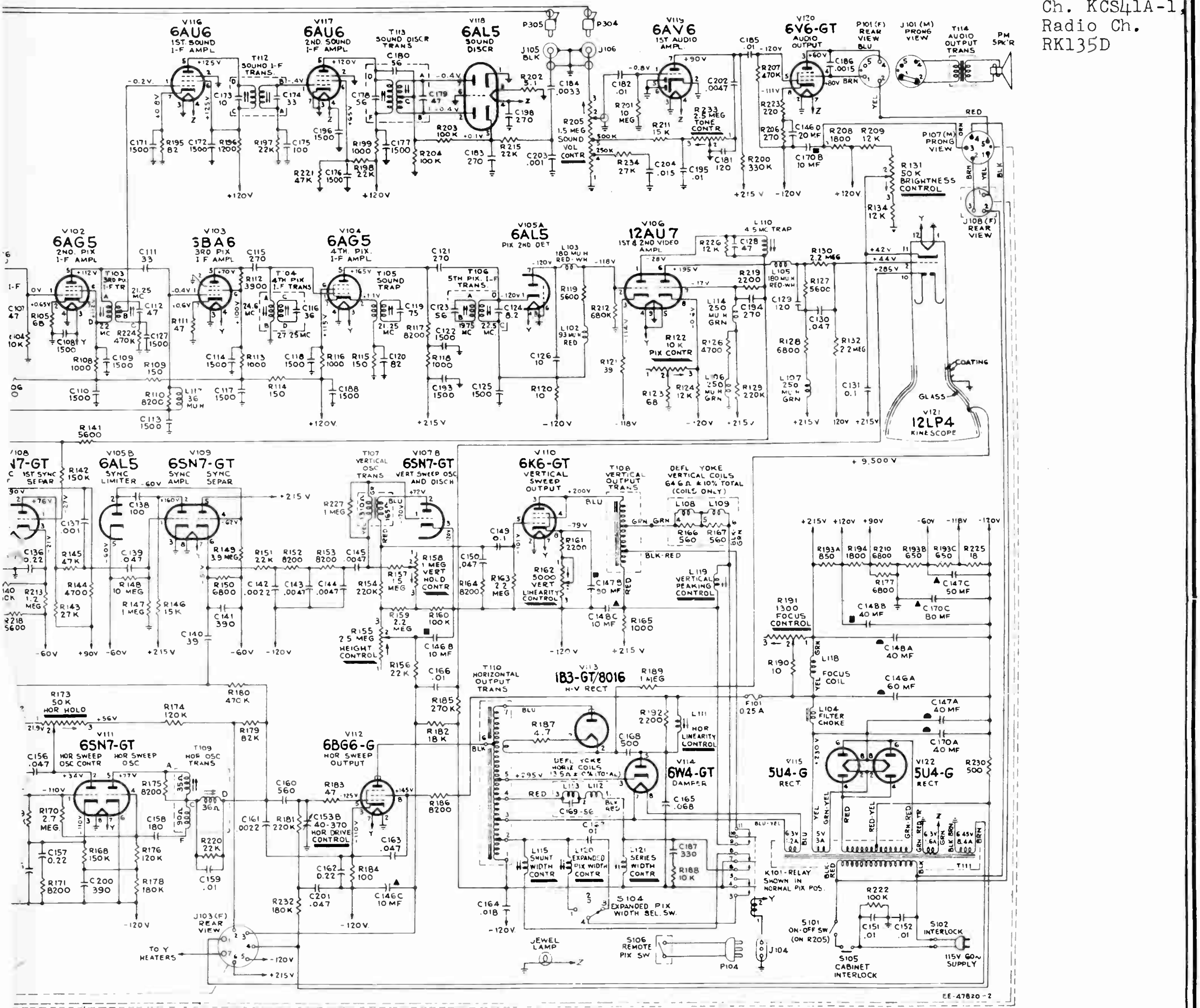
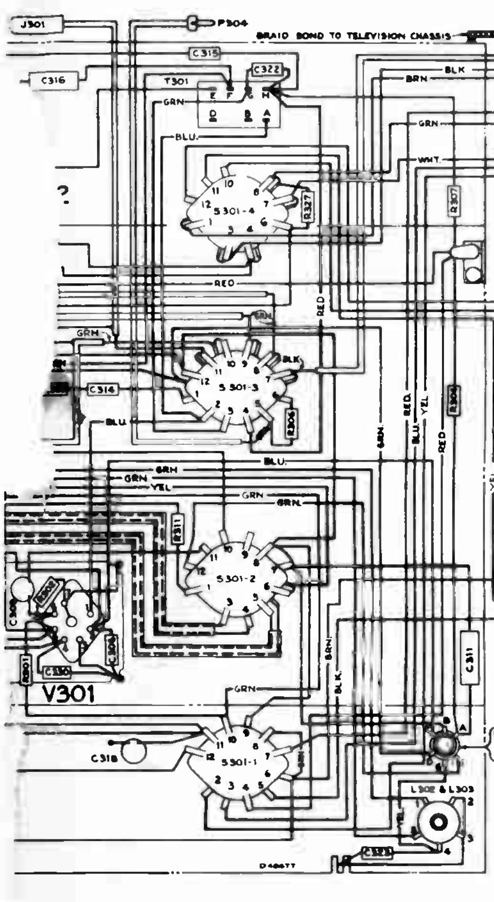
MODEL TA129,
Ch. KCS41A-1,
Radio Ch.
RK135D



RING DIAGRAM



iring Diagram (RK135D)

TELEVISION CRITICAL LEAD DRESS

1. The ground bus from pin 2 and the center shield of V117 socket should not be shortened or rerouted.
2. Do not change the dress of the filament leads or the by-pass capacitors in the picture or sound i-f circuits. The filament leads between V117, V118 and V119 should be down against the chassis and away from grid or plate leads.
3. If it is necessary to replace any of the 1500 mmf capacitors in the picture i-f circuit, the lead length must be kept as short as possible.
4. Picture i-f coupling capacitors C106, C111, C115 and C121 should be up and away from the chassis and should be clear of the pix i-f transformer adjustments by at least ¼ inch. If the dress of any of these capacitors is changed, the i-f alignment should be rechecked.
5. Leads to L102 and L103 must be as short as possible.
6. Dress peaking coils L105, L106 and L107 up and away from the chassis.
7. Dress C183 across tube pins 5 and 6 with leads not exceeding ⅜ inch.
8. Dress C129 and C130 up and away from the chassis.
9. Dress the yellow lead from the picture control away from the chassis and away from the volume-control leads. Dress the yellow lead from pin 8 of V106 away from the chassis.
10. Dress the green lead from pin 2 of V106 away from the chassis.
11. Dress R169, R169, R170, R176 and R178 up and away from the chassis.
12. The leads to the volume control should be dressed down against the chassis and away from V117 and V118.
13. Contact between the r-f oscillator frequency adjustment screws and the oscillator coils or channel switch eyelets must be avoided.
14. Dress leads from the width control coils away from the transformer frame.
15. Dress T110 winding leads as shown in Figure 72.

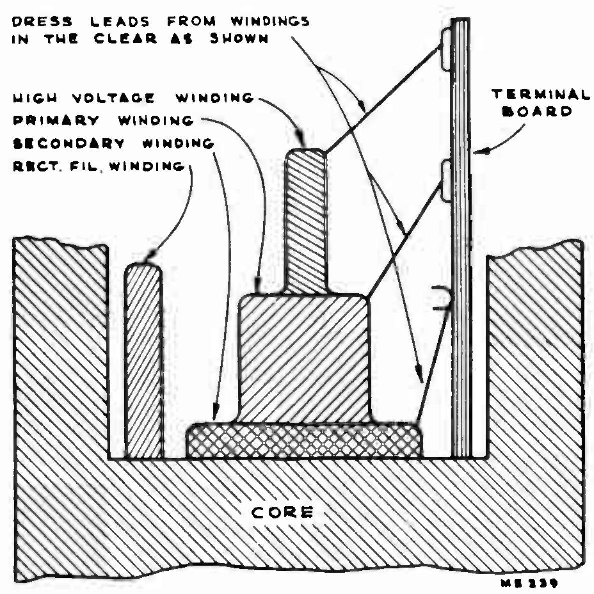


Figure 72—T110 Lead Dress

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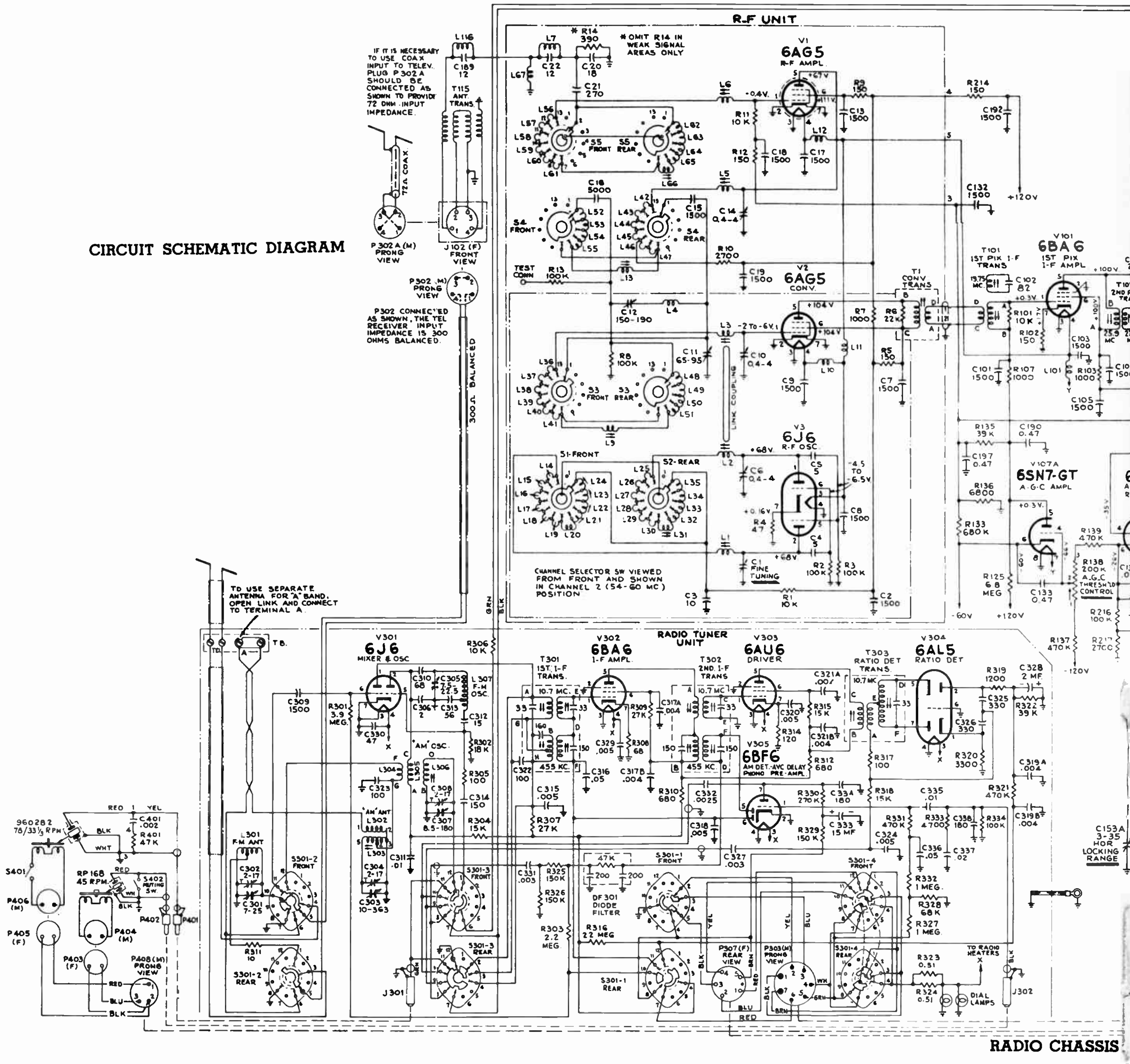
CIRCUIT SCHEMATIC DIAGRAM



Function switch S301 viewed from front and shown in Number 1 (maximum counterclockwise position).

Switch position 1—Television.
Switch position 2—AM.
Switch position 3—FM.
Switch position 4—Phono 45 RPM.
Switch position 5—Phono 78 RPM.

All resistance values in ohms. K = 1,000.
All capacitance values less than 1 in MF and above 1 in MMF unless noted.

Coil resistance values less than 1 ohm are not shown.
Direction of arrows at controls indicates clockwise rotation.

In some receivers, substitutions have caused changes in component lead color codes, in electrolytic capacitor values and their lug identification markings.

All voltages measured with "VoltOhmyst," no signal input with 117 v. a-c supply with the pix control fully clockwise and the brightness control set for average brightness.

In some sets, R227 was omitted.

Some chassis marked KCS41B were employed in this model. C184 was .01, a 1 meg resistor was added across the RP168 mute switch and R401 was 18K.

Figure 74—Circuit Schematic Diagram

RECORD CHANGERS: For RP168C, See Model RP168 Series, Pages RCD.CH.19-1 to RCD.CH.19-8; Model 960282, See Pages RCD.CH.21-18 through RCD.CH.21-33.

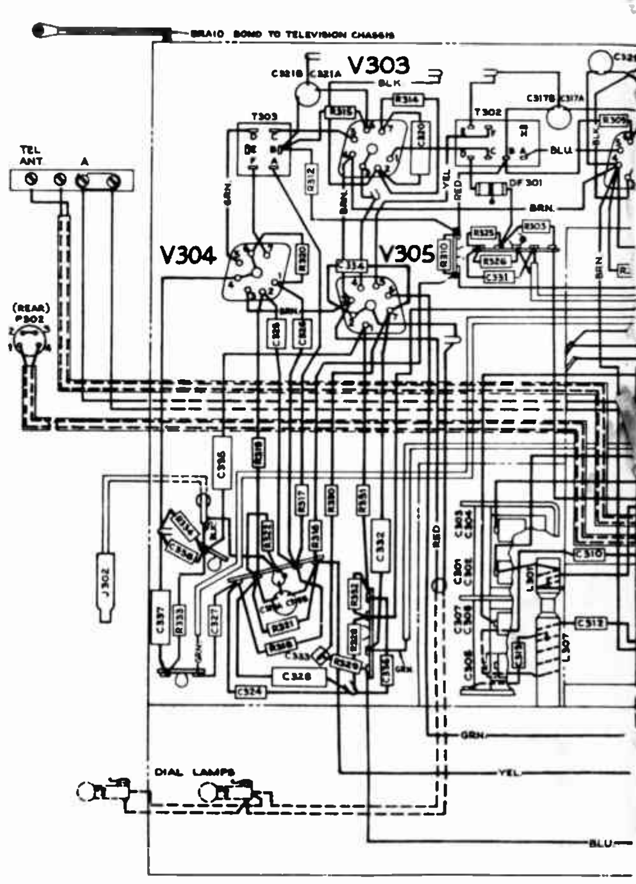


Figure 71—Radio Chassis I

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REPLACEMENT PARTS

STOCK No.	DESCRIPTION
	RF UNIT ASSEMBLIES KRK 5
73465	Belt—Drive belt
75069	Board—R-F unit power connection terminal board
75067	Bracket—Vertical bracket for r-f oscillator shield
73478	Cable—I-F transmission cable (W1)
73441	Cam—Fine tuning adjustment
74035	Capacitor—Ceramic, 5 mmf. (C4, C5)
53511	Capacitor—Ceramic, 10 mmf. (C3)
54297	Capacitor—Ceramic, 18 mmf. (C20)
73443	Capacitor—Ceramic trimmer comprising 1 section of 150-190 mmf. and 1 section of 65-95 mmf. (C11, C12)
73091	Capacitor—Ceramic, 270 mmf. (C21)
71501	Capacitor—Ceramic, 1500 mmf. (C2, C7, C8, C9, C13, C15, C17, C18, C19)
73473	Capacitor—Ceramic, 5000 mmf. (C16)
73460	Coil—R-F plate coil for channel 6 (L13)
73461	Coil—Rear section—Oscillator plate coil for channel 6 (L20)
73462	Coil—Coupling inductance coil (L4)
73475	Coil—Antenna filter shunt coil (C67)
73476	Coil—I-F trap (L7, C22)
73477	Coil—Choke coil (L10, L11, L12)
73874	Coil—Front section—Oscillator plate coil for channel 6 (L31)
74108	Coil—Fine tuning coil (1½ turns) with adjustable inductance core and capacitor stud (plunger adjustment) (L1, C1)
74109	Coil—Trimmer coil (1½ turns) with adjustable inductance core and capacitor stud (screw adjustment for oscillator section or converter section) (L2, L3, C6, C10)
74110	Coil—Trimmer coil (3 turns) with adjustable inductance core and capacitor stud (screw adjustment) for r-f amplifier section (L5, C14)
71493	Connector—Oscillator segment connector
73455	Core—Sliding core for fine tuning control trimmer
74187	Core—Adjustable core for coil L9
73440	Detent—R-F unit detent mechanism and fibre shaft
71487	Form—Coil form for coil L31
73453	Form—Coil form assembly for L9, L13
73412	Link—Link assembly for fine tuning
71462	Loop—Osc. to converter trimmer loop connector
73634	Nut—Speed nut for drive belt shield
73436	Plate—Front plate and bushing
73464	Pulley—Idler pulley
	Resistor—Fixed, composition:
	47 ohms, ±20%, ½ watt (R4)
	150 ohms, ±20%, ½ watt (R5, R9, R12)
	390 ohms, ±10%, ½ watt (R14)
	1000 ohms, ±20%, ½ watt (R7)
	2700 ohms, ±10%, ½ watt (R10)
	10,000 ohms, ±20%, ½ watt (R1, R11)
	100,000 ohms, ±20%, ½ watt (R2, R3, R8, R13)
14343	Retainer—Channel selector shaft retaining ring
30340	Retainer—Retainer ring for fine tuning stud
70881	Screw—#4-40 x ¼" binder head screw for adjusting coils L14, L15, L16, L17, L18, L19
73640	Screw—#4-40 x ⅝" adjusting screw for L66
71475	Screw—#4-40 x 15/32" adjusting screw for coils L21, L22, L23, L24
74575	Screw—#4-40 x 17/32" adjusting screw for L6
73437	Shaft—Channel selector shaft complete with pawl and stud
73438	Shaft—Fine tuning control shaft and pulley
73439	Shaft—Actuating shaft for fine tuning control
75443	Shield—"U" shape shield for bottom of r-f unit
72951	Shield—Metal tube shield for V3
73454	Shield—Metal shield for drive belt
73632	Shield—Metal tube shield for V1
71494	Socket—Tube socket, moulded, 7 prong, saddle mounted
73450	Socket—Tube socket, ceramic, 7 prong, bottom mounted
74576	Spacer—Insulating spacer for front plate (4 reqd.)
73457	Spring—Return spring for fine tuning control core

STOCK No.	DESCRIPTION
74188	Spring—Retaining spring for adjustable core RCA 74187
74578	Spring—Retaining spring for adjusting screws 73640 and RCA 74575
*75068	Spring—Retaining spring for r-f oscillator tube shield
73468	Stator—Front oscillator section stator complete with rotor, segment, coils and adjusting screws (S1, L14, L15, L16, L17, L18, L19, L21, L22, L23, L24)
73469	Stator—Rear oscillator section stator complete with rotor, segment and coils (S2, L25, L26, L27, L28, L29, L30, L32, L33, L34, L35)
73633	Stator—Antenna stator complete with rotor and coils (S5, L6, L56, L57, L58, L59, L60, L61, L62, L63, L64, L65, L66, C21)
73470	Stator—Converter stator complete with rotor and coils (S3, L9, L36, L37, L38, L39, L40, L41, L48, L49, L50, L51)
73471	Stator—R-F amplifier stator complete with rotor and coils (S4, L13, L42, L43, L44, L45, L46, L47, L52, L53, L54, L55, C15, C16, R10)
75446	Stud—Capacitor stud—brass #4-40 x 13/16" with [illegible] screw driver slot for trimmer coils 74109 and 74110 uncoded or coded "ER"
75447	Stud—Capacitor stud—brass #4-40 x 13/16" with [illegible] screw driver slot for trimmer coils 74109 and 74110 coded numerically or "Hi Q"
73448	Transformer—Converter transformer (T1, R6)
73466	Washer—Insulating washer for front shield (1 set)
2917	Washer—"C" washer for channel selector shaft or fine tuning shaft and cam
	TELEVISION CHASSIS ASSEMBLIES KCS 41A
74593	Capacitor—Mica trimmer comprising 1 section of 3-35 mmf. and 1 section of 40-370 mmf. (C153A, C153B)
39604	Capacitor—Mica, 10 mmf. (C126)
74105	Capacitor—Mica, 33 mmf. (C111)
74726	Capacitor—Mica, 39 mmf. (C140)
64062	Capacitor—Ceramic, 82 mmf. (C120)
39396	Capacitor—Ceramic, 100 mmf. (C175)
39628	Capacitor—Mica, 100 mmf. (C138)
73921	Capacitor—Ceramic, 120 mmf. (C129)
39630	Capacitor—Mica, 120 mmf. (C181)
73102	Capacitor—Mica, 180 mmf. (C158)
73922	Capacitor—Ceramic, 270 mmf. (C183, C194, C198)
73091	Capacitor—Mica, 270 mmf. (C106, C115, C121)
39640	Capacitor—Mica, 330 mmf. (C187)
39642	Capacitor—Mica, 390 mmf. (C141, C200)
74153	Capacitor—Hi-voltage, 500 mmf., 15 kv (C168)
74250	Capacitor—Mica, 560 mmf. (C160)
71501	Capacitor—Ceramic, 1500 mmf. (C101, C103, C104, C105, C108, C109, C110, C113, C114, C117, C118, C122, C125, C127, C132, C171, C172, C176, C177, C188, C192, C193, C196)
71432	Capacitor—Electrolytic comprising 2 sections of 40 mfd. 450 volts and 1 section of 10 mfd. 450 volts (C148A, C148B, C148C)
73582	Capacitor—Electrolytic comprising 1 section of 40 mfd. 450 volts, 1 section of 10 mfd. 450 volts and 1 section of 80 mfd. 200 volts (C170A, C170B, C170C)
73583	Capacitor—Electrolytic comprising 1 section of 40 mfd. 450 volts, 1 section of 90 mfd. 150 volts, and 1 section of 50 mfd. 150 volts (C147A, C147B, C147C)
73581	Capacitor—Electrolytic comprising 1 section of 60 mfd. 450 volts, 2 sections of 10 mfd. 450 volts, and 1 section of 20 mfd. 150 volts (C146A, C146B, C146C, C146D)
73801	Capacitor—Tubular, paper, oil impregnated, .001 mfd. 600 volts (C137,C203)
73802	Capacitor—Tubular, paper, oil impregnated, .0015 mfd. 1000 volts (C186)
73595	Capacitor—Tubular, paper, oil impregnated, .0022 mfd. 600 volts (C142, C154, C161)

STOCK No.	DESCRIPTION
73795	Capacitor—Tubular, paper, oil impregnated, .0033 mfd. 600 volts (C184)
73920	Capacitor—Tubular, paper, oil impregnated, .0047 mfd. 600 volts (C143, C144, C145, C202)
73561	Capacitor—Tubular, paper, oil impregnated, .01 mfd. 400 volts (C135, C166, C167, C182, C195)
73565	Capacitor—Tubular, moulded paper, .01 mfd. 1000 volts (C151, C152, C185)
73594	Capacitor—Tubular, moulded paper, oil impregnated, .01 mfd. 600 volts (C159)
73797	Capacitor—Tubular, paper, oil impregnated, .015 mfd. 600 volts (C204)
74727	Capacitor—Tubular, moulded paper, oil impregnated, .018 mfd. 1000 volts (C164)
73562	Capacitor—Tubular, paper, oil impregnated, .022 mfd. 400 volts (C155)
73553	Capacitor—Tubular, paper, oil impregnated, .047 mfd. 400 volts (C130, C139, C201)
73592	Capacitor—Tubular, moulded paper, oil impregnated, .047 mfd. 600 volts (C150, C156)
73597	Capacitor—Tubular, paper, oil impregnated, .047 mfd. 1000 volts (C163)
73815	Capacitor—Tubular, moulded paper, oil impregnated, .068 mfd. 1000 volts (C165)
73551	Capacitor—Tubular, paper, oil impregnated, 0.1 mfd. 400 volts (C149)
73557	Capacitor—Tubular, paper, oil impregnated, 0.1 mfd. 600 volts (C131)
73794	Capacitor—Tubular, paper, oil impregnated, 0.22 mfd. 400 volts (C136, C157, C162)
73787	Capacitor—Tubular, paper, oil impregnated, 0.47 mfd. 200 volts (C133, C190, C197)
73154	Choke—Filter choke (L104)
74585	Coil—Focus coil (L118)
71449	Coil—Horizontal linearity control coil (L111)
71429	Coil—Width control coil (L115, L120)
74877	Coil—Vertical peaking coil (L119)
74878	Coil—Series width coil (L121)
74170	Coil—Peaking coil (36 muh) (L117, R110)
71527	Coil—Peaking coil (93 muh) (L102)
74214	Coil—Peaking coil (180 muh) (L103, L105)
71526	Coil—Peaking coil (250 muh) (L106, L107, L114)
73477	Coil—Filament choke coil (L101)
74879	Connector—2 contact (polarized) female connector for electronic magnifier cable (J104)
72108	Connector—7 contact female connector (J103)
74594	Connector—2 contact male connector for power cord
72172	Connector—3 contact female connector (J108)
5040	Connector—4 contact female connector for speaker cable (P101)
71789	Connector—Anode connector
71521	Connector—Hi-voltage capacitor connector
14786	Connector—5 contact male connector (P107)
72734	Control—Horizontal and vertical hold control (R158, R173)
74047	Control—Brightness and picture control (R122, R131)
74359	Control—Tone control, volume control and power switch (R205, R233, S101)
71441	Control—Vertical linearity control (R162)
71440	Control—Height control (R155)
74597	Control—Focus control (R191)
74475	Control—AGC threshold control (R138)
71457	Cord—Power cord and plug
71437	Cover—Insulating cover for electrolytics #71432 and 73581
74811	Cushion—Rubber cushion for kinescope mounting
73590	Cushion—Rubber cushion for deflection yoke hood (2 required)
73600	Fuse—0.25 amp., 250 volts (F101)
71799	Grommet—Rubber grommet for yoke horizontal lead exit
37396	Grommet—Rubber grommet for mounting ceramic tube socket (2 required)
74030	Grommet—Rubber grommet for mounting radio chassis (3 required)

STOCK No.	DESCRIPTION
72283	Grommet—Rubber grommet for mounting relay (2 required)
74148	Magnet—Ion trap magnet (P.M. type)
73587	Nut—Speed nut to mount hi-voltage capacitor
18469	Plate—Bakelite mounting plate for electrolytics
33514	Receptacle—2 contact female receptacle for audio cable and switching cable (J105, J106)
74873	Relay—Electronic magnifier relay (K101)
72633	Resistor—Wire wound, 4.7 ohms, ½ watt (R187)
72067	Resistor—Wire wound, 5.1 ohms, ½ watt (R202)
18471	Resistor—Wire wound, 10 ohms, ½ watt (R190)
74049	Resistor—Wire wound, 500 ohms, 20 watts (R230)
73588	Resistor—Voltage divider, comprising 1 section of 850 ohms, 12 watts and 2 sections of 650 ohms, 6 watts (R193A, R193B, R193C)
	Resistor—Fixed, composition:
	10 ohms, ±20%, ½ watt (R120)
	18 ohms, ±10%, ½ watt (R225)
	39 ohms, ±10%, ½ watt (R121)
	47 ohms, ±5%, ½ watt (R111)
	47 ohms, ±20%, ½ watt (R183)
	68 ohms, ±10%, ½ watt (R105)
	68 ohms, ±20%, ½ watt (R123)
	82 ohms, ±10%, ½ watt (R195)
	100 ohms, ±10%, 2 watts (R184)
	150 ohms, ±5%, ½ watt (R102)
	150 ohms, ±10%, ½ watt (R115)
	150 ohms, ±20%, ½ watt (R106, R109, R114, R214)
	220 ohms, ±10%, 1 watt (R223)
	270 ohms, ±10%, 1 watt (R206)
	1000 ohms, ±20%, ½ watt (R103, R107, R108, R113, R116, R118, R165, R199)
	1200 ohms, ±10%, ½ watt (R196)
	1800 ohms, ±10%, 2 watts (R194, R208)
	2200 ohms, ±10%, ½ watt (R219)
	2200 ohms, ±10%, 1 watt (R161, R192)
	2700 ohms, ±10%, ½ watt (R217)
	3900 ohms, ±5%, ½ watt (R112)
	4700 ohms, ±5%, ½ watt (R126)
	4700 ohms, ±10%, ½ watt (R144)
	5600 ohms, ±5%, ½ watt (R119)
	5600 ohms, ±10%, ½ watt (R141, R218)
	5600 ohms, ±10%, 1 watt (R127)
	6800 ohms, ±5%, ½ watt (R136)
	6800 ohms, ±10%, ½ watt (R150)
	6800 ohms, ±5%, 1 watt (R128)
	6800 ohms, ±10%, 2 watts (R177, R210)
	8200 ohms, ±5%, ½ watt (R164, R175)
	8200 ohms, ±10%, ½ watt (R152, R153, R171)
	8200 ohms, ±5%, 1 watt (R117)
	8200 ohms, ±10%, 2 watts (R186)
	10,000 ohms, ±5%, ½ watt (R104)
	10,000 ohms, ±10%, ½ watt (R188)
	12,000 ohms, ±10%, ½ watt (R134, R209, R226)
	12,000 ohms, ±10%, 2 watts (R124)
	15,000 ohms, ±10%, ½ watt (R211)
	15,000 ohms, ±10%, 1 watt (R146)
	18,000 ohms, ±10%, 1 watt (R182)
	22,000 ohms, ±10%, ½ watt (R151, R156, R197, R220)
	22,000 ohms, ±20%, ½ watt (R198, R215)
	27,000 ohms, ±10%, ½ watt (R143, R234)
	39,000 ohms, ±5%, ½ watt (R135)
	47,000 ohms, ±10%, ½ watt (R145)
	47,000 ohms, ±20%, ½ watt (R221)
	68,000 ohms, ±10%, ½ watt (R172)
	82,000 ohms, ±10%, 1 watt (R179)
	100,000 ohms, ±5%, ½ watt (R203, R204)
	100,000 ohms, ±10%, ½ watt (R160, R216)
	100,000 ohms, ±20%, 1 watt (R222)
	120,000 ohms, ±5%, 1 watt (R176)
	120,000 ohms, ±10%, 1 watt (R174)
	150,000 ohms, ±10%, ½ watt (R168)
	150,000 ohms, ±20%, ½ watt (R142)
	180,000 ohms, ±10%, ½ watt (R232)
	180,000 ohms, ±5%, 1 watt (R178)
	220,000 ohms, ±10%, ½ watt (R129, R154, R181)

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REPLACEMENT PARTS (Continued)

STOCK No.	DESCRIPTION
	270,000 ohms, ±10%, ½ watt (R185)
	330,000 ohms, ±10%, ½ watt (R140, R200)
	470,000 ohms, ±10%, ½ watt (R137, R139, R224, R180)
	470,000 ohms, ±20%, ½ watt (R207)
	560,000 ohms, ±10%, ½ watt (R212)
	680,000 ohms, ±10%, ½ watt (R133)
	820,000 ohms, ±5%, ½ watt (R169)
	1 megohm, ±10%, ½ watt (R147)
	1 megohm, ±20%, 1 watt (R189, R227)
	1.2 megohm, ±5%, ½ watt (R123)
	1.5 megohm, ±5%, ½ watt (R157)
	2.2 megohm, ±10%, ½ watt (R130, R132, R159, R163)
	2.7 megohm, ±5%, 1 watt (R170)
	3.9 megohm, ±10%, ½ watt (R149)
	6.8 megohm, ±10%, ½ watt (R125)
	10 megohm, ±10%, ½ watt (R148)
	10 megohm, ±20%, ½ watt (R201)
74416	Screw—#10-32 x 1¾" cross recessed round head screw for kinescope retaining strap
71456	Screw—#8-32 wing screw for deflection yoke
74601	Screw—#8-32 x ⅜" cross recessed binder head screw for focus coil mounting (2 required)
74602	Screw—#10-32 x 1¼" cross recessed binder head screw for focus coil adjustment (3 required)
73584	Shield—Tube shield
74937	Sleeve—Rubber sleeve for focus coil
73117	Socket—Tube socket, 7 pin, miniature
72927	Socket—Tube socket, 9 pin, miniature
31251	Socket—Tube socket, octal, wafer
73249	Socket—Tube socket, octal, ceramic, plate mounted
71508	Socket—Tube socket for 8016
74834	Socket—Kinescope socket
31364	Socket—Pilot lamp socket
73586	Spring—Compression spring used under centering control screws (3 required)
74595	Spring—Anode lead spring
74936	Spring—Suspension spring for kinescope tube socket leads
74893	Strap—Kinescope retaining strap
74596	Support—Bakelite supports (1 set) for mounting hi-voltage rectifier tube mounting plate
74872	Switch—Width selector switch (S104)
74157	Switch—Interlock switch (S105)
74892	Transformer—Power transformer 115 volt (T111)
74875	Transformer—Vertical cutout transformer (T108)
73569	Transformer—Vertical oscillator transformer (T107)
74588	Transformer—Horizontal output and hi-voltage transformer (T110)
74589	Transformer—First pix. i-f transformer (T101, C102, R101)
74590	Transformer—Second pix. i-f transformer (T102, C107)
74591	Transformer—Third pix. i-f transformer (T103, C112)
74592	Transformer—Fourth pix. i-f transformer (T104, C116)
73575	Transformer—Fifth pix. i-f transformer (T106, C123, C124)
71424	Transformer—Sound i-f transformer (T112, C173, C174)
71427	Transformer—Sound discriminator transformer (T113, C178, C179, C180)
73576	Transformer—Horizontal oscillator transformer (T109)
73578	Transformer—Antenna transformer complete with socket and bracket (T115, J102)
73577	Trap—4.5 mc trap (L110, C128)
71778	Trap—Sound trap (T105, C119)
73476	Trap—I-F trap (L116, C189)
74262	Yoke—Deflection yoke (L108, L109, L112, L113, C169, R166, R167)

STOCK No.	DESCRIPTION
	RADIO CHASSIS ASSEMBLIES
	RK 135D
74039	Board—"Telv-Ant" terminal board (TB301)
74026	Bracket—Drive cord bracket complete with two pulleys—R.H.
74027	Bracket—Drive cord bracket complete with pulley—L.H.
74911	Cable—Shielded cable complete with female connector (W307, W311)
71105	Cable—Shielded cable complete with pin plug (W301, W302)
74017	Capacitor—Variable tuning capacitor (C301, C302, C303, C304, C305, C307, C308)
73866	Capacitor—Ceramic, 2 mmf. (C306)
39044	Capacitor—Ceramic, 15 mmf. (C312)
39042	Capacitor—Ceramic, 47 mmf. (C330)
73867	Capacitor—Ceramic, 56 mmf. (C313)
33379	Capacitor—Ceramic, 68 mmf. (C310)
39396	Capacitor—Ceramic, 100 mmf. (C322, C323)
48125	Capacitor—Ceramic, 150 mmf. (C314)
71922	Capacitor—Ceramic, 180 mmf. (C334, C338)
39640	Capacitor—Mica, 330 mmf. (C325, C326)
73748	Capacitor—Ceramic, 1500 mmf. (C309)
74009	Capacitor—Ceramic, dual, 4000 mmf. (C317, C319, C321)
73473	Capacitor—Ceramic, 5000 mmf. (C318, C329)
73747	Capacitor—Electrolytic, 2 mfd. 50 volts (C328)
32223	Capacitor—Electrolytic, 15 mfd. 300 volts (C333)
70602	Capacitor—Tubular, paper, .0025 mfd. 400 volts (C332)
73961	Capacitor—Tubular, paper, .003 mfd. 200 volts (C327, C331)
71553	Capacitor—Tubular, paper, .005 mfd. 400 volts (C315, C320, C324)
71923	Capacitor—Tubular, paper, .01 mfd. 200 volts (C335)
71925	Capacitor—Tubular, paper, .01 mfd. 400 volts (C311)
71928	Capacitor—Tubular, paper, .02 mfd. 200 volts (C337)
72596	Capacitor—Tubular, paper, .05 mfd. 200 volts (C336)
74455	Capacitor—Tubular, paper, .05 mfd. 400 volts (C316)
74020	Coil—Antenna coil—A.M. (L302, L303)
73744	Coil—Oscillator coil—A.M. (L304, L305, L306)
74024	Coil—Antenna coil—F.M. (L301)
74025	Coil—Oscillator coil—F.M. (L307)
36395	Connector—7 contact male connector (P103)
12493	Connector—5 contact female connector (P107B)
39153	Connector—4 prong male connector (P102)
72953	Cord—Drive cord (approximately 42" overall)
74011	Filter—Diode filter, dual 200 mmf. and 47,000 ohms (DF301)
74023	Resistor—Wire wound, 0.51 ohms, 1 watt (R323, R324)
	Resistor—Fixed, composition:
	10 ohms, ±20%, ½ watt (R311)
	68 ohms, ±20%, ½ watt (R308)
	100 ohms, ±20%, ½ watt (R305, R317)
	120 ohms, ±10%, ½ watt (R314)
	680 ohms, ±20%, ½ watt (R310, R312)
	1200 ohms, ±5%, ½ watt (R319)
	3300 ohms, ±5%, ½ watt (R320)
	4700 ohms, ±10%, ½ watt (R333)
	10,000 ohms, ±20%, ½ watt (R306)
	15,000 ohms, ±10%, ½ watt (R304)
	15,000 ohms, ±20%, ½ watt (R315, R318)
	18,000 ohms, ±10%, ½ watt (R302)
	27,000 ohms, ±10%, ½ watt (R307, R309)
	39,000 ohms, ±10%, ½ watt (R322)
	68,000 ohms, ±10%, ½ watt (R328)
	100,000 ohms, ±10%, ½ watt (R334)
	150,000 ohms, ±10%, ½ watt (R325, R326, R329)
	270,000 ohms, ±10%, ½ watt (R330)
	470,000 ohms, ±10%, ½ watt (R331)

STOCK No.	DESCRIPTION
	470,000 ohms, ±20%, ½ watt (R321)
	1 megohm, ±10%, ½ watt (R327, R332)
	2.2 megohm, ±20%, ½ watt (R303)
	3.9 megohm, ±10%, ½ watt (R301)
	22 megohm, ±20%, ½ watt (R316)
74028	Shaft—Tuning knob shaft
73632	Shield—Tube shield
73117	Socket—Tube socket, 7 pin, miniature for V301, V304, V305
74179	Socket—Tube socket, 7 pin, miniature for V302, V303
31364	Socket—Dial lamp socket
74038	Spring—Drive cord spring
74894	Switch—Selector switch (S301)
73745	Transformer—First i-f transformer dual (T301)
74019	Transformer—Second i-f transformer dual (T302)
73743	Transformer—Ratio detector transformer (T303)
33726	Washer—"C" washer for tuning shaft (rear)
34457	Washer—Spring washer for tuning shaft (front)
74172	Washer—Fibre washer to prevent drive cord slippage
	SPEAKER ASSEMBLIES
	92569-8W
	RL-111-10
	RMA-#274
13867	Cap—Dust cap
74901	Cone—Cone complete with voice coil (3.2 ohms)
5039	Connector—4 prong male connector (J101)
74900	Speaker—12" P.M. speaker complete with cone and voice coil (3.2 ohms) less transformer and plug
74902	Transformer—Audio output transformer (T114)
	NOTE: If stamping in instruments does not agree with above speaker number, order replacement parts by referring to model number of instruments, number stamped on speaker and full description of part required.
	MISCELLANEOUS
74895	Back—Cabinet back
74054	Bracket—Dial lamp bracket
71599	Bracket—Pilot lamp bracket
75041	Button—Plug button for shipping bolts holes in 33/78 RPM changer (2 required)
72437	Cable—Shielded pickup cable complete with pin plug for 45 RPM changer
74296	Cable—Shielded pickup cable complete with pin plug for 33/78 RPM changer
13103	Cap—Pilot lamp cap
73803	Capacitor—Tubular, paper, .002 mfd. 400 volts
74883	Case—Plastic case and bottom cover for electronic magnifier switch
71892	Catch—Bullet catch and strike for doors (3 required)
X3067	Cloth—Grille cloth for mahogany or walnut instruments
X3090	Cloth—Grille cloth for oak instruments
74882	Connector—3 contact male connector for electronic magnifier cable
14782	Connector—3 contact male connector for record changer power cable
30868	Connector—2 contact female connector for record changer power cable
74581	Cover—Mounting screw cover for 45 RPM changer (3 required)
74891	Cushion—Vinylite cushion (edging) for masking panel
74898	Decal—Control panel function decal for mahogany or walnut instruments
74899	Decal—Control panel function decal for oak instruments
71984	Decal—Trade mark decal (RCA Victor)

STOCK No.	DESCRIPTION
74273	Decal—Trade mark decal (Victrola)
74052	Dial—Dial scale and bezel
74809	Emblem—"RCA Victor" emblem
73642	Escutcheon—Channel marker escutcheon for mahogany or walnut instruments
73740	Escutcheon—Channel marker escutcheon for oak instruments
74755	Glass—Safety glass
37396	Grommet—Rubber grommet for mounting speaker
74206	Grommet—Rubber grommet for mounting 33/78 RPM changer (4 required)
74308	Hinge—Television compartment door hinge (1 set)
74896	Hinge—Record storage compartment door hinge (1 set)
70166	Hinge—Speaker compartment door hinge—upper
73200	Hinge—Speaker compartment door hinge—lower
74051	Indicator—Station selector indicator
74959	Knob—Fine tuning knob—dark—for mahogany or walnut instruments (outer)
73995	Knob—Fine tuning knob—tan—for oak instruments (outer)
74960	Knob—Channel selector knob—dark—for mahogany or walnut instruments (inner)
74961	Knob—Channel selector knob—tan—for oak instruments (inner)
74962	Knob—Vertical hold control, brightness control or tone control knob—dark—for mahogany or walnut instruments (outer)
73999	Knob—Vertical hold control, brightness control or tone control knob—tan—for oak instruments (outer)
74978	Knob—Radio tuning or selector switch knob—dark—for mahogany or walnut instruments
74979	Knob—Radio tuning or selector switch knob—tan—for oak instruments
74963	Knob—Horizontal hold control, picture control or volume control and power switch knob—dark—for mahogany or walnut instruments (inner)
74001	Knob—Horizontal hold control, picture control or volume control and power switch knob—tan—for oak instruments (inner)
11765	Lamp—Dial or pilot lamp, Mazda 51
74208	Nut—Tee nut to mount 45 RPM changer (3 required)
74162	Plate—Mounting plate for interlock switch
74897	Pull—Door pull (4 required)
	Resistor—Fixed, composition:
	47,000 ohms, ±10%, ½ watt
74582	Screw—#8-32 x 1¾", special head screw to mount 45 RPM changer (3 required)
74269	Screw—#8-32 x ¾" trimit head screw for door pull (2 required for each pull)
74050	Slide—Station indicator slide
74835	Slide—Slide mechanism for 45 RMP drawer
74736	Slide—Slide mechanism for 33/78 RPM drawer
73643	Spring—Spring clip for channel marker escutcheon
72845	Spring—Retaining spring for knobs #73995 and 74959
14270	Spring—Retaining spring for knobs #73999, 74960, 74961, 74962, 74978 and 74979
30330	Spring—Retaining spring for knobs #74001 and 74963
74055	Spring—Spring clip for dial and bezel assembly (2 required)
74421	Spring—Conical spring to mount 45 RPM changer—upper—R.H. (1 required)
74422	Spring—Conical spring to mount 45 RPM changer—upper—L.H. (2 required)
74423	Spring—Conical spring to mount 45 RPM changer—lower (3 required)
75040	Spring—Mounting spring for 33/78 RPM changer (4 required)
74161	Stud—Locating stud for back cover
74881	Switch—Electronic magnifier switch

To obtain resistors for which no stock number is given, order by stating type, value of resistance, tolerance and wattage.

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Model TA169
Walnut, Mahogany or Oak

GENERAL DESCRIPTION

Model TA169 is a "16 inch" television, AM-FM radio phonograph combination. The receiver employs thirty tubes plus three rectifiers and a 16GP4 kinescope. Two record changers are provided to play 33⅓, 45 and 78 RPM records.

Features of the television unit are full twelve channel coverage; FM sound system: improved picture brilliance; picture A-G-C; A-F-C horizontal hold; stabilized vertical hold; two stages of video amplification; noise saturation circuits; improved sync separator and clipper; four mc. band width for picture channel and reduced hazard high voltage supply.

ELECTRICAL AND MECHANICAL SPECIFICATIONS

PICTURE SIZE .... 146 square inches on a 16GP4 kinescope

TELEVISION R-F FREQUENCY RANGE

All 12 television channels, 54 mc. to 88 mc., 174 mc. to 216 mc.
Fine Tuning Range .. ±250 kc. on chan. 2, ±650 kc. on chan. 13
Picture Carrier Frequency .... 25.75 mc.
Sound Carrier Frequency .... 21.25 mc.

RADIO TUNING RANGE

Broadcast .... 540-1,600 kc.
Frequency Modulation .... 88-108 mc.
Intermediate Frequency—AM .... 455 kc.
Intermediate Frequency—FM .... 10.7 mc.

POWER SUPPLY RATING ...... 115 volts, 60 cycles, 270 watts

AUDIO POWER OUTPUT RATING .... 10 watts max.

CHASSIS DESIGNATIONS

Television Chassis KCS43
Radio Chassis RK135D
33⅓/78 RPM Record Changer 960285
45 RPM Record Changer RP168C
Refer to Service Data 960285 or RP168 for information on the record changers.

LOUDSPEAKER 92569-5 .... 12 inch PM Dynamic
Voice Coil Impedance .... 3.2 ohms at 400 cycles

WEIGHT

Chassis with Tubes in Cabinet .... 190 lbs.
Shipping Weight .... 230 lbs.

DIMENSIONS (inches)	Width	Height	Depth
Cabinet (outside)	37¾	39	23½
Chassis (overall)	19¼	11	18½

RECEIVER ANTENNA INPUT IMPEDANCE. 300 ohms balanced

If necessary, the television chassis may be fed separately from either a 300 ohm balanced line or a 72 ohm co-ax.

RCA TUBE COMPLEMENT

Tube Used	(Television Chassis) Function
(1) RCA 6AG5	R-F Amplifier
(2) RCA 6AG5	Converter
(3) RCA 6J6	R-F Oscillator
(4) RCA 6AU6	1st Sound I-F Amplifier
(5) RCA 6AU6	2nd Sound I-F Amplifier
(6) RCA 6AL5	Sound Discriminator
(7) RCA 12AX7	Audio Amplifier and Phase Inverter
(8) RCA 6V6GT	Audio Output (2 tubes)
(9) RCA 6BA6	1st Picture I-F Amplifier
(10) RCA 6AG5	2nd Picture I-F Amplifier
(11) RCA 6BA6	3rd Picture I-F Amplifier
(12) RCA 6AG5	4th Picture I-F Amplifier
(13) RCA 6AL5	Picture 2nd Detector & Sync Limiter
(14) RCA 12AU7	1st and 2nd Video Amplifier
(15) RCA 6SN7GT	AGC Amplifier & Vertical Sweep Osc.
(16) RCA 6SN7GT	AGC Rectifier & 1st Sync Separator
(17) RCA 6SN7GT	Sync Amplifier & 2nd Sync Separator
(18) RCA 6K6GT	Vertical Sweep Output
(19) RCA 6SN7GT	Horizontal Sweep Oscillator and Control
(20) RCA 6BG6G	Horizontal Sweep Output
(21) RCA 6W4GT	Damper
(22) RCA 1B3-GT/8016	High Voltage Rectifier
(23) RCA 5U4G	Power Supply Rectifier (2 tubes)
(24) RCA 16GP4	Kinescope

(Radio Tuner Chassis)

(1) RCA 6J6	Mixer and Oscillator
(2) RCA 6BA6	I-F Amplifier
(3) RCA 6AU6	F-M Driver
(4) RCA 6AL5	Ratio Detector
(5) RCA 6BF6	AM Detector AVC and Phone Preamp.

OPERATING CONTROLS (front panel)

Channel Selector, Fine Tuning .... Dual Control Knobs
Tone, Sound Volume and On-Off Switch .... Dual Control Knobs
Picture Horizontal Hold, Picture Vertical Hold .... Dual Control Knobs
Picture, Brightness .... Dual Control Knobs
Function Switch .... Single Control Knob
Radio Tuning .... Single Control Knob

NON-OPERATING CONTROLS

Centering .... cabinet adjustment
Width .... rear chassis adjustment
Height .... rear chassis adjustment
Horizontal Linearity .... rear chassis screwdriver adjustment
Vertical Linearity .... rear chassis adjustment
Horizontal Drive .... rear chassis screwdriver adjustment
Horizontal Oscillator Frequency ..... bottom chassis adjustment
Horizontal Oscillator Waveform .... side chassis adjustment
Focus .... rear chassis adjustment
Ion Trap Magnet .... cabinet adjustment
Deflection Coil .... cabinet adjustment
Focus Coil .... cabinet adjustment

PICTURE I-F FREQUENCIES

Picture Carrier Frequency .... 25.75 mc.
Adjacent Channel Sound Trap .... 27.25 mc.
Accompanying Sound Traps .... 21.25 mc.
Adjacent Channel Picture Carrier Trap .... 19.75 mc.

SOUND I-F FREQUENCIES

Sound Carrier Frequency .... 21.25 mc.
Sound Discriminator Band Width between peaks .... 350 kc.

VIDEO RESPONSE .... To 4 mc.

FOCUS .... Magnetic

SWEEP DEFLECTION .... Magnetic

SCANNING .... Interlaced, 525 line

HORIZONTAL SCANNING FREQUENCY .... 15,750 cps

VERTICAL SCANNING FREQUENCY .... 60 cps

FRAME FREQUENCY (Picture Repetition Rate) .... 30 cps

HIGH VOLTAGE WARNING

OPERATION OF THIS RECEIVER OUTSIDE THE CABINET OR WITH THE COVERS REMOVED, INVOLVES A SHOCK HAZARD FROM THE RECEIVER POWER SUPPLIES. WORK ON THE RECEIVER SHOULD NOT BE ATTEMPTED BY ANYONE WHO IS NOT THOROUGHLY FAMILIAR WITH THE PRECAUTIONS NECESSARY WHEN WORKING ON HIGH VOLTAGE EQUIPMENT. DO NOT OPERATE THE RECEIVER WITH THE HIGH VOLTAGE COMPARTMENT SHIELD REMOVED.

KINESCOPE HANDLING PRECAUTIONS

DO NOT OPEN THE KINESCOPE SHIPPING CARTON, INSTALL, REMOVE OR HANDLE THE KINESCOPE IN ANY MANNER UNLESS SHATTERPROOF GOGGLES, AND HEAVY GLOVES ARE WORN. PEOPLE NOT SO EQUIPPED SHOULD BE KEPT AWAY WHILE HANDLING KINESCOPES. KEEP THE KINESCOPE AWAY FROM THE BODY WHILE HANDLING.

The kinescope bulb encloses a high vacuum and, due to its large surface area, is subjected to considerable air pressure. For these reasons, kinescopes must be handled with more care than ordinary receiving tubes.

The large end of the kinescope bulb—particularly that part at the rim of the viewing surface—must not be struck, scratched or subjected to more than moderate pressure at any time. In installation, if the tube sticks or fails to slip smoothly into its socket, or deflecting yoke, investigate and remove the cause of the trouble. Do not force the tube. Refer to the Receiver Installation Section for detailed instructions on kinescope installation. All RCA kinescopes are shipped in special cartons and should be left in the cartons until ready for installation in the receiver. Keep the carton for posible future use.

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OPERATING INSTRUCTIONS

The following adjustments are necessary when turning the receiver on for the first time.

1. Turn the radio FUNCTION switch to Tel.

2. Turn the receiver "ON" and advance the SOUND VOLUME control to approximately mid-position.

3. Set the STATION SELECTOR to the desired channel.

4. Adjust the FINE TUNING control for best sound fidelity and SOUND VOLUME for suitable volume.

5. Turn the BRIGHTNESS control fully counter-clockwise, then clockwise until a light pattern appears on the screen.

6. Adjust the VERTICAL hold control until the pattern stops vertical movement.

7. Adjust the HORIZONTAL hold control until a picture is obtained and centered.

8. Turn the BRIGHTNESS control counter-clockwise until the retrace lines just disappear.

9. Adjust the PICTURE control for suitable picture contrast.

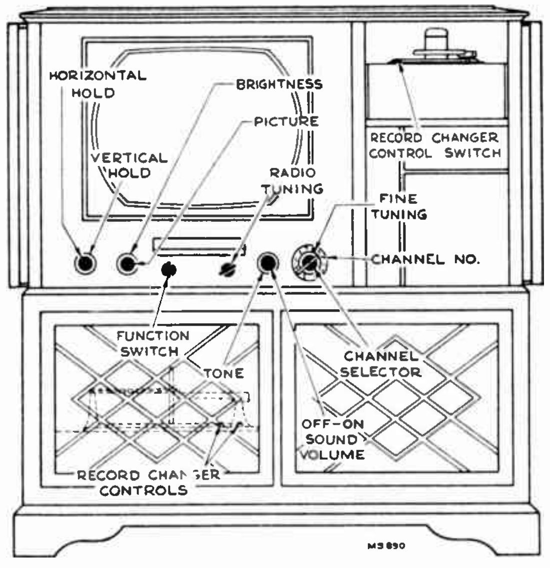

Figure 1—Receiver Operating Controls

10. After the receiver has been on for some time, it may be necessary to readjust the FINE TUNING control slightly for improved sound fidelity.

11. In switching from one station to another, it may be necessary to repeat steps numbers 4 and 9.

12. When the set is turned on again after an idle period, it should not be necessary to repeat the adjustments if the positions of the controls have not been changed. If any adjustment is necessary, step number 4 is generally sufficient.

13. If the positions of the controls have been changed, it may be necessary to repeat steps numbers 1 through 9.

14. For radio operation turn the FUNCTION switch to AM or FM and tune in station with the radio TUNING control.

15. For phono operation, turn the FUNCTION switch to PH for operation of the 33⅓/78 rpm record changer, or to XPH for operation of the 45 rpm record changer.

INSTALLATION INSTRUCTIONS

UNPACKING.—The TA169 receiver is packed complete with kinescope in a cardboard carton. To unpack, turn the shipping carton on its side and tear open the carton bottom flaps. Fold the flaps up along the side of the carton and turn the carton back up. Lift the carton up and off the cabinet.

A flat skid is attached to the bottom of the receiver cabinet which will permit the cabinet to be moved about without stressing the cabinet joints. To remove the skid, take off the nuts from the two bolts that hold the cabinet on the skid. With a man at each end of the cabinet, lift the cabinet off the skid.

The operating control knobs are packed in a bag and tied to a cabinet back rail. Remove the bag and install the knobs on the proper control shafts.

From the rear of the cabinet remove the single wood screw which holds the RP168C record changer drawer in the closed position. Slide the drawer out. From the top of the changer, remove the three filler plugs from over the motorboard mounting screws. Loosen these three screws to permit removal of two wooden shipping strips under the edge of the motorboard. Tighten the screws just enough to keep the motorboard springs from rattling and replace the filler plugs.

Remove the two red brackets which hold the 960285 changer drawer in the closed position. Open the drawer and untie the cord over the turntable. Fold the cardboard away from the spindle. Lift the turntable off the spindle. Remove the rubber band holding the drive wheel. Screw the front and back shipping screws under the turntable down tight. Pull out the cardboard under the motorboard. Push the drive wheel towards the spindle and slip the turntable down into place. The motorboard should then be free floating.

Make sure that all tubes are in place and are firmly seated in their sockets.

Check to see that the high voltage lead is connected in place between the rim of the kinescope and the kinescope mask.

WARNING.—The high voltage supply in this receiver delivers 12,000 volts! A.C. interlocks are provided at the back of the set so that when the back is removed so is the power.

ANTENNA AND POWER CONNECTIONS.—Connect the leads from the antenna to the receiver antenna terminals.

Make sure that the receiver power switch is in the off position. Plug the receiver power cord into a 115 volt, 60 cycle a-c outlet.

Turn the power switch to the "on" position, the brightness control three-quarters clockwise, and picture control fully counter-clockwise.

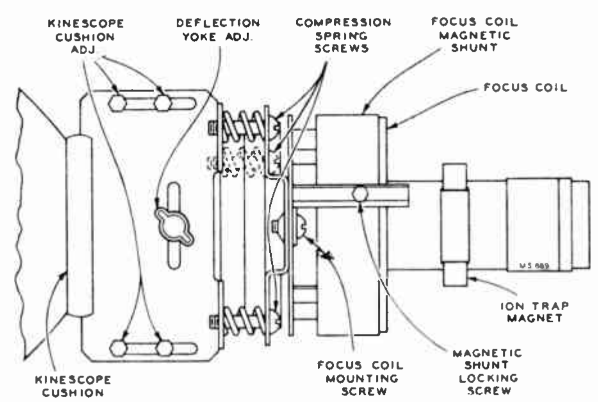

Figure 2—Yoke and Focus Coil Adjustments

ION TRAP MAGNET ADJUSTMENT.—Set the ion trap magnet approximately in the position shown in Figure 2. Starting from this position adjust the magnet by moving it forward or backward at the same time rotating it slightly around the neck of the kinescope for the brightest raster on the screen. Reduce the brightness control setting until the raster is slightly above average brilliance. Adjust the focus control (R191 on the chassis rear apron) until the line structure of the raster is clearly visible. Readjust the ion trap magnet for maximum raster brilliance. The final touches on this adjustment should be made with the brightness control at the maximum position with which good line focus can be maintained.

DEFLECTION YOKE ADJUSTMENT.—If the lines of the raster are not horizontal or squared with the picture mask, rotate the deflection yoke until this condition is obtained. Tighten the yoke adjustment wing screw.

PICTURE ADJUSTMENTS.—It will now be necessary to obtain a test pattern picture in order to make further adjustments. See steps 3 through 9 of the receiver operating instructions.

If the Horizontal Oscillator and AGC System are operating properly, it should be possible to sync the picture at this point. However, if the AGC threshold control is misadjusted, and the receiver is overloading, it may be impossible to sync the picture.

If the receiver is overloading, turn R138 on the rear apron (see Figure 3) clockwise until the set operates normally and the picture can be synced.

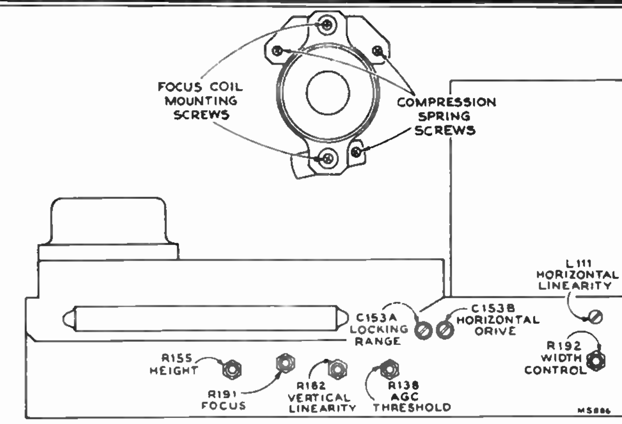

Figure 3—Rear Chassis Adjustments

CHECK OF HORIZONTAL OSCILLATOR ALIGNMENT.—Turn the horizontal hold control to the extreme counter-clockwise position. The picture should remain in horizontal sync. Momentarily remove the signal by switching off channel then back. Usually the picture will remain in sync. Turn the control clockwise slowly. If the picture did fall out of sync upon removal of the signal, the number of diagonal black bars will be gradually reduced and when only 2 bars sloping downward to the left are obtained, the picture will pull into sync upon slight additional clockwise rotation of the control. The picture should remain in sync for approximately 180 degrees of additional clockwise rotation of the control. At the extreme clockwise position, the picture should be out of sync and should show 1 vertical or diagonal black bar in the raster.

If the receiver passes the foregoing checks and the picture is normal and stable, the horizontal oscillator is properly aligned. Skip "Alignment of Horizontal Oscillator" and proceed with "Focus Coil Adjustments."

ALIGNMENT OF HORIZONTAL OSCILLATOR.—If in the above check the receiver failed to hold sync with the hold control at the extreme counter-clockwise position or failed to hold sync over 180 degrees of clockwise rotation of the control from the pull-in point, it will be necessary to make the following adjustments:

Horizontal Frequency Adjustment.—Turn the T109 sine wave core (on the outside of the apron) all the way out of the coil.

Set the locking range trimmer C153A one-half turn out from maximum capacity.

Turn the horizontal hold control to the extreme clockwise position. Tune in a television station and turn the frequency wave core of T109 under the chassis until the picture syncs and the sync bar just begins to move into the picture.

NOTE.—Occasionally, a tube may be found which does not respond to this alignment procedure since it may not be possible to sync the picture by means of the frequency core when the sine wave core is all the way out of the coil. Yet, the tube may work perfectly well when the circuit is properly aligned. In such a case, it may be necessary to turn the sine wave core in slightly, and readjust the frequency core to obtain sync.

Turn the sine wave core of T109 in until the blanking bar begins to move off to the left of the picture. Alternately turn the sine wave core in and the frequency out, keeping the picture in sync and the blanking bar showing in the picture.

Continue alternate adjustments until the picture falls from sync into a parasitic oscillation as indicated by a non-synchronized pattern which flickers in width and centering with possibly a light ragged vertical bar through the center of the screen.

Turn the sine wave core out ½ turn. Adjust the frequency core in until the picture is in sync and horizontal blanking appears as a vertical bar in the picture.

Check of Pull-in Range.—Turn the horizontal hold control fully counter-clockwise. Connect a 270K ohm resistor across C156. Momentarily switch off channel and back; the picture will then be out of sync. Turn the hold control clockwise slowly and observe the minimum number of bars obtained just before the picture pulls into sync.

The picture should snap in from two complete blanking bars. If two bars are not obtained, turn the locking range trimmer C153A in to obtain less bars or out to obtain more bars.

If C153A was adjusted, remove the 270K resistor, turn the horizontal hold control fully clockwise and adjust the T109 frequency core until horizontal blanking appears as a vertical bar in the synced picture. Then repeat the entire check of pull-in range to this point.

Repeat the adjustments under "Check of Pull-in Range" until the conditions specified are fulfilled. When the horizontal hold operates as outlined under "Check of Horizontal Oscillator Alignment" the oscillator is properly adjusted.

If the oscillator does not hold sync properly at this point and the AGC system is in proper adjustment it will be necessary to adjust the Horizontal Oscillator by the method outlined in the alignment procedure on page 11.

FOCUS COIL ADJUSTMENTS.—The focus coil should be adjusted so that there is approximately one-quarter inch of space between the rear cardboard shell of the yoke and the flat of the front face of the focus coil. This spacing gives best average focus over the face of the tube. The axis of the hole through the focus coil should be parallel with the axis of the kinescope neck. The focus coil is provided with a magnetic shunt in the form of a metal sleeve. If the receiver focuses with the focus control at or near the end of its range, loosen the shunt locking screw and slide the shunt forward or backward until focus is obtained with the focus control in the middle of its range.

CENTERING ADJUSTMENT.—No electrical centering controls are provided. Centering is obtained by loosening the two focus coil mounting screws and sliding the coil up or down or from side to side. If the focus coil was appreciably changed in position or if a corner of the raster is shadowed, check the position of the ion trap magnet. Reposition the magnet within the range of maximum raster brightness to eliminate the shadow and recenter the picture by sliding the coil. In no case should the magnet be adjusted to cause any loss of brightness since such operation may cause immediate or eventual damage to the tube. In extreme cases it may be necessary to adjust one or more of the three focus coil compression spring screws to eliminate a corner shadow.

WIDTH, DRIVE AND HORIZONTAL LINEARITY ADJUSTMENTS.—Adjustment of the horizontal drive control affects the high voltage applied to the kinescope. In order to obtain the highest possible voltage hence the brightest and best focused picture, adjust horizontal drive counter-clockwise as far as possible without losing tension on trimmer.

Set the width control to minimum picture width.

Turn the horizontal linearity coil out until appreciable loss in width occurs, then in until nearly maximum width and the best linearity is obtained. Do not run the core in beyond the point of maximum linearity change, as the current drawn by the 6BG6G then becomes excessive.

Adjust the width control for the proper picture width.

Readjust linearity, but again not beyond the point of maximum linearity change. If necessary adjust the drive control for best linearity.

If at very high line voltage, the picture width is excessive even with the width control set at minimum, turn the linearity coil out to obtain the proper width. On high line voltage, excessive width generally will be accompanied by good linearity, without retouching the drive.

Adjustments of the horizontal drive control affect horizontal oscillator hold and locking range. If the drive control was adjusted, recheck the oscillator alignment.

FOCUS.—Adjust the focus control (R191 on chassis rear apron) for maximum definition in the test pattern vertical "wedge" and best focus in the white areas of the pattern.

HEIGHT AND VERTICAL LINEARITY ADJUSTMENTS.—Adjust the height control (R155 on chassis rear apron) until the picture fills the mask vertically. Adjust vertical linearity (R162 on rear apron) until the test pattern is symmetrical from top to bottom. Adjustment of either control will require a readjustment of the other. Adjust the focus coil to align the picture with the mask.

Check to see that the cushion and yoke thumbscrews and the focus coil mounting screws are tight.

AGC THRESHOLD CONTROL.—The AGC threshold control R138 is adjusted at the factory and normally should not require readjustment in the field.

To check the adjustment of the AGC threshold control, tune

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INSTALLATION INSTRUCTIONS

in a strong signal, sync the picture and turn the picture control to the maximum clockwise position. Turn the brightness control counter-clockwise until the vertical retrace lines are just invisible. Momentarily remove the signal by switching off channel and then back. If the picture reappears immediately, the receiver is not overloading due to improper setting of R138. If the picture requires an appreciable portion of a second to reappear, R138 should be readjusted.

Set the picture control at the maximum clockwise position. Turn R138 fully clockwise. The top one-half inch of the picture may be bent slightly. This should be disregarded. Turn R138 counter-clockwise until there is a very, very slight bend or change of bend in the top one-half inch of the picture. Then turn R138 clockwise just sufficiently to remove this bend or change of bend.

If the signal is very weak, the above method may not work as it may be impossible to get the picture to bend. In this case, turn R138 counter-clockwise until the snow in the picture becomes more pronounced, then clockwise until the best signal to noise ratio is obtained.

The AGC control adjustment should be made on a strong signal if possible. If the control is set too far counter-clockwise on a weak signal, then the receiver may overload when a strong signal is received.

CHECK OF R-F OSCILLATOR ADJUSTMENTS.—Tune in all available stations to see if the receiver r-f oscillator is adjusted to the proper frequency on all channels. If adjustments are required, these should be made by the method outlined in the alignment procedure on page 10. The adjustments for channels 2 through 5 and 7 through 12 are available from the front of the cabinet by removing the station selector escutcheon as shown in Figure 4. Adjustment for channel 13 is on top of the chassis and channel 6 adjustment is in the kinescope well. See Figures 9 and 10 for their location.

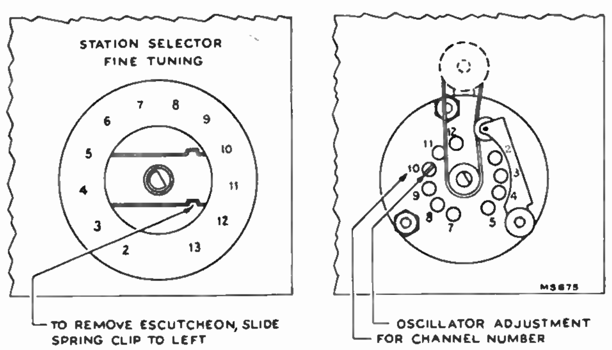

Figure 4—R-F Oscillator Adjustments

RADIO OPERATION.—Turn the receiver function switch to AM and FM positions and check the radio for proper operation. Tune in a station of known frequency. If the dial pointer does not point to the correct spot on the dial, slip the dial pointer on the dial cord until the proper indication is obtained.

RECORD CHANGER OPERATION.—Turn the receiver function switch to each phono position and check each record player for proper operation.

Replace the cabinet back and make sure that the screws are tight in order to prevent rattling at high volume.

WEAK SIGNAL AREA OPERATION.—Since the vast majority of receivers are sold in strong signal areas, the chassis are aligned to produce the cleanest pictures in those areas. However, if the receiver is to be operated in a weak signal area, better performance can be obtained by "peaking" the r-f unit.

To peak the r-f unit in these receivers, disconnect the 390 ohm resistor R14 which is on top of the r-f unit chassis. Adjust L66 to obtain the best possible picture on the weakest low channel station received.

If the peaked receiver is subsequently taken to a strong signal area, the resistor R14 should be connected in place and L66 adjusted for "flat" response on the low channels.

CHASSIS REMOVAL.—To remove the chassis from the cabinet for repair or installation of a new kinescope, remove the control knobs, the cabinet back, unplug the speaker cable, the kinescope socket, the antenna cable, the pilot light cable, the yoke and focus coil cable. Remove the yoke frame grounding strap and the interlock switch. Take out the six chassis bolts under the cabinet. Withdraw the chassis from the back of the cabinet.

KINESCOPE HANDLING PRECAUTION.—Do not install, remove, or handle the kinescope in any manner, unless shatter-proof goggles and heavy gloves are worn. People not so equipped should be kept away while handling the kinescope. Keep the kinescope away from the body while handling.

To remove the kinescope from the cabinet, take out the four screws and one wing screw which hold the yoke frame to the cabinet. Remove the kinescope, the yoke frame with yoke and focus coil as an assembly.

INSTALLATION OF KINESCOPE.—Handle this tube by the metal rim at the edge of the screen. Do not cover the glass bell of the tube with fingermarks as it will produce leakage paths which may interfere with reception. If this portion of the tube has inadvertently been handled, wipe it clean with a soft cloth moistened with "dry" carbon tetrachloride.

Wipe the kinescope screen surface and front panel safety glass clean of all dust and fingermarks with a soft cloth moistened with "Windex" or similar cleaning agent.

Turn the tube so that the key on the base of the tube will be down and insert the neck of the kinescope through the deflection and focus coils. If the tube sticks, or fails to slip into place smoothly, investigate and remove the cause of the trouble. Do not force the tube.

Replace the kinescope and yoke frame assembly in the cabinet. Insert the four screws and wing screw and tighten.

Slip the kinescope as far forward as possible. Slide the kinescope cushion firmly up against the flare of the tube and tighten the adjustment locking screws. Slide the deflection yoke as far forward as possible and tighten. If this is not done, difficulty will be encountered in adjusting the ion trap magnet and focus coil because of shadows on the corner of the raster.

Slide the chassis into the cabinet, then insert and tighten the six chassis bolts.

Slip the ion trap magnet over the neck of the kinescope.

Connect the kinescope socket to the tube base and slip the high voltage lead clip between the rim of the kinescope and the mask.

Reconnect all other cables. Do not forget to replace the yoke frame grounding strap.

As may be seen by inspection, the radio dial lights and dial pointer are attached to the cabinet front panel. The dial cord is attached to the receiver chassis. The method of attachment may be seen in Figure 5.

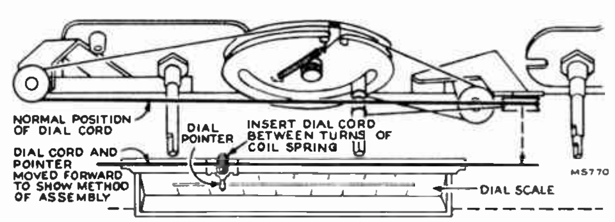

Figure 5—Dial Cord and Pointer Assembly

Reach over the television chassis to the radio and slip the radio pilot lights on the cabinet pilot light brackets.

To hook up the dial pointer, turn the tuning shaft until the gang is fully meshed. Slip the dial pointer to the low frequency end of the dial and press the dial cord well into the coil spring.

Turn the set on and to radio position to see that the dial lighting is correct. If it is not, adjust the dial lights and shields. Tune in a station of known calibration and check the dial calibration.

Perform the entire television set-up procedure beginning with Ion Trap Magnet Adjustment.

CABINET ANTENNA.—A cabinet antenna is provided for use in strong signal areas in which no reflections are experienced. The leads from the antenna are brought out near the receiver antenna terminal board. To connect the cabinet antenna, attach the leads to the terminal board. If reception is satisfactory, no other antenna is necessary. However, if reception is unsatisfactory, it will be necessary to employ an outdoor antenna or an indoor antenna which can be oriented.

CHASSIS TOP VIEW

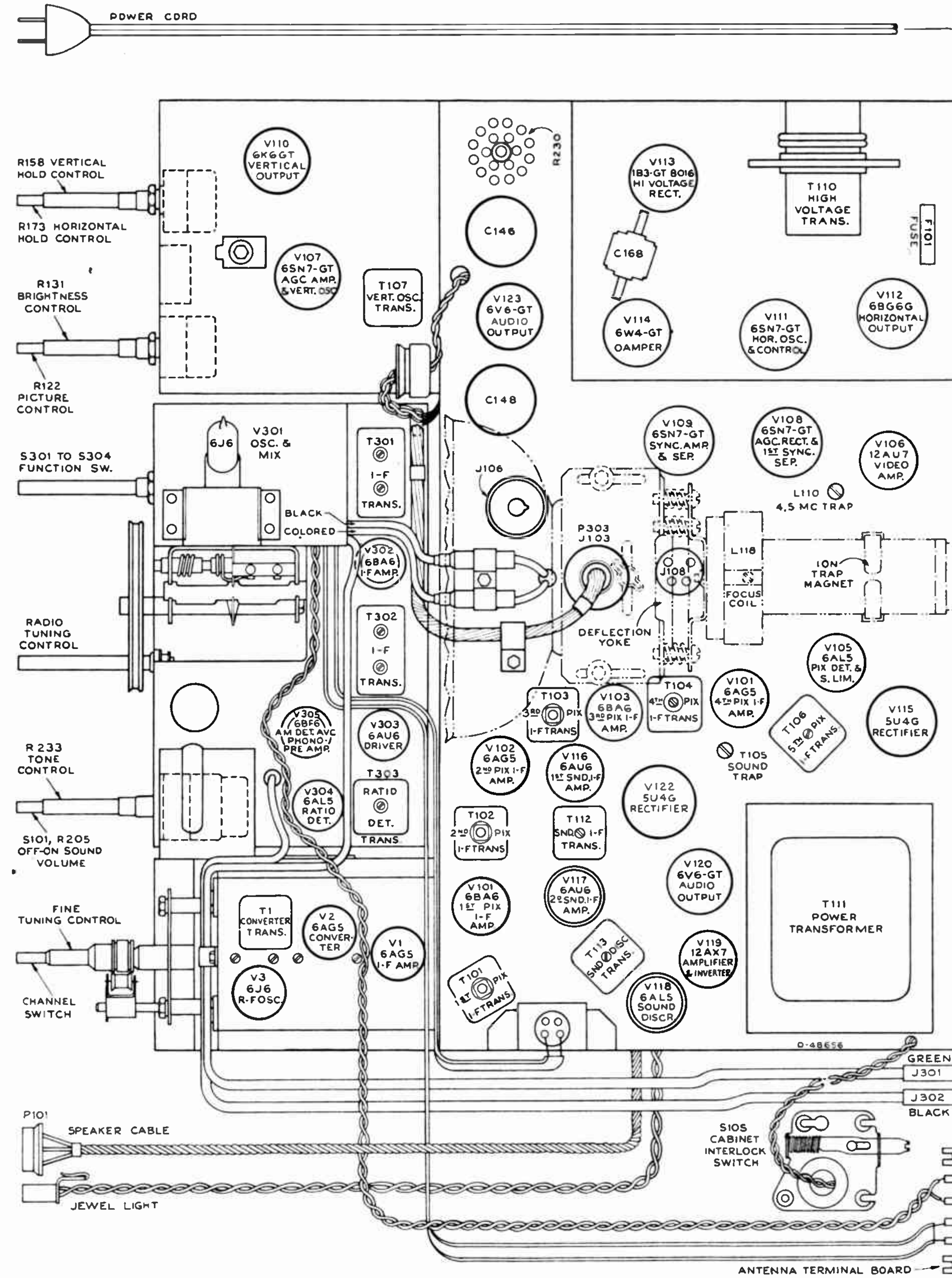

Figure 6—Chassis Top View

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CHASSIS BOTTOM VIEW

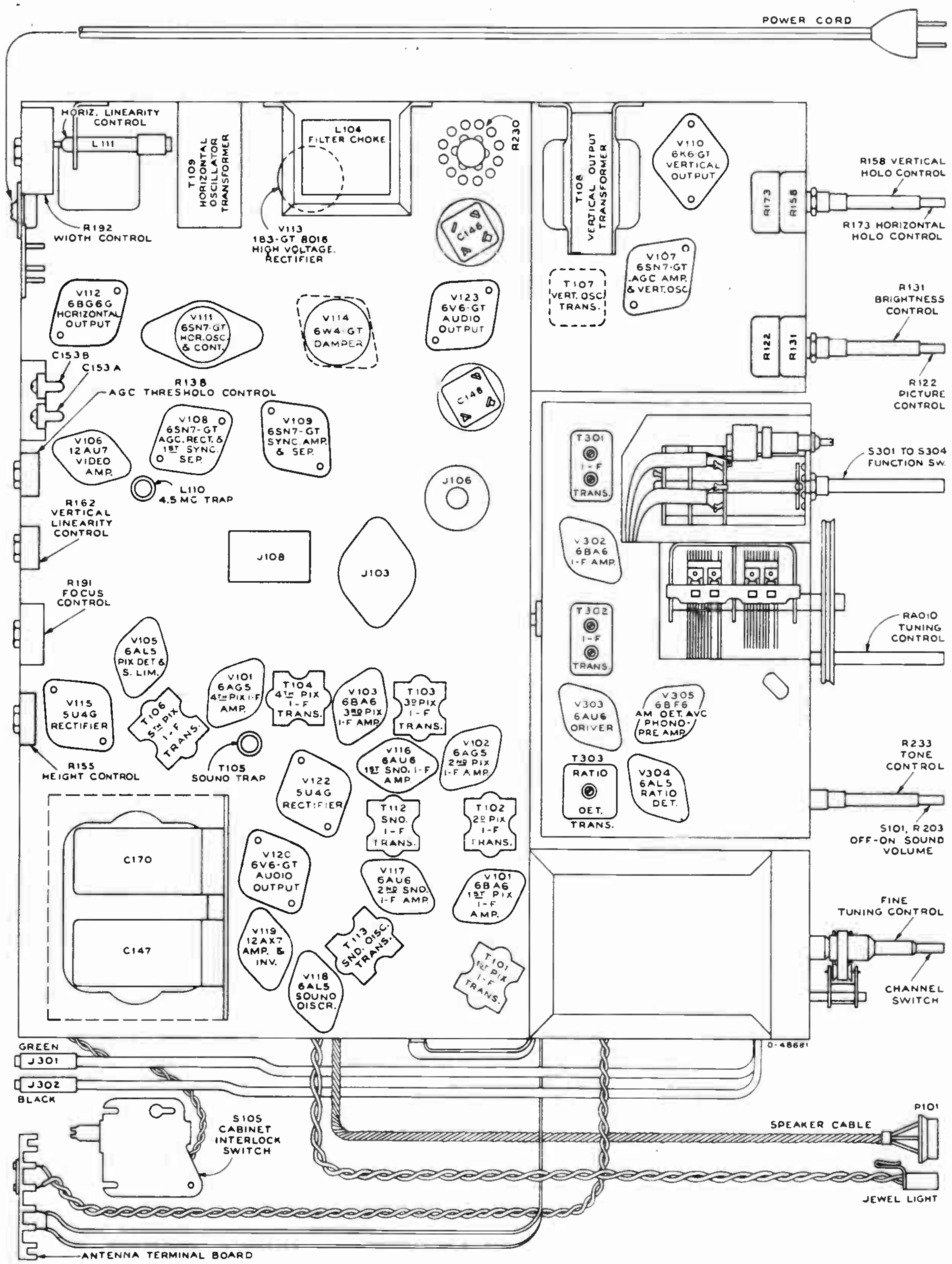

Figure 7—Chassis Bottom View

ALIGNMENT PROCEDURE

TEST EQUIPMENT. — To properly service the television chassis of this receiver, it is recommended that the following test equipment be available:

R-F Sweep Generator meeting the following requirements:

(a) Frequency Ranges

20 to 30 mc., 1 mc. and 10 mc. sweep width
50 to 90 mc., 10 mc. sweep width
170 to 225 mc., 10 mc. sweep width

(b) Output adjustable with at least .1 volt maximum.

(c) Output constant on all ranges.

(d) "Flat" output on all attenuator positions.

Cathode-Ray Oscilloscope. — For alignment purposes, the oscilloscope employed must have excellent low frequency and phase response, and should be capable of passing a 60-cycle square wave without appreciable distortion. While this requirement is not met by many commercial instruments, RCA Oscilloscopes, types WO-55A, WO-58A, WO-79A, and WO-60C fill the requirement and any of these may be employed.

For video and sync waveform observations, the oscilloscope must have excellent frequency and phase response from 10 cycles to at least two megacycles in all positions of the gain control. The RCA types WO-58A and WO-79A are ideally suited for this purpose.

Signal Generator to provide the following frequencies with crystal accuracy.

(a) Intermediate frequencies

19.75 mc. adjacent channel picture trap
21.25 mc. sound i-f and sound traps
22.05 and 24.75 mc. conv. and first pix i-f trans.
25.9 mc. second picture i-f transformer
24.6 mc. fourth picture i-f transformer
22.0 mc. third picture i-f transformer
22.5 mc. fifth picture i-f transformer
25.75 mc. picture carrier
27.25 mc. adjacent channel sound trap

(b) Radio frequencies

Channel Number	Picture Carrier Freq. Mc.	Sound Carrier Freq. Mc.
2	55.25	59.75
3	61.25	65.75
4	67.25	71.75
5	77.25	81.75
6	83.25	87.75
7	175.25	179.75
8	181.25	185.75
9	187.25	191.75
10	193.25	197.75
11	199.25	203.75
12	205.25	209.75
13	211.25	215.75

(c) Output of these ranges should be adjustable and at least .1 volt maximum.

Heterodyne Frequency Meter with crystal calibrator if the signal generator is not crystal controlled.

Electronic Voltmeter of Junior "VoltOhmyst" type and a high voltage multiplier probe for use with this meter to permit measurements up to 15 kv.

Service Precautions. — If possible, the chassis should be serviced without the kinescope. However, if it is necessary to view the raster during servicing, it would be a great convenience to have a set of yoke, focus coil, kinescope socket, high voltage and speaker extension cables.

CAUTION: Do not short the kinescope second anode lead. Its short circuit current represents a considerable overload on the high voltage rectifier V113.

Adjustments Required. — Normally, only the r-f oscillator line will require the attention of the service technician. All other circuits are either broad or very stable and hence will seldom require readjustment.

The oscillator line is relatively non critical. When oscillator tubes are changed, in all probability it will be necessary to adjust only C6 in order to bring the entire line into adjustment.

ORDER OF ALIGNMENT. — When a complete receiver alignment is necessary, it can be most conveniently performed in the following order:

(1) Sound discriminator
(2) Sound i-f transformers
(3) Picture i-f traps
(4) Picture i-f transformers
(5) R-F and converter lines
(6) R-F oscillator line
(7) 4.5 mc. video trap
(8) Sensitivity check

SOUND DISCRIMINATOR ALIGNMENT. — Set the signal generator for approximately .1 volt output at 21.25 mc. and connect it to the second sound i-f grid.

Detune T113 secondary (bottom).

Set the "VoltOhmyst" on the 10 volt scale.

Connect the meter in series with a one megohm resistor to the junction of diode resistors R203 and R204.

Adjust the primary of T113 (top) for maximum output on the meter.

Connect the "VoltOhmyst" to the junction of C183 and R203. Adjust T113 secondary (bottom). It will be found that it is possible to produce a positive or negative voltage on the meter dependent upon this adjustment. Obviously to pass from a positive to a negative voltage, the voltage must go through zero. T113 (bottom) should be adjusted so that the meter indicates zero output as the voltage swings from positive to negative. This point will be called discriminator zero output.

Connect the sweep oscillator to the grid of the second sound i-f amplifier.

Adjust the sweep band width to approximately 1 mc. with the center frequency at approximately 21.25 mc. and with an output of approximately .1 volt.

Connect the oscilloscope to the junction of C183 and R203. The pattern obtained should be similar to that shown in Figure 13. If it is not, adjust the T113 (top) until the waveform is symmetrical.

The peak-to-peak band width of the discriminator should be approximately 350 kc. and it should be linear from 21.175 mc. to 21.325 mc.

SOUND I-F ALIGNMENT. — Connect the sweep oscillator to the first sound i-f amplifier grid.

Connect the oscilloscope to the second sound i-f grid return (terminal A T112) in series with a 33,000 ohm isolating resistor.

Insert a 21.25 mc. marker signal from the signal generator into the second sound i-f grid.

Adjust T112 (top and bottom) for maximum gain and symmetry about the 21.25 mc. marker. The pattern obtained should be similar to that shown in Figure 14.

The output level from the sweep should be set to produce approximately .3 volt peak-to-peak at the second sound i-f grid return when the final touches on the above adjustment are made. It is necessary that the sweep output voltage should not exceed the specified values otherwise the response curve will be broadened, permitting slight misadjustment to pass unnoticed and possibly causing distortion on weak signals.

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ALIGNMENT PROCEDURE

The band width at 70% response from the first sound i-f grid to the second i-f grid should be approximately 200 kc.

PICTURE I-F TRAP ADJUSTMENT. — Connect the "VoltOhmyst" to the junction of R135 and C190.

Remove the 6SN7GT AGC Amplifier tube V107. Connect a 250,000 ohm potentiometer between pins 5 and 6 of the V107 socket. Adjust the potentiometer until the "VoltOhmyst" reads approximately −12 volts.

Set the channel switch to the blank position between channel numbers 2 and 13.

Connect the "VoltOhmyst" across the picture detector load resistor R119. Under this condition, both leads of the meter are at approximately −120 volts. In making this measurement, care should be taken not to touch the case of the meter or to permit the meter case to become grounded.

Connect the output of the signal generator to the grid of the converter tube V2. To do this, remove the tube from the socket and fashion a clip by twisting one end of a small piece of wire around pin number 1. Replace the tube in the socket leaving the end of the wire protruding from under the tube. Connect the signal generator to this wire through a 1,500 mmf capacitor keeping the leads as short as possible.

Set the generator to each of the following frequencies and with a thin fiber screwdriver tune the specified adjustment for minimum indication on the "VoltOhmyst." In each instance the generator should be checked against a crystal calibrator to insure that the generator is exactly on frequency.

(1) 21.25 mc.—T103 (top)	(4) 27.25 mc.—T104 (top)
(2) 21.25 mc.—T105 (top)	(5) 19.75 mc.—T106 (top)
(3) 27.25 mc.—T102 (top)	(6) 19.75 mc.—T101 (top)

In the above transformers using threaded cores, it is possible to run the cores completely through the coils and secure two peaks or nulls. The correct position is with the cores in the outside ends of the coils. If the cores are not in the correct position, the coupling will be incorrect and it will be impossible to secure the correct response.

PICTURE I-F TRANSFORMER ADJUSTMENTS. — Set the signal generator to each of the following frequencies and peak the specified adjustment for maximum indication on the "VoltOhmyst." During alignment, reduce the input signal if necessary to prevent overloading.

22.5 mc.—T106 (bottom)
24.6 mc.—T104 (bottom)
22.0 mc.—T103 (bottom)
25.9 mc.—T102 (bottom)

T1 and T101 are coupled by a link and in combination constitute an overcoupled transformer. The characteristics of such a transformer are such that it is impossible to adjust it to a single frequency.

To sweep align T1 and T101, connect a 330 ohm composition resistor across the primary coils of T102, T103, T104 and T106.

Connect the "VoltOhmyst" to the junction of R135 and C190. Adjust the 250,000 ohm potentiometer for −2.0 volts on the meter.

Connect the oscilloscope to the plate of the first video amplifier, pin 1 of V106.

Connect a sweep generator to the converter grid through a 1,500 mmf capacitor. Set the generator to sweep from 20.0 mc. to 30.0 mc. and adjust the output to provide a 4 volt peak-to-peak signal on the scope.

Connect the signal generator loosely to the converter grid and adjust to provide markers at 22.05 mc. and 24.75 mc.

Adjust T1 (top) and T101 (bottom) to obtain the response shown in Figure 15. The T1 core must penetrate to the terminal board end of the coil in order to obtain the correct response.

Remove the 330 ohm resistors from across T102, T103, T104 and T106.

Adjust the 250,000 ohm potentiometer for a 15 volt peak-to-peak signal at the plate of the first video amplifier. The bias as measured by the "VoltOhmyst" should be −12 volts or less.

Observe and analyze the response curve obtained. The response will not be ideal and the i-f adjustments must be retouched in order to obtain the desired curve. See Figure 16.

On final adjustment the picture carrier marker must be at approximately 45% response. The curve must be approximately flat topped, with the 22.1 mc. marker at approximately 95% response, the 25.0 mc. marker below 90% and the 26.5 mc. marker at 5% to 10% on the response curve.

The most important consideration in making the i-f adjustments is to get the picture carrier at the 45% response point. If the picture carrier operates too low on the response curve, loss of low frequency video response, of picture brilliance, of blanking, and of sync may occur. If the picture carrier operates too high on the response curve, the picture becomes smeared. In making these adjustments, care should be taken that no two transformers are tuned to the same frequency as i-f oscillation may result.

Remove the converter tube and take off the clip to pin number 1. Replace the tube in the socket.

Picture I-F Oscillation. — If the receiver will operate without oscillating with the test equipment disconnected but breaks into oscillation or becomes unstable with the equipment connected, it may become necessary to establish a ground plane. Cover the test bench with a sheet of copper and set the chassis on the sheet. Set all the test equipment except the "VoltOhmyst" on the sheet and bond or bypass them to it. A Junior "VoltOhmyst" should not be bonded to the sheet since the negative test probe is not always connected to ground during alignment.

If the receiver is badly misaligned and two or more of the i-f transformers are tuned to the same frequency, the receiver may fall into i-f oscillation. I-F oscillation shows up as a voltage across the picture detector load resistor that is unaffected by r-f signal input. If such a condition is encountered, it is sometimes possible to stop oscillation by increasing the grid bias. If so, it should then be possible to align the transformers by the usual method. Once aligned in this manner, the i-f should be stable with reduced bias.

If the oscillation cannot be stopped in the above manner, shunt the grids of the first three pix i-f amplifiers to ground with 1,000 mmf. capacitors. Connect the signal generator to the fourth pix i-f grid and align T106 to frequency. Progressively remove the shunt from each grid and align the plate coil of that stage to frequency.

If this does not stop the oscillation, the difficulty is not due to i-f misalignment as the i-f section is stable when properly aligned. Check all i-f by-pass condensers, transformer shunting resistors, tubes, socket voltages, etc.

ANTENNA, R-F AND CONVERTER LINE ADJUSTMENT.— In order to align the r-f tuner, it will first be necessary to set the channel 13 oscillator to frequency. The shield over the bottom of the r-f unit must be in place when making any adjustments.

The channel 13 oscillator may be aligned by adjusting it to beat with a crystal calibrated heterodyne frequency meter, or by feeding a signal into the receiver at the r-f sound carrier frequency and adjusting the oscillator for zero output from the sound discriminator. In this latter case the sound discriminator must first have been aligned to exact frequency. Either method of adjustment will produce the same results. The method used will depend upon the type of test equipment available. Regardless of which method of oscillator alignment is used, the frequency standard must be crystal controlled or calibrated.

If the receiver oscillator is to be adjusted by the heterodyne frequency meter method, couple the meter probe loosely to the receiver oscillator.

If the receiver oscillator is adjusted by feeding in the r-f sound carrier signal, connect the signal generator to the receiver antenna terminals. Connect the "VoltOhmyst" to the sound discriminator output (junction of C183 and R203).

Set the receiver channel switch to 13.

Adjust the frequency standard to the correct frequency (237 mc. for heterodyne frequency meter or 215.75 mc. for the signal generator).

Set the fine tuning control to the middle of its range while making the adjustment.

Adjust C6 for an audible beat on the heterodyne frequency meter or zero voltage from sound discriminator.

Now that the channel 13 oscillator is set to frequency, we may procede with the r-f alignment.

Remove the first pix i-f amplifier tube V101.

Connect the oscilloscope to the test connection at R13 in the r-f tuning unit.

Connect the "VoltOhmyst" to the junction of R135 and C197. Adjust the bias potentiometer for −3.5 volts on the meter.

Connect the r-f sweep oscillator to the receiver antenna terminals. The method of connection depends upon the output impedance of the sweep. The P102 connection for 300 ohm balanced or 72 ohm single-ended input are shown in the circuit diagram in Figure 73. If the sweep oscillator has a 50 ohm single-ended output, 300 ohm balanced output can be obtained by connecting as shown in Figure 8.

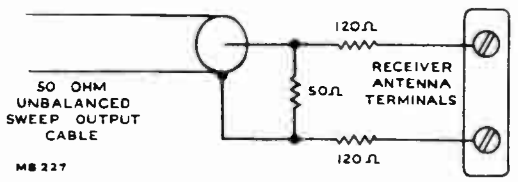

Figure 8—Unbalanced Sweep Cable Termination

Connect the signal generator loosely to the receiver antenna terminals.

Since channel 7 has the narrowest response of any of the high frequency channels, it should be adjusted first.

Set the receiver channel switch to channel 7.

Set the sweep oscillator to cover channel 7.

Insert markers of channel 7 picture carrier and sound carrier 175.25 mc. and 179.75 mc.

Adjust C10 and C14 until the curve falls symmetrically between the sound and picture carrier markers. Adjust C11 to give the proper bandwidth. Roughly peak L6 in conjunction with slight adjustments of C10 and C14 for a flat-topped, response curve with the sound and picture carriers at 90% to 95% response points on this curve. See Figure 17, channel 7.

Switch to channel 12 and adjust L6 for maximum response and minimum top slope of the curve.

Check the response of channels 7 through 13 by switching the receiver channel switch, sweep oscillator and marker oscillator to each of these channels and observe the response obtained. See Figure 17 for typical response curves. It should be found that all these channels have the proper shaped response with the markers above 80% response. If the markers do not fall within this requirement on one or more high frequency channels, since there are no individual channel adjustments, it will be necessary to readjust L6, C10, C11 and C14, and possibly compromise some channel slightly in order to get the markers up on other channels. Normally, however, no difficulty of this type should be experienced since the higher frequency channels become comparatively broad and the markers easily fall within the required range.

Channel 6 is next aligned in the same manner.

Set the receiver to channel 6.

Set the sweep oscillator to cover channel 6.

Set the marker oscillator to channel 6 picture and sound carrier frequencies.

Adjust L9, L13, L66 and C12, for an approximately flat-topped response curve located symmetrically between the markers. L9, L13 and L66 are the center frequency adjustments. C12 is the band width adjustment.

Check channels 5 down through channel 2 by switching the receiver, sweep oscillator and marker oscillator to each channel and observing the response obtained. In all cases, the markers should be above the 80% response point. If this is not the case, L9, L13, L66 and C12 should be retouched. On final adjustment, all channels must be within the 80% specification.

Disconnect the bias pot. and replace V107. Replace V101.

Following an r-f alignment, the oscillator alignment must be checked.

R-F OSCILLATOR LINE ADJUSTMENT. — The r-f oscillator line may be aligned by adjusting it to beat with a crystal calibrated heterodyne frequency meter, or by feeding a signal into the receiver at the r-f sound carrier frequency and adjusting the oscillator for zero output from the sound discriminator. In this latter case the sound discriminator must first have been aligned to exact frequency. Either method of adjustment will produce the same results. The method used will depend upon the type of test equipment available.

Regardless of which method of oscillator alignment is used, the frequency standard must be crystal controlled or calibrated. If the receiver oscillator is to be adjusted by the heterodyne frequency meter method, the calibration frequency listed under R-F Osc. Freq. must be available.

If the receiver oscillator is adjusted by feeding in the r-f sound carrier frequency, the frequencies listed under Sound Carrier Freq. must be available.

Channel Number	Receiver R-F Osc. Freq. Mc.	R-F Sound Carrier Freq. Mc.	Channel Oscillator Adjustment
2	81	59.75	L24
3	87	65.75	L23
4	93	71.75	L22
5	103	81.75	L21
6	109	87.75	L31
7	201	179.75	L19
8	207	185.75	L18
9	213	191.75	L17
10	219	197.75	L16
11	225	203.75	L15
12	231	209.75	L14
13	237	215.75	C6

If the heterodyne frequency meter method is used, couple the meter probe loosely to the receiver oscillator.

If the r-f sound carrier method is used, connect the "VoltOhmyst" to the sound discriminator output (junction of C183 and R203).

Connect the signal generator to the receiver antenna terminals. The order of alignment remains the same regardless of which method is used.

If the r-f unit is removed from the receiver for service and is aligned separately the shield over the bottom of the r-f unit must be in place when making adjustments.

Since lower frequencies are obtained by adding steps of inductance, it is necessary to align channel 13 first and continue in reverse numerical order.

Set the receiver channel switch to 13.

Adjust the frequency standard to the correct frequency (237 mc. for heterodyne frequency meter or 215.75 mc. for the signal generator).

Set the fine tuning control to the middle of its range while making the adjustment.

Adjust C6 for an audible beat on the heterodyne frequency, meter or zero voltage from sound discriminator. Oscillator adjustments L1 and L2 shown on the schematic are factory control adjustments and should not be touched in the field.

Switch the receiver to channel 12.

Set the frequency standard to the proper frequency as listed in the alignment table.

Adjust L14 for indications as above.

Adjust the oscillator to frequency on all channels by switching the receiver and the frequency standard to each channel and adjusting the appropriate oscillator trimmer for the speci-

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ALIGNMENT PROCEDURE

fied indication. It should be possible to adjust the oscillator to the correct frequency on all channels with the fine tuning control in the middle third of its range.

After the oscillator has been set on all channels, start back at channel 13 and recheck to make sure that all adjustments are correct.

AGC THRESHOLD ADJUSTMENT. — The AGC threshold adjustment can be made by the method outlined in the Installation Instructions. However, a more accurate adjustment can be obtained by the use of an oscilloscope.

Tune in a station and advance the picture control to the maximum clockwise position. Connect the low capacity probe from the oscilloscope to the plate of the first video amplifier. Adjust the oscilloscope to observe the horizontal sync pulse.

Turn the AGC threshold control R138 fully clockwise, then slowly counterclockwise. As the control is turned counterclockwise, the receiver gain will increase slowly, increasing the size of the pattern on the oscilloscope. R138 should be turned counterclockwise until the receiver begins to overload as indicated by clipping of the sync. The control should be left in the maximum gain position in which no clipping of sync is observed. See Figure 18 for proper waveforms.

HORIZONTAL OSCILLATOR ADJUSTMENT. — Normally the adjustment of the horizontal oscillator is not considered to be a part of the alignment procedure, but since the oscillator waveform adjustment requires the use of an oscilloscope, it can not be done conveniently in the field. The waveform adjustment is made at the factory and normally should not require readjustment in the field. However, the waveform adjustment should be checked whenever the receiver is aligned or whenever the horizontal oscillator operation is improper.

Horizontal Frequency Adjustment.—Set the locking range trimmer one half turn out from maximum capacity. With a clip lead, short circuit the coil between terminals C and D of the horizontal oscillator transformer T109. Tune in a television station and sync the picture if possible.

A. — Turn the horizontal hold control R173 to the extreme clockwise position. Adjust the T109 Frequency Adjustment (under the chassis) so that the picture is just out of sync and the horizontal blanking appears in the picture as a vertical bar. The position of the bar is unimportant.

Note.—Occasionally a tube may be found which does not respond to step "A" above, since it may not be possible to sync the picture by means of the frequency core when the sine wave coil is shorted out. Yet, the tube may work perfectly well when the circuit is properly aligned. In such a case, it may be necessary to remove the short then turn the sine wave core out then in until it is possible to obtain sync by adjustment of the frequency core.

B. — Turn the hold control approximately one-quarter of a turn from the extreme clockwise position and examine the width and linearity of the picture. If picture width or linearity is incorrect, adjust the horizontal drive control C153B, the width control R192 and the linearity control L111 until the picture is correct. If C153B was adjusted, repeat step "A" and note above.

Horizontal Oscillator Waveform Adjustment. — Remove the shorting clip from terminals C and D of T109. Turn the horizontal hold control to the extreme clockwise position. With a thin fibre screwdriver, if necessary, adjust the Oscillator Waveform Adjustment Core of T109 (on the outside of the chassis) until the horizontal blanking bar appears in the raster. The waveform adjustment core will sync the picture in two positions. The core should be in the position nearest the outside of the chassis.

A. Connect the low capacity probe of an oscilloscope to terminal C of T109. Alternately adjust the waveform and frequency cores of T109 until the peak of the sine wave is equal in amplitude to the peak of the saw tooth, on the oscilloscope as shown in Figure 19, while maintaining the picture in synchronization. Then adjust the frequency core until horizontal blanking shows as a vertical bar in the picture.

This adjustment is very important for correct operation of the circuit. If the broad peak of the wave on the oscilloscope is lower than the sharp peak, the noise immunity becomes poorer, the stabilizing effect of the tuned circuit is reduced and drift of the oscillator becomes more serious. On the other hand, if the broad peak is higher than the sharp peak, the oscillator is overstabilized, the pull-in range becomes inadequate and the broad peak can cause double triggering of the oscillator when the hold control approaches the clockwise position.

Remove the oscilloscope upon completion of this adjustment.

Check of Oscillator Pull-in Range. — Set the horizontal hold control to the full counter-clockwise position.

Connect a 270K ohm resistor across C156.

Momentarily switch off channel and back. The picture will then be out of sync.

Turn the hold control clockwise slowly and observe the minimum number of bars obtained just before the picture pulls into sync. The picture should snap in from two complete blanking bars. If two bars are not obtained turn the locking range trimmer C153A in to obtain less bars or out to obtain more bars.

After adjustment of C153A, remove the 270K resistor, turn the horizontal hold control fully clockwise and readjust the frequency core of T109 until the picture is in sync and the horizontal blanking bar begins to move in the picture. Then repeat the entire "Check of Pull-in Range" procedure to this point. Repeat this procedure until two bar pull-in is obtained.

Turn the horizontal hold control to the maximum clockwise position. The picture should be just out of sync to the extent that the horizontal blanking bar appears as a single vertical or diagonal bar in the picture. Adjust the T109 Frequency Adjustment until this condition is fulfilled.

4.5 MC. VIDEO TRAP ADJUSTMENT. — Tune in a strong input from a station, and with a very short clip lead, short the trap winding of T103. Observe the picture for the appearance of a 4.5 mc. beat. If the beat appears in the picture, adjust L110 until the beat is eliminated or minimized.

SENSITIVITY CHECK. — A comparative sensitivity check can be made by operating the receiver on a weak signal from a television station and comparing the picture and sound obtained to that obtained on other receivers under the same conditions.

This weak signal can be obtained by connecting the shop antenna to the receiver through a ladder type attenuator pad. The number of stages in the pad depends upon the signal strength available at the antenna. A sufficient number of stages should be inserted so that a somewhat less than normal contrast picture is obtained when the picture control is at the maximum clockwise position. Only carbon type resistors should be used to construct the pad.

RESPONSE CURVES. — The response curves shown on page 14 and referred to throughout the alignment procedure were taken from a production set. Although these curves are typical, some variations can be expected.

The response curves are shown in the classical manner of presentation, that is with "response up" and low frequency to the left. The manner in which they will be seen in a given test set-up will depend upon the characteristics of the oscilloscope and the sweep generator. The curves may be seen inverted and/or switched from left to right depending on the deflection polarity of the oscilloscope and the phasing of the sweep generator.

ALIGNMENT TABLE. — Both methods of oscillator alignment are presented in the alignment table. The service technician may thereby choose the method to suit his test equipment.

ALIGNMENT DATA

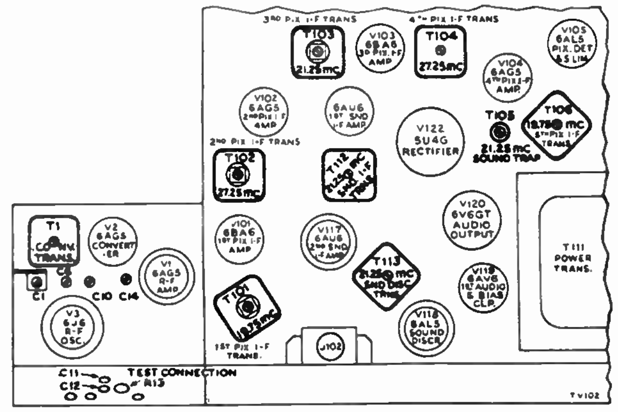


Figure 9—Top Chassis Adjustments

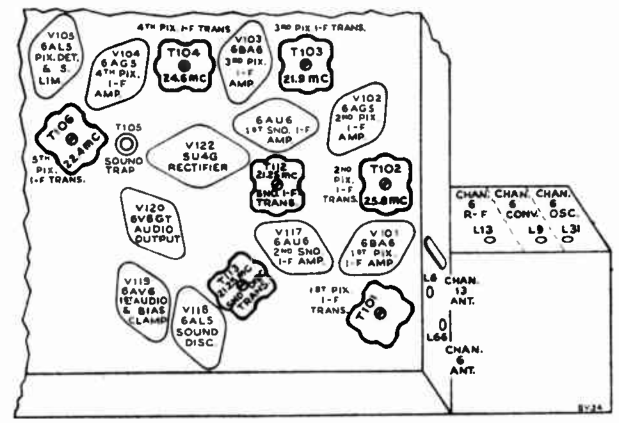


Figure 10—Bottom Chassis Adjustments

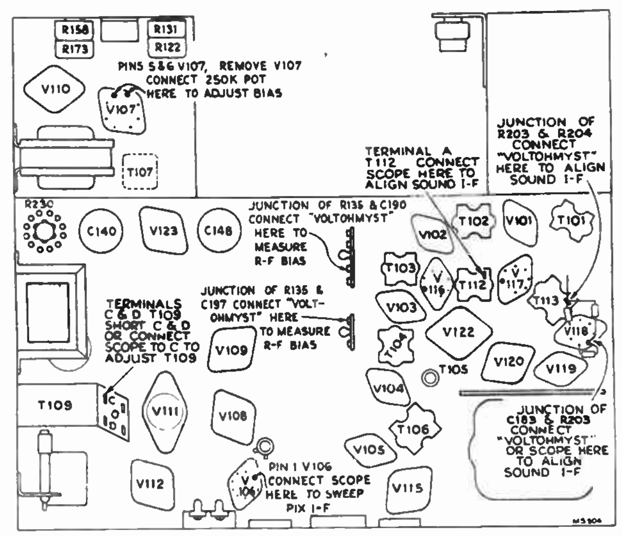
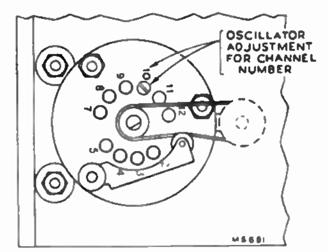


Figure 11—Test Connection Points



OSCILLATOR ADJUSTMENT FOR CHANNEL 13 IS ON TOP OF R-F UNIT AND CHANNEL 6 IS ON SIDE.

Figure 12—R-F Oscillator Adjustments

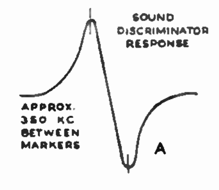


Figure 13 Discriminator Response

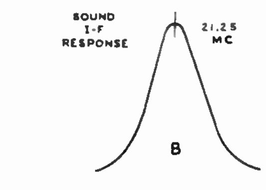


Figure 14 Sound I-F Response

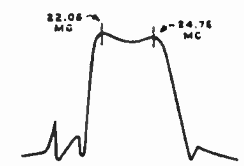


Figure 15 T1 and T101 Response

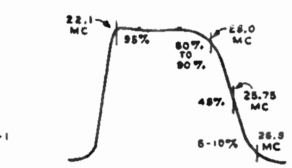


Figure 16 Overall I-F R-F Response

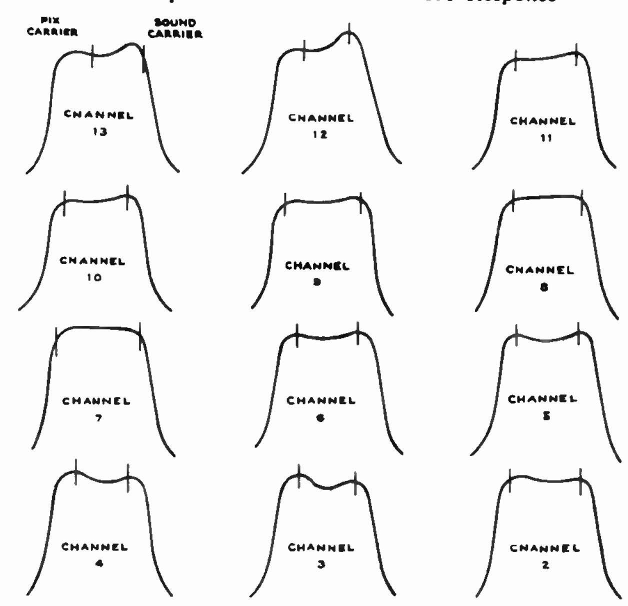


Figure 17—R-F Response

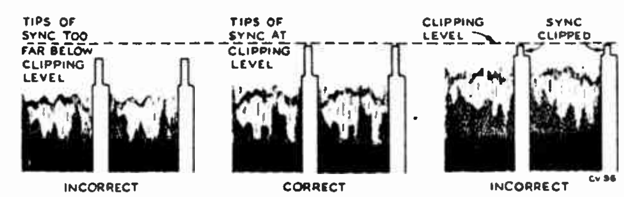


Figure 18—AGC Threshold Adjustment Waveforms

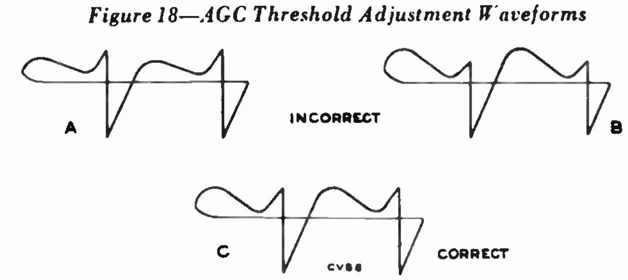


Figure 19—Horizontal Oscillator Waveforms

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ALIGNMENT TABLE

THE DETAILED ALIGNMENT PROCEDURE BEGINNING ON PAGE 8 SHOULD BE READ BEFORE ALIGNMENT BY USE OF THE TABLE IS ATTEMPTED.

STEP No.	CONNECT SIGNAL GENERATOR TO	SIGNAL GEN. FREQ. MC.	CONNECT SWEEP GENERATOR TO	SWEEP GEN. FREQ. MC.	CONNECT OSCILLOSCOPE TO	CONNECT "VOLTOHMYST" TO	MISCELLANEOUS CONNECTIONS AND INSTRUCTIONS	ADJUST	REFER TO
	DISCRIMINATOR AND SOUND I-F ALIGNMENT								
1	2nd sound i-f grid (pin 1, V117)	21.25 .1 volt output	Not used		Not used	In series with 1 meg. to junction of R203 & R204		Detune T113 (bot.) Adjust T113 (top) for max. on meter	Fig. 9 Fig. 10 Fig. 11
2	"	"	"		"	Junction of C183 & R203	Meter on 3 volt scale	T113 (bottom) for zero on meter	Fig. 10 Fig. 10
3	"	"	2nd sound i-f grid (pin 1, V117)	21.25 center 1 mc. wide .1 v. out	Junct. of C183 & R203	Not used	Check for symmetrical response waveform (positive & negative). If not equal adjust T113 (top) until they are equal		Fig. 11 Fig. 13
4	1st sound i-f grid (pin 1, V116)	21.25 reduced output	1st sound i-f grid	21.25 reduced output	Terminal A, T112 in series with a 33,000 ohm resistor.	"	Sweep output reduced to provide .3 volt p-to-p on scope	T112 (top & bot.) for max. gain and symmetry at 21.25 mc.	Fig. 11 Fig. 9 Fig. 10 Fig. 14
	PICTURE I-F AND TRAP ADJUSTMENT								
5	Not used		Not used		Not used	Junction of R135 & C190	Remove V107. Connect potentiometer between pins 5 & 6 of V107 socket	Adjust potentiometer for −12 volts on meter	Fig. 11 Fig. 9
6	Converter grid (pin 1, V2)	21.25	"		"	Across R119	Meter on 3 volt scale. Receiver between 2 & 13	T103 (top) for min. on meter	Fig. 9 Fig. 11
7	"	21.25	"		"	"	"	T105 (top) for min.	Fig. 11 Fig. 9
8	"	27.25	"		"	"	"	T102 (top) for min.	"
9	"	27.25	"		"	"	"	T104 (top) for min.	"
10	"	19.75	"		"	"	"	T106 (top) for min.	"
11	"	19.75	"		"	"	"	T101 (top) for min.	"
12	"	22.5	"		"	"	"	T106 (bottom) for max. on meter	Fig. 10
13	"	24.6	"		"	"	"	T104 (bottom) for max.	"
14	"	22.0	"		"	"	"	T103 (bottom) for max.	"
15	"	25.9	"		"	"	"	T102 (bottom) for max.	"
16	"	22.05 24.75	Converter grid (pin 1, V2)	Sweeping 20 to 30 mc.	Pin 1, V106	Junction of R135 & C190	Shunt 300 ohms across pri. T102, T103, T104, T106. Set bias −2 V. Set swp. gen. for 4 V. P-P on scope.	Adjust T1 (top) and T101 (bottom) for proper response	Fig. 10 Fig. 15
17	"		"	"	"	"	Remove shunt resistors. Set bias to give 15 volts P to P on scope.	Adjust T1 (top), T101, T102, T103, T104, T106 (bot.) for proper resp.	Fig. 9 Fig. 10 Fig. 11 Fig. 16
	ANTENNA, R-F AND CONVERTER LINE ALIGNMENT								
18	Antenna terminals	215.75	Not used		Not used	Junction of C183 & R203 for signal gen. method only	Fine tuning centered. Receiver on channel 13. Heterodyne meter coupled to oscillator if used.	C6 for zero on meter or beat on het. freq. meter	Fig. 11 Fig. 9
19						Junction of R135 & C197	Remove V101	Potentiometer for −3.5 volts on meter	Fig. 11 Fig. 9
20	Antenna terminal (loosely)	175.25 & 179.75	Antenna terminals (see text for precaution)	Sweeping channel 7	Test Connection R13	Not used	Receiver on channel 7	L6, C10, C11 & C14 for flat top response between markers. Markers above 90%.	Fig. 11 Fig. 10 Fig. 9 Fig. 17 (7)
21	"	205.25 209.75	"	channel 12	"	"	Receiver on channel 12	L6 for max. response and min. slope of top of curve	Fig. 16 Fig. 17 (12)
22	"	175.25 179.75	"	channel 7	"	"	Receiver on channel 7	Check to see that response is as above	Fig. 17 (7)
23	"	181.25 185.75	"	channel 8	"	"	Receiver on channel 8	"	Fig. 17 (8)
24	"	187.25 191.75	"	channel 9	"	"	Receiver on channel 9	"	Fig. 17 (9)
25	"	193.25 197.75	"	channel 10	"	"	Receiver on channel 10	"	Fig. 17 (10)

STEP No.	CONNECT SIGNAL GENERATOR TO	SIGNAL GEN. FREQ. MC.	CONNECT SWEEP GENERATOR TO	SWEEP GEN. FREQ. MC.	CONNECT OSCILLOSCOPE TO	CONNECT "VOLTOHMYST" TO	MISCELLANEOUS CONNECTIONS AND INSTRUCTIONS	ADJUST	REFER TO
	R-F AND CONVERTER LINE ALIGNMENT (Cont'd)								
26	"	199.25 203.75	"	channel 11	"	"	Receiver on channel 11	"	Fig. 17 (11)
27	"	205.25 209.75	"	channel 12	"	"	Receiver on channel 12	"	Fig. 17 (12)
28	"	211.25 215.75	"	channel 13	"	"	Receiver on channel 13	"	Fig. 17 (13)
29	If the response on any channel (steps 22 through 28) is below 80% at either marker, switch to that channel and adjust L6, C10, C11 & C14 to pull response up on that channel. Then recheck steps 22 through 28.								
30	Antenna terminals (loosely)	83.25 87.75	Ant. terminals (see text for precaution)	Sweeping chan. 6	Test Connection R13	Not used	Receiver on channel 6	L9, L13, L66 & C12 for response as above	Fig. 17 (6)
31	"	77.25 81.75	"	channel 5	"	"	Receiver on channel 5	Check to see that response is as above	Fig. 17 (5)
32	"	67.25 71.75	"	channel 4	"	"	Receiver on channel 4	"	Fig. 17 (4)
33	"	61.25 65.75	"	channel 3	"	"	Receiver on channel 3	"	Fig. 17 (3)
34	"	55.25 59.75	"	channel 2	"	"	Receiver on channel 2	"	Fig. 17 (2)
35	If the response on any channel (steps 31 through 34) is below 80% at either marker, switch to that channel and adjust L9, L13, L66 & C12 to pull response up on that channel. Then recheck steps 30 through 34. Disconnect bias pot and replace V101 and V107.								

R-F OSCILLATOR ALIGNMENT

STEP No.	CONNECT SIGNAL GENERATOR TO	SIGNAL GEN. FREQ. MC.	CONNECT HETERODYNE FREQ. METER TO	HET. METER FREQ. MC.	CONNECT OSCILLOSCOPE TO	CONNECT "VOLTOHMYST" TO	MISCELLANEOUS CONNECTIONS AND INSTRUCTIONS	ADJUST	REFER TO
36	Antenna terminals	215.75	Loosely coupled to r-f osc.	237	Not used	Junction of C183 & R203 for sig. gen. method only	Fine tuning centered. Receiver on channel 13	C6 for zero on meter or beat on het. freq. meter	Fig. 11 Fig. 10 Fig. 9
37	"	209.75	"	231	"	"	Rec. on chan. 12	L14 as above	Fig. 12
38	"	203.75	"	225	"	"	Rec. on chan. 11	L15 as above	"
39	"	197.75	"	219	"	"	Rec. on chan. 10	L16 as above	"
40	"	191.75	"	213	"	"	Rec. on chan. 9	L17 as above	"
41	"	185.75	"	207	"	"	Rec. on chan. 8	L18 as above	"
42	"	179.75	"	201	"	"	Rec. on chan. 7	L19 as above	"
43	"	87.75	"	109	"	"	Rec. on chan. 6	L31 as above	Fig. 10
44	"	81.75	"	103	"	"	Rec. on chan. 5	L21 as above	Fig. 12
45	"	71.75	"	93	"	"	Rec. on chan. 4	L22 as above	"
46	"	65.75	"	87	"	"	Rec. on chan. 3	L23 as above	"
47	"	59.75	"	81	"	"	Rec. on chan. 2	L24 as above	"
48	Repeat steps 36 through 47 as a check.								
	AGC THRESHOLD ADJUSTMENT								
49	Not used		Not used		Pin 1, V106	Not used	Tune in station, turn pix control clockwise. Adjust R138 for max. gain without clipping sync on scope		Fig. 11 Fig. 18
	HORIZONTAL OSCILLATOR ADJUSTMENT								
50	Short circuit terminals C and D of T109. Tune in a station. Set locking range trimmer C153A ½ turn out from maximum.								
51	Turn hold control fully clockwise. Adjust T109 Frequency Adjustment until horizontal blanking bar appears in the picture.								
52	Turn hold control ¼ turn from clockwise to sync picture. Adjust width (R192), linearity (L111) and drive (C153B) controls until picture is correct. Repeat step 51, then proceed with step 53.								
53	Remove clip from terminals C and D of T109. Turn hold control fully clockwise. Adjust T109 Oscillator Waveform Adjustment until horizontal blanking bar appears in picture with core in outer of two possible positions.								
54	Connect low capacity probe of oscilloscope to terminal C of T109. Alternately adjust T109 Oscillator Waveform Adjustment and frequency adjustment until broad and sharp peaks of wave on oscilloscope are same height while keeping picture in sync. Remove oscilloscope.								
55	Connect a 270K resistor across C156. Turn hold control fully counter-clockwise. Momentarily remove signal. Turn hold control slowly clockwise. Note least number of bars before pull-in. Adjust Locking Range Control (C153A) for 2 bar pull-in.								
56	Turn hold control fully clockwise. Adjust T109 Freq. Adjustment until horizontal blanking appears as single vertical or diagonal bar in pix.								
	4.5 MC VIDEO TRAP ADJUSTMENT								
57	Tune in a strong station. Short T103 trap. If a 4.5 mc. beat appears in picture adjust 4.5 mc. trap (L110) until beat is eliminated.								
	SENSITIVITY CHECK								
58	Connect antenna to receiver through attenuator pad to provide weak signal. Compare the picture and sound obtained to that obtained on other receivers under the same conditions.								

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RADIO ALIGNMENT PROCEDURE

If any lead dressing is necessary, it should be done before aligning the receiver. When making a complete alignment follow the table below in sequence. If only a portion of the circuit is to be aligned select the portion required and follow with the remaining steps in the section. Any adjustments made on the 455 kc. I-F's make it necessary to adjust the 10.7 mc. I-F's.

"AM" R-F—I-F ALIGNMENT

Test-Oscillator.—For all alignment operations, connect low side of the test-osc. to the receiver chassis, and keep the osc. output as low as possible to avoid a-v-c action. Output Meter.—Connect the meter across the speaker voice coil, and turn the receiver volume control to max.

Steps	Connect the High Side of the Test Osc. to—	Tune Test Osc. to—	Function Switch	Turn Radio Dial to—	Adjust the following
1	Antenna terminal in series with .01 mfd.	455 kc. Modulated	AM	Low Freq. end of Dial	†Top and bot. cores of T301 and T302. (For max. voltage across voice coil.)
2	Ant. terminal through dummy ant. of 200 mmfs.	1,620 kc.	AM	Min. capacity	Osc. C308 for maximum output.
3		1,400 kc.	AM	Tune to signal	Ant. C304 for maximum output.
4		600 kc.	AM	600 kc.	Osc. L306 and Ant. L303.
5	Repeat steps 2, 3 and 4 for maximum output.				

† Use alternate loading. Connect an 18,000-ohm resistor across the primary to load the plate winding while the grid winding of the same transformer is being peaked. Then load the grid winding with the 18,000-ohm resistor while the plate winding is being peaked.

RATIO DETECTOR ALIGNMENT

Connect probe of "VoltOhmyst" to negative side of C328 and low side to chassis. Connect output meter across speaker voice coil.

Steps	Connect the High Side of the Test Osc. to—	Tune Test Osc. to—	Function Switch	Radio Dial Tuned to—	Adjust
6	Pin No. 1 of 6AU6 (V303) in series with .01 mfd.	10.7 mc. 30% AM Modulated	FM	———	Top of T303 for maximum DC on "VoltOhmyst."
7	Pin No. 1 of 6AU6 (V303) in series with .01 mfd.		FM	———	Bottom of T303 for minimum audio output on meter.
8	Repeat steps 6 and 7 as necessary making final adjustment with r-f input level set to give approximately −3.0 volts d-c on "VoltOhmyst."				

"FM" R-F—I-F ALIGNMENT

Steps	Connect the High Side of the Test Osc. to—	Tune Test Osc. to—	Function Switch	Radio Dial Tuned to—	Adjust
9	Terminal 3 of S301-2 rear through 270 ohms.	10.7 mc.	FM	88 mc.	*T301 and T302 for max. with r-f input set to give −3 volts on "VoltOhmyst."
10	Terminal 3 of S301-2 rear through 270 ohms.	106 mc.	FM	106 mc.	Set C302 to max. capacity. Squeeze L307 and adjust C302 for maximum.
11	Terminal 3 of S301-2 rear through 270 ohms.	90 mc.	FM	Tune to signal	Squeeze L301 and rock gang for maximum output.
12	Repeat steps 10 and 11 as required.				

* Use a 680-ohm resistor to load the plate winding while the grid winding of the same transformer is being peaked. Then the grid winding is loaded with 680-ohm resistor while the plate winding is being peaked.

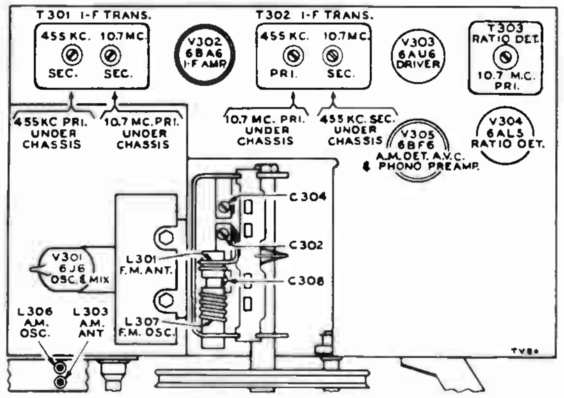

Figure 20—Chassis, Top View, Showing Adjustments

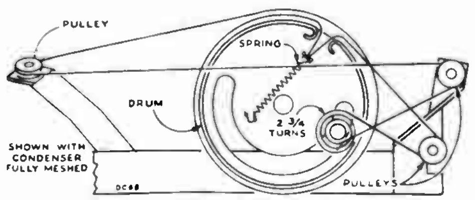

Figure 21—Dial and Drive Cord Assembly

CRITICAL LEAD DRESS:

1. Ground lead on pin 2 of V302 and V303 should be dressed down flat on chassis.
2. Dual .005 mfd. capacitors and diode filter should be dressed to clear the bottom of the cabinet.
3. Dress C329 across V302 sockets with short and direct leads.
4. Dress V302 plate lead from pin 5 down to the chassis.
5. Dress AVC lead from R321 to switch down to chassis and against back of gang mounting plate.
6. Dress lead from pin 6 of V305 down to chassis and against back of gang mounting plate.
7. Dress AVC lead from 1st I-F to switch against chassis and against gang mounting plate.
8. Dress lead from switch to pin 1 of V301 against plate supporting gang.
9. Dress all insulated F-M leads down to chassis.
10. Connect C309 with short lead to pin 6 of V301 keeping body of cap away from plate lead and switch terminals.
11. The coupling between L301 and L307 should be adjusted to give proper injection voltage to the mixer grid. This has been found to be correct when the distance between adjacent end turns is 3/8" to 7/16" measured at top of the form.
12. Dress cabled leads away from antenna transmission lines.
13. Dress all uninsulated bus wire so as to avoid short circuits.

SERVICE SUGGESTIONS

Following is a list of symptoms of possible failures and an indication of some of the possible faults:

NO RASTER ON KINESCOPE:

(1) Incorrect adjustment of ion trap magnet. Magnets reversed either front to back or top to bottom.

(2) V112 or V113 inoperative. Check waveforms on grids and plates.

(3) No high voltage—If horizontal deflection is operating as evidenced by the correct waveform on terminal 4 of J106, the trouble can be isolated to the 8016 circuit. Either the T110 high voltage winding is open, the 8016 tube is defective, its filament circuit is open, or C168 is shorted.

(4) V111 circuit inoperative—Refer to schematic and waveform chart.

(5) Damper tube (V114) inoperative.

(6) Defective kinescope.

(7) R131 open.

(8) No receiver plate voltage—filter capacitor shorted—bleeder or filter choke open.

NO VERTICAL DEFLECTION:

(1) V107B or V110 inoperative. Check voltage and waveforms on grids and plates.

(2) T107 or T108 open.

(3) Vertical deflection coils open.

SMALL RASTER:

(1) Low Plus B or low line voltage.

(2) V112 defective.

(3) Defective yoke.

POOR VERTICAL LINEARITY:

(1) If adjustments cannot correct, change V110.

(2) T107 or T108 transformer defective.

(3) V107B defective—check voltage and waveforms on grid and plate.

(4) C150, R164, C146B, C147C, C148C or C166 defective.

(5) Low bias or plate voltage—check rectifiers and capacitors in supply circuits.

POOR HORIZONTAL LINEARITY:

(1) If adjustments do not correct, change V112 or V114.

(2) T110 or L111 defective.

(3) C164 or C165 defective.

WRINKLES ON LEFT SIDE OF RASTER:

(1) C169 defective or incorrectly connected.

(2) C141 or C191 defective.

(3) Defective yoke.

PICTURE OUT OF SYNC HORIZONTALLY:

(1) T109 incorrectly tuned.

(2) R172, R173 or R174 defective.

TRAPEZOIDAL OR NON-SYMMETRICAL RASTER:

(1) Improper adjustment of focus coil or ion trap magnet.

(2) Defective yoke.

RASTER AND SIGNAL ON KINESCOPE BUT NO SOUND:

(1) R-F oscillator off frequency.

(2) Sound i-f, discriminator or audio amplifier inoperative—check V116, V117, V118, V119, V120 and their socket voltages.

(3) T114 defective.

(4) Speaker defective.

SIGNAL AT KINESCOPE GRID BUT NO SYNC:

(1) AGC threshold control R138 misadjusted.

(2) V105B, V107A, V108 or V109 inoperative. Check voltage and waveforms at their grids and plates.

SIGNAL ON KINESCOPE GRID BUT NO VERTICAL SYNC:

(1) Check V107B and associated circuit—C145, T107, etc.

(2) Integrating network inoperative—Check.

(3) R154, R155, R157, R158 or R159 defective.

SIGNAL ON KINESCOPE GRID BUT NO HORIZONTAL SYNC:

(1) T109 misadjusted—readjust as instructed on page 11.

(2) V111 inoperative—check socket voltages and waveforms.

(3) T109 defective.

(4) C134, C140, C146C, C153A, C154, C155, C156 or C157 defective.

(5) If horizontal speed is completely off and cannot be adjusted check C158, C159, R172, R173, R174, R179 and R182.

SOUND AND RASTER BUT NO PICTURE OR SYNC:

(1) Picture i-f, detector or video amplifier inoperative—check V103, V104, V105 and V106—check socket voltages.

(2) Bad contact to kinescope grid.

PICTURE STABLE BUT POOR RESOLUTION:

(1) V105A or V106 defective.

(2) Peaking coils defective—check for specified resistance.

(3) Make sure that the focus control operates on both sides of proper focus.

(4) R-F and I-F circuits misaligned.

PICURE SMEAR:

(1) R-F or I-F circuits misaligned.

(2) Open peaking coil.

(3) This trouble can originate at the transmitter—check on another station.

PICTURE JITTER:

(1) AGC threshold control R138 misadjusted.

(2) If regular sections at the left picture are displaced change V112.

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SERVICE SUGGESTIONS

(3) Vertical instability may be due to loose connections or noise.

(4) Horizontal instability may be due to unstable transmitted sync.

RASTER BUT NO SOUND, PICTURE OR SYNC:

(1) Defective antenna or transmission line.

(2) R-F oscillator off frequency.

(3) R-F unit inoperative—check V1, V2, V3.

DARK VERTICAL LINE ON LEFT OF PICTURE:

(1) Reduce horizontal drive and readjust width and horizontal linearity.

(2) Replace V112.

LIGHT VERTICAL LINE ON LEFT OF PICTURE:

(1) C169 defective.

(2) V114 defective.

PICTURE I-F RESPONSE.—At times it may be desirable to observe the individual i-f stage response. This can be achieved by the following method:

Shunt all i-f transformers and coils with a 330-ohm carbon resistor except the one whose response is to be observed.

Connect a wide band sweep generator to the converter grid and adjust it to sweep from 18 mc. to 30 mc.

Connect the oscilloscope across the picture detector load resistor and observe the overall response. The response obtained will be essentially that of the unshunted stage. The effects of the various traps are also visible on the stage response.

Figures 22 through 26 show the responses of the various stages obtained in the above manner. The curves shown are typical although some variation between receivers can be expected. Relative stage gain is not shown.

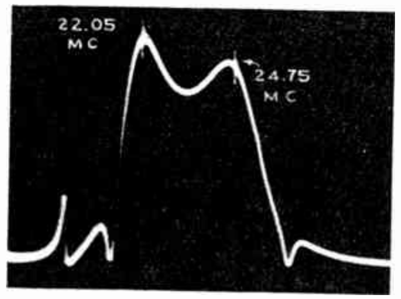

Figure 22—Response of Converter and First Pix I-F Transformer

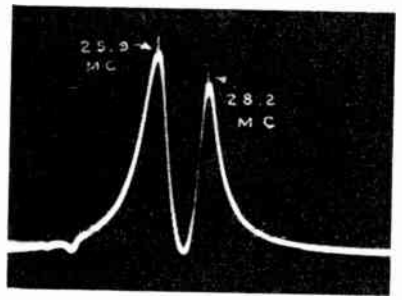

Figure 23—Response of Second Pix I-F Transformer

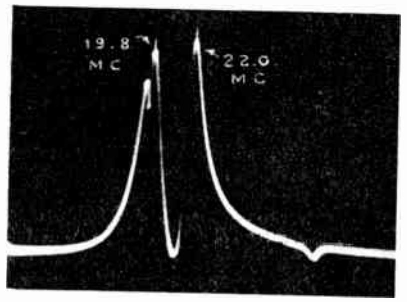

Figure 24—Response of Third Pix I-F Transformer

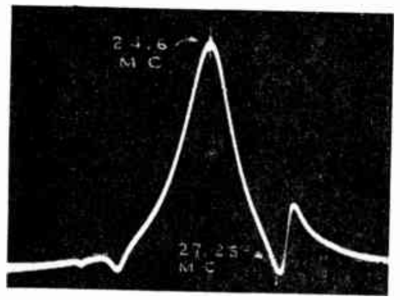

Figure 25—Response of Fourth Pix I-F Transformer

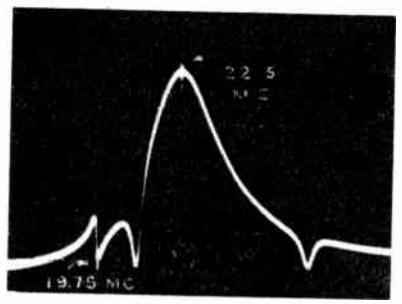

Figure 26—Response of Fifth Pix I-F Transformer

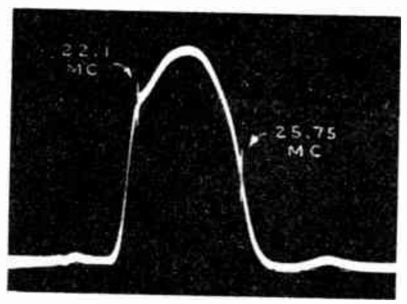

Figure 27—Response from First Pix I-F Grid to Pix. Det.

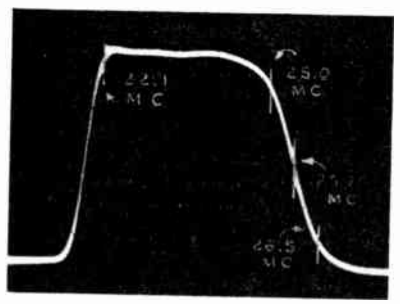

Figure 28—Overall Pix I-F Response

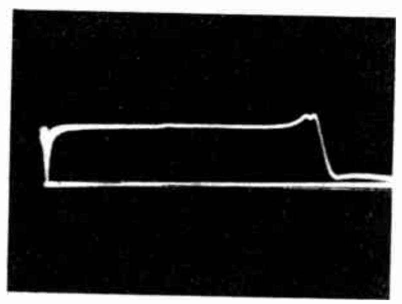

Figure 29—Video Response at Average Contrast

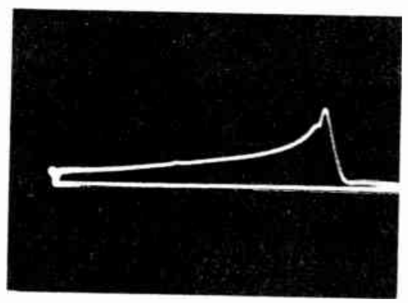

Figure 30—Video Response at Minimum Contrast

WAVEFORM PHOTOGRAPHS

Video Signal Input to 1st Video Amplifier (Pin 2 of V106) (12AU7)

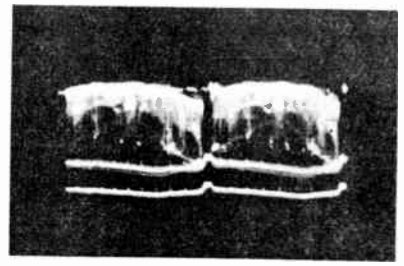

Figure 31—Vertical (Oscilloscope Synced to ½ of Vertical Sweep Rate) (5.4 Volts PP)

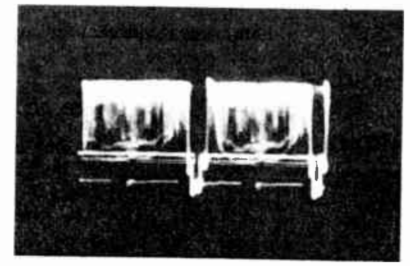

Figure 32—Horizontal (Oscilloscope Synced to ½ of Horizontal Sweep Rate) (5.4 Volts PP)

Sync Feed (Junction of L104, R219 and C194)

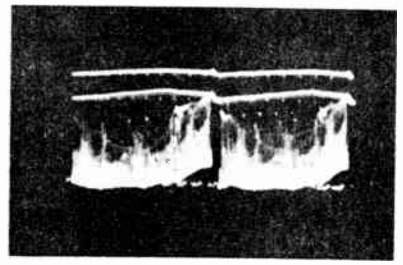

Figure 33—Vertical (28 Volts PP)

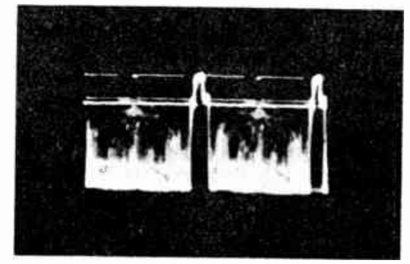

Figure 34—Horizontal (28 Volts PP)

Input to 2nd Video Amplifier (Pin 7 of V106) (12AU7)

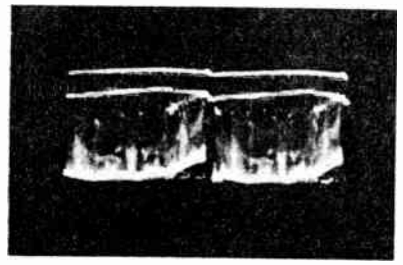

Figure 35—Vertical (17 Volts PP)

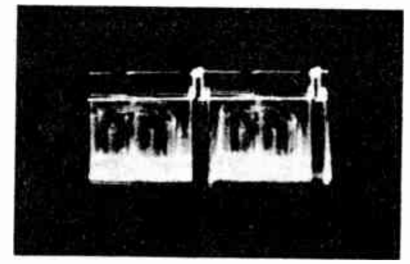

Figure 36—Horizontal (17 Volts PP)

Output of 2nd Video Amplifier (Junction of L105 and R127) (Picture Max.)

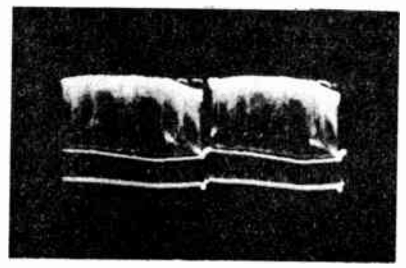

Figure 37—Vertical (96 Volts PP)

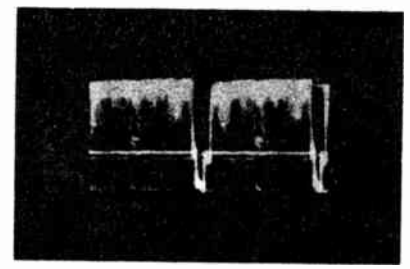

Figure 38—Horizontal (96 Volts PP)

Input to Kinescope (Junction of R127 and R128) (Picture Max.)

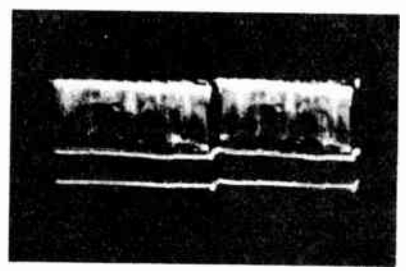

Figure 39—Vertical (65 Volts PP)

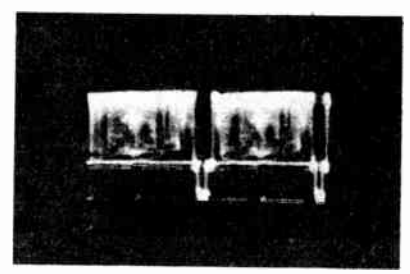

Figure 40—Horizontal (65 Volts PP)

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WAVEFORM PHOTOGRAPHS

Input to 1st Sync Separator (Pin 1 of V108) (6SN7GT)

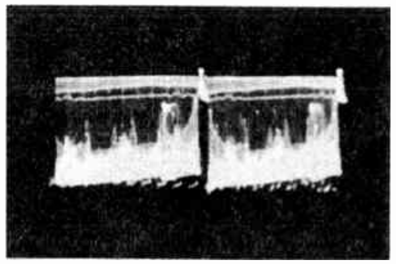
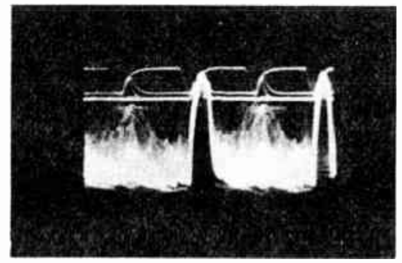


Figure 41—Vertical (25 Volts PP) ◄◄◄

Figure 42—Horizontal (23 Volts PP) ►►►



AGC Rectifier Cathode (Pin 6 of V108) (6SN7GT)

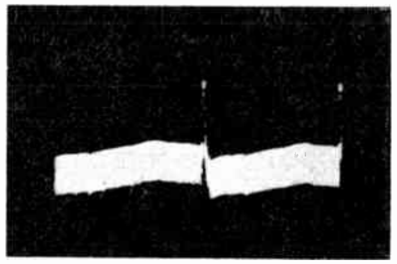


Figure 43—Vertical (4.7 Volts PP) ◄◄◄

Figure 44—Horizontal (1.5 Volts PP) ►►►

Output of AGC Rectifier (Pin 5 of V108) (6SN7GT)

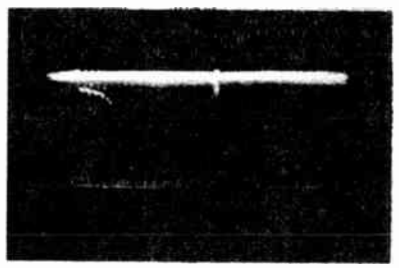
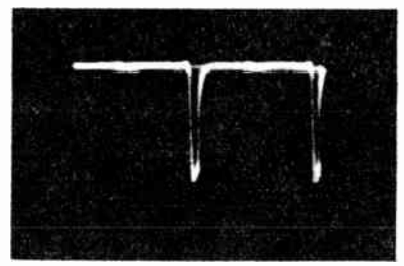


Figure 45—Vertical (24 Volts PP) ◄◄◄

Figure 46—Horizontal (24 Volts PP) ►►►



Output of 1st Sync Separator (Pin 2 of V108) (6SN7GT)

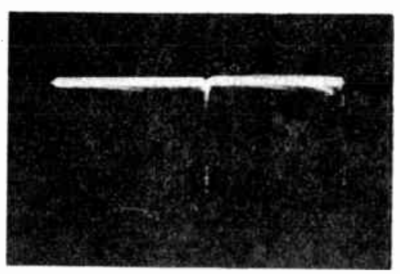
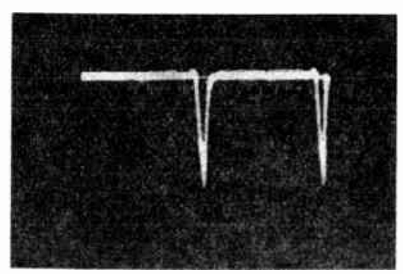


Figure 47—Vertical (26 Volts PP) ◄◄◄

Figure 48—Horizontal (25.5 Volts PP) ►►►



Input to Sync Amplifier (Junction of C137, C139 and R145)

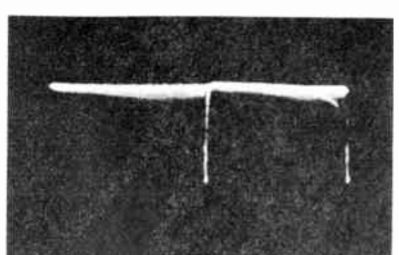
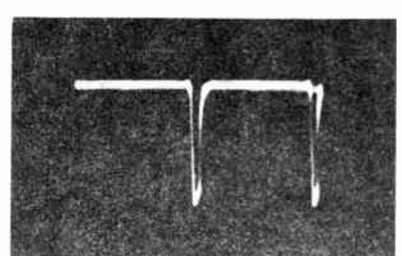


Figure 49—Vertical (21 Volts PP) ◄◄◄

Figure 50—Horizontal (21 Volts PP) ►►►



Output of Sync Amplifier (Pin 2 of V109) (6SN7GT)

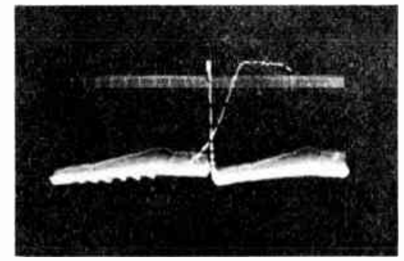
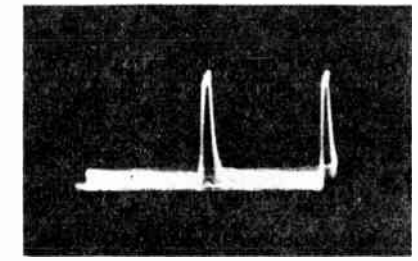


Figure 51—Vertical (115 Volts PP) ◄◄◄

Figure 52—Horizontal (105 Volts PP) ►►►



Cathode of 2nd Sync Separator (Pin 6 of V109) (6SN7GT)

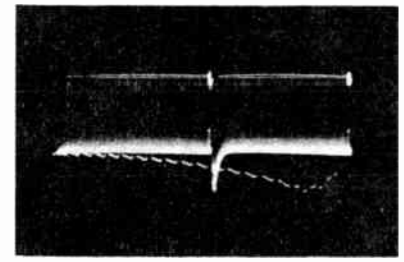
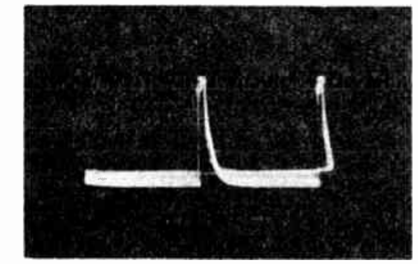


Figure 53—Vertical (17 Volts PP) ◄◄◄

Figure 54—Horizontal (11 Volts PP) ►►►



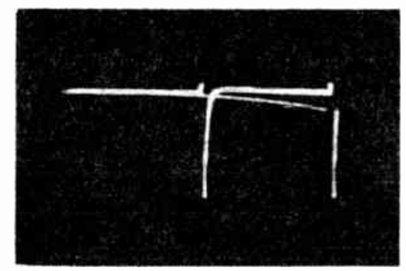
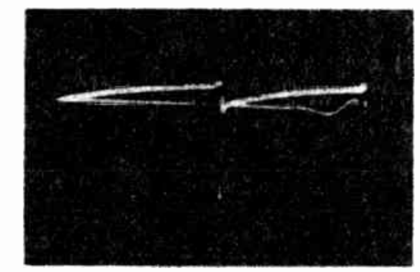


Figure 55—Output of Integrating Network (Junction of C144, C145 and R153) (45 Volts PP) ◄◄◄

Figure 56—Grid of Vertical Oscillator (720 Volts PP) (Pin 1 of V107) (6SN7GT) ►►►



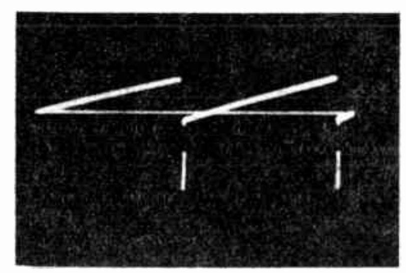
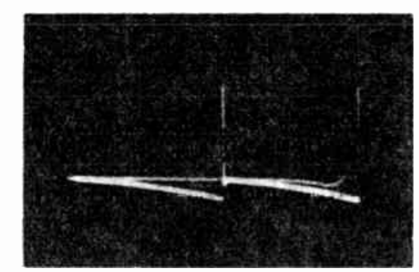


Figure 57—Grid of Vertical Output (160 Volts PP) (Pin 5 of V110) (6K6GT) ◄◄◄

Figure 58—Plate of Vertical Output (750 Volts PP) (Pin 3 of V110) (6K6GT) ►►►



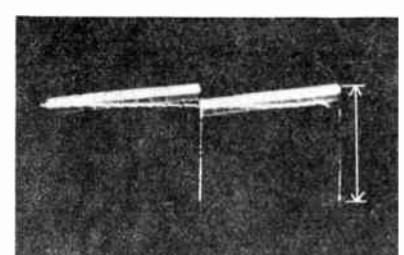
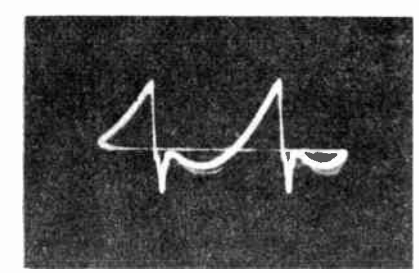


Figure 59—Input of Vertical Deflection Coils (75 Volts PP) (Junction of Green Lead of T108 and Green Lead of Yoke) ◄◄◄

Figure 60—Input to Horizontal Oscillator (17.5 Volts PP) (Junction of C153A and C154) ►►►



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WAVEFORM PHOTOGRAPHS

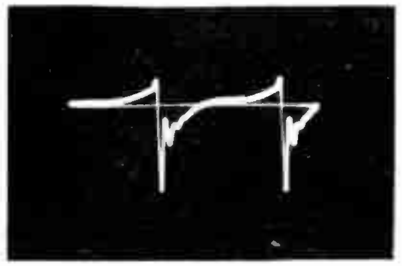

Figure 61—Junction of R168, R176 and R178 (150 Volts PP)

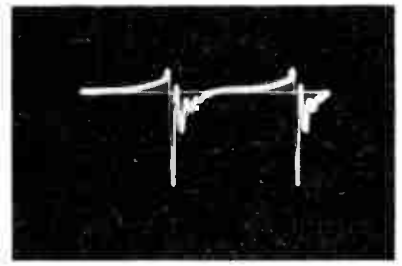

Figure 62—Grid of Horizontal Oscillator (480 Volts PP) (Pin 4 of V111) (6SN7GT)

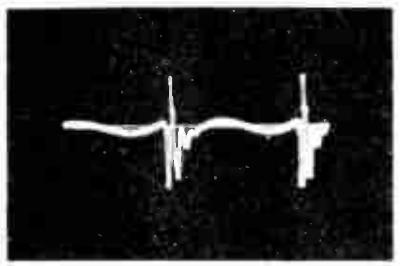

Figure 63—Plate of Horizontal Oscillator (270 Volts PP) (Pin 5 of V111) (6SN7GT)

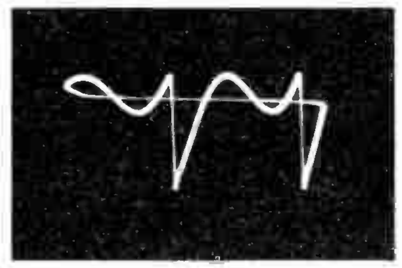

Figure 64—Terminal "C" of T109 (70 Volts PP)

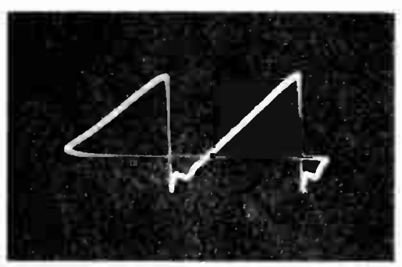

Figure 65—Input to Horizontal Output Tube (42 Volts PP) (Junction of C160, R183 and C153B)

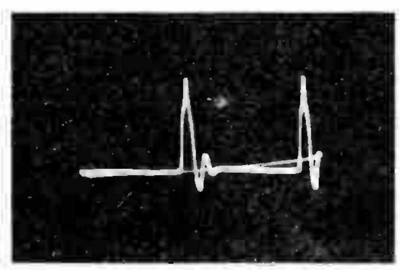

Figure 66—Plate of Horizontal Output (Approx. 6,500 Volts PP) (Measured Through a Capacity Voltage Divider Connected from Top Cap of V112 to Ground)

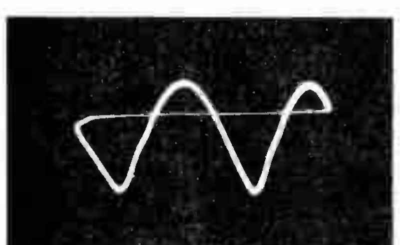

Figure 67—Terminal 1 of T110 (200 Volts PP)

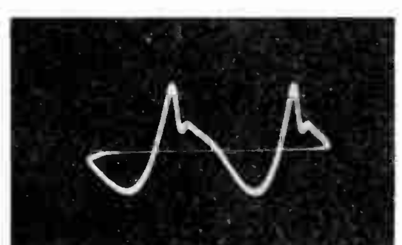

Figure 68—Plate of Damper (250 Volts PP) (Pin 5 of V114) (6W4GT)

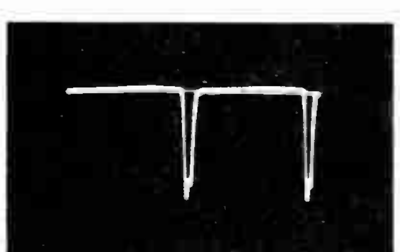

Figure 69—Input to Horizontal Deflection Coils (3,000 Volts PP)

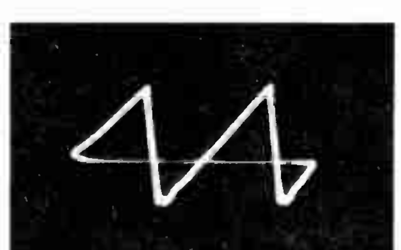

Figure 70—Horizontal Deflection Coil Current (0.5 amp. PP) Measured by inserting a 5-ohm Resistor in series with the yoke and observing the waveform across the resistor

RADIO CHASSIS WIRING DIAGRAM

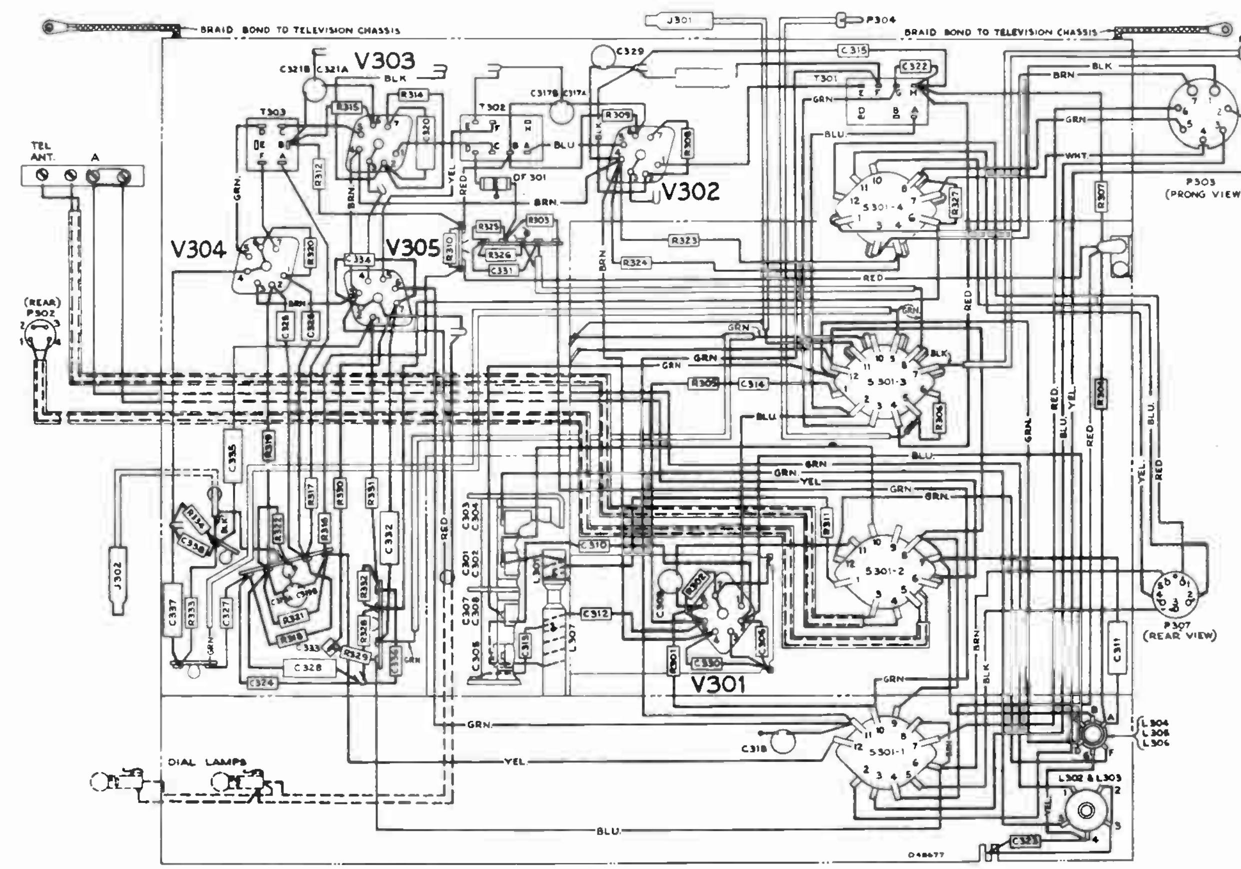

Figure 71—Radio Chassis Wiring Diagram (RK135D)

TELEVISION CRITICAL LEAD DRESS

1. The ground bus from pin 2 and the center shield of V117 socket should not be shortened or rerouted.
2. Do not change the dress of the filament leads or the bypass capacitors in the picture or sound i-f circuits. The filament leads between V117, V118 and V119 should be down against the chassis and away from grid or plate leads.
3. If it is necessary to replace any of the 1500 mmf capacitors in the picture i-f circuit, the lead length must be kept as short as possible.
4. Picture i-f coupling capacitors C106, C111, C115 and C121 should be up and away from the chassis and should be clear of the pix i-f transformer adjustments by at least ¼ inch. If the dress of any of these capacitors is changed, the i-f alignment should be rechecked.
5. Dress black lead from terminal C of T106 down next to chassis.
6. Leads to L102 and L103 must be as short as possible.
7. Dress peaking coils L105, L106 and L107 up and away from the chassis.
8. Dress C183 across tube pins 5 and 6 with leads not exceeding ⅜ inch.
9. Dress body of R215 as close to tube pin as possible.
10. Dress C129 and C130 up and away from the chassis.
11. Dress the yellow lead from the picture control away from the chassis and away from the volume-control leads. Dress the yellow lead from pin 8 of V106 away from the chassis.
12. Dress the green lead from pin 2 of V106 away from the chassis.
13. Dress R168, R169, R170, R176 and R178 up and away from the chassis.
14. The leads to the volume control should be dressed down against the chassis and away from V117 and V118.
15. Contact between the r-f oscillator frequency adjustment screws and the oscillator coils or channel switch eyelets must be avoided.
16. Dress three a-c leads to S101 under clamp and away from R211.
17. Dress black lead from power transformer and red lead from S102 to terminal board, on top of four potentiometers.
18. Dress all leads from V115 to V122 on power transformer side of terminal board.
19. Dress all leads away from R230.
20. Dress brown and yellow leads of phono motor cable under R165 and under C201.
21. All solder joints in the high voltage section should be free of sharp edges.
22. The lead side of the V113 plate cap should be turned away from the fixed high voltage shield.
23. All leads under the horizontal plate in the high voltage section should be kept reasonably short and dressed away from the V113 corona ring.

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VOLTAGE CHART

The following measurements represent two sets of conditions. In the first condition a 2200 microvolt test pattern signal was fed into the receiver, the picture was synced and the AGC threshold control was properly adjusted. The second condition was obtained by removing the antenna leads and short-circuiting the receiver antenna terminals. Voltages shown are as read with "Jr. VoltOhmyst" between the indicated terminal and chassis ground and with the receiver operating on 117 volts, 60 cycles a-c. Symbol < means less than.

Tube No.	Tube Type	Function	Operating Condition	E. Plate		E. Screen		E. Cathode		E. Grid		I Plate (ma.)	I Screen (ma.)	Notes on Measurements
				Pin No.	Volts	Pin No.	Volts	Pin No.	Volts	Pin No.	Volts			
V1	6AG5	R-F Amplifier	2200 Mu. V. Signal	5	130	6	132	2 & 7	0	1	—2.2	5	2	
			No Signal	5	67	6	111	2 & 7	0	1	0.0	14.0	5.0	
V2	6AG5	Converter	2200 Mu. V. Signal	5	*130 to 140	6	*130 to 140	2 & 7	0	1	*—3.0 to —7.0	*7.1 to 7.7	*2.3 to 2.7	*Depending upon channel
			No Signal	5	*107 to 109	6	*107 to 109	2 & 7	0	1	*—2.0 to —6.0	*5.3 to 5.9	*.8 to 1.0	
V3	6J6	R-F Oscillator	2200 Mu. V. Signal	1 & 2	*88 to 95	—	—	7	.19	5 & 6	*—5.1 to —7.3	*1.9 to 2.7	—	*Depending upon channel
			No Signal	1 & 2	*68 to 81	—	—	7	.16	5 & 6	*—4.5 to —6.6	*1.8 to 2.1	—	
V101	6BA6	1st Pix. I-F Amplifier	2200 Mu. V. Signal	5	128	6	128	7	.4	1	—11.0	1.9	.8	
			No Signal	5	95	6	95	7	1.73	1	+.2	8.1	3.4	
V102	6AG5	2nd Pix. I-F Amplifier	2200 Mu. V. Signal	5	119	6	119	2 & 7	.78	1	0	8.8	2.4	
			No Signal	5	100	6	100	2 & 7	.62	1	0	7.4	1.6	
V103	6BA6	3d Pix. I-F Amplifier	2200 Mu. V. Signal	5	81	6	119	7	.52	1	—2.2	11.1	.3	
			No Signal	5	55	6	96	2 & 7	.62	1	+.2	13.2	.3	
V104	6AG5	4th Pix. I-F Amplifier	2200 Mu. V. Signal	5	159	6	135	2 & 7	1.5	1	0	7.2	2.2	
			No Signal	5	165	6	118	2 & 7	1.35	1	0	6.8	2.4	
V105 A	6AL5	Picture 2d Det.	2200 Mu. V. Signal	7	—116	—	—	1	—127	—	—	.3	—	
			No Signal	7	—131	—	—	1	—135	—	—	<0.1	—	
V105 B	6AL5	Sync Limiter	2200 Mu. V. Signal	2	—117	—	—	5	—58	—	—	—	—	
			No Signal	2	—83	—	—	5	—60	—	—	—	—	
V106	12AU7	1st Video Amplifier	2200 Mu. V. Signal	1	—18.7	—	—	3	—125	2	—129	2.6	—	
			No Signal	1	—28.0	—	—	3	—133	2	—135	6.6	—	
V106	12AU7	2d Video Amplifier	2200 Mu. V. Signal	6	*120	—	—	8	*—11.0	7	*—13.2	9.2	—	*At minimum contrast
			No Signal	6	*127	—	—	8	*—17.0	7	*—21.0	8.5	—	
V107 A	6SN7 GT	AGC Amplifier	2200 Mu. V. Signal	5	—11.0	—	—	6	—58	4	—61	.12	—	
			No Signal	5	+0.2	—	—	6	—60	4	—66	0	—	
V107 B	6SN7 GT	Vertical Oscillator	2200 Mu. V. Signal	2	125	—	—	3	—127	1	—170	.31	—	
			No Signal	2	120	—	—	3	—135	1	—175	.30	—	
V108	6SN7 GT	AGC Rectifier	2200 Mu. V. Signal	5	87	—	—	6	—2	4	—19.5	.3	—	
			No Signal	5	75	—	—	6	—22	4	—28.0	<.1	—	
V108	6SN7 GT	1st Sync Separator	2200 Mu. V. Signal	2	87	—	—	3	—3	1	—18.5	<.1	—	
			No Signal	2	73	—	—	3	—22	1	—28.0	<.1	—	
V109	6SN7 GT	Sync Amplifier	2200 Mu. V. Signal	2	153	—	—	3	0	1	—5.7	5.8	—	
			No Signal	2	160	—	—	3	0	1	—5.6	5.4	—	
V109	6SN7 GT	Sync Separator	2200 Mu. V. Signal	5	241	—	—	6	—58	4	—117	.22	—	
			No Signal	5	240	—	—	6	—57	4	—65	.71	—	
V110	6K6-GT	Vertical Output	2200 Mu. V. Signal	3	240	4	*240	8	—78	5	—107	10	2.0	*Screen connected to plate
			No Signal	3	235	4	*235	8	—83	5	—111	10	1.9	
V111	6SN7 GT	Horizontal Osc. Control	2200 Mu. V. Signal	2	*48	—	—	3	—136	1	—127	.11	—	*Variation of hold gives — 21.9 to +56 volts on plate
			No Signal	2	*33	—	—	3	—140	1	—140	.10	—	
V111	6SN7 GT	Horizontal Oscillator	2200 Mu. V. Signal	5	86	—	—	6	—127	4	—193	2.0	—	
			No Signal	5	80	—	—	6	—135	4	—205	1.7	—	
V112	6BG6G	Horizontal Output	2200 Mu. V. Signal	Cap	Do Not Meas.	8	152	3	—117	5	—145	67.9	8.1	
			No Signal	Cap	Do Not Meas.	8	150	3	—126	5	—157	66.0	8.0	
V113	1B3GT /8016	H. V. Rectifier	Brightness Min.	Cap	Do Not Meas.	—	—	2 & 7	12,300	—	—	0	—	
			Brightness Average	Cap	Do Not Meas.	—	—	2 & 7	11,700	—	—	.1	—	
V114	6W4GT	Damper	2200 Mu. V. Signal	5	Do Not Meas.	—	—	3	498	—	—	86	—	
			No Signal	5	Do Not Meas.	—	—	3	496	—	—	70	—	
V115	5U4G	Rectifier	2200 Mu. V. Signal	4 & 6	385			2 & 8	267	—	—	225	—	*A-C measured from plate to trans. center tap
			No Signal	4 & 6	385			2 & 8	260	—	—	226	—	
V116	6AU6	1st Sound I-F Amplifier	2200 Mu. V. Signal	5	124	6	124	7	.87	1	—0.1	7.0	3.0	
			No Signal	5	107	6	107	7	.75	1	—0.15	6.4	2.3	
V117	6AU6	2nd Sound I-F Amplifier	2200 Mu. V. Signal	5	130	6	67	7	0	1	—9	4.3	1.5	
			No Signal	5	120	6	60	7	0	1	—0.37	3.7	1.6	
V118	6AL5	Sound Discrim.	2200 Mu. V. Signal	2 7	—8.4 —3.7	—	—	5 1	5.8 0	— —	— —	— —	— —	
			No Signal	2 7	—0.4 —0.4	—	—	5 1	0 0	—	—	—	—	
V119	12AX7	1st Audio Amplifier	2200 Mu. V. Signal	1	100	—	—	3	0	2	—.9	—	—	
			No Signal	1	100	—	—	3	0	2	—.9	—	—	
		Phase Inverter	2200 Mu. V. Signal	6	130	—	—	8	0	7	—.9	—	—	
			No Signal	6	130	—	—	8	0	7	—.9	—	—	
V120 V123	6V6-GT	Audio Output	2200 Mu. V. Signal	3	230	4	85	8	—113	5	—127	22	5	*Per tube
			No Signal	3	230	4	85	8	—120	5	—135	22	5	*Per tube
V121	16GP4	Kinescope	2200 Mu. V. Signal	Cap	12,300	10	250	11	77	2	35	.06	—	*Average Brightness
			No Signal	Cap	11,700	10	250	11	73	2	48	.18	—	Average Brightness
V301	6J6	Mixer and Oscillator	No Signal	1 2	110 95	— —	— —	7	0	6 5	—2.0 —5.0	— —	— —	Function switch in F-M position
V302	6BA6	Radio I-F Amplifier	No Signal	5	210	6	105	7	.8	1	—0.2	—	—	
V303	6AV6	Radio F-M Driver	No Signal	5	205	6	135	7	1.5	1	0	—	—	
V304	6AL5	Radio Ratio Det.	No Signal	2 7	—0.2 —0.2	—	—	5 1	—0.2 —0.1	— —	— —	— —	— —	
V305	6BF6	A-M Det. and Phono Preamp	No Signal	7	—0.2	—	—	2	0	—	—	—	—	

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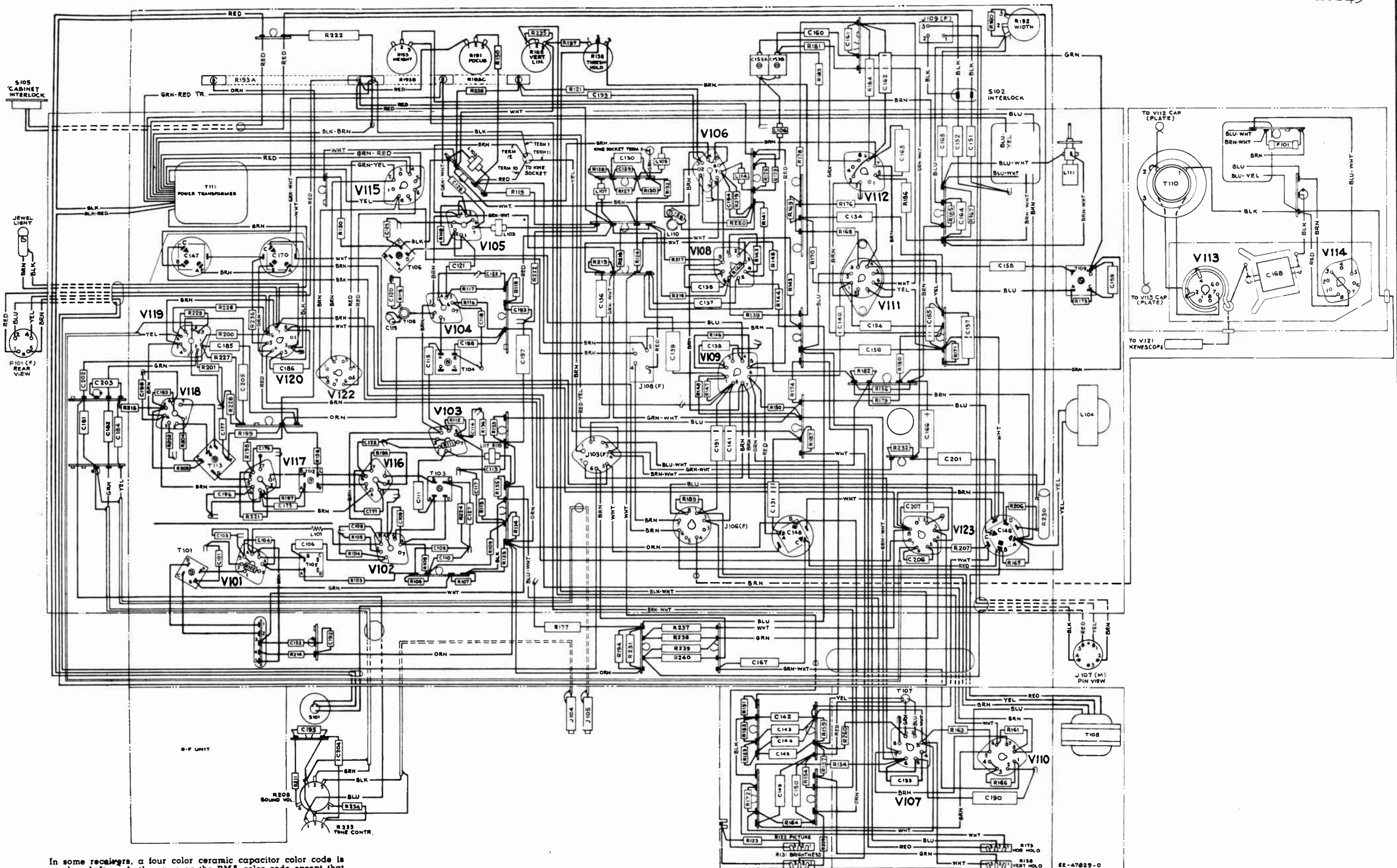
TELEVISION CHASSIS WIRING DIAGRAM



In some receivers, a four color ceramic capacitor color code is employed. It reads the same as the RMA color code except that the tolerance stripe is omitted.

If the coefficient stripe is silver, it indicates that the capacitor has a very large temperature coefficient and is to be employed for bypass or other usages where a wide variation of capacity is unimportant. Silver striped capacitors are rated at 350 volts unless otherwise marked.

Figure 72—Chassis Wiring Diagram

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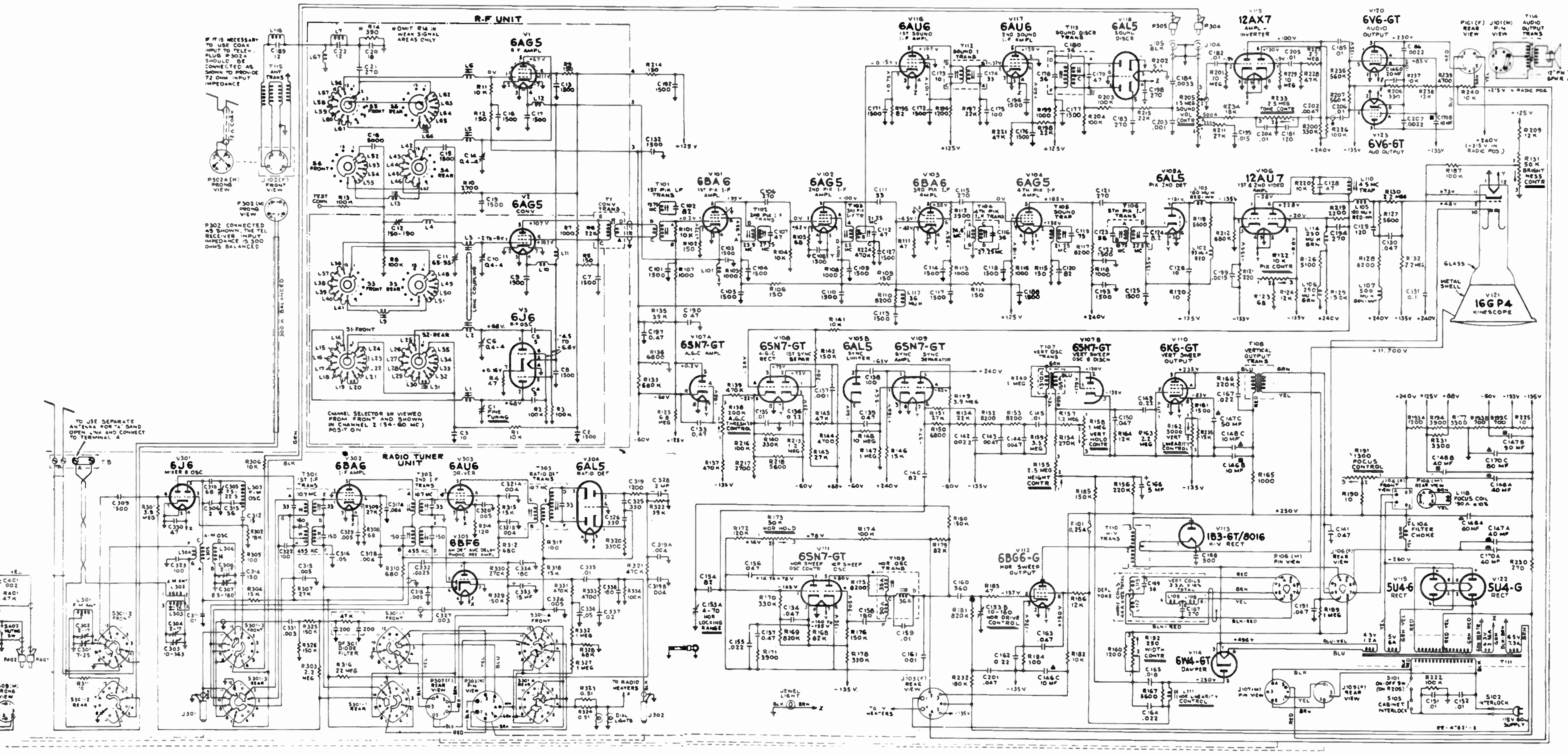
CIRCUIT SCHEMATIC DIAGRAM



Function switch S301 viewed from front and shown in Number 1 (maximum counterclockwise position).
Switch position 1—Television.

Switch position 2—AM.
Switch position 3—FM.
Switch position 4—Phono 45 RPM.
Switch position 5—Phono 78 RPM.

All resistance values in ohms. K = 1,000.
All capacitance values less than 1 in MF and above 1 in MMF unless noted.

Coil resistance values less than 1 ohm are not shown.
Direction of arrows at controls indicates clockwise rotation.

All voltages measured with "VoltOhmyst," no signal input with 117 v. a-c supply with the pix control fully clockwise and the brightness control set for average brightness.

In some receivers, C141 was omitted.
In some receivers, R220 was 12 K.
In some receivers, R121 was 39, R225 was 18, R128 was 6,800, R129 was 220 K, L107 was 250 Muh. and C199 was omitted.

In some receivers, R161 was 1,000 and R235 was omitted.
In some receivers, R160 and R167 were omitted.

In some receivers, R187 was 150 K and R188 470 K was connected from V121-11 to +125 V and V121-10 was connected to the junction of R156 and C166.
In some receivers, R260 was omitted.

Figure 73—Circuit Schematic Diagram

RECORD CHANGERS: Model RP168C, See Pages RCD.CH.19-1 through RCD.CH.19-8; Model 960285, See Pages RCD.CH.21-50 through RCD.CH.21-64.

MODEL TA169, Ch. KCS43

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REPLACEMENT PARTS

STOCK No.	DESCRIPTION
	R-F UNIT ASSEMBLIES KRK 5B
73465	Belt—Drive belt
75069	Board—R-F unit power connection terminal board (5 contact)
75067	Bracket—Vertical bracket for holding r-f oscillator tube shield
73478	Cable—I-F transmission cable (W1)
73441	Cam—Fine tuning adjustment
74035	Capacitor—Ceramic, 5 mmf. (C4, C5)
53511	Capacitor—Ceramic, 10 mmf. (C3)
54207	Capacitor—Ceramic, 18 mmf. (C20)
73449	Capacitor—Ceramic trimmer, comprising 1 section of 150-190 mmf. and 1 section of 65-95 mmf. (C11, C12)
73091	Capacitor—Ceramic, 270 mmf. (C21)
71501	Capacitor—Ceramic, 1,500 mmf. (C2, C7, C8, C9, C13, C15, C17, C18, C19)
73473	Capacitor—Ceramic, 5,000 mmf. (C16)
73460	Coil—R-F plate coil for channel 6 (L13)
73461	Coil—Rear section—Oscillator plate coil for channel 6 (L20)
73462	Coil—Coupling inductance coil (L4)
73475	Coil—Antenna filter shunt coil (C67)
73476	Coil—I-F trap (L7, C22)
73477	Coil—Choke coil (L10, L11, L12)
73874	Coil—Front section—Oscillator plate coil for channel 6 (L31)
74108	Coil—Fine tuning coil (1½ turns) with adjustable inductance core and capacitor stud (plunger adjustment) (L1, C1)
74109	Coil—Trimmer coil (1½ turns) with adjustable inductance core and capacitor stud (screw adjustment for oscillator section or converter section) (L2, L3, C6, C10)
74110	Coil—Trimmer coil (3 turns) with adjustable inductance core and capacitor stud (screw adjustment) for r-f amplifier section (L5, C14)
71493	Connector—Oscillator segment connector
73455	Core—Sliding core for fine tuning control trimmer
74187	Core—Adjustable core for coil L9
73440	Detent—R-F unit detent mechanism and fibre shaft
71487	Form—Coil form for coil L31
73453	Form—Coil form assembly for L9, L13
73442	Link—Link assembly for fine tuning
71462	Loop—Oscillator to converter trimmer loop connector
73634	Nut—Speed nut for drive belt shield
73436	Plate—Front plate and bushing
73464	Pulley—Idler pulley
	Resistor—Fixed, composition:
	47 ohms, ±20%, ½ watt (R4)
	150 ohms, ±20%, ½ watt (R5, R9, R12)
	390 ohms, ±10%, ½ watt (R14)
	1,000 ohms, ±20%, ½ watt (R7)
	2,700 ohms, ±10%, ½ watt (R10)
	10,000 ohms, ±20%, ½ watt (R1, R11)
	100,000 ohms, ±20%, ½ watt (R2, R3, R8, R13)
14343	Retainer—Channel selector shaft retaining ring
30340	Retainer—Retainer ring for fine tuning stud
70881	Screw—No. 4-40 x ¼"-binder head screw for adjusting coils L14, L15, L16, L17, L18, L19
73640	Screw—No. 4-40 x ⅝" adjusting screw for L66
71475	Screw—No. 4-40 x 15 32" adjusting screw for coils L21, L22, L23, L24
74575	Screw—No. 4-40 x 17 32" adjusting screw for L6
73437	Shaft—Channel selector shaft complete with pawl and stud
73438	Shaft—Fine tuning control shaft and pulley
73439	Shaft—Actuating shaft for fine tuning control
75443	Shield—"U" shape shield for bottom of r-f unit
72951	Shield—Metal tube shield for V3
73454	Shield—Metal shield for drive belt
73632	Shield—Metal tube shield for V1
71494	Socket—Tube socket, moulded, 7 prong, saddle mounted
73450	Socket—Tube socket, ceramic, 7 prong, bottom mounted
74576	Spacer—Insulating spacer for front plate (4 required)
73457	Spring—Return spring for fine tuning control core
74188	Spring—Retaining spring for adjustable core RCA 74187
74578	Spring—Retaining spring for adjusting screws RCA 73640 and RCA 74575
75068	Spring—Retaining spring for R-F oscillator tube shield
73468	Stator—Front oscillator section stator complete with rotor, segment, coils and adjusting screws (S1, L14, L15, L16, L17, L18, L19, L21, L22, L23, L24)
73469	Stator—Rear oscillator section stator complete with rotor, segment and coils (S2, L25, L26, L27, L28, L29, L30, L32, L33, L34, L35)
73633	Stator—Antenna stator complete with rotor and coils (S5, L6, L56, L57, L58, L59, L60, L61, L62, L63, L64, L65, L66, C21)
73470	Stator—Converter stator complete with rotor and coils (S3, L9, L36, L37, L38, L39, L40, L41, L48, L49, L50, L51)
73471	Stator—R-F amplifier stator complete with fotor and coils (S4, L13, L42, L43, L44, L45, L46, L47, L52, L53, L54, L55, C15, C16, R10)
75446	Stud—Capacitor stud — brass, No. 4-40 x 13/16" with 3 64" screwdriver slot for trimmer coils 74109 and 74110, uncoded or coded "ER"
75447	Stud—Capacitor stud — brass, No. 4-40 x 13/16" with 3 64" screwdriver slot for trimmer coils 74109 and 74110, coded numerically or "Hi Q"
73448	Transformer—Converter transformer (T1, R6)
73466	Washer—Insulating washer for front shield (1 set)
2917	Washer—"C" washer for channel selector shaft or fine tuning shaft and cam
	CHASSIS ASSEMBLIES KCS 43
*75086	Bracket—Mounting bracket (upper) for focus coil
*75087	Bracket—Mounting bracket (lower) for focus coil
74911	Cable—Shielded cable complete with female connector (W101, W103, J104, J105)
74946	Capacitor—Mica trimmer, comprising 1 section of 4-70 mmf. and 1 section of 10-160 mmf. (C153A, C153B)
39604	Capacitor—Mica, 10 mmf. (C126)
74105	Capacitor—Mica, 33 mmf. (C111)
64062	Capacitor—Ceramic, 82 mmf. (C120)
73090	Capacitor—Mica, 82 mmf. (C140, C154)
39396	Capacitor—Ceramic, 100 mmf. (C175)
75060	Capacitor—Mica, 100 mmf. (C138)
73921	Capacitor—Ceramic, 120 mmf. (C129)
39630	Capacitor—Mica, 120 mmf. (C181)
73102	Capacitor—Mica, 180 mmf. (C158)
73091	Capacitor—Mica, 270 mmf. (C106, C115, C121)
73922	Capacitor—Ceramic, 270 mmf. (C183, C194, C198)
74947	Capacitor—Ceramic, 500 mmf., 20,000 volts (C168)
74250	Capacitor—Mica, 560 mmf. (C160)
71501	Capacitor—Ceramic, 1,500 mmf. (C101, C103, C104, C105, C108, C109, C110, C113, C114, C117, C118, C122, C125, C127, C132, C171, C172, C176, C177, C188, C192, C193, C196)
28417	Capacitor—Electrolytic, 5 mfd., 450 volts (C166)
73582	Capacitor—Electrolytic, comprising 1 section of 40 mfd., 450 volts, and 1 section of 10 mfd., 450 volts, and 1 section of 80 mfd., 200 volts (C170A, C170B, C170C)
73583	Capacitor—Electrolytic, comprising 1 section of 40 mfd., 450 volts, 1 section of 90 mfd., 150 volts, and 1 section of 50 mfd., 150 volts (C147A, C147B, C147C)
71432	Capacitor—Electrolytic, comprising 2 sections of 40 mfd., 450 volts, and 1 section of 10 mfd., 450 volts (C148A, C148B, C148C)
73581	Capacitor—Electrolytic, comprising 1 section of 60 mfd., 450 volts, 2 sections of 10 mfd., 450 volts, and 1 section of 20 mfd., 150 volts (C146A, C146B, C146C, C146D)
73801	Capacitor—Tubular, moulded paper, oil impregnated, .001 mfd., 1,000 volts (C137, C161, C203)
73802	Capacitor—Tubular, paper, oil impregnated, .0015 mfd., 600 volts (C199)
73595	Capacitor—Tubular, paper, oil impregnated, .0022 mfd., 600 volts (C142)
73803	Capacitor—Tubular, paper, oil impregnated, .0022 mfd., 1,000 volts (C186, C207)
73795	Capacitor—Tubular, paper, oil impregnated, .0033 mfd., 600 volts (C184)
73920	Capacitor—Tubular, paper, oil impregnated, .0047 mfd., 600 volts (C143, C144, C202)
73561	Capacitor—Tubular, paper, oil impregnated, .01 mfd., 400 volts (C135, C182, C204)
73594	Capacitor—Tubular, paper, oil impregnated, .01 mfd., 600 volts (C145, C159, C205)
73565	Capacitor—Tubular, paper, oil impregnated, .01 mfd., 1,000 volts (C151, C152, C185, C206)
73797	Capacitor—Tubular, paper, oil impregnated, .015 mfd., 600 volts (C195)
74727	Capacitor—Tubular, paper, oil impregnated, .018 mfd., 1,000 volts (C165)
73562	Capacitor—Tubular, paper, oil impregnated, .022 mfd., 1,000 volts (C155, C164, C167)
73553	Capacitor—Tubular, paper, oil impregnated, .047 mfd., 400 volts (C130, C134, C201)
73592	Capacitor—Tubular, paper, oil impregnated, .047 mfd., 600 volts (C139, C156)
73597	Capacitor—Tubular, paper, oil impregnated, .047 mfd., 1,000 volts (C141, C150, C163, C191)
73557	Capacitor—Tubular, paper, oil impregnated, 0.1 mfd., 600 volts (C131)
73794	Capacitor—Tubular, paper, oil impregnated, 0.22 mfd., 200 volts (C136, C162)
74957	Capacitor—Tubular, paper, oil impregnated, 0.22 mfd., 600 volts (C149)
73787	Capacitor—Tubular, paper, oil impregnated, 0.47 mfd., 200 volts (C133, C157, C190, C197)
73154	Choke—Filter choke (L104)
74983	Coil—Focus coil (L118, P108)
71449	Coil—Horizontal linearity control coil (L111)
73477	Coil—Filament choke coil (L101)
74170	Coil—Peaking coil (36 muh) (L117, R110)
71527	Coil—Peaking coil (93 muh) (L102)
74214	Coil—Peaking coil (180 muh) (L103, L105)
71526	Coil—Peaking coil (250 muh) (L106, L114)
75252	Coil—Peaking coil (500 muh) (L107)
72172	Connector—3 contact female connector (J107A)
31027	Connector—4 contact female connector for focus coil leads (J108)
72108	Connector—7 contact female connector (J103)
74594	Connector—Male connector for power cable
60942	Connector—8 contact female connector for deflection yoke leads (J106)
30568	Connector—4 contact male connector—part of focus coil (P108)
35383	Connector—8 contact male connector—part of deflection yoke (P106)
*74967	Connector—Anode connector
5040	Connector—4 contact female connector for speaker cable (P101)
14786	Connector—5 contact male connector for motor switching cable (J107B)
72734	Control—Horizontal and vertical hold control (R158, R173)
74047	Control—Picture and brightness control (R122, R131)
74359	Control—Tone control, volume control and power switch (R205, R233, S101)
71441	Control—Vertical linearity control (R162)
71440	Control—Height control (R155)
74597	Control—Focus control (R191)
74475	Control—AGC threshold control (R138)
74945	Control—Width control (R192)
71457	Cord—Power cord and plug
71437	Cover—Insulating cover for electrolytics No. 71432 and No. 73581
74956	Cushion—Rubber cushion for yoke hood (2 required)
73600	Fuse—0.25 amp., 250 volts (F101)
71799	Grommet—Rubber grommet for yoke horizontal lead exit
37396	Grommet—Rubber grommet for mounting ceramic tube socket (2 required)
74030	Grommet—Rubber grommet for mounting radio chassis
75445	Hood—Deflection yoke hood less rubber cushions
74953	Magnet—Ion trap magnet (PM type)
18469	Plate—Bakelite mounting plate for electrolytics
75444	Plate—Bakelite plate complete with tube sockets for high voltage rectifier
72067	Resistor—Wire wound, 5.1 ohms, ½ watt (R202)
18471	Resistor—Wire wound, 10 ohms, ½ watt (R190)
*75085	Resistor—Wire wound, 270 ohms, 20 watts (R230)
74955	Resistor—Voltage divider, comprising 1 section of 1,200 ohms, 16 watts and 2 sections of 700 ohms, 5½ watts (C193A, C193B, C193C)
48207	Resistor—Wire wound, 3,300 ohms, 10 watts (R177)
	Resistor—Fixed, composition:
	10 ohms, ±20%, ½ watt (R120)
	10 ohms, ±10%, ½ watt (R225)
	47 ohms, ±5%, ½ watt (R111)
	47 ohms, ±20%, ½ watt (R183)
	68 ohms, ±10%, ½ watt (R105)
	68 ohms, ±20%, ½ watt (R123)
	82 ohms, ±10%, ½ watt (R195)
	100 ohms, ±10%, 2 watts (R184)
	150 ohms, ±5%, ½ watt (R102)
	150 ohms, ±10%, ½ watt (R115)
	150 ohms, ±20%, ½ watt (R106, R109, R114, R214)
	220 ohms, ±10%, ½ watt (R121)
	330 ohms, ±10%, 2 watts (R206)
	1,000 ohms, ±20%, ½ watt (R103, R107, R108, R113, R116, R118, R165, R199)
	1,200 ohms, ±10%, 1 watt (R160)
	1,200 ohms, ±10%, ½ watt (R196)
	1,500 ohms, ±10%, ½ watt (R161)
	2,200 ohms, ±10%, ½ watt (R219)
	2,700 ohms, ±10%, ½ watt (R217)
	3,300 ohms, ±10%, 2 watts (R231)
	3,900 ohms, ±5%, ½ watt (R112)
	3,900 ohms, ±10%, ½ watt (R171)
	3,900 ohms, ±10%, 2 watts (R194)
	4,700 ohms, ±10%, ½ watt (R144)
	4,700 ohms, ±10%, 2 watts (R239)
	5,100 ohms, ±5%, ½ watt (R126)
	5,600 ohms, ±5%, ½ watt (R119)
	5,600 ohms, ±10%, ½ watt (R218)
	5,600 ohms, ±10%, 1 watt (R127, R167)
	6,800 ohms, ±5%, ½ watt (R136)
	6,800 ohms, ±10%, ½ watt (R150)
	8,200 ohms, ±5%, ½ watt (R175)
	8,200 ohms, ±10%, ½ watt (R152, R153)
	8,200 ohms, ±5%, 1 watt (R117, R128)
	10,000 ohms, ±5%, ½ watt (R104)
	10,000 ohms, ±10%, ½ watt (R141, R182, R220)
	10,000 ohms, ±10%, 2 watts (R237, R240)
	12,000 ohms, ±5%, ½ watt (R164)
	12,000 ohms, ±10%, ½ watt (R209)
	12,000 ohms, ±10%, 1 watt (R186)
	12,000 ohms, ±10%, 2 watts (R124, R238)
	15,000 ohms, ±10%, 1 watt (R146)
	15,000 ohms, ±10%, ½ watt (R235)
	18,000 ohms, ±10%, ½ watt (R234)
	22,000 ohms, ±10%, ½ watt (R134, R197)
	22,000 ohms, ±20%, ½ watt (R198, R215)
	27,000 ohms, ±10%, ½ watt (R143, R151, R211)
	39,000 ohms, ±5%, ½ watt (R135)
	47,000 ohms, ±5%, ½ watt (R228)
	47,000 ohms, ±10%, ½ watt (R145)
	47,000 ohms, ±20%, ½ watt (R221)

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REPLACEMENT PARTS (Continued)

STOCK No.	DESCRIPTION
	82,000 ohms, ±5%, 1 watt (R179)
	82,000 ohms, ±10%, 1 watt (R168)
	100,000 ohms, ±5%, ½ watt (R203, R204)
	100,000 ohms, ±10%, ½ watt (R216, R226)
	100,000 ohms, ±10%, 1 watt (R174)
	100,000 ohms, ±20%, 2 watts (R222)
	120,000 ohms, ±10%, 1 watt (R172)
	150,000 ohms, ±10%, ½ watt (R129, R180, R185, R187)
	150,000 ohms, ±20%, ½ watt (R142)
	150,000 ohms, ±5%, 1 watt (R176)
	180,000 ohms, ±10%, ½ watt (R232)
	220,000 ohms, ±10%, ½ watt (R138, R166)
	270,000 ohms, ±10%, ½ watt (R154)
	330,000 ohms, ±10%, ½ watt (R140, R170, R200)
	330,000 ohms, ±5%, 1 watt (R178)
	470,000 ohms, ±10%, ½ watt (R137, R139, R188, R224)
	560,000 ohms, ±10%, ½ watt (R207, R236)
	680,000 ohms, ±10%, ½ watt (R133, R212)
	820,000 ohms, ±10%, ½ watt (R169, R181)
	1 megohm, ±10%, ½ watt (R147)
	1 megohm, ±20%, ½ watt (R189)
	1.2 megohm, ±5%, ½ watt (R157, R213)
	2.2 megohm, ±10%, ½ watt (R130, R132, R163)
	2.7 megohm, ±5%, 1 watt (R227)
	3.3 megohm, ±5%, ½ watt (R159)
	3.9 megohm, ±10%, ½ watt (R149)
	6.8 megohm, ±10%, ½ watt (R125)
	10 megohm, ±10%, ½ watt (R148)
	10 megohm, ±20%, ½ watt (R201, R229)
74602	Screw—No. 10-32 x 1¾" cross recessed round head screw for focus coil adjustments (3 required)
*75083	Screw—No. 8-32 x ¼" wing screw for deflection yoke mounting
74601	Screw—No. 8-32 x ⅜" cross recessed pan head screw for focus coil mounting (2 required)
73584	Shield—Tube shield
74937	Sleeve—Rubber sleeve for focus coil
73117	Socket—Tube socket, 7 pin, miniature
72927	Socket—Tube socket, 9 pin, miniature
31251	Socket—Tube socket, octal
73249	Socket—Tube socket, octal, ceramic, plate mounted
71508	Socket—Tube socket, 8 contact for 1B3 GT, 8016
74834	Socket—Kinescope socket
31364	Socket—Pilot lamp socket
74954	Spring—Compression spring used under centering control screws (3 required)
74936	Spring—Suspension spring (coil type) for kinescope socket leads
74944	Support—Rubber support for 2nd anode lead
74948	Support—Bakelite support (1 set) for mounting hi-voltage plate
74157	Switch—Cabinet interlock switch (S105)
*75084	Transformer—Power transformer, 115 volts, 60 cycles (T111)
74950	Transformer—Vertical output transformer (T108)
73569	Transformer—Vertical oscillator transformer (T107)
74951	Transformer—Hi-voltage transformer (T110)
74589	Transformer—First pix, i-f transformer (T101, C102, R101)
74590	Transformer—Second pix, i-f transformer (T102, C107)
74591	Transformer—Third pix, i-f transformer (T103, C112)
74592	Transformer—Fourth pix, i-f transformer (T104, C116)
73575	Transformer—Fifth pix, i-f transformer (T106, C123, C124)
71424	Transformer—Sound i-f transformer (T112, C173, C174)
71427	Transformer—Sound discriminator transformer (T113, C178, C179, C180)

STOCK No.	DESCRIPTION
73576	Transformer—Horizontal oscillator transformer (T109)
73578	Transformer—Antenna transformer complete with socket (T115, J102)
73577	Trap—4.5 mc trap (L110, C128)
71778	Trap—Sound trap (T105, C119)
73476	Trap—I-F trap (L116, C189)
74952	Yoke—Deflection yoke (L108, L109, L112, L113, C169, C187, P106)
	RADIO CHASSIS ASSEMBLIES RK 135 D
74039	Board—"Telv-Ant" terminal board (TB301)
74026	Bracket—Drive cord bracket complete with two pulleys—R.H.
74027	Bracket—Drive cord bracket complete with pulley—L.H.
74911	Cable—Shielded cable complete with female connector (W307, W311)
71105	Cable—Shielded cable complete with pin plug (W301, W302)
74017	Capacitor—Variable tuning capacitor (C301, C302, C303, C304, C305, C307, C308)
73866	Capacitor—Ceramic, 2 mmf. (C306)
39044	Capacitor—Ceramic, 15 mmf. (C312)
39042	Capacitor—Ceramic, 47 mmf. (C330)
73867	Capacitor—Ceramic, 56 mmf. (C313)
33379	Capacitor—Ceramic, 68 mmf. (C310)
39396	Capacitor—Ceramic, 100 mmf. (C322, C323)
48125	Capacitor—Ceramic, 150 mmf. (C314)
71922	Capacitor—Ceramic, 180 mmf. (C334, C338)
39640	Capacitor—Mica, 330 mmf. (C325, C326)
73748	Capacitor—Ceramic, 1,500 mmf. (C309)
74009	Capacitor—Ceramic, dual, 4,000 mmf. (C317, C319, C321)
73473	Capacitor—Ceramic, 5,000 mmf. (C318, C329)
73747	Capacitor—Electrolytic, 2 mfd., 50 volts (C328)
32223	Capacitor—Electrolytic, 15 mfd., 300 volts (C333)
70602	Capacitor—Tubular, paper, .0025 mfd., 400 volts (C332)
73961	Capacitor—Tubular, paper, .003 mfd., 200 volts (C327, C331)
71553	Capacitor—Tubular, paper, .005 mfd., 400 volts (C315, C320, C324)
71923	Capacitor—Tubular, paper, .01 mfd., 200 volts (C335)
71925	Capacitor—Tubular, paper, .01 mfd., 400 volts (C311)
71929	Capacitor—Tubular, paper, .02 mfd., 200 volts (C337)
72596	Capacitor—Tubular, paper, .05 mfd., 200 volts (C336)
74455	Capacitor—Tubular, paper, .05 mfd., 400 volts (C316)
74020	Coil—A-M antenna coil (L302, L303)
73744	Coil—A-M oscillator coil (L304, L305, L306)
74024	Coil—F-M antenna coil (L301)
74025	Coil—F-M oscillator coil (L307)
36395	Connector—7 contact male connector (P103)
12493	Connector—5 contact female connector (P107B)
39153	Connector—4 prong male connector (P102)
72953	Cord—Drive cord (approx. 42" overall)
74011	Filter—Diode filter, dual, 200 mmf. and 47,000 ohms (DF 301)
74023	Resistor—Wire wound, 0.51 ohms, 1 watt (R323, R324)
	Resistor—Fixed, composition:
	10 ohms, ±20%, ½ watt (R311)
	68 ohms, ±20%, ½ watt (R308)
	100 ohms, ±20%, ½ watt (R305, R317)
	120 ohms, ±10%, ½ watt (R314)
	680 ohms, ±20%, ½ watt (R310, R312)
	1,200 ohms, ±5%, ½ watt (R319)
	3,300 ohms, ±5%, ½ watt (R320)
	4,700 ohms, ±10%, ½ watt (R333)
	10,000 ohms, ±20%, ½ watt (R306)

STOCK No.	DESCRIPTION
	15,000 ohms, ±10%, ½ watt (R304)
	15,000 ohms, ±20%, ½ watt (R315, R318)
	18,000 ohms, ±10%, ½ watt (R302)
	27,000 ohms, ±10%, ½ watt (R307, R309)
	39,000 ohms, ±10%, ½ watt (R322)
	68,000 ohms, ±10%, ½ watt (R328)
	100,000 ohms, ±10%, ½ watt (R334)
	150,000 ohms, ±10%, ½ watt (R325, R326, R329)
	270,000 ohms, ±10%, ½ watt (R330)
	470,000 ohms, ±10%, ½ watt (R331)
	470,000 ohms, ±20%, ½ watt (R321)
	1 megohm, ±10%, ½ watt (R327, R332)
	2.2 megohm, ±20%, ½ watt (R303)
	3.9 megohm, ±10%, ½ watt (R301)
	22 megohm, ±20%, ½ watt (R316)
74028	Shaft—Tuning knob shaft
73632	Shield—Tube shield
73117	Socket—Tube socket, 7 pin, miniature for V301, V304, V305
74179	Socket—Tube socket, 7 pin, miniature for V302, V303
31364	Socket—Dial lamp socket
74038	Spring—Drive cord spring
74894	Switch—Selector switch (S301)
73745	Transformer—First i-f transformer, dual (T301)
74019	Transformer—Second i-f transformer, dual (T302)
73743	Transformer—Ratio detector transformer (T303)
33726	Washer—"C" washer for tuning shaft
34457	Washer—Spring washer for tuning shaft (front)
74172	Washer—Fibre washer to prevent drive cord slippage
	SPEAKER ASSEMBLIES 92569-5 W RL 111-8 RMA 274
13867	Cap—Dust cap
74901	Cone—Cone and voice coil assembly (3.2 ohms)
5039	Connector—4 contact male connector (J101)
73636	Transformer—Output transformer (T114)
73635	Speaker—12" P.M. speaker complete with cone and voice coil less output transformer and plug
	NOTE:—If stamping in instruments does not agree with above speaker number, order replacement parts by referring to model number of instrument, number stamped on speaker and full description of part required.
	MISCELLANEOUS
75102	Back—Cabinet back
71054	Bracket—Dial lamp bracket (2 required)
71599	Bracket—Pilot lamp bracket
74296	Cable—Shielded pickup cable complete with pin plug for 45 RPM changer
72437	Cable—Shielded pickup cable complete with pin plug for 33 78 RPM changer
13103	Cap—Pilot lamp cap
73803	Capacitor—Tubular, paper, .002 mfd., 400 volts (C401)
71892	Catch—Bullet catch and strike for doors (3 required)
X3092	Cloth—Grille cloth for mahogany or walnut cabinets
X3090	Cloth—Grille cloth for oak cabinets
30868	Connector—2 contact female connector for 45 RPM motor extension cable
30870	Connector—2 contact male connector for 45 RPM motor extension cable
14782	Connector—3 contact male connector for record changer power cable
74581	Cover—Mounting screw cover for 45 RPM changer

STOCK No.	DESCRIPTION
74273	Decal—Trade mark decal (Victrola)
74898	Decal—Control panel function decal for mahogany or walnut instruments
74899	Decal—Control panel function decal for oak instruments
74052	Dial—Dial scale and bezel assembly
74809	Emblem—"RCA Victor" emblem
73642	Escutcheon—Channel marker escutcheon for mahogany or walnut instruments
73740	Escutcheon—Channel marker escutcheon for oak instruments
74606	Glass—Safety glass
37396	Grommet—Rubber grommet to mount speaker (4 required)
74308	Hinge—Cabinet door hinges (1 set) for RH or LH door
70166	Hinge—Cabinet door hinge for center door—upper
73200	Hinge—Cabinet door hinge for center door—lower
74051	Indicator—Station selector indicator
74959	Knob—Fine tuning knob — maroon — for mahogany or walnut instruments (outer)
73995	Knob—Fine tuning knob—tan—for oak instruments (outer)
74960	Knob—Channel selector knob—maroon—for mahogany or walnut instruments (inner)
74961	Knob—Channel selector knob—tan—for oak instruments (inner)
74962	Knob—Vertical hold control, brightness control or tone control knob—maroon—for mahogany or walnut instruments (outer)
73999	Knob—Vertical hold control, brightness control or tone control knob—tan—for oak instruments (outer)
74978	Knob—Tuning or selector switch knob—maroon—for mahogany or walnut instruments
74979	Knob—Tuning or selector switch knob—tan—for oak instruments
74963	Knob—Horizontal hold control, picture control or volume control and power switch knob—maroon—for mahogany or walnut instruments
74001	Knob—Horizontal hold control, picture control or volume control and power switch knob—tan—for oak instruments (inner)
11765	Lamp—Dial or pilot lamp—Mazda 51
74208	Nut—Tee nut to mount 45 RPM changer (3 required)
74162	Plate—Mounting plate for cabinet interlock switch
75037	Pull—Door pull
	Resistor—Fixed, composition, 47,000 ohms, ±10%, ½ watt (R401)
74582	Screw—No. 8-32 x 1¾" special screw to mount 45 RPM changer (3 required)
74156	Screw—No. 8-32 x 7 16" wing screw for deflection yoke and focus coil support and bracket
75038	Screw—No. 8-32 x ½" trimit head screw for door pull
74050	Slide—Station indicator slide
71736	Slide—Slide mechanism for changer carriages
74055	Spring—Spring clip for dial and bezel assembly (2 required)
72845	Spring—Retaining spring for knobs No. 73995 and No. 74959
14270	Spring—Retaining spring for knobs 73999, 74960, 74961 and 74962
30330	Spring—Retaining spring for knobs 74001 and 74963
73643	Spring—Spring clip for channel marker escutcheon
74421	Spring—Conical spring to mount 45 RPM changer—upper—R.H. (1 required)
74422	Spring—Conical spring to mount 45 RPM changer—upper L.H. (2 required)
74423	Spring—Conical spring to mount 45 RPM changer—lower—(3 required)
74956	Spring—Formed spring for kinescope masking panel (8 required)
72936	Stop—Door stop
74161	Stud—Locating stud for back cover (2 required)
75146	Washer—"C" washer for mounting 33 78 RPM changer (2 required)

To obtain resistors for which no stock number is given, order by stating type, value of resistance, tolerance and wattage.

MODEL TA169,
Ch. KCS43

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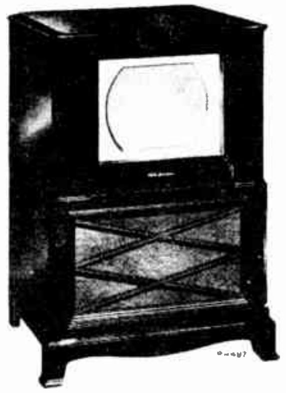
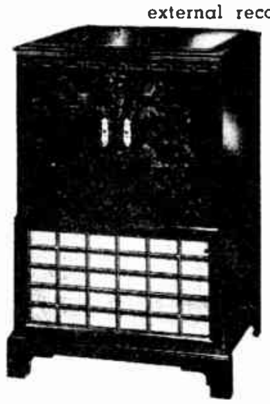
GENERAL DESCRIPTION

Models TC124, TC125, and TC127 are twelve and one-half inch television receivers and are electrically identical except for cabinets. The kinescopes are shipped in place in the cabinet. These receivers employ twenty-one tubes plus two rectifiers and a 12LP4 kinescope.

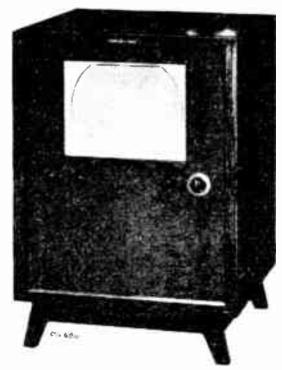
Features of the television unit are full twelve channel coverage; FM sound system; improved picture brilliance; picture A-G-C; A-F-C horizontal hold; stabilized vertical hold; two stages of video amplification; noise saturation circuits; improved sync separator and clipper; four mc. band width for picture channel and reduced hazard high voltage supply. An auxiliary audio input jack is provided to permit the use of an external record playing attachment.



Model TC125
Walnut, Mahogany or Oak



Model TC127
Walnut, Mahogany or Oak



Model TC124
Walnut, Mahogany or Oak

ELECTRICAL AND MECHANICAL SPECIFICATIONS

PICTURE SIZE ....87 square inches on a 12LP4 Kinescope

TELEVISION R-F FREQUENCY RANGE

All 12 television channels, 54 mc. to 88 mc., 174 mc. to 216 mc.
Fine Tuning Range..±250 kc. on chan. 2, ±650 kc. on chan. 13
Picture Carrier Frequency ....25.75 mc.
Sound Carrier Frequency ....21.25 mc.

VIDEO RESPONSE ....To 4 mc.

SWEEP DEFLECTION ....Magnetic

FOCUS ....Magnetic

POWER SUPPLY RATING ....115 volts, 60 cycles, 230 watts

AUDIO POWER OUTPUT RATING ....2.6 watts max.

LOUDSPEAKERS—92569-7 ....12" PM Dynamic, 2.2 ohms

CHASSIS DESIGNATION KCS34B

DIMENSIONS (inches)	Width	Height	Depth
Cabinet (outside) TC124	22 7/8	33 1/4	20 1/2
Cabinet (outside) TC125	25 1/4	36 1/4	21 1/4
Cabinet (outside) TC127	25 3/8	36 1/2	22 5/8
Chassis Assembly (overall)	19 1/2	14	20

WEIGHT

Chassis with Tubes in Cabinet	TC124	103 lbs.
	TC125	100 lbs.
	TC127	110 lbs.
Shipping Weight	TC124	125 lbs.
	TC125	122 lbs.
	TC127	133 lbs.

RECEIVER ANTENNA INPUT IMPEDANCE

Choice: 300 ohms balanced or 72 ohms unbalanced.

RCA TUBE COMPLEMENT

	Tube Used	Function
(1)	RCA 6AG5	R-F Amplifier
(2)	RCA 6AG5	Converter
(3)	RCA 6J6	R-F Oscillator
(4)	RCA 6AU6	1st Sound I-F Amplifier
(5)	RCA 6AU6	2nd Sound I-F Amplifier
(6)	RCA 6AL5	Sound Discriminator
(7)	RCA 6AV6	1st Audio Amplifier
(8)	RCA 6K6GT	Audio Output
(9)	RCA 6BA6	1st Picture I-F Amplifier
(10)	RCA 6AG5	2nd Picture I-F Amplifier
(11)	RCA 6BA6	3rd Picture I-F Amplifier
(12)	RCA 6AG5	4th Picture I-F Amplifier
(13)	RCA 6AL5	Picture 2nd Detector and Sync Limiter
(14)	RCA 12AU7	1st and 2nd Video Amplifier
(15)	RCA 6SN7GT	AGC Amplifier and Vertical Sweep Oscillator
(16)	RCA 6SN7GT	AGC Rectifier and 1st Sync Separator
(17)	RCA 6SN7GT	Sync Amplifier and 2nd Sync Separator
(18)	RCA 6K6GT	Vertical Sweep Output
(19)	RCA 6SN7GT	Horizontal Sweep Oscillator and Control
(20)	RCA 6BG6G	Horizontal Sweep Output
(21)	RCA 6W4GT	Damper
(22)	RCA 1B3-GT 8016	High Voltage Rectifier
(23)	RCA 5U4G	Power Supply Rectifier
(24)	RCA 12LP4	Kinescope

PICTURE INTERMEDIATE FREQUENCIES

Picture Carrier Frequency ....25.75 Mc.
Adjacent Channel Sound Trap ....27.25 Mc.
Accompanying Sound Traps ....21.25 Mc.
Adjacent Channel Picture Carrier Trap ....19.75 Mc.

SOUND INTERMEDIATE FREQUENCIES

Sound Carrier Frequency ....21.25 Mc.
Sound Discriminator Band Width between peaks ....350 kc

VIDEO RESPONSE ....To 4 Mc.

FOCUS ....Magnetic

SWEEP DEFLECTION ....Magnetic

SCANNING ....Interlaced, 525 line

HORIZONTAL SWEEP FREQUENCY ....15,750 cps

VERTICAL SWEEP FREQUENCY ....60 cps

FRAME FREQUENCY (Picture Repetition Rate) ....30 cps

OPERATING CONTROLS (front panel)

Channel Selector / Fine Tuning	Dual Control Knobs
Picture / Brightness	Dual Control Knobs
Picture Horizontal Hold / Picture Vertical Hold	Dual Control Knobs
Sound Volume and On-Off Switch	Single Control Knob

NON-OPERATING CONTROLS (not including r-f & i-f adjustments)

Horizontal Centering	top chassis screwdriver adjustment
Vertical Centering	top chassis screwdriver adjustment
Width	rear chassis screwdriver adjustment
Width Selector Switch	rear chassis adjustment
Height	rear chassis adjustment
Horizontal Linearity	rear chassis screwdriver adjustment
Vertical Linearity	rear chassis adjustment
Horizontal Drive	rear chassis screwdriver adjustment
Horizontal Osc. Freq.	bottom chassis adjustment
Horizontal Osc. Waveform	side chassis adjustment
Horizontal Locking Range	rear chassis adjustment
Focus	rear chassis adjustment
Ion Trap Magnet	top chassis adjustment
Deflection Coil	top chassis wing nut adjustment
AGC Threshold Control	rear chassis adjustment

OPERATING INSTRUCTIONS

The following adjustments are necessary when turning the receiver on for the first time:

1. See that the TV-PH switch on the rear apron is in the "TV" position.

2. Turn the receiver "ON" and advance the SOUND VOLUME control to approximately mid-position.

3. Set the STATION SELECTOR to the desired channel.

4. Adjust the FINE TUNING control for best sound fidelity and the SOUND VOLUME control for suitable volume.

5. Turn the BRIGHTNESS control fully counter-clockwise, then clockwise until a light pattern appears on the screen.

6. Adjust the VERTICAL hold control until the pattern stops vertical movement.

7. Adjust the HORIZONTAL hold control until a picture is obtained and centered.

8. Turn the BRIGHTNESS control counter-clockwise until the retrace lines just disappear.

9. Adjust the PICTURE control for suitable picture contrast.

10. After the receiver has been on for some time, it may be necessary to readjust the FINE TUNING control slightly for improved sound fidelity.

11. In switching from one station to another, it may be necessary to repeat steps 4, 8 and 9.

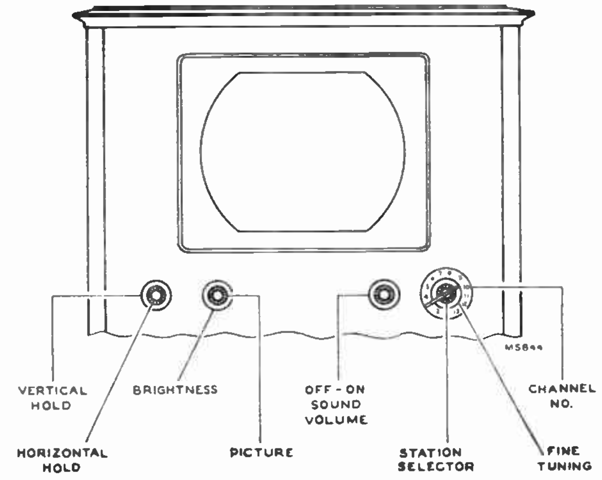


Figure 1—Receiver Operating Controls

12. When the set is turned on again after an idle period, it should not be necessary to repeat the adjustments if the positions of the controls have not been changed. If any adjustment is necessary, step number 4 is generally sufficient.

13. If the positions of the controls have been changed, it may be necessary to repeat steps 2 through 9.

14. To use the instrument with a record player, plug the record-player output cable into the PHONO jack on the rear apron, and set the TV-PH switch on "PH." Set the TV-PH switch back to TV on completion of the record program.

INSTALLATION INSTRUCTIONS

Models TC124, TC125 and TC127 receivers are shipped complete in one carton with the kinescope in place in the cabinet.

UNPACKING.—To unpack, turn the shipping carton on its side and tear open the carton bottom flaps. Fold the flaps up along the side of the carton and turn the carton back up. Lift the carton up and off the cabinet.

Remove the cabinet back grille. Take off the two nuts on the bolts holding the cabinet on the skid. With a man on each side of the cabinet, lift the receiver up and off the skid.

Remove the protective cardboard shield from the 5U4G rectifier. Remove all shipping material.

Remove the envelope containing the control knobs and install them on the proper control shafts.

Make sure that all tubes are in place and are firmly seated in their sockets.

Check to see that the high voltage lead is attached to the kinescope second anode connector socket on the bell of the tube.

ANTENNA AND POWER CONNECTIONS.—Connect the leads from the antenna to the receiver antenna terminals.

Make sure that the receiver power switch is in the off position. Plug the receiver power cord into a 115 volt 60 cycle a-c outlet.

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INSTALLATION INSTRUCTIONS

WARNING.—The high voltage supply in this receiver delivers 10,000 volts! A.C. interlocks are provided at the back of the set so that when the back is removed—so is the power.

Turn the power switch to the "on" position, the brightness control three-quarters clockwise, and picture control fully counter-clockwise.

ION TRAP MAGNET ADJUSTMENT.—Immediately adjust the magnet by moving it forward or backward at the same time rotating it slightly around the neck of the kinescope for the brightest raster on the screen. Reduce the brightness control setting until the raster is slightly above average brilliance. Adjust the focus control (R191 on the chassis rear apron) until the line structure of the raster is clearly visible. Readjust the ion trap magnet for maximum raster brilliance. The final touches on this adjustment should be made with the brightness control at the maximum position with which good line focus can be maintained.

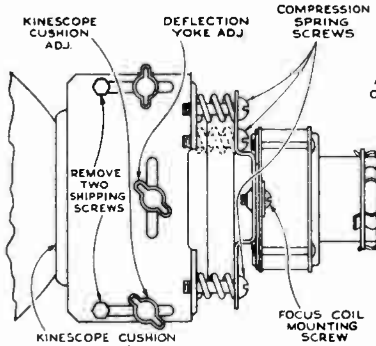

Figure 2—Yoke and Focus Coil Adjustments

DEFLECTION YOKE ADJUSTMENT.—If the lines of the raster are not horizontal or squared with the picture mask, rotate the deflection yoke until this condition is obtained. Tighten the yoke adjustment wing screw.

PICTURE ADJUSTMENTS.—It will now be necessary to obtain a test pattern picture in order to make further adjustments. See steps 3 through 9 of the receiver operating instructions.

If the Horizontal Oscillator and AGC System are operating properly, it should be possible to sync the picture at this point. However, if the AGC threshold control is misadjusted, and the receiver overloading, it may be impossible to sync the picture.

If the receiver is overloading, turn R138 (on the rear of the chassis, see Figure 3) clockwise until the set operates normally and the picture can be synced.

CHECK OF HORIZONTAL OSCILLATOR ALIGNMENT.—Turn the horizontal hold control to the extreme counterclockwise position. The picture should remain in horizontal sync. Momentarily remove the signal by switching off channel then back. Normally the picture will be out of sync. Turn the control clockwise slowly. The number of diagonal black bars will be gradually reduced and when only 3 bars sloping downward to the left are obtained, the picture will pull into sync upon slight additional clockwise rotation of the control. Pull-in should occur when the control is approximately 90 degrees from the extreme counterclockwise position. The picture should remain in sync for approximately 90 degrees of additional clockwise rotation of the control. At the extreme clockwise position, the picture should be out of sync and should show 1 vertical or diagonal black bar in the raster.

If the receiver passes the above checks and the picture is normal and stable, the horizontal oscillator is properly aligned. Skip "Alignment of Horizontal Oscillator" and proceed with "Focus Coil Adjustment."

ALIGNMENT OF HORIZONTAL OSCILLATOR.—If in the above check the receiver failed to hold sync with the hold control at the extreme counterclockwise position or failed to hold sync over 90 degrees of clockwise rotation of the control from the pull-in point, it will be necessary to make the following adjustments.

Horizontal Frequency Adjustment.—Turn the horizontal hold control to the extreme clockwise position. Tune in a television station and adjust the T109 horizontal frequency adjustment (under the chassis) until the picture is just out of sync and the horizontal blanking appears as a vertical or diagonal black bar in the raster.

Horizontal Lock in Range Adjustment.—Set the horizontal hold control to the full counterclockwise position. Momentarily remove the signal by switching off channel then back. Slowly turn the horizontal hold control clockwise and note the least number of diagonal bars obtained just before the picture pulls into sync.

If more than 3 bars are present just before the picture pulls into sync, adjust the horizontal locking range trimmer C153A slightly clockwise. If less than 3 bars are present adjust C153A slightly counterclockwise. Turn the picture control counterclockwise, momentarily remove the signal and recheck the number of bars present at the pull-in point. Repeat this procedure until 3 bars are present.

Repeat the adjustments under "Horizontal Frequency Adjustment" and "Horizontal Locking Range Adjustment" until the conditions specified under each are fulfilled. When the horizontal hold operates as outlined under "Check of Horizontal Oscillator Alignment" the oscillator is properly adjusted.

If it is impossible to sync the picture at this point and the AGC system is in proper adjustment it will be necessary to adjust the Horizontal Oscillator by the method outlined in the alignment procedure on page 68. For field purposes paragraph "A" under Horizontal Oscillator Waveform Adjustment may be omitted.

FOCUS COIL ADJUSTMENTS.—The focus coil should be adjusted so that there is approximately one-quarter inch of space between the rear cardboard shell of the yoke and the flat of the front face of the focus coil. This spacing gives best average focus over the face of the tube. However, it may be necessary to change this distance slightly in order to compensate for small differences in strength of the permanent magnets in the coil. If the receiver focuses with the focus control at or near the clockwise end of its range, the focus coil should be moved toward the yoke and if focus is obtained at or near the counterclockwise end of the control, the coil should be moved away from the yoke.

The axis of the hole through the focus coil should be parallel with the axis of the kinescope neck.

CENTERING ADJUSTMENT.—No electrical centering controls are provided. Centering is obtained by loosening the two focus coil mounting screws and sliding the coil up or down or from side to side. If the focus coil was appreciably changed in position or if a corner of the raster is shadowed, check the position of the ion trap magnet. Reposition the magnet within the range of maximum raster brightness to eliminate the shadow and recenter the picture by sliding the coil. In no case should the magnet be adjusted to cause any loss of brightness since such operation may cause immediate or eventual damage to the tube. In extreme cases it may be necessary to adjust one or more of the three focus coil compression spring screws to eliminate a corner shadow.

WIDTH, DRIVE AND HORIZONTAL LINEARITY ADJUSTMENTS.—Adjust the horizontal drive control C153B to give a picture of maximum width within the limits of good linearity. Adjust the horizontal linearity control L111 to provide best linearity. Adjust the width control until the picture just fills the mask.

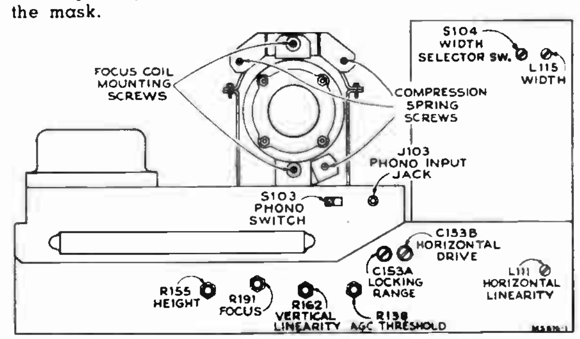

Figure 3—Rear Chassis Adjustments

A width control coil and a width selector switch are provided. With the switch in position 1 (fully counterclockwise), adjust the width coil until the picture fills the mask. On low line voltages it may not be possible to get sufficient width by adjustment of the width coil. In this case turn the width selector switch clockwise to position 2. In this position the width coil is disconnected, and adjustment of the width coil will have no effect. For still greater width, turn the width selector switch fully clockwise to position 3. In this position, the high voltage is reduced slightly thus permitting greater deflection.

Adjustments of the horizontal drive control affect horizontal oscillator hold and locking range. If the drive control was adjusted, recheck the oscillator alignment.

HEIGHT AND VERTICAL LINEARITY ADJUSTMENTS.—Adjust the height control (R155 on chassis rear apron) until the picture fills the mask vertically. Adjust vertical linearity (R162 on rear apron), until the test pattern is symmetrical from top to bottom. Adjustment of either control will require a readjustment of the other. Adjust centering to align the picture with the mask.

FOCUS.—Adjust the focus control (R191 on chassis rear apron) for maximum definition in the test pattern vertical "wedge" and best focus in the white areas of the pattern.

In some cases it may be possible to improve focus by a slight reposition of the ion trap magnet while staying within the range of maximum brightness.

Check to see that the cushion and yoke thumbscrews and the focus coil mounting screws are tight.

AGC THRESHOLD CONTROL.—The AGC threshold control R138 is adjusted at the factory and normally should not require readjustment in the field.

To check the adjustment of the AGC Threshold Control, tune in a strong signal, sync the picture and turn the picture control to the maximum clockwise position. Turn the brightness control counterclockwise until the vertical retrace lines are just invisible. Momentarily remove the signal by switching off channel then back. If the picture reappears immediately, the receiver is not overloading due to improper setting of R138. If the picture requires an appreciable portion of a second to reappear, R138 should be readjusted.

Set the picture control at the maximum clockwise position. Turn R138 fully clockwise. The top one-half inch of the picture may be bent slightly. This should be disregarded. Turn R138 counterclockwise until there is a very, very slight bend or change of bend in the top one-half inch of the picture. Then turn R138 clockwise just sufficiently to remove this bend or change of bend.

If the signal is very weak, the above method may not work as it may be impossible to get the picture to bend. In this case, turn R138 counterclockwise until the snow in the picture becomes more pronounced, then clockwise until the best signal to noise ratio is obtained.

The AGC control adjustment should be made on a strong signal if possible. If the control is set too far counterclockwise on a weak signal, then the receiver may overload when a strong signal is received.

Replace the cabinet back and make sure that the screws holding it are up tight, otherwise it may rattle or buzz when the receiver is operated at high volume.

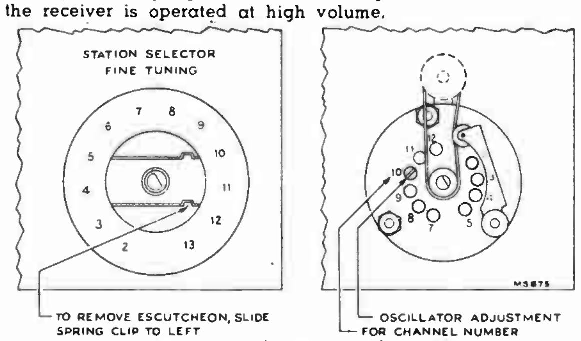

Figure 4—R-F Oscillator Adjustments

CHECK OF R-F OSCILLATOR ADJUSTMENTS.—Tune in all available stations to see if the receiver r-f oscillator is adjusted to the proper frequency on all channels. If adjustments are required, these should be made by the method outlined in the alignment procedure on page 10. The adjustments for channels 2 through 5 and 7 through 12 are available from the front of the cabinet by removing the station selector escutcheon as shown in Figure 4. Adjustment for channel 13 is on top of the chassis and channel 6 adjustment is in the kinescope well. See Figures 8 and 9 for their location.

CHASSIS REMOVAL.—To remove the chassis for repair or installation of a new kinescope, remove the cabinet back and the control knobs, unplug the speaker cable, and remove the six chassis bolts under the cabinet. Withdraw the chassis from the back of the cabinet. The kinescope is held on the chassis by means of a special strap, so that the chassis and the kinescope can be handled together, as a unit.

To remove the kinescope, remove the kinescope socket, the ion-trap magnet, and the second-anode connector. Loosen the cross-recessed head screw on the kinescope strap. Withdraw the kinescope toward the front of the chassis.

INSTALLATION OF KINESCOPE.—The kinescope second anode contact is a recessed metal well in the side of the bulb. The tube must be installed so that this contact is up but rotated approximately 30 degrees toward the high-voltage compartment.

Insert the neck of the kinescope through the deflection and focus coils. If the tube sticks, or fails to slip into place smoothly, investigate and remove the cause of the trouble. Do not force the tube.

Slide the kinescope cushion toward the rear of the chassis. Loosen the deflection yoke adjustment, slide the yoke toward the rear of the chassis and tighten.

Slip the ion trap magnet assembly over the neck of the kinescope.

Connect the kinescope socket to the tube base.

Connect the high voltage lead to the kinescope second anode socket.

Wipe the kinescope screen surface and front panel safety glass clean of all dust and finger marks.

To replace the chassis in the cabinet, first tighten the cross-recessed head screw on the kinescope strap. Slide the chassis into the cabinet, then insert and tighten the six chassis bolts. Loosen the kinescope strap from the rear of the cabinet. Push the kinescope forward until the face of the tube is against the mask. Push the yoke cushion forward against the kinescope flare, then tighten the cushion adjusting screws. Tighten the kinescope strap. Then replace the knobs, and the cabinet back.

WEAK SIGNAL AREA OPERATION.—Since the vast majority of receivers are sold in strong signal areas the chassis are aligned to produce the cleanest pictures in those areas. However, if the receiver is to be operated in a weak signal area, better performance can be obtained by "peaking" the r-f unit.

To peak the r-f unit in these receivers, disconnect R14, the 390 ohm resistor which is on top of the r-f unit chassis. Adjust L66 to obtain the best possible picture on the weakest low channel station received. By this action, the r-f gain is increased 50% at the expense of r-f bandwidth and an improvement in the weak signal picture results.

If the peaked receiver is subsequently taken to a strong signal area, the resistor R14 should be connected in place and L66 adjusted for "flat" response on the low channels.

ANTENNAS.—The finest television receiver built may be said to be only as good as the antenna design and installation. It is therefore important to select the proper antenna to suit the particular local conditions, to install it properly and orient it correctly.

RCA Television Antenna, type No. 225A1 is designed for reception of all twelve television channels. The antenna uses the 300-ohm RCA "Bright Picture" television transmission line. The antenna, a dipole with reflector, is unidirectional on channels two through six. When used on these channels, the maximum signal is obtained when the antenna rods are broadside toward the transmitting antenna, with the antenna element between the reflector and the transmitting antenna.

If two or more stations are available between channels two and six and the two stations are in different directions, it may be possible to make a compromise orientation which will provide a satisfactory signal on all such channels.

When operated on channels seven through thirteen (174 to 216 Mc), the antenna has side lobes. On these channels, the maximum signal will be obtained when the antenna is rotated approximately 35 degrees in either direction from its broadside position toward the transmitting antenna. In many instances this effect may not cause any difficulties and it may be possible to make a compromise orientation which will permit satisfactory reception on all high and low channels. In some instances, however, this will not be the case due to reflections or to insufficient signal strength from one or more stations.

RCA antennas type 204A1 is available for use in locations in which it is desirable to eliminate side lobes and to have the antennas 7-13 directivity the same as 2-6 directivity.

For use in cases where it is desirable to have adjustable 7-13 directivity different from 2-6, RCA antenna type 206A1 is provided.

If it is impossible to obtain satisfactory results on one or more channels, it may become necessary either to provide means for tuning the antenna when switching channels or to install a separate antenna for one or more channels and to switch antennas when switching channels.

In weak signal areas it is possible to "stack" the type 204A1 antenna to obtain increased signal strength by employing one type 204A1 antenna and one type 208A1 stacking kit.

REFLECTIONS.—Multiple images sometimes known as echoes or ghosts, are caused by the signal arriving at the antenna by two or more routes. The second or subsequent image occurs when a signal arrives at the antenna after being reflected off a building, a hill or other object. In severe cases of reflections, even the sound may be distorted. In less severe cases, reflections may occur that are not noticeable as reflections but that will instead cause a loss of definition in the picture.

Depending upon the circumstances, it may be possible to eliminate the reflections by rotating the antenna or by moving it to a new location. In extreme cases, it may be impossible to eliminate the reflection.

CABINET ANTENNA.—A cabinet antenna is provided in these receivers and the leads are brought out near the antenna terminal board. The cabinet antenna may be employed in place of the outdoor antenna in areas where the signals are strong and no reflections are experienced.

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CHASSIS TOP VIEW

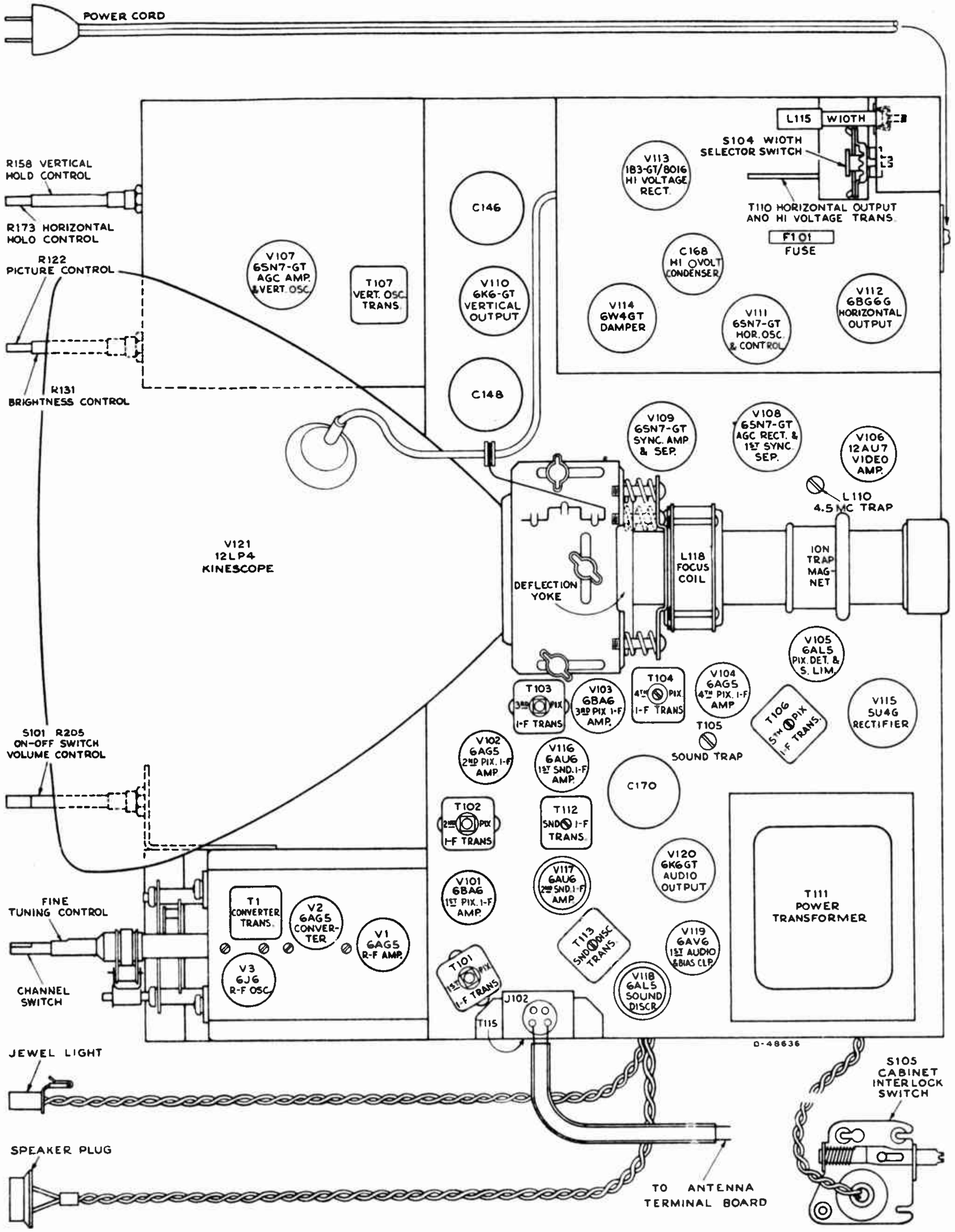

Figure 5—Chassis Top View

CHASSIS BOTTOM VIEW

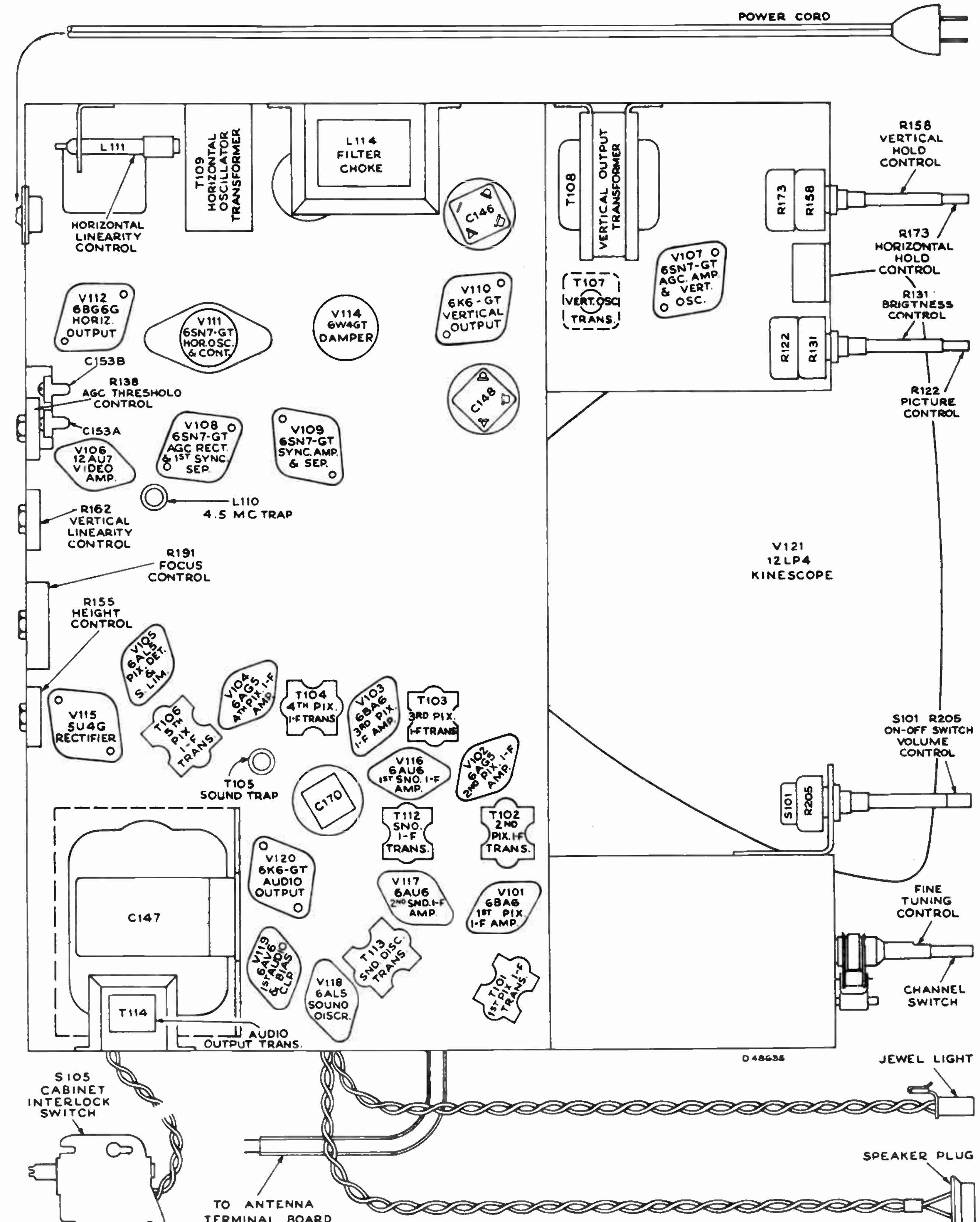

Figure 6—Chassis Bottom View

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ALIGNMENT PROCEDURE

TEST EQUIPMENT.—To properly service the television chassis of this receiver, it is recommended that the following test equipment be available:

R-F Sweep Generator meeting the following requirements:

(a) Frequency Ranges
20 to 30 mc., 1 mc. and 10 mc. sweep width
50 to 90 mc., 10 mc. sweep width
170 to 225 mc., 10 mc. sweep width

(b) Output adjustable with at least .1 volt maximum.

(c) Output constant on all ranges.

(d) "Flat" output on all attenuator positions.

Cathode-Ray Oscilloscope.—For alignment purposes, the oscilloscope employed must have excellent low frequency and phase response, and should be capable of passing a 60-cycle square wave without appreciable distortion. While this requirement is not met by many commercial instruments, RCA Oscilloscopes, types WO-55A, WO-58A, WO-79A, and WO-60C fill the requirement and any of these may be employed.

For video and sync waveform observations, the oscilloscope must have excellent frequency and phase response from 10 cycles to at least two megacycles in all positions of the gain control. The RCA types WO-58A and WO-79A are ideally suited for this purpose.

Signal Generator to provide the following frequencies with crystal accuracy.

(a) Intermediate frequencies
19.75 mc. adjacent channel picture trap
21.25 mc. sound i-f and sound traps
22.05 and 24.75 mc. conv. and first pix i-f trans.
25.9 mc. second picture i-f transformer
24.6 mc. fourth picture i-f transformer
22.0 mc. third picture i-f transformer
22.5 mc. fifth picture i-f transformer
25.75 mc. picture carrier
27.25 mc. adjacent channel sound trap

(b) Radio frequencies

Channel Number	Picture Carrier Freq. Mc.	Sound Carrier Freq. Mc.
2	55.25	59.75
3	61.25	65.75
4	67.25	71.75
5	77.25	81.75
6	83.25	87.75
7	175.25	179.75
8	181.25	185.75
9	187.25	191.75
10	193.25	197.75
11	199.25	203.75
12	205.25	209.75
13	211.25	215.75

(c) Output of these ranges should be adjustable and at least .1 volt maximum.

Heterodyne Frequency Meter with crystal calibrator if the signal generator is not crystal controlled.

Electronic Voltmeter of Junior "VoltOhmyst" type and a high voltage multiplier probe for use with this meter to permit measurements up to 10 kv.

Service Precautions.—If possible, the chassis should be serviced without the kinescope. However, if it is necessary to view the raster during servicing, make sure the kinescope retaining strap is secure, and the yoke cushion is up firmly against the flare of the tube.

CAUTION: Do not short the kinescope second anode lead. Its short circuit current is approximately 3 ma. This represents approximately 9 watts dissipation and a considerable overload on the high voltage filter resistor R189.

Adjustments Required.—Normally, only the r-f oscillator line will require the attention of the service technician. All other circuits are either broad or very stable and hence will seldom require readjustment.

The oscillator line is relatively non critical. When oscillator tubes are changed, in all probability it will be necessary to adjust only C6 in order to bring the entire line into adjustment.

ORDER OF ALIGNMENT.—When a complete receiver alignment is necessary, it can be most conveniently performed in the following order:

(1) Sound discriminator
(2) Sound i-f transformers
(3) Picture i-f traps
(4) Picture i-f transformers
(5) R-F and converter lines
(6) R-F oscillator line
(7) 4.5 mc. video trap
(8) Sensitivity check

SOUND DISCRIMINATOR ALIGNMENT.—Set the signal generator for approximately .1 volt output at 21.25 mc. and connect it to the second sound i-f grid.

Detune T113 secondary (bottom).

Set the "VoltOhmyst" on the 10 volt scale.

Connect the meter in series with a one megohm resistor to the junction of diode resistors R203 and R204.

Adjust the primary of T113 (top) for maximum output on the meter.

Connect the "VoltOhmyst" to the junction of C183 and R203. Adjust T113 secondary (bottom). It will be found that it is possible to produce a positive or negative voltage on the meter dependent upon this adjustment. Obviously to pass from a positive to a negative voltage, the voltage must go through zero. T113 (bottom) should be adjusted so that the meter indicates zero output as the voltage swings from positive to negative. This point will be called discriminator zero output.

Connect the sweep oscillator to the grid of the second sound i-f amplifier.

Adjust the sweep band width to approximately 1 mc. with the center frequency at approximately 21.25 mc. and with an output of approximately .1 volt.

Connect the oscilloscope to the junction of C183 and R203. The pattern obtained should be similar to that shown in Figure 12. If it is not, adjust the T113 (top) until the waveform is symmetrical.

The peak-to-peak band width of the discriminator should be approximately 350 kc. and it should be linear from 21.175 mc. to 21.325 mc.

SOUND I-F ALIGNMENT.—Connect the sweep oscillator to the first sound i-f amplifier grid.

Connect the oscilloscope to the second sound i-f grid return (terminal A T112) in series with a 33,000 ohm isolating resistor.

Insert a 21.25 mc. marker signal from the signal generator into the second sound i-f grid.

Adjust T112 (top and bottom) for maximum gain and symmetry about the 21.25 mc. marker. The pattern obtained should be similar to that shown in Figure 13.

The output level from the sweep should be set to produce approximately .3 volt peak-to-peak at the second sound i-f grid return when the final touches on the above adjustment are made. It is necessary that the sweep output voltage should not exceed the specified values otherwise the response curve will be broadened, permitting slight misadjustment to pass unnoticed and possibly causing distortion on weak signals.

The band width at 70% response from the first sound i-f grid to the second i-f grid should be approximately 200 kc.

PICTURE I-F TRAP ADJUSTMENT.—Connect the "VoltOhmyst" to the junction of R135 and C190.

Remove the 6SN7GT AGC Amplifier tube V107. Connect a 250,000 ohm potentiometer between pins 5 and 6 of the V107 socket. Adjust the potentiometer until the "VoltOhmyst" reads approximately −12.0 volts.

Set the channel switch to the blank position between channel numbers 2 and 13.

Connect the "VoltOhmyst" across the picture detector load resistor R119. Under this condition, both leads of the meter are at approximately −120 volts. In making this measurement, care should be taken not to touch the case of the meter or to permit the meter case to become grounded.

Connect the output of the signal generator to the grid of the converter tube V2. To do this, remove the tube from the socket and fashion a clip by twisting one end of a small piece of wire around pin number 1. Replace the tube in the socket leaving the end of the wire protruding from under the tube. Connect the signal generator to this wire through a 1,500 mmf. capacitor keeping the leads as short as possible.

Set the generator to each of the following frequencies and with a thin fiber screwdriver tune the specified adjustment for minimum indication on the "VoltOhmyst." In each instance the generator should be checked against a crystal calibrator to insure that the generator is exactly on frequency.

(1) 21.25 mc.—T103 (top)
(2) 21.25 mc.—T105 (top)
(3) 27.25 mc.—T102 (top)
(4) 27.25 mc.—T104 (top)
(5) 19.75 mc.—T106 (top)
(6) 19.75 mc.—T101 (top)

In the above transformers using threaded cores, it is possible to run the cores completely through the coils and secure two peaks or nulls. The correct position is with the cores in the outside ends of the coils. If the cores are not in the correct position, the coupling will be incorrect and it will be impossible to secure the correct response.

PICTURE I-F TRANSFORMER ADJUSTMENTS.—Set the signal generator to each of the following frequencies and peak the specified adjustment for maximum indication on the "VoltOhmyst." During alignment, reduce the input signal if necessary to prevent overloading.

22.5 mc.—T106 (bottom)
24.6 mc.—T104 (bottom)
22.0 mc.—T103 (bottom)
25.9 mc.—T102 (bottom)

T1 and T101 are coupled by a link and in combination constitute an overcoupled transformer. The characteristics of such a transformer are such that it is impossible to adjust it to a single frequency.

To sweep align T1 and T101, connect a 330 ohm composition resistor across the primary coils of T102, T103, T104 and T106.

Connect the "VoltOhmyst" to the junction of R135 and C190. Adjust the 250,000 ohm potentiometer for −2.0 volts on the meter.

Connect the oscilloscope to the plate of the first video amplifier, pin 1 of V106.

Connect a sweep generator to the converter grid through a 1,500 mmf. capacitor. Set the generator to sweep from 20.0 mc. to 30.0 mc. and adjust the output to provide a 4 volt peak-to-peak signal on the scope.

Connect the signal generator loosely to the converter grid and adjust to provide markers at 22.05 mc. and 24.75 mc.

Adjust T1 (top) and T101 (bottom) to obtain the response shown in Figure 14. The T1 core must penetrate to the terminal board end of the coil in order to obtain the correct response.

Remove the 330 ohm resistors from across T102, T103, T104 and T106.

Adjust the 250,000 ohm potentiometer for a 15 volt peak-to-peak signal at the plate of the first video amplifier. The bias as measured by the "VoltOhmyst" should be −12 volts or less.

Observe and analyze the response curve obtained. The response will not be ideal and the i-f adjustments must be retouched in order to obtain the desired curve. See Figure 15.

On final adjustment the picture carrier marker must be at approximately 45% response. The curve must be approximately flat topped, with the 22.1 mc. marker at approximately 95% response, the 25.0 mc. marker below 90% and the 26.5 mc. marker at 5% to 10% on the response curve.

The most important consideration in making the i-f adjustments is to get the picture carrier at the 45% response point. If the picture carrier operates too low on the response curve, loss of low frequency video response, of picture brilliance, of blanking, and of sync may occur. If the picture carrier operates too high on the response curve, the picture becomes smeared. In making these adjustments, care should be taken that no two transformers are tuned to the same frequency as i-f oscillation may result.

Remove the converter tube and take off the clip to pin number 1. Replace the tube in the socket.

Picture I-F Oscillation.—If the receiver will operate without oscillating with the test equipment disconnected but breaks into oscillation or becomes unstable with the equipment connected, it may become necessary to establish a ground plane. Cover the test bench with a sheet of copper and set the chassis on the sheet. Set all the test equipment except the "VoltOhmyst" on the sheet and bond or bypass them to it. A Junior "VoltOhmyst" should not be bonded to the sheet since the negative test probe is not always connected to ground during alignment.

If the receiver is badly misaligned and two or more of the i-f transformers are tuned to the same frequency, the receiver may fall into i-f oscillation. I-F oscillation shows up as a voltage across the picture detector load resistor that is unaffected by r-f signal input. If such a condition is encountered, it is sometimes possible to stop oscillation by increasing the grid bias. If so, it should then be possible to align the transformers by the usual method. Once aligned in this manner, the i-f should be stable with reduced bias.

If the oscillation cannot be stopped in the above manner, shunt the grids of the first three pix i-f amplifiers to ground with 1,000 mmf. capacitors. Connect the signal generator to the fourth pix i-f grid and align T106 to frequency. Progressively remove the shunt from each grid and align the plate coil of that stage to frequency.

If this does not stop the oscillation, the difficulty is not due to i-f misalignment as the i-f section is stable when properly aligned. Check all i-f by-pass condensers, transformer shunting resistors, tubes, socket voltages, etc.

ANTENNA, R-F AND CONVERTER LINE ADJUSTMENT.—In order to align the r-f tuner, it will first be necessary to set the channel 13 oscillator to frequency. The shield over the bottom of the r-f unit must be in place when making any adjustments.

The channel 13 oscillator may be aligned by adjusting it to beat with a crystal calibrated heterodyne frequency meter, or by feeding a signal into the receiver at the r-f sound carrier frequency and adjusting the oscillator for zero output from the sound discriminator. In this latter case the sound discriminator must first have been aligned to exact frequency. Either method of adjustment will produce the same results. The method used will depend upon the type of test equipment available. Regardless of which method of oscillator alignment is used, the frequency standard must be crystal controlled or calibrated.

If the receiver oscillator is to be adjusted by the heterodyne freqenecy meter method, couple the meter probe loosely to the receiver oscillator.

If the receiver oscillator is adjusted by feeding in the r-f sound carrier signal, connect the signal generator to the receiver antenna terminals. Connect the "VoltOhmyst" to the sound discriminator output (junction of C183 and R203).

Set the receiver channel switch to 13.

Adjust the frequency standard to the correct frequency (237 mc. for heterodyne frequency meter or 215.75 mc. for the signal generator).

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Set the fine tuning control to the middle of its range while making the adjustment.

Adjust C6 for an audible beat on the heterodyne frequency meter or zero voltage from sound discriminator.

Now that the channel 13 oscillator is set to frequency, we may proceed with the r-f alignment.

Remove the first pix i-f amplifier tube V101.

Connect the oscilloscope to the test connection at R13 in the r-f tuning unit.

Connect the "VoltOhmyst" to the junction of R135 and L117. Adjust the bias potentiometer for −3.5 volts on the meter.

Connect the r-f sweep oscillator to the receiver antenna terminals. The method of connection depends upon the output impedance of the sweep. The P102 connection for 300 ohm balanced or 72 ohm single-ended input are shown in the circuit diagram in Figure 79. If the sweep oscillator has a 50 ohm single-ended output, 300 ohm balanced output can be obtained by connecting as shown in Figure 7.

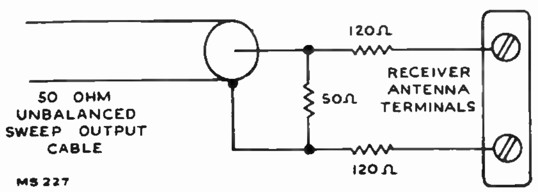

Figure 7—Unbalanced Sweep Cable Termination

Connect the signal generator loosely to the receiver antenna terminals.

Since channel 7 has the narrowest response of any of the high frequency channels, it should be adjusted first.

Set the receiver channel switch to channel 7.

Set the sweep oscillator to cover channel 7.

Insert markers of channel 7 picture carrier and sound carrier 175.25 mc. and 179.75 mc.

Adjust C10 and C14 until the curve falls symmetrically between the sound and picture carrier markers. Adjust C11 to give the proper bandwidth. Roughly peak L6 in conjunction with slight adjustments of C10 and C14 for a flat-topped, response curve with the sound and picture carriers at 90% to 95% response points on this curve. See Figure 16, channel 7.

Switch to channel 12 and adjust L6 for maximum response and minimum top slope of the curve.

Check the response of channels 7 through 13 by switching the receiver channel switch, sweep oscillator and marker oscillator to each of these channels and observe the response obtained. See Figure 16 for typical response curves. It should be found that all these channels have the proper shaped response with the markers above 80% response. If the markers do not fall within this requirement on one or more high frequency channels, since there are no individual channel adjustments, it will be necessary to readjust L6, C10, C11 and C14, and possibly compromise some channel slightly in order to get the markers up on other channels. Normally, however, no difficulty of this type should be experienced since the higher frequency channels become comparatively broad and the markers easily fall within the required range.

Channel 6 is next aligned in the same manner.

Set the receiver to channel 6.

Set the sweep oscillator to cover channel 6.

Set the marker oscillator to channel 6 picture and sound carrier frequencies.

Adjust L9, L13, L66 and C12, for an approximately flat-topped response curve located symmetrically between the markers. L9, L13 and L66 are the center frequency adjustments. C12 is the band width adjustment.

Check channels 5 down through channel 2 by switching the receiver, sweep oscillator and marker oscillator to each channel and observing the response obtained. In all cases, the markers should be above the 80% response point. If this is not the case, L9, L13, L66 and C12 should be retouched. On final adjustment, all channels must be within the 80% specification.

Disconnect the bias pot. and replace V107. Replace V101.

Following an r-f alignment, the oscillator alignment must be checked.

R-F OSCILLATOR LINE ADJUSTMENT.—The r-f oscillator line may be aligned by adjusting it to beat with a crystal calibrated heterodyne frequency meter, or by feeding a signal into the receiver at the r-f sound carrier frequency and adjusting the oscillator for zero output from the sound discriminator. In this latter case the sound discriminator must first have been aligned to exact frequency. Either method of adjustment will produce the same results. The method used will depend upon the type of test equipment available.

Regardless of which method of oscillator alignment is used the frequency standard must be crystal controlled or calibrated. If the receiver oscillator is to be adjusted by the heterodyne frequency meter method, the calibration frequency listed under R-F Osc. Freq. must be available.

If the receiver oscillator is adjusted by feeding in the r-f sound carrier frequency, the frequencies listed under Sound Carrier Freq. must be available.

Channel Number	Receiver R-F Osc. Freq. Mc.	R-F Sound Carrier Freq. Mc.	Channel Oscillator Adjustment
2	81	59.75	L24
3	87	65.75	L23
4	93	71.75	L22
5	103	81.75	L21
6	109	87.75	L31
7	201	179.75	L19
8	207	185.75	L18
9	213	191.75	L17
10	219	197.75	L16
11	225	203.75	L15
12	231	209.75	L14
13	237	215.75	C6

If the heterodyne frequency meter method is used, couple the meter probe loosely to the receiver oscillator.

If the r-f sound carrier method is used, connect the "VoltOhmyst" to the sound discriminator output (junction of C183 and R203).

Connect the signal generator to the receiver antenna terminals. The order of alignment remains the same regardless of which method is used.

If the r-f unit is removed from the receiver for service and is aligned separately the shield over the bottom of the r-f unit must be in place when making adjustments.

Since lower frequencies are obtained by adding steps of inductance, it is necessary to align channel 13 first and continue in reverse numerical order.

Set the receiver channel switch to 13.

Adjust the frequency standard to the correct frequency (237 mc. for heterodyne frequency meter or 215.75 mc. for the signal generator).

Set the fine tuning control to the middle of its range while making the adjustment.

Adjust C6 for an audible beat on the heterodyne frequency meter or zero voltage from sound discriminator. Oscillator adjustments L1 and L2 shown on the schematic are factory control adjustments and should not be touched in the field.

Switch the receiver to channel 12.

Set the frequency standard to the proper frequency as listed in the alignment table.

Adjust L14 for indications as above.

Adjust the oscillator to frequency on all channels by switching the receiver and the frequency standard to each channel and adjusting the appropriate oscillator trimmer for the specified indication. It should be possible to adjust the oscillator to the correct frequency on all channels with the fine tuning control in the middle third of its range.

After the oscillator has been set on all channels, start back at channel 13 and recheck to make sure that all adjustments are correct.

AGC THRESHOLD ADJUSTMENT.—The AGC threshold adjustment can be made by the method outlined in the Installation Instructions. However, a more accurate adjustment can be obtained by the use of an oscilloscope.

Tune in a station and advance the picture control to the maximum clockwise position. Connect the low capacity probe from the oscilloscope to the plate of the first video amplifier. Adjust the oscilloscope to observe the horizontal sync pulse.

Turn the AGC threshold control R138 fully clockwise, then slowly counterclockwise. As the control is turned counterclockwise, the receiver gain will increase slowly, increasing the size of the pattern on the oscilloscope. R138 should be turned counterclockwise until the receiver begins to overload as indicated by clipping of the sync. The control should be left in the maximum gain position in which no clipping of sync is observed. See Figure 17 for proper waveforms.

HORIZONTAL OSCILLATOR ADJUSTMENT.—Normally the adjustment of the horizontal oscillator is not considered to be a part of the alignment procedure, but since the oscillator waveform adjustment requires the use of an oscilloscope, it can not be done conveniently in the field. The waveform adjustment is made at the factory and normally should not require readjustment in the field. However, the waveform adjustment should be checked whenever the receiver is aligned or whenever the horizontal oscillator operation is improper.

Horizontal Frequency Adjustment.—With a clip lead, short circuit the coil between terminals C and D of the horizontal oscillator transformer T109. Tune in a television station and sync the picture if possible.

A.—Turn the horizontal hold control R173 to the extreme clockwise position. Adjust the T109 Frequency Adjustment (under the chassis) so that the picture is just out of sync and the horizontal blanking appears in the picture as a vertical bar. The position of the bar is unimportant.

B.—Turn the hold control approximately one quarter of a turn from the extreme clockwise position and examine the width and linearity of the picture. If picture width or linearity is incorrect, adjust the horizontal drive control C153B, the width control L115 and the linearity control L111 until the picture is correct. If C153B, L115 or L111 were adjusted, repeat step A above.

Horizontal Locking Range Adjustment.—Turn the horizontal hold control fully counterclockwise. Momentarily remove the signal by switching off channel then back. Slowly turn the horizontal hold control clockwise and note the least number of diagonal bars obtained just before the picture pulls into sync.

If more than 9 bars are present just before the picture pulls into sync, adjust the horizontal locking range trimmer C153A slightly clockwise. If less than 7 bars are present, adjust C153A slightly counterclockwise. Turn the horizontal hold control counterclockwise, momentarily remove the signal and recheck the number of bars present at the pull-in point. Repeat this procedure until 7 to 9 bars are present.

Horizontal Oscillator Waveform Adjustment.—Remove the shorting clip from terminals C and D of T109. Turn the horizontal hold control to the extreme clockwise position. With a thin fibre screwdriver, adjust the Oscillator Waveform Adjustment Core of T109 (on the outside of the chassis) until the horizontal blanking bar appears in the raster.

A.—Connect the low capacity probe of an oscilloscope to terminal C of T109. Turn the horizontal hold control one quarter turn from the clockwise position so that the picture is in sync. The pattern on the oscilloscope should be as drawn in Figure 18. Adjust the Oscillator Waveform Adjustment Core of T109 until the two peaks are at the same height. During this adjustment, the picture must be kept in sync by readjusting the hold control if necessary.

This adjustment is very important for correct operation of the circuit. If the broad peak of the wave on the oscilloscope is lower than the sharp peak, the noise immunity becomes poorer, the stabilizing effect of the tuned circuit is reduced and drift of the oscillator becomes more serious. On the other hand, if the broad peak is higher than the sharp peak, the oscillator is overstabilized, the pull-in range becomes inadequate and the broad peak can cause double triggering of the oscillator when the hold control approaches the clockwise position.

Remove the oscilloscope upon completion of this adjustment.

Check of Horizontal Oscillator Adjustments.—Set the horizontal hold control to the full counterclockwise position. Momentarily remove the signal by switching off channel then back. Slowly turn the horizontal hold control clockwise and note the least number of diagonal bars obtained just before the picture pulls into sync.

If more than 3 bars are present just before the picture pulls into sync, adjust the horizontal locking range trimmer C153A slightly clockwise. If less than 3 bars are present, adjust C153A slightly counterclockwise. Turn the horizontal hold control counterclockwise, momentarily remove the signal and recheck the number of bars present at the pull-in point. Repeat this procedure until bars are present.

Turn the horizontal hold control to the maximum clockwise position. The picture should be just out of sync to the extent that the horizontal blanking bar appears as a single vertical or diagonal bar in the picture. Adjust the T109 Frequency Adjustment until this condition is fulfilled.

4.5 MC. VIDEO TRAP ADJUSTMENT.—Tune in a strong input from a station, and with a very short clip lead, short the trap winding of T103. Observe the picture for the appearance of a 4.5 mc. beat. If the beat appears in the picture, adjust L110 until the beat is eliminated or minimized.

SENSITIVITY CHECK.—A comparative sensitivity check can be made by operating the receiver on a weak signal from a television station and comparing the picture and sound obtained to that obtained on other receivers under the same conditions.

This weak signal can be obtained by connecting the shop antenna to the receiver through a ladder type attenuator pad. The number of stages in the pad depends upon the signal strength available at the antenna. A sufficient number of stages should be inserted so that a somewhat less than normal contrast picture is obtained when the picture control is at the maximum clockwise position. Only carbon type resistors should be used to conduct the pad.

RESPONSE CURVES.—The response curves shown on page 14 and referred to throughout the alignment procedure were taken from a production set. Although these curves are typical, some variations can be expected.

The response curves are shown in the classical manner of presentation, that is with "response up" and low frequency to the left. The manner in which they will be seen in a given test set-up will depend upon the characteristics of the oscilloscope and the sweep generator. The curves may be seen inverted and/or switched from left to right depending on the deflection polarity of the oscilloscope and the phasing of the sweep generator.

ALIGNMENT TABLE.—Both methods of oscillator alignment are presented in the alignment table. The service technician may thereby choose the method to suit his test equipment.

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ALIGNMENT TABLE

THE DETAILED ALIGNMENT PROCEDURE BEGINNING ON PAGE 8 SHOULD BE READ BEFORE ALIGNMENT BY USE OF THE TABLE IS ATTEMPTED

STEP No.	CONNECT SIGNAL GENERATOR TO	SIGNAL GEN. FREQ. MC.	CONNECT SWEEP GENERATOR TO	SWEEP GEN. FREQ. MC.	CONNECT OSCILLOSCOPE TO	CONNECT "VOLTOHMYST" TO	MISCELLANEOUS CONNECTIONS AND INSTRUCTIONS	ADJUST	REFER TO
				DISCRIMINATOR AND SOUND I-F ALIGNMENT					
1	2nd sound i-f grid (pin 1, V117)	21.25 .1 volt output	Not used		Not used.	In series with 1 meg. to junction of R203 & R204		Detune T113 (bot.) Adjust T113 (top) for max. on meter	Fig. 13 Fig. 12 Fig. 11
2	"	"	"		"	Junction of C183 & R203	Meter on 3 volt scale	T113 (bottom) for zero on meter	Fig. 13 Fig. 12
3	"	"	2nd sound i-f grid (pin 1, V117)	21.25 center 1 mc. wide .1 v. out	Junct. of C183 & R203	Not used	Check for symmetrical response waveform (positive & negative). If not equal adjust T113 (top) until they are equal		Fig. 13 Fig. 15
4	1st sound i-f grid (pin 1, V116)	21.25 reduced output	1st sound i-f grid	21.25 reduced output	Terminal A, T112 in series with a 33,000 ohm resistor.	"	Sweep output reduced to provide .3 volt p-to-p on scope	T112 (top & bot.) for max. gain and symmetry at 21.25 mc.	Fig. 13 Fig. 11 Fig. 12 Fig. 16
				PICTURE I-F AND TRAP ADJUSTMENT					
5	Not used		Not used		Not used	Junction of R135 & C190	Remove V107. Connect potentiometer between pins 5 & 6 of V107 socket	Adjust potentiometer for −12.0 volts on meter	Fig. 13 Fig. 11
6	Converter grid (pin 1, V2)	21.25	"		"	Across R119	Meter on 3 volt scale. Receiver between 2 & 13	T103 (top) for min. on meter	Fig. 11 Fig. 13
7	"	21.25	"		"	"	"	T105 (top) for min.	Fig. 13 Fig. 11
8	"	27.25	"		"	"	"	T102 (top) for min.	"
9	"	27.25	"		"	"	"	T104 (top) for min.	"
10	"	19.75	"		"	"	"	T106 (top) for min.	"
11	"	19.75	"		"	"	"	T101 (top) for min.	"
12	"	22.5	"		"	"	"	T106 (bottom) for max. on meter	Fig. 12
13	"	24.6	"		"	"	"	T104 (bottom) for max.	"
14	"	22.0	"		"	"	"	T103 (bottom) for max.	"
15	"	25.9	"		"	"	"	T102 (bottom) for max.	"
16	"	22.05 24.75	Converter grid (pin 1, V2)	Sweeping 20 to 30 mc.	Pin 1, V106	Junction of R135 & C190	Shunt 300 ohms across pri. T102, T103, T104, T106. Set bias −2 V. Set swp. gen. for 4 V. P-P on scope.	Adjust T1 (top) and T101 (bottom) for proper response	Fig. 12 Fig. 17
17	"		"	"	"	"	Remove shunt resistors. Set bias to give 15 volts P to P on scope.	Adjust T1 (top), T101, T102, T103, T104, T106 (bot.) for proper resp.	Fig. 11 Fig. 12 Fig. 13 Fig. 18
				ANTENNA, R-F AND CONVERTER LINE ALIGNMENT					
18	Antenna terminals	215.75	Not used		Not used	Junction of C183 & R203 for signal gen. method only	Fine tuning centered. Receiver on channel 13. Heterodyne meter coupled to oscillator if used.	C6 for zero on meter or beat on het. freq. meter	Fig. 13 Fig. 11
19						Junction of R135 & L117	Remove V101	Potentiometer for −3.5 volts on meter	Fig. 13 Fig. 11
20	Antenna terminal (loosely)	175.25 & 179.75	Antenna terminals (see text for precaution)	Sweeping channel 7	Test Connection R13	Not used	Receiver on channel 7	L6, C10, C11 & C14 for flat top response between markers. Markers above 90%.	Fig. 13 Fig. 12 Fig. 11 Fig. 19 (7)
21	"	205.25 209.75	"	channel 12	"	"	Receiver on channel 12	L6 for max. response and min. slope of top of curve	Fig. 18 Fig. 19 (12)
22	"	175.25 179.75	"	channel 7	"	"	Receiver on channel 7	Check to see that response is as above	Fig. 19 (7)
23	"	181.25 185.75	"	channel 8	"	"	Receiver on channel 8	"	Fig. 19 (8)
24	"	187.25 191.75	"	channel 9	"	"	Receiver on channel 9	"	Fig. 19 (9)
25	"	193.25 197.75	"	channel 10	"	"	Receiver on channel 10	"	Fig. 19 (10)
				RF AND CONVERTER LINE ALIGNMENT (Cont'd)					
26	"	199.25 203.75	"	channel 11	"	"	Receiver on channel 11	"	Fig. 19 (11)
27	"	205.25 209.75	"	channel 12	"	"	Receiver on channel 12	"	Fig. 19 (12)
28	"	211.25 215.75	"	channel 13	"	"	Receiver on channel 13	"	Fig. 19 (13)
29	If the response on any channel (steps 22 through 28) is below 80% at either marker, switch to that channel and adjust L6, C10, C11 & C14 to pull response up on that channel. Then recheck steps 22 through 28.								
30	Antenna terminals (loosely)	83.25 87.75	Ant. terminals (see text for precaution)	Sweeping chan. 6	Test Connection R13	Not used	Receiver on channel 6	L9, L13, L66 & C12 for response as above	Fig. 19 (6)
31	"	77.25 81.75	"	channel 5	"	"	Receiver on channel 5	Check to see that response is as above	Fig. 19 (5)
32	"	67.25 71.75	"	channel 4	"	"	Receiver on channel 4	"	Fig. 19 (4)
33	"	61.25 65.75	"	channel 3	"	"	Receiver on channel 3	"	Fig. 19 (3)
34	"	55.25 59.75	"	channel 2	"	"	Receiver on channel 2	"	Fig. 19 (2)
35	If the response on any channel (steps 31 through 34) is below 80% at either marker, switch to that channel and adjust L9, L13, L66 & C12 to pull response up on that channel. Then recheck steps 30 through 34. Disconnect bias pot and replace V101 and V107.								

R-F OSCILLATOR ALIGNMENT

STEP No.	CONNECT SIGNAL GENERATOR TO	SIGNAL GEN. FREQ. MC.	CONNECT HETERODYNE FREQ. METER TO	HET. METER FREQ. MC.	CONNECT OSCILLOSCOPE TO	CONNECT "VOLTOHMYST" TO	MISCELLANEOUS CONNECTIONS AND INSTRUCTIONS	ADJUST	REFER TO
36	Antenna terminals	215.75	Loosely coupled to r-f osc.	237	Not used	Junction of C183 & R203 for sig. gen. method only	Fine tuning centered. Receiver on channel 13	C6 for zero on meter or beat on het. freq. meter	Fig. 13 Fig. 12 Fig. 11
37	"	209.75	"	231	"	"	Rec. on chan. 12	L14 as above	Fig. 14
38	"	203.75	"	225	"	"	Rec. on chan. 11	L15 as above	"
39	"	197.75	"	219	"	"	Rec. on chan. 10	L16 as above	"
40	"	191.75	"	213	"	"	Rec. on chan. 9	L17 as above	"
41	"	185.75	"	207	"	"	Rec. on chan. 8	L18 as above	"
42	"	179.75	"	201	"	"	Rec. on chan. 7	L19 as above	"
43	"	87.75	"	109	"	"	Rec. on chan. 6	L31 as above	Fig. 12
44	"	81.75	"	103	"	"	Rec. on chan. 5	L21 as above	Fig. 14
45	"	71.75	"	93	"	"	Rec. on chan. 4	L22 as above	"
46	"	65.75	"	87	"	"	Rec. on chan. 3	L23 as above	"
47	"	59.75	"	81	"	"	Rec. on chan. 2	L24 as above	"
48	Repeat steps 36 through 47 as a check.								
				AGC THRESHOLD ADJUSTMENT					
49	Not used		Not used		Pin 1, V106	Not used	Tune in station, turn pix control clockwise. Adjust R138 for max. gain without clipping sync on scope		Fig. 13 Fig. 20

HORIZONTAL OSCILLATOR ADJUSTMENT

50	Short circuit terminals C and D of T109. Tune in a station.
51	Turn hold control fully clockwise. Adjust T109 Frequency Adjustment until horizontal blanking bar appears in the picture.
52	Turn hold control ¼ turn from clockwise to sync picture. Adjust width (L115), linearity (L111) and drive (C153B) controls until picture is correct. Repeat step 51.
53	Turn hold control fully counterclockwise. Momentarily remove signal. Turn hold control slowly clockwise. Note least number of bars before pull-in. Adjust Locking Range Control (C153A) for 7 to 9 bar pull-in.
54	Remove clip from terminals C and D of T109. Turn hold control fully clockwise. Adjust T109 Oscillator Waveform Adjustment until horizontal blanking bar appears in picture.
55	Connect low capacity probe of oscilloscope to terminal C of T109. Turn hold control ¼ turn from clockwise. Adjust T109 Oscillator Waveform Adjustment until broad and sharp peaks of wave on oscilloscope are same height. Keep picture in sync with hold control during adjustment. Remove oscilloscope.
56	Turn hold control fully counterclockwise. Momentarily remove signal. Turn hold control slowly clockwise. Note least number of bars before pull-in. Adjust Locking Range Control (C153A) for 3 bar pull-in.
57	Turn hold control fully clockwise. Adjust T109 Freq. Adjustment until horizontal blanking appears as single vertical or diagonal bar in pix.

4.5 MC VIDEO TRAP ADJUSTMENT

58	Tune in a strong station. Short the trap winding of T103. If a 4.5 mc beat appears in picture adjust L110 until beat is eliminated.

SENSITIVITY CHECK

59	Connect antenna to receiver through attenuator pad to provide weak signal. Compare the picture and sound obtained to that obtained on other receivers under the same conditions.

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ALIGNMENT DATA

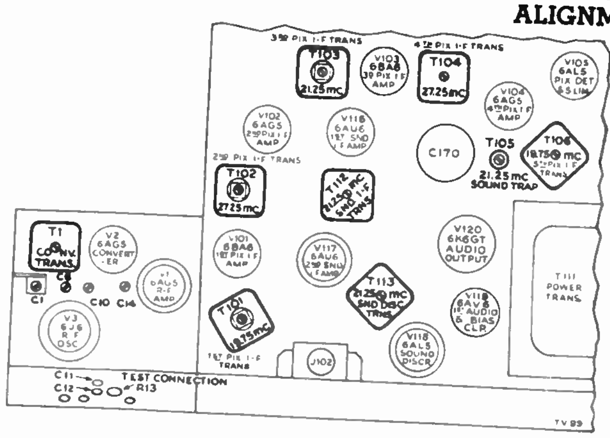


Figure 8—Top Chassis Adjustments

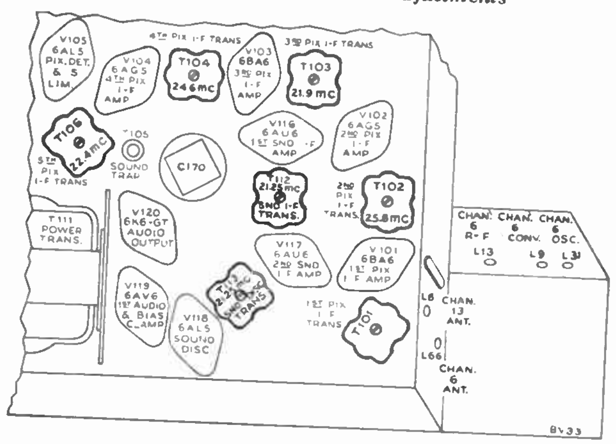


Figure 9—Bottom Chassis Adjustments

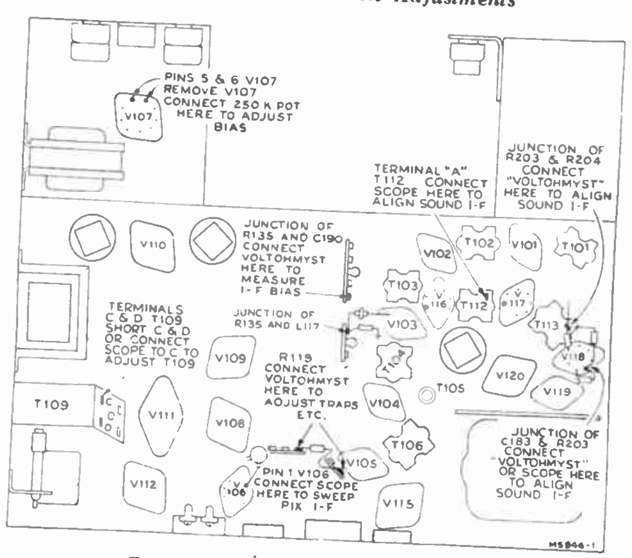
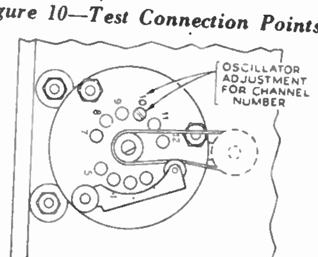


Figure 10—Test Connection Points



OSCILLATOR ADJUSTMENT FOR CHANNEL 13 IS ON TOP OF R-F UNIT AND CHANNEL 6 IS ON SIDE.

Figure 11—R-F Oscillator Adjustments

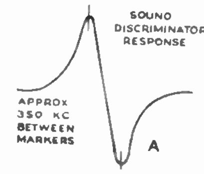


Figure 12 Discriminator Response

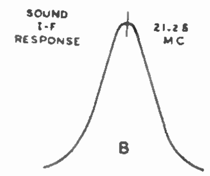


Figure 13 Sound I-F Response

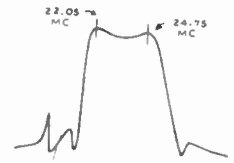


Figure 14 T1 and T101 Response

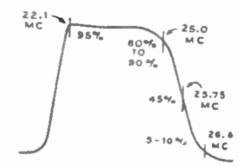


Figure 15 Overall I-F R-F Response

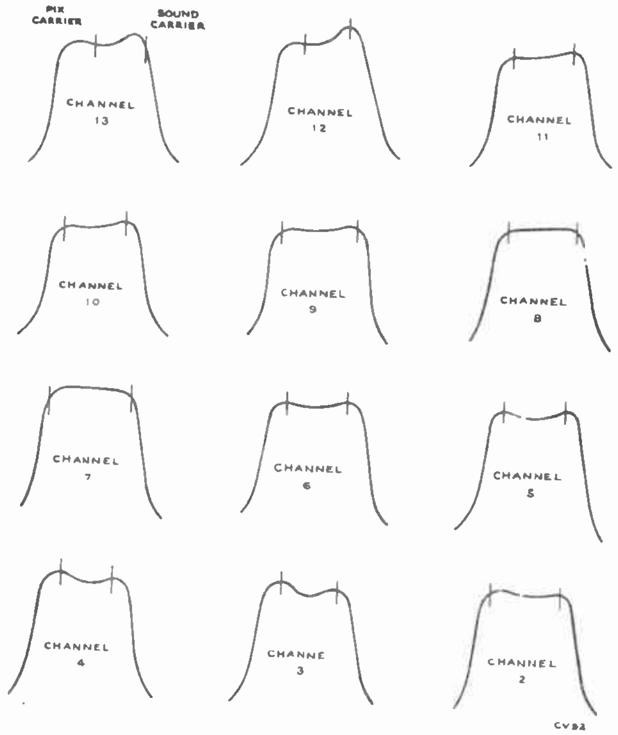


Figure 16—R-F Response

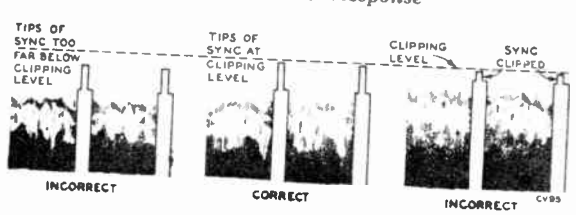


Figure 17—AGC Threshold Adjustment Waveforms

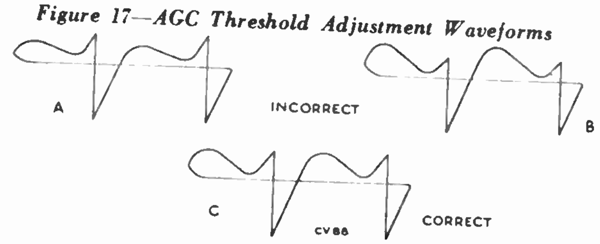


Figure 18—Horizontal Oscillator Waveforms

TELEVISION SERVICE SUGGESTIONS

Following is a list of symptoms of possible failures and an indication of some of the possible faults.

NO RASTER ON KINESCOPE:

(1) Incorrect adjustment of ion trap magnet—Magnets reversed either front to back or top to bottom, front magnet incorrectly oriented.

(2) V112 or V113 inoperative—check voltage and waveform on grids and plates.

(3) No high voltage—If horizontal deflection is operating as evidenced by the correct waveform on terminal 4 of horizontal output transformer, the trouble can be isolated to the 8016 circuit. Either the T110 high voltage winding is open, the 8016 tube is defective, its filament circuit is open, C168 is shorted or R187 or R189 open.

(4) V111 circuit inoperative—Refer to schematic and waveform chart.

(5) Damper tube (V114) inoperative.

(6) Defective kinescope.

(7) R131 open.

(8) No receiver plate voltage—filter capacitor or filter choke shorted—bleeder or filter choke open.

NO VERTICAL DEFLECTION:

(1) V107B or V110 inoperative—check voltage and waveforms on grids and plates.

(2) T107 or T108 open.

(3) Vertical deflection coils open.

SMALL RASTER:

(1) Low Plus B or low line voltage.

(2) V112 defective.

POOR VERTICAL LINEARITY:

(1) If adjustments cannot correct, change V110.

(2) Vertical output transformer defective.

(3) V107B defective—check voltage and waveforms on grid and plate.

(4) C150, R164, C147B or C148C defective.

(5) Low bias or plate voltage—check rectifiers and capacitors in supply circuits.

POOR HORIZONTAL LINEARITY:

(1) If adjustments do not correct, change V112 or V114.

(2) T110 or L111 defective.

(3) C164 or C165 defective.

WRINKLES ON LEFT SIDE OF RASTER:

(1) R166, R167 or C169 defective.

(2) Defective yoke.

PICTURE OUT OF SYNC HORIZONTALLY:

(1) T109 incorrectly tuned.

(2) R172, R173 or R174 defective.

TRAPEZOIDAL OR NON-SYMMETRICAL RASTER:

(1) Improper adjustment of focus coil or ion trap magnet.

(2) Defective yoke.

RASTER AND SIGNAL ON KINESCOPE BUT NO SOUND:

(1) R-F oscillator off frequency.

(2) Sound i-f, discriminator or audio amplifier inoperative—check V116, V117, V118, V119, V120 and their socket voltages.

(3) T114 or C186 defective.

(4) Speaker defective.

SIGNAL AT KINESCOPE GRID BUT NO SYNC:

(1) AGC threshold control R138 misadjusted.

(2) V105A, V107A, V108 or V109 inoperative—check voltage and waveforms at their grids and plates.

SIGNAL ON KINESCOPE GRID BUT NO VERTICAL SYNC:

(1) Check V107B and associated circuit—C145, T107, etc.

(2) Integrating network inoperative—check.

(3) R154, R155, R157, R158 or R159 defective.

SIGNAL ON KINESCOPE GRID BUT NO HORIZONTAL SYNC:

(1) T109 misadjusted—readjust as instructed on page 11.

(2) V111 inoperative—check socket voltages and waveforms.

(3) T109 defective.

(4) C140, C153A, C154, C155, C157, C161 or C200 defective.

(5) If horizontal speed is completely off and cannot be adjusted check C158, C159, R172, R173, R174, R179 and R182.

SOUND AND RASTER BUT NO PICTURE OR SYNC:

(1) Picture i-f, detector or video amplifier inoperative—check V103, V104, V105 and V106—check socket voltages.

(2) Bad contact to kinescope grid.

PICTURE STABLE BUT POOR RESOLUTION:

(1) V105A or V106 defective.

(2) Peaking coils defective—check for specified resistance.

(3) Make sure that the focus control operates on both sides of proper focus.

(4) R-F and I-F circuits misaligned.

PICTURE SMEAR:

(1) R-F or I-F circuits misaligned.

(2) Open peaking coil.

(3) This trouble can originate at the transmitter—check on another station.

PICTURE JITTER:

(1) AGC threshold control R138 misadjusted.

(2) If regular sections at the left picture are displaced change V112.

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TELEVISION SERVICE SUGGESTIONS

(3) Vertical instability may be due to loose connections or noise.

(4) Horizontal instability may be due to unstable transmitted sync.

RASTER BUT NO SOUND, PICTURE OR SYNC:

(1) Defective antenna or transmission line.

(2) R-F oscillator off frequency.

(3) R-F unit inoperative—check V1, V2, V3.

PICTURE I-F RESPONSE.—At times it may be desirable to observe the individual i-f stage response. This can be achieved by the following method:

Shunt all i-f transformers and coils with a 330 ohm carbon resistor except the one whose response is to be observed.

Connect a wide band sweep generator to the converter grid and adjust it to sweep from 18 mc. to 30 mc.

DARK VERTICAL LINE ON LEFT OF PICTURE:

(1) Reduce horizontal drive and readjust width and horizontal linearity.

(2) Replace V112.

LIGHT VERTICAL LINE ON LEFT OF PICTURE:

(1) C169 defective.

(2) V114 defective.

Connect the oscilloscope across the picture detector load resistor and observe the overall response. The response obtained will be essentially that of the unshunted stage. The effects of the various traps are also visible on the stage response.

Figures 27 through 31 show the response of the various stages obtained in the above manner. The curves shown are typical although some variation between receivers can be expected. Relative stage gain is not shown.

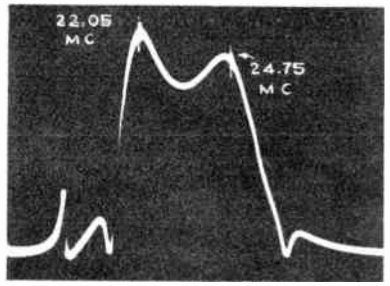

Figure 27—Response of Converter and First Pix I-F Transformer

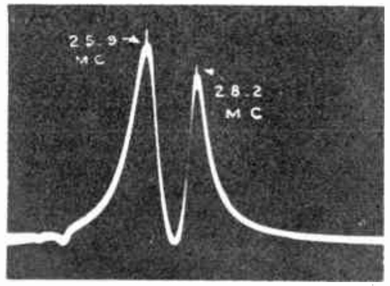

Figure 28—Response of Second Pix I-F Transformer

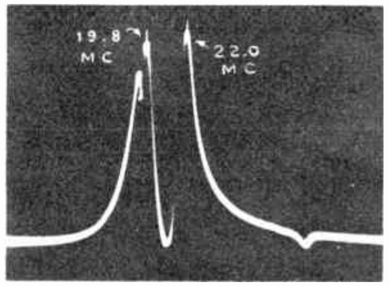

Figure 29—Response of Third Pix I-F Transformer

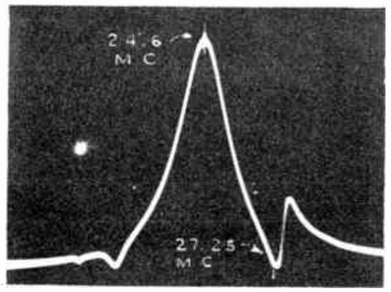

Figure 30—Response of Fourth Pix I-F Transformer

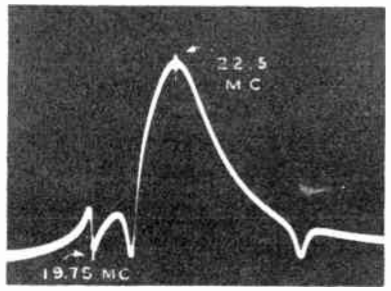

Figure 31—Response of Fifth Pix I-F Transformer

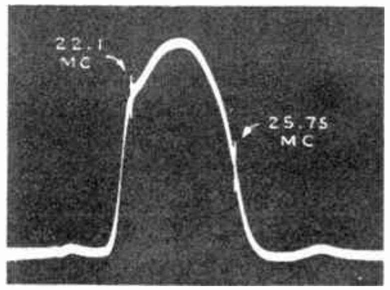

Figure 32—Response from First Pix I-F Grid to Pix Det.

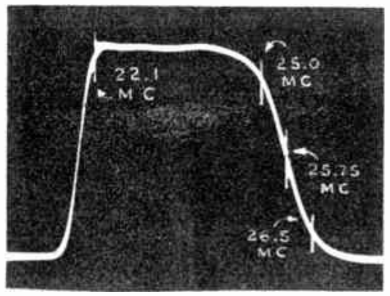

Figure 33—Overall Pix I-F Response

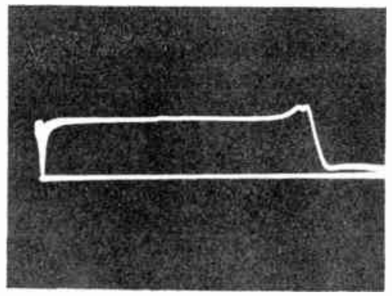

Figure 34—Video Response at Average Contrast

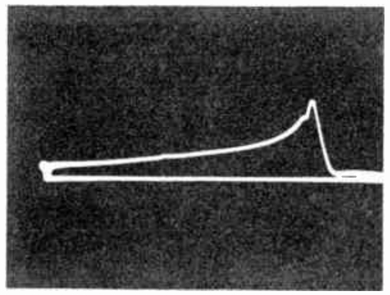

Figure 35—Video Response at Minimum Contrast

WAVEFORM PHOTOGRAPHS

Video Signal Input to 1st Video Amplifier (Pin 2 of V106) (12AU7)

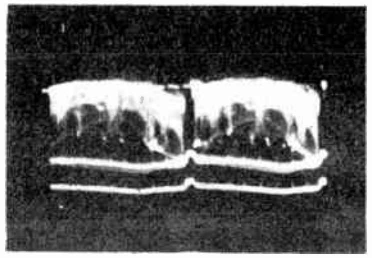

Figure 36—Vertical (Oscilloscope Synced to ½ of Vertical Sweep Rate) (5.4 Volts PP) ←

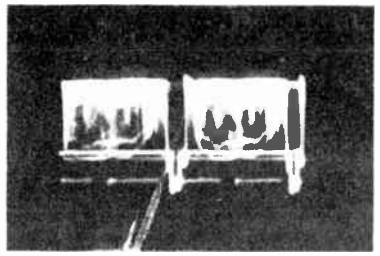

Figure 37—Horizontal (Oscilloscope Synced to ½ of Horizontal Sweep Rate) (5.4 Volts PP) →

Sync Feed (Junction of L110, R219 and C194)

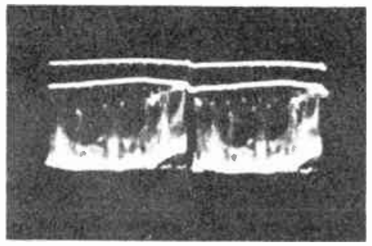

Figure 38—Vertical (28 Volts PP) ←

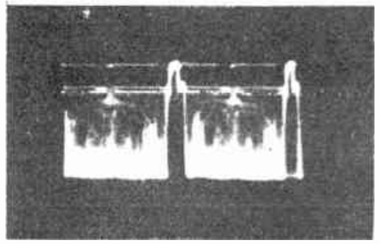

Figure 39—Horizontal (28 Volts PP) →

Input to 2nd Video Amplifier (Pin 7 of V106) (12AU7)

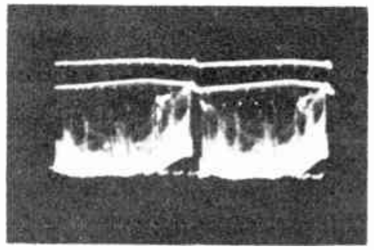

Figure 40—Vertical (17 Volts PP) ←

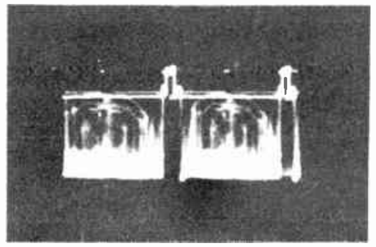

Figure 41—Horizontal (17 Volts PP) →

Output of 2nd Video Amplifier (Junction of L105 and R127) (Picture Max.)

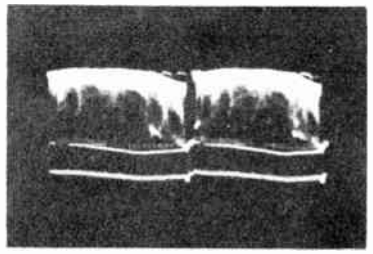

Figure 42—Vertical (96 Volts PP) ←

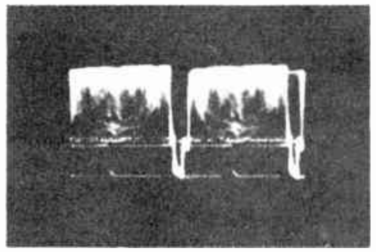

Figure 43—Horizontal (96 Volts PP) →

Input to Kinescope (Junction of R127 and R128) (Picture Max.)

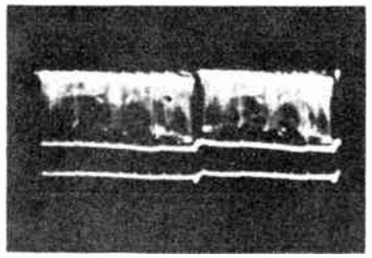

Figure 44—Vertical (65 Volts PP) ←

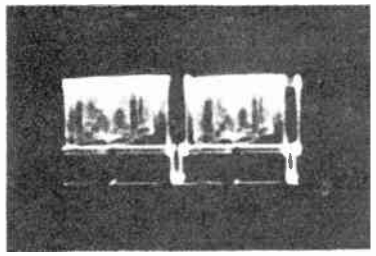

Figure 45—Horizontal (65 Volts PP) →

MODELS TC124, TC125, TC127, Ch. KCS34B

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Input to 1st Sync Separator (Pin 1 of V108) (6SN7GT)

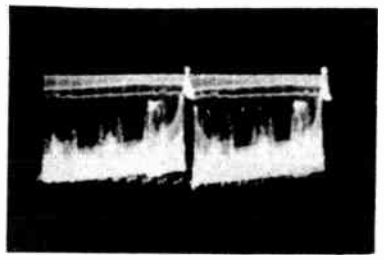
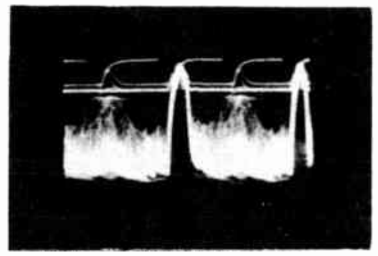


Figure 46—Vertical (25 Volts PP)

Figure 47—Horizontal (23 Volts PP)



AGC Rectifier Cathode (Pin 6 of V108) (6SN7GT)

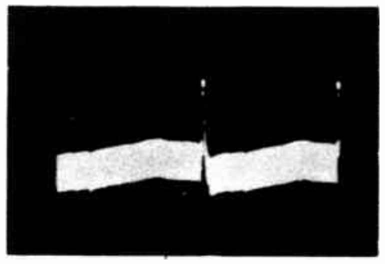


Figure 48—Vertical (4.7 Volts PP)

Figure 49—Horizontal (1.5 Volts PP)

Output of 1st Sync Separator (Pin 5 V108) (6SN7GT)

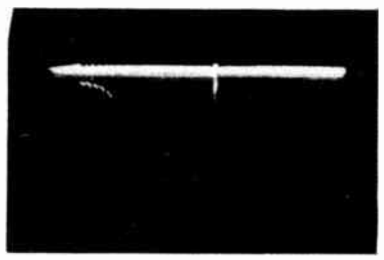
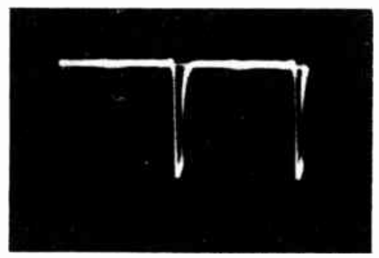


Figure 50—Vertical (24 Volts PP)

Figure 51—Horizontal (24 Volts PP)



Output of 1st Sync Separator (Pin 2 of V108) (6SN7GT)

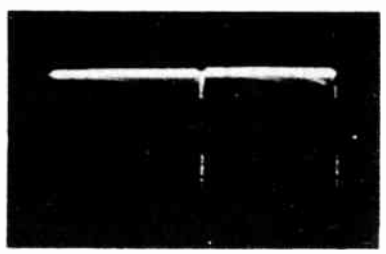
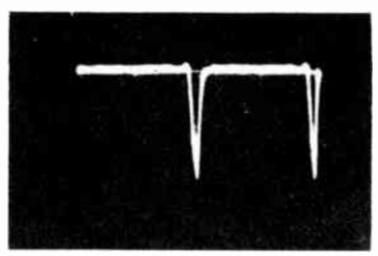


Figure 52—Vertical (26 Volts PP)

Figure 53—Horizontal (25.5 Volts PP)



Input to Sync Amplifier (Junction of C137, C139 and R145)

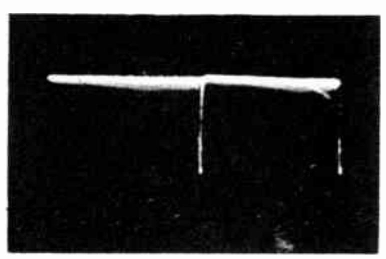
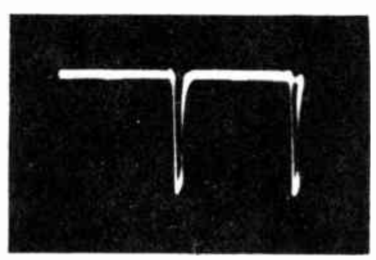


Figure 54—Vertical (21 Volts PP)

Figure 55—Horizontal (21 Volts PP)



Output of Sync Amplifier (Pin 2 of V109) (6SN7GT)

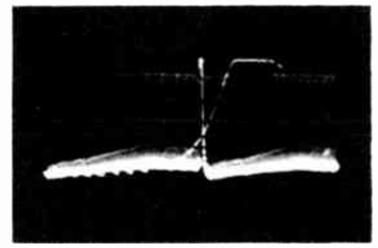
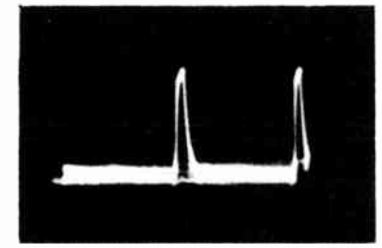


Figure 56—Vertical (115 Volts PP)

Figure 57—Horizontal (105 Volts PP)



Cathode of 2nd Sync Separator (Pin 6 of V109) (6SN7GT)

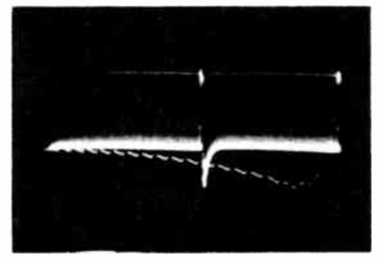
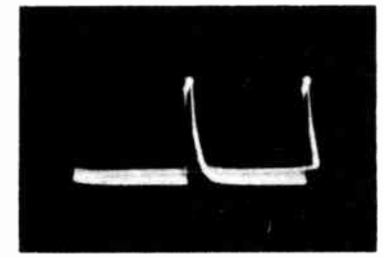


Figure 58—Vertical (17 Volts PP)

Figure 59—Horizontal (11 Volts PP)



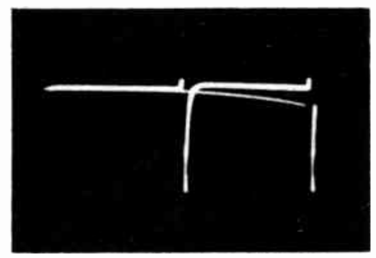
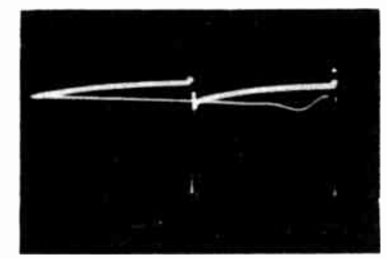


Figure 60—Output of Integrating Network (Junction of C144, C145 and R153) (45 Volts PP)

Figure 61—Grid of Vertical Oscillator (720 Volts PP) (Pin 1 of V107) (6SN7GT)



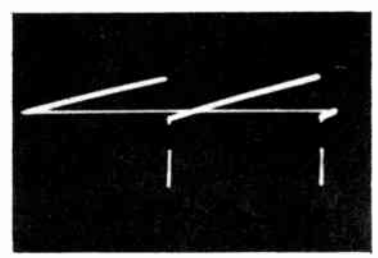
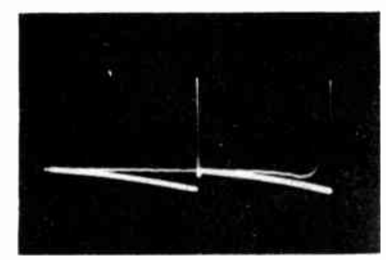


Figure 62—Grid of Vertical Output (160 Volts PP) (Pin 5 of V110) (6K6GT)

Figure 63—Plate of Vertical Output (750 Volts PP) (Pin 3 of V110) (6K6GT)



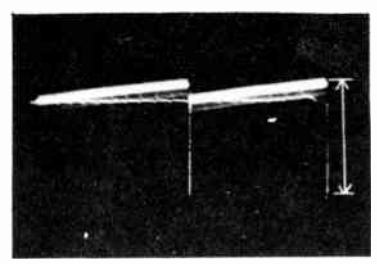
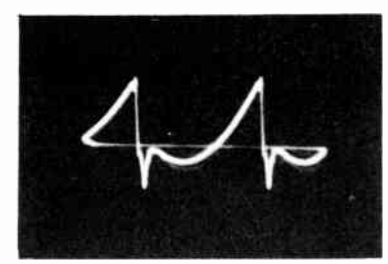


Figure 64—Input of Vertical Deflection Coils (75 Volts PP) (Junction of Green Lead of T108 and Green Lead of Yoke)

Figure 65—Input to Horizontal Oscillator (17.5 Volts PP) (Junction of C153A and C154)



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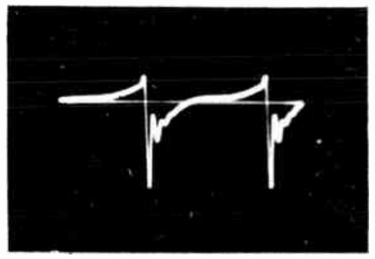


Figure 66—Junction of R168, R176 and R178 (150 Volts PP)

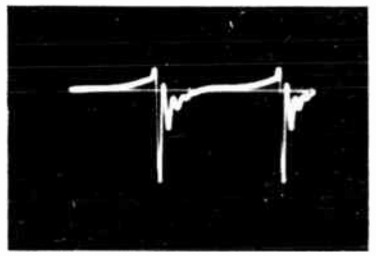


Figure 67—Grid of Horizontal Oscillator (480 Volts PP) (Pin 4 of V111) (6SN7GT)

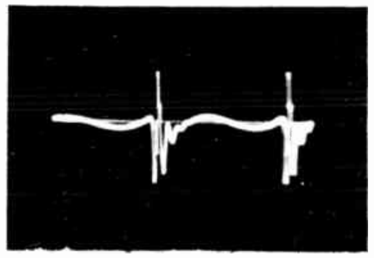


Figure 68—Plate of Horizontal Oscillator (270 Volts PP) (Pin 5 of V111) (6SN7GT)

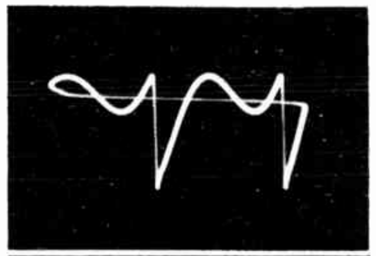


Figure 69—Terminal "C" of T109 (70 Volts PP)

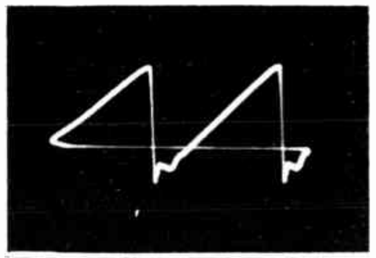


Figure 70—Input to Horizontal Output Tube (42 Volts PP) (Junction of C160, R183 and C153B)

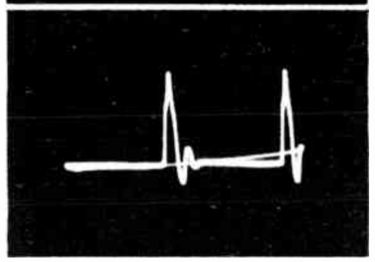


Figure 71—Plate of Horizontal Output (Approx. 6,000 Volts PP) (Measured Through a Capacity Voltage Divider Connected from Top Cap of V112 to Ground)

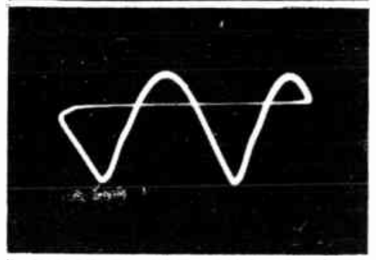


Figure 72—Junction of C167, L115 and Terminal 1 of T110 (165 Volts PP)

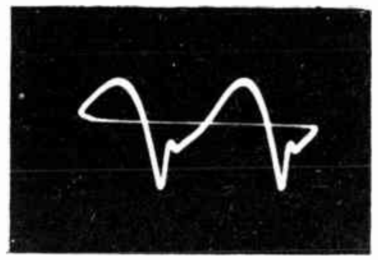


Figure 73—Plate of Damper (125 Volts PP) (Pin 5 of V114) (6W4GT)

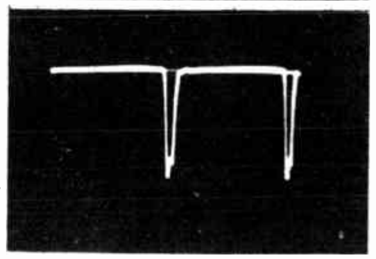


Figure 74—Input across Horizontal Deflection Coils (1,150 Volts PP)

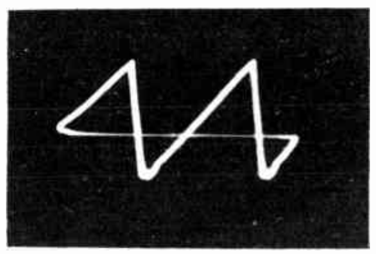


Figure 75—Horizontal Deflection Coil Current (0.6 amp. PP) Measured by Inserting a 5-ohm Resistor in Series with the Horizontal Deflection Coil and the Voltage across the Resistor Observed.

KINESCOPE HANDLING PRECAUTIONS

DO NOT OPEN THE KINESCOPE SHIPPING CARTON, INSTALL, REMOVE OR HANDLE THE KINESCOPE IN ANY MANNER UNLESS SHATTERPROOF GOGGLES, AND HEAVY GLOVES ARE WORN. PEOPLE NOT SO EQUIPPED SHOULD BE KEPT AWAY WHILE HANDLING KINESCOPES. KEEP THE KINESCOPE AWAY FROM THE BODY WHILE HANDLING.

The kinescope bulb encloses a high vacuum and, due to its large surface area, is subjected to considerable air pressure. For this reason, kinescopes must be handled with more care than ordinary receiving tubes.

The large end of the kinescope bulb particularly that part at the rim of the viewing surface—must not be struck, scratched or subjected to more than moderate pressure at any time. In installation, if the tube sticks or fails to slip smoothly into its socket, or deflecting yoke, investigate and remove the cause of the trouble. Do not force the tube. Refer to the Receiver Installation section for detailed instructions on kinescope installation. All RCA kinescopes are shipped in special cartons and should be left in the cartons until ready for installation in the receiver. Keep the carton for possible future use.

R-F UNIT WIRING DIAGRAM

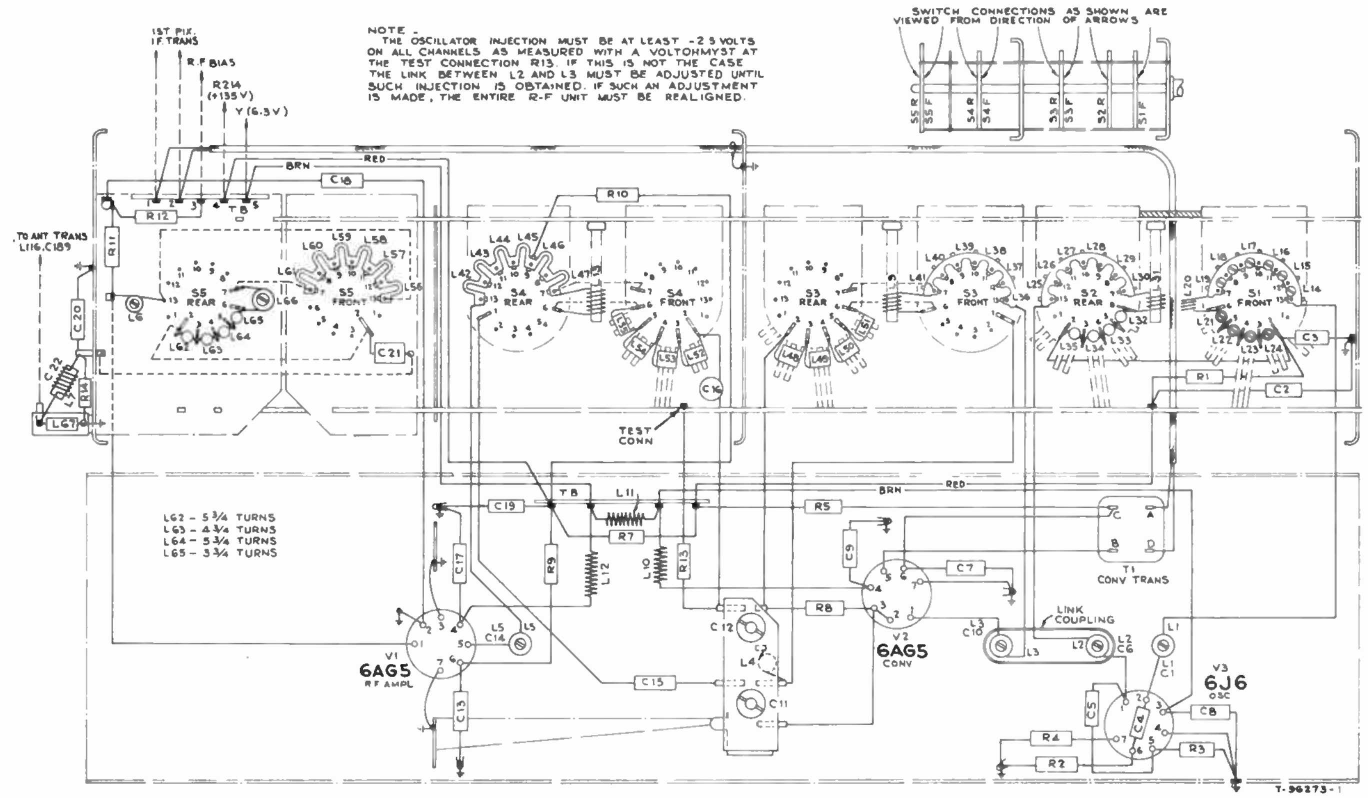
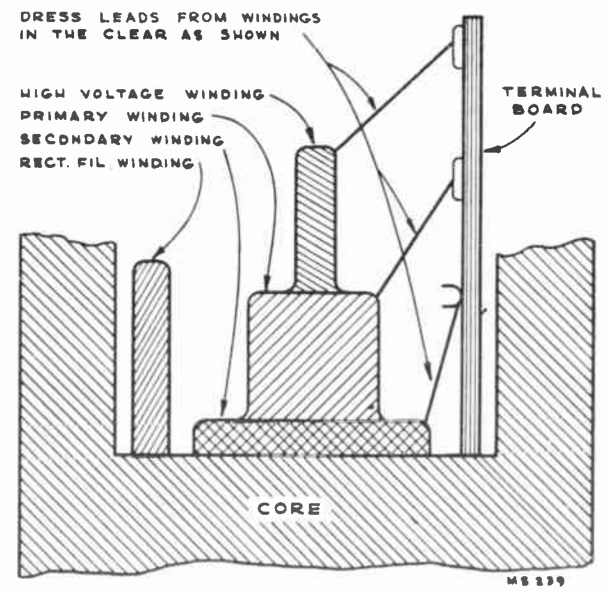


Figure 76—R-F Unit Wiring Diagram

CRITICAL LEAD DRESS:

1. The ground bus from pin 2 and the center shield of V117 socket should not be shortened or rerouted.
2. Do not change the dress of the filament leads or the by-pass capacitors in the picture or sound i-f circuits. The filament leads between V117, V118 and V119 should be down against the chassis and away from grid or plate leads.
3. If it is necessary to replace any of the 1500 mmf capacitors in the picture i-f circuit, the lead length must be kept as short as possible.
4. Picture i-f coupling capacitors C106, C111, C115 and C121 should be up and away from the chassis and should be clear of the pix i-f transformer adjustments by at least ¼ inch. If the dress of any of these capacitors is changed, the i-f alignment should be rechecked.
5. Leads to L102 and L103 must be as short as possible.
6. Dress peaking coils L105, L106 and L107 up and away from the chassis.
7. Dress C183 across tube pins 5 and 6 with leads not exceeding ⅜ inch.
8. Dress C129 and C130 up and away from the chassis.
9. Dress the yellow lead from the picture control away from the chassis and away from the volume-control leads. Dress the yellow lead from pin 8 of V106 away from the chassis.
10. Dress the green lead from pin 2 of V106 away from the chassis.
11. Dress R168, R169, R170, R176 and R178 up and away from the chassis.
12. The leads to the volume control should be dressed down against the chassis and away from V117 and V118.
13. Contact between the r-f oscillator frequency adjustment screws and the oscillator coils or channel switch eyelets must be voided.
14. Dress leads from L115 (width control coil) away from the transformer frame.
15. Dress T110 winding leads as shown in Figure 77.

Figure 77—T110 Lead Dress



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VOLTAGE CHART

The following measurements represent two sets of conditions. In the first condition, a 2200 microvolt test pattern signal was fed into the receiver, the picture synced and the AGC threshold control properly adjusted. The second condition was obtained by removing the antenna leads and short circuiting the receiver antenna terminals. Voltages shown are read with "Jr. VoltOhmyst" between the indicated terminal and chassis ground and with the receiver operating on 117 volts, 60 cycles, a-c.

Tube No.	Tube Type	Function	Operating Condition	E. Plate Pin No.	E. Plate Volts	E. Screen Pin No.	E. Screen Volts	E. Cathode Pin No	E. Cathode Volts	E. Grid Pin No.	E. Grid Volts	I Plate (ma.)	I Screen (ma.)	Notes on Measurements
V1	6AG5	R-F Amplifier	2200 Mu. V. Signal	5	140	6	142	2 & 7	0	1	-4.2	.72	.33	
			No Signal	5	67	6	111	2 & 7	0	1	-.5	14.0	5.0	
V2	6AG5	Converter	2200 Mu. V. Signal	5	*130 to 140	6	*130 to 140	2 & 7	0	1	*-3.0 to -7.0	*7.1 to 7.7	*2.3 to 2.7	*Depending upon channel
			No Signal	5	*104 to 109	6	*104 to 109	2 & 7	0	1	*-2.0 to -6.0	*5.3 to 5.9	*.8 to 1.0	
V3	6J6	R-F Oscillator	2200 Mu. V. Signal	1 & 2	*88 to 95	—	—	7	.19	5 & 6	*-5.1 to -7.3	*1.9 to 2.7	—	*Depending upon channel
			No Signal	1 & 2	*68 to 81	—	—	7	.16	5 & 6	*-4.5 to -6.6	*1.8 to 2.1	—	
V101	6BA6	1st Pix. I-F Amplifier	2200 Mu. V. Signal	5	125	6	125	7	.4	1	-11	2.8	1.3	
			No Signal	5	95	6	95	7	1.1	1	0.0	7.5	3.5	
V102	6AG5	2d Pix. I-F Amplifier	2200 Mu. V. Signal	5	115	6	115	2 & 7	.75	1	0	8.2	2.5	
			No Signal	5	100	6	100	2 & 7	.65	1	0	6.8	2.1	
V103	6BA6	3d Pix. I-F Amplifier	2200 Mu. V. Signal	5	110	6	135	7	.25	1	-4.2	4.0	3.8	
			No Signal	5	60	6	100	7	.75	1	-.5	11.0	4.8	
V104	6AG5	4th Pix. I-F Amplifier	2200 Mu. V. Signal	5	170	6	135	2 & 7	1.35	1	0	6.5	2.0	
			No Signal	5	175	6	120	2 & 7	1.2	1	0	5.9	1.8	
V105 A	6AL5	Picture 2d Det.	2200 Mu. V. Signal	7	-113	—	—	1	-112	—	—	.48	—	
			No Signal	7	-120	—	—	1	-120	—	—	—	—	
V105 B	6AL5	Sync Limiter	2200 Mu. V. Signal	2	-107	—	—	5	-56	—	—	—*	—	
			No Signal	2	-80	—	—	5	-60	—	—	—	—	
V106	12AU7	1st Video Amplifier	2200 Mu. V. Signal	1	-23.2	—	—	3	-111	2	-113	4.38	—	
			No Signal	1	-19.2	—	—	3	-117	2	-120	3.82	—	
V106	12AU7	2d Video Amplifier	2200 Mu. V. Signal	6	*166	—	—	8	*5.3	7	*-12.2	6.2	—	*At average contrast
			No Signal	6	*134	—	—	8	*-5.6	7	*10.3	6.9	—	
V107 A	6SN7 GT	AGC Amplifier	2200 Mu. V. Signal	5	-11.0	—	—	6	-55	4	-56	.9	—	
			No Signal	5	-.5	—	—	6	-60	4	-64	.3	—	
V107 B	6SN7 GT	Vertical Oscillator	2200 Mu. V. Signal	2	76	—	—	3	-111	1	-158	.2	—	
			No Signal	2	62	—	—	3	-120	1	-169	.2	—	
V108	6SN7 GT	AGC Rectifier	2200 Mu. V. Signal	5	97	—	—	6	-3.4	4	-19.3	.3	—	
			No Signal	5	81	—	—	6	-8.7	4	-19.3	.28	—	

VOLTAGE CHART

Tube No.	Tube Type	Function	Operating Condition	E. Plate Pin No.	E. Plate Volts	E. Screen Pin No.	E. Screen Volts	E. Cathode Pin No.	E. Cathode Volts	E. Grid Pin No.	E. Grid Volts	I Plate (ma.)	I Screen (ma.)	Notes on Measurements
V108	6SN7 GT	1st Sync Separator	2200 Mu. V. Signal	2	96	—	—	3	-1.8	1	-19.5	.1	—	
			No Signal	2	81	—	—	3	-9.7	1	-19.3	.1	—	
V109	6SN7 GT	Sync Amplifier	2200 Mu. V. Signal	2	158	—	—	3	0	1	-4.7	5.25	—	
			No Signal	2	154	—	—	3	0	1	-5.2	3.75	—	
V109	6SN7 GT	Sync Separator	2200 Mu. V. Signal	5	230	—	—	6	-51	4	-106	.4	—	
			No Signal	5	215	—	—	6	-59	4	-80	.35	—	
V110	6K6-GT	Vertical Output	2200 Mu. V. Signal	3	223	4	223	8	-67	5	-91		*7.85	*Screen connected to plate
			No Signal	3	208	4	208	8	-79	5	-101		*7.7	
V111	6SN7 GT	Horizontal Osc. Control	2200 Mu. V. Signal	2	*48	—	—	3	-110	1	-92	.2	—	*Variation of hold gives -21.9 to +56 volts on plate
			No Signal	2	*33	—	—	3	-120	1	-108	.2	—	
V111	6SN7 GT	Horizontal Oscillator	2200 Mu. V. Signal	5	70	—	—	6	-111	4	-185	2.4	—	
			No Signal	5	54	—	—	6	-120	4	-192	2.4	—	
V112	6BG6G	Horizontal Output	2200 Mu. V. Signal	Cap	*	8	180	3	-90	5	-110	68	9.4	*6000 volt pulse present
			No Signal	Cap	Do Not Meas.	8	170	3	-100	5	-115	67	9.2	
V113	1B3GT /8016	H. V. Rectifier	Brightness Min.	Cap	*	—	—	2 & 7	10200	—	—	0	—	*9700 volt pulse present
			Brightness Average	Cap	Do Not Meas.	—	—	2 & 7	9700	—	—	1	—	
V114	6W4GT	Damper	2200 Mu. V. Signal	5	*	—	—	3	290	—	—	66	—	*1200 volt pulse present
			No Signal	5	Do Not Meas.	—	—	3	280	—	—	65	—	
V115	5U4G	Rectifier	2200 Mu. V. Signal	4 & 6	*335	—	—	2 & 8	250	—	—	210	—	*A-C measured from plate to trans. center tap
			No Signal	4 & 6	*335	—	—	2 & 8	245 230	—	—	215	—	
V116	6AU6	1st Sound I-F Amplifier	2200 Mu. V. Signal	5	134	6	134	7	.9	1	0	8.2	3.3	
			No Signal	5	110	6	110	7	.7	1	0	5.7	2.6	
V117	6AU6	2d Sound I-F Amplifier	2200 Mu. V. Signal	5	148	6	90	7	0	1	-9	1.6	.8	
			No Signal	5	115	6	60	7	0	1	-.65	3.35	1.15	
V118	6AL5	Sound Discrim.	2200 Mu. V. Signal	2 7	-8.4 -3.7	—	—	5 1	5.8 0	—	—	—	—	
			No Signal	2 7	-2.0 -1.08	—	—	5 1	.41 0	—	—	—	—	
V119	6AV6	1st Audio Amplifier	2200 Mu. V. Signal	7	85	—	—	2	0	1	-.89	.49	—	
			No Signal	7	83	—	—	2	0	1	-.89	.4	—	
V120	6K6-GT	Audio Output	2200 Mu. V. Signal	3	102	4	113	8	-99	5	-108	19.3	3.3	
			No Signal	3	72	4	80	8	-111	5	-120	18	3	
V121	12LP4	Kinescope	2200 Mu. V. Signal	Cap	*9700	10	339	11	51	2	20	.1	—	*Average Brightness
			No Signal	Cap	—	10	322	11	42 34	2	14	—	—	

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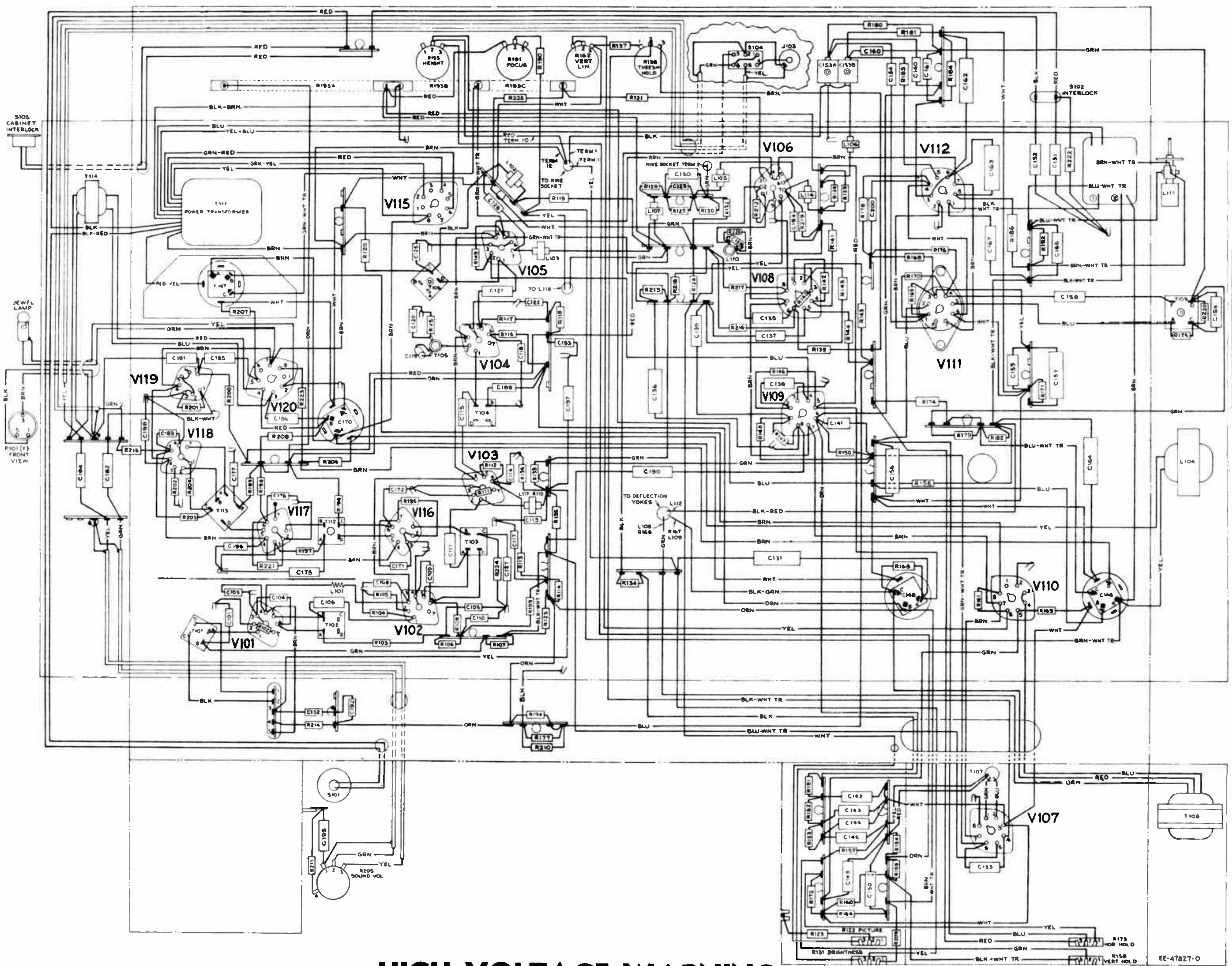

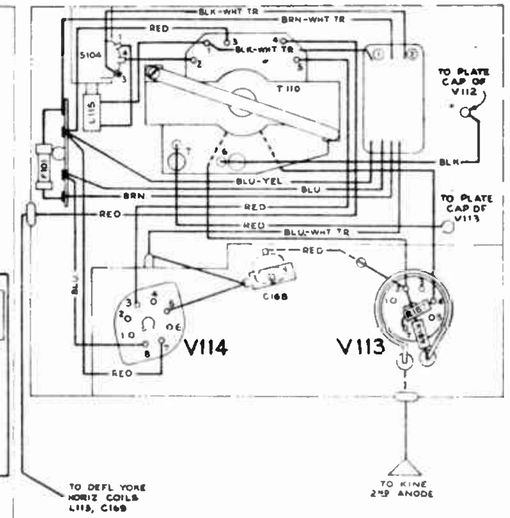

In some receivers, a four color ceramic capacitor color code is employed. It reads the same as the RMA color code except that the tolerance stripe is omitted. If the coefficient stripe is silver, it indicates that the capacitor has a very large temperature coefficient and is to be employed for bypass or other usages where a wide variation of capacity is unimportant. Silver striped capacitors are rated at 350 volts unless otherwise marked.

CHASSIS WIRING DIAGRAM

HIGH VOLTAGE WARNING

OPERATION OF THIS RECEIVER OUTSIDE THE CABINET OR WITH THE COVERS REMOVED, INVOLVES A SHOCK HAZARD FROM THE RECEIVER POWER SUPPLIES. WORK ON THE RECEIVER SHOULD NOT BE ATTEMPTED BY ANYONE WHO IS NOT THOROUGHLY FAMILIAR WITH THE PRECAUTIONS NECESSARY WHEN WORKING ON HIGH VOLTAGE EQUIPMENT. DO NOT OPERATE THE RECEIVER WITH THE HIGH VOLTAGE COMPARTMENT SHIELD REMOVED.

MODELS TC124, TC125, TC127, Ch. KCS34B

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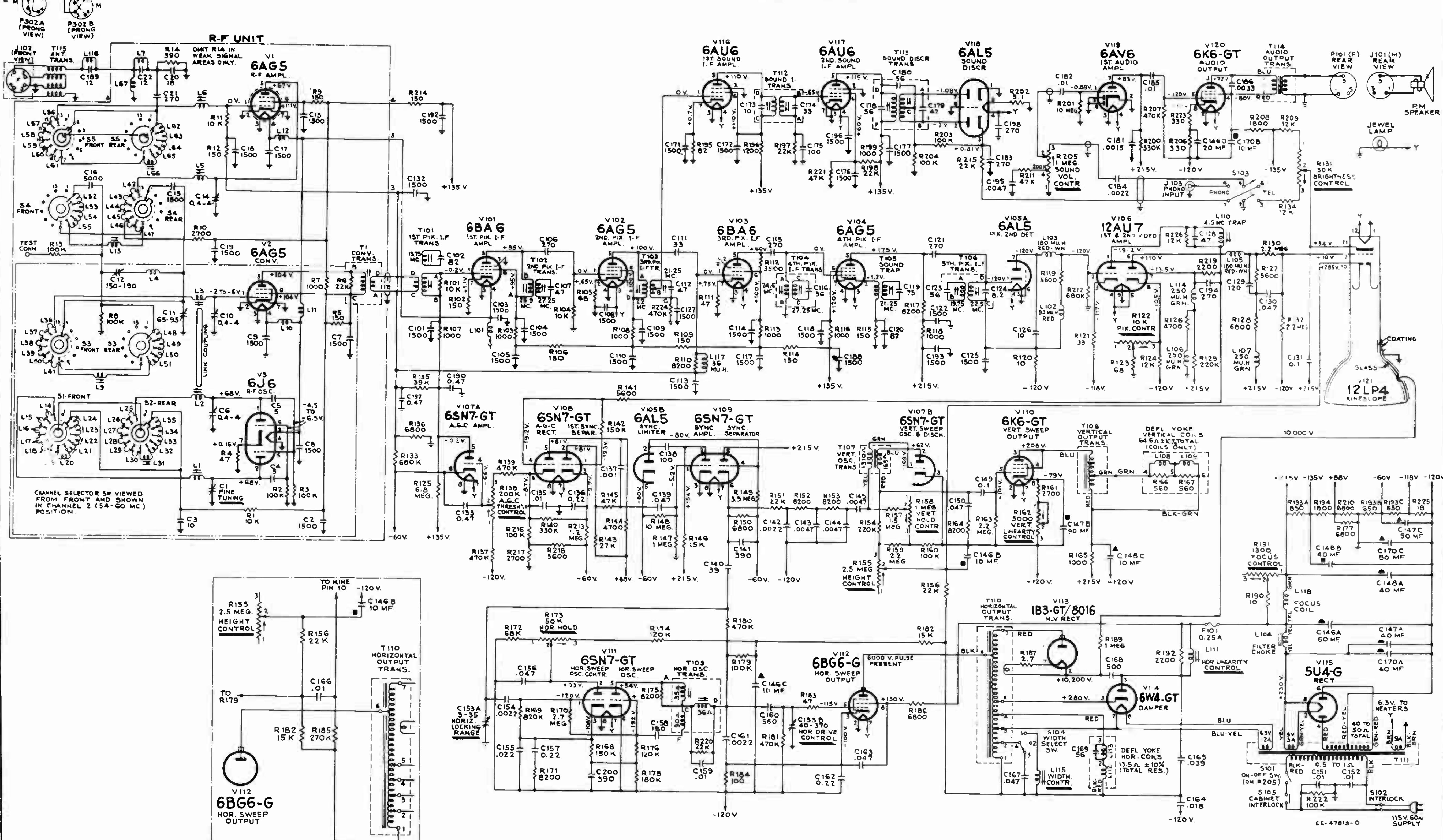
MODELS TC124, TC125, TC127, Ch. KCS34B

CIRCUIT SCHEMATIC DIAGRAM



All resistance values in ohms. K = 1000. All capacitance values less than 1 in MF and above 1 MMF unless otherwise noted.
Coil resistance values less than 1 ohm are not shown.

Direction of arrows at controls indicates clockwise rotation.
In some receivers, substitutions have caused changes in component lead color codes, in electrolytic capacitor values and their lug identification markings.

All voltages measured with "VoltOhmyst" and with no signal input. Voltages should hold within ±20% with 117 v. a-c supply.
Some early receivers were connected as shown in the partial schematic.

The deflection circuits must be connected as shown above for powdered iron core yokes.

Figure 79--Circuit Schematic Diagram

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REPLACEMENT PARTS

STOCK No.	DESCRIPTION
	RF UNIT ASSEMBLIES
	KRK 5
73465	Belt—Drive belt
75069	Board—R-F unit power connection terminal board (5 contact)
75067	Bracket—Vertical bracket for holding r-f oscillator tube shield
73478	Cable—I-F transmission cable (W1)
73441	Cam—Fine tuning adjustment
74035	Capacitor—Ceramic, 5 mmf. (C4, C5)
53511	Capacitor—Ceramic, 10 mmf. (C3)
54207	Capacitor—Ceramic, 18 mmf. (C20)
73449	Capacitor—Ceramic trimmer comprising 1 section of 150-190 mmf. and 1 section of 65-95 mmf. (C11, C12)
73091	Capacitor—Ceramic, 270 mmf. (C21)
71501	Capacitor—Ceramic, 1500 mmf. (C2, C7, C8, C9, C13, C15, C17, C18, C19)
73473	Capacitor—Ceramic, 5000 mmf. (C16)
73460	Coil—R-F plate coil for channel 6 (L13)
73461	Coil—Rear section—Oscillator plate coil for channel 6 (L20)
73462	Coil—Coupling inductance coil (L4)
73475	Coil—Antenna filter shunt coil (C67)
73476	Coil—I-F trap (L7, C22)
73477	Coil—Choke coil (L10, L11, L12)
73874	Coil—Front section—Oscillator plate coil for channel 6 (L31)
74108	Coil—Fine tuning coil (1½ turns) with adjustable inductance core and capacitor stud (plunger adjustment) (L1, C1)
74109	Coil—Trimmer coil (1½ turns) with adjustable inductance core and capacitor stud (screw adjustment for oscillator section or converter section) (L2, L3, C6, C10)
74110	Coil—Trimmer coil (3 turns) with adjustable inductance core and capacitor stud (screw adjustment) for r-f amplifier section (L5, C14)
73455	Core—Sliding core for fine tuning control trimmer
74187	Core—Adjustable core for coil L9
71493	Connector—Oscillator segment connector
73440	Detent—R-F unit detent mechanism and fibre shaft
71487	Form—Coil form for coil L31
73453	Form—Coil form assembly for L9, L13
73442	Link—Link assembly for fine tuning
71462	Loop—Oscillator to converter trimmer loop connector
73634	Nut—Speed nut for drive belt shield
73436	Plate—Front plate and bushing
73464	Pulley—Idler pulley
	Resistor—Fixed, composition:—
	47 ohms, ±20%, ½ watt (R4)
	150 ohms, ±20%, ½ watt (R5, R9, R12)
	390 ohms, ±10%, ½ watt (R14)
	1000 ohms, ±20%, ½ watt (R7)
	2700 ohms, ±10%, ½ watt (R10)
	10,000 ohms, ±20%, ½ watt (R1, R11)
	100,000 ohms, ±20%, ½ watt (R2, R3, R8, R13)
14343	Retainer—Channel selector shaft retaining ring
30340	Retainer—Retainer ring for fine tuning stud
70881	Screw—#4-40 x ¼" binder head screw for adjusting coils L14, L15, L16, L17, L18, L19

STOCK No.	DESCRIPTION
73640	Screw—#4-40 x ⅜" adjusting screw for L66
71475	Screw—#4-40 x 15/32" adjusting screw for coils L21, L22, L23, L24
74575	Screw—#4-40 x 17/32" adjusting screw for L6
73437	Shaft—Channel selector shaft complete with pawl and stud
73438	Shaft—Fine tuning control shaft and pulley
73439	Shaft—Actuating shaft for fine tuning control
72951	Shield—Metal tube shield for V3
73454	Shield—Metal shield for drive belt
73632	Shield—Metal tube shield for V1
75443	Shield "U" shaped shield for bottom of r-f unit.
71494	Socket—Tube socket, moulded, 7 prong, saddle mounted
73450	Socket—Tube socket, ceramic, 7 prong, bottom mounted
74576	Spacer—Insulating spacer for front plate (4 req'd)
73457	Spring—Return spring for fine tuning control core
74188	Spring—Retaining spring for adjustable core RCA 74187
74578	Spring—Retaining spring for adjusting screw RCA 73460 and 74575
75068	Spring—Retaining spring for r-f oscillator tube shield
73468	Stator—Front oscillator section stator complete with rotor, segment, coils and adjusting screws (S1, L14, L15, L16, L17, L18, L19, L21, L22, L23, L24)
73469	Stator—Rear oscillator section stator complete with rotor, segment, and coils (S2, L25, L26, L27, L28, L29, L30, L32, L33, L34, L35)
73633	Stator—Antenna stator complete with rotor and coils (S5, L6, L56, L57, L58, L59, L60, L61, L62, L63, L64, L65, L66, C21)
73470	Stator—Converter stator complete with rotor and coils (S3, L9, L36, L37, L38, L39, L40, L41, L48, L49, L50, L51)
73471	Stator—R-F amplifier stator complete with rotor and coils (S4, L13, L42, L43, L44, L45, L46, L47, L52, L53, L54, L55, C15, C16, R10)
73448	Transformer—Converter transformer (T1, R6)
73466	Washer—Insulating washer for front shield (1 set)
2917	Washer—"C" washer for channel selector shaft or fine tuning shaft and cam
	CHASSIS ASSEMBLIES
	KCS 34B
74593	Capacitor—Mica trimmer comprising 1 section of 3-35 mmf. and 1 section of 40-370 mmf. (C153A, C153B)
74153	Capacitor—Hi-voltage 500 mmf., 15,000 volts (C168)
72615	Capacitor—Mica, 10 mmf. (C126)
74105	Capacitor—Mica, 33 mmf. (C111)
74726	Capacitor—Mica, 39 mmf. (C140)
64062	Capacitor—Ceramic, 82 mmf. (C120)
39396	Capacitor—Ceramic, 100 mmf. (C175)
75060	Capacitor—Mica, 100 mmf. (1000 volts) (C138)
73921	Capacitor—Ceramic, 120 mmf. (C129)
73102	Capacitor—Mica, 180 mmf. (C158)
73922	Capacitor—Ceramic, 270 mmf. (C183, C194, C198)
73091	Capacitor—Mica, 270 mmf. (C106, C115, C121)
68542	Capacitor—Mica, 390 mmf. (C141, C200)

STOCK No.	DESCRIPTION
74250	Capacitor—Mica, 560 mmf. (C160)
71501	Capacitor—Ceramic, 1500 mmf. (C101, C103, C104, C105, C108, C109, C110, C113, C114, C117, C118, C122, C125, C127, C132, C171, C172, C176, C177, C188, C192, C193, C196)
71432	Capacitor—Electrolytic comprising 2 sections of 40 mfd. 450 volts and 1 section of 10 mfd. 450 volts (C148A, C148B, C148C)
73582	Capacitor—Electrolytic comprising 1 section of 40 mfd. 450 volts, 2 sections of 10 mfd. 450 volts and 1 section of 80 mfd. 200 volts (C170A, C170B, C170C)
73583	Capacitor—Electrolytic comprising 1 section of 40 mfd. 450 volts, 1 section of 90 mfd. 150 volts and 1 section of 50 mfd. 150 volts (C147A, C147B, C147C)
73581	Capacitor—Electrolytic comprising 1 section of 60 mfd. 450 volts, 2 sections of 10 mfd. 450 volts and 1 section of 20 mfd. 150 volts (C146A, C146B, C146C, C146D)
73801	Capacitor—Tubular, paper, oil impregnated, .001 mfd. 600 volts (C137)
73802	Capacitor—Tubular, paper, oil impregnated, .0015 mfd. 600 volts (C181)
73595	Capacitor—Tubular, moulded paper, oil impregnated, .0022 mfd. 600 volts (C142, C154, C161, C184)
73795	Capacitor—Tubular, paper, oil impregnated, .0033 mfd. 600 volts (C186)
73920	Capacitor—Tubular, moulded paper, oil impregnated, .0047 mfd. 600 volts (C143, C144, C145, C195)
73561	Capacitor—Tubular, paper, oil impregnated, .01 mfd. 400 volts (C135, C182)
73594	Capacitor—Tubular, moulded paper, oil impregnated, .01 mfd. 600 volts (C159)
73565	Capacitor—Tubular, paper, oil impregnated, .01 mfd. 1000 volts (C151, C152, C185)
74727	Capacitor—Tubular, moulded paper, oil impregnated, .018 mfd. 1000 volts (C164)
73562	Capacitor—Tubular, paper, oil impregnated, .022 mfd. 400 volts (C155)
74728	Capacitor—Tubular, moulded paper, oil impregnated, .039 mfd. 1000 volts (C165)
73553	Capacitor—Tubular, paper, oil impregnated, .047 mfd. 400 volts (C130, C139, C167)
73592	Capacitor—Tubular, moulded paper, oil impregnated, .047 mfd. 600 volts (C150, C156)
73597	Capacitor—Tubular, paper, oil impregnated, .047 mfd. 1000 volts (C163)
73551	Capacitor—Tubular, paper, oil impregnated, 0.1 mfd. 400 volts (C149)
73557	Capacitor—Tubular, paper, oil impregnated, 0.1 mfd. 600 volts (C131)
73794	Capacitor—Tubular, paper, oil impregnated, 0.22 mfd. 400 volts (C136, C157, C162)
73787	Capacitor—Tubular, paper, oil impregnated, 0.47 mfd. 200 volts (C133, C190, C197)
73154	Choke—Filter choke (L104)
74585	Coil—Focus coil (L118)
71429	Coil—Width control coil (L115)
71449	Coil—Horizontal linearity control coil (L111)
74170	Coil—Peaking coil (36 muh) (L117, R110)
71527	Coil—Peaking coil (93 muh) (L102)
74214	Coil—Peaking coil (180 muh) (L103, L105)

STOCK No.	DESCRIPTION
71526	Coil—Peaking coil (250 muh) (L106, L107, L114)
73477	Coil—Filament choke coil (L101)
74594	Connector—2 contact male connector for power cable
5119	Connector—3 contact female connector for speaker cable
71789	Connector—Anode connector
71521	Connector—Hi-voltage capacitor connector
35787	Connector—Phono input connector (J103)
72734	Control—Horizontal and vertical hold control (R158, R173)
74047	Control—Brightness and picture control (R122, R131)
38408	Control—Sound volume control and power switch (R205, S101)
71441	Control—Vertical linearity control (R162)
71440	Control—Height control (R155)
74597	Control—Focus control (R191)
74475	Control—AGC threshold control (R138)
71457	Cord—Power cord and plug
71437	Cover—Insulating cover for electrolytics #71432, 73581 and 73582
74811	Cushion—Rubber cushion for kinescope mounting
73590	Cushion—Rubber cushion for deflection yoke hood (2 req'd)
73600	Fuse—0.25 amp. 250 volts (F101)
71799	Grommet—Rubber grommet for yoke horizontal lead exit
37398	Grommet—Rubber grommet for mounting ceramic tube socket (2 required)
74823	Magnet—Ion trap magnet (P.M. type)
73587	Nut—Speed nut to mount hi-voltage capacitor
18469	Plate—Bakelite mounting plate for electrolytics
73588	Resistor—Voltage divider comprising 1 section of 850 ohms, and 2 sections of 650 ohms, 6 watts (R193A, R193B, R193C)
74598	Resistor—Wire wound, 2.7 ohms, 1/3 watt (R187)
72067	Resistor—Wire wound, 5.1 ohms, ½ watt (R202)
18471	Resistor—Wire wound, 10 ohms, ½ watt (R190)
	Resistor—Fixed, composition:—
	10 ohms, ±20%, ½ watt (R120)
	18 ohms, ±10%, ½ watt (R225)
	39 ohms, ±10%, ½ watt (R121)
	47 ohms, ±5%, ½ watt (R111)
	47 ohms, ±20%, ½ watt (R183)
	68 ohms, ±10%, ½ watt (R105)
	68 ohms, ±20%, ½ watt (R123)
	82 ohms, ±10%, ½ watt (R195)
	100 ohms, ±10%, 2 watts (R184)
	150 ohms, ±5%, ½ watt (R102)
	150 ohms, ±10%, ½ watt (R115)
	150 ohms, ±20%, ½ watt (R106, R109, R114, R214)
	330 ohms, ±10%, ½ watt (R206, R223)
	1000 ohms, ±20%, ½ watt (R103, R107, R108, R113, R116, R118, R165, R199)
	1200 ohms, ±10%, ½ watt (R196)
	1800 ohms, ±10%, 2 watts (R194, R208)
	2200 ohms, ±10%, ½ watt (R219)

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REPLACEMENT PARTS (Continued)

STOCK No.	DESCRIPTION
	2200 ohms, ±10%, 1 watt (R192)
	2700 ohms, ±10%, ½ watt (R161, R217)
	3900 ohms, ±5%, ½ watt (R112)
	4700 ohms, ±5%, ½ watt (R126)
	4700 ohms, ±10%, ½ watt (R144)
	5600 ohms, ±5%, ½ watt (R119)
	5600 ohms, ±10%, ½ watt (R141, R218)
	5600 ohms, ±10%, 1 watt (R127)
	6800 ohms, ±5%, ½ watt (R136)
	6800 ohms, ±10%, ½ watt (R150)
	6800 ohms, ±5%, 1 watt (R128)
	6800 ohms, ±10%, 2 watts (R177, R186, R210)
	8200 ohms, ±5%, ½ watt (R164, R175)
	8200 ohms, ±10%, ½ watt (R152, R153, R171)
	8200 ohms, ±5%, 1 watt (R117)
	10,000 ohms, ±5%, ½ watt (R104)
	12,000 ohms, ±10%, ½ watt (R134, R209, R226)
	12,000 ohms, ±10%, 2 watts (R124)
	15,000 ohms, ±10%, ½ watt (R182)
	15,000 ohms, ±10%, 1 watt (R146)
	22,000 ohms, ±10%, ½ watt (R151, R156, R197, R220)
	22,000 ohms, ±20%, ½ watt (R215)
	27,000 ohms, ±10%, ½ watt (R143)
	39,000 ohms, ±5%, ½ watt (R135)
	47,000 ohms, ±10%, ½ watt (R145, R211)
	47,000 ohms, ±10%, ½ watt (R221)
	68,000 ohms, ±10%, ½ watt (R172)
	100,000 ohms, ±5%, ½ watt (R203, R204)
	100,000 ohms, ±10%, ½ watt (R160, R216)
	100,000 ohms, ±10%, 1 watt (R179)
	100,000 ohms, ±20%, 1 watt (R222)
	120,000 ohms, ±5%, 1 watt (R176)
	120,000 ohms, ±10%, 1 watt (R174)
	150,000 ohms, ±10%, ½ watt (R168)
	150,000 ohms, ±20%, ½ watt (R142)
	180,000 ohms, ±5%, 1 watt (R178)
	220,000 ohms, ±10%, ½ watt (R129, R154)
	330,000 ohms, ±10%, ½ watt (R140, R200)
	470,000 ohms, ±10%, ½ watt (R137, R139, R180, R224)
	470,000 ohms, ±20%, ½ watt (R207)
	680,000 ohms, ±10%, ½ watt (R133, R212)
	820,000 ohms, ±5%, ½ watt (R169)
	1 megohm, ±10%, ½ watt (R147, R181)
	1 megohm, ±20%, 1 watt (R189)
	1.2 megohms, ±5%, ½ watt (R213)
	1.5 megohms, ±5%, ½ watt (R157)
	2.2 megohms, ±10%, ½ watt (R130, R132, R159, R163)
	2.7 megohms, ±5%, 1 watt (R170)
	3.9 megohms, ±10%, ½ watt (R149)
	6.8 megohms, ±10%, ½ watt (R125)

STOCK No.	DESCRIPTION
	10 megohms, ±10%, ½ watt (R148)
	10 megohms, ±20%, ½ watt (R201)
74416	Screw—#10-32 x 1¾" cross recessed round head screw for kinescope retaining strap
74601	Screw—#8-32 x ⅜" cross recessed binder head screw for focus coil mounting (2 required)
74602	Screw—#10-32 x 1¾" cross recessed round head screw for focus coil adjustment (3 required)
71456	Screw—#8-32 x 7/16" wing screw for deflection yoke mounting
75083	Screw—#8-32 x 1/4" wing screw for deflection yoke mounting
73584	Shield—Tube shield
74937	Sleeve—Rubber sleeve for focus coil
73117	Socket—Tube socket, 7 pin, miniature
72927	Socket—Tube socket, 9 pin, miniature
31251	Socket—Tube socket, octal, wafer
73249	Socket—Tube socket, octal ceramic, plate mounted
71508	Socket—Tube socket for 8016
74834	Socket—Kinescope socket
31364	Socket—Pilot lamp socket
73586	Spring—Compression spring used under centering control screws (3 required)
74595	Spring—Anode lead spring
74936	Spring—Suspension spring (coil type) for kinescope tube socket leads
74810	Strap—Kinescope retaining strap
74596	Support—Bakelite supports (1 set) for mounting hi-voltage rectifier tube mounting plate
46760	Switch—"TV-Phono" switch (S103)
74157	Switch—Interlock switch
74147	Switch—Width selector switch (S104)
73569	Transformer—Vertical oscillator transformer (T107)
71419	Transformer—Sound output transformer (T114)
74589	Transformer—First pix. i-f transformer (T101, C102, R101)
74590	Transformer—Second pix. i-f transformer (T102, C107)
74591	Transformer—Third pix. i-f transformer (T103, C112)
74592	Transformer—Fourth pix. i-f transformer (T104, C116)
73575	Transformer—Fifth pix. i-f transformer (T106, C123, C124)
71424	Transformer—Sound i-f transformer (T112, C173, C174)
71427	Transformer—Sound discriminator transformer (T113, C178, C179, C180)
73576	Transformer—Horizontal oscillator transformer (T109)
73578	Transformer—Antenna transformer complete with socket (T115, J102)
74586	Transformer—Power transformer, 115 volt, 60 cycle (T111)
74587	Transformer—Vertical output transformer (T108)
74588	Transformer—Horizontal output and hi-voltage transformer (T110)
73577	Trap—4.5 mc. trap (L110, C128)
71778	Trap—Sound trap (T105, C119)
73476	Trap—I-F trap (L116, C189)
71420	Yoke—Deflection yoke (L108, L109, L112, L113, C169, R166, R167)

STOCK No.	DESCRIPTION
	SPEAKER ASSEMBLIES
	92569-7W
	RL111-9
	RMA-274
13867	Cap—Dust cap
74901	Cone—Cone and voice coil assembly
5118	Plug—3-prong male plug for speaker
73635	Speaker—12" PM speaker complete with cone and voice coil less plug
	NOTE: If stamping on speaker in instrument does not agree with above speaker number, order replacement parts by referring to model number of instruments, number stamped on speaker and full description of part required.
	MISCELLANEOUS
74982	Back—Cabinet back for Model TC124
74968	Back—Cabinet back for Model TC125 and Model TC127
72857	Board—"Ant" terminal board
71599	Bracket—Pilot lamp bracket
13103	Cap—Pilot lamp cap
71892	Catch—Bullet catch and strike for doors (2 required) for Model TC127
X3092	Cloth—Grille cloth for mahogany or walnut instruments for Model TC124
X3093	Cloth—Grille cloth for oak instruments for Model TC124
X3094	Cloth—Grille cloth for mahogany or walnut instruments for Model TC125
X3089	Cloth—Grille cloth for oak instruments for Model TC125
X3074	Cloth—Grille cloth for mahogany or walnut instruments for Model TC127
X3075	Cloth—Grille cloth for oak instruments for Model TC127
39153	Connector—4-contact male connector for antenna cable
74891	Cushion—Vinylite cushion for metal kinescope mask
74731	Decal—Control panel function decal for mahogany or walnut instruments
74732	Decal—Control panel function decal for oak instruments
71768	Decal—Trade mark decal for Model TC127
74809	Emblem—"RCA Victor" emblem
73642	Escutcheon—Channel marker escutcheon for mahogany or walnut instruments
73740	Escutcheon—Channel marker escutcheon for oak instruments
74755	Glass—Safety glass for Models TC124 and TC127
74989	Glass—Safety glass for Model TC125
37396	Grommet—Rubber grommet for speaker mounting (4 required)
74308	Hinge—Cabinet door hinge (1 set) (2 required) for Model TC127

STOCK No.	DESCRIPTION
74959	Knob—Fine tuning control knob—dark—(outer) for mahogany or walnut instruments—Models TC125 and TC127
73995	Knob—Fine tuning control knob—tan—(outer) for oak instruments
75027	Knob—Fine tuning control knob—chocolate brown—(outer) for mahogany or walnut instruments—Model TC124
74960	Knob—Channel selector knob—dark—(inner) for mahogany and walnut instruments—Models TC125 and TC127
74961	Knob—Channel selector knob—tan—(inner) for oak instruments
75028	Knob—Channel selector knob—chocolate brown—(inner) for mahogany or walnut instruments for Model TC124
74962	Knob—Brightness control or vertical hold control knob—dark—(outer) for mahogany or walnut instruments—Models TC125 and TC127
73999	Knob—Brightness control or vertical hold control knob—tan—(outer) for oak instruments
75029	Knob—Brightness control or vertical hold control knob—chocolate brown—(outer) for mahogany or walnut instruments for Model TC124
74969	Knob—Volume control and power switch knob—dark—for mahogany or walnut instruments for Models TC125 and TC127
74003	Knob—Volume control and power switch knob—tan—for oak instruments
75030	Knob—Volume control and power switch knob—chocolate brown—for mahogany or walnut instruments for Model TC124
74963	Knob—Picture control or horizontal hold control knob—dark—(inner) for mahogany or walnut instruments—Models TC125 and TC127
74001	Knob—Picture control or horizontal hold control knob—tan—(inner) for oak instruments
75031	Knob—Picture control or horizontal hold control knob—chocolate brown—(inner) for mahogany or walnut instruments for Model TC124
11765	Lamp—Pilot lamp—Mazda 51
74730	Nail—Decorative head nail for grille bars (4 required) for Model TC127
74162	Plate—Mounting plate for interlock switch
74971	Plate—Back plate for door pulls (2 required) for Model TC127
74970	Pull—Cabinet door pull (2 required) for Model TC127
74113	Screw—#8-32 x 1" trimit head screw for door pulls for Model TC127
72845	Spring—Retaining spring for knobs #73995, 74959 and 75027
14270	Spring—Retaining spring for knobs #73999, 74003, 74960, 74961, 74962, 74969, 75028, 75029 and 75030
30330	Spring—Retaining spring for knobs #74001, 74963 and 75031
73643	Spring—Spring clip for channel marker escutcheon
72936	Stop—Door stop for Model TC127
74161	Stud—Locating stud for back covers

To obtain resistors for which no stock number is given, order by stating type, value of resistance, tolerance and wattage.

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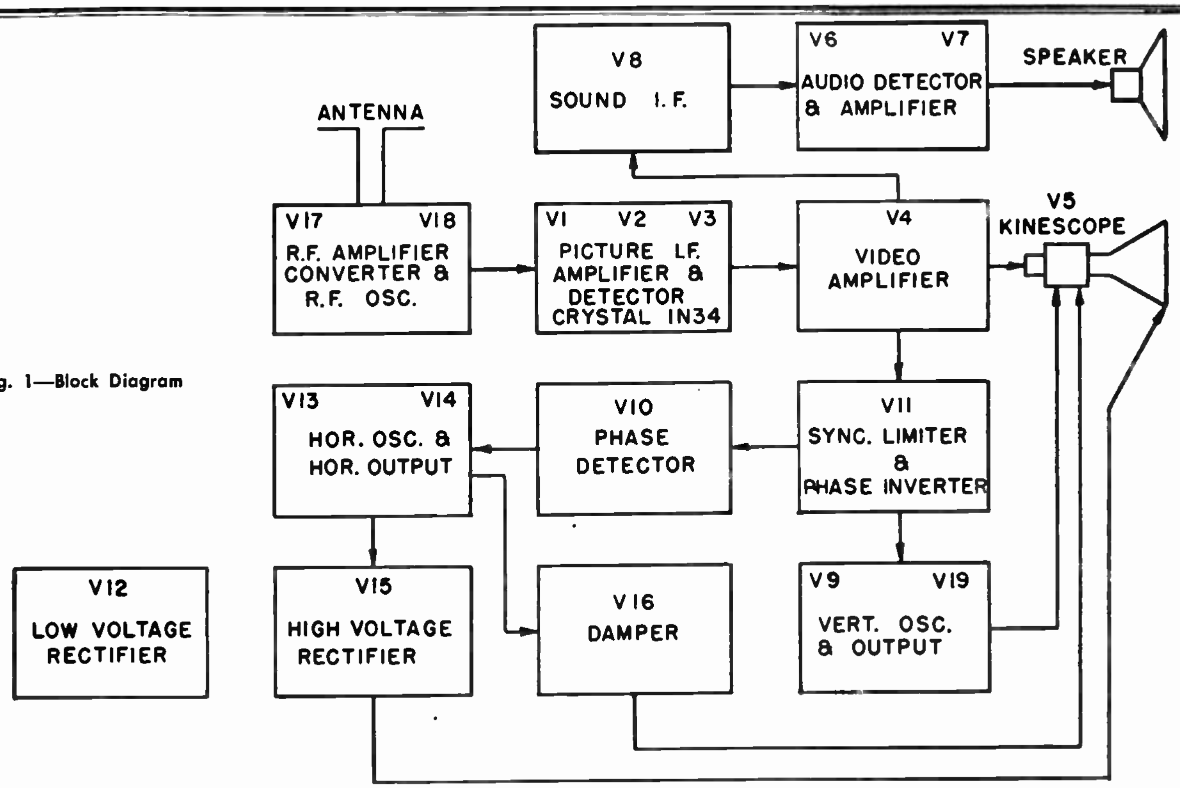

Fig. 1—Block Diagram

ELECTRICAL SPECIFICATIONS

Power Supply	105-125 Volts AC 60 Cycles Only
Power Consumption	230 Watts
Power Output	3.5 Watts Maximum 2 Watts Undistorted
Antenna Input Impedance	300 Ohms Balanced
Picture Area	130 Square Inch
Tuning Range	12 Channel
Loud Speaker	PM Dynamic
Voice Coil Impedance	3.2 Ohms 400 Cycles
Video Response	to 3.5 MC
Focus	Magnetic
Sweep Deflection	Magnetic
Scanning	Interlaced, 525 Line
Horizontal Scanning Frequency	15,750 CPS
Vertical Scanning Frequency	60 CPS
Frame Frequency	30 CPS

THIS RECEIVER CONTAINS THE FOLLOWING:

Symbol	Type	Function
V1	6CB6	1st I.F. Amplifier
V2	6CB6	2nd I.F. Amplifier
V3	6CB6	3rd I.F. Amplifier
V4	6AH6	Video Amplifier
V5		Kinescope
V6	6AQ5	Audio Output
V7	6T8	FM Detector and 1st Audio
V8	6AU6	Sound I.F.
V9	6SN7GT	Vertical blocking oscillator
V10	6AL5	Phase detector
V11	12AU7	Sync limiter and DC restorer
V13	6SN7GT	Horizontal oscillator
V14	6CD6	Horizontal output
V16	6W4	Diode damper
V17	6AG5 or 6BC5	R.F. Amplifier
V18	6J6	Oscillator and Mixer
V19	6S4	Vertical Output
V12	5U4G	Low Voltage Rectifier
V15	1B3	High Voltage Rectifier

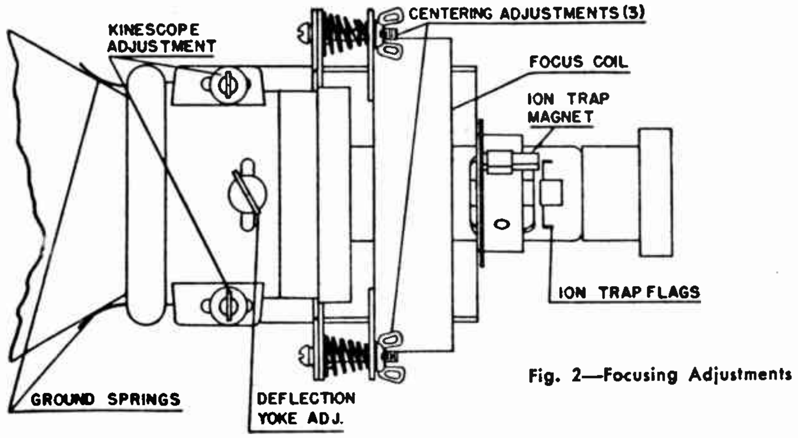

Fig. 2—Focusing Adjustments

NON-OPERATING CONTROLS
(Rear of Chassis)

Brilliance	R20
Vertical Linearity	R35
Vertical Hold	R42
Height	R39
Focus	R58
Horizontal Hold	R66
Width Control (H.V. cage)	L11
Horizontal Drive	C56
Horizontal Osc. Coil (H.V. cage)	L10
Horizontal Linearity	L13
Focus Coil	Wing nut adjustment
Deflection Coils	Wing nut adjustment
Ion trap magnet	

Turn on the set and tune to a channel on which a station is operating.

1. Adjust the Horizontal Hold (R66) to the center of its rotation. With the control in this position adjust the Horizonal Oscillator coil (L10) until a picture appears. If no raster or pattern appears on the screen, leave R66 in the center position and continue with the following instructions until a raster does appear then return for this adjustment.

2. Advance the Brilliance control (R20) in a clockwise direction until a raster appears. Allow this to remain in a clock wise position whether a raster appears or not.

3. Adjust the ion trap magnet for maximum brightness by moving it forward or backward along the neck of the picture tube, rotating it about the neck of the tube at the same time. The Brilliance should then be reduced to a suitable level by means of control R20.

4. Adjust the Vertical Hold control (R42) until the test pattern remains stationary. The Contrast (R16, front panel) and Brilliance (R20) should then be adjusted for normal picture contrast.

5. At this point the Focus control (R58) should be adjusted for the sharpest horizontal lines at the center of the pattern.

6. Adjust the Height control (R39) until the proper height is attained. Adjustment of this control may effect the Vertical Hold (R42), in which case, that control will have to be re-adjusted to maintain a stationary pattern.

7. The Vertical Linearity (R35) control should be adjusted to give maximum linearity in the upper portion of the raster.

8. Adjust the Horizontal Drive (C56) until a white vertical line appears on the left side of the screen. Then reduce the drive by turning the trimmer clockwise until this line just disappears. This can best be seen at reduced contrast. Now adjust the Horizontal Linearity (L13) control for best linearity.

9. Loosen the wing-nut on top of the yoke housing and square the pattern with the screen escutcheon by rotating the yoke. Be sure that the yoke is pushed as far forward as possible.

10. Adjusl the focus coil to center the picture by turning the three wing-nuts on the coil mounting bolts.

11. The Width control (L11) is a screw-driver adjustment located on top of the high voltage cage. The width is increased by turning this control in a clockwise direction.

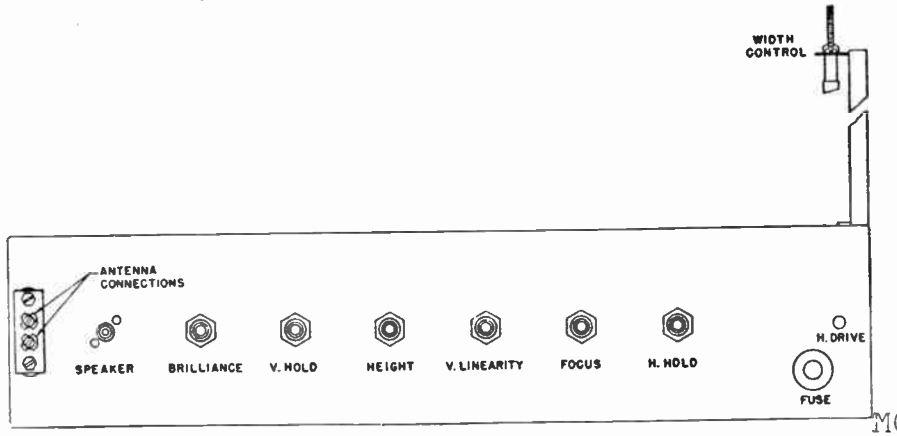

Fig. 3—Rear View of Chassis

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SERVICE SUGGESTIONS

NO RASTER ON KINESCOPE—If raster cannot be obtained, check below for possible causes.

1. Ion trap magnet adjustment is incorrect.
2. Check .25 amp. fuse in plate circuit of V14.
3. No high voltage — check V14 (6CD6) and V15 (1B3-GT) tubes and circuits. If the horizontal deflection circuits are operating as evidenced by the correct waveform measured on terminal 4 of horizontal output transformer (T9), the trouble can be isolated to the high voltage rectifier circuit (V15). Either the high voltage winding (between red and blue leads) on T9 is open, tube V15 is defective or its filament circuit is open.
4. Damper tube V16 (6W4) defective. Plate voltage supply for V14 (6CD6) horizontal output tube is obtained through the damper tube. Check tube and heater winding on power transformer (T7).
5. Defective kinescope. Heater open, cathode return circuit open.
6. No plate voltage. Electrolytic capacitor shorted. All B voltages are accessible for measurement underneath the chassis.

HORIZONTAL DEFLECTION ONLY—If only horizontal deflection is obtained as evidenced by a straight line across the face of the kinescope, it can be caused by the following:

1. Vertical oscillator V9 (6SN7-GT) inoperative. Check voltages on grid and plate.
2. Vertical output transformer (T5) open.
3. Yoke vertical coils (L7) open.
4. Vertical blocking transformer (T6) open or shorted.
5. Vertical output tube V19 (6S4) defective.

POOR VERTICAL LINEARITY—If adjustment of the vertical height and linearity controls will not correct this condition, any of the following may be the cause:

1. Vertical output transformer (T5), capacitors C30, C31, C32, or resistor R38.
2. V9 (6SN7GT) defective; check voltages.
3. Low plate and bias voltages. Check rectifier tube and capacitors in B supply.

POOR HORIZONTAL LINEARITY—Check the following:

1. V14 (6CD6) screen voltage.
2. Horizontal drive (C56) for incorrect adjustment.
3. Horizontal output tube V14 (6CD6).
4. Damper tube V16 (6W4).

TRAPEZOIDAL OR NON-SYMMETRICAL RASTER — Check for:

1. Improper adjustment of focus coil or ion trap magnet.
2. Defective yoke.

WRINKLES ON LEFT SIDE OF RASTER—This condition can be caused by incorrect adjustment of the horizontal drive C56.

SMALL RASTER—This condition can be caused by:

1. Low B or line voltage.
2. Insufficient output from horizontal output tube (V14) (6CD6). Replace tube.
3. Insufficient output from vertical output tube V19 (6S4) or V9 (6SN7GT). Replace tube.

RASTER; NO IMAGE, BUT ACCOMPANYING SOUND —This condition can be caused by:

1. No signal on kinescope cathode. Check for open coupling condenser C13.
2. Bad contact to kinescope or lead to socket broken.

SIGNAL APPEARS ON KINESCOPE CATHODE BUT IMPOSSIBLE TO SYNCHRONIZE THE PICTURE HORIZONTALLY AND VERTICALLY—A condition of this nature can be caused by:

1. Defective sync limiter V11 (12AU7) or phase detector V10 (6AL5).
2. If tubes are O.K. check voltages and associated circuits.

SIGNAL ON KINESCOPE CATHODE AND HORIZONTAL SYNC ONLY—Check:

1. Vertical integrating network capacitors C31, C34, C35, and resistors R44, R45, R46.

PICTURE STABLE BUT WITH POOR RESOLUTION — If the picture resolution is not up to standard, it may be caused by any of the following:

1. Defective picture detector (crystal 1N34) or video amplifier V4 (6AH6).
2. Open video peaking coil. Check coils L1, L2, L3, L4 and L5 for continuity. Note that L3 and L5 have shunting resistors. L4 is 4.5 MC trap.
3. Leakage in V4 (6AH6) grid capacitor C11, or C13 on V5 (kinescope).

If the above components are not found to be defective, check the following:

A. Check all potentials in video circuits.

B. Check the kinescope grid for poor or dirty contacts.

C. Check adjustment of focus control R48. It should be effective on either side of proper focus.

D. Check and re-align if necessary, the picture I.F. and the local oscillator.

E. Check for proper coils in turret switch.

PICTURE SMEAR:

1. Normally, smear can be attributed to phase shift at the low frequency end of the video characteristic. This can be caused by improper values of resistors and capacitors in the video circuits.
2. This trouble can also originate at the transmitter. Check reception from another station.

PICTURE JITTER:

1. Vertical instability may be due to loose connections or noise received with the signal.
2. Horizontal instability may be due to unstable transmitted sync or to noise.

ALIGNMENT TABLE

DISCRIMINATOR AND SOUND I-F ALIGNMENT

Step No.	Connect Signal Generator to	Signal Gen. Freq. Mc.	Connect Sweep Generator to	Sweep Gen. Freq. Mc.	Connect Oscilloscope to	Connect Voltmeter to	Miscellaneous Connections and Instructions	Adjust	Refer to
1	Video Grid (pin 1, V-4)	4.5 .1 volt output	Not used		Not used	Pin 2 V-7	Meter on 10 volt scale	T4 (bottom) and L6 for max. on meter. L4 for min.	Figs. 5
2	Video Grid (pin 1, V-4)	4.5 .1 volt output	Not used		Not used	See Note 1	Meter on 3 volt scale	T4 (top) for zero on meter	
3	Not used		Video Grid (pin 1, V-4)	4.5 center 1 mc .1 volt output	Discriminator output (Junction R28-R39)	Not used	Check for symmetrical response waveform (positive and negative). If not equal, adjust T4 (bottom) until they are equal. See Note 2.		Fig. 5

NOTE 1: Connect two 100 K resistors in series. Connect one end to pin 2 of V-7 (6T8) and the other end to ground. Connect the hot side of the VTVM to center of the two 100 K resistors and ground side to junction of R29 (150 ohms) and R28 (47 K ohms).

NOTE 2: The peak to peak band width at the discriminator should be approximately 300 KC and should be linear from 4.425 MC to 4.575 MC.

ALIGNMENT PROCEDURE

I-F ADJUSTMENTS

Step No.	Connect Signal Generator to	Signal Gen. Freq. Mc.	Connect Voltmeter to	Miscellaneous Connections and Instructions	Adjust	Refer to
4	Wire loop (top of tuner between V17 and V18)	24.6	Junction R13 and L2	Set station selector between channels; meter on 3 volt scale	T3 (top) maximum	Fig. 5
5	Wire loop (top of tuner between V17 and V18)	23.3	Junction R13 and L2		T2 (top) maximum	Fig. 5
6	Wire loop (top of tuner between V17 and V18)	25.6	Junction R13 and L2		T1 (top) maximum	Fig. 5
7	Wire loop (top of tuner between V17 and V18)	22.2	Junction R13 and L2		L15 maximum	Fig. 5
8	Wire loop (top of tuner between V17 and V18)	21.25	Junction R13 and L2		L14 minimum	Fig. 5

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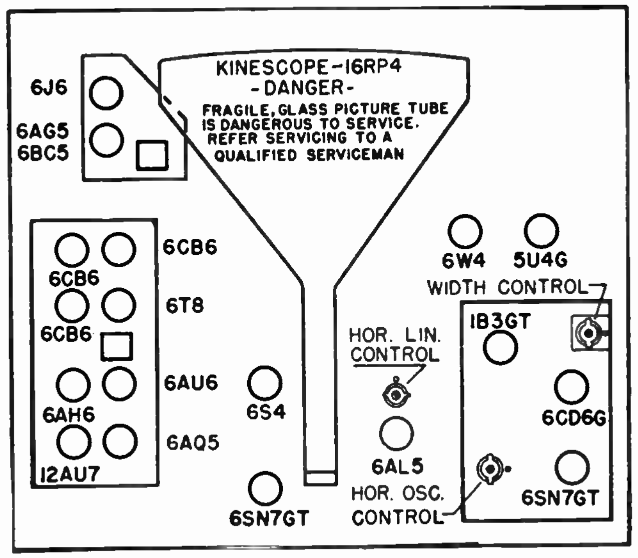

Fig. 4—Tube Layout

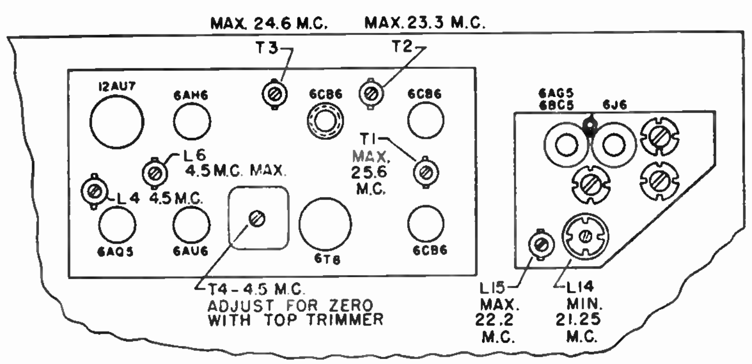

Fig. 5—Top Chassis—Video I.F. Adjustment

OSCILLATOR ADJUSTMENT

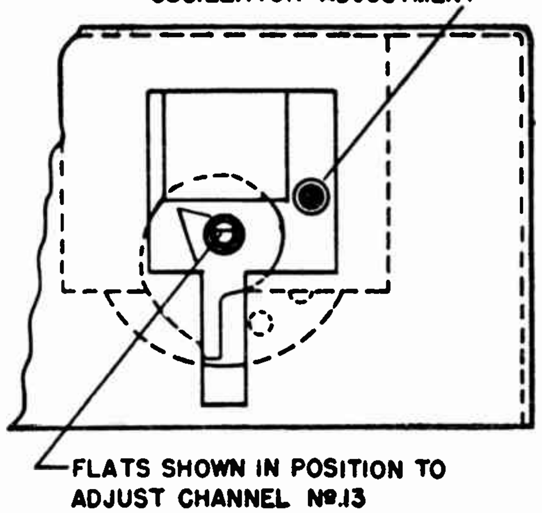

Fig. 6—Oscillator Adjustment

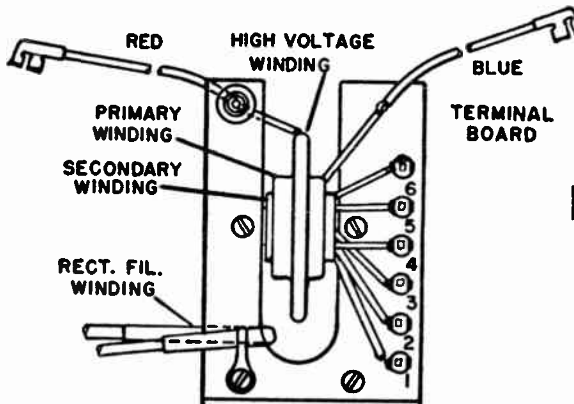

Fig. 7—High Voltage Transformer Winding Leads

ALIGNMENT PROCEDURE

TEST EQUIPMENT—To service this receiver properly, it is recommended that the following test equipment be available:

R-F SWEEP GENERATOR meeting the following requirements:

(a) Frequency range: 4 to 5 MC; 1 MC sweep width.
(b) Output adjustable with at least .1 volt maximum.
(c) Output constant on all ranges.
(d) Flat output in all attenuator positions.

CATHODE RAY OSCILLOSCOPE preferably one with a wide band vertical deflection and an input calibrating source.

SIGNAL GENERATOR to provide the following frequencies:

(Output on these ranges should be adjustable and at least .1 volt max.)

(a) Intermediate frequencies:
4.5 MC Sound I.F.
21.25 MC Trap (L14)
22.2 MC 1st I.F. (L15)
25.6 MC 2nd I.F. (T1)
23.3 MC 3rd I.F. (T2)
24.6 MC 4th I.F. (T3)

(b) Radio frequencies:

Channel Number	Picture Carrier Freq. Mc	Sound Carrier Freq. Mc
2	55.25	59.75
3	61.25	65.75
4	67.25	71.75
5	77.25	81.75
6	83.25	87.75
7	175.25	179.75
8	181.25	185.75
9	187.25	191.75
10	193.25	197.75
11	199.25	203.75
12	205.25	209.75
13	211.25	215.75

HETERODYNE FREQUENCY METER with crystal calibrator if the signal generator is not crystal controlled.

ELECTRONIC VOLTMETER and a high voltage probe for use with this meter to permit measurements up to 10 kilovolts.

SERVICE PRECAUTIONS—To service the receiver remove the chassis from the cabinet. To do so, remove the knobs, the cabinet back and the three chassis mounting bolts (bottom of cabinet). The chassis should normally be serviced without the kinescope. However, if it is necessary to view the raster during servicing, turn the chassis on its side, with the power transformer and high voltage cage down. In this position the chassis is self-balancing, and all controls and components are readily accessible for adjustment or measurement.

CAUTION: Do not permit the kinescope second-anode lead to become shorted to the chassis.

SENSITIVITY CHECK—A comparative sensitivity check can be made by operating the receiver on a weak signal from a television station and comparing the picture and sound obtained to that obtained on other receivers under the same conditions.

This weak signal can be obtained by connecting the shop antenna to the receiver through an attenuator pad of the type shown in figure 9. The number of stages in the pad depends upon the signal strength available at the antenna. A sufficient number of stages should be inserted so that a somewhat less than normal contrast picture is obtained when the picture control is at the maximum clockwise position.

Only carbon type resistors should be used to construct the attenuator pad. Since many of the low value moulded resistors generally available are of wire wound construction, it is advisable to break and examine one of each type of resistor used in order to determine its construction.

OSCILLATOR ADJUSTMENT—The oscillator slug for each channel can be adjusted by removing the chassis from the cabinet. Use only an insulated alignment tool. When adjusting the slugs to be sure that the fine tuning control is at the mid-capacity position (tip pointing down, as illustrated in Fig. 6).

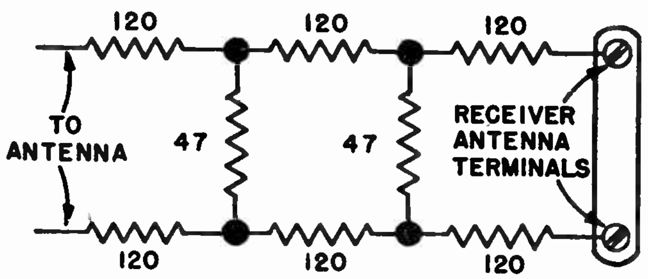

Fig. 9—Attenuator Pad

REPLACEMENT PARTS LIST FOR MODELS 616, 6161 & 1116

When ordering parts, specify part number, model number and any other pertinent information.

Ref. No.	Part Number	Description
		CAPACITORS
C1, C2, C4, C5, C7, C8, C20, C21, C24	16-177	Capacitor, ceramic; 5000 mmfd.
C3, C13, C16	16-188	Capacitor, tubular; .2-400 v. 85° C
C6, C26, C42, C43, C44, C49	18-295	Capacitor, electrolytic; 100 mfd. 200 v. 40-40 mfd. 450 v.
C9	15-196	Capacitor, ceramic; 100 mmfd.
C10	15-223	Capacitor, ceramic; 10 mmfd.
C11, C17, C39	16-189	Capacitor, tubular; .05-400 v. 85° C
C12	15-232	Capacitor, ceramic; 120 mmfd.
C14	18-276	Capacitor, electrolytic; 20 mfd. 450 v.
C15	18-299	Capacitor, electrolytic; 40 mfd. 250 v.
C18, C40	18-292	Capacitor, electrolytic; 4 mfd. 50 v.
C19, C47	15-200	Capacitor, mica; 470 mmfd.
C22	15-228	Capacitor, ceramic; 2000 mmfd.
C23	15-230	Capacitor, mica; 220 mmfd.
C25	15-222	Capacitor, ceramic; 5 mmfd.
C27	16-212	Capacitor, tubular; .2-600 v. 85° C
C28, C50, C54	16-208	Capacitor, tubular; .1-600 v. 85° C
C29, C32, C52, C57	16-193	Capacitor, tubular; .05-600 v. 85° C
C30	16-211	Capacitor, tubular; .0047-600 v. 85° C
C31, C34	16-209	Capacitor, tubular; .006-600 v. 85° C
C33	16-190	Capacitor, tubular; .005-600 v. 85° C
C35	16-198	Capacitor, tubular; .002-600 v. 85° C
C36, C37	15-220	Capacitor, ceramic; 1000 mmfd.
C38, C45	16-201	Capacitor, tubular; .01-600 v. 85° C
C41	15-210	Capacitor, ceramic; 33 mmfd.
C46	15-226	Capacitor, silver mica; 330 mmfd.
C48	15-231	Capacitor, mica; 390 mmfd.
C51	16-213	Capacitor, tubular; .03-600 v. 85° C
C53	15-233	Capacitor, mica; 50 mmfd. 800 v.
C55	18-293	Capacitor, electrolytic; 8 mfd. 500 v.
C56	20-145	Capacitor, trimmer; HORIZONTAL DRIVE

MODELS C-6161, T-616, 1116, 5816

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RESISTORS

R1, R8	60-759	Resistor, carbon; 4.7K ohm, ½ w. 10%
R2, R34	60-708	Resistor, carbon; 680 ohm, ½ w. 10%
R3, R7	60-806	Resistor, carbon; 56 ohm, ½ w. 10%
R4	60-786	Resistor, carbon; 6.8K ohm, ½ w. 10%
R5	60-668	Resistor, carbon; 1 megohm, ½ w.
R6, R9, R69	60-752	Resistor, carbon; 100 ohm, ½ w. 10%
R10, R15	60-776	Resistor, carbon; 82 ohm, ½ w. 10%
R11	60-817	Resistor, carbon; 120K ohm, ½ w. 10%
R12, R14, R49, R67	60-731	Resistor, carbon; 470K ohm, ½ w.
R13, R37, R44	60-778	Resistor, carbon; 8.2K ohm, ½ w. 10%
R16	25-19	Resistor, variable; 1000 ohm CONTRAST
R17, R64	60-760	Resistor, carbon; 10K ohm, ½ w. 10%
R18	60-808	Resistor, carbon; 6.8K ohm, 2 w. 10%
R19, R22, R23 R47, R48, R65	60-801	Resistor, carbon; 100K ohm, ½ w. 10%
R20, R66	25-10	Resistor, variable; 50K ohm, BRILLIANCE and HORIZONTAL HOLD
R21	60-816	Resistor, carbon; 3.3K ohm, 2 w. 10%
R23	60-788	Resistor, carbon; 180K ohm, ½ w. 5%
R24	60-747	Resistor, carbon; 270K ohm, ½ w. 10%
R25, R50	60-779	Resistor, carbon; 4.7 megohm, ½ w.
R26	60-811	Resistor, carbon; 12K ohm, ½ w. 10%
R27	24-190	Resistor, variable; 500K ohm VOLUME CONTROL
R28	60-730	Resistor, carbon; 47K ohm, ½ w.
R29	60-767	Resistor, carbon; 150 ohm, ½ w. 10%
R30	60-810	Resistor, carbon; 22K ohm, 2w. 10%
R31, R32	60-758	Resistor, carbon; 560 ohm, ½ w. 10%
R35	25-13	Resistor, variable; 2.5K ohm VERTICAL LINEARITY
R36, R38	60-726	Resistor, carbon; 2.2 megohm, ½ w.
R39	25-15	Resistor, variable; 2 megohm, HEIGHT
R40, R63	60-802	Resistor, carbon; 56K ohm, ½ w. 10%
R41, R4c	60-744	Resistor, carbon; 22K ohm, ½ w. 10%
R42	25-17	Resistor, variable; 1 megohm, VERTICAL HOLD
R43	60-780	Resistor, carbon; 1.5 megohm, ½ w.
R51	60-783	Resistor, carbon; 15K ohm, ½ w. 10%
R52, R53, R55	60-714	Resistor, carbon; 2.2K ohm, ½ w. 10%
R54	60-710	Resistor, carbon; 3.9K ohm, ½ w. 10%
R56	60-807	Resistor, carbon; 680K ohm, ½ w. 10%
R57	60-782	Resistor, carbon; 1.2 megohm, ½ w. 10%
R58	25-14	Resistor, variable; 2250 ohm FOCUS
R59	60-803	Resistor, carbon; 470 ohm, 2 w. 10%
R60	60-800	Resistor, wirewound; 800 ohm, 5 w. 10%
R61	60-729	Resistor, corbon; 1.5K ohm, ½ w. 10%
R62	60-747	Resistor, carbon; 270K ohm, ½ w. 10%
R68	60-805	Resistor, carbon; 47 ohm, 1 w. 10%
R70	60-804	Resistor, wirewound; 15K ohm, 5 w. 10%
R71	60-787	Resistor, carbon; 330K ohm, ½ w. 5%

TRANSFORMERS AND COILS

T1	10-541	Transformer, 2nd I.F. (blue)
T2	10-542	Transformer, 3rd I.F. (white)
T3	10-543	Transformer, 4th I.F. (red)
T4	10-552	Transformer, ratio detector, 4.5 MC
T5	80-261	Transformer, vertical output
T6	80-257	Transformer, vertical blocking
T7	80-260	Transformer, power
T8	80-253	Transformer, output (radio)
T9	80-259	Transformer, horizontal output
L1	10-557	Coil, peaking, 90 uh (orange)
L2	10-558	Coil, peaking, 375 uh (red)
L3	10-559	Coil, peaking, 230 uh (black) (on 18k resistor)
L4	10-562	Coil, 4.5 MC trap
L5	10-548	Coil, peaking, 650 uh (white) (on 10K resistor)
L6	10-556	Coil, sound take-off (includes 3 condensers)
L7, L12	83-669	Coil, deflection yoke
L8	10-550	Coil, line antenna choke
L9	10-560	Coil, focus
L10	10-555	Coil, horizontal oscillator (includes 3900 mmfd.)
L11	10-551	Coil, WIDTH CONTROL
L13	10-561	Coil, HORIZONTAL LINEARITY

MISCELLANEOUS CHASSIS PARTS

22-158	Connector, H.V.
48-45	Crystal, 1N34
43-13	Fuse, .25 amp. 250 v.
43-12	Fuse, 5 amp. 250 v.
83-670	Ion trap magnet
37-122	Insulator, ceramic, socket support
22-133	Jack, speaker
84-447	Line cord and shield assembly
31-126	Plate, electrolytic mounting
45-125	Plug, speaker
95-21	R.F. Tuner
68-18	Socket, octal, molded
68-43	Socket, miniature, 7 pin
68-44	Socket, miniature, 9 pin
68-47	Socket, octal, wafer (3 pins)
68-46	Socket, kinescope
27-16	Strap, kinescope support
79-388	Speaker, 5" P.M. (table)
79-389	Speaker, 10" P.M. (consolette)
83-652	Yoke mounting hood

CABINET PARTS

32-11	Back
42-471	Cabinet (table)
42-474	Cabinet (consolette)
48-50	Glass, front panel (table)
48-51	Glass, front panel (consolette)
98-11	Grille cloth (table)
98-17	Grille cloth (consolette)
52-311	Knob, PICTURE and OFF-VOLUME
52-312	Knob, CHANNEL SELECTOR
52-313	Knob, FINE TUNING
31-167	Plate, mask (table)
31-168	Plate, mask (consolette)
36-126	Wire screen

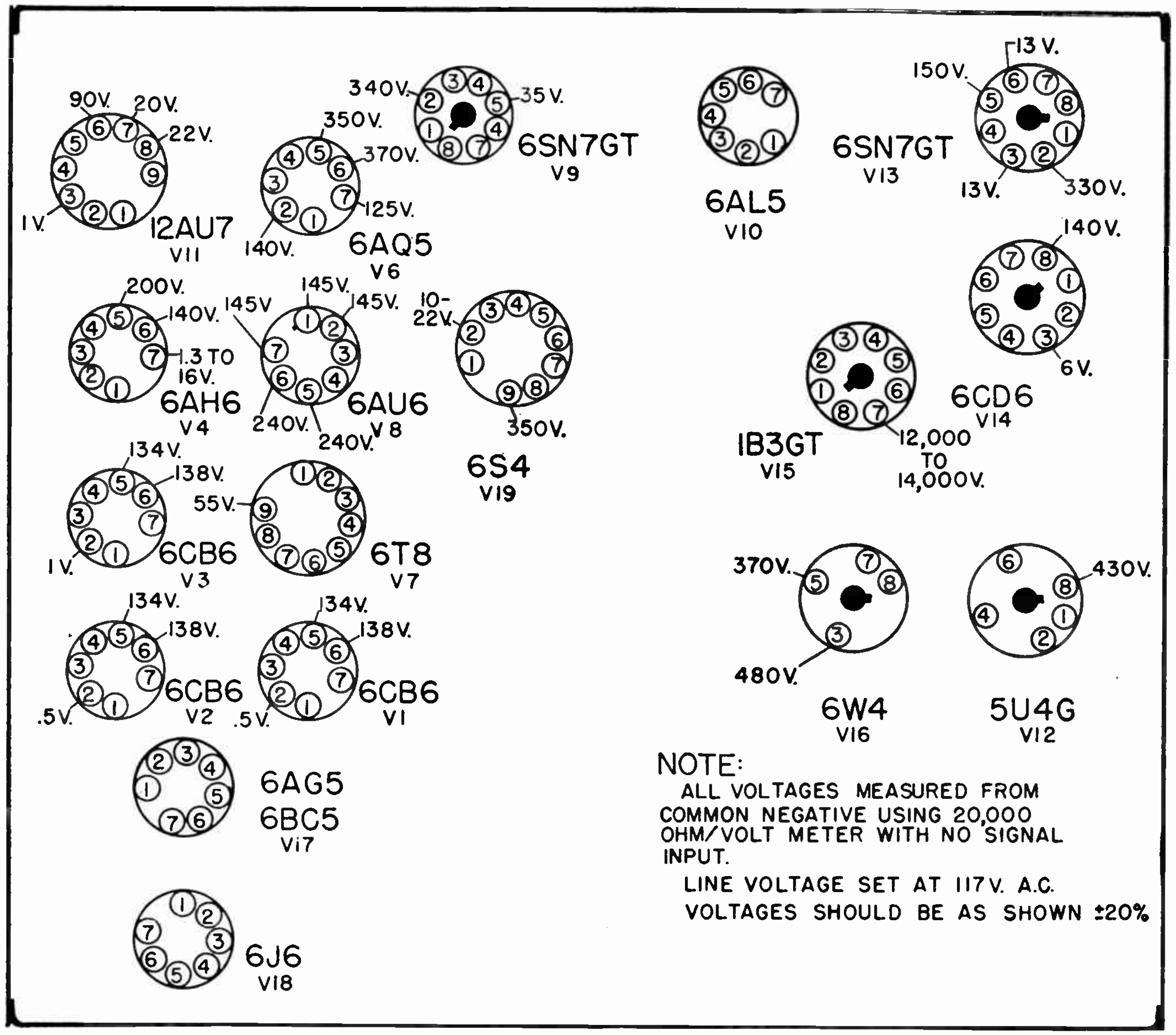

Fig. 8—Bottom Socket View

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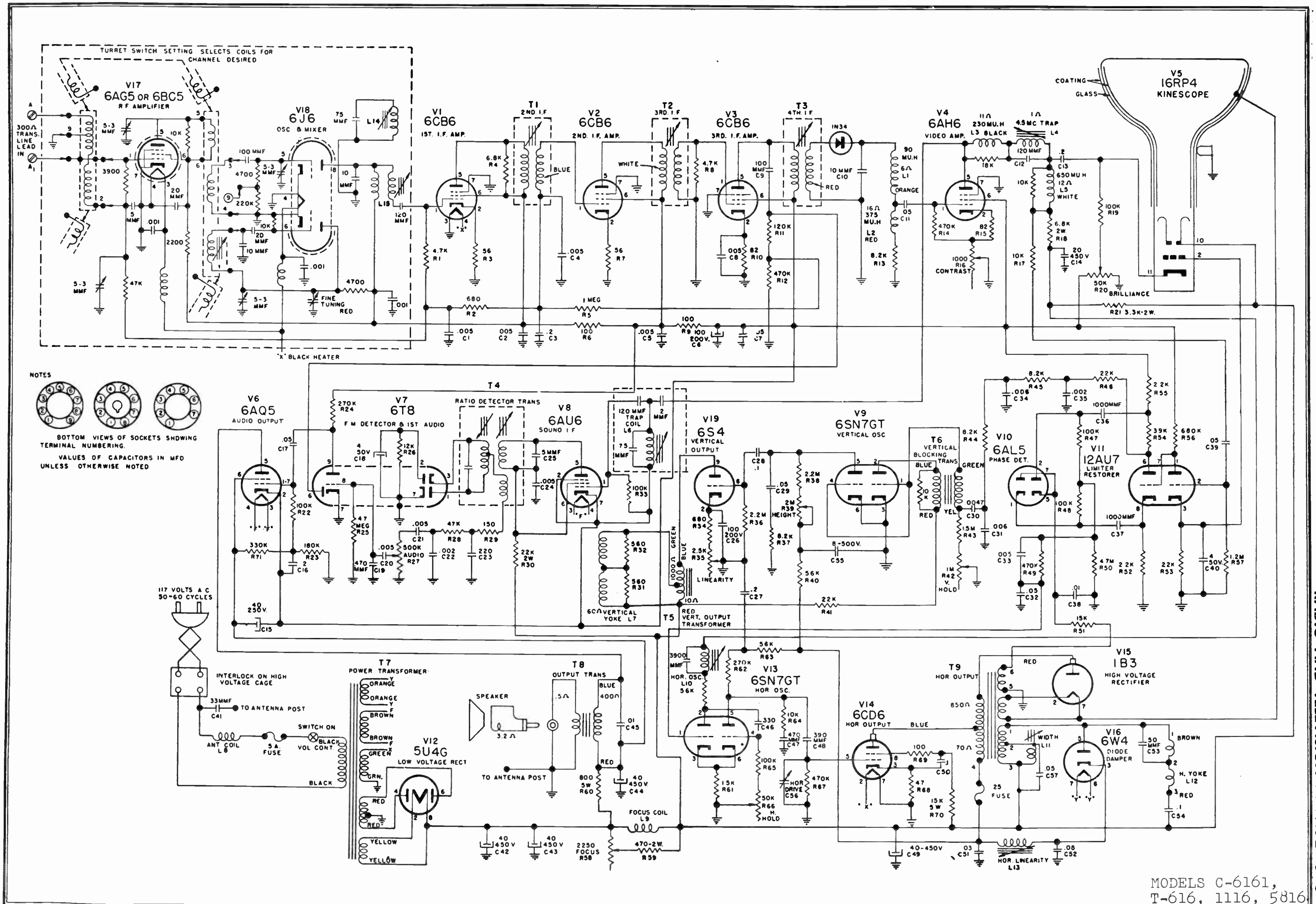

MODELS C-6161, T-616, 1116, 5816

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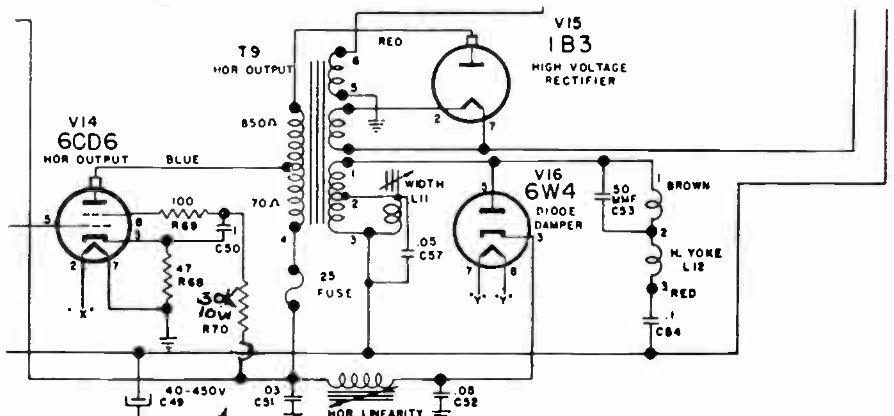
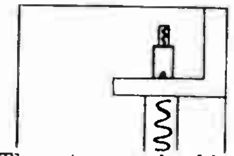
The following improvements are suggested to be incorporated in existing models 616, 6161 and 1116 rectangular tube chassis.
1. Substitute 30,000 (30K) ohm resistors in place of a single 15,000 ohm resistor now in use, as shown below.
2. Dress the AC choke on 1st video I.F. away from any sharp edges on the I.F. shield.
3. Dress the High Voltage lead to the anode connection away from the 5U4 tube.
4. Dress the blue plate lead to the 6CD6 tube away from the width coil.
5. Check all magnets and replace double magnet with single magnet on all bent gun tubes.
6. It has come to our attention that many of these units had been misadjusted as to the setting of the horizontal drive screw in the field by various technicians. The following is an outline of the procedure which must be properly adhered to, to gain the utmost from this unit.
a. The horizontal drive screw should be tightened and then turned counter clockwise until the white bar appears on the screen. When this bar appears the screw should then be turned clockwise approximately 1/4" of a turn until this bar disappears. Once this setting is achieved, the horizontal drive screw should not be touched to adjust the linearity or width. The width coil and the linearity coil which are located on the chassis will be adequate to make any such adjustments.

IT IS IMPERATIVE THAT THIS HORIZONTAL DRIVE SCREW IS NOT TO BE USED TO ADJUST THE LINEARITY OR WIDTH.



NOTE CHANGE

SUBJECT: REPLACEMENT OF HIGH VOLTAGE TRANSFORMER T-9 (80-263)
The following are the methods proposed to substitute the new type transformer for the old in models 616, 6161, and 1116.
1. Present transformer to be removed from the chassis, disconnecting all leads.
2. The screen resistor on 6CD6 (R70) to be removed from chassis.
3. Place black lead from unmarked terminal to the same point where the previous black lead was connected.
4. Place green lead from lug #6 to same point as previous green lead was connected. (Pin 6 of 6CD6).
5. Place orange lead from lug #7 to same point as previous orange lead B+ supply.
6. Place red lead from lug #4 to pin #5 on 6W4 only. (remove wire from yoke previously connected to pin #5 and place on empty pin #4 on 6W4)
7. Place white and black lead from lug #5 to the pin #4 (6W4) on which you had previously connected the red wire from yoke.
8. Install a resistor (82,000 to 100,000 ohm 3 w) from the boosted B supply (yellow lead coming out from the fuse to the terminal strip) to the screen on the 6CD6 (before the 100 ohm resistor) pin 1 being used as a tie point.
9. Place a 470,000 1/2 w resistor across the 8 mfd. 500 volt condenser (C55) on the vertical height control.
10. It is extremely important that the width coil bracket be mounted with the base of the bracket placed down in the high voltage compartment as shown:



to give you longer leads. The top winding is to be soldered to lug #6. The bottom winding to lug #7. Be extremely careful to dress these leads away from the blue plate of the 6CD6 and the Carona ring.
11. Place yellow lead from lug #1 to the fuse.

ALTERNATE TUBES FOR VIDEO AMPLIFIER STAGE

The 6AH6 Video Amplifier tube (V4) may be replaced by either a 6AC7 or a 6CB6. When either tube substitution is made, coils L3 and L5 must be changed as well as the socket wiring. When the 6CB6 is used, resistor R15 must be changed in addition to the coil. The 6AC7 requires a tube socket change.

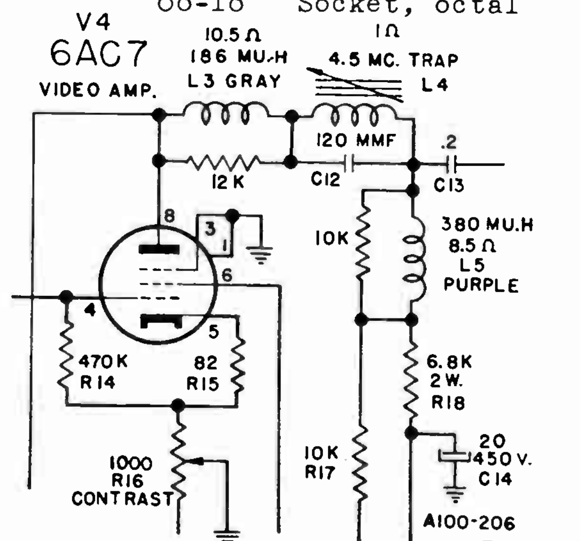
SUBSTITUTION OF THE 6AC7

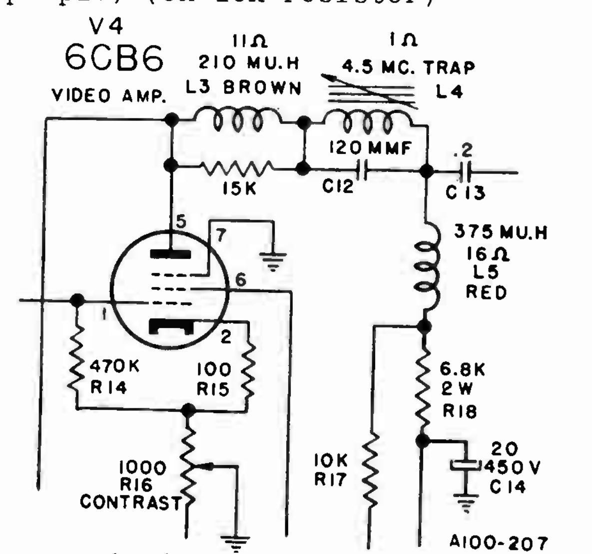
Remove:

L3	10-559	Coil, peaking, 230 uh (black)(on 18K resistor)
L5	10-548	Coil, peaking, 650 uh (white) (on 10K resistor)
	68-49	Socket, miniature, 7 pin

Add:

L3	10-566	Coil, peaking, 186 uh (gray) (on 12K resistor)
L5	10-565	Coil, peaking, 380 uh (purple) (on 10K resistor)
	68-18	Socket, octal





SUBSTITUTION OF THE 6CB6

Remove:

L3	10-559	Coil, peaking, 230 uh (black) (on 18K resistor)
L5	10-548	Coil, peaking, 650 uh (white) (on 10K resistor)
R15	60-776	Resistor, carbon, 100 ohm, 1/2 w. 10%

Add:

L3	10-567	Coil, peaking, 210 uh (brown) (on 15K resistor)
L5	10-558	Coil, peaking. 375 uh (red)
R15	60-752	Resistor, carbon. 100 ohm, 1/2 w. 10%

ALTERNATE TUBES FOR No. 3 I F STAGE

The 6CB6 I F Amplifier Tube may be replaced by a 6AG5. When this substitution is made, the ground connection on pin 7 of the socket will be removed.

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MODELS 19C31, 19C36, 19D31, 19D36, 17HD31, 17HD36

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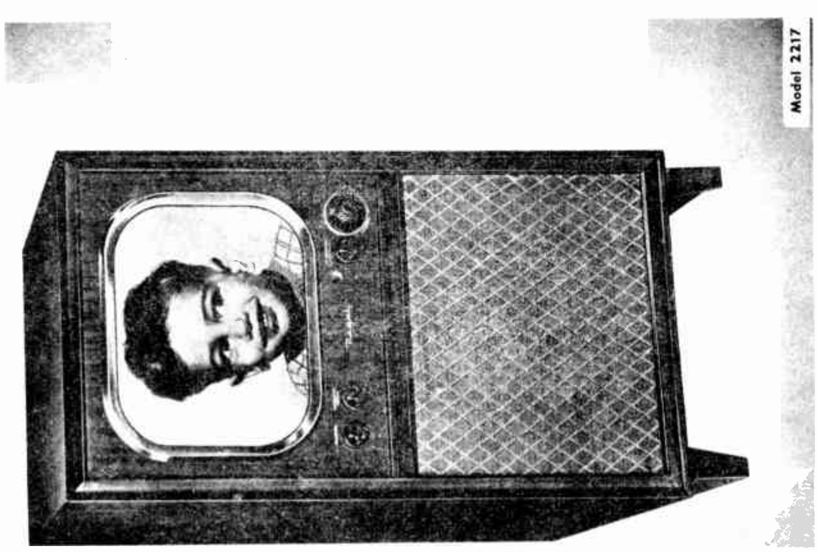
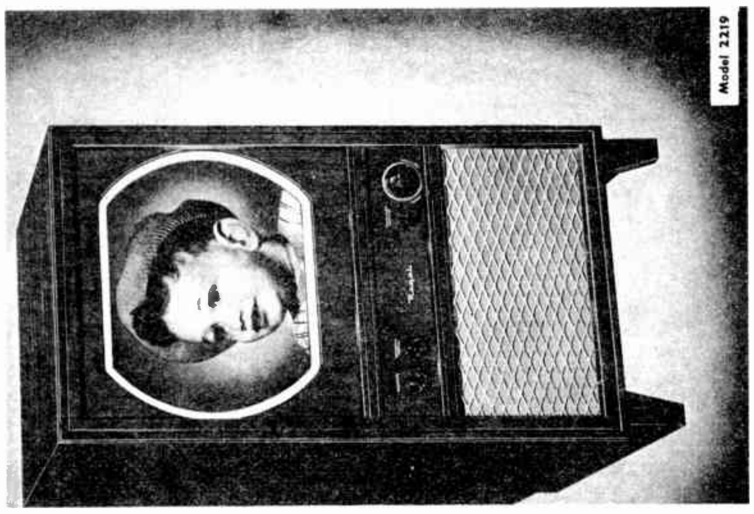
MODELS 17T22, 1708, 22D17, 2217, 22D19, 2219

Model 17T22



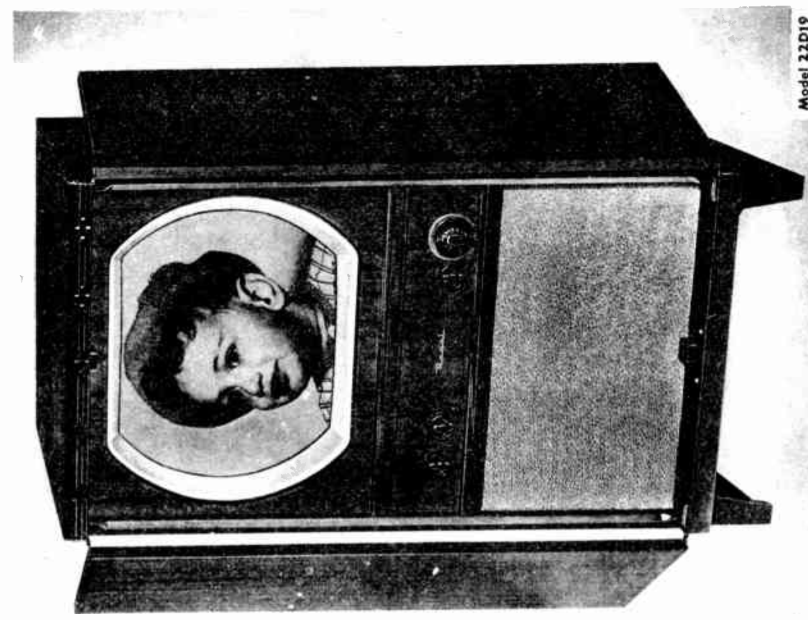
Model 2217



Model 2219

Model 1708

Model 22D17



Model 22D19

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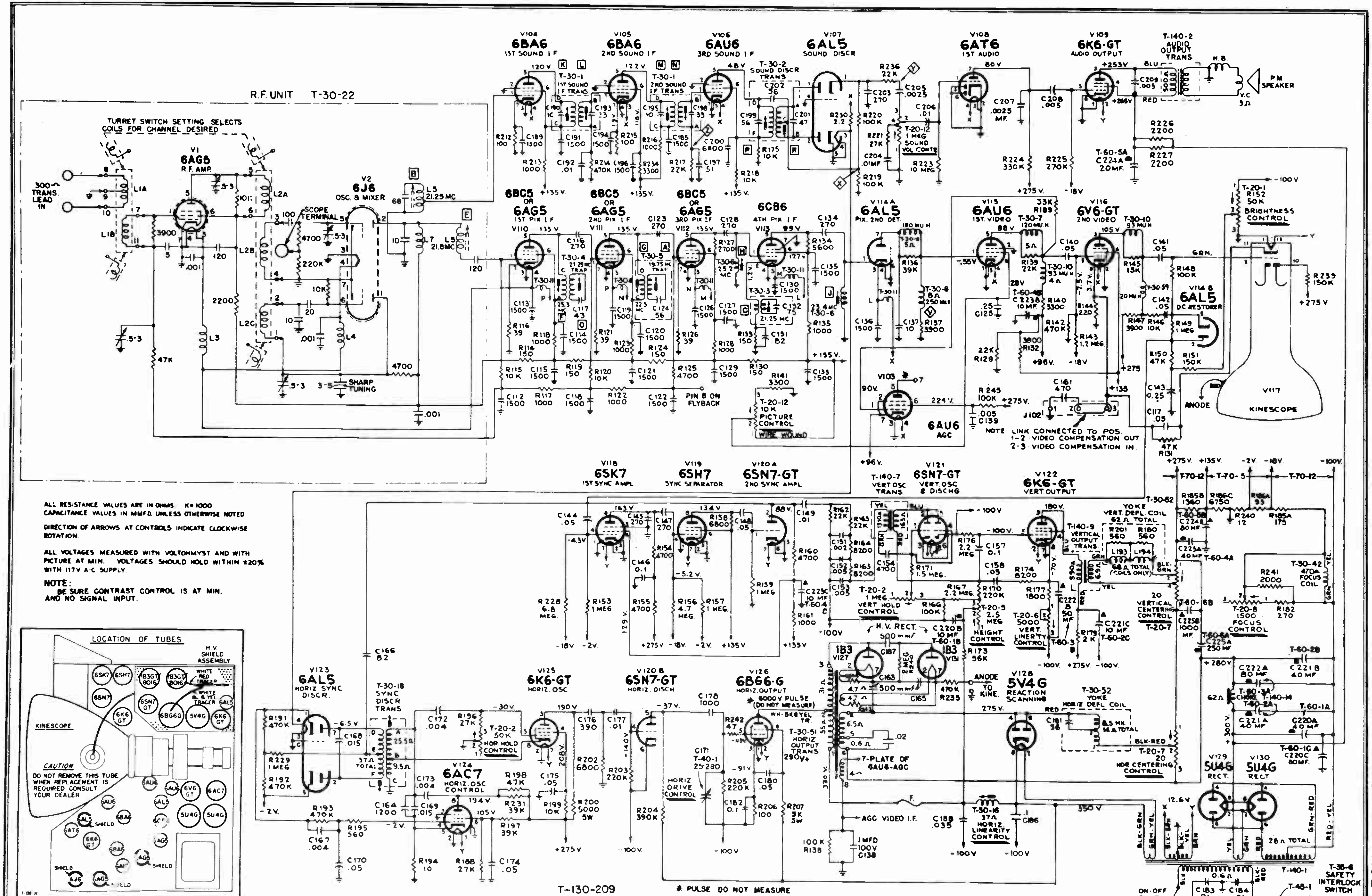

NOTE:- For additional service data, See RCA Model 630TS, Pgs. *1-76 to *1-116.

MODELS 19C31, 19D31, Ch. 1931; 19C36, 19D36, Ch. 1936; Code 51

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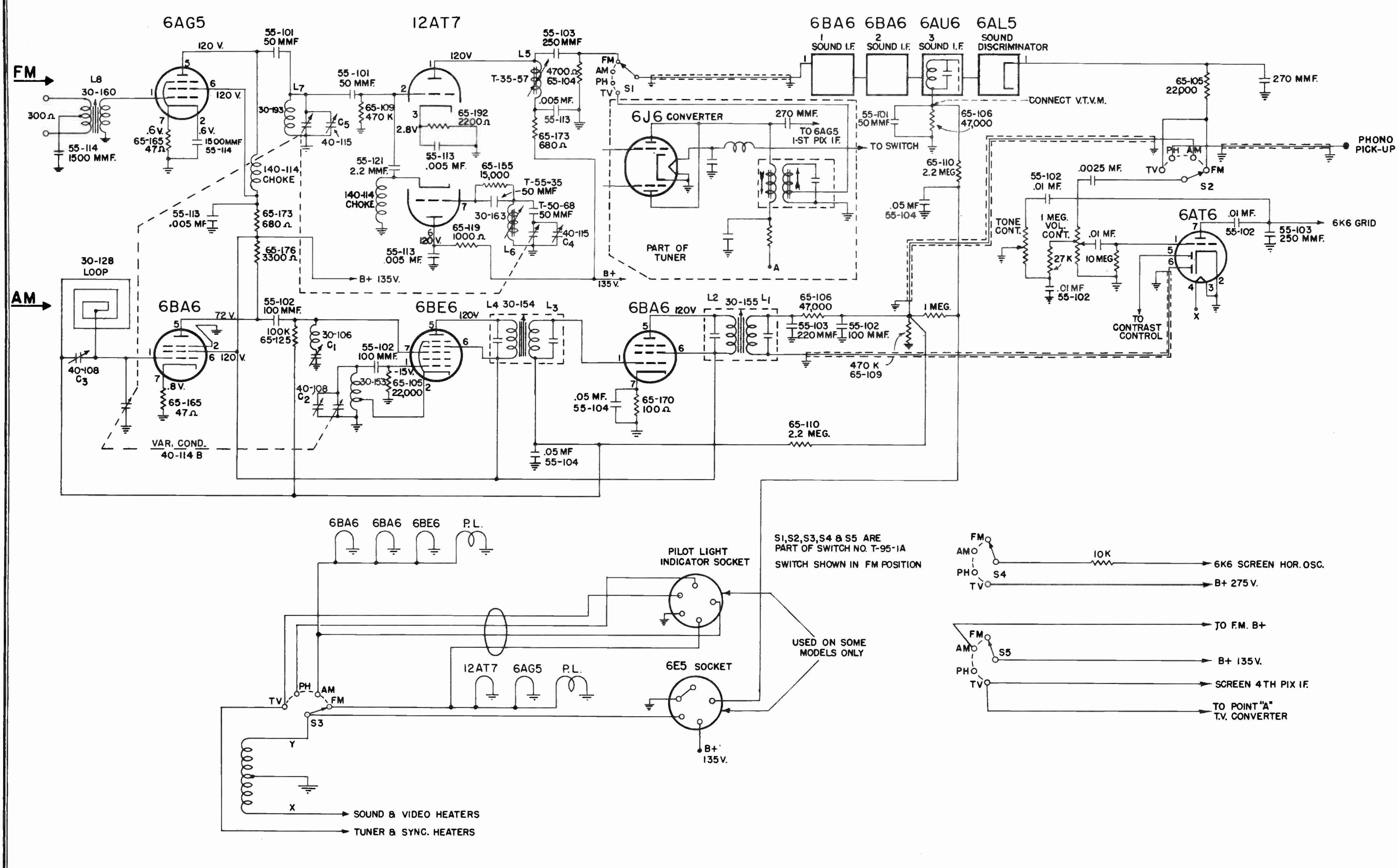
AM-FM-TUNER



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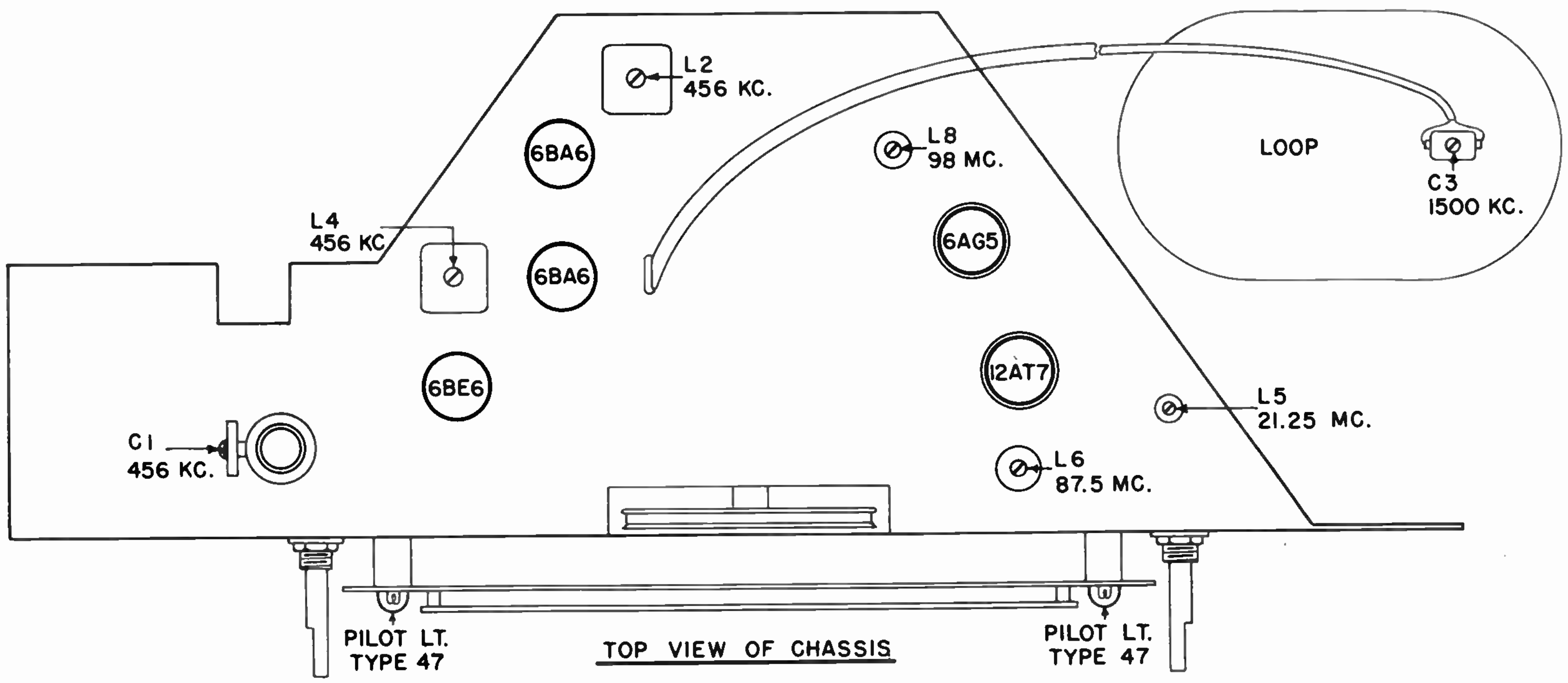
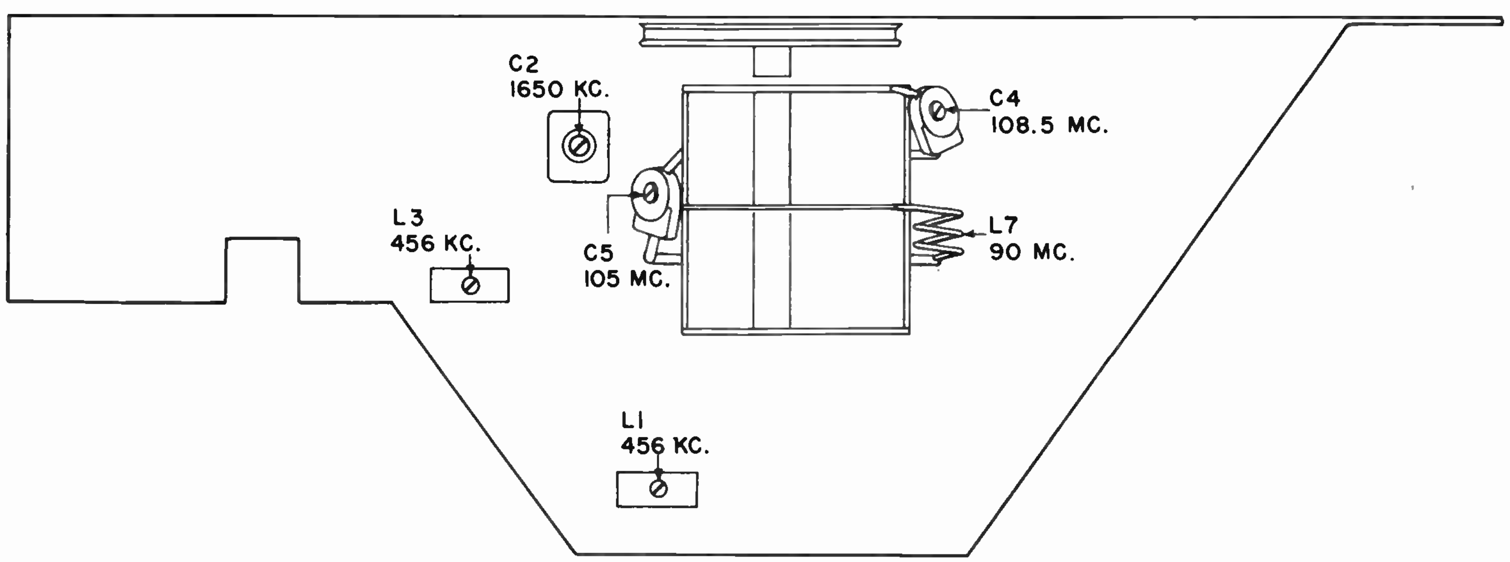
TUBE LAYOUT



TOP VIEW OF CHASSIS



INSIDE VIEW OF CHASSIS

ALIGNMENT PROCEDURE FOR AM-FM TUNER

A.M. ALIGNMENT: SELECTOR SWITCH IN A.M. POSITION. VOLUME CONTROL IN MAXIMUM. LOW RANGE A.C. VOLTMETER CONNECTED ACROSS VOICE COIL TO INDICATE OUTPUT. KEEP SIGNAL GENERATOR ATTENUATED TO MAINTAIN $\frac{1}{2}$ SCALE READING ON OUTPUT METER.

	RECEIVER FREQUENCY	SIGNAL GENERATOR FREQUENCY	SIGNAL GENERATOR IN SERIES WITH	SIGNAL GENERATOR CONNECTED TO	REFER TO CHASSIS LAYOUT FOR TRIMMER LOCATION
1	VARIABLE CONDENSER FULLY OPEN	456 KC	.05 MF CONDENSER	STATOR (RF) A.M. SECTION VARIABLE CONDENSER	ADJUST L1, L2, L3, & L4 FOR MAXIMUM OUTPUT
2	" "	456 KC	" "	" "	ADJUST C1, FOR MINIMUM OUTPUT
3	" "	1650 KC	" "	RADIATING LOOP $\frac{1}{2}$ METER (20") FROM RECEIVER LOOP	ADJUST C2, FOR MAXIMUM OUTPUT
4	APPROX. 1500 KC	APPROX. 1500 KC	" "	" "	ADJUST C3, FOR MAXIMUM OUTPUT

F.M. ALIGNMENT: SELECTOR SWITCH IN F.M. POSITION. USE ANY STANDARD V.T.V.M. WITH ZERO CENTER, OR REVERSE SWITCH. USE ANY STANDARD F.M. SIGNAL GENERATOR MODULATED 30%- 400 CYCLES, ATTENUATE SIGNAL GENERATOR TO MAINTAIN $1\frac{1}{2}$ VOLT READING ON V.T.V.M.

	RECEIVER FREQUENCY	SIGNAL GENERATOR FREQUENCY	SIGNAL GENERATOR CONNECTED TO:	CONNECT V.T.V.M. TO	REFER TO CHASSIS LAYOUT FOR TRIMMER LOCATION
1	VARIABLE CONDENSER FULLY OPEN	* 21.25 M.C.	CONTROL GRID PIN 2 12AT7 SOCKET THRU .01 CONDENSER	BOTTOM OF 3 I.F (SOUND) TRANS. ON TV CHASSIS AS INDICATED ON SCHEMATIC.	ADJUST L5 FOR MAXIMUM INDICATION ON V.T.V.M
2	" "	108.5 M.C.	F.M. ANT. TERM. IN SERIES WITH 2–150 Ω $\frac{1}{2}$ W. CARBONS	" "	ADJUST C4 F.M. OSC. TRIMMER TO PICK UP THIS FREQUENCY
3	APPROX. 105 MC	APPROX. 105 MC	" "	" "	ADJUST C5 FOR MAXIMUM INDICATION ON V.T.V.M WHILE ROCKING VARIABLE
4	FULLY CLOSED	87.5 MC	" "	" "	ADJUST L6 TO BRING IN THIS FREQUENCY
5			" "	" "	REPEAT STEPS 2 & 4 UNTIL OSC. RANGE COVERS 87.5 TO 108.5 MC
6	APPROX. 90 MC	APPROX. 90 MC	" "	" "	ADJUST L7 FOR MAXIMUM INDICATION ON V.T.V.M.
7			" "	" "	REPEAT STEPS 3 & 6 UNTIL NO FURTHER ADJUSTMENT IS NECESSARY
8	APPROX. 98 MC	APPROX. 98MC	" "	" "	ADJUST L8 FOR MAXIMUM INDICATION ON V.T.V.M
9	"	"	" "	" "	CHECK L7 FOR TRACKING & MAKE SLIGHT ADJUSTMENT IF NECESSARY

*A STANDARD A.M. GENERATOR MAY BE USED AT THIS POINT.

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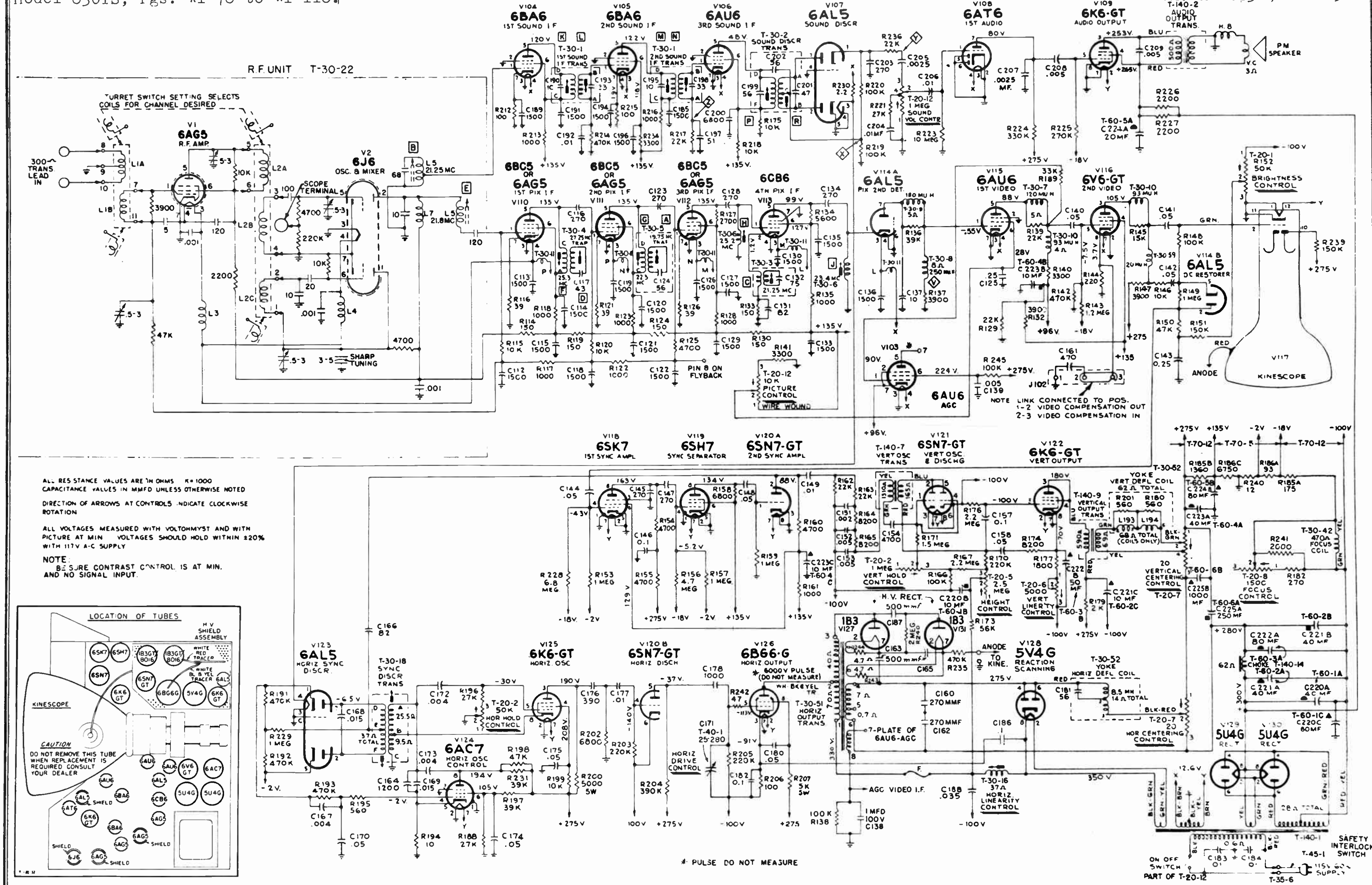
NOTE:- For Service Data, See RCA Model 630TS, Pgs. *1-76 to *1-116.

MODELS 17HD36; 17HD31, Ch. A-16T31; Code 51



T-130-13

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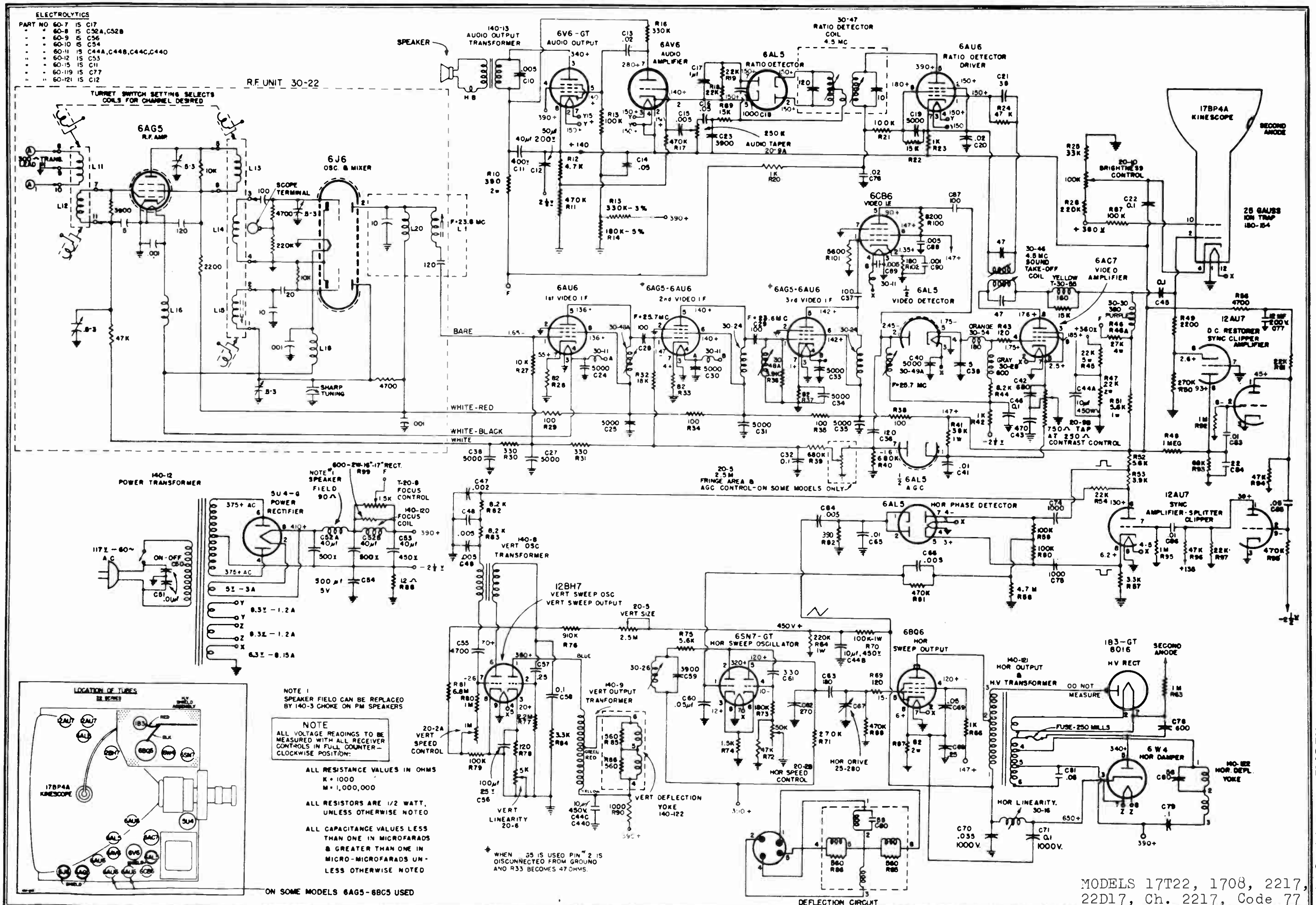

MODELS 17T22, 1708, 2217, 22D17, Ch. 2217, Code 77

REGAL TV PAGE 6-7

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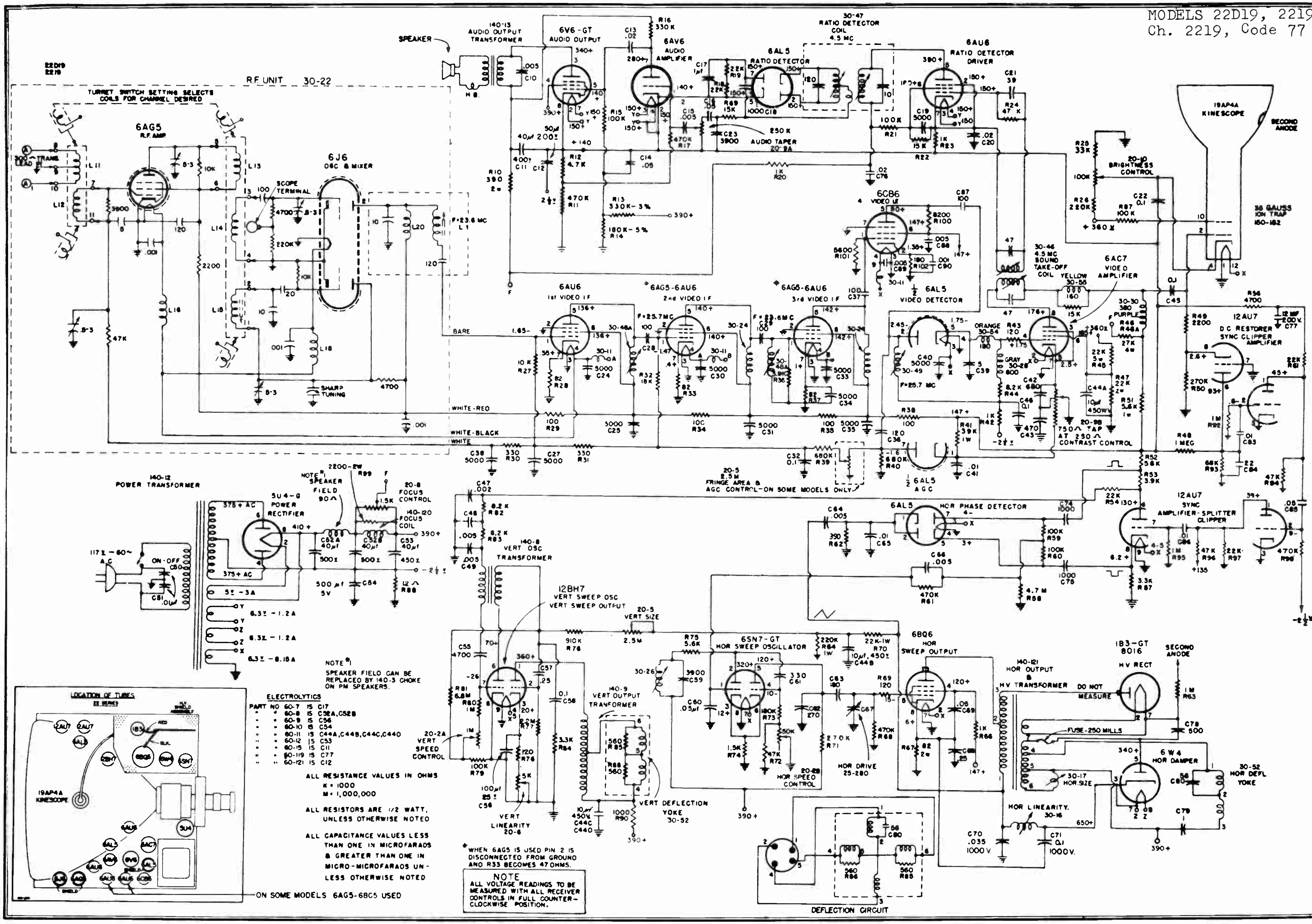
MODELS 22D19, 2219, Ch. 2219, Code 77



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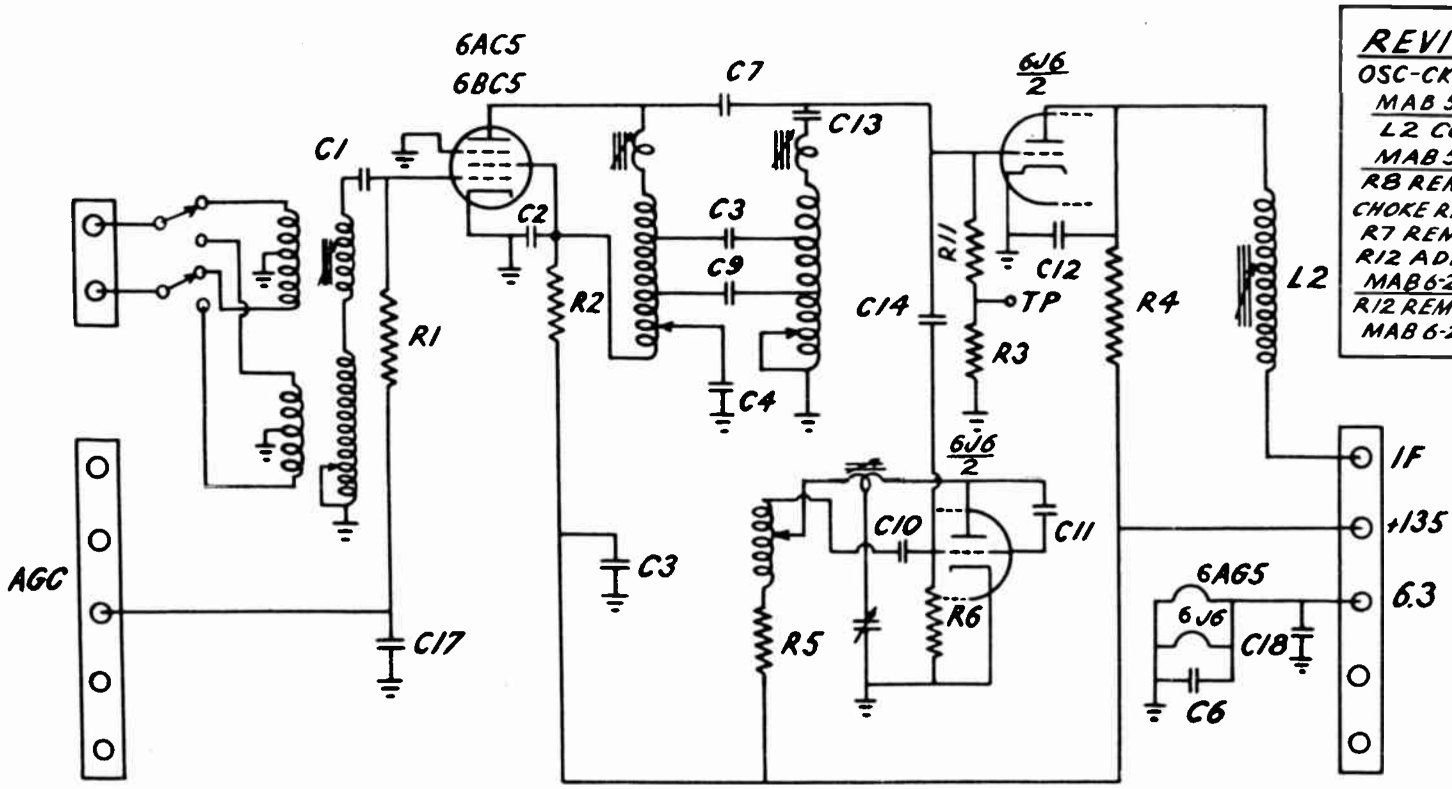
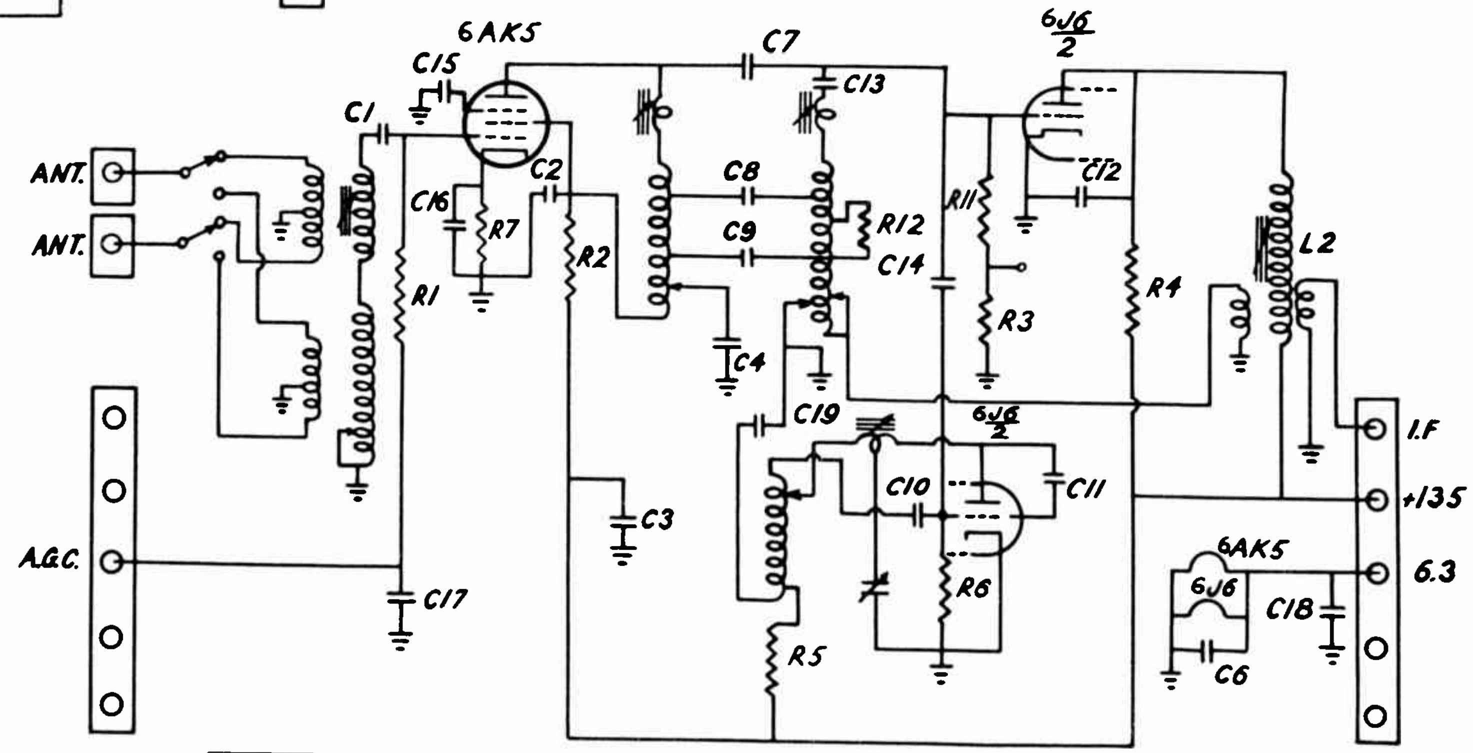


REVISIONS
OSC-CKT CORR. MAB 5-5-50 ①
L2 CORR. MAB 5-8-50 ②
R8 REMOVED
CHOKE REMOVED
R7 REMOVED
R12 ADDED
MAB 6-22-50 ③
R12 REMOVED
MAB 6-28-51 ④

TT3A
SCHEMATIC
SARKES TARZIAN
DWG Nº 1847



REVISIONS:
R8 REMOVED, R12 & C19
ADDED, MAB 6-14-50 ①

TT3B
SCHEMATIC
V9886
SARKES TARZIAN
DWG. Nº 1836

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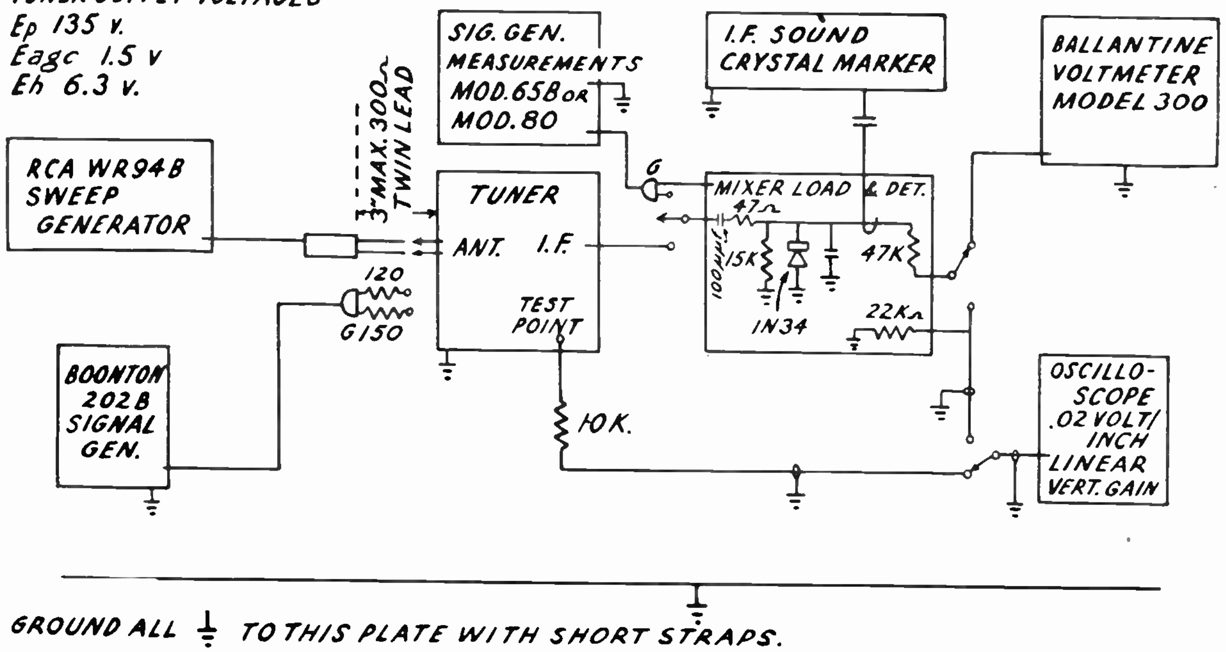
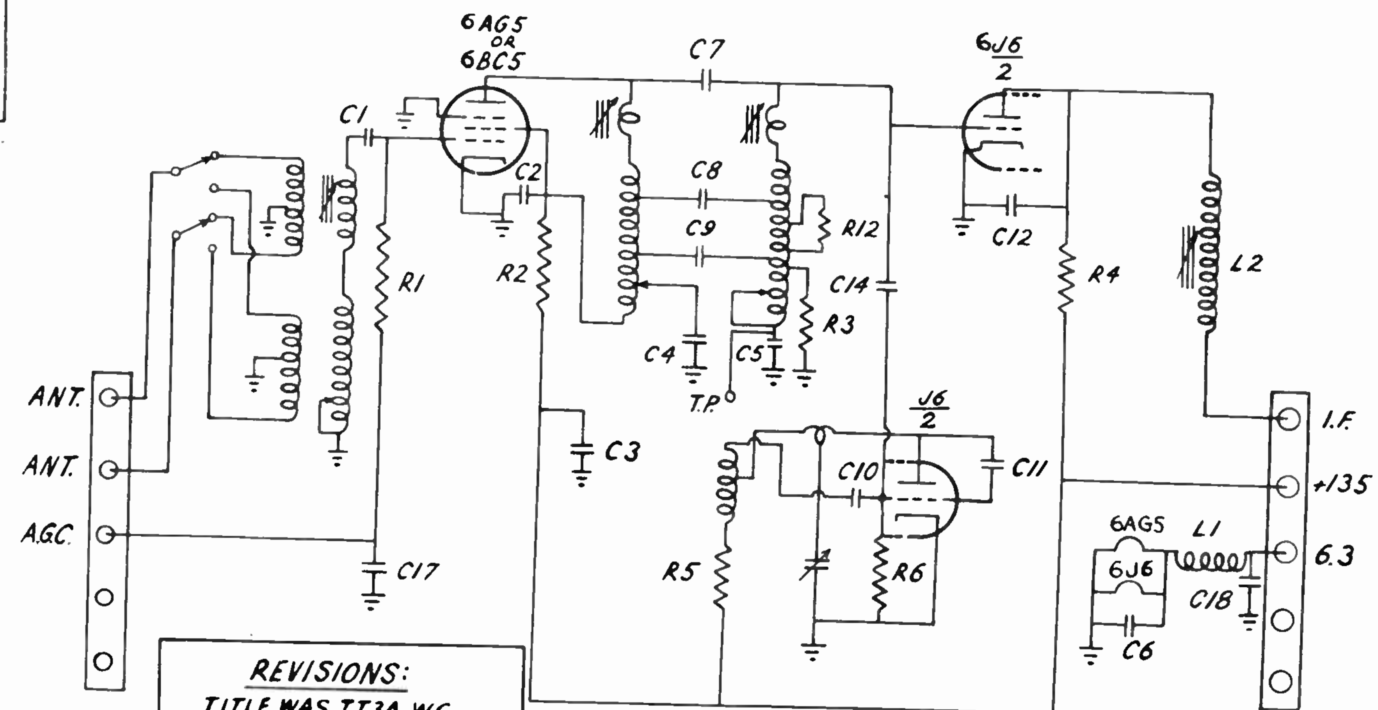
TUNER SUPPLY VOLTAGES
Ep 135 v.
Eagc 1.5 v
Eh 6.3 v.



GROUND ALL ⏚ TO THIS PLATE WITH SHORT STRAPS.

NOTE: CHECK ALL WIRING & LAYOUT FOR RESONANCE WHICH MAY AFFECT TUNER RESPONSE; SERIES RESISTORS AND/OR CHOKES MAY BE NECESSARY AT SOME POINTS UNTIL TUNER PERFORMANCE IS UNAFFECTED BY LEAD AND/OR HAND PLACEMENT OR MOVEMENT.
CHECK FOR HUM AND SPURIOUS SIGNALS PICK-UP.

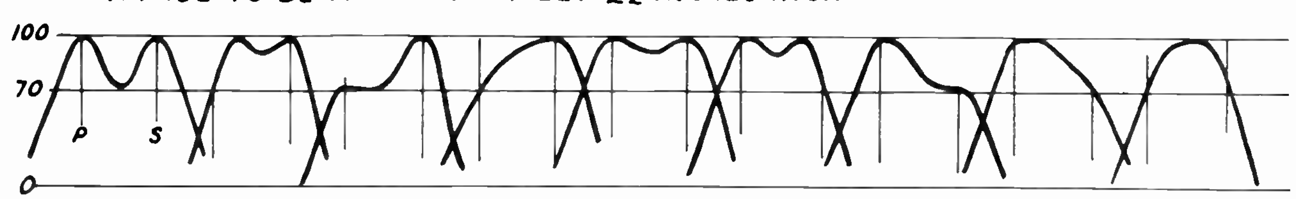
TUNER TEST & ALIGNMENT SET-UP
SARKES TARZIAN
DWG Nº 1862



REVISIONS:
TITLE WAS TT3A WC.
C18 ADDED MAB 4-26-50 ①
25C CKT CORR MAB 5-5-50 ②
R8 REMOVED R12 ADDED MAB 6-14-50 ③
R10 REMOVED (CORR) MAB 6-16-50 ④
R7 REMOVED MAB 8-7-50 ⑤

TT3X
SCHEMATIC
SARKES TARZIAN
DWG. Nº 1828

BAND PASS RESPONSE TEST;
COVER MUST BE ON (UNLESS OTHERWISE SPECIFIED)
WARM-UP TIME - 1 MINUTE MINIMUM
SET VERNIER AT CENTER OF RANGE
ALIGN I.F. TRANSFORMER AT 23-24 MC.
IMAGE TO BE APPROXIMATELY 2½ INCHES HIGH



ACCEPTABLE BAND PASS RESPONSES AT TEST POINT

TUNER PERFORMANCE DATA
DWG Nº 1862

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INDEX

GENERAL DESCRIPTION

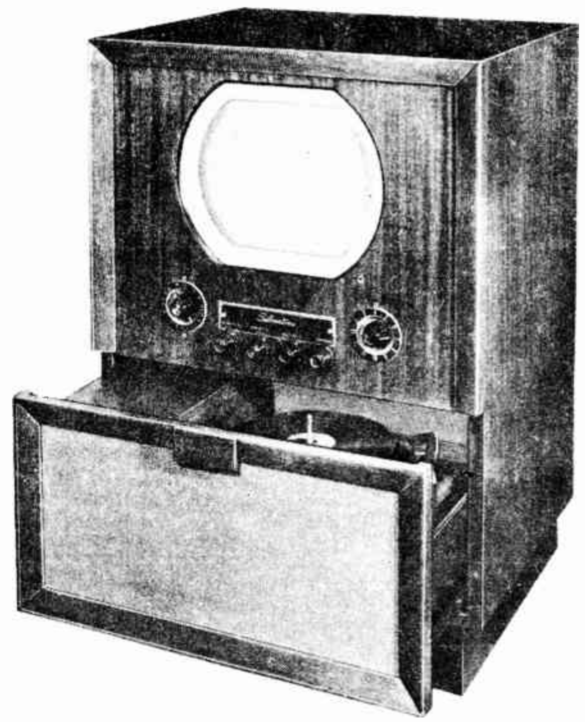
The information contained in this service RL covers the catalog 133 except for the record changer. Refer to 57 RL 539 for service information on the 100.211-20 intermix model record changer.

The catalog 133 is a combination, a console type television using Chassis 100.107, AM-FM radio using Chassis 100.043 and record changer 100.211-20. Television Chassis 100.107 utilizes twenty-two tubes solely for reproduction of the visual and aural portions of the television broadcast. The AM-FM tuner chassis 100.043 employs 5 tubes in specially designed, high sensitivity AM-FM receiver circuits. A heavy duty transformer and three rectifiers tubes, located on the 101.107 chassis, provide power for operation of all stages.

The circuit features of this receiver include a high gain R. F. tuner which is noted for its stability and rugged mechanical construction, an intercarrier sound system which is free from distortion normally caused by oscillator drift, automatic frequency control of horizontal sync system, "keyed" automatic gain control, and retrace line suppression. Exceptional sensitivity is achieved by a thoroughly stable and A.G.C. controlled R. F. amplifier and four stages of I. F. amplification followed by a two stage broad-band video amplifier. Another important feature is the compactly designed and tunable built-in antenna.

Remarkable picture stability and immunity to external interference are achieved by use of the new "keyed"type of A.G.C. system which also minimizes the "flutter"effect caused by passing airplanes.

Suppression of retrace lines by an ingenious circuit arrangement further contributes to ease operation of the receiver. This highly desirable performance feature permits a wide variety of picture brightness and contrast control settings without appearance of retrace lines.



Another feature provides for illumination of indicator lights to indicate the section of the receiver that is in use. The light above the channel number escutcheon is illuminated when receiver is being used for TV operation. When using the AM radio, a light below the dial scale turns on and when the FM radio is in use the light above the dial scale will glow. Another light located at the base of cabinet is always on whenever any part of the receiver is in use and is the only one lit when the record changer is being used.

Orderly and well spaced arrangement of all components on a generously proportioned chassis pan permits easy access to all circuits for measurements and analysis.

SPECIFICATIONS

POWER REQUIREMENTS

117 Volts 60 Cycles
Television-------------------------- 220 Watts
AM-FM Radio------------------------ 145 Watts
Phonograph------------------------- 160 Watts

FREQUENCY RANGE

Television---channels 2 through 13. For channel frequencies, see table on page 3.

Radio
Standard Broadcast (AM)--------- 540-1600 KC.
Frequency Modulation (FM)------- 88-108 MC.

PICTURE SIZE

Height	Width (at widest point)	Viewing Area (sq. inches)
9"	11"	91.6

SPEAKER

Type	Size	V.C. Imped.
P.M. Dynamic	6"x 9"	3.2 ohms

ANTENNA INPUT IMPEDANCE

72 ohms

BUILT-IN ANTENNA

High "Q" dipole with tunable matching stub.

R. F. TUNER

Fixed coil and selector switch type construction. All components are easily accessible for servicing

"KEYED" AUTOMATIC GAIN CONTROL

Outstanding new development; minimizes "airplane flutter"; reduces contrast variation when changing from one channel to another; increases immunity of sync system to external interference.

INTERMEDIATE FREQUENCIES

AM Sound-------------------------- 455 Kc.
FM Sound-------------------------- 10.7 Mc.
TV Sound Carrier------------------ 22.25 Mc.
Picture Carrier-------------------- 26.75 Mc.

I. F. SYSTEM

AM--- One stage (two tuned transformers)
FM--- Two stage (three tuned transformers)
TV --- Four stage (stagger tuner) for composite signal and two additional stages for intercarrier sound.

HORIZONTAL SYNCHRONIZATION

Automatic frequency control and "keyed" A.G.C. provide excellent picture stability and noise immunity.

VIDEO AMPLIFIER

Two Stage — broad band.

RETRACE LINE SUPPRESSOR

Eliminates retrace lines thruout the normal range of picture brightness and contrast.

FOCUS	DEFLECTION
Magnetic	Magnetic

HIGH VOLTAGE POWER SUPPLY

"Fly-back"type. Completely enclosed in a shielded compartment. Removal of H. V. compartment cover automatically opens interlock to disconnect receiver power cord.

SENSITIVITY

Antenna to Picture Tube Grid Sensitivity—To make this measurement, connect negative terminal of $1\frac{1}{2}$ volt battery to A.G.C. line, and positive terminal of battery to chassis. Also, set Contrast control to maximum clockwise position. Connect an A.C. vacuum-tube voltmeter betwen picture tube grid and ground, and place a .005 microfarad condenser across the same points.

Inject R. F. signal (modulated 30% at 400 cycles)at antenna terminals, using signal whose frequency corresponds to the center frequency of the selected channel, and adjust Fine Tuning control for maximum output. Generator must be connected to antenna terminals with a 22 ohm carbon resistor in high side lead to simulate proper impedance match.

Input signal required to produce standard output of 7.07 volts A. C. (r.m.s.) at picture tube grid is indicated in the following table. Since a fixed bias of $1\frac{1}{2}$ volts has been applied to the A.G.C. system in order to provide a reference level for these measurements, it will be understood that the sensitivities specified here are not intended to indicate the full capability of the receiver, but merely serve as a convenient basis for determining proper operation.

Low Band	Average — 25 microvolts	Range — 10 to 40 microvolts
High Band	Average — 40 microvolts	Range — 20 to 80 microvolts

Detector to Picture Tube Grid Sensitivity — To make this measurement, remove 6AU6, 4th Video I. F. tube (V - 10) and set Contrast contol to maximum clockwise position. Inject a 400 cycle (audio) signal across 6800 ohm video detector load resistor. In order to produce the standard output of 7.07 volts A C. (r.m.s.) at the picture tube grid, the input signal at the detector load resistor will be approximately .07 volts A. C An A. C. vacuum-tube voltmeter must be used for these voltage measurements.

Television Sound System Sensitivity —Inject 4.5 megacycle frequency modulated signal (400 cycle modulation with $7\frac{1}{2}$ Kc. deviation) across video detector load resistor and measure output at speaker voice coil. An input of 2200 microvolts will produce approximately 500 milliwatts or 1.26 volts across speaker voice coil.

A.M. Sound System Sensitivity —Inject a 1000 Kc. signal (modulated 30% at 400 cycles) at (high side) connection lug on antenna section of gang condenser Connect generator to this point through a .01 microfarad condenser. Tune receiver to 1000 Kc. signal. An input of 75 microvolts will produce approximately 500 milliwatts or 1.26 volts across the speaker voice coil.

F.M. Sound System Sensitivity—Inject a 98 megacycle frequency modulated signal (400 cycle modulation with $22\frac{1}{2}$ Kc. deviation) at pin 8 of 12AT7, F.M. R.F. Amplifier tube (V-26). Connect generator to this point through a 300 ohm resistor. Tune receiver to 98 Mc. signal. An input of 35 microvolts will produce approximately 500 milliwatts or 1.26 volts across speaker voice coil.

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TUBE COMPLEMENT

TUBE NO.	TUBE TYPE	FUNCTION
		TELEVISION CHASSIS (25 Tubes, Including Rectifiers)
V1	6AU6	1st Sound I. F. Amplifier (TV)
V2	6AU6	2nd Sound I. F. Amplifier — Limiter (TV)
V3	6T8	Dynamic Limiter — Sound Discriminator — Sound Amplifier
V4	6V6GT	Sound Output
V5	6AG5	R. F. Amplifier
V6	6J6	Oscillator — Mixer
V7	6AU6	1st I. F. Amplifier (TV)
V8	6AU6	2nd I. F. Amplifier (TV)
V9	6AU6	3rd I. F. Amplifier (TV)
V10	6AU6	4th I. F. Amplifier (TV)
V11	6AL5	Detector — D. C. Restorer
V12	6AU6	Video Amplifier
V13	6C4	Cathode Follower
V14	6K6GT	Video Output
V15	12LP4	Picture Tube
V16	6AU6	Keyer A. G. C.
V17	12AU7	Sync Clipper — Phase Splitter
V18	6AL5	Horizontal A.F.C. — Phase Detector
V19	12AU7	Horizontal Scanning Multivibrator
V20	6BG6G	Horizontal Scanning Output
V21	1B3/8016	High Voltage Rectifier
V22	6W4GT	Horizontal Damping
V23	6X5GT	Rectifier
V24	5U4G	Rectifier
V25	6SN7GT	Vertical Blocking Oscillator — Vertical Scanning Output
		AM-FM TUNER CHASSIS (5 Tubes)
V26	12AT7	(FM) R. F. — (FM) Mixer
V27	6BE6	(AM) Mixer — Oscillator (FM) Oscillator
V28	6BA6	1st I. F. Amplifier (AM-FM)
V29	6BA6	(FM) 2nd I. F. Amplifier — (AM) Detector — A. V. C.
V30	6AL5	Discriminator — A. V. C.

TELEVISION CHANNELS & FREQUENCIES

CHANNEL NO.	FREQ. MC.	PICTURE CARRIER MC	SOUND CARRIER MC	HETERODYNE OSC. FREQ. MC
2	54 - 60	55.25	59.75	82.00
3	60 - 66	61.25	65.75	88.00
4	66 - 72	67.25	71.75	94.00
5	76 - 82	77.25	81.75	104.00
6	82 - 88	83.25	87.75	110.00
7	174 - 180	175.25	179.75	202.00
8	180 - 186	181.25	185.75	208.00
9	186 - 192	187.25	191.75	214.00
10	192 - 198	193.25	197.75	220.00
11	198 - 204	199.25	203.75	226.00
12	204 - 210	205.25	209.75	232.00
13	210 - 216	211.25	215.75	238.00

CIRCUIT DESCRIPTION

This receiver is a complete home entertainment unit featuring television, AM and FM reception and equipped with a three-speed intermix record changer capable of playing all of the latest type records now on the market.

The television chassis (100.107) incorporates 24 tubes (including three rectifiers), plus a $12\frac{1}{2}$" cathode-ray tube (type 12LP4), and the auxiliary AM-FM tuner chassis (100.043) contains 5 additional tubes. Electrical connections of the AM-FM tuner to the TV chassis are effected by a 3 prong plug for the power supply and a single prong plug for output to the audio system of the TV chassis.

Selection of the desired type of reception is accomplished by properly positioning the Band Switch. This switch is composed of two separate sections, joined by a lever and link assembly. One switch section is located in the TV chassis and the other section is in the AM-FM tuner. The section in the TV chassis switches B+ and filament voltages, and also switches the audio amplifier on the TV chassis into the appropriate circuit. The section in the AM-FM tuner switches circuits in that tuner for either AM or FM reception.

With the Band Switch in the "TV" position, B+ voltage is applied to all tubes and filament voltage to only those tubes in the TV chassis.

With the Band Switch in the PHONO position, filament voltage is applied to all tubes in the TV chassis only, with the exception of the 6AG5 R.F. Amplifier tube (V-5), 6J6 Mixer-Oscillator tube (V-6), and 6BG6G Horizontal Scanning Output tube (V-20). Certain B+ voltages have been removed from circuits in the TV chassis and the input of the audio amplifier circuit is switched to the output of the record changer.

With the Band Switch in the "AM" position, filament voltage is applied to all tubes in the AM-FM tuner and all tubes in the TV chassis with the exception of the 6AG5 R.F. Amplifier tube (V-5), 6J6 Mixer-Oscillator tube (V-6), and 6BG6G Horizontal Scanning Output tube (V-20). B+ voltages have been removed from certain circuits in the TV chassis and plate voltage is applied effectively to only those tubes or sections of tubes in the AM-FM tuner used for AM operation.

With the Band Switch in the "FM" position, filament voltages are the same as with Band Switch in "AM" position. Certain B+ voltages have been removed from circuits in the TV chassis and plate voltage is applied to all tubes in the AM-FM tuner.

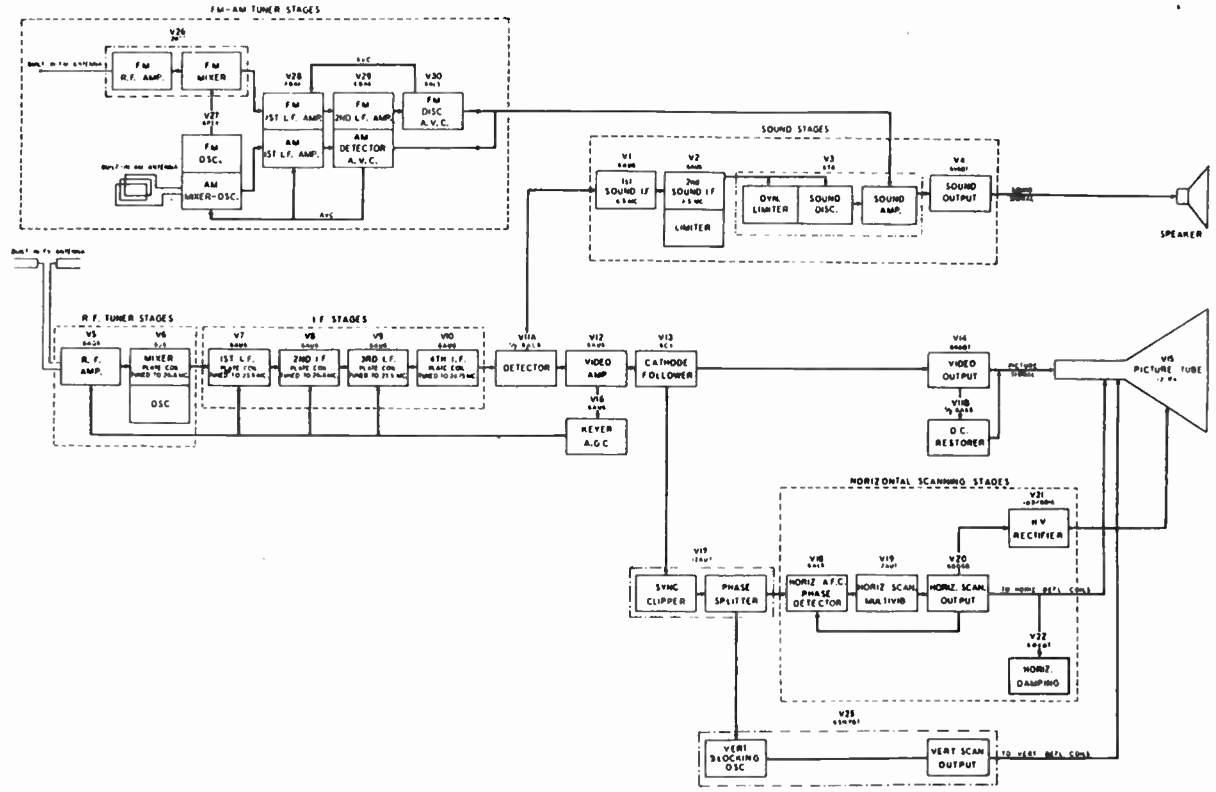

FIG. 1 BLOCK DIAGRAM

CIRCUIT DESCRIPTION — AM-FM TUNER

This tuner utilizes all 5 tubes for reception of standard FM broadcast signals and 3 tubes for reception of AM signals.

FM RADIO CIRCUIT

With the Band Switch set to the "FM" position, the received frequency modulated signal is fed into the cathode of one triode section of the 12AT7 tube (V-26A) which acts as a grounded grid F.M. R.F. Amplifier. The other triode section of this tube (V-26B) is used for the FM Mixer and its grid circuit is tuned by one section of the gang condenser. The second, third, and fourth grids of the 6BE6 (V-27) are now tied together and this tube is utilized as a triode for the FM oscillator circuit. The FM signal is then fed through 2 transformer-coupled 6BA6 I.F. Amplifiers (V-28 and V-29) which provide good overall selectivity and ease of tuning. A 6AL5 tube (V-30) is used in a ratio type FM discriminator circuit and this stage also provides A.V.C. voltage which is applied to the grid of the first I.F. Amplifier stage. Audio voltage developed in the discriminator stage is fed to the audio socket on the TV chassis. A section of the Band Switch in the TV chassis injects the audio signal across the Volume control. The triode section of the 6T8 (V-3) acts as a Sound Amplifier and is coupled to a 6V6GT (V-4) sound output tube. This stage drives a 6"x 9" P.M. dynamic speaker.

AM RADIO CIRCUIT

When the receiver is set for "AM" reception, the amplitude modulated signal received by the built-in low impedance loop antenna is coupled to the third

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grid of the 6BE6 tube (V-27) through a tuned antenna coupling coil. This tube acts as a Mixer-Oscillator for AM operation, the oscillator section being of the modified Hartley type. The I.F. signal is then fed through one stage of transformer-coupled I.F. amplification using a 6BA6 tube (V-28). The grid and cathode of the second 6BA6 (V-29) are used as a diode for AM detection and development of A.V.C. voltage. A.V.C. is applied to the mixer grid and the grid of the I.F. amplifier stage. Audio voltage developed across the detector load resistor #400 is fed to the audio system in the TV chassis where it is amplified in the same manner as was the detected FM signal.

CIRCUIT DESCRIPTION — TV CHASSIS

R. F. CIRCUITS

This television receiver is equipped with a built-in antenna which is capable of providing satisfactory television reception in areas of adequate signal strength and where reflected signals do not present an abnormal problem. The antenna has been designed so that it may be tuned through the entire television broadcast band by means of a trimmer condenser placed at the end of a stub in the built-in antenna transmission line. An antenna terminal strip provides a ready means of connection of transmission line from an outdoor antenna, if that type of installation is used.

The inductance and amount of coupling of the antenna input coils is changed by switch sections #282A, B, C and D as the Channel Selector switch is rotated in order to maintain a constant input impedance to the receiver of 72 ohms. This provides maximum energy transfer to the R. F. amplifier stage, particularly when interconnection between an outdoor antenna and the antenna terminal strip is made with coaxial cable of the 72 ohm type.

A type 6AG5 tube (V-5) is used for R.F. amplification and the plate circuit of this stage is tuned by varying its inductance. When the Channel Selector Switch is in the channel 2 position, twelve R.F. coils are connected in series, but each time the Channel Selector is advanced to the next channel higher in frequency, one coil is shorted out by switch section #282F.

A similar tuning arrangement is used in the grid circuit of the mixer stage, which utilizes one triode section of a 6J6 tube (V-6B). The other half of the 6J6 (V-6A) is connected as a modified Hartley oscillator which injects oscillator voltage into the mixer stage thru capacity coupling between adjacent terminals of switch sections #282G and #282J. Oscillator tuning is accomplished in the same manner as R.F. plate and mixer grid tuning, with the addition of a fine tuning control condenser in the oscillator plate circuit.

COMPOSITE PICTURE AND SOUND IF CIRCUITS

The I.F. picture and sound signals are taken off at the plate of the mixer stage and pass thru 4 stages of wide-band I.F. amplification using four type 6AU6 tubes (V-7, V-8, V-9, and V-10). A stagger-tuned I.F. system is utilized in this receiver and correct response is obtained by properly positioning the slugs in five plate coils. A sound trap is located in the cathode circuit of the 1st I.F. amplifier stage (coil #103 and condenser #105) and is used to correctly shape the response curve at the sound I.F. carrier frequency.

All I.F. stages contain plate and grid decoupling networks to prevent interaction between stages, and all cathode resistors are unbypassed to improve stability of the I.F. system.

DETECTOR CIRCUIT

Both picture and sound I.F. signals are injected at the cathode of one diode section of a 6AL5 tube (V-11A). This stage detects the video signal and develops a negative-going video voltage across the detector load resistor #139. It also acts as a converter in producing the 4.5 Mc. difference frequency between the 26.75 Mc. video carrier and the 22.25 Mc. sound carrier.

VIDEO CIRCUITS

The video detector output is directly coupled to the grid of the 1st wide-band Video Amplifier, which uses a 6AU6 tube (V-12). This stage amplifies the composite video signal and also acts as a noise limiter. Noise peaks on the negative-going video signal drive the 6AU6 beyond cutoff, and are therefore not present in the plate circuit of this stage.

The composite video signal is coupled to the grid of a 6C4 (V-13) connected as a Cathode Follower. The output is taken off the cathode of this stage and provides a more stable sync signal for control of the horizontal and vertical sweep circuits.

A second stage of wide-band video amplification provides a video signal of sufficient strength to drive the 12LP4 picture tube grid. The Contrast control is located in the cathode circuit of the 6K6GT (V-14) video output stage and effectively regulates the amount of degeneration of this stage.

KEYED A.G.C. CIRCUIT

The plate of the 6AU6 Keyer A.G.C. tube (V-16) returns to ground thru a winding of the Width coil #225 and the A.G.C. load resistor #151, thus plate voltage is applied to this tube only during a horizontal output pulse. During the interval of this pulse, an amount of plate current will flow thru the keyer tube determined by the grid voltage being applied to the tube. Since the grid is directly coupled to the 1st video amplifier plate circuit, the negative voltage developed across the A.G.C. load resistor during keyer tube conduction will vary directly with the amplitude of the signal across the video detector load resistor #139. The time constant of the A.G.C. filter network is approximately .01 seconds, which is high enough to compensate for signal strength fluctuation or "beating" action caused by passing aircraft.

Noise immunity of the circuit is further improved by keeping the grid of the keyer tube biased beyond cutoff at all times except during a positive-going sync pulse.

Filtered A.G.C. voltage is used to control the gain of the R.F. amplifier stage and the first three I.F. amplifier stages.

D.C. RESTORER CIRCUIT

The output of the 1st Video Amplifier contains both a.c. and d.c. components of the composite video signal, but a.c. coupling between this stage and the cathode follower stage results in a loss of the d.c. component. Restoration of this d.c. component must be accomplished just before the video signal is fed into the picture tube in order to maintain the black elements of the picture at a constant level.

One diode section of a 6AL5 tube (V-11B) is used as a D.C. Restorer to develop a positive voltage across resistor #170 which varies with the average level of the negative-going video signal. This bias voltage is fed to the picture tube grid to maintain the proper level of picture brightness.

TV SOUND CIRCUITS

The 4.5 Mc. difference frequency between the 26.75 Mc. video carrier and the 22.25 Mc. sound carrier is separated from the composite video signal at the output of the video detector and fed thru two transformer-coupled stages of sound I.F. amplification using two 6AU6 tubes (V-1 and V-2). The cathodes of these tubes are operated at approximately +160 volts to improve power supply regulation. The 2nd Sound I.F. Amplifier also acts as a grid leak limiter to clip unwanted AM interference.

Further limiting action of the positive portion of the 4.5 Mc. sound signal is accomplished using one diode section of a type 6T8 tube (V-3). The two other diode sections of this tube are connected in a conventional ratio-type Sound Discriminator circuit. This circuit performs the function of converting the constant amplitude FM signal to a varying amplitude audio output. Sound output is thus obtained from an appropriate coupling network connected to the tertiary winding of discriminator transformer #26.

The audio signal is fed thru section #43A of the Band Switch and is coupled to the triode section of the 6T8 tube thru the Volume control. This section of the 6T8 acts as a Sound Amplifier and feeds the audio signal to the 6V6GT (V-4) sound output stage. The output of this stage drives the P.M. dynamic speaker.

COMPOSITE SYNC CIRCUITS

A portion of the composite video signal is removed at the output of the cathode follower stage to control the horizontal and vertical sweep systems. The signal is first injected into the grid of one triode section of a 12AU7 (V-17A) acting as a Sync Clipper. The tube is operated at low plate voltage and is self-biased by grid resistor #188. Plate current flows only when the most positive portion of the video signal is present at the tube grid, namely during the horizontal and vertical sync pulses. Plate current saturation is reached with a further increase in signal, thus clipping the tops of the sync pulses and removing any undesirable interference.

The sync pulses are directly coupled to the grid of the other triode section of the 12AU7 (V-17B) which acts as a Phase Splitter. Positive-going sync pulses are removed at the plate of this tube and negative-going pulses are removed at the cathode. Both types of horizontal sync pulses are used for A.F.C. control while only the positive-going vertical pulses are used in the vertical sweep circuit.

VERTICAL SWEEP CIRCUITS

Positive-going vertical sync pulses from the output of the Phase Splitter are integrated in the Integrator Coupling Unit #262 and are used to control the frequency of a conventional type Blocking Oscillator. This oscillator utilizes one triode section of a 6SN7GT tube (V-25A) and its free-running frequency is determined by the condenser and resistor components (including the Vertical Hold Control) in its grid circuit. The sync pulses are impressed at the tube grid just before the oscillator would normally trigger and are of sufficient amplitude to drive the tube to conduction and cause the oscillator to lock-in at the sync frequency. The output of this stage is controlled by the Height potentiometer.

The Blocking Oscillator drives the other section of the 6SN7GT (V-25B) which is connected as a vertical scanning output stage. Adjustment of vertical linearity is accomplished in the cathode of this circuit by varying bias and thus changing the plate current operating point on the portion of the tube's non-linear characteristic curve. Sawtooth current wave output is applied to the vertical deflection coils thru the Vertical Output transformer #278.

RETRACE LINE SUPPRESSOR CIRCUIT

A portion of the voltage pulse across the vertical deflection coil is reshaped and coupled to the cathode of the picture tube to insure cutoff of the tube during the vertical retrace interval. In this manner, vertical retrace lines ordinarily seen with low Contrast and high Brightness control settings are no longer visible.

HORIZONTAL A.F.C. CIRCUIT

An automatic frequency control arrangement is utilized in this receiver to improve stability of the horizontal sweep system. The two 180° displaced sync pulses from the Phase Splitter are fed to the 6AL5 (V-18) Horizontal A.F.C. Phase Detector. At the same time, a pulse of horizontal output voltage is taken off one side of the Width coil, is reshaped, and its a.c. component is injected into the Phase Detector as a sawtooth wave. Any phase displacement between the feedback sawtooth and the horizontal sync pulses will cause the voltages across the two diode sections to differ. This will result in a d.c. control voltage injected at the Horizontal Scanning Multivibrator grid which will change Multivi-

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brator speed in a direction to bring its frequency "in step" with the incoming horizontal pulses. This bias voltage will be proportional to the amount of phase shift between the comparison voltage and the sync pulses and its polarity will depend on whether the sawtooth voltage leads or lags the sync pulses.

HORIZONTAL SWEEP CIRCUITS

The d.c. control voltage from the output of the Horizontal A.F.C. Phase Detector controls the frequency of a conventional cathode-coupled Horizontal Scanning Multivibrator, using a 12AU7 tube (V-19). Coarse frequency adjustment of the multivibrator is obtained by varying the position of the slug in the Horizontal Lock coil #202, while fine frequency control is accomplished using the front-panel Horizontal Hold potentiometer #208.

Horizontal Multivibrator output is used to drive a 6BG6G (V-20) horizontal scanning output stage. The plate circuit of this stage is fused to protect transformer #222 and kill high voltage in the event the 6BG6G or the high voltage rectifier circuit draws excessive current. Signal level to the horizontal output tube is controlled by means of Horizontal Drive control condenser #212. The sawtooth current wave output of this tube is applied to the horizontal deflection coils thru the impedance matching Horizontal Output transformer. A portion of the transformer secondary is shunted by the Width coil which adjusts picture width by controlling horizontal output current waveshape

The 6W4 Horizontal Damping tube (V-22) is connected across the transformer secondary to damp out oscillations created during rapid retrace of the sawtooth current wave. This circuit provides control of horizontal linearity and also uses some of the inductive kickback voltage to supply additional B+ for the horizontal and vertical sweep systems.

HIGH VOLTAGE POWER SUPPLY CIRCUIT

High voltage is obtained by using the inductive kickback voltage induced in the Horizontal Output transformer during the retrace period. This kickback voltage is produced in the primary winding of the transformer and is increased by autotransformer action before being applied to the plate of the 1B3GT/8016 High Voltage Rectifier tube (V-21). Filament voltage is obtained by a loop of wire around the transformer. The output of the rectifier (approximately 9,000 volts) is filtered and applied to the high voltage anode of the picture tube.

LOW VOLTAGE POWER SUPPLY CIRCUITS

The low voltage power supply provides heater and plate voltages for all stages except those portions supplied by the high voltage rectifier and horizontal damping circuits. A sturdy power transformer #239 supplies plate voltage to a 6X5GT Rectifier (V-23) and a 5U4G Rectifier (V-24) and also contains a 5 volt filament winding for the 5U4G plus a 6.3 volt winding for the adequately filtered parallel filament string. The output of the 6X5GT double-L-section RC filter supplies the 160 volt B+ buss while the output of the 5U4G pi-section LC filter supplies the 350 volt B+ buss. A 290 volt B+ buss is fed from the low side of the Focus coil. Focus coil current is obtained from the 350 volt B+ supply and this current is regulated by changing the setting of the Focus potentiometer across the coil

The various controls on the receiver may be divided into two classes, Operating and Pre-set. Operating controls are those which control program selection as well as sound and picture quality. All but one of these controls are located on the front panel and their functions are indicated in Figure 2. The built-in television antenna tuning condenser is accessible at the rear of the receiver. The Pre-set controls are those which require adjustment at the time the receiver is installed and they rarely need attention thereafter. There are eight of these controls, four of which are located at the back of the chassis (see Figure 4). Four controls are accessible by removing the Name Plate located directly above the Operating controls.

RECEIVER CONTROLS

AM-FM FINE TUNING CONTROL (outer knob)
Use to tune receiver to desired station after BAND SWITCH is set to either "AM" or "FM" position.

AM-FM COARSE TUNING CONTROL
Has same effect as AM-FM FINE TUNING control except that tuning is faster.

TELEVISION FINE TUNING CONTROL
Use to tune in station after CHANNEL SELECTOR is set to desired channel. See next page for complete description of tuning procedure.

CHANNEL SELECTOR (outer knob)
Set knob so that it points to desired television channel. Then use TELEVISION FINE TUNING control to tune in station.

ON-OFF SWITCH & VOLUME CONTROL (small knob)
Use to turn receiver on or off and to adjust for desired sound volume.

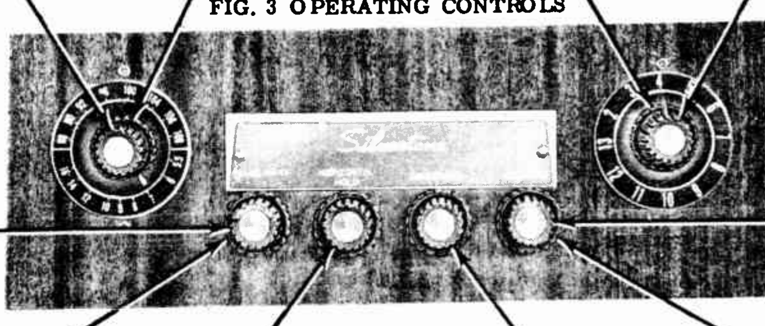

FIG. 3 OPERATING CONTROLS

TONE CONTROL (small knob)
Adjust for most pleasing tone. To increase bass emphasis turn counter-clockwise.

BAND SWITCH (large knob)
Set for desired type of reception. Starting from extreme clockwise position and turning counter-clock wise, the four settings are: (Television); (Phonograph); ("AM" Radio); and ("FM" Radio).

HORIZONTAL HOLD CONTROL
Adjust so that picture is stationary and does not move horizontally or break up into black and white streaks.

BRIGHTNESS CONTROL
Adjust for picture brillance. Re-adjust after setting CONTRAST control.

CONTRAST CONTROL (large knob)
Adjust to receive picture and obtain correct contrast between light and dark shades.

CONTROL ADJUSTMENT PROCEDURE

Although the pre-set controls have been factory adjusted for optimum performance, it is usually necessary to make some fine adjustments of these controls at the time of installation.

To gain access to the centering adjustments and ion trap, it will be necessary to remove the back cover of the cabinet by first removing the built-in antenna tuning knob and then taking out the screws around the rim of the back cover.

Be sure that locking device (see Fig. 5) used to hold the focus coil in position during shipment is removed before attempting to reposition that coil as described in the following procedure.

The receiver is now ready for an operation check.

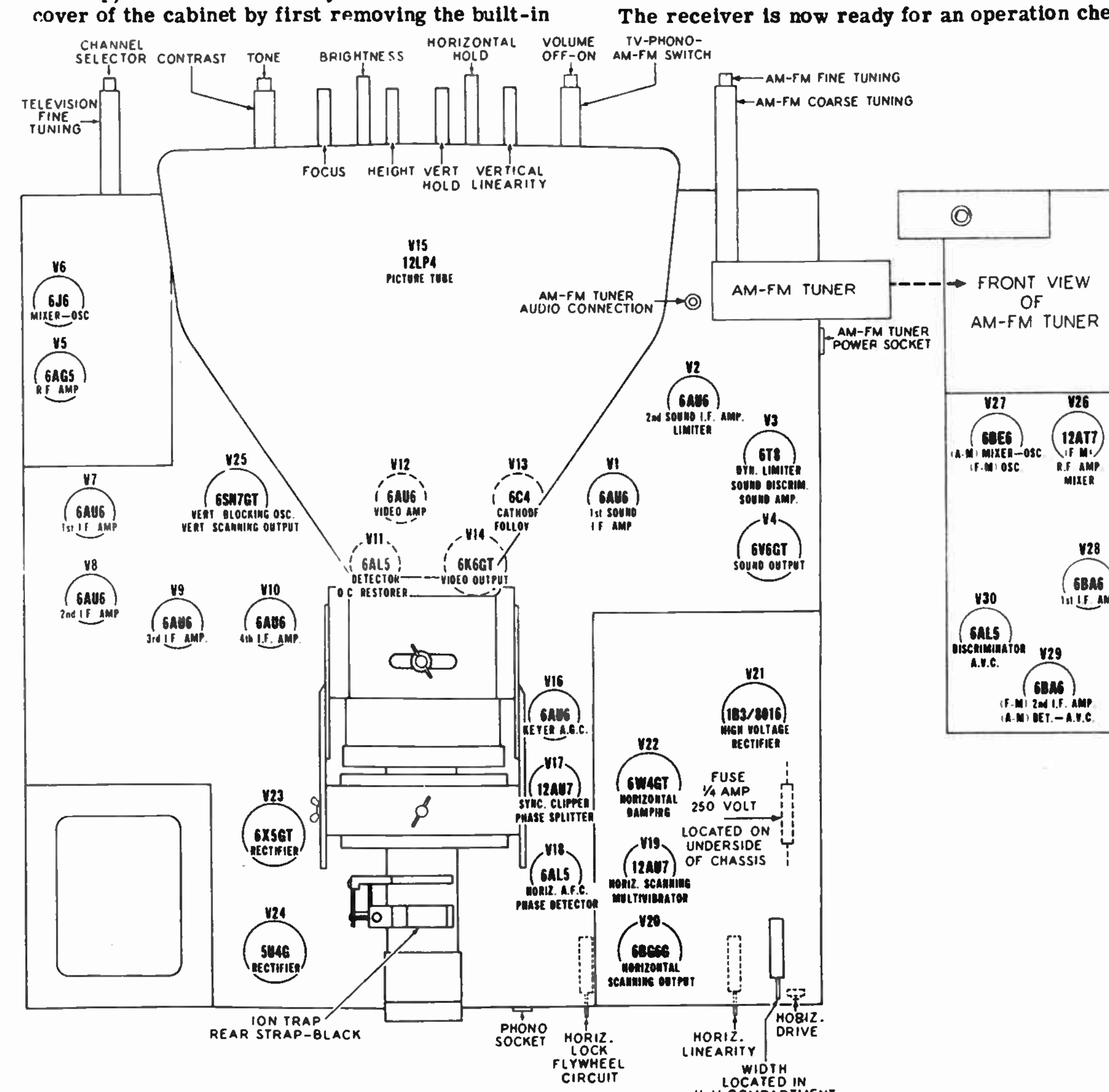

FIG. 2
TUBE LOCATIONS AND FUNCTIONS

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TO ADJUST CONTROLS FOR RECEPTION OF STANDARD BROADCAST OR FREQUENCY MODULATION STATIONS:

1. TURN SET ON — Rotate "On-Off Switch and Volume" knob clockwise to turn receiver on.

2. POSITION BAND SWITCH — Set "Band Switch" to either its "AM" or "FM" position. Small red indicator lite adjacent to corresponding dial scale will become illuminated.

3. TUNE — Use "AM-FM Fine Tuning" control to select desired station.

4. ADJUST VOLUME — Select "Volume" control setting for desired sound intensity.

5. ADJUST TONE — Select "Tone" control setting for most pleasing tone.

TO ADJUST RECEIVER FOR RECEPTION OF TELEVISION STATIONS:

1. TURN SET ON — Rotate the "On-Off Switch and Volume" knob approximately ½ turn clockwise to turn set on and obtain sufficient sound volume during the tuning process. Allow several minutes for all tubes in the receiver to warm up and for circuits to stabilize before attempting to obtain a picture on the screen.

2. POSITION BAND SWITCH — Set "Band Switch" to "TV" position. Small red indicator light above channel numbers will become illuminated.

3. ADVANCE BRIGHTNESS CONTROL — Turn "Brightness" control clockwise until picture screen is moderately illuminated. The screen may remain dark or dimly illuminated until ion trap is adjusted as described in next step. Should it be noted that a semi-circular portion of the raster is not illuminated, that condition may be disregarded as it will be corrected by subsequent adjustments.

4. ADJUST ION TRAP — The ion trap is located on the neck of the picture tube as shown in Figure 5 and consists of a magnet held in position by metal bands. The magnet identified by the black band must be in the rear position.

   Loosen the clamp screw which secures the ion trap to the tube neck. Then rotate the entire trap assembly while sliding it back and forth until picture tube screen is illuminated to maximum brillance. Reduce "Brightness" control setting and repeat this operation to assure accurate positioning of ion trap.

5. ADVANCE CONTRAST CONTROL — Rotate the "Contrast" control knob fully clockwise.

6. SET CHANNEL SELECTOR TO DESIRED CHANNEL — The "Channel Selector" knob designates the channel to which the television receiver is tuned. Set the "Channel Selector" knob to a channel on which a local television station is known to be broadcasting at the time.

7. FINE TUNING CONTROL — Use the "Television Fine Tuning" control (illustrated in Figure 3) to obtain the correct tuning point for both picture and sound. That is accomplished as follows:

   a. Turn "Television Fine Tuning" control in either direction until sound volume is maximum — if sound cannot be heard, advance the volume control and repeat fine tuning.

   b. When the point of maximum sound volume has been reached it will be noted that the picture has a "ragged" or "sawtooth" appearance or is partially obscured by "sound bars" (dark horizontal bars of varying width).

   THE CORRECT SETTING OF THE "TELEVISION FINE TUNING" CONTROL is now obtained by turning it away from the maximum volume position only far enough to eliminate the "sound bar" interference and permit sharp reproduction oi the picture. If an image is slightly distorted or tears into a series of black and white streaks, reduce the setting of the "Contrast" control and operate the "Horizontal Hold" control knob until picture appears stable and undistorted.

8. BUILT-IN ANTENNA ADJUSTMENT — If the receiver's built-in television antenna system is used, rotate the antenna tuning knob (located at rear of cabinet) until the best picture is obtained. It may be possible to find a single setting for this knob which will give satisfactory performance for a group of stations. In the event that is not the case, adjust the control for optimum performance each time the Channel Selector is rotated to a different station.

9. SOUND VOLUME — Adjust the setting of the "Volume" control by rotating it clockwise until the sound accompanying the television broadcast is received at a satisfactory level.

10. TONE — Adjust "Tone" control setting for most pleasing tonal quality.

11. HORIZONTAL HOLD — Should the picture appear to move horizontally across the screen or break up into a series of light and dark streaks, adjust the "Horizontal Hold" control until the picture remains stationary.

    If this control must be rotated to the end of its range for proper "locking" action, then it will be necessary to reset the position of the "Horizontal Lock" control (see Figure 5) for location). Adjustment is accomplished by first setting the "Horizontal Hold" control in the middle of its range and then changing the setting of the "Horizontal Lock" control until picture locks in horizontally.

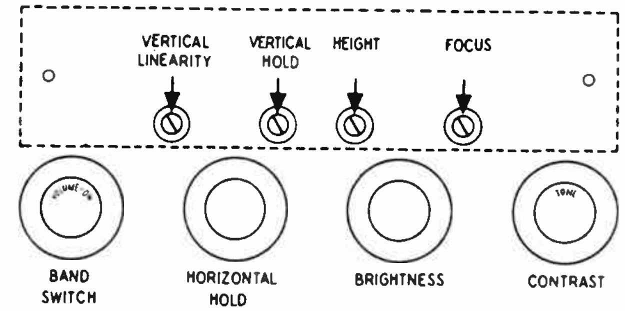

FIG. 4 PRE-SET CONTROLS

12. VERTICAL HOLD — Should the picture roll in a vertical direction or appear as multple vertical images, it will be necessary to adjust the "Vert. Hold" control located behind the Name Plate (see Figure 4).

    After this adjustment is made, reduce contrast until picture is barely visible and check setting of "Vertical Hold" control for proper picture synchronization.

13. INITIAL FOCUS — Adjust the "Focus" control, located behind Name Plate, until picture is clearly defined.

    Fuzzy picture may also be due to reproduction of poor quality film when station is televising a motion picture. Incorrect tuning of receiver, produces a similar effect. Check for proper tuning point as described in step 7.

14. STRAIGHTENING TILTED RASTER — If the pattern should appear on the screen in a tilted position, loosen the deflection yoke locking screw (see Figure 5) and rotate the yoke sufficiently to correct this condition. Be sure to re-tighten the screw securely.

<u>The following adjustments should be made while the station is transmitting its circular test pattern.</u>

15. CENTERING — Before attempting to center the test pattern on the screen, be sure that the focus coil locking device has been removed. This device is used only for clamping during shipment; see Figure 5. The pattern can then be readily centered by properly positioning the focus coil. This is done by turning the coil in the desired direction by hand. If coil does not move freely, loosen wing nuts labeled A and B in Figure 5.

16. WIDTH — Control of picture size in the horizontal direction is accomplished by means of the "Width" control located on the rear of H. V. power supply (see Fig. 5). If abnormally low line voltage makes it difficult to obtain sufficient picture width when using the "Width" control, then changing the setting of the "Horizontal Drive" control may be helpful. The "Drive" control is located at the rear of the chassis and its setting will affect horizontal linearity as well as picture width. Therefore, after adjusting this control for desired width, it may be necessary to re-adjust the "Horizontal Linearity" control as described in paragraph #19.

17. HEIGHT — Control of picture size in the vertical direction is accomplished by means of the "Height" control located behind the Name Plate. Height and width adjustments should be checked for all transmitting stations to be sure that picture properly fills the viewing area.

18. VERTICAL LINEARITY — Improper vertical linearity causes the circular test pattern to appear condensed on the upper edge of the screen and extended on the lower edge or vice versa. Adjust for proper linearity by using "Vert. Lin." control located behind Name Plate. It may be necessary to re-adjust the "Height" control if an appreciable change is made in the linearity control setting.

19. HORIZONTAL LINEARITY — Improper horizontal linearity causes the circular test pattern to appear condensed on the right edge of the screen and extended on the left edge or vice versa. Adjust for proper linearity by using "Horiz. Lin." control located on rear of chassis (see Figure 5). In event that proper horizontal linearity cannot be obtained by adjusting this control, then change the setting of "Horiz. Drive" control (also located at rear of chassis). As width and linearity of the picture are affected by the setting of Horiz. Drive control, it will be necessary to adjust this control in conjunction with the Horiz. Linearity and Width controls to obtain desired picture width and linearity.

20. ELIMINATING SEMI-CIRCULAR SHADOW — This shadow is caused by the electron stream striking the neck of the tube and it can generally be corrected by applying one or a combination of the following procedures:

    a. Reposition the focus coil to the extent permitted by the bracket assembly which supports this coil. Shift entire focus coil assembly forward or backward by

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loosening wing nuts labeled B in Figure 5.

b. Shift position of deflection yoke forward as far as possible against neck of picture tube. Yoke is held in position by a wing screw as illustrated in Figure 5.

c. In event neck shading cannot be eliminated by the above procedures, release the four wing nuts labeled C in Figure 5 and raise or lower entire yoke and focus coil assembly so that focus coil can be repositioned vertically with respect to the tube neck.

21. FINAL ADJUSTMENTS — Recheck settings of "Brightness," "Contrast" and "Focus" controls for best picture quality. Proper adjustment of all Pre-set and Operating controls on this receiver should result in a clear and stable picture.

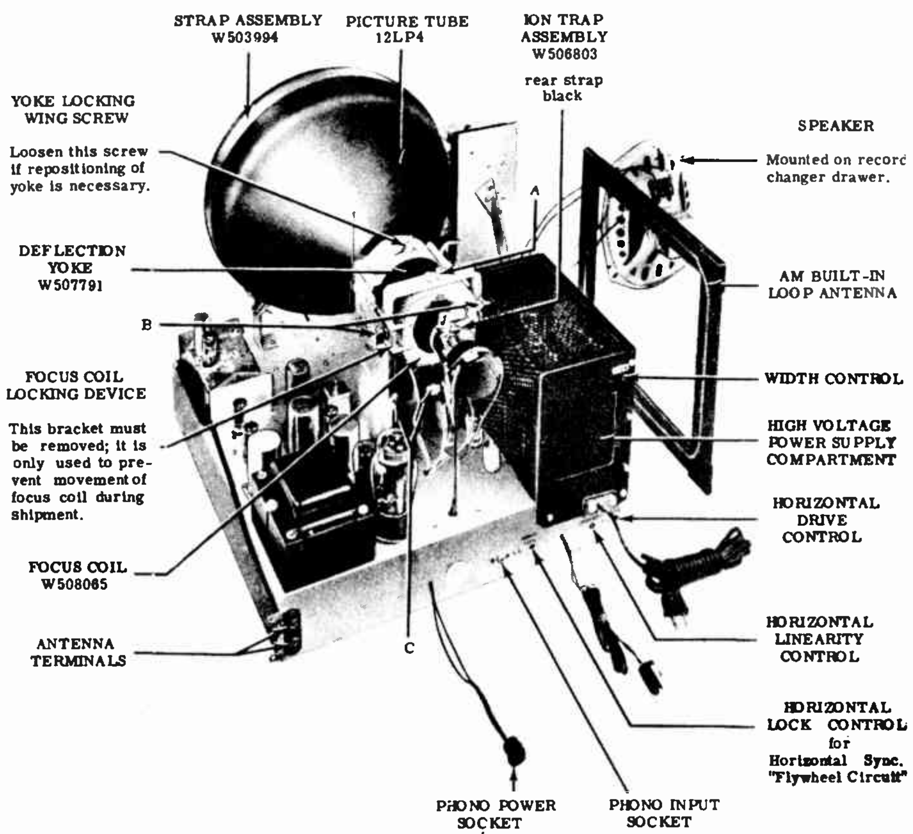


FIG. 5 CHASSIS AND PICTURE TUBE ASSEMBLY

SOCKET VOLTAGES

CAUTION

THE PICTURE TUBE is highly evacuated and if broken, glass fragments will be violently expelled. Scratching, chipping, undue pressure, or careless handling such as lifting the tube by its neck is dangerous and should be avoided. If it is necessary to handle the picture tube, use safety goggles and heavy gloves. Be sure to discharge the voltage developed across the capacitor formed by the inner and outer coating of the picture tube. This can be done by connecting the high voltage socket on the tube to the outer coating with a well insulated metal conductor.

HIGH VOLTAGE (approximately 9,000) is produced in a supply circuit of this receiver. Exercise care to avoid contact with elements of this circuit and particularly the tube terminals which are labeled "CAUTION" in the adjoining voltage chart. If measurement of voltage at these points is necessary, see procedure given below under note "S".

THE HIGH VOLTAGE LEAD, which supplies approximately 9,000 volts to the picture tube, should be momentarily shorted to the chassis whenever it is disconnected for service purposes. This discharges the high voltage filter condensers and prevents a shock hazard when working on the receiver after it has been turned off.

INTERMEDIATE B+ VOLTAGES are dangerous and caution should be observed when the receiver chassis components are exposed for service purposes.

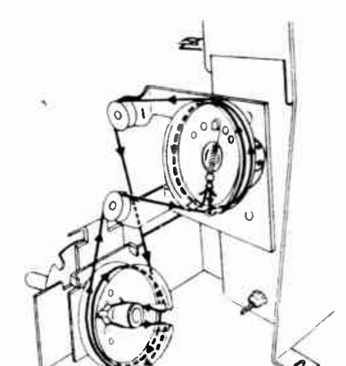
THE VOLTAGES SHOWN IN THE ADJOINING CHART WERE MEASURED UNDER THE FOLLOWING CONDITIONS

1.	Power Supply—117 volts 60 cycle AC.
2.	All voltages are measured between socket terminals and chassis unless otherwise indicated on adjoining chart.
3.	* Measurements made with voltmeter having sensitivity of 1000 ohms per volt except where indicated by (*). The (*) symbol designates a vacuum tube voltmeter measurement.
4.	Band Switch set to "TV" position unless otherwise indicated by the letters "X", "Y", or "Z" following voltages shown in adjoining chart.
5.	Antenna connected for reception of a television broadcast.
6.	Channel Selector and Fine Tuning Controls set for correct reception of a local station.
7.	All other controls set for "normal" reception of the transmitted signal unless the voltage shown on the chart is followed by letters indicating a special condition of measurement as outlined in step 8.
8.	Certain voltages were measured with two different settings of specific controls. It should therefore be understood that in these instances all controls, with the exception of one or two, were set for "normal" reception—letters following the voltage shown on the chart indicate the exceptions and are explained below.

EXPLANATION OF NOTES

A.	Vert. Hold max. counter-clockwise
B.	Brightness max. counter-clockwise
C.	Contrast max. clockwise
D.	Horiz. Drive max. clockwise
E.	Horiz. Hold max. clockwise
F.	Focus Control max. clockwise
G.	Width max. counter-clockwise
H.	Height max. clockwise
J.	Horiz. Hold set for normal picture
K.	Horiz. Lock set for normal picture
L.	Channel Selector set to channel #9
M.	Vertical Linearity max. counter-clockwise
N.	Channel Selector set to channel #5
P.	This measurement should NOT be made with a conventional type voltmeter as circuit may break into oscillation due to coupling thru instrument leads; use a vacuum tube voltmeter with short leads.
Q.	This voltage will vary from —13 to —17 depending upon setting of Horizontal Hold Control and Horizontal Lock Control.
R.	Do not attempt to measure the voltage at the tube cap. There is a high R. F. potential at this point.
S.	If you do not have an instrument capable of directly measuring voltages in this range, the voltage can be measured by using a voltage divider network consisting of twenty 2.2 megohm 2 watt resistors and one 1 megohm 2 watt resistor, all connected in series. Avoid using resistors of higher values as their individual voltage rating may be exceeded. It is also important to use resistors of equal wattage. Solder all connections between resistors. Accurately measure the overall resistance of the entire combination as well as the resistance of the 1 megohm section. With the set turned off, connect the 2.2 megohm end of the resistance voltage divider to the filament of the 1B3GT/8016 tube, or H.V. terminal of the picture tube, and connect the 1 megohm end to chassis. Now, turn the set on and measure the voltage drop across the 1 megohm resistor with a vacuum tube voltmeter. The voltage at the tube terminal can then be calculated as follows: $\left[\text{Volts At Tube Terminal}\right] = \dfrac{\left[\text{Measured Resistance Of Entire Voltage Divider}\right]}{\left[\text{Measured Resistance Of 1 Meg. Section}\right]} \times \left[\text{Volts Measured Across 1 Meg. Section}\right]$
T.	Grounding of center stud on tube socket is necessary to reduce capacity coupling between other pins. Oscillation may result if this ground is omitted.
U.	This voltage will vary from +4 to —4 depending upon setting of Horizontal Hold Control and Horizontal Lock Control.
V.	This voltage measured with antenna disconnected and no signal input to receiver.
W.	This voltage will vary from —6 to —12 depending upon setting of Horizontal Hold Control and Horizontal Lock Control.
X.	Band Switch set to "AM" position, dial tuned to 540 Kc. and AM loop antenna leads grounded.
Y.	Band Switch set to "FM" position, dial turned to 88 Mc. and FM antenna terminal grounded.
Z.	Band Switch set to "PH" position.

DIAL POINTER DRIVE CORD ARRANGEMENT



To string dial cord, first rotate "AM-FM" Coarse Tuning Control (pointer shaft) fully counter-clockwise until stop on drum contacts ear on mounting frame. Now, with gang set to fully meshed position, string dial cord using the following parts.

W114955 Clip on end of cord
W117057 Cord (2 ft. required)
W505161 Spring

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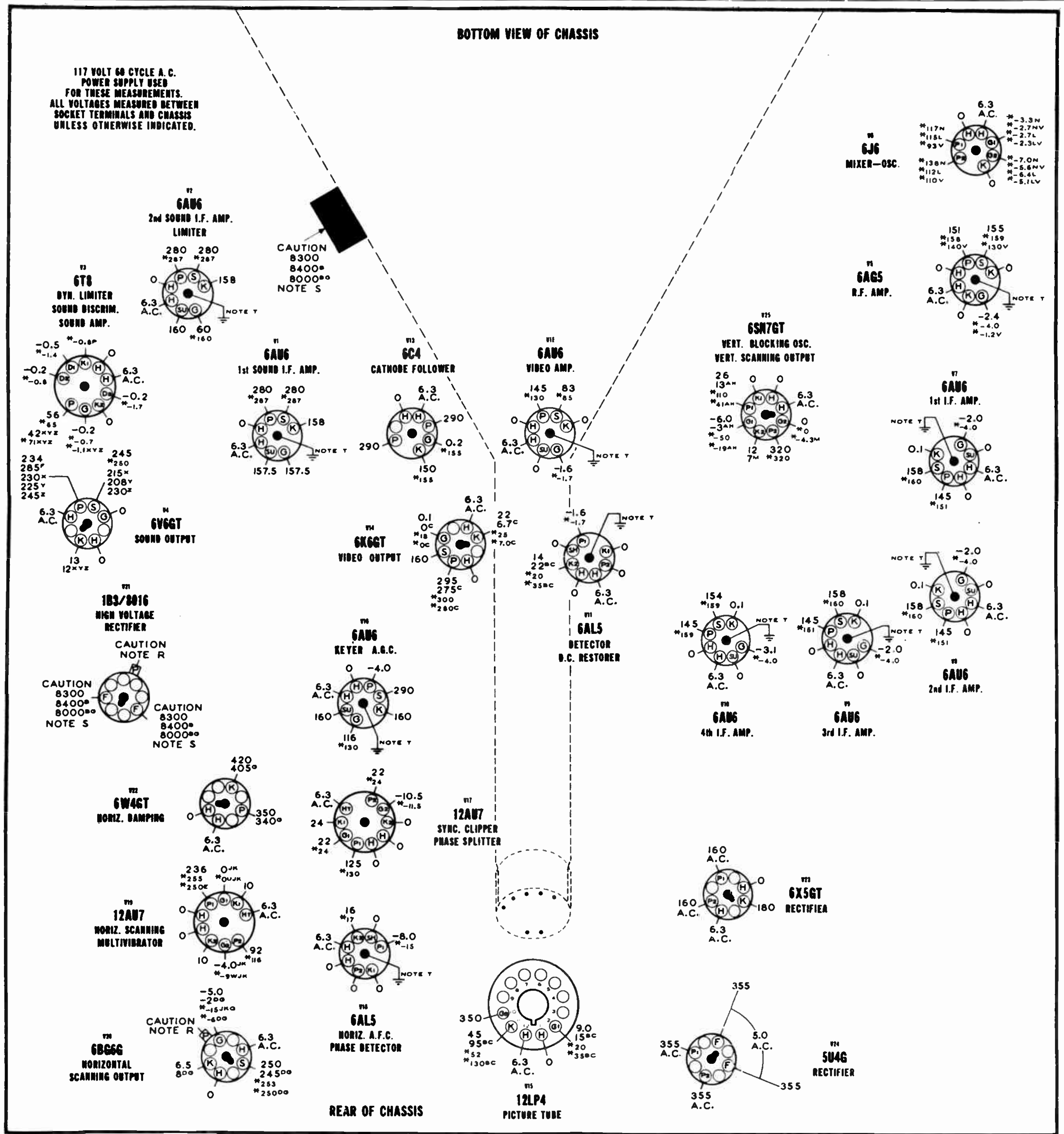

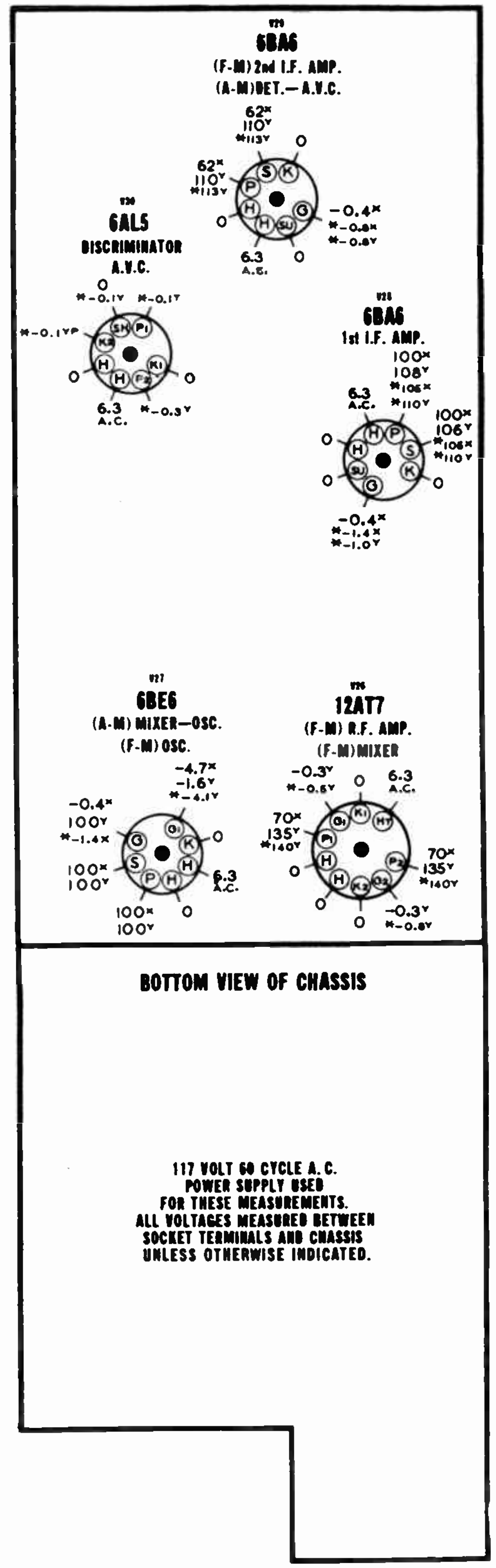

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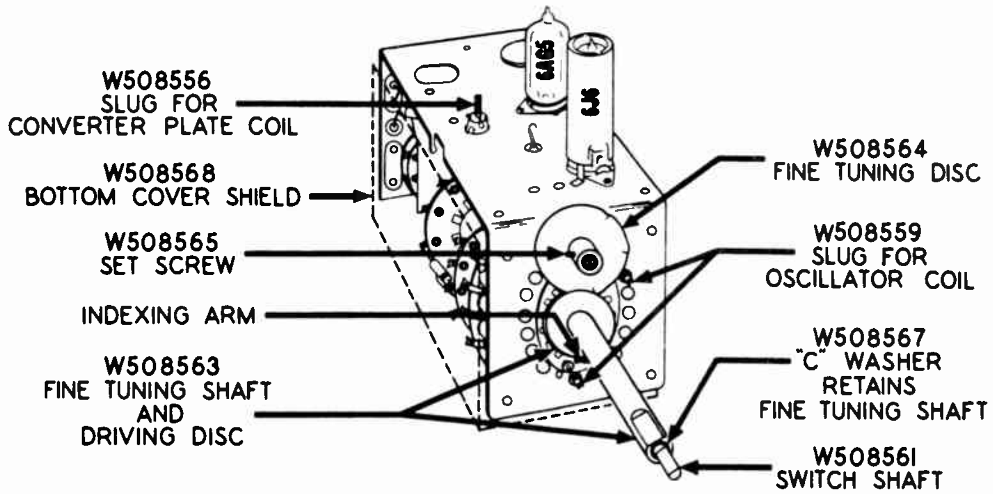
REPAIR DATA FOR W508431 RF TUNER UNIT

All replacement parts for the RF Tuner Unit are included in the complete receiver parts list.

This RF Tuner Unit consists of an RF amplifier stage (using 6AG5 tube) and a mixer-oscillator stage (using 6J6 tube). Channel selection is accomplished by a selector switch and fixed coil arrangement. The tuner also incorporates a Fine Tuning control.

Four groups of fixed coils permit tuning over the entire television band. These consist of 12 antenna coils, 12 RF amplifier plate coils, 12 mixer grid coils and 12 oscillator coils. Signal output from the mixer stage is coupled to the IF amplifiers through the converter plate circuit IF coil located on the tuner unit.



SERVICE PRECAUTIONS

SUBJECT	PRECAUTIONS
ELECTRICAL COMPONENTS	The high frequencies used in the RF section of a television receiver make it necessary that considerable care be exercised in servicing the tuner. Lead dress and location of components are very critical at these frequencies. When replacing parts, it is important to use components of identical electrical characteristics and physical size. Always reconnect the replacement item in the same location and position in the tuner as the original component.
TUBES	Replacement of tubes in the Tuner Unit may cause slight detuning of RF circuits due to inherent differences in inter-electrode capacitances. When replacing tubes (especially V6, 6J6 mixer-oscillator tube) make sure that Fine Tuning control will tune in television stations at approximately the middle of its range. If fine tuning cannot be accomplished, try several new tubes in order to obtain one which will permit correct tuning. When tube replacement does not give the desired result, realignment of the tuner is recommended (see "Alignment Procedure").
CHANNEL COILS AND SLUGS	Channel Coils must be handled with care. Do not disturb coil windings or slug positions except when re-aligning the tuner unit.

REMOVAL AND REPLACEMENT OF PARTS

ITEM	PROCEDURE
RF TUNER UNIT	To remove the Tuner Unit from receiver chassis, proceed as follows: 1. Remove TV Channel Lite socket. 2. Remove support bracket which positions front of Tuner Unit and also remove screws which hold tuner to rear support bracket. 3. Disconnect the leads from the tuner to the main chassis. See illustration on circuit diagram page showing tuner connections. After the Tuner Unit is replaced, make sure that TV Channel Lite socket and sleeving are correctly positioned so that small red indicator above channel selector knob will be properly illuminated.
BOTTOM COVER SHIELD	Squeeze upper edges of Bottom Cover Shield together at points adjacent to locking "ears" on top of tuner, and at the same time pull down on shield. When replacing Bottom Cover Shield, make sure it is held securely by the two locking "ears."
SWITCH SHAFT	To remove Switch Shaft from RF Tuner Unit, proceed as follows: 1. Remove tuner from receiver chassis. 2. Rotate Switch Shaft until portion of Indexing Arm which contacts front of tuner is pointing down (this corresponds to setting switch to channel #12). 3. Remove Switch Shaft "C" Washer located behind front plate of tuner. 4. Loosen Set Screw on Fine Tuning Disc. 5. Fine Tuning Disc, Fine Tuning Shaft and Driving Disc and Switch Shaft may now be removed by merely pulling them forward. To replace Switch Shaft: 1. Set Fine Tuning condenser to its completely meshed position. 2. Slip edge of Fine Tuning Disc (furthest from the three "stops" on the disc) into slot of Fine Tuning and Driving Disc. 3. With portion of Indexing Arm (which contacts front of tuner) pointing down, slide Switch Shaft into tuner and Fine Tuning Disc over Fine Tuning Condenser Shaft. 4. Replace "C" Washer on Switch Shaft. 5. Rotate Fine Tuning Shaft and Driving Disc to maximum counter-clockwise position and tighten Set Screw on Fine Tuning Disc. The Fine Tuning condenser range should now be from its fully meshed position (with Fine Tuning and Driving Disc in its maximum counter-clockwise position) to its fully open position (with the tuning control in its maximum clockwise position).

HIGH VOLTAGE POWER SUPPLY SERVICING

The High Voltage Power Supply used with this receiver is of the "fly-back" type and is located in the shielded compartment mounted at the left rear corner of the chassis. It consists of a sturdily constructed and well insulated horizontal sweep output transformer plus a 1B3GT/8016 high voltage rectifier tube and associated filter components.

CAUTION

The high voltage lead, which supplies approximately 9,000 volts to the picture tube, should be momentarily shorted to the chassis whenever it is disconnected for service purposes (that is, after receiver has been turned off). This discharges the high voltage filter condensers and prevents a shock hazard when working on the set.

Access to the horizontal output transformer, high voltage rectifier tube and high voltage filter condenser is accomplished by removing the rear section of the H.V. shield. This compartment shield is held in place by five screws.

REMOVAL OF THE H.V. COMPARTMENT SHIELD AUTOMATICALLY OPENS AN INTERLOCK TO DISCONNECT THE RECEIVER POWER CORD.

CORONA AND ARC-OVER

Corona or arc-over can best be detected by observing the operation of the power supply in a dark room. Several conditions may cause these phenomena

POOR CONNECTIONS — Arcing or corona may be due to poorly soldered connections (rosin joints or sharp points), or defective tube socket-pin connections. If the connectors which hold the high voltage filter condenser do not grasp this component securely, arcing will also result.

Inspect solder connections and resolder those joints which are unsatisfactory. Make sure tubes are firmly positioned in tube sockets and that high voltage filter condenser is held securely in place.

CLOSELY SPACED COMPONENTS — Arcing or corona may occur when H.V. components or leads are placed too close together. Make sure there is sufficient spacing between all parts and wiring. If necessary, the insulation between two elements of the circuit may be improved by coating both objects with a quick-drying liquid polystyrene or polyethylene.

The socket assembly for the 1B3GT/8016 rectifier tube includes a "corona ring" which prevents corona from the tube socket pin connections. The surface of this ring should be smooth and free of scratches, nicks, or sharp protusions.

HORIZONTAL SYNC SYSTEM ADJUSTMENT

If picture "tears" horizontally and cannot be synchronized by operating the Horizontal Hold control on front panel of receiver, this action may be due to incorrect setting of the slug in the Horizontal Lock Coil.

1. Set Horizontal Hold control in center of its range.
2. Adjust slug of Horizontal Lock Coil for picture synchronization (see chassis illustration in installation section of this manual for location of slug).

REDUCTION OF INTERCARRIER BUZZ

If a prominent humming or buzzing sound is noted in the sound reception of a television broadcast, it may be due to a fault in transmission from the station, or incorrect adjustment of the discriminator transformer (tuning of secondary circuit) in the receiver.

This type of disturbance, which is only present when receiving a station signal, is known as "Intercarrier Buzz" and it should not be confused with power supply hum that would occur upon failure of a filter condenser.

The procedure for correct adjustment of the television sound discriminator circuit is presented in the last section of the Television Sound Channel alignment instructions. When the discriminator secondary slug #1 is properly adjusted, intercarrier buzz will be reduced to an acceptable minimum, provided that the transmission from the station is not at fault.

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ALIGNMENT PROCEDURE

Alignment of all RF and IF tuned circuits in this receiver may be accomplished by utilizing the procedures described in the following charts.

SEQUENCE OF ALIGNMENT: These procedures should preferably be applied in the order in which they are presented, however, alignment of RF or IF channels for either AM, FM or TV may be accomplished individually if desired.

The Television RF Amplifier and Mixer alignment may also be accomplished independent of the Television IF Channel alignment, but oscillator calibration can only be done after IF Channel has been correctly aligned. Proper IF band pass characteristic is necessary for oscillator alignment as results of circut tuning are observed by means of an oscilloscope connected to the output of the video detector stage.

REMOVAL OF CHASSIS: The receiver chassis must be removed from the cabinet in order to accomplish alignment of all tuned circuits as there are adjustment points located on the underside of the unit and at the front of the AM-FM Tuner.

This can be accomplished by first removing all knobs and releasing the four hold-down screws located on the underside of the cabinet. Then disconnect "phono" pick-up and motor leads, speaker leads and all three "built-in" antennae (TV, AM and FM). Also release indicator lamp from bracket at base of cabinet.

CAUTION

The picture tube is highly evacuated and if broken, glass fragments will be violently expelled. Handle with care, using safety goggles and gloves. Avoid contact with high voltage terminal at side of tube even after it has been disconnected from the receiver—this precaution is necessary as inner and outer coatings on the tube form a capacitor which may carry a high voltage charge for an extended period of time after disconnection from the receiver.

INSTRUMENTS: The following instruments will be required as signal sources and output indicators during the alignment process. Since accurate alignment of a television receiver is heavily dependent upon the performance of your instruments, it is imperative that they meet the essential specifications described here.

1. **STANDARD SIGNAL GENERATOR** to provide signals at the following frequencies. Maximum output on all ranges should be at least .1 volt with provision for attenuation as desired. This instrument must have good frequency stability and be accurately calibrated. Generators which incorporate a separate crystal controlled oscillator and heterodyne circuit are self calibrating and therefore capable of providing the accuracy of frequency calibration required for television circuit alignment.

   A. IF Frequencies:

   455 Kc. (400 cycle modulated) for AM IF.
   4.5 Mc. (Unmodulated) for TV Sound.
   4.5 Mc. (400 cycle modulated) for TV Sound.
   10.7 Mc. (Unmodulated) for FM IF.
   22.25 Mc. (Unmodulated) marker for TV Sound IF carrier.
   22.4 Mc. (Unmodulated) for TV IF Trap.
   23.5 Mc. (Unmodulated) for TV 1st and 3rd IF.
   24.75 Mc. (Unmodulated) for TV 4th IF.
   26.6 Mc. (Unmodulated) for TV Converter and 2nd IF.
   26.75 Mc. (Unmodulated) marker for TV Picture IF carrier.

   B. RF Frequencies:

   550 to 1600 Kc. (400 cycle modulated) for AM RF.
   54 to 88 Mc. (Unmodulated) for TV RF.
   88 to 108 Mc. (400 cycle modulated) for FM RF.
   174 to 216 Mc. (Unmodulated) for TV RF.

2. **RF SWEEP GENERATOR** to provide frequency modulated signals at the following frequencies:

   10.7 Mc. with 300 Kc. sweep width.
   20 to 30 Mc. with 10 Mc. sweep width.
   54 to 88 Mc. with 10 Mc. sweep width.
   174 to 216 Mc. with 10 Mc. sweep width.

   Output adjustable with at least .1 volt maximum.

   Output should be "flat" (no amplitude variation) for all settings of the sweep width control.

   Provision for connection of generator sweep modulating voltage to horizontal deflection system of an oscilloscope.

   Provision for blanking the output signal on each return sweep so that oscillogram will not show retrace.

3. **CATHODE RAY OSCILLOSCOPE**, preferably a unit with vertical amplifier having wide range frequency response and low capacity pick-up probe.
4. **VACUUM TUBE VOLTMETER.** The lowest voltage range of this instrument should preferably permit a 1.0 volt reading to be indicated at not less than one third of full scale deflection.
5. **OUTPUT METER**, preferably a unit equipped with an impedance matching network that will present a 3.2 ohm load when connected to secondary of audio output transformer.

INSTRUMENT CONNECTIONS: The method of connection, including details of matching and coupling networks, for instruments used in this alignment procedure is given in several illustrations on subsequent pages. Specific instructions for each instrument application will also be found in various sections of the alignment charts.

IMPORTANT

AVOID EXCESSIVE INPUT SIGNAL WHEN USING OSCILLOSCOPE AS ALIGNMENT INDICATOR.

When observing the receiver band pass characteristic on an oscilloscope, it is exceedingly important to avoid distortion of that characteristic which would occur when using a large input signal from the sweep generator or standard generator (marker signal). Always set attenuator on sweep generator so that the reading on the vacuum tube voltmeter does not exceed one volt (when meter is connected from high side of video detector load resistor, symbol 139, to receiver chassis). Standard generator output should also be attenuated so that marker signal does not pull or tear the band pass characteristic as shown on the 'scope.

CHECKING SYNCHRONIZATION OF BAND SWITCHES ON AM-FM TUNER AND TV CHASSIS.

Note that the band switch on the AM-FM Tuner chassis is mechanically coupled (by a link arm and lever clamp arrangement) to the band switch on the TV chassis. Do not operate these switches by direct pressure on the link arm—always use a control knob attached to the TV switch shaft. If the mechanical linkage is forced or slips at the clamp on the TV switch shaft so that both switches get out of step, they can be re-synchronized as follows:

1. Loosen screw in actuating lever clamp on TV band switch shaft.
2. Turn both switches to extreme clockwise position and be sure that they detent properly at that position.
3. Retighten screw in actuating lever clamp on TV band switch shaft.

TELEVISION SOUND CHANNEL ALIGNMENT PROCEDURE

1. Short antenna terminals together with a jumper wire.
2. Turn the band switch to "TV" position and set receiver Channel Selector to any inactive television channel; other controls may be left at any desired setting.
3. No special aligning tool is required to adjust the cores in the Sound IF and discriminator transformers. The blade of a small screwdriver will fit the slot in these cores, however, the screwdriver should be of a non-metallic or insulated type to prevent detuning when inserted in the transformer can.

STANDARD SIGNAL GENERATOR		VTVM CONNECTIONS	MISCELLANEOUS INSTRUCTIONS	TRIMMER OR SLUG	TYPE OF ADJUSTMENT AND OUTPUT INDICATION
CONNECTIONS	FREQUENCY				
Connect as shown in Fig. 2.	**4.5 MC.** unmodulated **IMPORTANT** This signal must be accurate within 1/4 of 1% of 4.5 Mc. Check generator calibration against a crystal controlled signal source by "zero beating" (heterodyning) with harmonics of the crystal frequency.	Connect as shown in Fig. 3.	**IMPORTANT** Unsolder lead connected to terminal "T" of Horizontal Linearity coil (see Fig. 1). This will make the horizontal sweep system of the receiver inoperative so that the sweep voltage will not be picked up by stray coupling to leads of instruments used during Sound Channel alignment. Such coupling would otherwise result in spurious oscillation.	**#1** TV Sound Discriminator Secondary	Adjust for maximum reading on VTVM.
				#2 TV Sound Discriminator Primary	Adjust for maximum reading on VTVM.
				#3 2nd TV Sound IF Secondary	Adjust for maximum reading on VTVM.
				#4 2nd TV Sound IF Primary	Adjust for maximum reading on VTVM.
				#5 1st TV Sound IF Secondary	Adjust for maximum reading on VTVM.
				#6 1st TV Sound IF Primary	Adjust for maximum reading on VTVM.
Same as above.	Same as above.	Connect as shown in Fig. 4.	Same as above.	**#1** TV Sound Discriminator Secondary	Note that as slug #1 is rotated, a point will be found where the voltmeter will swing rather sharply from a positive to a negative reading or vice versa. The correct setting of slug #1 is obtained when the meter reads zero as the slug is moved thru this point.

REDUCTION OF INTERCARRIER BUZZ

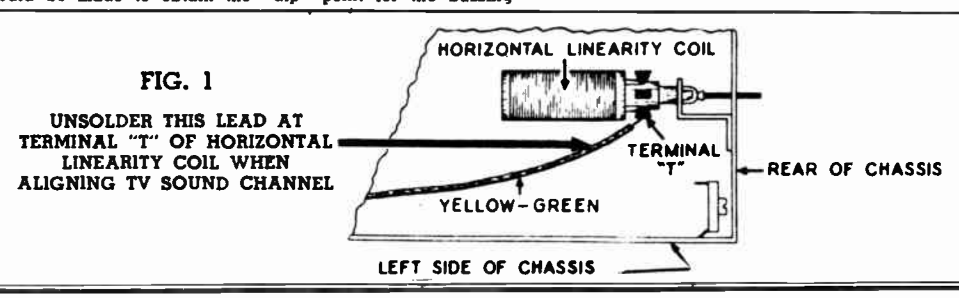
Slight "dynamic" unbalance of the discriminator secondary can emphasize intercarrier Buzz due to incomplete amplitude modulation rejection. Therefore it is vitally important to obtain an accurate setting of the discriminator secondary slug in the presence of an amplitude modulated signal, as outlined below.

Same as above.	**4.5 MC.** 400 cycle amplitude modulated	Not used.	Same as above. Turn up Volume control until 400 cycle signal can be heard.	**#1** TV Sound Discriminator Secondary	Note that as slug #1 is rotated, a point will be found where the sound volume changes rapidly from maximum to minimum and back to maximum again. The discriminator secondary slug is correctly positioned when this "dip" in volume is reached. Do not confuse the "dip" point with a gradual reduction in volume that occurs when the circuit is considerably detuned.

Resolder lead previously disconnected from terminal "T" of Horizontal Linearity coil (see Fig. 1).

Disconnect all instruments and then connect an antenna to the receiver to obtain program reception from a local station. If intercarrier buzz is still prominent, a slight readjustment of the discriminator secondary slug (#1) should be made to obtain the "dip" point for the buzzing sound. Note that program sound will be clear and free from distortion at this point. Buzz should now be at an acceptable minimum if station transmission is not at fault.

FIG. 1



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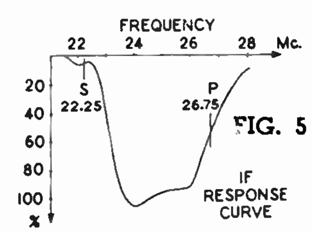
TELEVISION IF CHANNEL ALIGNMENT PROCEDURE

1. A special aligning tool designed to fit the stems on adjustable cores of the IF coils (see points 8, 9, 10 and 11 in Fig. 14) is available and may be obtained by requesting IF Alignment Tool #W507-479.
2. Turn receiver Channel Selector to television channel #12 and short antenna terminals together with a jumper wire.
3. Turn the band switch to the TV position.
4. Connect a 3 volt battery to the receiver AGC system so that negative terminal of battery connects to the AGC line and positive terminal of battery connects to receiver chassis. See Fig. 15 for convenient point of connection.
5. Note location of IF Trap Coil #12 by referring to Fig. 15. Before undertaking the alignment of any of the IF stages, Trap Coil #12 must be detuned so that it does not resonate in the IF pass band. Detuning is accomplished by merely compressing the windings so that they are closely spaced. Failure to detune the Trap Coil can cause the IF system to become regenerative thereby preventing alignment.
6. If the IF channel is badly misaligned and two or more immediately adjoining IF stages are tuned to the same frequency, oscillation may occur. Such oscillation shows up as a voltage across the video detector load resistor, symbol 139, and is indicated by the VTVM that is connected to this point during alignment. It should be noted that voltage due to IF oscillation is unaffected by strength of signal from the generator.

Where IF oscillation is encountered, it is generally possible to correct the condition by detuning the IF coils in different directions. If that does not have the desired effect, increase fixed bias on AGC line by using a 4½ volt battery instead of the 3 volt battery referred to in instruction #4. After stopping the oscillation in this manner it will then be possible to align all IF stages using the following procedure, however, the AGC bias battery must be changed back to 3 volts when using the oscilloscope to observe band pass characteristic. Once all stages have been aligned using the 4½ volt bias, the IF channel should be stable with reduced bias.

STANDARD SIGNAL GENERATOR		SWEEP GENERATOR		VTVM CONNECTIONS	OSCILLOSCOPE CONNECTIONS	MISCELLANEOUS INSTRUCTIONS	TRIMMER OR SLUG	TYPE OF ADJUSTMENT AND OUTPUT INDICATION
CONNECTIONS	FREQUENCY	CONNECTIONS	FREQ.					
Connect as shown in Fig. 6.	26.6 MC.	Use a 330 Mmf. isolating condenser and connect as shown in Fig. 6 but keep power switch turned off during this step.	—	Connect as shown in Fig. 7.	Not used.	—	#7 Converter plate coil	Adjust for maximum reading on VTVM.
							#8 2nd I.F.	Adjust for maximum reading on VTVM.
Same as above.	24.75 MC.	Same as above.	—	Same as above.	Not used.	—	#9 4th I.F.	Adjust for maximum reading on VTVM.
Same as above.	23.5 MC.	Same as above.	—	Same as above.	Not used.	—	#10 1st I.F.	Adjust for maximum reading on VTVM.
							#11 3rd I.F.	Adjust for maximum reading on VTVM.
Same as above.	22.4 MC.	Same as above.	—	Same as above.	Not used.	—	#12 IF Trap Coil	Adjust the spacing of the Trap Coil windings for MINIMUM reading on VTVM.
Same as above.	26.75 MC.	With connections made as shown in Fig. 6, turn on this generator and set controls for operation as specified in next column.	25 MC. Sweeping ± 5 Mc.	Same as above.	Connect as shown in Fig. 7.	IMPORTANT: 1. Remove the 6J6 (Mixer-Oscillator) tube and wrap a piece of fine wire around pins 6 and 7 so as to connect these two pins together. Then reinsert the tube in its socket. Oscillator section of tube will now be inoperative and therefore cannot cause undesirable "beat" response that would otherwise disturb the IF band pass characteristic. 2. Adjust output attenuator on sweep generator so that reading on VTVM is one volt. 3. Set attenuator on standard signal generator so that marker signal does not distort the pattern on the oscilloscope. 4. Be sure that a 3 volt battery is connected to AGC line as specified in instruction #4 at the head of this chart. Do not use a battery of any other voltage.		The IF band pass characteristic now displayed on the 'scope should be compared with the curve shown in Fig. 5. If top of curve is not properly shaped, make a slight readjustment of slug #9. Should that adjustment fail to yield the desired result, then note whether the curve has a peak on the high or low frequency side. Slugs #7 and #8 control high frequency response (26.6 Mc.) and slugs #10 and #11 affect the low frequency response (23.5 Mc.); by making a small change in the settings of the high or low frequency slugs, it will be possible to obtain correct band pass curve.  FIG. 5 The 26.75 Mc. picture IF carrier marker should now appear at the 50% amplitude position on side of the band pass characteristic (see Fig. 5). If position of the marker appears too high or too low, slight readjustment of slugs #7, 8 and 9 is required.
Same as above.	22.25 MC.	Same as above.	Same as above.	Same as above.	Same as above.	Same as above.		The 22.25 Mc. sound IF carrier marker should appear at the position indicated in Fig. 5. If the position of the sound marker is incorrect, readjust winding spacing of Trap Coil #12.

INSTRUMENT CONNECTIONS FOR TELEVISION SOUND CHANNEL ALIGNMENT PROCEDURE

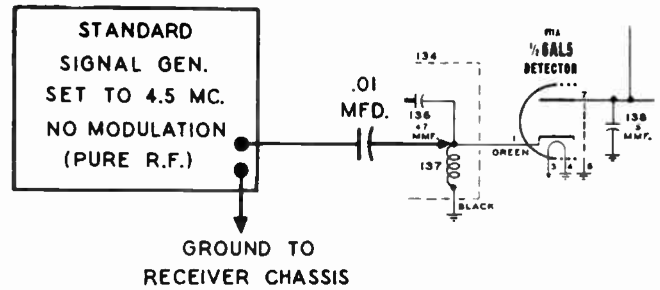


FIG. 2
Generator Connections for TV Sound Channel Alignment

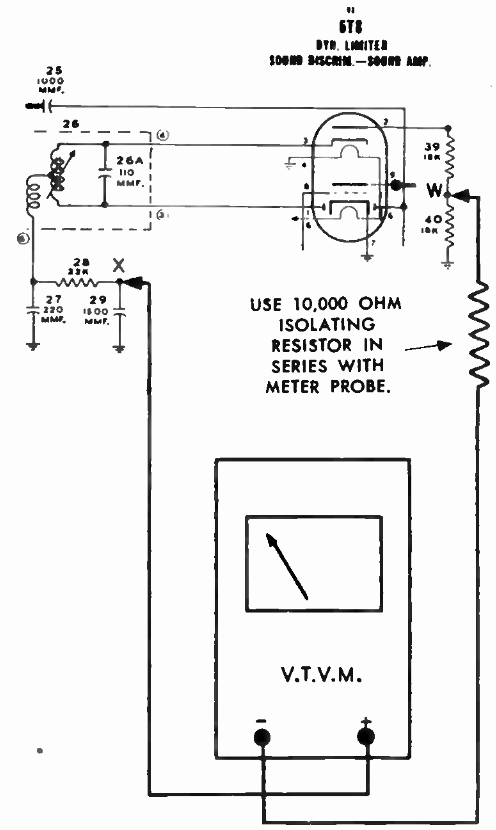


FIG. 4
VTVM Connections for TV Sound Discriminator Alignment

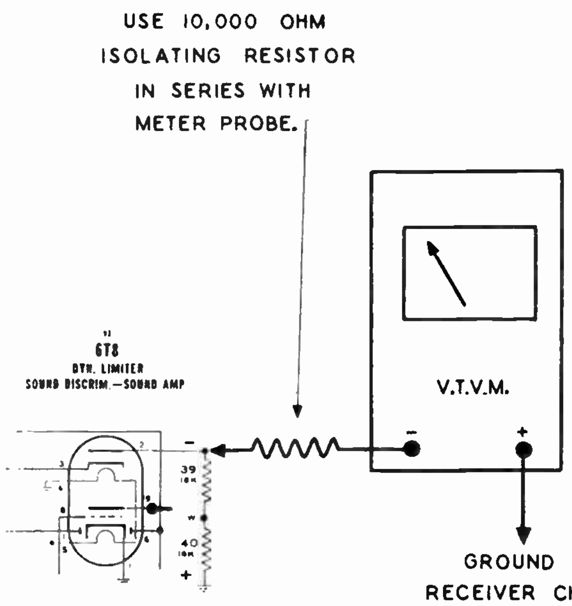


FIG. 3
VTVM Connections for TV Sound IF Alignment

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INSTRUMENT CONNECTIONS FOR TELEVISION IF CHANNEL ALIGNMENT PROCEDURE

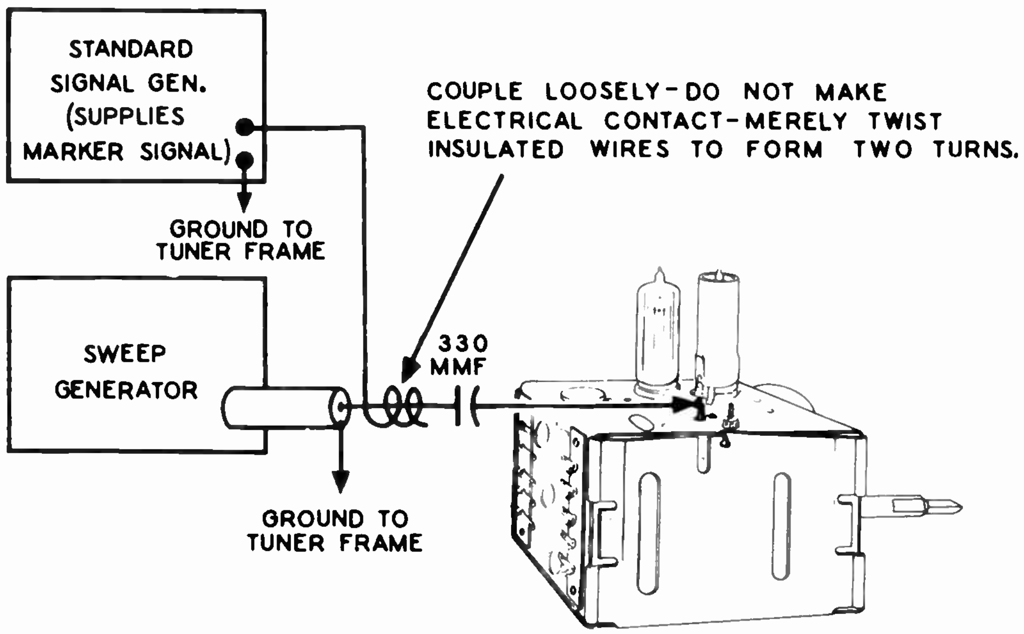

FIG. 6
Generator Connections for Television IF Channel Alignment

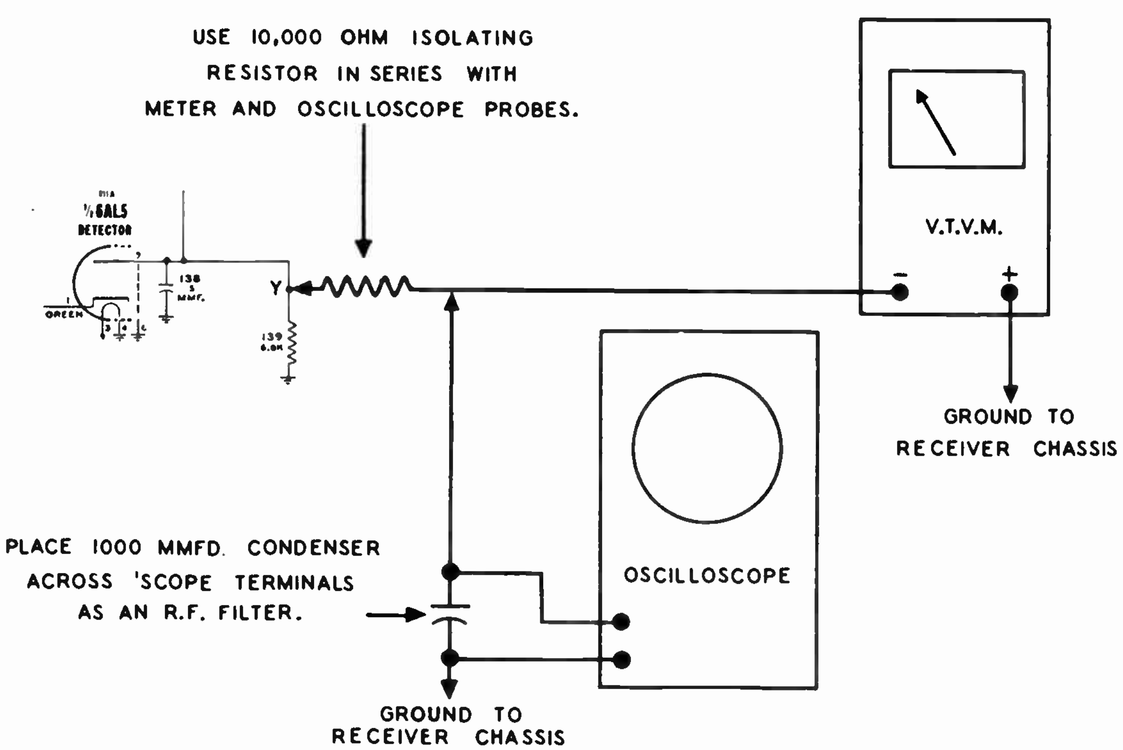

FIG. 7
VTVM and Oscilloscope Connections for Television IF Channel Alignment

TELEVISION RF CHANNEL ALIGNMENT PROCEDURE

1. Turn the band switch to the "TV" position.
2. Remove bottom cover shield of the Television RF Tuner unit.
3. Connect a 3 volt battery to the receiver AGC system so that negative terminal of battery connects to AGC line and positive terminal of battery connects to receiver chassis. (See Fig. 15 for convenient point of connection.)

STANDARD SIGNAL GENERATOR		SWEEP GENERATOR		VTVM CONNECTIONS	OSCILLOSCOPE CONNECTIONS	MISCELLANEOUS INSTRUCTIONS	COIL	TYPE OF ADJUSTMENT AND OUTPUT INDICATION
CONNECTIONS	FREQUENCY	CONNECTIONS	FREQ.					
RF AMPLIFIER AND MIXER ALIGNMENT								
Connect as shown in Fig. 11.	*215.75 MC. ‡211.25 MC.	Connect as shown in Fig. 11 and set controls for sweep width of 10 Mc. on television channel specified in the next column.	CHANNEL #13	Not used.	Connect as shown in Fig. 12	**IMPORTANT: Keep output of standard signal generator at a level that provides a readable marker but does not distort the curve that is being observed on the 'scope.**	CHANNEL #13 Antenna Coil CHANNEL #13 RF Amp. Plate Coil CHANNEL #13 Mixer Grid Coil	Adjust spacing of the turns on these coils to obtain properly shaped RF band pass characteristic as shown in Fig. 8. To determine whether the turns have to be spread or compressed, use a tuning wand having a brass slug in one end and a powdered iron slug in the other end. If the brass slug is placed near (or into) a coil and causes the response curve to approach that shown in Fig. 8, then the turns would have to be spread. On the other hand, if the powdered iron slug is similarly positioned and produces a correctly shaped response curve, then the coil turns should be compressed. Repeat these adjustments on the Antenna, RF Amp. Plate and Mixer Grid coils for Channel 13 to obtain the desired response characteristic. Do not overly broaden the curve as that would result in a loss of sensitivity. **IMPORTANT:** After the Channel #13 coils have been aligned correctly, melt the wax around the turns or apply a small amount of high frequency "coil dope" on the winding to assure that spacing will be maintained.
Same as above.	*209.75 MC. ‡205.25 MC.	Same as above.	CHANNEL #12	Not used.	Same as above.	Set Channel Selector to #12		The RF band pass characteristics of the other television channels should now be checked. Adjust the RF sweep generator and marker generator for operation on each of these television channels and observe position of sound carrier and picture carrier markers. (FIG. 8) The response curve for each channel should conform reasonably well with the curve shown in Fig. 8. If it does not, on channels 10, 11 or 12, then adjust the RF Amp. Plate coil for the particular channel; on channels 7, 8 or 9 adjust RF Amp. Plate and Mixer Grid coils; on channels 2 to 6 adjust RF Amp. Plate, Mixer Grid and Antenna coils. Adjustment consists of pushing the coil (or partial turn) toward or away from switch shaft and spreading or compressing the winding.
	*203.75 MC. ‡199.25 MC.		CHANNEL #11			Set Channel Selector to #11		
	*197.75 MC. ‡193.25 MC.		CHANNEL #10			Set Channel Selector to #10		
	*191.75 MC. ‡187.25 MC.		CHANNEL #9			Set Channel Selector to #9		
	*185.75 MC. ‡181.25 MC.		CHANNEL #8			Set Channel Selector to #8		
	*179.75 MC. ‡175.25 MC.		CHANNEL #7			Set Channel Selector to #7		
	* 87.75 MC. ‡ 83.25 MC.		CHANNEL #6			Set Channel Selector to #6		
	* 81.75 MC. ‡ 77.25 MC.		CHANNEL #5			Set Channel Selector to #5		
	* 71.75 MC. ‡ 67.25 MC.		CHANNEL #4			Set Channel Selector to #4		
	* 65.75 MC. ‡ 61.25 MC.		CHANNEL #3			Set Channel Selector to #3		
	* 59.75 MC. ‡ 55.25 MC.		CHANNEL #2			Set Channel Selector to #2		

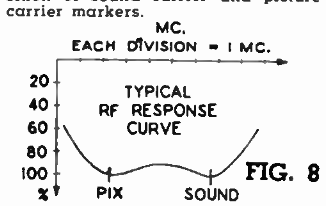

FIG. 8

*Sound Carrier Marker
‡Picture Carrier Marker

(Continued on next page)

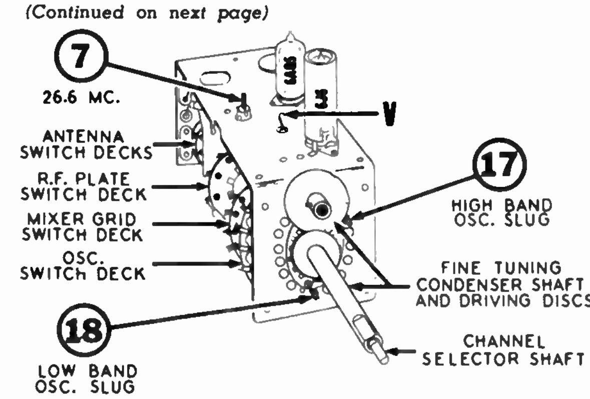

FIG. 9
Front view of TV Tuner Unit

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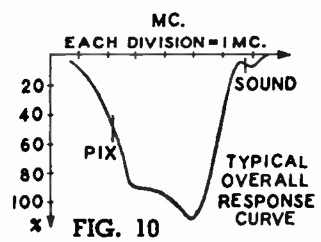
(Continued from preceding page)

STANDARD SIGNAL GENERATOR CONNECTIONS	STANDARD SIGNAL GENERATOR FREQUENCY	SWEEP GENERATOR CONNECTIONS	SWEEP GENERATOR FREQ.	VTVM CONNECTIONS	OSCILLOSCOPE CONNECTIONS	MISCELLANEOUS INSTRUCTIONS	COIL OR SLUG	TYPE OF ADJUSTMENT AND OUTPUT INDICATION
OSCILLATOR ALIGNMENT								
1. **IMPORTANT:** Before undertaking oscillator alignment be sure IF circuits are correctly aligned for band pass characteristic illustrated in Fig. 5. 2. During oscillator alignment, it is necessary to set the Fine Tuning control in the center of its range.								
Connect as shown in Fig. 11.	*215.75 MC. ‡211.25 MC.	Connect as shown in Fig. 11 and set controls for sweep width of 10 Mc. on television channel specified in the next column.	CHANNEL #13	Connect as shown in Fig. 13	Connect as shown in Fig. 13	During this step and thru-out all succeeding steps it is necessary to: 1. Be sure that Fine Tuning control has been set in the center of its range. 2. Keep output of sweep generator at a level that does not allow reading on VTVM to exceed one volt. 3. Keep output of standard signal generator at a level that provides a readable marker but does not distort the curve that is being observed on the 'scope.	#17 High Band Oscillator Slug. #18 Low Band Oscillator Slug.	Adjust the position of both slugs so that approximately 5 threads are visible outside of the fiber plate.
							CHANNEL #13 Oscillator Coil	NOTE: Before making the following adjustment, advance the vertical gain control on the 'scope in order to magnify the sound portion of the response curve. Examine the channel 13 oscillator coil and note that it has a "bucking turn." Adjust the spacing of this turn with respect to the main coil in order to shift the response curve until the sound carrier marker appears at the position shown in Fig. 10. Now, reduce gain control setting of 'scope to restore pattern to normal amplitude and observe position of picture carrier marker. This marker should appear approximately halfway up the low frequency side of the characteristic (see Fig. 10). After both pix and sound markers are correctly located on the curve, then melt the wax on the coil to permanently fix the position of the winding.
Same as above.	*209.75 MC. ‡205.25 MC.	Same as above.	CHANNEL #12	Same as above.	Same as above.	Set Channel Selector to #12		Adjust the RF sweep generator and marker generator for operation on the other television channels; set marker generator to sound carrier frequency. After setting Channel Selector to the corresponding channel, then adjust the oscillator coil  FIG. 10 for that channel so as to shift the response curve and permit the sound carrier marker to appear at the position shown in Fig. 10. Check to see that pix carrier marker falls at 50% amplitude position on opposite side of curve.
	*203.75 MC. ‡199.25 MC.		CHANNEL #11			Set Channel Selector to #11		
	*197.75 MC. ‡193.25 MC.		CHANNEL #10			Set Channel Selector to #10		
	*191.75 MC. ‡187.25 MC.		CHANNEL #9			Set Channel Selector to #9		
	*185.75 MC. ‡181.25 MC.		CHANNEL #8			Set Channel Selector to #8		
	*179.75 MC. ‡175.25 MC.		CHANNEL #7			Set Channel Selector to #7		
	* 87.75 MC. ‡ 83.25 MC.		CHANNEL #6			Set Channel Selector to #6		
	* 81.75 MC. ‡ 77.25 MC.		CHANNEL #5			Set Channel Selector to #5		
	* 71.75 MC. ‡ 67.25 MC.		CHANNEL #4			Set Channel Selector to #4		
	* 65.75 MC. ‡ 61.25 MC.		CHANNEL #3			Set Channel Selector to #3		
	* 59.75 MC. ‡ 55.25 MC.		CHANNEL #2			Set Channel Selector to #2		

Switch back to channel #13 and set both generator signals for that channel. Check position of sound carrier marker. A slight readjustment of slug #17 is usually necessary to reposition the curve so that the sound carrier is correctly located as shown in Fig. 10. If the setting of slug #17 has to be changed by two or more complete turns it should be left in its original position and all of the foregoing oscillator alignment procedure repeated. A similar check should be made for channel #6 using adjustable slug #18 in Fig. 9.

If an unsatisfactory overall response is obtained for a particular channel, observe RF Amp. and Mixer response curve for that channel as described on the preceding page. If characteristic does not conform reasonably well with the typical curve shown in Fig. 8, then attempt to obtain a better compromise for RF response on all channels by realigning Antenna, RF Amp. and Mixer circuits.

*Sound Carrier Marker
‡Picture Carrier Marker

TELEVISION RF AND OSCILLATOR CHANNEL ALIGNMENT PROCEDURE FOR INSTRUMENT CONNECTIONS

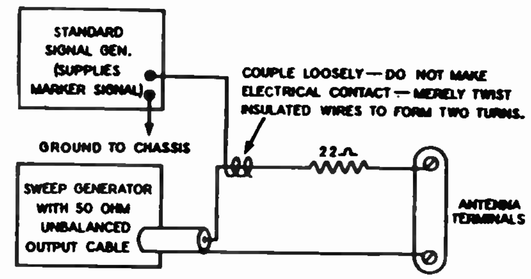


FIG. 11
Generator Connections for Television RF Channel Alignment

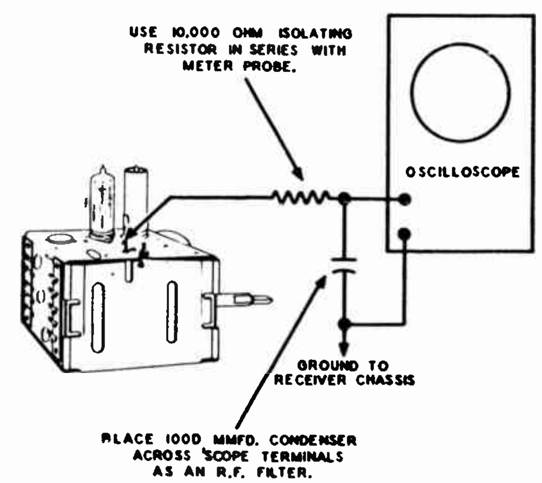


FIG. 12
Oscilloscope Connections for Television RF Amp. and Mixer Alignment

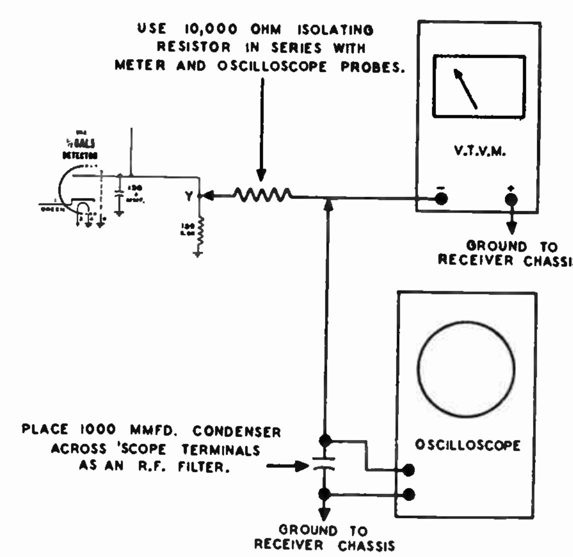
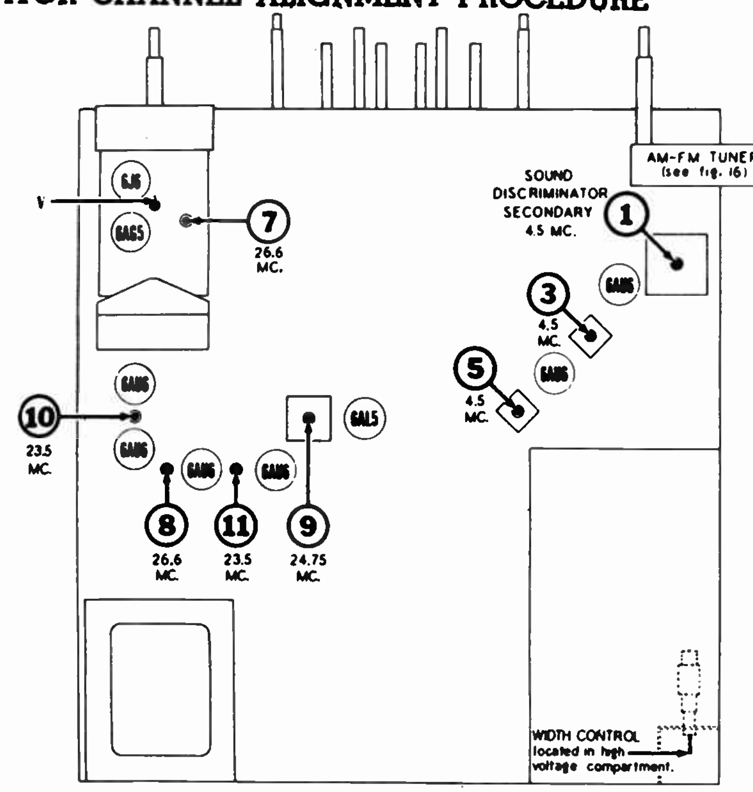
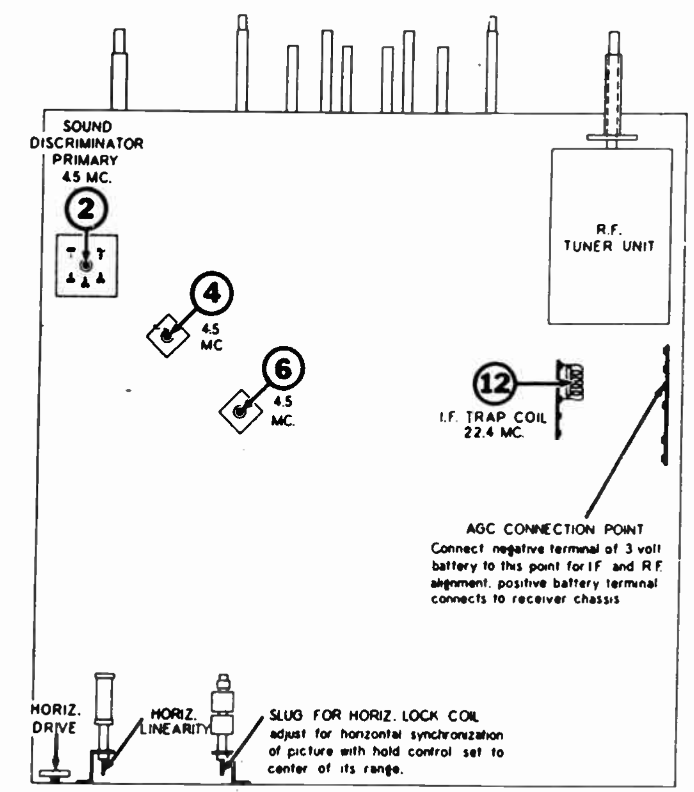


FIG. 13
VTVM and Oscilloscope Connections for TV Oscillator Alignment



TOP VIEW OF CHASSIS
FIG. 14



BOTTOM VIEW OF CHASSIS
FIG. 15

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BROADCAST BAND—"AM"—ALIGNMENT PROCEDURE

1. After the entire chassis assembly has been removed from the cabinet, remove the AM loop antena and reconnect it to the AM antenna leads extending from the AM-FM tuner chassis. Then wind one turn of insulated wire around frame of loop antenna so as to provide a means of coupling it to the signal generator. Connect one end of coupling turn to receiver chassis and allow other end to remain open until otherwise instructed in the following chart. Space loop antenna same distance away from the chassis as when assembled in the cabinet.
2. Reconnect the speaker to the two audio output leads extending from the main chassis. **IMPORTANT:** Do not confuse these leads with the two loop antenna leads.
3. Place the AM-FM dial scale escutcheon on the AM-FM tuning shaft and install the AM-FM pointer knob and fine tuning knob on their respective shafts. Then rotate these knobs to the extreme counter-clockwise position. At this setting, the gang condenser should be fully meshed; if it is not, loosen the set screws in the hub of the dial drum on the gang condenser and close gang plates manually. Then tighten set screws in hub of dial drum.
4. When aligning the RF circuits and calibrating the oscillator it is necessary to hold the AM-FM dial escutcheon in its normal mounting position so that the heavy lines below 88 and 108 are in a horizontal plane. Note that the pointer knob must point to the heavy line below 88 on the dial when tuning knob is turned fully counter-clockwise and gang plates are completely meshed.
5. **IMPORTANT:** Do not remove the metal bottom plate of AM-FM tuner chassis. Holes are provided for access to IF transformer tuning slugs. Removal of the bottom plate during alignment of the RF circuits will result in detuning when the plate is replaced.
6. Connect output meter across the speaker voice coil.
7. Connect ground lead of signal generator to the receiver chassis.
8. Set volume control to the maximum volume position and use a weak signal from the signal generator.
9. Set tone control to its extreme clockwise position.
10. Set band switch to the "AM" position.
11. After alignment procedure is completed and chassis and loop have been reinstalled in cabinet, arrange leads to loop so that they are separated from each other as much as possible avoid twisting, taping or extending these leads.

DUMMY ANT. IN SERIES WITH SIGNAL GENERATOR	CONNECT HIGH SIDE OF SIGNAL GENERATOR TO	SIGNAL GENERATOR FREQUENCY	RECEIVER DIAL SETTING	TRIMMER OR SLUG NUMBER	TRIMMER DESCRIPTION	TYPE OF ADJUSTMENT
.1 MFD. Condenser	Lug on trimmer #24 at bottom of gang (see figure 16 for location of trimmer).	455 KC	Any point where it does not affect the signal.	19 and 20	2nd I.F.	Adjust for maximum output. Then repeat adjustment.
				21 and 22	1st I.F.	
200 MMF Mica Condenser	Coupling turn on loop antenna.	1500 KC	1500 KC	23	AM Oscillator. This trimmer is accessible thru small hole in bottom of TV chassis.	Adjust for maximum output.
		1500 KC	Tune to 1500 Kc. generator signal.	24	AM Antenna	Adjust for maximum output.
200 MMF. Mica Condenser	Coupling turn on loop antenna.	600 KC	Tune to 600 Kc. generator signal.	25	Adjustable core of AM Antenna Coil.	Adjust for maximum output.

Repeat adjustment of trimmers 24 and 25 until one no longer detunes the other.

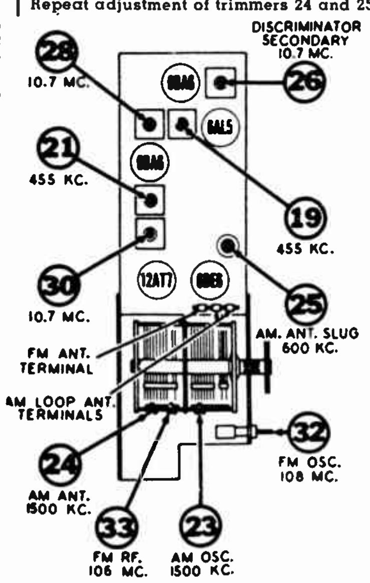


FIG. 16
AM-FM Tuner Chassis

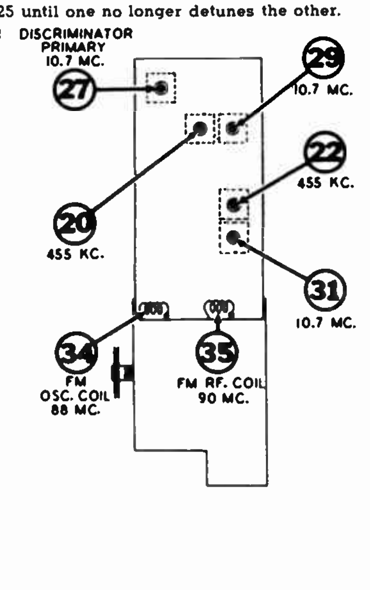


FIG. 17
AM-FM Tuner Chassis

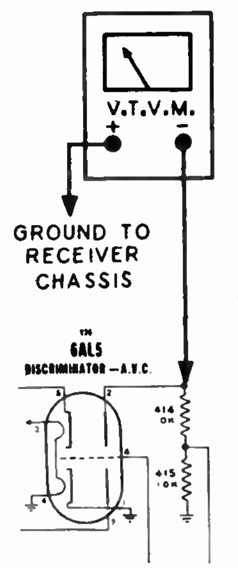


FIG. 18
VTVM Connections for FM Sound IF Alignment

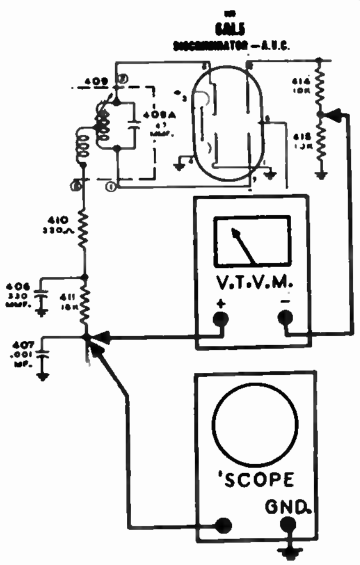
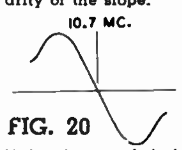


FIG. 19
VTVM and Oscilloscope Connections for FM Sound Discriminator Alignment

FREQUENCY MODULATION—"FM" ALIGNMENT PROCEDURE

1. After the entire chassis has been removed from the cabinet, replace the AM-FM dial escutcheon on the AM-FM tuning shaft and install the AM-FM pointer knob and fine tuning knob on their respective shafts. Then rotate these knobs to the extreme counter-clockwise position. At this setting, the gang condenser should be fully meshed; if it is not, loosen the set screws in the hub of the dial drum on the gang condenser and close gang plates manually. Then tighten set screws in hub of dial drum.
2. When aligning the RF circuits and calibrating the oscillator it is necessary to hold the AM-FM dial escutcheon in its normal mounting position so that the heavy lines below 88 and 108 are in a horizontal plane. Note that the pointer knob must point to the heavy line below 88 on the dial when tuning knob is turned fully counter-clockwise and gang plates are completely meshed.
3. Reconnect the speaker to the two audio output leads extending from the main chassis. **IMPORTANT:** Do not confuse these leads with the two AM loop antenna leads.
4. Remove bottom plate from AM-FM tuner during IF alignment but replace it before starting alignment of RF circuits. DO **NOT REMOVE the AM-FM tuner chassis from the TV chassis during alignment.**
5. Set band switch to the "FM" position.
6. Set volume control to the maximum volume position and use a weak signal from the signal generator.
7. Set tone control to its extreme clockwise position.
8. Dress FM circuit leads as short and straight as possible, particularly those in the oscillator circuit. IF plate and grid leads should also be kept short and straight.

STANDARD SIGNAL GENERATOR		SWEEP GENERATOR		VTVM OR OUTPUT METER CONNECTION	OSCILLOSCOPE CONNECTIONS	RECEIVER DIAL SETTING	TRIMMER OR SLUG NUMBER	TYPE OF ADJUSTMENT AND OUTPUT INDICATION
CONNECTIONS	FREQUENCY	CONNECTIONS	FREQ.					
Connect high side to lug on trimmer #33 (see Fig. 16 for location of trimmer) using a .01 Mfd. condenser in series with generator lead. Connect ground lead to the receiver chassis in vicinity of gang condenser.	10.7 MC. Unmodulated	Not used.	——	Connect VTVM as shown in Fig. 18.	Not used.	Any position where it does not affect the signal.	#26 Discriminator secondary; #27 Discriminator primary; #28—29 2nd IF; #30—31 1st IF	Adjust these trimmers for maximum meter reading — the output voltage will be of negative polarity.
Same as above.	Same as above.	Not used.	——	Connect VTVM as shown in Fig. 19.	Not used.	Same as above.	#26 Discriminator secondary	Note that as slug #26 is rotated, a point will be found where the voltmeter will swing rather sharply from a positive to a negative reading or vice versa. The correct setting is obtained when the meter reads zero as the slug is moved thru this point.
Same as above.	Same as above. —— Attenuate signal to prevent overload and distortion of response curve.	Connect high side to lug on trimmer #33 (see Fig. 16 for location of trimmer) using a .01 Mfd. condenser in series with generator lead. Connect ground lead to the receiver chassis in vicinity of gang condenser.	10.7 MC Sweeping ±300 Kc.	Not used.	Connect as shown in Fig. 19. —— Set vertical amplifier of 'scope for maximum amplification. —— Synchronize oscilloscope with sweep generator by connecting "horizontal input" terminals of 'scope to source of horizontal sweep modulating voltage on the sweep generator.	Same as above.	#26 Discriminator secondary	A pattern similar to that shown in Fig. 20 should appear on the oscilloscope screen. Check for symmetry about the 10.7 Mc. center point and linearity of the slope.  FIG. 20 If the characteristic is not shaped properly, attempt to obtain symmetry by changing the setting of slug #26. Should that fail to produce the desired results, then a slight readjustment of slugs #27, 28, 29 30 and 31 should be undertaken.
IMPORTANT:—Before starting alignment of the RF and Oscillator circuits, be sure to replace the bottom plate on the AM-FM Tuner chassis. Failure to observe this requirement would result in detuning if plate were replaced after alignment is completed.								
Connect high side in series with a 270 ohm carbon resistor to FM antenna terminal near gang condenser (see Fig. 16). Connect ground lead to receiver chassis.	108 MC. with 400 cycle AM Modulation.	Not used.	——	Connect OUTPUT METER across speaker voice coil.	Not used.	108 Mc.	#32 FM Oscillator	Set trimmer #32 to receive 108 Mc. signal as indicated by maximum meter reading.
Same as above.	106 MC. with 400 cycle AM Modulation.	Not used.	——	Same as above.	Not used.	Tune to 106 Mc. generator signal.	#33 FM RF	Adjust trimmer for maximum meter reading.

Check calibration and tracking of receiver with input signals of 88, 90 and 106 MC. If difference between dial pointer setting and the above mentioned frequencies does not exceed ±0.3 MC. and RF circuit is tracking properly, then alignment may be considered satisfactory and no further adjustment is necessary.
Where the calibration error is greater than ±0.3 MC. it is advisable to make the following adjustments:
Tune receiver to an 88 MC. signal and note whether dial pointer is above or below correct calibration point. Then tune receiver so that dial pointer is at the 88 MC. position. If generator signal was previously received at a setting above 88 MC., it will be necessary to slightly spread the windings of the FM oscillator coil (#34 in Fig. 17) so that signal will now be received at the correct dial setting. On the other hand, if generator signal was received at a dial setting below 88 MC., then slightly compress the windings of the oscillator coil until the signal comes in at the correct calibration point.
Check calibration at 108 MC. and if it is in error by more than ±0.3 MC., readjust setting of trimmer #32. Repeat calibration adjustment at 88 and 108 MC. until desired accuracy is obtained.
Observe dial calibration at 106 MC. If it is found to be incorrect by an appreciable amount, then make a very slight adjustment in the spacing of the gang condenser plates to receive the 106 MC. signal at the correct dial setting. Then check adjustment of RF trimmer #33 to obtain maximum output indication at 106 MC.

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PARTS LIST FOR CHASSIS

NOTICE: Some parts listed below have special characteristics. Do not use substitutes for replacement purposes.

SCHEMATIC LOCATION	PART NO.	DESCRIPTION
		CONDENSERS
11	W513001	Condenser—ceramic 2.2 Mmfd. 500 volt
12-A, B	W508061	Condenser—ceramic 51 Mmfd. (part of 1st Sound I.F. transformer)
13	W513013	Condenser—ceramic 5000 Mmfd. 450 volt
16	W513013	Condenser—ceramic 5000 Mmfd. 450 volt
18-A, B	W508061	Condenser—ceramic 51 Mmfd. (part of 2nd Sound I.F. transformer)
19	W513013	Condenser—ceramic 5000 Mmfd. 450 volt
21	W513433	Condenser—ceramic 47 Mmfd. ± 10% 500 volt (Temperature compensating)
23	W513013	Condenser—ceramic 5000 Mmfd. 450 volt
25	W513009	Condenser—ceramic 1000 Mmfd. 500 volt
26-A	W507321	Condenser—ceramic 110 Mmfd. (part of discriminator transformer)
27	W512527	Condenser—mica 220 Mmfd. ± 10% 500 volt
29	W513010	Condenser—ceramic 1500 Mmfd. 350 volt
30	W512027	Condenser—.05 Mfd. 200 volt
32	W512007	Condenser—.005 Mfd. 600 volt
34	W512007	Condenser—.005 Mfd. 600 volt
36	W505174	Condenser—electrolytic 10 Mfd. 150 volt
41	W513010	Condenser—ceramic 1500 Mmfd. 350 volt
42	W502547	Condenser—electrolytic 4 Mfd. 150 volt
44	W502527	Condenser—electrolytic 50 Mfd. 25 volt
46	W504719	Condenser—electrolytic 4 Mfd. 450 volt
48	W512003	Condenser—.002 Mfd. 600 volt
50	W504719	Condenser—electrolytic 4 Mfd. 450 volt
52-A, B, C	W508072	Condenser—electrolytic A—40 Mfd. 450 volt, B—40 Mfd. 450 volt, C—40 Mfd. 450 volt
54	W508324	Condenser—trimmer 4-70 Mmfd.
100	W513009	Condenser—ceramic 1000 Mmfd. 500 volt
105	W512532	Condenser—mica 240 Mmfd. ± 5% 500 volt
106	W513009	Condenser—ceramic 1000 Mmfd. 500 volt
109	W513016	Condenser—ceramic 82 Mmfd. ± 10% 500 volt
112	W513009	Condenser—ceramic 1000 Mmfd. 500 volt
114	W513009	Condenser—ceramic 1000 Mmfd. 500 volt
117	W513016	Condenser—ceramic 82 Mmfd. ± 10% 500 volt
120	W513009	Condenser—ceramic 1000 Mmfd. 500 volt
122	W513009	Condenser—ceramic 1000 Mmfd. 500 volt
126	W513016	Condenser—ceramic 82 Mmfd. ± 10% 500 volt
133	W513009	Condenser—ceramic 1000 Mmfd. 500 volt
136	W513433	Condenser—ceramic 47 Mmfd. ± 10% 500 volt (Temperature compensating)
138	W513432	Condenser—ceramic 5 Mmfd. ± 10% 500 volt (Temperature compensating)
140	W512045	Condenser—.25 Mfd. ± 10% 200 volt
145	W512027	Condenser—.05 Mfd. 200 volt
148	W512045	Condenser—.25 Mfd. ± 10% 200 volt
150	W513003	Condenser—ceramic 100 Mmfd. 500 volt
154	W512033	Condenser—.1 Mfd. 200 volt
157	W512027	Condenser—.05 Mfd. 200 volt
167, 168	W512031	Condenser—.05 Mfd. 600 volt
174	W512019	Condenser—.02 Mfd. 600 volt
175	W512031	Condenser—.05 Mfd. 600 volt
176	W513018	Condenser—ceramic 220 Mmfd. 500 volt
183	W513015	Condenser—mica 56 Mmfd. ±10% 500 volt
187	W512045	Condenser—.25 Mfd. ± 10% 200 volt
192, 193	W513009	Condenser—ceramic 1000 Mmfd. 500 volt
196	W512013	Condenser—.01 Mfd. 600 volt
199	W513013	Condenser—ceramic 5000 Mmfd. 450 volt
201	W512027	Condenser—.05 Mfd. 200 volt
204	W512531	Condenser—mica 3300 Mmfd. ± 5% 500 volt
205	W513007	Condenser—ceramic 330 Mmfd. 500 volt
210	W512535	Condenser—mica 390 Mmfd. ± 10% 500 volt
211	W512536	Condenser—mica 270 Mmfd. ± 10% 500 volt
212	W508071	Condenser—trimmer 10-160 Mmfd. (Horizontal Drive Control)
214-A to D	W508074	Condenser—electrolytic A—20 Mfd. 450 volt, B—10 Mfd. 450 volt, C—100 Mfd. 25 volt, D—10 Mfd. 450 volt
217	W512047	Condenser—.25 Mfd. ± 10% 400 volt
		CONDENSERS—Continued
219	W512031	Condenser—.05 Mfd. 600 volt
223	W512537	Condenser—mica 10 Mmfd. ± 10% 1500 volt
224	W512015	Condenser—.02 Mfd. 200 volt
227	W512031	Condenser—.05 Mfd. 600 volt
230	W513021	Condenser—ceramic 500 Mmfd. 10,000 volt
232	W512039	Condenser—.15 Mfd. ± 10% 200 volt
234	W512049	Condenser—.25 Mfd. ± 10% 600 volt
235	W512027	Condenser—.05 Mfd. 200 volt
236	W512049	Condenser—.25 Mfd. ± 10% 600 volt
237, 238	W512255	Condenser—.01 Mfd. 400 volt
240	W513013	Condenser—ceramic 5000 Mmfd. 450 volt
242, 243	W513009	Condenser—ceramic 1000 Mmfd. 500 volt
245, 246	W513009	Condenser—ceramic 1000 Mmfd. 500 volt
249-A, B	W508073	Condenser—electrolytic A—20 Mfd. 300 volt, B—60 Mfd. 300 volt
250	W513018	Condenser—ceramic 220 Mmfd. 500 volt
258	W513009	Condenser—ceramic 1000 Mmfd. 500 volt
260	W513013	Condenser—ceramic 5000 Mmfd. 450 volt
262-A	W508062	Condenser—ceramic .01 Mfd. 450 volt (part of integrator unit)
262-C	W508062	Condenser—ceramic 2000 Mmfd. 450 volt (part of integrator unit)
262-E	W508062	Condenser—ceramic 5000 Mmfd. 450 volt (part of integrator unit)
262-G	W508062	Condenser—ceramic 5000 Mmfd. 450 volt (part of integrator unit)
264	W512533	Condenser—mica 4700 Mmfd. ± 5% 1000 volt
273	W512306	Condenser—.1 Mfd. ± 10% 600 volt
274	W512037	Condenser—.1 Mfd. 600 volt
295	W508569	Condenser—ceramic 15 Mmfd. ± 10% 500 volt
297	W508570	Condenser—ceramic 680 Mmfd. 500 volt
299	W508572	Condenser—ceramic 470 Mmfd. 500 volt
300-A, B	W508576	Condenser—ceramic A—1000 Mmfd. 500 volt, B—1000 Mmfd. 500 volt
313	W508573	Condenser—ceramic .25 Mmfd. ± 10% 500 volt
314	W508574	Condenser—ceramic .5 Mmfd. ± 10% 500 volt (Temperature compensating)
315	W508575	Condenser—ceramic 1.8 Mmfd. ± 10% 500 volt
329	W508572	Condenser—ceramic 470 Mmfd. 500 volt
342	W508571	Condenser—ceramic 10 Mmfd. ± 10% 500 volt (Temperature compensating)
343	W508557	Condenser—ceramic 3 Mmfd. ± 10% 500 volt
346	W508551	Condenser—trimmer 1.2-2.5 Mmfd. when mounted to chassis (Fine tuning)
347	W508571	Condenser—ceramic 10 Mmfd. ± 10% 500 volt (Temperature compensating)
350	W513005	Condenser—ceramic 220 Mmfd. 500 volt
351	W513009	Condenser—ceramic 1000 Mmfd. 500 volt
353	W513006	Condenser—ceramic 270 Mmfd. 500 volt
355	W512007	Condenser—.005 Mfd. 600 volt
356	W512013	Condenser—.01 Mfd. 600 volt
359	W160095	Condenser—electrolytic 40 Mfd. 300 volt
362	W513002	Condenser—ceramic 47 Mmfd. 500 volt
366-A to D	W508186	Condenser—variable gang
367	W513009	Condenser—ceramic 1000 Mmfd. 500 volt
371	W507940	Condenser—trimmer 1.5-12 Mmfd.
373	W513007	Condenser—ceramic 330 Mmfd. 500 volt
376	W513009	Condenser—ceramic 1000 Mmfd. 500 volt
377	W513000	Condenser—ceramic 1.0 Mmfd. 500 volt
378	W513002	Condenser—ceramic 47 Mmfd. 500 volt
380	W513002	Condenser—ceramic 47 Mmfd. 500 volt
382	W513436	Condenser—ceramic 2.5 Mmfd. 500 volt (Temperature compensating)
384	W513001	Condenser—ceramic 2.2 Mmfd. 500 volt
387-A, B	W506080	Condenser—ceramic 33 Mmfd. (part of 1st FM I. F. transformer)
388-A	W505867	Condenser—ceramic 83 Mmfd. (part of 1st AM I. F. transformer)
388-B	W505867	Condenser—ceramic 66 Mmfd. (part of 1st AM I. F. transformer)
389	W513013	Condenser—ceramic 5000 Mmfd. 450 volt
391	W513013	Condenser—ceramic 5000 Mmfd. 450 volt
393	W513013	Condenser—ceramic 5000 Mmfd. 450 volt
		CONDENSERS—Continued
396	W513013	Condenser—ceramic 5000 Mmfd. 450 volt
397-A	W505905	Condenser—ceramic 83 Mmfd. (part of 2nd FM I. F. transformer)
398-A	W505867	Condenser—ceramic 83 Mmfd. (part of 2nd AM I. F. transformer)
398-B	W505867	Condenser—ceramic 66 Mmfd. (part of 2nd AM I. F. transformer)
399-A	W506338	Condenser—ceramic 100 Mmfd. 400 volt (part of diode filter unit)
399-C	W506338	Condenser—ceramic 100 Mmfd. 400 volt (part of diode filter unit)
401	W512028	Condenser—.05 Mfd. 400 volt
403, 404	W513013	Condenser—ceramic 5000 Mmfd. 450 volt
406	W513007	Condenser—ceramic 330 Mmfd. 500 volt
407	W512103	Condenser—.001 Mfd. 400 volt
408	W513013	Condenser—ceramic 5000 Mmfd. 450 volt
409-A	W508179	Condenser—ceramic 47 Mmfd. (part of FM discriminator)
412	W513013	Condenser—ceramic 5000 Mmfd. 450 volt
413	W513009	Condenser—ceramic 1000 Mmfd. 500 volt
416	W513007	Condenser—ceramic 330 Mmfd. 500 volt
417	W507946	Condenser—electrolytic 3 Mfd. 50 volt
419	W513023	Condenser—ceramic 10 Mmfd. ± 10% 500 volt
421	W513009	Condenser—ceramic 1000 Mmfd. 500 volt
		RESISTORS
14	W510117	Resistor—carbon 82 Ohms ± 10% ½ watt
17	W510137	Resistor—carbon 1000 Ohms ½ watt
20	W510185	Resistor—carbon 470,000 Ohms ½ watt
22	W510117	Resistor—carbon 82 Ohms ± 10% ½ watt
24	W510137	Resistor—carbon 1000 Ohms ½ watt
28	W510160	Resistor—carbon 22,000 Ohms ± 10% ½ watt
31	W510170	Resistor—carbon 68,000 Ohms ½ watt
35	W510197	Resistor—carbon 10 Meg. ½ watt
38	W510163	Resistor—carbon 33,000 Ohms ± 10% ½ watt
39, 40	W510159	Resistor—carbon 18,000 Ohms ± 10% ½ watt
45	W510227	Resistor—carbon 330 Ohms ± 10% 1 watt
47	W510153	Resistor—carbon 8200 Ohms ± 10% ½ watt
101	W510151	Resistor—carbon 6800 Ohms ± 10% ½ watt
102	W510137	Resistor—carbon 1000 Ohms ½ watt
104	W510117	Resistor—carbon 82 Ohms ± 10% ½ watt
108	W510137	Resistor—carbon 1000 Ohms ½ watt
110	W510153	Resistor—carbon 8200 Ohms ± 10% ½ watt
111	W510137	Resistor—carbon 1000 Ohms ½ watt
113	W510117	Resistor—carbon 82 Ohms ± 10% ½ watt
116	W510137	Resistor—carbon 1000 Ohms ½ watt
118	W510148	Resistor—carbon 4700 Ohms ± 10% ½ watt
119	W510137	Resistor—carbon 1000 Ohms ½ watt
121	W510117	Resistor—carbon 82 Ohms ± 10% ½ watt
123	W510153	Resistor—carbon 8200 Ohms ± 10% ½ watt
124	W510137	Resistor—carbon 1000 Ohms ½ watt
130	W510115	Resistor—carbon 68 Ohms ± 10% ½ watt
132	W510153	Resistor—carbon 8200 Ohms ± 10% ½ watt
135	W510137	Resistor—carbon 1000 Ohms ½ watt
139	W510151	Resistor—carbon 6800 Ohms ± 10% ½ watt
141	W510254	Resistor—carbon 10,000 Ohms ± 10% 1 watt
142	W510253	Resistor—carbon 8200 Ohms ± 10% 1 watt
144	W510166	Resistor—carbon 47,000 Ohms ± 10% ½ watt
146	W510164	Resistor—carbon 33,000 Ohms ½ watt
147	W510155	Resistor—carbon 10,000 Ohms ½ watt
149	W510150	Resistor—carbon 5600 Ohms ± 10% ½ watt
151	W510173	Resistor—carbon 100,000 Ohms ½ watt
153	W510150	Resistor—carbon 5600 Ohms ± 10% ½ watt
155	W510191	Resistor—carbon 1 Meg. ½ watt
156	W510356	Resistor—carbon 12,000 Ohms ± 10% 2 watt
158	W510191	Resistor—carbon 1 Meg. ½ watt
159	W510126	Resistor—carbon 270 Ohms ± 10% ½ watt
162	W510723	Resistor—carbon 12,000 Ohms ± 5% ½ watt
164, 165	W510339	Resistor—carbon 1500 Ohms ± 10% 2 watt
166	W510179	Resistor—carbon 220,000 Ohms ½ watt
169	W510191	Resistor—carbon 1 Meg. ½ watt
170	W510173	Resistor—carbon 100,000 Ohms ½ watt
		RESISTORS—Continued
171	W510171	Resistor—carbon 82,000 Ohms ± 10% ½ watt
172	W510161	Resistor—carbon 22,000 Ohms ½ watt
177	W510143	Resistor—carbon 2200 Ohms ½ watt
178	W510157	Resistor—carbon 15,000 Ohms ± 10% ½ watt
182	W510332	Resistor—carbon 560 Ohms ± 10% 2 watt
185, 186	W510132	Resistor—carbon 560 Ohms ± 10% ½ watt
188	W510180	Resistor—carbon 270,000 Ohms ± 10% ½ watt
189	W510181	Resistor—carbon 330,000 Ohms ± 10% ½ watt
190	W510141	Resistor—carbon 1800 Ohms ± 10% ½ watt
191	W510144	Resistor—carbon 2700 Ohms ± 10% ½ watt
194, 195	W510172	Resistor—carbon 100,000 Ohms ± 10% ½ watt
197	W510162	Resistor—carbon 27,000 Ohms ± 10% ½ watt
198	W510195	Resistor—carbon 4.7 Meg. ½ watt
200	W510185	Resistor—carbon 470,000 Ohms ½ watt
203	W510150	Resistor—carbon 5600 Ohms ± 10% ½ watt
206	W510139	Resistor—carbon 1500 Ohms ± 10% ½ watt
207	W510175	Resistor—carbon 150,000 Ohms ± 10% ½ watt
209	W510180	Resistor—carbon 270,000 Ohms ± 10% ½ watt
213	W510191	Resistor—carbon 1 Meg. ½ watt
215	W510116	Resistor—carbon 68 Ohms ½ watt
216	W510261	Resistor—carbon 22,000 Ohms 1 watt
218	W510317	Resistor—carbon 82 Ohms ± 10% 2 watt
220	W510248	Resistor—carbon 4700 Ohms ± 10% 1 watt
226	W510154	Resistor—carbon 10,000 Ohms ± 10% ½ watt
228	W510725	Resistor—carbon 3.3 Ohms ± 10% ½ watt
229	W510728	Resistor—wire wound 15,000 Ohms ± 10% 10 watt
231	W510391	Resistor—carbon 1 Meg. 2 watt
247	W510319	Resistor—carbon 100 Ohms 2 watt
252	W510726	Resistor—wire wound 850 Ohms 5 watt
262-B	W508062	Resistor—carbon 22,000 Ohms 1/5 watt (part of integrator unit)
262-D	W508062	Resistor—carbon 8200 Ohms 1/5 watt (part of integrator unit)
262-F	W508062	Resistor—carbon 8200 Ohms 1/5 watt (part of integrator unit)
265	W510190	Resistor—carbon 1 Meg. ± 10% ½ watt
267	W510172	Resistor—carbon 100,000 Ohms ± 10% ½ watt
268	W510196	Resistor—carbon 6.8 Meg. ½ watt
269	W510192	Resistor—carbon 1.5 Meg. ½ watt
271	W510168	Resistor—carbon 56,000 Ohms ± 10% ½ watt
272	W510145	Resistor—carbon 3300 Ohms ± 10% ½ watt
275	W510193	Resistor—carbon 2.2 Meg. ½ watt
276	W510132	Resistor—carbon 560 Ohms ± 10% ½ watt
279	W510244	Resistor—carbon 2700 Ohms ± 10% 1 watt
296	W510142	Resistor—carbon 2200 Ohms ± 10% ½ watt
298	W510148	Resistor—carbon 4700 Ohms ± 10% ½ watt
316	W510180	Resistor—carbon 270,000 Ohms ± 10% ½ watt
341	W510148	Resistor—carbon 4700 Ohms ± 10% ½ watt
344	W510161	Resistor—carbon 22,000 Ohms ½ watt
348	W510158	Resistor—carbon 15,000 Ohms ½ watt
354	W510185	Resistor—carbon 470,000 Ohms ½ watt
357	W510179	Resistor—carbon 220,000 Ohms ½ watt
358	W510733	Resistor—wire wound 650 Ohms ± 10% 10 watt
360	W510727	Resistor—wire wound 7500 Ohms ± 10% 5 watt
368	W510173	Resistor—carbon 100,000 Ohms ½ watt
381	W510193	Resistor—carbon 2.2 Meg. ½ watt
383	W510155	Resistor—carbon 10,000 Ohms ½ watt
386	W510136	Resistor—carbon 1000 Ohms ± 10% ½ watt
390	W510152	Resistor—carbon 6800 Ohms ½ watt
392	W510249	Resistor—carbon 4700 Ohms 1 watt
394	W510146	Resistor—carbon 3300 Ohms ½ watt
395	W510246	Resistor—carbon 3300 Ohms 1 watt
399-B	W506338	Resistor—carbon 47,000 Ohms 1/5 watt (part of diode filter unit)
400	W510185	Resistor—carbon 470,000 Ohms ½ watt
402	W510193	Resistor—carbon 2.2 Meg. ½ watt
405	W510240	Resistor—carbon 1500 Ohms 1 watt
410	W510125	Resistor—carbon 220 Ohms ½ watt
411	W510159	Resistor—carbon 18,000 Ohms ± 10% ½ watt
414, 415	W510155	Resistor—carbon 10,000 Ohms ½ watt
420	W510122	Resistor—carbon 150 Ohms ½ watt
422, 423	W510725	Resistor—carbon 3.3 Ohms ± 10% ½ watt

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PARTS LIST FOR CHASSIS (Cont.)

CONTROLS

SCHEMATIC LOCATION	PART NO.	DESCRIPTION
33-A, B	W508182	Volume control—1 Meg. (with switch)
43-A to D	W508458	Band switch (includes volume control)
54	W508324	Built-in Antenna tuning condenser (4-70 Mmfd.)
160-A, B	W508457	Tone and Contrast potentiometer A—Tone control; 500,000 Ohms ¼ watt B—Contrast control; 3000 Ohms ± 10% 4 w.
173	W508056	Brightness potentiometer (50,000 Ohms)
180	W508456	Focus potentiometer (5500 Ohms ± 10% 4 watt)
202	W508077	Horizontal Lock coil (less slug)
	W507429	Slug core for Horizontal Lock coil
208	W508056	Horizontal Hold potentiometer (50,000 Ohms)
212	W508071	Horizontal Drive trimmer condenser (10-160 Mmfd.)
225	W508218	Width coil (includes slug and clip)
	W508435	Slug core for Width coil
233	W162056	Horizontal Linearity coil (includes slug and clip)
	W507429	Slug core for Horizontal Linearity coil
266	W508454	Vertical Hold potentiometer (1 Meg.)
270	W508455	Height potentiometer (2.5 Meg.)
277	W508453	Vertical Linearity potentiometer (6000 Ohms)
346	W508551	Fine Tuning trimmer 1.2 to 2.5 Mmfd. when mounted to chassis
369-A to D	W508185	Band Switch (on AM-FM tuner)

COILS AND TRANSFORMERS

SCHEMATIC LOCATION	PART NO.	DESCRIPTION
12	W508061	Transformer—1st sound I. F.
15	W507373	Coil—choke
18	W508061	Transformer—2nd sound I. F.
26	W507321	Transformer—TV sound discriminator (includes condenser 26-A)
	W508438	Slug core for primary of TV sound discriminator transformer
	W508439	Slug core for secondary of TV sound discriminator transformer
37	W507373	Coil—choke
49	W505912	Transformer—sound output
103	W507567	Coil— I. F. trap
107	W507343	Coil—1st video I. F. (less slug)
	W507357	Slug core for 1st video I. F. coil
115	W507343	Coil—2nd video I. F. (less slug)
	W507357	Slug core for 2nd video I. F. coil
125	W507343	Coil—3rd video I. F. (less slug)
	W507357	Slug core for 3rd video I. F. coil
128	W507367	Coil—choke
134	W507591	Coil—4th video I. F. assembly (includes condenser 136 and choke coil 137)
	W507357	Slug core for 4th video I. F. coil
137	W507367	Coil—choke
143	W507374	Coil—peaking
152	W507374	Coil—peaking
161	W508069	Coil—peaking
163	W508070	Coil—peaking
181	W508065	Coil—focus
184	W507791	Yoke—picture tube deflection
202	W508077	Coil—Horizontal Lock (less slug)
	W507529	Slug core for Horizontal Lock coil
222	W508058	Transformer—horizontal fly-back
225	W508218	Coil—Width (includes slug and clip)
	W508435	Slug core for Width coil
233	W162056	Coil—Horizontal Linearity (includes slug and clip)
	W507429	Slug core for Horizontal Linearity coil
239	W508060	Transformer—power
241	W507586	Coil—choke
244	W507587	Coil—choke
248	W507584	Coil—choke
253	W508341	Choke—filter
254	W507584	Coil—choke
259	W507586	Coil—choke
263	W508076	Transformer—vertical blocking oscillator
278	W508059	Transformer—vertical output
	W508431	R. F. Unit complete with coils and tubes
283	W508553	Coil—antenna; channel #13
284	•	Coil—antenna; channel #12
285	•	Coil—antenna; channel #11
286	•	Coil—antenna; channel #10
287	•	Coil—antenna; channel #9

COILS AND TRANSFORMERS—Continued

SCHEMATIC LOCATION	PART NO.	DESCRIPTION
288	•	Coil—antenna; channel #8
289	•	Coil—antenna; channel #7
290	W508552	Coil—antenna; channel #6
291	•	Coil—antenna; channel #5 (6½ turns #24 wire .080" I. D.)
292	•	Coil—antenna; channel #4 (11½ turns #24 wire .080" I. D.)
293	•	Coil—antenna; channel #3 (11½ turns #24 wire .080" I. D.)
294	•	Coil—antenna; channel #2 (13½ turns #24 wire .080" I. D.)
301	W508554	Coil—R. F.; channel #13
302	•	Coil—R. F.; channel #12
303	•	Coil—R. F.; channel #11
304	•	Coil—R. F.; channel #10
305	•	Coil—R. F.; channel #9
306	•	Coil—R. F.; channel #8
307	•	Coil—R. F.; channel #7
308	•	Coil—R. F.; channel #6 (20½ turns #21 wire .125" I. D.)
309	•	Coil—R. F.; channel #5 (8½ turns #24 wire .080" I. D.)
310	•	Coil—R. F.; channel #4 (8½ turns #24 wire .125" I. D.)
311	•	Coil—R. F.; channel #3 (13½ turns #24 wire .080" I. D.)
312	•	Coil—R. F.; channel #2 (11½ turns #24 wire .080" I. D.)
317	•	Coil—mixer; channel #13 (4½ turns #21 wire .125" I. D.)
318	•	Coil—mixer; channel #12
319	•	Coil—mixer; channel #11
320	•	Coil—mixer; channel #10
321	•	Coil—mixer; channel #9
322	•	Coil—mixer; channel #8
323	•	Coil—mixer; channel #7
324	•	Coil—mixer; channel #6 (18½ turns #21 wire .125" I. D.)
325	•	Coil—mixer; channel #5 (6½ turns #24 wire .080" I. D.)
326	•	Coil—mixer; channel #4 (8½ turns #24 wire .125" I. D.)
327	•	Coil—mixer; channel #3 (11½ turns #24 wire .080" I. D.)
328	•	Coil—mixer; channel #2 (13½ turns #24 wire .080" I. D.)
330	•	Coil—oscillator; channel #12
331	•	Coil—oscillator; channel #11
332	•	Coil—oscillator; channel #10
333	•	Coil—oscillator; channel #9
334	•	Coil—oscillator; channel #8
335	•	Coil—oscillator; channel #7
336	W508558	Coil—oscillator; channel #6
	W508559	Slug for oscillator coil (brass); channel #6
337	•	Coil—oscillator; channel #5 (6½ turns #24 wire .080" I. D.)
338	•	Coil—oscillator; channel #4 (11½ turns #24 wire .080" I. D.)
339	•	Coil—oscillator; channel #3 (8½ turns #24 wire .080" I. D.)
340	•	Coil—oscillator; channel #2 (11½ turns #24 wire .080" I. D.)
345	W508560	Coil—oscillator; channel #13
	W508559	Slug for oscillator coil (brass); channel #13
349	W508555	Coil—converter plate (includes slug and clip)
	W508556	Slug core for converter plate coil
352	W507587	Coil—R. F. choke for 6J6 and 6AG5 filament
365	W508184	Coil—AM antenna
370	W507586	Coil—choke
372	W507935	Coil—choke
374	W507942	Coil—FM oscillator
375	W508195	Coil—AM oscillator
379	W507941	Coil—FM R. F.
385	W506581	Coil—R. F. choke (includes resistor 386)
387	W506080	Transformer—1st FM I. F.
388	W505867	Transformer—1st AM I. F.
397	W505905	Transformer—2nd FM I. F.
398	W505867	Transformer—2nd AM I. F.
409	W508179	Transformer—FM discriminator
418	W508212	Loop Antenna (AM)

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PARTS LIST FOR CHASSIS

OTHER ELECTRICAL PARTS

SCHEMATIC LOCATION	PART NO.	DESCRIPTION
43-A to D	W508458	Switch-band (includes volume control)
51	W508174	Speaker—P. M. Dynamic (6" x 9")
53	W508466	Built-in antenna (includes condenser 54)
179	W508432	Crystal cartridge
221	W508063	Fuse for horizontal sweep circuit; ¼ Amp. 250 volt
261	W118921	Lamp—TV Channel Lite (Mazda #47) 6-8 V. 150 Ma.
262-A to G	W508062	Integrator coupling unit
280	W508120	Motor—for record changer; 115 volt 60 cyc.
281	W505269	Switch—"ON-OFF" for record changer
282-A to K	•	Channel Selector switch
361	W118921	Lamp—OFF-ON Indicator Lite (Mazda #47) 6-8 V. 150 Ma.
363	W118921	Lamp—AM Channel Lite (Mazda #47) 6-8 V. 150 Ma.
364	W118921	Lamp—FM Channel Lite (Mazda #47) 6-8 V. 150 Ma.
369-A to D	W508185	Switch-band (on AM-FM tuner)
393-A,B,C	W506338	Diode filter unit A—Condenser—ceramic 100 Mmfd. 400 volt B—Resistor—carbon 47,000 Ohms 1/5 watt C—Condenser—ceramic 100 Mmfd. 400 volt
418	W508212	Loop Antenna (AM)

MECHANICAL PARTS OF R.F. TUNER

SCHEMATIC LOCATION	PART NO.	DESCRIPTION
	W508431	R. F. Unit complete with coils and tubes
	W508568	Bottom cover shield
	W508081	Bracket for tuner mounting (front)
	W508426	Bracket for tuner mtg. (rear)
	W508566	"C" washer—retains switch shaft
	W508567	"C" washer—retains fine tuning shaft
	W508564	Fine tuning disc (on trimmer shaft)
	W508565	Set screw for fine tuning disc
	W508563	Shaft, fine tuning and driving disc
	W508561	Shaft, switch (incl. indexing arm)
	W504599	Shield—tube
	W508556	Slug core for converter plate coil
	W508559	Slug—brass core for oscillator coil; channel #6 and 13
	W508562	Socket—miniature for 6J6 (incl. base for shield)
	W507364	Socket—miniature for 6AG5

CABINET PARTS

SCHEMATIC LOCATION	PART NO.	DESCRIPTION
	W508176	Back for cabinet
	W508217	Bracket for mtg. "OFF-ON" Indicator Lite at base of cabinet
	W117131	Bulls eye for "OFF-ON" Indicator Lite at base of cabinet
	W162095	Bulls eye for Channel Lite
	W508430	Cabinet
	W508529	Drawer, record changer compartment
	W508503	Escutcheon—AM-FM dial scale
	W507700	Escutcheon—channel number
	W507911	Glass window
	W502563	Knob—built-in antenna
	W507894	Knob—TV fine tuning
	W507895	Knob—channel selector
	W508471	Knob—AM-FM pointer and coarse tuning
	W508472	Knob—AM-FM fine tuning
	W508473	Knob—band switch
	W508474	Knob—"VOLUME-ON"
	W508475	Knob—horizontal hold or brightness
	W508476	Knob—contrast
	W508477	Knob—"TONE"
	W508331	Mask for picture tube
	W508479	Name plate
	W170193	Nut—retains name plate
	W508293	Rail for drawer ... per set
	W505497	Socket for OFF-ON Indicator Lite at base of cabinet
	W18796	Screw—#10 x 1", mounts chassis
	W162090	Terminal strip for TV antenna connection
	W508478	Washer—felt, for knob

MISCELLANEOUS

SCHEMATIC LOCATION	PART NO.	DESCRIPTION
	W508189	Back for AM-FM tuner
	W301270	Base for mtg. electrolytic condenser
	W508040	Bracket for deflection yoke mtg.
	W507106	Bracket for focus coil mtg.
	W508153	Bracket base for support of yoke and focus coil

MISCELLANEOUS—Continued

SCHEMATIC LOCATION	PART NO.	DESCRIPTION
	W508081	Bracket for tuner mtg. (front)
	W508426	Bracket for tuner mtg. (rear)
	W507214	Bracket, locking—holds focus coil in position during shipment
	W508510	Bracket—retains front of picture tube
	W508190	Bracket—supports AM FM tuner
	W506279	Bracket—supports band switch shaft on AM-FM tuner
	W508198	Bracket—supports band switch shaft on TV chassis
	W508038	Bracket—tube support (bottom front)
	W508154	Bracket ("U" shaped) for support of yoke and focus coil
	W505165	"C" washer for connecting link
	W507286	Connector for H.V. terminal of picture tube
	W117057	Cord—dial drive (2 ft. required) ... per ft.
	W112745	Clip for mtg. AM antenna coil
	W505101	Clip for mounting I.F. transformer
	W507592	Clip for mtg. 4th video I.F. coil
	W507339	Clip for mounting video converter plate coil 1st video I.F., 2nd video I.F., 3rd video I.F., horiz. lock and horiz. linearity coil
	W114955	Clip retainer on end of dial cord
	W508525	Drum—dial: on gang condenser
	W508155	Grounding spring for coating on picture tube
	W506803	Ion trap assy.—includes magnet
	W508527	Lever—band switch actuating (on AM-FM tuner)
	W508526	Lever—band switch actuating (on TV chassis)
	W508194	Link—connects band switch actuating levers
	W162093	Planetary drive and dial drum (incl. mtg. bracket)
	W506652	Plug for AM-FM tuner power cable
	W500966	Plug for Phono Pick-up cable
	W507699	Power cord assembly (incl. plugs at both ends)
	W507361	Rubber cover for H.V. terminal connector
	W508512	Rubber pad—fits between pix tube and bottom front support
	W507793	Rubber spacer support between flared neck of picture tube and yoke bracket
	W507422	Rubber sleeve between neck of picture tube and focus coil
	W18796	Screw—#10 x 1"; mounts chassis
	W162031	Shield—H.V. supply (front section)
	W508088	Shield—H. V. supply (rear section)
	W508506	Shield for Indicator Lite
	W507357	Slug core for 1st, 2nd, 3rd, and 4th video I.F. coils
	W507429	Slug core for Horizontal Lock and Horizontal Linearity coil
	W508438	Slug core for primary of TV sound discriminator transformer
	W508439	Slug core for secondary of TV sound discriminator transformer
	W508435	Slug core for Width coil
	W162038	Socket assembly for 1B3GT/8016 tube (incl. corona ring & mtg. frame)
	W508049	Socket and cable assembly for picture tube
	W507948	Socket for AM-FM tuner power cable
	W508460	Socket for AM or FM Channel Lite
	W508459	Socket for TV Channel Lite
	W508086	Socket for mtg. H.V. condenser 230
	W507932	Socket—male, power cord interlock
	W506576	Socket—miniature (7 pin) (for 6BE6)
	W507364	Socket—miniature (7 pin)
	W506331	Socket—miniature (9 pin) (for 12AT7)
	W508044	Socket—miniature (9 pin)
	W506220	Socket—octal
	W160039	Socket—phono plug
	W501182	Socket—phono motor cable
	W508514	Spring—retains H.V. lead
	W505161	Spring—tension
	W503994	Strap for picture tube support
	W111456	Washer—spring washer connecting link
	W170195	Wing nut #8-32; for yoke and focus coil mounting
	W170741	Wing screw #10-32; for yoke mounting
	W170817	Wing screw #10-24; for height adj. of yoke and focus coil

World Radio History

GENERAL DESCRIPTION

This RL covers Television Receiver, Catalog 149, which utilizes Television Chassis 100.107-1. The chassis is essentially the same as Television Chassis 100.107 which is covered by 57 RL 545. The differences, consisting of slight modifications in the Horizontal Sweep Circuit and a change in Cabinet styling, are described in this RL.

In addition to the above television chassis, Catalog 149, is also equipped with an AM-FM Tuner Chassis 100.043 that is identical to the AM-FM Tuner Chassis described in 57 RL 545.

A combined total of 31 tubes are provided in both chassis of this receiver. Television Chassis 100.107-1 contains 26 tubes, 23 of which are used solely for reproduction of the visual and aural portions of a television broadcast and three other rectifier tubes plus a heavy duty power transformer to provide necessary power for operation of all stages.

The AM-FM Tuner Chassis 100.043 employs 5 additional tubes in a compactly designed, high sensitivity circuit that provides reception of AM and FM broadcasts. Audio output from this chassis is fed into the audio amplifier and output stages located on the television chassis thereby permitting use of a single, high fidelity, audio system for all functions.

SPECIAL INSTRUCTIONS

The following special instructions should be observed when ordering new repair parts or returning defective parts:

1. Order new repair parts per "HOW TO ORDER PARTS" instructions on next page.
2. Return defective parts, within warranty period, to source 100 for no charge replacement. SEE DIV. 57 STANDARD NOMENCLATURE INDEX FOR SOURCE NAME AND ADDRESS.

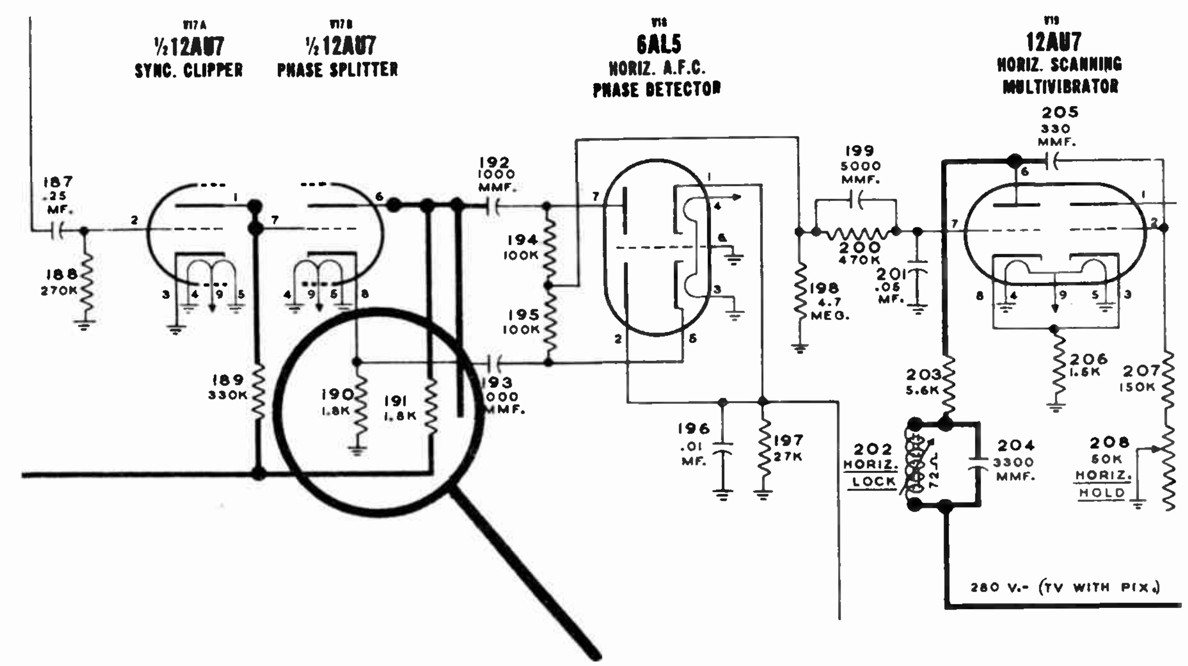
HOW TO ORDER PARTS

1. Use Correct Order Form.
2. On the Purchase Order always give the following information:
   (a) PART NUMBER (number printed on the part if different from that shown in this list) and DESCRIPTION for each part ordered. When no part number is assigned, order by description and rating. Also give PRICE of part (indicate if no selling).
   (b) The CHASSIS NUMBER, which is 100.107-1 or 100.043, will be found on a metal plate (pictured on previous page) at the rear of the chassis.
3. ORDERING INSTRUCTIONS: Send Purchase Orders DIRECT TO SOURCE No. 100. See "DIV. 57 STANDARD NOMENCLATURE INDEX" for source, name and address.
4. MARK-UP: Selling Prices in the following list produce a mark-up of A5, unless otherwise noted in the M.U. Code Column.
5. In all correspondence relating to cabinets, always mention the source code letter stamped into the bottom of table models, and the CATALOG NUMBER shown on the sticker on the back, bottom or inside of cabinet.

REPAIR PARTS LIST SUPPLEMENT

For a complete list of repair parts, refer to 57 RL 545

SCHEMATIC LOCATION	PART NO.	DESCRIPTION
51	W508157	Speaker—P.M. Dynamic (6")
190, 191	W510739	Resistor—carbon 1800 Ohms ± 5% ½ watt
	W508213	Back for cabinet
	W507783	Bottom plate
	W508706	Cabinet



CIRCUIT DIFFERENCES

The components which are encircled in the above diagram represent the only electrical difference between the 100.107-1 chassis and the 100.107 chassis as shown in 57 RL 545. These differences are listed below.

1. Resistor 190 in the cathode circuit of V17B (12AU7) Phase Splitter stage was changed in tolerance rating from ±10% to ±5%.
2. Resistor 191 in the plate circuit of V17B (12AU7) Phase Splitter stage was changed from 2700 Ohms ±10% to 1800 Ohms ±5%.

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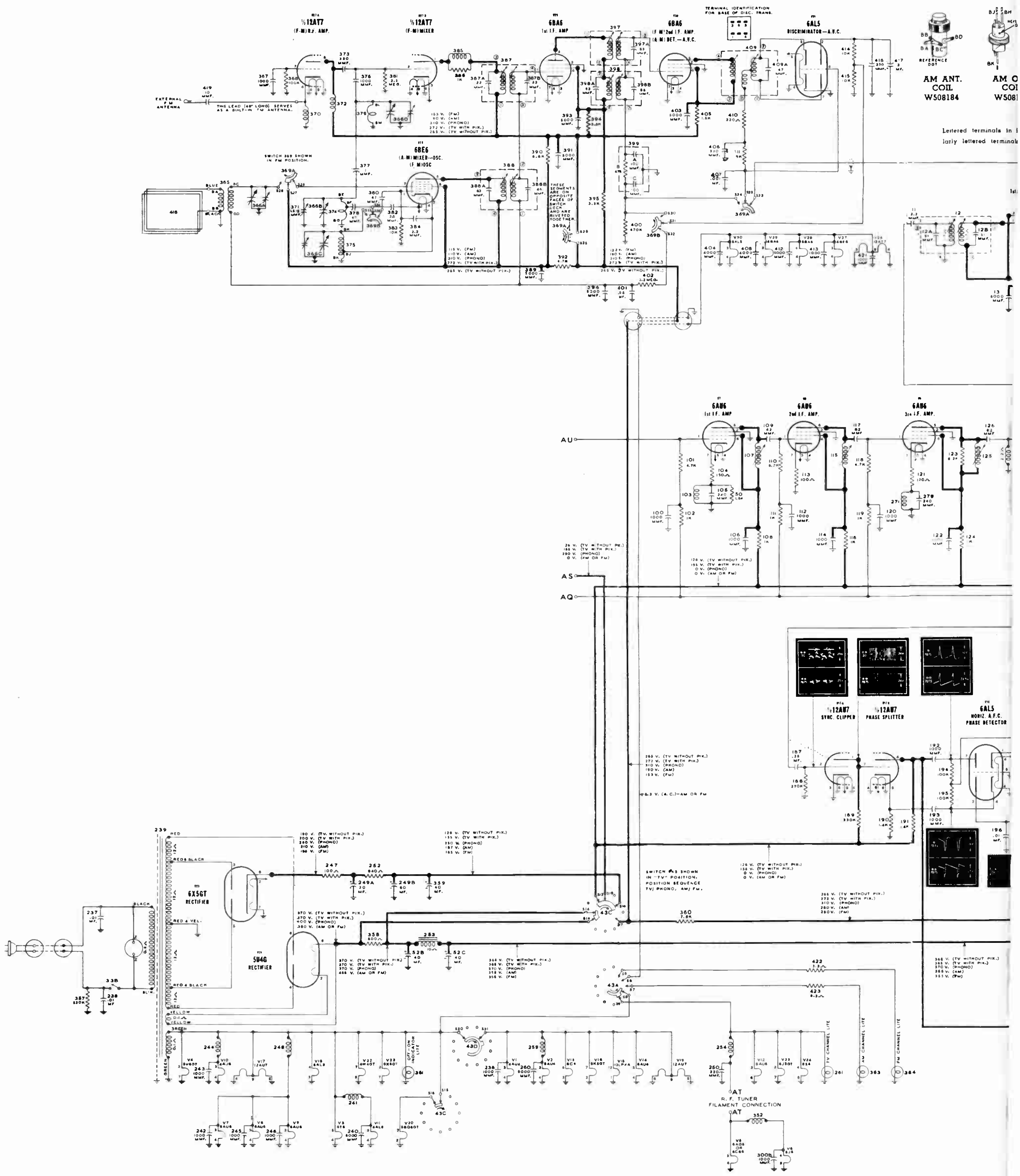
MODEL 142, Ch. 100.115,
Radio Ch. 100.959



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MODEL 133, Ch. 100.107,
Radio Ch. 100.043

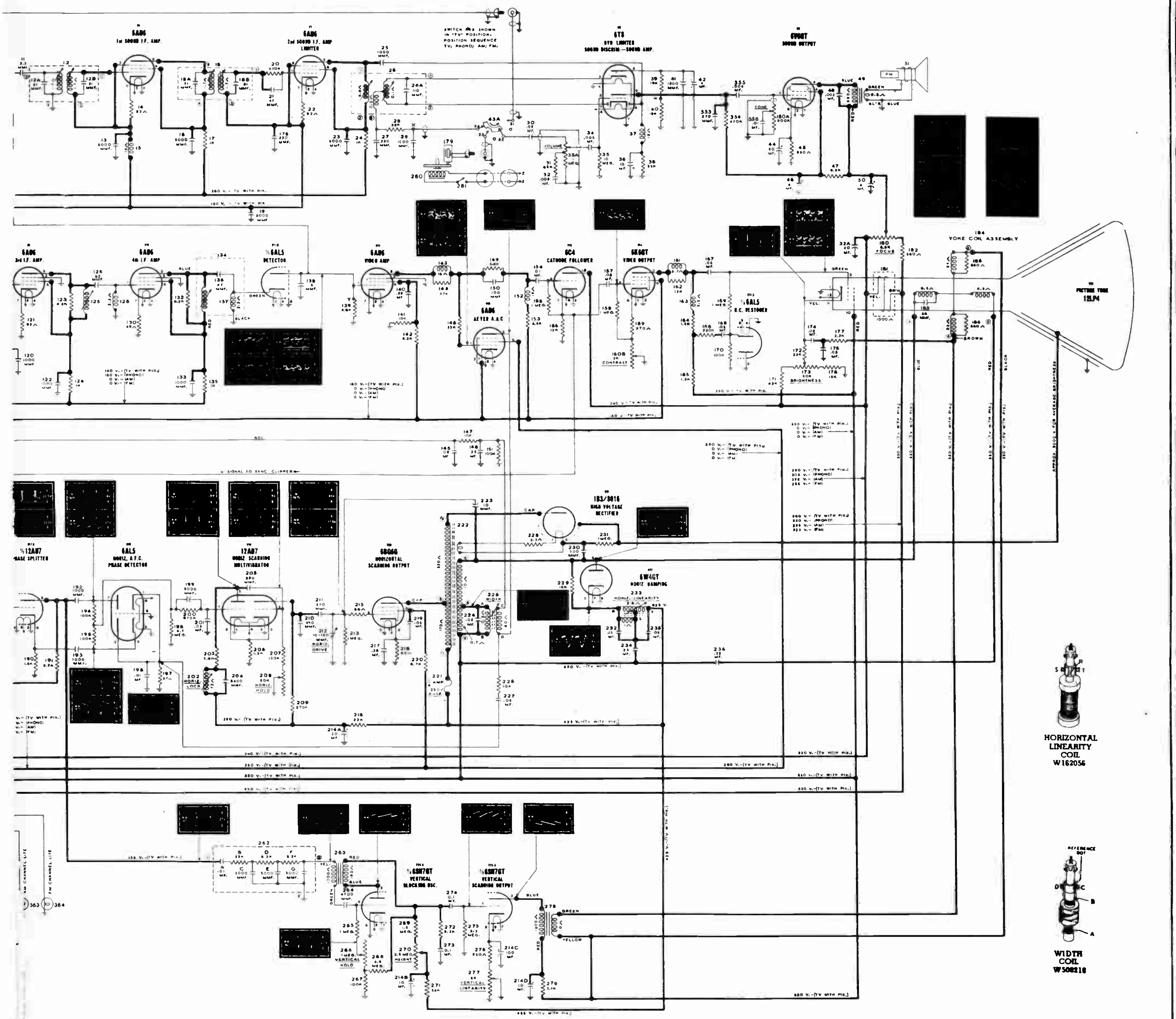
OSCILLOGRAMS

All oscillograms taken with ground lead of 'scope connected to receiver chassis (unless otherwise indicated) and with receiver controls set for normal reception of a station transmitting its standard test pattern.

Number appearing below asterisk specifies setting of horizontal sweep frequency control on 'scope.

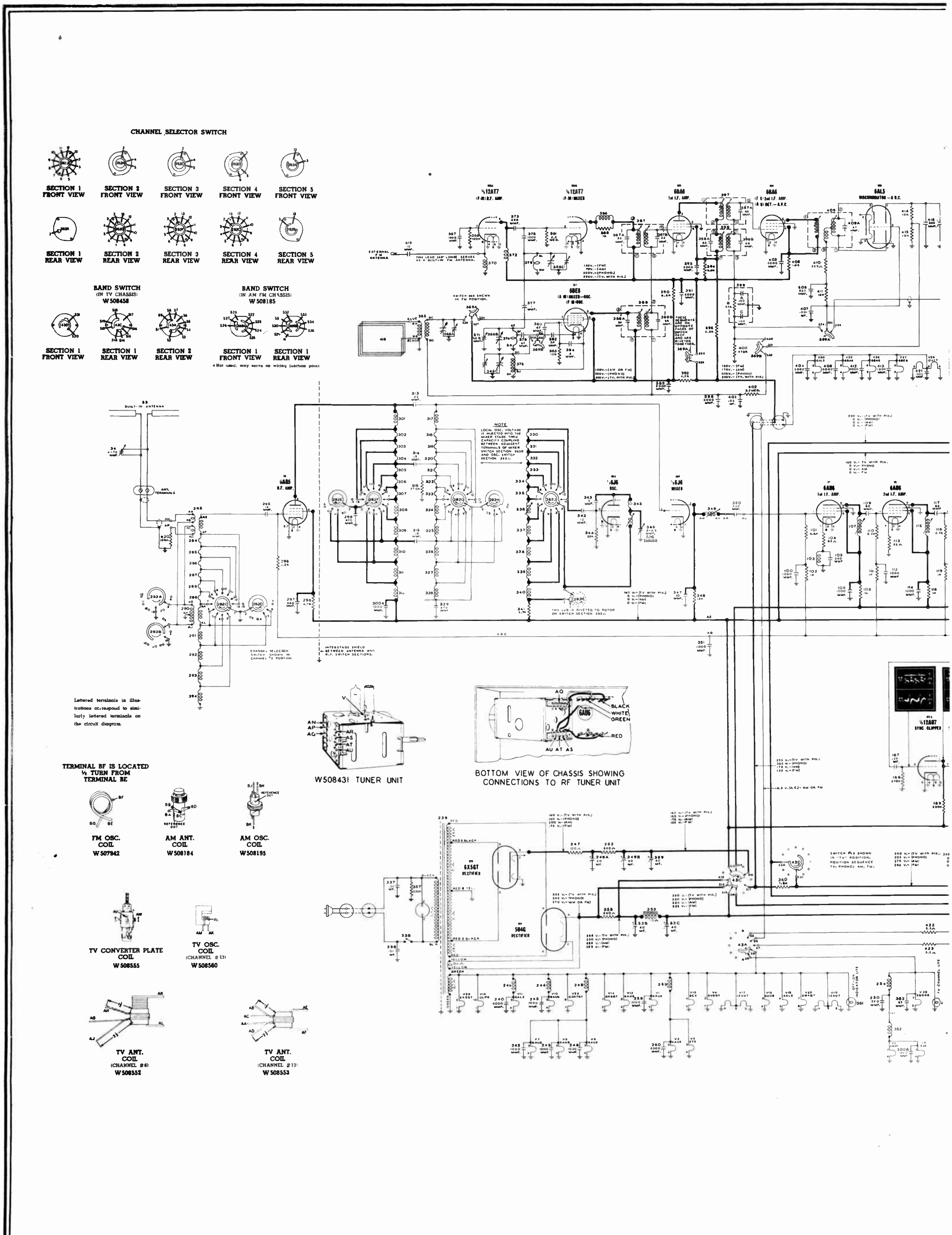
*— This symbol on illustration indicates that wave form was observed on a 'scope whose vertical amplifier had very limited high frequency response (50 to 100 Kc).

**— This symbol indicates that wave form was observed on a 'scope whose vertical amplifier frequency response was flat to within 20% up to 2 Mc.



HORIZONTAL LINEARITY COIL W162056

WIDTH COIL W508218



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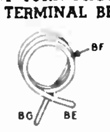
TERMINAL BF IS LOCATED ½ TURN FROM TERMINAL BE



FM OSC. COIL W507942

C.

5

...ustrations correspond to simi... on the circuit diagram.

OSCILLOGRAMS

All oscillograms taken with ground lead of 'scope connected to receiver chassis (unless otherwise indicated) and with receiver controls set for normal reception of a station transmitting its standard test pattern.

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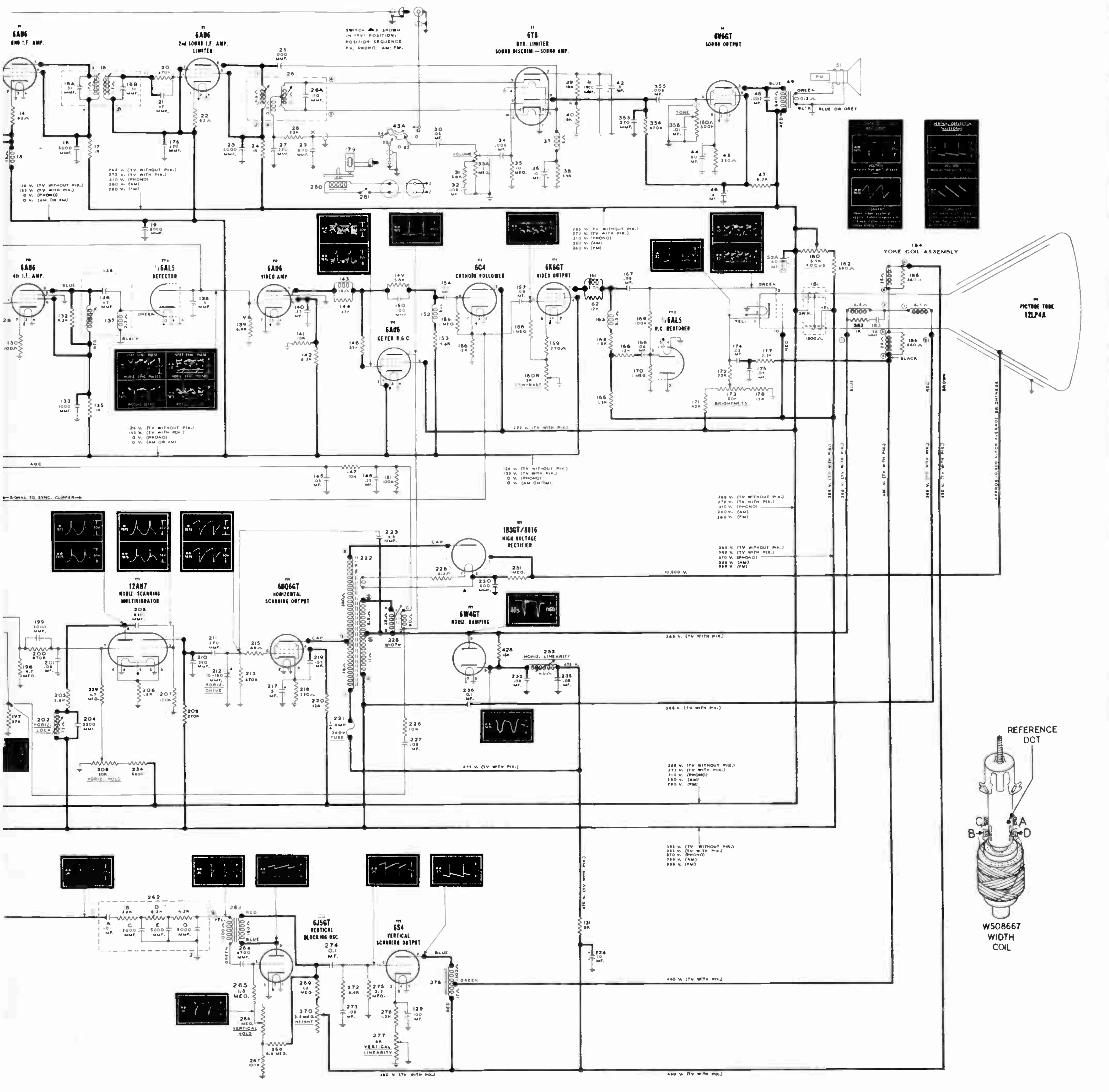

INDEX

SPECIFICATIONS

POWER REQUIREMENTS

117 volts 60 cycles

Television—230 watts
AM-FM Radio—145 watts
Phonograph—160 watts

FREQUENCY RANGE

Television—channels 2 through 13. For channel frequencies, see table on page 2.

Radio
Standard Broadcast (AM)—540-1600 Kc.
Frequency Modulation (FM)—88-108 Mc.

PICTURE SIZE

Height	Width (at widest point)	Viewing Area (sq. inches)
9"	11"	91.6

SPEAKER

Type	Size	V.C. Imped.
P.M. Dynamic	6" x 9"	3.2 ohms

ANTENNA INPUT IMPEDANCE

Balanced input for ribbon type transmission line—300 ohms.
Unbalanced input for coaxial cable—75 ohms.

BUILT-IN ANTENNA

High "Q" dipole with tunable matching stub.

R. F. TUNER

Fixed coil and selector switch construction. All components are easily accessible for servicing.

"KEYED" AUTOMATIC GAIN CONTROL

Outstanding new development; minimizes "airplane flutter"; reduces contrast variation when changing from one channel to another; increases immunity of sync system to external interference.

INTERMEDIATE FREQUENCIES

AM Sound—455 Kc.
FM Sound—10.7 Mc.
TV Sound Carrier—22.25 Mc.
Picture Carrier—26.75 Mc.

I.F. SYSTEM

AM—One stage (two tuned transformers)
FM—Two stage (three tuned transformers)
TV—Four stage (stagger tuned) for composite signal, and two additional stages for inter-carrier sound.

VIDEO AMPLIFIER

Two Stage—broad band.

RETRACE LINE SUPPRESSOR

Eliminates retrace lines thruout the normal range of picture brightness and contrast.

FOCUS

Magnetic

DEFLECTION

Magnetic

HORIZONTAL SYNCHRONIZATION

Automatic frequency control and "keyed" A.G.C. provide excellent picture stability and noise immunity.

HIGH VOLTAGE POWER SUPPLY

"Fly-back" type. Completely enclosed in a shielded compartment.

SENSITIVITY

Antenna to Picture Tube Grid Sensitivity — To make this measurement, connect negative terminal of 1½ volt battery to A.G.C. line, and positive terminal of battery to chassis. Also, set Contrast control to maximum clockwise position. Connect an **A.C.** vacuum-tube voltmeter between picture tube grid and ground, and place a .005 microfarad condenser across the same points.

Inject R.F. signal (400 cycle modulated) at antenna terminals, using signal whose frequency corresponds to the center frequency of the selected channel, and adjust Television Fine Tuning control for maximum output. Generator must be connected to antenna terminals with a 150 ohm carbon resistor in series with each lead to simulate proper impedance match.

Input signal required to produce standard output of 7.07 volts **A.C.** (r.m.s.) at picture tube grid is indicated in the following table. Since a fixed bias of 1½ volts has been applied to the A.G.C. system in order to provide a reference level for these measurements, it will be understood that the sensitivities specified here are not intended to indicate the full capability of the receiver, but merely serve as a convenient basis for determining proper operation.

Low Band { Average—50 microvolts; Range—25 to 100 microvolts

High Band { Average—80 microvolts; Range—40 to 160 microvolts

Detector to Picture Tube Grid Sensitivity — To make this measurement, remove 6AU6, 4th Video I.F. tube (V-10) and set Contrast control to maximum clockwise position. Inject a 400 cycle (audio) signal across 6800 ohm video detector load resistor. In order to produce the standard output of 7.07 volts **A.C.** (r.m.s.) at the picture tube grid, the input signal at the detector load resistor will be approximately .07 volts **A.C.** An **A.C.** vacuum-tube voltmeter must be used for these voltage measurements.

Television Sound System Sensitivity—Inject 4.5 megacycle frequency modulated signal (400 cycle modulation with 7½ Kc. deviation) across video detector load resistor and measure output at speaker voice coil. An input of 2200 microvolts will produce approximately 500 milliwatts or 1.26 volts across speaker voice coil.

F.M. Sound System Sensitivity—Inject a 98 megacycle frequency modulated signal (400 cycle modulation with 22½ Kc. deviation) at pin 8 of 12AT7, F.M. R.F. Amplifier tube (V-27). Connect generator to this point through a 300 ohm resistor. Tune receiver to 98 Mc. signal. An input of 35 microvolts will produce approximately 500 milliwatts or 1.26 volts across speaker voice coil.

A.M. Sound System Sensitivity—Inject a 1000 Kc. signal (modulated 30% at 400 cycles) at (high side) connection lug on antenna section of gang condenser. Connect generator to this point through a .01 microfarad condenser. Tune receiver to 1000 Kc. signal. An input of 75 microvolts will produce approximately 500 milliwatts or 1.26 volts across speaker voice coil.

TELEVISION CHANNELS & FREQUENCIES

CHANNEL NO.	FREQ. MC.	PICTURE CARRIER MC.	SOUND CARRIER MC.	HETERODYNE OSC. FREQ. MC.
2	54 — 60	55.25	59.75	82.00
3	60 — 66	61.25	65.75	88.00
4	66 — 72	67.25	71.75	94.00
5	76 — 82	77.25	81.75	104.00
6	82 — 88	83.25	87.75	110.00
7	174 — 180	175.25	179.75	202.00
8	180 — 186	181.25	185.75	208.00
9	186 — 192	187.25	191.75	214.00
10	192 — 198	193.25	197.75	220.00
11	198 — 204	199.25	203.75	226.00
12	204 — 210	205.25	209.75	232.00
13	210 — 216	211.25	215.75	238.00

TUBE COMPLEMENT

TELEVISION CHASSIS
(26 Tubes, Including Rectifiers)

TUBE NO.	TUBE TYPE	FUNCTION
V1	6AU6	1st Sound Amplifier
V2	6AU6	2nd Sound Amplifier — Limiter
V3	6T8	Dynamic Limiter — Sound Discriminator — Sound Amplifier
V4	6V6GT	Sound Output
V5	6AG5 or 6CB6	RF Amplifier
V6	6J6	Oscillator — Mixer
V7	6AU6	1st IF Amplifier
V8	6AU6	2nd IF Amplifier
V9	6AU6	3rd IF Amplifier
V10	6AU6	4th IF Amplifier
V11	6AL5	Detector — DC Restorer
V12	6AU6	Video Amplifier
V13	6C4	Cathode Follower
V14	6K6GT	Video Output
V15	12LP4A	Picture Tube
V16	6AU6	Keyer AGC
V17	12AU7	Sync Clipper — Phase Splitter
V18	6AL5	Horizontal AFC — Phase Detector
V19	12AU7	Horizontal Scanning Multivibrator
V20	6BQ6GT	Horizontal Scanning Output
V21	1B3GT/8016	High Voltage Rectifier
V22	6W4GT	Horizontal Damping
V23	6X5GT	Rectifier
V24	5U4G	Rectifier
V25	6J5CT	Vertical Blocking Oscillator
V26	6S4	Vertical Scanning Output

AM-FM TUNER CHASSIS
(5 Tubes)

TUBE NO.	TUBE TYPE	FUNCTION
V27	12AT7	(FM) RF—(FM) Mixer
V28	6BE6	(AM) Mixer—Oscillator (FM) Oscillator
V29	6BA6	1st IF Amplifier (AM-FM)
V30	6BA6	(FM) 2nd IF Amplifier—(AM) Detector—A.V.C.
V31	6AL5	Discriminator—A.V.C.

RECEIVER OPERATING CONTROLS

The various controls on the receiver may be divided into two classes, Operating and Pre-set. Operating controls are those which control program selection as well as sound and picture quality.

All but one of the operating controls of the receiver are located on the front panel and the name and use of each are described in Figure 1. The built-in antenna tuning control is accessible at the rear of the receiver. The Pre-set controls are those which require adjustment at the time the receiver is installed and they rarely need attention thereafter. There are eight Pre-set controls, four of which are located at the back of the chassis (see Figure 14). Four controls are accessible by removing the Name Plate located directly above the Operating controls. (see Fig. 6).

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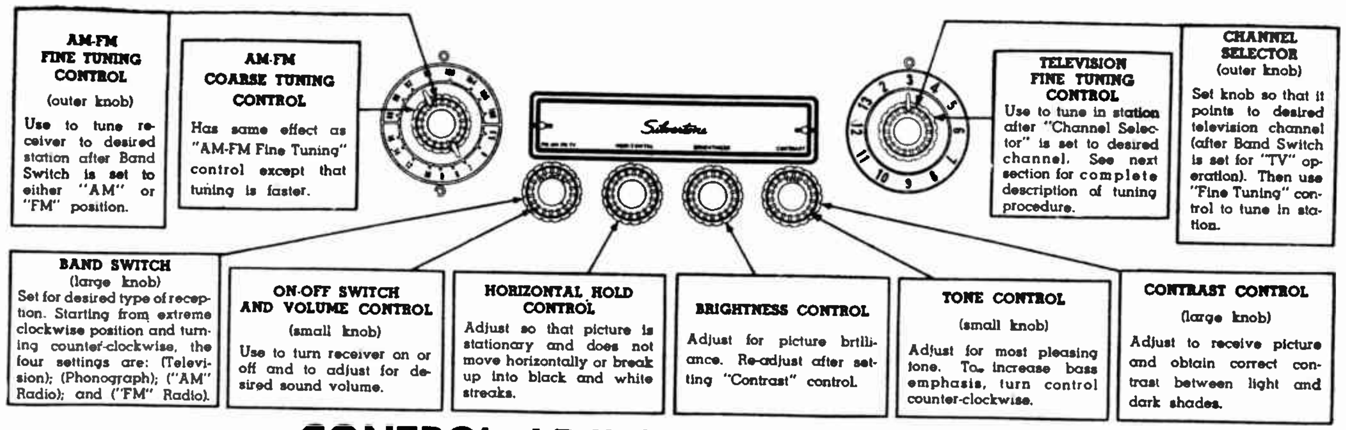
Fig. 1



CONTROL ADJUSTMENT PROCEDURE

TO ADJUST CONTROLS FOR RECEPTION OF STANDARD BROADCAST OR FREQUENCY MODULATION STATIONS:

1. Turn "On-Off Switch and Volume" knob clockwise to turn set on.
2. Set "Band Switch" to either its "AM" or "FM" position. Small red indicator light adjacent to corresponding dial scale will become illuminated.
3. Use "AM-FM Fine Tuning" control to select desired station.
4. Adjust "Volume" control setting for desired sound intensity.
5. Adjust "Tone" control setting for most pleasing tone.

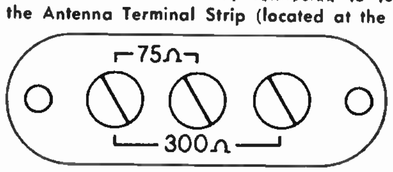
TO ADJUST RECEIVER FOR RECEPTION OF TELEVISION STATIONS:

Although the Pre-set controls have been factory adjusted for optimum performance, it is usually necessary to make some fine adjustments of these controls at the time of installation.

To gain access to the centering adjustments and ion trap, it will be necessary to remove the back cover of the cabinet by first removing the built-in antenna tuning knob and then taking out the screws around the rim of the back cover.

Removal of the cabinet back automatically opens an interlock to disconnect the receiver power cord, therefore, an auxiliary power cord assembly will be required when making centering and ion trap adjustments. This cord may be obtained by requesting Part #W507699. **Do not attempt to supply power to the receiver using any other device.**

CONNECTION OF TRANSMISSION LINE TO RECEIVER—This television receiver has an input circuit which can accommodate either 75 ohm or 300 ohm transmission line. When an outdoor antenna is used, first disconnect the two built-in antenna leads connected to terminals labeled "75 ohm" on the Antenna Terminal Strip (located at the left rear of the cabinet). If 300 ohm line is installed between the outdoor antenna and the receiver, connect the transmission line to the two terminals labeled "300 ohm" on the Antenna Terminal Strip; if low impedance line is installed, connect the transmission line between the two antenna terminals labeled "75 ohm."



TELEVISION ANTENNA TERMINAL STRIP

The receiver is now ready for an operational check.

1. **TURN SET ON**—Rotate the "On-Off Switch and Volume" knob approximately ½ turn clockwise to turn set on and obtain sufficient sound volume during the tuning process. Allow several minutes for all tubes in the receiver to warm up and for circuits to stabilize before attempting to obtain a picture on the screen.
2. **POSITION BAND SWITCH**—Set "Band Switch" to "TV" position. Small red indicator light above channel numbers will become illuminated.
3. **ADVANCE BRIGHTNESS CONTROL**—Turn the "Brightness" control knob clockwise until the picture tube screen is moderately illuminated.
4. **ADJUST ION TRAP**—If screen remains dark or is only dimly illuminated when "Brightness" control is turned clockwise, the ion trap may require adjustment.

   The ion trap is located on the neck of the picture tube as shown in Figure 14 and consists of a magnet held in position by metal bands. Rotate the entire trap assembly while sliding it back and forth until picture tube screen is illuminated to maximum brilliance. Reduce "Brightness" control setting and repeat this operation to assure accurate positioning of ion trap.
5. **ADVANCE CONTRAST CONTROL**—Turn the "Contrast" control knob to its maximum clockwise position.
6. **POSITION CHANNEL SELECTOR** — Set "Channel Selector" knob so that it points to the desired television channel.
7. **ADJUST FINE TUNING CONTROL** — After "Channel Selector" knob has been set, then use the "Fine Tuning" control to obtain the correct tuning point for both picture and sound. That is accomplished as follows:

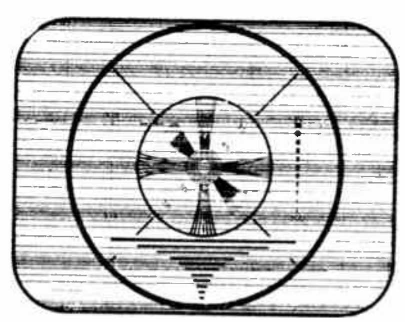


Fig. 2—SOUND INTERFERENCE; CAUSED BY INCORRECT TUNING

   a. Turn "Television Fine Tuning" control in either direction until sound volume is maximum—if sound cannot be heard, advance the volume control and repeat fine tuning.

   b. When the point of maximum sound volume has been reached it will be noted that the picture has a "ragged" or "sawtooth" appearance or is partially obscured by "sound bars" (dark horizontal bars of varying width—see Fig. 2).

   THE CORRECT SETTING OF THE FINE TUNING CONTROL is now obtained by turning it away from the maximum volume position only far enough to eliminate the "sound bar" interference and permit sharp reproduction of the picture.

   If image is slightly distorted or tears into a series of black and white streaks as shown in Fig. 3, reduce the setting of the Contrast control and operate the "Horizontal Hold" control knob until picture appears stable and undistorted.

8. **ADJUST SOUND VOLUME**—Readjust the setting of the "Volume" control until the sound accompanying the television broadcast is received at a satisfactory level.
9. **ADJUST BUILT-IN ANTENNA TUNING CONTROL**—If the receiver's built-in television antenna system is used, rotate the antenna tuning knob (located at rear of cabinet) until the best picture is obtained. It may be possible to find a single setting for this knob which will give satisfactory performance for a group of stations. In the event that is not the case, adjust the control for optimum performance each time the Channel Selector is rotated to a different station.
10. **HORIZONTAL HOLD**—Should the picture appear to move horizontally across the screen or break up into a series of light and dark streaks as shown in Figure 3, adjust the "Horizontal Hold" control until the picture remains stationary. If this control must be rotated to the end of its range for proper "locking" action, then it will be necessary to reset the position of the "Horizontal Lock" control (see Figure 14 for location). Adjustment is accomplished by first setting the "Horizontal Hold" control in the middle of its range and then changing the setting of the "Horizontal Lock" control until picture locks in horizontally.

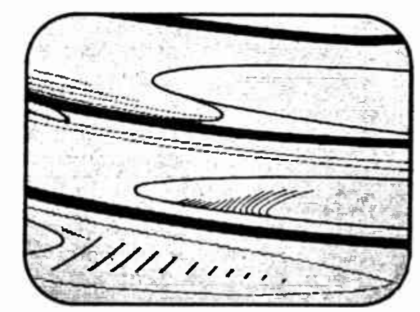


Fig. 3—HORIZONTAL MOVEMENT; ADJUST HORIZ. HOLD CONTROL

11. **VERTICAL HOLD**—Should the picture appear to roll by in a vertical direction or cause multiple vertical images as shown in Figure 4, it will be necessary to adjust the "Vert. Hold" control located behind the Name Plate (see Figure 6).

    After this adjustment is made, reduce contrast until picture is barely visible and check setting of "Vertical Hold" control for proper picture synchronization.

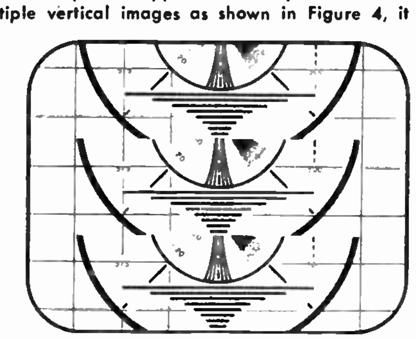


Fig. 4—VERTICAL MOVEMENT; ADJUST VERTICAL HOLD CONTROL

12. **INITIAL FOCUS**—Adjust the "Focus" control, located behind Name Plate, until picture is clearly defined.

    Fuzzy picture may also be due to reproduction of poor quality film when station is televising a motion picture. Incorrect tuning of receiver produces a similar effect. Check for proper tuning point as described in step 7 of this section.

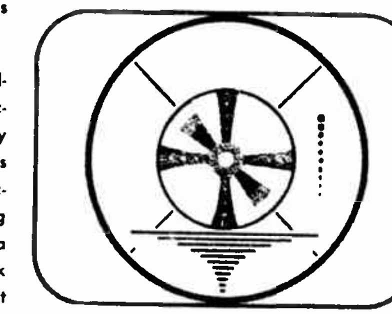


Fig. 5—BLURRED APPEARANCE; ADJUST FOCUS CONTROL

The following adjustments should be made while the station is transmitting its circular test pattern.

13. **STRAIGHTENING TILTED RASTER**—If the pattern should appear on the screen in a tilted position as shown in Figure 7, loosen the deflection yoke locking screw (see Figure 14) and rotate the yoke sufficiently to correct this condition. Be sure to re-tighten the screw securely.

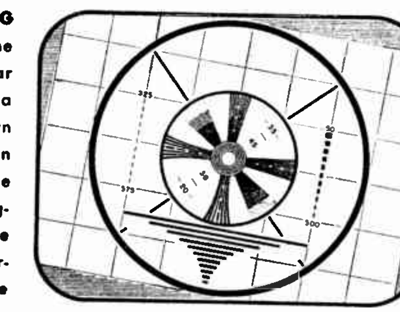


Fig. 7—TILTED PICTURE; ADJUST YOKE POSITION

14. **CENTERING:** To center the test pattern on the screen, proceed as follows:

    a. Make sure focus coil mounting plate is perpendicular to neck of picture tube by adjustment of three nuts labeled A in Figure 14.

    b. Rotate the two magnets in the centering magnet assembly (see Fig. 14). These magnets may be adjusted by grasping the cardboard "ears" attached to each magnet and rotating the magnets with respect to each other and with respect to the picture tube. Adjust the magnet position for best centering of the test pattern.

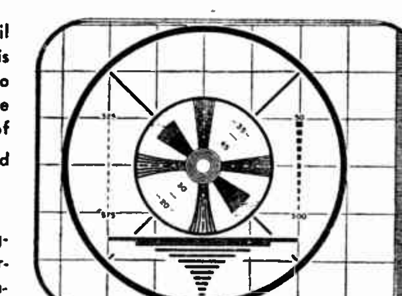


Fig. 8 —OFF CENTER; ADJUST FOCUS COIL POSITION

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c. If picture is still not centered, loosen four focus coil wing nuts labeled B in Fig. 14 and rotate focus coil for best centering of test pattern.

d. Readjust ion trap for maximum brightness on picture tube screen as explained in step # 4.

e. If picture is still not centered, position focus coil by adjusting the three nuts labeled A in Fig. 14.

In event picture cannot be centered by above procedures, release the four wing nuts labeled D in Fig. 14 and raise or lower entire yoke and focus coil assembly so that focus coil can be repositioned vertically with respect to the tube neck.

16. **HEIGHT** — Control of picture size in the vertical direction is accomplished by means of the "Height" control located behind the Name Plate. Height and width adjustments should be checked for all transmitting stations to be sure that picture properly fills the viewing area. It may be necessary to change the setting of the "Height" control after the "Vertical Linearity" control is adjusted.

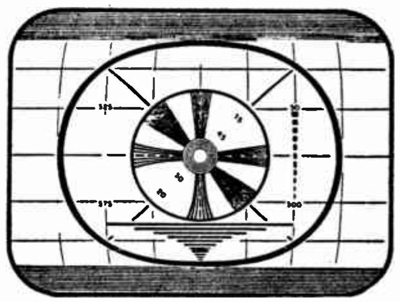

Fig. 10 — TOO SHORT; ADJUST HEIGHT CONTROL

15. **WIDTH** — Control of picture size in the horizontal direction is accomplished by means of the "Width" control located on the rear of H. V. power supply (see Fig. 14). If abnormally low line voltage makes it difficult to obtain sufficient picture width when using the "Width" control, then changing the setting of the "Horizontal Drive" control may be helpful. The "Drive" control is located at the rear of the chassis and its setting will affect horizontal linearity as well as picture width. Therefore, after adjusting this control for desired width, it may be necessary to re-adjust the "Horizontal Linearity" control as described in paragraph #18.

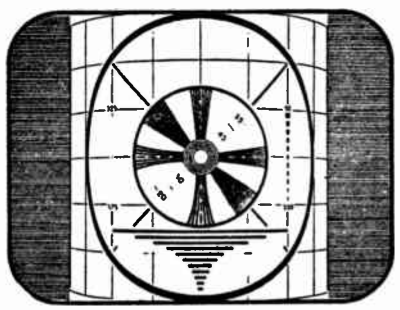

Fig. 9 — TOO NARROW; ADJUST WIDTH CONTROL

17. **HORIZONTAL DRIVE** — The "Horizontal Drive" control located at rear of chassis (see Fig. 14) should be rotated clockwise to the point where any white (or black) vertical lines near the left side of the picture are eliminated. As width and linearity of the picture are affected by the setting of "Horiz. Drive" control, it will be necessary to adjust this control in conjunction with the Horiz. Linearity and Width controls to obtain desired picture width and linearity.

18. **HORIZONTAL LINEARITY** — Improper horizontal linearity causes the circular test pattern to appear condensed on the right edge of the screen and extended on the left edge or vice versa. This effect is illustrated in Figure 11. Adjust for proper linearity by using "Horiz. Lin." control located at rear of chassis (see Figure 14). In event that proper horizontal linearity cannot be obtained by adjusting this control, then change the setting of the "Horiz. Drive" control.

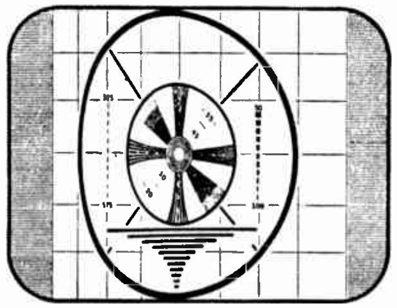

Fig. 11 — HORIZONTAL DISTORTION; ADJUST HORIZONTAL LINEARITY CONTROL

19. **VERTICAL LINEARITY** — Improper vertical linearity causes the circular test pattern to appear condensed on the upper edge of the screen and extended on the lower edge or vice versa. This effect is illustrated in Figure 12. Adjust for proper linearity by using "Vert. Lin." control located behind Name Plate. It may be necessary to readjust the "Height" control if an appreciable change is made in the linearity control setting.

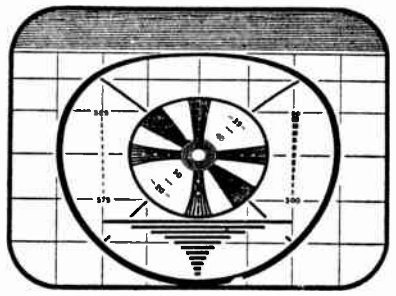

Fig. 12 — VERTICAL DISTORTION; ADJUST VERTICAL LINEARITY CONTROL

20. **ELIMINATING SEMI-CIRCULAR SHADOW** — This shadow is caused by the electron stream striking the neck of the tube and it can generally be corrected by applying one or a combination of the following procedures:

a. Make sure deflection yoke is positioned as far forward as possible by loosening the three wing nuts labeled C in Fig. 14.

b. Reposition the focus coil by readjusting the three nuts labeled A in Fig. 14 to shift the coil forward.

c. In event neck shading cannot be eliminated by the above procedures, release the four wing nuts labeled D in Figure 14 and raise or lower entire yoke and focus coil assembly so that focus coil can be repositioned vertically with respect to the tube neck.

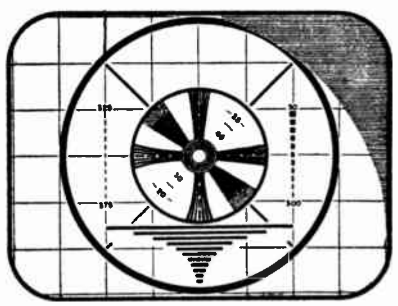

Fig. 13 SEMI-CIRCULAR SHADOW

21. **FINAL ADJUSTMENTS** — Recheck settings of "Brightness," "Contrast" and "Focus" controls for best picture quality.

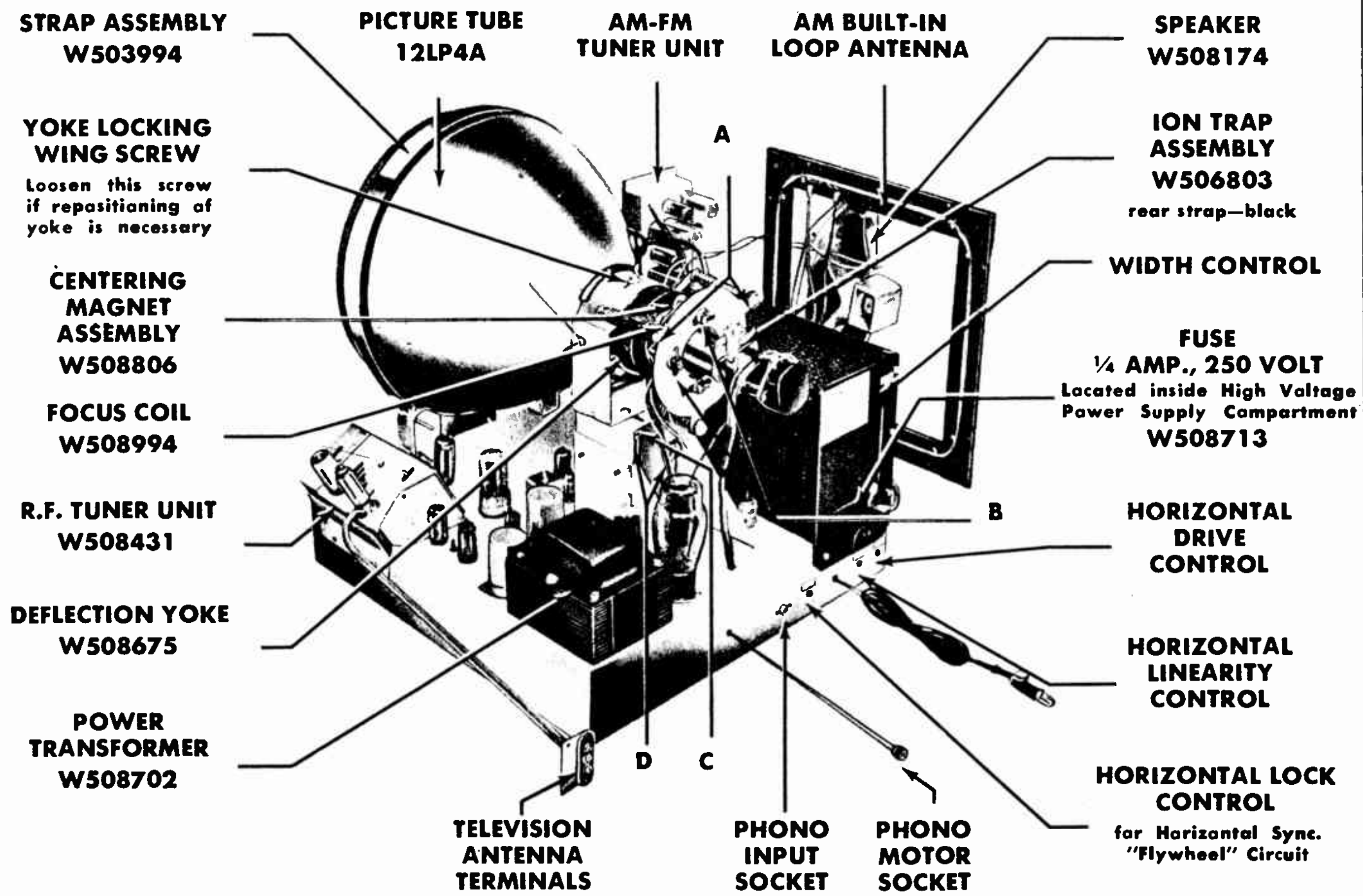

Fig. 14—CHASSIS AND PICTURE TUBE ASSEMBLY

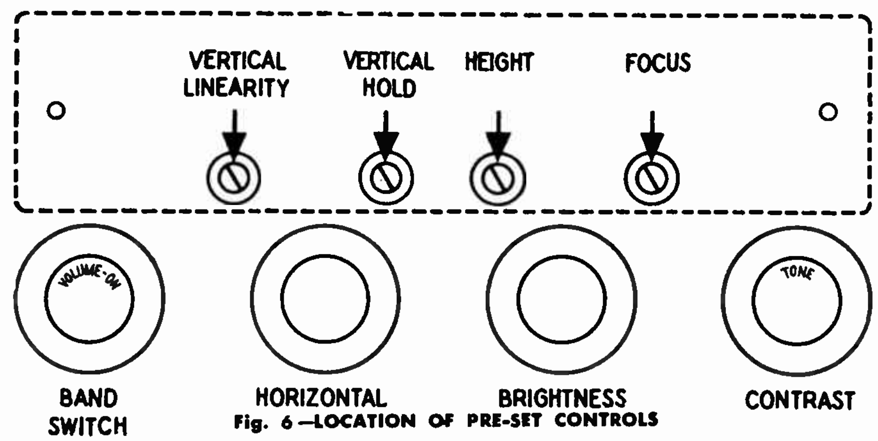

Fig. 6 — LOCATION OF PRE-SET CONTROLS

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SOCKET VOLTAGES

CAUTION

THE PICTURE TUBE is highly evacuated and if broken, glass fragments will be violently expelled. Scratching, chipping, undue pressure, or careless handling such as lifting the tube by its neck is dangerous and should be avoided. If it is necessary to handle the picture tube, use safety goggles and heavy gloves. Be sure to discharge the voltage developed across the capacitor formed by the inner and outer coating of the picture tube. This can be done by connecting the high voltage socket on the tube to the outer coating with a well insulated metal conductor.

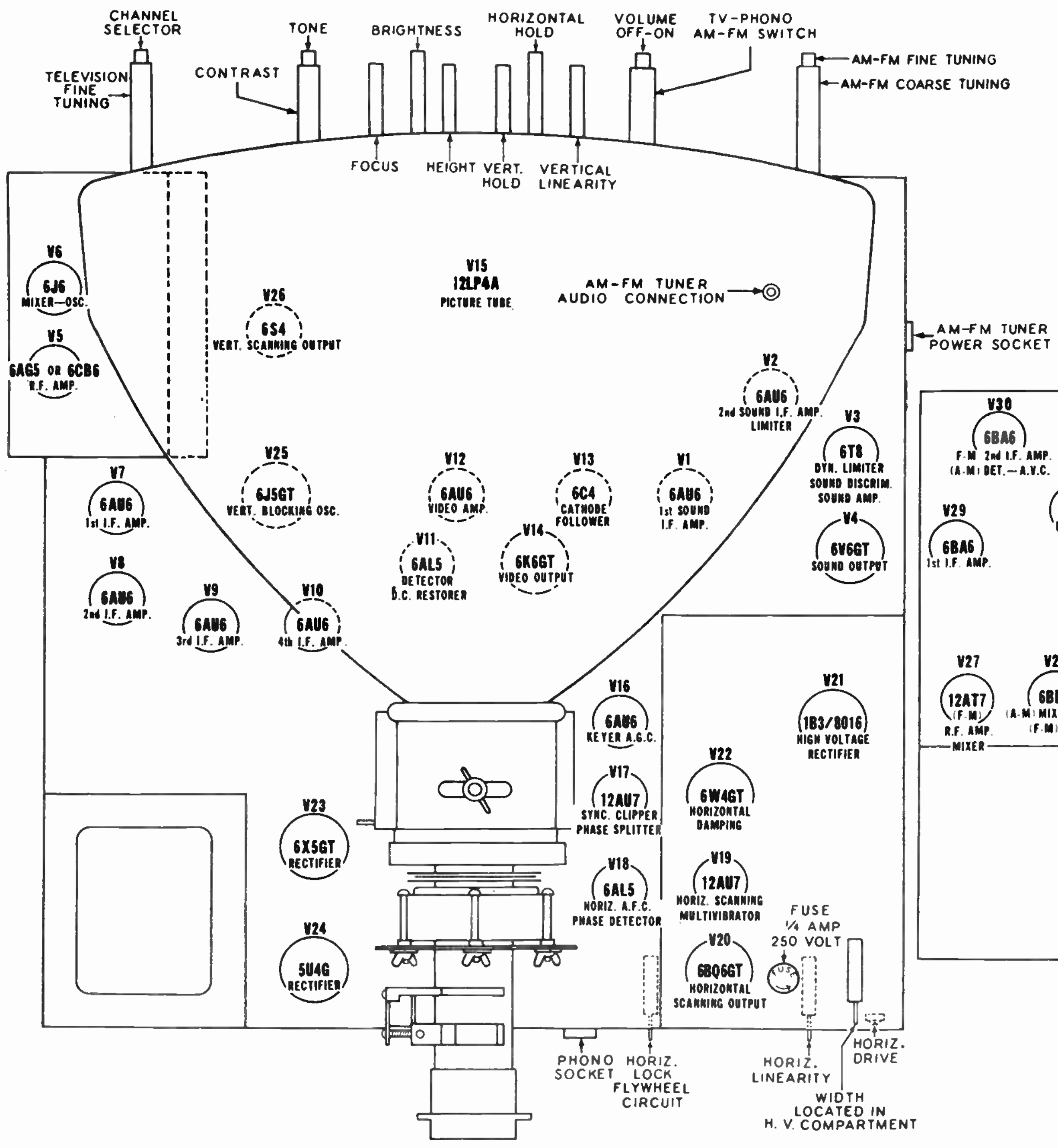
HIGH VOLTAGE (10 to 12 kilovolts) is produced in a supply circuit of this receiver. Exercise care to avoid contact with elements of this circuit and particularly the tube terminals which are labeled "CAUTION" in the adjoining voltage chart. If measurement of voltage at these points is necessary, see procedure given below under the note "E".

THE HIGH VOLTAGE LEAD, which supplies approximately 10 to 12 kilovolts to the picture tube, should be momentarily shorted to the chassis whenever it is disconnected for service purposes. This discharges the high voltage filter condenser and prevents a shock hazard when working on the receiver after it has been turned off.

INTERMEDIATE B+ VOLTAGES, 475 and 365, are dangerous and caution should be observed when the receiver chassis components are exposed for service purposes.

BE SURE TO CHECK FOR PROPER POSITIONING OF BAND SWITCH SECTIONS ON AM-FM and TV chassis when interconnecting link arm has been disengaged and bottom cover of the AM-FM chassis is removed for voltage measurements. DO NOT turn on the receiver until you have first determined that the respective switch sections are correctly synchronized or positioned. Failure to observe this precaution can result in damage to the receiver, as well as erroneous voltage measurements. For more complete discussion of this subject, see text shown adjoining AM-FM socket voltage chart on page 10.

TUBE LOCATIONS & FUNCTIONS



THE VOLTAGES SHOWN IN THE ADJOINING CHART WERE MEASURED UNDER THE FOLLOWING CONDITIONS

1.	Power Supply—117 volts 60 cycle AC.
2.	All voltages are measured between socket terminals and chassis unless otherwise indicated on adjoining chart.
3.	Measurements made with voltmeter having sensitivity of 1000 ohms per volt except where indicated by (*). The (*) symbol designates a vacuum tube voltmeter measurement.
4.	Band Switch set to "TV" position unless otherwise indicated by letters "P", "m" or "n" following voltages shown in adjoining chart.
5.	Channel Selector and Fine Tuning Controls set for normal reception of a local station.
6.	Focus control set to maximum counter-clockwise position. Setting of this control will affect B+ voltage on the 265 volt supply line. This voltage is obtained when control is at maximum counter-clockwise position and increases to 320 as control is rotated to clockwise position.
7.	All other controls (with exception of focus control) are set for normal reception of the transmitted signal unless the voltage shown on the chart is followed by a letter or letters indicating a special condition of measurement as explained in subsequent notes.
8.	Certain voltages were measured with two different settings of specific controls. It should therefore be understood that in these instances all controls, with the exception of one or two, were set for normal reception—letters following the voltage shown on the chart indicate the exceptions and are explained below.
9.	The external or built-in antenna should remain connected to the receiver only when taking voltage measurements in the sweep and sync circuits—for all other measurements, disconnect antenna, short antenna terminals together and connect them to ground.

EXPLANATION OF NOTES

A.	Vert. Hold Control max. counter-clockwise
a.	This voltage will vary from —3.6 to —8.7 depending upon setting of Horizontal Hold Control and Horizontal Lock Control.
B.	Brightness Control max. counter-clockwise
b.	This voltage will vary from 11 to 16 depending upon setting of Horizontal Hold Control and Horizontal Lock Control.
C.	Contrast Control max. clockwise
D.	Horiz. Drive Control max. clockwise
d.	This voltage will vary from 315 to 335 depending upon setting of Horizontal Hold Control and Horizontal Lock Control.
E.	If you do not have an instrument capable of directly measuring voltages in this range, the voltage can be measured by using a voltage divider network consisting of twenty 2.2 megohm 2 watt resistors and one 1 megohm 2 watt resistor, all connected in series. Avoid using resistors of higher values as their individual voltage rating may be exceeded. It is also important to use resistors of equal wattage. Solder all connections between resistors. Accurately measure the overall resistance of the entire combination as well as the resistance of the 1 megohm section. **With the set turned off,** connect the 2.2 megohm end of the resistance voltage divider to the filament of the 1B3GT/8016 tube, or H. V. terminal of the picture tube, and connect the 1 megohm end to chassis. Now, turn the set on and measure the voltage drop across the 1 megohm resistor with a vacuum tube voltmeter. The voltage at the tube terminal can then be calculated as follows: $\left[\text{Volts At Tube Terminal}\right] = \dfrac{\left[\text{Measured Resistance Of Entire Voltage Divider}\right]}{\left[\text{Measured Resistance Of 1 Meg. Section}\right]} \times \left[\text{Volts Measured Across 1 Meg. Section}\right]$
e.	This voltage will vary from —2.7 to +5.8 depending upon setting of Horizontal Hold Control and Horizontal Lock Control.
F.	Height Control max. counter-clockwise
f.	Contrast Control max. counter-clockwise
G.	Width Control max. counter-clockwise
g.	This voltage will vary from 8 to 15 depending upon setting of Horizontal Hold Control and Horizontal Lock Control.

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EXPLANATION OF NOTES

H. Height Control max. clockwise

h. This voltage will vary from 10 to 20 depending upon setting of Horizontal Hold Control and Horizontal Lock Control.

J. Horiz. Hold Control set for normal picture.

K. Horiz. Lock Control set for normal picture.

k. This voltage will vary from —5 to —11 depending upon settings of Horizontal Hold Control and Horizontal Lock Control.

L. This voltage will vary from —6 to —16 depending upon setting of Horizontal Hold Control and Horizontal Lock Control.

M. Vertical Linearity Control max. counter-clockwise.

m. Band switch set to "AM" position; dial tuned to 540 Kc. and AM loop antenna leads grounded.

N. Channel Selector set to channel #5

n. Band switch set to "FM" position; dial tuned to 88 Mc. and FM antenna terminal grounded.

P. Band switch set to "PHO" position.

R. Do not attempt to measure the voltage at the tube cap. There is a high R. F. potential at this point.

r. This vacuum tube voltmeter measurement will fluctuate in the vicinity of 0.9 volts.

S. Channel Selector set to channel #9

T. Grounding of center stud on tube socket is necessary to reduce capacity coupling between other pins. Oscillation may result if this ground is omitted.

t. This voltage will vary from —0.04 to +0.06 depending upon setting of Horizontal Hold Control and Horizontal Lock Control.

U. Vertical Hold Control max. clockwise

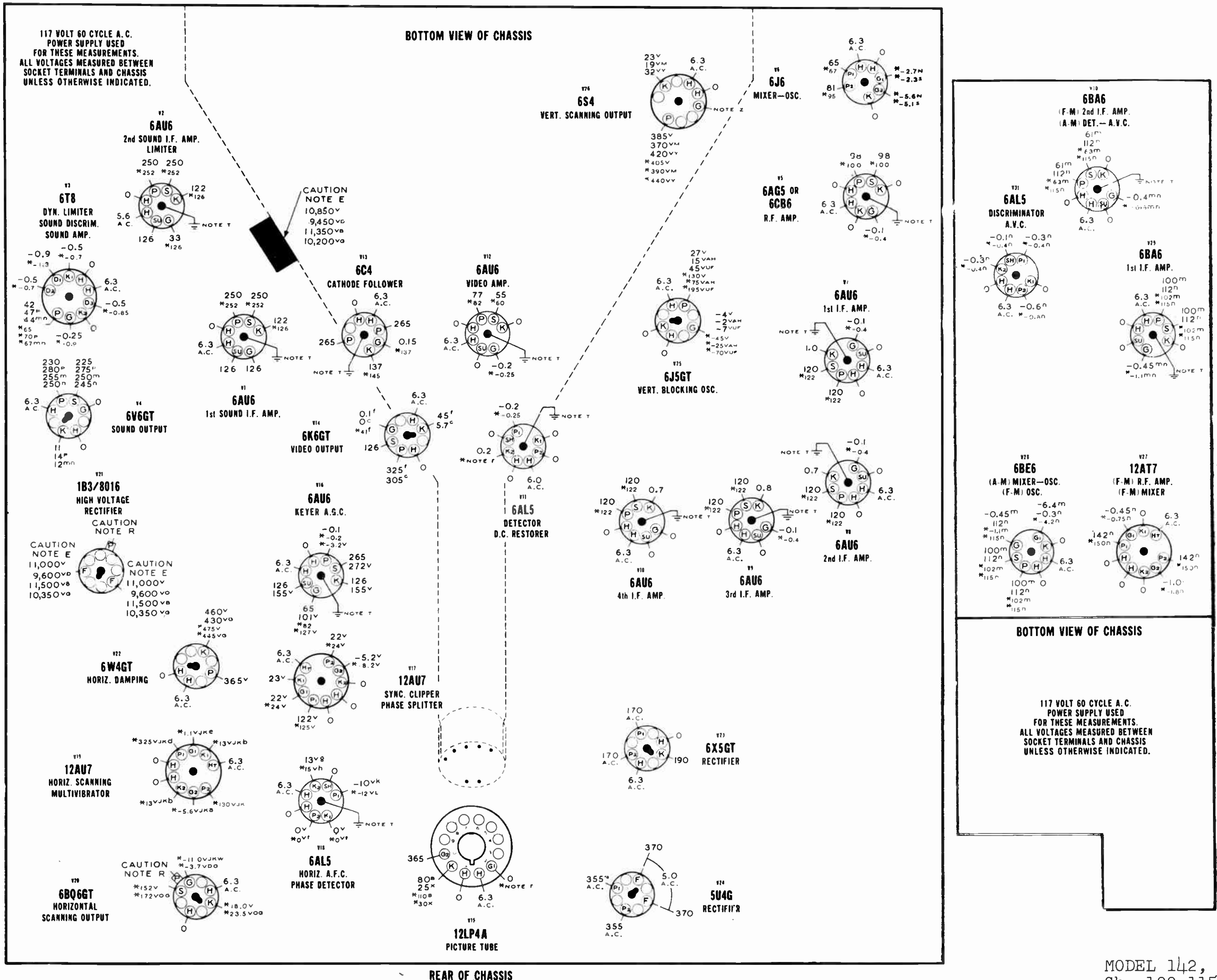
V. Before measuring this voltage, first connect external antenna and adjust controls for normal reception of station signal; then set Focus Control to maximum counter-clockwise position.

W. This voltage will vary from —10 to —12 depending upon setting of Horizontal Hold Control and Horizontal Lock Control.

X. Brightness Control max. clockwise

Y. Vertical Linearity Control max. clockwise.

Z. The measurement should be made with a vacuum tube voltmeter. The voltage reading will fluctuate in the vicinity of 0.04 volts.



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REMOVING BOTTOM COVER OF AM-FM CHASSIS

It will be necessary to remove the bottom cover of the AM-FM chassis in order to service the underside of this unit. Removal of that cover may be accomplished as follows:

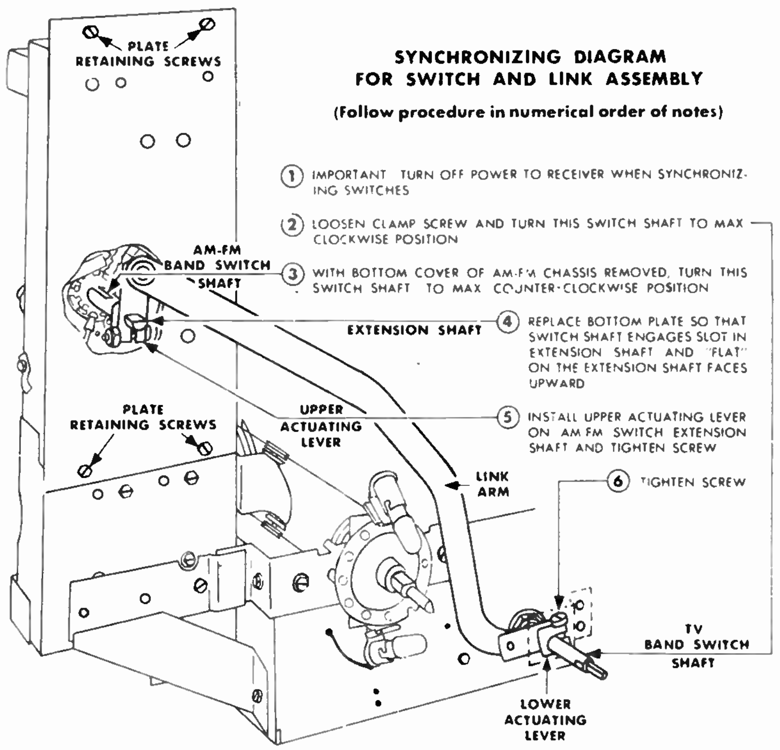
1. Make sure receiver is turned off by removing power cord plug from wall outlet.
2. Loosen screw in upper actuating lever on AM-FM band switch extension shaft and slide lever off the shaft. The link arm will now be disengaged from the AM-FM band switch.
3. Release the screws holding the bottom cover in position and carefully remove cover.

CHECKING SYNCHRONIZATION OF BAND SWITCHES ON AM-FM TUNER AND TV CHASSIS

Note that the band switch on the AM-FM Tuner chassis is mechanically coupled by a link arm and lever arrangement to the band switch on the TV chassis. Do not operate these switches by direct pressure on the link arm—always use a control knob attached to the TV switch shaft.

If the mechanical linkage is forced or slips at the lever on the TV switch shaft or the bottom cover of the AM-FM Tuner is removed for service purposes, it is possible for the respective switch sections to get out of step. As one function of the band switch is to control power supply circuits, the receiver can be damaged if the respective switch sections lose synchronism or are indiscriminately set to random positions.

In order to check for correct synchronization of the band switches, proceed as follows:



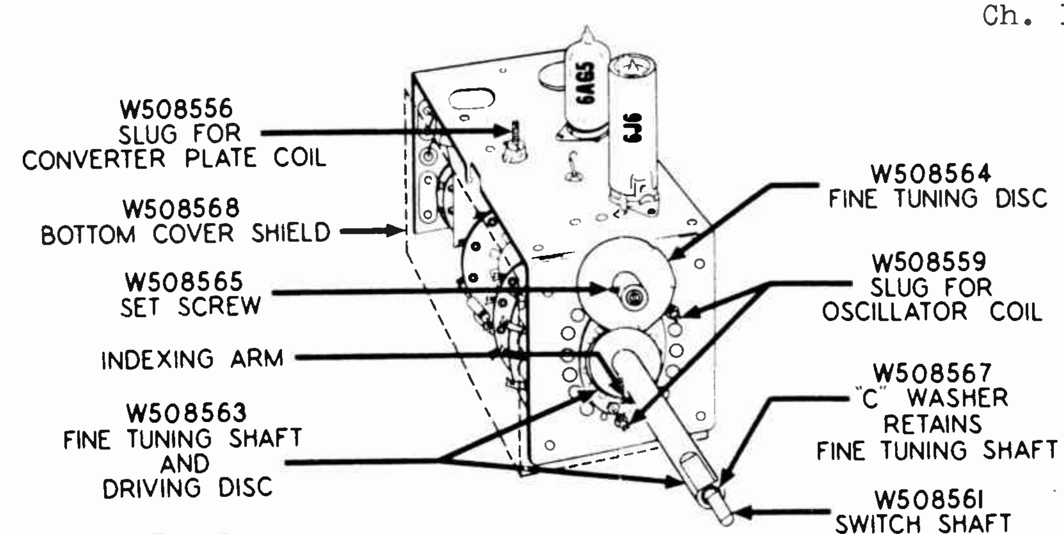
METHOD OF MAINTAINING BAND SWITCH SYNCHRONIZATION DURING VOLTAGE MEASUREMENTS OR OTHER SERVICE OPERATIONS ON AM-FM TUNER

After the bottom cover of the AM-FM chassis has been removed, it should be noted that the link arm is disengaged from the AM-FM band switch shaft, thereby removing mechanical coupling between the TV chassis band switch and AM-FM chassis band switch. For proper operation of the receiver while servicing the AM-FM Tuner, these switches must each be manually positioned so as to maintain correct synchronization. Positioning of these switches may be accomplished as follows:

1. Make sure receiver is turned off by removing power cord plug from wall outlet. **IMPORTANT: — Do not attempt to operate separate sections of band switch while power is on.**
2. Before attempting to select a specific setting (FM, AM, PHONO, or TV) for the respective switch sections, it is important to assure that both sections start at their correct position. That is done by setting the **switch section on the AM-FM chassis to its fully clockwise position** and then setting the **switch section on the TV chassis to its fully counter-clockwise position.** Both switch sections are now in their correct position for "FM" operation of the receiver.
3. To set switch sections for AM, PHONO or TV operation, position them as follows: NOTE THAT AS SWITCH SECTION ON AM-FM CHASSIS IS ADVANCED COUNTER-CLOCKWISE, THE TV CHASSIS SWITCH SECTION MUST BE ADVANCED IN A CLOCKWISE DIRECTION.

RECEIVER FUNCTION	SWITCH POSITION ON TV CHASSIS	SWITCH POSITION ON AM-FM CHASSIS
FM	Fully counter-clockwise	Fully clockwise
AM	2nd position, turning clockwise,	2nd position, turning counter-clockwise
PHONO	3rd position, turning clockwise	3rd position, turning counter-clockwise
TV	Fully clockwise	Fully counter-clockwise

4. When replacing bottom cover of AM-FM chassis and mechanical link arm between switch sections, refer to diagram above for re-assembly instructions.



REPAIR DATA FOR W508431 RF TUNER UNIT

All replacement parts for the RF Tuner Unit are included in the complete receiver parts list.

This RF Tuner Unit consists of an RF amplifier stage (using 6AG5 or 6CB6 tube) and a mixer-oscillator stage (using 6J6 tube). Channel selection is accomplished by a selector switch and fixed coil arrangement. The tuner also incorporates a Fine Tuning control.

Four groups of fixed coils permit tuning over the entire television band. These consist of 12 antenna coils, 12 RF amplifier plate coils, 12 mixer grid coils and 12 oscillator coils. Signal output from the mixer stage is coupled to the IF amplifiers through the converter plate circuit IF coil located on the tuner unit.

SERVICE PRECAUTIONS

SUBJECT	PRECAUTIONS
ELECTRICAL COMPONENTS	The high frequencies used in the RF section of a television receiver make it necessary that considerable care be exercised in servicing the tuner. Lead dress and location of components are very critical at these frequencies. When replacing parts, it is important to use components of identical electrical characteristics and physical size. Always reconnect the replacement item in the same location and position in the tuner as the original component.
TUBES	Replacement of tubes in the Tuner Unit may cause slight detuning of RF circuits due to inherent differences in inter-electrode capacitances. When replacing tubes (especially V6, 6J6 mixer-oscillator tube) make sure that Fine Tuning control will tune in television stations at approximately the middle of its range. If fine tuning cannot be accomplished, try several new tubes in order to obtain one which will permit correct tuning. When tube replacement does not give the desired result, realignment of the tuner is recommended (see "Alignment Procedure").
CHANNEL COILS AND SLUGS	Channel Coils must be handled with care. Do not disturb coil windings or slug positions except when re-aligning the tuner unit.

REMOVAL AND REPLACEMENT OF PARTS

ITEM	PROCEDURE
RF TUNER UNIT	To remove the Tuner Unit from receiver chassis, proceed as follows 1. Remove TV Channel Lite socket. 2. Remove support bracket which positions front of Tuner Unit and also remove screws which hold tuner to rear support bracket. 3. Disconnect the leads from the tuner to the main chassis. See illustration on circuit diagram page showing tuner connections. After the Tuner Unit is replaced, make sure that TV Channel Lite socket and sleeving are correctly positioned so that channel selector knob will be properly illuminated.
BOTTOM COVER SHIELD	Squeeze upper edges of Bottom Cover Shield together at points adjacent to locking "ears" on top of tuner, and at the same time pull down on shield. When replacing Bottom Cover Shield, make sure it is held securely by the two locking "ears."

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ITEM	PROCEDURE
SWITCH SHAFT	To remove Switch Shaft from RF Tuner Unit, proceed as follows: 1. Remove tuner from receiver chassis. 2. Rotate Switch Shaft until portion of Indexing Arm which contacts front of tuner is pointing down (this corresponds to setting switch to channel #12). 3. Remove Switch Shaft "C" Washer located behind front plate of tuner. 4. Loosen Set Screw on Fine Tuning Disc. 5. Fine Tuning Disc, Fine Tuning Shaft and Driving Disc, and Switch Shaft may now be removed by merely pulling them forward. To replace Switch Shaft: 1. Set Fine Tuning condenser to its completely meshed position. 2. Slip edge of Fine Tuning Disc (furthest from the three "stops" on the disc) into slot of Fine Tuning and Driving Disc. 3. With portion of Indexing Arm (which contacts front of tuner) pointing down, slide Switch Shaft into tuner and Fine Tuning Disc over Fine Tuning Condenser Shaft. 4. Replace "C" Washer on Switch Shaft. 5. Rotate Fine Tuning Shaft and Driving Disc to maximum counter-clockwise position and tighten Set Screw on Fine Tuning Disc. The Fine Tuning condenser range should now be from its fully meshed position (with Fine Tuning and Driving Disc in its maximum counter-clockwise position) to its fully open position (with the tuning control in its maximum clockwise position).

HORIZONTAL SYNC SYSTEM ADJUSTMENT

If picture "tears" horizontally and cannot be synchronized by operating the Horizontal Hold control on front panel of receiver, this action may be due to incorrect setting of the slug in the Horizontal Lock Coil.

1. Set Horizontal Hold control in center of its range.
2. Adjust slug of Horizontal Lock Coil for picture synchronization (see Fig. 14 for location of slug).

REDUCTION OF INTERCARRIER BUZZ

If a prominent humming or buzzing sound is noted in the sound reception of a television broadcast, it may be due to a fault in transmission from the station, or incorrect adjustment of the discriminator transformer (tuning of secondary circuit) in the receiver.

This type of disturbance, which is only present when receiving a station signal, is known as "Intercarrier Buzz" and it should not be confused with power supply hum that would occur upon failure of a filter condenser.

The procedure for correct adjustment of the television sound discriminator circuit is presented in the last section of the Television Sound Channel alignment instructions. When the discriminator secondary slug #1 is properly adjusted, intercarrier buzz will be reduced to an acceptable minimum, provided that the transmission from the station is not at fault.

HIGH VOLTAGE POWER SUPPLY SERVICING

The High Voltage Power Supply used with this receiver is of the "fly-back" type and is located in the shielded compartment mounted at the left rear corner of the chassis. It consists of a sturdily constructed and well insulated horizontal sweep output transformer plus a 1B3GT/8016 high voltage rectifier tube and associated filter components.

The plate circuit of the Horizontal Scanning Output stage is fused to protect the transformer and kill high voltage in the event the 6BQ6GT tube or the high voltage rectifier circuit draws excessive current.

CAUTION

The heavily insulated red lead, which supplies extremely high voltage (10 to 12 kilovolts) to the picture tube, should be momentarily shorted to the chassis whenever it is disconnected for service purposes (that is, after receiver has been turned off). This discharges the high voltage filter condenser and prevents a shock hazard when working on the set.

Access to the horizontal output transformer, high voltage rectifier tube, fuse and high voltage filter condenser is accomplished by removing the rear section of the H.V. shield. This compartment shield is held in place by five screws.

To replace the fuse, depress the cap of the fuse holder (located next to 6BQ6GT tube) and turn the cap counter-clockwise. Install new fuse of the same type (¼ amp., 250 volt, part W508713); do not use any other size.

REMOVAL OF THE CABINET BACK AUTOMATICALLY OPENS AN INTERLOCK TO DISCONNECT THE RECEIVER POWER CORD.

CORONA AND ARC-OVER

Corona or arc-over can best be detected by observing the operation of the power supply in a dark room. Several conditions may cause these phenomena.

POOR CONNECTIONS Arcing or corona may be due to poorly soldered connections (rosin joints or sharp points), or defective tube socket connections. If the leads or connectors to the high voltage filter condenser do not grasp this component securely, arcing will also result.

Inspect solder connections and resolder those joints which are unsatisfactory. Make sure tubes are firmly positioned in tube sockets and that high voltage filter condenser is held securely in place.

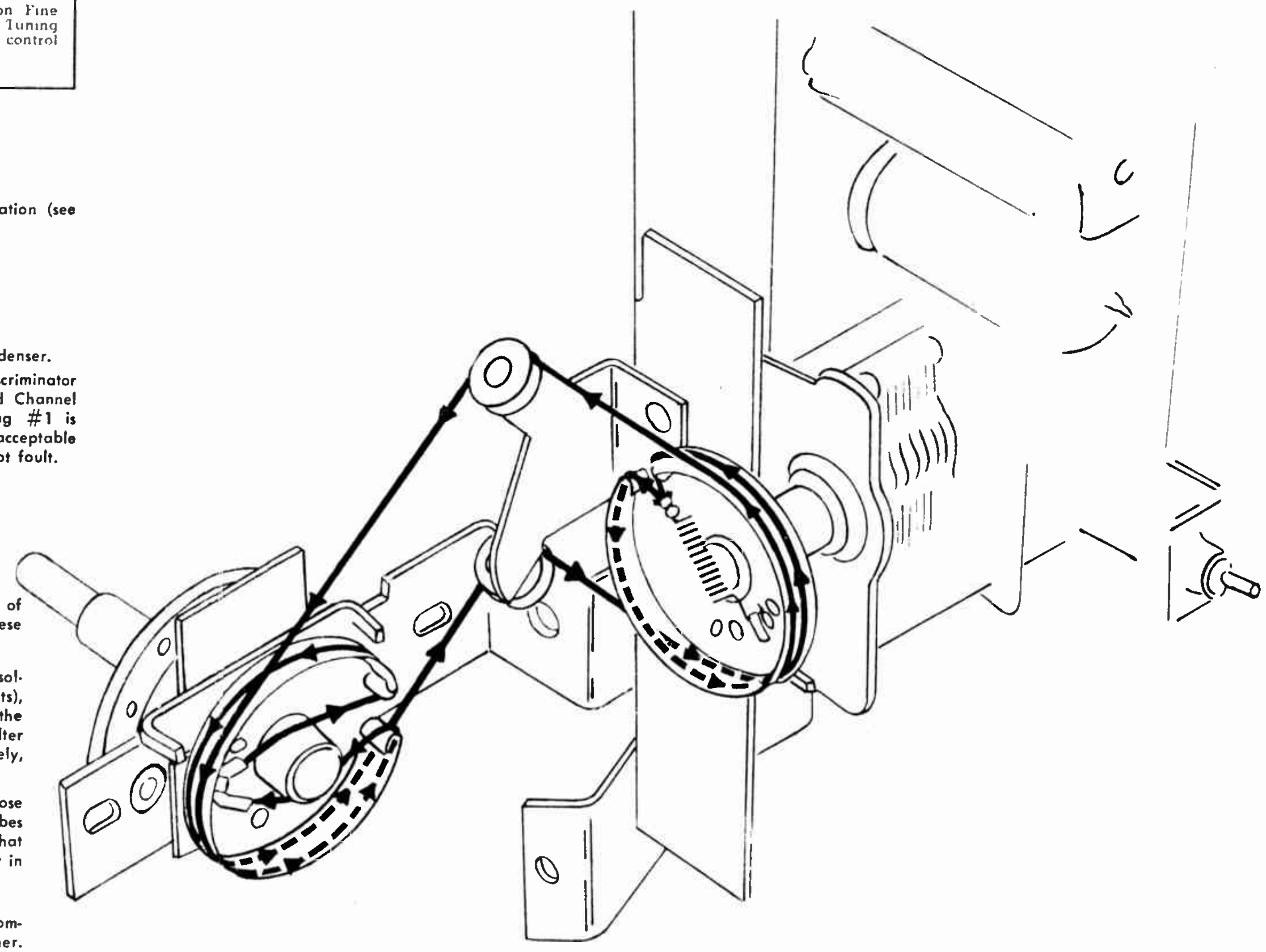
CLOSELY SPACED COMPONENTS Arcing or corona may occur when H.V. components or leads are placed too close together. Make sure there is sufficient spacing between all parts and wiring. If necessary, the insulation between two elements of the circuit may be improved by coating both objects with a quick-drying liquid polystyrene or polyethylene.

The socket assembly for the 1B3GT/8016 rectifier tube includes a "corona ring" which prevents corona from the tube socket connections. The surface of this ring should be smooth and free of scratches, nicks, or sharp protrusions.

DIAL POINTER DRIVE CORD ARRANGEMENT

To string dial cord, first rotate "AM-FM" Coarse Tuning Control fully counter-clockwise until stop on drum contacts ear on mounting frame. Now, with gang set to fully meshed position, string dial cord using the following parts:

W114955 Clip on end of cord
W117057 Cord (2½ ft. required)
W505161 Spring



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ALIGNMENT PROCEDURE.

Alignment of all RF and IF tuned circuits in this receiver may be accomplished by utilizing the procedures described in the following charts.

SEQUENCE OF ALIGNMENT: These procedures should preferably be applied in the order in which they are presented, however, alignment of RF or IF channels for either AM, FM or TV may be accomplished individually if desired.

The Television RF Amplifier and Mixer alignment may also be accomplished independent of the Television IF Channel alignment, but oscillator calibration can only be done after IF Channel has been correctly aligned. Proper IF band pass characteristic is necessary for oscillator alignment as results of circuit tuning are observed by means of an oscilloscope connected to the output of the video detector stage.

REMOVAL OF CHASSIS: The receiver chassis must be removed from the cabinet in order to accomplish alignment of all tuned circuits as there are adjustment points located on the undersides of both the main chassis and the AM-FM Tuner.

This can be accomplished by first removing all knobs and releasing the hold-down screws located on the underside of the cabinet. Then disconnect speaker leads and all three "built-in" antennae (TV, AM and FM). Release indicator lamp from bracket at base of cabinet.

CAUTION

The picture tube is highly evacuated and if broken, glass fragments will be violently expelled. Handle with care, using safety goggles and gloves. Avoid contact with high voltage terminal at side of tube even after it has been disconnected from the receiver—this precaution is necessary as inner and outer coatings on the tube form a capacitor which may carry a high voltage charge for an extended period of time after disconnection from the receiver.

INSTRUMENTS: The following instruments will be required as signal sources and output indicators during the alignment process. Since accurate alignment of a television receiver is heavily dependent upon the performance of your instruments, it is imperative that they meet the essential specifications described here.

1. **STANDARD SIGNAL GENERATOR** to provide signals at the following frequencies. Maximum output on all ranges should be at least .1 volt with provision for attenuation as desired. This instrument must have good frequency stability and be accurately calibrated. Generators which incorporate a separate crystal controlled oscillator and heterodyne circuit are self calibrating and therefore capable of providing the accuracy of frequency calibration required for television circuit alignment.

A. IF Frequencies:

- 455 Kc. (400 cycle amplitude modulated) for AM IF.
- 4.5 Mc. (Unmodulated) for TV Sound.
- 10.7 Mc. (Unmodulated) for FM IF.
- 22.25 (Unmodulated) marker for TV Sound IF carrier.
- 22.4 Mc. (Unmodulated) for TV 1st IF Trap.
- 22.8 Mc. (Unmodulated) for TV 3rd IF Trap.
- 23.5 Mc. (Unmodulated) for TV 1st and 3rd IF.
- 24.5 Mc. (Unmodulated) for TV 4th IF.
- 26.3 Mc. (Unmodulated) for TV Converter and 2nd IF.
- 26.75 Mc. (Unmodulated) marker for TV Picture IF carrier.

B. RF Frequencies:

- 550 to 1600 Kc. (400 cycle amplitude modulated) for AM RF.
- 54 to 88 Mc. (Unmodulated) for TV RF.
- 88 to 108 Mc. (400 cycle amplitude modulated) for FM RF.
- 174 to 216 Mc. (Unmodulated) for TV RF.

2. **RF SWEEP GENERATOR** to provide frequency modulated signals at the following frequencies:

   10.7 Mc. with 300 Kc. sweep width.
   20 to 30 Mc. with 10 Mc. sweep width.
   54 to 88 Mc. with 10 Mc. sweep width.
   174 to 216 Mc. with 10 Mc. sweep width.

   Output adjustable with at least .1 volt maximum.

   Output should be "flat" (no amplitude variation) for all settings of the sweep width control.

   Provision for connection of generator sweep modulating voltage to horizontal deflection system of an oscilloscope.

   Provision for blanking the output signal on each return sweep so that oscillogram will not show retrace.

3. **CATHODE RAY OSCILLOSCOPE**, preferably a unit with vertical amplifier having wide range frequency response and low capacity pick-up probe.

4. **VACUUM TUBE VOLTMETER.** The lowest voltage range of this instrument should preferably permit a 1.0 volt reading to be indicated at not less than one third of full scale deflection.

5. **OUTPUT METER**, preferably a unit equipped with an impedance matching network that will present a 3.2 ohm load when connected to secondary of audio output transformer.

INSTRUMENT CONNECTIONS: The method of connection, including details of matching and coupling networks, for instruments used in this alignment procedure is given in several illustrations on subsequent pages. Specific instructions for each instrument application will also be found in various sections of the alignment charts.

IMPORTANT

AVOID EXCESSIVE INPUT SIGNAL WHEN USING OSCILLOSCOPE AS ALIGNMENT INDICATOR.

When observing the receiver band pass characteristic on an oscilloscope, it is exceedingly important to avoid distortion of that characteristic which would occur when using a large input signal from the sweep generator or standard generator (marker signal). Always set attenuator on sweep generator so that reading on the vacuum tube voltmeter does not exceed one volt (when meter is connected from high side of video detector load resistor, symbol 139, to receiver chassis). Standard generator output should also be attenuated so that marker signal does not pull or tear the band pass characteristic as shown on the 'scope.

CHECKING SYNCHRONIZATION OF BAND SWITCHES ON AM-FM TUNER AND TV CHASSIS.

Note that the band switch on the AM-FM Tuner chassis is mechanically coupled by a link arm and lever arrangement to the band switch on the TV chassis. Do not operate these switches by direct pressure on the link arm—always use a control knob attached to the TV switch shaft.

If the mechanical linkage is forced or slips at the lever on the TV switch shaft, or the bottom cover of the AM-FM tuner is removed for service purposes, it is possible for the respective switch sections to get out of step. The receiver can be damaged if the switch sections lose synchronization, or are indiscriminately set to random positions. In order to check for proper synchronization of the band switches, refer to procedure on page 10.

BROADCAST BAND—"AM"—ALIGNMENT PROCEDURE

1. After the entire chassis assembly has been removed from the cabinet, remove the AM loop antenna and reconnect it to the AM antenna leads extending from the AM-FM tuner chassis. Then wind one turn of insulated wire around frame of loop antenna so as to provide a means of coupling it to the signal generator. Connect one end of coupling turn to receiver chassis and allow other end to remain open until otherwise instructed in the following chart. Space loop antenna same distance away from the chassis as when assembled in the cabinet.
2. Reconnect the speaker to the two audio output leads extending from the main chassis. IMPORTANT: Do not confuse these leads with the two loop antenna leads.
3. Place the AM-FM dial scale escutcheon on the AM-FM tuning shaft and install the AM-FM pointer knob and fine tuning knob on their respective shafts. Then rotate these knobs to the extreme counter-clockwise position. At this setting, the gang condenser should be fully meshed; if it is not, loosen the set screws in the hub of the dial drum on the gang condenser and close gang plates manually. Then tighten set screws in hub of dial drum.
4. When aligning the RF circuits and calibrating the oscillator it is necessary to hold the AM-FM dial escutcheon in its normal mounting position so that the heavy lines below 88 and 108 are in a horizontal plane. Note that the pointer knob must point to the heavy line below 88 on the dial when tuning knob is turned fully counter-clockwise and gang plates are completely meshed.
5. IMPORTANT: Do not remove the metal bottom plate of AM-FM tuner chassis. Holes are provided for access to IF transformer tuning slugs. Removal of the bottom plate during alignment of the RF circuits will result in detuning when the plate is replaced.
6. Connect output meter across the speaker voice coil.
7. Connect ground lead of signal generator to the receiver chassis.
8. Set volume control to the maximum volume position and use a weak signal from the signal generator.
9. Set tone control to its extreme clockwise position.
10. Set band switch to the "AM" position.
11. After alignment procedure is completed and chassis and loop have been reinstalled in cabinet, arrange leads to loop so that they are separated from each other as much as possible. Avoid twisting, taping or extending these leads.

DUMMY ANT. IN SERIES WITH SIGNAL GENERATOR	CONNECT HIGH SIDE OF SIGNAL GENERATOR TO	SIGNAL GENERATOR FREQUENCY	RECEIVER DIAL SETTING	TRIMMER OR SLUG NUMBER	TRIMMER DESCRIPTION	TYPE OF ADJUSTMENT
.1 MFD. Condenser	Lug on trimmer #23 at bottom of gang (see figure 1 for location of trimmer).	455 KC	Any point where it does not affect the signal.	18 and 19	2nd I.F.	Adjust for maximum output. Then repeat adjustment.
				20 and 21	1st I.F.	
200 MMF. Mica Condenser	Coupling turn on loop antenna.	1500 KC	1500 KC	#22	AM Oscillator.	Adjust for maximum output.
		1500 KC	Tune to 1500 Kc. generator signal.	#23	AM Antenna	Adjust for maximum output.
200 MMF. Mica Condenser	Coupling turn on loop antenna.	600 KC	Tune to 600 Kc. generator signal.	#24	Adjustable core of AM Antenna Coil.	Adjust for maximum output.

Repeat adjustment of trimmers 23 and 24 until one no longer detunes the other.

FREQUENCY MODULATION—"FM"—ALIGNMENT PROCEDURE

1. After the entire chassis has been removed from the cabinet, replace the AM-FM dial escutcheon on the AM-FM tuning shaft and install the AM-FM pointer knob and fine tuning knob on their respective shafts. Then rotate these knobs to the extreme counter-clockwise position. At this setting, the gang condenser should be fully meshed; if it is not, loosen the set screws in the hub of the dial drum on the gang condenser and close gang plates manually. Then tighten set screws in hub of dial drum.
2. When aligning the RF circuits and calibrating the oscillator it is necessary to hold the AM-FM dial escutcheon in its normal mounting position so that the heavy lines below 88 and 108 are in a horizontal plane. Note that the pointer knob must point to the heavy line below 88 on the dial when tuning knob is turned fully counter-clockwise and gang plates are completely meshed.
3. Reconnect the speaker to the two audio output leads extending from the main chassis. IMPORTANT: Do not confuse these leads with the two AM loop antenna leads.
4. Set band switch to the "FM" position.
5. Remove bottom cover from AM-FM tuner during IF alignment but replace it before starting alignment of RF circuits

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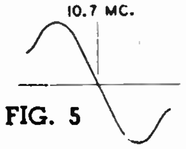
FREQUENCY MODULATION—"FM" ALIGNMENT PROCEDURE

IMPORTANT: Carefully follow procedure for removal and replacement of this plate, as well as synchronization of band switches on AM-FM tuner and TV chassis, as explained on page 10. Failure to correctly install bottom cover may result in serious damage to receiver.

6. Do not remove the AM-FM tuner chassis from the TV chassis during alignment.
7. Set volume control to the maximum volume position and use a weak signal from the signal generator.
8. Set tone control to its extreme clockwise position.
9. Dress FM circuit leads as short and straight as possible, particularly those in the oscillator circuit. If plate and grid leads should also be kept short and straight.

STANDARD SIGNAL GENERATOR		SWEEP GENERATOR		VTVM OR OUTPUT METER CONNECTION	OSCILLOSCOPE CONNECTIONS	RECEIVER DIAL SETTING	TRIMMER OR SLUG NUMBER	TYPE OF ADJUSTMENT AND OUTPUT INDICATION
CONNECTIONS	FREQUENCY	CONNECTIONS	FREQ.					
Connect high side to lug on trimmer #32 (see Fig. 1 for location of trimmer) using a .01 Mfd. condenser in series with generator lead. Connect ground lead to the receiver chassis in vicinity of gang condenser.	**10.7 MC.** Unmodulated	Not used.	———	Connect VTVM as shown in Fig. 3.	Not used.	Any position where it does not affect the signal.	#25 Discriminator secondary #26 Discriminator primary 27 and 28 2nd IF 29 and 30 1st IF	Adjust these trimmers for maximum meter reading — the output voltage will be of negative polarity.
Same as above.	Same as above.	Not used.	———	Connect VTVM as shown in Fig. 4.	Not used.	Same as above.	#25 Discriminator secondary	Note that as slug #25 is rotated, a point will be found where the voltmeter will swing rather sharply from a positive to a negative reading or vice versa. The correct setting is obtained when the meter reads zero as the slug is moved thru this point.
Same as above.	Same as above. ——— Attenuate signal to prevent overload and distortion of response curve.	Connect high side to lug on trimmer #32 (see Fig. 1 for location of trimmer) using a .01 Mfd. condenser in series with generator lead. Connect ground lead to the receiver chassis in vicinity of gang condenser.	**10.7 MC** Sweeping ±300 Kc.	Not used.	Connect as shown in Fig. 4. ——— Set vertical amplifier of 'scope for maximum amplification. ——— Synchronize oscilloscope with sweep generator by connecting "horizontal input" terminals of 'scope to source of horizontal sweep modulating voltage on the sweep generator.	Same as above.	#25 Discriminator secondary	A pattern similar to that shown in Fig. 5 should appear on the oscilloscope screen. Check for symmetry about the 10.7 Mc. center point and linearity of the slope.  FIG. 5 If the characteristic is not shaped properly, attempt to obtain symmetry by changing the setting of slug #25. Should that fail to produce the desired results, then a slight readjustment of slugs #26, 27, 28, 29 and 30 should be undertaken.
IMPORTANT: Before starting alignment of the RF and Oscillator circuits, be sure to replace the bottom plate on the AM-FM Tuner chassis as explained on page 10. Failure to observe this requirement would result in detuning if plate were replaced after alignment is completed.								
Connect high side in series with a 270 ohm carbon resistor to FM antenna terminal near gang condenser (see Fig. 1). Connect ground lead to receiver chassis.	**108 MC.** with 400 cycle AM Modulation.	Not used.	———	Connect OUTPUT METER across speaker voice coil.	Not used.	108 Mc.	#31 FM Oscillator	Set trimmer #31 to receive 108 Mc. signal as indicated by maximum meter reading.
Same as above.	**106 MC.** with 400 cycle AM Modulation.	Not used.	———	Same as above.	Not used.	Tune to 106 Mc. generator signal.	#32 FM RF	Adjust trimmer for maximum meter reading.

Check calibration and tracking of receiver with input signals of 88, 90 and 106 MC. If difference between dial pointer setting and the above mentioned frequencies does not exceed ±0.3 MC. and RF circuit is tracking properly, then alignment may be considered satisfactory and no further adjustment is necessary.

Where the calibration error is greater than 0.3 MC. it is advisable to make the following adjustments:

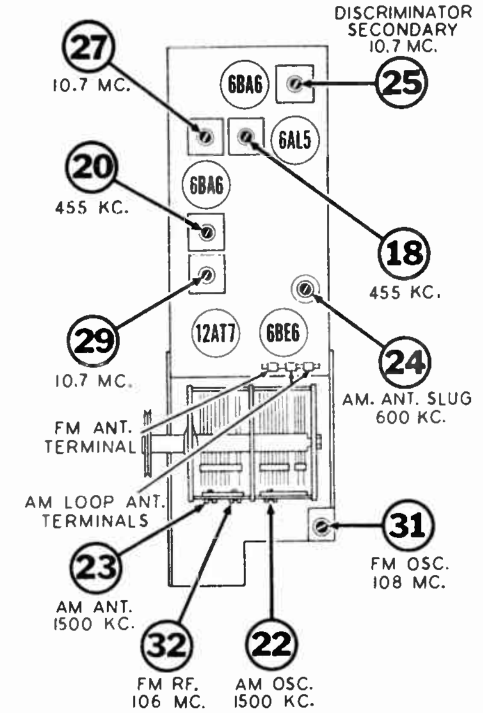
Tune receiver to an 88 MC. signal and note whether dial pointer is above or below correct calibration point. Then tune receiver so that dial pointer is at the 88 MC. position. If generator signal was previously received at a setting above 88 MC., it will be necessary to slightly spread the windings of the FM oscillator coil (#33 in Fig. 2) so that signal will now be received at the correct dial setting. On the other hand if generator signal was received at a dial setting below 88 MC., then slightly compress the windings of the oscillator coil until the signal comes in at the correct calibration point.

Adjustment of FM oscillator coil #33 will require removal of bottom cover. Before rechecking calibration, follow procedure on page 10 for removal and replacement of cover.

Check calibration at 108 MC. and if it is in error by more than ±0.3 MC., readjust setting of trimmer #31. Repeat calibration adjustment at 88 and 108 MC. until desired accuracy is obtained.

Observe dial calibration at 106 MC. If it is found to be incorrect by an appreciable amount, then make a very slight adjustment in the spacing of the gang condenser plates to receive the 106 MC. signal at the correct dial setting. Then check adjustment of RF trimmer #32 to obtain maximum output indication at 106 MC.

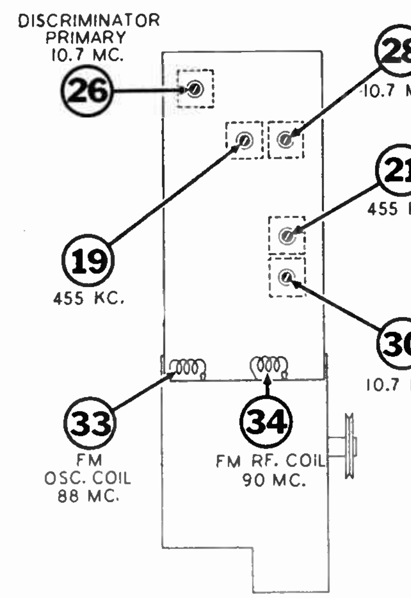
TRIMMER AND SLUG LOCATIONS FOR AM-FM TUNER ALIGNMENT



TOP VIEW

FIG. 1

AM-FM Tuner Chassis



BOTTOM VIEW

FIG. 2

AM-FM Tuner Chassis

INSTRUMENT CONNECTIONS FOR FM ALIGNMENT PROCEDURE

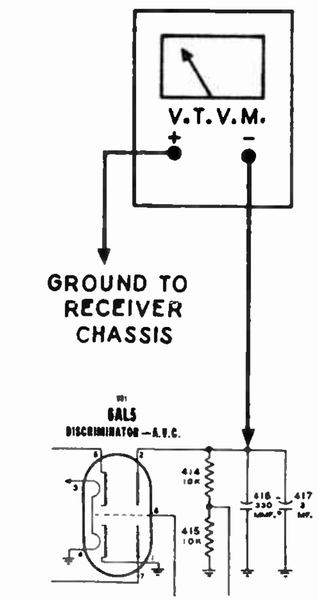


FIG. 3

VTVM Connections for FM Sound IF Alignment

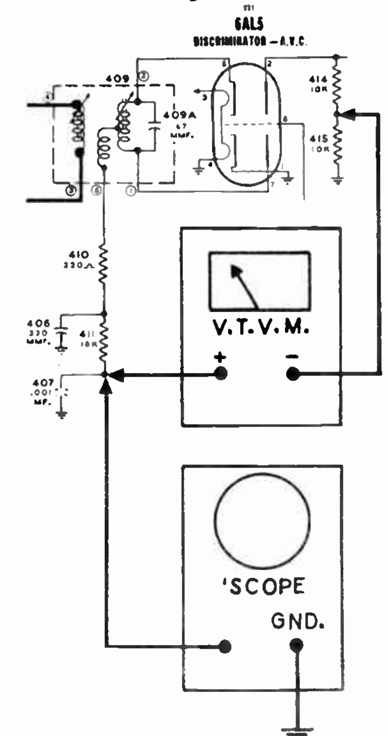


FIG. 4

VTVM and Oscilloscope Connections for FM Sound Discriminator Alignment

MODEL 1.2, ... 100.115

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INSTRUMENT CONNECTIONS FOR SOUND CHANNEL ALIGNMENT

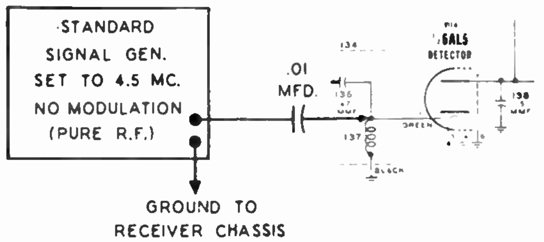

FIG. 6
Generator Connections for Television Sound Channel Alignment

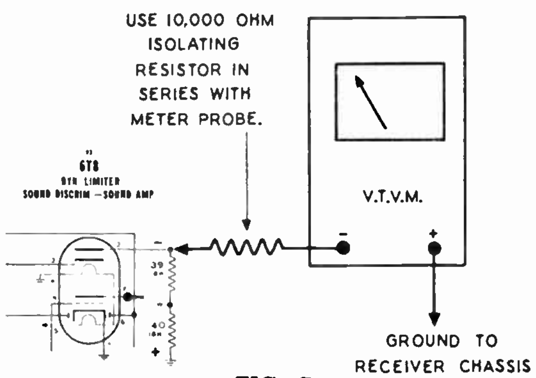

FIG. 7
VTVM Connections for Television Sound IF Alignment

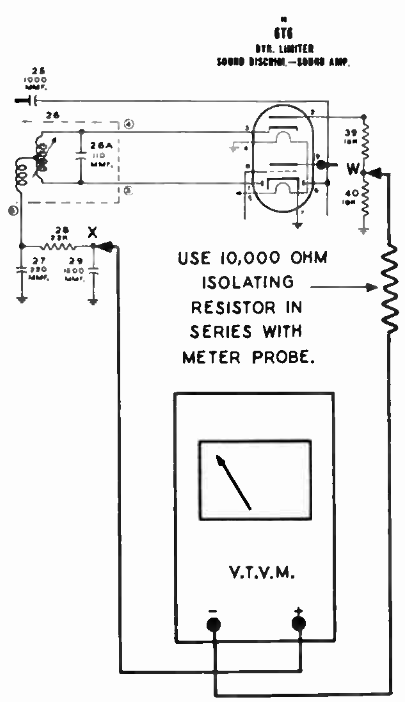

FIG. 8
VTVM Connections for Television Sound Discriminator Alignment

INSTRUMENT CONNECTIONS FOR IF CHANNEL ALIGNMENT

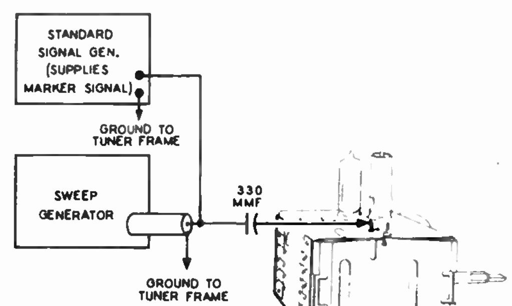

FIG. 9
Generator Connections for Television IF Channel Alignment

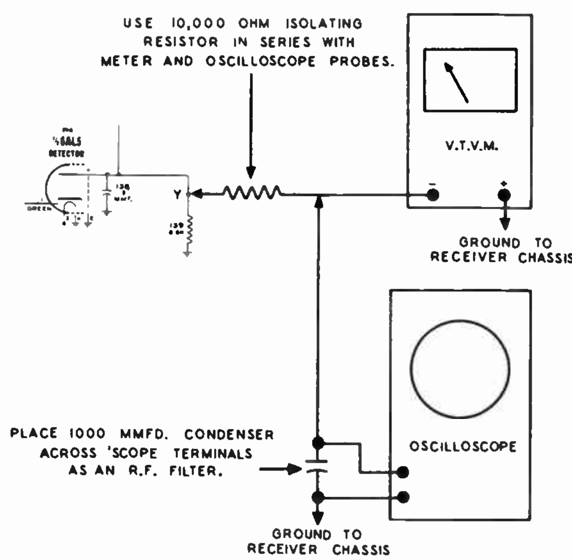

FIG. 10
VTVM and Oscilloscope Connections for Television IF Channel Alignment

TELEVISION SOUND CHANNEL ALIGNMENT PROCEDURE

1. Short antenna terminals together with a jumper wire.
2. Turn the band switch to "TV" position and set receiver Channel Selector to any inactive television channel; other controls may be left at any desired setting.
3. No special aligning tool is required to adjust the cores in the Sound IF and discriminator transformers. The blade of a small screwdriver will fit the slot in these cores, however, the screwdriver should be of a non-metallic or insulated type to prevent detuning when inserted in the transformer can.

STANDARD SIGNAL GENERATOR CONNECTIONS	STANDARD SIGNAL GENERATOR FREQUENCY	VTVM CONNECTIONS	MISCELLANEOUS INSTRUCTIONS	TRIMMER OR SLUG	TYPE OF ADJUSTMENT AND OUTPUT INDICATION
Connect as shown in Fig. 6.	**4.5 MC.** unmodulated **IMPORTANT** This signal must be accurate within 1/4 of 1% of 4.5 Mc. Check generator calibration against a crystal controlled signal source by "zero beating" (heterodyning) with harmonic of the crystal frequency.	Connect as shown in Fig. 7.	A "swishing" sound may be heard in the speaker during Sound Channel Alignment. This spurious oscillation is caused by horizontal sweep voltage being picked up in the audio system thru stray coupling of instrument leads; it should be disregarded as it will have no effect on alignment of the sound channel.	#1 Discriminator Secondary	Adjust for maximum reading on VTVM.
				#2 Discriminator Primary	Adjust for maximum reading on VTVM.
				#3 2nd Sound IF Secondary	Adjust for maximum reading on VTVM.
				#4 2nd Sound IF Primary	Adjust for maximum reading on VTVM.
				#5 1st Sound IF Secondary	Adjust for maximum reading on VTVM.
				#6 1st Sound IF Primary	Adjust for maximum reading on VTVM.
Same as above.	Same as above.	Connect as shown in Fig. 8.	Same as above.	#1 Discriminator Secondary	Note that as slug #1 is rotated, a point will be found where the voltmeter will swing rather sharply from a positive to a negative reading or vice versa. The correct setting of slug #1 is obtained when the meter reads zero as the slug is moved thru this point.

REDUCTION OF INTERCARRIER BUZZ

Slight "dynamic" unbalance of the discriminator secondary can emphasize intercarrier buzz due to incomplete amplitude modulation rejection. Therefore it is vitally important to obtain an accurate setting of the discriminator secondary slug under actual reception conditions.

Disconnect all instruments and then connect an antenna to the receiver to obtain program reception from a local station. If intercarrier buzz is prominent, a slight readjustment of the discriminator secondary slug (#1) should be made to obtain the "dip" point for the buzzing sound. Note that program sound will be clear and free from distortion at this point. Buzz should now be at an acceptable minimum if station transmission is not at fault.

TELEVISION IF CHANNEL ALIGNMENT PROCEDURE

1. A special aligning tool designed to fit the stems on adjustable cores of the IF coils (see points 8, 9, 10 and 11 in Fig. 18) is available and may be obtained by requesting IF Alignment Tool #W507479.
2. Turn receiver Channel Selector to television channel #12 and short antenna terminals together with a jumper wire.
3. Turn the band switch to the "TV" position.
4. Connect a 3 volt battery to the receiver AGC system so that negative terminal of battery connects to the AGC line and positive terminal of battery connects to receiver chassis. See Fig. 19 for convenient point of connection.
5. Note location of IF Trap Coils #12 and #13 by referring to Fig. 19. Before undertaking the alignment of any of the IF stages, Trap Coils #12 and #13 must be detuned so that they do not resonate in the IF pass band. Detuning is accomplished by merely compressing the windings so that they are closely spaced. Failure to detune the Trap Coils can cause the IF system to become regenerative, thereby preventing alignment.
6. If the IF channel is badly misaligned and two or more immediately adjoining IF stages are tuned to the same frequency, oscillation may occur. Such oscillation shows up as a voltage across the video detector load resistor, symbol 139, and is indicated by the VTVM that is connected to this point during alignment. It should be noted

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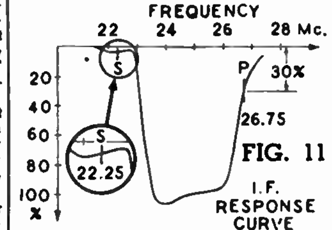
TELEVISION IF CHANNEL ALIGNMENT PROCEDURE

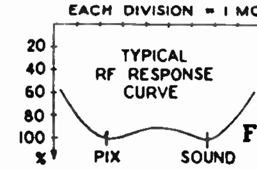
that voltage due to IF oscillation is unaffected by strength of signal from the generator.

Where IF oscillation is encountered, it is generally possible to correct the condition by detuning the IF coils in different directions. If that does not have the desired effect, increase fixed bias on AGC line by using a 4½ volt battery instead of the 3 volt battery referred to in instruction #4. After stopping the oscillation in this manner it will then be possible to align all IF stages using the following procedure, however, the AGC bias battery must be changed back to 3 volts when using the oscilloscope to observe band pass characteristic. Once all stages have been aligned using the 4½ volt bias, the IF channel should be stable with reduced bias.

STANDARD SIGNAL GENERATOR		SWEEP GENERATOR		VTVM CONNECTIONS	OSCILLOSCOPE CONNECTIONS	MISCELLANEOUS INSTRUCTIONS	TRIMMER OR SLUG	TYPE OF ADJUSTMENT AND OUTPUT INDICATION
CONNECTIONS	FREQUENCY	CONNECTIONS	FREQ.					
Connect as shown in Fig. 9.	26.3 MC.	Use a 330 Mmf. isolating condenser and connect as shown in Fig. 9 but keep power switch turned off during this step.	——	Connect as shown in Fig. 10.	Not used.	——	#7 Converter plate coil	Adjust for maximum reading on VTVM.
							#8 2nd I.F.	Adjust for maximum reading on VTVM.
Same as above.	24.5 MC.	Same as above.	——	Same as above.	Not used.	——	#9 4th I.F.	Adjust for maximum reading on VTVM.
Same as above.	23.5 MC.	Same as above.	——	Same as above.	Not used.	——	#10 1st I.F.	Adjust for maximum reading on VTVM.
							#11 3rd I.F.	Adjust for maximum reading on VTVM.
Same as above.	22.4 MC.	Same as above.	——	Same as above.	Not used.	——	#12 1st IF Trap Coil	Adjust the spacing of the Trap Coil windings for MINIMUM reading on VTVM.
Same as above.	22.8 MC.	Same as above.	——	Same as above.	Not used.	——	#13 3rd IF Trap Coil.	Adjust the spacing of the Trap Coil windings for MINIMUM reading on VTVM.
Same as above.	26.75 MC.	With connections made as shown in Fig. 9, turn on this generator and set controls for operation as specified in next column.	25 MC. Sweeping ± 5 Mc.	Same as above.	Connect as shown in Fig. 10.	IMPORTANT: 1. Remove the 6J6 (Mixer-Oscillator) tube and wrap a piece of fine wire around pins 6 and 7 so as to connect these two pins together. Then reinsert the tube in its socket. Oscillator section of tube will now be inoperative and therefore cannot cause undesirable "beat" response that would otherwise disturb the IF band pass characteristic. 2. Adjust output attenuator on sweep generator so that reading on VTVM is one volt. 3. Set attenuator on standard signal generator so that marker signal does not distort the pattern on the oscilloscope. 4. Be sure that a 3 volt battery is connected to AGC line as specified in instruction #4 at the head of this chart. Do not use a battery of any other voltage.	The IF band pass characteristic now displayed on the 'scope should be compared with the curve shown in Fig. 11. If top of curve is not properly shaped, make a slight readjustment of slug #9. Should that adjustment fail to yield the desired result, then note whether the curve has a peak on the high or low frequency side. Slugs #7 and #8 control high frequency response (26.3 Mc.) and slugs #10 and #11 affect the low frequency response (23.5 Mc.); by making a small change in the settings of the high or low frequency slugs, it will be possible to obtain correct band pass curve.  FIG. 11 I.F. RESPONSE CURVE The 26.75 Mc. picture IF carrier marker should now appear at the 30% amplitude position on side of the band pass characteristic (see Fig. 11). If position of the marker appears too high or too low, slight readjustment of slugs #7, 8 and 9 is require'.	
Same as above.	22.25 MC.	Same as above.	Same as above.	Same as above.	Same as above.		Adjust the vertical gain control on the 'scope in order to magnify the sound portion of the response curve. The 22.25 Mc. sound IF carrier marker should appear at the position indicated in Fig. 11. If the position of the sound marker is incorrect, readjust winding spacing of Trap Coils #12 and #13.	

TELEVISION RF CHANNEL ALIGNMENT PROCEDURE

1. Turn the band switch to the "TV" position.
2. Remove bottom cover shield of the Television RF Tuner unit.
3. Connect a 3 volt battery to the receiver AGC system so that negative terminal of battery connects to AGC line and positive terminal of battery connects to receiver chassis. (See Fig. 19 for convenient point of connection.)

STANDARD SIGNAL GENERATOR		SWEEP GENERATOR		VTVM CONNECTIONS	OSCILLOSCOPE CONNECTIONS	MISCELLANEOUS INSTRUCTIONS	COIL	TYPE OF ADJUSTMENT AND OUTPUT INDICATION
CONNECTIONS	FREQUENCY	CONNECTIONS	FREQ.					
RF AMPLIFIER AND MIXER ALIGNMENT								
Connect as shown in Fig. 15.	*215.75 MC. ‡211.25 MC.	Connect as shown in Fig. 15 and set controls for sweep width of 10 Mc. on television channel specified in the next column.	CHANNEL #13	Not used.	Connect as shown in Fig. 16	Set Channel Selector to #13 IMPORTANT: Keep output of standard signal generator at a level that provides a readable marker but does not distort the curve that is being observed on the 'scope.	CHANNEL #13 Antenna Coil; CHANNEL #13 RF Amp. Plate Coil; CHANNEL #13 Mixer Grid Coil	Adjust spacing of the turns on these coils to obtain properly shaped RF band pass characteristic as shown in Fig. 12. To determine whether the turns have to be spread or compressed, use a tuning wand having a brass slug in one end and a powdered iron slug in the other end. If the brass slug is placed near (or into) a coil and causes the response curve to approach that shown in Fig. 12, then the turns would have to be spread. On the other hand, if the powdered iron slug is similarly positioned and produces a correctly shaped response curve, then the coil turns should be compressed. Repeat these adjustments on the Antenna, RF Amp. Plate and Mixer Grid coils for Channel 13 to obtain the desired response characteristic. Do not overly broaden the curve as that would result in a loss of sensitivity. IMPORTANT: After the Channel #13 coils have been aligned correctly, melt the wax around the turns or apply a small amount of high frequency "coil dope" on the winding to assure that spacing will be maintained.
Same as above.	*209.75 MC. ‡205.25 MC.	Same as above.	CHANNEL #12	Not used.	Same as above.	Set Channel Selector to #12	The RF band pass characteristics of the other television channels should now be checked. Adjust the RF sweep generator and marker generator for operation on each of these television channels and observe position of sound carrier and picture carrier markers.  FIG. 12 The response curve for each channel should conform reasonably well with the curve shown in Fig. 12. If it does not, on channels 10, 11 or 12, then adjust the RF Amp. Plate coil for the particular channel; on channels 7, 8 or 9 adjust RF Amp. Plate and Mixer Grid coils; on channels 2 to 6 adjust RF Amp. Plate, Mixer Grid and Antenna coils. Adjustment consists of pushing the coil (or partial turn) toward or away from switch shaft and spreading or compressing the winding.	
	*203.75 MC. ‡199.25 MC.		CHANNEL #11			Set Channel Selector to #11		
	*197.75 MC. ‡193.25 MC.		CHANNEL #10			Set Channel Selector to #10		
	*191.75 MC. ‡187.25 MC.		CHANNEL #9			Set Channel Selector to #9		
	*185.75 MC. ‡181.25 MC.		CHANNEL #8			Set Channel Selector to #8		
	*179.75 MC. ‡175.25 MC.		CHANNEL #7			Set Channel Selector to #7		
	* 87.75 MC. ‡ 83.25 MC.		CHANNEL #6			Set Channel Selector to #6		
	* 81.75 MC. ‡ 77.25 MC.		CHANNEL #5			Set Channel Selector to #5		
	* 71.75 MC. ‡ 67.25 MC.		CHANNEL #4			Set Channel Selector to #4		
	* 65.75 MC. ‡ 61.25 MC.		CHANNEL #3			Set Channel Selector to #3		
	* 59.75 MC. ‡ 55.25 MC.		CHANNEL #2			Set Channel Selector to #2		

*Sound Carrier Marker
‡Picture Carrier Marker

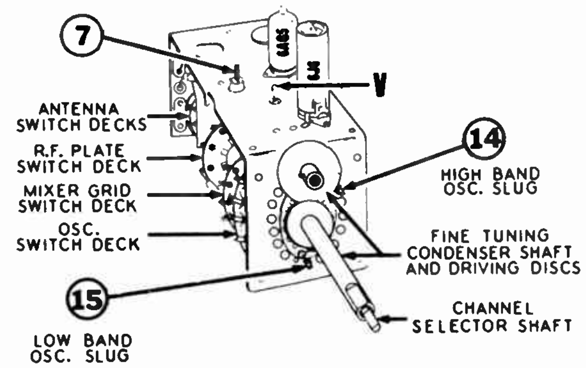


FIG. 13
Front view of RF Tuner Unit

MODEL 142, Ch. 100.115

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STANDARD SIGNAL GENERATOR		SWEEP GENERATOR		VTVM CONNECTIONS	OSCILLOSCOPE CONNECTIONS	MISCELLANEOUS INSTRUCTIONS	COIL OR SLUG	TYPE OF ADJUSTMENT AND OUTPUT INDICATION
CONNECTIONS	FREQUENCY	CONNECTIONS	FREQ.					

OSCILLATOR ALIGNMENT

1. **IMPORTANT:** Before undertaking oscillator alignment be sure IF circuits are correctly aligned for band pass characteristic illustrated in Fig. 11.
2. During oscillator alignment, it is necessary to set the Fine Tuning control in the center of its range.

STANDARD SIGNAL GENERATOR CONNECTIONS	FREQUENCY	SWEEP GENERATOR CONNECTIONS	FREQ.	VTVM CONNECTIONS	OSCILLOSCOPE CONNECTIONS	MISCELLANEOUS INSTRUCTIONS	COIL OR SLUG	TYPE OF ADJUSTMENT AND OUTPUT INDICATION
							#14 High Band Oscillator Slug. #15 Low Band Oscillator Slug.	Adjust the position of both slugs so that approximately 5 threads are visible outside of the fiber plate.
Connect as shown in Fig. 15.	*215.75 MC. ‡211.25 MC.	Connect as shown in Fig. 15 and set controls for sweep width of 10 Mc. on television channel specified in the next column.	CHANNEL #13	Connect as shown in Fig. 17	Connect as shown in Fig. 17	Set Channel Selector to #13 **During this step and thru-out all succeeding steps it is necessary to:** **1. Be sure that Fine Tuning control has been set in the center of its range.** **2. Keep output of sweep generator at a level that does not allow reading on VTVM to exceed one volt.** **3. Keep output of standard signal generator at a level that provides a readable marker but does not distort the curve that is being observed on the 'scope.**	CHANNEL #13 Oscillator Coil	NOTE: Before making the following adjustment, advance the vertical gain control on the 'scope in order to magnify the sound portion of the response curve. Examine the channel 13 oscillator coil and note that it has a "bucking turn." Adjust the spacing of this turn with respect to the main coil in order to shift the response curve until the sound carrier marker appears at the position shown in Fig. 14. Now, reduce gain control setting of 'scope to restore pattern to normal amplitude and observe position of picture carrier marker. This marker should appear at the 35% amplitude position on the low frequency side of the characteristic curve (see Fig. 14). After both pix and sound markers are correctly located on the curve, then melt the wax on the coil to permanently fix the position of the winding.
Same as above.	*209.75 MC. ‡205.25 MC.	Same as above.	CHANNEL #12	Same as above.	Same as above.	Set Channel Selector to #12	Adjust the RF sweep generator and marker generator for operation on the other television channels; set marker generator to sound carrier frequency. After setting Channel Selector to the corresponding channel, then adjust the oscillator coil for that channel so as to shift the response curve and permit the sound carrier marker to appear at the position shown in Fig. 14. Check to see that pix carrier marker falls at 35% amplitude position on opposite side of curve.	
	*203.75 MC. ‡199.25 MC.		CHANNEL #11			Set Channel Selector to #11		
	*197.75 MC. ‡193.25 MC.		CHANNEL #10			Set Channel Selector to #10		
	*191.75 MC. ‡187.25 MC.		CHANNEL #9			Set Channel Selector to #9		
	*185.75 MC. ‡181.25 MC.		CHANNEL #8			Set Channel Selector to #8		
	*179.75 MC. ‡175.25 MC.		CHANNEL #7			Set Channel Selector to #7		
	* 87.75 MC. ‡ 83.25 MC.		CHANNEL #6			Set Channel Selector to #6		
	* 81.75 MC. ‡ 77.25 MC.		CHANNEL #5			Set Channel Selector to #5		
	* 71.75 MC. ‡ 67.25 MC.		CHANNEL #4			Set Channel Selector to #4		
	* 65.75 MC. ‡ 61.25 MC.		CHANNEL #3			Set Channel Selector to #3		
	* 59.75 MC. ‡ 55.25 MC.		CHANNEL #2			Set Channel Selector to #2		

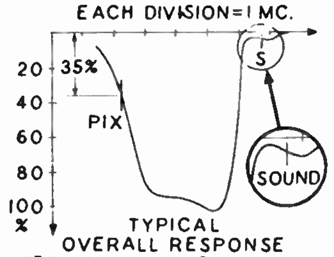

FIG. 14 TYPICAL OVERALL RESPONSE CURVE

Switch back to channel #13 and set both generator signals for that channel. Check position of sound carrier marker. A slight readjustment of slug #14 is usually necessary to reposition the curve so that the sound carrier is correctly located as shown in Fig. 14. If the setting of slug #14 has to be changed by two or more complete turns it should be left in its original position and all of the foregoing oscillator alignment procedure repeated. A similar check should be made for channel #6 using adjustable slug #15 in Fig. 13.

If an unsatisfactory overall response is obtained for a particular channel, observe RF Amp. and Mixer response curve for that channel as described on the preceding page. If characteristic does not conform reasonably well with the typical curve shown in Fig. 14, then attempt to obtain a better compromise for RF response on all channels by realigning Antenna, RF Amp. and Mixer circuits.

*Sound Carrier Marker
‡Picture Carrier Marker

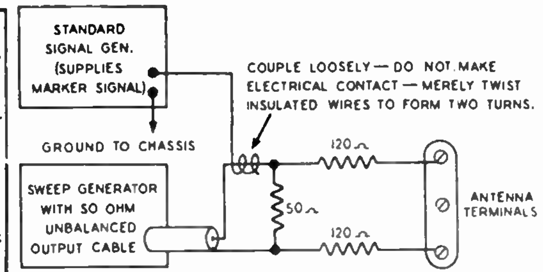

FIG. 15
Generator Connections for Television RF Channel Alignment

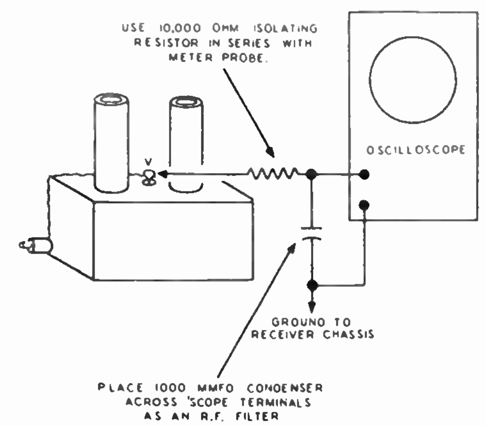

FIG. 16
Oscilloscope Connections for Television RF Amp. and Mixer Alignment

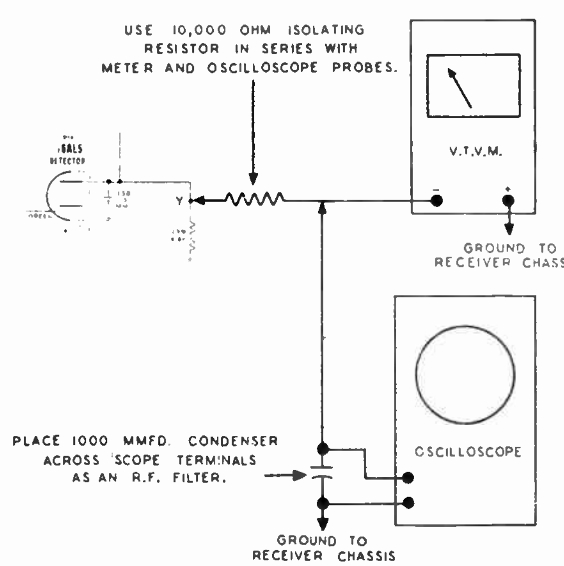

FIG. 17
VTVM and Oscilloscope Connections for Television Oscillator Alignment

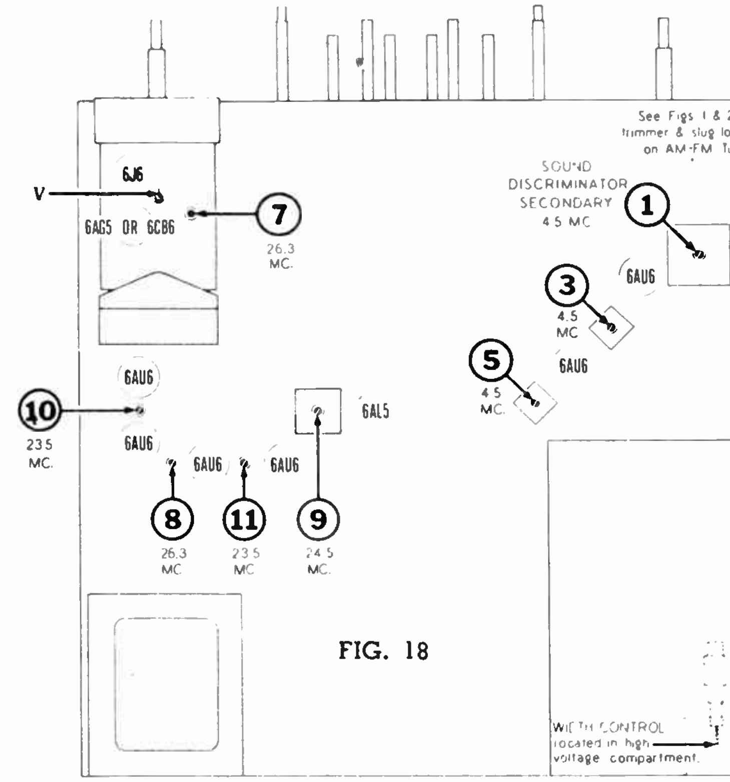

FIG. 18
TOP VIEW OF CHASSIS

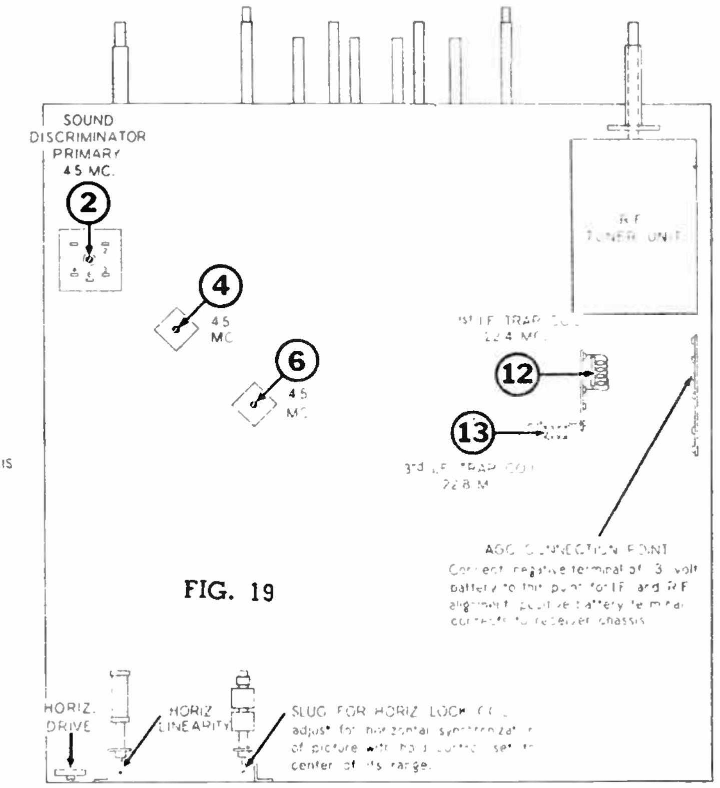

FIG. 19
BOTTOM VIEW OF CHASSIS

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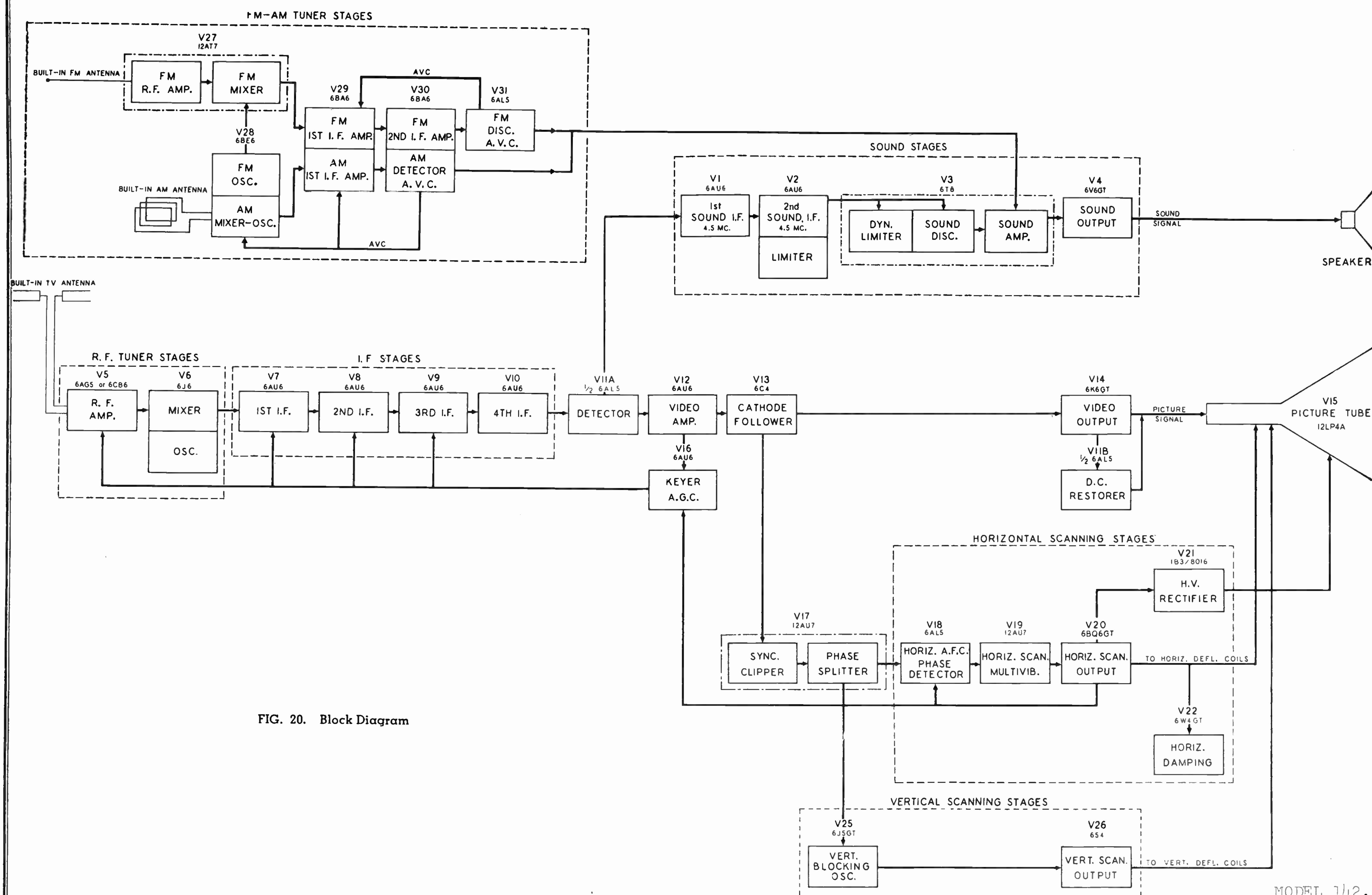

FIG. 20. Block Diagram

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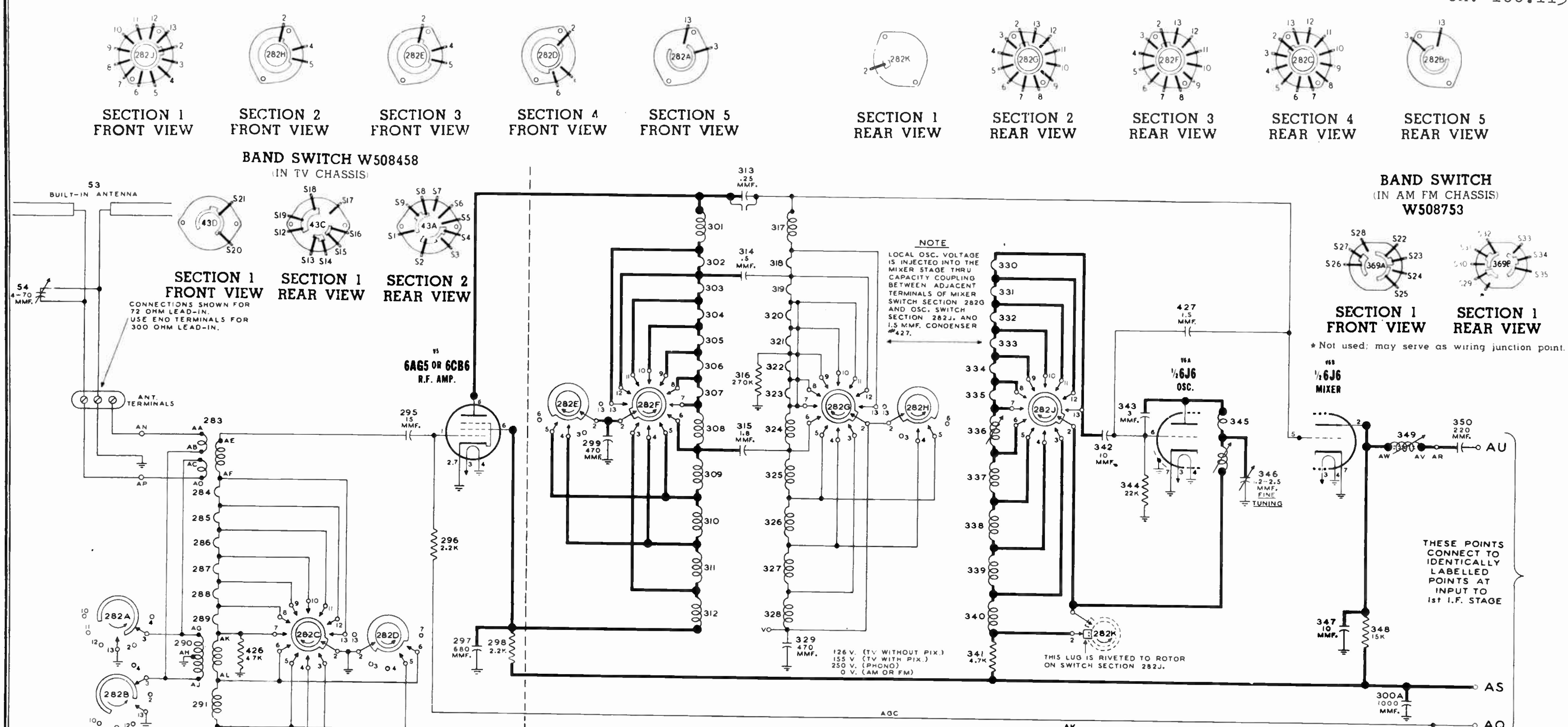
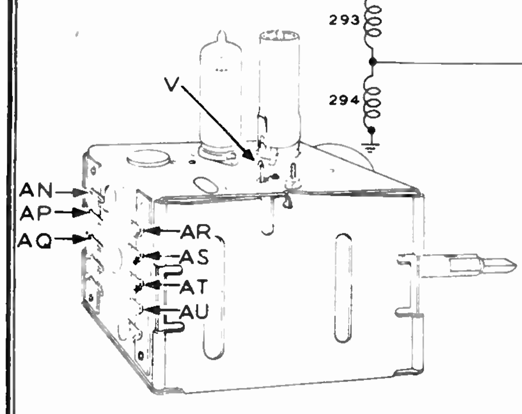
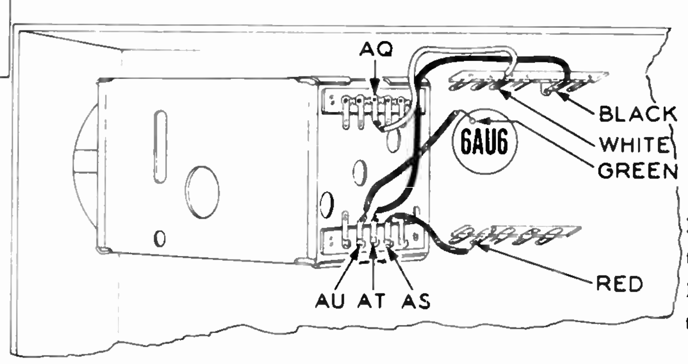
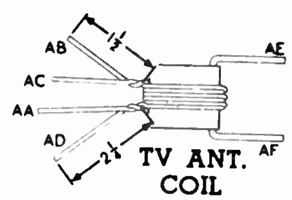




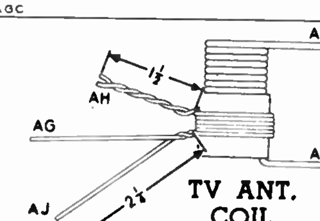
W508431 TUNER UNIT



BOTTOM VIEW OF CHASSIS SHOWING CONNECTIONS TO RF TUNER UNIT

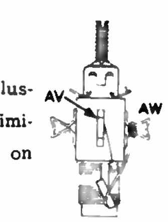


TV ANT. COIL (CHANNEL #13) W508553

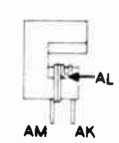


TV ANT. COIL (CHANNEL #6) W508552

Lettered terminals in illustrations correspond to similarly lettered terminals on the circuit diagram.



TV CONVERTER PLATE COIL W508555



TV OSC. COIL CHANNEL #13 W508560

PRODUCTION CHANGES

The following tabulation furnishes complete details on changes which occurred during production. Sequence of these changes is indicated by coding in alphabetical order; that is, "SERIES A" "SERIES B" etc., stamped on back surface of chassis.

The circuit shown on this page applies to "SERIES A" chassis.

CHANGE DESIGNATION STAMPED ON CHASSIS	DESCRIPTION OF CHANGE
UNCODED	INITIAL PRODUCTION
SERIES "A"	1. Resistor 420 (1 Meg.) was removed from grid circuit of V25 (6J5GT) Vertical Blocking Osc. 2. Resistor 265, in grid circuit of V25 (6J5GT), was changed from 1.8 Meg. to 1.5 Meg.

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PARTS LIST FOR CHASSIS

Notice: Some parts listed below have special characteristics. Do not use substitutes for replacement purposes.

CONDENSERS

SCHEMATIC LOCATION	PART NO.	DESCRIPTION
11	W513001	Condenser—ceramic 2.2 Mmfd. 500 volt
12-A, B	W508061	Condenser—ceramic 51 Mmfd. (part of 1st TV sound I.F. transformer)
13	W513013	Condenser—ceramic 5000 Mmfd. 450 volt
16	W513013	Condenser—ceramic 5000 Mmfd. 450 volt
18-A, B	W508061	Condenser—ceramic 51 Mmfd. (part of 2nd TV sound I.F. transformer)
19	W513013	Condenser—ceramic 5000 Mmfd. 450 volt
21	W513433	Condenser—ceramic 47 Mmfd. ± 10% 500 volt (Temperature compensating)
23	W513013	Condenser—ceramic 5000 Mmfd. 450 volt
25	W513009	Condenser—ceramic 1000 Mmfd. 500 volt
26-A	W507321	Condenser—ceramic 110 Mmfd. (part of TV discriminator transformer)
27	W512527	Condenser—mica 220 Mmfd. ± 10% 500 volt
29	W513010	Condenser—ceramic 1500 Mmfd. 350 volt
30	W512027	Condenser—.05 Mfd. 200 volt
32	W512007	Condenser—.005 Mfd. 600 volt
34	W512007	Condenser—.005 Mfd. 600 volt
36	W505174	Condenser—electrolytic 10 Mfd. 150 volt
41	W513010	Condenser—ceramic 1500 Mmfd. 350 volt
42	W502547	Condenser—electrolytic 4 Mfd. 150 volt
44	W502527	Condenser—electrolytic 50 Mfd. 25 volt
46	W504719	Condenser—electrolytic 4 Mfd. 450 volt
48	W512003	Condenser—.002 Mfd. 600 volt
52-A,B,C	W508072	Condenser—electrolytic A—40 Mmfd. 450 volt; B—40 Mmfd. 450 volt; C—40 Mmfd. 450 volt
54	W508324	Condenser—trimmer 4-70 Mmfd.
100	W513009	Condenser—ceramic 1000 Mmfd. 500 volt
105	W512532	Condenser—mica 240 Mmfd. ± 5% 500 volt
106	W513009	Condenser—ceramic 1000 Mmfd. 500 volt
109	W513016	Condenser—ceramic 82 Mmfd. ± 10% 500 volt
112	W513009	Condenser—ceramic 1000 Mmfd. 500 volt
114	W513009	Condenser—ceramic 1000 Mmfd. 500 volt
117	W513016	Condenser—ceramic 82 Mmfd. ± 10% 500 volt
120	W513009	Condenser—ceramic 1000 Mmfd. 500 volt
122	W513009	Condenser—ceramic 1000 Mmfd. 500 volt
126	W513016	Condenser—ceramic 82 Mmfd. ± 10% 500 volt
129	W508682	Condenser—electrolytic 100 Mfd. 50 volt
133	W513009	Condenser—ceramic 1000 Mmfd. 500 volt
136	W513433	Condenser—ceramic 47 Mmfd. ± 10% 500 volt (Temperature compensating)
138	W513432	Condenser—ceramic 5 Mmfd. ± 10% 500 volt (Temperature compensating)
140	W512045	Condenser—.25 Mfd. ± 10% 200 volt
145	W512027	Condenser—.05 Mfd. 200 volt
148	W512045	Condenser—.25 Mfd. ± 10% 200 volt
150	W513003	Condenser—ceramic 100 Mmfd. 500 volt
154	W512033	Condenser—.1 Mfd. 200 volt
157	W512027	Condenser—.05 Mfd. 200 volt
167, 168	W512031	Condenser—.05 Mfd. 600 volt
174	W512019	Condenser—.02 Mfd. 600 volt
175	W512031	Condenser—.05 Mfd. 600 volt
176	W513018	Condenser—ceramic 220 Mmfd. 500 volt
183	W513015	Condenser—mica 56 Mmfd. ± 10% 500 volt
187	W512045	Condenser—.25 Mfd. ± 10% 200 volt
192, 193	W513009	Condenser—ceramic 1000 Mmfd. 500 volt
196	W512013	Condenser—.01 Mfd. 600 volt
199	W513013	Condenser—ceramic 5000 Mmfd. 450 volt
201	W512027	Condenser—.05 Mfd. 200 volt
204	W512531	Condenser—mica 3300 Mmfd. ± 5% 500 volt
205	W513007	Condenser—ceramic 330 Mmfd. 500 volt
210	W512535	Condenser—mica 390 Mmfd. ± 10% 500 volt
211	W512536	Condenser—mica 270 Mmfd. ± 10% 500 volt
*212	W508071	Condenser—trimmer 10-160 Mmfd. (Horizontal Drive Control)
217	W508684	Condenser—electrolytic 5 Mfd. 50 volt
219	W512031	Condenser—.05 Mfd. 600 volt
223	W512538	Condenser—mica 3.3 Mmfd. ± 15% 1500 volt
224	W508680	Condenser—electrolytic 10 Mfd. 600 volt
227	W512031	Condenser—.05 Mfd. 600 volt
230	W513024	Condenser—ceramic 500 Mmfd. 20,000 volt
232	W512031	Condenser—.05 Mfd. 600 volt
235	W512031	Condenser—.05 Mfd. 600 volt
236	W512037	Condenser—.1 Mfd. 600 volt
237, 238	W512255	Condenser—.01 Mfd. 400 volt
240	W513013	Condenser—ceramic 5000 Mmfd. 450 volt
242, 243	W513009	Condenser—ceramic 1000 Mmfd. 500 volt
245, 246	W513009	Condenser—ceramic 1000 Mmfd. 500 volt
249-A,B	W508073	Condenser—electrolytic A—20 Mfd. 300 volt; B—60 Mfd. 300 volt
250	W513018	Condenser—ceramic 220 Mmfd. 500 volt
258	W513009	Condenser—ceramic 1000 Mmfd. 500 volt
260	W513013	Condenser—ceramic 5000 Mmfd. 450 volt
262-A	W508062	Condenser—ceramic .01 Mfd. 450 volt (part of Integrator Unit)
262-C	W508062	Condenser—ceramic 2000 Mmfd. 450 volt (part of Integrator Unit)
262-E	W508062	Condenser—ceramic 5000 Mmfd. 450 volt (part of Integrator Unit)
262-G	W508062	Condenser—ceramic 5000 Mmfd. 450 volt (part of Integrator Unit)
264	W512533	Condenser—mica 4700 Mmfd. ± 5% 1000 volt
273	W512308	Condenser—.05 Mfd. ± 10% 600 volt
274	W512037	Condenser—.1 Mfd. 600 volt
279	W512532	Condenser—mica 240 Mmfd. ± 5% 500 volt
295	W508569	Condenser—ceramic 15 Mmfd. ± 10% 500 volt
297	W508570	Condenser—ceramic 680 Mmfd. 500 volt
299	W508572	Condenser—ceramic 470 Mmfd. 500 volt
300-A,B	W508576	Condenser—ceramic A—1000 Mmfd. 500 volt; B—1000 Mmfd. 500 volt
313	W508573	Condenser—ceramic .25 Mmfd. ± 10% 500 volt
314	W508574	Condenser—ceramic .5 Mmfd. ± 10% 500 volt (Temperature compensating)
315	W508575	Condenser—ceramic 1.8 Mmfd. ± 10% 500 volt
329	W508572	Condenser—ceramic 470 Mmfd. 500 volt
342	W508571	Condenser—ceramic 10 Mmfd. ± 10% 500 volt (Temperature compensating)
343	W508557	Condenser—ceramic 3 Mmfd. ± 10% 500 volt
346	W508551	Condenser—trimmer 1.2 - 2.5 Mmfd. (Mounted) (Fine tuning)
347	W508571	Condenser—ceramic 10 Mmfd. ± 10% 500 volt (Temperature compensating)
350	W513005	Condenser—ceramic 220 Mmfd. 500 volt
351	W513009	Condenser—ceramic 1000 Mmfd. 500 volt
353	W513006	Condenser—ceramic 270 Mmfd. 500 volt
355	W512007	Condenser—.005 Mfd. 600 volt
356	W512013	Condenser—.01 Mfd. 600 volt
359	W160095	Condenser—electrolytic 40 Mfd. 300 volt
366-A to D	W508729	Condenser—variable gang
367	W513009	Condenser—ceramic 1000 Mmfd. 500 volt
371	W507940	Condenser—trimmer 1.5-12 Mmfd.
373	W513007	Condenser—ceramic 330 Mmfd. 500 volt
376	W513009	Condenser—ceramic 1000 Mmfd. 500 volt
377	W513000	Condenser—ceramic 1.0 Mmfd. 500 volt
378	W513002	Condenser—ceramic 47 Mmfd. 500 volt
380	W513002	Condenser—ceramic 47 Mmfd. 500 volt
382	W513436	Condenser—ceramic 2.5 Mmfd. 500 volt (Temperature compensating)
384	W513001	Condenser—ceramic 2.2 Mmfd. 500 volt
387-A,B	W506080	Condenser—ceramic 33 Mmfd. (part of 1st FM I.F. transformer)
388-A	W505867	Condenser—ceramic 83 Mmfd. (part of 1st AM I.F. transformer)
388-B	W505867	Condenser—ceramic 66 Mmfd. (part of 1st AM I.F. transformer)
389	W513013	Condenser—ceramic 5000 Mmfd. 450 volt
391	W513013	Condenser—ceramic 5000 Mmfd. 450 volt
393	W513013	Condenser—ceramic 5000 Mmfd. 450 volt
396	W513013	Condenser—ceramic 5000 Mmfd. 450 volt
397-A	W505905	Condenser—ceramic 83 Mmfd. (part of 2nd FM I.F. transformer)
398-A	W505867	Condenser—ceramic 83 Mmfd. (part of 2nd AM I.F. transformer)
398-B	W505867	Condenser—ceramic 66 Mmfd. (part of 2nd AM I.F. transformer)
399-A	W506338	Condenser—ceramic 100 Mmfd. 400 volt (part of Diode Filter Unit)
399-C	W506338	Condenser—ceramic 100 Mmfd. 400 volt (part of Diode Filter Unit)
401	W512028	Condenser—.05 Mfd. 400 volts
403	W513013	Condenser—ceramic 5000 Mmfd. 450 volt
404	W513013	Condenser—ceramic 5000 Mmfd. 450 volt
406	W513007	Condenser—ceramic 330 Mmfd. 500 volt
407	W512103	Condenser—.001 Mfd. 400 volt
408	W513013	Condenser—ceramic 5000 Mmfd. 450 volt
409-A	W508179	Condenser—ceramic 47 Mmfd. (part of FM discriminator)
412	W513013	Condenser—ceramic 5000 Mmfd. 450 volt
413	W513009	Condenser—ceramic 1000 Mmfd. 500 volt
416	W513007	Condenser—ceramic 330 Mmfd. 500 volt
417	W507946	Condenser—electrolytic 3 Mfd. 50 volt
419	W513023	Condenser—ceramic 10 Mmfd. ± 10% 500 volt
421	W513009	Condenser—ceramic 1000 Mmfd. 500 volt
427	W508783	Condenser—ceramic 1.5 Mmfd. ± 10% 500 volt

RESISTORS

SCHEMATIC LOCATION	PART NO.	DESCRIPTION
14	W510117	Resistor—carbon 82 Ohms ± 10% ½ watt
17	W510137	Resistor—carbon 1000 Ohms ½ watt
20	W510185	Resistor—carbon 470,000 Ohms ½ watt
22	W510117	Resistor—carbon 82 Ohms ± 10% ½ watt
24	W510137	Resistor—carbon 1000 Ohms ½ watt
28	W510160	Resistor—carbon 22,000 Ohms ± 10% ½ watt
31	W510170	Resistor—carbon 68,000 Ohms ½ watt
35	W510197	Resistor—carbon 10 Meg. ½ watt
38	W510163	Resistor—carbon 33,000 Ohms ± 10% ½ watt
39, 40	W510159	Resistor—carbon 18,000 Ohms ± 10% ½ watt
45	W510227	Resistor—carbon 330 Ohms ± 10% 1 watt
47	W510153	Resistor—carbon 8200 Ohms ± 10% ½ watt
50	W510140	Resistor—carbon 1500 Ohms ½ watt
101	W510148	Resistor—carbon 4700 Ohms ± 10% ½ watt
102	W510137	Resistor—carbon 1000 Ohms ½ watt
104	W510122	Resistor—carbon 150 Ohms ½ watt
108	W510137	Resistor—carbon 1000 Ohms ½ watt
110	W510153	Resistor—carbon 8200 Ohms ± 10% ½ watt
111	W510137	Resistor—carbon 1000 Ohms ½ watt
113	W510119	Resistor—carbon 100 Ohms ½ watt
116	W510137	Resistor—carbon 1000 Ohms ½ watt
118	W510148	Resistor—carbon 4700 Ohms ± 10% ½ watt
119	W510137	Resistor—carbon 1000 Ohms ½ watt
121	W510120	Resistor—carbon 120 Ohms ± 10% ½ watt
123	W510153	Resistor—carbon 8200 Ohms ± 10% ½ watt
124	W510137	Resistor—carbon 1000 Ohms ½ watt
130	W510119	Resistor—carbon 100 Ohms ½ watt
131	W510713	Resistor—carbon 3000 Ohms ± 5% 2 watt
132	W510153	Resistor—carbon 8200 Ohms ± 10% ½ watt
135	W510137	Resistor—carbon 1000 Ohms ½ watt
139	W510151	Resistor—carbon 6800 Ohms ± 10% ½ watt
141	W510254	Resistor—carbon 10,000 Ohms ± 10% 1 watt
142	W510253	Resistor—carbon 8200 Ohms ± 10% 1 watt
144	W510166	Resistor—carbon 47,000 Ohms ± 10% ½ watt
146	W510164	Resistor—carbon 33,000 Ohms ½ watt
147	W510155	Resistor—carbon 10,000 Ohms ½ watt
149	W510150	Resistor—carbon 5600 Ohms ± 10% ½ watt
151	W510173	Resistor—carbon 100,000 Ohms ½ watt
153	W510150	Resistor—carbon 5600 Ohms ± 10% ½ watt
155	W510191	Resistor—carbon 1 Meg. ½ watt
156	W510356	Resistor—carbon 12,000 Ohms ± 10% 2 watt
158	W510191	Resistor—carbon 1 Meg. ½ watt
159	W510126	Resistor—carbon 270 Ohms ± 10% ½ watt
162	W510723	Resistor—carbon 12,000 Ohms ± 5% ½ watt
164, 165	W510339	Resistor—carbon 1500 Ohms ± 10% 2 watt
166	W510156	Resistor—carbon 12,000 Ohms ± 10% ½ watt
169	W510173	Resistor—carbon 100,000 Ohms ½ watt
170	W510191	Resistor—carbon 1 Meg. ½ watt
171	W510171	Resistor—carbon 82,000 Ohms ± 10% ½ watt
172	W510161	Resistor—carbon 22,000 Ohms ½ watt
177	W510143	Resistor—carbon 2200 Ohms ½ watt
178	W510157	Resistor—carbon 15,000 Ohms ± 10% ½ watt
182	W510332	Resistor—carbon 560 Ohms ± 10% 2 watt
185, 186	W510132	Resistor—carbon 560 Ohms ± 10% ½ watt
188	W510180	Resistor—carbon 270,000 Ohms ± 10% ½ watt
189	W510181	Resistor—carbon 330,000 Ohms ± 10% ½ watt
190, 191	W510739	Resistor—carbon 1800 Ohms ± 5% ½ watt
194, 195	W510172	Resistor—carbon 100,000 Ohms ± 10% ½ watt
197	W510162	Resistor—carbon 27,000 Ohms ± 10% ½ watt
198	W510195	Resistor—carbon 4.7 Meg. ½ watt
200	W510185	Resistor—carbon 470,000 Ohms ½ watt
203	W510150	Resistor—carbon 5600 Ohms ± 10% ½ watt
206	W510139	Resistor—carbon 1500 Ohms ± 10% ½ watt
207	W510172	Resistor—carbon 100,000 Ohms ± 10% ½ watt
209	W510180	Resistor—carbon 270,000 Ohms ± 10% ½ watt
213	W510184	Resistor—carbon 470,000 Ohms ± 10% ½ watt
215	W510116	Resistor—carbon 68 Ohms ½ watt
218	W510716	Resistor—wire wound 220 Ohms ± 10% 5 watt
220	W510356	Resistor—carbon 12,000 Ohms ± 10% 2 watt
226	W510254	Resistor—carbon 10,000 Ohms ± 10% 1 watt
228	W510725	Resistor—carbon 3.3 Ohms ± 10% ½ watt
229	W510195	Resistor—carbon 4.7 Meg. ½ watt
231	W510391	Resistor—carbon 1 Meg. 2 watt
234	W510187	Resistor—carbon 680,000 Ohms ± 10% ½ watt
247	W510319	Resistor—carbon 100 Ohms 2 watt
252	W510726	Resistor—wire wound 850 Ohms 5 watt
262-B	W508062	Resistor—carbon 22,000 Ohms 1/5 watt (part of Integrator Unit)
262-D	W508062	Resistor—carbon 8200 Ohms 1/5 watt (part of Integrator Unit)
262-F	W508062	Resistor—carbon 8200 Ohms 1/5 watt (part of Integrator Unit)
265	W510743	Resistor—carbon 1.8 Meg. ± 5% ½ watt (used in "uncoded" chassis)
265	W510721	Resistor—carbon 1.5 ± 5% ½ watt (used in "series A" chassis)
267	W510172	Resistor—carbon 100,000 Ohms ± 10% ½ watt
268	W510196	Resistor—carbon 6.8 Meg. ½ watt
269	W510738	Resistor—carbon 1.2 Meg. ± 10% ½ watt
272	W510151	Resistor—carbon 6800 Ohms ± 10% ½ watt
275	W510193	Resistor—carbon 2.2 Meg. ½ watt
276	W510338	Resistor—carbon 1200 Ohms ± 10% 2 watt
296	W510142	Resistor—carbon 2200 Ohms ± 10% ½ watt
298	W510143	Resistor—carbon 2200 Ohms ½ watt
316	W510180	Resistor—carbon 270,000 Ohms ± 10% ½ watt
341	W510148	Resistor—carbon 4700 Ohms ± 10% ½ watt
344	W510161	Resistor—carbon 22,000 Ohms ½ watt
348	W510158	Resistor—carbon 15,000 Ohms ½ watt
354	W510185	Resistor—carbon 470,000 Ohms ½ watt
357	W510179	Resistor—carbon 220,000 Ohms ½ watt
358	W510741	Resistor—wire wound 600 Ohms 10 watt
360	W510727	Resistor—wire wound 7500 Ohms ± 10% 5 watt
362	W510136	Resistor—carbon 1000 Ohms ± 10% ½ watt
368	W510173	Resistor—carbon 100,000 Ohms ½ watt
381	W510193	Resistor—carbon 2.2 Meg. ½ watt
333	W510155	Resistor—carbon 10,000 Ohms ½ watt
386	W510136	Resistor—carbon 1000 Ohms ± 10% ½ watt
390	W510152	Resistor—carbon 6800 Ohms ½ watt
392	W510249	Resistor—carbon 4700 Ohms 1 watt
394	W510146	Resistor—carbon 3300 Ohms ½ watt
395	W510246	Resistor—carbon 3300 Ohms 1 watt
399-B	W506338	Resistor—carbon 47,000 Ohms 1/5 watt (part of Diode Filter Unit)
400	W510185	Resistor—carbon 470,000 Ohms ½ watt
402	W510193	Resistor—carbon 2.2 Meg. ½ watt
405	W510240	Resistor—carbon 1500 Ohms 1 watt
410	W510125	Resistor—carbon 220 Ohms ½ watt
411	W510159	Resistor—carbon 18,000 Ohms ± 10% ½ watt
414, 415	W510155	Resistor—carbon 10,000 Ohms ½ watt
420	W510190	Resistor—carbon 1 Meg. ± 10% ½ watt (used in "uncoded" chassis)
422, 423	W510725	Resistor—carbon 3.3 Ohms ± 10% ½ watt
426	W510148	Resistor—carbon 4700 Ohms ± 10% ½ watt
428	W510728	Resistor—wire wound 15,000 Ohms ± 10% 10 watt

CONTROLS

SCHEMATIC LOCATION	PART NO.	DESCRIPTION
33-A,B	W508182	Volume control—1 Meg. (with on-off switch)
43-A to D	W508458	Band switch (includes volume control)
54	W508324	Built-in Antenna Tuning Condenser (4-70 Mmfd.)
160-A,B	W508457	Tone and Contrast potentiometer A—Tone control; 500,000 Ohms ¼ watt; B—Contrast control; 3000 Ohms ± 10% 4 watt
173	W508056	Brightness potentiometer (50,000 Ohms)
180	W508456	Focus potentiometer (5500 Ohms ± 10% 4 watt
202	W508077	Horizontal Lock coil (less slug)
202	W507429	Slug core for Horizontal Lock coil
208	W508056	Horizontal Hold potentiometer (50,000 Ohms)
212	W508071	Horizontal Drive trimmer condenser (10-160 Mmfd.)
225	W508667	Width coil (includes slug and clip)
225	W508784	Slug core for Width coil
233	W162190	Horizontal Linearity coil (includes slug)
233	W507429	Slug core for Horizontal Linearity coil
266	W508454	Vertical Hold potentiometer (1 Meg.)
270	W508455	Height potentiometer (2.5 Meg.)
277	W508453	Vertical Linearity potentiometer (6000 Ohms)
346	W508551	Fine Tuning trimmer (1.2 - 2.5 Mmfd. when mounted to chassis)

COILS AND TRANSFORMERS

SCHEMATIC LOCATION	PART NO.	DESCRIPTION
12	W508061	Transformer—1st TV sound I.F. (includes condensers 12-A and 12-B)
15	W507373	Coil—choke
18	W508061	Transformer—2nd TV sound I.F. (includes condensers 18-A and 18-B)

*—This part is not supplied as a Service replacement item.

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PARTS LIST FOR CHASSIS (Contd.)

COILS and TRANSFORMERS—Continued

SCHEMATIC LOCATION	PART NO.	DESCRIPTION
26	W507321	Transformer—TV sound discriminator (includes condenser 26-A)
	W508438	Slug core (5/16" dia. x ⅜" long) for primary of TV sound discriminator trans.
	W508894	Slug core (¼" dia. x ½" long) for primary of TV sound discriminator trans.
	W508439	Slug core (5/16" dia. x ¾" long) for secondary of TV sound discriminator trans.
	W508894	Slug core (¼" dia. x ½" long) for secondary of TV sound discriminator trans.
37	W507373	Coil—choke
49	W505912	Transformer—sound output
103	W507567	Coil—1st I.F. trap
107	W507343	Coil—1st video I.F. (less slug)
	W507357	Slug core for 1st video I.F. coil
115	W507343	Coil—2nd video I.F. (less slug)
	W507357	Slug core for 2nd video I.F. coil
125	W507343	Coil—3rd video I.F. (less slug)
	W507357	Slug core for 3rd video I.F. coil
128	W507367	Coil—choke
134	W507591	Coil—4th video I.F. assembly (includes condenser 136 and choke coil 137)
	W507357	Slug core for 4th video I.F. coil
137	W507367	Coil—choke
143	W507374	Coil—peaking
152	W507374	Coil—peaking
161	W508069	Coil—peaking
163	W508070	Coil—peaking
181	W508994	Coil—focus
184	W508675	Yoke—picture tube deflection
202	W508077	Coil—Horizontal Lock (less slug)
	W507429	Slug core for Horizontal Lock coil
222	W508883	Transformer—horizontal fly-back
225	W508667	Coil—Width (includes slug and clip)
	W508784	Slug core for Width coil
233	W162190	Coil—Horizontal Linearity (includes slug)
	W507429	Slug core for Horizontal Linearity coil
239	W508702	Transformer—power
241	W507586	Coil—choke
244	W507587	Coil—choke
248	W507584	Coil—choke
253	W508341	Choke—filter
254	W507584	Coil—choke
259	W507586	Coil—choke
263	W508076	Transformer—vertical blocking oscillator
271	W507567	Coil—3rd I.F. trap
278	W508674	Transformer—vertical output
	W508431	R. F. Unit complete with coils and tubes
283	W508553	Coil—antenna; channel #13
284	*	Coil—antenna; channel #12
285	*	Coil—antenna; channel #11
286	*	Coil—antenna; channel #10
287	*	Coil—antenna; channel #9
288	*	Coil—antenna; channel #8
289	*	Coil—antenna; channel #7
290	W508552	Coil—antenna; channel #6
291	*	Coil—antenna; channel #5 (6½ turns #24 wire .080" I. D.)
292	*	Coil—antenna; channel #4 (11½ turns #24 wire .080" I. D.)
293	*	Coil—antenna; channel #3 (11½ turns #24 wire .080" I. D.)
294	*	Coil—antenna; channel #2 (13½ turns #24 wire .080" I. D.)
301	W508554	Coil—R. F.; channel #13
302	*	Coil—R. F.; channel #12
303	*	Coil—R. F.; channel #11
304	*	Coil—R. F.; channel #10
305	*	Coil—R. F.; channel #9
306	*	Coil—R. F.; channel #8
307	*	Coil—R. F.; channel #7
308	*	Coil—R. F.; channel #6 (20½ turns #21 wire .125" I. D.)
309	*	Coil—R. F.; channel #5 (8½ turns #24 wire .080" I. D.)
310	*	Coil—R. F.; channel #4 (8½ turns #24 wire .125" I. D.)
311	*	Coil—R. F.; channel #3 (13½ turns #24 wire .080" I. D.)
312	*	Coil—R. F.; channel #2 (11½ turns #24 wire .080" I. D.)
317	*	Coil—mixer; channel #13 (4½ turns #21 wire .125" I. D.)
318	*	Coil—mixer; channel #12
319	*	Coil—mixer; channel #11
320	*	Coil—mixer; channel #10
321	*	Coil—mixer; channel #9
322	*	Coil—mixer; channel #8
323	*	Coil—mixer; channel #7
324	*	Coil—mixer; channel #6 (18½ turns #21 wire .125" I. D.)
325	*	Coil—mixer; channel #5 (6½ turns #24 wire .080" I. D.)
326	*	Coil—mixer; channel #4 (8½ turns #24 wire .125" I. D.)
327	*	Coil—mixer; channel #3 (11½ turns #24 wire .080" I. D.)
328	*	Coil—mixer; channel #2 (13½ turns #24 wire .080" I. D.)
330	*	Coil—oscillator; channel #12
331	*	Coil—oscillator; channel #11
332	*	Coil—oscillator; channel #10
333	*	Coil—oscillator; channel #9
334	*	Coil—oscillator; channel #8
335	*	Coil—oscillator; channel #7
336	W508558	Coil—oscillator; channel #6
	W508559	Slug for oscillator coil (brass); channel #6
337	*	Coil—oscillator; channel #5 (6½ turns #24 wire .080" I. D.)
338	*	Coil—oscillator; channel #4 (11½ turns #24 wire .080" I. D.)
339	*	Coil—oscillator; channel #3 (8½ turns #24 wire .080" I. D.)
340	*	Coil—oscillator; channel #2 (11½ turns #24 wire .080" I. D.)
345	W508560	Coil—oscillator; channel #13
	W508559	Slug for oscillator coil (brass); channel #13
349	W508555	Coil—converter plate (includes slug and clip)
	W508556	Slug core for converter plate coil
352	W507587	Coil—R. F. choke for 6J6
365	W508184	Coil—AM antenna
370	W507586	Coil—choke
372	W507935	Coil—choke
374	W507942	Coil—FM oscillator
375	W508195	Coil—AM oscillator
379	W507941	Coil—FM R.F.
385	W506581	Coil—R.F. choke (includes resistor 386)
387	W506080	Transformer—1st FM I.F. (includes condensers 387-A and 387-B)
388	W505867	Transformer—1st AM I.F. (includes condensers 388-A and 388-B)
397	W505905	Transformer—2nd FM I.F. (includes condenser 397-A)
398	W505867	Transformer—2nd AM I.F. (includes condensers 398-A and 398-B)
402	W508179	Transformer—FM discriminator (includes condenser 409-A)
418	W508212	Loop antenna (AM)

OTHER ELECTRICAL PARTS

SCHEMATIC LOCATION	PART NO.	DESCRIPTION
43-A to D	W508458	Switch—band (on TV chassis)
51	W508174	Speaker—P.M. Dynamic (6" x 9")
53	W508466	Built-in antenna (includes condenser 54)
179	W508432	Crystal cartridge (includes both needles)
221	W508713	Fuse for horizontal sweep circuit ¼ Amp. 250 volt
261	W118921	Lamp—TV Channel Lite (Mazda #47) 6-8 V. 150 Ma.
262-A to G	W508062	Integrator coupling unit A—Condenser—ceramic .01 Mfd. 450 volt B—Resistor—carbon 22,000 Ohms 1/5 watt C—Condenser—ceramic 2000 Mmfd. 450 volt D—Resistor—carbon 8200 Ohms 1/5 watt E—Condenser—ceramic 5000 Mmfd. 450 volt F—Resistor—carbon 8200 Ohms 1/5 watt G—Condenser—ceramic 5000 Mmfd. 450 volt
280	W508120	Motor—115 volt, 60 cycle
281	W505269	Switch—"ON-OFF" for record changer
282-A to K		Channel switch
361	W118221	Lamp—"OFF-ON" Indicator Lite (Mazda #47) 6-8 volt 150 Ma.
363	W118921	Lamp—AM Channel Lite (Mazda #47) 6-8 v. 150 Ma.
364	W118921	Lamp—FM Channel Lite (Mazda #47) 6-8 v. 150 Ma.
369-A,B	W508753	Switch—band (on AM-FM tuner)
399-A, B,C	W506338	Diode filter unit A—Condenser—ceramic 100 Mmfd. 400 volt B—Resistor—carbon 47,000 Ohms 1/5 watt C—Condenser—ceramic 100 Mmfd. 400 volt
418	W508212	Loop antenna (AM)

MECHANICAL PARTS OF R.F. TUNER

PART NO.	DESCRIPTION
W508431	R. F. Unit complete with coils and tubes
W508558	Bottom cover shield
W508666	Bracket for tuner mounting (front)
W508651	Bracket for tuner mtg. (rear)
W508566	"C" washer—retains switch shaft
W508567	"C" washer—retains fine tuning shaft
W508564	Fine tuning disc (on trimmer shaft)
W508565	Set screw for fine tuning disc
W508563	Shaft, fine tuning and driving disc
W508561	Shaft, switch, (incl. indexing arm)
W504599	Shield—tube
W508556	Slug core for converter plate coil
W508559	Slug—brass core for oscillator coil; channel #6 or #13
W508562	Socket—miniature for 6J6 (incl. base for shield)
W507364	Socket—miniature for 6AG5

CABINET PARTS

PART NO.	DESCRIPTION
W508777	Back for cabinet (less power cord)
W508217	Bracket for mounting OFF-ON indicator lite at base of cabinet
W162095	Bull's-eye for channel lite
W117131	Bull's-eye for OFF-ON indicator lite at base of cabinet
W509015	Cabinet
W508499	Catch for door
W508778	Door—left hand
W508779	Door—right hand
W508781	Drawer—record changer compartment
W508773	Escutcheon—AM-FM dial scale
W508772	Escutcheon—channel number
W508540	Glass Window
W506640	Hinge for door per pair
W508471	Knob—AM-FM Pointer and Coarse Tuning
W508472	Knob—AM-FM Fine Tuning
W508475	Knob—Brightness or Horizontal Hold
W508473	Knob—Band Switch
W502563	Knob—built-in antenna
W507895	Knob—Channel Selector
W508476	Knob—Contrast
W508477	Knob—"TONE"
W507894	Knob—TV Fine Tuning
W508474	Knob—"VOLUME-ON"
W508331	Mask for picture tube
W508771	Name plate
W508774	Nut—retains name plate
W508293	Rail for drawer per set
W508621	Rubber gasket between mask and picture tube
W18796	Screw—#10 x 1"; mounts chassis
W508506	Shield for dial lite
W505497	Socket for OFF-ON indicator lite at base of cabinet
W162206	Terminal strip for TV antenna connection
W508478	Washer—felt for knob

MISCELLANEOUS

PART NO.	DESCRIPTION
W509048	Back cover and switch shaft bearing assembly for AM-FM tuner
W508829	Bracket base for support of yoke and focus coil (left hand)
W508830	Bracket base for support of yoke and focus coil (right hand)
W508613	Bracket for deflection yoke
W301270	Base for mounting electrolytic condenser
W508666	Bracket for mounting RF tuner (front)
W508651	Bracket for mounting RF tuner (rear)
W508728	Bracket for mounting trimmer #26
W508510	Bracket—retains front of picture tube
W508755	Bracket—supports AM-FM tuner
W509198	Bracket—supports band switch shaft on TV chassis
W508038	Bracket—tube support (bottom front) (less rubber pad)
W508154	Bracket ("U" shaped) for support of yoke and focus coil
W505165	"C" washer for connecting link
W505314	"C" washer for extension shaft
W508806	Centering magnet assembly
W112745	Clip for mounting AM antenna coil
W508683	Clip for mounting electrolytic condenser #129
W508681	Clip for mounting electrolytic condenser #224
W508715	Clip for mounting fuse holder
W500245	Clip for mounting H.V. condenser
W505101	Clip for mounting I.F. transformer or FM sound discriminator
W507339	Clip for mounting video converter plate, 1st video I.F., 2nd video I.F., 3rd video I.F., Horiz. Lock or Horiz. Linearity coil
W507592	Clip for mounting 4th video I.F. coil

MISCELLANEOUS—Continued

SCHEMATIC LOCATION	PART NO.	DESCRIPTION
	W114955	Clip—retainer on end of dial cord
	W507286	Connector for H.V. terminal of picture tube
	W117057	Cord—dial drive (2½ ft. required) per ft.
	W508525	Drum—dial; on gang condenser
	W508714	Fuse holder
	W508623	Grounding spring for coating on picture tube
	W506803	Ion trap assy.—includes magnet
	W509047	Lever—band actuating (on AM-FM tuner)
	W509049	Lever—band switch actuating (on TV chassis)
	W508756	Link—connects band switch actuating levers
	W508617	Nut—for retaining focus coil mounting plate
	W162198	Planetary drive and dial drum (includes mounting bracket)
	W508864	Plate—focus coil mounting
	W506652	Plug for AM-FM tuner power cable
	W500966	Plug for audio cable on AM-FM tuner
	W508878	Plug for focus coil leads
	W500966	Plug for phono. pick-up cable
	W507699	Power cord assembly (includes plugs at both ends)
	W507361	Rubber cover for H.V. terminal connector
	W508512	Rubber spacer on picture tube support bracket
	W507793	Rubber spacer support between flared neck of picture tube and yoke bracket
	W18796	Screw—#10 x 1"; mounts chassis
	W508732	Shaft, extension for band switch on AM-FM tuner
	W162138	Shield—H.V. supply (front section)
	W508088	Shield—H.V. supply (rear section)
	W508862	Shield—protector for band switch
	W507357	Slug core for 1st, 2nd, 3rd or 4th video I.F. coil
	W507429	Slug core for Horizontal Lock or Horizontal Linearity coil
	W508438	Slug core (5/16" dia. x ⅜" long) for primary of TV sound discriminator trans.
	W508894	Slug core (¼" dia. x ½" long) for primary of TV sound discriminator trans.
	W508439	Slug core (5/16" dia. x ¾" long) for secondary of TV sound discriminator trans.
	W508894	Slug core (¼" dia. x ½" long) for secondary of TV sound discriminator trans.
	W508784	Slug core for Width coil
	W160039	Socket—AM-FM tuner output
	W508769	Socket and bracket for TV channel lite
	W508049	Socket and cable assembly for picture tube
	W162038	Socket assembly for 1B3GT/8016 tube (includes corona ring and mounting frame)
	W507948	Socket for AM-FM tuner power cable
	W508460	Socket for AM or FM channel lite
	W508879	Socket for focus coil leads
	W508086	Socket for mounting H.V. condenser 230
	W507932	Socket—male, power cord interlock
	W507364	Socket—miniature (7 pin)
	W506576	Socket—miniature (7 pin) (for 6BE6)
	W508044	Socket—miniature (9 pin)
	W536331	Socket—miniature (9 pin) (for 12AT7)
	W508703	Socket—octal
	W501182	Socket—phono. motor cable
	W160039	Socket—phono. plug
	W505161	Spring—dial cord tension
	W508514	Spring—retains H.V. lead
	W508608	Spring—tension for focus coil mounting
	W503994	Strap for picture tube support (includes rubber pad)
	W111456	Washer—spring washer for connecting link
	W170851	Wing nut—#5-40; for mounting focus coil
	W170195	Wing nut—#8-32; for yoke and focus coil mounting
	W170817	Wing screw—#10-24; for height adj. of yoke and focus coil
	W170741	Wing screw—#10-32; for yoke mounting

*—This part is not supplied as a Service replacement item.

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Power Consumption
220 Watts

Input Impedance
72 Ohms, Co-axial

Power Output (Audio)
2 Watts (Undistorted)

Picture Size
$6\frac{3}{8}'' \times 8\frac{1}{2}''$

FREQUENCY CHART

IF FREQ. SOUND — 32.8 Mc. PICTURE — 37.3 Mc.

CHANNEL	FREQUENCY	PICTURE FREQUENCY	SOUND FREQUENCY	RF OSCILLATOR FREQUENCY
2	54-60	55.25	59.75	92.55
3	60-66	61.25	65.75	98.55
4	66-72	67.25	71.75	104.55
5	76-82	77.25	81.75	114.55
6	82-88	83.25	87.75	120.55
7	174-180	175.25	179.75	212.55
8	180-186	181.25	185.75	218.55
9	186-192	187.25	191.75	224.55
10	192-198	193.25	197.75	230.55
11	198-204	199.25	203.75	236.55
12	204-210	205.25	209.75	242.55
13	210-216	211.25	215.75	248.55

Picture Tube

A 10" direct view tube.

Antenna Equipment:

The antenna input is designed to operate with maximum efficiency on a dual channel dipole antenna using 72 ohm concentric coaxial lead in.

Speaker
6" Oval PM—Voice Coil 3.2 ohms at 400 Cycles

TUBE COMPLEMENT

1.	6J6	V20	RF Amplifier
2.	6AG5	V19	Mixer
3.	6J6	V18	RF Oscillator
4.	6AG5	V5	1st Video IF Amplifier
5.	6AG5	V6	2nd Video IF Amplifier
6.	6AG5	V7	3rd Video IF Amplifier
7.	12AU7	V9	1st and 2nd Video Amp'fier
8.	6AU6	V1	4.5 Mc. Sound Take-off Amplifier
9.	6AL5	V2	Ratio-Detector
10.	6AT6	V4	1st Audio Amplifier
11.	6K6	V3	Audio Output
12.	6AL5	V10	Sync Limiter and AGC
13.	6SN7	V11	Sync Sep. and Amplifier
14.	6SN7	V12	Vertical Oscil. and Amp.
15.	6SN7	V14	Horizontal Oscillator (Sync (Guide)
16.	6BG6G	V15	Horizontal Output
17.	1B3 8016	V13	High Voltage Rectifier
18.	5V4-G	V16	Damper
19.	5U4-G	V17	Low Voltage Rectifier
20.	10BP4	V21	Picture Tube
	1N34	V8	Crystal Video Detector

Vertical Scanning Frequency

60 cycles per second.

Horizontal Scanning Frequency

15,750 cycles per second

Scanning

525 lines per second, interlaced.

GENERAL DESCRIPTION

Model 9131 is a television table model receiver with a ten inch direct view picture tube. It employs twenty tubes plus a germanium crystal detector. The receiver is complete in one unit and is operated by the use of seven front panel controls. Features of the receiver include full twelve channel coverage, AFC horizontal hold, stabilized vertical hold and FM sound system.

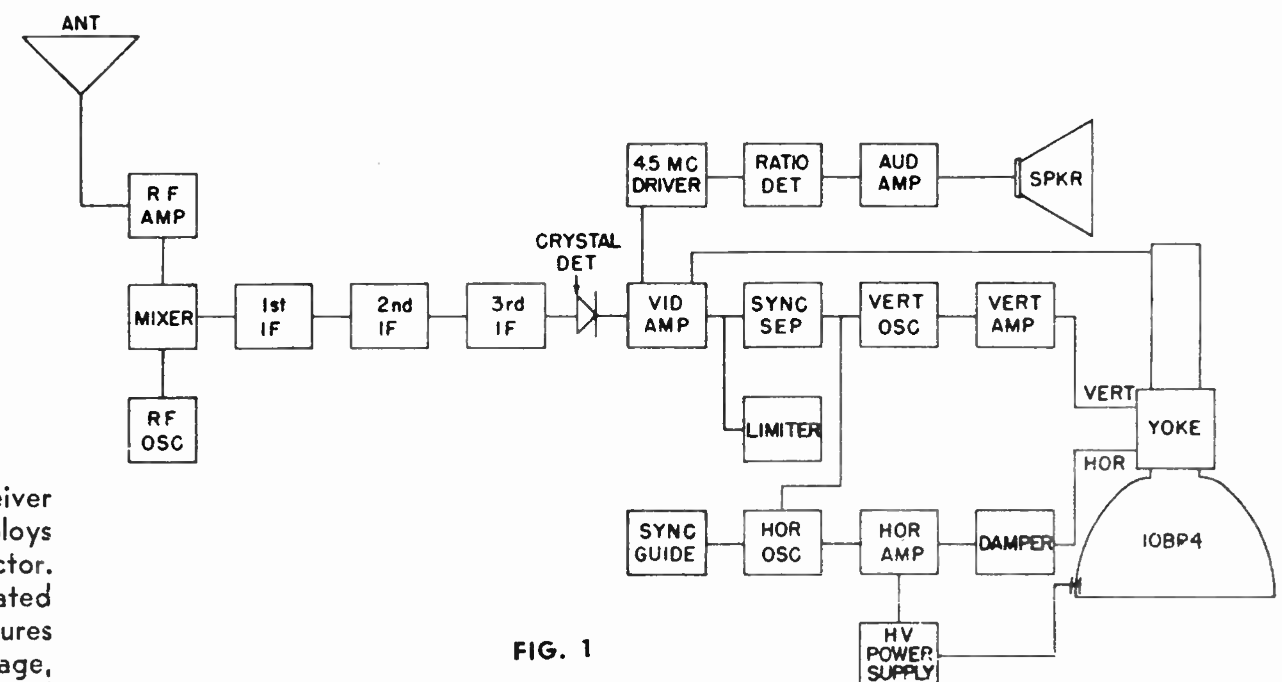

FIG. 1

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CONTROLS

FRONT PANEL

1 — PICTURE — The Picture or contrast control varies the video IF gain through the AGC diode. Due to the use of AGC the picture control should not require readjustment when channels are switched except where the signal received from different stations varies greatly.

2 — BRIGHTNESS — The Brightness control operates by varying the D.C. voltage on the cathode of the Picture Tube, thereby controlling the light on the face of the tube.

3 — HORIZONTAL — The horizontal control on the front panel is a fine frequency regulator for the horizontal sweep oscillator. Its setting is not critical and is used to restore sync when necessary.

4 — VERTICAL — The Vertical Control regulates the frequency of the vertical oscillator. Misadjustment of this control will cause the picture to "roll" up or down. The setting is not normally critical.

5 — VOLUME — ON-OFF — The volume control varies the input to the audio system. It controls the sound only and should have no effect on the picture. The ON-OFF switch is activated by rotating the control in clockwise direction until a click is heard.

6 — STATION SELECTOR — This control selects the channel desired for viewing.

7 — FINE TUNING — This control varies the local R.F. Oscillator Frequency. Correct adjustment will result in a picture with maximum definition. This is not a control for tuning the sound.

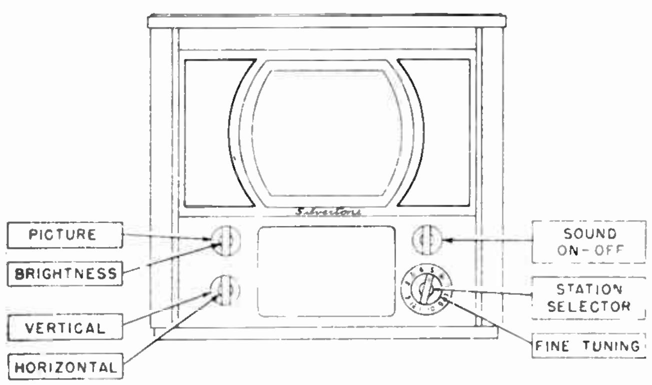

FIG. 2

CHASSIS (See Note)

1 — HEIGHT CONTROL — Varies the input to the vertical sweep amplifier. Since changes in height will effect picture linearity this control should be used in conjunction with the:

2 — VERTICAL LINEARITY CONTROL — Adjusts the vertical sweep waveform and should be used with the height control.

3 — FOCUS CONTROL — Varies the current flowing through the focus coil.

4 — HORIZONTAL LOCKING RANGE — Adjusts the sensitivity of the front panel Horizontal Hold control.

5 — HORIZONTAL FREQUENCY CONTROL —A coarse frequency control for the horizontal sweep oscillator.

6 — HORIZONTAL DRIVE CONTROL —Varies the input to the horizontal sweep amplifier and affects picture brightness and linearity.

7 — WIDTH CONTROL — This control permits variation of the picture width without affecting the high voltage.

8 — HORIZONTAL LINEARITY CONTROL — Adjusts the horizontal sweep waveform.

NOTE: — FOR PROPER ADJUSTMENT OF CHASSIS CONTROLS SEE "PICTURE ADJUSTMENTS"

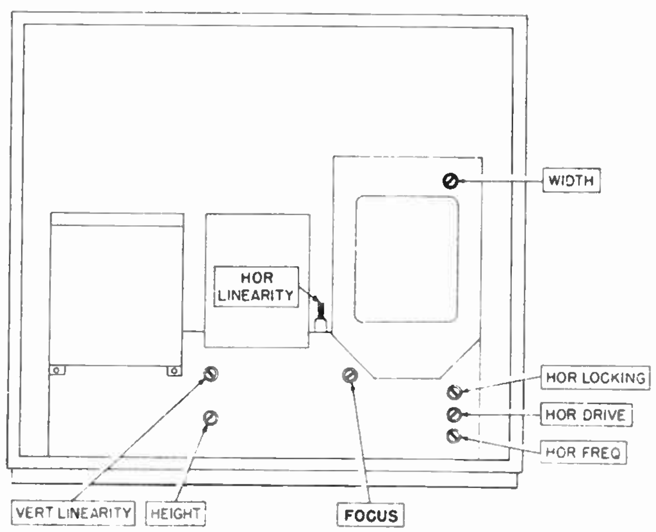

FIG. 3

BRIEF CIRCUIT ANALYSIS

This Television Receiver uses the Inter-Carrier Sound System. The basic difference between this and conventional systems is that in the use of Inter-carrier, the sound and the picture information are both fed through a single I.F. and video channel. The sound is separated after the second video amplifier and is then fed through an amplifier to the ratio detector (discriminator). The picture components of the received signal are split up into sync and pix components, the former being applied to the appropriate sweep circuits and the video intelligence to the grid of the Picture tube. The main advantages of the use of a system of this type are that duplication of I.F. amplifiers is avoided and that drift in the local oscillator does not distort or cut off "sound" reception.

The horizontal sweep circuits employ an improved type of AFC which minimizes picture disturbances caused by ignition and similar types of interference. The sync circuits for the vertical oscillator provide sufficient control to avoid "rolling" in high interference or fringe areas.

R. F. Amplifier — The antenna is fed between the grid and cathode of the R.F. amplifier. The input circuit of this stage is not tuneable. The R.F. stage is tuned by what is, electrically speaking, a single tapped inductance. Mechanically, this coil takes the form of several individual coils which are cut in or out of the plate circuit by the band switch. These coils, as well as the mixer coils, will rarely need touching.

MIXER — The output of the R.F. amplifier and the local oscillator are condenser fed into the control grid of the mixer stage. This circuit is tuned in much the same manner as the output of the R.F. Amplifier, previously described.

OSCILLATOR — The R.F. Oscillator is fairly straightforward in operation. Its main peculiarity is that the coil for Channel 2 is permanently parallel to all other Oscillator coils from 3 to 13. It is therefore necessary, when aligning the oscillators to ALIGN CHANNEL 2 FIRST and the rest of the coils in any order thereafter. They are tuned by brass slugs accessible from the outside of the cabinet by removing the Station Selector knob and the channel Escutcheon. Channel two is found at the top of the right hand slot and the others follow in regular order in a clockwise direction finishing with channel thirteen at the top of the left hand slot (See figure 4). The oscillators in the receiver have a fine tuning control which is operated from the front panel. This control should be set at an approximate mid point when oscillator slugs are being adjusted.

NOTE: THE CHANNEL NUMBERS ON THE ESCUTCHEON DO NOT CORRESPOND TO THE LOCATION OF THE OSCILLATOR COILS.

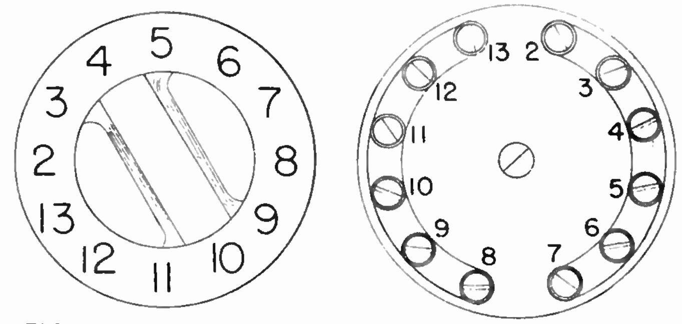

FIG. 4

VIDEO I.F. — Each Video I.F. transformer has one adjustment, a powdered iron slug accessible from the top of the chassis. The Video I.F. string is stagger tuned to two frequencies. The first and third I.F. transformers are tuned to 34.45 Mc. and the second and fourth are tuned to 37.00 Mc. In addition there is a sound trap which should be tuned for minimum output at the Sound Carrier Frequency of 32.8 Mc. The response curve is broad enough to produce good definition.

VIDEO DETECTOR — A crystal detector is used in this receiver. The use of a crystal in this circuit improves the detector sensitivity of the receiver.

VIDEO AMPLIFIERS — FIRST AND SECOND — A 12AU7, dual triode is used in this section of the receiver. The output of the crystal detector is fed to the grid of the first section (pin 2) and ultimately taken off plate of the second section of the tube (pin 6). It is at this point the three basic components of the received signal are separated and fed to their respective circuits. The sound is taken off and sent through the Driver, Ratio Detector and Audio Amplifiers to the speaker. The picture intelli-

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BRIEF CIRCUIT ANALYSIS (Continued)

gence is fed to the grid of the picture tube and the synchronization pulses to the grid (pin 1) of the Sync Separator and from there to the Horizontal and Vertical oscillators.

D. C. COMPONENT — The D.C. component of the transmitted signal (which controls the backgound brightness) is substantially duplicated in the receiver by direct coupling from the plate of the second video amplifier to the Picture tube grid.

SOUND SYSTEM — The sound Carrier is taken off the plate of the Video Amplifier by a 4.5 Megacycle trap and fed through a 4.5 MC Amplifier to the Ratio Detector, and then to the sound amplifier, audio output and speaker.

SWEEP SYSTEM — VERTICAL — One tube a 6SN7, dual triode serves as the Vertical oscillator, discharge and amplifier tube. The first section used as the oscillator and discharge tube is fed into the second section of the tube which in turn feeds through the vertical output transformer to the Vertical windings of the deflection yoke.

SWEEP SYSTEM — HORIZONTAL — The Horizontal Oscillator is essentially of the Blocking Oscillator type. The operation of the AFC system depends upon a correcting voltage developed in the control tube when the oscillator output and the incoming pulses differ in either phase or frequency. The control tube is maintained at cut-off until such time as the sync pulse is either ahead or behind the oscillator sawtooth peak. When either case occurs the control tube develops a voltage which is applied as a bias to the oscillator grid and alters the oscillator frequency to coincide with the frequency of the incoming pulses. The horizontal oscillator transformer has an adjustable core which is a coarse control of the oscillator frequency. The Horizontal Frequency Control (rear) is a fine adjustment in the same sense. The front panel Horizontal Hold Control permits slight adjustment of the frequency by adjusting the B voltage applied to the control tube plate. The Horizontal Locking range control affects the sensitivity of the control tube thus varying the range over which the AFC circuit will function.

NOTE: Many of the components in the Horizontal circuits are of critical value and therefor should only be replaced by the exact replacement part. Care should also be taken in dressing leads and parts when replaced. This can be accomplished by carefully noting parts positions before removal.

A. G. C. — The receiver uses an AGC circuit operating on the first 2 IF stages. While it is quite effective in most locations, the receiver may overload in regions of very high field intensity. The contrast can generally be adjusted for a normal picture under such conditions but spurious beats, jagged vertical lines (i.e. poor resolution) and a "Moire" pattern may appear. These effects can be eliminated by the use of a resistor network of 3 to 10 db attenuation in series with the antenna lead at the point where it is connected to the receiver.

HIGH VOLTAGE POWER SUPPLY — The energy stored in the horizontal windings of the deflection yoke during the forward sweep produces high voltage surges during retrace. This is "stepped up" by an "auto winding" on the horizontal output transformer and then rectified by a 1B3/8016, to provide approximately 8500 volts for the Picture Tube 2nd anode.

B VOLTAGE POWER SUPPLY — The B Supply of this receiver utilizes a standard type of transformer — rectifier circuit. It should be noted that there is a separate filament winding for the Picture tube (6.3 volts) and a separate 5 volt winding for the 5V4 Damper tube. The return of the B voltage developed by this supply is NOT grounded. Voltages are developed through a bleeder network of plus 225, plus 150, minus 3.5, minus 14, minus 17.5 and minus 85 volts WITH RESPECT TO GROUND (chassis).

ALIGNMENT PROCEDURE

A — TEST EQUIPMENT

CATHODE RAY OSCILLOSCOPE — The main requirement in a Cathode Ray Oscilloscope is that it should have a good high frequency response up to 1 Mc. The tube size is relatively unimportant, however, anything under 5" usually makes fine adjustment quite difficult. A Hickok Model 195B Oscilloscope is recommended.

SWEEP GENERATOR — The sweep generator used should have linear coverage of a center range from 30 to 220 megacycles. The output should be fairly flat over wide frequency variation of the sweep. It should be capable of an output of 0.1 volt with attenuation down to about 50 microvolts. It is preferable that the generator have a deflection output for the test oscilloscope. This is included in the Hickok model 610A Television Signal Generator

AM SIGNAL GENERATOR — This generator should have a frequency of from 4.5 to 220 megacycles. As this generator is used occasionally as a marker generator, accuracy is an important factor. It should be capable of 0.1 volt output with attenuation down to about 50 microvolts and should be linear through the range. These requirements are met in the Hickok model 610A.

VACUUM TUBE VOLTMETER — Almost any standard make VTVM will do. It should have reversible polarity switch. A Sylvania Polymeter is recommended.

B — VIDEO IF ALIGNMENT

An adequate signal may be fed through the I.F. string by feeding the output of the signal generator into a tube shield placed over the mixer tube 6AG5. Care should be taken that this shield is NOT grounded. The ground side of the generator output can be conveniently grounded to the shield of the adjacent oscillator tube.

The contrast control should be set to produce minus 2 volts on the AGC bus (Pin 7 6AL5 — AGC tube).

The vacuum tube voltmeter should be connected across the 5600 ohm detector load resistor, (R43) and should be set on the minus 3 Volt scale. Set channel selector to an unused low band channel.

The Signal generator should be set to a frequency of 34.45 Mc. The output of the generator should be adjusted to the point where the reading on the VTVM is between minus 1 to minus 1.5 volts.

The First (A) and Third (B) I.F. Coils should be peaked for a maximum reading on the VTVM. As the voltage reading increases with tuning, the generator should be attenuated to maintain a maximum of minus 1.5 volts.

Set the Signal Generator to a Frequency of 37.0 Mc and tune the Second (C) and Fourth (D) I.F. coils in the same manner as above.

Set the Signal Generator to a frequency of 32.8 and tune the trap (E) for a MINIMUM reading on the VTVM.

The third (B) I.F. coil should then be readjusted as described previously.

The Generator should now be shut off (or tuned to different band) and the VTVM should read no more than minus 0.20 volts. If there is a higher voltage reading, check for regeneration in the I.F. stages.

By shunting the signal generator with a sweep generator (30 to 40 Mc) and substituting a Cathode Ray Oscilloscope for the Vacuum tube Voltmeter in the above procedure the actual pass band of the Video I.F. circuits may be studied. Ideally the response curve should appear on the face of the oscilloscope in the form indicated in Figure (5) A. A slight slope of the top of the curve in either direction or a small dip in the center are acceptable as indicated in Figure (5) B, and C.

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ALIGNMENT PROCEDURE (Continued)

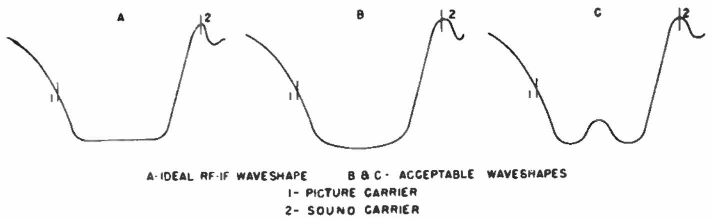

FIG. 5

C — RF ALIGNMENT

In the alignment of the RF section of this receiver three pieces of test equipment are necessary: a sweep generator, a signal generator and a cathode Ray Oscilloscope. For specifications see "Test Equipment" above.

The output of the Sweep Generator should be fed into the antenna. The signal generator (C.W.) should be connected to the antenna terminals of the receiver. The sweeper will provide the overall response curve with the oscilloscope properly connected. The signal generator is used as a marker as described below. Some Sweep generators made today contain their own marker oscillator. In cases where a generator of this type is used the Signal Generator may be eliminated.

The "hot" or "high" side of the Oscilloscope input should be connected to the junction point of the 5600 ohm detector load resistor and the peaking coil. The "low" or ground side should be connected to the nearest convenient ground point on the receiver chassis. Care shoud be taken that the generator and the scope leads are well separated to avoid regeneration.

The R.F. section of the receiver is tuned channel by channel. The proper frequency settings for any given channel can be determined by consulting the Frequency Chart on Page (2). For example in aligning channel 2 the sweep generator should be set to some mid frequency between 54 and 60 megacycles. This adjustment is not a fine one. After setting the sweeper in the general vicinity of the desired frequency it should be tuned to center the response curve on the Oscilloscope face. For picture and sound markers the signal generator should carefully be adjusted to the frequencies indicated in the Frequency chart. For example in the case of channel 2 the picture marker frequency is 55.25 Mc. and the Sound 59.75 Mc.

It is important to note at this point that the oscillator coil for channel 2 is in parallel with every other oscillator coil from 3 to 13. It is therefor imperative that channel 2 be aligned first and the others in any desired order thereafter.

Starting with channel 2 and applying the proper frequencies as indicated above, the output of the sweeper should be attenuated to the point where further attenuation will not affect the wave shape.

The Oscillator should then be adjusted to bring the sound carrier into the 32.8 Mc. trap valley. With the oscillator so adjusted the picture carrier should fall at a point approximatey 50% up on the slope of the opposite side of the band pass curve Certain variations in the waveshape and the location of the picture carrier are acceptable. The picture carrier may vary in position from a point between 45% and 60% of the slope and the overall waveshape may differ from the ideal, flat-topped response by being either slightly rounded or slightly dipped in the center. See figure (6).

If the position of the picture carrier varies beyond the 45% to 60% points on all channels correction may be made by turning to channel 6, applying the proper input signals and slightly realigning the I.F. transformers.

Care should be used not to push slug through coil form. If slug is pushed through, it may be replaced by reinserting slug through bottom of coil form and carefully threaded back to its normal position.

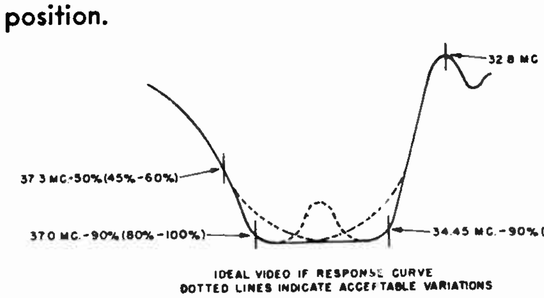

FIG. 6

D — SOUND ALIGNMENT

Sound alignment of the receiver is best accomplished with the AM Signal Generator and a vacuum tube volt meter. By feeding a 4.5 Megacycle signal thru a .01 mfd blocking condenser into the grid (pin 7) of the second section of the 12AU7 Video amplifier and placing the vacuum tube voltmeter between pin 2 of the ratio detector (6AL5) and ground, the primary (F) (Fig. 10) of the ratio detector and the 4.5 megacycle trap (G) (Fig. 10) may be adjusted. The signal generator should be attenuated so that the VTVM does not read more than minus 3 or minus 4 volts. These two slugs should be tuned for maximum deflection of the VTVM and the generator attenuated as needed to keep the above mentioned level. The VTVM (set for zero center operation) should then be placed at the junction of the 47,000 ohm resistor (R19) and the .0015 condenser (C22) and the secondary (H) of the ratio detector should be tuned through a sharp dip between positive and negative voltage. Adjust secondary for exact setting at lowest point of dip.

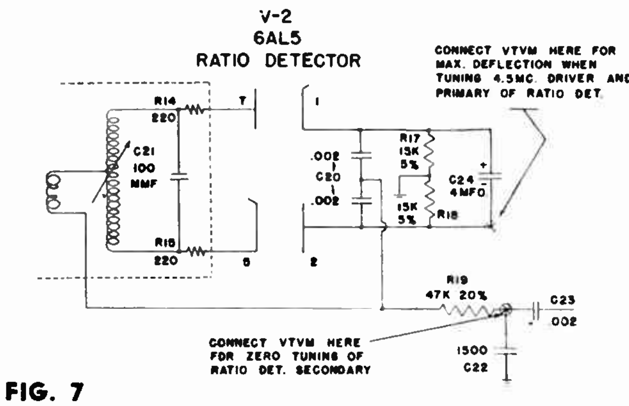

FIG. 7

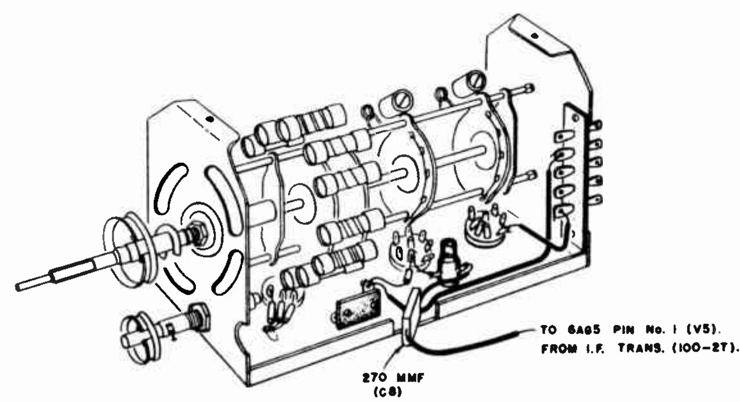

FIG. 8A

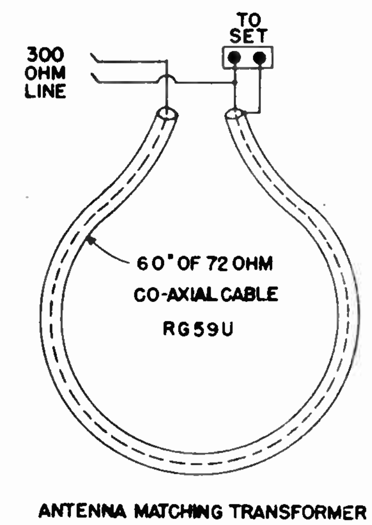

FIG. 8B

The Tuner assembly is a self contained unit utilizing a grounded-grid RF amplifier with 72 ohm unbalanced line input impedance. This mode of operating the RF amplifier (6J6) results in higher gain being delivered by the first amplifier stage with lowered noise and consequent improved receiver operation.

Though the tuning unit is designed to operate at optimum efficiency with the use of a 72 ohm co-axial transmission line as the down lead, a 300 ohm lead-in may be used in installations where the signal strength is low. A method of matching the 300 ohm transmission line to the 72 ohm input impedance of the tuner is shown in the Fig. 8B.

The length of the co-axial cable used as a matching stub shown in Fig. 8B may have to be altered slightly at different frequencies.

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PICTURE ADJUSTMENTS

A — ION TRAP, FOCUS AND YOKE

To properly adjust the Ion Trap, Focusing coil and the Deflection Yoke the following procedure should be followed.

The Deflection Yoke should be placed in position closest to the "bell" of the Picture Tube as far forward on the neck of the tube as is possible. Be sure the wire loops on the mounting make positive contact with the coating of the picture tube. The Focus Coil is next in line and the Ion Trap last. The arrow on Ion Trap should point toward picture face and center over flags in tube neck.

The antenna should NOT be connected to the receiver, the set should be turned on, the brilliance control turned to MAXIMUM and the picture contrast control at MINIMUM.

The Ion Trap should be moved forward and backward and at the same time rotated to achieve the brightest raster on the face of the Picture Tube.

Reduce the brilliance control to a point slightly over normal brightness and adjust the Focus Control on the rear of the chassis for clearest and sharpest horizontal sweep lines. The Ion Trap should then be readjusted slightly for the brightest response on the face of the tube at which good focus is maintained.

The Focus Coil itself should be moved to secure a complete raster, approximately centered and with no corners cut off. This being accomplished the Ion trap should be secured by the screws provided.

Finally the Deflection Yoke should be rotated to "square" the raster with the chassis as a reference. The thumb screws on the yoke brackets should then be set.

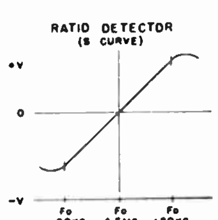


FIG. 9

For oscilloscope view of ratio detector alignment connect scope hot lead at junction of R19 and C22 and ground lead to nearest point on chassis. Set signal generator for 4.5 meg. center frequency with 100 KC deviation on each side of center. The curve should appear as in Fig. 10 above.

B — HORIZONTAL OSCILLATOR ALIGNMENT

To adjust the Horizontal oscillator and its control circuits it is necessary to first connect a working antenna to the receiver. It is preferable to use a test pattern as the incoming signal rather than a picture.

With the receiver turned on and the brightness and picture (contrast) adjusted to a normal position the Horizontal Frequency trimmer (J) (Fig. 12) and the Horizontal Locking trimmer (K) (Fig. 12) (rear of chassis) should be turned clockwise all the way and then backed off to about one turn (counter clockwise).

The Horizontal Hold Control (front panel) should be turned to a maximum clockwise position.

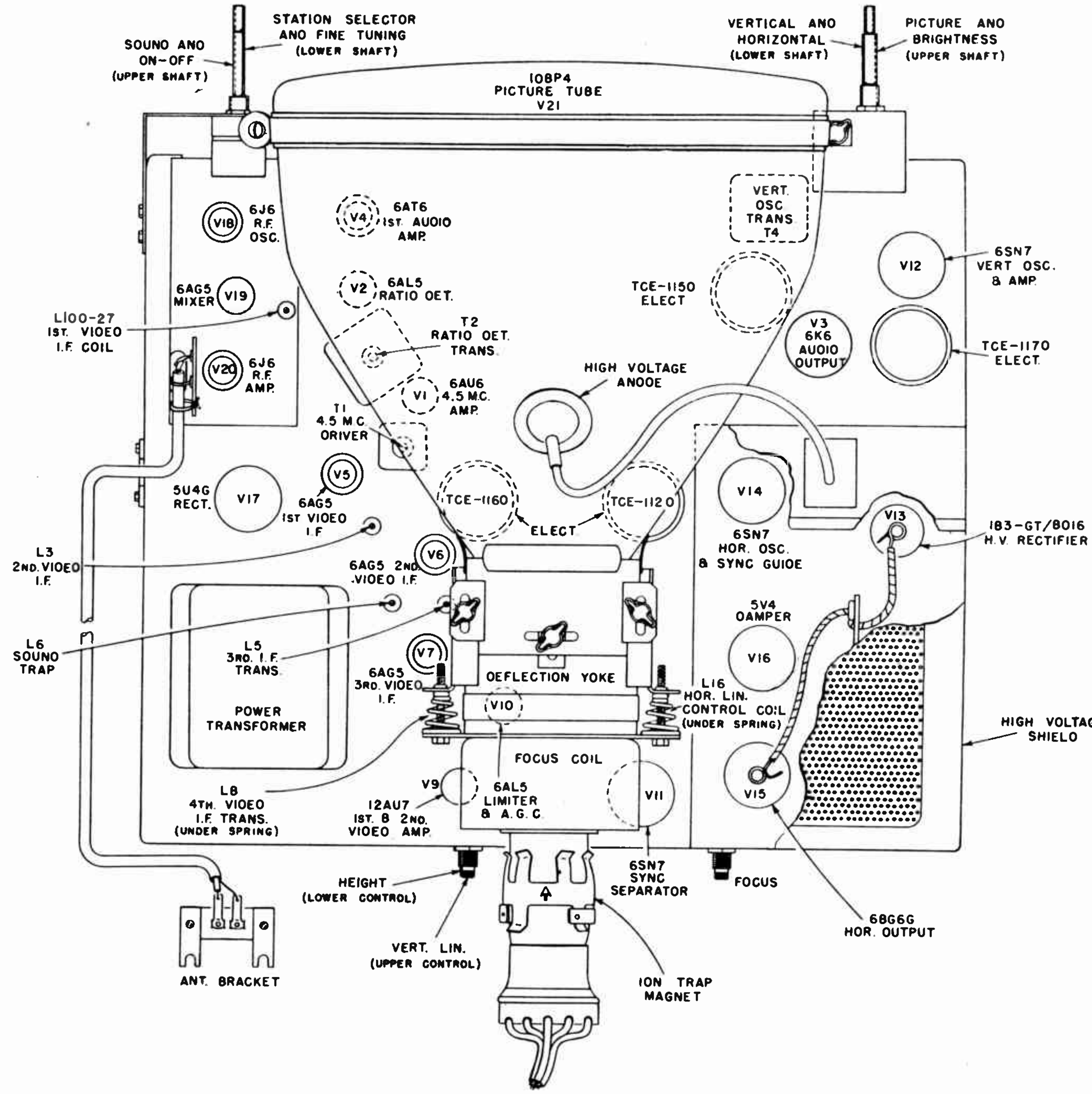
The core of the Horizontal Oscillator Transformer (L) (Fig. 12) should then be adjusted. Variation of this core will cause the pattern to resolve into a series of black and white bars sloping either to the right or the left depending upon the degree of adjustment. The transformer should be adjusted to the point where the picture resolves into a series of from 3½ to 4½ bars sloping downwards to the right.

The Horizontal Hold Control (front panel) should now be rotated to a full counter-clockwise position and the incoming signal momentarily interrupted. This can be done most easily by shorting the antenna terminals for a moment.

The Horizontal Hold Control (front panel) should now be rotated slowly in a clockwise direction. As the control is turned the number of bars sloping downward to the left should decrease. At approximately 90 degrees of rotation there should remain between 3½ and 4½ bars just prior to the time that the picture "falls into" sync. The picture should remain in sync for an additional 90 degrees of rotation. If MORE than 4½ bars are evident just before the picture syncs the Horizontal Locking Range trimmer (K) (Fig. 12) (rear of Chassis) should be tightened slightly. If LESS than 3½ bars the same trimmer should be loosened.

C — HEIGHT, WIDTH AND LINEARITY

To adjust the overall size and linearity of the picture it is almost mandatory that a pattern transmitted from a local station be used. Linearity ad-



TOP VIEW OF TELEVISION CHASSIS

FIG. 10

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justments, particularly, cannot be accurately made on moving transmissions. It should also be remembered that in areas where more than one station is being received, that pictures transmitted from different stations will vary slightly in size. The smallest transmitted picture should be made to fill the area delineated by the mask.

The first step in linearity and size adjustment is to turn the Width control (M) (Fig. 11) (rear of chassis), Fig.11, all the way in. (clockwise).

The Width Control (M) (Fig.11) should now be re-adjusted to achieve a picture 8½" wide.

The Horizontal Drive trimmer (N) (Fig. 12) should then be adjusted for the best compromise between maximum brightness and good horizontal linearity. This control will affect the left side of the picture primarily. The Horizontal Linearity control (o) (Fig. 12) (top rear of chassis) should then be adjusted for linearity of the right side of the picture.

The high voltage measurement made with a suitable kilo voltmeter with Brightness Control set to minimum should be at least 7500 volts from picture tube anode to ground. (A meter which draws more than 100 micro amperes will disturb the high voltage circuit and give erroneous reading).

The Height (P) (Fig. 12) and Vertical Linearity (Q) (Fig. 12) controls (both rear of chassis) should then be adjusted for a linear picture 6⅜" high.

Picture centering is accomplished by positioning focus coil mechanically by means of (4) hexagon head adjusting screws accessible from rear of chassis as shown in Figure (9). At this point the Focus control (R), (Fig. 12) previously set, should be re-adjusted for maximum definition of the lines in the vertical wedge of the test pattern. Proper adjustment and alignment of the receiver should result in clear and sharp definition.

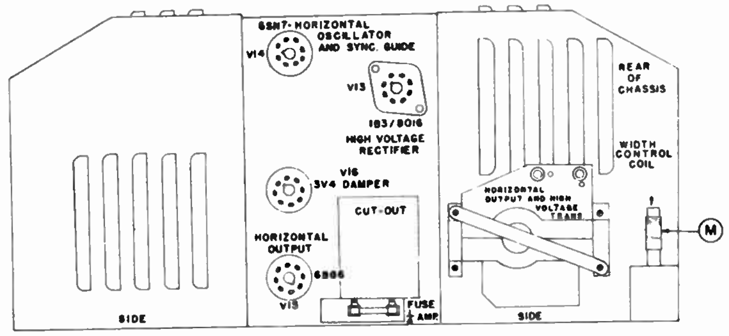

FIG. 11 TOP VIEW–HIGH VOLTAGE SUPPLY–PARTS LOCATION

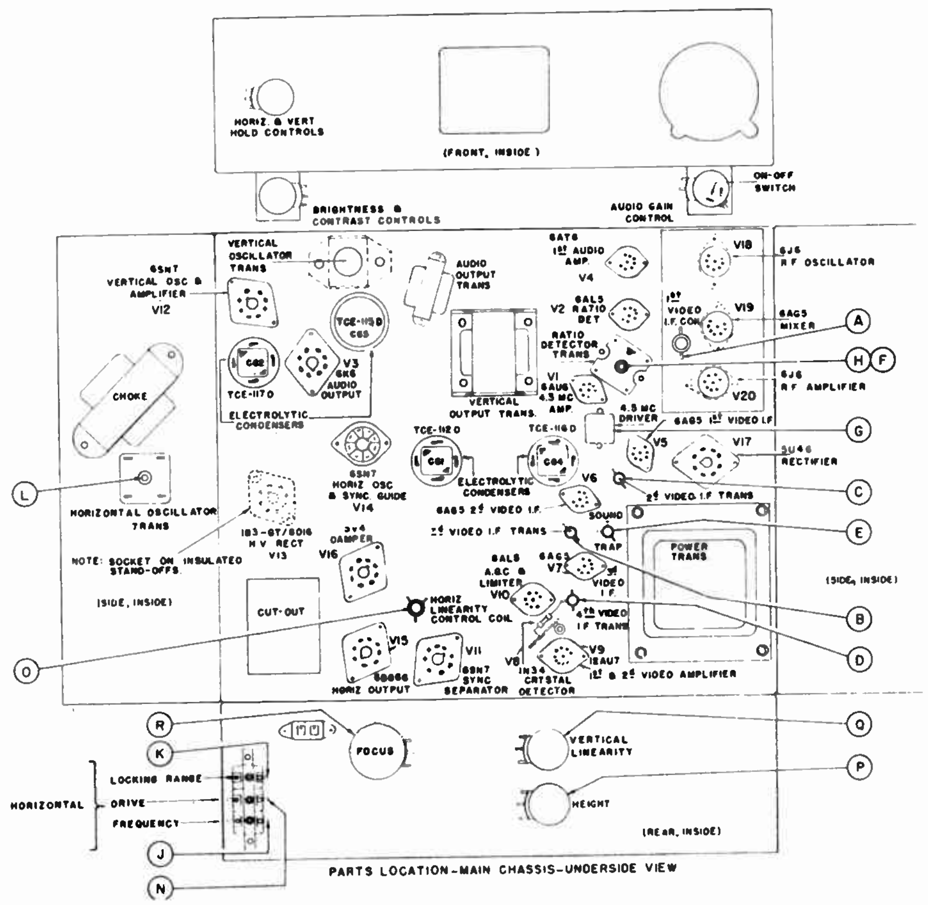

FIG. 12 PARTS LOCATION–MAIN CHASSIS–UNDERSIDE VIEW

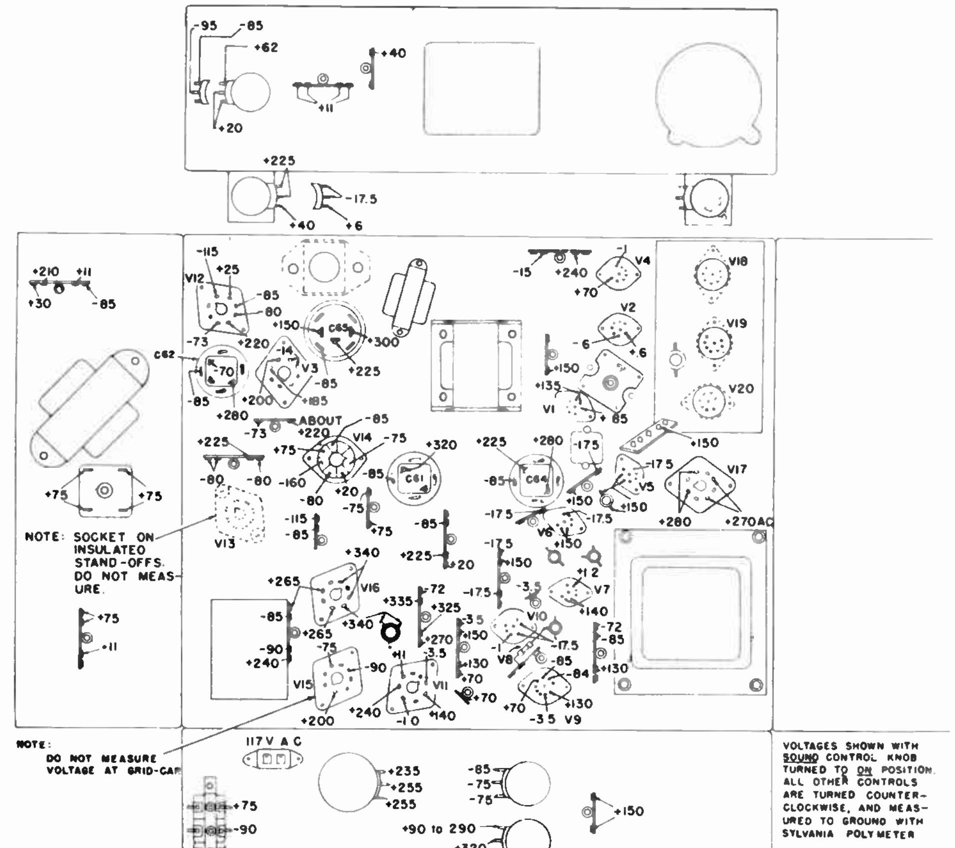

FIG. 13 Voltage Check Chart

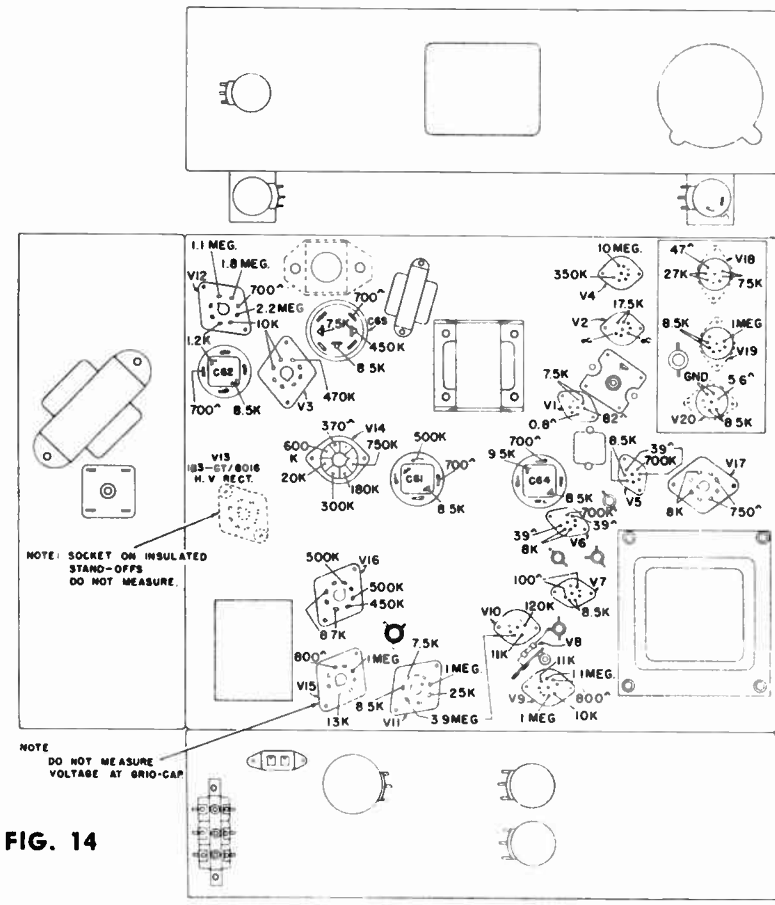

FIG. 14 Resistance Check Chart

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WAVEFORM PHOTOGRAPHS

Peak to peak voltages shown are nominal when 1 volt peak to peak video signal is applied to 1st video amplifier (V109)

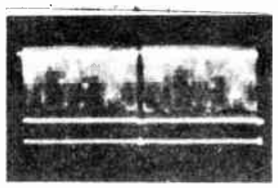

Figure 15—Vertical (1.0 Volts, P to P)

← Video Signal Input to 1st Video Amplifier (At Pin 2 of V109) →

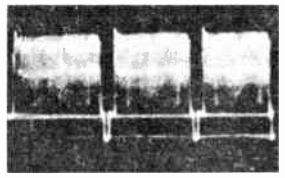

Figure 16—Horizontal (1.0 Volts, P to P)

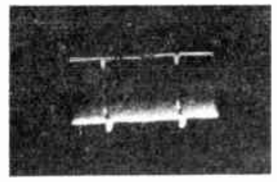

Figure 25—Vertical (10 Volts, P to P)

← Output of Sync Separator (Pin 6 of V11) →

Figure 26—Horizontal (10 Volts, P to P)

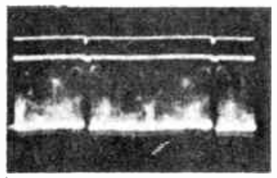

Figure 17—Vertical (5.0 Volts, P to P)

← Output of 1st Video Amplifier (Pin 1 of V109) →

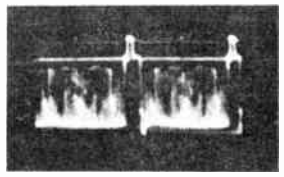

Figure 18—Horizontal (5.0 Volts, P to P)

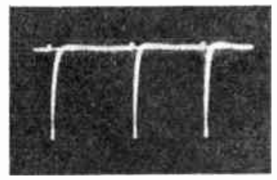

Figure 27 — Vertical (25 Volts, P to P) Output of Integrating Network (Junction of R60 and C58)

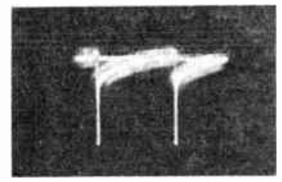

Figure 28—Grid of Vertical Oscillator Tube (175 Volts, P to P) (Pin 1 of V12)

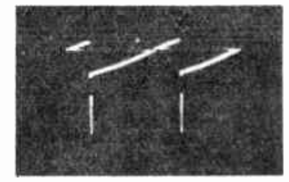

Figure 29—Input to Vertical Output Tube (65 Volts, P to P) (Junction of C60 and C63)

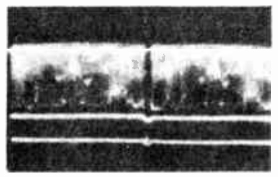

Figure 19—Vertical (32 Volts, P to P)

← Input to L1 Kinescope Grid (Junction of and Green Lead to Kinescope Socket) →

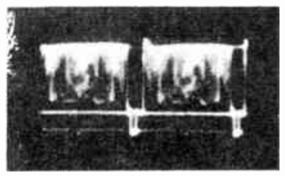

Figure 20—Horizontal (32 Volts, P to P)

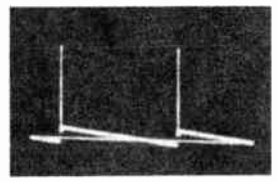

Figure 30—Plate of Vertical Output Tube (750 Volts, P to P) (Pin 5 of V12)

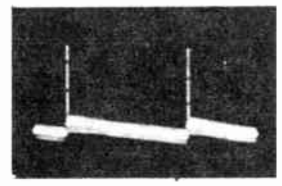

Figure 31 — Voltage Across Vertical Deflection Coils (L108, L13A) (90 Volts, P to P) (At Green Lead of T5 to Ground)

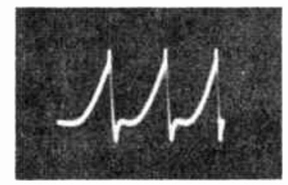

Figure 32 — Horizontal Oscillator Waveforms and Sync Pulse (20 Volts, P to P) (Junction of C67 and C70)

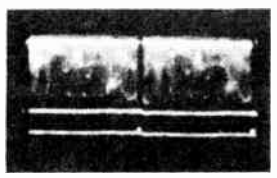

Figure 21—Vertical (8 Volts, P to P)

← Input to Grid Sync Amplifier (Pin 1 of V11) →

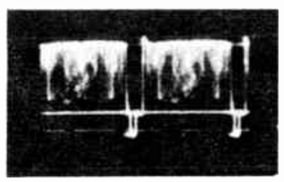

Figure 22—Horizontal (8 Volts, P to P)

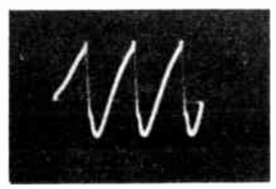

Figure 33 — Horizontal Oscillator Control (45 Volts, P to P) (Junction R91 and R92)

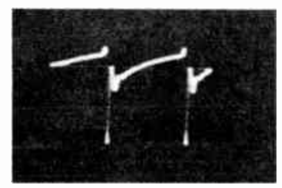

Figure 34—Grid of Horizontal Oscillator (400 Volts, P to P) (Pin 4 of V14)

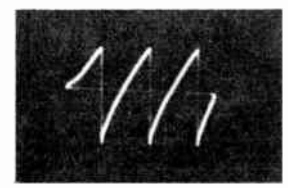

Figure 35 — Horizontal Oscillator Output (60 Volts, P to P) (Junction of C75 and C77)

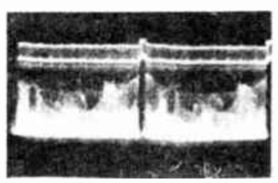

Figure 23—Vertical (90 Volts, P to P)

← Input to Sync Separator (Pin 2 of V11) →

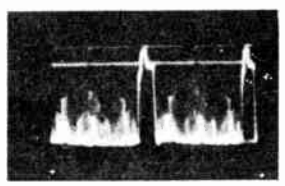

Figure 24—Horizontal (90 Volts, P to P)

Figure 36—Grid of Horizontal Output (40 Volts, P to P) (Pin 5 of V15)

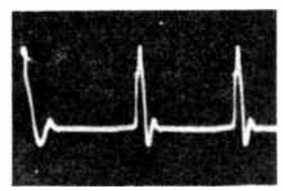

Figure 37—Plate of Horizontal Output (Approx. 5000 Volts, P to P) (Measured Through a Capacity Divider Connected from Plate to Ground)

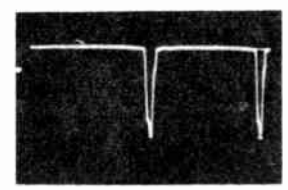

Figure 38 — Voltage Across Horizontal Deflection Coils (Approx. 1100 Volts, P to P) (Pin 4 or 6 of V16 to Ground)

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SCHEMATIC LOCATION	PART NUMBER	DESCRIPTION
		RESISTORS (MAIN CHASSIS) Carbon - 10% Unless Noted
R 101	TRC 33A-2	3.3 Ohms 1/2 W.
R 16	TRC 51A-2	5.1 Ohms 1/2 W.
R 30,33	TRC 390-2	39 Ohms 1/2 W.
R 45,95	TRC 470-1	47 Ohms 1/2 W. 20%
R 98	TRC 820-5	82 Ohms 1 W.
R 12	TRC 820-2	82 Ohms 1/2 W.
R 68,73,74	TRC 561-2	560 Ohms 1/2 W.
R 78,79	TRC 681-4	680 Ohms 1 W. 20%
R 72	TRC 102-4	1000 Ohms 1 W. 20%
R 23,27,34,38	TRC 102-1	1000 Ohms 1/2 W. 20%
R 13	TRC 122-1	1200 Ohms 1/2 W. 20%
R 42,47	TRC 332-5	3300 Ohms 1 W.
R 29,43	TRC 562-3	5600 Ohms 1/2 W. 5%
R 61	TRC 682-1	6800 Ohms 1/2 W. 20%
R 59,60,90	TRC 822-2	8200 Ohms 1/2 W.
R 93,103	TRC 103-2	10000 Ohms 1/2 W.
R 71	TRC 332-3	3300 Ohms 1/2 W. 5%
R 48	TRC 102-2	1000 Ohms 1/2 W. 10%
R 55	TRC 153-4	15K Ohms 1 W. 20%
R 58	TRC 223-1	22K Ohms 1/2 W. 20%
R 85	TRC 303-12	30K Ohms 1/4 W. Temp. Compensating
R 100	TRC 563-2	56K Ohms 1/2 W.
R 26,67	TRC 104-2	100K Ohms 1/2 W.
R 94	TRC 104-SP	100K Ohms 1/2 W. 1%
R 92	TRC 104-6	100K Ohms 1 W. 5%
R 49,83	TRC 124-2	120K Ohms 1/2 W.
R 53,96	TRC 124-5	120K Ohms 1 W.
R 87	TRC 154-2	150K Ohms 1/2 W.
R 91	TRC 184-2	180K Ohms 1/2 W.
R 86	TRC 274-5	270K Ohms 1 W.
R 21	TRC 334-1	330K Ohms 1/2 W. 20%
R 24	TRC 474-1	470K Ohms 1/2 W. 20%
R 39	TRC 564-3	560K Ohms 1/2 W. 5%
R 89,104	TRC 564-2	560K Ohms 1/2 W.
R 44,46,56,97	TRC 105-1	1 Meg 1/2 W. 20%
R 102	TRC 105-8	1 Meg 2 W. 10%
R 65	TRC 155-2	1.5 Meg 1/2 W.
R 70	TRC 225-1	2.2 Meg 1/2 W. 20%
R 88	TRC 335-6	3.3 Meg 1 W. 5%
R 57	TRC 395-2	3.9 Meg 1/2 W.
R 64	TRC 685-2	6.8 Meg 1/2 W.
R 22	TRC 106-1	10 Meg 1/2 W. 20%
R 17,18,28	TRC 153-3	15000 Ohms 1/2 W. 5%
R 19	TRC 473-1	47K Ohms 1/2 W. 20%
R 36	TRC 103-3	10K Ohms 1/2 W. 5%
R 32,35	TRC 331-2	330 Ohms 1/2 W.
R 62	TRC 105-3	1 Meg Ohms 1/2 W. 5%
R 77	TRC 390-5	39 Ohms 1 W.
R 37	TRC 101-2	100 Ohms 1/2 W.
R 51	TRC 152-1	1500 Ohms 1/2 W. 20%
R 14,15	TRC 221-1	220 Ohms 1/2 W. 20%

SCHEMATIC LOCATION	PART NUMBER	DESCRIPTION
		SPECIAL RESISTORS
R 75-A	TRP-1	1125 Ohms 20 W. 2 Section Wire Wound
R 75-B		610 Ohms 20 W.
R 76-A	TRP-2	8200 Ohms 5 W. 3 Section Wire Wound
R 76-B		35 Ohms 0.8 W.
R 76-C		100 Ohms 2 W.
R 99	TRW 472-8	4700 Ohms 2 W. Wire Wound
		VARIABLE RESISTORS
R 25,54	TVC 500-D	Dual Control - Brightness (500K) Picture (11.5K)
R 63,84	TVC 501-D	Dual Control - Hold - Vertical (1 Meg.) Hor. (50K)
R 20	TVC 502-D	Volume Control & Switch (1 Meg.)
R 69	TVC 503-D	Vertical Linearity (5K)
R 66	TVC 504-D	Height Control (2.5 Meg.)
R 80	TVC 506-D	Focus Control (2250 Ohms W. W.)
		CONDENSERS (MAIN CHASSIS) Electrolytic
C 29	TCE 112-D	30 mfd 450 Volts
C 61-A	TCE 113-D	80 mfd 450 Volts 2 Section
C 61-B		10 mfd 450 Volts
C 65-A	TCE 115-D	10 mfd 450 Volts 3 Section
C 65-B		30 mfd 400 Volts
C 65-C		30 mfd 300 Volts
C 64-A	TCE 116-D	40 mfd 450 Volts 2 Section
C 64-B		10 mfd 350 Volts
C 62-A	TCE 117-D	40 mfd 450 Volts 3 Section
C 62-B		40 mfd 150 Volts
C 62-C		130 mfd 50 Volts
C 24	TCE 104-D	4 mfd 25 Volts
		Paper Tubular
C23,26,56,71	TCP 202-10	.002 mfd 600 Volts
C57,58	TCP 502-4	.005 mfd 400 Volts
C28	TCP 502-10	.005 mfd 600 Volts
C80	TCP 353-10	.035 mfd 600 Volts Oil Impregnated
C19,85,86	TCP 103-4	.01 mfd 400 Volts
C25,27	TCPM 103-4	.01 mfd 400 Volts Molded Paper
C18,73	TCP 203-4	.02 mfd 400 Volts
C53, 68	TCP 503-4	.05 mfd 400 Volts
C46,50,79	TCP 503-10	.05 mfd 600 Volts
C63,81	TCP 104-13	0.1 mfd 1000 Volts Oil Impregnated
C40,51,60,72,78	TCP 254-4	0.25 mfd 400 Volts
C87	TCP 254-10	0.25 mfd 600 Volts
		Mica & Ceramic
C 84	TCM 050-20	5 mmf 1500 Volts mica 20%
C 54	TCM 101-7	100 mmf 500 Volts mica
C 67,70	TCM 121-8	120 mmf 500 Volts mica 10%
C 74	TCM 181-29	180 mmf 1000 Volts silver mica 2%
C 30,35,41	TCM 271-13	270 mmf 1000 Volts mica
C 55,75	TCM 391-14	390 mmf 1000 Volts mica 10%

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SCHEMATIC LOCATION	PART NUMBER	DESCRIPTION
		Mica & Ceramic (cont.)
C 82	TCM 501-SP	500 mmf High Voltage Capacitor
C 22,31,33,34,37,44	TCC 152-10	1500 mmf 600 Volts Ceramic
C 77	TCM 222-15	2200 mmf 1000 Volts Mica 5%
C 59	TCM 472-9	4700 mmf 500 Volts Mica 5%
C 32,36,42,43,45,52	TCC 502-SP	5000 mmf 600 Volts Ceramic - 10% + 100%
C 48	TCC 050-11	5 mmf 600 Volts Ceramic 10%
C 49	TCC 2.2-11	2.2 mmf 600 Volts Ceramic 10%
C 38	TCC 1.5-11	1.5 mmf 600 Volts Ceramic 10%
C 83	TCM 056-24	56 mmf 800 Volts Mica 5% (yoke)
C 47	TCC 471-10	470 mmf 600 Volts Ceramic 20%
C 39	TCC 030-11	30 mmf 600 Volts Ceramic 10%
C 20	TCC 2-1	2X .002 Ceramic Herlac
C 88	TCC 472-10	4700 mmf 600 Volts Ceramic
		Trimmers
C 69A, 69B, 69C	TAS 501-D	Trimmer Strip Assembly (Hor. Locking, Hor. Drive, Hor. Frequency)
		INDUCTANCES (MAIN CHASSIS)
T 4	TTR 152	Vertical Oscillator Transformer
T 5	TTR 153	Vertical Output Transformer (With electrostatic shield)
T 6	TTR154	Horizontal Output & H.V. Transformer
T 7	TTR 105	Power Transformer
T 3	TTR 156	Audio Output Transformer
L 17	TTR 157	Horizontal Oscillator Transformer
L 6	TTR 158	Sound Trap
L 13-A, 13-B	TTR 159-D	Deflection Yoke
L 14	TTR 106-D	Filter Choke
L 4, 7	TLF 146-D	I. F. Choke
L 3	TLF 517-D	I. F. Coil
L 5	TLF 148-D	I. F. Coil
L 8	TLF 149-D	I. F. Coil
L 1, 10	TLF 502	Peaking Coil (On 22K Resistor R40,41)
L 2, 11	TLF 503	Peaking Coil
L 15	TLF 505	Width Control Coil
L 16	TLF 506	Hor. Linearity Control Coil
L 12	TLF 521-D	Focus Coil
T 1	TLF 114-D	Sound Take-off Trap
T 2	TLF 115-D	Ratio Detector Coil
	TLF 500	Ion Trap Assembly
		HARDWARE (MAIN CHASSIS)
	TFA 2	CRT Anode Connector and Lead
	TFA 3	High Voltage Capacitor Connector
	TMS 127	Miniature Tube Shield
	TMS 532	Bottom CRT Clamp
	TSP 462	4" x 6" Oval PM Speaker
	TLD 101	Interlock Cord
	TMS 121-D	Escutcheon
	TSG 106	Escutcheon Mtg. Spring

SCHEMATIC LOCATION	PART NUMBER	DESCRIPTION
	TCB 258-D	Cabinet
	TGL 106-D	Safety Glass
	TBK 159-D	Back
	TKN 100	Outside Knob
	TKN 101	Inside Knob (Small Shaft)
	TKN 103	Inside Knob (Large Shaft)
	TKN 108	Inside Knob (Small Shaft Engraved Dot)
	TBF-152D	Bezel
	TFU-1	Fuse 250 V. 1/4 Amp.
		RESISTORS (TUNER) 1/2 Watt Carbon 20% Unless Noted
R 11	TRC 470-1	47 Ohms
R 1, 7	TRC 102-1	1K Ohms
R 8	TRC 472-3	4.7K Ohms 5%
R 9, 10	TRC 273-1	27K Ohms
R 6	TRC 105-1	1 Meg
R 2	TRC 560-2	56 Ohms 10%
R 3	TRC 331-2	330 Ohms 10%
		CONDENSERS (TUNER)
C 10	TCC 502-SP	5000 mmf 600 V. Disc.
C 14, 15	TCC 4.7-11	4.7 mmf 10% Tubular
C 9	TCC 22-12	22 mmf 5% Tubular
C 8	TCM 271-13	270 mmf 20% 1000 V. Mica
C 1,2,3,4,7,11,13, 76, 89	TCC 361-10	360 mmf Min. 600 V.
C 5, 12	TCC 010-11	1.0 mmf 10% Tubular
		COILS (TUNER)
L 100-1	TLF 120-1D	Channel 2 Osc. Coil
L 100-2	TLF 120-2D	Channel 3 Osc. Coil
L 100-3	TLF 120-3D	Channel 4 Osc. Coil
L 100-4	TLF 120-4D	Channel 5 Osc. Coil
L 100-5	TLF 120-5D	Channel 6 Osc. Coil
L 100-6	TLF 120-6D	Channel 7 Osc. Coil
L 100-7	TLF 120-7D	Channel 8 Osc. Coil
L 100-8	TLF 120-8D	Channel 9 Osc. Coil
L 100-9	TLF 120-9D	Channel 10 Osc. Coil
L 100-10	TLF 120-10D	Channel 11 Osc. Coil
L 100-11	TLF 120-10D	Channel 12 Osc. Coil
L 100-12	TLF 120-10D	Channel 13 Osc. Coil
L 100-25,26	TLF 140-D	Plate Choke
L 100-27	TLF 147-D	1st I. F. Coil
L 100-13, 14	TLF 128-D	R. F. Coils
L 100-21, 22	TLF 143-D	R. F. End. Ind.
L 100-15,16,17,18	TLF 129-D	R. F. Coil
L 100-19, 20	TLF 130-D	R. F. Coil
		HARDWARE (TUNER)
	TSW-102 D	Bandswitch
		FINE TUNING ASSEMBLY
	TAS-502D	Condenser Shaft and Pulley
	TAS-503D	Condenser & Bushing
	SG -1	Spring
	CR -2	Drive Cord

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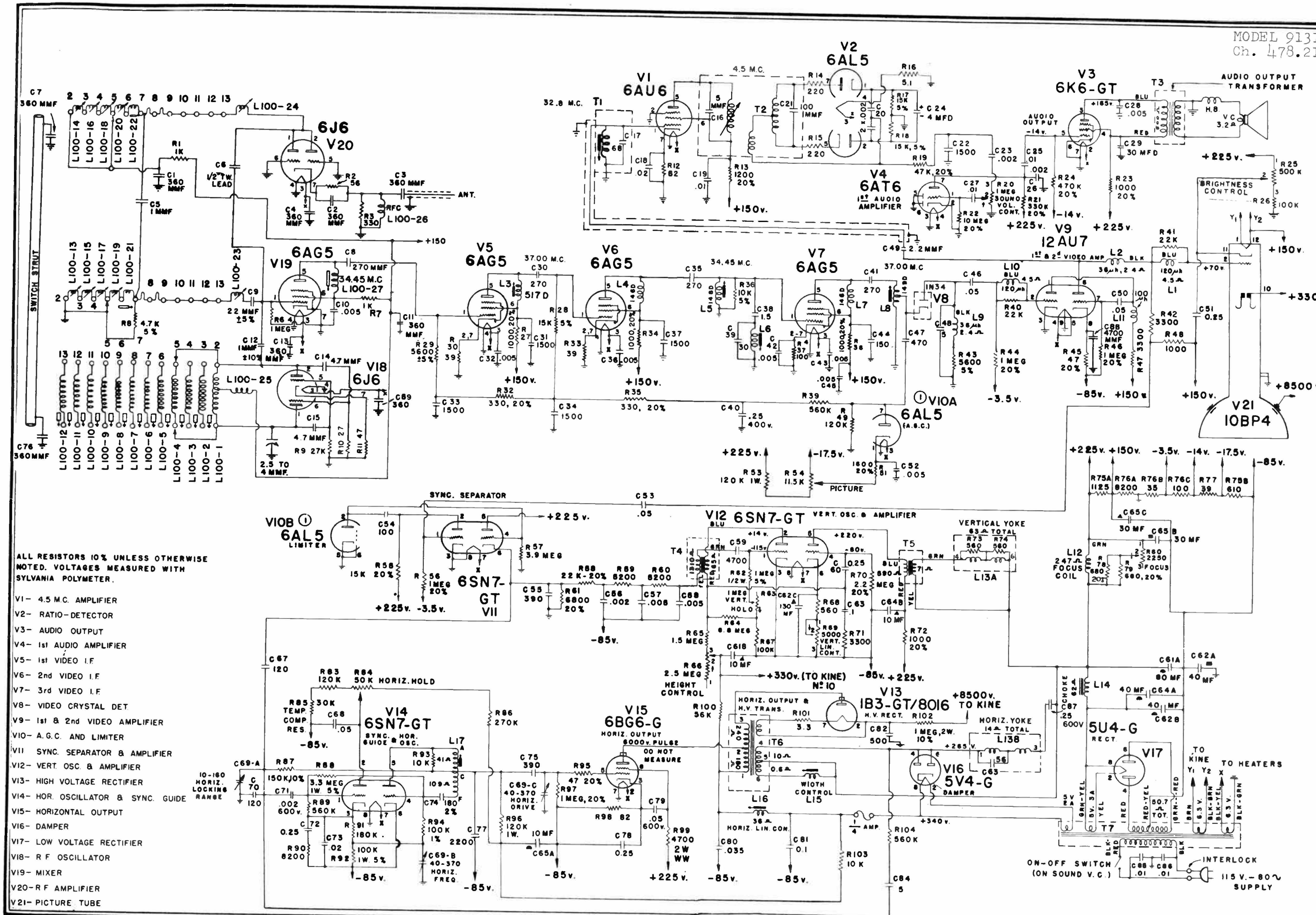

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GENERAL DESCRIPTION

The 102 television receiver is a direct view table model receiver employing the new rectangular type picture tube. Full twelve channel station coverage is provided by a rotary type channel selector employing condenser tuning over two frequency ranges. A stagger tuned intermediate frequency amplifier system carries both picture and sound intermediate frequencies, using the inter-carrier sound system. Power is supplied to the receiver through a switch ganged to the Picture control. The audio sound and picture brightness levels are established by the Volume and Brightness controls respectively. Picture brilliance is set by adjustment of the Picture control. The Vertical and Horizontal hold controls provide for synchronization of the horizontal and vertical components of the picture. Other picture adjustments which are not normally made by the operator are located on the rear of the receiver chassis.

SPECIFICATIONS

POWER SUPPLY

All models operate from a 105-125 volts 60 cycle AC source unless otherwise specified. Power consumption is 200 watts.

FREQUENCY RANGE

Channels 2 through 13. For specific channel frequencies see table on page 2.

ANTENNA EQUIPMENT

A dual antenna input is provided on the receiver to accommodate either 72-ohm shielded type lead in or 300-ohm ribbon type lead-in. The cabinet antenna lead, normally shipped connected to the 300-ohm terminals, must be disconnected if an outside antenna lead-in is connected. When connecting the antenna lead-in, connect the 72-ohm shielded type lead-in to the terminals marked "72 Ω" or connect the 300-ohm ribbon type lead-in to the terminals marked "300 Ω." Note that the shield braid on the shielded type lead-in must be connected to the terminal marked "GND". When 72-ohm shielded type lead-in is used, the two red coded leads at the back of the cabinet must be connected to the "300" terminals. When connecting 300-ohm balanced type lead-in, either wire may be connected to either 300-ohm terminal without affecting the quality of reception.

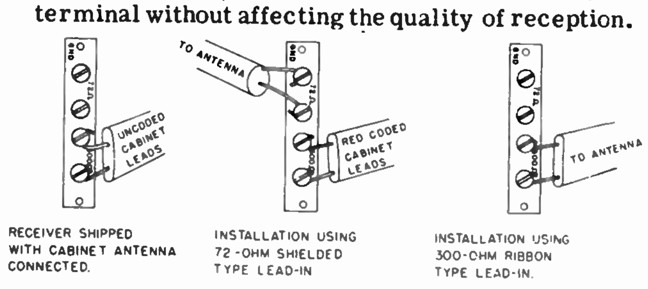

FIG. 1 - ANTENNA CONNECTIONS

TUBES (21, including rectifiers)

Function	Type	Function	Type
*RF Amplifier	6BC5 (6AG5)	Vertical Amplifier	6SN7GT
*RF Amplifier	6BC5 (6AG5)	Horizontal Oscillator	6SN7GT
Oscillator/Mixer	6J6	Horizontal Amplifier.	6BQ6GT
First IF Amplifier	6AU6	Damper	6W4GT
Second IF Amplifier	6AU6	Audio IF Amplifier.	6AU6
Third IF Amplifier.	6AU6	FM Detector	6AL5
Video Detector-First Video Amplifier . .	12AU7	Audio Amplifier.	6AV6
Second Video Amplifier - First Sync. Separator	12AU7	Audio Power Amplifier	6AQ5
Sync. Amplifier-Second Sync. Separator. .	12AU7	High Voltage Rectifier.	1X2
Vertical Oscillator.	6J5GT	Low Voltage Rectifier.	5V4G
		Picture Tube.	16RP4

*Note - Field replacement of RF amplifier tubes should be with 6BC5 tubes only. After the start of tuner production, the tube manufacturers reduced the transconductance (Gm) rating of 6AG5 tubes and designated the high Gm version as 6BC5. A reduction in receiver sensitivity will result unless 6BC5 tubes are used for replacement. The 6BC5 tube is completely interchangeable with the 6AG5 tube, so no socket wiring changes are involved.

TELEVISION CHANNEL vs CARRIER AND I-F AMPLIFIER FREQUENCIES

Channel No.	Channel Freq. (mc)	Picture Carrier Freq. (mc)	Sound Carrier Freq. (mc)	Receiver Osc. Freq. (mc)	Picture IF Freq. (mc)	Sound IF Freq. (mc)	Picture IF less Sound IF (mc)
2	54-60	55.25	59.75	81.5	26.25	21.75	4.5
3	60-66	61.25	65.75	87.5	26.25	21.75	4.5
4	66-72	67.25	71.75	93.5	26.25	21.75	4.5
5	76-82	77.25	81.75	103.5	26.25	21.75	4.5
6	82-88	83.25	87.75	109.5	26.25	21.75	4.5
7	174-180	175.25	179.75	201.5	26.25	21.75	4.5
8	180-186	181.25	185.75	207.5	26.25	21.75	4.5
9	186-192	187.25	191.75	213.5	26.25	21.75	4.5
10	192-198	193.25	197.75	219.5	26.25	21.75	4.5
11	198-204	199.25	203.75	225.5	26.25	21.75	4.5
12	204-210	205.25	209.75	231.5	26.25	21.75	4.5
13	210-216	211.25	215.75	237.5	26.25	21.75	4.5

CIRCUIT DESCRIPTION

The 549.100-2 television receiver chassis operates with eighteen tubes plus one high voltage rectifier, one low voltage rectifier and one 16RP4 rectangular picture tube. The operating controls as viewed from the front left to right are the vertical & horizontal hold (dual), power, switch & picture, volume & brightness (dual) and range selector & station tuning (dual).

For convenience in tracing the circuit, a block diagram of the complete receiver is shown in Fig. 2.

The antenna input circuit of the receiver's tuner is designed to match a 300-ohm impedance. However, a matching transformer and antenna terminals are provided to permit the use of either 72-ohm shielded type lead-in or 300-ohm ribbon type lead-in from an outside antenna system.

The cabinet antenna system permits satisfactory local reception without additional external antenna facilities. It is very important that the cabinet antenna leads be disconnected when an outside antenna system is installed.

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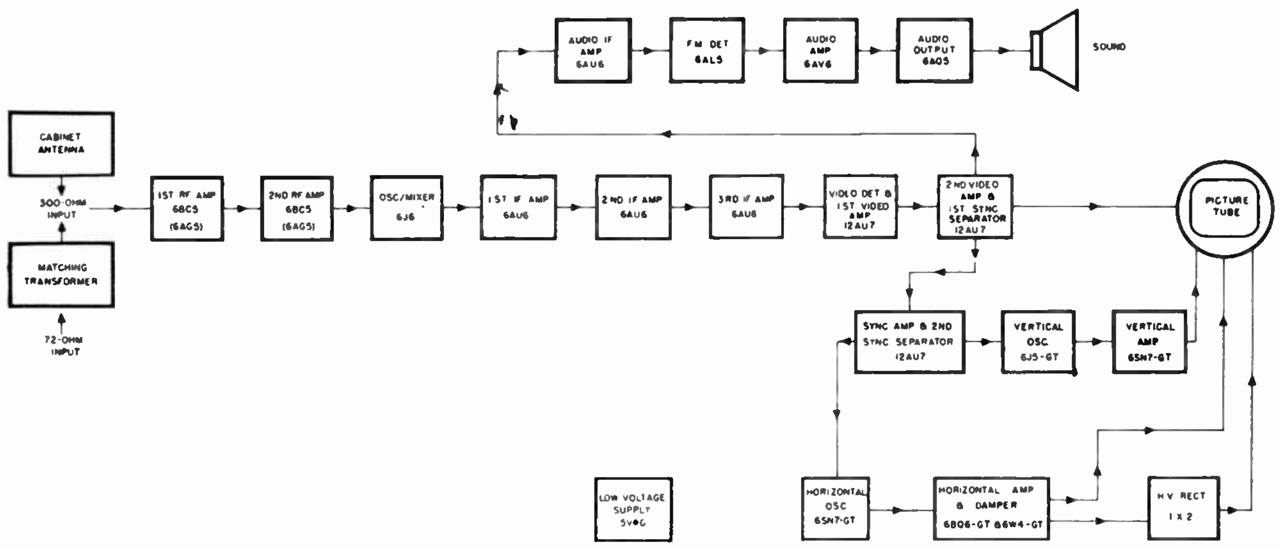

FIG. 2 - CIRCUIT BLOCK DIAGRAM

One of three antenna input systems shown is used for any given installation: i.e. cabinet antenna connected to 300-ohm terminals; outside antenna with shielded cable connected to 72-ohm terminals; or outside antenna with balanced ribbon type line connected to the 300-ohm terminals (Cabinet antenna leads disconnected in the last two cases.) The received signal is fed to the input of the RF tuner. The tuner is capacity tuned covering channels 2 through 6 in the first (Lo) range and 7 through 13 in the second (Hi) range. Continuous tuning is provided in each range. In order to facilitate tuning, a certain amount of additional coverage above the highest and below the lowest tunable channel in each range is provided. The extra coverage is referred to as "overtravel" in this text. A two position switch, actuated by a knob concentric with the station tuning shaft, is used to switch all circuits and will be referred to in this text as a range selector.

Three tubes are employed as follows:

6AG5 or 6BC5 first RF amplifier
6AG5 or 6BC5 second RF amplifier
6J6 oscillator-mixer

A three section gang condenser is used for tuning respectively the 1st RF plate circuit, 2nd RF plate circuit, and the plate circuit of the oscillator.

The antenna input system consists of two band-pass circuits. The required circuit is selected by the range selector. Each antenna band-pass circuit is a double tuned circuit consisting of a center tapped primary coil resonated by a trimmer capacitor and suitably coupled to a secondary coil resonated by the first RF grid input capacity. The tuner circuits are designed to match a 300-ohm transmission line.

Sketches of antenna band pass characteristics are shown below.

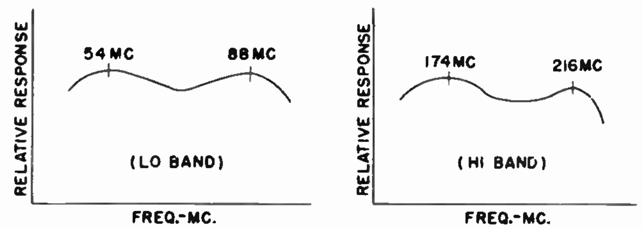

FIG. 3 - ANTENNA BAND-PASS CHARACTERISTICS

The RF amplifiers are used as stagger tuned amplifiers to provide a band-pass circuit of the proper band width. In both Hi and Lo ranges, the plate circuit of the 1st RF amplifier provides the low frequency stagger component, and the plate circuit of the second RF amplifier provides the high frequency stagger component as indicated below in a sketch of a typical RF pass-band.

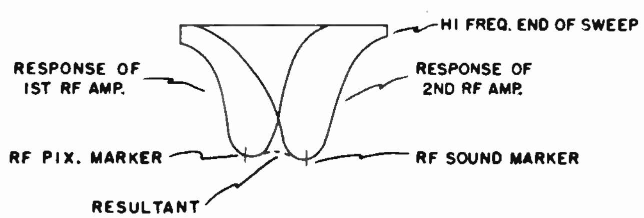

Fig. 4 - TYPICAL RF PASS BAND

With an RF sweep input to the antenna and an oscilloscope suitably connected to the mixer grid return at the LOOKER POINT shown in Fig. 14, the resultant overall RF response, which is a combination of the stagger responses in any channel appears as shown below:

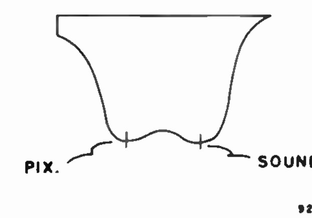

FIG. 5 - TYPICAL OVERALL RESPONSE

The oscillator employs a modified Colpitts circuit with one plate of the 6J6 tuned by the third section of the variable condenser.

In accordance with Fig. 14, the following tuning elements are brought out at the top of the tuner chassis:

Hi and Lo band antenna band-pass primary tuning trimmers•
1st and 2nd RF plate tuning trimmers
Oscillator plate tuning trimmer

The unity coupled, stagger tuned IF amplifier stages amplify both video and sound carriers. At the video detector stage the video intermediate frequencies and 4.5 mc beat frequency, which is the difference between the picture carrier intermediate frequency (26.25 mc) and the sound carrier intermediate frequency (21.75)mc), are detected and passed on to the two video amplifier stages. Note that the 4.5 mc beat still contains the FM modulation at this point.

At the second video amplifier plate, the 4.5 mc signal containing the FM carrier is taken off and fed to one stage of IF amplification before being detected at the FM detector stage. The audio frequency signal is then fed through one stage of voltage amplification to the power output stage and speaker.

The second video amplifier plate also carries the video signal which is fed to the grid of the picture tube.

Automatic gain control voltage is obtained from the rectified diode current flowing in the video detector stage. This negative voltage which is a function of signal level is applied to the grids of the 1st RF amplifier in the tuner and to the first and second IF amplifier stages to control the over-all gain over large variations in received signal levels.

The synchronizing pulses transmitted by the TV transmitter are carried along through the IF amplifier, video detector and first video amplifier stages where they are separated from the video signals by a two stage sync. separator.

The output of the second sync. separator is fed to the vertical and horizontal oscillators through filter networks designed to separate the horizontal and vertical sync. pulses supplied by the TV transmitter.

Vertical synchronizing pulses from the sync. separator are applied to the vertical sweep oscillator to hold this oscillator in step with the scanning equipment at the TV transmitter. The vertical sweep oscillator produces a saw-tooth voltage which is amplified on a second tube and energizes the vertical deflection coils of the picture tube.

Horizontal synchronizing pulses from the sync. separator are fed to the horizontal sweep oscillator stage to control closely the horizontal sweep rate.

The horizontal sweep oscillator stage employs a twin triode tube, one section of which operates as a "saw-tooth" oscillator and the other operates as a frequency controlling device by controlling the DC bias on the grid of the oscillator section. To exercise control over the frequency of the sweep oscillator, the control section of the twin triode samples the integrated wave form of the horizontal oscillator and "kick-back" pulse from the secondary of the horizontal output transformer as well as the synchronizing pulses from the TV transmitter via the sync. separator. The results of this sampling action provides control over the horizontal oscillator frequency for the three possible conditions of normal control, sync. too early, and sync. too late.

The output of the horizontal oscillator stage is amplified by the horizontal amplifier stage and coupled to the horizontal deflection coils of the picture tube by the horizontal output transformer. The output transformer serves the dual purpose of matching the output of the horizontal amplifier tube to the horizontal deflection coils of the picture tube and supplying high voltage for the second anode potential required by the picture tube.

The pulses generated in the transformer winding are rectified by the high voltage rectifier tube which also obtains its filament power from a separate winding on this transformer.

Focusing is accomplished magnetically by a combination permanent and electro-magnet. The load current of the receiver flows through the focusing control and focus coil winding such that the amount of focus coil current is controlled by the setting of the focus control. Since the focus coil contains a permanent magnet, the fields of the permanent magnet and focus coil winding must work together, hence the lead coding of the focus coil winding must be observed. Reversing the leads weakens the magnetic field so that focusing is not possible when this condition exists.

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PICTURE TUBE INSTALLATION

DISMANTLING

Remove the four front panel control knobs by pulling them straight from their shafts. The dual control knobs must be removed in two pieces, removing the center unit first.

Remove the back cover. Note that the line cord and half of the interlock connector comes along with the back cover.

Unfasten and remove the speaker to clear the picture tube. Remove the wood screws holding the antenna terminal bracket and matching transformer to the cabinet.

Remove the five chassis bolts holding the receiver chassis in the cabinet and slide the entire assembly from the cabinet.

REMOVING THE PICTURE TUBE

Read all warning notices on both tube and carton.

Disconnect the picture tube socket at the base of the picture tube.

Slip the ion trap from the neck of the picture tube past the picture tube base connector.

Measure the distance from the front edge of the steel band or front edge of the chassis apron to the face of the picture tube. Keep this dimension handy for the installation of the new tube.

Remove the steel band at the front rim of the picture tube and carefully slip the neck of the picture tube out of the focus coil and deflection yoke. If the tube fails to slip out smoothly investigate and remove the cause of the trouble. Do no use force.

INSTALLING THE PICTURE TUBE

Wrap the dust seal around the front rim of the picture tube and position the tube so that the anode contact is located on the left as viewed from the screen.

Slip the neck of the picture tube through the rear support, deflection yoke, and focus coil and seat the tube firmly against the rear support. If it fails to slip into place smoothly, investigate and remove the cause of the trouble. Do not force the tube.

Check the distance from the face of the tube to the front edge of the steel band or chassis apron as measured above. If the dimension is off; loosen the two rear support mtg. screws, position the tube correctly and fasten the steel band firmly about the rim of the tube. As a second check at this point it may be well to slip the chassis into the cabinet to check the installation before proceeding with the remaining adjustments.

Check the rear support. It must seat firmly against the flare of the tube and be securely anchored in place by the two rear support mounting screws. Check the spring contact grounding the outer coating of the picture tube. A high potential is developed on the outer coating of the tube if this contact is faulty.

The deflection yoke must seat firmly against the flare of the picture tube. Check by loosening the single deflection yoke adjusting screw and pushing the deflection yoke forward as far as it will go. Take up the slack in the screw temporarily to hold the coil in place.

Slip the ion trap over the neck of the tube. The arrow points toward the screen of the picture tube.

Reconnect the picture tube socket and anode connector.

Make the adjustments outlined under "Television Service Adjustments" before reassembling the chassis in the cabinet.

TELEVISION SERVICE ADJUSTMENTS

ION TRAP MAGNET ADJUSTMENT

Turn on the receiver and turn up the brightness control. Set the ion trap for maximum raster brilliance, backing off the brightness control adjustment as the maximum point is approached. The ion trap must be rotated about the axis of the tube as well as shifted along the neck of the tube to obtain the proper setting. The arrow on most ion traps points to the second anode connector when properly adjusted, hence a quick initial setting may be made as far as rotation is concerned.

FOCUS AND BRIGHTNESS CONTROL ADJUSTMENT

With the brightness control set for slightly above average brilliance and the picture control full counter-clockwise, adjust the focus control until the line structure of the raster is clearly visible.

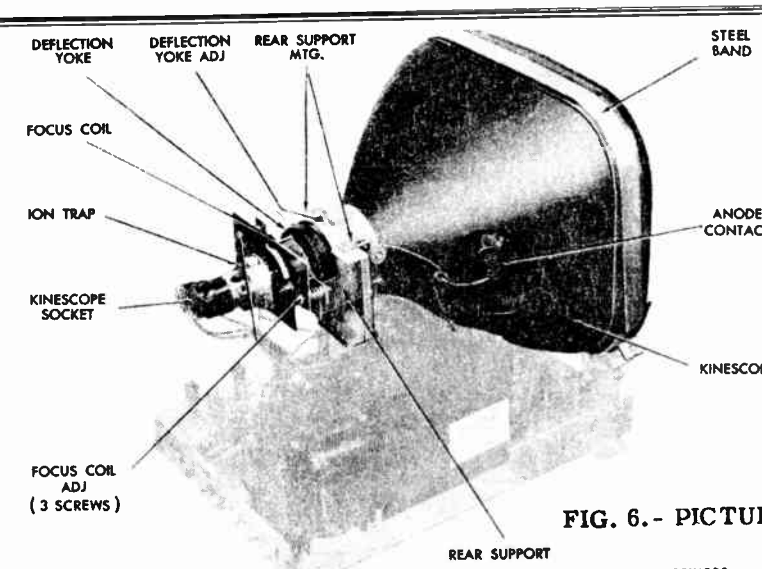

FIG. 6.- PICTURE TUBE MOUNTING DETAIL

Readjust the ion trap, if necessary, for maximum raster brilliance. The final touches on the focus control adjustment should be made with the brightness control at the maximum position with which good line focus can be maintained, then back off the setting of the brightness control until the white, wide spaced, retrace lines just disappear.

DEFLECTION YOKE ADJUSTMENT

If the lines of the raster are not horizontal or square with the escutcheon, loosen the deflection yoke adj. screw and rotate the deflection yoke until this condition is obtained. Tighten the adjustment screw.

PICTURE ADJUSTMENTS

A test pattern is desirable when making the following adjustments. Maintain normal picture contrast and brilliance when making these adjustments.

FOCUS COIL ADJUSTMENT

Check the position and appearance of the test pattern. If the test pattern is off center or shadowed at the corners (electron beam striking the neck of the tube) set the horizontal centering control in the middle of its range and adjust the three focus coil adjusting screws for a centered, evenly illuminated raster. Note that the three spring loaded adjustment screws tilt the focus coil to shift the position of the raster on the face of the picture tube. Do not turn all three screws up tight, use them to tilt the focus coil only.

It is not necessary to tilt the focus coil excessively. Excessive tilt may snap the neck of the picture tube if sufficient force is used. The focus coil may be shifted around the axis of the picture tube, if necessary, by loosening the two knurled nuts holding the coil to the mounting plate. The position of the focus coil that produces a centered, evenly focused pattern on the face of the tube is the correct one. Tighten the nuts after the adjustment has been made. The horizontal centering control may now be used as required without having to reset the focus coil position each time.

A slight adjustment of the ion trap while making the focus coil adjustments may be found effective in obtaining the desired results.

HORIZONTAL OSCILLATOR ADJUSTMENT

Check the action of the horizontal hold control on the front panel. If the control is excessively off center when sync. is established or fails to sync. at all, the horizontal oscillator transformer (See Fig. 9) requires adjustment.

To reset the horizontal transformer, set the horizontal hold control in the center of its range, tune in a TV station and sync. the picture by adjusting the bottom screw adjustment on the horizontal oscillator transformer. Note that the TV station must be carefully tuned for best picture when making this adjustment.

Check the horizontal hold control action on all TV channels and touch up the oscillator transformer adjustment if necessary.

NOTE: The top screw adjustment on the horizontal oscillator transformer has been arbitrarily set at its top limit. This adjustment should not be disturbed unless it is obvious that the adjustment has been tampered with. If this screw has been turned, reset it to the top limit of its travel.

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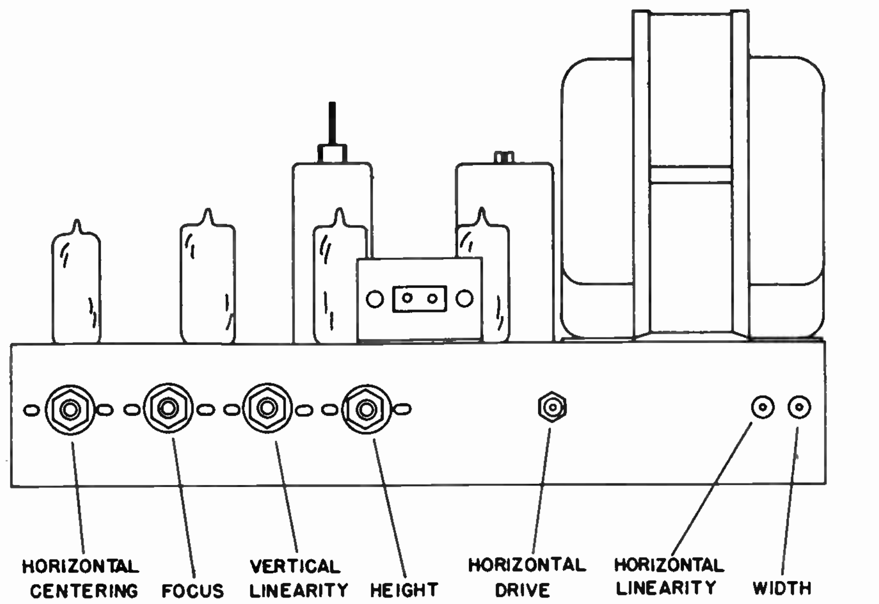

FIG. 7 - REAR CHASSIS VIEW

HORIZONTAL DRIVE ADJUSTMENT

Advance the HORIZONTAL DRIVE control (Fig. 7) as far as possible without causing fold over of the test pattern. (Vertical white line.) Insufficient horizontal drive will cause low second anode voltage with consequent loss of picture brilliance.

HORIZONTAL LINEARITY ADJUSTMENT

Set the HORIZONTAL LINEARITY control for a symmetrical pattern from left to right. A slight re-adjustment of the HORIZONTAL CENTERING control may be necessary when making this adjustment.

WIDTH ADJUSTMENT

Set the WIDTH control so that the test pattern fits the horizontal dimension of the picture tube escutcheon. A minor adjustment of the HORIZONTAL CENTERING control may be required to recenter the pattern.

HEIGHT ADJUSTMENT

Set the HEIGHT control so that the test pattern fits the vertical dimension of the picture tube escutcheon. A minor adjustment of the focus coil position may be required to recenter the pattern.

VERTICAL LINEARITY ADJUSTMENT

Set the VERTICAL LINEARITY control for a symmetrical test pattern in the vertical dimension. A slight readjustment of the height control may be required when making this adjustment.

HORIZONTAL CENTERING ADJUSTMENT

When the picture is not centered horizontally, adjust the HORIZONTAL CENTERING control until the picture is centered left to right. Slight readjustment of the WIDTH control may be necessary.

FOCUS

Carefully adjust the receiver for best picture definition and set the picture and brightness controls for normal picture brilliance. Adjust the FOCUS control for maximum picture definition watching the wedges of the test pattern. An alternate method for focusing consists of switching to an unused TV channel and with the brightness control turned up so that the raster is illuminated, set the focus control for well defined scanning lines.

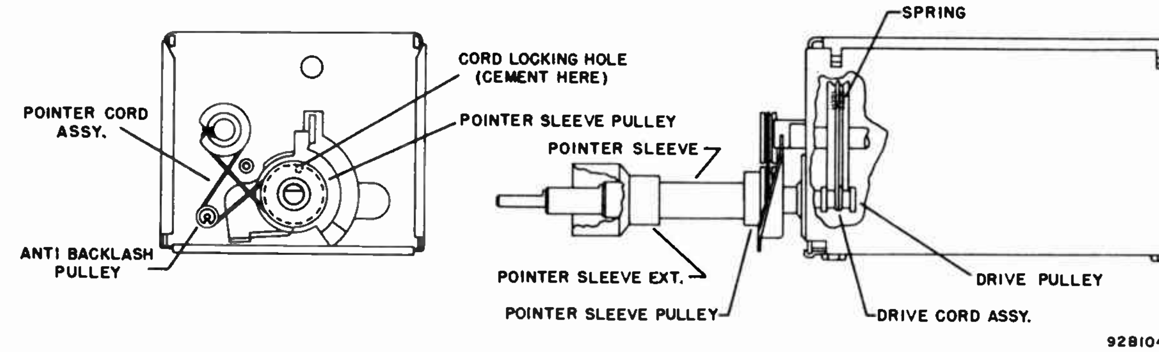

FIG. 8 - DIAL DRIVE DETAIL

RESTRINGING CONDENSER PULLEY DRIVE

Wrap drive cord assembly 1-1/2 turns on drive pulley (Fig. 8) and slip other end over pulley on rotor shaft, keeping prong clip in center of slot, hook one end of spring over cord, and the other end over tab on pulley.

RESTRINGING POINTER PULLEY DRIVE

With condenser at maximum capacity and hole in pointer sleeve pulley in position shown, press prong clip on pointer cord assembly into hole and wrap end of loop around end of condenser rotor shaft (Fig. 8.) making certain that cord is seated in groove in rotor shaft. Loop loose end of cord assembly over anti-backlash pulley as shown. Apply a drop of "Duco" household cement over cord seated in groove in rotor shaft to prevent cord from slipping.

RESETTING POINTER SLEEVE EXTENSION

If pointer cord breaks, it may be necessary to reset the pointer sleeve ferrule after restringing, in order to maintain coincidence of pointer and dial escutcheon.

1. Tune unit to channel 13 (station or signal generator).
2. Unsolder pointer sleeve ferrule and rotate until pointer registers on number 13 of dial escutcheon.
3. Solder pointer sleeve extension to pointer sleeve (Fig. 8.).

TELEVISION ALIGNMENT PROCEDURE

PRELIMINARY

This alignment is an exacting procedure and should be undertaken only when necessary. Before fully deciding that alignment is necessary and before removing the chassis from the customer's house:

1. Be sure of the antenna installation.
2. Check all operating controls and adjustments including the station tuning control.
3. Check reception on all channels
4. Check tubes by substitution of known good tubes.

In the repair shop.

5. Substitute a known good picture tube.
6. If picture definition is still inadequate, observe the overall IF response curve of the receiver.

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TEST EQUIPMENT REQUIRED FOR IF ALIGNMENT

Signal generator covering 4 mc to 30 mc.
Electronic voltmeter.

TEST EQUIPMENT REQUIRED FOR TUNER ALIGNMENT

Sweep Generator
Oscilloscope
Electronic Voltmeter
RF Marker Generator
Pix IF Marker Generator
Bias Supply 2-1.5 volt Dry Cells
IN-34 Crystal Detector (See Fig. 11.).

SPECIFICATIONS FOR TUNER TEST EQUIPMENT

Sweep Generator similar to RCA type WR59A, covering frequencies of 54 to 88 Mc, and 174 to 216 Mc with a minimum sweep of 10 Mc in any channel, and a 300-ohm balanced output at least 0.1 volt line to line.

Oscilloscope equivalent in vertical deflection sensitivity to Dumont type 208-B.

Electronic voltmeter similar to Voltohmyst.

RF marker generator similar to RCA type WR-39-A.

Pix IF marker generator may be a crystal controlled oscillator in vicinity of 26.25 Mc. As alternates, either a second WR-39-A or an all wave signal generator of suitable accuracy may be used to supply a picture IF marker.

FM SOUND CHANNEL I-F AMP. ALIGNMENT

1. Connect the low frequency signal generator output across resistor R-118 in the plate circuit of 12AU7 VIDEO DET. tube (V-104). This resistor is located at the terminal strip near the tube socket.

2. Connect the electronic voltmeter between pin 7 of the 6AL5 FM DET. tube (V-109) and chassis ground.

3. With the signal generator (unmodulated) set at 4.5 mc. set the 4.5 MC LIMITER GRID ADJ. (Top side of chassis) and FM DET PRI. ADJ. (Under side of chassis) (See Fig. 9) for maximum d-c voltage as measured by the electronic voltmeter. Adjust the limiter grid transformer (T-105) before adjusting the f-m detector transformer (T-108) primary. Use just enough signal generator output to obtain approximately one volt at the electronic voltmeter.

4. Connect the electronic voltmeter across the 1000 mmf condenser (C-135) at the output of the f-m detector stage and adjust the FM DET. SEC. ADJ. (top side of chassis) of the f-m detector transformer (T-108) for the null.

5. Shift the frequency of the signal generator either side of the 4.5 mc and touch up the FM DET. PRI. ADJ. (under side of chassis) for approximately equal peaks. Use just enough signal generator output to obtain one volt peaks for the best results.

6. After completing the alignment procedure and placing the receiver in operation again, carefully tune in a TV test pattern and adjust the 4.5 MC TRAP ADJ. for maximum vertical wedge definition. This adjustment is located on the under side of the chassis and on the same coil form as the 4.5 MC LIMITER GRID ADJ. shown in Fig. 9.

NOTE - The primary adjustment of T-108, the coarse frequency adjustment of T-111 and the 4.5 mc trap adjustment may all be made through the plugged holes in the cabinet bottom if desired.

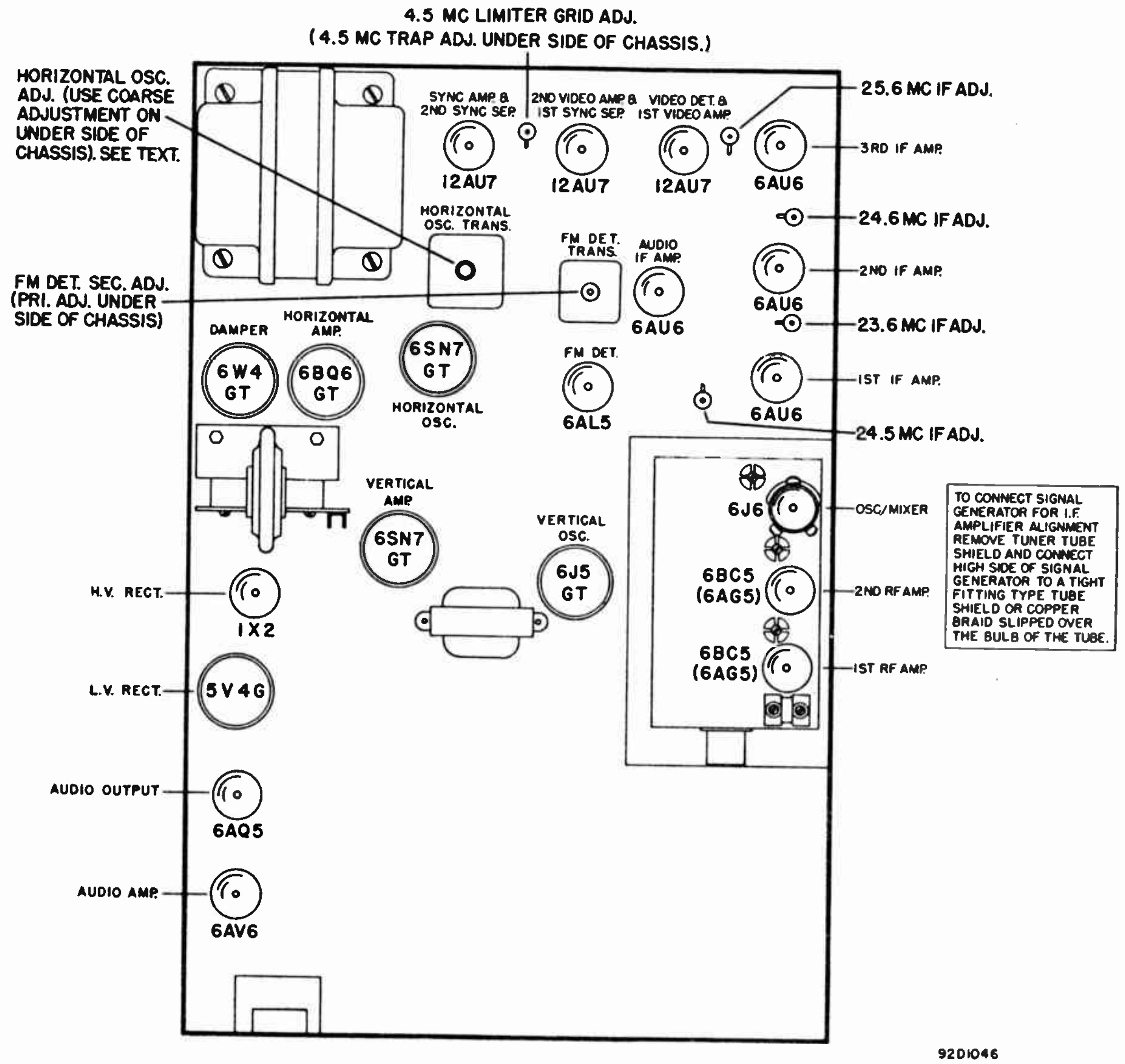

FIG. 9 - TOP VIEW - ALIGNMENT POINTS

I-F AMPLIFIER ALIGNMENT

1. Connect the electronic voltmeter across resistor R-118 in the plate circuit of the 12AU7 VIDEO DET. tube (V-104). This resistor is located on the terminal strip near the tube socket.

2. Couple the high side of the signal generator to the MIXER tube (V-3) by removing its shield and slipping a tight fitting tube shield or length of copper braid over the bulb of the tube and connecting the generator lead to it. Connect the ground side of the signal generator to the frame of the tuning unit.

3. Position the station tuning control at channel 2.

4. Set the signal generator output (unmodulated) to develop one or two volts at the electronic voltmeter and adjust the four i-f amplifier coils, according to the following chart, for maximum d-c voltage as measured by the electronic voltmeter. Since the first IF stage employs an overcoupled input transformer (T-101), it is necessary during the adjustment of this transformer to shunt the winding not being aligned with a 1,000 ohm resistor (i.e. shunt the secondary when aligning the primary and vice-versa). Readjust the signal generator output as required to maintain the two-volt potential at the electronic voltmeter.

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I-F AMPLIFIER ALIGNMENT CHART

Signal Generator Frequency (No Modulation)	Adjustment (Refer to Fig. 9)	Stage Adjusted
24.5 mc	24.5 MC IF ADJ. *	1st IF amp
23.6 mc	23.6 MC IF ADJ.	2nd IF amp
24.6 mc	24.6 MC IF ADJ.	3rd IF amp
25.6 mc	25.6 MC IF ADJ.	Video detector

* Note - Use 1000 ohm shunt resistor when making this adjustment. See step 4 above.

5. Check the i-f amplifier frequency response by tuning the signal generator from 21 mc through 26.25 mc and observing the change in d-c voltage at the electronic voltmeter. If the signal generator output is set for an electronic voltmeter reading of 1.5 volts at the peak i-f amplifier response, the d-c voltage should not drop below one volt between the two peaks normally obtained with this i-f amplifier. If the response is unsatisfactory, repeat the procedure or try slight modifications of the recommended settings to obtain the desired response. Avoid resonating the coils with the iron core at the bottom end of the coil form. (Adjustment screw near limit of its travel).

If a sweep type signal generator and oscilloscope are available the problem of making the final adjustments will be much easier. Check the two carrier i-f responses, 21.75 mc and 26.25 mc. The 21.75 mc response will be approximately 20 db below the peak response (Approx. 0.15 volt) and the 26.25 mc response will fall approximately 6 db below the peak (Approx. 0.4 volt). Refer to Fig. 10.

The average i-f amplifier sensitivity, when feeding the signal generator output through the receiver as described in step 2, will run approx. 2000 to 5000 microvolts for the one volt d-c peak measured at resistor R-118 (receiver's oscillator operating on channel 2).

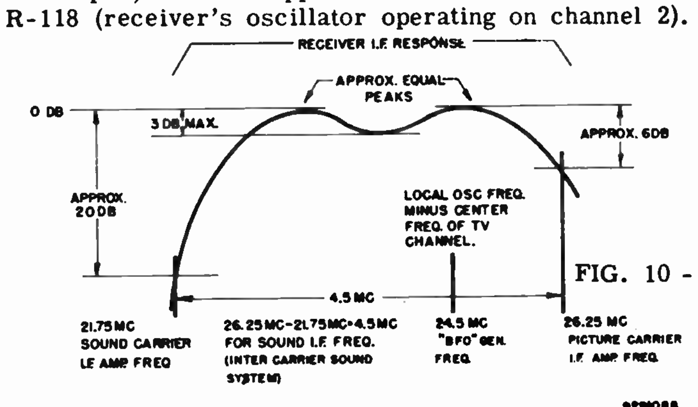

FIG. 10 - I-F AMPLIFIER RESPONSE

TUNER ALIGNMENT

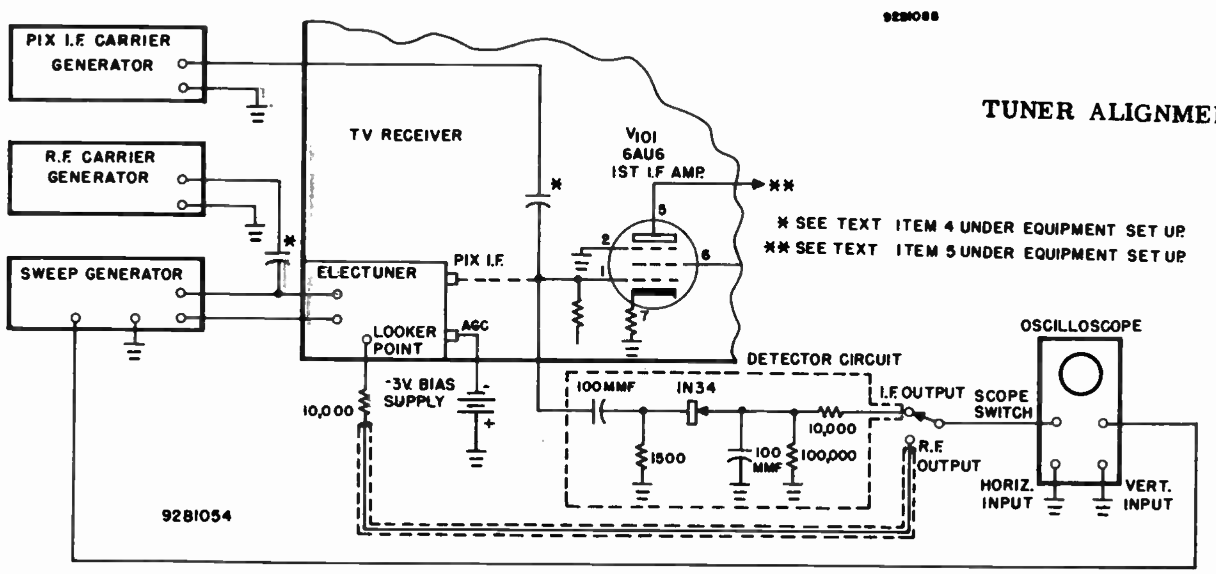

FIG. 11 - RECOMMENDED TEST EQUIPMENT CIRCUITS

Test Equipment Set Up - With reference to Fig. 11, the following precautions should be taken in making the equipment set up.

1. The detector circuit should be so constructed as to maintain leads as short as possible. Connection of the detector circuit to the 1st IF amplifier grid terminal should also be made with short leads.

2. Shielded leads should be used in making the following connections to reduce hum and synchronous voltage pick up.
   (a) The lead for observations of the RF response from the scope isolating resistor (10,000 ohms located at the tuner LOOKER POINT) to the RF output switch position of the scope switch.
   (b) The connection from the IF detector circuit output to the IF switch position of the scope switch.
   (c) The connection from the sweep generator to the horizontal input of the scope. (Use the externally generated sweep instead of internal oscilloscope sweep in order to obtain synchronization).

3. The single pole double throw SCOPE SWITCH should be located at the vertical input terminals of the scope. This switching arrangement will permit observation of either the IF response or the overall RF response. The aforementioned positions will be referred to in subsequent text as the "IF" and "RF" positions respectively.

4. The marker generator coupling condenser should be as small a value as possible to prevent any effect on tuner response, but must be large enough to permit easy observation of markers on either the IF response or overall RF response. (Approximately 2 or 3 mmf should be satisfactory in most cases).

5. For all tests which are outlined in this text, remove the second IF amplifier tube to prevent coupling back from the receiver IF system.

6. In all of the following tests the oscilloscope vertical gain should be as close to maximum gain as possible, consistant with hum and synchronous voltage interference limitations. This precaution will allow the use of low levels from the RF sweep generator and increase the visibility of IF and RF markers.

Procedure For Oscillator Alignment -

OVERTRAVEL CHART FOR OSCILLATOR COVERAGE

Channel No.	Overtravel	RF Overtravel Marker Frequency
13	+ 1.5 Mc	Pix carrier + 1.5 Mc = 212.75 Mc
7	- 2.5 Mc	Pix carrier - 2.5 Mc = 172.75 Mc
6	+ 1.5 Mc	Pix carrier + 1.5 Mc = 84.75 Mc
2	- 1.0 Mc	Pix carrier - 1.0 Mc = 54.25 Mc

High Band Oscillator Alignment

1. Turn range selector of the tuner to the Hi band (counter-clockwise rotation of switch knob), rotate variable condenser to minimum capacity (clockwise rotation of tuning shaft), and adjust sweep generator for channel 13.

2. With the scope switch in IF position, adjust scope gain, RF sweep input level, inject required IF picture marker (i.e. 26.25 Mc), and an RF overtravel marker of 212.75 Mc.

3. Adjust OSC. TRIMMER (Fig. 14) so that picture IF marker and 212.75 Mc overtravel markers coincide on the IF response characteristic on the scope.

4. Remove the two self tapping screws used for fastening the tuner shield and slide shield off until a point is reached where coils on switch are exposed and accessible.

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5. Rotate variable condenser to maximum capacity (counter-clockwise) and adjust sweep generator for channel 7.

6. Inject RF overtravel markers of 172.75 Mc.

7. With a bakelite alignment tool, adjust the spacing of the turns of the HI BAND OSC. COIL (Fig. 14) so that Pix IF marker and 175.75 Mc markers coincide. Spreading the coils apart will raise the oscillator frequency; squeezing the coils together will lower the frequency. After adjustment, slide shield back into its original position and note any frequency shift of markers. Slide shield off and compensate for the frequency shift by a slight readjustment of the Hi band oscillator coil. Slide shield back into original position and note if markers coincide. If they do not, repeat this process until proper adjustment is made and markers coincide.

8. Repeat steps 1 to 7 inclusive until correct oscillator coverage of entire Hi band is obtained.

Lo Band Oscillator Alignment -

9. Remove tuner shield completely, turn tuner range selector to Lo band position (clockwise), rotate variable condenser to minimum capacity and adjust sweep generator for channel 6.

10. Inject Pix IF marker and RF overtravel marker of 84.75 Mc.

11. With a bakelite alignment tool, adjust LOW BAND OSC. COIL (Fig. 14) so that the Pix IF marker and 84.75 Mc marker coincide.

12. Rotate variable condenser to maximum capacity (counter-clockwise) and adjust sweep generator for channel 2.

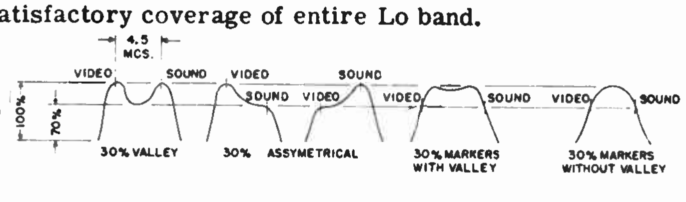
13. Inject RF overtravel marker 54.25 Mc.

14. Adjust LOW BAND OSC. SERIES PAD (See Fig. 14) until Pix IF marker and 54.25 Mc marker coincide.

15. Repeat steps 9 to 14 inclusive for satisfactory coverage of entire Lo band.

Procedure For RF Pass Band Alignment

FIG. 12 - ACCEPTABLE RF PASS BANDS



Hi Band RF Pass Bands -

16. Repeat step 1.

17. Replace tuner shield, set scope switch to IF position, and adjust scope gain.

18. Inject a Pix IF marker and a channel 13 Pix RF marker (211.25 Mc).

19. Rotate tuning shaft until Pix IF marker and 211.25 Mc marker coincide on the IF response. Do no disturb this setting of the variable condenser for the remainder of alignment of channel 13 RF pass band.

20. Set scope switch to RF, adjust scope gain and turn 1ST RF TRIMMER (Fig. 14) for maximum amplitude of first RF amplifier response in the region of the RF Pix marker.

21. Inject channel 13 sound RF marker (215.75 Mc) and adjust 2ND RF TRIMMER (Fig. 14) for maximum amplitude of second RF amplifier response in the vicinity of the RF sound marker.

22. Repeat steps 20 and 21 until desired pass band is obtained. See Fig. 12 for acceptable RF band pass response shapes.

23. Remove tuner shield as in step 4 and repeat step 5.

24. Set scope switch to IF position, adjust scope gain, and inject required Pix IF marker and channel 7 Pix RF marker of 175.25 Mc.

25. Rotate tuning shaft until Pix IF marker and channel 7 RF Pix RF markers coincide in IF response. Do not disturb this setting of the variable condenser for remainder of alignment of channel 7 RF pass band.

26. Set scope switch to RF position and with a bakelite alignment tool, adjust 1ST RF HI BAND COIL (Fig. 14) for maximum amplitude of 1st RF amplifier response in region of the Pix RF marker.

27. Inject a channel 7 RF sound carrier of 179.75 Mc and adjust 2ND RF HI BAND COIL (Fig. 14) for maximum amplitude of 2nd RF amplifier response in the region of the sound RF marker.

28. Repeat steps 26 and 27 until desired pass band is obtained, consistent with shapes shown in Fig. 12.

29. Repeat steps 16 to 28 inclusive for satisfactory coverage of entire Hi band RF response.

Lo Band RF Pass Bands -

30. Repeat step 9 set scope switch to IF position, adjust scope gain, and inject a channel 6 Pix RF marker (83.25 Mc).

31. Rotate tuning shaft until Pix IF marker and 83.25 Mc markers coincide. Do not disturb this setting for remainder of channel 6 RF pass band.

32. Set scope switch to RF position and adjust scope gain.

33. Adjust 1ST RF LO BAND COIL (Fig. 14) for maximum amplitude of 1st RF amplifier response in the region of channel 6 Pix RF marker.

34. Inject channel 6 sound RF marker of 87.75 Mc and adjust 2ND RF LO BAND COIL (Fig. 14) for maximum amplitude of 2nd RF amplifier response in the region of the channel 6 sound RF marker.

35. Repeat step 32 until desired pass band is obtained in accordance with acceptable RF pass bands shown in Fig. 12.

36. Rotate variable condenser to maximum capacity (counter-clockwise) and adjust sweep generator for channel 2.

37. Set scope switch to IF position, adjust scope gain, and inject a channel 2 Pix RF marker (55.25 Mc).

38. Rotate tuning shaft until Pix IF markers and 55.25 Mc markers coincide. Do not disturb this variable condenser setting for remainder of alignment of channel 2 RF pass band.

40. Adjust 1ST RF LO BAND COIL (Fig. 14) for maximum amplitude for 1st RF amplifier response in region of channel 2 Pix RF marker.

41. Inject channel 2 sound RF marker (59.75 Mc) and adjust 2ND RF LO BAND COIL (Fig. 14) for maximum amplifier response in region of channel 2 sound RF marker.

42. Repeat step 40 until desired pass band is obtained in accordance with acceptable RF pass band shown in Fig. 12.

43. Repeat steps 30 to 42 inclusive for satisfactory coverage of entire Lo band RF response.

Procedure For Antenna Pass Band Alignment -

The band pass antenna stages are normally aligned in the factory for minimum standing waves, with a wide range sweep oscillator and a delay line. The coupling between the primaries and secondairies are carefully adjusted and in general should not be disturbed.

Minor corrections of the primary trimmer tuning may be necessary, if they are accidentally or otherwise varied after leaving the factory. The procedure for resetting antenna primary trimmers is outlined below.

Hi Band Primary Antenna Trimmer Alignment -

With scope switch in RF position and equipment set for observation of channel 13 RF pass band (see step 1) turn HI BAND PRIMARY ANT. TRIMMER screw (counter-clockwise) i.e. to a reduced capacity setting. Start turning trimmer screw clockwise (increasing capacity) while observing the channel 13 RF pass band amplitude and shape. It will be noticed that the amplitude will increase to a certain point and thereafter the shape of the response will change as shown in Fig. 13, indicating the antenna to be cutting into the RF pass band. Back out the trimmer screw to a maximum amplitude and minimum "cutting-in" position.

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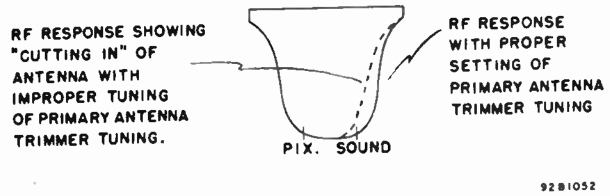


FIG. 13 - EFFECT OF PRIMARY ANTENNA TRIMMER ON RF PASS BAND RESPONSE

Lo Band Primary Antenna Trimmer Alignment

Procedure for aligning LO BAND PRIMARY ANT. TRIMMER is the same as outlined for Hi band primary antenna trimmer except the tuner should be tuned to channel 6 and adjustment of the Lo band antenna primary trimmer screw should be done while observing the RF response characteristic of channel 6.

Final Caution Note -

Upon completion of tuner alignment, remove crystal detector in 1st IF grid. Replace tuner shield and fastening screws, reinsert 2nd IF amplifier tube removed at start of alignment, and check performance of receiver with all available local stations.

Tuner Service Notes

Oscillator Injection Voltage-The oscillator injection voltage is specified as 2 volts minimum with normal B+ applied and is measured from the LOOKER POINT (Fig. 14) to ground with a Voltohmyst through a 10,000 ohms isolating resistor. In the event of a failure to meet these specifications, it is necessary to replace the 6J6 tube.

Tube Replacement-If the oscillator tube (6J6) is changed, it may be necessary to realign the tuner to compensate for the difference in tube characteristics. A slight adjustment of the oscillator trimmer (Fig. 14) will correct for any change of tube capacitance. Follow instructions for alignment of Hi Band and Lo Band oscillator alignment. Low oscillator injection voltage will reduce conversion gain with resulting loss in picture sensitivity.

If either RF tube is replaced, it may be necessary to realign tuner to compensate for a variation of tube characteristics. A slight adjustment of the RF trimmers (Fig. 14) will compensate for this. Follow instructions for alignment of Hi Band and Lo Band RF pass band alignment.

Variable Condenser

Do Not Attempt to bend variable condenser plates, as they have been calibrated in the factory on special equipment.

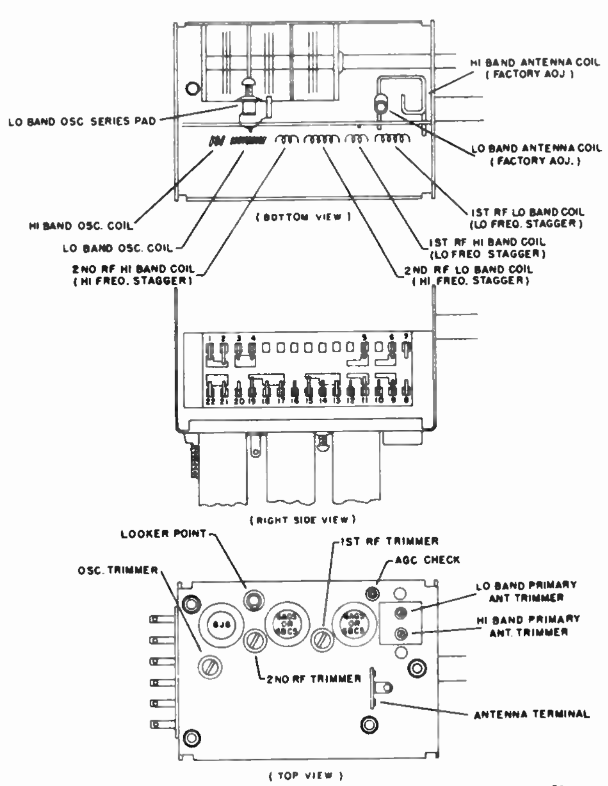
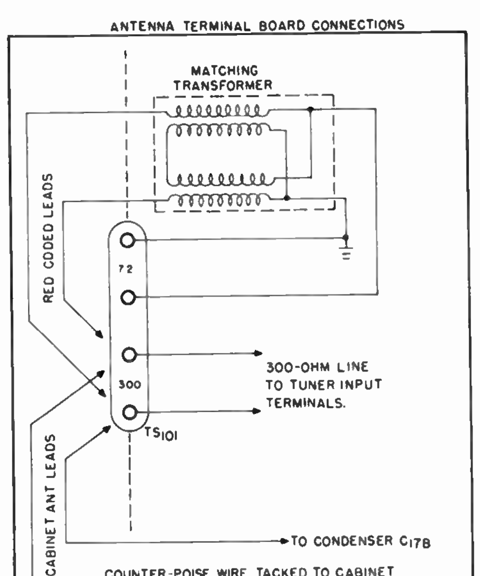
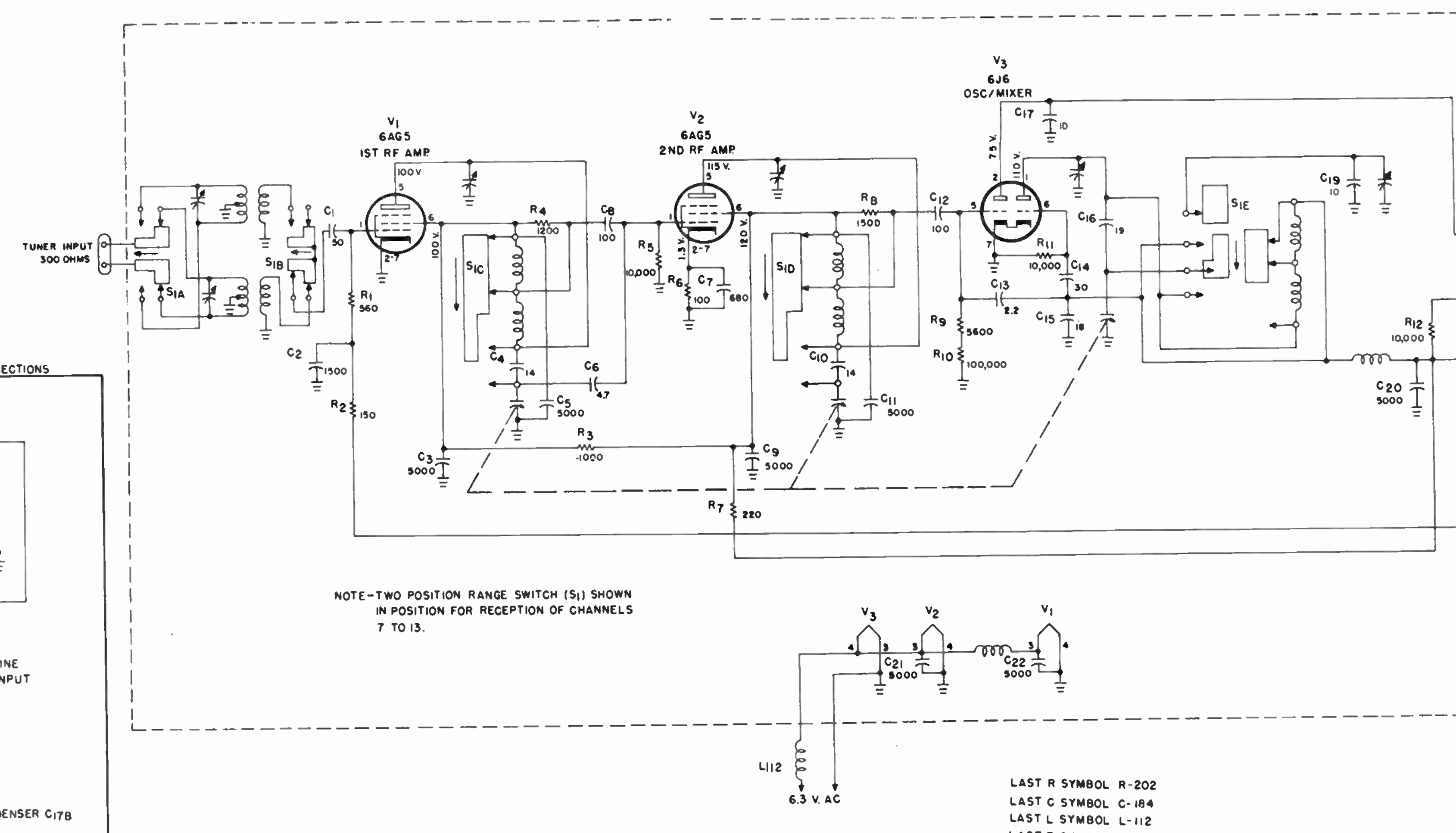


FIG. 14 - LOCATION OF TUNER ALIGNMENT ADJUSTMENTS





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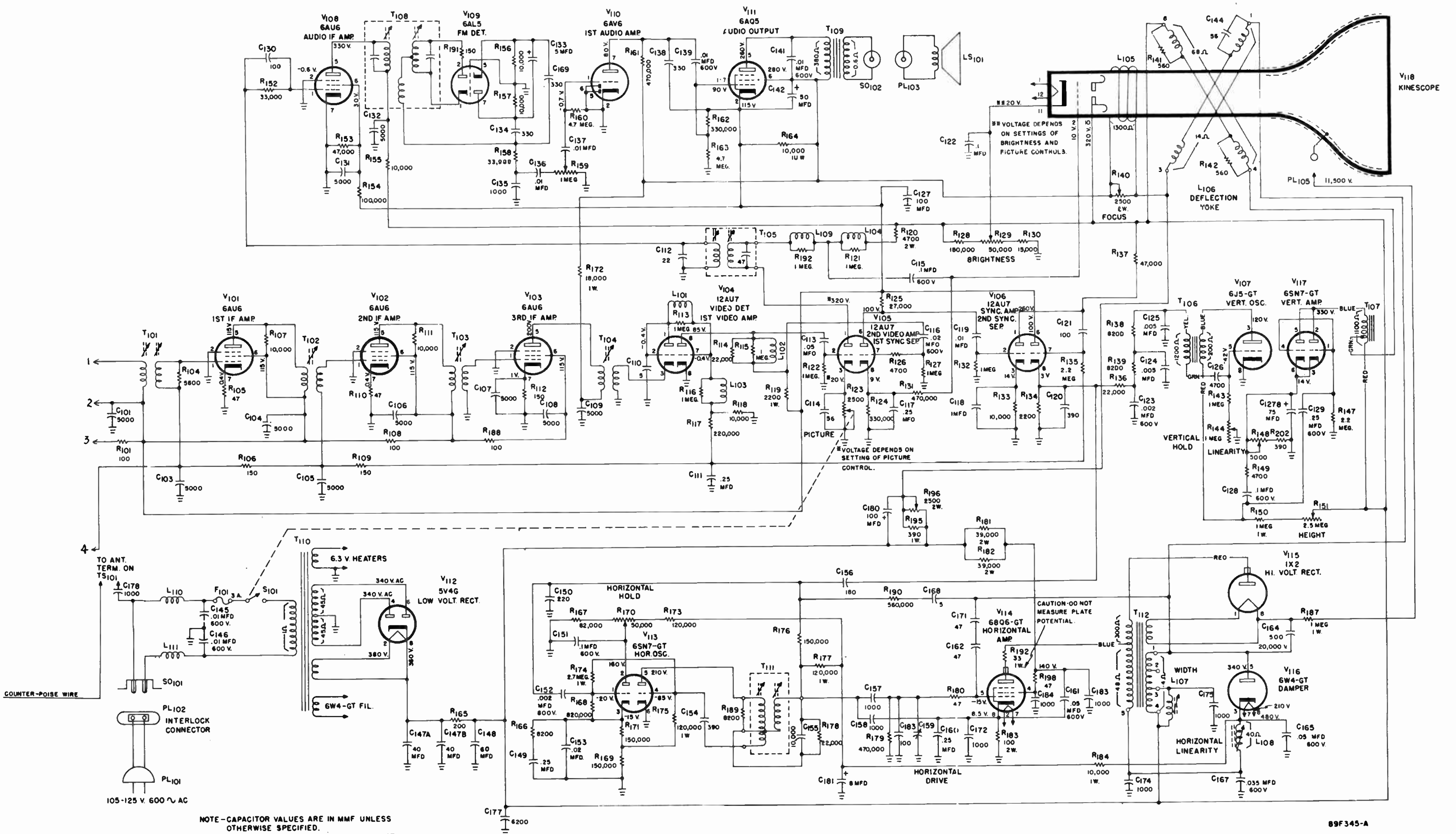

NOTE-CAPACITOR VALUES ARE IN MMF UNLESS OTHERWISE SPECIFIED.
RESISTOR VALUE ARE IN OHMS & 1/2 WATT RATING UNLESS OTHERWISE SPECIFIED.
ALL READINGS SHOWN ARE DC UNLESS OTHERWISE SPECIFIED.
ALL VOLTAGES ARE MEASURED BETWEEN TUBE SOCKET TERMINALS & CHASSIS WITH ZERO SIGNAL INPUT.
LINE VOLTAGE 117 V. AC.
VOLTAGES SHOWN WERE MEASURED WITH AN ELECTRONIC VOLTMETER.
CONTROLS SET FOR NORMAL PICTURE.

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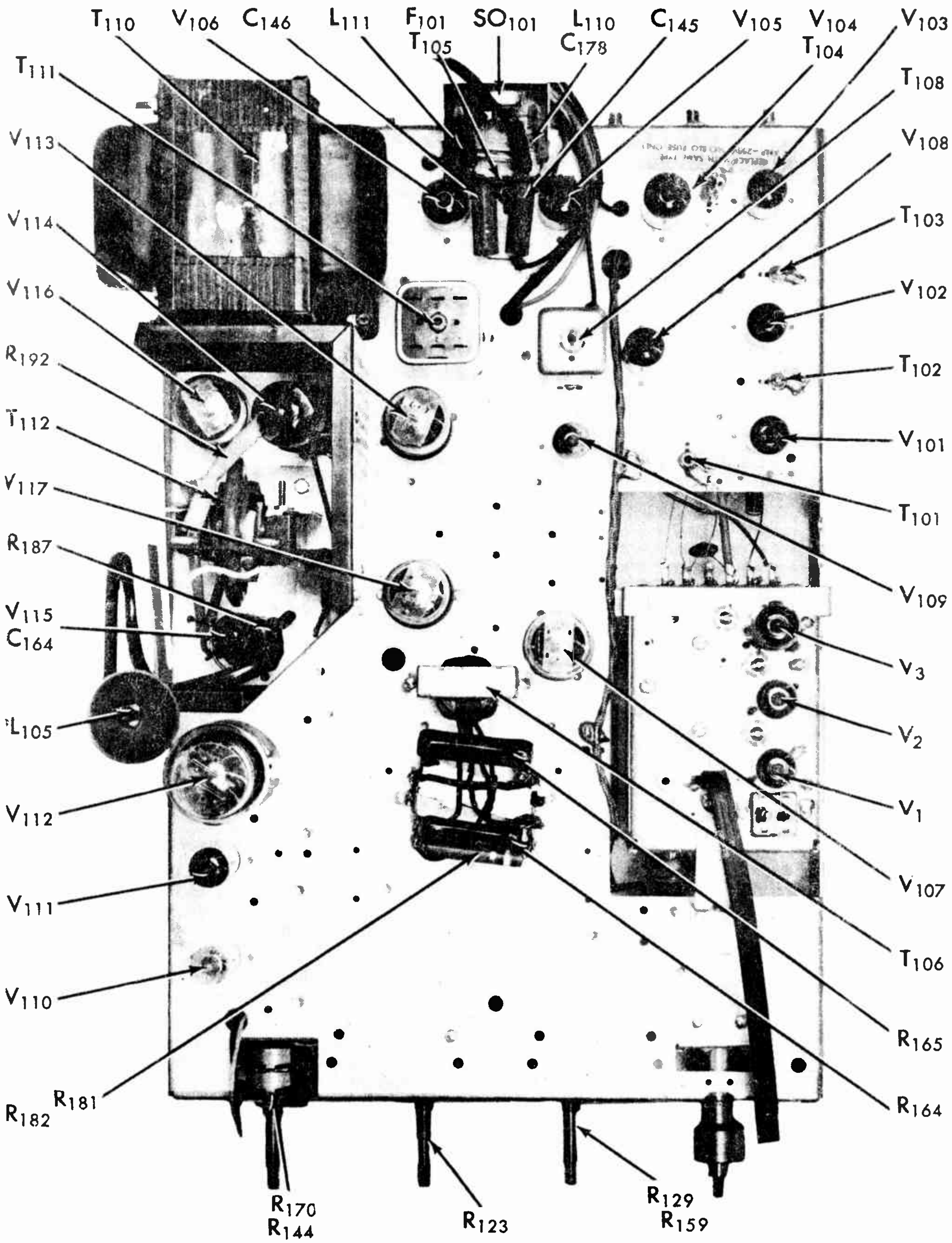

FIG. 15 - TOP VIEW - COMPONENT LOCATION 92X1036

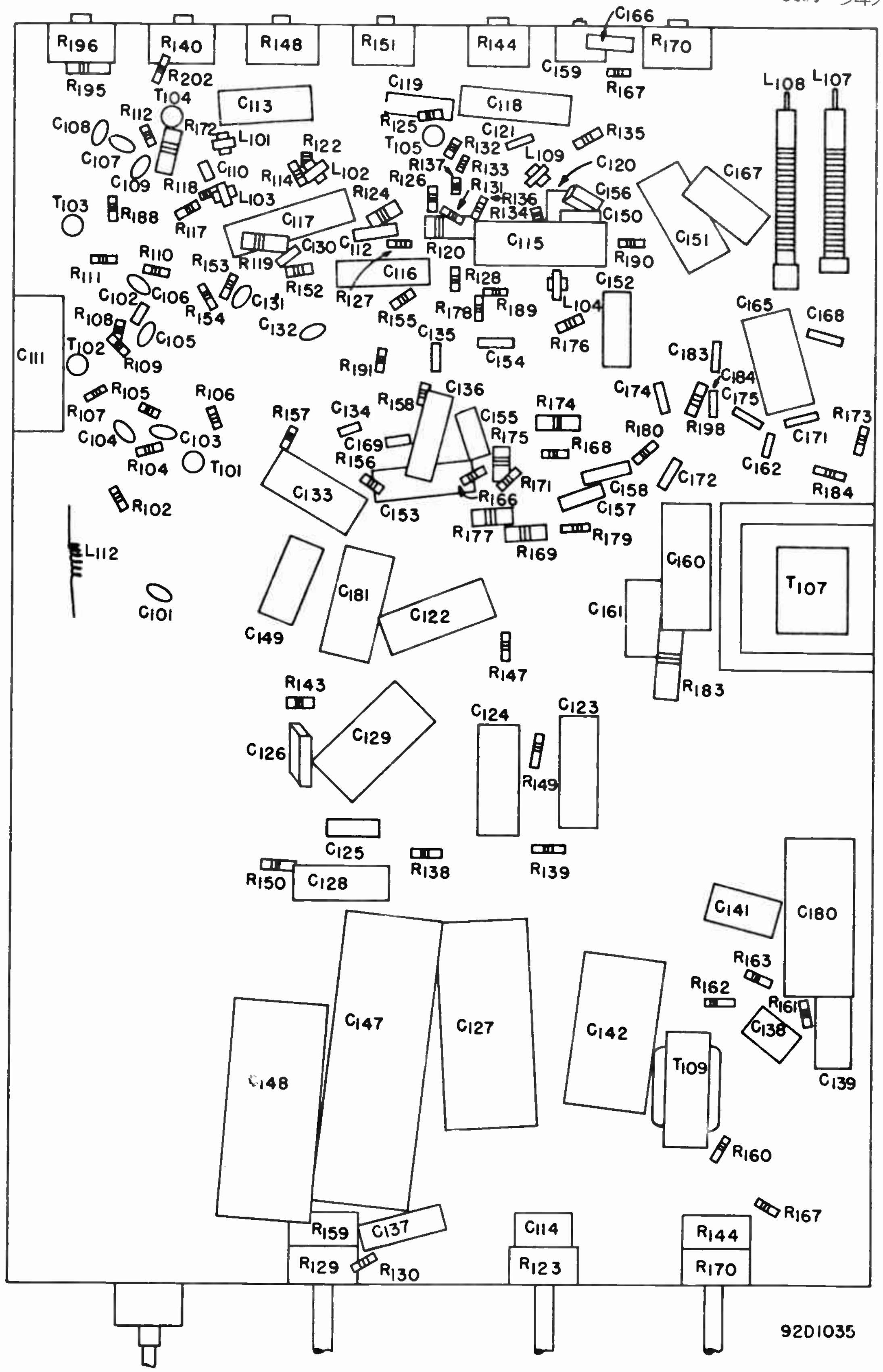

FIG. 16 - BOTTOM VIEW - COMPONENT LOCATION

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REPAIR PARTS LIST

SCHEMATIC LOCATION	PART NUMBER	DESCRIPTION
PL-105	M10A300-3	Anode Connector and Lead Ass'y.
C-123,152	M46AZ202J	Capacitor-.002 Mfd.600 V.
C-124,125	M46AU502J	Capacitor-.005 Mfd-200V.
C-119,136,137	M46AU103J	Capacitor-.01 Mfd-200 V.
C-139,141,146	M46AY103J	Capacitor-.01 Mfd-600 V.
C-153	M46AU203J	Capacitor-.02 Mfd-200 V.
C-116	M46AY203J	Capacitor-.02 Mfd-600 V.
C-167	M46AY353J	Capacitor-.035 Mfd-600 V.
C-113	M46AU503J	Capacitor-.05 Mfd-200 V.
C-161,165	M46AY503J	Capacitor-.05 Mfd-600 V.
C-118,122	M46AU104J	Capacitor-0.1 Mfd-200 V.
C-115,128,151	M46AY104J	Capacitor-0.1 Mfd-600 V.
C-111,117,149,160	M46AT254J	Capacitor-0.25 Mfd-200 V.
C-129	M46AX254J	Capacitor-0.25 Mfd-600 V.
*C-145,146	M46BR103L6	Capacitor-.01 Mfd-600 V.-Molded
C-102	M47A160-5	Capacitor-3.3 Mmfd-Ceramic
C-110,168	M47X20UJ050M	Capacitor-5 Mmfd-Ceramic
C-162,171	M47B20470K5	Capacitor-47 Mmfd-Ceramic
C-121,130	M47B20101K5	Capacitor-100 Mmfd-Ceramic
C-134,169	M47B20331K5	Capacitor-330 Mmfd-Ceramic
C-135	M47B20102M5	Capacitor-1,000 Mmfd-Ceramic
C-172,174,175,183, 184	M47B20A102M5	Capacitor-1,000 Mmfd-Ceramic
C-101,103,104,105, 106,107,108,109, 131,132	M47A168	Capacitor-5,000 Mmfd-Ceramic
C-164	47A216	Capacitor-500 Mmfd-20,000 V.-Standoff
C-112	M47X20A220K	Capacitor-22 Mmfd-Mica
C-114	M47X20A560M	Capacitor-56 Mmfd-Mica
*C-144	M47X15D560K	Capacitor-56 Mmfd-Mica
C-183	M47X20A101M	Capacitor-100 Mmfd-Mica
C-156	M47X20A181M	Capacitor-180 Mmfd-Mica
C-150	M47X20A221M	Capacitor-220 Mmfd-Mica
C-138	M47X20A331M	Capacitor-330 Mmfd-Mica
C-120,154	M47A20A391M	Capacitor-390 Mmfd-Mica
C-157,158,178	M47X20A102M	Capacitor-1000 Mmfd-Mica
C-126	M47X35A472M	Capacitor-4700 Mmfd-Mica
C-155	M47X35A103K	Capacitor-10,000 Mmfd-Mica
C-159	M44A361	Capacitor-Horizontal Drive-Adjustable
C-133	45A109	Capacitor-Electrolytic 5 Mfd-50 V.
C-181	M45A103	Capacitor-Electrolytic 8 Mfd-475 V.
C-147	M45A159	Capacitor-Electrolytic 40 Mfd-450 V. 40 Mfd-450 V.
C-142	M45B171	Capacitor-Electrolytic 50 Mfd-300 V.
C-127	M45B165	Capacitor-Electrolytic 50 Mfd-250 V. 75 Mfd-50 V.
C-148	M45B166	Capacitor-Electrolytic 60 Mfd-450 V.
C-180	M45B170	Capacitor-Electrolytic 100 Mfd-10 V.
L-110,111	M53B009	Choke-Cabinet antenna
L-112	M53A191	Choke-Heater
L-105	M51B1159	Coil-Focus
L-108	M51B1205	Coil-Horizontal Linearity Control
L-101,102,109	M51A1154	Coil-Video Peaking
L-103,104	M51A1155	Coil, Video Peaking
L-107	M51B1072-1	Coil, Width Control
L-106	M53B195	Coil-Yoke Deflection
R-146,196	M25B710	Control-Focus-Horizontal Centering
R-151	M25B711	Control-Height
R-170,144	M25B861	Control-Horizontal/Vertical
R-123	M25B790	Control-Off-On and Picture
R-148	M25B712	Control-Vertical Linearity
R-129,159	M25B874	Control-Volume-Brightness
PL-101	M87A1668	Cord-Line
F-101	M39A345	Fuse-Line
	M22D295	Glass-Safety
	M15A207	Knob-Brightness-Horizontal
	M15B223	Knob-Channel Selector
	M15C224	Knob-Indicator
	M15A205	Knob-Off-On and Picture
	M15C225	Knob-Range Selector
	M15B195	Knob-Volume-Vertical

SCHEMATIC LOCATION	PART NUMBER	DISCRIPTION
	M21A101	Magnet-Ion Trap
	M7A172	Mask-Escutcheon
	M10A287	Plug-Speaker (Includes SO-102)
R-105,110,180	M23X20X470K	Resistor-47 Ohms-1/2 watt.
R-102,108,188	M23X20X101K	Resistor-100 Ohms-1/2 watt.
R-106,109,112,191	M23X20X151K	Resistor-150 Ohms-1/2 watt.
R-141,142	M23X20X561K	Resistor-560 Ohms-1/2 watt.
R-134	M23X20X222K	Resistor-2200 Ohms-1/2 watt.
R-111	M23X20X332K	Resistor-3300 Ohms-1/2 watt
R-126,149	M23X20X472K	Resistor-4700 Ohms-1/2 watt
R-104	M23X20X562K	Resistor-5600 Ohms-1/2 watt
R-138,139,166,189	M23X20X822K	Resistor-8200 Ohms-1/2 watt
R-118,133,155	M23X20X103K	Resistor-10,000 Ohms-1/2 watt
*R-156,157	M23X20X103J	Resistor-10,000 Ohms-1/2 watt
R-114,130,136,178	M23X20X223K	Resistor-22,000 Ohms-1/2 watt
R-125	M23X20X273K	Resistor-27,000 Ohms-1/2 watt
R-107,152,158	M23X20X333K	Resistor-33,000 Ohms-1/2 watt
R-137,153	M23X20X473K	Resistor-47,000 Ohms-1/2 watt
R-167	M23X20X823K	Resistor-82,000 Ohms-1/2 watt
R-154	M23X20X104M	Resistor-100,000 Ohms-1/2 watt
R-173	M23X20X124M	Resistor-120,000 Ohms-1/2 watt
R-176	M23X20X154M	Resistor-150,000 Ohms-1/2 watt
R-128	M23X20X184M	Resistor-180,000 Ohms-1/2 watt
R-117	M23X20X224K	Resistor-220,000 Ohms-1/2 watt
R-124,162	M23X20X334K	Resistor-330,000 Ohms-1/2 watt
R-131,161,179	M23X20X474M	Resistor-470,000 Ohms-1/2 watt
R-190	M23X20X564K	Resistor-560,000 Ohms-1/2 watt
R-168	M23X20X824M	Resistor-820,000 Ohms-1/2 watt
R-122,127,132,143	M23X20X105K	Resistor-1 Megohm-1/2 watt
R-135,147	M23X20X225M	Resistor-2.2 Megohm-1/2 watt
R-160,163	M23X20X475J	Resistor-4.7 Megohm-1/2 watt
R-192	M23X30X330K	Resistor-33 Ohms-1 watt
R-195,202	M23X30X391K	Resistor-390 Ohms-1 watt
R-119	M23X30X222M	Resistor-2200 Ohms-1 watt
R-184	M23X30X103K	Resistor-10,000 Ohms-1 watt
R-172	M23X30X183K	Resistor-18,000 Ohms-1 watt
*R-175,177	M23X30BF124J	Resistor-120,000 Ohms-1 watt
*R-169,171	M23X30BF154K	Resistor-150,000 Ohms-1 watt
*R-150	M23X30BF105K	Resistor-1 Megohm-1 watt
R-187	M23X30X105M	Resistor-1 Megohm-1 watt
*R-174	M23X30BF275K	Resistor-2.7 Megohm-1 watt.
R-183	M23X40X101K	Resistor-100 Ohms-2 watts
R-120	M23X40X472K	Resistor-4700 Ohms-2 watts
R-181,182	M23X40X393K	Resistor-39,000 Ohms - 2 watts
R-164	M24BG103E	Resistor-10,000 Ohms-10 watts Wirewound
R-165	M24BH201E	Resistor-200 Ohms-20 watts Wirewound
	M6A348	Socket-Picture Tube
SO-101	M10A286	Socket-2 Prong AC
	M6A340	Socket-Tube-7 Prong-Miniature-Wafer
	M6A343	Socket-Tube-9 Prong-Miniature-Molded
	M6B334	Socket-Tube-9 Prong-Miniature-Wafer
	M6B296	Socket-Tube-8 Prong-Octal-Molded
	M6A339	Socket-Tube-8 Prong-Octal-Wafer
TS-101	M88A381	Strip-Antenna
LS-101	M85C101	Speaker Assembly
	M75A170	Spring-Focus Coil Mtg.
	M76B558	Strap-Picture Tube Mtg.
	M16C163	Strap-Dust Seal
	M51B1179	Transformer-Antenna Matching
T-109	M55C134	Transformer-Audio Output
T-111	M51B1153	Transformer-Horizontal Oscillator
T-112	M55C144	Transformer-Horizontal Output
T-101	M50B458	Transformer-1st IF Amplifier
T-102,103,104	M50A431	Transformer-IF Amplifier
T-110	M52C196	Transformer-60 Cycles-Power
T-108	M50B406	Transformer-Sound Disc.
T-105	M50A432	Transformer-4.5 MC Trap
T-106	M55B115	Transformer-Vertical Oscillator
T-107	M55A128	Transformer-Vertical Output
	M1C945	Tuning Unit Ass'y. Complete

*Use exact replacement part only.

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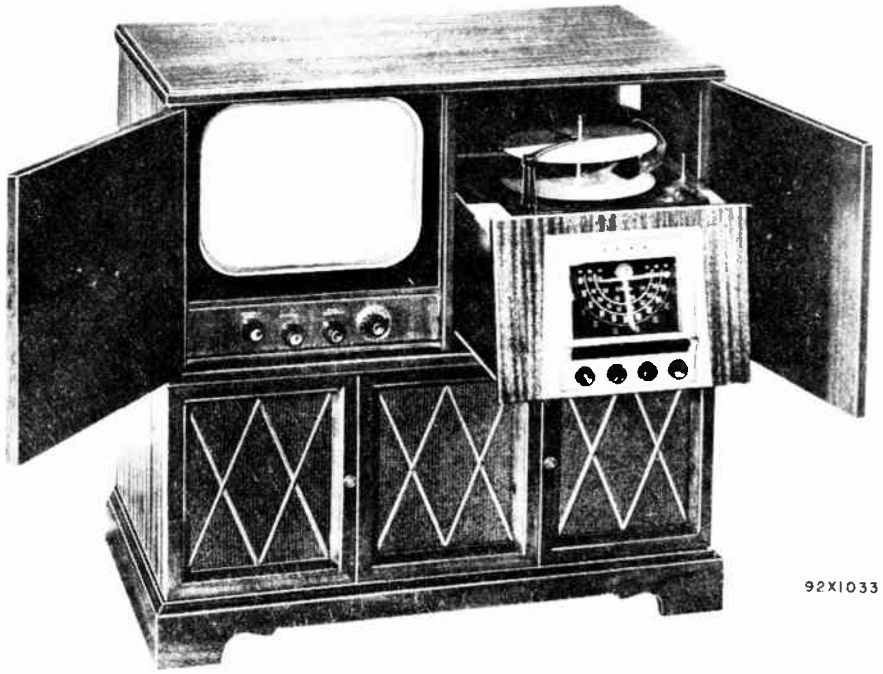


92X1033

SPECIFICATIONS

POWER SUPPLY

All models operate from a 105-125 volts 60 cycle AC source unless otherwise specified. Power consumption 200 watts.

FREQUENCY RANGE

For chassis 549.100-3 refer to 57 RL 546 Supplement 4. For cnassis 101.831-1 refer to 57 RL 474.

ANTENNA EQUIPMENT

The antenna connections for the television receiver chassis and the AM/FM receiver chassis are brought out to separate terminal boards. For details on the television chassis antenna terminal board arrangement refer to 57 RL 546 Supplement 4.

The cabinet antenna system for the AM/FM receiver unit consists of a loop for the broadcast band and a folded-doublet type antenna mounted on the rear of the cabinet for shortwave and FM band reception. The receiver is shipped with the doublet antenna connected to terminals "D-D" on the antenna terminal board. When installing the receiver, it may be necessary to rotate the loop slightly to avoid the customary null effects on the broadcast band produced by loop type receivers.

In areas where an outdoor antenna is required for broadcast reception, connect a length of wire to terminal "A" and if desired a ground wire to terminal "G". If an outdoor FM antenna is required, disconnect the FM cabinet antenna leads from terminals "D-D" and connect the outdoor FM antenna lead-in wires to these terminals.

TUBES

For chassis 549.100-1 refer to 57 RL 546 Supplement 4. Note that the rectifier has been replaced by a 5U4G.

For chassis 101.831-1 refer to 57 RL 474. Note that the rectifier tube 5U4G listed in 57 RL 474 has been replaced with a type 5V4G because of space limitations. (No socket wiring changes required.)

SERVICE INFORMATION

The following section covers differences in service data existing between the 549.100-2 and 549.100-3 television receiver chassis. Hence service information not mentioned below is given in 57 RL 546 Supplement 4 which was written for the 549.100-2 chassis.

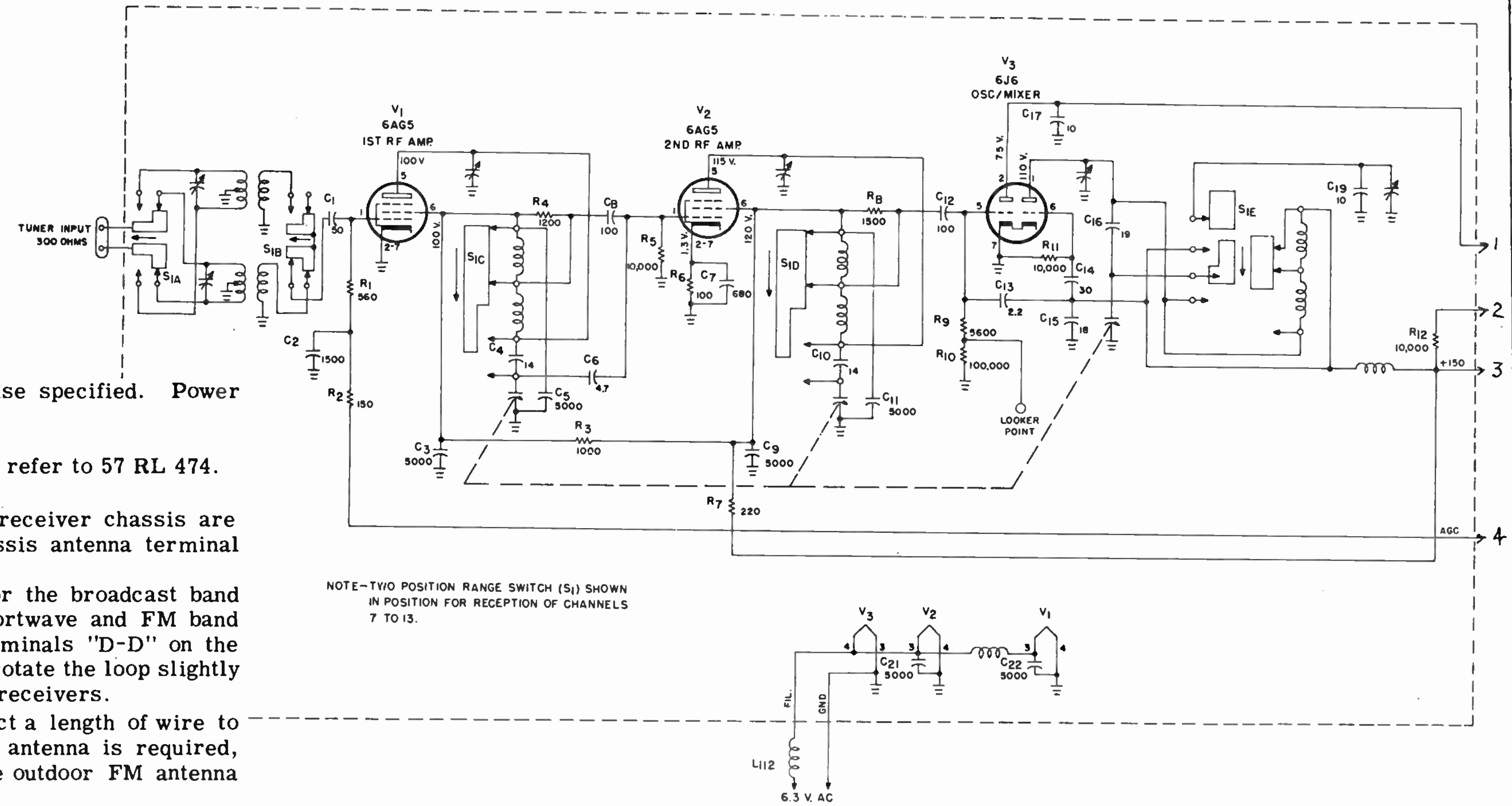
ALIGNMENT

If alignment of the television receiver 549.100-3 follows the procedure given in 57 RL 546 Supplement 4 except that the 2nd IF amplifier stage input transformer (T-102) should be aligned at 23.4 Mc and not 23.6 Mc.

After the sound and video alignment have been completed, it will be necessary to adjust L-113 (Top side of chassis) located electrically in the output of V-101, the 1st IF amplifier. Connect the electronic voltmeter across resistor R-118 and couple the high side of the signal generator to the MIXER tube (V-3) in the same manner as for IF amplifier alignment. With the signal generator set at 21.75 adjust L-113 for minimum voltage at R-118. It may be necessary to retune T-102 because of its interaction with L-113. Alternate "touching up" of both L-113 and T-102 will bring them into correct adjustment.

TUBE REPLACEMENT

A 5U4G has been substituted for a 5V4G as the low voltage rectifier to allow for increased B plus voltage. The socket has been mounted below chassis level to allow ample clearance for the top of the tube. The tube may still be replaced without removing the chassis from the cabinet.



FOR IF AMPLIFIER ALIGNMENT CONNECT THE HIGH SIDE OF THE SIGNAL GENERATOR TO THE OSC/MIXER TUBE (V-3) BY REMOVING ITS SHIELD & SLIPPING A TIGHT FITTING TUBE SHIELD OVER THE BULB OF TUBE & CONNECTING THE GENERATOR TO IT. USE ENOUGH SIGNAL GENERATOR OUTPUT TO OBTAIN APPROX 2 VOLTS AT THE VOLTMETER, WHICH IS CONNECTED ACROSS R-118. L-113 IS ADJUSTED FOR MINIMUM VOLTAGE AS OBSERVED ON VOLTMETER, ALL OTHER IF AMPLIFIER ADJUSTMENTS ARE ADJUSTED FOR MAX. VOLTAGE.

LAST R SYMBOL R-208
LAST C SYMBOL C-188
LAST L SYMBOL L-113
LAST T SYMBOL T-112

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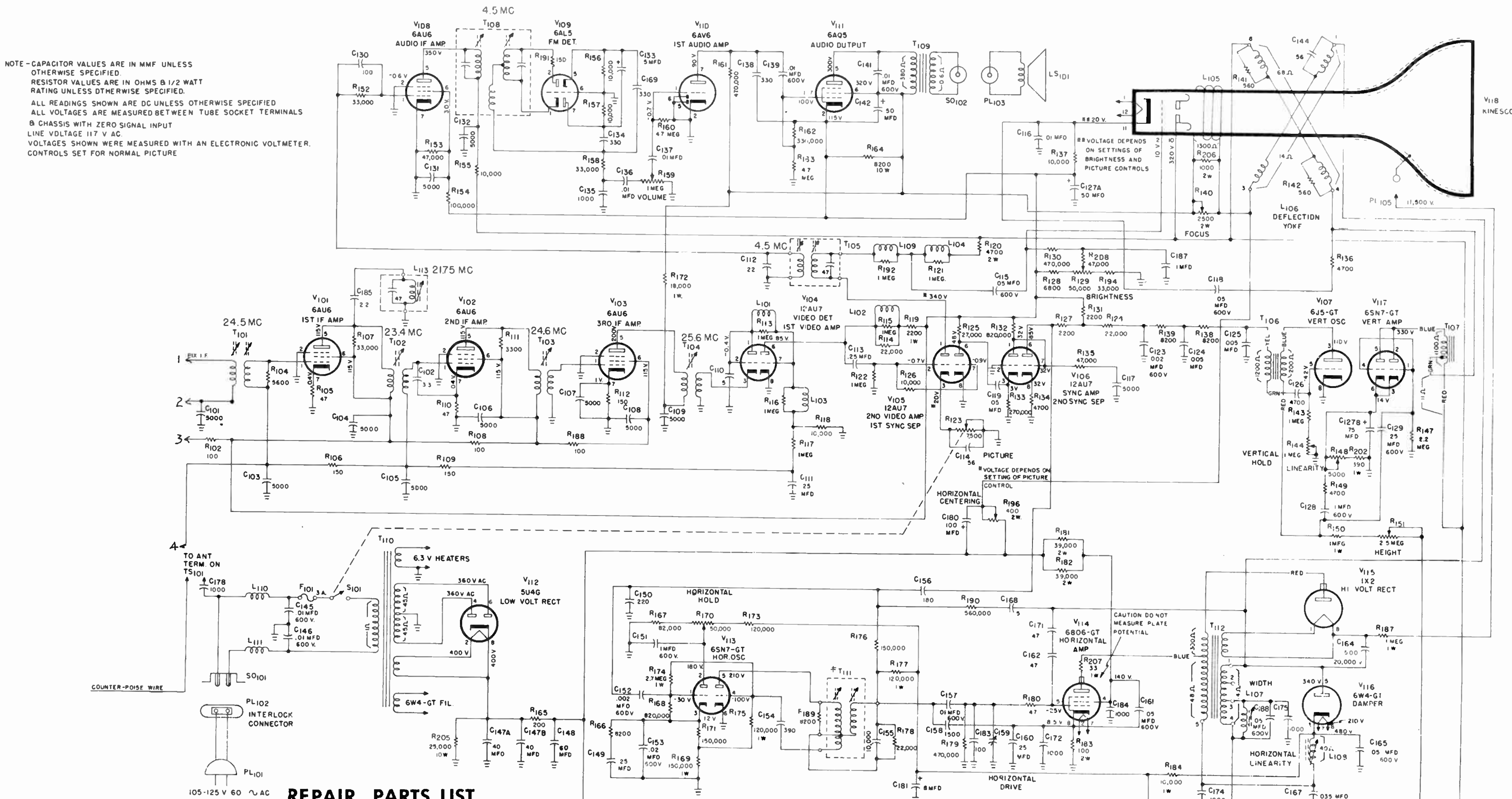

REPAIR PARTS LIST

Listed below are the cabinet and chassis parts that are different from those shown in 57 RL 546 Supplement 4. Except for parts listed below refer to the RL's covering the chassis 549.100-2

SCHEMATIC LOCATION	PART NUMBER	DESCRIPTION
C-185	M47A160-4	Capacitor- 2.2 Mmfd-Ceramic
C-135,172,174, 175,184,186	M47B20102M5	Capacitor- 1000 Mmfd-Ceramic
L-108	M51B1232	Coil-Horizontal Linearity Control
L-113	M51B1231	Coil-21.75 MC Trap
R-144,170	M25B861	Control-Vertical-Horizontal
R-123	M25B791	Control-Off-On and Picture
	M87A1626	Cord-Power Connector for AM/FM Receiver
	M7D153	Escutcheon-AM/FM Receiver
	M7D171	Escutcheon-Picture Tube
	M22D293	Glass - Safety
	M15B222	Knob -AM/FM Receiver
	M57-143	Loop - Antenna
	M10A302	Plug (4 Prong)-AM/FM Receiver Connector
*R-150	M23X30BF824K	Resistor-820,000 ohms - 1 watt
R-206	M23X40X102K	Resistor-1000 ohms - 2 watts
R-164	M24BG822E	Resistor-8200 ohms-10 watts-Wirewound
R-205	M24BG253E	Resistor-25,000-10 watts-Wirewound
	56-877	Crystal Cartridge-Phono Pick up (includes needle).
	56-879	Tone Arm (Phono)
	56-828	Tone Arm Support (Phono)

* Use exact replaceable part only

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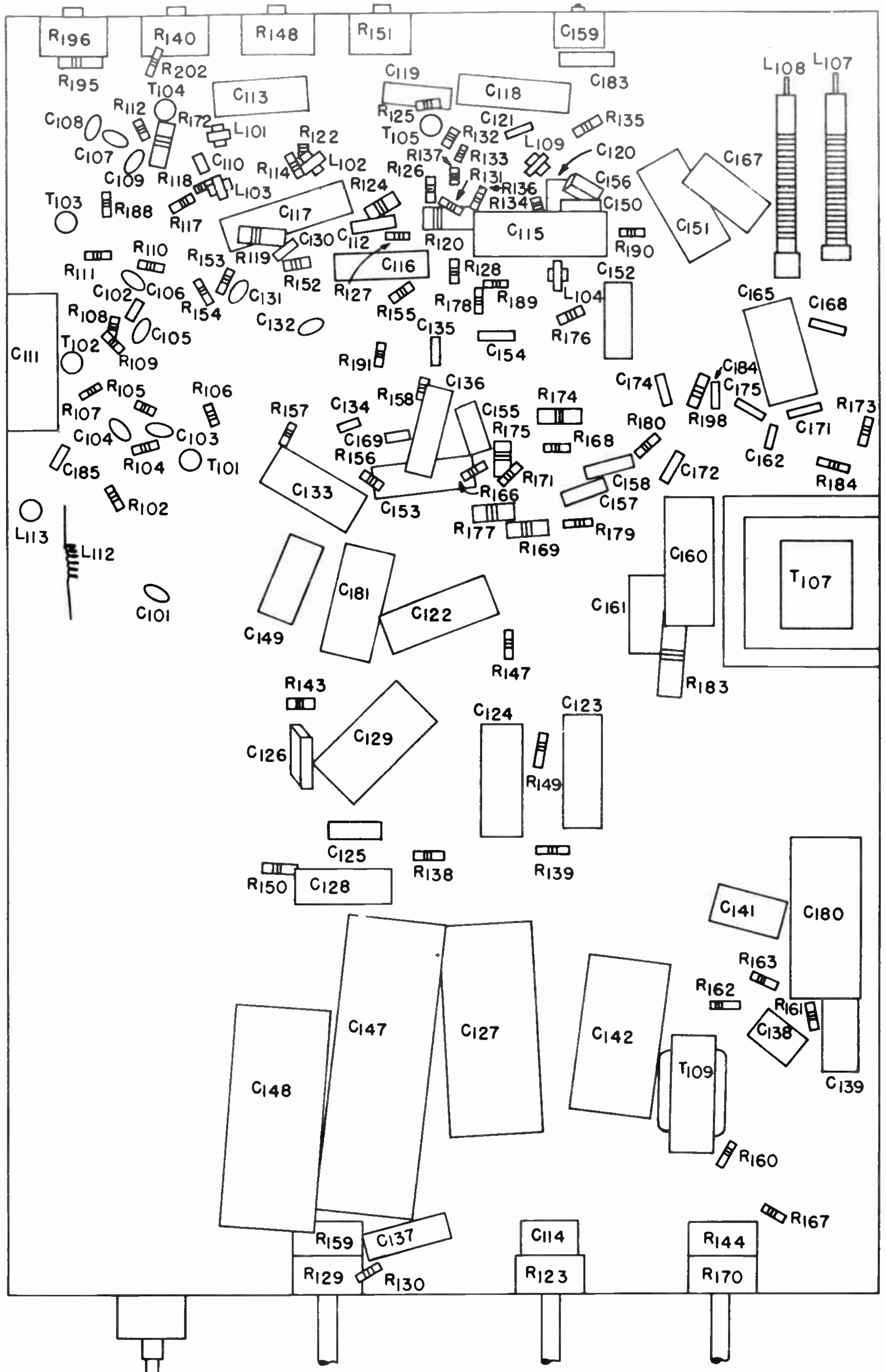
MODEL 138,
Ch. 549.100-3



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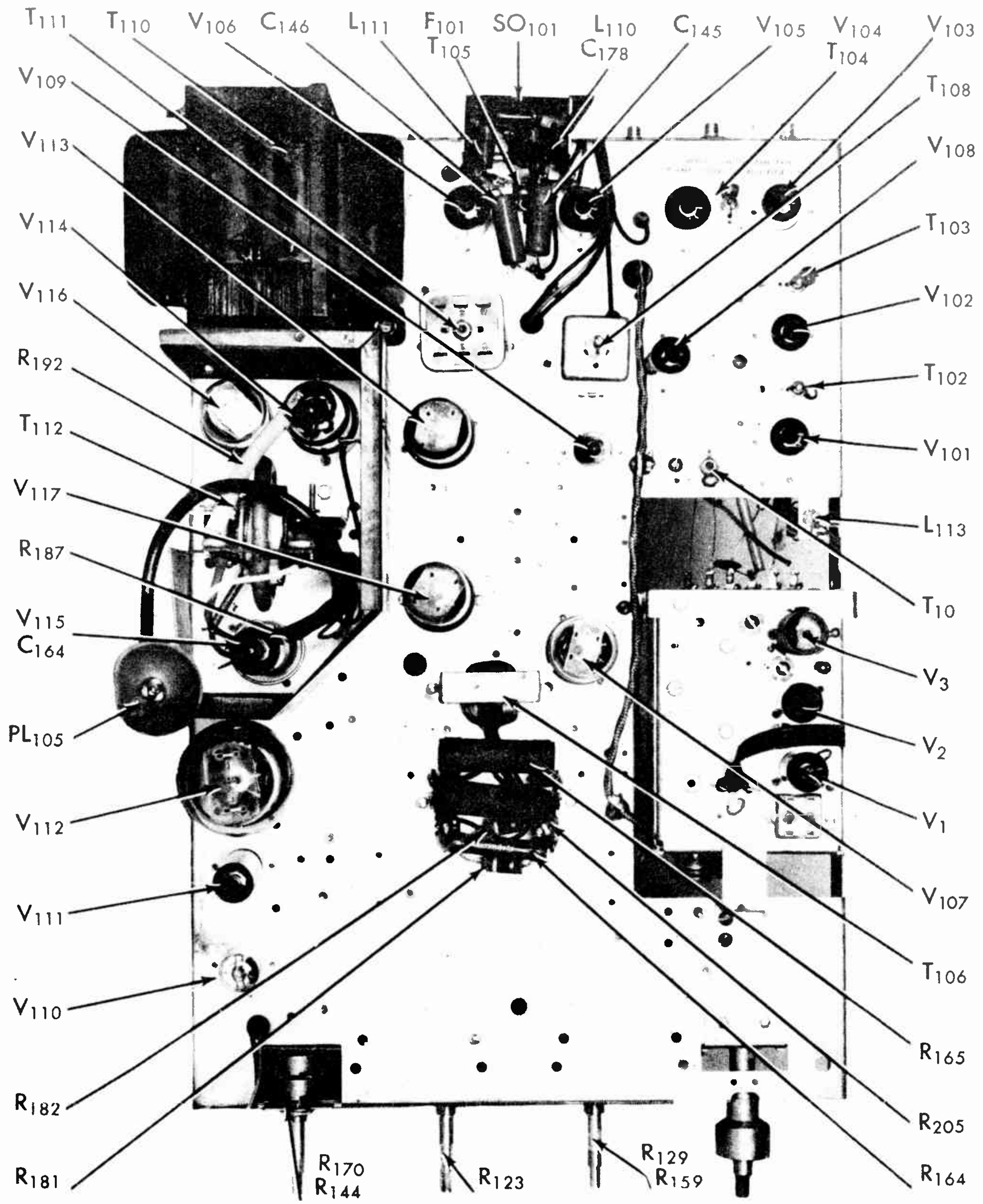

92X1036-A

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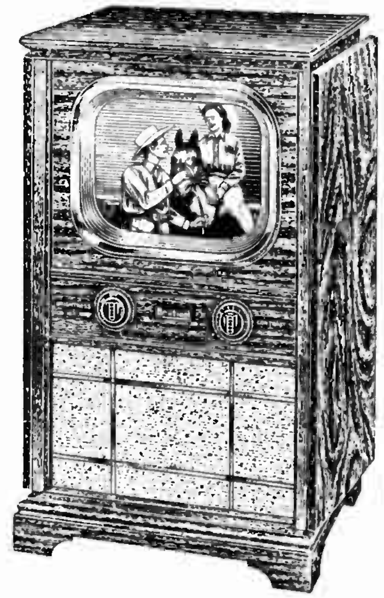
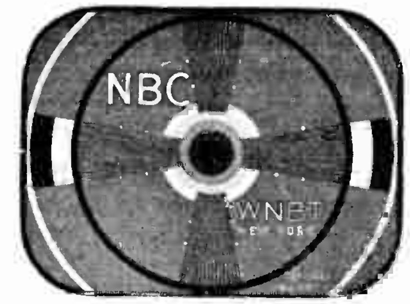
THE PHOTO BELOW IDENTIFIES THE CONTROLS ON FRONT OF CABINET AND SHOWS THE FUNCTION OF EACH CONTROL.

The "Contrast" and "Brightness" controls may be adjusted at any time there is picture or test pattern on the air. Because it is easier to adjust the controls with a test pattern picture, television stations usually telecast a pattern before the beginning of and sometimes between, the regularly scheduled programs. The test pattern, used below to illustrate "Correct Pattern," "Too Light Pattern" and "Too Much Con ·t Pattern" is one telecast by a station for this purpose. Wh· ne type of pattern will vary in design and appearance with st. .ons, its purpose is the same — to permit the television owner to adjust the controls before the start of the regular program.



CORRECTLY ADJUSTED PICTURE AND PATTERN: Note that when the receiver is correctly adjusted, the pattern is clear and steady and in the center of the screen with five distinct shades— black, dark gray, medium gray, light gray and white.



When picture is TOO LIGHT and/or has retrace lines, adjust BRIGHTNESS CONTROL. A slight readjustment of the Contrast Control may also be necessary.

NOTE: When the control is turned to the right, the picture will balloon, that is, become larger.

If picture has TOO MUCH CONTRAST as shown, adjust CONTRAST CONTROL to show less contrast. A slight readjustment of the Brightness Control may also be necessary.

CAUTION: If the control is turned too far to the right, picture may become distorted and/or a buzzing sound may be heard. Always adjust below this point.

BRIGHTNESS

CONTRAST

CHANNEL SELECTOR

"OFF-ON-VOLUME"

"OFF-ON-VOLUME" control knob: To turn receiver on, turn knob clockwise. To turn receiver off, turn knob to left until click is heard. Use this knob to adjust volume to desired level.

TURN CHANNEL SELECTOR KNOB to desired channel.

ELECTRICAL SPECIFICATIONS

POWER SUPPLY	110 to 120 Volt, 60 Cycle A.C.	Channels 2-13, inclusive
	225 Watts	3.2 Ohm at 400 Cycles
I.F. CIRCUIT	Inter-Carrier Sound	Undistorted 2.2 Watts
R.F. STAGE	One	Maximum 4.0 Watts
I.F. STAGES	Three "Combined Picture and Sound" and one "Sound"	300 Ohms Balanced
		TUNING RANGE
I.F. FREQ.	21.0 M.C. Sound Carrier	VOICE COIL IMPEDANCE
	25.5 M.C. Video Carrier	POWER OUTPUT
	4.5 M.C. Inter-Carrier Sound	
		ANTENNA INPUT

TUBE COMPLEMENT

1—6CB6 OR 6BC5 OR 6AG5	R.F. Amplifier Tube	1—6AL5	Video Detector Tube	1—6SN7GT	Horizontal Oscillator Tube
		1—6CB6	Video Amplifier Tube	1—6BQ6GT	Horizontal Output Tube
		1—6AU6	Sound I.F. Amplifier Tube	1—1X2A	H.V. Rectifier Tube
1—6CB6 OR 6BC5 OR 6AG5	Modulator Tube	1—6T8	Sound Detector and Audio Amplifier Tube	1—6W4GT	Damper Rectifier Tube
				1—6K6GT	Vertical Oscillator Tube
		1—6K6GT	Audio Output Tube	1—6S4 OR 6K6GT	Vertical Amplifier Tube
1—6C4	Oscillator Tube	1—12AU7	Sync Separator, D.C. Restorer and Phase Splitter Tube	1—5U4G	Power Rectifier Tube
3—6AG5	Video I.F. Amplifier Tube	1—6AL5	Phase Detector Tube	1—16RP4 OR 16KP4	Picture Tube

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SUBJECT: ELIMINATING SEMI-CIRCULAR SHADOW AROUND CORNER OF PATTERN

REASON: Metal ring inside Focus Magnet shifting position during shipment.

REMEDY: 1. Adjust the HEX STUD, located to the left of the focus adjustment screw, with a circular motion until semi-circular shadow is eliminated.

NOTE: The HEX STUD should be adjusted with a brass, copper, or a non-magnetic tool.

2. Adjust ION TRAP for maximum brightness.

CAUTION! DO NOT USE ION TRAP TO ELIMINATE SEMI-CIRCULAR SHADOW AROUND CORNER OF PATTERN, IF BY SO DOING THE INTENSITY OF THE RASTER IS DECREASED.

If necessary, after completing the above procedures, re-center picture withh the centering controls on the back of the chassis. DO NOT USE THE HORIZONTAL HOLD CONTROL TO CENTER PICTURE.

SUBJECT: FOLD OVER ON LEFT HAND SIDE OF PICTURE - SHOWING UP AS EITHER A WHITE POINTING TOWARDS THE CENTER OF THE PICTURE OR A FAINT MILKY-WHITE AREA EXTENDING BETWEEN THE LEFT HAND EDGE AND CENTER OF THE PICTURE.

REASON: Horizontal hold control out of adjustment. The extent of the area covered by fold-over depends upon the setting of the Horizontal Hold Control.

REMEDY: 1. Turn the Horizontal Centering Control until the left hand edge of the picture becomes visible.

2. Adjust the HORIZONTAL HOLD CONTROL TO THE POINT WHERE the fold-over just disappears. If the extreme top of the picture starts bending or jitter is noticed then adjust HORIZONTAL HOLD CONTROL for minimum fold-over with acceptable stability. To find this setting it may be necessary to readjust the HORIZONTAL LOCK CONTROL.

3. Center picture with HORIZONTAL CENTERING CONTROL-DO NOT AT ANY TIME USE THE HORIZONTAL HOLD CONTROL TO CENTER PICTURE.

DON'T DISTURB THE REAR PANEL CONTROLS UNNECESSARILY—IF THE PICTURE IS GOOD LEAVE THEM ALONE.

REAR PANEL CONTROL ADJUSTMENTS

Normally, after the receiver has been properly installed, only the front panel controls need be adjusted by the owner.

ONLY when the picture is too high or too low or too far to the right or left on the screen, or does not stay locked in the center of the screen, or is egg-shaped or very fuzzy, will it be necessary to adjust one of the rear controls.

If you experience a poor quality television picture, do not immediately assume that the difficulty is in your receiver. The cause may be due to temporary station transmitter difficulties.

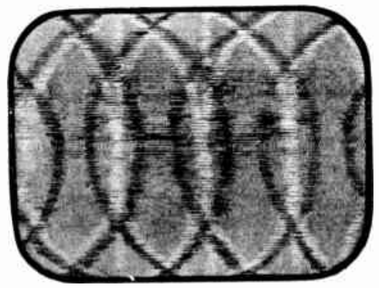
If a poor picture is noticed when a motion picture is being telecast, the difficulty may be due to the quality of the film being used by the station. Turn the "Channel Selector" knob to a different television station or wait until the end of the movie program. If there is no noticeable improvement in the picture, then adjustment of one or more of the controls on the back of the cabinet may be necessary.

Before adjusting any of the rear controls, study the picture you are receiving and compare it with one of the illustrative patterns having similar characteristics. If you find one similar to the picture you are receiving, ADJUST ONLY THE CONTROL INDICATED AS THE ONE TO BE USED to correct that particular type of mis-adjustment.

By placing a mirror in front of the cabinet it is possible to adjust the required control and still look at the screen while making the adjustment. Turn the proper control slowly to the right or left until the picture is centered on the screen, stops rolling, becomes clear, etc.

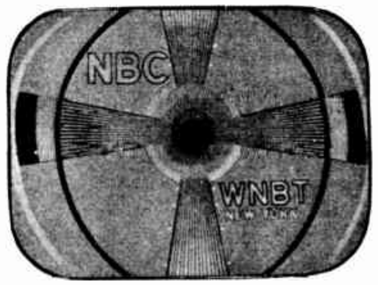
IMPORTANT: Interference caused by electrical equipment, flashing signs, auto ignition systems, electric razors and medical short-wave diathermy machines may cause white streaks or herringbone bands across the picture. Aircraft in the immediate vicinity can cause fluctuation in sound volume and picture brightness. Double images on the screen can be caused by reflections from buildings, mountains. etc. **NONE OF THESE DISTURBANCES CAN BE ELIMINATED BY ADJUSTMENT OF THE FRONT OR REAR CONTROLS.** Illustrations of these types of disturbances are shown in "Interference Patterns"

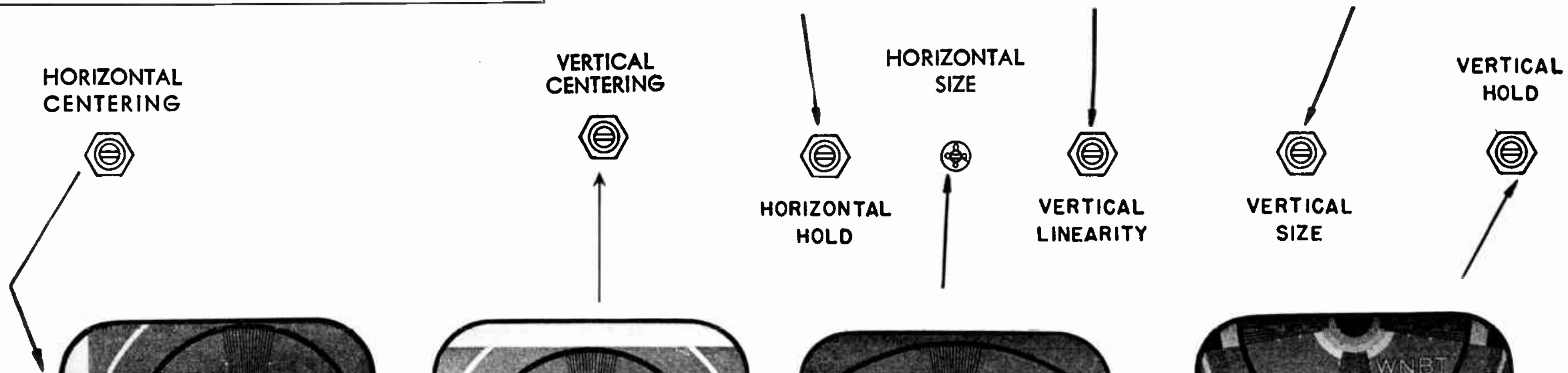
IF PATTERN continuously breaks up in horizontal direction (LEFT TO RIGHT) ACROSS SCREEN, adjust HORIZONTAL HOLD CONTROL to bring pattern to stationary position on screen.

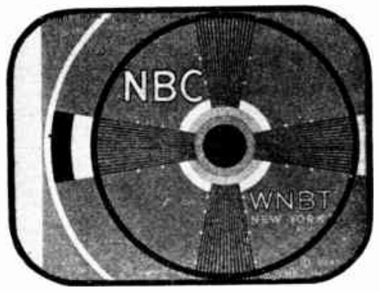


IF PATTERN is egg-shaped in vertical direction (flat on top), adjust VERTICAL LINEARITY CONTROL to make pattern round.
NOTE: If, after this adjustment, circle is round but is too small or too large, a slight adjustment of the VERTICAL SIZE will be necessary to make circle fit on screen properly.

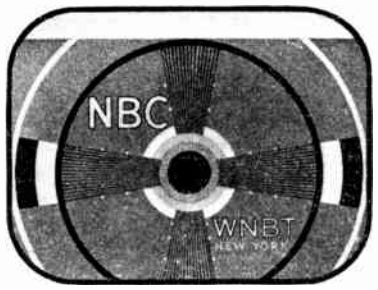
IF PATTERN extends over top and bottom of screen (too large) or is too small, in a vertical direction, adjust VERTICAL SIZE to make circle fit on screen.
NOTE: If, after this adjustment, circle is not uniformly round, a slight adjustment of the VERTICAL LINEARITY CONTROL may be necessary.





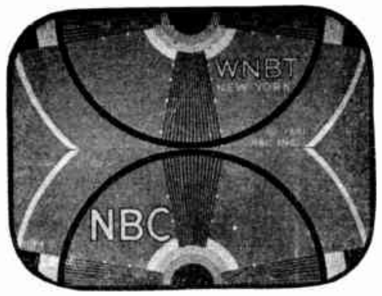


IF PATTERN IS TOO FAR TO THE RIGHT OR LEFT ON SCREEN, adjust HORIZONTAL CENTERING CONTROL to move pattern either right or left.



IF PATTERN IS TOO HIGH OR TOO LOW ON SCREEN, adjust VERTICAL CENTERING CONTROL to move pattern either up or down.

IF PATTERN extends over the right and left edge of the screen, adjust HORIZONTAL SIZE CONTROL to make circle fit on screen.



IF PATTERN continuously rolls across screen in vertical direction (up or down) ADJUST VERTICAL HOLD CONTROL so that pattern stops rolling and remains stationary on screen.

NOTE: IF PATTERN IS FUZZY, insert a screwdriver (non-magnetic preferably) into the hole in the cap on the cabinet back and adjust FOCUS CONTROL SCREW for sharpest definition.

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SERVICE NOTES

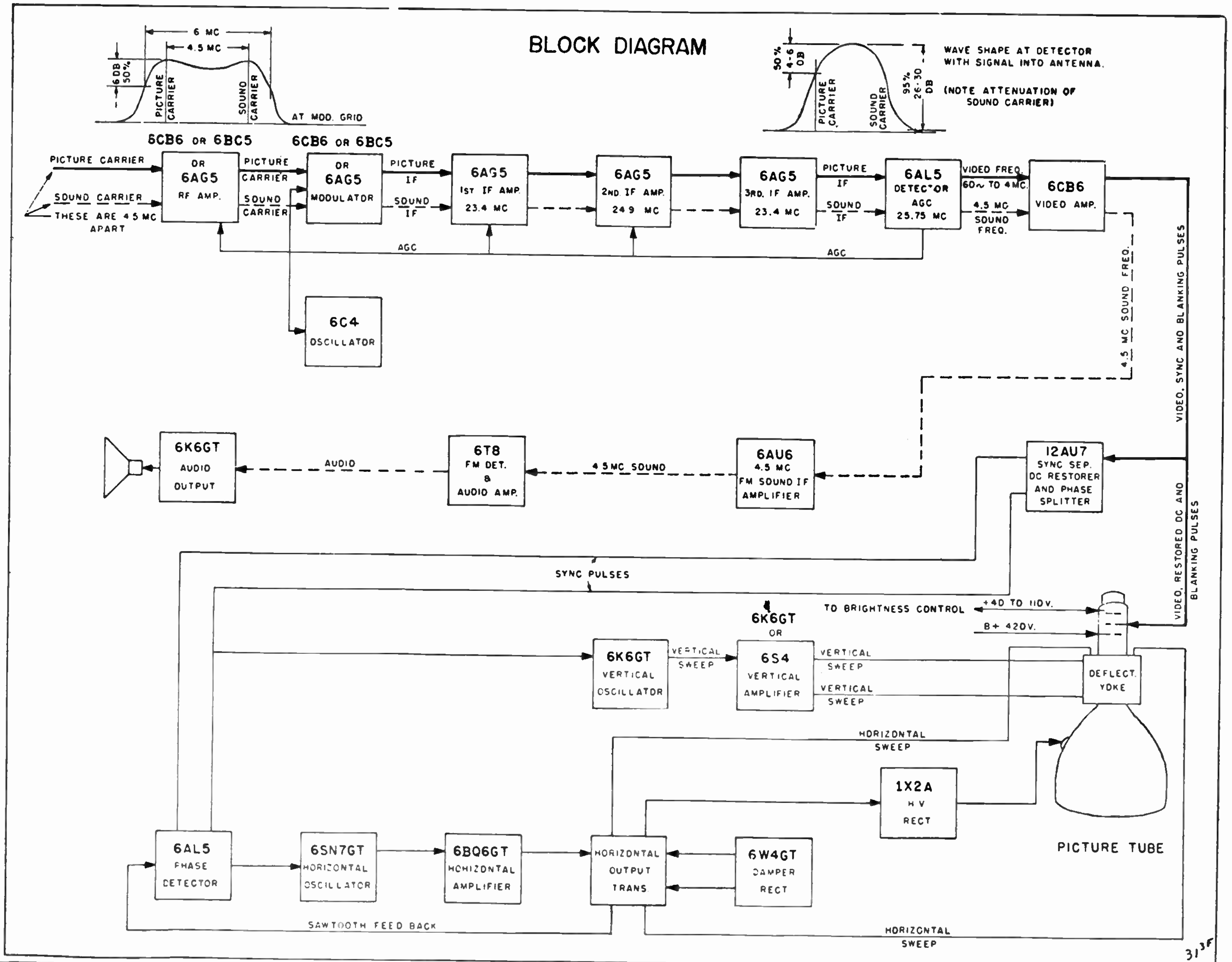
HIGH VOLTAGE WARNING

This television receiver contains high voltages which are dangerous to life or may result in serious burns. Never operate or service the receiver outside of the cabinet or with the high voltage shield cover removed until all the safety precautions necessary for working with high voltage equipment have been observed.

PICTURE TUBE

HANDLING PRECAUTION

Shatterproof goggles and heavy gloves must be worn by individuals while handling or installing the picture tube into the receiver. The picture tube encloses a high vacuum and is subjected to excessive air pressure. HANDLE WITH EXTREME CARE—do not strike or scratch the tube nor subject it to more than moderate pressure when inserting into or removing from its socket. Breakage and the resulting implosion may result in damage to property or injury to an individual.



CHECKING CHANNEL ADJUSTMENTS

WHILE EACH RECEIVER IS CORRECTLY ALIGNED AT THE FACTORY, ROUGH HANDLING in transit, ageing, drift, etc., MAY THROW THE RECEIVER OFF, so we suggest that the proper oscillator trimmers and the discriminator secondary adjustment—be checked for correct adjustment with a transmitted television station pattern, in the customer's home at the time of installation. Be sure to have the set operating for one-half to one hour before making these adjustment checks.

TO CHECK OSCILLATOR TRIMMER ADJUSTMENTS:

(A) Remove the Channel Switch Knob and Contrast Control Knob. This will expose the Oscillator Trimmer adjustment screws located around the Channel Selector Switch Shaft.

The channel number is marked alongside of each Oscillator Trimmer adjustment screw.

The extra adjustment screw located above the Channel 13 adjustment screw is to be used only in case there is not enough range to any oscillator adjustment screw in the Channel 7 to 13 range. If this screw is touched, then all channels from 7 to 13 will have to be re-**checked.**

(B) Turn receiver Channel Selector Switch to channel on which TV station is transmitting its modulated test pattern and adjust "Contrast" and "Brightness" control for best definition of pattern. IMPORTANT—There are 14 positions on the Channel Selector Switch. The MAXIMUM RIGHT and LEFT positions are NOT USED.

(C) Turn proper Oscillator Trimmer adjustment Screw clockwise until sound appears on pattern—indicated by bars across pattern and/or the lower vertical lines in pattern becoming wavy—then turn SAME Oscillator Trimmer adjustment screw counter-clockwise just to the point where the sound bars and/or wavy lines in pattern disappear.

IF STATION BUZZ is excessive and is NOT DUE to "Contrast" control being too far advanced in clockwise direction, adjust Discriminator Secondary adjustment screw for MINIMUM buzz. MAKE SURE THAT THIS POSITION IS BETWEEN the two MAXIMUM buzz peaks that will be noticed when adjusting screw is turned to the right and left of the MINIMUM buzz position. This screw is located on top of the **Discriminator** Coil Shield Can which is mounted between 6T8 Sound Detector tube and 6AU6 Sound I.F. Amplifier tube.

RADIO FREQUENCY RANGES

Channel Number	Channel Freq. (Mc)	Picture Carrier Freq. (Mc)	Sound Carrier Freq. (Mc)
2	54-60	55.25	59.75
3	60-66	61.25	65.75
4	66-72	67.25	71.25
5	76-82	77.25	81.75
6	82-88	83.25	87.75
7	174-180	175.25	179.75
8	180-186	181.25	185.75
9	186-192	187.25	191.75
10	192-198	193.25	197.75
11	198-204	199.25	203.75
12	204-210	205.25	209.75
13	210-216	211.25	215.75

FIG. 1

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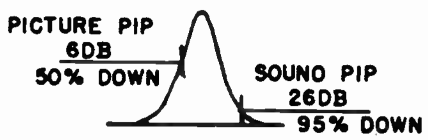
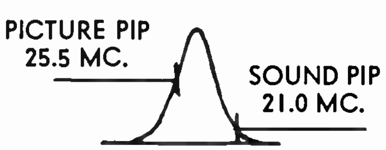
ALIGNMENT CURVES



PICTURE OVERALL RESPONSE CURVE WITH PICTURE AND SOUND CARRIER MARKER PIPS.

FIG. 2



PICTURE I.F. RESPONSE CURVE WITH PICTURE AND SOUND CARRIER MARKER PIPS.

FIG. 3

ALIGNMENT TABLE

Required equipment:

VACUUM TUBE VOLTMETER having a 5 volt and a 10 volt range.

SIGNAL GENERATOR supplying 4.5 M.C. (within .25%), 20 to 30 M.C. and 50 to 216 M.C. (within 1%) signals.

MODULATOR TUBE ADAPTER (Part No. AD6AG5) using 1½ volt battery as shown in Figure 7.

SWEEP GENERATOR capable of covering 20 to 30 M.C. and 50 to 216 M.C. with a 10 M.C. sweep.

4.5 VOLT "A" BATTERY to provide fixed bias during video I.F. alignment.

DISCRIMINATOR AND SOUND I-F ALIGNMENT

Step No.	Connect Signal Generator to	Signal Gen. Freq. MC	Connect Sweep Generator to	Sweep Gen. Freq. MC	Connect Oscilloscope to	Connect Voltmeter to	Miscellaneous Connections and Instructions	Adjust
1	In series with .01 Mfd. to junction of L-5 and C-20. See Fig. 5	4.5	Not used		Not used	In series with 47,000 ohm resistor and across C-39. See Fig. 5	Meter on 5 volt scale and maintain 3 volt reading	T-6 (top) and T-7 (bottom) for max. on meter. See Figs. 4 and 5
2	In series with .01 Mfd. to junction of L-5 and C-20. See Fig. 5	4.5	Not used		Not used	Center of R-14 and R-23 and to tie lug strip end of R-33. See Fig. 5	Meter on 10 volt scale	T-7 (top) for zero on meter. See Fig. 4

NOTE 1: For minimum buzz always adjust T-7 adjustment screw with the sound carrier of a TV station.

PICTURE I-F ALIGNMENT

Step No.	Connect Signal Generator to	Signal Gen. Freq. MC	Connect Sweep Generator to	Sweep Gen. Channel	Connect Oscilloscope to	Connect Voltmeter to	Miscellaneous Connections and Instructions	Adjust
3	Adapter and connect adapter to pin #1 on Mod. Tube. See Fig. 7	25.75	Not used		Not used	In series with 47,000 ohm resistor and across R-43 diode load. See Fig. 5. Contrast control at minimum position.	Connect a 4.5 volt battery, positive side to ground, across C-44. Meter on 5 volt scale and maintain 1 volt reading.	T-5 for maximum reading. See Fig. 4
4	Adapter and connect adapter to pin #1 on Mod. Tube. See Fig. 7	24.9	Not used		Not used	In series with 47,000 ohm resistor and across R-43 diode load. See Fig. 5. Contrast control at minimum position.	Connect a 4.5 volt battery, positive side to ground, across C-44. Meter on 5 volt scale and maintain 1 volt reading.	T-3 for maximum reading. See Fig. 4
5	Adapter and connect adapter to pin #1 on Mod. Tube. See Fig. 7	23.4	Not used		Not used	In series with 47,000 ohm resistor and across R-43 diode load. See Fig. 5. Contrast control at minimum position.	Connect a 4.5 volt battery, positive side to ground, across C-44. Meter on 5 volt scale and maintain 1 volt reading.	T-4 and T-2 for maximum reading. See Fig. 4

NOTE 2: For visual check of I.F. curve (see fig. 3) connect Sweep Generator to adapter and Oscilloscope across R-43.

PICTURE R-F OSCILLATOR ADJUSTMENT — VISUAL

Step No.	Connect Signal Generator to	Signal Gen. Freq. MC	Connect Sweep Generator to	Sweep Gen. Channel	Connect Oscilloscope to	Connect Voltmeter to	Miscellaneous Connections and Instructions	Adjust
6	Loosely couple to sweep Gen. leads	55.25 see fig. 1	300 ohm ant. terminals	2	Across R-43 diode load. See Fig. 5	Not used	Channel switch on channel 2 Adjust Sig. Gen. output for min. distortion of sweep curve	#2 trimmer (fig. 6) so that marker pip is 6 DB (50%) down from top of curve. See Fig. 2
7	Loosely couple to sweep Gen. leads	59.75 see fig. 1	300 ohm ant. terminals	2	Across R-43 diode load. See Fig. 5	Not used	Check pip. Should be 26DB (95%) down on opposite side of curve. See Fig. 2	Repeat step 5 if pip position is not correct
8	Repeat Steps 6 and 7 to Align Channels 3 to 13 Using Correct Frequency (See Fig. 1) and Oscillator Trimmer for Each Channel Being Aligned							

NOTE 3: This trimmer (see fig. 6) is to be used only in case there is not enough range to any oscillator screw from channels 7 to 13. If this screw is touched, then all channels from 7 to 13 will have to be rechecked. If insufficient range is still encountered, proceed as outlined in Note 4.

NOTE 4: Oscillator Padder adjustment screw (see fig. 6) should be used when there is not enough range to any one oscillator trimmer. Adjusting the Padder will necessitate the realignment of all the Oscillator Trimmers.

PICTURE R-F OSCILLATOR ADJUSTMENT — ALTERNATE (USING T.V. STATION TEST PATTERN)

Step No.	Connect Signal Generator to	Signal Gen. Freq. MC	Connect Sweep Generator to	Sweep Gen. Freq. MC	Connect Oscilloscope to	Connect Voltmeter to	Miscellaneous Connections and Instructions	Adjust
9	Not used		Not used		Not used	Not used	Turn channel switch to channel needing alignment	Proper osc. trimmer clockwise until sound bars appear on pattern; then Lack-off trimmer until sound bars disappear and best resolution is obtained. See Fig. 6
10	REPEAT STEP 9 FOR ANY OTHER CHANNELS NEEDING ALIGNMENT							

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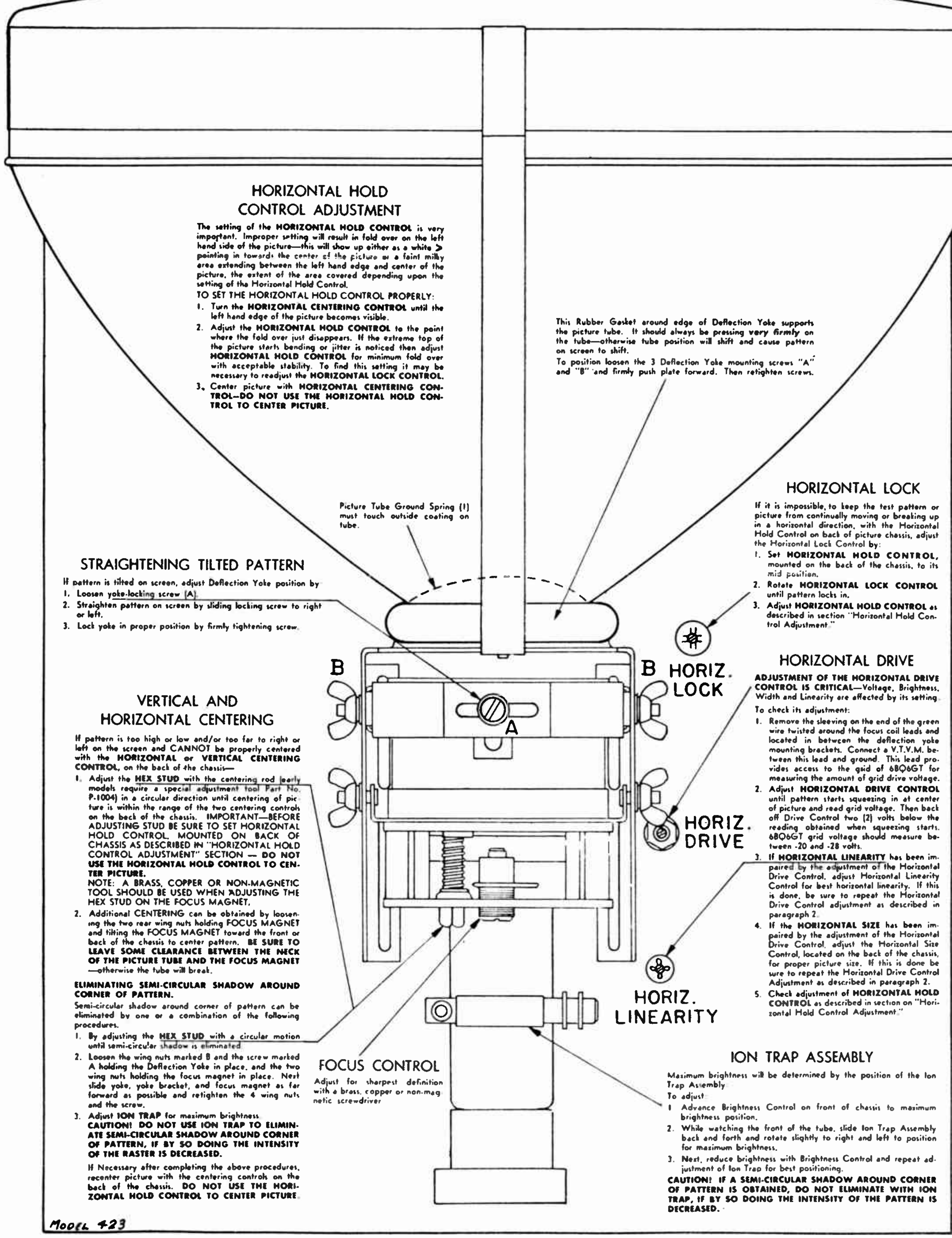


HORIZONTAL HOLD CONTROL ADJUSTMENT

The setting of the **HORIZONTAL HOLD CONTROL** is very important. Improper setting will result in fold over on the left hand side of the picture—this will show up either as a white > pointing in towards the center of the picture or a faint milky area extending between the left hand edge and center of the picture, the extent of the area covered depending upon the setting of the Horizontal Hold Control.

TO SET THE HORIZONTAL HOLD CONTROL PROPERLY:

1. Turn the **HORIZONTAL CENTERING CONTROL** until the left hand edge of the picture becomes visible.
2. Adjust the **HORIZONTAL HOLD CONTROL** to the point where the fold over just disappears. If the extreme top of the picture starts bending or jitter is noticed then adjust **HORIZONTAL HOLD CONTROL** for minimum fold over with acceptable stability. To find this setting it may be necessary to readjust the **HORIZONTAL LOCK CONTROL.**
3. Center picture with **HORIZONTAL CENTERING CONTROL—DO NOT USE THE HORIZONTAL HOLD CONTROL TO CENTER PICTURE.**

STRAIGHTENING TILTED PATTERN

If pattern is tilted on screen, adjust Deflection Yoke position by

1. Loosen yoke-locking screw (A).
2. Straighten pattern on screen by sliding locking screw to right or left.
3. Lock yoke in proper position by firmly tightening screw.

VERTICAL AND HORIZONTAL CENTERING

If pattern is too high or low and/or too far to right or left on the screen and CANNOT be properly centered with the **HORIZONTAL or VERTICAL CENTERING CONTROL**, on the back of the chassis—

1. Adjust the **HEX STUD** with the centering rod (early models require a special adjustment tool Part No. P-1004) in a circular direction until centering of picture is within the range of the two centering controls on the back of the chassis. IMPORTANT—BEFORE ADJUSTING STUD BE SURE TO SET HORIZONTAL HOLD CONTROL, MOUNTED ON BACK OF CHASSIS AS DESCRIBED IN "HORIZONTAL HOLD CONTROL ADJUSTMENT" SECTION — **DO NOT USE THE HORIZONTAL HOLD CONTROL TO CENTER PICTURE.**
   NOTE: A BRASS, COPPER OR NON-MAGNETIC TOOL SHOULD BE USED WHEN ADJUSTING THE HEX STUD ON THE FOCUS MAGNET.
2. Additional CENTERING can be obtained by loosening the two rear wing nuts holding FOCUS MAGNET and tilting the FOCUS MAGNET toward the front or back of the chassis to center pattern. **BE SURE TO LEAVE SOME CLEARANCE BETWEEN THE NECK OF THE PICTURE TUBE AND THE FOCUS MAGNET** —otherwise the tube will break.

ELIMINATING SEMI-CIRCULAR SHADOW AROUND CORNER OF PATTERN.

Semi-circular shadow around corner of pattern can be eliminated by one or a combination of the following procedures.

1. By adjusting the **HEX STUD** with a circular motion until semi-circular shadow is eliminated.
2. Loosen the wing nuts marked B and the screw marked A holding the Deflection Yoke in place, and the two wing nuts holding the focus magnet in place. Next slide yoke, yoke bracket, and focus magnet as far forward as possible and retighten the 4 wing nuts and the screw.
3. Adjust **ION TRAP** for maximum brightness.
   CAUTION! DO NOT USE ION TRAP TO ELIMINATE SEMI-CIRCULAR SHADOW AROUND CORNER OF PATTERN, IF BY SO DOING THE INTENSITY OF THE RASTER IS DECREASED.

If Necessary after completing the above procedures, recenter picture with the centering controls on the back of the chassis. **DO NOT USE THE HORIZONTAL HOLD CONTROL TO CENTER PICTURE.**

FOCUS CONTROL

Adjust for sharpest definition with a brass, copper or non-magnetic screwdriver

HORIZONTAL LOCK

If it is impossible, to keep the test pattern or picture from continually moving or breaking up in a horizontal direction, with the Horizontal Hold Control on back of picture chassis, adjust the Horizontal Lock Control by:

1. Set **HORIZONTAL HOLD CONTROL,** mounted on the back of the chassis, to its mid position.
2. Rotate **HORIZONTAL LOCK CONTROL** until pattern locks in.
3. Adjust **HORIZONTAL HOLD CONTROL** as described in section "Horizontal Hold Control Adjustment."

HORIZONTAL DRIVE

ADJUSTMENT OF THE HORIZONTAL DRIVE CONTROL IS CRITICAL—Voltage, Brightness, Width and Linearity are affected by its setting.

To check its adjustment:

1. Remove the sleeving on the end of the green wire twisted around the focus coil leads and located in between the deflection yoke mounting brackets. Connect a V.T.V.M. between this lead and ground. This lead provides access to the grid of 6BQ6GT for measuring the amount of grid drive voltage.
2. Adjust **HORIZONTAL DRIVE CONTROL** until pattern starts squeezing in at center of picture and read grid voltage. Then back off Drive Control two (2) volts below the reading obtained when squeezing starts. 6BQ6GT grid voltage should measure between -20 and -28 volts.
3. If **HORIZONTAL LINEARITY** has been impaired by the adjustment of the Horizontal Drive Control, adjust Horizontal Linearity Control for best horizontal linearity. If this is done, be sure to repeat the Horizontal Drive Control adjustment as described in paragraph 2.
4. If the **HORIZONTAL SIZE** has been impaired by the adjustment of the Horizontal Drive Control, adjust the Horizontal Size Control, located on the back of the chassis, for proper picture size. If this is done be sure to repeat the Horizontal Drive Control Adjustment as described in paragraph 2.
5. Check adjustment of **HORIZONTAL HOLD CONTROL** as described in section on "Horizontal Hold Control Adjustment."

ION TRAP ASSEMBLY

Maximum brightness will be determined by the position of the Ion Trap Assembly.

To adjust:

1. Advance Brightness Control on front of chassis to maximum brightness position.
2. While watching the front of the tube, slide Ion Trap Assembly back and forth and rotate slightly to right and left to position for maximum brightness.
3. Next, reduce brightness with Brightness Control and repeat adjustment of Ion Trap for best positioning.

CAUTION! IF A SEMI-CIRCULAR SHADOW AROUND CORNER OF PATTERN IS OBTAINED, DO NOT ELIMINATE WITH ION TRAP, IF BY SO DOING THE INTENSITY OF THE PATTERN IS DECREASED.

MODEL 423

TRIMMER LOCATION AND ALIGNMENT EQUIPMENT CONNECTION POINTS

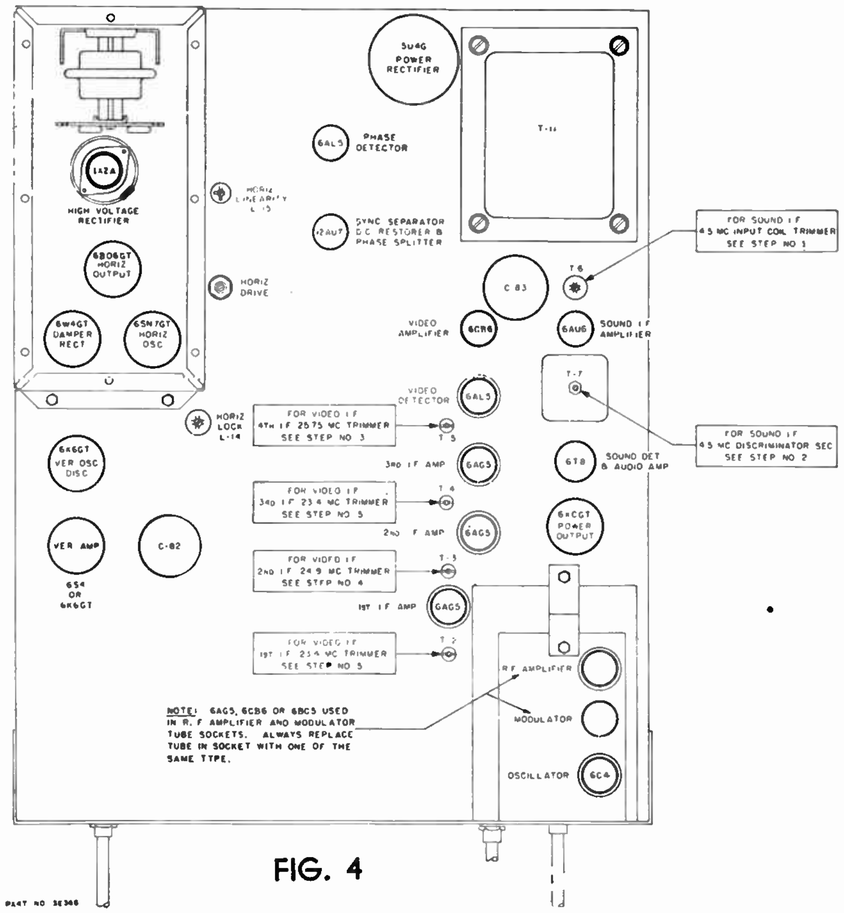
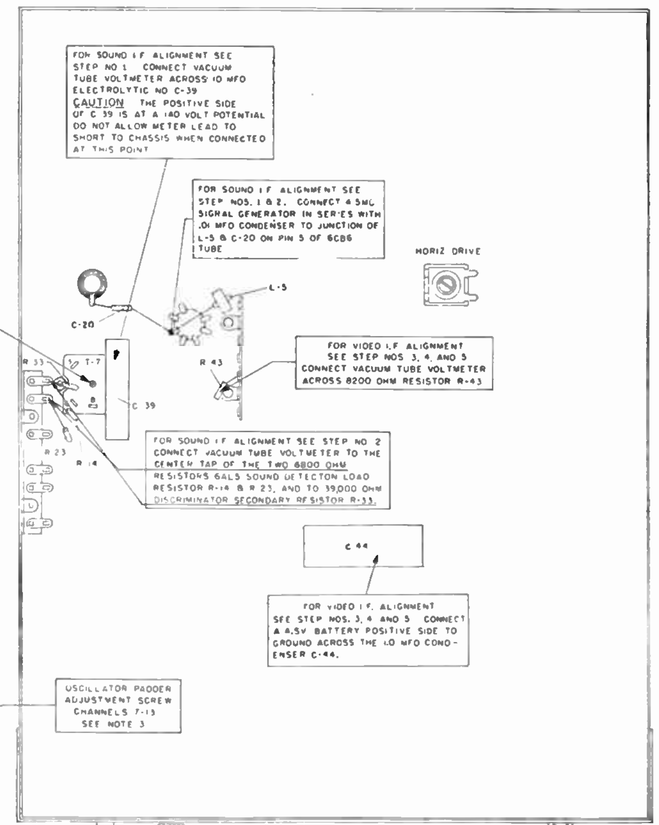


FIG. 4



OSCILLATOR TRIMMER ADJUSTMENT SCREWS ARE LOCATED AROUND SHAFT AS SHOWN SEE STEP NOS. 6 TO 10

IMPORTANT

THERE ARE 14 POSITIONS OF THE CHANNEL SELECTOR SWITCH. THE MAXIMUM RIGHT AND LEFT POSITIONS ARE NOT USED.

OSCILLATOR PADDER ADJUSTMENT SCREW SEE NOTE 4

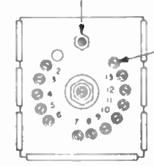


FIG. 6

FIG. 5

MODELS 420B, 423,424,1U420B, 1U423, 1U424

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PARTS LIST

R.F. TUNER UNIT

20E519 Complete Tuner—Using R.F. Amp. Tube, Mod. Tube & Osc. Tube—

CAPACITORS

Illus. No.	Description
C-1	Ceramic, 25 MMF
C-2	Ceramic, 25 MMF
C-3	Ceramic, .25 MMF
C-4	Ceramic, 15 MMF
C-5	Ceramic, 1.5 MMF
C-6	Ceramic, 680 MMF
C-7	Padder
C-8	Ceramic, .005 MFD
C-9	Ceramic, 680 MMF
C-10	Ceramic, .5 MMF
C-11	Ceramic, 3 MMF
C-12	Ceramic, 680 MMF
C-13	Ceramic, 1.5 MMF
C-14	Ceramic, 680 MMF
C-15	Ceramic, 680 MMF
C-16	Ceramic, 680 MMF

RESISTORS

Illus. No.	Description
R-1	Carbon, 1000 Ohm
R-2	Carbon, 10,000 Ohm
R-3	Carbon, 82,000 Ohm
R-4	Carbon, 82,000 Ohm
R-5	Carbon, 6800 Ohm
R-6	Carbon, 22,000 Ohm
R-7	Carbon, 4700 Ohm
R-8	Carbon, 1 Megohm
R-9	Carbon, 33,000 Ohm
R-10	Carbon, 18,000 Ohm
R-11	Carbon, 470 Ohm

COILS AND TRANSFORMERS

Illus. No.	Description
L-1	R.F. Choke Filament
L-2	R.F. Choke Filament
T-1	Transformer, Antenna

MAIN CHASSIS

CAPACITORS

Illus. No.	Our Part No.	Description
C-18	23E2027-2	Fixed Ceramic, 100 MMF 500 V.
C-19	23E25	Fixed Ceramic, 10 MMF 500 V.
C-20	23E21	Fixed Ceramic, 2 MMF 500 V.
C-21	23E413	Tubular, .02 MFD 400 V.
C-22	23E216	Tubular, .05 MFD 200 V.
C-23	23E608	Tubular, .005 MFD 600 V.
C-24	23E2027-2	Fixed Ceramic, 100 MMF 500 V.
C-25	23E2027-2	Fixed Ceramic, 100 MMF 500 V.
C-26	23E2027-2	Fixed Ceramic, 100 MMF 500 V.
C-27	23E208	Fixed Tubular, .005 MFD 200 V.
C-28	23E13	Fixed Ceramic, 3 MMF 500 V.
C-29	23E28	Fixed Ceramic, 5 MMF 500 V.
C-30	25E12	Dry Electrolytic, 100 MFD 10 V.
C-31A, C-31B	23E2037	Fixed Ceramic, Dual .004 MFD 350 V. (Disc)
C-32	23E2025	Fixed Ceramic, .005 MFD 350 V. (Disc)
C-33A, C-33B	23E2037	Fixed Ceramic, Dual .004 MFD 350 V. (Disc)
C-34A, C-34B	23E2037	Fixed Ceramic, Dual .004 MFD 350 V. (Disc)
C-35A, C-35B	23E2037	Fixed Ceramic, Dual .004 MFD 350 V. (Disc)
C-36A, C-36B	23E2037	Fixed Ceramic, Dual .004 MFD 350 V. (Disc)
C-37A, C-37B	23E2037	Fixed Ceramic, Dual .004 MFD 350 V. (Disc)
C-38	23E2025	Fixed Ceramic, .005 MFD 350 V. (Disc)
C-39	25E8	Dry Electrolytic, 10 MFD 25 V.
C-40	23E2012	Fixed Ceramic, .001 MFD 500 V.
C-41	23E216	Tubular, .05 MFD 200 V.
C-42	23E2025	Fixed Ceramic, .005 MFD 350 V. (Disc)
C-43	23E2025	Fixed Ceramic, .005 MFD 350 V. (Disc)
C-44	23E226	Tubular, 1.0 MFD 200 V.
C-45	23E418	Tubular, .1 MFD 400 V.
C-46	23E2012	Fixed Ceramic, .001 MFD 500 V.
C-47	23E205	Tubular, .002 MFD 200 V.
C-48	23E2012	Fixed Ceramic, .001 MFD 500 V.
C-50	23E211	Tubular, .01 MFD 200 V.
C-51	23E2030-4	Fixed Ceramic, 400 MMF 500 V.
C-52	23E2030-9	Fixed Ceramic, 500 MMF 500 V.
C-53	23E2039	Fixed Ceramic, 500 MMF 20,000 V.
C-54	23E2012	Fixed Ceramic, .001 MFD 500 V.
C-55	23E416	Tubular, .05 MFD 400 V.
C-56	23E2030-11	Fixed Ceramic, 56 MMF 1000 V.
C-57	23E222	Tubular, .25 MFD 200 V.
C-59	23E2030-3	Fixed Ceramic, 250 MMF 500 V.
C-61	23E616	Tubular, .05 MFD 600 V.
C-62	23E206	Tubular, .003 MFD 200 V.
C-63	23E86	Fixed Silver Mica, .004 MFD 500 V.
C-64	24E16	Padder, 340-460 MMF.
C-65	23E416	Tubular, .05 MFD 400 V.
C-66	23E418	Tubular, .1 MFD 400 V.
C-67	23E208	Tubular, .005 MFD 200 V.
C-68	23E208	Tubular, .005 MFD 200 V.
C-69	23E216	Tubular, .05 MFD 200 V.
C-71	23E208	Tubular, .005 MFD 200 V.
C-72	23E618	Tubular, .1 MFD 600 V.
C-73	23E618	Tubular, .1 MFD 600 V.
C-74	25E50	Dry Electrolytic, 1000 MFD 3 V.
C-75	23E2035-3	Tubular, .01 MFD 400 V.
C-76	23E2035-3	Tubular, .01 MFD 400 V.
C-77	25E52	Dry Electrolytic, 1000 MFD 5 V.
C-78	25E47	Dry Electrolytic, 40 MFD 450 V.
C-79	25E47	Dry Electrolytic, 40 MFD 450 V.
C-80	23E205	Tubular, .002 MFD 200 V.
C-82	25E44	Dry Electrolytic, 40 MFD 450 V., 50 MFD 150 V., 100 MFD 50 V.
C-83	25E36	Dry Electrolytic, 40-60 MFD 450 V.
C-84	23E216	Tubular, .05 MFD 200 V.
C-85	23E213	Tubular, .02 MFD 200 V.
C-86	23E213	Tubular, .02 MFD 200 V.
C-87	23E414	Tubular, .03 MFD 400 V.
C-88	23E618	Tubular, .1 MFD 600 V.
C-89	23E616	Tubular, .05 MFD 600 V.

RESISTORS

Illus. No.	Our Part No.	Description
R-12	27E101-2	Carbon, 100 Ohm 1/2 W.
R-13	27E334-2	Carbon, 330,000 Ohm 1/2 W.
R-14	27E682-2	Carbon, 6800 Ohm 1/2 W.
R-15	27E224-2	Carbon, 220,000 Ohm 1/2 W.
R-17	27E101-2	Carbon, 100 Ohm 1/2 W.
R-18	27E101-2	Carbon, 100 Ohm 1/2 W.

RESISTORS (Cont'd)

Illus. No.	Our Part No.	Description
R-19		Part of 20E363-8 I.F. Plate Choke Assembly (See Misc. Parts)
R-20		Part of 20E363-2 Diode Plate Choke Assembly (See Misc. Parts)
R-21	27E331-2	Carbon, 330 Ohm 1/2 W.
R-22		Part of 20E363-3 Video Plate Choke Assembly (See Misc. Parts)
R-23	27E682-2	Carbon, 6800 Ohm 1/2 W.
R-24A, R-24B	28E64	Off-On Volume, Brightness, Dual Control
R-25	27E1009-12	Carbon, 150,000 Ohm ± 5% 1/2 W.
R-26	27E1009-13	Carbon, 6800 Ohm ± 5% 1/2 W.
R-27	27E1009-13	Carbon, 6800 Ohm ± 5% 1/2 W.
R-28		Part of 20E363-9 3rd I.F. Grid Choke Assembly (See Misc. Parts)
R-29		Part of 20E363-6 Diode Load Choke Assembly (See Misc. Parts)
R-30	27E1015-2	Wirewound, 2.2 Ohm 1/2 W.
R-31		Part of 20E363-10 Video Load Choke Assembly (See Misc. Parts)
R-32	27E271-2	Carbon, 270 Ohm 1/2 W.
R-33	27E393-2	Carbon, 39,000 Ohm 1/2 W.
R-34	27E106-2	Carbon, 10 Megohm 1/2 W.
R-35	27E224-2	Carbon, 220,000 Ohm 1/2 W.
R-36	27E331-2	Carbon, 330 Ohm 1/2 W.
R-37	27E105-2	Carbon, 1 Megohm 1/2 W.
R-38	28E65	Contrast Control, 1000 Ohm
R-39	27E102-2	Carbon, 1000 Ohm 1/2 W.
R-40	27E102-2	Carbon, 1000 Ohm 1/2 W.
R-41	27E102-2	Carbon, 1000 Ohm 1/2 W.
R-42	27E102-2	Carbon, 1000 Ohm 1/2 W.
R-43	27E1009-15	Carbon, 8200 Ohm ± 5% 1/3 W.
R-44	27E393-3	Carbon, 39,000 Ohm 1 W.
R-45	27E1009-9	Carbon, 330,000 Ohm ± 5% 1/2 W.
R-46	27E1009-35	Carbon, 10,000 Ohm ± 5% 1/2 W.
R-47	27E102-2	Carbon, 1000 Ohm 1/2 W.
R-48	27E224-2	Carbon, 220,000 Ohm 1/2 W.
R-49	27E153-5	Carbon, 15,000 Ohm 2 W.
R-50	27E1016-3	Wirewound, 6000 Ohm 5 W.
R-51	27E1009-25	Carbon, 470,000 Ohm ± 5% 1/2 W.
R-52	27E151-2	Carbon, 150 Ohm 1/2 W.
R-53	27E222-2	Carbon, 2200 Ohm 1/2 W.
R-54	27E1009-25	Carbon, 470,000 Ohm ± 5% 1/2 W.
R-55	27E1015-4	Wirewound, 3.3 Ohm 1/2 W.
R-56	27E274-2	Carbon, 270,000 Ohm 1/2 W.
R-57	27E1009-21	Carbon, 820,000 Ohm 1/2 W.
R-58	27E333-2	Carbon, 33,000 Ohm 1/2 W.
R-59	27E474-2	Carbon, 470,000 Ohm 1/2 W.
R-60	27E333-2	Carbon, 33,000 Ohm 1/2 W.
R-61	27E1009-5	Carbon, 1.2 Megohm 1/2 W.
R-62	27E101-2	Carbon, 100 Ohm 1/2 W.
R-63	27E333-2	Carbon, 33,000 Ohm 1/2 W.
R-64	27E822-2	Carbon, 8200 Ohm 1/2 W.
R-65	27E273-2	Carbon, 27,000 Ohm 1/2 W.
R-66	27E1009-34	Carbon, 1500 Ohm ± 5% 1/2 W.
R-67	27E104-2	Carbon, 100,000 Ohm 1/2 W.
R-68	27E1009-8	Carbon, 5600 Ohm ± 5% 1/2 W.
R-69	27E561-2	Carbon, 560 Ohm 1/2 W.
R-70	27E682-2	Carbon, 6800 Ohm 1/2 W.
R-71	28E43	Horizontal Hold Control, 50,000 Ohm
R-72	27E103-2	Carbon, 10,000 Ohm 1/2 W.
R-73	27E474-2	Carbon, 470,000 Ohm 1/2 W.
R-74	27E1016-15	Wirewound, 22,000 Ohm 4 W.
R-75	27E472-2	Carbon, 4700 Ohm 1/2 W.
R-76	27E561-2	Carbon, 560 Ohm 1/2 W.
R-77	27E474-2	Carbon, 470,000 Ohm 1/2 W.
R-78	27E223-2	Carbon, 22,000 Ohm 1/2 W.
R-79	27E822-2	Carbon, 8200 Ohm 1/2 W.
R-80	27E474-2	Carbon, 470,000 Ohm 1/2 W.
R-81	27E1016-15	Wirewound, 22,000 Ohm 4 W.
R-82	27E822-2	Carbon, 8200 Ohm 1/2 W.
R-83	27E473-5	Carbon, 47,000 Ohm 2 W.
R-84	27E224-2	Carbon, 220,000 Ohm 1/2 W.
R-85	27E474-2	Carbon, 470,000 Ohm 1/2 W.
R-86	27E105-2	Carbon, 1 Megohm 1/2 W.
R-87	28E36	Vertical Size Control, 250,000 Ohm
R-88	28E67	Vertical Linearity Control, 2000 Ohm
R-89	27E683-3	Carbon, 68,000 Ohm 1 W.
R-90	28E72	Vertical Hold Control, 2 Megohm
R-91	27E272-2	Carbon, 2700 Ohm 1/2 W.
R-92	27E225-2	Carbon, 2.2 Megohm 1/2 W.
R-93	27E105-2	Carbon, 1 Megohm 1/2 W.
R-94	27E681-2	Carbon, 680 Ohm 1/2 W.
R-95	27E334-2	Carbon, 330,000 Ohm 1/2 W.
R-96	28E54	Horizontal Centering Control, 60 Ohm
R-97	27E1016-14	Wirewound, 400 Ohm 5 W.
R-98	28E68	Vertical Centering Control, 20 Ohm
R-99	27E102-2	Carbon, 1000 Ohm 1/2 W.
R-100	27E333-3	Carbon, 33,000 Ohm 1 W.
R-101	27E473-2	Carbon, 47,000 Ohm 1/2 W.
R-102	27E682-2	Carbon, 6800 Ohm 1/2 W.
R-103	27E474-2	Carbon, 470,000 Ohm 1/2 W.
R-104	27E104-2	Carbon, 100,000 Ohm 1/2 W.
R-105	27E475-2	Carbon, 4.7 Megohm 1/2 W.
R-106	27E222-2	Carbon, 2,200 Ohm 1/2 W.
R-107	28E44	Vertical Linearity Control, 5000 Ohm

COILS AND TRANSFORMERS

Illus. No.	Our Part No.	Description
L-3		Part of 20E363-8 I.F. Plate Choke Assembly (See Misc. Parts)
L-4		Part of 20E363-2 Diode Plate Choke Assembly (See Misc. Parts)
L-5		Part of 20E363-3 Video Plate Choke Assembly (See Misc. Parts)
L-6	2E92	Coil, Filament Choke
L-7	2E92	Coil, Filament Choke
L-8		Part of 20E363-9 3rd I.F. Grid Choke Assembly (See Misc. Parts)
L-9	2E92	Coil, Filament Choke
L-10		Part of 20E363-6 Diode Load Choke Assembly (See Misc. Parts)
L-11		Part of 20E363-10 Video Load Choke Assembly (See Misc. Parts)
L-12	2E78	Filament Choke Assembly
L-13	20E639	Coil, Horizontal Size Control
L-14	20E409	Coil, Horizontal Lock
L-15	20E524	Coil, Horizontal Linearity
L-16	22E52	Choke, Filter
L-17	2E92	Coil, R.F. Choke
T-2	20E360	Transformer, 1st I.F.
T-3	20E360	Transformer, 2nd I.F.
T-4	20E360	Transformer, 3rd I.F.
T-5	20E360	Transformer, 4th I.F.
T-6	20E361	Transformer, Sound I.F. Coil
T-7	20E537	Transformer, Discriminator Coil
T-8	22E35-2	Transformer, Output for Speaker
T-9	22E61	Transformer, Horizontal Output
T-10	22E55	Transformer, Vertical Blocking Osc.
T-11	22E43	Transformer, Power
T-12	22E51	Transformer, Vertical Output
T-13	30E164	Transformer, Deflection Yoke

MISCELLANEOUS

Our Part No.	Description
1E39	Speaker, 4x6" E.D. for Model 420B
1E43	Speaker, 10" P.M. for Model 423
1E48	Speaker, 12" P.M. for Model 424
20E519	Tuner Unit, Channel Switch and Multiple Resistor-Capacitor Assembly
20E363-2	Diode Plate Choke Assembly
20E363-3	Video Plate Choke Assembly
20E363-6	Diode Load Choke Assembly
20E363-10	Video Load Choke Assembly
20E363-8	I.F. Plate Choke Assembly
20E363-9	3rd I.F. Grid Choke Assembly
41E17	Line Cord, A.C. Cord with Female Receptacle
17E32	Receptacle, A.C., 2 contact, Male
17E1-17	Socket, Miniature, 9 pin
17E1-14	Socket, Miniature, 7 pin
20E517-2	Socket Assembly, Picture Tube
20E419-2	Connector, Picture Tube, Anode Lead with Cap
20E593	Picture Tube Clamp Assembly, Top
15E174-4	Ion Trap for 16RP4 Picture Tube
15E174-4-24	Ion Trap for 16KP4 Picture Tube
62E2	Focus Magnet
40E8-2	Fuse, 1/4 Amp. 250 V. (Slo Blo Type)
20E584	Fuse Holder, Clip type
AD6AG5	Alignment Adapter for Modulator Tube
20E585	Pulley Assembly, on Channel Switch Shaft
20E580	Pulley Assembly, for Contrast Control
20E253-27	Drive Cord, for Contrast Control
65E2	Spring, Tension, for Drive Cord
65E39	Spring "C" type, Locks Pulley Assembly on Channel Switch Shaft

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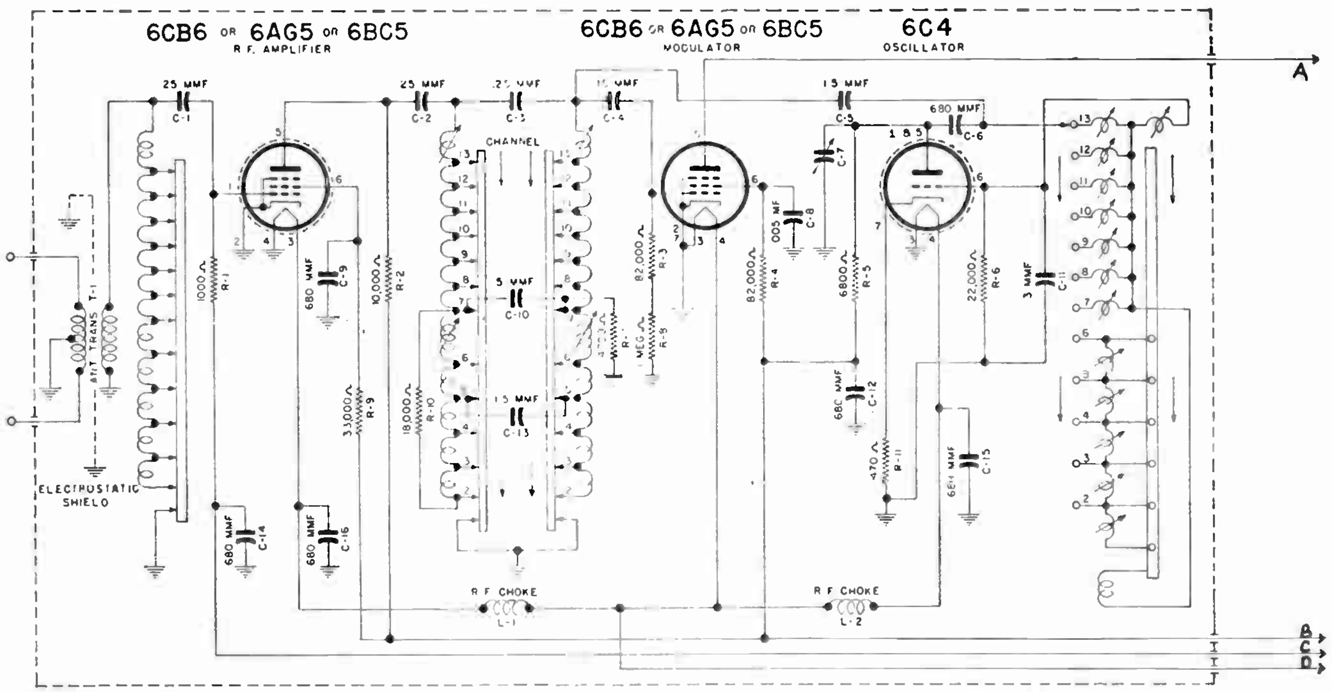
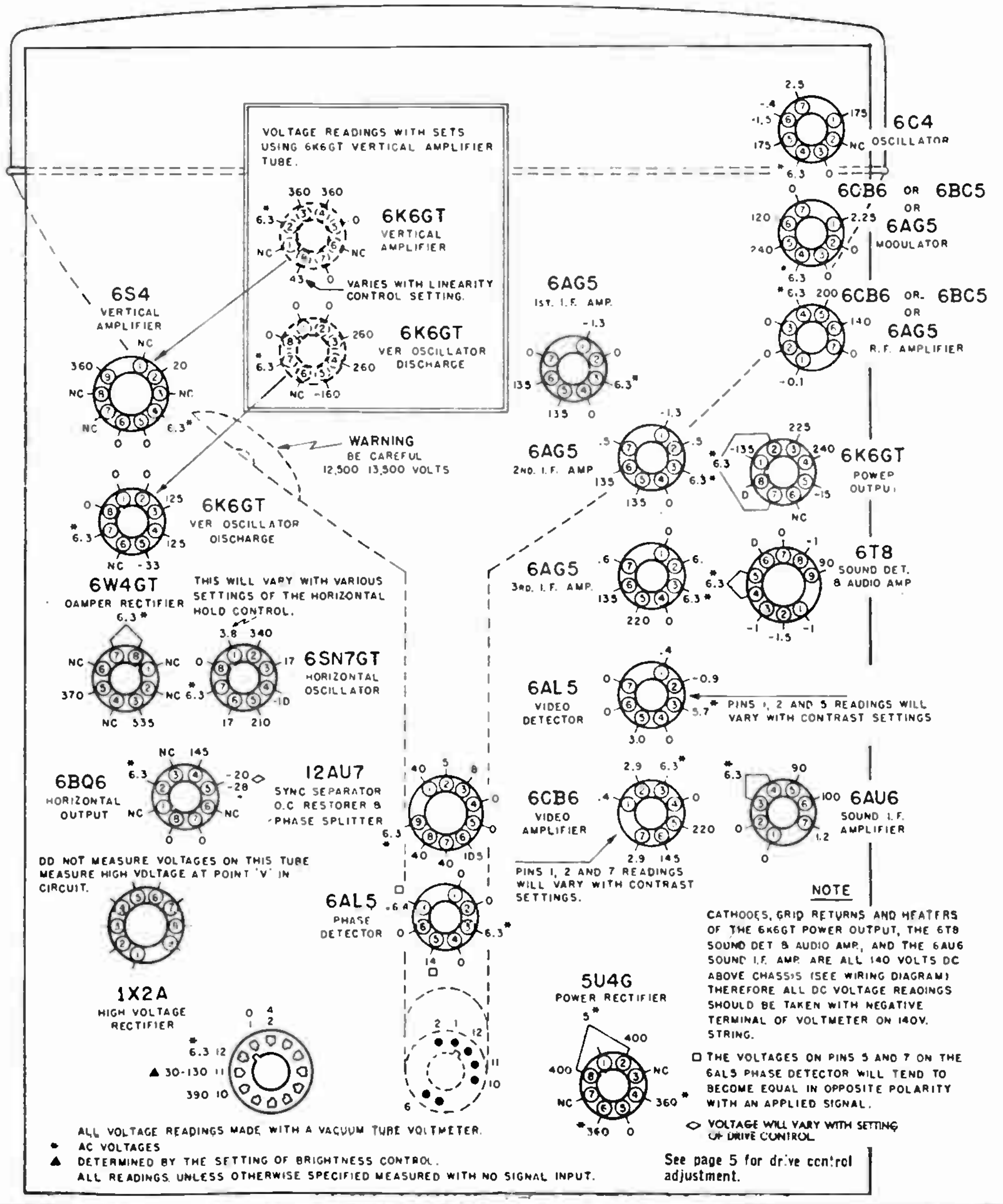
CABINET MISCELLANEOUS

Our Part No.	DESCRIPTION
20E546-13	Cabinet Back Assembly with line cord for Model 420B
20E546-10	Cabinet Back Assembly with line cord for Model 423
20E546-11	Cabinet Back Assembly with line cord for Model 424
9E34	Safety Glass, for Model 420B Mahogany
9E39	Safety Glass, for Model 423 Mahogany
9E39-2	Safety Glass, for Model 423 Blonde
9E36	Safety Glass, for Model 424
36E62-2	Mask, for Model 420B Mahogany
36E62-3	Mask, for Model 423 Mahogany
36E62-4	Mask, for Model 423 Blonde
36E69	Mask, for Model 424 Mahogany & Blonde
33E85	Gasket, Rubber for Mask—44 Inches
48E16	Escutcheon for Safety Glass, for Model 424
20E544-3	**Knob Assembly,** Channel Switch, for Models 420B, 423 & 424 Mahogany
20E544-6	**Knob Assembly,** Channel Switch, for Models 423 & 424 Blonde
20E545-3	**Knob Assembly,** Off-On-Vol., for Models 420B, 423 & 424 Mahogany
20E545-6	**Knob Assembly,** Off-On-Vol., for Models 423 & 424 Blonde
37E59-6	**Knob,** Channel Switch, Less Metal Plate, for Models 420B, 423 & 424 Mahogany
37E59	**Knob,** Channel Switch, Less Metal Plate, for Models 423 & 424 Blonde
37E59-5	**Knob,** Off-On-Vol., Less Metal Plate, for Models 420B, 423 & 424 Mahogany
37E59-11	**Knob,** Off-On-Vol., Less Metal Plate, for Models 423 & 424 Blonde
37E67	**Knob,** Contrast, for Model 420B Mahogany
37E67-7	**Knob,** Contrast, for Models 423 & 424 Mahogany & Blonde
37E67-2	**Knob,** Brightness, for Model 420B Mahogany
37E67-8	**Knob,** Brightness, for Models 423 & 424 Mahogany & Blonde
36E57-2	Metal Plate, for Channel Switch Knob
36E58-2	Metal Plate, for Off-On-Vol. Knob
20E550-4	Built-in Antenna Assembly for Model 423
30E154-4	Trimmer and Shaft Assembly, consists of shaft assembled to trimmer condenser for 20E550-4 Antenna
20E550	Built-in Antenna Assembly for Models 420B and 424
30E154	Trimmer and Shaft Assembly, consists of 9" shaft assembled to trimmer condenser for 20E550 Antenna
37E61	**Knob,** Antenna for Model 423 Mahogany
37E61-2	**Knob,** Antenna for Model 423 Blonde
37E62	**Knob,** Antenna for Models 420B Mahogany and 424 Mahogany and Blonde





NOTE: A 6CB6 or 6AG5 or 6BC5 is used in the R. F. amplifier and modulator tube sockets. Always use the same type tube for replacement. Intermixing these tubes may result in loss in sensitivity caused by the differences in tube capacities detuning the circuits and making it necessary to realign the R. F. amplifier and modulator stages by spreading or squeezing turns on the coils. The 6CB6 cannot be used in the video I. F. amplifier stages.

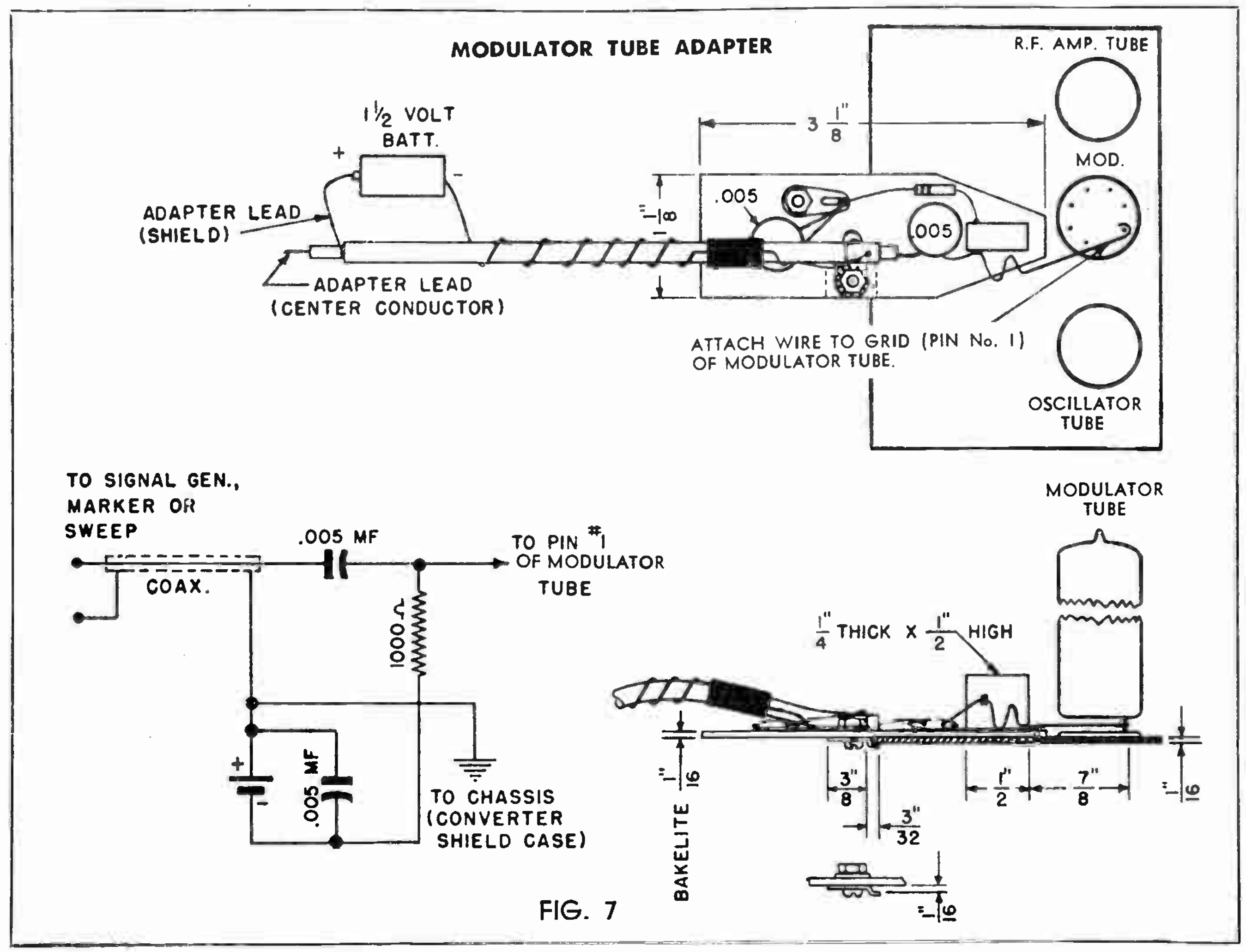


FIG. 7

SENTINEL TV PAGE 6-7

MODELS 1U420, 1U423, 1U424, 420B, 423, 424

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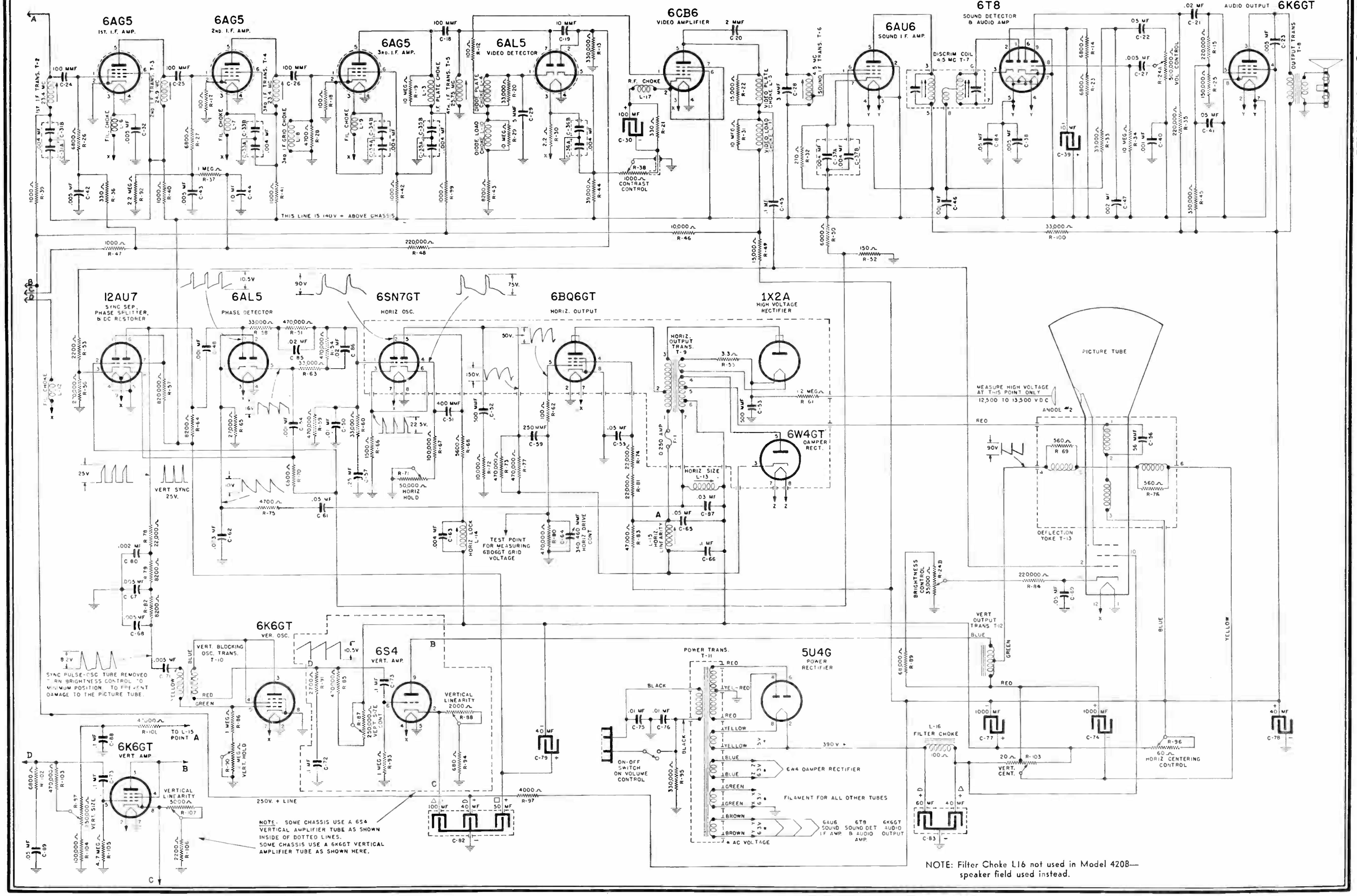
MODELS 1U420, 1U423, 1U424, 420B, 423, 424



NOTE- SOME CHASSIS USE A 6S4 VERTICAL AMPLIFIER TUBE AS SHOWN INSIDE OF DOTTED LINES. SOME CHASSIS USE A 6K6GT VERTICAL AMPLIFIER TUBE AS SHOWN HERE.

NOTE: Filter Choke L16 not used in Model 420B— speaker field used instead.

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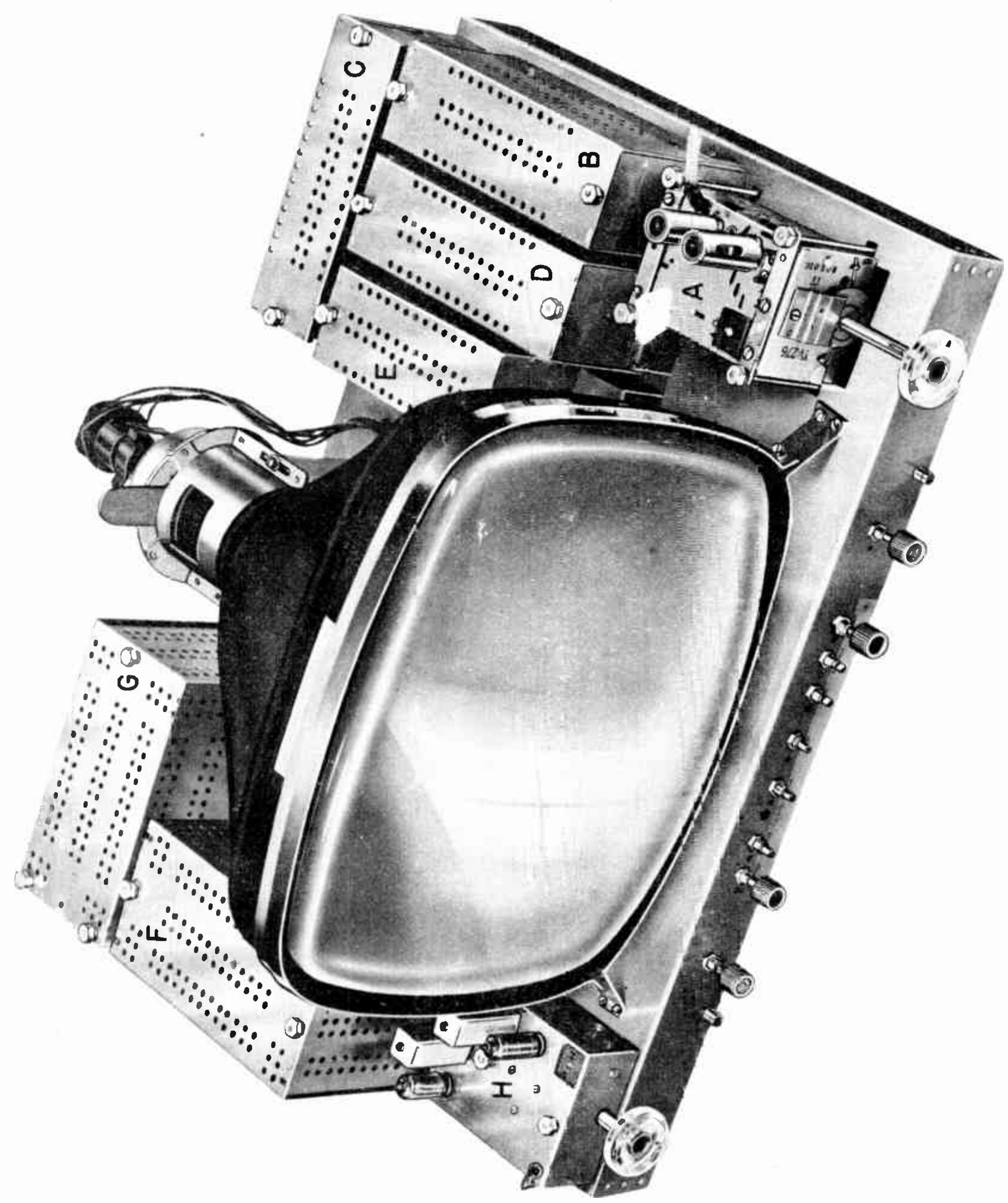
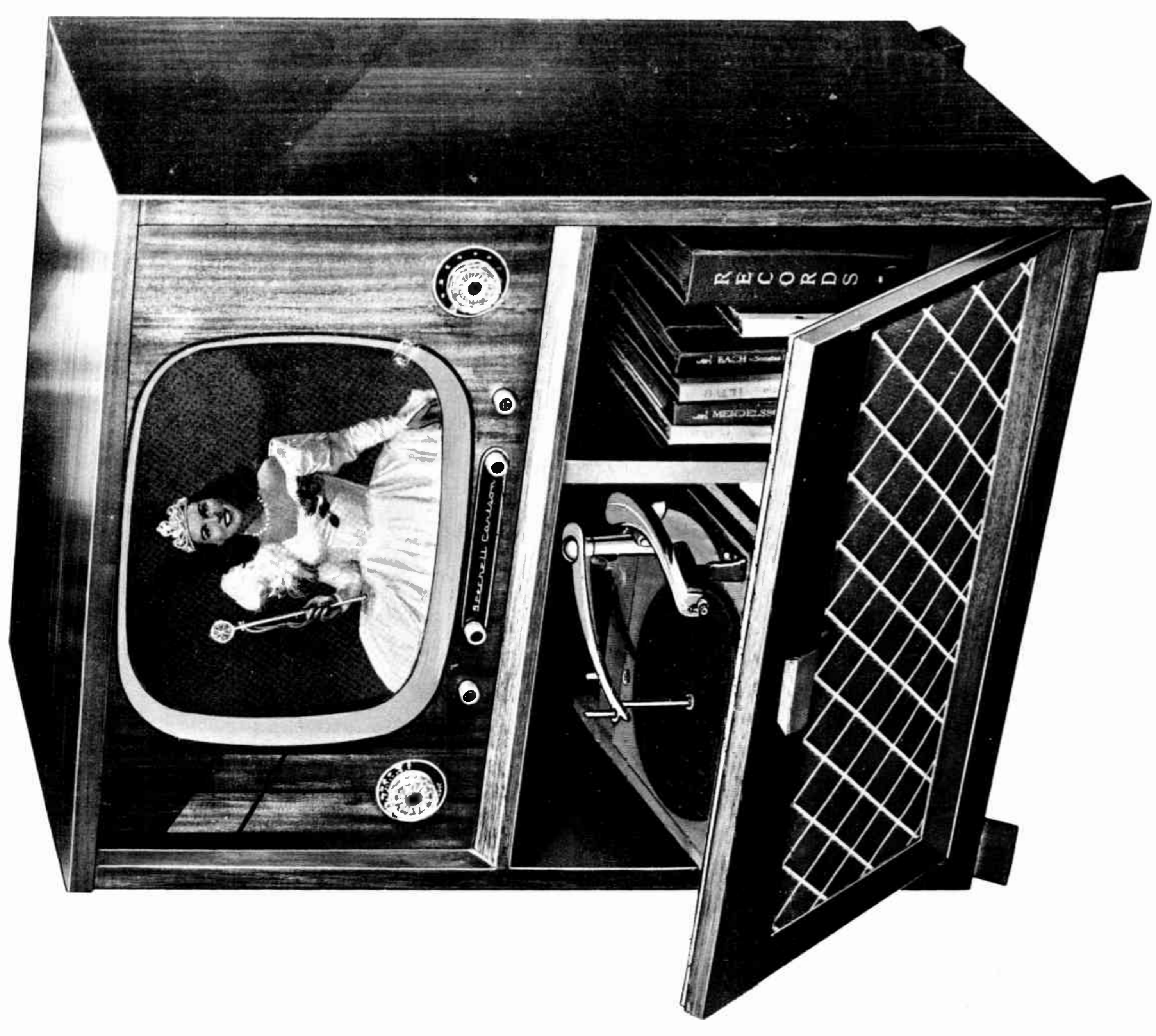
MODEL 2500,
Ch. 25





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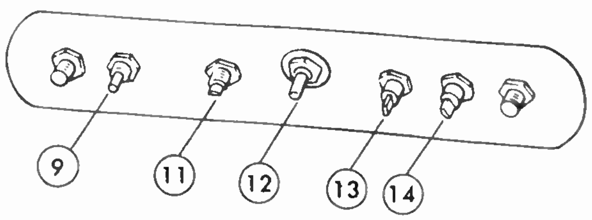
ADDITIONAL TV CONTROLS

The sensitivity of your TV set may be disturbed while being moved, or after the set has been in operation for a long time. The following adjustments can be made by you, or call your dealer for service.

Remove knobs on Brightness and Contrast Dials by pulling toward you. Remove plate (imprinted with Setchell-Carlson name). This is the TV Adjustment Panel:



All controls turn clockwise and counter-clockwise.

FOR BEST RESULTS, ADJUST DURING TEST PATTERN TIME.

9. HORIZONTAL HOLD—When properly adjusted, picture will come to lock-in position from bottom, not from either side. Rotate channel selector off and on station and watch direction that picture locks in.

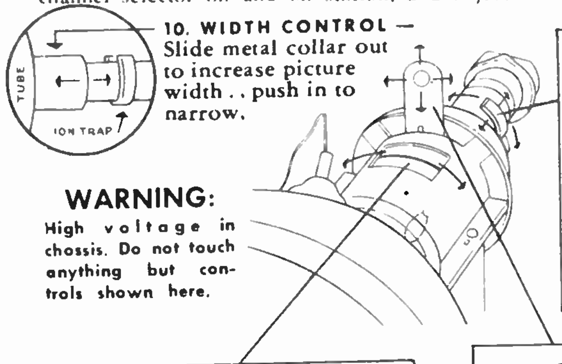
10. WIDTH CONTROL—Located on neck of picture tube. See next page.

11. VERTICAL LINEARITY—Spreads or contracts top portion of picture. Adjust during test pattern time.

12. FOCUS—Before adjusting focus control, set brightness and contrast to normal operating condition, then adjust for sharpest picture.

13. HEIGHT CONTROL—Varies the overall height of the picture. Adjust in connection with No. 11 (Vertical linearity) during test pattern time. Be sure centering control (rear of chassis) is properly adjusted before adjusting height.

14. VERTICAL HOLD—Stops up or down movement of picture. Rotate channel selector off and on station, and adjust for fastest lock-in.



10. WIDTH CONTROL — Slide metal collar out to increase picture width . . push in to narrow.

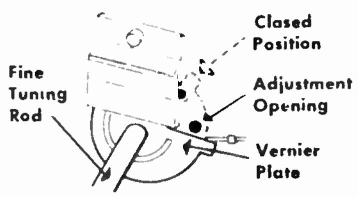
17. ION TRAP—Slowly rotate and slide for brightest picture with level horizontal lines without shadows. (Note: This adjustment is extremely critical and picture will completely disappear when improperly adjusted.)

WARNING:

High voltage in chassis. Do not touch anything but controls shown here.

15. HORIZONTAL PICTURE LEVELER—If picture tilts, rotate with finger until level.

16. PICTURE CENTERING CONTROL—Move horizontally and vertically until picture is properly centered on screen.



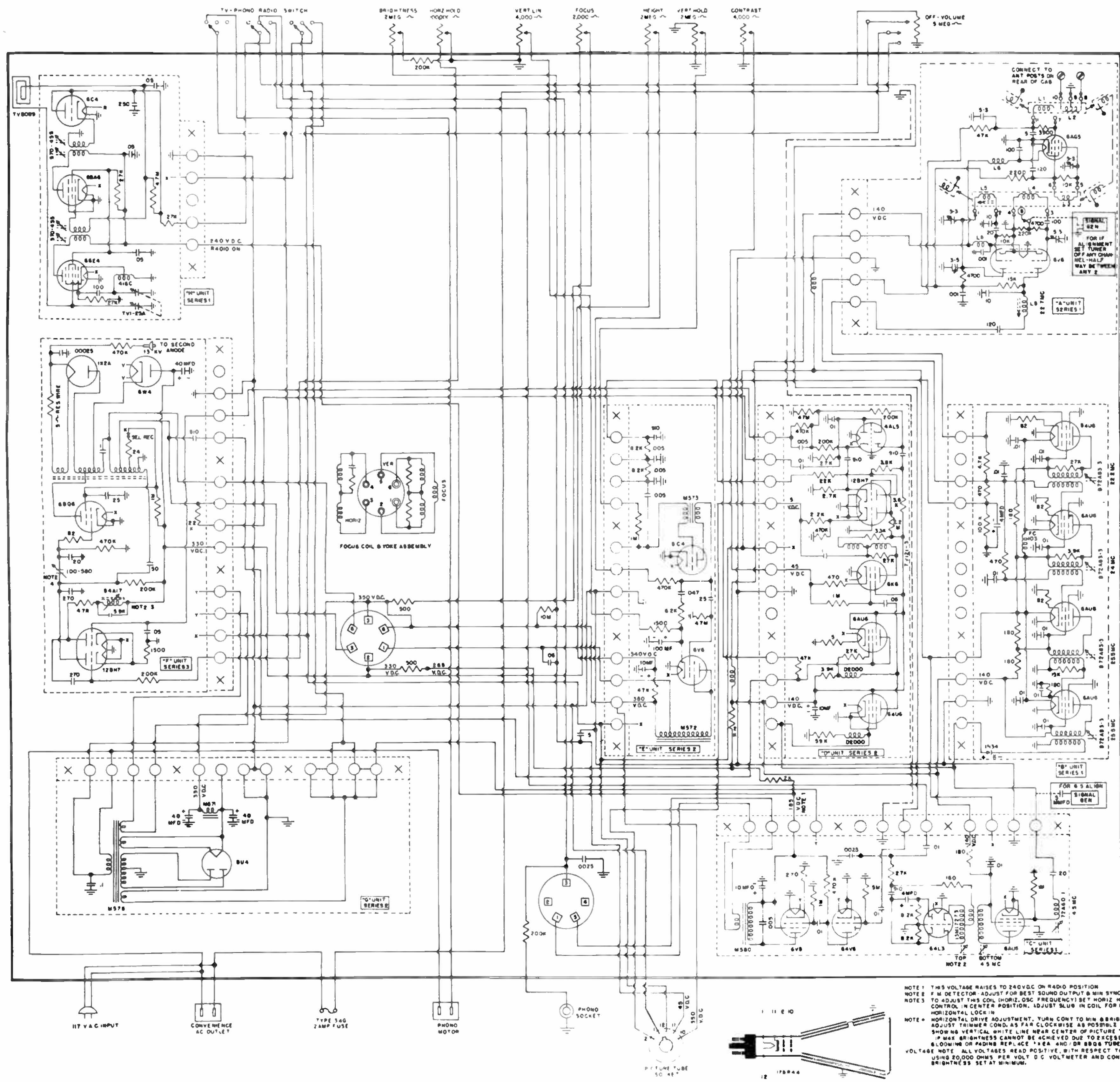
← This is what you see.

Turn fine tuning rod to left or right until the vernier plate is in the position shown, which uncovers the adjustment opening. Place a small screw driver through opening and adjust screw *slightly*, clockwise or counter-clockwise, until picture clears. CAUTION: DO NOT TURN MORE THAN 1½ TURNS EITHER WAY.

Remove screw driver and turn fine tuning rod until vernier plate is in closed position. If picture shows a slight sparkle at this point, adjustment is correct. This operation should be repeated for all channels being used for Telecasting in your locality.

IMPORTANT

If using the Fine Tuning Lever materially disturbs your picture on any channel, or if your sound is not clear, it may be necessary to adjust the fine tuning. Turn the channel selector to the affected channel. Remove the channel selector dial and fine tuning lever by pulling toward you. Then remove the channel selector plate.



NOTE 1 THIS VOLTAGE RAISES TO 240 V.D.C. ON RADIO POSITION
NOTE 2 F.M. DETECTOR - ADJUST FOR BEST SOUND OUTPUT & MIN SYNC BUZZ
NOTE 3 TO ADJUST THIS COIL (HORIZ. OSC FREQUENCY) SET HORIZ HOLD CONTROL IN CENTER POSITION. ADJUST SLUG IN COIL FOR BEST HORIZONTAL LOCK IN
NOTE 4 HORIZONTAL DRIVE ADJUSTMENT. TURN CONT TO MIN & BRIGHT. TO MAX. ADJUST TRIMMER COND. AS FAR CLOCKWISE AS POSSIBLE WITHOUT SHOWING VERTICAL WHITE LINE NEAR CENTER OF PICTURE TUBE. IF MAX BRIGHTNESS CANNOT BE ACHIEVED DUE TO EXCESSIVE BLOOMING OR FADING REPLACE 1B3GT AND/OR 6BG6 TUBES.
VOLTAGE NOTE ALL VOLTAGES READ POSITIVE, WITH RESPECT TO CHASSIS, USING 20,000 OHMS PER VOLT D.C. VOLTMETER AND CONTRAST & BRIGHTNESS SET AT MINIMUM.

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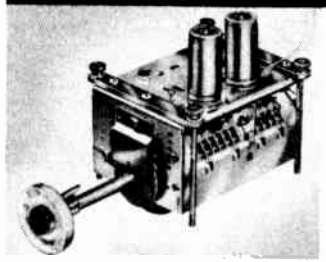
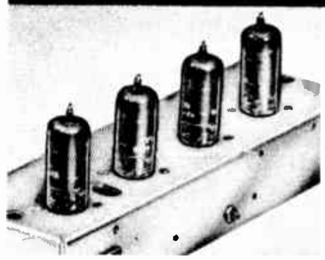
UNIT A - TV CHANNEL SELECTOR



12 channel (2-13 inclusive) with vernier tuning.

Tubes:
1 - 6AG5 RF Amplifier
1 - 6J6 Oscillator-Modulator

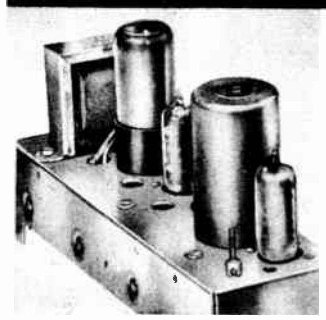
UNIT B - IF AMPLIFIER



4 stages of IF, staggered - tuned, plus germanium crystal detector.

Tubes:
4 - 6AU6

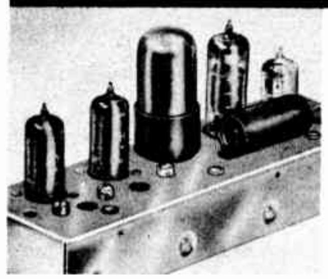
UNIT C - SOUND AMPLIFIER



1 stage of sound IF amplification - 4.5 MC. Ratio detector, 1st & 2nd audio amplifiers and output transformer.

Tubes:
1 - 6AU6 IF Amplifier
1 - 6AL5 Sound Detector
1 - 6AV6 1st Audio Amplifier
1 - 6V6GT Power Output

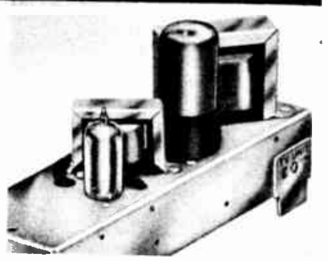
UNIT D - VIDEO AMPLIFIER - A.G.C. - SYNC SEPARATOR



2 stages of video amplification — combined sync-separator & D.C. restorer. Sync-amplifier and horizontal phase detector. Keyed A.G.C. amplifier.

1 - 6AU6 1st video amplifier
1 - 6AU6 Keyed A.G.C. amplifier
1 - 6K6 2nd video amplifier
1 - 12BH7 Sync-separator - D.C. restorer - amplifier
1 - 6AL5 Horizontal phase detector

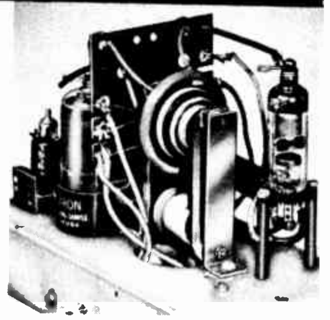
UNIT E - VERTICAL SWEEP AMPLIFIER



A stable vertical oscillator with power output stage and noise disintegrator.

Tubes:
1 - 6C4 Blocking oscillator
1 - 6V6GT power output

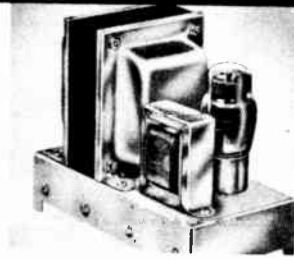
UNIT F - HORIZONTAL SWEEP AMPLIFIER



A stable horizontal oscillator driving an output tube in a fly-back circuit producing approximately 11 KV for picture tube.*

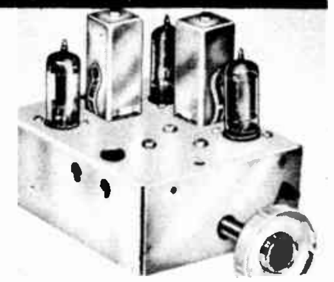
Tubes:
1 - 12BH7 Oscillator
1 - 6BQ6 Power output
1 - 6W4 Damper and
1 - 1X2 HV Rectifier

UNIT G - MAIN POWER SUPPLY



An oversized power transformer which in combination with a rectifier supplies all of the filament and filtered plate voltage.
1 - 5U4G Rectifier

UNIT H - A.M. RADIO TUNER

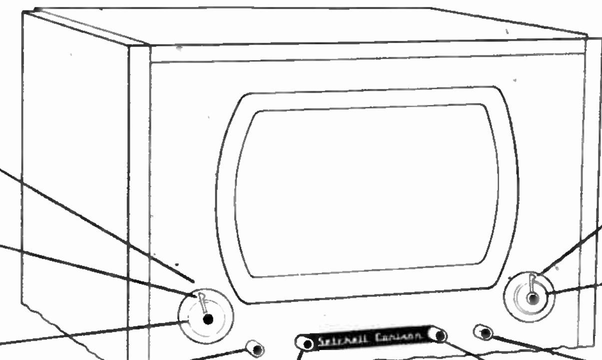


A superheterodyne tuner-535KC to 1650KC. Selective iron-core IF's 456KC. in conjunction with built-in loop antenna and perfect voltage supply, produce exceptional performance.

1 - 6BE6 Mixer
1 - 6BA6 IF amplifier
1 - 6C4 Detector

Radio in operation uses Main Power Supply and 2 tubes of Unit C.

VISIBLE TV AND RADIO TUNING DIALS



AM RADIO CONTROLS

1. SPEED TUNER FOR LOCATING RADIO STATIONS ON DIAL

2. FINER TUNING DIAL FOR EXACT TUNING OF RADIO STATIONS

3. SELECTOR FOR TV, RADIO, OR PHONOGRAPH

4. TV BRIGHTNESS CONTROL DIAL (TURN CLOCKWISE TO INCREASE PICTURE BRIGHTNESS)

5. TV CONTRAST CONTROL DIAL (TURN CLOCKWISE TO INCREASE PICTURE CONTRAST)

6. ON & OFF SWITCH AND VOLUME CONTROL FOR TV, RADIO, AND PHONOGRAPH

7. CHANNEL SELECTOR 2 THROUGH 13

8. FINE TUNING LEVER FOR TV SOUND AND PICTURES

TO OPERATE THE TV:
1. Turn selector No. 3 clockwise to final stop.
2. Turn on and off switch No. 6 to right until click is heard, then a quarter turn beyond.
3. Allow receiver to warm up until picture tube lights up.
4. Select your TV station by turning TV channel selector No. 7 until the marker points to desired channel number.
5. Turn contrast and brightness controls No. 4 and No. 5 to middle of their ranges, and adjust each for best picture detail.
6. Adjust fine TV tuning control No. 8 to best picture detail, and TV sound will automatically be tuned properly.
7. To turn off, turn switch No. 6 to left until click is heard.

TO OPERATE THE RADIO:
1. Turn selector No. 3 counter-clockwise to final stop.
2. Turn on and off switch No. 6 to right until click is heard, then a quarter turn beyond.
3. Allow receiver to warm up.
4. Select your station using speed tuner No. 1.
5. Refine station tuning with dial No. 2.
6. Adjust volume control No. 6.
7. To turn off, turn switch No. 6 to left until click is heard.

TO OPERATE PHONOGRAPH (console model 1500):
Note: Table model 150 and console model 1500 LP are equipped with phono sockets for attaching phonograph equipment. After plugging into phono motor and sound plug-ins on rear of set, proceed as follows:
1. Turn selector No. 3 to middle stop.
2. Turn on and off switch No. 6 to left until click is heard, then a quarter turn beyond.
3. Allow receiver to warm up.
4. Follow phono directions furnished (console model 1500 only).
5. To turn off, turn switch No. 6 to left until click is heard.

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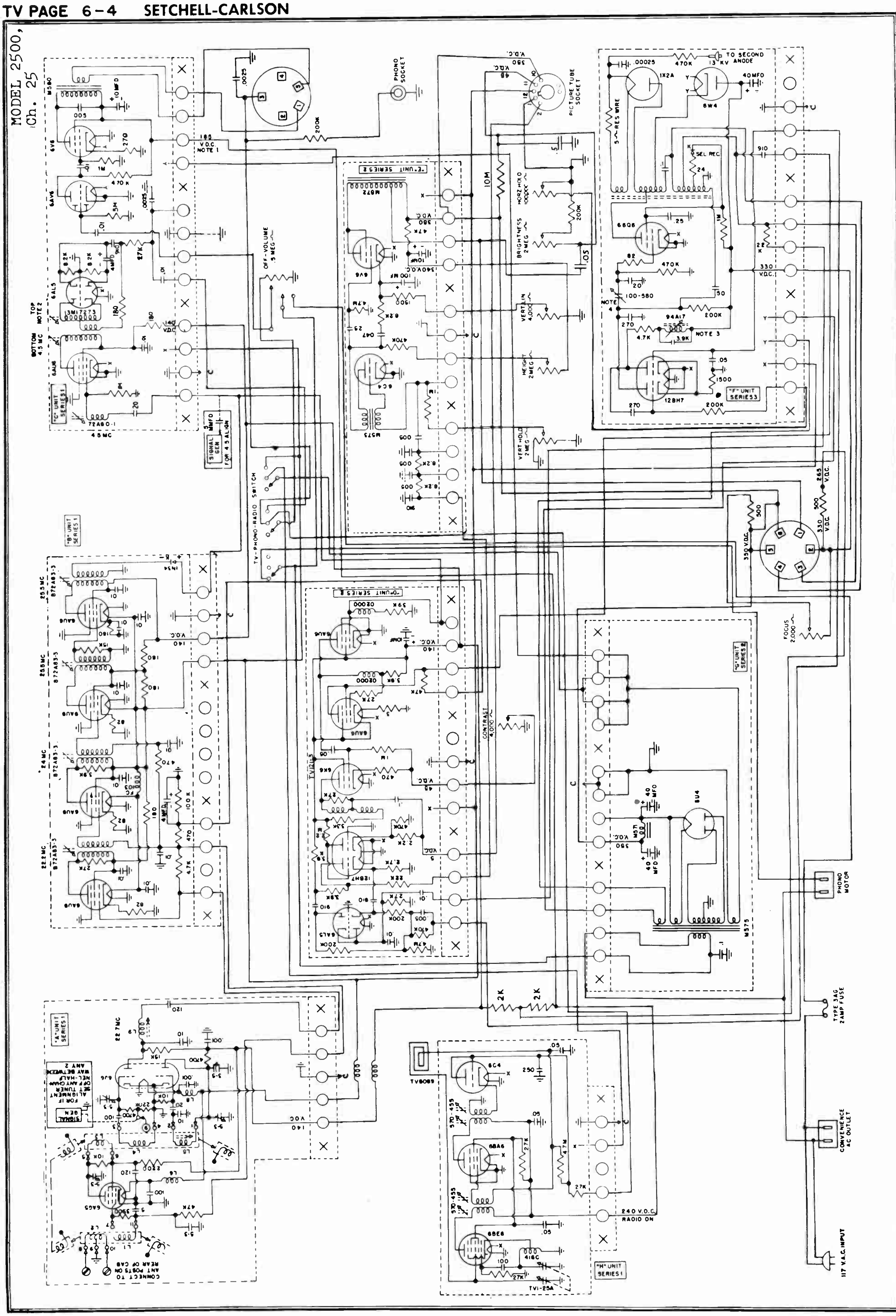

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IMPORTANT: SATISFACTORY OPERATION OF YOUR MASCO BOOSTER DEPENDS UPON YOUR READING AND FOLLOWING THESE INSTRUCTIONS CAREFULLY.

The Masco Sky Chief Booster operates from 110-120 volts, 60 cycles AC.

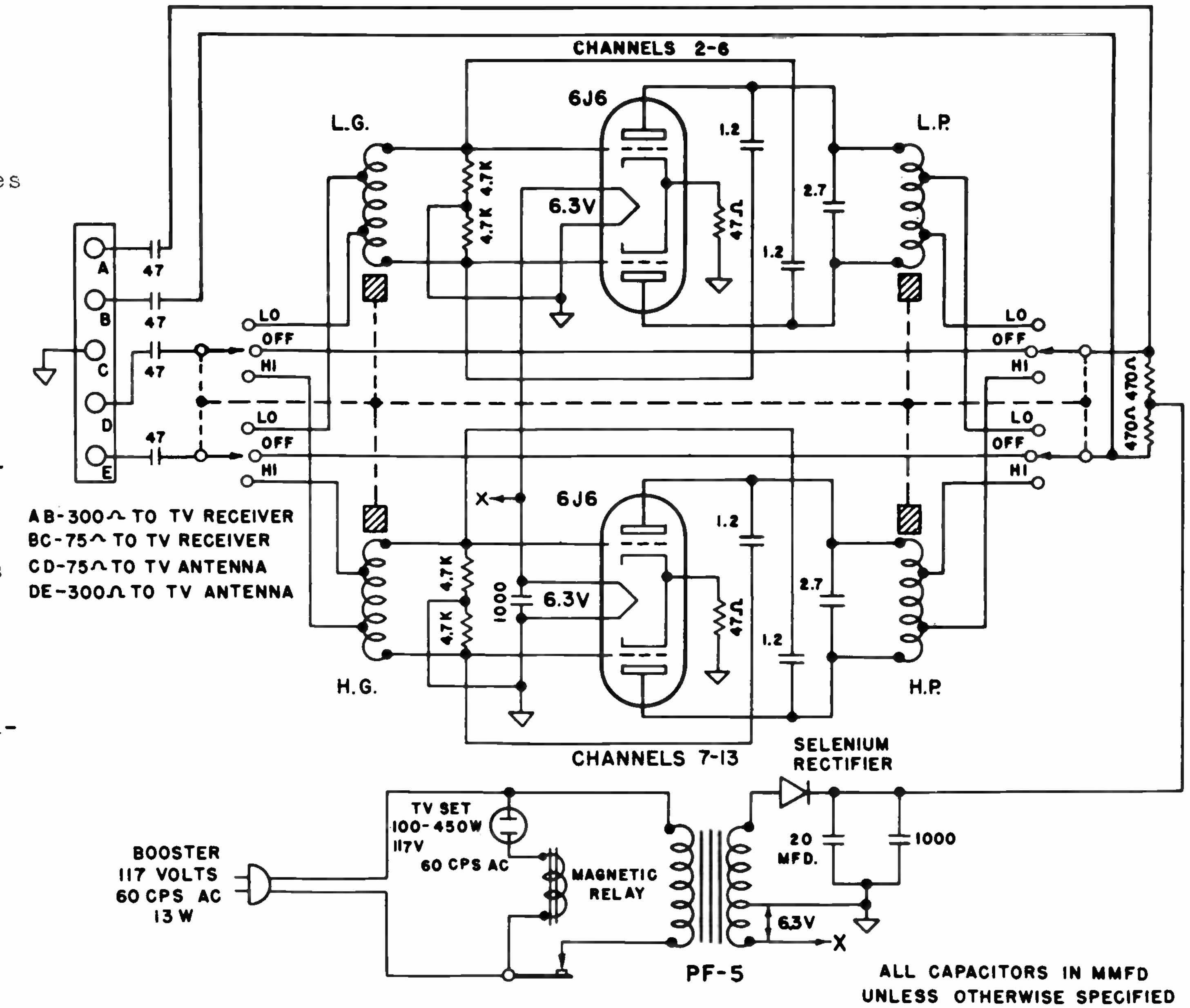
INSTALLATION

1. Remove the antenna lead-in wire from the antenna terminals of your television receiver.
2. Note the pre-tuned length of 300 ohm twin-lead wire which is supplied attached to terminals A and B (TV Receiver terminals). Connect the unused end of this wire to the antenna terminals of your television set.
   If your set uses a 75 ohm coaxial lead-in wire, cut off a three-foot length and connect it to terminals B and C of the Booster (connect shield to the grounded terminal C). Remove the length of 300 ohm line supplied.
3. Attach the 300 ohm twin-lead antenna lead-in wire to terminals D and E (TV ANTENNA) of your MASCO BOOSTER.
   If you have a 75 ohm coaxial lead-in, attach it to terminals C and D of the booster. The shield is connected to the ground terminal C.
4. DO NOT ALLOW INPUT AND OUTPUT LEADS TO CROSS.
5. Twist the bare strands of lead-in wire tightly when making connections to avoid shorting between terminals.

OPERATION

6. Remove the AC power cord of your television receiver from the wall receptacle and insert it into the AC receptacle of your MASCO SKY CHIEF TV BOOSTER. Insert the Booster line cord into the wall receptacle.

(Note: The magnetic switching relay in your MASCO Booster is designed to handle the power requirements of TV sets rated at up to 350 watts -- see the manufacturer's label at the rear of the receiver, in models not containing the relay then the continuously clockwise-rotating switch in your Booster turns both booster and TV set on and off. The pilot light next to the switch will glow when the booster and TV set are ON. If your TV receiver uses more than 350 watts, as TV-Radio-Phonograph consoles sometimes do, plug the AC cord of the TV section only into the Booster receptacle. This plug may be easily located inside the console. In this instance, the AC power plug of the Booster then is inserted into the socket of the TV section just vacated.



MODEL MB-2, Booster

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World Radio History

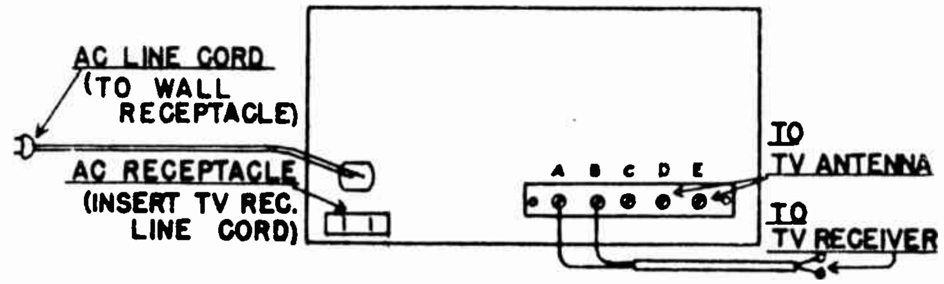
MODEL MB-2, Booster

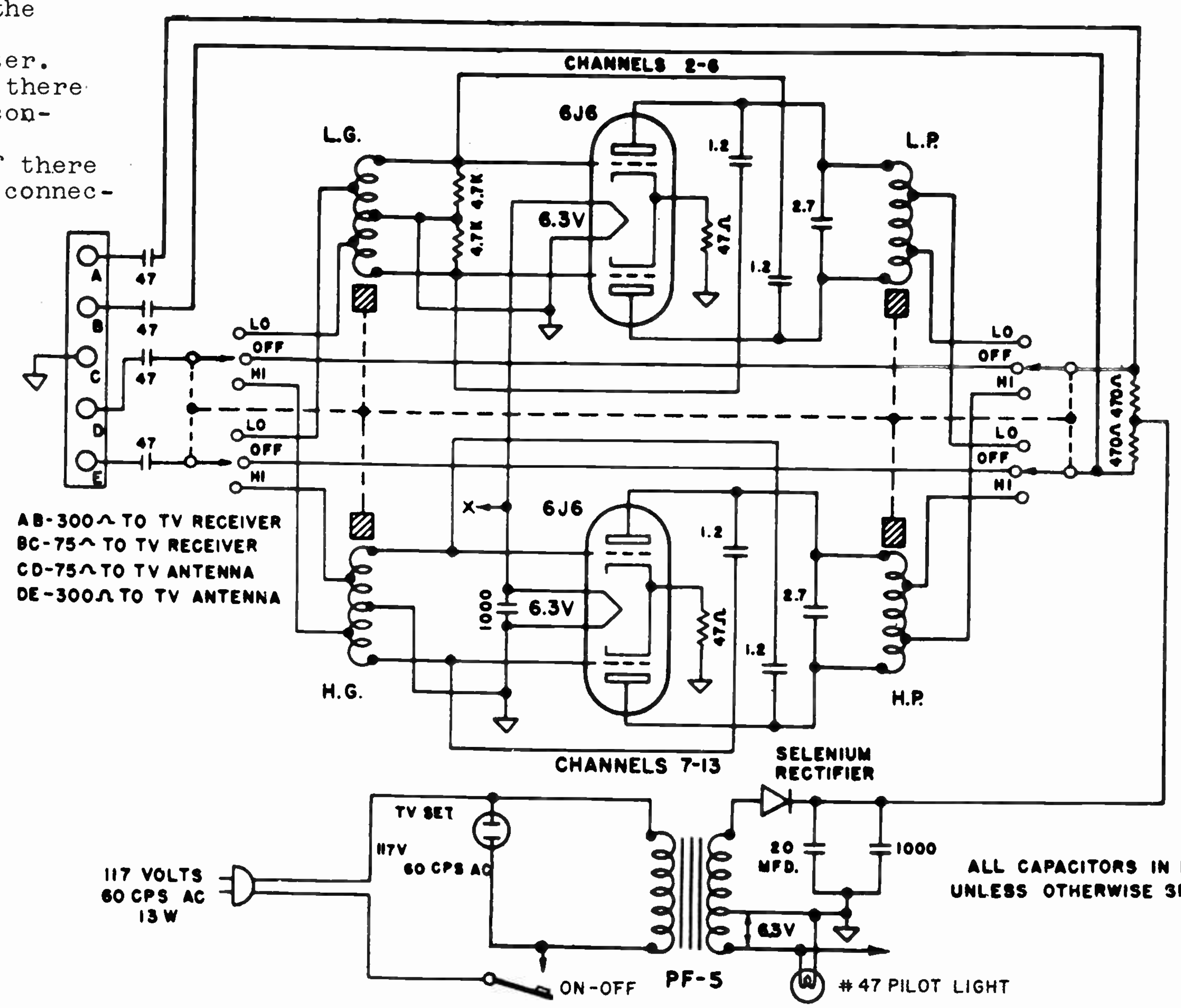
7. Turn the TV set ON. The Booster will now be turned on and off by the ON-OFF Switch of the TV set, only in models containing the magnetic switching relay.
8. Turn Booster CHANNEL SELECTOR KNOB to the desired station.
9. Tune TV receiver to the desired station.
10. KEEP THE RECEIVER CONTRAST CONTROL (ALSO CALLED PICTURE CONTROL) AT THE MINIMUM SETTING NEEDED TO GIVE A SATISFACTORY PICTURE.
11. Re-adjust CHANNEL SELECTOR KNOB for best picture.
12. IF THE STATION SIGNAL IS ORDINARILY STRONG and booster action is not required, place the Booster CHANNEL SELECTOR KNOB AT OFF POSITION. This feeds the signal from the antenna directly to the received while maintaining the Booster in a stand-by condition.

NOTE

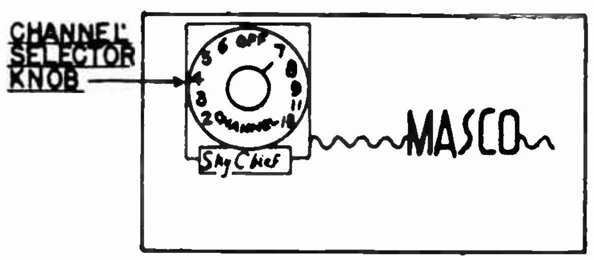
For best results the lead-in line should be tuned. This may be accomplished as follows:

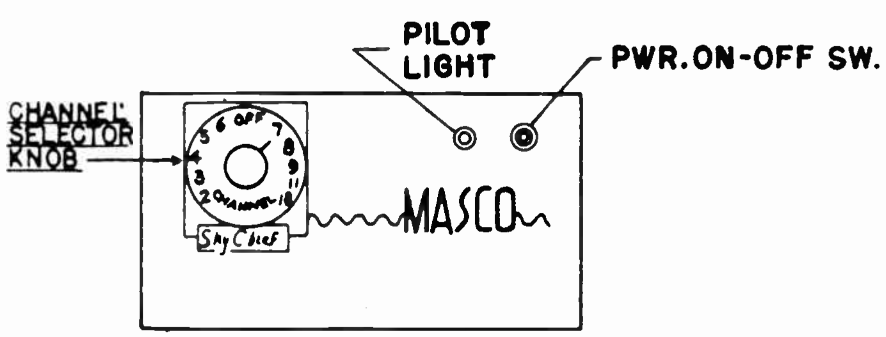
A. Set Booster and TV receiver to the weakest station. Adjust all receiver controls for best picture contrast.
B. Grasp the antenna lead-in line close to the Booster. Observe picture while running hand along this line. At one point the picture will appear brightest.
C. Cut the lead-in line at this point and reconnect to Booster.
D. Reverse antenna input connections on Booster and note if there is an improvement in the picture. If there is, allow the connections to remain reversed.
E. Reverse the output connections on the Booster and note if there is any improvement in the picture. If there is, allow the connections to remain reversed.





ALL CAPACITORS IN MMFD UNLESS OTHERWISE SPECIFIED





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GENERAL DESCRIPTION

These television chassis are twenty-one tube receivers. This includes rectifier and picture tubes. They have a continuous tuning range which permits the reception of the low and high frequency television bands and the FM radio band without interruption.

These chassis incorporate the LYT-L-TUNER. This Tuner is of unique design. It permits the reception of the low and high television bands as though they were but one band. The FM radio band which is situated between the low and high television bands is received with this Tuner at one end of the dial. The advantage of this design is that the television bands may be scanned for the desired program without the interruption of FM radio band reception. The high anode voltage is removed from the picture tube by the Tuner while the FM radio reception is being received.

The television and radio bands are covered by one turn of the coarse tuning knob or eight turns of the fine tuning knob. All stations are tuned for the best sound reception. The design of these chassis is such that when the best sound reception is received, the best television picture is received.

These chassis incorporating the LYT-L-TUNER are designed to operate with all commercial television broadband antennas. The Tuner is designed to match a 300 OHM impedance lead in.

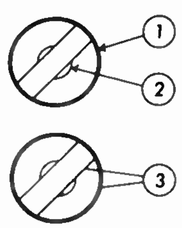
The high fidelity sound amplifier circuits and speaker reproduction capabilities which permit the utmost in enjoyment of FM high fidelity radio reception may be used as a phonograph amplifier. The record player is connected to the chassis by inserting the plug on the record player connecting wire into the phono jack located at the rear of the chassis.

When the phonograph is to be used the receiver should be tuned off any station and the contrast control should be turned to the full counterclockwise position.

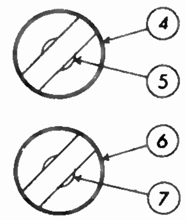
OPERATING CONTROLS

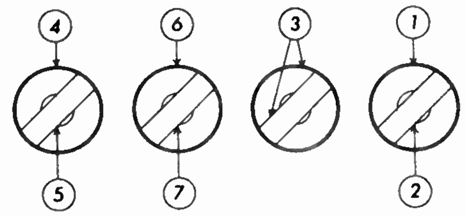
There are seven operating controls located at the front of the television set. These controls are:

1. Tuning-fine
2. Tuning-coarse
3. On-Off volume



4. Vertical Hold
5. Horizontal Hold
6. Contrast
7. Brightness





Operating controls as they will be found on our models

OPERATION

The power cord located at the rear of the cabinet is plugged into any convenient 115 volt AC outlet in the home. The 300 OHM antenna lead in wire is connected to the two terminals located at the rear of the cabinet (on the cabinet back and marked "300 OHM").

TUBE COMPLEMENT

	Tube Used	Function
(1)	RCA 12AT7	R.F. Amplifier
(2)	RCA 6J6	RP Oscillator
(3)	RCA 6AG5	Converter
(4)	RCA 6BA6	1st Sound IF Amplifier
(5)	RCA 6AU6	2nd Sound IF Amplifier
(6)	RCA 6AL5	Sound Discriminator
(7)	RCA 6AT6	1st Audio Amplifier and Bias Clamp
(8)	RCA 6K6GT	Audio Output
(9)	RCA 6AG5	1st Picture i-f Amplifier
(10)	RCA 6AG5	2nd Picture i-f Amplifier
(11)	RCA 6AG5	3rd Picture i-f Amplifier
(12)	RCA 6AL5	Picture 2nd Detector & Sync Limiter
(13)	RCA 12AU7	1st & 2nd Video Amplifier
(14)	RCA 6SN6-GT	Sync Amplifier & Sync Separator
(15)	RCA 6SN7-GT	Vertical Discharge and Output
(16)	RCA 6SN7-GT	Horizontal Sweep Oscillator and Control
(17)	RCA 6BG6G	Horizontal Sweep Output
(18)	RCA 5V4-G	Damper
(19)	RCA 1B3-GT/ 8016	High Voltage Rectifier
(20)	RCA 5U4G	Power Supply Rectifier
(21)		Picture Tube (Refer to Model Information)
(22)	RCA 6C4	Vertical Oscillator

RADIO FREQUENCY RANGES

Channel No.	Channel Freq. Mc.	Picture Carrier Freq. Mc.	Sound Carrier Freq. Mc.	Receiver R.F. Osc. Freq. Mc.
1	-	-	-	-
2	54.60	55.26	59.75	81
3	60.66	61.25	65.75	87
4	66.72	67.25	71.75	93
5	76.82	77.25	81.75	103
6	83.88	88.25	87.75	109
7	174-180	175.25	179.75	201
8	180-186	181.25	185.75	207
9	186-192	187.25	191.75	213
10	192-198	193.25	197.75	219
11	198-204	199.25	203.75	225
12	204-210	205.25	209.75	231
13	210-216	211.25	215.75	237

POWER SUPPLY RATING 115 volts, 60 cycles, 220 watts

AUDIO POWER OUTPUT RATING

Undistorted	2 watts
Maximum	3 watts

PICTURE INTERMEDIATE FREQUENCIES

Picture Carrier Frequency	25.75 MC
Accompanying Sound Traps	21.25 MC

SOUND INTERMEDIATE FREQUENCIES

Sound Carrier Frequency	21-25 MC
Sound Discriminator Width between peaks	350 KC
Video Response	To 3 MC
Focus	Magnetic
Sweep Deflection	Magnetic
Scanning	Interlaced 525 Line
Horizontal Scanning Frequency	15,750 cps
Vertical Scanning Frequency	60 cps
Frame Frequency Picture Repetition Rate	30 cps

NON-OPERATING CONTROLS (not including RF and IF Adjustments)

Horizontal Centering	Rear Chassis Adjustment
Vertical Centering	Rear Chassis Adjustment
Height	Rear Chassis Adjustment
Horizontal Linearity	Top Chassis Screw Driver Adjustment
Vertical Linearity	Rear Chassis Adjustment
Horizontal Drive	Rear Chassis Screw Driver Adjustment
Horizontal Frequency, Fine	Rear Chassis Adjustment
Horizontal Oscillator Frequency Coarse	Bottom Chassis Screw Driver Adjustment
Horizontal Locking Range	Rear Chassis Screw Driver Adjustment
Focus	Rear Chassis Adjustment (on early production) Screw on focus magnet on later sets
Focus Coil (or magnet)	Screws on coil bracket
Ion Trap Magnet	Top Chassis Screw Adjustment
Deflection Coil	Top Chassis Screw Adjustment

RECEIVER OPERATING INSTRUCTIONS

The following adjustments are necessary when turning the receiver on for the first time.

1. Turn the receiver ON and advance the volume control to approximately mid-position.
2. Set the RAPID TUNING to the desired channel.
3. Turn the CONTRAST control fully counter clockwise.
4. Turn the BRIGHTNESS control fully counterclockwise then clockwise until a faint glow just appears on the screen.
5. Turn the CONTRAST control approximately three-fourths clockwise.
6. Adjust the FINE TUNING control for best sound fidelity and the Sound control for suitable volume.
7. Adjust the VERTICAL hold control until the pattern stops vertical movement.
8. Adjust the HORIZONTAL hold control until the picture appears on the screen.
9. Adjust the CONTRAST control for suitable picture contrast.
10. After the receiver has been on for some time it may be necessary to readjust the FINE TUNING control slightly for improved sound fidelity.
11. In switching from one station to another it may be necessary to repeat steps number 6 and 9.
12. When the set is turned on again after an idle period, it should not be necessary to repeat the adjustments if the positions of the controls have not been changed. If any adjustment is necessary, step number 6 is generally sufficient.
13. If the positions of the controls have been changed it may be necessary to repeat steps Number 2 through 9.

HIGH VOLTAGE WARNING

OPERATION OF THIS RECEIVER OUTSIDE THE CABINET OR WITH THE COVERS REMOVED INVOLVES A SHOCK HAZARD FROM THE RECEIVER POWER SUPPLIES. WORK ON THE RECEIVER SHOULD NOT BE ATTEMPTED BY ANYONE WHO IS NOT THOROUGHLY FAMILIAR WITH THE PRECAUTIONS NECESSARY WHEN WORKING ON HIGH VOLTAGE EQUIPMENT. DO NOT OPERATE THE RECEIVER WITH THE HIGH VOLTAGE COMPARTMENT SHIELD REMOVED.

KINESCOPE HANDLING PRECAUTIONS

DO NOT OPEN THE KINESCOPE SHIPPING CARTON, INSTALL, REMOVE, OR HANDLE THE KINESCOPE IN ANY MANNER UNLESS SHATTERPROOF GOGGLES AND HEAVY GLOVES ARE WORN. PEOPLE NOT SO EQUIPPED SHOULD BE KEPT AWAY WHILE HANDLING KINESCOPES. KEEP THE KINESCOPE AWAY FROM THE BODY WHILE HANDLING.

The kinescope bulb encloses a high vacuum and due to its large surface area is subjected to considerable air pressure. For these reasons, kinescopes must be handled with more care than ordinary receiving tubes. The large end of the kinescope bulb - particularly the rim of the viewing surface - must not be struck, scratched or subjected to more than moderate pressure at any time. In installation, if the tube sticks or fails to slip smoothly through the deflecting yoke, investigate and remove the cause of the trouble. Do not force the tube. Refer to the Receiver Installation section for detailed instructions on kinescope installation. All kinescopes are shipped in special cartons and should be left in the cartons until ready for installation in the receiver. Keep the carton for possible future use.

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INSTALLATION INSTRUCTIONS

UNPACKING - To unpack the receiver, tear open the carton flaps, pick the receiver up from the bottom of the cabinet and lift it out of the shipping carton. The operating control knobs are packed in a paper bag which is tied to the focus coil mounting bracket inside the cabinet. Remove the bag, Remove the protective cardboard shield from the 5U4G rectifier. Make sure all tubes are in place and are firmly seated in their sockets.

INSTALLATION OF KINESCOPE - The kinescope second anode contact is a recessed metal well in the side of the bulb. The tube must be installed so that this contact is approximately on top. The final orientation of the tube will be determined by the position of the ion trap flags. Looking at the kinescope gun structure it will be observed that the second cylinder from the base inside the glass neck is provided with two small metal flags as shown in Figure 2. The kinescope must be installed so that when looking down on the chassis, the two flags will be seen as shown in Figure 2.

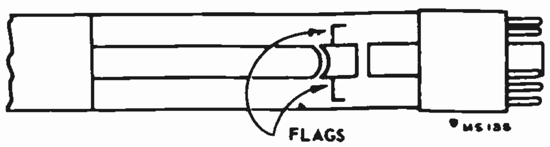

Figure 2. Ion Trap Flags

Slip the ion trap magnet on the neck of the kinescope with the small fingers toward the base of the tube. Connect the kinescope socket to the tube base. Install the control knobs on the proper control shafts. Determine that the deflection yoke is as far forward as possible. See that the high voltage lead to the kinescope second anode socket.

The antenna and power connections should now be made. Turn the power switch to the "ON" position, the brightness control fully clockwise and contrast control counter-clockwise.

ION TRAP MAGNET ADJUSTMENT - The ion trap rear magnet poles should be placed over the ion trap flags as shown in Figure 2. Starting from this position adjust the magnet by moving it forward or backward at the same time rotating it slightly around the neck of the kinescope for the brightest raster on the screen. Tighten the magnet adjustment thumb screw sufficiently to hold it in this position but still free enough to permit further adjustment. Reduce the brightness control setting until the raster is slightly above average brilliance. Adjust the focus control R129 on the chassis rear apron until the line structure of the raster is clearly visible. Readjust the ion trap magnet for maximum raster brilliance. The final touches on this adjustment should be made with the brightness control at the maximum position with which good line focus can be maintained.

FOCUS COIL ADJUSTMENTS - Turn the centering controls R152 and R166 to mid position. See Figure 3 for location of these rear apron controls.

If the corner of the raster is shadowed it indicates that the electron beam is striking the neck of the tube. Loosen the focus coil adjustment nuts and rotate the coil about its vertical and horizontal axes until the entire raster is visible, approximately centered and with no shadowed corners. Tighten the focus coil adjustment nuts with the coil in this position.

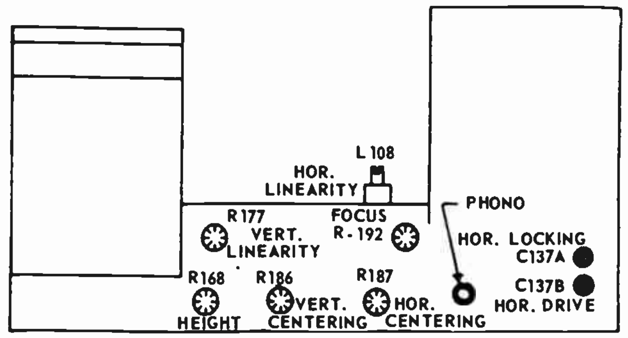

Figure 3. Rear Chassis Adjustment

DEFLECTION YOKE ADJUSTMENT - If the lines of the raster are not horizontal or squared with the picture mask, rotate the deflection yoke until this condition is obtained. Tighten the yoke adjustment screw.

PICTURE ADJUSTMENT - It will now be necessary to obtain a test pattern picture in order to make further adjustments. See steps 2 through 9 of the receiver operating instructions on Page 2.

CHECK OF HORIZONTAL OSCILLATOR ALIGNMENT - Turn the horizontal hold control to the extreme counter-clockwise position. The picture should remain in horizontal sync. Momentarily remove the signal by switching off channel and then back. Normally the picture will be out of sync. Turn the control clockwise slowly. The number of diagonal bars will be gradually reduced and when only 3-1/2 to 4-1/2 bars sloping downward to the left are obtained, the picture will pull into sync upon slight additional clockwise rotation of the control. Pull in should occur when the control is approximately 90 degrees from the extreme counterclockwise position. The picture should remain in sync for approximately 90 degrees of additional clockwise rotation of the control. At the extreme clockwise position, the picture should be out of sync and should show from 3-1/2 to 4-1/2 bars sloping downward to the right.

If the receiver passes the above checks and the picture is normal and stable the horizontal oscillator is properly aligned. Skip "Alignment of Horizontal Oscillator" and proceed with "Focus" adjustment.

ALIGNMENT OF HORIZONTAL OSCILLATOR - If in the above check the receiver failed to hold sync with the hold control at the extreme counterclockwise position or failed to hold sync at least 60 degrees of clockwise rotation of the control from the pull in point it will be necessary to make the following adjustments.

If the trimmer has insufficient range, set the trimmer to mid-position (1 turn out from max. capacity) and adjust the T106 horizontal frequency adjustment until this condition is obtained. See Figure 5 for the location of T106.

HORIZONTAL LOCKING RANGE ADJUSTMENT - Set the horizontal hold control to the full counter-clockwise position. Momentarily remove the signal by switching off channel and then back.

Slowly turn the horizontal hold control clockwise and note the least number of diagonal bars obtained just before the picture pulls into sync.

If more than 4-1/2 bars are present just before the picture pulls into sync, adjust the horizontal locking range trimmer C137A slightly clockwise. If less than 3-1/2 bars are present adjust C137 slightly counterclockwise.

Turn the picture control counter-clockwise, momentarily remove the signal and recheck the number of bars present at the pull in point. Repeat this procedure until 3-1/2 to 4-1/2 bars are present.

Repeat the adjustments under "Horizontal Frequency Adjustment" and "Horizontal Locking Range Adjustment" until the conditions specified under each are fulfilled. When the horizontal hold operates as outlined under "Check of Horizontal Oscillator Alignment," the oscillator is properly adjusted.

HEIGHT AND VERTICAL LINEARITY ADJUSTMENTS - Adjust the height control R168 on chassis rear apron until the picture fills the mask vertically. Adjust vertical linearity (R177 on rear apron) until the test pattern is symmetrical from top to bottom. Adjustment of either control will require a readjustment of the other. Adjust vertical centering to align the picture with the mask.

WIDTH, DRIVE AND HORIZONTAL LINEARITY ADJUSTMENTS - Vary the horizontal drive trimmer C137B to yield the best compromise between brightness and linearity. Adjust the horizontal linearity control of L108 for best linearity of the right half of the picture. Adjust horizontal centering to align the picture with the mask.

FOCUS - Adjust the focus control R192 for maximum definition of the vertical wedge of the test pattern.

Check to see that all cushion, yoke, focus coil and ion trap magnet thumb screws are tight. Replace the cabinet back grille. Make sure that the back is on tight, otherwise it may rattle at high volume.

CHECK OF R.F. OSCILLATOR ADJUSTMENTS - With a crystal calibrated test oscillator or heterodyne frequency meter, check to see if the receiver of oscillator is adjusted to the proper frequency on all channels. If adjustments are required, these should be made by the method outlined in the alignment procedures on Page 8.

Tune in all available Television Stations. Observe the picture for detail for proper interlacing and for the presence of interference or reflections.

RECEIVER LOCATION - The owner should be advised of the importance of placing the receiver in the proper location in the room.

The location should be chose:
- To give easy access for operation and comfortable viewing.
- To permit convenient connection to the antenna.
- Convenient to an electrical outlet.
- To allow adequate ventilation.

VENTILATION CAUTION - The receiver is provided with adequate ventilation holes in the bottom, sides and back of the cabinet. Care should be taken not to allow these holes to be covered or ventilation to be impeded in any way.

ANTENNAS - The finest television receiver built may be said to be only as good as the antenna design and installation. It is therefore important to use a correctly designed antenna, and to use care in its installation. We recommend Amphenol #114-005 or equivalent, on all twelve television channels. This antenna uses the 300 ohm television transmission line.

In most cases the antenna should not be installed permanently until the quality of the picture reception has been observed on a television receiver.

A temporary transmission line can be run between receiver and the antenna allowing sufficient slack to permit moving the antenna. Then, with a telephone system connecting an observer at the receiver and an assistant at the antenna, the antenna can be positioned to give the most satisfactory results on the receiver signal. A shift of direction or a few feet in antenna position may affect a tremendous difference in picture reception.

REFLECTIONS - Multiple images sometimes known as echoes or ghosts are caused by the signal arriving at the antenna by two or more routes. The second or subsequent image occurs when a signal arrives at the antenna after being reflected off a building, a hill or other object. In severe cases of reflections, even the sound may be distorted. In less severe cases, reflections may occur that are not noticeable as reflections but that will instead cause a loss of definition in the picture.

Depending upon the circumstances, it may be possible to eliminate the reflections by rotating the antenna or by moving it to a new location. In extreme cases it may be impossible to eliminate the reflection.

Under certain extremely unusual conditions, it may be possible to rotate or position the antenna so that it received the cleanest picture over a reflected path. If such is the case, the antenna should be so positioned. However, such a position may give variable results as the nature of reflecting surfaces may vary with weather conditions. Wet surfaces have been known to have different reflecting characteristics than dry surfaces.

INTERFERENCE - Auto ignition, street cars, electrical machinery and diathermy apparatus may cause interference which spoils the picture. Whenever possible the antenna location should be removed as far as possible from highways, hospitals, doctors offices and similar sources of interference. In mounting the antenna care must be taken to keep the antenna rods at least 1/4 wave length (at least 6 feet) away from other antennas, metal roofs, gutters or other metal objects.

Short-wave radio transmitting and receiving equipment may cause interference in the picture in the form of moving ripples. In some instances it may be possible to eliminate the interference by the use of a trap in the antenna transmission line. However, if the interfering signal is on the same frequency as the television station, a trap will provide no improvement.

WEAK PICTURE - When the installation is near the limit of the area served by the transmitting station, the picture may be speckled, having a "snow" effect and may not hold steady on the screen. This condition is due to lack of signal strength from the transmitter.

INFORMATION REFERENCES - In short, a television receiving antenna and its installation must conform to much higher standards than an antenna for reception of International Short Wave and Standard Broadcast signals. For further information on antennas and antenna installation see your dealer.

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SERVICE SUGGESTIONS

Some of the possible troubles that may be encountered, with their effects and causes, are listed below:

NO RASTER ON KINESCOPE - The effectof no raster can be caused by the following.

Incorrect adjustment of ion trap magnet. Open coil; negative bleeder open, coils reversed.

No high voltage. Check V17 (6BG6-G) and V18 (8016) tubes and circuits. If the horizontal deflection circuits are operating, as evidenced by the correct wave form measured on terminal 4 of horizontal output transformer T108, the trouble can be isolated to the high voltage rectifier (V18) circuit. Either the high voltage winding (points 2 to 3 on T108) is open; the 8016 tube is defective; its filament circuit is open; or the high voltage filter capacitor C163 is shorted.

Damper tube (V20, 5V4G), inoperative. Plate voltage supply for 6BG6-G horizontal output tube is obtained through the damper tube. Check tube, and heater winding on T110. If tube is O.K., check L108 horizontal llinearity coil for continuity and capacitors C157 and C159) for short circuit.

Defective kinescope. Heater open; cathode "return" circuit open.

No plate voltage. Shorted electrolytic capacitor open choke coil. All plus B measurements are accessible for measurement by removing cover from bleeder box.

Horizontal osc. and control tube (V17, 6SN7-GT) inoperative. Check for sawtooth on grid of horizontal output tube (V18, 6BG6-G) if not present, check waveforms, voltages, and components in V17 circuits.

HORIZONTAL DEFLECTION ONLY - If horizontal deflection only is obtained, evidences by a straight line across the face of the kinescope, it can be caused by the following:

(1) Vertical oscillator and output tube (V15 6C4) inoperative. Check waveforms and voltages on grid and plate.

(2) Vertical output transformer (T109) open.

(3) Yoke vertical coils open.

POOR VERTICAL LINEARITY - If adjustment of the vertical height and linearity controls will not correct this condition, any of the following may be the cause.

(1) Vertical output transformer (T109) defective.

(2) Capacitors C160-A or C158-A defective.

(3) V16 - (6SN7-GT) defective. Check waveforms and voltages.

(4) Excess leakage or incorrect value in capacitor C162.

(5) Low plate and bias voltages. Check rectifier tube and capacitors in plus B supply circuits.

(6) Capacitor C161 defective.

POOR HORIZONTAL LINEARITY - If adjustment of controls does not correct this condition, check the following:

(1) Check or replace horizontal output tube (V18, 6BG6-G).

(2) Check or replace damper tube (V20, 5V4-G).

(3) Check waveform on grid of V18.

(4) Check linearity coil L108 for short circuit.

(5) Check capacitors C157 and C159 for defects.

TRAPEZOIDAL OR NON-SYMMETRICAL RASTER - This condition can be caused by; Defective yoke.

WRINKLES ON LEFT SIDE OF RASTER - This condition can be caused by: Defective yoke due to R101, R151, or C141 (internal in yoke assembly) being wrong value or open. These components are mounted in rear of yoke assembly.

SMALL RASTER - This condition can be caused by;

(1) Low plus B or line voltage.

(2) Insufficient output from horizontal output tube V18 (6BG6-G). Replace tube.

RASTER - NO IMAGE, BUT ACCOMPANYING SOUND - This condition can be caused by;

(1) No signal on kinescope grid. Check picture i.f. amplifier tubes V4 (6AG5), V5 (6AG5), V6 (6AG5), second detector V7A (6AL5) and video amplifier V8 (12AU7).

(2) Bad contact to kinescope grid. (Lead to socket broken).

SIGNAL APPEARS ON KINESCOPE GRID BUT IMPOSSIBLE TO SYNCHRONIZE THE PICTURE VERTICALLY AND HORIZONTALLY - A condition of this nature can be caused by:

(1) Defective sync amplifier and separator (V14, 6SN7-GT).

(2) If tube is O.K. check voltages, waveforms and associated circuits.

SIGNAL ON KINESCOPE GRID AND HORIZONTAL SYNC ONLY - If this condition is encountered, check:

Vertical integrating network capacitors C148, C151, C152, C154 and resistors R161, R163, R165.

PICTURE STABLE BUT WITH POOR RESOLUTION - If the picture resolution is not up to standard, it may be caused by any of the following:

(1) Defective picture detector (V7A 6AL5) or video amplifier (V8, 12AU7).

(2) Open video peaking coil. Check all peaking coils (L104, L105, L106, L107) for continuity. Note that L105 and L106 have shunting resistors.

(3) Leakage in V8 grid capacitor C134.

If above components are not found to be defective, check the following:

(1) Check all potentials in video circuits.

(2) Check kinescope grid circuit for poor or dirty contact.

(3) Check adjustment of focus control (R192). It should be effective on either side of proper focus.

(4) Check and realign, if necessary, the picture i-f and r-f circuits.

PICTURE SMEAR -

(1) Normally, smear can be attributed to phase shift at the low frequency end of the video characteristic. This can be caused by improper values of R and C in the video circuits. Check for grid current on video amplifier tube V8.

(2) This trouble can originate in either the transmitter or the receiver. Check reception from another station.

PICTURE JITTER

(1) If regular sections at the left of the picture are displaced, replace the horizontal output tube (V18, 6BG6-G).

(2) Vertical instability may be due to loose connections or noise received with the signal.

(3) Horizontal instability may be due to unstable transmitted sync or to "noise."

ALIGNMENT PROCEDURE

TEST EQUIPMENT - To service this receiver properly, it is recommended that the following test equipment be available.

R-F SWEEP GENERATOR meeting the following requirements.

(a) Frequency ranges
18 to 30 mc, 1 mc sweep width
40 to 190 mc, 10 mc sweep width
170 to 225 mc, 10 mc sweep width

(b) Output adjustable with at least 1 volt maximum.

(c) Output constant on all ranges.

(d) Flat output in all attenuator positions.

CATHODE-RAY OSCILLOSCOPE - Preferably one with a wide band vertical deflection and an input calibrating source.

SIGNAL GENERATOR - To provide the following frequencies: Output on these ranges should be adjustable and at least 1 volt maximum.

(a) Intermediate frequencies;

21.25 mc sound i-f and sound traps
22.8 mc converter transformer
23.9 mc first picture i-f coil
24.5 mc third picture i-f coil
26.0 mc second picture i-f primary
27.25 mc second picture i-f secondary

(b) Radio frequencies

Channel Number	Picture Carrier Freq. Mc.	Sound Carrier Freq. Mc.
2	55.25	59.75
3	61.25	65.75
4	67.25	71.75
5	77.25	81.75
6	83.25	87.75
7	175.25	179.75
8	181.25	185.75
9	187.25	191.75
10	193.25	197.75
11	199.25	203.75
12	205.25	209.75
13	211.25	215.75

HETERODYNE FREQUENCY METER with crystal calibrator if the signal generator is not crystal controlled.

ELECTRONIC VOLTMETER of "Junior VoltOhmyst" type and a high voltage probe for use with this meter to permit measurements up to 10kv.

If possible the chassis should then be serviced without the kinescope. However, if it is necessary to view the raster during servicing, the kinescope should be carefully mounted. The kinescope should never be allowed to support its weight by resting in the deflecting yoke. A bracket should be used to support the tube at its viewing screen.

By turning the chassis on end with the power transformer "UP," all adjustments will be made conveniently available. Since this is the only safe position in which the chassis will rest and still leave adjustments accessible, the trimmer location drawings are oriented similarly for ease of use.

CAUTION: Do not permit the kinescope second anode lead to become shorted to the chassis. To do so will cause a considerable overload on the high voltage filter resistor R167.

ADJUSTMENTS REQUIRED - Normally only the r-f oscillator trimmers will require the attention of the service technician. All other circuits are either broad or very stable and hence will seldom require adjustment.

Due to the high frequencies at which the receiver operates the r-f oscillator adjustment is critical and may be affected by a tube change. The trimmers can be adjusted to the proper frequency on channel 6 and channel 10 with practically any 6J6 tube in the socket.

In replacing, if the old tube can be matched for frequency by trying several new ones, this practice is recommended. At best, however it will probably be necessary to realign the oscillator trimmers completely after changing the tube.

The detailed alignment procedure which follows is intended primarily as a discussion of the method used, precautions to be taken and the reasons for these precautions. Then for more convenient reference during alignment a tabulation of the i.f. alignment method is given. All the information necessary for alignment is given in the table; however, alignment by the table should not be attempted before reading the detailed instructions.

ORDER OF ALIGNMENT - When a complete receiver alignment is necessary, it can be most conveniently performed in the following order:

Sound discriminator
Sound i-f transformers
Picture i-f traps
Picture i-f coils
R-F and converter trimmers
R-F oscillator trimmers
Retouch picture i-f transformers
Sensitivity check

SOUND DISCRIMINATOR ALIGNMENT - Set the signal generator for approximately 1 volt output at 21.25 mc and connect it to the second sound i-f grid.

Detune T102 secondary (bottom).

Set the "VoltOhmyst" on the 10 volt scale.

Connect the meter in series with a one megohm resistor to the junction of diode resistors R106 and R108.

Adjust the primary of T102 (top) for maximum output on the meter.

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Connect the "VoltOhmyst" to pin 1 of V11 and set on the 3 volt scale.

Adjust T102 secondary (bottom). It will be found that it is possible to produce a positive or negative voltage on the meter dependent upon this adjustment. Obviously to pass from a positive to a negative voltage, the voltage must go through zero. T102 (bottom) should be adjusted so that the meter indicates zero output as the voltage swings from positive to negative. This point will be called discriminator zero output.

Connect the sweep oscillator to the grid of the second sound i-f amplifier.

Adjust the sweep band width to approximately 21.25 and with an output of approximately, 1 volt.

Connect the oscilloscope to pin 1 of V11.

The peak to peak bandwidth of the discriminator should be approximately 350 kc. and should be linear from 21.175 mc to 21.325 mc.

SOUND I-F ALIGNMENT - Connect the sweep and signal generator to the top end of the trap winding (on top of chassis).

Connect the oscilloscope to the second sound i-f grid return (terminal A T101) in series with a 33,000 ohm isolating resistor.

Connect a 5600 ohm resistor from terminal A T101 to ground. Insert a 21.25 mc marker signal from the signal generator into the first sound i-f grid.

Adjust T101 (top and bottom) for maximum gain and symmetry about 21.25 mc. marker. The band width at 80% response from the first sound i-f grid to the second i-f grid should be approximately 250 kc.

The output level from the sweep should be set to produce approximately 3 volt peak-to-peak at the second sound i-f grid return when the final touches on the above adjustment are made. It is necessary that the sweep output voltage should not exceed the specified values, otherwise the response curve will be broadened, permitting slight misadjustment to pass unnoticed and possibly causing distortion on weak signals.

PICTURE I-F TRAP ADJUSTMENT - Connect the "VoltOhmyst" to the junction of R118 and R120, and adjust the picture control for 3 volts on the meter.

Set the channel switch to channel 13.

Connect the "VoltOhmyst" across the picture second detector load resistor R132 and set it on the 3 volt scale.

Connect the output of the signal generator to pin #1 of the 6AG5 converter tube.

Set the generator to 21.25 mc and check it against a crystal calibrator to insure that the generator is exactly on frequency.

Adjust Trap and T105 for minimum indication on the "VoltOhmyst."

Set the generator to 27.25 mc. and adjust T104 secondary for minimum indication on the "VoltOhmyst."

PICTURE I-F COIL ADJUSTMENTS - Set the signal generator to each of the following frequencies, and peak the specified adjustment for maximum indication on the "VoltOhmyst."

22.8 mc T3 (bottom)
23.9 mc L101 (top of chassis)
26.0 mc L104 (top of chassis)
24.5 mc L102 (top of chassis)

PICTURE I-F OSCILLATION - If the receiver is badly misaligned and two or more of the i-f coils are tuned to the same frequency, the receiver may fall into i-f oscillation. I-F oscillation shows up as a voltage in excess of 3 volts at the picture detector load resistor. This voltage is unaffected by r-f signal input and sometimes is independent of picture control setting.

If such a condition is encountered it is sometimes possible to stop oscillation by adjusting the coils approximately to frequency by setting the adjustment stud extensions of T3, L101, T104 and L102 to be approximately equal to those of another receiver known to be in proper alignment. If this does not have the desired effect, it may be possible to stop oscillation by increasing the grid bias. If so, it should be possible to align the coils by the usual method. Once aligned in this manner the i-f should be stable with reduced bias.

If the oscillation cannot be stopped in the above manner, shunt the grids of the first two i-f amplifiers to ground with 1800 mmf capacitors. Connect the signal generator to the third i-f grid and adjust L102 to frequency.

Remove the shunting capacitor from the second i-f grid, connect the signal generator to this grid and align T104. Remove the shunting capacitor from the first i-f grid, connect the signal generator and align L101.

Connect the signal generator to pin #1 of the 6AG5 converter (in the r-f tuning unit) and align T3 to frequency.

If this does not stop the oscillation the difficulty is not due to i-f misalignment as the i-f section is very stable when properly aligned.

Check all i-f by-pass condensers, coil loading resistors, tubes, socket voltages, etc.

R-F AND CONVERTER TRIMMER ADJUSTMENT - Connect the r-f sweep oscillator to the receiver antenna terminals. If the sweep oscillator has a 50 ohm single-ended output, it will be necessary to obtain balanced output by connecting as shown in Figure 4.

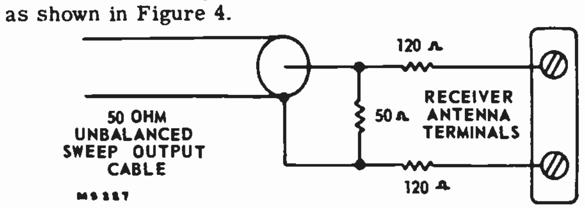

Figure 4. Unbalanced Sweep Cable Terminals

Connect the oscilloscope through a 47,000 ohm resistor to Pin 1 of the 6AG5 converter tube.

By-pass the first picture i-f grid to ground through 1000 mmid capacitor.

Keep the leads to this by-pass as short as possible. If this is not done lead resonance may fall in the r-f range and cause an incorrect picture of the r-f response.

Connect the "VoltOhmyst" to the junction of R115 and R116 and adjust the picture control for 3 volts on the meter.

Connect the signal generator loosely to the receiver antenna terminals.

Rotate the tuner knob to the maximum clockwise position and adjust the position of the pointer to the arrow on the back side of the dial plate.

Rotate the tuner knob until the pointer is aligned with the "6" mark on the back side of the dial plate.

Set the sweep oscillator to cover channel 6.

Insert markers of channel 6 picture carrier and sound carrier at 83.25 mc. and 87.75 mc.

Adjust the low band converter trimmer and low band R.F. trimmer.

Check the response of channels 2 through 5 by first setting the sweep generator to each of these channels and then turning the tuner knob until the pattern appears on the oscilloscope screen.

Rotate the tuner knob until the pointer is aligned with the "10" mark on the back side of the dial plate

Set the sweep oscillator to cover channel 10.

Insert markers of channel 10 picture carrier and sound carrier at 193.25 mc and 197.75 mc.

Adjust the high band converter trimmer, and high band R.F. trimmer, for the "W" shaped response centered about the marker.

Check the response of channels 6, 7, 9, 11, 12 and 13 by setting the sweep generator to each of the channels and then adjusting the tuner knob until the pattern appears.

Remove the 1000 mmf capacitor from the first picture i-f grid.

R.F. OSCILLATOR TRIMMER ADJUSTMENT - The r-f oscillator may be aligned by adjusting it to beat with a crystal calibrated heterodyne frequency meter or by feeding a signal into the receiver at the r-f sound carrier frequency and adjusting the oscillator for zero output from the sound discriminator. In this latter case the sound discriminator must first have been aligned to exact frequency. Either method of adjustment will produce the same results. The method used will depend upon the type of test equipment available.

Regardless of which method of oscillator alignment is used, the frequency standard must be crystal controlled or calibrated.

If the receiver oscillator is to be adjusted by the heterodyne frequency meter method, the frequencies listed under "R-F Sound Carrier" in the table must be available.

If the receiver oscillator is adjusted by feeding in the r-f sound carrier signal the frequencies listed under "R-F Sound Carrier" must be available.

Channel Number	Receiver R-F Osc. Freq. Mc.	R-F Sound Carrier Freq. Mc.
2	81	59.75
3	87	65.75
4	93	71.75
5	103	81.75
6	109	87.75
7	201	179.75
8	207	185.75
9	213	191.75
10	219	197.75
11	225	203.75
12	231	209.75
13	237	215.75

If the heterodyne frequency meter method is used, couple the meter probe loosely to the receiver oscillator.

ALIGNMENT PROCEDURE

Connect the signal generator to the receiver antenna terminals.

The order of alignment remains the same regardless of which method is used.

Rotate the tuner knob until the pointer is aligned with the "6" mark on the back side of the dial plate.

MODELS TV-116-A, TV-116-B, TV-117-A, TV-117-B, Ch. CTV-219-A; CTV-215-A

Adjust the frequency standard to the correct frequency (109.0 mc. for the heterodyne frequency meter of 87.75 mc. for the signal generator).

Adjust the low band oscillator trimmer, C19, for an audible beat on the heterodyne frequency meter of zero voltage from the sound discriminator. Be certain that the voltage across the discriminator varies + and - as the tuner knob is rotated slightly to either side of the channel 6 position.

Set the frequency standard to the proper frequency for channel 2 as listed in the alignment table.

Rotate the tuner knob toward the channel 2 position and see that the discriminator voltage goes through zero or that an audible beat note is obtained from the heterodyne frequency meter.

Rotate the tuner knob until the pointer is aligned with the "10" mark on the back side of the dial plate.

Adjust the high band oscillator trimmer, for an audible beat note on the heterodyne frequency meter or zero voltage from the sound discriminator.

Adjust the frequency standard to the correct frequency (219.0 mc. for the heterodyne frequency meter on 197.75 mc. for the signal generator).

Set the frequency standard to the proper frequency for channel 7 as listed in the alignment table.

Rotate the tuner knob toward the channel 7 position and see that the discriminator voltage goes through zero or that an audible beat note is heard from the heterodyne frequency meter.

Check the tuner coverage of channel 13 following the same general procedure as outlined for channel 7.

RETOUCHING OF PICTURE I-F ADJUSTMENT - The picture i-f response curve varies somewhat with the change of bias and for this reason it should be aligned with approximately the same single input as it will receive in operation.

If the receiver is located at the edge of the service area, it should be aligned with approximately -1 volt i-f grid bias. However, for normal conditions, (signals of 1000 microvolts or greater), it is recommended that the picture i-f be aligned with a grid bias of -3 volts. Set the picture control for -3 volts at the junction of R118 and R120.

Connect the r-f sweep generator to the receiver antenna terminals.

Connect the signal generator to the antenna terminals and feed in the 25.75 mc. i-f picture carrier marker and a 23 mc. marker.

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Connect the oscilloscope across the picture detector load resistor, R132.

Set the channel switch to channel (between 1 and 6) found to have the best response during the r-f and converter trimmer adjustment.

Set the sweep output to produce approximately .3 volt peak to peak across the picture detector load resistor.

Observe and analyze the response curve obtained. The response will not be ideal and the i-f adjustments must be retouched in order to obtain the desired curve. In making these adjustments care should be taken that no two transformers are tuned to the same frequency as i-f oscillation may result.

On final adjustment the picture carrier marker must be at approximately 50% response. The curve must be approximately flat topped and with the 23 mc. marker at approximately 90% response.

The most important consideration in making the i-f adjustments is to get the picture carrier at the 50% response point. If the picture carrier operates too low on the response curve, loss of low frequency video response, of picture brilliance, of blanking, and of sync may occur. If the picture carrier operates too high on the response curve, the picture definition is impaired by loss of high frequency video response.

SENSITIVITY CHECK - A comparative sensitivity check can be made by operating the receiver on a weak signal from a television station and comparing the picture and sound obtained to that obtained on other receivers under the same conditions.

This weak signal can be obtained by connecting the shop antenna to the receiver through an attenuator pad of the type shown in Figure 5. The number of stages in the pad depends upon the signal strength available at the antenna. A sufficient number of stages should be inserted so that a somewhat less than normal contrast picture is obtained when the picture control is at the maximum clockwise position.

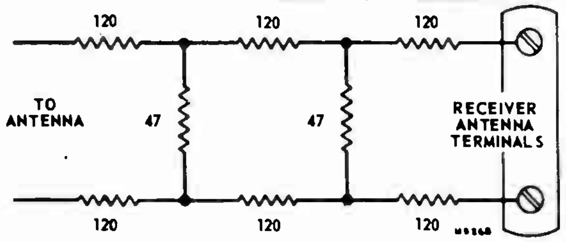

Figure 5. Attenuator Pad

Only carbon type resistors should be used to construct the attenuator pad. Since many of the low value moulded resistors generally available are of wire wound construction, it is advisable to break and examine one of each type of resistor used in order to determine its construction.

ALIGNMENT TABLE - Both methods of oscillator alignment are presented in the alignment table. The service technician may thereby choose the method to suit his test equipment. If it is found that the dual listing is confusing, the unwanted listing can be easily erased.

CRTICAL LEAD DRESS

(1) Dress all video coupling capacitors and peaking coi

CRITICAL LEAD DRESS

(1) Dress all video coupling capacitors and peaking coils up and away from the chassis.

(2) Contact between the R-F Oscillator frequency adjustment screws and the oscillator coils or channel switch eyelets must be avoided.

If any tuner troubles develop which indicate the need for realignment, the tuner should be returned to the factory.

It should be noted that normally replacement of tubes should not necessitate realignment of the tuner.

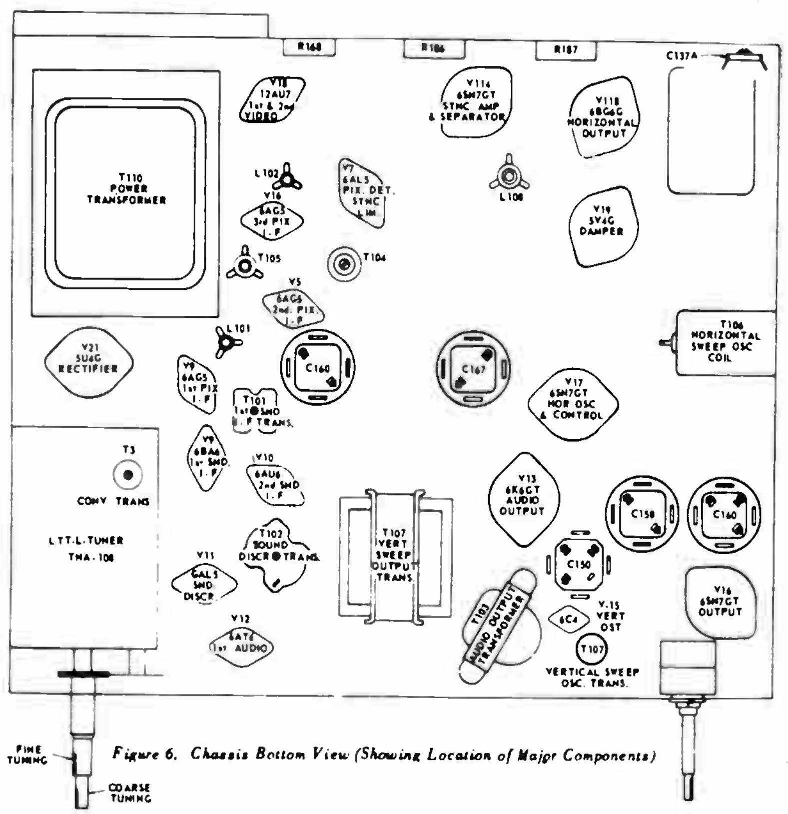

Figure 6. Chassis Bottom View (Showing Location of Major Components)

ALIGNMENT TABLE

The Detailed Alignment Procedure beginning on page 4 should be read before alignment by use of the tables is attempted.

Discrimination and Sound i-f Alignment

Step No.	Connect Signal Generator to	Signal gen. Freq. Mc.	Connect Sweep Generator to	Sweep gen. Freq. Mc.	Connect Oscilliscope to	Connect "VoltOhmyst" to	Misc Connections and Instructions	Adjust
1	2nd Sound i-f grid (pin 1 V10)	21.25 1 volt output	Not Used		Not Used	In series with 1 meg. to junction of R106 and R108	Meter on 10 volt scale	Detune T102 (bottom) adjust T102 (top) for max. on meter
2	2nd Sound i-f grid (pin 1 V10)	21.25 1 volt Output	Not Used		Not Used	Discriminator output (pin 1 of V11)	Meter on 3 Volt Scale	T102 (bottom) for zero on meter
3	2nd Sound i-f grid (pin 1 V10)	21.25 1 volt Output	2nd Sound I-F grid (Pin 1 V10)	21.25 Center 1 MC 1 Volt Output	Discriminator Output (pin 1 of V11)	Not Used	Check for symmetrical response waveform (pos. & neg.). If not equal adjust T102. (Top) until they are equal SEE NOTE 1	
4	Trap winding on T3 (top of chassis)	21.25 Reduced Output	Trap winding on T3	21.25 reduced output	Terminal A T102 in series with 33,000 ohms SEE NOTE 2.	Not Used	Sweep output reduced to provide 3 volts top on Scope SEE NOTE 3.	T101 (top) and bottom for max. gain and symmetrical at 21.25 mc

NOTE 1: The peak-to-peak bandwidth of the discriminator should be approximately 350 kc and should be linear from 21.175 inc. to 1.325 mc.

NOTE 2: If a 60 cycle sweep rate is used it will be necessary to reduce the time constant in the 2nd sound I-F grid circuit in order to reproduce the desired response curve. To do this, shunt R176 Terminal "A" of T107 to chassis with 5600 ohms.

NOTE 3: The sweep generator output should be set to produce approximately 0.3 volt peak-to-peak at the second sound I-F grid return (Terminal "A" of T107) for final touch upon this adjustment. Signal voltage in excess of 0.3 volt will tend to broaden the response curve permitting misadjustment to pass un-noticed.

Picture I-F and Trap Adjustment

Step No.	Connect Signal Generator to	Signal Gen. Freq. Mc.	Connect Sweep Generator to	Sweep Gen. Freq. Mc.	Connect Oscilloscope to	Connect "VoltOhmyst" to	Misc. Connections and Instructions	Adjust
5	Not used		Not used		Not Used	Junction R118 and R120	Set "Station Selector" switch to Channel 13	Adjust "Picture control for 3 volts reading on Voltohmyst
6	Pin No. 1 of 6AG5 Converter	21.25	Not Used		Not Used	Junction of L103 and R132	Meter on 3 volt scale	T3 (top) for min. on meter
7	"	21.25	Not Used		Not Used	Junction of L103 and R132	Meter on 3 volt scale	T105 for min.
8	"	22.8	Not Used		Not Used	Junction of L103 and R132	Meter on 3 volt scale	T3 (bottom) for max.
9	"	23.9	Not Used		Not Used	Junction of L103 and R132	Meter on 3 volt scale	L101 (top chassis) for max.
10	"	26.0	Not Used		Not Used	Junction of L103 and R132	Meter on 3 volt scale	T104 (top chassis) for max.
11	"	24.5	Not Used		Not Used	Junction of L103 and R132	Meter on 3 volt scale	L102 (top chassis) for max.

NOTE: Oscillation may occur if the I-F section is badly out of alignment. This will be evidenced by a meter reading in excess of 3 volts and is caused by the "staggered" I-F stages being tuned to approximately the same frequency. If this condition is encountered adjust the core studs of T3 (bottom) L101, T104 and L102 until oscillation ceases. Oscillation may not be encountered until proceeding with steps 9, 10 or 11 (See "Picture I-F Oscillation

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REPLACEMENT PARTS LIST

MODEL TV-116-A, TV-116-B, TV-117-A, TV-117-B and Chassis CTV-219-A

Reference No.	Description	Part No.
R-175	3.3 Ohm 20% 1 watt	
R-193	39 Ohm 20% 1/2 watt	
R-119, 126, 137, 164	47 Ohm 20% 1/2 watt	
R-101	82 Ohm 20% 1/2 watt	
R-166	82 Ohm 20% 1 watt	
R-129	150 Ohm 20% 1/2 watt	
R-190	270 Ohm 10% 10 watt W. W.	REX106
R-176, 184, 185	560 Ohm 10% 1/2 watt	
R-105, 121, 122, 124, 127, 131, 142, 183	1000 Ohm 20% 1/2 watt	
R-112	1000 Ohm 20% 1 watt	
R-102	1200 Ohm 10% 1/2 watt	
R-143, 194	2200 Ohm 20% 1 watt	
R-139, 178	3300 Ohm 10% 1/2 watt	
R-140	3300 Ohm 10% 1 watt	
R-134	3900 Ohm 10% 1/2 watt	
R-132	4700 Ohm 10% 1/2 watt	
R-169	5600 Ohm 10% 1 watt	
R-123, 128	5600 Ohm 5% 1/2 watt	
R-160	6800 Ohm 20% 1/2 watt	
R-130	6800 Ohm 5% 1/2 watt	
R-146, 154	8200 Ohm 20% 1/2 watt	
R-118,	10 K 20% 1/2 watt	
R-120	12 K 10% 1/2 watt	
R-117	15 K 10% 1/2 watt	
R-152	15 K 20% 1 watt	
R-104, 136, 141	22 K 20% 1/2 watt (R-136, 141 part of L-105, 107)	
R-156	22 K 10% 1/2 watt	
R-179	33 K 20% 1 watt	
R-133	39 K 10% 1/2 watt (part of L-104)	
R-115, 147	82 K 20% 1/2 watt	
R-153, 106, 108	100 K 10% 1/2 watt	
R-114, 144, 174	100 K 20% 1/2 watt	
R-159	120 K 20% 1 watt	
R-110	120 K 10% 1/2 watt	
R-149, 150	150 K 20% 1/2 watt	
R-157, 171	150 K 20% 1 watt	
R-103, 111	470 K 20% 1/2 watt	
R-182	560 K 10% 1/2 watt	
R-145	820 K 10% 1/2 watt	
R-135, 138, 155, 162, 172	1 Meg 20% 1/2 watt	
R-180	1 Meg 20% 1 watt	
R-167	1.5 Meg 20% 1/2 watt	
R-181	2.2 Meg 20% 1/2 watt	
R-148	2.7 Meg 10% 1/2 watt	
R-158	3.9 Meg 10% 1/2 watt	

Reference No.	Description	Part No.
R-116, 170	6.8 Meg 20% 1/2 watt	
R-109	10 Meg 20% 1/2 watt	
R-188-A-B	1125 Ohm & 610 Ohm 40 watt W.W.	REX105
R-189-A-B-C	8200 Ohm, 25 Ohm, 100 Ohm, Candohm	REX107
	CONTROLS	
R-113, 125	Brightness, contrast 500 K Ohms and 10K Ohms	PRA120
R-168	Height 2.5 Megohm	PRA114
R-177	Vertical Linearity 5000 Ohm	PRA118
R-186	Vertical centering 20 Ohm C.T.	PRA116
R-187	Horizontal centering 20 Ohm	PRA115
R-151, 173	Horizontal Vertical Hold 50 K Ohm and 1 Megohm	PRA117
R-107	On-Off Volume 1 Megohm with Switch	PRA108
R-113	Focus Control 2250 Ohm 4 watt	PRA113
L-108	Horizontal Linearity	CLA192
L-109	Horizontal Width	CLA193
	CAPACITORS	
C-165	5 mmf 3000V Mica	
C-132	10 mmf 500V Ceramic	
C-166	56 mmf 2000V Mica	
C-128	100 mmf 500V G.P. Ceramic	
C-143	100 mmf 500V Mica	
C-138, 144	180 mmf 1000V Mica	
C-112, 121, 126, 130	270 mmf 500V Mica	
C-148	390 mmf 500V Mica	
C-163	500 mmf 10,000V Ceramic	
C-149	560 mmf 1000V Mica	
C-100, 101, 103, 106, 109, 120, 123, 124, 131, 136, 118, 122	1500mmf 500V G.P. Ceramic	
C-147	2000mmf 1000V Mica	
C-111, 115	2000mmf 600V Paper	
C-139	2200mmf 1000V Mica	
C-156	4700mmf 2000V Mica	
C-116	.005MFD 600V Paper	
C-104, 113, 114, 146, 168, 169	.01 MFD 400V Paper	
C-142	.02 MFD 400V Paper	

REPLACEMENT PARTS LIST

MODEL TV-116-A, TV-116-B, TV-117-A, TV-117-B and Chassis CTV-219-A

Reference No.	Description	Part No.
C-157	.035MFD 1000V Paper	
C-133, 134, 145, 141, 155	.05 MFD 400V Paper	
C-162	.1 MFD 400V Paper	
C-159	.1 MFD 1000V Paper	
C-119, 135, 140, 153, 161	.25 MFD 400V Paper	
C-117	24 MFD 300V Electrolytic	CPX106
C-150-A-B-C	10 MFD 400V, 30 MFD 300V, 30 MFD 400V Electrolytic	CPX107
C-160-A-B-C	40 MFD 150V, 40 MFD 450V, 130 MFD 50V Electrolytic	CPX108
C-158-A-B	10 MFD 450V, 80 MFD 450V Electrolytic	CPX110
C-164-A-B	10 MFD 350V, 40 MFD 450V Electrolytic	CPX109
C-167-A-B	250MFD 10V, 1000MFD 6V Electrolytic	CPX111
C-137-A-B	Variable Trimmers 10-160mmf, 40-370mmf, Mica	VCX125
C-151, 152, 154	Couplate, Vertical Interg.	NKX100
R-163, 165	Couplate, Vertical Interg.	
	TRANSFORMERS & COILS	
T-101	Sound I.F. Trans (21.25mc)	CLA174
T-102	Sound Disc. Trans (21.25mc)	CLX185
T-103	Audio Output Trans.	TRA121
T-104	2nd Picture I.F.	CLA175
T-105	Cathode Trap	CLA169
T-106	Horizontal Os. Trans.	CLA170
T-107	Vertical Osc. Trans.	TRA119
T-108	Horizontal Output Trans.	TRA124
T-109	Vertical Output Trans.	TRA120
T-110	Power Trans.	TRA117
L-101, 102	Picture I.F. (1st & 3rd)	CLA176
L-103, 106	Video Peaking (36 mhy)	CLA173
L-104	Video Peaking (180 mhy wound on R-133)	CLA171
L-105, 107	Video Peaking (120 mhy wound on R-136, 141)	CLA172

Reference No.	Description	Part No.
L-112	Choke, Filter	CLA168
L-111	Focus, Coil, EM-PM	CLX191
L-110	Deflection Yoke (70°)	CLX184
	MISCELLANEOUS	
	TNA-108 LYT-L-TUNER (TV-FM)	TTA150
	Bakelite, Wafer mtg. Plate (Electrolytics)	SOX124
	Socket, 6 Prong Female w/cap	SOX127
	Socket, Power Interlock, 2 prong	SOX120
	Octal Bakelite, wafer	SOX115
	Octal, ceramic, rubber mtg. w/o rubber	SOX119
	Octal, corona Ring	SOX123
	CRT with 21.5" lead	SOX122
	Miniature, 7 pin, wafer	SOX117
	Min., 7 pin, molded with shielded base	SOX116
	Pilot light, 8" lead	SOX114
	Shield for 7 pin, min. Octal 1 3/8" High	SOX125
	Socket, Phono	SOX129
	Pins, Radio, Speaker connector	CCX157
	Power cable, terminated w/power connector	WCA109
	Fuse Holder w/lockwasher and nut	FUA102
	9 pin, wafer, small button	SOX118
	Plug, male, 6 prong w/cap	PLX107
	Fuse, 5 amp	FUA101
	Fuse, .25 amp	FUA100
	Dial Bracket	BRA317
	Bracket, Focus Coil Mtg.	BRX327
	Housing, H.V. compartment	SMA535
	Bracket, Width control, Mtg.	BRA322
	Cover, H.V. compartment	SMA536
	Cover, Bleeder resistor Assy.	SMA538
	Housing, Bleeder resistor Assy.	SMA537
	Light Diffuser	MPX213
	Reflector, Pilot Light	SOX130
	19AP4A Picture Tube	

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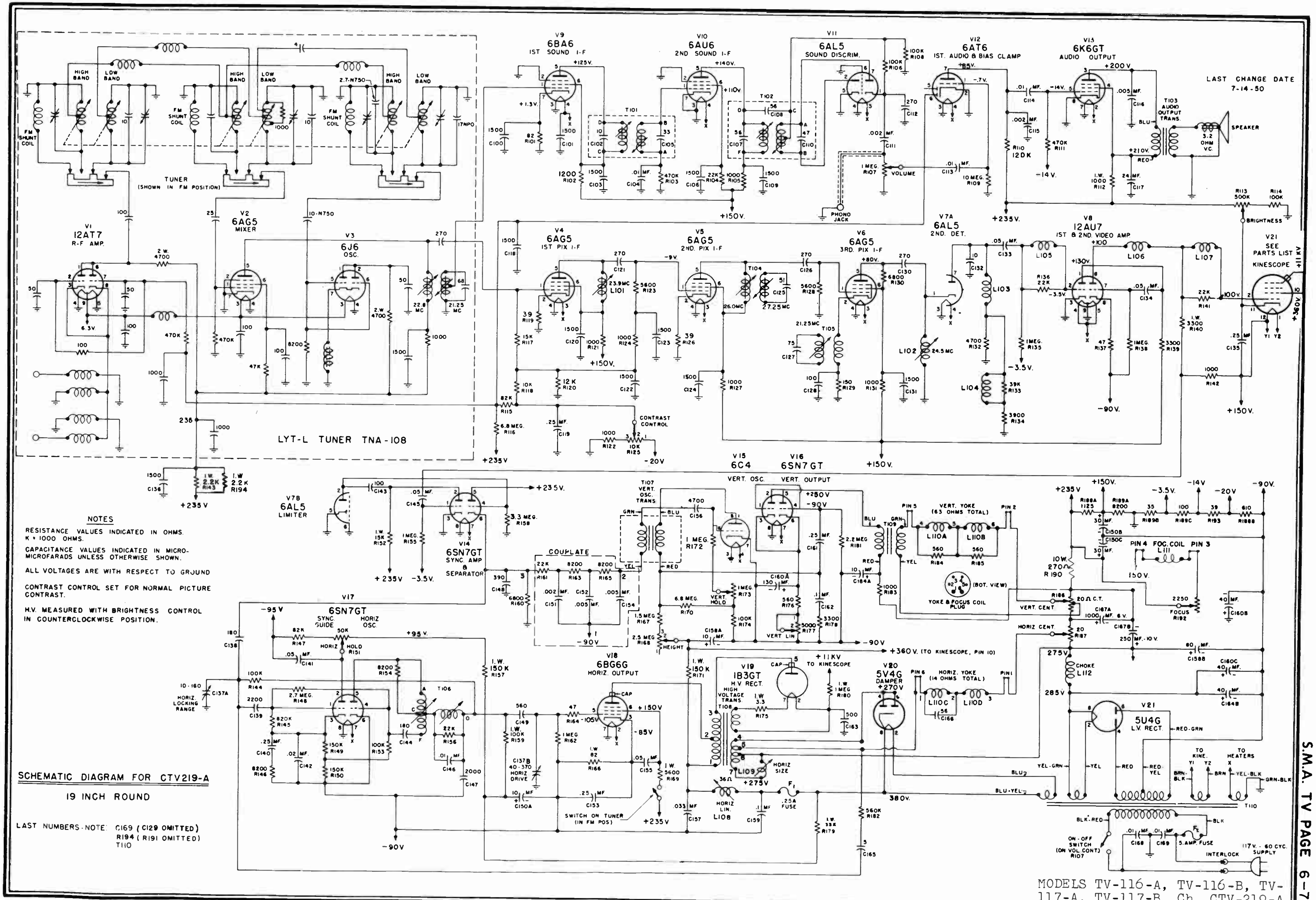

MODELS TV-116-A, TV-116-B, TV-117-A, TV-117-B, Ch. CTV-219-A

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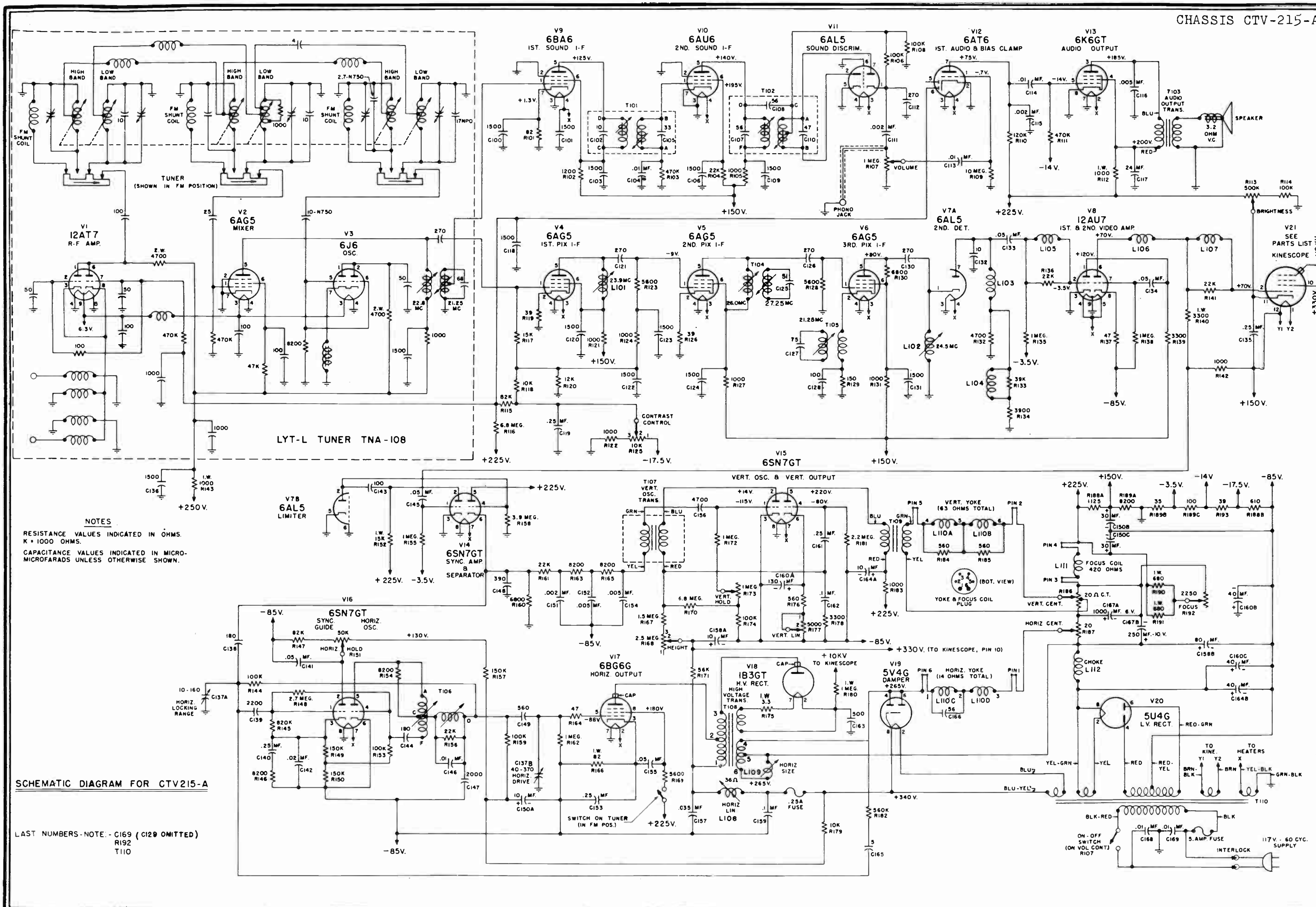

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World Radio History

These models use 20 Tubes (Including Picture Tube and Rectifiers) and employ an inter-carrier sound circuit. The picture Tube in both receivers is the 16TP4. Both receivers use ratio detector for the sound.

SAFETY PRECAUTIONS: The kinescope should be handled with extreme care. The person handling this tube should wear gloves and protective goggles as an added precaution.

When the power is connected, care must be taken in servicing the High Voltage Supply of these receivers. The interlock opens one side of the line only leaving one side of the line connected when the back is removed. For servicing with chassis out of the cabinet the interlock-socket can be shorted.

VOLTAGE READINGS: The voltage readings to be obtained at various locations in the receiver have been indicated on the schematic diagram. These voltages will be very advantageous when "trouble shooting". Check voltages, tubes, fuse and inspect for damaged or burned parts before attempting to re-align receiver. A wired-in 1/4 amp fuse is used to protect the high voltage circuit of the receiver.

All voltages were taken with a 117.5 V. line and with no signal input. The contrast control set at the maximum clockwise position; the brightness control at 50% rotation and all other controls in normal operating position. The tuner set for Channel 2. All voltages are positive with respect to ground unless otherwise indicated.

FREQUENCY CHART

CHANNEL NO.	CHANNEL FREQ.MC.	PICTURE CARRIER M.C.	SOUND CARRIER M.C.	RECEIVER RF. OSC. M.C.	CHANNEL NO.	CHANNEL FREQ.MC.	PICTURE CARRIER M.C.	SOUND CARRIER M.C.	RECEIVER RF. OSC. M.C.
2	54-60	55.25	59.75	81.35	8	180-186	181.25	185.75	207.35
3	60-66	61.25	65.75	87.35	9	186-192	187.25	191.75	213.35
4	66-72	67.25	71.75	93.35	10	192-198	193.25	197.75	219.35
5	76-82	77.25	81.75	103.35	11	198-204	199.25	203.75	225.35
6	82-88	83.25	87.75	109.35	12	204-210	205.25	209.75	231.35
7	174-180	175.25	179.75	201.35	13	210-216	211.25	215.75	237.35

IF. FREQ. M.C

PICTURE CARRIER	26.1
SOUND CARRIER	21.6

FOCUS ADJUSTMENT AND CENTERING

These receivers use a permanent magnet (PM) type of focusing. This focalizer is attached to a plate which i mounted behind the Yoke.

CENTERING OF PICTURE: The picture may be centered in relationship with the opening of the glass panel at the fac of the receiver by shifting the brass centering stud at the rear of the focalizer. (See top view of chassis)

FOCUS ADJUSTMENT: (The focus adjustment must be made with a screw-driver of non-magnetic material.) The focus adjustment (the large slotted screw) is located at the rear of the focalizer. The picture focus is adjusted by either increasing or decreasing the amount of screw insertion to either decrease or increase the magnetic flux as required.

CONTROL OPERATION

HEIGHT CONTROL (Rear Apron of Chassis) To increase the vertical size of the picture, turn this control in a counter-clockwise rotation. To reduce the size of the picture vertically, turn this control clockwise.

VERTICAL LINEARITY: (Rear Apron of Chassis) As this knob is turned to the left (counter-clockwise) the size of the top half of the picture is increased vertically; as it is turned clockwise, it is reduced.

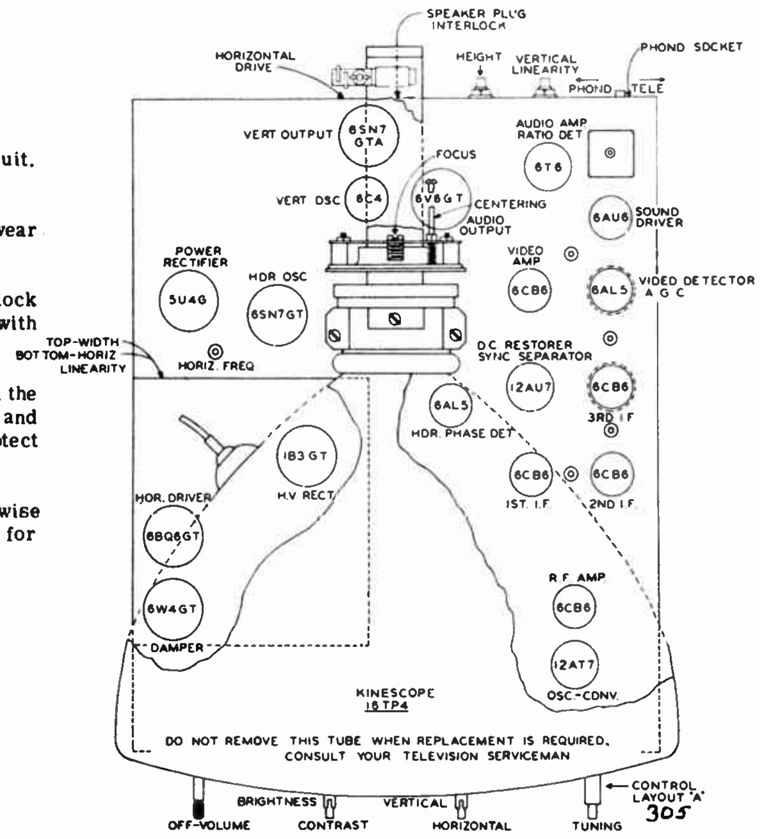
HORIZONTAL LINEARITY: (Top of Chassis - See Layout) moving the slug out of the coil increases the left hand side of the picture and moving the slug in decreases the left and increases the right hand side.

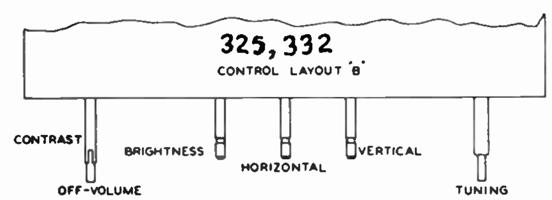
WIDTH CONTROL: (Top of Chassis - See Layout) Screw slug in to increase width and out to decrease width.

HORIZONTAL FREQUENCY: (Top of Chassis - See Layout) Locate the horizontal hold control (located on front apron) in the center of its rotation. Adjust horizontal frequency screw to lock in picture. When properly adjusted the horizontal hold control should hold in the picture when the picture is turned approximately equal amounts from the center position.

HORIZONTAL DRIVE: (Screw Driver Adjustment on rear apron of chassis) Turn counter-clockwise to increase drive and clockwise to decrease drive. Drive should be as high as possible without producing a bright vertical line on the raster.

CAUTION: INSUFFICIENT DRIVE WILL OVERLOAD HORIZONTAL DRIVER (6BQ6GT).





TUNER ASSEMBLY

SCHEMATIC LOCATION	NUMBER	DESCRIPTION
	CARBON RESISTORS	
R7		470 Ohms
R2,R3		1,000 Ohms
R4		2,200 Ohms
R6		18,000 Ohms
R1,R5		100,000 Ohms
	CERAMIC CONDENSERS	
C1		100 MMFD. 10%
(C2A,C2B),(C21A,C21B)		1000 MMFD. Dual Condenser
C3,C4		500 MMFD.
C11		25 MMFD.
C12		33 MMFD. 5% (N750 Temp. Coeff)
C13		30 MMFD. 5% (N750 Temp. Coeff)
C17		47 MMFD.
C18		15 MMFD. 5% (N-750 Temp. Coeff)
C20		20 MMFD.
C22		5 MMFD. 5% (N-750 Temp. Coeff)
	TRIMMER CONDENSERS	
C5		Low Band R.F. Trimmer
C6		Low Band Mixer Trimmer
C10		Low Band Oscillator Trimmer
C15		High Band R.F. Trimmer
C16		High Band Mixer Trimmer
C19		High Band Oscillator Trimmer
	TUNING CAPACITORS	
C7,C8,C9,C14		Main Gang Tuning Capacitors

SCHEMATIC LOCATION	PART NO.	DESCRIPTION
	COILS	
L1		Antenna Coil
L2		High Band R.F. Coil
L3		High Band Mixer Coil
L4		High Band Oscillator Coil
L5		I.F. Coil
L6,L7		R.F. Choke Coil - 1.8 Microhenries
	TRANSFORMERS	
T1		Antenna Transformer
T2		Low Band Coil Assembly

MAIN CHASSIS

SCHEMATIC LOCATION	PART NO.	DESCRIPTION
	CONTROLS (Control Layout "A")	
R35)	N-8053	(Contrast Control-2500 Ohms)
R100)		(Brightness Control - 50,000 Ohms)
R59)	N-7338	(Vertical Hold Control-1.0 Megohm)
R87)		(Horizontal Hold Control-50,000 Ohms)
R56	N-7172	Volume Control with On-Off Switch-0.5 Megohm
R61	N-7341	Height Control-2.5 Megohms
R66	N-8071	Vertical Linearity Control-3000 Ohms
	CONTROLS (Control Layout "B")	
R35)	N-8158	(Contrast Control-2500 Ohms)
R56)		(Volume Control with on-off switch-0.5 Megohm
R100	N-8160	Brightness Control - 50,000 Ohms
R87	N-8160	Horizontal Hold Control - 50,000 Ohms
R59	N-8159	Vertical Hold Control-1.0 Megohm
R61	N-7341	Height Control - 2.5 Megohm
R66	N-8071	Vertical Linearity Control-3000 Ohms
	WIREWOUND RESISTORS	
R68	N-8035	8,200 Ohms 5.0 Watts 10%
R21	N-8036	13,000 Ohms 4.0 Watts 7.5%
	CARBON RESISTORS	
R96	N-8126	4.3 Ohms 1/2 Watt 10%
R11,R16,R34	N-6237	47 Ohms 1/2 Watt 10%
R81	N-8155	56 Ohms 1.0 Watt 10%
R12,R17	N-5857	82 Ohms 1/2 Watt 10%
R31,R57,R91	N-1349	100 Ohms 1/2 Watt 20%
R92	N-8030	100 Ohms 2.0 Watts 10%
R23	N-3663	150 Ohms 1/2 Watt 10%
R32	N-4067	180 Ohms 1/2 Watt 10%
R49	N-4121	270 Ohms 1/2 Watt 10%
R24,R47,R69,R70	N-4280	560 Ohms 1/2 Watt 10%
R65	N-4279	820 Ohms 1/2 Watt 10%
R46,R95	N-3341	1,000 Ohms 1/2 Watt 10%
R10,R13,R18,R19	N-1694	1,000 Ohms 1/2 Watt 20%
R84	N-6793	1,200 Ohms 1/2 Watt 10%
R33,R75	N-7398	1,500 Ohms 1/2 Watt 10%
R42,R77	N-4896	2,200 Ohms 1/2 Watt 10%
R76	N-8103	2,700 Ohms 1/2 Watt 10%
R62	N-7399	3,900 Ohms 1/2 Watt 10%
R40	N-7154	4,700 Ohms 1.0 Watt 10%
R8	N-7000	4,700 Ohms 1/2 Watt 20%
R83	N-7406	5,600 Ohms 1.0 Watt 10%
R9,R22,R29,R89	N-4630	6,800 Ohms 1/2 Watt 10%
R45	N-8043	8,200 Ohms 1.0 Watt 10%
R71	N-4895	10,000 Ohms 1/2 Watt 10%
R97	N-4229	10,000 Ohms 2.0 Watts 10%
R50	N-5690	12,000 Ohms 1/2 Watt 10%
R15,R48,R101	N-6424	15,000 Ohms 1/2 Watt 10%
R14,R39	N-2970	15,000 Ohms 2.0 Watts 10%
R36	N-8031	18,000 Ohms 2.0 Watts 10%

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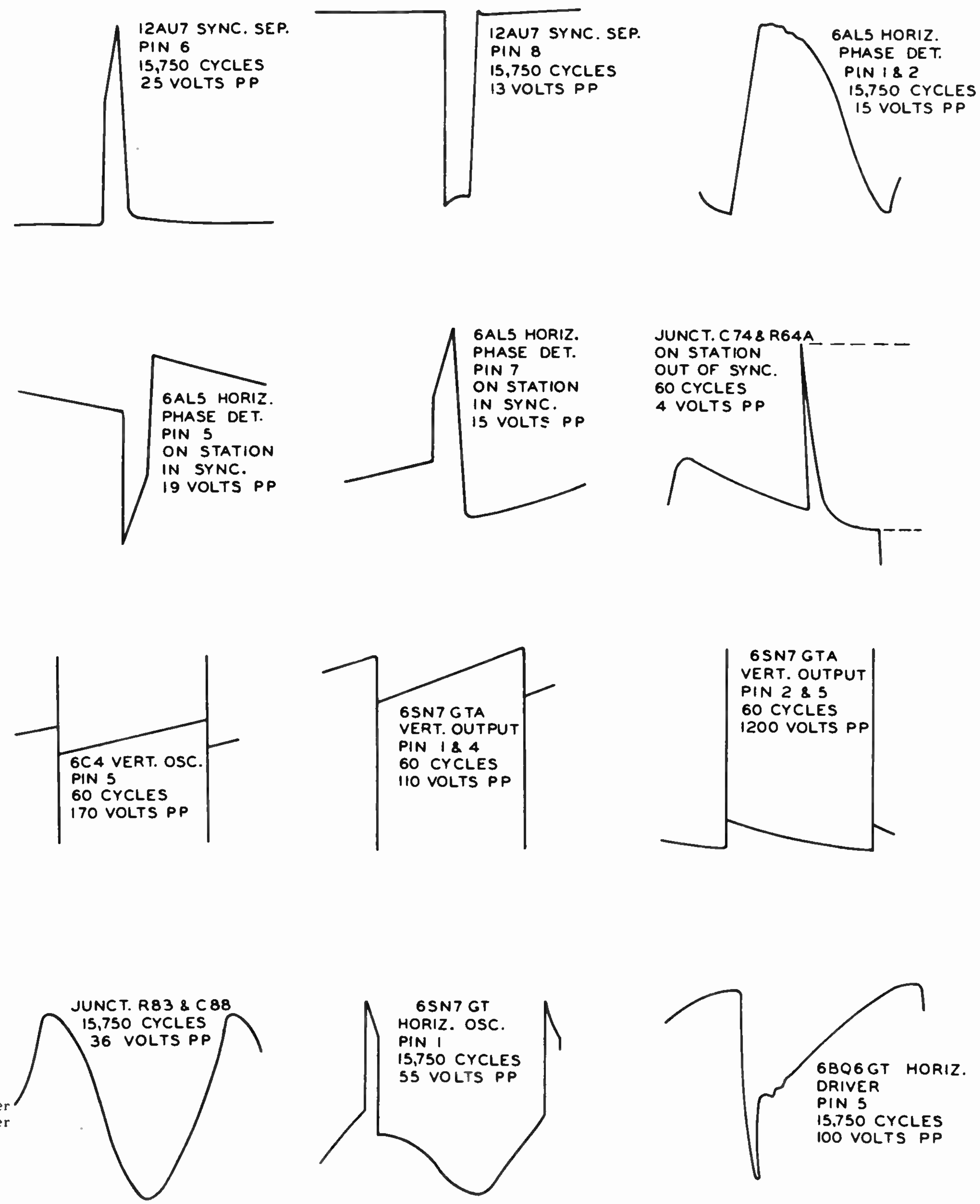
SCHEMATIC LOCATION	PART NO.	DESCRIPTION
		CARBON RESISTORS (Cont.)
R73	N-6012	22,000 Ohms 1/2 Watt 10%
R44	N-7012	27,000 Ohms 1.0 Watt 10%
R41	N-8044	33,000 Ohms 1.0 Watt 10%
R93	N-8032	33,000 Ohms 2.0 Watts 10%
R20	N-8033	47,000 Ohms 2.0 Watts 10%
R67	N-4823	56,000 Ohms 1/2 Watt 10%
R102	N-4120	68,000 Ohms 1/2 Watt 20%
R54,R78,R79,R85,R86	N-2973	100,000 Ohms 1/2 Watt 10%
R94	N-8028	100,000 Ohms 1.0 Watt 10%
R103	N-1778	100,000 Ohms 1/2 Watt 20%
R28,R43	N-4468	150,000 Ohms 1/2 Watt 10%
R55,R88	N-7003	180,000 Ohms 1/2 Watt 10%
R52	N-4899	220,000 Ohms 1/2 Watt 10%
R53	N-8025	300,000 Ohms 1/2 Watt 5%
R99	N-8026	390,000 Ohms 1/2 Watt 10%
R82,R90	N-5694	470,000 Ohms 1/2 Watt 10%
R98	N-8029	470,000 Ohms 1.0 Watt 10%
R72	N-7790	560,000 Ohms 1/2 Watt 10%
R26	N-7403	680,000 Ohms 1/2 Watt 10%
R25	N-4469	820,000 Ohms 1/2 Watt 10%
R30,R60,R74	N-2976	1.0 Megohm 1/2 Watt 10%
R58	N-4470	1.2 Megohm 1/2 Watt 10%
R63	N-4424	2.2 Megohm 1/2 Watt 10%
R80	N-4061	4.7 Megohm 1/2 Watt 20%
R51	N-4028	6.8 Megohm 1/2 Watt 20%
		ELECTROLYTIC CONDENSERS
C93	N-8054	4 MFD. 50 Volt
C60	N-6912	16 MFD. 50 Volt
C71	N-8037	100 MFD. 250 Volt
C75A)	N-8039	(10 MFD. 450 Volt
C75B)		(10 MFD. 450 Volt
C63A)	N-8038	(60 MFD. 450 Volt
C63B)		(40 MFD. 450 Volt
C48A)	N-8040	(10 MFD. 450 Volt
C48B)		(80 MFD. 200 Volt
C48C)		(100 MFD. 50 Volt
C48D)		(40 MFD. 200 Volt
		TRIMMER CONDENSERS
C91	N-7375	Horizontal Drive Control-20-270 MMFD
		HIGH VOLTAGE CONDENSERS
C99	N-8041	500 MMFD. 20,000 Volts
		CERAMIC CONDENSERS
C49	N-7776	5 MMFD. 500 V. 20%
C43	N-7843	10 MMFD. 500 V. 10%
C51	N-7844	68 MMFD. 500 V. 10%
C26,C31,C36,C39,C40,C66	N-6015	100 MMFD. 500 V. 20%
C27,C32	N-6887	.001 MFD. (Guar.Min.Value)
C23,C24,C28,C30,C33,C38,C42) C53,C54,C56,C59,C65,C73)	N-6272	.005 MFD. (Guar.Min.Value)
C29,C34	N-7371	.0015 MFD. (Guar. Min. Value)
(C35A,C35B), (C37A,C37B)	N-7774	(.004 MFD. 450 Volt) (.004 MFD. 450 Volt) DUAL COND.
		SILVER MICA CONDENSERS
C86	N-7777	330 MMFD. 500 Volt 10%
C88	N-7373	3,900 MMFD. 500 Volt 5%
C98	N-8073	1,500 MMFD. 1000 Volt 10%

SCHEMATIC LOCATION	PART NUMBER	DESCRIPTION
		MICA CONDENSERS
C47,C52,C87	N-7836	47 MMFD. 500 Volt 10%
C97	N-7509	56 MMFD. 1000 Volt 5%
C46	N-8106	220 MMFD. 500 Volt 20%
C90	N-8074	270 MMFD. 500 Volt 10%
C89	N-7780	560 MMFD. 500 Volt 10%
C81,C82	N-7783	1,100 MMFD. 500 Volt 10%
C57	N-6891	2,200 MMFD. 500 Volt 10%
C58	N-6892	3,900 MMFD. 500 Volt 10%
C74	N-6893	4,700 MMFD. 500 Volt 10%
		PAPER CONDENSERS
C61,C62	N-6979	.01 MFD. 600 Volt (Bakelite Case)
C64,C72,C84	N-4894	.005 MFD. 600 Volt
C44	N-1344	.01 MFD. 400 Volt
C55,C68,C69	N-1376	.02 MFD. 400 Volt
C45,C70	N-1345	.05 MFD. 200 Volt
C79	N-1346	.05 MFD. 400 Volt
C94,C100	N-8105	.05 MFD. 800 Volt
C67	N-8092	.08 MFD. 200 Volt
C25,C85,C83,C103	N-1351	.1 MFD. 200 Volt
C50,C76,C101,C102	N-1623	.1 MFD. 400 Volt
C41,C96	N-1479	.25 MFD. 200 Volt
C78,C92	N-2579	.25 MFD. 400 Volt
C95	N-6895	.25 MFD. 600 Volt
C80	N-6896	.5 MFD. 200 Volt
		INTEGRATING PLATE ASSEMBLY
R64A)		(Resistor 8,200 Ohms 20%
R64B)		(Resistor 8,200 Ohms 20%
R64C)		(Resistor 22,000 Ohms 20%
C77A)	N-8042	(Condenser .005 MFD.
C77B)		(Condenser .005 MFD.
C77C)		(Condenser .002 MFD.
		COILS
L8,L10,L12	N-7745	Coil, I.F.
L9,L11	N-7321	R.F. Filter Choke Coil-10 Microhenries
L13	N-8060	Coil, Detector Series-174 Microhenries
L14	N-8059	Coil, Detector Shunt - 933 Micohenries
L15	N-8061	Coil, Amplifier Series-217 Microhenries
L16	N-8062	Coil, Amplifier Shunt - 578 Microhenries
L17	N-7746	Coil, 4.5 MC Sound Take-Off
L18	N-8064	Choke, Filter
L19	N-7748	Coil, Horizontal Frequency Control
L20	N-8134	Coil, Width Control
L21	N-8063	Coil, Horizontal Linearity Control
	N-8057	Coil, Deflection Yoke
		TRANSFORMERS
T3	N-7744	Ratio Detector Transformer
T4	N-8069	Power Transformer
T5	PART OF SPEAKER	Audio Output Transformer
T6	N-7764	Vertical Blocking Oscillator Transformer
T7	N-7717	Vertical Output Transformer
T8	N-8070	(Horizontal Output Transformer-Mounted on Wood Spacers)
T8	N-8104	(Horizontal Output Transformer-Mounted directly to shelf)
		OTHER COMPONENTS
TABLE MODEL ONLY	N-8170	Speaker, 5" PM with Output Transformer
CONSOLETTE ONLY	N-8055	Speaker, 8" PM with Output Transformer
	N-7949	Internal Antenna Assembly
	N-8100	Tube Socket with Corona Ring
	N-7929	Ion Trap
	N-8067	Focalizer Assembly
	N-8099	Switch, Television-Phono

OSCILLOSCOPE PATTERNS



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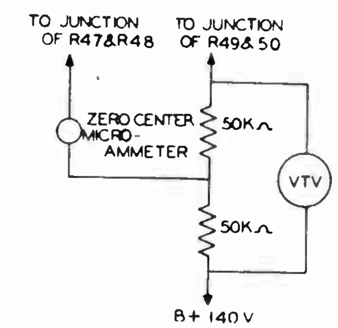
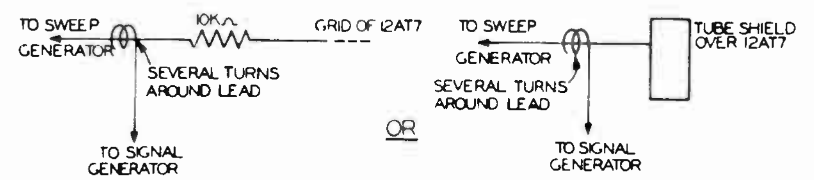
I.F. ALIGNMENT PROCEDURE

STEP NO.	Connect Signal Generator to	Signal Gerator Frequency MC	Connect Sweep Generator to	Sweep Generator Frequency	Connect Oscilloscope to	REMARKS	ADJUSTMENTS (Use peak obtained when screw is farthest out of can or coil.)
1. AUDIO IF ALIGNMENT	Grid of Video Amp. (6CB6) Pin #1. Contrast control at maximum.	4.5 MC. No Modulation. See Adjustments column.	NOT USED		NOT USED	Connect Vacuum Tube Voltmeter and zero center Microammeter as shown in note 1 (50,000 ohm resistors shown in note 1 must match within 5%)	Adjust L17 and T3 (Bottom) for maximum on Vacuum Tube Voltmeter. This adjustment should be made with voltage on Vacuum Tube Voltmeter under 12 Volts. Adjust T3 (Top) for zero on Microammeter. If the receiver is receiving a signal, the above adjustment can be made off a weak station keeping the reading on the Vacuum Tube Voltmeter under 12 Volts.
2. PRELIMINARY VIDEO IF ALIGNMENT	Grid (Pin 2) of 12AT7 through 10,000 ohm resistor or a tube shield and slip over 12AT7. Do Not Ground Shield	25.5 MC. No Modulation.	NOT USED		NOT USED	Connect Vacuum Tube Voltmeter to A.G.C.point. Junction of R19 and R25.	Adjust 2nd and 4th I.F. coils (L8 and L12) for maximum on Vacuum Tube Voltmeter. Adjust at approximately one volt.
3. PRELIMINARY VIDEO IF ALIGNMENT	Grid (Pin 2) of 12AT7 through 10.000 ohm resistor or a tube shield and slip over 12AT7. Do Not Ground Shield	23.0 MC. No Modulation.	NOT USED.		NOT USED	Connect Vacuum Tube Voltmeter to A.G.C.point. Junction of R19 and R25.	Adjust 1st and 3rd I.F. coils (L5 in Tuner and L10) for maximum on Vacuum Tube Voltmeter. Adjust at approximately one volt.
4. FINAL VIDEO IF ALIGNMENT	Signal Generator as shown in note 2.	26.1 and 22.8 MC MC. No Modulation. See Note 3.	Grid of 12AT7 through 10,000 ohm resistor, or a tube shield and slip over 12AT7. See Note 2.	24 MC Center Frequency and at least 6 MC wide.	Junction of R29 and L14.		With signal generator set at 26.1 MC adjust 2nd and 4th I.F. coils to give correct marker position as shown in note 3. Set signal generator at 22.8 MC and adjust 1st and 3rd I.F. coils for pattern shown in note 3. A slight readjustment of 2nd and 4th I.F. coils may be necessary. Curve shape should be between "A" and "C" on note 3 with maximum signal output for a low sweep input.

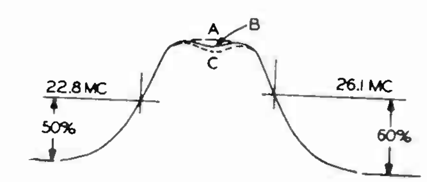
NOTE 1



NOTE 2



NOTE 3



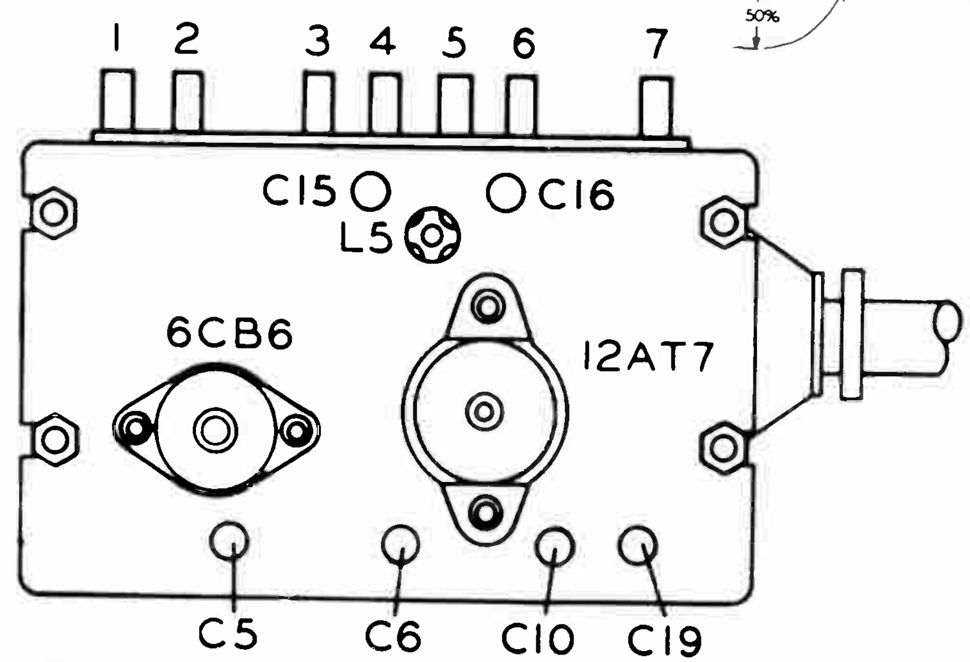
TUNER ALIGNMENT

The tuner should normally retain its alignment and need no realignment in the field. However, if it is tampered with or a condenser or resistor is replaced due to failure, realignment may be necessary but should not be attempted until the video I.F. is aligned. If a part is replaced be careful not to disturb any other parts and the replacement part should be placed in the same position as the previous part and with the same length of leads.
This tuner employs a gang condenser which retains its alignment. The adjusting is accomplished at the high and low ends of the two bands; channels 6 and 2, and 13 and 7.

The oscillator trimmers act independently, but the R.F. and mixer trimmers must be aligned first on the low channels as they are in parallel with high band trimmers.

Connect the antenna lead to the sweep generator which must terminate in 300 ohm. Connect signal generator to piece of wire and wrap around 300 ohm antenna lead. (If sweep generator has sound and picture markers the signal generator is not necessary.)
Adjust channel 6 first. Set the tuner to the center of channel 6 and set the signal generator to the picture carrier (83.25 MC). Adjust the low band oscillator trimmer (C10) to bring the marker approximately 60% up from the base of the curve. As this trimmer is increased in capacity the marker should move towards the top of the curve. If this is not the case, the marker is on the audio side of the curve. Reduce the trimmer until the marker is on the other side of the curve. Next adjust the low band R.F. (C5) and Mixer trimmers (C6) to give maximum sensitivity on the oscilloscope being careful to have sufficent width on the audio side of the curve. Check channel 2 with a marker frequency of 55.25 MC.

Adjust channel 13 in the same manner as for channel 6 except using the High Band trimmers (RF-C15, Mixer C16, and Oscillator C19) and the picture marker frequency which is 211.25 MC. Check channel 7 with a marker frequency of 175.25 MC.



TUNER ADJUSTMENTS

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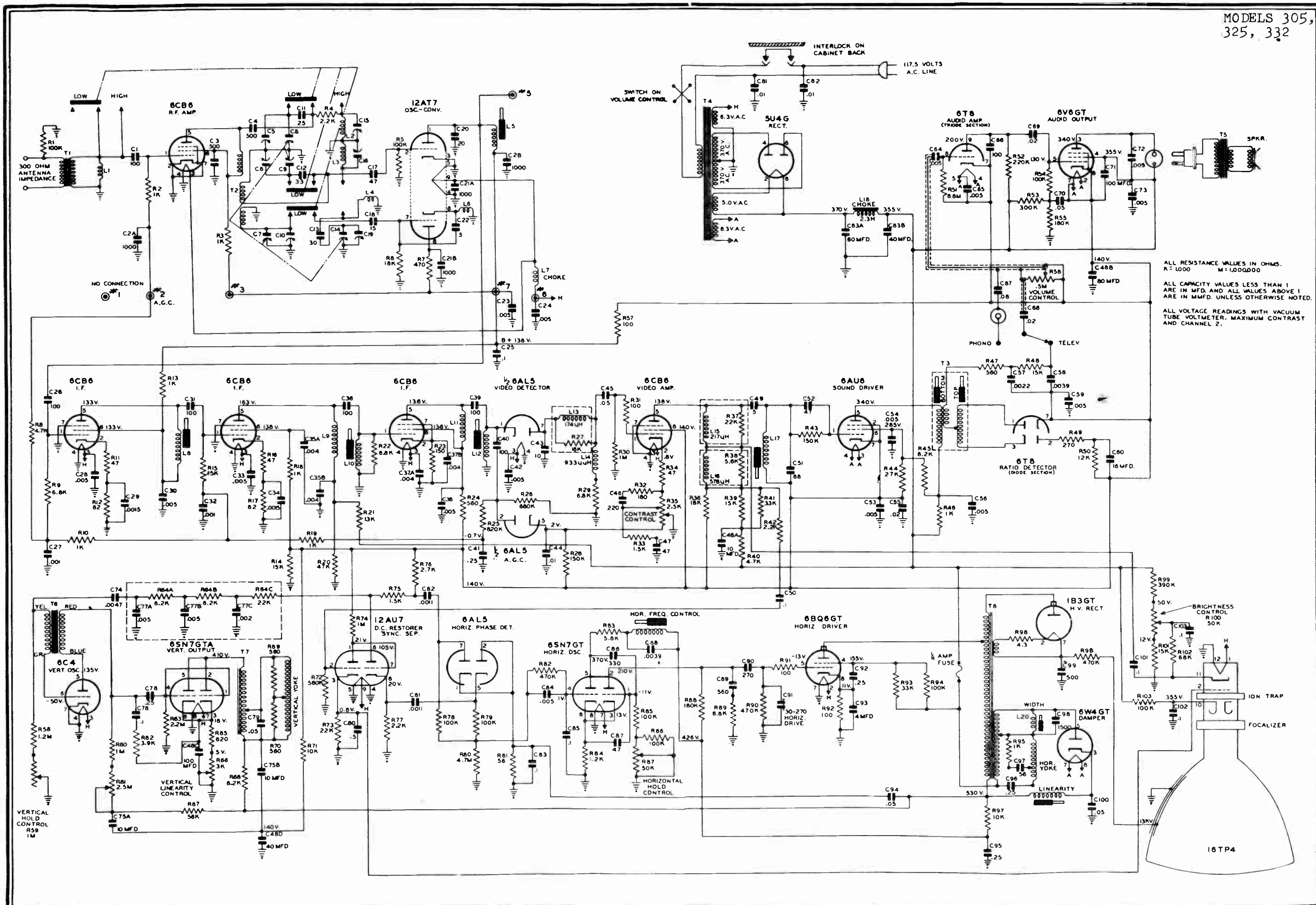
MODELS 305, 325, 332



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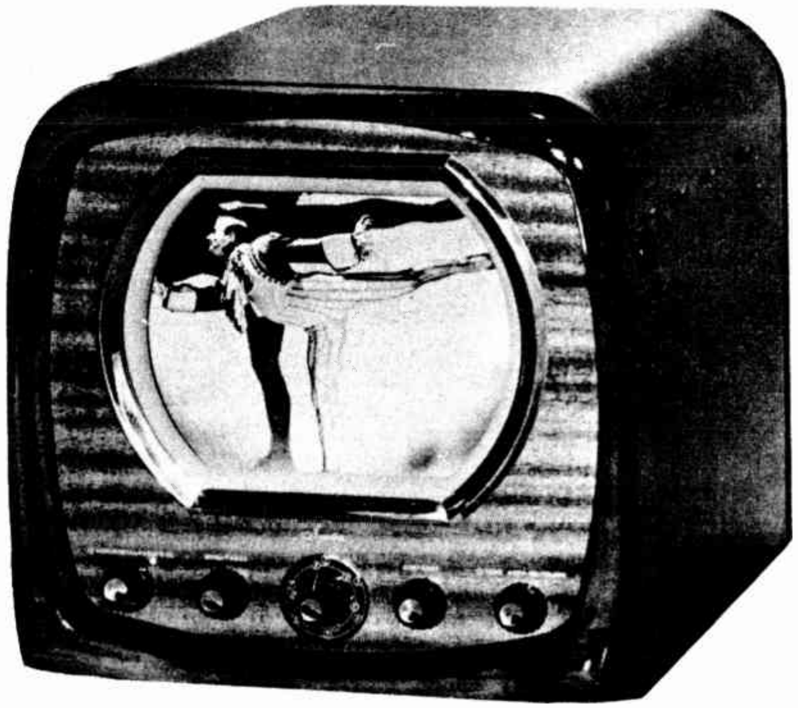

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UNPACKING INSTRUCTIONS

CAUTION: Before connecting this receiver for operation, be sure to observe the following procedure:

The receiver chassis has been blocked and tightened down for shipment and must be loosened as follows:

1. Remove the drive screw that hold the inter-lock plug and the wood screws that fastens the back cover to the cabinet.

2. Remove the wing nut, washer and plate that fastens the focus coil to back cover for shipping. (Plate should be saved in case re-shipment is necessary).

3. Remove the socket from base of picture tube.

4. Remove Ion Trap from neck of picture tube.

5. Reassemble washer and wing nut to focus coil, loosen wing nut on opposite side and slip focus coil over neck of picture tube so that the coil lead wires will lead from the upper left-hand corner of coil. Slide coil towards yoke assembly until the mounting studs engage the mounting slots in yoke frame. Assemble coil with dished washers between yoke bracket and focus coil housing.

6. Replace ION trap on neck of tube.

7. Attach socket to pix.tube base.

8. Loosen the (4) hex-head chassis mounting screws and pull out the shipping strips. Tighten the (4) mounting screws enough to prevent rattle.

9. Refer to Service Manual and adjust Ion Trap and Focus Coil.

10. Tune in a station and set the horizontal hold control to approximately the Center of its rotation. Adjust the horizontal oscillator coil until the picture is synchronized horizontally. For detailed instructions on this adjustment refer to Service Bulletin 2-33, Manual 7.

11. Replace back cover.

12. This receiver is equipped with a built-in dipole antenna which is hooked up for operation when shipped from the factory. A label on the back cover contains instructions for connecting an outside antenna.

13. NOTE: In the event this receiver is to be re-shipped, the chassis must be blocked and tightened down, the focus coil and Ion Trap remove from picture tube neck and fastened in their shipping positions, otherwise the shipper will assume all RESPONSIBILITY for picture tube breakage in transit and will stand LIABLE for breakage charges.

ELECTRICAL AND MECHANICAL SPECIFICATIONS

R.F. FREQUENCY RANGE

Channel Number	Channel Freq.Mc.	Picture Carrier Freq.Mc.	Sound Carrier Freq.Mc.	Receiver R.F.-Osc. Freq.Mc.
2	54-60	55.25	59.75	81.5
3	60-66	61.25	65.75	87.5
4	66-72	67.25	71.75	93.5
5	76-82	77.25	81.75	103.5
6	82-88	83.25	87.75	109.5
7	174-180	175.25	179.75	201.5
8	180-186	181.25	185.75	207.5
9	186-192	187.25	191.75	213.5
10	192-198	193.25	197.75	219.5
11	198-204	199.25	203.75	225.5
12	204-210	205.25	209.75	231.5
13	210-216	211.25	215.75	237.5

POWER SUPPLY RATING

117 Volts.......60 Cycles.......230 Watts

AUDIO POWER OUTPUT RATING

Maximum Undistorted............2.5 Watts

LOUD SPEAKER

Models 5006X and 5007X Table
5 X 7-Inch Oval Perm. Magnet
Voice Coil Impedance...........3.2 Ohms
At 400 Cycles

PICTURE I.F. FREQUENCIES

Picture Carrier Frequency..........26.25 Mc.
Adjacent Channel Sound Trap........27.75 Mc.
Accompanying Sound Traps...........21.75 Mc.
R.F. Oscillator Trap...............94.0 Mc.

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SOUND I.F. FREQUENCIES

Sound Carrier Frequency............21.75 Mc.
Sound Discriminator Band Width(between peaks) 500 Kc.
Video Response.....................to 4 Mc.
Focus..............................Magnetic
Sweep Deflection...................Magnetic
Scanning...........Interlaced 525 Lines
Horizontal Scanning Frequency..15,750 Cps.
Vertical Scanning Frequency........60 Cps.
Frame Frequency(Picture repetition Rate) 30 Cps.
Receiver Antenna Input Impedance..300 Ohms. Balanced

TUBE COMPLEMENT

TUBE	TYPE	FUNCTION
V1	6BH6	R.F. Amplifier
V2	6AG5	Converter
V3	6C4	R.F. Oscillator
V4	6BJ6	1st Pix.I.F. Amplifier
V5	6BJ6	2nd Pix. I.F.Amplifier
V6	6BH6	3rd Pix. I.F.Amplifier
V7	6BJ6	4th Pix. I.F.Amplifier
V8	6AL5	Pix. 2nd Det. Sync.Limiter
V9	6AU6	A.G.C. Amplifier
V10	6AH6	Video Amplifier
V11	12LP4	Picture Tube
V12	6AU6	1st Sound I.F.
V13	6AU6	2nd Sound I.F.
V14	6T8	Ratio Det.and Audio Amp.
V15	6V6GT	Audio Pwr. Amp.
V16	6V6GT	Vert. Output
V17	6SN7GT	Vert.Oscillator Disc.& Phase Splitter
V18	12AU7	Sync. strip,Amp.& Clipper
V19	6W4GT	Damper Tube
V20	1X2	Hi-Volt. Rect.
V21	6BG6G	Horiz. Output
V22	6SN7GT	Horiz. Osc.& Discharge
V23	6AL5	Horiz. Phase Det.
V24	6AX5GT	Low Voltage Rect.
V25	5UAG	Med. Volt.Rect.

OPERATING CONTROLS LOCATED ON FRONT PANEL

Tone............................See Fig.1
Volume.....(Dual)...............See Fig.1
Picture.........................See Fig.1
Fine Tuning.....................See Fig.1
Channel Switch..................See Fig.1
Brightness......................See Fig.1
Horizontal Hold.................See Fig.1
Vertical Hold...................See Fig.1

NON-OPERATING CONTROLS

(Not including R.F.& I.F. Adjustments)
Vertical Linearity..........Back of Chassis
Focus.......................Back of Chassis
Vertical Size...............Back of Chassis
Adjustments are made with fingers
Ion Trap
Deflection Coil.......Screwdriver or wrench
Horizontal Width......Screwdriver or wrench

TELEVISION FREQUENCY RANGES

Channel Number	Channel Freq.MC.	Wave Length Meters	Picture Carrier MC.	Sound Carrier MC.	Het.Osc. Freq.MC.	Dipole Length	Folded Dipole Length	Reflector Length	Half Wave Direct. Length	Shorted Channel Trap*
2	54-60	5.55-5.0	55.25	59.75	81	98"	96"	103"	95"	84"
3	60-66	5.0 -4.55	61.25	65.75	87	90"	88"	94"	86"	78"
4	66-72	4.55-417	67.25	71.75	93	82"	80"	86"	78"	70"
5	76-82	3.95-3.66	77.25	81.75	103	71"	69"	74"	68"	61"
6	82-88	3.66-3.41	83.25	87.75	109	66"	64"	69"	64"	53"
7	174-180	1.72-1.66	175.25	179.75	201	32"	30"	33"	30"	25"
8	180-186	1.66-1.61	181.25	185.75	207	31"	29"	32"	29 1/2"	24"
9	186-192	1.61-1.56	187.25	191.75	213	30"	28"	31"	29"	24"
10	192-198	1.56-1.51	193.25	197.75	219	29"	27"	30"	28"	23"
11	198-204	1.51-1.47	199.25	203.75	225	28"	26"	29"	27"	22"
12	204-210	1.47-1.43	205.25	209.75	231	27"	25"	28"	26"	22"
13	210-216	1.43-1.39	211.25	215.75	237	26"	24"	27"	25"	21"

*CONSTRUCTING A CHANNEL TRAP

*Constructed of a piece of 300 ohm transmission line, shorted on one end to serve as a 1/2 wave length shorting stub. Cut a piece of line slightly longer than given under the "Half-wave Shorted Channel Trap", column and connect the two leads of one end across the receiver antenna terminals.

Using diagonal cutters or razor blade, "short", across the transmission line at a place slightly longer than the calculated length. Care should be taken when "Shorting",the line to cut through the plastic covering only; do not cut the conductors. If the interference is not "Trapped Out", short the line in 1/8" intervals(working toward the terminals) until the critical point is reached. Cut the transmission line and place a carbon resistor across the line. The resistor should be approximately 60 ohms. For strong interference, it may be necessary to drop the resistance to 20 ohms, and for weak interference it may be possible to use a 150 ohm resistor. Do not use any lower value resistor than necessary to minimize the interference.

If the interference frequency is not that of a television station, the line may be cut and the leads shorted together without using the resistor. Generally, this will completely eliminate the interference frequency.

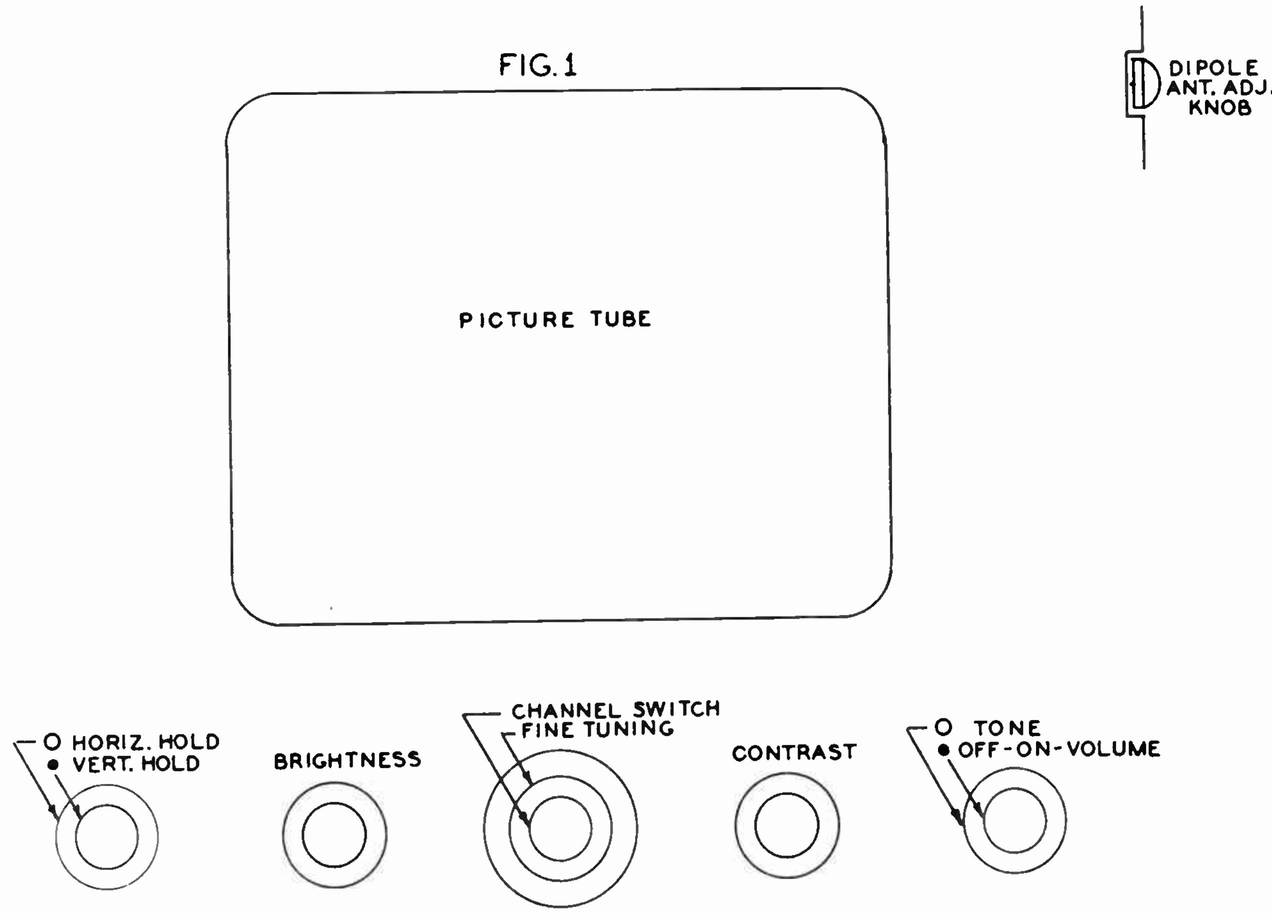
If the interference frequency being eliminated or "Trapped-out" is that of some other television station operating in the vicinity, the interfering frequency will also be eliminated or attenuated on its own channel. If the interference frequency is so strong that it can not be attenuated enough using a resistor across the line, it will be necessary to install a double-pole, single-throw switch on one of the trap leads so that the "Channel Trap", can be opened when the receiver is switched to this channel.

If the interference frequency is known, the transmission line can be cut by using the following formula.

$$\text{Half wave shorting stub in inches} = \frac{4841}{\text{Freq.(MC)}}$$

CONTROL POSITIONS AND FUNCTIONS

FIG. 1



CONTROL POSITION FOR MODELS 5006X & 5007X

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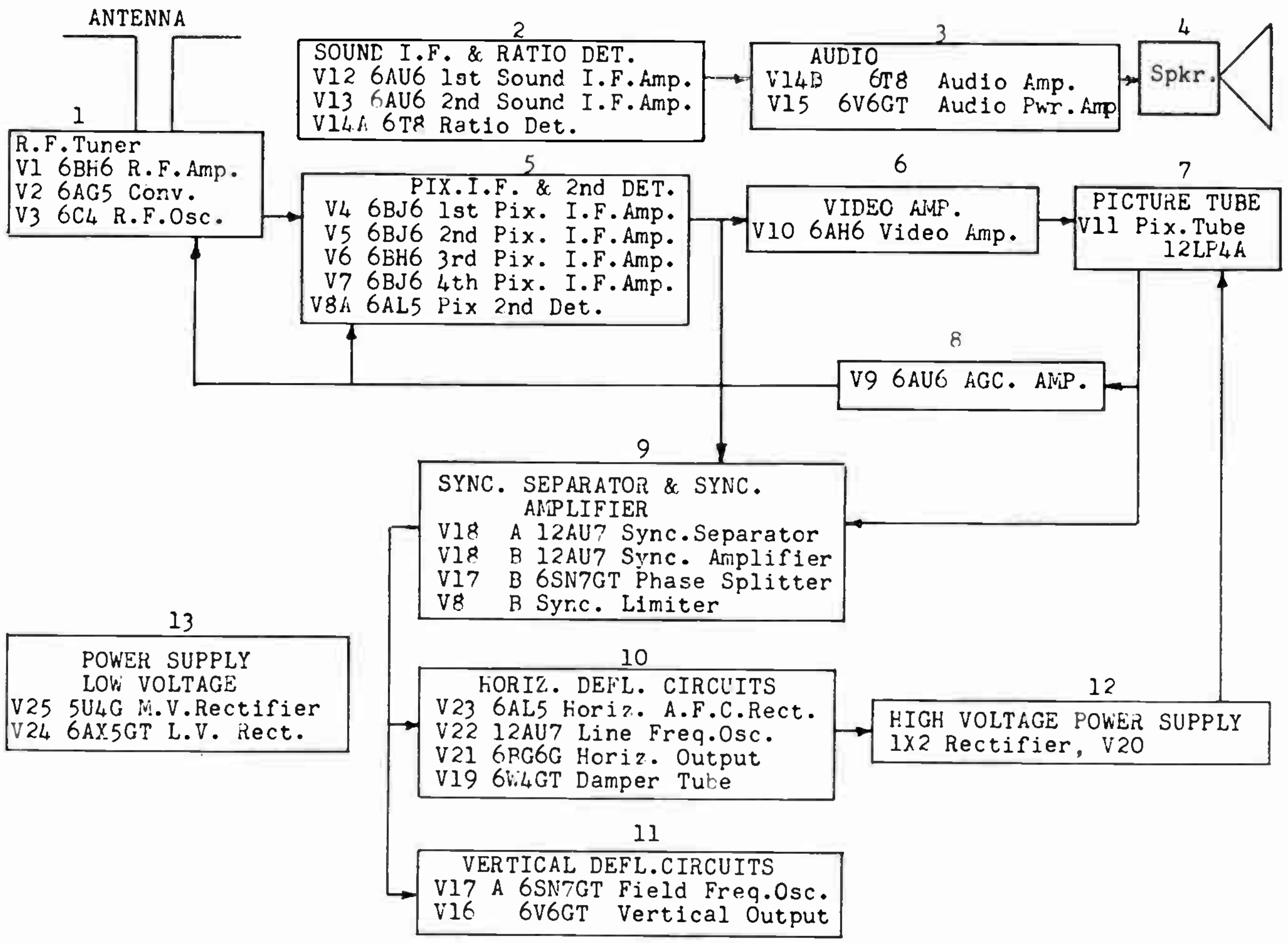
CIRCUIT DESCRIPTION

GENERAL: The following circuit description for Sparton Television Models provides all pertinent information necessary for proper servicing of these receivers. In the compliation of this data it is assumed that the service engineer is familiar with the basic electronic principles of modern television.

Fig. 2(below) shows a fundamental block diagram breakdown of the receiver circuits. The description for these circuits follows in the same order as the blocks appear on the diagram.



FUNCTIONAL BLOCK DIAGRAM FIG. 2.

R.F. TUNER (BLOCK #1)

SPECIAL SERVICE NOTE: Service replacement for the R.F. Tuning unit will be made only as a complete assembly including tubes. This unit will be shipped from the factory under part no. AD93152-2.

The R.F. Tuner is a separate sub-assembly of the receiver. It contains the R.F. amplifier, converter, local oscillator, fine tuning control, station selector switch, input transformers, R.F. amplifier coils, oscillator coils and the individual tuning adjustments for the transformers and coils. The unit provides operation on all twelve of the television channels. It serves to select the desired picture and sound carriers and associated side bands. It amplifies the selected R.F. signal and provides at the converter plate a picture I.F. carrier of 26.25 Mc. and a sound I.F. carrier of 21.75 Mc.

R.F. AMPLIFIER As shown in the schematic diagram (page 13), T1 to T9 together with incremental inductances L2,L3 and L4 are input transformers tuned to channels 2 to 13 respectively. The secondary of each of these transformers forms a parallel resonant circuit with the input capacity of V1 the 6BH6 R.F. amplifier. The inductances of the secondaries of the transformers T1 through T5, tuned to channels 2 to 6 respectively are adjusted by means of individual slugs placed within these coils. Incremental inductances L2,L3, and L4 are added in series with the slug tuned secondaries of transformers T6, T7 and T8, tuned to channels 8, 10 and 12 respectively, to form the tuned circuits for channels 7, 9, and 11. Thus the secondary of T6 tuned to channel 8 with an added series inductance L2 forms the tuned circuit for channel 7 and so on with channels 9-10 and 11 - 12. The secondary of transformer T9 is slug tuned for channel 13. On channels 7 through 13 small capacitors (C1,C2,C3,C4) are placed in series with the secondaries of transformers T6 through T9. In this way, the effective shunt capacity with which these coils resonate is decreased, and the use of larger inductance values is permitted.

CONVERTER Each of the inductances L5 through L16 forms a tuned pi-network with the input capacity of the converter (V2) and the output capacity of V1. These resonant circuits are tuned to channels 2 to 13 respectively and couple R.F. energy to the grid of V2. Since the oscillator output and the R.F. signal are both fed to the grid of V2 the heterodyne products (I.F. frequencies) will appear at the converter plate.

The inductance of coils L5 through L9, tuned to channels 2 through 6 respectively, is adjustable by means of individual slugs placed within these coils. Incremental inductances are added to the slug tuned coils for channels 8, 10 and 12 to form tuned curcuits for channels 7, 9, and 11. L16 is slug tuned to channel 13.

In the plate of the converter there are two tuned curcuits. They are the following:

FIRST: L32 with C21 forms a paralleled resonant circuit tuned to 94 Mc. that acts as a series trap preventing the oscillator voltage injected on the converter plate from developing bias on the grid of V4, the first video I.F. stage.

SECOND: L34 in conjunction with the output capacity of V2 and the input capacity of V4 forms a parallel resonant curcuit tuned to 22.4 Mc. This is the first stage of the stagger tuned video I.F. system.

R.F. OSCILLATOR: The local oscillator is a Colpitts type. The inductances L17 through L28 together with the incremental inductances L23, L25 and L27, form the oscillator tank circuits and are tuned above the R.F. frequencies at channels 2 to 13 respectively. Fine tuning is accomplished by means of C14, which has a capacity range sufficient to produce a ∠ 600 Kc. variation in oscillator output frequency on channel 2 and a variation of approximately ∠ 2.5 Mc. on channel 13.The output of the oscillator is coupled to the grid of the converter by means of capacitor C10. The oscillator operates at a frequency above that of the received signal.

SOUND I.F. AND RATIO DETECTOR (BLOCK #2) The sound and picture I.F. signals are common to stages V4 and V5. At V6 sound energy is taken off by means of the sound take off loop, which is part of L43, the 21.75 Mc. cathode trap inductance. This energy is fed to the first sound I.F. stage V12. Two stages of sound I.F. amplification are employed in order to secure adequate gain. Inductors L56 and L59 are 1" pieces of straight, tinned copper wire. They are employed in the cathode circuits of V12 and V13 to neutralize a regenerative condition in the 6AU6 tube produced by mutual inductance between suppressor and control grid leads.

T13 in conjunction with V14A forms a conventional ratio detector system that operates on a center frequency of 21.75 Mc. and has a peak-to-peak band width of approximately 500 Kc.

AUDIO AMPLIFIER AND SPEAKER(BLOCKS #3 AND #4)Tubes V14B and V15 form a conventional two stage audio amplifier that feeds a permanent magnet speaker. A compensated volume control R61A is employed. Continuous tone control is provided by means of R61B and its associated circuit. Maximum power output of the system is approximately 3. watts in the speaker voice coil.

PICTURE I.F. AMPLIFIER AND SEC. DET (BLOCK #5) The primary requirements of the picture I.F. system are wide overall response and adequate overall gain. To meet these requirements four stages of stagger tuned video I.F. amplification are employed.

As noted on the schematic diagram (page 19) these stages are V4, V5, V6 and V7. Single tuned I.F. coils are utilized in the plate circuit of the converter and each of the four successive stages. Starting with the coil L34 in the converter plate each of the coils L36,L40,L44,L47 in the following stages are tuned to a different frequency. Thus by virtue of stagger tuning the several stages, wide band picture I.F. response is obtained.

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CIRCUIT DESCRIPTION (CONT'D)

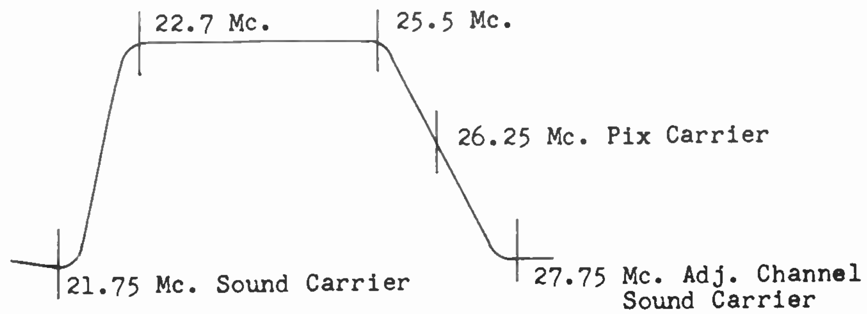


Figure (3) Pix. I.F. Response

In order to obtain a band pass as pictured in Figure (3), the I.F. coils are peaked to approximately the following fixed frequencies:

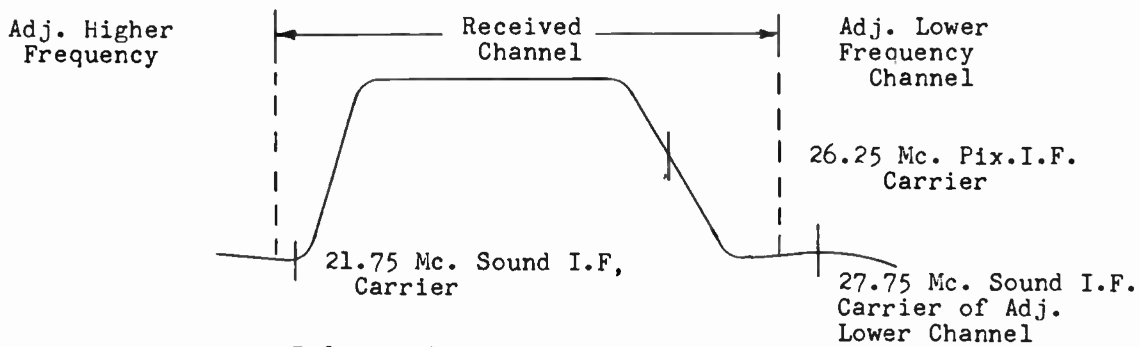
L34	Plate of the Conv.	(V2)	22.4 Mc.
L36	1st Pix. I.F.	(V4)	22.5 Mc.
L40	2nd Pix. I.F.	(V5)	25.9 Mc.
L44	3rd Pix. I.F.	(V6)	24.1 Mc.
L47	4th Pix. I.F.	(V7)	26.0 Mc.

In addition the trap L37 for the adjacent channel sound I.F. carrier, 27.75 Mc., and the traps L43 and L48 for the sound I.F. carrier, 21.75 Mc., are peaked for minimum output at the pix detector load. The overall response of the picture I.F. is observed with the aid of an I.F. sweep and an oscilloscope. Deviations in the observed response from that pictured in Figure (3) are compensated for by slight variations in the tuning of the pix. I.F. coils.

Under normal conditions replacement of any of the tubes in the picture I.F. strip will have little effect on the shape of the overall pass band. The information on physical location of the various transformers and traps will be found in the section on alignment.

TRAPS Referring to figure (4) it is evident that the I.F. frequency of the adj. channel sound carrier and the I.F. frequency of the received channel sound carrier are quite close to the frequencies passed by the picture I.F. system. If some means of attenuating these sound carriers is not provided in the picture I.F. they will pass through the pix detector where they will be demodulated and passed on to the kinescope grid as video information. Once there, these signals would appear as interference in the observed picture.

Figure 4



Relation between Pix. and Sound I.F. Carriers

Note that with the R.F. oscillator operating above the channel being received the I.F. relation of the pix to sound carriers is the reverse of their R.F. relation.

In order to prevent this interference, trap circuits L37, L43 and L48 are provided to attenuate the undesired sound carriers. L37 functions as a series trap in the plate circuit of V4 and is tuned to 27.75 Mc., the I.F. frequency of the adjacent channel sound carrier as noted in figure 4. The trapping action of this stage is sufficient to keep the sound interference from this source at a negligible value. L43 and L48 are tuned traps inserted in the cathode circuits of V6& V7 respectively.

VOLTAGE CHART AND ALIGNMENT TEST POINTS

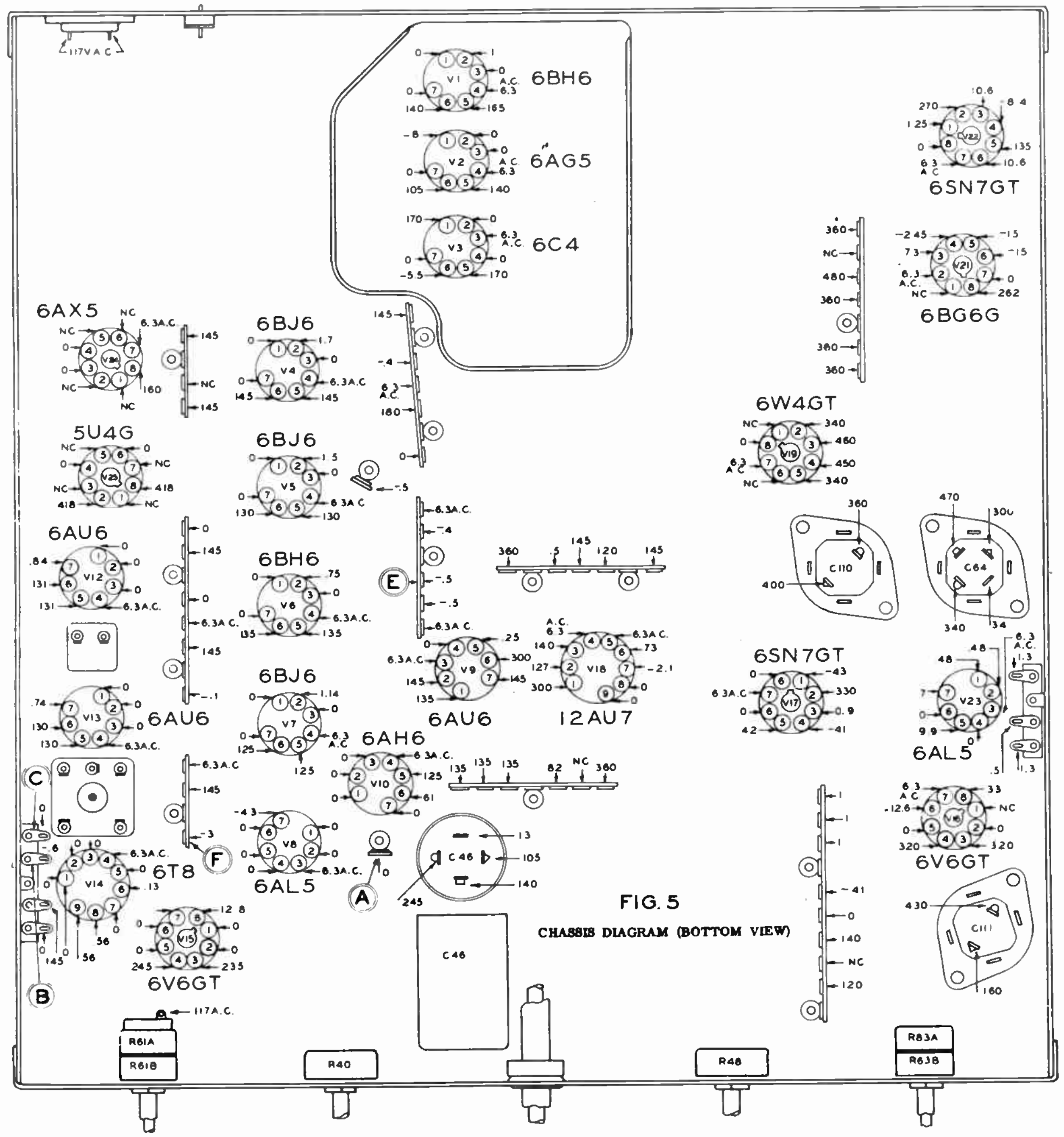


FIG. 5
CHASSIS DIAGRAM (BOTTOM VIEW)

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CIRCUIT DESCRIPTION (CONT'D)

These traps are tuned to 21.75 Mc., the sound I.F. frequency. At this frequency, the voltage developed across these traps will function as a degenerative voltage opposing the 21.75 Mc. sound I.F. signal at the grids of the respective stages. The combined attenuation offered by stages V6 and V7 is sufficient to suppress the 21.75 Mc. sound carrier before it reaches the pix detector. Inductors L42 and L46 are used to minimize changes in input impedance of stages V6 and V7. The neutralized changes in input impedance occur with frequency and are due to the respective cathode traps.

PIX DETECTOR The pix second detector is a conventional diode, V8A. It is D.C. coupled to the video amplifier and connected to produce a sync. signal of negative polarity across its load.

VIDEO AMPLIFIER BLOCK #6 The video amplifier is a D.C. coupled 6AH6 stage V10 having a maximum gain of approximately 35. The frequency response of the amplifier extends from DC. to 4 megacycles. A 4.5 megacycle trap (L52,C45) seems to prevent the beat note set up by picture and sound carriers from appearing in the picture as a fine interference pattern. L51, L53, L54 and L55 are peaking coils inserted in the circuit to get the desired frequency response.

The gain of the stage is varied by changing the screen grid voltage by means of the contrast control R40. The 6AH6 is a sharp cut-off high gain tube with the operating conditions adjusted in such a manner that noise pulses of sync. polarity are clipped off in the grid circuit and noise of opposite polarity is clipped off in the plate circuit.

Due to the fact that the video system is D.C. coupled from the picture detector to the kinescope cathode, no D.C. restorer is necessary in the receiver.

KINESCOPE BLOCK #7 The kinescope utilized in the receiver is a conventional 12" tube, This tube employs magnetic focus and deflection systems. An ion trap is used to prevent the ion beam from forming a dark spot on the kinescope screen. The flaring portion of the kinescope bulb has a metallic coating on both the inside and outside surfaces. The coating on the inside of the bulb forms the kinescope second anode and has the high voltage connected to it. The outside coating is grounded so that the capacity between the outside and inside coating acts as a filter for the high voltage power supply. The outside coating also serves as an electrostatic and external light shield to the tube.

A.G.C. AMPLIFIER BLOCK #8 A keyed A.G.C.amplifier tube V9 is used in order to get the best possible A.G.C. characteristic and to minimize the effects of noise in the A.G.C.circuit.

In a receiver using a conventional A.G.C. circuit any noise signals present at the Picture Detector will develop A.G.C. voltage and reduce the gain of the receiver. If the noise is of greater strength than the incoming signal which is often the case in weak signal areas the video signals will be so reduced by the A.G.C.voltage developed by noise that the pictures will become very unsteady and drop out of sync. entirely.

In the keyed A.G.C.system, the plate voltage for the A.G.C.amplifier tube is a high narrow positive pulse of about 300 volts taken from a winding on the horizontal width coil. This pulse is synchronized with the incoming horizontal sync. pulses and no plate voltage is applied to the tube except at the time a sync. pulse is present on its grid. Any noise pulses arriving between sync. pulses cannot generate A.G.C. because no plate voltage is applied to the plate and the tube cannot function. Therefore, the A.G.C.system is upset very little by noise.

Full A.G.C. is applied to the I.F.tubes but only approximately 1/3 of the A.G.C. is applied to the R.F.amplifier tube. This allows the R.F. stage to operate with a better signal-to-noise ratio than if full A.G.C.were applied.

SYNC. STRIPPER, AMPLIFIER AND CLIPPER(BLOCK #9) Synchronizing signals of positive polarity are taken from the plate load resistor of the video amplifier tube and fed to the grid of the first section of V18. This triode is biased beyond cut-off so that only the synchronizing pulses appear in the plate circuit. These sync. pulses are then amplified and partially clipped by the second section of V18 and applied to the grid of the phase splitter V17B and the plate of the sync.limiter diode V8B. The limiter diode (V8B) clips off the sync. and holds the level essentially constant

TRIMMER AND SLUG LOCATIONS

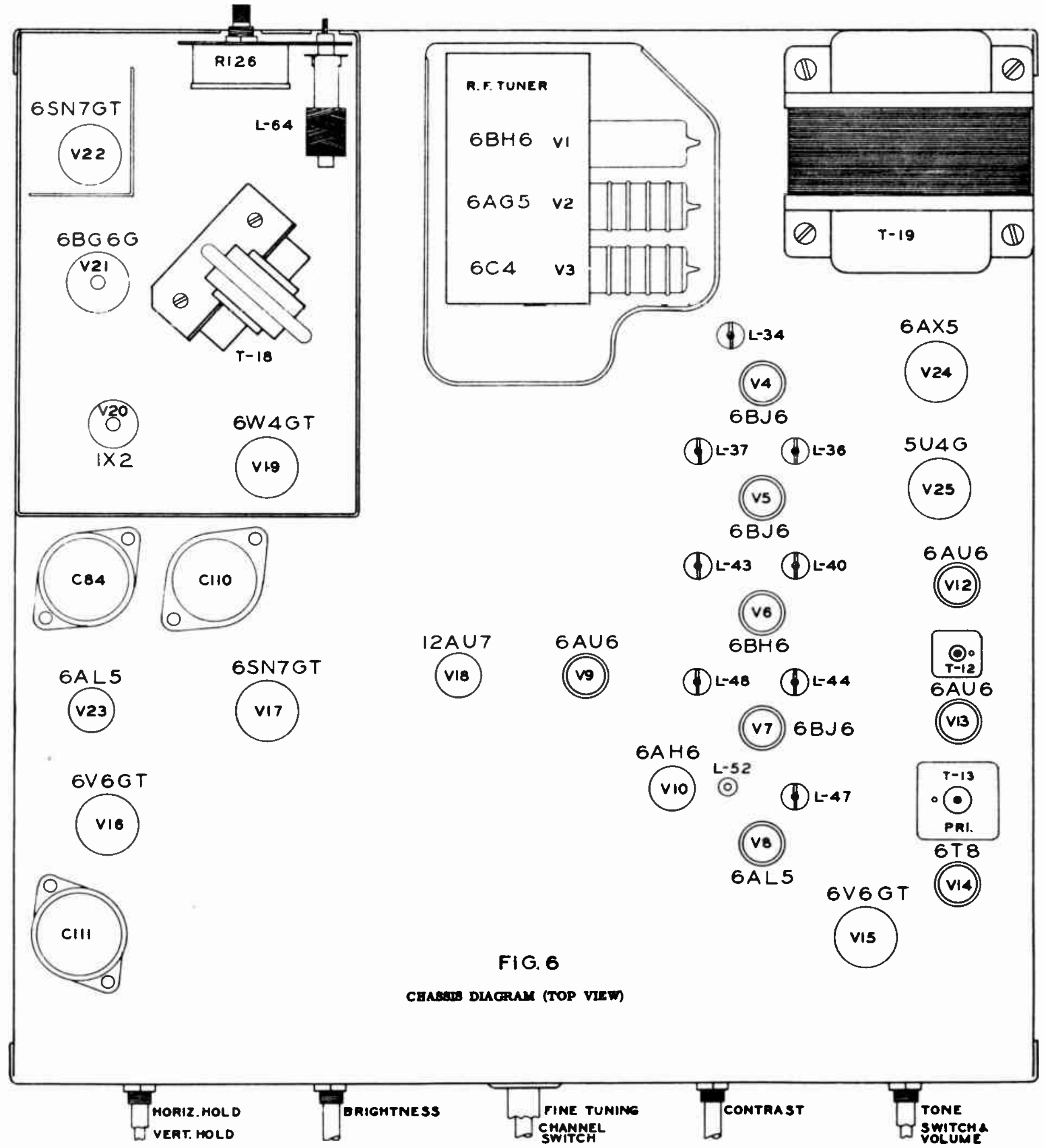

FIG. 6

CHASSIS DIAGRAM (TOP VIEW)

over a wide range of input signals. The phase splitter V17B further clips the sync. signals and provides both positive and negative sync.pulses in its output which are required for the horizontal AFC system.

HORIZONTAL DEFLECTION CIRCUITS (BLOCK #10) The horizontal deflection system is incorporated to provide a stable, linear, scanning current in the horizontal winding of the deflection yoke. This results in accurate horizontal reproduction of the transmitted picture.

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CIRCUIT DESCRIPTION (CONT'D)

HORIZONTAL OSCILLATOR AND AFC SYSTEM The horizontal oscillator V22 is a composite circuit incorporating a cathode coupled multivibrator and a tank circuit (L65 and C100) resonant at approximately 15, 750 cycles per second to produce a stabilizing sine wave voltage. This circuit possesses the RC time constand and grid bias frequency control characteristics of a typical multivibrator; but it achieves some of the operational frequency stability of a sine wave system. The free-running frequency of the oscillator is controlled primarily by the horizontal hold control R83B. This control is set for approximately 15,750 cycles per second. The oscillator is then locked into synchronism with the incoming signal by means of an automatic D.C.control voltage bias applied to one grid (pin #1) of the oscillator.

This D.C. voltage is developed by the horizontal A.F.C. rectifier V23. This circuit is a conventional duo-diode phase comparitor which compares the phase of the incoming sync. pules with the saw-tooth voltage across the horizontal output transformer secondary, the sawtooth being fed through C103 and R114. Any discrepancy in the exact phase relationship of these two voltages produces a change in D.C. voltage across C102 (at the oscillator grid). This changes the oscillator frequency to assure exact phase and frequency coincidence between the output sawtooth and the incoming sync.pulses from the signal. In this manner, the horizontal scanning of the receiver is locked in to synchronism with the signal sync.pulses.

The output of the horizontal oscillator is a aswtooth voltage(developed by the RC network R108 and C98) puls a peaking component(fed back through C95 from the horizontal output) across R107). The peaking component is sufficient to produce adequate high voltage and fast retrace time. The amount of this drive to the grid of the horizontal output tube V21 is controlled by a capacity divider consisting of C97 and a variable mica trimmer C96. This trimmer is adjusted for optimum horizontal linearity of picture

HORIZONTAL OUTPUT AND DAMPER The horizontal output tube and the damper tube V19 produce the required linear sawtooth scanning current in the horizontal deflection coil. The two tubes plus the horizontal output transformer also produce a high voltage pulse which is used to obtain the kinescope high voltage supply. The output system is a conventional kick-back type except that no electrical horizontal centering is provided. Capacitor C92 is employed to isolate direct current from the yoke. Centering is therefore accomplished by actual physical motion of the focus coil. The output transformer as far as deflection is concerned, is an impedance matching device for the output tube and yoke.

The width control L64 is provided to vary the output and hence the picture width. This is accomplished by shunting a portion of the secondary winding to change the effective transformation ratio. Clockwise rotation of L64 increases the shunting inductance and hence the width.

Because the horizontal transformer, deflection coil, and associated circuits are designed to resonant at a high frequency (period = 14 microseconds) for fast retrace time, they are shocked into resonance when the magnetic field collapses during the retrace. To prevent continued oscillatory currents in the deflection yoke, the damper diode, V19 is incorporated. During the first half cycle (7 microsecond) of retrace resonance, the circuit oscillates freely to insure rapid retrace time. During the next half cycle, however, the damper plate goes positive and conduction of the 6W4G occurs. This puts a very heavy load on the deflection coil so that it cannot oscillate.

The 6BG6G plate voltage is supplied through the 6W4G which is conducting over the major portion of the trace. Capacitor C93 is charged during this period and this charge is sufficient to supply the 6BG6G plate when the 6W4G is not conducting.

The charge is placed on this capacitor by the receiver d-c supply and by the current from the collapse of the field in the horizontal deflecting coil. The a-c axis of the sweep voltage is 360 volts above ground since the secondary is connected to the receiver, 350V volt bus. The charge placed on this capacitor by the coil kick-back is therefore in addition to that from the d-c supply and thus the capacitors are charged to a voltage greater than the d-c supply. This permits operation of the 6BG6G at a higher voltage than is obtainable from the receiver power supply and produces an increase in the system efficiency by salvaging energy that would otherwise have been wasted.

VERTICAL DEFLECTION SYSTEM(BLOCK #11) This section of the receiver functions to supply vertical scanning for the kinescope. A conventional system is utilized. Stage V17A operates as a field frequency oscillator whose output signal is used to drive the vertical output stage V16. The combined action of these stages and their associated circuits provides a linear deflection current of proper polarity and frequency in the vertical deflection yoke.

VERTICAL INTEGRATING NETWORK The integrating network composed of R79,R80,R81 and C82 A-B-C functions to separate the horizontal from the vertical sync.and to pass the vertical sync. pulse developed on to thefield frequency oscillator. In operation the network can be considered as a low pass filter that by-passes the horizontal sync. pulses and permits the low frequency vertical sync.to pass on through to the grid of V17A.

TRIMMER AND SLUG LOCATIONS

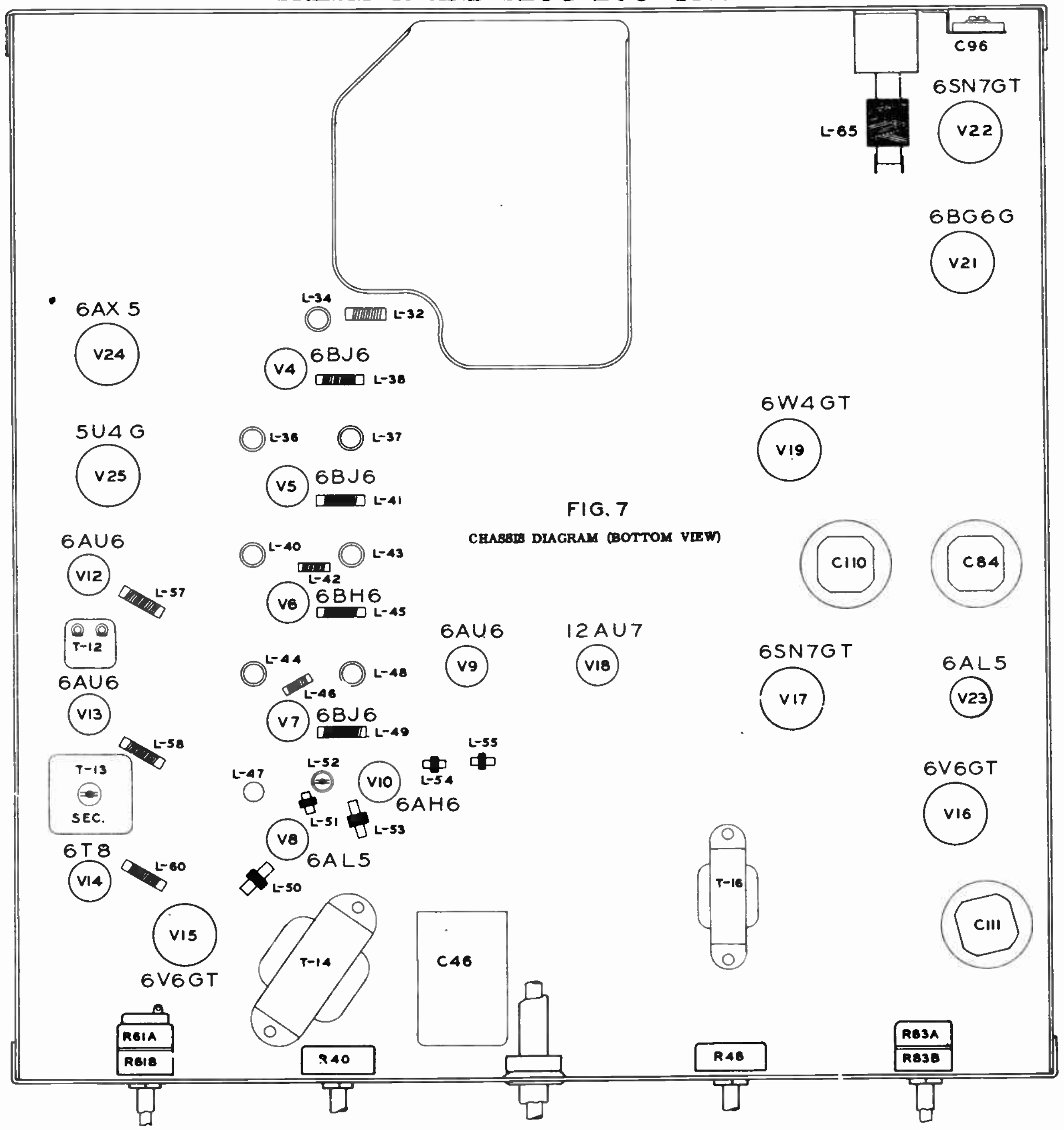

FIG. 7
CHASSIS DIAGRAM (BOTTOM VIEW)

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CIRCUIT DESCRIPTION (CONT'D)

FIELD FREQUENCY OSCILLATOR The field frequency oscillator V17A is a conventional blocking oscillator system. In actual operation the free running frequency of the oscillator is adjusted by means of the vertical hold control R83A. The oscillator is locked in sync.at field frequency by means of the vertical sync. pulses which are injected into its grid circuit by the integrator network. The cut off and conduction action of the oscillator charges and discharges capacitor C86 and the resulting sawtooth output is used to drive the output stage.V16.

VERTICAL OUTPUT The peaked sawtooth output of the blocking oscillator system is used to drive the grid of the vertical output stage. An impedance matching transformer, T17 is used to couple the output stage to the vertical deflection yoke,L63A.Picture height is controlled by means of R87 which varies the B+voltage supplied to the vertical system. Vertical trace linearity is adjustable by means of R91 in the cathode circuit of the output stage. In operation, adjustment of this control varies the bias and consequently the operating point of the stage.

HIGH VOLTAGE POWER SUPPLY(BLOCK #12) The kinescope high voltage supply is obtained from the energy stored in the deflection inductances during each horizontal scan. When the 6BG6G plate current is cut off by the incoming signal, a positive pulse appears on the T18 primary due to the collapsing field in the deflection coil. This pulse of voltage is stepped up, rectified by V20, filtered and applied to the second anode of the kinescope (V11). Since the frequency of the supply voltage is high (15,750 C.P.S.), relatively little filter capacity is necessary. Since the filter capacity is small, the stored energy is small, and the high voltage supply is made less dangerous.

LOW AND MEDIUM VOLTAGE POWER SUPPLY (BLOCK #13) This part of the receiver supplies the heater and plate supply voltages for all tubes. A 5U4G rectifier V25 supplies 350 volts at 170 ma. which is filtered by the speaker field and the focus coil and their associated capacitors C111A, C110A, C110B.

The focus control R126 allows adjustment of the amount of current flowing thru the focus coil in order that correct focusing of the electron beam in the kinescope is obtained.

A 6AX5GT rectifier V24 supplies 140 volts at 120 Ma. which is filtered by a choke L67 and its associated capacitors C11B and C46D.

BUILT-IN DIPOLE ANTENNA
Both Models, 5006X and 5007X are equipped with a built-in Dipole antenna which is hooked up for operation when shipped from the factory.

The antenna proper consists of two copper plates in the top of the cabinet. The dipole tuning is accomplished by capacitor C19 which is a 2-80 MMF. trimmer and a matching stub in the 300 Ohm. ribbon. A control knob has been provided on the right-hand side of the cabinet for individual station tuning.

This type of antenna is designed for operation on local stations only, and in locations where it will give satisfactory results. This antenna is not designed to work in conjunction with another antenna and must be disconnected when another antenna is attached.

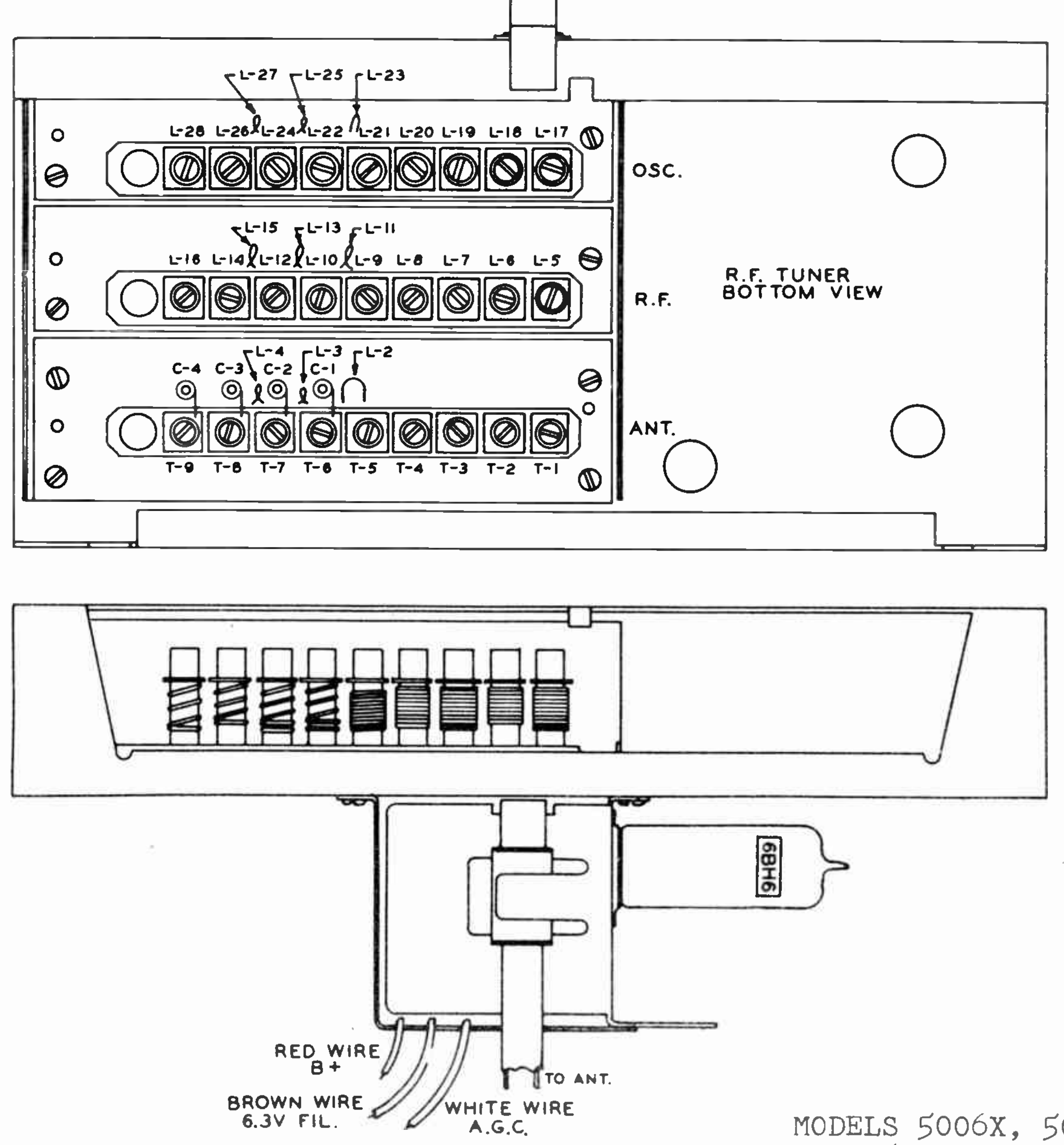
VOLTAGE TEST SPECIFICATIONS

1. Line Voltage = 117 Volts A.C.
2. Channel Switch Position = Channel #2.
3. Brightness Control Position = Average Brilliance on Picture Tube.
4. Contrast Control Position = Maximum (Clockwise).
5. Horizontal and Vertical Hold Control Positions = Set correct position to lock in picture.
6. Horizontal Width and Vertical Size Controls Positions = Set for Correct Size Raster = Height 8 3/4", Width 11 1/2".
7. Horizontal and vertical Linearity Control Position = Set for Best Linearity.
8. Focus Control Position = Properly focused.
9. Volume Control Position= Maximum Counter-Clockwise.
10. Tone Control Position = Maximum Counter-Clockwise.
11. Instrument (Meter) Used =(V.T.V.M.) Vacuum Tube Volt Meter.
12. Unless Otherwise Designated All Voltages Measured In Respect To Chassis Ground.

NOTE: The Points indicated by the letters A, B, C. E & F are the alignment test points referred to in the following alignment procedure. These points indicate the terminals for attaching Generator Leads.

R. F. TUNER SUB-CHASSIS ASSEMBLY

FIG.8



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ALIGNMENT PROCEDURE

TEST EQUIPMENT: In order to align and service Sparton television receivers properly the following test equipment should be available:

FIRST: AN R.F. SWEEP GENERATOR of reliable quality that performs the following functions:

A. Provides sweep outputs in the following frequency ranges:

19 to 30 Mc.	10 Mc. sweep width
40 to 90 Mc.	10 Mc. sweep width
170 to 225 Mc.	10 Mc. sweep width

B. Provides an output signal that can be varied by means of an attenuator up to a maximum of at least .1 volt.

SECOND: AN R.F. SIGNAL GENERATOR that will provide an adjustable output signal up to a maximum of at least .1 volt on the following fixed frequencies:

A. I.F. Frequencies

21.75 Mc.	Sound I.F. and sound traps
22.4 Mc.	1st video I.F. coil
22.5 Mc.	2nd video I.F. coil
24.1 Mc.	4th video I.F. coil
25.9 Mc.	3rd video I.F. coil
26.0 Mc.	5th video I.F. coil
26.25 Mc.	Picture I.F. carrier
27.75 Mc.	Adjacent channel sound traps

B. R.F. Frequencies

Channel No.	Picture Carrier	Sound Carrier
2	55.25 Mc.	59.75 Mc.
3	61.25 Mc.	65.75 Mc.
4	67.25 Mc.	71.75 Mc.
5	77.25 Mc.	81.75 Mc.
6	83.25 Mc.	87.75 Mc.
7	175.25 Mc.	179.75 Mc.
8	181.25 Mc.	185.75 Mc.
9	187.25 Mc.	191.75 Mc.
10	193.25 Mc.	197.75 Mc.
11	199.25 Mc.	203.75 Mc.
12	205.25 Mc.	209.75 Mc.
13	211.25 Mc.	215.75 Mc.

THIRD: A CATHODE-RAY OSCILLOSCOPE of good quality that has a fairly wide band vertical amplifier and a low capacity input probe.

FOURTH: AN ELECTRONIC VOLTMETER on which the input probes are all insulated from the meter case.

FIFTH: A CRYSTAL CALIBRATOR that can be used for checks on the accuracy of the output frequencies of the R.F. signal generator.

GENERAL INSTRUCTIONS: Practically all servicing with the exception of some tube replacement will require removal of the receiver chassis from the cabinet.
A convenient arrangement that makes both the top and bottom of the chassis accessible for alignment and servicing can be realized by orienting the receiver chassis in such a manner that it rests on its side and on the horizontal output shield can

ALIGNMENT REQUIREMENTS: Under normal conditions complete receiver realignment will seldom be necessary in the field. However, a detailed description of the overall alignment procedure is included to provide all necessary information if it should be required.

In general it is not recommended that the R.F. and converter circuits of the R.F. tuner be realigned by the service engineer unless absolutely necessary. In cases where tuner components have been damaged, or where complete realignment is indicated, the R.F. tuner assembly should be removed from the chassis and sent back to the factory in exchange for a new unit which will be shipped complete with tubes.
When the new R.F. unit is assembled to the chassis it will be necessary in all cases to realign L34 which is located on the receiver chassis. Normally this is the only adjustment that will be required with tuner change but a check on overall receiver alignment and sensitivity should be made for the sake of certainty and assured customer satisfaction.

EFFECTS OF TUBE REPLACEMENT ON THE ALIGNMENT OF R.F. TUNER CIRCUITS: The alignment of the R.F. and converter circuits of the R.F. tuner is critical and may be affected by a tube change. In cases where these tubes (6BH6 or 6AG5) are replaced it will be necessary for the service engineer to check for satisfactory receiver operation. If realignment is indicated it can usually be avoided by selection of replacement tubes until receiver operation is realized.

Replacement of the 6C4 local oscillator can usually be made with little or no effect on the alignment and operation of the oscillator circuits. However, when a replacement is made, a check should be performed to make certain that the vernier capacitor range is sufficient to tune in the sound carriers on all channels.

ORDER OF ALIGNMENT: When complete receiver realignment is indicated it should be performed in the following order:

1. Sound traps
2. Picture I.F.
3. Sound I.F.
4. Ratio Detector Transformer
5. Retouch Picture I.F.
6. Sound and Picture I.F. Sensitivity Check
7. RF.Oscillator Circuits
8. R.F.and Converter Circuits(not recommended)
9. Overall Sensitivity Check

PRELIMINARY ADJUSTMENTS: Before alignment the receiver controls should be adjusted to the approximated operating positions specified in the table below. The controls should remain in these positions for all checks unless otherwise specified.

Contrast Control - to center position
Brightness Control - to position where raster is visible on the kinescope
Focus Control - to position where focus is obtained
Vertical Hold - to center position
Vertical Linearity - to center position
Vertical Size - adjusted to give normal raster height
Horizontal Hold - to center position
Horizontal Size - adjusted to give normal raster width

TEST EQUIPMENT SET UP: A certain amount of experimentation must be employed to secure a stable test set up before alignment or service of the receiver is attempted. It is recommended that the top of the test bench be covered with a sheet of aluminum to insure good grounds between the various pieces of test equipment and the receiver chassis. In general all test signal input leads should be kept away from output leads as much as possible.

PICTURE I.F. INSTABILITY: If the picture I.F. strip is badly out of alignment it may become unstable and fall into oscillation. When this condition occurs a comparatively large voltage is developed across the picture detector load resistor. This voltage is independent of I.F.signal input at the converter grid.
It is usually possible to stop I.F. oscillation due to misalignment by adjusting the iron cores in the various picture I.F. coils and traps according to the information given in the table below:

L34	Slug in (Max. L.)
L37	Slug out
L36	Slug in
L40	Slug out
L44	Slug out
L43	Slug in
L47	Slug out
L48	Slug in

The actual physical location of the various coils and traps is shown in Figure 6 and 7. As soon as the oscillation has been stopped, continue with the alignment as outlined in the following sections.

SOUND TRAP ALIGNMENT: FIRST, remove VI (6BH6 R.F. amplifier) and V-3 (6C4 local oscillator tubes)from the RF.tuner, connect the R.F.signal generator to the grid of V-2 by means of the I.F. input adapter as shown in Fig. 9..

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ALIGNMENT PROCEDURE (CONT'D)

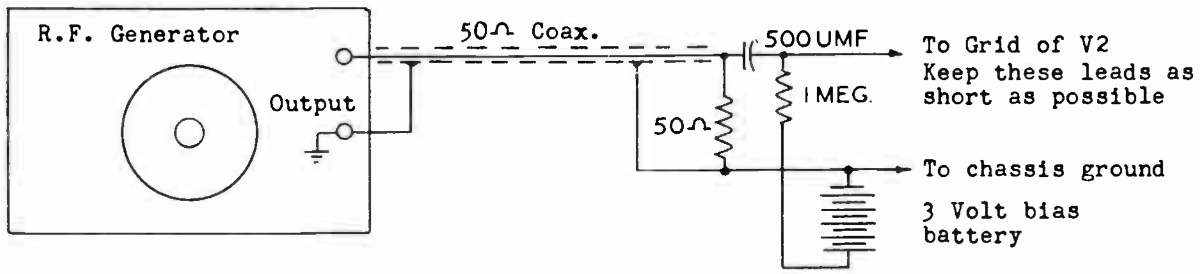

Figure 9 I.F. Input Adapter

SECOND: Set the R.F.tuner to channel #2.

THIRD: Connect a 3 volt bias battery between the A.G.C. buss (point E, Fig. 5) and chassis ground so that the voltage on the A.G.C. buss is-3 volts in respect to the chassis.

FOURTH: Connect the electronic voltmeter across the picture detector load resistor R37, Point A,Fig. 5 and set the voltmeter on the low DC.volt scale.

FIFTH: Set the R.F. signal generator to each of the frequencies shown in the table below and in each case tune the specified adjustment for minimum indication on the voltmeter. It is advisable to check the output of the generator with the crystal calibrator to make certain that it is exactly on frequency in each case.

27.75 Mc.	L37	(Top of chassis as shown in Fig. 6)
21.75 Mc.	L43	(Top of chassis as shown in Fig. 6)
21.75 Mc.	L48	(Top of chassis as shown in Fig. 6)

PICTURE I.F. ALIGNMENT: FIRST: Connect the R.F. signal generator, voltmeter and bias battery to the receiver as described in steps 1,2,3 and 4 of the sound trap alignment instructions.

SECOND: Set the signal generator to each of the following frequencies and peak the specified adjustments for maximum indication of the voltmeter.

22.4 Mc.	L-34	(Top of chassis as shown in Fig. 6)
22.5 Mc.	L-36	(Top of chassis as shown in Fig. 6)
25.9 Mc.	L-40	(Top of chassis as shown in Fig. 6)
24.1 Mc.	L-44	(Top of chassis as shown in Fig. 6)
26.0 Mc.	L-47	(Top of chassis as shown in Fig. 6)

NOTE: On some receivers it is possible to tune through resonance on L-40 and set the I.F. strip in oscillation. When this occurs the voltage across the picture detector load resistor will increase to a point where the effects of the oscillation may be mistaken for the actual resonance peak of L-40. If trouble of this nature is encountered tune L-40 to the point where I.F.oscillation ceases and go on to peak L44 and L47 at their respective frequencies and then return to peak L-40.

SOUND I.F. ALIGNMENT: FIRST: Connect the R.F. signal generator and bias battery to the receiver as described in steps 1,2 and 3 of sound trap alignment instructions.

SECOND: Connect the electronic voltmeter across C-69 (from point B to ground) as shown in Fig. 5 . Set the voltmeter on the low D.C. volt scale.

THIRD: Set the R.F.signal generator to 21.75 Mc. and peak the following coils for maximum indication on the voltmeter.

T-12	(Top of chassis as shown in Fig. 6)
T-13	(Primary (Ratio Det.) top of chassis as shown in Fig.6)

RATIO DETECTOR TRANSFORMER ALIGNMENT: FIRST: Connect the R.F. signal generator and bias battery to the receiver as described in steps 1,2 and 3 of the sound trap alignment instructions.

SECOND: Connect the electronic voltmeter from the junction of R63 and R64, Point F to the Junction of R59,C62 and C65. Point C as shown in Figure 5.

THIRD: Set the signal generator output to 21.75 Mc. Adjust the secondary of T13 (Bottom view of chassis as shown in Fig. 7). Notice that it is possible to produce a positive or negative voltage indication on the meter by varying this adjustment. As the voltage swings from positive to negative, adjust T13 for zero output as indicated by the voltmeter. This point is called zero ratio detector output and indicates correct alignment of T13 transformer. If the secondary of T13 is found to be way out of alignment it will be necessary to re-peak the primary as described in the preceeding section on sound I.F.alignment.

PICTURE I.F. TOUCH UP: Connect the R.F. sweep generator output to the grid of V-2 by means of the I.F. input adapter shown in Figure 9.

SECOND: Remove V-1 and V-2 from the R.F. tuner. Set R.F. Selector to channel #2.

THIRD: Connect the oscilloscope across the picture detector load resistor R37(point A, Fig. 5) by means of the shielded cable and the filter system shown in Fig. 10.

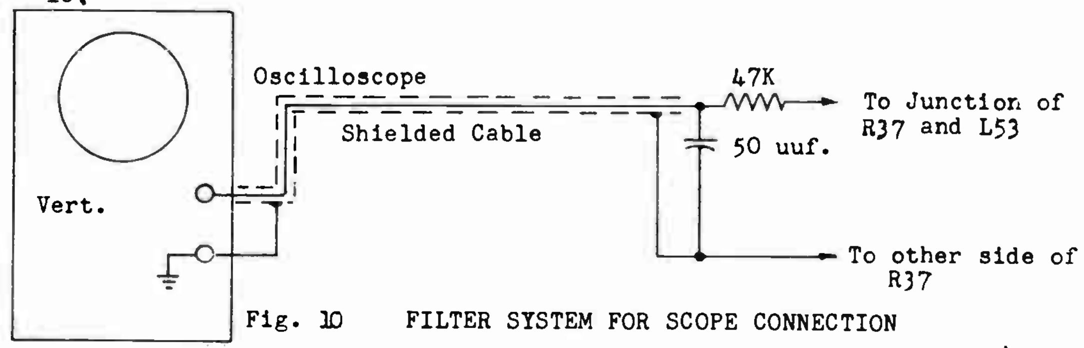

Fig. 10 FILTER SYSTEM FOR SCOPE CONNECTION

FOURTH: Set the R.F. sweep genterator so that it sweeps from approximately 20 to 30 Mc.

FIFTH: Adjust the oscilloscope so that the swept I.F. response is visible on the cathode-ray tube screen.

SIXTH: Loosely couple the output of the R.F. signal generator to the grid of V-2 so that marker signals of proper frequency can be mixed in with the R.F. sweep signal.

SEVENTH: Observe the band width, relative position of the picture carrier, and flatness of the overall I.F. response curve. If necessary slightly vary the tuning of the picture I.F. coils L-34,L-36,L-40,L-44 & L-47 until the picture I.F. response shown in Figure 11 is obtained. The solid curve in Figure 11 depicts the ideal I.F. response while the dotted curves show permissable variations.

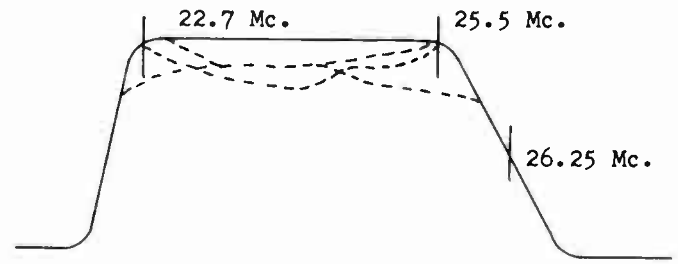

Fig. 11 IDEAL I.F. RESPONSE WITH PERMISSABLE VARIATIONS

The picture I.F. carrier should appear approximately half way down the I.F. response curve as shown in Figure 11. Variation in the pix carrier position should not exceed ± 10% from the half way point.

PICTURE I.F. SENSITIVITY CHECK: FIRST: Connect the R.F. signal generator to the receiver as specified in steps 1 and 2 of the sound trap alignment instructions. (When making sensitivity checks no bias battery is connected to the A.G.C. buss.)

SECOND: Connect the electronic voltmeter across the picture detector load resistor R37 Point A, Fig. 5, and set the meter on the low D.C. volts scale.

THIRD: Set the generator output frequency at approximately 23 Mc. Adjust the generator output until the voltmeter reads approximately 1.0 volt. Record the R.F.signal input in microvolts. Repeat the procedure with the generator output frequency set at 24.2 and 25.4 Mc. In all cases the I.F. input voltage should be 100 Microvolts or less. The sensitivity at the I.F. picture carrier 26.25 Mc..

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ALIGNMENT PROCEDURE (CONT'D)

should be approximately half of the I.F. sensitivity between 24.2 Mc. (Maximum of 200 microvolts.).
If the generator output is not calibrated in microvolts, comparative sensitivity measurements can be made by using another receiver that is known to be in good operating condition as a standard. This applies to all sensitivity measurements and good results can be obtained if sufficient care is used.

SOUND I.F. SENSITIVITY: FIRST: Connect the R.F. signal generator to the receiver chassis as specified in steps 1 and 2 of the sound trap alignment instructions.

SECOND: Connect the electronic voltmeter across C67 (from point B to ground) as shown in Figure 5. Set the meter on the low D.C. volts scale.

THIRD: Set the generator output frequency at 21.75 Mc. Adjust the output signal level until the voltmeter indicates 8 volts across C67. The generator output signal should then be 250 microvolts or less.

R.F. OSCILLATOR ALIGNMENT: The R.F. oscillator circuits may be aligned by feeding signals at the R.F. sound carrier frequencies into the receiver antenna terminals and adjusting the oscillator frequency on each channel for zero output from the ratio detector. The ratio detector should be aligned exactly before this method of R.F. oscillator adjustment is attempted.

Since incremental inductances are placed in series with the tuned circuits for channels 8, 10 and 12 to form the tuned circuits for channels 7, 9 and 11, the order in which these channels are aligned becomes important. In these cases it is necessary to align the higher channel of each connected pair before the alignment of the lower channel is attempted. For example, L22 forms the tuned circuit for channel 8 but with the additional series inductance L23 also forms the tuned circuit for channel 7. Note that the tuning of L22 not only affects oscillator operation on channel 8 but also on channel 7 since L22 is common to both circuits. L23, however, affects only channel 7 since it is switched out of curcuit when the tuner operates on channel 8. For these reasons it is necessary to first tune L22 for correct oscillator frequency on channel 8, and then to adjust L23 for correct oscillator frequency on channel 7. In practice the inductance of the incremental coils is adjusted by actual mechanical distortion of the incremental coils themselves.
The following description gives a step by step procedure that simplifies oscillator circuit alignment.

FIRST: Insert V-1 and V-3 in the R.F. tuner. Connect the signal generator to the receiver antenna terminals.

SECOND: Set the oscillator vernier capacitor (fine tuning) at approximately the center of its effective capacity range. This can best be determined by finding the maximum and minimum capacity settings of the vernier and then interpolating between the two extremes for the center position.

THIRD: Connect the electronic voltmeter from the junction of R63 and R64, Point F Figure 5 to the Junction of R59, C62 and C65. Point C as shown in Fig. 5.

FOURTH: Set the R.F. signal generator to each of the following sound R.F. carrier frequencies, thetuner to the corresponding R.F. channel, and peak the specified adjustment for zero output of the ratio detector as observed on the voltmeter. (Zero output of the ratio detector is explained in the section on ratio detector alignment.)

ADJUST R.F. GENERATOR FREQUENCY TO	SET TUNER TO CHANNEL	ADJUST INDUCTANCE OF COIL NO.
215.75 Mc.	13	L28 (Slug tuned)
209.75 Mc.	12	L26 (Slug tuned)
203.75 Mc.	11	L27 (Incremental)
197.75 Mc.	10	L24 (Slug tuned)
191.75 Mc.	9	L25 (Incremental)

ADJUST R.F. GENERATOR FREQUENCY TO	SET TUNER TO CHANNEL	ADJUST INDUCTANCE OF COIL NO.
185.75 Mc.	8	L22 (Slug tuned)
179.75 Mc.	7	L23 (Incremental)
87.75 Mc.	6	L21 (Slug tuned)
81.75 Mc.	5	L20 (Slug tuned)
71.75 Mc.	4	L19 (Slug tuned)
65.75 Mc.	3	L18 (Slug tuned)
59.75 Mc.	2	L17 (Slug tuned)

The physical location of all coils and adjustments is shown in Figure 6, and 7
The output of the R.F. generator should be checked by means of the crystal calibrator tomake certain that it is exactly on frequency in all cases.

CAUTION: In manufacture the slugs in the R.F. tuner coils are firmly held in place by means of wax which is put into the forms after alignment. This wax must be removed before tuning of the coils is attempted and must be replaced after re-alignment is completed.

R.F. AND CONVERTER CIRCUIT ALIGNMENT: The alignment of the R.F. and converter circuits of the tuner is a difficult and tedious task when it must be performed without benefit of special factory test equipment. For this reason it is not recommended that the complete re-alignment of these circuits be attempted by the service engineer.
The information provided in the paragraphs below is intended primarily for descriptive purposes and cases where only one or two of the coils may require readjustment. In general, where complete tuner re-alignment is indicated, it is recommended the the complete tuner assembly be removed and returned to the factory for a replacement unit.
On channels 2 through 6 the R.F. and converter circuits of the tuner are stagger tuned to obtain wide band R.F. response. In alignment the R.F. transformers T1 through T5 are peaked to the R.F. sound carrier frequencies on their respective channel while the converter coils L5 through L9 are peaked at the corresponding R.F. picture carrier frequencies. Slight deviations in the tuning of these coils are made to obtain an essentially flat R.F. pass band characteristic.

On the high channels, 7 through 13, the R.F. and converter coils are synchronously tuned to the center of each band. At these frequencies the tuned circuits are broad enough to provide an essentially broad, flat, pass band without stagger tuning.
The alignment of these circuits can best be accomplished in the following manner.
FIRST: Make certain all tubes are in place.

SECOND: Connect the R.F. signal generator to the receiver antenna terminals. If the R.F. generator has an unbalanced output it must be converted to a balanced system as shown in Figure 12. The component values indicated are for generators whose output impedance is approximately 50Ω. All specified resistors should be of the non-inductive type.

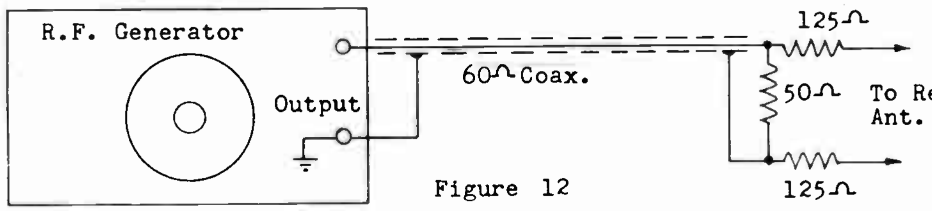

Figure 12

UNBALANCED OUTPUT CONVERSION SYSTEM

THIRD: Perform the operations indicated in the following table and in the order that they are shown. In all cases keep the R.F. signal input as low as possible so that the resonance peaks of the various coils are not masked by A.G.C. circuit action. (Shorting of the A.G.C. buss to chassis ground is recommended when aligning these circuits).

SET R.F. TUNER TO CHANNEL NO.	SET R.F. GEN. OUTPUT FREQ.TO.	ADJUST OSC. VERNIER CAP. IN EACH CASE FOR	CONNECT VOLTMETER	ADJUST THESE COILS FOR MAXIMUM INDICATION ON VOLTMETER
2	59.75 Mc.	Zero Ratio Det. output	Across C69	T1
3	65.75 Mc.	Zero Ratio Det. Output	Across C69	T2
4	71.75 Mc.	Zero Ratio Det. Output	Across C69	T3 ALL
5	81.75 Mc.	Zero Ratio Det. Output	Across C69	T4
6	87.75 Mc.	Zero Ratio Det. Output	Across C69	T5 SLUG
2	55.25 Mc.	Max. Volt.Across R37	Across R37	L5
3	61.25 Mc.	Max. Volt. Across R37	Across R37	L6
4	67.25 Mc.	Max. Volt. Across R37	Across R37	L7 TUNES
5	77.25 Mc.	Max. Volt. Across R37	Across R37	L8
6	83.25 Mc.	Max. Volt. Across R37	Across R37	L9
13	213 Mc.	Max. Volt. Across R37	Across R37	T9 & L16 Slug tuned
12	207 Mc.	Max. Volt. Across R37	Across R37	T8 & L14 Slug tuned
11	201 Mc.	Max. Volt. Across R37	Across R37	L4 & L15 Increment.
10	195 Mc.	Max. Volt. Across R37	Across R37	L12 Slug tuned
9	189 Mc.	Max. Volt. Across R37	Across R37	L3 & L13 Increment.
8	183 Mc.	Max. Volt. Across R37	Across R37	T6 & L10 Slug tuned
7	177 Mc.	Max. Volt. Across R37	Across R37	L2 & L11 Increment.

FOURTH: Replace the R.F. signal generator by the R.F. sweep generator. (If the sweep has an unbalanced output convert it to a balanced system as described in step #2).

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ALIGNMENT PROCEDURE (CONT'D)

FIFTH: Connect a cathode-ray oscilloscope across R37 as described in step #2 of the picture I.F. touch up instructions (Page 26).

SIXTH: Perform the operations indicated in the following table. In each case adjust the specified coils for flat wide band overall response with maximum gain as indicated on the oscilloscope screen. The oscillator vernier capacitor must be correctly adjusted (as indicated by zero ratio detector output) for the sound R.F.carrier on each channel before any adjustment of the R.F. or converter circuits is made.

The shape of the overall response curve on all channels should be approximately the same as that of the video I.F. response curve shown in Figure 11. Marker pulses of proper frequency should be mixed in with the R.F. sweep input to check overall bandwidth and relative position of the picture carrier on each channel. Always keep the R.F.input signal low so that slight variations in the tuning of the various coils are easily discernable on the oscilloscope screen. The physical location of all the adjustments is shown in Figure 6 and 7, page 17 and 18.

SET TUNER TO CHANNEL NO.	SET SWEEP GENERATOR CENTER FREQ. AT	SET SWEEP WIDTH AT APPROX.	SLIGHTLY ADJUST FOLLOWING WHERE NECESSARY
13	213 Mc.	10 Mc.	T9 and L16 (Slug tuned)
12	207 Mc.	10 Mc.	T8 and L14 (Slug tuned)

SET TUNER TO CHANNEL NO.	SET SWEEP GENERATOR CENTER FREQ. AT.	SET SWEEP WIDTH AT APPROX.	SLIGHTLY ADJUST FOLLOWING WHERE NECESSARY
11	201 Mc.	10 Mc.	L4 and L15(Incremental)
10	195 Mc.	10 Mc.	T7 and L12(Slug tuned)
9	189 Mc.	10 Mc.	L3 and L13(Incremental)
8	183 Mc.	10 Mc.	T6 and L10(Slug tuned)
7	177 Mc.	10 Mc.	L2 and L11 (Incremental)
6	85 Mc.	10 Mc.	L9 and T5 (Slug tuned)
5	79 Mc.	10 Mc.	L8 and T4 (Slug tuned)
4	69 Mc.	10 Mc.	L7 and T3
3	63 Mc.	10 Mc.	L6 and T2 (Slug tuned)
2	57 Mc.	10 Mc.	L5 and T1 (Slug tuned)

NOTE: If the output of the sweep generator cannot be adjusted to a satisfactory low level, an attenuator pad, (as shown in Figure 13) should be used in series with the receiver antenna terminals and the output connections of the sweep. (Several sections can be cascaded for increased attenuation if necessary.

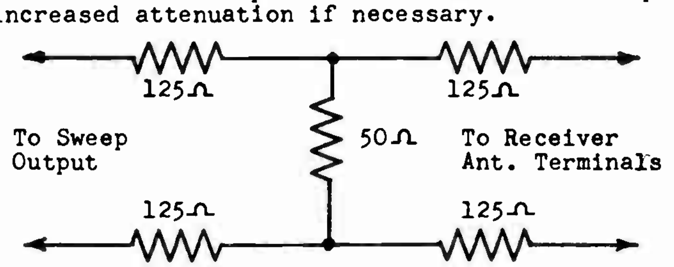

FIGURE 13

ATTENUATOR PAD

The same type of pad can be used in series with the receiver antenna terminals and the antenna lead in areas where the R.F. signal level is high enough to overload the receiver.

OVERALL PICT. SENSITIVITY CHECK: After alignment of the various sections of the receiver has been completed the following overall sensitivity checks should be made. (In cases where the signal generator output is not calibrated in microvolts comparative sensitivity measurements can be made by using another receiver which is known to be in good operation condition as a standard).

FIRST: Connect the R.F. signal generator to the receiver antenna terminals as described in step #2 of the R.F. and converter circuit alignment data.

SECOND: Connect the D.C. voltmeter across R37 as previously described. Set the voltmeter on the low D.C. volts scale.

THIRD: Perform the operations indicated in the following table. In each case the oscillator vernier should be tuned for zero detector output at the sound R.F. frequency of the channel being checked before any measurements are made.

SET R.F. TUNER TO CHANNEL NO.	SET R.F. GENERATOR OUTPUT FREQUENCY TO	ADJUST R.F. INPUT LEVEL UNTIL VOLTMETER READS	GENERATOR OUTPUT SHOULD BE
2	57 Mc.	1.0 V.D.C.	150 UV or less
3	63 Mc.	1.0 V.D.C.	150 UV or less
4	69 Mc.	1.0 V.D.C.	150 UV or less
5	79 Mc.	1.0 V.D.C.	150 UV or less
6	85 Mc.	1.0 V.D.C.	150 UV or less
7	177 Mc.	1.0 V.D.C.	150 UV or less
8	183 Mc.	1.0 V.D.C.	150 UV or less
9	189 Mc.	1.0 V.D.C.	150 UV or less
10	195 Mc.	1.0 V.D.C.	150 UV or less
11	201 Mc.	1.0 V.D.C.	150 UV or less
12	207 Mc.	1.0 V.D.C.	150 UV or less
13	213 Mc.	1.0 V.D.C.	150 UV or less

OVERALL SOUND SENSITIVITY CHECK: After proper circuit operation and alignment has been realized, with volume and tone controls set at maximum, the vernier capacitor (fine tuning) properly adjusted on each channel, the overall sound sensitivity can be checked as indicated in the table below:

SET R.F. TUNER TO CHANNEL NO.	SET R.F. GENERATOR FREQUENCY OUTPUT TO	SET GENERATOR MODULATION TO	ADJUST GEN. OUTPUT TO GIVE	GENERATOR OUTPUT
2	59.75 Mc.	400 ~	.5 Watts	200 UV or less
3	65.75 Mc.	± 7.5 Kc.		200 UV or less
4	71.75 Mc.		in speaker	200 UV or less
5	81.75 Mc.	deviation		200 UV or less
6	87.75 Mc.		Voice Coil	200 UV or less
7	179.75 Mc.			200 UV or less
8	185.75 Mc.		(Approx.	200 UV or less
9	191.75 Mc.		1.25 V.	200 UV or less
10	197.75 Mc.		A.C.	200 UV or less
11	203.75 Mc.		Across	200 UV or less
12	209.75 Mc.		Voice	200 UV or less
13	215.75 Mc.		coil	200 UV or less

COMPLETE HORIZONTAL OSCILLATOR AND DEFLECTION CIRCUIT ALIGNMENT

FIRST: Remove the safety-back on the receiver and by means of a separate line cord place the set in operation.

SECOND: Tune in a television station that is transmitting a test pattern and adjust the fine tuning control for best sound quality.

THIRD: With the horizontal hold control at the center of rotation, adjust the slug in the horizontal oscillator tank coil(L65 as shown in Fig. 7 Page 18) until the picture is synchronized horizontally. This is indicated by the fact that any vertical lines in the test pattern will be straight in the upper portion of the picture and not curved to the right or left. Picture must be synchronized vertically when making this adjustment.

FOURTH: Adjust the horizontal drive control (Trimmer C96 as shown in Fig.7 Page 18) by turning the adjusting screw counter clockwise until one or more white lines appear in the picture. Then back off the adjustment till the white lines just disappear and the linearity is best. This adjustment may affect the frequency of the horizontal oscillator in which case readjust as in Step 3.

FIFTH: Adjust the width control (L64 available through hole in H.V. case as shown in Fig. 6,Page 2-17).) until the picture just fills the mask horizontally.

SIXTH: Tune the receiver to channel No. 13 and check the raster for Barkhausen oscillations.

The flyback type of horizontal output and high voltage circuits used in this receiver can produce Barkhausen oscillations under certain conditions. These oscillations are at television R.F. frequencies and can be picked up by the tuner and appear as vertical black lines or smudges on the left hand side of the raster, particularly when a weak or no television is being received.

These oscillations can be minimized by adjustment of the horizontal drive control (trimmer C96) With his trimmer screwed tight (minimum drive) the oscillations are strongest; too tight a trimmer will also reduce the high voltage and increase the plate current of the horizontal output tube (6BG6) beyond safe limits. With the trimmer open(maximum drive) a vertical white bar or shading can occur in the left hand side of the roster accompanied by a linearity distortion at the white area. The optimum adjustment of the horizontal drive (C96) control lies between these two conditions and should be made in that manner.

After making the final adjustment check all channels to make sure that optimum operating condition for all channels has been realized.

SEVENTH: Recheck and touch up all adjustments as may be necessary.

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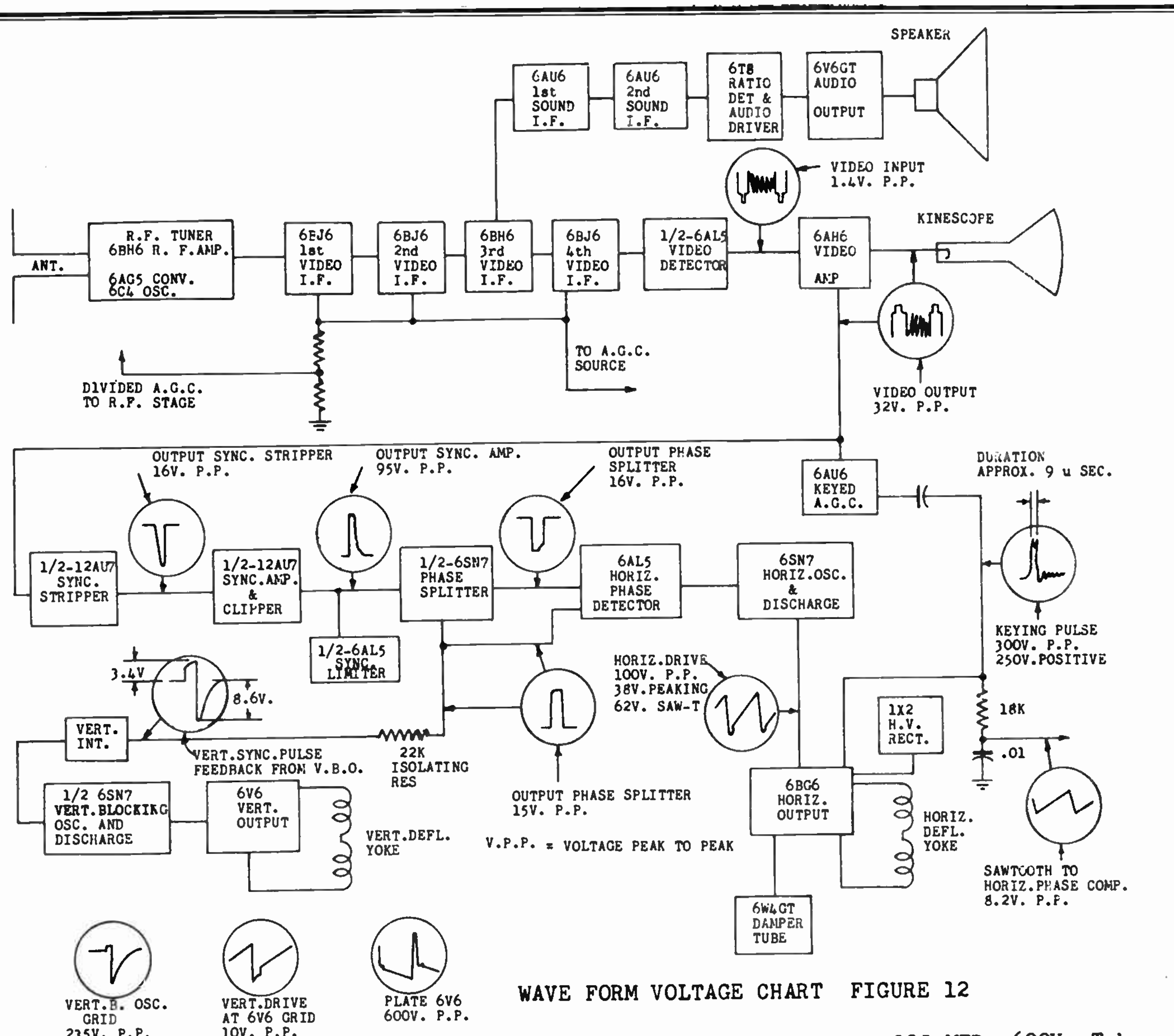
MODELS 5006X, 5007X,
Ch. 25TK10A



WAVE FORM VOLTAGE CHART FIGURE 12

DESCRIPTION		PART NO.
Condenser	-C20,22,24,33, 40,49,54,55,56, 61,67,76,77 Ceramic Disc 5MMF	PA4334-1
Condenser	-C21 Temp.Comp. 1.5 MMF.	PA4326-3
Condenser	-C23,28,31,35,41,66 Ceramic 270 MMF.	HK36M-271
Condenser	-C25,36,37,59,70 Ceramic 1K MMF	HK36H-102
Condenser	-C26 A & B,29A & B, 32A & B, 39A & B Dual Disc. 1K MMF.	PA4345-1
Condenser	-C27 Ceramic 100 MMF.	CC30A-101F
Condenser	-C53,58 Ceramic 100 MMF.	CC32A-101A
Condenser	-C71 Mica 100 MMF.	MC60E-101
Condenser	-C34,42 Mica 470 MMF.	MC60E-471
Condenser	-C43,60 Ceramic 10 MMF.	CC30A-100F
Condenser	-C38,80, .5 MFD 200V. Tub.	PC40GK-504
Condenser	-C44 .001 MFD. 600V. Tub.	PC40GM-102
Condenser	-C46A,B,C,D Electrolytic	PA4307-16
Condenser	-C47,50,86, .05 MFD 400V.Tub.	PC40GL-503
Condenser	-C48,87, .1 MFD 200V. Tub.	PC40GK-104
Condenser	-C57 Ceramic 22 MMF.	CC30A-220K
Condenser	-C62 Ceramic 2K	HK36G-202
Condenser	-C63 Ceramic 47 MMF.	CC30A-470F
Condenser	-C64 Temp. Comp. 3.3 MMF.	PA4326-4
Condenser	-C65,68 .02 MFD. 200V. Tub.	PC40GK-203
Condenser	-C69 Elect. 5 MFD. 50V.	PA4308-2
Condenser	-C72 .02 MFD., 600V. Tub.	PC40GM-203
Condenser	-C73,75 .005 MFD. 600V. Tub.	PC40GM-502
Condenser	-C74 .03 MFD 200V. Tub.	PC40GK-303
Condenser	-C82A,B,C Herlec Ceramic	PA4339-4
Condenser	-C84A,B,C,D Electrolytic	PA4307-18
Condenser	-C85 .1 MFD 400V. Tub.	PC40GL-104
Condenser	-C90 Mica 56 MMF. 1200V.	PA4340-6
Condenser	-C91 Hi-V. Ceramic 500 MMF.	PA4346
Condenser	-C92 .22 MFD. 200V. Tub.	PC42GK-224
Condenser	-C93 .22 MFD. 400V. Tub.	PC42GL-224
Condenser	-C93 .047 MFD. 400V. Tub.	PC42GL-473
Condenser	-C95 10 MFD. 1500V. Ceramic	PA4327-2
Condenser	-C96 Trimmer 20-270 MMF.	PA4368
Condenser	-C98,99 Mica 330 MMF.	MC60E-331
Condenser	-C100 Mica 3900 MMF.	MC63F-392
Condenser	-C101 Mica 5.1K MMF.	MC61E-512
Condenser	-C104,105 Mica 1K MMF.	MC61E-102
Condenser	-C106 .001 MFD 600V. Tub.	PC40GM-102
Condenser	-C110A,B Elect. 40 MFD 475V.	PA4307-13
Condenser	-C111A,B Elect. 40 MFD 475,250V.	PA4307-19
Condenser	-C112 .047 MFD 600V. Mold paper	PC42GM-475

R40 Control -	Contrast (25K)	PA4442
R48 Control -	Brightness (100K)	PA4432
R61A Control-	Volume (330K	PA4428-1
R61B Control-	Tone (1M)	
R83A Control-	Vertical Hold(1M)	PA4430-1

DESCRIPTION		PART NO.
R83B Control-	Horiz.Hold (50K)	PA4431
R87 Control-	Vert.size (2.5M)	PA4411
R91 Control-	Vert. Linearity (5K)	PA4426-1
R126 Control-	Focus (1500)	
L-32	Choke - R.F.	AA6654-1
L-33,35.39	Choke - R.F. (3.3 uh)	PA4225-3
L-34	Coil Pix. I.F. (22.4 MC)	AB43523-8
L-36	Coil Pix. I.F. (22.5 Mc)	AB43523-6
L-37	Coil Pix. I.F. (27.75 Mc)	AB43524-10
L-38,41,45,49,57,58,60	Choke-R.F.(3uh)	AA6651-1
L-40,41	Coil Pix. I.F. (25.9 Mc.& 24.1Mc)	AB43523-10
L-42,46	Choke R.F. (11uh)	AA6644-1
L-43	Coil Pix. I.F. (21.75 Mc)	AB43524-8
L-47	Coil Pix. I.F.(26.0 Mc)	AB43523-11
L-48	Coil Pix.I.F. (21.75 Mc)	AB43524-9
L-50	Choke-R.F. (25uh)	AA6650-1
L-51	Coil-Peaking (120uh)	AA6402-2
L-52	Coil Video Trap(4.5Mc)	AA6404-1
L-53	Coil-Peaking (243uh)	AA6613-7
L-54	Coil-Peaking (180uh)	AA6402-5
L-55	Coil-Peaking (200uh)	AA6402-4
*L-63 A & B	Coil- Yoke	PC70004
L-64	Coil-Width	AA6405-3
L-65	Coil-Horiz.Osc.Tank	AA6403-2
L-66	Coil-Focus	PC70005-1
L-67	Choke-Filter	AB47000-1
Knob -	Tuner (Outer)	PA5630-1
Knob -	Tuner (Inner) Band Indicator	PA5631-1
Knob -	Vol. or Vert.Hold(Outer)	PA5632-1
Knob -	Tone or Horiz. Hold(Inner)	PA5633-1
Knob -	Contrast or Brightness	PA5634-1
Knob -	Dipole Antenna	PA5650
T-12	Transformer-Sound I.F.	AA6663-2
T-13	Trans.Ratio Det.	AA6684-3
T-14	Trans. Audio Output	AB44066-2
T-16	Trans.Vert. Blocking Osc.	AB47006-4
T-17	Trans.Vert. Output	AB44062-4
T-18	Trans. Horiz. Output	PC70007
T-19	Trans.Power	AB44018-1
**R.F.Tuner Assem.(Complete with tubes)		AD93152-2
**Speaker (5"x7")		PC63000-29
Band-Indicator Dial		PA6572-2
Band-Indicator Dial Retainer		PA1199
Paper Washer		PA709-3
Bezel		PC63081
Glass-Safety		PC63078-1
Mask- Rubber		PC63080
Picture Tube 12LP4A(12 1/2-Inch)		PD93160
Ion Trap		PA1175

*Deflection Yoke supplied only as complete assemblies.
**Complete speakers and RF.tuner assemblies may be returned to Factory Service Department for repair or replacement.

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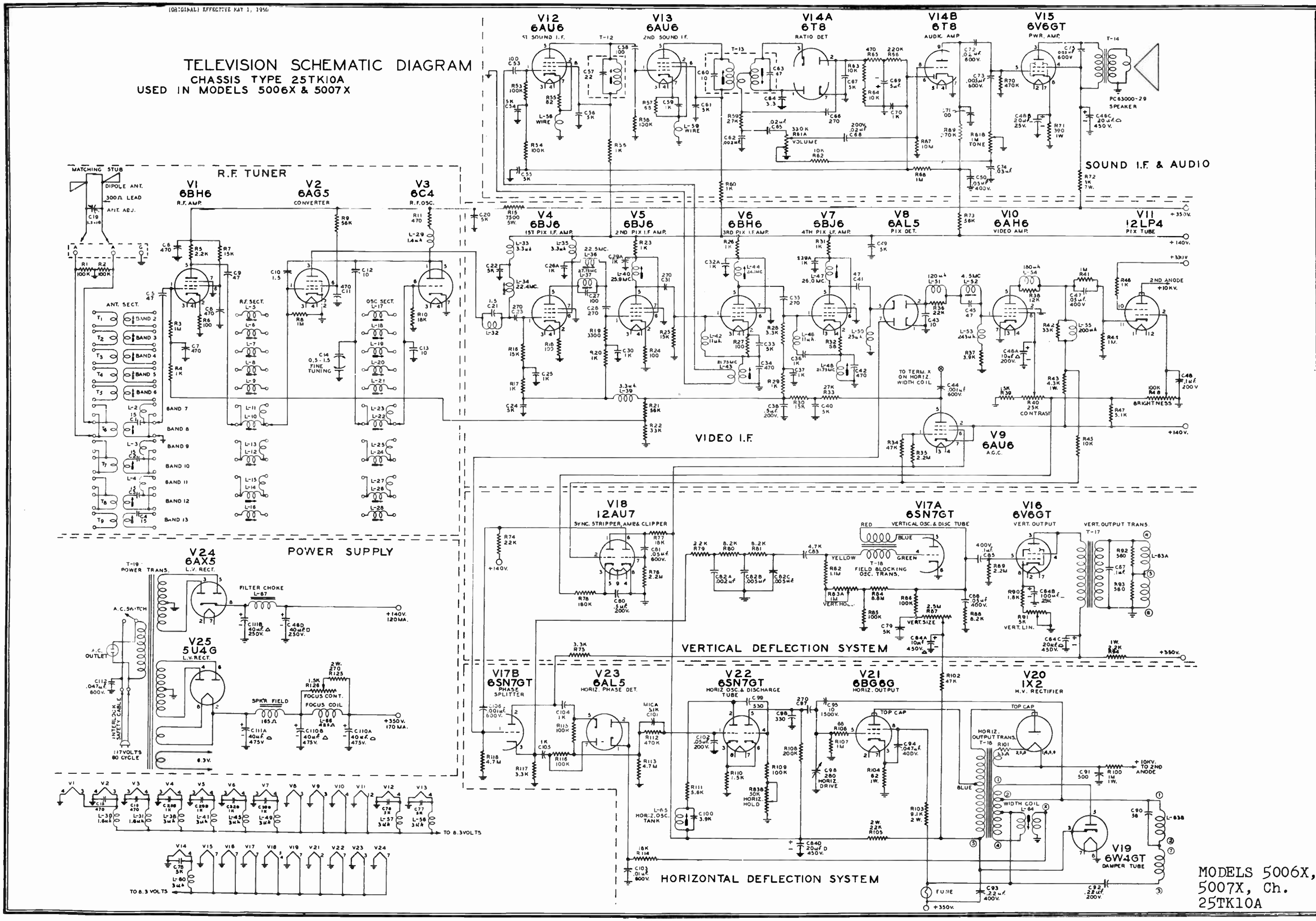
TELEVISION SCHEMATIC DIAGRAM
CHASSIS TYPE 25TK10A
USED IN MODELS 5006X & 5007X



SPARTON TV PAGE 6-13

MODELS 5006X, 5007X, Ch. 25TK10A

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World Radio History

MODELS 5010, 5011, 5014, 5015, 5056, 5057, 5071, 5072, Ch. 19TS10, 19TS10A, 19TW10, 19TW10A

INDEX

BRIEF DESCRIPTION

MECHANICALLY: The 19TS10 and 19TS10A receivers are constructed on a single base with mechanical dimensions approximately 16" X 17". These new receivers are used in both table and console models. The mechanical difference between the 19TS10 and 19TS10A receiver are the 19TS10A uses only a 12LP4(12") Picture tube which necessitates higher Pix tube mounting brackets and longer control shafts.

These receivers are controlled by the "Six" controls on the front panel. The extreme left-hand control is a dual control and are the adjustments for vertical and horizontal hold. For diagram showing operating control position and function, see Index for page number in this bulletin.

Controls to adjust the focus, height and vert. linearity are mounted on back of chassis and are adjusted with the fingers. Adjustments for horiz. osc. and width are also located on back of chassis and is made with a screw-driver. For diagram, see drawing showing Trimmer and Slug Locations in this Bulletin.In all models described in this bulletin the picture tube and yoke Assembly are mounted on the chassis proper.

ELECTRICALLY: The 19TS10 chassis is equipped with type 10BP4(10") Picture Tube and the capacitor C93 across the horizontal yoke winding should be 68 uuf. at 1200 volts. Table Model 5011 is shipped with 10" Pix tube.

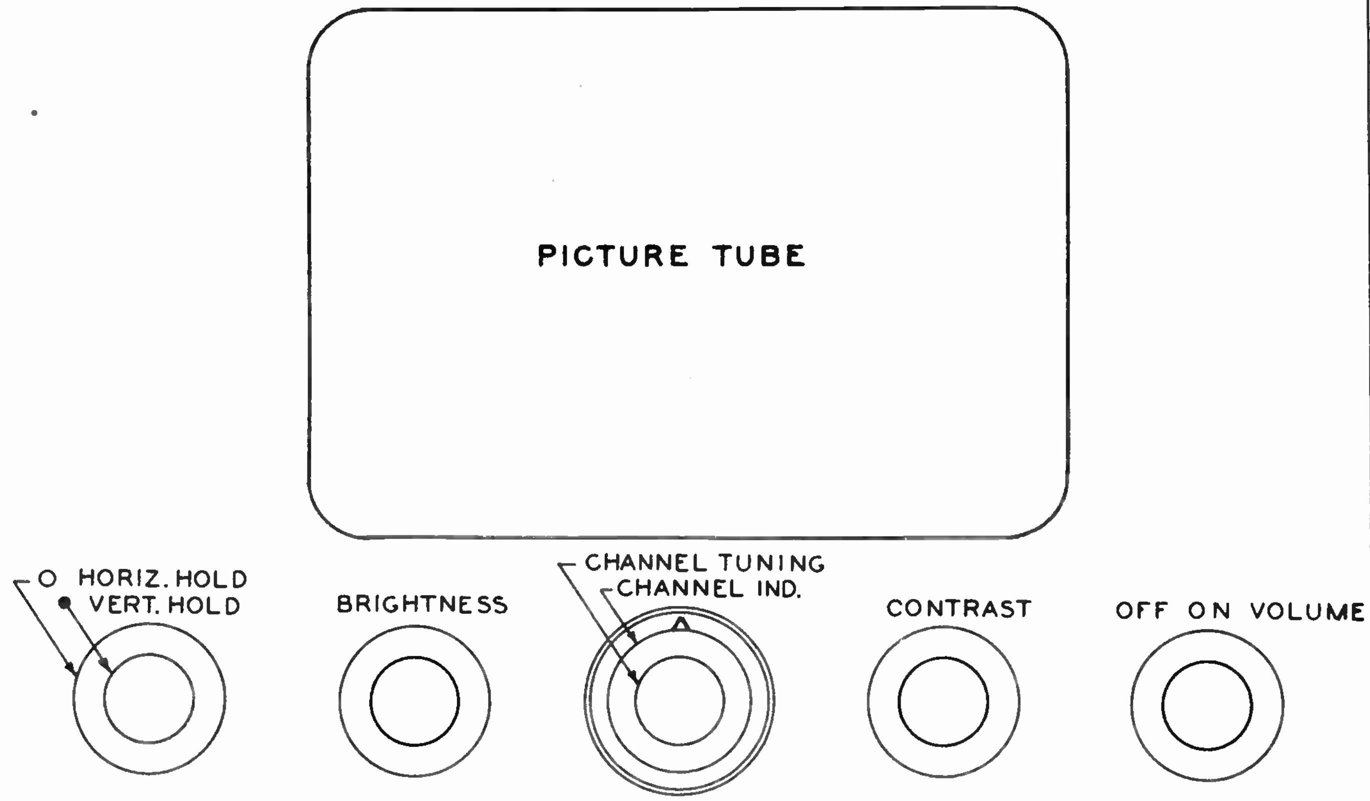
The 19TS10A chassis is equipped with Type 12LP4(12") pix tube and C93 capacitor across the horizontal yoke winding should be 150 uuf. with a voltage rating of 1500 volts.

Table models 5010,5014,5015 and Console Models 5056, 5057 and 5072 are shipped only with (12") pix tubes. An entirely new R.F. Tuner is used in all models listed in this bulletin and complete technical data is given in the circuit description and Schematic Diagram.

MODEL 5056 MAHOGANY
MODEL 5057 GOLDEN WHEAT

MODEL 5010 MAHOGANY
MODEL 5011 GOLDEN WHEAT

CONTROL POSITIONS AND FUNCTIONS
FIG. 1



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ELECTRICAL AND MECHANICAL SPECIFICATIONS

R.F. FREQUENCY RANGE

CHANNEL NUMBER	CHANNEL FREQ.MC.	PICTURE CARRIER FREQ.MC.	SOUND CARRIER FREQ.MC.	RECEIVER R.F.-OSC. FREQ.MC.
2	54-60	55.25	59.75	81.5
3	60-66	61.25	65.75	87.5
4	66-72	67.25	71.75	93.5
5	76-82	77.25	81.75	103.5
6	82-88	83.25	87.75	109.5
7	174-180	175.25	179.75	201.5
8	180-186	181.25	185.75	207.5
9	186-192	187.25	191.75	213.5
10	192-198	193.25	197.75	219.5
11	198-204	199.25	203.75	225.5
12	204-210	205.25	209.75	231.5
13	210-216	211.25	125.75	237.5

POWER SUPPLY RATING

117 Volts.....60 Cycles........185 Watts

AUDIO POWER OUTPUT RATING

Maximum Undistorted...........1.5 Watts

LOUD SPEAKER

Models 5010 5011 5014 & 5015 uses 5"Round
Models 5056 5057 5071 & 5072 uses 10"Round
Voice Coil impedance 3.2 ohms at 400 cycles

PICTURE I.F. FREQUENCIES

Picture Carrier Frequency........26.25 Mc.

SOUND I.F. FREQUENCIES

Sound Carrier Frequency..........21.75 Mc.
Inter-Carrier Sound I.F. Freq.....4.5 Mc.
Sound Discriminator Band Width(between peaks).......................... 200 Kc.
Video Response..................to 3.5 Mc.
Focus...........................Magnetic
Sweep Deflection................Magnetic
Scanning............Interlaced..525 Lines
Horizontal Scanning Frequency..15.750 Cps.
Vertical Scanning Frequency........60 Cps.
Frame Frequency(Picture Repetition Rate) 30 Cps.
Receiver Antenna Input Impedance. 300 Ohms Balanced

Note: Rauland Picture Tubes have an internal ion trap built-in: therefore an external ion trap is not used. They may be identified by the aluminum back.

TUBE COMPLEMENT

TUBE	TYPE	FUNCTION
V1 6CB6/	6AG5	R. F. Amplifier
V2	12AT7	Osc. and Mixer
V3	6AU6	1st Pix. I.F.Amplifier
V4	6AU6	2nd Pix. I.F.Amplifier
V5	6AG5	3rd Pix. I.F.Amplifier
V6	6AL5	Pix. 2nd Detector
V7	6AU6	Video Amplifier
V8	*10BP4	Picture Tube
V9	6AU6	Sound I.F.Amplifier
V10	6T8	Ratio Det.and Audio Amp.
V11	6AQ5	Audio Power Amp.
V12	6AU6	Sync. Sep.,Stripper and D.C. Restorer
V13	6SN7GT	Sync. Clipper, Separator, Phase Splitter, Vert.Osc.&Disc.Tube
V14	6V6GT	Vertical Output
V15	6W4GT	Damper Tube
V16	1 X 2	H.V. Rectifier
V17	6BQ6GT	Horiz.Sweep Amplifier
V18	6SN7GT	Horiz.Osc. & Discharge Tube
V19	6AL5	Horiz. Phase Detector
V20	5U4G	Low Voltage Rectifier

*Type 10BP4 Pix. Tube used in Model 5011
Type 12LP4 Pix. Tube used in all other Models

OPERATING CONTROLS LOCATED ON FRONT PANEL

Volume and Switch................See Fig. 1
Picture..........................See Fig. 1
Tuning...........................See Fig. 1
Brightness.......................See Fig. 1
Horizontal Hold } ..Dual...........See Fig. 1
Vertical Hold }

NON-OPERATING CONTROLS
(Not including R.F. & I.F. Adjustments)

Vertical Linearity...........Back of Chassis
Focus........................Back of Chassis
Vertical Size................Back of Chassis
Width........................Back of Chassis
Horiz. Osc.Freq.Control......Back of Chassis
Ion Trap
Deflection Coil

TELEVISION FREQUENCY RANGES

Channel Number	Channel Freq.MC.	Wave Length Meters	Picture Carrier MC.	Sound Carrier MC.	Het.Osc. Freq.MC	Dipole Length	Folded Dipole Length	Reflector Length	Director Length	Half Wave Shorted Channel Trap*
2	54- 60	5.55-5.0	55.25	59.75	81	98"	96"	103"	95",	84"
3	60- 66	5.0 -4.55	61.25	65.75	87	90"	88"	94"	86"	78"
4	66- 72	4.55-417	67.25	71.75	93	82"	80"	86"	78"	70"
5	76- 82	3.95-3.66	77.25	81.75	103	71"	69"	74"	68"	61"
6	82- 88	3.66-3.41	83.25	87.75	109	66"	64"	69"	64"	53"
7	174-180	1.72-1.66	175.25	179.75	201	32"	30"	33"	30"	25"
8	180-186	1.66-1.61	181.25	185.75	207	31"	29"	32"	29 1/2"	24"
9	186-192	1.61-1.56	187.25	191.75	213	30"	28"	31"	29"	24"
10	192-198	1.56-1.51	193.25	197.75	219	29"	27"	30"	28"	23"
11	198-204	1.51-1.47	199.25	203.75	225	28"	26"	29"	27"	22"
12	204-210	1.47-1.43	205.25	209.75	231	27"	25"	28"	26"	22"
13	210-216	1.43-1.39	211.25	215.75	237	26"	24"	27"	25"	21"

*CONSTRUCTING A CHANNEL TRAP

*Constructed of a piece of 300 ohm transmission line, shorted on one end to serve as a 1/2 wave length shorting stub. Cut a piece of line slightly longer than given under the "Half-wave Shorted Channel Trap", column and connect the two leads of one end across the receiver antenna terminals.

Using diagonal cutters or razor blade, "short", across the transmission line at a place slightly longer than the calculated length. Care should be taken when "Shorting" the line to cut through the plastic covering only; do not cut the conductors. If the interference is not "Trapped Out", short the line in 1/8" intervals(working toward the terminals) until the critical point is reached. Cut the transmission line and place a carbon resistor across the line. The resistor should be approximately 60 ohms. For strong interference, it may be necessary to drop the resistance to 20 ohms, and for weak interference it may be possible to use a 150 ohm resistor. Do not use any lower value resistor than necessary to minimize the interference.

If the interference frequency is not that of a television station, the line may be cut and the leads shorted together without using the resistor. Generally, this will completely eliminate the interference frequency.

If the interference frequency being eliminated or "Trapped-out" is that of some other television station operating in the vicinity, the interfering frequency will also be eliminated or attenuated on its own channel. If the interference frequency is so strong that it can not be attenuated enough using a resistor across the line, it will be necessary to install a double-pole, single-throw switch on one of the trap leads so that the "Channel Trap", can be opened when the receiver is switched to this channel.

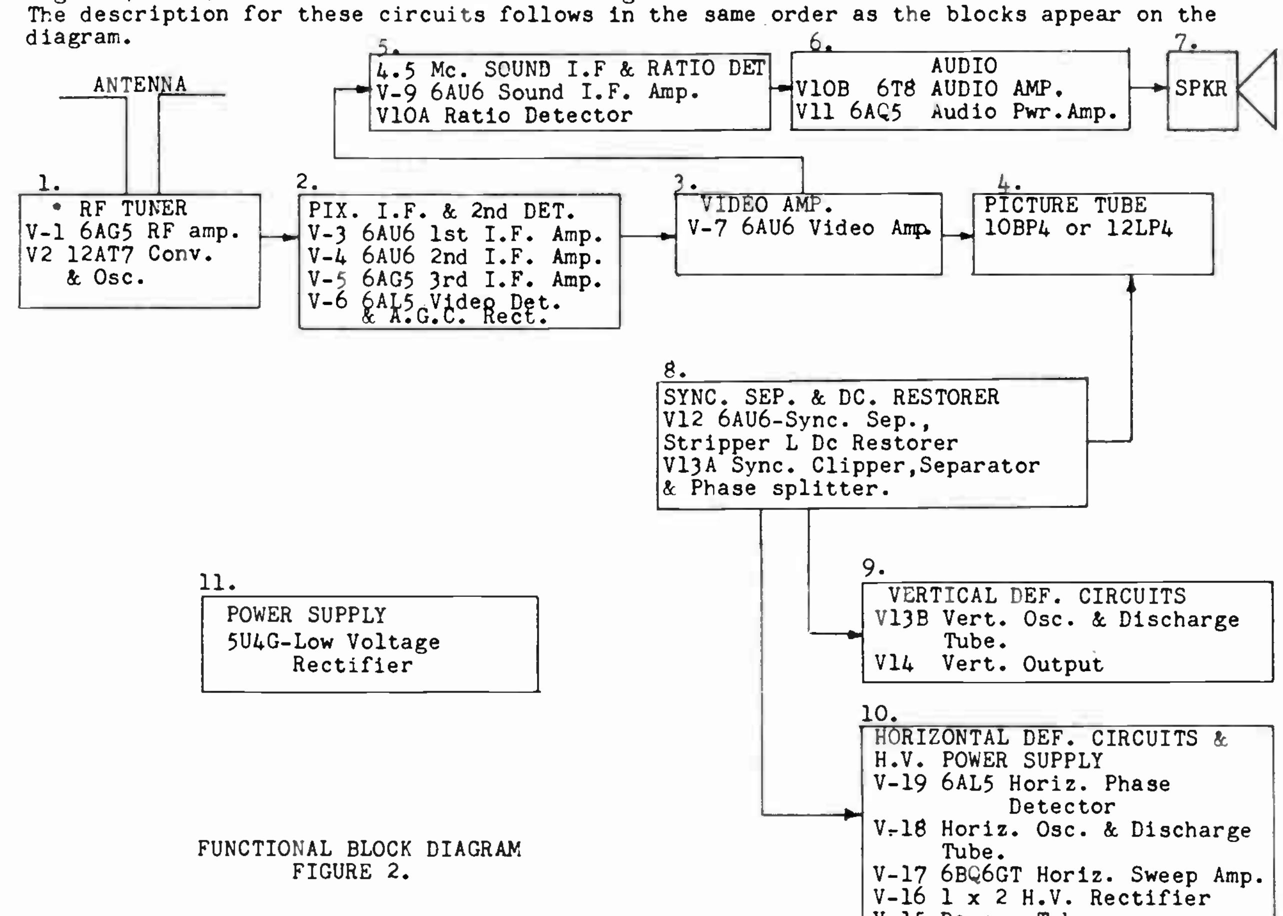
If the interference frequency is known, the transmission line can be cut by using the following formula.

$$\text{Half wave shorting stub in inches} = \frac{4841}{\text{Freq.(MC)}}$$

CIRCUIT DESCRIPTION

GENERAL: The following circuit description for Sparton Television Models provides all pertinent information necessary for proper servicing of these receivers. In the compilation of this data it is assumed that the service engineer is familiar with the basic electronic principles of modern television.

Fig. 2 (below) shows a fundamental block diagram breakdown of the receiver circuits. The description for these circuits follows in the same order as the blocks appear on the diagram.



FUNCTIONAL BLOCK DIAGRAM
FIGURE 2.

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CIRCUIT DESCRIPTION (CONT'D)

R.F. TUNER (BLOCK #1)

The R.F. Tuner is a separate sub-assembly of the receiver. This tuner is continuously variable and tunes the 12 TV channels in two ranges, channels 2 through 6 in the low range and channels 7 through 13 in the high range. The range is automatically selected by means of a cam operated switch on the tuning shaft. Tuning is accomplished by means of ganged tuning capacitors. The tuner serves to select the desired picture and sound carriers and associated side bands. It amplifies the selected R.F. signals and provides at the converter plate a picture I. F. carrier of 26.25 Mc. and a sound I.F. carrier of 21.75 Mc.

R.F. AMPLIFIER

The antenna input is fed to V1 the 6AG5 R.F. amplifier tube through fixed tuned input transformers T-1 for the low band and L-1 for the high band.

CONVERTER

The plate circuit of the R.F. amplifier and the grid circuit of V-2 the 12AT7 converter tube are coupled by means of overcoupled tuned circuits which are tuned by the ganged variable capacitor sections C8A and C8B.
In the plate circuit of the converter coil L-6 in conjunction with the output capacity of V-2 and the input capacity of V-3 forms a parallel tuned circuit tuned to 24.0 Mc. This is the first stage on the stagger tuned video I.F.system.

OSCILLATOR

The local oscillator uses one triode section of V-2. The 12AT7 in a Colpitts oscillator circuit tuned by the ganged capacitors C8C in the low band and C8D in the high band., Oscillator injection to the converter grid takes place through mutual inductance between coils in transformer T-2. The oscillator operates at a frequency above that of the received signal in all channels.

PICTURE I.F. & SECOND DETECTOR (BLOCK #2)

The primary requirements of the picture I.F. system are wide overall response and adequate overall gain. To meet these requirements three stages of video I.F. amplification are employed.
As noted on the schematic diagram these stages are V-3, V-4 and V-5. Single tuned I.F. coils are utilized in the plate circuit of the converter and each of the three successive stages. Starting with the coil L-6 in the converter plate each of the coils L-11, L-13 and L-15 in the following stages are tuned to a different frequency. Thus by virtue of stagger tuning the several stages, wide band picture I.F. response is obtained.

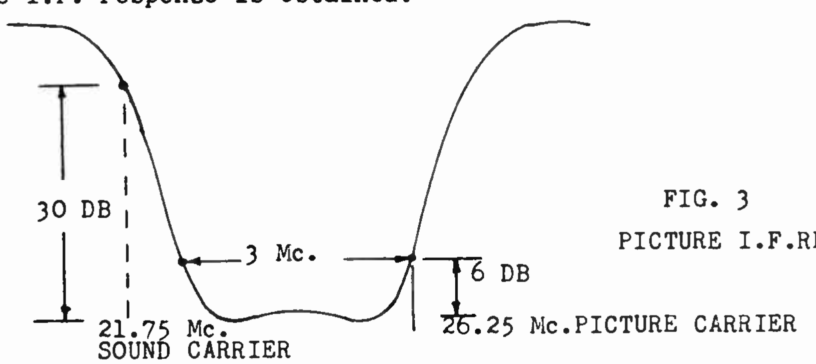

FIG. 3

PICTURE I.F.RESPONSE

In order to obtain a band pass as pictured in Fig. 3 the I.F. coils are peaked to the following fixed frequencies:

L-6	Plate of the converter	(V-2)	24.0 Mc.
L-11	1st picture I.F.	(V-3)	25.7 Mc.
L-13	2nd picture I.F.	(V-4)	23.7 Mc.
L-15	3rd picture I.F.	(V-5)	26.0 Mc.

Under normal conditions replacement of any of the tubes in the picture I.F. strip will have little effect on the shape of the overall pass band. The information on physical location of the various coils will be found in the section on alignment. The picture I.F. must amplify both picture and sound carriers, however the sound carrier must be attenuated below the picture carrier to prevent sound interference in the picture. For this reason the sound carrier is placed approximately 30 DB down from the top of the I.F. response curve.

PICTURE DETECTOR AND A.G.C. RECTIFIER

V-6 is a type 6AL5 double diode rectifier. One diode section is used as the video detector and is connected so as to provide an output signal of negative polarity across its output load. The other diode is used as an A.G.C. rectifier connected so as to produce a negative A.G.C. voltage across its load resistance. This voltage is applied to the grids of V-1, V-3, and V-4. It's action on these stages is such that it effectively varies the gain of the receiver to compensate for changes in R.F. input level to the antenna terminals. A positive delay voltage is applied to the cathode of the A.G.C. rectifier from the contrast control so that full delay is present at maximum contrast settings and zero delay at minimum contrast position. This delay action is such that full contrast must be attained before any A.G.C. voltage is developed.

VIDEO AMPLIFIER(BLOCK #3)

A single 6AU6 (V-7) video amplifier stage is fed from the output of the video detector. The frequency response extends to 3.5 Mc. while the overall gain is approximately 20x.

The video signal at the kinescope grid must be of such polarity that the syng. and blanking pulses will drive the grid in the negative direction. For this reason with a single video stage it is necessary to apply the video signal to the kinescope cathode.

Since the sync. is negative from the picture detector any large noise pulses above sync. level will drive the grid beyond cut-off. This results in a desirable peak noise limiting action by the video amplifier that effectively improves the overall signal to noise ratio of the receiver. Contrast control takes place by cathode circuit degeneration which controls gain without disturbing grid bias conditions most favorable to noise clipping.

SOUND I.F. AND RADIO DETECTOR

The picture I.F. carrier at 26.25 Mc. and the sound I.F. carrier at 21.75 Mc. are 4.5 Mc. apart. This is determined by the transmission standards and is controlled at the transmitter. Both carriers are present at the picture detector, the sound carrier being approximately 30 DB down as previously shown. (Under picture I.F. & 2nd. Det.) Due to non-linearity in the detecting diode a 4.5 Mc. beat frequency is produced. The picture carrier is amplitude modulated by the video signal while the sound carrier is frequency modulated, by the sound. The 4.5 Mc. beat is therefore frequency modulated by sound and also carries amplitude modulation from both sound and picture.

4.5 Mc. SOUND TRAP

The 4.5 Mc. beat frequency containing the frequency modulated sound and incidental amplitude modulation is applied to the video amplifier grid along with the detected video and sync. signals. A trap circuit in the video amplifier plate acts as a load impedance for 4.5 Mc. and at the same time appears as a series trap which prevents the 4.5 Mc. signal from reaching the kinescope.

The 4.5 Mc. signal across the trap coil L-20 is fed to the 6AU6 sound I. F. amplifier V-9. T-4 and V10A constitutes a conventional ratio detector operating at 4.5 Mc. The ratio detector has sufficient A.M. rejection to remove the incidental A.M. component. The detected F.M. sound modulation is then fed to the volume control.

SYNC. SEPARATOR, STRIPPER & DC RESTORER(BLOCK #8)

The video signal containing the sync. pulses is taken from across the video amplifier plate load resistor and applied to V-12. The cathode bias of V-12 is of the proper magnitude to place all picture information beyond cut-off and only the sync. pulses appear in the plate current. The sync. pulses are then applied to the grid of V-13A where further amplification takes place and vertical sync. pulses of proper phase are applied to the vertical deflection system.
V-13A also acts as a phase splitter and sync. pulses of opposity phase are taken from plate and cathode load resistors to feed the horizontal deflection system.
Since the grid of V13A is operating near cut-off positive noise pulses which were not clipped in the grid of V12 are now of negative polarity and are clipped in the grid of V13A, thus the sync. pulses have been clipped on both sides and are relatively free from noise pulses.

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CIRCUIT DESCRIPTION (CONT'D)

AUDIO AMPLIFIER & SPEAKER (BLOCKS 6 & 7)

Tubes V-10B and V-11 form a conventional two-stage audio amplifier which develops approximately 1.5 watts in the speaker voice coil. A tapped compensated volume control is used which provides increased bass compensation at low volume settings.

VERTICAL DEFLECTION SYSTEM (BLOCK #9)

This section of the receiver functions to supply vertical scanning for the kinescope. A conventional system is utilized. V-13B operates as a field frequency oscillator whose output signal is used to drive the vertical output stage V-14. The combined action of these stages and their associated circuits provides a linear deflection current of proper polarity and frequency in the vertical deflection yoke.

VERTICAL INTEGRATING NETWORK

The integrating network composed of R-73, R-74, R-76 and C-81 A- B-C functions to separate the horizontal from the vertical sync. and to pass the vertical sync. pulse developed on to the field frequency oscillator. In operation the network can be considered as a low pass filter that by-passes the horizontal sync. pulses and permits the low frequency vertical sync. to pass on through to the grid of V-13B.

FIELD FREQUENCY OSCILLATOR

The field frequency oscillator V-13B is a conventional blocking oscillator system. In operation the free running frequency of the oscillator is adjusted by means of the vertical hold control R-78A. The oscillator is locked in sync. at field frequency by means of the vertical sync. pulses which are injected into it's grid circuit from the integrator network. The cut-off and conduction action of the oscillator charges and discharges capacitor C-83and the resulting sawtooth output drives the output stage V-14.

VERTICAL OUTPUT

The peaked sawtooth output of the blocking oscillator system drives the grid of the vertical output stage. An impedance matching transformer T-6 couples V-14 to the vertical deflection yoke L-22A. Picture height is controlled by means of R-82 which varies the B+ voltage supplied to the vertical system. Vertical trace linearity is adjustable by means of R-86 in the cathode circuit of V-14. Adjustment of this control varies the bias and consequently the operating point of the tube.

HORIZONTAL DEFLECTION CIRCUITS(BLOCK #10)

The horizontal deflection system provides a stable, linear scanning current in the horizontal winding of the deflection yoke. This results in accurate horizontal reproduction of the transmitted picture.

HORIZONTAL OSCILLATOR AND A.F.C. SYSTEM

The horizontal oscillator V-18 is a composite circuit incorporating a cathode coupled multivibrator and a tank circuit(L-24 and C103) resonant at approximately 15,750 cycles per second to produce a stabilized sine wave voltage. This circuit possesses the RC time constant and grid bias frequency control characteristics of a multivibrator; but it achieves some of the frequency stability of a sine wave system. The free running frequency is controlled by the horizontal hold control R-78B. This control is set for approximately 15,750 cycles per second. The oscillator is then locked into synchronism with the incoming signal by means of an automatic D.C. control bias voltage applied to one grid (Pin #4) of the oscillator.

This D.C. voltage is developed by the horizontal A.F.C. rectifier V-19. This circuit is a conventional duo-diode phase comparitor which compares the phase of the incoming sync. pulses with the sawtooth voltage developed across the width control on the horizontal output transformer secondary. The sawtooth voltage being fed through R-111 and C107. Any discrepancy in the exact phase relationship of these two voltages produces a change in D.C. voltage across C105(at the oscillator grid). This changes the oscillator frequency to assure exact phase and frequency coincidence between the output sawtooth and the incoming sync. pulses from the signal. In this manner the horizontal scanning of the receiver is locked into synchronism with the signal sync. pulses.

The output of the horizontal oscillator is a sawtooth voltage plus a peaking component fed back through C-98 from the horizontal output. The peaking component is sufficient to produce adequate high voltage and fast retrace time. The amount of drive to the grid of the horizontal output tube V-17 is controlled by a capacity divider consisting of C99 and a variable mica trimmer C100. This trimmer is adjusted for optimum horizontal linearity of picture.

HORIZONTAL OUTPUT AND DAMPER

The horizontal output tube V-17 and the damper tube V-15 produce the required linear sawtooth scanning current in the horizontal deflection coil. The two tubes plus the horizontal output transformer also produce a high voltage pulse which is used to obtain the kinescope high voltage supply. The output system is a conventional kick-back type except that no electrical horizontal centering is provided. Capacitor C92 is employed to isolate direct current from the yoke. Centering is therefore accomplished by actual physical movement of the focus coil and, to some degree, the ion trap. The output transformer, as far as deflection is concerned, is an impedance matching device for the output tube and yoke.

The width control L-23 is provided to vary the output and hence the picture width. This is accomplished by shunting a portion of the secondary winding to change the effective transformation ratio. Clockwise rotation of L-23 increases the shunting inductance and hence the width.

Because the horizontal transformer (T-8), deflection coil and associated circuits are designed to resonate at a high frequency(Period =14 microseconds) for fast retrace time, they are shocked into resonance when the magnetic field collapses during retrace. To prevent continued oscillatory currents in the deflection yoke, the damper diode V-15 is used. During the first half cycle of retrace resonance, the circuit oscillates freely to insure rapid retrace time. During the next half cycle the damper plate goes positive and conduction occurs. This puts a heavy load on the deflection coil so that it cannot oscillate.

The 6BQ6GT plate voltage is supplied through the 6W4GT which is conducting over the major portion of the trace. Capacitor C96 is charged during this period and this charge is sufficient to supply the 6BQ6GT plate when the 6W4GT is not conducting.

The charge is placed on capacitor C96 by the receiver D.C. supply and by the current from the collapse of the field in the horizontal deflecting coil. The A.C. axis of the sweep voltage is 330 volts above ground since the T-8 secondary is connected to the receiver 330 volt bus. The charge on capacitor C96 by the coil kick-back is therefore in addition to that from the D.C. supply and so the capacitor C96 is charged to a voltage greater than the D.C. supply. This permits operation of the 6BQ6GT at a higher voltage than is obtainable from the receiver power supply and produces an increase in the system efficiency by salvaging energy that otherwise would be wasted.

HIGH VOLTAGE POWER SUPPLY

The kinescope high voltage supply is obtained from the energy stored in the deflection inductances during each horizontal scan. When the 6BQ6GT plate current is cut off by the incoming signal, a positive pulse appears on the T-8 primary due to the collapsing field in the deflection coil. This pulse of voltage is stepped up, rectified by V-16, filtered and applied to the second anode of the kinescope (V8). Since the frequency of the supply voltage is high(15,750 C.P.S.), relatively little filter capacity is necessary.Since the filter capacity is small, the stored energy is small and the high voltage supply is made less dangerous.

KINESCOPE & D.C. RESTORER(BLOCK #4)

A sync. positive video signal is applied to the kinescope cathode. The brightness control R-41 is part of a voltage divider from +140 volts to ground which permits the operating bias for the kinescope to be adjusted to the proper value(where sweep retrace lines are just extinguished). The kinescope grid returns to ground through R67 and R68 in the cathode circuit of V12. Since the video amplifier is an A.C. coupled system, the D.C. component of the video signal which represents the average background brightness of the televised scene is lost. If a white signal or a black signal is applied to the grid of V12, the D.C. voltage developed across the cathode resistors R67 and R68 changes and is a function of the average value of the signal. This potential is applied to the kinescope grid to re-insert the D.C. component.

The kinescope is a conventional 10" or 12" tube. These tubes employ magnetic focus and deflection systems. An ion trap prevents the ion beam from forming a dark spot on the kinescope screen.

MODELS 5010, 5011, 5014, 5015, 5056, 5057, 5071, 5072, Ch. 19TS10, 19TS10A, 19TW10, 19TW10A

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CIRCUIT DESCRIPTION (CONT'D)

LOW VOLTAGE POWER SUPPLY (BLOCK #11)

The low voltage power supply provides the filament and plate voltages for the receiver. The unit employs a single 5U4G rectifier (V20) to supply 330 volts at 160 Ma. Filtering is accomplished by the speaker field, the focus coil and their associated electrolytic condensers to ground.

The deflection circuits are supplied from +330 volts to ground. The audio output tube V11 and the sound I.F. amplifier V-9 operate with their plates at +330 volts and their cathodes at +140 volts, tubes V1, V2,V3,V4,V5,V7,V12 and V13A operating from +140 volts to ground. This system is self regulating since a change in the +140 volts to ground results in a bias change in V11 which increases or decreases the cathode current of V11 in a manner to oppose the change. Filament power is supplied by the two 6,3V.A.C. windings.

LINE CORD ANTENNA

All of the television models listed in this bulletin are equipped with a built-in line cord antenna which is hooked up for operation when shipped from the factory.

This type of antenna is designed for operation on local stations only, and in locations where it will give satisfactory results. Line cord antennas are not designed to work in conjunction with other type antennas and must be disconnected when another antenna is to be attached to the receiver.

A 3-point terminal strip on the back of the cabinet has been provided with a jumper connection which must be used when changing from line cord to outside antenna or vice-versa.

When the line cord antenna is to be used the lead wire from the chassis should be placed under the right-hand terminal marked "A" and the jumper link on terminal "G" must be connected to the center terminal "A".

When an outside antenna is to be connected the jumper link between terminals "G" and "A" must be disconnected.

The line cord antenna is composed of components L-27 choke coil and capacitor C115 (30 MMF)

ALIGNMENT EQUIPMENT AND TEST SET UP

TEST EQUIPMENT

In order to align and service Sparton television receivers properly the following test equipment should be available:

FIRST: AN R.F. SWEEP GENERATOR of reliable quality that performs the following functions:

A. Provides sweep outputs in the following frequency ranges:

19 to 30 Mc.	10 Mc. sweep width
40 to 90 Mc.	10 Mc. sweep width
170 to 225 Mc.	10 Mc. sweep width

B. Provides an output signal that can be varied by means of an attenuator up to a maximum of at least .1 volt.

SECOND: AN R.F. SIGNAL GENERATOR that will provide an adjustable output signal up to a maximum of at least .1 volt on the following fixed frequencies:

A. I. F. Frequencies

4.5 Mc.	Sound I.F.
21.75Mc.	Sound I.F. Carrier
24.0 Mc.	1st Video I.F.Coil
25.7 Mc.	2nd video I.F. coil
23.7 Mc.	3rd video I.F. coil
26.0 Mc.	4th video I.F. coil
26.25Mc.	Picture I.F. carrier

B. R.F. Frequencies

Channel No.	Picture Carrier	Sound Carrier
2	55.25 Mc.	59.75 Mc.
3	61.25 Mc.	65.75 Mc.
4	67.25 Mc.	71.75 Mc.
5	77.25 Mc.	81.75 Mc.
6	83.25 Mc.	87.75 Mc.
7	175.25 Mc.	179.75 Mc.
8	181.25 Mc.	185.75 Mc.
9	187.25 Mc.	191.75 Mc.
10	193.25 Mc.	197.75 Mc.
11	199.25 Mc.	203.75 Mc.
12	205.25 Mc.	209.75 Mc.
13	211.25 Mc.	215.75 Mc.

THIRD: A CATHODE-RAY OSCILLOSCOPE of good quality that has a fairly wide band vertical amplifier and a low capacity input probe.

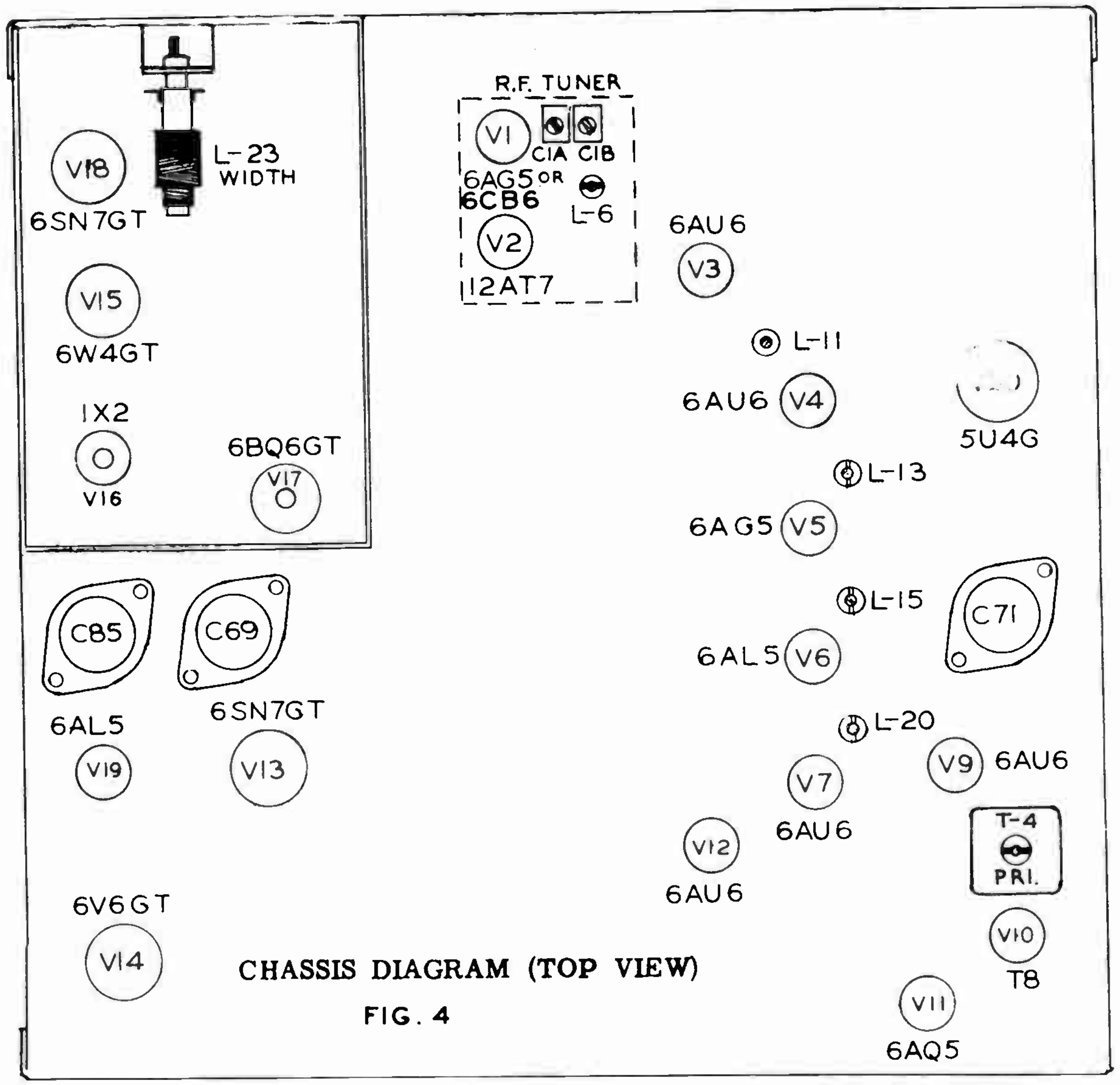
FOURTH: AN ELECTRONIC VOLTMETER on which the input probes are all insulated from the meter case.

FIFTH: A CRYSTAL CALIBRATOR that can be used for checks on the accuracy of the output frequencies of the R.F. signal generator.

GENERAL INSTRUCTIONS: Practically all servicing with the exception of some tube replacement will require removal of the receiver chassis from the cabinet.

A convenient arrangement that makes both the top and bottom of the chassis accessible for alignment and servicing can be realized by orienting the receiver chassis in such a manner that it rests on its side and on the horizontal output shield can.

TRIMMER AND SLUG LOCATIONS



CHASSIS DIAGRAM (TOP VIEW)

FIG. 4

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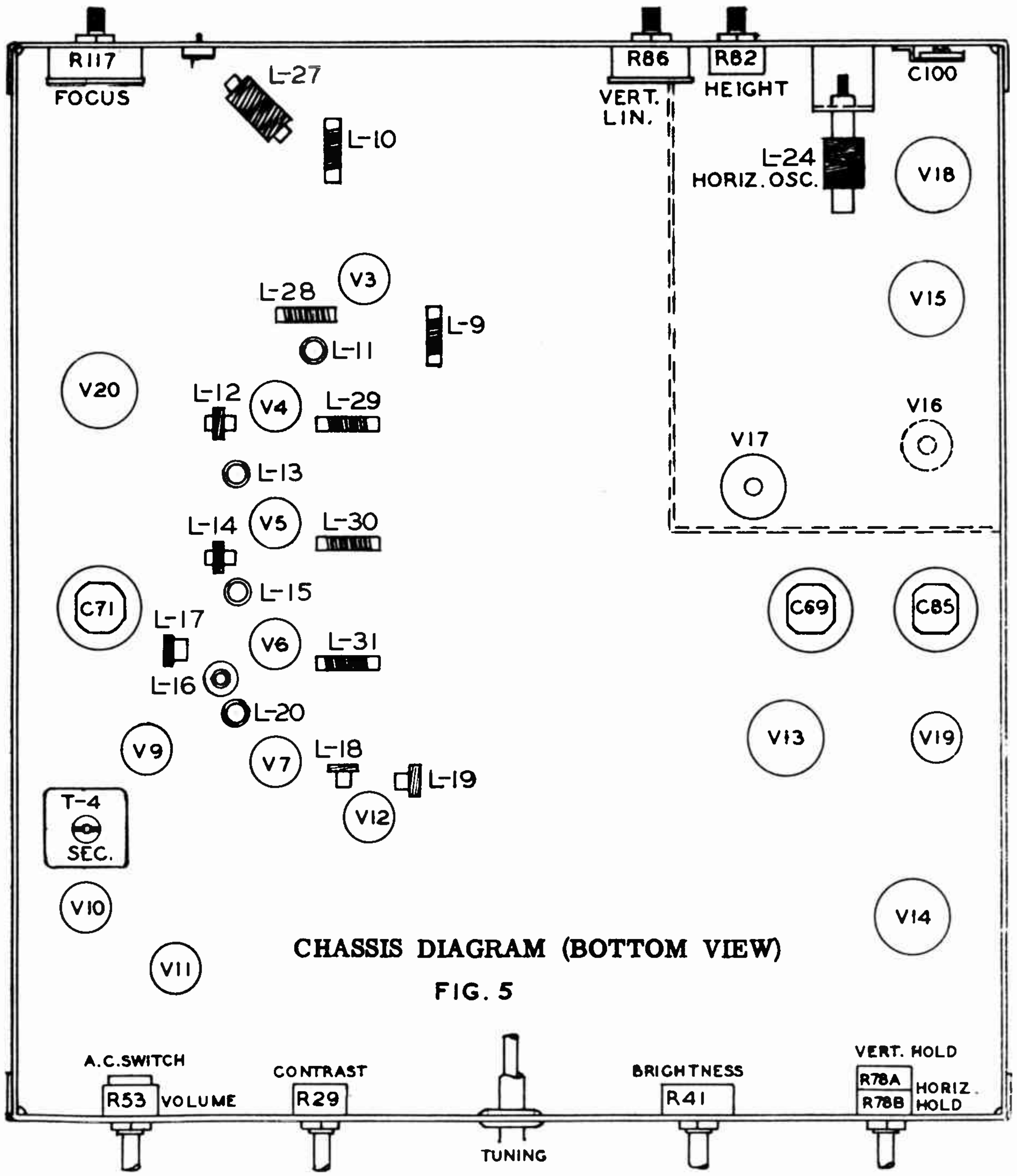
ALIGNMENT PROCEDURE

ALIGNMENT REQUIREMENTS: Under normal conditions complete receiver realignment will seldom be necessary in the field. However, a detailed description of the overall alignment procedure is included to provide all necessary information if it should be required.

In general it is not recommended that the R.F. and converter circuits of the R.F. tuner be realigned by the service engineer unless absolutely necessary. In cases where tuner components have been damaged, or where complete realignment is indicated, the R.F. tuner assembly should be removed from the chassis and sent back to the factory in exchange for a new unit which will be shipped complete with tubes. When the new R.F. unit is assembled to the chassis it will be necessary in all cases to realign L-6 the 1st picture I.F. @ 24 Mc. which is located on the tuner unit. Normally this is the only adjustment that will be required with tuner change but a check on overall receiver alignment and sensitivity should be made for the sake of certainty and assured customer satisfaction.

EFFECTS OF TUBE REPLACEMENT ON THE ALIGNMENT OF R.F. TUNER CIRCUITS: The alignment of the R.F. and converter circuits of the R.F. tuner is critical and may be affected by a tube change. In cases where these tubes (6AG5 or 12AT7) are replaced it will be necessary for the service engineer to check for satisfactory receiver operation. If realignment is indicated it can usually be avoided by selection of replacement tubes until receiver operation is realized.

TRIMMER AND SLUG LOCATIONS



CHASSIS DIAGRAM (BOTTOM VIEW)

FIG. 5

VOLTAGE CHART AND ALIGNMENT TEST POINTS

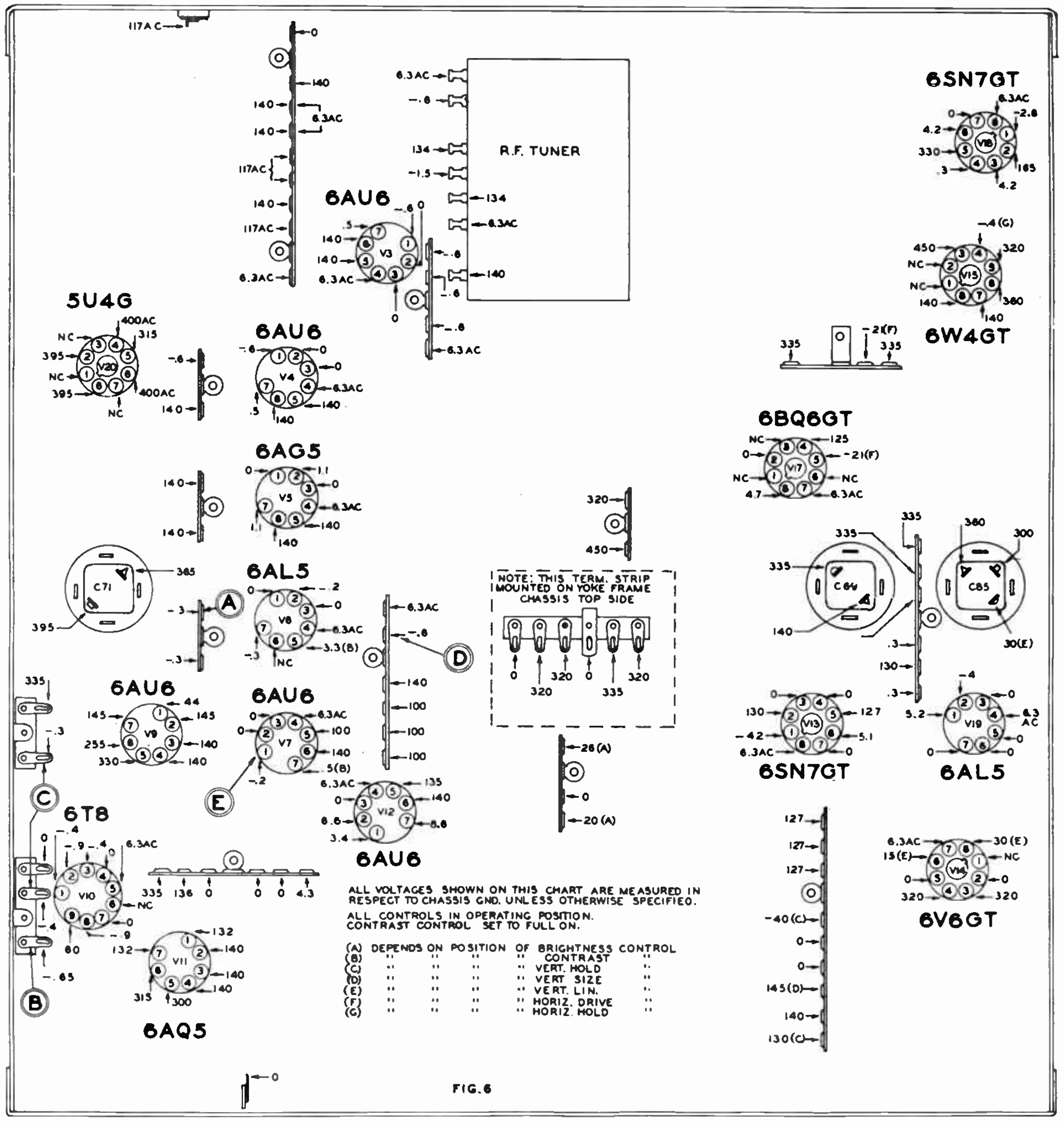


FIG. 6

MODELS 5010, 5011, 5014, 5015, 5056, 5057, 5071, 5072, Ch. 19TS10, 19TS10A, 19TW10, 19TW10A

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ALIGNMENT PROCEDURE (CONT'D)

MODELS 5010, 5011, 5014, 5015, 5056, 5057, 5071, 5072, Ch. 19TS10, 19TS10A, 19TW10, 19TW10A

ORDER OF ALIGNMENT: When complete receiver realignment is indicated it should be performed in the following order:

1. Picture I.F.
2. Sound I.F. Trap
3. Ratio Detector Transformer
4. Sound and Picture I.F.Sensitivity Check
5. R.F. Oscillator Circuits
6. R.F. and Converter Circuits(not recommended)
7. Overall sensitivity check

PRELIMINARY ADJUSTMENTS: Before alignment the receiver controls should be adjusted to the approximated operating positions specified in the table below. The controls should remain in these positions for all checks.unless otherwise specified.

Contrast Control - Full clockwise
Brightness Control - to position where raster is visible on the kinescope
Focus Control - to position where focus is obtained
Vertical Hold - to center position
Vertical Linerity - to center position
Vertical Size - adjusted to give normal raster height

Horizontal Hold - to center position
Horizontal Size - adjusted to give normal raster width

TEST EQUIPMENT SET UP: A certain amount of experimentation must be employed to secure a stable test set up before alignment or service of the receiver is attempted. It is recommended that the top of the test bench be covered with a sheet of aluminum to insure good grounds between the various pieces of test equipment and the receiver chassis. In general all test signal input leads should be kept away from output leads as much as possible.

PICTURE I.F. INSTABILITY: If the picture I.F. strip is badly out of alignment it may become unstable and fall into oscillation. When this condition occurs a comparatively large voltage is developed across the picture detector load resistor. This voltage is independent of I.F. signal input at the converter grid.

It is usually possible to stop I.F. oscillation due to misalignment by adjusting the iron cores in the various picture I.F. coils and traps according to the information given in the table below:

L-6 Slug in (Max. L.)
L-11 Slug out
L-13 Slug in
L-15 Slug out

The actual physical location of the various coils and traps is shown in Figure 4 and 5, pages 15 & 16. As soon as the oscillation has been stopped, continue with the alignment as outlined in the following sections.

PICTURE I.F. ALIGNMENT: First: Connect the R.F. signal generator to the grid of V-2 #2 pin. by means of the I.F. input adapter as shown in Fig. 7.

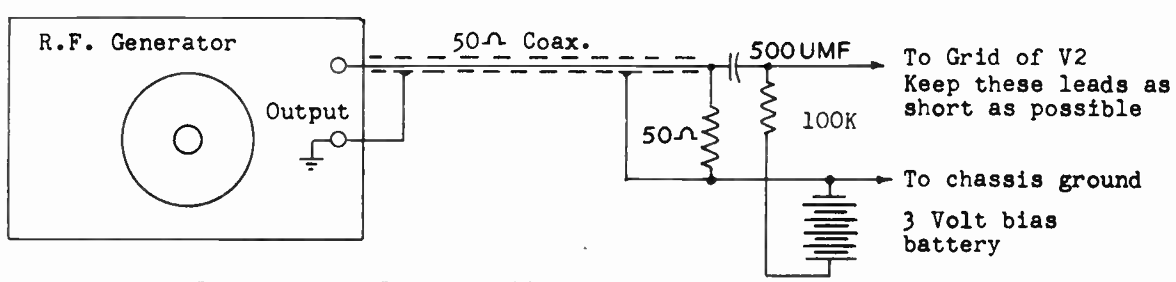

Figure 7 I.F. Input Adapter

SECOND: Set the R.F. tuner to channel #2.

THIRD: Connect a 3 volt bias battery between the A.G.C. buss(point D Fig.6 and chassis ground so that the voltage on the A.G.C. buss is -3 volts in respect to the chassis.

FOURTH: Connect the electronic voltmeter across the picture detector load resistor R30, point A Fig. 6 and set the voltmeter on the low D.C. volt scale.

FIFTH: Set the R.F. signal generator to each of the frequencies shown in the table below and in each case tune the specified adjustment for maximum indication on the voltmeter. It is advisable to check the output of the generator with the crystal calibrator to make certain that it is exactly on frequency in each case.

26.0 Mc.	L15	(Top of chassis as shown in Fig.14)
23.7 Mc.	L13	(Top of chassis as shown in Fig.14)
25.7 Mc.	L11	(Top of chassis as shown in Fig.14)
24.0 Mc.	L6	(Top of chassis as shown in Fig.14) (On Tuner)

PICTURE I.F. TOUCH UP: FIRST: Connect the R.F. sweep generator output to the grid of V-2 (Pin #2) by means of the I.F. input adapter shown in Fig. 7.

SECOND: Set R.F. Selector to channel #2.

THIRD: Connect the oscilloscope across the picture detector load resistor R-30 (point A, Fig. 6 by means of the shielded cable and the filter system shown in Fig. 8.

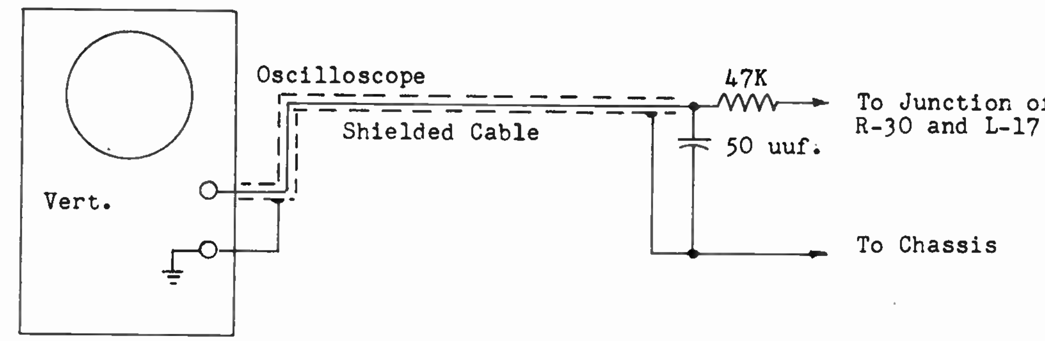

Fig. 8 FILTER SYSTEM FOR SCOPE CONNECTION

FOURTH: Set the R.F. sweep generator so that it sweeps from approximately 20 to 30 Mc.

FIFTH: Adjust the oscilloscope so that the swept I.F. response is visible on the cathode-ray tube screen.

SIXTH: Loosely couple the output of the R.F. signal generator to the grid of V-2 so that marker signals of proper frequency can be mixed in with the R.F. sweep signal.

SEVENTH: Observe the band width, relative position of the picture carrier, and flatness of the overall I.F. response curve. If necessary slightly vary the tuning of the picture I.F. coils L-6,L11,L13 and L15 until the picture I.F. response shown in Figure 9 is obtained. The solid curve in Figure 9 depicts the ideal I.F. response while the dotted curves show permissable variations.

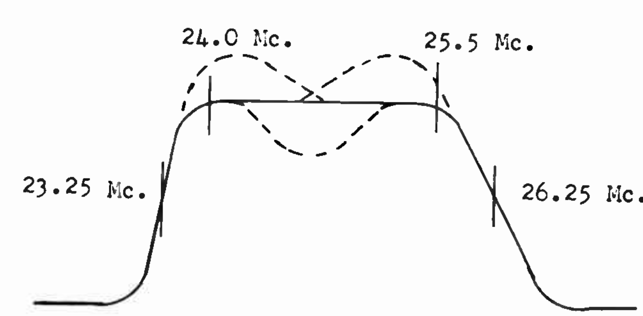

Fig. 9 IDEAL I.F. RESPONSE WITH PERMISSABLE VARIATIONS

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ALIGNMENT PROCEDURE (CONT'D)

The picture I.F. carrier should appear approximately half way down the I.F. response curve as shown in Figure 9. Variation in the pix carrier position should not exceed ∠ 10% from the half way point.

PICTURE I.F. SENSITIVITY CHECK: FIRST: Connect the R.F. signal generator to the receiver as specified in steps 1 and 2 of the sound trap alignment instructions. (When making sensitivity checks no bias battery is connected to the A.G.C. buss.)

SECOND: Connect the electronic voltmeter across the picture detector load resistor R-30 and set the meter on the low D.C. volts scale.

THIRD: Set the generator output frequency at approximately 23 Mc. Adjust the generator output until the voltmeter reads approximately 1.0 volt. Record the R.F. signal input in microvolts. Repeat the procedure with the generator output frequency set at 24.2 and 25.4 Mc. In all cases the I.F. input voltage should be 300 microvolts or less. The sensitivity at the I.F. picture carrier 26.25 Mc., should be approximately half of the I.F. sensitivity between 24.2 Mc. (Maximum of 400 microvolts.).
If the generator output is not calibrated in microvolts, comparative sensitivity measurements can be made by using another receiver that is known to be in good operating condition as a standard. This applies to all sensitivity measurements and good results can be obtained if sufficient care is used.

SOUND I.F. ALIGNMENT: FIRST: Connect the R.F. signal generator to the grid of V-7 (point E) Fig. 6.

SECOND: Connect the electronic voltmeter across C-64 (Point P) Fig.6. Set the voltmeter on a low D.C. scale.

THIRD: Set the R.F. signal generator to 4.5 Mc. and adjust L-20 and T-4 (both top of chassis) for maximum reading on meter. Repeat both adjustments.
NOTE: The 4.5 Mc. signal must be as accurately calibrated as possible, since alignment of the sound channel at an improper frequency may cause distortion or even complete loss of sound.

FOURTH: Connect the electronic voltmeter from the junction of R55 and R56 to the junction of R51, C59 and C61 (Point C as shown in Fig. 6).

FIFTH: With the signal generator still accurately set at 4.5 Mc. adjust the secondary of T-4 (bottom view of chassis as shown in Fig. 5). Notice that it is possible to produce a positive or negative voltage indication on the meter by varying this adjustment. As the voltage swings from positive to negative, adjust T-4 for zero output as indicated by the voltmeter. This point is called zero ratio detector output and indicates correct alignment of transformer T-4.

TUNER ALIGNMENT: The alignment of the R.F. circuits of the tuner is a difficult and tedious task when it must be performed without benefit of special factory test equipment. For this reason it is not recommended that the re-alignment of these circuits be attempted by the service engineer. The information provided in the paragraphs below is intended primarily for descriptive purposes and cases where slight adjustments may be necessary.

An overcoupled tuned circuit is used between the R.F. plate and the converter grid. This overcoupled circuit is tracked with the oscillator. All circuits are gang condenser tuned and shunt trimmer condensers are used. The capacity curves of the gang condenser sections and the high frequency series tracking condensers have been carefully chosen to guarantee a minimum of tuning condenser mistracking. It should never be necessary to adjust the gang condenser capacity by knifing the plates.

In order to correctly track the R.F. and mixer coils to achieve maximum tuner gain and to obtain best response curve symmetry, a system of padding double tuned, overcoupled transformers is used utilizing capacity loading. Capacity loading may be achieved by using a small blade screw driver, and adding additional capacity by touching the screw driver shank with one or more of the fingers. This additional capacity severely detunes one side of the double tuned, overcoupled transformer, so that the single peaked, resonant response of the other side may be observed.

TO ALIGN THE TUNER PROCEED AS FOLLOWS: FIRST: Picture I.F. must be properly aligned.

SECOND: Connect R.F. sweep generator to antenna Terminals through 300 ohm balanced dummy antenna. Dummy antenna may consist of two 150 ohms carbon resistors, one from each terminal of the generator to the antenna terminals marked "A".

THIRD: Connect oscilloscope across the picture detector load resistor R-30 (point A Fig. 6) by means of the shielded cable and the filter system shown in Fig.8.

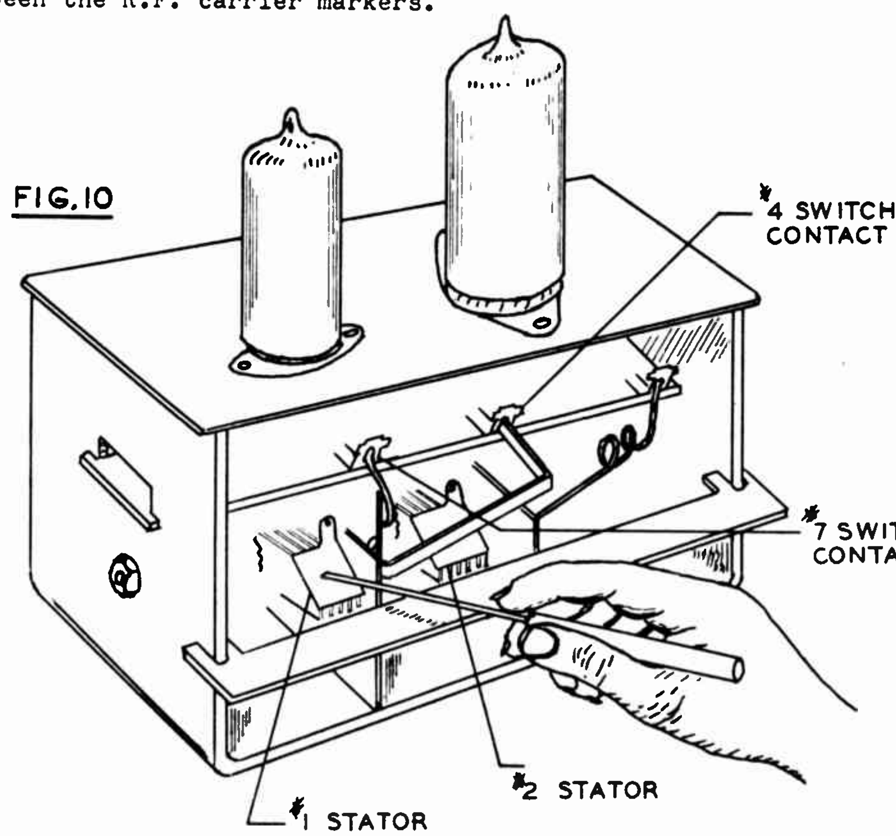
FOURTH: Perform the operations listed below. In each case adjust for flat wide band overall response with maximum gain as indicated on the oscilloscope screen. The shape of the overall response curve on all channels should be approximately the same as that of the video I.F. response curve shown in Fig.9. Marker pulses of proper frequency should be mixed in with the R.F. sweep input to check overall band width and relative position of the picture carrier on each channel. Always keep the R.F. input signal low so that slight variations in the tuning of the circuits are easily discernable on the oscilloscope screen. The physical location of all the adjustments is shown in Fig. 11, 12 & 13.

FIRST: Rotate the tuner to the channel 6 index position.

SECOND: Capacity load the R.F. coil (first stator plate) and adjust the low band mixer trimmer so that the single peaked response curve falls midway between the R.F. carrier markers. (See Figure 10 below)

THIRD: Capacity load the mixer coil (second stator plate) and adjust the low band R.F. trimmer, so that the single peaked response curve falls midway between the R.F. carrier markers.

FIG. 10



MODELS 5010, 5011, 5014, 5015, 5056, 5057, 5071, 5072, Ch. 19TS10, 19TS10A, 19TW10, 19TW10A

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ALIGNMENT PROCEDURE (CONT'D)

FOURTH: With no loading on the double tuned circuits adjust the low band oscillator trimmer so that the channel 6 picture carrier marker falls at the 50% voltage reference level. Without loading, the response curve should have symmetrical double humps, the valley between them not being more than 30% down from the peaks.

FIFTH: Turn station selector to channel 2 and adjust the low band antenna trimmer C1A and pad for maximum gain and symmetry.

SIXTH: Check all low band channels. The response curve should remain substantially unchanged through all channels.

HIGH BAND ALIGNMENT: FIRST: Rotate the tuner to the channel 13 index position.

SECOND: Capacity load the R.F. coil (#7 switch lug) and adjust the high band mixer trimmer so that the single peaked response curve falls midway between the R.F. carrier markers.

THIRD: Repeat step 2, loading the mixer coil(#4 switch lug) and adjust the high band R.F. trimmer.

FOURTH: With no loading on the double tuned circuits adjust the high band oscillator trimmer so that the channel 13 picture carrier marker falls at the 50% voltage reference level.

FIFTH: Turn station selector to channel #7 and adjust the high band antenna trimmer C1B for maximum gain regardless of the shape of the response curve. At channel 13, because of the relatively large grid-plate capacity of the GAG5 R.F. amplifier, there is some frequency drag between the antenna coil padding and the R.F. coil padding,(i.e.), large detuning of the antenna causes detuning of the R.F. This action will be indicated by a sharply peaked response curve. A slight readjustment of the R.F. padder will restore symmetry.

SIXTH: Check all high band channels. The response curve should remain substantially unchanged through all channels.

OVERALL PICTURE SENSITIVITY CHECK:

After alignment of the various sections of the receiver has been completed, the following overall sensitivity checks should be made. (In cases where the signal generator output is not calibrated in microvolts comparative sensitivity measurements can be made by using another receiver which is known to be in good operating condition as a standard.).

FIRST: Connect the R.F. signal generator to the receiver antenna terminals through 300 ohm balanced dummy antenna as described in step #2 of tuner alignment.

SECOND: Connect the D.C. voltmeter across R30 as previously described. Set the voltmeter on the low D.C. volts scale.

THIRD: Set the signal generator at the center frequency of the channel to be measured and tune receiver dial for maximum reading of the D.C. meter. Adjust R.F. level until meter reads 1.5 volts(contrast control in maximum clockwise position). Generator output should be 250 microvolts or less in the low bands and 350 microvolts or less in the high bands.

SOUND SENSITIVITY CHECK:

Two R.F. signal generators are required, one of which shall be frequency modulated ∠ 7.5 Kc. at 400 cycles.

FIRST: Connect both R.F. signal generators to the receiver antenna terminals through separate dummy antenna resistors, doubling the resistance value used for the picture sensitivity test.

SECOND: Open speaker voice coil and connect a 3.ohm audio output meter across output transformer secondary.

THIRD: Connect the D.C. voltmeter across R-30 as previously described.

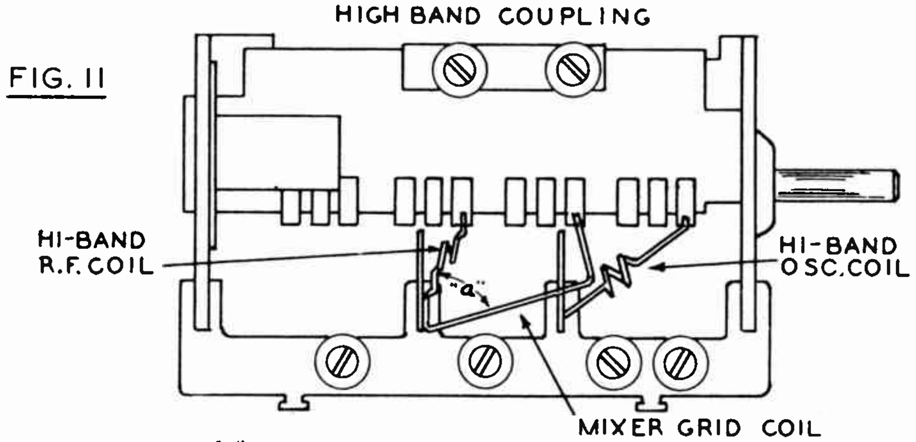
FOURTH: Set the unmodulated signal generator at the picture carrier frequency of the channel desired. Set the F.M. modulated signal generator at the sound carrier frequency. Keep the two generator outputs equal at all times. Tune receiver for maximum reading of the D.C. meter and then detune toward a lower frequency until the D.C. meter reading is reduced to half. Rock dial of frequency modulated generator for maximum reading on audio meter. Set signal generator outputs for 1/2 watt reading on audio meter. Divide generator microvolts by two since there is a 6DB insertion loss due to the dummy antenna used. This sensitivity reading should be 150 microvolts or less in all channels.

MAXIMUM AUDIO OUTPUT:

With signals applied as in the sound sensitivity check above, and the output of each generator set at 10,000 microvolts, the audio power output should be 2 watts or more.

HIGH BAND COUPLING

FIG. 11



DECREASE ∠"a", GREATER HIGH BAND COUPLING (DEEPEN VALLEY AT ∠)
INCREASE ∠"a" LESSEN " " " (LESSEN " " ∠)

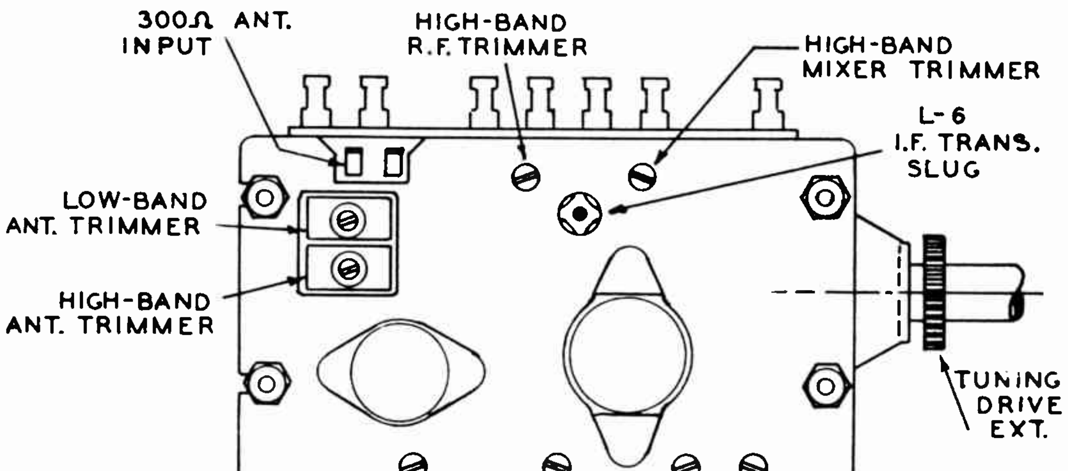


FIG. 12

TOP VIEW

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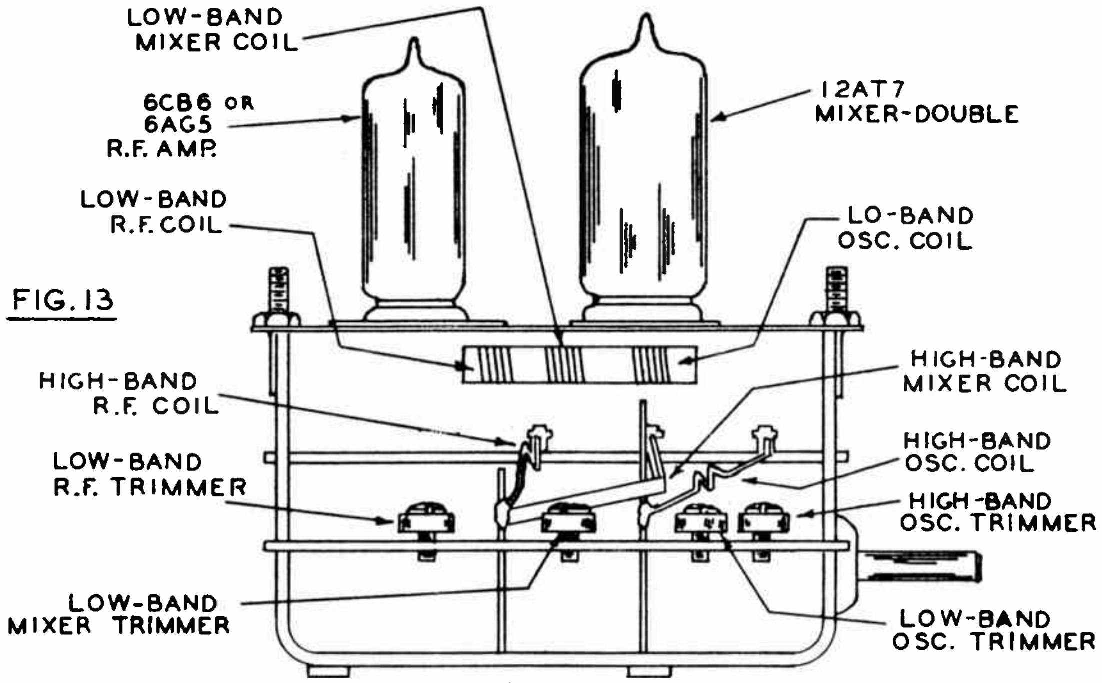

FIG. 13

LEFT SIDE VIEW

REPLACEMENT PARTS

DESCRIPTION		PART NO.
Condenser -	C25,27,28,29,31,32,34,36, 43,54,55,56,57,63,106,116 117,118 & 119 Ceramic Disc. 5K MMF.	PA4334-1
Condenser -	C26,30,33 & 37 Ceramic 270 MMF	HK36M-271
Condenser -	C35 Tubular .1 MFD 200V	PC40GK-104
Condenser -	C38 Ceramic 100 MMF.	HK36M-101
Condenser -	C39,70 Tubular .01 MFD.400V.	PC40GL-103
Condenser -	C40 Ceramic 4.7 MMF.	PA4328-11
Condenser -	C41 Ceramic 6.8 MMF.	PA4328-13
Condenser -	C42,46 Tubular .1 MFD. 200V.	PC40HK-104
Condenser -	C44 Mica 270 MMF.	MC60F-271
Condenser -	C45,68 Tubular .1 MFD.400V.	PC40HL-104
Condenser -	C51 Temp. Comp. 2.2 MMF.	PA4326-1
Condenser -	C52,53 Ceramic 100 MMF.	PA4332-3
Condenser -	C58 Silver Mica 120 MMF.	MC62F-121
Condenser -	C59 Ceramic 1,000 MMF.	HK36M-102
Condenser -	C60 Temp. Comp. 3.3 MMF.	PA4326-4
Condenser -	C61,67 Tubular .02 MFD.400V.	PC40HL-203
Condenser -	C62 Tubular .03 MFD.200V.	PC40GK-303
Condenser -	C64 Electrolytic 5 MFD. 50V.	PA4308-2
Condenser -	C65 Tubular .01 MFD.400V.	PC40HL-103
Condenser -	C66 Tubular .001 MFD. 600V.	PC40GM-102
Condenser -	C69 Electrolytic 80 MFD. 200V.40 MFD. 475V.	PA4307-15
Condenser -	C71 Electrolytic 40-40 MFD. 475V.	PA4307-13
Condenser -	C72 Electrolytic 10 MFD. 350V.	PA4303-13
Condenser -	C76 Tubular .05 MFD. 400V.	PC40GL-503
Condenser -	C77 Tubular .25 MFD. 200V.	PC40HK-254
Condenser -	C78,84 Tubular .1 MFD.400V.	PC40GL-104
Condenser -	C79,80 Mica 1,000 MMF.	MC61E-102
Condenser -	C81 Herlec 2K-5K-5K MMF.	PA4339-4
Condenser -	C82 Mica 4.700 MMF.	MC61F-472
Condenser -	C83 Tubular .05 MFD. 400V.	PC40FL-503
Condenser -	C93 Mica 150 MMF. 1500V.	PA4340-9
	Mica 1200V.	PA4340-2
Condenser -	C94 Mica 56 MMF.	PA4340-10
Condenser -	C95 Mica 500 MFD. 10 KV.	PA4342
Condenser -	C97 Tubular .05 MFD. 400V.	PC40HL-503
Condenser -	C98 Mica 22 MMF. 1500V.	PA4340-8
Condenser -	C99 Mica 1500 MMF.	MC61F-152
Condenser -	C100 Trimmer 20-270 MMF.	PA4368
Condenser -	C101 Mica 390 MMF.	MC60E-391
Condenser -	C103 Silver Mica 3900 MMF.	MC60E-392
Condenser -	C104 Mica 220 MMF.	MC60E-221
Condenser -	C105 Tubular .05 MFD. 200V.	PC40GK-503
Condenser -	C107 Tubular .01 MFD. 400V.	PC40FL-103
Condenser -	C114 Paper .047 MFD. 400V.	PC42GL-473
Condenser -	C115 Mica 30 MMF.	MC60G-300

R29	Control - Contrast (1K)	PA4437 (Table PA4437-1(Console
R41	Control - Brightness (100K)	PA4438 (Table) PA4438-1(Console)
R53	Control - Volume & Switch (330K)	PA4436 (Table) PA4436 (Console)
R78A	Control - Vert. Hold.(1M) Dual	PA4439 (Table)
R78B	Control - Horiz. Hold(50K)	PA4439-1(Console)
R82	Control - Vert. Size (2.5M)	PA4431
R86	Control - Vert. Linearity (5K)	PA4441

DESCRIPTION	PART NO.
L-10,28,29,30 & 31 Choke-R.F. (3 uh)	AA6651-1
L-11, Coil I.F. (25.7 Mc.)	AB43523-5
L-12,14 Choke- R.F. (25 uh)	AA6650-1
L-13,15 Coil- I.F. (23.7 MC.& 26.0 Mc.)	AB43523-6
L-16 Coil- Video Peaking (200 uh)	AA6613-4
L-17, 19 Coil Video Peaking (600 uh)	AA6613-8
L-18 Coil Video Peaking (175 uh)	AA6613-9
L-20 Coil Sound Trap (4.5 Mc.)	AB43523-7
** L-22A Coil - Vert. Defl.	
** L-22B Coil - Horiz. Defl.	PC70004
L-23 Coil- Width Control	AA6405-2
L-24 Coil- Horiz. Osc.	AA6403-1
L-26 Coil-Focus	PC70005-1
L-27 Choke-Line Cord Ant.	AA6664-1
Knob - Control Dummy Dual	PA5644
Knob - Control, Outer Dual Vert.Hold.	PA5645
Knob - Control, Inner Dual Horiz. Hold.	PA5646
Knob - Control, channel Ind. (Table)	PA5647
Knob - Control,Tuning (Console)	PA5648
Knob - Control, tuning	PA5649
Paper Washer	PA709-3
Control Panel(Models 5010,5011,5014,5015)	PC63092
Kinescope- Type 10 BP4 (10 Inch)	PC63042
Kinescope- Type 12 LP4 (12 Inch)	PD93160
Bezel (Models 5056,5057,5071 & 5072)	PC63081-1
Ion Trap	PA1175
* R.F. Tuner Assembly (Complete with tubes)	PD93153
* Speaker- 5 Inch Round	PC63000-27
* Speaker-10 Inch Round	PC63000-28
T-4 Transformer- Ratio Det.	AA6684-4
T-5 Trans.- Audio Output	AB44063-2
T-6 Trans.- Vert. Output	AB44062-4
T-7 Trans.- Vert. Osc. Blocking	AB47006-3
T-8 Trans.- Horiz. Output	PC63087-1
T-9 Trans.- Power	AB44017-1

**Deflection yoke supplied only as complete assemblies.

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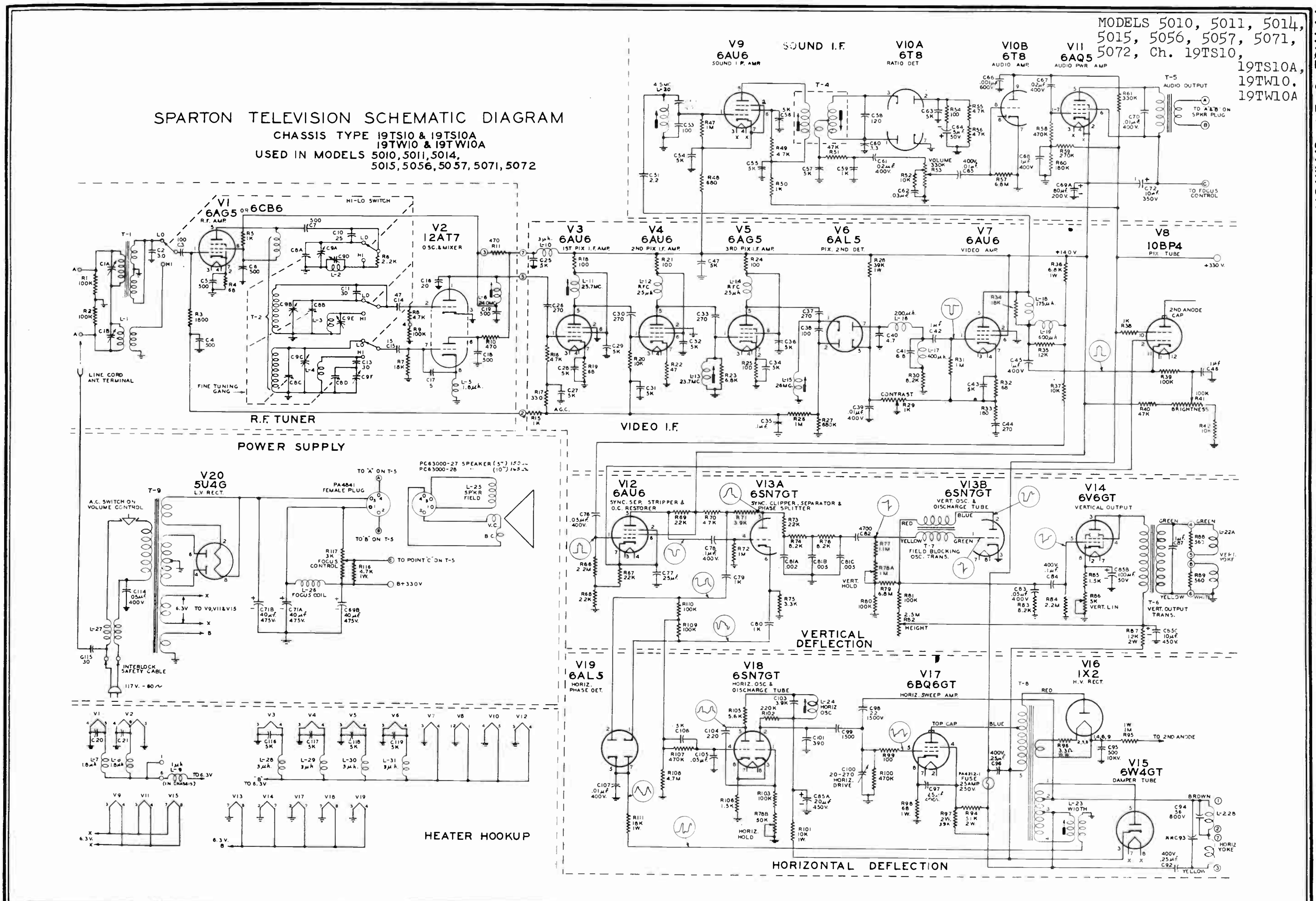
SPARTON TELEVISION SCHEMATIC DIAGRAM

CHASSIS TYPE 19TS10 & 19TS10A
19TW10 & 19TW10A
USED IN MODELS 5010, 5011, 5014, 5015, 5056, 5057, 5071, 5072



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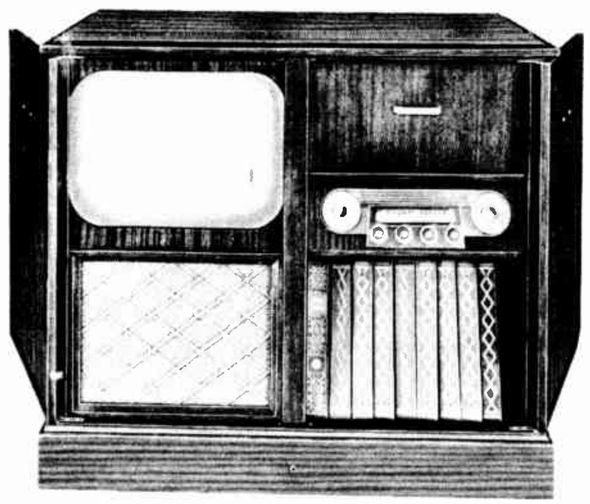

GENERAL SPECIFICATIONS

DIMENSIONS
36¼" x 42" x 24".

WEIGHT (packed)
260 lbs. (approx.)

POWER REQUIREMENTS
117 volts 60 cycles.
Television — 300 watts.
AM-FM Radio — 150 watts.
Phonograph — 170 watts.

PROJECTION SYSTEM
The projection system used in this receiver is an adaptation of the Schmidt optical principle which is recognized as the most efficient and practical method of picture projection. The sturdy and well engineered construction of the "Optical Box" provide optical stability which eliminates the need for frequent adjustment.

PICTURE SIZE

Height	Width	Viewing Area
13"	18"	226 sq. inches

SPEAKER
12" P.M. Dynamic.
Voice Coil Imped. — 3.2 ohms.

ANTENNA INPUT IMPEDANCE
300 ohms — balanced to ground.

BUILT-IN ANTENNA
High "Q" dipole with tunable matching stub.

R.F. TUNER
Turret type construction; individually removable coil assemblies for all channels. All components are easily accessible for servicing.

"KEYED" AUTOMATIC GAIN CONTROL
Outstanding new development; minimizes "airplane flutter"; reduces contrast variation when changing from one channel to another; increases immunity of sync system to external interference.

PICTURE TUBE PROTECTIVE CIRCUIT
An additional stage has been added to this receiver to protect the face of the picture tube in event of failure of either the horizontal or vertical sweep circuits. This added precaution is taken to prevent burning of the picture tube face which would otherwise be encountered in the event of sweep failure for only a few seconds.

INTERMEDIATE FREQUENCIES
AM Sound — 455 Kc.
FM Sound — 10.7 Mc.
TV Sound Carrier — 22.25 Mc.
Picture Carrier — 26.75 Mc.

I.F. SYSTEM
AM — One stage (two tuned transformers).
FM — Two stage (three tuned transformers).
TV — Four stage (stagger tuned) for composite signal and two additional stages for inter-carrier sound.

VIDEO AMPLIFIER
Two Stage — broad band.

RETRACE LINE SUPPRESSOR
Eliminates retrace lines thruout the normal range of picture brightness and contrast.

FOCUS
Magnetic.

DEFLECTION
Magnetic.

HORIZONTAL SYNCHRONIZATION
Automatic frequency control and "keyed" A.G.C. provide excellent picture stability and noise immunity.

HIGH VOLTAGE POWER SUPPLY
Separate oscillator (blocking type) generates the high voltage through a step-up transformer and voltage tripler circuit which is completely sealed in oil.

SENSITIVITY
Antenna to Picture Tube Grid Sensitivity — To make this measurement, connect negative terminal of 1½ volt battery to A.G.C. line, and positive terminal of battery to chassis. Also, set Contrast control to maixmum clockwise position. Connect an A.C. vacuum-tube voltmeter between picture tube grid and ground, and place a .005 microfarad condenser across the same points.

Inject R.F. signal (modulated 30% at 400 cycles) at antenna terminals, using signal whose frequency corresponds to the center frequency of the selected channel, and adjust Fine Tuning control for maximum output. Generator must be connected to antenna terminals with a 150 ohm carbon resistor in series with each lead to simulate proper impedance match.

CAUTION

HIGH VOLTAGES are used in the operation of this receiver. The back cover, while in place, prevents accidental contact with this voltage and therefore should not be opened by anyone except a qualified television serviceman.

THE HIGH VOLTAGE LEAD, which supplies approximately 25,000 volts to the picture tube, should be momentarily shorted to the chassis whenever it is disconnected for service purposes. This discharges the high voltage filter condenser and prevents a shock hazard when working on the receiver after it has been turned off.

THE PICTURE TUBE is highly evacuated and if broken, glass fragments will be violently expelled. Scratching, chipping, undue pressure, or careless handling such as lifting the tube by its neck is dangerous and should be avoided. If it is necessary to handle the picture tube, use safety goggles and heavy gloves.

Do not operate the picture tube outside the protective Optical Box. Prolonged exposure to the very soft X-Ray radiation from this tube may prove harmful.

The plate lead of the 6BG6G tube in the High Voltage power supply must be dressed to clear all objects by ¼" to prevent corona discharge. When replacing the cover on this unit, the high voltage lead must go directly up through the cover and not cross over inside the box. Severe arcing may result if the cover is reversed.

Extreme care should be exercised in handling the reflecting mirror. Organic matter deposited on the front surface of this mirror by handling may cause permanent stains.

Input signal required to produce standard output of 7.07 volts A.C. (r.m.s.) at picture tube grid is indicated in the following table. Since a fixed bias of 1½ volts has been applied to the A.G.C. system in order to provide a reference for these measurements, it will be understood that the sensitivities specified here are not intended to indicate the full capability of the receiver, but merely serve as a convenient basis for determining proper operation.

Low Band { Average — 25 microvolts.
Range — 10 to 40 microvolts.

High Band { Average — 40 microvolts.
Range — 20 to 80 microvolts.

Detector to Picture Tube Grid Sensitivity — To make this measurement, remove 6AU6, 4th Video I.F. tube (V-10) and set Contrast control to maximum clockwise position. Inject a 400 cycle (audio) signal across 6800 ohm video detector load resistor. In order to produce the standard output of 7.07 volts A.C. (r.m.s.) at the picture tube grid, the input signal at the detector load resistor will be approximately .07 volts A.C. An A.C. vacuum-tube voltmeter must be used for these measurements.

Television Sound System Sensitivity — Inject 4.5 megacycle frequency modulated signal (400 cycle modulation with 7½ Kc. deviation) across viedo detector load resistor and measure output at speaker voice coil. An input of 2200 microvolts will produce approximately 500 milliwatts or 1.26 volts across speaker voice coil.

A.M. Sound System Sensitivity — Inject a 1000 Kc. signal (modulated 30% at 400 cycles) at (high side) connection lug on antenna section of gang condenser. Connect generator to this point through a .01 microfarad condenser. Tune receiver to 1000 Kc. signal. An input of 75 microvolts will produce approximately 500 milliwatts or 1.26 volts across speaker voice coil.

F.M. Sound System Sensitivity — Inject a 98 megacycle frequency modulated signal (400 cycle modulation with 22½ Kc. deviation at pin 8 of 12AT7, F.M. R.F. Amplifier tube (V-26). Connect generator to this point through a 300 ohm resistor. Tune receiver to 98 Mc. signal. An input of 35 microvolts will produce approximately 500 milliwatts or 1.26 volts across speaker voice coil.

INSTALLATION INSTRUCTIONS

Television receiver performance is greatly dependent upon proper installation and correct initial adjustment of certain pre-set controls. It is therefore essential that the installation of the receiver be made by highly skilled television technicians. Installation consists of (1) unpacking and set-up, (2) adjustment of pre-set controls, and (3) instructing the customer how to operate the receiver. In addition the installation technician will determine whether television signals are sufficiently strong at the receiver location to permit satisfactory operation of the set when using its built-in antenna or whether an outdoor type antenna is necessary. In locations where signals are quite weak or reflected signals prove troublesome, the use of an outdoor antenna is generally recommended.

Should unfavorable reception conditions make it necessary to use an outdoor antenna, then the installation technician must select an antenna that best meets the requirements of the particular location. Careful assembly and mounting of the antenna on the roof of the home, as well as the selection and routing of transmission line, are factors that are also important if best reception is to be achieved, especially in a weak signal or "fringe" area.

Detailed instructions for accomplishing each of the installation operations are given in the following paragraphs and it is preferable to proceed in the order in which these subjects are discussed.

INSTALLING CABINET MIRROR — The special "front surface" mirror used to reflect the picture onto the receiver screen is packed separately in the compartment directly behind the screen. To gain access to it, remove the screws on that half of the cabinet back (section to which the name label is attached). The mirror can then be released by removing the screw blocks which hold it in place during shipment. Carefully unpack mirror and lay it flat on the protective tissue in which it was packed. **Extreme care should be exercised in handling it so that the front surface is not marred or stained by finger marks. Cleaning should be done with a soft clean cotton cloth, using light pressure.**

To determine which side of this mirror is the front surface, carefully approach one surface with any opaque object. **The front surface is that side on which the mirror image seems to touch the object when the object contacts the glass.** On the reverse side, the image will appear to be separated from the object by the thickness of the glass.

This front surface on which the silver has been deposited, must face towards the front of the receiver when the mirror is mounted in the cabinet. Failure to place the correct surface forward will result in optical distortion of the image on the screen.

Before attempting to install the mirror, remove the envelope which is stapled to the side wall of this compartment. This envelope contains the built-in antenna tuning knob which must be installed in accordance with the instructions in the next section. The mirror locking blocks, which are located at the top end of the mirror mounting rails (see Figure 1), must be positioned parallel to the rails before the mirror can be installed.

While holding the mirror carefully at its front and back edges with its front surface forward, slide it into position on the mounting rails until it clears the V-cleats at the bottom end of these rails. Then slide the mirror back on the rails until it is firmly seated in the cleats. The locking blocks should now be turned down to hold the mirror against the rails.

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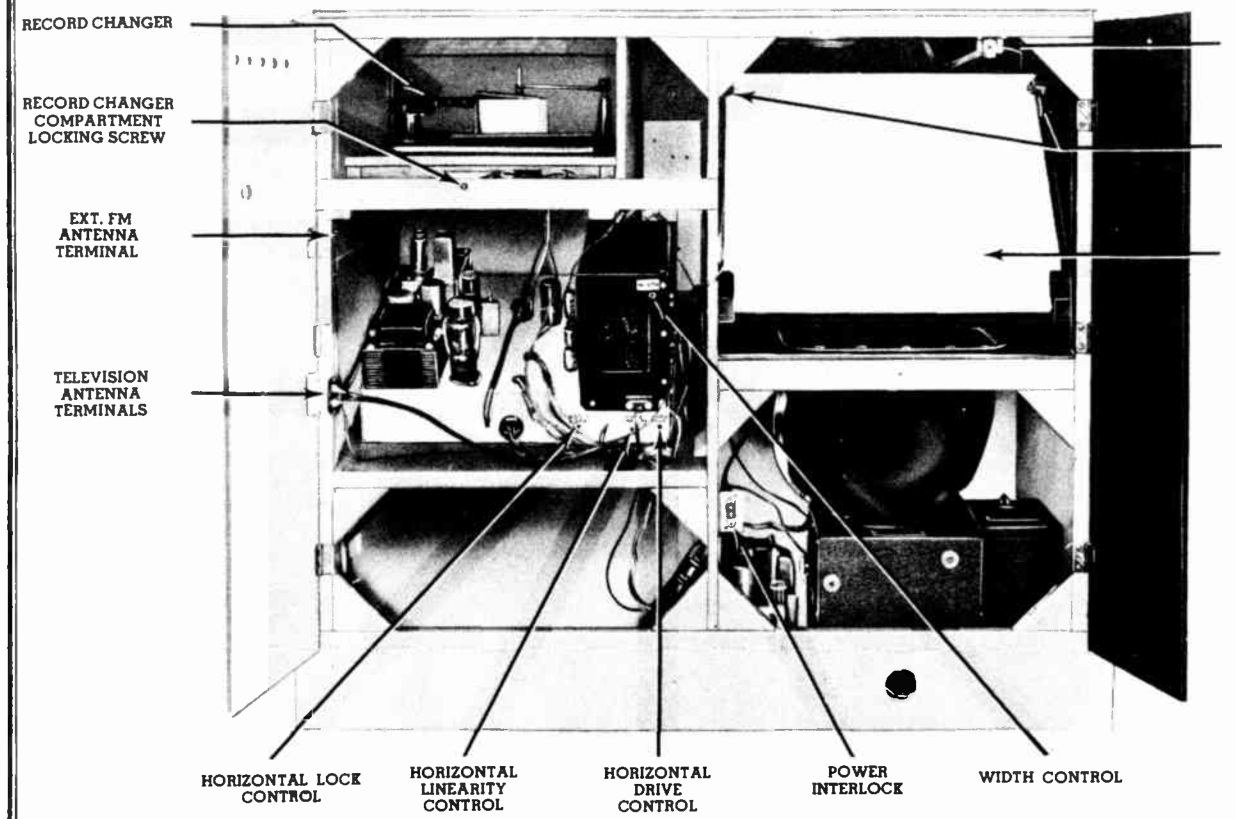

FIG. 1 — REAR VIEW — CABINET BACKS OPEN

ADJUSTING LIGHT SHROUD — Note the black shroud which is suspended from the shelf beneath the front surface mirror and extends to the Optical Box. The purpose of this shroud is to prevent spurious light from entering into the optical path of the projection system and also to prevent dust from settling on the face of corrector lens of the Optical Box. Untie the cord at the bottom edge of the shroud and lift it from the Optical Box to inspect the corrector lens for dust. If necessary, wipe this lens gently with a soft clean cloth to remove all foreign matter from its surface. Re-tie the shroud securely around the four upright studs on the Optical Box and make sure that it does not sag into the optical path.

RECEIVER CONTROLS

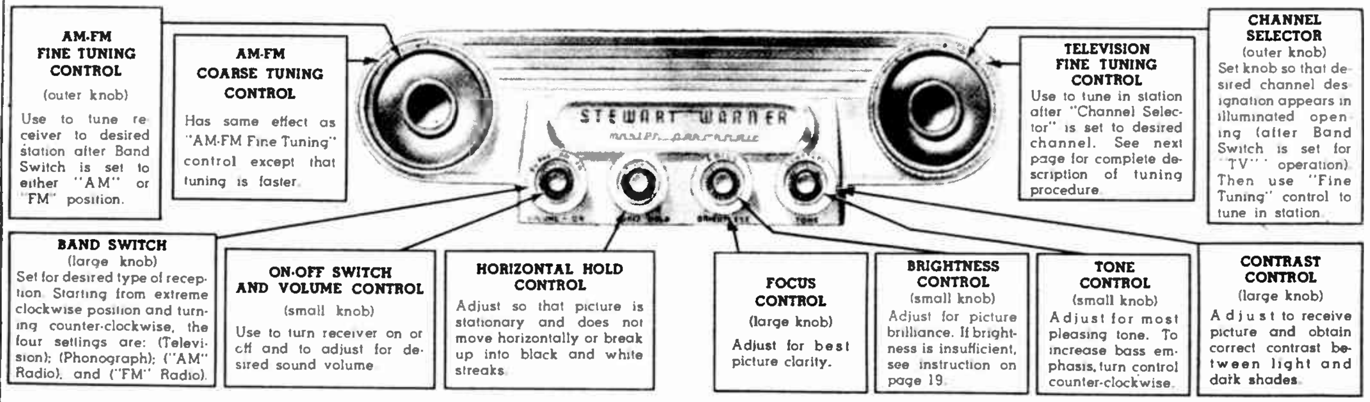

FIG. 2

The various controls on the receiver may be divided into two classes, Operating and Pre-set. Operating controls are those which control program selection as well as sound and picture quality. All but one of these controls are located on the front panel and their functions are indicated in Figure 2. The built-in television antenna tuning condenser is accessible at the rear of the receiver.

The Pre-set controls are those which require adjustment at the time the receiver is installed and they rarely need attention thereafter. There are nine of these controls, four of which are located at the back of the chassis (see Figure 1). Four controls are accessible by removing the Name Plate located directly above the Operating controls. Access to the "Auxiliary Fine Tuning" screw can be gained by removing the "Channel Selector" and "Fine Tuning" knobs.

CONTROL ADJUSTMENT PROCEDURE

Power interlocks are provided on the half of the cabinet back located behind the picture screen and on the speaker grille panel (see Figures 1 and 7). Should either the cabinet back or speaker grille panel be opened, the power supply to the receiver will be interrupted and a special power cord (Stewart-Warner part No. 507699) will be required to supply power to the receiver. If the speaker grille panel is removed, power must be supplied to the receiver through the interlock located at the front. If only the cabinet back is opened, power can be supplied to the receiver through the interlock at the rear.

CAUTION

When by-passing the power interlocks through the use of a special power cord, extreme care should be exercised to avoid contact with the high voltage components used for operation of this receiver.

Although the pre-set controls have been factory adjusted for optimum performance, it is usually necessary to make some fine adjustments of these controls at the time of installation.

To gain access to the centering adjustments and optical focusing it will be necessary to open the cabinet back, behind the picture screen, be removing screws around the rim of the back. The speaker grille panel must also be removed by grasping the grille frame at the upper edge and pulling outward.

Be sure that the locking brackets used to hold the Tailpiece Assembly to the Optical Box during shipment (see Figure 7) are removed before undertaking any optical adjustments as described in the following procedure. In addition, the felt block between the focus coil housing and picture tube clamp plate must be removed.

The receiver is now ready for an operational check.

TO ADJUST CONTROLS FOR RECEPTION OF STANDARD BROADCAST OR FREQUENCY MODULATION STATIONS:

1. **TURN SET ON** — Rotate "On-Off" Switch and Volume knob clockwise to turn receiver on.
2. **POSITION BAND SWITCH** — Set "Band Switch" to either its "AM" or "FM" position. Dial scale of corresponding band will be illuminated on face of "AM-FM Fine Tuning" knob.
   If the Channel Lite behind either the AM or FM dial scale does not light, and receiver otherwise operates satisfactorily, then that Channel Lite may be burned out and replacement should be undertaken. To gain access to Lites, remove all knobs on front of receiver (pull each knob forward) and remove Name Plate by grasping its upper edge and pulling it away from the cabinet. The Control Panel Escutcheon must then be removed by taking out the four wood screws which hold it in place. Replace Channel Lite with Stewart-Warner part #118921. Be sure to replace sleeving over new Channel Lite.
3. **TUNE** — Use "AM-FM" Fine Tuning" control to select desired station.
4. **ADJUST VOLUME** — Select "Volume" control setting for desired sound intensity.
5. **ADJUST TONE** — Select "Tone" control setting for most pleasing tone.

TO ADJUST RECEIVER FOR RECEPTION OF TELEVISION STATIONS:

1. **TURN SET ON** — Rotate the "On-Off Switch and Volume" knob approximately $\frac{1}{2}$ turn clockwise to turn set on and obtain sufficient sound volume during the tuning process. Allow several minutes for all tubes in the receiver to warm up and for circuits to stabilize before attempting to obtain a picture on the screen.
2. **POSITION BAND SWITCH** — Set "Band Switch" to "TV" position. The TV Channel Lite, located behind the "Channel Selector" knob, illuminates the particular television station designation corresponding to the setting of the Channel Selector.
   If the TV Channel Lite does not light, and receiver otherwise operates satisfactorily, then the Lite may be burned out and replacement should be undertaken. Follow the same procedure previously indicated for removal of AM-FM Channel Lites.
3. **ADVANCE BRIGHTNESS CONTROL** — Turn "Brightness" control clockwise until picture screen is moderately illuminated. The screen may remain dark or dimly illuminated until the "Coarse Brightness" control is adjusted as described in next step. If it should be found that the picture "blooms" or grows in size as the "Brightness" control is advanced, this condition can be corrected by adjustment of the "Coarse Brightness" control.
4. **ADJUST COARSE BRIGHTNESS CONTROL** — This control is located behind the Name Plate escutcheon (see Figure 5) which can be removed by grasping it at the upper edge and pulling forward. With the "Brightness" control on the front panel set to its maximum clockwise position, adjust the "Coarse Brightness" control for maximum brightness. The point of maximum brightness will occur just before the picture "blooms" or grows in size.
   Since maximum light transfer through the picture screen takes place perpendicular to its face, this adjustment should be undertaken with the operator looking directly into the screen.
5. **ADVANCE CONTRAST CONTROL** — Rotate the "Contrast" control knob fully clockwise.
6. **SET CHANNEL SELECTOR TO DESIRED CHANNEL** — The "Channel Selector" knob designates the channel to which the television receiver is tuned. (NOTE: Call letter or channel number tabs must be inserted into the "Channel Selector" knob for proper station identification — see paragraph #23 of this section of Installation Instructions for method of inserting these tabs.) Numbered positions indicated by the knob correspond to the station channel number. Set the "Channel Selector" knob to a channel on which a local television station is known to be broadcasting at the time.
7. **FINE TUNING CONTROL** — Use the "Television Fine Tuning" control (illustrated in Figure 2) to obtain the correct tuning point for both picture and sound. That is accomplished as follows:
   a. Turn "Television Fine Tuning" control in either direction until sound volume is maximum — if sound cannot be heard, advance the volume control and repeat fine tuning. If sound still cannot be heard, then refer to step 8.

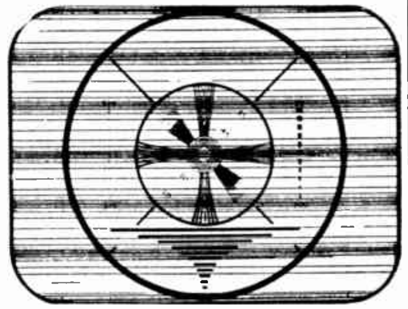

FIG. 3 — SOUND INTERFERENCE CAUSED BY INCORRECT TUNING

   b. When the point of maximum sound volume has been reached it will be noted that the picture has a "ragged" or "sawtooth" appearance or is partially obscured by "sound bars" (dark horizontal bars of varying width — see Figure 3).
   THE CORRECT SETTING OF THE "TELEVISION FINE TUNING" CONTROL is now obtained by turning it away from the maximum volume position only far enough to eliminate the "sound bar" interference and permit sharp reproduction of the picture. If an image is slightly distorted or tears into a series of black and white streaks as shown in Figure 6, reduce the setting of the "Contrast" control and operate the "Horizontal Hold" control knob until picture appears stable and undistorted.
8. **AUXILIARY FINE TUNING ADJUSTMENT** — If it is found that the tuning range of the "Television Fine Tuning" control is inadequate to permit correct tuning of a station in its assigned channel, then adjustments of the "Auxiliary Fine Tuning" screw will be necessary. This special screw is accessible after removal of the "Channel Selector" and "Television Fine Tuning" knobs. They may be removed by merely pulling them forward.

Adjustment of the "Auxiliary Fine Tuning" screw may now be undertaken in accordance with the following procedure.

a. Set "Channel Selector" to desired channel; then remove this knob.

b. Set "Television Fine Tuning" knob to the center of its range; then remove this knob. The flat portion of the main tuning shaft (outer brass shaft) should now be in the uppermost position. Note the location of the "Auxiliary Fine Tuning" adjustment screw on receiver chassis — see Figure 5.

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c. Using a thin screwdriver (preferably non-metallic), adjust the setting of "Auxiliary Fine Tuning" screw for correct tuning of the desired television station — **CAUTION: Do not attempt to rotate this screw more than two full turns in either direction, as further rotation may release it from the thread clip within the tuning mechanism and the TV chassis would then have to be removed from the cabinet in order to restore the screw to the correct position.** If a metal screwdriver is used, detuning occurs when the screwdriver is removed but it will be noted that this degree of detuning can now be compensated by resetting the "Television Fine Tuning" control (brass shaft). Thus the range of the "Television Fine Tuning" control (after knob is replaced on the shaft) will be adequate to tune in the station.

d. This completes the adjustment of the "Auxiliary Fine Tuning" screw for one channel. Identical screws are provided on each channel and they are all accessible thru the same opening in the tuning mechanism as each successfully moves into position when the "Channel Selector" knob is rotated.

9. **BUILT-IN ANTENNA ADJUSTMENT** — If the receiver's built-in television antenna system is used, rotate the antenna tuning knob (located at rear of cabinet) until the best picture is obtained. It may be possible to find a single setting for this knob which will give satisfactory performance for a group of stations. In the event that is not the case, adjust the control for optimum performance each time the Channel Selector is rotated to a different station.

10. **SOUND VOLUME** — Adjust the setting of the "Volume" control by rotating it clockwise until the sound accompanying the television broadcast is received at a satisfactory level.

11. **TONE** — Adjust "Tone" control setting for most pleasing tonal quality.

12. **HORIZONTAL HOLD** — Should the picture appear to move horizontally across the screen or break up into a series of light and dark streaks as shown in Figure 6, adjust the "Horizontal Hold" control until the picture remains stationary.

If this control must be rotated to the end of its range for proper "locking" action, then it will be necessary to reset the position of the "Horizontal Lock" control (see Figure 1) for location. This control is appropriately labeled on the cabinet back and is accessible without opening the back. Adjustment is accomplished by first setting the "Horizontal Hold" control in the middle of its range and then changing the setting of the "Horizontal Lock" control until picture locks in horizontally.

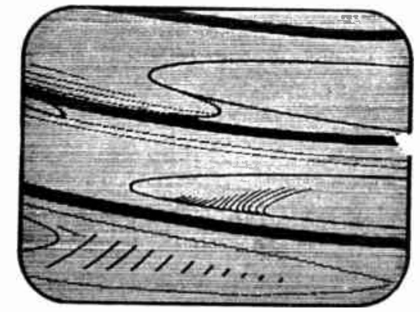

FIG. 6 — HORIZONTAL MOVEMENT; ADJUST HORIZONTAL HOLD CONTROL

13. **VERTICAL HOLD** — Should the picture roll in a vertical direction or appear as multiple vertical images as shown in Figure 8, it will be necessary to adjust the "Vert. Hold" control located behind the Name Plate (see Figure 5).

After this adjustment is made, reduce contrast until picture is barely visible and check setting of "Vertical Hold" control for proper picture synchronization.

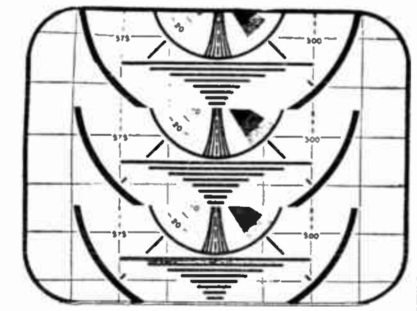

FIG. 8 — VERTICAL MOVEMENT; ADJUST VERTICAL HOLD CONTROL

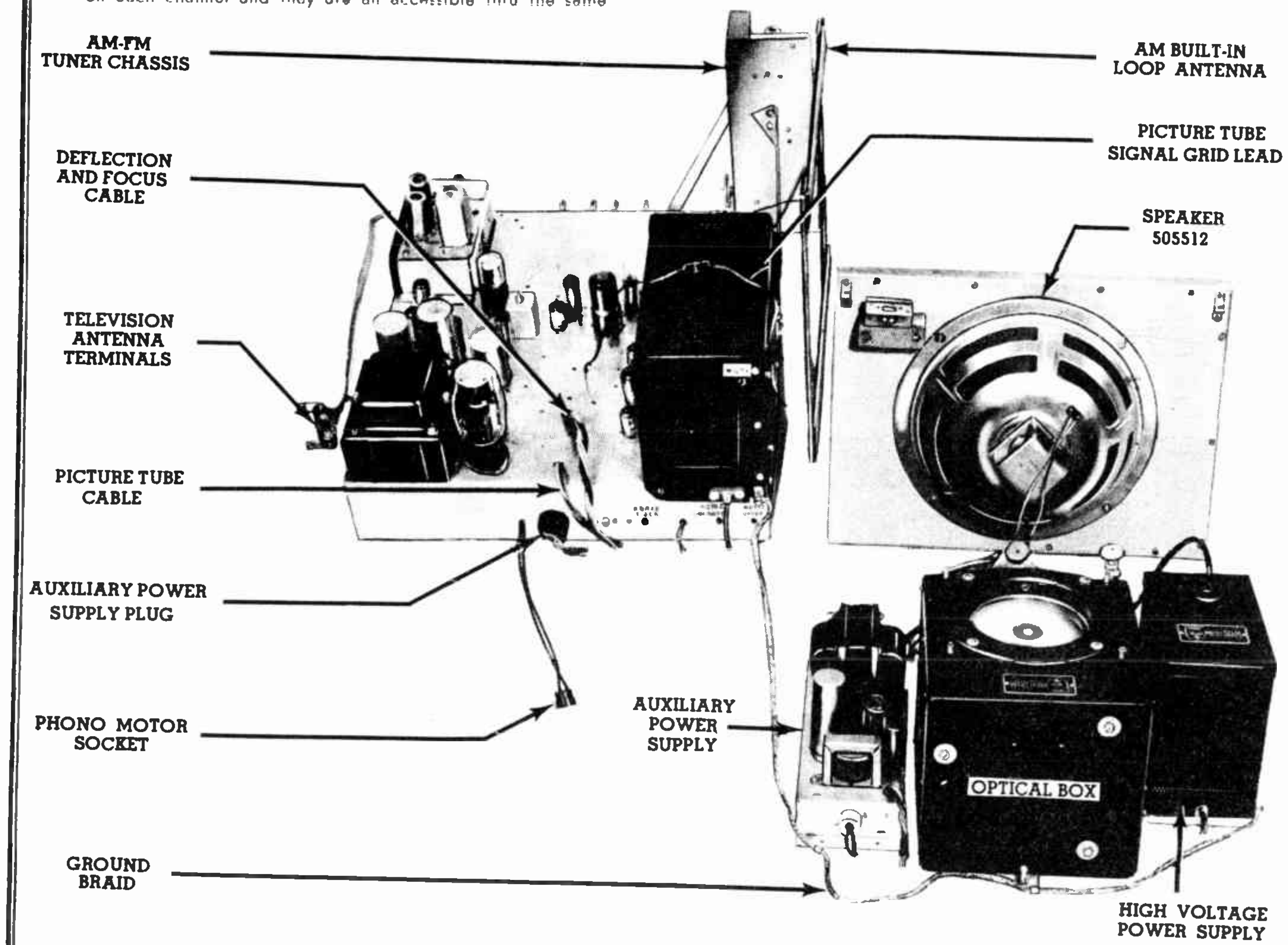

FIG. 4 — CHASSIS LOCATIONS

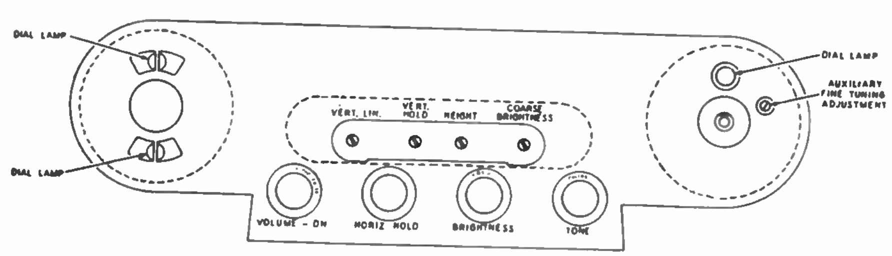

FIG. 5 — LOCATION OF PRE-SET CONTROLS

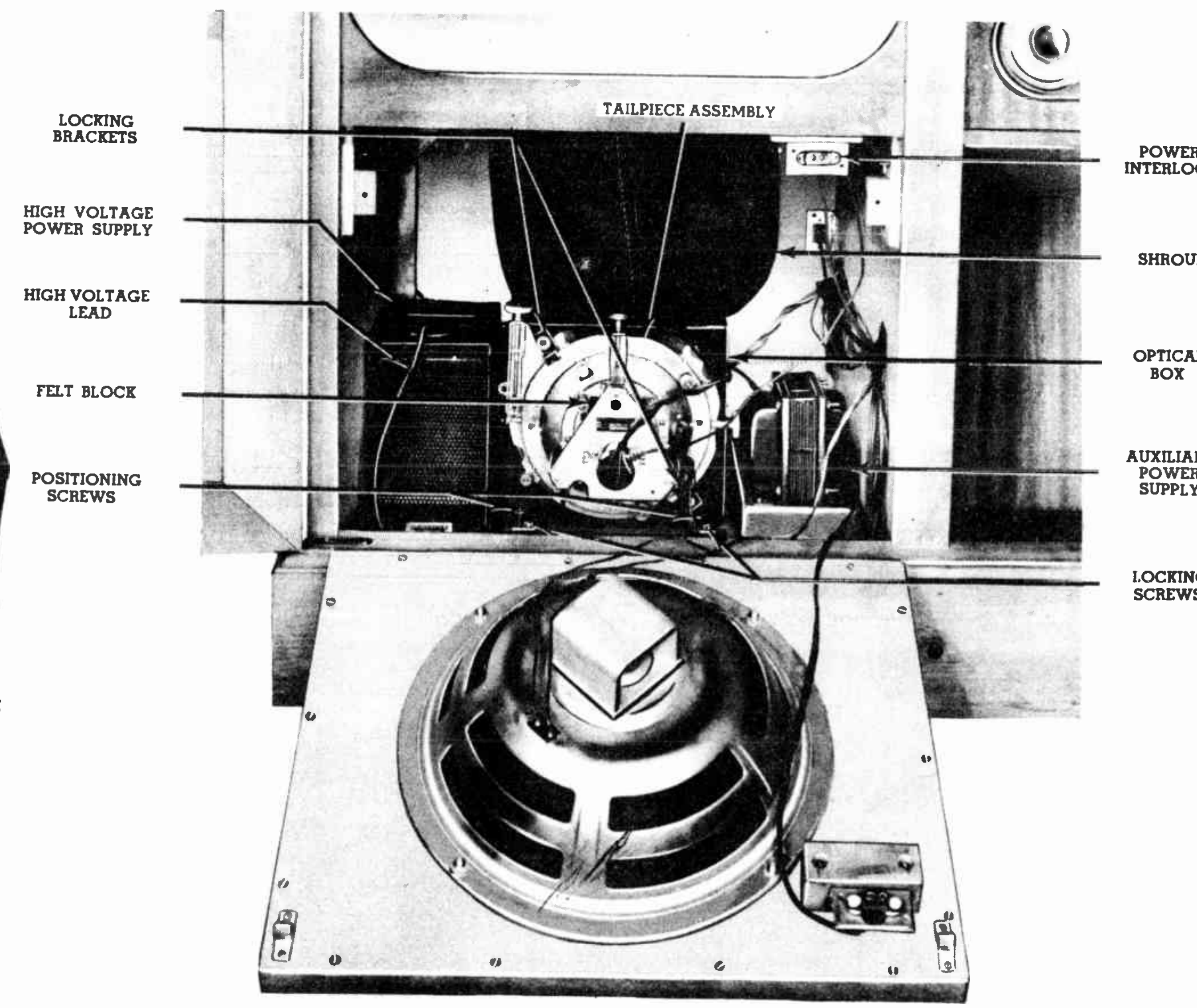

FIG. 7 — SPEAKER GRILLE PANEL REMOVED

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14. **INITIAL FOCUS**— Adjust the "Focus" control until picture is most clearly defined. In the event that proper overall focus cannot be obtained, or if a portion of the picture will not focus sharply, it will be necessary to make adjustments on the Optical Box. Be sure that Tailpiece shipping brackets and felt block are removed from Tailpiece assembly before attempting to make these adjustments.

a. Set "Focus" control to position of best focus.

b. Remove speaker grille panel and open cabinet back behind picture screen. Power must be supplied to the receiver through the interlock at the speaker grille opening. **CAUTION: Exercise care to avoid contact with high voltage components.**

c. Loosen two thumb nut "L" and three thumb screws "N" (see Figure 11).

d. Adjust thumbscrew "O" for overall focus, with sharp focusing occurring in the center of the picture.

e. Adjust thumbscrew "H" so that top and bottom of picture focus equally well.

f. Adjust thumbscrew "V" so that both sides of picture are in focus.

g. Repeat step "d".

h. Repeat steps "e", "f" and "g" if necessary.

i. Hand tighten thumb nuts "L" and thumbscrews "N".

If adjustment of thumbscrew "O" will not give overall focusing, check to see that tube clamp (see Figure 21) is securly holding the picture tube in position. Since the face of this tube is the first lens of the optical system, its position is critical and the tube must be well seated in the Tailpiece assembly. Loosen tube clamp screw and grasp tube neck, pulling back gently until it firmly seats itself. Exercise care in tightening tube clamp so as not to crack the tube neck.

Fuzzy picture may also be due to reproduction of poor quality film when station is televising a motion picture. Incorrect tuning of receiver produces a similar effect. Check for proper tuning point as described in step 7.

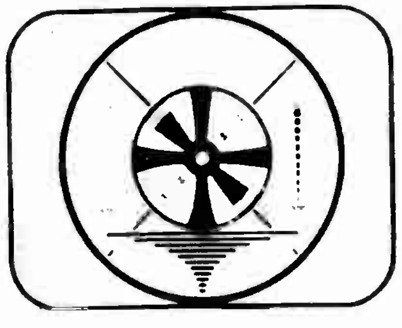

FIG. 9 — BLURRED APPEARANCE; ADJUST FOCUS CONTROL

15. **STRAIGHTENING TILTED RASTER** — If the pattern should appear on the screen in a tilted position as shown in Figure 10, loosen four thumb nuts "M" and rotate the entire Tailpiece assembly sufficiently to correct this condition. Be sure to re-tighten these four nuts securely.

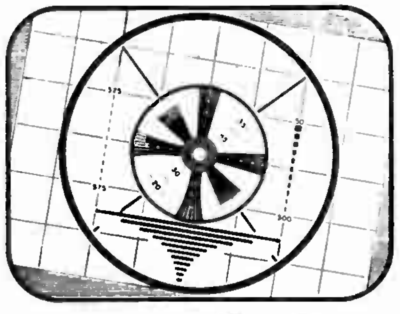

FIG. 10 — TILTED PICTURE; ADJUST TAILPIECE POSITION

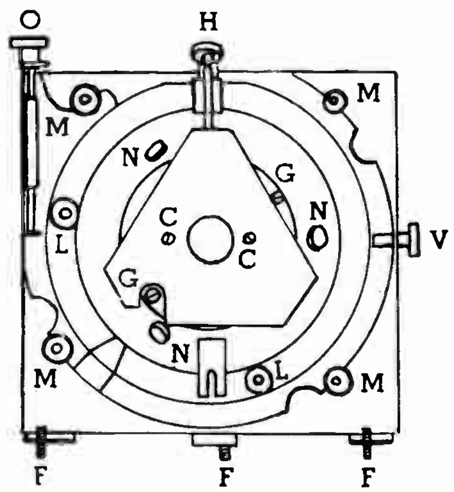

FIG. 11 — OPTICAL ADJUSTMENT CONTROLS

The following adjustments should be made while the station is transmitting its circular test pattern.

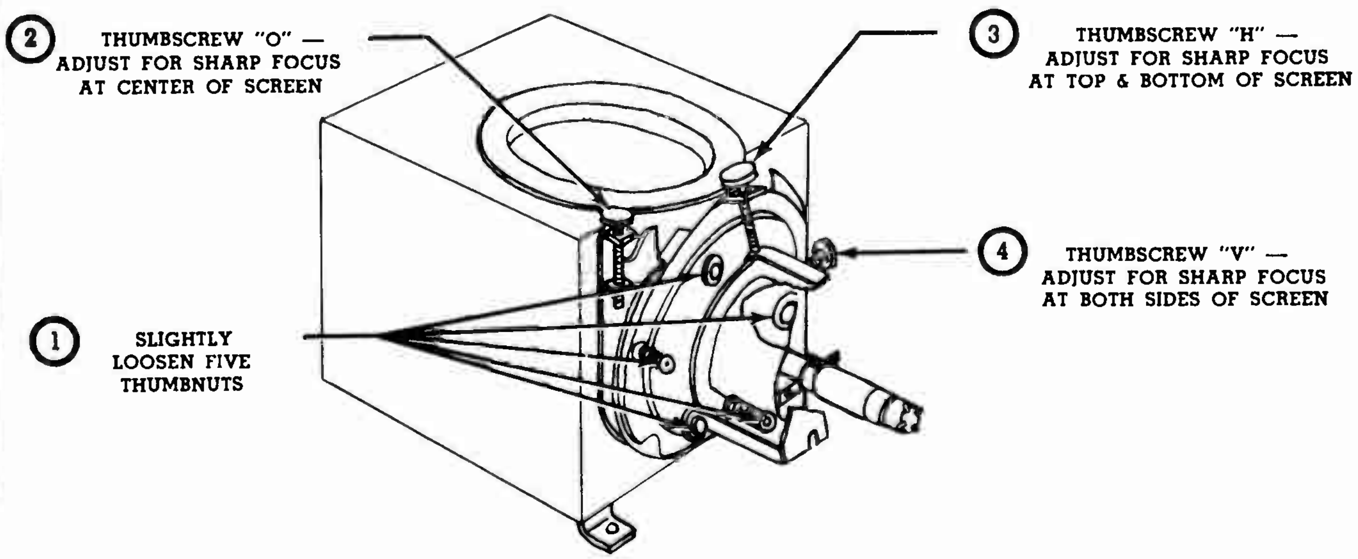

FIG. 12 — OPTICAL FOCUSING ADJUSTMENT

16. **CENTERING** — The position of the neck of the picture tube in the Tailpiece assembly will affect the position of the pattern on the screen. Loosen the two screws "C" on the back of the triangular tube clamp plate and center the neck of the tube in the hole in the plate and re tighten the screws.

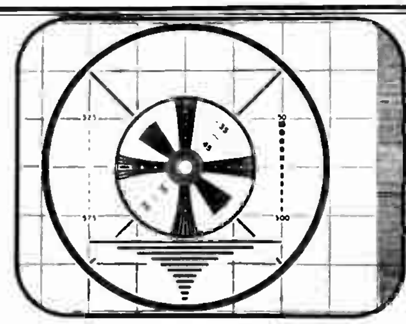

FIG. 13 — OFF CENTER; ADJUST FOCUS COIL POSITION

Further positioning of the raster on the screen can be accomplished by adjusting the position of the focus coil with respect to the tube. The position of the focus coil is adjusted by means of two screws located on the front edge of the focus coil housing assembly (see screws labeled "G" in Figure 11). If considerable displacement of the raster is encountered, full correction should not be undertaken by re-positioning the focus coil. This should be done by re-positioning the Optical Box as follows:

Loosen the three locking screws which hold the Optical Box fast to the bottom of the cabinet. Then adjust the three positioning screws "F" (see Figure 11) until the pattern is properly centered. Re-tighten the locking screws.

17. **WIDTH** — Control of picture size in the horizontal direction is accomplished by means of the "Width" control located on the rear of the screen cage on the television chassis (see Figure 1). If abnormally low line voltage makes it difficult to obtain sufficient picture width when using the "Width" control, then changing the setting of the "Horizontal Drive" control may be helpful. The "Drive" control is located at the rear of the chassis and its setting will affect horizontal linearity as well as picture width. Therefore, after adjusting this control for desired width, it may be necessary to re-adjust the "Horizontal Linearity" control as described in paragraph #18. The three controls referred to in this copy are all accessible through properly labeled openings on the cabinet back.

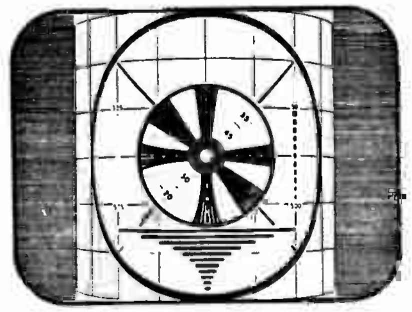

FIG. 14 — TOO NARROW; ADJUST WIDTH CONTROL

18. **HORIZONTAL LINEARITY** — Improper horizontal linearity causes the circular test pattern to appear condensed on the right edge of the screen and extended on the left edge or vice versa. This effect is illustrated in Figure 15. Adjust for proper linearity by using "Horiz. Lin." control located on rear of chassis (see Figure 1). In event that proper horizontal linearity cannot be obtained by adjusting this control, then change the setting of the "Horiz. Drive" control (also located at rear of chassis). As width and linearity of the picture are affected by the setting of Horiz. Drive control, it will be necessary to adjust this control in conjunction with the Horiz. Linearity and Width controls to obtain desired picture width and linearity.

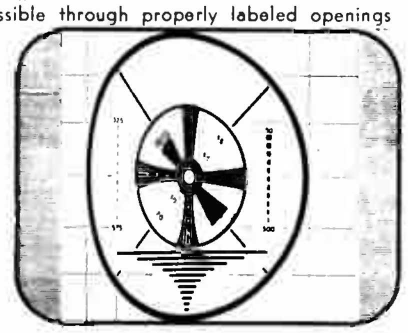

FIG. 15 — HORIZONTAL DISTORTION; ADJUST HORIZONTAL LINEARITY CONTROL

19. **HEIGHT** — Control of picture size in the vertical direction is accomplished by means of the "Height" control located behind the Name Plate. Height and width adjustments should be checked for all transmitting stations to be sure that picture properly fills the viewing area.

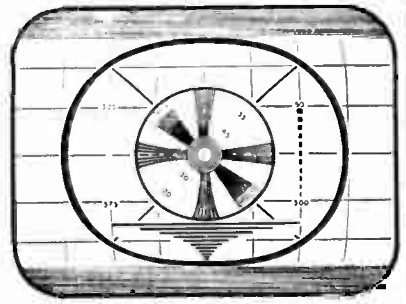

FIG. 16 — TOO SHORT; ADJUST HEGHT CONTROL

20. **VERTICAL LINEARITY** — Improper vertical linearity causes the circular test pattern to appear condensed on the upper edge of the screen and extended on the lower edge or vice versa. This effect is illustrated in Figure 17. Adjust for proper linearity by using "Vert. Lin." control located behind Name Plate. It may be necessary to readjust the "Height" control if an appreciable change is made in the linearity control setting.

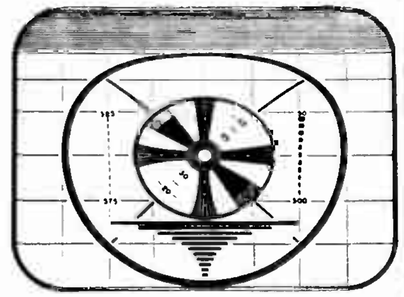

FIG. 17 — VERTICAL DISTORTION; ADJUST VERTICAL LINEARITY CONTROL

21. **FINAL OPTICAL FOCUSING** — Receiver adjustments which have been made since the original optical focusing was undertaken may cause a slight amount of de-focusing. It is therefore advisable to once more go through the optical focusing procedure as described in step 14.

22. **FINAL ADJUSTMENTS** — Recheck settings of "Brightness" "Contrast" and "Focus" control for best picture quality. Proper adjustment of all Pre-set and Operating controls on this receiver should result in the type of picture indicated in Figure 18.

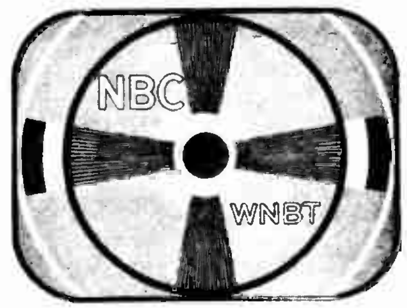

FIG. 18
CORRECTLY ADJUSTED PICTURE

23. **INSERTING STATION TABS** — A set of television station call letter tabs and channel numbers is supplied with each receiver and is to be used to identify the local television stations. To install these tabs, merely remove the "Channel Selector" knob, and insert either the correct station call letters or channel numbers into the proper circular recesses on the rear surface of the knob. The correct recess may be identified by the station channel number stamped on the outer edge of the "Channel Selector" knob adjacent to each recess. Insert black tabs in the remainder of the circular holes.

The unused tabs should be retained. The list of call letter tabs includes many of the television stations which are not yet on the air. When a new local station begins broadcasting, remove the "Channel Selector" knob, remove the previously inserted black tab for that channel, and insert the correct call letter tab.

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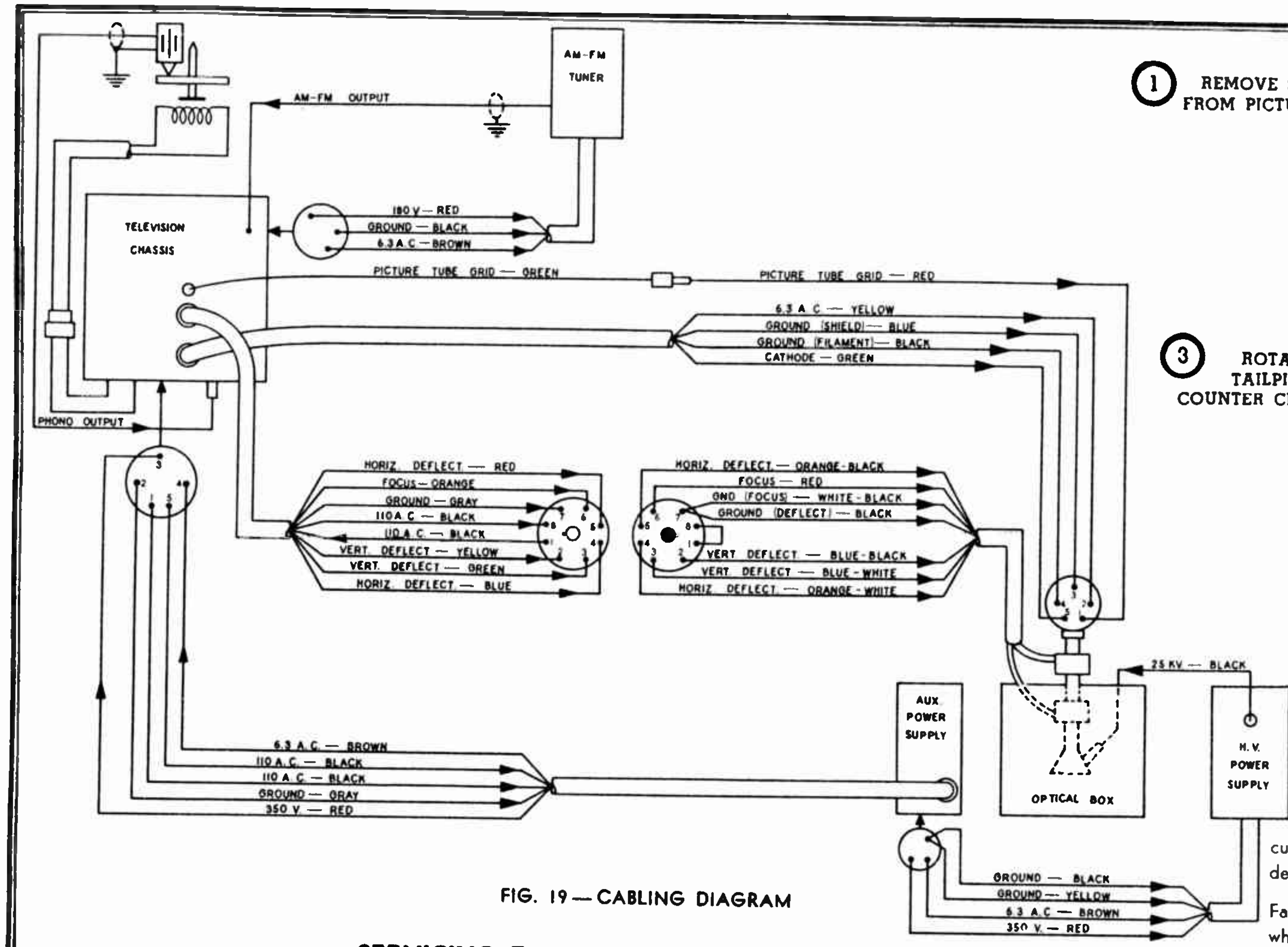

FIG. 19 — CABLING DIAGRAM

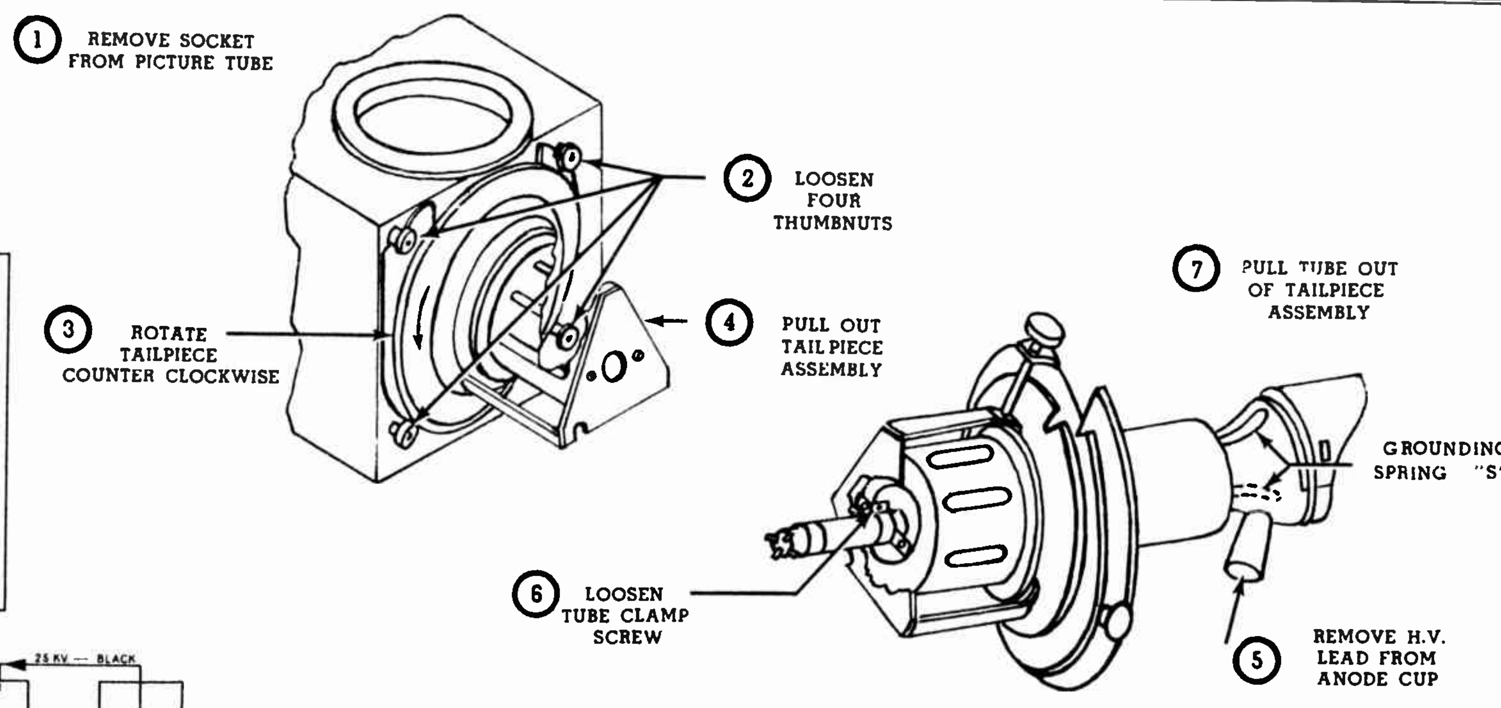

FIG. 21 — REMOVAL OF PICTURE TUBE

SERVICING THE HIGH VOLTAGE POWER SUPPLY

CAUTION

This unit supplies the 25,000 volts required for operation of the 3NP4 cathode ray tube. Although it is a reduced-hazard, pulse type power supply, whose power output capabilities are limited to the requirements of the 3NP4 tube, extreme care should be exercised while working on it.
If replacement of the 6BG6G tube is undertaken, care must be exercised to dress the plate lead at least ¼" from all objects so as to prevent corona discharge.
When replacing the cover on the high voltage unit, be sure that it is not reversed. The high voltage lead must go directly up through the cover and not cross over inside the box. Severe arcing may result if the cover is reversed.

The 6SR7 tube in the high voltage supply operates as a blocking oscillator whose frequency must be maintained at 1000 ±70 c.p.s. A frequency controlling trimmer condenser is accessible at the base of the high voltage power supply, **but adjustment should not be undertaken unless some frequency determining component has been replaced.** This 1000 cycle adjustment has a negligible effect on the output voltage or current regulation and should not be tampered with in an effort to correct for insufficient brightness or "blooming". Its only function is to provide the proper frequency which determines the correct amount of power delivered to the heaters of the three high voltage rectifier tubes inside the sealed can, and thereby assures maximum life for these tubes.

Adjustment of this trimmer should be done with an oscilloscope and a dependable 1000 cycle generator. Blocking oscillator voltage to operate the vertical amplifier of the oscilloscope can be obtained from the 350 volt B+ line to the High Voltage Supply. With a 1000 cycle signal from the generator applied to the horizontal sweep amplifier of the oscilloscope, adjust the trimmer condenser until a single stable oscillogram is obtained as indicated in Figure 20.

If the High Voltage supply does not operate, first check the 6SR7 and 6BG6G tubes by replacing them. Should this fail to correct the difficulty, check to see that the blocking oscillator is functioning as evidenced by a bias of −50 volts on the grid of the 6SR7 tube (V32).

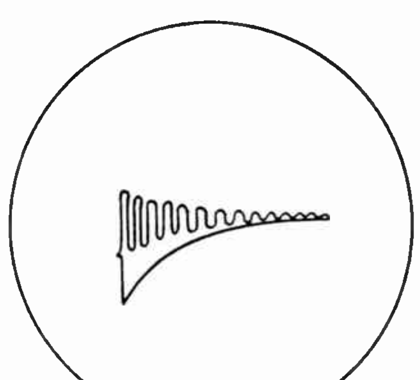

FIG. 20 — OSCILLOGRAM OBTAINED FOR CORRECT ADJUSTMENT OF H.V. OSCILLATOR TRIMMER

Failure of a component in the sealed can in the High Voltage supply, which contains the high voltage transformer and three rectifier tubes (V34, V35 and V36), can cause reduced high voltage on complete absence of this voltage. Since it is impractical to attempt replacement of any of these components individually, the entire can must be replaced. Exercise care when soldering to the glass insulator connections, as excessive heat may result in damage to the oil seals.

It should be kept in mind that action of the 6SN7 Protector Tube (V21) can cause the picture tube V15 to be biased to cut-off thereby causing the picture screen to go dark. In the event that the screen should go dark and it has been determined that the High Voltage supply is not at fault, check to see if the failure of one or both of the sweep circuits has caused the 6SN7 Protector Tube to bias the 3NP4 picture tube to cut-off.

REPLACEMENT OF 3NP4 PICTURE TUBE

To replace the 3NP4 picture tube, mounted in the Optical Box proceed as follows:

1. Remove tube socket from base of tube.
2. Loosen four thumb nuts "M" (see Figure 11).
3. Carefully rotate entire Tailpiece assembly counter-clockwise.
4. Use extreme care to gently pull entire Tailpiece assembly and picture tube out of Optical Box. This operation must be done very carefully to prevent the tube from hitting the plane mirror in the Optical Box.
5. Disconnect the High Voltage lead from the picture tube anode cup by pulling it straight out.
6. Loosen the screw on the tube clamp (see Figure 21) and pull tube out of Tailpiece assembly.
7. A light shield and neoprene band are packed with each 3NP4 replacement tube. Place this light shield over top of tube, (opposite high voltage anode cup) locating it over the two projecting lugs on the tube and hold it in place with the neoprene band as shown in Figure 21. The two grounding springs "S" (see Figure 21) must make good contact with the aquadag (black coating) on the outside of the tube. Therefore these springs must be kept clear of the light shield or placed under it.
8. Carefully insert the tube into the Tailpiece assembly, with the anode cup facing down.
9. Push the tube into the deflection yoke as far as it will go and tighten the screw in the tube clamp. Although care must be exercised to prevent cracking the tube neck, this screw must be sufficiently tight to prevent the tube from moving forward in the Tailpiece Assembly. Do not attempt to hold the Tailpiece Assembly by the deflection yoke.
10. Place the high voltage cable connector in the anode cup of the picture tube, making sure that the clip securely grips the metal button.
11. Carefully insert the Tailpiece Assembly in the Optical Box making sure that the tube and light shield properly clear the plane mirror.
12. Rotate the Tailpiece Assembly clockwise until the slots engage the four nuts "M". Keep the bottom edge of the triangular endplate parallel to the bottom of the Optical Box.
13. Connect the tube socket to the tube while holding the neck so as to avoid the possibility of pushing it out of position in the deflection yoke.

If picture tube replacement is undertaken, it will be necessary to re-adjust the optical focus as described in step 14 of the preceding section. It may also be necessary to re-center the picture on the screen as indicated in step 16 and to straighten the raster as outlined in step 15.

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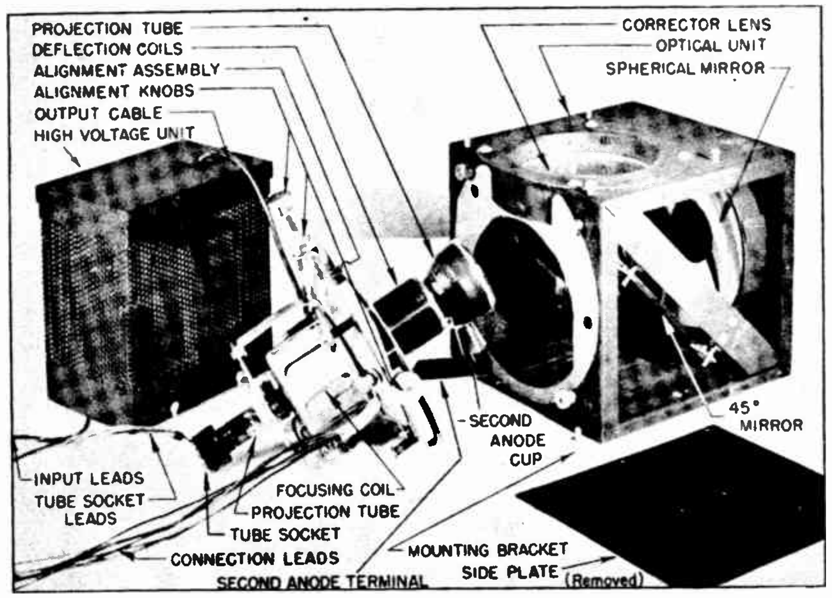
SERVICE NOTES FOR PROJECTION SYSTEM



CAUTIONS

HIGH VOLTAGES are used in the operation of this receiver. The back cover, while in place, prevents accidental contact with this voltage and therefore should not be opened by anyone except a qualified television serviceman.

THE HIGH VOLTAGE LEAD, which supplies approximately 25,000 volts to the picture tube, should be momentarily shorted to the chassis whenever it is disconnected for service purposes. This discharges the high voltage filter condenser and prevents a shock hazard when working on the receiver after it has been turned off.

THE PICTURE TUBE is highly evacuated and if broken, glass fragments will be violently expelled. Scratching, chipping, undue pressure, or careless handling such as lifting the tube by its neck is dangerous and should be avoided. If it is necessary to handle the picture tube, use safety goggles and heavy gloves.

Do not operate the picture tube outside the protective Optical Box. Prolonged exposure to the very soft X-ray radiation from this tube may prove harmful.

The plate lead of the 6BG6G tube in the High Voltage power supply must be dressed to clear all objects by ¼" to prevent corona discharge. When replacing the cover on this unit, the high voltage lead must go directly up through the cover and not cross over inside the box. Severe arcing may result if the cover is reversed.

Extreme care should be exercised in handling the reflecting mirror. Organic matter deposited on the front surface of this mirror by handling may cause permanent stains.

The Tailpiece Assembly should not be handled by grasping the Deflection Yoke. Undue strain on this yoke may cause breakage or distortion which cannot be compensated for through normal adjustments.

SERVICING THE OPTICAL BOX

The Optical Box contains a concave mirror, a plane mirror mounted at a 45° angle and the aspherical corrector lens. Optical alignment of these elements requires a special fixture and such adjustment should not be undertaken in the field. In the event that adjustment of these elements is required, the Optical Box should be returned to Stewart-Warner Electric. Do not return the Tailpiece Assembly (containing Picture Tube, Focus Coil and Deflection Yoke) as those components are not needed when making this adjustment.

The Optical Box is a dust-proof unit and the mirrors should seldom require cleaning. In cases where dust or grease conditions are unusually severe, a deposit on the optical surfaces may cause decreased picture brightness. Under those circumstances, cleaning of the optical surfaces should be undertaken as follows:

1. Remove Tailpiece Assembly from Optical Box as indicated in section entitled "REPLACEMENT OF 3NP4 PICTURE TUBE" on page 5.
2. Untie the light and dust shroud from around the studs on top of the Optical Box.
3. The Optical Box can now be removed from the cabinet by releasing the three locking screws which fasten it to the bottom.
4. The two sides of the box may now be removed by taking out the screws around the edges. This will expose all optical surfaces for cleaning. Do not touch the mirrors as they are front surface mirrors and organic deposits from the fingers will cause permanent stains.
5. Remove all dust from the optical surfaces with a camel's hair brush and then polish with lens tissue. Where dust deposit or discoloration is excessive, use a commercial spray such as "Windex."

The top surface of the corrector lens is covered with a glass plate and accordingly may be cleaned with a soft cloth without scratching.

Replacement of the Focus Coil or Deflection Yoke entails partial disassembly of the Tailpiece and this should be done in accordance with the applicable instructions. Care should be exercised in undertaking this disassembly and particular attention should be given to correct placement of parts during re-assembly. The exploded view of the Tailpiece Assembly (see Fig. 2) will be of valuable assistance in both dismantling and re-assembly.

REPLACEMENT OF FOCUS COIL ASSEMBLY

1. Remove 3NP4 picture tube from Tailpiece Assembly as indicated on Page 5.
2. Remove triangular Tube Clamp Plate (518 in Fig. 2).
3. Unsolder red and black-white wires from deflection yoke and focus coil plug. Loosen cable clamp and withdraw these wires which lead to focus coil.
4. Remove two centering screws "G" (See Fig. 1).
5. Remove "C" washer on spring-loaded stud at flange of Focus Coil. (Exercise care in doing this since spring is still under tension.) A similar "C" washer, located on the plain stud on opposite side of Focus Coil, must also be removed. The Coil may now be lifted free from the Tailpiece Assembly.
6. Place new Focus Coil Assembly on studs and replace spring and washers removed in Step 5.
7. Replace centering screws "G", thread Focus Coil wires through cable clamp and tighten clamp. Resolder wires into correct pins on cable plug (see circuit diagram Page 19,20). Replace triangular Tube Clamp Plate on end of Tailpiece Assembly.
8. Replace Picture Tube and Tailpiece Assembly as indicated on Page 5.
9. Re-focus, re-center and straighten raster as indicated on Pages 3 and 4.

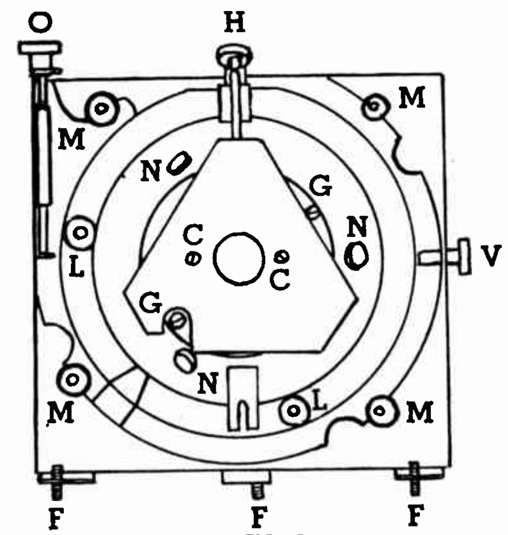


FIG. 1
OPTICAL ADJUSTMENT CONTROLS

REPLACEMENT OF DEFLECTION YOKE

1. Remove Focus Coil as indicated above.
2. Remove rubber ring around Deflection Yoke (diagram #500 in Fig. 2) by merely pulling it forward.
3. Note the exact mounting position of the Deflection Yoke with respect to the mounting plate. This is very important because the replacement yoke must be installed in the same position.
4. Remove three thumbscrews "N" and completely unscrew thumbscrew "H" (see Fig. 1). The Deflection Yoke and mounting plate can now be removed for convenient servicing.
5. Remove the screw which grounds the Deflection Yoke shield lug to the mounting plate.
6. The Deflection Yoke can now be released from the mounting plate by removing the four screws which hold it in position. Before removing the yoke, again check its position with respect to the mounting plate. Unsolder all cable wires from yoke connection lugs. It is not necessary to remove the two 560 ohm resistors since the replacement yoke is supplied with those components.
7. Resolder the cable leads to the correct lugs on the new Deflection Yoke. For correct connection of all wires, see the circuit diagram on page 19,20.
8. Place the Deflection Yoke Insulator (521 in Fig. 2) in position on the mounting plate and then properly locate the yoke in the same relative position as the original one. Be sure that the extrusions on the back side of the yoke fit into the holes in the mounting plate. The yoke should now be secured in position by the four mounting screws.
9. Properly dress the cable leads and then replace the screw which connects the yoke shield lug to the mounting plate.
10. Re-insert this assembly into the front section of the Tailpiece and engage thumbscrew "H" in the threaded hole in bracket. Replace three thumbscrews "N" (see Fig. 1).
11. The Focus Coil should now be replaced as indicated in the previous section entitled "REPLACEMENT OF FOCUS COIL ASSEMBLY."
12. Re-focus, re-center and straighten raster as indicated on pages 3 and 4.

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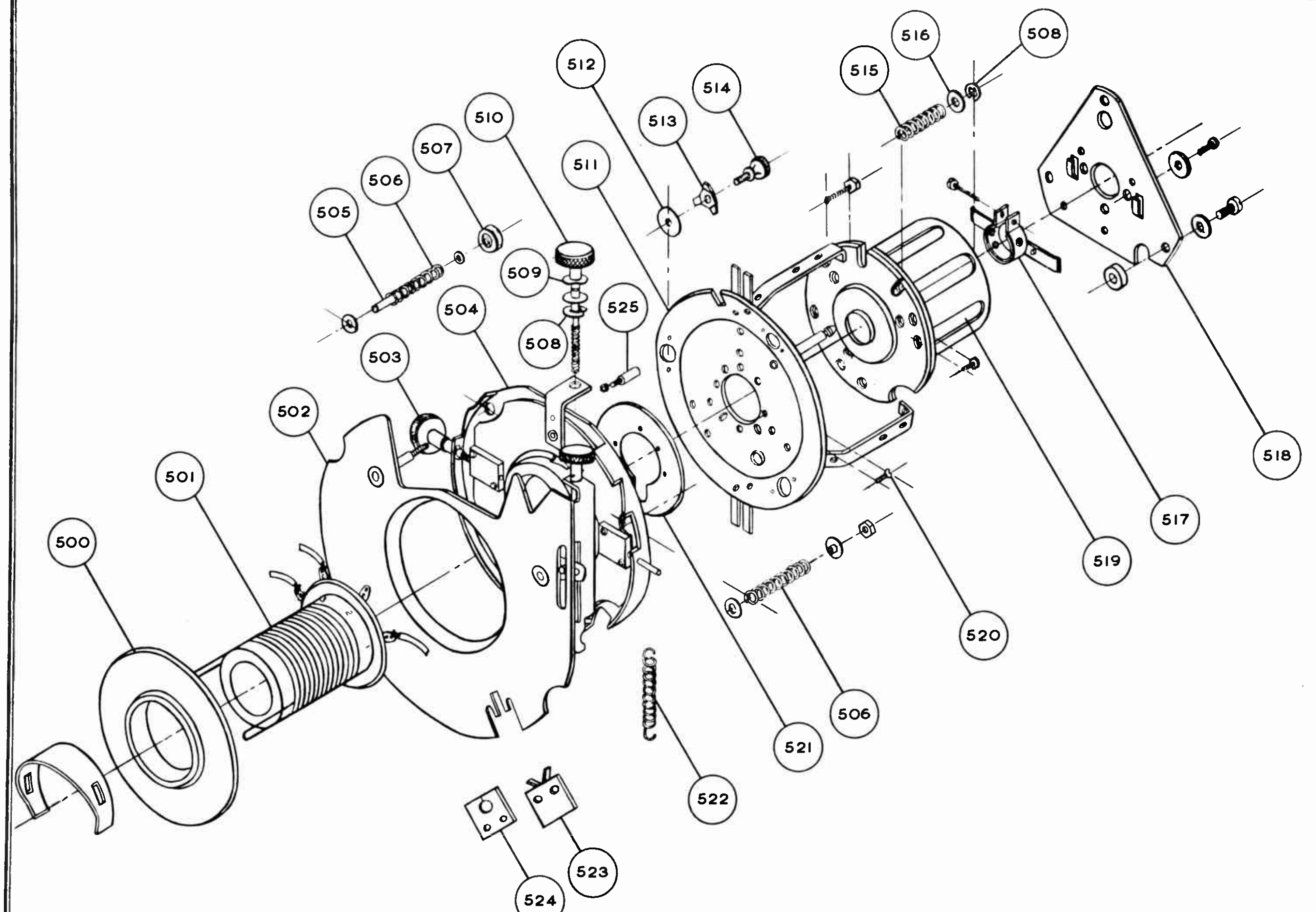

FIG. 2
EXPLODED VIEW OF TAILPIECE ASSEMBLY

REMOVAL AND RE-INSTALLING OF CHASSIS

In the event that complete overhaul service is required on this receiver, it is not necessary to remove the entire cabinet to the service shop. Each chassis can be removed independently and a final performance check of the receiver can be made by projecting the picture onto a flat white surface which is parallel to the plane surface of the corrector lens. This can be done by placing the Optical Box on its side with the top surface of the corrector lens 32 inches from the temporary projection surface. The "throw distance" of 32 inches is the projected picture distance when the Optical Box is properly installed in the cabinet.

If it can be determined that a particular receiver fault is in no way related directly to the High Voltage Power Supply, Deflection Yoke or Focus Coil, Picture Tube, Protector Tube or Auxiliary Power Supply, it will only be necessary to remove the TV chassis from the receiver for servicing. All stages on this chassis, with the exception of the 6SN7 Protector Tube (V21) and 6W4 Horizontal Damping Tube (V22), will be functioning and normal trouble shooting techniques can be applied. At such time as service is required on this receiver, careful analysis of the fault may eliminate unnecessary chassis removal.

TV CHASSIS (REMOVAL) — To remove TV chassis, disconnect auxiliary power supply cable, deflection yoke and focus cable, phone motor cable, speaker leads, AM loop antenna leads, phono pick-up plug, picture tube grid lead, picture tube socket and built-in TV antenna leads which are connected to TV antenna terminal strip. Unclip indicator lamp socket from bracket at base of cabinet. Also unscrew external FM antenna clip and external TV antenna terminal strip from cabinet frame. Remove back of shielded compartment on TV chassis by taking out 5 screws on rear surface.

All control knobs on front panel of receiver must be pulled off and the TV chassis can then be released by removing the four hold-down screws. Two of these screws are accessible from inside the record storage compartment and the other two are accessible from the rear. Before removing the chassis, be sure that all leads have been dressed so that they can be freely withdrawn from the cabinet with the chassis.

TV CHASSIS (RE-INSTALLATION) — When re-installing the chassis in the cabinet be sure that all leads and cables are properly routed. Special attention must be given to the picture tube grid lead which is to be routed independent of the picture tube cable. Failure to observe this precaution will result in deterioration of picture quality. Note that this lead is routed through the center partition wall and then to the picture tube socket.

Also be sure that the braided ground strap, connecting TV chassis to other units, is securely connected at each chassis.

AM-FM TUNER CHASSIS — Do not attempt to service this tuner assembly by using a separate power supply after removing it from the TV chassis. That would affect the tuned R.F. circuits and give incorrect results. If service is required on the AM-FM tuner, it should remain connected to the TV chassis for its power supply. Back cover plate of tuner may be removed to expose underside of tuner chassis. Where necessary, the AM loop antenna can be unscrewed from the center partition wall of the cabinet.

OPERATION OF PROTECTOR TUBE CIRCUIT

The acceleration of the electron beam in the picture tube is so great in this type of projection system that even a momentary failure of one or both of the sweep circuits will cause a burned spot to appear on the tube face. Consequently, a form of protection against such an occurrence has been devised through the use of the 6SN7GT Protector Tube V21. Referring to the circuit on page 1950-45, it will be noted that the plates of this dual triode tube are fed from the B+ developed in the Auxiliary Power Supply. The reason for this is to maintain the Protector Tube operative in the event of interruption of the TV chassis B+ system, as such interruption could cause failure of the sweep circuits. Since the Deflection Yoke can be disconnected from the sweep output, the picture tube face could be burned in the event that the receiver was inadvertently turned on with the deflection cable disconnected. To prevent this, the A.C. input to the Auxiliary Power Supply is also opened when the deflection yoke plug is disconnected. This interrupts the B+ to the High Voltage power supply and with no high voltage on the picture tube, the face cannot be burned.

Action of the 6SN7GT Protector Tube V21 is dependent upon positive sync pulses from both the horizontal and vertical sweep systems being fed to the grids of this tube. The positive horizontal sync pulse is taken from terminal 6 of the horizontal output transformer and fed through condenser 429 to grid pin 1 of the 6SN7GT (see circuit diagram page 19,20). These large positive pulses cause grid current to flow and the developed grid leak bias is sufficient to practically drive the triode to cut-off. This same action occurs on the other triode section which is fed by vertical sync pulses. In the absence of one or both of these pulses, the associated triode will pass a comparatively large current which causes the cathode voltage to become more positive. This positive voltage is fed to the cathode of the picture tube and biases it to cut-off so that the electron beam cannot burn the tube face.

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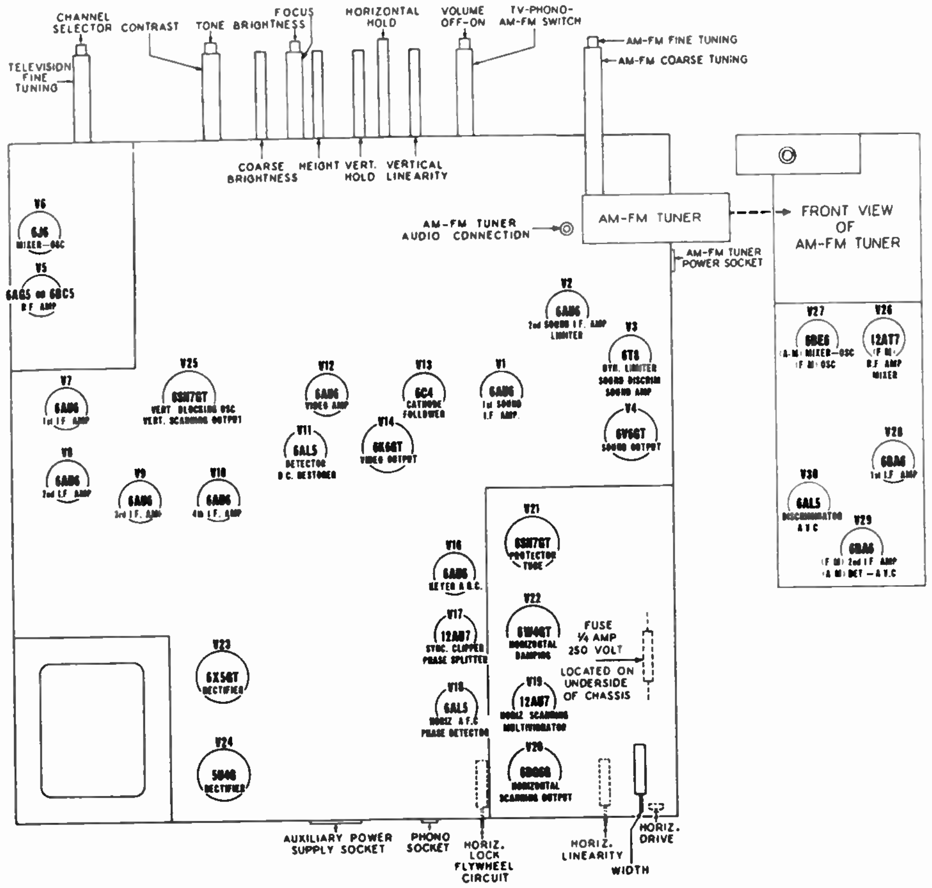
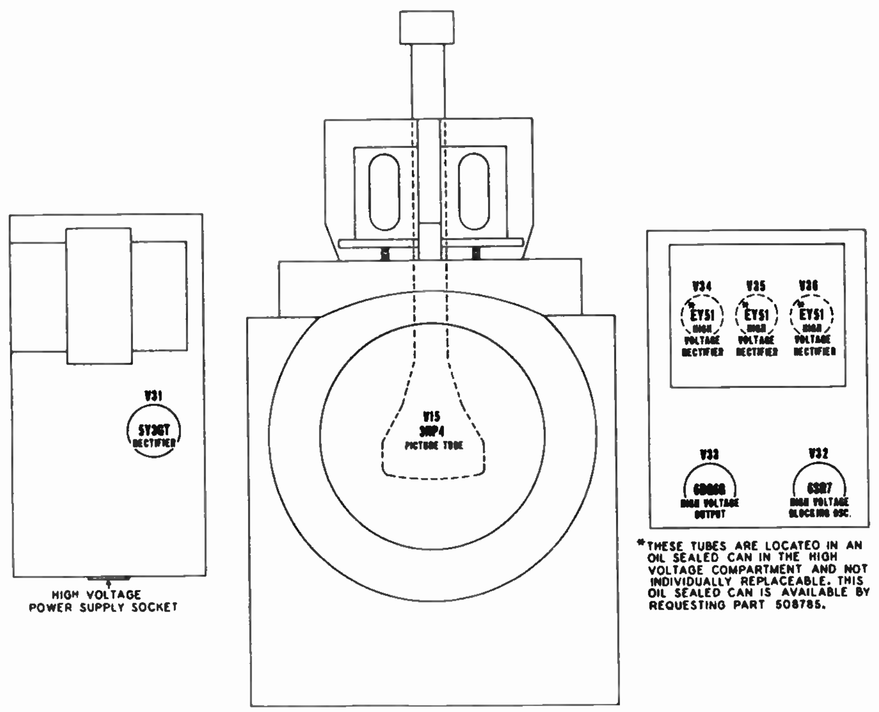


REAR OF RECEIVER CHASSIS



REAR OF PROJECTION SYSTEM CHASSIS

CAUTION

THE PICTURE TUBE is highly evacuated and if broken, glass fragments will be violently expelled. Scratching, chipping, undue pressure, or careless handling such as lifting the tube by its neck is dangerous and should be avoided. If it is necessary to handle the picture tube, use safety goggles and heavy gloves.

HIGH VOLTAGE (approximately 24,000) is produced in a supply circuit of this receiver. Exercise care to avoid contact with elements of this circuit and particularly the tube terminals which are labeled "CAUTION" in the adjoining voltage chart. If measurement of voltage at these points is necessary, see procedure given below under note "S".

THE HIGH VOLTAGE LEAD, which supplies approximately 24,000 volts to the picture tube, should be momentarily shorted to the chassis whenever it is disconnected for service purposes. This discharges the high voltage filter condensers and prevents a shock hazard when working on the receiver after it has been turned off.

INTERMEDIATE B+ VOLTAGES are dangerous and caution should be observed when the receiver chassis components are exposed for service purposes.

THE VOLTAGES SHOWN IN THE ADJOINING CHART WERE MEASURED UNDER THE FOLLOWING CONDITIONS

1.	Power Supply—117 volts 60 cycle AC.
2.	All voltages are measured between socket terminals and chassis unless otherwise indicated on adjoining chart.
3.	* Measurements made with voltmeter having sensitivity of 1000 ohms per volt except where indicated by (*). The (*) symbol designates a vacuum tube voltmeter measurement.
4.	Band Switch set to "TV" position unless otherwise indicated by the letters "X", "Y", or "Z" following voltages shown in adjoining chart.
5.	Antenna connected for reception of a television broadcast.
6.	Channel Selector and Fine Tuning Controls set for correct reception of a local station.
7.	All other controls set for "normal" reception of the transmitted signal unless the voltage shown on the chart is followed by letters indicating a special condition of measurement as outlined in step 8.
8.	Certain voltages were measured with two different settings of specific controls. It should therefore be understood that in these instances all controls, with the exception of one or two, were set for "normal" reception—letters following the voltage shown on the chart indicate the exceptions and are explained below.

EXPLANATION OF NOTES

A.	Vert. Hold max. counter-clockwise
B.	Brightness max. counter-clockwise (also set "Coarse" Brightness control fully clockwise).
C.	Contrast max. clockwise
D.	Horiz. Drive max. clockwise
E.	Horiz. Hold max. clockwise
F.	Focus Control max. clockwise
G.	Width max. counter-clockwise
H.	Height max. clockwise
J.	Horiz. Hold set for normal picture
K.	Horiz. Lock set for normal picture
L.	Channel Selector set to channel #9
M.	Vertical Linearity max. counter-clockwise
N.	Channel Selector set to channel #5
P.	This measurement should NOT be made with a conventional type voltmeter as circuit may break into oscillation due to coupling thru instrument leads; use a vacuum tube voltmeter with short leads.
Q.	This voltage measured with TV antenna terminals grounded.
R.	Do not attempt to measure the voltage at the tube cap. There is a high R. F. potential at this point.
S.	Exercise extreme care when undertaking measurement of this voltage. Use a voltmeter designed for measurement in the 25,000 volt range and be sure that the leads and probes are well insulated.
T.	Grounding of center stud on tube socket is necessary to reduce capacity coupling between other pins. Oscillation may result if this ground is omitted.
U.	This voltage will vary from +5.5 to —3.5 depending upon setting of Horizontal Hold Control and Horizontal Lock Control.
V.	This voltage measured with antenna disconnected and no signal input to receiver.
W.	This voltage will vary from —3.5 to —8.5 depending upon setting of Horizontal Hold Control and Horizontal Lock Control.
X.	Band Switch set to "AM" position, dial tuned to 540 Kc. and AM loop antenna leads grounded.
Y.	Band Switch set to "FM" position, dial turned to 88 Mc. and FM antenna terminal grounded.
Z.	Band Switch set to "PHO" position.

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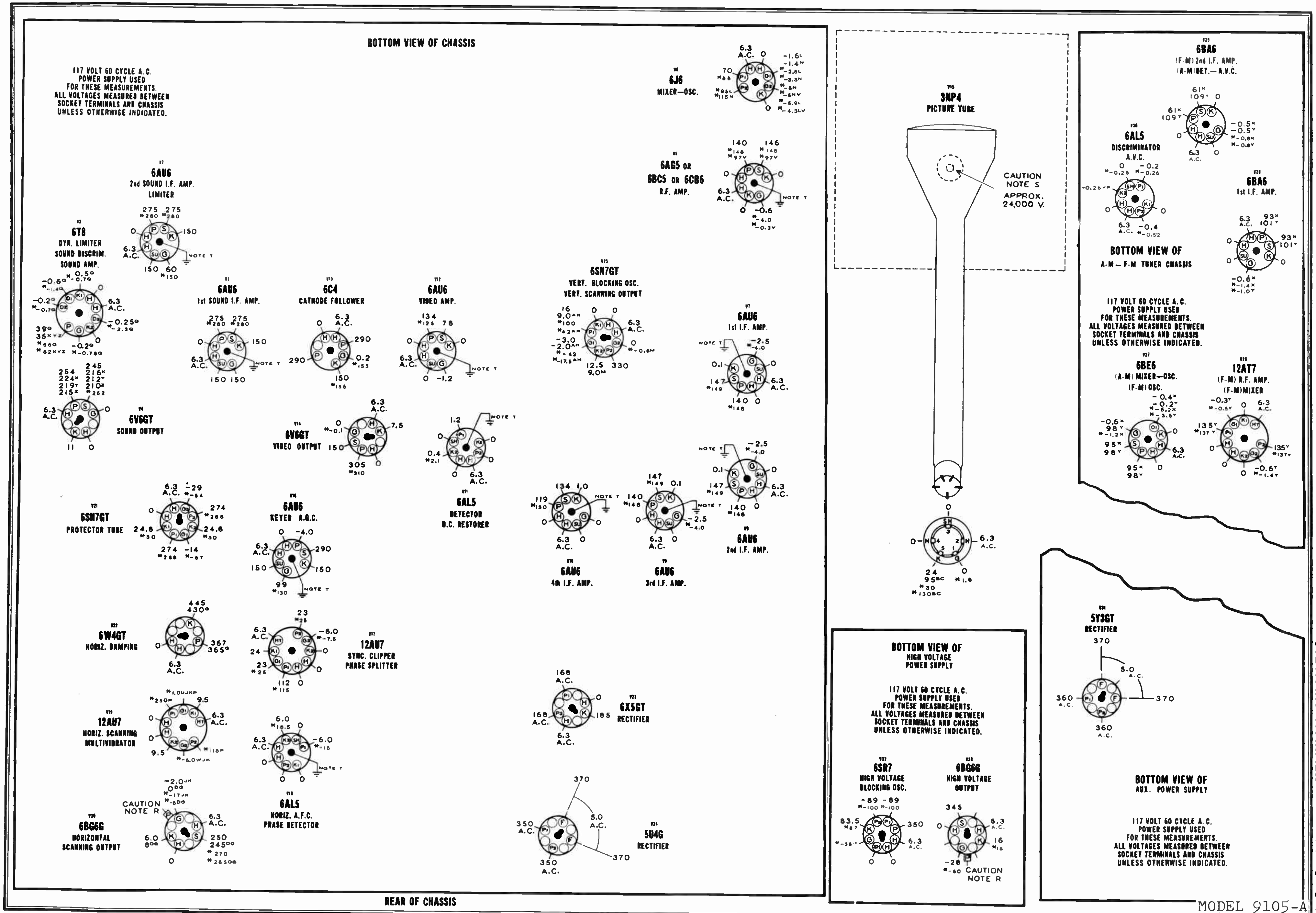

MODEL 9105-A

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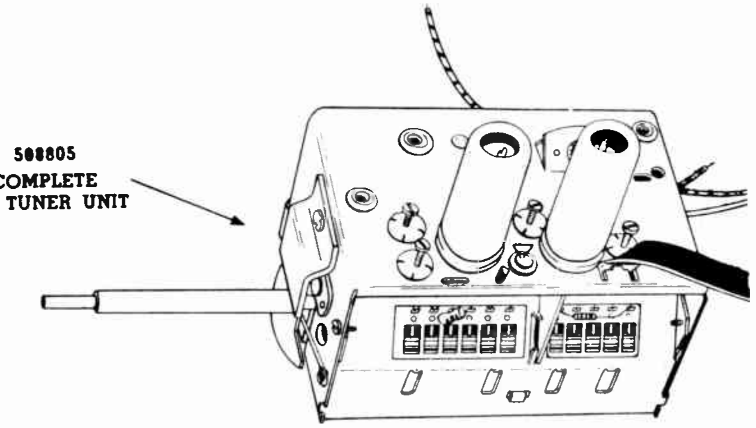
REPAIR DATA FOR 508805 RF TUNER UNIT

All replacement parts for the RF Tuner Unit are included in the complete receiver parts list.

This RF Tuner Unit consists of an RF amplifier stage (using 6AG5, 6BC5, or 6CB6 tube) and a mixer-oscillator stage (using 6J6 tube). Channel selection is accomplished by rotation of a turret assembly having 2 sets of snap-in coils for each of the 12 channels. The tuner also incorporates a Fine Tuning control.

Antenna Coils for each channel consist of a center-tapped primary and an RF amp. grid winding (secondary). The individual RF-Oscillator Coils include an RF amplifier plate section, a mixer grid section and an oscillator winding. Signal output from the mixer stage is coupled to the IF amplifiers through the input IF coil located on the tuner unit.

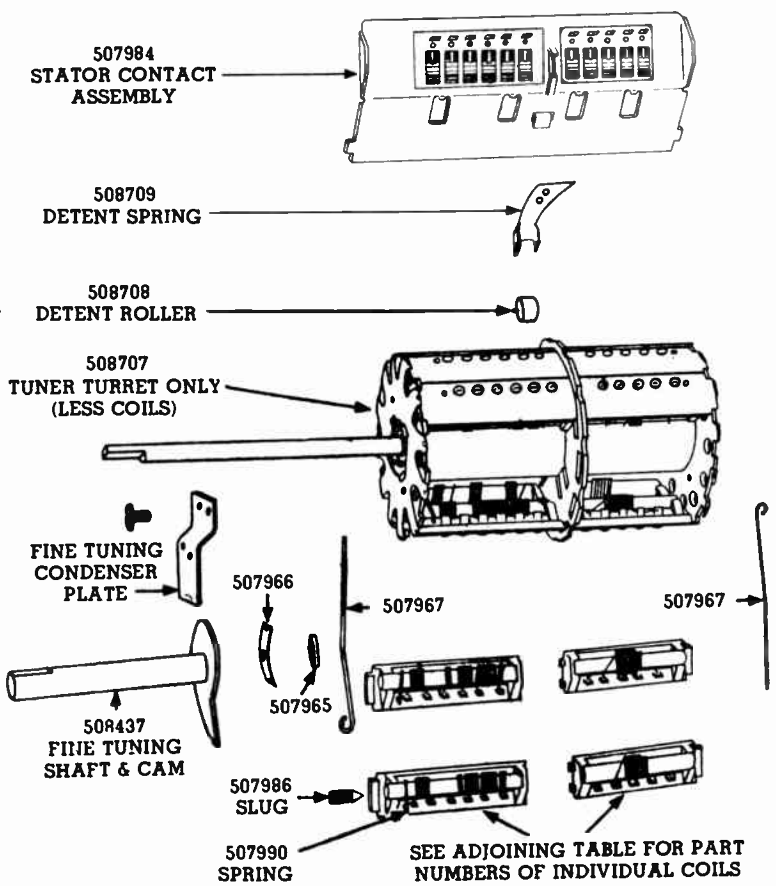


SERVICE PRECAUTIONS

SUBJECT	PRECAUTIONS
ELECTRICAL COMPONENTS	The high frequencies used in the RF section of a television receiver make it necessary that considerable care be exercised in servicing the tuner. Lead dress and location of components are very critical at these frequencies. When replacing parts, it is important to use components of identical electrical characteristics and physical size. Always reconnect the replacement item in the same location and position in the tuner as the original component.
TUBES	Replacement of tubes in the Tuner Unit may cause slight detuning of RF circuits due to inherent differences in inter-electrode capacitances. When replacing tubes (especially V6, 6J6 mixer-oscillator tube) make sure that Fine Tuning control will tune in television stations at approximately the middle of its range. It may be necessary to change the setting of the individual oscillator coil slugs for some channels to accomplish this.
CHANNEL COILS AND SLUGS	Channel Coils must be handled with care. Do not disturb coil windings. If an oscillator slug "falls into" its coil form during adjustment, remove the Channel Coil from the turret assembly and lift the Slug Retaining Spring aside. By tapping the coil form it should be possible to make the slug move toward the end so that its threads will be engaged by the Slug Retaining Spring when that spring is returned to its normal position.
FINE TUNING CONTROL	Rubbing of the bakelite Fine Tuning Cam against the Fine Tuning Condenser Plate is intentional in order to avoid vibration with resulting microphonics. However, the Fine Tuning Cam should not rub or contact the small circular plate located on the body of the tuner.

REMOVAL AND REPLACEMENT OF PARTS

ITEM	PROCEDURE
RF TUNER UNIT	To remove the Tuner Unit from receiver chassis, proceed as follows: 1. Remove metal plate which covers side of RF Tuner Unit nearest edge of chassis. This plate is held in place by two screws at side of chassis. 2. Remove channel selector dial lamp socket. 3. Remove support bracket which positions front of Tuner Unit and also remove screws which hold tuner to rear support bracket. 4. Disconnect the leads from the tuner to the main chassis. See illustration on page 1950-45 (circuit diagram page) showing tuner connections. After the Tuner Unit is replaced, make sure that channel selector dial lamp socket is correctly positioned so that channel selector knob will be properly illuminated.
CHANNEL COILS	Insert a screwdriver blade between Coil Retainer Spring and the end of the Tuner Turret. Twist the blade to pull spring away from the molded body of Channel Coil. Lift this end of coil body upward and remove individual coil assembly from tuner. When replacing Channel Coils, be sure they are reinstalled in their correct positions. Coil numbers should increase consecutively in a counter-clockwise direction when tuner is viewed from the front. If all the Channel Coils have been removed from the Tuner Turret, rotate turret until flat surface on end of tuner shaft points down. Install #3 Channel Coils into bottom position on turret. Then follow the correct sequence indicated above to replace other coils.
TUNER TURRET ASSEMBLY	To remove turret from RF Tuner Unit, proceed as follows: 1. Remove tuner from receiver chassis. 2. Remove rear Turret Shaft Retaining Spring by disengaging straight end of spring from projection on tuner. 3. Remove Fine Tuning Condenser Plate from front of Tuner Unit. This plate forms one side of Fine Tuning control condenser and is held in place by one screw. 4. Slide Fine Tuning Cam and Brass Shaft off of main Channel Selector Shaft. 5. Remove Contactor Washer Spring and Fiber Spacer Washer from Channel Selector Shaft. 6. Remove Shaft Retaining Spring at front of tuner by disengaging straight end of spring from projection on case. 7. Remove turret assembly from case. To replace turret, reverse the above procedure. Tooth on bakelite Fine Tuning Cam should point downward during assembly so that it does not become locked between the stops on the Fine Tuning Condenser Plate.
STATOR CONTACT ASSEMBLY	To remove this assembly, proceed as follows: 1. Remove the two screws at the front and rear of the Stator Contact Assembly. 2. Unsolder all electrical connections to contact plate. 3. Unsolder five soldered joints between Stator Contact Assembly and Tuner Unit. 4. Contact Assembly may now be withdrawn from case. To reinstall this assembly: 1. Place Stator Contact Assembly in position and replace, but do not tighten, the two screws at the front and rear of the assembly. 2. Remove 3 consecutive pairs of Channel Coils from the turret (for example, the antenna and rf-osc. coils for channels #5, 6 and 7). 3. Position Tuner Turret so that the edges of the next highest Channel Coils (in this case, the coils for channel #8) just pass the row of 11 contacts on the Stator Contact Assembly. 4. Adjust position of the Stator Contact Assembly so that there are a few thousandths of an inch spacing between the contacts on the contact plate and the molded body of the Channel Coils. 5. The Contact Assembly is now correctly positioned and screws at front and rear may be tightened. 6. Solder Stator Contact Assembly to tuner frame at same points that were used previously. 7. Make all electrical connections to contact plate. 8. Replace Channel Coils.



CHANNEL NUMBER	ANTENNA COIL PART NUMBER	RF & OSC COIL PART NUMBER
2	507952	507972
3	507953	507973
4	507954	507974
5	507955	507975
6	507956	507976
7	507957	507977
8	507958	507978
9	507959	507979
10	507960	507980
11	507961	507981
12	507962	507982
13	507963	507983

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ALIGNMENT PROCEDURE

Alignment of all RF and IF tuned circuits in this receiver may be accomplished by utilizing the procedures described in the following charts.

SEQUENCE OF ALIGNMENT: These procedures should preferably be applied in the order in which they are presented, however, alignment of RF or IF channels for either AM, FM or TV may be accomplished individually if desired.

The Television RF Amplifier and Mixer alignment may also be accomplished independent of the Television IF Channel alignment, but oscillator calibration can only be done after IF Channel has been correctly aligned. Proper IF band pass characteristic is necessary for oscillator alignment as results of circuit tuning are observed by means of an oscilloscope connected to the output of the video detector stage.

REMOVAL OF CHASSIS: The TV receiver chassis must be removed from the cabinet in order to accomplish alignment of all tuned circuits, as there are adjustment points located on the underside of the chassis and at the front of the AM-FM Tuner. Complete instrument alignment of the TV chassis can be accomplished without interconnection to any of the other units—do not remove other chassis unnecessarily.

To remove TV chassis, disconnect auxiliary power supply cable, deflection yoke and focus cable, phono motor cable, speaker leads, AM loop antenna leads, phono pick-up plug, picture tube grid lead, picture tube socket and built-in TV antenna leads which are connected to TV antenna terminal strip. Unclip indicator lamp socket from bracket at base of cabinet. Also unscrew external FM antenna clip and external TV antenna terminal strip from cabinet frame. Remove back of shielded compartment on TV chassis by taking out 5 screws on rear surface.

All control knobs on front panel of receiver must be pulled off and the TV chassis can then be released by removing the four hold-down screws. Two of these screws are accessible from inside the record storage compartment and the other two are accessible from the rear. Before removing the chassis, be sure that all leads have been dressed so that they can be freely withdrawn from the cabinet with the chassis.

INSTRUMENTS: The following instruments will be required as signal sources and output indicators during the alignment process. Since accurate alignment of a television receiver is heavily dependent upon the performance of your instruments, it is imperative that they meet the essential specifications described here.

1. **STANDARD SIGNAL GENERATOR** to provide signals at the following frequencies. Maximum output on all ranges should be at least .1 volt with provision for attenuation as desired. This instrument must have good frequency stability and be accurately calibrated. Generators which incorporate a separate crystal controlled oscillator and heterodyne circuit are self calibrating and therefore capable of providing the accuracy of frequency calibration required for television circuit alignment.

   A. IF Frequencies:

   455 Kc. (400 cycle amplitude modulated) for AM IF.
   4.5 Mc. (Unmodulated) for TV Sound.
   4.5 Mc. (400 cycle amplitude modulated) for TV Sound.
   10.7 Mc. (Unmodulated) for FM IF.
   22.25 Mc. (Unmodulated) marker for TV Sound IF carrier.
   22.4 Mc. (Unmodulated) for TV IF Trap.
   23.5 Mc. (Unmodulated) for TV 1st and 3rd IF
   24.75 Mc. (Unmodulated) for TV 4th IF (on chassis equipped with 508075 RF Tuner).
   25.0 Mc. (Unmodulated) for TV 4th IF (on chassis equipped with 508080 RF Tuner).
   26.1 Mc. (Unmodulated) for TV Converter and 2nd IF (on chassis equipped with 508080 RF Tuner).
   26.6 Mc. (Unmodulated) for TV Converter and 2nd IF (on chassis equipped with 508075 RF Tuner).
   26.75 Mc. (Unmodulated) marker for TV Picture IF carrier.

   B. RF Frequencies:

   550 to 1600 Kc. (400 cycle amplitude modulated) for AM RF.
   54 to 88 Mc. (Unmodulated) for TV RF.
   88 to 108 Mc. (400 cycle amplitude modulated) for FM RF.
   174 to 216 Mc. (Unmodulated) for TV RF.

2. **RF SWEEP GENERATOR** to provide frequency modulated signals at the following frequencies:

   10.7 Mc. with 300 Kc. sweep width.
   20 to 30 Mc. with 10 Mc. sweep width.
   54 to 88 Mc. with 10 Mc. sweep width.
   174 to 216 Mc. with 10 Mc. sweep width.

   Output adjustable with at least .1 volt maximum.

   Output should be "flat" (no amplitude variation) for all settings of the sweep width control.

   Provision for connection of generator sweep modulating voltage to horizontal deflection system of an oscilloscope.

   Provision for blanking the output signal on each return sweep so that oscillogram will not show retrace.

3. **CATHODE RAY OSCILLOSCOPE**, preferably a unit with vertical amplifier having wide range frequency response and low capacity pick-up probe.

4. **VACUUM TUBE VOLTMETER.** The lowest voltage range of this instrument should preferably permit a 1.0 volt reading to be indicated at not less than one third of full scale deflection.

5. **OUTPUT METER**, preferably a unit equipped with an impedance matching network that will present a 3.2 ohm load when connected to secondary of audio output transformer.

INSTRUMENT CONNECTIONS: The method of connection, including details of matching and coupling networks, for instruments used in this alignment procedure is given in several illustrations on subsequent pages. Specific instructions for each instrument application will also be found in various sections of the alignment charts.

IMPORTANT

AVOID EXCESSIVE INPUT SIGNAL WHEN USING OSCILLOSCOPE AS ALIGNMENT INDICATOR.

When observing the receiver band pass characteristic on an oscilloscope, it is exceedingly important to avoid distortion of that characteristic which would occur when using a large input signal from the sweep generator or standard generator (marker signal). Always set attenuator on sweep generator so that the reading on the vacuum tube voltmeter does not exceed one volt (when meter is connected from high side of video detector load resistor, symbol 139, to receiver chassis). Standard generator output should also be attenuated so that marker signal does not pull or tear the band pass characteristic as shown on the scope.

CHECKING SYNCHRONIZATION OF BAND SWITCHES ON AM-FM TUNER AND TV CHASSIS.

Note that the band switch on the AM-FM Tuner chassis is mechanically coupled (by a link arm and lever clamp arrangement) to the band switch on the TV chassis. Do not operate these switches by direct pressure on the link arm—always use a control knob attached to the TV switch shaft. If the mechanical linkage is forced or slips at the clamp on the TV switch shaft so that both switches get out of step, they can be re-synchronized as follows:

1. Loosen screw in actuating lever clamp on TV band switch shaft.
2. Turn both switches to extreme clockwise position and be sure that they detent properly at that position.
3. Retighten screw in actuating lever clamp on TV band switch shaft.

BROADCAST BAND—"AM"—ALIGNMENT PROCEDURE

1. After the entire chassis assembly has been removed from the cabinet, remove the AM loop antena and reconnect it to the AM antenna leads extending from the AM-FM tuner chassis. Then wind one turn of insulated wire around frame of loop antenna so as to provide a means of coupling it to the signal generator. Connect one end of coupling turn to receiver chassis and allow other end to remain open until otherwise instructed in the following chart. Space loop antenna same distance away from the chassis as when assembled in the cabinet.
2. Reconnect the speaker to the two audio output leads extending from the main chassis. **IMPORTANT:** Do not confuse these leads with the two loop antenna leads.
3. Replace **AM-FM Coarse and Fine Tuning knobs and rotate Fine Tuning knob to its extreme counter-clockwise position. At this setting, the gang condenser should be fully meshed and the heavy line next to 5.5 on the dial scale should be pointing straight up; if they are not, loosen the set screws in the hub of the dial drum on the gang condenser and close gang plates manually; also, position the dial scale correctly. Then tighten set screws in hub of dial drum.**
4. The Control Panel Escutcheon at the front of the cabinet normally provides a "position indicator" for the **AM-FM** dial scale, however, when the chassis is removed from the cabinet it becomes necessary to install a "temporary pointer." That can be readily accomplished by binding a piece of heavy wire around the planetary drive support brackets and shaping the free end of the wire so that it can be placed in a vertical position (pointing downward) between the dial knob and the lamp behind it (wire will then cast a shadow on the dial scale and show the frequency to which the receiver is tuned.

   With the gang condenser fully meshed, the "temporary pointer" should appear directly behind the heavy line preceding 5.5 on the dial scale.
5. **IMPORTANT:** Do not remove the metal bottom plate of AM-FM tuner chassis. Holes are provided for access to IF transformer tuning slugs. Removal of the bottom plate during alignment of the RF circuits will result in detuning when the plate is replaced.
6. Connect output meter across the speaker voice coil.
7. Connect ground lead of signal generator to the receiver chassis.
8. Set volume control to the maximum volume position and use a weak signal from the signal generator.
9. Set tone control to its extreme clockwise position.
10. Set band switch to the "AM" position.
11. After alignment procedure is completed and chassis and loop have been reinstalled in cabinet, arrange leads to loop so that they are separated from each other as much as possible avoid twisting, taping or extending these leads.

DUMMY ANT. IN SERIES WITH SIGNAL GENERATOR	CONNECT HIGH SIDE OF SIGNAL GENERATOR TO	SIGNAL GENERATOR FREQUENCY	RECEIVER DIAL SETTING	TRIMMER OR SLUG NUMBER	TRIMMER DESCRIPTION	TYPE OF ADJUSTMENT
.1 MFD. Condenser	Lug on trimmer #24 at bottom of gang (see figure 1 for location of trimmer).	455 KC	Any point where it does not affect the signal.	19 and 20	2nd I.F.	Adjust for maximum output. Then repeat adjustment.
				21 and 22	1st I.F.	
200 MMF. Mica Condenser	Coupling turn on loop antenna.	1500 KC	1500 KC	23	AM Oscillator. This trimmer is accessible thru small hole in bottom of TV chassis.	Adjust for maximum output.
		1500 KC	Tune to 1500 Kc. generator signal.	24	AM Antenna	Adjust for maximum output.
200 MMF. Mica Condenser	Coupling turn on loop antenna.	600 KC	Tune to 600 Kc. generator signal.	25	Adjustable core of AM Antenna Coil.	Adjust for maximum output.

Repeat adjustment of trimmers 24 and 25 until one no longer detunes the other.

FREQUENCY MODULATION—"FM"— ALIGNMENT PROCEDURE

1. After the entire chassis has been removed from the cabinet, replace AM-FM Coarse and Fine Tuning knobs and rotate Fine Tuning knob to its extreme counter-clockwise position. At this setting, the gang condenser should be fully meshed and the heavy line next to 88 on the dial scale should be pointing straight up; if they are not, loosen the set screws in the hub of the dial drum on the gang condenser and close gang plates manually; also, position the dial scale correctly. Then tighten set screws in hub of dial drum.
2. The Control Panel Escutcheon at the front of the cabinet normally provides a "position indicator" for the AM-FM dial scale, however, when the chassis is removed from the cabinet it becomes necessary to install a "temporary pointer." That can be readily accomplished by binding a piece of heavy wire around the planetary drive support brackets and shaping the free end of the wire so that it can be placed in a vertical position (pointing upward) between the dial knob and the lamp behind it (wire will then cast a shadow on the dial scale and show the frequency to which the receiver is tuned).

   With the gang condenser fully meshed, the "temporary pointer" should appear directly behind the heavy line next to 88 on the dial scale.

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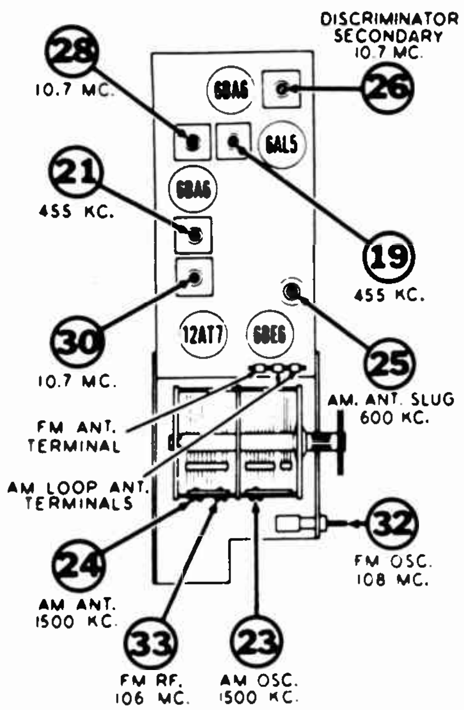
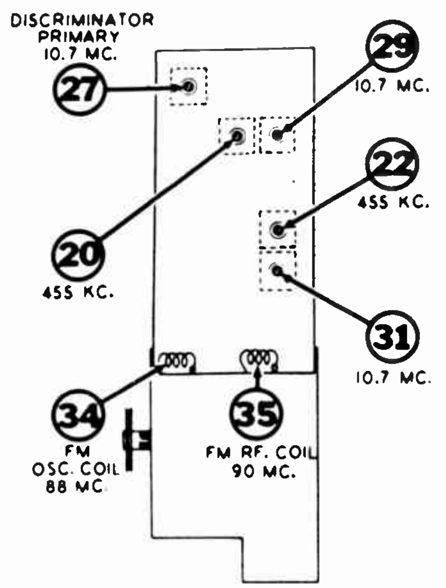
TRIMMER AND SLUG LOCATIONS FOR AM-FM TUNER ALIGNMENT



TOP VIEW

FIG. 1
AM-FM Tuner Chassis



BOTTOM VIEW

FIG. 2
AM-FM Tuner Chassis

INSTRUMENT CONNECTIONS FOR FM ALIGNMENT PROCEDURE

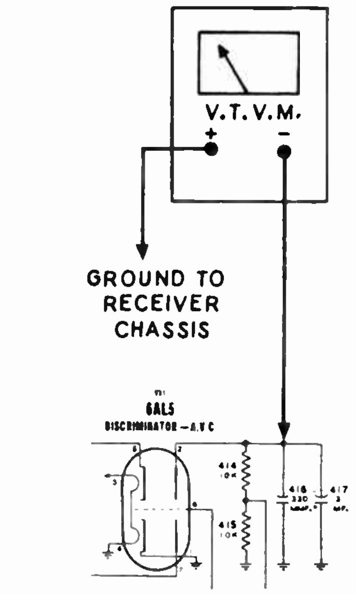


FIG. 3
VTVM Connections for FM Sound IF Alignment

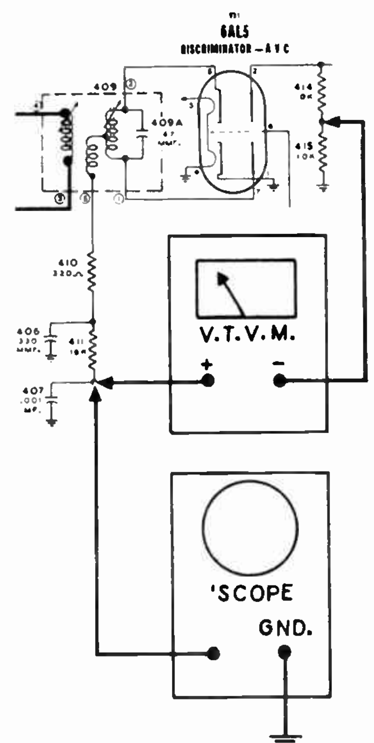
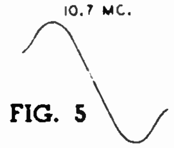


FIG. 4
VTVM and Oscilloscope Connections for FM Sound Discriminator Alignment

FREQUENCY MODULATION—"FM"—ALIGNMENT PROCEDURE

3. Reconnect the speaker to the two audio output leads extending from the main chassis. **IMPORTANT:** Do not confuse these leads with the two AM loop antenna leads.
4. Remove bottom plate from AM-FM tuner during IF alignment but replace it before starting alignment of RF circuits. **DO NOT REMOVE the AM-FM tuner chassis from the TV chassis during alignment.**
5. Set band switch to the "FM" position.
6. Set volume control to the maximum volume position and use a weak signal from the signal generator.
7. Set tone control to its extreme clockwise position.
8. Dress FM circuit leads as short and straight as possible, particularly those in the oscillator circuit. IF plate and grid leads should also be kept short and straight.

STANDARD SIGNAL GENERATOR		SWEEP GENERATOR		VTVM OR OUTPUT METER CONNECTION	OSCILLOSCOPE CONNECTIONS	RECEIVER DIAL SETTING	TRIMMER OR SLUG NUMBER	TYPE OF ADJUSTMENT AND OUTPUT INDICATION
CONNECTIONS	FREQUENCY	CONNECTIONS	FREQ.					
Connect high side to lug on trimmer #33 (see Fig. 1 for location of trimmer) using a .01 Mfd. condenser in series with generator lead. Connect ground lead to the receiver chassis in vicinity of gang condenser.	**10.7 MC.** Unmodulated	Not used.	—	Connect VTVM as shown in Fig. 3.	Not used.	Any position where it does not affect the signal.	#26 Discriminator secondary; #27 Discriminator primary; #28—29 2nd IF; #30—31 1st IF	Adjust these trimmers for maximum meter reading — the output voltage will be of negative polarity.
Same as above.	Same as above.	Not used.	—	Connect VTVM as shown in Fig. 4.	Not used.	Same as above.	#26 Discriminator secondary	Note that as slug #26 is rotated, a point will be found where the voltmeter will swing rather sharply from a positive to a negative reading or vice versa. The correct setting is obtained when the meter reads zero as the slug is moved thru this point.
Same as above.	Same as above. — Attenuate signal to prevent overload and distortion of response curve.	Connect high side to lug on trimmer #33 (see Fig. 1 for location of trimmer) using a .01 Mfd. condenser in series with generator lead. Connect ground lead to the receiver chassis in vicinity of gang condenser.	**10.7 MC** Sweeping ±300 Kc.	Not used.	Connect as shown in Fig. 4. — Set vertical amplifier of 'scope for maximum amplification. — Synchronize oscilloscope with sweep generator by connecting "horizontal input" terminals of 'scope to source of horizontal sweep modulating voltage on the sweep generator.	Same as above.	#26 Discriminator secondary	A pattern similar to that shown in Fig. 5 should appear on the oscilloscope screen. Check for symmetry about the 10.7 Mc. center point and linearity of the slope.  10.7 MC. FIG. 5 If the characteristic is not shaped properly, attempt to obtain symmetry by changing the setting of slug #26. Should that fail to produce the desired results, then a slight readjustment of slugs #27, 28, 29 30 and 31 should be undertaken.

IMPORTANT: Before starting alignment of the RF and Oscillator circuits, be sure to replace the bottom plate on the AM-FM Tuner chassis. Failure to observe this requirement would result in detuning if plate were replaced after alignment is completed.

Connect high side in series with a 270 ohm carbon resistor to FM antenna terminal near gang condenser (see Fig. 1) Connect ground lead to receiver chassis.	**108 MC.** with 400 cycle AM Modulation.	Not used.	—	Connect OUTPUT METER across speaker voice coil.	Not used.	108 Mc.	#32 FM Oscillator	Set trimmer #32 to receive 108 Mc. signal as indicated by maximum meter reading.
Same as above.	**106 MC.** with 400 cycle AM Modulation.	Not used.	—	Same as above.	Not used.	Tune to 106 Mc. generator signal.	#33 FM RF	Adjust trimmer for maximum meter reading.

Check calibration and tracking of receiver with input signals of 88, 90 and 106 MC. If difference between dial pointer setting and the above mentioned frequencies does not exceed ±0.3 MC. and RF circuit is tracking properly, then alignment may be considered satisfactory and no further adjustment is necessary.
Where the calibration error is greater than ±0.3 MC. it is advisable to make the following adjustments:
Tune receiver to an 88 MC. signal and note whether dial pointer is above or below correct calibration point. Then tune receiver so that dial pointer is at the 88 MC. position. If generator signal was previously received at a setting above 88 MC., it will be necessary to slightly spread the windings of the FM oscillator coil (#34 in Fig. 2) so that signal will now be received at the correct dial setting. On the other hand, if generator signal was received at a dial setting below 88 MC., then slightly compress the windings of the oscillator coil until the signal comes in at the correct calibration point.
Check calibration at 108 MC. and if it is in error by more than ±0.3 MC., readjust setting of trimmer #32. Repeat calibration adjustment at 88 and 108 MC. until desired accuracy is obtained.
Observe dial calibration at 106 MC. If it is found to be incorrect by an appreciable amount, then make a very slight adjustment in the spacing of the gang condenser plates to receive the 106 MC. signal at the correct dial setting. Then check adjustment of RF trimmer #33 to obtain maximum output indication at 106 MC.

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TELEVISION SOUND CHANNEL ALIGNMENT PROCEDURE

1. Short antenna terminals together with a jumper wire.
2. Turn the band switch to "TV" position and set receiver Channel Selector to any inactive television channel; other controls may be left at any desired setting.
3. No special aligning tool is required to adjust the cores in the Sound IF and discriminator transformers. The blade of a small screwdriver will fit the slot in these cores, however, the screwdriver should be of a non-metallic or insulated type to prevent detuning when inserted in the transformer can.

STANDARD SIGNAL GENERATOR CONNECTIONS	STANDARD SIGNAL GENERATOR FREQUENCY	VTVM CONNECTIONS	MISCELLANEOUS INSTRUCTIONS	TRIMMER OR SLUG	TYPE OF ADJUSTMENT AND OUTPUT INDICATION
Connect as shown in Fig. 7.	**4.5 MC.** unmodulated. **IMPORTANT** This signal must be accurate within ¼ of 1% of 4.5 Mc. Check generator calibration against a crystal controlled signal source by "zero beating" (heterodyning) with harmonics of the crystal frequency.	Connect as shown in Fig. 8.	**IMPORTANT** Unsolder lead connected to terminal "T" of Horizontal Linearity coil (see Fig. 6). This will make the horizontal sweep system of the receiver inoperative so that the sweep voltage will not be picked up by stray coupling to leads of instruments used during Sound Channel alignment. Such coupling would otherwise result in spurious oscillation.	**#1** TV Sound Discriminator Secondary	Adjust for maximum reading on VTVM.
				#2 TV Sound Discriminator Primary	Adjust for maximum reading on VTVM.
				#3 2nd TV Sound IF Secondary	Adjust for maximum reading on VTVM.
				#4 2nd TV Sound IF Primary	Adjust for maximum reading on VTVM.
				#5 1st TV Sound IF Secondary	Adjust for maximum reading on VTVM.
				#6 1st TV Sound IF Primary	Adjust for maximum reading on VTVM.
Same as above.	Same as above.	Connect as shown in Fig. 9.	Same as above.	**#1** TV Sound Discriminator Secondary	Note that as slug #1 is rotated, a point will be found where the voltmeter will swing rather sharply from a positive to a negative reading or vice versa. The correct setting of slug #1 is obtained when the meter reads zero as the slug is moved thru this point.

REDUCTION OF INTERCARRIER BUZZ

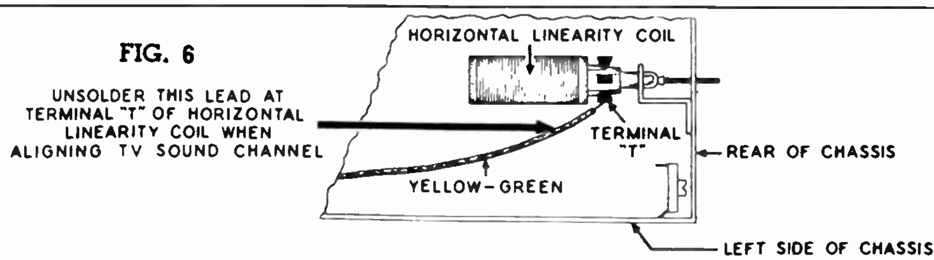
Slight "dynamic" unbalance of the discriminator secondary can emphasize intercarrier buzz due to incomplete amplitude modulation rejection. Therefore it is vitally important to obtain an accurate setting of the discriminator secondary slug in the presence of an amplitude modulated signal, as outlined below.

Same as above.	**4.5 MC.** 400 cycle amplitude modulated	Not used.	Same as above. Turn up Volume control until 400 cycle signal can be heard.	**#1** TV Sound Discriminator Secondary	Note that as slug #1 is rotated, a point will be found where the sound volume changes rapidly from maximum to minimum and back to maximum again. The discriminator secondary slug is correctly positioned when this "dip" in volume is reached. Do not confuse the "dip" point with a gradual reduction in volume that occurs when the circuit is considerably detuned.

Resolder lead previously disconnected from terminal "T" of Horizontal Linearity coil (see Fig. 6).

Disconnect all instruments and then connect an antenna to the receiver to obtain program reception from a local station. If intercarrier buzz is still prominent, a slight readjustment of the discriminator secondary slug (#1) should be made to obtain the "dip" point for the buzzing sound. Note that program sound will be clear and free from distortion at this point. Buzz should now be at an acceptable minimum if station transmission is not at fault.

FIG. 6



INSTRUMENT CONNECTIONS FOR IF CHANNEL ALIGNMENT

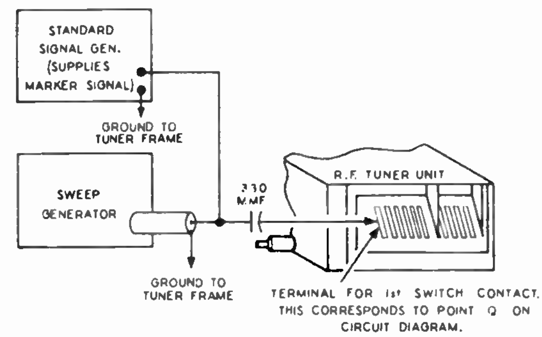


FIG. 10
Generator Connections for Television IF Channel Alignment

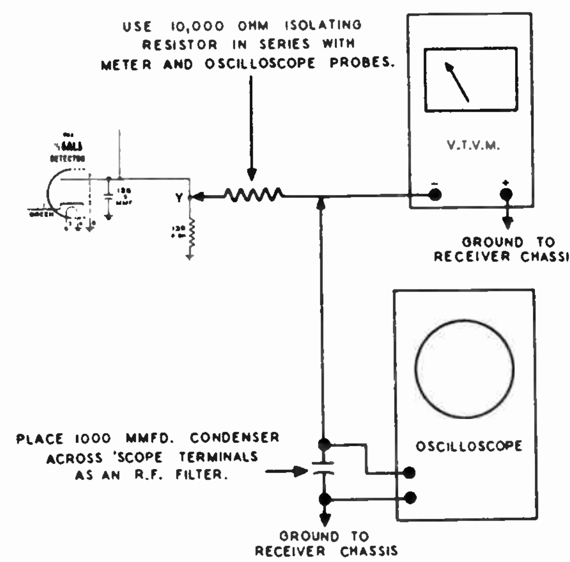


FIG. 11
VTVM and Oscilloscope Connections for Television IF Channel Alignment

INSTRUMENT CONNECTIONS FOR SOUND CHANNEL ALIGNMENT

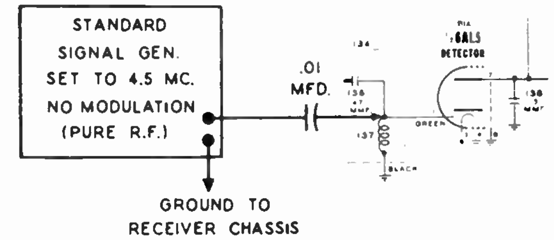


FIG. 7
Generator Connections for Television Sound Channel Alignment

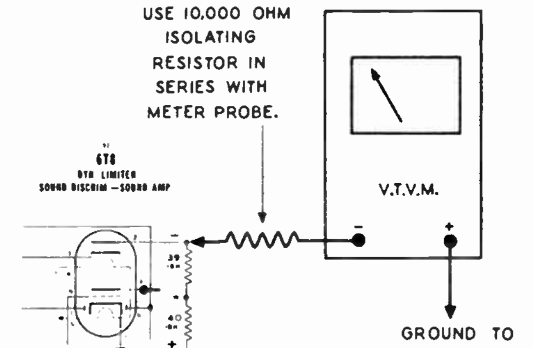


FIG. 8
VTVM Connections for Television Sound IF Alignment

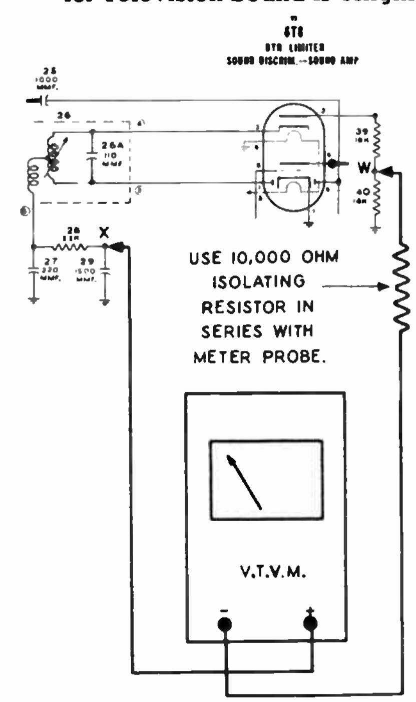


FIG. 9
VTVM Connections for Television Sound Discriminator Alignment

MODEL 9105-A

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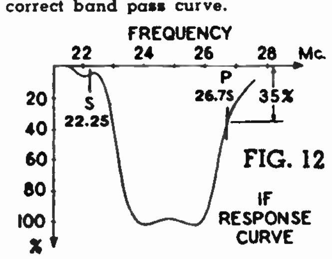
TELEVISION IF CHANNEL ALIGNMENT PROCEDURE

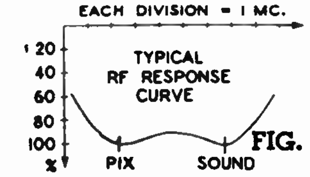
1. A special aligning tool designed to fit the stems on adjustable cores of the IF coils (see points 8, 9, 10 and 11 in Fig. 19) is available and may be obtained from Stewart-Warner by requesting IF Alignment Tool #507479.
2. Turn receiver Channel Selector to television channel #12 and short antenna terminals together with a jumper wire.
3. Turn the band switch to the "TV" position.
4. Remove metal plate which covers side of RF tuner unit nearest edge of chassis. This plate is held in place by two screws on the side of the chassis.
5. Connect a 1½ volt battery to the receiver AGC system so that negative terminal of battery connects to the AGC line and positive terminal of battery connects to receiver chassis. See Fig. 20 for convenient point of connection.
6. Note location of IF Trap Coil #12 by referring to Fig. 20. Before undertaking the alignment of any of the IF stages, Trap Coil #12 must be detuned so that it does not resonate in the IF pass band. Detuning is accomplished by merely compressing the windings so that they are closely spaced. Failure to detune the Trap Coil can cause the IF system to become regenerative thereby preventing alignment.
7. If the IF channel is badly misaligned and two or more immediately adjoining IF stages are tuned to the same frequency, oscillation may occur. Such oscillation shows up as a voltage across the video detector load resistor, symbol 139, and is indicated by the VTVM that is connected to this point during alignment. It should be noted that voltage due to IF oscillation is unaffected by strength of signal from the generator.

Where IF oscillation is encountered, it is generally possible to correct the condition by detuning the IF coils in different directions. If that does not have the desired effect, increase fixed bias on AGC line by using a 3 or 4½ volt battery instead of the 1½ volt battery referred to in instruction #5. After stopping the oscillation in this manner it will then be possible to align all IF stages using the following procedure, however, the AGC bias battery must be changed back to 1½ volts when using the oscilloscope to observe band pass characteristic. Once all stages have been aligned using the 3 to 4½ volt bias, the IF channel should be stable with reduced bias.

STANDARD SIGNAL GENERATOR		SWEEP GENERATOR		VTVM CONNECTIONS	OSCILLOSCOPE CONNECTIONS	MISCELLANEOUS INSTRUCTIONS	TRIMMER OR SLUG	TYPE OF ADJUSTMENT AND OUTPUT INDICATION
CONNECTIONS	FREQUENCY	CONNECTIONS	FREQ.					
Connect as shown in Fig. 10.	26.1 MC.	Use a 330 Mmf. isolating condenser and connect as shown in Fig. 10 but keep power switch turned off during this step.	—	Connect as shown in Fig. 11	Not used.	—	#7 Converter plate coil	Adjust for maximum reading on VTVM.
							#8 2nd I.F.	Adjust for maximum reading on VTVM.
Same as above.	25.0 MC.	Same as above.	—	Same as above.	Not used.	—	#9 4th I.F.	Adjust for maximum reading on VTVM.
Same as above.	23.5 MC.	Same as above.	—	Same as above.	Not used.	—	#10 1st I.F.	Adjust for maximum reading on VTVM.
							#11 3rd I.F.	Adjust for maximum reading on VTVM.
Same as above.	22.4 MC.	Same as above.	—	Same as above.	Not used.	—	#12 IF Trap Coil.	Adjust the spacing of the Trap Coil windings for MINIMUM reading on VTVM.
Same as above.	26.75 MC.	With connections made as shown in Fig. 10 turn on this generator and set controls for operation as specified in next column.	25 MC. Sweeping ± 5 Mc.	Same as above.	Connect as shown in Fig. 11	IMPORTANT: 1. Adjust output attenuator on sweep generator so that reading on VTVM is one volt. 2. Set attenuator on standard signal generator so that marker signal does not distort the pattern on the oscilloscope. 3. Be sure that a 1½ volt battery is connected to AGC line as specified in instruction #5 at the head of this chart. Do not use a battery of any other voltage.	The IF band pass characteristic now displayed on the 'scope should be compared with the curve shown in Fig. 12. If top of curve is not properly shaped, make a slight readjustment of slug #9. Should that adjustment fail to yield the desired result, then note whether the curve has a peak on the high or low frequency side. Slugs #7 and #8 control high frequency response (26.1 Mc.) and slugs #10 and #11 affect the low frequency response (23.5 Mc.); by making a small change in the settings of the high or low frequency slugs, it will be possible to obtain correct band pass curve.  FIG. 12 IF RESPONSE CURVE. The 26.75 Mc. picture IF carrier marker should now appear at the 35% amplitude position on side of the band pass characteristic (see Fig. 12). If position of the marker appears too high or too low, slight readjustment of slugs #7, 8 and 9 is required.	
Same as above.	22.25 MC.	Same as above.	Same as above.	Same as above.	Same as above.	Same as above.	The 22.25 Mc. sound IF carrier marker should appear at the position indicated in Fig. 12 If the position of the sound marker is incorrect, readjust winding spacing of Trap Coil #12.	

TELEVISION RF CHANNEL ALIGNMENT PROCEDURE

1. Turn the band switch to the "TV" position.
2. Replace metal plate which covers exposed terminal side of RF tuner unit. This plate was previously removed for IF channel alignment.
3. Connect a 1½ volt battery to the receiver AGC system so that the negative terminal of battery connects to AGC line and positive terminal of battery connects to receiver chassis. (See Fig. 20 for convenient point of connection.)

STANDARD SIGNAL GENERATOR		SWEEP GENERATOR		VTVM CONNECTIONS	OSCILLOSCOPE CONNECTIONS	MISCELLANEOUS INSTRUCTIONS	TRIMMER OR SLUG	TYPE OF ADJUSTMENT AND OUTPUT INDICATION
CONNECTIONS	FREQUENCY	CONNECTIONS	FREQ.					
RF AMPLIFIER AND MIXER ALIGNMENT								
Connect as shown in Fig. 16.	*209.75 MC. ‡205.25 MC.	Connect as shown in Fig. 16 and set controls for sweep width of 10 Mc. on television channel specified in the next column.	CHANNEL #12	Not used.	Connect as shown in Fig. 17	IMPORTANT: Keep output of standard signal generator at a level that provides a readable marker but does not distort the curve that is being observed on the 'scope.	#13 Mixer Grid.	Adjust these trimmers to obtain properly shaped RF band pass characteristic as shown in Fig. 13. Use Mixer Grid trimmer #13 and RF Amplifier Plate trimmer #14 to obtain correct amplitude of characteristic in vicinity of picture and sound carrier markers. Then adjust RF Amp. Grid trimmer #15 to equalize overall amplitude. Repeat adjustment of trimmers to be sure correct response has been obtained.
							#14 RF Amp. Plate.	
							#15 RF Amp. Grid.	IMPORTANT: When adjusting trimmers #13, 14 and 15 it will be noted that the band pass characteristic can be broadened by sacrificing amplitude. It is undesirable to overly broaden the curve as that would result in a loss of sensitivity.
Same as above.	*215.75 MC. ‡211.25 MC.	Same as above.	CHANNEL #13	Not used.	Same as above.	Set Channel Selector to #13	The RF band pass characteristic of the other television channels should now be checked without disturbing the settings of trimmers #13, 14 and 15. Adjust the RF sweep generator and marker generator for operation on the other television channels, observing position of both the sound carrier and picture carrier markers.	
	*203.75 MC. ‡199.25 MC.		CHANNEL #11			Set Channel Selector to #11		
	*197.75 MC. ‡193.25 MC.		CHANNEL #10			Set Channel Selector to #10		
	*191.75 MC. ‡187.25 MC.		CHANNEL #9			Set Channel Selector to #9		
	*185.75 MC. ‡181.25 MC.		CHANNEL #8			Set Channel Selector to #8	 FIG. 13	
	*179.75 MC. ‡175.25 MC.		CHANNEL #7			Set Channel Selector to #7		
	* 87.75 MC. ‡ 83.25 MC.		CHANNEL #6			Set Channel Selector to #6		
	* 81.75 MC. ‡ 77.25 MC.		CHANNEL #5			Set Channel Selector to #5	Band pass characteristic of these channels should conform to the RF response curve in Fig. 13. If necessary, a compromise may be obtained to compensate for small variations in channel response by returning to channel #12 and making slight changes in the settings of trimmers #13, 14 and 15.	
	* 71.75 MC. ‡ 67.25 MC.		CHANNEL #4			Set Channel Selector to #4		
	* 65.75 MC. ‡ 61.25 MC.		CHANNEL #3			Set Channel Selector to #3		
	* 59.75 MC. ‡ 55.25 MC.		CHANNEL #2			Set Channel Selector to #2		

*Sound Carrier Marker
‡Picture Carrier Marker

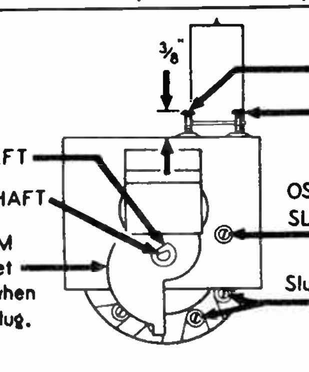


FIG. 14
Front view of RF Tuner Unit

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STANDARD SIGNAL GENERATOR		SWEEP GENERATOR		VTVM CONNECTIONS	OSCILLOSCOPE CONNECTIONS	MISCELLANEOUS INSTRUCTIONS	TRIMMER OR SLUG	TYPE OF ADJUSTMENT AND OUTPUT INDICATION
CONNECTIONS	FREQUENCY	CONNECTIONS	FREQ.					

OSCILLATOR ALIGNMENT

1. **IMPORTANT:** Before undertaking oscillator alignment be sure IF circuits are correctly aligned for band pass characteristic illustrated in Fig. 13.
2. During oscillator alignment, it is necessary to set the Fine Tuning control so that the tooth on the bakelite fine tuning cam points down (correct position for this control is shown in Fig. 14).

CONNECTIONS	FREQUENCY	CONNECTIONS	FREQ.	VTVM CONNECTIONS	OSCILLOSCOPE CONNECTIONS	MISCELLANEOUS INSTRUCTIONS	TRIMMER OR SLUG	TYPE OF ADJUSTMENT AND OUTPUT INDICATION
Connect as shown in Fig. 16	*209.75 MC. ‡205.25 MC.	Connect as shown in Fig. 16 and set controls for sweep width of 10 Mc. on television channel specified in the next column.	CHANNEL #12	Connect as shown in Fig. 18	Connect as shown in Fig. 18	Be sure that Fine Tuning control has been properly positioned (tooth on the cam pointing down—see Fig. 14). During this step and thru-out all succeeding steps it is necessary to: 1. Keep output of sweep generator at a level that does not allow reading on VTVM to exceed one volt. 2. Keep output of standard signal generator at a level that provides a readable marker but does not distort the curve that is being observed on the 'scope.	#16 Oscillator	Adjust height of Oscillator trimmer #16 to be approximately 3/8" from the top of trimmer screw to the top surface of RF tuner unit (see Fig. 14). NOTE: Before making the following adjustment, advance the vertical gain control on the 'scope in order to magnify the sound portion of the response curve. Then, use a non-metallic screwdriver to adjust channel #12 oscillator slug (accessible thru hole on front of RF Tuner Unit—see Fig. 14) and shift response curve so that sound carrier marker is located at the position indicated in Fig. 15. Now, reduce gain control of 'scope to restore pattern to normal amplitude and observe position of picture carrier marker. This marker should appear approximately halfway up the low frequency side of the characteristic (see Fig. 15).
Same as above.	*215.75 MC. ‡211.25 MC.	Same as above.	CHANNEL #13	Same as above.	Same as above.	Set Channel Selector to #13		Adjust the RF sweep generator and marker generator for operation on the other television channels; set marker generator to sound carrier frequency. After setting Channel Selector to corresponding channel, adjust oscillator slug thru hole on front of RF Tuner Unit (see Fig. 14). This permits response curve to be shifted so that sound carrier marker will appear at the position indicated in Fig. 15. The picture carrier marker for the corresponding channel should then appear at the 50% amplitude position on the opposite side of the band pass characteristic curve. NOTE: Make sure that cam on fine tuning control shaft remains properly positioned during this step (tooth on the cam pointing down—see Fig. 14).
	*203.75 MC. ‡199.25 MC.		CHANNEL #11			Set Channel Selector to #11		
	*197.75 MC. ‡193.25 MC.		CHANNEL #10			Set Channel Selector to #10		
	*191.75 MC. ‡187.25 MC.		CHANNEL #9			Set Channel Selector to #9		
	*185.75 MC. ‡181.25 MC.		CHANNEL #8			Set Channel Selector to #8		
	*179.75 MC. ‡175.25 MC.		CHANNEL #7			Set Channel Selector to #7		
	* 87.75 MC. ‡ 83.25 MC.		CHANNEL #6			Set Channel Selector to #6		
	* 81.75 MC. ‡ 77.25 MC.		CHANNEL #5			Set Channel Selector to #5		
	* 71.75 MC. ‡ 67.25 MC.		CHANNEL #4			Set Channel Selector to #4		
	* 65.75 MC. ‡ 61.25 MC.		CHANNEL #3			Set Channel Selector to #3		
	* 59.75 MC. ‡ 55.25 MC.		CHANNEL #2			Set Channel Selector to #2		

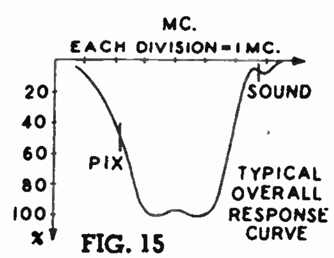


FIG. 15

If an oscillator slug "falls into" its coil form during adjustment, remove the Channel Coil from the turret assembly and lift the Slug Retaining Spring aside. By tapping the coil form it should be possible to make the slug move toward the end so that its threads will be engaged by the Slug Retaining Spring when that spring is returned to its normal position.

If an unsatisfactory overall response is obtained for a particular channel, observe RF Amp. and Mixer response curve for that channel (as described on page 1950-34). If characteristic does not conform reasonably well with the typical curve shown in Fig. 13, then, (1) attempt to obtain a better compromise for RF response on all channels by realigning RF Amp. and Mixer circuits, or (2) try replacing Antenna, RF and Oscillator coils for the particular channels.

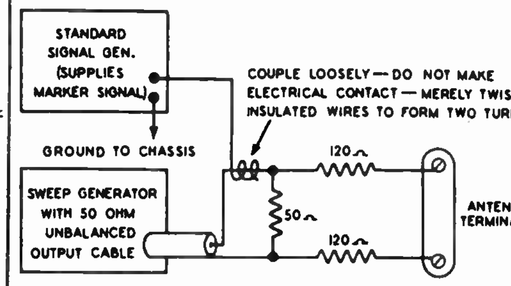


FIG. 16

Generator Connections for Television RF Channel Alignment

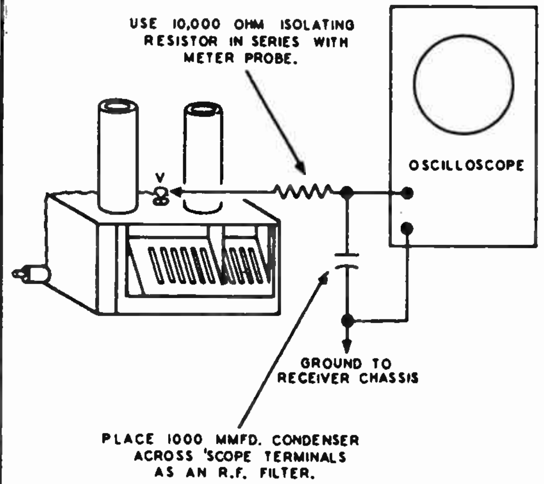


FIG. 17

Oscilloscope Connections for Television RF Amp. and Mixer Alignment

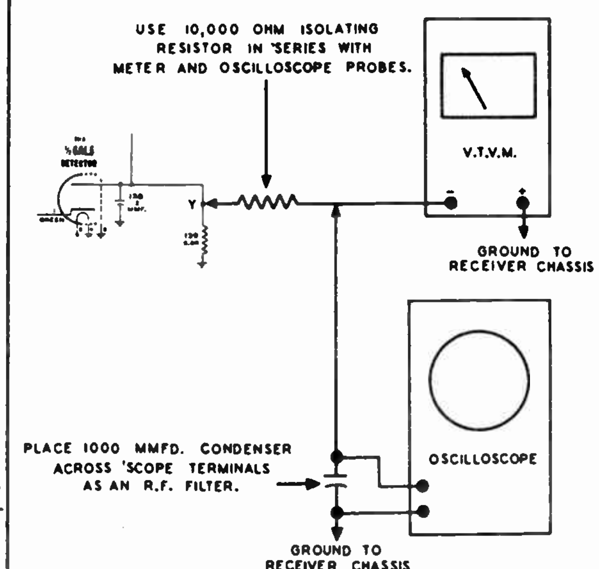
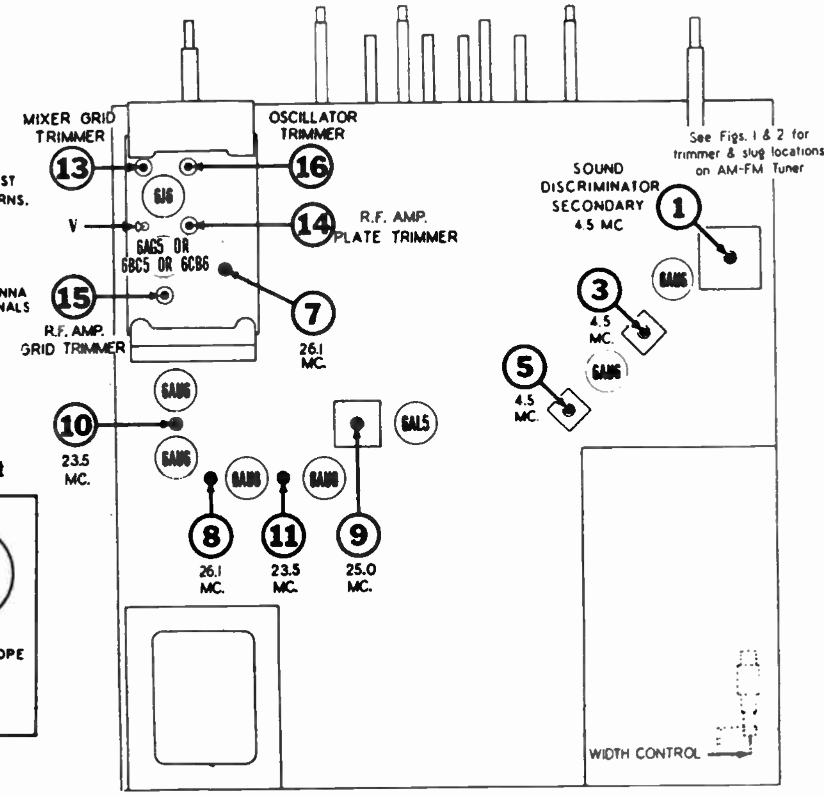


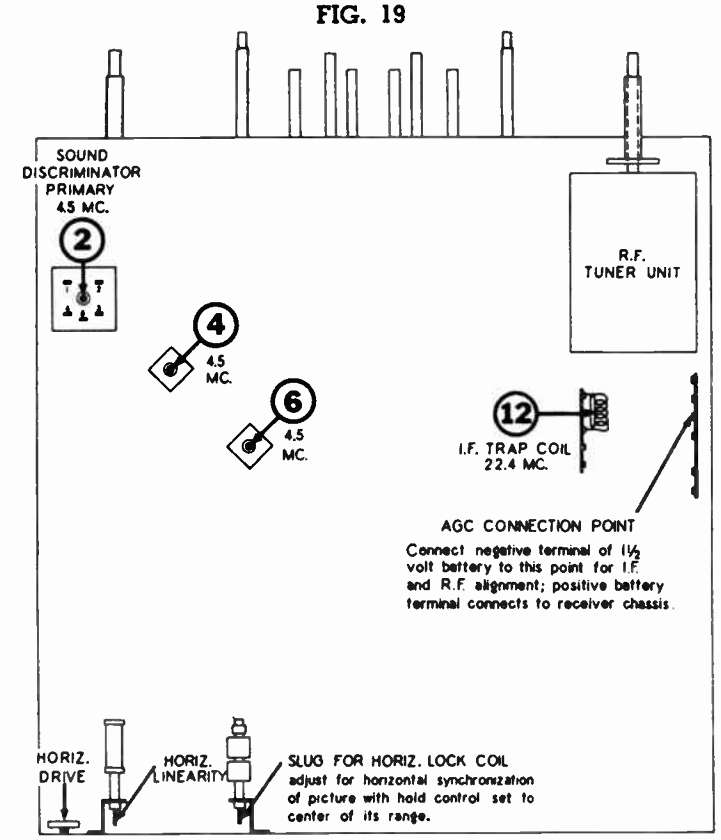
FIG. 18

VTVM and Oscilloscope Connections for Television Oscillator Alignment



TOP VIEW OF CHASSIS

FIG. 19



BOTTOM VIEW OF CHASSIS

FIG. 20.

MODEL 9105-A

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PARTS LIST

NOTICE: Some parts listed below have special characteristics. Do not use substitutes for replacement purposes.

CONDENSERS

DIAGRAM NO.	PART NO.	DESCRIPTION
11	513001	Condenser—ceramic 2.2 Mmfd. 500 volt
12-A,B	508061	Condenser—ceramic 51 Mmfd. (part of 1st TV sound I.F. transformer)
13	513013	Condenser—ceramic 5000 Mmfd. 450 volt
16	513013	Condenser—ceramic 5000 Mmfd. 450 volt
18-A,B	508061	Condenser—ceramic 51 Mmfd. (part of 2nd TV sound I.F. transformer)
19	513013	Condenser—ceramic 5000 Mmfd. 450 volt
21	513433	Condenser—ceramic 47 Mmfd. ± 10% 500 volt (Temperature compensating)
23	513013	Condenser—ceramic 5000 Mmfd. 450 volt
25	513009	Condenser—ceramic 1000 Mmfd. 500 volt
26-A	507321	Condenser—ceramic 110 Mmfd. (part of TV discriminator transformer)
27	512527	Condenser—mica 2[illegible]0 Mmfd. ± 10% 500 volt
29	513010	Condenser—ceramic 1500 Mmfd. 350 volt
30	512027	Condenser—.05 Mfd. 200 volt
32	512007	Condenser—.005 Mfd. 600 volt
34	512007	Condenser—.005 Mfd. 600 volt
36	505174	Condenser—electrolytic 10 Mfd. 150 volt
41	513010	Condenser—ceramic 1500 Mmfd. 350 volt
42	502547	Condenser—electrolytic 4 Mfd. 150 volt
44	502527	Condenser—electrolytic 50 Mfd. 25 volt
46	504719	Condenser—electrolytic 4 Mfd. 450 volt
48	512003	Condenser—.002 Mfd. 600 volt
52-A,B,C	508072	Condenser—electrolytic A—40 Mfd. 450 volt B—40 Mfd. 450 volt C—40 Mfd. 450 volt
54	508324	Condenser—trimmer 4-70 Mmfd.
	509064	Condenser—trimmer 3-9 Mmfd. (used only in chassis which do not have Condenser 70)
	507968	Condenser—trimmer 0.5-3 Mmfd. (used only in chassis which have Condenser 70)
70	513432	Condenser—ceramic 5 Mmfd. ±10% 500 volt (Temperature compensating) (used in some chassis; see note under Condenser 69)
71	513439	Condenser—ceramic 120 Mmfd. ± 5% 500 volt (Temperature compensating)
86	507968	Condenser—trimmer 0.5-3 Mmfd.
87	513442	Condenser—ceramic 10 Mmfd. ± 10% 500 volt (Temperature compensating)
88	*	Condenser 3-5 Mmfd. (Fine Tuning)
89	513440	Condenser—ceramic 100 Mmfd. ± 10% 500 volt (Temperature compensating)
92	507968	Condenser—trimmer 0.5-3 Mmfd.
93	513441	Condenser—ceramic 20 Mmfd. ± 10% 500 volt (Temperature compensating)
94	509063	Condenser—trimmer 0.5-3 Mmfd.
97	513009	Condenser—ceramic 1000 Mmfd. 500 volt
100	513009	Condenser—ceramic 1000 Mmfd. 500 volt
105	512532	Condenser—mica 240 Mmfd. ± 5% 500 volt
106	513009	Condenser—ceramic 1000 Mmfd. 500 volt
109	513016	Condenser—ceramic 82 Mmfd. ± 10% 500 volt
112	513009	Condenser—ceramic 1000 Mmfd. 500 volt
114	513009	Condenser—ceramic 1000 Mmfd. 500 volt
117	513016	Condenser—ceramic 82 Mmfd. ± 10% 500 volt
120	513009	Condenser—ceramic 1000 Mmfd. 500 volt
122	513009	Condenser—ceramic 1000 Mmfd. 500 volt
126	513016	Condenser—ceramic 82 Mmfd. ± 10% 500 volt
133	513009	Condenser—ceramic 1000 Mmfd. 500 volt
136	513433	Condenser—ceramic 47 Mmfd. ± 10% 500 volt (Temperature compensating)
138	513432	Condenser—ceramic 5 Mmfd. ± 10% 500 volt (Temperature compensating)

CONDENSERS—Continued

DIAGRAM NO.	PART NO.	DESCRIPTION
140	512045	Condenser—.25 Mfd. ± 10% 200 volt
145	512027	Condenser—.05 Mfd. 200 volt
148	512045	Condenser—.25 Mfd. ± 10% 200 volt
150	513003	Condenser—ceramic 100 Mmfd. 500 volt
154	512033	Condenser—.1 Mfd. 200 volt
157	512027	Condenser—.05 Mfd. 200 volt
167, 168	512031	Condenser—.05 Mfd. 600 volt
174	512019	Condenser—.02 Mfd. 600 volt
175	512031	Condenser—.05 Mfd. 600 volt
176	513018	Condenser—ceramic 220 Mmfd. 500 volt
187	512045	Condenser—.25 Mfd. ± 10% 200 volt
192, 193	513009	Condenser—ceramic 1000 Mmfd. 500 volt
196	512013	Condenser—.01 Mfd. 600 volt
199	513013	Condenser—ceramic 5000 Mmfd. 450 volt
201	512027	Condenser—.05 Mfd. 200 volt
204	512531	Condenser—mica 3300 Mmfd. ± 5% 500 volt
205	513007	Condenser—ceramic 330 Mmfd. 500 volt
210	512535	Condenser—mica 390 Mmfd. ± 10% 500 volt
211	512536	Condenser—mica 270 Mmfd. ± 10% 500 volt
212	508071	Condenser—trimmer 10-160 Mmfd. (Horizontal Drive Control)
214-A to D	508074	Condenser—electrolytic A— 20 Mfd. 450 volt B— 10 Mfd. 450 volt C—100 Mfd. 25 volt D— 10 Mfd. 450 volt
217	512047	Condenser—.25 Mfd. ± 10% 400 volt
219	512031	Condenser—.05 Mfd. 600 volt
223	512537	Condenser—mica 10 Mmfd. ± 10% 1500 volt
224	512015	Condenser—.02 Mfd. 200 volt
227	512031	Condenser—.05 Mfd. 600 volt
232	512039	Condenser—.15 Mfd. ± 10% 200 volt
234	512049	Condenser—.25 Mfd. ± 10% 600 volt
235	512027	Condenser—.05 Mfd. 200 volt
236	512049	Condenser—.25 Mfd. ± 10% 600 volt
237, 238	512255	Condenser—.01 Mfd. 400 volt
240	513013	Condenser—ceramic 5000 Mmfd. 450 volt
242, 243	513009	Condenser—ceramic 1000 Mmfd. 500 volt
245, 246	513009	Condenser—ceramic 1000 Mmfd. 500 volt
249-A, B	508073	Condenser—electrolytic A—20 Mfd. 300 volt B—60 Mfd. 300 volt
250	513018	Condenser—ceramic 220 Mmfd. 500 volt
251	513009	Condenser—ceramic 1000 Mmfd. 500 volt
256	513009	Condenser—ceramic 1000 Mmfd. 500 volt
258	513009	Condenser—ceramic 1000 Mmfd. 500 volt
260	513013	Condenser—ceramic 5000 Mmfd. 450 volt
262-A	508062	Condenser—ceramic .01 Mfd. 450 volt (part of integrator unit)
262-C	508062	Condenser—ceramic 2000 Mmfd. 450 volt (part of integrator unit)
262-E	508062	Condenser—ceramic 5000 Mmfd. 450 volt (part of integrator unit)
262-G	508062	Condenser—ceramic 5000 Mmfd. 450 volt (part of integrator unit)
264	512533	Condenser—mica 4700 Mmfd. ± 5% 1000 volt
273	512306	Condenser—.1 Mfd. ± 10% 600 volt
274	512037	Condenser—.1 Mfd. 600 volt
353	513006	Condenser—ceramic 270 Mmfd. 500 volt
355	512007	Condenser—.005 Mfd. 600 volt
356	512013	Condenser—.01 Mfd. 600 volt
359	160095	Condenser—electrolytic 40 Mfd. 300 volt
362	513002	Condenser—ceramic 47 Mmfd. 500 volt
366-A to D	508186	Condenser—variable gang

CONDENSERS—Continued

DIAGRAM NO.	PART NO.	DESCRIPTION
367	513009	Condenser—ceramic 1000 Mmfd. 500 volt
371	507940	Condenser—trimmer 1.5-12 Mmfd.
373	513007	Condenser—ceramic 330 Mmfd. 500 volt
376	513009	Condenser—ceramic 1000 Mmfd. 500 volt
377	513000	Condenser—ceramic 1.0 Mmfd. 500 volt
378	513002	Condenser—ceramic 47 Mmfd. 500 volt
380	513002	Condenser—ceramic 47 Mmfd. 500 volt
382	513436	Condenser—ceramic 2.5 Mmfd. 500 volt (Temperature compensating)
384	513001	Condenser—ceramic 2.2 Mmfd. 500 volt
387-A, B	506080	Condenser—ceramic 33 Mmfd. (part of 1st FM I.F. transformer)
388-A	505867	Condenser—ceramic 83 Mmfd. (part of 1st AM I.F. transformer)
388-B	505867	Condenser—ceramic 66 Mmfd. (part of 1st AM I.F. transformer)
389	513013	Condenser—ceramic 5000 Mmfd. 450 volt
391	513013	Condenser—ceramic 5000 Mmfd. 450 volt
393	513013	Condenser—ceramic 5000 Mmfd. 450 volt
396	513013	Condenser—ceramic 5000 Mmfd. 450 volt
397-A	505905	Condenser—ceramic 83 Mmfd. (part of 2nd FM I.F. transformer)
398-A	505867	Condenser—ceramic 83 Mmfd. (part of 2nd AM I.F. transformer)
398-B	505867	Condenser—ceramic 66 Mmfd. (part of 2nd AM I.F. transformer)
399-A	506338	Condenser—ceramic 100 Mmfd. 400 volt (part of diode filter unit)
399-C	506338	Condenser—ceramic 100 Mmfd. 400 volt (part of diode filter unit)
401	512028	Condenser—.05 Mfd. 400 volt
403, 404	513013	Condenser—ceramic 5000 Mmfd. 450 volt
406	513007	Condenser—ceramic 330 Mmfd. 500 volt
407	512103	Condenser—.001 Mfd. 400 volt
408	513013	Condenser—ceramic 5000 Mmfd. 450 volt
409-A	508179	Condenser—ceramic 47 Mmfd. (part of FM discriminator)
412	513013	Condenser—ceramic 5000 Mmfd. 450 volt
413	513009	Condenser—ceramic 1000 Mmfd. 500 volt
416	513007	Condenser—ceramic 330 Mmfd. 500 volt
417	507946	Condenser—electrolytic 3 Mfd. 50 volt
419	513023	Condenser—ceramic 10 Mmfd. ± 10% 500 volt
421	513009	Condenser—ceramic 1000 Mmfd. 500 volt
427	507386	Condenser—electrolytic 8 Mfd. 300 volt
429	512001	Condenser—.001 Mfd. 600 volt
430	505150	Condenser—eléctrolytic 16 Mfd. 400 volt
433	512007	Condenser—.005 Mfd. 600 volt
434	512013	Condenser—.01 Mfd. 600 volt
436	504719	Condenser—electrolytic 4 Mfd. 450 volt
439-A, B, C	508072	Condenser—electrolytic A—40 Mfd. 450 volt B—40 Mfd. 450 volt C—40 Mfd. 450 volt
444	507386	Condenser—electrolytic 8 Mfd. 300 volt
446	508915	Condenser—trimmer 110-560 Mmfd.
448	508896	Condenser—20 Mfd. 50 volt
452	512013	Condenser—.01 Mfd. 600 volt
455	508895	Condenser—.015 Mfd. 400 volt
457	512035	Condenser—.1 Mfd. 400 volt
458	512037	Condenser—.1 Mfd. 600 volt
460	508916	Condenser—mica 2700 Mmfd. ± 10% 500 volt
461	512023	Condenser—.03 Mfd. 400 volt
462	512503	Condenser—mica 100 Mmfd. 500 volt
465-B	508785	Condenser—2500 Mmfd. 20KV (part of High Voltage rectifier & transformer assy.)
465-C	508785	Condenser—5000 Mmfd. 10KV (part of High Voltage rectifier & transformer assy.)
465-D	508785	Condenser—2500 Mmfd. 20KV (part of High Voltage rectifier & transformer assy.)
470	513444	Condenser—ceramic 10 Mmfd. ± 5% 500 volt
471	512542	Condenser—mica 120 Mmfd. ± 10% 500 volt

RESISTORS

DIAGRAM NO.	PART NO.	DESCRIPTION
14	510117	Resistor—carbon 82 Ohms ± 10% ½ watt
17	510137	Resistor—carbon 1000 Ohms ½ watt
20	510185	Resistor—carbon 470,000 Ohms ½ watt
22	510117	Resistor—carbon 82 Ohms ± 10% ½ watt
24	510137	Resistor—carbon 1000 Ohms ½ watt
28	510160	Resistor—carbon 22,000 Ohms ± 10% ½ watt
31	510170	Resistor—carbon 68,000 Ohms ½ watt

RESISTORS—Continued

DIAGRAM NO.	PART NO.	DESCRIPTION
35	510197	Resistor—carbon 10 Meg. ½ watt
38	510163	Resistor—carbon 33,000 Ohms ± 10% ½ watt
39, 40	510159	Resistor—carbon 18,000 Ohms ± 10% ½ watt
45	510227	Pesistor—carbon 330 Ohms ± 10% 1 watt
47	510153	Resistor—carbon 8200 Ohms ± 10% ½ watt
67	510167	Resistor—carbon 47,000 Ohms ½ watt
68	510147	Resistor—carbon 3900 Ohms ± 10% ½ watt
72	510143	Resistor—carbon 2200 Ohms ½ watt
85	510155	Resistor—carbon 10,000 Ohms ½ watt
90	510149	Resistor—carbon 4700 Ohms ½ watt
91	510179	Resistor—carbon 220,000 Ohms ½ watt
95	510155	Resistor—carbon 10,000 Ohms ½ watt
96	510149	Resistor—carbon 4700 Ohms ½ watt
99	510158	Resistor—carbon 15,000 Ohms ½ watt
101	510151	Resistor—carbon 6800 Ohms ± 10% ½ watt
102	510137	Resistor—carbon 1000 Ohms ½ watt
104	510117	Resistor—carbon 82 Ohms ± 10% ½ watt
108	510137	Resistor—carbon 1000 Ohms ½ watt
110	510153	Resistor—carbon 8200 Ohms ± 10% ½ watt
111	510137	Resistor—carbon 1000 Ohms ½ watt
113	510117	Resistor—carbon 82 Ohms ± 10% ½ watt
116	510137	Resistor—carbon 1000 Ohms ½ watt
118	510148	Resistor—carbon 4700 Ohms ± 10% ½ watt
119	510137	Resistor—carbon 1000 Ohms ½ watt
121	510117	Resistor—carbon 82 Ohms ± 10% ½ watt
123	510153	Resistor—carbon 8200 Ohms ± 10% ½ watt
124	510137	Resistor—carbon 1000 Ohms ½ watt
130	510115	Resistor—carbon 68 Ohms ± 10% ½ watt
132	510153	Resistor—carbon 8200 Ohms ± 10% ½ watt
135	510137	Resistor—carbon 1000 Ohms ½ watt
139	510151	Resistor—carbon 6800 Ohms ± 10% ½ watt
141	510254	Resistor—carbon 10,000 Ohms ± 10% 1 watt
142	510253	Resistor—carbon 8200 Ohms ± 10% 1 watt
144	510166	Resistor—carbon 47,000 Ohms ± 10% ½ watt
146	510164	Resistor—carbon 33,000 Ohms ½ watt
147	510155	Resistor—carbon 10,000 Ohms ½ watt
149	510150	Resistor—carbon 5600 Ohms ± 10% ½ watt
151	510173	Resistor—carbon 100,000 Ohms ½ watt
153	510150	Resistor—carbon 5600 Ohms ± 10% ½ watt
155	510191	Resistor—carbon 1 Meg. ½ watt
156	510356	Resistor—carbon 12,000 Ohms ± 10% 2 watt
158	510191	Resistor—carbon 1 Meg. ½ watt
159	510126	Resistor—carbon 270 Ohms ± 10% ½ watt
162	510723	Resistor—carbon 12,000 Ohms ± 5% ½ watt
164, 165	510338	Resistor—carbon 1200 Ohms ± 10% 2 watt
166	510179	Resistor—carbon 220,000 Ohms ½ watt
169	510191	Resistor—carbon 1 Meg. ½ watt
170	510173	Resistor—carbon 100,000 Ohms ½ watt
171	510171	Resistor—carbon 82,000 Ohms ± 10% ½ watt
172	510161	Resistor—carbon 22,000 Ohms ½ watt
177	510143	Resistor—carbon 2200 Ohms ½ watt
188	510180	Resistor—carbon 270,000 Ohms ± 10% ½ watt
189	510181	Resistor—carbon 330,000 Ohms ± 10% ½ watt
190, 191	510739	Resistor—carbon 1800 Ohms ± 5% ½ watt
194, 195	510172	Resistor—carbon 100,000 Ohms ± 10% ½ watt
197	510162	Resistor—carbon 27,000 Ohms ± 10% ½ watt
198	510195	Resistor—carbon 4.7 Meg. ½ watt
200	510185	Resistor—carbon 470,000 Ohms ½ watt
203	510150	Resistor—carbon 5600 Ohms ± 10% ½ watt
206	510139	Resistor—carbon 1500 Ohms ± 10% ½ watt
207	510175	Resistor—carbon 150,000 Ohms ± 10% ½ watt
209	510180	Resistor—carbon 270,000 Ohms ± 10% ½ watt
213	510191	Resistor—carbon 1 Meg. ½ watt
215	510116	Resistor—carbon 68 Ohms ½ watt
216	510261	Resistor—carbon 22,000 Ohms 1 watt
218	510317	Resistor—carbon 82 Ohms ± 10% 2 watt
220	510248	Resistor—carbon 4700 Ohms ± 10% 1 watt
226	510254	Resistor—carbon 10,000 Ohms ± 10% 1 watt
229	510728	Resistor—wire wound 15,000 Ohms ± 10% 10 watt
247	510319	Resistor—carbon 100 Ohms 2 watt
252	510726	Resistor—wire wound 850 Ohms 5 watt
262-B	508062	Resistor—carbon 22,000 Ohms 1/5 watt (part of integrator unit)
262-D	508062	Resistor—carbon 8200 Ohms 1/5 watt (part of integrator unit)

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RESISTORS—Continued

DIAGRAM NO.	PART NO.	DESCRIPTION
262-F	508062	Resistor—carbon 8200 Ohms 1/5 watt (part of integrator unit)
265	510190	Resistor—carbon 1 Meg. ± 10% ½ watt
267	510172	Resistor—carbon 100,000 Ohms ± 10% ½ watt
268	510196	Resistor—carbon 6.8 Meg. ½ watt
269	510192	Resistor—carbon 1.5 Meg. ½ watt
271	510268	Resistor—carbon 56,000 Ohms ± 10% 1 watt
272	510145	Resistor—carbon 3300 Ohms ± 10% ½ watt
275	510193	Resistor—carbon 2.2 Meg. ½ watt
276	510132	Resistor—carbon 560 Ohms ± 10% ½ watt
279	510244	Resistor—carbon 2700 Ohms ± 10% 1 watt
354	510185	Resistor—carbon 470,000 Ohms ½ watt
357	510179	Resistor—carbon 220,000 Ohms ½ watt
358	510733	Resistor—wire wound 650 Ohms ± 10% 10 watt
360	510727	Resistor—wire wound 7500 Ohms ± 10% 5 watt
368	510173	Resistor—carbon 100,000 Ohms ½ watt
381	510193	Resistor—carbon 2.2 Meg. ½ watt
383	510155	Resistor—carbon 10,000 Ohms ½ watt
386	510136	Resistor—carbon 1000 Ohms ± 10% ½ watt
390	510152	Resistor—carbon 6800 Ohms ½ watt
392	510249	Resistor—carbon 4700 Ohms 1 watt
394	510146	Resistor—carbon 3300 Ohms ½ watt
395	510246	Resistor—carbon 3300 Ohms 1 watt
399-B	506338	Resistor—carbon 47,000 Ohms 1/5 watt (part of diode filter unit)
400	510185	Resistor—carbon 470,000 Ohms ½ watt
402	510193	Resistor—carbon 2.2 Meg. ½ watt
405	510240	Resistor—carbon 1500 Ohms 1 watt
410	510125	Resistor—carbon 220 Ohms ½ watt
411	510159	Resistor—carbon 18,000 Ohms ± 10% ½ watt
414, 415	510155	Resistor—carbon 10,000 Ohms ½ watt
426	510351	Resistor—carbon 6800 Ohms ± 10% 2 watt
428	510191	Resistor—carbon 1 Meg. ½ watt
431	510356	Resistor—carbon 12,000 Ohms ± 10% 2 watt
432	510191	Resistor—carbon 1 Meg. ½ watt
435	510732	Resistor—wire wound 2000 Ohms ± 10% 10 w.
442	510737	Resistor—wire wound 12,000 Ohms ± 10% 20 w.
443	510339	Resistor—carbon 1500 Ohms ± 10% 2 watt
445	510278	Resistor—carbon 220,000 Ohms ± 10% 1 watt
447	510259	Resistor—carbon 18,000 Ohms ± 10% 1 watt
449	510329	Resistor—carbon 390 Ohms ± 10% 2 watt
450	510128	Resistor—carbon 330 Ohms ½ watt
451	510181	Resistor—carbon 330,000 Ohms ± 10% ½ watt
453	508899	Resistor—carbon 390,000 Ohms ± 5% 1 watt
454	508898	Resistor—carbon 47,000 Ohms ± 5% ½ watt
456	508897	Resistor—carbon 220,000 Ohms ± 5% ½ watt
459	510128	Resistor—carbon 330 Ohms ½ watt
464	508919	Resistor—1.5 Meg. (in end of H. V. Lead)
466	510710	Resistor—wire wound 1700 Ohms ± 5% 10 watt
467, 468	510132	Resistor—carbon 560 Ohms ± 10% ½ watt

CONTROLS

DIAGRAM NO.	PART NO.	DESCRIPTION
33-A, B	508182	Volume control—1 Meg. (with "On-Off" switch)
43-A to D	508416	Band switch (includes volume control 33-A, "On-Off" switch 33-B and auxiliary power supply switch 437)
54	508324	Built-in Antenna Tuning condenser (4-70 Mmfd.)
88	•	Fine Tuning condenser (3-5 Mmfd.)
160-A, B	508201	Tone and Contrast potentiometer A—Tone control; 500,000 Ohms ¼ watt B—Contrast control; 3000 Ohms ± 10% 4 watt
173-A,B	508417	Brightness and Focus potentiometer A—Brightness control; 50,000 Ohms ¼ w. B—Focus control; 10,000 Ohms ± 10% 4 w.
202	508077	Horizontal Lock coil (less slug)
	507429	Slug core for Horizontal Lock coil
208	508202	Horizontal Hold potentiometer (50,000 Ohms)
212	508071	Horizontal Drive trimmer condenser (10-160 Mmfd.)
225	508218	Width coil (includes slug and clip)
	508435	Slug core for Width coil

CONTROLS—Continued

DIAGRAM NO.	PART NO.	DESCRIPTION
233	162056	Horizontal Linearity coil (includes slug and clip)
	507429	Slug core for Horizontal Linearity coil
266	508051	Vertical Hold potentiometer (1 Meg.)
270	508052	Height potentiometer (2.5 Meg.)
277	508053	Vertical Linearity potentiometer (6000 Ohms)
369-A to D	508185	Band Switch (on AM-FM tuner)
425	508057	Coarse Brightness potentiometer (5500 Ohms ± 10% 4 watt)
446	508915	High Voltage oscillator trimmer (110-560 Mmfd.)

COILS AND TRANSFORMERS

DIAGRAM NO.	PART NO.	DESCRIPTION
12	508061	Transformer—1st TV sound I.F. (includes condensers 12-A and 12-B)
15	507373	Coil—choke
18	508061	Transformer—2nd TV sound I.F. (includes condensers 18-A and 18-B)
26	507321	Transformer—TV sound discriminator (includes condenser 26-A)
	508438	Slug core (5/16" dia. x ⅜" long) for primary of TV sound discriminator trans.
	508439	Slug core (5/16" dia. x ¾" long) for secondary of TV sound discriminator transformer
37	507373	Coil—choke
49	505912	Transformer—sound output
	508805	R.F. Unit complete with coils and tubes
55	507952	Coil—antenna; Channel #2
56	507953	Coil—antenna; Channel #3
57	507954	Coil—antenna; Channel #4
58	507955	Coil—antenna; Channel #5
59	507956	Coil—antenna; Channel #6
60	507957	Coil—antenna; Channel #7
61	507958	Coil—antenna; Channel #8
62	507959	Coil—antenna; Channel #9
63	507960	Coil—antenna; Channel #10
64	507961	Coil—antenna; Channel #11
65	507962	Coil—antenna; Channel #12
66	507963	Coil—antenna; Channel #13
73	507972	Coil—R.F. and osc.; Channel #2
74	507973	Coil—R.F. and osc.; Channel #3
75	507974	Coil—R.F. and osc.; Channel #4
76	507975	Coil—R.F. and osc.; Channel #5
77	507976	Coil—R.F. and osc.; Channel #6
78	507977	Coil—R.F. and osc.; Channel #7
79	507978	Coil—R.F. and osc.; Channel #8
80	507979	Coil—R.F. and osc.; Channel #9
81	507980	Coil—R.F. and osc.; Channel #10
82	507981	Coil—R.F. and osc.; Channel #11
83	507982	Coil—R.F. and osc.; Channel #12
84	507983	Coil—R.F. and osc.; Channel #13
	507986	Slug for osc. coil fine tuning adjustment
98	509061	Coil—converter plate (I.F.)
	509062	Slug core for converter plate coil
103	507567	Coil—1st I.F. trap
107	507343	Coil—1st video I.F. (less slug)
	507357	Slug core for 1st video I.F. coil
115	507343	Coil—2nd video I.F. (less slug)
	507357	Slug core for 2nd video I.F. coil
125	507343	Coil—3rd video I.F. (less slug)
	507357	Slug core for 3rd video I.F. coil
128	507367	Coil—choke
134	507591	Coil—4th video I.F. assembly (includes condenser 136 and choke coil 137)
	507357	Slug core for 4th video I.F. coil
137	507367	Coil—choke
143	507374	Coil—peaking
152	507374	Coil—peaking
161	508069	Coil—peaking
163	508070	Coil—peaking
202	508077	Coil—Horizontal Lock (less slug)
	507429	Slug core for Horizontal Lock coil
222	508420	Transformer—horizontal output
225	508218	Coil—Width (includes slug and clip)
	508435	Slug core for Width coil
233	162056	Coil—Horizontal Linearity (includes slug and clip)
	507429	Slug core for Horizontal Linearity coil
239	508060	Transformer—power
241	507586	Coil—choke
244	507587	Coil—choke

COILS AND TRANSFORMERS—Continued

DIAGRAM NO.	PART NO.	DESCRIPTION
248	507584	Coil—choke
253	508341	Choke—filter
254	507584	Coil—choke
255	507970	Coil—choke
257	507971	Coil—choke
259	507586	Coil—choke
263	508076	Transformer—vertical blocking oscillator
278	508059	Transformer—vertical output
365	508184	Coil—AM antenna
370	507586	Coil—choke
372	507935	Coil—choke
374	507942	Coil—FM oscillator
375	508195	Coil—AM oscillator
379	507941	Coil—FM R. F.
385	506581	Coil—R. F. choke (includes resistor 386)
387	506080	Transformer—1st FM I.F. (includes condensers 387-A and 387-B)
388	505867	Transformer—1st AM I.F. (includes condensers 388-A and 388-B)
397	505905	Transformer—2nd FM I.F. (includes condenser 397-A)
398	505867	Transformer—2nd AM I.F. (includes condensers 398-A and 398-B)
409	508179	Transformer—FM discriminator (includes condenser 409-A)
418	508212	Loop Antenna (AM)
438	508413	Transformer—power (auxiliary power supply)
440	508414	Choke—filter
463	508937	Transformer—H. V. blocking oscillator
465-A	508785	High Voltage transformer (part of High Voltage rectifier and transformer assy.)
472, 473	509247	Coil—choke
501	508921	Deflection yoke
519	508940	Coil—focus (includes housing assembly)

OTHER ELECTRICAL PARTS

DIAGRAM NO.	PART NO.	DESCRIPTION
43-A to D	508416	Band Switch (includes volume control 33-A, "On-Off" switch 33-B and auxiliary power supply switch 437)
51	505512	Speaker—12 inch P.M. Dynamic
221	508063	Fuse for horizontal sweep circuit; ¼ Amp. 250 volt
261	118921	Lamp—TV Channel Lite (Mazda #47) 6-8 V. 150 Ma.
262-A to G	508062	Integrator coupling unit A—Condenser—ceramic .01 Mfd. 450 volt B—Resistor—carbon 22,000 Ohms 1/5 watt C—Condenser—ceramic 2000 Mmfd. 450 volt D—Resistor—carbon 8200 Ohms 1/5 watt E—Condenser—ceramic 5000 Mmfd. 450 volt F—Resistor—carbon 8200 Ohms 1/5 watt G—Condenser—ceramic 5000 Mmfd. 450 volt
361	118921	Lamp—OFF-ON Indicator Lite (Mazda #47) 6-8 V. 150 Ma.
363	118921	Lamp—AM Channel Lite (Mazda #47) 6-8 V. 150 Ma.
364	118921	Lamp—FM Channel Lite (Mazda #47) 6-8 V. 150 Ma.
369-A to D	508185	Switch-band (on AM-FM tuner)
399-A,B,C	506338	Diode filter unit A—Condenser—ceramic 100 Mmfd. 400 volt B—Resistor—carbon 47,000 Ohms 1/5 watt C—Condenser—ceramic 100 Mmfd. 400 volt
437	508947	Switch—auxiliary power supply (mounted on band switch on TV chassis)
441	508063	Fuse for auxiliary power supply; ¼ Amp. 250 volt
465	508785	High Voltage rectifier & transformer assy. (includes transformer 465-A, condensers 465-B, 465-C, 465-D and tubes V34, V35, V36)
469	508760	Built-in antenna (includes condenser 54)

MECHANICAL PARTS OF R.F. TUNER

(for electrical parts see preceding classified listings of condensers, resistors and coils)

DIAGRAM NO.	PART NO.	DESCRIPTION
	508805	R.F. Unit complete with coils and tubes
	508081	Bracket for mtg. tuner (front)
	508082	Bracket for mtg. tuner (rear)
	508437	Fine tuning cam and brass shaft
	508708	Roller—detent
	507989	Shield—tube; miniature (fits solid ring type clip)
	505367	Shield—tube; miniature (fits wing type clip)

MECHANICAL PARTS OF R.F. TUNER—Continued

DIAGRAM NO.	PART NO.	DESCRIPTION
	509062	Slug core for converter plate coil
	507986	Slug for osc. coil fine tuning adjustment
	507987	Socket—miniature (for 6J6) (includes solid ring type clip for shield)
	509065	Socket—miniature (6J6) (includes wing type clip for shield)
	507988	Socket—miniature (for 6AG5) (includes solid ring type clip for shield)
	509066	Socket—miniature (for 6AG5) (includes wing type clip for shield)
	507966	Spring contactor washer (on front turret shaft)
	508709	Spring—detent
	507990	Spring—retains osc. fine tuning slug
	507967	Spring—turret shaft retaining
	507984	Stator contact assembly (includes 11 contacts and metal frames)
	508707	Tuner turret and shaft assembly (less coils)
	507965	Washer, fiber spacer (turret shaft)

OPTICAL BOX PARTS

(Replacement of the mirrors or lens of the Optical Box requires special fixtures for correct alignment and this should not be undertaken in the field. Where such replacement might be required, the Optical Box only should be returned to the factory.

Tailpiece Assembly replacement parts are available as indicated below. For further identification of those parts, see exploded view of Tailpiece Assembly on page 7.)

DIAGRAM NO.	PART NO.	DESCRIPTION
500	508920	Rubber ring around deflection yoke
501	508921	Deflection yoke
502	508922	Tailpiece mounting and overall focus adjustment plate ass'y
503	508923	Screw assembly—vertical focus adjustment
504	508924	Vertical focus adjustment plate ass'y
505	508925	Spacer—locking
506	508926	Spring—locking (for overall focus adj.)
507	508927	Nut—thumb
508	508928	"C" washer
509	508929	Washer—spring
510	508930	Screw—horizontal focus adjustment
511	508931	Mounting plate—deflection yoke and focus coil
512	508932	Washer
513	508933	Washer—spring
514	508934	Screw—thumb
515	508935	Spring—focus coil positioning
516	508936	Washer
517	508938	Clamp—picture tube neck
518	508939	Plate—tube clamp
519	508940	Coil—focus (includes housing ass'y)
520	508941	Screw—deflection yoke mtg.
521	508942	Insulator—deflection yoke mtg.
522	508943	Spring—return for overall focus adj.
523	508944	Clamp—H. V. lead
524	508945	Insulator—H. V. lead clamp
525	508946	Stud—horizontal focusing guide

RECORD CHANGER PARTS

(for information on parts other than those listed below see separate record changer Service Data of the record changer section of the Stewart-Warner Manual)

DIAGRAM NO.	PART NO.	DESCRIPTION
	508222	Record Changer
179	508432	Crystal Cartridge
280	508120	Motor—115 volt, 60 cycle
281	505269	Switch—"On-Off"
	508533	Inserts for 45 R.P.M. records (package of 12)
	508433	Needle—phonograph; for "Standard" records
	508434	Needle-phonograph; for "Fine Groove" and "Microgroove" records
	501031	Plug for phono. motor cable
	500966	Plug for phono. pick-up cable

CABINET PARTS

DIAGRAM NO.	PART NO.	DESCRIPTION
	508534	Back for cabinet (control panel side)
	508535	Back for cabinet (picture screen side)
	508217	Bracket for mounting OFF-ON indicator lite at base of cabinet
	117131	Bull's-eye for OFF-ON indicator lite at base of cabinet
	508400	Cabinet

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PARTS LIST (Contd.)

CABINET PARTS—Continued

DIAGRAM NO.	PART NO.	DESCRIPTION
	507930	Call letter tabs
	505451	Catch and latch for speaker grille frame
	508409	Catch—door
	508204	Dial Scale, AM-FM
	508401	Door—cabinet (left side)
	508402	Door—cabinet (right side)
	508403	Door—record changer compartment
	508523	Escutcheon—control panel
	508405	Handle—cabinet door
	508404	Handle—record changer door
	508406	Hinge—cabinet door (per pair)
	508407	Hinge—record changer door
	508204	Knob—AM-FM coarse tuning and dial scale
	508205	Knob—AM-FM fine tuning
	502563	Knob—built-in antenna
	507916	Knob—channel selector
	508209	Knob—"CONTRAST"
	508521	Knob—"FOCUS"
	508206	Knob—horizontal hold
	507917	Knob—TV fine tuning
	508208	Knob—"TV-PHONO-AM-FM"
	508207	Knob—volume, brightness or tone
	508537	Mirror—front surface
	508524	Name plate (Master Panoramic)
	508408	Rail for drawer—(supplied in sets) (per set)
	508536	Screen—picture
	18796	Screw—#10 x 1"; mounts chassis
	508422	Socket—indicator lamp at base of cabinet
	508410	Speaker grille assembly (includes wood frame, grille cloth and metal grille)
	507351	Terminal strip for TV antenna connection

MISCELLANEOUS

DIAGRAM NO.	PART NO.	DESCRIPTION
	508189	Back for AM-FM tuner
	301270	Base for mounting electrolytic condenser
	508081	Bracket for mounting 508805 tuner (front)
	508082	Bracket for mounting 508805 tuner (rear)
	508190	Bracket—supports AM-FM tuner
	506279	Bracket—supports band switch shaft on AM-FM tuner
	508198	Bracket—supports band switch shaft on TV chassis
	505165	"C" washer for connecting link
	507930	Call letter tabs
	508948	Clamp assembly—mounts oil sealed can
	112745	Clip for mounting AM antenna coil
	505101	Clip for mounting I.F. transformer
	507592	Clip for mounting 4th video I.F. coil
	507339	Clip for mounting video converter plate coil, 1st video I.F., 2nd video I.F., 3rd video I.F., horiz. lock and horiz. linearity coil
	114955	Clip—retainer on end of dial cord
	117057	Cord—dial drive (2 ft. required) per foot

MISCELLANEOUS—Continued

DIAGRAM NO.	PART NO.	DESCRIPTION
	508525	Drum—dial; on gang condenser
	508949	Grommet—on lid of H.V. power supply
	508527	Lever—band switch actuating (on AM-FM tuner)
	508526	Lever—band switch actuating (on TV chassis)
	508194	Link—connect band switch actuating levers
	162059	Planetary drive and dial drum (includes mounting bracket)
	507699	Power cord assembly (includes plugs at both ends)
	508704	Power cord—for shielded compartment on TV chassis
	508918	Power interlock (includes plug and bracket for mounting to speaker grille frame)
	506652	Plug for AM-FM tuner power cable
	500966	Plug for audio cable on AM-FM tuner
	502984	Plug for auxiliary power supply cable
	508515	Plug for deflection yoke cable
	508518	Plug for high voltage power supply (3 prong)
	500966	Plug for phono. pick-up cable
	508517	Plug for picture tube grid lead
	18796	Screw—#10 x 1"; mounts chassis
	162031	Shield—on TV chassis (front section)
	508088	Shield—on TV chassis (rear section)
	507357	Slug core for 1st, 2nd, 3rd and 4th video I.F. coils
	507429	Slug core for Horizontal Lock or Horizontal Linearity coil
	508435	Slug core for Width coil
	508438	Slug core for primary of TV sound discriminator transformer
	508439	Slug core for secondary of TV sound discriminator transformer
	509062	Slug core for converter plate coil
	507468	Socket and cable assembly for picture tube
	508156	Socket and mounting bracket for TV channel lite
	160039	Socket—AM-FM tuner output
	508419	Socket—deflection and focus coil cable
	508335	Socket for AM or FM channel lite
	507948	Socket for AM-FM tuner power cable
	508423	Socket for auxiliary power supply cable (on TV chassis)
	507948	Socket for H.V. supply power cable
	162152	Socket—male, power cord interlock (includes mounting bracket)
	506576	Socket—miniature (7 pin) (for 6BE6)
	507364	Socket—miniature (7 pin)
	506331	Socket—miniature (9 pin) (for 12AT7)
	508044	Socket—miniature (9 pin)
	508703	Socket—octal
	160039	Socket—phono.-plug
	508516	Socket—picture tube grid lead
	508917	Spring clip—on end of H.V. lead
	505161	Spring, dial cord tension
	111456	Washer—spring washer for connecting lug

*—This part is not supplied as a Service replacement item.

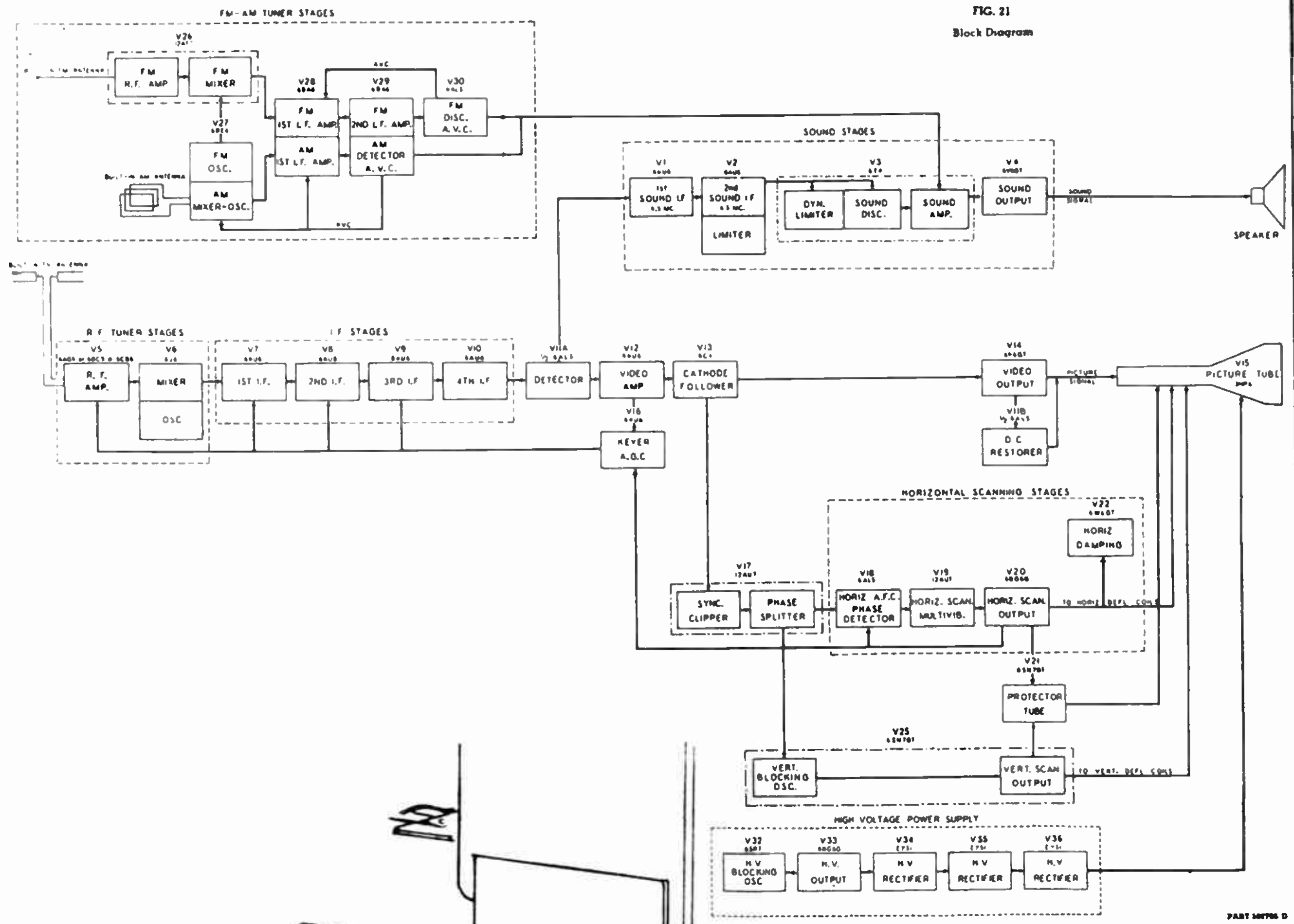
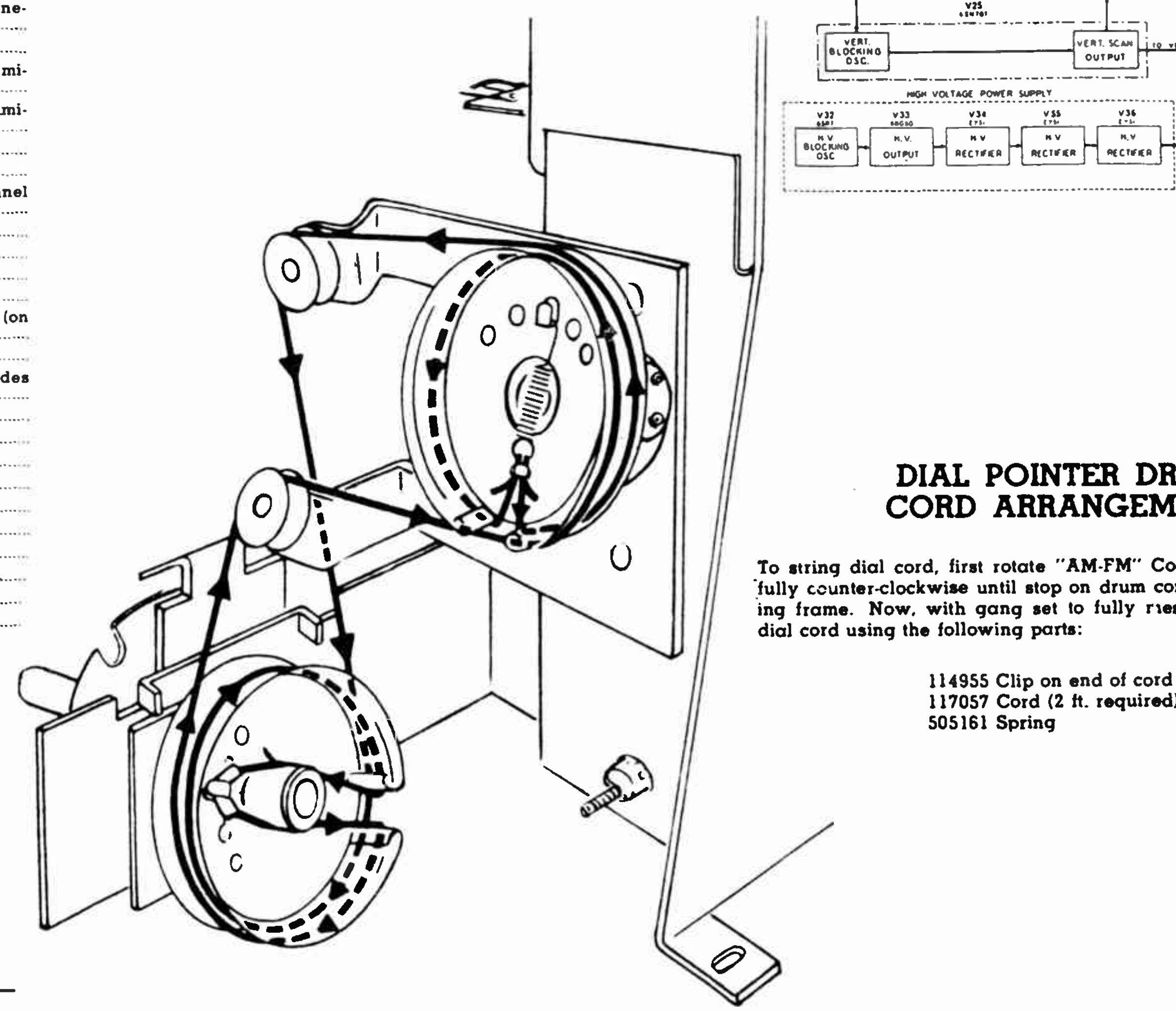


FIG. 21
Block Diagram



DIAL POINTER DRIVE CORD ARRANGEMENT

To string dial cord, first rotate "AM-FM" Coarse Tuning Control fully counter-clockwise until stop on drum contacts ear on mounting frame. Now, with gang set to fully meshed position, string dial cord using the following parts:

114955 Clip on end of cord
117057 Cord (2 ft. required)
505161 Spring

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MODELS 9109-A, 9109-B

All oscillograms taken wi
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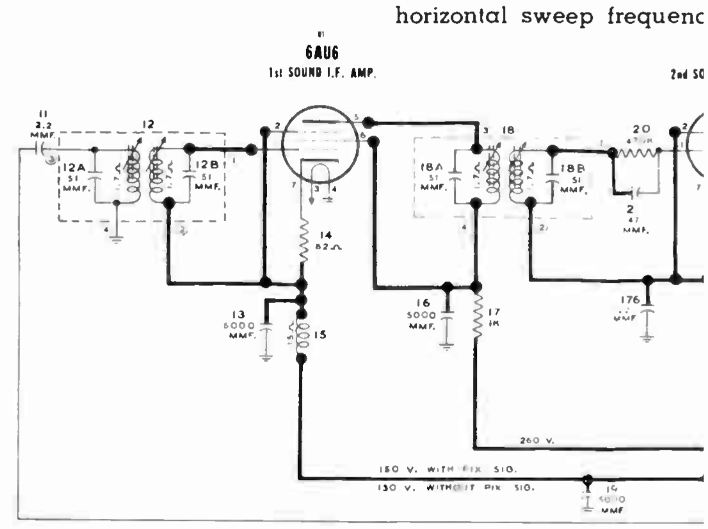
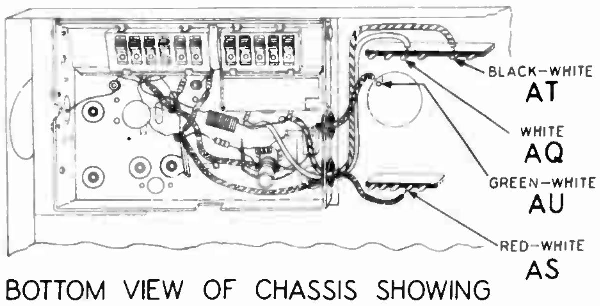
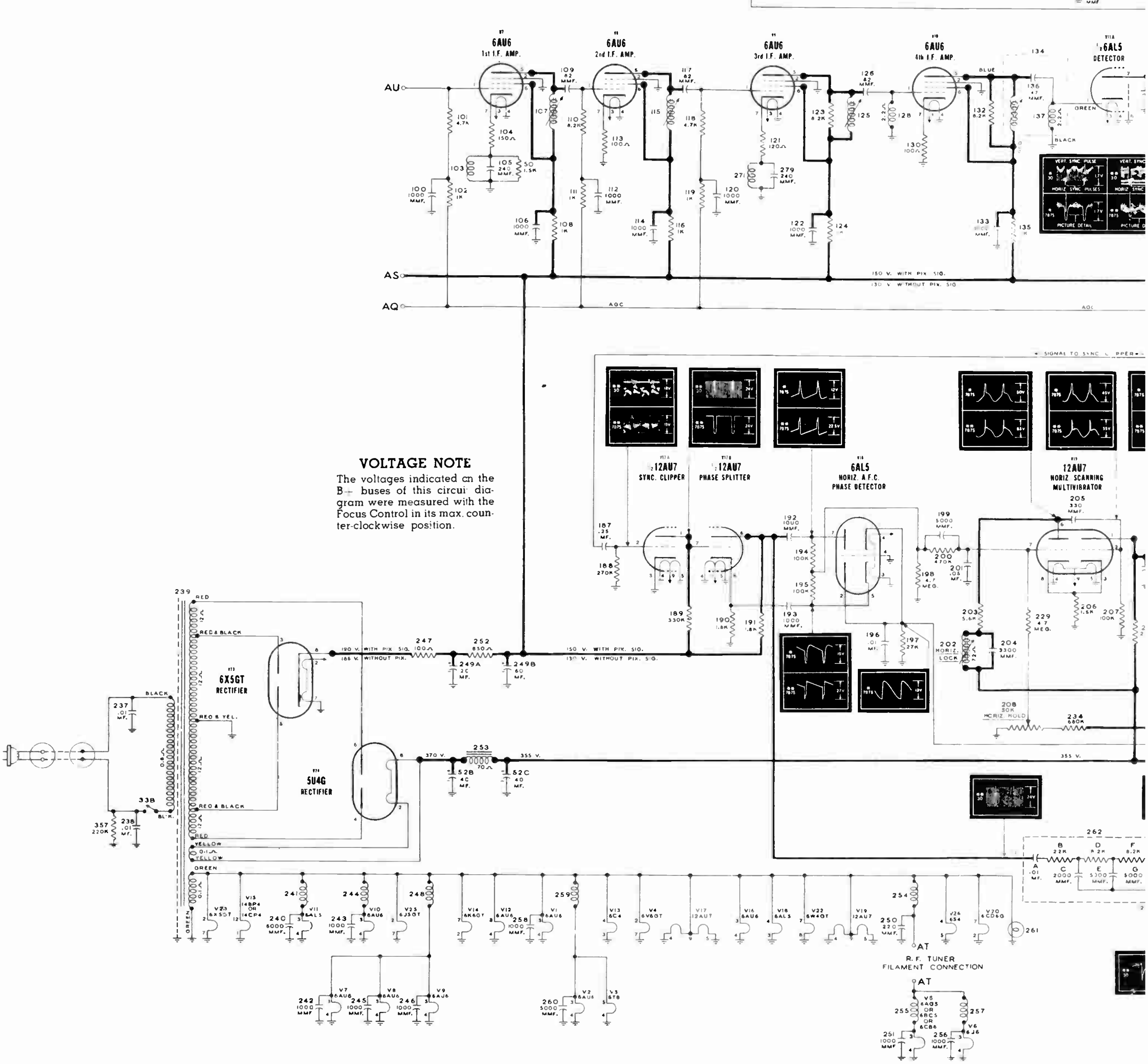




BOTTOM VIEW OF CHASSIS SHOWING CONNECTIONS TO RF TUNER UNIT



VOLTAGE NOTE

The voltages indicated on the B+ buses of this circuit diagram were measured with the Focus Control in its max. counter-clockwise position.

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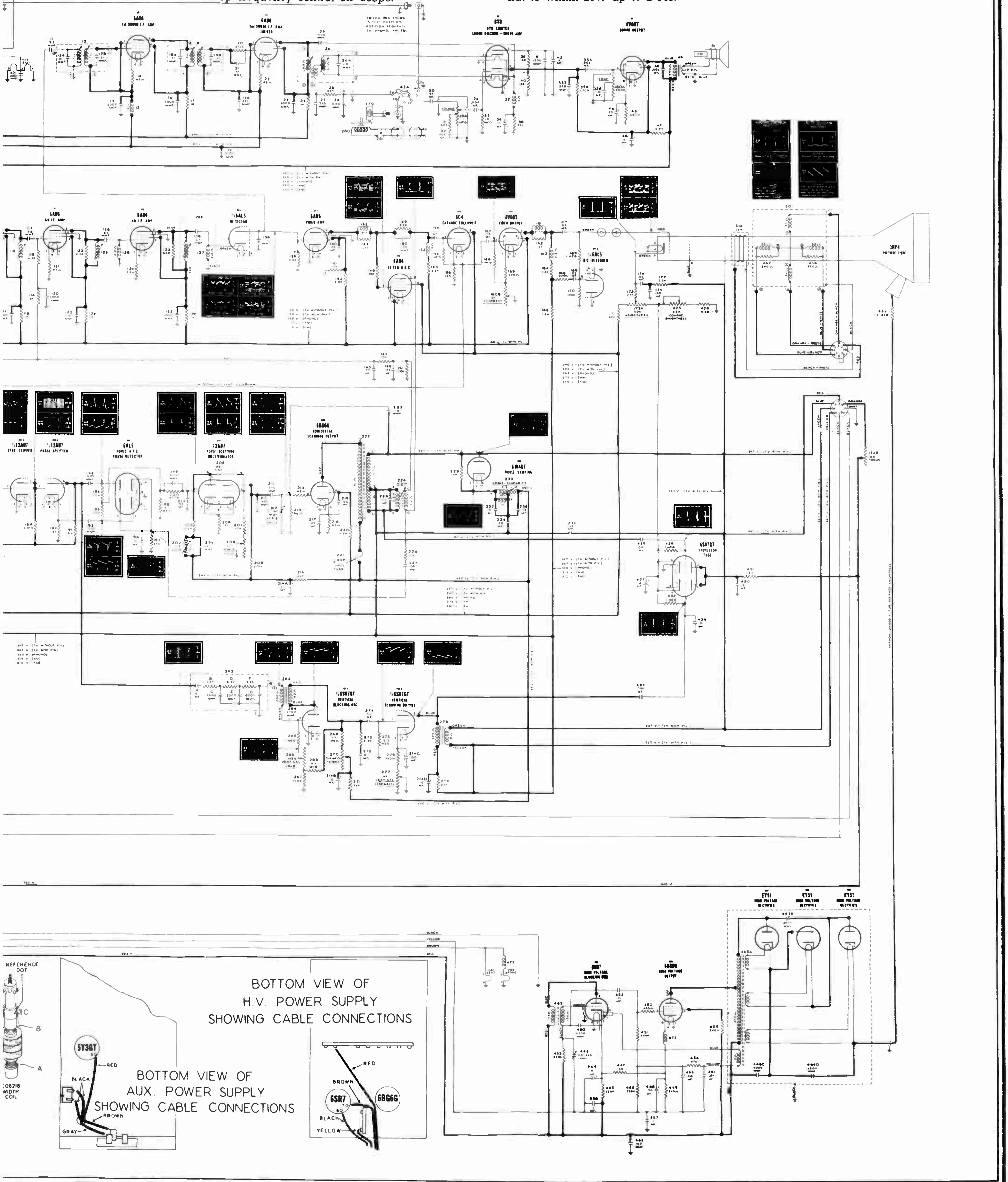
OSCILLOGRAMS

All oscillograms taken with ground lead of scope connected to receiver chassis (unless otherwise indicated) and with receiver controls set for normal reception of a station transmitting its standard test pattern.

Number appearing below asterisk specifies setting of horizontal sweep frequency control on 'scope.

*— This symbol on illustration indicates that wave form was observed on a 'scope whose vertical amplifier had very limited high frequency response (50 to 100 Kc).

**— This symbol indicates that wave form was observed on a 'scope whose vertical amplifier frequency response was flat to within 20% up to 2 Mc.



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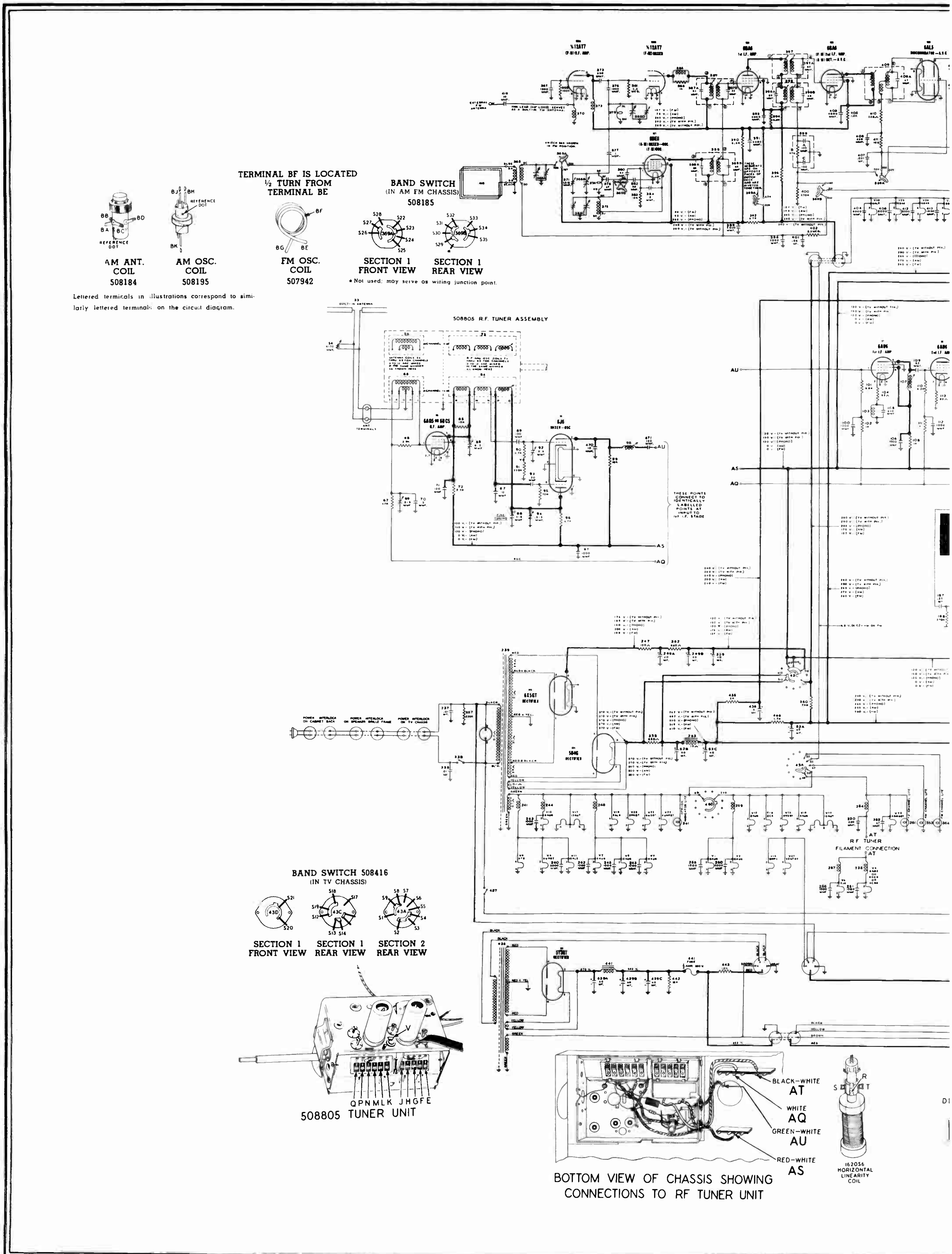

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OSCILLOGRAMS

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asterisk specifies setting of y control on 'scope.

*— This symbol on illustration indicates that wave form was observed on a 'scope whose vertical amplifier had very limited high frequency response (50 to 100 Kc).

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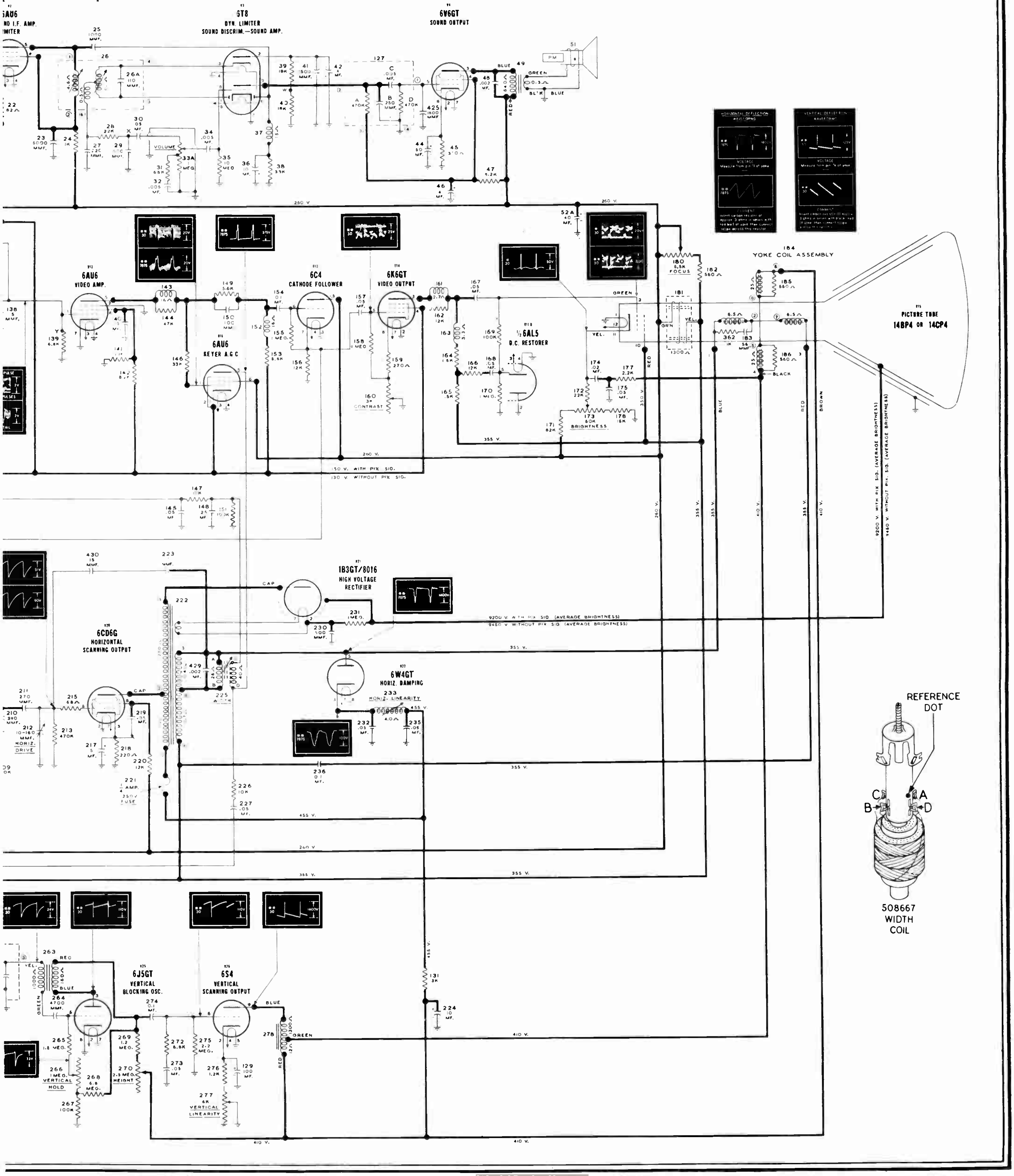

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MODEL 9109-A
14" RECTANGULAR PIX TUBE

MODEL 9109-B
14" RECTANGULAR PIX TUBE

CAUTION

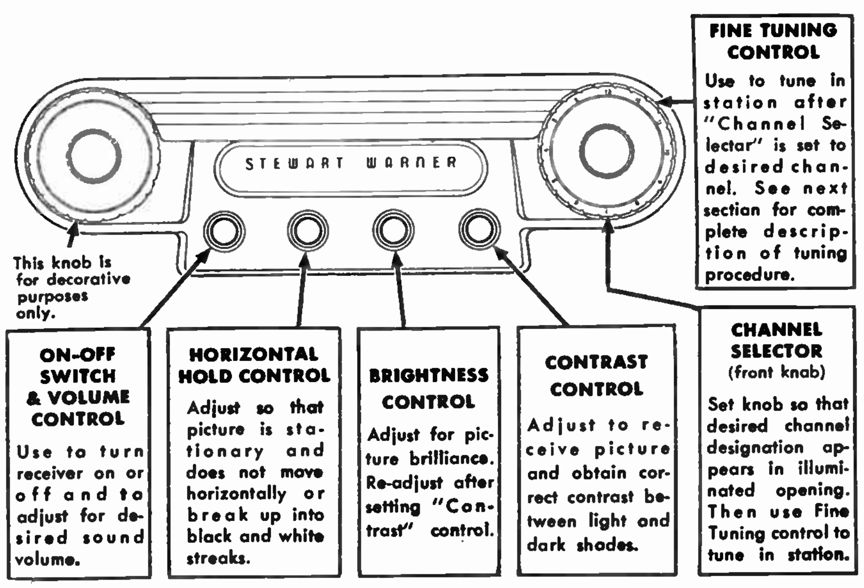
HIGH VOLTAGES are used in the operation of this receiver. The back cover, while in place, prevents accidental contact with this voltage and therefore should not be removed by anyone except a qualified television serviceman.

THE HIGH VOLTAGE LEAD, which supplies 10 to 12.5 kilovolts to the picture tube, should be momentarily shorted to the chassis whenever it is disconnected for service purposes. This discharges the high voltage filter condenser and prevents a shock hazard when working on the receiver after it has been turned off.

THE PICTURE TUBE is highly evacuated and if broken, glass fragments will be violently expelled. Scratching, chipping, undue pressure, or careless handling such as lifting the tube by its neck is dangerous and should be avoided. If it is necessary to handle the picture tube, use safety goggles and heavy gloves. Be sure to discharge the voltage developed across the capacitor formed by the inner and outer coating of the picture tube. This can be done by connecting the high voltage socket on the tube to the outer coating.

RECEIVER OPERATING CONTROLS

Fig. 1



REPLACING CHANNEL LITE

A dial lamp, located behind the "Channel Selector" knob, illuminates the particular television station designation corresponding to the setting of the Channel Selector.

If the dial lamp does not light, and receiver otherwise operates satisfactorily, then the dial lamp may be burned out and replacement should be undertaken. To gain access to lamp, remove all knobs on front of receiver (pull each knob forward) and remove name plate escutcheon by grasping its upper edge and pulling it away from the cabinet. The large escutcheon must then be removed by taking out the four wood screws which hold it in place. Replace dial lamp with Stewart-Warner Part #118921. Be sure to replace sleeving over new dial lamp.

CONTROL ADJUSTMENT PROCEDURE

The various controls on the receiver may be divided into two classes, Operating and Pre-set. Operating controls are those which control program selection as well as sound and picture quality and their functions are indicated in Fig. 1.

The Pre-set controls are those which require adjustment at the time the receiver is installed and they rarely need attention thereafter. Although they have been factory adjusted for optimum performance, it is usually necessary to make some fine adjustments of these controls at the time of installation.

There are nine Pre-set controls, four of which are located at the back of the chassis (see Figure 18). Four controls are accessible by removing the Name Plate located directly above the Operating controls. Access to the "Auxiliary Fine Tuning" screw can be gained by removing the "Channel Selector" and "Fine Tuning" knobs.

To gain access to the centering adjustments and ion trap, it will be necessary to remove the back cover of the cabinet by first removing the built-in antenna tuning knob and then taking out the screws around the rim of the back cover.

Removal of the cabinet back automatically opens an interlock to disconnect the receiver power cord. Centering and ion trap adjustments will require access to circuit components while the receiver is in operation, therefore an auxiliary power cord assembly will be needed. This cord may be ordered from Stewart-Warner by requesting Part #507699.

Operate the receiver according to the instructions given in the section of this manual entitled "How To Tune The Receiver" and make the following adjustments as required.

1. **ADJUST ION TRAP**—If screen remains dark or is only dimly illuminated when "Brightness" control is turned clockwise, the ion trap may require adjustment.

   The ion trap is located on the neck of the picture tube as shown in Figure 18 and consists of a magnet held in position by metal bands.

   Rotate the entire trap assembly while sliding it back and forth until picture tube screen is illuminated to maximum brilliance. Reduce "Brightness" control setting and repeat this operation to assure accurate positioning of ion trap.

2. **AUXILIARY FINE TUNING ADJUSTMENT**—If it is found that the tuning range of the "Fine Tuning" control is inadequate to permit correct tuning of a station in its assigned channel, then adjustment of the "Auxiliary Fine Tuning" screw will be necessary. This special screw is accessible after removal of the "Channel Selector" and "Fine Tuning" knobs. They may be removed by merely pulling them forward.

   Adjustment of the "Auxiliary Fine Tuning" screw may now be undertaken in accordance with the following procedure.

   a. Set "Channel Selector" to desired channel; then remove this knob.

   b. Set "Fine Tuning" knob to the center of its range; then remove this knob. The flat portion of the main tuning shaft (outer brass shaft) should now be in the uppermost position. Note the location of the "Auxiliary Fine Tuning" adjustment screw on receiver chassis —see Fig. 14.

   c. Using a thin screwdriver (preferably non-metallic), adjust the setting of "Auxiliary Fine Tuning" screw for correct tuning of the desired television station—**CAUTION: Do not attempt to rotate this screw more than two full turns in either direction, as further rotation may release it from the thread clip within the tuning mechanism and the coil for that channel (located in R.F. Tuner Unit) would then have to be removed in order to restore the screw to the correct position.** If a metal screwdriver is used, detuning occurs when the screwdriver is removed but it will be noted that this degree of detuning can now be compensated by resetting the "Fine Tuning" control (brass shaft). Thus the range of the "Fine Tuning" control (after knob is replaced on the shaft) will be adequate to tune in the station.

   d. This completes the adjustment of the "Auxiliary Fine Tuning" screw for one channel. Identical screws are provided on each channel

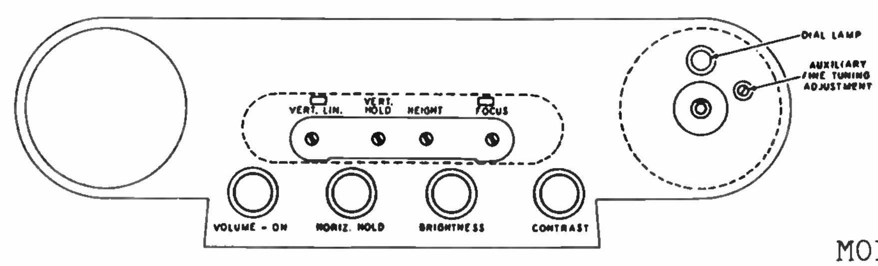


Fig. 14—LOCATION OF PRE-SET CONTROLS

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and they are all accessible thru the same opening in the tuning mechanism as each successively moves into position when the "Channel Selector" knob is rotated.

3. **HORIZONTAL HOLD**—Should the picture appear to move horizontally across the screen or break up into a series of light and dark streaks as shown in Figure 3, adjust the "Horizontal Hold" control until the picture remains stationary.

If this control must be rotated to the end of its range for proper "locking" action, then it will be necessary to reset the position of the "Horizontal Lock" control (see Figure 18 for location). Adjustment is accomplished by first setting the "Horizontal Hold" control in the middle of its range and then changing the setting of the "Horizontal Lock" control until picture locks in horizontally.

4. **VERTICAL HOLD**—Should the picture appear to roll by in a vertical direction or cause multiple vertical images as shown in Figure 15, it will be necessary to adjust the "Vert. Hold" control located behind the Name Plate (see Figure 14).

After this adjustment is made, reduce contrast until picture is barely visible and check setting of "Vertical Hold" control for proper picture synchronization.

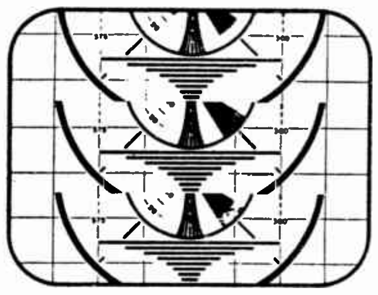

Fig. 15—VERTICAL MOVEMENT; ADJUST VERTICAL HOLD CONTROL

5. **INITIAL FOCUS**—Adjust the "Focus" control, located behind Name Plate, until picture is clearly defined.

Fuzzy picture may also be due to reproduction of poor quality film when station is televising a motion picture. Incorrect tuning of receiver produces a similar effect. Check for proper tuning point as described in step 6 of section entitled "How To Tune the Receiver."

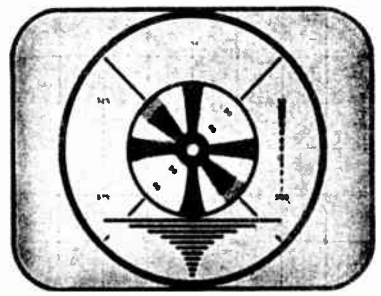

Fig. 16—BLURRED APPEARANCE; ADJUST FOCUS CONTROL

6. **STRAIGHTENING TILTED RASTER**—If the pattern should appear on the screen in a tilted position as shown in Figure 17, loosen the deflection yoke locking screw (see Figure 18) and rotate the yoke sufficiently to correct this condition. Be sure to re-tighten the screw securely.

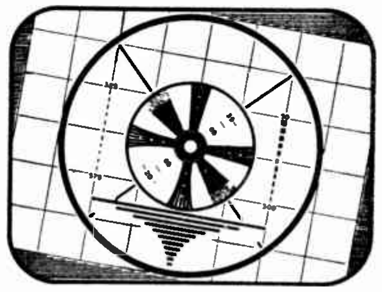

Fig. 17—TILTED PICTURE; ADJUST YOKE POSITION

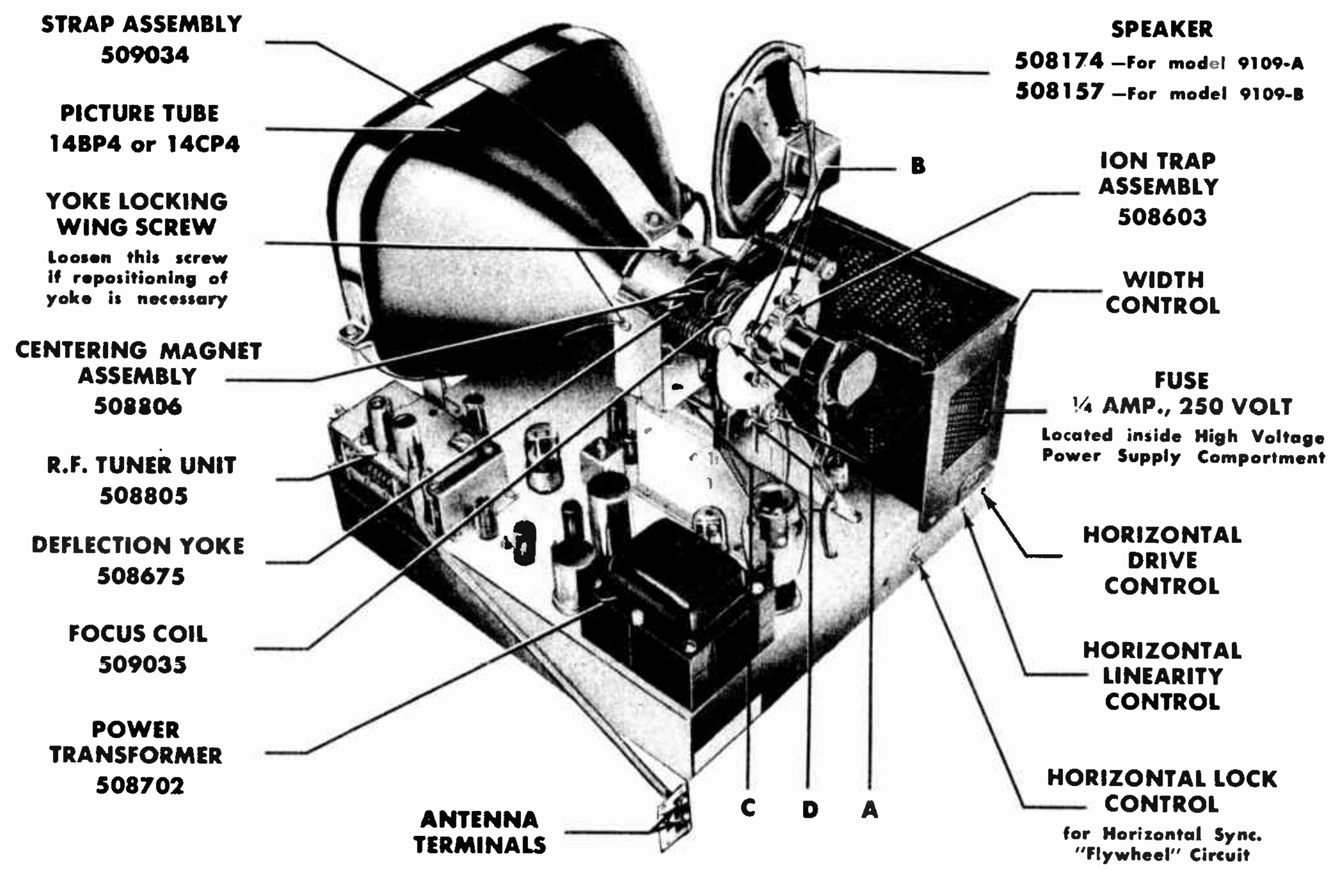

Fig. 18—CHASSIS AND PICTURE TUBE ASSEMBLY

The following adjustments should be made while the station is transmitting its circular test pattern.

7. **CENTERING:** To center the test pattern on the screen, proceed as follows:

a. Make sure focus coil mounting plate is perpendicular to neck of picture tube by adjustment of three nuts labeled A in Figure 18.

b. Rotate the two magnets in the centering magnet assembly (see Fig. 18). These magnets may be adjusted by grasping the "ears" attached to each magnet and rotating the magnets with respect to each other and with respect to the picture tube. Adjust the magnet position for best centering of the test pattern.

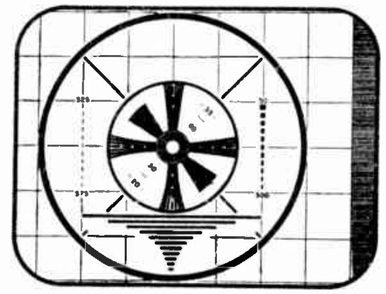

Fig. 19—OFF CENTER; ADJUST FOCUS COIL POSITION

c. If picture is still not centered, loosen four focus coil wing nuts labeled B in Fig. 18 and rotate focus coil for best centering of test pattern.

d. Readjust ion trap for maximum brightness on picture tube screen as explained in step #1.

e. If picture is still not centered, position focus coil by adjusting the three nuts labeled A in Fig. 18.

In event picture cannot be centered by above procedures, release the four wing nuts labeled D in Fig. 18 and raise or lower entire yoke and focus coil assembly so that focus coil can be repositioned vertically with respect to the tube neck.

8. **WIDTH** — Control of picture size in the horizontal direction is accomplished by means of the "Width" control located on the rear of H. V. power supply (see Fig. 18). If abnormally low line voltage makes it difficult to obtain sufficient picture width when using the "Width" control, then changing the setting of the "Horizontal Drive" control may be helpful. The "Drive" control is located at the rear of the chassis and its setting will affect horizontal linearity as well as picture width. Therefore, after adjusting this control for desired width, it may be necessary to re-adjust the "Horizontal Linearity" control as described in paragraph #12.

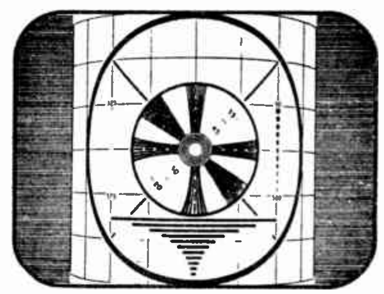

Fig. 20—TOO NARROW; ADJUST WIDTH CONTROL

9. **HEIGHT** — Control of picture size in the vertical direction is accomplished by means of the "Height" control located behind the Name Plate. Height and width adjustments should be checked for all transmitting stations to be sure that picture properly fills the viewing area. It may be necessary to change the setting of the "Height" control after the "Vertical Linearity" control is adjusted.

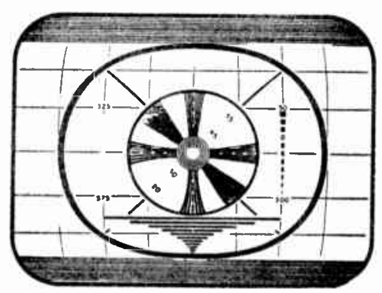

Fig. 21—TOO SHORT; ADJUST HEIGHT CONTROL

10. **VERTICAL LINEARITY** — Improper vertical linearity causes the circular test pattern to appear condensed on the upper edge of the screen and extended on the lower edge or vice versa. This effect is illustrated in Figure 22. Adjust for proper linearity by using "Vert. Lin." control located behind Name Plate. It may be necessary to readjust the "Height" control if an appreciable change is made in the linearity control setting.

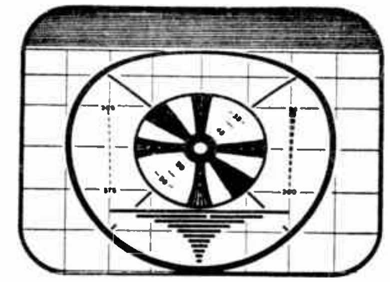

Fig. 22—VERTICAL DISTORTION; ADJUST VERTICAL LINEARITY CONTROL

11. **HORIZONTAL DRIVE** — The "Horizontal Drive" control located at rear of chassis (see Fig. 18) should be rotated clockwise to the point where any white (or black) vertical lines near the left side of the picture are eliminated. As width and linearity of the picture are affected by the setting of "Horiz. Drive" control, it will be necessary to adjust this control in conjunction with the Horiz. Linearity and Width controls to obtain desired picture width and linearity.

12. **HORIZONTAL LINEARITY** — Improper horizontal linearity causes the circular test pattern to appear condensed on the right edge of the screen and extended on the left edge or vice versa. This effect is illustrated in Figure 23. Adjust for proper linearity by using "Horiz. Lin." control located at rear of chassis (see Figure 18). In event that proper horizontal linearity cannot be obtained by adjusting this control, then change the setting of the "Horiz. Drive" control.

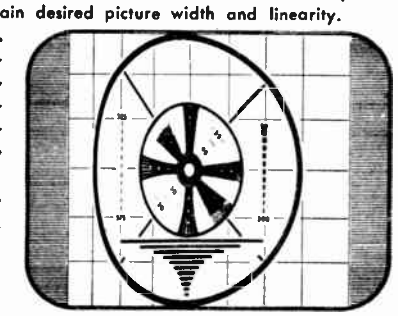

Fig. 23—HORIZONTAL DISTORTION; ADJUST HORIZONTAL LINEARITY CONTROL

13. **ELIMINATING SEMI-CIRCULAR SHADOW** — This shadow is caused by the electron stream striking the neck of the tube and it can generally be corrected by applying one or a combination of the following procedures:

a. Make sure deflection yoke is positioned as far forward as possible by loosening the three wing nuts labeled C in Fig. 18.

b. Reposition the focus coil by readjusting the three nuts labeled A in Fig. 18 to shift the coil forward.

c. In event neck shading cannot be eliminated by the above procedures, release the four wing nuts labeled D in Figure 18 and raise or lower entire yoke and focus coil assembly so that focus coil can be repositioned vertically with respect to the tube neck.

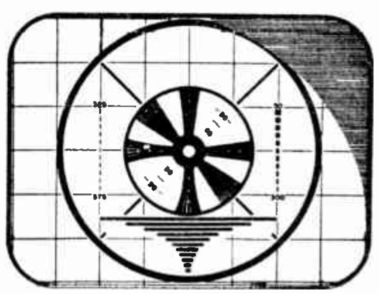

Fig. 24 SEMI-CIRCULAR SHADOW

14. **FINAL ADJUSTMENTS** — Recheck settings of "Brightness," "Contrast" and "Focus" controls for best picture quality.

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GENERAL SPECIFICATIONS

DIMENSIONS

Model	Height	Width	Depth
9109-A	36¾"	26¼"	20¾"
9109-B	17⅞"	19"	20¾"

WEIGHTS (packed)

Model 9109-A—138 lbs.
Model 9109-B—100 lbs.

POWER REQUIREMENTS

117 volts   60 cycles   240 watts

PICTURE SIZE

Height	Width	Viewing Area (sq. inches)
8½"	11½"	94

SPEAKER

P.M. Dynamic

Model	Size	V.C. Imped.
9109-A	6" x 9"	3.2 ohms
9109-B	6"	3.2 ohms

ANTENNA INPUT IMPEDANCE

300 ohms—balanced to ground.

BUILT-IN ANTENNA

High "Q" dipole with tunable matching stub.

R. F. TUNER

Turret type construction; individually removable coil assemblies for all channels. All components are easily accessible for servicing.

"KEYED" AUTOMATIC GAIN CONTROL

Outstanding new development; minimizes "airplane flutter"; reduces contrast variation when changing from one channel to another; increases immunity of sync system to external interference.

INTERMEDIATE FREQUENCIES

Sound Carrier—22.25 Mc.
Picture Carrier—26.75 Mc.

I.F. SYSTEM

Four Stage—stagger tuned—for composite signal.
Two additional stages for sound channel.

VIDEO AMPLIFIER

Two Stage—broad band.

RETRACE LINE SUPPRESSOR

Eliminates retrace lines thruout the normal range of picture brightness and contrast.

FOCUS

Magnetic

DEFLECTION

Magnetic

HORIZONTAL SYNCHRONIZATION

Automatic frequency control and "keyed" A.G.C. provide excellent picture stability and noise immunity.

HIGH VOLTAGE POWER SUPPLY

"Fly-back" type. Completely enclosed in a shielded compartment.

SENSITIVITY

Antenna to Picture Tube Grid Sensitivity — To make this measurement, connect negative terminal of 1½ volt battery to A.G.C. line, and positive terminal of battery to chassis. Also, set Contrast control to maximum clockwise position. Connect an **A.C.** vacuum-tube voltmeter between picture tube grid and ground, and place a .005 microfarad condenser across the same points.

Inject R.F. signal (400 cycle modulated) at antenna terminals, using signal whose frequency corresponds to the center frequency of the selected channel, and adjust Fine Tuning control for maximum output. Generator must be connected to antenna terminals with a 150 ohm carbon resistor in series with each lead to simulate proper impedance match.

Input signal required to produce standard output of 7.07 volts **A.C.** (r.m.s.) at picture tube grid is indicated in the following table. Since a fixed bias of 1½ volts has been applied to the A.G.C. system in order to provide a reference level for these measurements, it will be understood that the sensitivities specified here are not intended to indicate the full capability of the receiver, but merely serve as a convenient basis for determining proper operation.

Low Band { Average—50 microvolts; Range—25 to 100 microvolts

High Band { Average—80 microvolts; Range—40 to 160 microvolts

Detector to Picture Tube Grid Sensitivity — To make this measurement, remove 6AU6, 4th Video I.F. tube (V-10) and set Contrast control to maximum clockwise position. Inject a 400 cycle (audio) signal across 6800 ohm video detector load resistor. In order to produce the standard output of 7.07 volts **A.C.** (r.m.s.) at the picture tube grid, the input signal at the detector load resistor will be approximately .07 volts **A.C.** An **A.C.** vacuum-tube voltmeter must be used for these voltage measurements.

Sound System Sensitivity — Inject 4.5 megacycle frequency modulated signal (400 cycle modulation with 7½ Kc. deviation) across video detector load resistor and measure output at speaker voice coil. An input of 2200 microvolts will produce approximately 500 milliwatts or 1.26 volts across speaker voice coil.

HORIZONTAL SYNC SYSTEM ADJUSTMENT

If picture "tears" horizontally and cannot be synchronized by operating the Horizontal Hold control on front panel of receiver, this action may be due to incorrect setting of the slug in the Horizontal Lock Coil.

1. Set Horizontal Hold control in center of its range.
2. Adjust slug of Horizontal Lock Coil for picture synchronization (see Fig. 18 for location of slug).

REDUCTION OF INTERCARRIER BUZZ

If a prominent humming or buzzing sound is noted in the sound reception of a television broadcast, it may be due to a fault in transmission from the station, or incorrect adjustment of the discriminator transformer (tuning of secondary circuit) in the receiver.

This type of disturbance, which is only present when receiving a station signal, is known as "Intercarrier Buzz" and it should not be confused with power supply hum that would occur upon failure of a filter condenser.

The procedure for correct adjustment of the television sound discriminator circuit is presented in the last section of the Television Sound Channel alignment instructions. When the discriminator secondary slug #1 is properly adjusted, intercarrier buzz will be reduced to an acceptable minimum, provided that the transmission from the station is not at fault.

HIGH VOLTAGE POWER SUPPLY SERVICING

The High Voltage Power Supply used with this receiver is of the "fly-back" type and is located in the shielded compartment mounted at the left rear corner of the chassis. It consists of a sturdily constructed and well insulated horizontal sweep output transformer plus a 1B3GT/8016 high voltage rectifier tube and associated filter components.

The plate circuit of the Horizontal Scanning Output stage is fused to protect the transformer and kill high voltage in the event the 6BQ6GT tube or the high voltage rectifier circuit draws excessive current.

CAUTION

> The heavily insulated red lead, which supplies extremely high voltage (10 to 12.5 kilovolts) to the picture tube, should be momentarily shorted to the chassis whenever it is disconnected for service purposes (that is, after receiver has been turned off). This discharges the high voltage filter condenser and prevents a shock hazard when working on the set.

Access to the horizontal output transformer, high voltage rectifier tube, fuse and high voltage filter condenser is accomplished by removing the rear section of the H.V. shield. This compartment shield is held in place by five screws.

To replace the fuse, depress the cap of the fuse holder (located next to 6BQ6GT tube) and turn the cap counter-clockwise. Install new fuse of the same type (¼ amp., 250 volt, part 508713); do not use any other size.

REMOVAL OF THE CABINET BACK AUTOMATICALLY OPENS AN INTERLOCK TO DISCONNECT THE RECEIVER POWER CORD.

CORONA AND ARC-OVER

Corona or arc-over can best be detected by observing the operation of the power supply in a dark room. Several conditions may cause these phenomena.

POOR CONNECTIONS — Arcing or corona may be due to poorly soldered connections (rosin joints or sharp points), or defective tube socket connections. If the leads or connectors to the high voltage filter condenser do not grasp this component securely, arcing will also result.

Inspect solder connections and resolder those joints which are unsatisfactory. Make sure tubes are firmly positioned in tube sockets and that high voltage filter condenser is held securely in place.

CLOSELY SPACED COMPONENTS — Arcing or corona may occur when H.V. components or leads are placed too close together. Make sure there is sufficient spacing between all parts and wiring. If necessary, the insulation between two elements of the circuit may be improved by coating both objects with a quick-drying liquid polystyrene or polyethylene.

The socket assembly for the 1B3GT/8016 rectifier tube includes a "corona ring" which prevents corona from the tube socket connections. The surface of this ring should be smooth and free of scratches, nicks, or sharp protrusions.

PICTURE TUBE REPLACEMENT

INTERCHANGEABLE TYPES—Two types of picture tubes are used interchangeably in all model 9109 receivers and they differ only in the manner in which their electron guns are constructed. The 14CP4 tube utilizes a bent gun, while the 14BP4 tube contains a straight gun.

It is preferable to use a replacement tube of the same type as that originally furnished with the particular receiver on which you are working. Substitution of a 14BP4 for a 14CP4 or vice versa (as well as slight manufacturing variances between tubes produced by different suppliers) can occasionally give rise to a focusing or centering problem. Suggested remedies for those conditions are discussed in a subsequent paragraph.

REPLACEMENT PROCEDURE—When replacement of a picture tube is necessary, proceed as follows:

1. Disconnect power cord from wall outlet.
2. Remove chassis from cabinet.
3. Remove high voltage lead from side of picture tube and **momentarily short this lead to chassis to discharge high voltage filter condenser.**
4. **Discharge the voltage developed across the capacitor formed by the inner and outer coatings of the picture tube by connecting the high voltage socket on the tube to the outer coating.**
5. Remove the tube socket at base of picture tube.
6. Disengage ion trap from neck of tube.
7. Release three nuts labeled A in Fig. 18 and carefully remove Focus Coil and Focus Coil Mounting Plate. Slide large springs off the studs on the Deflection Yoke Mounting Bracket.
8. Remove Centering Magnet Assembly.
9. Loosen the two bolts on the ends of the Strap Assembly that encircles the front rim of the tube.
10. Carefully remove picture tube by pulling it forward.
11. Install the new tube and be sure that it has the same type number as the tube that is being replaced. Also be sure that Focus Coil Mounting Plate is replaced so that the two focus coil leads point downward.

SPECIAL FOCUSING AND CENTERING INSTRUCTIONS—If correct focusing or centering of the picure cannot be accomplished after installing a replacement picture tube, then the following recommendations should prove effective.

1. Slide Centering Magnet Assembly as close to Deflection Yoke as possible, then recheck focusing and centering.
2. If picture still will not focus, remove Centering Magnet Assembly from its position in front of the Focus Coil and then reinstall it on the neck of the tube but located behind the focus coil. In some instances, proper focus can only be obtained by completely removing the Centering Magnet Assembly.
3. If picture cannot be centered by adjusting the position of the Focus Coil and Centering Magnet Assembly, then remove tube and reinstall it so that the high voltage socket is on the **left** side of the tube when viewed from the rear.

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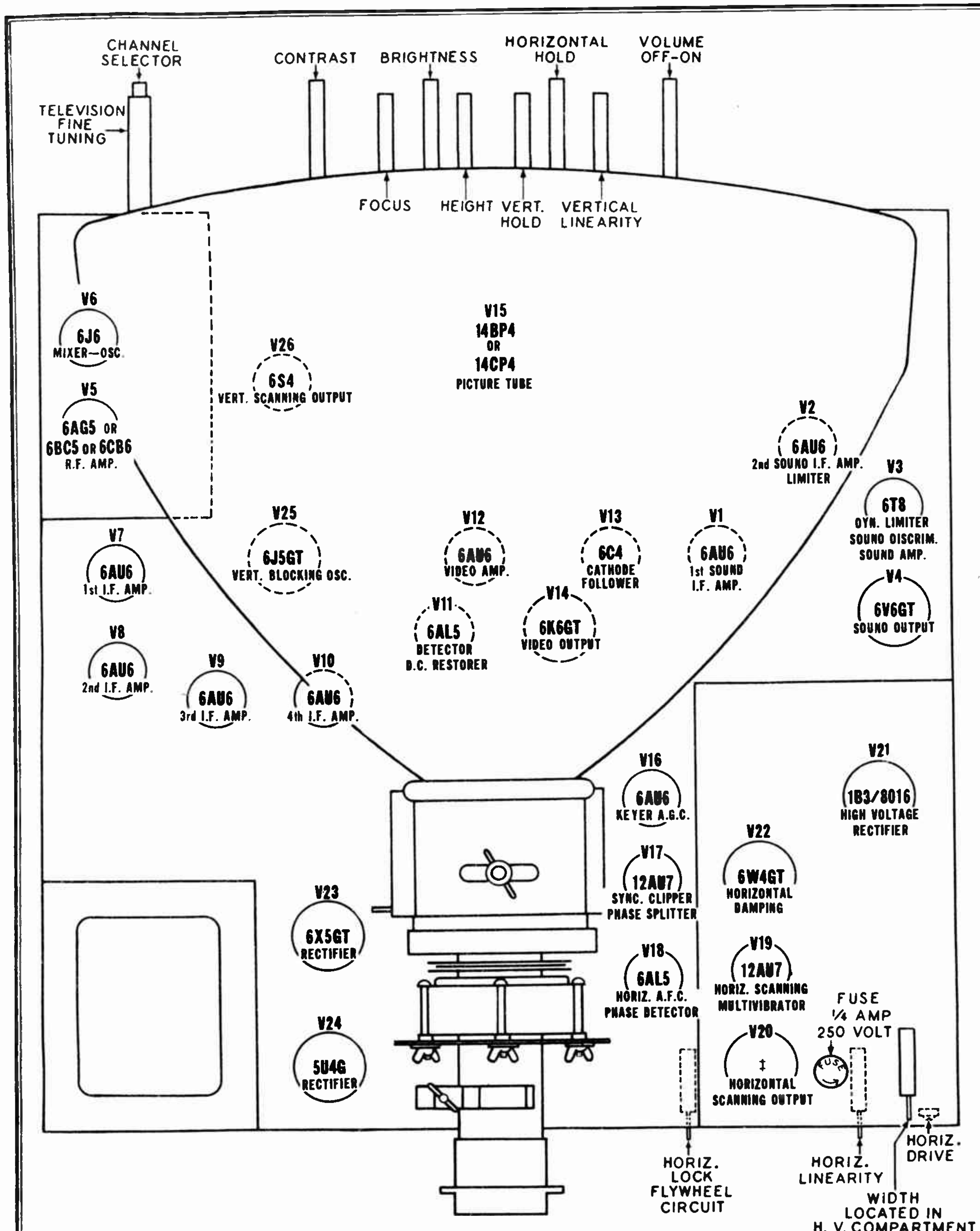

‡ Two different type Horizontal Scanning Output tubes are used in this receiver. All "uncoded" chassis contain a 6BQ6GT tube, while all chassis stamped "Series A" utilize a 6CD6G tube. These tubes are not interchangeable and failure to install the correct type tube may result in serious damage to the receiver.

CAUTION

THE PICTURE TUBE is highly evacuated and if broken, glass fragments will be violently expelled. Scratching, chipping, undue pressure, or careless handling such as lifting the tube by its neck is dangerous and should be avoided. If it is necessary to handle the picture tube, use safety goggles and heavy gloves. Be sure to discharge the voltage developed across the capacitor formed by the inner and outer coating of the picture tube. This can be done by connecting the high voltage socket on the tube to the outer coating with a well insulated metal conductor.

HIGH VOLTAGE (10 to 12.5 kilovolts) is produced in a supply circuit of this receiver. Exercise care to avoid contact with elements of this circuit and particularly the tube terminals which are labeled "CAUTION" in the adjoining voltage chart. If measurement of voltage at these points is necessary, see procedure given below under the note "E".

THE HIGH VOLTAGE LEAD, which supplies approximately 10 to 12.5 kilovolts to the picture tube, should be momentarily shorted to the chassis whenever it is disconnected for service purposes. This discharges the high voltage filter condenser and prevents a shock hazard when working on the receiver after it has been turned off.

INTERMEDIATE B+ VOLTAGES, 455 and 355, are dangerous and caution should be observed when the receiver chassis components are exposed for service purposes.

THE VOLTAGES SHOWN IN THE ADJOINING CHART WERE MEASURED UNDER THE FOLLOWING CONDITIONS

1. Power Supply—117 volts 60 cycle AC.

2. All voltages are measured between socket terminals and chassis unless otherwise indicated on adjoining chart.

*

3. Measurements made with voltmeter having sensitivity of 1000 ohms per volt except where indicated by (*). The (*) symbol designates a vacuum tube voltmeter measurement.

4. Channel Selector and Fine Tuning Controls set for normal reception of a local station.

5. Focus control set to maximum counter-clockwise position unless otherwise instructed by Note V on voltages in adjoining chart. Setting of this control will affect B+ voltage on the 260 volt supply line. This voltage is obtained when control is at maximum counter-clockwise position and increases to 300 as control is rotated to clockwise position.

6. All other controls (with exception of focus control) are set for normal reception of the transmitted signal unless the voltage shown on the chart is followed by a letter or letters indicating a special condition of measurement as explained in subsequent notes.

7. Certain voltages were measured with two different settings of specific controls. It should therefore be understood that in these instances all controls, with the exception of one or two, were set for normal reception—letters following the voltage shown on the chart indicate the exceptions and are explained below.

8. The external or built-in antenna should remain connected to the receiver only when taking voltage measurements in the sweep and sync circuits—for all other measurements, disconnect antenno, short antenna terminals together and connect them to ground.

EXPLANATION OF NOTES

A. Vert. Hold Control max. counter-clockwise

a. This voltage will vary from —4.7 to —9.5 depending upon setting of Horizontal Hold Control and Horizontal Lock Control.

B. Brightness Control max. counter-clockwise

b. This voltage will vary from 13 to 17 depending upon setting of Horizontal Hold Control and Horizontal Lock Control.

C. Contrast Control max. clockwise

D. Horiz. Drive Control max. clockwise

d. This voltage will vary from 280 to 310 depending upon setting of Horizontal Hold Control and Horizontal Lock Control.

E. If you do not have an instrument capable of directly measuring voltages in this range, the voltage can be measured by using a voltage divider network consisting of twenty 2.2 megohm 2 watt resistors and one 1 megohm 2 watt resistor, all connected in series. Avoid using resistors of higher values as their individual voltage rating may be exceeded. It is also important to use resistors of equal wattage. Solder all connections between resistors. Accurately measure the overall resistance of the entire combination as well as the resistance of the 1 megohm section.

With the set turned off, connect the 2.2 megohm end of the resistance voltage divider to the filament of the 1B3GT/8016 tube, or H. V. terminal of the picture tube, and connect the 1 megohm end to chassis. Now, turn the set on and measure the voltage drop across the 1 megohm resistor with a vacuum tube voltmeter. The voltage at the tube terminal can then be calculated as follows:

$$\left[\text{Volts At Tube Terminal}\right] = \left[\frac{\text{Measured Resistance Of Entire Voltage Divider}}{\text{Measured Resistance Of 1 Meg. Section}}\right] \times \left[\text{Volts Measured Across 1 Meg. Section}\right]$$

e. This voltage will vary from +6.8 to —1.6 depending upon setting of Horizontal Hold Control and Horizontal Lock Control.

F. Height Control max. counter-clockwise

f. Contrast Control max. counter-clockwise

G. Width Control max. counter-clockwise

g. This voltage will vary from 10 to 16 depending upon setting of Horizontal Hold Control and Horizontal Lock Control.

H. Height Control max. clockwise

h. This voltage will vary from +0.06 to —0.04 depending upon setting of Horizontal Hold Control and Horizontal Lock Control.

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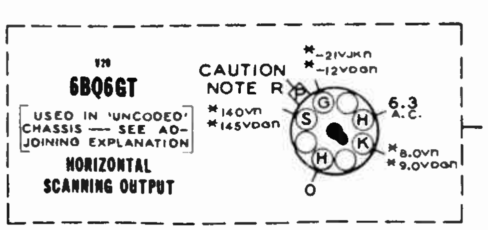
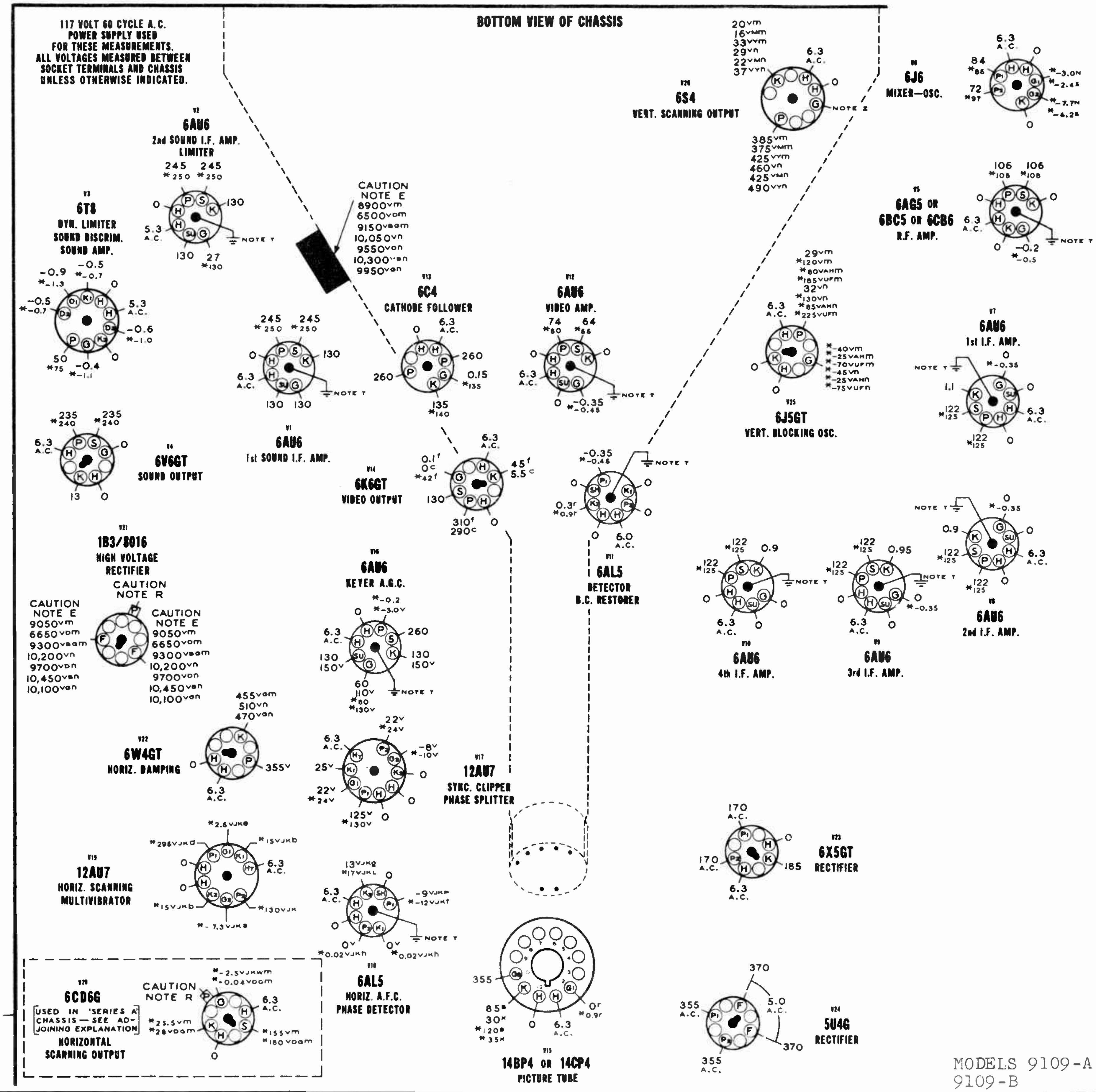
EXPLANATION OF NOTES

(Continued from preceding page)

J.	Horiz. Hold Control set for normal picture.
K.	Horiz. Lock Control set for normal picture.
L.	This voltage will vary from 13 to 21 depending upon setting of Horizontal Hold Control and Horizontal Lock Control.
M.	Vertical Linearity Control max. counter-clockwise.
m.	This voltage applies only to chassis stamped "Series A."
N.	Channel Selector set to channel #4
n.	This voltage applies only to "uncoded" chassis, not to units stamped "Series A," etc.
P.	This voltage will vary from —6 to —12 depending upon setting of Horizontal Hold Control and Horizontal Lock Control.
R.	Do not attempt to measure the voltage at the tube cap. There is a high R. F. potential at this point.
r.	Before making this measurement, remove one of the four 6AU6 IF Amplifier tubes (V7, V8, V9 or V10). This will prevent noise in the RF stages from affecting the voltage measured at this point.
S.	Channel Selector set to channel #10
T.	Grounding of center stud on tube socket is necessary to reduce capacity coupling between other pins. Oscillation may result if this ground is omitted.
t.	This voltage will vary from —8 to —16 depending upon setting of Horizontal Hold Control and Horizontal Lock Control.
U.	Vertical Hold Control max. clockwise
V.	Before measuring this voltage, first connect external antenna and adjust controls for normal reception of station signal; then set Focus Control to maximum counter-clockwise position.
W.	This voltage will vary from —2 to —3 depending upon setting of Horizontal Hold Control and Horizontal Lock Control.
X.	Brightness Control max. clockwise.
Y.	Vertical Linearity Control max. clockwise.
Z.	The measurement should be made with a vacuum tube voltmeter. The voltage reading will fluctuate in the vicinity of 0.05 volts.



Two different type Horizontal Scanning Output tubes are used in this receiver. All "uncoded" chassis contain a 6BQ6GT tube, while all chassis stamped "Series A" utilize a 6CD6G tube. **These tubes are not interchangeable and failure to install the correct type tube may result in serious damage to the receiver.**



MODELS 9109-A, 9109-B

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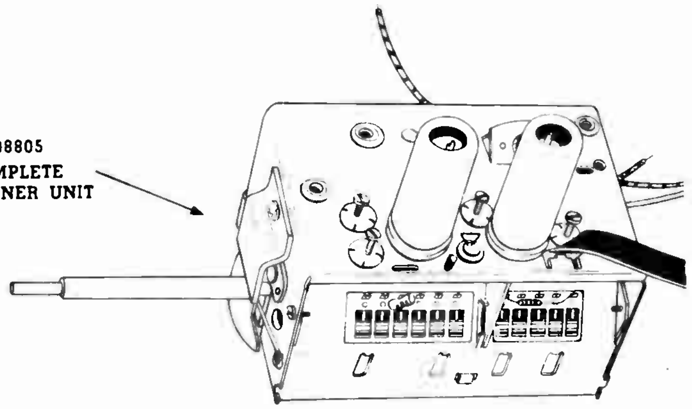
REPAIR DATA FOR 508805 RF TUNER UNIT

All replacement parts for the RF Tuner Unit are included in the complete receiver parts list.

This RF Tuner Unit consists of an RF amplifier stage (using 6AG5, 6BC5, or 6CB6 tube) and a mixer-oscillator stage (using 6J6 tube). Channel selection is accomplished by rotation of a turret assembly having 2 sets of snap-in coils for each of the 12 channels. The tuner also incorprates a Fine Tuning control.

Antenna Coils for each channel consist of a center-tapped primary and an RF amp. grid winding (secondary). The individual RF-Oscillator Coils include an RF amplifier plate section, a mixer grid section and an oscillator winding. Signal output from the mixer stage is coupled to the IF amplifiers through the input IF coil located on the tuner unit.



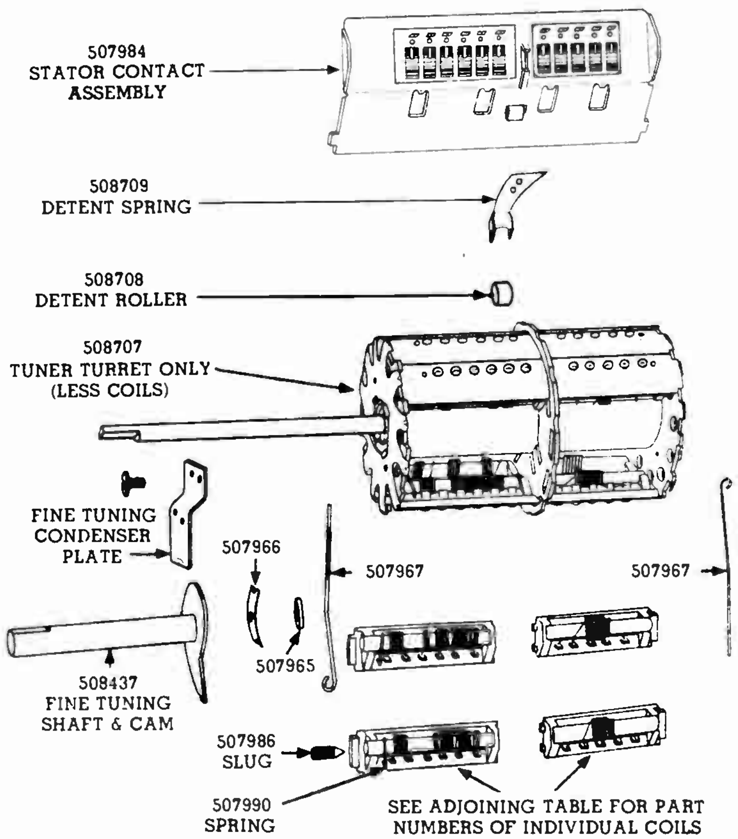
SERVICE PRECAUTIONS

SUBJECT	PRECAUTIONS
ELECTRICAL COMPONENTS	The high frequencies used in the RF section of a television receiver make it necessary that considerable care be exercised in servicing the tuner. Lead dress and location of components are very critical at these frequencies. When replacing parts, it is important to use components of identical electrical characteristics and physical size. Always reconnect the replacement item in the same location and position in the tuner as the original component.
TUBES	Replacement of tubes in the Tuner Unit may cause slight detuning of RF circuits due to inherent differences in inter-electrode capacitances. When replacing tubes (especially V6, 6J6 mixer-oscillator tube) make sure that Fine Tuning control will tune in television stations at approximately the middle of its range. It may be necessary to change the setting of the individual oscillator coil slugs for some channels to accomplish this.
CHANNEL COILS AND SLUGS	Channel Coils must be handled with care. Do not disturb coil windings. If an oscillator slug "falls into" its coil form during adjustment, remove the Channel Coil from the turret assembly and lift the Slug Retaining Spring aside. By tapping the coil form it should be possible to make the slug move toward the end so that its threads will be engaged by the Slug Retaining Spring when that spring is returned to its normal position.
FINE TUNING CONTROL	Rubbing of the bakelite Fine Tuning Cam against the Fine Tuning Condenser Plate is intentional in order to avoid vibration with resulting microphonics. However, the Fine Tuning Cam should not rub or contact the small circular plate located on the body of the tuner.

REMOVAL AND REPLACEMENT OF PARTS

ITEM	PROCEDURE
RF TUNER UNIT	To remove the Tuner Unit from receiver chassis, proceed as follows: 1. Remove metal plate which covers side of RF Tuner Unit nearest edge of chassis. This plate is held in place by two screws at side of chassis. 2. Remove channel selector dial lamp socket. 3. Remove support bracket which positions front of Tuner Unit and also remove screws which hold tuner to rear support bracket. 4. Disconnect the leads from the tuner to the main chassis. See illustration on page 21, 22 (circuit diagram page) showing tuner connections. After the Tuner Unit is replaced, make sure that channel selector dial lamp socket is correctly positioned so that channel selector knob will be properly illuminated.
CHANNEL COILS	Insert a screwdriver blade between Coil Retainer Spring and the end of the Tuner Turret. Twist the blade to pull spring away from the molded body of Channel Coil. Lift this end of coil body upward and remove individual coil assembly from tuner. When replacing Channel Coils, be sure they are reinstalled in their correct positions. Coil numbers should increase consecutively in a counter clockwise direction when tuner is viewed from the front. If all the Channel Coils have been removed from the Tuner Turret, rotate turret until flat surface on end of tuner shaft points down. Install #3 Channel Coils into bottom position on turret. Then follow the correct sequence indicated above to replace other coils.

ITEM	PROCEDURE
TUNER TURRET ASSEMBLY	To remove turret from RF Tuner Unit, proceed as follows: 1. Remove tuner from receiver chassis. 2. Remove rear Turret Shaft Retaining Spring by disengaging straight end of spring from projection on tuner. 3. Remove Fine Tuning Condenser Plate from front of Tuner Unit. This plate forms one side of Fine Tuning control condenser and is held in place by one screw. 4. Slide Fine Tuning Cam and Brass Shaft off of main Channel Selector Shaft. 5. Remove Contactor Washer Spring and Fiber Spacer Washer from Channel Selector Shaft. 6. Remove Shaft Retaining Spring at front of tuner by disengaging straight end of spring from projection on case. 7. Remove turret assembly from case. To replace turret, reverse the above procedure. Tooth on bakelite Fine Tuning Cam should point downward during assembly so that it does not become locked between the stops on the Fine Tuning Condenser Plate.
STATOR CONTACT ASSEMBLY	To remove this assembly, proceed as follows: 1. Remove the two screws at the front and rear of the Stator Contact Assembly. 2. Unsolder all electrical connections to contact plate. 3. Unsolder five soldered joints between Stator Contact Assembly and Tuner Unit. 4. Contact Assembly may now be withdrawn from case. **To reinstall this assembly:** 1. Place Stator Contact Assembly in position and replace, but do not tighten, the two screws at the front and rear of the assembly. 2. Remove 3 consecutive pairs of Channel Coils from the turret (for example, the antenna and rf-osc. coils for channels #5, 6 and 7). 3. Position Tuner Turret so that the edges of the next highest Channel Coils (in this case, the coils for channel #8) just pass the row of 11 contacts on the Stator Contact Assembly. 4. Adjust position of the Stator Contact Assembly so that there are a few thousandths of an inch spacing between the contacts on the contact plate and the molded body of the Channel Coils. 5. The Contact Assembly is now correctly positioned and screws at front and rear may be tightened. 6. Solder Stator Contact Assembly to tuner frame at same points that were used previously. 7. Make all electrical connections to contact plate. 8. Replace Channel Coils.



CHANNEL NUMBER	ANTENNA COIL PART NUMBER	RF & OSC COIL PART NUMBER
2	507952	507972
3	507953	507973
4	507954	507974
5	507955	507975
6	507956	507976
7	507957	507977
8	507958	507978
9	507959	507979
10	507960	507980
11	507961	507981
12	507962	507982
13	507963	507983

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ALIGNMENT PROCEDURE

MODELS 9109-A & 9109-B

Alignment of all RF and IF tuned circuits in this receiver may be accomplished by utilizing the procedures described in the following charts.

SEQUENCE OF ALIGNMENT: These procedures should preferably be applied in the order in which they are presented, however, alignment of the Sound Channel or IF Channel may be accomplished individually if desired.

The RF Amplifier and Mixer alignment may also be accomplished independent of Sound or IF Channel alignment, but oscillator calibration can only be done after IF Channel has been correctly aligned. Proper IF band pass characteristic is necessary for Oscillator alignment as results of RF circuit tuning are observed by means of an oscilloscope connected to the output of the detector stage.

REMOVAL OF CHASSIS: The receiver chassis must be removed from the cabinet in order to accomplish alignment of all tuned circuits as there are adjustment points located on the underside of the unit.

This can be accomplished by first removing all knobs and disconnecting the receiver "built-in" antenna and speaker. The chassis may then be removed by releasing the hold-down screws located on the underside of the cabinet.

Removal of the cabinet back automatically opens an interlock to disconnect the receiver power cord, therefore, an auxiliary power cord assembly will be required when aligning this receiver. This cord may be ordered from Stewart-Warner by requesting Part #507699. **Do not attempt to supply power to the receiver by using any other device.**

CAUTION

The picture tube is highly evacuated and if broken, glass fragments will be violently expelled. Handle with care, using safety goggles and gloves. Avoid contact with high voltage terminal at side of tube even after it has been disconnected from the receiver— this precaution is necessary as inner and outer coatings on the tube form a capacitor which may carry a high voltage charge for an extended period of time after disconnection from the receiver.

The metal plate which covers the side of the RF tuner unit must be removed for IF alignment as IF signal injection is accomplished at a terminal located behind this plate (see Fig. 4). That plate must be replaced when RF alignment is undertaken.

INSTRUMENTS: The following instruments will be required as signal sources and output indicators during the alignment process. Since accurate alignment of a television receiver is heavily dependent upon the performance of your instruments, it is imperative that they meet the essential specifications described here.

1. **STANDARD SIGNAL GENERATOR** to provide unmodulated (pure RF) signals at the following frequencies. Maximum output on all ranges should be at least .1 volt with provision for attenuation as desired. This instrument must have good frequency stability and be accurately calibrated. Generators which incorporate a separate crystal controlled oscillator and heterodyne circuit are self calibrating and therefore capable of providing the accuracy of frequency calibration required for television circuit alignment.

   a. IF Frequencies:
   - 4.5 Mc. Sound Channel
   - 22.25 Mc. Sound IF marker
   - 22.4 Mc. 1st IF Trap Coil
   - 22.8 Mc. 3rd IF Trap Coil
   - 23.5 Mc. 1st and 3rd IF stages
   - 24.5 Mc. 4th IF stage
   - 26.3 Mc. Converter and 2nd IF stages
   - 26.75 Mc. Picture IF marker

   b. RF Frequencies:
   - 54 to 88 Mc.
   - 174 to 216 Mc.

2. **RF SWEEP GENERATOR** to provide frequency modulated signals at the following frequencies:
   - 20 to 30 Mc. with 10 Mc. sweep width.
   - 54 to 88 Mc. with 10 Mc. sweep width.
   - 174 to 216 Mc. with 10 Mc sweep width.

   Output adjustable with at least .1 volt maximum.

   Output should be "flat" (no amplitude variation) for all settings of the sweep width control.

   Provision for connection of generator sweep modulating voltage to horizontal deflection system of an oscilloscope.

   Provision for blanking the output signal on each return sweep so that oscillogram will not show retrace.

3. **CATHODE RAY OSCILLOSCOPE**, preferably a unit with vertical amplifier having wide range frequency response and low capacity pick-up probe.

4. **VACUUM TUBE VOLTMETER.** The lowest voltage range of this instrument should preferably permit a 1.0 volt reading to be indicated at not less than one third of full scale deflection.

INSTRUMENT CONNECTIONS: The method of connection, including details of matching and coupling networks, for instruments used in this alignment procedure is given in several illustrations on subsequent pages. Specific instructions for each instrument application will be found in various sections of the alignment charts.

GENERAL INSTRUCTIONS: When aligning IF and RF circuits it is necessary to apply a fixed bias voltage to the AGC system of the receiver. This fixed bias is obtained by using a 3 volt battery and connecting it as described in Fig. 14.

IMPORTANT

When observing the receiver band pass characteristic on an oscilloscope, it is exceedingly important to avoid distortion of that characteristic which would occur when using a large input signal from the sweep generator or standard generator (marker signal). Always set attenuator on sweep generator so that the reading on the vacuum tube voltmeter does not exceed one volt (when meter is connected from high side of video detector load resistor, symbol 139, to receiver chassis). Standard generator output should also be attenuated so that marker signal does not pull or tear the band pass characteristic as shown on the 'scope.

SOUND CHANNEL ALIGNMENT PROCEDURE

1. Short antenna terminals together with a jumper wire.
2. Set receiver Channel Selector to any inactive television channel; other controls may be left at any desired setting.
3. No special aligning tool is required to adjust the cores in the Sound IF and discriminator transformers. The blade of a small screwdriver will fit the slot in these cores, however, the screwdriver should be of a non-metallic or insulated type to prevent detuning when inserted in the transformer can.

STANDARD SIGNAL GENERATOR: CONNECTIONS	STANDARD SIGNAL GENERATOR: FREQUENCY	VTVM CONNECTIONS	MISCELLANEOUS INSTRUCTIONS	TRIMMER OR SLUG	TYPE OF ADJUSTMENT AND OUTPUT INDICATION
Connect as shown in Fig. 1.	**4.5 MC.** unmodulated **IMPORTANT** This signal must be accurate within ¼ of 1% of 4.5 Mc. Check generator calibration against a crystal controlled signal source by "zero beating" (heterodyning) with harmonics of the crystal frequency.	Connect as shown in Fig. 2.	A "swishing" sound may be heard in the speaker during Sound Channel Alignment. This spurious oscillation is caused by horizontal sweep voltage being picked up in the audio system thru stray coupling of instrument leads; it should be disregarded as it will have no effect on alignment of the sound channel.	**#1** Discriminator Secondary	Adjust for maximum reading on VTVM.
				#2 Discriminator Primary	Adjust for maximum reading on VTVM.
				#3 2nd Sound IF Secondary	Adjust for maximum reading on VTVM.
				#4 2nd Sound IF Primary	Adjust for maximum reading on VTVM.
				#5 1st Sound IF Secondary	Adjust for maximum reading on VTVM.
				#6 1st Sound IF Primary	Adjust for maximum reading on VTVM.
Same as above.	Same as above.	Connect as shown in Fig. 3.	Same as above.	**#1** Discriminator Secondary	Note that as slug #1 is rotated, a point will be found where the voltmeter will swing rather sharply from a positive to a negative reading or vice versa. The correct setting of slug #1 is obtained when the meter reads zero as the slug is moved thru this point.

REDUCTION OF INTERCARRIER BUZZ

Slight "dynamic" unbalance of the discriminator secondary can emphasize intercarrier buzz due to incomplete amplitude modulation rejection. Therefore it is vitally important to obtain an accurate setting of the discriminator secondary slug under actual reception conditions.

Disconnect all instruments and then connect an antenna to the receiver to obtain program reception from a local station. If intercarrier buzz is prominent, a slight readjustment of the discriminator secondary slug (#1) should be made to obtain the "dip" point for the buzzing sound. Note that program sound will be clear and free from distortion at this point. Buzz should now be at an acceptable minimum if station transmission is not at fault.

IF CHANNEL ALIGNMENT PROCEDURE

1. A special aligning tool designed to fit the stems on adjustable cores of the IF coils (see points 8, 9, 10 and 11 in Fig. 13) is available and may be obtained from Stewart-Warner by requesting IF Alignment Tool #507479.
2. Turn receiver Channel Selector to television channel #12 and short antenna terminals together with a jumper wire.
3. Remove metal plate which covers side of RF tuner unit nearest edge of chassis. This plate is held in place by two screws on the side of the chassis.
4. Connect a 3 volt battery to the receiver AGC system so that negative terminal of battery connects to the AGC line and positive terminal of battery connects to receiver chassis. See Fig. 14 for convenient point of connection.
5. Note location of IF Trap Coils #12 and #13 by referring to Fig. 14. Before undertaking the alignment of any of the IF stages, Trap Coils #12 and #13 must be detuned so that they do not resonate in the IF pass band. Detuning is accomplished by merely compressing the windings so that they are closely spaced. Failure to detune the Trap Coils can cause the IF system to become regenerative, thereby preventing alignment.
6. If the IF channel is badly misaligned and two or more immediately adjoining IF stages are tuned to the same frequency, oscillation may occur. Such oscillation shows up as a voltage across the video detector load resistor, symbol 139, and is indicated by the VTVM that is connected to this point during alignment. It should be noted

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INSTRUMENT CONNECTIONS FOR SOUND CHANNEL ALIGNMENT

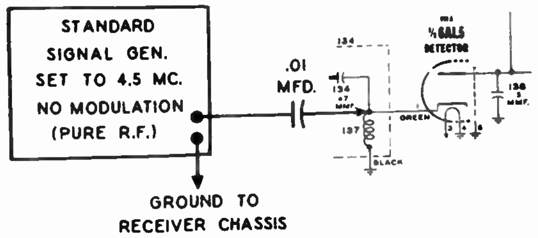


FIG. 1

Generator Connections for Sound Channel Alignment

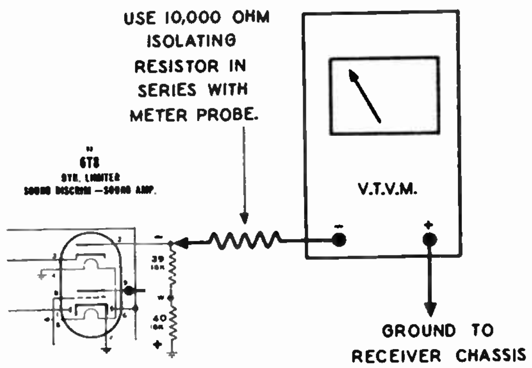
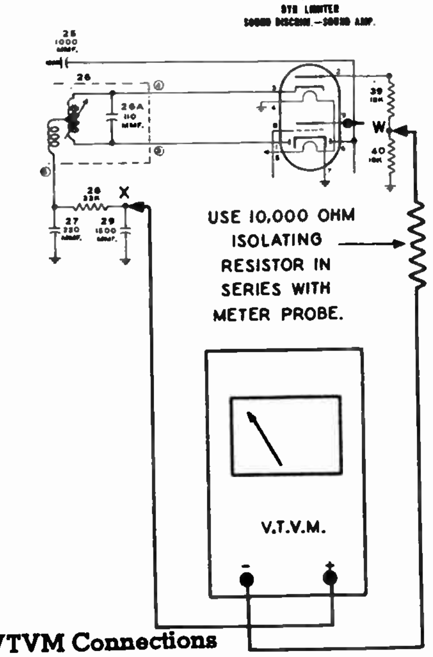


FIG. 2

VTVM Connections for Sound IF Alignment



VTVM Connections for Sound Discriminator Alignment

FIG. 3

INSTRUMENT CONNECTIONS FOR IF CHANNEL ALIGNMENT

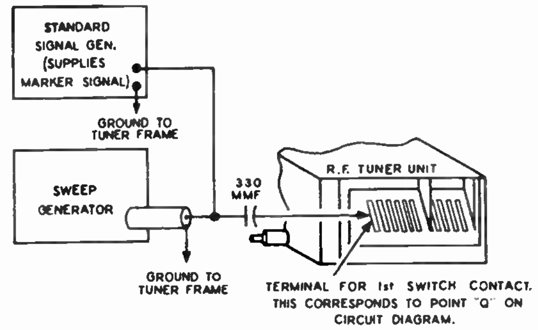


FIG. 4

Generator Connections for IF Channel Alignment

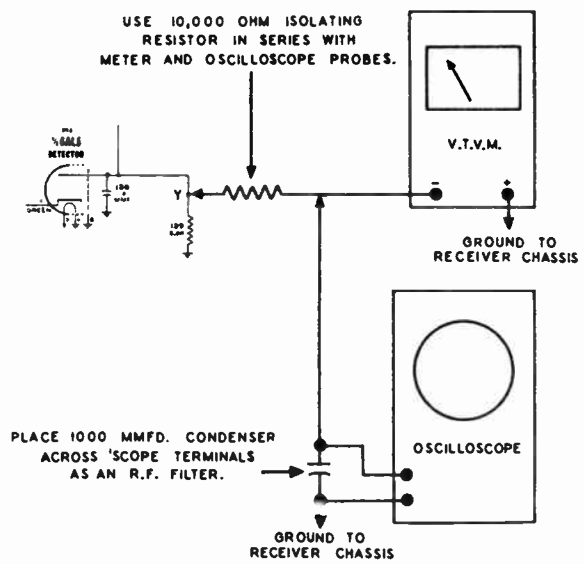


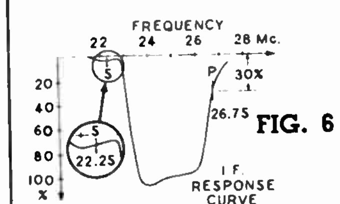
FIG. 5

VTVM and Oscilloscope Connections for IF Channel Alignment

IF CHANNEL ALIGNMENT PROCEDURE

that voltage due to IF oscillation is unaffected by strength of signal from the generator.

Where IF oscillation is encountered, it is generally possible to correct the condition by detuning the IF coils in different directions. If that does not have the desired effect, increase fixed bias on AGC line by using a 4½ volt battery instead of the 3 volt battery referred to in instruction #4. After stopping the oscillation in this manner it will then be possible to align all IF stages using the following procedure, however, the AGC bias battery must be changed back to 3 volts when using the oscilloscope to observe band pass characteristic. Once all stages have been aligned using the 4½ volt bias, the IF channel should be stable with reduced bias.

STANDARD SIGNAL GENERATOR		SWEEP GENERATOR		VTVM CONNECTIONS	OSCILLOSCOPE CONNECTIONS	MISCELLANEOUS INSTRUCTIONS	TRIMMER OR SLUG	TYPE OF ADJUSTMENT AND OUTPUT INDICATION
CONNECTIONS	FREQUENCY	CONNECTIONS	FREQ.					
Connect as shown in Fig. 4.	26.3 MC.	Use a 330 Mmf. isolating condenser and connect as shown in Fig. 4 but keep power switch turned off during this step.	—	Connect as shown in Fig. 5.	Not used.	—	#7 Converter plate coil	Adjust for maximum reading on VTVM.
							#8 2nd I.F.	Adjust for maximum reading on VTVM.
Same as above.	24.5 MC.	Same as above.	—	Same as above.	Not used.	—	#9 4th I.F.	Adjust for maximum reading on VTVM.
Same as above.	23.5 MC.	Same as above.	—	Same as above.	Not used.	—	#10 1st I.F.	Adjust for maximum reading on VTVM.
							#11 3rd I.F.	Adjust for maximum reading on VTVM.
Same as above.	22.4 MC.	Same as above.	—	Same as above.	Not used.	—	#12 1st IF Trap Coil	Adjust the spacing of the Trap Coil windings for MINIMUM reading on VTVM.
Same as above.	22.8 MC.	Same as above.	—	Same as above.	Not used.	—	#13 3rd IF Trap Coil.	Adjust the spacing of the Trap Coil windings for MINIMUM reading on VTVM.
Same as above.	26.75 MC.	With connections made as shown in Fig. 4, turn on this generator and set controls for operation as specified in next column.	25 MC. Sweeping ± 5 Mc.	Same as above.	Connect as shown in Fig. 5	IMPORTANT: 1. Adjust output attenuator on sweep generator so that reading on VTVM is approximately one volt. 2. Set attenuator on standard signal generator so that marker signal does not distort the pattern on the oscilloscope. 3. Be sure that a 3 volt battery is connected to AGC line as specified in instruction #4 at the head of this chart. Do not use a battery of any other voltage.	The IF band pass characteristic now displayed on the 'scope should be compared with the curve shown in Fig. 6. If top of curve is not properly shaped, make a slight readjustment of slug #9. Should that adjustment fail to yield the desired result, then note whether the curve has a peak on the high or low frequency side. Slugs #7 and #8 control high frequency response (26.3 Mc.) and slugs #10 and #11 affect the low frequency response (23.5 Mc.); by making a small change in the settings of the high or low frequency slugs, it will be possible to obtain correct band pass curve.  FIG. 6 The 26.75 Mc. picture IF carrier marker should now appear at the 30% amplitude position on side of the band pass characteristic (see Fig. 6). If position of the marker appears too high or too low, slight readjustment of slugs #7, 8 and 9 is required.	
Same as above.	22.25 MC	Same as above.	Same as above.	Same as above.	Same as above.	Same as above.	Adjust the vertical gain control on the 'scope in order to magnify the sound portion of the response curve. The 22.25 Mc. sound IF carrier marker should appear at the position indicated in Fig. 6. If the position of the sound marker is incorrect, readjust winding spacing of Trap Coils #12 and #13.	

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RF CHANNEL ALIGNMENT PROCEDURE

1. Replace metal plate which covers exposed terminal side of RF tuner unit. This plate was previously removed for IF channel alignment.

2. Connect a 3 volt battery to the receiver AGC system so that negative terminal of battery connects to AGC line and positive terminal of battery connects to receiver chassis. (See Fig. 14 for convenient point of connection.)

STANDARD SIGNAL GENERATOR		SWEEP GENERATOR		VTVM CONNECTIONS	OSCILLOSCOPE CONNECTIONS	MISCELLANEOUS INSTRUCTIONS	TRIMMER OR SLUG	TYPE OF ADJUSTMENT AND OUTPUT INDICATION
CONNECTIONS	FREQUENCY	CONNECTIONS	FREQ.					
RF AMPLIFIER AND MIXER ALIGNMENT								
Connect as shown in Fig. 10.	*209.75 MC. ‡205.25 MC.	Connect as shown in Fig. 10 and set controls for sweep width of 10 Mc. on television channel specified in the next column.	CHANNEL #12	Not used.	Connect as shown in Fig. 11.	Set Channel Selector to #12 — IMPORTANT: Keep output of standard signal generator at a level that provides a readable marker but does not distort the curve that is being observed on the 'scope.	#14 Mixer Grid. / #15 RF Amp. Plate. / #16 RF Amp. Grid.	Adjust these trimmers to obtain properly shaped RF band pass characteristic as shown in Fig. 7. Use Mixer Grid trimmer #14 and RF Amplifier Plate trimmer #15 to obtain correct amplitude of characteristic in vicinity of picture and sound carrier markers. Then adjust RF Amp. Grid trimmer #16 to equalize overall amplitude. Repeat adjustment of trimmers to be sure correct response has been obtained. IMPORTANT: When adjusting trimmers #14, 15 and 16 it will be noted that the band pass characteristic can be broadened by sacrificing amplitude. It is undesirable to overly broaden the curve as that would result in a loss of sensitivity.
Same as above.	*215.75 MC. ‡211.25 MC.	Same as above.	CHANNEL #13	Not used.	Same as above.	Set Channel Selector to #13		The RF band pass characteristic of the other television channels should now be checked without disturbing the settings of trimmers #14, 15 and 16. Adjust the RF sweep generator and marker generator for operation on the other television channels, observing position of both the sound carrier and picture carrier markers.
	*203.75 MC. ‡199.25 MC.		CHANNEL #11			Set Channel Selector to #11		
	*197.75 MC. ‡193.25 MC.		CHANNEL #10			Set Channel Selector to #10		
	*191.75 MC. ‡187.25 MC.		CHANNEL #9			Set Channel Selector to #9		
	*185.75 MC. ‡181.25 MC.		CHANNEL #8			Set Channel Selector to #8		
	*179.75 MC. ‡175.25 MC.		CHANNEL #7			Set Channel Selector to #7		
	* 87.75 MC. ‡ 83.25 MC.		CHANNEL #6			Set Channel Selector to #6		
	* 81.75 MC. ‡ 77.25 MC.		CHANNEL #5			Set Channel Selector to #5		Band pass characteristic of these channels should conform to the RF response curve in Fig. 7. If necessary, a compromise may be obtained to compensate for small variations in channel response by returning to channel #12 and making slight changes in the settings of trimmers #14, 15 and 16.
	* 71.75 MC. ‡ 67.25 MC.		CHANNEL #4			Set Channel Selector to #4		
	* 65.75 MC. ‡ 61.25 MC.		CHANNEL #3			Set Channel Selector to #3		
	* 59.75 MC. ‡ 55.25 MC.		CHANNEL #2			Set Channel Selector to #2		

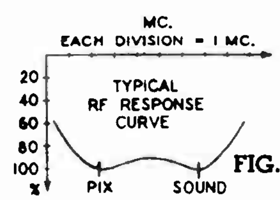

FIG. 7

*Sound Carrier Marker
‡Picture Carrier Marker

(Continued on next page)

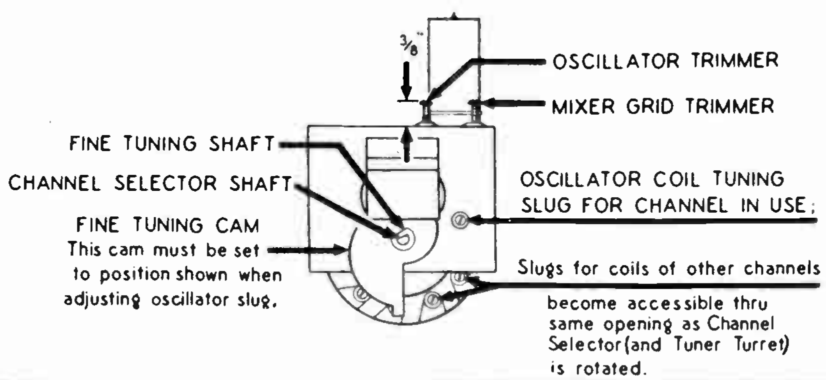

FIG. 8
Front view of
RF Tuner Unit

STANDARD SIGNAL GENERATOR		SWEEP GENERATOR		VTVM CONNECTIONS	OSCILLOSCOPE CONNECTIONS	MISCELLANEOUS INSTRUCTIONS	TRIMMER OR SLUG	TYPE OF ADJUSTMENT AND OUTPUT INDICATION
CONNECTIONS	FREQUENCY	CONNECTIONS	FREQ.					
OSCILLATOR ALIGNMENT								
Connect as shown in Fig. 10.	*209.75 MC. ‡205.25 MC.	Connect as shown in Fig. 10 and set controls for sweep width of 10 Mc. on television channel specified in the next column.	CHANNEL #12	Connect as shown in Fig. 12	Connect as shown in Fig. 12	Set Channel Selector to #12 — Be sure that Fine Tuning control has been properly positioned (tooth on the cam pointing down—see Fig. 8). — During this step and thru-out all succeeding steps it is necessary to: 1. Keep output of sweep generator at a level that does not allow reading on VTVM to exceed one volt. 2. Keep output of standard signal generator at a level that provides a readable marker but does not distort the curve that is being observed on the 'scope.	#17 Oscillator	Adjust height of Oscillator trimmer #17 to be approximately 3/8" from the top of trimmer screw to the top surface of RF tuner unit (see Fig. 8). NOTE: Before making the following adjustment, advance the vertical gain control on the 'scope in order to magnify the sound portion of the response curve. Then, use a non-metallic screwdriver to adjust channel #12 oscillator slug (accessible thru hole on front of RF Tuner Unit—see Fig. 8) and shift response curve so that sound carrier marker is located at the position indicated in Fig. 9. Now, reduce gain control setting of 'scope to restore pattern to normal amplitude and observe position of picture carrier marker. This marker should appear at the 35% amplitude position on the low frequency side of the characteristic curve (see Fig. 9).
Same as above.	*215.75 MC. ‡211.25 MC.	Same as above.	CHANNEL #13	Same as above.	Same as above.	Set Channel Selector to #13		Adjust the RF sweep generator and marker generator for operation on the other television channels; set marker generator to sound carrier frequency. After setting Channel Selector to corresponding channel, adjust oscillator slug thru hole on front of RF Tuner Unit (see Fig. 8). This permits response curve to be shifted so that sound carrier marker will appear at the position indicated in Fig. 9. The picture carrier marker for the corresponding channel should then appear at the 35% amplitude position on the opposite side of the band pass characteristic curve. NOTE: Make sure that cam on fine tuning control shaft remains properly positioned during this step (tooth on the cam pointing downward—see Fig. 8).
	*203.75 MC. ‡199.25 MC.		CHANNEL #11			Set Channel Selector to #11		
	*197.75 MC. ‡193.25 MC.		CHANNEL #10			Set Channel Selector to #10		
	*191.75 MC. ‡187.25 MC.		CHANNEL #9			Set Channel Selector to #9		
	*185.75 MC. ‡181.25 MC.		CHANNEL #8			Set Channel Selector to #8		
	*179.75 MC. ‡175.25 MC.		CHANNEL #7			Set Channel Selector to #7		
	* 87.75 MC. ‡ 83.25 MC.		CHANNEL #6			Set Channel Selector to #6		
	* 81.75 MC. ‡ 77.25 MC.		CHANNEL #5			Set Channel Selector to #5		
	* 71.75 MC. ‡ 67.25 MC.		CHANNEL #4			Set Channel Selector to #4		
	* 65.75 MC. ‡ 61.25 MC.		CHANNEL #3			Set Channel Selector to #3		
	* 59.75 MC. ‡ 55.25 MC.		CHANNEL #2			Set Channel Selector to #2		

1. IMPORTANT: Before undertaking oscillator alignment be sure IF circuits are correctly aligned for band pass characteristic illustrated in Fig. 6.

2. During oscillator alignment, it is necessary to set the Fine Tuning control so that the tooth on the bakelite fine tuning cam points downward (correct position for this control is shown in Fig. 8).

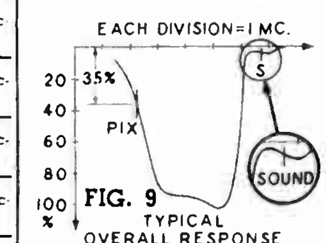

FIG. 9

If an oscillator slug "falls into" its coil form during adjustment, remove the Channel Coil from the turret assembly and lift the Slug Retaining Spring aside. By tapping the coil form it should be possible to make the slug move toward the end so that its threads will be engaged by the Slug Retaining Spring when that spring is returned to its normal position.

If an unsatisfactory overall response is obtained for a particular channel, observe RF Amp. and Mixer response curve for that channel (as described on page 31.) If characteristic does not conform reasonably well with the typical curve shown in Fig. 7, then, (1) attempt to obtain a better compromise for RF response on all channels by realigning RF Amp. and Mixer circuits, or (2) try replacing Antenna, RF and Oscillator coils for the particular channels.

*Sound Carrier Marker
‡Picture Carrier Marker

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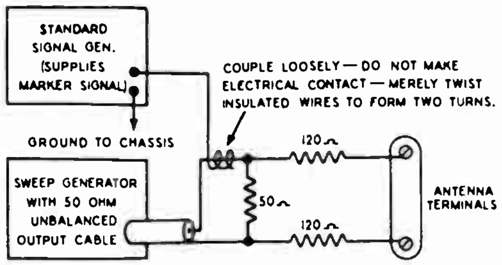

FIG. 10
Generator Connections for RF Channel Alignment

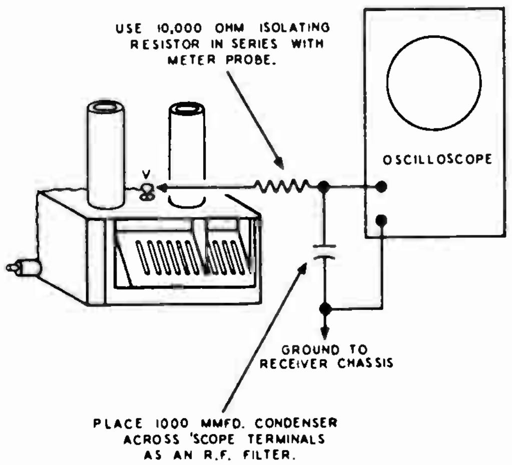

FIG. 11
Oscilloscope Connections for RF Amp. and Mixer Alignment

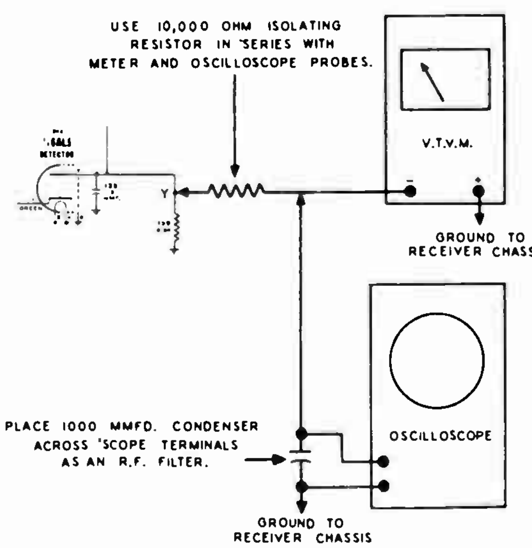

FIG. 12
VTVM and Oscilloscope Connections for Oscillator Alignment

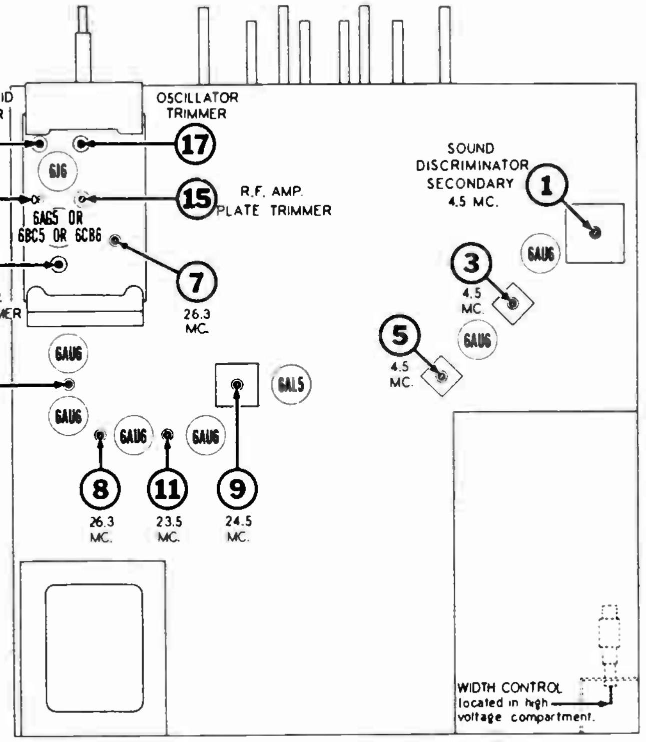

FIG. 13 TOP VIEW OF CHASSIS

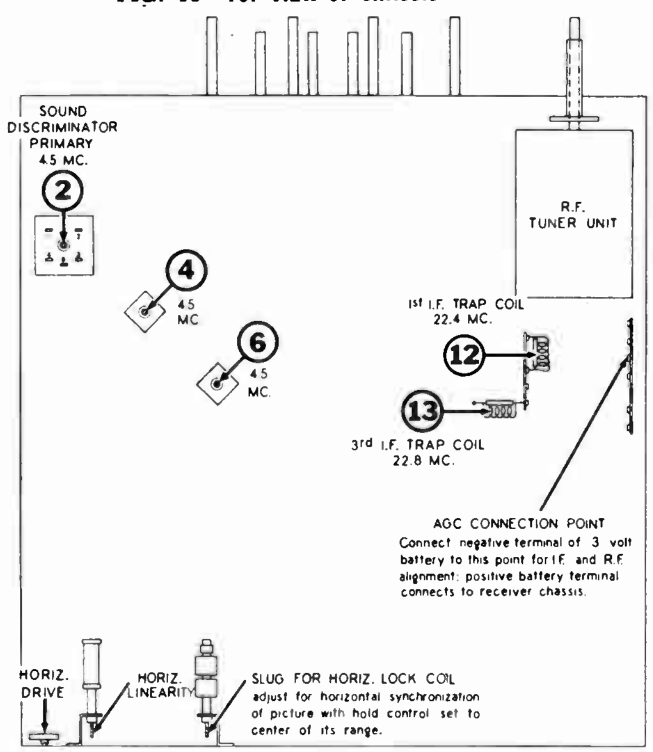

FIG. 14 BOTTOM VIEW OF CHASSIS

NOTICE: Some parts listed below have special characteristics. Do not use substitutes for replacement purposes.

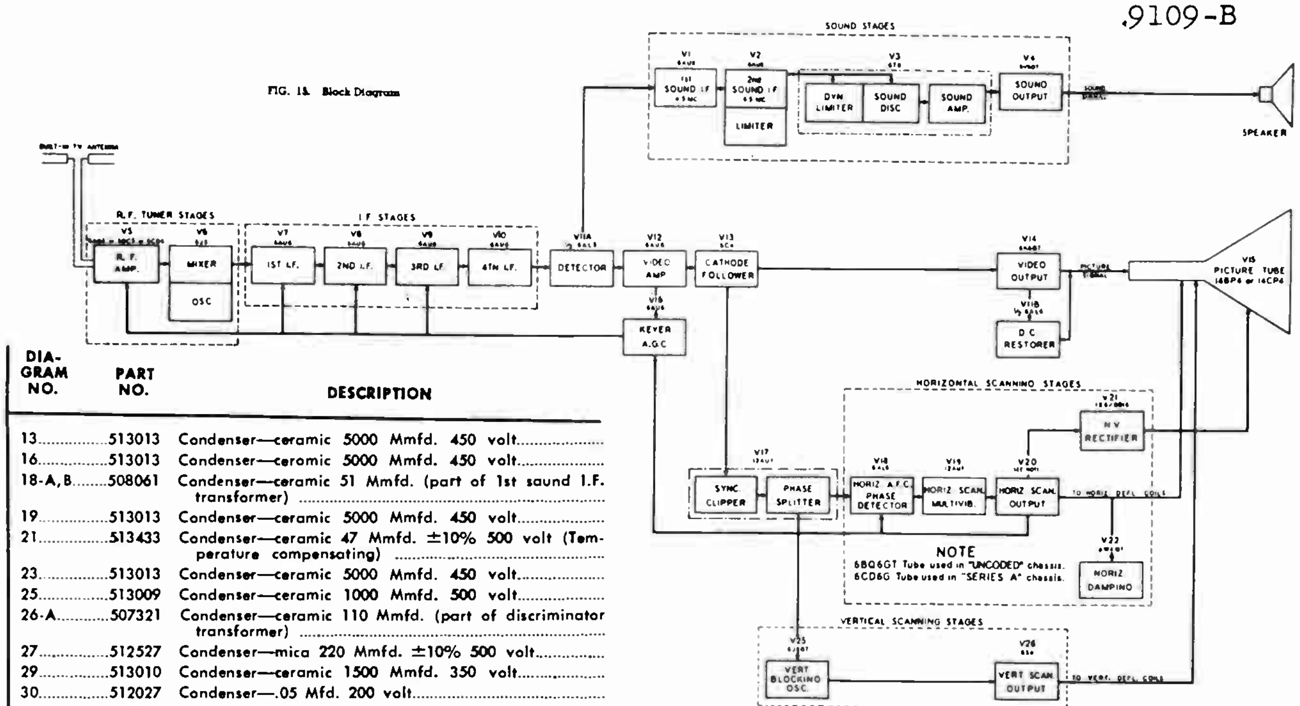

DIAGRAM NO.	PART NO.	DESCRIPTION
		CONDENSERS
11	513001	Condenser—ceramic 2.2 Mmfd. 500 volt
12-A, B	508061	Condenser—ceramic 51 Mmfd. (part of 1st sound I.F. transformer)
13	513013	Condenser—ceramic 5000 Mmfd. 450 volt
16	513013	Condenser—ceramic 5000 Mmfd. 450 volt
18-A, B	508061	Condenser—ceramic 51 Mmfd. (part of 1st sound I.F. transformer)
19	513013	Condenser—ceramic 5000 Mmfd. 450 volt
21	513433	Condenser—ceramic 47 Mmfd. ±10% 500 volt (Temperature compensating)
23	513013	Condenser—ceramic 5000 Mmfd. 450 volt
25	513009	Condenser—ceramic 1000 Mmfd. 500 volt
26-A	507321	Condenser—ceramic 110 Mmfd. (part of discriminator transformer)
27	512527	Condenser—mica 220 Mmfd. ±10% 500 volt
29	513010	Condenser—ceramic 1500 Mmfd. 350 volt
30	512027	Condenser—.05 Mfd. 200 volt
32	512007	Condenser—.005 Mfd. 600 volt
34	512007	Condenser—.005 Mfd. 600 volt
36	505174	Condenser—electrolytic 10 Mfd. 150 volt
41	513010	Condenser—ceramic 1500 Mmfd. 350 volt
42	502547	Condenser—electrolytic 4 Mfd. 150 volt
44	502527	Condenser—electrolytic 50 Mfd. 25 volt
46	504719	Condenser—electrolytic 4 Mfd. 450 volt
48	512003	Condenser—.002 Mfd. 600 volt
52-A, B, C	508072	Condenser—electrolytic A—40 Mfd. 450 volt B—40 Mfd. 450 volt C—40 Mfd. 450 volt
54	508324	Condenser—trimmer 4-70 Mmfd.
69	509064	Condenser—trimmer 3-9 Mmfd. (used only in chassis which do not have Condenser 70)
	507968	Condenser—trimmer 0.5-3 Mmfd. (used only in chassis which have Condenser 70)
70	513432	Condenser—ceramic 5 Mmfd. ± 10% 500 volt (Temperature compensating) (used in some chassis; see note under Condenser 69)
71	513439	Condenser—ceramic 120 Mmfd. ± 5% 500 volt (Temperature compensating)
86	507968	Condenser—trimmer 0.5-3 Mmfd.
87	513442	Condenser—ceramic 10 Mmfd. ± 10% 500 volt (Temperature compensating)
88	•	Condenser 3-5 Mmfd. (Fine Tuning)
89	513440	Condenser—ceramic 100 Mmfd. ± 10% 500 volt (Temperature compensating)
92	507968	Condenser—trimmer 0.5-3 Mmfd.
93	513441	Condenser—ceramic 20 Mmfd. ± 10% 500 volt (Temperature compensating)
94	509063	Condenser—trimmer 0.5-3 Mmfd.
97	513009	Condenser—ceramic 1000 Mmfd. 500 volt
100	513009	Condenser—ceramic 1000 Mmfd. 500 volt
105	512532	Condenser—mica 240 Mmfd. ± 5% 500 volt
106	513009	Condenser—ceramic 1000 Mmfd. 500 volt
109	513016	Condenser—ceramic 82 Mmfd. ± 10% 500 volt
112	513009	Condenser—ceramic 1000 Mmfd. 500 volt
114	513009	Condenser—ceramic 1000 Mmfd. 500 volt
117	513016	Condenser—ceramic 82 Mmfd. ± 10% 500 volt
120	513009	Condenser—ceramic 1000 Mmfd. 500 volt
122	513009	Condenser—ceramic 1000 Mmfd. 500 volt
126	513016	Condenser—ceramic 82 Mmfd. ± 10% 500 volt
127-B	505858	Condenser—ceramic 250 Mmfd. 450 volt; (part of Audio Coupling Unit)
127-C	505858	Condenser—ceramic .005 Mfd. 450 volt; (part of Audio Coupling Unit)
129	508682	Condenser—electrolytic 100 Mfd. 50 volt
133	513009	Condenser—ceramic 1000 Mmfd. 500 volt
136	513433	Condenser—ceramic 47 Mmfd. ± 10% 500 volt (Temperature compensating)
138	513432	Condenser—ceramic 5 Mmfd. ± 10% 500 volt (Temperature compensating)
140	512045	Condenser—.25 Mfd. ± 10% 200 volt
145	512027	Condenser—.05 Mfd. 200 volt
148	512045	Condenser—.25 Mfd. ± 10% 200 volt
150	513003	Condenser—ceramic 100 Mmfd. 500 volt
154	512033	Condenser—.1 Mfd. 200 volt
157	512027	Condenser—.05 Mfd. 200 volt
167, 168	512031	Condenser—.05 Mfd. 600 volt
174	512019	Condenser—.02 Mfd. 600 volt
175	512031	Condenser—.05 Mfd. 600 volt
176	513018	Condenser—ceramic 220 Mmfd. 500 volt
183	513015	Condenser—mica 56 Mmfd. ± 10% 500 volt
187	512045	Condenser—.25 Mfd. ± 10% 200 volt
192, 193	513009	Condenser—ceramic 1000 Mmfd. 500 volt
196	512013	Condenser—.01 Mfd. 600 volt
199	513013	Condenser—ceramic 5000 Mmfd. 450 volt
201	512027	Condenser—.05 Mfd. 200 volt
204	512531	Condenser—mica 3300 Mmfd. ± 5% 500 volt
205	513007	Condenser—ceramic 330 Mmfd. 500 volt
210	512535	Condenser—mica 390 Mmfd. ± 10% 500 volt
211	512536	Condenser—mica 270 Mmfd. ± 10% 500 volt
212	508071	Condenser—trimmer 10-160 Mmfd. (Horizontal Drive Control)
217	508684	Condenser—electrolytic 5 Mfd. 50 volt
219	512031	Condenser—.05 Mfd. 600 volt
223	512538	Condenser—mica 3.3 Mmfd. ± 15% 1500 volt (used in "Uncoded" chassis)
	513435	Condenser—ceramic 15 Mmfd. ± 5% 500 volt (Temperature compensating) (used in "Series A" chassis)
224	508680	Condenser—electrolytic 10 Mfd. 600 volt
227	512031	Condenser—.05 Mfd. 600 volt
230	513024	Condenser—ceramic 500 Mmfd. 20,000 volt
232	512031	Condenser—.05 Mfd. 600 volt
235	512031	Condenser—.05 Mfd. 600 volt
236	512037	Condenser— .1 Mfd. 600 volt
237, 238	512255	Condenser—.01 Mfd. 400 volt
240	513013	Condenser—ceramic 5000 Mmfd. 450 volt
242, 243	513009	Condenser—ceramic 1000 Mmfd. 500 volt
245, 246	513009	Condenser—ceramic 1000 Mmfd. 500 volt
249-A, B	508073	Condenser—electrolytic A—20 Mfd. 300 volt B—60 Mfd. 300 volt
250	513018	Condenser—ceramic 220 Mmfd. 500 volt
251	513009	Condenser—ceramic 1000 Mmfd. 500 volt
256	513009	Condenser—ceramic 1000 Mmfd. 500 volt
258	513009	Condenser—ceramic 1000 Mmfd. 500 volt
260	513013	Condenser—ceramic 5000 Mmfd. 450 volt
262-A	508062	Condenser—ceramic .01 Mfd. 450 volt (part of Integrator Unit)
262-C	508062	Condenser—ceramic 2000 Mmfd. 450 volt (part of Integrator Unit)
262-E	508062	Condenser—ceramic 5000 Mmfd. 450 volt (part of Integrator Unit)

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DIAGRAM NO.	PART NO.	DESCRIPTION
262-G	508062	Condenser—ceramic 5000 Mmfd. 450 volt (part of Integrator Unit)
264	512533	Condenser—mica 4700 Mmfd. ± 5% 1000 volt
273	512308	Condenser—.05 Mfd. ± 10% 600 volt
274	512037	Condenser—.1 Mfd. 600 volt
279	512532	Condenser—mica 240 Mmfd. ± 5% 500 volt
425	513010	Condenser—ceramic 1500 Mmfd. 350 volt
429	512003	Condenser—.002 Mfd. 600 volt
430	513435	Condenser—ceramic 15 Mmfd. ± 5% 500 volt (Temperature compensating) (used in "Series A" chassis)
431	513444	Condenser—ceramic 10 Mmfd. ± 5% 500 volt
432	512542	Condenser—mica 120 Mmfd. ± 10% 500 volt

RESISTORS

DIAGRAM NO.	PART NO.	DESCRIPTION
14	510117	Resistor—carbon 82 Ohms ± 10% ½ watt
17	510137	Resistor—carbon 1000 Ohms ½ watt
20	510185	Resistor—carbon 470,000 Ohms ½ watt
22	510117	Resistor—carbon 82 Ohms ± 10% ½ watt
24	510137	Resistor—carbon 1000 Ohms ½ watt
28	510160	Resistor—carbon 22,000 Ohms ± 10% ½ watt
31	510170	Resistor—carbon 68,000 Ohms ½ watt
35	510197	Resistor—carbon 10 Meg. ½ watt
38	510163	Resistor—carbon 33,000 Ohms ± 10% ½ watt
39, 40	510159	Resistor—carbon 18,000 Ohms ± 10% ½ watt
45	510227	Resistor—carbon 330 Ohms ± 10% 1 watt
47	510153	Resistor—carbon 8200 Ohms ± 10% ½ watt
50	510140	Resistor—carbon 1500 Ohms ½ watt
67	510167	Resistor—carbon 47,000 Ohms ½ watt
68	510147	Resistor—carbon 3900 Ohms ± 10% ½ watt
72	510143	Resistor—carbon 2200 Ohms ½ watt
85	510155	Resistor—carbon 10,000 Ohms ½ watt
90	510149	Resistor—carbon 4700 Ohms ½ watt
91	510179	Resistor—carbon 220,000 Ohms ½ watt
95	510155	Resistor—carbon 10,000 Ohms ½ watt
96	510149	Resistor—carbon 4700 Ohms ½ watt
99	510158	Resistor—carbon 15,000 Ohms ½ watt
101	510148	Resistor—carbon 4700 Ohms ± 10% ½ watt
102	510137	Resistor—carbon 1000 Ohms ½ watt
104	510122	Resistor—carbon 150 Ohms ½ watt
108	510137	Resistor—carbon 1000 Ohms ½ watt
110	510153	Resistor—carbon 8200 Ohms ± 10% ½ watt
111	510137	Resistor—carbon 1000 Ohms ½ watt
113	510119	Resistor—carbon 100 Ohms ½ watt
116	510137	Resistor—carbon 1000 Ohms ½ watt
118	510148	Resistor—carbon 4700 Ohms ± 10% ½ watt
119	510137	Resistor—carbon 1000 Ohms ½ watt
121	510120	Resistor—carbon 120 Ohms ± 10% ½ watt
123	510153	Resistor—carbon 8200 Ohms ± 10% ½ watt
124	510137	Resistor—carbon 1000 Ohms ½ watt
127-A	505858	Resistor—carbon 470,000 Ohms 1/5 watt; (part of Audio Coupling Unit)
127-D	505858	Resistor—carbon 470,000 Ohms 1/5 watt; (part of Audio Coupling Unit)
130	510119	Resistor—carbon 100 Ohms ½ watt
131	510713	Resistor—carbon 3000 Ohms ± 5% 2 watt
132	510153	Resistor—carbon 8200 Ohms ± 10% ½ watt
135	510137	Resistor—carbon 1000 Ohms ½ watt
139	510151	Resistor—carbon 6800 Ohms ± 10% ½ watt
141	510254	Resistor—carbon 10,000 Ohms ± 10% 1 watt
142	510253	Resistor—carbon 8200 Ohms ± 10% 1 watt
144	510166	Resistor—carbon 47,000 Ohms ± 10% ½ watt
146	510164	Resistor—carbon 33,000 Ohms ½ watt
147	510155	Resistor—carbon 10,000 Ohms ½ watt
149	510150	Resistor—carbon 5600 Ohms ± 10% ½ watt
151	510173	Resistor—carbon 100,000 Ohms ½ watt
153	510150	Resistor—carbon 5600 Ohms ± 10% ½ watt
155	510191	Resistor—carbon 1 Meg. ½ watt
156	510356	Resistor—carbon 12,000 Ohms ± 10% 2 watt
158	510191	Resistor—carbon 1 Meg. ½ watt
159	510126	Resistor—carbon 270 Ohms ± 10% ½ watt
162	510723	Resistor—carbon 12,000 Ohms ± 5% ½ watt
164, 165	510339	Resistor—carbon 1500 Ohms ± 10% 2 watt
166	510156	Resistor—carbon 12,000 Ohms ± 10% ½ watt
169	510173	Resistor—carbon 100,000 Ohms ½ watt
170	510191	Resistor—carbon 1 Meg. ½ watt
171	510171	Resistor—carbon 82,000 Ohms ± 10% ½ watt
172	510161	Resistor—carbon 22,000 Ohms ½ watt
177	510143	Resistor—carbon 2200 Ohms ½ watt
178	510157	Resistor—carbon 15,000 Ohms ± 10% ½ watt
182	510332	Resistor—carbon 560 Ohms ± 10% 2 watt
185, 186	510132	Resistor—carbon 560 Ohms ± 10% ½ watt
188	510180	Resistor—carbon 270,000 Ohms ± 10% ½ watt
189	510181	Resistor—carbon 330,000 Ohms ± 10% ½ watt
190, 191	510739	Resistor—carbon 1800 Ohms ± 5% ½ watt
194, 195	510172	Resistor—carbon 100,000 Ohms ± 10% ½ watt
197	510162	Resistor—carbon 27,000 Ohms ± 10% ½ watt
198	510195	Resistor—carbon 4.7 Meg. ½ watt
200	510185	Resistor—carbon 470,000 Ohms ½ watt
203	510150	Resistor—carbon 5600 Ohms ± 10% ½ watt
206	510139	Resistor—carbon 1500 Ohms ± 10% ½ watt
207	510172	Resistor—carbon 100,000 Ohms ± 10% ½ watt
209	510180	Resistor—carbon 270,000 Ohms ± 10% ½ watt
213	510184	Resistor—carbon 470,000 Ohms ± 10% ½ watt
215	510116	Resistor—carbon 68 Ohms ½ watt
218	510317	Resistor—carbon 82 Ohms ± 10% 2 watt (used in "Uncoded" chassis)
218	510716	Resistor—wire wound 220 Ohms ± 10% 5 watt (used in "Series A" chassis)
220	510358	Resistor—carbon 15,000 Ohms ± 10% 2 watt (used in "Uncoded" chassis)
220	510356	Resistor—carbon 12,000 Ohms ± 10% 2 watt (used in "Series A" chassis)
226	510254	Resistor—carbon 10,000 Ohms ± 10% 1 watt
228	510725	Resistor—carbon 3.3 Ohms ± 10% ½ watt (used in "Uncoded" chassis)
229	510195	Resistor—carbon 4.7 Meg. ½ watt
231	510391	Resistor—carbon 1 Meg. 2 watt
234	510187	Resistor—carbon 680,000 Ohms ± 10% ½ watt
247	510319	Resistor—carbon 100 Ohms 2 watt
252	510726	Resistor—wire wound 850 Ohms 5 watt
262-B	508062	Resistor—carbon 22,000 Ohms 1/5 watt (part of Integrator Unit)
262-D	508062	Resistor—carbon 8200 Ohms 1/5 watt (part of Integrator Unit)
262-F	508062	Resistor—carbon 8200 Ohms 1/5 watt (part of Integrator Unit)
265	510721	Resistor—carbon 1.5 Meg. ± 5% ½ watt
267	510172	Resistor—carbon 100,000 Ohms ± 10% ½ watt
268	510196	Resistor—carbon 6.8 Meg. ½ watt
269	510738	Resistor—carbon 1.2 Meg. ± 10% ½ watt
272	510151	Resistor—carbon 6800 Ohms ± 10% ½ watt
275	510193	Resistor—carbon 2.2 Meg. ½ watt
276	510338	Resistor—carbon 1200 Ohms ± 10% 2 watt
357	510179	Resistor—carbon 220,000 Ohms ½ watt
362	510136	Resistor—carbon 1000 Ohms ± 10% ½ watt

CONTROLS

DIAGRAM NO.	PART NO.	DESCRIPTION
33-A,B	508054	Volume control (1 Meg.) (with switch)
54	508324	Built-in Antenna Tuning Condenser (4-70 Mmfd)
88	*	Fine Tuning condenser (3-5 Mmfd.)
160	508055	Contrast potentiometer (3000 Ohms ± 10% 2 w.)
173	508056	Brightness potentiometer (50,000 Ohms)
180	508057	Focus potentiometer (5500 Ohms ± 10% 4 watt)
202	508077	Horizontal Lock coil (less slug)
202	507429	Slug core for Horizontal Lock coil
208	508056	Horizontal Hold potentiometer (50,000 Ohms)
212	508071	Horizontal Drive trimmer condenser (10-160 Mmfd)
225	508667	Width coil (includes slug and clip)
225	508784	Slug core for Width coil
233	162190	Horizontal Linearity coil (includes slug and clip)
233	507429	Slug core for Horizontal Linearity coil
266	508051	Vertical Hold potentiometer (1 Meg.)
270	508052	Height potentiometer (2.5 Meg.)
277	508053	Vertical Linearity potentiometer (6000 Ohms)

COILS AND TRANSFORMERS

DIAGRAM NO.	PART NO.	DESCRIPTION
12	508061	Transformer—1st TV sound I.F. (includes condensers 12-A and 12-B)
15	507373	Coil—choke
18	508061	Transformer—2nd TV sound I.F. (includes condensers 18-A and 18-B)
26	507321	Transformer—TV sound discriminator (includes condenser 26-A)
26	508438	Slug core (5/16" dia. x ⅜" long) for primary of TV sound discriminator trans.
26	508894	Slug core (¼" dia. x ½" long) for primary of TV sound discriminator trans.
26	508439	Slug core (5/16" dia. x ¾" long) for secondary of TV sound discriminator trans.
26	508894	Slug core (¼" dia. x ½" long) for secondary of TV sound discriminator trans.
37	507373	Coil—choke
49	505912	Transformer—sound output
	508805	R.F. Unit complete with coils and tubes
55	507952	Coil—antenna; Channel #2
56	507953	Coil—antenna; Channel #3
57	507954	Coil—antenna; Channel #4
58	507955	Coil—antenna; Channel #5
59	507956	Coil—antenna; Channel #6
60	507957	Coil—antenna; Channel #7
61	507958	Coil—antenna; Channel #8
62	507959	Coil—antenna; Channel #9
63	507960	Coil—antenna; Channel #10
64	507961	Coil—antenna; Channel #11
65	507962	Coil—antenna; Channel #12
66	507963	Coil—antenna; Channel #13
73	507972	Coil—R.F. and osc.; Channel #2
74	507973	Coil—R.F. and osc.; Channel #3
75	507974	Coil—R.F. and osc.; Channel #4
76	507975	Coil—R.F. and osc.; Channel #5
77	507976	Coil—R.F. and osc.; Channel #6
78	507977	Coil—R.F. and osc.; Channel #7
79	507978	Coil—R.F. and osc.; Channel #8
80	507979	Coil—R.F. and osc.; Channel #9
81	507980	Coil—R.F. and osc.; Channel #10
82	507981	Coil—R.F. and osc.; Channel #11
83	507982	Coil—R.F. and osc.; Channel #12
84	507983	Coil—R.F. and osc.; Channel #13
	507986	Slug for osc. coil fine tuning adjustment
98	509061	Coil—converter plate (I.F.)
98	509062	Slug core for converter plate coil
103	507567	Coil—1st I.F. trap
107	507343	Coil—1st video I.F. (less slug)
107	507337	Slug core for 1st video I.F. coil
115	507343	Coil—2nd video I.F. (less slug)
115	507357	Slug core for 2nd video I.F. coil
125	507343	Coil—3rd video I.F. (less slug)
125	507357	Slug core for 3rd video I.F. coil
128	507367	Coil—choke
134	507591	Coil—4th video I.F. assembly (includes condenser 136 and choke coil 137)
134	507357	Slug core for 4th video I.F. coil
137	507367	Coil—choke
143	507374	Coil—peaking
152	507374	Coil—peaking
161	508069	Coil—peaking
163	508070	Coil—peaking
181	509035	Coil—focus
184	508675	Yoke—picture tube deflection
202	508077	Coil—Horizontal Lock (less slug)
202	507429	Slug core for Horizontal Lock coil
222	508883	Transformer—horizontal sweep (used in "Uncoded" chassis)
222	509055	Transformer—horizontal sweep (used in "Series A" chassis)
225	508667	Coil—Width (includes slug and clip)
225	508784	Slug core for Width coil
233	162190	Coil—Horizontal Linearity (includes slug and clip)
233	507429	Slug core for Horizontal Linearity
239	508702	Transformer—power
241	507586	Coil—choke
244	507587	Coil—choke
248	507584	Coil—choke
253	508341	Choke filter
254	507584	Coil—choke
255	507970	Coil—choke
257	507971	Coil—choke
259	507586	Coil—choke
263	508076	Transformer—vertical blocking oscillator
271	507567	Coil—3rd I.F. trap
278	508674	Transformer—vertical output

OTHER ELECTRICAL PARTS

DIAGRAM NO.	PART NO.	DESCRIPTION
51	508174	Speaker—P.M. Dynamic (6" x 9"); Model 9109-A
51	508157	Speaker—P.M. Dynamic (6"); Model 9109-B
53	508325	Built-in antenna (includes condenser 54)
127	505858	Audio coupling unit A—Resistor—carbon 470,000 Ohms 1/5 watt B—Condenser—ceramic 250 Mmfd. 450 volt C—Condenser—ceramic .005 Mfd. 450 volt D—Resistor—carbon 470,000 Ohms 1/5 watt
221	508713	Fuse for horizontal sweep circuit ¼ Amp. 250 volt
261	118921	Lamp—TV Channel Lite (Mazda #47) 6-8 V. 150 Mo.
262-A to G	508062	Integrator coupling unit A—Condenser—ceramic .01 Mfd. 450 volt B—Resistor—carbon 22,000 Ohms 1/5 watt C—Condenser—ceramic 2000 Mmfd. 450 volt D—Resistor—carbon 8200 Ohms 1/5 watt E—Condenser—ceramic 5000 Mmfd. 450 volt F—Resistor—carbon 8200 Ohms 1/5 watt G—Condenser—ceramic 5000 Mmfd. 450 volt

MECHANICAL PARTS OF R.F. TUNER

(for electrical parts see preceding classified listings of condensers, resistors and coils)

PART NO.	DESCRIPTION
508805	R.F. Unit complete with coils and tubes
508081	Bracket for mtg. tuner (front)
508082	Bracket for mtg. tuner (rear)
508437	Fine Tuning cam and brass shaft
508708	Roller—detent
507989	Shield—tube; miniature (fits solid ring type clip)
505367	Shield—tube; miniature (fits wing type clip)
509062	Slug core for converter plate coil
507986	Slug for osc. coil fine tuning adjustment
507987	Socket—miniature (for 6J6) (includes solid ring type clip for shield)
509065	Socket—miniature (for 6J6) (includes wing type clip for shield)
507988	Socket—miniature (for 6AG5) (includes solid ring type clip for shield)
509066	Socket—miniature (for 6AG5) (includes wing type clip for shield)
507966	Spring contactor washer (on front turret shaft)
508709	Spring—detent
507990	Spring—retains osc. fine tuning slug
507967	Spring—turret shaft retaining
507984	Stator contact assembly (includes 11 contacts and metal frames)
508707	Tuner turret and shaft assembly (less coils)
507965	Washer, fiber spacer (turret shaft)

CABINET PARTS

PART NO.	DESCRIPTION
508855	Back for cabinet; Model 9109-A (less power cord)
508857	Back for cabinet; Model 9109-B (less power cord)
507783	Bottom plate for Model 9109-B
508640	Cabinet for Model 9109-A
508720	Cabinet for Model 9109-B
507930	Call letter tabs
508159	Escutcheon—control panel
508852	Glass window
502563	Knob—built-in antenna
507916	Knob—Channel Selector
509205	Knob—Dummy
507918	Knob for any control except Channel Selector and Fine Tuning
507917	Knob—TV Fine Tuning
508853	Mask for picture tube
508854	Name plate for Model 9109-A (Royal De Luxe 14)
508858	Name plate for Model 9109-B (Super De Luxe 14)
508621	Rubber gasket between mask and picture tube
162163	Terminal strip for TV antenna connection
18796	Screw—#10 x 1"; mounts chassis
162016	Shaft and mounting plate for Dummy knob

MISCELLANEOUS

PART NO.	DESCRIPTION
301270	Base for mounting electrolytic condenser
508829	Bracket base for support of yoke and focus coil (left hand)
508830	Bracket base for support of yoke and focus coil (right hand)
508613	Bracket for deflection yoke mounting
508081	Bracket for mounting R.F. tuner (front)
508082	Bracket for mounting R.F. tuner (rear)
508832	Bracket—tube support (bottom front) (less rubber pad)
508834	Bracket ("U" shaped) for support of yoke and focus coil
507930	Call letter tabs
508806	Centering magnet assembly
508681	Clip for mounting electrolytic condenser #224
508683	Clip for mounting electrolytic condenser #129
508715	Clip for mounting fuse holder
500245	Clip for mounting H.V. condenser
505101	Clip for mounting I.F. sound transformer
507339	Clip for mounting video converter plate, 1st video I.F., 2nd video I.F., 3rd video I.F., Horizontal Lock or Horizontal Linearity coil
507592	Clip for mounting 4th video I.F. coil
507286	Connector for H.V. terminal of picture tube
508714	Fuse holder
508623	Grounding spring for coating on picture tube
508603	Ion trap
508617	Nut—for retaining focus coil mounting plate
508864	Plate—mounts focus coil
509089	Plate—mounts horizontal sweep transformer (used in "Series A" chassis)
508878	Plug for focus coil leads
507699	Power cord assembly (includes plugs at both ends)
507361	Rubber cover for H.V. terminal connector
508619	Rubber spacer on picture tube support bracket
507793	Rubber spacer support between flared neck of picture tube and yoke bracket
18796	Screw—#10 x 1"; mounts chassis
170182	Screw—#10-32 x 1½"; retains tube support strap
162138	Shield—H.V. supply (front section)
508088	Shield—H.V. supply (rear section)
507357	Slug core for 1st, 2nd, 3rd or 4th video I.F. coil
507429	Slug core for Horizontal Lock or Horizontal Linearity coil
508438	Slug core (5/16" dia. x ⅜" long) for primary of TV sound discriminator transformer
508894	Slug core (¼" dia. x ½" long) for primary of TV sound discriminator transformer
508439	Slug core (5/16" dia. x ¾" long) for secondary of TV sound discriminator transformer
508894	Slug core (¼" dia. x ½" long) for secondary of TV sound discriminator transformer
508784	Slug core for Width coil
508049	Socket and cable assembly for picture tube
508156	Socket and mounting bracket for TV Channel Lite
162038	Socket assembly for 1B3GT/8016 tube (includes corona ring and mounting frame)
508879	Socket for focus coil leads
508086	Socket for mounting H.V. condenser #230
507932	Socket—male, power cord interlock
507364	Socket—miniature (7 pin)
508044	Socket—miniature (9 pin)
508703	Socket—octal
508514	Spring—retains H.V. lead
508608	Spring—tension for focus coil mounting
509034	Strap for picture tube support (includes rubber pad)
170851	Wing nut—#5-40; for mounting focus coil to plate
170195	Wing nut—#8-32; for yoke and focus coil mounting
170817	Wing screw—#10-24; for height adj. of yoke and focus coil
170741	Wing screw—#10-32; for yoke mounting

MODELS 9109-A, 9109-B

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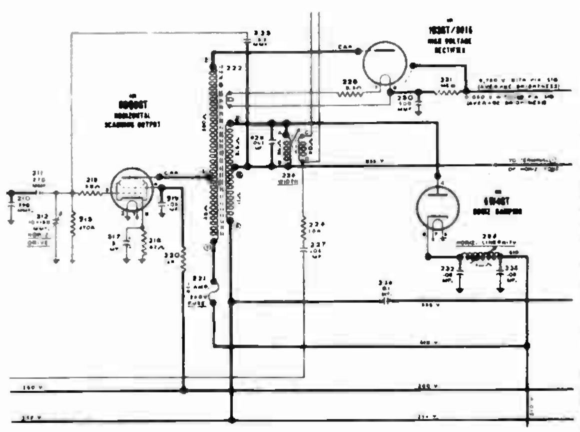
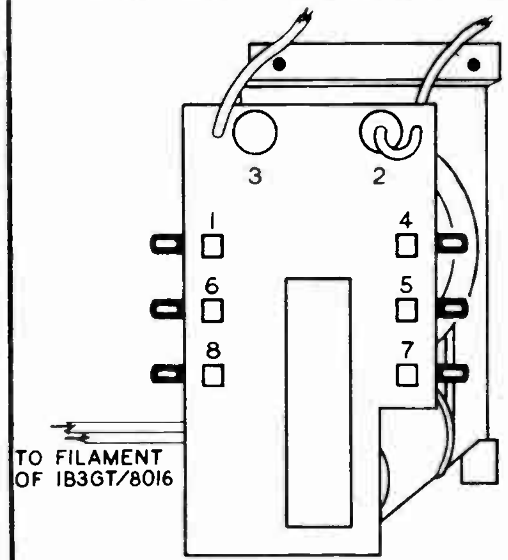
PRODUCTION CHANGES

The following tabulation furnishes complete details on changes which occurred during production. Sequence of these changes is indicated by coding in alphabetical order; that is, "SERIES A" "SERIES B", etc., stamped on back surface of chassis.

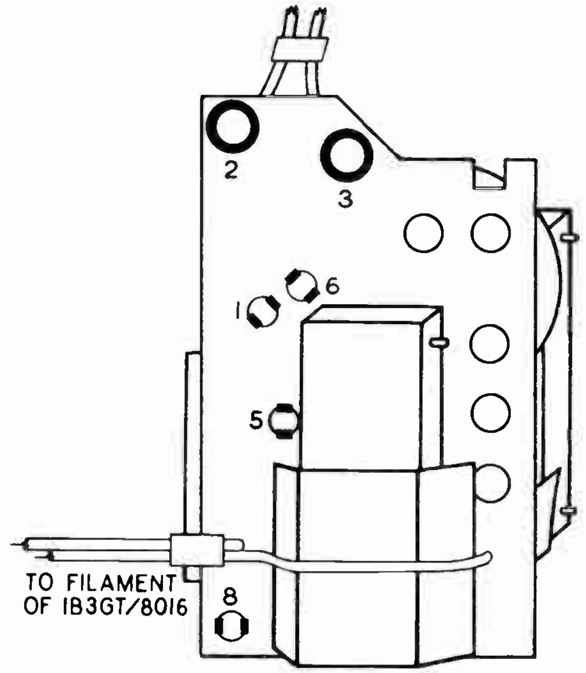
The circuit shown on this page applies to "series A" chassis.

CHANGE DESIGNATION STAMPED ON CHASSIS	DESCRIPTION OF CHANGE
UNCODED	**INITIAL PRODUCTION**—All uncoded chassis utilized a horizontal scanning output circuit as shown below. Conversion of this circuit arrangement to the type used in "Series A" chassis (illustrated in complete wiring diagram) was undertaken so as to permit use of a Horizontal Sweep Transformer produced by a different supplier. Identification of the two alternate type Sweep Transformers can be accomplished by means of the two illustrations at the bottom of this page. It should be understood that there is no performance advantage of a "Series A" chassis over an "Uncoded" chassis—the sweep circuit and associated transformer in either chassis performs equally well.  **CAUTION**—Note that a type 6BQ6GT output tube must be used with the sweep transformer incorporated in "Uncoded" chassis and a type 6CD6G output tube must be used with the alternate type transformer in "Series A" chassis. Do not attempt indiscriminate substitution of these tubes—it is vitally important to use the correct output tube and sweep transformer combination.
SERIES "A"	The differences between chassis containing the "Series A" coding and the "Uncoded" chassis described above are solely concerned with the use of an alternate type horizontal sweep output transformer and power output tube (see preceding explanation). Details on these differences are as follows:

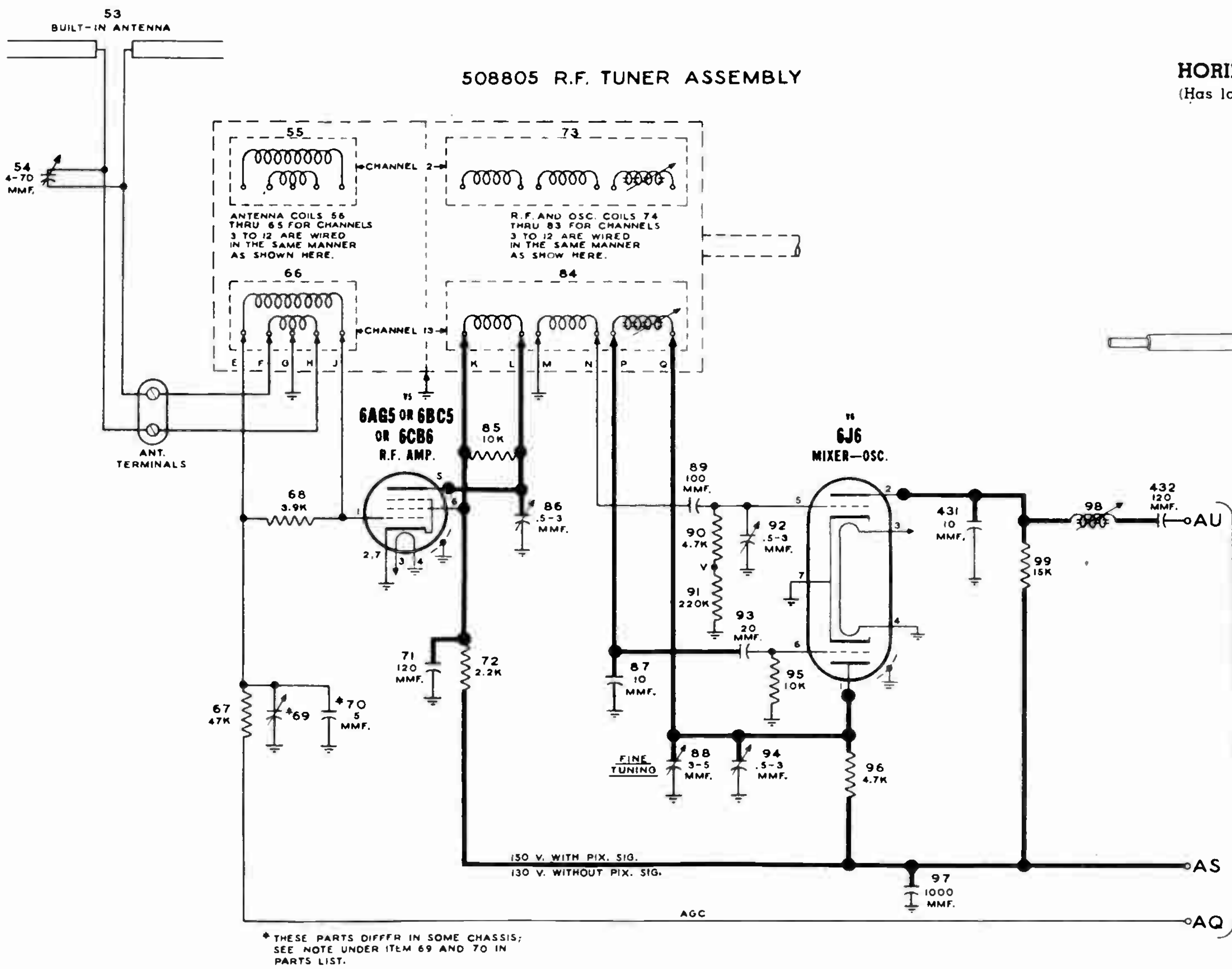
	"UNCODED"	"SERIES A"
Output Tube	6BQ6T	6CD6G
Horizontal Sweep Transformer	Part #508883	Part #509055
Resistor 218	82 Ohms 2 watt.	220 Ohms, wire wound 5 watt.
Condenser 219	Low potential side grounded.	Low potential side connected to cathode of V20.
Resistor 220	15,000 Ohms 2 watt.	12,000 Ohms 2 watt.
Condenser 223	3.3 Mmfd.; one terminal connects to terminal 8 of Horizontal Sweep Transformer and other terminal connects to junction of Resistors 213 and 215.	15 Mmfd.; one terminal connects to terminal 5 of Horizontal Sweep Transformer and other terminal is in series with condenser 430.
Condenser 430	Not used.	Connected in series with condenser 223 and other terminal connects to junction of Resistors 213 and 215.
Resistor 228	3.3 Ohms.	Not used. Pin 7 (filament) of V21 1B3GT/8016 connects directly to filament winding of Horizontal Sweep Transformer.
Yoke Connection	Terminal 1 of deflection yoke connects to terminal 8 of Horizontal Sweep Transformer.	Terminal 1 of deflection yoke connects to terminal 5 of Horizontal Sweep Transformer.



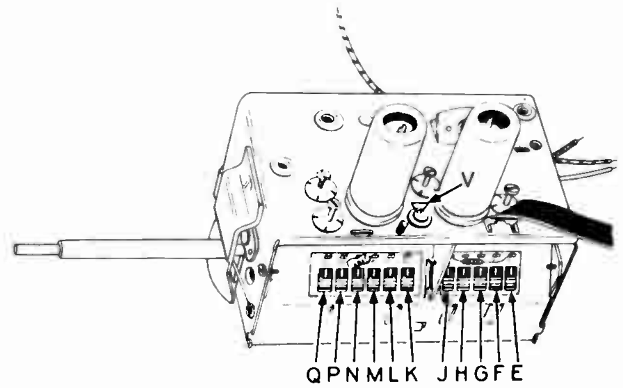
508883
HORIZONTAL SWEEP TRANSFORMER
(Has molded powdered iron core)



509055
HORIZONTAL SWEEP TRANSFORMER
(Has laminated iron core and entire unit is coated with grey Hollowax)



* THESE PARTS DIFFER IN SOME CHASSIS; SEE NOTE UNDER ITEM 69 AND 70 IN PARTS LIST.



508805 TUNER UNIT

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INSTALLATION INSTRUCTIONS

MODEL 9113-A
12" PIX TUBE

CAUTION

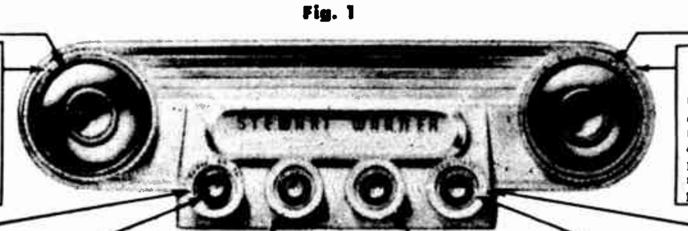
HIGH VOLTAGES are used in the operation of this receiver. The back cover, while in place, prevents accidental contact with this voltage and therefore should not be removed by anyone except a qualified television serviceman.

THE HIGH VOLTAGE LEAD, which supplies 10 to 12 kilovolts to the picture tube, should be momentarily shorted to the chassis whenever it is disconnected for service purposes. This discharges the high voltage filter condenser and prevents a shock hazard when working on the receiver after it has been turned off.

THE PICTURE TUBE is highly evacuated and if broken, glass fragments will be violently expelled. Scratching, chipping, undue pressure, or careless handling such as lifting the tube by its neck is dangerous and should be avoided. If it is necessary to handle the picture tube, use safety goggles and heavy gloves. Be sure to discharge the voltage developed across the capacitor formed by the inner and outer coating of the picture tube. This can be done by connecting the high voltage socket on the tube to the outer coating.

RECEIVER OPERATING CONTROLS

Fig. 1



AM-FM FINE TUNING CONTROL (outer knob)
Use to tune receiver to desired station after Band Switch is set to either "AM" or "FM" position.

AM-FM COARSE TUNING CONTROL
Has same effect as "AM-FM Fine Tuning" control except that tuning is faster.

BAND SWITCH (large knob)
Set for desired type of reception. Starting from extreme clockwise position and turning counter-clockwise, the four settings are: (Television); (Phonograph); ("AM" Radio); and ("FM" Radio).

ON-OFF SWITCH AND VOLUME CONTROL (small knob)
Use to turn receiver on or off and to adjust for desired sound volume.

HORIZONTAL HOLD CONTROL
Adjust so that picture is stationary and does not move horizontally or break up into black and white streaks.

BRIGHTNESS CONTROL
Adjust for picture brilliance. Re-adjust after setting "Contrast" control.

TONE CONTROL (small knob)
Adjust for most pleasing tone. To increase bass emphasis, turn control counter-clockwise.

CONTRAST CONTROL (large knob)
Adjust to receive picture and obtain correct contrast between light and dark shades.

TELEVISION FINE TUNING CONTROL
Use to tune in station after "Channel Selector" is set to desired channel. See next page for complete description of tuning procedure.

CHANNEL SELECTOR (outer knob)
Set knob so that desired channel designation appears in illuminated opening (after Band Switch is set for "TV" operation). Then use "Fine Tuning" control to tune in station.

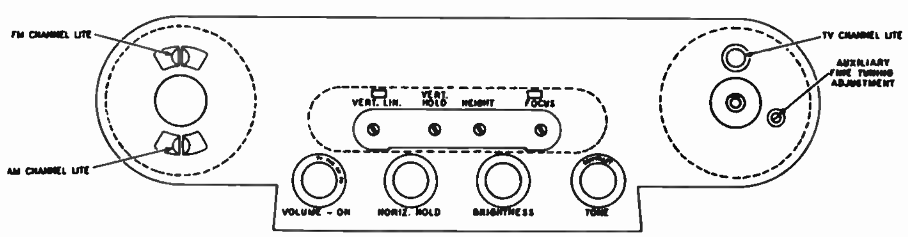


Fig. 14—LOCATION OF PRE-SET CONTROLS

CONTROL ADJUSTMENT PROCEDURE

The various controls on the receiver may be divided into two classes, Operating and Pre-set. Operating controls are those which control program selection as well as sound and picture quality and their functions are indicated in Fig. 1.

The Pre-set controls are those which require adjustment at the time the receiver is installed and they rarely need attention thereafter. Although they have been factory adjusted for optimum performance, it is usually necessary to make some fine adjustments of these controls at the time of installation.

There are nine Pre-set controls, four of which are located at the back of the chassis (see Figure 18). Four controls are accessible by removing the Name Plate located directly above the Operating controls. Access to the "Auxiliary Fine Tuning" screw can be gained by removing the "Channel Selector" and "Fine Tuning" knobs.

To gain access to the centering adjustments and ion trap, it will be necessary to remove the back cover of the cabinet by first removing the built-in antenna tuning knob and then taking out the screws around the rim of the back cover.

Removal of the cabinet back automatically opens an interlock to disconnect the receiver power cord. Centering and ion trap adjustments will require access to circuit components while the receiver is in operation, therefore an auxiliary power cord assembly will be needed. This cord may be ordered from Stewart-Warner by requesting Part #507699.

Operate the receiver according to the instructions given in the section of this manual entitled "How To Tune The Receiver" and make the following adjustments as required.

1. **ADJUST ION TRAP**—If screen remains dark or is only dimly illuminated when "Brightness" control is turned clockwise, the ion trap may require adjustment.

   The ion trap is located on the neck of the picture tube as shown in Figure 18 and consists of two magnets held in position by metal bands. The magnet identified by the **black** band must be in the rear position.

   Rotate the entire trap assembly while sliding it back and forth until picture tube screen is illuminated to maximum brilliance. Reduce "Brightness" control setting and repeat this operation to assure accurate positioning of ion trap.

2. **AUXILIARY FINE TUNING ADJUSTMENT**—If it is found that the tuning range of the "Television Fine Tuning" control is inadequate to permit correct tuning of a station in its assigned channel, then adjustment of the "Auxiliary Fine Tuning" screw will be necessary. This special screw is accessible after removal of the "Channel Selector" and "Television Fine Tuning" knobs. They may be removed by merely pulling them forward.

   Adjustment of the "Auxiliary Fine Tuning" screw may now be undertaken in accordance with the following procedure.

   a. Set "Channel Selector" to desired channel; then remove this knob.

   b. Set "Television Fine Tuning" knob to the center of its range; then remove this knob. The flat portion of the main tuning shaft (outer brass shaft) should now be in the uppermost position. Note the location of the "Auxiliary Fine Tuning" adjustment screw on receiver chassis—see Fig. 14.

   c. Using a thin screwdriver (preferably non-metallic), adjust the setting of "Auxiliary Fine Tuning" screw for correct tuning of the desired television station—**CAUTION: Do not attempt to rotate this screw more than two full turns in either direction, as further rotation may release it from the thread clip within the tuning mechanism and the coil for that channel (located in R.F. Tuner Unit) would then have to be removed in order to restore the screw to the correct position.** If a metal screwdriver is used, detuning occurs when the screwdriver is removed but it will be noted that this degree of detuning can now be compensated by resetting the "Fine Tuning" control (brass shaft). Thus the range of the "Fine Tuning" control (after knob is replaced on the shaft) will be adequate to tune in the station.

   d. This completes the adjustment of the "Auxiliary Fine Tuning" screw for one channel. Identical screws are provided on each channel **and they are all accessible thru the same opening in the tuning mechanism as each successively moves into position when the "Channel Selector" knob is rotated.**

3. **HORIZONTAL HOLD—Should the picture appear to move horizontally across the screen or break up into a series of light and dark streaks as shown in Figure 3, adjust the "Horizontal Hold" control until the picture remains stationary.**

   If this control must be rotated to the end of its range for proper "locking" action, then it will be necessary to reset the position of the "Horizontal Lock" control (see Figure 18 for location). Adjustment is accomplished by first setting the "Horizontal Hold" control in the middle of its range and then changing the setting of the "Horizontal Lock" control until picture locks in horizontally.

4. **VERTICAL HOLD**—**Should the picture appear to roll by in a vertical direction or cause multiple vertical images as shown in Figure 15, it will be necessary to adjust the "Vert. Hold" control located behind the Name Plate (see Figure 14).**

   After this adjustment is made, reduce contrast until picture is barely visible and check setting of "Vertical Hold" control for proper picture synchronization.

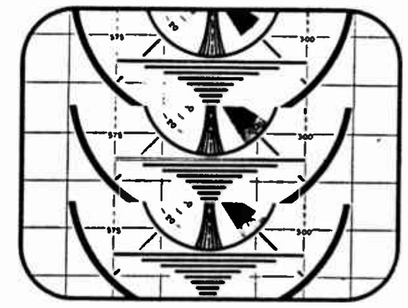


Fig. 15—VERTICAL MOVEMENT; ADJUST VERTICAL HOLD CONTROL

5. **INITIAL FOCUS—Adjust the "Focus" control, located behind Name Plate, until picture is clearly defined.**

   Fuzzy picture may also be due to reproduction of poor quality film when station is televising a motion picture. Incorrect tuning of receiver produces a similar effect. Check for proper tuning point as described in step 7 of section entitled "How To Tune the Receiver."

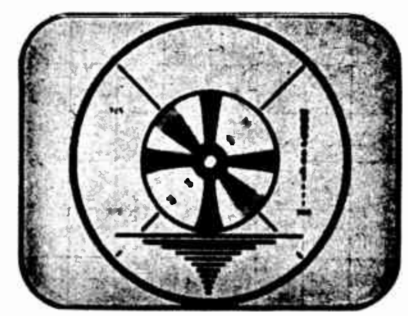


Fig. 16—BLURRED APPEARANCE; ADJUST FOCUS CONTROL

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6. **STRAIGHTENING TILTED RASTER**—If the pattern should appear on the screen in a tilted position as shown in Figure 17, loosen the deflection yoke locking screw (see Figure 18) and rotate the yoke sufficiently to correct this condition. Be sure to re-tighten the screw securely.

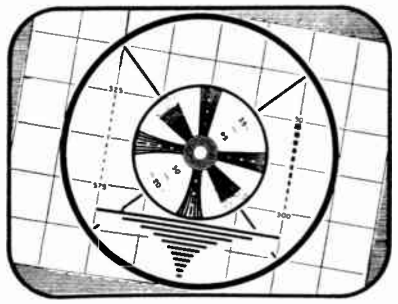

Fig. 17—TILTED PICTURE; ADJUST YOKE POSITION

The following adjustments should be made while the station is transmitting its circular test pattern.

7. **CENTERING:** To center the test pattern on the screen, proceed as follows:

a. Make sure focus coil mounting plate is perpendicular to neck of picture tube by adjustment of three nuts labeled A in Figure 18.

b. Rotate the two magnets in the centering magnet assembly (see Fig. 18). These magnets may be adjusted by grasping the "ears" attached to each magnet and rotating the magnets with respect to each other and with respect to the picture tube. Adjust the magnet position for best centering of the test pattern.

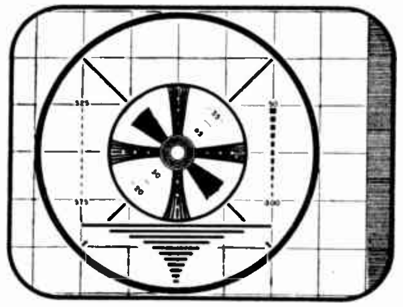

Fig. 19—OFF CENTER; ADJUST FOCUS COIL POSITION

c. If picture is still not centered, loosen four focus coil wing nuts labeled B in Fig. 18 and rotate focus coil for best centering of test pattern.

d. Readjust ion trap for maximum brightness on picture tube screen as explained in step #1.

e. If picture is still not centered, position focus coil by adjusting the three nuts labeled A in Fig. 18.

In event picture cannot be centered by above procedures, release the four wing nuts labeled D in Fig. 18 and raise or lower entire yoke and focus coil assembly so that focus coil can be repositioned vertically with respect to the tube neck.

8. **WIDTH** — Control of picture size in the horizontal direction is accomplished by means of the "Width" control located on the rear of H. V. power supply (see Fig. 18). If abnormally low line voltage makes it difficult to obtain sufficient picture width when using the "Width" control, then changing the setting of the "Horizontal Drive" control may be helpful. The "Drive" control is located at the rear of the chassis and its setting will affect horizontal linearity as well as picture width. Therefore, after adjusting this control for desired width, it may be necessary to re-adjust the "Horizontal Linearity" control as described in paragraph #12.

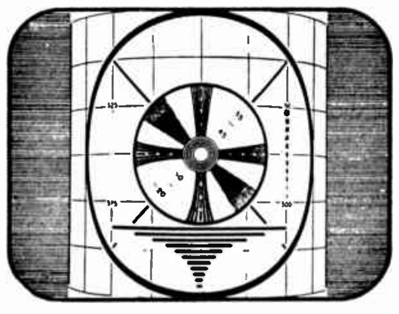

Fig. 20—TOO NARROW; ADJUST WIDTH CONTROL

9. **HEIGHT** — Control of picture size in the vertical direction is accomplished by means of the "Height" control located behind the Name Plate. Height and width adjustments should be checked for all transmitting stations to be sure that picture properly fills the viewing area. It may be necessary to change the setting of the "Height" control after the "Vertical Linearity" control is adjusted.

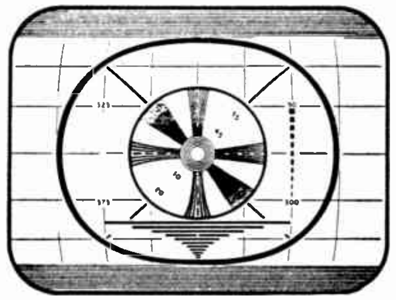

Fig. 21—TOO SHORT; ADJUST HEIGHT CONTROL

10. **VERTICAL LINEARITY** — Improper vertical linearity causes the circular test pattern to appear condensed on the upper edge of the screen and extended on the lower edge or vice versa. This effect is illustrated in Figure 22. Adjust for proper linearity by using "Vert. Lin." control located behind Name Plate. It may be necessary to readjust the "Height" control if an appreciable change is made in the linearity control setting.

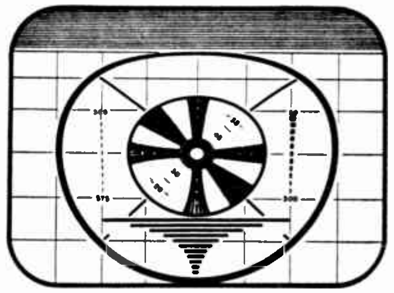

Fig. 22—VERTICAL DISTORTION; ADJUST VERTICAL LINEARITY CONTROL

11. **HORIZONTAL DRIVE** — The "Horizontal Drive" control located at rear of chassis (see Fig. 18) should be rotated clockwise to the point where any white (or black) vertical lines near the left side of the picture are eliminated. As width and linearity of the picture are affected by the setting of "Horiz. Drive" control, it will be necessary to adjust this control in conjunction with the Horiz. Linearity and Width controls to obtain desired picture width and linearity.

12. **HORIZONTAL LINEARITY** — Improper horizontal linearity causes the circular test pattern to appear condensed on the right edge of the screen and extended on the left edge or vice versa. This effect is illustrated in Figure 23. Adjust for proper linearity by using "Horiz. Lin." control located at rear of chassis (see Figure 18). In event that proper horizontal linearity cannot be obtained by adjusting this control, then change the setting of the "Horiz. Drive" control.

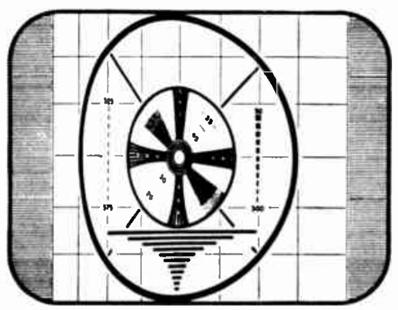

Fig. 23—HORIZONTAL DISTORTION; ADJUST HORIZONTAL LINEARITY CONTROL

13. **ELIMINATING SEMI-CIRCULAR SHADOW** — This shadow is caused by the electron stream striking the neck of the tube and it can generally be corrected by applying one or a combination of the following procedures:

a. Make sure deflection yoke is positioned as far forward as possible by loosening the three wing nuts labeled C in Fig. 18.

b. Reposition the focus coil by readjusting the three nuts labeled A in Fig. 18 to shift the coil forward.

c. In event neck shading cannot be eliminated by the above procedures, release the four wing nuts labeled D in Figure 18 and raise or lower entire yoke and focus coil assembly so that focus coil can be repositioned vertically with respect to the tube neck.

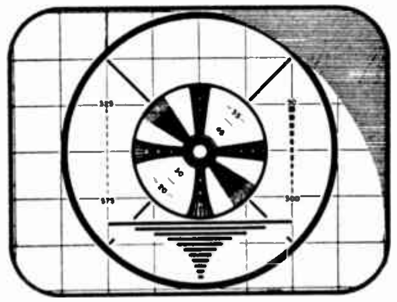

Fig. 24 SEMI-CIRCULAR SHADOW

14. **FINAL ADJUSTMENTS** — Recheck settings of "Brightness," "Contrast" and "Focus" controls for best picture quality.

GENERAL SPECIFICATIONS

DIMENSIONS

Model	Height	Width	Depth
9113-A	36¾"	26¼"	20¾"

WEIGHTS (packed)

Model 9113-A—138 lbs.

POWER REQUIREMENTS

117 volts 60 cycles
Television—230 watts
AM-FM Radio—145 watts

PICTURE SIZE

Height	Width (at widest point)	Viewing Area (sq. inches)
9"	11"	91.6

SPEAKER

Type	Size	V.C. Imped.
P.M. Dynamic	6" x 9"	3.2 ohms

ANTENNA INPUT IMPEDANCE

300 ohms—balanced to ground.

BUILT-IN ANTENNA

High "Q" dipole with tunable matching stub.

R. F. TUNER

Turret type construction; individually removable coil assemblies for all channels. All components are easily accessible for servicing.

"KEYED" AUTOMATIC GAIN CONTROL

Outstanding new development; minimizes "airplane flutter"; reduces contrast variation when changing from one channel to another; increases immunity of sync system to external interference.

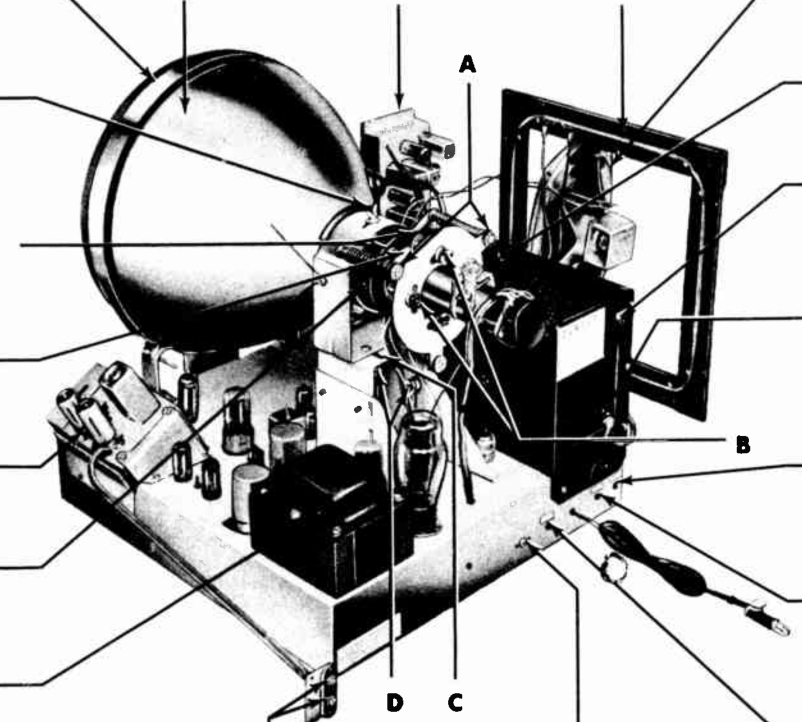

Fig. 18—CHASSIS AND PICTURE TUBE ASSEMBLY

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INTERMEDIATE FREQUENCIES

AM Sound—455 Kc.
FM Sound—10.7 Mc.
TV Sound Carrier—22.25 Mc.
Picture Carrier—26.75 Mc.

I.F. SYSTEM

AM—One stage (two tuned transformers)
FM—Two stage (three tuned transformers)
TV—Four stage (stagger tuned) for composite signal, and two additional stages for inter-carrier sound.

VIDEO AMPLIFIER

Two Stage—broad band.

RETRACE LINE SUPPRESSOR

Eliminates retrace lines thruout the normal range of picture brightness and contrast.

FOCUS

Magnetic

DEFLECTION

Magnetic

HORIZONTAL SYNCHRONIZATION

Automatic frequency control and "keyed" A.G.C. provide excellent picture stability and noise immunity.

HIGH VOLTAGE POWER SUPPLY

"Fly-back" type. Completely enclosed in a shielded compartment.

SENSITIVITY

Antenna to Picture Tube Grid Sensitivity — To make this measurement, connect negative terminal of 1½ volt battery to A.G.C. line, and positive terminal of battery to chassis. Also, set Contrast control to maximum clockwise position. Connect an **A.C.** vacuum-tube voltmeter between picture tube grid and ground, and place a .005 microfarad condenser across the same points.

Inject R.F. signal (400 cycle modulated) at antenna terminals, using signal whose frequency corresponds to the center frequency of the selected channel, and adjust Television Fine Tuning control for maximum output. Generator must be connected to antenna terminals with a 150 ohm carbon resistor in series with each lead to simulate proper impedance match.

Input signal required to produce standard output of 7.07 volts **A.C.** (r.m.s.) at picture tube grid is indicated in the following table. Since a fixed bias of 1½ volts has been applied to the A.G.C. system in order to provide a reference level for these measurements, it will be understood that the sensitivities specified here are not intended to indicate the full capability of the receiver, but merely serve as a convenient basis for determining proper operation.

Low Band	Average—50 microvolts	Range—25 to 100 microvolts
High Band	Average—80 microvolts	Range—40 to 160 microvolts

Detector to Picture Tube Grid Sensitivity — To make this measurement, remove 6AU6, 4th Video I.F. tube (V-10) and set Contrast control to maximum clockwise position. Inject a 400 cycle (audio) signal across 6800 ohm video detector load resistor. In order to produce the standard output of 7.07 volts **A.C.** (r.m.s.) at the picture tube grid, the input signal at the detector load resistor will be approximately .07 volts **A.C.** An **A.C.** vacuum-tube voltmeter must be used for these measurements.

Television Sound System Sensitivity—Inject 4.5 megacycle frequency modulated signal (400 cycle modulation with 7½ Kc. deviation) across video detector load resistor and measure output at speaker voice coil. An input of 2200 microvolts will produce approximately 500 milliwatts or 1.26 volts across speaker voice coil.

F.M. Sound System Sensitivity—Inject a 98 megacycle frequency modulated signal (400 cycle modulation with 22½ Kc. deviation) at pin 8 of 12AT7, F.M. R.F. Amplifier tube (V-27). Connect generator to this point through a 300 ohm resistor. Tune receiver to 98 Mc. signal. An input of 35 microvolts will produce approximately 500 milliwatts or 1.26 volts across speaker voice coil.

A.M. Sound System Sensitivity—Inject a 1000 Kc. signal (modulated 30% at 400 cycles) at (high side) connection lug on antenna section of gang condenser. Connect generator to this point through a .01 microfarad condenser. Tune receiver to 1000 Kc. signal. An input of 75 microvolts will produce approximately 500 milliwatts or 1.26 volts across speaker voice coil.

REDUCTION OF INTERCARRIER BUZZ

If a prominent humming or buzzing sound is noted in the sound reception of a television broadcast, it may be due to a fault in transmission from the station, or incorrect adjustment of the discriminator transformer (tuning of secondary circuit) in the receiver.

This type of disturbance, which is only present when receiving a station signal, is known as "Intercarrier Buzz" and it should not be confused with power supply hum that would occur upon failure of a filter condenser.

The procedure for correct adjustment of the television sound discriminator circuit is presented in the last section of the Television Sound Channel alignment instructions. When the discriminator secondary slug #1 is properly adjusted, intercarrier buzz will be reduced to an acceptable minimum, provided that the transmission from the station is not at fault.

HIGH VOLTAGE POWER SUPPLY SERVICING

The High Voltage Power Supply used with this receiver is of the "fly-back" type and is located in the shielded compartment mounted at the left rear corner of the chassis. It consists of a sturdily constructed and well insulated horizontal sweep output transformer plus a 1B3GT/8016 high voltage rectifier tube and associated filter components.

The plate circuit of the Horizontal Scanning Output stage is fused to protect the transformer and kill high voltage in the event the 6BQ6GT tube or the high voltage rectifier circuit draws excessive current.

CAUTION

The heavily insulated red lead, which supplies extremely high voltage (10 to 12 kilovolts) to the picture tube, should be momentarily shorted to the chassis whenever it is disconnected for service purposes (that is, after receiver has been turned off). This discharges the high voltage filter condenser and prevents a shock hazard when working on the set.

Access to the horizontal output transformer, high voltage rectifier tube, fuse and high voltage filter condenser is accomplished by removing the rear section of the H.V. shield. This compartment shield is held in place by five screws.

To replace the fuse, depress the cap of the fuse holder (located next to 6BQ6GT tube) and turn the cap counter-clockwise. Install new fuse of the same type (¼ amp., 250 volt, part 508713); do not use any other size.

CORONA AND ARC-OVER

Corona or arc-over can best be detected by observing the operation of the power supply in a dark room. Several conditions may cause these phenomena.

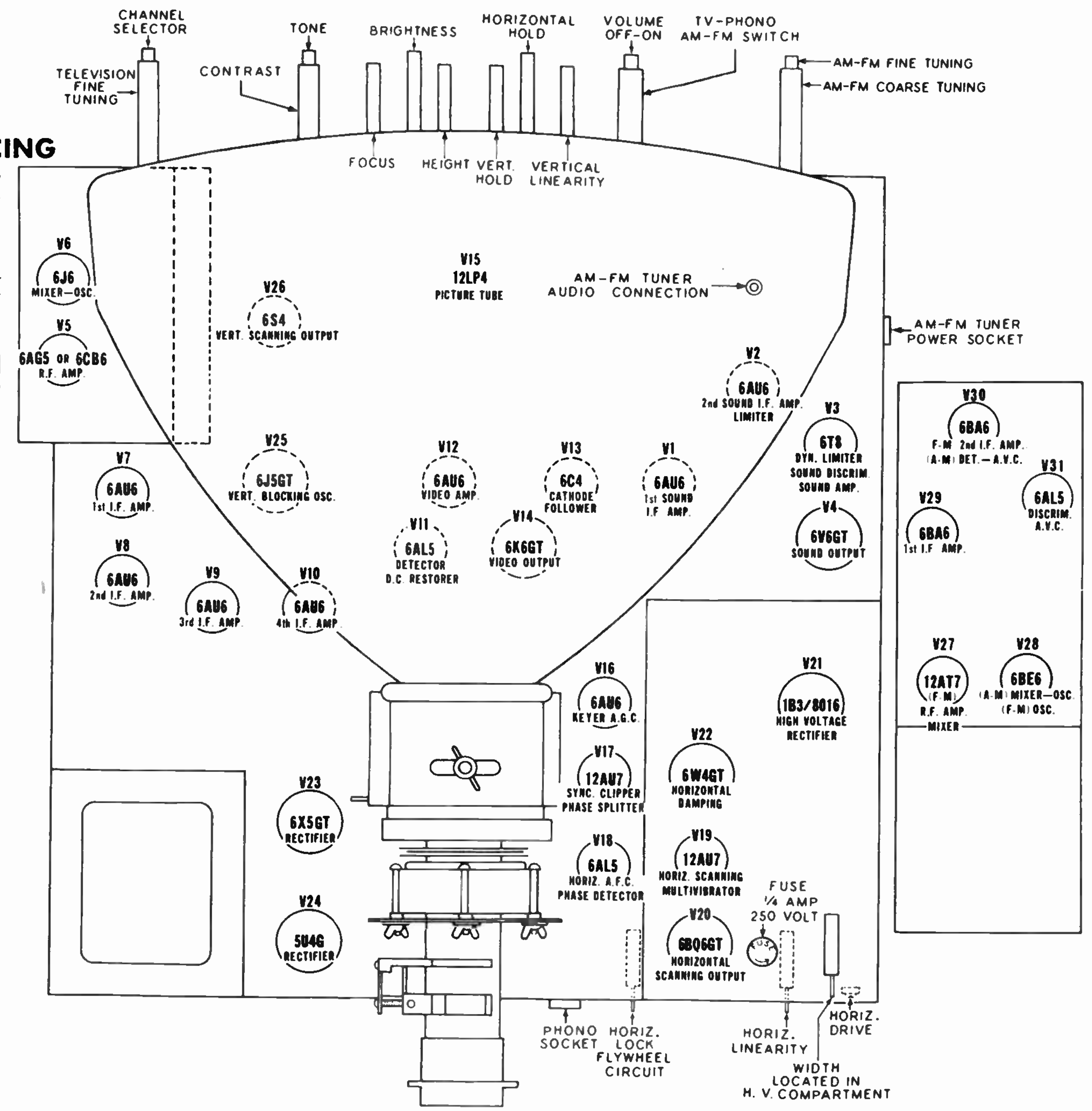
POOR CONNECTIONS—Arcing or corona may be due to poorly soldered connections (rosin joints or sharp points), or defective tube socket connections. If the leads or connectors to the high voltage filter condenser do not grasp this component securely, arcing will also result.

Inspect solder connections and resolder those points which are unsatisfactory. Make sure tubes are firmly positioned in tube sockets and that high voltage filter condenser is held securely in place.

CLOSELY SPACED COMPONENTS—Arcing or corona may occur when H.V. components or leads are placed too close together. Make sure there is sufficient spacing between all parts and wiring. If necessary, the insulation between two elements of the circuit may be improved by coating both objects with a quick-drying liquid polystyrene or polyethylene.

The socket assembly for the 1B3GT/8016 rectifier tube includes a "corona ring" which prevents corona from the tube socket connections. The surface of this ring should be smooth and free of scratches, or sharp protrusions.

TUBE LOCATIONS & FUNCTIONS
MODEL 9113-A



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SOCKET VOLTAGES

MODEL 9113-A

CAUTION

THE PICTURE TUBE is highly evacuated and if broken, glass fragments will be violently expelled. Scratching, chipping, undue pressure, or careless handling such as lifting the tube by its neck is dangerous and should be avoided. If it is necessary to handle the picture tube, use safety goggles and heavy gloves. Be sure to discharge the voltage developed across the capacitor formed by the inner and outer coating of the picture tube. This can be done by connecting the high voltage socket on the tube to the outer coating with a well insulated metal conductor.

HIGH VOLTAGE (10 to 12 kilovolts) is produced in a supply circuit of this receiver. Exercise care to avoid contact with elements of this circuit and particularly the tube terminals which are labeled "CAUTION" in the adjoining voltage chart. If measurement of voltage at these points is necessary, see procedure given below under the note "E."

THE HIGH VOLTAGE LEAD, which supplies approximately 10 to 12 kilovolts to the picture tube, should be momentarily shorted to the chassis whenever it is disconnected for service purposes. This discharges the high voltage filter condenser and prevents a shock hazard when working on the receiver after it has been turned off.

INTERMEDIATE B+ VOLTAGES, 475 and 365, are dangerous and caution should be observed when the receiver chassis components are exposed for service purposes.

BE SURE TO CHECK FOR PROPER POSITIONING OF BAND SWITCH SECTIONS ON AM-FM and TV chassis when interconnecting link arm has been disengaged and bottom cover of the AM-FM chassis is removed for voltage measurements. DO NOT turn on the receiver until you have first determined that the respective switch sections are correctly synchronized or positioned. Failure to observe this precaution can result in damage to the receiver, as well as erroneous voltage measurements. For more complete discussion of this subject, see text shown adjoining AM-FM socket voltage chart on page 40.

THE VOLTAGES SHOWN IN THE ADJOINING CHART WERE MEASURED UNDER THE FOLLOWING CONDITIONS

1. Power Supply—117 volts 60 cycle AC.

2. All voltages are measured between socket terminals and chassis unless otherwise indicated on adjoining chart.

*

3. Measurements made with voltmeter having sensitivity of 1000 ohms per volt except where indicated by (*). The (*) symbol designates a vacuum tube voltmeter measurement.

4. Band Switch set to "TV" position unless otherwise indicated by letters "P", "m" or "n" following voltages shown in adjoining chart.

5. Channel Selector and Fine Tuning Controls set for normal reception of a local station.

6. Focus control set to maximum counter-clockwise position. Setting of this control will affect B+ voltage on the 265 volt supply line. This voltage is obtained when control is at maximum counter-clockwise position and increases to 320 as control is rotated to clockwise position.

7. All other controls (with exception of focus control) are set for normal reception of the transmitted signal unless the voltage shown on the chart is followed by a letter or letters indicating a special condition of measurement as explained in subsequent notes.

8. Certain voltages were measured with two different settings of specific controls. It should therefore be understood that in these instances all controls, with the exception of one or two, were set for normal reception—letters following the voltage shown on the chart indicate the exceptions and are explained below.

9. The external or built-in antenna should remain connected to the receiver only when taking voltage measurements in the sweep and sync circuits—for all other measurements, disconnect antenna, short antenna terminals together and connect them to ground.

EXPLANATION OF NOTES

A. Vert. Hold Control max. counter-clockwise

a. This voltage will vary from —3.6 to —8.7 depending upon setting of Horizontal Hold Control and Horizontal Lock Control.

B. Brightness Control max. counter-clockwise

b. This voltage will vary from 11 to 16 depending upon setting of Horizontal Hold Control and Horizontal Lock Control.

C. Contrast Control max. clockwise

D. Horiz. Drive Control max. clockwise

d. This voltage will vary from 315 to 335 depending upon setting of Horizontal Hold Control and Horizontal Lock Control.

E. If you do not have an instrument capable of directly measuring voltages in this range, the voltage can be measured by using a voltage divider network consisting of twenty 2.2 megohm 2 watt resistors and one 1 megohm 2 watt resistor, all connected in series. Avoid using resistors of higher values as their individual voltage rating may be exceeded. It is also important to use resistors of equal wattage. Solder all connections between resistors. Accurately measure the overall resistance of the entire combination as well as the resistance of the 1 megohm section.

With the set turned off, connect the 2.2 megohm end of the resistance voltage divider to the filament of the 1B3GT/8016 tube, or H. V. terminal of the picture tube, and connect the 1 megohm end to chassis. Now, turn the set on and measure the voltage drop across the 1 megohm resistor with a vacuum tube voltmeter. The voltage at the tube terminal can then be calculated as follows:

$$\left[\text{Volts At Tube Terminal}\right] = \frac{\left[\text{Measured Resistance Of Entire Voltage Divider}\right]}{\left[\text{Measured Resistance Of 1 Meg. Section}\right]} \times \left[\text{Volts Measured Across 1 Meg. Section}\right]$$

e. This voltage will vary from —2.7 to +5.8 depending upon setting of Horizontal Hold Control and Horizontal Lock Control.

F. Height Control max. counter-clockwise

f. Contrast Control max. counter-clockwise

G. Width Control max. counter-clockwise

g. This voltage will vary from 8 to 15 depending upon setting of Horizontal Hold Control and Horizontal Lock Control.

H. Height Control max. clockwise

h. This voltage will vary from 10 to 20 depending upon setting of Horizontal Hold Control and Horizontal Lock Control.

J. Horiz. Hold Control set for normal picture.

K. Horiz. Lock Control set for normal picture.

k. This voltage will vary from —5 to —11 depending upon setting of Horizontal Hold Control and Horizontal Lock Control.

L. This voltage will vary from —6 to —16 depending upon setting of Horizontal Hold Control and Horizontal Lock Control.

M. Vertical Linearity Control max. counter-clockwise.

m. Band switch set to "AM" position; dial tuned to 540 Kc. and AM loop antenna leads grounded.

N. Channel Selector set to channel #4

n. Band switch set to "FM" position; dial tuned to 88 Mc. and FM antenna terminal grounded.

P. Band switch set to "PHO" position.

R. Do not attempt to measure the voltage at the tube cap. There is a high R. F. potential at this point.

r. This vacuum tube voltmeter measurement will fluctuate in the vicinity of 0.9 volts.

S. Channel Selector set to channel #10

T. Grounding of center stud on tube socket is necessary to reduce capacity coupling between other pins. Oscillation may result if this ground is omitted.

t. This voltage will vary from —0.04 to +0.06 depending upon setting of Horizontal Hold Control and Horizontal Lock Control.

U. Vertical Hold Control max. clockwise

V. Before measuring this voltage, first connect external antenna and adjust controls for normal reception of station signal; then set Focus Control to maximum counter-clockwise position.

W. This voltage will vary from —10 to —12 depending upon setting of Horizontal Hold Control and Horizontal Lock Control.

X. Brightness Control max. clockwise

Y. Vertical Linearity Control max. clockwise.

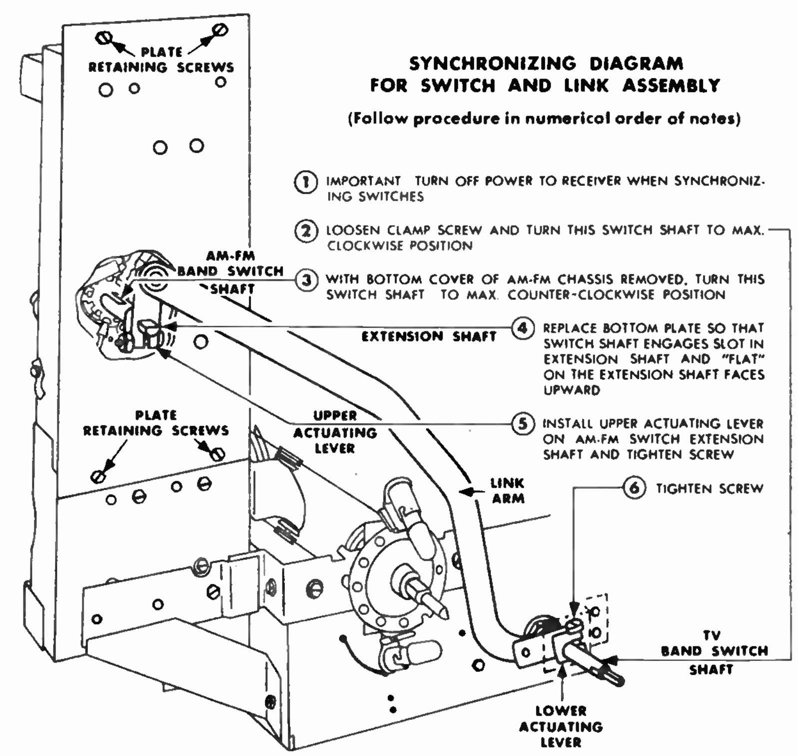
Z. The measurement should be made with a vacuum tube voltmeter. The voltage reading will fluctuate in the vicinity of 0.04 volts.

CHECKING SYNCHRONIZATION OF BAND SWITCHES ON AM-FM TUNER AND TV CHASSIS

Note that the band switch on the AM-FM Tuner chassis is mechanically coupled by a link arm and lever arrangement to the band switch on the TV chassis. Do not operate these switches by direct pressure on the link arm—always use a control knob attached to the TV switch shaft.

If the mechanical linkage is forced or slips at the lever on the TV switch shaft or the bottom cover of the AM-FM Tuner is removed for service purposes, it is possible for the respective switch sections to get out of step. As one function of the band switch is to control power supply circuits, the receiver can be damaged if the respective switch sections lose synchronism or are indiscriminately set to random positions.

In order to check for correct synchronization of the band switches, proceed as follows:



SYNCHRONIZING DIAGRAM FOR SWITCH AND LINK ASSEMBLY
(Follow procedure in numerical order of notes)

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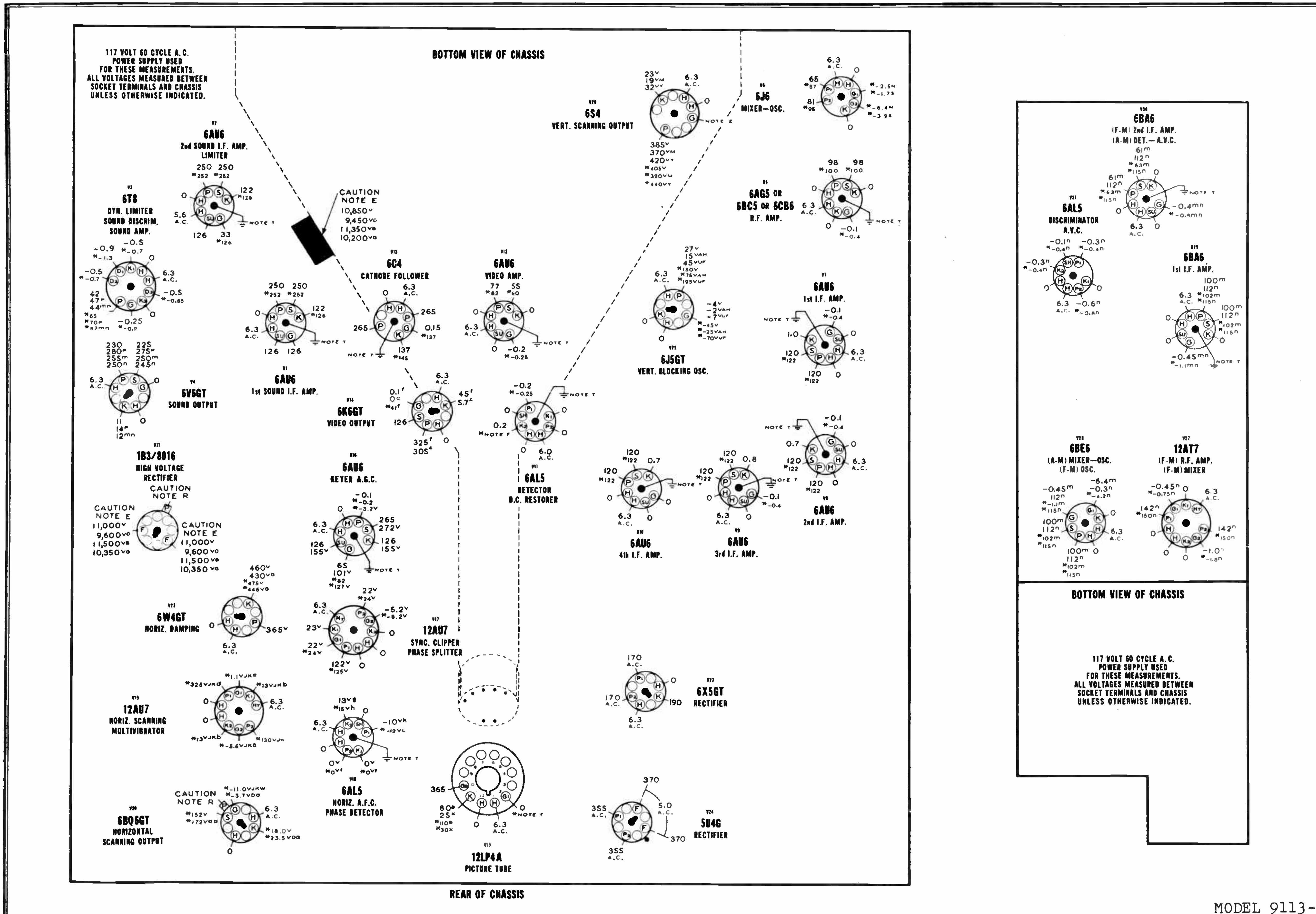

MODEL 9113-A

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REMOVING BOTTOM COVER OF AM-FM CHASSIS

It will be necessary to remove the bottom cover of the AM-FM chassis in order to service the underside of this unit. Removal of that cover may be accomplished as follows:

1. Make sure receiver is turned off by removing power cord plug from wall outlet.
2. Loosen screw in upper actuating lever on AM-FM band switch extension shaft and slide lever off the shaft. The link arm will now be disengaged from the AM-FM band switch.
3. Release the screws holding the bottom cover in position and carefully remove cover.

METHOD OF MAINTAINING BAND SWITCH SYNCHRONIZATION DURING VOLTAGE MEASUREMENTS OR OTHER SERVICE OPERATIONS ON AM-FM TUNER

After the bottom cover of the AM-FM chassis has been removed, it should be noted that the link arm is disengaged from the AM-FM band switch shaft, thereby removing mechanical coupling between the TV chassis band switch and AM-FM chassis band switch. For proper operation of the receiver while servicing the AM-FM Tuner, these switches must each be manually positioned so as to maintain correct synchronization. Positioning of these switches may be accomplished as follows:

1. Make sure receiver is turned off by removing power cord plug from wall outlet. **IMPORTANT: — Do not attempt to operate separate sections of band switch while power is on.**
2. Before attempting to select a specific setting (FM, AM, PHONO, or TV) for the respective switch sections, it is important to assure that both sections start at their correct position. That is done by setting the **switch section on the AM-FM chassis to its fully clockwise position** and then setting the **switch section on the TV chassis to its fully counter-clockwise position.** Both switch sections are now in their correct position for "FM" operation of the receiver.
3. To set switch sections for AM, PHONO or TV operation, position them as follows: NOTE THAT AS SWITCH SECTION ON AM-FM CHASSIS IS ADVANCED COUNTER-CLOCKWISE, THE TV CHASSIS SWITCH SECTION MUST BE ADVANCED IN A CLOCKWISE DIRECTION.

RECEIVER FUNCTION	SWITCH POSITION ON TV CHASSIS	SWITCH POSITION ON AM-FM CHASSIS
FM	Fully counter-clockwise	Fully clockwise
AM	2nd position, turning clockwise	2nd position, turning counter-clockwise
PHONO	3rd position, turning clockwise	3rd position, turning counter-clockwise
TV	Fully clockwise	Fully counter-clockwise

4. When replacing bottom cover of AM-FM chassis and mechanical link arm between switch sections, refer to diagram above for re-assembly instructions.

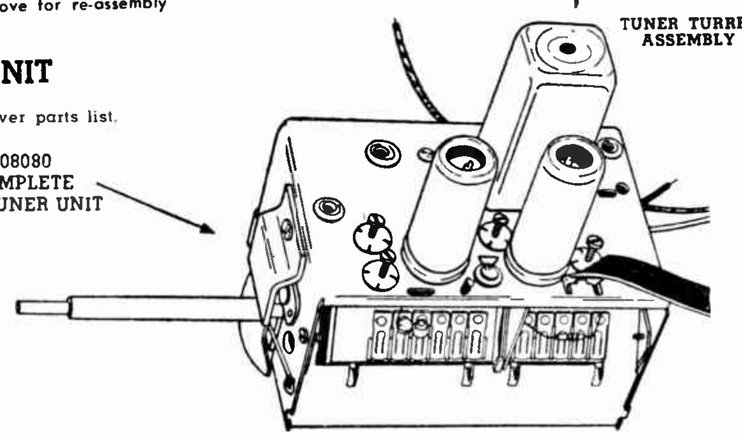
REPAIR DATA FOR 508080 RF TUNER UNIT

All replacement parts for the RF Tuner Unit are included in the complete receiver parts list.

This RF Tuner Unit consists of an RF amplifier stage (using 6AG5, 6BC5, or 6CB6 tube) and a mixer-oscillator stage (using 6J6 tube). Channel selection is accomplished by rotation of a turret assembly having 2 sets of snap-in coils for each of the 12 channels. The tuner also incorporates a Fine Tuning control.

Antenna Coils for each channel consist of a center-tapped primary and an RF amp. grid winding (secondary). The individual RF-Oscillator Coils include an RF amplifier plate section, a mixer grid section and an oscillator winding. Signal output from the mixer stage is coupled to the IF amplifiers through the input IF coil located on the tuner unit.

508080
COMPLETE
R.F. TUNER UNIT



SERVICE PRECAUTIONS

SUBJECT	PRECAUTIONS
ELECTRICAL COMPONENTS	The high frequencies used in the RF section of a television receiver make it necessary that considerable care be exercised in servicing the tuner. Lead dress and location of components are very critical at these frequencies. When replacing parts, it is important to use components of identical electrical characteristics and physical size. Always reconnect the replacement item in the same location and position in the tuner as the original component.
TUBES	Replacement of tubes in the Tuner Unit may cause slight detuning of RF circuits due to inherent differences in inter-electrode capacitances. When replacing tubes (especially V6, 6J6 mixer-oscillator tube) make sure that Fine Tuning control will tune in television stations at approximately the middle of its range. It may be necessary to change the setting of the individual oscillator coil slugs for some channels to accomplish this.
CHANNEL COILS AND SLUGS	Channel Coils must be handled with care. Do not disturb coil windings. If an oscillator slug "falls into" its coil form during adjustment, remove the Channel Coil from the turret assembly and lift the Slug Retaining Spring aside. By tapping the coil form it should be possible to make the slug move toward the end so that its threads will be engaged by the Slug Retaining Spring when that spring is returned to its normal position.
FINE TUNING CONTROL	Rubbing of the bakelite Fine Tuning Cam against the Fine Tuning Condenser Plate is intentional in order to avoid vibration with resulting microphonics. However, the Fine Tuning Cam should not rub or contact the small circular plate located on the body of the tuner.

REMOVAL AND REPLACEMENT OF PARTS

ITEM	PROCEDURE
RF TUNER UNIT	To remove the Tuner Unit from receiver chassis, proceed as follows: 1. Remove metal plate which covers side of RF Tuner Unit nearest edge of chassis. This plate is held in place by two screws at side of chassis. 2. Remove channel selector dial lamp socket. 3. Remove support bracket which positions front of Tuner Unit and also remove screws which hold tuner to rear support bracket. 4. Disconnect the leads from the tuner to the main chassis. See illustration on page 1950-216 (circuit diagram page) showing tuner connections. After the Tuner Unit is replaced, make sure that channel selector dial lamp socket is correctly positioned so that channel selector knob will be properly illuminated.
CHANNEL COILS	Insert a screwdriver blade between Coil Retainer Spring and the end of the Tuner Turret. Twist the blade to pull spring away from the molded body of Channel Coil. Lift this end of coil body upward and remove individual coil assembly from tuner. When replacing Channel Coils, be sure they are reinstalled in their correct positions. Coil numbers should increase consecutively in a counter-clockwise direction when tuner is viewed from the front. If all the Channel Coils have been removed from the Tuner Turret, rotate turret until flat surface on end of tuner shaft points down. Install #3 Channel Coils into bottom position on turret. Then follow the correct sequence indicated above to replace other coils.

ITEM	PROCEDURE
TUNER TURRET ASSEMBLY	To remove turret from RF Tuner Unit, proceed as follows: 1. Remove tuner from receiver chassis. 2. Remove rear Turret Shaft Retaining Spring by disengaging straight end of spring from projection on tuner. 3. Remove Fine Tuning Condenser Plate from front of Tuner Unit. This plate forms one side of Fine Tuning control condenser and is held in place by one screw. 4. Slide Fine Tuning Cam and Brass Shaft off of main Channel Selector Shaft. 5. Remove Contactor Washer Spring and Fiber Spacer Washer from Channel Selector Shaft. 6. Remove Shaft Retaining Spring at front of tuner by disengaging straight end of spring from projection on case. 7. Slide turret assembly out of case and remove Detent Roller. To replace turret, reverse the above procedure. Tooth on bakelite Fine Tuning Cam should point downward during assembly so that it does not become locked between the stops on the Fine Tuning Condenser Plate.

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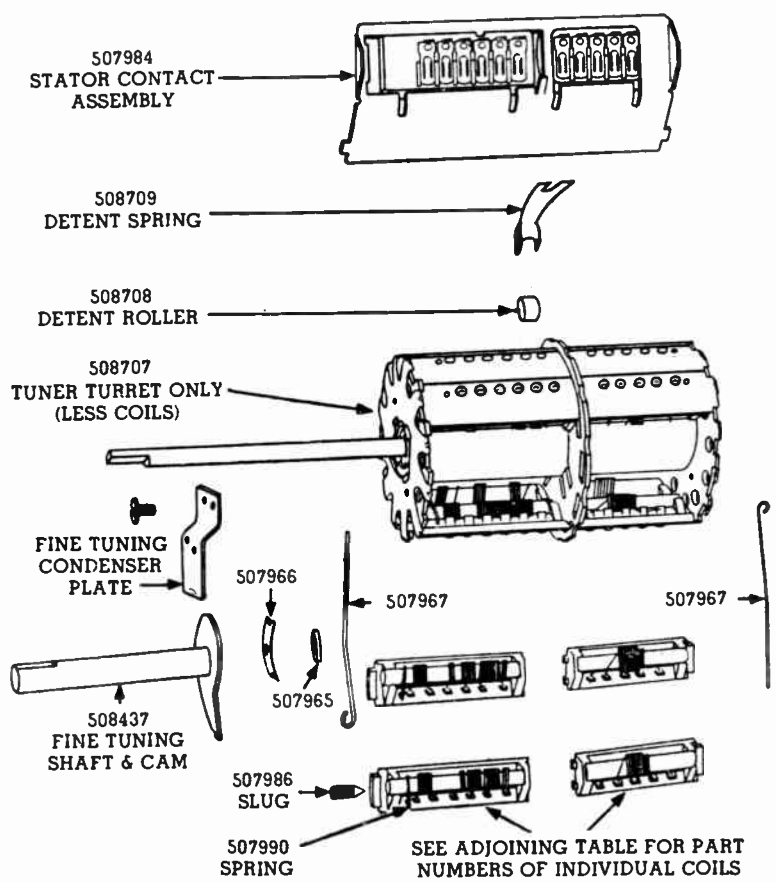
STATOR CONTACT ASSEMBLY	To remove this assembly, proceed as follows: 1. Remove the two screws at the front and rear of the Stator Contact Assembly. 2. Unsolder all electrical connections to contact plate. 3. Unsolder four soldered joints between Stator Contact Assembly and Tuner Unit. 4. Contact Assembly may now be withdrawn from case. To reinstall this assembly: 1. Place Stator Contact Assembly in position and replace, but do not tighten, the two screws at the front and rear of the assembly. 2. Remove 3 consecutive pairs of Channel Coils from the turret (for example, the antenna and rf-osc. coils for channels #5, 6 and 7). 3. Position Tuner Turret so that the edges of the next highest Channel Coils (in this case, the coils for channel #8) just pass the row of 11 contacts on the Stator Contact Assembly. 4. Adjust position of the Stator Contact Assembly so that there are a few thousandths of an inch spacing between the contacts on the contact plate and the molded body of the Channel Coils. 5. The Contact Assembly is now correctly positioned and screws at front and rear may be tightened. 6. Solder Stator Contact Assembly to tuner frame at same four points that were used previously. 7. Make all electrical connections to contact plate. 8. Replace Channel Coils. 9. Reset Detent Spring as indicated in next section of this chart.
DETENT SPRING	When servicing the Detent Spring, or when replacing Stator Contact Assembly, it will be necessary to correctly set the position of this spring so that coil contacts will properly engage stator contacts. To release the Detent Spring, loosen mounting screw. Then, position the Detent Spring and Roller so that the contacts on the Stator Contact Assembly engage coil contacts (proper contact position is indicated when contact springs on stator reach point of maximum displacement). Detent Spring can then be positioned so that Detent Roller exactly fits into notch on center plate of turret.

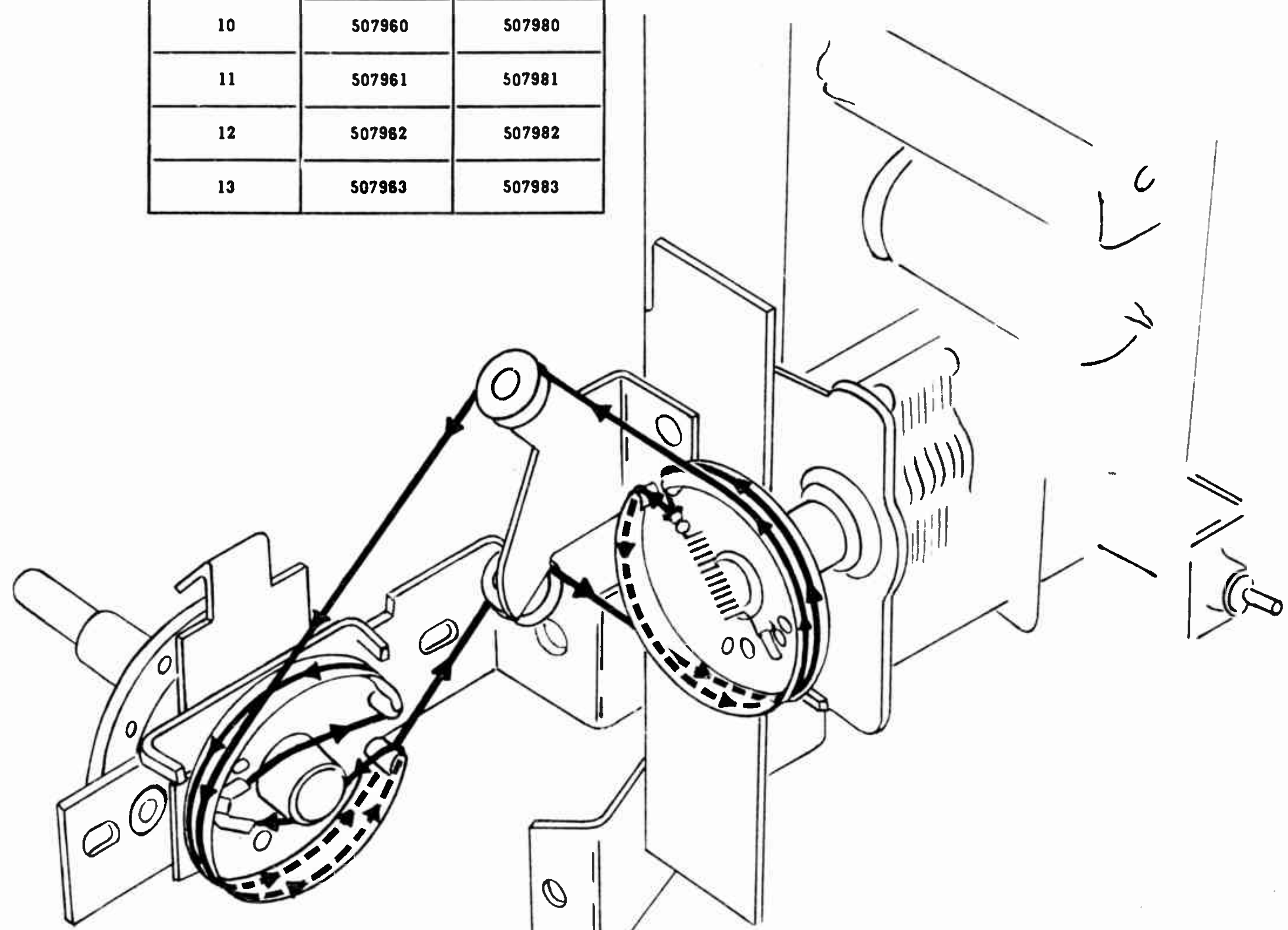
CHANNEL NUMBER	ANTENNA COIL PART NUMBER	RF & OSC COIL PART NUMBER
2	507952	507972
3	507953	507973
4	507954	507974
5	507955	507975
6	507956	507976
7	507957	507977
8	507958	507978
9	507959	507979
10	507960	507980
11	507961	507981
12	507962	507982
13	507963	507983

DIAL POINTER DRIVE CORD ARRANGEMENT

To string dial cord, first rotate "AM-FM" Coarse Tuning Control fully counter-clockwise until stop on drum contacts ear on mounting frame. Now, with gang set to fully meshed position, string dial cord using the following parts:

114955 Clip on end of cord
117057 Cord ($2\frac{1}{2}$ ft. required)
505161 Spring





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ALIGNMENT PROCEDURE
MODEL 9113-A

Alignment of all RF and IF tuned circuits in this receiver may be accomplished by utilizing the procedures described in the following charts.

SEQUENCE OF ALIGNMENT: These procedures should preferably be applied in the order in which they are presented, however, alignment of RF or IF channels for either AM, FM or TV may be accomplished individually if desired.

The Television RF Amplifier and Mixer alignment may also be accomplished independent of the Television IF Channel alignment, but oscillator calibration can only be done after IF Channel has been correctly aligned. Proper IF band pass characteristic is necessary for oscillator alignment as results of circuit tuning are observed by means of an oscilloscope connected to the output of the video detector stage.

REMOVAL OF CHASSIS: The receiver chassis must be removed from the cabinet in order to accomplish alignment of all tuned circuits as there are adjustment points located on the undersides of both the main chassis and the AM-FM Tuner.

This can be accomplished by first removing all knobs and releasing the hold-down screws located on the underside of the cabinet. Then disconnect speaker leads and all three "built-in" antennae (TV, AM and FM). Release indicator lamp from bracket at base of cabinet.

CAUTION

The picture tube is highly evacuated and if broken, glass fragments will be violently expelled. Handle with care, using safety goggles and gloves. Avoid contact with high voltage terminal at side of tube even after it has been disconnected from the receiver—this precaution is necessary as inner and outer coatings on the tube form a capacitor which may carry a high voltage charge for an extended period of time after disconnection from the receiver.

INSTRUMENTS: The following instruments will be required as signal sources and output indicators during the alignment process. Since accurate alignment of a television receiver is heavily dependent upon the performance of your instruments, it is imperative that they meet the essential specifications described here.

1. **STANDARD SIGNAL GENERATOR** to provide signals at the following frequencies. Maximum output on all ranges should be at least .1 volt with provision for attenuation as desired. This instrument must have good frequency stability and be accurately calibrated. Generators which incorporate a separate crystal controlled oscillator and heterodyne circuit are self calibrating and therefore capable of providing the accuracy of frequency calibration required for television circuit alignment.

A. IF Frequencies:

455 Kc. (400 cycle amplitude modulated) for AM IF.
4.5 Mc. (Unmodulated) for TV Sound.
10.7 Mc. (Unmodulated) for FM IF.
22.25 (Unmodulated) marker for TV Sound IF carrier.
22.4 Mc. (Unmodulated) for TV 1st IF Trap.
22.8 Mc. (Unmodulated) for TV 3rd IF Trap.
23.5 Mc. (Unmodulated) for TV 1st and 3rd IF.
24.5 Mc. (Unmodulated) for TV 4th IF.
26.3 Mc. (Unmodulated) for TV Converter and 2nd IF.
26.75 Mc. (Unmodulated) marker for TV Picture IF carrier.

B. RF Frequencies:

550 to 1600 Kc. (400 cycle amplitude modulated) for AM RF.
54 to 88 Mc. (Unmodulated) for TV RF.
88 to 108 Mc. (400 cycle amplitude modulated) for FM RF.
174 to 216 Mc. (Unmodulated) for TV RF.

2. **RF SWEEP GENERATOR** to provide frequency modulated signals at the following frequencies:

10.7 Mc. with 300 Kc. sweep width.
20 to 30 Mc. with 10 Mc. sweep width.
54 to 88 Mc. with 10 Mc. sweep width.
174 to 216 Mc. with 10 Mc. sweep width.

Output adjustable with at least .1 volt maximum.

Output should be "flat" (no amplitude variation) for all settings of the sweep width control.

Provision for connection of generator sweep modulating voltage to horizontal deflection system of an oscilloscope.

Provision for blanking the output signal on each return sweep so that oscillogram will not show retrace.

3. **CATHODE RAY OSCILLOSCOPE**, preferably a unit with vertical amplifier having wide range frequency response and low capacity pick-up probe.

4. **VACUUM TUBE VOLTMETER.** The lowest voltage range of this instrument should preferably permit a 1.0 volt reading to be indicated at not less than one third of full scale deflection.

5. **OUTPUT METER**, preferably a unit equipped with an impedance matching network that will present a 3.2 ohm load when connected to secondary of audio output transformer.

INSTRUMENT CONNECTIONS: The method of connection, including details of matching and coupling networks, for instruments used in this alignment procedure is given in several illustrations on subsequent pages. Specific instructions for each instrument application will also be found in various sections of the alignment charts.

IMPORTANT

AVOID EXCESSIVE INPUT SIGNAL WHEN USING OSCILLOSCOPE AS ALIGNMENT INDICATOR.

When observing the receiver band pass characteristic on an oscilloscope, it is exceedingly important to avoid distortion of that characteristic which would occur when using a large input signal from the sweep generator or standard generator (marker signal). Always set attenuator on sweep generator so that reading on the vacuum tube voltmeter does not exceed one volt (when meter is connected from high side of video detector load resistor, symbol 139, to receiver chassis). Standard generator output should also be attenuated so that marker signal does not pull or tear the band pass characteristic as shown on the 'scope.

CHECKING SYNCHRONIZATION OF BAND SWITCHES ON AM-FM TUNER AND TV CHASSIS.

Note that the band switch on the AM-FM Tuner chassis is mechanically coupled by a link arm and lever arrangement to the band switch on the TV chassis. Do not operate these switches by direct pressure on the link arm—always use a control knob attached to the TV switch shaft.

If the mechanical linkage is forced or slips at the lever on the TV switch shaft, or the bottom cover of the AM-FM tuner is removed for service purposes, it is possible for the respective switch sections to get out of step. The receiver can be damaged if the switch sections lose synchronization, or are indiscriminately set to random positions. In order to check for proper synchronization of the band switches, refer to procedure on page 40.

BROADCAST BAND—"AM"—ALIGNMENT PROCEDURE

1. After the entire chassis assembly has been removed from the cabinet, remove the AM loop antenna and reconnect it to the AM antenna leads extending from the AM-FM tuner chassis. Then wind one turn of insulated wire around frame of loop antenna so as to provide a means of coupling it to the signal generator. Connect one end of coupling turn to receiver chassis and allow other end to remain open until otherwise instructed in the following chart. Space loop antenna same distance away from the chassis as when assembled in the cabinet.
2. Reconnect the speaker to the two audio output leads extending from the main chassis. **IMPORTANT:** Do not confuse these leads with the two loop antenna leads.
3. Replace AM-FM Coarse and Fine Tuning knobs and rotate Fine Tuning knob to its extreme counter-clockwise position. At this setting, the gang condenser should be fully meshed and the heavy line next to 5.5 on the dial scale should be pointing straight up; if they are not, loosen the set screws in the hub of the dial drum on the gang condenser and close gang plates manually; also, position the dial scale correctly. Then tighten set screws in hub of dial drum.
4. The Control Panel Escutcheon at the front of the cabinet normally provides a "position indicator" for the AM-FM dial scale, however, when the chassis is removed from the cabinet it becomes necessary to install a "temporary pointer." That can be readily accomplished by binding a piece of heavy wire around the planetary drive support brackets and shaping the free end of the wire so that it can be placed in a vertical position (pointing downward) between the dial knob and the lamp behind it (wire will then cast a shadow on the dial scale and show the frequency to which the receiver is tuned).

   With the gang condenser fully meshed, the "temporary pointer" should appear directly behind the heavy line preceding 5.5 on the dial scale.
5. **IMPORTANT:** Do not remove the metal bottom plate of AM-FM tuner chassis. Holes are provided for access to IF transformer tuning slugs. Removal of the bottom plate during alignment of the RF circuits will result in detuning when the plate is replaced.
6. Connect output meter across the speaker voice coil.
7. Connect ground lea of signal generator to the receiver chassis.
8. Set volume control to the maximum volume position and use a weak signal from the signal generator.
9. Set tone control to its extreme clockwise position.
10. Set band switch to the "AM" position.
11. After alignment procedure is completed and chassis and loop have been reinstalled in cabinet, arrange leads to loop so that they are separated from each other as much as possible. Avoid twisting, taping or extending these leads.

DUMMY ANT. IN SERIES WITH SIGNAL GENERATOR	CONNECT HIGH SIDE OF SIGNAL GENERATOR TO	SIGNAL GENERATOR FREQUENCY	RECEIVER DIAL SETTING	TRIMMER OR SLUG NUMBER	TRIMMER DESCRIPTION	TYPE OF ADJUSTMENT
.1 MFD. Condenser	Lug on trimmer #23 at bottom of gang (see figure 1 for location of trimmer).	455 KC	Any point where it does not affect the signal.	18 and 19	2nd I.F.	Adjust for maximum output. Then repeat adjustment.
				20 and 21	1st I.F.	
200 MMF. Mica Condenser	Coupling turn on loop antenna.	1500 KC	1500 KC	#22	AM Oscillator.	Adjust for maximum output.
		1500 KC	Tune to 1500 Kc. generator signal.	#23	AM Antenna	Adjust for maximum output.
200 MMF. Mica Condenser	Coupling turn on loop antenna.	600 KC	Tune to 600 Kc. generator signal.	#24	Adjustable core of AM Antenna Coil.	Adjust for maximum output.
Repeat adjustment of trimmers 23 and 24 until one no longer detunes the other.						

FREQUENCY MODULATION—"FM"—ALIGNMENT PROCEDURE

1. After the entire chassis has been removed from the cabinet, replace AM-FM Coarse and Fine Tuning knobs and rotate Fine Tuning knob to its extreme counter-clockwise position. At this setting, the gang condenser should be fully meshed and the heavy line next to 88 on the dial scale should be pointing straight up; if they are not, loosen the set screws in the hub of the dial drum on the gang condenser and close gang plates manually; also, position the dial scale correctly. Then tighten set screws in hub of dial drum.
2. The Control Panel Escutcheon at the front of the cabinet normally provides a "position indicator" for the AM-FM dial scale, however, when the chassis is removed from the cabinet it becomes necessary to install a "temporary pointer." That can be readily accomplished by binding a piece of heavy wire around the planetary drive support brackets and shaping the free end of the wire so that it can be placed in a vertical position (pointing upward) between the dial knob and the lamp behind it (wire will then cast a shadow on the dial scale and show the frequency to which the receiver is tuned).

   With the gang condenser fully meshed, the "temporary pointer" should appear directly behind the heavy line next to 88 on the dial scale.
3. Reconnect the speaker to the two audio output leads extending from the main chassis. **IMPORTANT:** Do not confuse these leads with the two AM loop antenna leads.
4. Set band switch to the "FM" position.
5. Remove bottom cover from AM-FM tuner during IF alignment but replace it before starting alignment of RF circuits.

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TRIMMER AND SLUG LOCATIONS FOR AM-FM TUNER ALIGNMENT

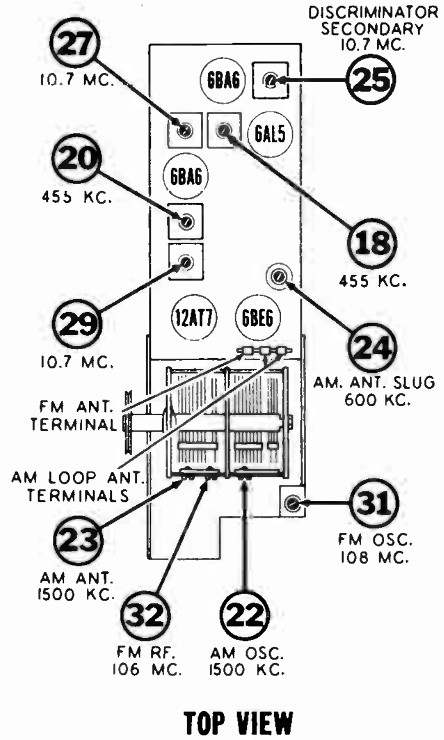


FIG. I
AM-FM Tuner Chassis

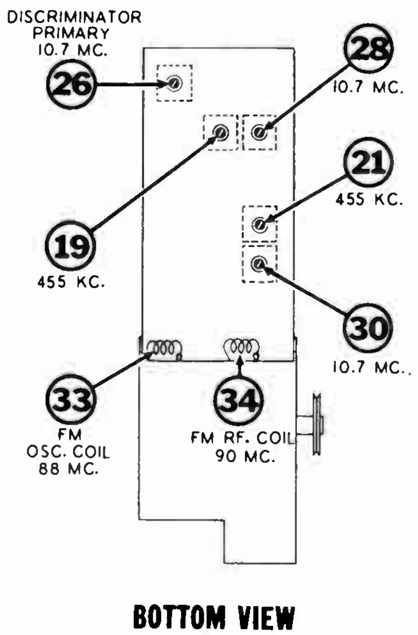


FIG. 2
AM-FM Tuner Chassis

INSTRUMENT CONNECTIONS FOR FM ALIGNMENT PROCEDURE

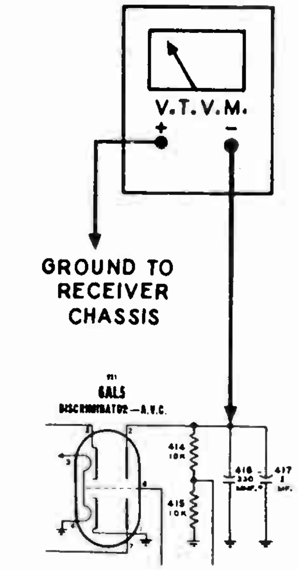


FIG. 3
VTVM Connections for FM Sound IF Alignment

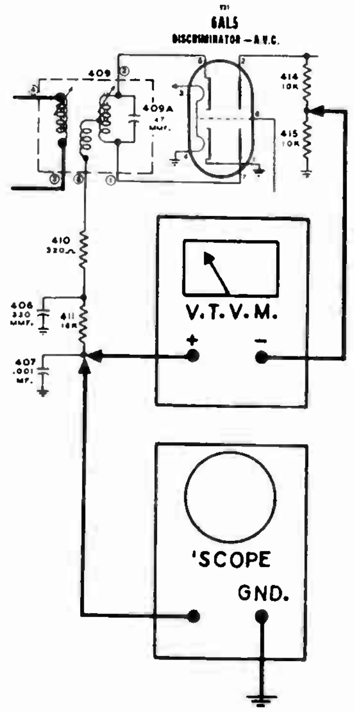


FIG. 4
VTVM and Oscilloscope Connections for FM Sound Discriminator Alignment

FREQUENCY MODULATION—"FM" ALIGNMENT PROCEDURE

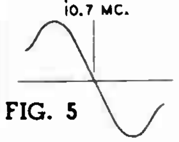
IMPORTANT: Carefully follow procedure for removal and replacement of this plate, as well as synchronization of band switches on AM-FM tuner and TV chassis, as explained on page 40. **Failure to correctly install bottom cover may result in serious damage to receiver.**

6. **Do not remove the AM-FM tuner chassis from the TV chassis during alignment.**

7. Set volume control to the maximum volume position and use a weak signal from the signal generator.

8. Set tone control to its extreme clockwise position.

9. Dress FM circuit leads as short and straight as possible, particularly those in the oscillator circuit. IF plate and grid leads should also be kept short and straight.

STANDARD SIGNAL GENERATOR		SWEEP GENERATOR		VTVM OR OUTPUT METER CONNECTION	OSCILLOSCOPE CONNECTIONS	RECEIVER DIAL SETTING	TRIMMER OR SLUG NUMBER	TYPE OF ADJUSTMENT AND OUTPUT INDICATION
CONNECTIONS	FREQUENCY	CONNECTIONS	FREQ.					
Connect high side to lug on trimmer #32 (see Fig. 1 for location of trimmer) using a .01 Mfd. condenser in series with generator lead. Connect ground lead to the receiver chassis in vicinity of gang condenser.	10.7 MC. Unmodulated	Not used.	——	Connect VTVM as shown in Fig. 3.	Not used.	Any position where it does not affect the signal.	#25 Discriminator secondary #26 Discriminator primary 27 and 28 2nd IF 29 and 30 1st IF	Adjust these trimmers for maximum meter reading — the output voltage will be of negative polarity.
Same as above.	Same as above.	Not used.	——	Connect VTVM as shown in Fig. 4.	Not used.	Same as above.	#25 Discriminator secondary	Note that as slug #25 is rotated, a point will be found where the voltmeter will swing rather sharply from a positive to a negative reading or vice versa. The correct setting is obtained when the meter reads zero as the slug is moved thru this point.
Same as above.	Same as above. —— Attenuate signal to prevent overload and distortion of response curve.	Connect high side to lug on trimmer #32 (see Fig. 1 for location of trimmer) using a .01 Mfd. condenser in series with generator lead. Connect ground lead to the receiver chassis in vicinity of gang condenser.	10.7 MC Sweeping ±300 Kc.	Not used.	Connect as shown in Fig. 4. —— Set vertical amplifier of 'scope for maximum amplification. —— Synchronize oscilloscope with sweep generator by connecting "horizontal input" terminals of 'scope to source of horizontal sweep modulating voltage on the sweep generator.	Same as above.	#25 Discriminator secondary	A pattern similar to that shown in Fig. 5 should appear on the oscilloscope screen. Check for symmetry about the 10.7 Mc. center point and linearity of the slope. 10.7 MC.  FIG. 5 If the characteristic is not shaped properly, attempt to obtain symmetry by changing the setting of slug #25. Should that fail to produce the desired results, then a slight readjustment of slugs #26, 27, 28, 29 and 30 should be undertaken.
IMPORTANT:—Before starting alignment of the RF and Oscillator circuits, be sure to replace the bottom plate on the AM-FM Tuner chassis as explained on page 1950-198. Failure to observe this requirement would result in detuning if plate were replaced after alignment is completed.								
Connect high side in series with a 270 ohm carbon resistor to FM antenna terminal near gang condenser (see Fig. 1). Connect ground lead to receiver chassis.	108 MC. with 400 cycle AM Modulation.	Not used.	——	Connect OUTPUT METER across speaker voice coil.	Not used.	108 Mc.	#31 FM Oscillator	Set trimmer #31 to receive 108 Mc. signal as indicated by maximum meter reading.
Same as above.	106 MC. with 400 cycle AM Modulation.	Not used.	——	Same as above.	Not used.	Tune to 106 Mc. generator signal.	#32 FM RF	Adjust trimmer for maximum meter reading.

Check calibration and tracking of receiver with input signals of 88, 90 and 106 MC. If difference between dial pointer setting and the above mentioned frequencies does not exceed ±0.3 MC. and RF circuit is tracking properly, then alignment may be considered satisfactory and no further adjustment is necessary.

Where the calibration error is greater than ±0.3 MC. it is advisable to make the following adjustments:

Tune receiver to an 88 MC. signal and note whether dial pointer is above or below correct calibration point. Then tune receiver so that dial pointer is at the 88 MC. position. If generator signal was previously received at a setting above 88 MC., it will be necessary to slightly spread the windings of the FM oscillator coil (#33 in Fig. 2) so that signal will now be received at the correct dial setting. On the other hand, if generator signal was received at a dial setting below 88 MC., then slightly compress the windings of the oscillator coil until the signal comes in at the correct calibration point.

Adjustment of FM oscillator coil #33 will require removal of bottom cover. Before rechecking calibration, follow procedure on page 1950-198 for removal and replacement of cover.

Check calibration at 108 MC. and if it is in error by more than ±0.3 MC., readjust setting of trimmer #31. Repeat calibration adjustment at 88 and 108 MC. until desired accuracy is obtained.

Observe dial calibration at 106 MC. If it is found to be incorrect by an appreciable amount, then make a very slight adjustment in the spacing of the gang condenser plates to receive the 106 MC. signal at the correct dial setting. Then check adjustment of RF trimmer #32 to obtain maximum output indication at 106 MC.

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INSTRUMENT CONNECTIONS FOR SOUND CHANNEL ALIGNMENT

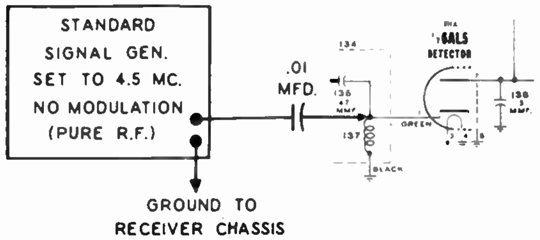

FIG. 6
Generator Connections for Television Sound Channel Alignment

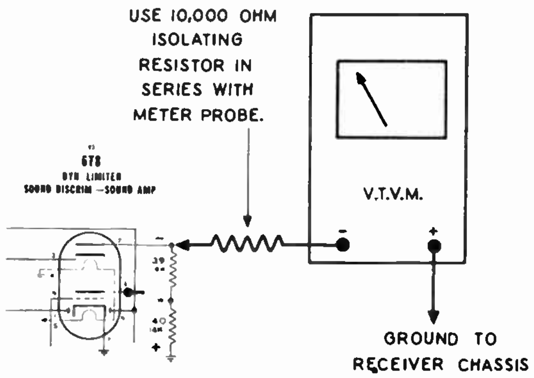

FIG. 7
VTVM Connections for Television Sound IF Alignment

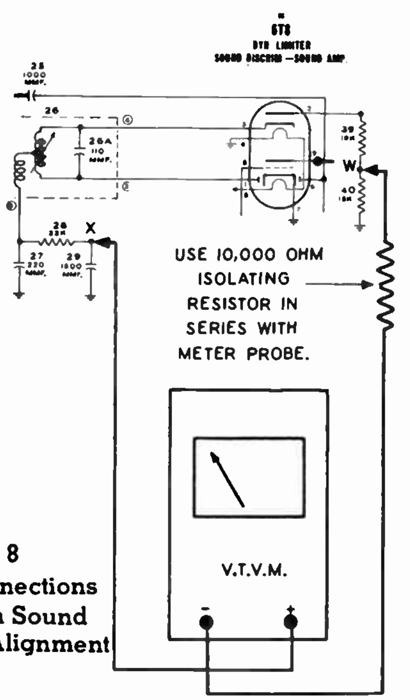

FIG. 8
VTVM Connections for Television Sound Discriminator Alignment

INSTRUMENT CONNECTIONS FOR IF CHANNEL ALIGNMENT

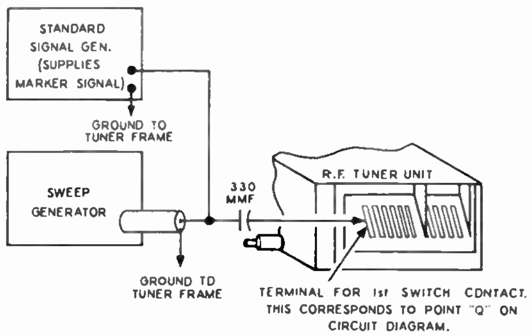

FIG. 9
Generator Connections for Television IF Channel Alignment

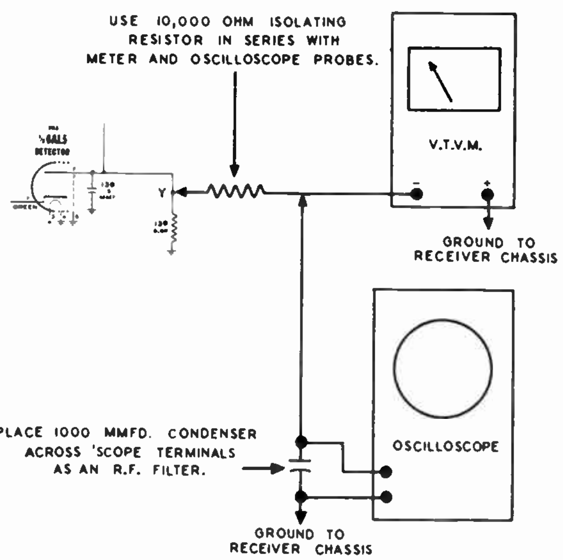

FIG. 10
VTVM and Oscilloscope Connections for Television IF Channel Alignment

TELEVISION SOUND CHANNEL ALIGNMENT PROCEDURE

1. Short antenna terminals together with a jumper wire.
2. Turn the band switch to "TV" position and set receiver Channel Selector to any inactive television channel: other controls may be left at any desired setting.
3. No special aligning tool is required to adjust the cores in the Sound IF and discriminator transformers. The blade of a small screwdriver will fit the slot in these cores, however, the screwdriver should be of a non-metallic or insulated type to prevent detuning when inserted in the transformer can.

STANDARD SIGNAL GENERATOR		VTVM CONNECTIONS	MISCELLANEOUS INSTRUCTIONS	TRIMMER OR SLUG	TYPE OF ADJUSTMENT AND OUTPUT INDICATION
CONNECTIONS	FREQUENCY				
Connect as shown in Fig. 6.	**4.5 MC.** unmodulated **IMPORTANT** This signal must be accurate within ¼ of 1% of 4.5 Mc. Check generator calibration against a crystal controlled signal source by "zero beating" (heterodyning) with harmonics of the crystal frequency.	Connect as shown in Fig. 7.	A "swishing" sound may be heard in the speaker during Sound Channel Alignment. This spurious oscillation is caused by horizontal sweep voltage being picked up in the audio system thru stray coupling of instrument leads: it should be disregarded as it will have no effect on alignment of the sound channel.	#1 Discriminator Secondary	Adjust for maximum reading on VTVM.
				#2 Discriminator Primary	Adjust for maximum reading on VTVM.
				#3 2nd Sound IF Secondary	Adjust for maximum reading on VTVM.
				#4 2nd Sound IF Primary	Adjust for maximum reading on VTVM.
				#5 1st Sound IF Secondary	Adjust for maximum reading on VTVM.
				#6 1st Sound IF Primary	Adjust for maximum reading on VTVM.
Same as above.	Same as above.	Connect as shown in Fig. 8.	Same as above.	#1 Discriminator Secondary	Note that as slug #1 is rotated, a point will be found where the voltmeter will swing rather sharply from a positive to a negative reading or vice versa. The correct setting of slug #1 is obtained when the meter reads zero as the slug is moved thru this point.

REDUCTION OF INTERCARRIER BUZZ

Slight "dynamic" unbalance of the discriminator secondary can emphasize intercarrier buzz due to incomplete amplitude modulation rejection. Therefore it is vitally important to obtain an accurate setting of the discriminator secondary slug under actual reception conditions.

Disconnect all instruments and then connect an antenna to the receiver to obtain program reception from a local station. If intercarrier buzz is prominent, a slight readjustment of the discriminator secondary slug (#1) should be made to obtain the "dip" point for the buzzing sound. Note that program sound will be clear and free from distortion at this point. Buzz should now be at an acceptable minimum if station transmission is not at fault.

TELEVISION IF CHANNEL ALIGNMENT PROCEDURE

1. A special aligning tool designed to fit the stems on adjustable cores of the IF coils (see points 8, 9, 10 and 11 in Fig. 18) is available and may be obtained from Stewart-Warner by requesting IF Alignment Tool #507479.
2. Turn receiver Channel Selector to television channel #12 and short antenna terminals together with a jumper wire.
3. Turn the band switch to the "TV" position.
4. Remove metal plate which covers side of RF tuner unit nearest edge of chassis. This plate is held in place by two screws on the side of the chassis.
5. Connect a 3 volt battery to the receiver AGC system so that negative terminal of battery connects to the AGC line and positive terminal of battery connects to receiver chassis. See Fig. 19 for convenient point of connection.
6. Note location of IF Trap Coils #12 and #13 by referring to Fig. 19. Before undertaking the alignment of any of the IF stages, Trap Coils #12 and #13 must be detuned so that they do not resonate in the IF pass band. Detuning is accomplished by merely compressing the windings so that they are closely spaced. Failure to detune the Trap Coils can cause the IF system to become regenerative, thereby preventing alignment.
7. If the IF channel is badly misaligned and two or more immediately adjoining IF stages are tuned to the same frequency, oscillation may occur. Such oscillation shows up as a voltage across the video detector load resistor, symbol 139, and is indicated by the VTVM that is connected to this point during alignment. It should be noted

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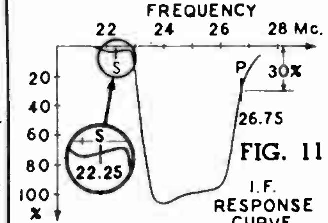
TELEVISION IF CHANNEL ALIGNMENT PROCEDURE

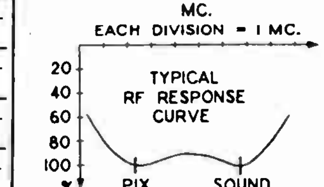
that voltage due to IF oscillation is unaffected by strength of signal from the generator.

Where IF oscillation is encountered, it is generally possible to correct the condition by detuning the IF coils in different directions. If that does not have the desired effect, increase fixed bias on AGC line by using a 4½ volt battery instead of the 3 volt battery referred to in instruction #5. After stopping the oscillation in this manner it will then be possible to align all IF stages using the following procedure, however, the AGC bias battery must be changed back to 3 volts when using the oscilloscope to observe band pass characteristic. Once all stages have been aligned using the 4½ volt bias, the IF channel should be stable with reduced bias.

STANDARD SIGNAL GENERATOR		SWEEP GENERATOR		VTVM CONNECTIONS	OSCILLOSCOPE CONNECTIONS	MISCELLANEOUS INSTRUCTIONS	TRIMMER OR SLUG	TYPE OF ADJUSTMENT AND OUTPUT INDICATION
CONNECTIONS	FREQUENCY	CONNECTIONS	FREQ.					
Connect as shown in Fig. 9.	26.3 MC.	Use a 330 Mmf. isolating condenser and connect as shown in Fig. 9 but keep power switch turned off during this step.	———	Connect as shown in Fig. 10.	Not used.	———	#7 Converter plate coil	Adjust for maximum reading on VTVM.
							#8 2nd I.F.	Adjust for maximum reading on VTVM.
Same as above.	24.5 MC.	Same as above.	———	Same as above.	Not used.	———	#9 4th I.F.	Adjust for maximum reading on VTVM.
Same as above.	23.5 MC.	Same as above.	———	Same as above.	Not used.	———	#10 1st I.F.	Adjust for maximum reading on VTVM.
							#11 3rd I.F.	Adjust for maximum reading on VTVM.
Same as above.	22.4 MC.	Same as above.	———	Same as above.	Not used.	———	#12 1st IF Trap Coil	Adjust the spacing of the Trap Coil windings for MINIMUM reading on VTVM.
Same as above.	22.8 MC.	Same as above.	———	Same as above.	Not used.	———	#13 3rd IF Trap Coil.	Adjust the spacing of the Trap Coil windings for MINIMUM reading on VTVM.
Same as above.	26.75 MC.	With connections made as shown in Fig. 9, turn on this generator and set controls for operation as specified in next column.	25 MC. Sweeping ± 5 Mc.	Same as above.	Connect as shown in Fig. 10.	IMPORTANT: 1. Adjust output attenuator on sweep generator so that reading on VTVM is approximately one volt. 2. Set attenuator on standard signal generator so that marker signal does not distort the pattern on the oscilloscope. 3. Be sure that a 3 volt battery is connected to AGC line as specified in instruction #5 at the head of this chart. Do not use a battery of any other voltage.	The IF band pass characteristic now displayed on the 'scope should be compared with the curve shown in Fig. 11. If top of curve is not properly shaped, make a slight readjustment of slug #9. Should that adjustment fail to yield the desired result, then note whether the curve has a peak on the high or low frequency side. Slugs #7 and #8 control high frequency response (26.3 Mc.) and slugs #10 and #11 affect the low frequency response (23.5 Mc.); by making a small change in the settings of the high or low frequency slugs, it will be possible to obtain correct band pass curve.  FIG. 11 I.F. RESPONSE CURVE The 26.75 Mc. picture IF carrier marker should now appear at the 30% amplitude position on side of the band pass characteristic (see Fig. 11). If position of the marker appears too high or too low, slight readjustment of slugs #7, 8 and 9 is required.	
Same as above.	22.25 MC.	Same as above.	Same as above.	Same as above.	Same as above.	Same as above.	Adjust the vertical gain control on the 'scope in order to magnify the sound portion of the response curve. The 22.25 Mc. sound IF carrier marker should appear at the position indicated in Fig. 11. If the position of the sound marker is incorrect, readjust winding spacing of Trap Coils #12 and #13.	

TELEVISION RF CHANNEL ALIGNMENT PROCEDURE

1. Turn the band switch to the "TV" position.
2. Replace metal plate which covers exposed terminal side of RF tuner unit. This plate was previously removed for IF channel alignment.
3. Connect a 3 volt battery to the receiver AGC system so that negative terminal of battery connects to AGC line and positive terminal of battery connects to receiver chassis. (See Fig. 19 for convenient point of connection.)

STANDARD SIGNAL GENERATOR		SWEEP GENERATOR		VTVM CONNECTIONS	OSCILLOSCOPE CONNECTIONS	MISCELLANEOUS INSTRUCTIONS	TRIMMER OR SLUG	TYPE OF ADJUSTMENT AND OUTPUT INDICATION
CONNECTIONS	FREQUENCY	CONNECTIONS	FREQ.					
RF AMPLIFIER AND MIXER ALIGNMENT								
Connect as shown in Fig. 15.	*209.75 MC. †205.25 MC.	Connect as shown in Fig. 15 and set controls for sweep width of 10 Mc. on television channel specified in the next column.	CHANNEL #12	Not used.	Connect as shown in Fig. 16.	IMPORTANT: Keep output of standard signal generator at a level that provides a readable marker but does not distort the curve that is being observed on the 'scope.	#14 Mixer Grid.	Adjust these trimmers to obtain properly shaped RF band pass characteristic as shown in Fig. 12. Use Mixer Grid trimmer #14 and RF Amplifier Plate trimmer #15 to obtain correct amplitude of characteristic in vicinity of picture and sound carrier markers. Then adjust RF Amp. Grid trimmer #16 to equalize overall amplitude. Repeat adjustment of trimmers to be sure correct response has been obtained.
							#15 RF Amp. Plate.	
							#16 RF Amp. Grid.	IMPORTANT: When adjusting trimmers #14, 15 and 16 it will be noted that the band pass characteristic can be broadened by sacrificing amplitude. It is undesirable to overly broaden the curve as that would result in a loss of sensitivity.
Same as above.	*215.75 MC. †211.25 MC.	Same as above.	CHANNEL #13	Not used.	Same as above.	Set Channel Selector to #13	The RF band pass characteristic of the other television channels should now be checked without disturbing the settings of trimmers #14, 15 and 16. Adjust the RF sweep generator and marker generator for operation on the other television channels, observing position of both the sound carrier and picture carrier markers.	
	*203.75 MC. †199.25 MC.		CHANNEL #11			Set Channel Selector to #11		
	*197.75 MC. †193.25 MC.		CHANNEL #10			Set Channel Selector to #10	 FIG. 12	
	*191.75 MC. †187.25 MC.		CHANNEL #9			Set Channel Selector to #9		
	*185.75 MC. †181.25 MC.		CHANNEL #8			Set Channel Selector to #8		
	*179.75 MC. †175.25 MC.		CHANNEL #7			Set Channel Selector to #7		
	* 87.75 MC. † 83.25 MC.		CHANNEL #6			Set Channel Selector to #6		
	* 81.75 MC. † 77.25 MC.		CHANNEL #5			Set Channel Selector to #5		
	* 71.75 MC. † 67.25 MC.		CHANNEL #4			Set Channel Selector to #4	Band pass characteristic of these channels should conform to the RF response curve in Fig. 12. If necessary, a compromise may be obtained to compensate for small variations in channel response by returning to channel #12 and making slight changes in the settings of trimmers #14, 15 and 16.	
	* 65.75 MC. † 61.25 MC.		CHANNEL #3			Set Channel Selector to #3		
	* 59.75 MC. † 55.25 MC.		CHANNEL #2			Set Channel Selector to #2		

*Sound Carrier Marker
†Picture Carrier Marker

(Continued on next page)

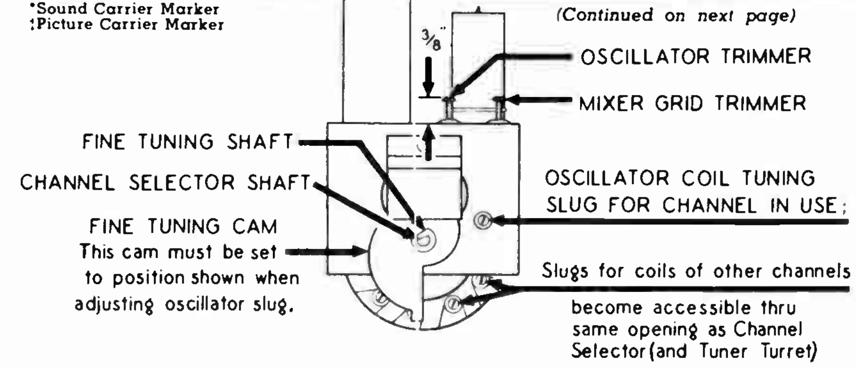


FIG. 13
Front view of
RF Tuner Unit

MODEL 9113-A

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(Continued from preceding page)

OSCILLATOR ALIGNMENT

1. **IMPORTANT:** Before undertaking oscillator alignment be sure IF circuits are correctly aligned for band pass characteristic illustrated in Fig. 11.
2. During oscillator alignment, it is necessary to set the Fine Tuning control so that the tooth on the bakelite fine tuning cam points downward (correct position for this control is shown in Fig. 13).

STANDARD SIGNAL GENERATOR CONNECTIONS	STANDARD SIGNAL GENERATOR FREQUENCY	SWEEP GENERATOR CONNECTIONS	SWEEP GENERATOR FREQ.	VTVM CONNECTIONS	OSCILLOSCOPE CONNECTIONS	MISCELLANEOUS INSTRUCTIONS	TRIMMER OR SLUG	TYPE OF ADJUSTMENT AND OUTPUT INDICATION
Connect as shown in Fig. 15.	*209.75 MC. ‡205.25 MC.	Connect as shown in Fig. 15 and set controls for sweep width of 10 Mc. on television channel specified in the next column.	CHANNEL #12	Connect as shown in Fig. 17	Connect as shown in Fig. 17	Be sure that Fine Tuning control has been properly positioned (tooth on the cam pointing down—see Fig. 13). During this step and thru-out all succeeding steps it is necessary to: 1. Keep output of sweep generator at a level that does not allow reading on VTVM to exceed one volt. 2. Keep output of standard signal generator at a level that provides a readable marker but does not distort the curve that is being observed on the 'scope.	#17 Oscillator	Adjust height of Oscillator trimmer #17 to be approximately 3/8" from the top of trimmer screw to the top surface of RF tuner unit (see Fig. 13). NOTE: Before making the following adjustment, advance the vertical gain control on the 'scope in order to magnify the sound portion of the response curve. Then, use a non-metallic screwdriver to adjust channel #12 oscillator slug (accessible thru hole on front of RF Tuner Unit —see Fig. 13) and shift response curve so that sound carrier marker is located at the position indicated in Fig. 14. Now, reduce gain control setting of 'scope to restore pattern to normal amplitude, and observe position of picture carrier marker. This marker should appear at the 35% amplitude position on the low frequency side of the characteristic curve (see Fig. 14).
Same as above.	*215.75 MC. ‡211.25 MC.	Same as above.	CHANNEL #13	Same as above.	Same as above.	Set Channel Selector to #13	Adjust the RF sweep generator and marker generator for operation on the other television channels; set marker generator to sound carrier frequency. After setting Channel Selector to corresponding channel, adjust oscillator slug thru hole on front of RF Tuner Unit (see Fig. 13). This permits response curve to be shifted so that sound carrier marker (see FIG. 14) will appear at the position indicated in Fig. 14. The picture carrier marker for the corresponding channel should then appear at the 35% amplitude position at the opposite side of the band pass characteristic curve. NOTE: Make sure that cam on fine tuning control shaft remains properly positioned during this step (tooth on the cam pointing downward—see Fig. 13).	
	*203.75 MC. ‡199.25 MC.		CHANNEL #11			Set Channel Selector to #11		
	*197.75 MC. ‡193.25 MC.		CHANNEL #10			Set Channel Selector to #10		
	*191.75 MC. ‡187.25 MC.		CHANNEL #9			Set Channel Selector to #9		
	*185.75 MC. ‡181.25 MC.		CHANNEL #8			Set Channel Selector to #8		
	*179.75 MC. ‡175.25 MC.		CHANNEL #7			Set Channel Selector to #7		
	* 87.75 MC. ‡ 83.25 MC.		CHANNEL #6			Set Channel Selector to #6		
	* 81.75 MC. ‡ 77.25 MC.		CHANNEL #5			Set Channel Selector to #5		
	* 71.75 MC. ‡ 67.25 MC.		CHANNEL #4			Set Channel Selector to #4		
	* 65.75 MC. ‡ 61.25 MC.		CHANNEL #3			Set Channel Selector to #3		
	* 59.75 MC. ‡ 55.25 MC.		CHANNEL #2			Set Channel Selector to #2		

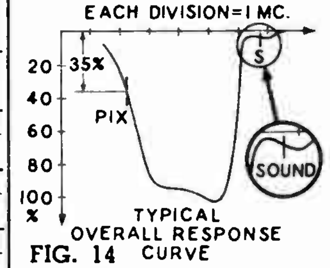


FIG. 14

If an oscillator slug "falls into" its coil form during adjustment, remove the Channel Coil from the turret assembly and lift the Slug Retaining Spring aside. By tapping the coil form it should be possible to make the slug move toward the end so that its threads will be engaged by the Slug Retaining Spring when that spring is returned to its normal position.

If an unsatisfactory overall response is obtained for a particular channel, observe RF Amp. and Mixer response curve for that channel (as described on page 45.) If characteristic does not conform reasonably well within the typical curve shown in Fig. 12, then, (1) attempt to obtain a better compromise for RF response on all channels by realigning RF Amp. and Mixer circuits, or (2) try replacing Antenna, RF and Oscillator coils for the particular channels.

*Sound Carrier Marker
‡Picture Carrier Marker

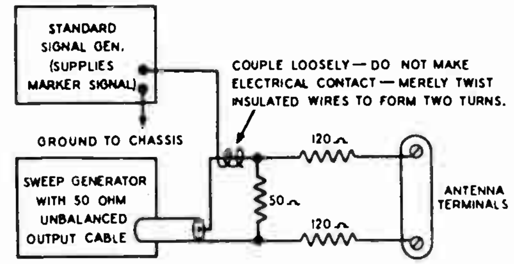


FIG. 15
Generator Connections for Television RF Channel Alignment

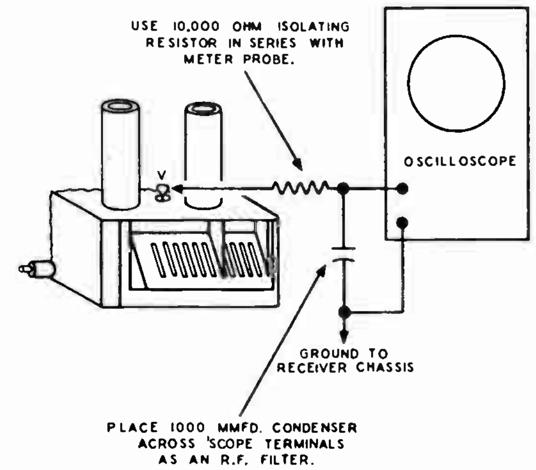


FIG. 16
Oscilloscope Connections for Television RF Amp. and Mixer Alignment

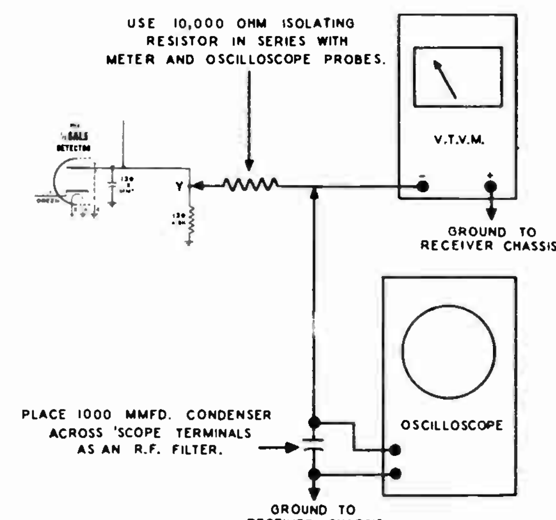
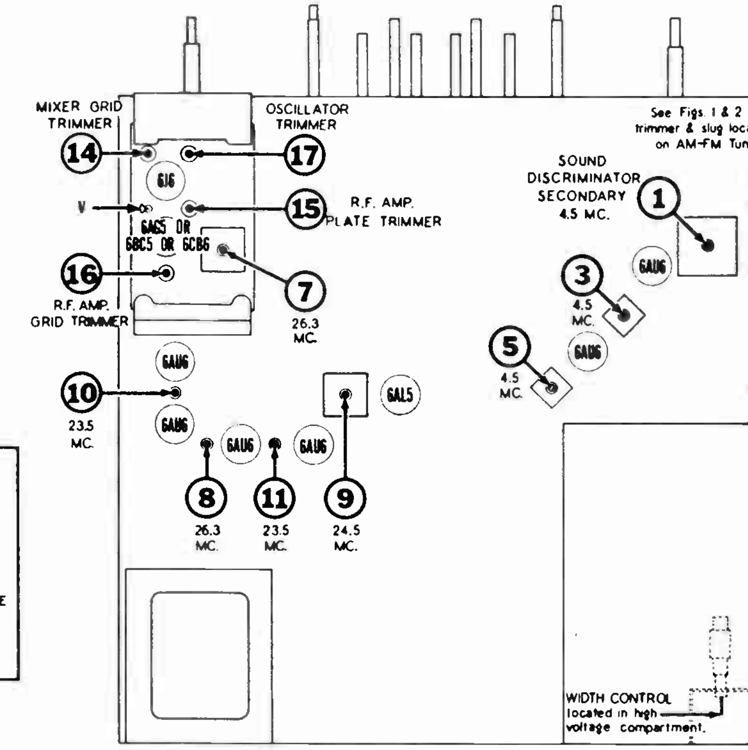
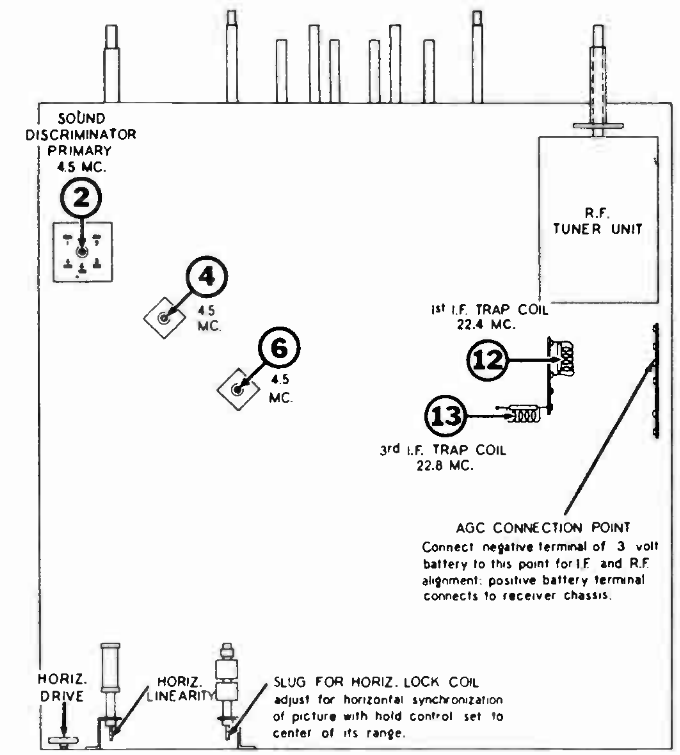


FIG. 17
VTVM and Oscilloscope Connections for Television Oscillator Alignment



TOP VIEW OF CHASSIS

FIG. 18



BOTTOM VIEW OF CHASSIS

FIG. 19

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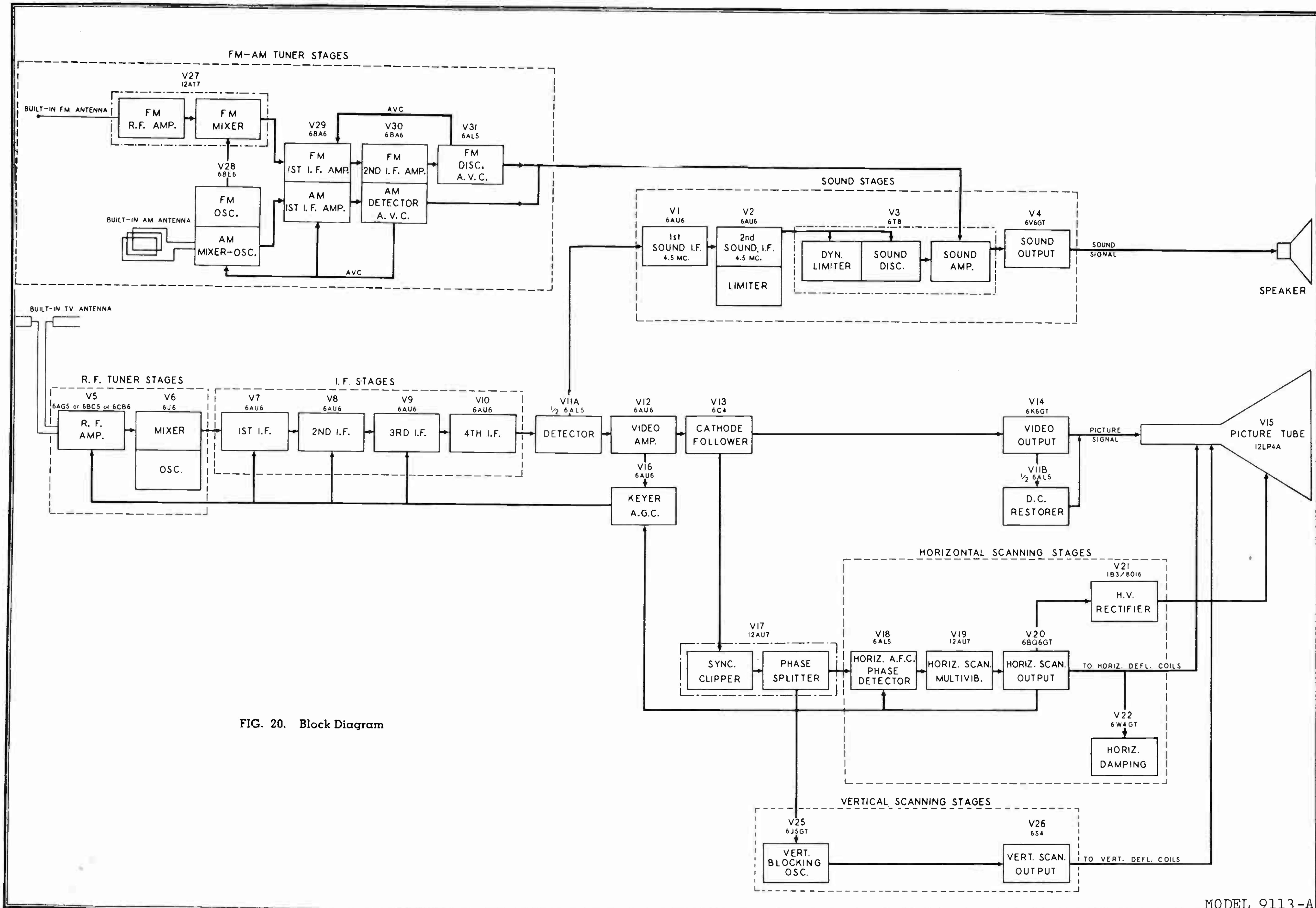

FIG. 20. Block Diagram

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PARTS LIST (Contd.)

NOTICE: Some parts listed below have special characteristics. Do not use substitutes for replacement purposes.

CONDENSERS

DIAGRAM NO.	PART NO.	DESCRIPTION
11	513001	Condenser—ceramic 2.2 Mmfd. 500 volt
12-A, B	508061	Condenser—ceramic 51 Mmfd. (part of 1st TV sound I.F. transformer)
13	513013	Condenser—ceramic 5000 Mmfd. 450 volt
16	513013	Condenser—ceramic 5000 Mmfd. 450 volt
18-A, B	508061	Condenser—ceramic 51 Mmfd. (part of 2nd TV sound I.F. transformer)
19	513013	Condenser—ceramic 5000 Mmfd. 450 volt
21	513433	Condenser—ceramic 47 Mmfd. ±10% 500 volt (Temperature compensating)
23	513013	Condenser—ceramic 5000 Mmfd. 450 volt
25	513009	Condenser—ceramic 1000 Mmfd. 500 volt
26-A	507321	Condenser—ceramic 110 Mmfd. (part of TV discriminator transformer)
27	512527	Condenser—mica 220 Mmfd. ±10% 500 volt
29	513010	Condenser—ceramic 1500 Mmfd. 350 volt
30	512027	Condenser—.05 Mfd. 200 volt
32	512007	Condenser—.005 Mfd. 600 volt
34	512007	Condenser—.005 Mfd. 600 volt
36	505174	Condenser—electrolytic 10 Mfd. 150 volt
41	513010	Condenser—ceramic 1500 Mmfd. 350 volt
42	502547	Condenser—electrolytic 4 Mfd. 150 volt
44	502527	Condenser—electrolytic 50 Mfd. 25 volt
46	504719	Condenser—electrolytic 4 Mfd. 450 volt
48	512003	Condenser—.002 Mfd. 600 volt
52-A, B, C	508072	Condenser—electrolytic A—40 Mfd. 450 volt, B—40 Mfd. 450 volt, C—40 Mfd. 450 volt
54	508324	Condenser—trimmer 4-70 Mmfd.
69	507968	Condenser—trimmer 0.5-3 Mmfd.
70	513432	Condenser—ceramic 5 Mmfd. ±10% 500 volt (Temperature compensating)
71	513439	Condenser—ceramic 120 Mmfd. ±5% 500 volt (Temperature compensating)
86	507968	Condenser—trimmer 0.5-3 Mmfd.
87	513442	Condenser—ceramic 10 Mmfd. ±10% 500 volt (Temperature compensating)
88	*	Condenser—3-5 Mmfd. (Fine Tuning)
89	513440	Condenser—ceramic 100 Mmfd. ±10% 500 volt (Temperature compensating)
92	507968	Condenser—trimmer 0.5-3 Mmfd.
93	513441	Condenser—ceramic 20 Mmfd. ±10% 500 volt (Temperature compensating)
94	507968	Condenser—trimmer 0.5-3 Mmfd.
97	513009	Condenser—ceramic 1000 Mmfd. 500 volt
98-A	507985	Condenser—ceramic 10 Mmfd. (part of 1st video I.F. coil)
98-B	507985	Condenser—ceramic 120 Mmfd. (part of 1st video I.F. coil)
100	513009	Condenser—ceramic 1000 Mmfd. 500 volt
105	512532	Condenser—mica 240 Mmfd. ± 5% 500 volt
106	513009	Condenser—ceramic 1000 Mmfd. 500 volt
109	513016	Condenser—ceramic 82 Mmfd. ±10% 500 volt
112	513009	Condenser—ceramic 1000 Mmfd. 500 volt
114	513009	Condenser—ceramic 1000 Mmfd. 500 volt
117	513016	Condenser—ceramic 82 Mmfd. ±10% 500 volt
120	513009	Condenser—ceramic 1000 Mmfd. 500 volt
122	513009	Condenser—ceramic 1000 Mmfd. 500 volt
126	513016	Condenser—ceramic 82 Mmfd. ±10% 500 volt
129	508682	Condenser—electrolytic 100 Mfd. 50 volt
133	513009	Condenser—ceramic 1000 Mmfd. 500 volt
136	512433	Condenser—ceramic 47 Mmfd. ±10% 500 volt (Temperature compensating)
138	513432	Condenser—ceramic 5 Mmfd. ±10% 500 volt (Temperature compensating)
140	512045	Condenser—.25 Mfd. ±10% 200 volt
145	512027	Condenser—.05 Mfd. 200 volt
148	512045	Condenser—.25 Mfd. ±10% 200 volt
150	513003	Condenser—ceramic 100 Mmfd. 500 volt

CONDENSERS—Continued

DIAGRAM NO.	PART NO.	DESCRIPTION
154	512033	Condenser—.1 Mfd. 200 volt
157	512027	Condenser—.05 Mfd. 200 volt
167, 168	512031	Condenser—.05 Mfd. 600 volt
174	512019	Condenser—.02 Mfd. 600 volt
175	512031	Condenser—.05 Mfd. 600 volt
176	513018	Condenser—ceramic 220 Mmfd. 500 volt
183	513015	Condenser—mica 56 Mmfd. ±10% 500 volt
187	512045	Condenser—.25 Mfd. ±10% 200 volt
192, 193	513009	Condenser—ceramic 1000 Mmfd. 500 volt
196	512013	Condenser—.01 Mfd. 600 volt
199	513013	Condenser—ceramic 5000 Mmfd. 450 volt
201	512027	Condenser—.05 Mfd. 200 volt
204	512531	Condenser—mica 3300 Mmfd. ±5% 500 volt
205	513007	Condenser—ceramic 330 Mmfd. 500 volt
210	512535	Condenser—mica 390 Mmfd. ±10% 500 volt
211	512536	Condenser—mica 270 Mmfd. ±10% 500 volt
212	508071	Condenser—trimmer 10-160 Mmfd. (Horizontal Drive Control)
217	508684	Condenser—electrolytic 5 Mfd. 50 volt
219	512031	Condenser—.05 Mfd. 600 volt
223	512538	Condenser—mica 3.3 Mmfd. ±15% 1500 volt
224	508680	Condenser—electrolytic 10 Mfd. 600 volt
227	512031	Condenser—ceramic .05 Mfd. 600 volt
230	513024	Condenser—ceramic 500 Mmfd. 20,000 volt
232	512031	Condenser—.05 Mfd. 600 volt
235	512031	Condenser—.05 Mfd. 600 volt
236	512037	Condenser—.1 Mfd. 600 volt
237, 238	512255	Condenser—.01 Mfd. 400 volt
240	513013	Condenser—ceramic 5000 Mmfd. 450 volt
242, 243	513009	Condenser—ceramic 1000 Mmfd. 500 volt
245, 246	513009	Condenser—ceramic 1000 Mmfd. 500 volt
249-A, B	508073	Condenser—electrolytic A—20 Mfd. 300 volt, B—60 Mfd. 300 volt
250	513018	Condenser—ceramic 220 Mmfd. 500 volt
251	513009	Condenser—ceramic 1000 Mmfd. 500 volt
256	513009	Condenser—ceramic 1000 Mmfd. 500 volt
258	513009	Condenser—ceramic 1000 Mmfd. 500 volt
260	513013	Condenser—ceramic 5000 Mmfd. 450 volt
262-A	508062	Condenser—ceramic .01 Mfd. 450 volt (part of Integrator Unit)
262-C	508062	Condenser—ceramic 2000 Mmfd. 450 volt (part of Integrator Unit)
262-E	508062	Condenser—ceramic 5000 Mmfd. 450 volt (part of Integrator Unit)
262-G	508062	Condenser—ceramic 5000 Mmfd. 450 volt (part of Integrator Unit)
264	512533	Condenser—mica 4700 Mmfd. ±5% 1000 volt
273	512308	Condenser—.05 Mfd. ±10% 600 volt
274	512037	Condenser—.1 Mfd. 600 volt
279	512532	Condenser—mica 240 Mmfd. ±5% 500 volt
353	513006	Condenser—ceramic 270 Mmfd. 500 volt
355	512007	Condenser—.005 Mfd. 600 volt
356	512013	Condenser—.01 Mfd. 600 volt
359	160095	Condenser—electrolytic 40 Mfd. 300 volt
366-A to D	508729	Condenser—variable gang
367	513009	Condenser—ceramic 1000 Mmfd. 500 volt
371	507940	Condenser—trimmer 1.5-12 Mmfd.
373	513007	Condenser—ceramic 330 Mmfd. 500 volt
376	513009	Condenser—ceramic 1000 Mmfd. 500 volt
377	513000	Condenser—ceramic 1.0 Mmfd. 500 volt
378	513002	Condenser—ceramic 47 Mmfd. 500 volt
380	513002	Condenser—ceramic 47 Mmfd. 500 volt
382	513436	Condenser—ceramic 2.5 Mmfd. 500 volt (Temperature compensating)
384	513001	Condenser—ceramic 2.2 Mmfd. 500 volt
387-A, B	506080	Condenser—ceramic 33 Mmfd. (part of 1st FM I.F. transformer)
388-A	505867	Condenser—ceramic 83 Mmfd. (part of 1st AM I.F. transformer)
388-8	505867	Condenser—ceramic 66 Mmfd. (part of 1st AM I.F. transformer)

*—This part is not supplied as a Service replacement item.

CONDENSERS—Continued

DIAGRAM NO.	PART NO.	DESCRIPTION
389	513013	Condenser—ceramic 5000 Mmfd. 450 volt
391	513013	Condenser—ceramic 5000 Mmfd. 450 volt
393	513013	Condenser—ceramic 5000 Mmfd. 450 volt
396	513013	Condenser—ceramic 5000 Mmfd. 450 volt
397-A	505905	Condenser—ceromic 83 Mmfd. (part of 2nd FM I.F. transformer)
398-A	505867	Condenser—ceramic 83 Mmfd. (part of 2nd AM I.F. transformer)
398-B	505867	Condenser—ceramic 66 Mmfd. (part of 2nd AM I.F. transformer)
399-A	506338	Condenser—ceramic 100 Mmfd. 400 volt (part of Diode Filter Unit)
399-C	506338	Condenser—ceramic 100 Mmfd. 400 volt (part of Diode Filter Unit)
401	512028	Condenser—.05 Mfd. 400 volt
403, 404	513013	Condenser—ceramic 5000 Mmfd. 450 volt
406	513007	Condenser—ceramic 330 Mmfd. 500 volt
407	512103	Condenser—.001 Mfd. 400 volt
408	513013	Condenser—ceramic 5000 Mmfd. 450 volt
409-A	508179	Condenser—ceramic 47 Mmfd. (part of FM discriminator)
412	513013	Condenser—ceramic 5000 Mmfd. 450 volt
413	513009	Condenser—ceramic 1000 Mmfd. 500 volt
416	513007	Condenser—ceramic 330 Mmfd. 500 volt
417	507946	Condenser—electrolytic 3 Mfd. 50 volt
419	513023	Condenser—ceramic 10 Mmfd. ±10% 500 volt
421	513009	Condenser—ceramic 1000 Mmfd. 500 volt

RESISTORS

DIAGRAM NO.	PART NO.	DESCRIPTION
14	510117	Resistor—carbon 82 Ohms ±10% ½ watt
17	510137	Resistor—carbon 1000 Ohms ½ watt
20	510185	Resistor—carbon 470,000 Ohms ½ watt
22	510117	Resistor—carbon 82 Ohms ±10% ½ watt
24	510137	Resistor—carbon 1000 Ohms ½ watt
28	510160	Resistor—carbon 22,000 Ohms ±10% ½ watt
31	510170	Resistor—carbon 68,000 Ohms ½ watt
35	510197	Resistor—carbon 10 Meg. ½ watt
38	510163	Resistor—carbon 33,000 Ohms ±10% ½ watt
39, 40	510159	Resistor—carbon 18,000 Ohms ±10% ½ watt
45	510227	Resistor—carbon 330 Ohms ±10% 1 watt
47	510153	Resistor—carbon 8200 Ohms ±10% ½ watt
50	510140	Resistor—carbon 1500 Ohms ½ watt
67	510167	Resistor—carbon 47,000 Ohms ½ watt
68	510147	Resistor—carbon 3900 Ohms ±10% ½ watt
72	510143	Resistor—carbon 2200 Ohms ½ watt
85	510155	Resistor—carbon 10,000 Ohms ½ watt
90	510149	Resistor—carbon 4700 Ohms ½ watt
91	510179	Resistor—carbon 220,000 Ohms ½ watt
95	510155	Resistor—carbon 10,000 Ohms ½ watt
96	510149	Resistor—carbon 4700 Ohms ½ watt
99	510158	Resistor—carbon 15,000 Ohms ½ watt
101	510148	Resistor—carbon 4700 Ohms ±10% ½ watt
102	510137	Resistor—carbon 1000 Ohms ½ watt
104	510122	Resistor—carbon 150 Ohms ½ watt
108	510137	Resistor—carbon 1000 Ohms ½ watt
110	510153	Resistor—carbon 8200 Ohms ±10% ½ watt
111	510137	Resistor—carbon 1000 Ohms ½ watt
113	510119	Resistor—carbon 100 Ohms ½ watt
116	510137	Resistor—carbon 1000 Ohms ½ watt
118	510148	Resistor—carbon 4700 Ohms ±10% ½ watt
119	510137	Resistor—carbon 1000 Ohms ½ watt
121	510120	Resistor—carbon 120 Ohms ±10% ½ watt
123	510153	Resistor—carbon 8200 Ohms ±10% ½ watt
124	510137	Resistor—carbon 1000 Ohms ½ watt
130	510119	Resistor—carbon 100 Ohms ½ watt
131	510713	Resistor—carbon 3000 Ohms ±5% 2 watt
132	510153	Resistor—carbon 8200 Ohms ±10% ½ watt
135	510137	Resistor—carbon 1000 Ohms ½ watt
139	510151	Resistor—carbon 6800 Ohms ±10% ½ watt
141	510254	Resistor—carbon 10,000 Ohms ±10% 1 watt
142	510253	Resistor—carbon 8200 Ohms ±10% 1 watt

RESISTORS—Continued

DIAGRAM NO.	PART NO.	DESCRIPTION
144	510166	Resistor—carbon 47,000 Ohms ±10% ½ watt
146	510164	Resistor—carbon 33,000 Ohms ½ watt
147	510155	Resistor—carbon 10,000 Ohms ½ watt
149	510150	Resistor—carbon 5600 Ohms ±10% ½ watt
151	510173	Resistor—carbon 100,000 Ohms ½ watt
153	510150	Resistor—carbon 5600 Ohms ±10% ½ watt
155	510191	Resistor—carbon 1 Meg. ½ watt
156	510356	Resistor—carbon 12,000 Ohms ±10% 2 watt
158	510191	Resistor—carbon 1 Meg. ½ watt
159	510126	Resistor—carbon 270 Ohms ±10% ½ watt
162	510723	Resistor—carbon 12,000 Ohms ±5% ½ watt
164, 165	510339	Resistor—carbon 1500 Ohms ±10% 2 watt
166	510156	Resistor—carbon 12,000 Ohms ±10% ½ watt
169	510173	Resistor—carbon 100,000 Ohms ½ watt
170	510191	Resistor—carbon 1 Meg. ½ watt
171	510171	Resistor—carbon 82,000 Ohms ±10% ½ watt
172	510161	Resistor—carbon 22,000 Ohms ½ watt
177	510143	Resistor—carbon 2200 Ohms ½ watt
178	510157	Resistor—carbon 15,000 Ohms ±10% ½ watt
182	510332	Resistor—carbon 560 Ohms ±10% 2 watt
185, 186	510132	Resistor—carbon 560 Ohms ±10% ½ watt
188	510180	Resistor—carbon 270,000 Ohms ±10% ½ watt
189	510181	Resistor—carbon 330,000 Ohms ±10% ½ watt
190, 191	510739	Resistor—carbon 1800 Ohms ±5% ½ watt
194, 195	510172	Resistor—carbon 100,000 Ohms ±10% ½ watt
197	510162	Resistor—carbon 27,000 Ohms ±10% ½ watt
198	510195	Resistor—carbon 4.7 Meg. ½ watt
200	510185	Resistor—carbon 470,000 Ohms ½ watt
203	510150	Resistor—carbon 5600 Ohms ±10% ½ watt
206	510139	Resistor—carbon 1500 Ohms ±10% ½ watt
207	510172	Resistor—carbon 100,000 Ohms ±10% ½ watt
209	510180	Resistor—carbon 270,000 Ohms ±10% ½ watt
213	510184	Resistor—carbon 470,000 Ohms ±10% ½ watt
215	510116	Resistor—carbon 68 Ohms ½ watt
218	510716	Resistor—wire wound 220 Ohms ±10% 5 watt
220	510356	Resistor—carbon 12,000 Ohms ±10% 2 watt
226	510254	Resistor—carbon 10,000 Ohms ±10% 1 watt
228	510725	Resistor—carbon 3.3 Ohms ±10% ½ watt
229	510195	Resistor—carbon 4.7 Meg. ½ watt
231	510391	Resistor—carbon 1 Meg. 2 watt
234	510187	Resistor—carbon 680,000 Ohms ±10% ½ watt
247	510319	Resistor—carbon 100 Ohms 2 watt
252	510726	Resistor—wire wound 850 Ohms 5 watt
262-B	508062	Resistor—carbon 22,000 Ohms 1/5 watt (part of Integrator Unit)
262-D	508062	Resistor—carbon 8200 Ohms 1/5 watt (part of Integrator Unit)
262-F	508062	Resistor—carbon 8200 Ohms 1/5 watt (part of Integrator Unit)
265	510721	Resistor—carbon 1.5 Meg. ±5% ½ watt
267	510172	Resistor—carbon 100,000 Ohms ±10% ½ watt
268	510196	Resistor—carbon 6.8 Meg. ½ watt
269	510738	Resistor—carbon 1.2 Meg. ±10% ½ watt
272	510151	Resistor—carbon 6800 Ohms ±10% ½ watt
275	510193	Resistor—carbon 2.2 Meg. ½ watt
276	510338	Resistor—carbon 1200 Ohms ±10% 2 watt
354	510185	Resistor—carbon 470,000 Ohms ½ watt
357	510179	Resistor—carbon 220,000 Ohms ½ watt
358	510741	Resistor—wire wound 600 Ohms 10 watt
360	510727	Resistor—wire wound 7500 Ohms ±10% 5 watt
362	510136	Resistor—carbon 1000 Ohms ±10% ½ watt
368	510173	Resistor—carbon 100,000 Ohms ½ watt
381	510193	Resistor—carbon 2.2 Meg. ½ watt
383	510155	Resistor—carbon 10,000 Ohms ½ watt
386	510136	Resistor—carbon 1000 Ohms ±10% ½ watt
390	510152	Resistor—carbon 6800 Ohms ½ watt
392	510249	Resistor—carbon 4700 Ohms 1 watt
394	510146	Resistor—carbon 3300 Ohms ½ watt
395	510246	Resistor—carbon 3300 Ohms 1 watt

*—This part is not supplied as a Service replacement item.

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PARTS LIST (Contd.)

RESISTORS—Continued

DIAGRAM NO.	PART NO.	DESCRIPTION
399-B	506338	Resistor—carbon 47,000 Ohms 1/5 watt (part of Diode Filter Unit)
400	510185	Resistor—carbon 470,000 Ohms ½ watt
402	510193	Resistor—carbon 2.2 Meg. ½ watt
405	510240	Resistor—carbon 1500 Ohms 1 watt
410	510125	Resistor—carbon 220 Ohms ½ watt
411	510159	Resistor—carbon 18,000 Ohms ±10% ½ watt
414, 415	510155	Resistor—carbon 10,000 Ohms ½ watt
428	510728	Resistor—carbon 15,000 Ohms ± 10% 10 watt

CONTROLS

DIAGRAM NO.	PART NO.	DESCRIPTION
33-A, B	508182	Volume control—1 Meg. (with on-off switch)
43-A to D	508203	Band switch (includes volume control)
54	508324	Built-in Antenna Tuning condenser (4-70 Mmfd.)
88	*	Fine Tuning condenser (3-5 Mmfd.)
160-A, B	508201	Tone and Contrast potentiometer A—Tone control; 500,000 Ohms ¼ watt B—Contrast control; 3000 Ohms ±10% 4 w.
173	508202	Brightness potentiometer (50,000 Ohms)
180	508057	Focus potentiometer (5500 Ohms ±10% 4 watt)
202	508077	Horizontal Lock coil (less slug)
	507429	Slug core for Horizontal Lock coil
208	508202	Horizontal Hold potentiometer (50,000 Ohms)
212	508071	Horizontal Drive trimmer condenser (10-160 Mmfd.)
225	508667	Width coil (includes slug clip)
	508784	Slug core for Width coil
233	162190	Horizontal Linearity coil (includes slug)
	507429	Slug core for Horizontal Linearity coil
266	508051	Vertical Hold potentiometer (1 Meg.)
270	508052	Height potentiometer (2.5 Meg.)
277	508053	Vertical Linearity potentiometer (6000 Ohms)

COILS AND TRANSFORMERS

DIAGRAM NO.	PART NO.	DESCRIPTION
12	508061	Transformer—1st TV sound I.F. (includes condensers 12-A and 12-B)
15	507373	Coil—choke
18	508061	Transformer—2nd TV sound I.F. (includes condensers 18-A and 18-B)
26	507321	Transformer—TV sound discriminator (includes condenser 26-A)
	508438	Slug core (5/16" dia. x ⅜" long) for primary of TV sound discriminator transformer
	508894	Slug core (¼" dia. x ½" long) for primary of TV sound discriminator transformer
	508439	Slug core (5/16" dia. x ¾" long) for secondary of TV sound discriminator transformer
	508894	Slug core (¼" dia. x ½" long) for secondary of TV sound discriminator transformer
37	507373	Coil—choke
49	505912	Transformer—sound output
	508080	R.F. Unit complete with coils and tubes
55	507952	Coil—antenna; Channel #2
56	507953	Coil—antenna; Channel #3
57	507954	Coil—antenna; Channel #4
58	507955	Coil—antenna; Channel #5
59	507956	Coil—antenna; Channel #6
60	507957	Coil—antenna; Channel #7
61	507958	Coil—antenna; Channel #8
62	507959	Coil—antenna; Channel #9
63	507960	Coil—antenna; Channel #10
64	507961	Coil—antenna; Channel #11
65	507962	Coil—antenna; Channel #12
66	507963	Coil—antenna; Channel #13
73	507972	Coil—R.F. and osc.; Channel #2
74	507973	Coil—R.F. and osc.; Channel #3
75	507974	Coil—R.F. and osc.; Channel #4
76	507975	Coil—R.F. and osc.; Channel #5
77	507976	Coil—R.F. and osc.; Channel #6
78	507977	Coil—R.F. and osc.; Channel #7
79	507978	Coil—R.F. and osc.; Channel #8
80	507979	Coil—R.F. and osc.; Channel #9
81	507980	Coil—R.F. and osc.; Channel #10
82	507981	Coil—R.F. and osc.; Channel #11
83	507982	Coil—R.F. and osc.; Channel #12
84	507983	Coil—R.F. and osc.; Channel #13
	507986	Slug for osc. coil fine tuning adjustment
98	507985	Coil—converter plate (includes condensers 98-A, 98-B, resistor 99 and slug)
103	507567	Coil—1st I.F. trap
107	507343	Coil—1st video I.F. (less slug)
	507357	Slug core for 1st video I.F. coil
115	507343	Coil—2nd video I.F. (less slug)
	507357	Slug core for 2nd video I.F. coil
125	507343	Coil—3rd video I.F. (less slug)
	507357	Slug core for 3rd video I.F. coil

COILS AND TRANSFORMERS—Continued

DIAGRAM NO.	PART NO.	DESCRIPTION
128	507367	Coil—choke
134	507591	Coil—4th video I.F. assembly (includes condenser 136 and choke coil 137)
	507357	Slug core for 4th video I.F. coil
137	507367	Coil—choke
143	507374	Coil—peaking
152	507374	Coil—peaking
161	508069	Coil—peaking
163	508070	Coil—peaking
181	508994	Coil—focus
184	508675	Yoke—picture tube deflection
202	508077	Coil—Horizontal Lock (less slug)
	507429	Slug core for Horizontal Lock coil
222	508883	Transformer—horizontal fly-back
225	508667	Coil—Width (includes slug and clip)
	508784	Slug core for Width coil
233	162190	Coil—Horizontal Linearity (includes slug)
	507429	Slug core for Horizontal Linearity Coil
239	508702	Transformer—power
241	507586	Coil—choke
244	507587	Coil—choke
248	507584	Coil—choke
253	508341	Choke—filter
254	507584	Coil—choke
255	507970	Coil—choke
257	507971	Coil—choke
259	507586	Coil—choke
263	508076	Transformer—vertical blocking oscillator
271	507567	Coil—3rd I.F. trap
278	508674	Transformer—vertical output
365	508184	Coil—AM antenna
370	507586	Coil—choke
372	507935	Coil—choke
374	507942	Coil—FM oscillator
375	508195	Coil—AM oscillator
379	507941	Coil—FM R.F.
385	506581	Coil—R.F. choke (includes resistor 386)
387	506080	Transformer—1st FM I.F. (includes condensers 387-A and 387-B)
388	505867	Transformer—1st AM I.F. (includes condensers 388-A and 388-B)
397	505905	Transformer—2nd FM I.F. (includes condenser 397-A)
398	505867	Transformer—2nd AM I.F. (includes condensers 398-A and 398-B)
409	508179	Transformer—FM discriminator (includes condenser 409-A)
418	508212	Loop antenna (AM)

OTHER ELECTRICAL PARTS

DIAGRAM NO.	PART NO.	DESCRIPTION
43-A to D	508203	Switch—band (on TV chassis)
51	508174	Speaker—P.M. Dynamic (6" x 9")
53	508325	Built-in antenna (includes condenser 54)
221	508713	Fuse for horizontal sweep circuit; ¼ Amp. 250 volt
261	118921	Lamp—TV Channel Lite (Mazda #47) 6-8 v. 150 Ma.
262-A to G	508062	Integrator coupling unit A—Condenser—ceramic .01 Mfd. 450 volt B—Resistor—carbon 22,000 Ohms 1/5 watt C—Condenser—ceramic 2000 Mmfd. 450 volt D—Resistor—carbon 8200 Ohms 1/5 watt E—Condenser—ceramic 5000 Mmfd. 450 volt F—Resistor—carbon 8200 Ohms 1/5 watt G—Condenser—ceramic 5000 Mmfd. 450 volt
361	118921	Lamp—OFF-ON Indicator Lite (Mazda #47) 6-8 v. 150 Ma.
363	118921	Lamp—AM Channel Lite (Mazda #47) 6-8 v. 150 Ma.
364	118921	Lamp—FM Channel Lite (Mazda #47) 6-8 v. 150 Ma.
369-A, B	508753	Switch—band (on AM-FM tuner)
399-A, B, C	506338	Diode filter unit A—Condenser—ceramic 100 Mmfd. 400 volt B—Resistor—carbon 47,000 Ohms 1/5 watt C—Condenser—ceramic 100 Mmfd. 400 volt
418	508212	Loop antenna (AM)

MECHANICAL PARTS OF R.F. TUNER

(For electrical parts see preceding classified listings of condensers, resistors and coils.)

DIAGRAM NO.	PART NO.	DESCRIPTION
	508080	R.F. Unit complete with coils and tubes
	508666	Bracket for mounting tuner (front)
	508665	Bracket for mounting tuner (rear)
	508437	Fine Tuning cam and brass shaft
	508708	Roller—detent
	507989	Shield—tube; miniature for 6J6 or 6AG5
	507986	Slug for osc. coil fine tuning adjustment

MECHANICAL PARTS of R.F. TUNER—Continued

DIAGRAM NO.	PART NO.	DESCRIPTION
	507987	Socket—miniature for 6J6
	507988	Socket—miniature for 6AG5
	507966	Spring contactor washer (on front turret shaft)
	508709	Spring—detent
	507990	Spring—retains osc. fine tuning slug
	507967	Spring—turret shaft retaining
	507984	Stator contact assembly (includes 11 contacts and metal frames)
	508707	Tuner turret and shaft assembly (less coils)
	507965	Washer, fiber spacer (turret shaft)

CABINET PARTS

DIAGRAM NO.	PART NO.	DESCRIPTION
	508722	Back for cabinet (less power cord)
	508217	Bracket for mounting OFF-ON indicator lite at base of cabinet
	117131	Bull's-eye for OFF-ON indicator lite at base of cabinet
	508550	Cabinet
	507930	Call letter tabs
	508204	Dial scale, AM-FM
	508210	Escutcheon, control panel
	508540	Glass window
	508204	Knob—AM-FM Coarse Tuning and dial scale
	508205	Knob—AM-FM Fine Tuning
	508206	Knob—Brightness or Horizontal Hold
	502563	Knob—built-in antenna
	508627	Knob—Channel Selector
	508209	Knob—"CONTRAST"
	507917	Knob—TV Fine Tuning
	508208	Knob—"TV-PHONO-AM-FM"
	508207	Knob—Volume or Tone
	508331	Mask for picture tube
	508211	Name plate (Custom Deluxe 12)
	508621	Rubber gasket between mask and picture tube
	18796	Screw—#10 x 1"; mounts chassis
	505497	Socket for OFF-ON indicator lite at base of cabinet
	162163	Terminal strip for TV antenna connection

MISCELLANEOUS

DIAGRAM NO.	PART NO.	DESCRIPTION
	509048	Back cover and switch shaft bearing assembly for AM-FM tuner
	301270	Base for mounting electrolytic condenser
	508829	Bracket base for support of yoke and focus coil (left hand)
	508830	Bracket base for support of yoke and focus coil (right hand)
	508613	Bracket for deflection yoke mounting
	508728	Bracket for mounting trimmer #26
	508666	Bracket for mounting tuner (front)
	508665	Bracket for mounting tuner (rear)
	508510	Bracket—retains front of picture tube
	508755	Bracket—supports AM-FM tuner
	508198	Bracket—supports band switch shaft on TV chassis
	508038	Bracket—tube support (bottom front) (less rubber pad)
	508154	Bracket ("U" shaped) for support of yoke and focus coil
	505165	"C" washer for connecting link
	505314	"C" washer for extension shaft
	507930	Call letter tabs
	508806	Centering magnet assembly
	112745	Clip for mounting AM antenna coil
	508683	Clip for mounting electrolytic condenser #129
	508681	Clip for mounting electrolytic condenser #224
	507339	Clip for mounting, 1st video I.F., 2nd video I.F., 3rd video I.F., horiz. lock or horiz. linearity coil
	507592	Clip for mounting 4th video I.F. coil
	508715	Clip for mounting fuse holder

MISCELLANEOUS—Continued

DIAGRAM NO.	PART NO.	DESCRIPTION
	500245	Clip for mounting H.V. condenser
	505101	Clip for mounting I.F. transformer or FM sound discriminator
	114955	Clip—retainer on end of dial cord
	507286	Connector for H.V. terminal of picture tube
	117057	Cord—dial drive (2½ ft. required) per ft.
	508525	Drum—dial; on gang condenser
	508714	Fuse holder
	508623	Grounding spring for coating on picture tube
	506803	Ion trap
	509047	Lever—band switch actuating (on AM-FM tuner)
	509049	Lever—band switch actuating (on TV chassis)
	508756	Link—connects band switch actuating levers
	508617	Nut—for retaining focus coil mounting plate
	162183	Planetary drive and dial drum (includes mounting bracket)
	508864	Plate—focus coil mounting
	506652	Plug for AM-FM tuner power cable
	500966	Plug for audio cable on AM-FM tuner
	508878	Plug for focus coil leads
	507699	Power cord assembly (includes plugs at both ends)
	507361	Rubber cover for H.V. terminal connector
	508512	Rubber spacer on picture tube support bracket
	507793	Rubber spacer support between flared neck of picture tube and yoke bracket
	18796	Screw—#10 x 1"; mounts chassis
	508732	Shaft, extension for band switch on AM-FM tuner
	162138	Shield—H.V. supply (front section)
	508088	Shield—H.V. supply (rear section)
	508862	Shield—protector for band switch
	507357	Slug core for 1st, 2nd, 3rd or 4th video I.F. coil
	507429	Slug core for Horizontal Lock or Horizontal Linearity coil
	508438	Slug core (5/16" dia. x ⅜" long) for primary of TV sound discriminator transformer
	508894	Slug core (¼" dia. x ½" long) for primary of TV sound discriminator transformer
	508439	Slug core (5/16" dia. x ¾" long) for secondary of TV sound discriminator transformer
	508894	Slug core (¼" dia. x ½" long) for secondary of TV sound discriminator transformer
	508784	Slug core for Width coil
	160039	Socket—AM-FM tuner output
	162038	Socket assembly for 1B3GT/8016 tube (includes corona ring and mounting frame)
	508049	Socket and cable assembly for picture tube
	508156	Socket and mounting bracket for TV channel lite
	507948	Socket for AM-FM tuner power cable
	508335	Socket for AM or FM channel lite
	508879	Socket for focus coil leads
	508086	Socket for mounting H. V. condenser #230
	507932	Socket—male, power cord interlock
	506576	Socket—miniature (7 pin) for 6BE6)
	507364	Socket—miniature (7 pin)
	506331	Socket—miniature (9 pin) (for 12AT7)
	508044	Socket—miniature (9 pin)
	508703	Socket—octal
	160039	Socket—phono. plug
	505161	Spring—dial cord tension
	508514	Spring—retains H.V. lead
	508608	Spring—tension for focus coil mounting
	503994	Strap for picture tube support (includes rubber pad)
	111456	Washer—spring washer for connecting link
	170195	Wing nut—#8-32; for yoke and focus coil mounting
	170851	Wing nut—#5-40; for mounting focus coil to plate
	170817	Wing screw—#10-24; for height adj. of yoke and focus coil
	170741	Wing screw—#10-32; for yoke mounting

*—This part is not supplied as a Service replacement item.

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1. DESCRIPTIVE SPECIFICATIONS.

Power Supply — 117 volts, 60 cycle, 210 watts.

Kinescope — 12QP4, 12LP4, or 12KP4, kinescope, magnetic, deflection, mechanical picture centering, and magnetic focus. (Focus coil permanent magnet with electromagnetic vernier.)

Sweep Circuits.

Horizontal — Oscillator and driver tube, sweep amplifier tube, damper tube, and H.V. rectifier tube. Sweep frequency is automatically controlled.

Vertical — Oscillator, driver, and sweep amplifier tubes. Frequency is manually controlled.

Radio Frequency and Intermediate Frequency Circuits.

AM Picture — Superhetrodyne, tuned RF stage, converter and 4 I.F. stages. 2nd Detector and Video Amplifier. (Sound traps in 1st and 3rd I.F. stages.) Keyed A.G.C. operating from video detector.

FM Sound — Intercarrier system, limiter, ratio detector, triode audio driver, and beam power amplifier.

Number of Tubes — 24 including kinescope and rectifiers.

Frequency Ranges — Low Band, 54 mc. thru 88 mc. High band 147 mc. thru 216 mc.

Intermediate Frequencies.

Picture Carrier — 26.4 mc., 3.7 bandwidth at 50% response points.

Sound Carrier — 21.9 mc. Beat with picture carrier at 2nd detector to produce 4.5 mc.

Front Controls.

Top — Dual Control
 Center Knob — Vertical Hold.
 Outside Knob — Horizontal Hold.

2nd from Top — Dual Control
 Center Knob — Off-On-Volume.
 Outside Knob — Picture Control.

3rd from Top — Dual Control.
 Center Knob — Brightness Control.
 Outside Knob — Hi-Lo Channel Switch.

Bottom — Dual Control.
 Center Knob — Opera Glass.
 Outside Knob — Tuning Control.

Rear Controls.

1 — Horizontal Linearity.
2 — Horizontal Damping.
3 — Horizontal Size.
4 — Vertical Size Small.
5 — Vertical Linearity Small.
6 — Tone Switch.
7 — Vertical Linearity Large.
8 — Vertical Size Large.
9 — Focus.

Speaker Equipment

12" Permanent Magnet — 3.2 ohm impedence.

Audio Power Rating.

2.0 watts at 400 cycles with 10% distortion.

Tubes — Types and Function.

V-1	12AU7	Vertical Sweep Output.
V-2	6SN7-GT	Horizontal Sweep Oscillator.
V-3	6BG6-G	Horizontal Sweep Output.
V-4	6W4-GT	Damper.
V-5	1B3-GT 8016	High Voltage Rectifier.
V-6	6AL5	Horizontal Phase Detector.
V-7	12AU7	Sync Splitter and DC Restorer.
V-8	6AC7	Video Amplifier.
V-9	6AL5	Video Detector and Limiter.
V-10	6BH6	3rd Video I.F. Amplifier.
V-11	6BH6	2nd Video I.F. Amplifier.
V-12	6BH6	1st Video I.F. Amplifier.
V-13	6AU6	Ratio Detector Driver.
V-14	6T8	Ratio Detector and Audio Amplifier.
V-15	6V6-GT G	Audio Output.
V-16	6J6	Hi-Band Converter and Oscillator.
V-17	6J6	Lo-Band Converter and Oscillator.
V-18	6BC5	Hi-Band R.F. Amplifier.
V-19	6BH6	Lo-Band R.F. Amplifier
V-20	5U4-G	Power Rectifier.
V-21	12KP4 / 12LP4 / 12QP4	Kinescope.
V-22	12AU7	Vertical Sweep Oscillator and Sync Clipper.
V-23	6AH6	4th I.F.-Video I.F. Amplifier.
V-24	6AU6	A.G.C.

GENERAL ASSEMBLY PARTS LIST

Description	TC-125-LA-4 S-C Part No.	TC-125-LS-2 S-C Part No.	TC-125-LM-3 S-C Part No.
Cabinet Assembly	108155	108160	108154
Speaker	155154	155154	155154
Escutcheon—Tube Ring	125049	125048	125048
Mask Assembly	174016	174014	174014
Lens	138028	138028	138028
Back Panel Assembly	101131	101133	101131
Knob — Tuning	134132	134115	134115
Knob — 7-13, 2-6 (Range)	134131	134117	134117
Knob — Brightness	134130	134120	134120
Knob — Opera Glass	134134	134134	134134
Knob — Picture (Contrast)	134129	134118	134118
Knob — Valume	134128	134121	134121
Knob — Horizontal	134127	134116	134116
Knob — Vertical	134126	134119	134119
Name Plate— Stromberg-Carlson	121054	121049	121049
Tel Atenna—Loop Support	103018	103018	103018
Tel Atenna—Loop Assembly	139037	139037	139037

2. ALIGNMENT PROCEDURE.

General.

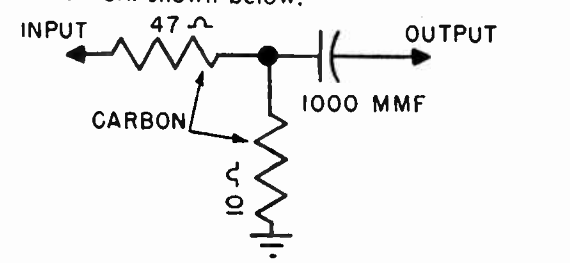
All precautions for aligning high frequency devices should be observed. Signal generators and oscilloscope leads should be well shielded and as short as possible. If necessary to reduce regeneration, a metal plate should be placed on the bench where the alignment work is done.

Video I.F. Alignment.

The video I.F. system consists of a double tuned converter plate transformer followed by four single tuned stages. These four are the 1st, 2nd, 3rd, and 4th I.F. Stages. They are aligned as a "quadruple" unit previous to the adjustment of the double-tuned stage.

Alignment of the "Quadruple".

1. Set the contrast control at the maximum contrast position.
2. Apply an external bias of approximately 3V D.C. to the AGC line at the junction of R-119, 100 ohms, R-73, 27,000 ohms, and C-7, 10 MF.
3. Connect the oscilloscope to the grid of the video amplifier, pin 4 of V-8 (6AC7). The lead used for this connection should be a low capacity type shielded cable. A 47,000 ohm isolating resistor at the input end of the cable is advisable to minimize disturbances caused by I.F. energy pickup on the cable. Failure to observe this precaution may result in incorrect alignment of the receiver.
4. Connect the output of the sweep generator to the grid of the 1st I.F. amplifier V-12 (6BH6) thru the network shown below.



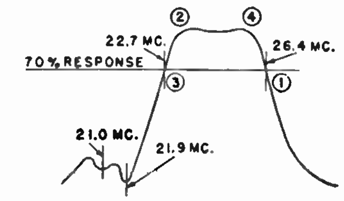
The 47 ohm and 10 ohm resistor network is recommended to give proper terminaton to the generator output cable and also to provide a low grid to ground impedance to minimize feedback from other receiver circuits.

5. Adjust the gain of the scope and the signal input to produce a 2 volt peak to peak output on the oscilloscope screen. This level of output should be maintained throughout the alignment procedure by re-adjusting the bias and/or the input.
6. Adjust the 21.9 mc. trap L-2 so that the 21.9 marker is coincident with the valley of the trap as shown below.
7. The 21 mc. L-5 trap may then be adjusted (without using a marker) to give the response curve the approximate shape as shown below. The response between the 21.9 mc. and 21 mc. should be kept at a minimum.
8. The tuning slugs are identified in accordance with their approximate frequency settings as follows:

No. 1 — 1st I.F. Plate coil, T-9 hi-hi frequency.
No. 2 — 2nd I.F. Plate coil, T-10 hi-lo frequency.
No. 3 — 3rd I.F. Plate coil, T-11 lo-lo frequency.
No. 4 — 4th I.F. Plate coil, T-12 lo-hi frequency.

Refer to the circled numbers on the response curve shown below for the relative positions.

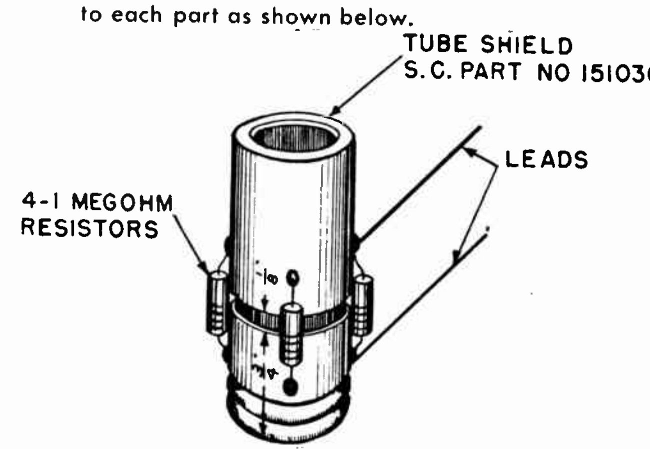
Maintaining these relative frequency positions, the slugs should be set to produce a curve approximately as shown below with 26.4 mc. and 22.7 mc. markers at the 70% response.



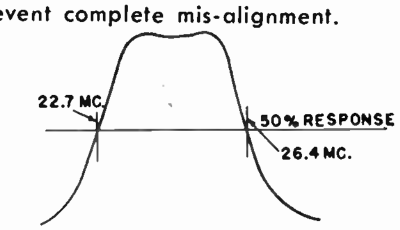
9. It is suggested the traps be checked to insure correct frequency setting after finishing Step No. 8.

Alignment of the Double-Tuned Stage.

1. The band switch is turned to the Lo Band position and the external bias is still applied to the AGC bus.
2. The output from the sweep generator is coupled into the plate of the Lo Band converter tube V-17, 6J6, by means of the special tube shield. This special shield is constructed by cutting tube shield SC No. 151036 in two, ¾" from the base. Separate the two pieces by ⅛" and secure by soldering 4-1 meg. ohm ½ watt carbon resistors to each part as shown below.



3. Adjust the primary L-26 and secondary T-8 of the double-tuned pair until the 26.4 mc. and 22.7 mc. markers are at 50% response as shown below.
4. It may be necessary to make slight adjustments on the "Quadruple" in order to achieve the desired response, but caution should be exercised to prevent complete mis-alignment.



Sound I.F. Alignment.

1. Apply a modulated 4.5 mc. signal to the grid of the video amplifier, pin 4 of V-8 (6AC7). Connect the input of the oscilloscope thru the crystal detector shown below to the grid of the kinescope tube.

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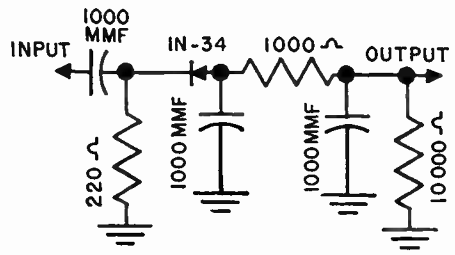
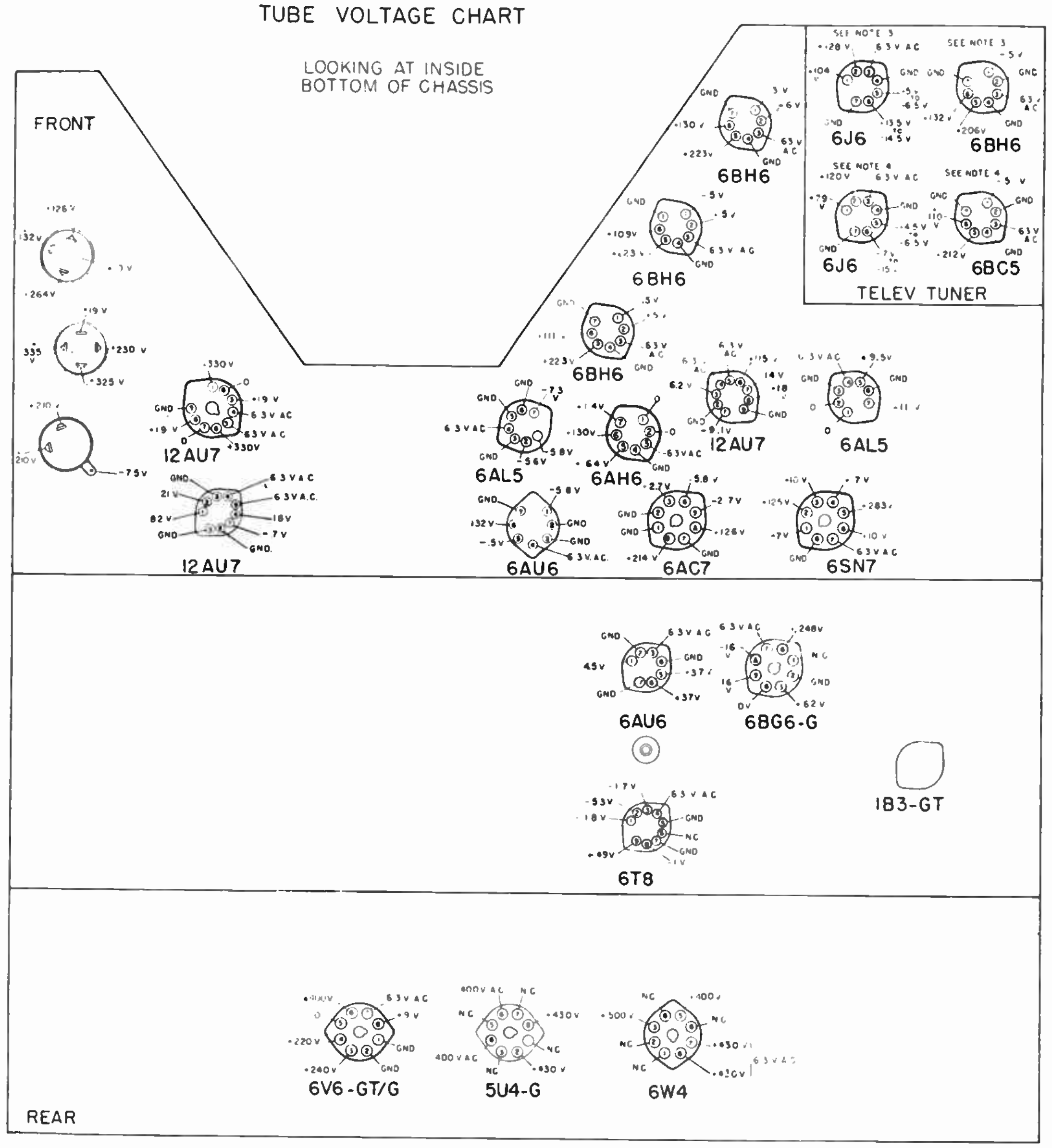


2. Adjust the core of T-5 the 4.5 mc. sound take-off coil for minimum response.

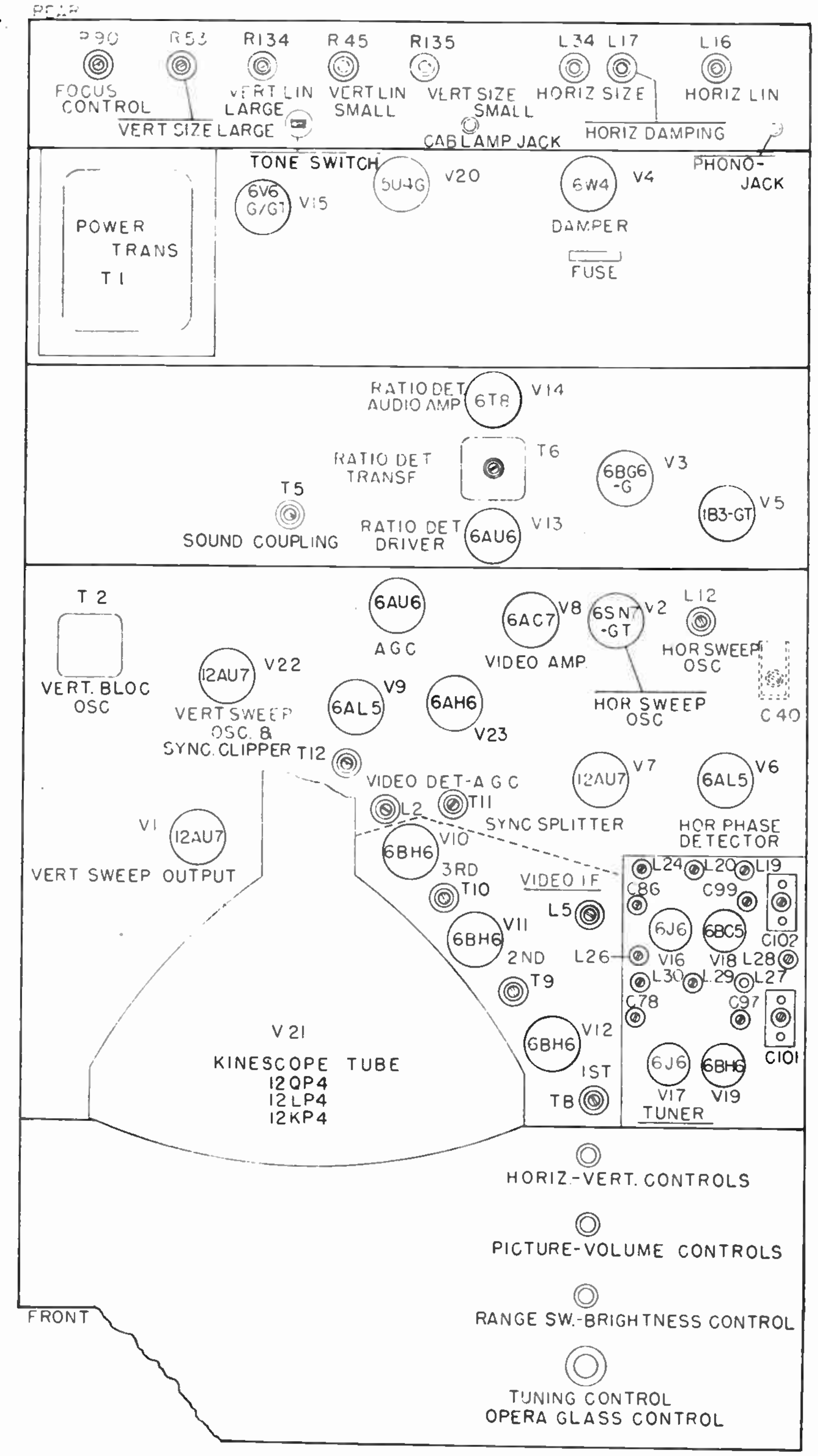
3. Remove the modulation on the 4.5 mc. signal and adjust the primary of the ratio detector transformer T-6 for maximum AGC voltage. This voltage is measured across the 5.0 MF electrolytic capacitor C-56 in the ratio detector diode circuit.

4. Adjust the secondary of the ratio detector transformer for zero voltage from the junction of R-79, 22K and R-80, 22K to the junction of C-58, .047 MF and R-78, 18K. This voltage in adjustment should pass thru zero between positive and negative swings on the VTVM.

TUBE VOLTAGE CHART



NOTES:
1- MEASUREMENTS ARE MADE AT 117 V LINE USING 11 MEGOHM VACUUM TUBE VOLTMETER ALL VOLTAGES ARE D C AND ARE POSITIVE WITH RESPECT TO CHASSIS GROUND EXCEPT WHERE NOTED.
2- ALL VOLTAGES ARE THE SAME IN ANY POSITION OF THE RANGE SWITCH EXCEPT AS SHOWN IN NOTES 3 AND 4.
3- VOLTAGES SHOWN ARE FOR LOW BAND (CHANNELS 2 TO 6)
4- VOLTAGES SHOWN ARE FOR HIGH BAND (CHANNELS 7 TO 13)
5- CONTRAST CONTROL SET MINIMUM, ANTENNA DISCONNECTED, NORMAL PICTURE SIZE.



CIRCUIT SYMBOL	S-C PART NO.	CAPACITY	TYPE	VOLTAGE
C-1	110484	2.5 MMF	Ceramic	500
C-2	110586	5000 MMF	Ceramic	450
C-3	110586	5000 MMF	Ceramic	450
C-4	110586	5000 MMF	Ceramic	450
C-5	110586	5000 MMF	Ceramic	450
C-6	110586	5000 MMF	Ceramic	450
C-7	111084	10 MF	Elect.	25
C-8	110464	470 MMF	Ceramic	350
C-9	110586	5000 MMF	Ceramic	450
C-10	110586	5000 MMF	Ceramic	450
C-11	110540	.01 MF	Molded	400
C-12	111067	80 MFD	Elect.	300
C-13	110586	5000 MMF	Ceramic	450
C-14	110660	.047 MF	Molded	200
C-16	110548	.22 MF	Molded	400
C-17	110263	470 MMF	Mica	500
C-18	110586	5000 MMF	Ceramic	450
C-19	110546	.1 MF	Molded	400
C-21	110540	.01 MF	Molded	400
C-22	110534	.001 MF	Molded	400
C-23	110534	.001 MF	Molded	400
C-24	110538	.0047 MF	Molded	400
C-25	110586	5000 MMF	Ceramic	450
C-27	111067	80 MFD	Elect.	300
C-28	110586	5000 MMF	Ceramic	450
C-29	110679	.25 MF	Paper	600
C-30	110538	.0047 MF	Molded	400
C-31	110546	.1 MF	Molded	400
C-32	110548	.22 MF	Molded	400
C-33	110558	.033 MF	Molded	600
C-34	110536	.0022 MF	Molded	400
C-35	110272	3900 MMF	Mica	500
C-36	110767	.15 MF	Molded	200
C-37	110208	270 MMF	Mica	500
C-38	110216	390 MMF	Mica	500
C-39	110208	270 MMF	Mica	500
C-40	110037	30-273 MMF	Mica Trimmer	
C-41	111065	40-10-10-25	Elect.	450-25
C-42	110544	.047 MF	Molded	400
C-43	111030	5 MFD	Elect.	50
C-44	110558	.033 MF	Molded	600
C-45	110561	.1 MF	Molded	600
C-46	110664	36 MMF	Ceramic	1000
C-47	110664	36 MMF	Ceramic	1000
C-48	110658	500 MMF	Molded	10000
C-49	110666	56 MMF	Ceramic	1000
C-50	110548	.22 MF	Molded	400
C-51	110665	39 MMF	Ceramic	400

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CIRCUIT SYMBOL	S-C PART NO.	CAPACITY	TYPE	VOLTAGE
C-53	110586	5000 MMF	Ceramic	450
C-54	110561	0.1 MF	Molded	600
C-55	110454	330 MMF	Ceramic	350
C-56	111030	5 MF	Elect.	50
C-57	110537	.0033 MF	Molded	400
C-58	110660	.047 MF	Molded	200
C-59	110538	.0047 MF	Molded	400
C-61	110540	.01 MF	Molded	400
C-62	110557	.022 MF	Molded	600
C-63	110586	5000 MMF	Ceramic	450
C-64	110538	.0047 MF	Molded	400
C-65	110568	.01 MF	Molded	1000
C-66	110568	.01 MF	Molded	1000
C-67	110538	.0047 MF	Molded	400
C-68	111068	40-20-10-100	Elect.	450-50
C 69	111064	80-80	Elect.	300-300
C-70	110586	5000 MMF	Ceramic	450
C-71	110653	22 MMF	Ceramic	500
C-72	110598	5 MMF	Ceramic	350
C-73	110586	5000 MMF	Ceramic	450
C-74	110586	5000 MMF	Ceramic	450
C-75	110586	5000 MMF	Ceramic	450
C-76	110656	10 MMF	Ceramic	400
C-77	110654	750 MMF	Ceramic	350
C-78	110034	1-8 MMF	Trimmer	
C-79	110586	5000 MMF	Ceramic	450
C-80	110656	10 MMF	Ceramic	400
C-81	110438	1.5 MMF	Ceramic	500
C-82	110586	5000 MMF	Ceramic	450
C-83	110653	22 MMF	Ceramic	500
C-84	110654	750 MMF	Ceramic	350
C-85	110656	10 MMF	Ceramic	400
C-86	110034	1-8 MMF	Trimmer	
C-87	110652	2000 MMF	Ceramic	350
C-88	110652	2000 MMF	Ceramic	350
C-89	110483	75 MMF	Ceramic	400
C-90	110667	4.5 MMF	Ceramic	350
C-91	110667	4.5 MMF	Ceramic	350
C-92	110655	5.5 MMF	Ceramic	400
C-93	110652	2000 MMF	Ceramic	350
C-94	110652	2000 MMF	Ceramic	350
C-95	110654	750 MMF	Ceramic	350
C-96	110462	220 MMF	Ceramic	350
C-97	110035	.5-5 MMF	Trimmer	
C-98	110654	750 MMF	Ceramic	350
C-99	110035	.5-5 MMF	Trimmer	
C-100	110462	220 MMF	Ceramic	350
C-101	27081	20-75 MMF	Trimmer	
C-102	27081	20-75 MMF	Trimmer	
C-103	110586	5000 MMF	Ceramic	450
C-104	110586	5000 MMF	Ceramic	450
C-105	110451	100 MMF	Ceramic	500
C-106	110438	1.5 MMF	Ceramic	500

CIRCUIT SYMBOL	S-C PART NO.	CAPACITY	TYPE	VOLTAGE
C-107	110499	20 MMF	Ceramic	500
C-108	110654	750 MMF	Ceramic	350
C-109	110483	75 MMF	Ceramic	400
C-112	110538	.0047 MF	Molded	400
C-113	110586	5000 MMF	Ceramic	450
C-115	111082	500 MMF	Elect.	12
C-116	110546	.1 MF	Molded	400
C-117	110439	2.2 MMF	Ceramic	500
C-118	110586	5000 MMF	Ceramic	450
C-119	110464	470 MMF	Ceramic	350
C-121	110586	5000 MMF	Ceramic	450
C-122	110658	500 MMF	Molded	10000
C-123	110678	.056 MF	Molded	400
C-124	110681	1500 MMF	Ceramic	500

CIRCUIT SYMBOL	S-C PART NO.	RESISTANCE	WATT	TOL.
R-1	149098	330 ohms	½	20%
R-2	28170	10000 ohms	½	10%
R-3	28145	82 ohms	½	10%
R-4	149095	100 ohms	½	20%
R-5	149098	330 ohms	½	20%
R-6	28168	6800 ohms	½	10%
R-7	28145	82 ohms	½	10%
R-8	28168	6800 ohms	½	10%
R-9	149096	150 ohms	½	20%
R-10	149095	100 ohms	½	20%
R-11	149027	22 ohms	2 W	10%
R-12	149095	100 ohms	½	20%
R-13	37200	8200 ohms	1 W	10%
R-14	149119	1 Megohm	½	20%
R-15	149111	47000 ohms	½	20%
R-16	28166	4700 ohms	½	10%
R-17	149113	0.1 Meg.	½	20%
R-18	28147	120 ohms	½	10%
R-19	145077	750 ohm 250K		POT
R-20	149113	.1 Meg	½	20%
R-21	149095	100 ohms	½	20%
R-22	149113	.1 Meg	½	20%
R-23	149101	1000 ohms	½	20%
R-24	149101	1000 ohms	½	20%
R-25	149044	1000 ohms	2 W	10%
R-26	149103	2200 ohms	½	20%
R-27	149117	470000 ohms	½	20%
R-28	149110	33000 ohms	½	20%
R-29	149116	330000 ohms	½	20%
R-30	28155	560 ohms	½	10%
R-31	28165	3900 ohms	½	10%
R-32	149119	1 Meg	½	20%
R-33	28164	3300 ohms	½	10%
R-34	149109	22000 ohms	½	20%
R-35	28006	.1 Meg	½	10%
R-36	28006	.1 Meg	½	10%

CIRCUIT SYMBOL	S-C PART NO.	RESISTANCE	WATT	TOL.
R-37	149123	4.7 Meg	½	20%
R-38	149117	.47 Meg	½	20%
R-39	28146	100 ohms	½	10%
R-40	149095	100 ohms	½	20%
R-41	149332	1000 ohms	15 W	WW
R-42	149124	6.8 Meg	½	20%
R-43	149120	1.5 Meg	½	20%
R-44	149113	.1 Meg	½	20%
R-45	145079	5000 ohms		POT
R-46	28157	820 ohms	½	10%
R-47	149121	2.2 Meg	½	20%
R-48	149107	10000 ohms	½	20%
R-49	149054	8200 ohms	2 W	20%
R-50	28155	560 ohms	½	10%
R-51	28155	560 ohms	½	10%
R-52	28194	1.8 Meg	½	10%
R-53	145100	6 Meg		POT
R-54	149184	5600 ohms	1 W	10%
R-55	149102	1500 ohms	½	20%
R-56	149113	.1 Meg	½	20%
R-57	145101	50K2 Meg		POT
R-58	28184	.27 Meg	½	10%
R-59	149084	22000 ohms	2 W	20%
R-60	28169	8200 ohms	½	10%
R-61	149094	68 ohms	½	20%
R-62	149119	1 Meg	½	20%
R-63	149166	82 ohms	1 W	10%
R-64	149055	12000 ohms	2 W	10%
R-65	149111	47000 ohms	½	20%
R-66	149271	5.6 ohms	½	10%
R-67	149331	8000 ohms	10 W	WW
R-68	149202	680000 ohms	1 W	10%
R-69	149101	1000 ohms	½	20%
R-70	149115	.22 Meg	½	20%
R-71	145084	.1 Meg		POT
R-72	149107	10000 ohms	½	20%
R-73	28174	27000 ohms	½	10%
R-74	149103	2200 ohms	½	20%
R-77	149111	47000 ohms	½	20%
R-78	28173	18000 ohms	½	10%
R-79	27407	22000 ohms	½	10%
R-80	27407	22000 ohms	½	10%
R-81	28169	8200 ohms	½	10%
R-82	149330	4000 ohms	5 W	WW
R-83	149117	.47 Meg	½	20%
R-84	149113	.1 Meg	½	20%
R-85	149069	68 ohms	2 W	20%
R-86	149082	10000 ohms	2 W	20%
R-87	149125	10 Meg	½	20%
R-88	149170	270 ohms	1 W	10%
R-89	149117	.47 Meg	½	20%
R-90	145087	2250 ohms	4 W	POT
R-91	149356	2700 ohms	2 W	10%
R-92	149157	12 ohms	1 W	10%
R-93	149113	.1 Meg	½	20%

CIRCUIT SYMBOL	S-C PART NO.	RESISTANCE	WATT	TOL.
R-94	149105	4700 ohms	½	20%
R-95	149107	10000 ohms	½	20%
R-96	149096	150 ohms	½	20%
R-97	149101	1000 ohms	½	20%
R-98	149101	1000 ohms	½	20%
R-99	28155	560 ohms	½	10%
R-100	149103	2200 ohms	½	20%
R-101	149113	.1 Meg	½	20%
R-102	149101	1000 ohms	½	20%
R-103	149105	4700 ohms	½	20%
R-104	149101	1000 ohms	½	20%
R-105	149107	10000 ohms	½	20%
R-106	149096	150 ohms	½	20%
R-107	149096	150 ohms	½	20%
R-108	28163	2700 ohms	½	10%
R-109	149101	1000 ohms	½	20%
R-110	149096	150 ohms	½	20%
R-111	149110	33000 ohms	½	20%
R-112	149110	33000 ohms	½	20%
R-114	149145	15000 ohms	1 W	20%
R-115	149355	2200 ohms	2 W	10%
R-117	149111	47000 ohms	½	20%
R-118	145095	100 ohms	½	20%
R-119	149095	100 ohms	½	20%
R-120	149107	10000 ohms	½	20%
R-121	149103	2200 ohms	½	20%
R-122	34578	27000 ohms	1 W	10%
R-123	149116	330000 ohms	½	20%
R-124	149095	100 ohms	½	20%
R-125	28168	6800 ohms	½	10%
R-126	28145	82 ohms	½	10%
R-127	149095	100 ohms	½	20%
R-128	28176	39000 ohms	½	10%
R-130	149111	47000 ohms	½	20%
R-131	149120	1.5 Meg.	½	20%
R-132	149117	.47 Meg.	½	20%
R-134	145079	5000 ohms		POT
R-135	145082	100 ohms		POT

CIRCUIT SYMBOL	S-C PART NO.	DESCRIPTION
L-2	114394	COIL ASM (21.9 MC TRAP)
L-3	20608	LINK (No. 24 POLYETHYLENE)
L-4	20608	LINK (No. 24 POLYETHYLENE)
L-5	114384	COIL ASM (TRAP)
L-10	114669	COIL ASM (PEAKING COIL)
L-12	114069	HORIZ. SWEEP OSC
L-14	114656	COIL ASM (PEAKING COIL)
L-15	114655	COIL ASM (PEAKING COIL)
L-16	114071	LINEARITY COIL
L-17	114075	BOOSTER COIL
L-19	114066	COIL ASM (HI-BAND R F PRI)
L-20	114066	COIL ASM (HI-BAND R F SEC)

MODEL TC-125, Series "O"

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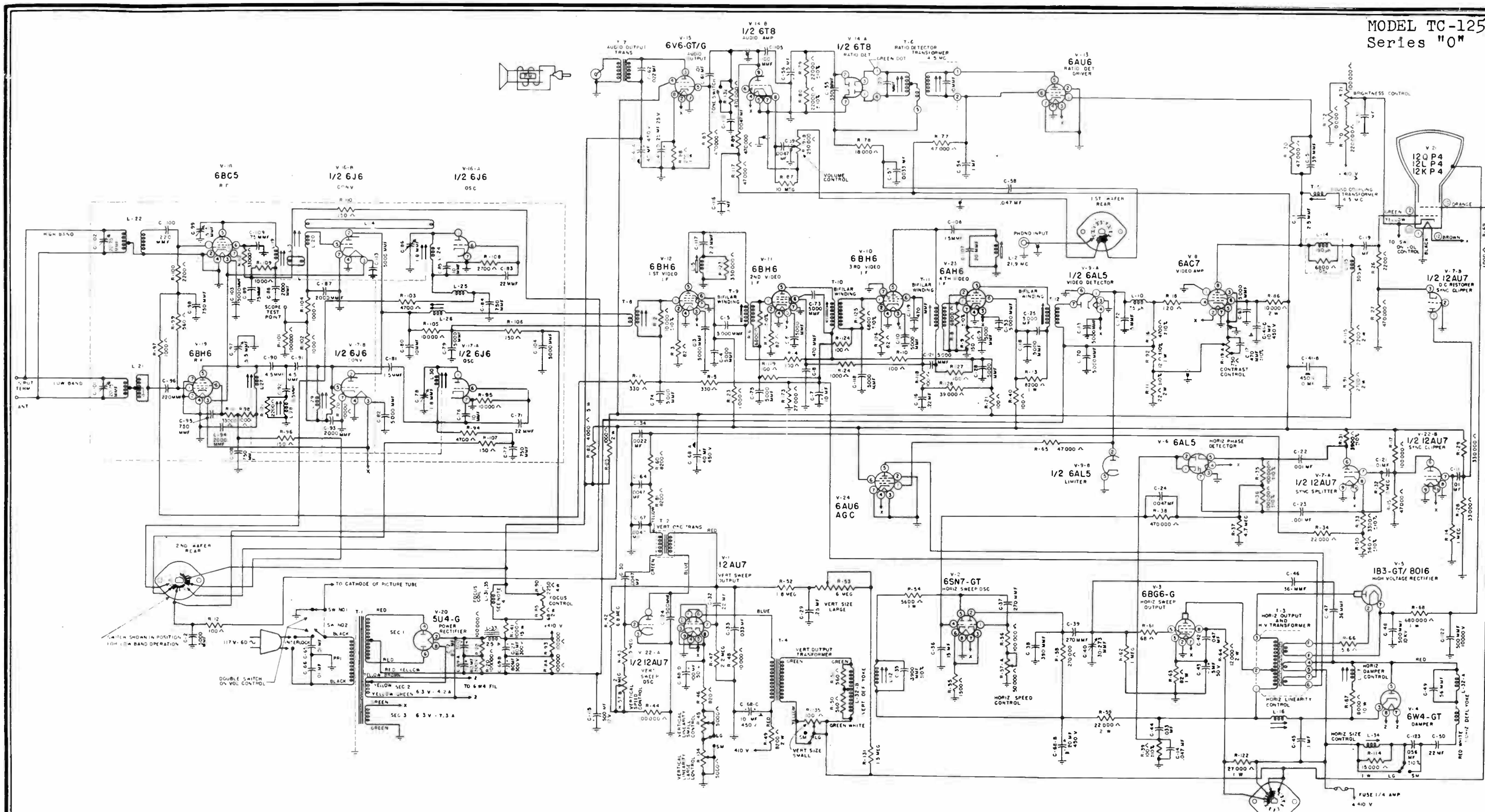
World Radio History

MODEL TC-125, Series "O"



CIRCUIT SYMBOL	S-C PART NO.	DESCRIPTION
L-21	114057	COIL ASM (LO-BAND ANT)
L-22	114676	COIL ASM (HI-BAND ANT.)
L-24	114066	COIL ASM (HI-BAND OSC)
L-25	114060	COIL ASM (R F C)
L-26	114061	COIL ASM (VIDEO IF CONV PRI)
L-27	114065	COIL ASM (LO-BAND R F PRI)
L-28	114642	COIL ASM (LO-BAND R F TRIM)
L-29	114065	COIL ASM (LO-BAND R F SEC)
L-30	114065	COIL ASM (LO-BAND OSC)
L-31	114660	COIL ASM (FOCUS COIL—12LP4)
	114661	COIL ASM (Focus Coil—12KP4—12QP4)
L-32	114659	HORIZ & VERT DEF YOKE
L-33	161020	FILTER CHOKE 2.5 H
L-34	114074	COIL ASM (HOR SIZE CONT)
T-1	161420	TRANS POWER
T-2	114658	TRANS VERT BL OSC
T-3	161028	TRANS HORIZ DEFLECT
T-4	161242	TRANS VERTICAL DEFL
T-5	114395	TRANS SOUND COUPLING
T-6	114375	TRANS RATIO DETECTOR
T-7	161249	TRANS AUDIO OUTPUT
T-8	114377	COIL ASM (VID IF CONV SEC)
T-9	114376	IF TRANS (1st VIDEO)
T-10	114376	IF TRANS (2nd VIDEO)
T-11	114382	IF TRANS (3rd VIDEO)
T-12	114376	IF TRANS (4th VIDEO)
T-13	114635	ION TRAP—12LP4
T-14	114645	ION TRAP—12QP5

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World Radio History

SERVICE INSTRUCTIONS FOR THE 116-C, 116-T, AND 116-RP TELEVISION RECEIVERS

1. DESCRIPTIVE SPECIFICATIONS.

Power Supply — 117 volts, 60 cycle, 240 watts.

Kinescope — 16GP4, 16KP4, 16RP4, or 16TP4, kinescope, magnetic, deflection, mechanical picture centering, and magnetic focus. (Focus coil permanent magnet with electromagnetic vernier.)

Sweep Circuits.

Horizontal — Oscillator and driver tube, sweep amplifier tube, damper, and 2 H.V. rectifier tubes. Sweep frequency is automatically controlled.

Vertical — Oscillator and sweep amplifier tubes. Frequency is manually controlled.

Radio Frequency and Intermediate Frequency Circuits.

AM Picture — Superhetrodyne, tuned RF stage, converter and 4 I.F. stages. 2nd Detector and Video Amplifier. (Sound traps in 1st and 3rd I.F. stages.) Keyed A.G.C. operating from video detector.

FM Sound — Intercarrier system, limiter, ratio detector, triode audio driver, and beam power amplifier.

Number of Tubes — 26 including kinescope and rectifiers.

Frequency Ranges — Low Band, 54 mc. thru 88 mc. High band 147 mc. thru 216 mc.

Intermediate Frequencies.

Picture Carrier — 26.4 mc., 3.7 bandwidth at 50% response points.

Sound Carrier — 21.9 mc. Beat with picture carrier at 2nd detector to produce 4.5 mc.

Front Controls.

Top — Dual Control
- Center Knob — Vertical Hold.
- Outside Knob — Horizontal Hold.

2nd from Top — Dual Control
- Center Knob — Off-On-Volume.
- Outside Knob — Picture Control.

3rd from Top — Dual Control.
- Center Knob — Brightness Control.
- Outside Knob — Hi-Lo Channel Switch.

Bottom — Dual Control.
- Center Knob — Fine Tuning Control.
- Outside Knob — Tuning Control.

Rear Controls.

1 — Horizontal Linearity.
2 — Horizontal Drive.
3 — Horizontal Size.
4 — Vertical Size.
5 — Vertical Linearity.
6 — Focus.
7 — Tone.

Speaker Equipment

116-C — RP — 12″ Permanent Magnet — 3.2 ohm impedance.

116-T — 5½″ Permanent Magnet — 3.2 ohm impedance.

Audio Power Rating.

2.0 watts at 400 cycles with 10% distortion.

Tubes — Types and Function.

V-1	12AU7	Vertical Sweep Output.
V-2	6SN7-GT	Horizontal Sweep Oscillator.
V-3	6BG6-G	Horizontal Amplifier.
V-4	6W4-GT	Damper.
V-5	16GP4, 16KP4, 16RP4, 16TP4	Kinescope.
V-6	6AL5	Horizontal Phase Detector.
V-7	12AU7	Sync Splitter and DC Restorer.
V-8	6AC7	Video Amplifier.
V-9	6AL5	Video Detector and Limiter.
V-10	6BH6	3rd Video I.F. Amplifier.
V-11	6BH6	2nd Video I.F. Amplifier.
V-12	6BH6	1st Video I.F. Amplifier.
V-13	6AU6	Ratio Detector Driver.
V-14	6T8	Ratio Detector and Audio Amplifier.
V-15	6V6-GT/G	Audio Output.
V-16	6J6	Hi-Band Converter and Oscillator.
V-17	6J6	Lo-Band Converter and Oscillator.
V-18	6BC5	Hi-Band R.F. Amplifier.
V-19	6CB6	Lo-Band R.F. Amplifier.
V-20	5U4-G	Power Rectifier.
V-21	1X2	High Voltage Rectifier.
V-22	12AU7	Vertical Sweep Oscillator and Sync Clipper.
V-23	6AH6	4th I.F.-Video I.F. Amplifier.
V-24	6AU6	A.G.C.
V-25	6AU6	Sound I.F. Amp.
V-26	1X2	High-Voltage Rectifier.

2. ALIGNMENT PROCEDURE.

General.

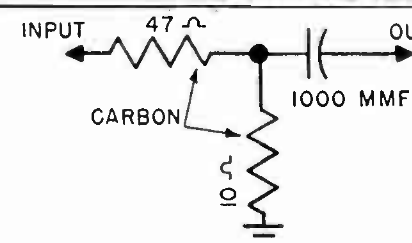
All precautions for aligning high frequency devices should be observed. Signal generators and oscilloscope leads should be well shielded and as short as possible. If necessary to reduce regeneration, a metal plate should be placed on the bench where the alignment work is done.

Video I.F. Alignment.

The video I.F. system consists of a double tuned converter plate transformer followed by four single tuned stages. These four are the 1st, 2nd, 3rd, and 4th I.F. Stages. They are aligned as a "quadruple" unit previous to the adjustment of the double-tuned stage.

Alignment of the "Quadruple".

1. Set the contrast control at the maximum contrast position.
2. Apply an external of approximately —3V D.C. to the AGC line at the junction of R-119, 100 ohms, R-73, 27,000 ohms, and C-7, 10 MF.
3. Connect the oscilloscope to the grid of the video amplifier, pin 4 of V-8 (6AC7). The lead used for this connection should be a low capacity type shielded cable. A 47,000 ohm isolating resistor at the input end of the cable is advisable to minimize disturbances caused by I.F. energy pickup on the cable. Failure to observe this precaution may result in incorrect alignment of the receiver.
4. Connect the output of the sweep generator to the grid of the 1st I.F. amplifier V-12 (6BH6) thru the network



The 47 ohm and 10 ohm resistor network is recommended to give proper terminaton to the generator output cable and also to provide a low grid to ground impedance to minimize feedback from other receiver circuits.

5. Adjust the gain of the scope and the signal input to produce a 2 volt peak to peak output on the oscilloscope screen. This level of output should be maintained throughout the alignment procedure by re-adjusting the bias and/or the input.
6. Adjust the 21.9 mc. trap L-2 so that the 21.9 marker is coincident with the valley of the trap as shown in Fig. 1.
7. The 21 mc. L-5 trap may then be adjusted (without using a marker) to give the response curve the approximate shape as shown in Fig. 1. The response between the 21.9 mc. and 21 mc. should be kept at a minimum.
8. The tuning slugs are identified in accordance with their approximate frequency settings as follows:

   No. 1 — 1st I.F. Plate coil, T-9 hi-hi frequency.
   No. 2 — 2nd I.F. Plate coil, T-10 hi-lo frequency.
   No. 3 — 3rd I.F. Plate coil, T-11 lo-lo frequency.
   No. 4 — 4th I.F. Plate coil, T-12 lo-hi frequency.

   Maintaining these relative frequency positions, the slugs should be set to produce a curve approximately as shown below with 26.4 mc. and 22.7 mc. markers at the 70% response.
9. It is suggested the traps be checked to insure correct frequency setting after finishing Step No. 8.

Alignment of the Double-Tuned Stage.

1. The band switch is turned to the Lo Band position and the external bias is still applied to the AGC bus.

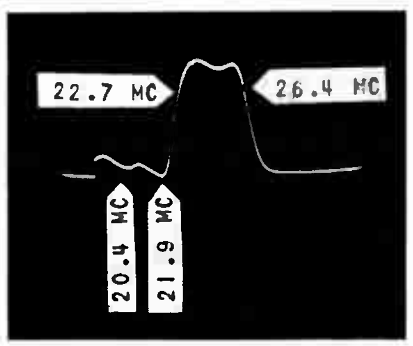
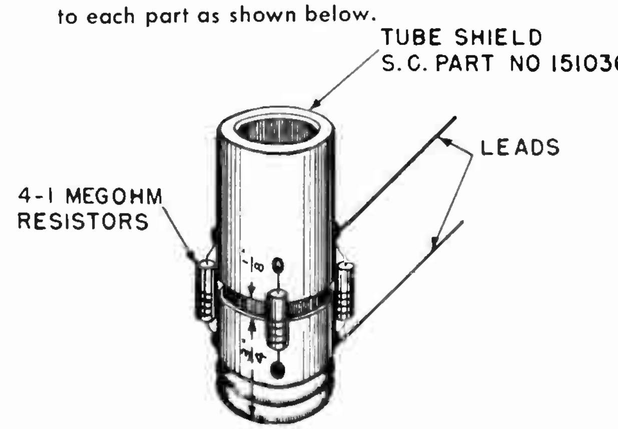


FIG. 1

2. The output from the sweep generator is coupled into the plate of the Lo Band converter tube V-17, 6J6, by means of the special tube shield. This special shield is constructed by cutting tube shield SC No. 151036 in two, ¾″ from the base. Separate the two pieces by ⅛″ and secure by soldering 4-1 meg. ohm ½ watt carbon resistors to each part as shown below.



3. Adjust the primary L-26 and secondary T-8 of the double-tuned pair until the 26.4 mc. and 22.7 mc. markers are at 50% response as shown in Fig. 2.
4. It may be necessary to make slight adjustments on the "Quadruple" in order to achieve the desired response, but caution should be exercised to prevent complete mis-alignment.

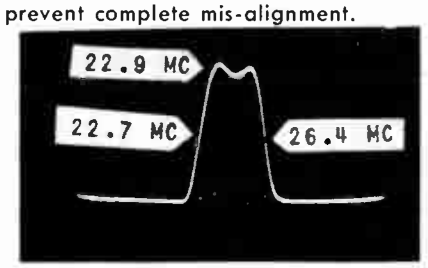
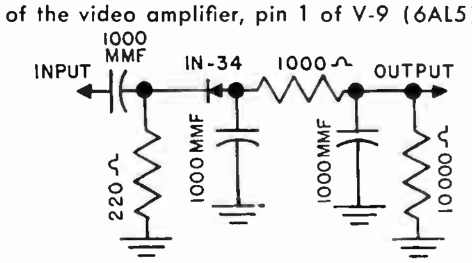


FIG. 2

Sound I.F. Alignment.

1. Apply an unmodulated 4.5 mc. signal to the grid of the video amplifier, pin 1 of V-9 (6AL5).



2. Adjust T-5, L-7, and the primary of the ratio detector transformer T-6 for maximum AGC voltage. This voltage is measured across the 5.0 MF electrolytic capacitor C-56 in the ratio detector diode circuit.
3. Adjust the secondary of the ratio detector transformer for zero voltage from the junction of R-79, 22K and R-80, 22K to the junction of C-58, .047 MF and R-78, 18K. This voltage in adjustment should pass thru zero between positive and negative swings on the VTVM.

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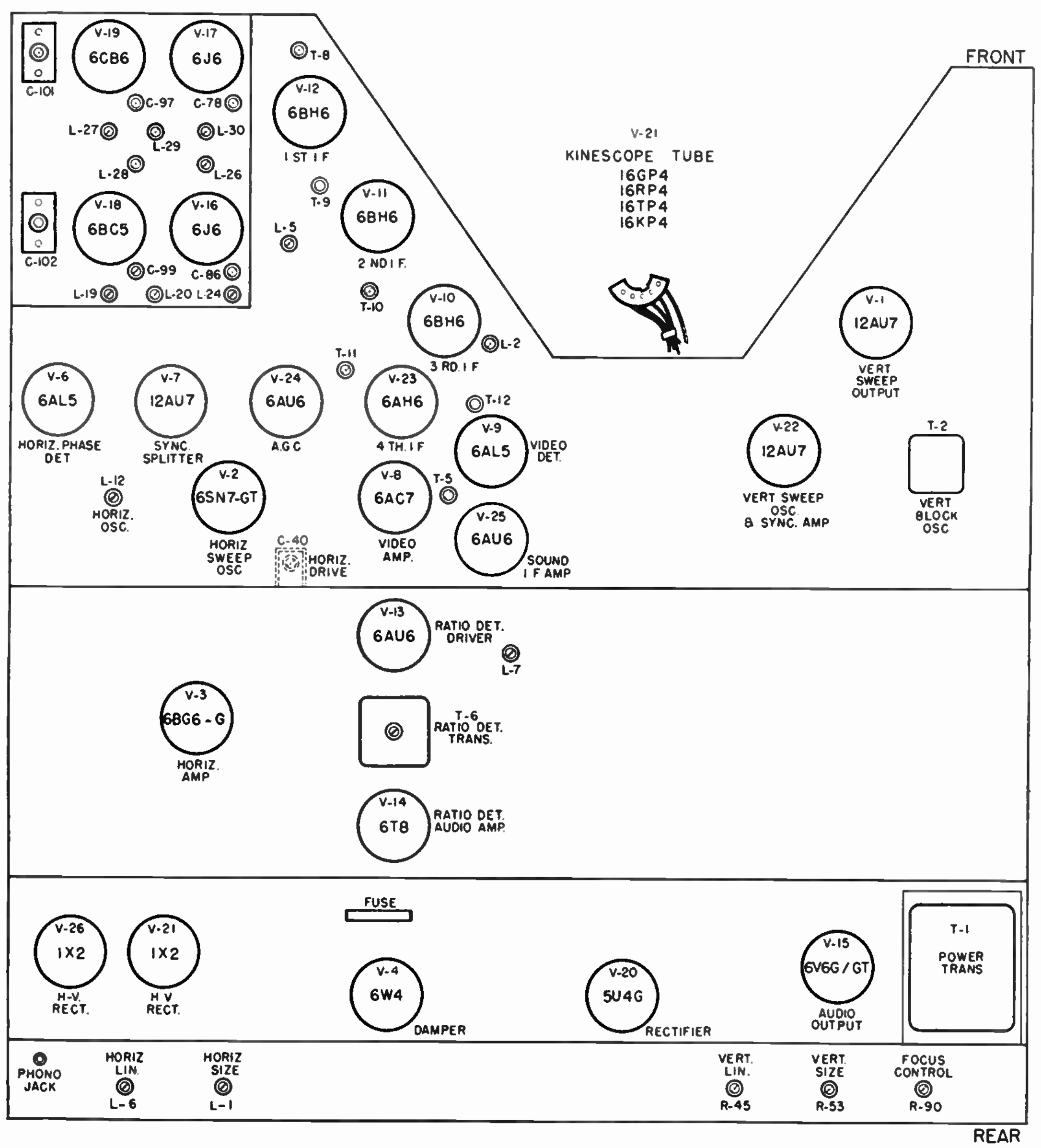
World Radio History

MODELS 116CA, 116CD2, 116CF, 116CM, Ch. 112109; 116RPM, Ch. 112111; 116TDA, 116TDM, 116TM, Ch. 112110

GENERAL ASSEMBLY PARTS LIST

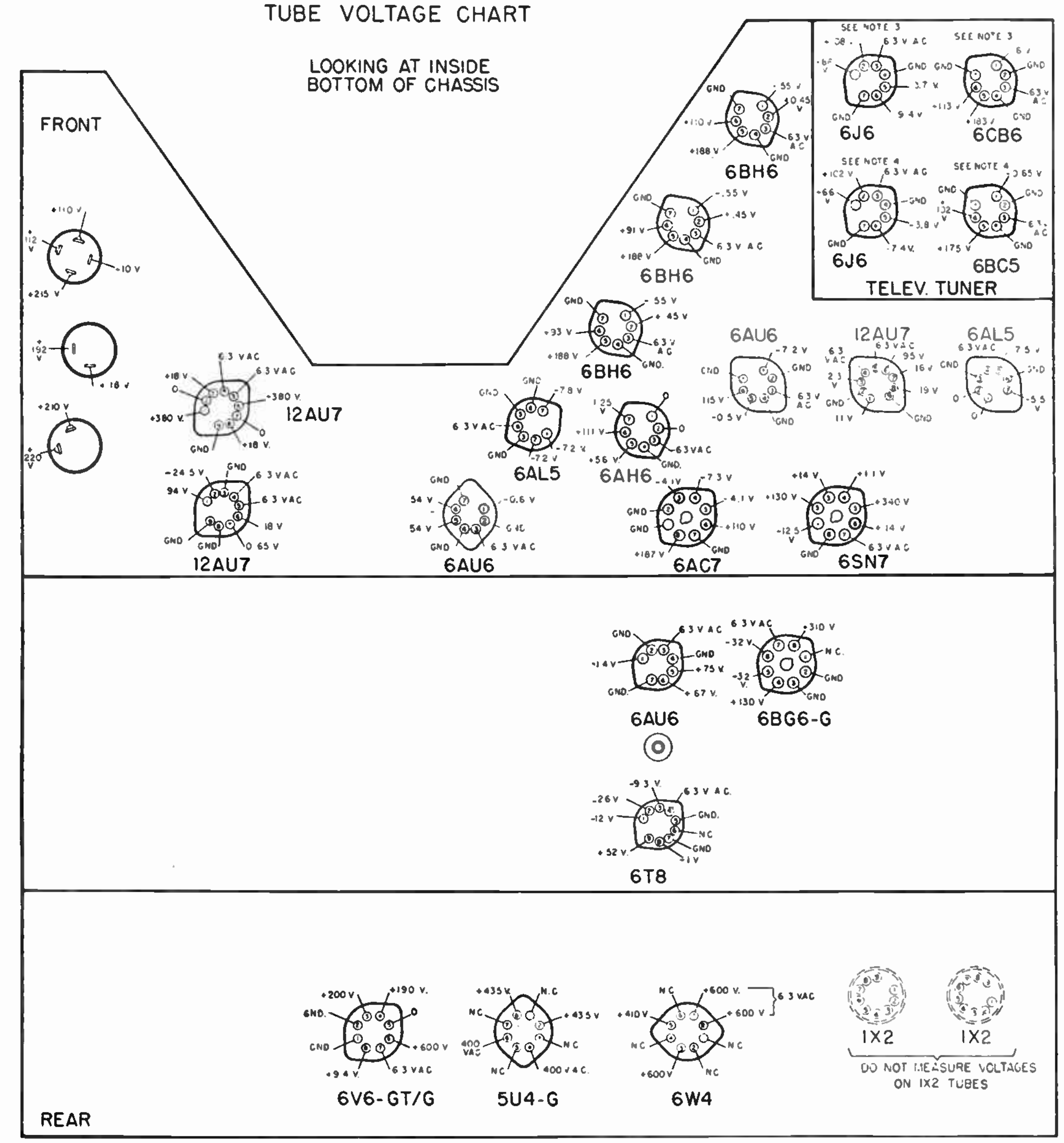
Description	116RPM	116CM	116CA	116CF	116CD2	TM	TDM	TDA
Chassis Assembly—TV	112111	112109	112109	112109	112109	112110	112110	112110
Chassis Assembly—Radio	112108							
Cabinet Assembly	108179	108172	108187	108181	108171	108174	108175	108176
Mask Assembly	174026	174025	174025	174025	174025	174026	174024	174026
Lens		138026	138026	138026	138026			
Knob—Tuning—Radio	134138							
Knob—Tuning—TV	134139	134139	134139	134139	134139	134139	134139	134139
Knob—Vernier	134140	134140	134140	134140	134140	134140	134140	134140
Knob—Vertical	134141	134141	134141	134141	134141	134141	134141	134141
Knob—Horizontal	134145	134145	134145	134145	134145	134145	134145	134145
Knob—Contrast	134146	134146	134146	134146	134146	134146	134146	134146
Knob—Range	134148	134147	134147	134147	134147	134147	134147	134147
Knob—Tone	134150							
Knob—Brightness	134155	134142	134142	134142	134142	134142	134142	134142
Knob—Volume	134156	134143	134143	134143	134143	134143	134143	134143
Back Panel Assembly	101163	101158	101158	101158	101147	101156	101156	101156
Speaker and Cable Assembly	155199	155156	155156	155156	155156	155168	155168	155168
Speaker Only	155197	155154	155154	155154	155154	155121	155121	155121
Phono—VM-950	148045							
Phono Drawer Bracket—Left	105263							
Phono Drawer Bracket—Right	105264							
Phono Slide	132151							
Lamp Cap	801401							
Loop Assembly—AM	139031							
Loop Assembly—FM	139045							

116-SERIES TUBE LOCATION AND TRIMMER CHART



TUBE VOLTAGE CHART

LOOKING AT INSIDE BOTTOM OF CHASSIS



NOTES:
1- MEASUREMENTS ARE MADE AT 117 V. LINE USING. 11 MEGOHM VACUUM TUBE VOLTMETER. ALL VOLTAGES ARE D.C. AND ARE POSITIVE WITH RESPECT TO CHASSIS GROUND EXCEPT WHERE NOTED.
2- ALL VOLTAGES, SHOWN, ARE MEASURED WITH THE RANGE SWITCH IN EITHER HIGH OR LOW BAND POSITION EXCEPT AS SHOWN IN NOTES 3 AND 4.
3- VOLTAGES SHOWN ARE FOR LOW BAND (CHANNELS 2 TO 6).
4- VOLTAGES SHOWN ARE FOR HIGH BAND (CHANNELS 7 TO 13).
5- CONTRAST AND BRIGHTNESS CONTROLS SET AT MINIMUM. ANTENNA DISCONNECTED.

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World Radio History

The following photographs were taken from a Du Mont 208-B Oscilloscope, and were taken on a standard receiver, adjusted to give a normal picture.

FIG. 3

Cathode of video detector (pin 1 of V-9-A, 6AL5) 50 volts peak-to-peak—60 cps.

FIG. 4

Grid of Kinescope (pin 2 of V-5) 40 volts peak-to-peak—60 cps.

FIG. 5

Plate of sync clipper (pin 1 of V-7-B, 12AU7) 12 volts peak-to-peak—60 cps.

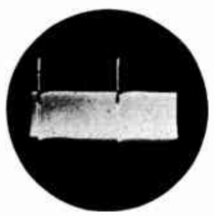

FIG. 6

Plate of sync amplifier (pin 6 of V-22-B, 12AU7) 20 volts peak-to-peak—60 cps.

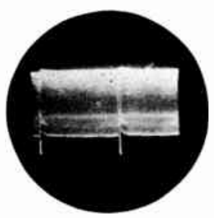

FIG. 7

Plate of sync splitter (pin 6 of V-7-A, 12AU7) 20 volts peak-to-peak—60 cps.

FIG. 8

Cathode of sync splitter (pin 8 of V-7-A, 12AU7) 20 volts peak-to-peak—60 cps.

FIG. 9

Plate and cathode of horizontal phase detector (pin 1 or 2 of V-6, 6AL5) 13 volts peak-to-peak—15,750 cps.

FIG. 10

Grid of horizontal sweep oscillator (pin 1 of V-2, 6SN7-GT) 43 volts peak-to-peak—15,750 cps.

FIG. 11

Plate of horizontal sweep oscillator (pin 2 of V-2, 6SN7-GT) 80 volts peak-to-peak—15,750 cps.

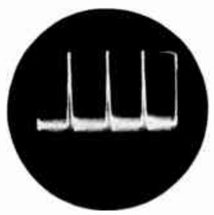

FIG. 12

Plate of AGC (pin 5 of V-24, 6AU6) 160 volts peak-to-peak—15,750 cps.

FIG. 13

Grid of vertical sweep oscillator (pin 2 of V-22-A, 12AU7) 150 volts peak-to-peak—60 cps.

FIG. 14

Plate of vertical sweep oscillator (pin 1 of V-22-A, 12AU7) 85 volts peak-to-peak—60 cps.

FIG. 15

Plate of vertical sweep oscillator output (pin 1 and 6 of V-1, 12AU7) 600 volts peak-to-peak—60 cps.

CIRCUIT SYMBOL	S-C PART NO.	CAPACITY	TYPE	VOLTAGE
C-1	110484	2.5 MMF	Ceramic	500
C-2	110586	5000 MMF	Ceramic	450
C-3	110586	5000 MMF	Ceramic	450
C-4	110586	5000 MMF	Ceramic	450
C-5	110586	5000 MMF	Ceramic	450
C-6	110586	5000 MMF	Ceramic	450
C-7	111084	10 MF	Elect.	25
C-8	110464	470 MMF	Ceramic	350
C-9	110586	5000 MMF	Ceramic	450
C-10	110586	5000 MMF	Ceramic	450
C-11	110540	.01 MF	Molded	400
C-12	111067	80 MFD	Elect.	300
C-13	110586	5000 MMF	Ceramic	450
C-14	110542	.022 MF	Molded	400
C-15	110459	68 MMF	Ceramic	500
C-16	110548	.22 MF	Molded	400
C-17	110464	470 MMF	Ceramic	350
C-18	110586	5000 MMF	Ceramic	450
C-19	110546	.1 MF	Molded	400
C-20	110572	.047 MF	Molded	1000
C-21	110540	.01 MF	Molded	400
C-22	110534	.001 MF	Molded	400
C-23	110534	.001 MF	Molded	400
C-24	110538	.0047 MF	Molded	400
C-25	110586	5000 MMF	Ceramic	450
C-26	110458	.47 MMF	Ceramic	500
C-27	111067	80 MFD	Elect.	300
C-28	110586	5000 MMF	Ceramic	450
C-29	110679	.25 MF	Paper	600
C-30	110538	.0047 MF	Molded	400
C-31	110546	.1 MF	Molded	400
C-32	110548	.22 MF	Molded	400
C-33	110558	.033 MF	Molded	600
C-34	110536	.0022 MF	Molded	400
C-35	110272	3900 MMF	Mica	500
C-36	110660	.047 MF	Molded	200
C-37	110289	270 MMF	Mica	1000
C-38	110216	390 MMF	Mica	500
C-39	110289	270 MMF	Mica	1000
C-40	110047	30-273 MMF	Mica Trimmer	
C-41	111065	40-10-10-25	Elect.	450-25
C-42	110544	.047 MF	Molded	400
C-43	110415	.1 MF	Paper	200
C-44	110558	.033 MF	Molded	600
C-45	110561	.1 MF	Molded	600
C 46	110561	.1 MF	Molded	600
C-47	110548	.22 MF	Molded	400
C-48	110680	500 MMF	Ceramic	20000
C-49	110286	56 MMF	Mica	1500
C-50	110548	.22 MF	Molded	400
C-51	110548	.22 MF	Molded	400

CIRCUIT SYMBOL	S-C PART NO.	CAPACITY	TYPE	VOLTAGE
C-52	110209	470 MMF	Mica	500
C-53	110586	5000 MMF	Ceramic	450
C-54	110672	.01 MF	Ceramic	450
C-55	110454	330 MMF	Ceramic	350
C-56	111030	5 MF	Elect.	50
C-57	110537	.0033 MF	Molded	400
C-58	110660	.047 MF	Molded	200
C-59	110538	.0047 MF	Molded	400
C-60	110458	47 MMF	Ceramic	500
C-61	110540	.01 MF	Molded	400
C-62 116C	110553	.0047 MF	Molded	600
C-62 116T	110555	.01 MF	Molded	600
C-62 116RP	110553	.0047 MF	Molded	600
C-63	110586	5000 MMF	Ceramic	450
C-64	110538	.0047 MF	Molded	400
C-65	110568	.01 MF	Molded	1000
C-66	110568	.01 MF	Molded	1000
C-67	110538	.0047 MF	Molded	400
C-68	111083	40-100	Elect.	450-50
C 69	111064	80-80	Elect.	300-300
C-70	110586	5000 MMF	Ceramic	450
C-71	110653	22 MMF	Ceramic	500
C-72	110598	5 MMF	Ceramic	350
C-73	110586	5000 MMF	Ceramic	450
C-74	110586	5000 MMF	Ceramic	450
C-75	110586	5000 MMF	Ceramic	450
C-76	110656	10 MMF	Ceramic	400
C-77	110654	750 MMF	Ceramic	350
C-78	110041	1-8 MMF	Trimmer	
C-79	110586	5000 MMF	Ceramic	450
C-80	110656	10 MMF	Ceramic	400
C-81	110438	1.5 MMF	Ceramic	500
C-82	110586	5000 MMF	Ceramic	450
C-83	110653	22 MMF	Ceramic	500
C-84	110654	750 MMF	Ceramic	350
C-85	110656	10 MMF	Ceramic	400
C-86	110041	1-8 MMF	Trimmer	
C-87	110652	2000 MMF	Ceramic	350
C-88	110652	2000 MMF	Ceramic	350
C-89	110483	75 MMF	Ceramic	400
C-90	110667	4.5 MMF	Ceramic	350
C-91	110667	4.5 MMF	Ceramic	350
C-92	110655	5.5 MMF	Ceramic	400
C-93	110652	2000 MMF	Ceramic	350
C-94	110652	2000 MMF	Ceramic	350
C-95	110654	750 MMF	Ceramic	350
C-96	110462	220 MMF	Ceramic	350
C-97	110035	.5-5 MMF	Trimmer	
C-98	110654	750 MMF	Ceramic	350
C-99	110035	.5-5 MMF	Trimmer	
C-100	110462	220 MMF	Ceramic	350
C-101	27081	20-75 MMF	Trimmer	
C-102	27081	20-75 MMF	Trimmer	
C-103	110586	5000 MMF	Ceramic	450

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CIRCUIT SYMBOL	S-C PART NO.	CAPACITY	TYPE	VOLTAGE
C-104	110586	5000 MMF	Ceramic	450
C-105	110451	100 MMF	Ceramic	500
C-106	110438	1.5 MMF	Ceramic	500
C-107	110499	20 MMF	Ceramic	500
C-108	110654	750 MMF	Ceramic	350
C-109	110483	75 MMF	Ceramic	400
C-110	111085	20 MF	Elect.	300
C-111	111085	20 MF	Elect.	300
C-112	110538	.0047 MF	Molded	400
C-113	110586	5000 MMF	Ceramic	450
C-114	110209	470 MMF	Mica	500

CIRCUIT SYMBOL	S-C PART NO.	CAPACITY	TYPE	VOLTAGE
C-115	111082	500 MF	Elect.	12
C-116	110546	.1 MF	Molded	400
C-117	110439	2.2 MMF	Ceramic	500
C-118	110586	5000 MMF	Ceramic	450
C-119	110464	470 MMF	Ceramic	350
C-120	110658	500 MMF	Molded	10 KV
C-121	110586	5000 MMF	Ceramic	450
C-122	110680	500 MMF	Ceramic	20 KV
C-123 116C	110287	7500 MMF	Mica	500
C-123 116T	110272	3900 MMF	Mica	500
C-123 116RP	110272	3900 MMF	Mica	500
C-124	110462	220 MMF	Ceramic	350

CIRCUIT SYMBOL	S-C PART NO.	RESISTANCE	WATT	TOL.
R-1	149098	330 ohms	½	20%
R-2	28170	10K ohms	½	10%
R-3	28145	82 ohms	½	10%
R-4	149095	100 ohms	½	20%
R-5	149098	330 ohms	½	20%
R-6	28168	6800 ohms	½	10%
R-7	28145	82 ohms	½	10%
R-8	28168	6800 ohms	½	10%
R-9	149096	150 ohms	½	20%
R-10	149095	100 ohms	½	20%
R-11	149027	22 ohms	2 W	10%
R-12	149095	100 ohms	½	20%
R-13	37200	8200 ohms	1 W	10%
R-14	149119	1 Megohm	½	20%
R-15	149111	47K ohms	½	20%
R-16	28166	4700 ohms	½	10%
R-17	149113	100K ohms	½	20%
R-18	28147	120 ohms	½	10%
R-19	145113	750 ohms-250K		POT
R-20	149113	100K ohms	½	20%
R-21	149095	100 ohms	½	20%
R-22	149113	100K ohms	½	20%
R-23	149101	1000 ohms	½	20%
R-24	149101	1000 ohms	½	20%
R-25	149044	1000 ohms	2 W	10%
R-26	149103	2200 ohms	½	20%
R-27	149117	470K ohms	½	20%
R-28	149110	33K ohms	½	20%
R-29	28185	330K ohms	½	10%
R-30	28159	1200 ohms	½	10%
R-31	28165	3900 ohms	½	10%
R-32	149119	1 Megohm	½	20%
R-33	28163	2700 ohms	½	10%
R-34	149109	22K ohms	½	20%
R-35	28006	100K ohms	½	10%
R-36	28006	100K ohms	½	10%
R-37	149123	4.7 Megohms	½	20%
R-38	149117	470K ohms	½	20%

CIRCUIT SYMBOL	S-C PART NO.	RESISTANCE	WATT	TOL.
R-39	149368	680K ohms IRC Type BTAV 2000V.	½	10%
R-40	149095	100 ohms	½	20%
R-41	149366	1200 ohms	20 W	WW
R-43	149119	1 Megohm	½	20%
R-45	145079	5000 ohms		POT
R-46	28157	820 ohms	½	10%
R-47	149121	2.2 Megohms	½	20%
R-48	149107	10K ohms	½	20%
R-49	149136	470 ohms	1 W	20%
R-50	28155	560 ohms	½	10%
R-51	28155	560 ohms	½	10%
R-52	28194	1.8 Megohms	½	10%
R-53	145100	6 Megohms		POT
R-54	149184	5600 ohms	1 W	10%
R-55	149102	1500 ohms	½	20%
R-56	149113	100K ohms	½	20%
R-57	145110	50K-2 Megohms		POT
R-58	28184	270K ohms	½	10%
R-59	37200	8200 ohms	1 W	20%
R-60	28169	8200 ohms	½	10%
R-61	149094	68 ohms	½	20%
R-62	149119	1 Megohm	½	20%
R-63	149198	33K ohms	1 W	10%
R-64	149055	12K ohms	2 W	10%
R-65	149029	33 ohms	2 W	10%
R-66	149368	680K ohms IRC Type BTAV 2000V.	½	10%
R-67	149113	100K ohms	½	20%
R-68	149113	100K ohms	½	20%
R-69	149101	1000 ohms	½	20%
R-70	149115	220K ohms	½	20%
R-71	145112	250K ohms		POT
R-72	28173	18K ohms	½	10%
R-73	28174	27K ohms	½	10%
R-74	149111	47K ohms	½	20%
R-75	149368	680K ohms IRC Type BTAV 2000V.	½	10%
R-76	149101	1000 ohms	½	20%
R-77	149108	15K ohms	½	20%
R-78	28173	18K ohms	½	10%
R-79	27407	22K ohms	½	10%

CIRCUIT SYMBOL	S-C PART NO.	RESISTANCE	WATT	TOL.
R-80	27407	22K ohms	½	10%
R-81	28169	8200 ohms	½	10%
R-82	149365	3000 ohms	10 W	WW
R-83	149117	470K ohms	½	20%
R-84	149113	100K ohms	½	20%
R-85	149069	68 ohms	2 W	20%
R-86	149082	10K ohms	2 W	20%
R-87	149125	10 Megohms	½	20%
R-88	149170	270 ohms	1 W	10%
R-89	149117	470K ohms	½	20%
R-90	145087	2250 ohms	4 W	POT
R-91	149356	2700 ohms	2 W	10%
R-92	149157	12 ohms	1 W	10%
R-93	149113	100K ohms	½	20%
R-94	149105	4700 ohms	½	20%
R-95	149107	10K ohms	½	20%
R-96	149096	150 ohms	½	20%
R-97	149101	1000 ohms	½	20%
R-98	149101	1000 ohms	½	20%
R-99	28155	560 ohms	½	10%
R-100	149103	2200 ohms	½	20%
R-101	149113	100K ohms	½	20%
R-102	149101	1000 ohms	½	20%
R-103	149105	4700 ohms	½	20%
R-104	149101	1000 ohms	½	20%

CIRCUIT SYMBOL	S-C PART NO.	RESISTANCE	WATT	TOL.
R-105	149107	10K ohms	½	20%
R-106	149096	150 ohms	½	20%
R-107	149096	150 ohms	½	20%
R-108	28163	2700 ohms	½	10%
R-109	149101	1000 ohms	½	20%
R-110	149096	150 ohms	½	20%
R-111	149110	33K ohms	½	20%
R-112	149110	33K ohms	½	20%
R-113	149282	4.7 ohms	1 W	10%
R-114	149117	470K ohms 116RP Only	½	20%
R-115	149355	2200 ohms	2 W	10%
R-116	149368	680K ohms IRC Type BTAV-2000V	½	10%
R-117	149111	47K ohms	½	20%
R-118	149095	100 ohms	½	20%
R-119	149095	100 ohms	½	20%
R-120	149107	10K ohms	½	20%
R-121	149103	2200 ohms	½	20%
R-123	149116	330K ohms	½	20%
R-124	149095	100 ohms	½	20%
R-125	28168	6800 ohms	½	10%
R-126	28145	82 ohms	½	10%
R-127	149095	100 ohms	½	20%
R-128	28176	39K ohms	½	10%
R-129	145120	500K ohms		POT
R-130	149111	47K ohms	½	20%
R-131	28195	2.2 Megohms	½	10%
R-132	149108	15K ohms	½	20%
R-133	149111	47K ohms	½	20%

CIRCUIT SYMBOL	S-C PART NO.	DESCRIPTION
L-1	114083	HORIZONTAL SIZE
L-2	114394	COIL ASM (21.9 MC TRAP)
L-3	20608	LINK (No. 24 POLYETHYLENE)
L-5	114384	COIL ASM (TRAP) (POP-UP)
L-6	114084	HORIZONTAL LINEARITY
L-7	114383	COIL ASM (SOUND INTERSTAGE)
L-10	114669	COIL ASM (PEAKING COIL)
L-12	114069	HORIZ. OSC
L-14	114690	COIL ASM (PEAKING COIL)
L-15	114691	COIL ASM (PEAKING COIL)
L-19	114066	COIL ASM (HI-BAND R F PRI)
L-20	114066	COIL ASM (HI-BAND R F SEC)
L-21	114057	COIL ASM (LO-BAND ANT)
L-22	114676	COIL ASM (HI-BAND ANT.)
L-24	114066	COIL ASM (HI-BAND OSC)
L-25	114060	COIL ASM (HI-BAND OSC PLATE CHOKE)
L-26	114061	COIL ASM (CONV PLATE)
L-27	114065	COIL ASM (LO-BAND R F PRI)
L-28	114642	COIL ASM (LO-BAND IMAGE TRAP)
L-29	114065	COIL ASM (LO-BAND R F SEC)

CIRCUIT SYMBOL	S-C PART NO.	DESCRIPTION
L-30	114065	COIL ASM (LO-BAND OSC)
L-31	114687	COIL ASM (FOCUS—16KP4)
L-31	114683	COIL ASM (FOCUS—16GP4, 16RP4, 16TP4)
L-32	114685	HORIZ & VERT DEF YOKE
L-33	161020	FILTER CHOKE 2.5 H—90 OHM
L-34	114696	POWER LINE CHOKE
T-1	161423	TRANS POWER
T-2	114658	TRANS VERT BL OSC
T-3	161029	TRANS HORIZ OUTPUT
T-4	161252	TRANS VERTICAL OUTPUT
T-5	114374	TRANS SOUND COUPLING
T-6	114375	TRANS RATIO DETECTOR
T-7	161249	TRANS AUDIO OUTPUT
T-8	114377	COIL ASM (VID IF INPUT)
T-9	114376	IF TRANS (1st IF PLATE)
T-10	114376	IF TRANS (2nd IF PLATE)
T-11	114382	IF TRANS (3rd IF PLATE)
T-12	114376	IF TRANS (4th IF PLATE)
T-13	114090	AFC SAWTOOTH
	114645	ION TRAP

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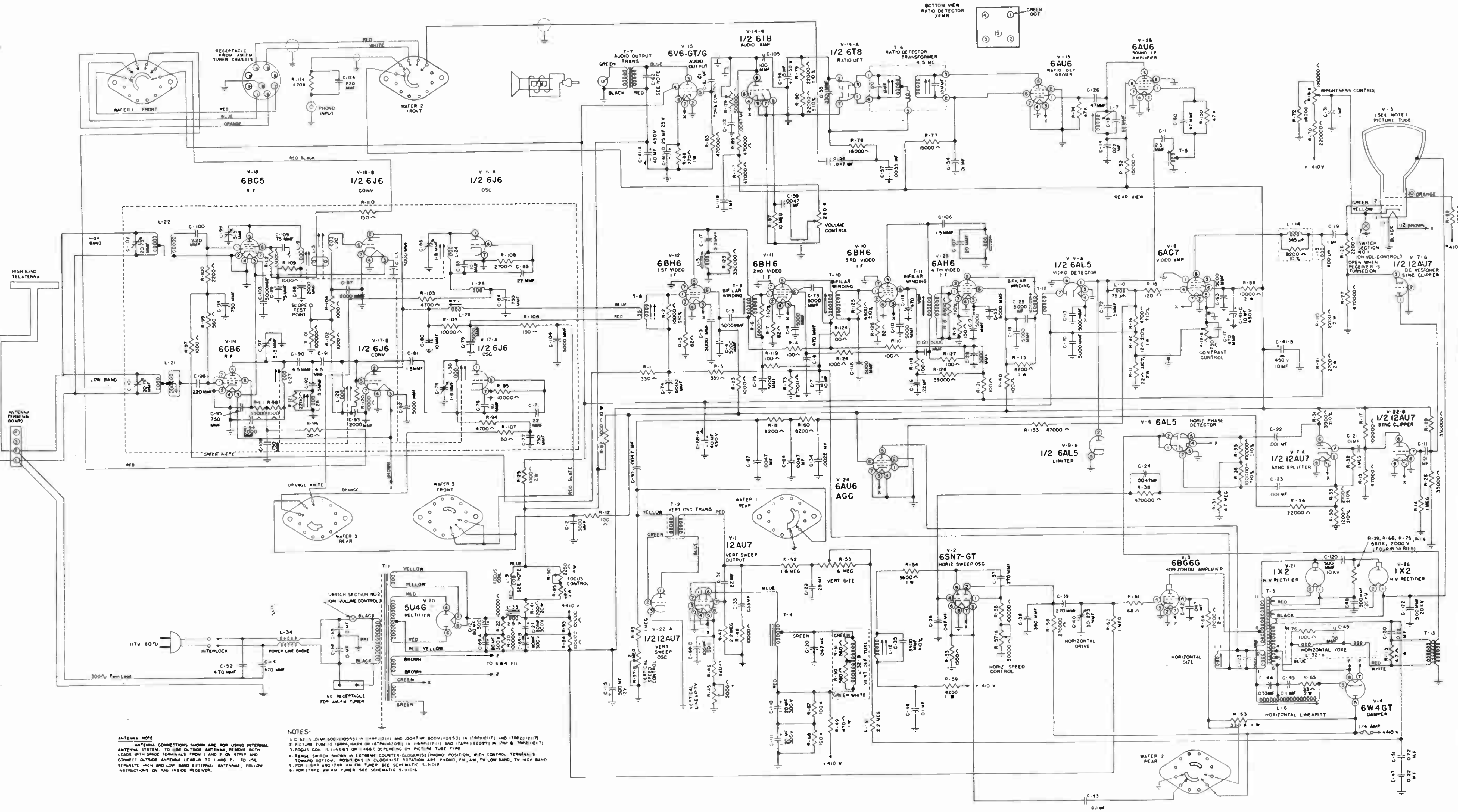
SCHEMATIC DIAGRAM 116-RP



ANTENNA NOTE

ANTENNA CONNECTIONS SHOWN ARE FOR USING INTERNAL ANTENNA SYSTEM. TO USE OUTSIDE ANTENNA, REMOVE BOTH LEADS WITH SPADE TERMINALS FROM 1 AND 2 ON STRIP AND CONNECT OUTSIDE ANTENNA LEAD-IN TO 1 AND 2. TO USE SEPARATE HIGH AND LOW BAND EXTERNAL ANTENNAE, FOLLOW INSTRUCTIONS ON TAG INSIDE RECEIVER.

NOTES:

1. C-62 IS .01 MF 600V (110555) IN 17RP (112111) AND .0047 MF 600V (110553) IN 17RP (112117) AND 17RP2 (112117)
2. PICTURE TUBE IS 16RP4, 16KP4 OR 16TP4 (116208) IN 116RP (112111) AND 17AP4 (162097) IN 17RP & 17RP2 (112117)
3. FOCUS COIL IS 114683 OR 114887, DEPENDING ON PICTURE TUBE TYPE
4. RANGE SWITCH SHOWN IN EXTREME COUNTER-CLOCKWISE (PHONO) POSITION, WITH CONTROL TERMINALS TOWARD BOTTOM. POSITIONS IN CLOCKWISE ROTATION ARE PHONO, FM, AM, TV LOW BAND, TV HIGH BAND
5. FOR 116RP AND 17RP AM FM TUNER SEE SCHEMATIC S-91012
6. FOR 17RP2 AM FM TUNER SEE SCHEMATIC S-91016

MODEL 116-RPM,
Ch. 112111

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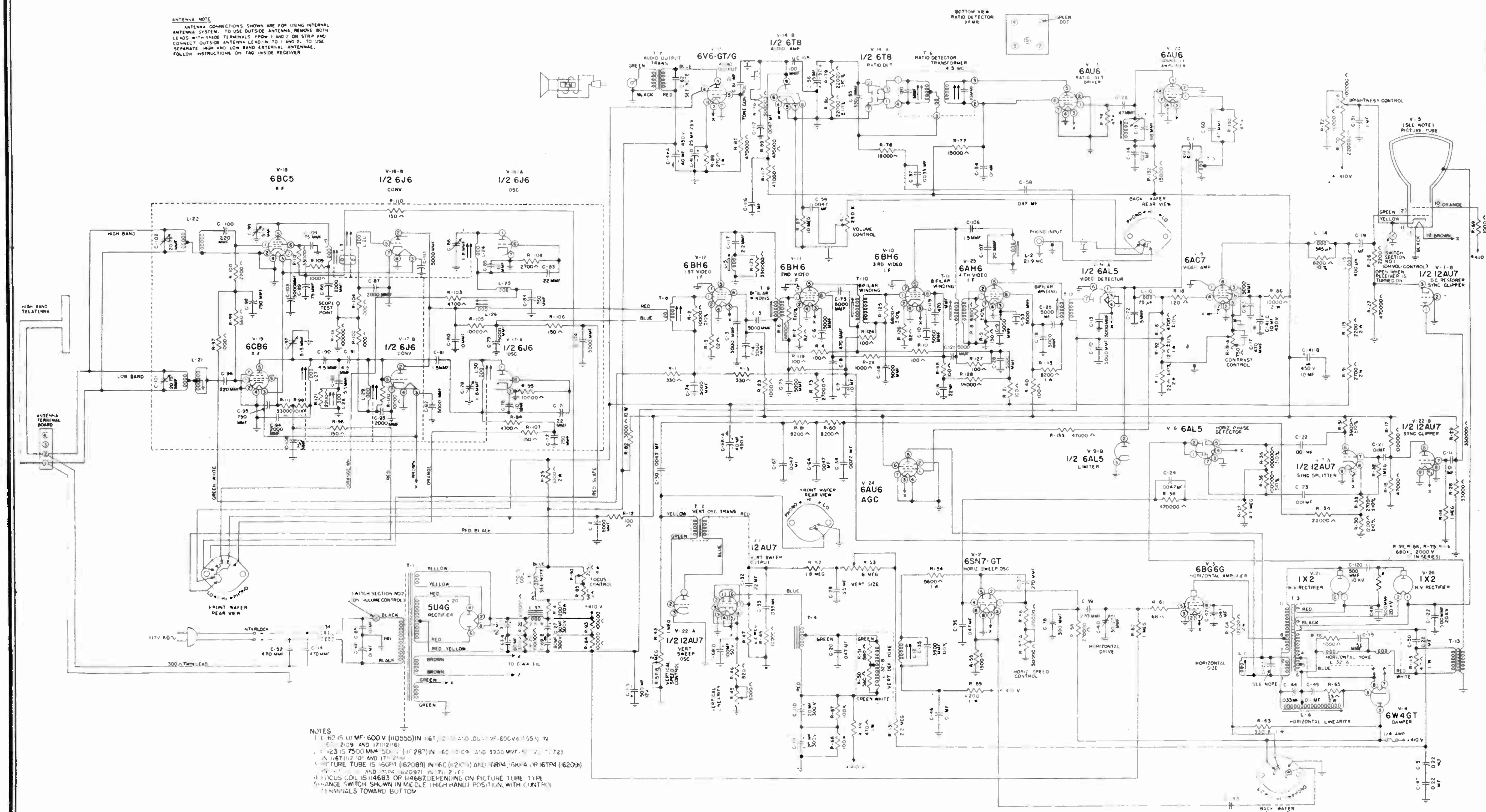
MODELS 116CA, 116CD2, 116CF, 116CM, Ch. 112109; 116TDA, 116TDM, 116TM, Ch. 112110

SCHEMATIC DIAGRAM 116-C — 116-T



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MODEL 5140B

(19" Picture - Blonde)
available also in Mahogany

MODEL 6140M

(16" Picture - Mahogany)
available also in Walnut

MODEL 5130W

(19" Picture - Walnut)
available also in Blonde and Mahogany

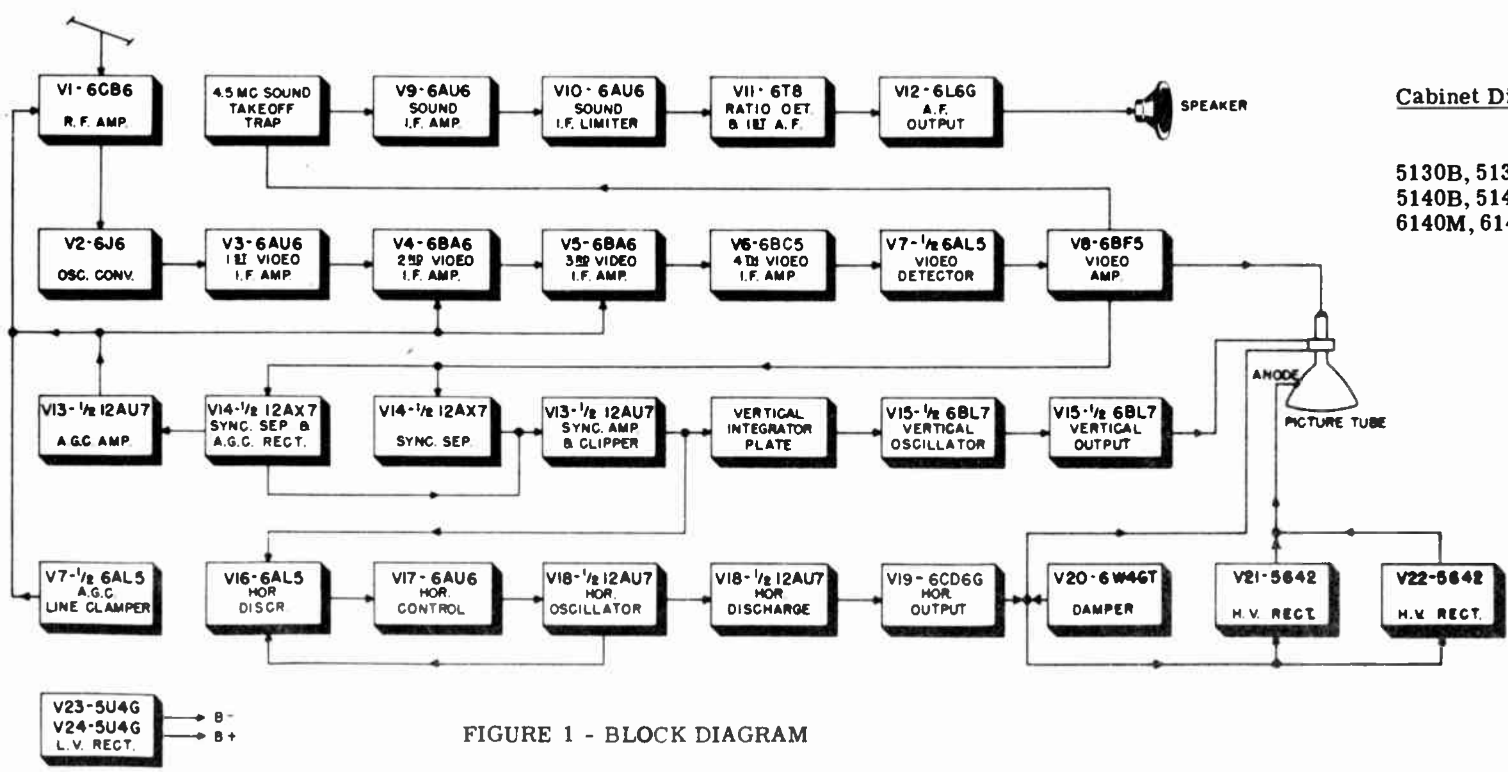

FIGURE 1 - BLOCK DIAGRAM

GENERAL DESCRIPTION

All models are direct viewing television receivers providing reception of all 12 commercial television channels. The television picture is reproduced on either a 16 inch rectangular or a 19 inch round, black-faced, electromagnetically deflected, tetrode type picture tube. The receivers are electrically similar except for picture tubes. Chassis 1-271 (16 inch picture tube) is used in models 6140M and 6140W. Chassis 1-290 (19 inch picture tube) is used in models 5130B, 5130M, 5130W, 5140B, and 5140M.

SPECIFICATIONS

Frequency Range

All 12 television channels,	54 Mc. to 88 Mc.
	174 Mc. to 216 Mc.
Picture IF Carrier	26.4 Mc.
Sound IF Carrier	4.5 Mc. and 21.9 Mc.

Power Supply

105-128 Volts 60cycle AC, 300 Watts

Loud Speaker

5130B, 5130M, 5130W, 5140B, 5140M, 6140M, 6140W	12" P.M.

Cabinet Dimensions (inches)	Width	Height	Depth
5130B, 5130M, 5130W	27.5	39.4	22.9
5140B, 5140M	27.5	39.4	24.7
6140M, 6140W	24.3	37.3	21.3

Antenna Input Impedance

These receivers have an antenna input impedance of 300 ohms, and are shipped to the customer with the built-in antenna connected. However, this must be disconnected in those locations where an external antenna is used.

SYLVANIA TUBE COMPLEMENT

(includes rectifiers and picture tube)

Symbol	Function	Type
V1	R. F. Amplifier	6CB6
V2	Oscillator-Converter	6J6
V3	1st Video IF Amplifier	6AU6
V4	2nd Video IF Amplifier	6BA6
V5	3rd Video IF Amplifier	6BA6
V6	4th Video IF Amplifier	6BC5
V7	Video Detector - AGC Line Clamper	6AL5
V8	Video Amplifier	6BF5
V9	Sound IF Amplifier	6AU6
V10	Sound IF Limiter	6AU6
V11	Ratio Detector - 1st Audio Amplifier	6T8
V12	Audio Output	6L6G
V13	AGC Amplifier - Sync Amplifier & Clipper	12AU7
V14	AGC Rectifier - Sync Separator	12AX7
V15	Vertical Oscillator and Output	6BL7GT
V16	Horizontal Discriminator	6AL5
V17	Horizontal Control	6AU6
V18	Horizontal Oscillator and Discharge	12AU7
V19	Horizontal Output	6CD6G
V20	Damper	6W4GT
V21	High Voltage Rectifier	5642
V22	High Voltage Rectifier	5642
V23	Low Voltage Rectifier	5U4G
V24	Low Voltage Rectifier	5U4G
V25	Picture Tube (Models 6140W, 6140M)	16KP4
V25	Picture Tube (Models 5130W, 5130M, 5130B, 5140M, 5140B)	19AP4A

CAUTION NOTICE

THE HIGH VOLTAGE LEAD TO THE PICTURE TUBE HAS A POTENTIAL OF 13,500 VOLTS. PRECAUTIONS SHOULD BE OBSERVED WHEN THE CHASSIS IS REMOVED FROM THE CABINET FOR SERVICE PURPOSES. DO NOT OPERATE THE RECEIVER WITH THE H V COVER REMOVED.

ALWAYS USE SAFETY GOGGLES AND GLOVES IF IT IS NECESSARY TO REMOVE THE PICTURE TUBE.

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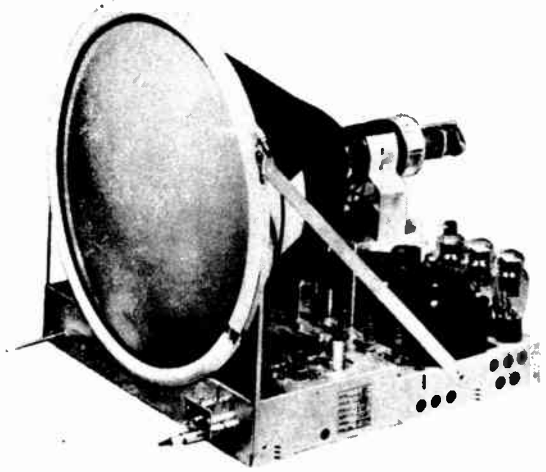
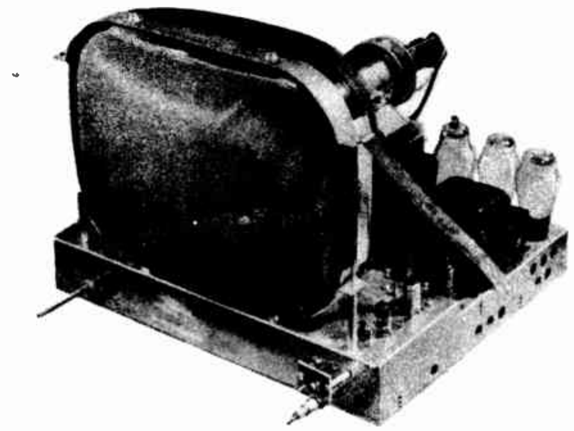


CHASSIS 1-290
19 inch picture tube



CHASSIS 1-271
16 inch picture tube

CIRCUIT DESCRIPTION

The Sylvania television receiver chassis 1-271, 1-290 operate with twenty tubes plus two high voltage rectifiers, two low voltage rectifiers, and one picture tube. The operating controls on the front panel have been reduced to a minimum: Brightness, Volume, and Tuning. The remaining controls, which are seldom adjusted, are located at the rear of the chassis. Special features of this receiver are as follows:

Rotary Channel Selector

A compact, low drift, 12 channel rotary tuner is provided in these chassis for simplicity of operation. Continuous tuning eliminates the need of a fine tuning control.

Built-In Antenna

Eliminating the cost and inconvenience of an external antenna a Sylvania tuned dipole type antenna is built-in to provide satisfactory reception in most locations. The antenna is peaked for resonance to the individual channel by rotating the trimmer knob on the top of the receiver.

Automatic Gain Control

Simplified customer operation is provided by a very flat AGC system which has a high degree of noise immunity. Very little, if any, readjustment of controls is required in going from one station to another.

Direct-Coupled Video System

A direct coupled video system eliminates all video coupling capacitors and D.C. Restorer. This reduces the visible effects of noise.

Horizontal Automatic Frequency Control

A sine wave Horizontal AFC is employed, providing excellent picture stability, even in the presence of noise and weak signals.

For convenience in tracing circuits a block diagram is shown in Figure 1. The antenna is connected to the input of the RF tuner. This tuner functions to select the desired television channel by continuous tuning. The output of the tuner is at intermediate frequency and of sufficient band width to pass both picture and sound carriers of the desired signal.

The output of the tuner is then applied to the video IF Amplifier consisting of 3 stagger-tuned stages and one bandpass stage. The adjacent channel carriers and co-sound carrier are attenuated by this IF Amplifier.

The video signal out of the video detector is amplified by a single stage and impressed on the picture tube.

Automatic gain control is obtained from the AGC Rectifier, amplified by the AGC Amplifier and applied to the RF and IF Amplifiers. The AGC Line Clamper prevents the Tuner AGC Line from going positive under weak signal conditions.

The sync pulses are separated from the video signal, amplified, and clipped and then fed to the Horizontal Discriminator and Vertical Integrator plate. The Vertical Sync information from the vertical integrator plate is applied to Vertical Oscillator to keep this oscillator in step with the vertical sync pulses from the station. The Vertical Oscillator produces a peaked saw-tooth wave which is applied to the Vertical Output stage energizing the Vertical Deflection coils.

Horizontal Sync information from the Sync clipper is supplied to the Horizontal Discriminator. A voltage from the Horizontal Oscillator is also supplied to the Horizontal Discriminator. The output of the Horizontal Discriminator is then applied to the Horizontal Control tube which functions to hold the Horizontal Oscillator in synchronism with the incoming horizontal sync pulses.

The Horizontal Oscillator actuates the Horizontal Discharge tube through the Horizontal Ringing Coil producing a peaked saw-tooth wave. Approximately one-half of the saw-tooth component of this wave causes current to flow in the plate circuit of the Horizontal Output tube. This current energizes the Horizontal Deflection Coils through the Horizontal Scanning Transformer to provide the right half of the horizontal scan. During the right half of the scan, a small amount of current is also flowing through the Damper tube. At the end of the saw-tooth, the inverse pulse component acts on the grid of the Horizontal Output Tube to cut off plate current flow. When this occurs, the energy in the Horizontal Deflection circuit transfers rapidly from the inductive branch of the circuit to the capacitive branch resulting in a voltage peak of approximately 2000 Volts across the Horizontal Deflection Coils. This voltage is stepped up to approximately 6750 Volts by the turns ratio of the Horizontal Scanning Transformer and fed to the voltage doubling rectifier circuit to provide approximately 13,500 Volts for the picture tube H.V. anode.

The damper tube does not conduct during the high voltage pulse period because of the polarity of the pulse. During this pulse period, when the energy transfers from the inductive branch of the horizontal deflection circuit to the capacitive branch and back again to the inductive branch, the electron beam in the picture tube is moved rapidly from the right to the left edge of the raster to accomplish retrace.

At the completion of retrace, energy again flows out of the inductive branch of the circuit. The horizontal output tube is still cut off during this time and a strong current flows through the damper tube. This current decreases to zero linearly to provide the left half of the scan. As the current approaches zero, the horizontal output tube again begins to conduct and the entire cycle is repeated.

ANTENNA INSTALLATION

The 1-271, 1-290 chassis models are shipped with a built-in antenna connected to the two terminal antenna board. For most receiver installations the built-in antenna will provide satisfactory reception.

A variable capacitor controlled from above the picture tube screen adjusts the antenna circuit to resonance. At each individual channel this capacitor should be adjusted for best picture quality.

If an external antenna is desirable for satisfactory reception, the Sylvania Hideaway Antenna, Part 580-0005, gives optimum performance where an indoor installation is indicated, and the Sylvania Conical Fan Television Antenna, Part 580-0001, is available in one, two and

TELEVISION CHANNELS & FREQUENCIES

CHANNEL NO.	FREQ. MC.	PICTURE CARRIER MC.	SOUND CARRIER MC.	HETERODYNE OSC. FREQ. MC.
2	54 - 60	55.25	59.75	81.65
3	60 - 66	61.25	65.75	87.65
4	66 - 72	67.25	71.75	93.65
5	76 - 82	77.25	81.75	103.65
6	82 - 88	83.25	87.75	109.65
7	174 - 180	175.25	179.75	201.65
8	180 - 186	181.25	185.75	207.65
9	186 - 192	187.25	191.75	213.65
10	192 - 198	193.25	197.75	219.65
11	198 - 204	199.25	203.75	225.65
12	204 - 210	205.25	209.75	231.65
13	210 - 216	211.25	215.75	237.65

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four bay arrays, providing superior performance in an outside installation. When using the Sylvania Hideaway Antenna or the Sylvania Conical Fan Antenna, remove the leads to the built-in antenna from the antenna terminal and then connect matching 300 Ohm twin lead from the antenna installation in its place. A 300 Ohm lead is especially recommended where the lead-in is in excess of 100 feet.

A 75 Ohm shielded coaxial input may be used with the 1-271, 1-290 chassis if impedance matching coils, Sylvania Part No. 111-0007, are wired between the lead-in and the antenna terminals. A coaxial lead-in may be the only solution in those areas where high noise signals prevail.

OPERATING INSTRUCTIONS

A. To adjust and tune this receiver, proceed as follows:

1. Turn Volume Control (3) clockwise until it clicks.
2. Allow several minutes warm-up period.
3. Turn band switch (5) either way to the appropriate band (i. e. channels 2-6 or channels 7-13).
4. Rotate the Channel Selector (4) until the channel number of the desired station appears in the dial opening.
5. Turn Brightness Control (2) to mid position.
6. Adjust the Channel Selector (4) for best picture quality.
7. Adjust Volume Control (3) for desired volume.
8. Adjust Brightness Control (2) for best picture.

B. To change from one station to another:

1. Turn Band Switch (5) to the appropriate band (i. e. channels 2-6 or channels 7-13).
2. Rotate the Channel Selector (4) until the channel number of the desired station appears in the dial opening.
3. If necessary, adjust the Brightness Control (2) for best picture. Only slight adjustment of this control should be necessary.

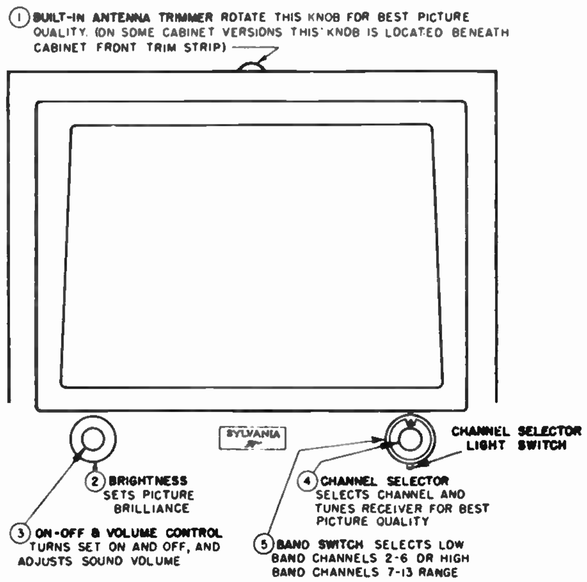

FIGURE 2 - FRONT OF CABINET CONTROLS

C. To turn on the dial light:

1. Push the dial light switch to the left.

INSTALLATION AND SERVICE INSTRUCTIONS

Picture Tube Handling

All Sylvania Television receivers incorporating chassis 1-271, 1-290 are shipped complete with picture tube installed on the chassis and connected for operation. However, if it becomes necessary to re-install a picture tube due to replacement or servicing, the following precautions should be observed.

1. Do not open the picture tube carton until ready to install the picture tube.
2. Do not handle the picture tube unless protective goggles and gloves are worn. People not so equipped with safety devices should be kept at a distance while the picture tube is being handled.
3. Keep the picture tube as far from the body as possible while handling.

Picture Tube Replacement

For Model 271 (16" rectangular tube)

To remove the picture tube from the chassis, remove the picture tube socket, high voltage anode connector, and ion trap magnet. Remove the tube holddown strap by removing the two screws on either side. When the rim of the tube is free of the strap, carefully pull the picture tube out through the focus magnet and deflection coils.

For Model 290 (19" round tube)

To remove the picture tube from the chassis, remove the picture tube socket, high voltage anode connector, and ion trap magnet. Loosen the #10-32 bolt on the holddown strap at the upper right of the tube. Remove the holddown strap. Pull the tube braces away from the sides of the tube. Lift the tube clear of the front edge of the chassis and move it forward gently until the tube base is clear of the focus magnet and yoke. The plastic rim around the face of the tube may then be removed.

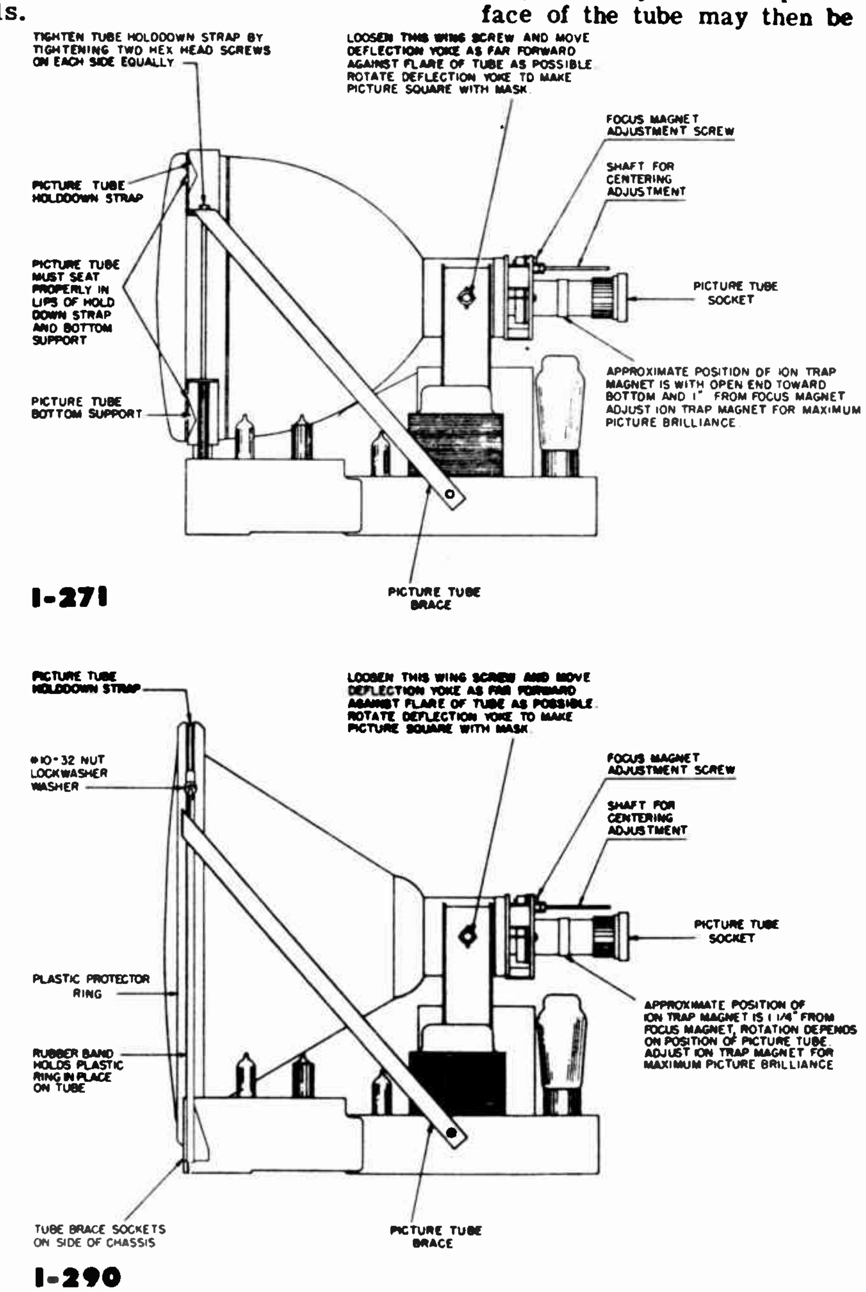

FIGURE 3 - PICTURE TUBE INSTALLATION

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To replace the 16" rectangular tube, reverse the removal procedure, being careful not to force the tube if the neck binds. Be sure the tube is properly placed before securing the holddown strap.

To replace the 19" round tube, replace the plastic rim and reverse the removal procedure, being careful not to force the tube if the neck binds. There is no specified angle of rotation for the picture tube although the opening in the plastic rim must be in the lower right and the anode clip fastened at the lower left. Be certain the tube is properly placed before tightening the holddown strap. There is no specified angle of rotation for the approximate initial setting of the ion trap. (See "Adjustment of Ion Trap Magnet, Focus Magnet, and Centering Shutter").

On all chassis dress the yellow picture tube cable lead away from the H.V. scan box and the other leads in the cable.

Chassis Removal

To remove the chassis from the cabinet, proceed as follows:

1. Remove all panel control knobs from the front of cabinet.
2. Remove the holddown screws from the underside of the chassis shelf. Access to these screws is from the rear of the cabinet.
3. Disconnect the built-in antenna, remove the interlock cover screws and remove interlock cover.
4. Remove speaker plug from socket on chassis.
5. Slide the chassis all the way out the back of the cabinet.

To replace the chassis, reverse the above procedure.

Preset Controls Adjustments

All preset controls are located at the rear of the receiver and are readily available without removing the interlock cover.

<u>AGC - See AGC Control Adjustment</u>

Horizontal Hold - See "Adjustment of Horizontal AFC Operation".

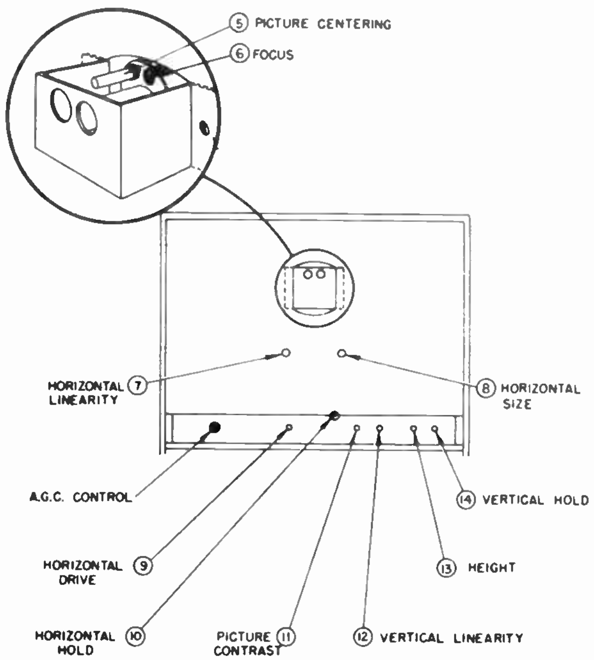

FIGURE 4 - REAR PANEL CONTROLS

Contrast - Adjust contrast control to obtain best contrast with a good picture or test pattern.

Vertical Linearity and Height - Adjust the height control until the picture fills the screen vertically. Adjust the Vertical Linearity control until the pattern is symmetrical from top to bottom. Adjustment of either control will require a readjustment of the other.

Vertical Hold - Rotate the Vertical Hold control until the pattern is slowly moving downward. Back off on the control to a point just beyond where the vertical motion stops.

Horizontal Drive - Turn the horizontal drive control clockwise as far as possible without crowding of center of the picture.

Horizontal Size - Adjust the horizontal size control until picture fills the mask horizontally.

Horizontal Linearity - Adjust the horizontal linearity control until the picture is symmetrical left to right. Re-check Horizontal Drive after adjusting Horizontal Size and Horizontal Linearity.

Adjustment of Ion Trap Magnet, Focus Magnet, and Centering Shutter

These adjustments are interdependent and, therefore, it is necessary to check all three at the same time.

Before making any adjustments, the function of each magnet should be noted.

The ion trap magnet is used to obtain maximum brilliance of the raster or picture and should be adjusted to obtain maximum brilliance as described below.

The focus magnet is used to obtain correct focus of the picture.

The centering shutter is an integral part of the focus magnet assembly. Its function is to position the picture, both horizontally and vertically.

Before making any adjustments, check that the deflection yoke is positioned so that it is pressing against the flare of the picture tube. To ensure this, loosen the thumb-screws located at each side of the yoke and push the yoke as far forward as it will go. If the picture is not square with the screen mask, rotate the yoke.

Next, check that the focus magnet is held firmly by both brass screws against the yoke; there should not be any gap between the yoke and the focus magnet.

When adjusting the focus of the receiver it is to be noted that optimum focus of the picture does not necessarily result when either the vertical or the horizontal is adjusted for maximum definition. Optimum focus is frequently a compromise between these two settings. It is highly desirable, therefore, that a transmitted picture, containing both vertical and horizontal lines, be available for correct focusing of the receiver.

Before proceeding with the adjustment of the focus of the receiver, first ensure that the ion trap magnet is correctly adjusted.

Set the contrast control at minimum and the brightness control at maximum. The ion trap magnet should first be positioned so that there is approximately 1 inch for 1-271 and 1 1/4 inch for 1-290 between the ion trap magnet and the focus magnet. The ion trap magnet should be slowly rotated until a picture (or raster, if the receiver is not yet tuned to a station) is visible on the screen. The brightness should now be reduced by means of the brightness control and the ion trap magnet carefully twisted and moved a small amount backwards and forwards on the neck of the tube, to obtain maximum brightness.

Finally, adjust the brightness control to obtain maximum brightness on the screen and then carefully adjust the ion trap magnet. It may be possible to increase the brightness still more by turning the contrast control towards maximum and again adjusting the ion trap magnet. The correct position of the ion trap magnet is that which ensures the greatest possible brightness of the raster of picture before it enlarges and "blooms" as the setting of the brightness control is increased. <u>Do not leave the brightness control in this position as the condition causes overload of the picture tube.</u>

A preliminary adjustment of the screw on the focus magnet should now be made to obtain a raster or picture which is focused - this preliminary adjustment will not, of course, be necessary if the raster or picture is already in focus. (Note: Use a non-magnetic screw driver to adjust the focus screw.)

If the picture is not centered on the screen, either horizontally or vertically, properly position it by adjustment of the centering shutter. This centering adjustment will move the picture up, down, left or right as required to center the picture. With the brightness control at a low level, check the horizontal size and height of the picture to insure that when the picture is properly positioned it just fills the mask with no corner cutting.

Carefully make final adjustments of the focus screw for optimum focus in both horizontal and vertical directions. Best focus of the picture does not necessarily result when either the vertical or horizontal focus is optimum and the final setting should, therefore, be a compromise between the two. A test pattern with both vertical and horizontal lines is, therefore, highly desirable when making focus adjustment.

Finally, check that the adjustment of the ion trap magnet is such that the brightest possible picture is obtained, as previously mentioned.

Since all these adjustments are interdependent, recheck the adjustment of all three until the best possible picture is obtained.

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ADJUSTMENT OF HORIZONTAL AFC CIRCUIT

Check of Operation

The operation of the AFC circuit should be checked as follows:

A. Tune the receiver to a channel on which no signal is received and return to the original channel. The picture should immediately fall into synchronization.

B. Switch off the power to the receiver for about five minutes and then switch back on. Picture should immediately fall into sync.

C. Check for correct phasing of Horizontal AFC circuit oy noting that there is approximately 1/8" of blanking visible on the right hand edge of the picture. It will be necessary to turn the contrast control almost to minimum, readjust the brightness control and reduce picture size slightly to see the blanking.

NOTE: Before making check C above, be sure the horizontal drive control is correctly adjusted. Refer to "Preset Controls Adjustment," page 8. If the receiver passes the above checks, no adjustments to the horizontal AFC circuits need be made.

If the receiver cannot pass checks "A," "B," or "C" the adjustment of the Horizontal Hold Control as noted under "Horizontal Hold Adjustment" should be made.

Horizontal Hold Adjustment

(A) Tune in a station and adjust the tuning control for best picture quality. Adjust the contrast and brightness controls for normal picture.

(B) Remove V16 - 6AL5 - Horizontal Discriminator tube.

(C) Turn the Horizontal Hold Control until the picture moves back and forth across the screen with blanking bars vertical.

(D) Replace the Horizontal Discriminator tube and repeat A, B, and C under "Check of Operation".

(E) If receiver still will not pass these checks, it will be necessary to proceed with "Phase Adjustment".

Phase Adjustment

(A) Turn the core in the horizontal "ringing" coil all the way out (counterclockwise). Short out the 4700 ohm horizontal charge circuit peaking resistor R226.

With the horizontal size coil set for approximately the correct picture width, and with the horizontal linearity coil adjusted for best linearity, rotate the horizontal drive control fully counterclockwise. Slowly turn the drive control clockwise until crowding is visible in the center of the picture. Now carefully turn the control back (counterclockwise) only sufficient to remove the crowding in the picture or pattern. On some chassis, it may not be possible to obtain crowding of the picture. In such cases the control should be set to the fully clockwise position.

NOTE: Do not operate the receiver with the horizontal drive control mis-adjusted.

(B) Remove the 6AL5 horizontal discriminator tube from its socket.

(C) Carefully turn the frequency adjustment screw (top of discriminator transformer T62) until the picture moves back and forth across the screen of the picture tube with the blanking bar vertical.

(D) Insert the 6AL5 horizontal discriminator tube back into its socket.

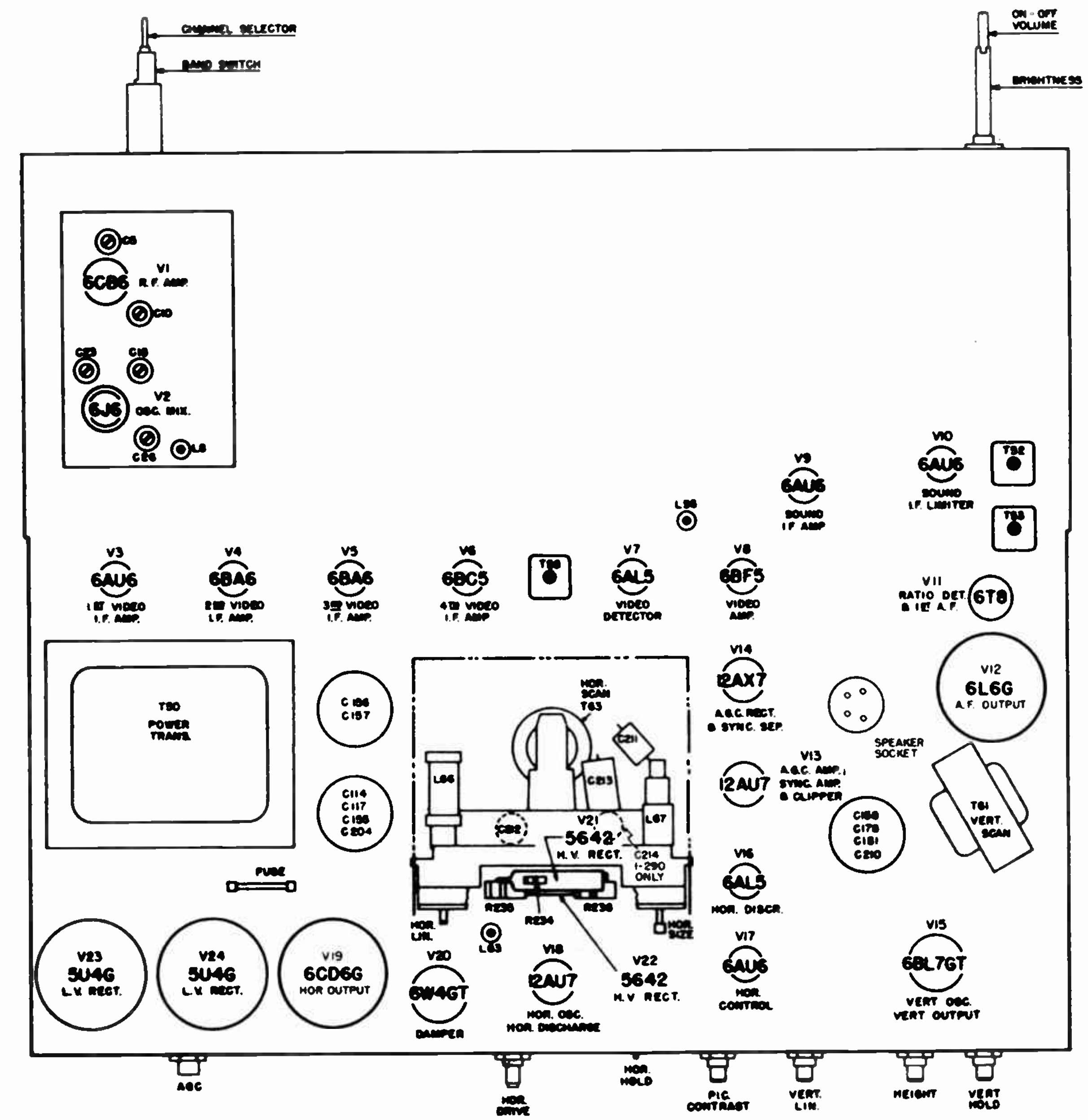

FIGURE 5 - CHASSIS TOP LAYOUT

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(E) Adjust the phase adjustment screw (underside of discriminator transformer T62) until approximately 1/8" of "blanking" is visible on the right-hand edge of the picture. In order to see the "blanking", it will be necessary to turn the contrast control almost to minimum, re-adjust the brightness control and reduce picture size.

(F) Check the "free-running" of the horizontal oscillator as described under paragraphs "B," "C," and "D," and, if necessary, readjust the frequency adjustment screw on top of horizontal discriminator transformer.

(G) Make a final check of the phasing as described in paragraph "E" above. It is important that both the "free-running" and the phasing are correct.

(H) Remove the short from across the 4700 ohm resistor R226 and readjust the horizontal drive control as described in (A). Turn the core in the horizontal "ringing" coil clockwise until approximately 1/8" of "blanking" is again visible on the right-hand edge of the picture.

(I) Before the horizontal synchronization circuit is adjusted to the final position, it will be necessary to check the operation as follows:

Slowly turn the oscillator frequency adjustment screw (top of transformer T62) in either direction until the picture suddenly falls out of synchronization as indicated by the presence of a number of diagonal bars. The total number of bars visible must not be less than six. These bars may consist of either several full bars and two half bars for the total number or they may be all full bars for the same total number. Slowly turn the adjustment screw so as to decrease the number of bars and note the total number of bars visible just before the picture again falls into synchronization. The last number of bars visible must not be less than three, or more than four. The adjustment screw must be turned very slowly and carefully after the number of bars has been reduced to four or five in order to get an accurate indication of the minimum number of bars it is possible to obtain.

Turn the adjustment screw in the opposite direction until the picture suddenly falls out of synchronization in the opposite direction and repeat the foregoing procedure. Again, the total number of bars visible when the picture falls out of synchronization must not be less than six and not less than three or more than four bars must be visible just before the picture falls into synchronization.

(J) After checking the operation as in I, it is necessary to repeat the procedure described in paragraphs "B," "C," and "D."

(K) Remove the signal by tuning to a "free" channel, then retuning to the original channel. The picture should immediately fall into synchronization.

(L) Switch "off" the power to the receiver for about five minutes and then switch receiver "on" and check that the picture pulls into synchronization.

AGC CONTROL ADJUSTMENT

This control has been correctly adjusted at the factory and should require no further adjustment. If adjustment becomes necessary as evidenced by poor horizontal or vertical sync; poor video signal (poor contrast). Adjust as follows:

1. Connect a good antenna installation to the receiver.

2. Tune the receiver to a channel on which no picture is received.

3. Set the contrast control to mid-position.

4. Turn the AGC control fully clockwise. The AGC control is located on the rear panel of the chassis.

5. Connect a VTVM from the AGC Amplifier plate to ground (V13, 12AU7, pin 6) and set the AGC control to obtain a negative 0.1 volt reading.

Note: On some receivers the closest approacn to this reading will be the fully clockwise position.

6. With the AGC Control set as above, turn the contrast control to almost maximum (about 7/8) and tune in the strongest station available in the area.

7. Again read the AGC Amplifier plate voltage; if reading is less than a negative 2.0 volts leave the control as set.

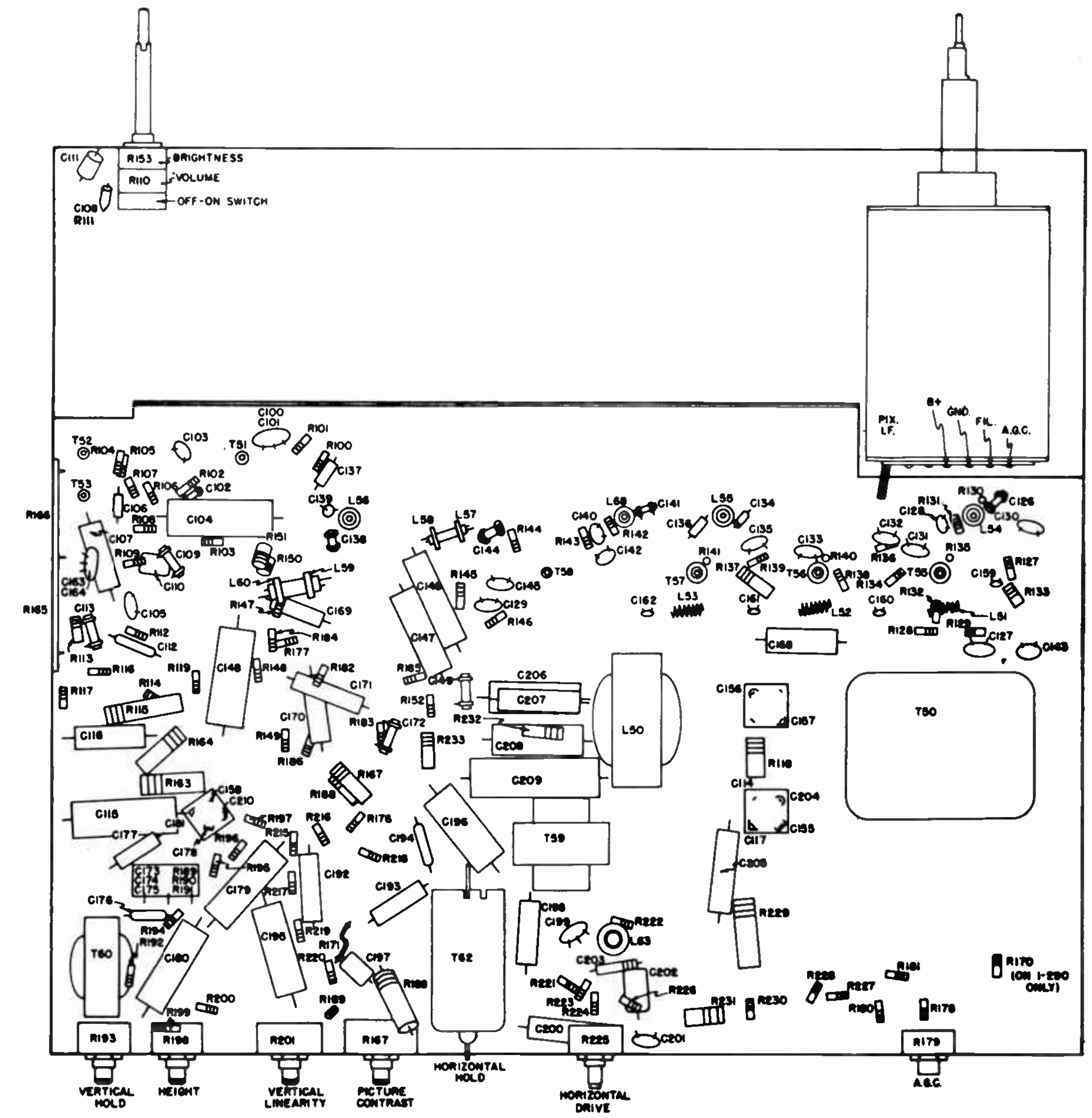

FIGURE 6 - CHASSIS BOTTOM LAYOUT

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8. If the AGC Amplifier plate voltage is more than 2 volts negative, slowly turn the AGC control counterclockwise observing the picture.

9. The picture will get darker and then finally start to fall out of sync as evidenced by a sudden shift or jittering of the picture in either the horizontal or vertical direction. Do not turn beyond this point.

10. Back off (clockwise) slowly on the control until the picture holds in sync without flutter and turn slightly beyond. (Experience will dictate how far beyond to turn).

11. Rock the tuning control slightly either side of the best tuning point to insure picture stays in sync; if not, turn slightly further clockwise and check again.

12. As a final check, turn the volume control up to normal level. Intercarrier buzz should be negligible.

13. Remove objectionable intercarrier buzz by turning the AGC control slightly further clockwise. (Note: The intercarrier buzz is merely a reference for correct adjustment of the AGC control and only a slight touch-up should be necessary. If much adjustment is required to remove intercarrier buzz, the sound section is maladjusted and requires realignment).

14. Rock the tuning control slightly either side of the best tuning point and turn the AGC control slightly more clockwise as necessary to remove objectionable intercarrier buzz.

The intent of the above AGC control adjustment is to provide a maximum of AGC action consistent with proper sync and minimum intercarrier buzz on strong signals.

TEST EQUIPMENT REQUIREMENTS

1. RF sweep generator or generators with frequency range from 4-220 Mc. having sweep width adjustable from 50 Kc. to 10 Mc. with an output of at least 0.1 volt, a marker system, either built-in or external type and flat within + 1 Db.
2. Signal generator or generators with a frequency range from 4-222 Mc. and an adjustable output of at least 0.1 volt.
3. Sylvania cathode ray oscilloscope type 132 or equivalent capable of passing a 60 cycle square wave.
4. Sylvania Polymeter type 221 or equivalent vacuum tube voltmeter.
5. Sylvania High Voltage Probe Adapter type 225 or equivalent with 0-30 KV DC range (not shown).
6. Sylvania tube tester type 220 or equivalent capable of testing shorts with proper voltages and performance under dynamic conditions.
7. Jig Tube Shield - made by cutting off or insulating the tube shield used on the 6J6 converter tube on the tuner so that the shield does not ground when in place on the tube.

FIGURE 7

SYLVANIA POLYMETER TYPE 221 | SYLVANIA TUBE TESTER TYPE 220 | SYLVANIA OSCILLOSCOPE TYPE 132

ALIGNMENT PROCEDURE

Should any chassis under service require complete realignment, the alignment procedure should be carried out in the following listed order.

PRE-ALIGNMENT INSTRUCTIONS - READ CAREFULLY BEFORE ATTEMPTING ALIGNMENT.

Lay chassis on left side for alignment. Ground all equipment to receiver chassis. Use special alignment tool Service Part No. 898-0003.

VIDEO IF ALIGNMENT

1. Connect signal generator to the jig shield on the 6J6 Oscillator-Mixer. Allow set to warm-up for 15 minutes.

2. Connect the negative lead of a 3 volt battery to the AGC Line, positive lead to ground.

3. Connect D. C. VTVM across the diode load resistor R145 - 3300 Ohm.

4. Adjust the cores of the IF traps in the following order. Keep Voltmeter reading between 1 and 2 volts by reducing Generator Output as required.

Set Signal Generator At:	Adjust:
21.9 Mc.	Core on 4th IF Trap L68 for minimum output
27.9 Mc.	Core on 3rd IF Trap L55 for minimum output
21.9 Mc.	Core on 1st IF Trap L54 for minimum output

5. Adjust the cores of the Video IF Transformers in the following order. Reduce generator output to keep voltmeter reading between 1 and 2 volts.

Set Signal Generator At:	Adjust:
26.0 Mc.	Core on 3rd Video IF Transformer T57 for maximum output
22.7 Mc.	Core on 2nd Video IF Transformer T56 for maximum output
25.3 Mc.	Core on 1st Video IF Transformer T55 for maximum output
23.5 Mc.	Core on Converter Coil L8 for maximum output

Repeat tuning of cores on Trap Coils as described in step 4 above.

6. Disconnect Signal Generator and VTVM.

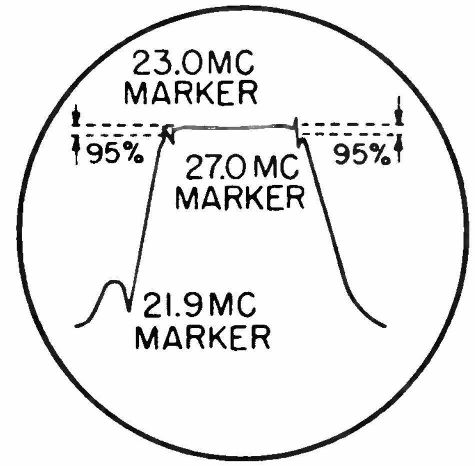

FIGURE 8 - IF BANDPASS RESPONSE

7. Connect sweep generator (frequency 24 Mc., sweeping 10 Mc.) using a .005 Mfd. capacitor to pin 1 of the 4th Video IF 6BC5.

8. Connect oscilloscope to junction of diode load R145 - 3300 Ohm - and coil L58.

9. Adjust primary (top core) and then secondary (lower core) of IF Bandpass T58 to obtain curve shown in Figure 8. (Both adjusted from bottom of Transformer with hex end of special alignment tool.)

10. Disconnect Sweep Generator from 4th IF Grid and connect it to the Jig Shield on Converter 6J6. Loosely couple signal generator at this point for markers.

11. Observe IF Response Curve and if necessary adjust IF transformer cores slightly to obtain response curve shown in Figure 9. Keep oscilloscope gain high enough to prevent overload of the receiver which will distort the curve.

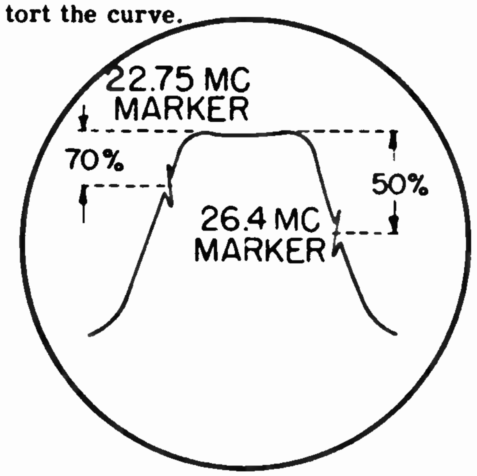

FIGURE 9 - OVERALL IF RESPONSE

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SOUND TAKE OFF & 4.5 MC. TRAP ALIGNMENT

1. Connect a 4.5 Mc. Signal Generator through .005 Mfd. to pin 1 of Video Amplifier Tube - 6BF5. Loosely couple signal generator for use as markers.

2. Connect probe of High Frequency Vacuum Tube Voltmeter at the junction of peaking coil L59 and R148 - 39,000 ohms.

3. With enough output from signal source to give a readable indication on the VTVM, adjust the core on Sound Take-Off Trap - L56 - For a sharp dip.

INTERSTAGE TRANSFORMER ALIGNMENT

1. Disconnect the 4.5 Mc. signal from the Video Amplifier. Connect a 4.5 Mc. sweep oscillator having a 250Kc. deviation through a .005 Mfd. capacitor to pin 1 of Video Amplifier - 6BF5. Connect oscilloscope input across the limiter grid resistor R102 47,000 Ohms - using a 10,000 Ohm carbon resistor between scope lead and receiver chassis.

2. Adjust the primary and secondary of the Interstage Transformer T51 so that the 4.5 Mc. marker appears in the exact center of the response curve and so the curve has the greatest attainable amplitude. The response curve should appear as shown in Figure 10.

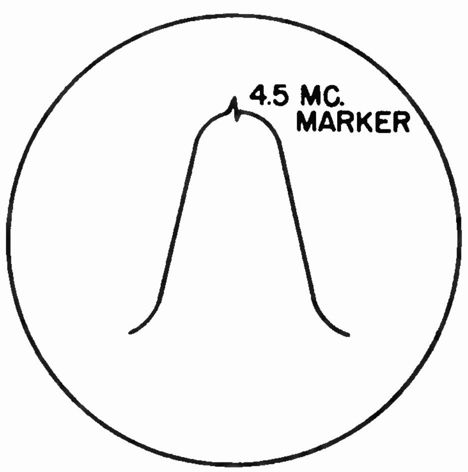


FIGURE 10 - SOUND IF RESPONSE

SOUND DISCRIMINATOR ALIGNMENT

1. With the 4.5 Mc. Sweep Oscillator connected as described in step 1 of "Interstage Transformer Alignment," disconnect the oscilloscope from the limiter grid resistor and connect the oscilloscope across the volume control.

2. Adjust cores of the Discriminator Transformers T52 and T53 until the discriminator curve corresponds to that in Figure 11. Note especially that:

   (a) 4.5 Mc. marker is exactly in the center of the curve.
   (b) The curve is linear between the two adjacent markers.
   (c) The amplitude is the greatest obtainable.

RF TUNER ALIGNMENT

NOTES ON TUNER ALIGNMENT SETUP

In reference to Figure 12, the following precautions should be taken in making the equipment setup.

1. The detector circuit should be so constructed as to maintain leads as short as possible. Connection of the detector circuit to the 1st IF grid terminal (see Fig. 12 for location) should also be made with short leads.

2. Shielded leads should be used in making the following connections to reduce hum and synchronous voltage pick-up.

   (a) The lead for observation of the RF response from the scope isolating resistor (10 K ohms located at the tuner "looker point") to the RF output switch position of the scope switch.
   (b) The connection from the IF detector circuit output to the IF switch position of the scope switch.
   (c) The connection from the sweep generator to the horizontal input of the scope. (Use externally generated sweep instead of internal oscilloscope sweep in order to obtain synchronization).

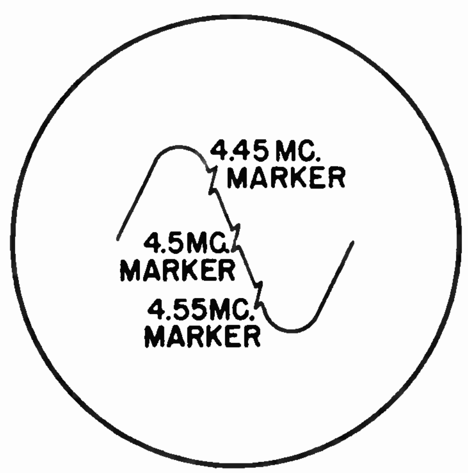


FIGURE 11 - SOUND DISCRIMINATOR RESPONSE

3. The single pole double throw "Scope Switch" should be located at the vertical input terminals of the scope. This switching arrangement will permit observation of either the IF response or the overall RF response. The aforementioned positions will be referred to in subsequent text as the "IF" and "RF" positions respectively.

4. The marker generator coupling condenser should be as small a value as possible to prevent any effect on tuner response, but must be large enough to permit easy observation of markers on either the IF response or overall RF response. (Approximately 2 or 3 MMF should be satisfactory in most cases).

5. For all tuner alignment tests which are outlined in this text, remove the second IF amplifier tube or bypass its plate circuit with approximately 1000 MMF to prevent coupling back from the receiver IF system.

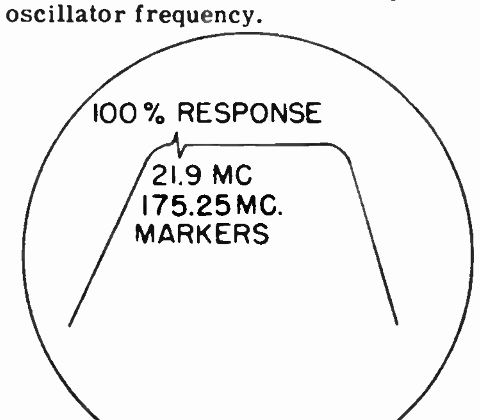
6. In all of the following tests the oscilloscope vertical gain should be as close to maximum gain as possible, consistent with hum and synchronous voltage interference limitations. This precaution will allow the use of low levels from RF sweep Generator and increase the visibility of IF and RF markers.

OSCILLATOR ALIGNMENT

In making adjustments of the oscillator alignment it should be noted that any change in the setting of the high band oscillator trimmer will also effect the low band oscillator tuning, however, because of switching the adjustment of the low band oscillator trimmer will not affect high band oscillator tuning. Also, there is a slight shift of oscillator frequency in the high band position only when the bottom cover is removed.

High Band Oscillator Alignment

1. Remove the bottom cover and rotate the band switch to the high band position.
2. Rotate variable condenser to maximum capacity position (fully counterclockwise position of tuning control knob).
3. Tune sweep generator to channel 7 and set scope switch to IF output position.
4. Inject 175.25 Mc. and 21.9 Mc. markers.
5. With a non-metallic pick vary the turns spacing on the high band oscillator coil L9 until markers coincide (squeezing the coil lowers the oscillator frequency and spacing the turns farther apart raises oscillator frequency.



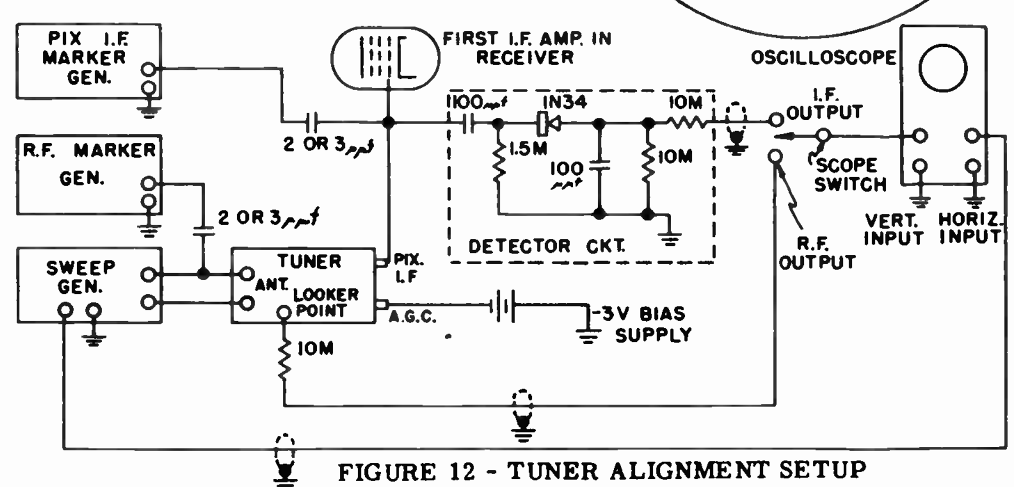


FIGURE 12 - TUNER ALIGNMENT SETUP

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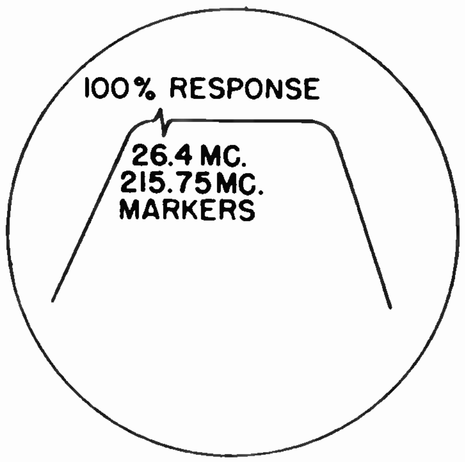
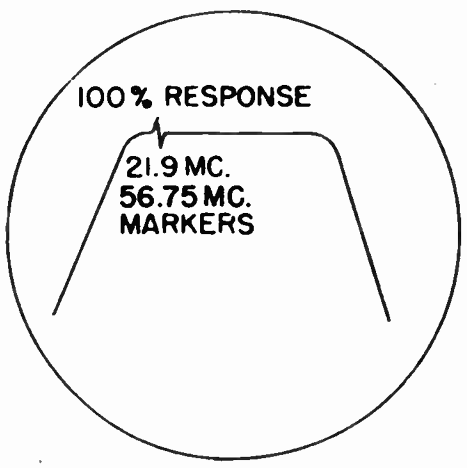
6. Replace bottom cover and check for shift of markers. If there is a shift remove the bottom cover and compensate by re-adjusting L9 as necessary. Repeat until markers coincide with bottom cover in place.
7. Rotate variable condenser to minimum capacity (fully clockwise position of tuning control knob).
8. Tune sweep generator to channel 13.
9. Inject 215.75 Mc. and 26.4 Mc. markers.
10. With bottom cover in place, adjust oscillator grid trimmer C23 to make markers coincide.



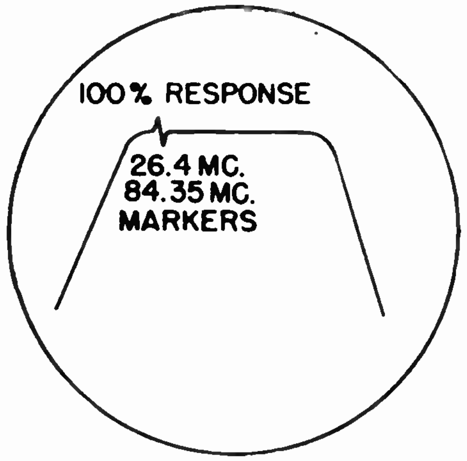
11. Repeat steps one through ten until proper end frequencies are reached at maximum and minimum capacity settings.

Low Band Oscillator Alignment

12. Remove bottom cover, turn band switch to low band position and rotate variable condenser to maximum capacity (tuning control knob fully counterclockwise).
13. Tune sweep generator to channel 2.
14. Inject 56.75 Mc. and 21.9 Mc. markers.
15. Using a non-metallic pick adjust the spacing between turns on the low band oscillator coil L9 until the markers coincide.



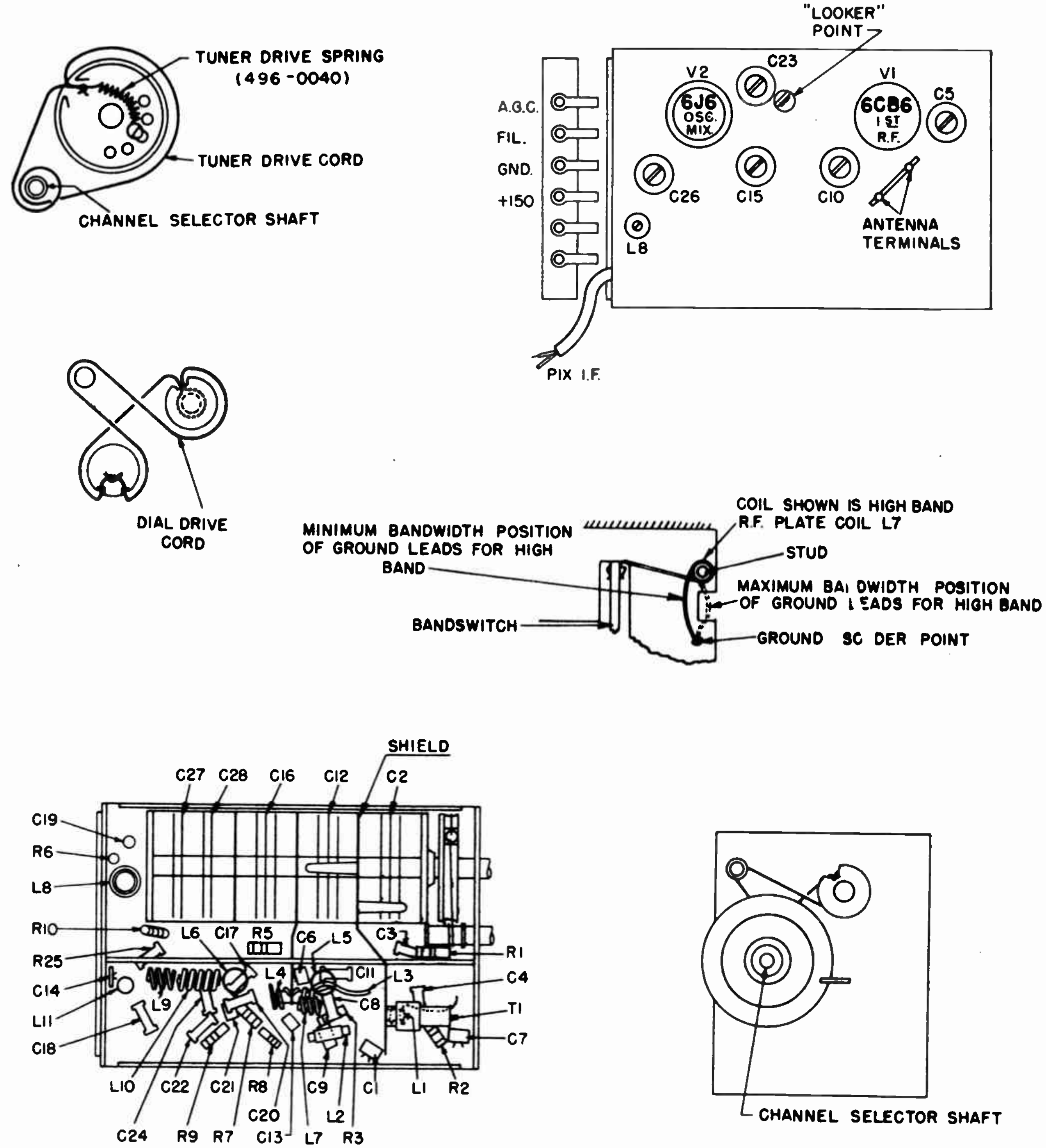
16. Rotate the variable condenser to minimum capacity (tuning control knob fully clockwise).
17. Tune sweep generator to channel 6.
18. Inject 84.35 Mc. and 26.4 Mc. markers.
19. Adjust oscillator plate trimmer C26 to make markers coincide.



20. Replace bottom cover and recheck in steps 12-19.
21. Recheck all four oscillator frequencies as in-steps 1-19.

R. F. PASSBAND ALIGNMENT

1. If only the RF Passband is being aligned it is advisable to check oscillator coverage as noted under Oscillator Alignment step 21 above.
2. Remove bottom cover and turn band switch to high band position.
3. Rotate tuning control so that pointer is at channel 7 on the dial calibration.
4. Tune sweep generator to channel 7. Set scope switch to the IF output.
5. Inject 175.25 Mc. and 26.4 Mc. markers and adjust tuning control so the markers coincide. Leave tuning control at this setting for the remainder of channel 7 adjustment.
6. Change scope switch to the RF output.
7. Check that the RF response curve is similar to those shown in Figure 14.
8. If the response curve differs much from those shown in Figure 14, the inductance and coupling of the high band RF plate coil L3, the high band mixer grid coil L4 and the high band antenna coil L1 for proper band width and symmetry. In determining the band width, it will be necessary to switch the marker generator alternately between channel 7 picture carrier (175.25 Mc.) and sound carrier (179.75).
9. The high band RF plate coil L3 and the high band mixer grid coil L4 are properly adjusted when a slight variation in the inductance of either coil will result in a



Note: This RF tuner has been thoroughly tested at the factory and should provide trouble-free reception throughout the life of the chassis. However, if service other than alignment is required, return the complete tuner to the factory for replacement.

FIGURE 13 - TUNER LAYOUT

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frequency shift of the entire response with no noticeable narrowing of the band width.

10. The high band antenna coil L1 is properly adjusted when a slight variation of its inductance will cause both peaks to rock slightly. If only one peak moves, the high band antenna coil L1 is staggered away from the center of the passband.
11. The inductance of these coils (L1, L3, L4) is varied by pushing the coil on or off the brass stud. Pushing the coil on the stud will raise the frequency and pushing the coil off the stud will lower the frequency.
12. The band width of channel 7 interstage transformer (L3, L4) is controlled by dressing the ground leads of these coils past the cut out in the RF shield plate (see Fig. 13). When both leads cross the cutout the greater separation of peak occurs. For maximum gain the band width should be adjusted so that the response is no greater than that required to keep the sound and picture carrier frequency markers on the peaks of the overall RF curves.
13. Replace tuner bottom cover and check RF passband response.
14. If necessary, remove bottom cover and make slight compensating adjustments. Replace bottom cover and recheck.
15. With the bottom cover in place, rotate the tuning control knob so that the pointer indicates channel 13.
16. Tune sweep generator to channel 13 and change scope switch to IF output.
17. Inject 215.75 Mc. and 21.9 Mc. markers and adjust tuning control so markers coincide. Leave tuning control as set for remainder of channel 13 adjustments.
18. Change scope switch to RF output position. If RF response differs noticeably from the curves in Figure 14, the antenna trimmer (C5), the RF plate trimmer (C10) and mixer grid trimmer (C15) must be adjusted for proper passband and maximum amplitude of response.
19. Return tuner and sweep generator to channel 7 and check response as in part 13 above. A slight compensation of coils L1, L3, and L4 may be necessary.
20. Recheck passband on both channel 7 and channel 13, compromising adjustments for tilt as necessary until satisfactory High Band RF passband responses are obtained.

Low Band RF Alignment

21. Rotate band switch to Low Band position.
22. Turn the tuning control knob so that the pointer indicates channel 2 on the dial.
23. Set the scope switch to the IF output position and inject 59.75 Mc. and 21.9 Mc. markers. Adjust the tuning control so the markers coincide. Leave the tuning control as set for the remainder of the channel 2 adjustments.
24. Change the scope switch to the RF output position.
25. If the desired passband response is not obtained (as shown in Fig. 14) the Low Band RF coil L5, the low band mixer coil (L6), and the low band antenna transformer (T1) secondary must be adjusted until the desired passband is obtained.
26. When the low band RF coil (L5) and the low band mixer coil are aligned slight variation in the inductance of either should cause no noticeable narrowing of the passband.
27. When the secondary of the low band antenna transformer is properly adjusted, a slight variation in its inductance should cause both peaks to rock slightly. If only one peak moves, the T1 secondary is staggered away from the center of the double tuned circuit response.
28. The low band mutual coil (L7) varies the band width of the interstage coupling circuit. Squeezing the turns together broadens the band width and separating the turns narrows the band width. The band width should be adjusted so that it is not greater than that required to keep both the picture carrier and sound carrier markers at the peaks of the response curve.
29. Replace the tuner bottom cover and check passband response.
30. Remove bottom cover and make any compensating adjustments as needed.
31. With the bottom cover in place, rotate the tuning control knob to align the pointer with channel 6 on the dial.
32. Tune the sweep generator to channel 6 and change the scope output switch to the IF output position.
33. Inject 83.25 Mc. and 26.4 Mc. markers and adjusting tuning control to make the markers coincide. Leave the tuning control at this setting for the remainder of the channel 6 adjustments.
34. Change the scope switch to the RF output position.
35. Check the response curve. If not as desired, remove the bottom cover and slightly readjust the inductance of the low band RF coil L5, the low band mixer coil (L6), the low band mutual coil (L7) and the secondary of the low band antenna transformer (T1) as necessary, keeping in mind that these adjustments must be compromised with those made for channel 2 in steps 21-30 above.
36. Recheck passband on channel 2 and channel 6 and re-adjust as necessary to obtain acceptable passband on both channel 2 and 6.

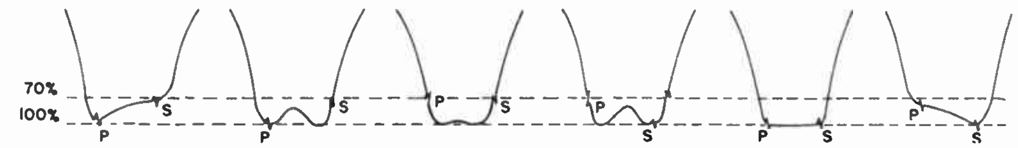


FIGURE 14 - ACCEPTABLE RF RESPONSE CURVES FOR TUNER

WAVEFORMS

Note 1: The terms "Horizontal," "Vertical" or "60 cps sine wave" refer to the oscilloscope sweep employed.

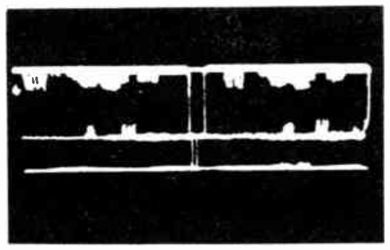
Note 2: All waveforms are taken with the oscilloscope horizontal sweep direction from left to right and with upward deflection corresponding to positive polarity.

Note 3: In some instances the waveforms obtained will not be identical with those shown, due to the electrical characteristics of the oscilloscope used.

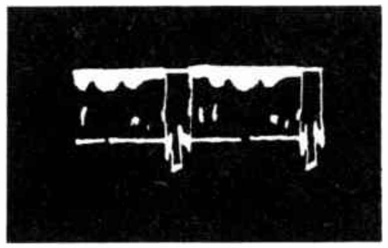
Note 4: All waveforms are measured with respect to chassis unless otherwise indicated.

Note 5: Contrast maximum unless otherwise indicated.

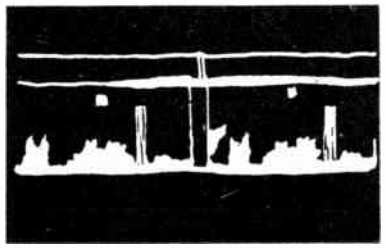
*The peak to peak (P/P) voltages of these waveforms are dependent on the depth of modulation of the transmitted signal; voltages shown are obtained when modulation is approximately 90 percent.



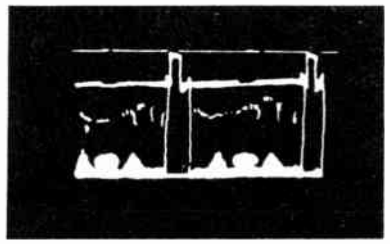
*6BF5 (V8) Video Amplifier Control Grid (Pins 1 and 7) 3.5 Volts P/P Vertical



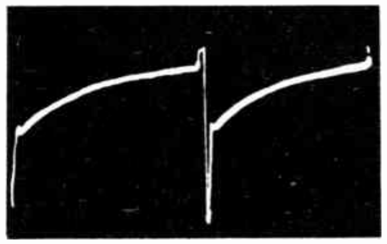
*6BF5 (V8) Video Amplifier Control Grid (Pins 1 and 7) 3.5 Volts P/P Horizontal



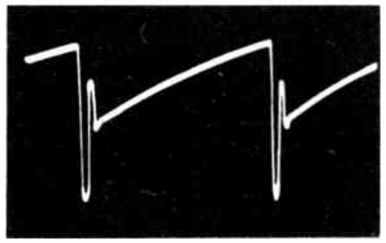
*6BF5 (V8) Video Amplifier Plate (Pin 5) 55 Volts P/P Vertical



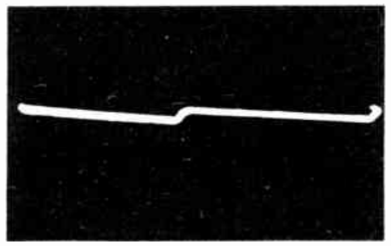
*6BF5 (V8) Video Amplifier Plate (Pin 5) 55 Volts P/P Horizontal



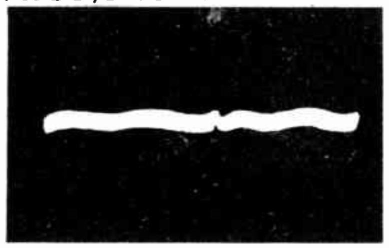
6BL7GT (V15) Vertical Oscillator Control Grid (Pin 1) 600 Volts P/P Vertical



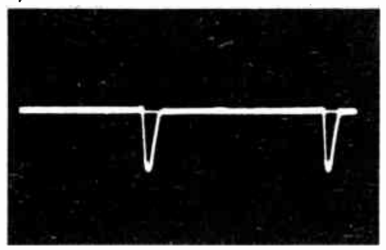
6BL7GT (V15) Vertical Oscillator Plate (Pin 2) 235 Volts P/P Vertical



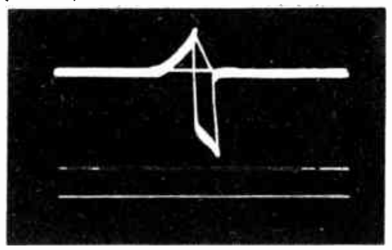
12AX7 (V14) Hor. Sync. Sep. and AGC Rectifier Cathode (Pin 8) 2.6 Volts P/P Horizontal



12AX7 (V14) Hor. Sync. Sep. and AGC Rectifier Cathode (Pin 8) 2.6 Volts P/P Vertical



12AX7 (V14) Hor. Sync. Sep. Plate (Pin 6) 37 Volts P/P Horizontal



12AX7 (V14) Hor. Sync. Sep. Plate (Pin 6) 37 Volts P/P Vertical

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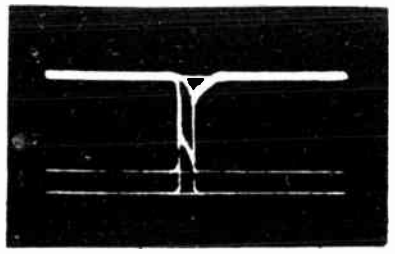
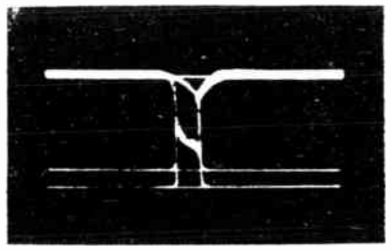
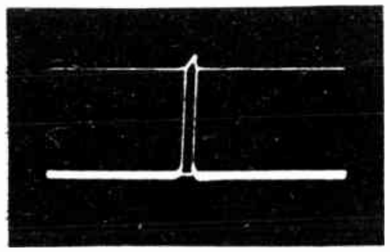


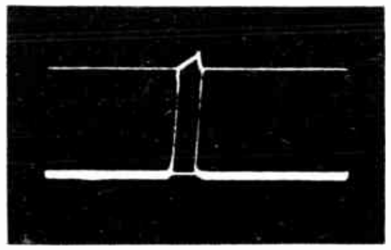
12AX7 (V14) Sync Separator Plate (Pin 1) 25 Volts P/P Vertical



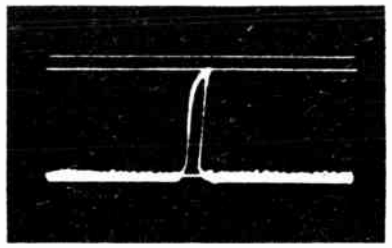
12AX7 (V14) Sync Separator Plate (Pin 1) 25 Volts P/P 60 cps sine wave



12AU7 (V13) Sync. Amp. and Clipper Plate (Pin 1) 110 Volts P/P Vertical

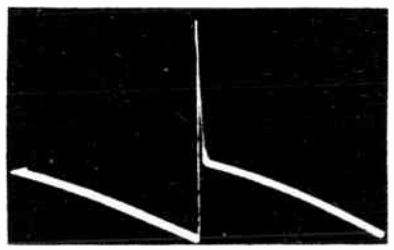


12AU7 (V13) Sync Amp. and Clipper Plate (Pin 1) 110 Volts P/P 60 cps sine wave

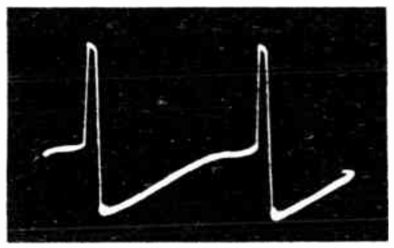


12AU7 (V13) Sync Amp. and Clipper Plate (Pin 1) 100 Volts P/P Horizontal

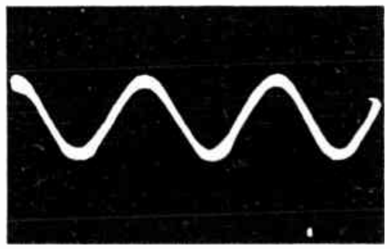
6BL7GT (V15) Vertical Output Control Grid (Pin 4) 95 Volts P/P Vertical



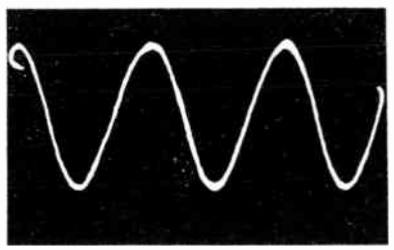
6BL7GT (V15) Vertical Output Plate (Pin 5) 830 Volts P/P Vertical



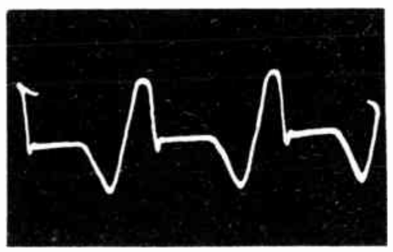
6AL5 (V16) Hor. Discriminator Plate (Pin 7) 70 Volts P/P Horizontal



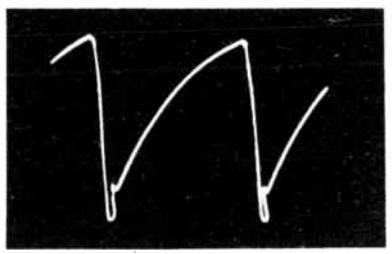
6AL5 (V16) Hor. Discriminator Plate to Plate (Pin 7 to Pin 2) Scope ground to pin 7 - 23 Volts P/P Horizontal



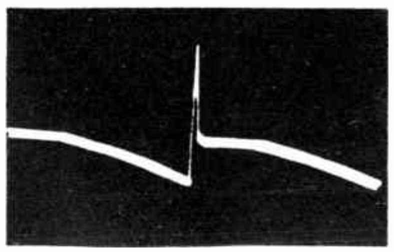
6AU6 (V17) Hor. Control Plate (Pin 5) 68 Volts P/P Horizontal



12AU7 (V18) Hor. Oscillator Plate (Pin 6) 95 Volts P/P Horizontal

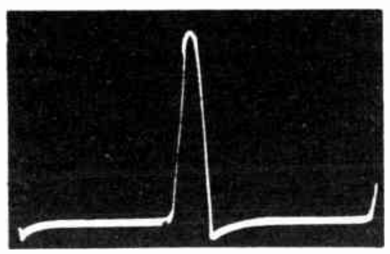


12AU7 (V18) Hor. Discharge Plate (Pin 1) 105 Volts P/P Horizontal



Vertical Yoke Coils (Test Point 1) 55 Volts P/P Vertical

6W4GT Damper Cathode (Pin 3) 2000 Volts P/P Horizontal



REPAIR PARTS LIST

SCHEMATIC LOCATION	SERVICE PART NUMBER	DESCRIPTION
	196-0003	Anode Connector and Lead Assembly (1-271)
	196-0013	Anode Connector and Lead Assembly (1-290)
	415-0007	Anode Connector Assembly (1-290)
	582-0005	Antenna Assembly - Built-in
	714-0001	Bezel - 16" Rectangular (6140M, 6140W)
	411-0013	Board - Pilot Light Mounting Assembly
	416-0008	Board - Antenna Terminal
	417-0005	Cable and Socket Assembly (1-271)
	417-0008	Cable and Socket Assembly (1-290)
C146	162-0201	Capacitor - Paper - .1 Mfd. - 200 V.
C148	162-0202	Capacitor - Paper - .2 Mfd. - 200 V.
C104	162-0402	Capacitor - Paper - .2 Mfd. - 400 V.
C209	162-0602	Capacitor - Paper - .2 Mfd. - 600 V.
C179, C180, C195	162-0401	Capacitor - Paper - .1 Mfd. - 400 V.
C206	162-0601	Capacitor - Paper - .1 Mfd. - 600 V.
C205, C147	162-0615	Capacitor - Paper - .05 Mfd. - 600 V.
C207	162-0613	Capacitor - Paper - .03 Mfd. - 600 V.
C200	162-0611	Capacitor - Paper - .01 Mfd. - 600 V.
C116, C170, C192, C193	162-0625	Capacitor - Paper - .005 Mfd. - 600 V.
C169, C177	162-0623	Capacitor - Paper - .003 Mfd. - 600 V.
C198	162-0422S	Capacitor - Paper - .002 Mfd. - 400 V.
C109, C111, C113, C149, C172	168-0002N	Capacitor - Ceramic - .01 Mfd. - 500 V.
C103, C105, C127, C128, C129, C130, C131, C132, C133, C135, C140, C142, C143, C145, C199, C201	166-5000D	Capacitor - Ceramic - .005 Mfd. - 450 V.
C100, C101, C163, C164	168-0003D	Capacitor - Ceramic - .004 - Dual - 450 V.
C203	166-1000P	Capacitor - Ceramic - .001 Mfd. - 500 V.
C159, C160, C161, C162	166-1000D	Capacitor - Ceramic - .001 Mfd. - 600 V.
C106	166-0250P	Capacitor - Ceramic - .00025 Mfd. - 500 V.
C102	166-0050N	Capacitor - Ceramic - .00005 Mfd. - 500 V.
C126, C141	168-0009N	Capacitor - Ceramic - .00005 Mfd. - 500 V.
C137	166-0010P	Capacitor - Ceramic - .00001 Mfd. - 500 V.
C134, C138, C139, C144	168-0008N	Capacitor - Ceramic - .0000047 Mfd. - 500 V.
C136	168-0004P	Capacitor - Ceramic - .00000068 Mfd. - 500 V.
C176	163-0750	Capacitor - Mica - .00075 Mfd. - 500 V.
C110, C202	163-0680	Capacitor - Mica - .00068 Mfd. - 500 V.
C112, C194, C197	163-0100	Capacitor - Mica - .0001 Mfd. - 500 V.
C212, C213	160-14350	Capacitor - Molded Paper - .0005 Mfd. - 10,000 V.
C214	160-14350	Capacitor - Molded Paper - .0005 Mfd. - 10,000 V. (1-290 only)
C211	174-1200	Capacitor - Molded Paper - .0012 Mfd. - 1,000 V.
C171	160-02147	Capacitor - Molded Paper .047 Mfd. - 200 V.
C208	160-02022	Capacitor - Molded Paper .22 Mfd. - 200 V.
C196	169-0010	Capacitor - Molded Polystyrene - .015 Mfd. - 400 V.
C108, R111	190-0006	Capacitor - Resistor Combination .01 Mfd. 4,700 Ohms - 1/2 W.

MODELS 5130B, 5130M, 5130W, 5140B, 5140M, 6140M, 6140W, Ch. 1-271, 1-290

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SCHEMATIC LOCATION	SERVICE PART NUMBER	DESCRIPTION
	190-0007	Capacitor - Resistor Integrator Plate
C173		.002 Mfd.
C174, C175		.005 Mfd.
R189		22,000 Ohms
R190, R191		8,200 Ohms
	172-0030	Capacitor - Trimmer - Antenna
C181	161-4003	Capacitor - Electrolytic - 100 Mfd. - 50 V.
C158		60 Mfd. - 200 V.
C178		10 Mfd. - 450 V.
C210		10 Mfd. - 450 V.
C117	161-4002	Capacitor - Electrolytic - 60 Mfd. - 350 V.
C155		40 Mfd. - 350 V.
C114		25 Mfd. - 25 V.
C204		10 Mfd. - 50 V.
C157	161-2003	Capacitor - Electrolytic - 80 Mfd. - 350 V.
C156		40 Mfd. - 350 V.
C115	161-1007	Capacitor - Electrolytic - 10 Mfd. - 350 V.
C168	161-1000	Capacitor - Electrolytic - 10 Mfd. - 25 V.
C107	161-1001	Capacitor - Electrolytic - 2 Mfd. - 50 V.
	822-0001	Case and Terminal Assembly, H.V. Chassis
L50	145-0004	Choke - Filter B+
L51, L52, L53	147-0014	Choke - Heater
	487-0008	Clip - Fuse
	487-0011	Clip - Glass Mounting (6140M, 6140W)
	487-0004	Clip - IF Transformer Mounting
L66	133-0001	Coil - Horizontal Linearity
L67	132-0001	Coil - Horizontal Size
L55	118-0007	Coil - IF Trap
L54, L68	118-0005	Coil - IF Cathode Trap
L57, L58	131-2006	Coil - Peaking - Dual
L59, L60	131-2005	Coil - Peaking - Dual
L63	146-0005	Coil - Ringing
L56	130-0001	Coil - Sound TakeOff
	417-0006	Connector - Pin - Antenna Lead
R179	153-0009	Control - AGC
R110, R153	157-0009	Control - Dual - Brightness, Volume and On-Off Switch (1-271)
R110, R153	157-0011	Control - Dual - Brightness, Volume and On-Off Switch (1-290)
R167	153-3007	Control - Contrast
R225	153-0007	Control - Drive
R193, R198	153-0001	Control - Vertical Hold - Height
R201	153-0010	Control - Vertical Linearity
	195-0001	Cord - Line (6140M, 6140W)
	760-0005	Cover - Interlock Assembly (6140M, 6140W)
	760-0007	Cover - Interlock Assembly (5130M, 5130W, 5130B, 5140M, 5140B)
	498-0014	Cover - H.V. Case
	191-0005	Fuse - 1/4 Amp. - 250 V. (clip type)
	710-0002	Glass - Picture Window - 16" (6140M, 6140W)
	710-0005	Glass - Picture Window - 19" (5130M, 5130W, 5130B, 5140M, 5140B)
	476-0002	Insulator - Electrolytic Capacitor Mounting
	740-0011	Knob - Inner
	744-0011	Knob - Outer - Brightness
	740-0013	Knob - Plain - Antenna (6140M, 6140W, 5140M, 5140B)
	740-0012	Knob - Plain - Antenna (5130M, 5130W, 5130B)
	743-0006	Knob - TV Tuner - Band
	792-0004	Knob - TV Tuner - Pointer
	611-0047	Lamp - Dial Light
	591-0013	Leaflet - Customer Instruction
	716-0301	Mask and Gasket Assembly (6140W)
	716-0201	Mask and Gasket Assembly (6140M)
	716-0102	Mask - 19" Round Tube
	400-0007	Magnet Assembly - Focus and Centering (1-271)

SCHEMATIC LOCATION	SERVICE PART NUMBER	DESCRIPTION
	400-0008	Magnet Assembly - Focus and Centering (1-290)
	400-0006	Magnet Assembly - Ion Trap
	415-0002	Plug - 2 Prong - Interlock
	415-0001	Plug - 4 Prong - Speaker
R171	189-0007	Resistor - 4.3 Ohm - 1/2 W. - W.W.
R169	181-04705	Resistor - 47 Ohm - 1/2 W.
R116	181-0470	Resistor - 47 Ohm - 1/2 W.
R136, R139	181-0820	Resistor - 82 Ohm - 1/2 W.
R101, R146, R228, R230	181-0101	Resistor - 100 Ohm - 1/2 W.
R104	181-0121	Resistor - 120 Ohm - 1/2 W.
R131, R142	181-0221	Resistor - 220 Ohm - 1/2 W.
R119	181-0471	Resistor - 470 Ohm - 1/2 W.
R202, R203	181-0561	Resistor - 560 Ohm - 1/2 W.
R200	181-0681	Resistor - 680 Ohm - 1/2 W.
R133	181-0821	Resistor - 820 Ohm - 1/2 W.
R103, R134, R138, R143, R220, R234	181-0102	Resistor - 1,000 Ohm - 1/2 W.
R117	181-0152	Resistor - 1,500 Ohm - 1/2 W.
R127	181-0332	Resistor - 3,300 Ohm - 1/2 W.
R145	181-03325	Resistor - 3,300 Ohm - 1/2 W.
R197	181-04725	Resistor - 4,700 Ohm - 1/2 W.
R144, R226	181-0472	Resistor - 4,700 Ohm - 1/2 W.
R135	181-0562	Resistor - 5,600 Ohm - 1/2 W.
R128	181-0682	Resistor - 6,800 Ohm - 1/2 W.
R219	181-0822	Resistor - 8,200 Ohm - 1/2 W.
R176, R177, R184	181-0103	Resistor - 10,000 Ohm - 1/2 W.
R185	181-0123	Resistor - 12,000 Ohm - 1/2 W.
R222	181-0223	Resistor - 22,000 Ohm - 1/2 W.
R140, R141	181-0273	Resistor - 27,000 Ohm - 1/2 W.
R105, R107, R130, R147, R182	181-0333	Resistor - 33,000 Ohm - 1/2 W.
R148	181-03935	Resistor - 39,000 Ohm - 1/2 W.
R100, R102, R194	181-0473	Resistor - 47,000 Ohm - 1/2 W.
R108	181-0683	Resistor - 68,000 Ohm - 1/2 W.
R224	181-0823	Resistor - 82,000 Ohm - 1/2 W.
R109, R215, R129, R216, R196	181-0104	Resistor - 100,000 Ohm - 1/2 W.
R223	181-0154	Resistor - 150,000 Ohm - 1/2 W.
R113, R170	181-0224	Resistor - 220,000 Ohm - 1/2 W.
R149	181-02745	Resistor - 270,000 Ohm - 1/2 W.
R178	181-03345	Resistor - 330,000 Ohm - 1/2 W.
R114, R152, R195, R217, R221, R227	181-0474	Resistor - 470,000 Ohm - 1/2 W.
R180	181-05645	Resistor - 560,000 Ohm - 1/2 W.
R199, R218	181-0105	Resistor - 1 Megohm - 1/2 W.
R192	181-0155	Resistor - 1.5 Megohm - 1/2 W.
R181, R183, R186	181-0225	Resistor - 2.2 Megohm - 1/2 W.
R132	181-0335	Resistor - 3.3 Megohm - 1/2 W.
R112	181-0156	Resistor - 15 Megohm - 1/2 W.
R137	182-0471	Resistor - 470 Ohm - 1 W.
R232	182-0102	Resistor - 1,000 Ohm - 1 W.
R106	182-0103	Resistor - 10,000 Ohm - 1 W.
R187	182-0333	Resistor - 33,000 Ohm - 1 W.
R115	183-0151	Resistor - 150 Ohm - 2 W.
R118	183-0221	Resistor - 220 Ohm - 2 W.
R163	183-03325	Resistor - 3,300 Ohm - 2 W.
R233	183-0472	Resistor - 4,700 Ohm - 2 W.

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SCHEMATIC LOCATION	SERVICE PART NUMBER	DESCRIPTION
R151	183-0562	Resistor - 5,600 Ohm - 2 W.
R150	183-0682	Resistor - 6,800 Ohm - 2 W.
R188	183-0153	Resistor - 15,000 Ohm - 2 W.
R235, R236	189-0019	Resistor - 1.5 Megohm - 2 W.
R229	189-0020	Resistor - 150 Ohm - 3 W.
R164	189-0003	Resistor - 3,600 Ohm - 3 W.
R231	187-0004	Resistor - 6,800 Ohm - 3 W.
R168	187-0003	Resistor - 270 Ohm - 5 W. - W.W.
R166	185-0001	Resistor - 1,165 Ohm
R165		Resistor - 3,000 Ohm
	486-0001	Ring - Insulator - 19" Metal Tube (1-290)
	539-1201	Speaker - 12" PM
	414-0004	Socket - 4 Prong
	412-0006	Socket - 8 Prong - Octal
	412-0012	Socket - 9 Prong - Miniature
	412-0015	Socket - 7 Prong - Miniature
	496-0049	Spring - Grounding (1-271)
	473-0002	Switch Arm Assembly - Pilot Light
T54	143-0017	Transformer - Output - Speaker
T52	128-0004	Transformer - Sound Discriminator - Primary
T53	128-0005	Transformer - Sound Discriminator - Secondary
T59	240-0001	Transformer - Heater Isolation
T55, T56, T57	125-0002	Transformer - IF Interstage
T58	120-0002	Transformer - IF Bandpass
T51	120-0001	Transformer - IF Sound 4.5 Mc.
T62	128-0006	Transformer - Horizontal Discriminator
T63	241-0003	Transformer - Horizontal Scanning Assembly
T50	141-0015	Transformer - Power - 60 cycle
T61	241-0004	Transformer - Vertical Scan
T60	242-0001	Transformer - Vertical Oscillator
	633-0003G	Tube - 5U4G
	623-0011G	Tube - 6BC5
	623-0003G	Tube - 6AL5
	623-0005G	Tube - 6AU6
	623-0004G	Tube - 6BA6
	623-0017G	Tube - 6BF5
	622-0011G	Tube - 6BL7GT
	623-0022G	Tube - 6CB6
	622-0013G	Tube - 6CD6G
	623-0002G	Tube - 6J6
	622-0012G	Tube - 6L6G
	623-0010G	Tube - 6T8
	633-0004G	Tube - 6W4GT
	623-0006G	Tube - 12AU7
	623-0008G	Tube - 12AX7
	636-0001G	Tube - 5642
	642-0006G	Tube - 16KP4
	642-0005G	Tube - 19AP4A
	323-0002	Tuner Unit (1-271)
	323-0004	Tuner Unit (1-290)
L61, L62, L64, L65	100-0003	Yoke - Deflection

CHASSIS 1-271 C01
CHASSIS 1-290 C01

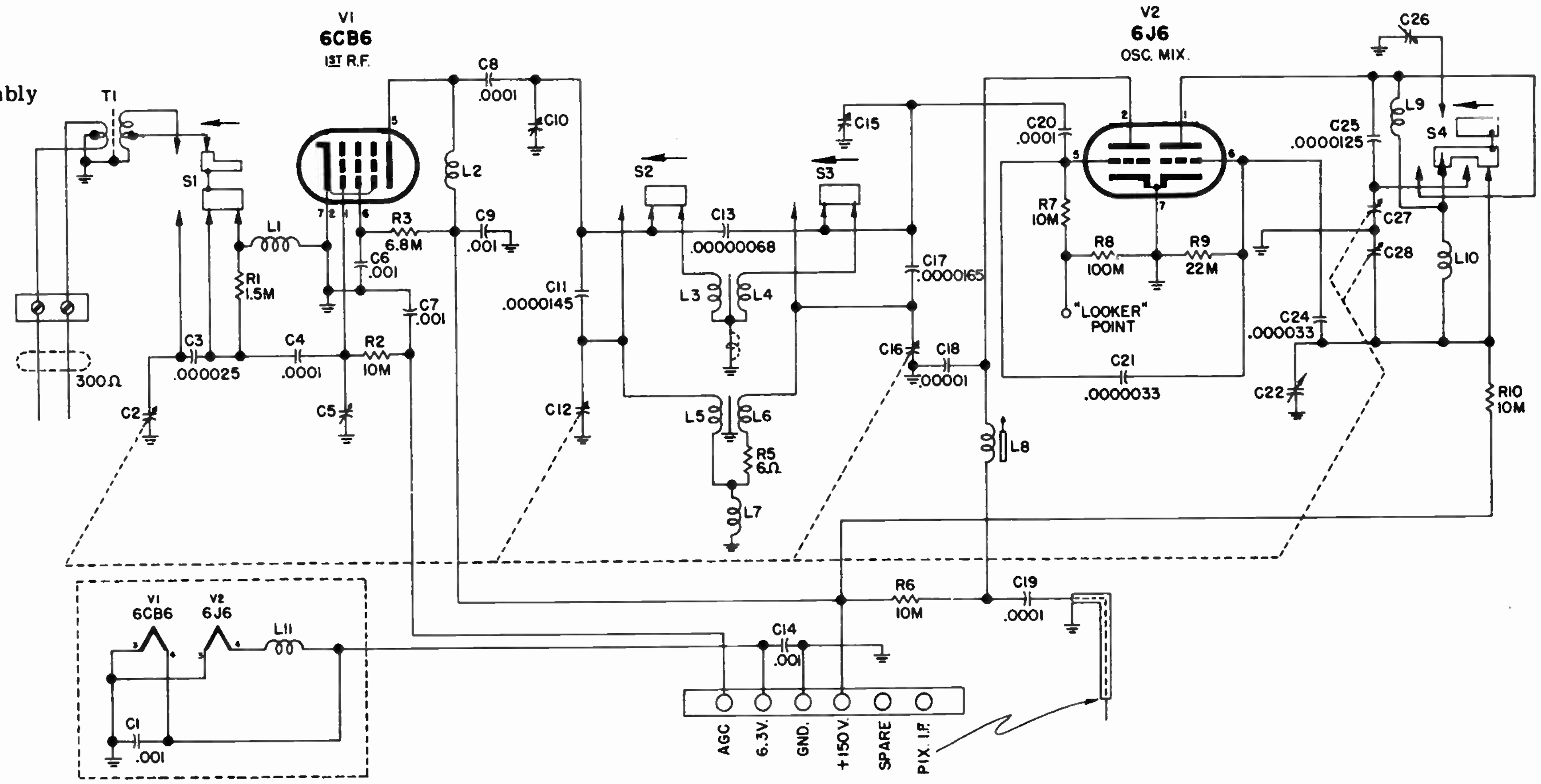
This supplement covers the code C01 change in the 1-271, 1-290 television chassis.

Code C01 changes the value of resistors in the schematic as follows: R148 from 39 M to 180 M
R149 from 270 M to 1.2 Meg
R186 from 2.2 Meg to 1.2 Meg

To correct the parts list to this change, the following additions and deletions should be made.

REPAIR PARTS LIST

SCHEMATIC LOCATION	SERVICE PART NUMBER	DESCRIPTION
	DELETE	
R148	181-03935	Resistor - 39,000 Ohm - 1/2 W.
R149	181-0274	Resistor - 270,000 Ohm - 1/2 W.
R186	181-0225	Resistor - 2.2 Megohm - 1/2 W.
	ADD	
R148	181-01845	Resistor - 180,000 Ohm - 1/2 W.
R186	181-0125	Resistor - 1.2 Megohm - 1/2 W.
R149	181-01255	Resistor - 1.2 Megohm - 1/2 W.



NOTE:
1. SWITCH SECTIONS 1-4 ARE PARTS OF A TWO POSITION SLIDE SWITCH. SWITCH SHOWN IN POSITION FOR HI BAND RECEPTION. ARROW INDICATES SWITCH DIRECTION FOR LO TV RECEPTION.

FIGURE 16 - TUNER SCHEMATIC FOR CHASSIS 1-271 AND 1-290

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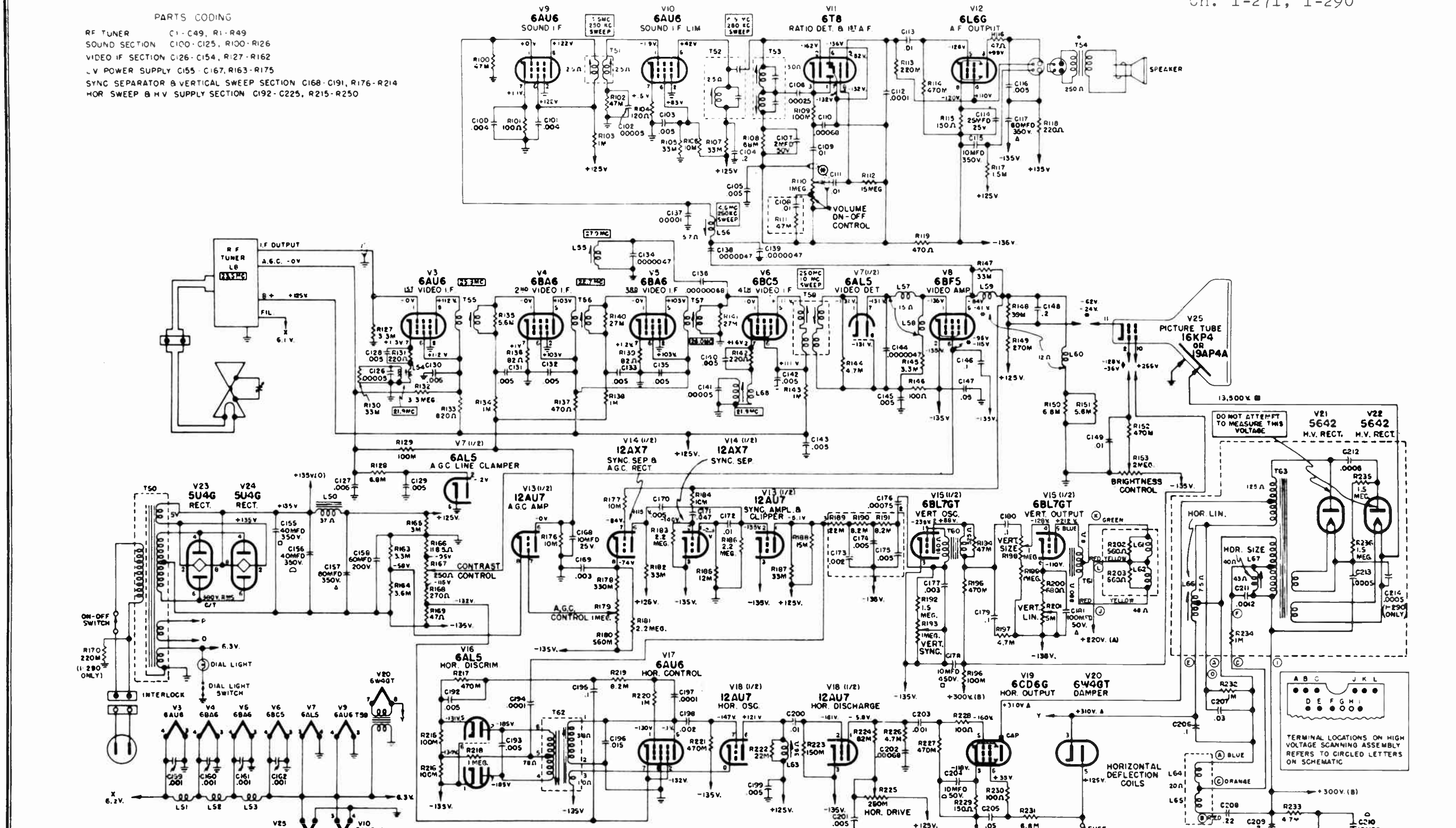
MODELS 5130B, 5130M, 5130W, 5140B, 5140M, 6140M, 6140W, Ch. 1-271, 1-290

SCHEMATIC DIAGRAM FOR 1-271 AND 1-290 TV CHASSIS

PARTS CODING

RF TUNER	C1 - C49, R1 - R49
SOUND SECTION	C100 - C125, R100 - R126
VIDEO IF SECTION	C126 - C154, R127 - R162
LV POWER SUPPLY	C155 - C167, R163 - R175
SYNC SEPARATOR & VERTICAL SWEEP SECTION	C168 - C191, R176 - R214
HOR SWEEP & H V SUPPLY SECTION	C192 - C225, R215 - R250



- ◘ USE HIGH VOLTAGE MULTIPLIER PROBE WITH SYLVANIA POLYMETER FOR ALL HIGH VOLTAGE MEASUREMENTS
- ⊛ CAUTION: VOLUME CONTROL SHIELDS ARE AT -135V. DO NOT CONNECT TO GROUND
- * CONTRAST CONTROL AT MINIMUM
- ♦ BRIGHTNESS CONTROL AT MAXIMUM
- Δ HIGH PEAK VOLTAGE OF SHORT DURATION (APPROX. 2,000 V) MAY DAMAGE METER USED FOR THIS MEASUREMENT

ALL VOLTAGES MEASURED WITH A SYLVANIA POLYMETER TYPE 134 2 (VACUUM TUBE VOLTMETER) UNLESS OTHERWISE STATED. ANTENNA DISCONNECTED & NO SIGNAL INPUT. LINE POTENTIAL 117 VOLTS, 60 CYCLES AC SUPPLY. CONTRAST CONTROL AT MAXIMUM AND BRIGHTNESS CONTROL AT MINIMUM UNLESS OTHERWISE STATED.
ALL OTHER CONTROLS ADJUSTED TO NORMAL POSITIONS. VOLTAGES MEASURED IN RESPECT TO GROUND UNLESS OTHERWISE STATED.
ALL COIL RESISTANCES ARE APPROXIMATE. THOSE NOT LISTED ARE TOO SMALL FOR PRACTICAL MEASUREMENT OR OF TOO WIDE A RANGE OF VALUE. RESISTANCES OF TAPPED COILS ARE FOR ENTIRE COIL LENGTH

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Addition of Chassis 1-356, Models 7140M, 7140W.

GENERAL DESCRIPTION

Models 7140M, 7140W are direct viewing television receivers providing reception of all 12 commercial television channels. The television picture is reproduced on a 17 inch rectangular, black faced, electromagnetically deflected, tetrode type picture tube. The cabinets are identical in appearance to 6140M and 6140W.

SPECIFICATIONS

The 1-356 chassis is electrically similar to the 1-271 chassis except for minor circuit changes.

All servicing data for the 1-271 also applies to the 1-356, except for the Repair Parts List which is given below.

REPAIR PARTS LIST

SCHEMATIC LOCATION	SERVICE PART NUMBER	DESCRIPTION
	196-0003	Anode Connector and Lead Assembly
	582-0005	Antenna Assembly - Built-in
	714-0001	Bezel - 17" Rectangular
	411-0013	Board - Pilot Light Mounting Assembly
	416-0008	Board - Antenna Terminal
	488-0003	Bumper - Glass
	417-0005	Cable and Socket Assembly
C148	162-0202	Capacitor - Paper - .2 Mfd. - 200 V.
C104	162-0402	Capacitor - Paper - .2 Mfd. - 400 V.
C209	162-0602	Capacitor - Paper - .2 Mfd. - 600 V.
C179, C180, C195	162-0401	Capacitor - Paper - .1 Mfd. - 400 V.
C206	162-0601	Capacitor - Paper - .1 Mfd. - 600 V.
C205	162-0615	Capacitor - Paper - .05 Mfd. - 600 V.
C207	162-0613	Capacitor - Paper - .03 Mfd. - 600 V.
C172, C200	162-0611	Capacitor - Paper - .01 Mfd. - 600 V.
C116, C170, C192, C193	162-0625	Capacitor - Paper - .005 Mfd. - 600 V.
C169, C177	162-0623	Capacitor - Paper - .003 Mfd. - 600 V.
C198	162-0422S	Capacitor - Paper - .002 Mfd. - 400 V.
C109, C111, C113, C149	168-0002N	Capacitor - Ceramic - .01 Mfd. - 500 V.
C103, C105, C127, C128, C129, C130, C131, C132, C133, C135, C140, C142, C143, C145, C146, C199, C201	166-5000D	Capacitor - Ceramic - .005 Mfd. - 450 V.
C100, C101, C163, C164	168-0003D	Capacitor - Ceramic - .004 - Dual - 450 V.
C203	166-1000P	Capacitor - Ceramic - .001 Mfd. - 500 V.
C159, C160, C161, C162	166-1000D	Capacitor - Ceramic .001 Mfd. - 600 V.
C106	166-0250P	Capacitor - Ceramic - .00025 Mfd. - 500 V.
C102	166-0050N	Capacitor - Ceramic - .00005 Mfd. - 500 V.
C126, C141	168-0009N	Capacitor - Ceramic - .00005 Mfd. - 500 V.
C137	166-0010P	Capacitor - Ceramic - .00001 Mfd. - 500 V.
C134, C138, C139, C144	168-0008N	Capacitor - Ceramic - .0000047 Mfd. - 500 V.
C136	168-0004P	Capacitor - Ceramic - .00000068 Mfd. - 500 V.
C176	163-0750	Capacitor - Mica - .00075 Mfd. - 500 V.
C110, C202	163-0680	Capacitor - Mica - .00068 Mfd. - 500 V.
C112, C194, C197	163-0100	Capacitor - Mica - .0001 Mfd. - 500 V.
C211	174-1200	Capacitor - Mica - .0012 Mfd. - 1,000 V.
C212, C213	160-14350	Capacitor - Molded Paper - .0005 Mfd. - 10,000 V.
C171	160-02147	Capacitor - Molded Paper - .047 Mfd. - 200 V.
C208	160-02022	Capacitor - Molded Paper - .22 Mfd. - 200 V.
C196	169-0010	Capacitor - Molded Polystyrene - .015 Mfd. - 400 V.
	190-0006	Capacitor - Resistor Combination
C108		.01 Mfd.
R111		4,700 Ohms - 1/2 W.
	190-0007	Capacitor - Resistor Integrator Plate
C173		.002 Mfd.
C174, C175		.005 Mfd.

SCHEMATIC LOCATION	SERVICE PART NUMBER	DESCRIPTION
R189		22,000 Ohms
R190, R191		8,200 Ohms
	172-0030	Capacitor - Trimmer - Antenna
C181	161-4003	Capacitor - Electrolytic - 100 Mfd. - 50 V.
C158		60 Mfd. - 200 V.
C178		10 Mfd. - 450 V.
C210		10 Mfd. - 450 V.
C117	161-4002	Capacitor - Electrolytic - 60 Mfd. - 350 V.
C155		40 Mfd. - 350 V.
C114		25 Mfd. - 25 V.
C204		10 Mfd. - 50 V.
C157	161-2003	Capacitor - Electrolytic - 80 Mfd. - 350 V.
C156		40 Mfd. - 350 V.
C115	161-1007	Capacitor - Electrolytic - 10 Mfd. - 350 V.
C168	161-1000	Capacitor - Electrolytic - 10 Mfd. - 25 V.
C107	161-1001	Capacitor - Electrolytic - 2 Mfd. - 50 V.
	822-0001	Case and Terminal Assembly, H.V. Chassis
L50	145-0004	Choke - Filter B+
L51, L52, L53	147-0014	Choke - Heater
	487-0014	Clip - Bezel Mounting
	487-0008	Clip - Fuse
	487-0011	Clip - Glass Mounting
	487-0004	Clip - IF Transformer Mounting
L66	133-0001	Coil - Horizontal Linearity
L67	132-0001	Coil - Horizontal Size
L55	118-0007	Coil - IF Trap
L54, L68	118-0005	Coil - IF Cathode Trap
L57, L58	131-2006	Coil - Peaking - Dual
L59, L60	131-2005	Coil - Peaking - Dual
L63	146-0005	Coil - Ringing
L56	130-0001	Coil - Sound Take-Off
	417-0006	Connector - Pin - Antenna Lead
R179	153-0009	Control - AGC
R110, R153	157-0009	Control - Dual - Brightness, Volume and On-Off Switch
R167	153-3007	Control - Contrast
R225	153-0007	Control - Drive
R193, R198	153-0001	Control - Vertical Hold - Height
R201	153-0010	Control - Vertical Linearity
	195-0001	Cord - Line
	760-0005	Cover - Interlock Assembly
	498-0014	Cover - H.V. Case
	191-0005	Fuse - 1/4 Amp. - 250 V. (clip type)
	710-0002	Glass - Picture Window - 17"
	476-0002	Insulator - Electrolytic Capacitor Mounting
	415-0008	Jumper - Audio Socket
	740-0011	Knob - Inner
	744-0011	Knob - Outer - Brightness
	740-0013	Knob - Plain - Antenna
	743-0006	Knob - TV Tuner - Band
	792-0004	Knob - TV Tuner - Pointer
	611-0047	Lamp - Dial Light
	591-0017	Leaflet - Customer Instruction
	716-0302	Mask and Gasket Assembly (7140W)
	716-0203	Mask and Gasket Assembly (7140M)
	400-0007	Magnet Assembly - Focus and Centering
	400-0011	Magnet Assembly - Ion Trap
	415-0002	Plug - 2 Prong - Interlock
	415-0001	Plug - 4 Prong - Speaker
R171	189-0007	Resistor - 4.3 Ohm - 1/2 W. - W.W.
R116	181-0470	Resistor - 47 Ohm - 1/2 W.
R136, R139	181-0820	Resistor - 82 Ohm - 1/2 W.
R101, R146, R228, R230	181-0101	Resistor - 100 Ohm - 1/2 W.
R104	181-0121	Resistor - 120 Ohm - 1/2 W.
R169	181-01815	Resistor - 180 Ohm - 1/2 W.
R131, R142	181-0221	Resistor - 220 Ohm - 1/2 W.
R119	181-0471	Resistor - 470 Ohm - 1/2 W.

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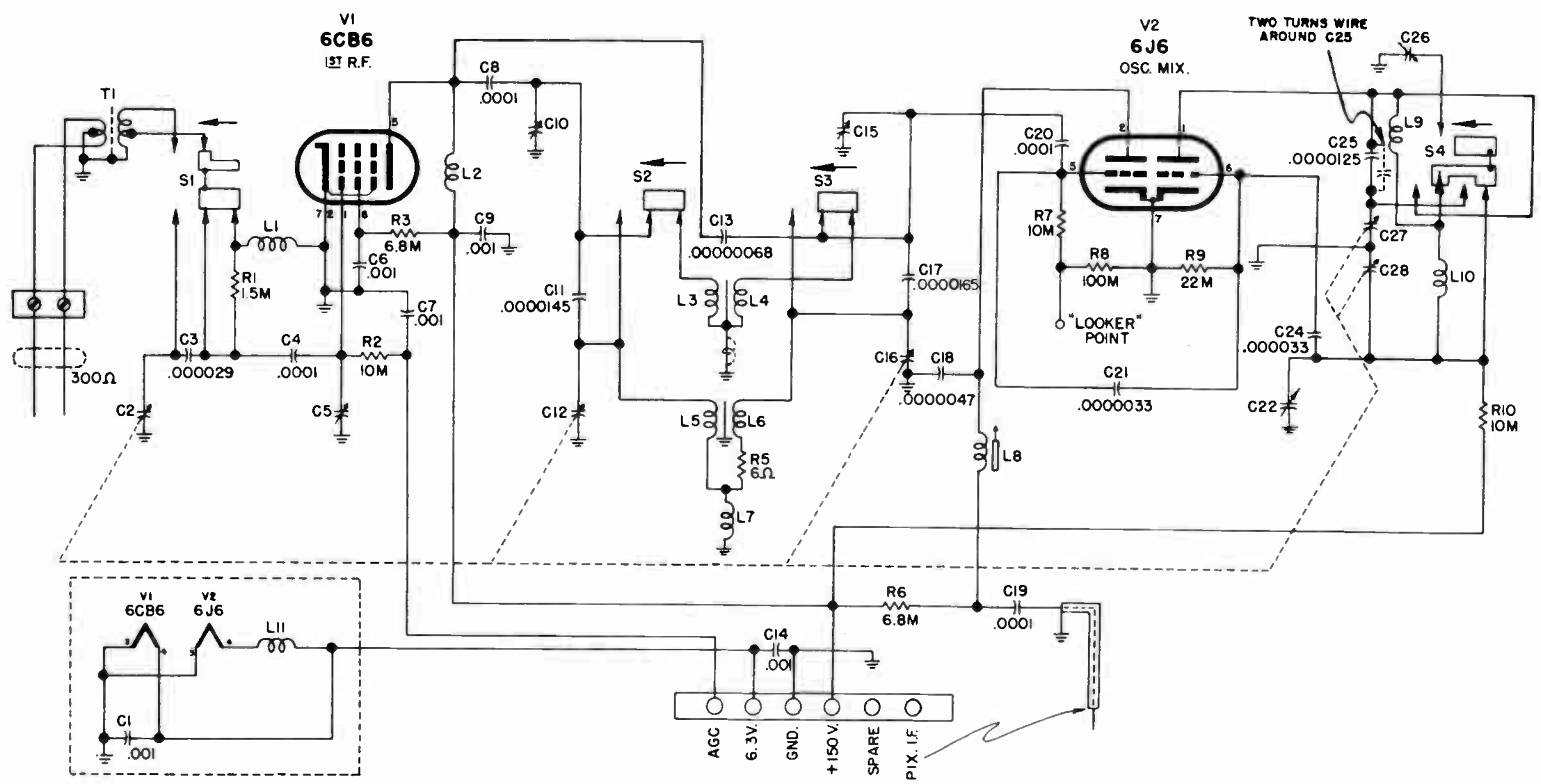
SCHEMATIC LOCATION	SERVICE PART NUMBER	DESCRIPTION
R202, R203	181-0561	Resistor - 560 Ohm - 1/2 W.
R200	181-0681	Resistor - 680 Ohm - 1/2 W.
R133	181-0821	Resistor - 820 Ohm - 1/2 W.
R103, R134, R138, R143, R220, R234	181-0102	Resistor - 1,000 Ohm - 1/2 W.
R117	181-0152	Resistor - 1,500 Ohm - 1/2 W.
R127	181-0332	Resistor - 3,300 Ohm - 1/2 W.
R145	181-03325	Resistor - 3,300 Ohm - 1/2 W.
R197	181-04725	Resistor - 4,700 Ohm - 1/2 W.
R144, R226	181-0472	Resistor - 4,700 Ohm - 1/2 W.
R135	181-0562	Resistor - 5,600 Ohm - 1/2 W.
R128	181-0682	Resistor - 6,800 Ohm - 1/2 W.
R219	181-0822	Resistor - 8,200 Ohm - 1/2 W.
R176, R177, R184	181-0103	Resistor - 10,000 Ohm - 1/2 W.
R185	181-0123	Resistor - 12,000 Ohm - 1/2 W.
R222	181-0223	Resistor - 22,000 Ohm - 1/2 W.
R140, R141	181-0273	Resistor - 27,000 Ohm - 1/2 W.
R105, R107, R130, R147, R182	181-0333	Resistor - 33,000 Ohm - 1/2 W.
R100, R102, R194	181-0473	Resistor - 47,000 Ohm - 1/2 W.
R108	181-0683	Resistor - 68,000 Ohm - 1/2 W.
R224	181-0823	Resistor - 82,000 Ohm - 1/2 W.
R109, R215, R129, R216, R196	181-0104	Resistor - 100,000 Ohm - 1/2 W.
R223	181-0154	Resistor - 150,000 Ohm - 1/2 W.
R148	181-01845	Resistor - 180,000 Ohm - 1/2 W.
R113	181-0224	Resistor - 220,000 Ohm - 1/2 W.
R178	181-03345	Resistor - 330,000 Ohm - 1/2 W.
R114, R152, R195, R217, R221, R227	181-0474	Resistor - 470,000 Ohm - 1/2 W.
R180	181-05645	Resistor - 560,000 Ohm - 1/2 W.
R183, R199, R218	181-0105	Resistor - 1 Megohm - 1/2 W.
R149	181-01255	Resistor - 1.2 Megohm - 1/2 W.
R186, R192	181-0125	Resistor - 1.2 Megohm - 1/2 W.
R181	181-0225	Resistor - 2.2 Megohm - 1/2 W.
R132	181-0335	Resistor - 3.3 Megohm - 1/2 W.
R112	181-0156	Resistor - 15 Megohm - 1/2 W.
R137	182-0471	Resistor - 470 Ohm - 1 W.
R232	182-0102	Resistor - 1,000 Ohm - 1 W.
R106	182-0103	Resistor - 10,000 Ohm - 1 W.
R187	182-0333	Resistor - 33,000 Ohm - 1 W.
R115	183-0151	Resistor - 150 Ohm - 2 W.
R118	183-0221	Resistor - 220 Ohm - 2 W.
R163	183-03325	Resistor - 3,300 Ohm - 2 W.
R233	183-0472	Resistor - 4,700 Ohm - 2 W.
R151	183-0562	Resistor - 5,600 Ohm - 2 W.
R150	183-0682	Resistor - 6,800 Ohm - 2 W.
R188	183-0153	Resistor - 15,000 Ohm - 2 W.
R235, R236	189-0019	Resistor - 1.5 Megohm - 2 W.
R229	189-0020	Resistor - 150 Ohm - 3 W.
R164	189-0023	Resistor - 3,600 Ohm - 3 W.
R231	187-0004	Resistor - 6,800 Ohm - 3 W.
R168	187-0003	Resistor - 270 Ohm - 5 W. - W.W.
R166	185-0001	Resistor - 1,185 Ohm
R165		Resistor - 3,000 Ohm
	539-1201	Speaker - 12" PM
	414-0004	Socket - 4 Prong
	412-0006	Socket - 8 Prong - Octal
	412-0018	Socket - 8 Prong - Octal - Shock Mounted
	412-0012	Socket - 9 Prong - Miniature
	412-0015	Socket - 7 Prong - Miniature
	558-0003	Spacer - Shock Mounted Socket
	496-0049	Spring - Grounding
	488-0004	Stop - Rubber
	473-0002	Switch Arm Assembly - Pilot Light
T54	143-0017	Transformer - Output - Speaker
T52	128-0004	Transformer - Sound Discriminator - Primary
T53	128-0005	Transformer - Sound Discriminator - Secondary
T59	240-0001	Transformer - Heater Isolation
T55, T56, T57	125-0002	Transformer - IF Interstage

SCHEMATIC LOCATION	SERVICE PART NUMBER	DESCRIPTION
T58	120-0002	Transformer - IF Bandpass
T51	120-0001	Transformer - IF Sound 4.5 Mc.
T62	128-0006	Transformer - Horizontal Discriminator
T63	241-0003	Transformer - Horizontal Scanning Assembly
T50	141-0015	Transformer - Power - 60 cycle
T61	241-0004	Transformer - Vertical Scan
T60	242-0001	Transformer - Vertical Oscillator
	633-0003G	Tube - 5U4G
	623-0011G	Tube - 6BC5
	623-0003G	Tube - 6AL5
	623-0005G	Tube - 6AU6
	623-0004G	Tube - 6BA6
	623-0017G	Tube - 6BF5
	622-0011G	Tube - 6BL7GT
	623-0022G	Tube - 6CB6
	622-0013G	Tube - 6CD6G
	623-0002G	Tube - 6J6
	622-0012G	Tube - 6L6G
	622-0005G	Tube - 6SN7GT
	623-0010G	Tube - 6T8
	633-0004G	Tube - 6W4GT
	623-0008G	Tube - 12AX7
	636-0001G	Tube - 5642
	642-0008G	Tube - 17BP4A
	323-0002	Tuner Unit
L61, L62, L64, L65	100-0003	Yoke - Deflection



NOTE:
1. SWITCH SECTIONS 1-4 ARE PARTS OF A TWO POSITION SLIDE SWITCH. SWITCH SHOWN IN POSITION FOR HI BAND RECEPTION. ARROW INDICATES SWITCH DIRECTION FOR LO TV RECEPTION.

FIGURE 18 - TUNER SCHEMATIC FOR CHASSIS 1-356

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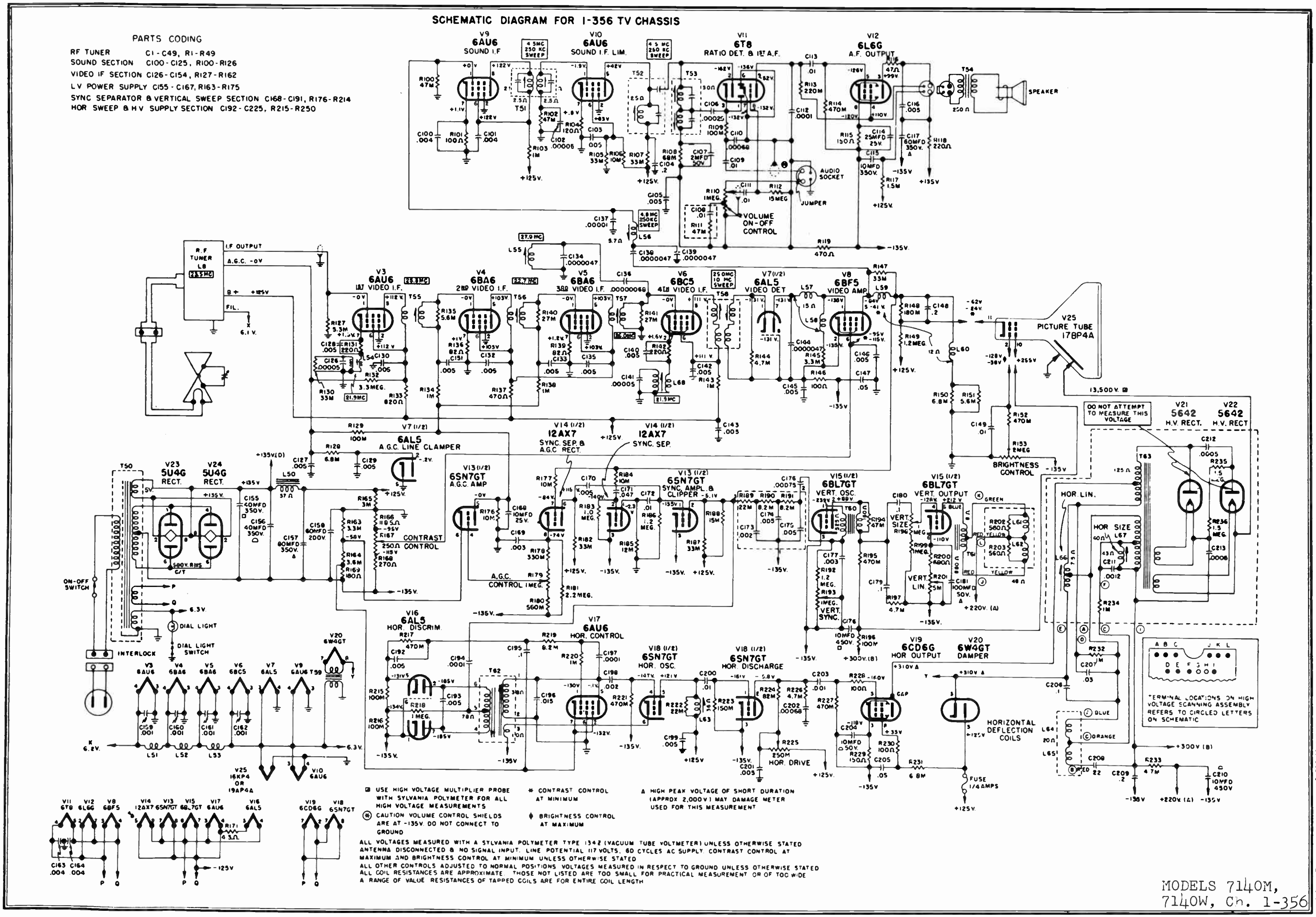
SCHEMATIC DIAGRAM FOR 1-356 TV CHASSIS

PARTS CODING

- RF TUNER C1-C49, R1-R49
- SOUND SECTION C100-C125, R100-R126
- VIDEO IF SECTION C126-C154, R127-R162
- L.V. POWER SUPPLY C155-C167, R163-R175
- SYNC SEPARATOR & VERTICAL SWEEP SECTION C168-C191, R176-R214
- HOR SWEEP & H.V. SUPPLY SECTION C192-C225, R215-R250



- ■ USE HIGH VOLTAGE MULTIPLIER PROBE WITH SYLVANIA POLYMETER FOR ALL HIGH VOLTAGE MEASUREMENTS
- ⊛ CAUTION VOLUME CONTROL SHIELDS ARE AT -135V. DO NOT CONNECT TO GROUND
- * CONTRAST CONTROL AT MINIMUM
- ♦ BRIGHTNESS CONTROL AT MAXIMUM
- Δ HIGH PEAK VOLTAGE OF SHORT DURATION (APPROX 2,000 V) MAY DAMAGE METER USED FOR THIS MEASUREMENT

ALL VOLTAGES MEASURED WITH A SYLVANIA POLYMETER TYPE 134-2 (VACUUM TUBE VOLTMETER) UNLESS OTHERWISE STATED ANTENNA DISCONNECTED & NO SIGNAL INPUT. LINE POTENTIAL 117 VOLTS, 60 CYCLES AC SUPPLY. CONTRAST CONTROL AT MAXIMUM AND BRIGHTNESS CONTROL AT MINIMUM UNLESS OTHERWISE STATED
ALL OTHER CONTROLS ADJUSTED TO NORMAL POSITIONS. VOLTAGES MEASURED IN RESPECT TO GROUND UNLESS OTHERWISE STATED
ALL COIL RESISTANCES ARE APPROXIMATE. THOSE NOT LISTED ARE TOO SMALL FOR PRACTICAL MEASUREMENT OR OF TOO WIDE A RANGE OF VALUE. RESISTANCES OF TAPPED COILS ARE FOR ENTIRE COIL LENGTH

MODELS 7140M, 7140W, Ch. 1-356

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MODEL 7150M

MODEL 7160B

GENERAL DESCRIPTION

Chassis 1-357, Models 7150M and 7160B, are combinations providing a direct viewing television receiver capable of receiving all 12 commercial television channels, a radio capable of receiving the standard broadcast band and frequency modulation band, and an automatic record changer. The television picture is reproduced on a 17 inch rectangular, black faced, tetrode type picture tube using electromagnetic deflection.

SPECIFICATIONS

Frequency Range

Television	
All 12 television channels	54-88 Mc., 174-216 Mc.
Picture IF Carrier	26.4 Mc.
Sound IF Carrier	4.5 Mc. & 21.9 Mc.
Standard Broadcast (AM)	540-1600 Kc.
IF Carrier	455 Kc.
Frequency Modulation (FM)	88-108 Mc.
IF Carrier	10.7 Mc.

Power Supply 105-128 Volts 60 cycle AC, 330 watts

Loud Speaker 12" Permanent Magnet

Cabinet Dimensions (inches)	Height	Width	Depth
7150M	37.4	35.6	21.7
7160B	39.5	37.6	21.4

Weight (pounds)	Net	Gross
7150M	176	211
7160B	185	215

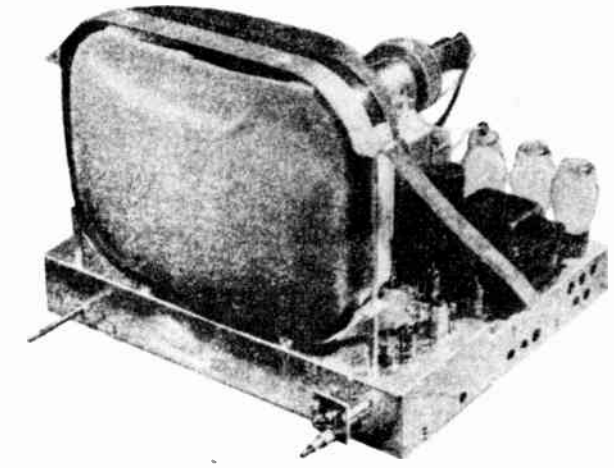
Antenna Input Impedance

The receiver, having an antenna input impedance of 300 ohms, is shipped to the customer with the built-in antenna connected. This must be disconnected when an external antenna is used.

SYLVANIA TUBE COMPLEMENT

(includes rectifiers and picture tube)

Symbol	Function	Type
V1	R. F. Amplifier	6CB6
V2	Oscillator-Converter	6J6
V3	1st Video IF Amplifier	6AU6
V4	2nd Video IF Amplifier	6BA6
V5	3rd Video IF Amplifier	6BA6
V6	4th Video IF Amplifier	6BC5
V7	Video Detector - AGC Line Clamper	6AL5
V8	Video Amplifier	6BF5
V9	Sound IF Amplifier	6AU6
V10	Sound IF Limiter	6AU6
V11	Ratio Detector - 1st Audio Amplifier	6T8
V12	Audio Output	6L6G
V13	AGC Amplifier - Sync Amplifier & Clipper	12AU7
V14	AGC Rectifier - Sync Separator	12AX7
V15	Vertical Oscillator and Output	6BL7GT
V16	Horizontal Discriminator	6AL5
V17	Horizontal Control	6AU6
V18	Horizontal Oscillator and Discharge	12AU7
V19	Horizontal Output	6CD6G
V20	Damper	6W4GT
V21	High Voltage Rectifier	5642
V22	High Voltage Rectifier	5642
V23	Low Voltage Rectifier	5U4G
V24	Low Voltage Rectifier	5U4G
V25	Picture tube	17BP4A



CHASSIS 1-357

RADIO TUNER

V26	Oscillator-Mixer	7F8
V27	1st IF Amplifier, AM & FM	6BA6
V28	2nd IF Amplifier, AM & FM	6BA6
V29	FM Ratio Detector, AM Detector	6T8

CIRCUIT DESCRIPTION

The Sylvania television and AM-FM receiver chassis 1-357 operates with twenty-four tubes, plus two low-voltage rectifiers, two high-voltage rectifiers, and one picture tube. The operating controls on the front panel have been reduced to a minimum; which are Tone, AM-FM Radio Tuning, Volume, Function Switch, Brightness, and TV Channel Selector and Band Switch. The remaining controls, which are seldom ad-

CAUTION NOTICE

THE HIGH VOLTAGE LEAD TO THE PICTURE TUBE HAS A POTENTIAL OF 13,500 VOLTS. PRECAUTIONS SHOULD BE OBSERVED WHEN THE CHASSIS IS REMOVED FROM THE CABINET FOR SERVICE PURPOSES. DO NOT OPERATE THE RECEIVER WITH THE H V COVER REMOVED.

ALWAYS USE SAFETY GOGGLES AND GLOVES IF IT IS NECESSARY TO REMOVE THE PICTURE TUBE.

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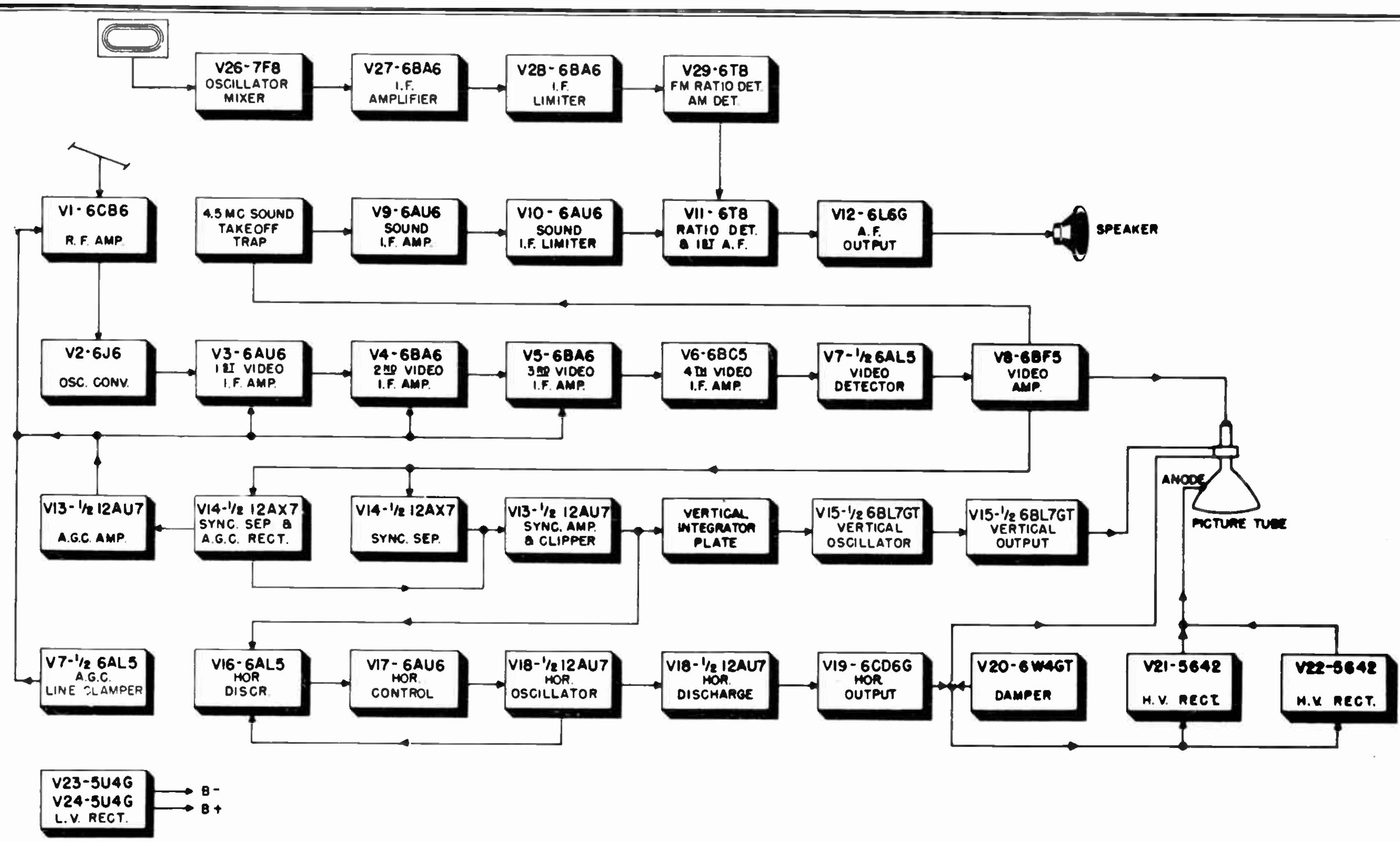

FIGURE 1 - BLOCK DIAGRAM

justed, are located at the rear of the chassis. Special features of this receiver are as follows:

Rotary Channel Selector

A compact, low drift, 12 channel rotary tuner is provided in these chassis for simplicity of operation. Continuous tuning eliminates the need of a fine tuning control.

Built-In Antenna

Eliminating the cost and inconvenience of an external antenna a Sylvania tuned dipole type antenna is built-in to provide satisfactory reception in most locations. The antenna is peaked for resonance to the individual channel by rotating the trimmer knob on the top of the receiver.

Automatic Gain Control

Simplified customer operation is provided by a very flat AGC system which has a high degree of noise immunity. Very little, if any, readjustment of controls is required in going from one station to another.

Direct-Coupled Video System

A direct coupled video system eliminates all video coupling capacitors and D.C. Restorer. This reduces the visible effects of noise.

Horizontal Automatic Frequency Control

A sine wave Horizontal AFC is employed, providing excellent picture stability, even in the presence of noise and weak signals.
For convenience in tracing circuits a block diagram is shown in Figure 1. The antenna is connected to the input of the RF tuner. This tuner functions to select the desired television channel by continuous tuning. The output of the tuner is at intermediate frequency and of sufficient band width to pass both picture and sound carriers of the desired signal.

The output of the tuner is then applied to the video IF Amplifier consisting of 3 stagger-tuned stages and one bandpass stage. The adjacent channel carriers and co-sound carrier are attenuated by this IF Amplifier.

The video signal out of the video detector is amplified by a single stage and impressed on the picture tube.

Automatic gain control is obtained from the AGC Rectifier, amplified by the AGC Amplifier and applied to the RF and IF Amplifiers. The AGC Line Clamper prevents the Tuner AGC Line from going positive under weak signal conditions.

The sync pulses are separated from the video signal, amplified, and clipped and then fed to the Horizontal Discriminator and Vertical Integrator plate. The Vertical Sync information from the vertical integrator plate is applied to Vertical Oscillator to keep this oscillator in step with the vertical sync pulses from the station. The Vertical Oscillator produces a peaked saw-tooth wave which is applied to the Vertical Output stage energizing the Vertical Deflection coils.

Horizontal Sync information from the Sync clipper is supplied to the Horizontal Discriminator. A voltage from the Horizontal Oscillator is also supplied to the Horizontal Discriminator. The output of the Horizontal Discriminator is then applied to the Horizontal Control tube which functions to hold the Horizontal Oscillator in synchronism with the incoming horizontal sync pulses.

The Horizontal Oscillator actuates the Horizontal Discharge tube through the Horizontal Ringing Coil producing a peaked saw-tooth

TELEVISION CHANNELS & FREQUENCIES

CHANNEL NO.	FREQ. MC.	PICTURE CARRIER MC.	SOUND CARRIER MC.	HETERODYNE OSC. FREQ. MC.
2	54 - 60	55.25	59.75	81.65
3	60 - 66	61.25	65.75	87.65
4	66 - 72	67.25	71.75	93.65
5	76 - 82	77.25	81.75	103.65
6	82 - 88	83.25	87.75	109.65
7	174 - 180	175.25	179.75	201.65
8	180 - 186	181.25	185.75	207.65
9	186 - 192	187.25	191.75	213.65
10	192 - 198	193.25	197.75	219.65
11	198 - 204	199.25	203.75	225.65
12	204 - 210	205.25	209.75	231.65
13	210 - 216	211.25	215.75	237.65

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wave. Approximately one-half of the saw-tooth component of this wave causes current to flow in the plate circuit of the Horizontal Output tube. This current energizes the Horizontal Deflection Coils through the Horizontal Scanning Transformer to provide the right half of the horizontal scan. During the right half of the scan, a small amount of current is also flowing through the Damper tube. At the end of the saw-tooth, the inverse pulse component acts on the grid of the Horizontal Output Tube to cut off plate current flow. When this occurs, the energy in the Horizontal Deflection circuit transfers rapidly from the inductive branch of the circuit to the capacitive branch resulting in a voltage peak of approximately 2000 Volts across the Horizontal Deflection Coils. This voltage is stepped up to approximately 6750 Volts by the turns ratio of the Horizontal Scanning Transformer and fed to the voltage doubling rectifier circuit to provide approximately 13,500 Volts for the picture tube H.V. anode.

The damper tube does not conduct during the high voltage pulse period because of the polarity of the pulse. During this pulse period, when the energy transfers from the inductive branch of the horizontal deflection circuit to the capacitive branch and back again to the inductive branch, the electron beam in the picture tube is moved rapidly from the right to the left edge of the raster to accomplish retrace.

At the completion of retrace, energy again flows out of the inductive branch of the circuit. The horizontal output tube is still cut off during this time and a strong current flows through the damper tube. This current decreases to zero linearly to provide the left half of the scan. As the current approaches zero, the horizontal output tube again begins to conduct and the entire cycle is repeated.

ANTENNA INSTALLATION

Television

The 1-357 chassis model is shipped with a built-in antenna connected to the antenna board. For most installations the built-in antenna will provide satisfactory reception.

A variable capacitor controlled from the top of the receiver adjusts the antenna circuit to resonance. At each individual channel the capacitor should be adjusted for best picture quality.

If an external antenna is desirable, the Sylvania Hideaway Antenna, Part 580-0005, gives optimum performance where an indoor installation is indicated, and the Sylvania Conical Fan Television Antenna, Part 580-0001, is available in one, two and four bay arrays, providing superior performance in an outside installation. When using the Sylvania Hideaway Antenna or the Sylvania Conical Fan Antenna, remove the leads to the built-in antenna from the antenna terminal and then connect matching 300 Ohm twin lead from the antenna installation in its place. A 300 Ohm lead is especially recommended where the lead-in is in excess of 100 feet.

A 75 Ohm shielded coaxial input may be used with the chassis if impedance matching coils, Sylvania Part No. 111-0007, are wired between the lead-in and the antenna terminals. A coaxial lead-in may be necessary in those areas where high noise signals prevail.

AM-FM Radio

AM RECEPTION - Excellent local reception may be obtained by the use of only the built-in loop which is installed on all 1-357 chassis models. However, if an outside installation is desirable, connect the antenna lead-in to the terminal provided at back of loop.

FM RECEPTION - Provisions are also made on this chassis for FM reception without the use of an external antenna. For this circuit operation, connect the metal jumper between terminals 2 and 3 as shown in Figure 2. In this manner, one side of the AC power line is used as an FM antenna. If reception is not satisfactory and an external installation is desirable, remove the jumper from terminals 2 and 3 and connect antenna lead-in to terminals 1 and 2.

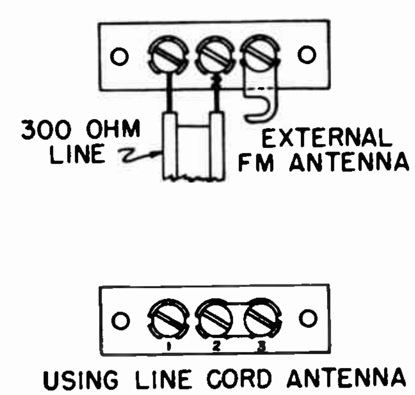

FIGURE 2 - ANTENNA HOOKUP

The FM antenna terminal board, shown in Figure 2 is located at the right on the rear of the television chassis.

OPERATING INSTRUCTIONS

TELEVISION RECEPTION

A. To adjust and tune this receiver for television reception, proceed as follows:

1. Turn On-Off, Tone Control (18) to On.
2. Turn the Function switch (19) to TV.
3. Allow several minutes warm-up period.
4. Turn band switch (5) either way to the appropriate band (i.e. channels 2-6 or channels 7-13).
5. Rotate the Channel Selector (4) so that the desired channel number is seen in the window and until you can see the picture.
6. Turn the Brightness control (2) fully counterclockwise, and then slowly clockwise until activity is clearly visible on the screen.
7. Adjust the Channel Selector (4) and Antenna Trimmer (1) for best picture quality.
   Note: Adjustment of the Antenna Trimmer is not necessary if an external antenna is used.
8. Adjust the Volume control (3) for desired volume and Tone control (18) for desired tone.
9. Slight adjustment of the Brightness control (2) may be necessary to obtain the best possible picture.

B. To change from one television station to another:

1. Turn the Band switch (5) fully clockwise to tune any channel from 2 through 6 or fully counterclockwise to tune any channel from 7 through 13.
2. Rotate the Channel Selector (4) so that the desired channel number is seen in the window and adjust for best picture quality.
3. If necessary, adjust the Brightness control (2) for best picture. Only slight adjustment of this control should be necessary.

C. To turn on dial light, push dial light switch to left.

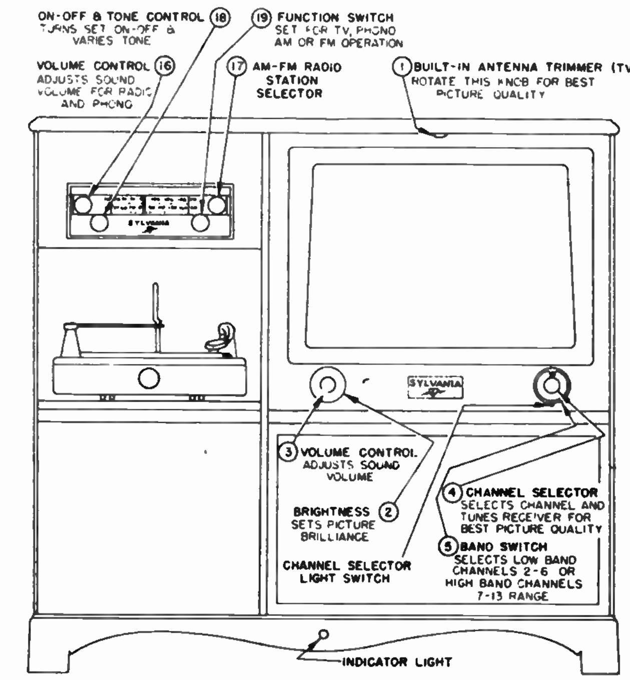

FIGURE 3 - FRONT OF CABINET CONTROLS

AM-FM & PHONO OPERATION

For AM, FM, or Phonograph operation, proceed as follows:

1. Turn On-Off, Tone Control (18) to On.
2. Turn Function Switch (19) to AM, FM, or Phono position. Starting at counterclockwise position, settings of this switch are: FM, AM, Phono, TV.
3. Select desired AM or FM station by turning AM-FM Radio Station Selector (17) until the approximate frequency of the desired station is indicated behind the dial pointer. Read bottom dial scale for AM, top scale for FM band. Tune carefully for clearest reception.
4. If phonograph operation has been selected, follow the record changer operating instructions given on Page 2 of Bulletin 9-14.
5. Radio or phonograph volume may be adjusted by turning the Volume Control (16). Tone may be changed to individual taste by turning the Tone Control (18).

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INSTALLATION AND SERVICE INSTRUCTIONS

Picture Tube Handling

All Sylvania Television receivers incorporating chassis 1-357 are shipped complete with picture tube installed on the chassis and connected for operation. However, if it becomes necessary to re-install a picture tube due to replacement or servicing, the following precautions should be observed.

1. Do not open the picture tube carton until ready to install the picture tube.
2. Do not handle the picture tube unless protective goggles and gloves are worn. People not so equipped with safety devices should be kept at a distance while the picture tube is being handled.
3. Keep the picture tube as far from the body as possible while handling.

Picture Tube Replacement

To remove the picture tube from the chassis, remove the picture tube socket, anode connector, and ion trap magnet. Remove the tube holddown strap by removing the two screws on either side. When the rim of the picture tube is free of the strap, carefully pull the picture tube out through the focus magnet and deflection coils.

To replace picture tube follow the above procedure in reverse order being careful not to force the picture tube if neck binds. Be sure the tube is properly held by the lips of the holddown straps before tightening the holddown screws.

Chassis Removal

To remove the chassis from the cabinet, proceed as follows:

1. Remove all panel control knobs from the front of cabinet.
2. Remove the holddown screws from the underside of the chassis shelf. Access to these screws is from the rear of the cabinet.
3. Disconnect the built-in antenna, remove the interlock cover screws and remove interlock cover.
4. Remove plugs from the power, speaker, indicator light, and audio sockets on the TV chassis.
5. Slide the chassis all the way out the back of the cabinet.

To replace the chassis, reverse the above procedure.

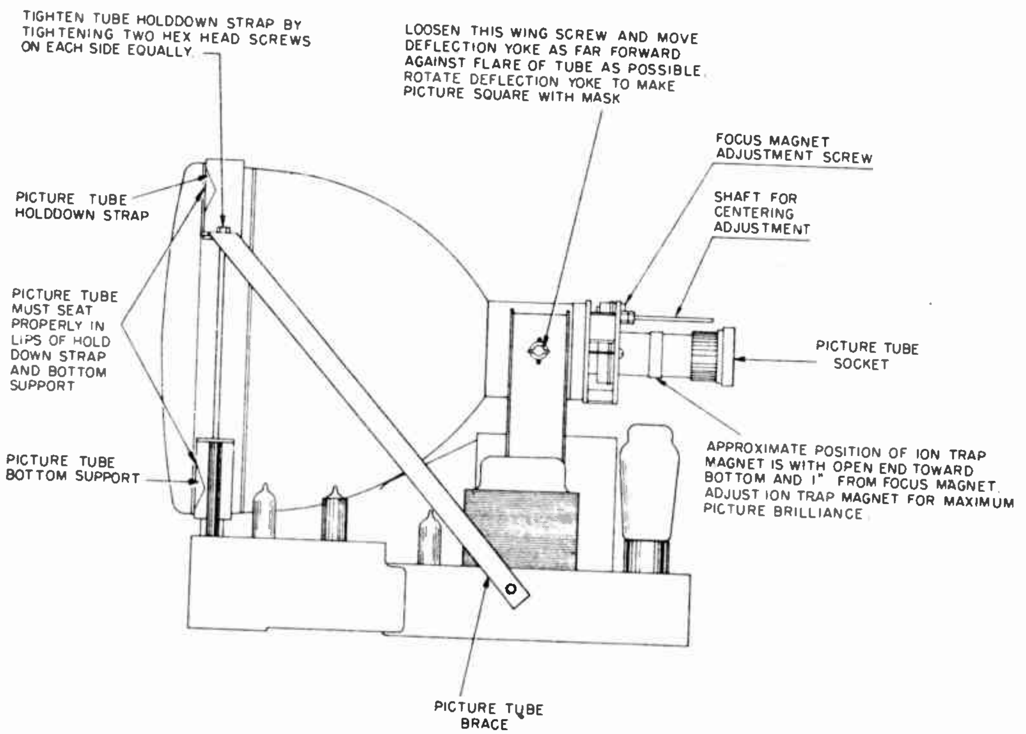

FIGURE 4 - PICTURE TUBE INSTALLATION

Preset Controls Adjustments

All preset controls are located at the rear of the receiver and are readily available without removing the interlock cover.

AGC - See AGC Control Adjustment

Horizontal Hold - See "Adjustment of Horizontal AFC Operation".

Contrast - Adjust contrast control to obtain best contrast with a good picture or test pattern.

Vertical Linearity and Height - Adjust the height control until the picture fills the screen vertically. Adjust the Vertical Linearity control until the pattern is symmetrical from top to bottom. Adjustment of either control will require a readjustment of the other.

Vertical Hold - Rotate the Vertical Hold control until the pattern is slowly moving downward. Back off on the control to a point just beyond where the vertical motion stops.

Horizontal Drive - Turn the horizontal drive control clockwise as far as possible without crowding of center of the picture.

Horizontal Size - Adjust the horizontal size control until picture fills the mask horizontally.

Horizontal Linearity - Adjust the horizontal linearity control until the picture is symmetrical left to right. Re-check Horizontal Drive after adjusting Horizontal Size and Horizontal Linearity.

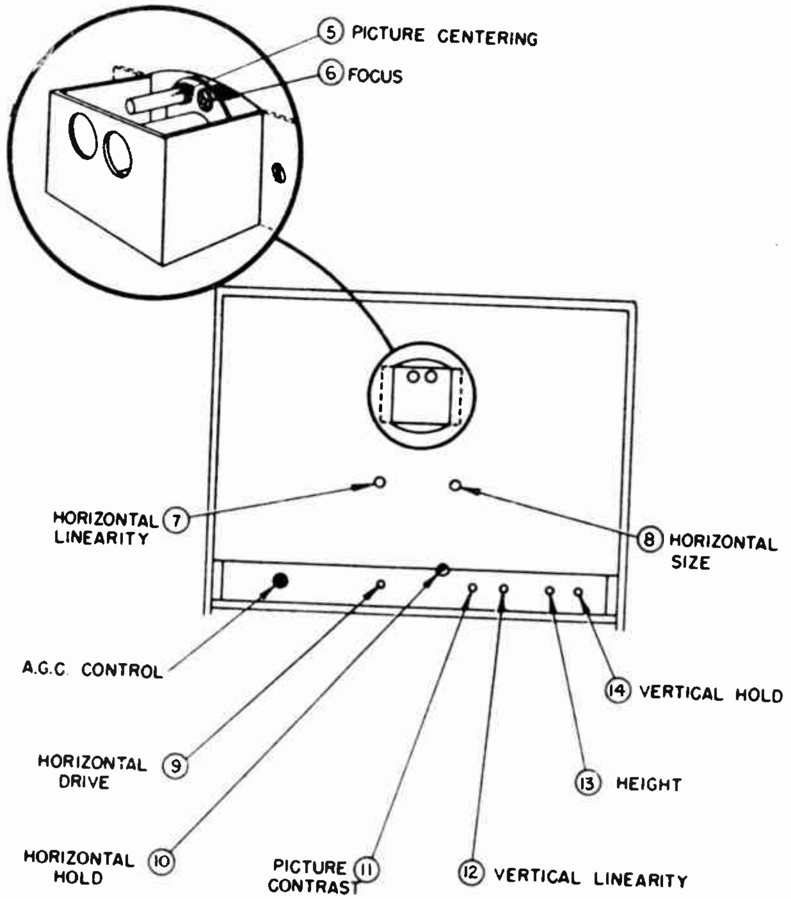

FIGURE 5 - REAR PANEL CONTROLS

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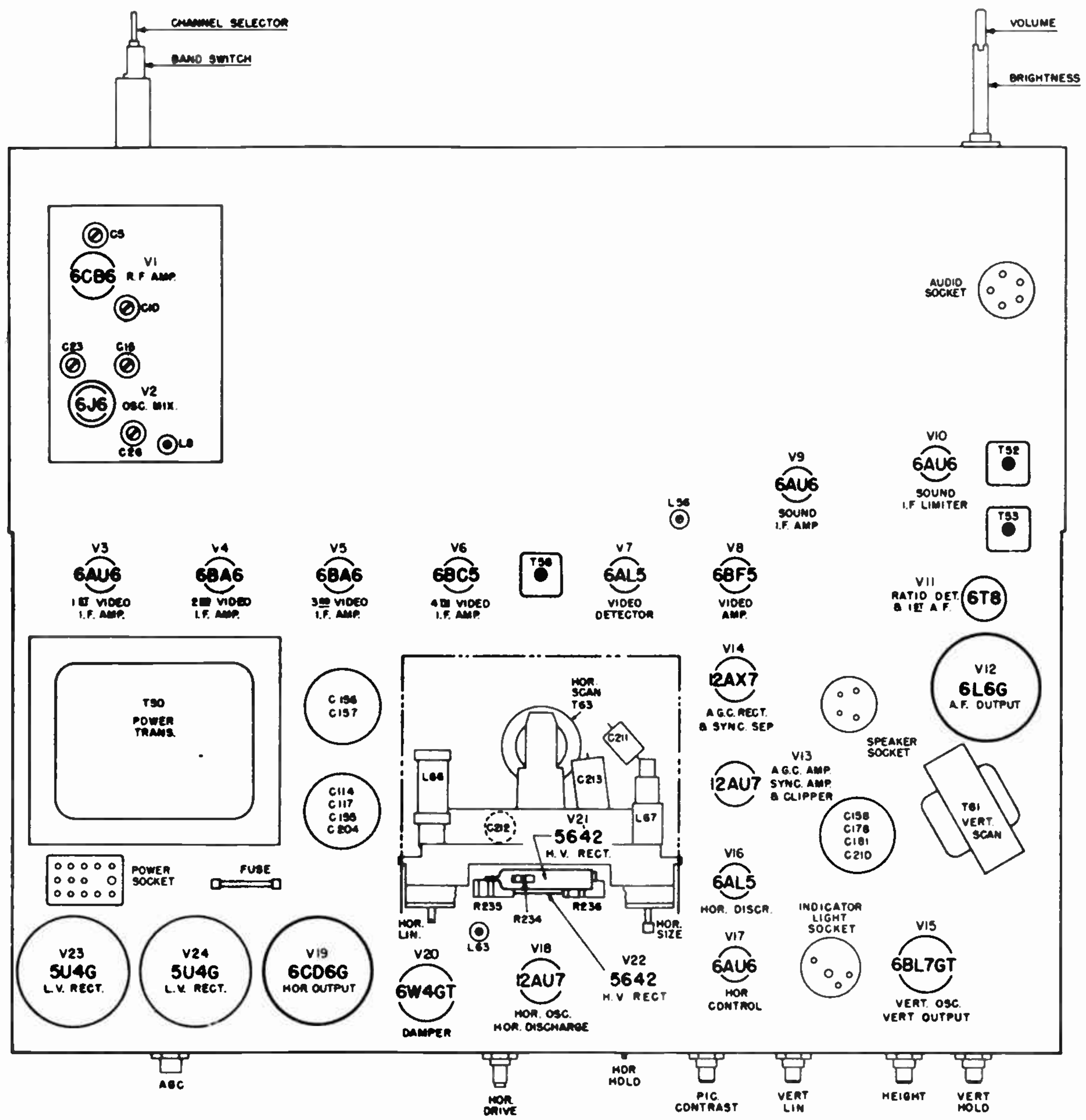

FIGURE 6 - CHASSIS TOP LAYOUT

Adjustment of Ion Trap Magnet, Focus Magnet, and Centering Shutter

These adjustments are interdependent and, therefore, it is necessary to check all three at the same time.

Before making any adjustments, the function of each magnet should be noted.

The ion trap magnet is used to obtain maximum brilliance of the raster or picture and should be adjusted to obtain maximum brilliance as described below.

The focus magnet is used to obtain correct focus of the picture.

The centering shutter is an integral part of the focus magnet assembly. Its function is to position the picture, both horizontally and vertically.

Before making any adjustments, check that the deflection yoke is positioned so that it is pressing against the flare of the picture tube. To ensure this, loosen the thumb-screws located at each side of the yoke and push the yoke as far forward as it will go. If the picture is not square with the screen mask, rotate the yoke.

Next, check that the focus magnet is held firmly by both brass screws against the yoke; there should not be any gap between the yoke and the focus magnet.

When adjusting the focus of the receiver it is to be noted that optimum focus of the picture does not necessarily result when either the vertical or the horizontal is adjusted for maximum definition. Optimum focus is frequently a compromise between these two settings. It is highly desirable, therefore, that a transmitted picture, containing both vertical and horizontal lines, be available for correct focusing of the receiver.

Before proceeding with the adjustment of the focus of the receiver, first ensure that the ion trap magnet is correctly adjusted.

Set the contrast control at minimum and the brightness control at maximum. The ion trap magnet should first be positioned so that there is approximately one inch between the ion trap magnet and the focus magnet. There is no specific angle of rotation for the initial setting of the ion trap. The ion trap magnet should be slowly rotated until a picture (or raster, if the receiver is not yet tuned to a station) is visible on the screen. The brightness should now be reduced by means of the brightness control and the ion trap magnet carefully twisted and moved a small amount backwards and forwards on the neck of the tube, to obtain maximum brightness.

Finally, adjust the brightness control to obtain maximum brightness on the screen and then carefully adjust the ion trap magnet. It may be possible to increase the brightness still more by turning the contrast control towards maximum and again adjusting the ion trap magnet. The correct position of the ion trap magnet is that which ensures the greatest possible brightness of the raster or picture before it enlarges and "blooms" as the setting of the brightness control is increased. Do not leave the brightness control in this position as the condition causes overload of the picture tube.

A preliminary adjustment of the screw on the focus magnet should now be made to obtain a raster or picture which is focused - this preliminary adjustment will not, of course, be necessary if the raster or picture is already in focus. (Note: Use a non-magnetic screw driver to adjust the focus screw.)

If the picture is not centered on the screen, either horizontally or vertically, properly position it by adjustment of the centering shutter. This centering adjustment will move the picture up, down, left or right as required to center the picture. With the brightness control at a low level, check the horizontal size and height of the picture to insure that when the picture is properly positioned it just fills the mask with no corner cutting.

Carefully make final adjustments of the focus screw for optimum focus in both horizontal and vertical directions. Best focus of the picture does not necessarily result when either the vertical or horizontal focus is optimum and the final setting should, therefore, be a compromise between the two. A test pattern with both vertical and horizontal lines is, therefore, highly desirable when making focus adjustment.

Finally, check that the adjustment of the ion trap magnet is such that the brightest possible picture is obtained, as previously mentioned.

Since all these adjustments are interdependent, recheck the adjustment of all three until the best possible picture is obtained.

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ADJUSTMENT OF HORIZONTAL AFC CIRCUIT

Check of Operation

The operation of the AFC circuit should be checked as follows:

A. Tune the receiver to a channel on which no signal is received and return to the original channel. The picture should immediately fall into synchronization.

B. Switch off the power to the receiver for about five minutes and then switch back on. Picture should immediately fall into sync.

C. Check for correct phasing of Horizontal AFC circuit by noting that there is approximately 1/8" of blanking visible on the right hand edge of the picture. It will be necessary to turn the contrast control to minimum and readjust the brightness control and reduce picture size to see the blanking.

NOTE: Before making check C above, be sure the horizontal drive control is correctly adjusted. Refer to "Preset Controls Adjustment," page 8. If the receiver passes the above checks, no adjustments to the horizontal AFC circuits need be made.

If the receiver cannot pass checks "A," "B," or "C" the adjustment of the Horizontal Hold Control as noted under "Horizontal Hold Adjustment" should be made.

Horizontal Hold Adjustment

A. Tune in a station and adjust the tuning control for best picture quality. Adjust the contrast and brightness controls for normal picture.

B. Remove V16 - 6AL5 - Horizontal Discriminator tube.

C. Turn the Horizontal Hold Control until the picture moves back and forth across the screen with blanking bars vertical.

D. Replace the Horizontal Discriminator tube and repeat A, B, and C under "Check of Operation."

E. If receiver still will not pass these checks, it will be necessary to proceed with "Phase Adjustment."

Phase Adjustment

A. Turn the core in the horizontal "ringing" coil all the way out (counterclockwise). Short out the 4700 ohm horizontal charge circuit peaking resistor R226.

With the horizontal size coil set for approximately the correct picture width, and with the horizontal linearity coil adjusted for best linearity, rotate the horizontal drive control fully counterclockwise. Slowly turn the drive control clockwise until crowding is visible in the center of the picture. Now carefully turn the control back (counterclockwise) only sufficient to remove the crowding in the picture or pattern. On some chassis, it may not be possible to obtain crowding of the picture. In such cases the control should be set to the fully clockwise position.

NOTE: Do not operate the receiver with the horizontal drive control mis-adjusted.

B. Remove the 6AL5 horizontal discriminator tube from its socket.

C. Carefully turn the frequency adjustment screw (top of discriminator transformer T62) until the picture moves back and forth across the screen of the picture tube with the blanking bar vertical.

D. Insert the 6AL5 horizontal discriminator tube back into its socket.

E. Adjust the phase adjustment screw (underside of discriminator transformer T62) until approximately 1/8" of "blanking" is visible on the right-hand edge of the picture. In order to see the "blanking", it will be necessary to turn the contrast control almost to minimum, re-adjust the brightness control and reduce picture size.

F. Check the "free-running" of the horizontal oscillator as described under paragraphs "B," "C," and "D," and, if necessary, readjust the frequency adjustment screw on top of horizontal discriminator transformer.

G. Make a final check of the phasing as described in paragraph "E" above. It is important that both the "free-running" and the phasing are correct.

H. Remove the short from across the 4700 ohm resistor R226 and readjust the horizontal drive control as described in (A). Turn the core in the horizontal "ringing" coil clockwise until approximately 1/8" of "blanking" is again visible on the right-hand edge of the picture.

I. Before the horizontal synchronization circuit is adjusted to the final position, it will be necessary to check the operation as follows:

Slowly turn the oscillator frequency adjustment screw (top of transformer T62) in either direction until the picture suddenly falls out of synchronization as indicated by the presence of a number of diagonal bars. The total number of bars visible must not be less than six. These bars may consist of either several full bars and two half bars for the total number or they may be all full bars for the same total number. Slowly turn the adjustment screw so as to decrease the number of bars and note the total number of bars visible just before the picture again falls into synchronization. The last number of bars visible must not be less than three, or more than four. The adjustment screw must be turned very slowly and carefully after the number of bars has been reduced to four or five in order to get an accurate indication of the minimum number of bars it is possible to obtain.

Turn the adjustment screw in the opposite direction until the picture suddenly falls out of synchronization in the opposite direction and repeat the foregoing procedure. Again, the total number of bars visible when the picture falls out of synchronization must not be less than six and not less than three or more than four bars must be visible just before the picture falls into synchronization.

J. After checking the operation as in "I," it is necessary to repeat the procedure described in paragraphs "B," "C," and "D."

K. Remove the signal by tuning to a "free" channel, then retuning to the original channel. The picture should immediately fall into synchronization.

L. Switch "off" the power to the receiver for about five minutes and then switch receiver "on" and check that the picture pulls into synchronization.

AGC CONTROL ADJUSTMENT

This control has been correctly adjusted at the factory and should require no further adjustment. If adjustment becomes necessary as evidenced by poor horizontal or vertical sync; poor video signal (poor contrast). Adjust as follows:

1. Connect a good antenna installation to the receiver.
2. Tune the receiver to a channel on which no picture is received.
3. Set the contrast control to mid-position.
4. Turn the AGC control fully clockwise. The AGC control is located on the rear panel of the chassis.
5. Connect a VTVM from the AGC Amplifier plate to ground (V13, 12AU7, pin 6) and set the AGC control to obtain a negative 0.1 volt reading.

Note: On some receivers the closest approach to this reading will be the fully clockwise position.

6. With the AGC Control set as above, turn the contrast control to almost maximum (about 7/8) and tune in the strongest station available in the area.
7. Again read the AGC Amplifier plate voltage; if reading is less than a negative 2.0 volts leave the control as set.
8. If the AGC Amplifier plate voltage is more than 2 volts negative, slowly turn the AGC control counterclockwise observing the picture.
9. The picture will get darker and then finally start to fall out of sync as evidenced by a sudden shift or jittering of the picture in either the horizontal or vertical direction. Do not turn beyond this point.

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10. Back off (clockwise) slowly on the control until the picture holds in sync without flutter and turn slightly beyond. (Experience will dictate how far beyond to turn).

11. Rock the tuning control slightly either side of the best tuning point to insure picture stays in sync; if not, turn slightly further clockwise and check again.

12. As a final check, turn the volume control up to normal level. Intercarrier buzz should be negligible.

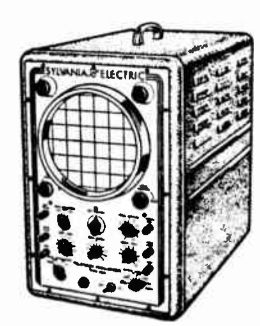
13. Remove objectionable intercarrier buzz by turning the AGC control slightly further clockwise. (Note: The intercarrier buzz is merely a reference for correct adjustment of the AGC control and only a slight touch-up should be necessary. If much adjustment is required to remove intercarrier buzz, the sound section is maladjusted and requires realignment).

14. Rock the tuning control slightly either side of the best tuning point and turn the AGC control slightly more clockwise as necessary to remove objectionable intercarrier buzz.

The intent of the above AGC control adjustment is to provide a maximum of AGC action consistent with proper sync and minimum intercarrier buzz on strong signals.

TEST EQUIPMENT REQUIREMENTS

1. RF sweep generator or generators with frequency range from 4-220 Mc. having sweep width adjustable from 50 Kc. to 10 Mc. with an output of at least 0.1 volt, a marker system, either built-in or external type and flat within ± 1 Db.
2. Signal generator or generators with a frequency range from 4-222 Mc. and an adjustable output of at least 0.1 volt.
3. Sylvania cathode ray oscilloscope type 132 or equivalent capable of passing a 60 cycle square wave.
4. Sylvania Polymeter type 221 or equivalent vacuum tube voltmeter.
5. Sylvania High Voltage Probe Adapter type 225 or equivalent with 0-30 KV DC range (not shown).
6. Sylvania tube tester type 220 or equivalent capable of testing shorts with proper voltages and performance under dynamic conditions.
7. Jig Tube Shield - made by cutting off or insulating the tube shield used on the 6J6 converter tube on the tuner so that the shield does not ground when in place on the tube.



SYLVANIA
POLYMETER
TYPE 221

SYLVANIA
TUBE TESTER
TYPE 220

SYLVANIA
OSCILLOSCOPE
TYPE 132

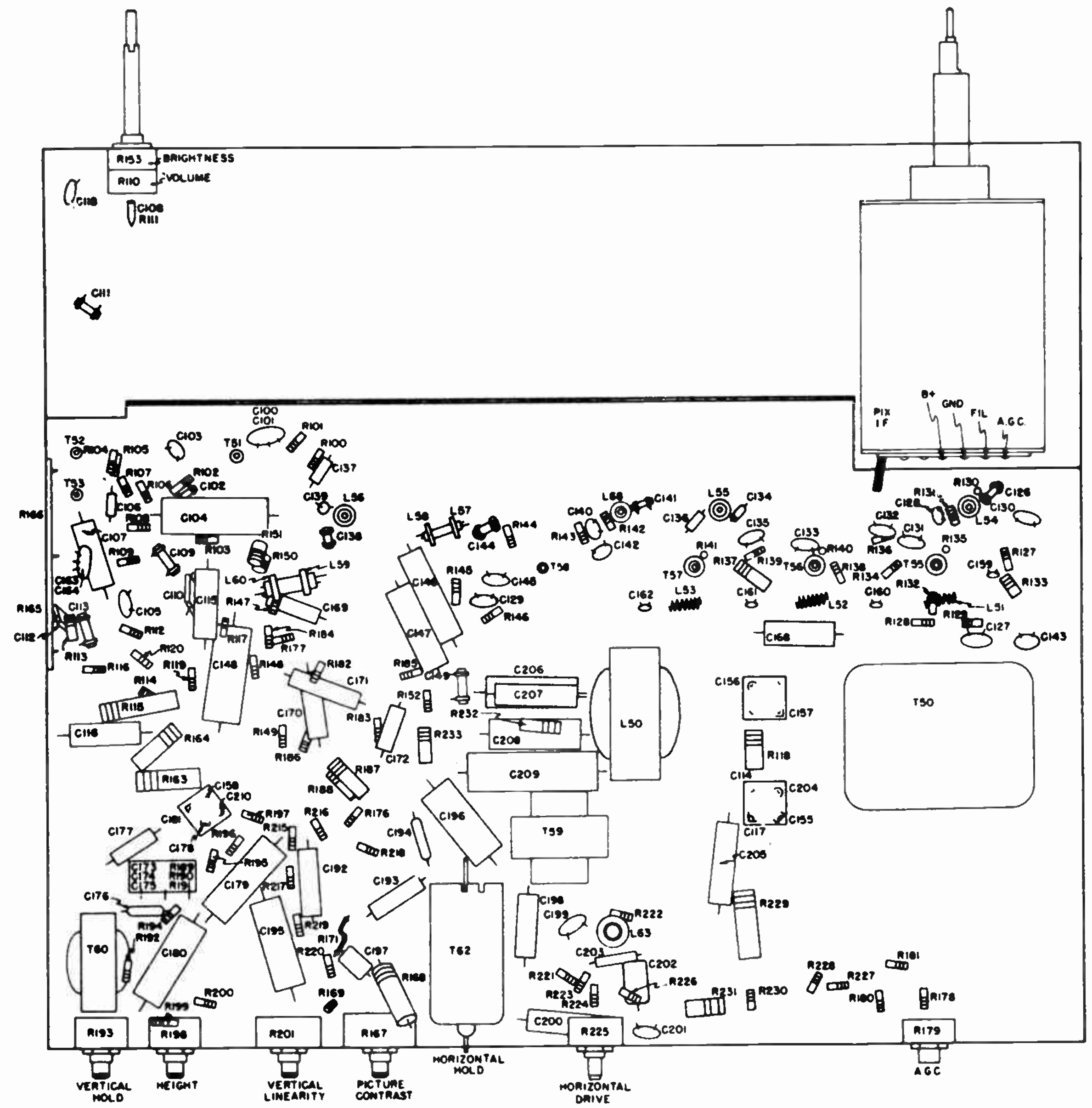


FIGURE 7 - CHASSIS BOTTOM LAYOUT

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ALIGNMENT PROCEDURE

Should any chassis under service require complete realignment, the alignment procedure should be carried out in the following listed order.

PRE-ALIGNMENT INSTRUCTIONS - READ CAREFULLY BEFORE ATTEMPTING ALIGNMENT.

Lay chassis on left side for alignment. Ground all equipment to receiver chassis. Use special alignment tool Service Part No. 898-0003.

VIDEO IF ALIGNMENT

1. Connect signal generator to the jig shield on the 6J6 Oscillator-Mixer. Allow set to warm-up for 15 minutes.

2. Connect the negative lead of a 3 volt battery to the AGC Line, positive lead to ground.

3. Connect D.C. VTVM across the diode load resistor R145 - 3300 Ohm.

4. Adjust the cores of the IF traps in the following order. Keep Voltmeter reading between 1 and 2 volts by reducing Generator Output as required.

Set Signal Generator At:	Adjust:
21.9 Mc.	Core on 4th IF Trap L68 for minimum output
27.9 Mc.	Core on 3rd IF Trap L55 for minimum output
21.9 Mc.	Core on 1st IF Trap L54 for minimum output

5. Adjust the cores of the Video IF Transformers in the following order. Reduce generator output to keep voltmeter reading between 1 and 2 volts.

Set Signal Generator At:	Adjust:
26.0 Mc.	Core on 3rd Video IF Transformer T57 for maximum output
22.7 Mc.	Core on 2nd Video IF Transformer T56 for maximum output
25.3 Mc.	Core on 1st Video IF Transformer T55 for maximum output
23.5 Mc.	Core on Converter Coil L8 for maximum output

Repeat tuning of cores on Trap Coils as described in step 4 above.

6. Disconnect Signal Generator and VTVM.

7. Connect sweep generator (frequency 24Mc., sweeping 10 Mc.) using a .005 Mfd. capacitor to pin 1 of the 4th Video IF 6BC5.

8. Connect oscilloscope to junction of diode load R145 - 3300 Ohm - and coil L58.

9. Adjust primary (top core) and then secondary (lower core) of IF Bandpass T58 to obtain curve shown in Figure 8. (Both adjusted from bottom of Transformer with hex end of special alignment tool.)

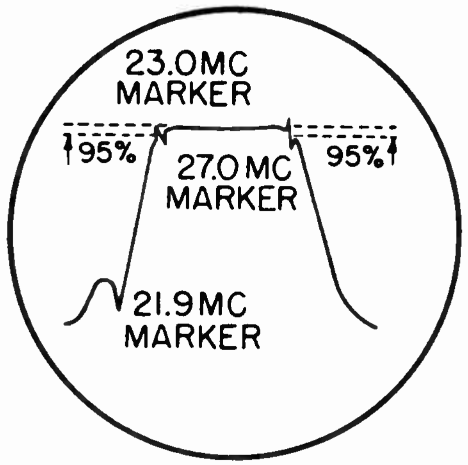

FIGURE 8 - IF BANDPASS RESPONSE

10. Disconnect Sweep Generator from 4th IF Grid and connect it to the Jig Shield on Converter 6J6. Loosely couple signal generator at this point for markers.

11. Observe IF Response Curve and if necessary adjust IF Transformer Core slightly to obtain response curve shown in Figure 9. Keep oscilloscope gain high enough to prevent overload of the receiver which will distort the curve.

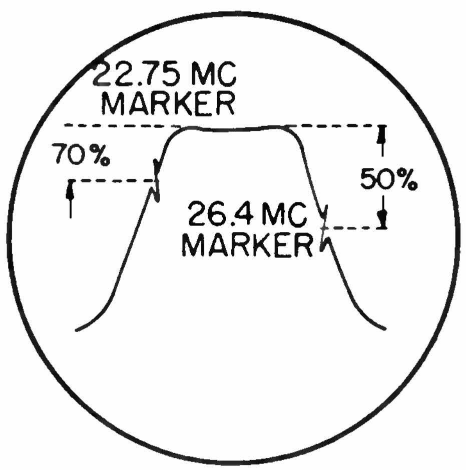

FIGURE 9 - OVERALL IF RESPONSE

SOUND TAKE OFF & 4.5 MC. TRAP ALIGNMENT

1. Connect a 4.5 Mc. Signal Generator through .005 Mfd. to pin 1 of Video Amplifier Tube - 6BF5. Loosely couple signal generator for use as markers.

2. Connect probe of High Frequency VTVM at junction of coil L59 and R148.

3. With enough output from signal source to give a readable indication on the VTVM, adjust the core on Sound Take-Off Trap - L56 - For a sharp dip. The dip should have an output 4 to 1 less than the output obtained when the signal source is tuned to 2 Mc. (Note: The above tests shall be made with the picture tube removed and a VTVM having an input capacity of 5 Mmfd. $\pm$ 2 Mmfd.

INTERSTAGE TRANSFORMER ALIGNMENT

1. Disconnect the 4.5 Mc. signal from the Video Amplifier. Connect a 4.5 Mc. sweep oscillator having a 250Kc. deviation through a .005 Mfd. capacitor to pin 1 of Video Amplifier - 6BF5. Connect oscilloscope input across the limiter grid resistor R102 47,000 Ohms - using a 10,000 Ohm carbon resistor between scope lead and receiver chassis.

2. Adjust the primary and secondary of the Interstage Transformer T51 so that the 4.5 Mc. marker appears in the exact center of the response curve and so the curve has the greatest attainable amplitude. The response curve should appear as shown in Figure 10.

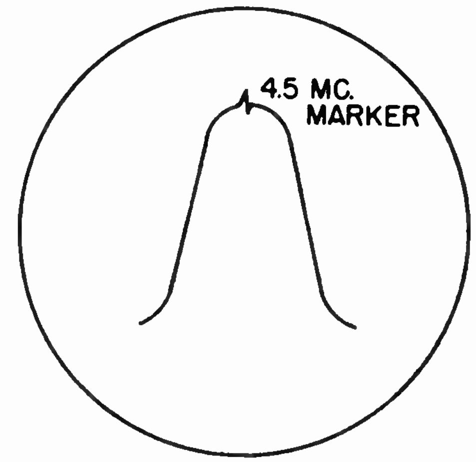

FIGURE 10 - SOUND IF RESPONSE

SOUND DISCRIMINATOR ALIGNMENT

1. With the 4.5 Mc. Sweep Oscillator connected as described in step 1 of "Interstage Transformer Alignment," disconnect the oscilloscope from the limiter grid resistor and connect the oscilloscope across the volume control.

2. Adjust cores of the Discriminator Transformers T52 and T53 until the discriminator curve corresponds to that in Figure 11. Note especially that:

(a) 4.5 Mc. marker is exactly in the center of the curve.
(b) The curve is linear between the two adjacent markers.
(c) The amplitude is the greatest obtainable.

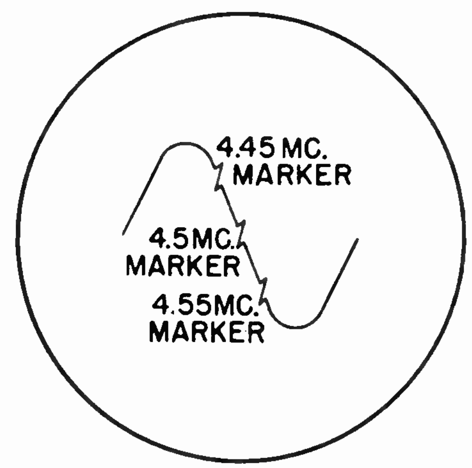

FIGURE 11 - SOUND DISCRIMINATOR RESPONSE

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R F TUNER ALIGNMENT

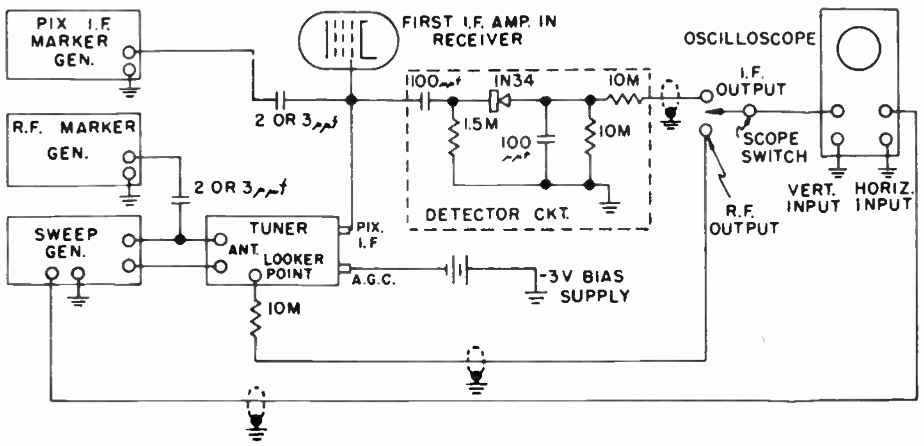


FIGURE 12 - TUNER ALIGNMENT SETUP

NOTES ON TUNER ALIGNMENT SETUP

In reference to Figure 12, the following precautions should be taken in making the equipment setup.

1. The detector circuit should be so constructed as to maintain leads as short as possible. Connection of the detector circuit to the 1st IF grid terminal (see Fig. 12 for location) should also be made with short leads.

2. Shielded leads should be used in making the following connections to reduce hum and synchronous voltage pick-up.
   (a) The lead for observation of the RF response from the scope isolating resistor (10 K ohms located at the tuner "looker point") to the RF output switch position of the scope switch.
   (b) The connection from the IF detector circuit output to the IF switch position of the scope switch.
   (c) The connection from the sweep generator to the horizontal input of the scope. (Use externally generated sweep instead of internal oscilloscope sweep in order to obtain synchronization).

3. The single pole double throw "Scope Switch" should be located at the vertical input terminals of the scope. This switching arrangment will permit observation of either the IF response or the overall RF response. The aforementioned positions will be referred to in subsequent text as the "IF" and "RF" positions respectively.

4. The marker generator coupling condenser should be as small a value as possible to prevent any effect on tuner response, but must be large enough to permit easy observation of markers on either the IF response or overall RF response. (Approximately 2 or 3 MMF should be satisfactory in most cases).

5. For all tuner alignment tests which are outlined in this text, remove the second IF amplifier tube or bypass its plate circuit with approximately 1000 MMF to prevent coupling back from the receiver IF system.

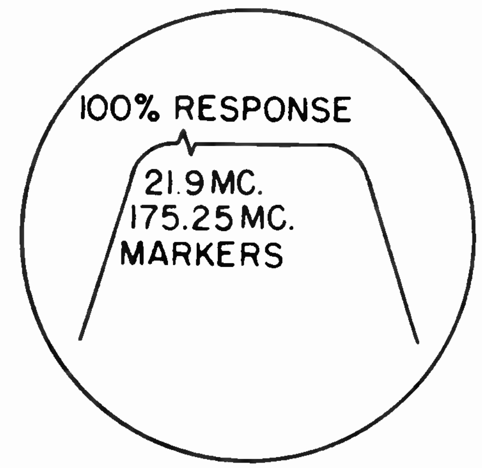
6. In all of the following tests the oscilloscope vertical gain should be as close to maximum gain as possible, consistent with hum and synchronous voltage interference limitations. This precaution will allow the use of low levels from RF sweep Generator and increase the visibility of IF and RF markers.

OSCILLATOR ALIGNMENT

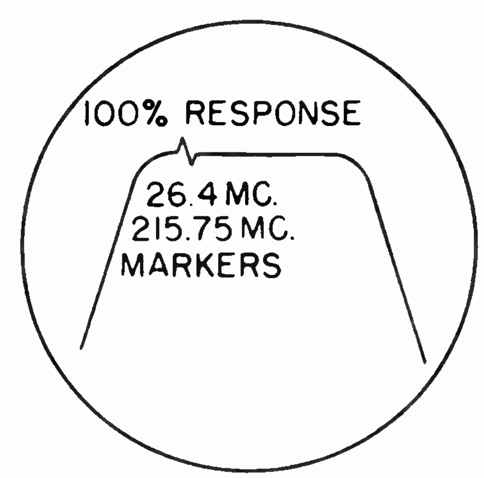
In making adjustments of the oscillator alignment it should be noted that any change in the setting of the high band oscillator trimmer will also effect the low band oscillator tuning, however, because of switching, the adjustment of the low band oscillator trimmer will not affect high band oscillator tuning. Also, there is a slight shift of oscillator frequency in the high band position only when the bottom cover is removed.

High Band Oscillator Alignment

1. Remove the bottom cover and rotate the band switch to the high band position.
2. Rotate variable condenser to maximum capacity position (fully counterclockwise position of tuning control knob).
3. Tune sweep generator to channel 7 and set scope switch to IF output position.
4. Inject 175.25 Mc. and 21.9 Mc. markers.
5. With a non-metallic pick vary the turns spacing on the high band oscillator coil L9 until markers coincide (squeezing the coil lowers the oscillator frequency and spacing the turns farther apart raises oscillator frequency.



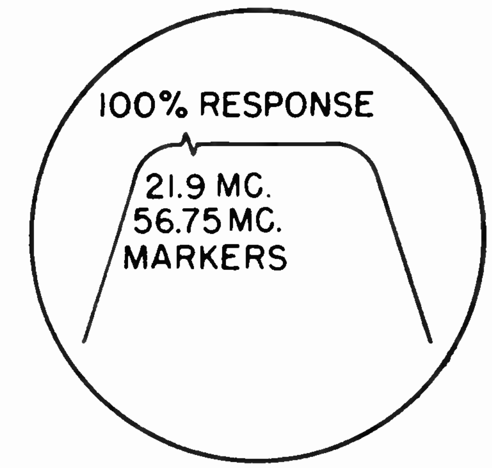
6. Replace bottom cover and check for shift of markers. If there is a shift remove the bottom cover and compensate by re-adjusting L9 as necessary. Repeat until markers coincide with bottom cover in place.
7. Rotate variable capacitor to minimum capacity (fully clockwise position of tuning control knob).
8. Tune sweep generator to channel 13.
9. Inject 215.75 Mc. and 26.4 Mc. markers.
10. With bottom cover in place, adjust oscillator grid trimmer C23 to make markers coincide.



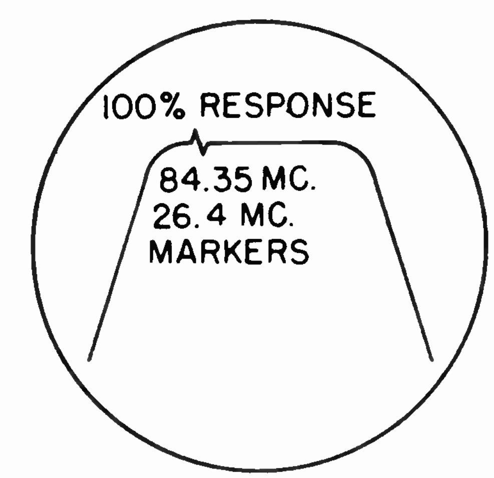
11. Repeat steps one through ten until proper end frequencies are reached at maximum and minimum capacity settings.

Low Band Oscillator Alignment

12. Remove bottom cover, turn band switch to low band position and rotate variable capacitor to maximum capacity (tuning control knob fully counterclockwise).
13. Tune sweep generator to channel 2.
14. Inject 56.75 Mc. and 21.9 Mc. markers.
15. Using a non-metallic pick adjust the spacing between turns on the low band oscillator coil L9 until the markers coincide.



16. Rotate the variable capacitor to minimum capacity (tuning control knob fully clockwise).
17. Tune sweep generator to channel 6.
18. Inject 84.35 Mc. and 26.4 Mc. markers.
19. Adjust oscillator plate trimmer C26 to make markers coincide.



20. Replace bottom cover and recheck in steps 12-19.
21. Recheck all four oscillator frequencies as in steps 1-19.

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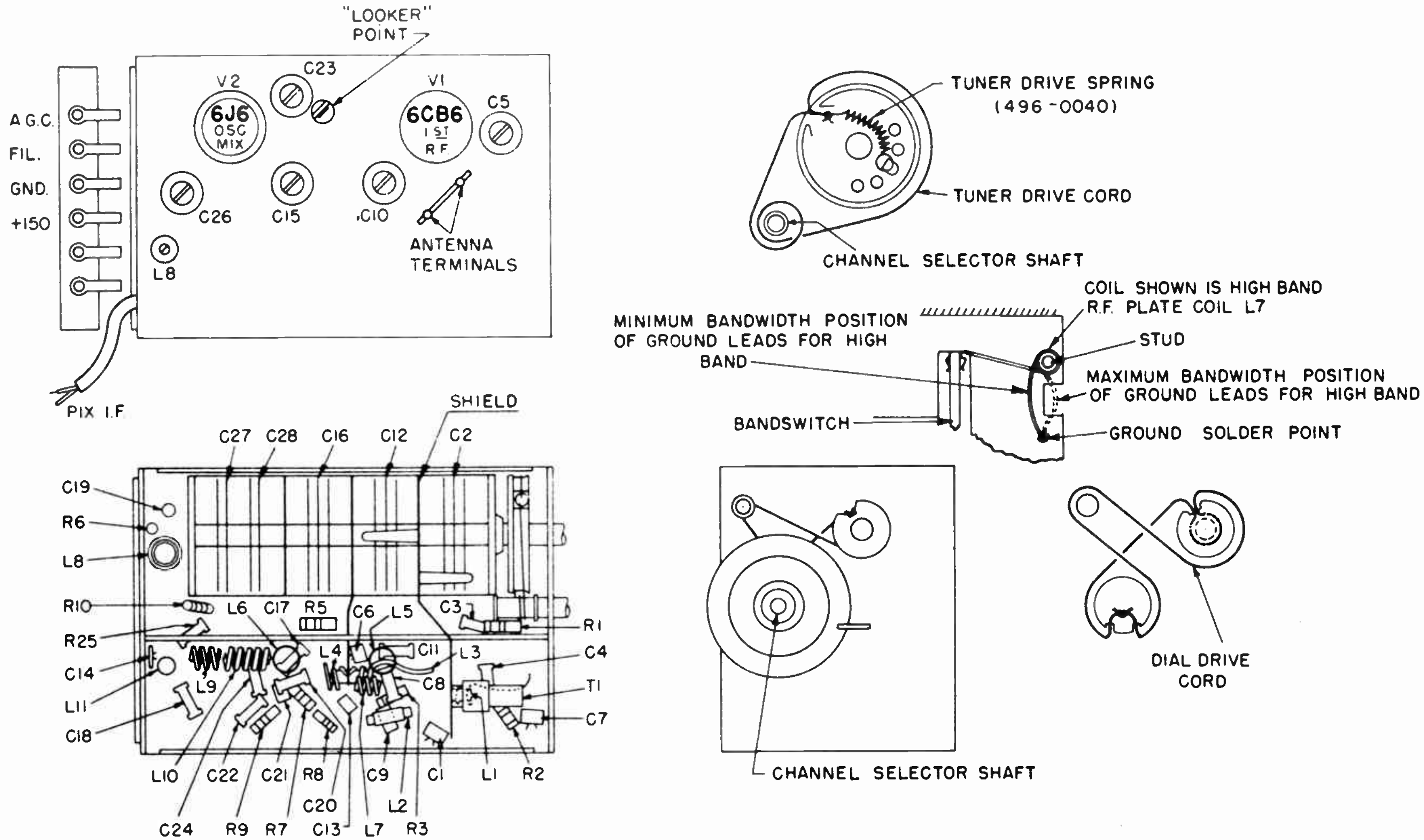

Note: This RF tuner has been thoroughly tested at the factory and should provide trouble-free reception throughout the life of the chassis. However, if service other than alignment is required, return the complete tuner to the factory for replacement.

FIGURE 13 - TUNER LAYOUT

R. F. PASSBAND ALIGNMENT

1. If only the RF Passband is being aligned it is advisable to check oscillator coverage as noted under Oscillator Alignment step 21 above.
2. Remove bottom cover and turn band switch to high band position.
3. Rotate tuning control so that pointer is at channel 7 on the dial calibration.
4. Tune sweep generator to channel 7. Set scope switch to the IF output.
5. Inject 175.25 Mc. and 26.4 Mc. markers and adjust tuning control so the markers coincide. Leave tuning control at this setting for the remainder of channel 7 adjustment.
6. Change scope switch to the RF output.
7. Check that the RF response curve is similar to those shown in Figure 14.
8. If the response curve differs much from those shown in Figure 14, the inductance and coupling of the high band RF plate coil L3, the high band mixer grid coil L4 and the high band antenna coil L1 for proper band width and symmetry. In determining the band width, it will be necessary to switch the marker generator alternately between channel 7 picture carrier (175.25Mc.) and sound carrier (179.75 Mc.).
9. The high band RF plate coil L3 and the high band mixer grid coil L4 are properly adjusted when a slight variation in the inductance of either coil will result in a frequency shift of the entire response with no noticeable narrowing of the band width.
10. The high band antenna coil L1 is properly adjusted when a slight variation of its inductance will cause both peaks to rock slightly. If only one peak moves, the high band antenna coil L1 is staggered away from the center of the passband.
11. The inductance of these coils (L1, L3, L4) is varied by pushing the coil on or off the brass stud. Pushing the coil on the stud will raise the frequency and pushing the coil off the stud will lower the frequency.
12. The band width of channel 7 interstage transformer (L3, L4) is controlled by dressing the ground leads of these coils past the cut out in the RF shield plate (see Fig. 13). When both leads cross the cutout the greater separation of peak occurs. For maximum gain the band width should be adjusted so that the response is no greater than that required to keep the sound and picture carrier frequency markers on the peaks of the overall RF curves.
13. Replace tuner bottom cover and check RF passband response.
14. If necessary, remove bottom cover and make slight compensating adjustments. Replace bottom cover and recheck.
15. With the bottom cover in place, rotate the tuning control knob so that the pointer indicates channel 13.
16. Tune sweep generator to channel 13 and change scope switch to IF output.
17. Inject 215.75 Mc. and 21.9 Mc. markers and adjust tuning control so markers coincide. Leave tuning control as set for remainder of channel 13 adjustments.
18. Change scope switch to RF output position, if RF response differs noticeably from the curves in Figure 14. The antenna trimmer(C5), the RF plate trimmer (C10) and mixer grid trimmer (C15) must be adjusted for proper passband and maximum amplitude of response.
19. Return tuner and sweep generator to channel 7 and check response as in part 13 above. A slight compensation of coils L1, L3, and L4 may be necessary.
20. Recheck passband on both channel 7 and channel 13, compromising adjustments for tilt as necessary until satisfactory High Band RF passband responses are obtained.

Low Band RF Alignment

21. Rotate band switch to Low Band position.
22. Turn the tuning control knob so that the pointer indicates channel 2 on the dial.
23. Set the scope switch to the IF output position and inject 59.75 Mc. and 21.9 Mc. markers. Adjust the tuning control so the markers coincide. Leave the tuning control as set for the remainder of the channel 2 adjustments.
24. Change the scope switch to the RF output position.
25. If the desired passband response is not obtained (as shown in Fig. 14) the Low Band RF coil L5, the low band mixer coil (L6), and the low band antenna transformer (T1) secondary must be adjusted until the desired passband is obtained.
26. When the low band RF coil (L5) and the low band mixer coil are aligned, slight variation in the inductance of either should

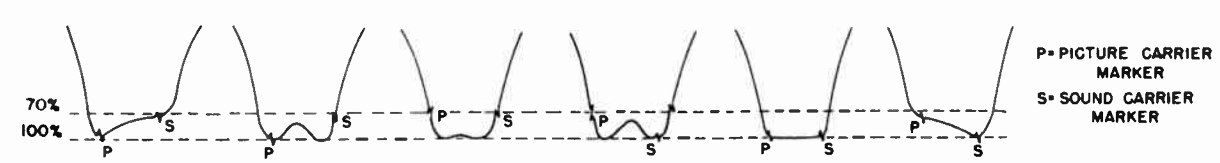

FIGURE 14 - ACCEPTABLE RF RESPONSE CURVES FOR TUNER

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cause no noticeable narrowing of the pass-band.

27. When the secondary of the low band antenna transformer is properly adjusted, a slight variation in its inductance should cause both peaks to rock slightly. If only one peak moves, the T1 secondary is staggered away from the center of the double tuned circuit response.
28. The low band mutual coil (17) varies the band width of the interstage coupling circuit. Squeezing the turns together broadens the band width and separating the turns narrows the band width. The band width should be adjusted so that it is not greater than that required to keep both the picture carrier and sound carrier markers at the peaks of the response curve.
29. Replace the tuner bottom cover and check passband response.
30. Remove bottom cover and make any compensating adjustments as needed.
31. With the bottom cover in place, rotate the tuning control knob to align the pointer with channel 6 on the dial.
32. Tune the sweep generator to channel 6 and change the scope output switch to the IF output position.
33. Inject 83.25 Mc. and 26.4 Mc. markers and adjust the tuning control to make the markers coincide. Leave the tuning control at this setting for the remainder of the channel 6 adjustments.
34. Change the scope switch to the RF output position.
35. Check the response curve. If not as desired, remove the bottom cover and slightly readjust the inductance of the low band RF coil L5, the low band mixer coil (L6), the low band mutual coil (L7) and the secondary of the low band antenna transformer (T1) as necessary, keeping in mind that these adjustments must be compromised with those made for channel 2 in steps 21-30 above.
36. Recheck passband on channel 2 and channel 6 and re-adjust as necessary to obtain acceptable passband on both channel 2 and 6.

WAVEFORMS

Note 1: The terms "Horizontal," "Vertical" or "60 cps sine wave" refer to the oscilloscope sweep employed.

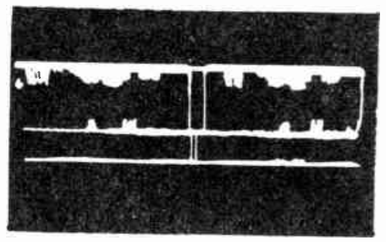
Note 2: All waveforms are taken with the oscilloscope horizontal sweep direction from left to right and with upward deflection corresponding to positive polarity.

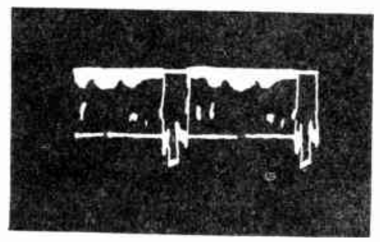
Note 3: In some instances the waveforms obtained will not be identical with those shown, due to the electrical characteristics of the oscilloscope used.

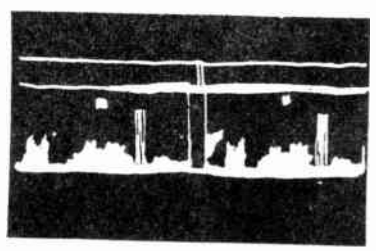
Note 4: All waveforms are measured with respect to chassis unless otherwise indicated.

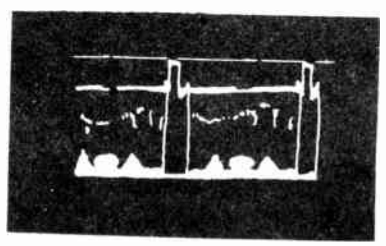
Note 5: Contrast maximum unless otherwise indicated.

*The peak to peak (P/P) voltages of these waveforms are dependent on the depth of modulation of the transmitted signal; voltages shown are obtained when modulation is approximately 90 percent.

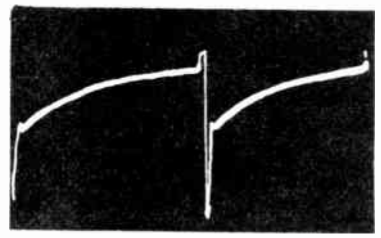

*6BF5 (V8) Video Amplifier Control Grid (Pins 1 and 7) 3.5 Volts P/P Vertical

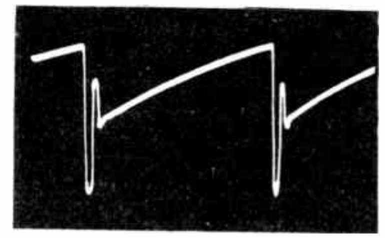

*6BF5 (V8) Video Amplifier Control Grid (Pins 1 and 7) 3.5 Volts P/P Horizontal

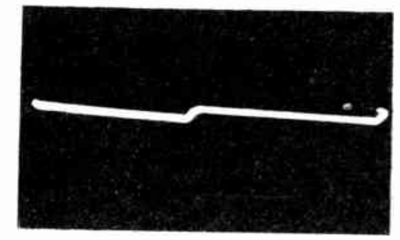

*6BF5 (V8) Video Amplifier Plate (Pin 5) 55 Volts P/P Vertical

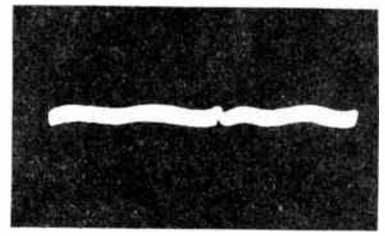

*6BF5 (V8) Video Amplifier Plate (Pin 5) 55 Volts P/P Horizontal

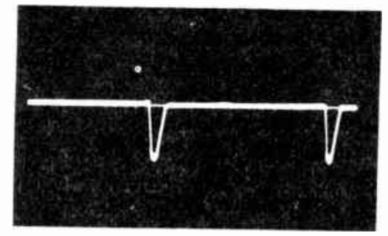
WAVEFORMS

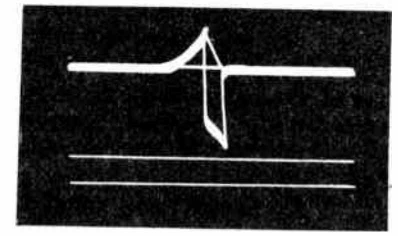

6BL7GT (V15) Vertical Oscillator Control Grid (Pin 1) 600 Volts P/P Vertical

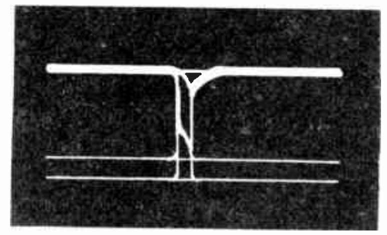

6BL7GT (V15) Vertical Oscillator Plate (Pin 2) 235 Volts P/P Vertical

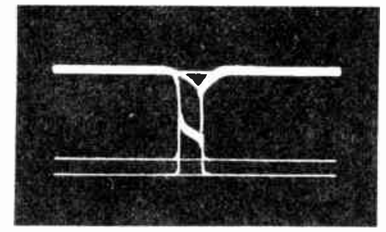

12AX7 (V14) Hor. Sync. Sep. and AGC Rectifier Cathode (Pin 8) 2.6 Volts P/P Horizontal

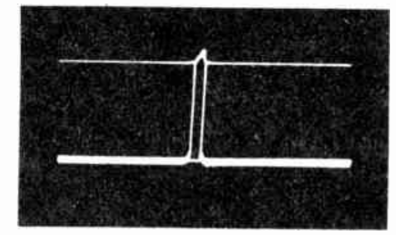

12AX7 (V14) Hor. Sync. Sep. and AGC Rectifier Cathode (Pin 8) 2.6 Volts P/P Vertical

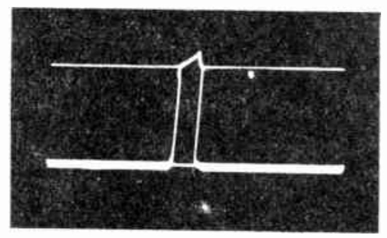

12AX7 (V14) Hor. Sync. Sep. Plate (Pin 6) 37 Volts P/P Horizontal

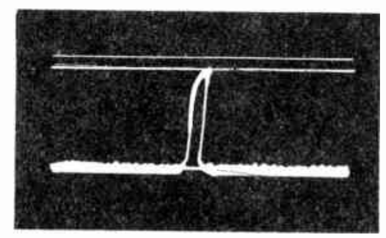

12AX7 (V14) Hor. Sync. Sep. Plate (Pin 6) 37 Volts P/P Vertical

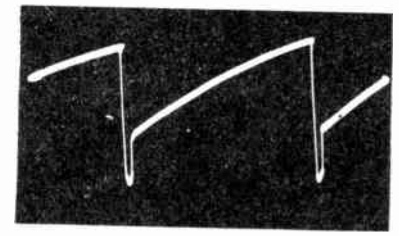

12AX7 (V14) Sync Separator Plate (Pin 1) 25 Volts P/P Vertical

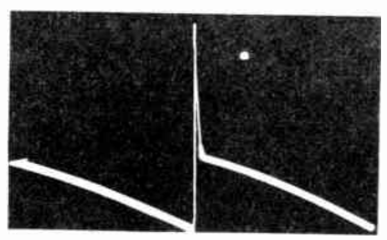

12AX7 (V14) Sync Separator Plate (Pin 1) 25 Volts P/P 60 cps sine wave

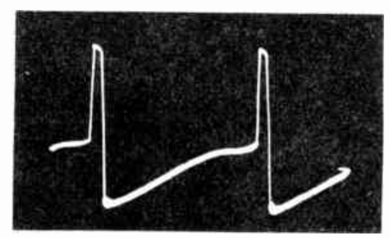

12AU7 (V13) Sync. Amp. and Clipper Plate (Pin 1) 110 Volts P/P Vertical

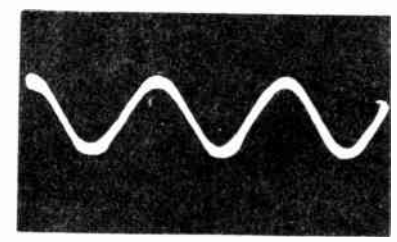

12AU7 (V13) Sync Amp. and Clipper Plate (Pin 1) 110 Volts P/P 60 cps sine wave


12AU7 (V13) Sync Amp. and Clipper Plate (Pin 1) 100 Volts P/P Horizontal


6BL7GT (V15) Vertical Output Control Grid (Pin 4) 95 Volts P/P Vertical


6BL7GT (V15) Vertical Output Plate (Pin 5) 830 Volts P/P Vertical


6AL5 (V16) Hor. Discriminator Plate (Pin 7) 70 Volts P/P Horizontal


6AL5 (V16) Hor. Discriminator Plate to Plate (Pin 7 to Pin 2) Scope ground to pin 7 - 23 Volts P/P Horizontal

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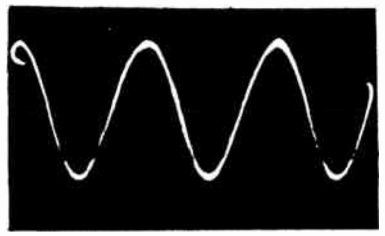
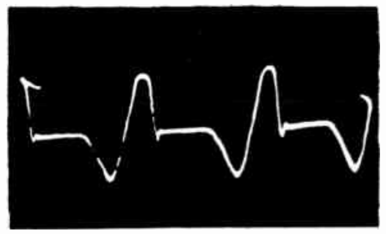
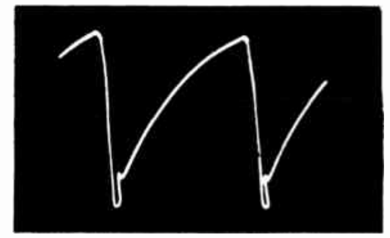


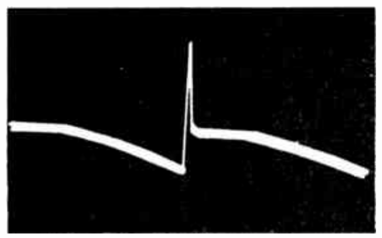
6AU6 (V17) Hor. Control Plate (Pin 5) 68 Volts P/P Horizontal



12AU7 (V18) Hor. Oscillator Plate (Pin 6) 95 Volts P/P Horizontal

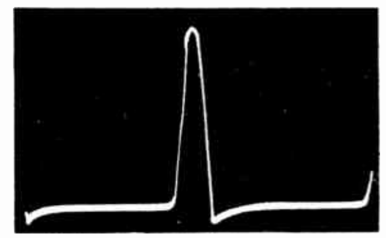


12AU7 (V18) Hor. Discharge Plate (Pin 1) 105 Volts P/P Horizontal



Vertical Yoke Coils (Test Point 1) 55 Volts P/P Vertical

6W4GT Damper Cathode (Pin 3) 2000 Volts P/P Horizontal



AM-FM RADIO

APPROXIMATE FM IF ALIGNMENT

1. Connect vacuum tube DC voltmeter (with a high input resistance) across 33,000 ohm 6T8 cathode resistor (R70).
2. Connect generator ground lead to receiver chassis and generator positive lead to oscillator-mixer grid (pin 1) using a .1 Mfd. dummy antenna.
3. Set generator modulation to off position and generator frequency to 10.7 Mc.
4. Set Function Switch to FM position, volume and tone controls fully clockwise and Tuner fully closed. (With the tuner fully closed, the pointer should be at the last line below the 88 Mc. calibration mark on the dial).
5. Adjust the IF cores for maximum reading on the voltmeter in the following order: T27-Top, T27-Bottom, T25-Top, T25-Bottom As cores are adjusted decrease the output of the generator to maintain approximately 2.5 volts.

AM ALIGNMENT

1. Connect an output meter across loudspeaker voice coil terminals.
2. Connect signal generator "ground" lead to tuner chassis; the "high" lead through a .1 Mfd. capacitor to grid (pin 1) of Oscillator-Mixer 7F8, V26.
3. Set generator to 455 Kc. with 400 cycle modulation. Allow tuner and generator to warm up for several minutes.
4. Disconnect any external antenna and set receiver Function Switch to A M position. Turn volume and tone controls fully clockwise.
5. Rotate Tuner variable capacitor to maximum capacity position (plates fully in mesh).
6. With the least usable generator output, adjust I.F. transformer cores in this sequence to obtain maximum output meter indication: T29 - Bottom, T28 - Top, T28 - Bottom, T26 - Top, T26 - Bottom.
7. Connect generator output to a Hazeltine Loop to radiate a signal into the Tuner Loop antenna.
8. Set Tuner and generator to 1600 Kc.
9. Adjust oscillator trimmer, C79 (on rear section of variable capacitor front gang), for maximum output reading.
10. Set generator and Tuner to 1400 Kc.
11. Adjust antenna trimmer, C51 (on loop antenna), for maximum output.

FINAL FM ALIGNMENT

A. Repeat APPROXIMATE FM-IF ALIGNMENT to obtain exact maximum on DC voltmeter connected across 33,000 ohm 6T8 cathode resistor R70.

B. If a 10.7 Mc. frequency modulated generator is available, connect to oscillator-mixer grid (pin 1) through a 270 to 500 ohm resistor and proceed to Section D.

C. If a 10.7 Mc. frequency modulated generator is not available, connect an RF-FM generator to antenna terminals through two 120 ohm resistors, one in series with each terminal of the generator.

D. Connect the sweep output of the generator to the X-axis (horizontal) amplifier of the oscilloscope.

E. Connect the Y-axis (vertical) amplifier of the oscilloscope across 100,000 ohm resistor R72 through 10,000 to 100,000 ohms at receiver end of one lead.

F. Adjust the generator for 300 Kc. deviation. Use full gain of the oscilloscope Y-axis amplifier and only as much output from the generator as is necessary.

G. Adjust T29-Top for maximum output, vertically.

Adjust T30-Top and T30-Bottom until the center of the pattern becomes a straight line diagonally across the oscilloscope screen. Repeat these three cores to obtain a symmetrical pattern of maximum vertical amplitude. See oscilloscope pattern in Figure 15.

H. Connect an RF-FM generator to antenna terminals through two 120 resistors, one in series with each terminal of the generator. Adjust the generator for 22.5 Kc. deviation.

I. Remove the dial background. Set the pointer to 108 Mc. on the dial. Tune the generator to 108 Mc. Adjust C57 to maximum output meter reading. If two such points are found by tuning C57, use the higher frequency. (Lowest capacity setting of C57).

J. Tune the generator and receiver to 106 Mc. and peak C53 for maximum output meter reading.

K. Remove the signal generator, oscilloscope, and resistors, restoring receiver to normal operating condition.

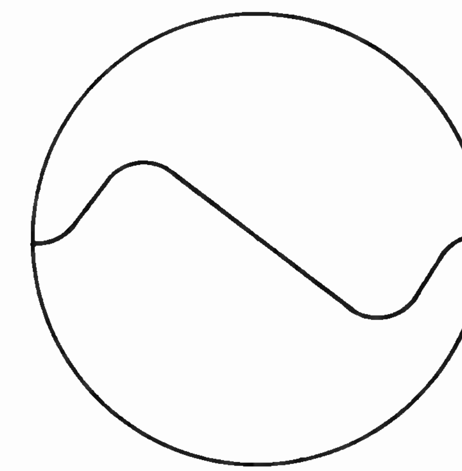
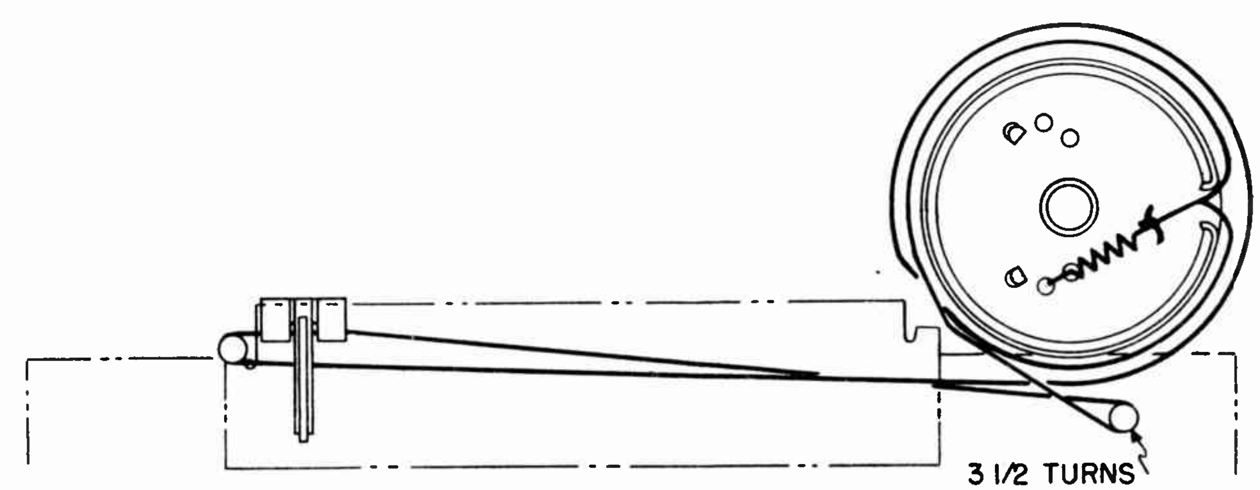


FIGURE 15 - FM DISCRIMINATOR RESPONSE



DIAL CORD HOOKUP

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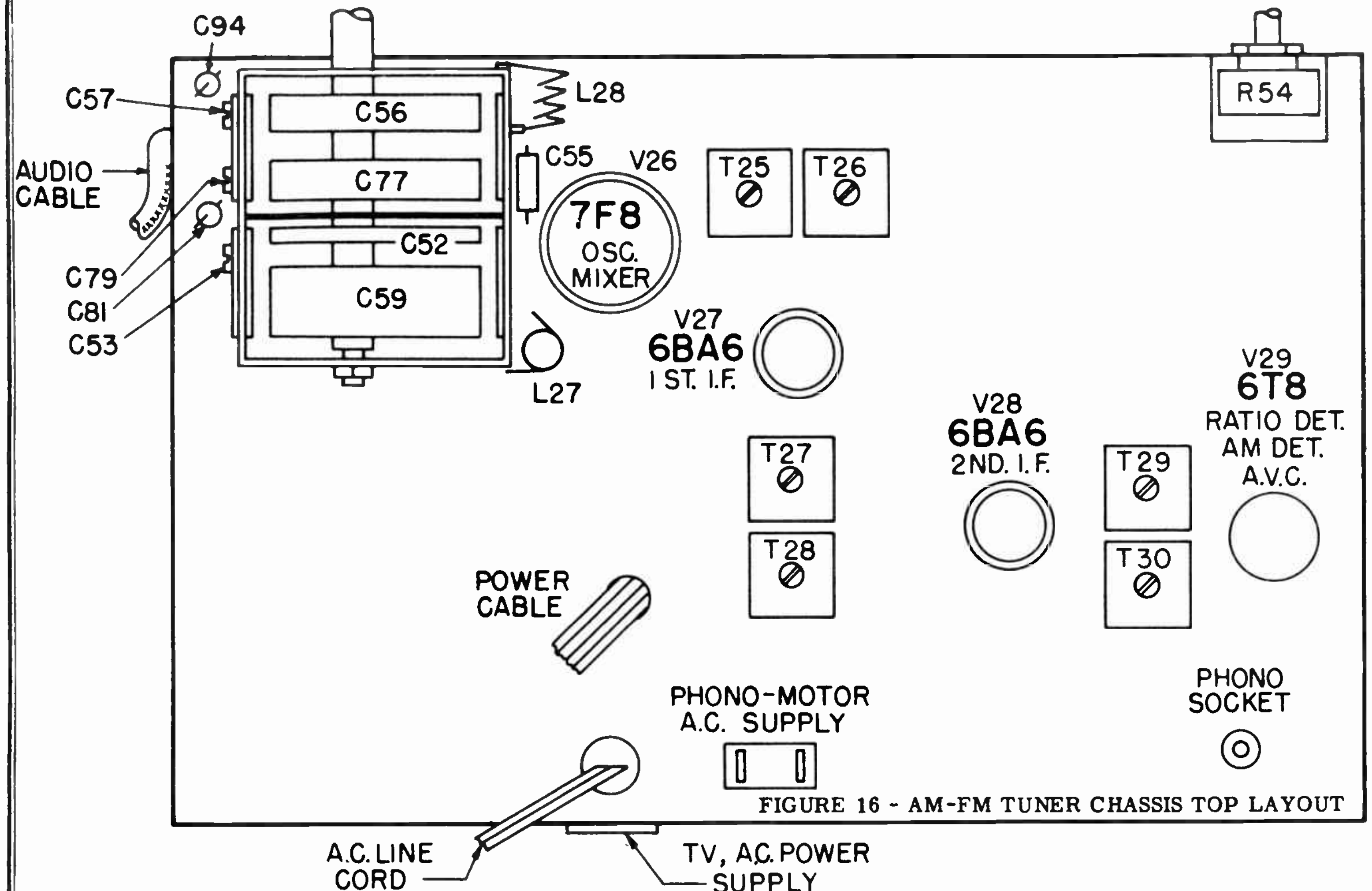

FIGURE 16 - AM-FM TUNER CHASSIS TOP LAYOUT

REPAIR PARTS LIST

SCHEMATIC LOCATION	SERVICE PART NUMBER	DESCRIPTION
	196-0003	Anode Connector and Lead Assembly
	582-0005	Antenna Assembly - Built-in
L25	582-0006	Antenna Loop - AM
	726-0002	Background - Dial
	482-0002	Base for AM-FM Tuner Tube Shields
	714-0001	Bezel
	416-0008	Board - Antenna Terminal
	411-0013	Board - Pilot Light Mounting Assembly
	487-0013	Button - Snap - Dial Background Mounting
	417-0005	Cable and Socket Assembly
C208	160-02022	Capacitor - Paper - .22 Mfd. - 200 V.
C148	162-0202	Capacitor - Paper - .2 Mfd. - 200 V.
C209	162-0602	Capacitor - Paper - .2 Mfd. - 600 V.
C104	162-0402	Capacitor - Paper - .2 Mfd. - 400 V.
C146,C179,C180	162-0401	Capacitor - Paper - .1 Mfd. - 400 V.
C206	162-0601	Capacitor - Paper - .1 Mfd. - 600 V.
C147,C205	162-0615	Capacitor - Paper - .05 Mfd. - 600 V.
C65,C72	162-0411M	Capacitor - Paper - .01 Mfd. - 400 V.
C116, C170, C193, C192	162-0625	Capacitor - Paper - .005 Mfd. - 600 V.
C80	162-0425	Capacitor - Paper - .005 Mfd. - 400 V.
C92,C169,C177	162-0623	Capacitor - Paper - .003 Mfd. - 600 V.
C85, C87	162-0415	Capacitor - Paper - .05 Mfd. - 400 V.
C171	160-02147	Capacitor - Paper - .047 Mfd. - 200 V.
C207	162-0613	Capacitor - Paper - .03 Mfd. - 600 V.
C75,C76,C78,C84, C82	162-0612	Capacitor - Paper - .02 Mfd. - 600 V.
C200	162-0611	Capacitor - Paper - .01 Mfd. - 600 V.
C66	162-0622	Capacitor - Paper - .002 Mfd. - 600 V.
C198	162-0422S	Capacitor - Paper - .002 Mfd. - 400 V.
C109, C111, C113, C149, C172	168-0002N	Capacitor - Ceramic - .01 Mfd. - 500 V.
C58, C86	168-0002D	Capacitor - Ceramic - .01 Mfd. - 500 V.
C103,C105,C118, C127,C128,C129, C130,C131,C132, C133,C135,C140, C142,C143,C145, C199,C201	166-5000D	Capacitor - Ceramic - .005 Mfd. - 450 V.
C100, C101, C163, C164	168-0003D	Capacitor - Ceramic - .004 Mfd. - Dual - 450 V.
C203	166-1000P	Capacitor - Ceramic - .001 Mfd. - 500 V.
C159, C160, C161, C162	166-1000D	Capacitor - Ceramic - .001 Mfd. - 600 V.
C106	166-0250P	Capacitor - Ceramic - .00025 Mfd. - 500 V.
C102	166-0050N	Capacitor - Ceramic - .00005 Mfd. - 500 V.
C126, C141	168-0009N	Capacitor - Ceramic - .00005 Mfd. - 500 V.
C81	166-0015P	Capacitor - Ceramic - .000015 Mfd. - 500 V.
C137	166-0010P	Capacitor - Ceramic - .00001 Mfd. - 500 V.
C50, C62	166-0006D	Capacitor - Ceramic - .000006 Mfd. - 500 V.
C94	166-0006N	Capacitor - Ceramic - .000006 Mfd. - 500 V.
C134, C138, C139, C144	168-0008N	Capacitor - Ceramic - .0000047 Mfd. - 500 V.
C73	166-0004P	Capacitor - Ceramic - .000004 Mfd. - 500 V.
C55	166-0003P	Capacitor - Ceramic - .000003 Mfd. - 500 V.
C136	168-0004P	Capacitor - Ceramic - .00000068 Mfd. - 500 V.
C211	174-1200	Capacitor - Mica - .0012 Mfd. - 1000 V
C176	163-0750	Capacitor - Mica - .00075 Mfd. - 500 V.
C91, C110, C202	163-0680	Capacitor - Mica - .00068 Mfd. - 500 V.
C67, C88	163-0500	Capacitor - Mica - .0005 Mfd. - 500 V.
C61, C90	163-0250	Capacitor - Mica - .00025 Mfd. - 500 V.
C54	163-0200	Capacitor - Mica - .0002 Mfd. - 500 V.
C68	163-0150	Capacitor - Mica - .00015 Mfd. - 500 V.
C112, C194, C197, C71, C78	163-0100	Capacitor - Mica - .0001 Mfd. - 500 V.
C63,C69,C83,C93	163-0050	Capacitor - Mica - .00005 Mfd. - 500 V.
C60	163-0025	Capacitor - Mica - .000025 Mfd. - 500 V.
C74	163-0010	Capacitor - Mica - .000010 Mfd. - 500 V.
C212, C213	160-14350	Capacitor - Molded Paper - .0005 Mfd. - 10,000 V
C196	169-0010	Capacitor - Molded Paper - .015 Mfd. - 400 V.
	190-0006	Capacitor - Resistor Combination
C108		.01 Mfd.
R111		47,000 Ohms - 1/2 W.
	190-0008	Capacitor - Resistor Combination
C64		.02 Mfd.
R52		2,200 Ohms - 1/2 W.
	190-0007	Capacitor - Resistor Integrator Plate
C173		.002 Mfd.
C174,C175		.005 Mfd.
R189		22,000 Ohms
R190, R191		8,200 Ohms
C51	172-0030	Capacitor - Trimmer Antenna

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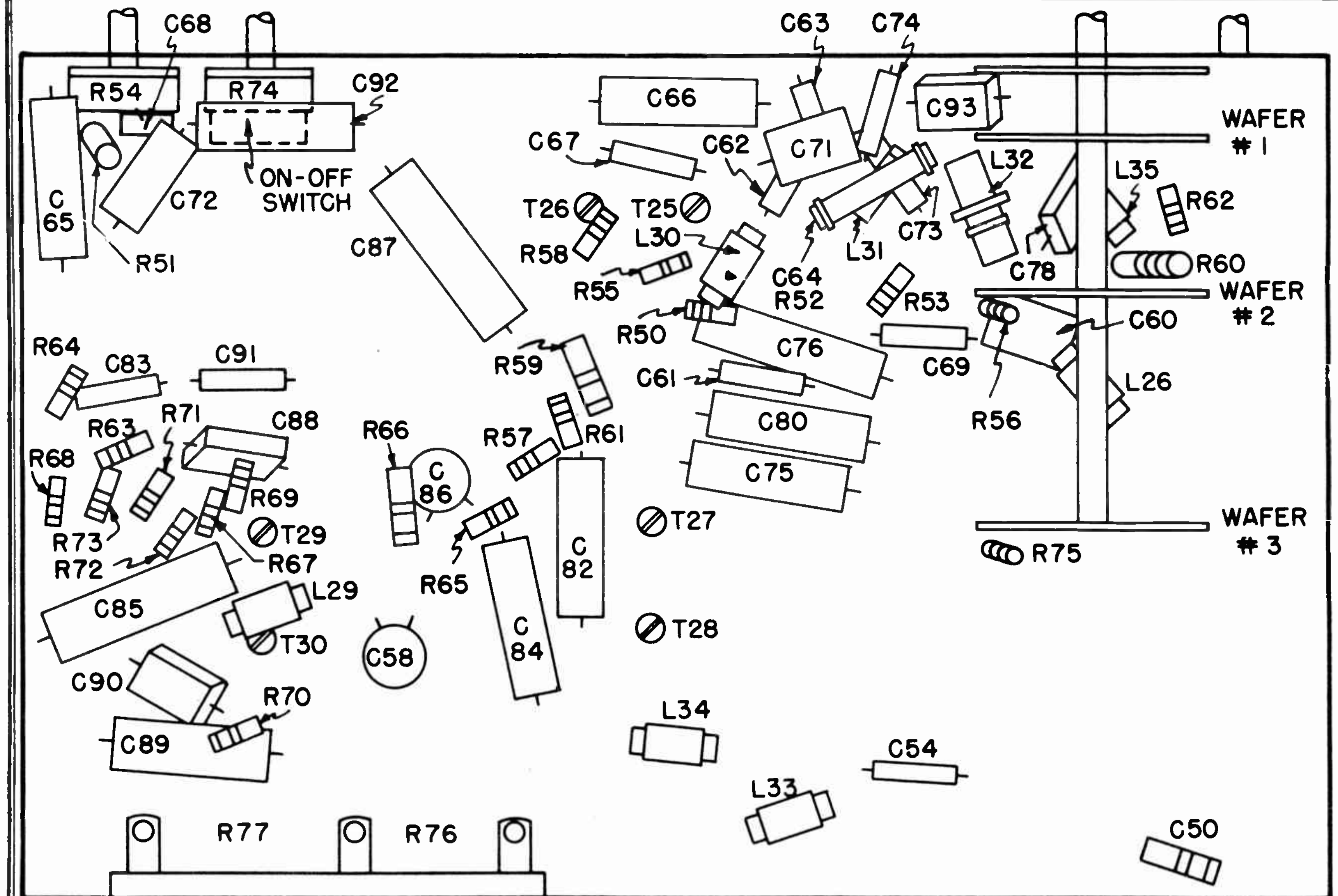

FIGURE 17 - AM-FM TUNER CHASSIS BOTTOM LAYOUT

C181	161-4003	Capacitor - Electrolytic -	100 Mfd. - 50 V.
C158			60 Mfd. - 200 V.
C178			10 Mfd. - 450 V.
C210			10 Mfd. - 450 V.
C117	161-4004	Capacitor - Electrolytic -	60 Mfd - 350 V.
C155			40 Mfd - 350 V
C114			25 Mfd. - 25 V.
C204			10 Mfd. - 50 V.
C157	161-2003	Capacitor - Electrolytic -	80 Mfd. - 350 V.
C156			40 Mfd. - 350 V.
C115	161-1007	Capacitor - Electrolytic -	10 Mfd. - 350 V.
C168	161-1000	Capacitor - Electrolytic -	10 Mfd. - 25 V.
C89	161-1008	Capacitor - Electrolytic -	4 Mfd. - 50 V.
C107	161-1001	Capacitor - Electrolytic -	2 Mfd. - 50 V.
C52, C53, C56, C57, C59, C77, C79	170-0005	Capacitor - Variable	
	822-0001	Case & Terminal Assembly	
L50	145-0004	Choke Filter - B+	
L51, L52, L53	147-0014	Choke Heater	
L26, L29, L30, L33, L34	146-0007	Choke - RF - AM-FM Tuner Unit	
L35	146-0008	Choke - FM oscillator plate	

L31	146-0009	Choke - FM oscillator cathode
	487-0008	Clip - Fuse
	487-0004	Clip - IF Transformer Mounting
L66	133-0001	Coil - Horizontal Linearity
L67	132-0001	Coil - Horizontal Size
L55	118-0007	Coil - IF Trap
L54, L68	118-0005	Coil - IF Cathode Trap
L57, L58	131-2006	Coil - Peaking - Dual
L59, L60	131-2005	Coil - Peaking - Dual
L63	146-0005	Coil - Ringing
L56	130-0001	Coil - Sound Takeoff
L32	113-0011	Coil - BC oscillator
L28	113-0019	Coil - FM oscillator
L27	111-0009	Coil - FM antenna
	417-0006	Connector - Pin - Antenna Lead
R179	153-0009	Control - AGC
R110, R153	154-0002	Control - Brightness and Volume
R167	153-3007	Control - Contrast
R225	153-0007	Control - Horizontal Drive
R193, R198	153-0001	Control - Vertical Hold - Height
R201	153-0010	Control - Vertical Linearity
R54	153-0013	Control - Volume - AM-FM
R74	152-0010	Control - On-Off and Tone
	195-0004	Cord - Line TV
	195-0003	Cord - Line AM-FM Tuner
	760-0011	Cover - Interlock Assembly
	498-0014	Cover - H. V. Case
	760-0013	Cover - Album Compartment
	713-0001	Dial & Escutcheon Assembly - AM-FM
	400-0007	Focalizer and Centering Unit - H. V.
	191-0005	Fuse - 1/4 Amp. - 250 V. (clip type)
	476-0002	Insulator - Electrolytic Capacitor Mounting
	740-0011	Knob - Center
	744-0011	Knob - Outer - Brightness
	740-0013	Knob - Plain - Antenna
	743-0006	Knob - TV Tuner - (Band)
	743-0002	Knob - Function
	611-0047	Lamp - Type #47
	591-0015	Leaflet - Customer Instruction
	400-0009	Magnet - Ion Trap
	716-0203	Mask & Gasket Assembly (7150M)
	716-0103	Mask & Gasket Assembly (7160B)
	415-0002	Plug - 2 prong - Interlock
	417-0009	Plug - 2 prong - Female - TV and Phono
	415-0001	Plug - 4 prong - Speaker
	196-0011	Plug and Cable - Power
	792-0004	Pointer Assembly - TV
	792-0005	Pointer and Slide Assembly - AM-FM
	494-0007	Pulley - AM-FM Tuner Unit
R171	189-0007	Resistor - 4.3 Ohm - 1/2 W. - W.W.
R56	181-0120	Resistor - 12 Ohm - 1/2 W.
R169	181-04705	Resistor - 47 Ohm - 1/2 W.
R116	181-0470	Resistor - 47 Ohm - 1/2 W.
R57, R65	181-0680	Resistor - 68 Ohm - 1/2 W.
R136, R139	181-0820	Resistor - 82 Ohm - 1/2 W.
R75, R101, R146, R228, R230	181-0101	Resistor - 100 Ohm - 1/2 W.
R104	181-0121	Resistor - 120 Ohm - 1/2 W.
		Resistor - 150 Ohm - 1/2 W.
R131, R142	181-0221	Resistor - 220 Ohm - 1/2 W.
R61, R119	181-0471	Resistor - 470,Ohm - 1/2 W.
R202, R203	181-0561	Resistor - 560 Ohm - 1/2 W.

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R200	181-0681	Resistor - 680 Ohm - 1/2 W.
R133	181-0821	Resistor - 820 Ohm - 1/2 W.
R103,R120,R134, R138,R143,R220, R234	181-0102	Resistor - 1,000 Ohm - 1/2 W.
R117	181-0152	Resistor - 1,500 Ohm - 1/2 W.
R145	181-03325	Resistor - 3,300 Ohm - 1/2 W.
R127	181-0332	Resistor - 3,300 Ohm - 1/2 W.
R197	181-04725	Resistor - 4,700 Ohm - 1/2 W.
R73, R67, R144, R226	181-0472	Resistor - 4,700 Ohm - 1/2 W.
R135	181-0562	Resistor - 5,600 Ohm - 1/2 W.
R128	181-0682	Resistor - 6,800 Ohm - 1/2 W.
R219	181-0822	Resistor - 8,200 Ohm - 1/2 W.
R176, R177, R184	181-0103	Resistor - 10,000 Ohm - 1/2 W.
R185	181-0123	Resistor - 12,000 Ohm - 1/2 W.
R179	153-0009	Control - AGC
R110, R153	154-0002	Control - Brightness and Volume
R167	153-3007	Control - Contrast
R225	153-0007	Control - Horizontal Drive
R193, R198	153-0001	Control - Vertical Hold - Height
R201	153-0010	Control - Vertical Linearity
R54	153-0013	Control - Volume - AM-FM
R74	152-0010	Control - On-Off and Tone
	195-0004	Cord - Line TV
	195-0003	Cord - Line AM-FM Tuner
	760-0011	Cover - Interlock Assembly
	498-0014	Cover - H.V. Case
	760-0013	Cover - Album Compartment
	713-0001	Dial & Escutcheon Assembly - AM-FM
	400-0007	Focalizer and Centering Unit - H.V.
	191-0005	Fuse - 1/4 Amp. - 250 V. (clip type)
	476-0002	Insulator - Electrolytic Capacitor Mounting
	740-0011	Knob - Center
	744-0011	Knob - Outer - Brightness
	740-0013	Knob - Plain - Antenna
	743-0006	Knob - TV Tuner - (Band)
	743-0002	Knob - Function
	611-0047	Lamp - Type #47
	591-0015	Leaflet - Customer Instruction
	400-0009	Magnet - Ion Trap
	716-0203	Mask & Gasket Assembly (7150M)
	716-0103	Mask & Gasket Assembly (7160B)
	415-0002	Plug - 2 prong - Interlock
	417-0009	Plug - 2 prong - Female - TV and Phono
	415-0001	Plug - 4 prong - Speaker
	196-0011	Plug and Cable - Power
	792-0004	Pointer Assembly - TV
	792-0005	Pointer and Slide Assembly - AM-FM
	494-0007	Pulley - AM-FM Tuner Unit
R171	189-0007	Resistor - 4.3 Ohm - 1/2 W. - W.W.
R56	181-0120	Resistor - 12 Ohm - 1/2 W.
R169	181-04705	Resistor - 47 Ohm - 1/2 W.
R116	181-0470	Resistor - 47 Ohm - 1/2 W.
R57, R65	181-0680	Resistor - 68 Ohm - 1/2 W.
R136, R139	181-0820	Resistor - 82 Ohm - 1/2 W.
R75, R101, R146, R228, R230	181-0101	Resistor - 100 Ohm - 1/2 W.
R104	181-0121	Resistor - 120 Ohm - 1/2 W.
		Resistor - 150 Ohm - 1/2 W.
R131, R142	181-0221	Resistor - 220 Ohm - 1/2 W.
R61, R119	181-0471	Resistor - 470,Ohm - 1/2 W.
R202,R203	181-0561	Resistor - 560 Ohm - 1/2 W.
R200	181-0681	Resistor - 680 Ohm - 1/2 W.
R133	181-0821	Resistor - 820 Ohm - 1/2 W.
R103,R120,R134, R138,R143,R220,	181-0102	Resistor - 1,000 Ohm - 1/2 W.
R234		
R117	181-0152	Resistor - 1,500 Ohm - 1/2 W.
R145	181-03325	Resistor - 3,300 Ohm - 1/2 W.
R127	181-0332	Resistor - 3,300 Ohm - 1/2 W.
R197	181-04725	Resistor - 4,700 Ohm - 1/2 W.
R73, R67, R144, R226	181-0472	Resistor - 4,700 Ohm - 1/2 W.
R135	181-0562	Resistor - 5,600 Ohm - 1/2 W.
R128	181-0682	Resistor - 6,800 Ohm - 1/2 W.
R219	181-0822	Resistor - 8,200 Ohm - 1/2 W.
R176, R177, R184	181-0103	Resistor - 10,000 Ohm - 1/2 W.
R185	181-0123	Resistor - 12,000 Ohm - 1/2 W.
	412-0017	Socket - Tube - 8 prong - Lock-in - Molded
	412-0002	Socket - Tube - 9 prong - Miniature
	417-0011	Socket - Tube - 12 prong - AM-FM - Power Female Connector
	411-0012	Socket - Pilot Lamp
	539-1202	Speaker - 12" P.M. with Transformer
	496-0023	Spring - Tension Dial Cord
	573-0003	Switch - 4 position - FM, AM, Phono & TV
	473-0002	Switch Arm Assembly - Pilot Light
T54	143-0017	Transformer - Speaker - Output
T52	128-0004	Transformer - Sound Discriminator - Primary
T53	128-0005	Transformer - Sound Discriminator - Secondary
T60	242-0001	Transformer - Vertical oscillator
T51	120-0001	Transformer - IF Sound - 4.5 Mc.
T62	128-0006	Transformer - Horizontal Discriminator
T59	240-0001	Transformer - Heater Isolation
T55, T56, T57	125-0002	Transformer - IF Interstage
T58	120-0002	Transformer - IF Bandpass
T61	241-0004	Transformer - Vertical Scan
T50	141-0016	Transformer - Power
T63	241-0003	Transformer & Core Assembly - Horizontal Scan
T26	121-0010	Transformer IF #1 - AM
T28	122-0010	Transformer IF #2 - AM
T25	121-0011	Transformer IF #1 - FM
T27	122-0011	Transformer IF #2 - FM
T29	119-0001	Transformer - Discriminator - Primary - FM & 3rd IF AM
T30	128-0003	Transformer - IF Discriminator - FM
V23,V24	633-0003G	Tube - 5U4G
V7,V16	623-0003G	Tube - 6AL5
V6	623-0011G	Tube - 6BC5
V3,V9,V10,V17	623-0005G	Tube - 6AU6
V4, V5, V27, V28	623-0004G	Tube - 6BA6
V8	623-0017G	Tube - 6BF5
V15	622-0011G	Tube - 6BL7GT
V1	623-0022G	Tube - 6CB6
V19	623-0013G	Tube - 6CD6GT
V2	623-0002G	Tube - 6J6
V12	622-0012G	Tube - 6L6G
V11,V29	623-0010G	Tube - 6T8
V20	633-0004G	Tube - 6W4GT
V26	621-0007G	Tube - 7F8
V13,V18	623-0006G	Tube - 12AU7
V14	623-0008G	Tube - 12AX7
V21, V22	636-0001G	Tube - 5642
V25	642-0008G	Tube - 17BP4A
	323-0002	Tuner Unit
L61,L62,L64, L65	100-0003	Yoke - Deflection

CHASSIS 1-357 C01

Under chassis code C01, R183 and R192 have been changed in value as follows:

SCHEMATIC LOCATION		SERVICE PART NUMBER	DESCRIPTION
R183	to	181-0105	Resistor - 1.0 Megohm - 1/2 W.
R192	to	181-0125	Resistor - 1.2 Megohm - 1/2 W.

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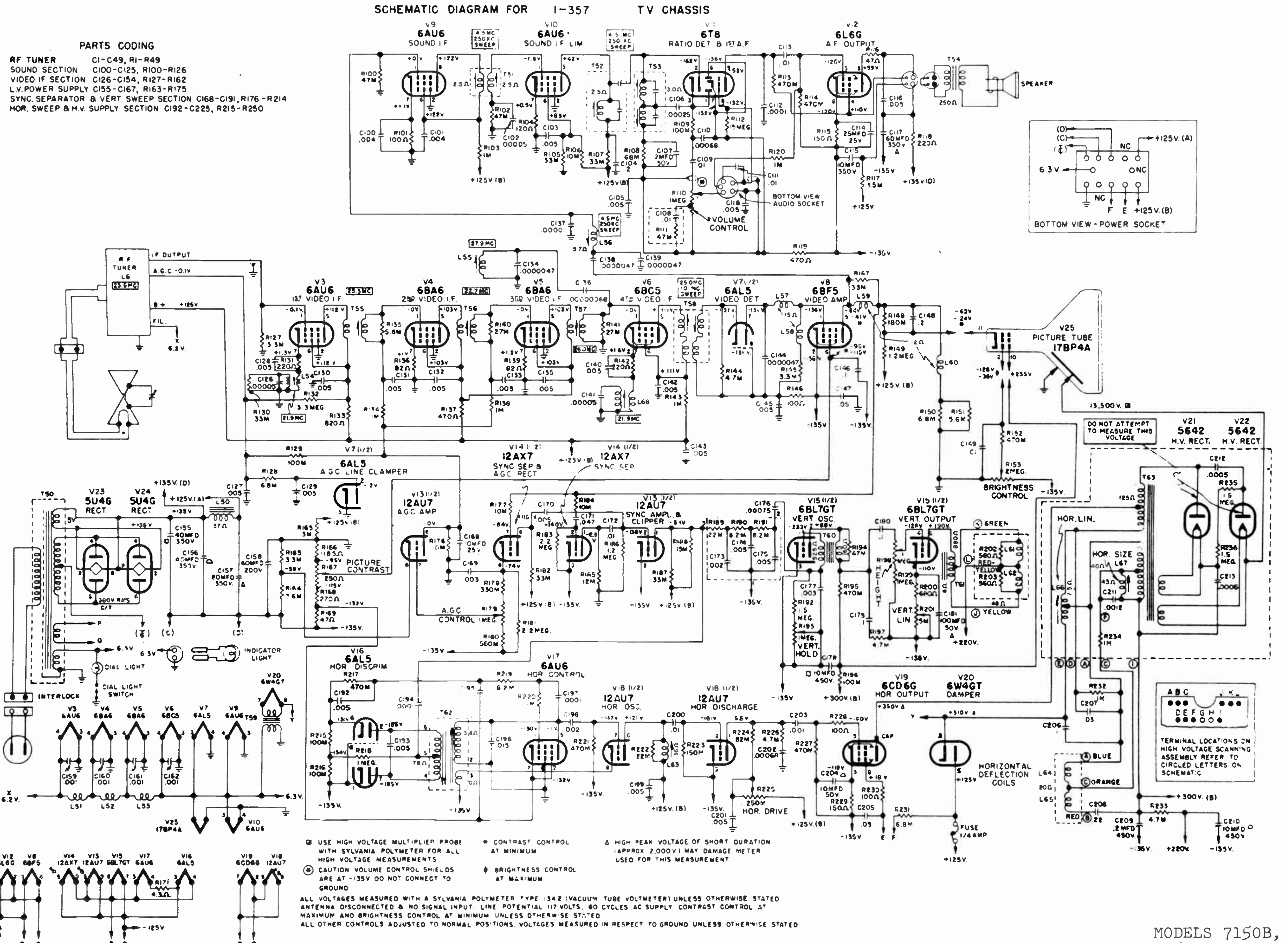

MODELS 7150B, 7150M, Ch. 1-357

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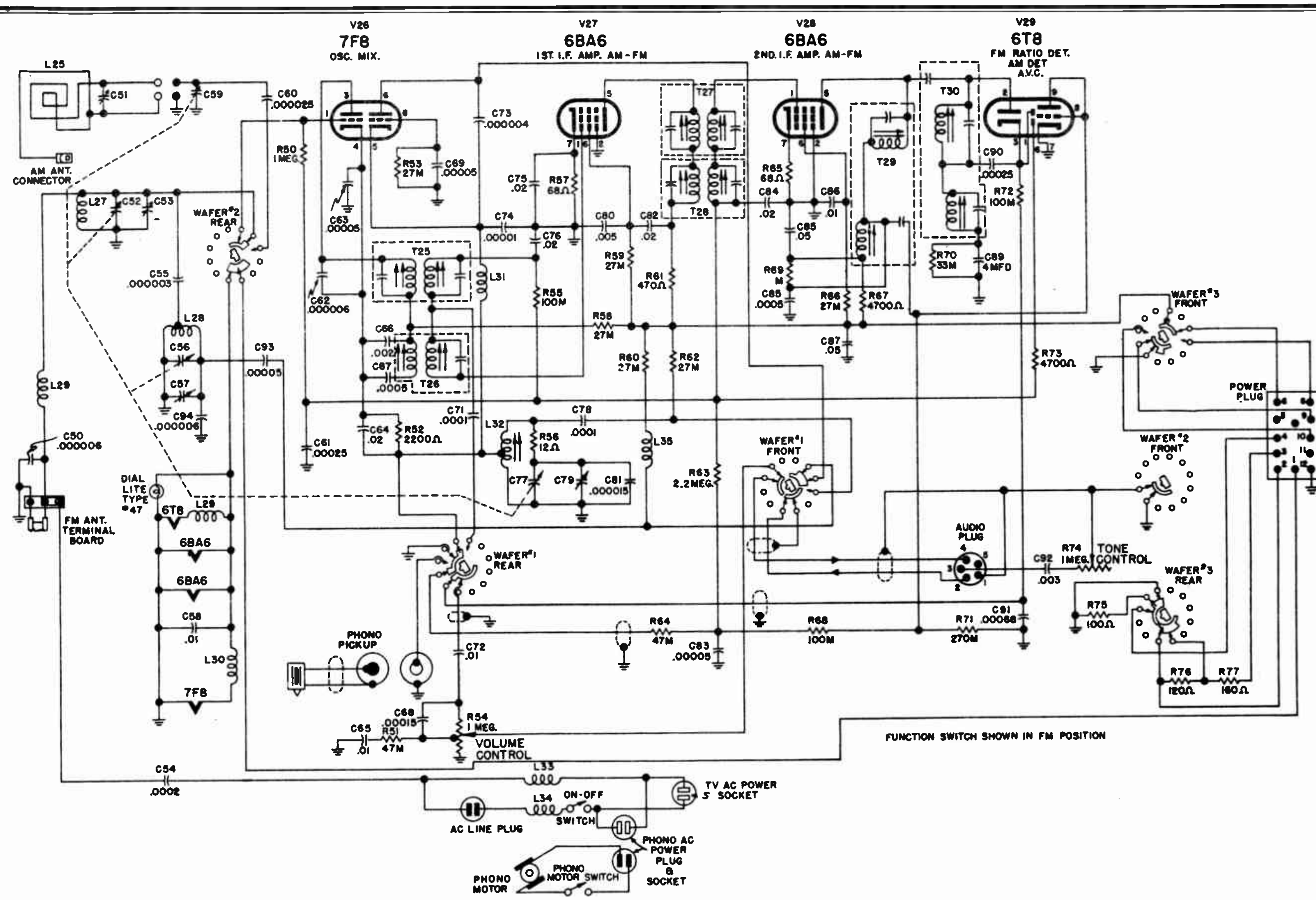
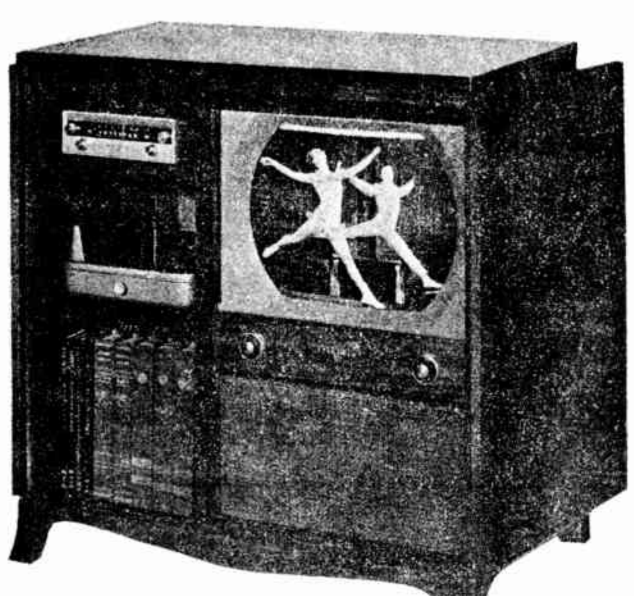


FIGURE 18 - AM-FM RADIO SCHEMATIC DIAGRAM



MODEL 5150M
(19" Picture - Mahogany)
available only in
Mahogany

ADDITION OF CHASSIS 1-274, MODEL 5150M

GENERAL DESCRIPTION

Chassis 1-274, Model 5150M, is a direct viewing television, radio, and record changer combination providing reception of all 12 commercial television channels, standard broadcast band, and frequency modulation band. The television picture is reproduced on a 19 inch electromagnetically deflected tetrode type black face picture tube.

SPECIFICATIONS

Cabinet Dimensions (inches)	Width	Height	Depth
	40.4	40	24.6
Weight (pounds)	Net		Gross
	185		215

The 1-274 chassis, Model 5150M, very closely resembles the 1-357 chassis, Models 7150M and 7160B, whose technical service data appears in Bulletin 9-13. Circuitwise, these chassis are similar except for the mechanical and electrical changes necessary to accommodate the 19 inch picture tube. Servicing data for the 1-274 is the same as for the 1-357 other than the following:

Picture Tube Replacement

To remove the picture tube from the chassis, remove the picture tube socket, high voltage anode connector, and ion trap magnet. Loosen the #10-32 bolt on the holddown strap at the upper right of the tube. Remove holddown strap. Pull the tube braces away from the sides of the tube. Lift the tube clear of the front edge of the chassis and move it forward gently until the tube base is clear of the focus magnet and yoke. The plastic rim around the face of the tube may then be removed.

To replace the picture tube reverse the removal procedure being careful not to force the tube if the neck binds. There is no specific angle of rotation for the picture tube. The yellow lead of the picture tube socket cable must be dressed away from the remainder of the picture tube leads and high voltage box. The high voltage anode connector should be positioned in the lower left hand corner and the gap in the plastic rim should be positioned in the lower right hand corner. Be sure the plastic rim is in place before replacing the tube and that the tube is properly placed before tightening the holddown strap. Note: There is no specific angle of rotation for the initial setting of the ion trap.

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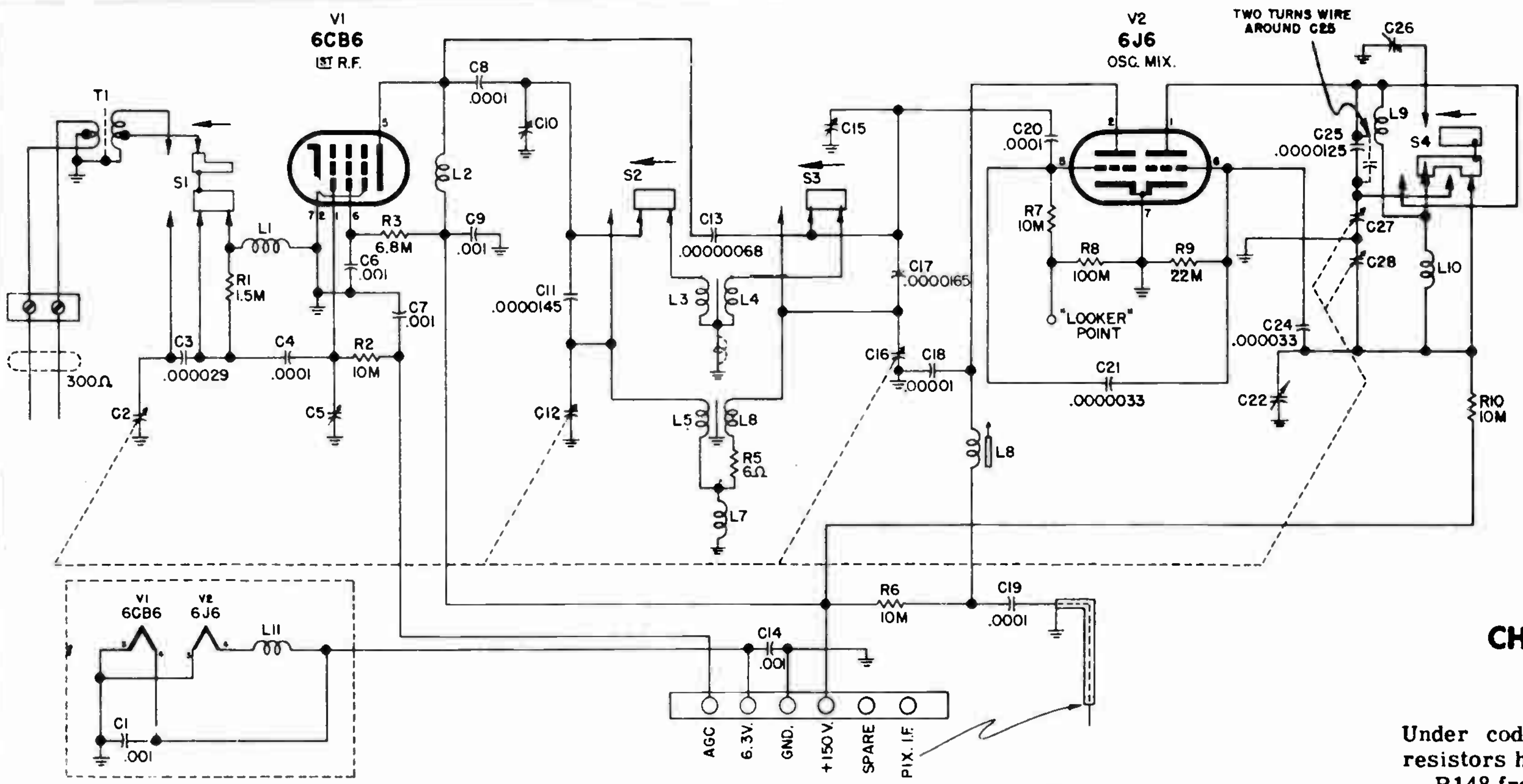

FIGURE 20 - RF TUNER SCHEMATIC FOR 1-357 TV CHASSIS

NOTE:
SWITCH SECTIONS 1-4 ARE PARTS OF A TWO POSITION SLIDE SWITCH. SWITCH SHOWN IN POSITION FOR HI BAND RECEPTION. ARROW INDICATES SWITCH DIRECTION FOR LO TV RECEPTION.

REPAIR PARTS LIST

SCHEMATIC LOCATION	SERVICE PART NO.	DESCRIPTION
	196-0013	Anode Connector and Lead Assembly
	400-0006	Beam Bender
C214	160-14350	Capacitor - Molded Paper - .0005 Mfd. - 10,000 V.
R110, R153	154-0003	Control - Brightness and Volume
	760-0009	Cover - Interlock Assembly
	710-0005	Glass - Picture Window - 19"
	716-0102	Mask - 19" Round Tube
R170	181-0224	Resistor - 220,000 Ohm - 1/2 W.
	486-0001	Ring - Insulator - 19" Metal Tube
V25	642-0005G	Tube - 19AP4A
	323-0004	Tuner Unit
R148	181-01845	Resistor - 180,000 Ohm - 1/2 W.
R183	181-0105	Resistor - 1.0 Megohm - 1/2 W.
R186, R192	181-0125	Resistor - 1.2 Megohm - 1/2 W.
R149	181-01255	Resistor - 1.2 Megohm - 1/2 W.

CHASSIS 1-274 C01, C02

Under code C01 the values of the following resistors have been changed:
R148 from 39,000 Ohm to 180,000 Ohm
R149 from 270,000 Ohm to 1.2 Megohm
R186 from 2.2 Megohm to 1.2 Megohm

Under code C02 the values of the following resistors have been changed:
R183 from 2.2 Megohm to 1.0 Megohm
R192 from 1.5 Megohm to 1.2 Megohm

The Repair Parts List information covering these revised values is as follows:

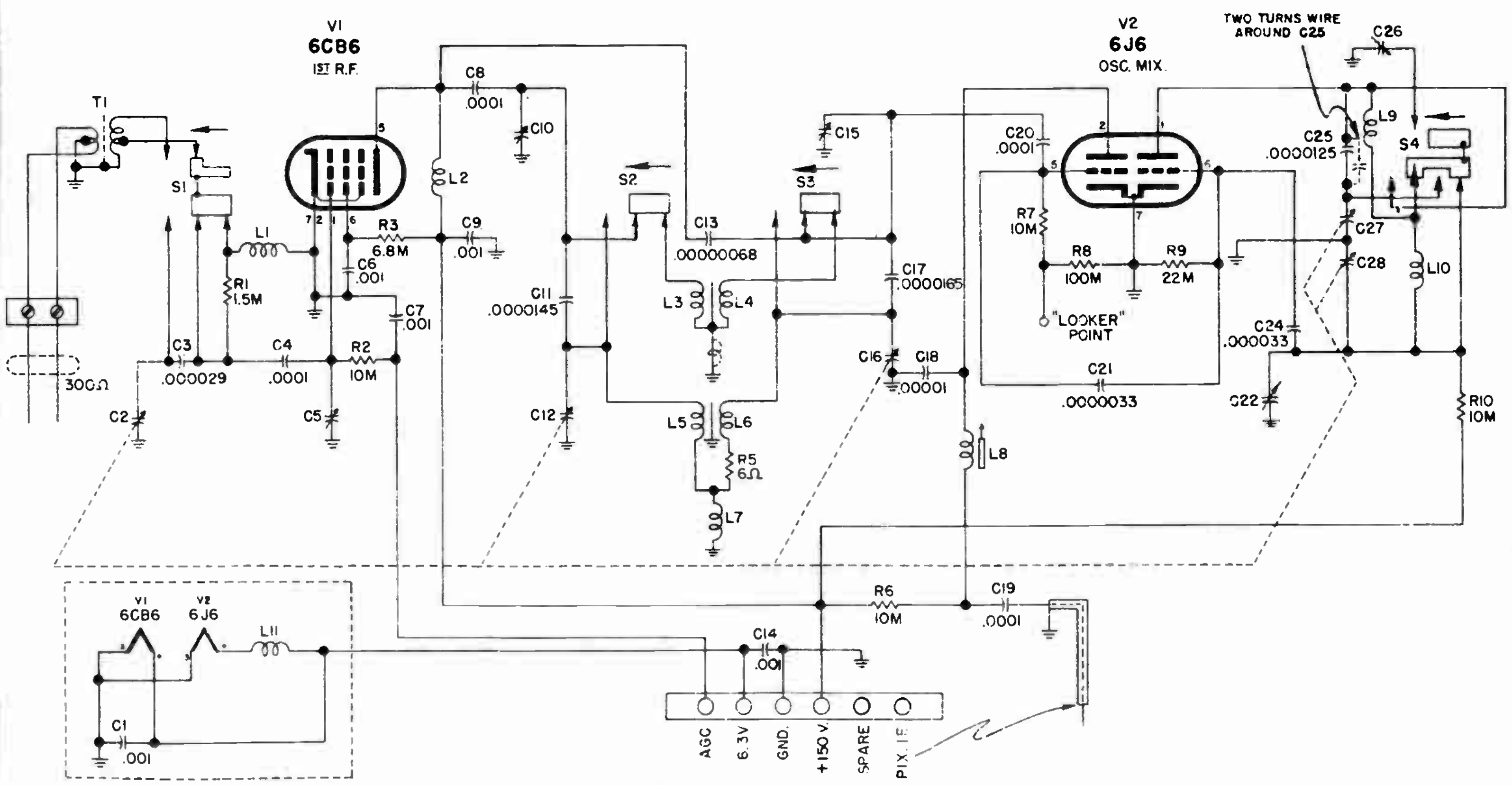

FIGURE 21 - R.F. TUNER SCHEMATIC FOR 1-274 TV CHASSIS

NOTE:
1. SWITCH SECTIONS 1-4 ARE PARTS OF A TWO POSITION SLIDE SWITCH. SWITCH SHOWN IN POSITION FOR HI BAND RECEPTION. ARROW INDICATES SWITCH DIRECTION FOR LO TV RECEPTION.

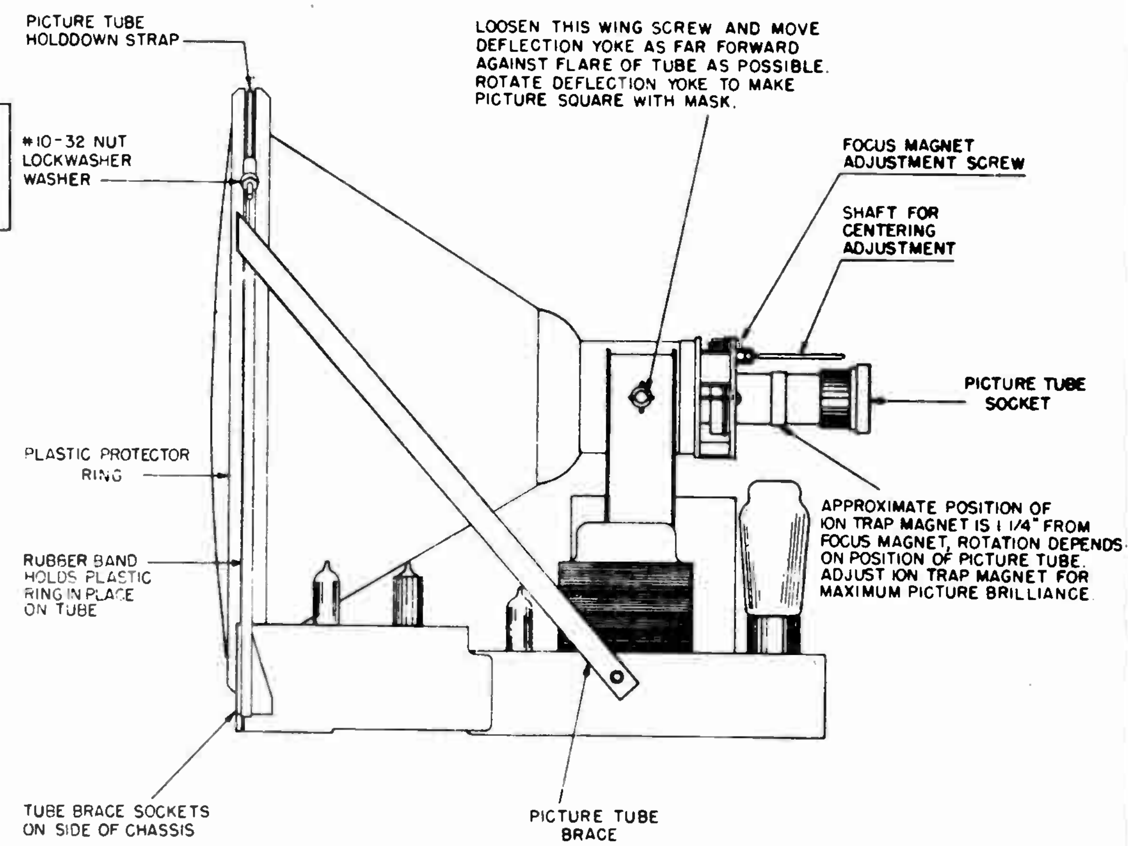

FIGURE 19 - PICTURE TUBE INSTALLATION

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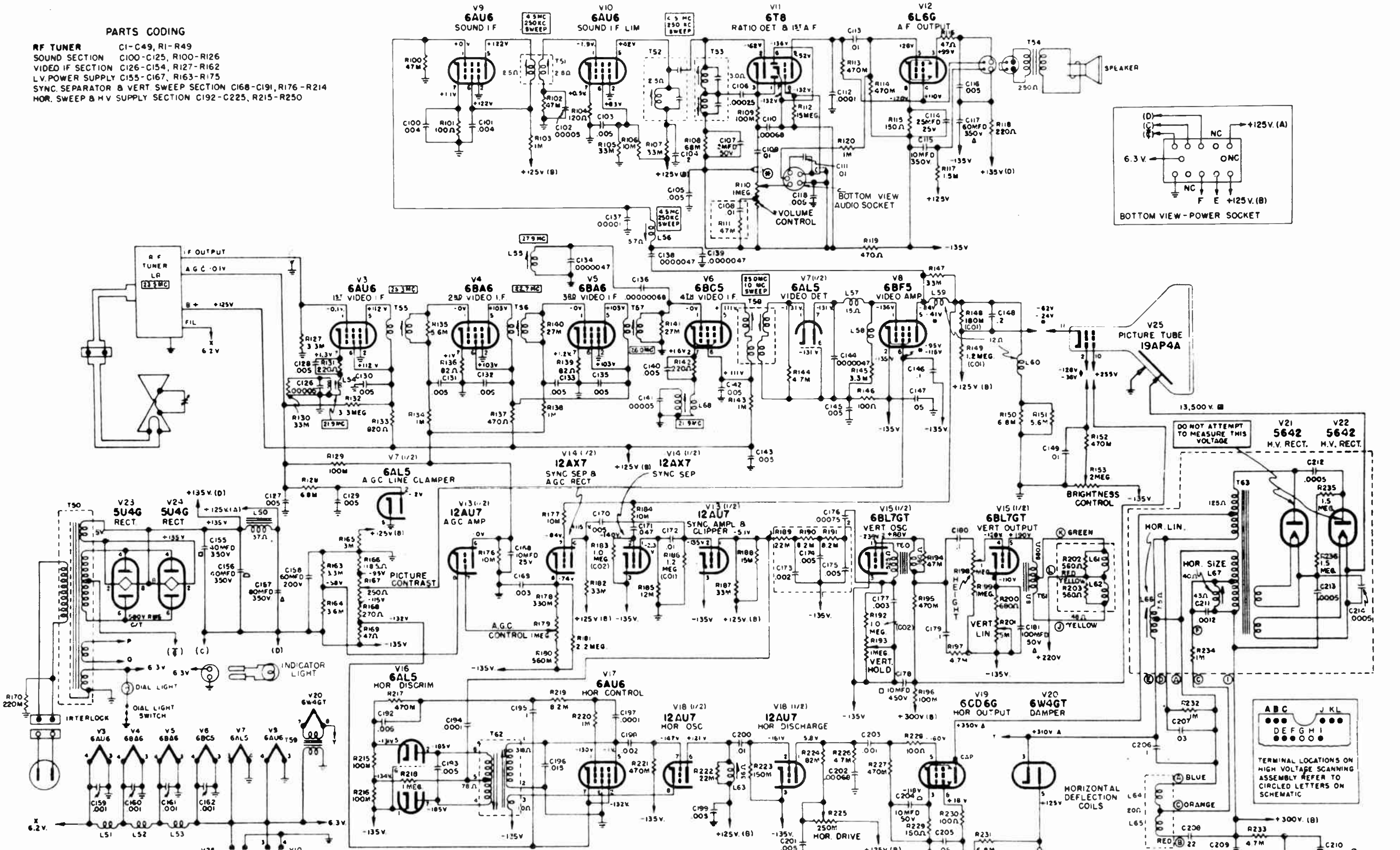
SCHEMATIC DIAGRAM FOR 1-274 TV CHASSIS

PARTS CODING

RF TUNER C1-C49, R1-R49
SOUND SECTION C100-C125, R100-R126
VIDEO IF SECTION C126-C154, R127-R162
L.V. POWER SUPPLY C155-C167, R163-R175
SYNC. SEPARATOR & VERT. SWEEP SECTION C168-C191, R176-R214
HOR. SWEEP & H.V. SUPPLY SECTION C192-C225, R215-R250



■ USE HIGH VOLTAGE MULTIPLIER PROBE WITH SYLVANIA POLYMETER FOR ALL HIGH VOLTAGE MEASUREMENTS

⊛ CAUTION VOLUME CONTROL SHIELDS ARE AT -135V. DO NOT CONNECT TO GROUND

* CONTRAST CONTROL AT MINIMUM

♦ BRIGHTNESS CONTROL AT MAXIMUM

Δ HIGH PEAK VOLTAGE OF SHORT DURATION (APPROX 2,000 V) MAY DAMAGE METER USED FOR THIS MEASUREMENT

ALL VOLTAGES MEASURED WITH A SYLVANIA POLYMETER TYPE 134 2 (VACUUM TUBE VOLTMETER) UNLESS OTHERWISE STATED ANTENNA DISCONNECTED & NO SIGNAL INPUT. LINE POTENTIAL 117 VOLTS, 60 CYCLES AC SUPPLY. CONTRAST CONTROL AT MAXIMUM AND BRIGHTNESS CONTROL AT MINIMUM UNLESS OTHERWISE STATED
ALL OTHER CONTROLS ADJUSTED TO NORMAL POSITIONS. VOLTAGES MEASURED IN RESPECT TO GROUND UNLESS OTHERWISE STATED

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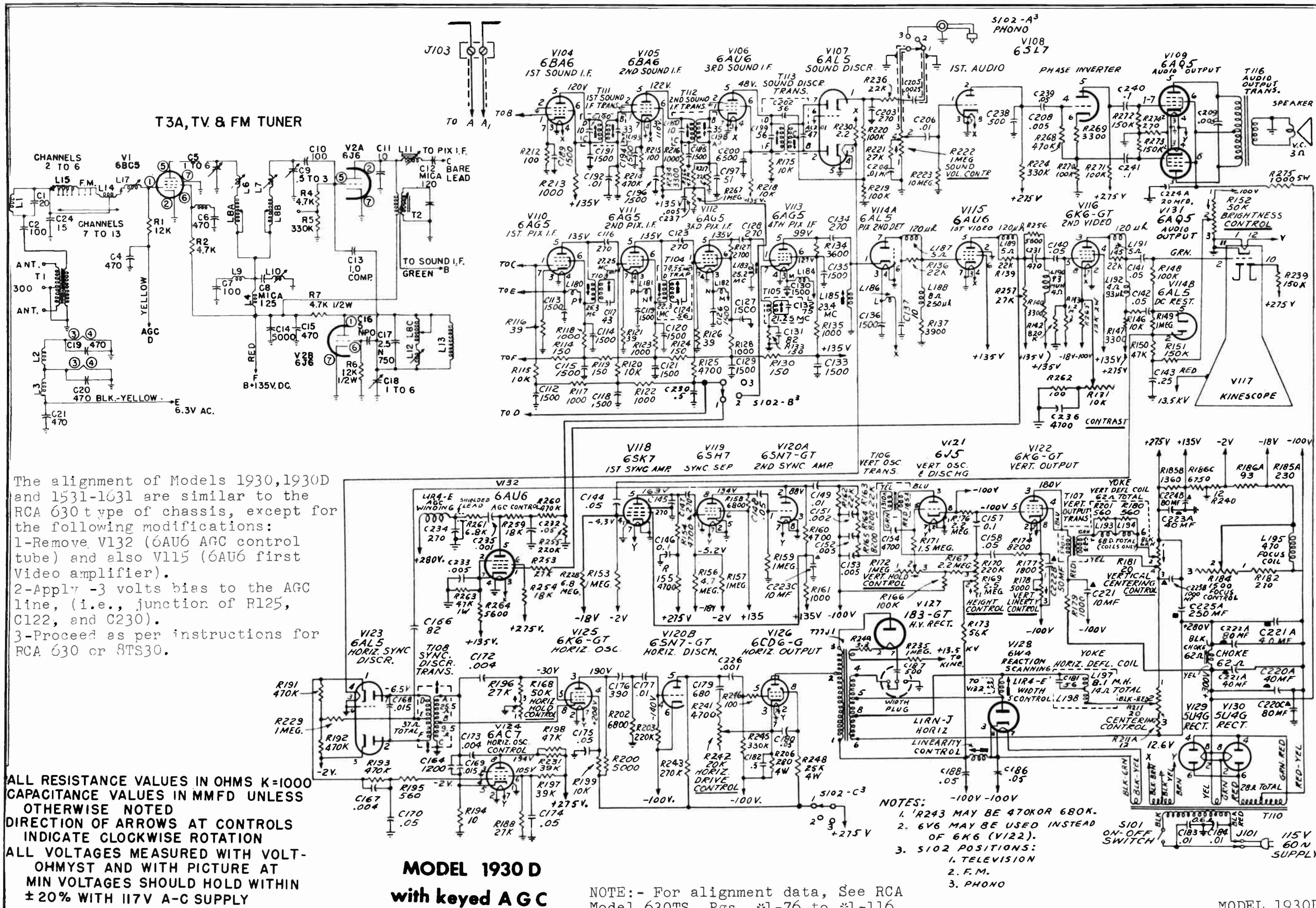

The alignment of Models 1930, 1930D and 1531-1631 are similar to the RCA 630 type of chassis, except for the following modifications:

1-Remove V132 (6AU6 AGC control tube) and also V115 (6AU6 first Video amplifier).

2-Apply -3 volts bias to the AGC line, (i.e., junction of R125, C122, and C230).

3-Proceed as per instructions for RCA 630 or 8TS30.

ALL RESISTANCE VALUES IN OHMS K=1000
CAPACITANCE VALUES IN MMFD UNLESS OTHERWISE NOTED
DIRECTION OF ARROWS AT CONTROLS INDICATE CLOCKWISE ROTATION
ALL VOLTAGES MEASURED WITH VOLT-OHMYST AND WITH PICTURE AT MIN VOLTAGES SHOULD HOLD WITHIN ± 20% WITH 117V A-C SUPPLY

MODEL 1930 D with keyed AGC

NOTE:- For alignment data, See RCA Model 630TS, Pgs. *1-76 to *1-116.

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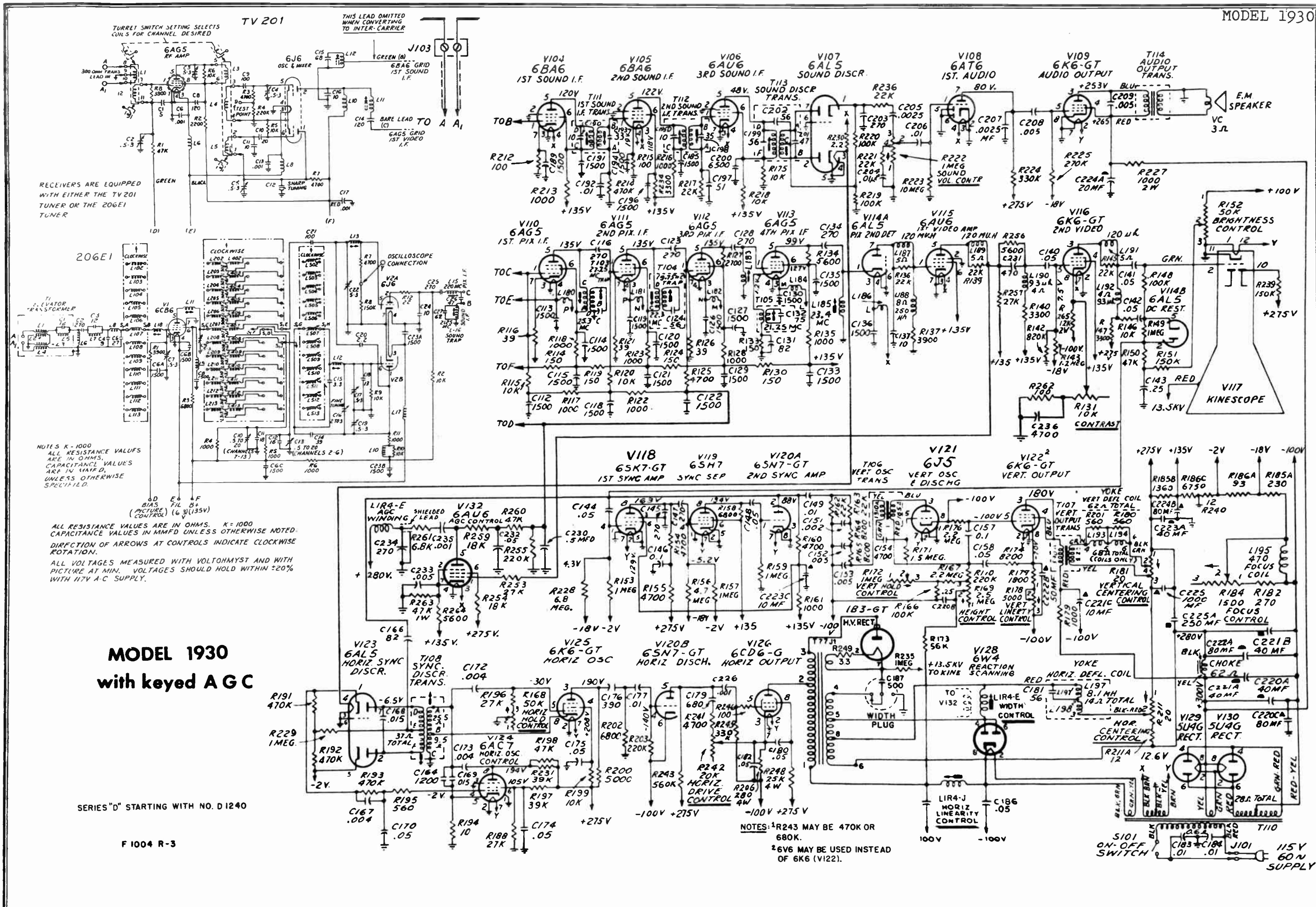

MODEL 1930
with keyed AGC

SERIES "D" STARTING WITH NO. D1240

F 1004 R-3

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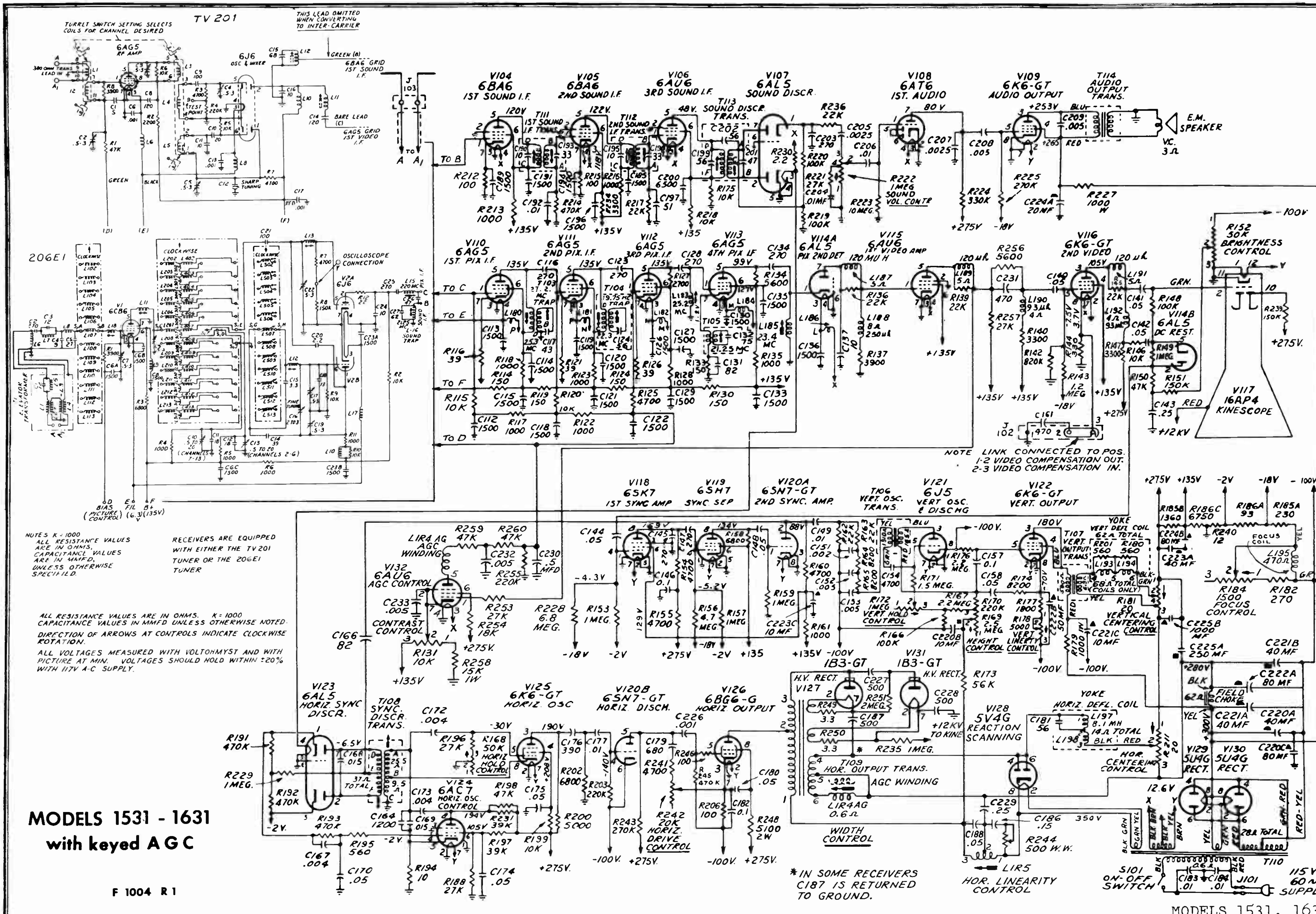

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SERVICE DATA FOR THE TELEQUIP TELEVISION RECEIVERS

ELECTRICAL SPECIFICATIONS

105-125 Volts 60 Cycle AC only 200 Watts

RF FREQUENCY RANGE

Channels 2-13, 54-88 MC and 174-216 MC.

IF FREQUENCY

Video Carrier - 26.1 MC
Audio Carrier - 21.6 MC
Intercarrier Audio Beat - 4.5 MC

TUBE COMPLEMENT

TV 138, 238, or 279 Tuners
V1-6AG5 - RF Amplifier
V2-6J6 - Mixer oscillator

Chassis 14T, 16T, 19T, 14TR, 16TR, and 19TR

V4-6AU6 - IF Amplifier
V5-6AU6 - IF Amplifier
V6-6AU6 - IF Amplifier
V7-6AL5 - Video Detector and AGC
V8-6AU6 - Video Amplifier
V9-12AU7 - Sync Clipper - DC Restorer
V10-6AU6 - Ratio Detector Driver
V11-6T8 - Ratio Detector, First Audio
V12-6AQ5 - Audio Output
V13-6J5 - Vertical Blocking Oscillator
V14-6SN7 - Horizontal Oscillator and AFC
V15-6BG6 - Horizontal Output
V16-5U4 - Damper
V17-1B3 - High Voltage Rectifier
V18-5U4 - Low Voltage Rectifier
V19-Kinescope
V3-6V6 - Vertical Output

Chassis 12TR

V4-6AU6 - IF Amplifier
V5-6AU6 - IF Amplifier
V6-6AU6 - IF Amplifier
V7-6AL5 - Video Detector and AGC
V8-6AU6 - Video Amplifier
V9-12AU7 - Sync Clipper - DC Restorer
V10-6AU6 - Ratio Detector Driver
V11-6T8 - Ratio Detector, First Audio
V12-6AQ5 - Audio Output
V13-6SN7 - Vertical Blocking Oscillator and Output
V14-6SN7 - Horizontal Oscillator and AFC
V15-6BG6 - Horizontal Output
V16-5U4 - Damper
V17-1B3 - High Voltage Rectifier
V18-5U4 - Low Voltage Rectifier
V19-Kinescope

KINESCOPE INSTALLATION

1. Remove the knobs.
2. Remove the four chassis retaining screws from the bottom of the cabinet.
3. Remove the chassis from the cabinet.
4. Loosen the strap holding bracket screws, the yoke mounting hood screws, and the focus coil wing nut.
5. Insert the kinescope with the high voltage connect cap toward the power transformer.
6. Insert the high voltage connector.
7. Place the kinescope strapping over the tube and tighten.
8. Tighten the yoke mounting hood screws such that the rubber bumpers are tight against the kinescope.
9. Put on the ion trap, attach the kinescope socket, and proceed with the adjustments as given below.

ION TRAP ADJUSTMENTS

The ion trap magnet should be approximately over the ion trap flags. Rotate the ion trap slightly and move it back and forth until a full raster is obtained. Adjust the ion trap in this manner for greatest brilliance.

FOCUS COIL ADJUSTMENT

Rotate the focus coil on its vertical and horizontal axis until a full raster is visible.

CENTERING

Centering is accomplished both vertically and horizontally by careful manipulation of the focus coil. This may be better accomplished by noting that the raster moves at right angles to the direction that the focus coil points. The deflection yoke should be as far forward as possible.

DEFLECTION YOKE ADJUSTMENT

Adjust the picture to the proper horizontal plane by loosening the deflection yoke wing nut and rotating the yoke.

SWEEP ALIGNMENT

VERTICAL: Set the height and linearity controls to approximately full clockwise position, and slowly rotate the vertical hold control until the picture looks vertically. After the picture is locked, adjust the height control for the proper vertical scan, and the linearity control for proper picture symmetry. Adjustment of any of these three controls may require readjustment of one or both of the other controls.

HORIZONTAL OSCILLATOR ALIGNMENT CHECK: Allow five minutes for the receiver to warm up. Turn the horizontal hold control fully clockwise; then fully counter-clockwise. The picture should remain locked except at the fully clockwise position. With the horizontal hold control fully counterclockwise, momentarily remove the signal by switching to another channel and back again. The picture should then be out of lock. As the hold control is turned slowly clockwise, the number of diagonal bars on the picture tube screen will reduce to four or five. At this point more rotation should pull the picture into lock.

HORIZONTAL OSCILLATOR ALIGNMENT: If the above conditions do not occur, set the horizontal hold control fully clockwise, set the horizontal locking range trimmer to approximately three turns of maximum tightness. Tune to the station. Turn the horizontal control until the picture pulls into lock. It may be necessary to alternately readjust the horizontal locking range trimmer so that the picture reduces to four or five bars before pulling into lock. Repeat the horizontal alignment check.

HORIZONTAL LINEARITY: Adjust the horizontal drive control so that there is no excessive scan. Adjust the horizontal linearity control for the best horizontal linearity.

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TROUBLESHOOTING

1. No raster.
   (a) Improperly adjusted brightness control.
   (b) Check for proper setting of the ion trap.
   (c) No high voltage. Check 6BG6 (V15), 1B3 (V17), 5U4 (V16) tubes, and the high voltage circuit components. Check the ¼ A fuse, and the 400 MMF coupling condenser at the grid of the 6BG6.
   (d) No "B" supply.
   (e) Defective horizontal oscillator and AFC tube 6SN7 (V14) or circuit components.
   (f) Defective kinescope or kinescope circuit.

2. No video.
   (a) Check IF and RF circuits and tubes. Check video coupling circuit to kinescope.

3. No sound.
   (a) Check IF and RF circuits and tubes. Check 6AU6 (V10), 6T8 (V11), 6AQ5 (V12), and the speaker and connections.

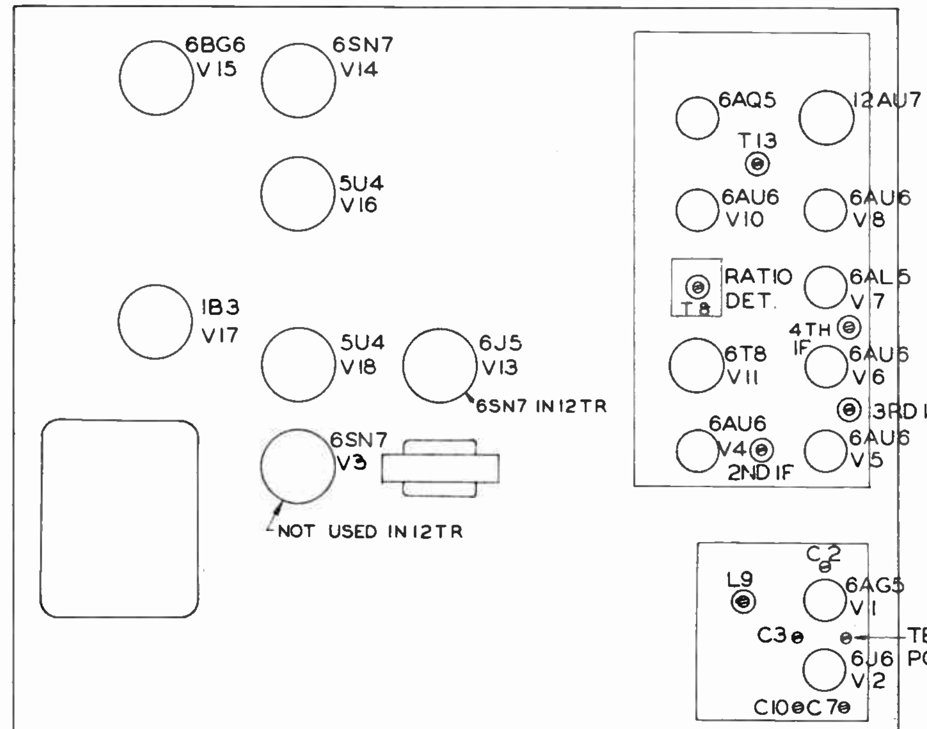
4. Raster too small horizontally.
   (a) Improper horizontal drive adjustment.
   (b) Line voltage too low.
   (c) Replace 6BG6 (V15).
   (d) Replace 6SN7 (V14).
   (e) Low "B" supply. Check 5U4 (V18), and for shorts.
   (f) Check .2 mfd isolating condenser of the horizontal deflection coils for open.
   (g) Check the flyback transformer and the yoke.

5. Vertical jittering.
   (a) Reset vertical hold for the least jitter.
   (b) Replace 6SN7 or 6J5 (V13), vertical blocking oscillator.
   (c) Replace 12AU7 (V9) sync clipper.
   (d) Check sync clipper for proper clipping.

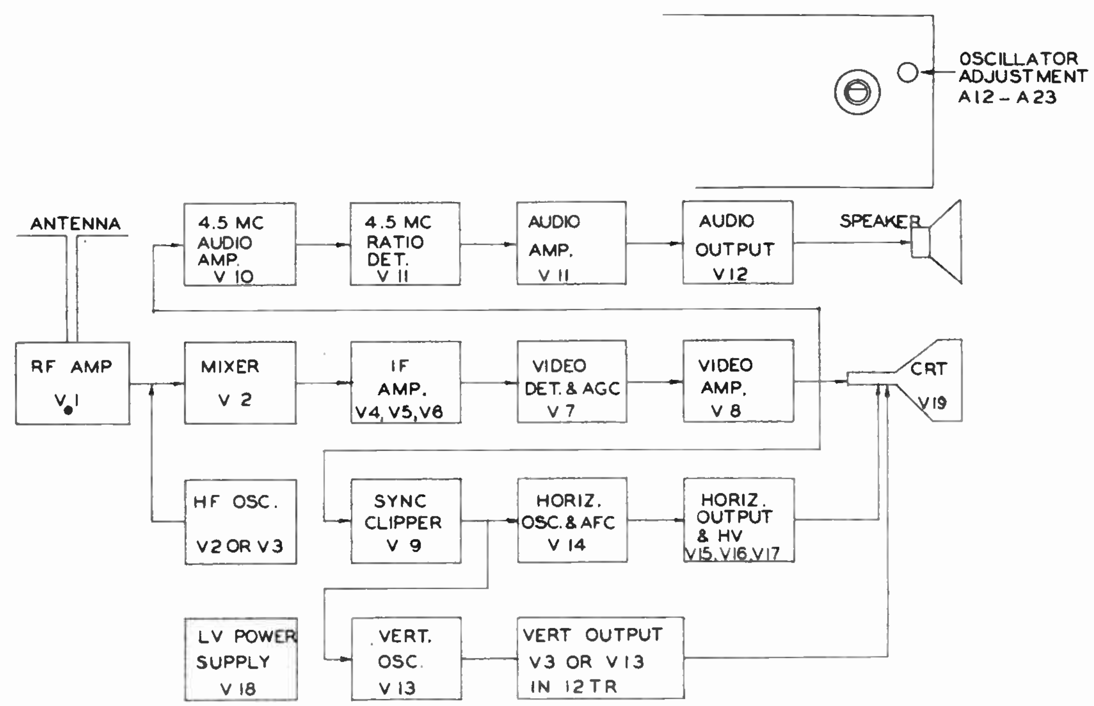
6. Lack of height.
   (a) Replace 6SN7 or 6J5 (V13) vertical blocking oscillator.
   (b) Replace 6V6 (V3) Vertical output tube.
   (c) Check "B" supply.
   (d) Check blocking oscillator transformer for short or open.
   (e) Check integrating circuit for short.
   (f) Check cathode capacitor (100mfd) for open.
   (g) Check vertical deflection coil.

7. Elimination of Audio Buzz
   (a) Set the fine tuning control properly.
   (b) Set the contrast control for a normal contrast.
   (c) Readjust the tuning slug on top of the ratio detector transformer (T8) for minimum buzz and maximum audio signal.
   (d) Replace 6T8 (V11) and retune T8.
   (e) Readjust the RF oscillator tuning slug for any particular station concerned.

8. Station not tuning properly.
   (a) Remove the channel marker plate.
   (b) Retune the RF Oscillator tuning slug for the channel concerned.



TUBE AND ADJUSUTMENT LAYOUT
FOR CHASSIS 14T, 16T, & 19T
14TR, 16TR, & 19TR
12TR AS NOTED



BLOCK DIAGRAM

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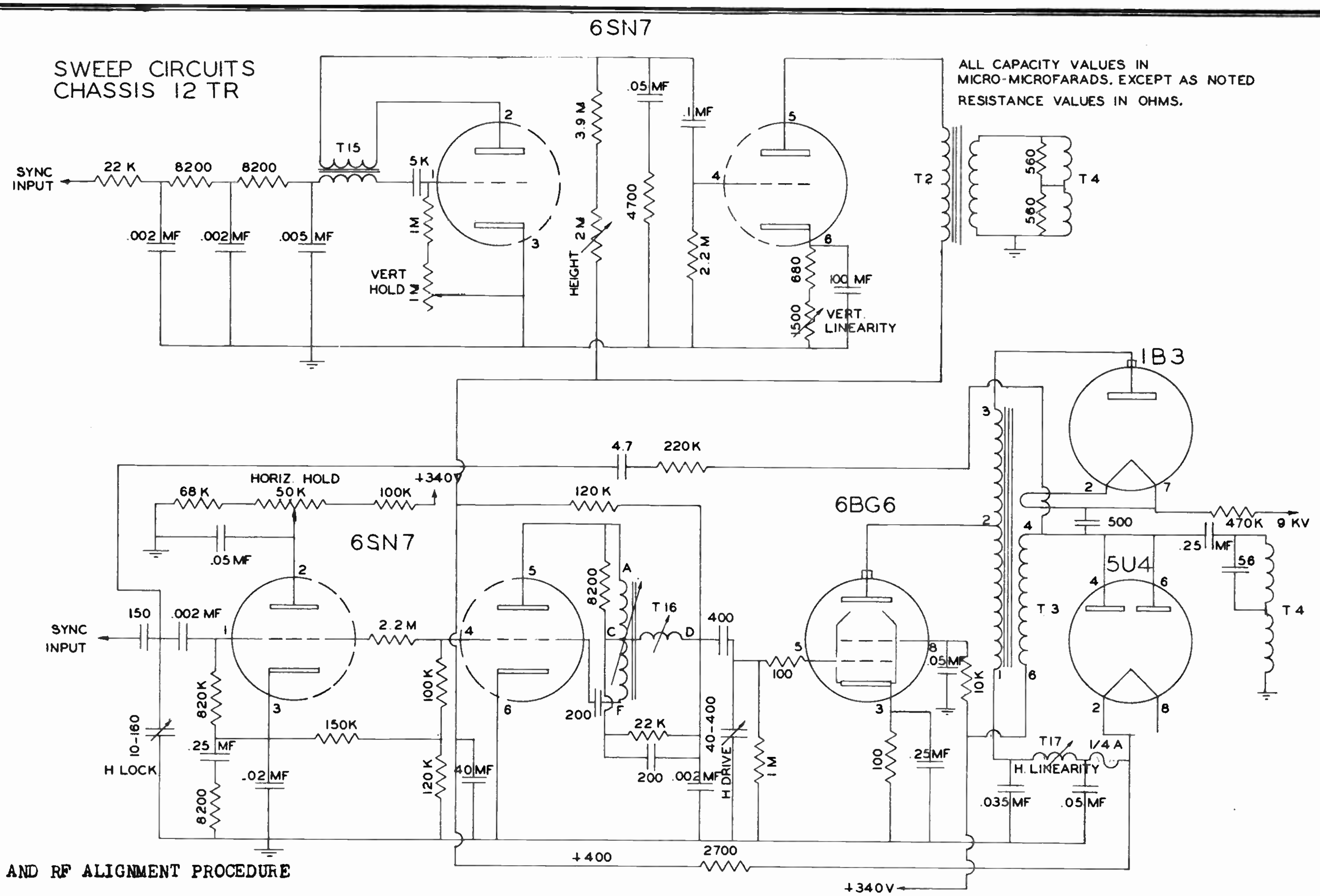

IF AND RF ALIGNMENT PROCEDURE

TEST EQUIPMENT

The following test equipment is necessary for proper alignment of the TELEQUIP receiver:

RF SWEEP GENERATOR:

18 - 30 MC range	10 MC sweep width
50 - 90 MC range	10 MC sweep width
170 - 225 MC range	10 MC sweep width

OUTPUT IMPEDANCE: 300 Ohms balanced to ground for RF ranges.

OUTPUT VOLTAGE: Adjustable

MARKER GENERATOR:

18 - 30 MC frequency range
50 - 90 MC frequency range
170 - 225 MC frequency range

SIGNAL GENERATOR:

Accurate signal generator, range 30-225 MC with calibrated output attenuator and low impedance output.

OSCILLOSCOPE: Standard oscilloscope with wide band vertical deflection.

VOLTMETER: Vacuum tube voltmeter or 20,000 ohms per voltmeter preferably with a zero center low voltage scale.

IF AMPLIFIER ALIGNMENT:

1. Remove one section of oscillator mixer coil (6 terminal) from turret to this position.
2. Connect 10 K resistor and 500 MMF mica capacitor between pin 7 of 6AL5 and ground.

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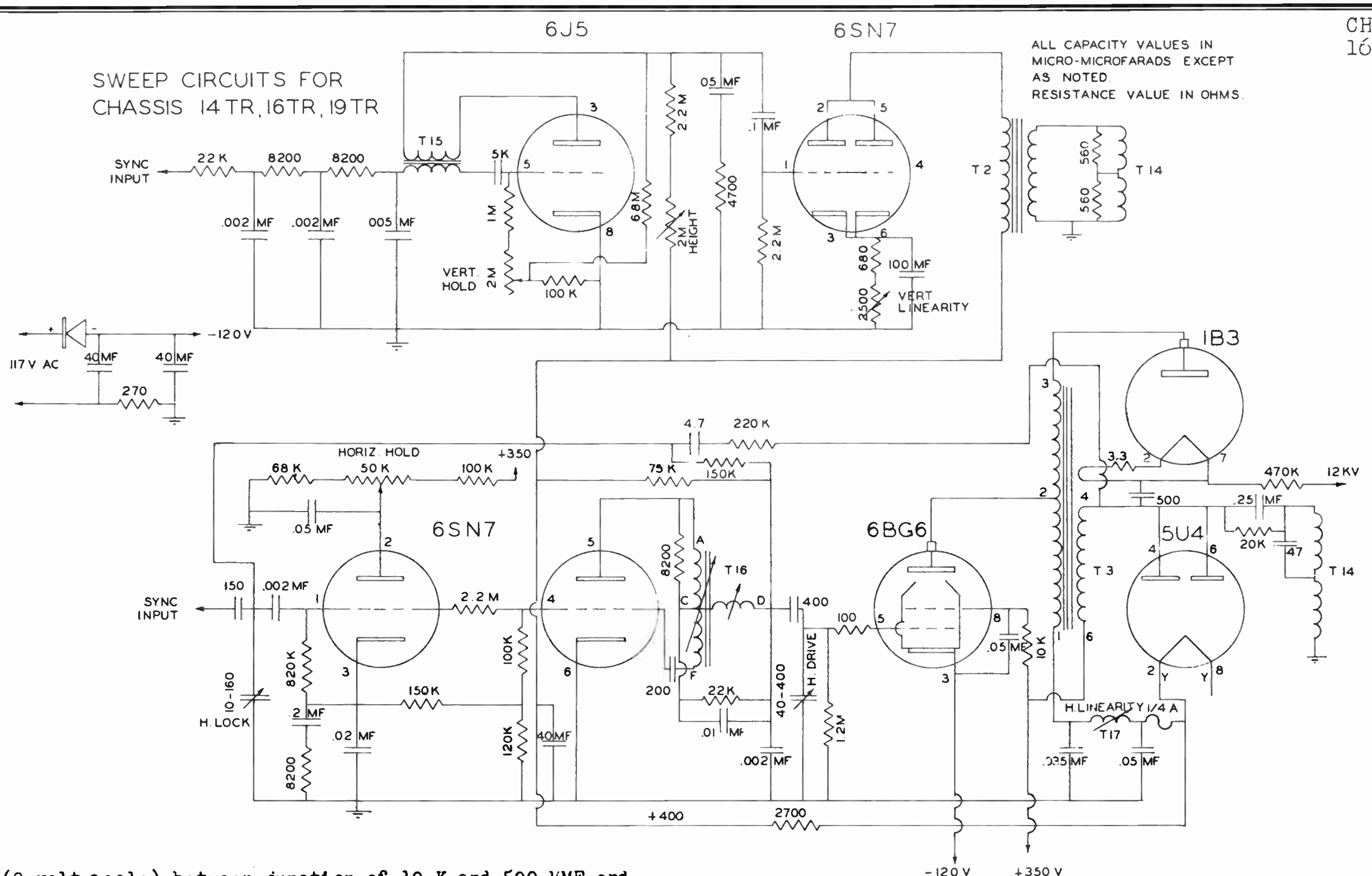

3. Connect voltmeter (3 volt scale) between junction of 10 K and 500 MMF and chassis ground.
4. With TV 138 tuner, connect signal generator hot side to point #9, loop on top of the tuner chassis, ground side to chassis ground. With TV 100 tuner disconnect 100 MMF coupling condenser for grid of 6AU6-V2 mixer tube from switch and connect hot side of signal generator to 100 MMF.
5. Set signal generator frequency for 25.3 MC unmodulated, adjust second and fourth IF coil for maximum deflection on the voltmeter.
6. Set signal generator frequency for 23.1 MC unmodulated, adjust L9 and 3rd IF for maximum deflection on the voltmeter.
7. Disconnect signal generator and connect sweep generator between point D and ground. Set sweep to IF band 20-30 MC.
8. Disconnect voltmeter and connect input of scope between junction of 10 K and 500 MMF and ground.
9. Loosely couple the marker generator to the high side of the sweep generator.
10. To avoid distortion it is important to keep the sweep generator and marker generator outputs as low as possible.
11. Check the response curve obtained against the ideal overall IF response curve and retouch the IF coils as required.
12. It is important that the marker pips be in the proper location as shown on the ideal response curve.

4.5 MC AUDIO IF ALIGNMENT

1. The accuracy of the signal generator used in this alignment should be within 1 kilocycle. If this quality signal generator is not available, it is recommended that touch-up of the zero setting adjustment be made, using a television station signal rather than the 4.5 MC signal from the signal generator.
2. Set the frequency of the signal generator at 4.5 MC unmodulated.
3. Connect hot side signal generator through a .01 condenser to the grid of 6AU6 video amplifier, ground side to chassis ground.
4. Connect 2-12K resistors across ratio detector as shown on schematic.
5. Connect voltmeter across (A) and tune T13 and bottom slug of T8 for maximum reading.

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6. Connect voltmeter using 3V zero center scale across (B) and tune top slug of T8 for a zero point. A correct zero center point is between a positive and negative maximum point.

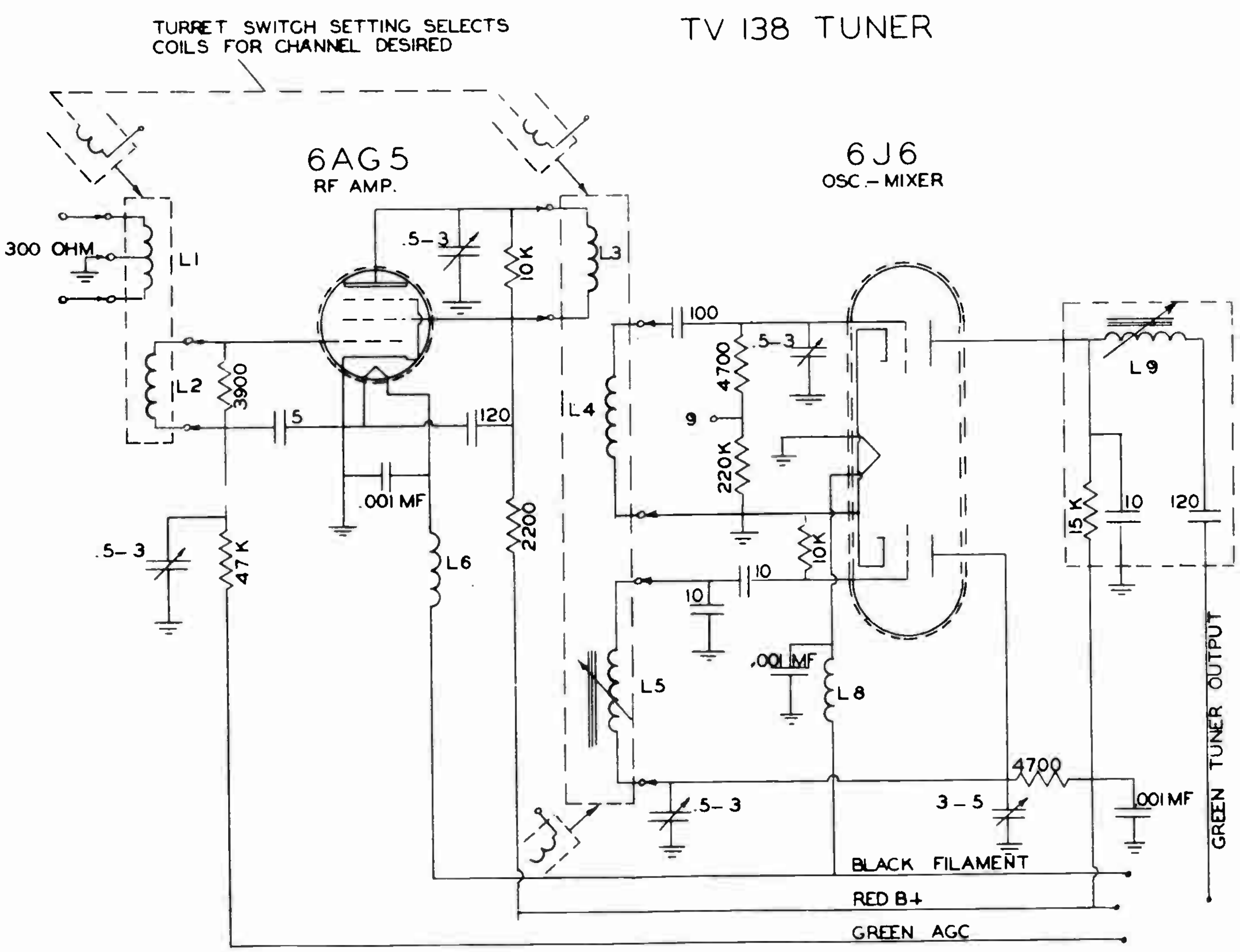
7. Retouch, if necessary, as outlined in 1 above.

TV 138 RF TUNER ALIGNMENT REQUIREMENTS

With normal use or operating conditions, tuner alignment is seldom necessary. The RF mixer coils have been designed for stable band pass operation, and under normal operating conditions will seldom need realignment. The high frequency oscillator coils may require some slight readjustment, if the oscillator mixer tube has been replaced.

RF and mixer coils are self tuned by distributed and tube capacities. Since the tuner features replaceable channel snap-in coil, individual RF and mixer coil adjustments are not provided. Overall adjustment covering all channels can be made with capacitors C2, C3, and C7. These adjustments should be made on a higher channel, preferably channel 12.

TV 138 TUNER



TV 138 RF AMPLIFIER ALIGNMENT

RF MIXER ALIGNMENT:

1. Connect sweep generator to antenna terminals.

2. Loosely couple marker generator to antenna terminals. Marker generator output should be kept at a minimum, such that the marker pips are just barely visible.

3. Connect oscilloscope through a 10,000 ohm resistor to point 9, the loop on top of the tuner chassis.

Step	Marker Gen. Freq. MC	Sweep Generator Frequency	Adjustment
1	205.25 209.75	Sweeping Channel 12	Check for curve resembling RF response curve. If necessary, adjust C2, C3, and C7 as required.
2	211.25 215.75	13	Check channel for curve resembling RF response curve shown below. In general, the adjustment performed in step 1 is sufficient to give satisfactory response curves on all channels. However, if reasonable alignment is not obtained on a particular channel, (a) check to see that coils have not been intermixed, or (b) try replacing a pair of coils for that particular channel, or (c) repeat step 1 for this particular weak channel as a compromise adjustment to favor this channel. If a compromise adjustment is made, other channels should be checked to see that they have not been appreciably affected.
3	199.25 203.75	11	
4	193.25 197.75	10	
5	187.25 191.75	9	
6	181.25 185.75	8	
7	175.25 179.75	7	
8	83.25 87.75	6	
9	77.25 81.75	5	
10	67.25 71.75	4	
11	61.25 65.75	3	
12	55.25 59.75	2	

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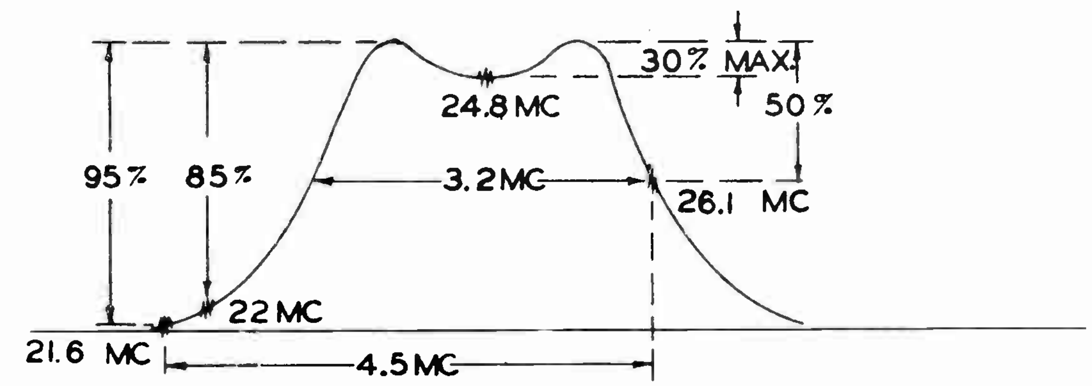
TV 138 H. F. OSCILLATOR ALIGNMENT

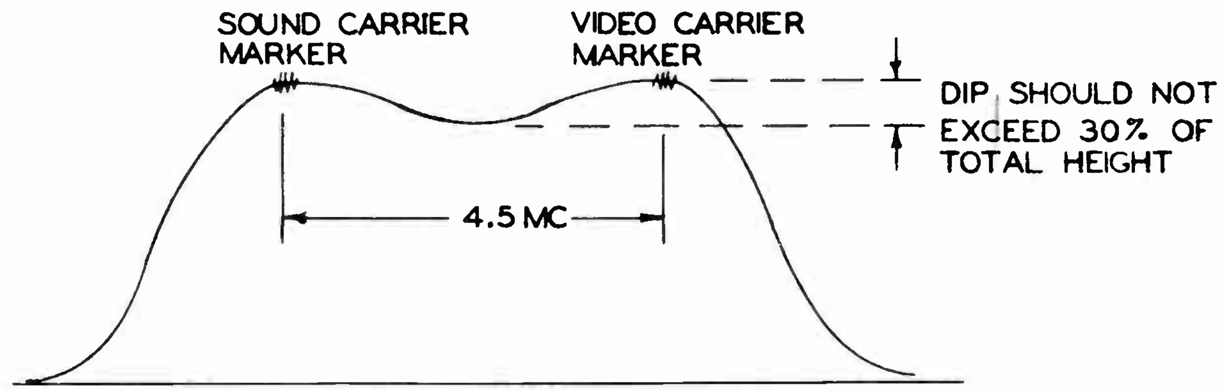
1. Connect sweep generator to antenna terminals.
2. Loosely couple marker generator to antenna terminal.
3. Connect oscilloscope between function of 10 K and 500 MMF network and ground.
4. Set vernier control to the center of its range.
5. Use a non-metallic screwdriver for all H.F. oscillator adjustments.

HIGH FREQUENCY ALIGNMENT

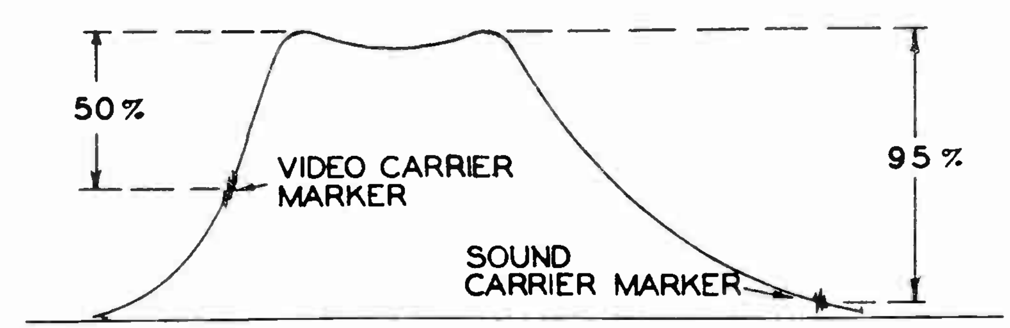
Step	Marker Generator Frequency (MC)	Sweep Generator Frequency	Adjustment
1			Before aligning the HF oscillator, check the IF response curve. Retouch if necessary.
2	211.25 215.75	Sweeping Channel 13	Check to see if the video carrier marker appears at the 50% point on the response curve when the sharp tuning control is tuned to the center of its range. If adjustment is needed, check to see if the misalignment is apparent on channel 13 only, or also exists on all channels. If overall adjustment is needed, adjust C10; otherwise A12.
3	205.25 209.75	12	Check all channels individually for proper marker location; if overall adjustment has been made, it may not be necessary to make any further adjustments. If necessary, however, make individual HF oscillator adjustments (A 12 to A23) for individual channels.
4	199.25 203.75	11	
5	193.25 197.75	10	
6	187.25 191.75	9	
7	181.25 185.75	8	
8	175.25 179.75	7	
9	83.25 87.75	6	
10	77.25 81.75	5	
11	67.25 71.75	4	
12	61.25 65.75	3	
13	55.25 59.75	2	



IDEAL IF RESPONSE CURVE



RF RESPONSE CURVE



OVERALL RF MIXER AND IF RESPONSE CURVE

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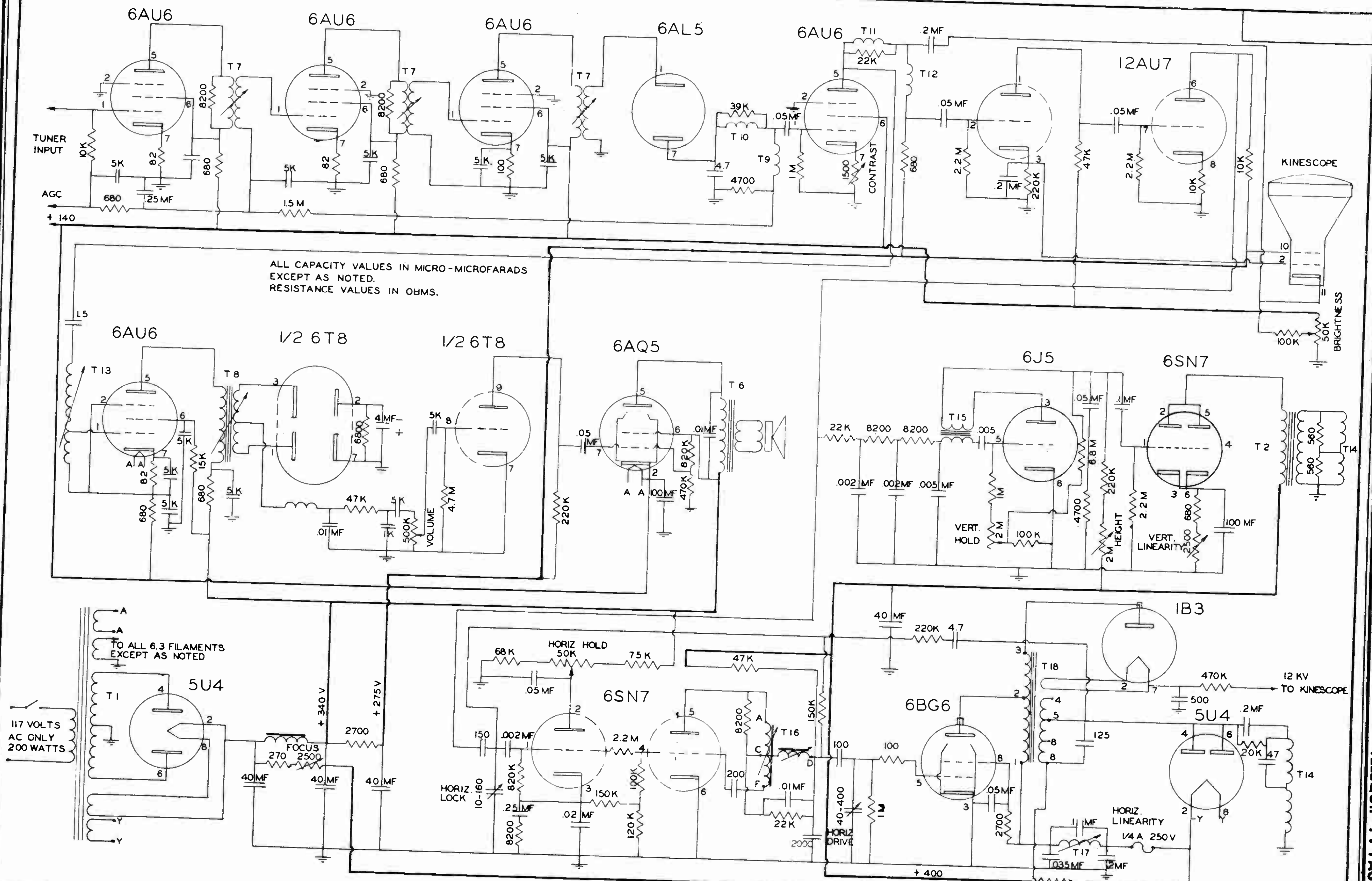

SCHEMATIC FOR CHASSIS #16T 14T & 19T

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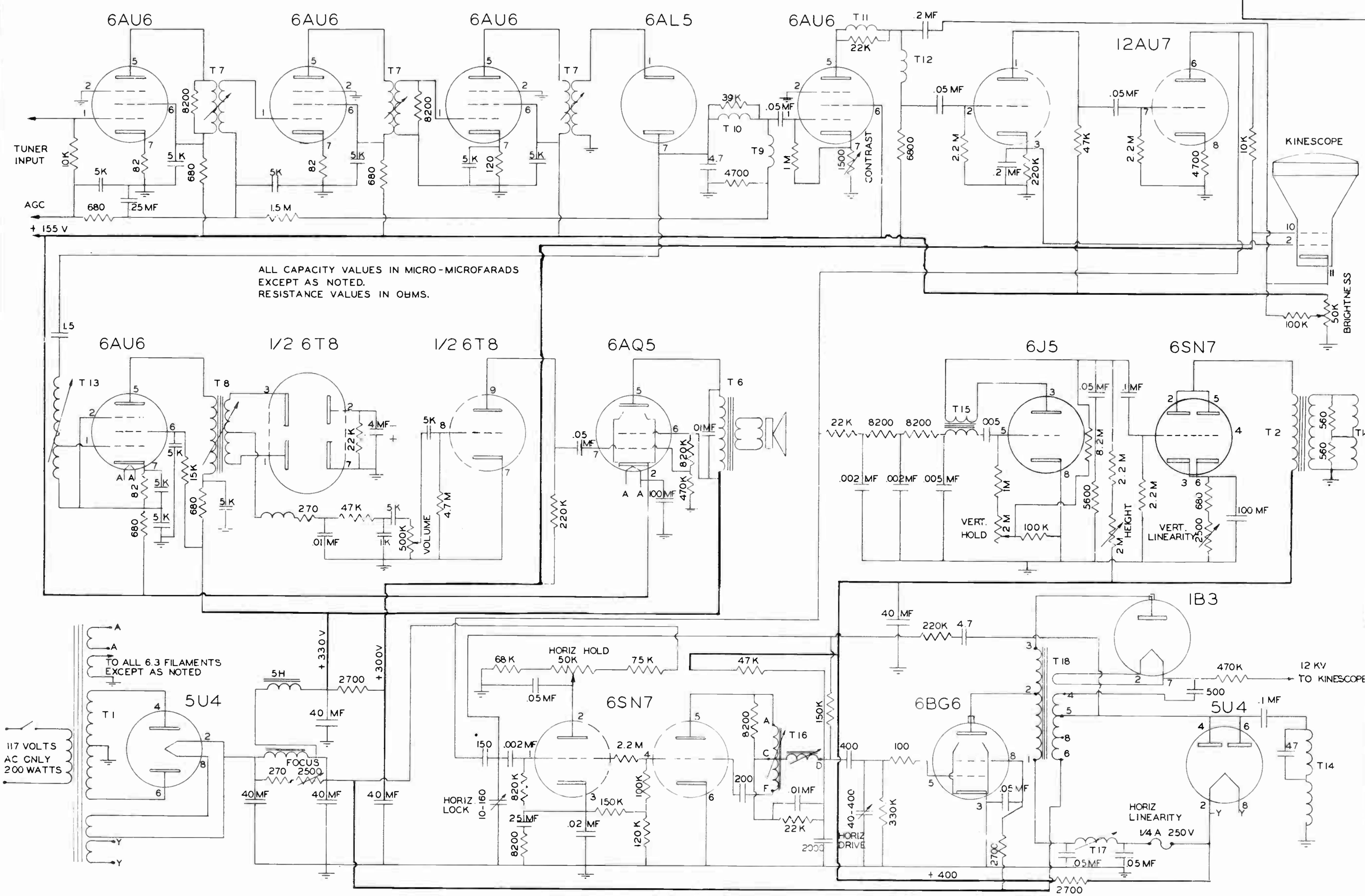

SCHEMATIC FOR CHASSIS #16T 14T & 19T

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Model TV-288

Model TV-286

Model TV-284

Model TV-287

SPECIFICATIONS

POWER SUPPLY
105 to 125 V. 60 Cycle A.C.

POWER CONSUMPTION
180 Watts

POWER OUTPUT (AUDIO)
2 Watts (Undistorted)

INPUT IMPEDANCE
72 Ohms Unbalanced

PICTURE TUBE SIZE
12½ inch — TV-284, 287, 288
16 inch — TV-286

SPEAKER
4 x 6 inch Oval PM — Voice Coil 3 Ohms

DIMENSIONS
TV-284 — 22" Wide x 20" Deep x 39" High
TV-286 — 24" Wide x 24" Deep x 40" High
TV-287 — 21" Wide x 20" Deep x 16¾" High
TV-288 — 21" Wide x 20⅛" Deep x 16½" High

SHIPPING WEIGHT
TV-284 — 114 lbs.
TV-286 — 135 lbs.
TV-287 — 90 lbs.
TV-288 — 90 lbs.

TUBE COMPLEMENT

	V1	6J6	R. F. Amplifier
	V2	6AG5	Mixer
	V3	6J6	R. F. Oscillator
	V4	6AG5	1st Video I. F. Amplifier
	V5	6AG5	2nd Video I. F. Amplifier
	V6	6AG5	3rd Video I. F. Amplifier
	V7	6AL5	Video Detector — A.G.C.
	V8	6AC7	Video Amplifier
	V9	6AU6	Ratio Detector Driver
	V10	6AL5	Ratio Detector
	V11	6AT6	Audio Amplifier
	V12	6V6-GT	Audio Output
	V13	6AL5	D.C. Restorer-Limiter
	V14	12AU7	Sync Separator
	V15	6C4	Vertical Oscillator and Discharge
	V16	6K6-GT	Vertical Output
	V17	6SN7-GT	Horizontal Oscillator and Sync Guide
	V18	6BG6-G	Horizontal Output
	V19	6W4-GT	Horizontal Damper
TV286	V20	1B3-GT	High Voltage Rectifier
	V21	1B3-GT	High Voltage Rectifier
	V22	5U4-G	Power Rectifier
	V23	16AP4	Picture Tube (16")
TV284 287 288	V20	1B3GT	High Voltage Rec.
	V21	5U4G	Power Rectifier
	V22	12LP4	Picture Tube (12½")

FREQUENCY CHART

CHANNEL	FREQUENCY	PICTURE FREQUENCY	SOUND FREQUENCY	RF OSCILLATOR FREQUENCY
2	54-60	55.25	59.75	92.55
3	60-66	61.25	65.75	98.55
4	66-72	67.25	71.75	104.55
5	76-82	77.25	81.75	114.55
6	82-88	83.25	87.75	120.55
7	174-180	175.25	179.75	212.55
8	180-186	181.25	185.75	218.55
9	186-192	187.25	191.75	224.55
10	192-198	193.25	197.75	230.55
11	198-204	199.25	203.75	236.55
12	204-210	205.25	209.75	242.55
13	210-216	211.25	215.75	248.55

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INSTALLATION

WARNING

This receiver is designed for use on 105 to 125 Volt 60 cycle AC only. Do not connect to Direct Current (DC) power supply. If in doubt, check your local power supply company.

GENERAL — For best results this Tele-tone receiver should be installed by a competent television serviceman who is properly equipped to make necessary adjustments to the receiver and determine the most suitable type of antenna installation.

OUTDOOR ANTENNA —For best results with your Tele-tone Television Receiver an outdoor antenna is recommended. In areas where both Low (Channels 2 to 6) and High (channels 7 to 13) are received a separate antenna should be used for each band.

In areas where both high band and low band reception is available, these antennas may be used in the form of a stacked array.

Where a stacked array is used, it may prove advantageous in some locations to connect separate down leads from each antenna and connect a suitable switch at the receiver as shown in figure 1.

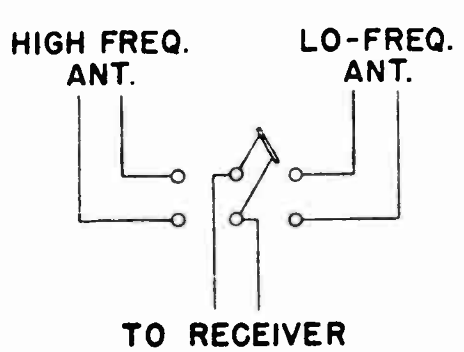
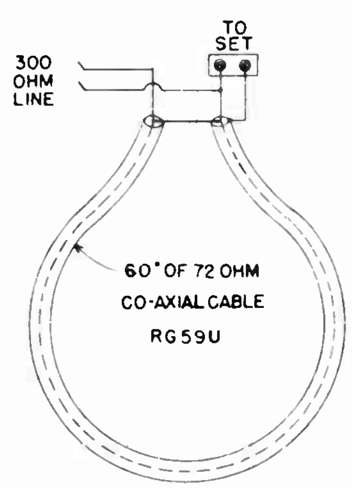


FIG. 1

INDOOR ANTENNA — Indoor antennas, although acceptable in many cases, are subject to many disturbing factors. For example; viewers approaching the antenna, electrical appliances within the home, defective lighting fixtures, etc., all of which will affect the receiver where an indoor antenna is used and would probably be eliminated with an outdoor installation. However, in cases where an indoor antenna is acceptable, or becomes a necessity because of local restrictions, etc., we recommend the adjustable type indoor antenna.

TRANSMISSION LINE — In non-critical locations, satisfactory results may be obtained with a 300 ohm down lead connected directly to the receiver antenna terminals. In more critical locations (insufficient signal) increased pick-up may be obtained by using the 300 ohm down lead in conjunction with a suitable matching transformer at the receiver. (See figure 2). In unusually noisy locations considerably improved performance may be obtained by the use of 72 ohm co-axial transmission line.



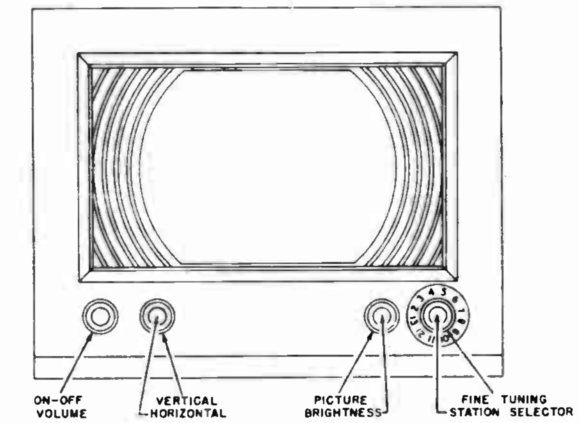
ANTENNA MATCHING TRANSFORMER

FIG. 2

NOTE: — When using 72 ohm co-axial down lead, it is important that its outer lead be connected to the shield side of the receiver transmission line. Check antenna terminal connections to determine shield side.

CONTROL FUNCTIONS

RECEIVER FRONT PANEL CONTROLS



CONTROLS IDENTICAL ON MODELS TV-284, 286, 287, 288

FIG. 3

VOLUME — ON — OFF — The volume control is an audio control only and has no effect on the picture. It is connected in the grid circuit of the audio amplifier (V-11). The power on and off switch is combined with the volume control.

HORIZONTAL HOLD — The Horizontal Sweep Oscillator uses Automatic Frequency control. As a result the Horizontal Hold Control will only be used if the picture should resolve into a series of heavy, oblique, black and white lines. A slight readjustment of the knob will then cause the picture to correct itself.

VERTICAL HOLD — The vertical hold control should be adjusted in the event of picture roll. Slight readjustment will cause the picture to lock vertically. It is found in the grid circuit of the vertical oscillator (V-15).

PICTURE — This control is primarily a picture control. It operates in the cathode circuit of the video amplifier. It controls the picture strength by varying the gain of this stage.

BRIGHTNESS — This control operates by varying the DC potential on the cathode of the Kinescope.

STATION SELECTOR — The (inner) bar knob of this control will operate the station selector. The (outer) circular knob will activate the Fine Tuning control which is a vernier adjustment of the RF oscillator.

RECEIVER REAR CHASSIS CONTROLS

WIDTH — The Horizontal Sweep is determined by the current flowing through the Horizontal Yoke Coil. The current through this coil (L23) is controlled by Width Control (L21) which is a variable reactor having the effect of changing the turns ratio of this winding of the Horizontal Output and H.V. Transformer (T6). This is a screwdriver adjustment.

RECEIVER REAR CHASSIS CONTROLS

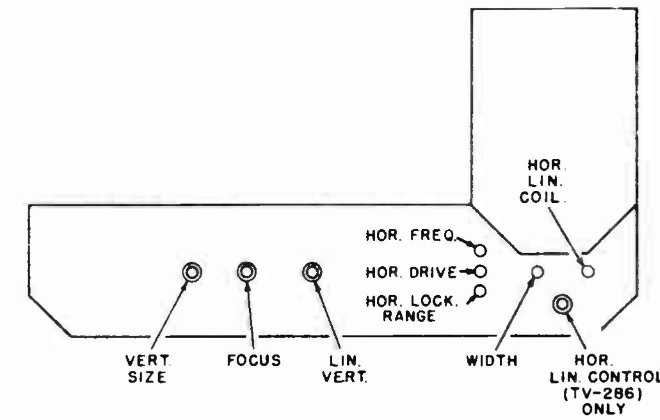


FIG. 4

HORIZONTAL LINEARITY —Horizontal linearity in all models is controlled by a coil (Horizontal Linearity Coil), and in Model 286 by a potentiometer in addition (Horizontal Linearity Control). Both controls are located at the lower right rear of the chassis (see Fig. 4) and operate in the Horizontal Output Stage of the receiver. For complete adjustment data see page 8.

HEIGHT — This control is a voltage dropping rheostat operating in the plate circuit of the Vertical Sweep Oscillator first half (V-15). It changes the voltage delivered to the Vertical Amplifier (V-16) feeding current to transformer coupled Vertical Yoke Coil (L-19). Since changes in height will affect picture linearity, this Height Control must be adjusted in conjunction with Vertical Linearity Control.

VERTICAL LINEARITY CONTROL — This is a variable resistor control (R70) in the cathode of the Vertical Output Tube (V-16) which changes the plate current curve of the tube thus affecting the linearity of the Vertical Sweep Wave form. To be adjusted as height control is adjusted.

FOCUS CONTROL — This is a Variable Resistor (R64) which varies the current through focus coil (L18).

HORIZONTAL AND VERTICAL CENTERING —Centering of the picture area is accomplished in this receiver by finding that position for the focus coil in the horizontal and vertical planes that produces this result. The focus coil bracket is arranged so that if the four hexagon-head screws are loosened it can be shifted up and down and from side to side enabling the centering position to be found by trial. The four hexagon-head adjusting screws shown in figure (10) should be tightened to hold the coil firmly.

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BRIEF CIRCUIT ANALYSIS

The Tele-tone Television Receiver Models TV-284, 286, 287, 288 uses the Inter-Carrier sound system. In this system the RF section of the receiver receives both the picture and sound carriers which are converted by mixer (V-2) into the IF. This IF is fed through a single IF channel. The sound signals are separated at the video amplifier (V-8) and fed through a 4.5 Megacycle Trap into a Ratio Detector Driver (V-9) and to the Ratio Detector (V-10).

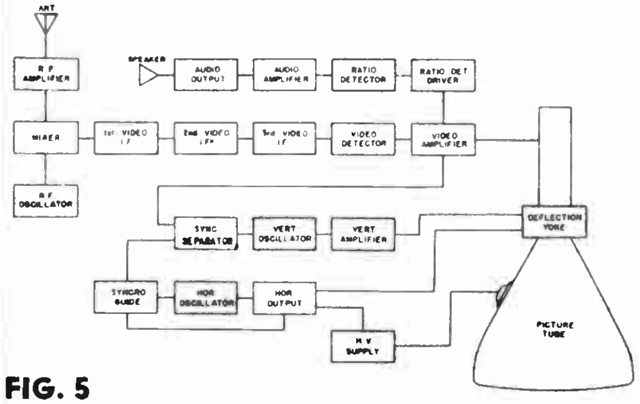


FIG. 5

TUNER — The tuner in this model covers 12 channels (2 to 13 inclusive). The local oscillator is tuned to the high side on all channels and is adjusted to provide a picture I.F. of 37.3 Mc and a sound I.F. of 32.8 Mc.

The tuning inductance for channel 2 is across the oscillator at all times. The tuning inductances for channels 3 to 13 respectively is shunted across the channel 2 inductance as these channels are selected.

In aligning the receiver channel 2 must first be adjusted and channel 3 to 13 then adjusted. Misalignment of channel 2 will detune the other channels. Appreciable readjustment of channel 2 may require retuning of several low frequency channels. This effect is of less importance on channels 7 to 13. Alignment should be attempted only after the receiver has been operating for 5 minutes.

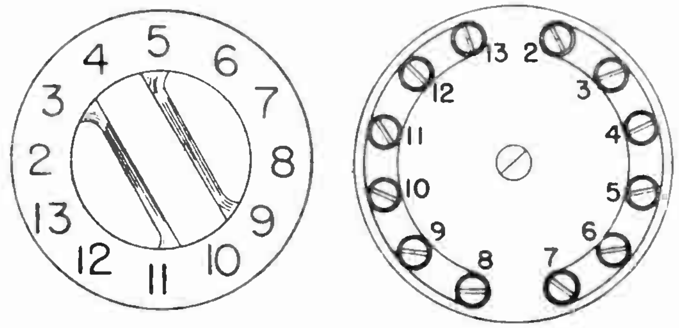
R.F. AMPLIFIER — The antenna is fed between cathode and grid of the grounded grid RF amplifier (V-1), the input circuits of which are untuned. Double tuned interstage coupling is used between the plate of the RF Amplifier (V-1) and the grid of the mixer (V-2). Mechanically, the series inductances used take the form of several individual coils which are cut in or out of their respective circuits by means of the band switch. These coils will rarely need readjustment.

MIXER — The output of the RF Amplifier (V-1) and the Local Oscillator are condenser fed into the Control Grid Mixer Stage (V-2). This circuit is tuned in much the same manner as the output of the RF Amplifier, previously decribed.

OSCILLATOR — The RF Oscillator (V-3) is fairly straight-forward in operation. Its main peculiarity previously mentioned is that the coil for Channel 2 is permanently parallel to all other Oscillator coils from 3 to 13. It is therefore necessary, when aligning the oscillators to ALIGN CHANNEL 2 FIRST and the rest of the coils in any order thereafter. They are tuned by brass slugs accessible through two slots in the front of the receiver chassis. Channel 2 is found at the top of the right hand slot and the others follow in regular order in a clockwise direction finishing with Channel 13 at the top of the left hand slot.

NOTE: The channel numbers on the escutcheon do not correspond to the location of the oscillator coils.

FIG. 6



VIDEO IF — Each Video IF transformer has only one adjustment, a powdered iron slug accessible from the top of the chassis. The Video IF String is stagger tuned to two frequencies. The first and third IF transformers are tuned to 34.45 Megacycles and the second and fourth are tuned to 36.8 Megacycles. The response curve is fairly flat topped and should produce a picture with good definition.

VIDEO AMPLIFIER — A 6AC7 pentode is used in this section of the receiver. The output of the detector is directly coupled into the grid (pin 4) and taken off the plate (pin 8). It is at this point that the three basic components of the received signal are separated and fed to their respective circuits. The sound is picked off by the Sound-Take-off Trap and sent through the Ratio Detector Driver (V-9), the Ratio Detector (V-10) and Audio Amplifiers (V-11 and 12) to the speaker. The picture intelligence is fed to the grid of the Picture Tube, and the sync pulses are fed into the sync seperator and from there to the Vertical oscillator and the horizontal sync. guide.

SOUND SYSTEM — The sound Carrier is taken off the plate of the Video Amplifier (V-9) by a 4.5 Megacycle trap and fed through a Ratio Detector Driver (V-9) to the Ratio Detector (V-10), and then to the audio amplifier (V-11), audio output (V-12) and speaker.

D. C. COMPONENT — D. C. restoration is accomplished through the use of one half of a 6AL5 (V-13A). The Voltage developed at the cathode of this tube is fed to the grid of the Cathode Ray Tube to maintain a constant blanking level and to restore the original background illumination.

SWEEP SYSTEM — VERTICAL — The Vertical Sync pulses are fed by an integrating network into the Vertical Oscillator (V-15) thereby controlling the oscillator frequency. The output of the oscillator is then amplified by the output stage (V-16). The plate of the Vertical Output stage is transformer coupled to the Vertical windings of the Deflection Yoke.

SWEEP SYSTEM — HORIZONTAL — The Horizontal Oscillator is essentially of the Blocking Oscillator type. The operation of the AFC system depends upon a correcting voltage developed in the control tube when the oscillator output and the incoming pulses differ in either phase or frequency. The control tube, first section (V-17), is maintained at cut-off until such time as the sync pulse is either ahead or behind the oscillator, (second section V-17), sawtooth peak. When either case occurs the control tube develops a voltage which is applied as a bias to the oscillator grid and alters the oscillator frequency to coincide with the frequency of the incoming pulses. The horizontal oscillator transformer has an adjustable core which is a coarse control of the oscillator frequency. The Horizontal Frequency Control (rear) is a fine adjustment in the same sense. The front panel Horizontal Hold Control permits slight adjustment of the frequency by adjusting the B voltage applied to the control tube plate. The Horizontal Locking range control affects the sensitivity of the control tube thus varying the range over which the AFC circuit will function.

NOTE: Many of the components in the Horizontal circuits are of critical value and therefor should only be replaced by the exact replacement part. Care should also be taken in dressing leads and parts when replaced. This can be accomplished by carefully noting parts positions before removal. For complete alignment procedure on these circuits see page 8.

A.G.C. — The receiver uses an AGC circuit operating on the first 2 IF stages (V-4) (V-5). While it is quite effective in most locations, the receiver may overload in regions of very high field intensity. The contrast can generally be adjusted for a normal picture under such conditions but spurious beats, jagged vertical lines (i.e. poor resolution) and a "Moire" pattern may appear. These effects can be eliminated by the use of a resistor network of 3 to 10 db attenuation in series with the antenna lead at the point where it is connected to the receiver.

HIGH VOLTAGE POWER SUPPLY—The energy stored in the horizontal windings of the deflection yoke during the forward sweep produces high voltage surges during retrace. This is stepped up by the "auto-transformer" winding of the Horizontal Output Transformer and then rectified by the 1B3 (V-20) (and doubled in the TV286 by the second 1B3 (V-21) to provide approximately 12,500 volts for the anode of the Cathode Ray Tube.)

B VOLTAGE POWER SUPPLY —The B Supply utilizes a conventional Transformer-rectifier circuit. The only feature of this section which might be considered slightly unusual is that the Focus Coil is used as a part of the Filter system. The focus Control shunts the coil and thereby varies the current flowing through the coil itself. The use of a bleeder is eliminated by placing the audio output, audio amplifier and ratio detector driver tubes in series with the tubes in the IF and tuner stages as far as B plus supply is concerned.

ALIGNMENT PROCEDURE

The alignment of this Receiver can be broken down into three basic parts.

1 — Video IF Alignment 2 — RF Alignment
3 — Sound Alignment

CATHODE RAY OSCILLOSCOPE — The tube size is relatively unimportant, however, anything under 5" usually makes fine adjustment quite difficult.

SWEEP GENERATOR —The sweep generator used should have linear coverage of a center range from 30 to 220 megacycles. The output should be fairly flat over wide frequency variation of the sweep. It should be capable of an output of about 0.1 volt with attenuation. It is preferable that the generator have a deflection output for the test oscilloscope.

AM SIGNAL GENERATOR — This generator should have a frequency range of from 4.5 to 220 megacycles. As this generator is used occasionally as a marker generator, accuracy is an important factor. It should be capable of 0.1 volt output with attenuation and should be linear through the range.

VACUUM TUBE VOLTMETER — Almost any standard make VTVM will do. It should preferably have a reversible polarity switch.

VIDEO IF ALIGNMENT

An adequate signal can be fed through the video IF string by feeding the output of the sweep generator into a tube shield placed over the mixer tube (6AG5) (V-2). Care should be taken that this shield is NOT grounded. The ground side of the generator output can be conveniently grounded to the shield of the adjacent oscillator tube.

A vacuum tube voltmeter should be connected just after the first series peaking coil (L-6) with the Gnd. lead to the junction of R45 and R46 it should be set to the plus 3 Volt scale. Set channel selector to an unused low band channel.

The Signal generator should be set to a frequency of 34.45 Mc. The output of the generator should be adjusted to the point where the reading on theVTVM is between plus 1 to plus 1.5 volts.

The first and third IF coils should be peaked for a maximum reading on the VTVM. As the voltage reading increases with tuning, the generator should be attenuated to maintain a maximum of plus 1.5 volts.

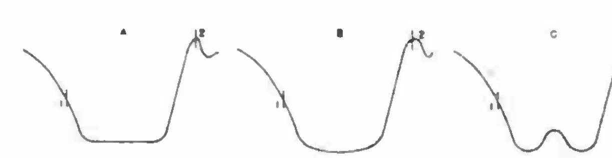
Set the Signal Generator to a Frequency of 36.8 Mc. and tune the second and fourth IF coils in the same manner as above.

Set the Signal Generator to a frequency of 32.8 and tune the trap for a MINIMUM reading on the VTVM.

The third IF coil should then be readjusted as described previously.

The Generator should now be shut off (or tuned to different band) and the VTVM should read no more than 0.50 volts. If there is a higher voltage reading, check for regeneration in the IF stages.

By shunting the signal generator with a sweep generator (30 to 40 Mc.) and substituting a Cathode Ray Oscilloscope for the Vacuum tube Voltmeter in the above procedure the actual pass band of the Video IF circuits may be studied. Ideally the response curve should appear on the face of the oscilloscope in the form indicated in Figure (7). A slight slope of the top of the curve in either direction or a small dip in the center are acceptable as indicated in Figure (8).



A- IDEAL RF-IF WAVESHAPE B & C - ACCEPTABLE WAVESHAPES
1- PICTURE CARRIER
2- SOUND CARRIER

FIG. 7

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MODELS TV-284, TV-287, TV-288, Ch. TT; TV-286, Ch. TH, TJ, Rev.

In the alignment of the RF section of this receiver three pieces of test equipment are necessary. A sweep generator, a signal generator and a cathode Ray Oscilloscope. For specifications see "Test Equipment" above.

The output of the Sweep Generator should be fed into the antenna. The signal generator (C.W.) should be connected to the antenna terminals of the receiver. The sweeper will provide the overall response curve with the oscilloscope properly connected. The signal generator is used as a marker as described below. Some Sweep generators made today contain their own marker oscillator. In cases where a generator of this type is used the Signal Generator may be eliminated.

The "hot" or "high" side of the Oscilloscope input should be connected to the junction point of the 8200 ohm detector load resistor and the peaking coil. The "low" or ground side should be connected to the nearest convenient ground point on the receiver chassis. Care should be taken that the generator and the scope leads are well separated to avoid regeneration.

The R.F. section of the receiver is tuned channel by channel. The proper frequency settings for any given channel can be determined by consulting the Frequency Chart on Page (2). For example in aligning channel 2 the sweep generator should be set to some mid frequency between 54 and 60 megacycles. This adjustment is not a fine one. After setting the sweeper in the general vicinity of the desired frequency it should be tuned to center the response curve on the Oscilloscope face. For picture and sound markers the signal generator should carefully be adjusted to the frequencies indicated in the Frequency chart. For example in the case of channel 2 the picture marker frequency is 55.25 Mc. and the Sound 59.75 Mc.

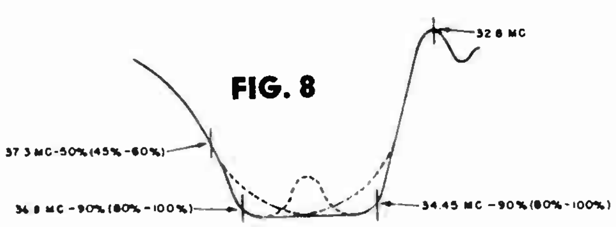
It is important to note at this point that the oscillator coil for channel 2 is in parallel with every other oscillator coil from 3 to 13. It is therefor imperative that channel 2 be aligned first and the others in any desired order thereafter.

Starting with channel 2 and applying the proper frequencies as indicated above, the output of the sweeper should be attenuated to the point where further attenuation will not affect the wave shape.

The Oscillator should then be adjusted to bring the sound carrier into the 32.8 Mc. trap valley. With the oscillator so adjusted the picture carrier should fall at a point approximately 50% up on the slope of the opposite side of the band pass curve. Certain variations in the waveshape and the location of the picture carrier are acceptable. The picture carrier may vary in position from a point between 45% and 60% of the slope and the overall waveshape may differ from the ideal, flat-topped response by being either slightly rounded or slightly dipped in the center. See Figure (8).

If the position of the picture carrier varies beyond the 45% to 60% points on all channels correction may be made by turning to channel 6, applying the proper input signals and slightly realigning the I.F. transformers.

FIG. 8



IDEAL VIDEO IF RESPONSE CURVE
DOTTED LINES INDICATE ACCEPTABLE VARIATIONS

SOUND ALIGNMENT

Sound alignment of the receiver is best accomplished with the AM Signal Generator and Vacuum Tube Voltmeter. By feeding a 4.5 Megacycle signal through a .01 mfd blocking condenser into the grid of the video amplifier and placing the vacuum tube voltmeter probe on pin (7) of the ratio detector and the ground lead at the junction point of the two 15,000 ohm resistors in the ratio detector circuit, the primary of the ratio detector and the 4.5 megacycle trap may be adjusted. The signal generator should be attenuated so that the VTVM does not read more than minus 3 or minus 4 volts. The two slugs should be tuned for maximum deflection of the VTVM and the generator attenuated as needed to keep the above mentioned level. The VTVM probe (set for zero center operation) should then be placed at the junction of the 47,000 ohm resistor and the .0015 condenser and the secondary of the ratio detector should be tuned for zero reading on the VTVM. This adjustment is very sharp between a plus and minus swing. For oscilloscope view of ratio detector alignment connect scope hot lead at junction of 47000 ohm resistor and the 1500 MMF condenser and the ground lead connected to nearest point on chassis. Shown in Figure (9A). Set signal generator for 4.5 meg. center frequency with 100 KC deviation on each side of center. The curve should appear as in Figure (9B).

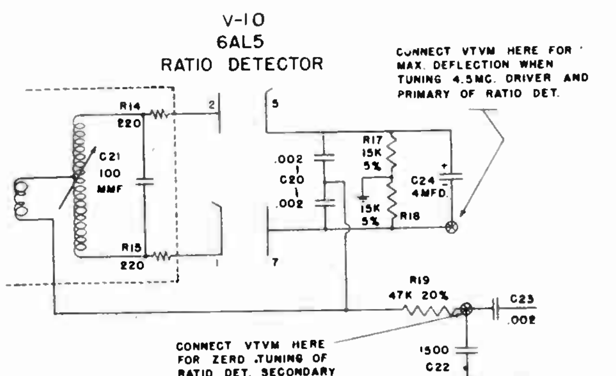


FIG. 9A

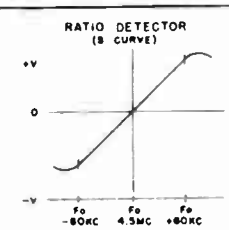


FIG. 9B

PICTURE ADJUSTMENTS

ION TRAP, FOCUS AND YOKE

To properly adjust the Ion Trap, Focusing coil and the Deflection Yoke the following procedure should be followed.

The Deflection Yoke should be placed in position closest to the "bell" of the Picture Tube as far forward on the neck of the tube as is possible. Be sure the wire loops on the mounting make positive contact with the coating of the picture tube. The Focus Coil is next in line and the Ion Trap last.

Turn the set on. The antenna should NOT be connected to the receiver and the picture contrast control should be set at MINIMUM.

With the brilliance control set at about one-quarter turn back from maximum, the Ion trap should be adjusted to achieve the brightest raster on the face of the Picture Tube. Trap should be simultaneously rotated and moved back and forth on the neck of tube until exact setting is obtained.

Adjust the brilliance control to a point slightly over normal brightness and adjust the Focus Control on the rear of the chassis for clearest and sharpest horizontal sweep lines. The Ion Trap should then be readjusted slightly for the brightest response on the face of the tube at which good focus is maintained.

The Focus Coil itself should be moved to secure a complete raster, approximately centered and with no corners cut off. This being accomplished it should be secured by the screws provided.

Finally the Deflection Yoke should be rotated to "square" the raster with the chassis as a reference. The thumb screws on the yoke brackets should then be set.

HORIZONTAL OSCILLATOR ALIGNMENT

HORIZONTAL OSCILLATOR ALIGNMENT — To adjust the horizontal oscillator and its control circuits it is necessary to first connect a working antenna to the receiver. It is preferable to use a test pattern as the incoming signal rather than a picture.

The following steps should then be taken:

1 — With the receiver turned on and the brightness and picture controls adjusted to a normal position the Horizontal Frequency trimmer and the Horizontal Locking trimmer (both rear of chassis) should be turned clockwise all the way and then back off about $1\frac{1}{2}$ turns (counter-clockwise).

2 — The Horizontal Hold Control (front panel) should be turned to a maximum clockwise position.

3 — The core of the Horizontal Oscillator Transformer (see figure 11 parts location) should then be adjusted. Variation of this core will cause the pattern to resolve into a series of black and white bars sloping either to the right or to the left depending upon the degree of adjustment. The transformer should be adjusted to the point where the picture resolves into a series of from $3\frac{1}{2}$ to $4\frac{1}{2}$ bars sloping downwards to the right.

4 — The Horizontal Hold Control (front panel) should now be rotated to a full counter-clockwise position and the incoming signal momentarily interrupted. (This can be done most easily by shorting the antenna terminals for a moment). This should cause the picture to again resolve into a series of black and white bars slanting now downward to the left.

5 — The Horizontal Hold Control (front panel) should now be rotated slowly in a clockwise direction. As the control is turned the number of bars sloping downward to the left should decrease. At approximately 90° of rotation there should remain between $3\frac{1}{2}$ and $4\frac{1}{2}$ bars just prior to the time that the picture "falls into" sync. The picture should remain in sync for an additional 90° of clockwise rotation. If MORE than $4\frac{1}{2}$ bars are evident just before the picture syncs the Horizontal Locking Range trimmer (rear of chassis) should be tightened slightly. If LESS than $3\frac{1}{2}$ bars, the same trimmer should be loosened.

HEIGHT, WIDTH AND LINEARITY

To adjust the overall size and linearity of the picture it is necessary that a pattern transmitted from a local station be used. Linearity adjustments, particularly, cannot be accurately made on moving transmissions. It should also be remembered that in areas where more than one station is being received, pictures transmitted by different stations will vary slightly in size and linearity. In view of this the smallest transmitted picture should be made to fill the area of the Picture tube delineated by the mask.

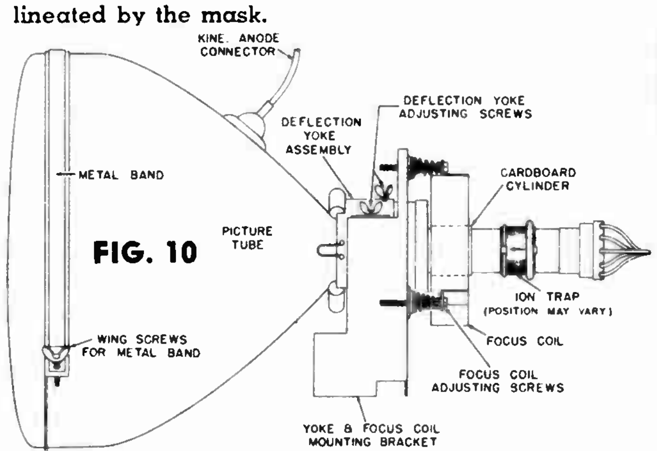


FIG. 10

Following is the recommended procedure for complete height, width and linearity adjustment; (see Fig. 4 for location of controls).

1 — Turn the Width Control coil screw all the way in (clockwise).

2 — Adjust Horizontal Drive Trimmer for the best compromise between maximum brightness and good horizontal linearity. This control will primarily affect the overall width and the left side of the picture.

3 — Adjust the Horizontal Linearity Coil, (and the Horizontal Linearity control in Model 286) for best overall horizontal linearity. It will be noted that the Horizontal Linearity Coil will have most effect on the center of the picture while the Control will adjust the center and right half. These two adjustments will interact and the setting of one will affect the range and effect of the other.

4 — The width control coil should now be adjusted to give a picture that will fill the mask horizontally.

5 — The Height and Vertical Linearity controls should be adjusted for a linear picture that will fill the mask vertically.

6 — Picture centering is accomplished by positioning the focus coil mechanically by means of four 4 hex-head adjusting screws (3 in Model 286) accessible from the rear of the chassis as shown in Fig. 10.

7 — Adjust the Focus Control for clearest delineation of the horizontal sweep lines. This adjustment should be made with a picture rather than with a raster.

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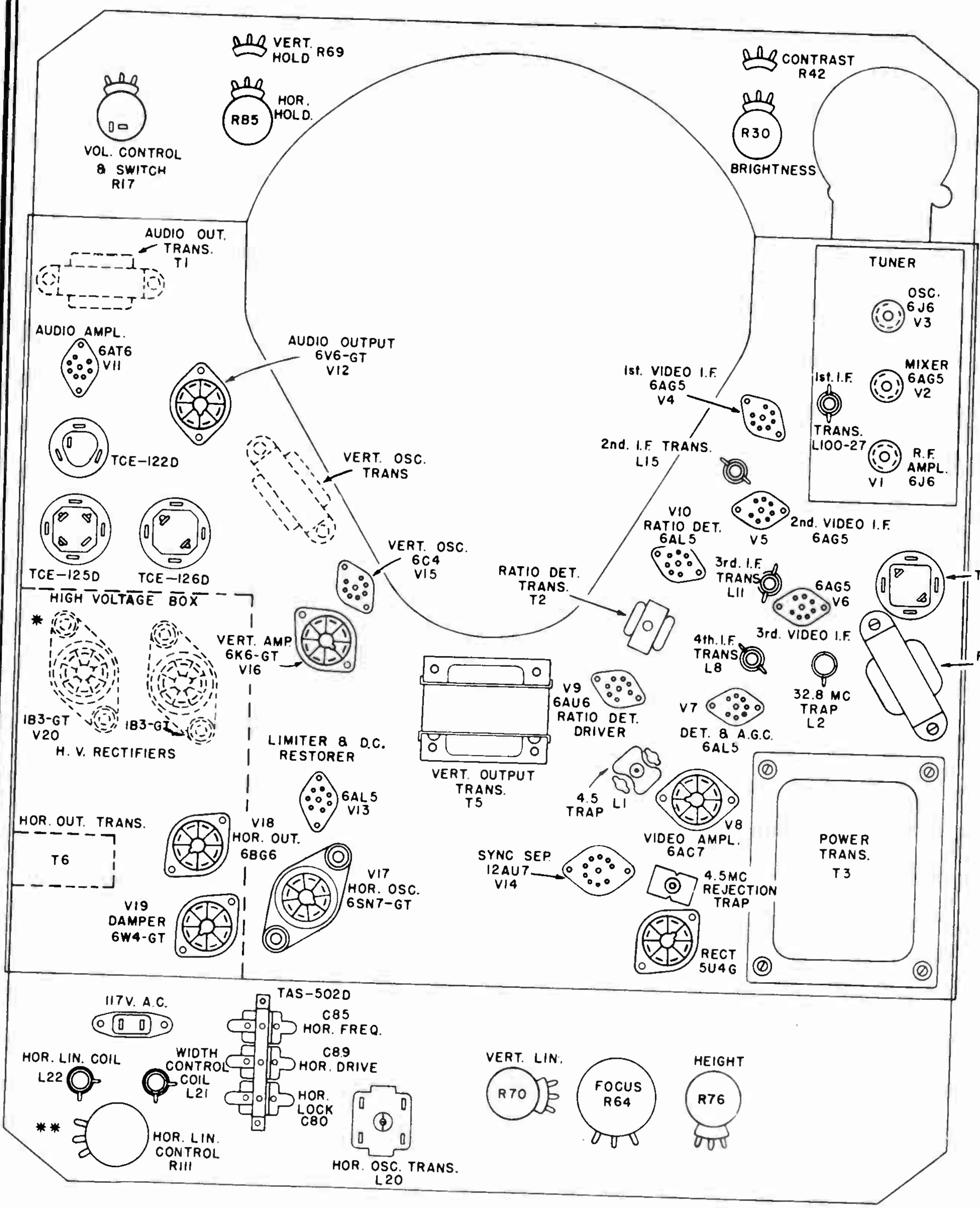

PARTS LOCATION—UNDERSIDE VIEW

NOTE:

*Only one 1B3GT tube is used on Models TV-284, 287, 288.

**Used only in Model TV-286.

FIG. 11

RESISTANCE CHECK CHART

Tube Function	Tube	Pin Numbers 1	2	3	4	5	6	7	8	9
Osc.	6J6	30 K	30 K	0	0	27 K	27 K	47		
Mixer	6AG5	1 Meg	0	0	0	24 K	28 K	0		
RF Amp.	6J6	25 K	25 K	0	0	0	0	56		
1st Video IF	6AG5	700 K	47	0	Gnd.	28 K	28 K	47		
2nd Video IF	6AG5	700 K	47	0	Gnd.	28 K	28 K	47		
3rd Video IF	6AG5	0	100	Gnd.	0	28 K	28 K	100		
Video Det.	6AL5	500	1000	0	Gnd.	10 K	Gnd.	470 K		
Video Ampl.	6AC7	Gnd.	Gnd.	300	10 K	300	18 K	0		
Rect.	5U4	INF.	28 K	INF.	40	INF.	40	INF.	28 K	
Sync. Set.	12AU7	(C) 60 K	1 Meg	Gnd.	Gnd.	Gnd.	(C) 60 K	3.9 Meg	28 K	
Ratio Det.	6AL5	INF.	INF.	30 K	30 K	30 K	INF.	60 K	10 K	0
RD Driver	6AU6	120 K	28 K	30 K	30 K	30 K	60 K	30 K		
Audio Amp.	6AT6	650 K	30 K	30 K	30 K	INF.	INF.	500 K		
Audio Out.	6V6	INF.	28 K	28 K	28 K	260 K	90 K	28 K	28 K	
Vert. Osc.	6C4	1.5 Meg	280 K	0	Gnd.	1.5 Meg	2 Meg	Gnd.		
Vert. Out.	6K6	Gnd.	Gnd.	30 K	30 K	2 Meg	2 K	0	4 K	
Clipper	6AL5	1 Meg	3.9 Meg	0	Gnd.	Gnd.	Gnd.	Gnd.		
Hor. Osc.	6SN7	700 K	160 K	290 K	180 K	150 K	Gnd.	Gnd.	0	
Hor. Out.	6BG6	INF.	0	(A) 100	INF.	1 Meg	INF.	Gnd.	(B) 30 K	
Damper	6W4	INF.	INF.	(B) 32 K	INF.	20 K	INF.	(B) 32 K	(B) 32 K	

Conditions:

All Measurements to ground (chassis)
All controls set at mid-point.
Line cord disconnected - switch off.

Note:

(A) In model TV-286 - 82 ohms

(B) Im model TV-286 - 500 K

(C) Was 140 K in early models

FIG. 12

VOLTAGE CHECK CHART

Tube Function	Tube	Pin Numbers 1	2	3	4	5	6	7	8	9
RF Osc.	6J6	105 V	105 V			-5.0 V	-5.0 V	.3 V		
Mixer	6AG5	-3.0 V	Gnd.			105 V	105 V	Gnd.		
RF Amp.	6J6	105 V	105 V			Gnd.	Gnd.	.9 V		
1st Video IF	6AG5	-0.5 V	.3 V			110 V	110 V	.3 V		
2nd Video IF	6AG5	-0.5 V	.3 V			120 V	120 V	.3 V		
3rd Video IF	6AG5		1 V			120 V	120 V	1 V		
Video Det.	6AL5	1.2 V	-2.3 V			-2.1 V	Gnd.	-0.5 V		
Video Amp.	6AC7			.9 V	-2.4 V	.9 V	150 V		180 V	
Rectifier	5U4		380 V						380 V	
Sync Sep.	12AU7	(D)90 V	-0.2 V	Gnd.	Gnd.	Gnd.	(E)225 V			
Ratio Det.	6AL5	130 V	130 V			130 V		130 V		
RD Driver	6AU6	130 V	130 V			350 V	130 V	130 V		
Audio Amp.	6AT6	130 V	130 V				120 V	210 V		
Audio Out.	6V6		130 V	320 V	330 V	110 V	120 V	130 V	130 V	
Vert. Osc.	6C4	170 V	-12 V			170 V	-50 V	Gnd.		
Vert. Out.	6K6	Gnd.		300 V	300 V	-1.5 V	20 V		35 V	
Limiter-DC Res.	6AL5	.8 V	-1.4 V			Gnd.	Gnd.	Gnd.		
Hor. Osc.	6SN7	-9.1 V	115 V	3.5 V	-85 V	180 V	Gnd.			
Hor. Out.	6BG6			(F)7.5 V		-13 V		440 V	270 V	
Damper	6W4			440 V		360 V		440 V	440 V	

All Measurements taken under the following conditions: -

- No Antenna or signal incoming
- Tuner set to Channel 3
- Line Voltage - 117 Volts 60 Cycle AC-
All measurements to chassis (Ground)
- Volume, Horizontal Hold, Vertical Hold, Brightness, and Contrast controls set at mid-point.

Note:

All Voltages in DC Volts as measured With a Vacuum Tube Volt Meter.

Note:

(D) Was 40 V in early models

(E) Was 140 V in early models

(F) In model TV-286 - 9 V

FIG. 13

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World Radio History

MODELS TV-284, TV-287, TV-288, Ch. TT; TV-286, Ch. TH, TJ, Rev.

PARTS LIST

PART NUMBER	SCHEMATIC LOCATION	DESCRIPTION
		RESISTORS
TRC-47A-2 (2)	R 104,105	4.7 Ohms 1/2 W. 10%
TRC-51A-2	R 21	5.1 Ohms 1/2 W. 10%
TRW-150-5	R 65	15 Ohms W. W. 1 W. 10%
TRC-470-2 (3)	R 57,61,98	47 Ohms 1/2 W. 10%
TRC-560-5	R 110	56 Ohms 1 W. 10%
TRC-101-2	R 44,53	100 Ohms 1/2 W. 10%
TRC-101-8	R 100	100 Ohms 2 W. 10%
TRW-151-1	R 48,52,56,60	150 Ohms W. W. 1/2 W. 20%
TRC-221-1	R 22,23	220 Ohms 1/2 W. 20%
TRC-331-1	R 59	330 Ohms 1/2 W. 20%
TRC-391-5	R 10	390 Ohms 1 W. 10%
TRC-561-2	R 77,78	560 Ohms 1/2 W. 10%
TRC-102-1	R 24,27,50,55	1,000 Ohms 1/2 W. 20%
TRC-102-5	R 32,46	1,000 Ohms 1 W. 10%
TRC-152-2	R 71	1,500 Ohms 1/2 W. 10%
TRC-152-8	R 63	1,500 Ohms 2 W. 10%
TRC-272-5	R 36	2,700 Ohms 1 W. 10%
TRC-332-5	R 75	3,300 Ohms 1 W. 10%
TRC-392-5	R 37	3,900 Ohms 1 W. 10%
TRC-472-2	R 11	4,700 Ohms 1/2 W. 10%
TRC-622-3	R 62	6,200 Ohms 1/2 W. 5%
TRC-822-2	R 66,67,73,92	8,200 Ohms 1/2 W. 10%
TRC-822-3	R 45,54	8,200 Ohms 1/2 W. 5%
TRC-103-1	R 33,35,82	10K Ohms 1/2 W. 20%
TRC-103-2	R 88,114	10K Ohms 1/2 W. 10%
TRC-113-3	R 58	11K Ohms 1/2 W. 5%
TRC-153-3	R 18,19	15K Ohms 1/2 W. 5%
TRC-153-7	R 79,115	15K Ohms 2 W. 20%
TRC-223-1	R 29,83	22K Ohms 1/2 W. 20%
TRC-223-5	R 41	22K Ohms 1 W. 10%
TRC-273-8 (4)	R 102,103	27K Ohms 2 W. 10%
TRC-303-12	R 86	30K Ohms Temperature Compensating
TRC-333-8	R 40	33K Ohms 2 W. 10%
TRC-393-8	R 38,39	39K Ohms 2 W. 10%
TRC-473-1	R 20,26	47K Ohms 1/2 W. 20%
TRC-473-5	R 47	47K Ohms 1 W. 10%
TRC-563-1	R 99	56K Ohms 1/2 W. 20%
TRC-683-5	R 43	68K Ohms 1 W. 10%
TRC-104-1	R 112	100K Ohms 1/2 W. 20%
TRC-104-2	R 13,25,28	100K Ohms 1/2 W. 10%
TRC-104-5	R 96	100K Ohms 1 W. 10%
TRC-104-6	R 93	100K Ohms 1 W. 5%
TRC-104-SP	R 95	100K Ohms 1/2 W. 1%
TRC-124-2	R 84	120K Ohms 1/2 W. 10%
TRC-154-2	R 89	150K Ohms 1/2 W. 10%
TRC-184-2	R 94	180K Ohms 1/2 W. 10%
TRC-184-3	R 14	180K Ohms 1/2 W. 5%
TRC-224-2	R 31,51,74	220K Ohms 1/2 W. 10%
TRC-274-1	R 117	270K Ohms 1 W. 20%
TRC-274-5	R 87	270K Ohms 1 W. 10%
TRC-334-3	R 113	330K Ohms 1/2 W. 5%
TRC-394-1	R 15	390K Ohms 1/2 W. 20%
TRC-474-1	R 12,16,49	470K Ohms 1/2 W. 20%
TRC-474-4	R 109	470K Ohms 1 W. 20%
TRC-564-2	R 91,101	560K Ohms 1/2 W. 10%
TRC-684-8	R 106,107,108	680K Ohms 2 W. 10%
TRC-105-1	R 34,80	1M Ohms 1/2 W. 20%
TRC-105-2	R 97	1M Ohms 1/2 W. 10%
TRC-185-3	R 68	1.8M Ohms 1/2 W. 5%
TRC-225-2	R 72	2.2M Ohms 1/2 W. 10%
TRC-335-6	R 90	3.3M Ohms 1 W. 5%
TRC-395-1	R 81	3.9M Ohms 1/2 W. 20%
		CONDENSER
TCC-1.5-11	C 50	1.5 MMF Ceramic 10% 600V
TCC-2.2-11	C 32	2.2 MMF Ceramic 10% 600V
TCC-050-11	C 42	5 MMF Ceramic 10% 600V
TCC-680-10	C 31	68 MMF Ceramic 20% 600V
TCC-181-11	C 45	180 MMF Ceramic 10% 600V
TCC-471-10	C 39	470 MMF Ceramic 20% 600V
TCC-681-10	C 40	680 MMF Ceramic 20% 600V
TCC-152-10	C 25,46,56,58, 59,69,105	1,500 MMF Ceramic 20% 600V
TCC-502-SP	C 20,29,37,43, 44,51	5,000 MMF Ceramic Disc 600V
TCC-103-SP	C 41	.01 MFD Ceramic Disc 600V
TCC-2-1	C 47,52,54,104	2,000-2,000 MMF Dual Herlac
TCM-050-20	C 95	5 MMF Mica 1500V
TCM-056-24 (7)	C 99	56 MMF Mica 5% 1000V
TCM-101-7	C 76	100 MMF Mica 500V
TCM-121-8	C 78,81	120 MMF Mica 500V
TCM-181-29	C 86	180 MMF Silver Mica 2% 1000V
TCM-271-13	C 48,55,57,92	270 MMF Mica
TCM-331-14	C 25	330 MMF Mica 20% 1000V
TCM-391-7	C 77	390 MMF Mica 20% 500V
TCM-681-8	C 90	680 MMF Mica 10% 500V
TCM-222-14	C 87	2,200 MMF Mica 10% 500V
TCM-472-9	C 70	4,700 MMF Mica 5% 500V
TCM-501-1-SP (5)	C 96,97,98	500 MMF Mica H.V. Condenser 10KV

PART NUMBER	SCHEMATIC LOCATION	DESCRIPTION
TAS-501D		Trimmer Assembly
TCP-202-10	C 19,66,82	.002 MFD 600V Paper Tubular
TCP-502-10	C 14,22,67,68	.005 MFD 600V Paper Tubular
TCPM-103-4	C 60,61	.01 MFD 400V Paper Molded
TCP-103-10	C 18,23	.01 MFD 600V Paper Tubular
TCP-203-4	C 84	.02 MFD 400V Paper Tubular
TCPM-203-10	C 28,30	.022 MFD 600V Paper Molded
TCP-503-10 (8)	C 17,75,101	.05 MFD 600V Paper Tubular
TCPM-503-10	C 79,74	.047 MFD 600V Paper Molded
TCP-503-13	C 93	.05 MFD 1000V Paper Tubular Oil
TCPM-104-4	C 34,35	.1 MFD 400V Paper Molded
TCPM-104-10	C 71	.1 MFD 600V Paper Molded
TCP-154-4 (6)	C 100	.15 MFD 400V Paper Tubular
TCP-254-1	C 53,94	.25 MFD 200V Paper Tubular
TCP-254-4	C 83,103	.25 MFD 400V Paper Tubular
TCP-254-10 (1)	C 102,88	.25 MFD 600V Paper Tubular
		ELECTROLYTICS
TCE-108-D	C 62,63	40-40 MFD 500V Can
TCE-126-D	C 65	40 MFD- 500V, 50 MFD-200V Can
TCE-129-D	C 64	500 MFD 6V Tubular
TCE-144-D	C 72	100 MFD 50V Tubular
TCE-122-D	C 15	40 MFD 300V Can
TCE-125-D	C 38,91,73,106	(10 MFD 200V) Can (20 MFD 450V) (10 MFD 450V) (10 MFD 450V)
TCE-130-D	C 21	4 MFD 50V Tubular
		CONTROLS
TVC-110-D	R 76	Vertical Size 2.5 Megohms
TVC-111-D	R 70	Vertical Linearity 5K Ohms
TVC-112-D	R 64	Focus 1500 Ohms 2 W - W.W.
TVC-113-D	R 17	Volume, ON-OFF 500K Ohm Taper
TVC-114-DA		Hor. & Vert. Hold 50K & 1.5M Ohm
	R 69,85	Dual
TVC-115-D	R 30,42	Contrast & Brightness Dual
TVC-515 (9)	R 111	Horjzontal Linearity 500
		COILS & TRANSFORMERS
TLF-529 (10)	L 21	Width Control Coil
TLF-530 (11)	L 22	Hor. Linearity Coil
TLF-525-D	L 4	4.5 Mc Rejection Trap
TTR-157	L 20	Synchro-Guide Trans. (Hor. Osc.)
TLF-144-D	L 13	Filament Choke
TLF-520-D	L 8,10,16	Filament Choke
TLF-147-D	L 8,15	I. F. Coil
TLF-148-D	L 11	I. F. Coil
TLF-513-D	L 6	Video Peaking Coil (120 uh)
TLF-514-D	L 7	Video Peaking Coil (600 uh)
TLF-157-D	L 2	32.8 MC Trap
TLF-146-D	L 9,12,14	I. F. Choke
TLF-526-D		Video Peaking Coil (210 uh)
	L 3	18K Resistor
TLF-527-D	L 5	Video Peaking Coil (300 uh)
TTR-170-D	T 3	Power Transformer
TLF-114-D	L 1	4.5 MC Trap Coil
TTR-152-1	T 4	Vert. Osc. Trans.
TTR-153-2-D	T 5	Vert. Output Trans.
TLF-531-D	T 2	Ratio Detector Trans.
TLF-522-D (12)	L 18	Focus Coil
TTR-159-D	L 19,23	Deflection Yoke
TTR-106-1D	L 17	Filter Choke
TTR-172-D (13)	T 6	Hor. Output Trans.
TTR-165-D	T 1	Audio Output Trans.
		HARDWARE
TFU-2		Fuse - 1/4A 250V (TV-287)
TPL-150		Interlock Plug (TV-287)
TLD-101		Interlock Cord (TV-287)
TMS-121-R		Escutcheon (TV-287)
TDK-168-D		Back (TV-287)
TKN-114-D		Outside Knob (TV-287)
TKN-115-D		Inside Knob (TV-287)
TKN-116-D		Dual Knob (TV-287)
TKN-117-D		Dual Indicator Knob (TV-287)
TGL-113-D		Safety Glass (TV-287)
TMS-875-D		Mask (TV-287)
TSP-462		Speaker (TV-287)
TCB-267-D		Cabinet (TV-287)
TMS-121-R		Escutcheon (TV-284)
TBK-165-D		Back (TV-284)
TKN-114-D		Outside Knob (TV-284)
TKN-115-D		Inside Knob (TV-284)
TKN-116-D		Dual Knob (TV-284)
TKN-117-D		Dual Indicator Knob (TV-284)
TGL-111-D		Safety Glass (TV-284)
TMS-850-D		Metal Mask (TV-284)
TSP-80		8" Speaker (TV-284)
TCB-265-D		Cabinet (TV-284)

PART NUMBER	DESCRIPTION	MODEL
TMS-121-R	Escutcheon	TV-286
TAS-529	Back	TV-286
TKN-114-D	Inside Knob	TV-286
TKN-115-D	Outside Knob	TV-286
TKN-116-D	Dual Knob	TV-286
TKN-117-D	Dual Indicator Knob	TV-286
TGL-110-D	Safety Glass	TV-286
TMS-841-D	Metal Grille	TV-286
TSP-465-D	10" PM Speaker	TV-286
TCB-264-D	Cabinet	TV-286
TMS-121-R	Escutcheon	TV-288
TBK-161-D	Back	TV-288
TKN-114-D	Inside Knob	TV-288
TKN-115-D	Outside Knob	TV-288
TKN-116-D	Dual Knob	TV-288
TKN-117-D	Dual Indicator Knob	TV-288
TGL-108-D	Safety Glass	TV-288
TSP-462	Speaker	TV-288
TCB-260-D	Cabinet	TV-288

TUNER

PART NUMBER	DESCRIPTION
TRC-470-1	47 Ohms - 1/2 W.
TRC-560-2	56 Ohms - 1/2 W. - 10%
TRC-331-2	330 Ohms - 1/2 W. - 10%
TRC-102-1	1K Ohms - 1/2 W.
TRC-472-3	4.7K Ohms - 1/2 W. - 5%
TRC-273-1	27K Ohms - 1/2 W.
TRC-105-1	1 Meg - 1/2 W.
TCC-010-11	1.0 MMF 10% Tubular Ceramic
TCC-4.7-11	4.7 MMF 10% Tubular Ceramic
TCC-22-12	22 MMF 5%
TCC-361-10	360 MMF 600V Miniature
TCC-502-SP	5,000 MMF 600V Disc
TCM-271-13	270 MMF 20% 1000V Mica
TAS-503-D	Fine Tuning, Bushing & Condenser
TAS-502-D	Fine Tuner, Shaft & Pulley
TLF-120-1D	Channel 2 Osc. Coil
TLF-120-2D	Channel 3 Osc. Coil
TLF-120-3D	Channel 4 Osc. Coil
TLF-120-4D	Channel 5 Osc. Coil
TLF-120-5D	Channel 6 Osc. Coil
TLF-120-6D	Channel 7 Osc. Coil
TLF-120-7D	Channel 8 Osc. Coil
TLF-120-8D	Channel 9 Osc. Coil
TLF-120-9D	Channel 10 Osc. Coil
TLF-120-10D	Channel 11,12,13, Osc. Coil
TLF-147-D	1st I.F. Coil

PARTS LIST NOTES

(1) - C 102 is not used in models 284, 287, 288

(2) - R 104 & 105 are 4.7 Ohms in model 286
R 104 is 3.3 Ohms in models 284, 287, 288
R 105 is 1M-1W in models 284, 287, 288

(3) - R 98 is 47 Ohms in model 286 and 68 Ohms in models 284, 287, 288

(4) - R 102, 103 are 27 K 2 W in model 286
R 102 only in models 284, 287, 288 is 8200 Ohms 2 W 10%

(5) - In models 284, 287, 288, C 97 is .25 - 400 V and C 98 is .1 - 1000 V.

(6) - In models 284, 287, 288, C 100 is 56 MMF in yoke

(7) - In models 284, 287, 288, C 99 is .035 - 600 V.

(8) - In models 284, 287, 288, C 101 is 10 MMF - 1500 V Mica.

(9) - R 111 - 500 Ohm Lin. Control not used in models 284, 287, 288

(10) - TLF - 505 is used in models 284, 287, 288

(11) - TLF - 506 is used in models 284, 287, 288

(12) - TLF - 545 - D is used in models 284, 287, 288

(13) - TTR - 183 - D is used in models 284, 287, 288

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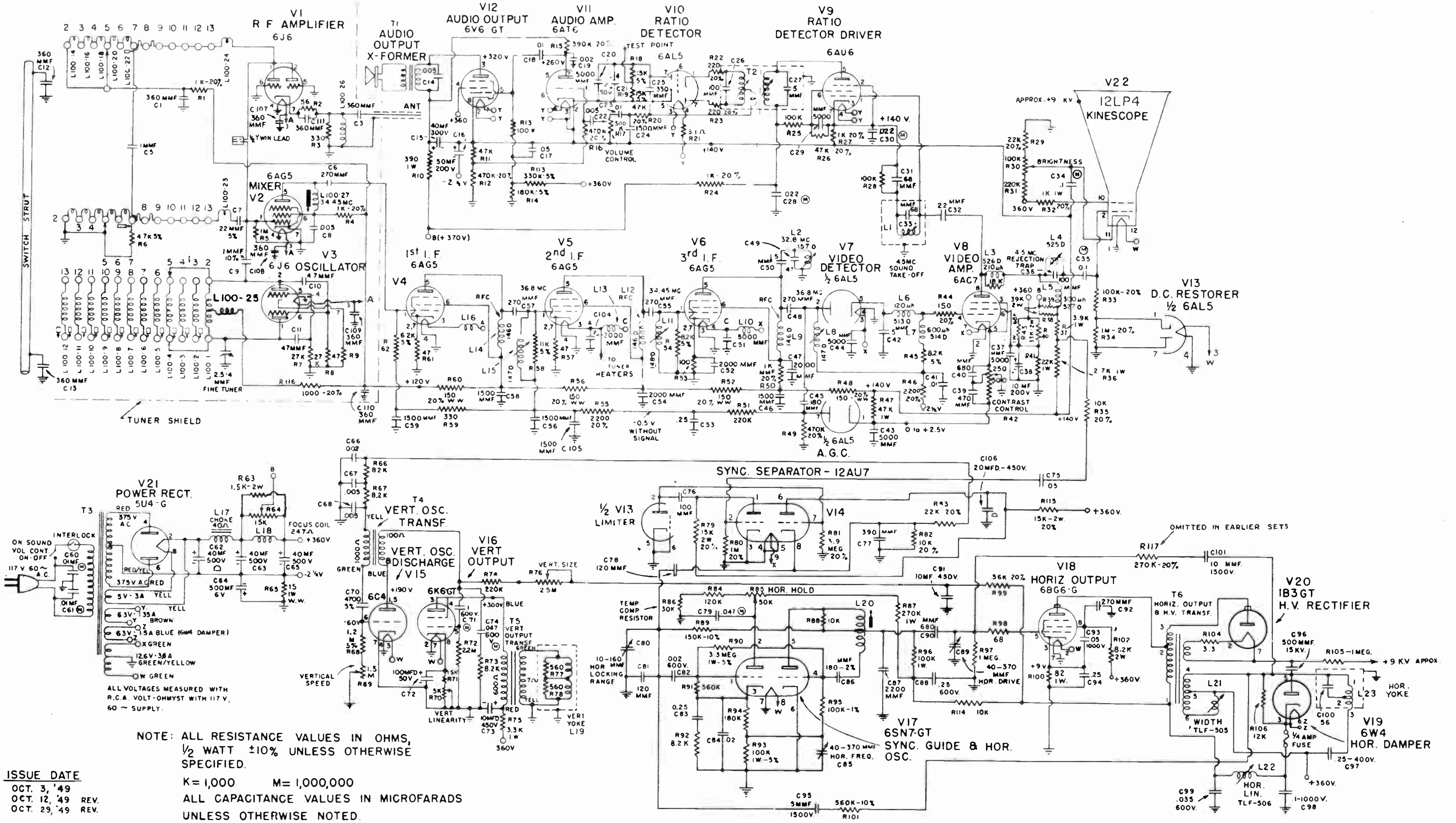
MODELS TV-284, 287, 288

12½" TELEVISION RECEIVER

"TT" CHASSIS



NOTE: ALL RESISTANCE VALUES IN OHMS, ½ WATT ±10% UNLESS OTHERWISE SPECIFIED.

K= 1,000 M= 1,000,000

ALL CAPACITANCE VALUES IN MICROFARADS UNLESS OTHERWISE NOTED.

Ⓜ= MOLDED PAPER

ISSUE DATE

OCT. 3, '49
OCT. 12, '49 REV.
OCT. 29, '49 REV.

NOTE: IN EARLY MODELS, R79 WAS 100K, R33 WAS 10K, R79 WAS RETURNED DIRECTLY TO +360V. AND PIN 6 OF V14 WAS CONNECTED DIRECTLY TO +140V. ALSO, A 100K RESISTOR & 1500 MMF CONDENSER WERE CONNECTED ACROSS T4 GRID WINDING.

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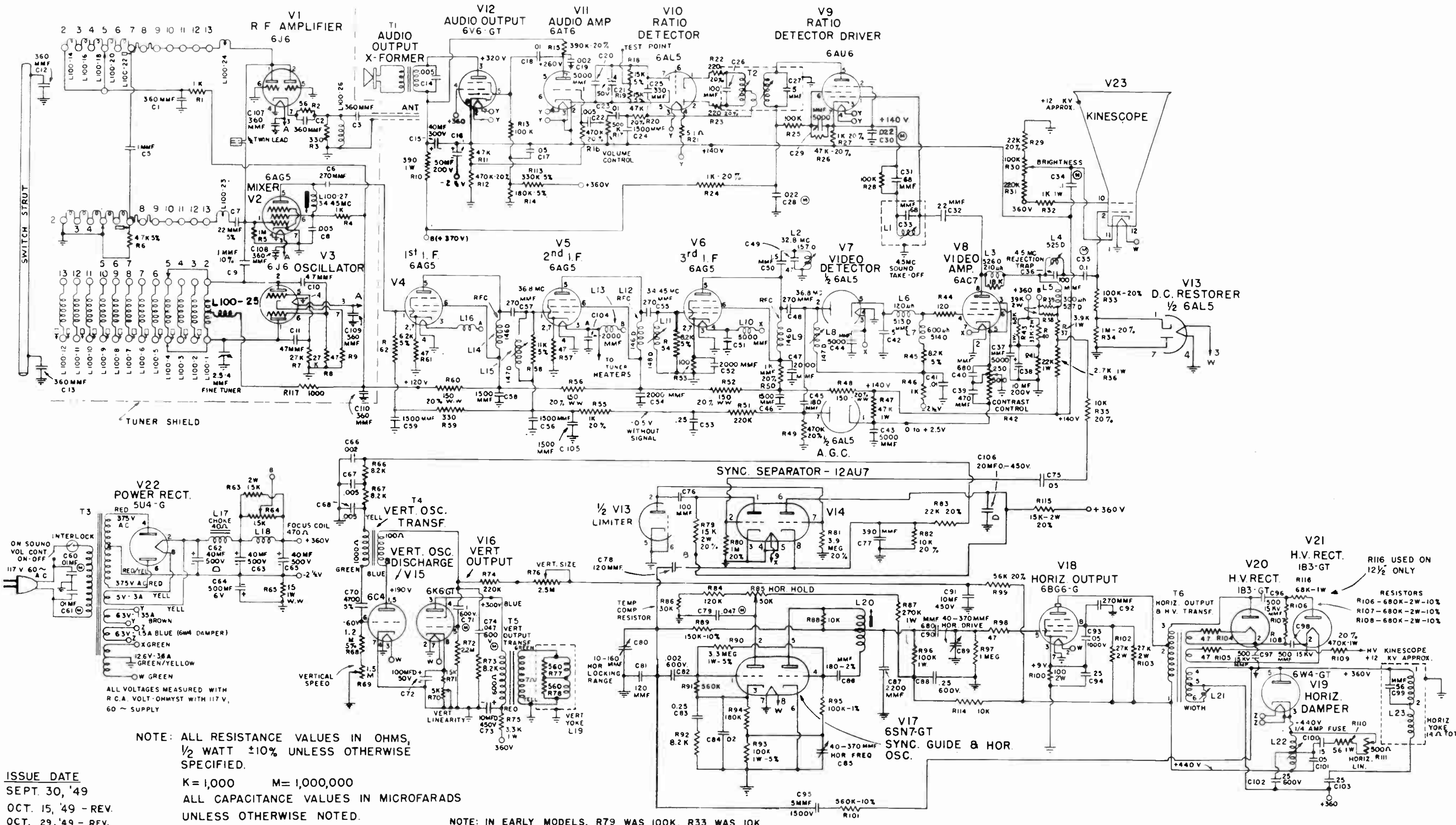
MODEL TV-286 REVISED
12½" & 16" TELEVISION RECEIVER
"TH" & "TJ" CHASSIS



NOTE: ALL RESISTANCE VALUES IN OHMS, ½ WATT ±10% UNLESS OTHERWISE SPECIFIED.
K = 1,000   M = 1,000,000
ALL CAPACITANCE VALUES IN MICROFARADS UNLESS OTHERWISE NOTED.
(M) = MOLDED PAPER

ISSUE DATE
SEPT. 30, '49
OCT. 15, '49 - REV.
OCT. 29, '49 - REV.

NOTE: IN EARLY MODELS, R79 WAS 100K, R33 WAS 10K, R79 WAS RETURNED DIRECTLY TO +360V. AND PIN 6 OF V14 WAS CONNECTED DIRECTLY TO +140V. ALSO, A 100K RESISTOR & 1500MMF CONDENSER WERE CONNECTED ACROSS T4 GRID WINDING.

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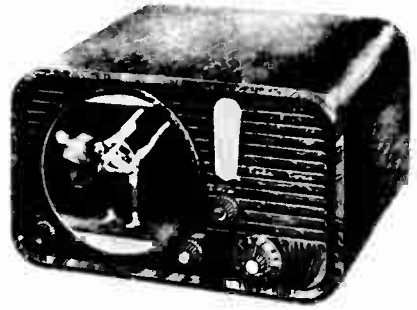
World Radio History

TV 301

TV 305



SPECIFICATIONS

POWER SUPPLY
105 to 125 Volts — 60 Cycle AC

POWER CONSUMPTION
220 Watts

POWER OUTPUT (AUDIO)
2 Watts (undistorted)

INPUT IMPEDANCE
72 Ohms

PICTURE TUBE SIZE
TV 300 — 301 10 inch
TV 304 — 305 12 inch

SPEAKER
4" X 6" oval PM — Voice coil 3 ohms

DIMENSIONS
TV 300 — 301
20" Wide X 19" Deep X 12½" High
TV 304 — 305
21½" Wide X 18" Deep X 16" High

SHIPPING WEIGHT
TV 300 — 301 App. 81 lbs.
TV 304 — 305 App. 79 lbs.

TUBE COMPLEMENT

1.	6J6	V20	RF Amplifier
2.	6AG5	V19	Mixer
3.	6J6	V18	RF Oscillator
4.	6AG5	V5	1st Video IF Amplifier
5.	6AG5	V6	2nd Video IF Amplifier
6.	6AG5	V7	3rd Video IF Amplifier
7.	6AL5	V10-A	Video Detector
		V10-B	A.G.C.
8.	12AU7	V9	1st and 2nd Video Amplifier
9.	6AU6	V1	4.5 Mc. Amplifier
10.	6AL5	V2	Ratio Detector
11.	6AT6	V4	1st Audio Amplifier
12.	6K6	V3	Audio Output
13.	6SN7	V11	Sync Separator
14.	6BF6	V8-A	Limiter
		V8-B	Vertical Sweep Oscillator
15.	6K6	V12	Vertical Sweep Amplifier
16.	6SN7	V14	Horizontal Sweep Oscillator and Sync Guide
17.	6BG6	V15	Horizontal Sweep Output
18.	6W4	V16	Damper
19.	1B3	V13	High Voltage Rectifier
20.	5U4	V17	Power Rectifier
21.	10BP4	V21	Picture Tube TV 300—301
	12LP4	V21	Picture Tube TV 305

FREQUENCY CHART

IF FREQ. — SOUND — 32.8 MC PICTURE — 37.3 MC

CHANNEL	FREQUENCY	PICTURE FREQUENCY	SOUND FREQUENCY	RF OSCILLATOR FREQUENCY
2	54-60	55.25	59.75	92.55
3	60-66	61.25	65.75	98.55
4	66-72	67.25	71.75	104.55
5	76-82	77.25	81.75	114.55
6	82-88	83.25	87.75	120.55
7	174-180	175.25	179.75	212.55
8	180-186	181.25	185.75	218.55
9	186-192	187.25	191.75	224.55
10	192-198	193.25	197.75	230.55
11	198-204	199.25	203.75	236.55
12	204-210	205.25	209.75	242.55
13	210-216	211.75	215.75	248.55

INSTALLATION

WARNING

This Receiver is designed for use on 105 to 125 Volt 60 Cycle AC only. Do NOT connect to Direct Current (DC) power supply. If in doubt check with your local Power Supply Company.

TELE-TONE BUILT-IN ANTENNA

Models 300, 301, 304 and 305 are equipped with the Teletone Automatic Built-in Antenna. The efficiency of this antenna is very high and normally will perform as well as or better than most indoor antennas. It consists of two concentric circular antennas and an auxiliary counterpoise type antenna. The circular antennas are mounted on the inside top of the cabinet while the auxiliary is found on the back cover. Electrically the Teletone Automatic Built-in Antenna functions as a double dipole. The auxiliary aids reception on the lower channels. If the area or location in which the receiver is installed precludes the use of an indoor type antenna the Built-in antenna should be disconnected by loosening the two screws on the antenna terminal on the back of the set and removing the black and red leads connected thereto. A regular outdoor installation should be made and the lead-in connected to the same two screws on the antenna terminal strip.

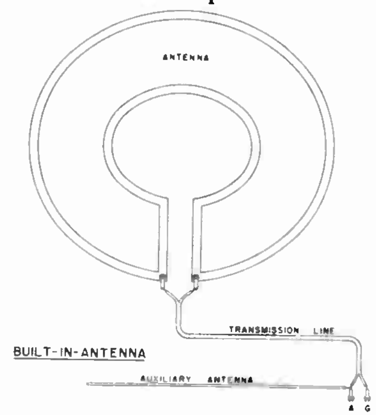


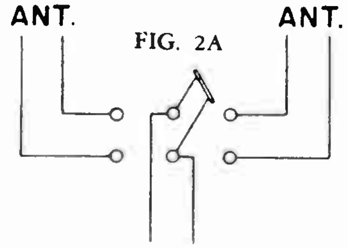
FIG. 1

OUTDOOR ANTENNA

In areas where both high band and low band reception is available, antennas may be used in the form of a stacked array. Where a stacked array is used, it may prove advantageous in some locations to connect separate down leads from each antenna and connect a suitable switch at the receiver as shown in figure 2A.

HIGH FREQ. ANT. LO-FREQ. ANT.

FIG. 2A



TO RECEIVER
TRANSMISSION LINE

In non-critical locations, satisfactory results may be obtained with a 300 ohm down lead connected directly to the receiver antenna terminals. In more critical locations (insufficient signal) increased pick-up may be obtained by using the 300 ohm down lead in conjunction with a suitable matching transformer at the receiver. (See figure 2B). In unusually noisy locations considerably improved performance may be obtained by the use of 72 ohm co-axial transmission line.

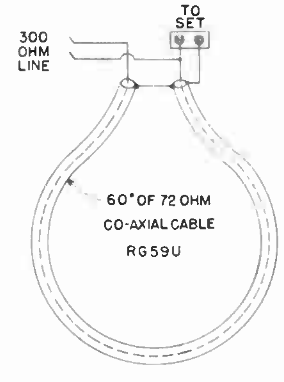


FIG. 2B

ANTENNA MATCHING TRANSFORMER

NOTE: — When using 72 ohm co-axial down lead, it is important that its outer lead be connected to the shield side of the receiver transmission line. Check antenna terminal connections to determine shield side.

CONTROL FUNCTIONS

RECEIVER FRONT PANEL CONTROLS

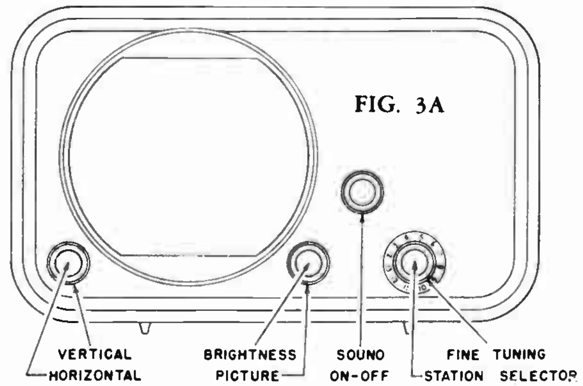


FIG. 3A

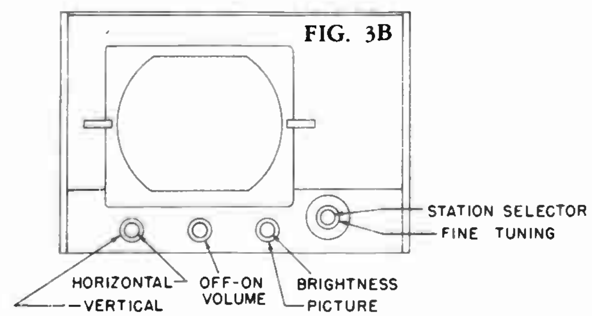


FIG. 3B

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VOLUME — ON-OFF — The volume control is an audio control only and has no effect on the picture. It is connected in the grid circuit of the audio amplifier (V-4). The power on and off switch is combined with the volume control.

HORIZONTAL HOLD — The Horizontal Sweep Oscillator uses Automatic Frequency control. As a result the Horizontal Hold Control will only be used if the picture should resolve into a series of heavy, oblique, black and white lines. A fast twist of the knob will then cause the picture to correct itself.

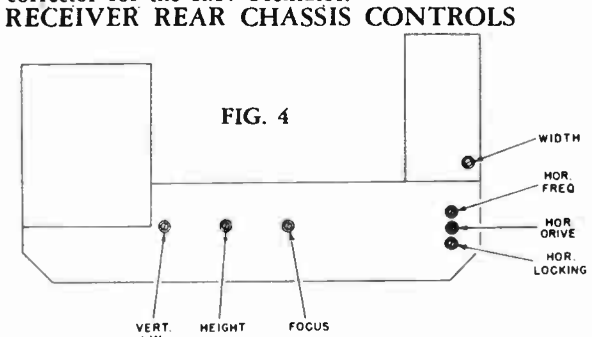
VERTICAL HOLD — The vertical hold control is not a critical control. This control is in the grid circuit of the first half of the vertical oscillator (V-8B).

PICTURE — Controls video gain through the AGC diode cathode (V-10A). It should be remembered that this receiver uses AGC and therefore will rarely overload despite contrast setting.

BRIGHTNESS — This control operates by varying the DC potential on the cathode of the Kinescope (V-21).

STATION SELECTOR — The inner (bar) knob of this control will operate the station selector. The outer (circular) knob will activate the Fine Tuning control, a corrector for the R.F. Oscillator.

RECEIVER REAR CHASSIS CONTROLS



WIDTH — The Horizontal Sweep is determined by the current flowing through the Horizontal Yoke Coil. The current through this coil (L13B) is controlled by Width Control (L15) which is a variable reactor having the effect of changing the turns ratio of this winding of the Horizontal Output and H.V. Transformer (T6).

HEIGHT — This control is a voltage dropping rheostat operating in the plate circuit of the Vertical Sweep Oscillator (V8B). It changes the voltage delivered to (V-12) Vertical Amplifier feeding current to transformer coupled Vertical Yoke Coil (L13A). Since changes in height will affect picture linearity, this Height Control must be adjusted in conjunction with Vertical Linearity Control.

VERTICAL LINEARITY CONTROL — This is a variable resistor control (R69) in the cathode of (V-12) which provides inverse feedback variation affecting the linearity of the Vertical Sweep Wave form. To be adjusted as height control is adjusted.

FOCUS CONTROL — This is a Variable Resistor (R80) which varies the current through focus coil (L-12).

HORIZONTAL AND VERTICAL CENTERING — Centering of the picture area is accomplished in this receiver by finding that position for the focus coil in the horizontal and vertical planes that produces this result. The focus coil bracket is adjusted so that if the four hexagon-head screws are loosened it can be shifted up and down and from side to side enabling the centering position to be found by trial.

BRIEF CIRCUIT ANALYSIS

The Tele-tone Television receivers Models, TV 300, 301, 304 and 305 use the Intercarrier sound systems. In this system the RF section of the receiver receives both the picture and the sound carriers which are converted by the mixer (V19) and then fed into the IF. No separation takes place until after the Video Amplifier (V9). At this point the sound component of the dual signal is picked off by the 4.5 trap (T1) and fed through the Ratio Detector, the sound Amplifier and the Audio output stages. The Picture IF frequency is 37.3 Mc and the Sound IF is 32.8. For individual stage frequencies see "Video IF Alignment". (Page 7).

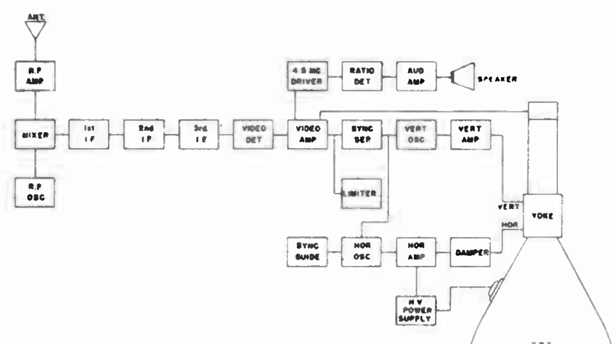


FIG. 5

TUNER — In the initial runs of this model a 12 coil tuner, much the same as previous Tele-tone tuners is used. In later runs a new type 7 coil tuner is employed. The terms "12 coil" and "7 coil" refer to the variable oscillator coils only. The RF and Mixer sections remain essentially the same.

RF AMPLIFIER — The antenna is fed between cathode and grid of the grounded grid RF amplifier (V-20). The input circuits of which are untuned. Double tuned interstage coupling is used between the plate of the RF Amplifier (V-20) and the grid of the mixer (V-19). Mechanically, the series inductances used take the form of several individual coils which are cut in or out of their respective circuits by means of the band switch. These coils will rarely need adjustment.

MIXER — The output of the RF Amplifier (V-20) and the Local Oscillator are condenser fed into the Control Grid Mixer Stage (V-19). This circuit is tuned in much the same manner as the output of the RF Amplifier, previously described.

OSCILLATOR—12 COIL TUNER—The RF Oscillator (V-18) is fairly straight-forward in operation. Its main peculiarity is that the coil for Channel 2 is permanently parallel to all other Oscillator coils from 3 to 13. It is therefore necessary, when aligning the oscillators to ALIGN CHANNEL 2 FIRST and the rest of the coils in any order thereafter. They are tuned by brass slugs accessible through two slots in the front of the receiver chassis. Channel 2 is found at the top of the right hand slot and the others follow in regular order in a clockwise direction finishing with Channel 13 at the top of the left hand slot.

OSCILLATOR—7 COIL TUNER—As stated above, in later runs of these models a new type, 7 coil tuner is employed. In these tuners the only change is in the arrangement of the Oscillator coils. Where, previously, 12 individual coils were used (one for each channel) 7 coils are now substituted. The coils for Channels 2 and 13 will remain substantially as before. The other channels will be paired with one variable and two small fixed coils, as shown in Fig. 6B. Typically, channels 3 and 4 have only one adjustment. This adjustment may be made on either station and the other will be found to be properly tuned. Any slight variations will be more than compensated for by the fine tuner. A study of Fig. 6B will show that, as previously, channel two must be tuned first, if at all, and the remaining channels in any order thereafter. The seven adjustments are for the following groups of channels; — Channel 2 — Channels 3 and 4 — Channels 5 and 6 — Channels 7 and 8 — Channels 9 and 10 — Channels 11 and 12 — Channel 13.

NOTE: The channel numbers on the escutcheon do not correspond to the location of the oscillator coils.

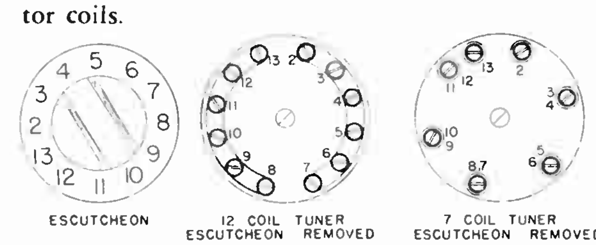


FIG. 6A

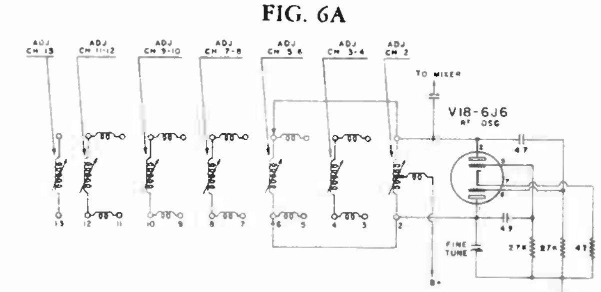


FIG. 6B

VIDEO IF — Each Video IF transformer has only one adjustment, a powdered iron slug accessible from the top of the chassis. The Video IF String is stagger tuned to two frequencies. The first and third IF transformers are tuned to 34.9 Megacycles and the second and fourth are tuned to 36.8 Megacycles. The response curve is fairly flat topped and should produce a picture with good definition.

VIDEO AMPLIFIERS — FIRST AND SECOND — A 12AU7 (V-9), dual triode is used in this section of the receiver. The output of the detector is fed to the grid of the first section (pin 2) and ultimately taken off plate of the second section of the tube (pin 6). It is at this point the three basic components of the received signal are separated and fed to their respective circuits. The picture intelligence is fed to the grid of the Picture Tube (V-21) and the synchronization pulses to the grid (pin 1) of the Sync Separator (V-11) and from there to the Horizontal (V-14) and Vertical oscillators (V-8B), also see "Sound System" below.

D. C. COMPONENTS — The D.C. component of the transmitted signal (which controls the background brightness) is substantially duplicated in the receiver by direct coupling from the plate of the second video amplifier to the Picture Tube grid.

SOUND SYSTEM — The sound Carrier is taken off the plate of the Video Amplifier (V-9) by a 4.5 Megacycle trap and fed through a 4.5 MC Amplifier (V-1) to the Ratio Detector (V-2), and then to the sound amplifier (V-4), audio output (V-3) and speaker.

SWEEP SYSTEM — VERTICAL — The triode section of a 6BF6 (V8B) serves as the Vertical oscillator and discharge tube. A 6K6 (V12) is utilized as the Vertical Sweep Amplifier. The plate circuit of the 6K6 (V12) is transformer coupled to the vertical windings of the Deflection Yoke (L13-A).

SWEEP SYSTEM — HORIZONTAL — The Horizontal Oscillator is essentially of the Blocking Oscillator type. The operation of the AFC system depends upon a correcting voltage developed in the control tube when the oscillator output and the incoming pulses differ in either phase or frequency. The control tube, first section (V-14), is maintained at cut-off until such time as the sync pulse is either ahead of or behind the oscillator, (second section V-14), sawtooth peak. When either case occurs the control tube develops a voltage which is applied as a bias to the oscillator grid and alters the oscillator frequency to coincide with the frequency of the incoming pulses. The horizontal oscillator transformer has an adjustable core which is a coarse control of the oscillator frequency. The Horizontal Frequency Control (rear) is a fine adjustment in the same sense. The front panel Horizontal Hold Control permits slight adjustment of the frequency by adjusting the B voltage applied to the control tube plate. The Horizontal Locking Range Control affects the sensitivity of the control tube thus varying the range over which the AFC circuit will function.

NOTE: Many of the components in the Horizontal circuits are of the critical value and therefore should only be replaced by the exact replacement part. Care should also be taken in dressing leads and parts when replaced. This can be accomplished by carefully noting parts positions before removal. For complete alignment procedure on these circuits see page (8).

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A.G.C. — The receiver uses an AGC circuit operating on the first 2 IF stages (V-5) (V-6). While it is quite effective in most locations, the receiver may overload in regions of very high field intensity. The contrast can generally be adjusted for a normal picture under such conditions but spurious beats, jagged vertical lines (i.e. poor resolution) and a "Moire" pattern may appear. These effects can be eliminated by the use of a resistor network of 3 to 10 db attenuation in series with the antenna lead at the point where it is connected to the receiver.

HIGH VOLTAGE POWER SUPPLY — The energy stored in the horizontal windings of the deflection yoke during the forward sweep produces high voltage surges during retrace. This is "stepped up" by the "auto-transformer" winding of the horizontal output transformer (T-6) and then rectified by a 1B3/8016 (V-13) to provide approximately 9000 volts for the picture tube (V-21) anode.

B VOLTAGE POWER SUPPLY — The B Supply of these models utilizes a standard type of transformer-rectifier circuit. It should be noted that the transformer contains a separate filament winding (6.3 volts) to heat the Cathode Ray Tube (V21) and the Damper (V16). The use of a center-grounded bleeder network provides a B Supply with the following voltages measured with respect to ground; plus 240 volts, plus 140 volts, plus 4 volts, minus 3.5 volts, minus 14 volts, and minus 90 volts.

ALIGNMENT PROCEDURE

The alignment of this Receiver can be broken down into three basic parts.

1 — Video IF Alignment   2 — RF Alignment
3 — Sound Alignment

TEST EQUIPMENT

CATHODE RAY OSCILLOSCOPE — The tube size is relatively unimportant, however, anything under 5" usually makes fine adjustment quite difficult.

SWEEP GENERATOR — The sweep generator used should have linear coverage of a center range from 30 to 220 megacycles. The output should be fairly flat over wide frequency variation of the sweep. It should be capable of an output of about 0.1 volt with attenuation. It is preferable that the generator have a deflection output for the test oscilloscope.

AM SIGNAL GENERATOR — This generator should have a frequency range of from 4.5 to 220 megacycles. As this generator is used occasionally as a market generator, accuracy is an important factor. It should be capable of 0.1 volt output with attenuation and should be linear through the range.

VACUUM TUBE VOLTMETER — Almost any standard make VTVM will do. It should preferably have a reversible polarity switch.

TEST SOCKET

In each of these models a Test Socket is provided which gives convenient access to the various points where either a vacuum tube voltmeter or an oscilloscope must be inserted for proper alignment. A letter diagram in the margin of the schematic will locate these points by means of corresponding letters in the schematic proper. A typical Octal socket is used and it should be noted that the diagram shows an UNDERSIDE VIEW. Two ground points are supplied on separate pins of the test socket for easy metering. Reference is made, in the following Alignment Procedures, to the pins on this Test Socket.

VIDEO IF ALIGNMENT

An adequate signal can be fed through the video IF string by feeding the output of the signal generator into a tube shield placed over the mixer tube (6AG5) (V-19). Care should be taken that this shield is NOT grounded. The ground side of the generator output can be conveniently grounded to the shield of the adjacent oscillator tube.

The contrast control should be set to produce minus 2 volts on Pin 7 6AL5-AGC tube. (V-10A).

The vacuum tube voltmeter should be connected across the 8200 ohm detector load resistor (Pin B Test Socket) and should be set on the minus 3 Volt scale. Set channel selector to an unused low band channel.

The Signal generator should be set to a frequency of 34.9 Mc. The output of the generator should be adjusted to the point where the reading on the VTVM is between minus 1 to minus 1.5 volts.

The First and Third I.F. coils should be peaked for a maximum reading on the VTVM. As the voltage reading increases with tuning, the generator should be attenuated to maintain a maximum of minus 1.5 volts.

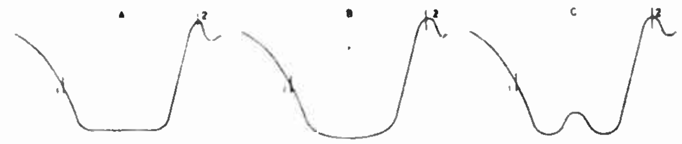
Set the Signal Generator to a Frequency of 36.8 Mc and tune the Second and Fourth I.F. coils in the same manner as above.

Set the Signal Generator to a frequency of 32.8 and tune the trap (L6) for a MINIMUM reading on the VTVM.

The Third I.F. coil should then be readjusted as described previously.

The Generator should now be shut off (or tuned to different band) and the VTVM should read no more than minus 0.20 volts. If there is a higher voltage reading, check for regeneration in the I.F. stages.

By shunting the signal generator with a sweep generator (30 to 40 Mc) and substituting a Cathode Ray Oscilloscope for the Vacuum tube Voltmeter in the above procedure the actual pass band of the Video I.F. circuits may be studied. Ideally the response curve should appear on the face of the oscilloscope in the form indicated in Figure (7A). A slight slope of the top of the curve in either direction or a small dip in the center are acceptable as indicated in Figure (7B & C).



A IDEAL RF IF WAVESHAPE   B & C ACCEPTABLE WAVESHAPES
1- PICTURE CARRIER
2- SOUND CARRIER

FIG. 7

RF ALIGNMENT

In the alignment of the RF section of this receiver three pieces of test equipment are necessary. A sweep generator, a signal generator and a cathode Ray Oscilloscope. For specifications see "Test Equipment" above.

The output of the Sweep Generator should be fed into the antenna. The signal generator (C.W.) should be connected to the antenna terminals of the receiver. The sweeper will provide the overall response curve with the oscilloscope properly connected. The signal generator is used as a marker as described below. Some Sweep generators made today contain their own marker oscillator. In cases where a generator of this type is used the Signal Generator may be eliminated.

The "hot" or "high" side of the Oscilloscope input should be connected to the junction point of the 8200 ohm detector load resistor and the peaking coil. (Pin B Test Socket). The "low" or ground side should be connected to the nearest convenient ground point. Care should be taken that the generator and the scope leads are well separated to avoid regeneration.

The R.F. section of the receiver is tuned channel by channel. The proper frequency settings for any given channel can be determined by consulting the Frequency Chart on Page (2). For example in aligning channel 2 the sweep generator should be set to some mid frequency between 54 and 60 megacycles. This adjustment is not a fine one. After setting the sweeper in the general vicinity of the desired frequency it should be tuned to center the response curve on the Oscilloscope face. For picture and sound markers the signal generator should carefully be adjusted to the frequencies indicated in the Frequency chart. For example in the case of channel 2 the picture marker frequency is 55.25 Mc. and the Sound 59.75 Mc.

It is important to note at this point that the oscillator coil for channel 2 is in parallel with every other oscillator coil from 3 to 13. It is therefor imperative that channel 2 be aligned first and the others in any desired order thereafter.

Starting with channel 2 and applying the proper frequencies as indicated above, the output of the sweeper should be attenuated to the point where further attenuation will not affect the wave shape.

The Oscillator should then be adjusted to bring the sound carrier into the 32.8 Mc trap valley. With the oscillator so adjusted the picture carrier should fall at a point approximately 50% up on the slope of the opposite side of the band pass curve. Certain variations in the waveshape and the location of the picture carrier are acceptable. The picture carrier may vary in position from a point between 45% and 60% of the slope and the overall waveshape may differ from the ideal, flat-topped response by being either slightly rounded or slightly dipped in the center. See Figure (8).

If the position of the picture carrier varies beyond the 45% to 60% points on all channels correction may be made by turning to channel 6, applying the proper input signals and slightly realigning the I.F. transformers.

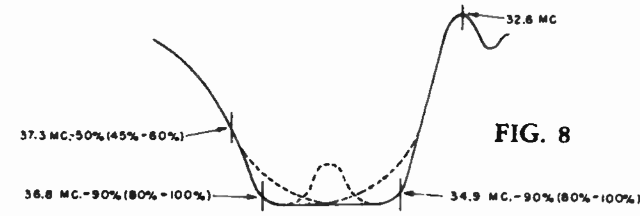


FIG. 8

IDEAL VIDEO IF RESPONSE CURVE
DOTTED LINES INDICATE ACCEPTABLE VARIATIONS

SOUND ALIGNMENT

Sound alignment on these receivers is best accomplished by using an actual transmission received on an antenna and fed in the normal manner to the antenna terminals. A Vacuum Tube Voltmeter should first be inserted between the output plate of the Ratio Detector Diode (pin 2 V2) and ground. This point may be reached through pin C of the Test Socket. The meter should be set on the *minus* 10 volt scale. With the equipment so placed the 4.5 Mc trap (T1) and the primary of the Ratio Detector Transformer (bottom adjustment, T2) should be adjusted for a maximum deflection of the meter. The hot lead of the meter should now be moved to the junction point of R19, C22 and C23 (Pin A Test Socket), and the secondary of the Ratio Detector Transformer should be adjusted for a *ZERO* reading. (Note: There are 3 points at which the meter will zero. Only one of these is correct. At the proper setting the meter should swing negative on one side and positive on the other side of zero). In cases where it is necessary to align the sound section when no station transmission is available a Single frequency signal generator tuned to 4.5 megacycles may be fed into the output circuit of the Video Detector (Pin B Test Socket). The receiver should then be aligned in the same manner as described above. The disadvantage of this method is that any inaccuracy in your signal generator will show up as misalignment when the set is in actual operation, since proper adjustment is very critical.

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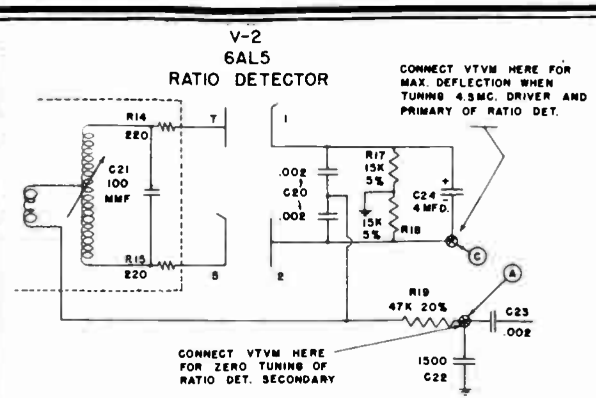

FIG. 9A

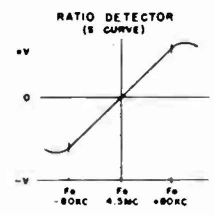

FIG. 9B

PICTURE ADJUSTMENTS

ION TRAP, FOCUS AND YOKE

To properly adjust the Ion Trap, Focusing coil and the Deflection Yoke the following procedure should be followed.

The Deflection Yoke should be placed in position closest to the "bell" of the Picture Tube as far forward on the neck of the tube as is possible. Be sure the wire loops on the mounting make positive contact with the coating of the picture tube. The Focus Coil is next in line and the Ion Trap last.

Turn the set on. The antenna should NOT be connected to the receiver and the picture contrast control should be set at MINIMUM.

With the brilliance control set at about one-quarter turn back from maximum, the Ion trap should be adjusted to achieve the brightest raster on the face of the Picture Tube. Trap should be simultaneously rotated and moved back and forth on the neck of tube until exact setting is obtained.

Adjust the brilliance control to a point slightly over normal brightness and adjust the Focus Control on the rear of the chassis for clearest and sharpest horizontal sweep lines. The Ion Trap should then be readjusted slightly for the brightest response on the face of the tube at which good focus is maintained.

The focus Coil itself should be moved to secure a complete raster approximately centered and with no corners cut off.

Finally the Deflection Yoke should be rotated to "square" the raster with the chassis as a reference. The thumb screws on the yoke brackets should then be set.

HORIZONTAL OSCILLATOR ALIGNMENT

To adjust the Horizontal oscillator and its control circuits it is necessary to first connect a working antenna

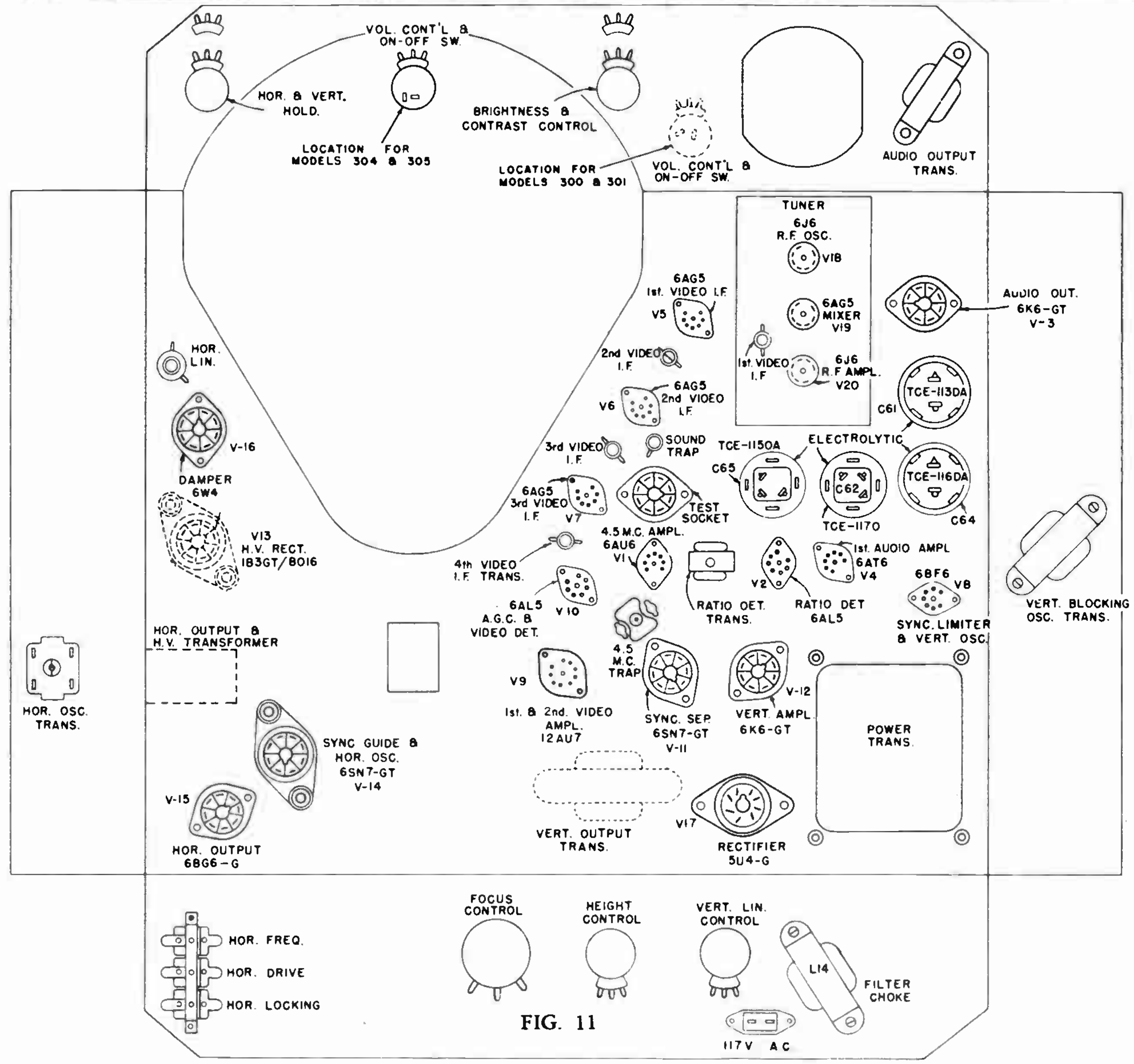

FIG. 11

PARTS LOCATION — MAIN CHASSIS — UNDERSIDE VIEW

to the receiver. It is preferable to use a test pattern as the incoming signal rather than a picture.

With the receiver turned on and the brightness and the picture contrast controls adjusted to a normal position the Horizontal Frequency trimmer and the Horizontal Locking trimmer (rear of chassis) should be turned clockwise all the way and then backed off to about one turn (counter-clockwise).

The Horizontal Hold Control (front panel) should be turned to a maximum clockwise position.

The core of the Horizontal Oscillator Transformer should then be adjusted. Variation of this core will cause the pattern to resolve into a series of black and white bars sloping either to the right or the left depending upon the degree of adjustment. The transformer should be adjusted to the point where the picture resolves into a series of from 3½ to 4½ bars sloping downwards to the right.

The Horizontal Hold Control (front panel) should now be rotated to a full counter-clockwise position and the incoming signal momentarily interrupted. This can be done most easily by shorting the antenna terminals for a moment.

The Horizontal Hold Control (front panel) should now be rotated slowly in a clockwise direction. As the control is turned the number of bars sloping downward to the left should decrease. At approximately 90 degrees of rotation there should remain between 3½ and 4½ bars just prior to the time that the picture "falls into" sync. The picture should remain in sync for an additional 90 degrees of rotation. If MORE than 4½ bars are evident just before the picture syncs the Horizontal Locking Range trimmer (rear of Chassis) should be tightened slightly. If LESS than 3½ bars the same trimmer should be loosened.

HEIGHT, WIDTH AND LINEARITY

To adjust the overall size and linearity of the picture it is almost mandatory that a pattern transmitted from a local station be used. Linearity adjustments, particularly, cannot be accurately made on moving transmissions. It should also be remembered that in areas where more than one station is being received, that pictures transmitted from different stations will vary slightly in size. The smallest transmitted picture should be made to fill the area delineated by the mask.

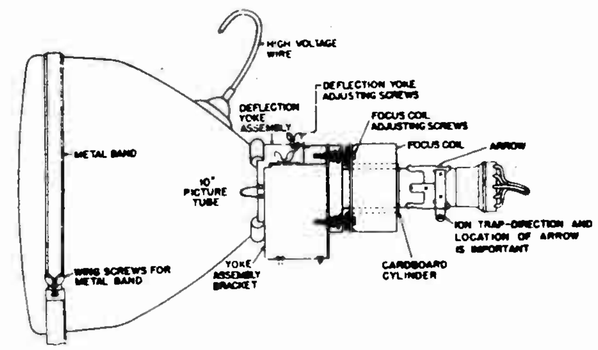

FIG. 10

The first step in linearity and size adjustment is to turn the Width control (rear of chassis Figure 4) all the way in (clockwise).

The Horizontal Drive trimmer should then be adjusted for the best compromise between maximum brightness and good horizontal linearity. This control will affect the left side of the picture primarily. The Horizontal Linearity control (top rear of chassis) should then be adjusted for linearity of the right side of the picture.

The Width Control should now be readjusted to achieve a picture that will fill the mask horizontally.

The Height and Vertical Linearity controls (both rear of chassis) should then be adjusted for a linear picture that will fill the mask vertically.

Picture centering is accomplished by positioning focus coil mechanically by means of 4 hexagon-head adjusting screws accessible from rear of chassis as shown in Figure (10). At this point the Focus control, previously set, should be retouched for maximum definition of the lines in the vertical wedge of the test pattern. Proper adjustment and alignment of the receiver should result in clear and sharp definition.

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RESISTANCE CHECK CHART

TV 300, 301, 304 and 305

Tube Function	Tube	PIN NUMBERS 1	2	3	4	5	6	7	8	9
1st Vid. IF	6AG5	800 K	40	0	0	9 K	9 K	40		
2nd Vid. IF	6AG5	800 K	40	0	0	9 K	9 K	40		
3rd Vid. IF	6AG5	0	100	0	0	9 K	9 K	100		
Vid. Det.	6AL5	0	140 K	0	0	2 K	0	8 K		
Vid. Amp.	12AU7	11 K	1 M	0	0	0	13 K	1 M	600	0
4.5 Amp.	6AU6	1.5	0	0	0	9 K	9 K	100		
Ratio Det.	6AL5	15 K	15 K	2	0	Inf.	0	Inf.		
1st Aud.Amp.	6AT6	10 M	0	0	0	0	0	350K		
Aud. Output	6K6	8 K	0	9 K	9 K	500 K	100	0	0	
Sync. Sep.	6SN7	1 M	23 K	0	3.5M	8 K	6 K	0	0	
Limiter-V.Osc.	6BF6	1 M	0	0	0	3.5 M	3.5 M	800K		
Vert. Amp.	6K6		0	10K	10K	2 M		0	3 K	
Hor. Osc.	6SN7	800 K	180 K	300K	200K	500 K	600	0	0	
Hor. Output	6BG6		0	600		1 M		0	16 K	
Damper	6W4			500K		10 K		8 K	8 K	
Power Rect.	5U4		9 K		600		600		9 K	

Conditions:-

1 All measurements taken with RCA Voltohmyst to ground.
2 Switch-off, Power Line disconnected.
3 All controls at "normal" setting.

VOLTAGE CHECK CHART

TV 300, 301, 304 and 305

Tube Function	Tube	PIN NUMBERS 1	2	3	4	5	6	7	8	9
1st Vid. IF	6AG5	-3.5	.2	0	0	135	135	.2		
2nd Vid. IF	6AG5	-3.5	.2	0	0	135	135	.2		
3rd Vid. IF	6AG5	0	1	0	0	135	135	1		
Vid. Amp.	12AU7	130	-4	0	0	0	120	-105	-100	0
Vid. Det.	6AL5	0	-3.5	0	0	3.5	0	-3.5		
4.5 Amp.	6AU6	0	0	0	0	135	135	1.2		
Ratio Det.	6AL5	23	-23	0	0	-2.5	0	-2.5		
1st Aud. Amp.	6AT6	-.5	0	0	0	0	0	70		
Aud. Output	6K6	250	0	220	225	-14	-15	0	0	
Sync. Sep.	6SN7	-4	135	0	-50	250	1.5	0	0	
Limiter-V.Osc.	6BF6	-50	0	0	0	-50	-50	160		
Vert. Amp.	6K6		0	230	230	-85		0	-60	
Hor. Osc.	6SN7	-90	34	-93	-180	70	-100	0	0	
Hor. Output	6BG6		0	-90		-105		0	165	
Damper	6W4			360		280		140	140	
Power Rect.	5U4		295						295	

Conditions:-

1 - All measurements DC voltage to Ground (Chassis)
2 - All measurements taken with RCA Voltohmyst.
3 - All controls at "Normal" setting with signal being received.
4 - Input Voltage 117 Volt - 60 cycle AC.

PART NUMBER	SCHEMATIC LOCATION	DESCRIPTION
		RESISTORS
TRC 33A-1	R 101	3.3 Ohms 1/2 Watt 20%
TRC 51A-1	R 16	5.1 Ohms 1/2 Watt 20%
TRC 330-5	R 77	33 Ohms 1 Watt 10%
TRC 390-2	R 30,33	39 Ohms 1/2 Watt 10%
TRC 470-1	R 45,95	47 Ohms 1/2 Watt 20%
TRC 820-4	R 98	82 Ohms 1 Watt 20%
TRC 820-8	R 78	82 Ohms 2 Watt 10%
TRC 101-1	R 12,37	100 Ohms 1/2 Watt 20%
TRC 221-1	R 14,15,76	220 Ohms 1/2 Watt 20%
TRC 331-1	R 32,35	330 Ohms 1/2 Watt 20%
TRC 331-7	R 79	330 Ohms 2 Watt 20%
TRC 561-2	R 73,74	560 Ohms 1/2 Watt 10%
TRC 102-1	R 13,27,34,38,72	1000 Ohms 1/2 Watt 20%
TRC 102-2	R 48	1000 Ohms 1/2 Watt 10%
TRC 102-4	R 23	1000 Ohms 1 Watt 20%
TRC 152-1	R 66,51	1500 Ohms 1/2 Watt 20%
TRC 332-1	R 71	3300 Ohms 1/2 Watt 20%
TRC 332-5	R 42,47	3300 Ohms 1 Watt 10%
TRC 392-2	R 29	3900 Ohms 1/2 Watt 10%
TRC 682-1	R 61	6800 Ohms 1/2 Watt 20%
TRC 682-5	R 99	6800 Ohms 1 Watt 10%
TRC 822-1	R 59	8200 Ohms 1/2 Watt 20%
TRC 822-5	R 43,90	8200 Ohms 1 Watt 10%
TRC 103-1	R 103	10K Ohms 1/2 Watt 20%
TRC 103-2	R 93	10K Ohms 1/2 Watt 10%
TRC 153-2	R 17,18	15K Ohms 1/2 Watt 10%
TRC 153-4	R 55	15K Ohms 1 Watt 20%
TRC 223-1	R 40,41,58	22K Ohms 1/2 Watt 20%
TRC 303-12	R 85	30K Ohms Temp. Compensating
TRC 473-1	R 19	47K Ohms 1/2 Watt 20%
TRC 563-1	R 100	56K Ohms 1/2 Watt 20%
TRC 104-1	R 26	100K Ohms 1/2 Watt 20%
TRC 104-6	R 92	100K Ohms 1 Watt 5%
TRC 104-SP	R 94	100K Ohms 1/2 Watt 1%
TRC 124-1	R 49	120K Ohms 1/2 Watt 20%
TRC 124-5	R 83,96	120K Ohms 1 Watt 10%
TRC 154-2	R 87	150K Ohms 1/2 Watt 10%
TRC 184-1		180K Ohms 1/2 Watt 20%
TRC 184-2	R 91	180K Ohms 1/2 Watt 10%
TRC 224-1	R 65	220K Ohms 1/2 Watt 20%
TRC 274-5	R 86	270K Ohms 1 Watt 10%
TRC 334-1	R 21	330K Ohms 1/2 Watt 20%
TRC 474-1	R 24	470K Ohms 1/2 Watt 20%
TRC 564-1	R 39,104	560K Ohms 1/2 Watt 20%
TRC 564-3	R 89	560K Ohms 1/2 Watt 5%
TRC 105-1	R 44,46,56,97	1 Meg Ohm 1/2 Watt 20%
TRC 105-2	R 62	1 Meg Ohm 1/2 Watt 10%
TRC 225-1	R 70	2.2 Meg Ohms 1/2 Watt 20%
TRC 335-6	R 88	3.3 Meg Ohms 1 Watt 5%
TRC 395-1	R 57	3.9 Meg Ohms 1/2 Watt 20%
TRC 106-1	R 22	10 Meg Ohms 1/2 Watt 20%
TRP 17DA	R 75A	1125 Ohms 9.8 Watt
	R 75C	8200 Ohms 2.3 Watt
	R 75B	650 Ohms 10.1 Watt
		CONTROLS
TVC 504-1D	R 66	Height (2.5 Meg)
TVC 523-D	R 63,84	Vertical Hold (50K) Hor. Hold (1.5 Meg)
TVC 524D	R 25,54	Brightness (500K) Picture (11.5K)
TVC 526D	R 20	Volume (500K) and Switch
TVC 503-1D	R 69	Vert. Linearity (5000 WW)
TVC 506-1-D	R 80	Focus (2250 W.W.)
		CONDENSERS
		Ceramic
TCC 1.5-8	C 38	1.5 MMF 500 Volts 10%
TCC 2.2-7	C 49	2.2 MMF 500 Volts 20%
TCC 050-8	C 16,7	5 MMF 500 Volts 10%
TCC 060-7	C 48	6 MMF 500 Volts 20%
TCC 030-8	C 39	30 MMF 500 Volts 10%
TCC 361-10	C 47	360 MMF 500 Volts GMV
TCC 152-7	C 22	1500 MMF 500 Volts 20%
TCC 152-SP	C 33,34,31,37,44	1500 MMF 500 Volts GMV
TCC 472-7	C 59,88	4700 MMF 500 Volts 20%
TCC 2-1	C 20	2000/2000 MMF 500 Volts Dual Herlec
		Mica
TCM 050-20	C 84	5 MMF 1000 Volt 10%
TCM 056-14	C 83	56 MMF 1000 Volt 10%
TCM 101-7	C 21,54	100 MMF 500 Volt 20%
TCM 121-7	C 67,70	120 MMF 500 Volt 20%
TCM 181-29	C 74	180 MMF 1000 Volt 2% Silver
TCM 271-7	C 8,30,35,41	270 MMF 500 Volt 20%
TCM 391-7	C 55	390 MMF 500 Volt 20%
TCM 391-14	C 75	390 MMF 1000 Volt 10%
TCM 222-14	C 77	2200 MMF 1000 Volt 10%
TCM 472-8	C 59,88	4700 MMF 500 Volt 10%
		Trimmers
TAS 501 D	C 69A,B,C	Horizontal Trimmer Assembly
		Paper
TCP 202-10	C 23,56,71	.002 MFD 600 Volts
TCPM 202-10	C 26	.0022 MFD 600 Volts Molded
TCPM 502-10	C 28	.0047 MFD 600 Volts Molded
TCP 502-10	C 32,36,43,42,45, 52,58	.005 MFD 600 Volts
TCP 103-10	C 27,85,86	.01 MFD 600 Volts
TCPM 103-4		.01 MFD 400 Volts Molded
TCPM 103-10	C 19,25	.01 MFD 600 Volts Molded
TCP 203-1	C 18	.02 MFD 200 Volts
TCP 203-4	C 73	.02 MFD 400 Volts
TCP 353-10	C 80	.035 MFD 600 Volts Oil
TCPM 503-10	C 28,50,68,53	.047 MFD 600 Volts Molded
TCP 503-10	C 46,63	.05 MFD 600 Volts
TCP 503-13	C 79	.05 MFD 1000 Volts Oil
TCP 104-13	C 81	.1 MFD 1000 Volts Oil
TCPM 254-4	C 60	.22 MFD 400 Volts Molded
TCP 254-1	C 40,78	.25 MFD 200 Volts
TCP 254-4	C 51,72	.25 MFD 400 Volts
TCP 254-4 SP	C 87	.25 MFD 400 Volts
		Electrolytics
TCE 112 DA	C 29	24 MFD 350 Volt
TCE 113 DA	C 61A	80 MFD 450 Volt
	C 61B	10 MFD 475 Volt
TCE 115 DA	C 65A	10 MFD 475 Volt
	C 65B	30 MFD 400 Volt
	C 65C	30 MFD 300 Volt
TCE 116 DA	C 64A	40 MFD 450 Volt
	C 64B	10 MFD 400 Volt
TCE 117 DA	C 62B	40 MFD 450 Volt
	C 62A	40 MFD 150 Volt
	C 62C	130 MFD 50 Volt
TCE 104 D	C 24	4 MFD 25 Volt
TCE 147 D*		10 MFD 475 Volt
		30 MFD 400 Volt
		60 MFD 50 Volt
		125 MFD 450 Volt
TCE 148 D*		80 MFD 450 Volt
		40 MFD 150 Volt
		30 MFD 300 Volt
		10 MFD 400 Volt
		COILS & TRANSFORMERS
TLF 551 D	L 100,28	First I.F. Coil
TLF 517 D	L 3	Second I.F. Coil
TLF 146 D	L 5	Third I.F. Coil
TLF 149 D	L 8	Fourth I.F. Coil
TLF 146 D	L 4,7,18	I.F. Choke
TLF 502	L 1,10	Peaking Coil (120 u.h.
TLF 503	L 2,9	Peaking Coil (36 u.h.)
TLF 519 D	L 11	Peaking Coil (100 u.h.)
TLF 114 D	T 1	4.5 Trap (Sound Take-Off)
TLF 142 D	T 2	Ratio Detector Coil
TLF 508	L 16	Horizontal Linearity Coil
TLF 505 D	L 15	Width Control Coil
TLF 545 DA	L 12	Focus Coil
TLF 509-1D		Ion Trap - 10"
TLF 546		Ion Trap - 12"
TTR 161-2-D	T 4	Vertical Oscillator Transformer
TTR 157	L 17	Horizontal Oscillator Sync. Guide Transformer
TTR 106-2-D	L 14	Filter Choke
TTR 158	L 6	Sound Trap
TTR 153-4-D	T 5	Vertical Output Transformer
TTR 168-D	T 7	Power Transformer
TTR 181-D	T 6	Horizontal Output H.V. Trans.
TTR 159-D	L 13 (A,B)	Deflection Yoke
		HARDWARE
TFU 1	with	Fuse
TSP 463-D	T3	4" x 6" Oval Speaker (PM)
TPL 150		Interlock Plug
TLD 101		Interlock Cord
		CABINET & HARDWARE - TV 300
TCB 255-DB		Cabinet
TGL 107-D		Safety Glass
TMS 798-D		Mask
TNP 4-D		Trade Mark Escutcheon
TKN 100-1		Outside Knob
TKN 101-1		Inside Knob (Small Shaft)
TKN 103-1		Inside Knob (Large Shaft)
TKN 108-1		Selector Knob
TMS 121-R		Escutcheon
TSG 113-D		Escutcheon Spring
TBP 541-D		Built-In-Antenna
TBK 173-D		Back
		CABINET & HARDWARE - TV 301
TCB 255 DM		Cabinet
TGL 107 D		Safety Glass
TMS 798 D		Mask
TNP 5 D		Trade Mark Escutcheon
TKN 114 D		Outside Knob
TKN 115 D		Inside Knob
TKN 116 D		Dual Knob
TKN 117 D		Indicator Knob
TMS 121 R		Escutcheon
TSG 113 D		Escutcheon Spring
TBP 541 D		Built-In Antenna
TBK 174 D		Back
		CABINET & HARDWARE - TV 304
TCB 275-D		Cabinet
TMS 520 D		Perforated Bottom
TMS 121 R		Escutcheon
TSG 108		Escutcheon Spring
TBK 175 1-D		Back
TKN 114		Outside Knob
TKN 115		Inside Knob
TKN 116		Dual Knob
TKN 117		Indicator Knob
TGL 116 D		Safety Glass
TRE 1 D		Safety Glass Retainer
TBP 539 D		Built-In Antenna
		CABINET & HARDWARE - TV 305
TCB 271 D		Cabinet
TGR 155 D		Grille Cloth
TMS 520 D		Perforated Bottom
TMS 121 R		Escutcheon
TSG 108 D		Escutcheon Spring
TBK 175 D		Back
TKN 114 D		Outside Knob
TKN 115 D		Inside Knob
TKN 116 D		Dual Knob
TKN 117 D		Indicator Knob
TGL 116 D		Safety Glass
TRE 1 D		Glass Retainer
TMS 921 D		Mask
TBP 539 D		Built-In Antenna
		TUNER
		Resistors
TRC 470-4	R 11	47 Ohm 1/2 Watt 20%
TRC 560-2	R 2	56 Ohm 1/2 Watt 10%
TRC 331-2	R 3	330 Ohm 1/2 Watt 10%
TRC 102-1	R 1,7,106	1000 Ohm 1/2 Watt 20%
TRC 472-3	R 8	4700 Ohm 1/2 Watt 5%
TRC 273-1	R 9,10	27K Ohm 1/2 Watt 20%
TRC 105-1	R 6	1 Megohm 1/2 Watt 20%
		CONDENSERS
		Ceramic
TCC 010-11	C 5,12	1 MMF 600 Volts 10%
TCC 4.7-11	C 14,15	4.7 MMF 600 Volts 10%
TCC 22-12	C 9	22 MMF 600 Volts 5%
TCC 361-10	C 1,2,3,4,11,13,89	360 MMF 600 Volts Min.
TCC 502-SP	C 10	5000 MMF 600 Volts Disc.
		Mica
TCM 271-7	C 8	270 MMF 500 Volts 20%
		FINE TUNER
TAS 524 D		Bushing Assembly
TAS 525 D		Shaft Assembly
		COILS - 12 - COIL TUNER
TLF 146 D	L 100,27	I.F. Choke
TLF 551 D	L 100,28	First I.F. Coil
TLF 120-1	L 100-1	Channel 2 Oscillator Coil
TLF 120-2	L 100-2	Channel 3 Oscillator Coil
TLF 120-3	L 100-3	Channel 4 Oscillator Coil
TLF 120-4	L 100-4	Channel 5 Oscillator Coil
TLF 120-5	L 100-5	Channel 6 Oscillator Coil
TLF 120-6	L 100-6	Channel 7 Oscillator Coil
TLF 120-7	L 100-7	Channel 8 Oscillator Coil
TLF 120-8	L 100-8	Channel 9 Oscillator Coil
TLF 120-9	L 100-9	Channel 10 Oscillator Coil
TLF 120-10	L 100-10	Channel 11 Oscillator Coil
TLF 120-10	L 100-11	Channel 12 Oscillator Coil
TLF 120-10	L 100-12	Channel 13 Oscillator Coil
		COILS - 7-COIL TUNER (See Page 5)
TLF 146 D	L 100-27	I.F. Choke
TLF 551 D	L 100-28	First I.F. Coil
TLF 120-1	L 100-1	Channel 2 Oscillator Coil
TLF 120-3	L 100-3	Channel 3-4 Oscillator Coil
TLF 120-5	L 100-5	Channel 5-6 Oscillator Coil
TLF 120-7	L 100-7	Channel 7-8 Oscillator Coil
TLF 120-9	L 100-9	Channel 9-7 Oscillator Coil
TLF 120-10	L 100-10	Channel 11-12 Oscillator Coil
TLF 120-10	L 100-13	Channel 13 Oscillator Coil

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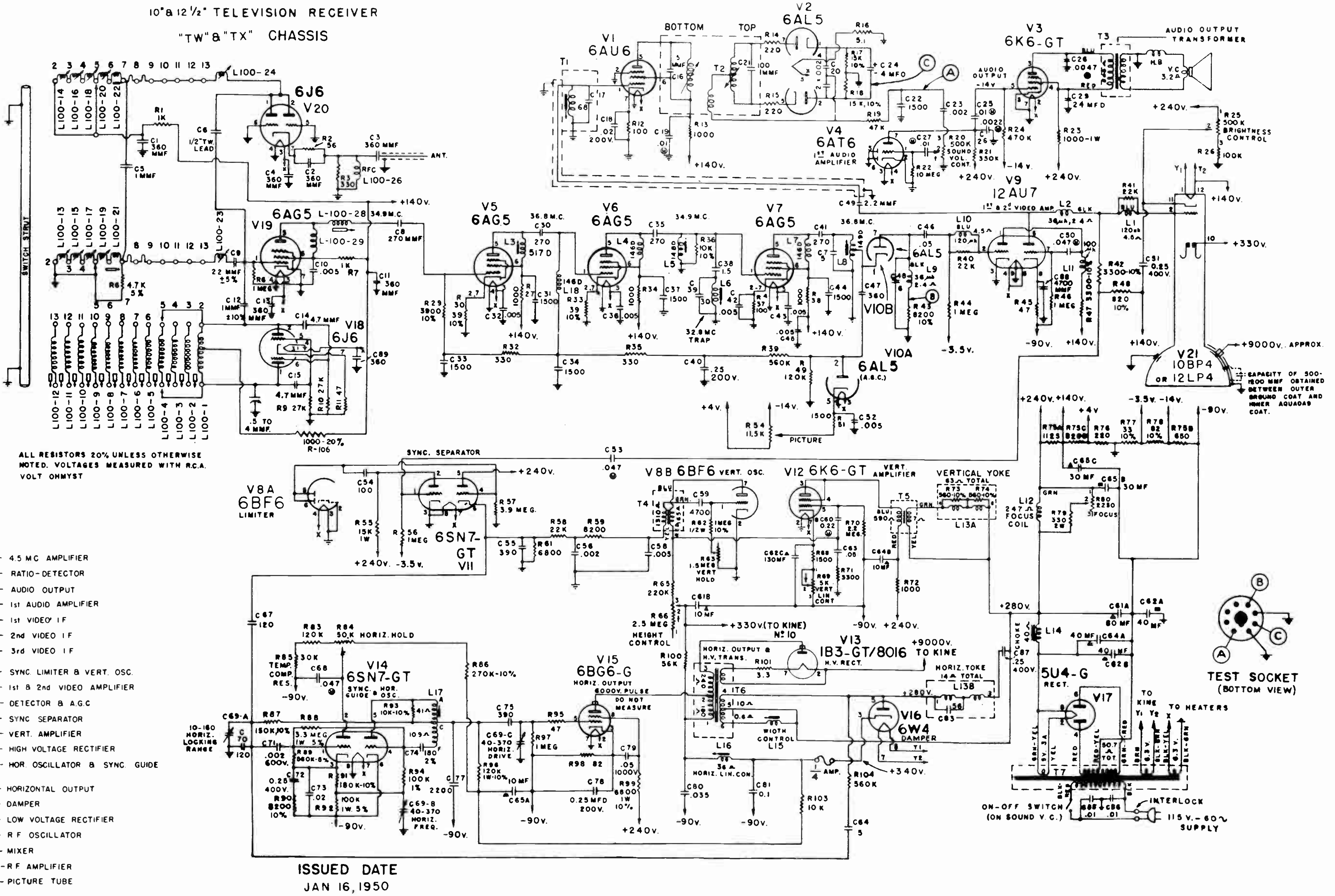
World Radio History


10" & 12 1/2" TELEVISION RECEIVER
"TW" & "TX" CHASSIS
ALL RESISTORS 20% UNLESS OTHERWISE NOTED. VOLTAGES MEASURED WITH R.C.A. VOLT OHMYST
V1- 4.5 MC AMPLIFIER
V2- RATIO-DETECTOR
V3- AUDIO OUTPUT
V4- 1st AUDIO AMPLIFIER
V5- 1st VIDEO I F
V6- 2nd VIDEO I F
V7- 3rd VIDEO I F
V8- SYNC LIMITER & VERT. OSC.
V9- 1st & 2nd VIDEO AMPLIFIER
V10- DETECTOR & A.G.C
V11- SYNC SEPARATOR
V12- VERT. AMPLIFIER
V13- HIGH VOLTAGE RECTIFIER
V14- HOR. OSCILLATOR & SYNC GUIDE
V15- HORIZONTAL OUTPUT
V16- DAMPER
V17- LOW VOLTAGE RECTIFIER
V18- R F OSCILLATOR
V19- MIXER
V20- R F AMPLIFIER
V21- PICTURE TUBE
TEST SOCKET (BOTTOM VIEW)
ISSUED DATE JAN 16, 1950

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SPECIFICATIONS

POWER SUPPLY
105 to 125 Volts - 60 Cycle A.C.

POWER CONSUMPTION
225 Watts

POWER OUTPUT
2 Watt (Undistorted)

INPUT IMPEDANCE
72 and/or 300 Ohm

PICTURE TUBE SIZE
12-1/2" Round

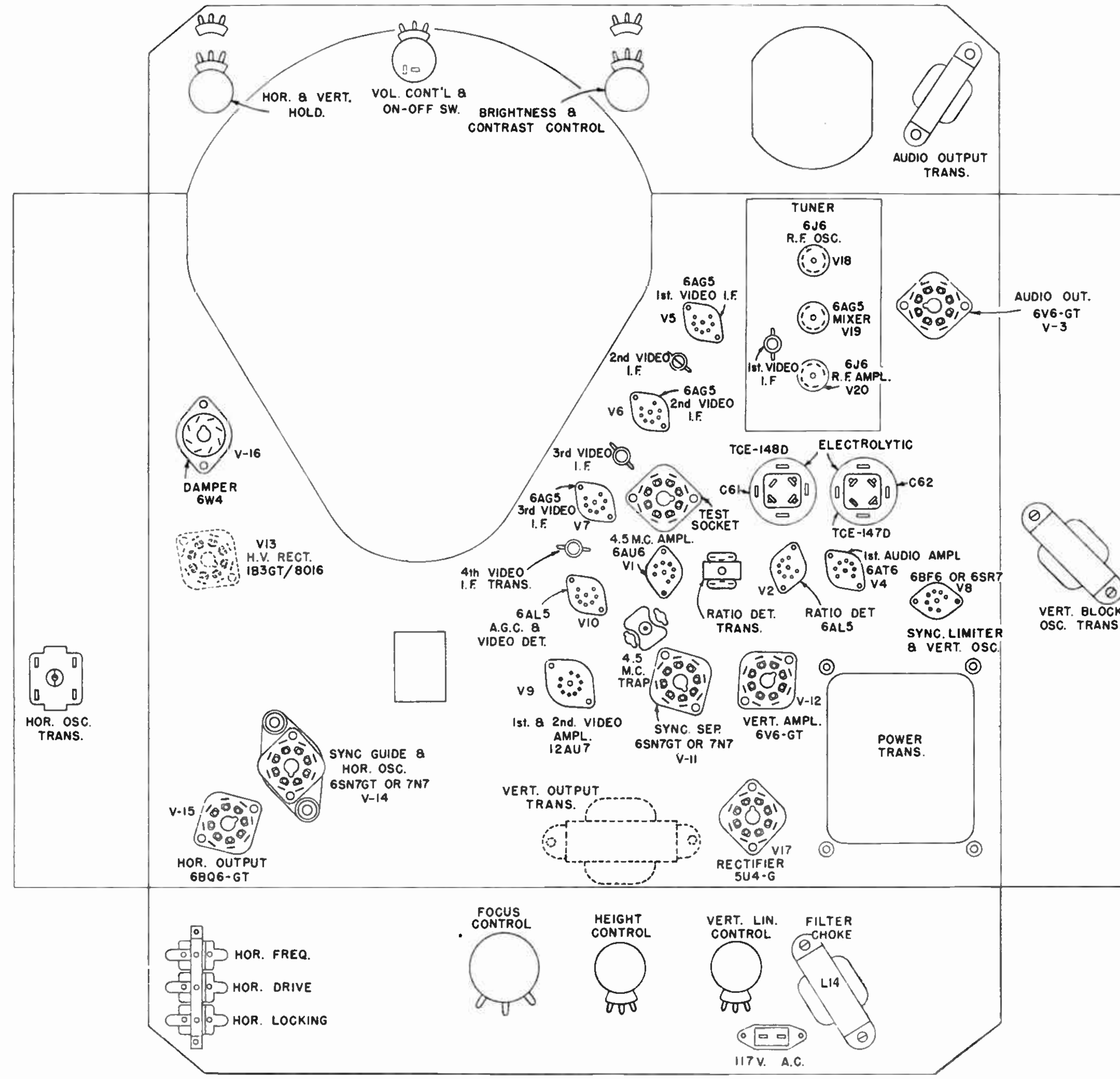
SPEAKER
4" x 6" Oval PM - Voice Coil 3 Ohms

DIMENSIONS
21-1/2" Wide x 18" Deep x 12-1/2" High

SHIPPING WEIGHT
App. 71 Lbs.

TUBE COMPLEMENT

1	6J6	V20	RF Amplifier
2	6AG5	V19	Mixer
3	6J6	V18	RF Oscillator
4	6AG5	V5	1st Video IF Amplifier
5	6AG5	V6	2nd Video IF Amplifier
6	6AG5	V7	3rd Video IF Amplifier
7	6AL5	V10B	Video Detector
		V10A	AGC
8	12AU7	V9	1st & 2nd Video Amplifiers
9	6AU6	V1	Ratio Detector Driver
10	6AL5	V2	Ratio Detector
11	6AT6	V4	Audio Amplifier
12	6V6	V3	Audio Output
13	6SN7 or 7N7	V11	Sync. Separator
14	6BF6 or 6SR7	V8A	Limiter
		V8B	Vertical Sweep Oscillator
15	6V6	V12	Vertical Sweep Amplifier
16	6SN7 or 7N7	V14	Horizontal Sweep Oscillator and Sync - Guide.
17	6BQ6	V15	Horizontal Sweep Amplifier
18	6W4	V16	Damper
19	1B3	V13	High Voltage Rectifier
20	5U4	V17	Power Rectifier
21	12LP4	V21	Cathode Ray Tube



PARTS LOCATION — MAIN CHASSIS — UNDERSIDE VIEW

FOR DETAILED ALIGNMENT PROCEDURE AND A DISCUSSION OF CIRCUITS SEE TV 300-301-304-305 MANUAL

MODEL TV315,
Ch. TAB, TAA

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World Radio History

RESISTANCE CHECK CHART

Function	Tube	Pin Numbers 1	2	3	4	5	6	7	8	9
4.5 Mc Amp.	6AU6	1.5	0	0	0	29K	29K	200		
Rat. Det.	6AL5	15K	15K	1.8	0	Inf.	0	Inf.		
Aud. Output	6V6	29K	0	29.4K	29K	470K	-	0	150	
Aud. Amp.	6AT6	10Meg	0	0	0	0	0	450K		
1st IF	6AG5	700K	39	0	0	30K	30K	39		
2nd IF	6AG5	700K	39	0	0	30K	30K	39		
3rd IF	6AG5	.1	100	0	0	30K	30K	100		
Vid. Amp.	12AU7	32K	8.2K	0	0	0	33K	1Meg	47	0
Det.-AGC	6AL5	0	120K	0	0	2.7K*	0	8.2K		
Ver. Osc. - Lim.	6SR7	0	1Meg+	0	3.9Meg	3.9Meg	2.5Meg++	0	0	
Syn. Sep.	7N7	0	0	46K	1Meg	3.9Meg	30K	6.8K	0	
Vert. Amp.	6V6	-	0	140K	140K	2.2Meg	30K	0	1K	
Hor. Osc.	6SN7	750K	140K**	300K	220K	220K	0	0	0	
Hor. Output	6BQ6	28K	0	-	32K	220K	45	0	140	
Damper	6W4	100K	-	120K	28K	28K	-	28K	28K	
Rectifier	5U4	-	29K	-	72	-	72	-	29K	

Conditions:-

A - All Measurements to ground (chassis).
B - All controls fully clockwise except Focus control fully counter-clockwise.
C - Line cord disconnected - switch off.

Notes:-

* Reading will vary with setting of picture control.
** Reading will vary with setting of horizontal hold control.
+ Reading will vary with setting of vertical hold control.
++ Reading will vary with setting of height control.

VOLTAGE CHECK CHART

Function	Tube	Pin Numbers 1	2	3	4	5	6	7	8	9
4.5 Mc Amp.	6AU6	0	0			140v	140v	1.4v		
Rat. Det.	6AL5	0	0			0	0	0		
Aud. Output	6V6	230v	0	185v	200v	0			7v	
Aud. Amp.	6AT6	1v	0			0	0	52v		
1st IF	6AG5	-7v	0			150v	150v			
2nd IF	6AG5	-7v	0			150v	150v			
3rd IF	6AG5	0	1v			140v	140v			
Vid. Amp.	12AU7	100v	-.3v	0			150v	0	1v	0
Det. AGC	6AL5	0	-7.5v*			-7.5v*	0	-.3v		
Ver.Osc.-Lim.	6SR7	0	70v+	0	-3.1v	-3.1v	330v++		0	
Syn. Sep.	7N7	0	0	100v	-.5v	-3v	230v	7.5v		
Vert. Amp.	6V6		0	360v	360v	-1v	150v		45v	
Hor. Osc.	6SN7	-15v	90v**	-7v	-70v	170v	0			
Hor. Output	6BQ6	150v			120v	-18v	-7.5v	0	.7v	
Damper	6W4	340v		380v	260v	255v		230v	230v	
Rectifier	5U4		255v						255v	

Conditions:-

A - Line Voltage 117 Volts 60 cycle A.C.
B - All Measurements to ground, (chassis) taken with a Vacuum Tube.Voltmeter.
C - Switch on and all controls at minimum (counterclockwise).
D - Tuner set to Channel 3 with no antenna or signal applied.

Notes:-

* Reading will vary with setting of picture control.
** Reading will vary with setting of horizontal hold control.
+ Reading will vary with setting of vertical hold control.
++ Reading will vary with setting of height control.

PART NUMBER	SCHEMATIC LOCATION	DESCRIPTION
		RESISTORS
TRC 51A-1	R 16	5.1 Ohms 1/2 Watt 20%
TRC 180-8		18 Ohms 2 Watt 10%
TRC 390-2	R 30,33	39 Ohms 1/2 Watt 10%
TRC 470-1	R 45,95	47 Ohms 1/2 Watt 20%
TRC 470-8	R 78	47 Ohms 2 Watt 10%
TRC 820-4	R 98	82 Ohms 1 Watt 20%
TRC 101-1	R 12,37	100 Ohms 1/2 Watt 20%
TRC 221-1	R 14,15	220 Ohms 1/2 Watt 20%
TRC 331-1	R 32,35	330 Ohms 1/2 Watt 20%
TRC 561-2	R 73,74	560 Ohms 1/2 Watt 10%
TRC 681-8	R 23,79	680 Ohms 2 Watt 10%
TRC 821-2	R 48	820 Ohms 1/2 Watt 10%
TRC 102-1	R 13,27,34,38,72	1,000 Ohms 1/2 Watt 20%
TRC 102-2	R 77	1,000 Ohms 1/2 Watt 10%
TRC 152-1	R 51,68	1,500 Ohms 1/2 Watt 20%
TRC 182-2	R 47	1,800 Ohms 1/2 Watt 10%
TRC 332-1	R 99	3,300 Ohms 1/2 Watt 20%
TRC 392-2	R 29	3,900 Ohms 1/2 Watt 10%
TRC 4"2-3	R 43	4,700 Ohms 1/2 Watt 5%
TRC 47: -5	R 42	4,700 Ohms 1 Watt 10%
TRC 682-1	R 61,71	6,800 Ohms 1/2 Watt 20%
TRC 822-1	R 59	8,200 Ohms 1/2 Watt 20%
TRC 822-2	R 90	8,200 Ohms 1/2 Watt 10%
TRC 103-1	R 103	10K Ohms 1/2 Watt 20%
TRC 103-2	R 36,93	10K Ohms 1/2 Watt 10%
TRC 153-2	R 17,18	15K Ohms 1/2 Watt 1J%
TRC 153-7	R 55	15K Ohms 2 Watt 20%
TRC 183-2		18K Ohms 1/2 Watt 10%
TRC 223-1	R 40,58	22K Ohms 1/2 Watt 20%
TRC 273-8	R 76	27K Ohms 2 Watt 10%
TRC 303-12	R 85	30K Ohms Temp. Compensating
TRC 473-1	R 19,105	47K Ohms 1/2 Watt 20%
TRC 563-1	R 100	56K Ohms 1/2 Watt 20%
TRC 104-1	R 21,24,26	100K Ohms 1/2 Watt 20%
TRC 104-2	R 106	100K Ohms 1/2 Watt 10%
TRC 104-4	R 96	100K Ohms 1 Watt 20%
TRC 104-6	R 92	100K Ohms 1 Watt 5%
TRC 104-SP	R 94	100K Ohms 1/2 Watt 1%
TRC 124-1	R 49,83	120K Ohms 1/2 Watt 20%
TRC 154-2	R 87	150K Ohms 1/2 Watt 10%
TRC 184-1	R 97	180 K Ohms 1/2 Watt 20%
TRC 184-2	R 91	160K Ohms 1/2 Watt 10%
TRC 224-1	R 65	220K Ohms 1/2 Watt 20%
TRC 274-5	R 86	270K Ohms 1 Watt 10%
TRC 474-4	R 102	470K Ohms 1 Watt 20%
TRC 564-1	R 39,104	560K Ohms 1/2 Watt 20%
TRC 564-3	R 89	560K Ohms 1/2 Watt 5%
TRC 105-1	R 46,56	1 Meg Ohm 1/2 Watt 20%
TRC 105-2	R 62	1 Meg Ohm 1/2 Watt 10%
TRC 225-1	R 70	2.2 Meg Ohms 1/2 Watt 20%
TRC 335-6	R 88	3.3 Meg Ohms 1 Watt 5%
TRC 395-1	R 57	3.9 Meg Ohms 1/2 Watt 20%
TRC 106-1	R 22	10 Meg Ohms 1/2 Watt 20%
TRP 19D	R 75	1,000 Ohms 20 Watt Pigtail
		CONTROLS
TVC 504-1D	R 66	Height (2.5 Meg)
TVC 523-D	R 63,64	Vert. (1.5) Meg & Hor.Hold (50K)
TVC 524-D	R 25,54	Brightness (500K) & Contrast (11.5K)
TVC 526-D	R 20	Volume (500K) & Switch
TVC 503-1D	R 69	Vert. Linearity (5,000 WW)
TVC 506-1D	R 80	Focus (2,250 WW)
		CONDENSERS
		Mica
TCM 050-20	C 84	5 Mmf 1,500 Volts 20%
TCM 056-14	C 83	56 Mmf 1,000 Volts 10%
TCM 101-7	C 21,54	100 Mmf 500 Volts 20%
TCM 121-7	C 67,70	120 Mmf 500 Volts 20%
TCSM 181-29	C 74	180 Mmf 1,000 Volts 2% Silver
TCM 271-7	C 30,35,41	270 Mmf 500 Volts 20%
TCM 391-7	C 55	390 Mmf 500 Volts 20%
TCM 222-14	C 77	2,200 Mmf 1,000 Volts 10%
		Ceramic
TCC 2.2-7	C 49	2.2 Mmf 500 Volts 20%
TCC 050-8	C 16,7	5 Mmf 500 Volts 10%
TCC 060-7	C 48	6 Mmf 500 Volts 20%
TCC 361-10	C 47	360 Mmf 500 Volts GMV
TCC 152-7	C 22	1,500 Mmf 500 Volts 20%
TCC 152-SP	C 31,33,34,37,44	1,500 Mmf 500 Volts GMV
TCC 472-7	C 59,88	4,700 Mmf 500 Volts 20%
TCC 2-1	C 20	2,000/2,000 Mmf Dual Herlec
		Paper
TCP 202-10	C 23,26,56,71	.002 Mfd 600 Volts
TCP 502-4	C 32,36,42,43,45, 52,58	.005 Mfd 400 Volts
TCP 103-4	C 27,47,85,86	.01 Mfd 400 Volts
TCP 203-1	C 18	.02 Mfd 200 Volts
TCP 203-4	C 73	.02 Mfd 400 Volts
TCP 503-4	C 64	.05 Mfd 400 Volts
TCP 503-10	C 63	.05 Mfd 600 Volts
TCP 254-1	C 40,78	.25 Mfd 200 Volts
TCP 254-4	C 51,72	.25 Mfd 400 Volts
TCP 254-4-SP	C 87	.25 Mfd 400 Volts Oil
TCP 254-10	C 65,81	.25 Mfd 600 Volts
TCPM 502-10	C 28	.0047 Mfd 600 Volts 20% Molded
TCPM 103-4	C 19,25,75	.01 Mfd 400 Volts Molded
TCPM 503-4	C 50,68,79	.047 Mfd 400 Volts 20% Molded
TCPM 503-10	C 53,80	.047 Mfd 600 Volts 20% Molded
TCPM 254-4	C 60	.22 Mfd 400 Volts Molded
		Electrolytic
TCE 104-D	C 24	4 Mfd 25 Volts
TCE 149-DA	C 62B	40 Mfd 400 Volts Triple
	C 62C	80 Mfd 350 Volts Triple
	C 62A	40 Mfd 10 Volts Triple
TCE-151-D	C 61B	50 Mfd 150 Volts Quadruple
	C 61C	10 Mfd 400 Volts Quadruple
	C 61D	130 Mfd 50 Volts Quadruple
	C 61A	24 Mfd 250 Volts Quadruple

PART NUMBER	SCHEMATIC LOCATION	DESCRIPTION
		Trimmer
TAS 538-D	C 69A,69B	Trimmer Assembly
		COILS & TRANSFORMERS
TLF 551-D	L 100-28	1st IF Coil
TLF 560-D	L 3	2nd IF Coil
TLF 148-D	L 5	3rd IF Coil
TLF 149-D	L 8	4th IF Coil
TLF 146-D	L 4,7,18,100-29	IF Choke
TLF 502-D	L 1,10	Peaking Coil - 120 uh -(22K) Blue Dot
TLF 503-D	L 2,9	Peaking Coil - 36 uh Form Black Dot
TLF 519-D	L 11	Peaking Coil - 100 uh Form Red Dot
TLF 114-D	T 1	Sound Take-Off Trap
TLF 531-D	T 2	Ratio Det. Coil
TTR 161-2-D	T 4	Vert. Blocking Osc. Transformer
TTR 185-D	T 5	Vert. Output Transformer
TTR 157-D	L 17	Hor. Osc. - Sync.Guide Transformer
TTR 209-D	T 6	Hor. Output - H.V. Trans.
TTR 193-D	T 7	Power Transformer
TTR 106-2D	L 14	Filter Choke
TLF 545-DA	L 12	Focus Coil
TTR 159-D	L 13, A,B	Deflection Yoke
TLF 553-D		Width Coil
TTR 195-D	T 3	Audio Output Transformer
		CABINET AND HARDWARE
TFU 1		Fuse 1/4 Amp. Pigtail
TMS 782		Tube Shield
TMS 127		Miniature Tube Shield
TSO 186		CRT Socket Assembly
TTS 403		Speaker Connector (male)
TTS 404		Speaker Connector (female)
TSP 464		4" x 6" Oval PM Speaker
TPL 150		Interlock Plug
TLD 101		Interlock Cord
TFA 510-D		Anode Connector & Lead
TCB 278-D		Cabinet
TGR 160-D		Grille Cloth
TFF 101		Felt Feet
TMS 981-D		Bezel
TGL 161-D		Glass
TMS 982-D		Mask
TMS 520-D		Bottom
TMS 121-R		Escutcheon
TSG 106-D		Escutcheon Spring
TKN 114		Outside Knob
TKN 115		Inside Knob
TKN 116		Dual Knob
TKN 117		Indicator Knob
TWF 151		Felt Washer
TBK 182-D		Back
TIM 523-D		CRT Cup
TBP 539-D		Built-In-Antenna
TTS 407-D		Antenna Term. Strip (3 Post)
TLF 565		Antenna Matching Trans.
		TUNER
		Resistors
TRC 470-4	R 11	47 Ohm 1/2 Watt 20%
TRC 560-2	R 2	56 Ohm 1/2 Watt 10%
TRC 331-2	R 3	330 Ohm 1/2 Watt 10%
TRC 102-1	R 1,7,104	1,000 Ohm 1/2 Watt 20%
TRC 472-3	R 8	4,700 Ohm 1/2 Watt 5%
TRC 273-1	R 9,10	27K Ohm 1/2 Watt 20%
TRC 105-1	R 6	1 Meg ohm 1/2 Watt 20%
		CONDENSERS
		Ceramic
TCC 010-11	C 5,12	1 Mmf 600 Volts 10%
TCC 4.7-11	C 14,15	4.7 Mmf 600 Volts 10%
TCC 22-12	C 9	22 Mmf 600 Volts 5%
TCC 361-10	C 1,2,3,4,11,13,89	360 Mmf 600 Volts Min.
TCC 502-SP	C 10	5,000 Mmf 600 Volts Disc.
		CONDENSERS
		Mica
TCM 271-7	C 8	270 Mmf 500 Volts 20%
		FINER TUNER
TAS 524-D		Bushing Assembly
TAS 525-D		Shaft Assembly
		COILS - 12 - COIL TUNER
TLF 146-D	L 100,27	I.F. Choke
TLF 551-D	L 100,28	First I.F. Coil
TLF 120-1	L 100-1	Channel 2 Oscillator Coil
TLF 120-2	L 100-2	Channel 3 Oscillator Coil
TLF 120-3	L 100-3	Channel 4 Oscillator Coil
TLF 120-4	L 100-4	Channel 5 Oscillator Coil
TLF 120-5	L 100-5	Channel 6 Oscillator Coil
TLF 120-6	L 100-6	Channel 7 Oscillator Coil
TLF 120-7	L 100-7	Channel 8 Oscillator Coil
TLF 120-8	L 100-6	Channel 9 Oscillator Coil
TLF 120-9	L 100-9	Channel 10 Oscillator Coil
TLF 120-10	L 100-10	Channel 11 Oscillator Coil
TLF 120-10	L 100-11	Channel 12 Oscillator Coil
TLF 120-10	L 100-12	Channel 13 Oscillator Coil
		COILS - 7 - COIL TUNER
TLF 146-D	L 100-27	I.F. Choke
TLF 551-D	L 100-28	First I.F. Coil
TLF 120-1	L 100-1	Channel 2 Oscillator Coil
TLF 120-3	L 100-3	Channel 3-4 Oscillator Coil
TLF 120-5	L 100-5	Channel 5-6 Oscillator Coil
TLF 120-7	L 100-7	Channel 7-8 Oscillator Coil
TLF 120-9	L 100-9	Channel 9-10 Oscillator Coil
TLF 120-10	L 100-10	Channel 11-12 Oscillator Coil
TLF 120-10	L 100-13	Channel 13 Oscillator Coil

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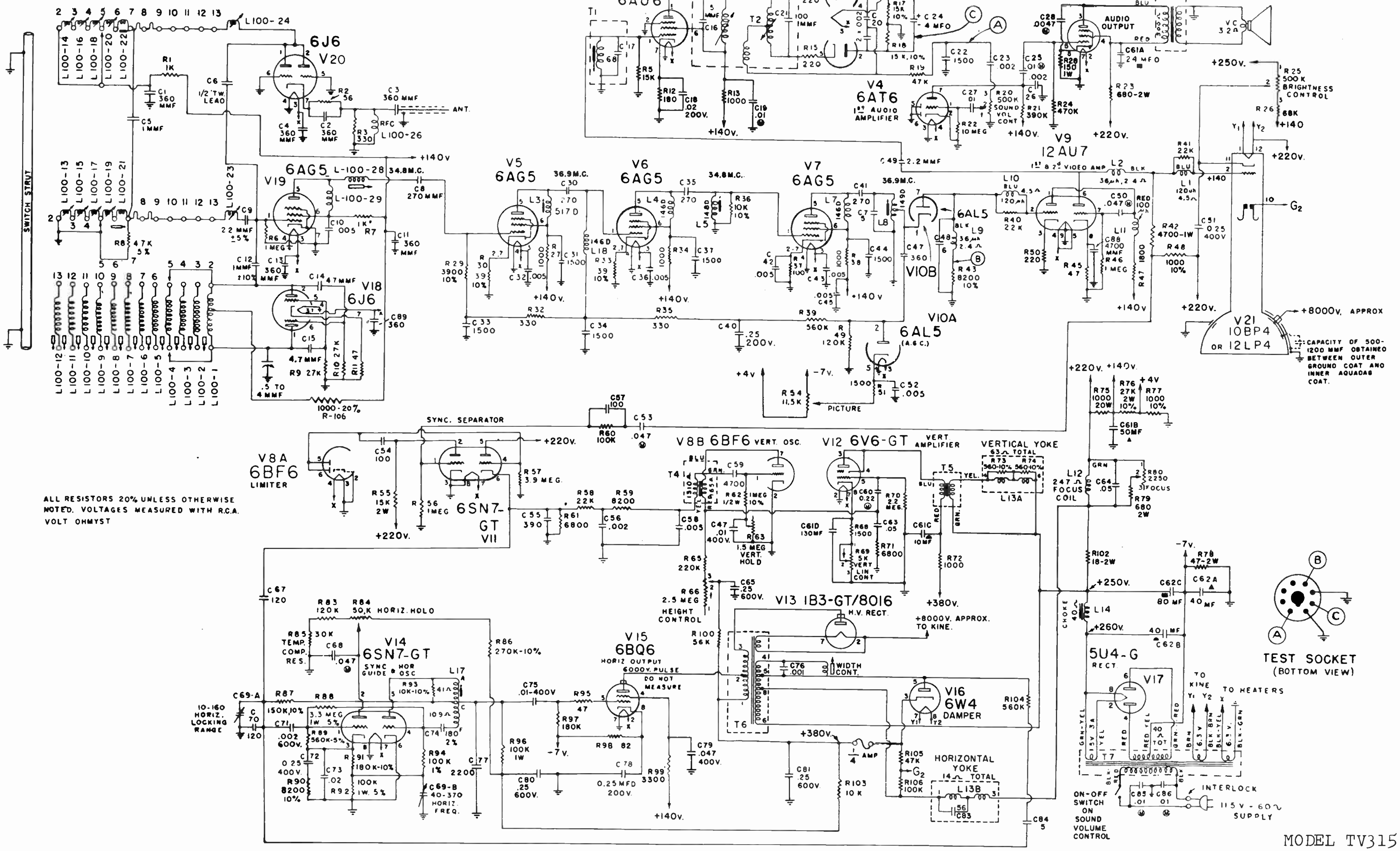
V1- 4.5 M.C. AMPLIFIER
V2- RATIO-DETECTOR
V3- AUDIO OUTPUT
V4- 1st AUDIO AMPLIFIER
V5- 1st VIDEO I.F.
V6- 2nd VIDEO I.F.
V7- 3rd VIDEO I.F.
V8- SYNC. LIMITER & VERT. OSC.
V9- 1st & 2nd VIDEO AMPLIFIER
V10- DETECTOR & A.G.C.
V11- SYNC SEPARATOR
V12- VERT. AMPLIFIER
V13- HIGH VOLTAGE RECTIFIER
V14- HOR. OSCILLATOR & SYNC. GUIDE
V15- HORIZONTAL OUTPUT
V16- DAMPER
V17- LOW VOLTAGE RECTIFIER
V18- R.F. OSCILLATOR
V19- MIXER
V20- R.F. AMPLIFIER
V21- PICTURE TUBE



MODEL TV315, Ch. TAA, TAB

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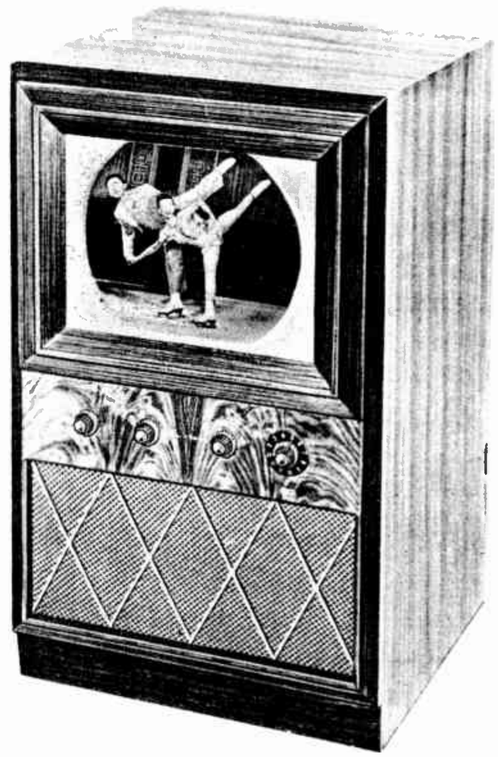
TV 306



TUBE COMPLEMENT

1.	6J6	V20	RF Amplifier
2.	6AG5	V19	Mixer
3.	6J6	V18	RF Oscillator
4.	6AG5	V5	1st Video IF Amplifier
5.	6AG5	V6	2nd Video IF Amplifier
6.	6AG5	V7	3rd Video IF Amplifier
7.	6AL5	V10-A	Video Detector
		V10-B	A.G.C.
8.	12AU7	V9	1st and 2nd Video Amplifier
9.	6AU6	V1	4.5 Mc. Amplifier
10.	6AL5	V2	Ratio Detector
11.	6AT6	V4	1st Audio Amplifier
12.	6K6	V3	Audio Output
13.	6SN7	V11	Sync Separator
14.	6BF6	V8-A	Limiter
		V8-B	Vertical Sweep Oscillator
15.	6V6	V12	Vertical Sweep Amplifier
16.	6SN7	V14	Horizontal Sweep Oscillator and Sync Guide
17.	6BG6	V15	Horizontal Sweep Output
18.	6W4	V16	Damper
19.	1B3	V13	High Voltage Rectifier
20.	5U4	V17	Power Rectifier
21.	16TP4	V21	Picture Tube TV 306
	16HP4	V21	Picture Tube TV 307

SPECIFICATIONS

POWER SUPPLY
105 to 125 Volts — 60 Cycle AC

POWER CONSUMPTION
220 Watts

POWER OUTPUT (AUDIO)
2 Watts (undistorted)

INPUT IMPEDANCE
72 Ohms

PICTURE TUBE SIZE
TV 306 — 16" Rectangular
TV 307 — 16" Round

SHIPPING WEIGHT
TV 306 — App. 92 Lbs.
TV 307 — App. 130 Lbs.

SPEAKER
TV 306 — 4" x 6" PM OVAL
TV 307 — 10" PM

DIMENSIONS
TV 306 — 18¼" Deep x 23" Wide x 18¼" High
TV 307 — 21½" Deep x 24" Wide x 40½" High

FREQUENCY CHART

IF FREQ. — SOUND — 32.8 MC PICTURE — 37.3 MC

CHANNEL	FREQUENCY	PICTURE FREQUENCY	SOUND FREQUENCY	RF OSCILLATOR FREQUENCY
2	54-60	55.25	59.75	92.55
3	60-66	61.25	65.75	98.55
4	66-72	67.25	71.75	104.55
5	76-82	77.25	81.75	114.55
6	82-88	83.25	87.75	120.55
7	174-180	175.25	179.75	212.55
8	180-186	181.25	185.75	218.55
9	186-192	187.25	191.75	224.55
10	192-198	193.25	197.75	230.55
11	198-204	199.25	203.75	236.55
12	204-210	205.25	209.75	242.55
13	210-216	211.25	215.75	248.55

INSTALLATION

WARNING

This Receiver is designed for use on 105 to 125 Volt 60 Cycle AC only. Do NOT connect to Direct Current (DC) power supply. If in doubt check with your local Power Supply Company.

TELE-TONE BUILT-IN ANTENNA

Models TV 306 and 307 are equipped with the Teletone Automatic Built-in Antenna. The efficiency of this antenna is very high and normally will perform as well as or better than most indoor antennas. It consists of two concentric circular antennas and an auxiliary counterpoise type antenna. The circular antennas are mounted on the inside top of the cabinet while the auxiliary is found on the back cover. Electrically the Teletone Automatic Built-in Antenna functions as a double dipole. The auxiliary aids reception on the lower channels. If the area or location in which the receiver is installed precludes the use of an indoor type antenna the Built-in antenna should be disconnected by loosening the two screws on the antenna terminal on the back of the set and removing the black and red leads connected thereto. A regular outdoor installation should be made and the lead-in connected to the same two screws on the antenna terminal strip.

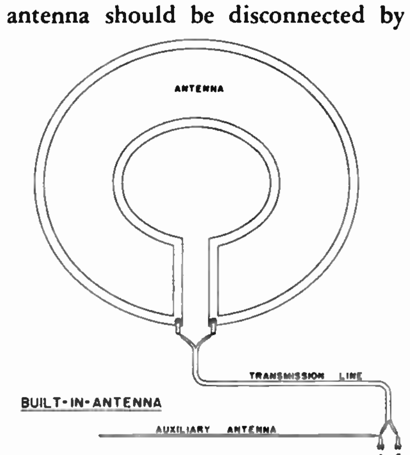


FIG. 1

OUTDOOR ANTENNA

In areas where both high band and low band reception is available, antennas may be used in the form of a stacked array. Where a stacked array is used, it may prove advantageous in some locations to connect separate down leads from each antenna and connect a suitable switch at the receiver as shown in figure 2A.

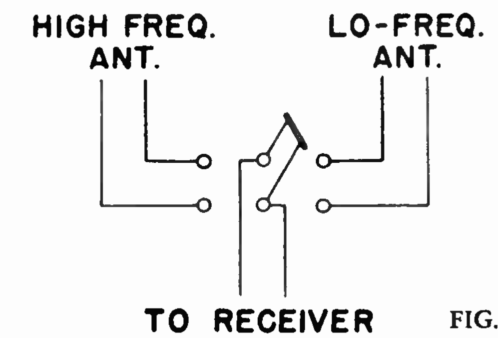


FIG. 2A

TRANSMISSION LINE

In non-critical locations, satisfactory results may be obtained with a 300 ohm down lead connected directly to the receiver antenna terminals. In more critical locations (insufficient signal) increased pick-up may be obtained by using the 300 ohm down lead in conjunction with a suitable matching transformer at the receiver. (See figure 2B). In unusually noisy locations considerably improved performance may be obtained by the use of 72 ohm co-axial transmission line.

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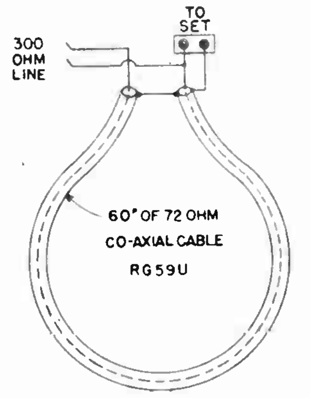

FIG. 2B ANTENNA MATCHING TRANSFORMER

NOTE: — When using 72 ohm co-axial down lead, it is important that its outer lead be connected to the shield side of the receiver transmission line. Check antenna terminal connections to determine shield side.

CONTROL FUNCTIONS

RECEIVER FRONT PANEL CONTROLS

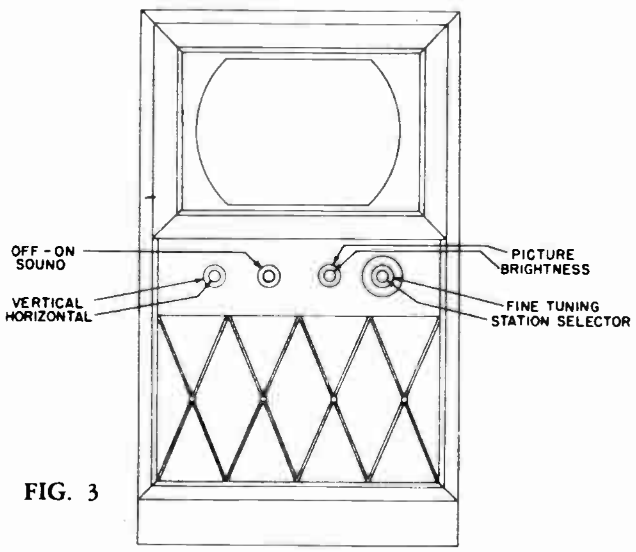

FIG. 3

VOLUME — ON-OFF — The volume control is an audio control only and has no effect on the picture. It is connected in the grid circuit of the audio amplifier (V-4). The power on and off switch is combined with the volume control.

HORIZONTAL HOLD — The Horizontal Sweep Oscillator uses Automatic Frequency control. As a result the Horizontal Hold Control will only be used if the picture should resolve into a series of heavy, oblique, black and white lines. A fast twist of the knob will then cause the picture to correct itself.

VERTICAL HOLD — The vertical hold control is not a critical control. This control is in the grid circuit of the first half of the vertical oscillator (V-8B).

PICTURE — Controls video gain through the AGC diode cathode (V-10A). It should be remembered that this receiver uses AGC and therefore will rarely overload despite contrast setting.

BRIGHTNESS — This control operates by varying the DC potential on the cathode of the Kinescope (V-21).

STATION SELECTOR — The inner (bar) knob of this control will operate the station selector. The outer (circular) knob will activate the Fine Tuning control, a corrector for the R.F. Oscillator.

RECEIVER REAR CHASSIS CONTROLS

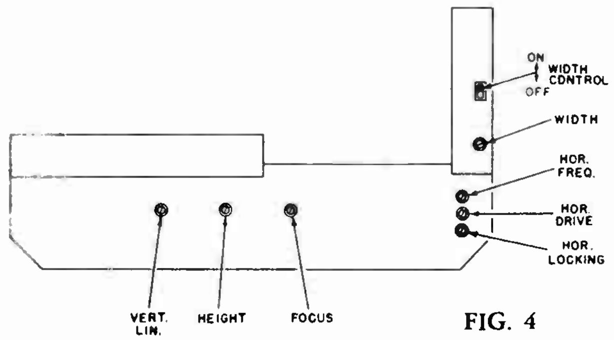

FIG. 4

WIDTH — The Horizontal Sweep is determined by the current flowing through the Horizontal Yoke Coil. The current through this coil (L13B) is controlled by Width Control (L15) which is a variable reactor having the effect of changing the turns ratio of this winding of the Horizontal Output and H.V. Transformer (T6).

HEIGHT — This control is a voltage dropping rheostat operating in the plate circuit of the Vertical Sweep Oscillator (V8B). It changes the voltage delivered to (V-12) Vertical Amplifier feeding current to transformer coupled Vertical Yoke Coil (L13A). Since changes in height will affect picture linearity, this Height Control must be adjusted in conjunction with Vertical Linearity Control.

VERTICAL LINEARITY CONTROL — This is a variable resistor control (R69) in the cathode of (V-12) which provides inverse feedback variation affecting the linearity of the Vertical Sweep Wave form. To be adjusted as height control is adjusted.

FOCUS CONTROL — This is a Variable Resistor (R80) which varies the current through focus coil (L-12).

HORIZONTAL AND VERTICAL CENTERING — Centering of the picture area is accomplished in this receiver by finding that position for the focus coil in the horizontal and vertical planes that produces this result. The focus coil bracket is adjusted so that if the four hexagon-head screws are loosened it can be shifted up and down and from side to side enabling the centering position to be found by trial.

BRIEF CIRCUIT ANALYSIS

The Tele-tone Television receivers Models, TV 300, 301, 304 and 305 use the Intercarrier sound systems. In this system the RF section of the receiver receives both the picture and the sound carriers which are converted by the mixer (V19) and then fed into the IF. No separation takes place until after the Video Amplifier (V9). At this point the sound component of the dual signal is picked off by the 4.5 trap (T1) and fed through the Ratio Detector, the sound Amplifier and the Audio output stages. The Picture IF frequency is 37.3 Mc and the Sound IF is 32.8. For individual stage frequencies see "Video IF Alignment". (Page 7).

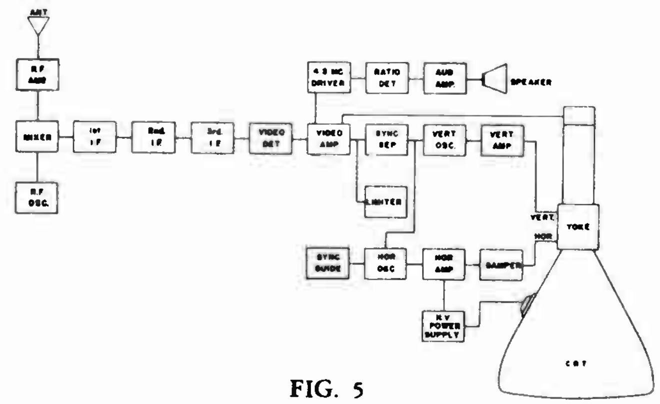

FIG. 5

TUNER — In the initial runs of this model a 12 coil tuner, much the same as previous Tele-tone tuners is used. In later runs a new type 7 coil tuner is employed. The terms "12 coil" and "7 coil" refer to the variable oscillator coils only. The RF and Mixer sections remain essentially the same.

RF AMPLIFIER — The antenna is fed between cathode and grid of the grounded grid RF amplifier (V-20). The input circuits of which are untuned. Double tuned interstage coupling is used between the plate of the RF Amplifier (V-20) and the grid of the mixer (V-19). Mechanically, the series inductances used take the form of several individual coils which are cut in or out of their respective circuits by means of the band switch. These coils will rarely need adjustment.

MIXER — The output of the RF Amplifier (V-20) and the Local Oscillator are condenser fed into the Control Grid Mixer Stage (V-19). This circuit is tuned in much the same manner as the output of the RF Amplifier, previously described.

OSCILLATOR—12 COIL TUNER—The RF Oscillator (V-18) is fairly straight-forward in operation. Its main peculiarity is that the coil for Channel 2 is permanently parallel to all other Oscillator coils from 3 to 13. It is therefore necessary, when aligning the oscillators to ALIGN CHANNEL 2 FIRST and the rest of the coils in any order thereafter. They are tuned by brass slugs accessible through two slots in the front of the receiver chassis. Channel 2 is found at the top of the right hand slot and the others follow in regular order in a clockwise direction finishing with Channel 13 at the top of the left hand slot.

OSCILLATOR—7 COIL TUNER—As stated above, in later runs of these models a new type, 7 coil tuner is employed. In these tuners the only change is in the arrangement of the Oscillator coils. Where, previously, 12 individual coils were used (one for each channel) 7 coils are now substituted. The coils for Channels 2 and 13 will remain substantially as before. The other channels will be paired with one variable and two small fixed coils, as shown in Fig. 6B. Typically, channels 3 and 4 have only one adjustment. This adjustment may be made on either station and the other will be found to be properly tuned. Any slight variations will be more than compensated for by the fine tuner. A study of Fig. 6B will show that, as previously, channel two must be tuned first, if at all, and the remaining channels in any order thereafter. The seven adjustments are for the following groups of channels; — Channel 2 — Channels 3 and 4 — Channels 5 and 6 — Channels 7 and 8 — Channels 9 and 10 — Channels 11 and 12 — Channel 13.

NOTE: The channel numbers on the escutcheon do not correspond to the location of the oscillator coils.

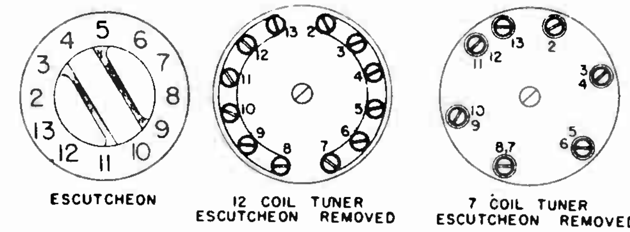

FIG. 6A

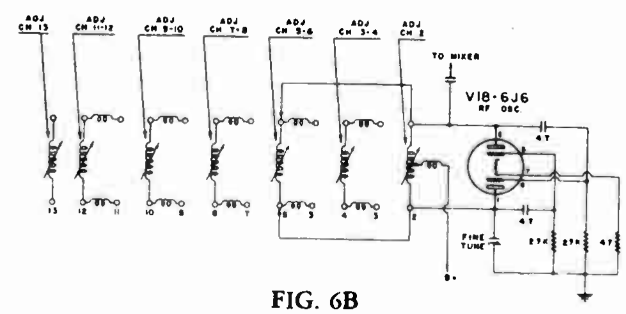

FIG. 6B

VIDEO IF — Each Video IF transformer has only one adjustment, a powdered iron slug accessible from the top of the chassis. The Video IF String is stagger tuned to two frequencies. The first and third IF transformers are tuned to 34.8 Megacycles and the second and fourth are tuned to 36.9 Megacycles. The response curve is fairly flat topped and should produce a picture with good definition.

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VIDEO AMPLIFIERS — FIRST AND SECOND — A 12AU7 (V-9), dual triode is used in this section of the receiver. The output of the detector is fed to the grid of the first section (pin 2) and ultimately taken off plate of the second section of the tube (pin 6). It is at this point the three basic components of the received signal are separated and fed to their respective circuits. The picture intelligence is fed to the grid of the Picture Tube (V-21) and the synchronization pulses to the grid (pin 1) of the Sync Separator (V-11) and from there to the Horizontal (V-14) and Vertical oscillators (V-8B), also see "Sound System" below.

D. C. COMPONENTS — The D.C. component of the transmitted signal (which controls the background brightness) is substantially duplicated in the receiver by direct coupling from the plate of the second video amplifier to the Picture Tube grid.

SOUND SYSTEM — The sound Carrier is taken off the plate of the Video Amplifier (V-9) by a 4.5 Megacycle trap and fed through a 4.5 MC Amplifier (V-1) to the Ratio Detector (V-2), and then to the sound amplifier (V-4), audio output (V-3) and speaker.

SWEEP SYSTEM — VERTICAL — The triode section of a 6BF6 (V8B) serves as the Vertical oscillator and discharge tube. A 6V6 (V12) is utilized as the Vertical Sweep Amplifier. The plate circuit of the 6V6 (V12) is transformer coupled to the vertical windings of the Deflection Yoke (L13-A).

SWEEP SYSTEM — HORIZONTAL — The Horizontal Oscillator is essentially of the Blocking Oscillator type. The operation of the AFC system depends upon a correcting voltage developed in the control tube when the oscillator output and the incoming pulses differ in either phase or frequency. The control tube, first section (V-14), is maintained at cut-off until such time as the sync pulse is either ahead of or behind the oscillator, (second section V-14), sawtooth peak. When either case occurs the control tube develops a voltage which is applied as a bias to the oscillator grid and alters the oscillator frequency to coincide with the frequency of the incoming pulses. The horizontal oscillator transformer has an adjustable core which is a coarse control of the oscillator frequency. The Horizontal Frequency Control (rear) is a fine adjustment in the same sense. The front panel Horizontal Hold Control permits slight adjustment of the frequency by adjusting the B voltage applied to the control tube plate. The Horizontal Locking Range Control affects the sensitivity of the control tube thus varying the range over which the AFC circuit will function.

NOTE: Many of the components in the Horizontal circuits are of the critical value and therefore should only be replaced by the exact replacement part. Care should also be taken in dressing leads and parts when replaced. This can be accomplished by carefully noting parts positions before removal. For complete alignment procedure on these circuits see page (9).

A.G.C. — The receiver uses an AGC circuit operating on the first 2 IF stages (V-5) (V-6). While it is quite effective in most locations, the receiver may overload in regions of very high field intensity. The contrast can generally be adjusted for a normal picture under such conditions but spurious beats, jagged vertical lines (i.e. poor resolution) and a "Moire" pattern may appear. These effects can be eliminated by the use of a resistor network of 3 to 10 db attenuation in series with the antenna lead at the point where it is connected to the receiver.

HIGH VOLTAGE POWER SUPPLY — The energy stored in the horizontal windings of the deflection yoke during the forward sweep produces high voltage surges during retrace. This is "stepped up" by the "auto-transformer" winding of the horizontal output transformer (T-6) and then rectified by a 1B3/8016 (V-13) to provide approximately 12,000 volts for the picture tube (V-21) anode.*

B VOLTAGE POWER SUPPLY — The B Supply of these models utilizes a standard type of transformer-rectifier circuit. It should be noted that the transformer contains a separate filament winding (6.3 volts) to heat the Cathode Ray Tube (V21) and the Damper (V16). The use of a center-grounded bleeder network provides a B Supply with the following voltages measured with respect to ground; plus 235 volts, plus 140 volts, plus 4 volts, minus 3.5 volts, minus 14 volts, and minus 90 volts.

ALIGNMENT PROCEDURE

The alignment of this Receiver can be broken down into three basic parts: 1 — Video IF Alignment 2 — RF Alignment 3 — Sound Alignment

TEST EQUIPMENT

CATHODE RAY OSCILLOSCOPE — The tube size is relatively unimportant, however, anything under 5" usually makes fine adjustment quite difficult.

SWEEP GENERATOR — The sweep generator used should have linear coverage of a center range from 30 to 220 megacycles. The output should be fairly flat over wide frequency variation of the sweep. It should be capable of an output of about 0.1 volt with attenuation. It is preferable that the generator have a deflection output for the test oscilloscope.

AM SIGNAL GENERATOR — This generator should have a frequency range of from 4.5 to 220 megacycles. As this generator is used occasionally as a marker generator, accuracy is an important factor. It should be capable of 0.1 volt output with attenuation and should be linear through the range.

VACUUM TUBE VOLTMETER — Almost any standard make VTVM will do. It should preferably have a reversible polarity switch.

*11,500V in the TV 307

TEST SOCKET

In each of these models a Test Socket is provided which gives convenient access to the various points where either a vacuum tube voltmeter or an oscilloscope must be inserted for proper alignment. A letter diagram in the margin of the schematic will locate these points by means of corresponding letters in the schematic proper. A typical Octal socket is used and it should be noted that the diagram shows an UNDERSIDE VIEW. Two ground points are supplied on separate pins of the test socket for easy metering. Reference is made, in the following Alignment Procedures, to the pins on this Test Socket.

VIDEO IF ALIGNMENT

An adequate signal can be fed through the video IF string by feeding the output of the signal generator into a tube shield placed over the mixer tube (6AG5) (V-19). Care should be taken that this shield is NOT grounded. The ground side of the generator output can be conveniently grounded to the shield of the adjacent oscillator tube.

The contrast control should be set to produce minus 2 volts on Pin 7 6AL5-AGC tube. (V-10A).

The vacuum tube voltmeter should be connected across the 8200 ohm detector load resistor (Pin B Test Socket) and should be set on the minus 3 Volt scale. Set channel selector to an unused low band channel.

The Signal generator should be set to a frequency of 34.8 Mc. The output of the generator should be adjusted to the point where the reading on the VTVM is between minus 1 to minus 1.5 volts.

The First and Third I.F. coils should be peaked for a maximum reading on the VTVM. As the voltage reading increases with tuning, the generator should be attenuated to maintain a maximum of minus 1.5 volts.

Set the Signal Generator to a Frequency of 36.9 Mc and tune the Second and Fourth I.F. coils in the same manner as above.

The Generator should now be shut off (or tuned to different band) and the VTVM should read no more than minus 0.20 volts. If there is a higher voltage reading, check for regeneration in the I.F. stages.

By shunting the signal generator with a sweep generator (30 to 40 Mc) and substituting a Cathode Ray Oscilloscope for the Vacuum tube Voltmeter in the above procedure the actual pass band of the Video I.F. circuits may be studied. Ideally the response curve should appear on the face of the oscilloscope in the form indicated in Figure (7). A slight slope of the top of the curve in either direction or a small dip in the center are acceptable.

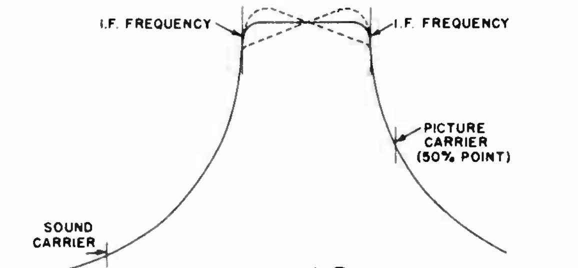

FIG. 7

RF ALIGNMENT

In the alignment of the RF section of this receiver three pieces of test equipment are necessary. A sweep generator, a signal generator and a cathode Ray Oscilloscope. For specifications see "Test Equipment" above.

The output of the Sweep Generator should be fed into the antenna. The signal generator (C.W.) should be connected to the antenna terminals of the receiver. The sweeper will provide the overall response curve with the oscilloscope properly connected. The signal generator is used as a marker as described below. Some Sweep generators made today contain their own marker oscillator. In cases where a generator of this type is used the Signal Generator may be eliminated.

The "hot" or "high" side of the Oscilloscope input should be connected to the junction point of the 8200 ohm detector load resistor and the peaking coil. (Pin B Test Socket). The "low" or ground side should be connected to the nearest convenient ground point. Care should be taken that the generator and the scope leads are well separated to avoid regeneration.

The R.F. section of the receiver is tuned channel by channel. The proper frequency settings for any given channel can be determined by consulting the Frequency Chart on Page (2). For example in aligning channel 2 the sweep generator should be set to some mid frequency between 54 and 60 megacycles. This adjustment is not a fine one. After setting the sweeper in the general vicinity of the desired frequency it should be tuned to center the response curve on the Oscilloscope face. For picture and sound markers the signal generator should carefully be adjusted to the frequencies indicated in the Frequency chart. For example in the case of channel 2 the picture marker frequency is 55.25 Mc. and the Sound 59.75 Mc.

It is important to note at this point that the oscillator coil for channel 2 is in parallel with every other oscillator coil from 3 to 13. It is therefor imperative that channel 2 be aligned first and the others in any desired order thereafter.

Starting with channel 2 and applying the proper frequencies as indicated above, the output of the sweeper should be attenuated to the point where further attenuation will not affect the wave shape.

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The Oscillator should then be adjusted to bring the sound carrier into the 32.8 Mc trap valley. With the oscillator so adjusted the picture carrier should fall at a point approximately 50% up on the slope of the opposite side of the band pass curve. Certain variations in the waveshape and the location of the picture carrier are acceptable. The picture carrier may vary in position from a point between 45% and 60% of the slope and the overall waveshape may differ from the ideal, flat-topped response by being either slightly rounded or slightly dipped in the center. See Figure (8).

If the position of the picture carrier varies beyond the 45% to 60% points on all channels correction may be made by turning to channel 6, applying the proper input signals and slightly realigning the I.F. transformers.

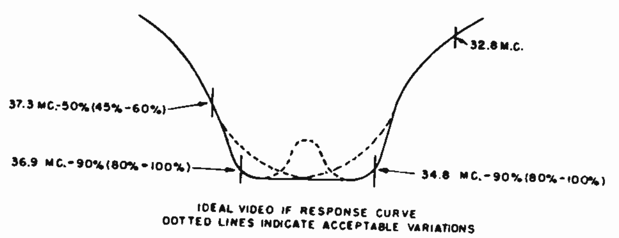

FIG. 8

SOUND ALIGNMENT

Sound alignment on these receivers is best accomplished by using an actual transmission received on an antenna and fed in the normal manner to the antenna terminals. A Vacuum Tube Voltmeter should first be inserted between the output plate of the Ratio Detector Diode (pin 2 V2) and ground. This point may be reached through pin C of the Test Socket. The meter should be set on the *minus* 10 volt scale. With the equipment so placed the 4.5 Mc trap (T1) and the primary of the Ratio Detector Transformer (bottom adjustment, T2) should be adjusted for a maximum deflection of the meter. The hot lead of the meter should now be moved to the junction point of R19, C22 and C23 (Pin A Test Socket), and the secondary of the Ratio Detector Transformer should be adjusted for a *ZERO* reading. (Note: There are 3 points at which the meter will zero. Only one of these is correct. At the proper setting the meter should swing negative on one side and positive on the other side of zero). In cases where it is necessary to align the sound section when no station transmission is available a Single frequency signal generator tuned to 4.5 megacycles may be fed into the output circuit of the Video Detector (Pin B Test Socket). The receiver should then be aligned in the same manner as described above. The disadvantage of this method is that any inaccuracy in your signal generator will show up as misalignment when the set is in actual operation, since proper adjustment is very critical.

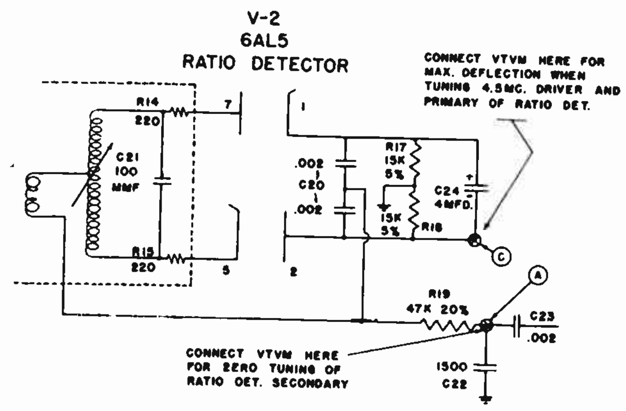

FIG. 9A

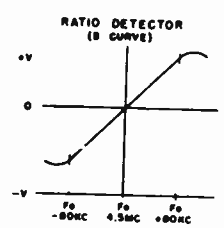

FIG. 9B

PICTURE ADJUSTMENTS

ION TRAP, FOCUS AND YOKE

To properly adjust the Ion Trap, Focusing coil and the Deflection Yoke the following procedure should be followed.

The Deflection Yoke should be placed in position closest to the "bell" of the Picture Tube as far forward on the neck of the tube as is possible. Be sure the wire loops on the mounting make positive contact with the coating of the picture tube. The Focus Coil is next in line and the Ion Trap last.

Turn the set on. The antenna should NOT be connected to the receiver and the picture contrast control should be set at MINIMUM.

With the brilliance control set at about one-quarter turn back from maximum, the Ion trap should be adjusted to achieve the brightest raster on the face of the Picture Tube. Trap should be simultaneously rotated and moved back and forth on the neck of tube until exact setting is obtained.

Adjust the brilliance control to a point slightly over normal brightness and adjust the Focus Control on the rear of the chassis for clearest and sharpest horizontal sweep lines. The Ion Trap should then be readjusted slightly for the brightest response on the face of the tube at which good focus is maintained.

The focus Coil itself should be moved to secure a complete raster, approximately centered and with no corners cut off.

Finally the Deflection Yoke should be rotated to "square" the raster with the chassis as a reference. The thumb screws on the yoke brackets should then be set.

HORIZONTAL OSCILLATOR ALIGNMENT

To adjust the Horizontal oscillator and its control circuits it is necessary to first connect a working antenna to the receiver. It is preferable to use a test pattern as the incoming signal rather than a picture.

With the receiver turned on and the brightness and the picture contrast controls adjusted to a normal position the Horizontal Frequency trimmer and the Horizontal Locking trimmer (rear of chassis) should be turned clockwise all the way and then backed off to about one turn (counter-clockwise).

The Horizontal Hold Control (front panel) should be turned to a maximum clockwise position.

The core of the Horizontal Oscillator Transformer should then be adjusted. Variation of this core will cause the pattern to resolve into a series of black and white bars sloping either to the right or the left depending upon the degree of adjustment. The transformer should be adjusted to the point where the picture resolves into a series of from 3½ to 4½ bars sloping downwards to the right.

The Horizontal Hold Control (front panel) should now be rotated to a full counter-clockwise position and the incoming signal momentarily interrupted. This can be done most easily by shorting the antenna terminals for a moment.

The Horizontal Hold Control (front panel) should now be rotated slowly in a clockwise direction. As the control is turned the number of bars sloping downward to the left should decrease. At approximately 90 degrees of rotation there should remain, between 3½ and 4½ bars just prior to the time that the picture "falls into" sync. The picture should remain in sync for an additional 90 degrees of rotation. If MORE than 4½ bars are evident just before the picture syncs the Horizontal Locking Range trimmer (rear of Chassis) should be tightened slightly. If LESS than 3½ bars the same trimmer should be loosened.

HEIGHT, WIDTH AND LINEARITY

To adjust the overall size and linearity of the picture it is almost mandatory that a pattern transmitted from a local station be used. Linearity adjustments, particularly, cannot be accurately made on moving transmissions. It should also be remembered that in areas where more than one station is being received, that pictures transmitted from different stations will vary slightly in size. The smallest transmitted picture should be made to fill the area delineated by the mask.

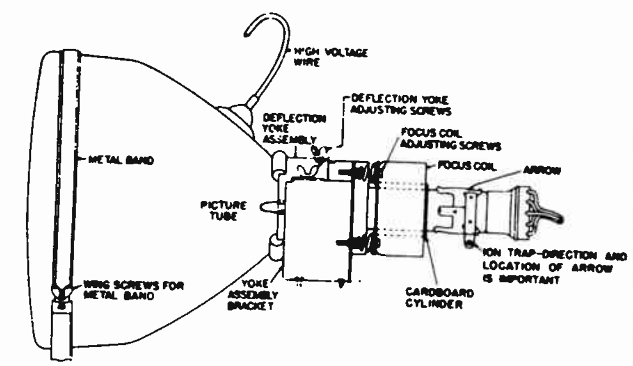

FIG. 10

The first step in linearity and size adjustment is to turn the Width control (rear of chassis Figure 4) all the way in (clockwise).

The Horizontal Drive trimmer should then be adjusted for the best compromise between maximum brightness and good horizontal linearity. This control will affect the left side of the picture primarily. The Horizontal Linearity control (top rear of chassis) should then be adjusted for linearity of the right side of the picture.

The Width Control should now be readjusted to achieve a picture that will fill the mask horizontally. If necessary the width coil may be removed entirely by use of a switch on rear of chassis.

The Height and Vertical Linearity controls (both rear of chassis) should then be adjusted for a linear picture that will fill the mask vertically.

Picture centering is accomplished by positioning focus coil mechanically by means of 4 hexagon-head adjusting screws accessible from rear of chassis as shown in Figure (10). At this point the Focus control, previously set, should be retouched for maximum definition of the lines in the vertical wedge of the test pattern. Proper adjustment and alignment of the receiver should result in clear and sharp definition.

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RESISTANCE CHECK CHART TV 306 - 307

Function	Tube	Model	1	2	3	4	5	6	7	8	9
1st IF	6AG5	306	700K	39	FIL	FIL	10K	10K	39		
		307	700K	39	FIL	FIL	10K	10K	39		
2nd IF	6AG5	306	700K	39	FIL	FIL	10K	10K	39		
		307	700K	39	FIL	FIL	10K	10K	39		
3rd IF	6AG5	306	0	100	FIL	FIL	10K	10K	100		
		307	0	100	FIL	FIL	10K	10K	100		
Vid. Det.	6AL5	306	0	150K	FIL	FIL	4K		8K		
		307	0	150K	FIL	FIL	4K		8K		
Vid. Amp.	12AU7	306	12K	1 Meg	0	FIL	FIL		1 Meg	47	FIL
		307	12K	1 Meg	0	FIL	FIL		1 Meg	1K	FIL
4.5 Amp.	6AU6	306	1.5	0	FIL	FIL	10K	10K	100		
		307	1.5	0	FIL	FIL	10K	10K	100		
Rat. Det.	6AL5	306	15K	15K	FIL	FIL	INF	0	INF		
		307	15K	15K	FIL	FIL	INF	0	INF		
Aud. Amp.	6AT6	306	10 Meg	0	FIL	FIL	0	0	350K		
		307	10 Meg	0	FIL	FIL	0	0	350K		
Aud. Out.	6K6	306		FIL	10K	10K	470K		FIL	0	
		307		FIL	10K	10K	470K		FIL	0	
Sync Sep.	6SN7	306	1 Meg	20K	0	3.9 Meg	9K	7K	FIL	FIL	
		307	1 Meg	20K	0	3.9 Meg	9K	7K	FIL	FIL	
V. Osc.	6BF6	306	1.5 Meg	0	FIL	FIL	4 Meg	4 Meg	1.5 Meg		
		307	1.5 Meg	0	FIL	FIL	4 Meg	4 Meg	1.5 Meg		
V. Amp.	6V6	306		FIL	10K	10K	2.2 Meg		FIL	3.5K	
		307		FIL	10.5K	10.5K	2.2 Meg		FIL	3.5K	
H. Osc.	6SN7	306	500K	130K	250K	180K	400K	700	FIL	FIL	
		307	500K	130K	250K	180K	400K	700	FIL	FIL	
H. Amp.	6BG6	306		FIL	850		1 Meg		FIL	10K	
		307		FIL	850		1 Meg		FIL	90K*	
Damper	6W4	306			150K		10K		8K	8K	
		307			300K		10K		8K	8K	
Rect.	5U4	306		10K		750		750		10K	
		307		10K		750		750		10K	

* Will be infinity if 68K is left out from Pin 5 Damper.

Conditions:
1. All readings taken with RCA Volt Ohmist.
2. All controls at "Normal Setting"
3. Switch off - line cord disconnected.

VOLTAGE CHECK CHART TV 306-307

Function	Tube	Model	1	2	3	4	5	6	7	8	9
1st IF	6AG5	306	-4.5*	0	FIL	FIL	140	140	0		
		307	-4.5*	0	FIL	FIL	140	140	0		
2nd IF	6AG5	306	-4.5*	0	FIL	FIL	140	140	0		
		307	-4.5*	0	FIL	FIL	140	140	0		
3rd IF	6AG5	306	0	1	FIL	FIL	125	125	1		
		307	0	1	FIL	FIL	125	125	1		
Vid. Det.	6AL5	306	0	-4.5*	FIL	FIL	2*		-2		
		307	0	-4.5*	FIL	FIL	2*		-2		
Vid. Amp.	12AU7	306	120	-3.5	0	FIL	FIL	210	-7.5	4	FIL
		307	120	-3.5	0	FIL	FIL	95	-100	-100	FIL
4.5 Amp.	6AU6	306	0	0	FIL	FIL	130	130	1		
		307	0	0	FIL	FIL	130	130	1		
Rat.Det.	6AL5	306	15	-15	FIL	FIL	-2.5		-2.5		
		307	15	-15	FIL	FIL	-2.5		-2.5		
Aud. Amp.	6AT6	306	-0.9	0	FIL	FIL	0	0	75		
		307	-0.9	0	FIL	FIL	0	0	75		
Aud. Out.	6K6	306		FIL	190	200	-14		FIL	0	
		307		FIL	190	200	-14		FIL	0	
Sync Sep.	6SN7	306	-3.5	150	0	-60	235	2.8	FIL	FIL	
		307	-3.5	150	0	-80	235	2.8	FIL	FIL	
Ver. Osc.	6BF6	306	-35+	0	FIL	FIL	-60	-60	150++		
		307	-35+	0	FIL	FIL	-60	-60	110++		
Ver. Out.	6V6	306		FIL	220	220	-80		FIL	-65	
		307		FIL	220	220	-80		FIL	-85	
Hor. Osc.	6SN7	306	-85	35**	-90	-180	140	-90	FIL	FIL	
		307	-85	35**	-90	-180	140	-90	FIL	FIL	
Hor. Out.	6BG6	306		FIL	-85		-110		FIL	235	
		307		FIL	-85		-110		FIL	235	
Damper	6W4	308			475		280		150	140	
		307			360		280		130	140	
Rect.	5U4	306		300		-85		-85		300	
		307		300		-85		-85		300	

Conditions:
1. Switch on - set connected to 117 Volt 60 cycle AC.
2. No antenna connected and set tuned to unused channel.
3. All controls at "Normal" setting.
4. Measurements taken with RCA Volt-Ohmist.

Notes:
- * Reading will vary with setting of Picture Control.
- ** Reading will vary with setting of Horizontal Hold Control.
- \+ Reading will vary with setting of Vertical Hold Control.
- ++ Reading will vary with setting of Height Control.

PART NUMBER	SCHEMATIC LOCATION	DESCRIPTION
		RESISTORS
TRC-33A-1	R 101	3.3 Ohm 1/2 Watt 20% - TV 307 Only
TRC-51A-1	R 16,101	5.1 Ohm 1/2 Watt 20%
TRC 330-5	R 77	33 Ohm 1 Watt 10%
TRC 390-2	R 30,33	39 Ohm 1/2 Watt 10%
TRC 470-1	R 45,95	47 Ohm 1/2 Watt 20%
TRC 820-4	R 98	82 Ohm 1 Watt 20%
TRC 820-8	R 78	82 Ohm 2 Watt 10%
TRC 101-1	R 12,37	100 Ohm 1/2 Watt 20%
TRC 221-1	R 14,15,76	220 Ohm 1/2 Watt 20%
TRC 331-1	R 32,35	330 Ohm 1/2 Watt 20%
TRC 331-7	R 79	330 Ohm 2 Watt 20% - TV 306 Only
TRC 561-2	R 73,74	560 Ohm 1/2 Watt 10% - TV 307 Only
TRC 681-7	R 79	680 Ohm 2 Watt 20% - TV 307 Only
TRC 102-1	R 13,27,34,38,72	1,000 Ohm 1/2 Watt 20%
TRC-102-2	R 48	1,000 Ohm 1/2 Watt 10%
TRC-102-4	R 23	1,000 Ohm 1 Watt 20%
TRC-152-1	R 51,68	1,500 Ohm 1/2 Watt 20%
TRC 332-1	R 71	3,300 Ohm 1/2 Watt 20%
TRC 332-5	R 42,47	3,300 Ohm 1 Watt 10%
TRC 392-2	R 29	3,900 Ohm 1/2 Watt 10%
TRC 472-5	R 64,99	4,700 Ohm 1 Watt 10% - TV 307 Only
TRC 682-1	R 61	6,800 Ohm 1/2 Watt 20%
TRC 822-1	R 59	8,200 Ohm 1/2 Watt 20%
TRC 822-2	R 43,90	8,200 Ohm 1/2 Watt 10%
TRC 103-1	R 103	10K Ohm 1/2 Watt 20%
TRC 103-2	R 36,93	10K Ohm 1/2 Watt 10%
TRC 153-2	R 17,18	15K Ohm 1/2 Watt 10%
TRC 153-4	R 55	15K Ohm 1 Watt 20%
TRC 223-1	R 40,41,58	22K Ohm 1/2 Watt 20%
TRC 303-12	R 85	30K Ohm Temperature Compensating
TRC 333-8	R 64,99	33K Ohm 2 Watt 10% TV 307 Only
TRC 473-1	R 19	47K Ohm 1/2 Watt 20%
TRC 563-1	R 100	56K Ohm 1/2 Watt 20%
TRC 683-7	R 67	68K Ohm 2 Watt 20% - TV 307 Only
TRC 104-1	R 26	100K Ohm 1/2 Watt 20% - TV307 Only
TRC 104-5	R 96	100K Ohm 1 Watt 10%
TRC 104-6	R 92	100K Ohm 1 Watt 5%
TRC 104-SP	R 94	100K Ohm 1/2 Watt 1%
TRC 124-1	R 49,83	120K Ohm 1/2 Watt 20%
TRC 154-2	R 87	150K Ohm 1/2 Watt 10%
TRC 184-2	R 91	180K Ohm 1/2 Watt 10%
TRC 224-1	R 65	220K Ohm 1/2 Watt 20%
TRC 274-5	R 86	270K Ohm 1 Watt 10%
TRC 334-1	R 21	330K Ohm 1/2 Watt 20%
TRC 474-1	R 24	470K Ohm 1/2 Watt 20%
TRC 564-1	R 39,104	560K Ohm 1/2 Watt 20%
TRC 564-3	R 89	560K Ohm 1/2 Watt 5%
TRC 105-1	R 44,46,56,97	1 Meg Ohm 1/2 Watt 20%
TRC 105-2	R 82	1 Meg Ohm 1/2 Watt 10%
TRC 105-4	R 101	1 Meg Ohm 1 Watt 20% TV 307 Only
TRC 225-1	R 70	2.2 Meg Ohm 1/2 Watt 10%
TRC 335-6	R 88	3.3 Meg Ohm 1 Watt 5%
TRC 395-1	R 57	3.9 Meg Ohm 1/2 Watt 20%
TRC 106-1	R 22	10 Meg Ohm 1/2 Watt 20%
TRP-16	Alt. R 99-84	16,500 Ohms 4 Watt - W.W. 10% TV 307 Only
TRP-17DA	R 75A	1,125 Ohms 9.8 Watt
	R 75C	8,200 Ohms 2.3 Watt
	R 75B	650 Ohms 10.1 Watt
		CONDENSERS
		Ceramic
TCC 1.5-8	C 38	1.5 MMF 500 Volt 10%
TCC 2.2-7	C 49	2.2 MMF 500 Volt 20%
TCC 050-8	C 7,16	5 MMF 500 Volt 10%
TCC 060-7	C 48	6 MMF 500 Volt 20%
TCC 030-8	C 39	30 MMF 500 Volt 10%
TCC 361-10	C 47	360 MMF 500 Volt GMV
TCC 501-4-SP-D	C 82	500 MMF 15K Volt
TCC 152-7	C 22	1500 MMF 500 Volt 20%
TCC 152-SP	C 31,33,34, 37,44	1500 MMF 500 Volt GMV
TCC 472-7	C 88	4700 MMF 500 Volt 20%
TCC 2-1	C 20	2000/2000 MMF Dual - Herlec
		TRIMMERS
TAS 501D	C 89A-B-C	Hor. Trimmers
		CONDENSERS
		Mica
TCM 050-20	C 84	5 MMF 1500 Volt 20%
TCM 058-14	C 83	56 MMF 1000 Volt 10% - TV 307 Only
TCM 101-7	C 21,54,76	100 MMF 500 Volt 20%
TCM 121-7	C 67,70	120 MMF 500 Volt 20%
TCM 181-29	C 74	180 MMF 1000 Volt 2% Silver
TCM 271-7	C 8,30,35,41	270 MMF 500 Volt 20%
TCM 391-7	C 55	390 MMF 500 Volt 20%
TCM 681-13	C 75	680 MMF 1000 Volt 20%
TCM 222-14	C 77	2200 MMF 1000 Volt 10%
TCM 472-8	C 59	4700 MMF 500 Volt 10%
		CONDENSERS
		Paper
TCPM 202-10	C 26	.0022 MFD 600 Volt Molded
TCP 202-10	C 23,56,71	.002 MFD 800 Volt
TCPM 502-10	C 28	.0047 MFD 600 Volt Molded
TCP 502-10	C 32,36,42,43, 45,52,58	.005 MFD 600 Volt
TCPM 103-4	C 19,25	.01 MFD 400 Volt Molded

PART NUMBER	SCHEMATIC LOCATION	DESCRIPTION
		CONDENSERS Paper (Continued)
TCPM 103-10	C 27	.01 MFD 600 Volt Molded
TCP 103-10	C 85,86	.01 MFD 600 Volt
TCP 203-1	C 18	.02 MFD 200 Volt
TCP 203-4	C 73	.02 MFD 400 Volt
TCP 353-10	C 80	.035 MFD 600 Volt Oil - TV 307 Only
TCP 353-13	C 80	.035 MFD 1000 Volt Oil - TV 306 Only
TCPM 503-10	C 50,53,68	.047 MFD 600 Volt Molded
TCP 503-10	C 46,63	.05 MFD 600 Volt
TCP 503-13	C 79	.05 MFD 1000 Volt Oil
TCP 104-13	C 81	.1 MFD 1000 Volt Oil
TCPM 254-4	C 60	.22 MFD 400 Volt Molded
TCP 254-1	C 40	.25 MFD 200 Volt
TCP 254-4	C 51,72	.25 MFD 400 Volt
TCP 254-4-SP	C 87	.25 MFD 400 Volt
TCP 254-10-SP	Instead of C 65A,C 61B	.25 MFD 1000 Volt Oil - TV 306 Only
		CONDENSERS Electrolytics
TCE 112 DA	C 29	24 MFD 350 Volt
TCE 113 DA	C 61A	80 MFD 450 Volt
	C 61B	10 MFD 475 Volt
TCE 115 DA	C 65A	10 MFD 475 Volt
	C 65B	30 MFD 400 Volt
	C 65C	30 MFD 300 Volt
TCE 116 DA	C 64A	40 MFD 450 Volt
	C 64B	10 MFD 400 Volt
TCE 117-DA	C 62A	40 MFD 450 Volt
	C 62B	40 MFD 150 Volt
	C 62C	130 MFD 50 Volt
TCE 104 D	C 24,78	4 MFD 25 Volt
		CONTROLS
TVC 504-1D	R 66	Height (2.5 Meg)
TVC 523-D	R 63,84	Vert. (1.5 Meg) & Hor. (50K) Hold
TVC 524-D	R 25,54	Brightness (500K) Picture (11.5K)
TVC 526-D	R 20	Volume (500K) with Switch
TVC 503-1D	R 69	Vertical Linearity (5K WW)
TVC 506-1D	R 80	Focus (2250 WW)
		COILS & TRANSFORMERS
TLF 551-D	L 100-28	1st I.F. Coil
TLF 517-D	L 3	2nd I.F. Coil
TLF 148-D	L 5	3rd I.F. Coil
TLF 149-D	L 8	4th I.F. Coil
TLF 146-D	L 4,7,18	I.F. Choke
TLF 502	L 10	Peaking Coil (120 u.h.)
TLF 503	L 2	Peaking Coil (36 u.h.)
TLF 519-D	L 11	Peaking Coil (100 u.h.)
TLF 114-D	T 1	4.5 Trap (Sound Take-off)
TLF 525-D	L 19	4.5 Rejection Trap
TLF 142-D	T 2	Ratio Detector Coil
TLF 506	L 16	Hor. Linearity Coil
TLF 553-D	L 15	Width Control Coil - TV 306
TLF 505-D	L 15	Width Control Coil - TV 307
TLF 522-D	L 12	Focus Coil
TLF 546-D		Ion Trap - TV 307 Only
TLF 554		Ion Trap - TV 306 Only
TTR 161-2-D	T 4	Vertical Osc. Trans.
TTR 157	L 17	Hor. Osc. - Sync Guide Trans.
TTR 106-2D	L 14	Filter Choke
TTR 158	L 6	Sound Trap
TTR 185-D	T 5	Vert. Output Trans.
TTR 188-D	T 7	Power Trans.
TTR 200-D	T 8	Hor. Output - HV Trans. - TV 306
TTR 190-D	T 6	Hor. Output - HV Trans. - TV 307
TTR 191-D	L 13A-B	Deflection Yoke - TV 307
TTR 201-D	L 13A-B	Deflection Yoke - TV 306
TTR 179-D	T 3	Audio Output Trans.
		HARDWARE
TTS-403		Speaker Connector - Male
TTS-404		Speaker Connector - Female
TSP-465		10" Speaker - TV-307
TSP-464		4" x 6" Speaker - TV-306
TLD-101-D		Interlock Cord
TPL-150		Interlock Plug
		CABINET & HARDWARE
		TV - 306
TCB-273-D		Cabinet
TGL-117-D		Safety Glass
TMP-186-D		Mask
TMS-121-R		Escutcheon
TSG-113-D		Spring
TKN-114-D		Outside Knob
TKN-115-D		Inside Knob
TKN-116-D		Dual Knob
TKN-117-D		Indicator Knob
TMS-520-D		Bottom Cover
TBK-177-D		Back
TBP-539-D		Built-in-Antenna
		TV - 307
TCB-274-DM		Cabinet - Mahogany
TCB-274-DW		Cabinet - Walnut
TGR-156-D		Grille Cloth - Mahogany
TGR-158-DA		Grille Cloth - Walnut
TMS-931-D		Mask
TMS-922-D		Metal Grille
TGL-110-D		Safety Glass
TMS-121-R		Escutcheon
TSG-113-D		Escutcheon Spring
TKN-114-D		Outside Knob
TKN-115-D		Inside Knob
TKN-118-D		Dual Knob
TKN-117-D		Indicator Knob
TMS-520-D		Bottom Cover
TBK-176-D		Back
TBP-539-D		Built-in-Antenna

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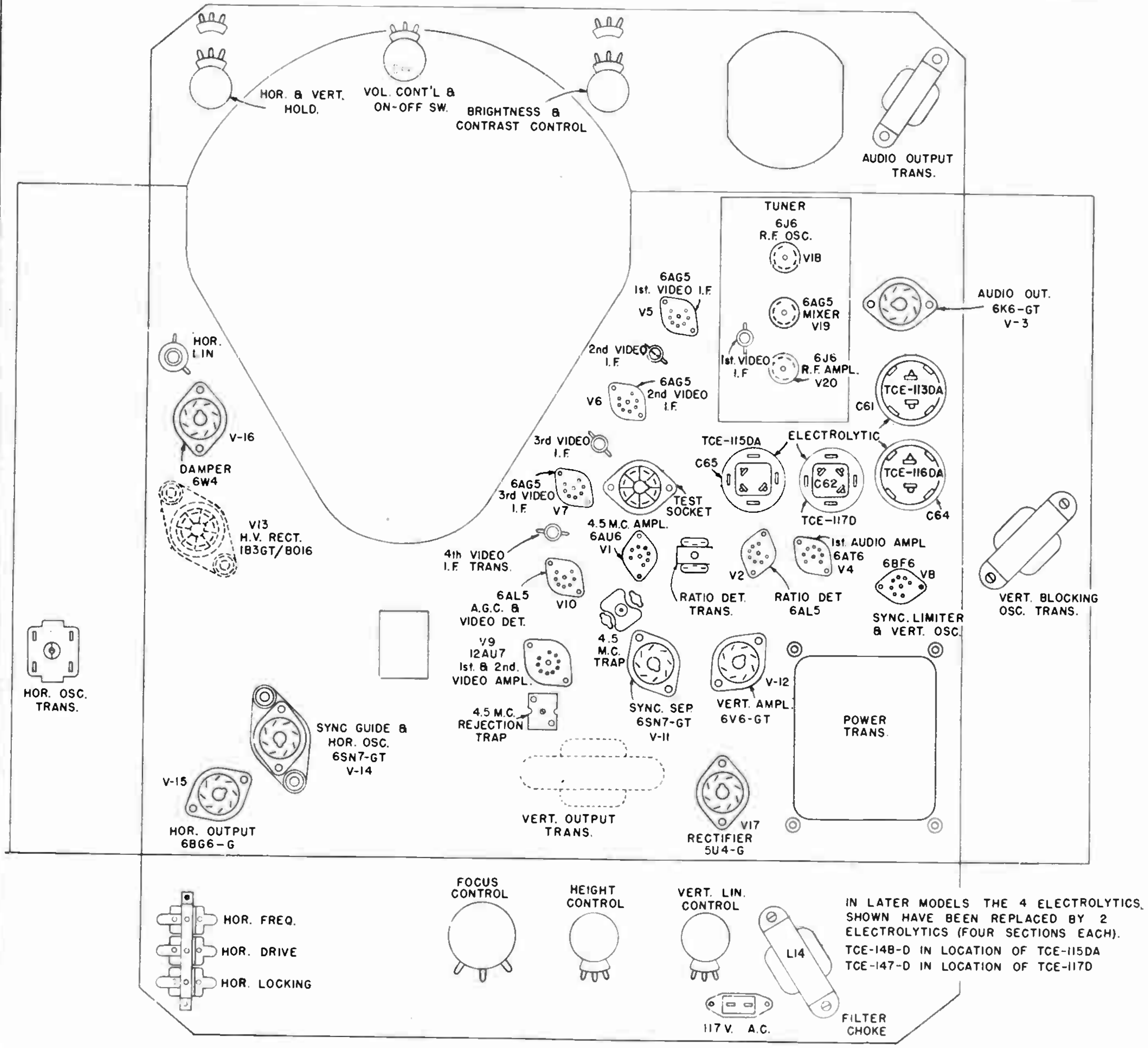

PARTS LOCATION — MAIN CHASSIS — UNDERSIDE VIEW

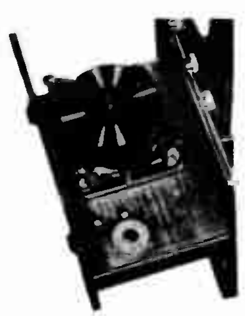

FIG. 11

DESCRIPTION

The Model TV 316B includes the TELE-TONE TV 316 Televison receiver and the automatic Radio-Phono Base which is designed as a stand for this receiver. The two units can be used separately if desired.

TELEVISION SPECIFICATIONS

CHASSIS DESCRIPTION

TZ CHASSIS

POWER SUPPLY
105 to 125 Volts - 60 Cycle AC

POWER CONSUMPTION
220 Watts

POWER OUTPUT (AUDIO)
2 Watts (undistorted)

INPUT IMPEDANCE
300 or 72 Ohms

PICTURE TUBE SIZE
16" Rectangular

SPEAKER
4" x 6" PM OVAL

DIMENSIONS
18-1/4" Deep
23" Wide
18-1/4" High

SHIPPING WEIGHT
Approx. 92 Lbs.

TUBE COMPLEMENT

1.	6J6	V20	RF Amplifier
2.	6AG5	V19	Mixer
3.	6J6	V18	RF Oscillator
4.	6AG5	V5	1st Video IF Amplifier
5.	6AG5	V6	2nd Video IF Amplifier
6.	6AG5	V7	3rd Video IF Amplifier
7.	6AL5	V10-A	Video Detector
		V10-B	A.G.C.
8.	12AU7	V9	1st and 2nd Video Amplifier
9.	6AU6	V1	4.5 Mc. Amplifier
10.	6AL5	V2	Ratio Detector
11.	6AT6	V4	1st Audio Amplifier
12.	6K6	V3	Audio Output
13.	6SN7	V11	Sync Separator
14.	6BF6	V8-A	Limiter
		V8-B	Vertical Sweep Oscillator
15.	6V6	V12	Vertical Sweep Amplifier
16.	6SN7	V14	Horizontal Sweep Oscillator and Sync Guide
17.	6BG6	V15	Horizontal Sweep Output
18.	6W4	V16	Damper
19.	1B3	V13	High Voltage Rectifier
20.	5U4	V17	Power Rectifier
21.	16TP4	V21	Picture Tube TV 306

RADIO SPECIFICATIONS

RADIO CHASSIS
BN (with built-in loop antenna)

IF FREQUENCY
455 Kc

FREQUENCY RANGE
532 Kc - 1620 Kc

(SEE PARTS LIST ON PAGE 4)

TUBE COMPLEMENT

1.	R.F. OSC.	12BE6
2.	I.F. AMP.	12BA6
3.	DET.-AGC	12SQ7
4.	AUDIO AMP.	50L6
5.	RECTIFIER	35Z5

RECORD CHANGER SPECIFICATIONS

MODEL
V-M 406 3-SPEED TRI-O-MATIC CHANGER

POWER SUPPLY
105 - 125 Volts 60 Cycle AC

FEATURES
Plays and automatically changes as many as ten 12", twelve 10" or any assortment of 10 records intermixed.
Plays a full stack of twelve 7", 33-1/3 RPM or a full stack of twelve 7", 45 RPM records (with adapter inserted in the record).

RADIO PHONO BASE SPECIFICATIONS

DIMENSIONS
24-1/2" Wide, 18-1/2" Deep, 23-1/2" High

SHIPPING WEIGHT
62 Lbs.

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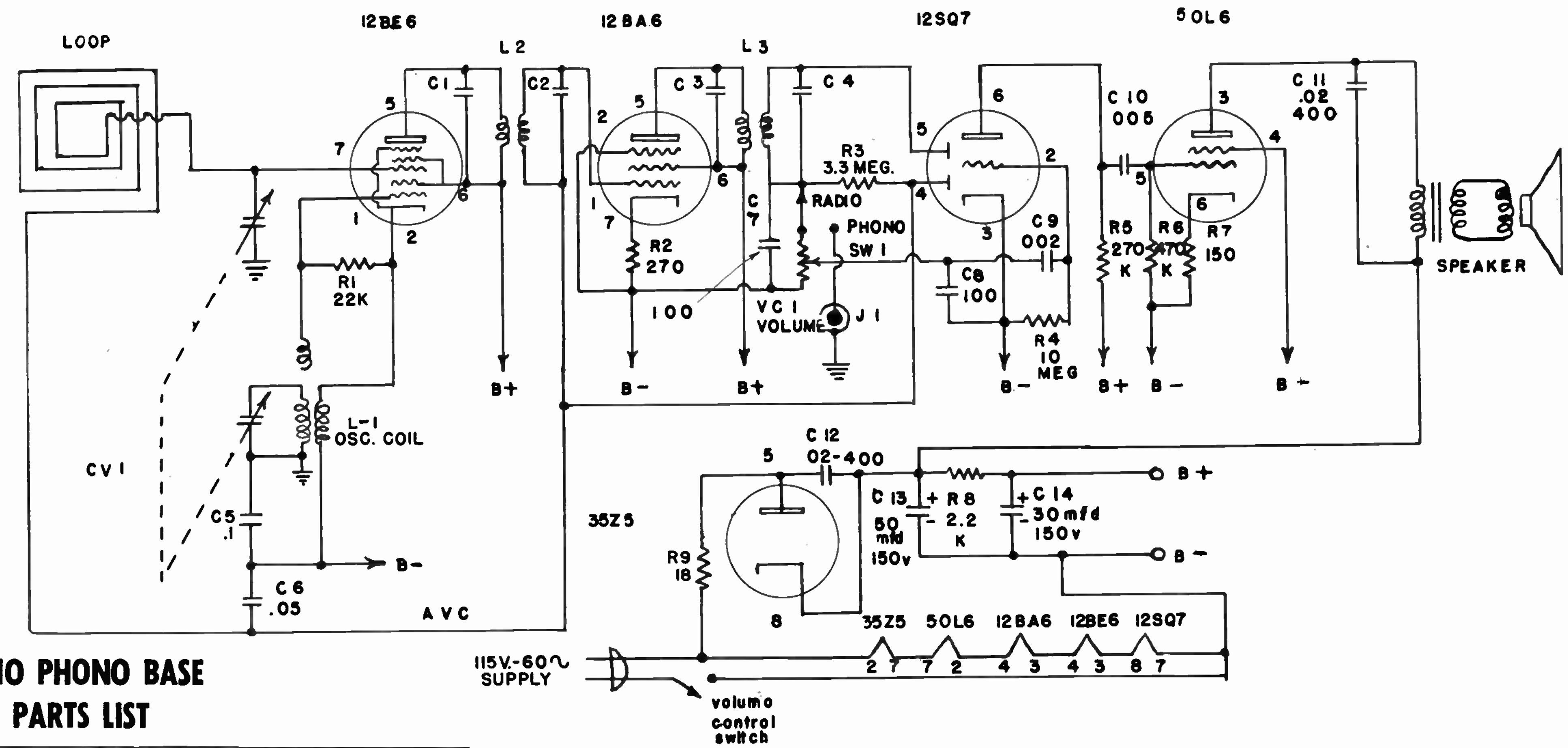
"BN" CHASSIS



RADIO PHONO BASE PARTS LIST

PART NUMBER	SCHEMATIC LOCATION	DESCRIPTION
CABINET AND HARDWARE		
TCB 282D		Cabinet
MO 6		Record changer VM Model 406
DL 30		Radio Dial Plate
EP 2		Escutcheon Pin
KN 34		Pointer Knob
KN 20		Knobs
IB 28		Radio Instruction Sheet
SP 40-10B		4" P.M. Speaker with Trans.
RADIO CHASSIS		
Resistors		
RC 180-1	R 9	18 Ohm 1/2 Watt 20%
RC 151-1	R 7	150 Ohm 1/2 Watt 20%
RC 271-2	R 2	270 Ohm 1/2 Watt 10%
RC 222-5	R 8	2,200 Ohm 1 Watt 10%
RC 223-2	R 1	22K Ohm 1/2 Watt 10%
RC 274-1	R 5	270K Ohm 1/2 Watt 20%
RC 474-1	R 6	470K Ohm 1/2 Watt 20%
RC 335-1	R 3	3.3 Meg 1/2 Watt 20%
RC 106-1	R 4	10 Meg 1/2 Watt 20%
CONTROLS		
VC 11	VC 1	Volume Control
CONDENSERS		
CM 101-1	C 7,8	100 MMF 500 Volts 20% Mica
CP 202-2	C 9	.002 MFD 400 Volt Paper
CP 502-2	C 10	.005 MFD 400 Volt Paper
CP 203-1	C 11,12	.02 MFD 400 Volt Paper
CP 503-4	C 6	.05 MFD 200 Volt Paper
CP 104-2	C 5	.1 MFD 200 Volt Paper
CV 19	CV 1	Variable Condenser (tuning)
ELECTROLYTICS		
CE 20	C 13,14	30/50 MFD 150 Volt
COILS AND TRANSFORMERS		
LP 20		Antenna Loop
LC 9		Oscillator Coil
LF 24		I.F. Transformers
SW 13		Phono-Radio Switch
LD 64		6 FT. Line Cord

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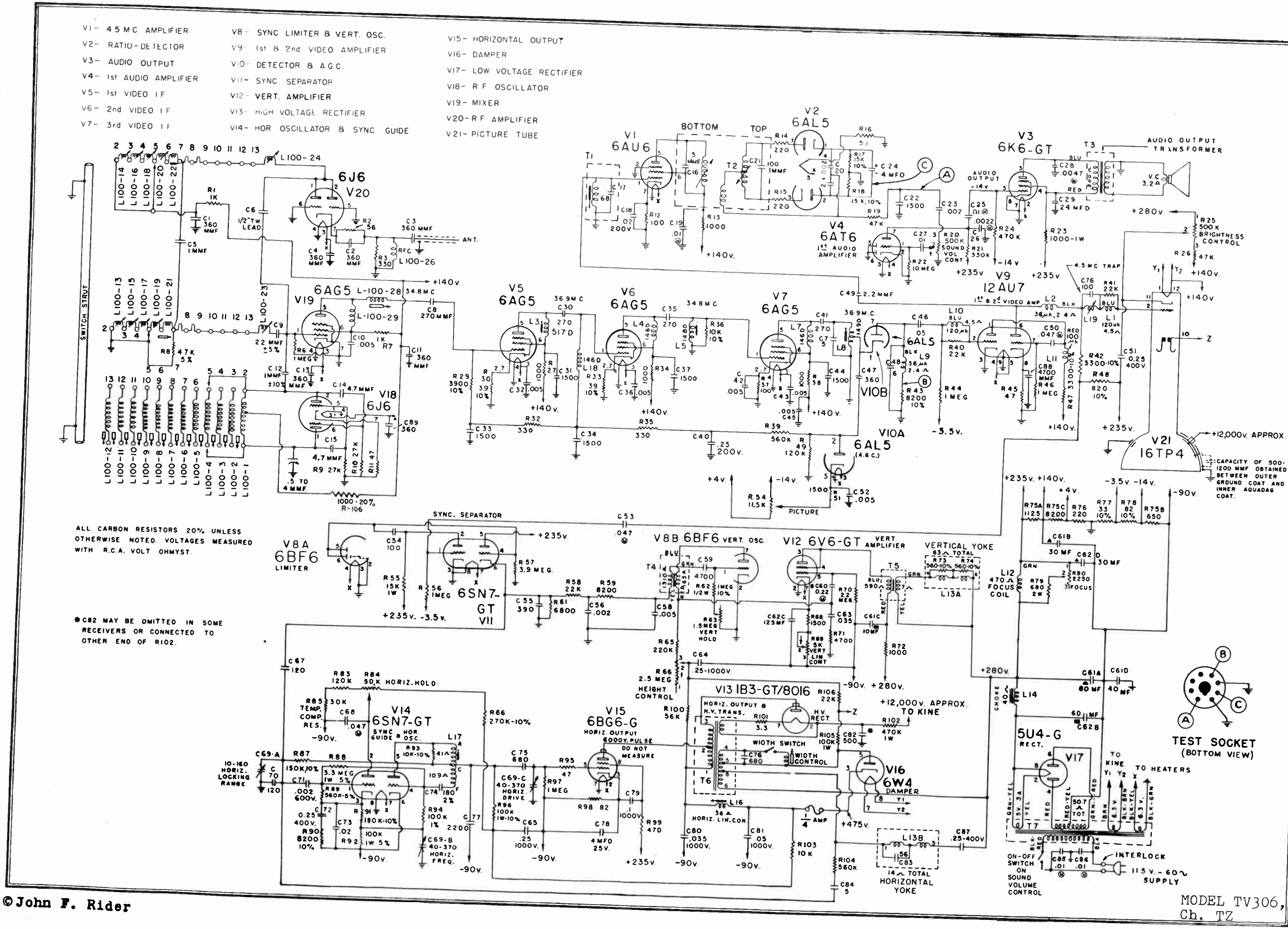

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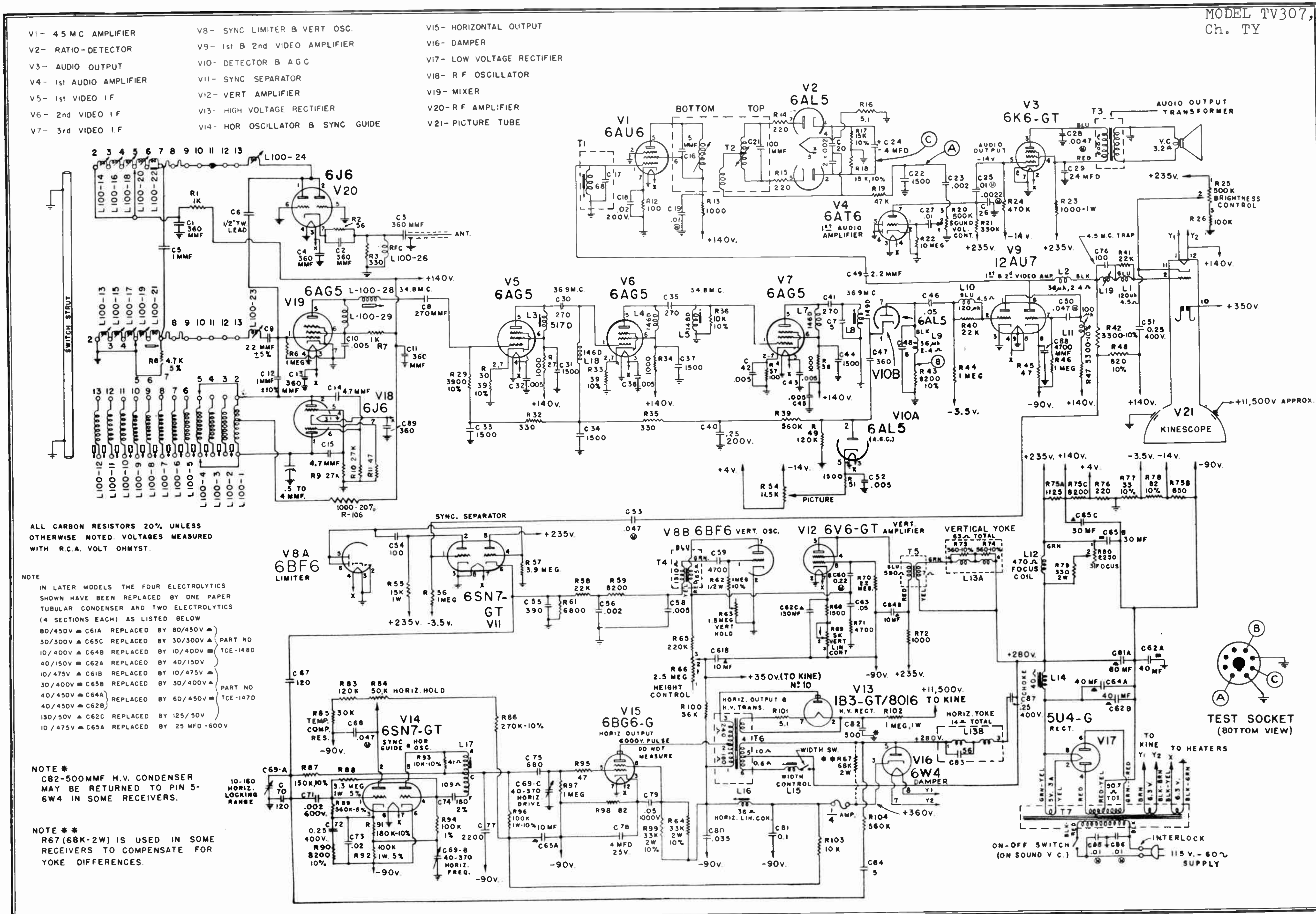
MODEL TV306, Ch. TZ



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ALIGNMENT PROCEDURE FOR MODEL 1621W

PART #1
Tools required:
1. Vacuum Tube Volt Meter (similer to RCA 75A)
2. Sweep Generator with marker (similar to Philco 7008)
3. Scope (similar to Philco 7008)
4. Insulated Screwdriver

PART#2

1. Connect all associated components of T.V. receiver together, making sure speaker plug is making good contact.
2. Set contrast control in full counter-clockwise position and brilliance control to full clockwise position.
3. Adjust Ion Trap (Beam Bender) for brightest raster.

PART #3 Front End Alignment
1. Set contrast to 1.5 volts negative. The terminals at which you take your reading are in the rear of the front end.
2. Setting channel selector at channel #12, connect sweep generator to antenna terminals and set marker generator for 204.0Mc to 210.0Mc.
3. Connect scope with 10k ohm resistor in series with hot lead to #1 of Fig. 1.
4. Adjust peaks for symmetrical waveform at 204.0Mc and 210.0Mc.
5. Adjust screws 2 and 4 for 204.0Mc and 210.0Mc.
6. Adjust screw 5 for symmetrical waveform.

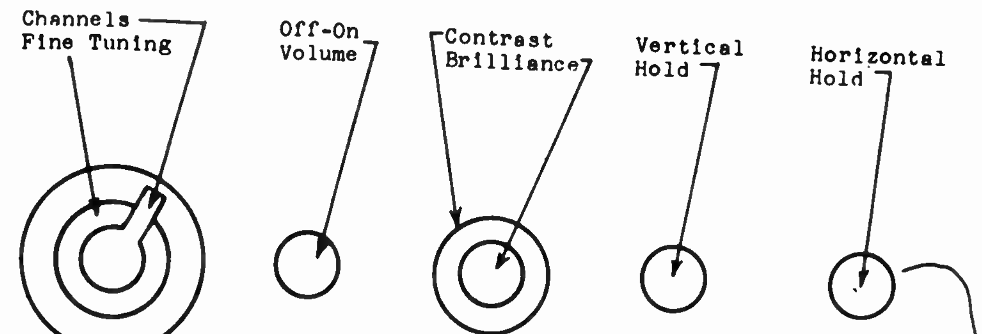
PART #4 Video Alignment
1. Remove all test leads from set and set channel selector switch between any two channels. Set contrast so that you do not distort waveform when aligning Video I.F..
2. Connect sweep generator to pin #4 of 3rd I.F. (6AC7) and ground.
3. Connect scope to point "A" and "B" of Fig. 3. The hot side of scope connect to "A". Ground of scope connect to "B". Adjust video coil between 6AC7 and 6AL5 for 26.0Mc. Remove sweep lead and connect to pin #4 of preceding 6AC7, adjusting coil between these two 6AC7 tubes for 23.5Mc. Remove sweep lead and connect to pin #1 of 6AG5, adjusting video coil between 6AG5 and 6AC7 tubes for 26.0Mc. Connect sweep lead to shield of 6J6 tube in front end, taking care that shield does not touch chassis. Align top slug of converter can for waveform, as shown in Fig. 4.

PART #5 Sound Alignment
1. Remove all test leads. Connect VTVM for 10 volt scale with selector switch set at positive. Take hot leed of VTVM and connect to pin #1 of discriminator tube (6AL5). Connect coil lead to pin #2 of same tube.
2. Connect signal generator to points "A" and "B" in Fig. 3, setting generator for 4.5Mc.
3. Adjust top and bottom slugs of sound take-off for maximum voltage readings.
4. Remove VTVM leads and connect VTVM leads between points "A" and ground, as shown in Fig. 5. Set VTVM at zero center.
5. Adjust bottom slug of discriminator transformer for maximum positive or negative voltage.
6. Adjust top slug for zero center.

PART #6 Final Check
1. Remove all test leads and connect antenna to antenna posts.
2. Set controls for best picture.
3. Adjust Ion Trap for brightest picture without shadows.
4. Put fine tuning control in center and take insulated screwdriver and insert in hole next to channel selector and adjust for best picture on all channels, being careful to remove insulated screwdriver when switching from channel to channel.

PART #7
1. Using 10v. scale on VTVM, connect hot lead to pin #5 of 6BG6G and cold lead to pin #6 of 6SN7GT, Hor. Block. Osc.
2. Adjust trimmer on pin #5 of 6BG6G in conjunction with Hor. drive control (part #17), in maximum counter-clockwise position.
3. Voltage should not read more than 10 volts with proper setting of Trimmer Cond.
4. Then adjust Hor. drive Control so that this voltage reads between 4-5 volts with proper width on Cathode-Ray Tube.
5. This Trimmer Cond. should never again need re-setting unless circuit constants are changed.

LOCATION OF FRONT CONTROLS-MODEL 1621W



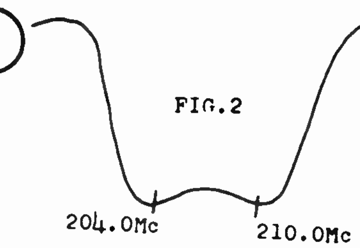
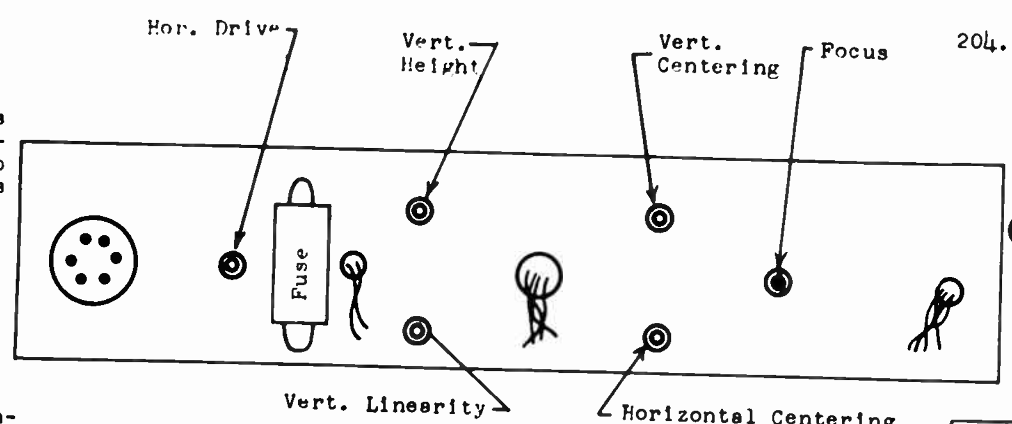


FIG.2

LOCATION OF REAR CONTROLS



DIAGRAMS FOR ALIGNMENT PROCEDURE

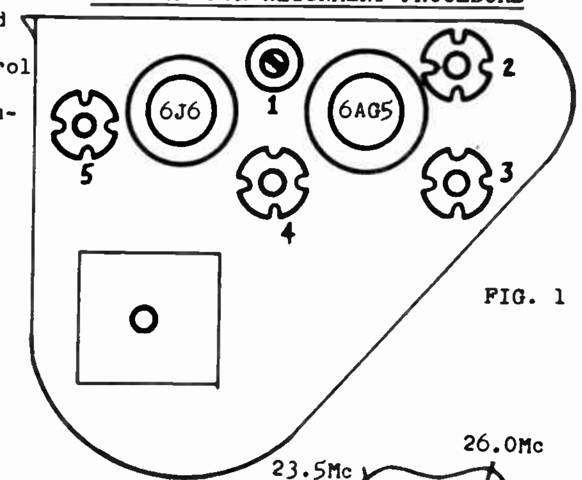


FIG. 1

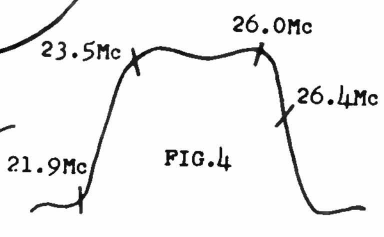


FIG.4

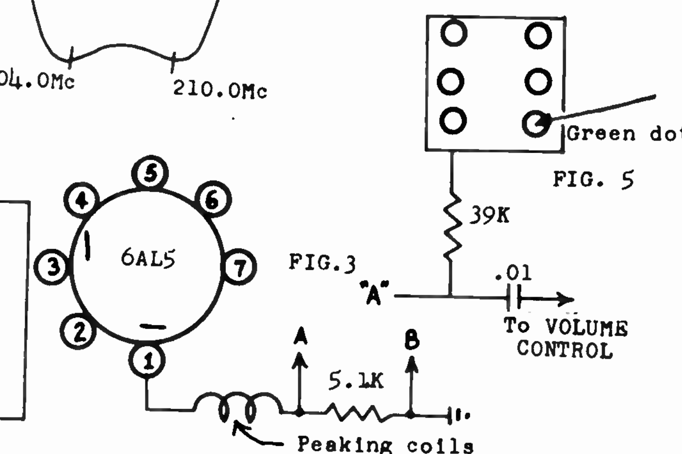
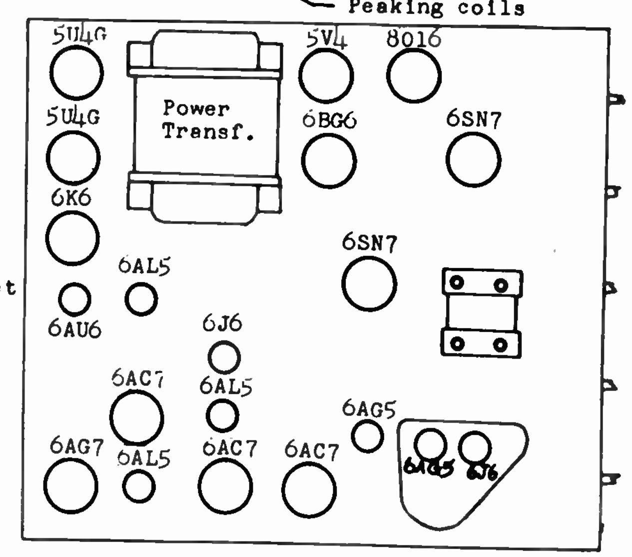


FIG.3

FIG. 5

TUBE FUNCTIONS

(2) 5U4G-L.V. Rectifiers
(1) 5V4G-Damper
(1) 6BG6G-Hor. Amp.
(1) 8016/1B3GT-H.V. Rect.
(1) 6SN7GT-Vert.Osc. & Discharge
(1) 6SN7GT-Hor. Osc. & Discharge
(1) 6K6GT-Power Amp.
(1) 6AU6-Voltage Amp.
(1) 6AG7-Video Output
(1) 6AG5-1st Video I.F.
(1) 6AC7-2nd Video I.F.
(1) 6AC7-3rd Video I.F.
(1) 6AC7-Sound I.F.
(1) 6AL5-Ratio Det.
(1) 6AL5-A.G.C. Rec.-Video 2nd Det
(1) 6AL5-Sync Clipper
(1) 6J6-Sync. Amp. & Separator
(1) 6J6-Mixer & Osc.
(1) 6AG5-R.F. Amp.



TUBE LAYOUT-1621W

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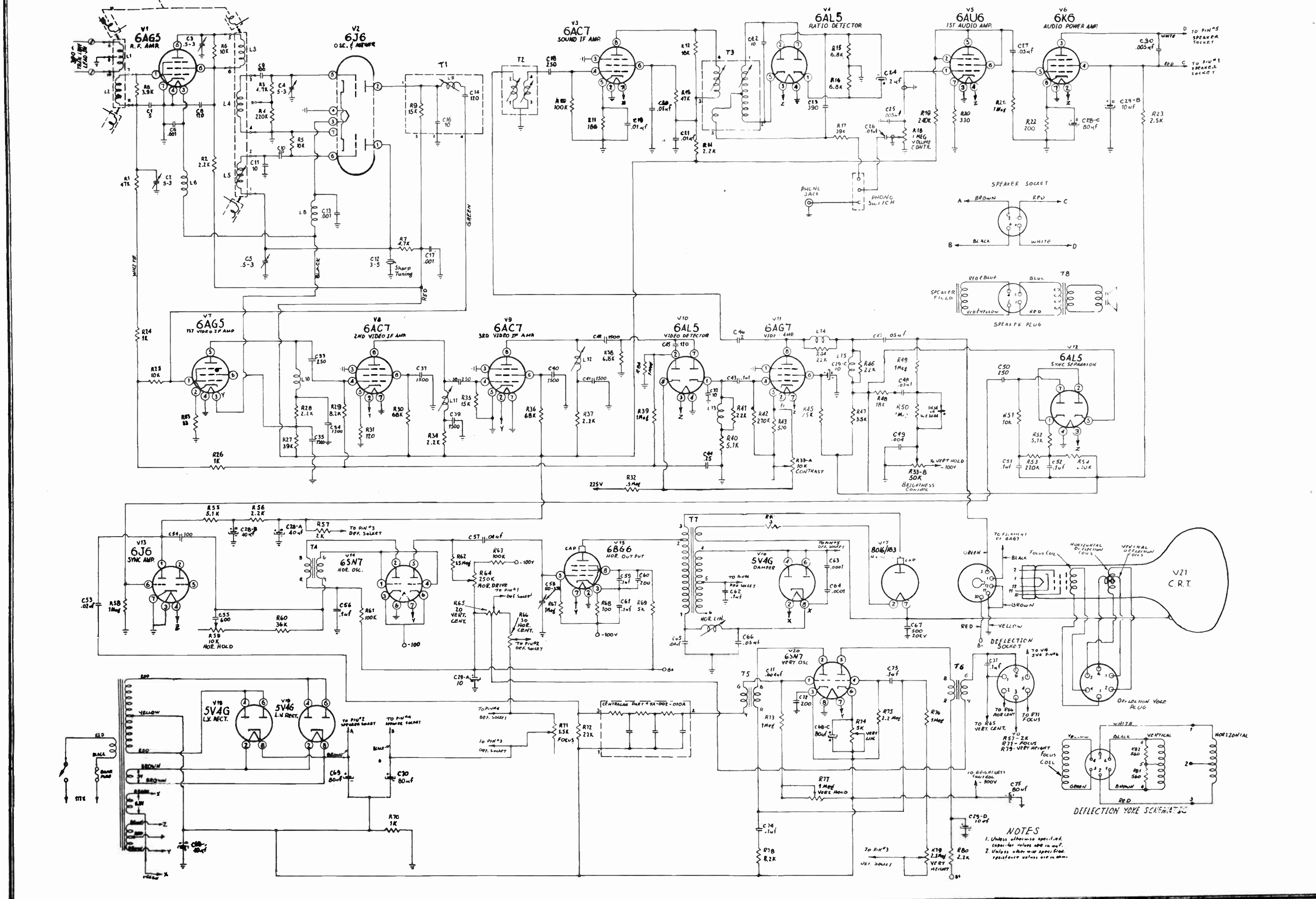

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SERVICE NOTES
MODEL A CHASSIS

ALIGNMENT PROCEDURE

If turning on the set for the first time check all controls front and rear to be sure they are not more than half advanced in the clockwise direction, with the exception of the brightness control which should be turned towards the OFF position and the volume control which may be adjusted to give a comfortable volume level.

The brightness and contrast controls also operate a switch at the counter clockwise end. Be sure that these switches are not in the OFF position before attempting the following adjustments.

Adjust the brightness control and ion trap. The ion trap should be adjusted for maximum light output in the picture tube.
Set the station selector to the desired channel, the strongest and most reliable station in your locality should be used.
Advance the contrast control until a picture or horizontal streaks appear.
If picture frame is in motion or if it tears, synchronize it by adjusting the horizontal hold or vertical hold controls. rols.
Adjust the focus control for best focus.
Adjust the fine tuner or the tuner on deluxe models for best picture.
After the picture has been locked, adjust the height control and vertical linearity controls for proper picture proportion.
Adjust the horizontal linearity control, horizontal linearity coil, and horizontal drive control for proper horizontal linearity.
Again check the focus control for best definition of the vertical wedges of a test pattern.

I.F. ADJUSTMENT

Observe carefully the resolution of the vertical wedges and other fine detail. In the case of the deluxe model, rotate the tuner in the clockwise direction very slowly, meanwhile watching for a noticeable brightening of the picture accompanied by sharp resolution of the vertical wedge. In either case, when the sharpest detail has been achieved, desist from further tuning and do not again adjust either the sound sensitivity control or the tuner until all other adjustments have been made.

On both types of tuners the adjustment on the top of the tuner should be set to about 25.75 Mc, or for a maximum of picture (dim picture). The other slug coil on the tuner plate should be set to about 22 mc or for a high level of sound.

The tuner adjustment may be made by observing the AGC voltage on a VTVM with a received signal and setting the coil to a frequency just slightly below that which gives a maximum on the meter.

ALIGNMENT OF SOUND IF AND DETECTOR TRANSFORMERS

Turn volume control full on. A slight hiss only may be heard. Adjust top and bottom slug of can #317 for maximum sound output and minimum distortion. A dip on either side of peak indicates proper operation.

Connect a high resistance D.C. Voltmeter between the AVC line and ground.

Adjust the trap on transformer #175 for maximum deflection of meter.

Adjust first the top slug and then the bottom slug of transformer #319 for maximum deflection of the meter.

Recheck the adjustment of the top and bottom slug of sound detector transformer #317 at low volume. This is a critical adjustment.

Tighten trimmer of video I.F. trap on transformer #174 and back off slightly for best picture. Look for a decrease and final elimination of sound bars, beads, dark streaks and striations from the picture.

AUTOMATIC GAIN CONTROL

The A.G.C. in this set consists of a filter network after the video detector and individual decoupling filters to supply the A.G.C. voltage to the tuner, the 6AG5 and the first two 6AC7 video I.F. amplifiers.

In the event that the A.G.C. does not function, trouble may be expected in a defective 2.2 meg resistor or 0.1 condenser, or defective tubes V-22, V-1 or V-7.

Under extreme strong signal conditions, the deluxe set may develop a slight buzz in the sound which is the result of an overload in the tuner. Padding of the antenna to reduce the signal to the set will help in this condition.

A.F.C. CIRCUIT

PRINCIPLE OF OPERATION:

The TRANSVISION A.F.C. CIRCUIT is basicly a phase converter for converting the phase difference between the incoming horizontal sync pulse and the horizontal flyback pulse to D.C. of the correct polarity and applying this voltage to control the frequency of the horizontal oscillator.

The TRANSVISION set uses a conventional blocking oscillator in the horizontal circuit. The frequency is controlled by the time constant of the grid blocking condenser and the grid resistor. In the A.F.C. circuit an additional element of control has been added. This is the bias voltage applied by the cathode follower to the bottom end of the grid resistor and is derived from the A.F.C. converter.

With no signal input, it should be possible to go completely through the hold frequency by turning the hold control end to end. The frequency range should roughly be from 10,000 to 20,000 cycles.

A rough check can be made by watching the size or width of the raster. A frequency too high will give a small dim raster. A frequency too low will give a wide bright raster and may be accompanied by an audible whistle from the horizontal transformer.

A-If the voltage reading is different from the normal reading; check the following:
1. 6AL5 Tube
2. 100K resistors connected to pins 5 & 7 of 6AL5 tube.
3. Peaking coil (#77) for continuity, approximately 50 ohms.
4. 47K 2 watt resistor from 6X5 tube plates and .001 condenser to pins 1 & 2 of 6AL5 tube.
5. 500 mmfd condenser from the junction of 47k & .001 to pins 5 & 7 of 6AL5 tube.

If sync is erratic or unstable, but the hold control can obviously carry sweep frequency either side of sync, the trouble will be with the 6AL5 tube or its associated-circuits.

B- Severe hacking at the edges of the picture and sharp displacement of sections of the picture may be caused by one of the following:
1. Defective 6RG6G tube.
2. Open .01 condenser.

C- Picture locks good but wavers or is unsteady:
1. Picture getting into sync., see poor synchronizing instructions.
2. Standard and deluxe sets - Interaction between horizontal output leads and other circuits. Dress both leads to the horizontal hold control well away from all other leads. They may be pulled away from the chassis and run directly to hold control.

D- Picture locks good but jumps out of sync with change of contrast control.
1. Poor limiting action in sync amplifiers. Check sync tubes, grid and plate resistors for value and coupling condensers for leakage.
2. Unbalance to sync input diodes. Check plate and cathode resistors of sync output circuit (phase inverter).
3. Check values of sync coupling condensers .0005.
4. Check diode resistor 100K.
5. Check 6AL5 tube.

E- Fold over on right side of picture.
1. May be caused by poor adjustment at transmitter. Check on other stations. Defective 6BG6G tube.
2. Too much inductance in diode output filter coil, unscrew slug a few turns.
3. Open output filter coil on 6AL5 tube PC3.

F- Lateral ripples at top of picture or large lateral waves in picture. Standard or Deluxe.
Off-value 4700 ohm resistor or 0.1 mfd condenser.

G- Slow sync recovery when changing stations.
1. Improver adjustment of hold control.
2. Re-adjust hold control after set has been running about an hour. Turn hold control till sync is lost on low frequency side, (large bright raster) then turn control back slowly till picture locks. Do not try to center control.

H- Sync locks at half frame or with black vertical bars some place in middle of screen.
1. Output filter coil slug out too far.
2. Shorted filter coil.

VERTICAL SYNC AND SWEEP CIRCUITS
Insufficient or erratic

Check for:

1 - Tubes V20, V21
2 - Voltages on above tubes
3 - All condensers and resistors used in above tube circuits
4 - Vertical oscillator and output transformers
5 - Vertical yoke winding
6 - Vertical, size, linearity and hold controls

HORIZONTAL SYNC CIRCUITS
Insufficient or erratic

1 - Tubes V11, V12, V13, V14
2 - Voltages on above tubes
3 - Condensers, resistors and slug coils in above circuits
4 - Horizontal oscillator transformer
5 - Horizontal size, linearity and hold controls

HORIZONTAL SWEEP CIRCUITS
Insufficient or erratic

1 - Tubes V14, V15, V16, V17
2 - Voltages on above tubes
3 - Condensers and resistors in above circuits
4 - Horizontal oscillator transformer #307 and horizontal output transformer #1279
5 - Horizontal linearity coil slug
6 - Horizontal linearity, size, and hold controls.

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SOUND AND PICTURE CIRCUITS

Picture OK - No Sound
Check for: -
1 - Check tubes V2, V3, V4, V5, V6
2 - Voltages on the above tubes
3 - All condensers and resistors in the above tube circuits
4 - I.F. Transformers #175, #317, and #318
5 - Audio output transformer, part #21
6 - Speaker
7 - Shorts in shielded leads
8 - Open volume control or defective switch section on phono-contrast switch

No Picture - Sound OK
1 - Tubes V7, V8, V9, V10
2 - Voltages on the above tubes
3 - All condensers and resistors in the above tube circuits
4 - All peaking coils for open circuits
5 - I.F. Transformers #174, #175. and #176
6 - Open contrast control

No picture or sound - Raster OK
1 - Tubes V1, V22 and tuner tubes
2 - Voltages on above tubes
3 - All condensers and resistors in above tube circuits
4 - All coils in above circuits
5 - Antenna system

No raster or sound
1 - Make sure set is plugged in and turned on
2 - Check fuse
3 - If fuse is open check for shorted filter condensers, CF1, CF2 and CF3
4 - Open focus coil, centering control or filter choke
5 - Tubes V18 and V19
6 - B plug voltage at output filter condenser

No raster - Sound OK
1 - Check for proper ion trap placement
2 - Tubes V10, V14, V15. V16, V17, CRT
3 - Voltages on the above tubes. CAUTION CRT 2nd anode is approximately 12K.V.
4 - Horizontal oscillator and output transformers
5 - Horizontal drive, Horizontal size and brightness controls
6 - Condensers and resistors on tubes V14,V15,V16,V17, V10
7 - Open yoke or linearity coil
8 - Opne HV fuse

MISCELLANEOUS

Poor high voltage regulation is evident by varying the brightness control which causes the screen to become very dim or extinguished. Replace the 1B3 tube.

A hissing or cracking noise is sometimes due to arcing between the focus coil and ion trap. A short wire connected between the trap and focus coil will prevent this.

In some cases the brightness drops when the set has been placed in the cabinet. This may be due to the cup on the cabinet either becoming magnetized or distorting the magnetic field of the ion trap. Try to center the cup with reference to the axis of the tube neck or replace cup with one of non-magnetic material.

Horizontal tearing is sometimes due to break down of the resistor in series with the anode cap lead.

MODEL A CHASSIS VOLTAGE READINGS

	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8
V21	Vert.Amp 6V6	0	6.3 AC	310	310	0	NC	0	28 Appx.
V20	Vert.Osc. 6SN7	-100*	100*	0	-100*	280	0	6.3 AC	0
V17	Horz.Damp. 6X5	0	-100	370	370	370	0	** 0-100 DC	500
V15	Horz.Amp. 6BG6	0	0	7.5*	370	-10	370	6.3 AC	260
V18 V19	L.V. Rect. 5U4	NC	400	NC	387	NC	387	NC	400
V14	Horz.Osc. 6SN7	-40*	155	0	-40*	225	0	6.3 AC	0
V10	Video Amp. 6AG7	0	0	0	Mod.Sig -5	0-6	170-240	6.3 AC	310
V11	1st Syn.Amp 6SN7	-5 Mod.Sig	40	0	-8*	330	10	6.3 AC	0
V12	2nd Syn.Amp 6SN7	0	180	6	-18 Mod.Sig	320	11	6.3 AC	0
V9	Det. DC RSTR 6AL5	0	-5 Mod.Sig	0	6.3 AC	0	0	-5 Mod.Sig	X
V8	4th Video IF 6AC7	0	0	0	0	2	160	6.3 AC	310
V7	3rd Video IF 6AC7	0	0	0	0-1	1	300	6.3 AC	310
V1	2nd Video IF 6AC7	0	0	0	0-1	1	220	6.3 AC	300
V22	1st Video IF 6AG5	0-1	0.5	0	6.3 AC	210	180	0.5	X
V6	Audio Amp. 6V6	0	0	230	280	0	0	6.3 AC	15*
V2	Sound IF 6AC7	0	0	0	0	0.2	300	6.3 AC	310
V3	Sound IF 6AC7	0	0	0	0	1.5	90	6.3 AC	280
V4	Sound Det. 6AL5	0	0	0	6.3 AC	0	0	0 - 15	X
V5	Audio Amp. 6SL7	0	80	0	0	90	0	0	0
V13	AFC 6AL5	0-20	0-20	0	6.3 AC	35	0	-35	X
V16	H.V. Rect. 1B3	H.V. DO NOT MEASURE							

* Approximate. depending upon control settings
**Due to D.C. leakage in tube. This is normal.
All readings to ground with 20,000 OHM per volt meter.

IMPROPER FOCUS

1- Check focus coil (May have shorted turn. Try substitute if in doubt)
2- Check focus control.
3- Check for leaky filter condenser, CF1, CF2, or CF3.
4- Check for correct placement of ion trap.
5- Focus coil may be set too far back on neck of cathode ray tube.

NOTES

MAKE THE FOLLOWING CHANGES:
1- On voltage chart on V17 pin 2, the reading should be 0-100 volts.
2- On resistance chart V22 pin 4, reading should be 0.1 ohms.

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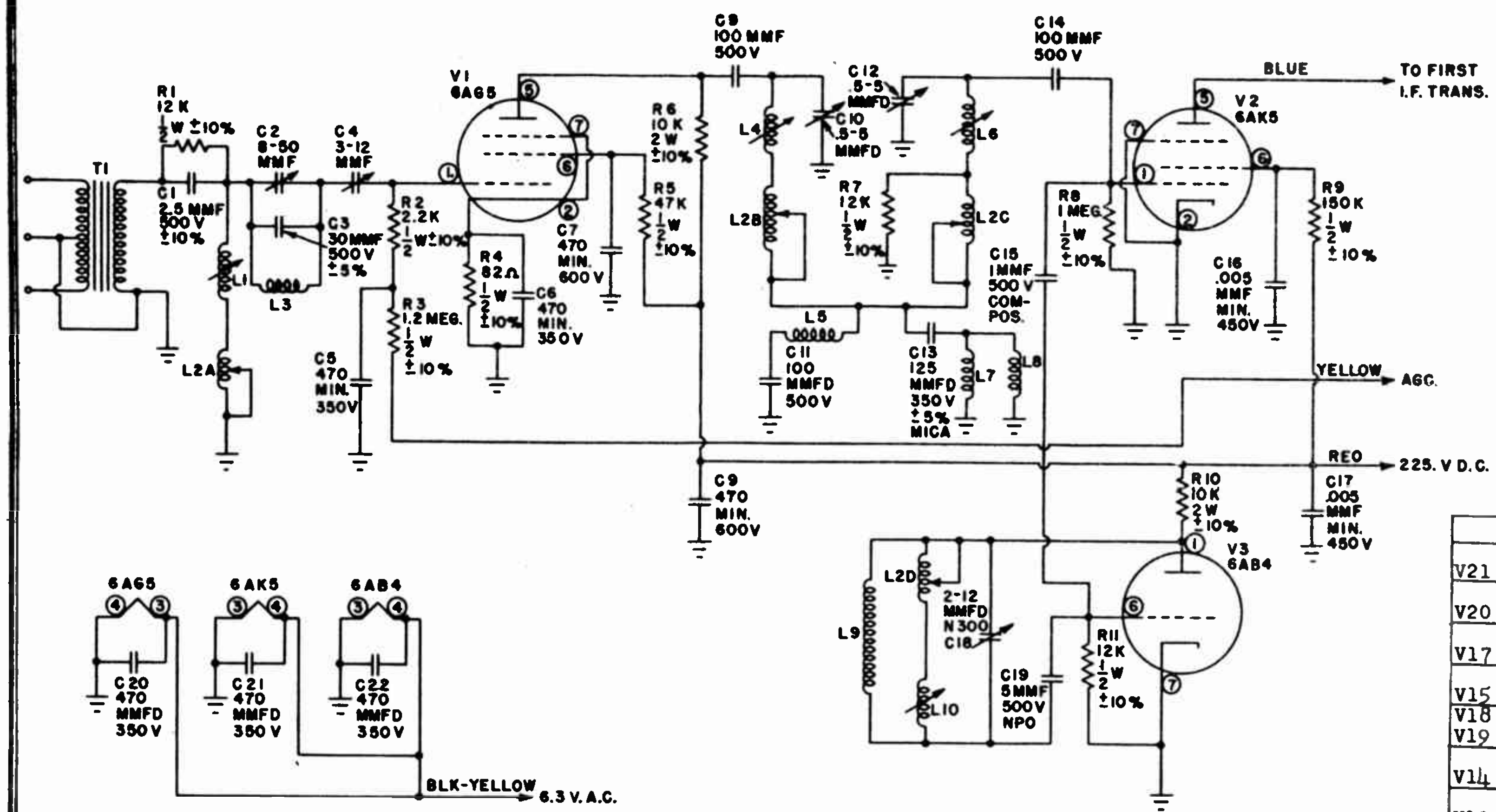

DUMONT SERIES T4A INPUTUNER

3- Certain sets may come through with type 6AG7 instead of 6AC7's in sockets V2 and V3. This change may be necessary due to shortage of type 6AC7. This change will not affect the operation of the set. The only change will take place at the point where the slug coils peak during alignment. If the 6AG7's are replaced at a future date it will be necessary to re-align the #317 - #318 transformers.

4- A few models will have a 10,000 ohm 10 watt bleeder resistor connected from B plus to ground. This is shown on the diagram directly above V10 (6AG7). Current production will not have this bleeder.

5- The B plus dropping resistor to the tuner should be 10,000 ohms 10 watts for the model TT-4 tuner and 5,000 ohms 10 watt as shown for the Deluxe model. This resistor is located on the circuit diagram directly above V11 A (6SN7).

6- Certain models may have a Bucking transformer. The windings of which will be connected in series with the 5U4 plates to decrease the voltage. If necessary to replace this unit the correct polarity must be observed.

MODEL A CHASSIS RESISTANCE READINGS

	Tube	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8
V21	Vert.Amp. 6V6	NC	0.1**	50K**	50K**	1 Meg	NC	0	1-5K
V20	Vert. Osc. 6SN7	* 2 meg	1.5M*	0	2 meg	100K**	0	0.1	0
V17	Hor.Damp. 6X5	NC	INF.	50K**	50K**	50K**	NC	Inf.	Inf.
V15	Hor.Amp. 6BG6	NC	0	68	50K**	1 meg	100K**	0.1	50K**
V18 V19	L.V. Rect. 5U4	NC	30K**	NC	25	NC	25	NC	30K**
V14	Hor.Osc. 6SN7	100K*	350K**	0	100K	150K**	0	0.1	0
V10	Video Amp. 6AG7	0	0	0	5K	0-1K	100K**	0.1	50K**
V11	1st Syn.Amp. 6SN7	1 meg	100K	0	Inf.	50K**	10K	0.1	0
V12	2nd Syn Amp 6SN7	470K	50K**	1K	470K	40K**	5K	0.1	0
V9	Det DC Rstr. 6AL5	0.1K	1 meg	0	0.1	0	0	5K	X
V8	4th Vid. Amp 6AC7	0	0	0	0.1	150	100K**	0.1	50K**
V7	3rd Vid. Amp 6AC7	0	0	0	3 meg	100	100K**	0.1	50K**
V1	2nd Vid. Amp 6AC7	0	0	0	2 meg	100	100K**	0.1	50K**
V22	1st Vid. Amp 6AG5	2	50	0	0.1K**	50K**	100K**	50	X
V6	Audio Amp 6V6	0	0	30K**	1 meg	470K**	1	0.1	390
V2	Sound IF 6AC7	0	0	0	0.1	47	150K**	0.1	50K**
V3	Sound IF 6AC7	0	0	0	0.1	150	150K**	0	50K**
V4	Sound Det. 6AL5	Inf.	Inf.	0	0.1	0	0	50.K	X
V5	Audio Amp. 6SL7	3 meg	270K	0	1	270K	3K	0.1	0
V13	AFC 6AL5	Inf.	Inf.	0	0.1	100K	0	100K	X
V16	HV Rect. 1B3	Inf.	More than 20M	Inf.	Inf.	Inf.	More than 20 M	Inf.	NC

** Actual value is higher due to charging condensers but values should not be less than indicated.
* Indicates variable value K- 1,000 ohms M- 1,000,000 ohms

All front panel controls turned to counter clockwise position.
All measurements made with 20,00 ohms per volt meter.

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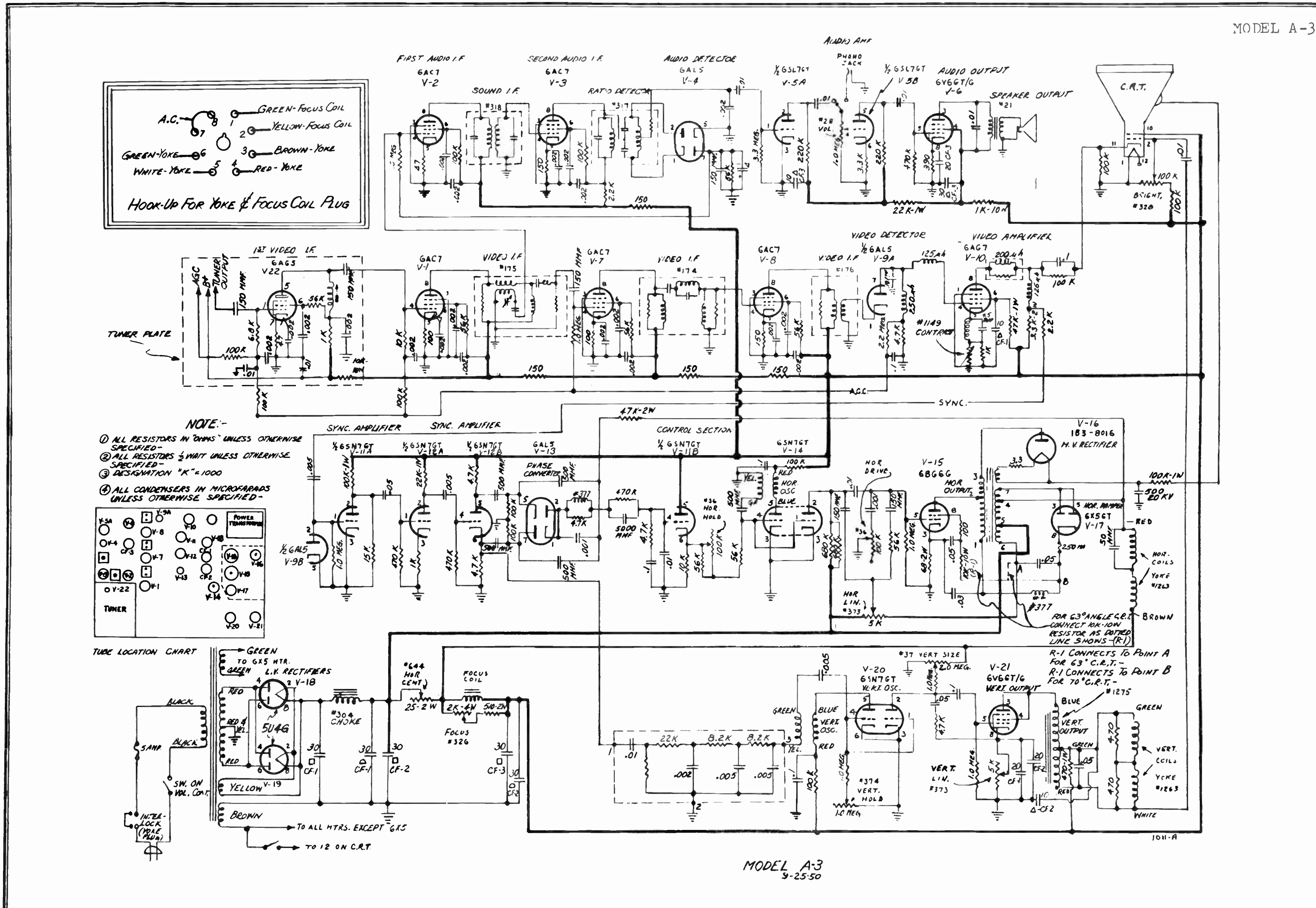

MODEL A-3
9-25-50

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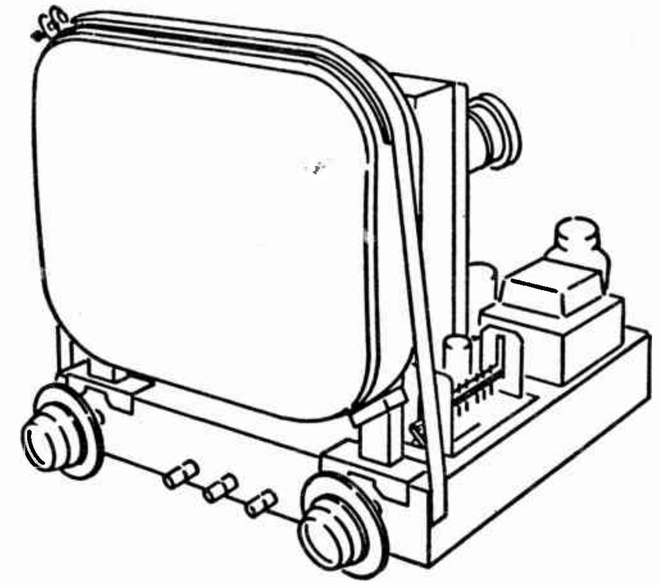

16AY210 Television Chassis

Model 660 (BRC 16AY210)

GENERAL DESCRIPTION

The model shown above is a 22 tube, AC operated, direct view, 16-inch rectangular television receiver. The set is complete in one unit and features complete coverage of all 12 television channels, automatic gain control, automatic horizontal frequency control, intercarrier sound system, permanent magnet focused and magnetically deflected picture tube.

On the back of the cabinet is a safety interlock to prevent dangerous electrical shock. As an added safety measure, a fuse is located in the power supply to protect the set in case of overloading.

Located on the rear of the chassis are a phono input plug and phono TV switch for connection of a phonograph.

FUNCTIONS OF THE CONTROLS

All the controls normally used in tuning in a program—both picture and sound—are located on the front of the receiver and at the top of the back of the cabinet. At the rear of the set are several controls which are preset at the factory and may need slight readjustment at the time of installation. After installation, they should not be adjusted further, unless required by replacement or aging of tubes, variations in power-line voltage, or other external conditions.

The receiver actually requires only four controls when tuning in a program. On the left is a dual knob, the large knob controls picture contrast, while the small outer knob is the off-on switch and volume control. The control on the right is the station selector and the antenna tuning knob is located at the top of the back of the cabinet.

The three other controls under the name plate; brightness, horizontal hold, and vertical hold need only be adjusted periodically. The six front controls are shown below in figure 1.

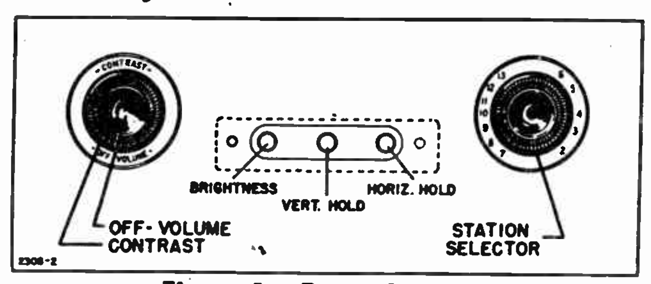

Figure 1. Front Controls

The focus and centering controls are located on the picture tube assembly (figure 2). These controls can be operated through the opening provided in the cabinet back. The remaining six controls, vertical linearity, vertical size, horizontal size, horizontal drive, horizontal linearity and coarse horizontal hold are located on the rear of the chassis (figure 3).

OPERATOR'S CONTROLS

Volume-Off — Turns set on or off and adjusts sound volume.

Contrast—Varies contrast between light and dark portions of picture.

Brightness—Controls brilliance of picture.

V. Hold—Stops picture from moving up or down.

H. Hold—Stops picture from moving left or right.

Station Selector Knob—Tunes set to desired channel (station). May be turned in either direction.

Antenna Tuning Knob—Tunes the antenna for maximum signal.

Centering—Moves entire picture both horizontally and vertically.

SERVICEMAN'S CONTROLS

V. Linearity—Provides vertical distribution of picture.

V. Size—Changes size of picture vertically. Does not affect horizontal size.

H. Size — Changes size of picture horizontally. Does not affect vertical size.

Focus—Focuses picture on face of picture tube.

H. Linearity — Provides horizontal distribution of picture.

H. Drive—Controls the drive to the Pulse Amplifier.

Coarse H. Hold — Stops picture from moving left or right.

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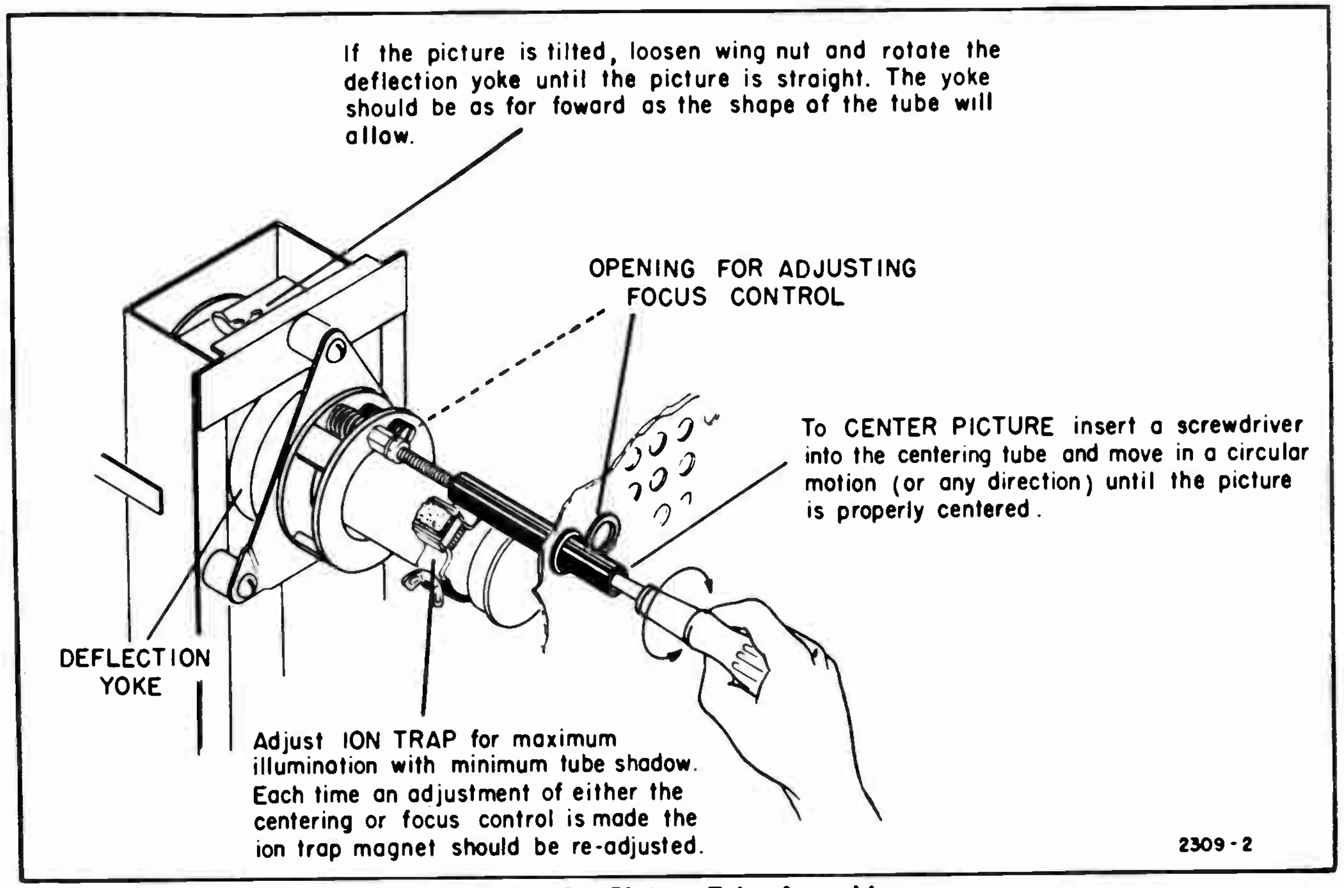

Figure 2. Picture Tube Assembly

TUBE COMPLEMENT

1	6AG5, RF Amplifier
2	6J6, IF Amplifier
3-4-5-6	6AU6, IF Amplifier
7	6AL5, Detector, D.C. Restorer
8	12AT7, Video Amplifier
9	6SN7, Sync Amp.- Sync Sep.
10	6AU6, AGC Amplifier
11	6AU6, Sound IF Amplifier
12	6AV6, Audio Amplifier
13	6K6, Audio Output
14	6SN7, Blocking Osc. Pulse Amp.
15	6AL5, AFC Discriminator
16	6SN7, Horizontal Multivibrator
17	6BG6, Pulse Amplifier
18	6W4, Damper
19	1X2, H. V. Rectifier
20	5U4, L. V. Rectifier
21	6AL5, Audio Detector
22	16" Retangular Picture Tube

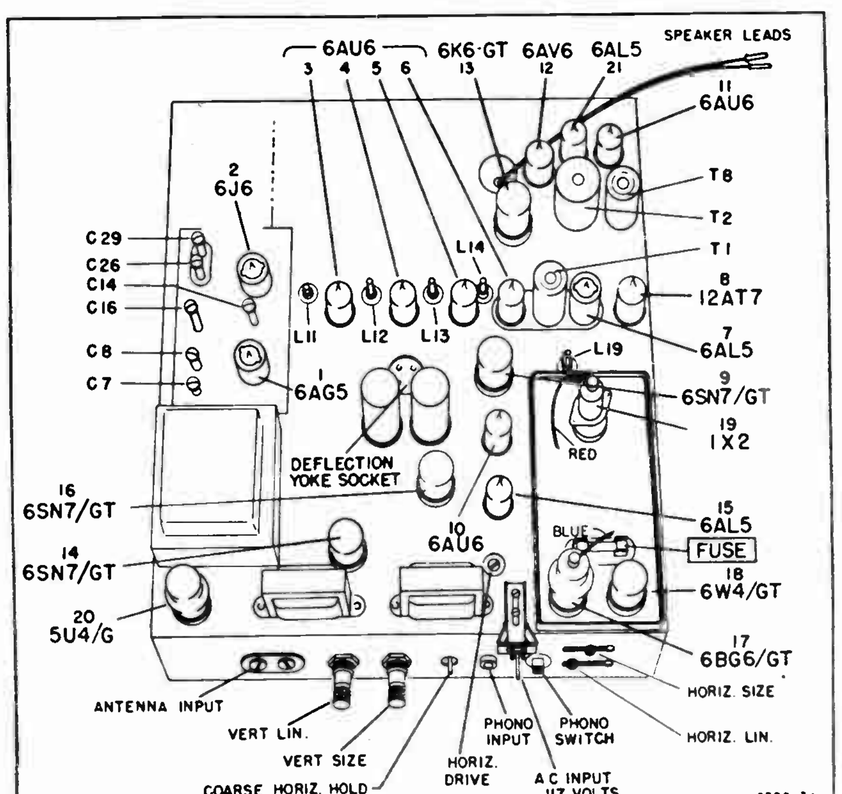

Figure 3. Tube Layout

INSTALLATION

Power Source.

The receiver should be operated from a 115 Volt, 60-Cycle A.C. power source. The power consumption is 235 watts.

Location of Receiver.

The set should be so located in the room that no direct light strikes the face of the picture tube. However, some indirect illumination in the room is desirable; it is not necessary to darken the room completely for proper viewing of the picture. Due consideration should be given also to the convenience of the electric outlet, and to the position of the receiver which gives the best reception with the built-in antenna.

Built-In Antenna.

The new Built-In Television Antenna incorporated in the receiver eliminates the need of an outside antenna in many locations. In areas too distant for normal reception with a built-in antenna, provision is made for outside antenna connections. If any other type of antenna is used with the set, disconnect the transmission line from the built-in antenna to the antenna terminals.

The antenna is mounted inside the cabinet and is operated by the use of a knob at the top of the back of the cabinet. Since the antenna is fastened to the cabinet it may be necessary to orient the cabinet to obtain the best reception. It is desirable that either the front or the back of the cabinet face the transmitting station. If however, "ghosts" or multiple images appear, the cabinet may be rotated slightly to minimize this condition. In some cases it may be necessary to face the back or the front of the cabinet toward a window to obtain a television picture. This may be due to walls, water pipes, or a steel structure in the location preventing television reception.

The antenna tuning knob should be used as a fine tuning control and should be adjusted until the best picture is obtained. In order to eliminate "Body effect" when adjusting the antenna tuning knob, stand in front and reach over the top of the set. If at any time the knob becomes difficult to turn, reverse the direction of rotation. Do not force the knob in either direction.

If the receiver fails to operate satisfactorily with the built-in antenna, check the following trouble:

1. Check the antenna dipole to make sure it is not touching the chassis or any other object.
2. Check the antenna dipole to make sure it is stapled to the side of the cabinet and does not vibrate.
3. Check the connections at the coil, transmission line, and trimmer capacitor.
4. Check to make sure that the antenna terminal screws are moderately tight.

Final Adjustments.

The television receiver has been completely assembled and adjusted for operation before shipment. It is recommended, however, that the adjustments discussed in this section be checked over at the time the set is installed.

While the required adjustments, if any, will probably be slight, the instructions may also be used for receivers which are considerably misadjusted because of replacement parts, etc.

Deflection Yoke.

If the picture seems to be tilted or the edges of the raster are not vertical, loosen the deflection coil adjusting wing nut (located at the top of the picture tube assembly, Figure 2) and using the wing nut as a handle, rotate clockwise or counter-clockwise until the edges of the raster are exactly vertical.

The correct position for the deflection yoke is as far forward on the neck of the picture tube as the shape of the tube will allow. Tube shadow may be the result of an incorrectly positioned deflection yoke.

To correctly position the yoke, loosen the wing nut and push the yoke as far forward as the tube will allow and while keeping the edges of the raster vertical tighten the wing nut.

Ion Trap Magnet.

The initial setting for the Ion trap magnet is over the "L" shape metallic flags inside the glass neck of the picture tube. See figure 2. From this starting position rotate the magnet about the neck of the tube and slide forward and backward until the position that gives maximum illumination with minimum tube shadow is found. This adjustment should be made with the brightness control set at slightly less than ½ its clockwise rotation.

If the ion trap magnet interferes with the centering control, rotate the magnet 180° and readjust for maximum illumination.

Each time an adjustment of either the centering or focus control is made, the ion trap magnet should be readjusted.

Centering.

The receiver may require centering at the time of installation. To recenter the picture follow the centering instructions on page 5.

Other Adjustments.

Refer to the "Service Adjustments" section and touch up each control following the instructions carefully.

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SERVICE ADJUSTMENTS

Station Selector.

The station selector pointer should not rub or scrape against the channel indicator plate, and the knob should not rub against the pointer, otherwise the control may slip between channel 6 and 13. This condition can be corrected either by a fast turn or moving the pointer itself.

Brightness Control (R-46).

The brightness control located behind the front name plate need only be adjusted at the time of installation. The control is adjusted in conjunction with the contrast control. Turn the contrast control fully counter-clockwise. Then turn the brightness control clockwise until the picture tube just becomes dark. The contrast control may then be adjusted for proper picture quality.

H. and V. Hold Controls (R-94 and R-74).

For the best results the H. and V. Hold controls should be adjusted at low contrast levels. After a station has been tuned in, turn the contrast control fully counter-clockwise and then turn the brightness control clockwise until the picture reappears. Adjust the H. Hold control (if necessary) for a steady picture. Adjust the V. Hold control until the picture stops moving up or down. The controls should be set mid-way between positions where the picture is effected.

If you cannot obtain a steady picture at minimum contrast, turn the contrast control slightly clockwise.

After the H. and V. Hold controls have been properly set, they will not have to be used when tuning in a station.

Centering Control.

The centering control is located on the picture tube assembly (figure 2). This control is operated through the opening provided in the cabinet back. The control should be operated in the following manner.

1. Place a screwdriver in the centering tube.
2. Observe the face of the picture tube while making the adjustment.
3. Moving the control to the left will move the entire picture (looking at the face of the picture tube) upward.
4. Moving the control to the right will move the picture downward.
5. Moving the control up will move the picture to the left. Down will move the picture to the right.

V. Size and V. Linearity Controls (R-70 and R-80).

The V. Size and V. Linearity controls should both be adjusted at the same time while a test pattern is being transmitted. The Linearity control effects the upper portion of the picture while the Size control effects the lower portion of the picture. Adjust both the controls simultaneously until the test pattern is symmetrical and fills the entire screen vertically. Readjust the V. Hold control if necessary.

H. Size and H. Linearity Controls (L-24 and L-26).

The H. Size and H. Linearity controls should be adjusted only when a test pattern is being transmitted. The Size control should be adjusted until the test pattern fills the entire screen horizontally, and the Linearity control should be adjusted for a horizontal symmetrical test pattern. The H. Drive control must be readjusted after adjusting either the H. Size or H. Linearity controls.

Coarse and Fine Hold Controls (L-23 and R-94).

The coarse horizontal hold control should be adjusted in the following manner.

Set the Fine H. Hold control to the center of its range.

Set the contrast control to the normal operating position. Adjust the Coarse H. Hold control until there is a steady picture (no horizontal movement).

When the Coarse H. Hold control is adjusted properly, a fast turn of the Fine H. Hold control in either direction (clockwise or counter-clockwise) will make the picture go out of sync (only in low signal areas). Turning the Fine H. Hold control slowly in either direction should not make the picture go out of sync. If the Coarse H. Hold control is not adjusted properly, the horizontal sync will not come in immediately (or not at all) when the tuner is switched from one station to another.

Focus Control.

The permanent magnet focus assembly is essentially a magnet within an assembly so designed as to provide a flexible means of adjusting focus and centering on the face of the picture tube. Do not use a steel screwdriver or any magnetic material when adjusting the focus control. A non-magnetic material should be used, as a magnetic material will increase the flux density of the assembly and a correct adjustment cannot be obtained. This control is located on the picture tube assembly and can be operated through the hole provided in the cabinet back. A long adjusting tool is necessary for the adjustment.

There are two focus screws on the focus magnet assembly. The focus screw on the side is preset at the factory and should be all the way in. Only the top screw should be used for the focus adjustment.

Adjust the focus screw for the best focus. Reset the ion trap magnet and again re-focus the picture. If the focus is best at the edge turn the slug in, if best at center turn the slug out. Turn in or out until the best average focus is obtained and then reset the ion trap magnet.

H. Drive Control.

The H. Drive control is located next to the A.C. input at the rear of the chassis (figure 3). The control requires a small screwdriver for adjustment. The control should be adjusted in the following manner.

1. Tune in a station.
2. Turn the drive control counter-clockwise until a fold-over (white vertical line) appears at the left side of the picture.
3. Turn the drive control clockwise until the fold-over just disappears.
4. Turn the drive control one-half turn clockwise.

SERVICE DATA

SPECIFICATIONS

Sensitivity at the Antenna
Video — 100 microvolts
Audio — 100 microvolts

Power Supply Rating
115 volts, 50-60 cycles, AC, 235 watts.

Audio Output Rating
Undistorted — 3 watts.
Maximum — 4½ watts.

Speaker
Permanent magnet type,
3.2 ohm voice coil impedance.

Antenna Impedance Requirements
Balanced 300-ohm.

Dimensions
Chassis — 16" x 16¼" x 2¾".

WARNING.

High voltage on all pins of the 1X2 high voltage rectifier and the plate cap of the 6BG6. DO NOT MEASURE this voltage unless a high range voltmeter is used.

Replacing ¼ amp. Fuse.

To check or replace the fuse, first turn off the set. Remove the High Voltage shield cover, short the 6BG6 plate cap to chassis, and remove the 6W4 tube and then take out the fuse. Replace fuse and reverse procedure.

Schematic Diagram.

The schematic diagram located at the rear of the manual shows all the values of resistance and capacitance and gives all the proper voltages at the pins of the tube sockets. The voltage readings were taken with a 20,000 ohm/volt voltmeter with normal operation, no signal input, and line voltage at 117 V. A. C.

R. M. A. WIRE COLOR CODE

Listed below is a R. M. A. wire color code chart to aid in circuit tracing.

Wire Color	Where used
Black	B- or Ground leads
Brown	Filament leads
Red	B+ leads
Orange	Screen leads
Yellow	Cathode leads
Green	Grid or Control leads
Blue	Plate leads
Violet	Not used
Gray	A.C. leads
White	Bias leads

Replacing Tubes

Before replacing any tubes the cabinet back must first be removed. Removing the cabinet back disengages the safety interlock and removes the power to the receiver. Do not tamper with or attempt to defeat the purpose of the safety interlock.

Before replacing the High Voltage tubes first be sure the power is turned off and then short the plate caps of the 6BG6 and 1X2 tubes to the chassis.

WARNING: Do not remove any tubes while the receiver is in operation as overloading and component failures may result.

If the receiver has been in operation for some time, the tubes become hot and gloves should be used when replacing tubes to prevent finger burns.

Phono T V Switch.

The phono T V switch is located on the rear flange of the chassis and should be in the "off" position (up) for T V operation. In the "on" position there will be no sound or raster, and the audio input plug can be utilized.

COIL DC RESISTANCE CHART

The DC resistance readings shown in the chart below have been taken with an ohmmeter directly across the coil being measured. Only a few of the coils were disconnected to obtain a correct reading and these are indicated by an asterisk after the coil reference number. All the coils not listed in the chart have a DC resistance reading of approximately zero ohms.

COILS	RESISTANCE IN OHMS	COILS	RESISTANCE IN OHMS
L3	.8	T1 Pri.	1
L10	10	Sec.	1
L11	.2	T2 term 1 to 2	3.8
L12	.2	term 3 to 4	.1
L13	.2	term 3 to 6	.5
L14	.2	term 4 to 6	.5
L15	.2	T3 Pri.	500
L16	.2	Sec. (speaker out)	.4
L17*	.1	T4 Pri.	650
L18*	.1	Sec. (yoke plug out)	8
L19	1.5	T5A (yoke plug out)	60
L20	13	B (yoke plug out)	11
L21	19	T6 (6BG6 to 1X2)	560
L23	58	(6BG6 to term 1)	60
L24*	.2	(term 5 to 7)	5
L25	35	(term 5 to 6)	9.5
L26 (H. Lin.)	3.5	(term 1 to 2)*	1
L28	35	(term 1 to 3)	4
L30	23	(term 1 to 4)	7
		T7 Pri.	1
		Sec.	65
		T8	1.6
		T9 Pri.	192
		Sec.	1090

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MODEL 660,
Ch. 16AY210

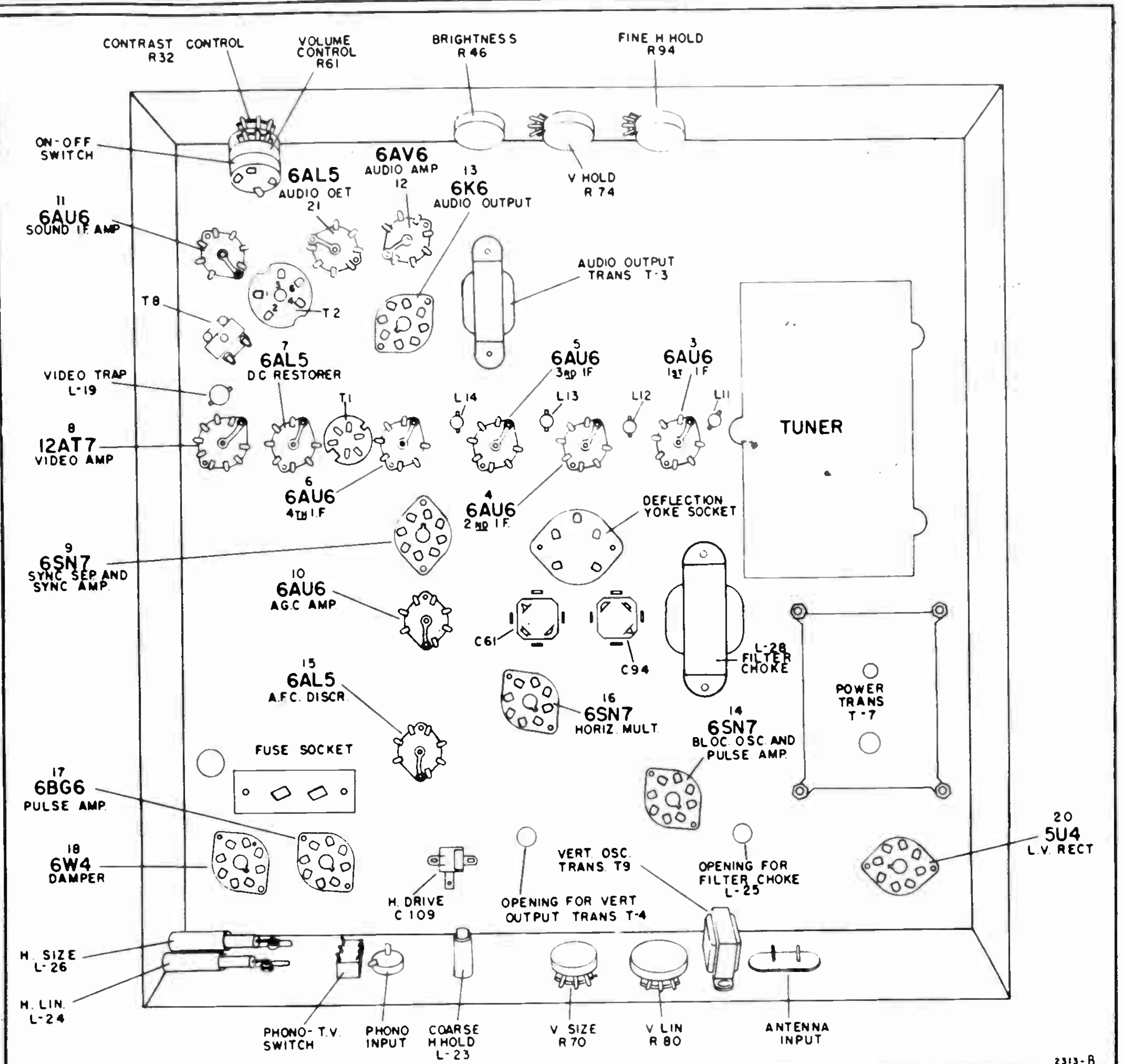

Figure 4. Bottom view of Chassis.

TELEVISION FREQUENCY RANGES

(All figures represent megacycles)

Channel	Channel Frequencies	Picture Carrier Frequency	Sound Carrier Frequency	Receiver RF Oscillator Frequency
Low Band				
2	54-60	55.25	59.75	82
3	60-66	61.25	65.75	88
4	66-72	67.25	71.75	94
5	76-82	77.25	81.75	104
6	82-88	83.25	87.75	110
High Band				
7	174-180	175.25	179.75	202
8	180-186	181.25	185.75	208
9	186-192	187.25	191.75	214
10	192-198	193.25	197.75	220
11	198-204	199.25	203.75	226
12	204-210	205.25	209.75	232
13	210-216	211.25	215.75	238

GENERAL DESCRIPTION

Tuner.

The tuner is composed of a separate sub-chassis using a 6AG5 (pentode) R.F. Amplifier and a 6J6 tube (twin triode) for the Oscillator and Converter. Separate high and low band coils and trimmers are used with a switching device to change bands. The tuner selects and amplifies the station signal and converts it to the carrier IF frequencies of 26.75 Mc for video and 22.25 Mc for sound which in turn is then fed to the IF amplifiers for further amplification.

Video IF Amplifiers.

The IF Amplifiers, video detector and DC restorer stages are all mounted on a sub-chassis. The IF amplifier section consists of four (4) stagger-tuned stages using 6AU6 (pentode) tubes with self-resonant slug tuned coils. Since the receiver is of the intercarrier type, both the video and sound IF frequencies are amplified simultaneously. The signal is then detected by one half of the 6AL5 (twin diode) and coupled to the video amplifier. The other half of the 6AL5 is used as the DC Restorer.

Sound Section.

The sound section is also mounted on a sub-chassis and consists of a 6AU6 (pentode) IF amplifier, 6AL5 (twin diode) detector, 6AV6 (triode) amplifier and a 6K6 (pentode) output tube. Due to the hetrodyne action between the video and sound IF frequencies a 4.5 mc signal is obtained containing the audio information. After the video detector, the audio information is separated from the video signal by the pick-off coil T8. The signal is then amplified, detected and further amplified by the 6AV6 and the 6K6.

Video Amplifier.

The video section is a conventional two stage amplifier using the 12AT7 (twin triode) tube. The parallel resonant video trap coil (L-19 and C-65) is tuned to 4.5 MC to separate the audio from the video. A combination of shunt and series peaking coils are used with a degenerative contrast control to vary the signal to the grid of the cathode-ray tube.

DC Restorer.

One half of the 6AL5 tube is used as the DC restorer. Since the video is coupled to the grid of the CRT by capacitor C-64 the DC component of video signal will not be passed, therefore the background level of the picture will vary. A bias voltage proportional to the average video signal level will be developed across resistor R-31 and maintain the proper brightness level.

Sync Separator and V. Sync Amplifier.

The sync pulses from the plate of the first video amplifier are coupled to the sync separator tube (½ of 6SN7) thru capacitor C-103. The sync pulses are then separated from the blanking pedestal and due to the low plate voltage sync clipping is accomplished. The horizontal pulses are coupled to the AFC Discriminator thru capacitor C-91 and the vertical pulses are coupled thru capacitor C-121 and amplified by the other half of the 6SN7 before being fed to the intergrating network of the vertical deflection circuit.

Vertical Deflection.

The vertical deflection circuit consists of a 6SN7 (twin triode) tube one half used as a blocking oscillator and the other half as a pulse amplifier. The V. Hold control varies the oscillators operation point thus providing an adustment for synchronization. The V. Size control varies the amplitude of the pulse to the grid of the amplifier and controls the amount of vertical deflection. Thus V. linearity control varies the cathode resistance thus changing the operating characteristics of the amplifier tube to obtain a linear sawtooth pulse. Therefore, it can be seen that the V. Size and V. Linearity controls must be operated in conjunction with one another.

AFC Discriminator.

The automatic frequency control section utilizes a 6AL5 (twin diode) tube. The sync separator feeds the horizontal sync pulses to the AFC tube while at the same time two voltages of opposite polarity are fed back from the horizontal deflection transformer. Any phase shift between the horizontal sync pulses and the horizontal multivibrator signal will cause the input voltage applied to one diode section to differ from that of the other. This results in a DC bias voltage applied to the grid of the multivibrator. The output of the AFC discriminator thus synchronizes the horizontal multivibrator to the horizontal pulse of the video signal. This arrangement improves horizontal stability and offers ease of operation.

Horizontal Multivibrator.

The horizontal multivibrator circuit (6SN7 tube) is of the conventional cathode coupled type using a parallel resonant circuit (L-23 and C-107) as a coarse hold adjustment to control the frequency of oscillation. The fine hold adjustment R-94 varies the grid resistance thus slightly controlling frequency of oscillation. The horizontal sawtooth pulse is then fed to the grid of the pulse amplifier.

Pulse Amplifier.

The horizontal drive control, C-109 in the grid circuit controls the amount of voltage applied to the pulse amplifier. (Increasing the capacity decreases the drive.) The 6BG6 is a beam tetrode used to develop the necessary power for the flyback pulse and the horizontal deflection coil. The Horizontal size coil, L-24 shunts a portion of the horizontal deflection transformer winding. Varying the inductance of the H. size coil varies the high voltage which in turn controls the size of the picture.

Damper.

The damper tubes (6W4) main function is to damp out oscillations which occur over part of the horizontal scanning cycle. The damper tube is connected in such a way as to give an increase in plate supply voltage for the vertical output amplifier. This additional voltage is developed across capacitor C-115 and gives an additional 90 volts increase in plate supply voltage. Varying the inductance of the H. Linearity coil, L-26 changes the damper tubes operating point and thus controls the linearity of the horizontal sweep.

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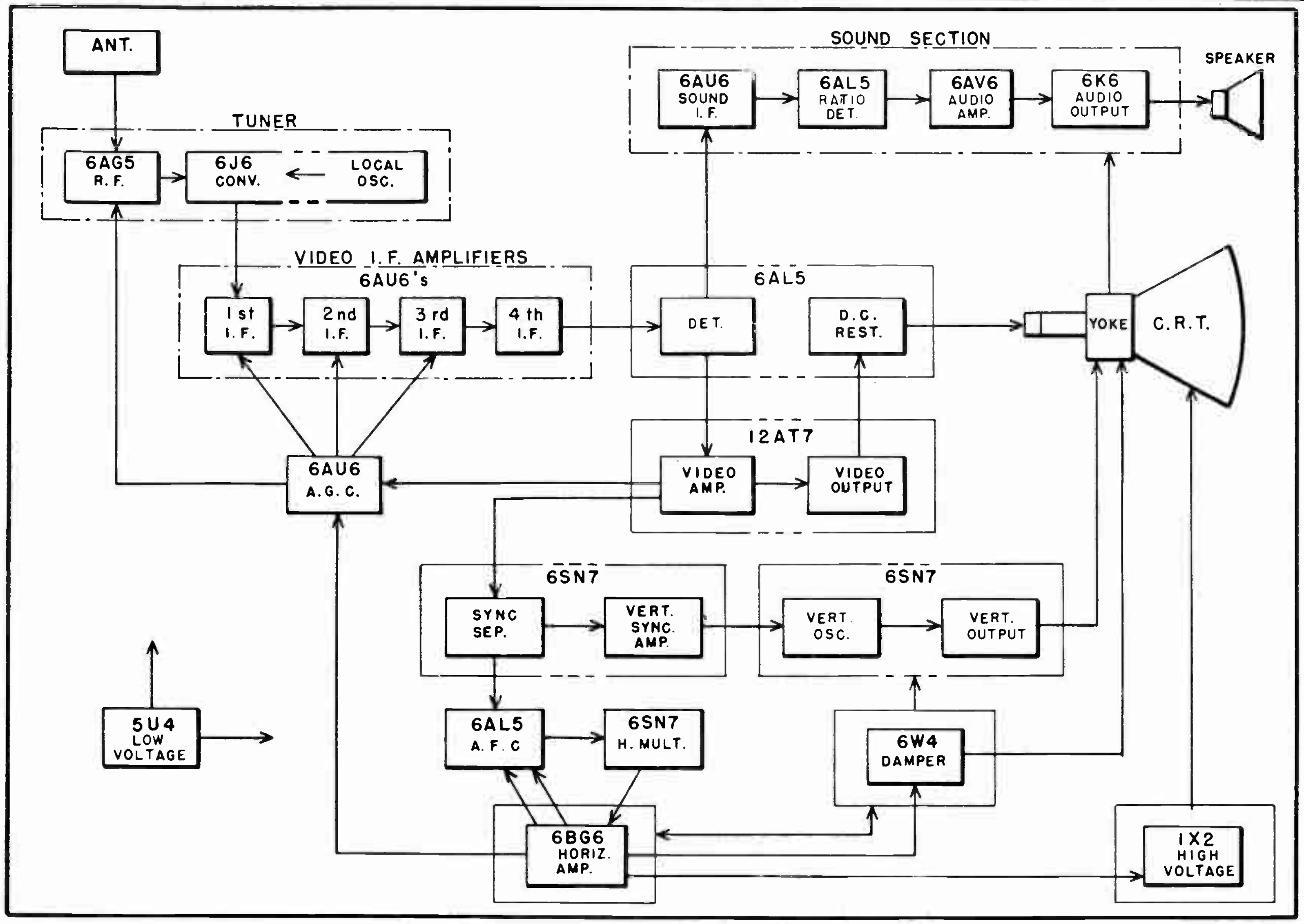

Figure 5. Block Diagram of the Receiver

GENERAL DESCRIPTION

High Voltage Supply.

The high voltage is obtained from the auto-transformer type primary winding of the horizontal output transformer. When the plate current of the pulse amplifier tube is cut off, the field built up in the primary winding collapses and induces a high voltage surge which is rectified by the 1X2 tube, filtered by the aqua-dag coating of the Cathode-ray tube and applied to the second anode.

Automatic Gain Control.

Plate voltage for the 6AU6 (pentode) gated AGC tube is obtained from a separate winding on the horizontal deflection transformer. The plate voltage is thus applied at a horizontal rate while the grid signal is obtained from the output of the first video amplifier. The AGC voltage is developed across resistor R-50 and fed to the first three IF amplifiers. Due to the divider network of R-44 and R51 only a portion of this voltage is fed to the RF amplifier. The AGC voltage will vary considerably according to the strength of the transmitted signal but should be in the vicinity of the voltage across R-37 (detector output).

SERVICE HINTS

Tuner.

If the receiver is "dead" and the picture tube shows nothing but a raster (no snow) first check the I.F. and video amplifier stages before looking into the tuner. If the set is dead and snow appears on the face of the picture tube, first determine whether a signal is being transmitted and then check the antenna or lead-in connections before suspecting the tuner for trouble.

The tuner can easily be serviced by removing the three (3) hex-head screws holding the bottom cover in place. Removing the bottom cover makes all the tuner components within easy reach and all parts can be serviced. When working inside the tuner do not move any component a great distance as a change in the distributed capacity will result and offset the alignment. When replacing components be sure to obtain the same lead lengths and replace the components in the same position.

A majority of tuner troubles are often open and high resistance ground or coil solder connections, defective trimmers or coils and defective contacts.

Open or high resistance connections can easily be repaired by placing a hot soldering iron at the solder connection.

Defective contacts may cause an intermittent condition or the loss of one or both bands. Contact replacement is easily accomplished by following the simple procedure on page 14, figure C.

The tuner should never be removed from the chassis unless contact replacement is necessary.
CAUTION:—If the 6AG5 (RF Amp.) is placed in the 6J6 (osc.-con.) socket resistors R-9 and R-10 will burn up.

Speaker Leads.

To insure minimum video interference, dress the speaker leads away from the 6AL5 (detector tube 7) as shown in figure 3, on page 3.

A.G.C.

A defective AGC system will not effect the sound but over-load the video amplifier circuit and the result will be a loss of both horizontal and vertical sync and very weak video. This condition can easily be noticed and checked by measuring the AGC voltage and the voltage across resistor R-37. Under normal operating conditions these two voltages will be approximately the same. A defective AGC system will cause a large increase in voltage across R-37 and a decrease in AGC voltage.

To determine the cause for trouble check the 6AU6 tube, capacitors C-70 and C-59 and resistors R-44, R-50, R-51 and R-107. To check the AGC winding of the horizontal deflection transformer, place a scope on pin 5 of AGC tube and a horizontal pulse similar to wave shape number 20, on page 13, should be obtained with a peak-to-peak voltage of 400 volts.

CORRESPONDING CATHODE-RAY TUBES

Due to the fact that 16RP4 and 16TP4 Cathode-Ray tubes from various suppliers are not directly interchangeable, different focus or ion trap magnets must be used. A B.R.C. part number sticker will be pasted on the tubes coating in 16AY210 chassis. When replacement is necessary be sure to state the B.R.C. part number of the picture tube. This is necessary as a supplier may manufacture two of the same RMA tube types which will differ in construction.
Listed below is a chart showing the various 16-inch rectangular tubes used in the 16AY210 chassis.

SUPPLIER	BRC NUMBER	FOCUS MAGNET	ION TRAP MAGNET
Raytheon	C-55W-19341	A-55P-19336	B-16M-19337
Sylvania	" 19344	" 19336	" 19343
Martin	" 19345	" 18915	" 18623
Raytheon	" 19362	" 19336	" 18623
Martin	" 19362	" 19336	" 18623
Thomas	" 19426	" 18915	" 19343
Arcturus	" 19345	" 18915	" 18623

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TROUBLE-SHOOTING

Trouble	Probable Location
No Raster No Sound	1. Phono TV switch defective or in "ON" position. 2. Defective 5U4 tube (20). 3. Defective power transformer (T-7). 4. Defective filter choke (L-25 or L-28). 5. Defective filter condenser (C-61 or C-94) 6. Defective fuse.
No Raster Sound Normal	1. High voltage lead disconnected. 2. Ion trap magnet incorrectly positioned. 3. Yoke plug not in place or loose. 4. Insufficient or no high voltage, (refer to "No high voltage section"). 5. Defective resistors R46-47-48-100 and capacitor C-67. 6. Defective picture tube.
No Picture No Sound Raster Normal	1. Defective antenna or lead-in. 2. Defective tubes 1 through 7, or associated circuits. 3. Improper voltages or resistances at sockets of tubes 1 through 7. 4. Improper alignment.
No Sound Picture Normal	1 Defective tubes 11, 12, 13, and 21 or associated circuits. 2. Improper voltages or resistances at sockets of tubes 11, 12, 13 and 21. 3. Speaker leads broken or not in place. 4. Improper alignment of transformer T2, T8 (see page 14).
No Picture Raster Normal Sound Normal	1. Defective tubes 7, 8, 10. 2. Improper voltages or resistances at sockets of tubes 7, 8, 10. 3. Defective capacitors C-64-70, and L-20-21-30.
No Sync	1. Defective tubes 8, 9, 10. 2. Defective capacitors C-103, 121 and resistors R-45, 114.
No Vertical Sync Picture otherwise normal	1. Defective capacitors C-71, C-90, C-95. 2. Defective tube 9. 3. Defective resistors R-73, R-77, R-88.

Trouble	Probable Location
No Horiz. Sync Picture otherwise normal	1. Defective tubes 15, 16. 2. Defective resistors R-81-82-83-84-85-86-87, and capacitors C-91-98-99-100-101-102-105-125. 3. Defective Horizontal transformer T-6.
No Vertical Sweep	1. Defective tube 14. 2. Defective transformers T-9, T-4, T-5A. 3. Defective capacitors C-92, 95, 116 and resistors R-75, 78.
Picture cannot be Centered	1. Defective ion trap magnet. 2. Defective focus magnet. 3. Defective picture tube. 4. Defective capacitor C-114.
Picture cannot be Focused	1. Focus magnet not properly located or centered on the picture tube neck. 2. Ion trap magnet not properly adjusted or defective. 3. Defective picture tube. 4. Improper high voltage.
No High Voltage	1. Defective tubes 16, 17, 18, 19. 2. Defective transformer T-6, yoke T-5B. 3. Defective capacitors C-108, 112, 113, 114 or resistors R-90 through R-98 and R-112-118-119-120.
Bunching or folding at side of Picture	1. Improper adjustment of horizontal drive control C-109. 2. Defective tubes 17, 18. 3. Defective C-115 or H. Linearity coil.
Audio in Picture	1. Improper alignment and ratio of video carrier to sound response (see page 14).
Snow or poor Signal	1. Improper adjustment of antenna tuning knob (see page 6). 2. Cabinet (built-in antenna) not properly oriented. 3. Check alignment of C-1 and C-2 (see page 15). 4. Insufficient signal input. 5. Defective capacitors C-59, C-62 or peaking coil L-21.

WAVE FORM ANALYSIS

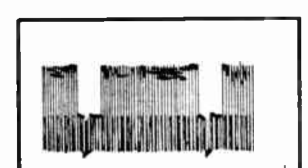
The drawings in this section illustrate the wave shapes at various positions within the set. These wave shapes are not theoretical but exact copies of the oscilloscope wave shapes taken with a transmitted signal.

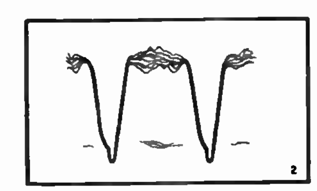
The peak-to-peak voltage indicated was measured by a calibrated oscilloscope under typical operating conditions. When analyzing a particular wave shape, the peak-to-peak voltage may vary somewhat depending upon the setting of the contrast control and the strength of the signal. The wave shapes may vary somewhat in video section depending on the picture being transmitted.

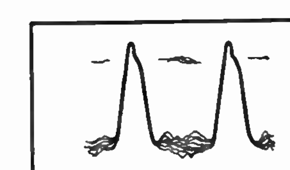
When checking these wave shapes connect the ground lead from the oscilloscope to the chassis and the hot lead to the position shown in the chart.

The chart below lists the test point, peak-to-peak voltage and the corresponding wave shape number. Under each drawing is the type of wave shape referring either to a Horizontal (15,750 cycles) or Vertical pulse (60 cycles).

Test Point	Taken At	Peak-to-peak Voltage	Wave Form Number
1	Pin 7 of Tube 7	8	1 and 2
2	Pin 7 of Tube 8	8	1 and 2
3	Pin 6 of Tube 8	42	3 and 4
4	Pin 2 of Tube 8	12	3 and 5
5	Pin 1 of Tube 8	32	1 and 2
6	Pin 4 of Tube 9	26	3 and 5
7	Pin 5 of Tube 9	11	6
8	Pin 1 of Tube 9	11	6
9	Pin 2 of Tube 9	40	7
10	Pin 5 of Tube 10	410	20
11	Junction of R77 and C90	13	8
12	Junction of C90 and C95	27	9
13	Pin 1 of Tube 14	40	10
14	Pin 2 of Tube 14	76	11
15	Pin 4 of Tube 14	28	12
16	Pin 5 of Tube 14	650	13
17	Pin 5 of Yoke Socket	42	13
18	Pin 1 of Tube 15	8	14
19	Pin 2 of Tube 15	7	22
20	Pin 7 of Tube 15	11	21
21	Pin 4 of Tube 16	1	15
22	Pin 5 of Tube 16	48	16
23	Pin 1 of Tube 16	32	17
24	Pin 2 of Tube 16	45	18
25	Pin 5 of Tube 17	50	18
26	Pin 5 of Tube 18	1500	19

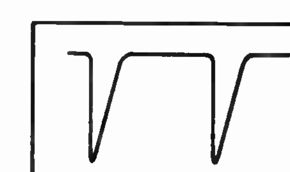

1. Vertical Pulse


2. Horizontal Pulse


3. Horizontal Pulse


4. Vertical Pulse


5. Vertical Pulse


6. Horizontal Pulse

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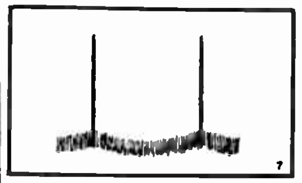
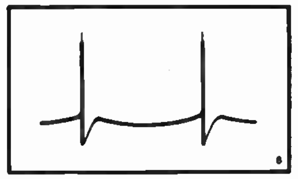
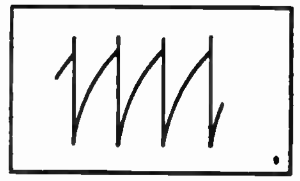
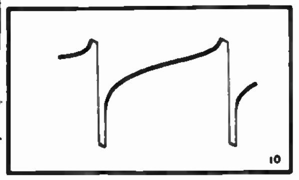
WAVE FORMS


7. Vertical Pulse


8. Vertical Pulse


9. Vertical Pulse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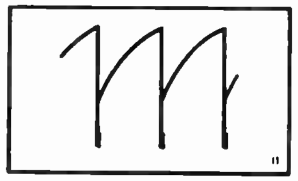
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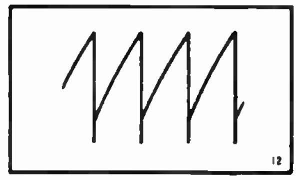
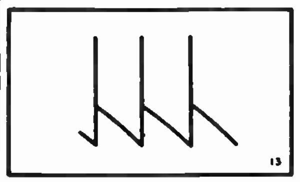
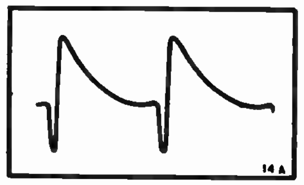
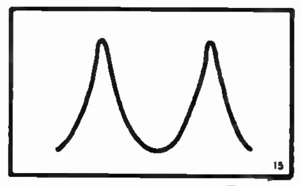
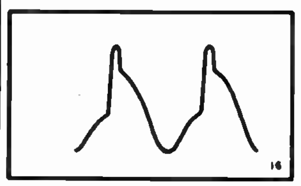
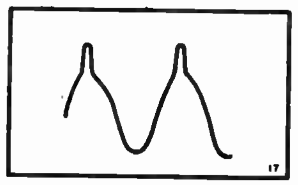

12. Vertical Pulse


13. Vertical Pulse


14. Horizontal Pulse


15. Horizontal Pulse


16. Horizontal Pulse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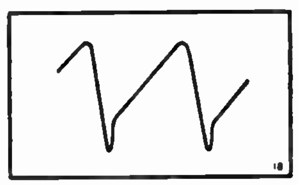
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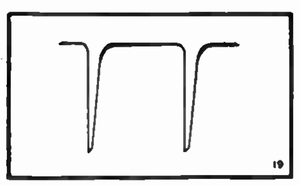
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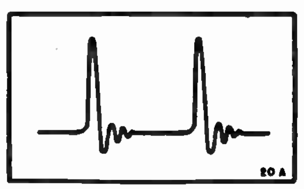
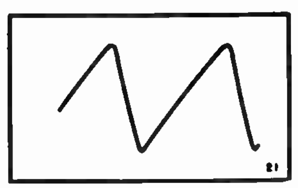
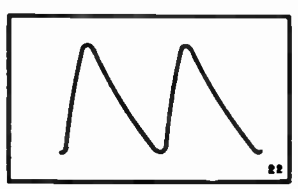
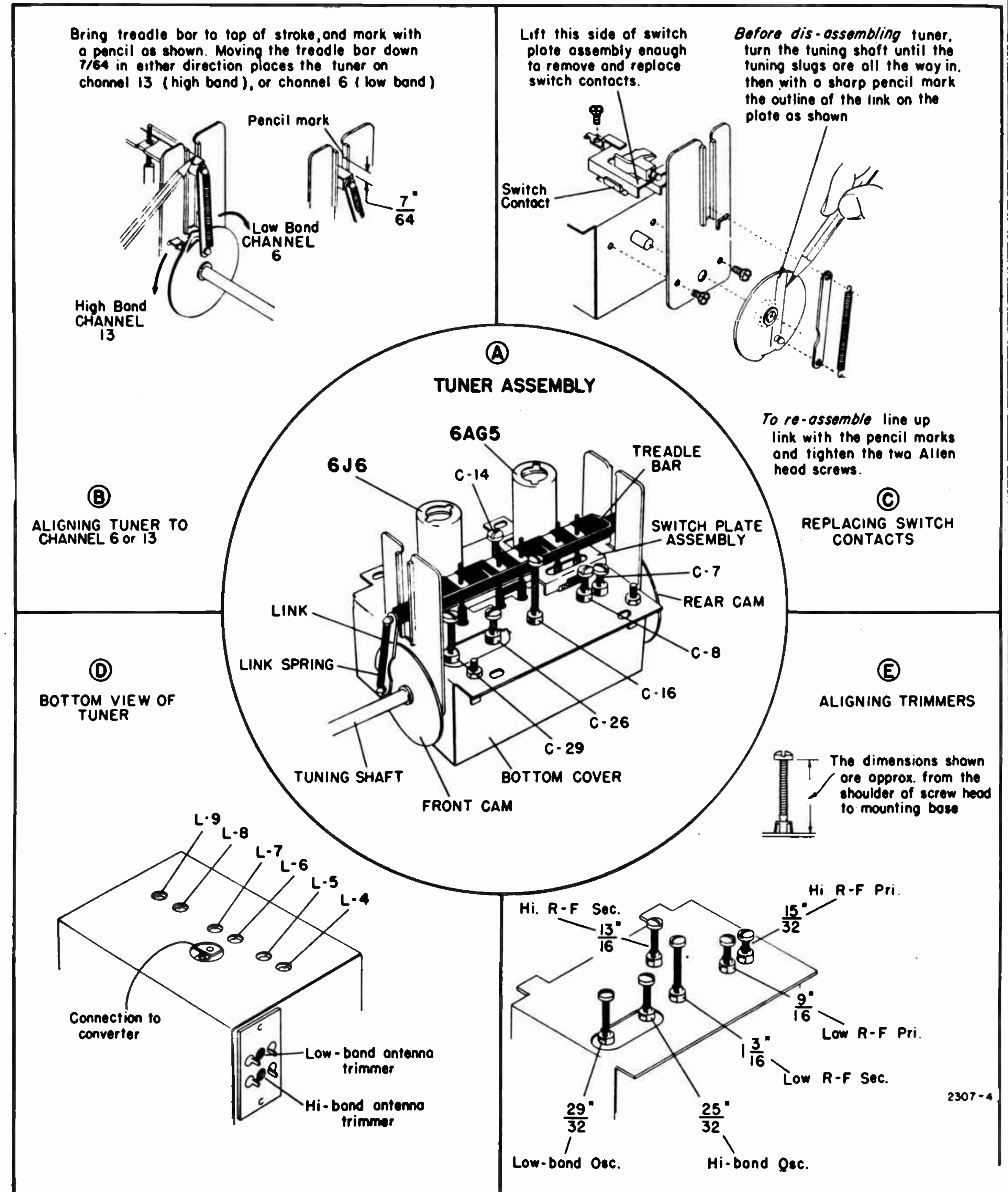

20. Horizontal Pulse


21. Horizontal Pulse


22. Horizontal Pulse



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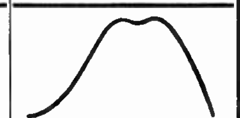
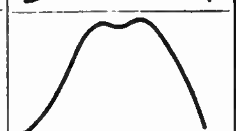
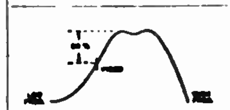
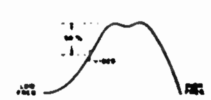
TUNER ALIGNMENT

1. Preset trimmer screws C7, 8, 14, 16, 26, 29 to dimensions shown on page 14, figure E.
2. Preset coil cores L4, 5, 6, 7, 8, 9 in the following manner.
   (a) In low band position, turn tuner shaft to top of stroke as on page 14, figure B.
   (b) The switch will be in low band position.
   (c) Adjust coil cores 1.6" from core to coil mounting strip. (Use core aligning tool if available).
   (d) Turn L-9 core (low band oscillator) an additional four (4) turns out of coil.

LOW BAND TRACKING

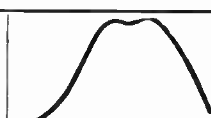
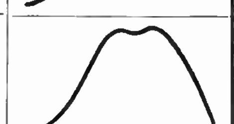
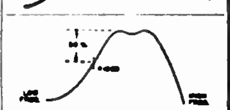
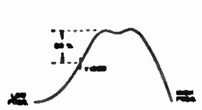
Turn tuner to channel 6. See page 12, figure B.

Step No.	Signal Generator Freq. (mc.)	Sweep Generator Freq. (mc.)	Signal Input Point	Output Point	Adjust	Remarks	Response
1	——	Channel 6	Antenna Terminals	Scope across R-37	C-2	Adjust for maximum response with symmetrical peaks	
2	——	Channel 6	Antenna Terminals	Scope across R-37	C-8 C-16	Adjust for maximum response with symmetrical peaks	
3	83.25	Channel 6	Antenna Terminals	Scope across R-37	C-29	Adjust until marker is 50% down on low frequency slope. Repeat step 2 if necessary.	
4	(a) 61.25 (b) 67.25 (c) 77.25 (d) 55.25	(a) Channel 3 (b) Channel 4 (c) Channel 5 (d) Channel 2	Antenna Terminals	Scope across R-37	C-8 C-16	Adjust tuner until response curve appears on scope. Adjust trimmers for compromise which will give the best overall response across band.	

NOTE: If trimmer C-8 reaches maximum and additional capacity is needed, turn L-5 core, into coil.

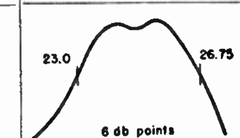
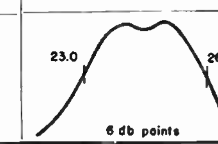
HIGH BAND TRACKING

Turn tuner to channel 13. See page 12, figure B.

Step No.	Signal Generator Freq. (mc.)	Sweep Generator Freq. (mc.)	Signal Input Point	Output Point	Adjust	Remarks	Response
1	——	Channel 13	Antenna Terminals	Scope across R-37	C-1	Adjust for maximum response with symmetrical peaks	
2	——	Channel 13	Antenna Terminals	Scope across R-37	C-7 C-14	Adjust for maximum response with symmetrical peaks	
3	211.25	Channel 13	Antenna Terminals	Scope across R-37	C-26	Adjust until marker is 50% down on low frequency slope. Repeat step 2 if necessary.	
4	(a) 205.25 (b) 199.25 (c) 193.25 (d) 187.25 (e) 181.25 (f) 175.25	(a) Channel 12 (b) Channel 11 (c) Channel 10 (d) Channel 9 (e) Channel 8 (f) Channel 7	Antenna Terminals	Scope across R-37	C-7 C-14	Adjust tuner until response curve appear on scope. Adjust trimmers for compromise which will give the best overall response across band.	

VIDEO IF ALIGNMENT

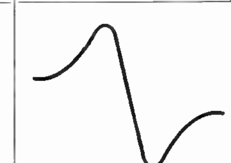
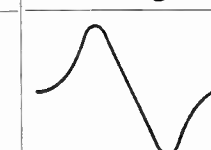
Turn to any high band channel. Connect the generator thru a 1000 mmf capacitor and set the contrast control to maximum

Step No.	Signal Generator Freq. (mc.)	Sweep Generator Freq. (mc.)	Signal Input Point	Output Point	Adjust	Remarks	Response
1	26.4	——	Converter Grid	VTVM across R-37	L-11 L-13	Adjust generator output approx. 1 volt	Maximum Reading
2	23.4	——	Converter Grid	VTVM across R-37	L-12 L-14	Adjust generator output approx. 1 volt	Maximum Reading
3	25.0	——	Converter Grid	VTVM across R-37	T-1	Adjust generator output approx. 1 volt	Maximum Reading
4	25.0	——	Converter Grid	VTVM across R-37	——	SENSITIVITY Generator output should be less than 100 microvolts. (If not, repeat alignment).	1 volt VTVM Reading
5	26.75 23.0	25.0	Converter Grid	Scope across R-37	——	SELECTIVITY Markers should be as shown in response column. (If not, repeat alignment).	
6	——	Channels 2-4-6-8-10-12	Antenna Terminal	Scope across R-37	T-1 for flat response	Check channels for band width (3.5 to 4 mc. at 6db points).	

Picture I.F. frequency 26.75 mc — Sound I.F. frequency 22.25 mc.

SOUND I-F ALIGNMENT

Short antenna to ground and connect generator thru a 1000 mmf capacitor.

1	4.5	——	Pin 1 of Tube 11	VTVM junction of R-59 and C-77	T-8 and T-2 primary (bottom of can)	——	Maximum Reading
2	——	4.5	Pin 1 of Tube 11	Scope junction of R-58 and C-77	T-2 secondary (top of can)	Sweep approx. 100 kc. Adjust for max linearity	
3	——	4.5	Pin 1 of Tube 11	Scope junction of R-58 and C-77	T-2 primary (bottom of can)	Sweep approx. 100 kc. Adjust for symmetry of peaks	
4	4.5	——	Pin 1 of Tube 11	VTVM junction of R-58 and C-77	——	Generator output should be less than .01 volt	.05 watt output

Video trap Coil (L-19) Adjustment.

(a) Tune in a station.
(b) Adjust the tuner until sound bars just appear.
(c) Turn L-19 slug all the way out (counter-clockwise).
(d) Turn the slug in (clockwise) until the horizontal scanning lines are smooth and continuous.

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World Radio History

REPLACEMENT PARTS LIST

When ordering parts or writing, always mention model number, series, serial number and RMA date code number.

TUNER

Capacitors

Ref. No.	Part No.	Description
C3	A-8G-13962	Ceramic, .005 mfd
C4-30	C-8G-16045	Ceramic, 220 mmf, 20%
C5-12-15-21	C-8G-13201	Ceramic, 1000 mmf
C6	C-8G-17305	Ceramic, 12 mmf, 10%
C7-8-14-16-26-29	B-201-15142	Trimmer capacitor (5-10 mmf)
C9	A-8G-12495-7	Ceramic, .5 mmf
C11	A-8G-12495-4	Ceramic, 1.5 mmf
C13	C-8G-11893	Ceramic, 4 mmf, ± 1/4 mmf
C18-22	A-8G-11891	Ceramic, 51 mmf, 5%
C19-20	A-8G-12495-4	Ceramic, 2.2 mmf
C23	C-8G-15737	Ceramic, 2.5 mmf 20%
C24	C-8G-15224	Ceramic, 7 mmf, ± 1/2 mmf

Resistors

Ref. No.	Part No.	Description
R1	C-9B1-60	680 ohms, 1/2 watt, 10%
R4-8-11	C-9B1-74	10K ohms, 1/2 watt, 10%
R5	C-9B1-48	68 ohms, 1/2 watt, 10%
R6	C-9B1-13	1000 ohms, 1/2 watt, 20%
R7-9	C-9B1-71	5600 ohms, 1/2 watt, 10%
R10	C-9B1-54	220 ohms, 1/2 watt, 10%
R12-13	C-9B1-38	10 ohms, 1/2 watt, 10%

Chokes, Transformers, Coils

Ref. No.	Part No.	Description
L1-2 (incl. C1-2, R2)	B-201-17143	Antenna transformer assembly
L3	A-16A-17128	R.F. choke
L4-6-8	B-13E-17140	High band coils, Osc., RF pri., RF sec.
L5-7	B-13E-12046	Low band coils, RF pri., RF sec.
L-9	B-13D-12155	Low band coil, oscillator

Miscellaneous

Ref. No.	Part No.	Description
	A-51A-15715	Iron core, for L5
	A-51A-17162	Iron core, for L6
	A-51A-17161	Iron core, for L7
	A-51A-15713	Iron core, for L4-8-9
	A-15C-10717	Tube socket, 7-prong, miniature
	A-2M-16276	Core mounting clip
	A-2H-11494	Tube shield
	B-200-18825	Shaft assembly
	B-5M-18807	Treadle bar
	A-200-18824	Rear switch plate assembly
	A-49A-18799	Link spring
	A-2H-12337	Tube shield base
	A-7M-15510-1	Coil alignment strip
	A-2J-16310	Sliding contact
	A-5F-16311	Contact holder
	B-200-18840	Switch lever assembly
	C-2E-15486-1	Bottom cover

VIDEO I-F STRIP ASSEMBLY

Capacitors

Ref. No.	Part No.	Description
C34	A-8G-13962	.005 mfd, disc type
C35-37-38-40-41-42-44-45-46-47-49-50-51-54-57-63	C-8G-13201	1000 mmf, ceramic
C36	C-8F3-8	100 mmf, mica
C39-43-48	C-8F3-109	47 mmf, mica
C55	C-8G-12166	5 mmf, ceramic
C120	C-8G-11790	7 mmf, ceramic

Resistors

Ref. No.	Part No.	Description
R15-17-19-21-23-25-27	C-9B1-13	1000 ohms, 1/2 watt, 10%
R16-24	C-9B1-73	8200 ohms, 1/2 watt, 10%
R18-22-26	C-9B1-49	82 ohms, 1/2 watt, 10%
R20-29	C-9B1-70	4700 ohms, 1/2 watt, 10%
R28	C-9B1-51	120 ohms, 1/2 watt, 10%
R30	C-9B1-77	18K ohms, 1/2 watt, 10%
R31	C-9B1-98	1 megohm, 1/2 watt, 10%
R33	C-9B2-84	68K ohms, 1 watt, 10%
R40	C-9B1-50	100 ohms, 1/2 watt, 10%
R41	C-9B1-78	22K ohms, 1/2 watt, 10%
R59	C-9B1-71	5600 ohms, 1/2 watt, 10%

Chokes, Transformers, Coils

Ref. No.	Part No.	Description
T1	B-13B-18784	Output IF coil
L10	A-16A-18025	Plate choke coil
L11	A-13M-18026	Converter coil
	A-51A-17966	Iron core (for above)
L12-13-14	B-201-15612	Stagger tuned coil
	A-51A-17966	Iron core (for above)
L15	A-201-15608	Choke coil assembly
L17	A-201-15609	Filament choke
L18	A-16A-17937	RF choke

Miscellaneous

Ref. No.	Part No.	Description
	A-15C-16007	7-pin, miniature tube socket
	B-43D-17860	Coil tube fastener
	A-2H-10974	Tube shield

AUDIO STRIP ASSEMBLY

Capacitors

Ref. No.	Part No.	Description
C73	A-8G-12495-5	3.3 mmf, ceramic
C74-82	A-8G-13962	.005 mfd, ceramic disk
C76	C-8D-17958	.004 mmf x 400 volts
C79	C-8F3-122	560 mmf x 20%
C80	C-8D-17258	.01 mfd x 200 volts
C81-83	A-8C-17183	10 mmf x 50 volts
C84	C-8D-17270	.01 mfd x 400 volts
C85	C-8D-10789	.002 mfd x 600 volts
C88	C-8G-16049	2000 mmf, ceramic

Resistors

Ref. No.	Part No.	Description
R55-66	C-9B1-90	220K ohms, 1/2 watt, 10%
R56	C-9B1-51	120 ohms, 1/2 watt, 10%
R58	C-9B1-79	27K ohms, 1/2 watt, 10%
R60	C-9B1-82	47K ohms, 1/2 watt, 10%
R62	C-9B1-37	10 megohms, 1/2 watt, 20%
R63	C-9B2-60	680 ohms, 1 watt, 10%
R64	C-9B1-78	22K ohms, 1/2 watt, 10%
R65-66	C-9B1-29	470K ohms, 1/2 watt, 20%
R115	C-9B1-66	2200 ohms, 1/2 watt, 10%

Miscellaneous

Ref. No.	Part No.	Description
T2	B-13M-19257	Ratio detector coil
T8	B-13A-18783	Pick-off coil
	A-15C-16007	7-pin, minature tube socket
	A-15B-10440	Octal tube socket

HIGH VOLTAGE POWER SUPPLY

Ref. No.	Part No.	Description
T6	C-12M-19407	H. V. Deflection transfomer
	A-5M-18733	Standoff insulator
	A-62D-18734	Hi-Voltage ring
	B-29G-3217	Vellutex washers
	A-15C-18735	1X2 tube socket
	B-14C-19133	H. V. lead assembly
	A-2M-18193	Power supply clamp
	C-2B-19184	Shield can
	A-46B-18033	1/4 ampere, 250 volt fuse
	A-55F-18024	Fuse mounting
	B-2M-11382	Cable clamp

REPLACEMENT PARTS LIST

MAIN CHASSIS

Capacitors

Ref. No.	Part No.	Description
C59	B-8C-19424	5 mfd x 50 volts
C60	C-8F3-111	100 mmf, mica
C61-A-B-C	A-8C-18487	30-30 mfd x 450 volts, 120 mfd x 25 volts
C62	C-8D-17270	.01 mfd x 400 volts
C64-113	C-8D-10983	.1 mfd x 600 volts
C67	C-8D-10760	.1 mfd x 400 volts
C70-121	C-8D-17259	.1 mfd x 200 volts
C71	C-8D-10761	.01 mfd x 400 volts
C77	C-8D-17258	.01 mfd x 200 volts
C78-98	C-8D-17268	.02 mfd x 200 volts
C90	C-8D-10935	.005 mfd x 600 volts
C91-103-125	C-8F3-121	470 mmf, mica
C92	C-8D-13439	.25 mfd x 400 volts
C93	C-8D-14461	.05 mfd x 400 volts
C94-A-B-C	A-8C-17845	10-30-60 mfd x 450 volts
C95	C-8D-10774	.02 mfd x 400 volts
C99-102-108	C-8F3-117	220 mmf, mica
C100-101	C-8F3-123	680 mmf, mica
C105	C-8D-10778	.002 mmf x 600 volts
C106	C-8D-10771	.1 mfd x 200 volts
C107	C-8F11-132	3900 mmf, mica
C111	C-8F3-120	390 mmf x 500 volts, mica
C112	C-8D-12020	.001 mfd x 600 volts
C114	C-8D-11270	.5 mfd x 200 volts
C115	A-8C-11495	10 mfd x 150 volts
C116-129	A-8C-13453	8 mfd x 450 volts
C119	C-8F6-125	1000 mmf, mica
C126-110	C-8G-12198	47 mmf

Resistors

Ref. No.	Part No.	Description
R34	C-9B1-74	10K ohms, 1/2 watts, 10%
R35	C-9B1-70	4700 ohms, 1/2 watt, 10%
R36-84-85-89-107	C-9B1-102	2.2 megohms, 1/2 watt 10%
R38	C-9B2-64	1500 ohms, 1 watt, 10%
R39	C-9B4-70	4700 ohms, 2 watts, 10%
R42	C-9B1-106	4.7 megohms, 1/2 watt, 10%
R44-47-113	C-9B1-84	68K ohms, 1/2 watt, 10%
R45	C-9B4-84	68K ohms, 2 watts, 10%
R48-79-125-126	C-9B1-62	1000 ohms, 1/2 watt, 10%
R50	C-9B1-66	2200 ohms, 1/2 watt, 10%
R51	C-9B1-80	33K ohms, 1/2 watt, 10%
R71-37	C-9B1-69	3900 ohms, 1/2 watt, 10%
R72	C-9B1-100	1.5 megohms, 1/2 watt, 10%
R73-81	C-9B1-82	47K ohms, 1/2 watt, 10%
R75	C-9B1-98	1 megohm, 1/2 watt, 10%
R76-82-97-104	C-9B1-94	470K ohms, 1/2 watt, 10%
R77	C-9B1-83	56K ohms, 1/2 watt, 10%
R78-87-92-106	C-9B1-90	220K ohms, 1/2 watt, 10%
R88	C-9B2-82	47K ohms, 1 watt, 10%
R83-86	C-9B1-88	150K ohms, 1/2 watt, 10%
R90	C-9B1-64	1500 ohms, 1/2 watt, 10%
R91	C-9B2-71	5600 ohms, 1 watt, 10%
R93-100	C-9B1-86	100K ohms, 1/2 watt, 10%
R96	C-9B1-54	220 ohms, 1/2 watt, 10%
R98	C-9B2-72	6800 ohms, 1 watt, 10%
R101	C-9C14-1099	1000 ohms, 10 watts, 10%
R102	C-9C14-1100	1200 ohms, 10 watts, 10%
R108	C-9C12-1104	2700 ohms, 5 watts, 10%
R114	C-9B1-73	8200 ohms, 1/2 watt, 10%
R123	C-9B4-21	22K ohms, 2 watts, 20%

Chokes, Transformers, Coils

Ref. No.	Part No.	Description
T3	B-12C-18743	Audio output transformer
T4	B-12C-19048	Vertical output transformer
T5A-B	B-13M-18888	Deflection yoke
T7	C-12A-18839	Power transformer
T9	B-12M-18241	Vertical oscillator transformer
L16	A-16A-17961	Peaking coil
L19 (incl. C65)	A-201-19363	Video trap and coil assembly
	A-51A-17966	Iron core for above
L20-21	A-16A-18685	Peaking coil
L25-28	B-16A-17959	Filter choke

Controls

Ref. No.	Part No.	Description
C109	A-8E-18508	H. Drive (80-480 mmf trimmer)
L23	A-13D-19355	Coarse H. Hold coil
L24	A-13M-18233	H. Size coil
L26	A-13M-19320	H. Linearity coil
R32-61	A-10A-18441	Dual control and switch Contrast (5K ohms); Volume (1 megohm)
R46-94	A-10B-17764	Brightness and H. Hold control, 5K ohms
R70	A-10B-18240	V. Size control, 750K ohms
R74	A-10B-17275	V. Hold control, 100K ohms
R80	A-10B-17766	V. Linearity control, 5K ohms

Miscellaneous

Ref. No.	Part No.	Description
	A-2M-19325	Tube clamp
	A-19B-11044	Phono receptacle
	A-19A-12465	Phono plug
	A-20F-12108	Phono TV switch
	A-2D-19159	R. H. tube bracket
	A-2D-19157	L. H. tube bracket
	A-25B-18536	Rubber bumper
	A-2M-18808	Tube strap
	A-2M-18790	Tube strap
	A-2D-18542	Tube strap bracket
	A-25M-16992	Rubber strap
	C-2D-18775	Deflection coil mounting bracket
	A-25H-18363	Tube gasket
	A-38A-18283-1	Anode retainer
	B-2M-11382	Cable clamp (H. V.)
	B-2D-17237	Deflection coil support bracket
	A-23M-16744	Wing nut, 8-32x7/16 (yoke)
	A-15C-17983	9-pin, tube socket
	A-15C-16007	7-pin, tube socket
	A-15B-10440	Octal tube socket
	B-15B-14274	Yoke socket
	A-19A-14275	Yoke plug
	B-15B-17278	C.R.T. socket and cable assembly
	A-7B-13050	Antenna terminal board
	B-43D-17860	Coil tube fastener
	A-51A-17966	Iron core for L-19
	A-51A-16945	Iron core for L23-24-26
	A-49A-19012	Springs for L-24-26
	A-3M-18885	Centering tube
	B-29J-18887	Rubber washer
	A-3M-18274	Groove pin
	B-55A-18896	Vinyl tubing
	N-201-18386	Inside antenna assembly
	A-8E-18360	Adjustable trimmer
	A-3A-18380	Trimmer shaft
	A-13M-18359	Matching coil
	C-13E-18514	Antenna dipole
	A-3C-18496	Stud
	A-2D-19390	Reinforcing bracket
	B-55P-19336	Focus magnet
	B-55P-18915	Focus magnet
	B-16M-19337	Ion trap magnet
	B-16M-19343	Ion trap magnet
	B-16M-18623	Ion trap magnet

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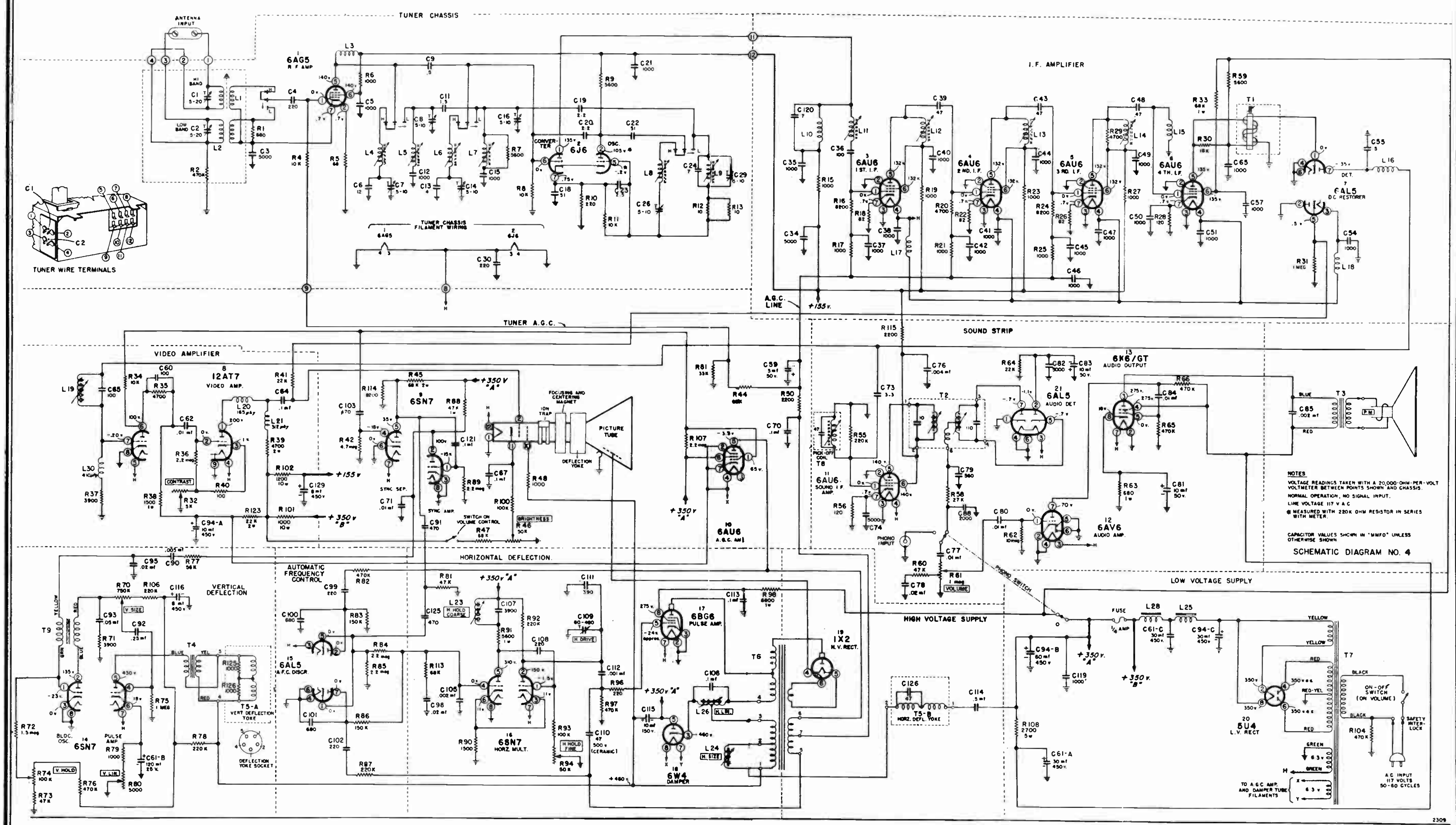

NOTE: Resistor R98 should be 4700 ohms, 1 watt.

16AY210 SCHEMATIC DIAGRAM

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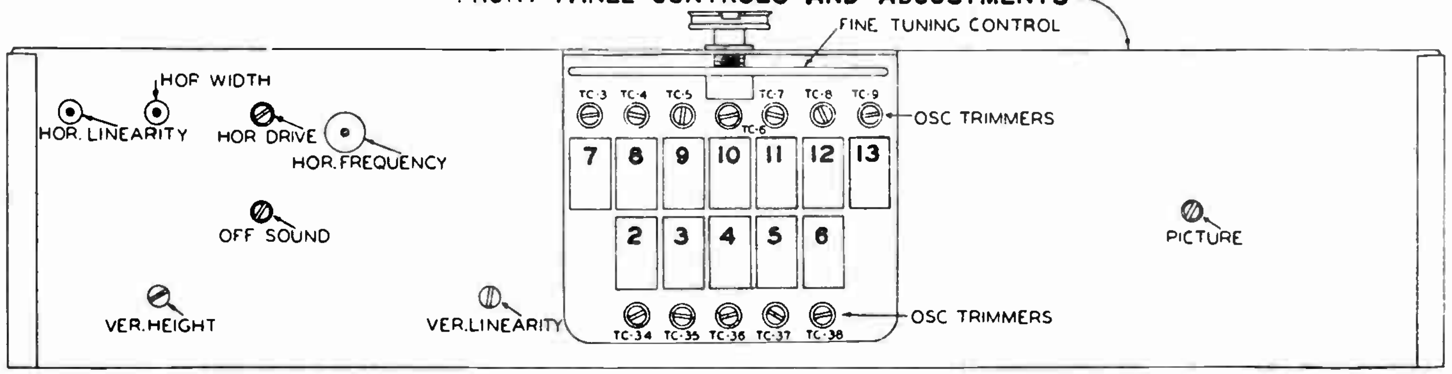
World Radio History

FRONT PANEL CONTROLS AND ADJUSTMENTS



FIGURE—1

REAR PANEL CONTROLS AND ADJUSTMENTS

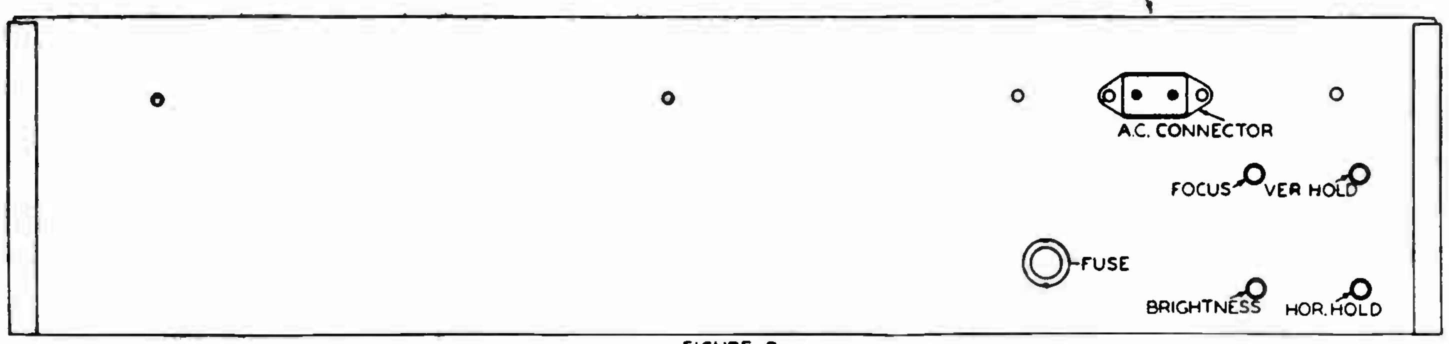


FIGURE-2

INSTALLATION AND SERVICE INSTRUCTIONS

Service and adjustment controls are located on both the front and rear aprons of the chassis. (See Fig. #1 & #2.) The front controls are accessible by removing the two round control knobs. It will not be necessary to remove the push buttons. Lift the control panel straight up so that the bottom of the panel comes out of the bottom groove in the cabinet. Pull the control panel down at an angle at the bottom so that the top of the panel comes out of the top groove. When reinstalling the panel reverse the foregoing procedure.

HORIZONTAL FREQUENCY:

Turn the horizontal hold control to the center of its rotation. Turn the picture control all the way to the left. Adjust the horizontal frequency until the picture is stationary. Push different buttons to select other channels. Each channel should lock in. If the picture does not lock in, readjust the horizontal frequency until it does. This adjustment should only be made after the receiver has warmed up for about 15 minutes.

HORIZONTAL DRIVE:

Adjust for best balance of brightness and linearity. If this adjustment is turned too far to the left a vertical white line will appear near the center of the picture.

HORIZONTAL WIDTH:

The horizontal width should be turned in until the picture covers the full width of the picture opening.

HORIZONTAL LINEARITY:

The horizontal linearity control should be adjusted for best horizontal linearity after the horizontal drive and width controls have been properly adjusted.

CENTERING:

If the picture is not centered in the picture opening, it may be centered by removing the cabinet back and adjusting the mechanical position of the focus coil. The coil can be moved in any direction after its mounting screws have been loosened. If the picture is tilted at an angle, it may be straightened by loosening the deflection yoke locking screw and adjusting the deflection yoke.

Make sure that all screws and nuts are well tightened after adjustment.

ION TRAP AND FOCUS CONTROL:

If the picture tube does not appear to be bright enough or if the tube dims when the brightness control is turned all the way to the right, the ion trap must be adjusted. Remove the cabinet back, turn the picture control all the way to the right. Turn the brightness control all the way to the right. Move the ion trap forward or backward very slowly and at the same time turn it to the right or left until the brightest picture is obtained.

OSCILLATOR AND FINE TUNING:

The fine tuning control is set at our factory so that the picture just begins to appear and the sound is at maximum, when the fine tuning control is turned all the way to the left. If it is necessary, each push button may be adjusted individually so that practically all transmitting channels may be received with the same picture and sound. The oscillator trimmers for channels #7 through #13 are located above their corresponding switch shaft. The trimmers for channels #2 through #6 are located below their corresponding switch shafts.

A non-metallic screw driver with a 3/16" wide tip and about 8 inches long should be used for oscillator alignment. Select a transmitting channel and push the corresponding button. Set the fine tuning control in the center of its range. Insert the screw driver into the trimmer adjustment for the button that has been pushed. Turn the screw driver very slowly to the right until the fine grainey appearance just disappears from the picture. With the fine tuning control still set, push another button and adjust its oscillator trimmer. Continue to do this until all buttons have been adjusted. It will now be possible to push each button and receive each channel, that is transmitting, within normal receiving range, without resetting the fine tuning condenser for each station. After the receiver has warmed up thoroughly it will be possible to adjust the receiver, on one channel, then select any other channels without having to readjust the hold, fine tuning, contrast or brightness controls.

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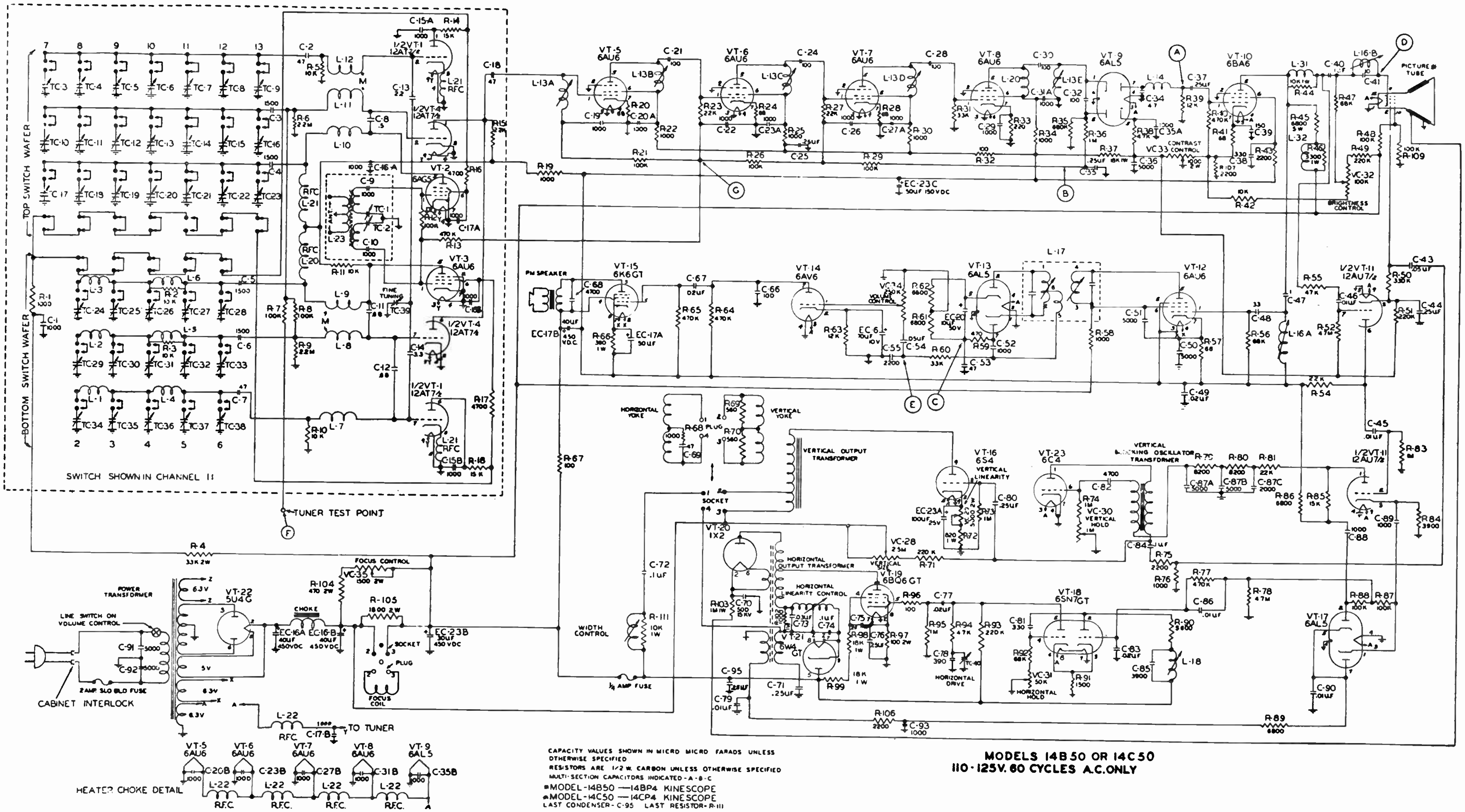
World Radio History



CAPACITY VALUES SHOWN IN MICRO MICRO FARADS UNLESS OTHERWISE SPECIFIED

RESISTORS ARE 1/2 W. CARBON UNLESS OTHERWISE SPECIFIED

MULTI-SECTION CAPACITORS INDICATED - A - B - C

■MODEL-14B50 —14BP4 KINESCOPE

●MODEL-14C50 —14CP4 KINESCOPE

LAST CONDENSER - C-95 LAST RESISTOR - R-111

MODELS 14B50 OR 14C50
110-125V. 60 CYCLES A.C. ONLY

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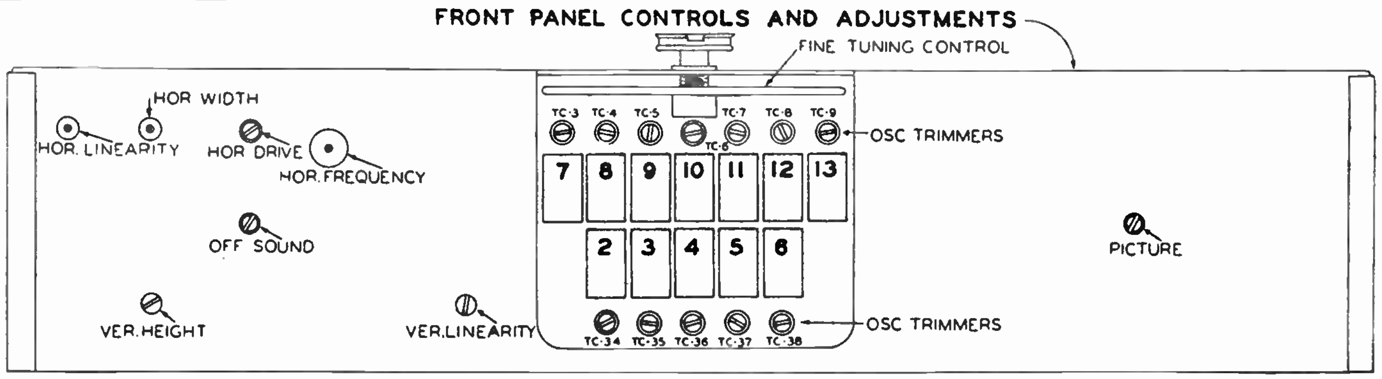


FIGURE—1

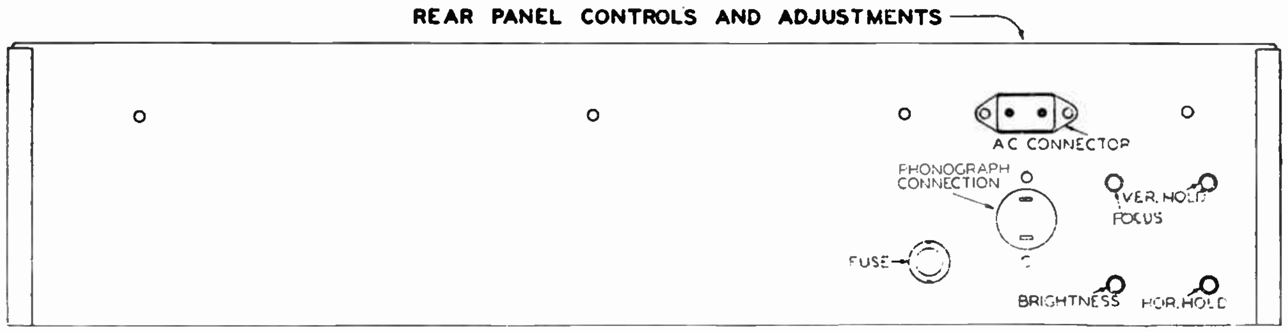
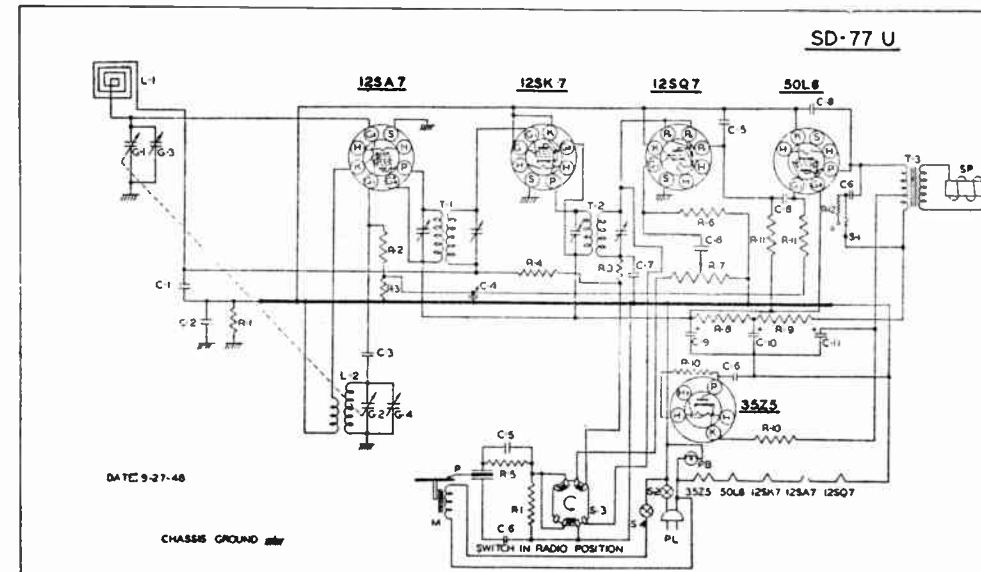


FIGURE 2

SCHEMATIC DIAGRAM – MODEL 16R70 RADIO-PHONOGRAPH UNIT



PART NO.		DESCRIPTION
PC-2	C-1	.05MFD. CONDENSER 200 V.
PC-8	C-2	.1MFD. CONDENSER 400 V.
MC-4	C-3	.00005MFD. MICA
PC-4	C-4	.25MFD. CONDENSER 200V.
MC-5	C-5	.0005MFD. MICA
PC-5	C-6	.05MFD. CONDENSER 400V.
MC-2	C-7	.0001MFD. MICA
PC-7	C-8	.01MFD. CONDENSER 400V.
EC-14	C-9	20MFD. } 150WV ELECTROLYTIC
	C-10	40MFD.
	C-11	40MFD.
IR-20	R-1	220M Ω RESISTOR 1/2 W. 20 %
IR-9	R-2	22 M Ω RESISTOR 1/2 W. 20%
IR-10	R-3	47 M Ω RESISTOR 1/2 W. 20%
IR-23	R-4	3.3MEG Ω RESISTOR 1/2 W. 20%
IR-12	R-5	1MEG Ω RESISTOR 1/2 W. 20%
IR-13	R-6	2.2MEG Ω RESISTOR 1/2 W. 20%
VC-4	R-7	1MEG. VOLUME CONTROL

PART NO.		DESCRIPTION
IR-1	R-8	470 Ω RESISTOR 1/2 W. 20 %
IR-42	R-9	1000 Ω RESISTOR 1 W. 10 %
IR-17	R-10	33 Ω RESISTOR 1/2 W. 20 %
IR-11	R-11	470M Ω RESISTOR 1/2 W. 20 %
IR-15	R-12	2200 Ω RESISTOR 1/2 W. 30%
GC-5	G-1	GANG CONDENSER
	G-2	
	G-3	ANT. TRIMMER
	G-4	OSC. TRIMMER
LI 6	T-1	INPUT I.F. TRANSFORMER
LI 7	T-2	OUTPUT I.F. TRANSFORMER
	T-3	OUTPUT TRANSFORMER
LL-17	L 1	LOOP ANT.
LO-14	L-2	OSC. COIL
SPH-12	SP	5" P.M. SPEAKER

PART NO.		DESCRIPTION
SW-2	S-1	TONE SWITCH
	S-2	SWITCH ON VOLUME CONTROL
SW-1	S-3	PHONO-RADIO SWITCH
	S-4	SWITCH ON RECORD CHANGER
AC-M-7	M	RECORD CHANGER MOTOR
AC-PU-7	P	CRYSTAL PICKUP ARM CARTRIDGE S-1
PB-2	PB	110 V. 7 1/2 W. PILOT BULB
CO-2	PL	LINE CORD

INSTALLATION AND SERVICE INSTRUCTIONS

Service and adjustment controls are located on both the front and rear aprons of the chassis. (See Fig. #1 & #2.) The front controls are accessible by removing the two round control knobs. It will not be necessary to remove the push buttons. Lift the control panel straight up so that the bottom of the panel comes out of the bottom groove in the cabinet. Pull the control panel down at an angle at the bottom so that the top of the panel comes out of the top groove. When reinstalling the panel reverse the foregoing procedure.

HORIZONTAL FREQUENCY:

Turn the horizontal hold control to the center of its rotation. Turn the picture control all the way to the left. Adjust the horizontal frequency until the picture is stationary. Push different buttons to select other channels. Each channel should lock in. If the picture does not lock in, readjust the horizontal frequency until it does. This adjustment should only be made after the receiver has warmed up for about 15 minutes.

HORIZONTAL DRIVE:

Adjust for best balance of brightness and linearity. If this adjustment is turned too far to the left a vertical white line will appear near the center of the picture.

HORIZONTAL WIDTH:

The horizontal width should be turned in until the picture covers the full width of the picture opening.

HORIZONTAL LINEARITY:

The horizontal linearity control should be adjusted for best horizontal linearity after the horizontal drive and width controls have been properly adjusted.

CENTERING:

If the picture is not centered in the picture opening, it may be centered by removing the cabinet back and adjusting the mechanical position of the focus coil. The coil can be moved in any direction after its mounting screws have been loosened. If the picture is tilted at an angle, it may be straightened by loosening the deflection yoke locking screw and adjusting the deflection yoke.

Make sure that all screws and nuts are well tightened after adjustment.

ION TRAP AND FOCUS CONTROL:

If the picture tube does not appear to be bright enough or if the tube dims when the brightness control is turned all the way to the right, the ion trap must be adjusted. Remove the cabinet back, turn the picture control all the way to the right. Turn the brightness control all the way to the right. Move the ion trap forward or backward very slowly and at the same time turn it to the right or left until the brightest picture is obtained.

OSCILLATOR AND FINE TUNING:

The fine tuning control is set at our factory so that the picture just begins to appear and the sound is at maximum, when the fine tuning control is turned all the way to the left. If it is necessary, each push button may be adjusted individually so that practically all transmitting channels may be received with the same picture and sound. The oscillator trimmers for channels #7 through #13 are located above their corresponding switch shaft. The trimmers for channels #2 through #6 are located below their corresponding switch shafts.

A non-metallic screw driver with a 3/16" wide tip and about 8 inches long should be used for oscillator alignment. Select a transmitting channel and push the corresponding button. Set the fine tuning control in the center of its range. Insert the screw driver into the trimmer adjustment for the button that has been pushed. Turn the screw driver very slowly to the right until the fine grainey appearance just disappears from the picture. With the fine tuning control still set, push another button and adjust its oscillator trimmer. Continue to do this until all buttons have been adjusted. It will now be possible to push each button and receive each channel, that is transmitting, within normal receiving range, without resetting the fine tuning condenser for each station. After the receiver has warmed up thoroughly it will be possible to adjust the receiver, on one channel, then select any other channels without having to readjust the hold, fine tuning, contrast or brightness controls.

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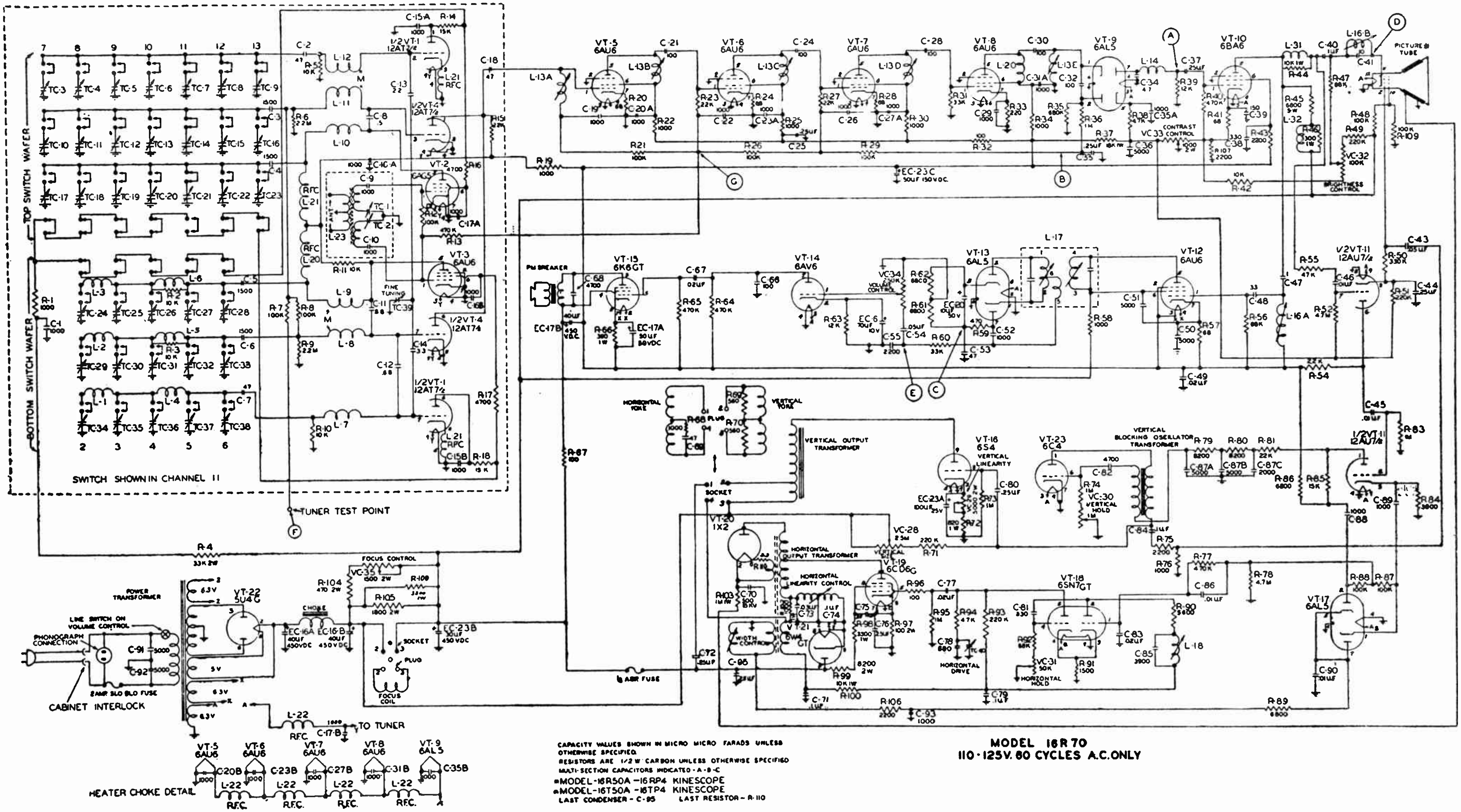

CAPACITY VALUES SHOWN IN MICRO MICRO FARADS UNLESS OTHERWISE SPECIFIED.
RESISTORS ARE 1/2 W CARBON UNLESS OTHERWISE SPECIFIED
MULTI-SECTION CAPACITORS INDICATED - A - B - C
*MODEL-16R50A -16RP4 KINESCOPE
*MODEL-16T50A -16TP4 KINESCOPE
LAST CONDENSER - C-95 LAST RESISTOR - R-110

MODEL 16R70
110-125V. 60 CYCLES A.C. ONLY

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MODELS: T16030, TFM16031, C16030 CFM16031, T19031, TFM19032, CFM19032, DFM19032 and CKFM19032

I GENERAL DESCRIPTION

Subject models are direct-viewing receivers using 16" and 19" all-glass cathode-ray tubes. The receivers are complete in one unit. Features of the receivers include U.S.T. FM sound, syncrolok system for horizontal framing, one stage RF, four stages video IF, two stages sound IF, one stage sound limiter, one high power stage, video amplifier, non-hazardous high voltage supply using a voltage doubler circuit.

POWER SUPPLY RATING
115 volts -- 60 cycles -- 276 watts

ANTENNA INPUT IMPEDANCE
72 ohms or 300 ohms on F.M. models *
300 ohms on straight T.V. receivers

* Note: When 300 ohm tape is used for antenna downlead to FM models, the shielded lead must be removed from the tuner and the 300 ohm downlead must be wired to the indicated 300 ohm terminals on the tuner.

	TUBE COMPLEMENT	TUBE FUNCTION
	6AG5) continuous	RF amplifier
	6AK5) tuner with	Converter
	6AB4) FM	Oscillator
	6BC5 or 6AG5) straight	RF amplifier
	1/2 6J6) T.V.	Converter
	1/2 6J6) tuner	Oscillator
V 4	6BA6	1st sound IF amplifier
V 5	6BA6	2nd sound IF amplifier
V 6	6AU6	Sound IF limiter
V 7	6AL5	Sound discriminator
V 8	6AT6	1st audio amplifier
V 9	6K6GT	Audio output
V10	6AG5	1st video IF amplifier
V11	6AG5	2nd video IF amplifier
V12	6AG5	3rd video IF amplifier
V13	6AG5	4th video IF amplifier
V14	1/2 6AL5)	Video detector
V14	1/2 6AL5)	A.G.C. detector
V15	6AG7	Video amplifier
V16A	1/2 6AL5	DC restorer
V19A	1/2 6SN7GT	Sync clipper
V17	6SJ7	Sync amplifier
V18	1/2 6SN7GT)	Sync limiter
V18	1/2 6SN7GT)	AGC amplifier
V16B	1/2 6AL5	Sync leveler
V19B	1/2 6SN7GT	Horizontal discharge
V20	6J5	Vertical Scanning Oscillator
V21	6V6GT	Vertical Output
V22	6AL5	Horizontal Sync Phase Discriminator
V27	6AC7	Horizontal scanning oscillator control
V23	6AK6	Horizontal scanning oscillator
V28	6BG6	Horizontal output
V24	6BG6	" " (19" receivers only)
V29	6AS7	Horizontal damper
V25	1B3GT	High voltage rectifier
V26	1B3GT	High voltage rectifier
V30	5U4G	Low voltage rectifier
V31	5U4G	Low voltage rectifier
V32	16DP4	Zetka Picture Tube (use with 16" receivers)
V32	19CP4	Zetka Picture Tube (use with 19" receivers)

PICTURE I-F FREQUENCIES

Picture carrier frequency	25.75 Mc.
Adjacent Channel Sound Trap	27.25 Mc.
Accompanying Sound Traps	21.25 Mc.
Adjacent Channel Picture Carrier Trap	19.75 Mc.

SOUND I-F FREQUENCIES

Sound Carrier Frequency	21.25 Mc.
Discriminator Band Width (between peaks)	350 kc.

VIDEO RESPONSE	to 4.25 Mc.
FOCUS	Magnetic
SWEEP DEFLECTION	60° on 16" 67° on 19" (magnetic)
SCANNING	Interlaced, 525 line
HORIZONTAL SCANNING FREQUENCY	15, 750 cps
FIELD FREQUENCY	60 cps Picture repetition rate 30 cps

OPERATING CONTROLS (Front Panel)
1. Tuner Control
2. Sound, volume and on-off switch
3. Contrast
4. Brightness
5. Function sketch (FM, TV and phono) on all models having FM

CONTROLS ON REAR OF CHASSIS (not including RF & IF adjustments
Horizontal drive
Horizontal Linearity
Height
Syncrolok (horizontal speed)
Vertical Linearity
Focus
Vertical Centering
Horizontal Centering
Vertical speed
Horizontal Speed

CONTROLS TOP SIDE OF CHASSIS -- FRONT & CENTER
AGC Threshold Control

ADDITIONAL CONTROLS
Focus coil above chassis - wing nut adjustments
Ion trap magnet - adjusted on tube neck
Deflection yoke above chassis - thumb screw adjustments
Horizontal Phasing - underneath chassis rear slug on A.F.C. can
Horizontal width accessible through hole in high voltage cage.

PICTURE MASK SIZE

16" Models	14 7/8" x 11 3/4"
19" Models	17" x 13 1/4"

II MAINTENANCE

A. WARNING

Operation of this equipment outside of the overall enclosure involves a shock hazard from the 400 volt supply and an explosion hazard in handling the kinescope. The second anode supply does not involve a dangerous shock hazard, but lack of caution may result in an unpleasant shock or burn. Be sure to wear some form of eye protection while handling the kinescope.

MODELS C16030, C19031, CFM16031, CFM19032, CKFM19032, KFM19032, T16030, T19031, TFM16031, TFM19032, Rev.

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B. TEST EQUIPMENT

To properly service the television receiver, it is recommended that the following test equipment be available.

1. R-F sweep generator meeting the following requirements:
   a. Frequency ranges — 18 to 30 Mc., 40 to 90 Mc., 170 to 225 Mc.
   b. Sweep width adjustable from 1 to 12 Mc.
   c. Output at least 0.1 volts.

2. Cathode-ray oscillograph, preferably one with a wide band vertical deflection and a calibrating input source.

3. Electronic voltmeter with high-voltage probe, such as RCA Junior Voltohmyst with multiplier probe, capable of measuring up to 15 kv.

4. An accurate R.F. signal generator covering the following frequency ranges with can be used to set traps, local oscillators, and for frequency markers.

Intermediate frequencies. (21.25 Mc. (25.75 Mc.

Trap frequencies (19.75 Mc. (27.25 Mc.

CHANNEL NUMBER	MC.	PIX MCS	SOUND MCS	HETERODYNE OSC. FREQ. MC.
2	54-60	55.25	59.75	81
3	60-66	61.25	65.75	87
4	66-72	67.25	71.75	93
5	76-82	77.25	81.75	103
6	82-88	83.25	87.75	109
7	174-180	175.25	175.75	201
8	180-186	181.25	185.75	207
9	186-192	187.25	191.75	213
10	192-198	193.25	197.25	219
11	198-204	199.25	203.75	225
12	204-210	205.25	209.75	231
13	210-216	211.25	215.75	237

III INTERMEDIATE FREQUENCY ALIGNMENT PROCEDURE:

The signal generator should be calibrated with the crystal at 21.25 and 25.75. If the frequency stability of the signal generator is known to be poor, a check should be made with the crystal each time one of these frequencies is used.

1. SOUND DISCRIMINATOR ALIGNMENT

Connect output of the signal generator to the third i-f grid, pin 1 of V6, and set output of signal generator for approximately one volt at 21.25 Mc. Connect Junior Voltohmyst in series with one megohm resistor to junction of diode load resistors (R60 and R62). Adjust primary core (top) of T5 for maximum d-c output. Move Junior Voltohmyst to output of discriminator (V7, Pin 1) and adjust secondary core (bottom) of T5 for zero d-c output. Readjust T5 primary for symmetrical plus or minus d-c output on either side of 21.25 Mc.

The sweep, in conjunction with marker signals, can also be used to align the discriminator but the center position of the sound carrier cannot be set as accurately using this method.

The peak to peak bandwidth of the discriminator should be approximately 350 Kc. and it should be linear from 21.75 Mc. to 21.325 Mc.

2. SOUND INTERMEDIATE FREQUENCY ALIGNMENT

Connect sweep output to first I-f grid, pin 1 of V4. Connect oscilloscope to third i-f grid return (high end of R57) and adjust T3 and T4 for maximum gain at 21.25 Mc. and symmetry about 21.25 Mc. The output level from the sweep should be set to produce approximately 0.3 volt peak-to-peak at the third sound i-f grid return. The bandwidth at 70% response from the first sound i-f grid to the third sound i-f grid should be approximately 200 Kc. (Refer to Figure 8) If a 60 cycle sweep rate is used, it will be necessary to reduce the time constant in the second sound i-f grid circuit in order to reproduce the response curve. To do this, shunt R57 with approximately 5,600 ohms. For overall S curve response connect oscilloscope to junction of C66 and R63 and compare to curve in Figure 7.

3. PICTURE INTERMEDIATE FREQUENCY ALIGNMENT

Open jumper on tie point where C98 is located. This disables the A.G.C. feed to the R.F.-I.F. gain control stages. Apply minus three volts, d-c, where C98 is wired to the tie point. Connect oscilloscope vertical amplifier lead through a 10,000 ohm isolating resistor to high side of R105 video detector load resistor. Connect VTVM to the same point. The meter needle is the indicating means for the alignment and the oscilloscope's primary function is to indicate over-load of the circuits under test. When this is indicated, the signal source level should be reduced. Capacity couple A.M. signal generator to tuner converter tube by slipping tight-fitting, ungrounded shield over converter tube and connect generator to this ungrounded shield.

Set signal generator to 19.75, audio modulated, and adjust T8 secondary for minimum reading on VTVM.
Set signal generator to 21.25 Mc., audio modulated, and adjust T15 secondary and T9 secondary for minimum indication on VTVM.
Set signal generator to 27.25 Mc., audio modulated, and adjust T7 secondary for minimum indication on VTVM.
For proper indication of these trap adjustments, high level output is required from signal generator.
Set signal generator to 21.8 Mc. and adjust T15 primary for maximum indication on VTVM.
Set signal generator to 25.3 Mc. and adjust T7 primary for maximum indication on VTVM.
Set signal generator to 22.3 Mc. and adjust T8 primary for maximum indication on VTVM.
Set signal generator to 25.2 Mc. and adjust L5 for maximum indication on VTVM.
Set signal generator to 23.4 Mc. and adjust L6 for maximum indication on VTVM.

Disconnect signal generator from shield and apply sweep generator output to shield. Adjust sweep generator to give an I.F. amplitude frequency response curve on the oscilloscope. The picture intermediate frequency can now be retouched, if necessary to secure the standard i-f response curve with the picture carrier at approximately 55% on the response curve. For curve comparison refer to Figure 6.

In making any final touch-up adjustments on the picture i-f amplifier, it should be remembered that the converter stage and second picture intermediate frequency are relatively high Q circuits and tend to control the I-f response at the high and low frequency ends of the pass-band respectively. The first and third picture intermediate frequencies are relatively low Q circuits and tend to control the response of the center portion of the pass-band.

The picture I.F. amplifiers can also be aligned without first peaking the individual stages to the specified single frequencies, but by using the sweep and markers only. If the receiver is completely mis-aligned, this method is not recommended.

Since there is some shift in response in both the picture and sound i-f amplifiers with bias, the recommended bias levels should always be used when aligning these circuits.

IV ALIGNMENT OF STRAIGHT T.V. STANDARD COIL TUNER

Open jumper on tie point where C98 is located. (Refer to Figure 2.) This disables the A.G.C. bias feed to the RF and IF gain controlled stages. Apply minus three volts d-c where C98 is wired to the tie point.

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V CONVERTER COIL I.F. & TRAP ALIGNMENT (if adjusted in I.F. alignment procedure do not repeat) REFER TO FIGURES 1 & 2

Connect VTVM to second detector video load resistor R105 on main chassis. Remove tube shield from 6J6 on tuner. Capacity couple A.M. signal generator to 6J6 by slipping tight-fitting ungrounded shield over 6J6 and connect generator to ungrounded shield. Set frequency of generator to 21.25 Mc. Tune L12 for minimum voltage on VTVM. Set generator to 21.8 Mc. and tune L11 for maximum voltage on VTVM. Use high output on signal generator at 21.25 Mc. and low output on 21.8 Mc. for above alignment procedure.

VI RF & MIXER ALIGNMENT

1. Having first aligned PIX I.F. section set station selector switch to channel 12.
2. Connect oscilloscope through 10,000 ohms to second detector video output on main chassis.
3. Feed sweep generator into antenna terminals, sweeping channel 12.
4. Adjust C2, C3 and C4 for flat top response curve. Check markers on all channels. They should fall in automatically on all channels.

OSCILLATOR ALIGNMENT

1. Turn station selector switch to channel 12. Flat on fine tuning facing upwards to 12 o'clock.
2. Connect signal generator using A.M. or F.M. modulation to one antenna terminal and ground. Set to sound carrier frequency 209.75 Mc.
3. Connect vacuum tube voltmeter to D.C. output of discriminator in main chassis.
4. Adjust C5 for zero reading on VTVM between a positive and negative peak for A.M. modulation or maximum reading for F.M. modulation.
5. Check all channels for zero or maximum reading on VTVM. It is usually not necessary to make any further adjustments. If you find it necessary to touch up the oscillator coils, the following procedure is recommended.

OSCILLATOR COIL TOUCH-UP (usually not necessary)

a. Fine tuning control in mid-position.
b. Place a non-metallic screwdriver through opening, and adjust oscillator coil on channel 12.
c. Turn channel selector switch to channel 13 and repeat adjustment.
d. This adjustment can be repeated for all channels or, if necessary, on any single channel.

VII ALIGNMENT OF HORIZONTAL CIRCUITS

The horizontal drive control should be kept at or close to maximum clockwise position. Syncrolok speed control on rear of chassis should be adjusted so that for either extreme position of the horizontal hold control, (refer to Figures 1 and 2 for control locations), the picture will lock horizontally when the station is returned from either frequency side. The phasing slug, located underneath the chassis on the rear of the horizontal discriminator can, should be adjusted so that for either extreme position of the horizontal hold control there is no squeezing at either end of the picture and no white line smears. The horizontal hold control should then be set at mid position.

It is important that the AFC bias measured with a vacuum tube voltmeter at pin 5 on V22 socket does not exceed minus 2.4 volts, d-c. This voltage may exceed the specified value if the drive control is not advanced far enough in the clockwise direction. This will limit the pull-in range of the horizontal scanning oscillator.

VIII ION TRAP, YOKE & FOCUS COIL ADJUSTMENT

The brightness control should be gradually advanced clockwise as ion trap motions about the kinescope gun internal flags are made. When the raster appears, the ion trap should be adjusted for maximum brightness. Dark corners or neck cutoff are to be eliminated by adjustment of the focus coil. At all times check that the yoke is up against the kinescope neck flair as far as it can go. Any adjustments of the focus coil, or focus control, should be followed by a readjustment of the ion trap. Insofar as wide angle kinescope deflection is used, the adjustments of yoke, focus coil and ion trap are more critical and require more attention.

IX A.G.C. THRESHOLD CONTROL SETTING

The picture must first be framed with proper size, linearity and focus. The channel selector must be set to the station having the strongest signal. Contrast control should be set to mid-position. The A.G.C. threshold control, located top-side of the chassis, (refer to Figure 1) is to be advanced clockwise to the point where the picture is over driven and then very slightly backed down. The service man must carefully switch through on all channels with the contrast fully clockwise to make certain that the picture pulls in without going out of synchronization.

Another means of making this adjustment is by putting the vertical amplifier lead of an oscilloscope on the kinescope cathode. The threshold control is advanced clockwise to the point where the top of the sync starts to contract.

X LINE VOLTAGE VARIATIONS

The synchronizing circuits will hold the visible picture regardless of the line voltage. When the horizontal size is not sufficient due to low line voltage (between 100 and 109 R.M.S. volts), the following changes can be made for corrections of horizontal size in the indicated order.

16" Receivers

1. Wire in one .01 to .027 microfarad 600 volt capacitor as shown in figure 5. This places the capacitor electrically across 5 and 6 terminals on the horizontal flyback transformer. Reset the horizontal and vertical dimensions and the focus.

19" Receivers

1. Add a capacitor from .003 to .005 microfarads 600 volts as shown in Figure 4. This is in addition to the .022 microfarad 600 volt capacitor which is in the receiver.

XI PERFORMANCE SUMMARY

These receivers are by design and components used, high quality receivers. The synchronizing circuits have the greatest degree of noise immunity available in the field. The interlace is very good. The synchronizing circuits are entirely independent of the contrast control. The horizontal scanning oscillator system is very stable with respect to temperature and time. It is decidedly the most superior type system used. All of this contributes to a steady picture with all the attendant advantages.

The A.G.C. circuit is a gated, fast, high gain type system. As a result, the noise figure is very good and amplitude changes of input signal introduced by airplanes and similar disturbances are definitely controlled. An additional advantage is that the different T.V. channels available may be selected with no necessity of brightness and contrast readjustments unless required by personal taste. These features make the receivers extremely simple to operate. For marginal area application these models will give the finest performance obtainable, due to their high sensitivity and high signal to noise ratio.

The models with F.M. have a function switch for selection of F.M., T.V. or Phono. Features of this circuit are the switching out of possible interfering circuits with the function switch setting and instantaneous action of any of the selected functions.

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MODELS C16030, C19031, CFM16031, CFM19032, CKFM19032, KFM19032, T16030, T19031, TFM16031, TFM19032, Rev.

TELEVISION CHASSIS TOP VIEW

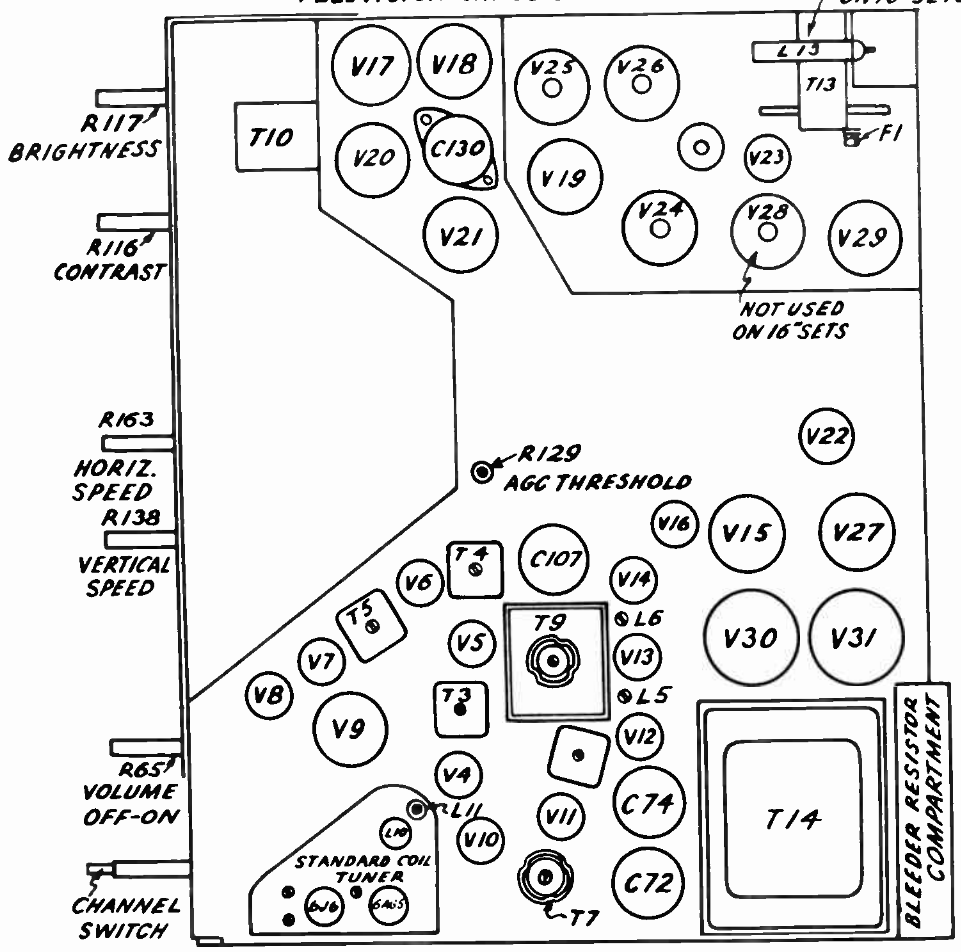


FIGURE 1
REFER TO SCHEMATIC

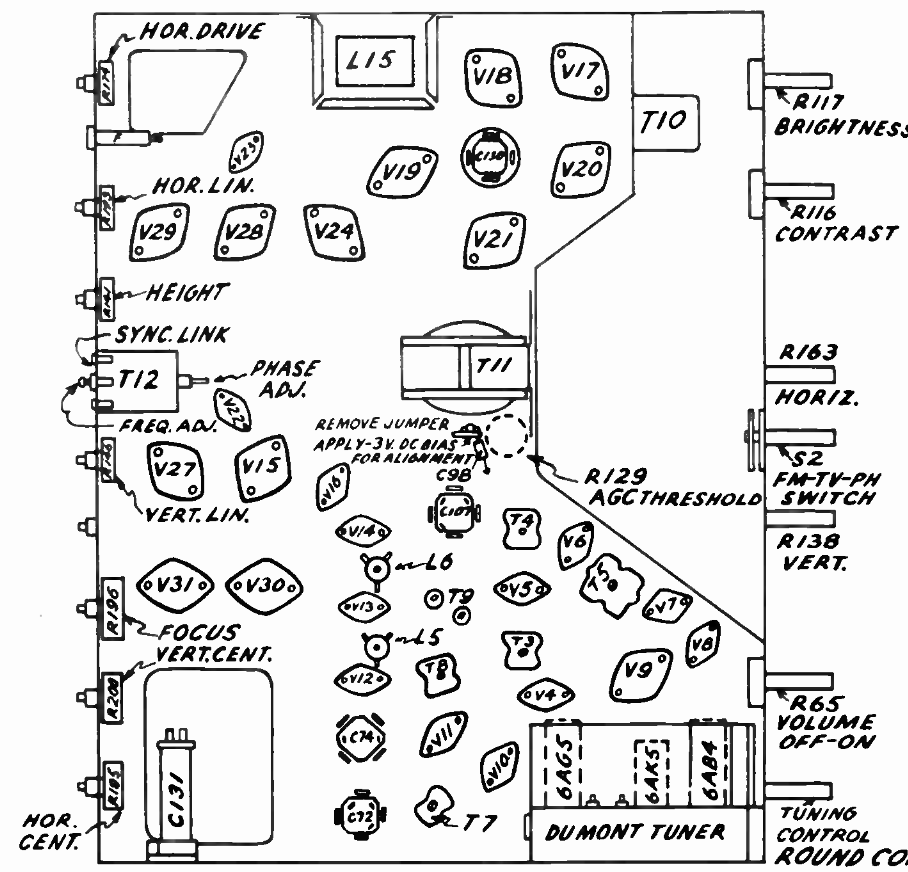


FIGURE 2
REFER TO SCHEMATIC

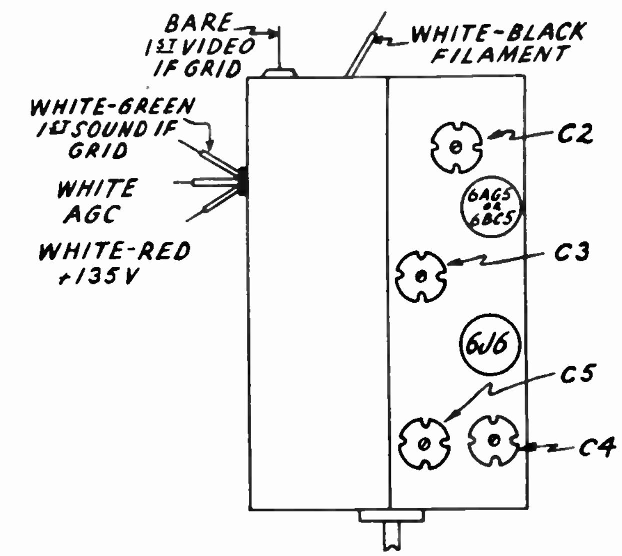


FIGURE 3
STANDARD COIL TUNER
REFER TO TEXT & SCHEMATIC

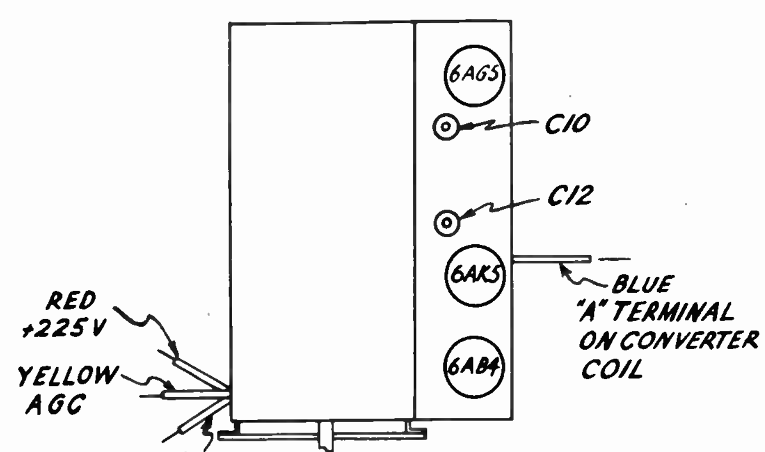
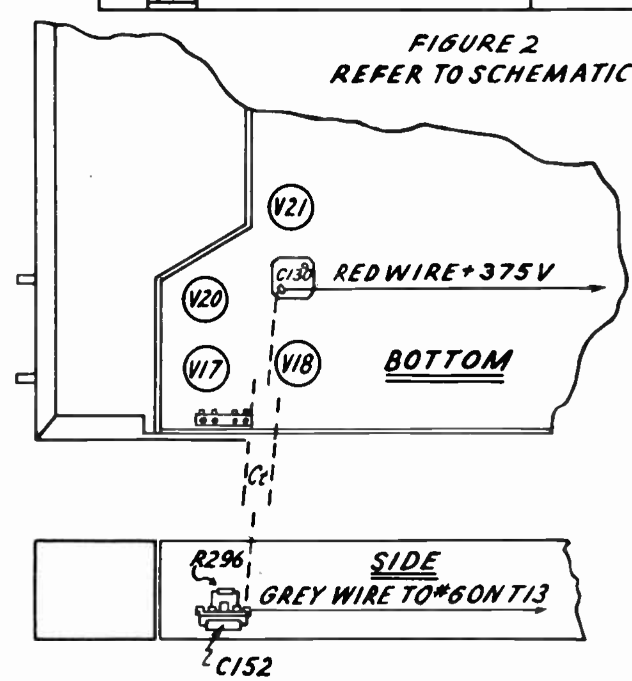


FIGURE 4
DU MONT TUNER
REFER TO TEXT & SCHEMATIC



Ct - CAPACITOR TO BE ADDED FOR INCREASING PICTURE SIZE FOR LINE VOLTAGE BETWEEN 100 & 105 V. RMS. REFER TO TEXT.

FIGURE 5

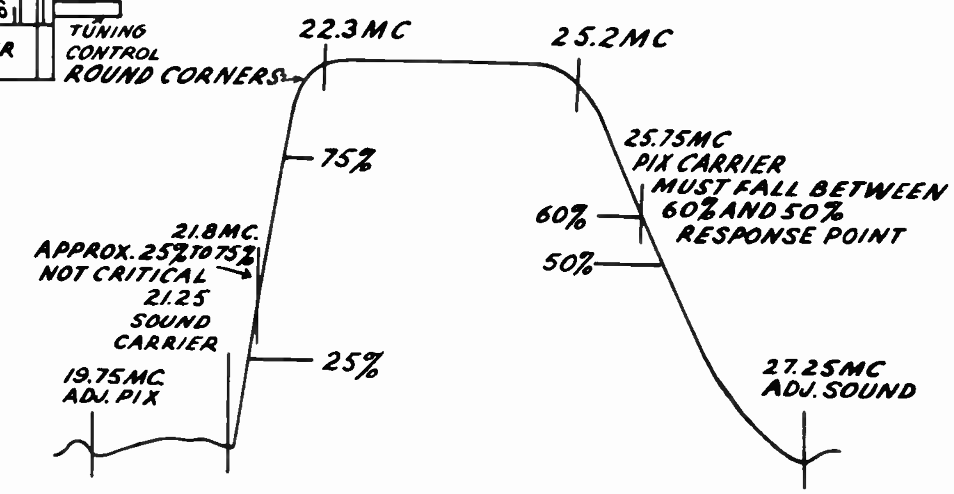


FIGURE 6
OVERALL VIDEO IF AMPLITUDE FREQUENCY RESPONSE

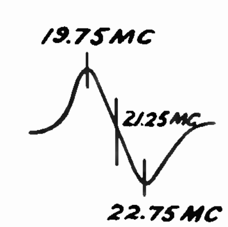


FIGURE 7
SOUND DISCRIMINATOR
AMPLITUDE FREQUENCY RESPONSE

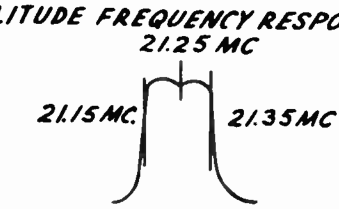


FIGURE 8
SOUND IF
AMPLITUDE FREQUENCY RESPONSE

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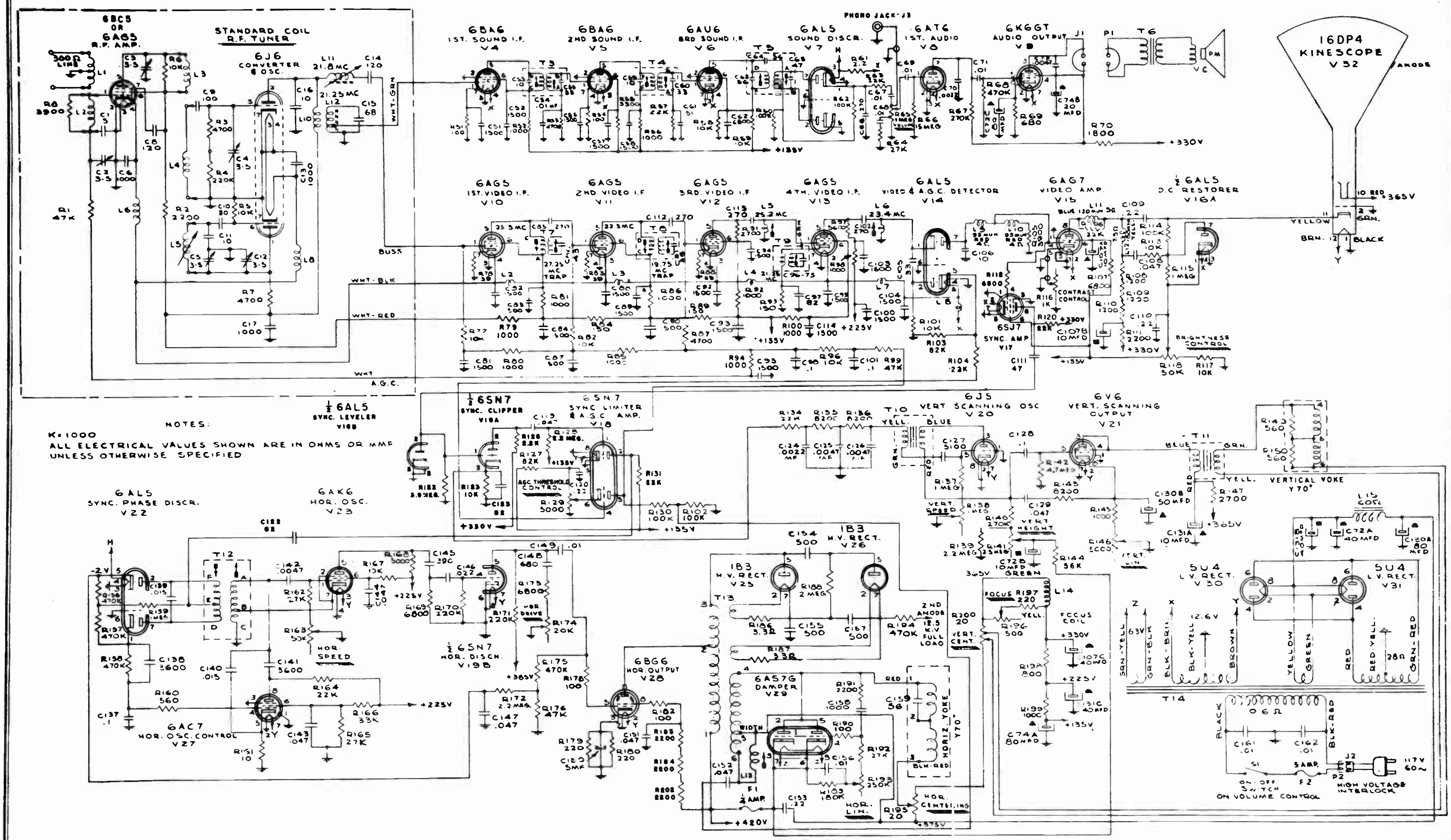

UNITED STATES TELEVISION TV PAGE 6-5

PN-5-75014

MODELS C16030, T16030, Rev.

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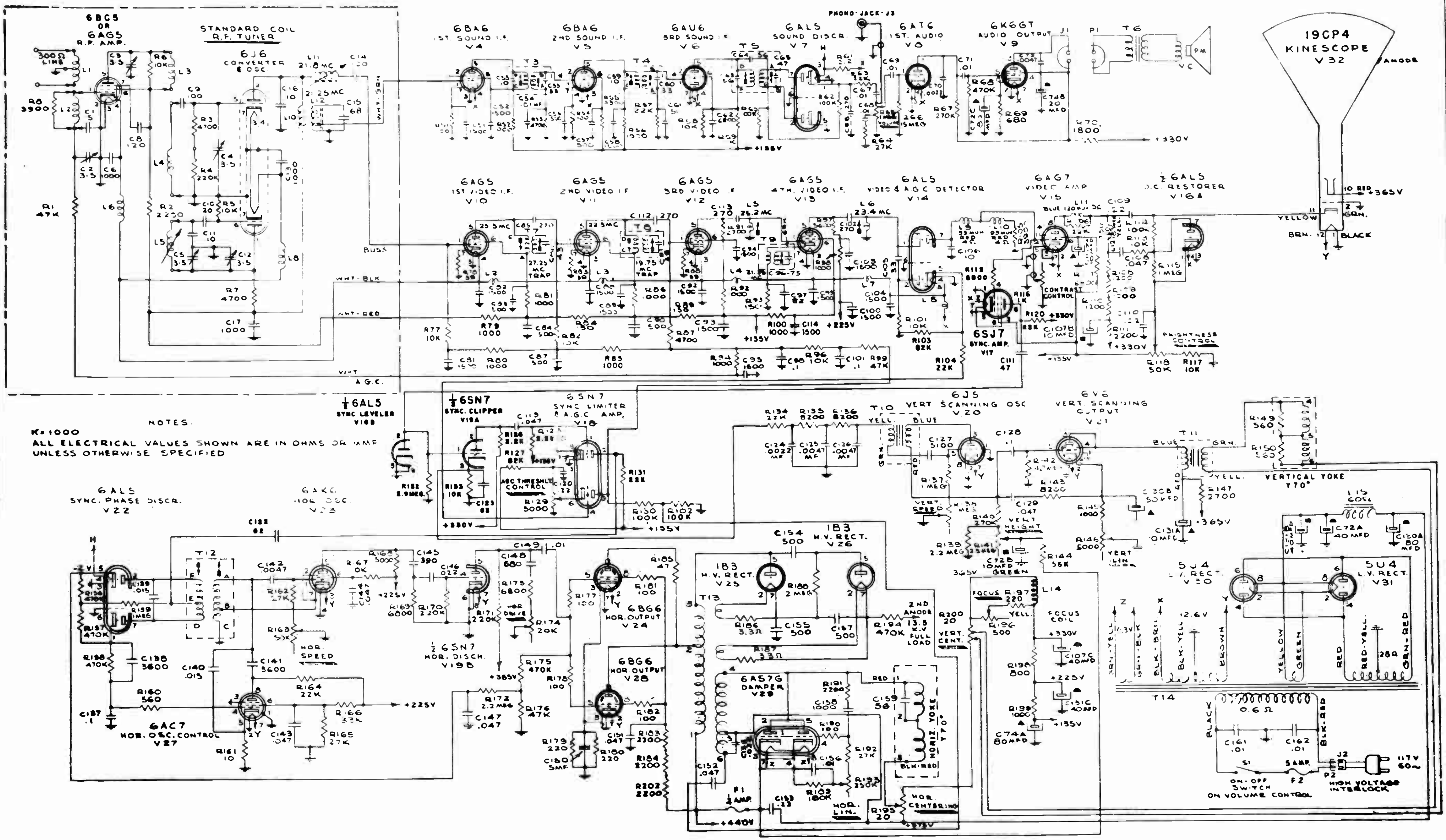

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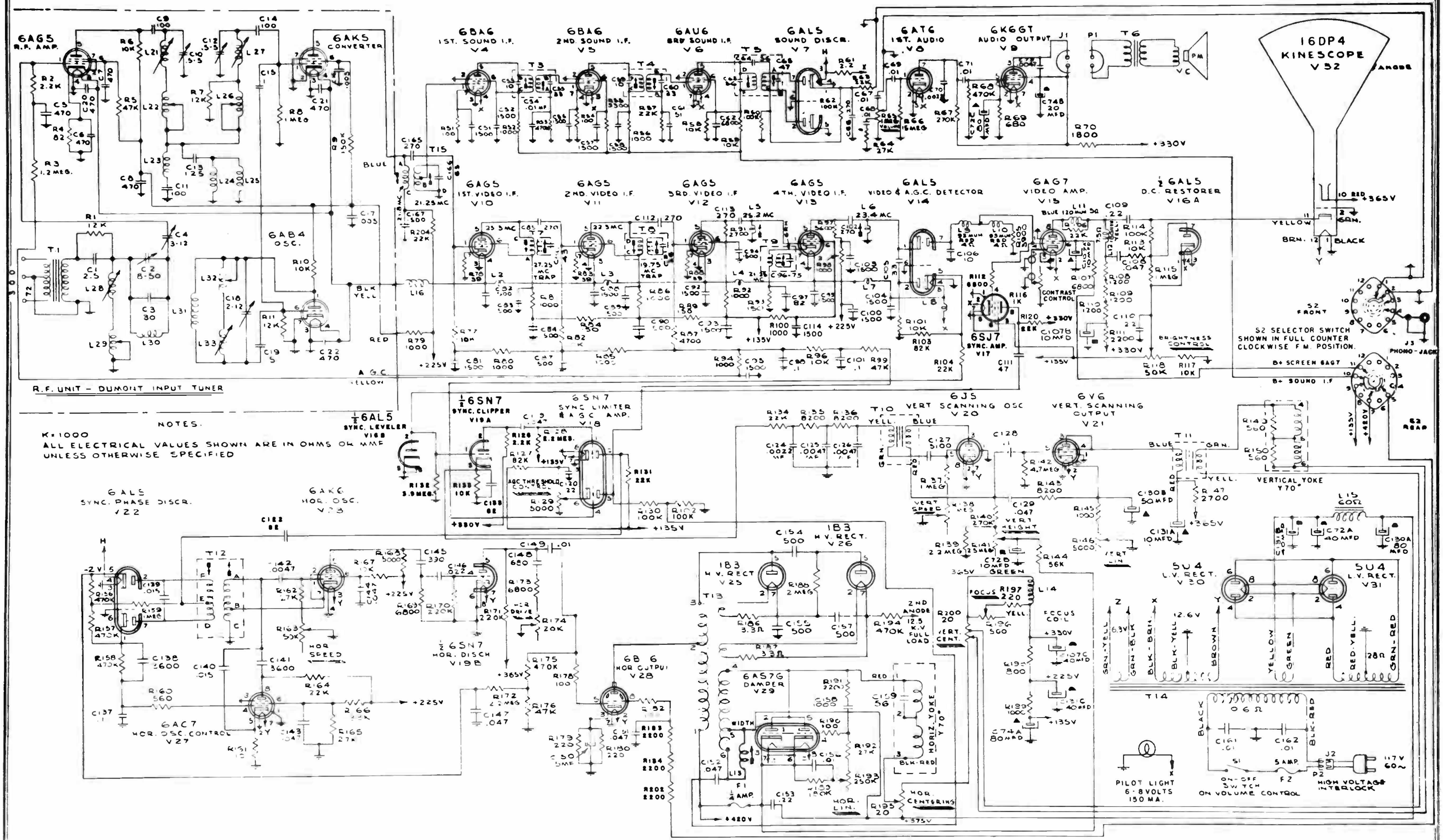

MODELS CFM16031,
TFM16031, Rev.

PN-5-75016

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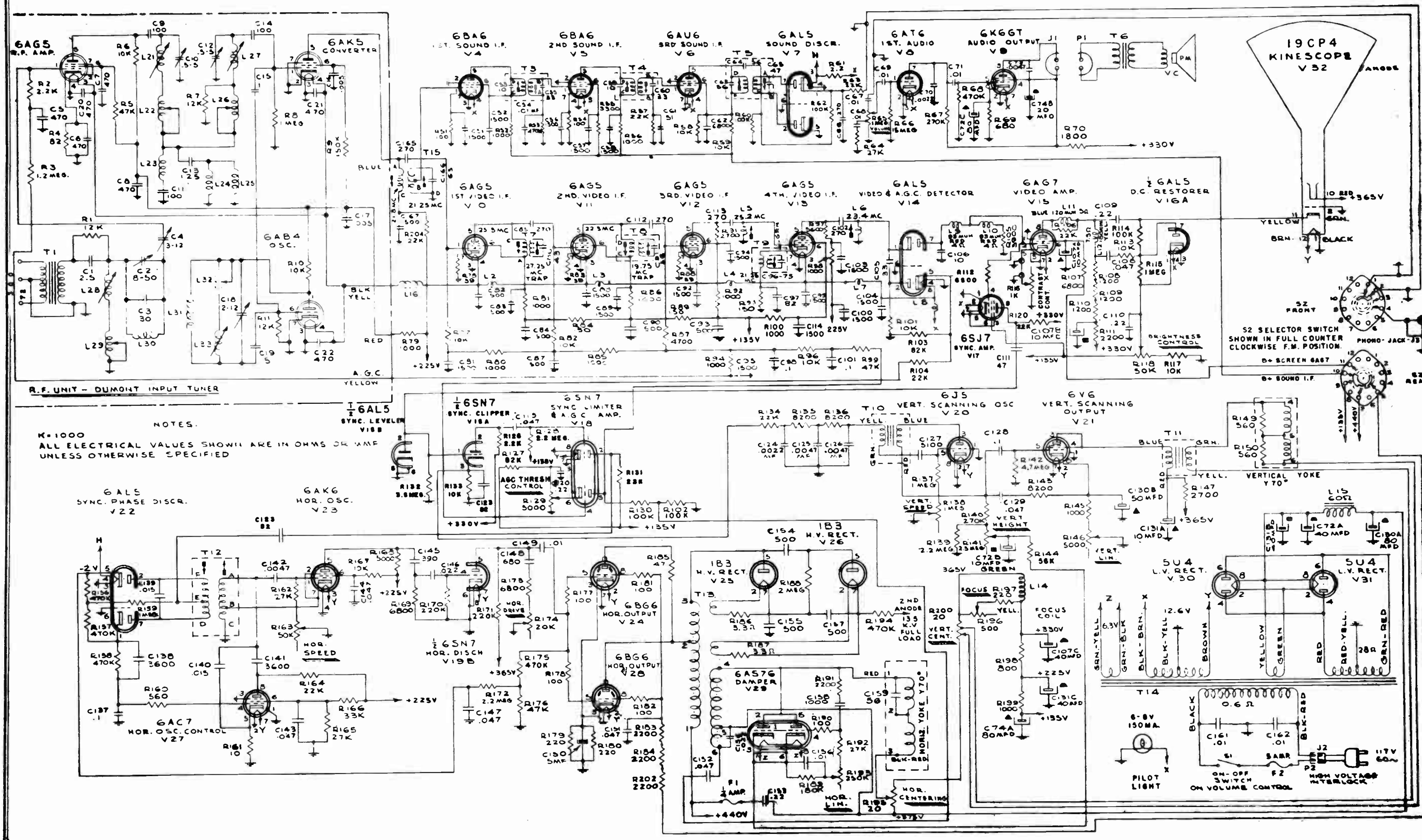

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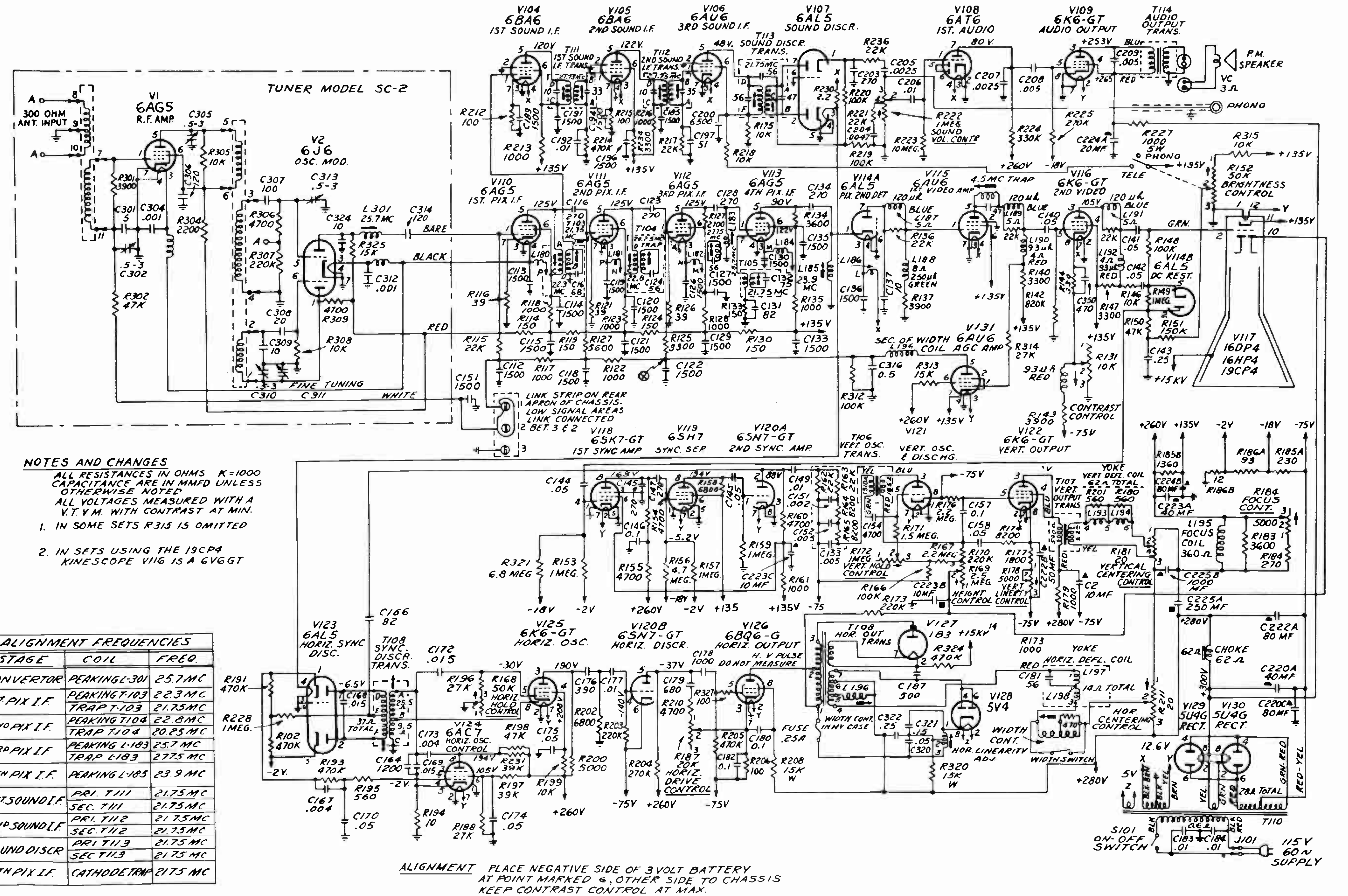

NOTES AND CHANGES

ALL RESISTANCES IN OHMS K=1000
CAPACITANCE ARE IN MMFD UNLESS OTHERWISE NOTED
ALL VOLTAGES MEASURED WITH A V.T.V.M. WITH CONTRAST AT MIN.

1. IN SOME SETS R315 IS OMITTED
2. IN SETS USING THE 19CP4 KINESCOPE V116 IS A 6VGGT

ALIGNMENT FREQUENCIES

STAGE	COIL	FREQ.
CONVERTOR	PEAKING L-301	25.7MC
1ST PIX I.F.	PEAKING T-103	22.3MC
	TRAP T-103	21.75MC
2ND PIX I.F.	PEAKING T104	22.8MC
	TRAP T104	20.25MC
3RD PIX I.F.	PEAKING L-183	25.7MC
	TRAP L183	27.75MC
4TH PIX I.F.	PEAKING L-185	23.9MC
1ST SOUND I.F.	PRI. T111	21.75MC
	SEC. T111	21.75MC
2ND SOUND I.F.	PRI. T112	21.75MC
	SEC. T112	21.75MC
SOUND DISCR	PRI T113	21.75MC
	SEC T113	21.75MC
4TH PIX I.F.	CATHODE TRAP	21.75MC

ALIGNMENT PLACE NEGATIVE SIDE OF 3 VOLT BATTERY AT POINT MARKED ⏚, OTHER SIDE TO CHASSIS
KEEP CONTRAST CONTROL AT MAX.

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SUBJECT: Proper Operation of the Syncrolok

General: Proper adjustment of the Syncrolok becomes an increasingly important factor in the proper operation of the receiver, since the keyed AGC action is entirely dependent upon the relative phase between the sync pulse and the keying pulse.

Although careful and complete adjustment of the Syncrolok is made at the factory before each receiver is shipped, vibration in shipment may cause the syncrolok to become out of optimum adjustment when the set arrives at its installation point. The following procedure is recommended for checking the operation of the syncrolok and adjusting it if necessary.

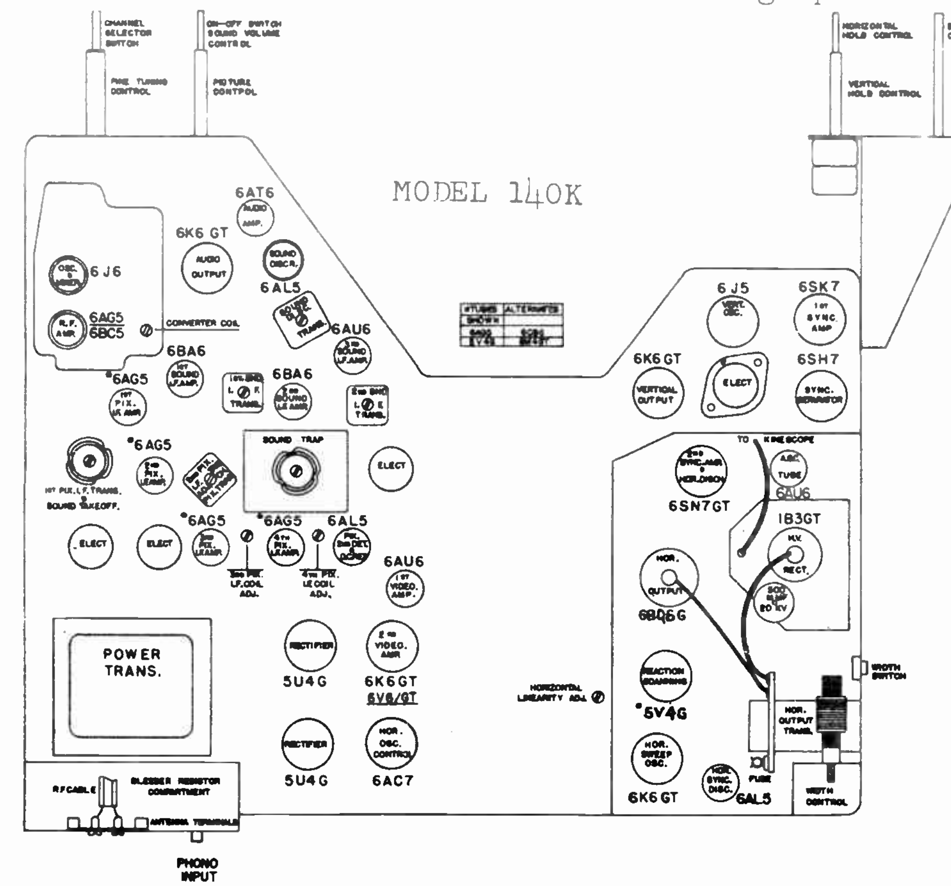
1. Checking the Syncrolok for Normal Frequency and Phasing.
a. Rotate the horizontal hold control to its extreme clockwise position.
b. Then adjust the vertical hold control to a point where the vertical is just about to jump a frame upwards, but doesn't quite tear out.
c. Then rotate the horizontal hold control to its extreme counter-clockwise position.
d. If the vertical should lose a frame, jump, or go out of frequency then the Syncrolok is out of adjustment with respect to proper phasing.
e. Frequency may be checked in the normal Syncrolok manner by rotating the horizontal hold control to its extreme clockwise and counter-clockwise positions while switching the tuner from a picture channel to an off-channel and determining whether the horizontal will lock in.

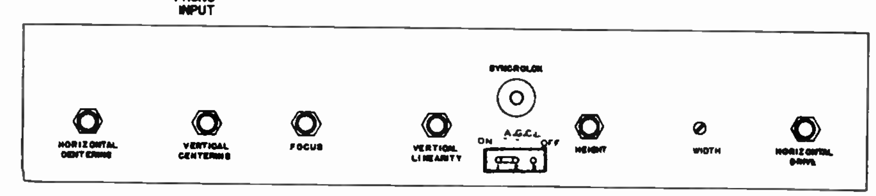
2. Adjustment of the Syncrolok When Not in Normal Frequency.
To adjust the Syncrolok in frequency, the normal procedure is followed. Should the picture break at either end of the hold control, adjust the Syncrolok control, located at the rear of the chassis, and then recheck in the manner outlined above in Paragraph 1.

3. Adjustment of the Syncrolok When Phasing is Out of Adjustment.
If the phasing is found to be out of adjustment, the normal phasing procedure is used except that the right-hand edge of the picture is used as the guide rather than the left. The phasing adjustment is a slotted screw control on the inside of the Syncrolok coil and can only be reached from underneath the chassis. If unfamiliar with the proper Syncrolok phasing procedure, then proceed with the following steps.

a. Move the picture to the left by means of the horizontal centering control until the right hand edge of the picture is exposed from the mask.
b. Reduce the contrast and advance the brightness until the blanked out raster appears behind the picture.
c. Then, with the horizontal hold control in its extreme clockwise position, adjust the phasing screw so that the end of the picture and the end of the sweep lines almost coincide.
d. When performing step C, note that a slight cramping will appear at the extreme right-hand edge, indicating the start of a fold-over.

The optimum adjustment of the phasing control is at a point just before such cramping occurs.
e. After these adjustments have been made, recheck for normal operation of the Syncrolok as described in Paragraph 1.





IMPORTANT * Dress Kinescope Socket Leads away from Deflection Yoke Leads. Do Not Permit Yoke Plug to touch any part of chassis.

MODELS 140K and 140KB

SUBJECT: Adjustments for Optimum Width and Brightness

A. With Width Switch in Normal Position (down):
1. Adjust Width Coil in cage with slug completely out.
2. Adjust Horizontal Drive Control fully clockwise, then readjust slightly for good linearity.
3. Adjust Horizontal Linearity Coil for proper Linearity (Located on top of chassis next to High Voltage Cage)
4. Width Coil on rear apron of chassis is adjusted for proper width.

B. In Low Line Voltage areas or whenever picture Width isn't sufficient, place Width Switch in E X P A N D E D (up) position and:

1. Adjust Width Coil in cage for proper width.

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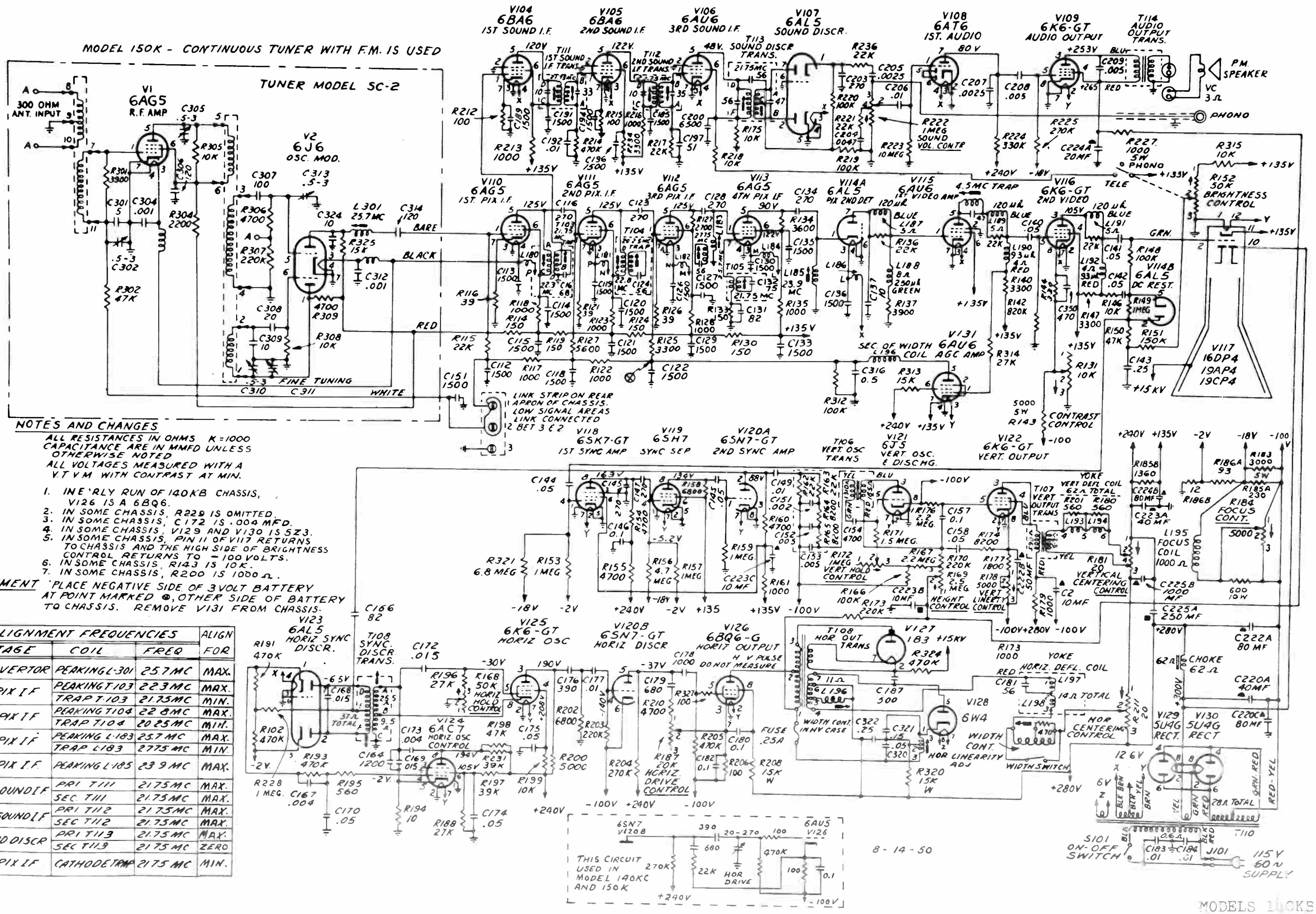

NOTES AND CHANGES

ALL RESISTANCES IN OHMS K=1000
CAPACITANCE ARE IN MMFD UNLESS OTHERWISE NOTED
ALL VOLTAGES MEASURED WITH A V.T.V.M. WITH CONTRAST AT MIN.

1. IN E'RLY RUN OF 140KB CHASSIS, V126 IS A 6BQ6.
2. IN SOME CHASSIS, R229 IS OMITTED.
3. IN SOME CHASSIS, C172 IS .004 MFD.
4. IN SOME CHASSIS, V129 AND V130 IS 5Z3.
5. IN SOME CHASSIS, PIN 11 OF V117 RETURNS TO CHASSIS AND THE HIGH SIDE OF BRIGHTNESS CONTROL RETURNS TO −100 VOLTS.
6. IN SOME CHASSIS, R143 IS 10K.
7. IN SOME CHASSIS, R200 IS 1000Ω.

ALIGNMENT PLACE NEGATIVE SIDE OF 3 VOLT BATTERY AT POINT MARKED ⊕, OTHER SIDE OF BATTERY TO CHASSIS. REMOVE V131 FROM CHASSIS.

ALIGNMENT FREQUENCIES			ALIGN
STAGE	COIL	FREQ	FOR
CONVERTOR	PEAKING L-301	25.7MC	MAX.
1ST PIX I F	PEAKING T-103	22.3MC	MAX.
	TRAP T-103	21.75MC	MIN.
2ND PIX I F	PEAKING T104	22.8MC	MAX.
	TRAP T104	20.25MC	MIN.
3RD PIX I F	PEAKING L-183	25.7 MC	MAX.
	TRAP L-183	27.75 MC	MIN.
4TH PIX I.F.	PEAKING L-185	23.9 MC	MAX.
1ST SOUND I F	PRI T111	21.75MC	MAX.
	SEC. T111	21.75MC	MAX.
2ND SOUND I.F	PRI. T112	21.75MC	MAX.
	SEC T112	21.75MC	MAX.
SOUND DISCR	PRI T113	21.75MC	MAX.
	SEC T113	21.75 MC	ZERO
4TH PIX I F	CATHODE TRAP	21.75 MC	MIN.

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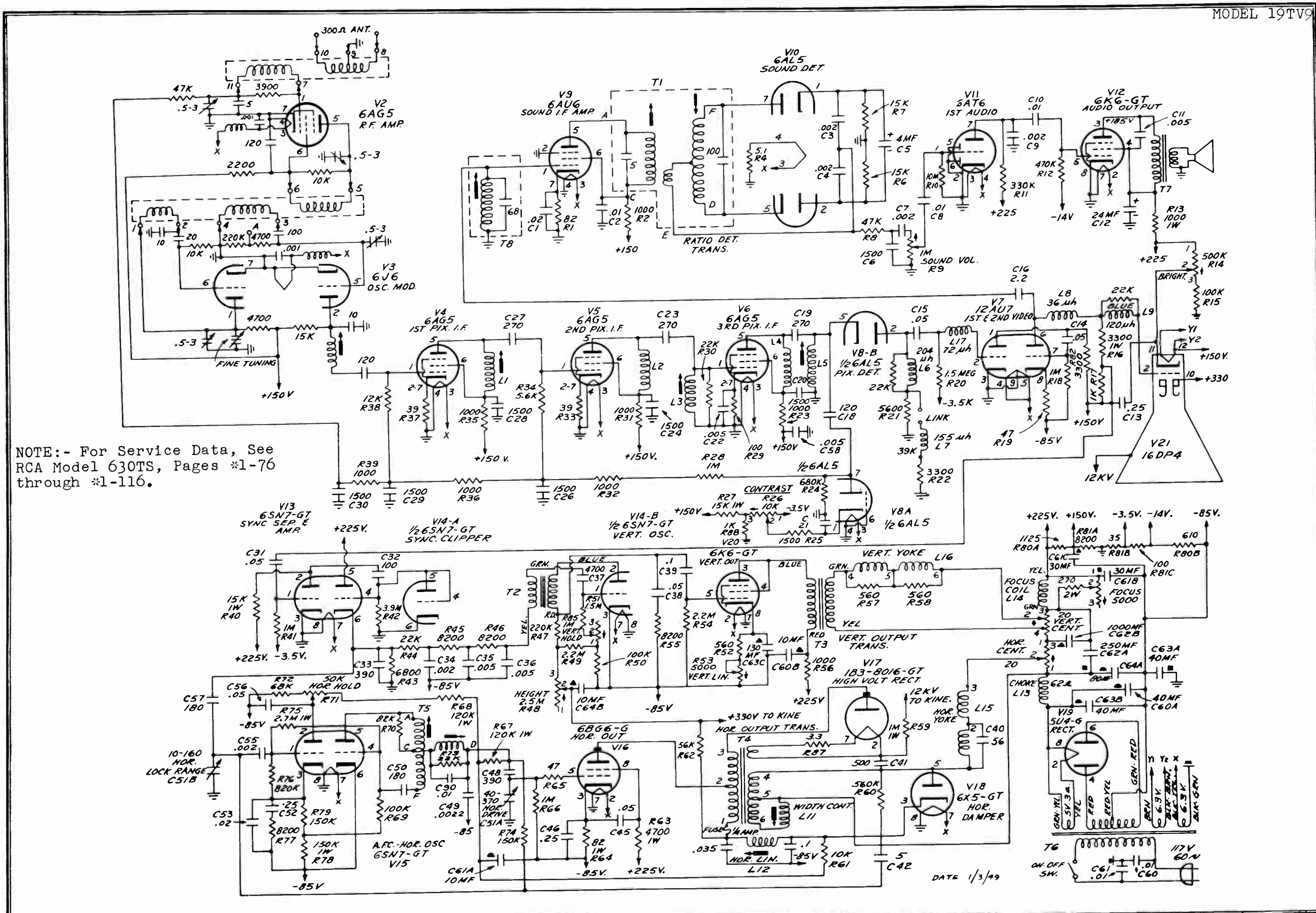

NOTE:- For Service Data, See RCA Model 630TS, Pages *1-76 through *1-116.

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General Description

The 600 and 900 series television receivers are 18 tube direct view types, featuring clear, bright pictures. The circuit is of advanced design using multi-purpose tubes, and featurers full channel coverage, Automatic Gain Control, high sensitivity, excellent horizontal frequency stability, low power consumption, and the Plakron Compensator circuit.

The receiver operates from a 115 volt 60 cycle power source and consumes 180 watts.

Tube complement

R. F. Tuner - R. F. Amplifier	6AG5
R. F. oscillator - converter	6J6
1st Video Amplifier (I.F.)	6AU6
2nd Video Amplifier (I.F.)	6AU6
3rd Video Amplifier (I.F.)	6AU6
Video Detector, A.G.C. Diode	6AL5
Video Amplifier	6AC7
Sync Clipper, D.C. Restorer, Sync Amplifier	12AU7
Ratio Detector Driver (4.5 mc)	6AU6
Ratio Detector, First Audio Amplifier	6T8
Audio Power Amplifier	6V6
Horizontal Deflection Amplifier	6BQ6
Horizontal Deflection Oscillator	6SN7
High Voltage Rectifier	1B3GT
Horizontal Damper Diode	6W4GT
Vertical Deflection Oscillator, Vertical Output	6SN7
Power Rectifier	5V4

The receiver operates with a 300 ohm balanced antenna input. The audio output is 2.5 watts undistorted, with a maximum output of 4 watts.

Operating Controls (Front of Receiver)

Horizontal Hold - Stops sideways motion of picture.
Vertical Hold --- Stops up or down rolling action of picture.
Volume-Off - - - -Adjusts sound volume; turns set on and off.
Contrast - - - - Varies contrast between light and dark areas.
Brightness - - - -Varies overall picture brightness.
Bandswitch - - - -Selects TV Channel.

NOTE: Sets employing the intercarrier sound system, such as this one, are tuner, not for the maximum sound, but for the sharpest, clearest picture.

Non-Operating Controls

Vertical Size - - - -	Varies height of picture.
Vertical Linearity -	Adjusts ratio between top and bottom of picture.
Horiz. Linearity ---	Varies ratio between right and left side of picture.
Horiz. Drive - - - -	Varies width and linearity.
Horiz. Waveform - - -	Maintains horizontal synchronization.
Width Control - - - -	Varies width of picture.
Focus - - - - - - - -	Focuses picture on screen.
Horiz. Centering - -	Shifts picture from left to right.

OPERATING INSTRUCTIONS

The following adjustments are necessary when turning the receiver on for the first time.

1. Turn the receiver "ON" and advance the SOUND VOLUME control to approximately mid-position. Wait a few moments.

2. Set the STATION SELECTOR to the desired channel.

3. Adjust the FINE TUNING control for sharpest, clearest picture.

4. Turn the BRIGHTNESS control fully counterclockwise, then clockwise until a light pattern appears on the screen.

5. Adjust the VERTICAL hold control until the picture stops vertical movement.

6. Adjust the HORIZONTAL hold control until a picture is obtained and centered.

7. Turn the BRIGHTNESS control counterclockwise until retrace lines just disappear.

8. Adjust the PICTURE control for suitable picture contrast.

9. After the receiver has been on for some time, it may be necessary to readjust the FINE TUNING control for improved picture clearness.

10. In switching from one station to another, it may be necessary to repeat steps numbers 3 and 8.

11. When the set is turned on again after an idle period, it should not be necessary to repeat the adjustments if the positions of the controls have not been changed. If any adjustment is necessary, step number 3 is generally sufficient.

12. If the positions of the controls have been changed, it may be necessary to repeat step numbers 1 through 8.

INSTALLATION INSTRUCTIONS

Receivers are shipped complete in one carton except for the kinescope. The kinescope is shipped in a special carton and should not be unpacked until ready for installation.

UNPACKING

The table models are shipped in an air cushioned carton. To open the carton, tear open the carton top flaps, remove the cardboard side packing material and with men on either side of the cabinet, lift it out of the carton.

Console models are also shipped in cartons. To unpack, turn the shipping carton on its side and tear open the carton bottom flaps. Fold the flaps up along the side of the carton and turn the carton back on its base. Lift the carton up and off the cabinet. Remove the cabinet back grille. Next, remove the speaker plug located on the rear apron of the chassis. Remove all shipping materials. Remove the envelope containing the door handles. Make sure all tubes are in place and are firmly seated in their sockets. Remove all knobs and the four bolts on the bottom of the cabinet, that hold the chassis from the cabinet, and insert the large tube strap in the slot near the front apron on the chassis or in the case of the 19 inch metal CRT, screw the bracket into sides of chassis. The tube mounting straps are usually shipped in the carton with the kinescope. Plug the deflection assembly into the six prong socket on top of chassis.

Kinescope Handling Precautions

Do not open the kinescope shipping carton, install, remove or handle the kinescope in any manner unless shatterproof goggles, and heavy gloves are worn. People not so equipped should be kept away while handling kinescopes. Keep the kinescope away from the body while handling. The kinescope bulb encloses a high vacuum and, due to its large surface area, is subjected to considerable air pressure. For these reasons, kinescopes must be handled with more care than ordinary receiving tubes. The large end of the kinescope bulb--particularly that part at the rim of the viewing surface--must not be struck, scratched or subjected to more than moderate pressure at any time. In installation, if the tube sticks or fails to slip smoothly into its socket, or deflecting yoke, investigate and remove the cause of the trouble. Do not force the tube. Refer to the Receiver Installation section for detailed instructions on kinescope installation. All kinescopes are shipped in special cartons and should be left in the carton until ready for installation in the receiver. Keep the carton for possible future use.

KINESCOPE INSTALLATION

Turn the tube so that the key on the base of the tube will be down and insert the neck of the kinescope through the deflection and focus coils so that the rim of the viewing surface rests on the rubber cushions. If the tube sticks, or fails to slip into place smoothly, investigate and remove the cause of the trouble. Do not force the tube. Insert the kinescope straps in the chassis slots and tighten with the wing nut and screw until the rubber cushions just begin to compress.

The focusing unit is shipped separately and must be installed. It is provided with a mechanical centering arrangement. Inspection will reveal it consists of a moveable plate with an opening slightly smaller than that of the focusing unit. Center these two opening by hand. Slip the focusing unit assembly over the neck of the kinescope with the centering adjustment and focusing slug toward the base of the tube. Fasten the unit to the CRT brackets placing the unit approximately one- half inch behind the deflection yoke. Slip the ion trap magnet over the neck of the kinescope with the large magnet towards the base of the tube.

Wipe the kinescope screen surface and front panel safety glass or mask clean of all dust and finger marks with a soft cloth moistened with the Drackett Co.'s "Windex" or similar cleaning agent.

Slide the deflection yoke as far forward as possible. If this is not done, difficulty will be encountered in adjusting the ion trap magnet and focus coil because of shadows on the corner of the raster.

Replace the chassis with CRT in cabinet being careful to properly center all controls. Slide the chassis up as far as possible so that the CRT fills the mask and is properly centered. Replace the four bolts in the bottom of the chassis. Reconnect the speaker plug. The antenna and power connections should now be made. Install the front panel control knobs.

WARNING

The high voltage supply in this receiver delivers 14,000 volts! If it is necessary to remove the kinescope after the receiver has been operating, short the kinescope lead to the chassis before attempting removal of, or adjustments to, the kinescope. A.C. interlocks are provided so that when the back of the high voltage cage is removed--so is the power.

Ion Trap Magnet Adjustment

Looking at the kinescope gun structure, it will be observed that the second cylinder from the base inside the glass neck is provided with two small metal flags as shown in Figure 2

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Turn the power switch to the "on" position, the brightness control fully clockwise, and contrast control counterclockwise.

The ion trap rear magnet poles should be approximately over the ion trap flags. Starting from this position adjust the magnet by moving it forward or backward at the same time rotating it slightly around the neck of the kinescope for the brightest raster on the screen. Reduce the brightness control setting until the raster is slightly above average brilliance. Adjust the focus control until the line structure of the raster is clearly visible. Readjust the ion trap magnet for maximum raster brilliance. The final touches on this adjustment should be made with the brightness control at the maximum position with which good line focus can be maintained.

DEFLECTION YOKE ADJUSTMENT

If the lines of the raster are not horizontal or squared with the picture mask, rotate the deflection yoke until this condition is obtained. Tighten the yoke adjustment wing screw.

Picture Adjustment

It will now be necessary to obtain a test pattern picture in order to make further adjustments. See steps 2 through 8 of the receiver operating instructions on page 3.

If the horizontal oscillator is operating properly, it should be possible to sync the picture at this point.

Check of Horizontal Oscillator Alignment

Turn the horizontal hold control to the extreme counterclockwise position. The picture should remain in horizontal sync. Momentarily remove the signal by switching off channel then back. Normally the picture will be out of sync. Turn the control clockwise slowly. The number of diagonal black bars will be gradually reduced and when only 3 bars sloping downward to the left are obtained, the picture will pull into sync upon slight additional clockwise rotation of the control. Pull in should occur when the control is approximately 90 degrees from the extreme counterclockwise position. The picture should remain in sync for approximately 90 degrees of additional clockwise rotation of the control. At the extreme clockwise position, the picture should be out of sync and should show 1 vertical or diagonal black bar in the raster.

If the receiver passes the above checks and the picture is normal and stable, the horizontal oscillator is properly aligned. Skip "Alignment of Horizontal Oscillator" and proceed with "Centering Adjustment".

ALIGNMENT OF HORIZONTAL OSCIALLATOR

If in the above check the receiver failed to hold sync with the hold control at the extreme counterclockwise position or failed to hold sync over 90 degrees of clockwise rotation of the control from the pull in point, it will be necessary to make the following adjustments:

Horizontal Frequency Adjustment

Turn the horizontal hold control to the extreme clockwise position. Tune in a television station and adjust T7 horizontal frequency adjustment (under the chassis) until the picture is just out of sync and the horizontal blanking appears as a vertical or diagonal black bar in the raster.

Horizontal Lock-in Range Adjustment

Set the horizontal hold control to the full counterclockwise position. Momentarily remove the signal by switching off channel then back. Slowly turn the horizontal hold control clockwise and note the least number of diagonal bars obtained just before the picture pulls into sync.

If more than 3 bars are present just before the picture pulls into sync, adjust the horizontal locking range trimmer C62 slightly clockwise. If less than 3 bars are present, adjust C62 slightly counterclockwise. Turn the picture control counterclockwise, momentarily remove the signal and recheck the number of bars present at the pull in point. Repeat this procedure until 3 bars are present.

Repeat the adjustments under "Horizontal Frequency Adjustment" and "Horizontal Lock-in Range Adjustment" until the conditions specified under each are fulfilled. When the horizontal hold operates as outlined under "Check of Horizontal Oscillator Alignment" the oscillator is properly adjusted.

If it is possible to sync the picture at this point and the AGC system is operating properly it will be necessary to adjust the Horizontal Oscillator by the method outlines in the alignment procedure on page 23. For field purposes paragraph "A" under Oscillator Waveform Adjustment may be omitted.

CENTERING ADJUSTMENTS

Centering is accomplished by mechanically orienting the focus coil. Moving the focus coil up and down, causes the picture to move sideways, and a sideward movement of the coil causes the picture to move up or down. The focus coil is supported on a set of brackets provided with slots which allow for its proper orientation. An additional amount of centering is provided by a centering adjustment screw on the rear of the focusing unit. The focusing unit should be installed as outlined under "Installation Instructions" and centered without the use of this auxiliary centering device except for final "fine" adjustment.

In some cases the electron gun of the kinescope is not properly centered and the picture tends to pull to one side, making horizontal centering difficult. To overcome this difficulty, a horizontal centering potentiometer has been provided. The procedure for centering as outlined above should first be followed, then an additional sideward movement as may be necessary, is provided for by this control.

After the centering has been accomplished, readjust the ion trap as outlined under "Ion Trap Magnet Adjustment".

Focus Adjustments

In most cases, the focus coil is placed approximately a half-inch away from the deflection coil. The contrast control should be turned counterclockwise and the brightness control turned clockwise until the desired viewing brightness is on the screen. Adjust the focus control screw using a brass screwdriver for maximum definition in the test pattern vertical "Wedge" and best focus in the white areas of the pattern. Readjust the position of the ion trap magnet to insure that maximum brilliance is obtained. For PM-Type Focalizer Units, a brass screwdriver should be used to adjust the shorting slug to prevent inter-action between focus unit and ion trap.

Height and vertical linearity

Adjust the vertical size control until the picture fills the mask vertically. Adjust the vertical linearity control until the test pattern is symmetrical from top to bottom.

Adjustment of either control will require a readjustment of the other. Adjust vertical centering to align the picture with the mask.

HORIZONTAL DRIVE, WIDTH AND LINEARITY

Adjustments

Adjust the horizontal drive control to give a picture of maximum width within the limits of good linearity. Usually the picture width is too great and must be reduced by turning out the width control slug. Adjustments of the horizontal drive control affect the horizontal oscillator hold and locking range. If the drive control was adjusted, recheck the oscillator alignment.

Check of R.F. Oscillator

Tune in all available stations to see if the receiver r.f. oscillator is adjusted to the proper frequency on all channels. The fine tuning control should be adjusted for the sharpest, clearest picture--not for maximum sound volume. Adjustments usually are not required, but if so, these should be made by the method outlined in the alignment procedure.

CIRCUIT DESCRIPTION

It is assumed in this description that the reader is familiar with recent television principles as well as the operation of conventional circuits used in radio receivers.

Low Voltage Power Supply

The power supply has been designed to eliminate all high wattage bleeders thus reducing considerably the amount of heat generated inside the chassis. This has been accomplished by connecting the circuits operating at lower voltages, in series, across the higher voltages necessary for the deflection system.

The deflection circuit operates at the higher voltage (360 volts) while the RF, If and audio circuits are connected in series across the deflection circuits, thus saving a substantial amount of current.

Referring to the schematic diagram, the RF and If plates and screens are at 140 volts while the cathodes return to ground. The audio cathodes are at the same 140 volts while the audio plates are at 360 volts or 220 volts with respect to their cathodes. The 390 ohm resistor together with the 40 mf condenser act as a filter, preventing the current variations from modulating the B voltage.

Automatic voltage regulation of the 140 volts is accomplished by the 6V6 which acts as a series regulator. Current variations in the RF and IF circuits changing the 140 volts, changes the effective grid cathode voltage of the 6V6 since its grid is connected to the divider going from 360 volts to ground. Thus the change in the 140 volt system is only about 10% with AGC bias changes although the current change is much greater.

360 volts at 175 ma. is obtained from a conventional transformer power supply circuit using a 5V4G full wave rectifier. The 8016/1B3GT functions as the high voltage rectifier, while a 6W4GT is used as the horizontal damper tube.

R.F. Unit

The R.F. unit covers all 12 channels, (2 to 13 inclusive), and operates from a balanced input of 300 ohms. The local oscillator is tuned to the high side of the channels and provides a picture I.F. of 25.75 mc and a sound I.F. of 21.25 mc.

I.F. Amplifier

This amplifier consists of 3 6AU6 tubes in a simple but sensitive circuit. Alignment is also simple since only two frequencies are utilized. Since the intercarrier sound system is used, no sound traps in the video I.F. are necessary, further simplifying align-

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ment. The tubes are operated at a slightly higher voltage than is usually found in regular I.F. amplifiers resulting in a substantial increase in gain yet not affecting the life of the tubes. Automatic Gain Control is applied to the R. F. Amplifier and first two video I.F. stages.

Automatic Gain Control

The function of the AGC circuit is to maintain a constant signal at the kinescope grid in the presence of fading and to reduce the amount the contrast control must be rotated when switching from a weak to a strong signal or vice versa.

The slide arm of the contrast control R40 and the 39K resistor R37 form a voltage divider which provides a variable positive voltage on the cathode of the AGC diode (pin 1). The I.F. signal is coupled to the AGC diode through C34 and appears across R36 and the diode in parallel. In order for the diode to conduct, the peak amplitude of the I.F. signal must exceed the d.c. voltage on the cathode of the AGC diode. When this occurs, the rectification current develops a voltage across R36 which is then suitably filtered by R35 and C35 and utilized as bias. For a weak signal the contrast control is rotated to give maximum gain from the video amplifier and a higher positive voltage is applied to the AGC diode cathode, thus reducing the bias on the I.F. video amplifier and increasing its gain. The contrast control, then, has performed two functions: (1) increased the gain of the video amplifier and (2) increased the gain of the I.F. video amplifier.

Video Amplifier

A 6AC7 is used as a d.c. coupled video amplifier and its output is capacitively coupled to the kinescope grid. It has high gain and good noise clipping action that is independent of picture content.

The video amplifier grid bias of 2.5 volts is developed across a 12 ohm resistor R55 in the B minus circuit. A filter capacitor (C51) with low impedance to all video frequencies is used across this bias resistor so as to prevent charging in the presence of noise pulses that draw grid current.

The screen voltage is taken from a bleeder connected between 360 volts and ground (R41 and R42). The internal impedance is low enough to maintain the screen voltage at approxiamtely 150 volts over a normal operating range, yet high enough to keep screen dissipation within limits even if the set is improperly operated.

The video amplifier plate load consists of two resistors, R47 connected from plate to 140 volts and the other R45 from plate to 360 volts. They are effectively in parallel for AC and give an effective plate supply voltage of 190 volts.

In order that the clipping level and maximum output may be obtained from the weakest to the strongest signals, the contrast control provides variable AC degeneration and bias for the video amplifier. It controls the gain of the video amplifier stage and at the same time provides the proper cathode bias to offset the positive voltage developed across the diode load resistor which would otherwise be applied to the control grid of the 6AC7.

Plakron Compensator

Tests and experience have shown that a crisper picture results if the overall video circuit response is not flat but rises with frequency. Partly, this is so because the output of commonly used camera tubes fall off with frequency and in addition even a perfect picture may appear better when viewed from the normal viewing distance if the high frequencies are boosted. The result is a transient which sharpens up all video detail.

However, boosting the high frequencies would increase apparent picture noise but in this case, the boost is varied with the contrast control setting so that it is present when signals are strong and absent when signals are weak.

The 750 ohm contrast control is tapped as in fig. 4 with a 680mmf capacitor from the tap to the 6AC7 cathode a 480 mmf capacitor from the tap to ground. With the contrast control set at full gain, as in the case of a weak signal, there is zero resistance in the cathode circuit and all frequencies are amplified equally. On a stronger signal, the gain is reduced and by-passed resistance is introduced in the cathode circuit. Since the capacitor is of low value, only the higher frequencies are by-passed, and the circuit becomes degenerate at the low frequencies. Thus the higher frequencies receive more amplification than the lower ones.

D. C. Restorer - Sync Clipper - Sync Amplifier

The first half of the 12AU7, serves the dual purpose of d. c. restorer and sync clipper. The cathode and grounded grid forms a diode which acts as the d. c. restorer. A very low voltage is applied to the plate, and the cathode resistor, R 49, is adjusted so that little or no plate current flows except when the sync pulses drive the cathode sufficiently negative so as to cause conduction. The sync pulses then appear across R50, and are coupled to the horizontal and vertical oscillators after further amplification in the second half of the 12AU7.

Vertical Deflection Circuit

One triode of the 6SN7 is used as a blocking oscillator and sawtooth generator, while the other triode section is the vertical deflection amplifier. This type of circuit permits more reliable interlace than most other types of oscillators. The frequency is varied by the potentiometer R58 in the front of the receiver. Vertical linearity is varied with the 5K potentiometer R61, while height is varied with the 2.5 megohm potentiometer R63, both located in the front of the set.

HORIZONTAL OSCILLATOR AND SAWTOOTH GENERATOR

The first section of V12 is used as a control tube to maintain the frequency of the second section which operates as a blocking oscillator.

Referring to the schematic diagram, (Fig. 6), T7 is seen to have three windings. The windings from A to C and C to F from the blocking oscillator transformer. C67, R77 and R78 are the frequency determining elements as in ordinary blocking oscillators. The frequency is controlled by regulating the voltage across R78 instead of varying the resistance of this element which is usually the method employed.

The blocking oscillator grid bias is about -85 volts and a portion of this negative voltage is applied through R76 to the grid of the first section of V12, the control tube. Due to the negative voltage and the high value of cathode resistance, this tube is normally cut off in the absence of sync pulses.

A sawtooth voltage, an integrated square wave, and the sync pulse appear across C62 and are coupled to the control tube grid by C63. The sawtooth is derived from the sawtooth generator through R81. The integrated square wave is fed from the horizontal output transformer T8, through R89 and C79, and the sync pulse from the sync amplifier through C61. The three voltages combine to produce a wave shape as shown in Fig. 7.

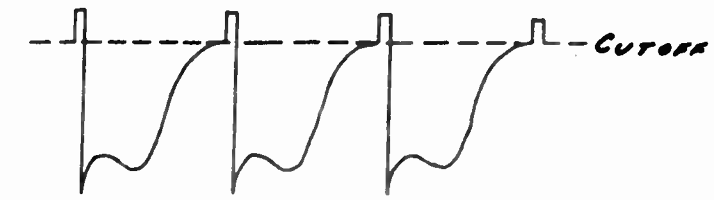

FIGURE 7- WAVE SHAPE AT PIN 1

C62 is adjusted so that the amplitude of the wave shape of Fig. 7 is such as to cause the control tube section of V12 to conduct only on the sync pulses. With this adjustment, conduction takes place only for the time of duration of the sync pulses as shown in Fig. 8 which depends upon the phase relation of the sync pulse and the horizontal oscillator frequency. When the control tube conducts, the average current produced by the pulse develops a voltage drop across R78 which subtracts from the negative voltage normally across it. As the duration of the sync pulses increases, the average current increases, and the voltage across R78 becomes less negative. With less bias on the blocking oscillator tube grid, the frequency increases and the phase relation between the sync pulses and feed-back voltages change in such a direction as to shorten the conduction time. Normal operation produces a conduction time such as "t2", fig. 8

FIGURE 8 - VARIATION IN SYNC. PULSE DURATION

WHEN THE HOLD CONTROL (R74) is in mid-position, so that the conduction time may vary in both directions and compensate for frequency drift. C65, C66 and R72 provide a filter network which eliminates hunting and gives smooth operation. The winding from C to D in T7 is a resonant circuit which impresses a sine wave on the sawtooth voltage from point C to ground and provides additional synchronization of the blocking oscillator. C65 is the charging capacitor and the sawtooth output is coupled to the grid of V13 (6GQ6) through a capacity voltage divider C70 and C71.

The horizontal sweep output circuit is of popular design and should require no explanation.

Sound System

The intercarrier sound system is employed in this receiver. The 4.5 mc sound I.F. frequency is taken from the plate of the video amplifier by T1, which also serves as a trap at this frequency. The 4.5 mc signal is then fed through an I.F. amplifier to the ratio detector and audio amplifier.

An important advantage of this type of sound system is that even if the local oscillator drifts, the difference between the sound and picture carrier remains at 4.5 mc so that the sound is unaffected.

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ALIGNMENT PROCEDURE

Test Equipment

To properly service this receiver it is recommended that the following test equipment be available:

R.F. Sweep Generator

Specifications:

(a) Frequency Ranges
18 to 30 mc., 1 mc. sweep width
40 to 90 mc., 10 mc. sweep width
170 to 225 mc., 10 mc. sweep width

(b) Output adjustable with at least 0.1 volt maximum.
(c) Output constant on all ranges and on all attenuator positions.

Cathode Ray Oscilloscope - Preferably one with a wide band vertical deflection, an input calibrating source and a low sapacity probe.

Signal Generator - To provide the following frequencies

(a) I.F. Frequencies
23.3 mc., First and Third I.F. Transformer
25.36mc., Second and Fourth I.F. Transformer
21.25mc., Sound carrier Marker
25.75mc., Picture Carrier Marker

(b) R.F. Frequencies

Channel Number	Picture Carrier Freq. Mc.	Sound Carrier Freq. Mc.
2	55.25	59.75
3	61.25	65.75
4	67.25	71.75
5	77.25	81.75
6	83.25	87.75
7	175.25	179.75
8	181.25	185.75
9	187.25	191.75
10	193.25	197.75
11	199.25	203.75
12	205.25	209.75
13	211.25	215.75

(c) Output on these ranges should be adjustable and at least 0.1 volt maximum.

Heterodyne Frequency meter with Crystal calibrator if the signal generator is not crystal controlled. Electronic Voltmeter of Junior "Volt Ohmyst" type and a high voltage multiplier probe for use with this meter to permit measurements up to 15 KV.

Adjustments Required

Normally, only the RF oscillator will require a slight "touching up". All other circuits are either broad or very stable and hence will seldom require attention. It is recommended that when making replacements the oscillator tube be selected for this service to make the "touching up" as easy as possible or, in some cases, to eliminate it.

Order of Alignment

When a complete receiver alignment is necessary, it can be most conveniently performed in the following order:

1. Picture I.F. transformer
2. Sound I.F. transformer
3. Sound I.F. transformer
4. R.F. Tuner
5. Sensitivity check

Picture I.F. Transformer Adjustment

Remove all tubes from the tuner leaving only the 6J6 converter. Place a miniature tube shield cut in half over the glass envelope of the 6J6 and connect the signal generator to this cap. The cap forms a low capacity coupling to the plate of the converter and loosely couples the signal generator into the I.F. amplifier. Connect the low side of the generator to ground (or chassis). All leads from the generator should be as short as possible. Connect the electronic voltmeter (VTVM) across the opposite ends of R38 in the video detector circuit.

Set the generator to 23.3 mcs and the contrast control to maximum. Adjust coils LI and L3 for maximum d.c. voltage reading on the VTVM. Decrease the generator output so that the maximum voltage reading is in the order of one volt. Set the generator to 25.3 mcs and adjust coils L_2 and L_4 as outlined above. (LI is located in the tuner.) Tune the sound trap coil to minumum response at 21.25 mcs.

It is necessary to use a sweep generator for a more accurate alignment. Replace the signal generator with the sweep generator. Disconnect the VTVM and connect an oscilloscope to the junction of L_5 and L_6. Adjust the sweep generator output to a point below that at which limiting, or over-load takes place. Retune L_1, L_2, L_3, and L_4 as necessary to obtain the response curve as shown in Fig. 9

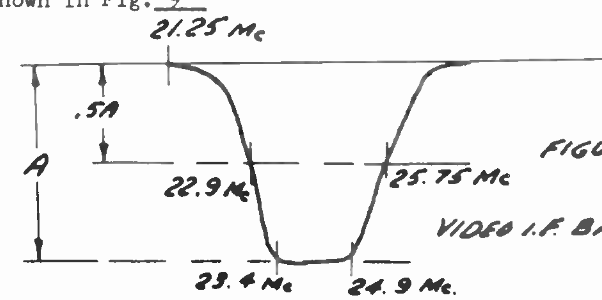

FIGURE 9
VIDEO I.F. BAND PASS

The 22.9 mc marker must be at the 50% response point to insure buzz-free sound. Similarly, the 25.75 mcs marker must be at 50% response point on the right side of the curve to insure good picture quality. If the curve tends to become "peaky" at one end of the response curve, replace C22, C26 or C30. Check all ground connections.

Sound I.F. Adjustment

1. Set the signal generator to 4.5 mc and the output to approximately 5000 microvolts. Connect the high side of the signal generator through a 1000 MMF capacitor to the video amplifier (V8) control grid and ground.

2. Connect the VTVM in series with a 10,000 ohm decoupling resistor across R9 with ground lead to pin 7, V2.

3. Peak the primary and secondary of T1 for maximum reading on the VTVM.

4. Peak the primary of T2 (bottom of chassis) for maximum reading on VTVM.

5. Remove the meter and decoupling resistor from across R9. Connect two well matched 150K resistors in series across R9. Connect the high side of the meter to the junction of the 150K resistors and the low side to the junction of C7 and R7.

6. Adjust secondary of T2 for zero reading on the VTVM.

IMPORTANT: As the adjustments are brought to resonance, reduce the signal input to prevent overloading. Inasmuch as using too much signal input will result in misalignment and a buzz in the audio output, use as low a signal input amplitude as possible.

If desired, the symmetry of the curve may be checked by tuning the secondary to both sides of zero and noting the maximum voltage produced. For proper balance of the ratio detector, the maximum voltages in each direction should be equal. If not, T1 and the primary of T2 should be returned.

R.F. Tuner Alignment

The present series includes four different styles of tuners, three of which are of the turret type and the remaining one -- the R-C tuner -- is of the continuous tuning variety. The circuit diagrams of all four are included below, along with the alignment procedure recommended for the Standard Coil Co's., and the RCA tuners. The other tuners are not treated separately. The remaining turret type tuner is made by the Leonard Electric Products Co. and is similar to the Standard Coil Co. tuner for alignment purposes. The R-C tuner alignment procedure requires special equipment and it is not recommended that the Service Man make these adjustments. However, should such information be desired, it may be obtained by writing to the Video Corporation of America.

Standard TV Tuner

For circuit diagram refer to Fig. 10 . The location of the trimmer capacitors is given in Fig. 11.

RF and Mixer Alignment

1. Set station selector switch to channel 12.

2. Connect oscilloscope through 10,000 ohms to test point 9 (wire loop on top of tuner).

3. Set sharp tuning control at approximately mid point of its tuning range.

4. Feed sweep generator into antenna terminals (properly matched) sweeping channel 12.

5. Adjust C2, C3, and C4 for flat top response curve. Check markers on all channels. They should fall in automatically on all channels.

Oscillator Alignment

1. Turn station selector switch to channel 12.

2. Connect R.F. Sweep generator marker generator and oscilloscope so as to boserve overall band pass characteristics.

3. Set marker generator to channel 12 video carrier frequency, 205.25 mcs.

4. With the fine tuning control in its center position, adjust C5 until the marker is 50% or half way up the left side of the curve.

A 1000 mmf capacitor connected across the oscilloscope input will facilitate observing the marker.

5. Check all channels for above result. It is usually not necessary to make any further adjustments.

6. If some channels are off, place a non-metallic screw driver through opening in front of tuner and adjust the slug for those channels where needed.

RCA Type TV Tuner

For circuit diagram refer to fig. 12. The location of trimmer capacitors is given in fig. 13. Symbols used refer to circuit diagram.

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Antenna Alignment

1. Connect sweep generator to terminals of T1.
2. Connect scope through crystal diode unit to pin 5 of V1.
3. Adjust C7 for required response curve of channel 6 on scope.
4. Adjust L18 for required response curve of channel 7 on scope.
5. View channels 2 to 6 and readjust C7 if a compromise is necessary.
6. View channels 7 to 13 and readjust L18 if a compromise is necessary.
7. Remove scope from pin 5.

R.F. Alignment

1. Connect scope to oscilloscope connection "Y".
2. Adjust L11, C10, L13, for required response curve of channel 13 on scope.
3. Adjust C9 and C22 for required response curve of channel 7 on scope.
4. Adjust C13 for required response curve of channel 6 on scope.
5. View channels 2 to 6 and readjust C9, C13, C22, if a compromise is necessary.
6. View channels 7 to 13 and readjust L11, C10, L13, if a compromise is necessary.
7. Remove scope and sweep generator.

Oscillator Alignment

1. Connect sweep generator to terminals of T1.
2. Connect "marker" frequency generator to terminals of T1.
3. Connect oscilloscope to junction of L5 and L6.
4. Set sweep generator to Channel 2 and marker frequency to 55.25 mcs
5. With the fine tuning control in its center position, adjust C19 until the marker is 50% or half-way up the left side of the curve. (A 1000 mmf capacitor connected across the oscilloscope input will facilitate observing the marker.
6. Switch tuner and sweep generator to channel 13 and marker to 211.25 mcs.
7. Adjust L12 for same result as in step 5 above.
8. Check channels 3 to 12 and set individual strip oscillator adjustment screws.

If necessary. Channel 2 and 13 strip adjustments have been made at the factory, and resetting C19 and L12, makes readjustment of these strips unnecessary.

Recheck RF Alignment for curve shape as outlined above and repeat steps 5 and 6 of RF Alignment if necessary.

Horizontal Frequency Adjustment

With a clip lead, short circuit the coil between terminals C and D of the horizontal oscillator transformer T7. Tune in a television station and sync the picture if possible.

A. Turn the horizontal hold control to the extreme clockwise position. Adjust the T7 Frequency Adjustment (under the chassis) so that the picture is just out of sync and the horizontal blanking appears in the picture as a vertical bar. The position of the bar is unimportant.

B. Turn the hold control approximately one quarter of a turn from the extreme clockwise position and examine the width and linearity of the picture. If picture width or linearity is incorrect, adjust the horizontal drive control, C71, the width control and the linearity control until the picture is correct. If C71, or either control, was adjusted, repeat Step A above.

Horizontal Oscillator Alignment

Normally the adjustment of the horizontal oscillator is not considered to be a part of the alignment procedure, but since the oscillator waveform adjustment requires the use of an oscilloscope, it can not be done conveniently in the field. The waveform adjustment is made at the factory and normally should not require readjustment in the field. However, the waveform adjustment should be checked whenever the receiver is aligned or whenever the horizontal oscillator operation is improper.

Horizontal Locking Range Adjustment

Turn the horizontal hold control fully counterclockwise. Momentarily remove the signal by switching off channel then back. Slowly turn the horizontal hold control clockwise and note the least number of diagonal bars obtained just before the picture pulls into sync.

If more than 9 bars are present just before the picture pulls into sync adjust the horizontal locking range trimmer C62 slightly clockwise. If less than 7 bars are present, adjust C62 slightly counterclockwise. Turn the horizontal hold control counterclockwise, momentarily remove the signal and recheck the number of bars present at the pull-in-point Repeat this procedure until 7 to 9 bars are present.

Horizontal Oscillator Waveform Adjustment

Remove the shorting clip from terminals C and D of T7. Turn the horizontal hold control to the extreme clockwise position. With a thin fibre screwdriver, adjust the Oscillator Waveform Core of T7 (on the outside of the chassis) until the horizontal blanking bar appears in the raster.

A. Connect the low capacity probe of an oscilloscope to terminal C of T7. Turn the horizontal hold control one quarter turn from the clockwise position so that the picture is in sync. The pattern on the oscilloscope should be as shown in Fig. 15. Adjust the Oscillator Waveform Adjustment Core of T7 until the two peaks are at the same height. During this adjustment, the picture must be kept in sync by readjusting the hold control if necessary.

This adjustment is very important for correct operation of the circuit. If the broad peak of the wave on the oscilloscope is lower than the sharp peak, the noise immunity becomes poorer, the stabilizing effect of the tuned circuit is reduced and drift of the oscillator becomes more serious. On the other hand, if the broad peak is higher than the sharp peak, the oscillator is overstabilized, the pull-in range becomes inadequate and the broad peak can cause double triggering of the oscillator when the hold control approaches the clockwise position.

Remove the oscilloscope upon completion of this adjustment.

Check of Horizontal Oscillator Adjustments

Set the horizontal hold control to the full counterclockwise position. Momentarily remove the signal by switching off channel then back. Slowly turn the horizontal hold control clockwise and note the least number of diagonal bars obtained just before the picture pulls into sync.

If more than 3 bars are present just before the picture pulls into sync, adjust the horizontal locking range trimmer C62 slightly clockwise. If less than 3 bars are present, adjust C62 slightly counterclockwise. Turn the horizontal hold control counterclockwise momentarily remove the signal and recheck the number of bars present at the pull-in point. Repeat this procedure until 3 bars are present.

Turn the horizontal hold control to the maximum clockwise position. The picture should be just out of sync to the extent that the horizontal blanking bar appears as a single vertical or diagonal bar in the picture. Adjust the T7 Frequency Adjustment until this condition is fulfilled.

SENSITIVITY CHECK

A comparative sensitivity check can be made by operating the receiver on a weak signal from a television station and comparing the picture and sound obtained to that obtained on other receivers under the same conditions.

This weak signal can be obtained by connecting the shop antenna to the receiver through a ladder type attenuator pad. The number of stages in the pad depends upon the signal strength available at the antenna. A sufficient number of stages should be inserted so that a somewhat less than normal contrast picture is obtained when the picture control is at the maximum clockwise position. Only carbon type resistors should be used to construct the pad.

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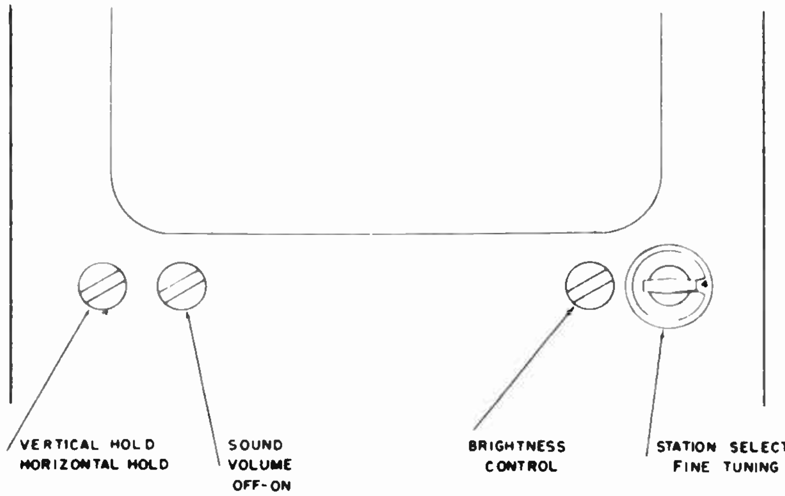


FIG 1 FRONT PANEL OF RECEIVER-OPERATING CONTROLS

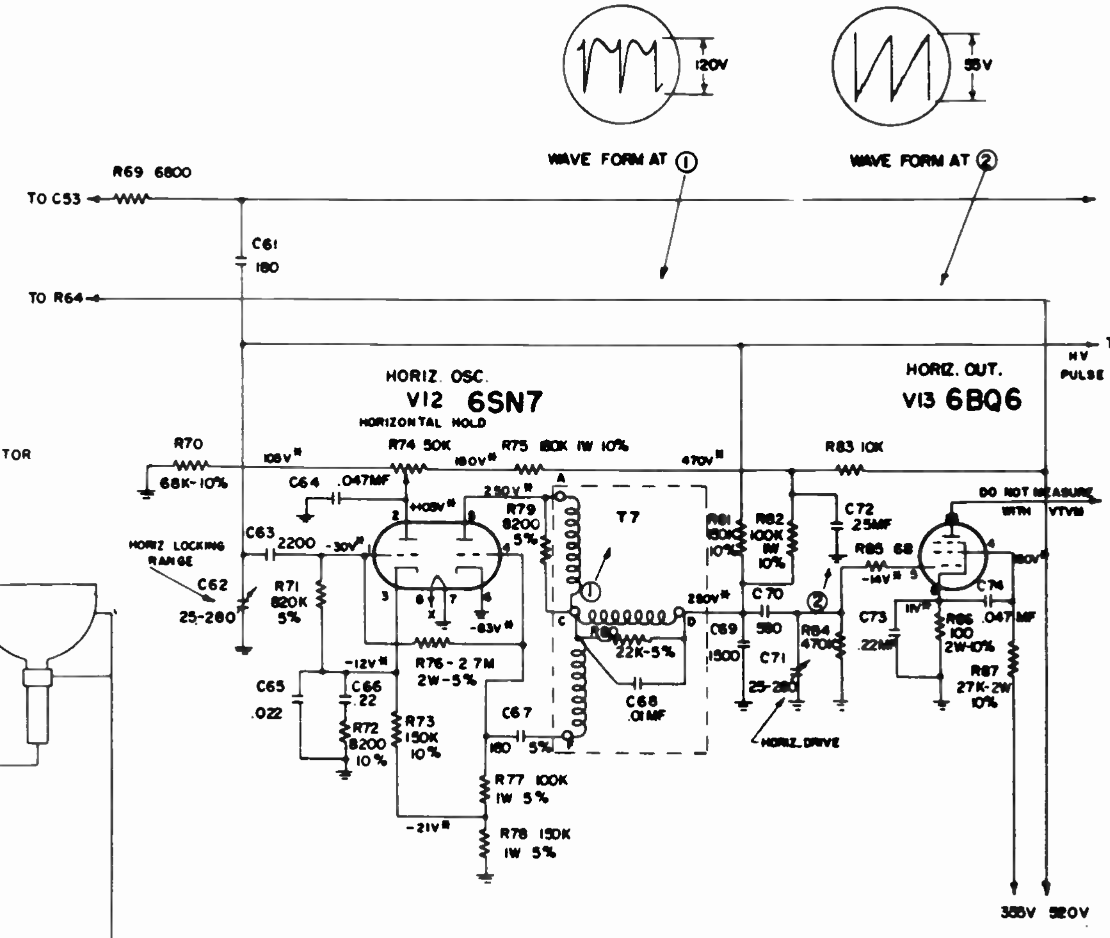


FIG 6

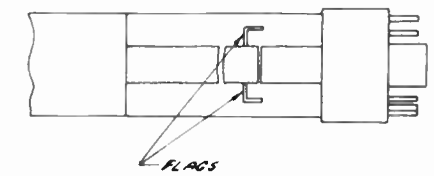


FIG. 2 — TUBE GUN & FLAGS

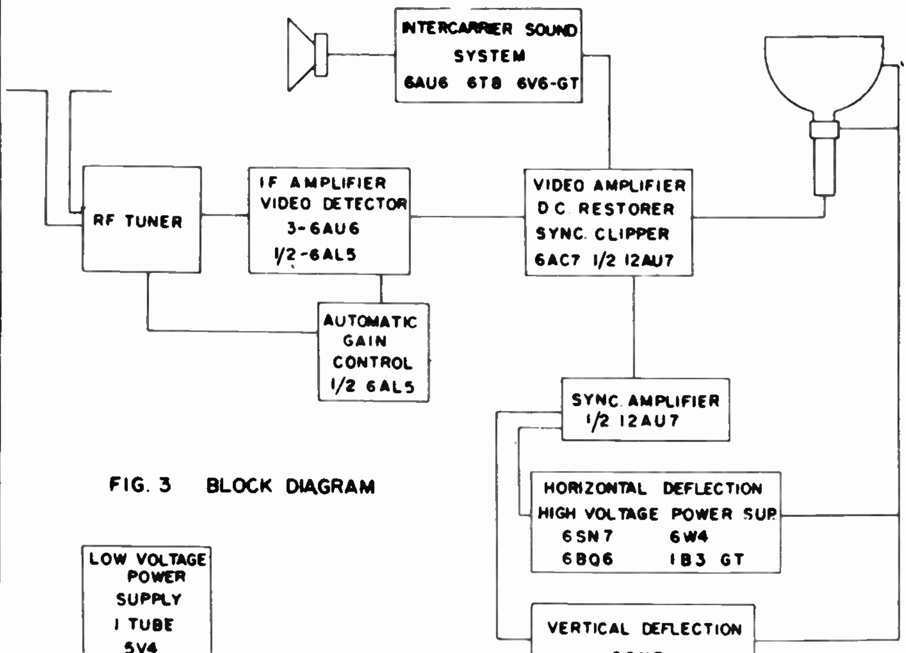


FIG. 3 BLOCK DIAGRAM

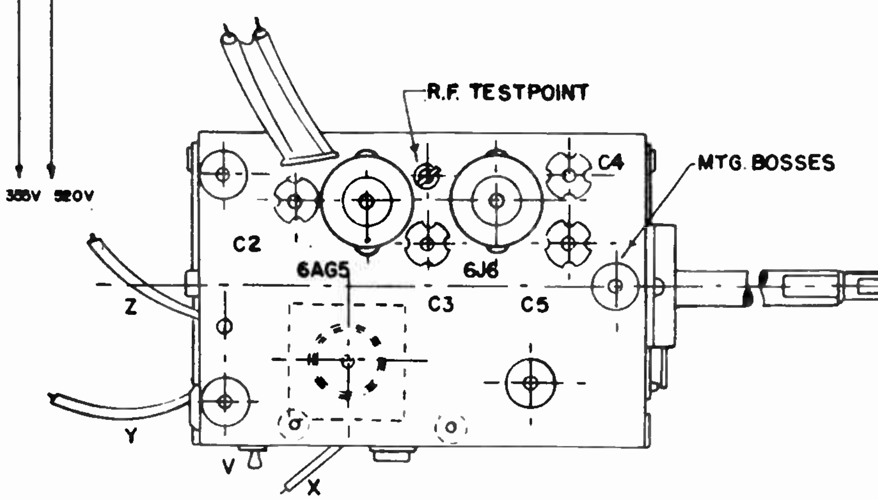
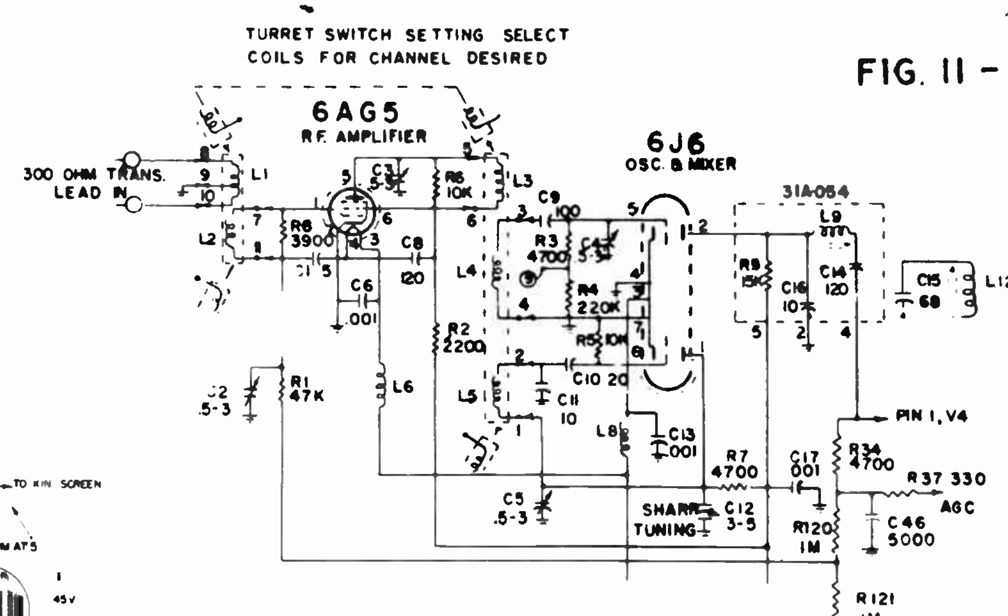


FIG. 11 - TOP VIEW OF STANDARD TUNER

FIG. 10- STANDARD COIL TUNER



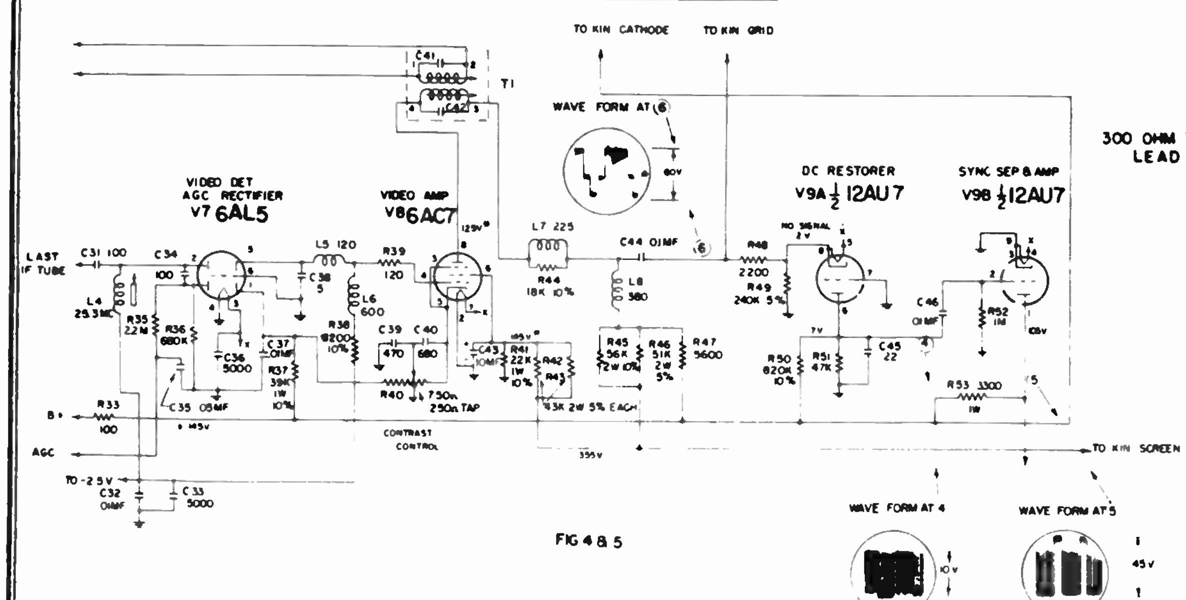


FIG 4 & 5

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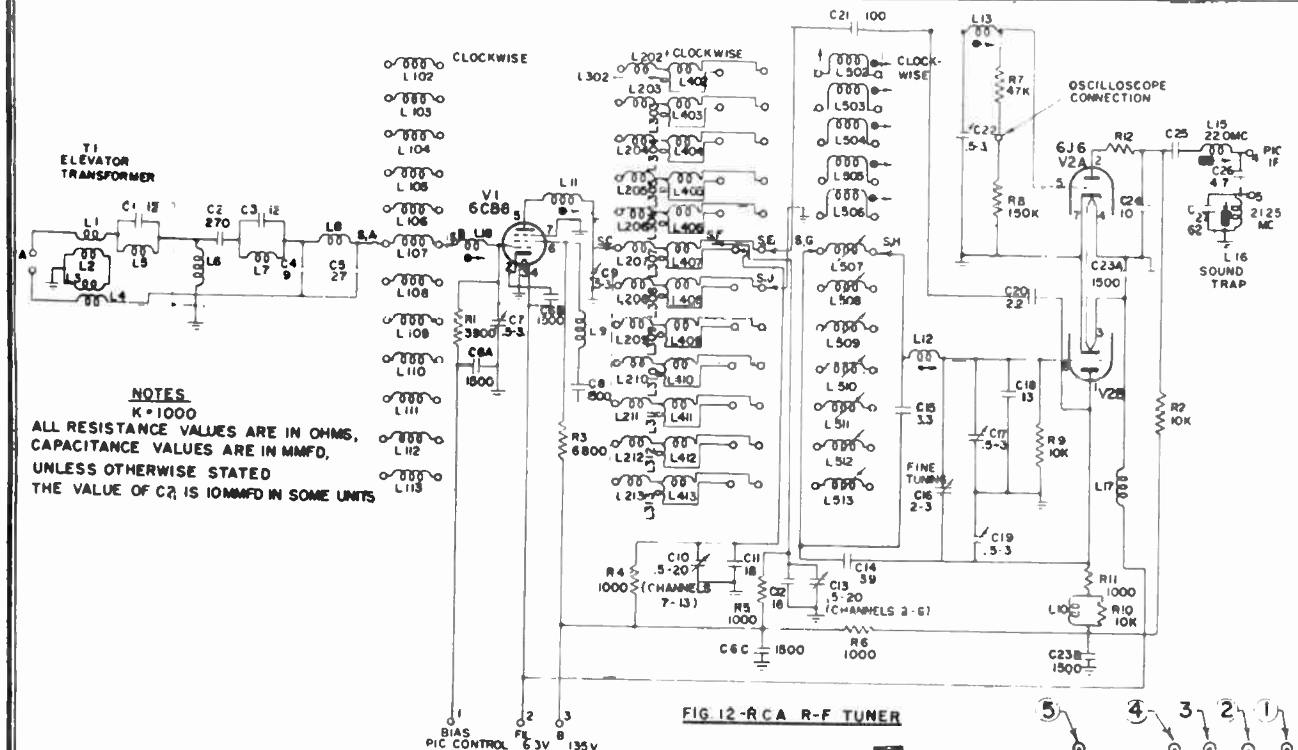
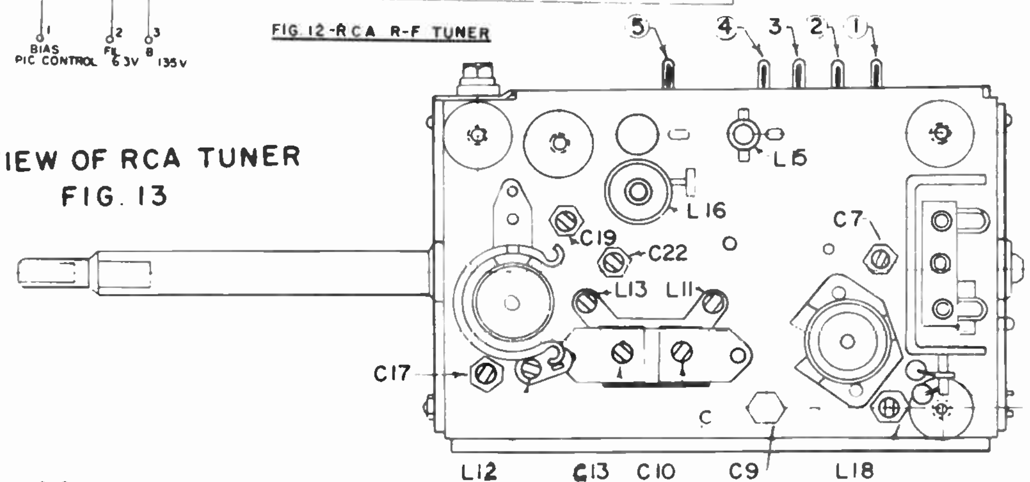


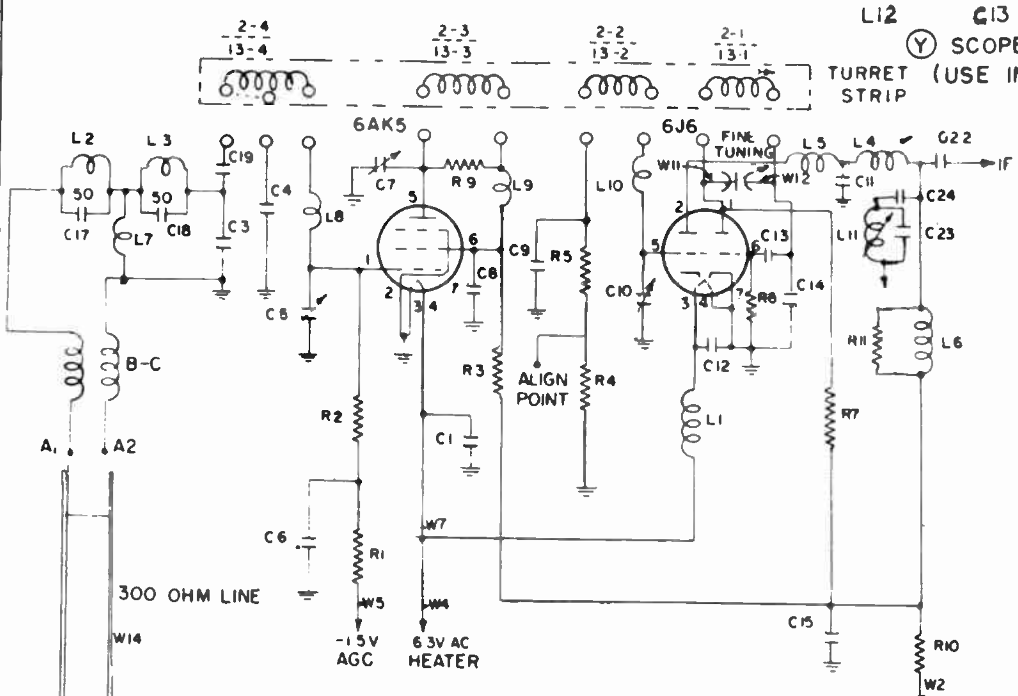
NOTES
K = 1000
ALL RESISTANCE VALUES ARE IN OHMS,
CAPACITANCE VALUES ARE IN MMFD,
UNLESS OTHERWISE STATED
THE VALUE OF C2 IS 10MMFD IN SOME UNITS

FIG. 12 - RCA R-F TUNER

TOP VIEW OF RCA TUNER
FIG. 13



(Y) SCOPE TERMINAL (USE IN ALIGNMENT)



C1,C6,C12,C15 - 100 MMF ± 20%
C3 - 15MMF - 10%
C4 - 20MMF - 10%
C5,C7,C10 - .5-3 MMF
C8 - 120MMF - 10%
C8,C11,C19 - 100 MMF - 10%
C13 - 47 MMF - 20%
C14 - 5MMF - 10%
C17 - 8 L2 IF TRAP

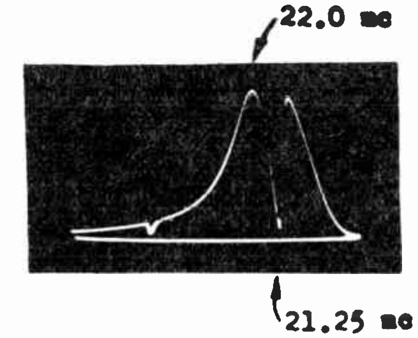
C18 & L3 IF TRAP
C22 - 120MMF - 20%
C23 - 75 MMF
C24 - 4.7 MMF
R1,R3,R10 - 1K - 20%
R2 - 3.3K - 10%
R4 - 100K - 20%
R5,R7,R9 - 10K - 20%
R6 - 22K - 10%

R11 & L6 - (PEAKING COIL) 1.2 MEG
L1 - RFC
L4 - PIF
L5 - MIXER PLATE LOOP
L7 - SHUNT COIL
L8 - RF GRID LOOP
L9 - RF PLATE LOOP
L10 - MIXER GRID LOOP
L11 - 21.25 MC SOUND TRAP COIL

FIG. 15 LEONARD TURRET TUNER

Shown on the right is a photograph of a typical response curve of the overall tuner measured from the antenna terminals to the grid of the first video i-f tube.

Shown below are photographs of typical response curves of the r-f circuits measured from the antenna terminals to point (Y).



Picture Carrier   Sound Carrier

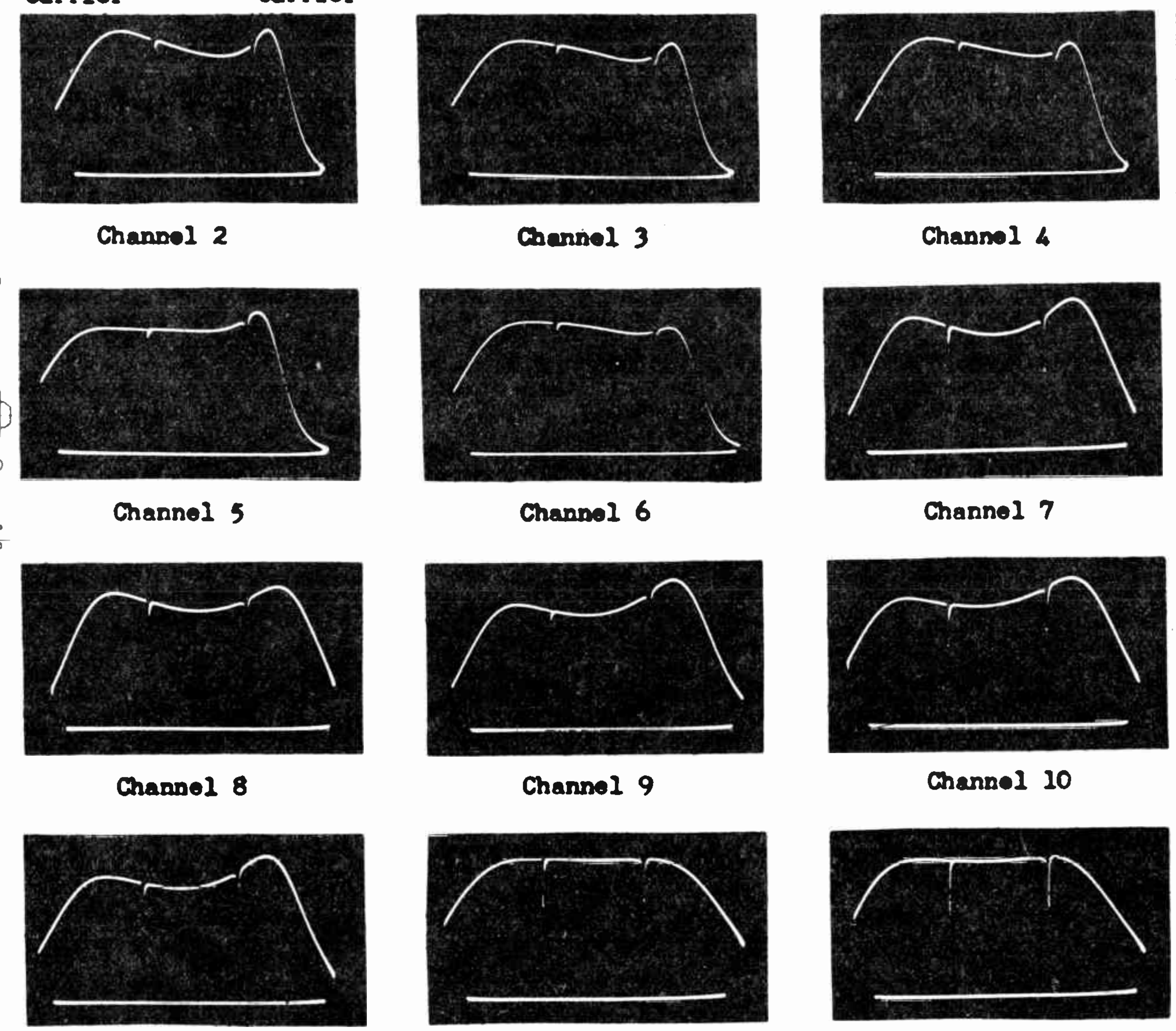


FIG. 14 - WAVEFORMS

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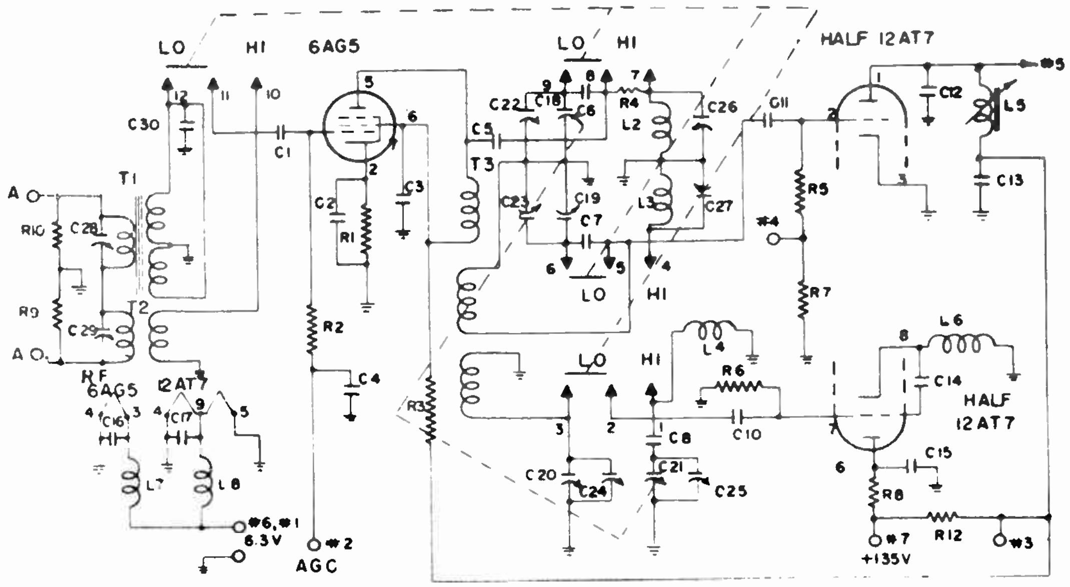


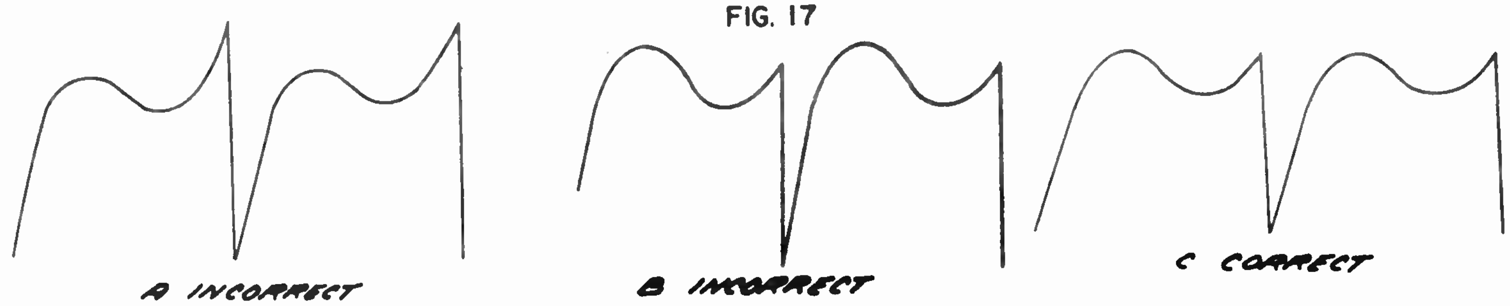
FIG.16 RC TUNER

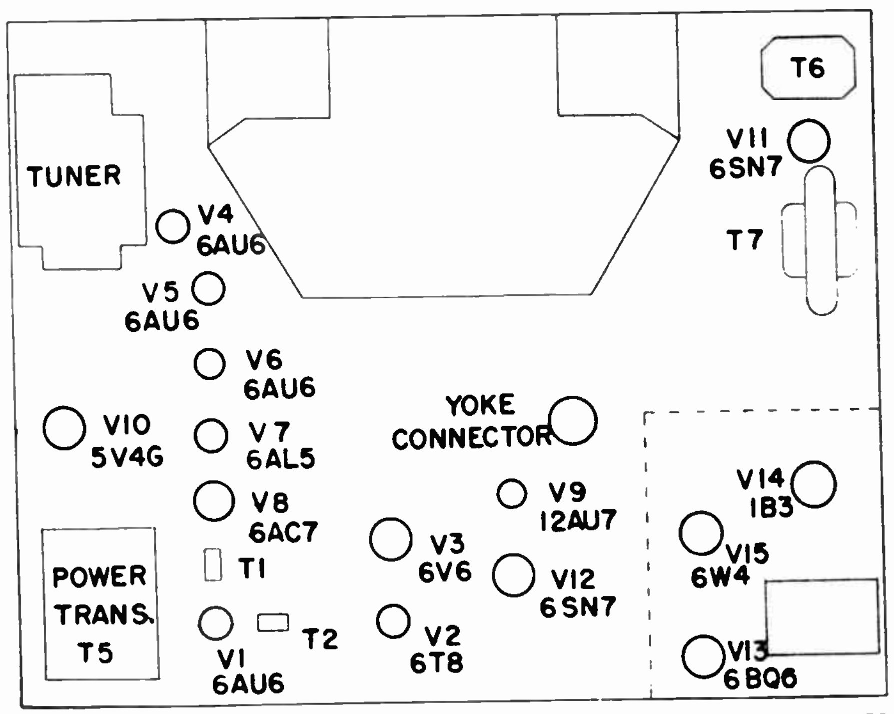
C1 100 MMF CAPACITOR-10%
C2,C3,C4,C5 500 MMF CAPACITOR
C6 25 MMF CAPACITOR
C7,C8- 30 MMF " (N 750 5%)
C13-1500 MMF "
C10- 15 MMF " (N 750 5%)
C11- 47 MMF "
C12- 20 MMF "
C15,C16,C17- 500 MMF CAPACITOR
C14 - 5 MMF CAPACITOR (N 750 5%)
C18- RF TUNING "

C19-MXR TUNING CAPACITOR
C20-OSC " " -LOW BAND
C21- " " " -HIGH BAND
C22,C23,C24,C25-MAIN GANG TRIMMERS
C26,C27- RF & MXR TRIMMERS HIGH BAND
C28 LOW BAND ANT TRIMMER
C29 HIGH " " "
C30 3 MMF CAPACITOR "
L2 HIGH BAND RF COIL
L3 " " MXR "
L4 " " OSC " L5 IF COIL

L6,L7,L8 RF CHOKE(1.8Ω)
R1 68 OHMS R2 1800 OHMS
R3 1000 OHMS
R4 2200 "
R5 4700 "
R6 18,000 "
R7,R9,R10 100,000 OHMS
R8,R12 470 OHMS
T1- LOW BAND ANT TRANS
T2-HIGH " " "
T3- LOW " COIL ASSEM

FIG. 17

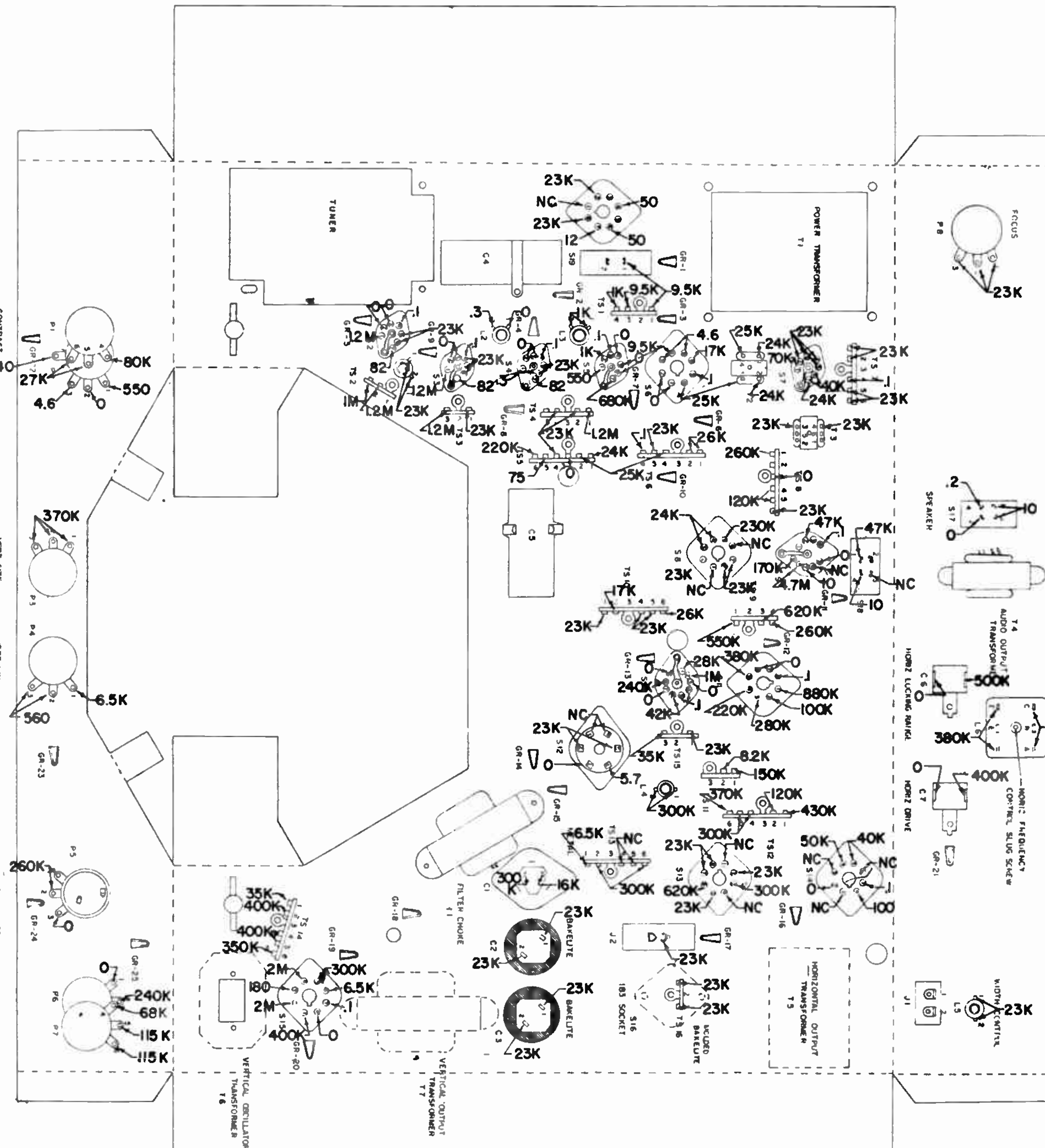




LOCATION OF TUBES

7-1-50

FIG. 18



NOTE-ALL MEASUREMENTS WITH CONTROLS IN CLOCKWISE POSITION AND WITH 20,000 OHM PER VOLT METER

FIG.19-RESISTANCE CHECK CHART

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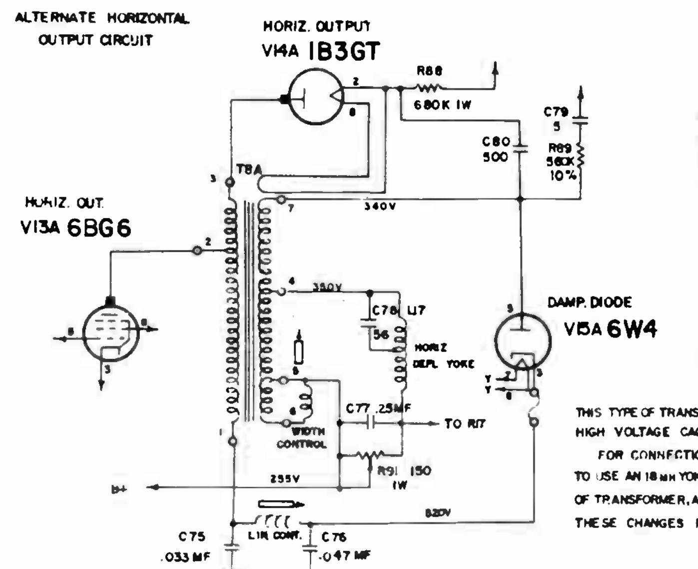
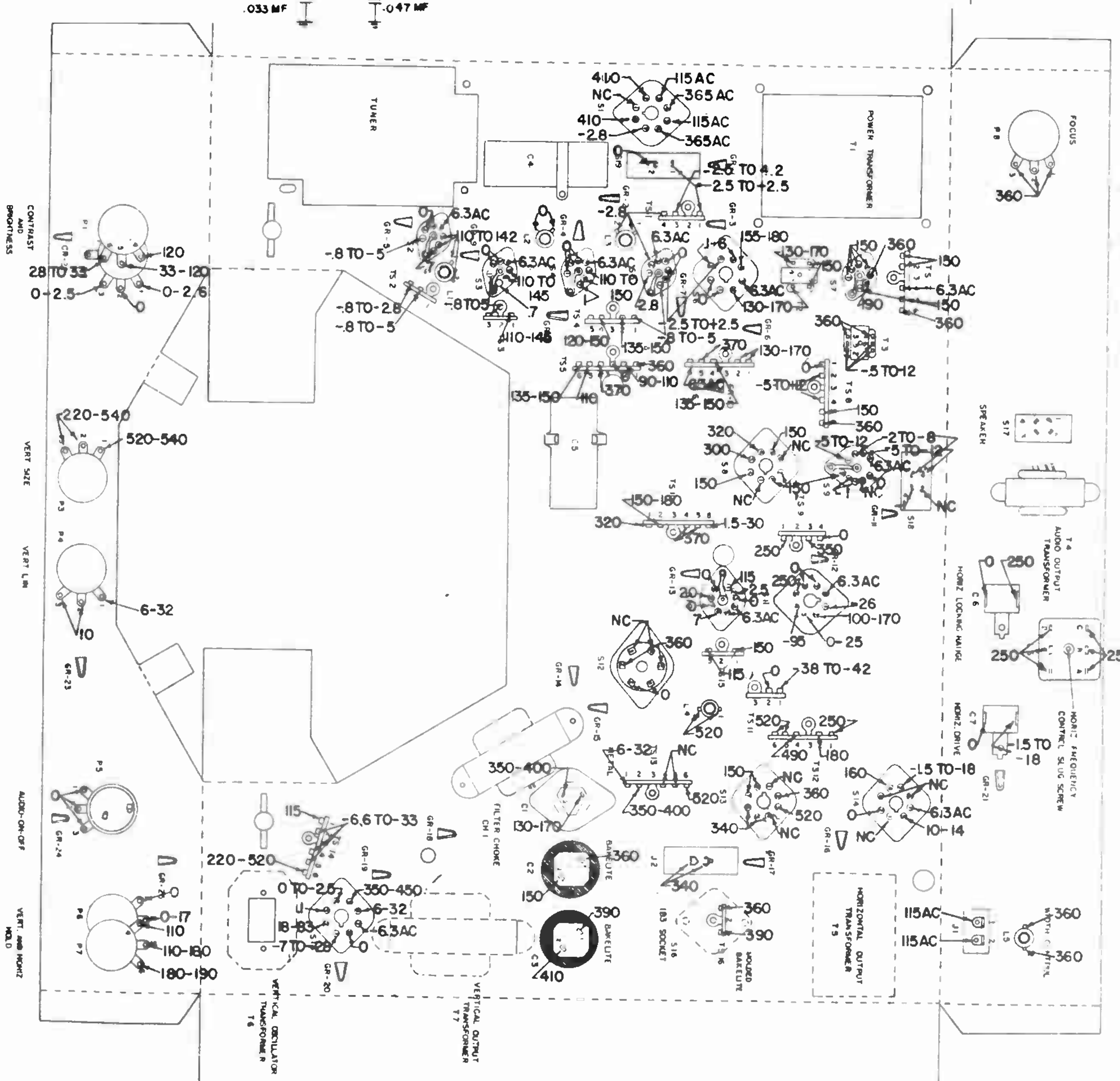


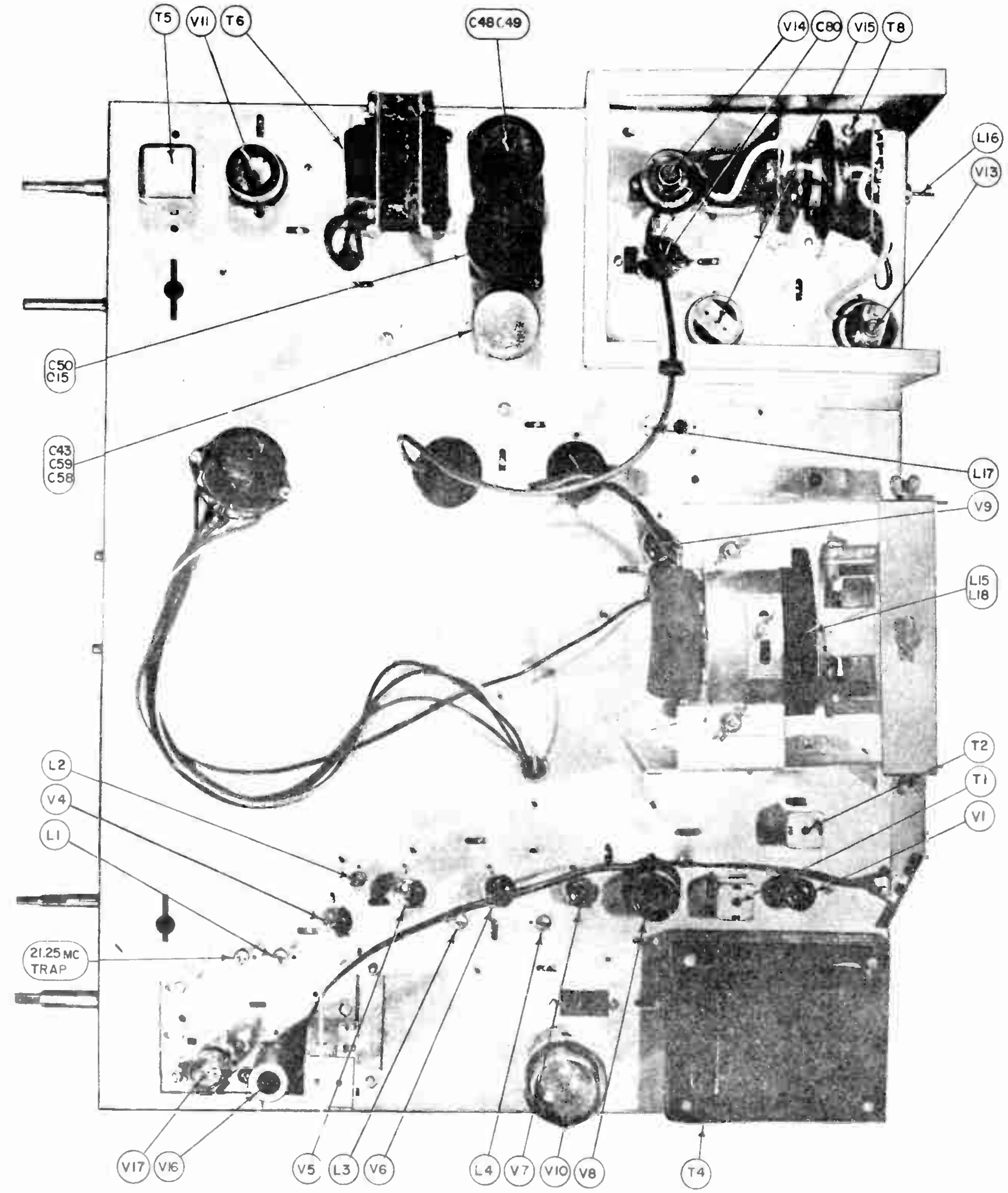
THIS TYPE OF TRANS. MOUNTS HORIZ ON THE SIDE PIECE OF THE HIGH VOLTAGE CAGE AND MAY BE IDENTIFIED BY THIS MEANS. FOR CONNECTION SHOWN AN 8MH YOKE MUST BE USED. TO USE AN 18MH YOKE, REMOVE CONNECTION FROM TERM. 4 OF TRANSFORMER, AND RECONNECT TO TERM. 7. ALSO MAKE THESE CHANGES FOR A 14MH YOKE.



NOTE - ALL DC VOLTAGE MEASUREMENTS TO GROUND USING A 20,000 OHM PER VOLT METER

FIG. 20-VOLTAGE CHECK CHART

CHASSIS TOP VIEW



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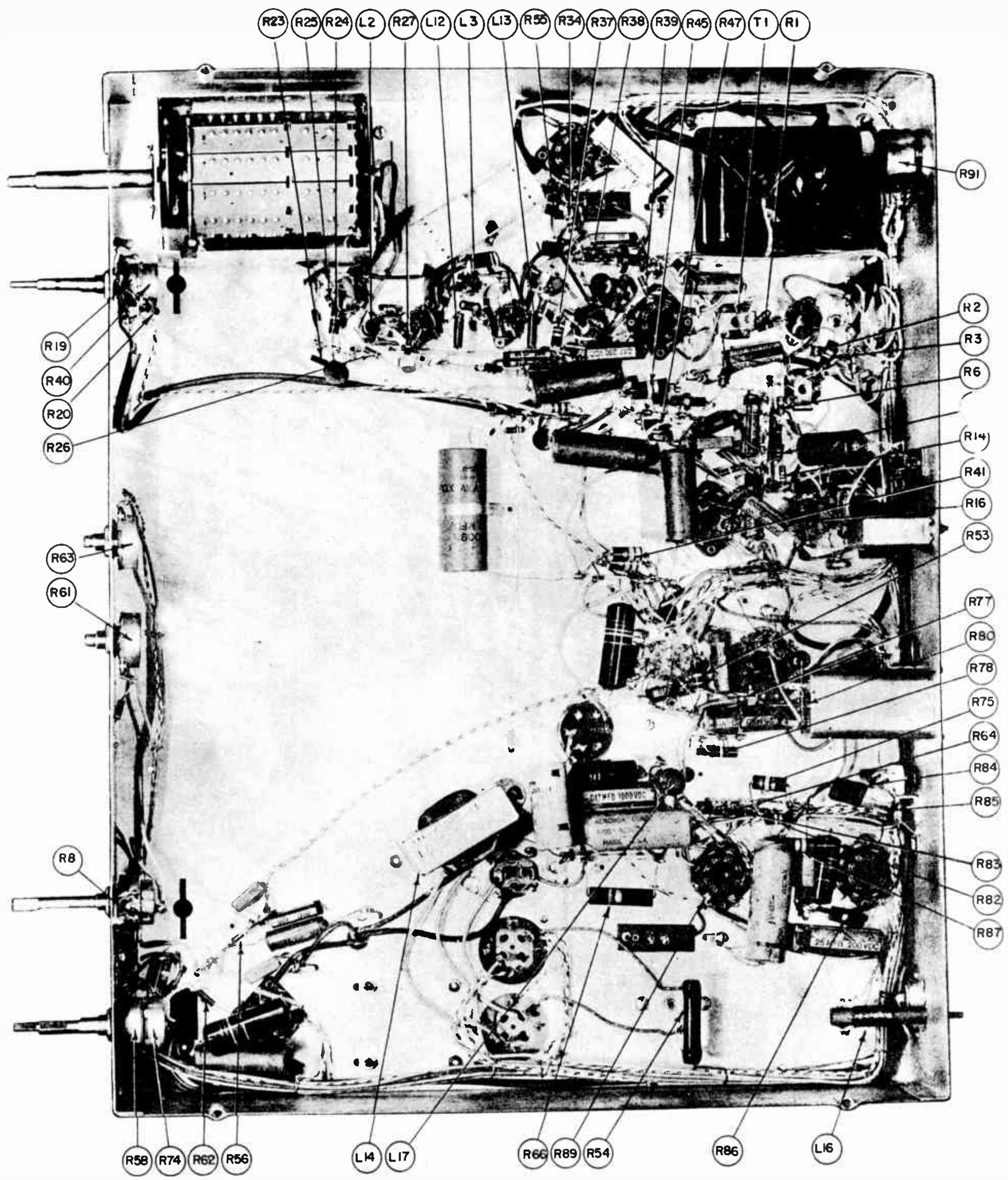
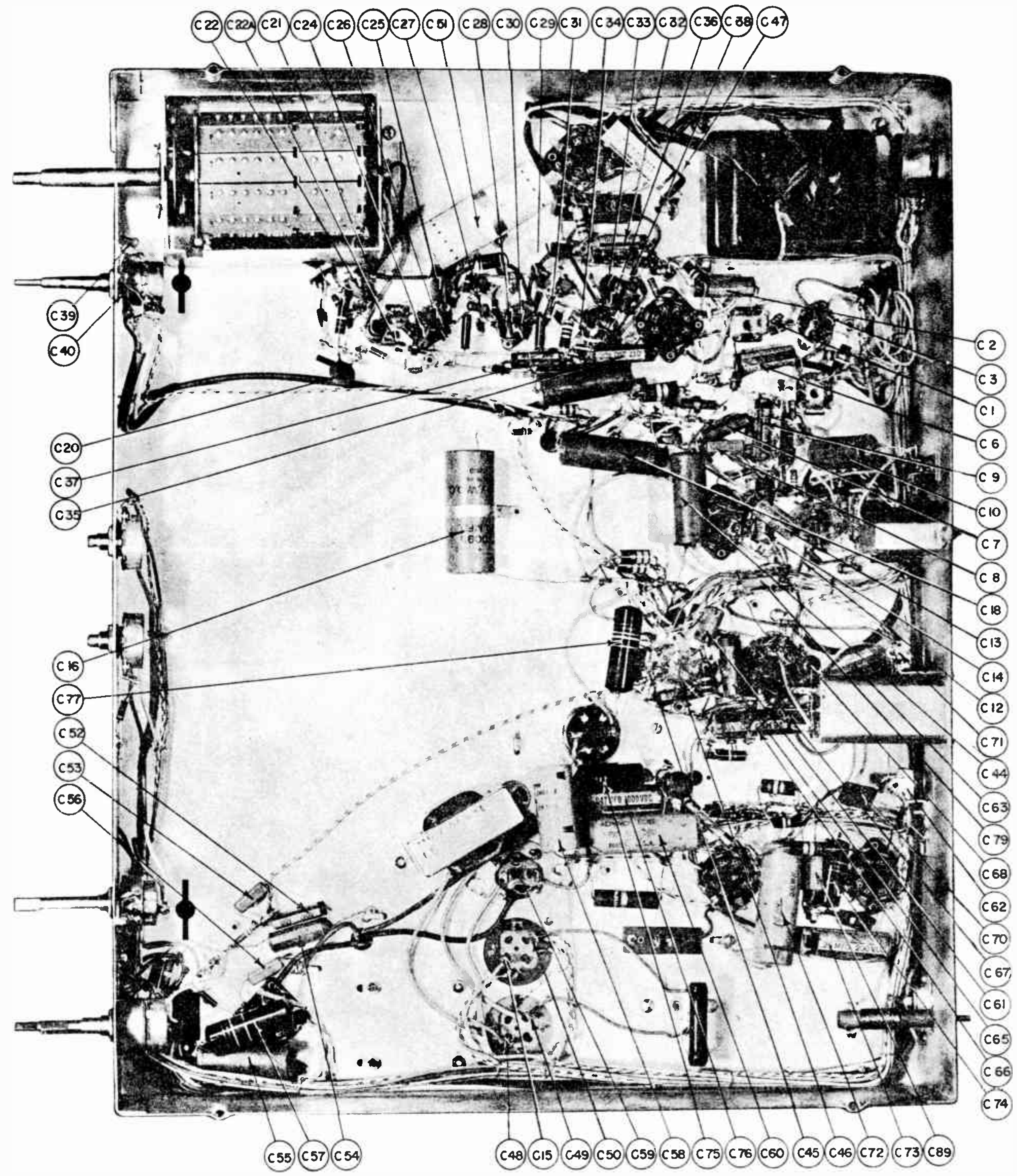
CHASSIS BOTTOM VIEW– TRANS., INDUCT., AND RESISTOR IDENTIFICATION



CHASSIS BOTTOM VIEW–CAPACITOR IDENTIFICATION



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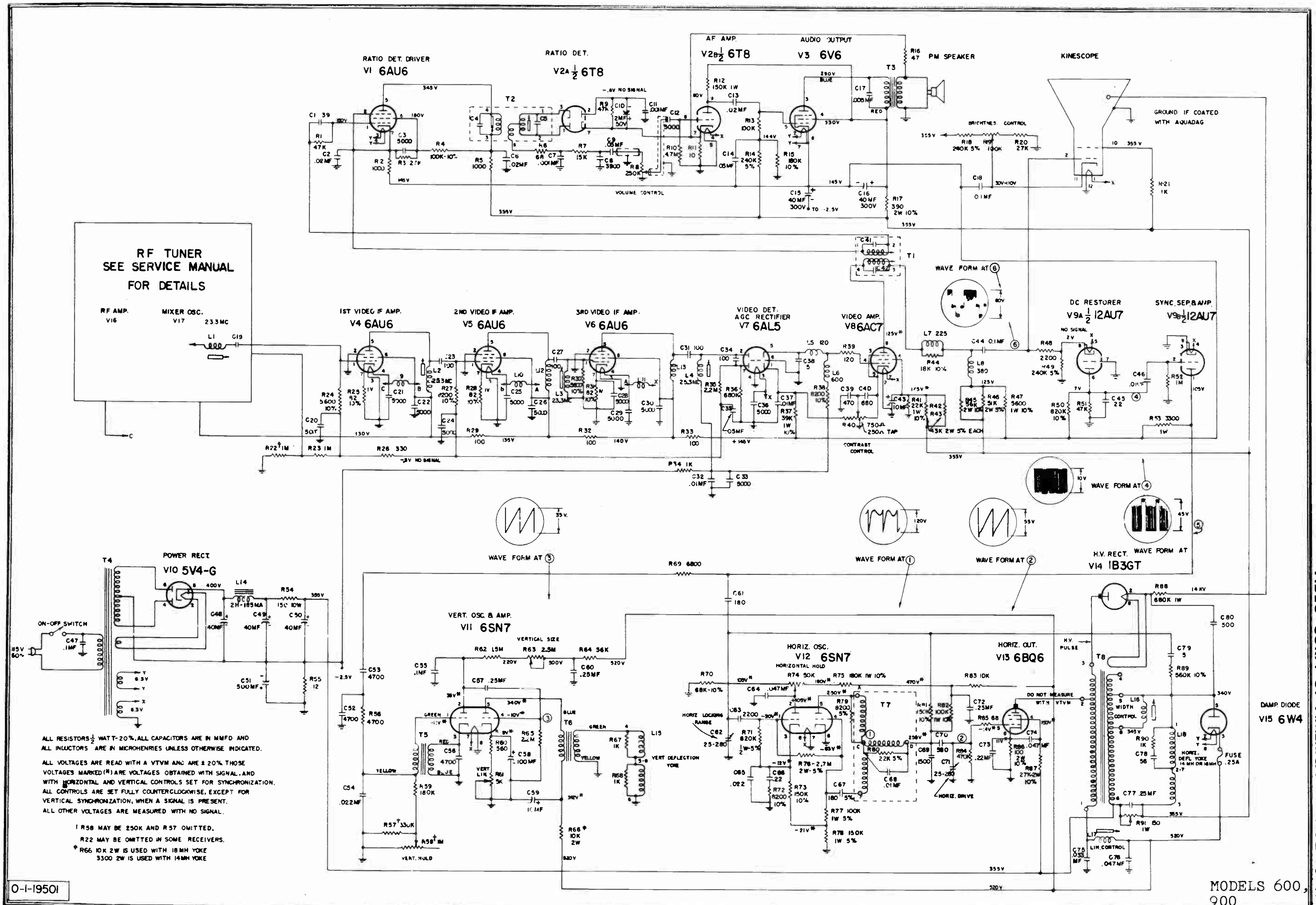

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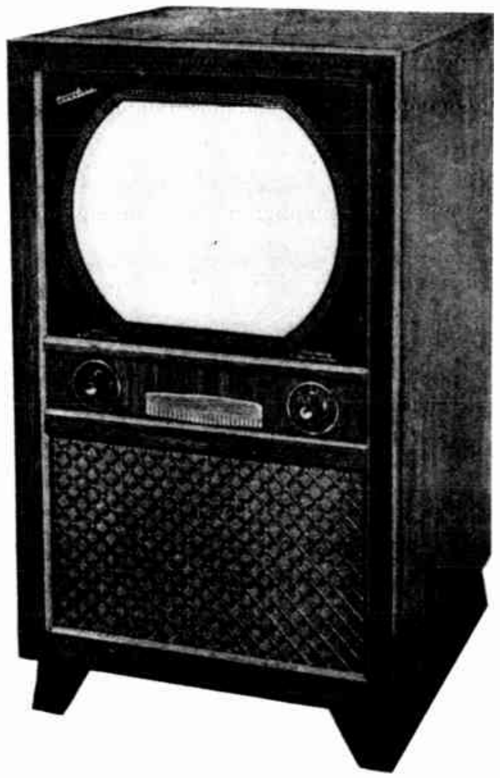

MODEL 2D1088 (12½" PIX TUBE)
MODEL 2D1089 (16" PIX TUBE)

ELECTRICAL SPECIFICATIONS

Power Supply . . . . .105-125 Volts AC
60 cycles only

Power Consumption . . . . . . .12½" Tube Receivers—220 watts
16" Tube Receivers — 250 watts

Power Output . . . . .2.4 watts Maximum
1.8 watts Undistorted

Antenna Input Impedance . .300 Ohms Balanced

Picture Area (12½" Tube). .90 Sq. In.

Picture Area (16" Tube). . . .144 Sq. In.

Tuning Range . . . . .12 Channel

Intermediate Frequencies . . .Picture—26.20 MC
Sound—21.70 MC

ELECTRICAL SPECIFICATIONS—continued

Loud Speaker . . . . .12" PM Dynamic

Voice Coil Impedance . . . . .3.2 Ohms 400 Cycles

Video Response . . . . .To 3.9 MC

Focus . . . . .Magnetic

Sweep Deflection . . . . .Magnetic

Scanning . . . . .Interlaced, 525 Line

Horizontal Scanning Freq. . . .15,750 CPS

Vertical Scanning Freq. . . . .60 CPS

Frame Frequency . . . . .30 CPS

Anode Voltage (12½" Tube) 11,000 V.
(16" Tube). .12,500 V.

Mask Size (12½" Tube). . . .10-7/8" x 9-3/8"
(16" Tube). . . . .14-5/8" x 11"

TUBE COMPLEMENT

Symbol	Type	Function
	6J6	R-F Osc. & Mixer
	6AG5 or	R-F Amplifier
	6AK5	R-F Amplifier
V1	6BA6	1st Sound I-F
V2	6AU6	Sound Limiter
V3	6AL5	Sound Discriminator
V4	6AV6	1st Audio
V5	6K6-GT	Audio Output
V6	6AG5	1st Pix I-F Amp.
V7	6AG5	2nd Pix I-F Amp.
V8	6AG5	3rd Pix I-F Amp.
V9A-9B	6AL5	Picture Det. and D. C. Restorer
V10 A & B	12AT7	1st Video Amp. and 1st Sync Amp.
V11 A & B	12AU7	Video Output and Sync Separator
V12	6AU6	Automatic Gain Control
*V13 A & B	6SN7-GT	Phase Splitter & Vert. Osc.
V13 A & B	6SN7-GT	Sync Output & Vert. Osc.
V14	6K6-GT	Vertical Output
V15	1B3-GT	High Voltage Rectifier
V16	5U4-GT	Low Voltage Rectifier
*V17	6SN7-GT	Horizontal Osc.
V17	6SN7-GT	Horizontal Osc. & Sync Guide
*V18	6BQ6-G	Horizontal Output
V18	6BG6	Horizontal Output
V19	6W4-GT	Damper
V20	12LP4A	Picture Tube 12½"
or V20	16EP4A	Picture Tube 16"
*V21	6BQ6-GT	Horizontal Output
*V22	6AL5	Horizontal Phase Disc.
*V23	5Y3-GT	Rectifier

*Tubes not used in 12½" Picture Tube Receivers.

RADIO FREQUENCY RANGES

Channel Number	Channel Frequency Mc	Picture Carrier Frequency Mc	Sound Carrier Frequency Mc	Receiver R-F Osc. Frequency Mc
2	54-60	55.25	59.75	81.45
3	60-66	61.25	65.75	87.45
4	66-72	67.25	71.75	93.45
5	76-82	77.25	81.75	103.45
6	82-88	83.25	87.75	109.45
7	174-180	175.25	179.75	201.45
8	180-186	181.25	185.75	207.45
9	186-192	187.25	191.75	213.45
10	192-198	193.25	197.75	219.45
11	198-204	199.25	203.75	225.45
12	204-210	205.25	209.75	231.45
13	210-216	211.25	215.75	237.45

RECEIVER LOCATION—Advise the owner as to the proper location for the television receiver. The following may be used as a guide:

1. Choose an area in the home where sunlight or light from lamps does not strike the face of the picture tube and cause glare.
2. Remember the necessity of an electrical outlet and the location of the point at which the antenna leads enter the room.
3. The receiver should be placed a short distance from the wall to allow adequate ventilation.
4. The receiver should be placed to permit easy access for operation and comfortable viewing from all angles.

ANTENNA—This receiver has been designed to use an antenna with a 300 ohm balanced transmission line. This line must be as short as possible because the longer the line the greater the chances are for picking up electrical disturbances. Stand-off insulation should be used to keep the line away from the mast, metal or walls. Twist this line about one turn per foot throughout the line to cancel out direct signal and/or noise pickup by the transmission line. It should also be securely anchored in place so that a change in weather will not affect its position.

HIGH VOLTAGE WARNING

This television receiver contains high voltages which are dangerous to life. Never operate or service the receiver outside of the cabinet or with the covers removed until all the safety precautions necessary for working with high voltage equipment have been observed.

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PICTURE TUBE HANDLING PRECAUTION

Shatterproof goggles and heavy gloves must be worn by individuals while handling the picture tube or installing the picture tube into the receiver.

The picture tube encloses a high vacuum and due to the large surface area, is subjected to excessive air pressure. Therefore, care should be taken not to bump or scratch the picture tube accidentally as it may cause the tube to implode resulting in damage to property or injury to an individual.

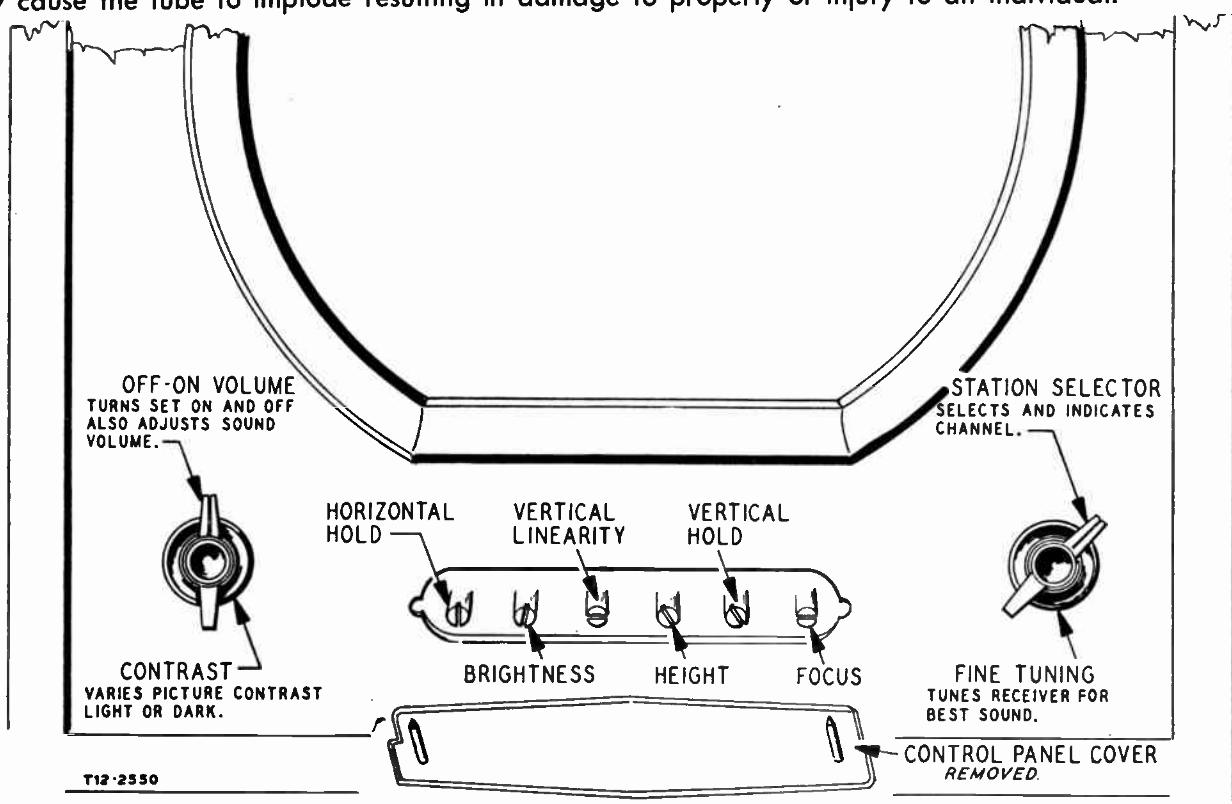

Fig. 2—Front Panel Controls

TUNING PROCEDURE

1. To turn the television receiver on, turn the OFF-ON SOUND CONTROL clockwise until a click is heard. Allow approximately 30 seconds for the tubes to warm up.
2. Turn the STATION SELECTOR CONTROL to the desired channel. This control may be turned in either direction.
3. Turn the CONTRAST CONTROL clockwise until activity or definite form is noted on the screen.
4. Adjust the FINE TUNING CONTROL for best tonal quality and the SOUND CONTROL for desired volume.
5. After the receiver has been on for a while it may be necessary to readjust the FINE TUNING CONTROL for best sound quality.
6. To turn off the receiver, turn only the OFF-ON SOUND CONTROL counterclockwise until a click is heard.

OCCASIONAL ADJUSTMENTS TO IMPROVE PICTURE RECEPTION

There are six controls at the front of the chassis. These controls are accessible after the removal of the control panel cover at the front of the cabinet. (See illustration) The controls are pre-set at the factory and may occasionally need adjustment due to aging of the components in the receiver and the fluctuating line voltages in different areas.

If any adjustments are necessary, follow the instructions under "Controls and Functions."

IMPORTANT—Be sure that the fine tuning control has been set for best tonal quality and clearest picture before adjusting any controls.

CONTROLS AND FUNCTIONS

HORIZONTAL HOLD—Stops horizontal movement (diagonal bars.)
BRIGHTNESS—Adjusts for desired picture brilliance.
VERTICAL LINEARITY—Adjusts picture symmetry, top to bottom.

HEIGHT—Adjusts picture to fit mask vertically.

VERTICAL HOLD—Stops upward or downward picture movement.

FOCUS—Adjusts picture sharpness and clarity.

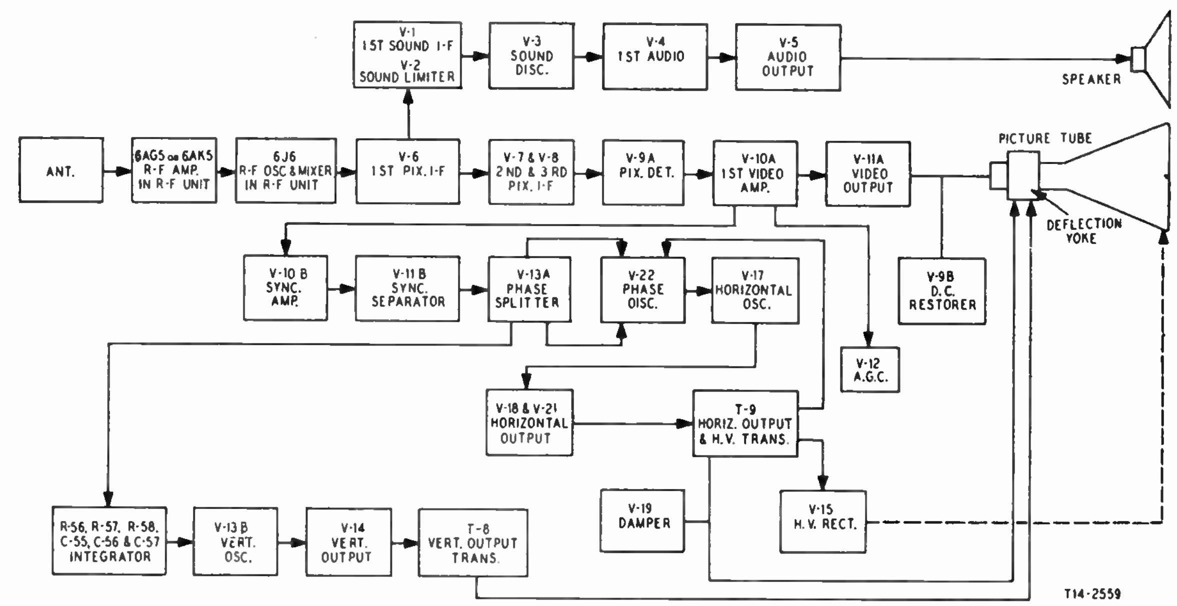

Fig. 3—Block Diagram (16" Pix Tube Receivers)

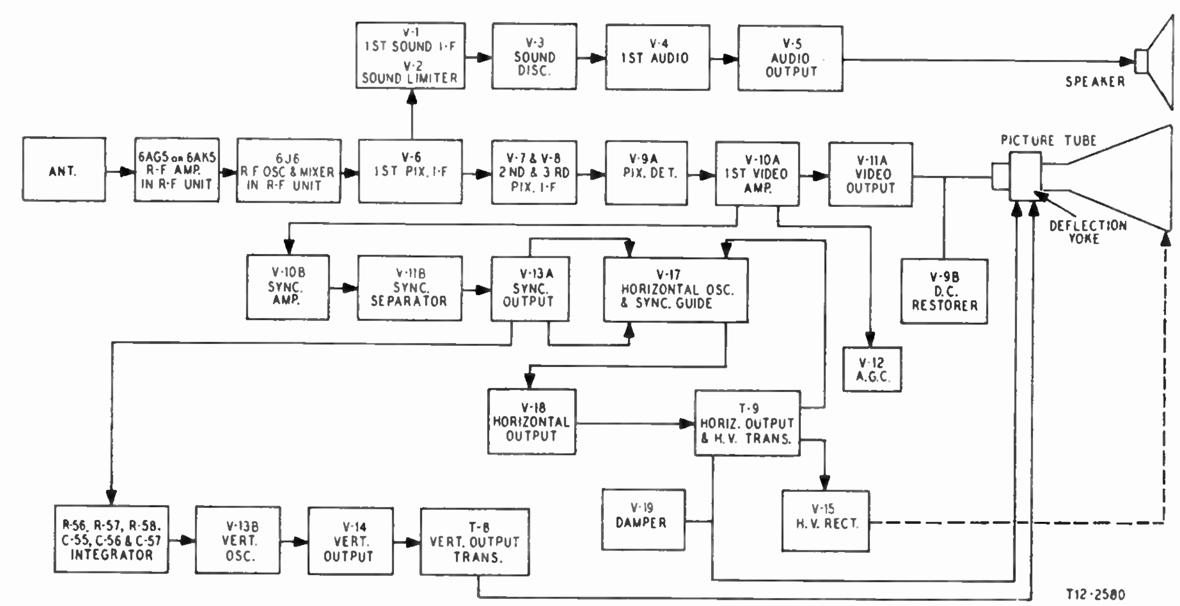

Fig. 4—Block Diagram (12½" Pix Tube Receivers)

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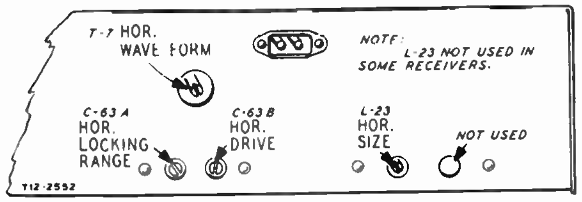

Fig. 5—Rear Chassis Adjustments (12½" Pix Tube Receivers)

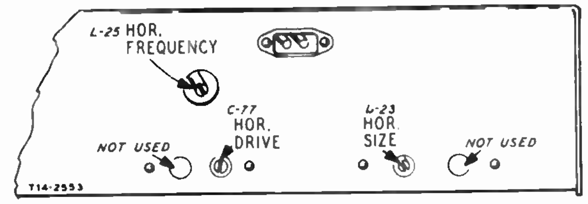

Fig. 6—Rear Chassis Adjustments (16" Pix Tube Receivers)

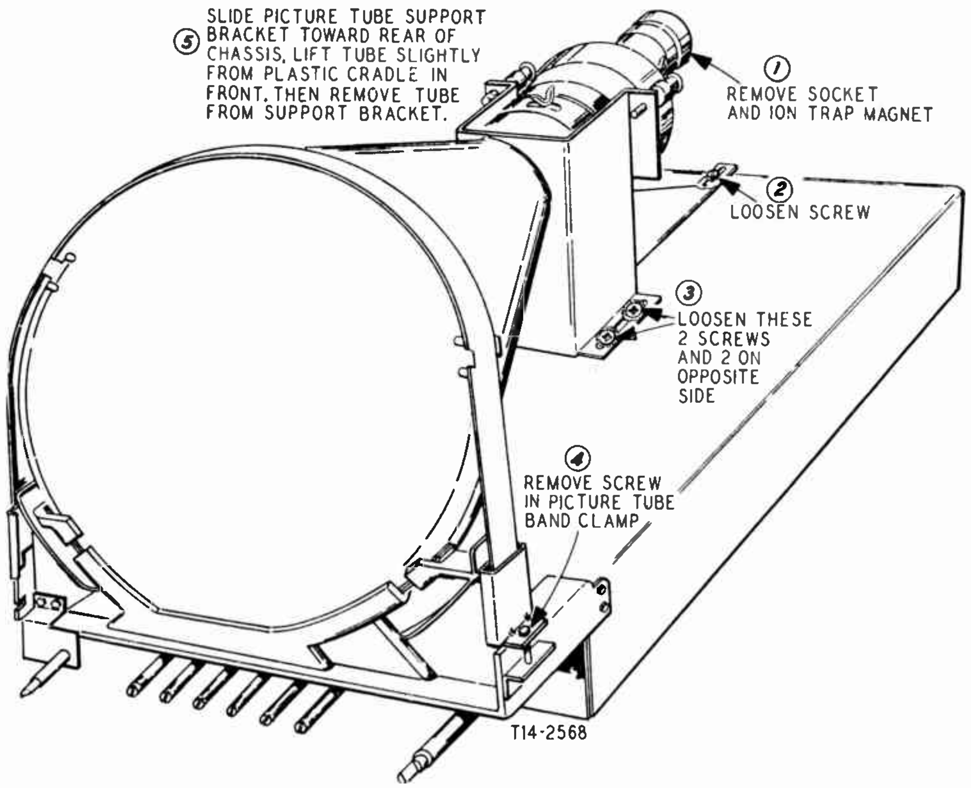

Fig. 7—Removal of Picture Tube

PICTURE TUBE — All receivers are shipped with the picture tube in place. However, to prevent picture tube breakage in 16" pix tube receivers the three focus coil mounting screws were drawn up tight. To place the receiver in operation the following must be performed:

1. Remove the interlocked cabinet back. Make sure that all the tubes are firmly seated in their respective sockets and note the location of the focus coil mounting screws. Back out the focus coil mounting screws until there is approximately a 3/8 inch space between the focus coil and the deflection yoke. Replace the cabinet back.
2. Connect the receiver to a power outlet and turn the receiver on. Turn the channel selector knob to a channel that you know is operating.
3. Observe the picture and adjust the three focus coil mounting screws (through the openings in the cabinet back with a screwdriver which has a seven inch blade) until proper horizontal and vertical centering is obtained.

WARNING — If a screwdriver with a blade longer than seven inches is used, it may accidentally touch a portion of the receiver that carries a high potential.

4. If adjustments are necessary on the deflection yoke or the ion trap magnet, follow the procedures on page 20.

PICTURE TUBE REPLACEMENT — To replace the picture tube it is necessary to remove the chassis from the cabinet. This may be accomplished in the following manner:

1. Remove the front panel control knobs by pulling them straight from their shafts.
2. Remove the cabinet back. You will note that the interlocked line cord disconnects the power when the cabinet back is removed.
3. Disconnect the leads to the speaker, remove the antenna terminal board at rear of cabinet, remove the five chassis mounting bolts and pull the chassis CAREFULLY out of the cabinet.

WARNING — Before handling the picture tube, it will be necessary to remove the static charge. In receivers with glass picture tubes, ground the anode lead to chassis, and insert an insulated wire from the well in the tube to chassis. In receivers with metal picture tubes, remove the static charge by grounding an insulated wire from the chassis to the metal portion of the tube.

4. Remove the picture tube as shown and outlined in the illustration. To install a new picture tube, reverse the procedure making sure that the picture tube is fitted closely against the picture tube cushion. If the picture tube sticks or fails to slip into place smoothly, investigate and remove the source of the trouble. Never force the tube. It is important that all the clips and shims used in mounting the tube be replaced, otherwise difficulty may be encountered when horizontal or vertical centering is required.

NON-OPERATING CONTROLS REAR OF CHASSIS

Focus Coil	Focus Coil Screw Adjustments
Horizontal Centering	Focus Coil Screw Adjustments
Vertical Centering	Focus Coil Screw Adjustments
Ion Trap Magnet	Wing Nut Adjustment
Deflection Yoke	Wing Screw
Horizontal Size	L-23
Horizontal Locking Range (12½" Picture Tube Receivers)	C-63A
Horizontal Drive (12½" Picture Tube Receivers)	C-63B
Horizontal Drive (16" Picture Tube Receivers)	C-77
Horizontal Wave Form (12½" Picture Tube Receivers) Back of Chassis	T-7
Horizontal Frequency (16" Picture Tube Receivers)	L-25
Horizontal Frequency (12½" Picture Tube Receivers) Inside Chassis	T-7

FRONT OF CHASSIS

(Accessible After The Removal of Front Panel Control Cover)

Horizontal Hold	R-110
Brightness	R-54
Vertical Linearity	R-87
Height	R-63
Vertical Hold	R-60
Focus	R-81

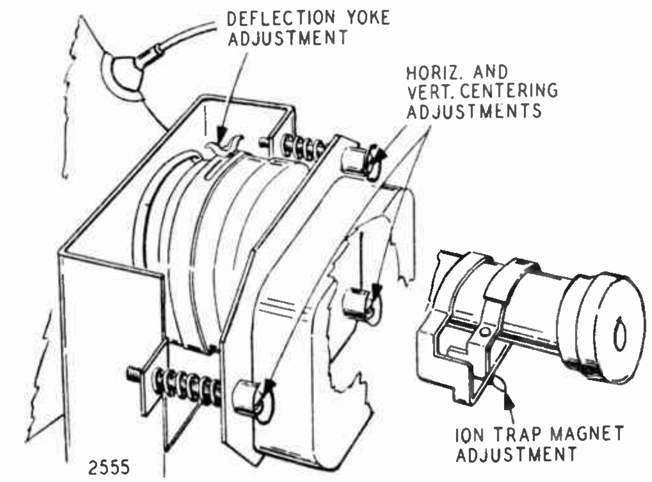

Fig. 8—Ion Trap, Focus and Yoke Adjustments.

ION TRAP MAGNET ADJUSTMENT — The ion trap magnet should be positioned exactly as shown in Figure 8. Adjust the magnet by moving it back and forth and at the same time rotating it slightly around the neck of the picture tube until the brightest raster is obtained on the picture screen. Reduce the brightness control setting until the raster is slightly above average brilliance. Adjust the Focus Control R-81 (see Figure 2) until the line structure of the raster is clearly visible. Readjust the ion trap magnet for maximum raster brilliance.

DEFLECTION YOKE ADJUSTMENT — If the lines of the raster are not horizontal or squared with the picture mask, rotate the deflection yoke until this condition is obtained. Tighten the yoke adjustment wing screw.

FOCUS COIL ADJUSTMENT — If horizontal or vertical centering is required, adjust the three focus coil mounting screws until proper centering is obtained. See Fig. 8.

PICTURE ADJUSTMENT — For further adjustments, obtain a test pattern on the receiver. Turn on receiver and follow tuning procedure on page 3. When a test pattern is obtained it may be necessary to slightly re-adjust the focus control for maximum picture detail.

12½" PIX RECEIVER ADJUSTMENTS

CHECK OF HORIZONTAL OSCILLATOR ALIGNMENT — Turn the horizontal hold control to the extreme counter-clockwise position. The picture should remain in horizontal sync. Momentarily remove the signal by switching off channel and then back. Normally the picture will be out of sync.

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Turn the control clockwise slowly. The number of diagonal bars will be gradually reduced and when only 3-1/2 to 4-1/2 bars sloping downward to the left are obtained, the picture will pull into sync upon slight additional clockwise rotation of the control. The pull-in should occur when the control is approximately 90 degrees from the extreme counter-clockwise position. The picture should remain in sync for approximately 90 degrees of additional clockwise rotation of the control.

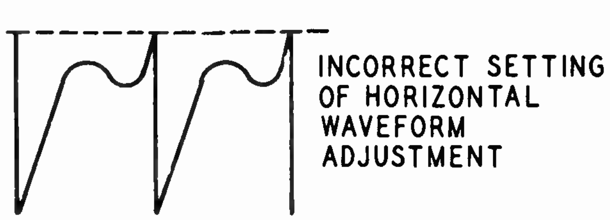
At the extreme clockwise position the picture should be just starting to pull out of sync. Usually one vertical bar will be seen.

If the receiver passes the above checks and the picture is normal and stable, the horizontal oscillator is properly aligned.

ALIGNMENT OF HORIZONTAL OSCILLATOR — If in the above check the receiver failed to hold sync with the hold control at the extreme counter-clockwise position or failed to hold sync for at least 60 degrees of clockwise rotation of the control from the pull in point, it will be necessary to make the following adjustments.

HORIZONTAL FREQUENCY ADJUSTMENT — Turn the horizontal hold control to the extreme clockwise position. Tune in a station and adjust the horizontal frequency control (T-7 See Fig. 17) until the picture is just out of sync and shows one vertical bar. In order to obtain this condition it may be necessary to slightly re-adjust the horizontal locking range trimmer (C-63A) on the rear apron.

HORIZONTAL WAVE FORM ADJUSTMENT — This is a factory adjustment and it should not be necessary to re-adjust unless the setting has been disturbed. However, if it is found that re-adjustment is required, follow this procedure: With the picture in sync, connect an oscilloscope through about a 10 mmf isolation condenser to Terminal C of T-7. Adjust the horizontal wave form (T-7 See Fig. 5) until the two peaks of the wave form shown in Fig. 9 are equal. NOTE: Picture must be in sync during this adjustment.



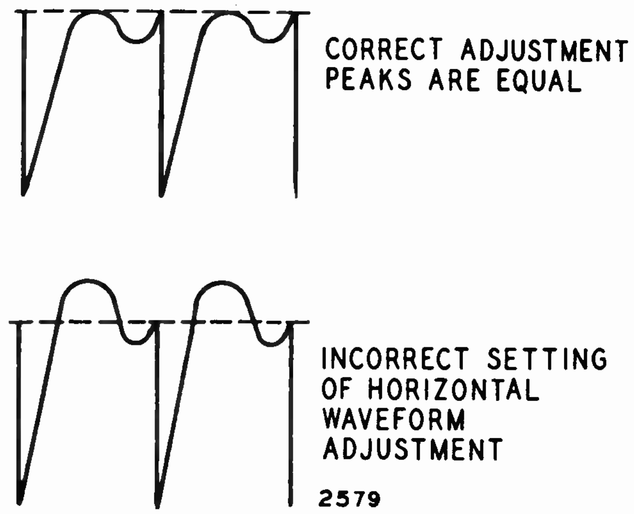


Fig. 9—Horizontal Wave Form Adjustment

HORIZONTAL LOCKING RANGE ADJUSTMENT — Set the horizontal hold control to the extreme counter-clockwise position. Momentarily remove the signal by switching off channel and then back. Slowly turn the horizontal hold control clockwise and note the least number of diagonal bars obtained just before the picture pulls into sync. If more than 4-1/2 bars are present just before the picture pulls into sync, adjust the horizontal locking range trimmer C-63A (See Figure 5) slightly clockwise. If less than 3-1/2 bars are present, adjust trimmer C-63A slightly counter-clockwise. Turn the horizontal hold control counter-clockwise, momentarily remove the signal and recheck the number of bars present at the pull-in point. Repeat this procedure until 3-1/2 to 4-1/2 bars are present. Repeat the adjustments under "Horizontal Frequency Adjustment" and "Horizontal Locking Range Adjustment" until the condition specified under each are fulfilled. When the horizontal hold operates as outlined under "Check of Horizontal Oscillator Alignment" the oscillator is properly adjusted.

16" PIX RECEIVER ADJUSTMENTS

CHECK OF HORIZONTAL OSCILLATOR ALIGNMENT —Tune in a station and adjust the horizontal hold control until the picture falls into sync. Momentarily remove the signal by switching off channel and then back. The picture should pull into sync over a range of 90° rotation of the horizontal hold control. If in the above check the receiver fails to hold sync or the pull-in range is at the extreme end of the control, and is less than 60°, it will be necessary to make the following adjustment.

HORIZONTAL FREQUENCY ADJUSTMENT —With the horizontal hold control set to the center of its range of rotation, adjust the horizontal frequency control (L-25) until the picture pulls into sync. Recheck the "Horizontal Oscillator Alignment."

THE FOLLOWING ADJUSTMENTS ARE APPLICABLE TO 12½" AND 16" PIX TUBE RECEIVERS.

HEIGHT AND LINEARITY ADJUSTMENTS —Adjust the height control (R-63) until the picture fills the mask vertically. Adjust the vertical linearity control (R-87) until the picture is symmetrical from top to bottom. Adjustment of either control will require a re-adjustment of the other control. Adjust vertical centering (3 focus coil mounting screws) to align picture with the mask.

HORIZONTAL SIZE AND DRIVE ADJUSTMENTS—Turn the horizontal size control L-23 (See Fig. 5 & 6) to the maximum clockwise position. Vary the horizontal drive trimmer (C-63B on 12-1/2" Pix Tube Receiver) (C-77 on 16" Pix Tube Receiver) to yield the best linearity. Re-adjust the horizontal size control L-23 until the picture just fills the mask. Adjust horizontal centering (3 focus coil mounting screws) to align the picture with the mask.

If the horizontal drive trimmer is opened too far counter-clockwise, a white line may appear to the left of the center of the picture.

CHECK OF R-F OSCILLATOR ADJUSTMENTS

With an accurately calibrated signal generator (crystal calibrated type preferred check to see if the receiver R-F oscillator is adjusted to the proper frequency on all channels. For this check, it will be necessary to remove the chassis from the cabinet. Illustrated on this page are the two types of tuners used in these receivers. For switch-type

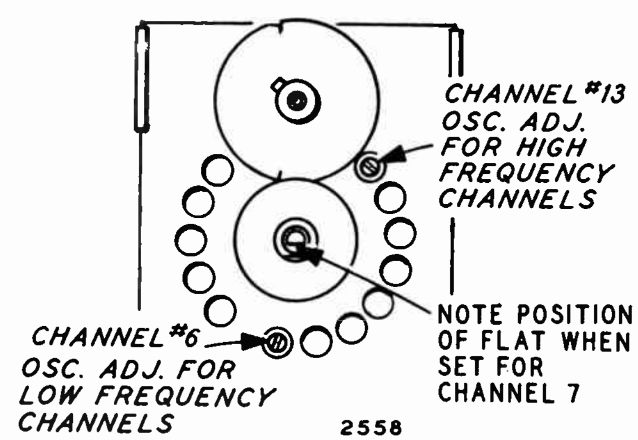


Fig. 10—Switch Type Tuner Adjustment

tuners adjust as shown in Fig. 10. When Channel 6 (low) and Channel 13 (high) trimmers are adjusted properly, other channels in the high and low frequency band will fall in automatically.

For turret type tuners adjust each channel through the clearance hole as shown in Fig. 11.

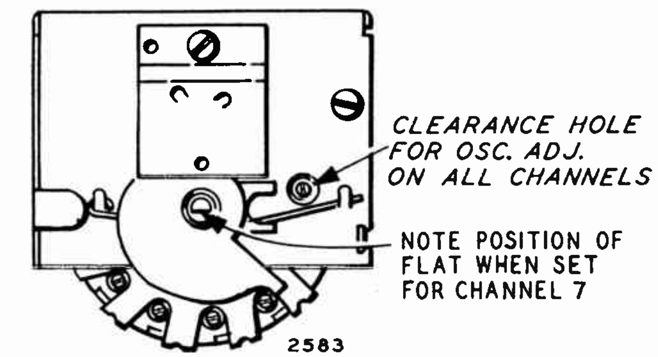


Fig. 11—Turret Type Tuner Adjustment

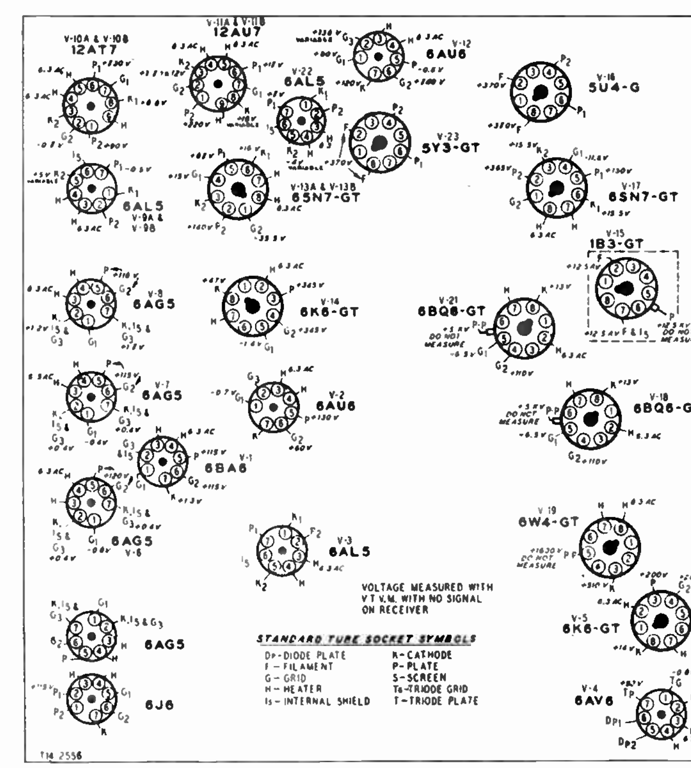


Fig. 12—16" Pix Receiver Voltages

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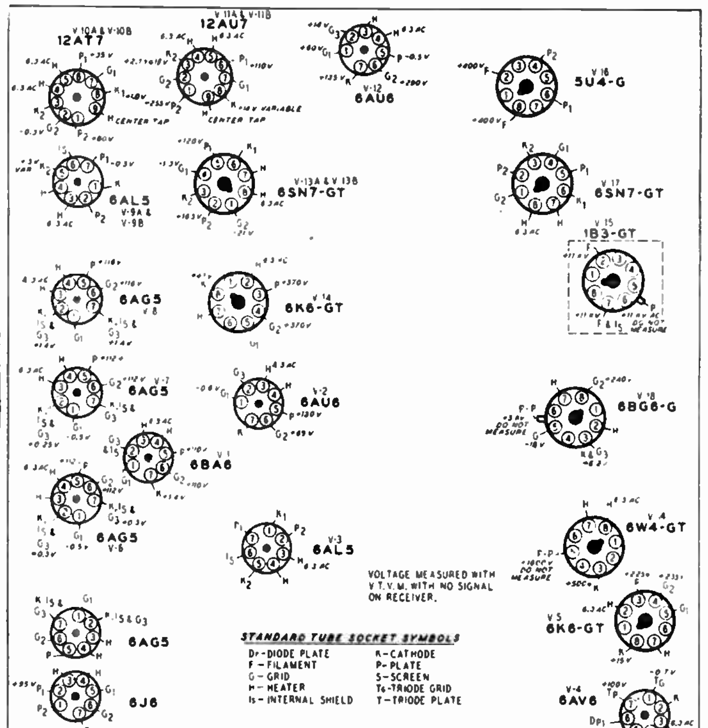

Fig. 13—12½" Pix Receiver Voltages

SERVICE SUGGESTIONS

NO RASTER ON PICTURE TUBE—If raster cannot be obtained check below for the possible causes.

1. Ion trap magnet adjustment is incorrect.
2. No +B voltage. Check 1/4 ampere fuse (F-1). *Replace if defective. If fuse continually burns out, check (A) Horizontal output tube V-18 (6BG6-G in 12-1/2" pix tube receivers) or V-18 and V-21 (6BQ6-GT's) in 16" pix tube receivers. (B) Check damper tube V-19 (6W4-GT). (C) Check horizontal oscillator V-17 (6SN7-GT) for proper operation. In the 16" pix tube models, connect a jumper wire from the +B side of F-1 to the junction of C-79 and R-85. For the 12-1/2" pix tube models use a similar wire from the +B side to the junction of R-70 and R-73. (D) With an ohm-meter, check for a short between terminal 2 of the horizontal output transformer T-9 and the chassis. (E) Check capacitors C-22C and C-73C.
3. No high voltage. Check V-15 and V-18 tubes and circuits. If the horizontal deflection circuits are operating as evidenced by the correct voltage measured on terminal 2 of the horizontal output transformer T-9, the trouble can be isolated to the high voltage rectifier V-15 circuit. Either the high voltage winding (points 6 to 7 on T-9) is open, tube V-15 is defective, its filament circuit is open, or the high voltage filter capacitor C-86 or C-83 on 12-1/2" models is shorted.
4. Defective picture tube. Heater open or cathode return circuit open.

*This fuse is accessible from bottom of cabinet. Remove wire screen, unsolder old fuse, solder in the new fuse and replace wire screen.

HORIZONTAL DEFLECTION ONLY—If only horizontal deflection is obtained as evidenced by a straight line across the face of the picture tube, it can be caused by the following:

1. Vertical oscillator V-13 (6SN7-GT) or vertical output tube V-14 (6K6-GT) inoperative. Check voltages on grid and plate.
2. Vertical output transformer (T-8) open.
3. Yoke vertical coils open.
4. Vertical hold, height or linearity controls may be defective.

POOR VERTICAL LINEARITY—If adjustment of the vertical hold, height or linearity controls will not correct this condition, any of the following may be the cause.

1. Vertical output transformer (T-8) defective.
2. Capacitors C-73A or C-73B defective.
3. V-13 (6SN7-GT) or V-14 (6K6-GT) defective, check voltages.
4. Excess leakage or incorrect value in capacitor C-64.
5. Low plate voltages. Check rectifier tubes and capacitors in +B supply circuits.
6. Capacitor C-65 defective.

POOR HORIZONTAL LINEARITY—If adjustment of the Horizontal drive control does not correct this condition, check the following:

1. Check or replace horizontal output tubes V18 & V-21.
2. Check or replace damper tube V-19 (6W4-GT).
3. Check capacitor C-82 for defects.

TRAPEZOIDAL OR NONSYMMETRICAL RASTER

1. Improper adjustment of focus coil or ion trap magnet.
2. Defective yoke.
3. Open condenser C-85 on horizontal yoke coil L-21.

WRINKLES ON LEFT SIDE OF RASTER—This condition can be caused by:

Defective yoke due to C-85 (internal in yoke assembly) being wrong value or open. This component is mounted in rear of yoke assembly.

SMALL RASTER—This condition can be caused by:

1. Low +B or line voltage.
2. Insufficient output from horizontal output tubes V-18 or V-21. Replace tubes.
3. Insufficient output from vertical oscillator V-13 or vertical output tube V-14. Replace tubes.

RASTER; NO IMAGE, BUT ACCOMPANYING SOUND—This condition can be caused by:

1. No signal on picture tube grid. Check picture I-F amplifier tubes V-6, 7 and 8 (6AG5's), second detector V-9A (6AL5) and video amplifiers V-10 (12AT7) and V-11 (12AU7).
2. Bad contact to picture tube grid (lead to socket broken).

SIGNAL APPEARS ON PICTURE TUBE GRID BUT IMPOSSIBLE TO SYNCHRONIZE THE PICTURE VERTICALLY AND HORIZONTALLY—A condition of this nature can be caused by:

1. Defective sync amplifier and separator V-11 (12AU7-V-10 (12AT7) or V-13 (6SN7-GT).
2. If tubes are O.K. check voltages, and associated circuits.
3. AGC system inoperative. Check V-12 (6AU6) AGC tube and associated circuits.

SIGNAL ON PICTURE TUBE GRID AND HORIZONTAL SYNC ONLY—If this condition is encountered, check:

1. Vertical integrating network capacitors C-55, C-56, and C-57; and resistors R-56, R-57 and R-58.
2. Vertical hold control R-60 defective.

PICTURE STABLE BUT WITH POOR RESOLUTION—If the picture resolution is not up to standard, it may be caused by any of the following:

1. Defective picture detector V-9A (6AL5) or video amplifier V-10 (12AT7) and V-11 (12AU7).
2. Open video peaking coil. Check all peaking coils L-9, L-10, L-11, L-12 and L-13 for continuity. Note that L-10 and L-12 have shunting resistors.
3. Leakage in V-11 (12AU7) grid capacitor C-90. If the above components are not found to be defective, check the following:

1. Check all potentials in video circuits.
2. Check picture tube grid circuit for poor or dirty contact.
3. Check adjustment of focus control R-81. It should be effective on either side of proper focus.
4. Check and realign, if necessary, the picture I-F and R-F circuits.

PICTURE SMEAR:

1. Normally, smear can be attributed to phase shift at the low frequency end of the video characteristic. This can be caused by improper values of resistors and capacitors in the video circuits. Check for grid current on video output tube V-11 (12AU7).
2. This trouble can also originate at the transmitter. Check reception from another station.
3. Check and realign, if necessary, the picture I-F and R-F circuits.

PICTURE JITTER:

1. If regular sections at left of the picture are displaced, replace the horizontal output tubes V-18 or V-21.
2. Vertical instability may be due to loose connections or noise received with the signal.
3. Horizontal instability may be due to unstable transmitted sync or to noise.
4. Check receiver AGC system for proper operation.

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ALIGNMENT PROCEDURE

TEST EQUIPMENT—To service this receiver properly, it is recommended that the following test equipment be available:

R-F SWEEP GENERATOR meeting the following requirements:
(a) Frequency ranges:
18 to 30 mc, 10 mc sweep width
40 to 90 mc, 10 mc sweep width
170 to 225 mc, 10 mc sweep width
(b) Output adjustable with at least .1 volt maximum.
(c) Output constant on all ranges.
(d) Flat output in all attenuator positions.

CATHODE-RAY OSCILLOSCOPE preferably one with a wide band vertical deflection and an input calibrating source.

SIGNAL GENERATOR to provide the following frequencies:

(Output on these ranges should be adjustable and at least .1 volt maximum.)
(a) Intermediate alignment frequencies:
*17.0 mc adjacent picture trap
20.2 mc adjacent picture trap
22.7 mc first picture I-F coil
**24.1 mc third picture I-F coil
25.7 mc second picture I-F coil
27.7 mc adjacent sound trap
21.7 mc sound trap (takeoff)
4.5 mc video trap

* This frequency is not used in receivers with the turret type tuner.

** If turret type tuner is used the frequency will be 23.7 mc.

(b) Radio frequencies:

Channel Number	Picture Carrier Freq. Mc.	Sound Carrier Freq. Mc.
2	55.25	59.75
3	61.25	65.75
4	67.25	71.75
5	77.25	81.75
6	83.25	87.75
7	175.25	179.75
8	181.25	185.75
9	187.25	191.75
10	193.25	197.75
11	199.25	203.75
12	205.25	209.75
13	211.25	215.75

HETERODYNE FREQUENCY METER with crystal calibrator if the signal generator is not crystal controlled.

ELECTRONIC VOLTMETER and a high voltage probe for use with this meter to permit measurements up to 20 kilovolts.

SERVICE PRECAUTIONS — To service the receiver remove the chassis from the cabinet. To do so, remove the knobs, the cabinet back, the antenna terminal board at rear of cabinet and the 5 chassis mounting bolts. The chassis may be serviced with the picture tube in place provided the chassis is turned on its side with the power transformer on the bottom. The weight of the chassis will be supported against the high voltage housing.

CAUTION: Do not permit the kinescope second-anode lead to become shorted to the chassis. To do so will cause a considerable overload on the high voltage filter resistor R-79 on 12½" receivers or R-97 on 16" receivers.

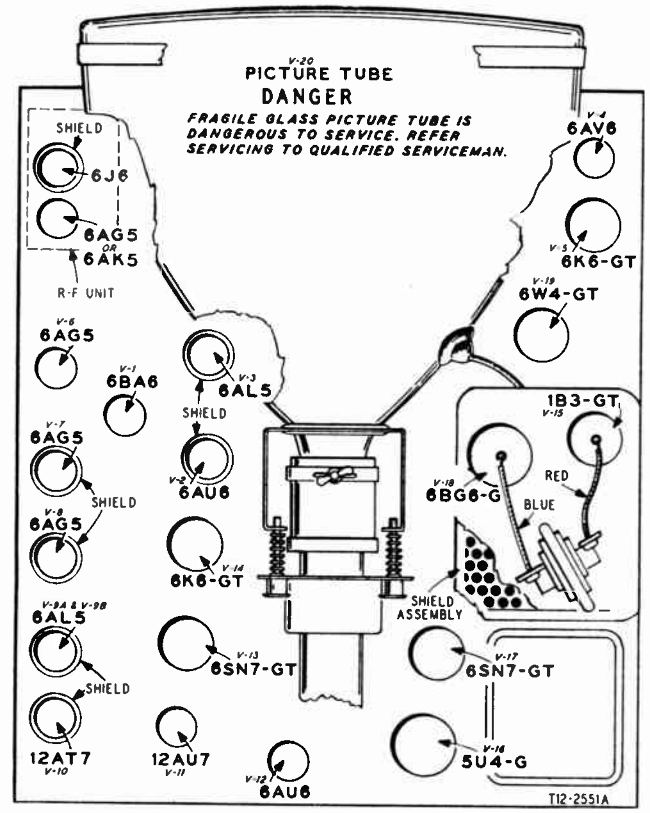

Fig. 15—Tube Layout—12½" Pix Tube Receivers

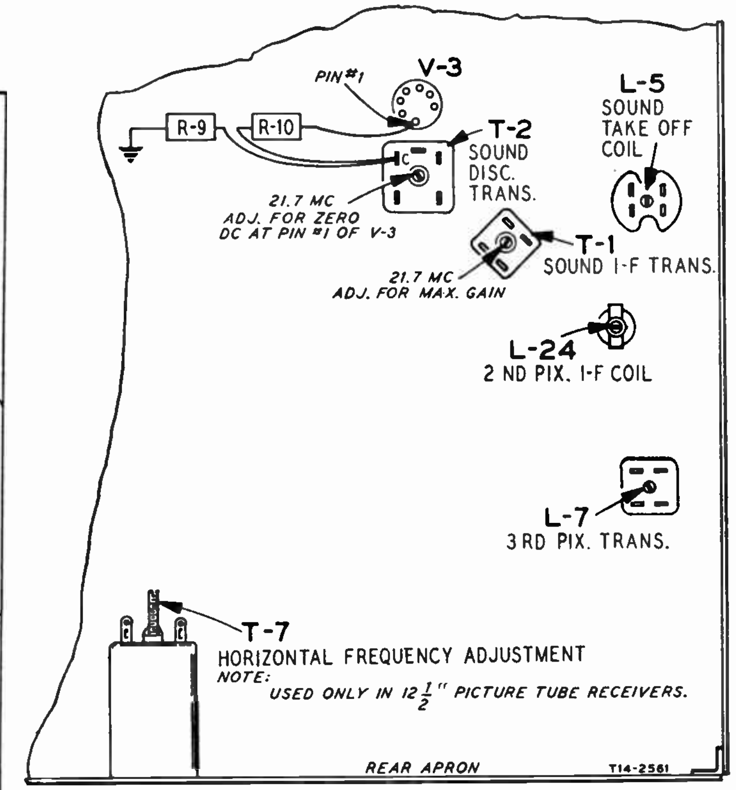

Fig. 17—Bottom Chassis Video and Audio I-F Adjustments

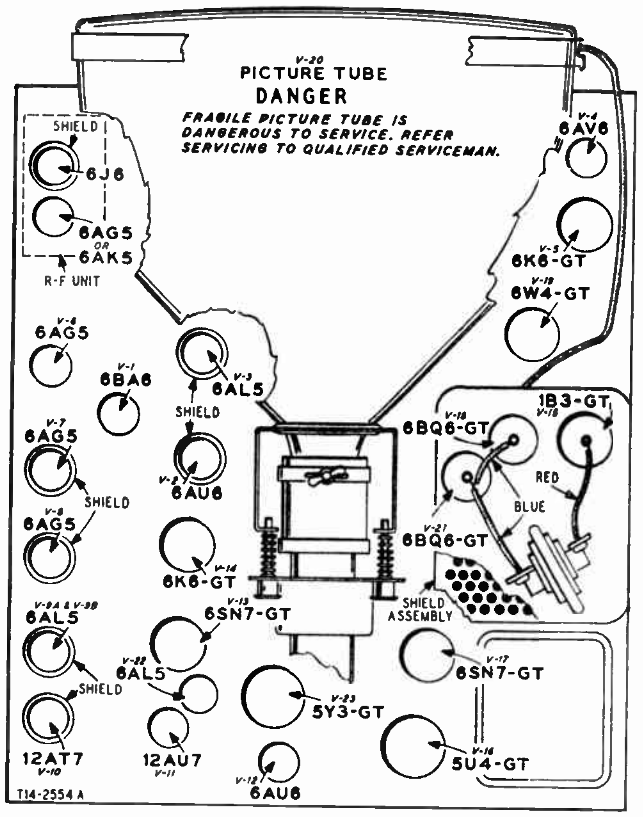

Fig. 14—Tube Layout—16" Pix Tube Receivers

ALIGNMENT PROCEDURE PIX I-F

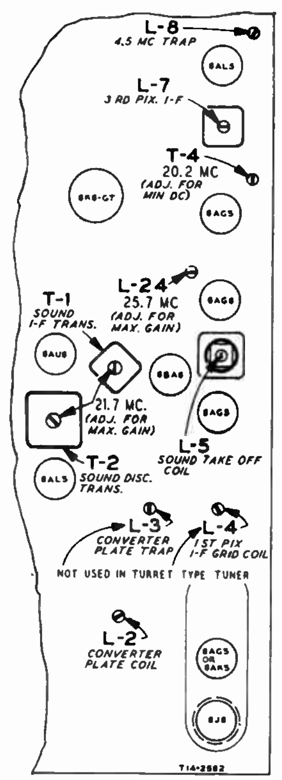

Fig. 16. Top Chassis Video and Audio I-F Adjustments

A. CW Carrier into Converter Grid. VTVM with filter in lead of 10 K ohms and 5000 uuf connected to pic. det. load resistor, (R-31) 4700 ohms, in series with peaking coil (L-9) from Pin 7 of 6AL5. Input level should be such that output is less than 2 volts DC.

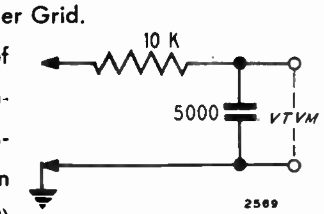

Fig. 18—VTVM Connections

	FREQUENCY	ADJUST
1.	20.2	Adjacent pix trap (T-4) — (3rd P-IF Cathode Coil) (above chassis) for minimum dc at picture detector.
2.	22.7	1st pix IF (L-5) (Sound Take-off Coil) primary (below chassis) for maximum dc at picture detector.
3.	25.7	2nd pix IF (L-24) (top of chassis) for maximum dc at picture det.

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ALIGNMENT PROCEDURE (continued)

	FREQUENCY	ADJUST
4.	24.1 (Switch Type Tuner) 23.7 (Turret Type Tuner)	3rd pix IF (L-7) (below chassis) for maximum dc at picture detector.
5.	27.7	2nd pix IF (L-24) transformer (below chassis) for minimum dc at picture detector.
6.	21.7	Sound Take-off Coil (L-5) (1st picture IF) (top of coil) For minimum dc at picture detector.
7.	21.7	3rd pix IF (L-7) (top of can) adjust for minimum dc at picture detector.
*8.	17 MC (2 volts required)	Converter plate trap coil (L-3) for minimum dc at pic. detector.

*Step 8 omitted in Receivers with turret type tuner.

B. I-F Sweep Generator into converter grid (through tube shield insulated from chassis) with markers at 21.7 MC, and 26.2 MC.
Connect oscilloscope probe to plate of 1st I-F tube V-6 (Pin 5 of 6AG5).
Ground A-G-C Line.

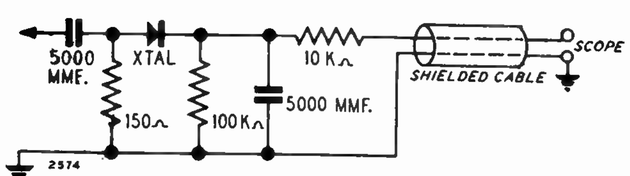

Fig. 19—Oscilloscope Connection

SWITCH TYPE TUNERS

Adjust converter plate coil (L-2) and 1st Pic. I-F grid coil (L-4) (top of chassis) to give the response shown below in figure 20.
A slight re-adjustment of L-3 converter plate trap may be necessary.

TURRET TYPE TUNERS

Adjust converter plate coil (L-2) to give response shown in dotted line in figure 20.

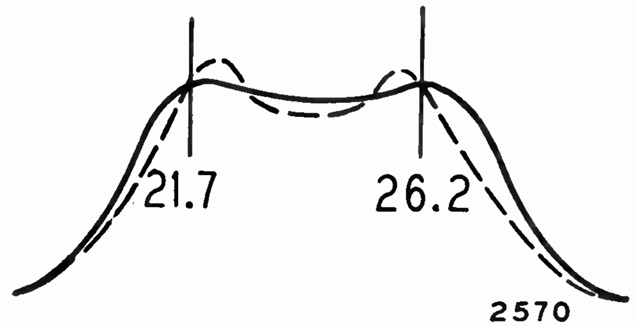

Fig. 20—Response Curve

C. With same I-F sweep input, connect scope probe to second detector (junction of peaking coil (L-9) and 4700 ohm resistor (R-31) off Pin 7, 6AL5). Input should be adjusted to give 2 volt P to P output.
Apply 3 V, bias (dc) to AGC line. (battery).

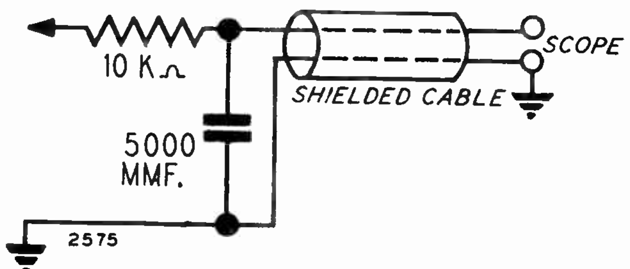

Fig. 21—Oscilloscope Connection

Observe overall I-F response, which should be as shown in Figure 22. Slight touch-up may be required.

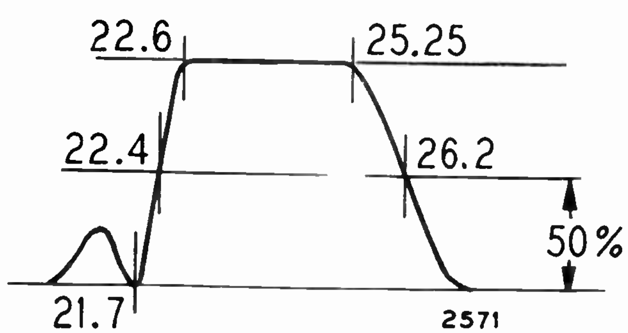

Fig. 22—Overall Response Curve

D. Sweep generator with balanced 300 ohm output into antenna for each channel. Adjust fine tuning to receive sound and observe overall response at second detector as in C. above.

If 26.2 marker is not at 50% point, a slight touch-up of 2nd Pix-IF transformer (L-24 on top of chassis) is required.

If there is a noticeable peak near 23 MC, a slight touch-up of 1st Pix-IF transformer (L-5 sound take-off coil on bottom of chassis) is required.

If the top of the curve is tilted, a slight re-adjustment of the 3rd Pix-IF transformer L-7 (bottom of chassis) may be necessary.

AUDIO I-F

With 21.7 CW Carrier into converter grid as in A., and VTVM connected to terminal "C" of sound discriminator transformer, adjust sound I-F transformer (T-1) pri. and sec., and pri. (top of can) of discriminator (T-2) for max. dc. Input should be adjusted for 2 volts out.

Connect VTVM to Pin 1 of 6AL5 discriminator and adjust secondary of discriminator (T-2) (bottom of can) for cross-over. (Zero voltage).

VIDEO

With 4.5 MC CW Carrier from a high impedance source, (10,000 ohms in series with generator), into grid of 1st video tube (Pin 7 of 6AL5 second detector) and VTVM on picture tube grid, tune 4.5 MC trap L-8 (top of chassis) for minimum response.

REPLACEMENT PARTS LIST

16" PICTURE TUBE

NOTICE: There is a model number label on the chassis. This label identifies the receiver as to chassis and issue letter. When ordering parts or writing, give ALL information on this label.

CAPACITORS

C-1, C-2, C-3, C-4, C-7, C-8, C-12, C-15, C-26, C-27, C-28, C-32, C-33, C-35, C-46, C-47, C-48, C-49, C-50, C-51, C-66, C-67, C-88	47X519	1000 mmf		Ceramic.....
C-5	47X501	68 mmf		Ceramic......
C-6, C-19, C-24, C-29, C-34, C-76	47X445	270 mmf		Molded Mica..
C-9, C-17	47X507	5000 mmf		Ceramic......
C-16, C-56, C-57	B65502	.005 mf	200 V	Tubular......
C-18, C-41, C-43, C-53, C-83, C-89, C-90, C-91	D67503	.05 mf	400 V	Tubular......
C-20, C-59, C-72	B65103	.01 mf	200 V	Tubular......
C-21, C-69	B65503	.05 mf	200 V	Tubular......
C-22A	45X375	40 mf	50 V	Dry Electrolytic
C-22B		10 mf	450 V	
C-22C		10 mf	450 V	
C-23	F65502	.005 mf	600 V	Tubular......
C-25		Part of L-5 Sound Take-off Coil		
C-30		Part of L-24—2nd Pix Trans.		
C-31	47X565	47 mmf	500 V	Molded Mica..
C-36		Part of L-7—3rd Pix Trans.		
C-37	47X562	5 mmf	500 V	Ceramic......
C-38	47X568	360 mmf	500 V	Molded Mica..
C-39	47X563	43 mmf	500 V	Ceramic......
C-40	45X378	5 mf	25 V	Dry Electrolytic
C-42	F65104	.1 mf	600 V	Tubular......
C-44	D65104	.1 mf	400 V	Tubular......
C-45	B65104	.1 mf	200 V	Tubular......
C-52, C-84, C-93	B65504	.5 mf	200 V	Tubular......
C-54	47X569	1000 mmf	1000 V	Molded Mica..
C-55	B65202	.002 mf	200 V	Tubular......
C-58	47X543	4700 mmf		Molded Mica..
C-61A	45X376	80 mf	450 V	Dry Electrolytic
C-61B		30 mf	450 V	
C-60, C-70	46X410	.01 mf	400 V	Molded Paper
C-62A	45X376	80 mf	450 V	Dry Electrolytic
C-62B		30 mf	450 V	
C-64	F65203	.02 mf	600 V	Tubular......
C-65	D65254	.25 mf	400 V	Tubular......
C-68, C-81	F67503	.05 mf	600 V	Tubular......
C-71	47X570	330 mmf	500 V	Molded Mica..
C-73A	45X375	40 mf	50 V	Dry Electrolytic
C-73B		10 mf	450 V	
C-73C		10 mf	450 V	
C-75	47X571	390 mmf	500 V	Molded Mica..
C-77	17A261	40-370 mmf		Trimmer......

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REPLACEMENT PARTS LIST Cont.

16" PICTURE TUBE

C-78	B65354	.35 mf	200 V	Tubular
C-79	47X572	3900 mmf	500 V	Molded Mica
C-80	47X574	12 mmf	2500 V	Ceramic
C-82	B65254	.25 mf	200 V	Tubular
C-85		Part of Deflection Yoke		
C-86	47X560	500 mmf	20,000 V	Hi-Voltage
C-87		Part of Tuner Assembly		
C-94	45X379	30 mf	450 V	Dry Electrolytic

RESISTORS

		Ohms	Watts	
R-1, R-2, R-3, R-5, R-8, R-24, R-26, R-27, R-65	B85102	1 K	0.5	Carbon
R-4	B84820	82	0.5	Carbon
R-6, R-17, R-36, R-73, R-89	B85474	470 K	0.5	Carbon
R-7, R-23, R-37, R-39, R-56, R-113	B84223	22 K	0.5	Carbon
R-9, R-10, R-53, R-55, R-61, R-70, R-72, R-109, R-112	B84104	100 K	0.5	Carbon
R-11	43X239	5.1	0.5	Wirewound
R-12, R-106	B84683	68 K	0.5	Carbon
R-13, R-44	78X4	1 Meg. / 3 K		ON-OFF Volume / Contrast
R-14	B85106	10 Meg.	0.5	Carbon
R-15, R-35	B85274	270 K	0.5	Carbon
R-16	C84471	470	1.0	Carbon
R-18	D84102	1 K	2.0	Carbon
R-19	B83470	47	0.5	Carbon
R-20	B83822	8.2 K	0.5	Carbon
R-21	B83330	33	0.5	Carbon
R-22	B83123	12 K	0.5	Carbon
R-25, R-28, R-92, R-93	B84151	150	0.5	Carbon
R-29	B84331	330	0.5	Carbon
R-30, R-43, R-80, R-88, R-108	B84222	2.2 K	0.5	Carbon
R-31, R-74, R-79	B83472	4.7 K	0.5	Carbon
R-32	B83562	5.6 K	0.5	Carbon
R-33		Part of L-10		
R-34	C83272	2.7 K	1.0	Carbon
R-38	B84333	33 K	0.5	Carbon
R-40, R-45, R-52, R-62, R-69	B84105	1 Meg.	0.5	Carbon
R-41, R-50	B84103	10 K	0.5	Carbon
R-42	B84123	12 K	0.5	Carbon
R-46, R-94, R-95	B84101	100	0.5	Carbon
R-47	B84824	820 K	0.5	Carbon
R-48	B84473	47 K	0.5	Carbon
R-49		Part of L-12		
R-51	C83392	3.9 K	1.0	Carbon
R-54	40X297	500 K		Brightness Control
R-57, R-58, R-64	B84822	8.2 K	0.5	Carbon
R-59	B84155	1.5 Meg.	0.5	Carbon
R-60	40X298	1 Meg.		Vertical Hold
R-63	40X293	2.5 Meg.		Height Control
R-66, R-67	B83332	3.3 K	0.5	Carbon
R-68	B85335	3.3 Meg.	0.5	Carbon
R-71	B85475	4.7 Meg.	0.5	Carbon
R-75	B84152	1.5 K	0.5	Carbon
R-76	B85271	270	0.5	Carbon
R-77A, R-77B		Part of Deflection Yoke		
R-78	43X251	3.9	0.5	Wirewound
R-81	40X302	6.5 K		Focus Control
R-82	43X245	500	10.0	Wirewound
R-83	43X248	1 K	10.0	Wirewound
R-84	43X247	10 K	5.0	Wirewound
R-85	B84274	270 K	0.5	Carbon
R-86	B84273	27 K	0.5	Carbon
R-87	40X294	5 K		Vertical Linearity
R-90, R-91	D84221	220	2.0	Carbon
R-96	43X253	22 K	5.0	Wirewound
R-97	C85105	1 Meg.	1.0	Carbon
R-98	C84103	10 K	1.0	Carbon
R-99	C84183	18 K	1.0	Carbon
R-100	D84104	100 K	2.0	Carbon
R-101	C84562	5.6 K	1.0	Carbon
R-102, R-103	C84220	22	1.0	Carbon
R-107		Part of Tuner Assembly		
R-110	40X299	50 K		Horizontal Hold
R-111	B85473	47 K	0.5	Carbon
R-114	B84425	2.2 Meg.	0.5	Carbon
R-115	D84392	3900	2.0	Carbon

REPLACEMENT PARTS LIST Cont.

16" PICTURE TUBE

TRANSFORMERS AND COILS

L-1, L-16, L-17, L-18	9A2033	Filament Choke
L-2		Part of Tuner (See Miscellaneous)
L-3	9A2059	Converter Plate Trap
L-4	9A2072	1st Pix I.F. Grid Coil
L-5	9A2076	Sound Take-Off Coil
L-6	9A1979	Plate Choke
L-7	9A2071	3rd Pix I-F Trans.
L-8	9A2074	4.5 MC Trap
L-9	9A2090	Peaking Coil
L-10	9A2086	Peaking Coil
L-11	9A2088	Peaking Coil
L-12	9A2089	Peaking Coil
L-13	9A2087	Peaking Coil
L-14	52X88	Filter Choke
L-15	9A2081	Focus Coil
L-19, L-20, L-21, L-22		Part of 9A2080 Deflection Yoke Assembly (See Miscellaneous)
L-23	9A2075	Horizontal Size Control
L-24	9A2055	2nd Pix I-F Trans.
L-25	9A2096	Horizontal Frequency
T-1	9A1986	Sound I-F Trans.
T-2	9A2049	Sound Disc. Trans.
T-3	51X146	Audio Output Trans.
T-4	9A2073	Cathode Trap
T-5	53X302	Power Trans.
T-6	54X5	Vert. Oscillator Trans.
T-8	51X147	Vertical Output Trans.
T-9	53X303	High Voltage Trans.

MISCELLANEOUS

12A490	12" P. M. Speaker
*25A1066	R-F Tuner Assembly (Switch Type)
*25A1074	R-F Tuner Assembly (Switch Type)
25A1070	R-F Tuner Assembly (Turret Type)
9A2080	Deflection Yoke Assembly
2A401	Ion Trap Magnet
3A428	Tube Socket (Miniature)
3A443	Tube Socket (12AT7)
3A453	Tube Socket (12AU7)
3A303	Tube Socket (Octal)
3A454	Tube Socket (H. V. Rectifier)
13X772	Tube Socket (Pix Tube)
32X390	Tube Shield
32X401	Tube Shield (12AT7)
17X112	Pix Crystal
4X1077	Pix Mask
8X217	Rubber Cushion } Mtg. rear of Pix Tube
25X1667	Support Bracket } Mtg. rear of Pix Tube
28X587	Ground Spring
25X1665	Tube Mtg. Bracket (Right Hand)
25X1666	Tube Mounting Bracket (Left Hand)
20X1646	Eyelet (Screwdriver Guide) } Mtg. Focus Coil
28X578	Mounting Spring } Mtg. Focus Coil
	No. 10-32 x 1-3/4" Fillister Head Steel Machine Screw } Mtg. Focus Coil
20X1558	Wing Screw (Mtg. Def. Yoke)

16X133	Fuse (1/4 Amp) 250 V
11X145	Tube Insulator
S-14X19	Cabinet Back & Power Cord Assembly
14X485	Ventilator Grille
4X1065	Escutcheon (Channel Selector)
4X1029	Escutcheon (Off-Volume and Contrast)
10A741	Knob (Channel Selector)
10A742	Knob (Fine Tuning)
10A752	Knob (Contrast)
10A753	Knob (Off-Volume)
4X1072	Front Panel Cover
16X136	Tube Holder Bracket Assembly
16X137	Tube Cradle } Part of 16X136 Assembly
16X138	Strap Assembly } Part of 16X136 Assembly
16X139	Tube Clip } Part of 16X136 Assembly
16X140	Strap Mtg. Bracket Assembly } Part of 16X136 Assembly

*Order by part number stamped on tuner.

REPLACEMENT PARTS LIST

12½" PICTURE TUBE

NOTICE: There is a model number label on the chassis. This label identifies the receiver as to chassis and issue letter. When ordering parts or writing, give ALL information on this label.

CAPACITORS

C-1, C-2, C-3, C-4, C-7, C-8, C-12, C-15, C-26, C-27, C-28, C-32, C-33, C-35, C-46, C-47, C-48, C-49, C-50, C-51, C-87	47X519	1000 mmf	Ceramic
C-5	47X501	68 mmf	Ceramic
C-6, C-19, C-24, C-29, C-34	47X445	270 mmf	Molded Mica

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REPLACEMENT PARTS LIST Cont.

12½" PICTURE TUBE

Ref.	Part No.	Value	Voltage	Type
C-9, C-17	47X507	5000 mmf		Ceramic
C-16, C-56, C-57	B65502	.005 mf	200 V	Tubular
C-18, C-21, C-41, C-43, C-53, C-91	D67503	.05 mf	400 V	Tubular
C-20	B65103	.01 mf	200 V	Tubular
C-22A	45X375	40 mf	50 V	Dry Electrolytic
C-22B		10 mf	450 V	
C-22C		10 mf	450 V	
C-23	F65502	.005 mf	600 V	Tubular
C-25		Part of L-5 Sound Take-Off Coil		
C-30		Part of L-24—2nd Pix I-F		
C-31	47X565	47 mmf	500 V	Molded Mica
C-36		Part of L-7—3rd Pix I-F		
C-37	47X562	5 mmf	500 V	Ceramic
C-38	47X568	360 mmf	500 V	Molded Mica
C-39	47X563	43 mmf	500 V	Ceramic
C-40	47X533	5 mmf	1500 V	Molded Mica
C-42	D65104	.1 mf	400 V	Tubular
C-44	F65104	.1 mf	600 V	Tubular
C-45	B65104	.1 mf	200 V	Tubular
C-52, C-82, C-84, C-92	B65504	.5 mf	200 V	Tubular
C-54	47X569	1000 mmf	1000 V	Molded Mica
C-55	B65202	.002 mf	200 V	Tubular
C-58	47X543	4700 mmf		Molded Mica
C-59, C-60	46X410	.01 mf	200 V	Molded Paper
C-61A	45X376	80 mf	450 V	Dry Electrolytic
C-61B		30 mf	450 V	
C-62A	45X376	80 mf	450 V	Dry Electrolytic
C-62B		30 mf	450 V	
C-63A	17A260	40-370 mmf		Dual Trimmer
C-63B		10-160 mmf		
C-64	F65303	.03 mf	600 V	Tubular
C-65	D65254	.25 mf	400 V	Tubular
C-66	47X526	100 mmf	500 V	Molded Mica
C-67	47X564	180 mmf	500 V	Molded Mica
C-68, C-80	F67503	.05 mf	600 V	Tubular
C-69	F67202	.002 mf	600 V	Tubular
C-70	45X378	5 mf	100 V	Dry Electrolytic
C-71, C-79	B65254	.25 mf	200 V	Tubular
C-72	B65203	.02 mf	200 V	Tubular
C-73A	45X375	40 mf	50 V	Dry Electrolytic
C-73B		10 mf	450 V	
C-73C		10 mf	450 V	
C-74	47X573	220 mmf	500 V	Molded Mica
C-75	B64103	.01 mf	200 V	Tubular
C-76	47X567	1600 mmf	500 V	Molded Mica
C-77	47X566	680 mmf	500 V	Molded Mica
C-83	47X560	500 mmf	20,000 V	Hi Voltage
C-85		Part of Deflection Yoke Assembly		
C-86	47X574	12 mmf	2500 V	Ceramic
C-88		Part of Tuner Assembly		
C-90	B65503	.05 mf	200 V	Tubular
C-93	45X379	30 mf	450 V	Dry Electrolytic

RESISTORS

Ref.	Part No.	Ohms	Watts	Type
R-1, R-2, R-3, R-5, R-8, R-24, R-26, R-27	B84102	1000	0.5	Carbon
R-4	B84820	82	0.5	Carbon
R-6, R-17, R-100	B85474	470 K	0.5	Carbon
R-7, R-23, R-37, R-39, R-56, R-93	B84223	22 K	0.5	Carbon
R-9, R-10	B84104	100 K	0.5	Carbon
R-11	43X239	5.1	0.5	Wirewound
R-12, R-47, R-71	B84683	68 K	0.5	Carbon
R-13, R-44	78X4	1 Meg. / 3 K		ON-OFF Volume / Contrast Control
R-14	B85106	10 Meg.	0.5	Carbon
R-15	B85274	270 K	0.5	Carbon
R-16	C84471	470	1.0	Carbon
R-18	D84102	1000	2.0	Carbon
R-19	B83470	47	0.5	Carbon
R-20	B83822	8.2 K	0.5	Carbon
R-21	B83330	33	0.5	Carbon
R-22	B83123	12 K	0.5	Carbon
R-25, R-28, R-95	B84151	150	0.5	Carbon
R-29, R-65	B84331	330	0.5	Carbon
R-30, R-43, R-74	B84222	2200	0.5	Carbon
R-31	B83472	4700	0.5	Carbon
R-32	C84562	5600	1.0	Carbon
R-33		Part of L-10 Peaking Coil		
R-34	C83272	2700	1.0	Carbon
R-35, R-69, R-88, R-89	B84154	150 K	0.5	Carbon
R-36, R-75	B84824	820 K	0.5	Carbon
R-38	B84333	33 K	0.5	Carbon
R-40, R-45, R-52, R-62, R-67, R-94	B84105	1 Meg.	0.5	Carbon
R-41, R-50	B84103	10 K	0.5	Carbon
R-42	C84223	22 K	1.0	Carbon
R-46	B84101	100	0.5	Carbon
R-48, R-105	B83473	47 K	0.5	Carbon
R-49		Part of L-12 Peaking Coil		
R-51	C83392	3.9 K	0.5	Carbon
R-53, R-55, R-61	B85104	100 K	0.5	Carbon
R-54	40X290	500 K		Brightness Control
R-57, R-58, R-64, R-86, R-92, R-102	B84822	8.2 K	0.5	Carbon
R-59	B84155	1.5 Meg.	0.5	Carbon
R-60	40X291	1 meg.		Vertical Hold Control
R-63	40X293	2.5 meg.		Height Control
R-66	B84681	680	0.5	Carbon
R-68	B85335	3.3 meg.	0.5	Carbon
R-70	B84823	82 K	0.5	Carbon
R-73	B84124	120 K	0.5	Carbon
R-76, R-97	D84103	10 K	2.0	Carbon
R-77A, R-77B		Part of Deflection Yoke		
R-78	43X249	1.0	0.5	Wirewound
R-79	C85105	1 meg.	1.0	Carbon
R-80	D84681	680	2.0	Carbon
R-81	40X295	6.5 K		Focus Control
R-82	43X245	500	10.0	Wirewound
R-83	43X246	1500	10.0	Wirewound
R-84	43X247	10 K	5.0	Wirewound
R-85	B84564	560 K	0.5	Carbon
R-87	40X294	5 K		Vertical Linearity
R-90	B83104	100 K	0.5	Carbon
R-91	B84275	2.7 meg.	0.5	Carbon
R-96	C84820	82	1.0	Carbon
R-98	C84183	18 K	1.0	Carbon
R-99	B84563	56 K	0.5	Carbon
R-101	B83562	5.6 K	0.5	Carbon
R-103	43X252	3.3 K	5.0	Wirewound
R-104		Part of Tuner Assembly		
R-110	40X292	50 K		Horizontal Hold Control
R-111	B85224	220 K	0.5	Carbon

TRANSFORMERS AND COILS

Ref.	Part No.	Description
L-1, L-16, L-17, L-18	9A2033	Filament Choke
L-2		Part of Tuner (See Miscellaneous)
L-3	9A2059	Converter Plate Trap
L-4	9A2072	1st Pix I-F Grid Coil
L-5	9A2076	Sound Take-Off Coil
L-6	9A1979	Plate Choke
L-7	9A2071	3rd Pix I-F Trans.
L-8	9A2074	4.5 M.C. Trap
L-9	9A2090	Peaking Coil
L-10	9A2086	Peaking Coil
L-11	9A2088	Peaking Coil
L-12	9A2089	Peaking Coil
L-13	9A2087	Peaking Coil
L-14	52X88	Filter Choke
L-15	9A2083	Focus Coil
L-19, L-20, L-21, L-22		Part of 9A2069 Deflection Yoke Assembly (See Miscellaneous)
L-23	9A1976	Horizontal Size Control
L-24	9A2055	2nd Pix I-F Coil
T-1	9A1986	Sound I-F Trans.
T-2	9A2049	Sound Disc Trans.
T-3	51X146	Audio Output Trans.
T-4	9A2073	Cathode Trap
T-5	53X298	Power Trans.
T-6	54X5	Vertical Osc. Trans.
T-7	9A2057	Synchro Guide Trans.
T-8	51X147	Vertical Output Trans.
T-9	53X301	High Voltage Trans.

MISCELLANEOUS

Part No.	Description
12A490	12" P. M. Speaker
*25A1062	R-F Tuner Assembly (Switch Type)
*25A1075	R-F Tuner Assembly (Switch Type)
9A2069	Deflection Yoke Assembly
2A382	Ion Trap Magnet
3A428	Tube Socket (Miniature)
3A443	Tube Socket (12AT7)
3A453	Tube Socket (12AU7)
3A303	Tube Socket (Octal)
3A454	Tube Socket (H. V. Rectifier)
13X751	Tube Socket
32X390	Tube Shield
32X401	Tube Shield (12AT7)
17X104	Pix Crystal
4X1076	Pix Mask
8X213	Rubber Cushion
25X1654	Support Bracket
28X579	Ground Spring
S-25X53	Tube Strap & Mtg. Bracket Assembly
4X1063	Screen Escutcheon
25X1658	Tube Mtg. Bracket (Right Hand)
25X1659	Tube Mtg. Bracket (Left Hand)
20X1646	Eyelet (Screwdriver Guide) — Mtg. Focus Coil
28X578	Mounting Spring — Mtg. Focus Coil
	No. 10-32 x 1-3/4" Fillister Head Steel Machine Screw — Mtg. Focus Coil
20X1558	Wing Screw (Mtg. Def. Yoke)
16X133	Fuse (1/4 Amp.) 250 V
S-14X20	Cabinet Back & Power Cord Assembly
14X485	Ventilator Grille
4X1065	Escutcheon (Channel Selector)
4X1029	Escutcheon (Off-Volume & Contrast)
10A741	Knob (Channel Selector)
10A742	Knob (Fine Tuning)
10A752	Knob (Contrast)
10A753	Knob (Off-Volume)
4X1072	Front Panel Cover
6A314	Anode Connector

*Order by part number stamped on tuner

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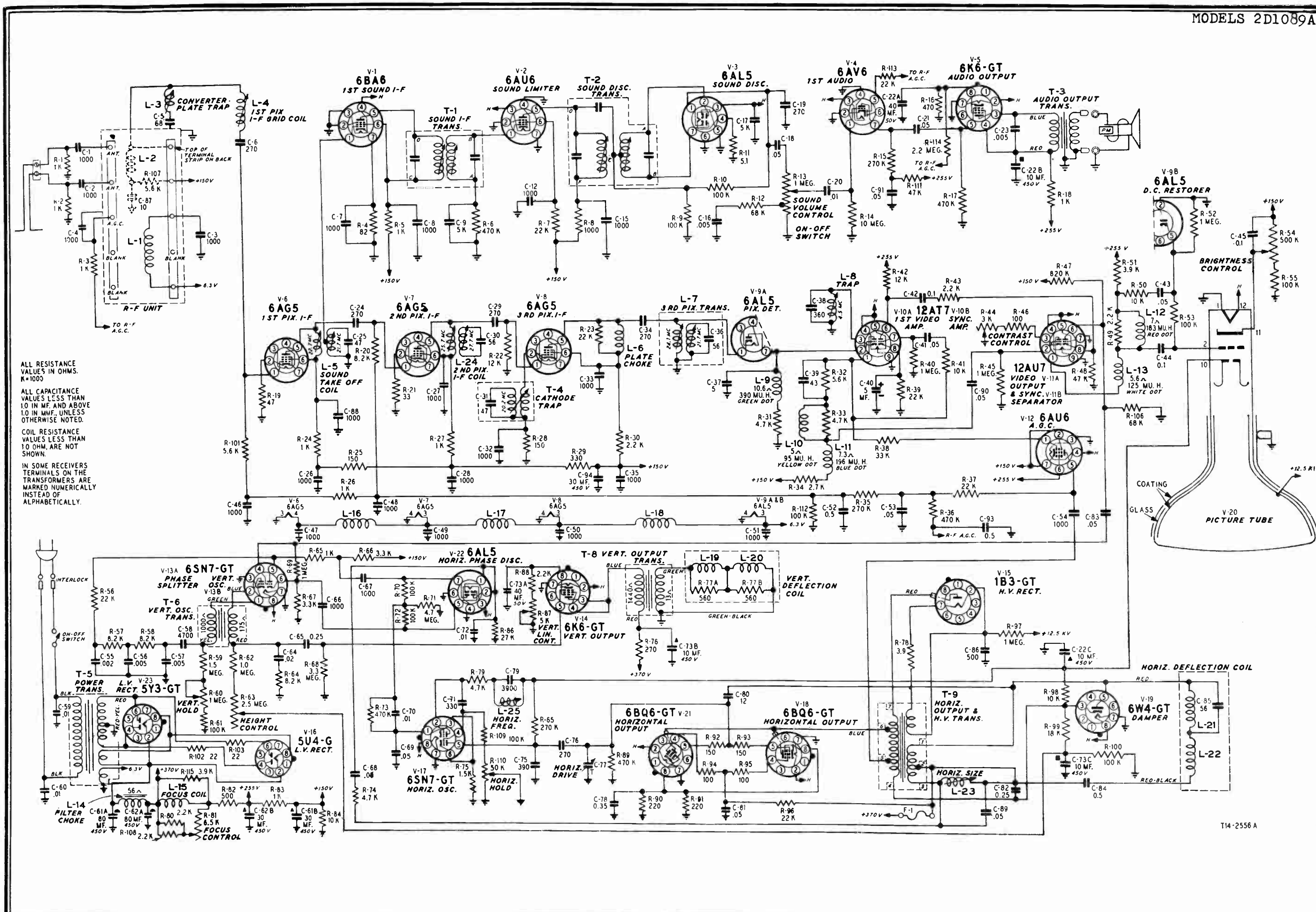

ALL RESISTANCE VALUES IN OHMS. K=1000

ALL CAPACITANCE VALUES LESS THAN 1.0 IN MF. AND ABOVE 1.0 IN MMF., UNLESS OTHERWISE NOTED.

COIL RESISTANCE VALUES LESS THAN 1.0 OHM, ARE NOT SHOWN.

IN SOME RECEIVERS TERMINALS ON THE TRANSFORMERS ARE MARKED NUMERICALLY INSTEAD OF ALPHABETICALLY.

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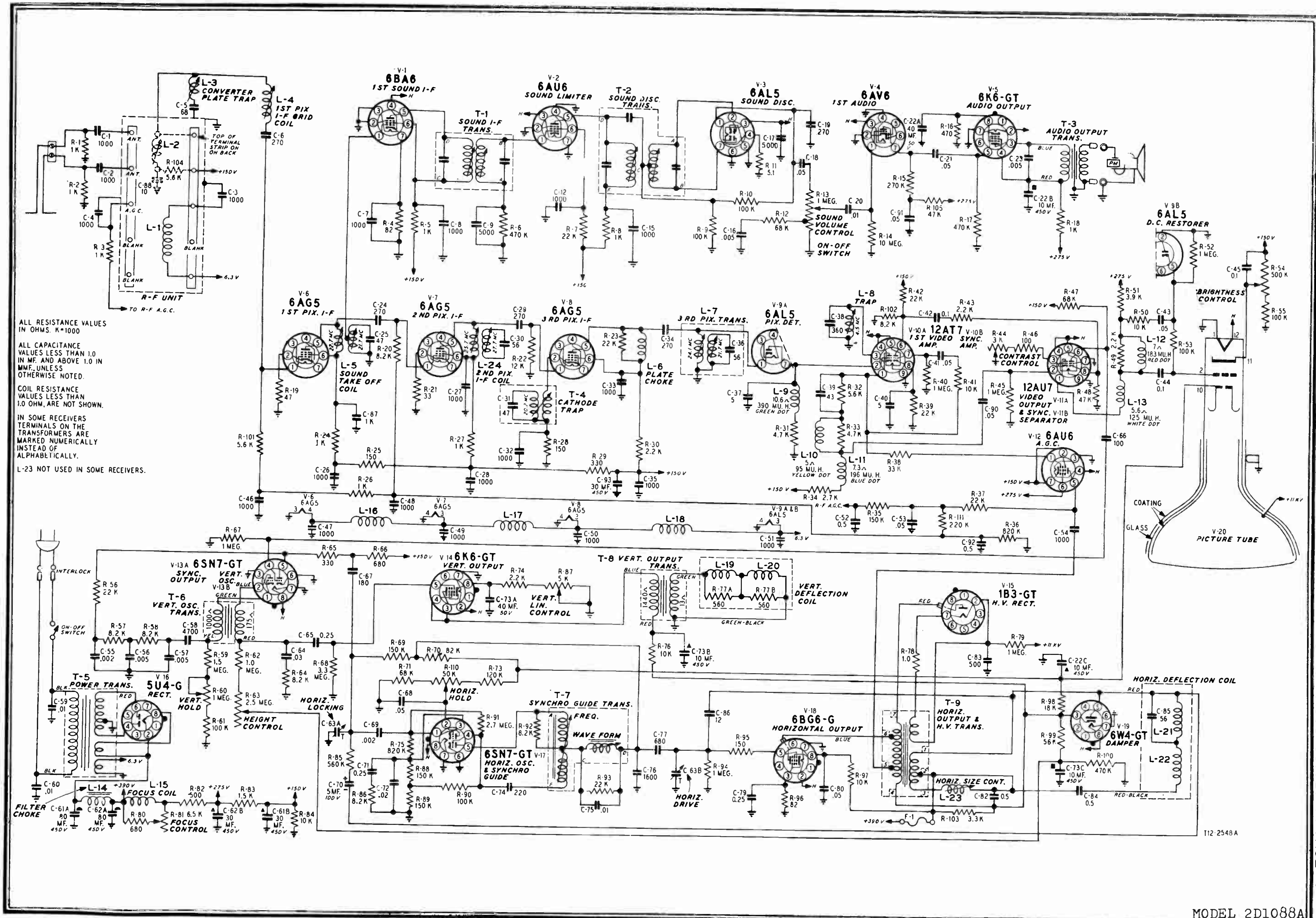

ALL RESISTANCE VALUES IN OHMS. K=1000

ALL CAPACITANCE VALUES LESS THAN 1.0 IN MF. AND ABOVE 1.0 IN MMF., UNLESS OTHERWISE NOTED.

COIL RESISTANCE VALUES LESS THAN 1.0 OHM, ARE NOT SHOWN.

IN SOME RECEIVERS TERMINALS ON THE TRANSFORMERS ARE MARKED NUMERICALLY INSTEAD OF ALPHABETICALLY.

L-23 NOT USED IN SOME RECEIVERS.

MODEL 2D1088A

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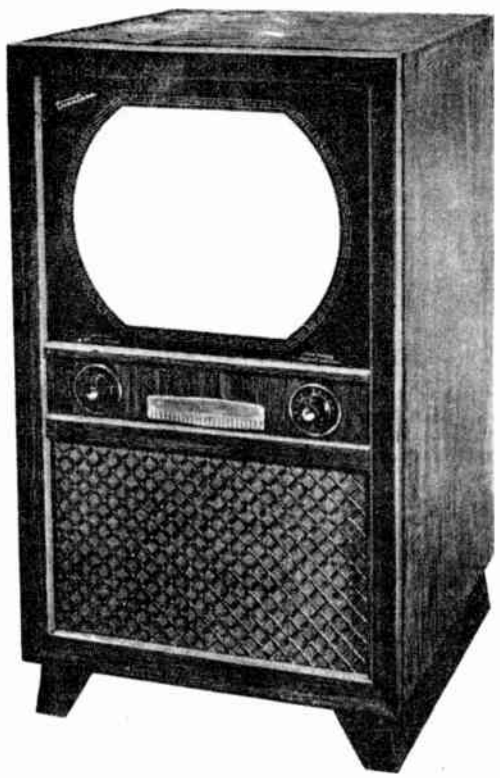


MODEL 2D1088B (12½" PIX TUBE)

SUPPLEMENTARY MANUAL

All service information applicable to the issue "B" series of Model 2D1088 is contained in Service Manual No. 69X2092 and this Supplementary Service Manual.

The differences between issue "A" and "B" series receivers are as follows:

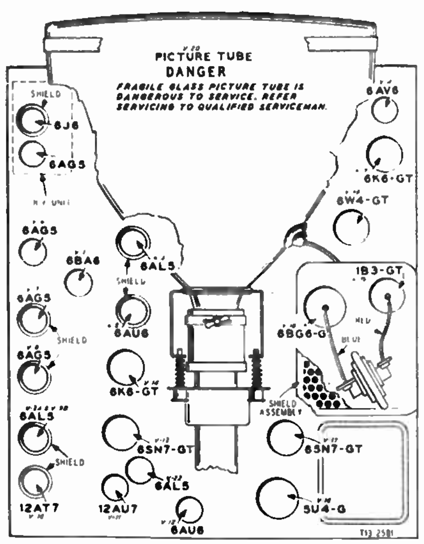
1. A 6AL5 horizontal Phase Discriminator Tube (V-22, see illustration) was added to the circuit to improve receiver performance.

2. The synchro-guide transformer (T-7) was removed and replaced with a horizontal frequency coil (L-25).

3. Because of various electrical changes that have been made in the receiver, it was necessary to include in this supplement a complete parts list and a schematic diagram.

   When ordering parts, for the issue "B" receivers, use the part numbers listed in this Supplementary Manual.

4. For test patterns, alignment procedure and other service information, refer to Manual No. 69X2092 and use all data pertaining to the 16" picture tube receiver.



TUBE LAYOUT

REPLACEMENT PARTS LIST

12½" MODEL 2D1088B

NOTICE: There is a model number label on the chassis. This label identifies the receiver as to chassis and issue letter. When ordering parts or writing, give complete model number.

CAPACITORS

Ref. No.	Part No.	Description
C-1, C-2, C-3, C-4, C 7, C-8, C-12, C-15, C-26, C-27, C-28, C-32, C-33, C-35, C-46, C-47, C-48, C-49, C 50, C-51, C-66, C-67, C-88	47X519	1000 mmf Ceramic......
C-5	47X501	68 mmf Ceramic......
C-6, C-19, C-24, C-29, C-34, C-76	47X445	270 mmf Molded Mica......
C-9, C-17	47X507	5000 mmf Ceramic......
C-16, C-56, C-57, C-70	B65502	.005 mf 200 V Tubular......
C-18, C-53	B64503	.05 mf 200 V Tubular......
C-20, C-72	B64103	.01 mf 200 V Tubular......
C-21, C-41, C-43, C-69, C-83, C-90, C-91	D67503	.05 mf 400 V Tubular......
C-22A, C-22B, C-22C	45X375	40 mf 50 V; 10 mf 450 V; 10 mf 450 V Dry Electrolytic......
C-23	F65502	.005 mf 600 V Tubular......
C-25		Part of L-5 Sound Take-Off Coil
C-30		Part of L-24—2nd Pix I-F Coil
C-31	47X565	47 mmf 500 V Molded Mica......
C-36		Part of L-7—3rd Pix I-F Coil
C-37	47X562	5 mmf 500 V Ceramic......
C-38	47X568	360 mmf 500 V Molded Mica......
C-39	47X563	43 mmf 500 V Ceramic......
C-40	45X378	5 mf 100 V Dry Electrolytic......
C-42	D65104	.1 mf 400 V Tubular......
C-44	F65104	.1 mf 600 V Tubular......
C-45	B65104	.1 mf 200 V Tubular......
C-52, C-82, C-84, C-93	B65504	.5 mf 200 V Tubular......
C-54	47X569	1000 mmf 1000 V Molded Mica......
C-55	B65202	.002 mf 200 V Tubular......
C-58	47X543	4700 mmf Molded Mica......
C-59, C-60	46X410	.01 mf 200 V Molded Paper......
C-61A, C-61B	45X376	80 mf 450 V; 30 mf 450 V Dry Electrolytic......
C-62A, C-62B	45X376	80 mf 450 V; 30 mf 450 V Dry Electrolytic......
C-64	F65303	.03 mf 600 V Tubular......
C-65, C-78	D65254	.25 mf 400 V Tubular......
C-68, C-81	F67503	.05 mf 600 V Tubular......
C-71	47X570	330 mmf 500 V Molded Mica......
C-73A, C-73B, C-73C	45X375	40 mf 50 V; 10 mf 450 V; 10 mf 450 V Dry Electrolytic......
C-75	47X571	390 mmf 500 V Molded Mica......
C-77	17A261	40-370 mmf Trimmer......
C-79	47X572	3900 mmf 500 V Molded Mica......
C-80	47X574	12 mmf 2500 V Ceramic......
C-85		Part of Deflection Coil
C-86	47X560	500 mmf 20,000 V ......
C-87		Part of Tuner Assembly
C-94	45X379	30 mf 450 V Dry Electrolytic......

RESISTORS

Ref. No.	Part No.	Ohms	Watts	Description
R-1, R-2, R-3, R 5, R 8, R-24, R-26, R-27, R-65	B84102	1000	0.5	Carbon......
R-4	B84820	82	0.5	Carbon......
R-6, R-17, R-73, R-100	B85474	470 K	0.5	Carbon......
R-7, R-23, R-37, R-39, R-56	B84223	22 K	0.5	Carbon......
R-9, R-10, R-70, R 72	B84104	100 K	0.5	Carbon......
R-11	43X329	5.1	0.5	Wirewound...
R-12, R-106	B84683	68 K	0.5	Carbon......
R-13, R-44	78X4	1 meg.; 3 K		On-Off Volume; Contrast......
R-14	B85106	10 meg.	0.5	Carbon......
R-15, R-85	B85274	270 K	0.5	Carbon......
R-16	C84471	470	1.0	Carbon......
R-18	D84102	1000	2.0	Carbon......
R-19	B83470	47	0.5	Carbon......
R-20	B83822	8.2 K	0.5	Carbon......
R-21	B83330	33	0.5	Carbon......
R-22	B83123	12 K	0.5	Carbon......
R-25, R-28, R-93	B84151	150	0.5	Carbon......

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REPLACEMENT PARTS LIST (Continued)

12½" MODEL 2D1088B

RESISTORS—Cont.

Ref. No.	Part No.	Ohms	Watts	Description
R-29	B84331	330	0.5	Carbon
R-30, R-43, R-88	B84222	2200	0.5	Carbon
R-31, R-79	B83472	4.7 K	0.5	Carbon
R-32	C84562	5600	1.0	Carbon
R-33		Part of L-10		
R-34	C83272	2700	1.0	Carbon
R-35	B84154	150 K	0.5	Carbon
R-38	B84333	33 K	0.5	Carbon
R-40, R-45, R-52, R-62, R-69, R-89	B84105	1 meg.	0.5	Carbon
R-41, R-50	B84103	10 K	0.5	Carbon
R-42	B84123	12 K	0.5	Carbon
R-46	B84101	100	0.5	Carbon
R-47, R-95	B84824	820 K	0.5	Carbon
R-48	884473	47 K	0.5	Carbon
R-49		Part of L-12		
R-51	C83392	3.9 K	1.0	Carbon
R-53, R-55, R-61	B85104	100 K	0.5	Carbon
R-54	40X290	500 K		Brightness Control
R-57, R-58, R-64	B84822	8.2 K	0.5	Carbon
R-59	B84155	1.5 meg.	0.5	Carbon
R-60	40X291	1 meg.		Vertical Hold
R-63	40X293	2.5 meg.		Height Control
R-66	43X252	3.3 K	0.5	Wirewound
R-67, R-112	B83332	3.3 K	0.5	Carbon
R-68	B85335	3.3 meg.	0.5	Carbon
R-71	B85475	4.7 meg.	0.5	Carbon
R-74	C84223	22 K	1.0	Carbon
R-75	B84152	1500	0.5	Carbon
R-76, R-113	D84103	10 K	2.0	Carbon
R-77A, R-77B		Part of Deflection Coil		
R-78	43X249	1.0	0.5	Wirewound
R-81	40X295	6.5 K		Focus Coil
R-82	43X245	500	10.0	Wirewound
R-83	43X246	1500	10.0	Wirewound
R-84	43X247	10 K	5.0	Wirewound
R-86	B84273	27 K	0.5	Carbon
R-87	40X294	5 K		Vertical Linearity
R-92	C85820	82	1.0	Carbon
R-94	B85224	220 K	0.5	Carbon
R-97	C84105	1 meg.	1.0	Carbon
R-98	C84183	18 K	1.0	Carbon
R-99	B84563	56 K	0.5	Carbon
R-101	B83562	5.6 K	0.5	Carbon
R-107		Part of Tuner Assembly		
R-108	D84681	680	2.0	Carbon
R-109	B83104	100 K	0.5	Carbon
R-110	40X292	50 K		Hor. Hold Control
R-111	B85473	47 K	0.5	Carbon

TRANSFORMERS AND COILS

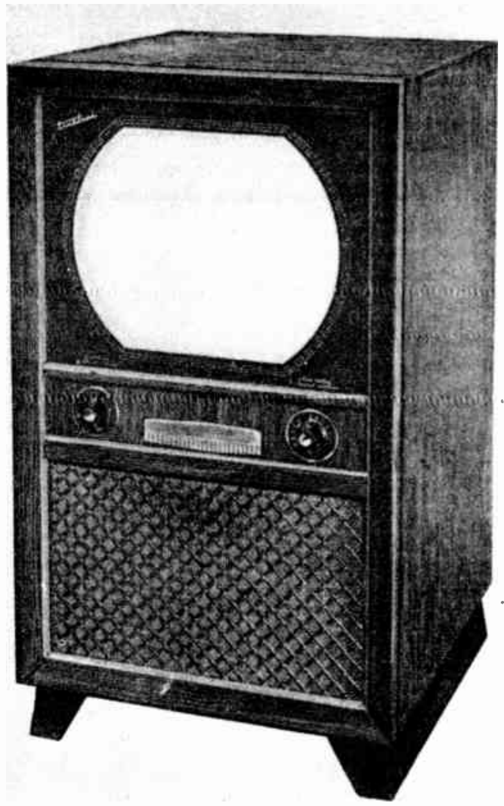
Ref. No.	Part No.	Description
L-1, L-16, L-17, L-18	9A2033	Filament Choke

TRANSFORMER AND COILS—Cont.

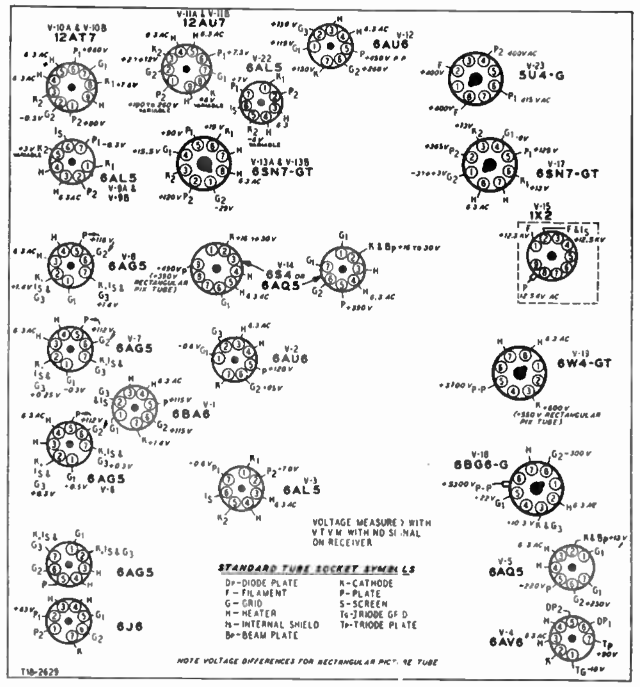
Ref. No.	Part No.	Description
L-2		Part of Tuner Assembly
L-3	9A2059	Converter Plate Trap
L-4	9A2072	1st I.F. Grid Coil
L-5	9A2076	Sound Take-Off Coil
L-6	9A1979	Plate Choke
L-7	9A2071	3rd Pix Trans.
L-8	9A2074	4.5 M.C. Trap
L-9	9A2090	Peaking Coil
L-10	9A2086	Peaking Coil
L-11	9A2088	Peaking Coil
L-12	9A2089	Peaking Coil
L-13	9A2087	Peaking Coil
L-14	52X88	Filter Choke
L-15	9A2107	Focus Coil
L-19, L-20, L-21, L-22		Part of 9A2069 Deflection Coil (See Miscellaneous)
L-23	9A1976	Horizontal Size Control
L-24	9A2055	2nd Pix I.F. Coil
L-25	9A2096	Horizontal Frequency
T-1	9A1986	Sound I-F Trans.
T-2	9A2049	Sound Disc. Trans.
T-3	51X146	Audio Output Trans.
T-4	9A2073	Cathode Trap
T-5	53X298	Power Trans.
T-6	54X5	Vert. Osc. Trans.
T-8	51X147	Vert. Output Trans.
T-9	53X307	Horiz. Output Trans.

MISCELLANEOUS

Part No.	Description
12A490	12" P.M. Speaker
25A1071	R-F Tuner Assembly (Turret Type)
25A1075	R-F Tuner Assembly (Switch Type)
9A2069	Deflection Yoke Assembly
2A382	Ion Trap Magnet
3A428	Tube Socket (miniature)
3A455	Tube Socket (12AU7—12AT7)
3A303	Tube Socket (Octal)
3A454	Tube Socket (H.V. Rectifier)
13X751	Tube Socket (Pix. Tube)
32X390	Tube Shield
32X401	Tube Shield (12AT7)
17X104	Pix Crystal
4X1076	Pix Mask
8X218	Rubber Cushion
25X1654	Support Bracket (Mtg. Rear of Tube)
28X589	Ground Spring
S-25X60	Tube Strap & Mtg. Bracket Assembly
25X1658	Tube Mtg. Bracket (Front Right)
25X1659	Tube Mtg. Bracket (Front Left)
20X1646	Eyelet (Screwdriver Guide) — Mtg. Focus Coil
28X578	Mounting Spring; No. 10—32x1¾" Fillister Head Steel—Machine Screw — Mtg. Focus Coil
20X1558	Wing Screw (Mtg. Def. Yoke)
16X147	Fuse (1/4 Amp.)
S-14X20	Cabinet Back & Power Cord Assembly
14X485	Ventilator Grille
4X1065	Escutcheon (Channel Selector)
4X1029	Escutcheon (Off-Volume & Contrast)
10A741	Knob (Channel Selector)
10A742	Knob (Fine Tuning)
10A752	Knob (Contrast)
10A753	Knob (Off-Volume)
4X1072	Front Panel Cover
6A314	Anode Connector



MODEL 2D1089B (16" PIX TUBE)



BOTTOM SOCKET VOLTAGES

SUPPLEMENTARY MANUAL

Model 2D1089B is similar to Model 2D1089A except for minor mechanical and electrical changes. Because of these changes, it was necessary to include in this supplementary service manual a complete parts list and a schematic diagram. For test patterns, alignment procedure and other service information, refer to Manual 69X2092 and use all data pertaining to the 16" picture tube receiver.

NOTE: When ordering parts for the issue "B" receivers, use the part numbers listed in this Supplementary Service Manual.

TUBE COMPLEMENT

Symbol	Type	Function
	6J6	R-F Osc. & Mixer
	6AG5	R-F Amplifier
V1	6BA6	1st Sound I-F
V2	6AU6	Sound Limiter
V3	6AL5	Sound Discriminator
V4	6AV6 or 6AT6	1st Audio
V5	6AQ5	Audio Output
V6	6AG5	1st Pix I-F Amp.
V7	6AG5	2nd Pix I-F Amp.
V8	6AG5	3rd Pix I-F Amp.
V9 A & B	6AL5	Picture Det. and D. C. Restorer
V10 A & B	12AT7	1st Video Amp. and 1st Sync Amp.
V11 A & B	12AU7	Video Output and Sync Separator
V12	6AU6	Automatic Gain Control
V13 A & B	6SN7-GT	Phase Splitter & Vert. Osc.
V14	6S4 or 6AQ5	Vertical Output
V15	1X2	High Voltage Rectifier
V17	6SN7-GT	Horizontal Osc.
V18	6BG6-G	Horizontal Output
V19	6W4-GT	Damper
V20	16GP4	Picture Tube 16" Round
V22	6AL5	Horizontal Phase Disc.
V23	5U4GT	Low Voltage Rectifier

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REPLACEMENT PARTS LIST

16" MODEL 2D1089B

NOTICE: There is a model number label on the chassis. This label identifies the receiver as to chassis and issue letter. When ordering parts or writing, give complete model number.

CAPACITORS

Ref. No.	Part No.	Description
C-7, C-8, C-12, C-15, C-26, C-27, C-28, C-32, C-33, C-35, C-46, C-47, C-48, C-49, C-50, C-51, C-66, C-67, C-88, C-95	47X519	1000 mmf Ceramic
C-9, C-17	47X507	5000 mmf Ceramic
C-16, C-70	B65502	.005 mf 200 V. Tubular
C-18, C-69	B65503	.05 mf 200 V. Tubular
C-19, C-24, C-29, C-34, C-75	47X445	270 mmf Molded Mica
C-20, C-72	B65103	.01 mf 200 V. Tubular
C-21A, C-21B, C-21C		Part of 76X5 (See Miscellaneous)
C-22A, C-22B, C-22C	45X375	40 mf 50 V.; 40 mf 50 V.; 10 mf 450 V. Dry Electrolytic
C-23	F65502	.005 mf 600 V. Tubular
C-25		Part of L-5 (Sound Take-Off Coil)
C-30		Part of L-24 (2nd Pix. I-F Coil)
C-31	47X565	47 mmf 500 V. Molded Mica
C-36		Part of L-7
C-37	47X562	5 mmf 500 V. Ceramic
C-38	47X568	360 mmf 500 V. Molded Mica
C-39	47X563	43 mmf 500 V. Ceramic
C-40	45X378	5 mf 25 V. Dry Electrolytic
C-41, C-43, C-82, C-83, C-90, C-91	D67503	.05 mf 400 V. Tubular
C-42, C-99	D65104	.1 mf 400 V. Tubular
C-44	F65104	.1 mf 600 V. Tubular
C-45, C-53	B65104	.1 mf 200 V. Tubular
C-52, C-93	B65504	.5 mf 200.V. Tubular
C-54	47X569	1000 mmf 1000 V. Molded Mica
C-55A, C-55B, C-55C		Part of 76X7 (See Miscellaneous)
C-58	47X543	4700 mmf Molded Mica
C-59, C-60	46X410	.01 mf 400 V. Molded Paper
C-61A, C-61B	45X376	80 mf 450 V.; 30 mf 450 V. Dry Electrolytic
C-62A, C-62B	45X376	80 mf 450 V.; 30 mf 450 V. Dry Electrolytic
C-64	F65503	.05 mf 600 V. Tubular
C-65	D65254	.25 mf 400 V. Tubular
C-68, C-78	F67503	.05 mf 600 V. Tubular
C-71	47X570	330 mmf 500 V. Molded Mica
C-73A, C-73B	45X380	40 mf 50 V.; 30 mf 450 V. Dry Electrolytic
C-76	47X571	390 mmf 500 V. Molded Mica
C-77	17A261	40-370 mmf Trimmer
C-79	47X572	3900 mmf 500 V. Molded Mica
C-81, C-84	B65254	.25 mf 200 V. Tubular
C-85	47X539	56 mmf 1000 V. Molded Mica
C-86	47X560	500 mmf 20,000 V. Hi-Voltage
C-96	D65303	.03 mf 400 V. Tubular
C-98	45X382	20 mf 400 V. Dry Electrolytic

RESISTORS

Ref. No.	Part No.	Ohms	Watts	Description
R-4	B84820	82	0.5	Carbon
R-5, R-8, R-24, R-26, R-27, R-35, R-65, R-68	B84102	1000	0.5	Carbon
R-6, R-36, R-73, R-94, R-112, R-113	B85474	470 K	0.5	Carbon
R-7, R-23, R-37, R-39	B84223	22 K	0.5	Carbon
R-9, R-10, R-70, R-72, R-109, R-114	B84104	100 K	0.5	Carbon
R-11	43X239	5.1	0.5	Wirewound
R-12, R-106	B84683	68 K	0.5	Carbon
R-13, R-44	78X4	1 meg.; 3 K		Off-On Volume; Contrast
R-14	B85106	10 meg.	0.5	Carbon
R-15A, R-15B		Part of 76X5 (See Miscellaneous)		
R-16	B85473	47 K	0.5	Carbon
R-18, R-57, R-108	D84102	1000	2.0	Carbon
R-19	B83470	47	0.5	Carbon
R-20	B83822	8.2 K	0.5	Carbon

16" MODEL 2D1089B

RESISTORS—Cont.

Ref. No.	Part No.	Ohms	Watts	Description
R-21	B83330	33	0.5	Carbon
R-22	B83123	12 K	0.5	Carbon
R-25, R-28, R-91	B84151	150	0.5	Carbon
R-29	B84331	330	0.5	Carbon
R-30, R-43	B84222	2200	0.5	Carbon
R-31, R-79	B83472	4.7 K	0.5	Carbon
R-32	C84562	5600	1.0	Carbon
R-33		Part of L-10 Peaking Coil		
R-34	C83272	2700	1.0	Carbon
R-38	B84333	33 K	0.5	Carbon
R-40, R-45, R-52, R-59, R-69, R-89	B84105	1 meg.	0.5	Carbon
R-41, R-50	B84103	10 K	0.5	Carbon
R-42	B84123	12 K	0.5	Carbon
R-46	B84101	100	0.5	Carbon
R-47, R-95	B84824	820 K	0.5	Carbon
R-48	B84473	47 K	0.5	Carbon
R-49		Part of L-12 Peaking Coil		
R-51	C83392	3.9 K	1.0	Carbon
R-53, R-55, R-61	B85104	100 K	0.5	Carbon
R-54	40X290	500 K		Brightness Control
R-56A, R-56B, R-56C		Part of 76X7 (See Miscellaneous)		
R-60	40X291	1.5 meg.		Vertical Hold
R-62	B84155	1.5 meg.	0.5	Carbon
R-63	40X293	2.5 meg.		Height Control
R-64, R-103	B84472	4.7 K	0.5	Carbon
R-66, R-67	B83332	3.3 K	0.5	Carbon
R-71	B85475	4.7 meg.	0.5	Carbon
R-74	C83223	22 K	1.0	Carbon
R-75	B84152	1500	0.5	Carbon
R-76	D84682	6.8 K	2.0	Carbon
R-77A, R-77B	B84561	560	0.5	Carbon
R-78	43X238	3.3	0.5	Wirewound
R-81	40X304	6.5 K		Focus Control
R-82	43X245	500	10.0	Wirewound
R-83	43X246	1500	10.0	Wirewound
R-84	43X247	10 K	5.0	Wirewound
R-85	B84274	270 K	0.5	Carbon
R-86	B84273	27 K	0.5	Carbon
R-87	40X294	5 K		Vertical Linearity
R-88	B84821	820	0.5	Carbon
R-90	B84185	1.8 meg.	0.5	Carbon
R-92	43X247	10 K	5.0	Wirewound
R-93	D84151	150	2.0	Carbon
R-97	C85105	1 meg.	1.0	Carbon
R-101	B83103	10 K	0.5	Carbon
R-110	40X292	50 K		Horizontal Hold
R-111	C84391	390	1.0	Carbon

TRANSFORMERS AND COILS

Ref. No.	Part No.	Description
L-5	9A2076	Sound Take-Off Coil
L-6	9A1979	Plate Choke
L-7	9A2071	3rd Pix Trans.

TRANSFORMER AND COILS—Cont.

Ref. No.	Part No.	Description
L-8	9A2074	4.5 Mc Trap
L-9	9A2090	Peaking Coil
L-10	9A2086	Peaking Coil
L-11	9A2088	Peaking Coil
L-12	9A2089	Peaking Coil
L-13	9A2087	Peaking Coil
L-14	52X88	Filter Choke
L-15	9A2147	Focus Control
L-16, L-17, L-18	9A2033	R. F. Choke
L-19, L-20, L-21, L-22		Part of 9A2149 Deflection Coil (See Miscellaneous)
L-23	9A1976	Horizontal Size
L-24	9A2055	2nd Pix I-F Coil
L-25	9A2096	Horizontal Freq.
L-26	9A2111	Horizontal Linearity
T-1	9A1986	Sound I-F Trans.
T-2	9A2049	Sound Disc. Trans.
T-3	51X150	Audio Output Trans.
T-4	9A2073	Cathode Trap
T-5	53X308	Power Trans.
T-6	54X5	Vert. Osc. Trans.
T-8	51X149	Vertical Output Trans.
T-9	53X315	Horizontal Output H. V. Trans.

MISCELLANEOUS

Part No.	Description
12A490	12" P. M. Speaker
25A1071	R-F Tuner Assembly
9A2149	Deflection Yoke Assembly
2A401	Ion Trap Magnet
4X1029	Escutcheon (Off-Volume & Contrast)
4X1065	Escutcheon (Channel Selector)
4X1102	Escutcheon (Control Panel)
10A741	Knob (Channel Selector)
10A742	Knob (Fine Tuning)
10A752	Knob (On-Off Volume)
10A753	Knob (Contrast)
4X1093	Pix Mask
17X126	Pix Crystal
4X1097	Pix Tube Mtg. Ring
6A315	Anode Connector
3A457	Tube Socket (H.V. Rectifier)
3A428	Tube Socket (Miniature)
3A455	Tube Socket (12AT7-12AU7)
3A303	Tube Socket (Octal)
3A456	Tube Socket (6AQ5)
32X390	Tube Shield
32X401	Tube Shield (12AT7)
13X772	Tube Socket (Pix Tube)
16X147	Fuse (1/4 Amp.)
76X5	Multiple Resistor-Capacitor Combination
76X7	Multiple Resistor-Capacitor Combination
20X1646	Eyelet (Screwdriver Guide) — Mtg. Focus Coil
28X578	Mounting Spring — Mtg. Focus Coil
	No. 10-32x1 3/4 Fillister Hd. Steel Machine Screw — Mtg. Focus Coil
20X1652	Wing Screw (Mtg. Def. Yoke)
28X587	Ground Spring
14X485	Ventilator Grille
S-14X24	Cabinet Back Assembly
S-25X65	Tube Mtg. Strap Assembly
25X1722	Pix Tube Ring Mtg. Bracket (Left Front)
25X1721	Pix Tube Ring Mtg. Bracket (Right Front)
25X1724	Pix Tube Mtg. Bracket (Rear of Pix Tube)
8X217	Mounting Cushion (Mtg. Pix Tube)

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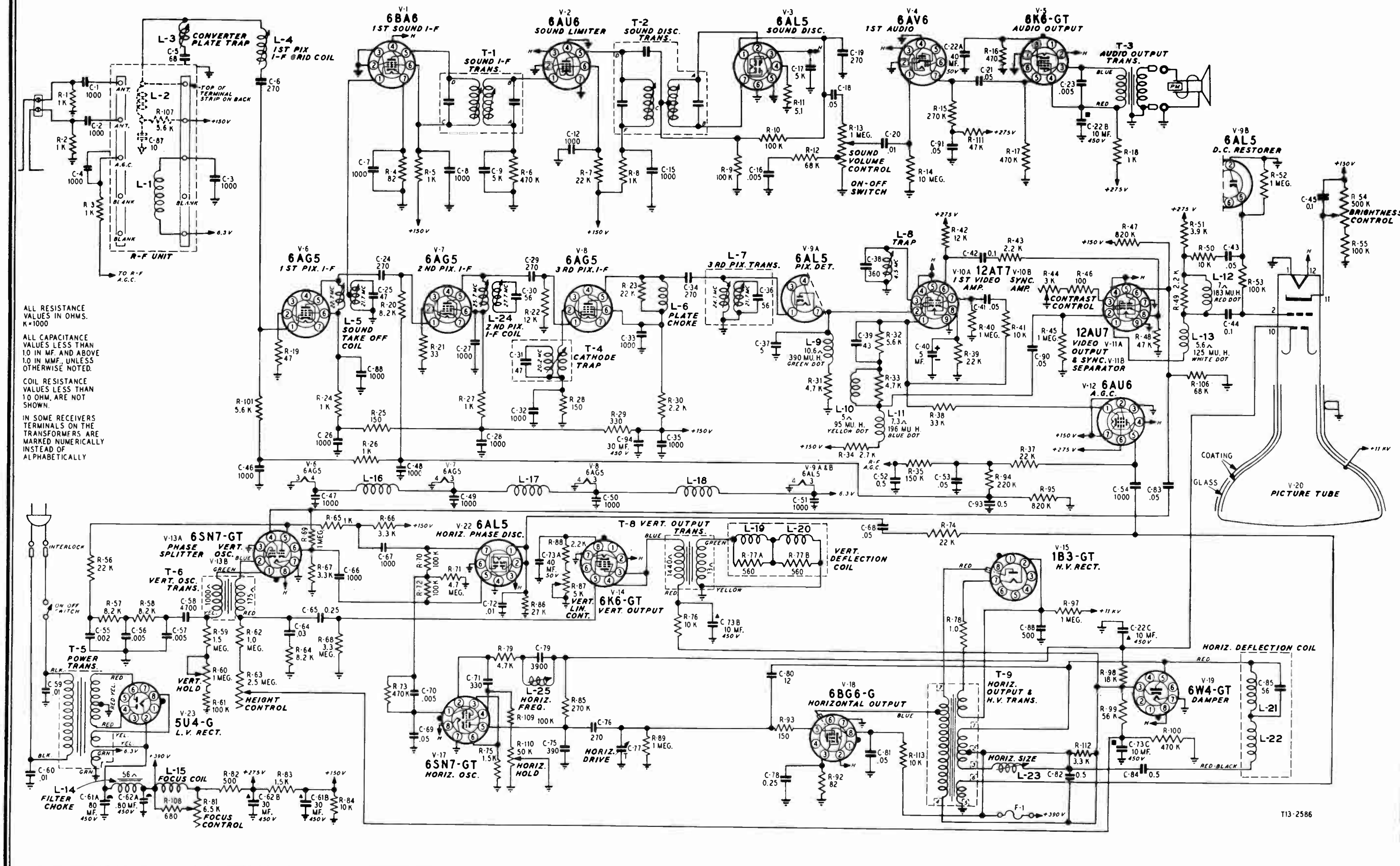
12½" MODEL 2D1088B



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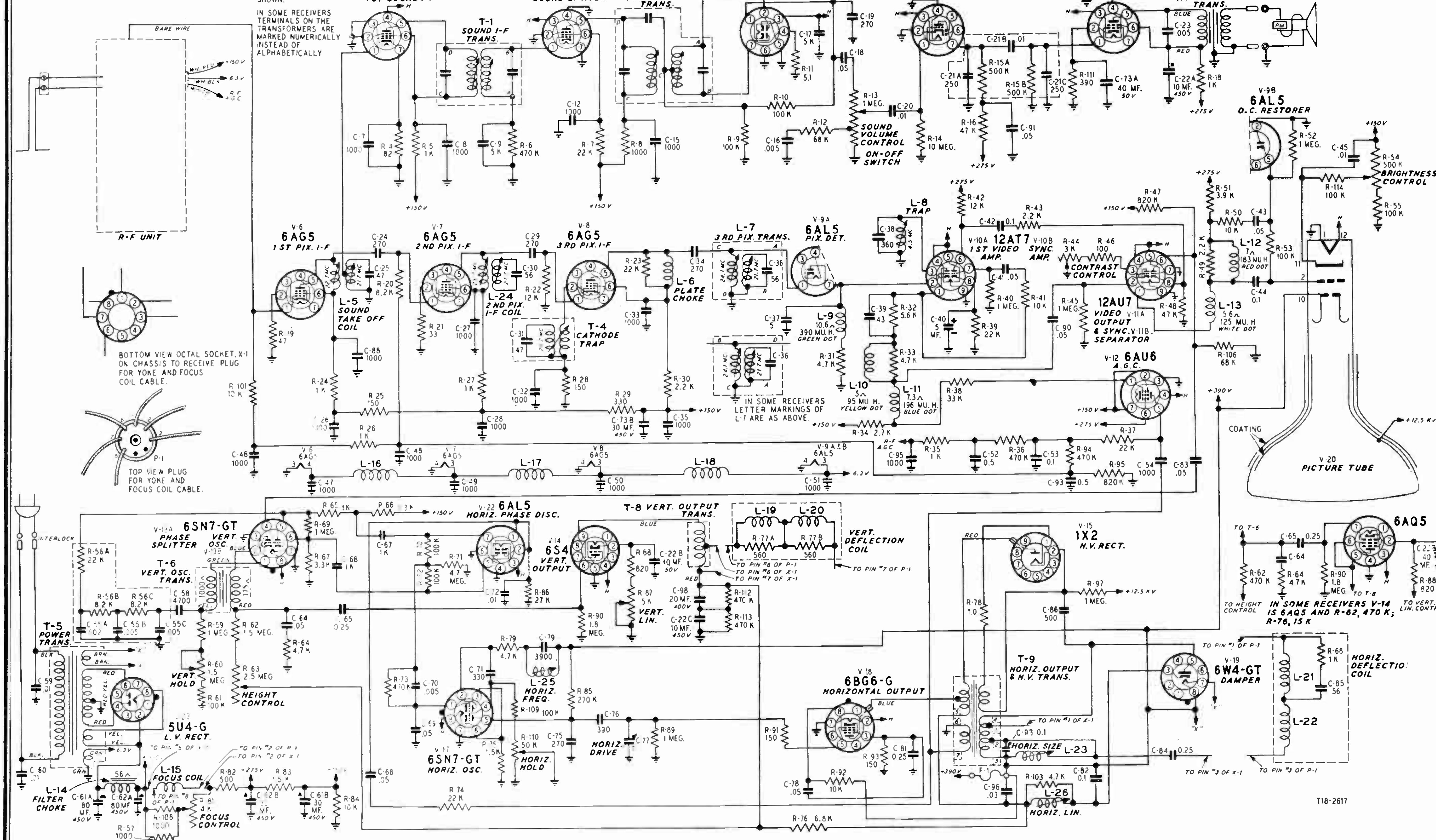
16" MODEL 2D1089B

ALL RESISTANCE VALUES IN OHMS. K=1000

ALL CAPACITANCE VALUES LESS THAN 1.0 IN MF AND ABOVE 1.0 IN MMF, UNLESS OTHERWISE NOTED.

COIL RESISTANCE VALUES LESS THAN 1.0 OHM, ARE NOT SHOWN.

IN SOME RECEIVERS TERMINALS ON THE TRANSFORMERS ARE MARKED NUMERICALLY INSTEAD OF ALPHABETICALLY



NOTE—In later production R-78 is 3.3 ohms.

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NOTE: For additional Service Data,
See Model D2047

TELEVISION SPECIFICATIONS

Sensitivity at the Antenna
Video—100 microvolts
Audio—100 microvolts

Power Supply Rating
115 volts, 50-60 cycles, AC
235 watts.

Audio Power Output Rating
Undistorted—3 watts
Maximum—4½ watts

Speaker
10" PM
3.2 ohm voice coil impedance

Picture Size
70 square inches

Antenna Impedance Requirements
Balanced 300-ohm

Dimensions
Chassis—16"x 16"x 2½"

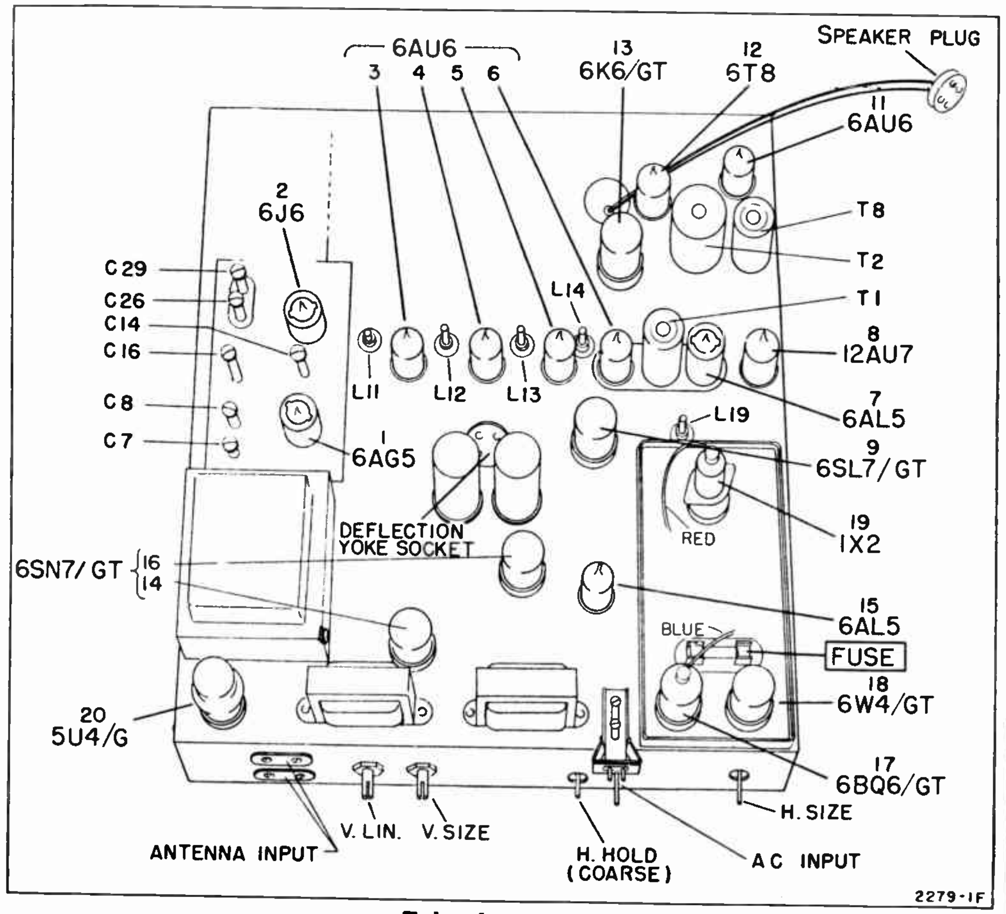
Tube Complement
6AG5, RF-Amplifier
6J6, Oscillator-Converter
6AU6's, (4) IF-Amplifier
6AL5, Detector, DC Restorer and Sync Separator
12AU7, Video Amplifier
6SL7, Sync-Amplifier A.G.C. Amplifier
6AU6, Sound IF-Amplifier
6T8, Audio Detector and Amp.
6K6, Audio Output
6SN7, Vertical Multivibrator
6AL5, AFC-Discriminator
6SN7, Horizontal Multivibrator
6BQ6, Pulse Amplifier
6W4, Damper
1X2, High Voltage Rectifier
5U4, Low Voltage Rectifier
10BP4, Picture Tube

GENERAL DESCRIPTION

The Model 10AXF44 is a combination television, AM-FM radio, and a 45 RPM record changer.

The Television set is a 20-tube, AC operated, direct view, 10-inch television receiver and features complete coverage of all 12 television channels, automatic gain control, automatic frequency control, intercarrier sound system, permanent magnet focused and magnetically deflected picture tube.

On the back of the cabinet is a safety interlock to prevent dangerous electrical shock. As an added safety measure, a fuse is located in the high voltage power supply to protect the set in case of overloading.



Tube Layout

OPERATION OF THE TELEVISION

FUNCTIONS OF THE CONTROLS

All the controls normally used in tuning in a program—both picture and sound—are located on the front of the receiver. On the rear of the set are several controls which are pre-set at the factory and may need slight readjustment at the time of installation. After installation, they should not be adjusted further, unless required by replacement or aging of tubes, variations in power-line voltage, or other external conditions. The function of each of the controls is described below.

OPERATOR'S CONTROLS

Volume-Off — Turns set on or off and adjusts sound volume.

Contrast—Varies contrast between light and dark portions of picture.

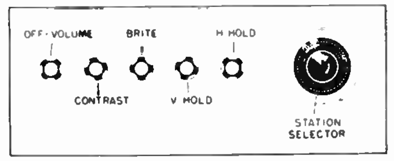
Brightness—Controls brilliance of picture.

V. Hold—Stops pictures from moving up or down.

H. Hold—Stops pictures from moving left or right.

Station Selector Knob—Tunes set to desired channel (station). May be turned in either direction.

Model 10AXF44 actually requires only three controls when tuning in a program. The three controls, off-on-volume, contrast and station selector are located on the front of the receiver. The three other controls on the front of the set: brightness, horizontal hold, and vertical hold, need only be adjusted periodically. The six operator's controls are shown below:



Three of the seven serviceman's controls; focus, horizontal centering, and vertical centering, are located on the picture tube assembly. The remaining four controls, vertical linearity, vertical size, horizontal size, and coarse horizontal hold are located on the rear of the set. (See tube layout).

SERVICEMAN'S CONTROLS

Vert. Lin.—Provides vertical distribution of picture.

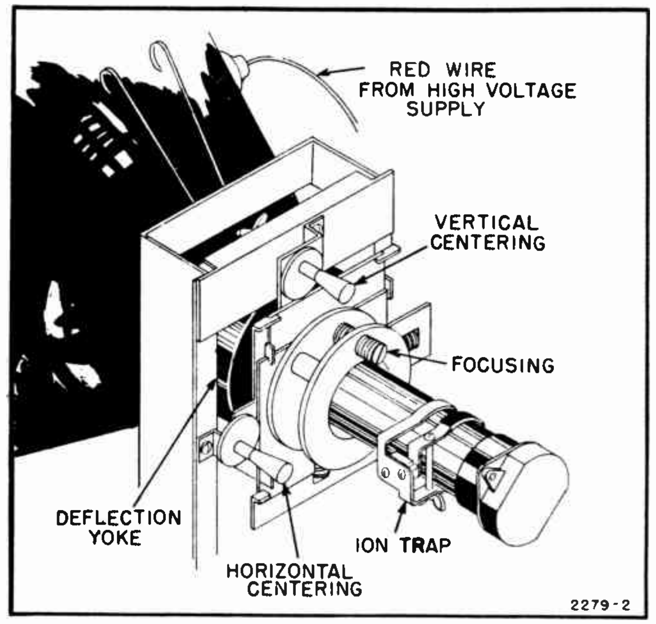
Vert. Size — Changes size of picture vertically. Does not affect horizontal size.

Horiz. Size—Changes size of picture horizontally. Does not affect vertical size.

Focus—Focuses picture on face of picture tube.

H. Centering—Moves entire picture horizontally.

V. Centering—Moves entire picture vertically.



Picture Tube Assembly

TUNING PROCEDURE

1. Turn the VOLUME control clockwise to turn the set on. Allow one-half minute for the set to warm up.
2. Rotate the Station Selector knob to the desired channel.
3. Turn the CONTRAST control fully counter-clockwise.
4. Turn the BRIGHTNESS control fully clockwise, and then turn it slowly counter-clockwise until the picture tube just becomes dark. *For any particular installation this adjustment of the BRIGHTNESS control need be made only the first time the set is used, unless required by replacement of tubes.*
5. Adjust the CONTRAST control until the proper contrast between blacks and whites is obtained.
6. Adjust the VOLUME control for the desired sound level.
7. When switching from one station to another, it may be necessary to readjust the CONTRAST control.

ADJUSTMENT OF STATION SELECTOR

The station selector of your television set has been partially pre-set at the factory, but readjustment of the settings may have to be made at the time of the initial installation. This should be done by the serviceman.

If at a later time a new station comes on the air, or if the receiver is moved to a locality where other stations can be received, adjust the station selector in the following manner.

1. Turn the set on. Allow the set to warm up for 20 minutes.
2. Turn the contrast control approximately two-thirds of the way toward its full clockwise position.
3. Turn the volume control approximately to its mid-position.
4. Set the station selector knob to the desired channel.
5. Grasp the station escutcheon at the upper right edge and slowly push down until the hole above the station selector knob appears.
6. Insert a screwdriver into the hole (see illustration). Turn the screw slowly counter-clockwise (and then clock-

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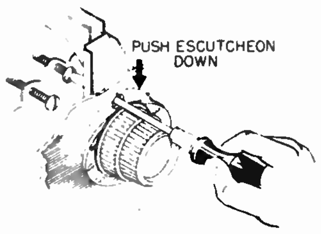
wise, if necessary) until maximum sound is heard. This may require several turns in one direction or the other. Turn up the volume control if necessary. (Do not at any time turn the screw in either direction more than 3 revolutions. Do not force it if turning becomes difficult as the screw has then reached



the end of its travel in that direction and its direction should be reversed.)

7. When the sound is at maximum, the picture will appear on the screen but "sound bars" (dark horizontal bars of varying width) will be seen traveling vertically from bottom to top across the picture. With the screwdriver, turn the station selector screw counter-clockwise only far enough to remove the sound bars from the picture.

8. Push the station escutcheon back into place.

ANTENNA CONNECTIONS

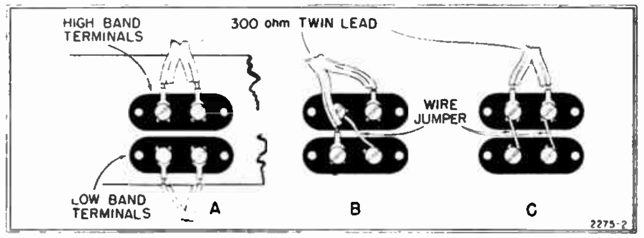
1. For those who use separate Hi and Low Band antennae, with two lead-in cables, connect the Hi-Band leads to the two top terminals marked Hi-Band, connect the Lo-Band leads to the two bottom terminals, marked Lo-Band. See fig. 4, sketch A.

2. For those who use a combined Hi-Lo Band antenna, better known as a "All Wave Antenna" with one lead-in cable, connect as shown in fig. 4, sketch B.

3. In some cases due to location or environment of the Receiving antennae, better results can be had by connecting the lead-in as shown in fig. 4, sketch C.

4. An alternate arrangement for those who receive from Hi-Band stations only (Channels 7 thru 13), the All Wave Antenna lead-in may be connected to the two top terminals marked Hi-Band, with no strap or connection to the Lo-Band terminals.

5. Use the arrangement which gives the most satisfactory results.



Alternate Antenna Connections

CAUTION!: 9,000 volts on all pins of the 1X2 high voltage rectifier. DO NOT MEASURE this voltage unless a high range voltmeter is used.

WARNING!: Do not tamper with or attempt to defeat the purpose of the safety interlock.

FUSE: To replace the fuse in the high voltage power supply, lift off the high voltage shield, remove the old fuse, and replace with the same type 1/4 ampere fuse.

TELEVISION REPLACEABLE PARTS LIST

TUNER

Ref. Symbol	Part No.	Description
Capacitors		
C3	A-8G-13962	Ceramic, .005 mfd
C4-30-31-32	C-8G-16045	Ceramic, 220 mmf, 20%
C5-12-15-17-21-33	C-8G-13201	Ceramic, 1000 mmf
C6	C-8G-17305	Ceramic, 12 mmf, 10%
C7-8-14-16-26-29	B-201-15142	Trimmer capacitor
C9-10	A-8G-12495-7	Ceramic, .5 mmf
C11	A-8G-12495-3	Ceramic, 1.5 mmf
C13	C-8G-11893	Ceramic, 4 mmf, ±1/4 mmf
C18-22-25-28	C-8G-11891	Ceramic, 51 mmf, 5%
C19-20	A-8G-12495-4	Ceramic, 2.2 mmf
C23	C-8G-15737	Ceramic, 2.5 mmf, 20%
C24-27	C-8G-15224	Ceramic, 7 mmf, ±1/2 mmf
Resistors		
R1	C-9B1-60	680 ohms, 1/2 watt, 10%
R4	C-9B1-86	100,000 ohms, 1/2 watt, 10%
R5	C-9B1-48	68 ohms, 1/2 watt, 10%
R6	C-9B1-13	1000 ohms, 1/2 watt, 20%
R7-9	C-9B1-71	5600 ohms, 1/2 watt, 10%
R8-11	C-9B1-74	10,000 ohms, 1/2 watt, 10%
R10	C-9B1-54	220 ohms, 1/2 watt, 10%
R12-13	C-9B1-38	10 ohms, 1/2 watt, 10%
Chokes, Transformers, Coils		
L1-2 (Incl. C1-2 R2-3)	B-201-17143	Antenna transformer assembly
L3	A-16A-17128	R.F. choke
L4-6-8	B-13E-17140	High band coils, Osc., RF pri., RF sec.
L5-7	B-13E-12046	Low band coils, RF pri., RF sec.
L9	B-13D-12155	Low band coil, oscillator
Miscellaneous		
	A-51A-15715	Iron core, for L5
	A-51A-17162	Iron core, for L6
	A-51A-17161	Iron core, for L7
	A-51A-17513	Iron core, for L4-8-9
	A-15C-10717	Tube socket, 7-prong, miniature
	A-2M-16276	Core mounting clip
	A-2M-15504	Leaf spring
	A-2H-11494	Tube shield
	A-49A-15977	Coil spring
	C-5M-15487	Treadle bar, bakelite
	A-49A-15837	Detent spring

MAIN CHASSIS

Ref. Symbol	Part No.	Description
Capacitors		
C34-74-75-82	A-8G-13962	.005 mfd, ceramic disk
C35-37-38-40-41-42-44-45-46-47-49-50-51-54-57-	C-8G-13201	1000 mmf, ceramic
C36	C-8F3-8	100 mmf, mica, 20%
C39-43-48	C-8F3-109	47 mmf, mica, 10%
C55	C-8G-12166	5 mmf, ceramic
C56	C-8G-13909	22 mmf, ceramic
C61-A-B-C-D	A-8C-17844	30-30 mfd x 450 volts, 125-125 mfd x 25 volts
C62	C-8D-17268	.02 mfd 200 volts +30% —10%
C63	C-8G-13201	1000 mmf, ceramic
C64-66	C-8D-17270	.01 mfd, 400 volts
C65		22 mmf (See L19)
C67-113	C-8D-10760	.1 mfd, 400 volts, +30% —10%
C68	C-8D-10813	.05 mfd, 400 volts, 20%
C70	C-8D-10771	.1 mfd, 200 volts, +30% —10%
C71	C-8F6-125	1000 mmf, 500 volts, 10%
C72-105	C-8D-17785	.005 mfd, 200 volts, +50% —25%
C73	A-8G-12495-5	3.3 mmf, ceramic
C76	C-8D-17958	.004 mfd, 400 volts, +50% —25%
C77-80-84-93-95	C-8D-17258	.01 mfd, 200 volts, +30% —10%
C78-85	C-8D-17607	.02 mfd, 400 volts, +30% —10%
C79-88	C-8F3-12	470 mmf, mica, 20%
C81-83	A-8C-17183	10 mfd, 50 volts,
C85	C-8D-17258	.01 mfd, 200 volts, +30% —20%
C86	C-8F3-10	220 mmf, mica, 20%
C87	C-8G-13877	4.7 mmf, ±1/2 mmf
C90	C-8F9-19	6800 mmf, 300 volts, 20%
C91-99-102-108-110	C-8F3-117	220 mmf, 500 volts, 10%
C92	C-8D-17784	.25 mfd, 400 volts, +30% —10%
C93	C-8D-14461	.05 mfd, 400 volts, +30% —20%
C94	A-8C-13453	8 mfd, 450 volts, lytic
C98	C-8F3-222	75 mmf, 500 volts, 5%
C100-101-111	C-8F3-123	680 mmf, 300 volts, 10%
C103	C-8D-17259	.1 mfd, 200 volts, +30% —10%
C104	C-8F3-113	100 mmf, 500 volts, 10%
C106	C-8D-10775	.25 mfd, 200 volts, +30% —10%
C107	C-8F11-132	3900 mmf, 500 volts, 10%
C109	A-8E-18508	80-480 mmf, trimmer
C112	C-8D-10787	.001 mfd, 600 volts, 20%
C114	C-8D-17260	.5 mfd, 200 volts, +30% —10%
C115	A-8C-11495	10 mfd, 150 volts, lytic
C117	A-8C-17179	500 mmf, 15,000 volts
C118-A-B-C	A-8C-17845	60-30-10 mfd x 450 volts
Resistors		
R15-17-19-21-23-25-27-33	C-9B1-62	1000 ohms, 1/2 watt, 10%
R16-24	C-9B1-73	8200 ohms, 1/2 watt, 10%
R18-22-26	C-9B1-49	82 ohms, 1/2 watt, 10%
R20-29-59	C-9B1-70	4700 ohms, 1/2 watt, 10%
R28-56	C-9B1-48	68 ohms, 1/2 watt, 10%
R30-34-50-60	C-9B1-82	47K ohms, 1/2 watt, 10%
R31-42-75-82-76	C-9B1-98	1 megohm, 1/2 watt, 10%
R32	A-10B-17316	8000 ohms, (Contrast)
R36-72-84-85	C-9B1-102	2.2 megohms, 1/2 watt, 10%
R37-79	C-9B1-13	1000 ohms, 1/2 watt, 20%
R38	C-9B2-66	2200 ohms, 1 watt, 10%
R39-95	C-9B4-70	4700 ohms, 2 watts, 10%
R40-63	C-9B1-59	560 ohms, 1/2 watt, 10%
R41-58	C-9B1-74	10K ohms, 1/2 watt, 10%
R44	C-9B1-34	3.3 megohms, 1/2 watt, 20%
R45	C-9B1-91	270K ohms, 1/4 watt, 10%
R46	A-10B-17764	50K ohms, (Brightness)
R47	C-9B1-72	6800 ohms, 1/2 watt, 10%
R48-73-93-105	C-9B1-86	100K ohms, 1/2 watt, 10%
R49-51-55-66-78-89-106-92	C-9B1-90	220K ohms, 1/2 watt, 10%
R53	C-9B1-95	560K ohms, 1/2 watt, 10%
R54-65-97-100-104	C-9B1-94	470K ohms, 1/2 watt 10%
R57-64	C-9B1-78	22K ohms, 1/2 watt, 10%
R61	A-10A-17215	1 megohm, (Volume and Switch)
R62	C-9B1-37	10 megohms, 1/2 watt, 20%
R70	A-10B-18240	750K ohms, (Vertical Size)
R71	C-9B1-69	3900 ohms, 1/2 watt, 10%
R74	A-10B-17275	100K ohms, (Vertical Hold)
R77	C-9B1-83	56K ohms, 1/2 watt, 10%
R80	A-10B-17766	5000 ohms, (Vertical Linearity)
R81	C-9B1-66	2200 ohms, 1/2 watt, 10%
R83-86	C-9B1-88	150K ohms, 1/2 watt, 10%
R87	C-9B1-32	1.5 megohms, 1/2 watt, 20%
R88	C-9B1-80	33K ohms, 1/2 watt, 10%
R90	C-9B1-64	1500 ohms, 1/2 watt, 10%
R91	C-9B1-71	5600 ohms, 1 watt, 10%
R94	A-10B-17764	50K ohms, (Horizontal Hold)
R96	C-9B1-54	220 ohms, 1/2 watt, 10%
R98	C-9C12-1115	22K ohms, 5 watts, 10%
R99	C-9B2-98	1 megohm, 1 watt, 10%
R101-102	C-9C14-1099	1000 ohms, 10 watts 10%
R103	C-9C12-1104	2700 ohms, 5 watts
Chokes, Transformers, Coils		
T1	B-13B-17956	Output IF coil
T2	B-13M-17273	Ratio detector coil
T3		Output transformer mounted on spkr.
T4	B-12C-17303	Vertical output transformer
T5-A-B	B-13M-13590	Deflection yoke
T6	C-12M-18286	Horizontal deflection transformer
T7	C-12A-17822	Power transformer
T8	B-13A-17978	Input IF coil
T9	B-12M-18241	Vertical oscillator transformer
L10	A-16A-18025	Plate choke coil
L11	A-13M-18026	Converter coil
L12-13-14	B-201-15612	Stagger tune coil assembly
	A-51A-17966	Iron core (for above)
L15	A-201-15608	Choke coil assembly
L16	A-16A-17048	Peaking coil
L17	A-201-15609	Filament choke
L18	A-16A-17937	RF choke
L19	A-201-17962	Video trap and coil assembly
	A-51A-17966	Iron core (for above)
L20-21	A-16A-17961	Peaking coil
L23	A-13D-16943	Horizontal hold (course) coil
	A-51A-16945	Iron core (for above)
L24	A-13M-18233	Horizontal size coil
	A-51A-16945	Iron core (for above)
L25	B-16A-17959	Filter choke

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REPLACEABLE PARTS LIST

Miscellaneous

A-15C-18162	9-pin miniature tube socket
A-15C-17983	9-pin miniature tube socket (wafer)
A-15B-10440	Octal tube socket
A-15C-16007	7-pin miniature tube socket
B-2M-13062	Plug button
B-15B-14274	Yoke socket
A-19A-14275	Yoke plug
C-2B-18056	Shield can
A-19B-18023	Speaker socket assembly
B-15B-17278	Socket and cable
A-2B-17337	Coil shield
A-2M-17336	Coil retaining spring
A-2H-10974	Tube shield
A-7B-13050	Antenna terminal board
A-49A-18192	Antenna shorting bar
A-55F-18024	Fuse mounting
A-55F-18362	Fuse, 1/4 ampere, 250 volts
A-3A-17234	Extension shaft
A-6M-17744	Shaft connector
A-2D-17219	RH-tube bracket
A-2D-17218	LH- tube bracket
A-25M-16992	Rubber strap
A-2M-17241	Tube strap
A-2D-11493	Bracket
C-2D-17235	Deflection coil mounting bracket
A-49A-18269	Tube contact spring
B-55P-18282	Focus magnet
C-2D-18078	Focus magnet mounting bracket
A-49A-18084	Spring
B-16M-17982	Ion trap magnet
B-43D-17860	Coil-tube, mounting clip
B-14MA-11066-20	Twin lead transmission line
A-201-18085	AC chassis connector (male)

Cabinet Parts

R-24D-18589	Cabinet
C-18A-18588	10" PM speaker
B-30M-16962	Picture glass
C-4B-16958	Tube escutcheon
B-2C-18572	Control plate
B-2M-17067-1	Channel indicator plate
B-5B-17763-68	Tuning knob (T.V.)
A-6M-17803	Indicator
B-5B-18244-68	Knob (5) T.V.
B-5B-16698-57	Tuning knob
B-5B-16699-57	Volume knob
B-5B-16700-57	Tone knob
B-5B-16701-57	FM-AM-Phono knob
C-23J-17182	Back cover
B-14M-11479	Line cord and plug
B-23J-17240	Bottom cover
B-30A-16684	Dial scale
A-23A-10344	Line cord lock
A-23C-18205	Truetone name plate

PRODUCTION CHANGES

As changes were made in the production of Model 10AXF44 chassis, code numbers were assigned to distinguish the differences in the set. The differences between the different code numbers are explained below.

Code 1 Chassis.

Code 1 chassis are wired as shown in the schematic diagram except the grounded end of C-117 is connected to terminal 1 of T6 and a 1000 mmf capacitor is used in place of the parallel connection of C-109 and C-111.

Code 2 Chassis.

Code 2 chassis are wired as shown in the schematic diagram except a 1000 mmf capacitor is used in place of the parallel connection of C-109 and C-111.

Code 3 Chassis.

Code 3 chassis are wired as shown in the schematic diagram.

SERVICE NOTES

Lubrication — The automatic record changer leaves the factory oiled and lubricated. Under normal conditions further lubrication will not be required for at least one year or 1,000 hours of operation. We recommend periodic lubrication thereafter by a competent serviceman.

If Needle Skips Groove—Check the following points:

1. Record Changer not level.
2. Foreign matter in record groove.
3. Badly worn record groove.
4. Badly worn or bent needle.

OPERATION OF THE RADIO

Broadcast Band—This is the tuning band in which the standard broadcast stations operate. The left scale on the dial covers the broadcast range of 535-1620 Kc., and is calibrated in channel numbers. To obtain the kilocycle reading, multiply the number on the dial by 10; thus 80 on the dial corresponds to 800 kilocycles.

FM Band—The FM tuning range covers the newly allocated frequency-modulation band of 88 to 108 megacycles into which all FM stations were required to move. Check with your local newspaper to determine the frequency of your local FM stations.

On-off Switch and Volume Control- The knob second from the bottom is both the on-off switch and the volume control. When this control is turned all the way to the left the set is off. A slight rotation to the right will click the switch and turn the set on. The knob may then be used to regulate the volume. Be sure your set is turned completely off when not in use; otherwise the tubes will wear out unnecessarily.

Tone Control—Rotating the bottom knob gives a full variation of the tonal response from a deep bass to a brilliant treble.

Tuning Knob—The knob second from the top is the tuning knob; rotation of this knob moves the indicator along the dial scales. When selecting a station turn the knob back and forth until the tone is clearest and loudest. Do not use the tuning knob to regulate volume; the volume control should be used for that purpose after the station has been tuned in properly. It is particularly important in FM reception to tune the station accurately; otherwise the tone is distorted and the background noise not eliminated.

Band Switch—The knob on the top is used to select FM BAND, BROADCAST BAND, or PHONO. When this knob is turned fully clockwise FM programs can be tuned in. In the center position STANDARD BROADCASTS can be heard.

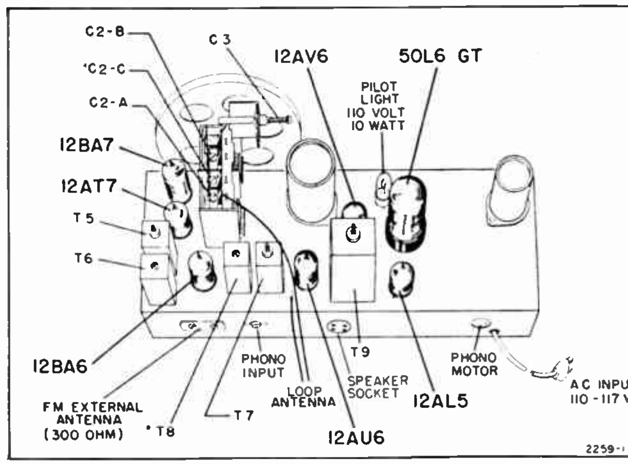
Phonograph — Turning the Bandswitch fully counterclockwise allows the radio to be used for the playing of phonograph records in conjunction with the automatic record player mounted in this cabinet. This automatic Record Player accommodates eight of the NEW 45 RPM records, approximately 40 minutes of entertainment without attention. For operation of this unit please refer to the Automatic Record Changer Operating Instructions on separate sheet.

ALIGNMENT PROCEDURE

Broadcast Band Section I. F. and R. F.

The alignment procedure below includes the sensitivities at the inputs of various stages. All signal input values are based on an output of .50 watts. This may be measured by disconnecting the speaker voice coil and substituting a 3.2-ohm resistor across the secondary winding of the output transformer. A reading of 1.25 volts AC across this resistor will be approximately equivalent to .50 watt output with the speaker connected. The volume control must be set at maximum. The tone control must be set for maximum treble.

The signal source must be an accurately calibrated signal generator capable of supplying the frequencies designated, modulated 30% with a 400-cycle audio signal. A 400 cycle audio signal is required for the audio measurement. Variations in sensitivities of plus or minus 25% are usually permissable.



Chassis View

AM—I. F. ALIGNMENT

Band Switch in AM Position, Gang Open, Dummy Antenna .1 Mfd.

SIGNAL GENERATOR FREQUENCY	CONNECTION TO RADIO	ADJUSTMENTS TO BE MADE	ADJUST FOR
455 Kc. Use 2500 microvolts	Pin 1 of 12BA6 I.F. Amp. and B minus	Primary and Secondary of T8. See chassis view.	Maximum output should be .5 watts
455 Kc. Use 75 microvolts	Pin 7 of 12BA7 Converter and B minus	Primary and Secondary of T6. See chassis view.	Maximum output should be .5 watts
400 cycles. Use 45 millivolts	High side of Volume Control and B minus	None	Maximum output should be .5 watts

For the alignment procedure and trouble-shooting charts, refer to the D-2047 Service Manual.

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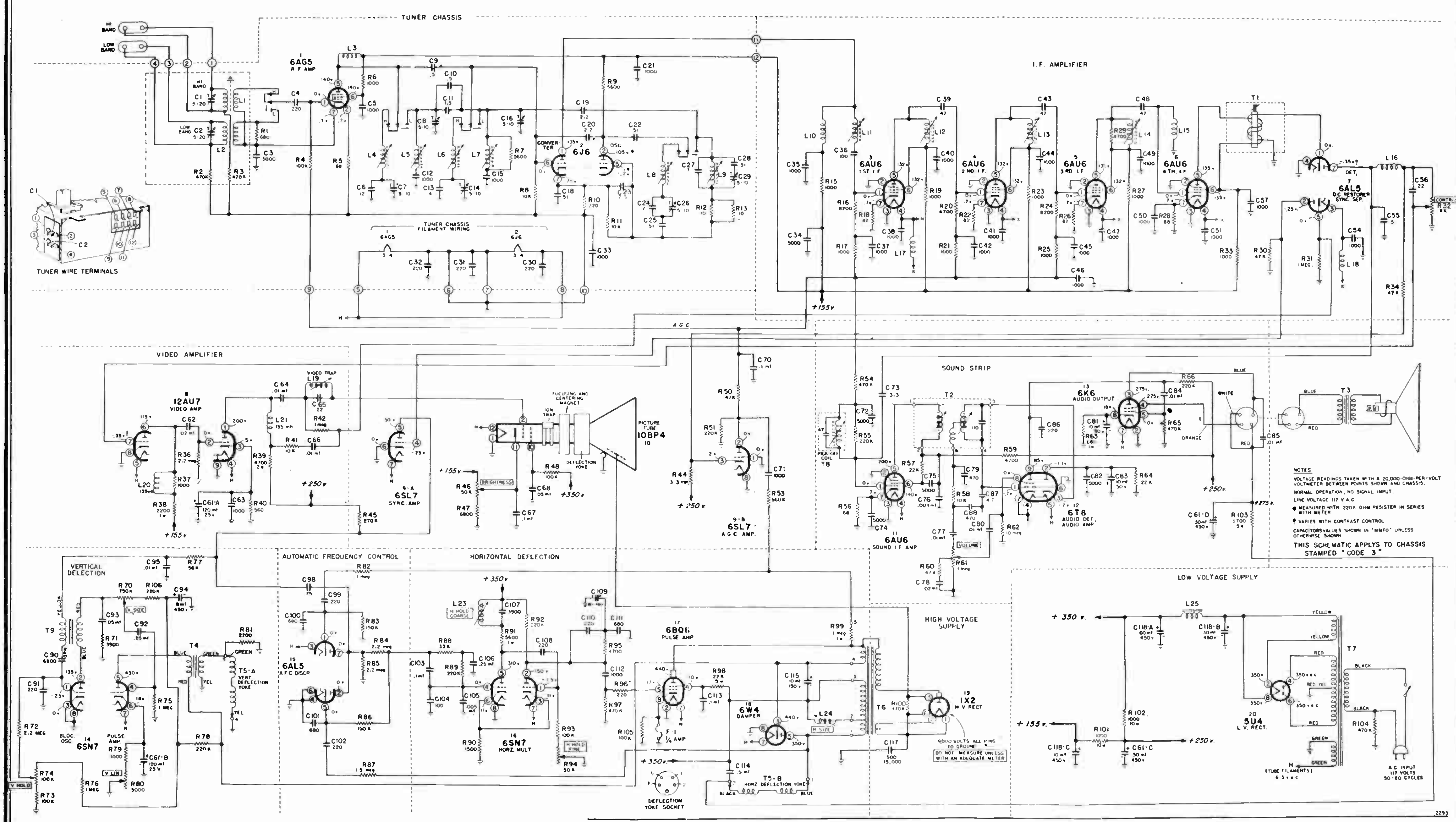
MODEL 10AXF44



Schematic Diagram of Chassis - (Code 3)

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ALIGNMENT PROCEDURE

FM Band Section I. F. and R. F.

A non-metallic alignment tool must be used.

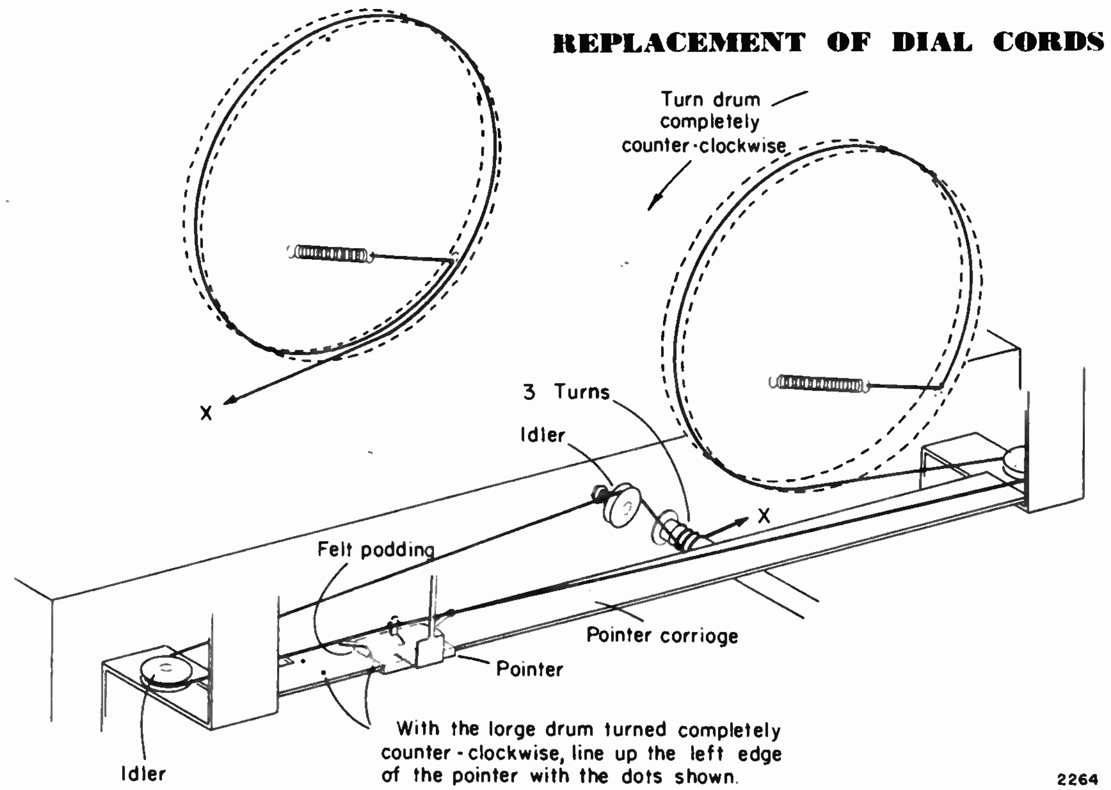
BROADCAST BAND—R. F. ALIGNMENT

Check pointer so that the right hand edge of the pointer skirt coincides with the right hand edge of dial marker at the extreme right when gang is closed. For Adjustment, see dial mechanism illustration.

SIGNAL GENERATOR FREQUENCY	SET POINTER AT	CONNECT TO RADIO	ADJUST
1620 Kc.	Extreme Right Calibration Marker	AM Antenna Clip and B minus	Oscillator trimmer C2-B for maximum
1400 Kc.	Second Calibration from Right	AM Antenna Clip and B minus	Antenna trimmer C2-A for maximum

Check tracking at 1000 Kc, 600 Kc, and 535 Kc to be sure oscillator is set correctly.

REPLACEMENT OF DIAL CORDS



Pointer Stringing and Alignment

ELECTRICAL SPECIFICATIONS

Power Supply .... 105 to 125 volts, AC, 60-cycles; Chassis only 75 watts. With phono operation 100 watts.

Frequency Ranges .... Broadcast Band—535 to 1620 kc. FM Band—88 to 108 mc.

Intermediate Freq. .... AM-455 kc.; FM-10.7 mc.

Selectivity .... AM-43 kc. broad at 1000 times signal, measured at 1000 kc. I.F. FM-250 kc. broad at 2 times down. I.F. FM-650 kc. broad at 10 times down.

AM Sensitivity .... (For .5 watt output with external antenna)—18 microvolts average.

FM Sensitivity .... (For .5 watt output)—16 microvolts average.

Power Output .... 2 watts, 10% distortion. 4 watts maximum.

Loud Speaker .... 10" PM. Voice coil impedance 3.2 ohms, 400 cycles.

Tube Complement ....
12AT7, FM-RF amp. mixer;
12BA7, AM converter, FM oscillator;
12BA6, IF amplifier;
12AU6, FM driver;
12AL5, FM detector;
12AV6, AM detector, AVC, 1st audio;
50L6GT, output.

Automatic Changer See Manual 5084.

IMPORTANT

No alignment of the FM section of this radio should be attempted unless you are positive that the circuits are in need of adjustment and you have the necessary equipment.

All components used in this radio are extremely stable and the tuned circuits should require no adjustment over a long period of time.

NOTE

The following alignment is based on the use of the new Simpson vacuum tube voltmeter which has a "floating ground". In other words, the meter, when used as a vacuum tube voltmeter, can have both the positive and negative sides connected to points above ground and still give true readings.

A standard AM signal generator is required.

FM—I.F. ALIGNMENT

Band Switch in FM Position. Dummy Antenna .1 Mfd.

SIGNAL GENERATOR FREQUENCY	CONNECTION TO RADIO	VACUUM TUBE VOLT METER CONNECTION TO RADIO	ADJUSTMENTS TO BE MADE	ADJUST FOR
10.7 Mc. Use about .1 volt	Pin No. 1 of 12AU6	Pin No. 7 of 12AL5 and B minus	Bottom Core Primary of T9 Ratio Detector	Resonance should be about 3 volts
10.7 Mc. Use about .1 volt	Pin No. 1 of 12AU6	See note "A"	Top Core Secondary of T9 Ratio Detector	Zero. Use zero center scale See note "B"
10.7 Mc. Use about 330 microvolts	Pin No. 1 of 12BA6	Pin No. 7 of 12AL5 and B minus	Primary and Secondary of T7. FM Driver IF See chassis view.	Resonance should be about 3 volts
10.7 Mc. Use about 600 microvolts	Top end of C2-C	Pin No. 7 of 12AL5 and 8 minus	Primary and Secondary of T5. Input IF See chassis view.	Resonance should be about 3 volts

NOTES ON FM—I. F. ALIGNMENT

NOTE "A"—Connect two resistors in series, 100K OHMS each, from Pin No. 7 of 12AL5 to B minus (pin no. 5). These resistors must be matched within 5%. Connect vacuum tube voltmeter between the midpoint of the resistors and point zz.

NOTE "B"—If T9 has been tampered with, it is possible that no crossover point will be found at first. Careful adjustment of both primary and secondary is necessary.

NOTE "C"—To use a VTVM which does not have the "floating ground" feature, in step 2 above, connect "ground" side of VTVM to midpoint of resistors (Note "A") and "high" side to point zz.

GENERAL—Input signals should be adjusted to give approximately 3 volts. The ratio detector is operating at a reasonable level at this point and will give the truest indication of correct alignment with the procedure specified.

FM—R. F. ALIGNMENT

Check pointer so that the right hand edge of the pointer skirt coincides with the right hand edge of dial marker at the extreme right when gang is closed. For Adjustment, see dial mechanism illustration.

SIGNAL GENERATOR FREQUENCY	POINTER	CONNECTION TO RADIO	ADJUST	VTVM CONNECTIONS
108 MC.	108 MC. Marker	FM antenna terminals	FM Osc C3 for maximum	Pin No. 7 of 12AL5 to B minus
98 MC.	Tune in Gen. Signal	See Note "B" below	FM Mixer C2-C for maximum	

NOTE "A"—If a signal generator with the above fundamental frequency is not available, it is sometimes possible to use harmonics. Use extreme care in picking harmonics. An alternate procedure is to use a local station carrier of known frequency to align the FM Band and to use the vacuum tube volt-meter as above for resonance indication. A weak carrier, however, will not produce 3 volts.

NOTE "B"—Connect 300 ohms in series with "hot" side of generator and connect to left hand screw of external FM Antenna Terminals. Connect cold side of generator to right hand screw.

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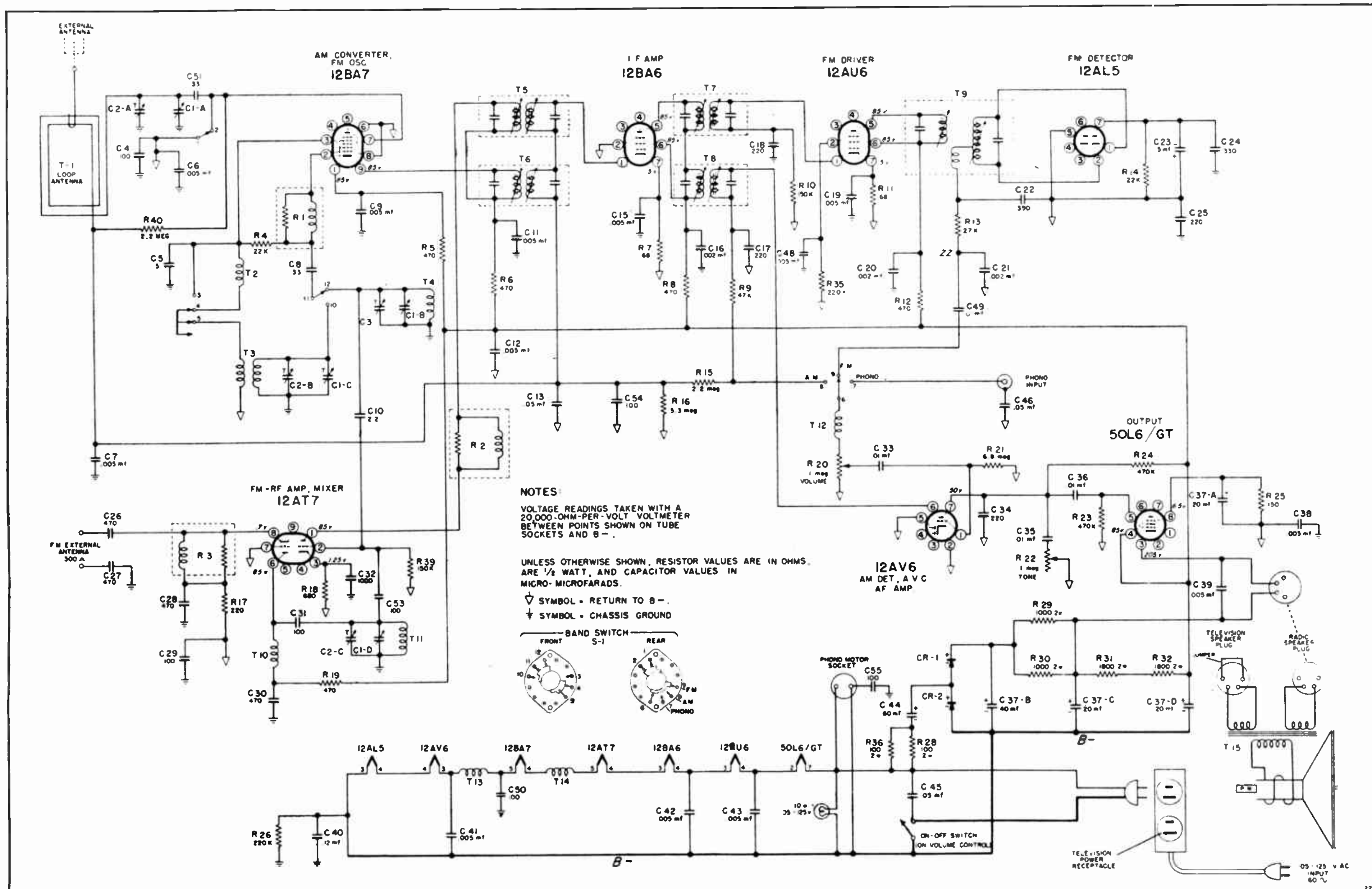
RADIO REPLACEMENT PARTS LIST

When ordering, specify part number, model number, and manual issue.

Ref. No.	Part No.	Description	Qty. Used In Set
CONDENSERS			
C1, ABCD	B-8A-16592	4 section gang condenser	1
C2, ABC		Trimmer on gang	
C3	A-201-15142	FM Osc. trimmer	1
C4,29,31,50,53,	C-8G-11734	100 mmf, ceramic	5
C5, 54	C-8G-12166	5 mmf, ceramic	1
C6,7,9,11,12, 15,19,38,41,42, 43,48,54	A-8G-13962	.005 mf, disk ceramic	12
C8,51	C-8G-14172	33 mmf, ceramic	2
C10	A-8G-12495-4	2.2 mmf, ceramic	1
C14,46	C-8D-10770	.05 mf, 200 volts, paper	2
C16,20,21	C-8G-16049	.002 mmf, ceramic	3
C17,18,25,34	C-8G-11733	220 mmf, ceramic	4
C22	C-8F3-120	390 mmf, mica	1
C23	C-8C-16013	5 mf x 100 volts, electrolytic	1
C24, 55	C-8F3-11	330 mmf, mica	1
C26,27,28,30	C-8G-11732	470 mmf, ceramic	1
C32	C-8G-13201	1000 mmf, ceramic	1
C33,35,36,49	C-8D-10761	.01 mf, 400, volts, paper	4
C37, ABCD	A-8G-16432-1	40-20-20 mf x 300 volts, electrolytic, 20 mf x 25 volts	1
C39	C-8D-10935	.005 mf, 600 volts, paper	1
C40	C-8D-16791	.12 mf, 200 volts, paper	1
C44	A-8C-16370	60 mf x 120 volts, electrolytic	1
C45	C-8D-10813	.05 mf, 400 volts, paper	1
RESISTORS			
R1	A-16B-16615	Suppressor	1
R2	A-16B-16614	Suppressor	1
R3	A-16B-16616	Suppressor	1
R4,14	C-9B1-78	22K ohms, 1/2 watt	2
R5,6,8,12,19	C-9B1-58	470 ohms, 1/2 watt	5
R7,11	C-9B1-48	68 ohms, 1/2 watt	2
R9	C-9B1-82	47K ohms, 1/2 watt,	1
R10,39	C-9B1-26	150K ohms, 1/2 watt	2
R13	C-9B1-79	27K ohms, 1/2 watt	1
R15,40	C-9B1-33	2.2 megohms, 1/2 watt	2
R16	C-9B1-34	3.3 megohms 1/2 watt	1
R17	C-9B1-54	220 megohms, 1/2 watt	1
R18	C-9B1-60	680 megohms, 1/2 watt	1
R20	A-10A-16503	1 megohm, volume control and switch	1
R21	C-9B1-36	6.8 megohm, 1/2 watt	1
R22	A-11B-16502	1 megohm, tone control	1
R23,24	C-9B1-94	470K ohms, 1/2 watt	2
R25	C-9B1-52	150 ohms, 1/2 watt	1
R26,35	C-9B1-27	220K ohms 1/2 watt	2
R28,36	C-9C4-50	100 ohms, 2 watts	2
R29,30	C-9B4-62	1000 ohms, 2 watts	2
R31,32	C-9B4-65	1800 ohms, 2 watts	2
COILS AND TRANSFORMERS			
T1	C-13E-16496	Loop antenna	1
T2,13,14	A-16B-16023	RF choke	3
T3	B-13D-16611	AM Osc. coil	1
T4	A-13D-16617	FM Osc. coil	1
T5	B-13A-16612	FM input IF	1
T6	B-13A-16662	AM input IF	1
T7	B-13B-16000	FM driver IF	1
T8	B-13B-16302	AM output IF	1
T9	B-13M-16001	FM ratio detector	1
T10	A-16B-16613	RF choke	1
T11	A-13E-16618	FM mixer coil	1
T12	A-16A-16637	RF choke	1
T15		Output transformer	On Speaker
	C-18A-17238	10" PM speaker and output transformer	1

Ref. No.	Part No.	Description	Qty. Used In set
DIAL PARTS			
	B-30A-16684	Dial scale	1
	B-23J-17158	Escutcheon gasket	1
	B-6B-16506	Diffuser	1
	A-3A-16504	Tuning shaft	1
	B-29C-15876	"C"washer for above	1
	B-2M-16656	Pointer bar	1
	A-3H-10299	Idler pulley	2
	B-2G-16505	Dial Pointer	1
	A-53A-10989	Dial string 60" req.	
	A-49A-10078	Tension spring	2
	B-4M-15913-1	Dial scale bracket	2
RECORD CHANGER			
	C-201-17184	45 RPM Automatic Record Changer	1
	P-73	Crystal cartridge	1
		45 RPM needle	1
MISCELLANEOUS			
	B-20A-16663	Band switch	1
	A-46A-16545	Pilot lite bulb	1
	A-15B-13430	Min. 9 pin tube socket	2
	A-15C-16297	Min. 7 pin tube socket	4
	A-15B-10440	Octal tube socket	1
	A-3B-16758	Tuning shaft bushing	1
	A-7B-13050	FM dipole Terminal strip	1
	A-47A-16546	Pilot lite assembly	1
	A-19B-12468	Phono motor socket	1
	B-14M-17244	Line cord with Pol. plug	1
	A-19B-12170	Phono pickup socket	1
	A-15B-11538	Speaker socket	1
	B-14MA-11066-6-16	FM dipole ribbon	1
CR-1,2	A-21J-12775	Selenium rectifier	2
	B-15B-13785	Large lytic mtg. plate	1
	B-15B-10076	Small lytic mtg. plate	1



RADIO SCHEMATIC DIAGRAM

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World Radio History

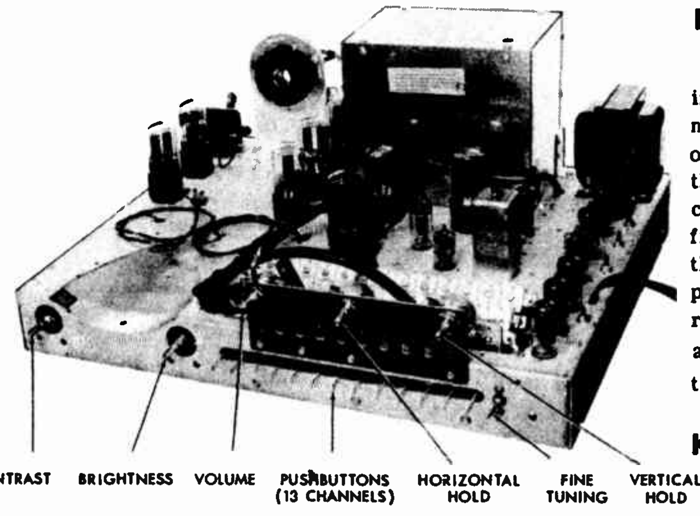
GENERAL

Picture Area	23 square inches
Tubes	Nineteen plus three rectifiers
Speaker	5 x 7-inch P.M.
Speaker V.C. Impedance	3.2 ohms
Antenna	Provision for external antenna using 300-ohm transmission line.
Tuning	Pushbutton plus manual trimming adjustment.
Tuning Range	Thirteen pre-set channels

Channel No.	Frequency (mc)	Channel No.	Frequency (mc)
1	44-50	7	174-180
2	54-60	8	180-186
3	60-66	9	186-192
4	66-72	10	192-198
5	76-82	11	198-204
6	82-88	12	204-210
		13	210-216

Intermediate Frequency
- Picture carrier . . . . . 26.25 mc
- Sound carrier . . . . . . 21.75 mc
- Inter-carrier sound system . . . . 4.5 mc

Power Supply	105-125 V. 60 cycles AC
Power Consumption	135 Watts
Model Differences	Model T-54 - Metal cabinet Model 505, 506 - Wood cabinet



CARE OF THE KINESCOPE WINDOW

Certain cleaning solutions will fog the clear plastic window located in front of the kinescope tube. Clean the window with a soft dry cloth only. In the event the plastic is fogged accidently, it may be readily replaced.

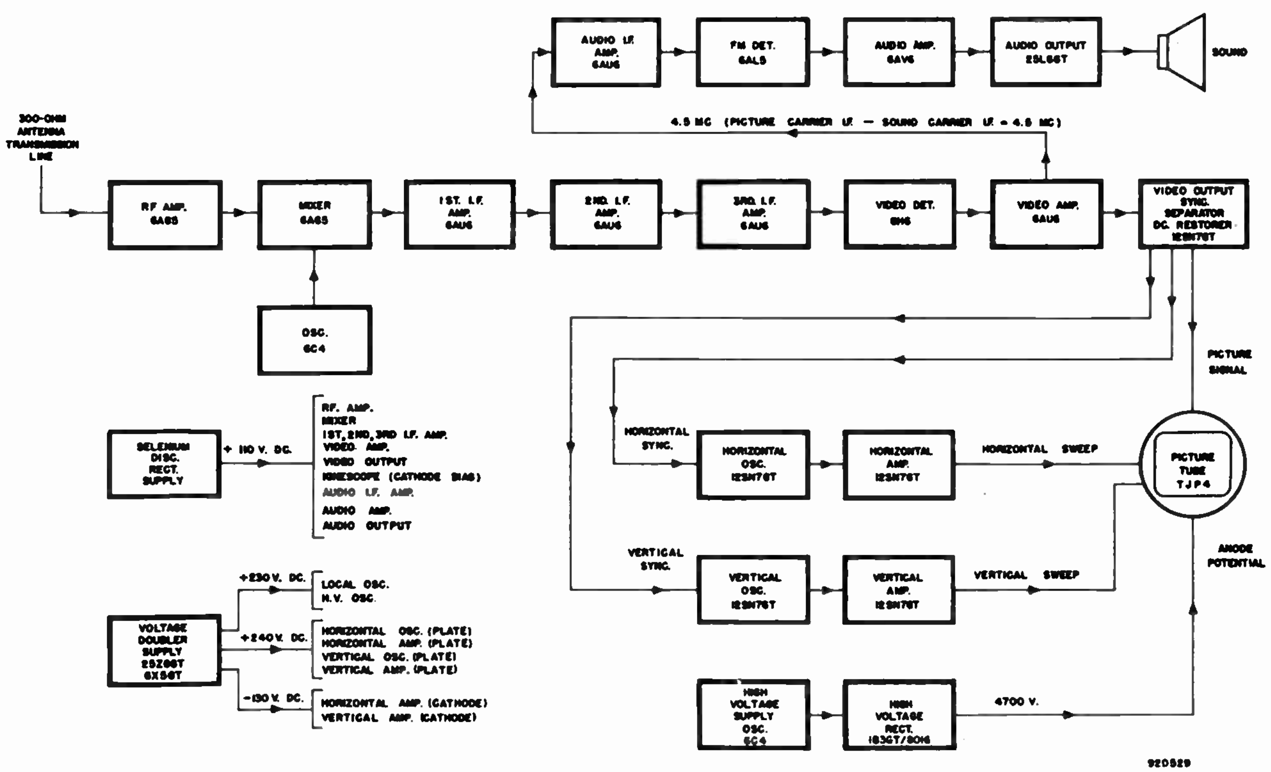


Fig. 1. Functional block diagram.

HIGH VOLTAGE WARNING

Operation of the receiver chassis outside of the cabinet involves a shock hazard. An interlock in the line cord disconnects the power when the Model T-54 cabinet cover is lifted or the Model 505/506 cabinet back is removed. When operating the chassis outside of the cabinet, keep in mind the chassis is connected to one side of the a-c line and must be isolated from ground unless the power plug is correctly polarized so that the chassis is at ground potential with respect to the power source. The HIGH VOLTAGE supply while of low current capacity operates at a 4700 VOLT potential. Exercise all normal HIGH VOLTAGE precautions while working with this equipment.

KINESCOPE HANDLING PRECAUTIONS

The kinescope housing provides adequate protection against possible tube implosure while in the cabinet. Do not expose the kinescope or handle it in any way without providing personal protection in the form of shatterproof goggles and heavy gloves. The kinescope tube should be handled by qualified personnel only.

The kinescope envelope encloses a high vacuum and with the large surface area of glass involved, the stresses set up particularly at the front rim of the tube, are considerable. An abnormal handling stress, accidental blow at a highly stressed surface, or even a scratch on the surface of the tube could cause it to implode or collapse with destructive violence

DISMANTLING FOR KINESCOPE TUBE REPLACEMENT OR ALIGNMENT ADJUSTMENTS

1. Remove the five front panel control knobs and front panel. The control knobs pull straight off their shafts. The panel is fastened to the cabinet with two panel screws accessible from the outside and two screws accessible from the inside of the cabinet. The speaker is fastened to the front panel and must be disconnected at the speaker connector mounted on the speaker frame. Leave the rubber escutcheon fastened to the kinescope tube for additional protection. The kinescope tube may now be removed for replacement. When installing a new tube, the two screws holding the tube socket to the mounting bracket, may have to be loosened to permit rotation of the tube for picture alignment. Note that the oscillator mixer and r-f amplifier adjustments are now accessible. To expose the remaining alignment adjustments, the following dismantling procedure must be carried out.

2. Detach the cabinet interlock receptacle from the cabinet. This is held on with two machine screws.

3. Release the chassis from the cabinet by removing the four rubber mounting feet at the bottom of the cabinet and pull the chassis from the cabinet.

4. Detach the cover half of the interlock connector from the cabinet cover and use it to supply power to the unit while it is being serviced outside the cabinet.

1. Remove the five front panel control knobs. They pull straight off their shafts.

2. Remove the back cover. It is fastened with wood screws. The line cord and half of the interlock connector will come along with the back cover.

3. Detach the cabinet half of the interlock connector fastened to the cabinet with two wood screws.

4. Release the chassis by removing the four mounting screws at the bottom of the cabinet and pull the chassis clear of the cabinet. The kinescope tube may now be removed for replacement. When installing a new tube, the two screws holding the tube socket to the mounting bracket, may have to be loosened to permit rotation of the tube for picture alignment. Caution - The rubber escutcheon on the kinescope tube should be left on the tube for additional protection.

5. Reconnect the interlock connector for power while making adjustments on the bench and the receiver is ready for alignment.

HIGH VOLTAGE SUPPLY OSCILLATOR ADJUSTMENTS

CAUTION HIGH VOLTAGE

Do not use hand held flexible test leads when making the following measurement. Tack solder the resistor string in place and keep the hands clear of the circuit while making measurements or adjustments.

A 5000 V. potential exists in this circuit. Exercise all normal high voltage precautions while working with this circuit.

1. Connect a 50-megohm resistor string in series with a 0-150 microampere meter across the .001 mfd 6000 V. filter condenser (C-82). The resistor string should be made up of 10-megohm resistors or less to provide a safety factor for voltage breakdown. If 10-megohm resistors are used, a total of five will be required to obtain the 50-megohms required. Connect the meter on the ground side of the string.

2. A meter reading of 95 microamperes (4700 V.) should be obtained under normal conditions. To obtain the desired voltage adjust the H.V. OSC. TRIMMER through the adjustment hole in the top of the H.V. power supply housing with a non-metallic screwdriver. The trimmer is a compression type condenser, hence should be set on the maximum capacity side of oscillator resonance, i.e., increasing trimmer capacity decreases the supply voltage. The BRIGHTNESS control must be set at minimum or full counter-clockwise when making the high voltage adjustment.

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ALIGNMENT PROCEDURE

EQUIPMENT REQUIRED

Signal generator covering 4 mc to 30 mc.

Signal generator covering 40 mc to 215 mc.

Electronic voltmeter.

Two 150-ohm carbon resistors

One 0.01 mfd. 600 V. tubular paper condenser.

F-M SOUND CHANNEL I-F ALIGNMENT

1. Connect the low frequency signal generator output between the control grid (pin 1) of the 6AU6 VIDEO AMP. tube (V-11) and chassis ground.

2. Connect the electronic voltmeter between pin 7 of the 6AL5 FM DET tube (V-2) and chassis ground.

3. With the signal generator (unmodulated) set at 4.5 mc, set the 4.5 mc LIMITER GRID ADJ. and FM DET. PRIMARY ADJ. for maximum d-c voltage as measured by the electronic voltmeter. Adjust the limiter grid coil (L-23) before adjusting the FM detector transformer (T-1) primary. Use just enough signal generator output to obtain approximately 1 volt at the electronic voltmeter.

4. Connect the electronic voltmeter across the 1000 mmf condenser (C-22) at the output of the FM detector stage and adjust the SEC. ADJ. of the FM detector transformer (T-1) for the null.

5. Shift the frequency of the signal generator either side of 4.5 mc and touch up the FM DET. PRIMARY ADJ. for approximately equal peaks. Use just enough signal generator output to obtain one volt peaks for best results.

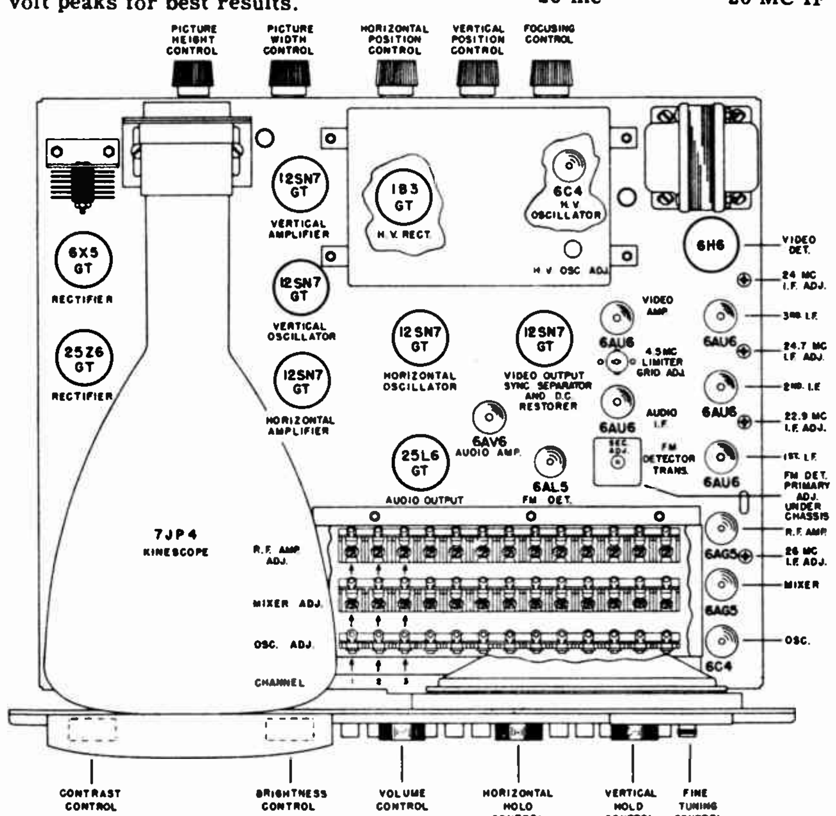

Fig. 2. Top view, alignment points.

I-F AMPLIFIER ALIGNMENT

1. Connect the electronic voltmeter across the 5600-ohm resistor (R-43) in the 6H6 VIDEO DET. (V-10) plate circuit.

This resistor is located at the terminal strip next to the 6H6 tube socket.

2. Connect the low frequency signal generator output to the receiver's antenna transmission line through two 150-ohm carbon resistors, one connected in each side of the transmission line.

3. Use just enough signal generator output (unmodulated) to develop about a volt at the electronic voltmeter and adjust the four i-f amplifier coils, according to the following chart, for maximum d-c voltage as measured by the electronic voltmeter. To avoid the effects of the local oscillator when feeding the i-f signal through the mixer stage, disable the oscillator by triggering out all of the pushbuttons. Do not leave all the buttons out longer than necessary as certain resistors dissipate more heat than normal with the oscillator disabled.

I-F AMPLIFIER ALIGNMENT CHART

Signal Generator Frequency (No Modulation)	Adjustment (Refer to Fig. 2)	Stage Adjusted
24 mc	24 MC IF ADJ.	Video detector
24.7 mc	24.7 MC IF ADJ.	2nd IF amp.
22.9 mc	22.9 MC IF ADJ.	1st IF amp.
26 mc	26 MC IF ADJ.	Mixer

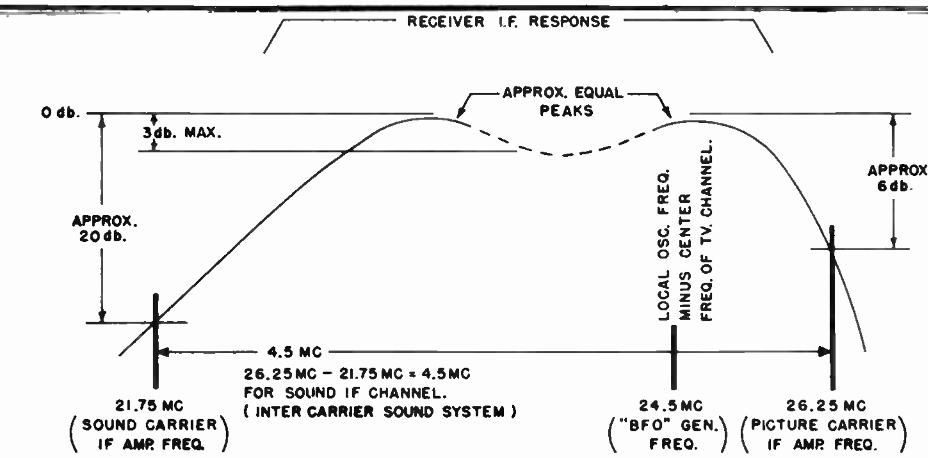

Fig. 3. IF amplifier response.

4. With the local oscillator disabled, check the i-f amplifier frequency response by tuning the signal generator from 21 mc through 26.25 mc and observing the change in d-c voltage at the electronic voltmeter. If the signal generator output is set for an electronic voltmeter reading of 1.5 volts at the peak i-f amplifier response, the d-c voltage should not drop below 1 volt between the two peaks normally obtained with this i-f amplifier. Should the two peaks be unequal in amplitude, the 24.7 MC IF ADJ. slug may be readjusted slightly to equalize them.

Check the two carrier i-f responses, 21.75 mc and 26.25 mc. The 21.75 mc response will be approximately 20 db below the peak response and the 26.25 mc response will fall approximately 6 db below the peak. Refer to Fig. 3.

The average i-f amplifier sensitivity when feeding the signal generator in through the antenna input as described above will run approximately 8000-10,000 microvolts for the 1.5 volt d-c peaks measured at resistor R-43. (5600 ohms).

STATION CHANNEL ALIGNMENT

1. Due to the broad frequency response of the i-f amplifier, it is necessary to use a 24.5 mc signal generator or oscillator (unmodulated) as a beat frequency oscillator (BFO) is used in conventional superheterodyne receivers in order to locate the center frequency of the i-f amplifier response for the correct local oscillator adjustment. This "BFO" generator should be loosely coupled by means of a wire from the generator output placed in close proximity to the 6H6 VIDEO DET. tube (V-10).

2. Connect the high frequency signal generator output to the receiver's antenna transmission line through two 150-ohm carbon resistors, one connected in each side of the transmission line.

3. Connect the electronic voltmeter across the 5600-ohm resistor (R-43) in the 6H6 VIDEO DET. (V-10) plate circuit.

4. Alignment of the individual channels is carried out as follows: Each channel may be aligned independently without affecting the alignment of the others.

(a) Set the FINE TUNING control condenser in the center of its capacity range.

(b) Press the channel button corresponding to the channel number to be aligned.

(c) Set the "BFO" generator at 24.5 mc (no modulation).

(d) Set the high frequency signal generator per the alignment chart. (Generator unmodulated).

(e) Clip on a 0.01 mfd. condenser between pin 3 of the 12SN7GT VIDEO OUTPUT tube (V-12) and pin 1 of the 6AV6 AUDIO AMP tube (V-3) and adjust the OSC. ADJ. trimmer corresponding to the channel being aligned for a rough audio beat note using the speaker output as a detector.

(f) Disconnect the 0.01 mfd. condenser, shut off the "BFO" signal generator, and adjust the MIXER ADJ. and RF AMP. ADJ. trimmers for maximum d-c voltage as measured by the electronic voltmeter. Use just enough signal generator output to obtain approximately one volt at the electronic voltmeter. This completes the alignment of any one channel, and all other channels may be treated alike.

CHANNEL ALIGNMENT CHART

Channel No.	Channel Freq. (mc)	H.F. Signal Generator Freq. (No modulation)	Channel No.	Channel Freq. (mc)	H.F. Signal Generator Freq. (No modulation)
1	44-50	47 mc	7	174-180	177 mc
2	54-60	57 mc	8	180-186	183 mc
3	60-66	63 mc	9	186-192	189 mc
4	66-72	69 mc	10	192-198	195 mc
5	76-82	79 mc	11	198-204	201 mc
6	82-88	85 mc	12	204-210	207 mc
			13	210-216	213 mc

The overall sensitivity for the receiver will run approximately 200-400 microvolts for 1 volt DC at resistor R-43 when measured in the above manner.

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CARRIER vs I-F FREQUENCY CHART

Channel No.	Channel Freq. (mc)	Picture Carrier Freq. (mc)	Sound Carrier Freq. (mc)	Receiver Osc. Freq. (mc)	Picture IF Freq. (mc)	Sound IF (Freq. (mc)	Picture IF less Sound IF (mc)
1	44-50	45.25	49.75	71.5	26.25	21.75	4.5
2	54-60	55.25	59.75	81.5	26.25	21.75	4.5
3	60-66	61.25	65.75	87.5	26.25	21.75	4.5
4	66-72	67.25	71.75	93.5	26.25	21.75	4.5
5	76-82	77.25	81.75	103.5	26.25	21.75	4.5
6	82-88	83.25	87.75	109.5	26.25	21.75	4.5
7	174-180	175.25	179.75	201.5	26.25	21.75	4.5
8	180-186	181.25	185.75	207.5	26.25	21.75	4.5
9	186-192	187.25	191.75	213.5	26.25	21.75	4.5
10	192-198	193.25	197.75	219.5	26.25	21.75	4.5
11	198-204	199.25	203.75	225.5	26.25	21.75	4.5
12	204-210	205.25	209.75	231.5	26.25	21.75	4.5
13	210-216	211.25	215.75	237.5	26.25	21.75	4.5

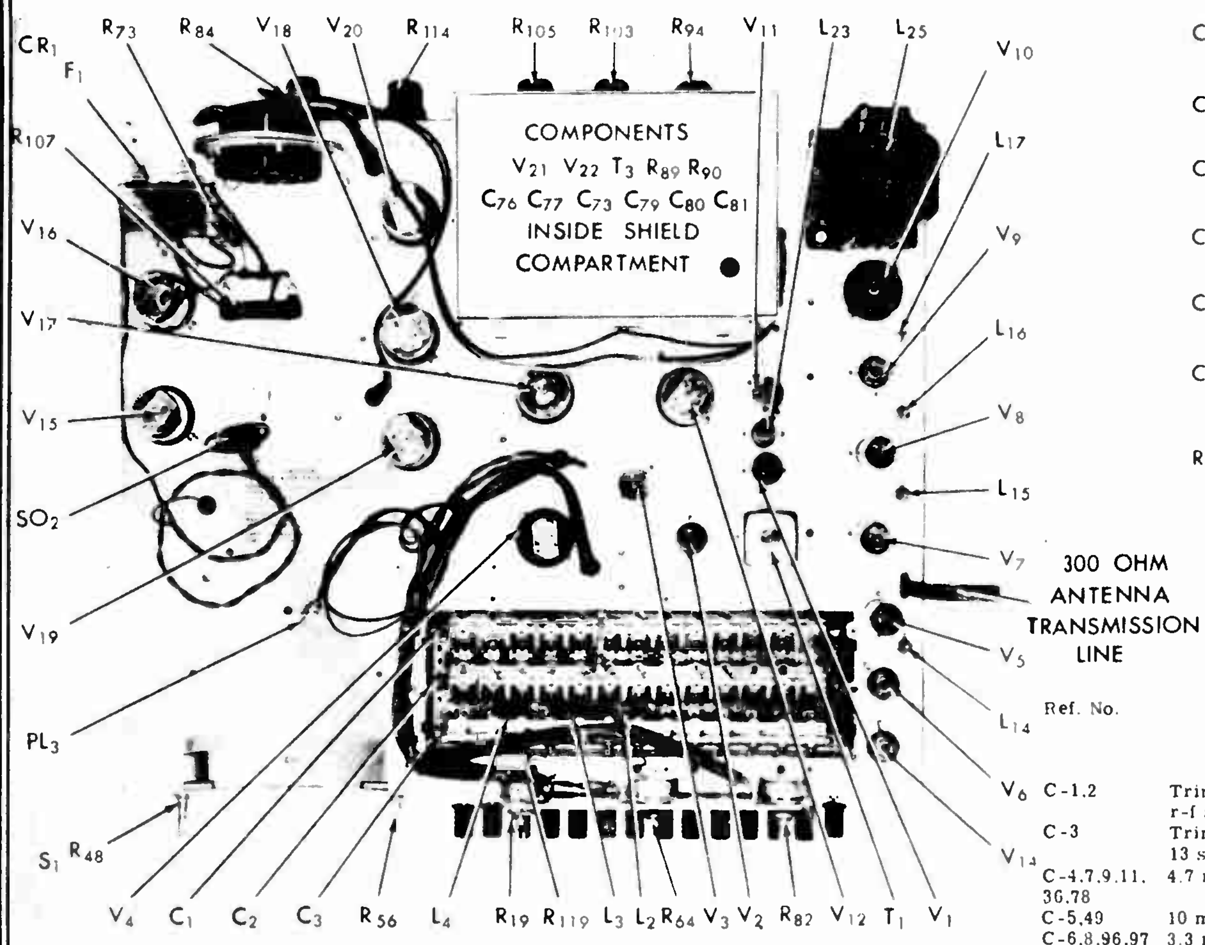

Fig. 4. Top view, component location.

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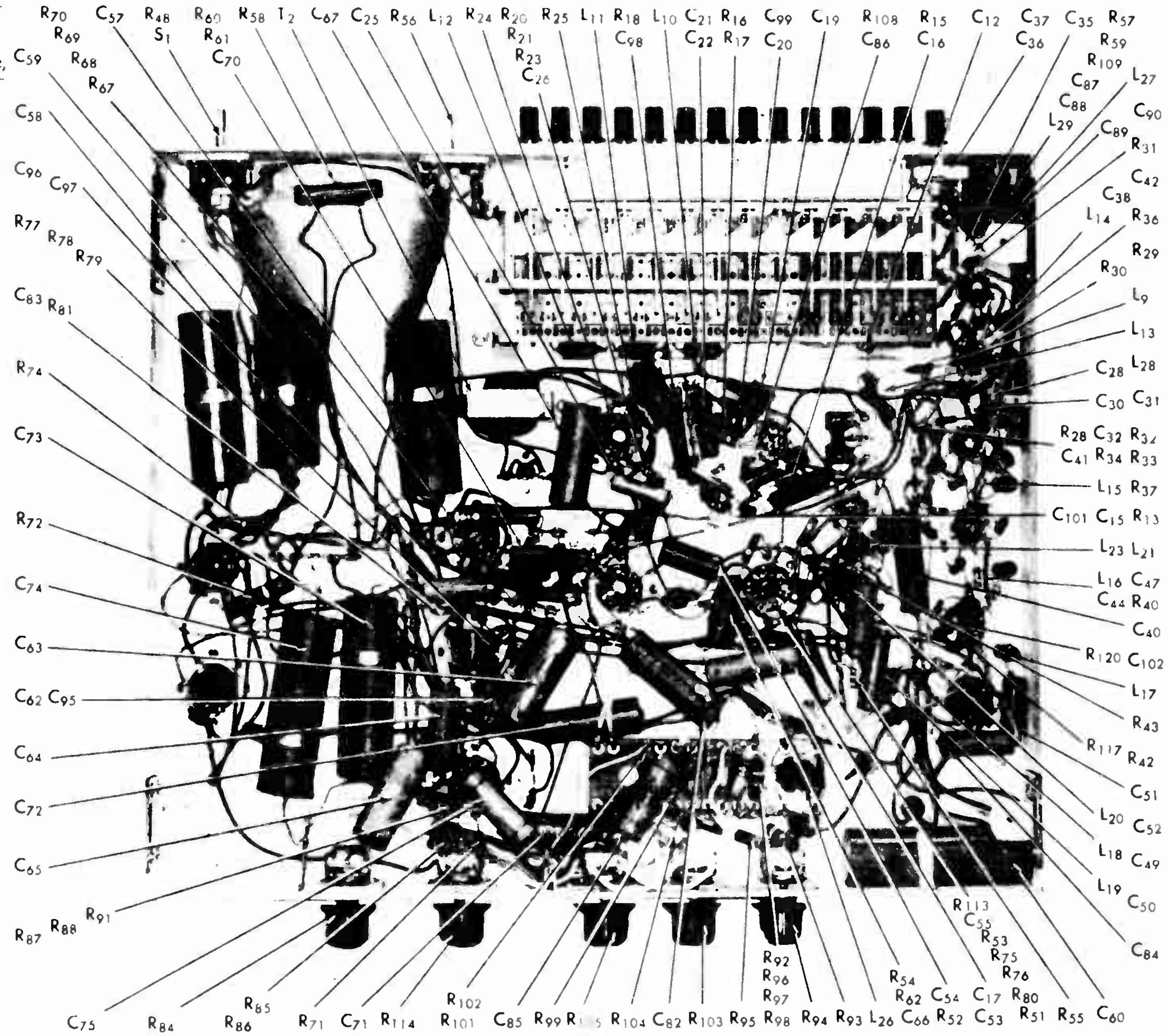

Fig. 5. Bottom view, component location.

92X648

SERVICE PARTS LIST

Ref. No.	Description	Part Number
	CONDENSERS	
C-1,2	Trimmer assembly, mixer and r-f amp. stage, 13 sections	44B358
C-3	Trimmer assembly, osc. stage, 13 sections	44B357
C-4,7,9,11, 36,78	4.7 mmf. 500 V., bakelite	47A160-6
C-5,49	10 mmf. 500 V., bakelite	47A160-11
C-6,8,96,97	3.3 mmf. 500 V., bakelite	47A160-5
C-10	2.2 mmf. 500 V., bakelite	47A160-4
C-12,13,14	39 mmf. 500 V., ceramic	47B20390K5
C-15,48,55, 68,69	100 mmf. 500 V., ceramic	47B20101K5
C-16,21,26	.02 mfd. 200 V., tubular	46AU203J
C-17,50,52, 83,84	.1 mfd. 200 V., tubular	46AU104J
C-18,22,28, 29,32,34,41, 42,43,44,45, 46,56,79,86, 87,88,89,90, 91,92,93,94, 102	1000 mmf. 150 V., ceramic	47B20A102N1
C-19,54	5 mfd. 50 V., electrolytic	45A109
C-20,99	330 mmf. 500 V., ceramic	47B0331K5
C-25	.01 mfd. 200 V., tubular	46AU103J
C-27	1 mmf. 500 V., bakelite	47A160-2
C-30,31	47 mmf. 500 V., ceramic	47B20470K5
C-33,100	1.5 mmf. 500 V., bakelite	47A160-3
C-35	0.68 mmf. 500 V., bakelite	47A160-1
C-37	Trimmer, FINE TUNING	48A199
C-38,39,47	50 mmf. 500 V., ceramic	47B20500K5
C-40,53	.25 mfd. 200 V., tubular	46AT254J
C-51,66	.05 mfd. 200 V., tubular	46AU503J
C-57	60-30 mfd. 300-450 V., electrolytic	45B126
C-58	40-40 mfd. 300 V., electrolytic	45B125
C-59	30-30 mfd. 200 V., electrolytic	45B123
C-60	100-100 mfd. 150 V., electrolytic	45B124
C-62	.005 mfd. 200 V., tubular	46AU502J
C-63,65, 67,76,77	.25 mfd. 600 V., tubular	46AX254J
C-64,75,85	.1 mfd. 600 V., tubular	46AY104J
C-70	680 mmf. 500 V., mica	CM20A681M
C-71,72	.0005 mfd. 6000 V., tubular	46A145
C-73,74	.03 mfd. 6000 V., tubular	46B149
C-80	Trimmer, adjustable, HV osc.	44A359
C-81,82	.001 mfd. 6000 V., tubular	46A146
C-95	.01 mfd. 600 V., tubular	46AZ103J
C-98	10 mfd. 25 V., electrolytic	45A121
C-101	5000 mmf. 500 V., ceramic	47A168
	RESISTORS	
R-1,3,4,6	3300 ohms 1 watt, carbon, part of coils L-12, 10, 8, 6.	
R-2	2200 ohms 1 watt, carbon, part of coil L-11	
R-5	2200 ohms 1 watt, carbon, part of coil L-7	

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RESISTORS (Cont.)

Ref. No.	Part Number	Description
R-7, 8,9		1 megohm 1 watt, carbon, part of coils L-4, 3 and 2.
R-10,11,12		1 megohm 1/2 watt, carbon, part of coils L-9, 5 and 1.
R-13,91	RC20AE154M	150,000 ohms ½ watt, carbon
R-14,18,21, 52,62,76	RC20AF333M	33,000 ohms ½ watt, carbon
R-15,39	RC20AE123K	12,000 ohms ½ watt, carbon
R-16,17	RC20AE103J	10,000 ohms ½ watt, carbon
R-19	25B721	1 megohm, VOLUME control
R-20,26,27	RC20AE151M	150 ohms ½ watt, carbon
R-23,24,55	RC20AE474M	470,000 ohms ½ watt, carbon
R-25	RC30AE101M	100 ohms 1 watt, carbon
R-28,32,88	RC20AE225M	2.2 megohms ½ watt, carbon
R-30,36,37, 38,57,120	RC20AE101M	100 ohms ½ watt, carbon
R-31,44, 49,66	RC20AE105M	1 megohm ½ watt, carbon
R-33,40	RC20AE183K	18,000 ohms ½ watt, carbon
R-34,35	RC20AE124K	120,000 ohms ½ watt, carbon
R-41		1 megohm ½ watt, carbon, part of coil L-19
R-42,83	RC20AE564M	560,000 ohms ½ watt, carbon
R-43,89 113	RC20AE562K	5600 ohms ½ watt, carbon
R-45		68,000 ohms 1 watt, carbon, part of coil L-20
R-46		1 megohm 1 watt, carbon, part of coil L-21
R-47	RC20AE822M	8200 ohms ½ watt, carbon
R-48	25B739	1000 ohms WW, CONTRAST control. (Includes SW-2)
R-50,54	RC20AE334M	330,000 ohms ½ watt, carbon
R-51	RC20AE823M	82,000 ohms ½ watt, carbon
R-53,117	RC20AE682M	6800 ohms ½ watt, carbon
R-56	25B722	25,000 ohms, BRIGHTNESS control
R-58	24BG332E	3300 ohms 10 watts, WW
R-59	RC20AE223M	22,000 ohms ½ watt, carbon
R-60,77, 85,86	RC30AE104M	100,000 ohms 1 watt, carbon
R-61,79	RC30AE473M	47,000 ohms 1 watt, carbon
R-63,81	RC30AE681M	680 ohms 1 watt, carbon
R-64	25B720	500,000 ohms, HORIZONTAL control
R-65	RC20AE334M	270,000 ohms ½ watt, carbon
R-67,68	RC40AE473M	47,000 ohms 2 watts, carbon
R-69,70	RC20AE475M	4.7 megohms ½ watt, carbon
R-71,119	RC20AE224K	220,000 ohms ½ watt, carbon
R-72	RC40AE681M	680 ohms 2 watt, carbon
R-73	RC40AE180M	18 ohms 2 watts, carbon
R-74	RC30AE122M	1200 ohms 1 watt, carbon
R-75	RC20AE471M	470 ohms ½ watt, carbon
R-78	RC20AE155M	1.5 megohm ½ watt, carbon
R-80	RC20AE472M	4700 ohms ½ watt, carbon
R-82	25B720	500,000 ohms, VERTICAL control
R-84	25B724	2.5 megohms, HEIGHT control
R-87	RC30AE272M	2700 ohms 1 watt, carbon
R-90	RC30AE124K	120,000 ohms 1 watt, carbon
R-92,93	RC30AE395M	3.9 megohms 1 watt, carbon
R-94	25B723	5 megohms, FOCUS control
R-95,96 100,106	RC30AE475M	4.7 megohms 1 watt, carbon
R-97,98 101,102	RC30AE335M	3.3 megohms 1 watt, carbon
R-99,104	RC30AE565M	5.6 megohms 1 watt, carbon
R-103	25B723	5 megohms, VERTICAL POSITION control
R-105	25B723	5 megohms, HORIZONTAL POSITION control
R-107	24BG180E	18 ohms 10 watts, WW
R-108	RC40AE121M	120 ohms 2 watts, carbon
R-109	RC30AE470K	47 ohms 1 watt, carbon
R-110	RC30AE390K	39 ohms 1 watt, carbon
R-112		33,000 ohms 1 watt, carbon, part of coil L-18
R-114	25B724	2.5 megohms, WIDTH control
R-115		470 ohms 1 watt, carbon, part of coil L-22

TRANSFORMERS AND COILS

T-1	Transformer, FM sound detector	50B406
T-2	Transformer, audio output	55B080-3
T-3	Transformer, H.V. osc.	51B1038
L-1,5	Coil, osc. and mixer stages	51A1041
L-2	Coil, osc. stage	51A1042
L-3	Coil, osc. stage	51A1043
L-4	Coil, osc. stage	51A1044
L-6	Coil, mixer stage	51A1046
L-7	Coil, mixer stage	51A1047
L-8,12	Coil, mixer and r-f stages	51A1048
L-9	Coil, r-f amp. stage	51A1049
L-10	Coil, r-f amp. stage	51A1050
L-11	Coil, r-f amp. stage	51A1051
L-13,29	Choke, RF (Red color code)	53B008
L-14,15 16,17	Coil, i-f amplifier	50A372
L-18	Coil, video peaking, video detector	51A1053
L-19	Coil, video peaking, video detector	51A1054
L-20	Coil, video peaking, video amp.	51A1055
L-21	Coil, video peaking, video amp.	51A1057
L-22	Coil, sync. shaping	51B1040
L-23	Coil, 4.5 mc. sound trap	51B1037
L-25	Choke, filter	56C093
L-26	Choke, dual winding, HV oscillator	53A134
L-27	Choke, dual winding, 6C4 oscillator fil.	53A133
L-28	Antenna coil	51A1039

PLUGS AND SOCKETS

	Socket, octal (tube)	6A296
	Socket, miniature (tube)	6A297
	Socket, kinescope (tube)	6B298
PL-1	Line cord and plug PL2 (Model T-54)	87B1668
PL-1	Line cord and plug PL2 (Model 505, 506 and 506M)	87B1668-1
SO-2	Connector, line cord	10A286
PL-3	Connector and cord assembly, speaker	87A1670
	Receptacle, fuse	6A287

TUBES, RECTIFIERS AND FUSES

V-1,7,8,9, 11	Type 6AU6, audio IF; 1st, 2nd and 3rd IF amp; video amp.	90X6AU6
V-2	Type 6AL5, FM detector	90X6AL5
V-3	Type 6AV6, audio amp.	90X6AV6
V-4	Type 25L6GT, audio output	90X25L6GT
V-5,6	Type 6AG5, mixer, R.F. amp.	90X6AG5
V-10	Type 6H6, video detector	90X6H6
V-12,17, 18,19,20	Type 12SN7GT, video output; horizontal osc; vertical osc; horizontal amp.; vertical amp.	90X12SN7GT
V-13	Type 7JP4, kinescope	90X7JP4
V-14,21	Type 6C4, RF oscillator, H.V. osc.	90X6C4
V-15	Type 25Z6GT, rectifier	90X25Z6GT
V-16	Type 6X5GT, rectifier	90X6X5GT
V-22	Type, 1B3GT, H.V. rectifier	90X1B3GT
CR-1	Rectifier, silenium	27B147
F-1	Fuse, 2 amp., type 3AG	39A307

MISCELLANEOUS

	Channel selector assembly complete (Includes PB switch, trimmers, coils, etc.)	41X11203
LS-1	Speaker assembly (Includes SO-1)	85B070
	Baffle, speaker (Model T-54)	78B314
	Knob, rear chassis controls	15B141
	Knob, front panel controls (Model T-54)	15B068-4
	Knob, front panel controls (Model 505 & 506M)	15B068-3
	Knob, front panel controls (Model 506)	15B093-1
	Knob, push button & FINE TUNING (Model T-54 & 506)	17A041
	Knob, push button & FINE TUNING (Model 505 & 506M)	17A041-1
	Escutcheon, kinescope tube (Model T-54, 506 & 506M)	7DO71
	Escutcheon, kinescope tube (Model 505)	7DO71-1
	Window, escutcheon	22B206
	Foot, rubber (Model T-54)	16A029
	Plate, foot reinforcing (Model T-54)	63A334
	Cabinet back (Model 505, 506 & 506M)	8D844
	Mounting plate, chassis apron controls	8A786
	Mounting plate, front panel controls	8B788
	Insulating plate, mounting foot brackets	8A787
	Bracket, mounting foot	67A797
	Bracket, selenium rectifier mounting	67A807
	Bracket, kinescope tube mounting	67A809
	Bracket, a-c receptacle mtg. (505, 506 & 506M)	67B894
	Ring, kinescope tube mounting	76A393
	Terminal board, resistor mounting	88A574

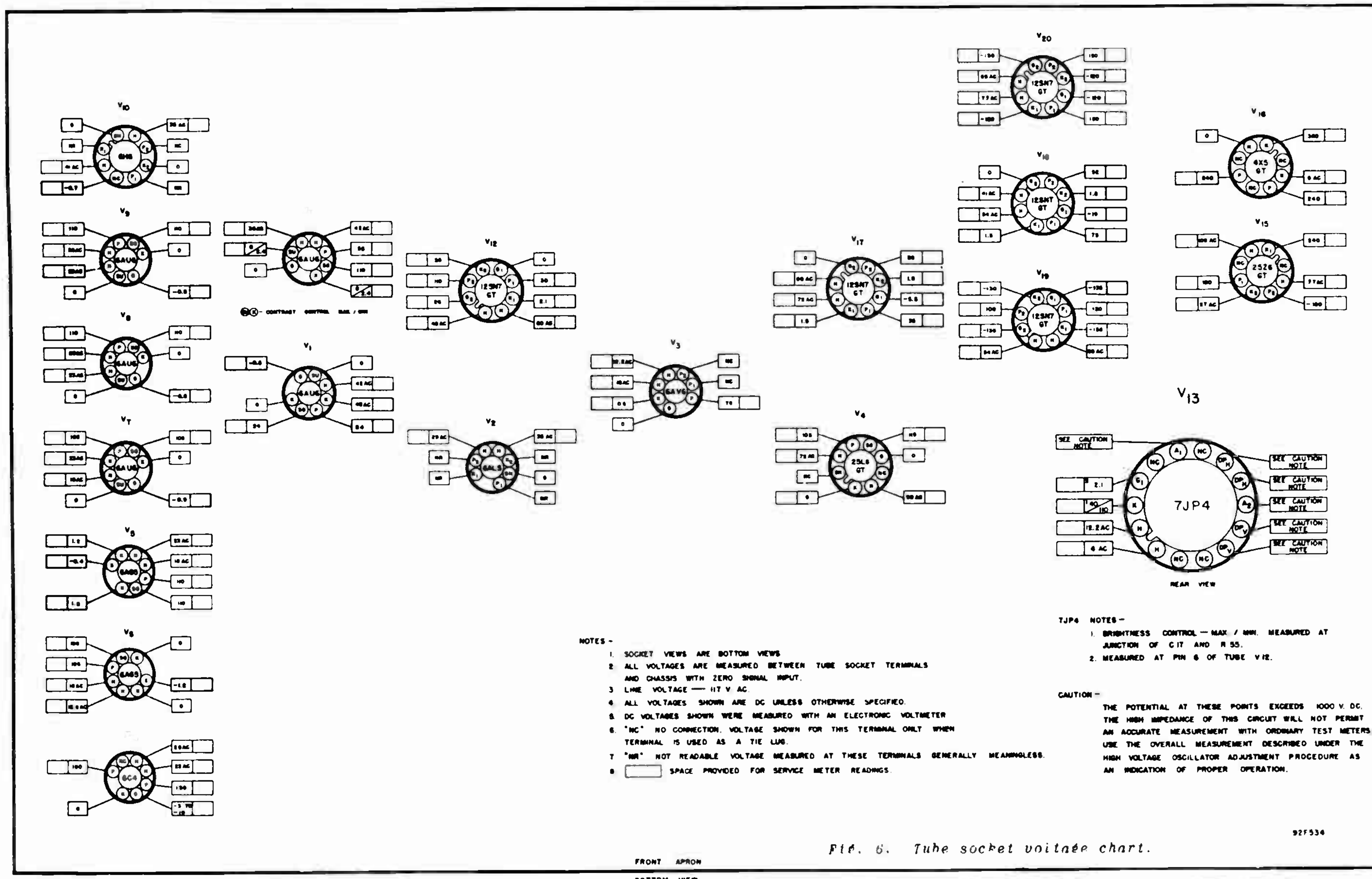

Fig. 6. Tube socket voltage chart.

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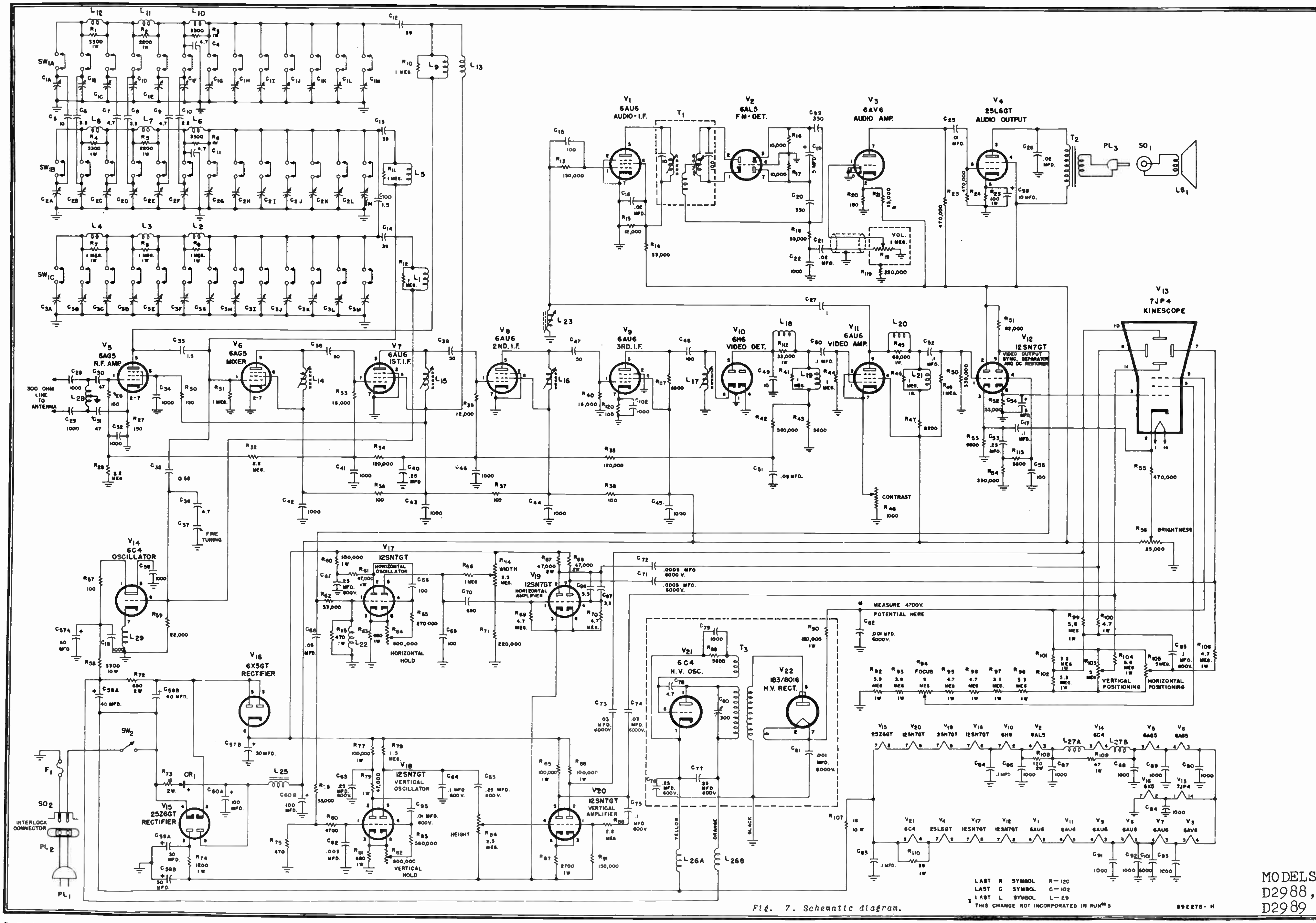

Fig. 7. Schematic diagram.

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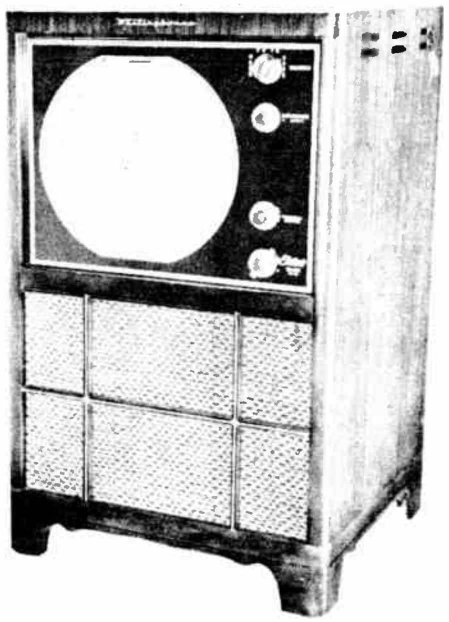

SERVICE NOTES

SPECIFICATIONS

FREQUENCY RANGES:

Channel Number	Channel Frequency (mc.)	Video Carrier Frequency (mc.)	Audio Carrier Frequency (mc.)	Receiver H-F Oscillator Frequency (mc.)
1	not used	--	--	--
2	54 - 60	55.25	59.75	81.35
3	60 - 66	61.25	65.75	87.35
4	66 - 72	67.25	71.75	93.35
5	76 - 82	77.25	81.75	103.35
6	82 - 88	83.25	87.75	109.35
7	174 - 180	175.25	179.75	201.35
8	180 - 186	181.25	185.75	207.35
9	186 - 192	187.25	191.75	213.35
10	192 - 198	193.25	197.75	219.35
11	198 - 204	199.25	203.75	225.35
12	204 - 210	205.25	209.75	231.35
13	210 - 216	211.25	215.75	237.35

FINE TUNING RANGE:

Plus or minus 400 kc. on Channel 2;
Plus or minus 2 mc. on Channel 13.

OPERATING VOLTAGE:

105 to 120 volts, 60 cycles.

POWER CONSUMPTION: .... 300 watts

AUDIO POWER OUTPUT:

Undistorted .... 3.5 watts
Maximum .... 4.5 watts

LOUDSPEAKER:

Type .... 12" P.M.
Voice Coil Impedance ..... 3.2 ohms at 400 cycles

RECEIVER ANTENNA INPUT IMPEDANCE:

.. 300 ohms balanced or 72 ohms unbalanced

TUBE COMPLEMENT:

1	1B3/GT	High Voltage Rectifier
2	5U4G	Low Voltage Rectifier
1	6AH6	Video Output
1	6AG5	Mixer
1	6AG5	R.F. Amplifier
1	6AL5	Video Detector and Noise Clipper
1	6AL5	Ratio Detector
1	6AL5	Horizontal A. F. C.
1	6AQ5	Vertical Output
2	6AU5/GT	Horizontal Output
1	6AV6	1st Audio Amplifier
1	6BH6	1st I. F. Amplifier
1	6BH6	2nd I. F. Amplifier
1	6BH6	3rd I. F. Amplifier
1	6BH6	1st Sound I. F. Amplifier
1	6BH6	2nd Sound I. F. Amplifier
1	6BH6	Keyed AGC
1	6BJ6	4th I. F. Amplifier
1	6C4	H. F. Oscillator
1	6Y6G	High Voltage Oscillator
1	6Y6G	Audio Output
1	6W4/GT	Horizontal Damper
1	12AT7	1st Sync. Amp. & Sync. Separator
1	12AU7	Vertical Multivibrator
1	12AU7	Horizontal Multivibrator
1	12AU7	2nd Sync. Amp. & Phase Invertor
1	12LP4 or 12LP4A	Cathode Ray Tube

VIDEO CARRIER INTERMEDIATE FREQUENCY: .... 26.1 mc.

VIDEO RESPONSE: .... 3.6 mc.

AUDIO CARRIER INTERMEDIATE FREQUENCY: .... 4.5 mc.

AUDIO DISCRIMINATOR BAND WIDTH: (between peaks) .... 150 kc.

FOCUS: .... Magnetic

SWEEP DEFLECTION: .... Magnetic

SCANNING: .... Interlaced 525 line

HORIZONTAL SCANNING FREQUENCY: .... 15,750 CPS

VERTICAL SCANNING FREQUENCY: .... 60 CPS

FRAME FREQUENCY (picture repetition rate): .... 30 CPS

CATHODE RAY TUBE HANDLING PRECAUTIONS

Shatterproof goggles and heavy gloves should be worn at all times when handling the cathode ray tube. The tube should not be handled in the vicinity of any person not so equipped. When handling the cathode ray tube, always keep it away from the body.

The cathode ray tube bulb, due to its large surface area and high vacuum contained within, is subjected to high air pressure. More than ordinary care is required to prevent shattering the tube. The large end of the bulb, particularly the rim of the viewing surface, must not be struck, scratched, or subjected to more than moderate pressure at any time. If the tube sticks or fails to slip smoothly into place during installation, remove the tube and determine the cause of the trouble - - DO NOT FORCE THE TUBE.

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HIGH VOLTAGE WARNING

The danger accompanying shock is always present when the receiver is operated outside the cabinet or when the rear cover is removed from the cabinet. Only a person familiar with the precautions to be observed when working with high-voltage equipment should service this receiver.

INSTALLATION INSTRUCTIONS

TO PREPARE THE RECEIVER FOR OPERATION:

1. Remove the screws that secure the rear cover to the cabinet.

2. Remove the rear cover by pulling it straight out from the cabinet.

3. Check the operation of the Electronic Magnifier. If the shutters bind, *do not force the control*. Re-position the chassis to allow smooth operation of the control. If the shutters still bind, remove the chassis from the cabinet as outlined under CHASSIS REMOVAL to determine the cause of the binding.

4. Models H-606K12 and H-607K12 contain a built-in antenna for use in areas of normal reception. In such areas where the built-in antenna provides good reception, no antenna connections are required. However, in weak signal areas or under adverse conditions, it may be necessary to use an external antenna. In this event, the antenna lead-in can be connected to the antenna terminals on the back of the receiver after disconnecting the built-in antenna wires that normally connect to these terminals. The lugs on the built-in antenna should be insulated and dressed in such a position that they do not touch the chassis or components. The clamp located at the top, inside, rear of the cabinet may be used to hold the built-in antenna feeder out of the way.

5. Apply power to the receiver by connecting a temporary line cord between the receptacle on the chassis and a 105 to 120 volt 60 cycle A-C outlet.

TO CHECK THE OPERATION:

1. Turn the magnifier switch to the clockwise (magnified) position.

2. Rotate the brightness and contrast controls completely counterclockwise.

3. Turn on the receiver by rotating the off-on-volume control clockwise.

4. Rotate the channel selector to the channel number of the desired station.

5. Rotate the brightness control clockwise until the screen is well lighted.

6. Rotate the contrast control clockwise until a picture appears on the screen.

7. If the built-in antenna is in use adjust the television antenna control for maximum picture contrast. If an external antenna is in use, this step is not required.

8. If the picture is moving up or down or quivering adjust the vertical hold control to stabilize the image.

9. If vertical or diagonal bars or a folded over picture appears on the screen, adjust the horizontal hold control to obtain a stable picture.

10. Adjust the fine tuning control for best picture detail.

11. Readjust the brightness and contrast controls until pleasing shades ranging from clear white to intense black are attained.

12. If shadows appear on the face of the tube or the picture is not properly centered, adjust the ion trap magnet and focus coil as outlined under ADJUSTMENTS.

13. Adjust the volume control for the desired sound volume.

14. Turn the magnifier switch to the counterclockwise (normal) position.

15. If vertical or diagonal bars appear on the screen, adjust the width control as described under ADJUSTMENTS. *Do not readjust the horizontal hold control.*

16. If necessary, adjust the height, height magnifier, vertical linearity, vertical linearity magnifier, and focus controls as explained under ADJUSTMENTS.

17. Check the operation on all available television stations. Note that if the built-in antenna is in use, the television antenna control must be readjusted for maximum picture contrast each time the receiver is tuned to a different channel.

18. Turn off the receiver, disconnect the temporary line cord and external antenna (if used), and replace the rear cover.

19. Re-connect the external antenna (if used) to the antenna terminals on the rear of the chassis, and connect the A-C plug to a 105 to 120 volt 60 cycle power outlet.

20. Re-check the operation on all available stations.

ADJUSTMENTS

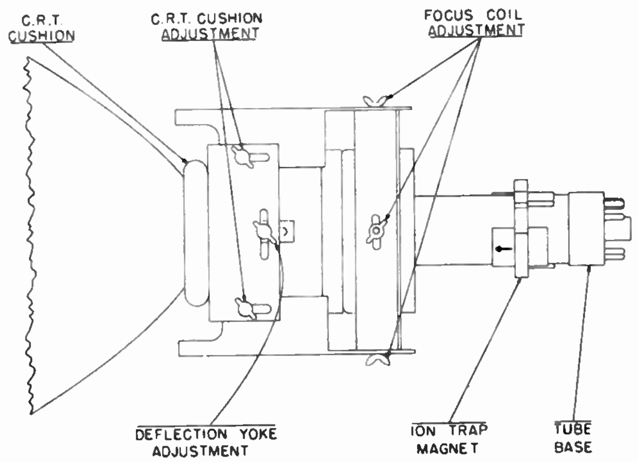

FIG. 1 — CRT ADJUSTMENTS

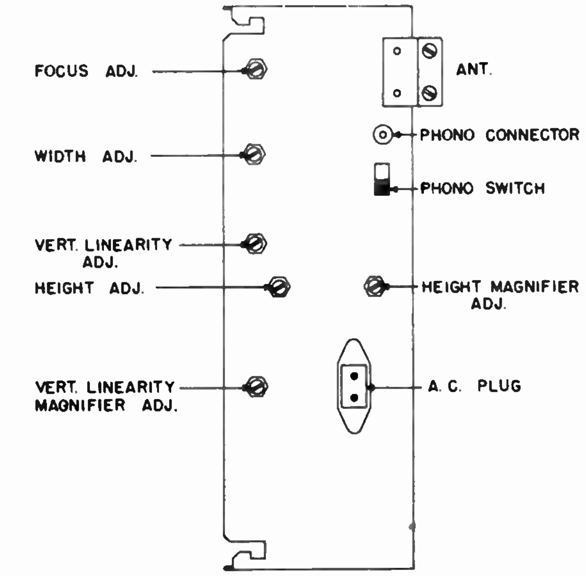

FIG. 2 — ADJUSTMENTS ON REAR OF CHASSIS

The picture adjustments are located on the rear of the chassis and are accessible through cut-outs in the back cover.

An insulated, long shank screwdriver is preferred for making the ringing coil and H.V. oscillator adjustments.

ION TRAP MAGNET

CAUTION: When adjusting the ion trap magnet, care must be exercised to avoid breaking the neck of the C.R.T.

The ion trap magnet must always be adjusted for maximum picture brightness. With the magnet oriented approximately as shown in Fig. 1, rotate it around the neck of the tube and move it forward and backward until the position is found where the brightest raster is obtained.

FOCUS COIL

If a shadow falls on one corner of the picture or if the picture is not centered, adjustment of the focus coil will be necessary. To adjust, loosen the focus coil adjustment wing screws and slightly rotate the coil about its vertical and horizontal axis until a position is found where the picture is centered and there are no shadowed corners. Tighten the wing screws with the coil in this position.

CATHODE RAY TUBE CUSHION

The cushion must fit snugly against the flare of the cathode ray tube in order that the rear of the tube will be supported firmly.

DEFLECTION YOKE

This adjustment controls the angle of the picture with respect to the horizontal. If the picture is not squared in the picture mask, loosen the wing nut and move it to the left or right so as to rotate the deflection yoke. The picture will tilt to the left or right with the deflection yoke rotation.

FOCUS CONTROL

The focus control (Fig. 2) should be adjusted with the brightness and contrast controls in their normal positions. If correct focusing cannot be obtained, the high voltage oscillator may require adjustment.

HEIGHT AND VERTICAL LINEARITY (NORMAL)

The height adjustment controls the overall height of the picture, while the vertical linearity adjustment governs contraction or expansion of the upper portion only. For this reason, a balance between the two controls is necessary to make the picture symmetrical and fill the mask vertically.

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HEIGHT AND VERTICAL LINEARITY (MAGNIFIED)

The height magnifier adjustment controls the overall height of the magnified picture, while the vertical linearity magnifier adjustment governs contraction or expansion of the upper portion only. For this reason, a balance between the two controls is necessary to make the picture symmetrical and fill the mask vertically. *These controls must be reset if the height and vertical linearity controls governing the normal picture are changed.*

WIDTH

The width adjustment must always be made with the magnifier control set for a normal size picture. The correct adjustment is made as follows:

1. Rotate the magnifier control to the magnified position, and adjust the horizontal hold control until magnified picture hold holds horizontal sync.

2. Set the magnifier control for a normal size picture, and *without re-adjusting the horizontal hold control* adjust the width control until the picture holds horizontal sync and fills the mask horizontally.

HORIZONTAL RINGING COIL

To adjust the horizontal ringing coil.

1. Turn the magnifier switch to the clockwise (magnified) position.

2. Tune in the weakest station in your area.

3. Set the horizontal hold control at approximately the center of its range.

4. Adjust the ringing coil (L403) until the picture is properly "locked-in".

HIGH VOLTAGE OSCILLATOR

1. *Turn off the receiver* and disconnect the high voltage lead from the CRT.

2. Connect 18 one megohm, one watt resistors in series between the high voltage lead and the chassis.

3. Connect a kilovoltmeter across the 18 megohms of resistance.

4. Turn on the receiver and adjust C507 (location shown on Fig. 8) for maximum voltage indication on the meter. When C507 is peaked using an 18 megohm load, the voltage across the load should be 9.3 kilovolts (approximately).

5. *Turn off the receiver,* disconnect the kilovoltmeter, remove the 18 megohms of resistance, and connect the high voltage lead to the CRT. Note that when the 18 megohm load is removed and the high voltage lead is connected to the CRT, the output voltage of the H.V. power supply will rise because of the higher load resistance offered by the CRT.

13. Tighten the CRT strap and the wing nut on the stud at the top of the CRT strap.

14. Adjust the CRT cushion and tighten the CRT cushion screws.

15. Replace the ion trap magnet and the CRT socket.

16. Adjust the ion trap magnet and focus coil as outlined under ADJUSTMENTS.

17. Turn the magnifier switch to the clockwise (magnified) position. Open the shutters completely and tighten the set screw to lock the shutter actuating link to the control shaft.

18. Check the operation of the shutters to make certain there is no binding.

19. Replace the chassis in the cabinet.

CHASSIS REMOVAL

To remove the chassis from the cabinet:

1. Remove the control knobs from the front of the cabinet.

2. Remove the wood screws that hold the rear cover to the cabinet, and remove the rear cover.

3. Remove the two red-headed wood screws from the block located on the top (inside) of the cabinet, and remove the block.

4. Disconnect the built-in antenna feeder from the antenna terminals.

5. Release the antenna stub from the top of the cabinet by pulling out the thumbtack.

6. Remove the two screws that secure the antenna trimmer assembly to the top of the cabinet.

7. Remove the trimmer assembly and rubber coupling sleeve by carefully pulling the coupling sleeve off the drive shaft.

8. Temporarily tape the drive shaft to the top of the cabinet to avoid breakage.

9. Remove the bracket that clamps the shutter frame to the bottom of the cabinet. This bracket is located near the front (inside) of the cabinet and can be released by removing the screw from the under side of the cabinet.

10. Remove the hex-head chassis bolts from the under side of the cabinet.

11. Remove the chassis by pushing the front of the chassis against the left side of the cabinet and then easing the chassis out of the cabinet while moving the rear of the chassis gradually toward the right. The chassis must leave the cabinet at an angle so that the shutter mechanism will clear the antenna drive pulleys. This step must be performed cautiously to prevent scratching the plastic front plate.

CATHODE RAY TUBE REPLACEMENT

1. Remove the chassis from the cabinet as explained under CHASSIS REMOVAL.

2. Back off the screw locking the shutter actuating link to the magnifier control shaft.

3. Remove the two self-tapping screws that secure the shutter assembly frame to the chassis.

4. Remove the two self-tapping screws that secure the shutter assembly frame to the brace bars.

5. Remove the wing nut and lock washer from the stud on top of the CRT strap.

6. Remove the shutter assembly by lifting the bronze strap over the stud and sliding the complete assembly forward.

7. Remove the ion trap magnet and the CRT socket.

8. Loosen the CRT cushion screws, the focus coil wing screws, and remove the screw from the CRT strap.

9. Remove the defective CRT and insert the replacement through the deflection yoke and focus coil, exercising the caution necessary when handling cathode ray tubes.

10. Replace the screw in the CRT strap and tighten the strap about the tube just enough to hold the tube in place.

11. Replace the shutter assembly and tighten the self-tapping screws only. Do not tighten the CRT strap wing nut or the set screws on the magnifier control shaft.

12. Position the CRT so that the clearance between the tube and the mask is approximately 1/32".

ALIGNMENT

TEST EQUIPMENT—To properly service this chassis, the following test equipment should be available:

1. R-F sweep generator which meets the following requirements:

a. Frequency range from 18 to 30 mc. with a sweep width of 10 mc.

b. Output adjustable with at least 100,000 microvolts maximum and a very low minimum.

c. Output "flat" on all attenuator positions.

2. Cathode-ray oscilloscope, preferably one with a wide band vertical deflection amplifier and a low-capacitance input probe.

3. Signal generator capable of providing output frequencies listed below.

21.6 mc. 4th I-F trap
22.6 mc. 1st I-F
25.9 mc. 2nd I-F
25.6 mc. 3rd I-F
23.8 mc. 4th I-F
23.0 mc. 5th I-F
4.5 mc. Audio I-F and ratio detector (the frequency must be extremely accurate, preferably crystal controlled.)

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NOTE—The R-F output level on all the above frequencies should be adjustable with at least 100,000 microvolts maximum and a very low minimum.

4. Heterodyne frequency meter with crystal calibrator (if the signal generator does not include a crystal calibrator).

5. Electronic voltmeter (vacuum tube voltmeter), with a high voltage multiplier probe for measurements up to 15,000 volts and an R-F probe for measuring R-F voltages.

GENERAL INFORMATION—All test equipment and the chassis should be bonded together by short lengths of heavy (½ inch) braided copper ribbon. The interconnecting leads should be shielded (72 ohms coaxial cable) and should be as short as possible consistent with ease of making connections. The effectiveness of the bonding can be checked during alignment by placing the hand on the metal chsssis or test equipment case. If the response pattern or meter reading changes visibly, the bonding must be improved before the circuits are aligned.

COMMON I-F ALIGNMENT PROCEDURE

1. Rotate the channel selector switch to channel 3.

2. Connect the signal generator to the mixer tube through the coupling device shown in Fig. 4. The device is constructed by squeezing together a miniature tube shield until it fits the tube snugly and does not ground to the chassis. A .005 mfd capacitor is then soldered to the side of the shield. By sliding the tube shield up or down on the tube, the capacitance between the shield and the tube elements can be varied to obtain additional control of the coupling over that provided by the attenuator in the generator itself. The ground side of the generator output cable should be connected to the receiver chassis.

3. Connect a vacuum tube voltmeter to the video test jack on the receiver chassis, and set the meter to its 5 volt scale.

4. Set the signal generator to 21.6 mc. (unmodulated), and adjust C329 for *minimum* voltage on the VTVM. Use a strong signal for this adjustment.

5. Set the signal generator to 22.6 mc. (unmodulated), and adjust L306 for maximum voltage on the VTVM. *During this adjustment, keep the signal generator output adjusted so that the VTVM reading does not exceed 2 volts.*

6. Set the signal generator to 25.9 mc. (unmodulated), and adjust L307 for maximum voltage on the VTVM. *During this adjustment, keep the signal generator output adjusted so that the VTVM reading does not exceed 2 volts.*

7. Set the signal generator to 25.6 mc. (unmodulated), and adjust L308 for maximum voltage on the VTVM. *During this adjustment, keep the signal generator output adjusted so that the VTVM reading does not exceed 2 volts.*

8. Set the signal generator to 23.8 mc. (unmodulated), and adjust L309 for maximum voltage on the VTVM. *During this adjustment, keep the signal generator output adjusted so that the VTVM reading does not exceed 2 volts.*

9. Set the signal generator to 23.0 mc. (unmodulated), and adjust L313 for maximum voltage on the VTVM. *During this adjustment, keep the signal generator output adjusted so that the VTVM reading does not exceed 2 volts.*

10. Connect the *sweep* generator to the mixer tube through the coupling device previously described. The *signal* generator will be used in the following steps to provide marker indications at various frequencies on the response curve. In this application, the signal generator input to the set must be low in amplitude to avoid distorting the response curve. To reduce the signal generator input accordingly, the signal generator should be *loosely* coupled to the set by wrapping a few turns of insulated wire around the coupling capacitor "pigtail" and connecting the signal generator to this wire.

11. Connect the vertical input of the oscilloscope to the video test jack through the de-coupling network shown in Fig. 5. The oscilloscope horizontal input should be connected to the sweep output from the sweep generator; turn the sweep control on the oscilloscope to the "X" or "OFF" position.

12. Adjust the sweep generator for a center frequency of 25.3 mc. with a 10 mc. deviation. Adjust the sweep generator output until a setting is found where there is very little noise on the oscilloscope pattern.

The oscilloscope pattern obtained should be similar to that shown in Fig. 6. Use the signal generator as a marker to check at the frequencies indicated. If the pattern obtained is not similar to Fig. 6, L306, L307, L308, L309, and L313 should be re-adjusted to produce the correct pattern. The affect of the adjustments will be as follows:

L306 affects the low frequency side of the curve.
L307 affects the high frequency side of the curve and the position of the video I-F carrier.
L308 affects the center of the curve.
L309 affects the tilt of the "shelf" of the curve.
L313 affects the center and the low frequency side of the curve.

SOUND I-F AND 4.5 MC. TRAP ALIGNMENT PROCEDURE

1. Connect the "high" side of the signal generator to the video test jack through a .001 mfd capacitor, and ground the "low" side to the chassis.

2. Connect the vacuum tube voltmeter to the points indicated on the bottom view of the chassis, Fig. 8. The common lead should connect to point "C", and the "high" lead should connect to point "A". Set the meter on its 5 volt (-DC) scale.

3. Adjust the signal generator to 4.5 mc. (unmodulated). The accuracy of this frequency is very important. If a crystal controlled signal generator is not available, the frequency should be checked using a frequency meter with a crystal calibrator.

4. Adjust T201 and the primary of T202 for maximum voltage on the VTVM. *During this adjustment keep the signal generator output adjusted so that the VTVM reading does not exceed 5 volts.*

5. Connect the common lead from the VTVM to point "A" (Fig. 8), and connect the "high" lead to point "B". Here it is important that the case and components of the VTVM are *not* grounded to the receiver chassis; otherwise, point "A" would be shorted to the chassis through the common lead.

6. Using the same signal generator amplitude and frequency as in step 4, adjust the secondary of T202 for *zero* voltage on the VTVM. As the adjustment is tuned through resonance, the voltage will rapidly change from one polarity to the opposite polarity. The point where the voltage is zero is the correct setting.

7. Connect the common lead from the VTVM to the chassis, and connect the *R-F probe* from the VTVM to the junction of R332 and R326. This point is shown as point "D" on Fig. 8. *Note that this point is 150 volts above ground and, therefore, the R-F probe must contain a blocking capacitor.*

8. Using a strong 4.5 mc. signal applied as in step 1, adjust C321 for *minimum* indication on the meter.

H. F. OSCILLATOR ALIGNMENT PROCEDURE

If the 6C4 H-F oscillator tube is replaced the different inter-electrode capacitance of the new tube may change the oscillator frequency enough to necessitate re-alignment of the oscillator.

The oscillator adjusting screws are located on the front of the tuner assembly, and this procedure should be followed for their adjustment:

1. Remove the channel selector and fine tuning knobs. Remove the selector escutcheon plate and escutcheon mounting plate by removing the Phillips head screws securing them to the cabinet. The adjustments are accessible through the hole in the cabinet.

2. Set the fine tuning control to the middle of its range, and leave it in this position during the following adjustments.

3. Set the channel selector switch to the highest of the low band (channels 2 through 6) stations operating in your locality.

4. Peak the appropriate oscillator slug for the best picture detail.

5. Repeat step 4 for each progressively lower channel on which a station transmits in your area.

6. Set the channel selector switch to the highest of the high band (channels 7 through 13) stations operating in your locality.

7. Peak the appropriate oscillator slug for the best picture detail.

8. Repeat step 7 for each progressively lower channel in the high band on which a nearby station transmits.

9. Check the previously made low band adjustments, and if the tuning has changed repeat steps 3 through 8.

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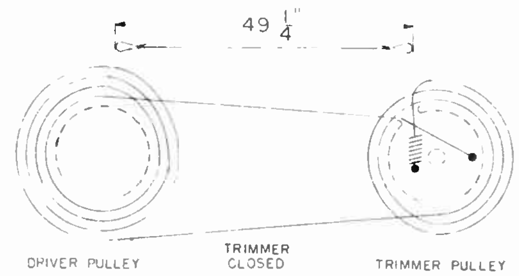

FIG. 3 — DRIVE STRING ARRANGEMENT FOR ANTENNA TRIMMER

I-F ALIGNMENT CHART

Turn the channel selector to channel 3 to avoid undesirable beat response during alignment.

COMMON I-F SECTION

Couple the sweep and marker generators to the mixer tube as shown in Fig. 4.

Step	*Sweep Gen. Frequency*	*Marker Gen. Frequency*	*Remarks*	*Indicator Connection*	*Adjust*
1.	Not used	21.6 mc. unmodulated	Use a strong signal	Connect VTVM to video test jack	C-329 for *minimum* voltage
2.	Not used	22.6 mc. unmodulated	Keep marker output adjusted so VTVM reading does not exceed 2 v.	Same as step 1	L-306 for maximum voltage
3.	Not used	25.9 mc. unmodulated	Same as step 2	Same as step 1	L-307 for maximum voltage
4.	Not used	25.6 mc. unmodulated	Same as step 2	Same as step 1	L-308 for maximum voltage
5.	Not used	23.8 mc. unmodulated	Same as step 2	Same as step 1	L-309 for maximum voltage
6.	Not used	23.0 mc. unmodulated	Same as step 2	Same as step 1	L-313 for maximum voltage
7.	25.3 mc. with 10 mc. deviation	check at: 21.6 mc. 22.5 mc. 23.5 mc. 25.3 mc. 26.1 mc.	Keep sweep output low enough so that very little noise appears on the oscilloscope trace	Connect oscilloscope to video test jack. See Fig. 5.	If necessary, adjust L-306, L-307, L-308, L-309, and L-313 to obtain correct response curve. See Fig. 6.

SOUND I-F SECTION AND 4.5 MC. TRAP

Connect the signal generator to the video test jack through a .001 mfd mica capacitor.

Step	*Signal Gen. Frequency*	*VTVM Connection*	*Remarks*	*Adjust*
1.	4.5 mc. unmodulated	See Fig. 8. Common lead to point "C" and high lead to point "A".	Use 5 v. (−DC) scale on meter. Set sig. gen. output accordingly.	T-201 and pri. of T-202 for maximum voltage
2.	4.5 mc. unmodulated	See Fig. 8. Common lead to point "A" and high lead to point "B".	Use same sig. gen. output as in step 1.	Sec. of T-202 for *zero* voltage
3.	4.5 mc. unmodulated	See Fig. 8. R-F probe to point "D" and common lead to chassis.	Use strong signal from generator.	C-321 for *minimum* voltage

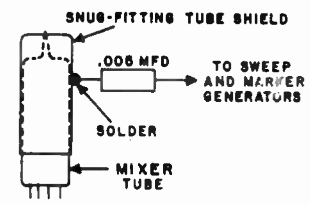

FIG. 4—COUPLING SIGNAL GENERATORS TO MIXER TUBE

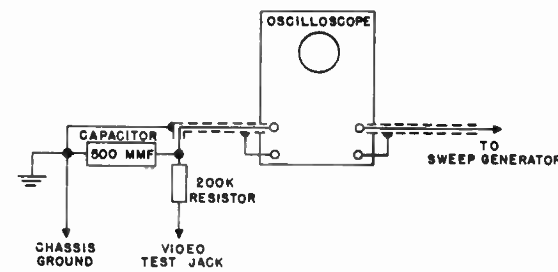

FIG. 5—OSCILLOSCOPE ISOLATION NETWORK

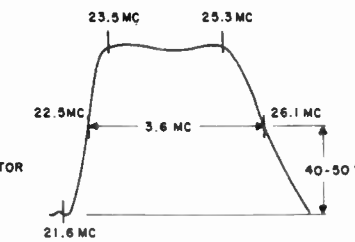

FIG. 6—I-F RESPONSE CURVE

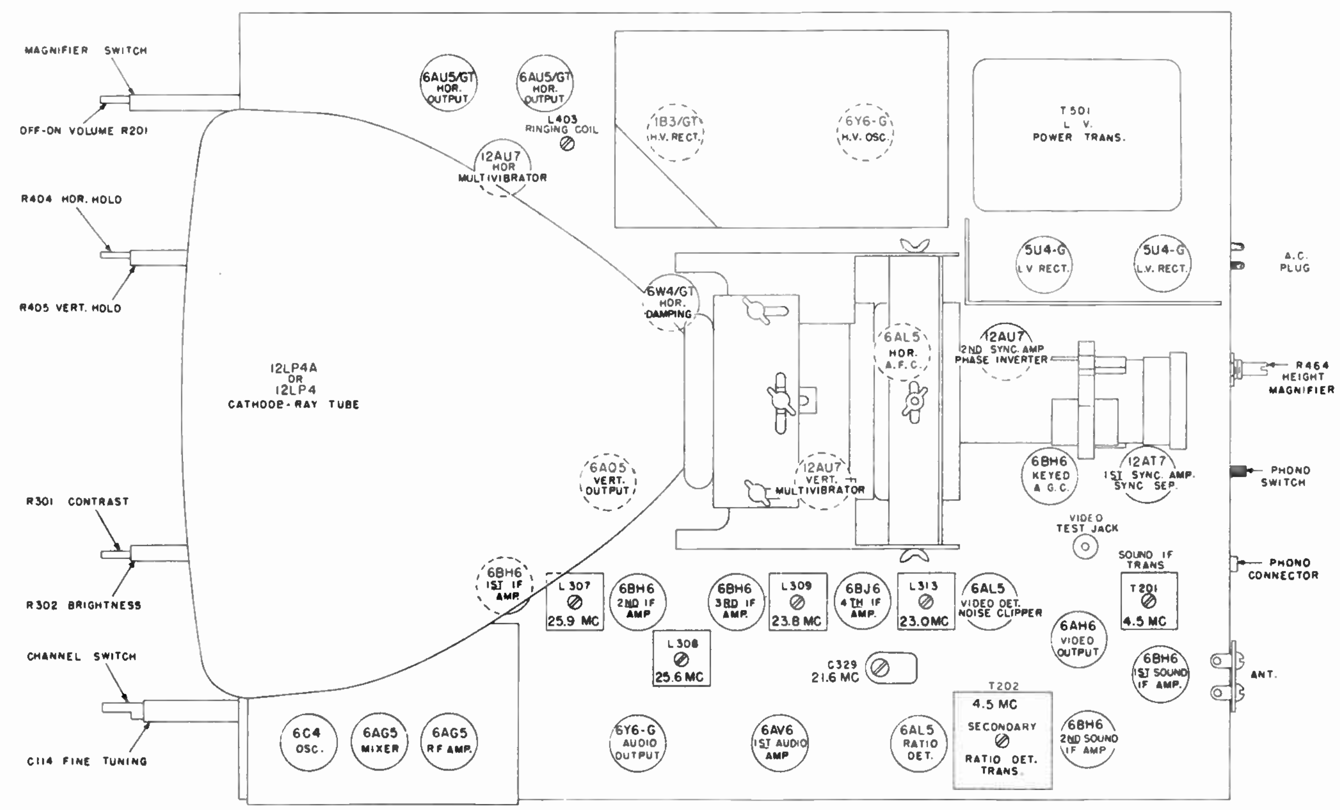

FIG. 7—TOP VIEW OF CHASSIS

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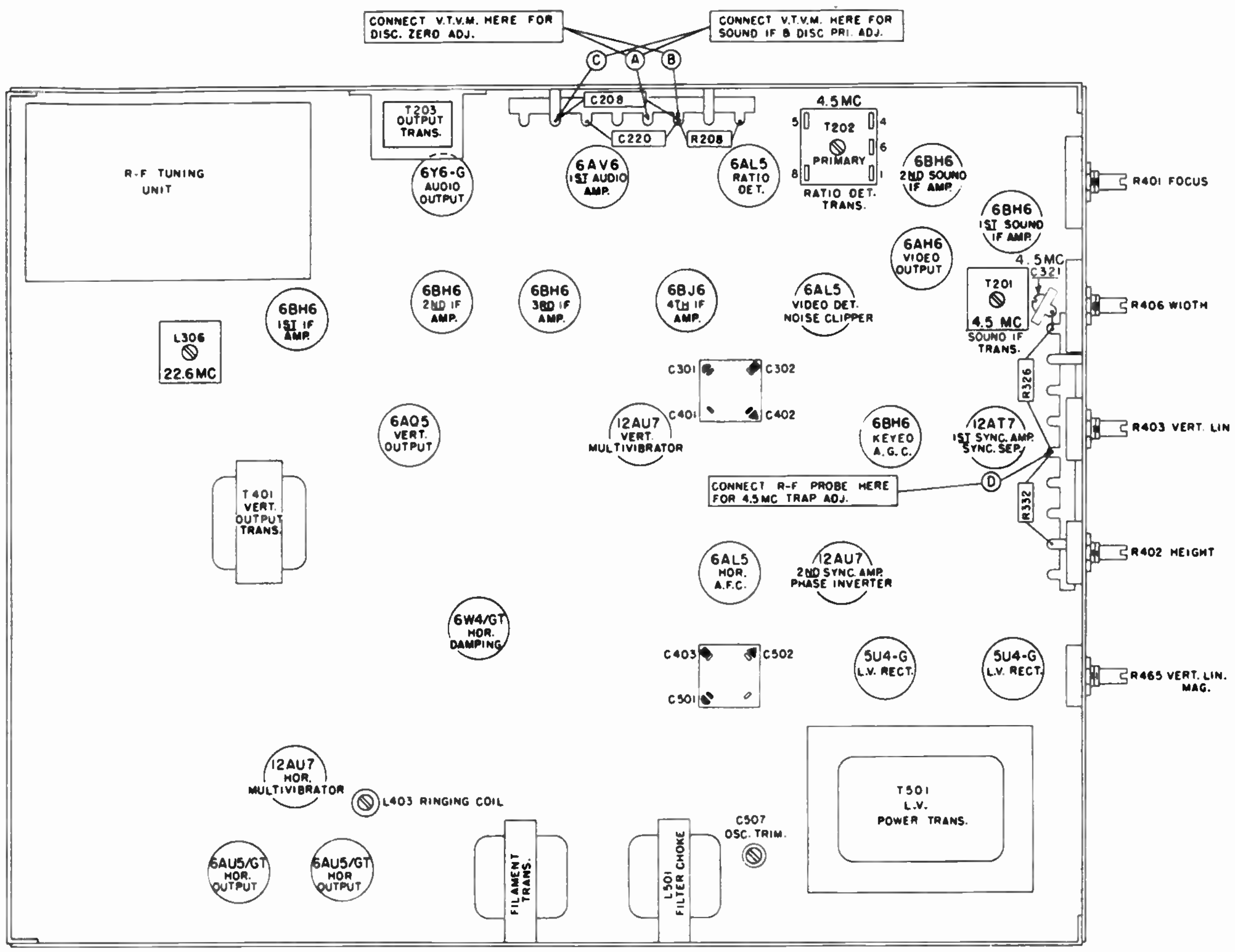

FIG. 8—BOTTOM VIEW OF CHASSIS

PARTS LIST FOR MODELS H-606K12 AND H-607K12

When ordering parts, specify model number of set in addition to part number and description of part.

CABINET

Part No.	Description
V-9485-1	Baffle and grille cloth assembly (mahogany)
V-9485-2	Baffle and grille cloth assembly (blond)
V-1197-1	Cabinet (mahogany)
V-1197-2	Cabinet (blond)
V-5522	Cord, AC
V-3219S-1	Cord, dial drive
V-9255-1	Cover assembly, back
V-4902	Glide, furniture
V-6146-5	Knob, television antenna (mahogany)
V-6146-7	Knob, television antenna (blond)
V-6146-1	Knob, contrast, horizontal hold, volume on-off (mahogany)
V-6146-6	Knob, contrast, horizontal hold, volume on-off (blond)
V-9104-1	Knob, brightness, vertical hold (plastic)
V-9104-4	Knob, fine tuning (plastic)
V-6284-2	Knob, channel selector (mahogany)
V-6284-3	Knob, channel selector (blond)
V-9471-1	Knob, magnifier (plastic)
V-9491-2	Plate, front glass (mahogany)

PARTS LIST FOR MODELS H-606K12 AND H-607K12 *(Continued)*

Part No.	Description
V-9491-3	Plate, front glass (blond)
V-9323-1	Pulley assembly (driver)
V-9324-1	Pulley assembly (trimmer)
V-6059	Spring, knob (fine tuning)
V-6063-1	Spring, knob (selector)
V-4057	Spring, dial drive
V-5421-5	Washer, felt (knobs)
V-3752S	Washer, felt (television antenna knob)
V-3436	Washer, "C" (television antenna shaft)

MISCELLANEOUS

Part No.	Description
V-6451-2	Adapter plate, RF tuner
V-9358-1	Antenna assembly, television
V-4169-1	Base, miniature tube (6BH6, 6BJ6, 6AL5)
V-6602-1	Base, miniature tube (12AU7 vertical MV)
V-5948-2	Bracket, focus control
V-6974-1	Bracket assembly, deflection yoke
V-5860-8	Cable assembly, speaker
V-5426	Clip, I-F mounting
V-3254S	Connector, phono
V-5906-1	Connector assembly, hi-voltage
V-9014	Fastener, hi-voltage lid
V-9234	Hood, yoke mounting
V-5977	Jack, test (video)
V-6573-1	Magnet, ion trap
V-5549	Plug, AC male
V-6518-1	Plug assembly, yoke
V-9478-2	Ring, mask
V-6602-2	Shield, miniature tube (12AU7 vertical MV)
V-4169-2	Shield, miniature tube (6BH6, 6AL5, 6BJ6)
V-9175-8	Shutter assembly
V-5979	Sleeve, rubber (focus coil)
V-9440-2	Socket assembly, CRT
V-9166-1	Socket, deflection
V-5929	Socket, molded octal (1B3GT)
V-3299	Socket, speaker
V-6295-1	Socket, miniature wafer (6BH6, 6AU6)
V-5556-1	Socket, miniature molded (12AU7, 12AU7 2nd sync)
V-4514	Socket, molded octal (5U4G, 6Y6, 6W4)
V-4315-2	Socket, molded octal (6AU6GT)
V-4292S-1	Socket, miniature molded (6BH6, 6BJ6, 6AQ5)
V-6089-1	Socket, miniature (12AU7 vertical MV)
V-6878-1	Socket, miniature wafer (6AL5 horizontal AFC)
V-6997-1	Socket, miniature (6AH6)
V-6072-3	Socket, miniature (12AU7 horizontal MV)
V-9431	Speaker, 12" PM
V-6908	Strap assembly, CRT
V-5406	Switch, phono

V-2150-111 CHASSIS ELECTRICAL PARTS

Section 1—RF

Item	Part No.	Description	Function
C-101	V-5596	Capacitor, hi-kap .005 mfd	Filament
C-102	V-5596	Capacitor, hi-kap .005 mfd	Filament
L-101	V-4886-2	Coil, 1.1 microhenries	RF filament choke
	V-8209	Tuner assembly, RF	

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PARTS LIST FOR MODELS H-606K12 AND H-607K12 (Continued)

Item	Part No.	Description	Function
		Section 2—Sound I-F and Audio	
C-201	V-6570	Capacitor, electrolytic 30 mfd 450 v.	Screen by-pass
C-202	V-4880	Capacitor, electrolytic 2 mfd 50 v.	Ratio det stabilizer
C-203	V-3236	Capacitor, electrolytic 20 mfd 25 v.	Cathode by-pass
C-204	V-5658-6	Capacitor, 4.7 mmf	Audio I-F coupling
C-205	V-5596	Capacitor, hi-kap, .005 mfd	Cathode by-pass
C-206	V-6023-4103M	Capacitor, .01 mfd 400 v.	Screen by-pass
C-207	V-6023-6202M	Capacitor, .002 mfd 600 v.	Plate by-pass
C-208	V-6023-6202M	Capacitor, .002 mfd 600 v.	De-emphasis
C-209	V-6023-4103M	Capacitor, .01 mfd 400 v.	Screen by-pass
C-210	RCM20B681M	Capacitor, 680 mmf	De-emphasis
C-211	V-6023-4103M	Capacitor, .01 mfd 400 v.	Bass boost
C-212	V-6023-4103M	Capacitor, .01 mfd 400 v.	AF coupling
C-214	V-6023-4103M	Capacitor, .01 mfd 400 v.	Coupling
C-215	V-6023-4104M	Capacitor, .1 mfd 400 v.	Plate decoupling
C-216	RCM20B100K	Capacitor, 10 mmf	Ratio det tuning
C-217	RCM20B470K	Capacitor, 47 mmf	AF coupling
C-218	RCM20B101K	Capacitor, 100 mmf	Grid by-pass
C-219	RCM20B271K	Capacitor, 270 mmf	Plate by-pass
C-220	V-6023-4103M	Capacitor, .01 mfd 400 v.	AF coupling
L-205	V-5902-4	Coil	Plate load
*R-201	V-9482-1 assy	Control (assy consists of R-201, SW-401 and SW-501)	Volume
R-203	RC30AE331K	Resistor, 330 ohms 1 w.	Cathode bias
R-204	RC20AE101K	Resistor, 100 ohms ½ w.	Cathode bias
R-205	RC20AE103J	Resistor, 10,000 ohms ½ w.	Ratio det load
R-206	RC20AE103J	Resistor, 10,000 ohms ½ w.	Ratio det load
R-207	RC20AE223K	Resistor, 22,000 ohms ½ w.	Bass boost
R-208	RC20AE333K	Resistor, 33,000 ohms ½ w.	De-emphasis
R-209	RC20AE473K	Resistor, 47,000 ohms ½ w.	Grid return
R-210	RC20AE473K	Resistor, 47,000 ohms ½ w.	Decoupling
R-211	RC20AE274K	Resistor, 270,000 ohms ½ w.	Plate load
R-212	RC20AE474K	Resistor, 470,000 ohms ½ w.	Grid return
R-213	RC20AE106M	Resistor, 10 megohms ½ w.	Grid return
R-214	RC30AE683K	Resistor, 68,000 ohms 1 w.	Decoupling
R-215	RC41AE471K	Resistor, 470 ohms 2 w.	Screen load
T-201	V-6517	Transformer, 4.5 mc	Sound IF
T-202	V-6483	Transformer	Sound disc
T-203	V-9685	Transformer	Audio output
		Section 3—Video	
*C-301	V-6977 assy	Capacitor, electrolytic 80 mfd 400 v. (assy consists of C-301, C-302, C-401 and C-402)	Filter
*C-302	V-6977 assy	Capacitor, electrolytic 10 mfd 400 v. (assy consists of C-301, C-302, C-401 and C-402)	Screen by-pass
C-303	V-6570	Capacitor, electrolytic 30 mfd 450 v.	Decoupling
C-304	V-5658-6	Capacitor, 4.7 mmf	I-F peaking
C-305	V-5658-6	Capacitor, 4.7 mmf	Detector by-pass
C-306	V-5596	Capacitor, hi-kap .005 mfd	R-F by-pass
C-307	V-5596	Capacitor, hi-kap .005 mfd	AGC decoupling
C-308	V-5596	Capacitor, hi-kap .005 mfd	Screen by-pass
C-309	V-5596	Capacitor, hi-kap .005 mfd	Plate decoupling
C-310	V-5596	Capacitor, hi-kap .005 mfd	AGC decoupling
C-311	V-5596	Capacitor, hi-kap .005 mfd	Plate decoupling
C-312	V-5596	Capacitor, hi-kap .005 mfd	Screen by-pass
C-313	V-5596	Capacitor, hi-kap .005 mfd	Cathode by-pass
C-314	V-5596	Capacitor, hi-kap .005 mfd	Screen by-pass
C-315	V-5596	Capacitor, hi-kap .005 mfd	Plate decoupling
C-316	V-5596	Capacitor, hi-kap .005 mfd	Cathode by-pass
C-317	V-5596	Capacitor, hi-kap .005 mfd	Screen by-pass

Item	Part No.	Description	Function
C-318	V-5596	Capacitor, hi-kap .005 mfd	Plate decoupling
C-319	V-6023-4103M	Capacitor, .01 mfd 400 v.	AGC delay
C-320	V-5658-6	Capacitor, 4.7 mmf	I-F peaking
C-321	V-9398	Capacitor, trimmer	4.5 mc trap tuning
C-322	V-6023-4104M	Capacitor, .1 mfd 400 v.	Video coupling
C-323	V-6023-4104M	Capacitor, .1 mfd 400 v.	Grid by-pass
C-324	RCM20B101K	Capacitor, 100 mmf	I-F coupling
C-325	RCM20B271K	Capacitor, 270 mmf	I-F coupling
C-326	RCM20B271K	Capacitor, 270 mmf	I-F coupling
C-327	RCM20B271K	Capacitor, 270 mmf	I-F coupling
C-328	RCM20B151K	Capacitor, 150 mmf	I-F coupling
C-329	V-3713-3	Capacitor, ceramic variable	Trap tuning
C-330	V-5596	Capacitor, hi-kap .005 mfd	AGC decoupling
C-335	V-5596	Capacitor, hi-kap .005 mfd	Screen by-pass
L-301	V-5902-7	Coil	Video peaking
L-302	V-5902-7	Coil	Video peaking
L-303	V-5902-7	Coil	Video peaking
L-304	V-5899	Coil	Cathode trap
L-306	V-9231	Coil	I-F peaking
L-307	V-6459	Coil	I-F peaking
L-308	V-6459	Coil	I-F peaking
L-309	V-6459	Coil	I-F peaking
L-310	V-5902-4	Coil	Video peaking
L-311	V-5902-5	Coil	Video peaking
L-312	V-5902-1	Coil	Video peaking
L-313	V-6459	Coil	I-F peaking
*R-301	V-9235-2 assy	Control, 1500 ohms (assy consists of R-301 and R-302)	Contrast
*R-302	V-9235-2 assy	Control, 50,000 ohms (assy consists of R-301 and R-302)	Brightness
R-306	RC41AE103K	Resistor, 10,000 ohms 2 w.	Cathode bias
R-307	V-6984-1	Resistor, 2000 ohms 5 w.	Decoupling
R-309	RC20AE680K	Resistor, 68 ohms ½ w.	Cathode bias
R-310	RC20AE680K	Resistor, 68 ohms ½ w.	Cathode bias
R-311	RC20AE101K	Resistor, 100 ohms ½ w.	Cathode bias
R-312	RC20AE101K	Resistor, 100 ohms ½ w.	Cathode bias
R-313	RC20AE102M	Resistor, 1000 ohms ½ w.	Plate decoupling
R-314	RC20AE102M	Resistor, 1000 ohms ½ w.	Screen load
R-315	RC20AE102M	Resistor, 1000 ohms ½ w.	Plate decoupling
R-316	RC20AE102M	Resistor, 1000 ohms ½ w.	Screen load
R-317	RC20AE472K	Resistor, 4700 ohms ½ w.	Grid return
R-318	RC20AE472K	Resistor, 4700 ohms ½ w.	Grid bias
R-319	RC20AE472K	Resistor, 4700 ohms ½ w.	Grid return
R-320	RC20AE103K	Resistor, 10,000 ohms ½ w.	Grid return
R-321	RC20AE103K	Resistor, 10,000 ohms ½ w.	Plate decoupling
R-322	RC20AE103M	Resistor, 10,000 ohms ½ w.	AGC decoupling
R-323	RC20AE103M	Resistor, 10,000 ohms ½ w.	AGC decoupling
R-324	RC20AE223K	Resistor, 22,000 ohms ½ w.	4.5 mc trap loading
R-325	RC20AE473K	Resistor, 47,000 ohms ½ w.	DC divider
R-326	RC20AE104K	Resistor, 100,000 ohms ½ w.	DC divider
R-327	RC20AE682K	Resistor, 6800 ohms ½ w.	Grid return
R-328	RC20AE102M	Resistor, 1000 ohms ½ w.	Plate decoupling
R-329	RC20AE225K	Resistor, 2.2 megs ½ w.	AGC decoupling
R-331	RC20AE123K	Resistor, 12,000 ohms ½ w.	Grid return
R-332	RC20AE154K	Resistor, 150,000 ohms ½ w.	DC divider
R-333	RC30AE473K	Resistor, 47,000 ohms 1 w.	Screen load
R-334	RC30AE224K	Resistor, 220,000 ohms 1 w.	AGC filter
R-335	RC30AE683K	Resistor, 68,000 ohms 1 w.	Screen load
R-336	RC30AE104K	Resistor, 100,000 ohms 1 w.	Screen load
R-337	RC30AE362J	Resistor, 3600 ohms 1 w.	Plate load
R-338	RC41AE103K	Resistor, 10,000 ohms 2 w.	Plate decoupling
R-339	RC20AE222K	Resistor, 2200 ohms ½ w.	Cathode bias
		Section 4—Sweep	
*C-401	V-6977 assy	Capacitor, electrolytic 10 mfd 400 v. (assy consists of C-301, C-302, C-401 and C-402)	Plate decoupling
*C-402	V-6977 assy	Capacitor, electrolytic 10 mfd 400 v. (assy consists of C-301, C-302, C-401 and C-402)	Plate decoupling

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PARTS LIST FOR MODELS H-606K12 AND H-607K12 (*Continued*)

Item	Part No.	Description	Function
*C-403	V-6978 assy	Capacitor, electrolytic 30 mfd 450 v. (assy consists of C-403 and C-501 and C-502)	Filter
C-404	V-9009-1	Capacitor, electrolytic 150 mfd 50 v.	Cathode by-pass
C-405	V-6570	Capacitor, electrolytic 30 mfd 450 v.	Filter
C-406	RCP10W4104M	Capacitor, .1 mfd 400 v.	H.V. supply decoupling
C-407	V-5596	Capacitor, hi-kap .005 mfd	Filament by-pass
C-408	V-5596	Capacitor, hi-kap .005 mfd	Filament by-pass
C-409	V-5596	Capacitor, hi-kap .005 mfd	Filament by-pass
C-410	V-6023-6102M	Capacitor, .001 mfd 600 v.	AFC coupling
C-411	V-6023-6102M	Capacitor, .001 mfd 600 v.	AFC coupling
C-412	V-6023-4472M	Capacitor, .0047 mfd 400 v.	AFC delay
C-413	V-6023-6222M	Capacitor, .0022 mfd 600 v.	Pulse divider
C-414	V-6023-4103M	Capacitor, .01 mfd 400 v.	Vert. sync. coupling
C-415	V-6023-4103M	Capacitor, .01 mfd 400 v.	H. MV coupling
C-416	V-6023-4503M	Capacitor, .05 mfd 400 v.	Sync coupling
C-417	V-6023-4503M	Capacitor, .05 mfd 400 v.	Cathode by-pass
C-418	V-6023-4503M	Capacitor, .05 mfd 400 v.	AFC delay
C-419	V-6023-4104M	Capacitor, .1 mfd 400 v.	Grid by-pass
C-420	V-6023-4104M	Capacitor, .1 mfd 400 v.	V. MV coupling
C-421	V-6023-4104M	Capacitor, .1 mfd 400 v.	Plate decoupling
C-422	V-6023-4104M	Capacitor, .1 mfd 400 v.	Plate decoupling
C-423	V-6066-4254M	Capacitor, .25 mfd 400 v.	Sync coupling
C-424	V-6023-4104M	Capacitor, .1 mfd 400 v.	Coupling
C-425	V-6023-4104M	Capacitor, .1 mfd 400 v.	Cathode by-pass
C-426	V-6023-4104M	Capacitor, .1 mfd 400 v.	Screen by-pass
C-427	V-6066-4254M	Capacitor, .25 mfd 400 v.	Plate by-pass
C-428	V-6023-4104K	Capacitor, .1 mfd 400 v.	Vertical discharge
C-429	V-6023-4103K	Capacitor, .01 mfd	MV coupling
C-430	RCM20B271K	Capacitor, 270 mmf	Grid by-pass
C-431	RCM20B101K	Capacitor, 100 mmf	Plate by-pass
C-432	RCM20B681M	Capacitor, 680 mmf	Horiz. discharge
C-433	RCM20C331J	Capacitor, 330 mmf	Error volt. coupling
C-434	RCM20C331J	Capacitor, 330 mmf	H. MV coupling
C-435	RCM30C392K	Capacitor, 3900 mmf	MV plate tank
C-436	V-9176-15560K	Capacitor, 56 mmf	Transient by-pass
C-437	RCM20B391K	Capacitor, 390 mmf	H. sync coupling
C-438	V-6023-4503M	Capacitor, .05 mfd	Sync coupling
C-442	V-6023-4104M	Capacitor, .1 mfd	Grid by-pass
C-443	RCM20B101K	Capacitor, 100 mmf	Plate by-pass
C-444	V-9465-2	Capacitor, 7 mmf (twin lead 150 ohms)	AGC coupling
L-401	V-9230-2	Choke, feed	Plate load
L-402	V-5900-2	Coil	Focus
L-403	V-6764	Coil	Ringing
L-404	V-4886-2	Choke, RF	Filament
L-405	V-4886-2	Choke	Filament
L-406	V-4886-2	Choke	Filament
L-407	V-4886-2	Choke	Filament
L-413	V-4886-2	Choke, RF	Filament
R-401	V-5908	Control, 400 ohms	Focus
R-402	V-6462	Control, 1 meg	Height
R-403	V-6463	Control, 5,000 ohms	Vert. Lin.
*R-404	V-6464-1 assy	Control, 100,000 ohms (assy consists of R-404 and R-405)	Horizontal hold
*R-405	V-6464-1 assy	Control, 500,000 ohms (assy consists of R-404 and R-405)	Vertical hold
R-406	V-6500-1	Control, 5000 ohms	Width
R-407	RC20AE561K	Resistor, 560 ohms ½ w.	Transient damping
R-408	RC20AE561K	Resistor, 560 ohms ½ w.	Transient damping
R-409	V-6984-6	Resistor, 560 ohms 5 w.	Plate load
R-410	V-6984-5	Resistor, 10,000 ohms 5 w.	Screen load
R-411	V-6984-1	Resistor, 2000 ohms 5 w.	Plate load
R-412	V-4758	Resistor, 110 ohms 3 w.	Focus coil shunt
R-415	RC20AE105K	Resistor, 1 megohm ½ w.	Positive bias limiting
R-418	RC20AE101K	Resistor, 100 ohms ½ w.	Hor. sweep stabilizer
R-419	RC20AE331K	Resistor, 330 ohms ½ w.	Cathode bias
R-420	RC20AE471K	Resistor, 470 ohms ½ w.	Cathode bias
R-421	RC20AE471K	Resistor, 470 ohms ½ w.	Focus coil shunt
R-422	RC20AE102K	Resistor, 1000 ohms ½ w.	Limiting
R-423	RC20AE102K	Resistor, 1000 ohms ½ w.	Cathode bias
R-424	RC20AE182K	Resistor, 1800 ohms ½ w.	Cathode bias
R-425	RC20AE272K	Resistor, 2700 ohms ½ w.	Cathode bias
R-426	RC20AE272K	Resistor, 2700 ohms ½ w.	Plate load
R-427	RC20AE392K	Resistor, 3900 ohms ½ w.	Waveform correction
R-428	RC20AE223K	Resistor, 22,000 ohms ½ w.	Plate load
R-429	RC20AE562K	Resistor, 5600 ohms ½ w.	Plate load
R-430	RC30AE333K	Resistor, 33,000 ohms 1 w.	H. MV decoupling
R-431	RC30AE333K	Resistor, 33,000 ohms 1 w.	H. MV decoupling
R-432	RC20AE273K	Resistor, 27,000 ohms ½ w.	Waveform correction
R-433	RC20AE333K	Resistor, 33,000 ohms ½ w.	Voltage divider
R-434	RC20AE473K	Resistor, 47,000 ohms ½ w.	Plate decoupling
R-436	RC20AE683K	Resistor, 68,000 ohms ½ w.	Error voltage load
R-437	RC20AE104J	Resistor, 100,000 ohms ½ w.	AFC diode load
R-438	RC20AE104J	Resistor, 100,000 ohms ½ w.	AFC diode load
R-439	RC20AE225K	Resistor, 2.2 megohms ½ w.	Grid return
R-440	RC20AE104K	Resistor, 100,000 ohms ½ w.	Plate load
R-441	RC20AE224J	Resistor, 220,000 ohms ½ w.	Grid bias
R-442	RC20AE394J	Resistor, 390,000 ohms ½ w.	Plate load
R-443	RC20AE474K	Resistor, 470,000 ohms ½ w.	Charge limiting
R-444	RC20AE474K	Resistor, 470,000 ohms ½ w.	Grid return
R-445	RC20AE474K	Resistor, 470,000 ohms ½ w.	AFC delay
R-446	RC20AE104K	Resistor, 100,000 ohms ½ w.	Grid return
R-447	RC20AE105K	Resistor, 1.0 megohms ½ w.	Grid return
R-448	RC20AE105K	Resistor, 1.0 megohms ½ w.	Grid return
R-449	RC20AE225K	Resistor, 2.2 megohms ½ w.	Grid return
R-450	RC20AE475K	Resistor, 4.7 megohms ½ w.	Plate load
R-451	RC20AE224K	Resistor, 220,000 ohms ½ w.	Plate load
R-452	RC20AE154K	Resistor, 150,000 ohms ½ w.	Plate load
R-453	RC30AE224K	Resistor, 220,000 ohms 1 w.	Limiting
R-455	RC20AE153K	Resistor, 15,000 ohms ½ w.	Plate load
R-456	V-6067-4	Resistor, glasohm, 150 ohms 3 w.	Cathode bias
R-464	V-5909	Control, 2.5 megohms	Height magnifier
R-465	V-5910	Control, 25,000 ohms	V. lin magnifier
R-469	RC20AE225K	Resistor, 2.2 megohms ½ w.	Diode shunt
R-470	RC20AE101K	Resistor, 100 ohms ½ w.	Parasitic suppressor
R-471	RC20AE101K	Resistor, 100 ohms ½ w.	Parasitic suppressor
SW-401	V-9482-1 assy	Magnifier (assy consists of R-201, SW-401 and SW-501)	
T-401	V-6981-1	Transformer	Vertical output
T-402	V-6481-2	Transformer	Filament
Z-401	V-9213	Filter	Integrating
Z-402	V-6486-2	Yoke assembly	Deflection

Section 5—Power

Item	Part No.	Description	Function
C-501	V-6978 assy	Capacitor, electrolytic 30 mfd 450 v. (assy consists of C-501, C-502 and C-403)	Filter
C-502	V-6978 assy	Capacitor, electrolytic 30 mfd 450 v. (assy consists of C-501, C-502 and C-403)	Filter
C-503	V-5040-15	Capacitor, .01 mfd 600 v.	A-C line by-pass
C-504	V-5040-15	Capacitor, .01 mfd 600 v.	A-C line by-pass
C-505	V-6023-4503M	Capacitor, .05 mfd 400 v.	Screen by-pass
C-506	V-6023-4503M	Capacitor, .05 mfd 400 v.	Plate decoupling
C-507	V-6454	Capacitor	Osc trimmer
C-508	RCM20B271K	Capacitor, 270 mmf	Grid bias
C-509	V-5895	Capacitor, 500 mmf	HV filter
C-510	V-5895	Capacitor, 500 mmf	HV filter
L-501	V-6471	Choke	Filter
L-502	V-9279-1	Choke	RF
R-501	RC41AE333K	Resistor, 33,000 ohms 2 w.	Screen drop
R-502	RC20AE680K	Resistor, 68 ohms ½ w.	Plate decoupling
R-503	RC20AE683K	Resistor, 68,000 ohms ½ w.	Grid bias
R-504	RC20AE104K	Resistor, 100,000 ohms ½ w.	HV filter
SW-501	V-9482-1 assy	Switch, on-off (assy consists of R-201, SW-401 and SW-501)	
T-501	V-6988	Transformer	Power
T-502	V-9278	Transformer, HV	RF

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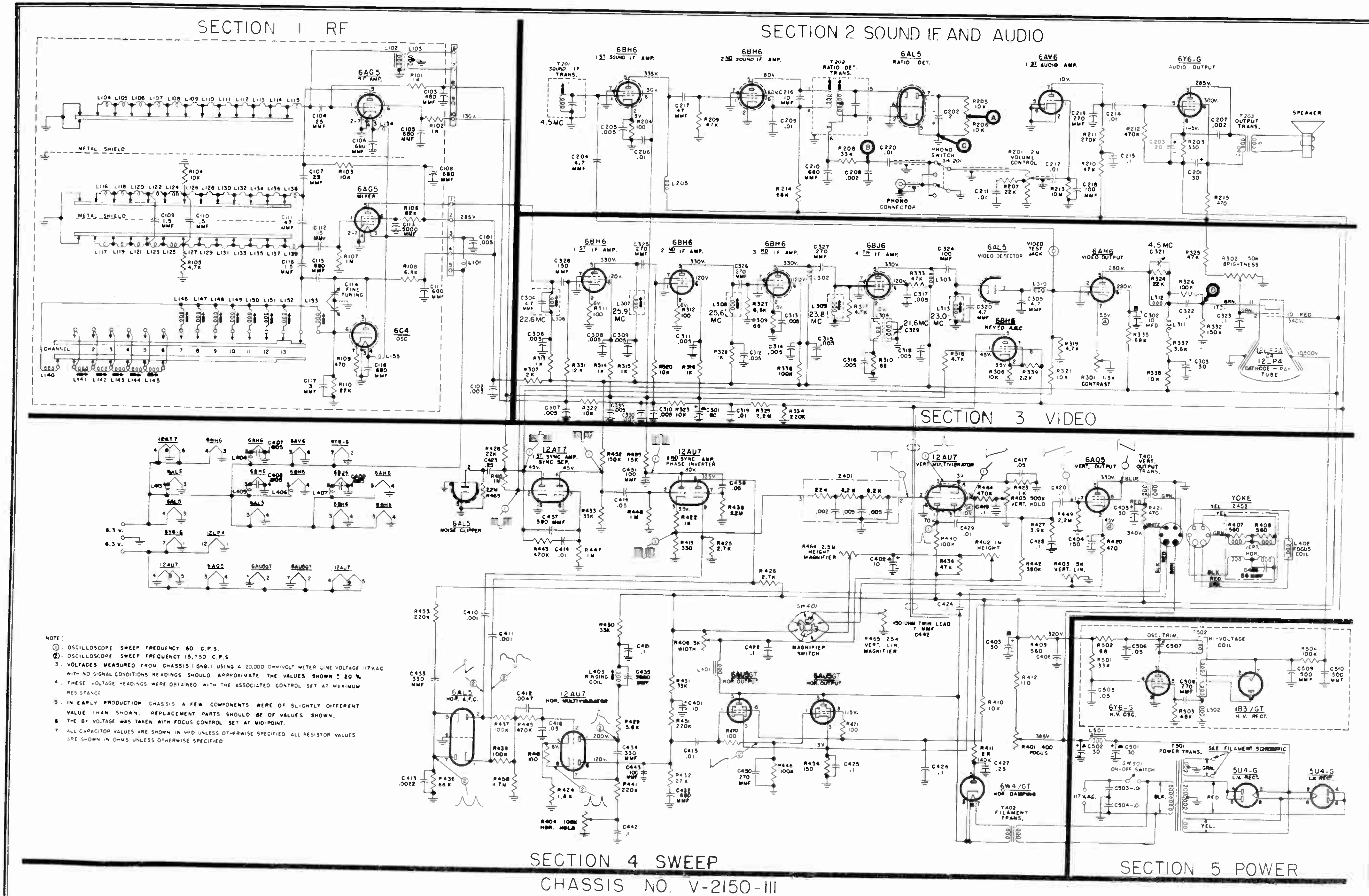

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FIG. 9—SCHEMATIC DIAGRAM

IMPORTANT—Since many of the components are very critical, exact duplicates must be used for replacement purposes. However, any substitute supplied by Westinghouse will assure performance equal to or better than the listed part.

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FREQUENCY RANGES:

Channel Number	Channel Frequency (mc.)	Video Carrier Frequency (mc.)	Audio Carrier Frequency (mc.)	Receiver H-F Oscillator Frequency (mc.)
1	not used	--	--	--
2	54 - 60	55.25	59.75	81.35
3	60 - 66	61.25	65.75	87.35
4	66 - 72	67.25	71.75	93.35
5	76 - 82	77.25	81.75	103.35
6	82 - 88	83.25	87.75	109.35
7	174 - 180	175.25	179.75	201.35
8	180 - 186	181.25	185.75	207.35
9	186 - 192	187.25	191.75	213.35
10	192 - 198	193.25	197.75	219.35
11	198 - 204	199.25	203.75	225.35
12	204 - 210	205.25	209.75	231.35
13	210 - 216	211.25	215.75	237.35

FINE TUNING RANGE:
Plus or minus 400 kc. on Channel 2;
Plus or minus 2 mc. on Channel 13.

OPERATING VOLTAGE:
105 to 120 volts, 60 cycles.

POWER CONSUMPTION: .... 185 watts

AUDIO POWER OUTPUT:
Undistorted .... 1.2 watts
Maximum .... 1.5 watts

LOUDSPEAKER:
Type .... 4" E. M.
Voice Coil Impedance .... 3.2 ohms at 400 cycles

RECEIVER ANTENNA INPUT IMPEDANCE:
.. 300 ohms balanced or 72 ohms unbalanced

TUBE COMPLEMENT:
1 1B3/GT .... High Voltage Rectifier
1 5U4G .... Low Voltage Rectifier
1 6AH6 .... Video Output
1 6AG5 .... Mixer
1 6AG5 .... R.F. Amplifier
1 6AL5 . Video Detector and Noise Clipper
1 6AL5 .... Ratio Detector
1 6AL5 .... Horizontal A. F. C.
1 6K6GT .... Audio Output
1 6AQ5 .... Vertical Output
1 6AV6 .... 1st Audio Amplifier
1 6BH6 .... 1st I. F. Amplifier
1 6BH6 .... 2nd I. F. Amplifier
1 6BH6 .... 3rd I. F. Amplifier
1 6BH6 .... 1st Sound I. F. Amplifier
1 6BH6 .... 2nd Sound I. F. Amplifier
1 6BH6 .... Keyed AGC
1 6BJ6 .... 4th I. F. Amplifier
1 6C4 .... H. F. Oscillator
1 6V6/GT .... High Voltage Oscillator
1 6W4/GT .... Horizontal Damper
1 6BQ6/GT .... Horizontal Output
1 12AT7 1st Sync. Amp. & Sync. Separator
1 12AU7 .... Vertical Multivibrator
1 12AU7 .... Horizontal Multivibrator
1 12AU7 2nd Sync. Amp. & Phase Inverter
1 10BP4 .... Cathode Ray Tube

VIDEO CARRIER INTERMEDIATE FREQUENCY: .... 26.1 mc.

VIDEO RESPONSE: .... 3.6 mc.

AUDIO CARRIER INTERMEDIATE FREQUENCY: .... 4.5 mc.

AUDIO DISCRIMINATOR BAND WIDTH:
(between peaks) .... 150 kc.

FOCUS: .... Magnetic

SWEEP DEFLECTION: .... Magnetic

SCANNING: .... Interlaced 525 line

HORIZONTAL SCANNING FREQUENCY: .... 15,750 CPS

VERTICAL SCANNING FREQUENCY: .... 60 CPS

FRAME FREQUENCY (picture repetition rate): .... 30 CPS

HIGH VOLTAGE WARNING

The danger accompanying shock is always present when the receiver is operated outside the cabinet or when the rear cover is removed from the cabinet. Only a person familiar with the precautions to be observed when working with high-voltage equipment should service this receiver.

CATHODE RAY TUBE HANDLING PRECAUTIONS

Shatterproof goggles and heavy gloves should be worn at all times when handling the cathode ray tube. The tube should not be handled in the vicinity of any person not so equipped. When handling the cathode ray tube, always keep it away from the body.

The cathode ray tube bulb, due to its large surface area and high vacuum contained within, is subjected to high air pressure. More than ordinary care is required to prevent shattering the tube. The large end of the bulb, particularly the rim of the viewing surface, must not be struck, scratched, or subjected to more than moderate pressure at any time. If the tube sticks or fails to slip smoothly into place during installation, remove the tube and determine the cause of the trouble - - **DO NOT FORCE THE TUBE.**

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INSTALLATION INSTRUCTIONS

TO PREPARE THE RECEIVER FOR OPERATION:

Model H-609T10 is shipped in operating condition. There is no shipping material to be removed. Simply remove the receiver from its carton, and connect the A-C plug to a 105 to 120 volt 60 cycle A-C outlet.

However, it is desirable that the adjustment of the ion trap magnet be checked in order to obtain best performance from the receiver. A check of this adjustment will also avoid the possibility of C.R.T. damage resulting from prolonged operation with an incorrectly adjusted ion trap magnet. To check the adjustment, proceed as follows:

1. Remove the screws that secure the rear cover to the cabinet.

2. Remove the rear cover by pulling it straight out from the cabinet.

3. Apply power to the receiver using a temporary line cord connected between the A-C receptacle on the chassis and an A-C outlet.

4. Adjust the ion trap magnet as explained under ADJUSTMENTS.

Model H-609T10 contains a built-in antenna for use in areas of normal reception. In such areas when the built-in antenna provides good reception, no antenna connections are required. However, in weak signal areas or under adverse conditions, it may be necessary to use an external antenna. In this event, the antenna lead-in can be connected to the antenna terminals on the back of the receiver after disconnecting the built-in antenna wires that normally connect to these terminals. The lugs on the built-in antenna should then be insulated and dressed in such a position that they do not touch the chassis or components. If desired, the clamp located on the left side (facing the rear) of the cabinet can be used to hold the built-in antenna feeder out of the way.

TO CHECK THE OPERATION OF THE RECEIVER:

1. Rotate the BRIGHTNESS and CONTRAST controls completely counterclockwise.

2. Turn on the receiver by rotating the OFF-ON-VOLUME control clockwise.

3. Rotate the CHANNEL SELECTOR to the channel number of the desired station.

4. Rotate the BRIGHTNESS control clockwise until the screen is well lighted.

5. Rotate the CONTRAST control clockwise until a picture appears on the screen.

6. If the built-in antenna is in use, adjust the TELEVISION ANTENNA control for maximum picture contrast. If an external antenna is in use, this step is not required.

7. If the picture is moving up or down or quivering, adjust the VERTICAL HOLD control to stabilize the image.

8. If horizontal or diagonal bars or a folded-over picture appears on the screen, adjust the HORIZONTAL HOLD control to obtain a clear picture.

9. Adjust the FINE TUNING control for the best picture detail.

10. Readjust the BRIGHTNESS and CONTRAST controls until pleasing shades ranging from clear white to intense black are attained.

11. Adjust the VOLUME control for the desired sound volume.

12. Check the operation on all available television stations. Note that if the built-in antenna is in use, the TELEVISION ANTENNA control must be readjusted for maximum picture contrast each time the receiver is tuned to a different channel.

13. If necessary, adjust the vertical linearity, height, width, and focus controls as explained under ADJUSTMENTS.

ADJUSTMENTS

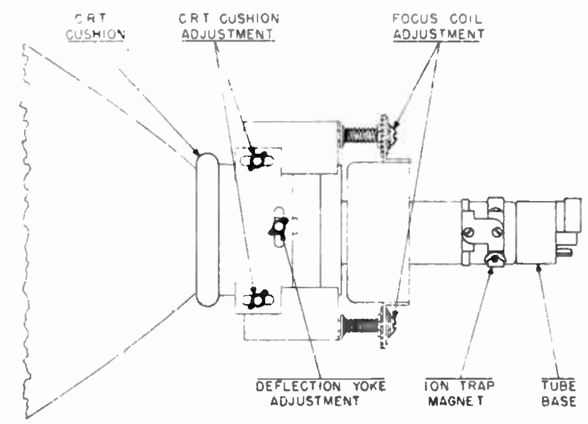

FIG. 1 — TOP VIEW OF C.R.T.

The picture adjustments are located on the rear of the chassis and are accessible through cut-outs in the back cover.

ION TRAP MAGNET

CAUTION: When adjusting the ion trap magnet, care must be exercised to avoid breaking the neck of the C.R.T.

The ion trap magnet must always be adjusted for maximum picture brightness. With the magnet oriented approximately as shown in Fig. 1, rotate it around the neck of the tube and move it forward and backward until the position is found where the brightest raster is obtained.

FOCUS COIL

Incorrect centering of the picture or a shadow on one corner of the picture may indicate that the focus coil is in need of adjustment. If only a slight adjustment is required, it can be made by turning the focus coil adjustment screws in or out as required.

If a major adjustment of the focus coil is required, the procedure is as follows:

1. Turn the focus coil adjustment screws in or out until the focus coil is positioned at right angles to the neck of the C.R.T. and there is a slight separation between the deflection yoke and the focus coil.

2. Loosen the lock nuts located under the heads of the adjustment screws and slide the focus coil up or down or sideways until the picture is correctly centered. Large holes in the focus coil brackets permit this movement of the coil.

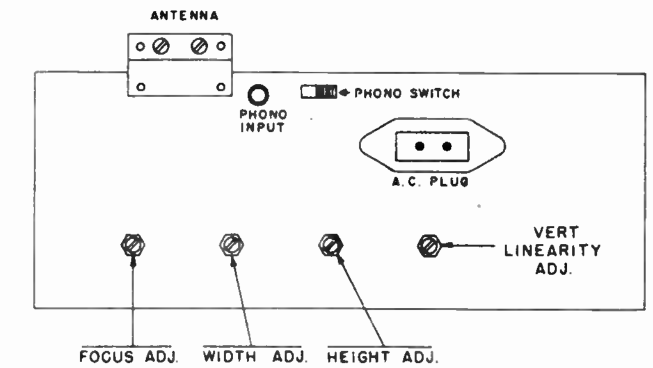

FIG. 2 — REAR VIEW OF CHASSIS

3. Tighten the lock nuts while taking care that the screws do not turn during the process.

4. Fine centering adjustments can be made by turning one or more of the screws in or out.

CATHODE RAY TUBE CUSHION

The cushion must fit snugly against the flare of the cathode ray tube in order that the rear of the tube will be supported firmly.

DEFLECTION YOKE

This adjustment controls the angle of the picture with respect to the horizontal. If the picture is not squared in the picture mask, loosen the wing nut and move it to the left or right so as to rotate the deflection yoke. The picture will tilt to the left or right with the deflection yoke rotation.

FOCUS CONTROL

The focus control (Fig. 2) should be adjusted with the brightness and contrast controls in their normal positions. If correct focusing cannot be obtained, the high voltage oscillator may require adjustments.

HEIGHT AND VERTICAL LINEARITY

The height adjustment controls the overall height of the picture, while the vertical linearity adjustment governs contraction or expansion of the upper portion only. For this reason, a balance between the two controls is necessary to make the picture symmetrical and fill the mask vertically.

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WIDTH

The width control should be adjusted so that the picture fills the mask horizontally.

HORIZONTAL RINGING COIL

To adjust the horizontal ringing coil (L403), tune in the weakest station in the area, set the horizontal hold control at approximately the middle of its range, and adjust L403 (location shown on Fig. 8) until the picture is properly "locked-in".

HIGH VOLTAGE OSCILLATOR

1. *Turn off the receiver* and disconnect the high voltage lead from the C.R.T.

2. Connect 13 one megohm, one watt resistors in series between the high voltage lead and the chassis.

3. Connect a kilovoltmeter across the 13 megohms of resistance.

4. Turn on the receiver and adjust C507 (location shown on Fig. 8) for maximum voltage indication on the meter.

5. *Turn off the receiver*, disconnect the kilovoltmeter, remove the 13 megohms of resistance, and connect the high voltage lead to the C.R.T.

CHASSIS REMOVAL

Removal of the chassis is complicated somewhat by the built-in antenna. The recommended procedure is as follows:

1. Remove the control knobs from the front of the receiver.

2. Remove the wood screws that secure the back cover, and remove the back cover by pulling it away from the cabinet.

3. Remove the built-in antenna feeder from the antenna terminals on the rear of the chassis.

4. Remove the thumb tack that secures the end of the antenna tuning stub to the top of the cabinet.

5. Remove the two screws that secure the antenna trimmer brackets to the top of the cabinet.

6. Using care to avoid bending the antenna tuning stub, pull the trimmer shaft and rubber coupling off the pulley shaft thus detaching the trimmer and tuning stub assembly.

7. Remove the hex-head chassis mounting bolts from the bottom of the cabinet.

8. Remove the chassis from the cabinet. The pulley shaft is sufficiently flexible to allow passage of the chassis.

To replace the chassis, the above procedure should be reversed.

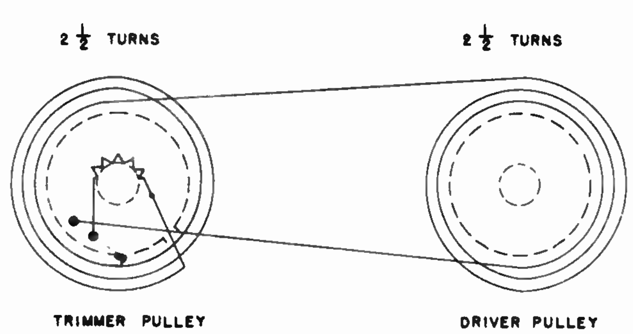

FIG. 3 — DRIVE STRING ARRANGEMENT

ALIGNMENT

TEST EQUIPMENT—To properly service the chassis, the following test equipment should be available:

1. R-F sweep generator which meets the following requirements:

   a. Frequency range from 18 to 30 mc. with a sweep width of 10 mc.

   b. Output adjustable with at least 100,000 microvolts maximum and a very low minimum.

   c. Output "flat" on all attenuator positions.

2. Cathode-ray oscilloscope, preferably one with a wide band vertical deflection amplifier and a low-capacitance input probe.

3. Signal generator capable of providing output frequencies listed below.

21.6 mc.	4th I-F trap
22.6 mc.	1st I-F
25.9 mc.	2nd I-F
25.6 mc.	3rd I-F
23.8 mc.	4th I-F
23.0 mc.	5th I-F
4.5 mc.	Audio I-F and ratio detector (the frequency must be extremely accurate, preferably crystal controlled.)

NOTE: The R-F output level on all the above frequencies should be adjustable with at least 100,000 microvolts maximum and a very low minimum.

4. Heterodyne frequency meter with crystal calibrator (if the signal generator does not include a crystal calibrator).

5. Electronic voltmeter (vacuum tube voltmeter), with a high voltage multiplier probe for measurements up to 15,000 volts and an R-F probe for measuring R-F voltages.

GENERAL INFORMATION—All test equipment and the chassis should be bonded together by short lengths of heavy (½ inch) braided copper ribbon. The interconnecting leads should be shielded (72 ohms coaxial cable) and should be as short as possible consistent with ease of making connections. The effectiveness of the bonding can be checked during alignment by placing the hand on the metal chassis or test equipment case. If the response pattern or meter reading changes visibly, the bonding must be improved before the circuits are aligned.

COMMON I-F ALIGNMENT PROCEDURE

1. Rotate the channel selector switch to channel 3.

2. Connect the signal generator to the mixer tube through the coupling device shown in Fig. 4. The device is constructed by squeezing together a miniature tube shield until it fits the tube snugly and does not ground to the chassis. A .005 mfd capacitor is then soldered to the side of the shield. By sliding the tube shield up or down on the tube, the capacitance between the shield and the tube elements can be varied to obtain additional control of the coupling over that provided by the attenuator in the generator itself. The ground side of the generator output cable should be connected to the receiver chassis.

3. Connect a vacuum tube voltmeter to the video test jack on the receiver chassis, and set the meter to its 5 volt scale.

4. Set the signal generator to 21.6 mc. (unmodulated), and adjust C329 for ***minimum*** voltage on the VTVM. Use a strong signal for this adjustment.

5. Set the signal generator to 22.6 mc. (unmodulated), and adjust L306 for maximum voltage on the VTVM. *During this adjustment, keep the signal generator output adjusted so that the VTVM reading does not exceed 2 volts.*

6. Set the signal generator to 25.9 mc. (unmodulated), and adjust L307 for maximum voltage on the VTVM. *During this adjustment, keep the signal generator output adjusted so that the VTVM reading does not exceed 2 volts.*

7. Set the signal generator to 25.6 mc. (unmodulated), and adjust L308 for maximum voltage on the VTVM. *During this adjustment, keep the signal generator output adjusted so that the VTVM reading does not exceed 2 volts.*

8. Set the signal generator to 23.8 mc. (unmodulated), and adjust L309 for maximum voltage on the VTVM. *During this adjustment,*

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keep the signal generator output adjusted so that the VTVM reading does not exceed 2 volts.

9. Set the signal generator to 23.0 mc. (unmodulated), and adjust L313 for maximum voltage on the VTVM. *During this adjustment, keep the signal generator output adjusted so that the VTVM reading does not exceed 2 volts.*

10. Connect the *sweep* generator to the mixer tube through the coupling device previously described. The *signal* generator will be used in the following steps to provide marker indications at various frequencies on the response curve. In this application, the signal generator input to the set must be low in amplitude to avoid distorting the response curve. To reduce the signal generator input accordingly, the signal generator should be *loosely* coupled to the set by wrapping a few turns of insulated wire around the coupling capacitor "pigtail" and connecting the signal generator to this wire.

11. Connect the vertical input of the oscilloscope to the video test jack through the de-coupling network shown in Fig. 5. The oscilloscope horizontal input should be connected to the sweep output from the sweep generator; turn the sweep control on the oscilloscope to the "X" or "OFF" position.

12. Adjust the sweep generator for a center frequency of 25.3 mc. with a 10 mc. deviation. Adjust the sweep generator output until a setting is found where there is very little noise on the oscilloscope pattern.

The oscilloscope pattern obtained should be similar to that shown in Fig. 6. Use the signal generator as a marker to check at the frequencies indicated. If the pattern obtained is not similar to Fig. 6, L306, L307, L308, L309, and L313 should be re-adjusted to produce the correct pattern. The affect of the adjustments will be as follows:

- L306 affects the low frequency side of the curve.
- L307 affects the high frequency side of the curve and the position of the video I-F carrier.
- L308 affects the center of the curve.
- L309 affects the tilt of the "shelf" of the curve.
- L313 affects the center and the low frequency side of the curve.

SOUND I-F AND 4.5 MC. TRAP ALIGNMENT PROCEDURE

1. Connect the "high" side of the signal generator to the video test jack through a .001 mfd capacitor, and ground the "low" side to the chassis.

2. Connect the vacuum tube voltmeter to the points indicated on the bottom view of the chassis, Fig. 8. The common lead should connect to point "C" and the "high" lead should connect to point "A". Set the meter on its 5 volt (-DC) scale.

3. Adjust the signal generator to 4.5 mc. (unmodulated). The accuracy of this frequency is very important. If a crystal controlled signal generator is not available, the frequency should be checked using a frequency meter with a crystal calibrator.

4. Adjust T201 and the primary of T202 for maximum voltage on the VTVM. *During this adjustment, keep the signal generator output adjusted so that the VTVM reading does not exceed 5 volts.*

5. Connect the common lead from the VTVM to point "A" (Fig. 8), and connect the "high" lead to point "B". Here it is important that the case and components of the VTVM are *not* grounded to the receiver chassis; otherwise, point "A" would be shorted to the chassis through the common lead.

6. Using the same signal generator amplitude and frequency as in step 4, adjust the secondary of T202 for *zero* voltage on the VTVM. As the adjustment is tuned through resonance, the voltage will rapidly change from one polarity to the opposite polarity. The point where the voltage is zero is the correct setting.

7. Connect the common lead from the VTVM to the chassis, and connect the *R-F probe* from the VTVM to the junction of R324 and R325. This point is shown as point "D" on Fig. 8. *Note that point "D" is 150 volts above ground and, therefore, the R-F probe must contain a blocking capacitor.*

8. Using a strong 4.5 mc. signal applied as in step 1, adjust C321 for ***minimum*** voltage on the meter.

H.F. OSCILLATOR ALIGNMENT PROCEDURE

If the 6C4 H-F oscillator tube is replaced in this tuner, the different inter-electrode capacitance of the new tube may change the oscillator frequency enough to necessitate re-alignment of the oscillator.

The oscillator adjusting screws are located on the front of the tuner assembly, and this procedure should be followed for their adjustment:

1. Remove the channel selector and fine tuning knobs. Remove the selector escutcheon plate and escutcheon mounting plate by removing the Phillips head screws securing them to the cabinet. The adjustments are accessible through the hole in the cabinet.

2. Set the fine tuning control to the middle of its range, and leave it in this position during the following adjustments.

3. Set the channel selector switch to the highest of the low band (channels 2 through 6) stations operating in your locality.

4. Peak the appropriate oscillator slug for the best picture detail.

5. Repeat step 4 for each progressively lower channel on which a station transmits in your area.

6. Set the channel selector switch to the highest of the high band (channels 7 through 13) stations operating in your locality.

7. Peak the appropriate oscillator slug for the best picture detail.

8. Repeat step 7 for each progressively lower channel in the high band on which a nearby station transmits.

9. Check the previously made low band adjustments, and if the tuning has changed repeat steps 3 through 8.

I-F ALIGNMENT CHART

Turn the channel selector to channel 3 to avoid undesirable beat response during alignment.

COMMON I-F SECTION

Couple the sweep and marker generators to the mixer tube as shown in Fig. 4.

Step	*Sweep Gen. Frequency*	*Marker Gen. Frequency*	*Remarks*	*Indicator Connection*	*Adjust*
1.	Not used	21.6 mc. unmodulated	Use a strong signal	Connect VTVM to video test jack	C329 for *minimum* voltage
2.	Not used	22.6 mc. unmodulated	Keep marker output adjusted so VTVM reading does not exceed 2 v.	Same as step 1	L306 for maximum voltage
3.	Not used	25.9 mc. unmodulated	Same as step 2	Same as step 1	L307 for maximum voltage
4.	Not used	25.6 mc. unmodulated	Same as step 2	Same as step 1	L308 for maximum voltage
5.	Not used	23.8 mc. unmodulated	Same as step 2	Same as step 1	L309 for maximum voltage
6.	Not used	23.0 mc. unmodulated	Same as step 2	Same as step 1	L313 for maximum voltage
7.	25.3 mc. with 10 mc. deviation	check at: 21.6 mc. 22.5 mc. 23.5 mc. 25.3 mc. 26.1 mc.	Keep sweep output low enough so that very little noise appears on the oscilloscope trace	Connect oscilloscope to video test jack. See Fig. 5.	If necessary, adjust L306, L307, L308, L309, and L313 to obtain correct response curve. See Fig. 6.

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SOUND I-F SECTION AND 4.5 MC. TRAP

Connect the signal generator to the video test jack through a .001 mfd mica capacitor.

Step	Signal Gen. Frequency	VTVM Connection	Remarks	Adjust
1.	4.5 mc. unmodulated	See Fig. 8. Common lead to point "C" and high lead to point "A".	Use 5 v. (—DC) scale on meter. Set sig. gen. output accordingly.	T201 and the primary of T202 for maximum voltage
2.	4.5 mc. unmodulated	See Fig. 8. Common lead to point "A" and high lead to point "B".	Use same sig. gen. output as in step 1.	The secondary of T202 for *zero* voltage
3.	4.5 mc. unmodulated	See Fig. 8. R-F probe to point "D" and common lead to chassis.	Use strong signal from generator	C321 for *minimum* voltage

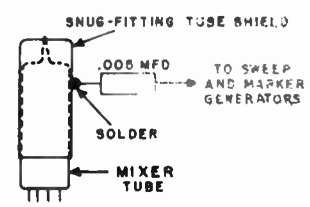

FIG. 4—COUPLING SIGNAL GENERATORS TO MIXER TUBE

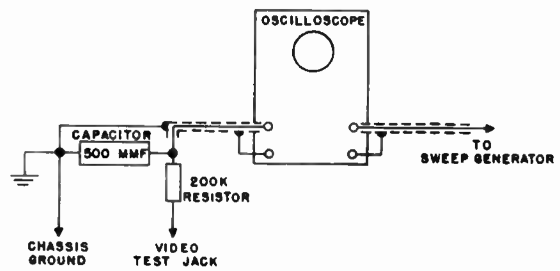

FIG. 5—OSCILLOSCOPE ISOLATION NETWORK

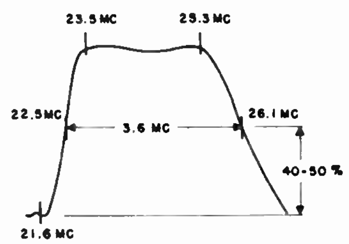

FIG. 6—I-F RESPONSE CURVE

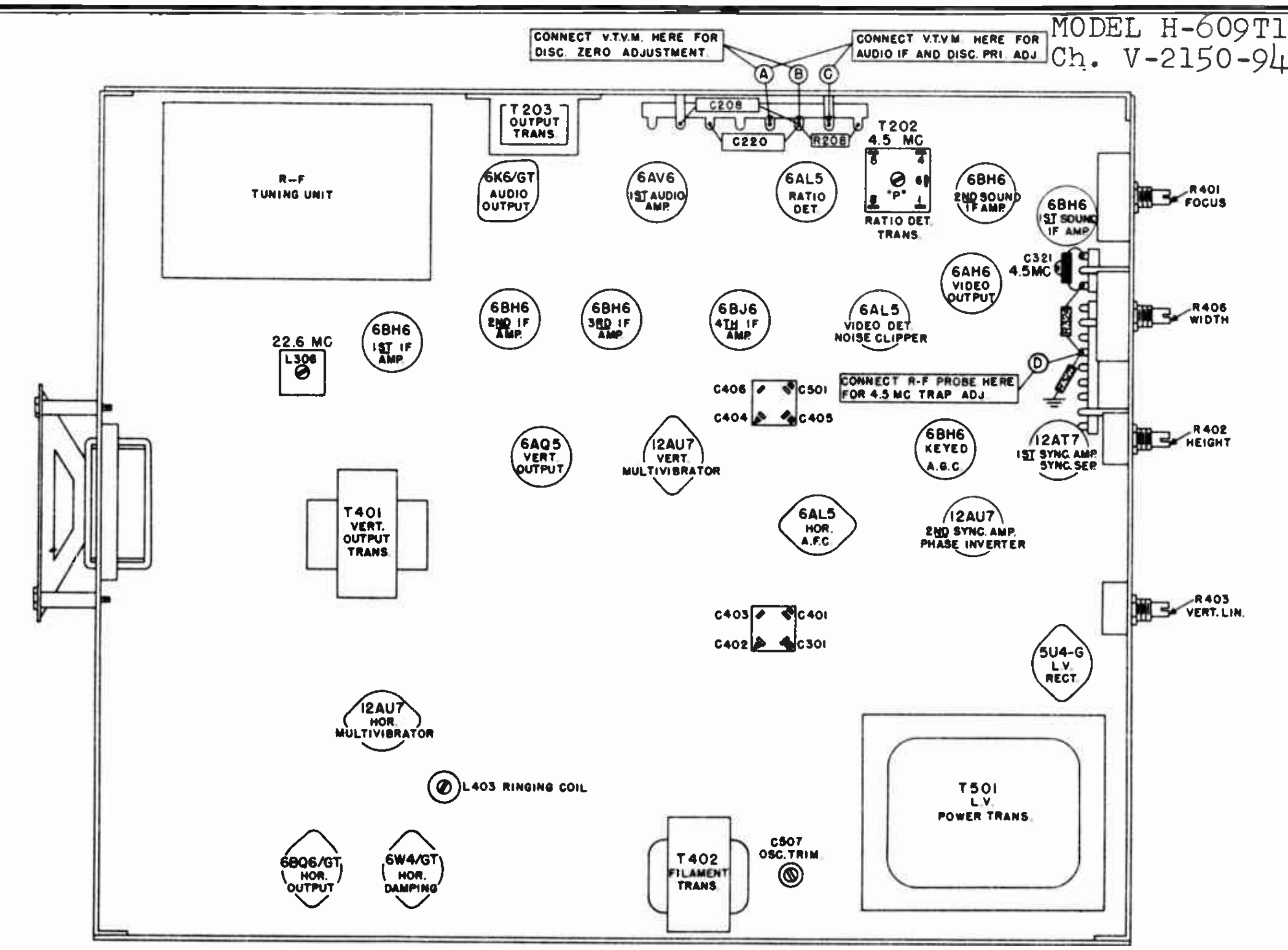

FIG. 8—BOTTOM VIEW OF CHASSIS

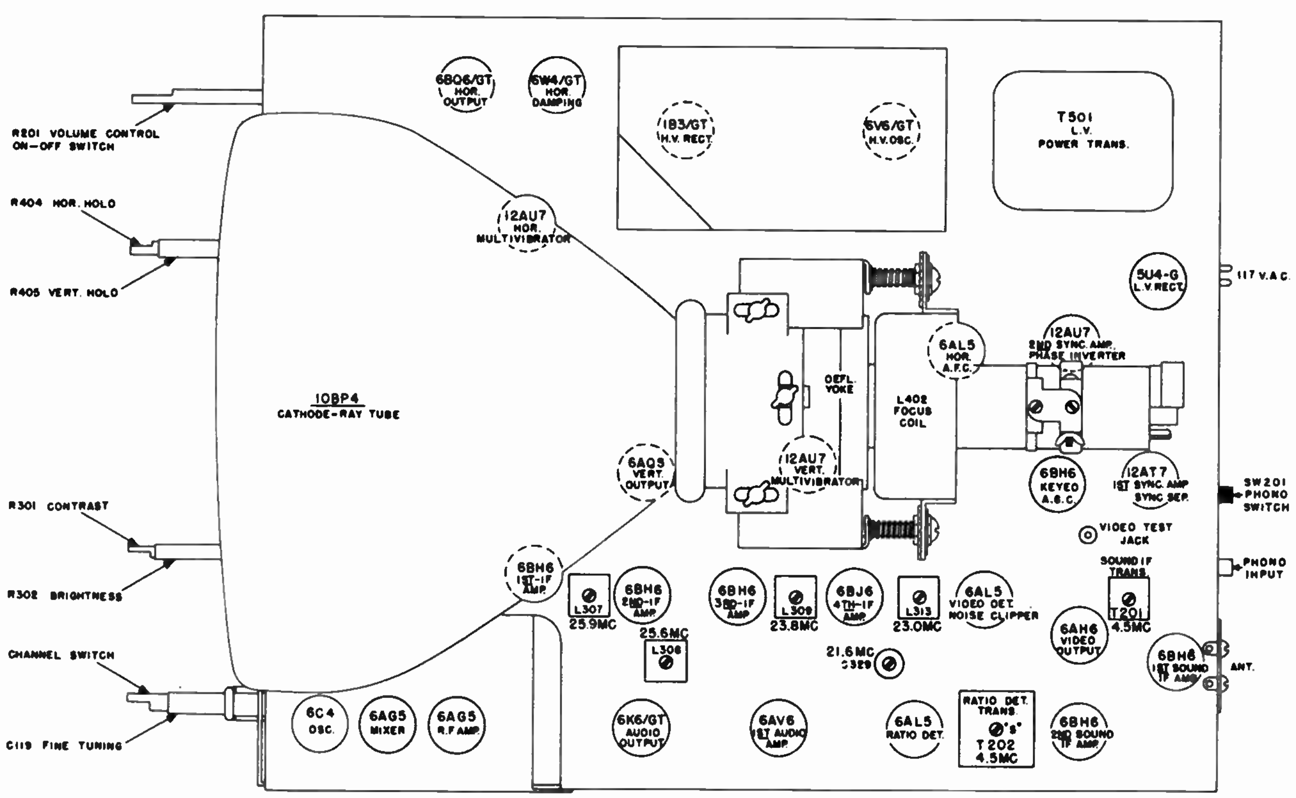

FIG. 7—TOP VIEW OF CHASSIS

PARTS LIST FOR MODEL H-609T10

When ordering parts, specify model number of set in addition to part number and description of part.

CABINET

Part No.	Description
V-3371-1	Bumper, feet (recessed)
V-1198-1	Cabinet
V-9221-2	Cover, assembly, back
V-5976	Cushion, rubber (strap assembly)
V-9103-2	Escutcheon, channels
V-6146-1	Knob, contrast, horizontal hold (front)
V-9104-1	Knob, brightness, vertical hold (rear)
V-9104-3	Knob, volume, on-off (rear)
V-6146-5	Knob, volume, on-off (front)
V-9104-4	Knob, fine tuning (rear)
V-7983	Knob, channel selector (rear)
V-5100-1	Knob, television antenna
V-9475-1	Mask, 10" television tube
V-6935	Plate, escutcheon
V-6288-8	Plate, front glass
V-9324-2	Pulley assembly, top
V-9323-2	Pulley assembly, side
V-6936-2	Screw, #2 Phillips recessed (selector escutcheon)
V-6049-2	Screw, #2 Phillips recessed (escutcheon plate)
V-6059	Spring, fine tuning knob
V-6063-1	Spring, selector knob
V-3258S	Spring, television antenna, knob
V-5421-5	Washer, felt (vertical and brightness knob)
V-3267S-10	Washer, flat (mounting chassis)

MISCELLANEOUS

Part No.	Description
V-9376-1	Antenna assembly
V-6511-2	Adapter plate, RF tuner
V-4169-1	Base, miniature tube (6BH6, 6AL5, 6BJ6)
V-6602-1	Base, miniature tube (12AU7 vertical MV)
V-6453-2	Bracket rivet assembly, deflection yoke
V-5426	Clip, I-F mounting
V-9242	Clip, tube cap
V-5906-1	Connector assembly, hi-voltage
V-3254S	Connector, phono
V-5522	Cord, power A-C
V-3449	Drive shaft, bearing (focus coil mounting)
V-9234	Hood, yoke mounting
V-5917-2	Insulator, stand off
V-6573-3	Magnet, ion trap
V-5549	Plug, A-C male
V-5926	Screw, #8-32 wing (hood and yoke)
V-6602-2	Shield, miniature tube (12AU7 vertical MV)
V-4169-2	Shield, miniature tube (6BH6, 6AL5, 6BJ6)
V-9440-3	Socket assembly, cathode ray tube
V-5929	Socket, molded octal tube (1B3 hi-voltage)

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PARTS LIST FOR MODEL H-609T10 (Continued)

Ref. No.	Part No.	Description	Function
V-4292S-1		Socket, miniature molded (6BH6, 6BJ6, 6AV6, 6AL5, 6AQ5)	
V-6878-1		Socket, miniature wafer (6AL5 horizontal AFC)	
V-6997-2		Socket, miniature shock mounted (6AH6)	
V-5556-1		Socket, miniature molded (12AU7 2nd sync amp, 12AT7)	
V-6089-1		Socket, miniature molded (12AU7 vertical MV)	
V-4514		Socket, molded octal (6BQ6, 6W4)	
V-4195		Socket, molded octal (6K6, 5U4)	
V-9236		Speaker, 4" EM	
V-6477-1		Spring, focus coil mounting	
V-6478		Strap assembly, CRT	
V-5977		Tip jack, (video test)	
V-6294		Terminal board, antenna	
V-3274S		Tube holder, 5U4G	

V-2150—94C CHASSIS

Section 1—R-F Unit

Ref. No.	Part No.	Description	Function
V-8215		Tuner assembly	

Section 2—Sound I-F and Audio

Ref. No.	Part No.	Description	Function
C204	V-6570	Capacitor, electrolytic, 30 mfd 450 v.	Audio decoupling
C205	V-3236	Capacitor, electrolytic, 20 mfd 25 v.	Audio cathode by-pass
C206	V-4880	Capacitor, electrolytic, 2 mfd 50 v.	Ratio det. stabilizer
C207	V-5658-2	Capacitor, 2.2 mmf	Sound take off
C208	RCP10W6202M	Capacitor, .002 mfd	De-emphasis
C209	V-6066-4103M	Capacitor, .01 mfd	Cathode by-pass
C210	RCP10W6202M	Capacitor, .002 mfd	Plate by-pass
C211	RCP10W4502M	Capacitor, .005 mfd	Bass compensation
C212	RCP10W4103M	Capacitor, .01 mfd	Screen by-pass
C213	RCM20B681M	Capacitor, 680 mmf	De-emphasis
C214	RCP10W4103M	Capacitor, .01 mfd	A-F coupling
C215	RCP10W4103M	Capacitor, .01 mfd	A-F coupling
C216	V-5658-6	Capacitor, 4.7 mmf	Tuning capacitor
C217	RCM20B470M	Capacitor, 47 mmf	A-F coupling
C218	RCM20B101M	Capacitor, 100 mmf	Grid by-pass
C219	RCM20B271M	Capacitor, 270 mmf	R-F by-pass
C220	RCP10W4103M	Capacitor, .01 mfd	A-F coupling
L205	V-5902-4	Coil, 100 microhenries	Plate load
*R201	Part of V-6465-1 assy	Control, 1 meg (assy consists of R201 and switch)	Volume control
R202	RC20AE121K	Resistor, 120 ohms ½ w.	Cathode bias
R203	RC20AE331K	Resistor, 330 ohms ½ w.	Cathode bias
R204	RC20AE681K	Resistor, 680 ohms ½ w.	Audio decoupling
R205	RC20AE103J	Resistor, 10,000 ohms ½ w.	Ratio det. load
R206	RC20AE103J	Resistor, 10,000 ohms ½ w.	Ratio det. load
R207	RC20AE223K	Resistor, 22,000 ohms ½ w.	Bass boost
R208	RC20AE333K	Resistor, 33,000 ohms ½ w.	De-emphasis
R209	RC20AE473K	Resistor, 47,000 ohms ½ w.	Grid return
R210	RC20AE274K	Resistor, 270,000 ohms ½ w.	Plate load
R211	RC20AE474K	Resistor, 470,000 ohms ½ w.	Grid bias
R212	RC20AE106M	Resistor, 10 megs ½ w.	Grid return
R213	RC30AE683K	Resistor, 68,000 ohms 1 w.	Plate load
SW201	V-5406	Switch, phono	
T201	V-6517	Transformer, sound I-F	I-F tuning
T202	V-6483	Transformer	Ratio detector
T203	V-9238	Transformer	Output

Section 3—Video

Ref. No.	Part No.	Description	Function
*C301	Part of V-5891 assy	Capacitor, electrolytic 10 mfd 350 v. (assy consists of C403, C402, C401 and C301)	Filter
C302	V-5658-1	Capacitor, 1.0 mmf	H. F. osc. trap
C303	V-5658-6	Capacitor, 4.7 mmf	Plate by-pass
C304	V-5596	Capacitor, hi-kap .005 mfd	AGC filter
C305	V-5596	Capacitor, hi-kap .005 mfd	Cathode by-pass
C306	V-5985	Capacitor, electrolytic, 10 mfd 350v.	Screen filter
C308	RCP10W4104M	Capacitor, .1 mfd	Video coupling
C309	RCP10W4104M	Capacitor, .1 mfd	Grid by-pass
C310	R5CC21ZY101M	Capacitor, 100 mmf	I-F coupling
C312	R5CC21ZY151M	Capacitor, 150 mmf	I-F coupling
C313	R5CC21ZY151M	Capacitor, 150 mmf	I-F coupling
C314	R5CC21ZY151M	Capacitor, 150 mmf	I-F coupling
C315	R5CC21ZY151M	Capacitor, 150 mmf	I-F coupling
C316	R5CC26ZY152M	Capacitor, 1500 mmf	Plate decoupling
C317	R5CC26ZY152M	Capacitor, 1500 mmf	AGC decoupling
C318	R5CC26ZY152M	Capacitor, 1500 mmf	Screen by-pass
C319	R5CC26ZY152M	Capacitor, 1500 mmf	AGC decoupling
C320	R5CC26ZY152M	Capacitor, 1500 mmf	Screen by-pass
C321	V-6376	Capacitor, ceramic variable	4.5 mc trap
C322	R5CC26ZY152M	Capacitor, 1500 mmf	Screen by-pass
C323	R5CC26ZY152M	Capacitor, 1500 mmf	Cathode by-pass
C324	R5CC26ZY152M	Capacitor, 1500 mmf	Screen dropping
C326	V-5596	Capacitor, hi-kap .005 mfd	Screen by-pass
C329	V-3713-3	Capacitor, ceramic variable	21.6 mc trap
	V-6962-1	Crystal, 1N34	AGC detector
C330	V-5658-6	Capacitor, 4.7 mmf	I-F tuning
C331	RCP10W4103M	Capacitor, .01 mfd	AGC filter
L301	V-9501-1	Coil, reactor, 1.1 microhenries	HF osc. trap
L302	V-5902-7	Coil, 40 microhenries	Plate load
L303	V-5902-7	Coil, 40 microhenries	Plate load
L304	V-5902-7	Coil, 40 microhenries	Plate load
L305	V-5902-4	Coil, 100 microhenries	Video peaking
L306	V-9231	Coil	I-F peaking
L307	V-6459	Coil	I-F peaking
L308	V-6459	Coil	I-F peaking
L309	V-6459	Coil	I-F peaking
L310	V-5899	Coil	Cathode trap
L312	V-5902-5	Coil, 250 microhenries	Video peaking
L313	V-6459	Coil	I-F peaking
L314	V-5902-1	Coil, 140 microhenries	Video peaking
R301	Part of V-9235-2 assy	Control, 1500 ohms (assy consists of R301 and R302)	Contrast control
R302	Part of V-9235-2 assy	Control, 50,000 ohms (assy consists of R301 and R302)	Brightness control
R303	V-6984-8	Resistor, 2700 ohms 5 w.	Screen bus dropping
R304	RC20AE683K	Resistor, 68,000 ohms ½ w.	Screen dropping
R305	RC20AE680K	Resistor, 68 ohms ½ w.	Cathode bias
R306	RC20AE680K	Resistor, 68 ohms ½ w.	Cathode bias
R307	RC20AE101K	Resistor, 100 ohms ½ w.	Cathode bias
R308	RC20AE101K	Resistor, 100 ohms ½ w.	Cathode bias
R309	RC20AE102M	Resistor, 1000 ohms ½ w.	I-F decoupling
R310	RC20AE102M	Resistor, 1000 ohms ½ w.	Plate decoupling
R311	RC20AE102M	Resistor, 1000 ohms ½ w.	Plate decoupling
R312	RC20AE102M	Resistor, 1000 ohms ½ w.	Plate decoupling
R314	RC20AE472K	Resistor, 4700 ohms ½ w.	Grid return
R316	RC20AE562K	Resistor, 5600 ohms ½ w.	Grid return
R317	RC20AE103K	Resistor, 10,000 ohms ½ w.	Grid return
R318	RC20AE103K	Resistor, 10,000 ohms ½ w.	AGC decoupling
R319	RC20AE103K	Resistor, 10,000 ohms ½ w.	AGC decoupling
R320	RC20AE333K	Resistor, 33,000 ohms ½ w.	4.5 mc trap load
R324	RC20AE104K	Resistor, 100,000 ohms ½ w.	DC divider
R325	RC20AE154K	Resistor, 150,000 ohms ½ w.	Cathode bias
R327	RC20AE225K	Resistor, 2.2 megs ½ w.	DC divider
R329	RC20AE123K	Resistor, 12,000 ohms ½ w.	Grid return
R330	RC30AE362J	Resistor, 3600 ohms 1 w.	Plate load
R331	RC30AE392K	Resistor, 3900 ohms 1 w.	Screen drop
R332	RC20AE223K	Resistor, 22,000 ohms ½ w.	Bass Boost
R334	RC20AE473K	Resistor, 47,000 ohms ½ w.	DC divider
R335	RC20AE222K	Resistor, 2200 ohms ½ w.	Contrast control shunt
R336	RC20AE103K	Resistor, 10,000 ohms ½ w.	Decoupling
R337	RC20AE472K	Resistor, 4700 ohms ½ w.	Grid return
R338	RC30AE334K	Resistor, 330,000 ohms 1 w.	AGC filter
R339	RC20AE472K	Resistor, 4700 ohms ½ w.	Grid AGC keyer
R340	RC20AE103K	Resistor, 10,000 ohms ½ w.	Cathode bias
R341	RC20AE473K	Resistor, 47,000 ohms ½ w.	Cathode bias

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PARTS LIST FOR MODEL H-609T10 *(Continued)*

Section 4—Sweep

Ref. No.	Part No.	Description	Function
C401	Part of V-5891 assy	Capacitor, electrolytic, 80 mfd 350 v. (assy consists of C401, C402, C403 and C301)	Filter
C402	Part of V-5891 assy	Capacitor, electrolytic 10 mfd 350 v. (assy consists of C401, C402, C403 and C301)	Filter
C403	Part of V-5891 assy	Capacitor, electrolytic 10 mfd 350 v. (assy consists of C401, C402, C403 and C301)	Filter
C404	Part of V-6509 assy	Capacitor, electrolytic 40 mfd 350 v. (assy consists of C404, C405, C406 and C501)	Filter
C405	Part of V-6509 assy	Capacitor, electrolytic 40 mfd 350 v. (assy consists of C404, C405, C406 and C501)	Filter
C406	Part of V-6509 assy	Capacitor, electrolytic 150 mfd 50 v. (assy consists of C404, C405, C406 and C501)	Cathode by-pass
C407	V-6066-4254M	Capacitor, midget .25 mfd	Sync clip coupling
C409	V-6023-4104K	Capacitor, hi-temp 0.1 mfd	Vertical discharge
C410	V-6023-4104M	Capacitor, hi-temp 0.1 mfd	Yoke coupling
C411	R5CC21ZY151M	Capacitor, hi-temp 150 mmf	Grid by-pass
C412	RCP10W6102M	Capacitor, .001 mfd	AFC coupling
C413	RCP10W6102M	Capacitor, .001 mfd	AFC coupling
C415	RCP10W4502M	Capacitor, .005 mfd	AFC delay
C416	RCP10W4103M	Capacitor, .01 mfd	Horizontal output coupling
C417	RCP10W4503M	Capacitor, .05 mfd	Coupling
C418	RCP10W4503M	Capacitor, .05 mfd	AFC delay
C420	RCP10W4104M	Capacitor, .01 mfd	Vertical output coupling
C422	RCP10W4104M	Capacitor, 0.1 mfd	Screen by-pass
C423	RCP10W4104M	Capacitor, 0.1 mfd	Horizontal discharge
C424	RCP10W4254M	Capacitor, .25 mfd	Plate by-pass
C425	R5CC26ZY152M	Capacitor, 1500 mmf	Heater by-pass
C427	R2CC26SL560J	Capacitor, 56 mmf	Transient by-pass
C430	RCM20C331J	Capacitor, 330 mmf	Error voltage coupling
C431	RCM20C331J	Capacitor, 330 mmf	MV coupling
C432	RCM20C331J	Capacitor, 330 mmf	Horizontal discharge
C434	RCM30C392K	Capacitor, 3900 mmf	Ringing coil tuning
C438	RCM20B681M	Capacitor, 680 mmf	Plate by-pass
C439	RCP10W4104M	Capacitor, .1 mfd	Plate by-pass
C440	RCP10W4103M	Capacitor, .01 mfd	Vert. sync. coupling
C441	RCM20B391M	Capacitor, 390 mmf	Horiz. sync. coupling
C442	RCM20B101M	Capacitor, 100 mmf	Plate by-pass
C443	V-9465-2	Capacitor, 7 mmf (150 ohm twin lead)	AGC coupling
C444	RCP10W4503M	Capacitor, .05 mfd	Sync. coupling
C445	V-6023-4103M	Capacitor, hi-temp .01 mfd	V. MV coupling
C446	RCP10W4503M	Capacitor, .05 mfd	Cathode by-pass
C447	RCP10W4104M	Capacitor, .1 mfd	Plate by-pass
C448	RCP10W4104M	Capacitor, .1 mfd	HV supply decoupling
C449	RCP10W6102M	Capacitor, .001 mfd	Pulse divider
L401	V-9230-1	Coil	Plate load
L402	V-6639-2	Coil	Focus coil
L403	V-6764	Coil, ringing	Horizontal coarse tuning
L404	V-9501-1	Coil	Filament
L405	V-9501-1	Coil	Filament
R401	V-9232	Control, 600 ohms	Focus control
R402	V-6462	Control, 1 meg	Height control
R403	V-6463	Control, 5000 ohms	Vertical lin. control
R404	Part of V-9233 assy	Control, 100,000 ohms (assy consists of R404 and R405)	Horizontal hold control
R405	Part of V-9233 assy	Control, 500,000 ohms (assy consists of R404 and R405)	Vertical hold control
R406	V-6500-1	Control, 5000 ohms	Width control
R407	V-9002-4822K	Resistor, 8200 ohms 2 w.	Horiz. output screen drop
R408	V-4758	Resistor, 110 ohms 3 w.	Focus coil shunt
R410	RC20AE330M	Resistor, 33 ohms ½ w.	Plate load
R411	RC20AE121K	Resistor, 120 ohms ½ w.	Grid parasitic suppressor
R412	RC20AE151K	Resistor, 150 ohms ½ w.	Damper diode decoupling
R413	RC20AE471K	Resistor, 470 ohms ½ w.	Cathode bias
R414	RC20AE102M	Resistor, 1000 ohms ½ w.	Vert. output decoupling
R417	RC20AE122K	Resistor, 1200 ohms ½ w.	Cathode bias
R418	RC20AE182K	Resistor, 1800 ohms ½ w.	Cathode bias
R420	RC20AE272K	Resistor, 2700 ohms ½ w.	Cathode bias
R421	RC20AE392K	Resistor, 3900 ohms ½ w.	Plate load
R424	RC20AE562K	Resistor, 5600 ohms ½ w.	Plate load
R426	RC20AE153K	Resistor, 15,000 ohms ½ w.	Waveform correction
R427	RC20AE101K	Resistor, 100 ohms ½ w.	Horiz. sweep stabilizer
R430	RC20AE473K	Resistor, 47,000 ohms ½ w.	Plate decoupling
R431	RC20AE683K	Resistor, 68,000 ohms ½ w.	Phase reference
R432	RC20AE104J	Resistor, 100,000 ohms ½ w.	Diode load
R433	RC20AE104J	Resistor, 100,000 ohms ½ w.	Diode load
R434	RC20AE224J	Resistor, 220,000 ohms ½ w.	Grid return
R435	RC20AE154K	Resistor, 150,000 ohms ½ w.	DC divider
R436	RC20AE224K	Resistor, 220,000 ohms ½ w.	Plate load
R437	RC20AE394K	Resistor, 390,000 ohms ½ w.	Plate load
R438	RC20AE474K	Resistor, 470,000 ohms ½ w.	AFC delay
R440	RC20AE103K	Resistor, 10,000 ohms ½ w.	Plate load
R441	RC20AE105K	Resistor, 1 meg ½ w.	Grid return
R442	RC20AE105K	Resistor, 1 meg ½ w.	Grid return
R443	RC20AE225K	Resistor, 2.2 meg ½ w.	Grid return
R445	RC20AE475M	Resistor, 4.7 meg ½ w.	Grid return
R446	V-9002-4151K	Resistor, 150 ohms 2 w.	Cathode bias
R448	RC40AE153K	Resistor, 15,000 ohms 2 w.	Plate load
R449	RC20AE561K	Resistor, 560 ohms ½ w.	Transient damping
R450	RC20AE561K	Resistor, 560 ohms ½ w.	Transient damping
R455	RC20AE223K	Resistor, 22,000 ohms ½ w.	Plate load
R456	RC20AE225K	Resistor, 2.2 megohms ½ w.	Diode shunt
R457	RC20AE105K	Resistor, 1 megohm ½ w.	Positive bias limiting
R459	RC20AE474K	Resistor, 470,000 ohms ½ w.	Charge limiting
R460	RC20AE333K	Resistor, 33,000 ohms ½ w.	DC divider
R461	RC20AE225K	Resistor, 2.2 megohms ½ w.	Grid return
R462	RC20AE102K	Resistor, 1000 ohms ½ w.	Limiting
R463	RC20AE331K	Resistor, 330 ohms ½ w.	Cathode bias
R464	RC20AE474K	Resistor, 470,000 ohms ½ w.	Grid return
R465	RC20AE104K	Resistor, 100,000 ohms ½ w.	Plate load
R466	RC20AE680K	Resistor, 68 ohms ½ w.	Plate load
R467	RC20AE104K	Resistor, 100,000 ohms ½ w.	Grid return
R468	RC30AE224K	Resistor, 220,000 ohms 1 w.	Horiz. error take off
R469	RC20AE333K	Resistor, 33,000 ohms ½ w.	H. MV decoupling
T401	V-6981-2	Transformer	Vertical output
T402	V-6481-3	Transformer	Filament
Z401	V-9213-1	Network	Integrating
Z402	V-6486-3	Yoke assembly, complete	Deflection

Section 5—Power

Ref. No.	Part No.	Description	Function
C501	Part of V-6509 assy	Capacitor, electrolytic, 40 mfd 350 v. (assy consists of C501, C404, C405, and C406)	Filter HV
C502	V-6023-4503M	Capacitor, hi-temp .05	Screen by-pass
C503	V-6023-4503M	Capacitor, hi-temp .05	Plate decoupling
C504	V-6023-4503M	Capacitor, hi-temp .05	Grid bias
C505	V-5895	Capacitor, hi-voltage 500 mmf	HV filter
C507	V-6454	Capacitor, osc. trimmer	HV osc. trimmer
R501	RC20AE680K	Resistor, 68 ohms ½ w.	Plate decoupling
R502	RC20AE104K	Resistor, 100,000 ohms ½ w.	HV filter
R503	RC20AE222K	Resistor, 2200 ohms ½ w.	Grid return
R504	RC30AE103K	Resistor, 10,000 ohms 1 w.	Screen dropping
SW501	V-6465-1	Switch, on-off	
T501	V-9395	Transformer	Power L. V.
T502	V-6457	Transformer	Hi-voltage
	V-9445	High voltage supply assy, R-F	

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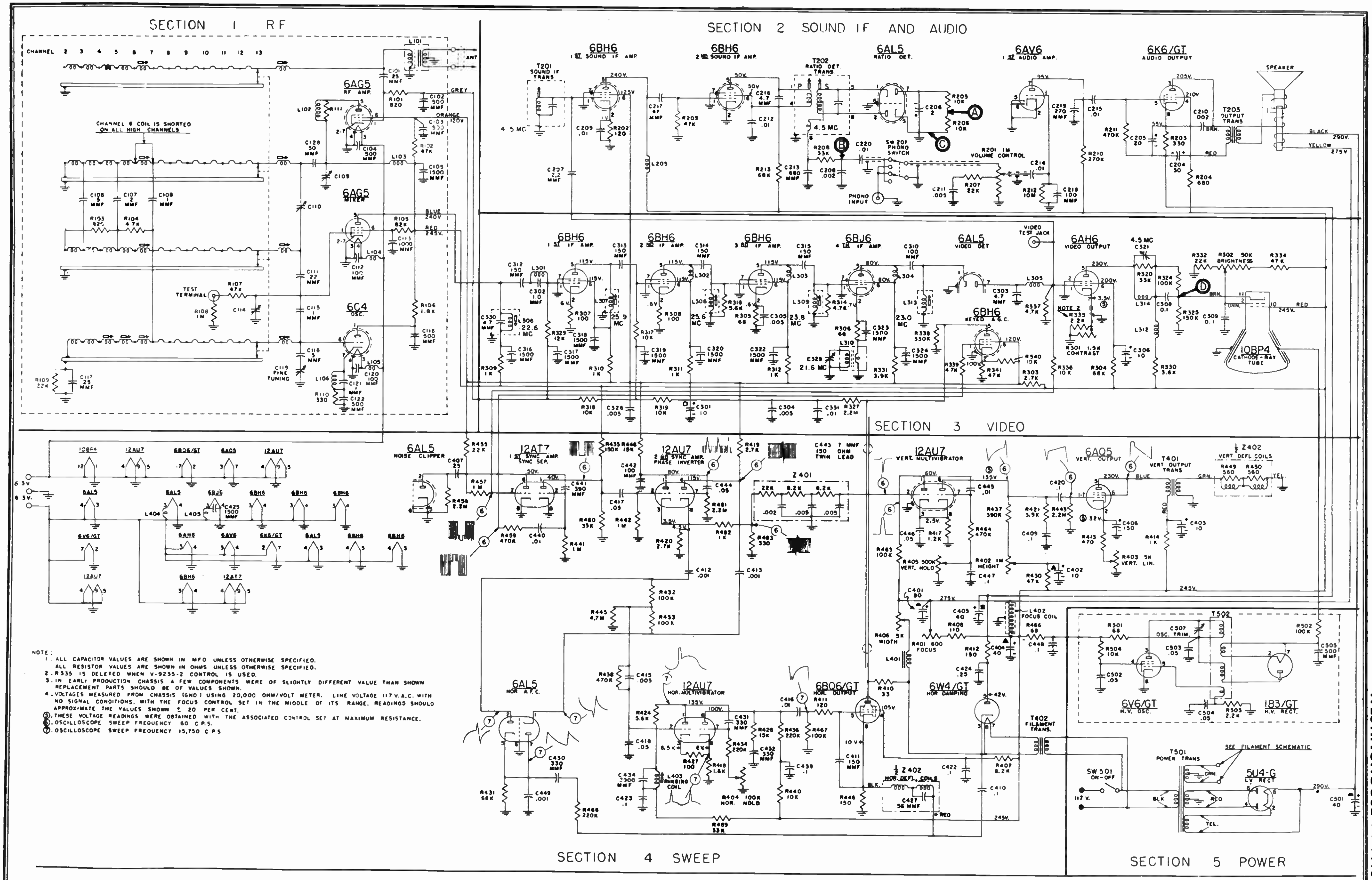

FIG. 9—SCHEMATIC DIAGRAM OF V-2150-94C CHASSIS

IMPORTANT—Since many of the components are very critical, exact duplicates must be used for replacement purposes.

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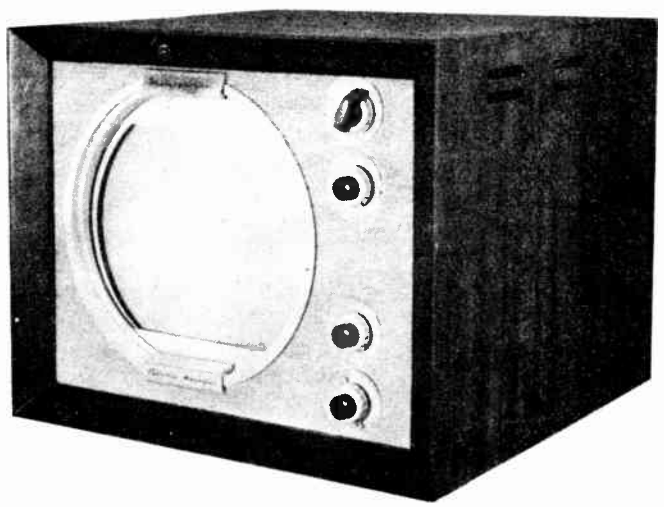

SPECIFICATIONS

FREQUENCY RANGES:

Channel Number	Channel Frequency (mc.)	Video Carrier Frequency (mc.)	Audio Carrier Frequency (mc.)	Receiver H-F Oscillator Frequency (mc.)
1	not used	--	--	--
2	54 - 60	55.25	59.75	81.35
3	60 - 66	61.25	65.75	87.35
4	66 - 72	67.25	71.75	93.35
5	76 - 82	77.25	81.75	103.35
6	82 - 88	83.25	87.75	109.35
7	174 - 180	175.25	179.75	201.35
8	180 - 186	181.25	185.75	207.35
9	186 - 192	187.25	191.75	213.35
10	192 - 198	193.25	197.75	219.35
11	198 - 204	199.25	203.75	225.35
12	204 - 210	205.25	209.75	231.35
13	210 - 216	211.25	215.75	237.35

FINE TUNING RANGE:
Plus or minus 1 mc. minimum
Plus or minus 2 mc. maximum

OPERATING VOLTAGE:
105 to 120 volts, 60 cycles

POWER CONSUMPTION: .... 275 watts

AUDIO POWER OUTPUT:
Undistorted .... 1.5 watts
Maximum .... 2.5 watts

LOUDSPEAKER:
Type .... 5" E. M.
Voice Coil Impedance—3.2 ohms at 400 cycles

RECEIVER ANTENNA INPUT IMPEDANCE:
... 300 ohms balanced or 72 ohms unbalanced

TUBE COMPLEMENT:

1	1B3/GT	High Voltage Rectifier
2	5U4G	Low Voltage Rectifier
1	6AH6	Video Output
1	6AK5	R.F. Amplifier
1	6AL5	Video Detector and Noise Clipper
1	6AL5	Ratio Detector
1	6AL5	Horizontal A. F. C.
1	6AQ5	Vertical Output
2	6AU5/GT	Horizontal Output
1	6AU6	1st Audio I. F. Amplifier
1	6AU6	2nd Audio I. F. Amplifier
1	6AU6	Keyed A. G. C.
1	6AV6	1st Audio Amplifier
1	6BH6	1st I. F. Amplifier
1	6BH6	2nd I. F. Amplifier
1	6BH6	3rd I. F. Amplifier
1	6BJ6	4th I. F. Amplifier
1	6J6	H. F. Oscillator and Mixer
1	6W4/GT	Horizontal Damper
1	6Y6G	High Voltage Oscillator
1	6Y6G	Audio Output
1	12AT7	Sync. Amp. & Sync. Separator
1	12AU7	Vertical Multivibrator
1	12AU7	Horizontal Multivibrator
1	12AU7	D. C. Restorer & Phase Invertor
1	12LP4 or 12LP4A	Cathode Ray Tube

VIDEO CARRIER INTERMEDIATE FREQUENCY: .... 26.1 mc.

VIDEO RESPONSE: .... 4.0 mc.

AUDIO CARRIER INTERMEDIATE FREQUENCY: .... 4.5 mc.

AUDIO DISCRIMINATOR BAND WIDTH: (between peaks) .... 150 kc.

FOCUS: .... Magnetic

SWEEP DEFLECTION: .... Magnetic

SCANNING: .... Interlaced 525 line

HORIZONTAL SCANNING FREQUENCY: .... 15,750 CPS

VERTICAL SCANNING FREQUENCY: .... 60 CPS

FRAME FREQUENCY (picture repetition rate): .... 30 CPS

HIGH VOLTAGE WARNING

The danger accompanying shock is always present when the receiver is operated outside the cabinet or when the rear cover is removed from the cabinet. Only a person familiar with the precautions to be observed when working with high-voltage equipment should service this receiver.

CATHODE RAY TUBE HANDLING PRECAUTIONS

Shatterproof goggles and heavy gloves should be worn at all times when handling the cathode ray tube. The tube should not be handled in the vicinity of any person not so equipped. When handling the cathode ray tube, always keep it away from the body.

The cathode ray tube bulb, due to its large surface area and high vacuum contained within, is subjected to high air pressure. More than ordinary care is required to prevent shattering the tube. The large end of the bulb, particularly the rim of the viewing surface, must not be struck, scratched, or subjected to more than moderate pressure at any time. If the tube sticks or fails to slip smoothly into place during installation, remove the tube and determine the cause of the trouble - - DO NOT FORCE THE TUBE.

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INSTALLATION INSTRUCTIONS

TO PREPARE THE RECEIVER FOR OPERATION:

Later production models are shipped in operating condition, and there is no shipping material to be removed.

Early production models contain shipping precautions, however, and these steps should be followed to prepare the receiver for operation:

1. Remove the screws that hold the rear cover to the cabinet, and remove the rear cover by pulling it away from the cabinet.

2. Remove the red-headed wood screw from the shipping block located on the top (inside) of the cabinet, and remove the shipping block.

3. Remove the two red-headed wood screws from the shipping block located between the upper left side of the cabinet and the chassis, and remove the shipping block.

4. Inspect the face of the CRT and the glass window for dust or smudges. If the face of the CRT or the inside of the glass window is smudged, refer to REMOVAL OF FRONT GLASS FOR CLEANING.

5. Loosen the two, red, hex-head bolts on the under side of the cabinet.

6. In some models, a wood shipping strip is located between the chassis and the bottom of the cabinet. This strip should be removed.

7. Loosen the screws that secure the upper chassis mounting bracket to the top inside of the cabinet.

8. Adjust the position of the chassis so that the knobs and the face of the CRT are properly aligned with respect to the holes in the front of the cabinet.

9. Re-tighten the two, red, hex-head bolts on the under side of the cabinet, and the two screws of the upper chassis mounting bracket.

10. Make certain that all tubes are secure in their sockets.

11. These models contain a built-in antenna for use in areas of normal reception. In such areas when the built-in antenna provides good reception, no additional antenna connections are required. However, in weak signal areas or under adverse conditions, it may be necessary to use an external antenna. If an external antenna is to be used, the built-in antenna should be disconnected from the antenna terminals on the back of the chassis, and the lugs of the built-in antenna should be insulated and dressed in such a position that they do not touch the chassis or components.

12. If an outside antenna is to be used, connect the lead-in to the antenna terminals on the back of the set.

13. Connect the A-C plug to a 105 to 120 volt 60 cycles A-C power outlet.

14. Refer to REMOVAL OF FRONT GLASS FOR CLEANING. If the receiver contains a removable front glass plate, instruct the owner as to the correct procedure for removing the glass and cleaning the face of the CRT and the inside of the glass.

TO CHECK THE OPERATION OF THE RECEIVER:

1. Turn the magnifier switch to the clockwise (magnified) position.

2. Rotate the brightness and contrast controls completely counterclockwise.

3. Turn on the receiver by rotating the off-on-volume control clockwise.

4. Rotate the channel selector to the channel number of the desired station.

5. Rotate the brightness control clockwise until the screen is barely lighted. Check the adjustment of the ion trap magnet as outlined under ADJUSTMENTS.

6. Rotate the contrast control clockwise until a picture appears on the screen.

7. If the built-in antenna is in use, adjust the television antenna control for maximum picture contrast. If an external antenna is in use, this step is not required.

8. If the picture is moving up or down or quivering, adjust the vertical hold control to stabilize the image.

9. If vertical or diagonal bars or a folded-over picture appears on the screen, adjust the horizontal hold control to obtain a stable picture.

10. Adjust the fine tuning control for best picture detail.

11. Re-adjust the brightness and contrast controls until pleasing shades ranging from clear white to intense black are attained.

12. Check the adjustment of the focus coil as outlined under ADJUSTMENTS.

13. Adjust the volume control for the desired sound volume (phono switch on back of set must be in TV position).

14. Turn the magnifier switch to the counter-clockwise (normal) position.

15. If vertical or diagonal bars appear on the screen, adjust the width control as described under ADJUSTMENTS. *Do not re-adjust the horizontal hold control.*

16. If necessary, adjust the height, height magnifier, vertical linearity, vertical linearity magnifier, and focus controls as explained under ADJUSTMENTS.

17. Check the operation on all available television stations. Note that if the built-in antenna is in use, the television antenna control must be readjusted for maximum picture contrast each time the receiver is tuned to a different channel.

18. Replace the rear cover.

ADJUSTMENTS

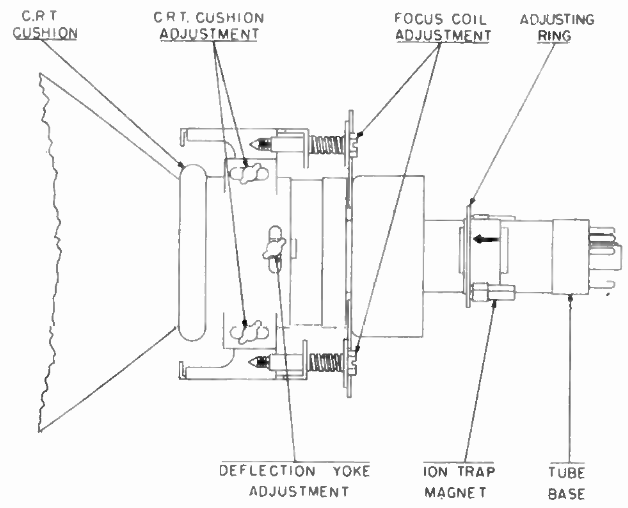

FIG. 1 – CRT ADJUSTMENTS

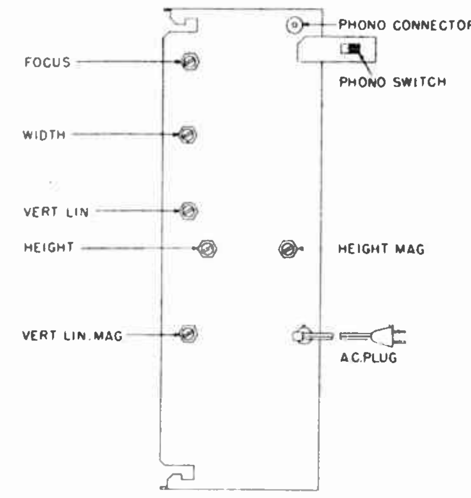

FIG. 2 – ADJUSTMENTS ON REAR OF CHASSIS

The picture adjustments are located on the rear of the chassis and are accessible through cut-outs in the back cover.

An insulated, long shank screwdriver is preferred for making the ringing coil and H. V. oscillator adjustments.

ION TRAP MAGNET

Caution: When adjusting the ion trap magnet, care should be exercised to avoid breaking the neck of the cathode ray tube.

The magnet should first be oriented approximately as shown in Fig. 1. Then, with the brightness control rotated completely clockwise, adjust the magnet by rotating it about the neck of the tube and moving it forward and backward until the raster is brightest on the screen.

If shadows on the face of the tube are not completely removed by either coarse or fine adjustment of the focus coil as outlined below, rotate the adjusting ring on the front of the ion trap magnet to remove the shadows.

FOCUS COIL

If a shadow falls on one corner of the picture, or the picture is not properly centered, adjustment of the focus coil will be necessary. To adjust, loosen the short hex head bolts that lock the coil to the adapter plates, and move the coil horizontally and vertically until the position is found where the picture is properly centered and shadows are removed. Tighten the short hex head bolts to lock the coil in this position. Fine adjustment is provided by the long hex head bolts at each corner of the focus coil.

If shadows cannot be completely removed by adjustment of the focus coil, refer to *ION TRAP MAGNET* above.

CATHODE RAY TUBE CUSHION

The cushion must fit snugly against the flare of the cathode ray tube in order that the rear of the tube will be supported firmly.

DEFLECTION YOKE

This adjustment controls the angle of the picture with respect to the horizontal. If the picture is not squared in the picture mask, loosen the wing nut and move it up or down so as to rotate the deflection yoke. The picture will tilt to the left or right with the deflection yoke rotation.

FOCUS CONTROL

The focus control (Fig. 2) should be adjusted with the brightness and contrast controls in their normal positions. If correct focusing cannot be obtained, the high voltage oscillator may require adjustment.

HEIGHT AND VERTICAL LINEARITY (NORMAL)

The height adjustment controls the over-all height of the picture, while the vertical linearity adjustment governs contraction or expansion of the upper portion only. For this reason, a balance between the two controls is necessary to make the picture symmetrical and fill the mask vertically.

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HEIGHT AND VERTICAL LINEARITY (MAGNIFIED)

The height magnifier adjustment controls the over-all height of the magnified picture, while the vertical linearity magnifier adjustment governs contraction or expansion of the upper portion only. For this reason, a balance between the two controls is necessary to make the picture symmetrical and fill the mask vertically. *These controls must be reset if the height and vertical linearity controls governing the normal picture are changed.*

WIDTH

The width adjustment must always be made with the magnifier control set for a normal size picture. The correct adjustment is made as follows:

1. Rotate the magnifier control to the magnified position, and adjust the horizontal hold control until the magnified picture holds horizontal sync.

2. Set the magnifier control for a normal size picture, and *without re-adjusting the horizontal hold control* adjust the width control until the picture holds horizontal sync and fills the mask horizontally.

HORIZONTAL RINGING COIL

The horizontal ringing coil is accessible through a hole in the bottom of the cabinet. To adjust the coil:

1. Turn the magnifier switch to the clockwise (magnified) position.

2. Tune in the weakest station in your area.

3. Set the horizontal hold control at approximately the center of its range.

4. Adjust the ringing coil (L403) until the picture is properly "locked-in."

HIGH VOLTAGE OSCILLATOR

1. *Turn off the receiver* and disconnect the high voltage lead from the CRT.

2. Connect 18 one megohm, one watt resistors in series between the high voltage lead and the chassis.

3. Connect a kilovoltmeter across the 18 megohms of resistance.

4. Turn on the receiver and adjust C507 (location shown on Fig. 7) for maximum voltage indication on the meter. When C507 is peaked using an 18 megohm load, the voltage across the load should be 9.3 kilovolts (approximately).

5. *Turn off the receiver*, disconnect the kilovoltmeter, remove the 18 megohms of resistance, and connect the high voltage lead to the CRT. Note that when the 18 megohm load is removed and the high voltage lead is connected to the CRT, the output voltage of the H.V. power supply will rise because of the higher load resistance offered by the CRT.

CATHODE RAY TUBE REPLACEMENT

1. Remove the chassis from the cabinet as explained under CHASSIS REMOVAL.

2. Back off the set screw locking the shutter actuating link to the magnifier control shaft.

3. Remove the two self-tapping screws that secure the shutter assembly frame to the chassis.

4. Remove the two self-tapping screws that secure the shutter assembly frame to the brace bars.

5. Remove the wing nut and lock washer from the stud on top of the CRT strap.

6. Remove the shutter assembly by lifting the bronze strap over the stud and sliding the complete assembly forward.

7. Remove the ion trap magnet and the CRT socket.

8. Loosen the CRT cushion screws and the focus coil mounting screws, and remove the screw from the CRT strap.

9. Remove the defective CRT and insert the replacement through the deflection yoke and focus coil, exercising the caution necessary when handling cathode ray tubes.

10. Replace the screw in the CRT strap and tighten the strap about the tube just enough to hold the tube in place.

11. Replace the shutter assembly and tighten the self-tapping screws only. Do not tighten the CRT strap wing nut or the set screw on the magnifier control shaft.

12. Position the CRT so that the clearance between the tube and the mask is approximately 1/32".

13. Tighten the CRT strap and the wing nut on the stud at the top of the CRT strap.

14. Adjust the CRT cushion and tighten the CRT cushion screws.

15. Replace the ion trap magnet and the CRT socket.

16. Adjust the ion trap magnet and focus coil as outlined under ADJUSTMENTS.

17. Turn the magnifier switch to the clockwise (magnified) position. Open the shutters completely and tighten the set screws to lock the shutter actuating link to the control shaft.

18. Check the operation of the shutters to make certain there is no binding.

19. Replace the chassis in the cabinet.

CHASSIS REMOVAL

To remove the chassis from the cabinet:

1. Remove the control knobs.

2. Remove the wood screws that secure the rear cover to the cabinet and remove the rear cover.

3. Disconnect the antenna feed line from the antenna terminals.

4. Release the antenna terminal mounting plate by removing the screws that secure the plate to the rear of the cabinet.

5. Remove the two bolts that hold the upper chassis mounting bracket to the top inside of the cabinet, and swing the bracket clear of the cabinet. On some models, a wood block is used instead of the bracket; the two screws that hold the block in place should be removed to remove the block.

6. Remove the clamp that secures the shutter frame to the bottom of the cabinet by removing the machine screw that holds the clamp in place. This screw is accessible from beneath the cabinet.

7. Remove the two hex head chassis mounting bolts from beneath the cabinet.

8. Remove the chassis from the cabinet carefully to avoid damaging the built-in antenna system. Removal may be facilitated by turning the cabinet on its side so that the chassis is upright during removal.

NOTE: When replacing the chassis in the cabinet, make certain that the shutter mechanism operates freely and that the control shafts and the face of the CRT is correctly aligned with respect to the holes in the front of the cabinet before tightening the chassis mounting bolts and the upper support bracket bolts.

REMOVAL OF FRONT GLASS FOR CLEANING

With early production Models, it is necessary to remove the chassis from the cabinet in order to clean the inside of the front glass plate or the face of the CRT. Later Models, however, contain provisions for removing the front glass plate for cleaning purposes.

Whether or not the glass is removable from the front of the cabinet can be determined by inspecting the brass retainers at the top and bottom of the glass. If two screw heads are visible on the face of each retainer, the glass is removable from the front of the cabinet. Otherwise, the chassis must be removed to clean the inside of the glass.

For Models that contain the removable glass, the removal procedure is as follows:

1. Remove the power plug from the outlet.

2. Remove the two screws from each of the brass retainers. This will detach the retainers from the cabinet.

3. Remove the glass by lifting it straight out from the front. *Use care to avoid scratching paint off the mask.*

ALIGNMENT

TEST EQUIPMENT—To properly service this chassis, the following test equipment should be available:

1. R-F sweep generator which meets the following requirements:

a. Frequency range from 18 to 30 mc. with a sweep width of 10 mc.

b. Output adjustable with at least 100,000 microvolts maximum and a very low minimum.

c. Output "flat" on all attenuator positions.

2. Cathode-ray oscilloscope, preferably one with a wide band vertical deflection amplifier and a low-capacitance input probe.

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3. Signal generator capable of providing output frequencies listed below.

21.6 mc. 4th I-F trap
22.6 mc. 1st I-F
25.9 mc. 2nd I-F
25.6 mc. 3rd I-F
24.7 mc. 4th I-F
23.0 mc. 5th I-F
4.5 mc. Audio I-F and ratio detector (the frequency must be extremely accurate, preferably crystal controlled.)

NOTE—The R-F output level on all the above frequencies should be adjustable with at least 100,000 microvolts maximum and a very low minimum.

4. Heterodyne frequency meter with crystal calibrator (if the signal generator does not include a crystal calibrator).

5. Electronic voltmeter (vacuum tube voltmeter), with a high voltage multiplier probe for measurements up to 15,000 volts and an R-F probe for measuring R-F voltages.

GENERAL INFORMATION—All test equipment and the chassis should be bonded together by short lengths of heavy (½ inch) braided copper ribbon. The interconnecting leads should be shielded (72 ohms coaxial cable) and should be as short as possible consistent with ease of making connections. The effectiveness of the bonding can be checked during alignment by placing the hand on the metal chassis or test equipment case. If the response pattern or meter reading changes visibly, the bonding must be improved before the circuits are aligned.

COMMON I-F ALIGNMENT PROCEDURE

1. Remove the 6AK5 R-F amplifier tube from its socket, and rotate the channel selector to channel 13 to avoid undesirable beat response during alignment. The channel selector is at channel 13 when the flat of the shaft faces the top of the tuner.

2. Connect the signal generator to the mixer tube through the coupling device shown in Fig. 3. The device is constructed by squeezing together a miniature tube shield until it fits the tube snugly and does not ground to the chassis. A .005 mfd capacitor is then soldered to the side of the shield. By sliding the tube shield up or down on the tube, the capacitance between the shield and the tube elements can be varied to obtain additional control of the coupling over that provided by the attenuator in the generator itself. The ground side of the generator output cable should be connected to the receiver chassis.

3. Connect a vacuum tube voltmeter to the video test jack on the receiver chassis, and set the meter to its 5 volt scale.

4. Set the signal generator to 21.6 mc. (unmodulated), and adjust T305 for *minimum* voltage on the VTVM. Use a strong signal for this adjustment.

5. Set the signal generator to 22.6 mc. (unmodulated), and adjust L110 for maximum voltage on the VTVM. *During this adjustment, keep the single generator output adjusted so that the VTVM reading does not exceed 2 volts.*

6. Set the signal generator to 25.9 mc. (unmodulated), and adjust T301 for maximum voltage on the VTVM. *During this adjustment, keep the signal generator output adjusted so that the VTVM reading does not exceed 2 volts.*

7. Set the signal generator to 25.6 mc. (unmodulated), and adjust T302 for maximum voltage on the VTVM. *During this adjustment, keep the signal generator output adjusted so that the VTVM reading does not exceed 2 volts.*

8. Set the signal generator to 24.7 mc. (unmodulated), and adjust T303 for maximum voltage on the VTVM. *During this adjustment, keep the signal generator output adjusted so that the VTVM reading does not exceed 2 volts.*

9. Set the signal generator to 23.0 mc. (unmodulated), and adjust T304 for maximum voltage on the VTVM. *During this adjustment, keep the signal generator output adjusted so that the VTVM reading does not exceed 2 volts.*

10. Connect the *sweep* generator to the mixer tube through the coupling device previously described. The *signal* generator will be used in the following steps to provide marker indications at various frequencies on the response curve. In this application, the signal generator input to the set must be low in amplitude to avoid distorting the response curve. To reduce the signal generator input accordingly, the signal generator should be *loosely* coupled to the set by wrapping a few turns of insulated wire around the coupling capacitor "pigtail" and connecting the signal generator to this wire.

11. Connect the vertical input of the oscilloscope to the video test jack through the decoupling network shown in Fig. 4. The oscilloscope horizontal input should be connected to the sweep output from the sweep generator; turn the sweep control on the oscilloscope to the "X" or "OFF" position.

12. Adjust the sweep generator for a center frequency of 25.3 mc. with a 10 mc. deviation. Adjust the sweep generator output until a setting is found where there is very little noise on the oscilloscope pattern.

The oscilloscope pattern obtained should be similar to that shown in Fig. 5. Use the signal generator as a marker to check at the frequencies indicated. If the pattern obtained is not similar to Fig. 5, L110, T301, T302, T303, and T304 should be re-adjusted to produce the correct pattern.

SOUND I-F AND 4.5 MC. TRAP ALIGNMENT PROCEDURE

1. Connect the "high" side of the signal generator to the video test jack through a .001 mfd capacitor, and ground the "low" side to the chassis.

2. Connect the vacuum tube voltmeter to the points indicated on the bottom view of the chassis, Fig. 7. The common lead should connect to point "C", and the "high" lead should connect to point "A". Set the meter on its 5 volt (-DC) scale.

3. Adjust the signal generator to 4.5 mc. (unmodulated). The accuracy of this frequency is very important. If a crystal controlled signal generator is not available, the frequency should be checked using a frequency meter with a crystal calibrator.

4. Adjust T201 and the primary of T202 for maximum voltage on the VTVM. *During this adjustment, keep the signal generator output adjusted so that the VTVM reading does not exceed 5 volts.*

5. Connect the common lead from the VTVM to point "A" (Fig. 7, and connect the "high" lead to point "B". Here it is important that the case and components of the VTVM are *not* grounded to the receiver chassis; otherwise, point "A" would be shorted to the chassis through the common lead.

6. Using the same signal generator amplitude and frequency as in step 4, adjust the secondary of T202 for *zero* voltage on the VTVM. As the adjustment is tuned through resonance, the voltage will rapidly change from one polarity to the opposite polarity. The point where the voltage is zero is the correct setting.

7. Connect the common lead from the VTVM to the chassis, and connect the *R-F probe* from the VTVM to the CRT cathode terminal. This point is shown as point "D" on Fig. 7. *Note that this point is above ground and, therefore, the R-F probe must contain a blocking capacitor.*

8. Using a strong 4.5 mc. signal applied as in step 1, adjust Z301 for *minimum* indication on the meter.

H. F. OSCILLATOR ALIGNMENT PROCEDURE:

If the 6J6 oscillator tube is replaced, the different inter-electrode capacity of the new tube may change the oscillator frequency enough to necessitate realignment of the oscillator.

Alignment of the oscillator on the high band is accomplished by adjusting the brass slug located adjacent to the vernier drive wheel on the front of the tuner. Alignment of the oscillator on the low band is accomplished by adjusting the brass slug on the lower front of the tuner. *A non-metallic screwdriver is required.*

The oscillator alignment procedure is as follows:

1. Set the fine tuning control at the middle of its range, and leave it in this position during the following adjustments.

2. Set the selector switch to the highest of the low-band (channels 2 through 6) stations operating in your vicinity.

3. Peak the low band adjustment slug for the best picture detail.

4. Set the selector switch to the highest of the high-band (channels 7 through 13) stations operating in your vicinity.

5. Peak the high band adjustment slug for best picture detail.

6. Check the previously made low band adjustment, and if the tuning has changed, repeat steps 2 and 3.

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I-F ALIGNMENT CHART

Remove the 6AK5 R-F amplifier tube and turn the channel selector to channel 13 to avoid undesirable beat response during alignment.

COMMON I-F SECTION

Couple the sweep and marker generators to the mixer tube as shown in Fig. 3.

Step	*Sweep Gen. Frequency*	*Marker Gen. Frequency*	*Remarks*	*Indicator Connection*	*Adjust*
1.	Not used	21.6 mc. unmodulated	Use a strong signal	Connect VTVM to video test jack	T305 for *minimum* voltage
2.	Not used	22.6 mc. unmodulated	Keep marker output adjusted so VTVM reading does not exceed 2 v.	Same as step 1	L110 for maximum voltage
3.	Not used	25.9 mc. unmodulated	Same as step 2	Same as step 1	T301 for maximum voltage
4.	Not used	25.6 mc. unmodulated	Same as step 2	Same as step 1	T302 for maximum voltage
5.	Not used	24.7 mc. unmodulated	Same as step 2	Same as step 1	T303 for maximum voltage
6.	Not used	23.0 mc. unmodulated	Same as step 2	Same as step 1	T304 for maximum voltage
7.	25.3 mc. with 10 mc. deviation	Check at: 21.6 mc. 22.5 mc. 23.5 mc. 25.3 mc. 26.1 mc.	Keep sweep output high enough so that very little noise appears on the oscilloscope trace	Connect oscilloscope to video test jack. See Fig. 4.	If necessary, adjust L110, T301, T302, T303 and T304 to obtain correct response curve. See Fig. 5.

SOUND I-F SECTION AND 4.5 MC. TRAP

Connect the signal generator to the video test jack through a .001 mfd mica capacito

Step	*Signal Gen. Frequency*	*VTVM Connection*	*Remarks*	*Adjust*
1.	4.5 mc. unmodulated	See Fig. 7. Common lead to point "C" and high lead to point "A".	Use 5 v. (−DC) scale on meter. Set sig. gen. output accordingly.	T201 and the primary of T202 for maximum voltage
2.	4.5 mc. unmodulated	See Fig. 7. Common lead to point "A" and high lead to point "B".	Use same sig. gen. output as in step 1.	The secondary of T202 for *zero* voltage
3.	4.5 mc. unmodulated	See Fig. 7. R-F probe to point "D" and common lead to chassis.	Use strong signal from generator.	Z301 for minimum voltage

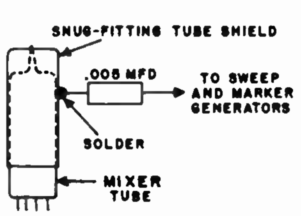

FIG. 3—COUPLING SIGNAL GENERATORS TO MIXER TUBE

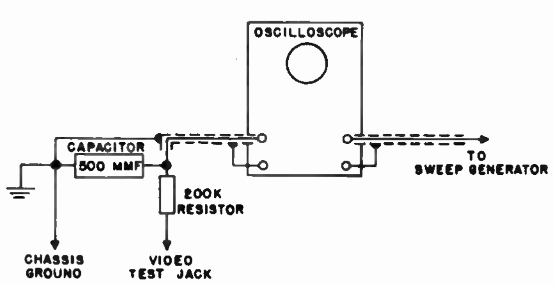

FIG. 4—OSCILLOSCOPE ISOLATION NETWORK

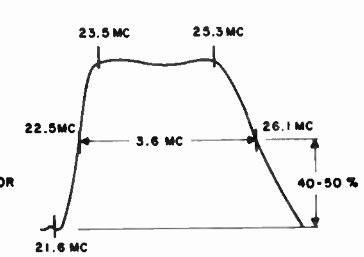

FIG. 5—I-F RESPONSE CURVE

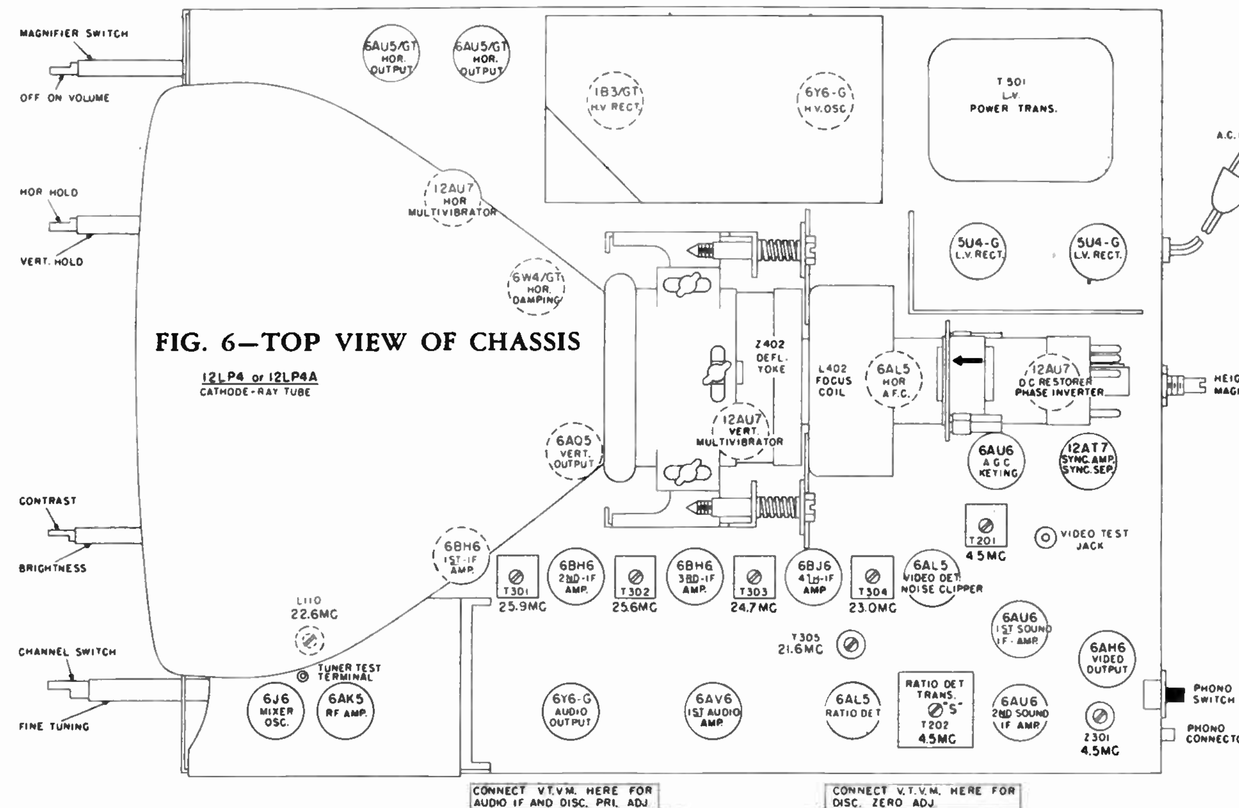

FIG. 6—TOP VIEW OF CHASSIS

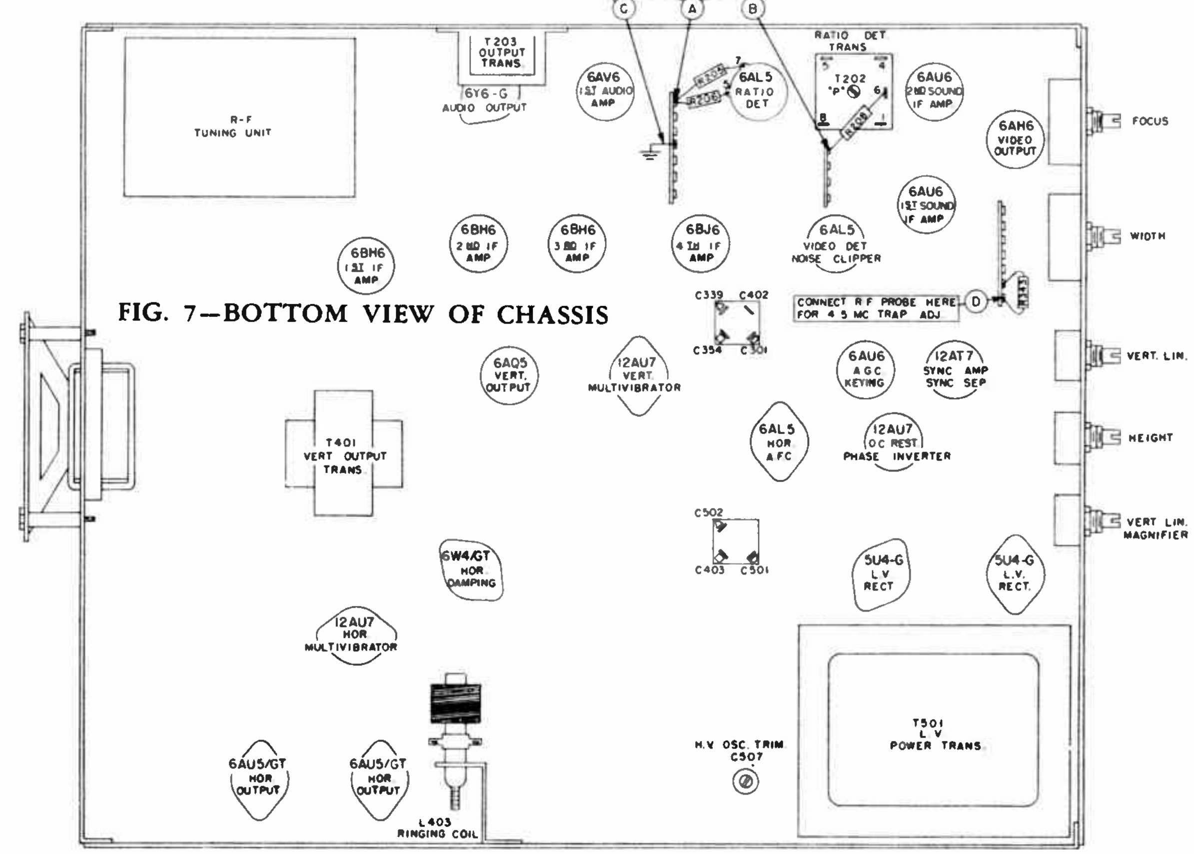

FIG. 7—BOTTOM VIEW OF CHASSIS

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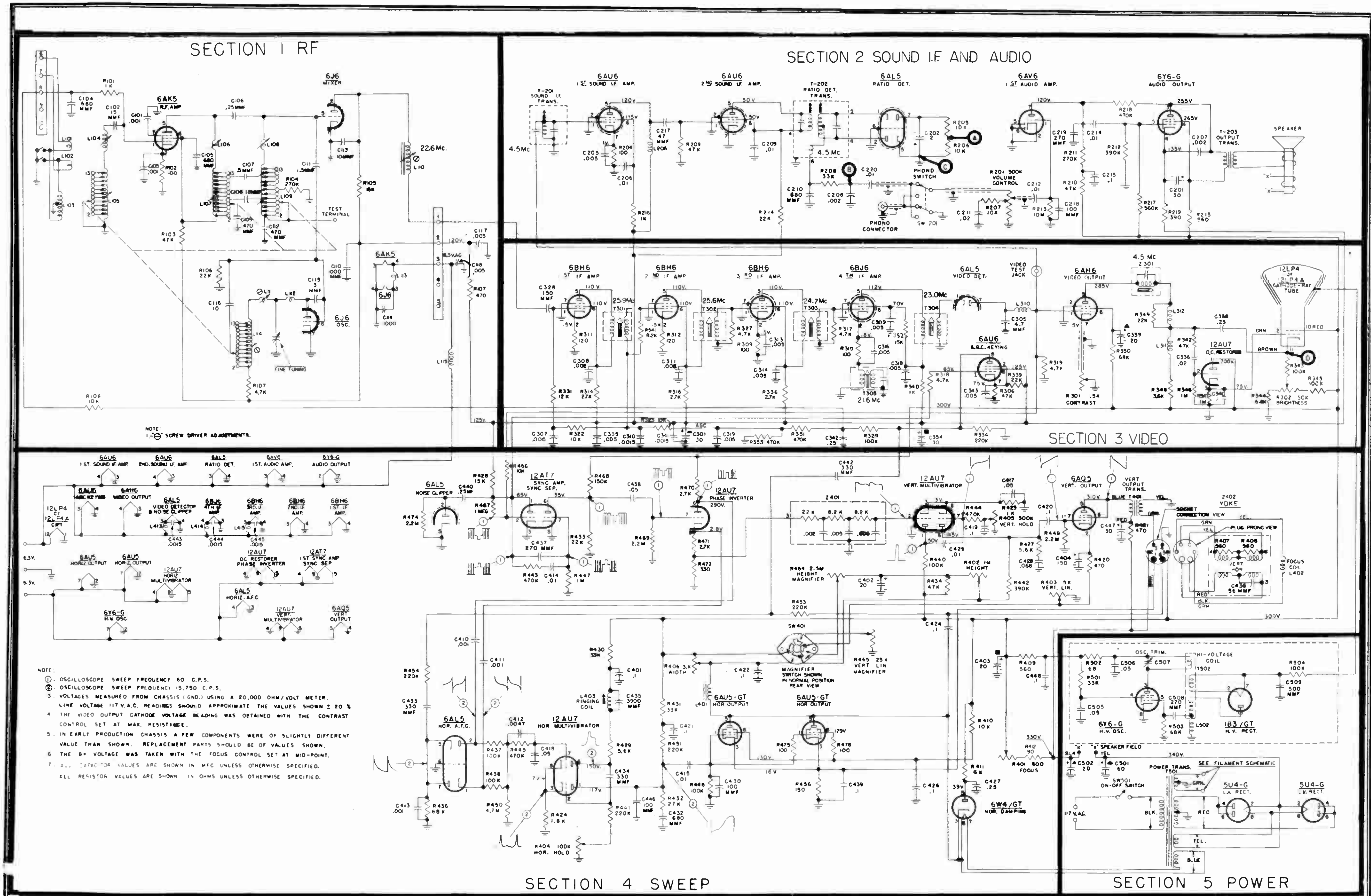

CHASSIS NO. V-2150-136

FIG. 8—SCHEMATIC DIAGRAM

IMPORTANT—Since many of the components are very critical, exact duplicates must be used for replacement purposes.

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PARTS LIST

CABINET

Part No	Description
V-9549-1	Baffle and grille cloth assembly
V-4471-2	Bumper, feet
V-6021-14	Bumper, retainer (front plate glass)
V-1200-2	Cabinet, blond
V-1200-1	Cabinet, mahogany
V-9550-1	Cover, back
V-9562-1	Disc. control (channel)
V-9562-2	Disc. control (brightness, contrast)
V-9562-3	Disc. control (vertical, horizontal)
V-9562-4	Disc. control (electronic mag., off-volume)
V-9551-2	Frame, front glass
V-9547-2	Knob, television antenna (blond)
V-6146-6	Knob, contrast, horizontal volume on-off (blond)
V-9104-1	Knob, vertical, brightness (rear)
V-9104-4	Knob, fine tuning (rear)
V-9471-1	Knob, magnifier
V-9547-1	Knob, television antenna (mahogany)
V-6146-1	Knob, contrast, horizontal, volume on-off (mahogany)
V-6284-7	Knob, channel selector (mahogany)
V-6284-9	Knob, channel selector (blond)
V-9554	Plate, front glass
V-9555-2	Retainer, glass (Westinghouse) (no holes in face)
V-9556-2	Retainer, glass (electronic magnifier) (no holes in face)
V-8316	Retainer, glass (Westinghouse) (two countersunk holes in face)
V-8317	Retainer, glass (electronic magnifier) (two countersunk holes in face
V-9808	Retainer Anchor Plate (for use with V-8316 and V-8317 retainer)
V-4802-9	Screw, oval head, #6-32 (for use with V-8316 and V-8317 retainer)
V-6059	Spring (fine tuning knob)
V-6063-1	Spring (selector knob)
V-5466	Teenut, panel

MISCELLANEOUS

Part No	Description
V-6451-2	Adapter plate, RF tuner
V-9521-1	Antenna assembly, television
V-4169-1	Base, miniature tube (6BH6, 6BJ6, 6AL5, 6AU6)
V-6602-1	Base, miniature tube (12AU7)
V-9610-1	Bracket rivet assembly, deflection yoke
V-3371-3	Bumper, recessed (chassis mounting)
V-5906-4	Connector assembly, hi-voltage
V-3254S	Connector, phono
V-4349-9	Cord, power AC
V-9234	Hood, yoke mounting
V-5917-2	Insulator, stand off
V-6573-4	Magnet, ion trap
V-5920	Nut, #8-32 wing (shutter assembly mounting)
V-9599-1	Plug assembly, deflection yoke
V-5926	Screw, #8-32 wing
V-9203-5	Screw, #8 flat head Phillips recessed (speaker mounting)
V-9344-4	Shaft, television antenna
V-6602-2	Shield, miniature tube (12AU7)
V-4169-2	Shield, miniature tube (6BH6, 6BJ6, 6AL5, 6AU6)
V-9175-10	Shutter assembly
V-5979	Sleeve, rubber (focus coil)
V-5556-1	Socket, miniature molded (12AT7, 12AU7, DC rest., phase inverter)
V-4514	Socket, molded octal (5U4, 6Y6, 6W4)
V-4315-2	Socket, molded octal (6AU5 horizontal output)
V-4292S-1	Socket, miniature molded (6BH6, 6BJ6, 6AL5, 6AU6, 6AV6, 6AQ5)
V-6089-1	Socket, miniature molded (12AU7 vert. mv.)
V-6878-1	Socket, miniature wafer (6AL5)
V-9166-1	Socket, yoke

*Sold only as complete assembly.

Part No	Description
V-9603-1	Socket assembly, CRT
V-9593	Speaker, 5" E.M.
V-6908	Strap assembly, CRT
V-6294	Terminal board, antenna
V-5977	Tip Jack
V-3274S	Tube, holder

PARTS LIST

V-2150-136 CHASSIS

Section 1—R-F

Ref No.	Part No.	Description	Function
	V-8210	Tuner assembly, RF	
C117	V-5596	Capacitor, hi-kap .005 mfd	Filament
C118	V-5596	Capacitor, hi-kap .005 mfd	Filament
L115	V-9099-2	Choke, RF	Filament
R107	RC20AE471K	Resistor, 470 ohms ½ w.	Decoupling
R108	RC20AE103K	Resistor, 10,000 ohms ½ w.	AGC decoupling

Section 2—Sound I-F and Audio

Ref No.	Part No.	Description	Function
C201	V-6570	Capacitor, electrolytic 30 mfd 450 v.	Audio decoupling
C202	V-4880	Capacitor, electrolytic 2 mfd 50 v.	Ratio det. stabilizer
C205	V-5596	Capacitor, .005 mfd hi-kap	Cathode by-pass
C206	V-6023-4103M	Capacitor, tubular hi-temp .01 mfd	Screen by-pass
C207	V-6023-6202M	Capacitor, tubular hi-temp .002 mfd	Plate by-pass
C208	V-6023-6202M	Capacitor, tubular hi-temp .002 mfd	De-emphasis
C209	V-6023-4103M	Capacitor, tubular hi-temp .01 mfd	Screen by-pass
C210	RCM20B681K	Capacitor, 680 mmf	De-emphasis
C211	V-6023-4203M	Capacitor, tubular hi-temp .02 mfd	Bass boost
C212	V-6023-4103M	Capacitor, tubular hi-temp .01 mfd	A-F coupling
C214	V-6023-4103M	Capacitor, tubular hi-temp .01 mfd	A-F coupling
C215	V-6023-4104M	Capacitor, tubular hi-temp .1 mfd	Plate decoupling
C217	RCM20B470K	Capacitor, 47 mmf	A-F coupling
C218	RCM20B101K	Capacitor, 100 mmf	Grid by-pass
C219	RCM20B271K	Capacitor, 270 mmf	Plate by-pass
C220	V-6023-4103K	Capacitor, .01 mfd	A-F coupling
L205	V-5902-4	Coil, plate (100 microhenries)	Plate load
*R201	V-9607-1 assy	Control, volume 500,000 ohms (assy consists of R201, SW401 and SW501)	Volume
R204	RC20AE101K	Resistor, 100 ohms ½ w.	Cathode bias
R205	RC20AE103K	Resistor, 10,000 ohms ½ w.	Ratio det. load
R206	RC20AE103K	Resistor, 10,000 ohms ½ w.	Ratio det. load
R207	RC20AE103K	Resistor, 10,000 ohms ½ w.	Bass boost
R208	RC20AE333K	Resistor, 33,000 ohms ½ w.	De-emphasis
R209	RC20AE473K	Resistor, 47,000 ohms ½ w.	Grid return
R210	RC20AE473K	Resistor, 47,000 ohms ½ w.	Decoupling
R211	RC20AE274K	Resistor, 270,000 ohms ½ w.	Plate load
R212	RC20AE394J	Resistor, 390,000 ohms ½ w.	Grid return
R213	RC20AE106M	Resistor, 10 megohms ½ w.	Grid return
R214	RC20AE223K	Resistor, 22,000 ohms ½ w.	Decoupling
R215	V-6984-6	Resistor, 560 ohms 5 w. w.w.	Plate load
R216	RC20AE102M	Resistor, 1000 ohms ½ w.	Screen load
R217	RC20AE564J	Resistor, 560,000 ohms ½ w.	Grid return
R218	RC20AE474K	Resistor, 470,000 ohms	Audio degen.
R219	V-6984-9	Resistor, 390 ohms 5 w. w.w.	Audio decoupling
SW201	V-5406	Switch, phono.	
T201	V-9594	Transformer (complete)	Sound I-F
T202	V-9574	Transformer (complete)	Ratio det.
T203	V-9685	Transformer (complete)	Audio output

Section 3—Video

Ref No.	Part No	Description	Function
*C301	V-9577 assy	Capacitor, electrolytic 20 mfd 400 v. (assy consists of C354, C402, C301 and C339)	Filter
C305	V-5658-6	Capacitor, 4.7 mmf	Plate by-pass
C307	R5CC26ZY152M	Capacitor, .0015 mfd	AGC delay
C308	V-5596	Capacitor, .005 mfd	Decoupling
C309	V-5596	Capacitor, .005 mfd	Screen by-pass
C310	R5CC26ZY152M	Capacitor, .0015 mfd	AGC decoupling
C311	V-5596	Capacitor, .005 mfd	Decoupling
C313	V-5596	Capacitor, .005 mfd hi-kap	Cathode by-pass
C314	V-5596	Capacitor, .005 mfd hi-kap	Decoupling
C316	R5CC26ZY152M	Capacitor, .0015 mfd	Cathode by-pass
C318	V-5596	Capacitor, .005 mfd hi-kap	Decoupling
C319	V-5596	Capacitor, .005 mfd hi-kap	AGC filter
C328	R5CC21ZY151M	Capacitor, 150 mmf	I-F coupling
C335	V-5596	Capacitor, .005 mfd hi-kap	By-pass
C336	V-6023-4203M	Capacitor, tubular hi-temp .02 mfd	Coupling
C338	V-6066-4254M	Capacitor, .25 mfd	Coupling
*C339	V-9577 assy	Capacitor, electrolytic 20 mfd 400 v. (assy consists of C354, C402, C301 and C339)	Decoupling
C340	V-6023-4104M	Capacitor, .1 mfd	Cathode by-pass
C341	R5CC26ZY152M	Capacitor, .0015 mfd	Screen by-pass
C342	V-6066-4254M	Capacitor, .25 mfd	AGC filter
C343	V-5596	Capacitor, hi-kap .005 mfd	Cathode by-pass
*C354	V-9577 assy	Capacitor, electrolytic 30 mfd 400 v. (assy consists of C354, C402, C301 and C339)	Screen by-pass
L310	V-5902-4	Coil, video peaking 100 microhenries	Video peaking
L311	V-5902-5	Coil, video peaking 250 microhenries	Video peaking
L312	V-5902-1	Coil, video peaking	Video peaking
*R301	V-9235-2 assy	Control, 1,500 ohms (assy consists of R301 and R302)	Contrast
*R302	V-9235-2 assy	Control, 50,000 ohms (assy consists of R301 and R302)	Brightness
R306	RC20AE473K	Resistor, 47,000 ohms ½ w.	Cathode bias
R309	RC20AE101K	Resistor, 100 ohms ½ w.	Cathode bias
R310	RC20AE101K	Resistor, 100 ohms ½ w.	Cathode bias
R311	RC20AE121K	Resistor, 120 ohms ½ w.	Cathode bias
R312	RC20AE121K	Resistor, 120 ohms ½ w.	Cathode bias
R314	RC20AE272K	Resistor, 2700 ohms ½ w.	Decoupling
R316	RC20AE272K	Resistor, 2700 ohms ½ w.	Decoupling
R317	RC20AE472K	Resistor, 4700 ohms ½ w.	Grid return
R318	RC20AE472K	Resistor, 4700 ohms ½ w.	AGC keyer
R319	RC20AE472K	Resistor, 4700 ohms ½ w.	Grid return
R322	RC20AE103K	Resistor, 10,000 ohms ½ w.	AVC decoupling
R323	RC20AE103K	Resistor, 10,000 ohms ½ w.	AVC decoupling
R327	RC20AE472K	Resistor, 4700 ohms ½ w.	Grid return
R329	RC20AE104K	Resistor, 100,000 ohms ½ w.	AGC filter
R331	RC20AE123K	Resistor, 12,000 ohms ½ w.	Grid return
R334	RC20AE224K	Resistor, 220,000 ohms ½ w.	Plate load
R336	RC20AE272K	Resistor, 2700 ohms ½ w.	Decoupling
R339	RC20AE103K	Resistor, 10,000 ohms ½ w	Cathode bias
R340	RC20AE102M	Resistor, 1000 ohms ½ w.	Decoupling
R341	RC20AE822K	Resistor, 8200 ohms ½ w.	Grid return
R342	RC20AE473K	Resistor, 47,000 ohms ½ w.	Decoupling
R343	RC20AE473K	Resistor, 47,000 ohms ½ w.	Cathode bias
R344	RC20AE682K	Resistor, 6800 ohms ½ w.	Series brightness
R345	RC20AE104K	Resistor, 100,000 ohms ½ w.	D-C divider
R346	RC20AE105K	Resistor, 1 megohm ½ w.	Grid return
R347	RC20AE105K	Resistor, 1 megohm ½ w.	Cathode bias
R348	RC30AE362J	Resistor, 3600 ohms 1 w.	Plate decoupling
R349	RC20AE223K	Resistor, 22,000 ohms ½ w.	Plate load
R350	RC30AE683K	Resistor, 68,000 ohms 1 w.	Decoupling
R351	RC20AE474K	Resistor, 470,000 ohms ½ w.	AGC divider
R352	RC20AE153K	Resistor, 15,000 ohms ½ w.	AGC divider
R353	RC20AE474K	Resistor, 470,000 ohms ½ w.	D-C divider
T301	V-9586-1	Transformer	Picture I-F
T302	V-9586-1	Transformer	Picture I-F
T303	V-9586-1	Transformer	Picture I-F
T304	V-9586-2	Transformer	Picture I-F
T305	V-9592	Transformer	Sound trap
Z301	V-9591	4.5 mc trap	

Section 4—Sweep

Ref No.	Part No.	Description	Function
C401	V-6023-4104M	Capacitor, .1 mfd	Plate decoupling
*C402	V-9577 assy	Capacitor, electrolytic 30 mfd 400 v. (assy consists of C354, C402, C301 and C339)	Plate decoupling
*C403	V-9575 assy	Capacitor, electrolytic 20 mfd 450 v. (assy consists of C403, C501 and C502)	Filter
C404	V-9576-1	Capacitor, electrolytic 150 mfd 50 v.	Cathode by-pass
C410	V-6023-6102M	Capacitor, tubular hi-temp .001 mfd	AFC coupling
C411	V-6023-6102M	Capacitor, tubular hi-temp .001 mfd	AFC coupling
C412	V-6023-4472M	Capacitor, tubular hi-temp .0047 mfd	AFC delay
C413	V-6023-6102M	Capacitor, tubular hi-temp .001 mfd	Pulse divider
C414	V-6023-4103M	Capacitor, .01 mfd	Vert. sync. coupling
C415	V-6023-4103M	Capacitor, .01 mfd	Horiz. mv. coupling
C417	V-6023-4503M	Capacitor, .05 mfd	Cathode by-pass
C418	V-6023-4503M	Capacitor, .05 mfd	AFC delay
C419	V-6023-4104M	Capacitor, .1 mfd	Grid by-pass
C420	V-6023-4104M	Capacitor, .1 mfd	Vert. mv. coupling
C421	V-6023-4104M	Capacitor, .1 mfd	Plate decoupling
C422	V-6023-4104M	Capacitor, .1 mfd	Plate decoupling
C424	V-6023-4104M	Capacitor, .1 mfd	Coupling
C426	V-6023-4104M	Capacitor, .1 mfd	Screen by-pass
C427	V-6066-4254M	Capacitor, .25 mfd	Plate by-pass
C428	V-6023-4683K	Capacitor, .068 mfd	Plate decoupling
C429	V-6023-4103K	Capacitor, .01 mfd	V. mv. coupling
C430	RCM20B271K	Capacitor, 270 mfd	Grid by-pass
C432	RCM20B681K	Capacitor, 680 mmf	Horiz. discharge
C433	RCM20C331J	Capacitor, 330 mmf	Error volt. coupling
C434	RCM20C331J	Capacitor, 330 mmf	Horiz. mv. coupling
C435	RCM30C392K	Capacitor, 3900 mmf	MV. plate tank
C436	V-9176-15560K	Capacitor, 56 mmf	Transient by-pass
C437	RCM20B271K	Capacitor, 270 mmf	Horiz. sync. coupling
C438	V-6023-4503M	Capacitor, .05 mfd	Coupling
C439	V-6023-4104M	Capacitor, .1 mfd	Cathode by-pass
C440	V-6066-4254M	Capacitor, .25 mfd	Noise clipper coupling
C442	RCM20C331J	Capacitor, 330 mmf	AGC pulse coupling
C443	R5CC26ZY152M	Capacitor, .0015 mfd	Filament by-pass
C444	R5CC26ZY152M	Capacitor, .0015 mfd	Filament by-pass
C445	R5CC26ZY152M	Capacitor, .0015 mfd	Filament by-pass
C446	RCM20B101K	Capacitor, 100 mmf	Plate by-pass
C447	V-6570	Capacitor, electrolytic 30 mfd 450 v.	Vert. output coupling
C448	V-6023-4104M	Capacitor, .1 mfd	HV supply decoupling
L401	V-9589-1	Choke, feed	Plate load
L402	V-9590-1	Coil	Focus
L403	V-6764	Coil	Ringing
L413	V-9099-1	Choke, RF	Filament
L414	V-9099-1	Choke, RF	Filament
L415	V-9099-1	Choke, RF	Filament
R401	V-9232	Control, 600 ohms	Focus
R402	V-6462	Control, 1 megohm	Height
R403	V-6463	Control, 5000 ohms	Vert. Lin.
*R404	V-9233 assy	Control, 100,000 ohms (assy consists of R404 and R405)	Horiz. hold
*R405	V-9233 assy	Control, 500,000 ohms (assy consists of R404 and R405)	Vert. hold
R406	V-6500-2	Control, 3000 ohms	Width
R407	RC20AE561K	Resistor, 560 ohms ½ w	Transient damping
R408	RC20AE561K	Resistor, 560 ohms ½ w.	Transient damping
R409	V-6984-6	Resistor, 560 ohms 5 w.	Plate load
R410	V-6984-5	Resistor, 10,000 ohms 5 w.	Screen load
R411	V-6500-2	Resistor, 6000 ohms 10 w.	Plate load
R412	V-9002-4900K	Resistor, 90 ohms 2 w	Focus control shunt
R420	RC20AE471K	Resistor, 470 ohms ½ w.	Cathode bias
R421	RC20AE471K	Resistor, 470 ohms ½ w.	Decoupling
R423	RC20AE102K	Resistor, 1000 ohms ½ w.	Cathode bias
R424	RC20AE182K	Resistor, 1800 ohms ½ w.	Cathode bias
R427	RC20AE562K	Resistor, 5600 ohms ½ w.	V. mv. charging
R428	RC20AE153K	Resistor, 15,000 ohms	Plate load
R429	RC20AE562K	Resistor, 5600 ohms ½ w.	Plate load
R430	RC30AE333K	Resistor, 33,000 ohms 1 w.	MV. decoupling
R431	RC20AE103K	Resistor, 10,000 ohms ½ w.	MV. decoupling
R432	RC20AE273K	Resistor, 27,000 ohms ½ w.	Waveform correction
R433	RC20AE333K	Resistor, 33,000 ohms ½ w.	D-C divider
R434	RC20AE473K	Resistor, 47,000 ohms ½ w.	V. mv. decoupling
R436	RC20AE683K	Resistor, 68,000 ohms ½ w.	Error volt. load
R437	RC20AE104J	Resistor, 100,000 ohms ½ w.	AFC diode load
R438	RC20AE104J	Resistor, 100,000 ohms ½ w.	AFC diode load
R440	RC20AE104K	Resistor, 100,000 ohms ½ w.	Plate load
R441	RC20AE224J	Resistor, 220,000 ohms ½ w.	Mag. hold compensator
R442	RC20AE394J	Resistor, 390,000 ohms ½ w.	Plate load
R443	RC20AE474K	Resistor, 470,000 ohms ½ w.	Charge limiting
R444	RC20AE474K	Resistor, 470,000 ohms ½ w.	Grid return
R445	RC20AE474K	Resistor, 470,000 ohms ½ w.	AFC delay
R447	RC20AE105K	Resistor, 1 megohm ½ w.	Grid return
R448	RC20AE104K	Resistor, 100,000 ohms ½ w.	Grid return
R449	RC20AE225K	Resistor, 2.2 megohms ½ w.	Grid return
R450	RC20AE475K	Resistor, 4.7 megohms ½ w.	D-C return
R451	RC20AE224K	Resistor, 220,000 ohms ½ w.	Plate load
R453	RC30AE224K	Resistor, 220,000 ohms 1 w.	Limiting
R454	RC30AE224K	Resistor, 220,000 ohms 1 w.	Error volt. take-off
R456	V-6067-4	Resistor, 150 ohms 3 w.	Cathode bias
R464	V-5909	Control, 2.5 megohms	Height mag.
R465	V-5910	Control, 25,000 ohms	Vert. lin. mag.
R466	RC20AE103K	Resistor, 10,000 ohms ½ w.	Sync. amp. input
R467	RC20AE105K	Resistor, 1 megohm ½ w.	Positive bias limiting
R468	RC20AE154K	Resistor, 150,000 ohms ½ w.	Plate load
R469	RC20AE225K	Resistor, 2.2 megohms ½ w.	Grid return
R470	RC20AE272K	Resistor, 2700 ohms ½ w.	Plate load
R471	RC20AE272K	Resistor, 2700 ohms ½ w.	Limiting
R472	RC20AE331K	Resistor, 330 ohms ½ w.	Cathode bias
R474	RC20AE225K	Resistor, 2.2 megohms ½ w.	Diode shunt
R475	RC20AE101K	Resistor, 100 ohms ½ w.	Parasitic suppressor
R476	RC20AE101K	Resistor, 100 ohms ½ w.	Parasitic suppressor
*SW401	V-9607-1 assy	Switch, magnifier (assy consists of R201, SW501 and SW401)	
T401	V-9584-1	Transformer (complete)	Vert. output
Z401	V-9213	Filter	Integrating
Z402	V-9596-1	Yoke assembly (complete)	Deflection

Section 5—Power

Ref. No.	Part No.	Description	Function
*C501	V-9575 assy	Capacitor, electrolytic 60 mfd 450 v. (assy consists of C403, C501 and C502)	Filter
*C502	V-9575 assy	Capacitor, electrolytic 20 mfd 450 v. (assy consists of C403, C501 and C502)	Filter
C505	V-6023-4503M	Capacitor, tubular hi-temp .05 mfd	Screen by-pass
C506	V-6023-4503M	Capacitor, tubular hi-temp .05 mfd	Plate decoupling
C507	V-6454	Capacitor, osc. trimmer	HV osc. trimmer
C508	RCM20B271K	Capacitor, 270 mmf	Grid by-pass
C509	V-5895	Capacitor, 500 mmf	HV filter
L502	V-9279-1	Coil, RF	RF filter
R501	RC41AE333K	Resistor, 33,000 ohms 2 w.	Screen drop
R502	RC20AE680K	Resistor, 63 ohms ½ w.	Decoupling
R503	RC20AE683K	Resistor, 68,000 ohms ½ w.	Grid return
R504	RC20AE104K	Resistor, 100,000 ohms ½ w.	Filter
*SW501	V-9607-1 assy	Switch, on-off (assy consists of R201, SW401 and SW501)	
T501	V-9595-1	Transformer	Power
T502	V-9278	Transformer	Hi-voltage RF

*Sold only as complete assembly

When ordering parts, specify model number of set in addition to part number and description of part.

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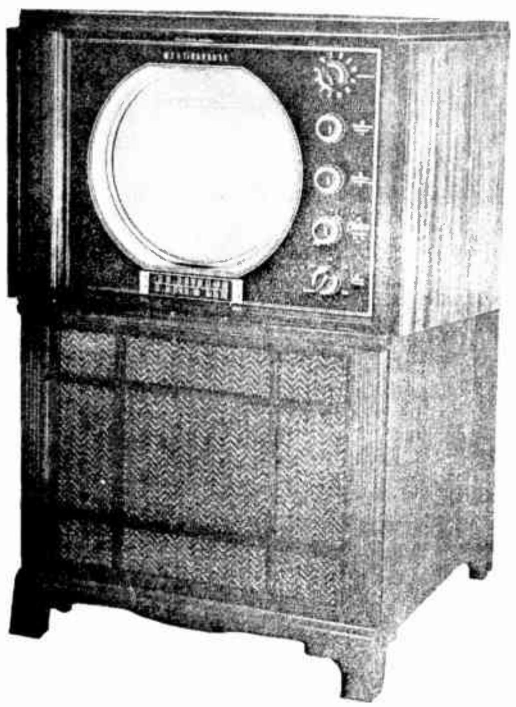

SPECIFICATIONS

TELEVISION FREQUENCY RANGES:

Channel Number	Channel Frequency (MC.)	Video Carrier Frequency (MC.)	Audio Carrier Frequency (MC.)	Receiver H-F Oscillator Frequency (MC.)
1	not used	--	--	--
2	54 - 60	55.25	59.75	81.35
3	60 - 66	61.25	65.75	87.35
4	66 - 72	67.25	71.75	93.35
5	76 - 82	77.25	81.75	103.35
6	82 - 88	83.25	87.75	109.35
7	174 - 180	175.25	179.75	201.35
8	180 - 186	181.25	185.75	207.35
9	186 - 192	187.25	191.75	213.35
10	192 - 198	193.25	197.75	219.35
11	198 - 204	199.25	203.75	225.35
12	204 - 210	205.25	209.75	231.35
13	210 - 216	211.25	215.75	237.35

NOTE: The fine tuning range is plus or minus 1 mc. on channel 2 and plus or minus 2 mc. on channel 13.

AM/FM FREQUENCY RANGES:

Standard Broadcast .... 540 to 1600 kc.
Frequency Modulation .... 88 to 108 mc.

INTERMEDIATE FREQUENCIES:

Television Video Carrier .... 26.1 mc.
TV sound and FM .... 4.5 mc.
AM .... 455 kc.

OPERATING VOLTAGE: .... 105 to 120 volts, 60 cycles A-C

POWER CONSUMPTION: .... 325 watts

TV RECEIVER ANTENNA INPUT IMPEDANCE:

.. 300 ohms balanced or 72 ohms unbalanced

PILOT LAMP:

Westinghouse No. 44 .... 6.3 v., 0.25 amp.

AUDIO POWER OUTPUT:

Undistorted .... 3 watts
Maximum .... 4.5 watts

SPEAKER:

Size and Type .... 10" PM
Voice Coil Impedance-3.2 ohms at 400 cycles

TUBE COMPLEMENT:

1	1B3GT	High Voltage Rectifier
2	5U4G	Low Voltage Rectifier
1	6AH6	Video Output
1	6AK5	R-F Amplifier (TV)
1	6AL5	Video Detector and Noise Clipper
1	6AL5	Ratio Detector
1	6AL5	Horizontal AFC
2	6AU5GT	Horizontal Output
1	6AV6	1st A-F Amplifier and AM Det. — AVC
1	6BE6	FM HF Oscillator/AM Converter
1	6BH6	1st I-F Amplifier (TV)
1	6BH6	2nd I-F Amplifier (TV)
1	6BH6	3rd I-F Amplifier (TV)
1	6BH6	2nd Sound I-F Amplifier And FM AVC
1	6BH6	AGC Keying
1	6BJ6	1st Sound I-F Amplifier
1	6BJ6	4th I-F Amplifier (TV)
1	6J6	HF Oscillator and Mixer (TV)
1	6V6GT	Vertical Output
1	6W4GT	Horizontal Damper
1	6Y6G	H.V. Oscillator
1	6Y6G	Audio Output
1	12AT7	FM R-F Amplifier and Mixer
1	12AT7	Sync Amplifier and Sync Separator
1	12AU7	Vertical Multivibrator
1	12AU7	Horizontal Multivibrator
1	12AU7	DC Restorer and Phase Inverter
1	12KP4, 12KP4A, or 12LP4	Cathode Ray Tube

VIDEO RESPONSE: .... 3.6 mc.

AUDIO DISCRIMINATOR BAND WIDTH (between peaks): .... 180 kc.

FOCUS: .... Magnetic

SWEEP DEFLECTION: .... Magnetic

SCANNING: .... Interlaced, 525 line

HORIZONTAL SCANNING FREQUENCY: .... 15,750 CPS

VERTICAL SCANNING FREQUENCY: .... 60 CPS

FRAME FREQUENCY (picture repetition rate): .... 30 CPS

INSTALLATION INSTRUCTIONS

TO PREPARE THE RECEIVER FOR OPERATION:

1. Remove the red screw and wood spacer located at the rear of the record changer slide mechanism.

2. Remove all packing from the record changer compartment.

3. Remove the phono needle guard if one is used.

4. Remove the turntable by lifting it straight up.

5. Turn the two large, round-head screws, located under the turntable, *clockwise* to the limit of their travel.

6. Replace the turntable.

7. Remove the screws that secure the rear cover of the television section to the cabinet, and remove the rear cover by pulling it away from the cabinet.

8. Remove the red headed wood screw from the shipping block located on the top (inside) of the cabinet, and remove the shipping block.

9. Remove the two red headed wood screws from the shipping block located between the upper left side of the cabinet and the chassis, and remove the shipping block.

10. Inspect the face of the C.R.T. and the glass window for dust or smudges. If the face of the C.R.T. or the inside of the glass window is smudged, it will be necessary to remove the chassis to clean the smudged surface. In this event, refer to CHASSIS REMOVAL.

11. Loosen the two hex-head bolts on the under side of the cabinet, and remove the

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wood shipping strip located between the chassis and the bottom of the cabinet.

12. Loosen the two screws securing the shock mounting bracket to the top (inside) of the cabinet.

13. Adjust the position of the chassis so that the knobs and the face of the C.R.T. are properly aligned with respect to the holes in the front of the cabinet.

14. Re-tighten the two red headed bolts on the under side of the cabinet and the two screws securing the shock mount bracket on the top of the cabinet.

15. Make certain that all tubes are secure in their socket.

16. Models H-611C12 and H-615C12 contain a built-in antenna for use in areas of normal reception. In such areas when the built-in antenna provides good reception, no additional antenna connections are required. However, in weak signal areas or under adverse conditions, it may be necessary to use an external antenna. If an external antenna is used the built-in antenna should be disconnected from the antenna terminals on the rear of the cabinet, and the lugs of the built-in antenna should be insulated and dressed in such a position that they do not touch the chassis or components. The spring clamp located on the top (inside) of the cabinet can be used to hold the built-in antenna feeder out of the way.

17. Replace the rear cover.

18. If an outside antenna is to be used, connect the lead-in to the antenna terminals on the back of the set.

19. Connect the A-C plug to a 105 to 120 volt 60 cycle A-C power outlet.

TO CHECK THE OPERATION:

1. Rotate the selector to the TV position.

2. Turn the magnifier switch to the clockwise (magnified) position.

3. Rotate the brightness, and contrast controls completely counterclockwise.

4. Turn on the receiver by rotating the off-on-volume control clockwise.

5. Rotate the channel selector to the channel number of the desired station.

6. Rotate the brightness control clockwise until the screen is well lighted.

7. Rotate the contrast control clockwise until a picture appears on the screen.

8. If the built-in antenna is in use, adjust the television antenna control for maximum picture contrast. If an external antenna is in use, this step is not required.

9. If the picture is moving up or down or quivering, adjust the vertical hold control to stabilize the image.

10. If vertical or diagonal bars or a folded over picture appears on the screen, adjust the horizontal hold control to obtain a stable picture.

11. Adjust the fine tuning control for best picture detail.

12. Readjust the brightness and contrast controls until pleasing shades ranging from clear white to intense black are attained.

13. Adjust the volume control for the desired sound volume.

14. Turn the magnifier switch to the counterclockwise (normal) position. If vertical or diagonal bars appear on the screen, adjust the width control as described under TELEVISION ADJUSTMENTS. *Do not readjust the horizontal hold control.*

15. If necessary, adjust the height, height magnifier, vertical linearity, vertical linearity magnifier, and focus controls as explained under TELEVISION ADJUSTMENTS.

16. Check the operation on all available television stations. Note that if the built-in antenna is in use, the television antenna control must be readjusted for maximum picture contrast each time the receiver is tuned to a different channel.

17. Rotate the selector to the FM position, and check the operation of the radio section on the FM band.

18. Rotate the selector to the AM position, and check the operation of the radio section on the broadcast band.

19. Rotate the selector to the PHONO position, and completely check the operation of the record changer using 78 RPM intermixed 10" and 12" records, 33-1/3 RPM intermixed 10" and 12" records, and 45 RPM 7" records.

TELEVISION ADJUSTMENTS

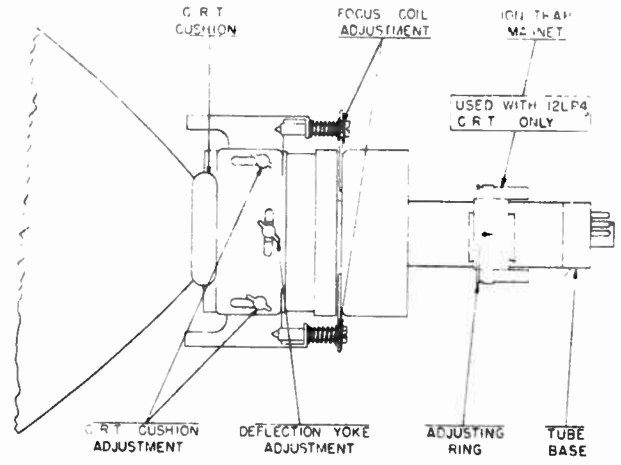

FIG. 1 — CRT ADJUSTMENTS

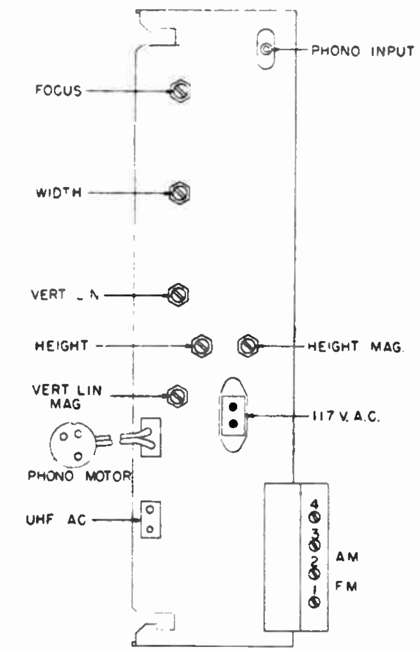

FIG. 2 — ADJUSTMENTS ON REAR OF CHASSIS

The picture adjustments are located on the rear of the chassis and are accessible through cut-outs in the back cover.

ION TRAP MAGNET

Adjustment of the ion trap magnet is required only when a 12LP4 cathode ray tube is used. An ion trap magnet is not used with 12KP4 or 12KP4A cathode ray tubes.

The ion trap magnet must always be adjusted for maximum picture brightness. With the magnet oriented approximately as shown in Fig. 1, rotate it around the neck of the tube and move it forward and backward until the position is found where the brightest raster is obtained.

CAUTION: When adjusting the ion trap magnet, care must be exercised to avoid breaking the neck of the CRT.

FOCUS COIL

If a shadow falls on one corner of the picture or the picture is not properly centered, adjustment of the focus coil is required. To adjust, loosen the short hex-head bolts that lock the focus coil to the adapter plates and move the coil up and down and to the left and right until the position is found where the picture is properly centered and there are no shadowed corners. Tighten the short hex-head bolts to lock the coil in this position. Fine adjustment is provided by the long hex-head bolts at each corner of the focus coil.

If a 12LP4 CRT is in use and shadows cannot be removed completely by adjusting the focus coil, the ion trap magnet may be in need of adjustment.

CATHODE RAY TUBE CUSHION

The cushion must fit snugly against the flare of the cathode ray tube in order that the rear of the tube will be supported firmly.

DEFLECTION YOKE

This adjustment controls the angle of the picture with respect to the horizontal. If the picture is not squared in the picture mask, loosen the wing nut and move it up or down so as to rotate the deflection yoke. The picture will tilt to the left or right with the deflection yoke rotation.

FOCUS CONTROL

The focus control (Fig. 2) should be adjusted with the brightness and contrast controls in their normal positions. If correct focusing cannot be obtained, the high voltage oscillator may require adjustment.

HEIGHT AND VERTICAL LINEARITY (NORMAL)

The height adjustment controls the overall height of the picture, while the vertical

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linearity adjustment governs contraction or expansion of the upper portion only. For this reason, a balance between the two controls is necessary to make the picture symmetrical and fill the mask vertically.

HEIGHT AND VERTICAL LINEARITY (MAGNIFIED)

The height magnifier adjustment controls the overall height of the magnified picture, while the vertical linearity magnifier adjustment governs contraction or expansion of the upper portion only. For this reason, a balance between the two controls is necessary to make the picture symmetrical and fill the mask vertically. *These controls must be reset if the height and vertical linearity controls governing the normal picture are changed.*

WIDTH

The width adjustment must always be made with the magnifier control set for a normal size picture. The correct adjustment is made as follows:

1. Rotate the magnifier control to the magnified position, and adjust the horizontal hold control until the magnified picture holds horizontal sync.

2. Set the magnifier control for a normal size picture, and *without re-adjusting the horizontal hold control* adjust the width control until the picture holds horizontal sync and fills the mask horizontally.

HORIZONTAL RINGING COIL

To adjust the horizontal ringing coil:

1. Turn the magnifier switch to the magnified (clockwise) position.

2. Tune in the weakest TV station in your area.

3. Set the horizontal hold control at approximately the center of its range.

4. Adjust the ringing coil (L403) until the picture is properly "locked-in".

HIGH VOLTAGE OSCILLATOR

An insulated, long-shank screwdriver is preferred for making the H.V. oscillator adjustment The procedure is as follows:

1. *Turn off the receiver* and disconnect the high voltage lead from the CRT.

2. Connect 18 one megohm, one watt resistors in series between the high voltage lead and the chassis.

3. Connect a kilovoltmeter across the 18 megohms of resistance.

4. Turn on the receiver and adjust C507 for maximum voltage indication on the meter. When C507 is peaked using an 18 megohm load, the voltage across the load should be 9.3 kilovolts (approximately).

5. *Turn off the receiver*, disconnect the kilovoltmeter, remove the 18 megohms of resistance, and connect the high voltage lead to the CRT. Note that when the 18 megohm load is removed and the high voltage lead is connected to the CRT, the output voltage of the H.V. power supply will rise because of the higher load resistance offered by the CRT.

CHASSIS REMOVAL

To remove the chassis from the cabinet, proceed as follows:

1. Remove the control knobs.

2. If an external antenna is in use, disconnect the transmission line from the antenna terminals.

3. Remove the screws that secure the rear cover, and remove the rear cover by pulling it straight out.

4. Disconnect the FM dipole and the AM loop from the antenna terminals on the rear of the chassis.

5. Disconnect the built-in TV antenna (if in use) from the TV antenna terminals, and release the TV antenna terminal strip from the cabinet.

6. Disconnect the phono cable from the connector on the chassis.

7. Disconnect the A-C power cord from the record changer

8. Disconnect the speaker leads from the terminals on the chassis.

9. Open the record changer drawer by pulling it out to the limit of its travel.

10. Remove the pilot lamp socket located under the AM/FM dial scale by removing the screw that secures it to the underside of the supporting shelf.

11. Pull the pilot lamp socket and leads up through the hole in the supporting shelf, and dress it clear of the cabinet.

12. Remove the clamp that secures the shutter frame to the supporting shelf after removing the machine screw that holds the clamp in place. The screw is accessible from the underside of the supporting shelf.

13. Remove the two bolts that hold the upper chassis mounting bracket to the top (inside) of the cabinet.

14. Remove the two red headed chassis mounting bolts from the underside of the supporting shelf.

15. Slide the chassis out of the cabinet, keeping the front of the chassis against the cabinet partition and progressively moving the rear of the chassis to the right so that the chassis components will clear the cabinet accessories.

CATHODE RAY TUBE REPLACEMENT

To remove the CRT from the chassis, it is not necessary to remove the shutter assembly or the radio dial cord. The CRT can most readily be removed as follows:

1. Remove the chassis from the cabinet as explained under CHASSIS REMOVAL.

2. Remove the wing nut that holds the shutter assembly to the CRT strap. This wing nut is located at the top front of the CRT.

3. Remove the CRT strap bolt.

4. Slide the upper section of the CRT strap free from the bracket on the shutter assembly, and bend the strap away from the CRT.

5. Release the deflection yoke connector socket from the superstructure by removing the two screws that hold it in place.

6. Remove the CRT socket and the ion trap magnet (if used).

7. Remove the two short hex-head bolts from the focus coil, and slide the focus coil and its mounting bracket off the neck of the CRT.

8. Remove the CRT cushion adjustment wing screws. These are the screws that secure the deflection yoke and hood to the superstructure.

9. Slide the deflection yoke and hood assembly toward the base of the CRT until the yoke and hood are clear of the superstructure and the neck of the CRT.

10. Remove the CRT by pulling it slightly toward the rear of the chassis to clear the shutter mechanism and then lifting it straight up from the chassis. Care must be exercised to avoid damaging the aquadag of scratching the face of the tube.

ALIGNMENT INFORMATION

TEST EQUIPMENT REQUIRED

To properly service the chassis, the following test equipment should be available:

1. R-F sweep generator which meets the following requirements:
   a. Frequency range from 18 to 30 mc. with a sweep width of 10 mc.
   b. Output adjustable with at least 100,000 microvolts maximum and a very low minimum.
   c. Output "flat" on all attenuator positions.

2. Cathode-ray oscilloscope, preferably one with a wide band vertical deflection amplifier and a low-capacitance input probe.

3. Signal generator or generators capable of providing output at various frequencies between 455 kc. and 108.5 mc. The R-F output level should be adjustable with at least 100,000 microvolts maximum and a very low minimum. Amplitude modulation is required on the frequencies between 455 kc. and 1615 kc.

4. Heterodyne frequency meter with crystal calibrator (if the signal generator does not include a crystal calibrator.

5. Electronic voltmeter (vacuum tube voltmeter), with a high voltage multiplier probe for measurements up to 15,000 volts and an R-F probe for measuring R-F voltages.

INTERCONNECTIONS AND BONDING

The test equipment and the chassis should be bonded together by short lengths of heavy, braided copper ribbon. The effectiveness of the bonding can be checked during alignment by placing the hand on the metal chassis or test equipment case. If the response pattern

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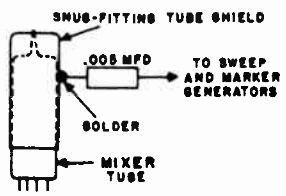

FIG. 3 — COUPLING SIGNAL GENERATORS TO TV MIXER TUBE

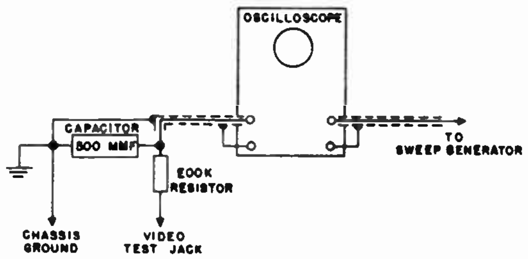

FIG. 4 — OSCILLOSCOPE CONNECTIONS

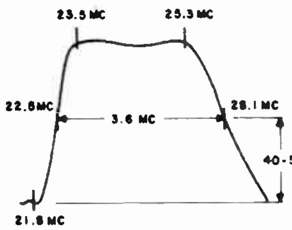

FIG. 5 — TV COMMON I-F RESPONSE CURVE

or meter reading changes visibly, the bonding should be improved before the circuits are aligned.

An exception to this general bonding rule is the instrument case of the VTVM. Difficulty will be encountered during the ratio detector zero adjustment if the common terminal of the VTVM is bonded (either directly or through the instrument case) to the television chassis. During this adjustment, both connection points for the VTVM are above ground in the television chassis, and both VTVM terminals must therefore be isolated from ground.

The interconnecting leads should be shielded (72 ohms coaxial cable) and should be as short as possible consistent with ease of making connections.

SIGNAL GENERATOR COUPLING FOR TV ALIGNMENT

In steps 1 to 7 of the TV common I-F procedure, an unmodulated signal is applied to the TV mixer tube through the coupling device illustrated in Fig. 3. The device is constructed by squeezing together a miniature tube shield until it fits the tube snugly and does not ground to the chassis. A .005 mfd capacitor is then soldered to the side of the shield. By sliding the tube shield up or down on the tube, the capacitance between the shield and the tube elements can be varied to obtain additional control of the coupling over that provided by the attenuator in the generator itself. The ground side of the generator output cable should be connected to the receiver chassis.

In step 8 of the TV common I-F alignment procedure, a sweep generator is connected to the coupling device described above. An unmodulated signal generator is used to provide marker indications at various frequencies on the response curve. In this application, the signal generator input of the set must be low in amplitude to avoid distorting the response curve. To reduce the signal generator input accordingly, the signal generator should be *loosely* coupled to the set by wrapping a few turns of insulated wire around the coupling capacitor "pigtail" and connecting the signal generator to this wire. The sweep generator should be connected directly to the coupling device.

USE OF OSCILLOSCOPE

In step 8 of the TV common I-F alignment procedure, the I-F response pattern on the oscilloscope screen serves as a check on the I-F alignment. The vertical input to the oscilloscope is connected to the video test jack on the receiver chassis through the de-coupling network illustrated in Fig. 4. The horizontal input of the oscilloscope should be connected to the sweep output from the sweep generator, and the sweep control on the oscilloscope should be turned to the "X" or "OFF" position.

The oscilloscope pattern obtained in step 8 of the TV common I-F alignment procedure should be similar to that shown in Fig. 5. Use the signal generator as a marker to check at the frequencies indicated. If the pattern obtained is not similar to Fig. 5, it will be necessary to re-adjust L110, T301, T302, T303, and T304 to produce the correct pattern.

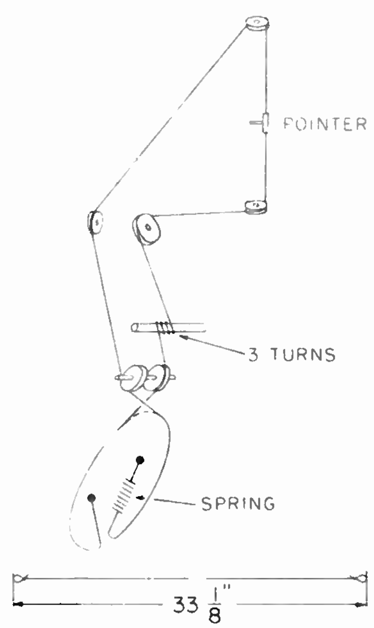

FIG. 6 — AM/FM DIAL DRIVE

ALIGNMENT PROCEDURE

AM RADIO SECTION

Set the selector switch to the "AM" position.

Connect an output meter across the speaker voice coil.

While making the following adjustments, keep the volume control set for maximum output, the tone control set for maximum treble, and the signal generator output attenuated to avoid AVC action.

Step	Connect Signal Generator to—	Sig. Gen. Freq.	Radio Dial Setting	Adjust for Maximum Output —
1.	Stator of AM ant. section (C250E) of tuning gang thru a 0.1 mfd capacitor	455 kc. amplitude modulated	minimum capacity	Primary and secondary of T204 and T205
	NOTE: If the I-F transformers are badly mis-aligned, it may be impossible to obtain sufficient output using the above system. In this event it will be necessary to align each transformer separately. Start with T205 and work forward, connecting the signal generator through a 0.1 mfd capacitor to the control grid of the tube preceding the transformer under alignment.			
2.	Same as step 1	1615 kc. amplitude modulated	minimum capacity	AM oscillator trimmer.
3.	Radiated signal (no actual connection)	1400 kc. amplitude modulated	tune for maximum signal	AM antenna trimmer (rock-in adjustment).

NOTE: The alignment of T204 and T205 affects the alignment of T201 and T202. Therefore, it will be necessary to check the alignment of the 4.5 mc. I-F system whenever T204 or T205 are adjusted. The check can be made by performing steps 3 and 4 under "FM Radio Section."

FM RADIO SECTION

If AM adjustments are required, do not align the FM circuits until the AM adjustments have been completed.

Set the selector switch to the "FM" position.

Step	Connect Signal Generator to—	Sig. Gen. Frequency	Radio Dial Setting	Adjust —
1.	Connect a VTVM between points "A" and "B" (shown on Fig. 8) with the common lead to point "A" and the high lead to point "B".			
2.	Stator of FM mixer section (C250B) of tuning gang thru a .01 mfd mica capacitor.	4.5 mc. unmodulated	maximum capacity	Secondary (top slug) of T203 for *zero* voltage.
3.	Connect the VTVM between points "A" and "C" with the common lead to point "C" and the high lead to point "A". Set the VTVM on the 5 volt (-DC) scale, and keep the signal generator output adjusted accordingly.			
4.	Same as step 2.	4.5 mc. unmodulated	maximum capacity	Primary and secondary of T201 and T202 and primary of T203 for maximum voltage.
5.	Repeat steps 1 and 2.			
6.	Re-connect the VTVM as in step 3.			
7.	Ant. terminal No. 1 thru a 300 ohm non-inductive resistor.	108.5 mc. unmodulated	minimum capacity	FM oscillator trimmer (C247) for maximum voltage*.
	NOTE: If two peaks appear, use the one that occurs with the trimmer nearest maximum capacity.			
8.	Same as step 7.	105 mc. unmodulated	tune for maximum signal	FM R-F amp. trimmer for maximum voltage (rock-in adjustment).
9.	Same as step 7.	105 mc. unmodulated	tune for maximum signal	FM mixer trimmer for maximum voltage (rock-in adjustment).

* To check the dial calibration after adjusting the FM oscillator trimmer (C247), set the tuning gang at maximum capacity and adjust the signal generator frequency in the vicinity of 87.5 mc. for maximum voltage on the VTVM. If maximum response occurs at a generator frequency of 87.5 mc., no further adjustments are necessary. If maximum response occurs when the generator frequency is lower than 87.5 mc., slightly expand the FM oscillator coil (L203); if the generator frequency is higher than 87.5 mc., slightly compress the FM oscillator coil (L203). Re-adjust the FM oscillator trimmer (C247) at 108.5, and again check the calibration. Repeat this process until correct calibration is obtained.

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ALIGNMENT PROCEDURE (continued)

TV SOUND I-F SECTION

The 4.5 mc. circuits serve as an I-F channel for both the TV sound and the FM radio. Alignment of the TV sound I-F section is therefore accomplished when steps 1 to 5 inclusive under "FM Radio Section" have been performed.

TV COMMON I-F AND 4.5 MC. TRAP

Set the selector switch to the "TV" position.

Turn the TV channel selector to channel 13 to avoid undesirable beat response during alignment.

Step	*Sweep Gen. Frequency*	*Marker Gen. Frequency*	*Remarks*	*Indicator Connection*	*Adjust*
1.	Couple the sweep and marker generators to the TV mixer tube as shown in Fig. 3.				
2.	Not used	21.6 mc. unmodulated	Use a strong signal	Connect VTVM to video test jack	T305 for *minimum* voltage
3.	Not used	22.6 mc. unmodulated	Keep marker output adjusted so VTVM reading does not exceed 2 v.	Same as step 2	L110 for maximum voltage
4.	Not used	25.9 mc. unmodulated	Same as step 3	Same as step 2	T301 for maximum voltage
5.	Not used	25.6 mc. unmodulated	Same as step 3	Same as step 2	T302 for maximum voltage
6.	Not used	23.8 mc. unmodulated	Same as step 3	Same as step 2	T303 for maximum voltage
7.	Not used	23.0 mc. unmodulated	Same as step 3	Same as step 2	T304 for maximum voltage
8.	25.3 mc. with 10 mc. deviation	check at: 21.6 mc. 22.5 mc. 23.5 mc. 25.3 mc. 26.1 mc.	Keep sweep output low enough so that very little noise appears on the oscillo-scope trace	Connect oscilloscope to video test jack. See Fig. 4.	If necessary, adjust L110, T301, T302, T303, and T304 to obtain correct response curve. See Fig. 5.
9.	Connect the signal generator to the video test jack through a .001 mfd mica capacitor.				
10.	Not used	4.5 mc. unmodulated	Use a strong signal	Connect high side of R-F probe from VTVM to point "D" (see Fig. 8) and common lead to chassis	Z301 for *minimum* voltage

TV HIGH FREQUENCY OSCILLATOR

If the 6J6 oscillator tube is replaced, the different inter-electrode capacity of the new tube may change the oscillator frequency enough to necessitate realignment of the oscillator.

Alignment of the oscillator on the high band is accomplished by adjusting the brass slug located adjacent to the vernier drive wheel on the front of the tuner. Alignment of the oscillator on the low band is accomplished by adjusting the brass slug on the lower front of the tuner. *A non-metallic screwdriver is required.*

The oscillator alignment procedure is as follows.

1. Set the fine tuning control at the middle of its range, and leave it in this position during the following adjustments.
2. Set the selector switch to the highest of the low-band (channels 2 through 6) stations operating in your vicinity.
3. Peak the low band adjustment slug for the best picture detail.
4. Set the selector switch to the highest of the high-band (channels 7 through 13) stations operating in your vicinity.
5. Peak the high band adjustment slug for best picture detail.
6. Check the previously made low band adjustment, and if the tuning has changed, repeat steps 2 and 3.

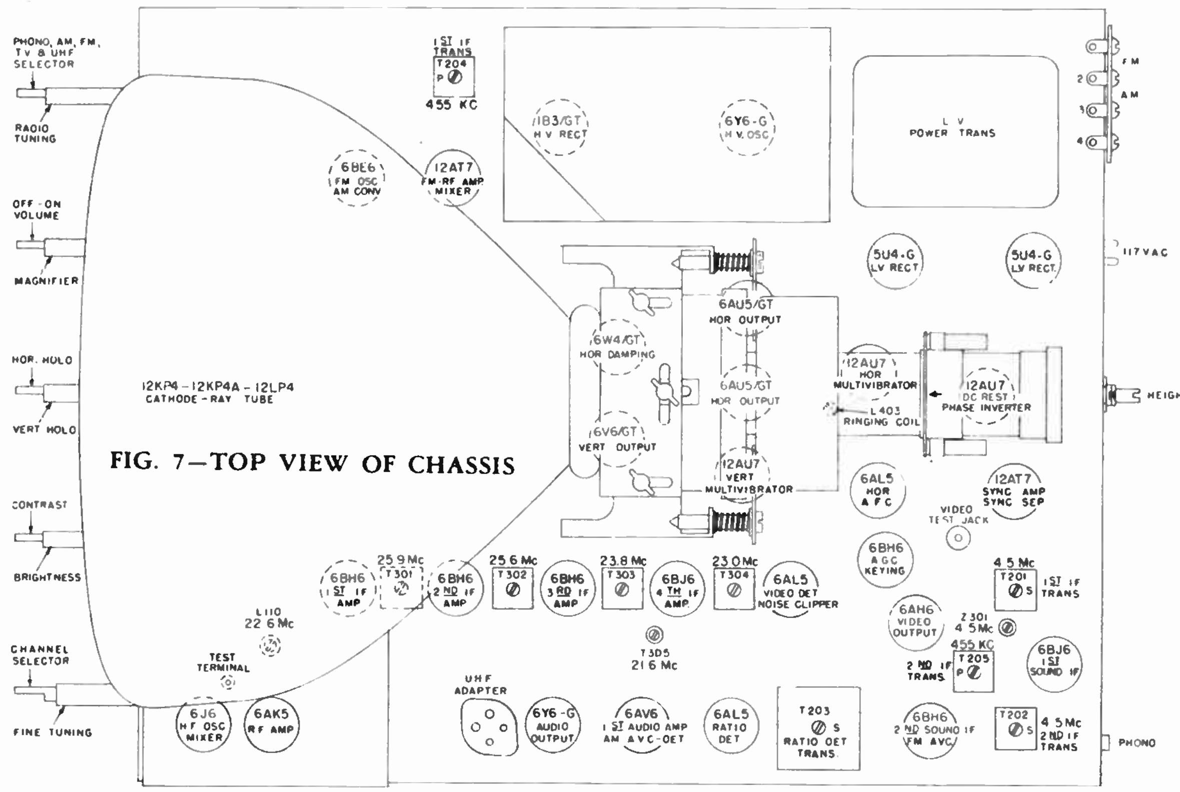

FIG. 7—TOP VIEW OF CHASSIS

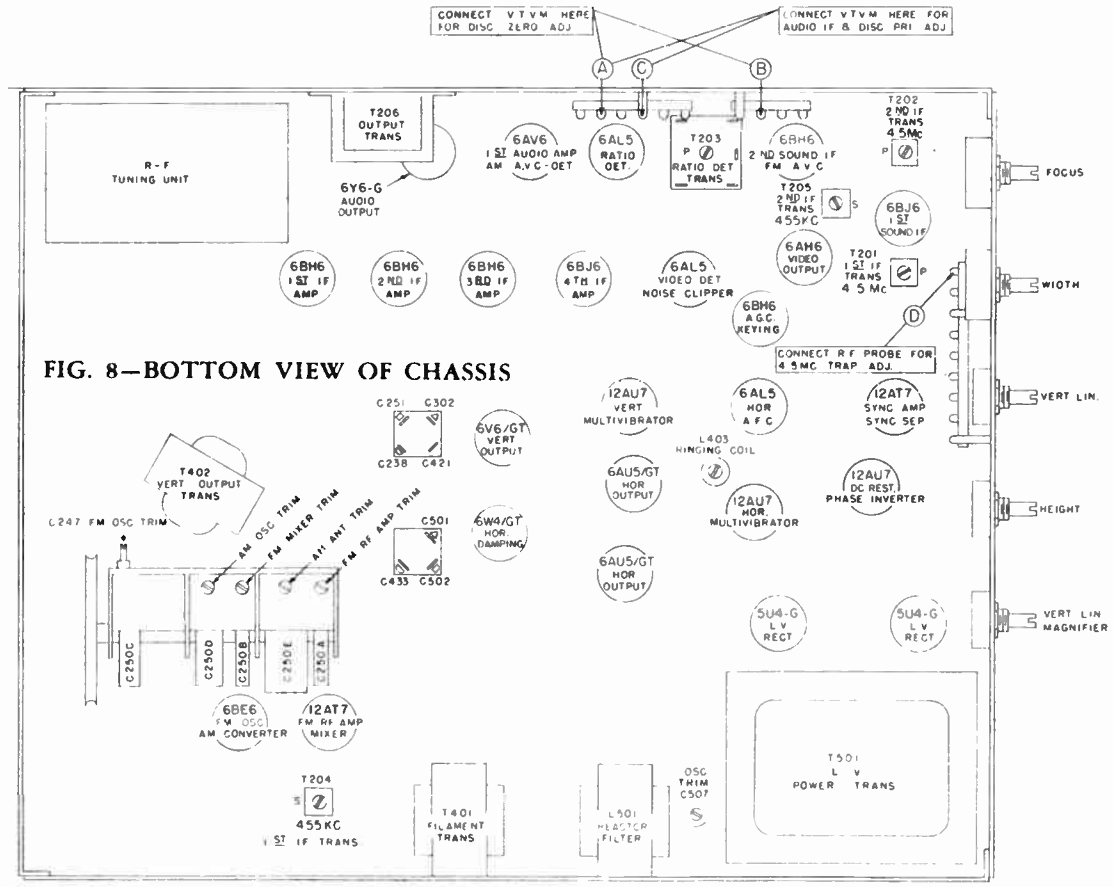

FIG. 8—BOTTOM VIEW OF CHASSIS

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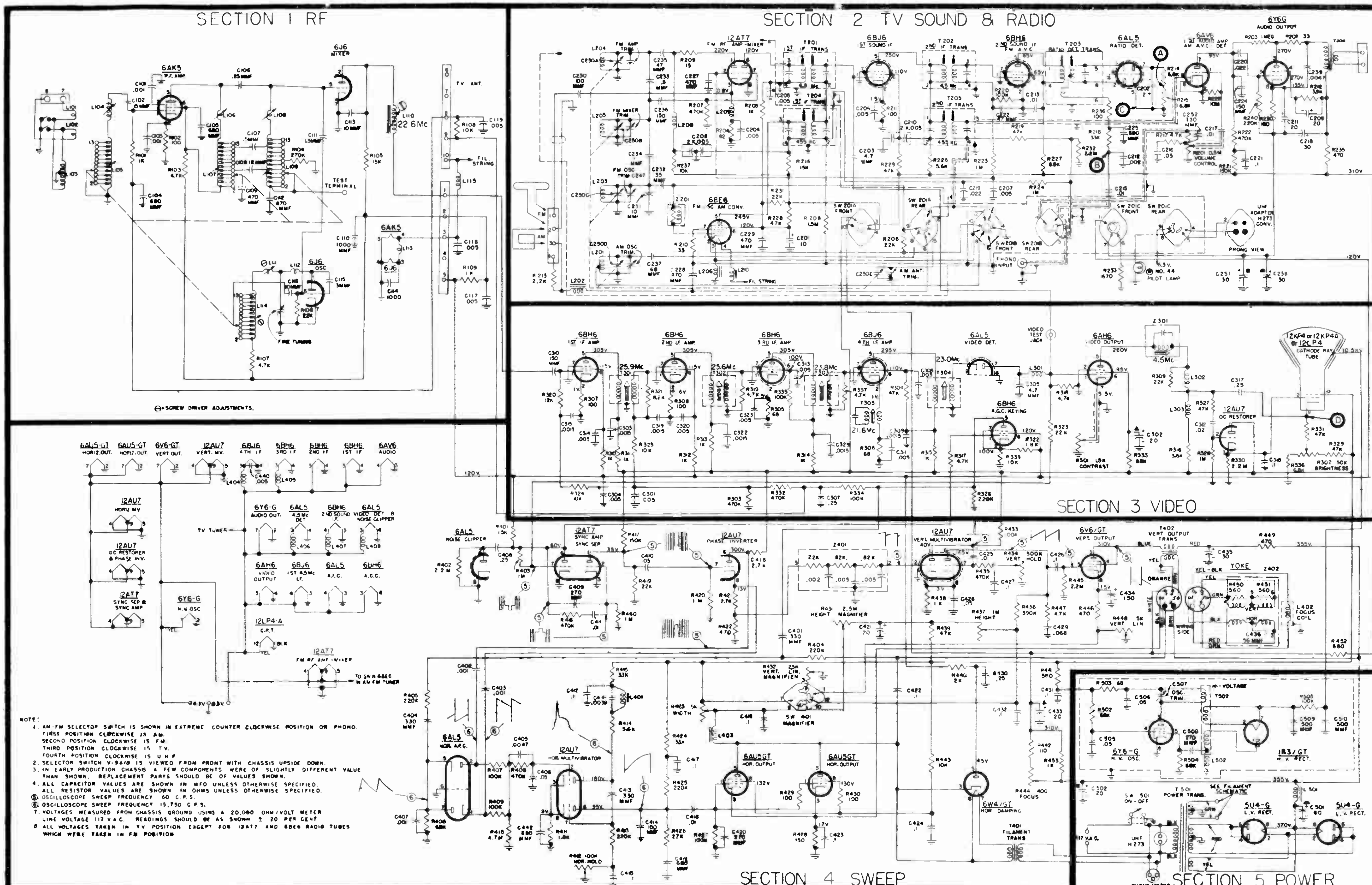
IMPORTANT—Since many of the components are very critical, exact duplicates must be used for replacement purposes.

MODELS H-611C12, H-615C12, Ch. V-2152-16



CHASSIS NO V-2152-16

FIG. 9—SCHEMATIC DIAGRAM

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PARTS LIST FOR MODELS H-611C12 AND H-615C12

CABINET

Part No.	Description
V-9545-1	Baffle and grille cloth assembly (mahogany)
V-9545-2	Baffle and grille cloth assembly (blond)
V-9249-2	Bracket, chassis shock mounting
V-1202-1	Cabinet (mahogany)
V-1202-2	Cabinet (blond)
V-4898-1	Catch, bullet (mahogany)
V-4898-2	Catch, bullet (blond)
V-9310-2	Cover assembly, back
V-9316	Dial, AM and FM
V-4902	Glide, furniture
V-9091-1	Hinge, L.H. (mahogany)
V-9091-3	Hinge, L.H. (blond)
V-9091-2	Hinge, R.H. (mahogany)
V-9091-4	Hinge, R.H. (blond)
V-6146-1	Knob, contrast-volume, off-on, horizontal (mahogany)
V-6146-6	Knob, contrast-volume, off-on, horizontal (blond)
V-9471-1	Knob, magnifier
V-9104-2	Knob, AM/FM tuning (rear)
V-9104-1	Knob, brightness, vertical (rear)
V-9104-4	Knob, fine tuning (rear)
V-6284-7	Knob, channel selector (mahogany)
V-6284-9	Knob, channel selector (blond)
V-6284-2	Knob, band selector (mahogany)
V-6284-3	Knob, band selector (blond)
V-9731-1	Knob, television antenna (mahogany)
V-9731-2	Knob, television antenna (blond)
V-9536-2	Plate, front glass (mahogany)
V-9536-3	Plate, front glass (blond)
V-5631-3	Slide, mechanism (L.H.)
V-5631-4	Slide, mechanism (R.H.)
V-6059	Spring, fine tuning knob
V-6063-1	Spring, selector and band selector knob
V-4900-1	Strike, bullet (mahogany)
V-4900-2	Strike, bullet (blond)
V-5421-5	Washer, felt (control knob)

MISCELLANEOUS

Part No.	Description
V-6451-2	Adapter plate, R-F tuner
V-5982-2	Antenna assembly, AM loop
V-5986-2	Antenna assembly, FM dipole
V-9521-1	Antenna assembly, television
V-6120-2	Background, dial
V-4169-1	Base, miniature tube (6BJ6, 6BH6, 6AL5)
V-6602-1	Base, miniature tube (12AU7)
V-9581-1	Bracket weld assembly, deflection yoke
V-3371-4	Bumper, recessed (chassis mounting)
V-5860-9	Cable assembly, speaker
V-4965-6	Cable, phono
V-5426	Clip, I-F mounting
V-5906-1	Connector assembly, hi-voltage
V-3254S	Connector, phono
V-9077-3	Cord, A-C phono
V-3219S-1	Cord, dial drive (100 ft. spool)
V-5522	Cord, power A-C
V-9234	Hood, yoke mounting
W #44	Lamp, pilot
V-9488-1	Lever assembly, magnifier
V-6573-4	Magnet, ion trap
V-6518-3	Plug assembly, yoke
V-5549	Plug, power cord
V-9383	Plug, U.H.F.
V-6096-2	Pulley, dial drive (.380 diam.)
V-6096-1	Pulley, dial drive (.600 diam.)
V-9344-3	Shaft, television antenna
V-6602-2	Shield, miniature tube (12AU7)
V-4169-2	Shield, miniature tube (6BH6, 6BJ6, 6AL5)
V-9175-11	Shutter assembly, (blond)
V-9175-9	Shutter assembly, (mahogany)
V-9297	Sleeve, dial drive
V-5979	Sleeve, rubber (focus coil)
V-9063-3	Socket, pilot light
V-9440-4	Socket assembly, cathode ray tube
V-5929	Socket, molded octal (1B3 GT)
V-4292S-1	Socket, miniature molded (6BH6, 6BJ6, 6AV6, 6AL5, 6AH6)

*Sold only as complete assembly.

PARTS LIST FOR MODELS H-611C12 AND H-615C12

Part No.	Description
V-5556-1	Socket, miniature molded (12AU7, 12AT7)
V-6089-1	Socket, miniature molded (12AU7 vertical mv.)
V-6997-1	Socket, miniature shock mounted (12AU7 horiz. mv.)
V-4514	Socket, molded octal (5U4-G, 6V6G, 6W4/GT, 6Y6-G, 6AU5/GT)
V-9061	Socket, U.H.F. power connector
V-6072-4	Socket, miniature wafer (12AT7)
V-6163-1	Socket, miniature wafer (6BE6)
V-9166-1	Socket, deflection yoke
V-9335	Speaker, 10" P.M.
V-4057	Spring, dial drive
V-6795-2	Spring, shutter
V-6908	Strap assembly, cathode ray tube
V-6294	Terminal board, antenna
V-5977	Tip jack
V-3274S	Tube holder

ELECTRICAL PARTS FOR V-2152-16 CHASSIS

Section 1—R-F

Item	Part No.	Description	Function
	V-8210	Tuner assembly, R-F	
C117	V-5596	Capacitor, hi-kap .005 mfd	Decoupling
C118	V-5596	Capacitor, hi-kap .005 mfd	Filament by-pass
C119	V-5596	Capacitor, hi-kap .005 mfd	AGC filter
L115	V-9099-1	Choke, R-F	
R108	RC20AE103K	Resistor, 10,000 ohms ½ w.	AGC decoupling
R109	RC20AE102M	Resistor, 1000 ohms ½ w.	Screen dropping

Section 2—TV Sound and Radio

Item	Part No.	Description	Function
C201	V-9351	Capacitor, electrolytic, 10 mfd 350 v.	Filter
C202	V-4880	Capacitor, electrolytic, 2 mfd 50 v.	Ratio det. stabilizer
C203	V-5658-6	Capacitor, 4.7 mmf	Audio I-F coupling
C204	V-5596	Capacitor, hi-kap .005 mfd	Cathode by-pass
C205	V-5596	Capacitor, hi-kap .005 mfd	R-F by-pass
C206	V-5596	Capacitor, hi-kap .005 mfd	Cathode by-pass
C207	V-5596	Capacitor, hi-kap .005 mfd	AVC by-pass
C208	V-9044-1	Capacitor, dual hi-kap (consists of A and B)	
A	Part of C208	Capacitor, hi-kap .005 mfd	Decoupling
B	Part of C208	Capacitor, hi-kap .005 mfd	Decoupling
C209	V-3236	Capacitor, electrolytic, 20 mfd 25 v.	Screen by-pass
C210	V-9044-1	Capacitor, dual hi-kap (consists of A and B)	
A	Part of C210	Capacitor, hi-kap .005 mfd	Screen by-pass
B	Part of C210	Capacitor, hi-kap .005 mfd	Feed back
C211	V-3236	Capacitor, electrolytic, 20 mfd 25 v.	Cathode by-pass
C212	V-6023-6202M	Capacitor, hi-temp .002 mfd 600 v.	De-emphasis
C213	V-6023-4103M	Capacitor, hi-temp .01 mfd 400 v.	Screen by-pass
C215	V-6023-4103M	Capacitor, hi-temp .01 mfd 400 v.	AF coupling
C216	V-6023-4503M	Capacitor, hi-temp .05 mfd 400 v.	Low frequency boost
C217	V-6023-4103M	Capacitor, hi-temp .01 mfd 400 v.	AF coupling
C218	V-6570	Capacitor, electrolytic, 30 mfd 450 v.	Screen by-pass
C219	V-6023-4223K	Capacitor, hi-temp .022 mfd 400 v.	AVC filter
C220	V-6023-4223K	Capacitor, hi-temp .022 mfd 400 v.	Audio coupling
C221	V-6023-4104M	Capacitor, hi-temp .1 mfd 400 v.	Decoupling
C222	RCM20B470K	Capacitor, 47 mmf	Grid limiting
C224	RCM20B151K	Capacitor, 150 mmf	R-F by-pass
C225	RCM20B681M	Capacitor, 680 mmf	De-emphasis
C227	R5CC21ZY471M	Capacitor, 470 mmf	Grid by-pass
C228	R5CC21ZY471M	Capacitor, 470 mmf	AM coupling
C229	R5CC21ZY471M	Capacitor, 470 mmf	Screen by-pass
C230	R3CC30SL101M	Capacitor, 100 mmf	FM coupling
C231	R2CC30CK100D	Capacitor, 10 mmf	Connective capacitor
C232	R3CC30SL330M	Capacitor, 33 mmf	FM coupling
C233	R3CC20SLR50C	Capacitor, .5 mmf	FM coupling
C234	R3CC20SL1R0C	Capacitor, 1.0 mmf	FM coupling
C235	R3CC30SL470M	Capacitor, 47 mmf	R-F coupling
C236	R3CC32SL151M	Capacitor, 150 mmf	FM coupling mixer
C237	R3CC30SL680M	Capacitor, 68 mmf	AM osc. coupling
*C238	V-9577 assy	Capacitor, electrolytic 30 mfd 400 v. (assy consists of C238, C302, C421 and C251)	Filters
C239	V-6023-4472M	Capacitor, hi-temp .0047 mfd 400 v.	Tone compensation

PARTS LIST FOR MODELS H-611C12 AND H-615C12

Item	Part No.	Description	Function
C247	V-9356-1	Capacitor, trimmer	FM osc.
C250	V-9349-2	Capacitor, variable	Tuning
*C251	V-9577 assy	Coil, electrolytic 30 mfd 400 v. (assy consists of C238, C302, C341, and C251)	Filters
C252	RCM20A331M	Capacitor, 330 mfd	Hi-frequency boost
L201	V-9352	Coil	AM oscillator
L202	V-6157	Coil	Antenna loading
L203	V-9353	Coil	FM oscillator
L204	V-9355	Coil	FM amp.
L205	V-9317-2	Coil	FM mixer
L206	V-4886-2	Choke	Filament
L208	V-4886-4	Choke	Plate R-F
L209	V-4886-10	Choke	Cathode
L210	V-4886-2	Choke	Filament
*R201	V-9607-2 assy	Control, 500,000 ohms (assy consists of R201, SW401, and SW501)	Volume
R202	RC20AE330M	Resistor, 33 ohms ½ w.	6Y6 plate suppressor
R203	RC20AE105K	Resistor, 1 megohm ½ w.	Feed back
R204	RC10AE820K	Resistor, 82 ohms ¼ w.	Cathode bias
R205	RC10AE102K	Resistor, 1000 ohms ¼ w.	Plate drop
R206	RC10AE223K	Resistor, 22,000 ohms ¼ w.	Osc. grid
R207	RC10AE474M	Resistor, 470,000 ohms ¼ w.	Grid return
R208	RC10AE155M	Resistor, 1.5 megohms ¼ w.	Isolating
R209	RC10AE150M	Resistor, 15 ohms ¼ w.	Parasitic suppressor
R210	RC10AE330K	Resistor, 33 ohms ¼ w.	Parasitic suppressor
R211	RC20AE101K	Resistor, 100 ohms ½ w.	Cathode bias
R212	RC20AE392K	Resistor, 3900 ohms ½ w.	Screen drop
R213	RC20AE222K	Resistor, 2200 ohms ½ w.	Decoupling
R214	RC20AE682J	Resistor, 6800 ohms ½ w.	Ratio det. load
R215	RC20AE682J	Resistor, 6800 ohms ½ w.	Ratio det. load
R216	RC20AE153K	Resistor, 15,000 ohms ½ w.	Plate drop
R217	RC20AE472K	Resistor, 4700 ohms	Bass boost
R218	RC20AE333K	Resistor, 33,000 ohms ½ w.	De-emphasis
R219	RC20AE473K	Resistor, 47,000 ohms ½ w.	455 kc filter
R220	RC20AE104K	Resistor, 100,000 ohms ½ w.	Grid return
R221	RC20AE154K	Resistor, 150,000 ohms ½ w.	Decoupling
R222	RC20AE474K	Resistor, 470,000 ohms ½ w.	Plate load
R223	RC20AE105K	Resistor, 1 megohm ½ w.	AVC load
R224	RC20AE105K	Resistor, 1 megohm ½ w.	AVC load
R225	RC20AE106M	Resistor, 10 megohms ½ w.	Grid return
R226	RC30AE562K	Resistor, 5600 ohms 1 w.	Plate load
R227	RC30AE683K	Resistor, 68,000 ohms 1 w.	Decoupling
R228	RC30AE473K	Resistor, 47,000 ohms ½ w.	Screen dropping
R229	RC30AE473K	Resistor, 47,000 ohms ½ w.	Screen dropping
R230	RC40AE181K	Resistor, 180 ohms 2 w.	Cathode bias
R231	RC40AE223K	Resistor, 22,000 ohms 2 w.	Screen dropping
R232	RC20AE225K	Resistor, 2.2 megohms ½ w.	455 kc diode load
R233	V-9085-4	Resistor, glasohm, 1670 ohms 10 w.	Screen bus load
R235	V-6067-6	Resistor, glasohm, 470 ohms 4 w.	Screen load
R236	RC20AE101K	Resistor, 100 ohms ½ w.	Ratio det.
R237	RC40AE103K	Resistor, 10,000 ohms 2 w.	Plate dropping
R240	RC20AE224K	Resistor, 220,000 ohms ½ w.	Grid return
SW201	V-9618	Switch, selector (consists of wafer A, B and C)	
T201	V-9370	Transformer (complete)	FM 1st I-F (4.5 mc)
T202	V-9371	Transformer (complete)	FM 2nd I-F (4.5 mc)
T203	V-9340	Transformer (complete)	Ratio detector
T204	V-6130-1	Transformer (complete)	AM 1st I-F (455 kc)
T205	V-6130-2	Transformer (complete)	AM 2nd I-F (455 kc)
T206	V-9685	Transformer (complete)	Audio output
Z201	V-4886-7	Parasitic suppressor	

Section 3—Video

Item	Part No.	Description	Function
C301	V-5596	Capacitor, hi-kap .005 mfd	AGC filter
*C302	V-9577 assy	Capacitor, electrolytic, 20 mfd 400 v. (assy consists of C238, C302, C421 and C417)	Screen by-pass
C303	R5CC26ZY152M	Capacitor, .0015 mfd	
C304	V-5596	Capacitor, hi-kap .005 mfd	R-F by-pass
C305	V-5658-6	Capacitor, 4.7 mmf	Diode plate by-pass
C307	V-6066-4254M	Capacitor, .25 mfd 400 v.	AGC filter
C308	V-5596	Capacitor, hi-kap .005 mfd	Screen by-pass
C309	R5CC26ZY152M	Capacitor, .0015 mfd	Plate decoupling
C310	R5CC21ZY151M	Capacitor, 150 mmf	I-F coupling
C311	V-5596	Capacitor, hi-kap .005 mfd	Cathode by-pass
C312	V-6023-4223K	Capacitor, hi-temp .022 mfd 400 v.	Coupling (DC restorer)

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PARTS LIST FOR MODELS H-611C12 AND H-615C12 (*Continued*)

Item	Part No.	Description	Function
C313	V-5596	Capacitor, hi-kap .005 mfd	Screen by-pass
C314	V-5596	Capacitor, hi-kap .005 mfd	Screen by-pass
C315	R5CC26ZY152M	Capacitor, .0015 mfd	Grid by-pass
C317	V-6066-4254M	Capacitor, .25 mfd 400 v.	Video coupling
C318	V-6023-4104M	Capacitor, hi-temp .1 mfd 400 v.	Cathode by-pass
C319	R5CC26ZY152M	Capacitor, .0015 mfd	Grid by-pass
C320	V-5596	Capacitor, hi-kap .005 mfd	Screen by-pass
C322	R5CC26ZY152M	Capacitor, .0015 mfd	Plate decoupling
C323	V-5596	Capacitor, hi-kap .005 mfd	Cathode by-pass
C329	R5CC26ZY152M	Capacitor, .0015 mfd	Plate decoupling
L301	V-5902-4	Coil, 100 microhenries	Video peaking
L302	V-5902-1	Coil, 140 microhenries	Video peaking
L303	V-5902-5	Coil, 250 microhenries	Video peaking
*R301	V-9235-2 assy	Control, 1500 ohms (assy consists of R301 and R302)	Contrast
*R302	V-9235-2 assy	Control, 50,000 ohms (assy consists of R301 and R302)	Brightness
R303	RC20AE474K	Resistor, 470,000 ohms ½ w.	AGC divider
R304	RC30AE473K	Resistor, 47,000 ohms ½ w.	Screen dropping
R305	RC20AE680K	Resistor, 68 ohms ½ w.	Cathode bias
R306	RC20AE680K	Resistor, 68 ohms ½ w.	Cathode bias
R307	RC20AE101K	Resistor, 100 ohms ½ w.	Cathode bias
R308	RC20AE101K	Resistor, 100 ohms ½ w.	Cathode bias
R309	RC20AE223K	Resistor, 22,000 ohms ½ w.	Video peaking shunt
R310	RC20AE102M	Resistor, 1000 ohms ½ w.	Screen dropping
R311	RC20AE102M	Resistor, 1000 ohms ½ w.	Plate decoupling
R312	RC20AE102M	Resistor, 1000 ohms ½ w.	Screen dropping
R313	RC20AE102M	Resistor, 1000 ohms ½ w.	Plate decoupling
R314	RC20AE102M	Resistor, 1000 ohms ½ w.	Plate decoupling
R315	RC20AE102M	Resistor, 1000 ohms ½ w.	Plate decoupling
R316	RC30AE362J	Resistor, 3600 ohms 1 w.	Plate decoupling
R317	RC20AE472K	Resistor, 4700 ohms ½ w.	Screen dropping
R318	RC20AE472K	Resistor, 4700 ohms ½ w.	Grid return
R319	RC20AE472K	Resistor, 4700 ohms ½ w.	Grid return
R320	RC20AE123K	Resistor, 12,000 ohms ½ w.	Grid return
R321	RC20AE822K	Resistor, 8200 ohms ½ w.	Grid return
R322	RC20AE182K	Resistor, 1800 ohms ½ w.	Screen bias
R323	RC20AE223K	Resistor, 22,000 ohms ½ w.	Isolating
R324	RC20AE103M	Resistor, 10,000 ohms ½ w.	AGC decoupling
R325	RC20AE103M	Resistor, 10,000 ohms ½ w.	AGC decoupling
R326	RC30AE224K	Resistor, 220,000 ohms 1 w.	Plate load
R327	RC20AE473K	Resistor, 47,000 ohms ½ w.	Isolating
R328	RC20AE105K	Resistor, 1 megohm ½ w.	Grid return
R329	RC20AE473K	Resistor, 47,000 ohms ½ w.	DC divider
R330	RC20AE105K	Resistor, 1 megohm ½ w.	Cathode bias
R331	RC20AE473K	Resistor, 47,000 ohms ½ w.	Cathode bias
R332	RC20AE474K	Resistor, 470,000 ohms ½ w.	AGC divider
R333	RC30AE683K	Resistor, 68,000 ohms 1 w.	Screen dropping
R334	RC20AE104K	Resistor, 100,000 ohms ½ w.	AGC divider
R335	RC30AE104K	Resistor, 100,000 ohms 1 w.	Screen dropping
R336	RC20AE682K	Resistor, 6800 ohms ½ w.	DC divider
R337	RC20AE472K	Resistor, 4700 ohms	Grid return
R339	RC20AE103K	Resistor, 10,000 ohms ½ w.	Cathode bias
T301	V-9586-3	Transformer (complete)	1st I-F
T302	V-9586-2	Transformer (complete)	2nd I-F
T303	V-9586-2	Transformer (complete)	3rd I-F
T304	V-9586-3	Transformer (complete)	4th I-F
T305	V-9592	Transformer (complete)	Cathode trap
Z301	V-9591	Trap	4.5 mc trap

Section 4—Sweep

Item	Part No.	Description	Function
C401	RCM20C331J	Capacitor, 330 mmf	Keyed AGC coupling
C402	V-6023-6102M	Capacitor, hi-temp .001 mfd 600 v.	AFC coupling
C403	V-6023-6102M	Capacitor, hi-temp .001 mfd 600 v.	AFC coupling
C404	RCM20C331J	Capacitor, 330 mmf	Error voltage coupling
C405	V-6023-4472M	Capacitor, hi-temp .0047 mfd 400 v.	AFC delay
C406	V-6023-4503M	Capacitor, hi-temp .05 mfd 400 v.	AFC delay
C407	V-6023-6102M	Capacitor, hi-temp .001 mfd 600 v.	Transient by-pass
C408	V-6066-4254M	Capacitor, .25 mfd 400 v.	Noise clipper coupling
C409	RCM20B271K	Capacitor, 270 mmf	Horizontal sync coupling
C410	V-6023-4503M	Capacitor, hi-temp .05 mfd 400 v.	Sync coupling
C411	V-6023-4103M	Capacitor, hi-temp .01 mfd 400 v.	Vertical sync coupling
C412	V-6023-4104M	Capacitor, hi-temp .1 mfd 400 v.	Plate decoupling
C413	RCM20C331J	Capacitor, 330 mmf	Horizontal mv coupling
C414	RCM20B101K	Capacitor, 100 mmf	Charge limiting
C415	V-6023-4104M	Capacitor, hi-temp .1 mfd 400 v.	Grid by-pass
C416	V-6023-4104M	Capacitor, hi-temp .1 mfd 400 v.	R-F by-pass
C417	V-6023-4104M	Capacitor, hi-temp .1 mfd 400 v.	Decoupling
C418	V-6023-4103M	Capacitor, hi-temp .01 mfd 400 v.	Horizontal coupling
C419	RCM20B681M	Capacitor, 680 mmf	Horizontal discharge
C420	RCM20B271K	Capacitor, 270 mmf	Grid by-pass
*C421	V-9577 assy	Capacitor, electrolytic 20 mfd 400 v. (assy consists of C421, C302, C417 and C238)	Decoupling
C422	V-6023-4104M	Capacitor, hi-temp .1 mfd 400 v.	Horiz. output coupling
C423	V-6023-4104M	Capacitor, hi-temp .1 mfd 400 v.	Cathode by-pass
C424	V-6023-4104M	Capacitor, hi-temp .1 mfd 400 v.	Decoupling
C425	V-6023-4103K	Capacitor, hi-temp .01 mfd 400 v.	Vertical mv coupling
C426	V-6023-4104M	Capacitor, hi-temp .1 mfd 400 v.	Vertical coupling
C427	V-6023-4104M	Capacitor, hi-temp .1 mfd 400 v.	Grid by-pass
C428	V-6023-4503M	Capacitor, hi-temp .05 mfd 400 v.	Cathode by-pass
C429	V-6023-4683K	Capacitor, hi-temp .068 mfd 400 v.	Vertical discharge
C430	V-6066-4254M	Capacitor, .25 mfd 400 v.	Plate by-pass
C431	V-6023-4104M	Capacitor, hi-temp .1 mfd 400 v.	HV osc. decoupling
C432	V-6023-4104M	Capacitor, hi-temp .1 mfd 400 v.	Vertical mv decoupling
*C433	V-9575 assy	Capacitor, electrolytic, 20 mfd 450 v. (assy consists of C501, C502 and C433)	Filter
C434	V-9009-1	Capacitor, electrolytic 150 mfd 50 v.	Cathode by-pass
C435	V-6570	Capacitor, electrolytic 30 mfd 450 v.	Filter
C436	V-9792-15560K	Capacitor, 56 mmf	Transient by-pass
C440	V-5596	Capacitor, hi-kap .005 mfd	Filament by-pass
C441	RCM30C392K	Capacitor, 3900 mmf	Horiz. mv plate tank
C442	RCM20B681K	Capacitor, 680 mmf	Cathode by-pass
L401	V-6764	Coil	Horizontal ringing
L402	V-9590-3	Coil	Focus
L403	V-9230-2	Choke	Horizontal feed
L404	V-9099-1	Choke	Filament
L405	V-9099-1	Choke	Filament
L406	V-9099-1	Choke	Filament
L407	V-9099-1	Choke	Filament
L408	V-9099-2	Choke	Filament
R401	RC20AE223K	Resistor, 22,000 ohms ½ w.	Plate load
R402	RC20AE225K	Resistor, 2.2 megohms ½ w.	Diode load
R403	RC20AE105K	Resistor, 1 megohm ½ w.	Voltage divider
R404	RC30AE224K	Resistor, 220,000 ohms 1 w.	Limiting
R405	RC30AE224K	Resistor, 220,000 ohms 1 w.	Limiting
R406	RC20AE683K	Resistor, 68,000 ohms ½ w.	Phase reference
R407	RC20AE104J	Resistor, 100,000 ohms ½ w.	AFC diode load
R408	RC20AE474K	Resistor, 470,000 ohms ½ w.	AFC delay
R409	RC20AE104J	Resistor, 100,000 ohms ½ w.	AFC diode load
R410	RC20AE475M	Resistor, 4.7 megohms ½ w.	Grid return
R411	RC20AE182K	Resistor, 1800 ohms ½ w.	Cathode bias
*R412	V-9233 assy	Control, 100,000 ohms (assy consists of R412 and R434)	Horizontal hold
R413	RC20AE224J	Resistor, 220,000 ohms ½ w.	Grid return
R414	RC20AE562K	Resistor, 5600 ohms ½ w.	Plate load
R415	RC30AE333K	Resistor, 33,000 ohms 1 w.	Decoupling
R416	RC20AE474K	Resistor, 470,000 ohms ½ w.	Charge limiting
R417	RC20AE154K	Resistor, 150,000 ohms ½ w.	Plate load
R418	RC20AE272K	Resistor, 2700 ohms ½ w.	Plate load
R419	RC20AE223K	Resistor, 22,000 ohms ½ w.	DC divider
R420	RC20AE105K	Resistor, 1 megohm ½ w.	Grid return
R421	RC20AE272K	Resistor, 2700 ohms ½ w.	Limiting
R422	RC20AE471K	Resistor, 470 ohms ½ w.	Cathode bias
R423	V-6500-2	Control, 5000 ohms	Width
R424	RC30AE333K	Resistor, 33,000 ohms 1 w.	Decoupling
R425	RC20AE224K	Resistor, 220,000 ohms ½ w.	Horiz. mv plate load
R426	RC20AE273K	Resistor, 27,000 ohms ½ w.	Horizontal discharge
R427	RC20AE104K	Resistor, 100,000 ohms ½ w.	Grid return
R428	V-6067-4	Resistor, glasohm, 150 ohms 3 w.	Cathode bias
R429	RC20AE101K	Resistor, 100 ohms ½ w.	Parasitic suppressor
R430	RC20AE101K	Resistor, 100 ohms ½ w.	Parasitic suppressor
R431	V-5909	Control, 2.5 megohms	Height mag.
R432	V-5910	Control, 2500 ohms	Vertical linearity
R433	RC20AE104K	Resistor, 100,000 ohms ½ w.	Plate load
*R434	V-9233 assy	Control, 500,000 ohms (assy consists of R412 and R434)	Vertical hold
R435	RC20AE474K	Resistor, 470,000 ohms ½ w.	Grid return
R436	RC20AE394J	Resistor, 390,000 ohms ½ w.	Plate load
R437	V-6462	Control, 1 megohm	Height
R438	RC20AE102K	Resistor, 1000 ohms ½ w.	Cathode bias
R439	RC20AE473K	Resistor, 47,000 ohms ½ w.	Plate decoupling
R440	V-6984-1	Resistor, 2000 ohms 5 w. w.w.	Plate load
R441	V-6984-6	Resistor, 560 ohms 5 w. w.w.	Decoupling
R442	V-4758	Resistor, 110 ohms 3 w.	Focus coil shunt
R443	V-6984-5	Resistor, 10,000 ohms 5 w. w.w.	Screen dropping
R444	V-5908	Control, 400 ohms	Focus
R445	RC20AE225K	Resistor, 2.2 megohms ½ w.	Grid return
R446	RC30AE471K	Resistor, 470 ohms 1 w.	Cathode bias
R447	RC20AE472K	Resistor, 4700 ohms ½ w.	Vertical discharge
R448	V-6463	Control, 5000 ohms	Vertical linearity
R449	RC30AE471K	Resistor, 470 ohms 1 w.	Plate decoupling
R450	RC20AE561K	Resistor, 560 ohms ½ w.	Transient damping
R451	RC20AE561K	Resistor, 560 ohms ½ w.	Transient damping
R452	V-9085-5	Resistor, 680 ohms 10 w.	Current limiting
R453	RC40AE102K	Resistor, 1000 ohms 2 w.	Focus shunt
R460	RC20AE105K	Resistor, 1 megohm ½ w.	Grid return
*SW401	V-9607-2 assy	Switch, (assy consists of R201 and SW401 and SW501)	Magnifier
T401	V-6481-2	Transformer	Filament
T402	V-9584-1	Transformer	Vertical output
Z401	V-9213	Filter	Integrating
Z402	V-6486-4	Yoke assembly	Deflection

Section 5—Power

Item	Part No.	Description	Function
*C501	V-9575 assy	Capacitor, electrolytic 60 mfd 400 v. (assy consists of C501, C502 and C433)	Filter
*C502	V-9575 assy	Capacitor, electrolytic 20 mfd 400 v. (assy consists of C501, C502 and C433)	Filter
C505	V-6023-4503M	Capacitor, hi-temp .05 mfd 400 v.	Screen by-pass
C506	V-6023-4503M	Capacitor, hi-temp .05 mfd 400 v.	Screen by-pass
C507	V-6454	Capacitor	Hi-volt osc. trimmer
C508	RCM20B271K	Capacitor, 270 mmf	Osc. feed back
C509	V-5895	Capacitor, 500 mmf	Hi-volt filter
C510	V-5895	Capacitor, 500 mmf	Hi-volt filter
L501	V-6471	Choke	Filter
L502	V-9279-1	Choke, R-F	HV osc. load
R502	RC41AE333K	Resistor, 33,000 ohms 2 w.	Screen drop
R503	RC20AE680K	Resistor, 68 ohms ½ w.	Grid bias
R504	RC20AE683K	Resistor, 68,000 ohms ½ w.	Plate decoupling
R505	RC20AE104K	Resistor, 100,000 ohms ½ w.	Hi-volt filter
*SW501	V-9607-2 assy	Switch, on-off (assy consists of SW501, R201, and SW401)	
T501	V-6988	Transformer	Power L. V.
T502	V-9278	Transformer	Hi-voltage R-F

*Sold only as complete assembly.

HIGH VOLTAGE WARNING

The danger accompanying shock is always present when the receiver is operated outside the cabinet or when the rear cover is removed from the cabinet. Only a person familiar with the precautions to be observed when working with high-voltage equipment should service this receiver.

CATHODE RAY TUBE HANDLING PRECAUTIONS

Shatterproof goggles and heavy gloves should be worn at all times when handling the cathode ray tube. The tube should not be handled in the vicinity of any person not so equipped. When handling the cathode ray tube, always keep it away from the body.

The cathode ray tube bulb, due to its large surface area and high vacuum contained within, is subjected to high air pressure. More than ordinary care is required to prevent shattering the tube. The large end of the bulb, particularly the rim of the viewing surface, must not be struck, scratched, or subjected to more than moderate pressure at any time. If the tube sticks or fails to slip smoothly into place during installation, remove the tube and determine the cause of the trouble.—DO NOT FORCE THE TUBE.

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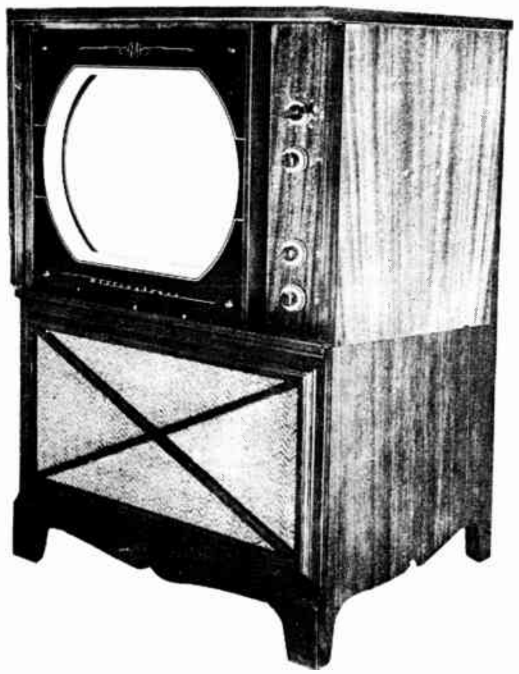

SPECIFICATIONS

FREQUENCY RANGES:

Channel Number	Channel Frequency (mc.)	Video Carrier Frequency (mc.)	Audio Carrier Frequency (mc.)	Receiver H-F Oscillator Frequency (mc.)
1	not used	--	--	--
2	54 - 60	55.25	59.75	81.35
3	60 - 66	61.25	65.75	87.35
4	66 - 72	67.25	71.75	93.35
5	76 - 82	77.25	81.75	103.35
6	82 - 88	83.25	87.75	109.35
7	174 - 180	175.25	179.75	201.35
8	180 - 186	181.25	185.75	207.35
9	186 - 192	187.25	191.75	213.35
10	192 - 198	193.25	197.75	219.35
11	198 - 204	199.25	203.75	225.35
12	204 - 210	205.25	209.75	231.35
13	210 - 216	211.25	215.75	237.35

FINE TUNING RANGE:

Plus or minus 1 mc. on Channel 2 (minimum)
Plus or minus 2 mc. on Channel 13 (maximum)

OPERATING VOLTAGE:

105 to 120 volts, 60 cycles

POWER CONSUMPTION: .... 275 watts

AUDIO POWER OUTPUT:

Undistorted .... 1.5 watts
Maximum .... 2.5 watts

LOUDSPEAKER:

Type .... 12" P.M.
Voice Coil Impedance-3.2 ohms at 400 cycles

RECEIVER ANTENNA INPUT IMPEDANCE:

... 300 ohms balanced or 72 ohms unbalanced

TUBE COMPLEMENT:

1 1B3GT .... High Voltage Rectifier
2 5U4G .... Low Voltage Rectifier
1 6AH6 .... Video Output
1 6AK5 .... R-F Amplifier
1 6AL5 .... Ratio Detector
1 6AL5 .... Horizontal AFC
1 6AL5 ...... Video Det. and Noise Clipper
1 6AQ5 .... Vertical Output
2 6AU5GT .... Horizontal Output
1 6AU6 .... AGC Keying
1 6AU6 .... 1st Sound I-F Amplifier
1 6AU6 .... 2nd Sound I-F Amplifier
1 6AV6 .... 1st A-F Amplifier
1 6BH6 .... 1st I-F Amplifier
1 6BH6 .... 2nd I-F Amplifier
1 6BH6 .... 3rd I-F Amplifier
1 6BJ6 .... 4th I-F Amplifier
1 6J6 .... H-F Oscillator and Mixer
1 6W4GT .... Horizontal Damper
1 6Y6G .... Audio Output Amplifier
1 6Y6G .... H.V. Oscillator
1 12AT7. Sync Amplifier and Sync Separator
1 12AU7 .... Vertical Multivibrator
1 12AU7 .... Horizontal Multivibrator
1 12AU7 .. D-C Restorer and Phase Inverter
1 16JP4 .... Cathode Ray Tube

VIDEO CARRIER INTERMEDIATE FREQUENCY:

.... 26.1 mc.

VIDEO RESPONSE: .... 3.6 mc.

AUDIO CARRIER INTERMEDIATE FREQUENCY:

.... 4.5 mc.

AUDIO DISCRIMINATOR BAND WIDTH:

(between peaks) .... 150 kc.

FOCUS: .... Magnetic

SWEEP DEFLECTION: .... Magnetic

SCANNING: .... Interlaced 525 Line

HORIZONTAL SCANNING FREQUENCY:

.... 15,750 CPS

VERTICAL SCANNING FREQUENCY:

.... 60 CPS

FRAME FREQUENCY

(picture repetition rate): .... 30 CPS

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MODEL H-613K16,
Ch. V-2150-146

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INSTALLATION INSTRUCTIONS

TO PREPARE THE RECEIVER FOR OPERATION:

1. Remove the screws that hold the rear cover to the cabinet, and remove the rear cover by pulling it away from the cabinet.

2. Inspect the face of the CRT and the glass window for dust or smudges. If the face of the CRT or the inside of the glass window is smudged, it will be necessary to remove the front glass to clean the smudged surfaces. In this event, refer to REMOVAL OF FRONT GLASS FOR CLEANING.

3. If the control shafts and CRT face are not properly aligned with the holes in the front of the cabinet, loosen the two hex-head bolts on the under side of the chassis shelf and adjust the position of the chassis accordingly. Then re-tighten the two hex-head bolts.

4. Make certain that all tubes are secure in their sockets.

5. Connect the A-C plug to a 105 to 120 volt, 60 cycles A-C, power outlet, and adjust the ion trap magnet as outlined under ADJUSTMENTS.

6. Model H-613K16 contains a built-in antenna for use in areas of normal reception. In such areas when the built-in antenna provides good reception, no additional antenna connections are required. However, in weak signal areas or under adverse conditions, it may be necessary to use an external antenna. If an external antenna is to be used, the built-in antenna should be disconnected from the antenna terminals on the back of the chassis, and the lugs of the built-in antenna should be insulated and dressed in such a position that they do not touch the chassis or components.

7. Replace the rear cover.

8. If an outside antenna is to be used, connect the lead-in to the antenna terminals on the back of the set.

TO CHECK THE OPERATION OF THE RECEIVER:

1. Rotate the volume, brightness, and contrast controls completely counterclockwise.

2. Turn on the receiver by rotating the off-on-tone control clockwise.

3. Rotate the channel selector to the channel number of the desired station.

4. Rotate the brightness control clockwise until light becomes barely visible on the picture screen.

5. Rotate the contrast control clockwise until a picture appears on the screen.

6. If the built-in antenna is in use, adjust the television antenna control for maximum picture contrast. If an external antenna is in use, this step is not required.

7. If the picture is moving up or down or quivering adjust the vertical hold control to stabilize the image.

8. If vertical or diagonal bars or a folded over picture appears on the screen, adjust the horizontal hold control to obtain a stable picture.

9. Adjust the fine tuning control for best picture detail.

10. Readjust the brightness and contrast controls until pleasing shades ranging from clear white to intense black are attained.

11. Adjust the volume control for the desired sound volume.

12. If necessary, adjust the height, width, vertical linearity, and focus controls as explained under ADJUSTMENTS.

13. Check the operation on all available television stations. Note that if the built-in antenna is in use, the television antenna control must be readjusted for maximum picture contrast each time the receiver is tuned to a different channel.

ADJUSTMENTS

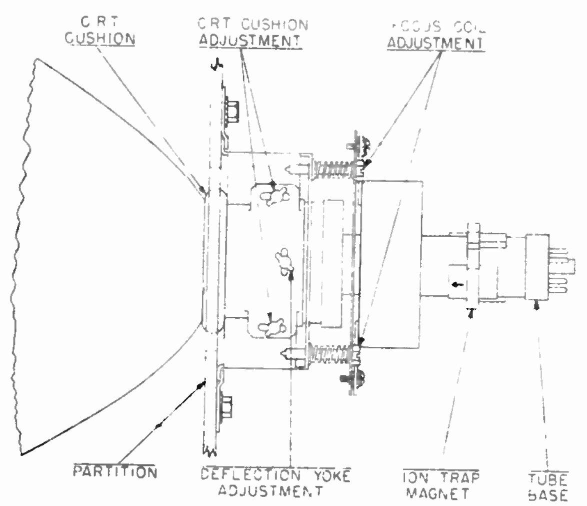

FIG. 1 — CRT ADJUSTMENTS

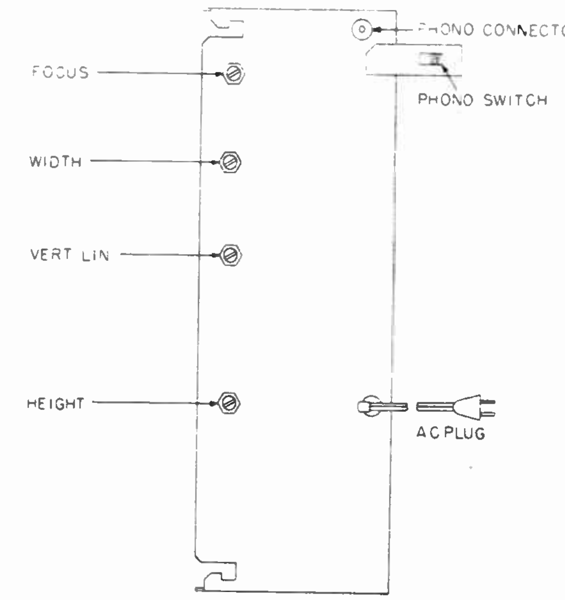

FIG. 2 — ADJUSTMENTS ON REAR OF CHASSIS

The picture adjustments are located on the rear of the chassis and are accessible through cut-outs in the back cover.

An insulated, long shank screwdriver is preferred for making the ringing coil and H.V. oscillator adjustments.

ION TRAP MAGNET

The magnet should be oriented approximately as shown in Fig. 1 with the arrow on the magnet pointing toward the large end of the CRT and the bar magnets lined up with the "flags" inside the neck of the cathode ray tube. Starting from this position, adjust the magnet by rotating it around the neck of the tube and moving it forward and backward until the raster is brightest on the screen.

CAUTION: When adjusting the ion trap magnet, care should be exercised to avoid breaking the neck of the cathode ray tube.

FOCUS COIL

If a shadow falls on one corner of the picture or if the picture is not centered, adjustment of the focus coil is required.

A coarse adjustment is made by loosening the two hex-head bolts that secure the focus coil to its mounting plate and shifting the position of the coil around the neck of the tube until the picture is centered and there are no shadowed edges. Re-adjustment of the ion trap magnet may be required to obtain these conditions.

A fine adjustment of picture centering is made by adjusting the three bolts marked FOCUS COIL ADJUSTMENT on Fig. 1.

CATHODE RAY TUBE CUSHION

The cushion must fit snugly against the flare of the cathode ray tube in order that the rear of the tube will be supported firmly.

DEFLECTION YOKE

This adjustment controls the angle of the picture with respect to the horizontal. If the picture is not squared in the picture mask, loosen the wing nut and move it to the left or right so as to rotate the deflection yoke. The picture will tilt to the left or right with the deflection yoke rotation.

FOCUS CONTROL

The focus control (Fig. 2) should be adjusted with the brightness and contrast controls in their normal positions. If correct focusing cannot be obtained, the high voltage oscillator may require adjustment.

HEIGHT AND VERTICAL LINEARITY

The height adjustment controls the overall height of the picture, while the vertical linearity adjustment governs contraction or expansion of the upper portion only. For this reason, a balance between the two controls

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is necessary to make the picture symmetrical and fill the mask vertically.

WIDTH

Adjust the width control (Fig. 2) until the picture fills the mask horizontally.

HORIZONTAL RINGING COIL

To adjust the horizontal ringing coil:

1. Tune in the weakest station in your area.

2. Set the horizontal hold control at approximately the center of its range.

3. Adjust the ringing coil (L403), which is accessible through a hold in the bottom of the cabinet, until the picture is properly "locked-in".

HIGH VOLTAGE OSCILLATOR

1. *Turn off the receiver* and disconnect the high voltage lead from the CRT.

2. Connect 18 one megohm, one watt resistors in series between the high voltage lead and the chassis.

3. Connect a kilovoltmeter across the 18 megohms of resistance.

4. Turn on the receiver and adjust C507 (location shown on Fig. 7) for maximum voltage indication on the meter. When C507 is peaked using an 18 megohm load, the voltage across the load should be 9.3 kilovolts (approximately).

5. *Turn off the receiver*, disconnect the kilovoltmeter, remove the 18 megohms of resistance, and connect the high voltage lead to the CRT. Note that when the 18 megohm load is removed and the high voltage lead is connected to the CRT, the output voltage of the H.V. power supply will rise because of the higher load resistance offered by the CRT.

REMOVAL OF FRONT GLASS FOR CLEANING

If it is necessary to clean dust or smudges off the face of the CRT or the inside of the front glass plate, the front glass plate can be removed from the front of the cabinet. To remove the glass, first remove the four screws from the corners of the glass plate, and then carefully lift out the glass plate and CRT mask assembly.

CATHODE RAY TUBE REPLACEMENT

1. Remove the screws that hold the rear cover to the cabinet, and remove the rear cover.

2. Remove the CRT socket, ion trap magnet, and high voltage anode connector from the CRT.

3. Loosen the two wing bolts that secure the deflection yoke assembly.

4. Remove the four screws from the corners of the front glass plate, and carefully lift out the front glass plate and the CRT mask assembly.

5. Remove the four hex-head bolts that secure the CRT mounting strap to the front bulkhead.

6. Grasp the CRT and mounting strap securely from the front of the cabinet, and remove the CRT by pulling it straight out.

7. Remove the mounting strap from the CRT, and replace it in exactly the same position on the replacement CRT. The strap must be replaced in the same position to provide correct orientation of the high voltage anode contact.

8. Insert the replacement CRT through the yoke and focus coil assemblies, and replace the four washers and bolts that secure the mounting strap to the forward mounting bulkhead.

9. Replace the front glass plate and CRT mask assembly, and replace the four screws in the corners of the glass.

10. Position the deflection yoke assembly snugly against the flare of the CRT, and tighten the two wing bolts that secure the yoke assembly.

11. Replace the ion trap magnet, CRT socket, and high voltage anode connector.

12. Adjust the focus coil and ion trap magnet as described under ADJUSTMENTS.

13. Replace the rear cover.

CHASSIS REMOVAL

To remove the chassis from the cabinet:

1. Remove the control knobs from the front of the cabinet.

2. Remove the wood screws that hold the rear cover to the cabinet, and remove the rear cover.

3. Disconnect the built-in antenna feeder from the antenna terminals, and release the antenna terminal bracket from the cabinet by removing the two screws that hold it in place.

4. Loosen the bracket at the top (inside) of the cabinet by removing the two screws that secure it to the top of the cabinet.

5. Disconnect the CRT socket from the base of the CRT, the deflection yoke plug from its socket on the chassis, the ground lead from the yoke assembly, the speaker leads from the speaker, and the H.V. connector from the CRT high voltage contact.

6. Remove the hex-head chassis bolts from the under side of the chassis shelf.

7. Remove the chassis by pushing it to the left of the cabinet and then pulling it straight back until clear of the cabinet.

ALIGNMENT

TEST EQUIPMENT—To properly service this chassis, the following test equipment should be available:

1. R-F sweep generator which meets the following requirements:

a. Frequency range from 18 to 30 mc. with a sweep width of 10 mc.

b. Output adjustable with at least 100,000 microvolts maximum and a very low minimum.

c. Output "flat" on all attenuator positions.

2. Cathode-ray oscilloscope, preferably one with a wide band vertical deflection amplifier and a low-capacitance input probe.

3. Signal generator capable of providing output frequencies listed below.

21.6 mc.	4th I-F trap
22.6 mc.	1st I-F
25.9 mc.	2nd I-F
25.6 mc.	3rd I-F
24.7 mc.	4th I-F
23.0 mc.	5th I-F
4.5 mc.	Audio I-F and ratio detector (the frequency must be extremely accurate, preferably crystal controlled.)

NOTE—The R-F output level on all the above frequencies should be adjustable with at least 100,000 microvolts maximum and a very low minimum.

4. Heterodyne frequency meter with crystal calibrator (if the signal generator does not include a crystal calibrator).

5. Electronic voltmeter (vacuum tube voltmeter), with a high voltage multiplier probe for measurements up to 15,000 volts and an R-F probe for measuring R-F voltages.

GENERAL INFORMATION—All test equipment and the chassis should be bonded together by short lengths of heavy (½ inch) braided copper ribbon. The interconnecting leads should be shielded (72 ohms coaxial cable) and should be as short as possible consistent with ease of making connections. The effectiveness of the bonding can be checked during alignment by placing the hand on the metal chassis or test equipment case. If the response pattern or meter reading changes visibly, the bonding must be improved before the circuits are aligned.

COMMON I-F ALIGNMENT PROCEDURE

If a common I-F transformer is replaced or, for any other reason, is badly out of adjustment, it is advisable to turn the slug out (counterclockwise) as far as possible before beginning alignment. Then starting from this position, turn the slug in a clockwise direction until the *first* peak is reached. This procedure is recommended to obtain the correct peak rather than an undesired second peak which is sometimes obtained when the slug is turned clockwise past the first peak.

The common I-F alignment procedure is as follows:

1. Rotate the channel selector to the position where the flat of the shaft is parallel with the top of the tuner, thus selecting channel 13. Remove the 6AK5 R-F amplifier tube from its socket to avoid

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undesirable noise pickup and beat response during alignment.

2. Connect the signal generator to the mixer tube through the coupling device shown in Fig. 3. The device is constructed by squeezing together a miniature tube shield until it fits the tube snugly and does not ground to the chassis. A .005 mfd capacitor is then soldered to the side of the shield. By sliding the tube shield up or down on the tube, the capacitance between the shield and the tube elements can be varied to obtain additional control of the coupling over that provided by the attenuator in the generator itself. The ground side of the generator output cable should be connected to the receiver chassis.

3. Connect a vacuum tube voltmeter to the video test jack on the receiver chassis, and set the meter to its 5 volt scale.

4. Set the signal generator to 21.6 mc. (unmodulated), and adjust T305 for *minimum* voltage on the VTVM. Use a strong signal for this adjustment.

5. Set the signal generator to 22.6 mc. (unmodulated), and adjust L110 for maximum voltage on the VTVM. *During this adjustment, keep the signal generator output adjusted so that the VTVM reading does not exceed 2 volts.*

6. Set the signal generator to 25.9 mc. (unmodulated), and adjust T301 for maximum voltage on the VTVM. *During this adjustment, keep the signal generator output adjusted so that the VTVM reading does not exceed 2 volts.*

7. Set the signal generator to 25.6 mc. (unmodulated), and adjust T302 for maximum voltage on the VTVM. *During this adjustment, keep the signal generator output adjusted so that the VTVM reading does not exceed 2 volts.*

8. Set the signal generator to 24.7 mc. (unmodulated), and adjust T303 for maximum voltage on the VTVM. *During this adjustment, keep the signal generator output adjusted so that the VTVM reading does not exceed 2 volts.*

9. Set the signal generator to 23.0 mc. (unmodulated), and adjust T304 for maximum voltage on the VTVM. *During this adjustment, keep the signal generator output adjusted so that the VTVM reading does not exceed 2 volts.*

10. Connect the *sweep* generator to the mixer tube through the coupling device previously described. The *signal* generator will be used in the following steps to provide marker indications at various frequencies on the response curve. In this application, the signal generator input to the set must be low in amplitude to avoid distorting the response curve. To reduce the signal generator input accordingly, the signal generator should be *loosely* coupled to the set by wrapping a few turns of insulated wire around the coupling capacitor "pigtail" and connecting the signal generator to this wire.

11. Connect the vertical input of the oscilloscope to the video test jack through the de-coupling network shown in Fig. 4. The oscilloscope horizontal input should be connected to the sweep output from the sweep generator; turn the sweep control on the oscilloscope to the "X" or "OFF" position.

12. Adjust the sweep generator for a center frequency of 25.3 mc. with a 10 mc. deviation. Adjust the sweep generator output until a setting is found where there is very little noise on the oscilloscope pattern.

The oscilloscope pattern obtained should be similar to that shown in Fig. 5. Use the signal generator as a marker to check at the frequencies indicated. If the pattern obtained is not similar to Fig. 5, L110, T301, T302, T303, and T304 should be re-adjusted to produce the correct pattern.

SOUND I-F AND 4.5 MC. TRAP ALIGNMENT PROCEDURE

1. Connect the "high" side of the signal generator to the video test jack through a .001 mfd capacitor, and ground the "low" side to the chassis.

2. Connect the vacuum tube voltmeter to the points indicated on the bottom view of the chassis, Fig. 7. The common lead should connect to point "C", and the "high" lead should connect to point "A". Set the meter on its 5 volt (-DC) scale.

3. Adjust the signal generator to 4.5 mc. (unmodulated). The accuracy of this frequency is very important. If a crystal controlled signal generator is not available, the frequency should be checked using a frequency meter with a crystal calibrator.

4. Adjust T201 and the primary of T202 for maximum voltage on the VTVM. *During this adjustment, keep the signal generator output adjusted so that the VTVM reading does not exceed 5 volts.*

5. Connect the common lead from the VTVM to point "A" (Fig. 7), and connect the "high" lead to point "B". Here it is important that the case and components of the VTVM are *not* grounded to the receiver chassis; otherwise, point "A" would be shorted to the chassis through the common lead.

6. Using the same signal generator amplitude and frequency as in step 4, adjust the secondary of T202 for *zero* voltage on the VTVM. As the adjustment is tuned through resonance, the voltage will rapidly change from one polarity to the opposite polarity. The point where the voltage is zero is the correct setting.

7. Connect the common lead from the VTVM to the chassis, and connect the *R-F probe* from the VTVM to the junction of C338 and R343. This point is shown as point "D" on on Fig. 7. *Note that this point is above ground and, therefore, the R-F probe must contain a blocking capacitor.*

8. Using a strong 4.5 mc. signal applied as in step 1, adjust Z301 for *minimum* indication on the meter.

H.F. OSCILLATOR ALIGNMENT PROCEDURE

If the 6J6 oscillator tube is replaced, the different inter-electrode capacity of the new tube may change the oscillator frequency enough to necessitate realignment of the oscillator.

Alignment of the oscillator on the high band is accomplished by adjusting the brass slug located adjacent to the vernier drive wheel on the front of the tuner. Alignment of the oscillator on the low band is accomplished by adjusting the brass slug on the lower front of the tuner. *A non-metallic screwdriver is required.*

The oscillator alignment procedure is as follows:

1. Set the fine tuning control at the middle of its range, and leave it in this position during the following adjustments.

2. Set the selector switch to the highest of the low-band (channels 2 through 6) stations operating in your vicinity.

3. Peak the low band adjustment slug for the best picture detail.

4. Set the selector switch to the highest of the high-band (channels 7 through 13) stations operating in your vicinity.

5. Peak the high band adjustment slug for best picture detail.

6. Check the previously made low band adjustment, and if the tuning has changed, repeat steps 2 and 3.

I-F ALIGNMENT CHART

Turn the channel selector to channel 13 to avoid undesirable beat response during alignment.

COMMON I-F SECTION

Couple the sweep and marker generators to the mixer tube as shown in Fig. 3.

Step	*Sweep Gen. Frequency*	*Marker Gen. Frequency*	*Remarks*	*Indicator Connection*	*Adjust*
1.	Not used	21.6 mc. unmodulated	Use a strong signal	Connect VTVM to video test jack	T305 for *minimum* voltage
2.	Not used	22.6 mc. unmodulated	Keep marker output adjusted so VTVM reading does not exceed 2 v.	Same as step 1	L110 for maximum voltage
3.	Not used	25.9 mc. unmodulated	Same as step 2	Same as step 1	T301 for maximum voltage
4.	Not used	25.6 mc. unmodulated	Same as step 2	Same as step 1	T302 for maximum voltage
5.	Not used	24.7 mc. unmodulated	Same as step 2	Same as step 1	T303 for maximum voltage
6.	Not used	23.0 mc. unmodulated	Same as step 2	Same as step 1	T304 for maximum voltage
7.	25.3 mc. with 10 mc. deviation	check at: 21.6 mc. 22.5 mc. 23.5 mc. 25.3 mc. 26.1 mc.	Keep sweep output high enough so that very little noise appears on the oscilloscope trace	Connect oscilloscope to video test jack. See Fig. 4.	If necessary, adjust L110, T301, T302, T303, and T304 to obtain correct response curve. See Fig. 5.

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SOUND I-F SECTION AND 4.5 MC. TRAP

Connect the signal generator to the video test jack through a .001 mfd mica capacitor.

Syep	Signal Gen. Frequency	VTVM Connection	Remarks	Adjust
1.	4.5 mc. unmodulated	See Fig. 7. Common lead to point "C" and high lead to point "A".	Use 5 v. (−DC) scale on meter. Set sig. gen. output accordingly.	T201 and pri. of T202 for maximum voltage
2.	4.5 mc. unmodulated	See Fig. 7. Common lead to point "A" and high lead to point "B".	Use same sig. gen. output as in step 1.	Sec. of T202 for *zero* voltage
3.	4.5 mc. unmodulated	See Fig. 7. R-F probe to point "D" and common lead to chassis.	Use strong signal from generator.	Z301 for *minimum* voltage

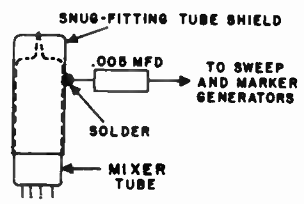

FIG. 3—COUPLING SIGNAL GENERATORS TO MIXER TUBE

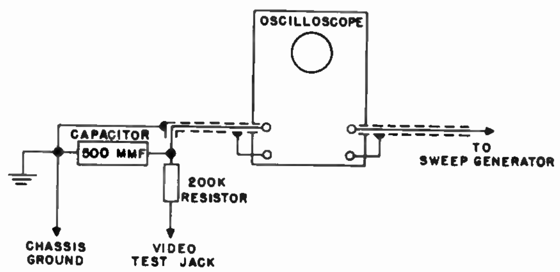

FIG. 4—OSCILLOSCOPE ISOLATION NETWORK

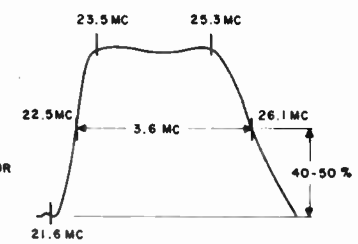

FIG. 5—I-F RESPONSE CURVE

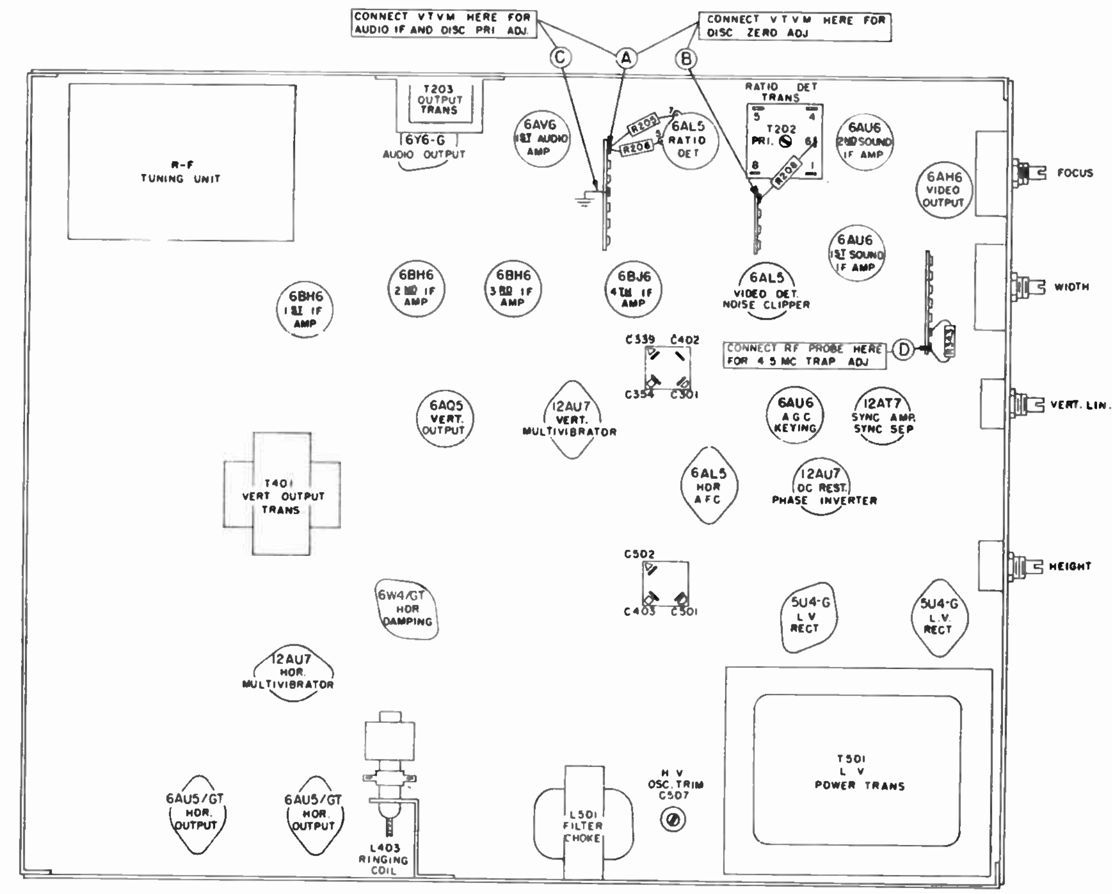

FIG. 7—BOTTOM VIEW OF CHASSIS

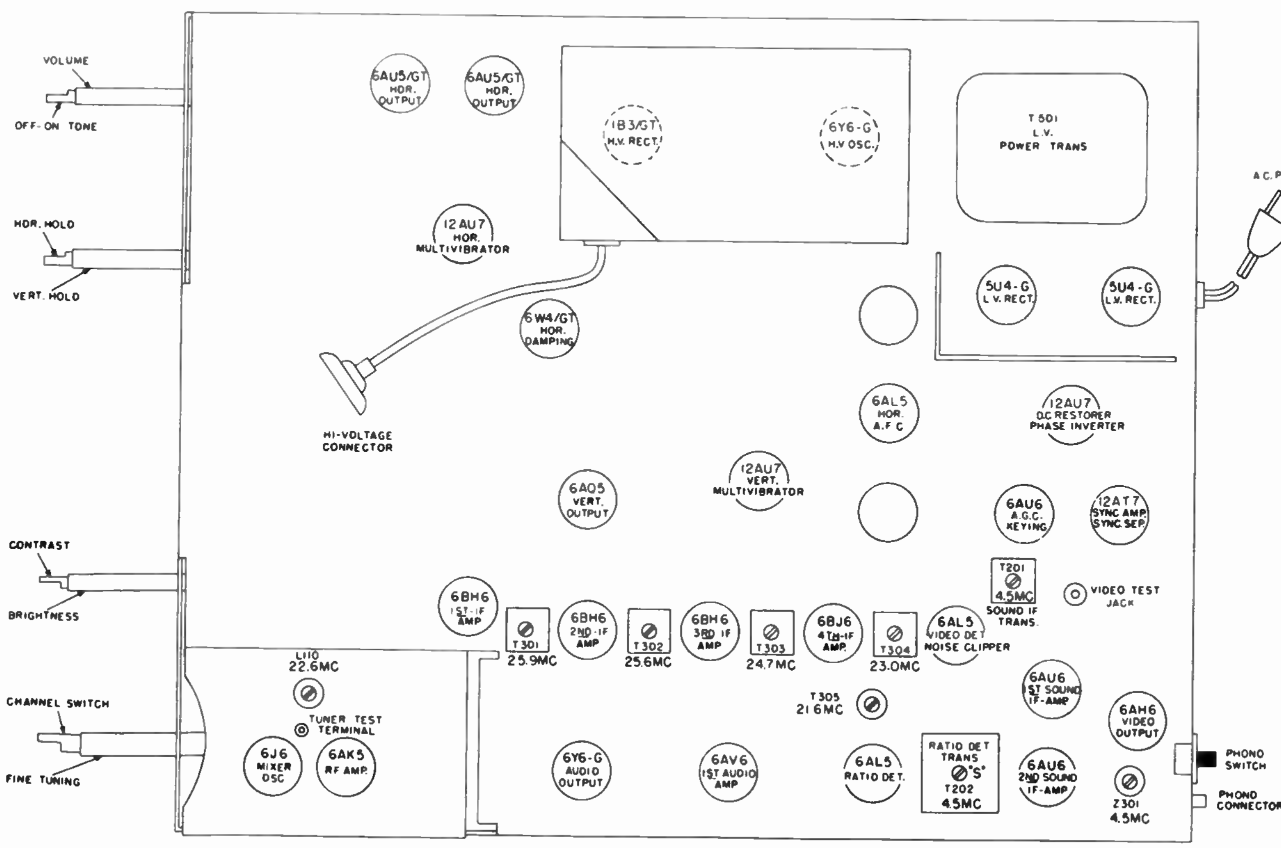

FIG. 6—TOP VIEW OF CHASSIS

PARTS LIST FOR MODEL H-613K16

CABINET

Part No.	Description
V-9621-1	Baffle and grille cloth assembly
V-1203-1	Cabinet, mahogany
V-4898-1	Catch, bullet
V-9622-1	Cover, back
V-4902	Glide, furniture
V-9091-2	Hinge, R.H.
V-9091-1	Hinge, L.H.
V-6284-7	Knob, channel selector
V-9104-4	Knob, fine tuning
V-9547-1	Knob, TV antenna
V-9104-1	Knob, brightness, vertical hold, tone (rear)
V-6146-1	Knob, contrast, horizontal hold, and volume on-off
V-9188-2	Mask, 16" tube
V-9626-2	Plate, front glass
V-6744-2	Pull, door
V-9627-1	Screw, #8-32 Phillips (front glass)
V-6059	Spring, fine tuning knob
V-6063-1	Spring, channel selector knob
V-4900-1	Strike, bullet
V-5421-5	Washer, felt (knob)

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PARTS LIST FOR MODEL H-613K16 *(Continued)*

MISCELLANEOUS

Part No.	Description
V-6451-2	Adapter plate, R-F tuner
V-9521-2	Antenna assembly, TV
V-4169-1	Base, miniature (6BH6, 6AU6, 6AH6, 6AL5, 6BJ6)
V-6602-1	Base, miniature tube (12AU7)
V-5906-3	Connector assembly, hi-voltage
V-3254S	Connector, phono
V-4349-9	Cord, power A-C
V-9234	Hood, yoke mounting
V-5917-2	Insulator, stand off
V-6573-4	Magnet, ion trap
V-9608	Plug, deflection yoke (male)
V-9203-1	Screw, #8 Phillips
V-9344-5	Shaft, TV antenna
V-6602-2	Shield, miniature tube (12AU7)
V-4169-2	Shield, miniature tube (6BH6, 6AU6, 6AH6, 6AL5, 6BJ6)
V-9328-2	Sleeve, rubber (TV antenna)
V-9603-2	Socket assembly, Cathode Ray Tube
V-5929	Socket, molded octal tube (6Y6-G HV osc)
V-5556-1	Socket, miniature molded (12AU7, 12AT7)
V-4514	Socket, molded octal (5U4-G, 6W4, 6Y6-G)
V-4315-2	Socket, molded octal (6AU5)
V-4292S-1	Socket, miniature molded (6BH6, 6BJ6, 6AU6, 6AL5, 6AV6, 6AH6)
V-6089-1	Socket, miniature (12AU7 vert MV)
V-6878-1	Socket, miniature wafer (6AL5 horiz. AFC)
V-9166-1	Socket, yoke
V-9628	Speaker, 12" P.M.
V-9191-1	Strap assembly, CRT
V-9206	Support assembly, antenna terminal board
V-5406	Switch, phono
V-5977	Tip jack
V-3274S	Tube holder

ELECTRICAL PARTS FOR V-2150-146 CHASSIS

Section 1—R-F

Ref. No.	Part No.	Description	Function
	V-8210	Tuner assembly, R-F	
C117	V-5596	Capacitor, hi-kap .005 mfd	R-F by-pass
C118	V-5596	Capacitor, hi-kap .005 mfd	Filament by-pass
L115	V-4886-2	Choke, R-F	Filament
R107	RC20AE471K	Resistor, 470 ohms ½ w.	Decoupling
R108	RC20AE103K	Resistor, 10,000 ohms ½ w.	AGC decoupling

Section 2—Sound I-F and Audio

Ref. No.	Part No.	Description	Function
C201	V-6570	Capacitor, electrolytic, 30 mfd 450 v.	Screen by-pass
C202	V-4880	Capacitor, electrolytic, 2 mfd 50 v.	Ratio det stabilizer
C205	V-5596	Capacitor, hi-kap .005 mfd	Cathode by-pass
C206	V-6023-4103M	Capacitor, hi-temp .01 mfd 400 v.	Screen by-pass
C207	V-6023-6202M	Capacitor, hi-temp .002 mfd 600 v.	Plate by-pass
C208	V-6023-6202M	Capacitor, hi-temp .002 mfd 600 v.	De-emphasis
C209	V-6023-4103M	Capacitor, hi-temp .01 mfd 400 v.	Screen by-pass
C210	RCM20B681K	Capacitor, 680 mmf	De-emphasis
C211	V-6023-4203M	Capacitor, hi-temp .02 mfd 400 v.	Bass boost
C212	V-6023-4103M	Capacitor, hi-temp .01 mfd 400 v.	A-F coupling
C214	V-6023-4103M	Capacitor, hi-temp .01 mfd 400 v.	A-F coupling
C215	V-6023-4104M	Capacitor, hi-temp .1 mfd 400 v.	A-F decoupling
C217	RCM20B470K	Capacitor, 47 mmf	I-F coupling
C218	RCM20B101K	Capacitor, 100 mmf	Grid by-pass
C219	RCM20B271K	Capacitor, 270 mmf	Plate by-pass
C220	V-6023-4103M	Capacitor, hi-temp .01 mfd 400 v.	A-F coupling
C226	V-6023-4103M	Capacitor, hi-temp .01 mfd 400 v.	Decoupling
L205	V-5902-4	Coil	Plate load
*R200	V-9686-1 assy	Control, 1 megohm (assy consists of R200, R201 and SW501)	Tone
*R201	V-9686-1 assy	Control, 500,000 ohms (assy consists of R200, R201 and SW501)	Volume
R204	RC20AE101K	Resistor, 100 ohms ½ w.	Cathode bias
R205	RC20AE103K	Resistor, 10,000 ohms ½ w.	Ratio det load
R206	RC20AE103K	Resistor, 10,000 ohms ½ w.	Ratio det load
R207	RC20AE103K	Resistor, 10,000 ohms ½ w.	Bass boost
R208	RC20AE333K	Resistor, 33,000 ohms ½ w.	De-emphasis
R209	RC20AE473K	Resistor, 47,000 ohms ½ w.	Grid return
R210	RC20AE473K	Resistor, 47,000 ohms ½ w.	A-F decoupling
R211	RC20AE274K	Resistor, 270,000 ohms ½ w.	Plate load
R212	RC20AE394J	Resistor, 390,000 ohms ½ w.	Grid return
R213	RC20AE106M	Resistor, 10 megohms ½ w.	Grid return
R214	RC20AE223K	Resistor, 22,000 ohms ½ w.	Screen load
R215	V-6984-6	Resistor, 560 ohms 5 w. w.w.	Audio decoupling
R216	RC20AE102M	Resistor, 1000 ohms ½ w.	I-F decoupling
R217	RC20AE564J	Resistor, 560,000 ohms ½ w.	Grid return
R218	RC20AE474K	Resistor, 470,000 ohms ½ w.	Audio degeneration
R219	V-6984-9	Resistor, 390 ohms 5 w. w.w.	Audio decoupling
R220	RC20AE121K	Resistor, 120 ohms ½ w.	Grid return
T201	V-9594	Transformer	Sound I-F
T202	V-9574	Transformer	Ratio detector
T203	V-9685	Transformer	Audio output

Section 3—Video

Ref. No.	Part No.	Description	Function
*C301	V-9577 assy	Capacitor, electrolytic 30 mfd 400 v. (assy consists of C354, C402, C339 and C301)	Screen by-pass
C305	V-5658-6	Capacitor, 4.7 mmf	Plate by-pass
C307	R5CC26ZY152M	Capacitor, .0015 mmf	AGC decoupling
C308	V-5596	Capacitor, hi-kap .005 mfd	I-F decoupling
C309	V-5596	Capacitor, hi-kap .005 mfd	Screen by-pass
C310	R5CC26ZY152M	Capacitor, .0015 mmf	AGC decoupling
C311	V-5596	Capacitor, hi-kap .005 mfd	I-F decoupling
C313	V-5596	Capacitor, hi-kap .005 mfd	Cathode by-pass
C314	V-5596	Capacitor, hi-kap .005 mfd	I-F decoupling
C316	V-5596	Capacitor, hi-kap .005 mfd	Cathode by-pass
C318	V-5596	Capacitor, hi-kap .005 mfd	I-F decoupling
C319	V-5596	Capacitor, hi-kap .005 mfd	AGC delay
C328	R5CC21ZY151M	Capacitor, 150 mmf	I-F coupling
C335	V-5596	Capacitor, hi-kap .005 mfd	Screen by-pass
C336	V-6023-4203M	Capacitor, hi-temp .02 mfd 400 v.	Coupling
C338	V-6066-4254M	Capacitor, .25 mfd 400 v.	CRT-coupling
*C339	V-9577 assy	Capacitor, electrolytic, 20 mfd 400 v. (assy consists of C354, C402, C339 and C301)	Decoupling
C340	V-6023-4104M	Capacitor, hi-temp .1 mfd 400 v.	Cathode by-pass
C341	R5CC26ZY152M	Capacitor, .0015 mmf	Screen by-pass
C342	V-6066-4254M	Capacitor, 25 mfd 400 v.	AGC filter
*C354	V-9577 assy	Capacitor, electrolytic 30 mfd 400 v. (assy consists of C354, C402, C339 and C301)	Filter
C355	V-5596	Capacitor, hi-kap .005 mfd	Cathode bias
L310	V-5902-4	Coil	Video peaking
L311	V-5902-5	Coil	Video peaking
L312	V-5902-1	Coil	Video peaking
*R301	V-9235-2 assy	Control, 1500 ohms (assy consists of R301 and R302)	Contrast
*R302	V-9235-2 assy	Control, 50,000 ohms (assy consists of R301 and R302)	Brightness
R306	RC20AE473K	Resistor, 47,000 ohms ½ w.	Cathode bias
R309	RC20AE101K	Resistor, 100 ohms ½ w.	Cathode bias
R310	RC20AE101K	Resistor, 100 ohms ½ w.	Cathode bias
R311	RC20AE121K	Resistor, 120 ohms ½ w.	Cathode bias
R312	RC20AE121K	Resistor, 120 ohms ½ w.	Cathode bias
R314	RC20AE272K	Resistor, 2700 ohms ½ w.	I-F decoupling
R316	RC20AE272K	Resistor, 2700 ohms ½ w.	I-F decoupling
R317	RC20AE472K	Resistor, 4700 ohms ½ w.	Grid return
R318	RC20AE472K	Resistor, 4700 ohms ½ w.	Grid return
R319	RC20AE472K	Resistor, 4700 ohms ½ w.	Plate load
R322	RC20AE103K	Resistor, 10,000 ohms ½ w.	AGC decoupling
R323	RC20AE103K	Resistor, 10,000 ohms ½ w.	AGC decoupling
R327	RC20AE472K	Resistor, 4700 ohms ½ w.	Grid return
R329	RC20AE104K	Resistor, 100,000 ohms ½ w.	AGC filter
R331	RC20AE123K	Resistor, 12,000 ohms ½ w.	Grid rdturn
R334	RC30AE224K	Resistor, 220,000 ohms 1 w.	Plate load
R336	RC20AE272K	Resistor, 2700 ohms ½ w.	I-F decoupling
R339	RC20AE153K	Resistor, 15,000 ohms ½ w.	Cathode bias
R340	RC20AE102M	Resistor, 1000 ohms ½ w.	I-F decoupling
R341	RC20AE822K	Resistor, 8200 ohms ½ w.	Grid return
R342	RC20AE473K	Resistor, 47,000 ohms ½ w.	Decoupling
R343	RC20AE104K	Resistor, 100,000 ohms ½ w.	Cathode bias
R344	RC20AE682K	Resistor, 6800 ohms ½ w.	Series brightness
R345	RC20AE104K	Resistor, 100,000 ohms ½ w.	Series brightness
R346	RC20AE105K	Resistor, 1 megohm ½ w.	Grid return
R347	RC20AE105K	Resistor, 1 megohm ½ w.	Cathode bias
R348	RC30AE362J	Resistor, 3600 ohms 1 w.	Decoupling
R349	RC20AE223K	Resistor, 22,000 ohms ½ w.	Plate load
R350	RC30AE683K	Resistor, 68,000 ohms 1 w.	Screen load
R351	RC20AE474K	Resistor, 470,000 ohms ½ w.	AGC divider
R352	RC20AE153K	Resistor, 15,000 ohms ½ w.	Screen load
R353	RC20AE104K	Resistor, 100,000 ohms ½ w.	AGC divider
T301	V-9586-1	Transformer	1st I-F
T302	V-9586-1	Transformer	2nd I-F
T303	V-9586-1	Transformer	3rd I-F
T304	V-9586-2	Transformer	4th I-F
T305	V-9592	Transformer	Sound trap
Z301	V-9591	4.5 mc trap	

Section 4—Sweep

Ref. No.	Part No.	Description	Function
C401	V-6023-4104M	Capacitor, hi-temp .1 mfd 400 v.	Horiz MV decoupling
*C402	V-9577 assy	Capacitor, electrolytic, 20 mfd 400 v. (assy consists of C354, C402, C339 and C301)	Filter
*C403	V-9575 assy	Capacitor, electrolytic, 20 mfd 450 v. (assy consists of C403, C501 and C502)	Filter
C404	V-9576-1	Capacitor, electrolytic, 150 mfd 50 v.	Cathode by-pass
C410	V-6023-6102M	Capacitor, hi-temp .001 mfd 600 v.	AFC coupling
C411	V-6023-6102M	Capacitor, hi-temp .001 mfd 600 v.	AFC coupling
C412	V-6023-4472M	Capacitor, hi-temp .0047 mfd 400 v.	AFC delay
C413	V-6023-6102M	Capacitor, hi-temp .001 mfd 600 v.	Pulse divider
C414	V-6023-4103M	Capacitor, hi-temp .01 mfd 400 v.	Vert sync coupling
C415	V-6023-4103M	Capacitor, hi-temp .01 mfd 400 v.	Horiz output coupling
C417	V-6023-4503M	Capacitor, hi-temp .05 mfd 400 v.	Cathode by-pass
C418	V-6023-4503M	Capacitor, hi-temp .05 mfd 400 v.	AFC delay

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PARTS LIST FOR MODEL H-613K16 *(Continued)*

Ref. No.	Part No.	Description	Function
C419	V-6023-4104M	Capacitor, hi-temp .1 mfd 400 v.	Grid by-pass
C420	V-6023-4104M	Capacitor, hi-temp .1 mfd 400 v.	Vert output coupling
C421	V-6023-4104M	Capacitor, hi-temp .1 mfd 400 v.	Horiz MV decoupling
C422	V-6023-4104M	Capacitor, hi-temp .1 mfd 400 v.	Plate by-pass
C424	V-6023-4104M	Capacitor, hi-temp .1 mfd 400 v.	Horiz output coupling
C426	V-6023-4104M	Capacitor, hi-temp .1 mfd 400 v.	Screen by-pass
C427	V-6066-4254M	Capacitor, .25 mfd 400 v.	Plate by-pass
C428	V-6023-4683K	Capacitor, hi-temp .068 mfd 400 v.	Vert discharge
C429	V-6023-4103K	Capacitor, hi-temp .01 mfd 400 v.	Coupling
C430	RCM20B271K	Capacitor, 270 mmf	Grid by-pass
C432	RCM20B681K	Capacitor, 680 mmf	Horiz discharge
C433	RCM20C331J	Capacitor, 330 mmf	Error volt coupling
C434	RCM20C331J	Capacitor, 330 mmf	Horiz MV coupling
C435	RCM30C392K	Capacitor, 3900 mmf	MV plate tank
C436	V-9176-15560K	Capacitor, 56 mmf	Transient by-pass
C437	RCM20B271K	Capacitor, 270 mmf	Horiz sync coupling
C438	V-6023-4503M	Capacitor, hi-temp .05 mfd 400 v.	Phase invert coupling
C439	V-6023-4104M	Capacitor, hi-temp .1 mfd 400 v.	Cathode by-pass
C440	V-6066-4254M	Capacitor, .25 mfd 400 v.	Sync. coupling
C442	RCM20C331J	Capacitor, 330 mmf	AGC pulse coupling
C443	R5CC26ZY152M	Capacitor, .0015 mfd	Filament by-pass
C444	R5CC26ZY152M	Capacitor, .0015 mfd	Filament by-pass
C445	R5CC26ZY152M	Capacitor, .0015 mfd	Filament by-pass
C446	RCM20B101K	Capacitor, 100 mmf	Plate by-pass
C447	V-6570	Capacitor, electrolytic, 30 mfd 450 v.	Decoupling
C448	V-6023-4104M	Capacitor, hi-temp .1 mfd 400 v.	R-F by-pass
L401	V-9589-1	Choke	Feed
L402	V-9235-2	Coil	Focus
L403	V-6764	Coil	Ringing
L413	V-9099-2	Choke, R-F	I-F filament
L414	V-9099-1	Choke, R-F	I-F filament
L415	V-9099-1	Choke, R-F	I-F filament
R401	V-9232	Control, 600 ohms	Focus
R402	V-6462	Control, 1 megohm	Height
R403	V-6463	Control, 5000 ohms	Vert linearity
*R404	V-9233 assy	Control, 100,000 ohms (assy consists of R405 and R404)	Horiz hold
*R405	V-9233 assy	Control, 500,000 ohms (assy consists of R405 and R404)	Vert hold
R406	V-6500-2	Control, 3000 ohms	Width
R407	RC20AE561K	Resistor, 560 ohms ½ w.	Transient damping
R408	RC20AE561K	Resistor, 560 ohms ½ w.	Transient damping
R409	RC40AE221K	Resistor, 220 ohms 2 w.	Plate load
R410	V-6984-5	Resistor, 10,000 ohms 5 w. w.w.	Screen load
R411	V-9600-3	Resistor, 7500 ohms 10 w. ww.	Plate load
R412	V-9002-4900K	Resistor, 90 ohms 2 w.	Focus coil shunt
R420	RC20AE471K	Resistor, 470 ohms ½ w.	Cathode bias
R421	RC20AE471K	Resistor, 470 ohms ½ w.	Decoupling
R423	RC20AE102K	Resistor, 1000 ohms ½ w.	Cathode bias
R424	RC20AE182K	Resistor, 1800 ohms ½ w.	Cathode bias
R427	RC20AE562K	Resistor, 5600 ohms ½ w.	Waveform correction
R428	RC20AE153K	Resistor, 15,000 ohms ½ w.	Plate load
R429	RC20AE562K	Resistor, 5600 ohms ½ w.	Plate load
R430	RC30AE333K	Resistor, 33,000 ohms 1 w.	MV decoupling
R431	RC20AE333K	Resistor, 33,000 ohms ½ w.	MV decoupling
R432	RC20AE273K	Resistor, 27,000 ohms ½ w.	Waveform correction
R433	RC20AE223K	Resistor, 22,000 ohms ½ w.	DC divider
R434	RC20AE473K	Resistor, 47,000 ohms ½ w.	Vert MV decoupling
R436	RC20AE683K	Resistor, 68,000 ohms ½ w.	Phase reference
R437	RC20AE104J	Resistor, 100,000 ohms ½ w.	AFC diode load
R438	RC20AE104J	Resistor, 100,000 ohms ½ w.	AFC diode load
R440	RC20AE104K	Resistor, 100,000 ohms ½ w.	Plate load
R441	RC20AE224J	Resistor, 220,000 ohms ½ w.	Grid return
R442	RC20AE394J	Resistor, 390,000 ohms ½ w.	Plate load
R443	RC20AE474K	Resistor, 470,000 ohms ½ w.	Charge limiting
R444	RC20AE474K	Resistor, 470,000 ohms ½ w.	Grid return
R445	RC20AE474K	Resistor, 470,000 ohms ½ w.	AFC delay
R446	RC20AE104K	Resistor, 100,000 ohms ½ w.	Grid return
R447	RC20AE105K	Resistor, 1 megohm ½ w.	Grid return
R449	RC20AE225K	Resistor, 2.2 megohms ½ w.	Grid return
R450	RC20AE475M	Resistor, 4.7 megohms ½ w.	Cathode bias
R451	RC20AE224K	Resistor, 220,000 ohms ½ w.	MV plate load
R453	RC30AE224K	Resistor, 220,000 ohms 1 w.	Error volt take off
R454	RC30AE224K	Resistor, 220,000 ohms 1 w.	Error volt take off
R456	V-6067-4	Resistor, glasohm, 150 ohms 3 w.	Cathode bias
R466	RC20AE103K	Resistor, 10,000 ohms ½ w.	Decoupling
R467	RC20AE105K	Resistor, 1 megohm ½ w.	Positive bias limiting
R468	RC20AE154K	Resistor, 150,000 ohms ½ w.	Plate load
R469	RC20AE225K	Resistor, 2.2 megohms ½ w.	Grid return
R470	RC20AE272K	Resistor, 2700 ohms ½ w.	Plate load
R471	RC20AE272K	Resistor, 2700 ohms ½ w.	Limiting
R472	RC20AE331K	Resistor, 330 ohms ½ w.	Cathode bias
R474	RC20AE225K	Resistor, 2.2 megohms ½ w.	Diode shunt
R475	RC20AE101K	Resistor, 100 ohms ½ w.	Parasitic suppressor
R476	RC20AE101K	Resistor, 100 ohms ½ w.	Parasitic suppressor
T401	V-9584-1	Transformer	Vert output
Z401	V-9213	Filter	Integrating
Z402	V-8298	Yoke assembly (complete)	Deflection

Section 5—Power

*C501	V-9575 assy	Capacitor, electrolytic, 60 mfd 450 v. (assy consists of C403, C501 and C502)	Filter
*C502	V-9575 assy	Capacitor, electrolytic, 20 mfd 450 v. (assy consists of C403, C501 and C502)	Filter
C505	V-6023-4503M	Capacitor, hi-temp .05 mfd 400 v.	Screen by-pass
C506	V-6023-4503M	Capacitor, hi-temp .05 mfd 400 v.	Plate decoupling
C507	V-6454	Capacitor	Osc. trimmer
C508	RCM20B271K	Capacitor, 270 mmf	Grid bias
C509	V-5895	Capacitor, 500 mmf	HV filter
L501	V-6471	Choke	Filter
L502	V-9279-1	Coil	R-F
R501	RC41AE333K	Resistor, 33,000 ohms 2 w.	Screen load
R502	RC20AE680K	Resistor, 68 ohms ½ w.	Plate decoupling
R503	RC20AE683K	Resistor, 68,000 ohms ½ w.	Grid return
R504	RC20AE104K	Resistor, 100,000 ohms ½ w.	HV filter
*SW501	V-9686-1 assy	Switch (assy consists of SW501, R200 and R201	On-off
T501	V-9595-1	Transformer	Power
T502	V-9278	Transformer	Hi-voltage

*Sold only as complete assembly.

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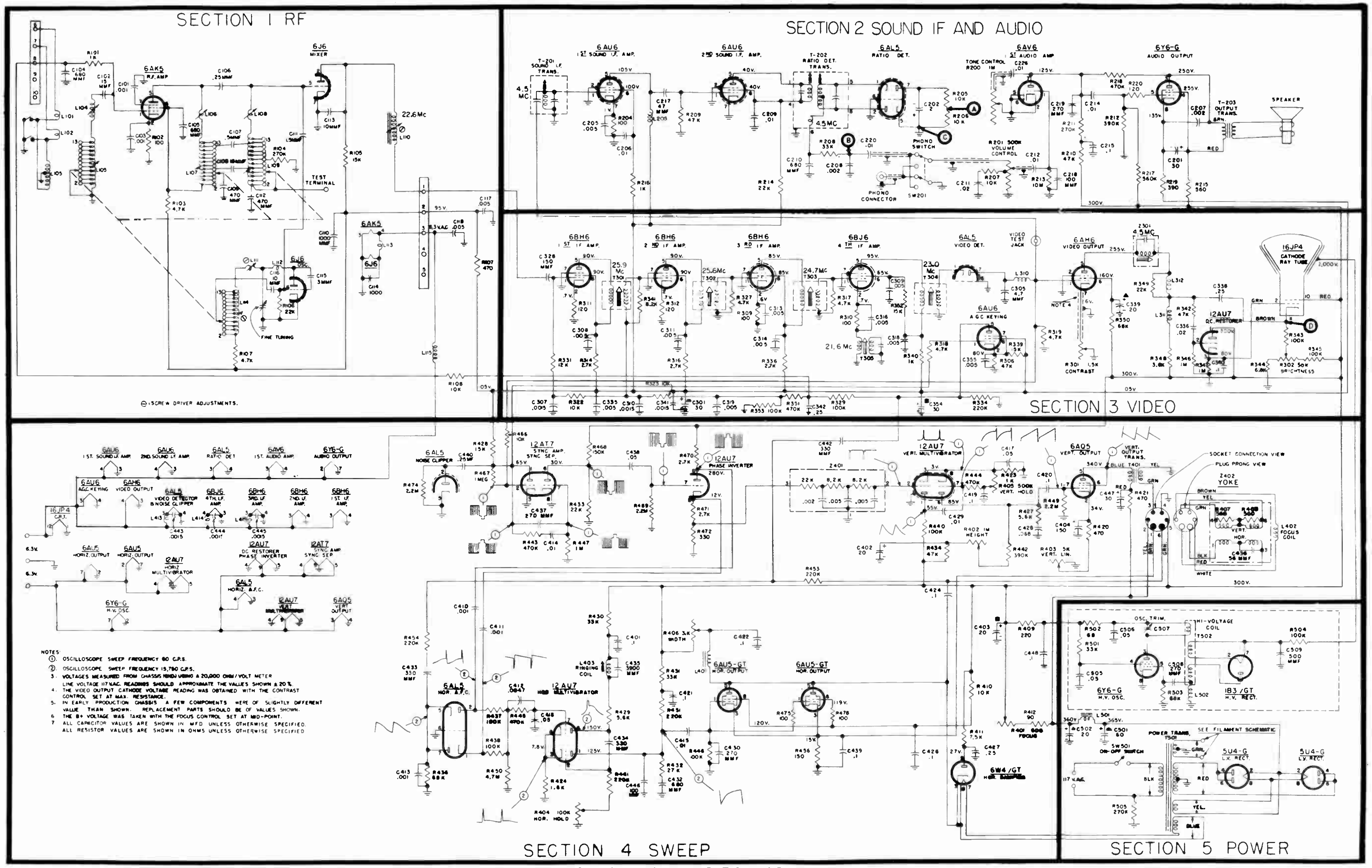

CHASSIS NO V-2150-146

IMPORTANT—Since many of the components are very critical, exact duplicates must be used for replacement purposes.

FIG. 8—SCHEMATIC DIAGRAM

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H-617T12

H-619T12

SPECIFICATIONS

FREQUENCY RANGES:

Channel Number	*Channel Frequency (mc.)*	*Video Carrier Frequency (mc.)*	*Audio Carrier Frequency (mc.)*	*Receiver H-F Oscillator Frequency (mc.)*
1	not used	--	--	--
2	54 - 60	55.25	59.75	81.35
3	60 - 66	61.25	65.75	87.35
4	66 - 72	67.25	71.75	93.35
5	76 - 82	77.25	81.75	103.35
6	82 - 88	83.25	87.75	109.35
7	174 - 180	175.25	179.75	201.35
8	180 - 186	181.25	185.75	207.35
9	186 - 192	187.25	191.75	213.35
10	192 - 198	193.25	197.75	219.35
11	198 - 204	199.25	203.75	225.35
12	204 - 210	205.25	209.75	231.35
13	210 - 216	211.25	215.75	237.35

FINE TUNING RANGE:

1 mc. minimum; 2 mc. maximum

OPERATING VOLTAGE:

105 to 120 volts, 60 cycles.

POWER CONSUMPTION: .... 230 watts

AUDIO POWER OUTPUT:

Undistorted .... 1.5 watts
Maximum .... 3.5 watts

LOUDSPEAKER:

Type .... 4" E.M.
Voice Coil Impedance-3.2 ohms at 400 cycles

RECEIVER ANTENNA INPUT IMPEDANCE:

... 300 ohms balanced or 72 ohms unbalanced

TUBE COMPLEMENT:

2 1V2 .... High voltage rectifier
1 6AK5 .... R-F amplifier
1 6AL5 ... Video detector and noise clipper
1 6AL5 .... Ratio detector
1 6AL5 .... Horizontal AFC
1 6AQ5 .... Vertical output
1 6AU5GT .... Horizontal output
1 6AU6 .... Sound I-F amplifier
1 6AU6 .... Keyed AGC
1 6AV6 .... 1st. audio amplifier
1 6C4 .... Phase inverter
1 6CB6 .... Video output
1 6CB6 .... 1st. I-F amplifier
1 6CB6 .... 2nd. I-F amplifier
1 6CB6 .... 3rd. I-F amplifier
1 6J6 .... H-F oscillator and mixer
1 6K6GT .... Audio output
1 6W4GT or 6U4GT .... Horizontal damper
2 6W4GT or 6U4GT ... Low voltage rectifier
1 12AU7 .... Vertical multivibrator
1 12AU7 .... Horizontal multivibrator
1 12AT7 ..... Sync separator and amplifier
1 12LP4 or 12LP4A .... Cathode ray tube

VIDEO CARRIER INTERMEDIATE FREQUENCY: .... 26.1 mc.

VIDEO RESPONSE: .... 2.7 mc.

AUDIO CARRIER INTERMEDIATE FREQUENCY: .... 4.5 mc.

AUDIO DISCRIMINATOR BAND WIDTH:

(between peaks) .... 150 kc.

FOCUS: .... Magnetic

SWEEP DEFLECTION: .... Magnetic

SCANNING: .... Interlaced 525 line

HORIZONTAL SCANNING FREQUENCY: .... 15,750 CPS

VERTICAL SCANNING FREQUENCY: .... 60 CPS

FRAME FREQUENCY

(picture repetition rate): .... 30 CPS

HIGH VOLTAGE WARNING

The danger accompanying shock is always present when the receiver is operated outside the cabinet or when the rear cover is removed from the cabinet. Only a person familiar with the precautions to be observed when working with high-voltage equipment should service this receiver.

CATHODE RAY TUBE HANDLING PRECAUTIONS

Shatterproof goggles and heavy gloves should be worn at all times when handling the cathode ray tube. The tube should not be handled in the vicinity of any person not so equipped. When handling the cathode ray tube, always keep it away from the body.

The cathode ray tube bulb, due to its large surface area and high vacuum contained within, is subjected to high air pressure. More than ordinary care is required to prevent shattering the tube. The large end of the bulb, particularly the rim of the viewing surface, must not be struck, scratched, or subjected to more than moderate pressure at any time. If the tube sticks or fails to slip smoothly into place during installation, remove the tube and determine the cause of the trouble - - DO NOT FORCE THE TUBE.

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INSTALLATION INSTRUCTIONS

TO PREPARE THE RECEIVER FOR OPERATION:

Models H-617T12 and H-619T12 are shipped in operating condition. There is no shipping material to be removed. Simply remove the receiver from its carton, and connect the A-C plug to a 105 to 120 volt 60 cycle A-C outlet.

However, it is desirable that the adjustment of the ion trap magnet be checked in order to obtain best performance from the receiver. A check of this adjustment will also avoid the possibility of C.R.T. damage resulting from prolonged operation with an incorrectly adjusted ion trap magnet. To check the adjustment, proceed as follows:

1. Remove the screws that secure the rear cover to the cabinet.

2. Remove the rear cover by pulling it straight out from the cabinet.

3. Apply power to the receiver.

4. Adjust the ion trap magnet as explained under ADJUSTMENTS.

These models contain a built-in antenna for use in areas of normal reception. In such areas when the built-in antenna provides good reception, no antenna connections are required. However, in weak signal areas or under adverse conditions, it may be necessary to use an external antenna. In this event, the antenna lead-in can be connected to the antenna terminals on the back of the receiver after disconnecting the built-in antenna wires that normally connect to these terminals. The lugs on the built-in antenna should then be insulated and dressed in such a position that they do not touch the chassis or components.

TO CHECK THE OPERATION OF THE RECEIVER:

1. Rotate the BRIGHTNESS and CONTRAST controls completely counterclockwise.

2. Turn on the receiver by rotating the OFF-ON-VOLUME control clockwise.

3. Rotate the CHANNEL SELECTOR to the channel number of the desired station.

4. Rotate the BRIGHTNESS control clockwise until the screen is well lighted.

5. Rotate the CONTRAST control clockwise until a picture appears on the screen.

6. If the built-in antenna is in use, adjust the TELEVISION ANTENNA control for maximum picture contrast. If an external antenna is in use, this step is not required.

7. If the picture is moving up or down or quivering, adjust the VERTICAL HOLD control to stabilize the image.

8. If horizontal or diagonal bars or a folded-over picture appears on the screen, adjust the HORIZONTAL HOLD control to obtain a clear picture.

9. Adjust the FINE TUNING control to the best picture detail.

10. Readjust the BRIGHTNESS and CONTRAST controls until pleasing shades ranging from clear white to intense black are attained.

11. Adjust the VOLUME control for the desired sound volume.

12. Check the operation on all available television stations. Note that if the built-in antenna is in use, the TELEVISION ANTENNA control must be readjusted for maximum picture contrast each time the receiver is tuned to a different channel.

13. If necessary, adjust the vertical linearity, height, width, and focus controls as explained under ADJUSTMENTS.

ADJUSTMENTS

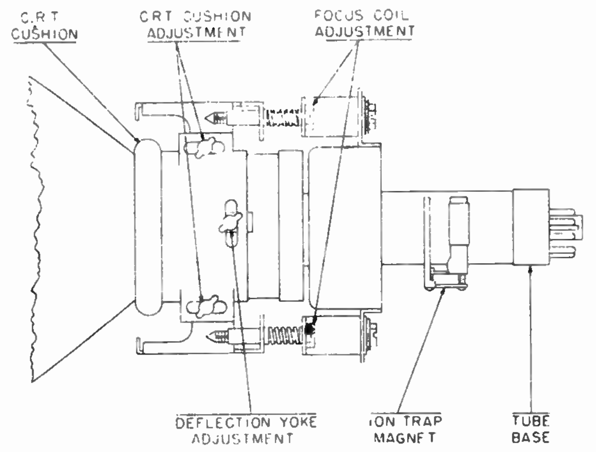

FIG. 1 — TOP VIEW OF C.R.T.

The picture adjustments are located on the rear of the chassis and are accessible through cut-outs in the back cover.

ION TRAP MAGNET

Caution: When adjusting the ion trap magnet, care must be exercised to avoid breaking the neck of the C.R.T.

The ion trap magnet must always be adjusted for maximum picture brightness. With the magnet oriented approximately as shown in Fig. 1, rotate it around the neck of the tube and move it forward and backward until the position is found where the brightest raster is obtained.

FOCUS COIL

If a shadow falls on one corner of the picture or if the picture is not properly centered, adjustment of the focus coil will be necessary. To adjust, loosen the short hex head bolts that lock the coil to the adapter plates, and move the coil horizontally and vertically until the position is found where the picture is properly centered and shadows are removed. Tighten the short hex head bolts to lock the coil in this position. Fine adjustment is provided by adjustment of the four hex head bolts at each corner of the focus coil.

If shadows cannot be removed completely, refer to ION TRAP MAGNET.

CATHODE RAY TUBE CUSHION

The cushion must fit snugly against the flare of the cathode ray tube in order that the rear of the tube will be supported firmly.

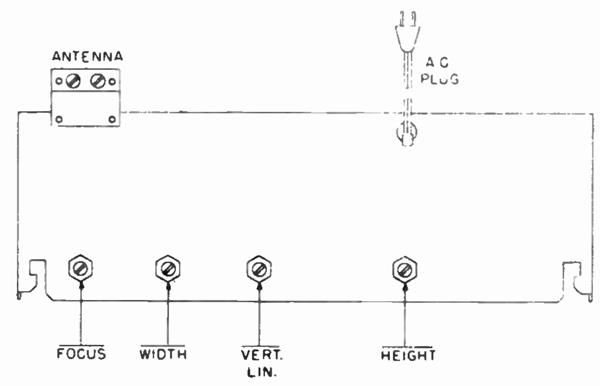

FIG. 2 — REAR VIEW OF CHASSIS

DEFLECTION YOKE

This adjustment controls the angle of the picture with respect to the horizontal. If the picture is not squared in the picture mask, loosen the wing nut and move it to the left or right so as to rotate the deflection yoke. The picture will tilt to the left or right with the deflection yoke rotation.

FOCUS CONTROL

The focus control (Fig. 2) should be adjusted with the brightness and contrast controls in their normal positions. If correct focusing cannot be obtained, the high voltage oscillator may require adjustment.

HEIGHT AND VERTICAL LINEARITY

The height adjustment controls the overall height of the picture, while the vertical linearity adjustment governs contraction or expansion of the upper portion only. For this reason, a balance between the two controls is necessary to make the picture symmetrical and fill the mask vertically.

WIDTH

The width control should be adjusted so that the picture fills the mask horizontally.

HORIZONTAL RINGING COIL

To adjust the horizontal ringing coil (L403), tune in the weakest station in the area, set the horizontal hold control at approximately the middle of its range, and adjust L403 (location shown on Fig. 7) until the picture is properly "locked-in".

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ALIGNMENT

TEST EQUIPMENT—To properly service the chassis, the following test equipment should be available:

1. R-F sweep generator which meets the following requirements:

   a. Frequency range from 18 to 30 mc. with a sweep width of 10 mc.

   b. Output adjustable with at least 100,000 microvolts maximum and a very low minimum.

   c. Output "flat" on all attenuator positions.

2. Cathode-ray oscilloscope, preferably one with a wide band vertical deflection amplifier and a low-capacitance input probe.

3. Signal generator capable of providing output frequencies listed below.

   25.6 mc. 1st I-F
   24.1 mc. 2nd I-F
   23.6 mc. 3rd I-F
   24.7 mc. 4th I-F
   4.5 mc. Audio I-F and ratio detector (the frequency must be extremely accurate, preferably crystal controlled.)

NOTE: The R-F output level on all the above frequencies should be adjustable with at least 100,000 microvolts maximum and a very low minimum.

4. Heterodyne frequency meter with crystal calibrator (if the signal generator does not include a crystal calibrator).

5. Electronic voltmeter (vacuum tube voltmeter), with a high voltage multiplier probe for measurements up to 15,000 volts and an R-F probe for measuring R-F voltages.

GENERAL INFORMATION—All test equipment and the chassis should be bonded together by short lengths of heavy (¼ inch) braided copper ribbon. The interconnecting leads should be shielded (72 ohm coaxial cable) and should be as short as possible consistent with ease of making connections. The effectiveness of the bonding can be checked during alignment of placing the hand on the metal chassis or test equipment case. If the response pattern or meter reading changes visibly, the bonding must be improved before the circuits are aligned.

COMMON I-F ALIGNMENT PROCEDURE

If a common I-F transformer is replaced or, for any other reason, is badly out of adjustment, it is advisable to turn the slug out (counterclockwise) as far as possible before beginning alignment. Then starting from this position, turn the slug in a clockwise direction until the *first* peak is reached. This procedure is recommended to obtain the correct peak rather than an undesired second peak which is sometimes obtained when the slug is turned clockwise past the first peak.

The common I-F alignment procedure is as follows:

1. Rotate the channel selector to the position where the flat of the shaft is parallel with the top of the tuner, thus selecting channel 13. Remove the 6AK5 R-F amplifier tube from its socket to avoid undesirable beat response during alignment.

2. Connect the signal generator to the mixer tube through the coupling device shown in Fig. 3. The device is constructed by squeezing together a miniature tube shield until it fits the tube snugly and does not ground to the chassis. A .005 mfd capacitor is then soldered to the side of the shield. By sliding the tube shield up or down on the tube, the capacitance between the shield and the tube elements can be varied to obtain additional control of the coupling over that provided by the attenuator in the generator itself. The ground side of the generator output cable should be connected to the receiver chassis.

3. Connect a vacuum tube voltmeter to the video test jack on the receiver chassis, and set the meter to its 5 volt scale.

4. Set the signal generator to 25.6 mc. (unmodulated), and adjust L110 for maximum voltage on the VTVM. *During this adjustment, keep the signal generator output adjusted so that the VTVM reading does not exceed 2 volts.*

5. Set the signal generator to 24.1 mc. (unmodulated), and adjust T301 for maximum voltage on the VTVM. *During this adjustment, keep the signal generator output adjusted so that the VTVM reading does not exceed 2 volts.*

6. Set the signal generator to 23.6 mc. (unmodulated), and adjust T302 for maximum voltage on the VTVM. *During this adjustment, keep the signal generator output adjusted so that the VTVM reading does not exceed 2 volts.*

7. Set the signal generator 24.7 mc. (unmodulated), and adjust T303 for maximum voltage on the VTVM. *During this adjustment, keep the signal generator output adjusted so that the VTVM reading does not exceed 2 volts.*

8. Connect the *sweep* generator to the mixer tube through the coupling device previously described. The *signal* generator will be used in the following steps to provide marker indications at various frequencies on the response curve. In this application, the signal generator input to the set must be low in amplitude to avoid distorting the response curve. To reduce the signal generator input accordingly, the signal generator should be *loosely* coupled to the set by wrapping a few turns of insulated wire around the coupling capacitor "pigtail" and connecting the signal generator to this wire.

9. Connect the vertical input of the oscilloscope to the video test jack through the de-coupling network shown in Fig. 4. The oscilloscope horizontal input should be connected to the sweep output from the sweep generator; turn the sweep control on the oscilloscope to the "X" or "OFF" position.

10. Adjust the sweep generator for a center frequency of 25.3 mc. with a 10 mc. deviation. Adjust the sweep generator output until a setting is found where there is very little noise on the oscilloscope pattern.

The oscilloscope pattern obtained should be similar to that shown in Fig. 5. Use the signal generator as a marker to check at the frequencies indicated. If the pattern obtained is not similar to Fig. 5, L110, T301, T302 and T303 should be re-adjusted to produce the correct pattern.

SOUND I-F ALIGNMENT PROCEDURE

1. Connect the "high" side of the signal generator to the video test jack through a .001 mfd capacitor, and ground the "low" side to the chassis.

2. Connect the vacuum tube voltmeter to the points indicated on the bottom view of the chassis, Fig. 7. The common lead should connect to point "C", and the "high" lead should connect to point "A". Set the meter on its 5 volt (-DC) scale.

3. Adjust the signal generator to 4.5 mc. (unmodulated). The accuracy of this frequency is very important. If a crystal controlled signal generator is not available, the frequency should be checked using a frequency meter with a crystal calibrator.

4. Adjust primary and secondary slugs of T201 and primary of T202 for maximum voltage on the VTVM. During this adjustment, keep the signal generator output adjusted so that the VTVM reading does not exceed 5 volts. The primary adjustments are made from the bottom of the chassis while secondary adjustments are made from the top.

5. Connect the common lead from the VTVM to point "A" (Fig. 7), and connect the "high" lead to point "B". Here it is important that the case and components of the VTVM are *not* grounded to the receiver chassis; otherwise, point "A" would be shorted to the chassis through the common lead.

6. Using the same signal generator amplitude and frequency as in step 4, adjust the secondary of T202 for *zero* voltage on the VTVM. As the adjustment is tuned through resonance, the voltage will rapidly change from one polarity to the opposite polarity. The point where the voltage is zero is the correct setting.

H.F. OSCILLATOR ALIGNMENT PROCEDURE

If the 6J6 oscillator tube is replaced, the different inter-electrode capacity of the new tube may change the oscillator frequency enough to necessitate realignment of the oscillator.

Alignment of the oscillator on the high band is accomplished by adjusting the brass slug located adjacent to the vernier drive wheel on the front of the tuner. Alignment of the oscillator on the low band is accomplished by adjusting the brass slug on the lower front of the tuner. A *non-metallic screwdriver is required.*

The oscillator alignment procedure is as follows:

1. Set the fine tuning control at the middle of its range, and leave it in this position during the following adjustments.

2. Set the selector switch to the highest of the low-band (channels 2 through 6) stations operating in your vicinity.

3. Peak the low band adjustment slug for the best picture detail.

4. Set the selector switch to the highest of the high-band (channels 7 through 13) stations operating in your vicinity.

5. Peak the high band adjustment slug for best picture detail.

6. Check the previously made low band adjustment, and if the tuning has changed, repeat steps 2 and 3.

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I-F ALIGNMENT CHART

Turn the channel selector to channel 13, and remove the 6AK5 R-F amplifier tube.

COMMON I-F SECTION

Couple the sweep and marker generators to the mixer tube as shown in Fig. 3.

Step	Sweep Gen. Frequency	Marker Gen. Frequency	Remarks	Indicator Connections	Adjust
1.	Not used	25.6 mc. unmodulated	Keep marker output adjusted so VTVM reading does not exceed 2 v.	Connect VTVM to video test jack	L110 for maximum voltage
2.	Not used	24.1 mc. unmodulated	Same as step 1	Same as step 1	T301 for maximum voltage
3.	Not used	23.6 mc. unmodulated	Same as step 1	Same as step 1	T302 for maximum voltage
4.	Not used	24.7 mc. unmodulated	Same as step 1	Same as step 1	T303 for maximum voltage
5.	25.3 mc. with 10 mc. deviation	Check at: 23.0 mc. 23.4 mc. 24.0 mc. 25.3 mc. 26.1 mc.	Keep sweep output high enough so that very little noise appears on the oscilloscope trace	Connect oscilloscope to video test jack. See Fig. 4.	If necessary, adjust L110, T301, T302 and T303 to obtain correct response curve. See Fig. 5.

SOUND I-F SECTION

Connect the signal generator to the video test jack through a .001 mfd mica capacitor.

Step	Signal Gen. Frequency	VTVM Connection	Remarks	Adjust
1.	4.5 mc. unmodulated	See Fig. 7. Common lead to point "C" and high lead to point "A".	Use 5 v. (−DC) scale on meter. Set sig. gen. output accordingly.	Pri. and sec. of T201 and pri. of T202 for maximum voltage
2.	4.5 mc. unmodulated	See Fig. 7. Common lead to point "A" and high lead to point "B".	Use same sig. gen. output as in step 1.	Sec. of T202 for *zero* voltage

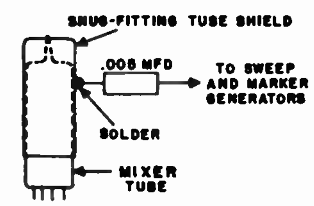

FIG. 3—COUPLING SIGNAL GENERATORS TO MIXER TUBE

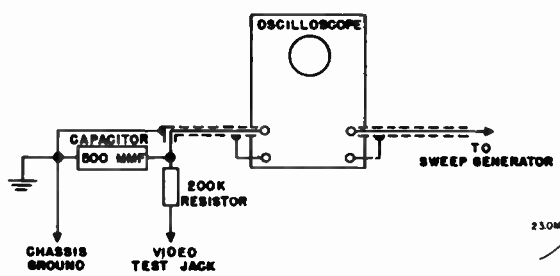

FIG. 4—OSCILLOSCOPE ISOLATION NETWORK

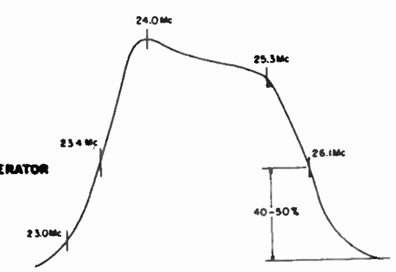

FIG. 5—I-F RESPONSE CURVE

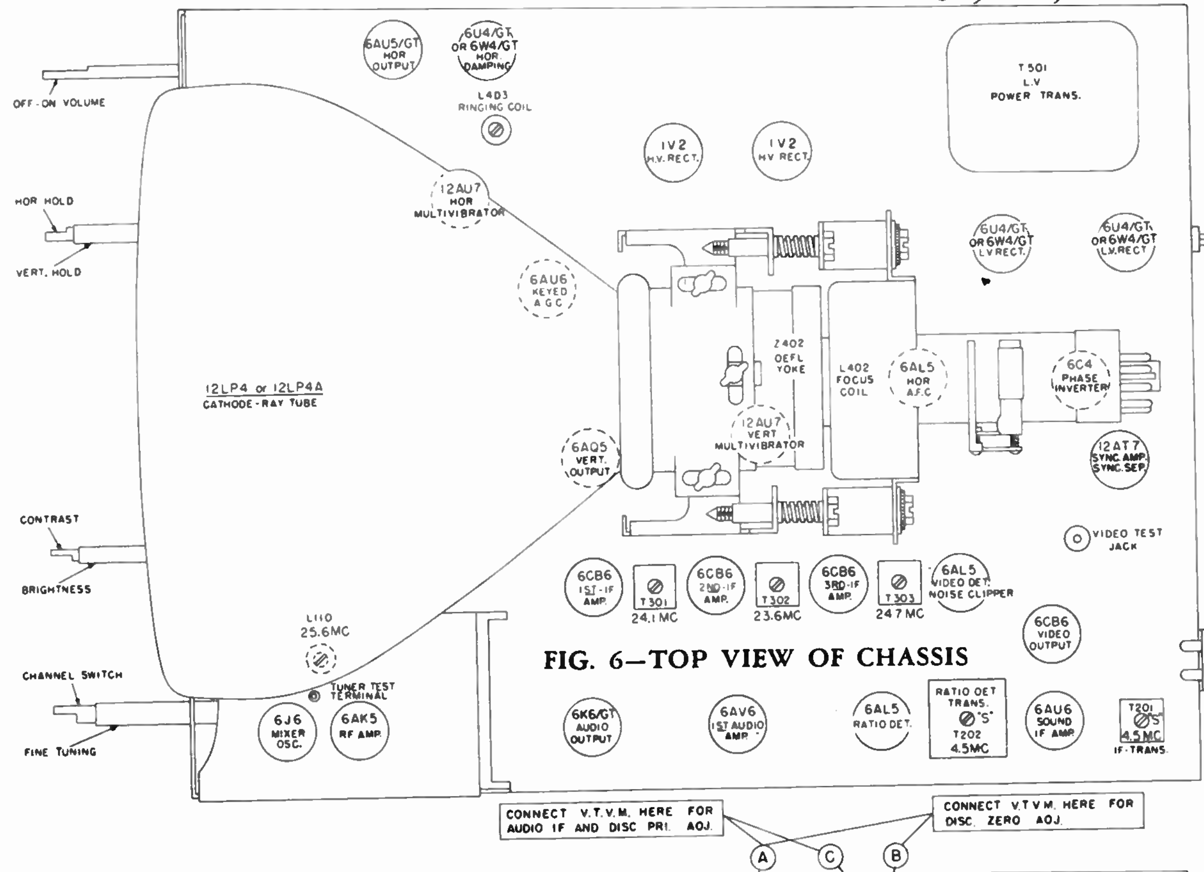

FIG. 6—TOP VIEW OF CHASSIS

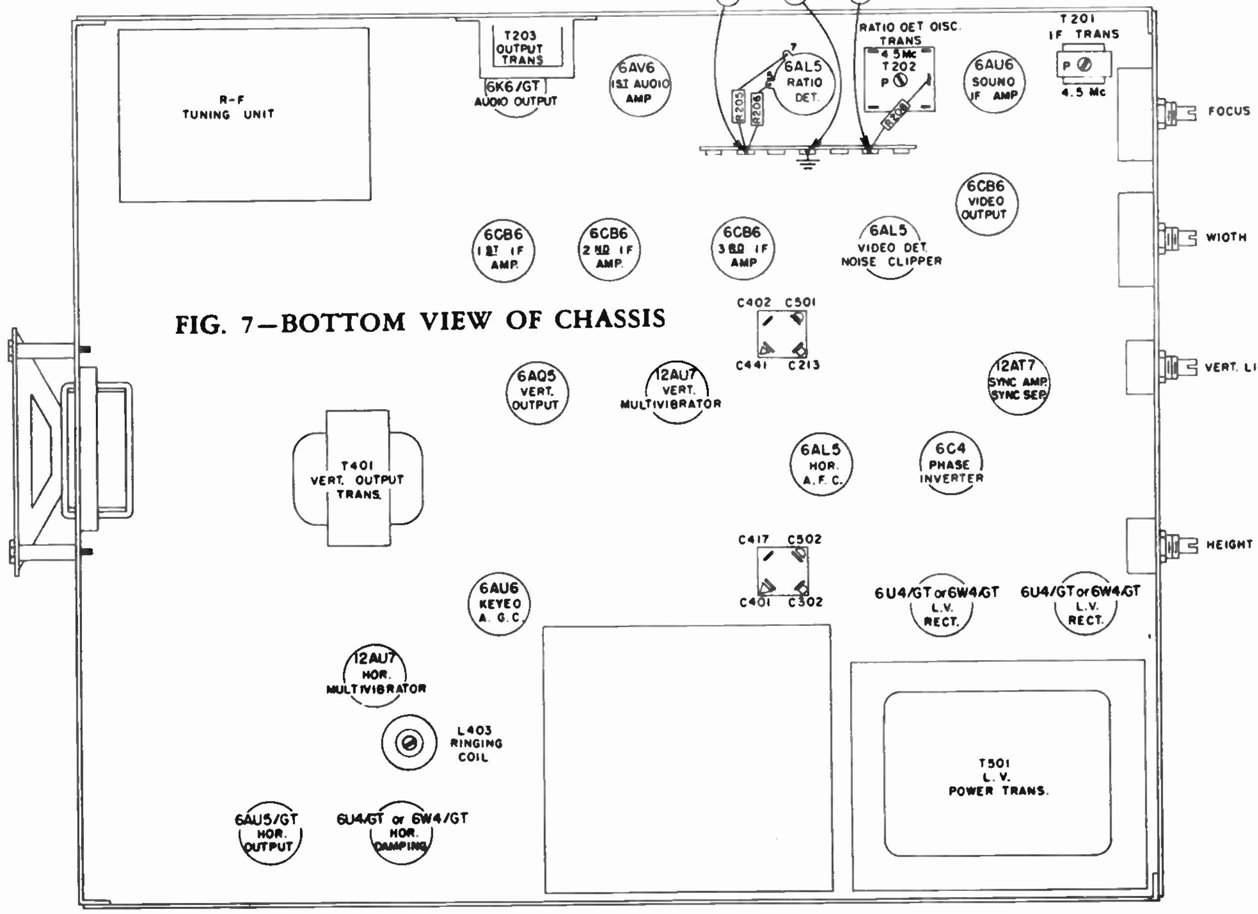

FIG. 7—BOTTOM VIEW OF CHASSIS

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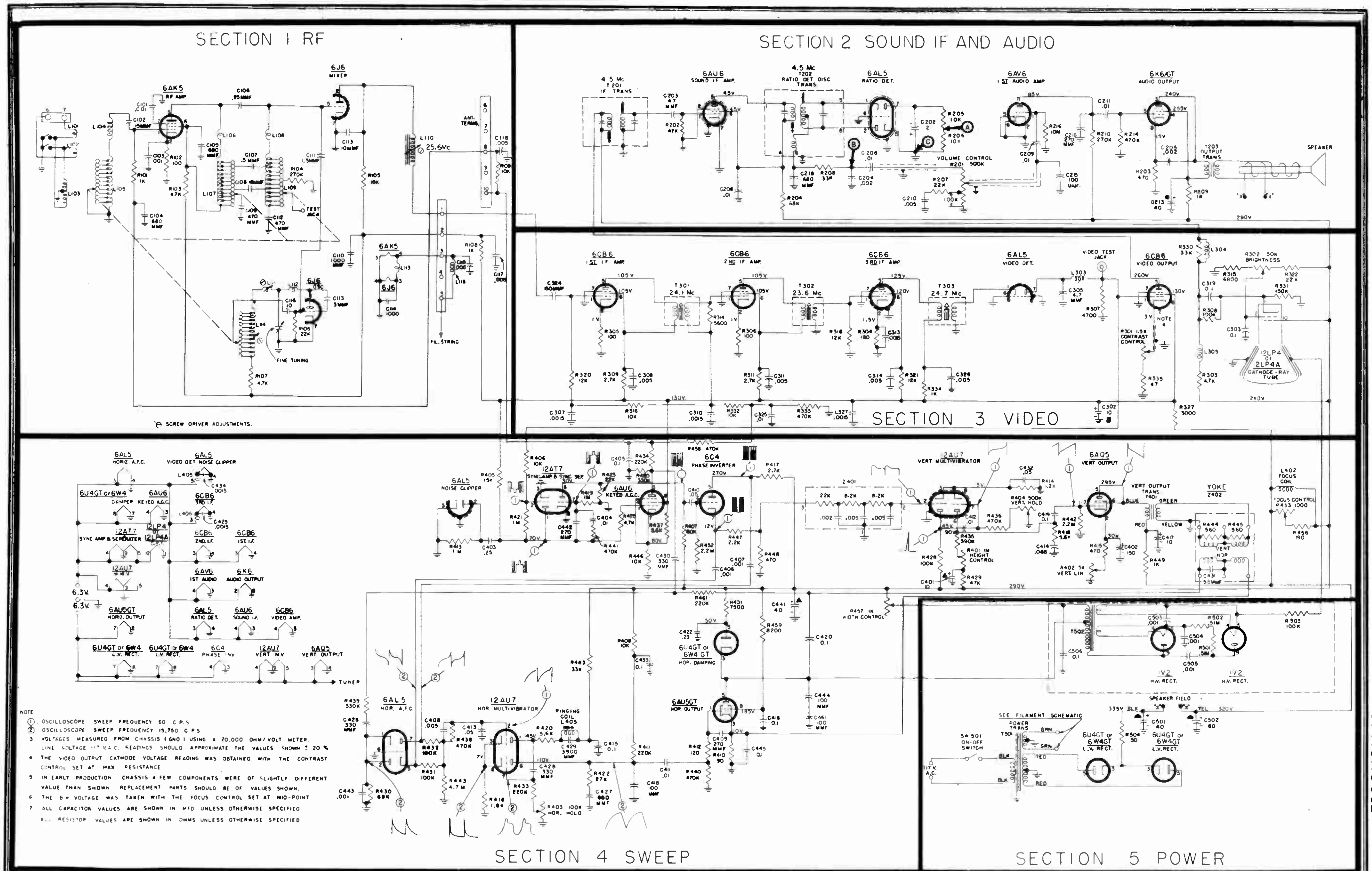

CHASSIS NO V-2150-176

FIG. 8—SCHEMATIC DIAGRAM

IMPORTANT—Since many of the components are very critical, exact duplicates must be used for replacement purposes.

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PARTS LIST

CABINET

Part No.	Description
V-9692-1	Baffle and grille cloth assembly
V-3371-1	Bumper, recessed (feet)
V-1206-1	Cabinet (H-617T12)
V-1209-1	Cabinet (H619T12)
V-9788-1	Cover, back
V-9713-3	Disc, channel indicator (H-617T12)
V-6146-1	Knob, contrast, horizontal hold (front)
V-9104-1	Knob, brightness, vertical hold (rear)
V-9104-3	Knob, volume, on-off (rear)
V-9104-4	Knob, fine tuning (rear)
V-6146-5	Knob, volume on-off (front)
V-6284-6	Knob, channel selector
V-5100-1	Knob, TV antenna
V-9709-2	Mask, CRT (H-617T12)
V-6288-10	Plate, front glass (H-617T12)
V-6288-11	Plate, front glass (H-619T12)
V-6059	Spring, knob (fine tuning)
V-3258S	Spring, knob (TV antenna)
V-6063-1	Spring, knob (channel selector)
V-5421-5	Washer, felt (knobs)

MISCELLANEOUS

Part No.	Description
V-6511-2	Adapter plate, RF tuner
V-9366-2	Antenna assembly
V-4169-1	Base, miniature tube (6AU6, 6AL5, 6CB6)
V-6602-1	Base, miniature tube (12AU7)
V-9581-1	Bracket weld assembly, deflection yoke
V-5426	Clip, I-F mounting
V-5906-3	Connector assembly, hi-voltage
V-4349-9	Cord, power AC
V-5976	Cushion, rubber (CRT strap)
V-9234	Hood, yoke mounting
V-9784-1	Magnet, ion trap
V-5926	Screw = 8-32 wing
V-9344-7	Shaft, television antenna
V-6602-2	Shield, miniature tube (12AU7)
V-4169-2	Shield, miniature (6AU6, 6AL5, 6CB6)
V-5979	Sleeve, rubber (focus coil)
V-9328-1	Sleeve, rubber (television antenna)
V-9566-2	Socket assembly (CRT)
V-4292S-1	Socket, miniature molded (10)
V-6878-1	Socket, miniature wafer (2)
V-5556-1	Socket, miniature 9 prong (1)
V-6089-1	Socket, miniature 9 prong (1)
V-4514	Socket, molded octal (3)
V-4195	Socket, molded octal (1)
V-9315-2	Socket, molded octal (2)

*Sold only as complete assembly.

Part No.	Description
V-9236-2	Speaker, 4" EM
V-6212-2	Strap assembly (CRT)
V-6294	Terminal board antenna
V-5977	Tip jack

V-2150-176 CHASSIS

Section 1—RF

Item	Part No.	Description	Function
	V-8210	Tuner assembly, RF	
C117	V-5596	Capacitor, hi-kap .005 mfd	Decoupling
C118	V-5596	Capacitor, hi-kap .005 mfd	Decoupling
C119	V-5596	Capacitor, hi-kap .005 mfd	Decoupling
L115	V-9099-1	Coil	Filament
R108	RC20AE102M	Resistor, 1000 ohms ½ w.	Decoupling
R109	RC20AE103M	Resistor, 10,000 ohms ½ w.	Decoupling

Section 2—Sound I-F and Audio

Item	Part No.	Description	Function
C202	V-4880	Capacitor, electrolytic 2 mfd 50 v.	Ratio det. stabilizer
C203	RCM20B470M	Capacitor, 47 mmf	Coupling
C204	RCP10W6202M	Capacitor, .002 mfd	De-emphasis
C205	RCP10W6202M	Capacitor, .002 mfd	Plate by-pass
C206	RCP10W4103M	Capacitor, .01 mfd	Screen by-pass
C208	RCP10W4103M	Capacitor, .01 mfd	AF coupling
C209	RCP10W4103M	Capacitor, .01 mfd	AF coupling
C210	RCP10W4502M	Capacitor, .005 mfd	Bass boost
C211	RCP10W4103M	Capacitor, .01 mfd	AF coupling
*C213	V-6509 assy	Capacitor, electrolytic 40 mfd 150 v. (assy consists of C213, C501, C402 and C441)	Decoupling
C215	RCM20B101M	Capacitor, 100 mmf	Grid by-pass
C216	RCM20B271M	Capacitor, 270 mmf	Plate by-pass
C218	RCM20B681M	Capacitor, 680 mmf	De-emphasis
*R201	V-6198-4 assy	Control, 500,000 ohms (assy consists of R201 and SW501)	Volume
R202	RC20AE473K	Resistor, 47,000 ohms ½ w.	Grid return
R203	RC30AE471K	Resistor, 470 ohms 1 w.	Cathode bias
R204	RC30AE683K	Resistor, 68,000 ohms 1 w.	Plate load
R205	RC20AE103K	Resistor, 10,000 ohms ½ w.	Ratio det. load
R206	RC20AE103K	Resistor, 10,000 ohms ½ w.	Ratio det. load
R207	RC20AE223K	Resistor, 22,000 ohms ½ w.	Bass boost
R208	RC20AE333K	Resistor, 33,000 ohms ½ w.	De-emphasis
R209	RC30AE102M	Resistor, 1000 ohms 1 w.	Decoupling
R210	RC20AE274K	Resistor, 270,000 ohms ½ w.	Plate load
R214	RC20AE474K	Resistor, 470,000 ohms ½ w.	Grid return
R216	RC20AE106M	Resistor, 10 megohms ½ w.	Grid return
T-201	V-9371	Transformer (complete)	4.5 mc.
T202	V-9574	Transformer (complete)	Ratio det.
T203	V-9238	Transformer (complete)	Audio output

Section 3—Video

Item	Part No.	Description	Function
*C302	V-5891 assy	Capacitor, electrolytic 10 mfd 350 v. (assy consists of C401, C417, C502 and C302)	Screen by-pass
C303	RCP10W4104M	Capacitor, .1 mfd	Grid return
C305	V-5658-6	Capacitor, 4.7 mmf	Plate by-pass
C307	R5CC26ZY152M	Capacitor, .0015 mfd	I-F decoupling
C308	V-5596	Capacitor, hi-kap .005 mfd	I-F decoupling
C310	R5CC26ZY152M	Capacitor, .0015 mfd	I-F decoupling
C311	V-5596	Capacitor, hi-kap .005 mfd	I-F decoupling
C313	R5CC26ZY152M	Capacitor, .0015 mfd	Cathode by-pass
C314	V-5596	Capacitor, hi-kap .005 mfd	I-F decoupling
C319	RCP10W4104M	Capacitor, .1 mfd	Video coupling
C324	R5CC21ZY151M	Capacitor, 150 mmf	I-F coupling
C325	RCP10W4103M	Capacitor, .01 mfd	AGC delay
C326	V-5596	Capacitor, hi-kap .005 mfd	I-F decoupling
C327	R5CC26ZY152M	Capacitor, .0015 mfd	Decoupling
L303	V-5902-4	Coil	Video peaking
L304	V-5902-1	Coil	Video peaking
L305	V-5902-1	Coil	Video peaking
*R301	V-9235-2 assy	Control, 1500 ohms (assy consists of R301 and R302)	Contrast
*R302	V-9235-2 assy	Control, 50,000 ohms (assy consists of R301 and R302)	Brightness
R303	RC30AE472K	Resistor, 4700 ohms 1 w.	Decoupling
R304	RC20AE181K	Resistor, 180 ohms ½ w.	Cathode bias
R305	RC20AE101K	Resistor, 100 ohms ½ w.	Cathode bias
R306	RC20AE101K	Resistor, 100 ohms ½ w.	Cathode bias
R307	RC20AE472K	Resistor, 4700 ohms ½ w.	Diode load
R308	RC20AE104K	Resistor, 100,000 ohms ½ w.	Cathode bias
R309	RC20AE272K	Resistor, 2700 ohms ½ w.	I-F decoupling
R311	RC20AE272K	Resistor, 2700 ohms ½ w.	I-F decoupling
R314	RC20AE562K	Resistor, 5600 ohms ½ w.	Grid return
R315	RC20AE682K	Resistor, 6800 ohms ½ w.	Series brightness
R316	RC20AE103M	Resistor, 10,000 ohms ½ w.	AGC decoupling
R318	RC20AE123K	Resistor, 12,000 ohms ½ w.	I-F load
R320	RC20AE123K	Resistor, 12,000 ohms ½ w.	Grid return
R321	RC20AE123K	Resistor, 12,000 ohms ½ w.	Screen decoupling
R322	RC20AE223K	Resistor, 22,000 ohms ½ w.	DC divider
R327	V-9600-5	Resistor, 3000 ohms 10 w. w.w.	Screen buss load
R330	RC20AE333K	Resistor, 33,000 ohms ½ w.	Decoupling
R331	RC20AE154K	Resistor, 150,000 ohms ½ w.	Cathode bias
R332	RC20AE103M	Resistor, 10,000 ohms ½ w.	AGC decoupling
R333	RC20AE474M	Resistor, 470,000 ohms ½ w.	AGC filter
R334	RC20AE102M	Resistor, 1000 ohms ½ w.	Plate decoupling
R335	RC20AE470K	Resistor, 47 ohms	Cathode bias
T301	V-9586-1	Transformer	Video I-F
T302	V-9586-1	Transformer	Video I-F
T303	V-9586-2	Transformer	Video I-F

Section 4—Sweep

Item	Part No.	Description	Function
*C401	V-5891 assy	Capacitor, electrolytic 10 mfd 350 v. (assy consists of C401, C417, C502 and C302)	Filter
*C402	V-6509 assy	Capacitor, electrolytic 150 mfd 50 v. (assy consists of C213, C501, C402 and C441)	Filter
C403	V-6066-4254M	Capacitor, .25 mfd	Coupling
C404	RCP10W4103M	Capacitor, .01 mfd	Vert. sync. coupling
C405	RCP10W4104M	Capacitor, .1 mfd	AGC filter
C406	RCP10W6102M	Capacitor, .001 mfd	AFC coupling
C407	RCP10W6102M	Capacitor, .001 mfd	AFC coupling
C408	RCP10W4502M	Capacitor, .005 mfd	AFC delay
C409	RCM20B271M	Capacitor, 270 mmf	Grid by-pass
C410	RCP10W4503M	Capacitor, .05 mfd	Sync coupling
C411	RCP10W4103M	Capacitor, .01 mfd	Horiz coupling
C412	V-6023-4103K	Capacitor, hi-temp .01 mfd	Vert. mv. coupling
C413	RCP10W4503M	Capacitor, .05 mfd	AFC delay
C414	V-6023-4683K	Capacitor, hi-temp .068 mfd	Vert. discharge
C415	RCP10W4104M	Capacitor, .1 mfd	Horiz. mv. decoupling
C416	RCP10W4104M	Capacitor, .1 mfd	Screen by-pass
*C417	V-5891 assy	Capacitor, electrolytic 10 mfd 350 v. (assy consists of C502, C302, C401 and C417)	Filter
C418	RCM20B101M	Capacitor, 100 mmf	Plate by-pass
C419	RCP10W4104M	Capacitor, .1 mfd	Vert. mv. coupling
C420	V-6023-4104M	Capacitor, hi-temp .1 mfd	Yoke coupling
C422	RCP10W4254M	Capacitor, .25 mfd	Plate by-pass
C425	R5CC26ZY152M	Capacitor, .0015 mfd	Filament by-pass
C426	RCM20C331J	Capacitor, 330 mmf	Error volt. coupling
C427	RCM20B681K	Capacitor, 680 mmf	Horiz. discharge
C428	RCM20C331J	Capacitor, 330 mmf	Horiz. mv. coupling
C429	RCM30C392K	Capacitor, 3900 mmf	Mv. plate tank
C431	V-9176-15560K	Capacitor, 56 mmf	Transient by-pass
C432	RCP10W4503M	Capacitor, .05 mfd	Cathode by-pass
C430	RCM20C331J	Capacitor, 330 mmf	AGC coupling
C433	RCP10W4104M	Capacitor, .1 mfd	Horiz. mv. coupling
C434	R5CC26ZY152M	Capacitor, .0015 mfd	Filament by-pass
*C441	V-6509 assy	Capacitor, electrolytic 40 mfd 350 v. (assy consists of C213, C501, C402 and C441)	Filter
C442	RCM20B271M	Capacitor, 270 mmf	Horiz. sync. coupling
C443	RCP10W6102M	Capacitor, .001 mfd	Pulse divider
C444	V-9176-15101K	Capacitor, 100 mmf	Plate by-pass
C445	RCP10W4101M	Capacitor, 0.1 mfd	Cathode by-pass
C461	V-9176-15101K	Capacitor, 100 mmf	Plate by-pass
L402	V-9590-4	Coil	Focus
L403	V-6764	Coil, ringing	Horiz. coarse tuning
L405	V-9099-2	Coil	Filament
L406	V-9099-1	Coil	Filament
R401	V-6462	Control, 1 megohm	Height
R402	V-6463	Control, 5000 ohms	Vert. lin.
*R403	V-9233 assy	Control, 100,000 ohms (assy consists of R403 and R404)	Horiz. hold
*R404	V-9233 assy	Control, 500,000 ohms (assy consists of R403 and R404)	Vert. hold
R405	RC20AE153K	Resistor, 15,000 ohms ½ w.	Plate load
R406	RC20AE103M	Resistor, 10,000 ohms ½ w.	Decoupling
R407	RC20AE154K	Resistor, 150,000 ohms ½ w.	Decoupling
R408	RC20AE103K	Resistor, 10,000 ohms ½ w.	Mv. decoupling
R410	V-9002-4900K	Resistor, 90 ohms 2 w. w.w.	Cathode bias
R411	RC20AE224K	Resistor, 220,000 ohms ½ w.	Plate load
R412	RC20AE121M	Resistor, 120 ohms ½ w.	Parasitic suppressor
R413	RC20AE105K	Resistor, 1 megohm ½ w.	Diode shunt
R414	RC20AE122K	Resistor, 1200 ohms ½ w.	Cathode bias
R415	RC20AE471K	Resistor, 470 ohms ½ w.	Cathode bias
R416	RC20AE182K	Resistor, 1800 ohms ½ w.	Cathode bias
R417	RC20AE272K	Resistor, 2700 ohms ½ w.	Plate load
R418	RC20AE562K	Resistor, 5600 ohms ½ w.	Vert. discharge
R419	RC20AE105K	Resistor, 1 megohm ½ w.	Grid return
R420	RC20AE562K	Resistor, 5600 ohms ½ w.	Plate load
R421	RC20AE105K	Resistor, 1 megohm ½ w.	Positive bias limiting
R422	RC20AE273K	Resistor, 27,000 ohms ½ w.	Horiz. discharge
R423	RC20AE223K	Resistor, 22,000 ohms ½ w.	DC divider
R425	RC20AE472K	Resistor, 4700 ohms ½ w.	Grid bias
R428	RC20AE104K	Resistor, 100,000 ohms ½ w.	Plate load
R429	RC20AE473K	Resistor, 47,000 ohms ½ w.	Plate decoupling
R430	RC20AE683K	Resistor, 68,000 ohms ½ w.	Error voltage load
R431	RC20AE104J	Resistor, 100,000 ohms ½ w.	AFC diode load
R432	RC20AE104J	Resistor, 100,000 ohms ½ w.	AFC diode load
R433	RC20AE224J	Resistor, 220,000 ohms ½ w.	Mag. hold comp.
R434	RC20AE224M	Resistor, 220,000 ohms ½ w.	AGC filter
R435	RC20AE394K	Resistor, 390,000 ohms ½ w.	Plate load
R436	RC20AE474K	Resistor, 470,000 ohms ½ w.	Grid return
R437	RC30AE562K	Resistor, 5600 ohms 1 w.	Cathode bias
R438	RC20AE474K	Resistor, 470,000 ohms ½ w.	AFC delay
R439	RC30AE334K	Resistor, 330,000 ohms 1 w.	H. error take off
R440	RC20AE474K	Resistor, 470,000 ohms ½ w.	Grid return
R441	RC20AE474K	Resistor, 470,000 ohms ½ w.	Charge limiting
R442	RC20AE225M	Resistor, 2.2 megohms ½ w.	Grid return
R443	RC20AE475M	Resistor, 4.7 megohms ½ w.	DC return
R444	RC20AE561K	Resistor, 560 ohms ½ w.	Transient damp.
R445	RC20AE561K	Resistor, 560 ohms ½ w.	Transient damp.
R446	RC40AE103K	Resistor, 10,000 ohms 2 w.	Cathode bias
R447	RC20AE222K	Resistor, 2200 ohms ½ w.	Limiting
R448	RC20AE471K	Resistor, 470 ohms ½ w.	Cathode bias
R449	RC20AE102M	Resistor, 1000 ohms ½ w.	Plate decoupling
R450	RC30AE334M	Resistor, 330,000 ohms 1 w.	Plate load
R451	V-9600-3	Resistor, 7500 ohms 10 w.	Plate load
R452	RC20AE225M	Resistor, 2.2 megohms ½ w.	Grid return
R453	V-9612-1	Control, 1000 ohms	Focus
R456	V-5134	Resistor, glasohm 190 ohms 3 w.	Focus coil shunt
R457	V-9612-1	Control, 1000 ohms	Width
R458	RC20AE474M	Resistor, 470,000 ohms ½ w.	AGC filter
R459	V-9002-4822K	Resistor, 8200 ohms 2 w.	Screen load
R461	RC30AE224K	Resistor, 220,000 ohms 1 w.	H. error take off
R463	RC20AE333K	Resistor, 33,000 ohms ½ w.	Mv. decoupling
T401	V-9584-1	Transformer	Vertical output
Z401	V-9213	Filter	Integrating
Z402	V-9210-2	Yoke assembly (complete)	Deflection

*Sold only as complete assembly.

Section 5—Power

Item	Part No.	Description	Function
*C501	V-6509 assy	Capacitor, electrolytic, 40 mfd 350 v. (assy consists of C501, C213, C402 and C441)	Filter
*C502	V-5891	Capacitor, electrolytic, 80 mfd 350 v. (assy consists of C502, C401, C417 and C302)	Filter
C503	V-9571-1	Capacitor, .001 mfd	Filter
C504	V-9571-1	Capacitor, .001 mfd	Filament by-pass
C505	V-9571-1	Capacitor, .001 mfd	Coupling
C506	RCP10W4104M	Capacitor, .1 mfd	RF by-pass
R501	V-9016-2514J	Resistor, 510,000 ohms ½ w.	Voltage doubler
R502	V-9016-2514J	Resistor, 510,000 ohms ½ w.	Voltage doubler
R503	RC20AE104M	Resistor, 100,000 ohms ½ w.	Filter
R504	V-6597	Resistor, 50 ohms 10 w.	Input filter
T501	V-9723	Transformer	Power
T502	V-9572-1	Transformer	High voltage
*SW501	V-6198-4 assy	Switch, on-off (assy consists of R201 and SW501)	

*Sold only as complete assembly.

When ordering parts, specify model number of set in addition to part number and description of part.

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CHANGES IN V-2150-176 CHASSIS

In later production of the V-2150-176 chassis used in Models H-617T12 and H-619T12, the following changes are incorporated:

1. To reduce horizontal wobble under strong signal conditions and increase the contrast range, R437 (connected between pins 6 and 7 of the 6AU6 AGC tube) is 3300 ohms 1 watt (RC30AE332K) rather than 5600 ohms.

2. To improve horizontal linearity, C427 (horizontal discharge capacitor) is 330 mmf (RCM20C331K) rather than 680 mmf.

NOTE: The information given above under "CHANGES IN V-2150-176 CHASSIS" applies also to the V-2150-176U chassis.

HORIZONTAL DAMPING TUBE

The H-617T12 and H-619T12 service notes specify a type 6U4GT or 6W4GT as the horizontal damping tube. Only a 6U4GT tube should be used in this application, however, and all references to a 6W4GT as the horizontal damping tube should be deleted from the service notes.

MODEL H-619T12U — CHASSIS V-2150-176U AND V-2150-177U

The difference between the two chassis is in the use of different R-F amplifier tubes; the V-2150-176U chassis uses a 6AK5 while the V-2150-177U uses a 6AG5.

With the exception of parts that correspond in function or item number to the parts listed below, the H-617T12 and H-619T12 parts list applies to Model H-619T12U. When ordering parts for Model H-619T12U (V-2150-176U and V-2150-177U chassis), the following parts should be ordered in lieu of the corresponding parts listed in the H-617T12 and H-619T12 service notes.

Item	*Part No.*	*Description*
	V-5522	Cord, A-C power ....
	V-9805-1	Cover assembly, black ....
	V-9756-2	Mask, CRT (H-619T12 and H-619T12U)
R209	RC30AE471K	Resistor, 470 ohms, 1 w ....
T203	V-9814	Transformer, audio output ....
T301	V-9798	Transformer, video I-F ....
T302	V-9798	Transformer, video I-F ....
T303	V-9798	Transformer, video I-F ....
C443	RCP10W6202M	Capacitor, .002 mfd ....
C462	RCP10W4104M	Capacitor, 0.1 mfd ....
C463	V-5596	Capacitor, hi-kap, .005 mfd ......
R401	V-9813	Control, height (1 megohm) ....
R416	RC20AE152K	Resistor, 1500 ohms ½ w. ....
R417	RC20AE392K	Resistor, 3900 ohms ½ w. ....
R433	RC20AE334J	Resistor, 330,000 ohms ½ w. ....
R437	RC30AE332K	Resistor, 3300 ohms 1 w. ....
R439	RC30AE224K	Resistor, 220,000 ohms 1 w. ....
R447	RC20AE392K	Resistor, 3900 ohms ½ w. ....
R461	RC30AE104K	Resistor, 100,000 ohms 1 w. ....
R464	V-5924-2	Resistor, 10,000 ohms 10 w (used when V-9759 HV Trans., T502, is used) ....
R464	RC40AE183K	Resistor, 18000 ohms 2 w. (used when V-9803 HV Trans., T502, is used) ....
R505	RC30AE224K	Resistor, 220,000 ohms 1 w ....
*T502	V-9759	Transformer, high voltage ....

*Some chassis use a V-9803 HV transformer (T502) instead of a V-9759. Only the V-9759 HV transformer is stocked as a replacement. When replacing a V-9803 with a V-9759, refer to note 8 on the V-2150-176U and V-2150-177U chassis schematic.

CHANGES IN V-2150-176 CHASSIS

The schematic diagram, Fig. 8 in the original H-617T12 and H-619T12 service notes, should be altered to include later production changes as follows:

1. Add a fuse between the center tap of the power transformer (T501) and ground, and label the fuse F501.

2. Add a 510,000 ohm resistor in series with R501 and R502 in the H.V. power supply, and label the resistor R506. This reduces heating in the network.

3. Change the capacitance of C427 in the pin 6 plate circuit of the 12AU7 horizontal multivibrator to 330 mmf. This improves the horizontal linearity.

4. Change the resistance of R437 connected between pins 6 and 7 of the 6AU6 AGC tube to 3.3K. This reduces horizontal wobble under strong signal conditions and increases the contrast range.

5. Delete R333 located between the AGC line and ground, and change the resistance of R458 in the AGC line to 10K. These changes improve the signal to noise ratio at medium signal levels. *Note, however, that these changes are effective in medium or low signal areas only. If receiver overload occurs in strong signal areas, R333 should be re-inserted and R458 should be 470K as shown on the schematic.*

In accordance with the preceding information, the parts list in the original H-617T12 and H-619T12 service notes should be altered as follows:

1. Change R303 to read RC40AE472K Resistor, 4700 ohms 2 w.

2. Change C427 to read RCM20C331K Capacitor, 330 mmf

3. Change R437 to read RC30AE332K Resistor, 3300 ohms 1 w.

4. Add the following parts to the list:

R458	RC20AE103M	Resistor, 10,000 ohms ½ w. (see change #5)	$.05
F501	V-6171-4	Fuse, 0.5 amp. 250 v.	.20
R506	V-9016-2514J	Resistor, 510,000 ohms ½ w.	.11

CHANGES IN V-2150-176U AND V-2150-177U CHASSIS

The schematic diagram of the V-2150-176U and V-2150-177U chassis given in supplement #2 to the H-617T12 and H-619T12 service notes should be altered to include production changes as follows:

1. Add a fuse between the center tap of the power transformer (T501) and ground, and label the fuse F501.

2. Add a 680 mmf capacitor connected in parallel with R416 in the cathode circuit of the 12AU7 horizontal multivibrator, and label the capacitor C464.

3. Change the resistance of R463 in the plate supply circuit (pin 1) for the 12AU7 horizontal multivibrator to 47K. This along with the preceding change improves the horizontal sweep stability.

4. Delete R333 located between the AGC line and ground, and change the resistance of R458 in the AGC line to 10K. These changes improve the signal to noise ratio at medium signal levels. *Note, however, that these are effective in medium or low signal areas only. If receiver overload occurs in strong signal areas, R333 should be re-inserted and R458 should be 470K as shown on the schematic.*

In accordance with the preceding information, the following parts should be added to the parts list in supplement #2 to the H-617T12 and H-619T12 service notes:

C427	RCM20B681K	Capacitor, 680 mmf ...
C464	RCM20B681M	Capacitor, 680 mmf ...
R463	RC30AE473K	Resistor, 47,000 ohms 1 w. ....

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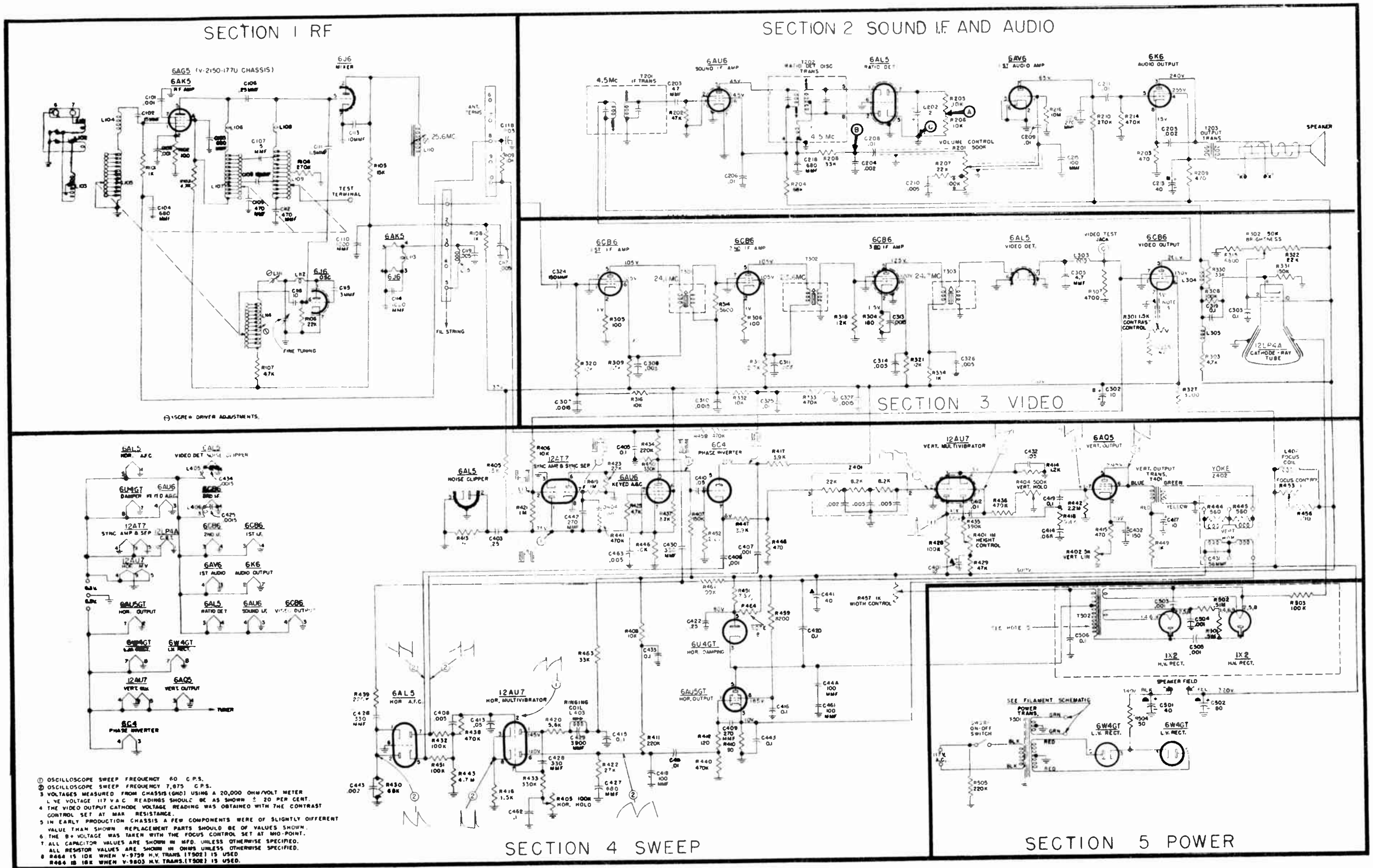
SCHEMATIC DIAGRAM



CHASSIS NO. V-2150-176U & V-2150-177U

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The 22H20/23H22/24H20-21 series of direct view TV receivers have many outstanding features. These include Remote Control, Turret Tuning with replaceable channel strips, main chassis construction using interchangeable sub-chassis and provision for easy addition of Phonevision.

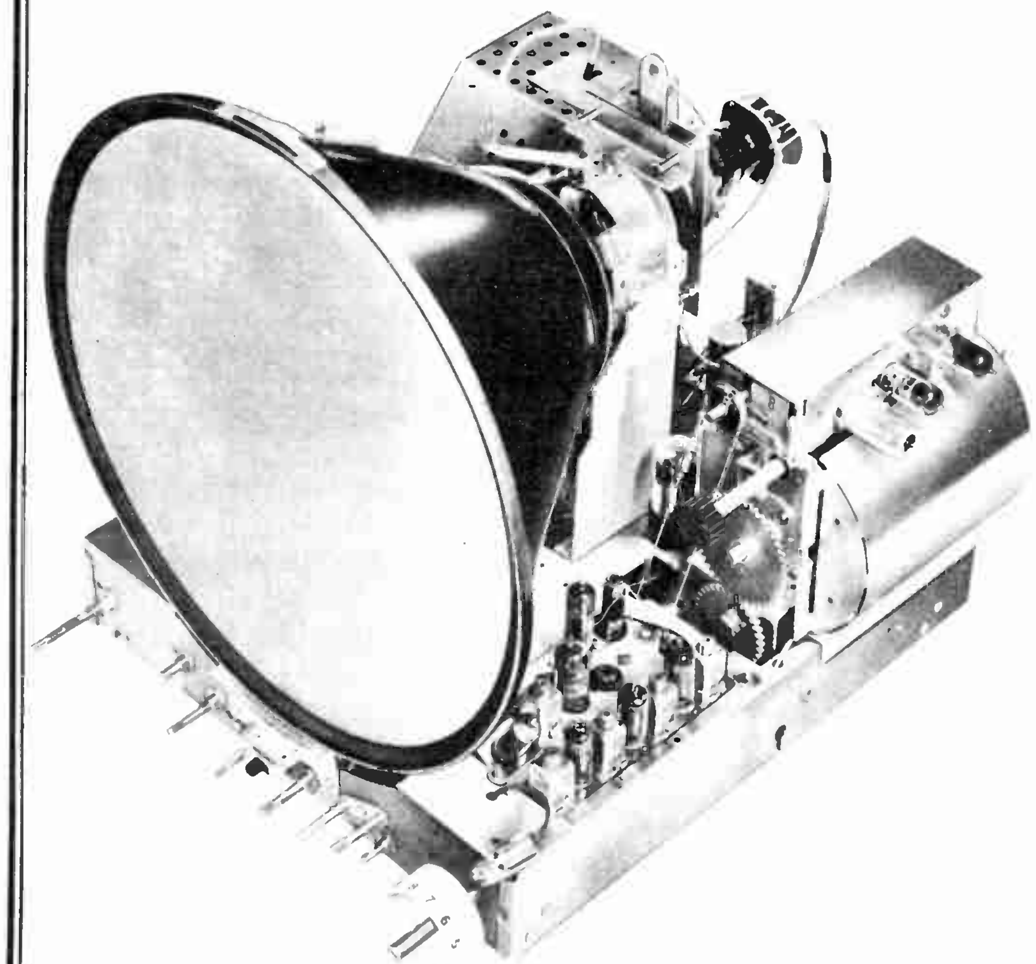
In addition, provisions are made for reception, under present standards, of the new ultra high frequencies by the simple addition of ultra high frequency channel strips as required.

For the convenience of the serviceman, a built-in oscillator adjustment wrench and easily accessible test points are provided for use during alignment and test of the receiver.

Zenith television receivers are being manufactured with the new Glare-Ban "Black" tubes. These tubes are constructed with a special glass containing certain metallic oxides which reduce halations and provide much better contrast.

The etched surface on the picture tube face coupled with the precise tilt of the protective glass, virtually eliminates undesirable reflections from windows, room lights, etc.

On those receivers equipped with the Remote Control Unit, station selection can be made with ease from any point in the room within reach of the 17-foot extension cable.



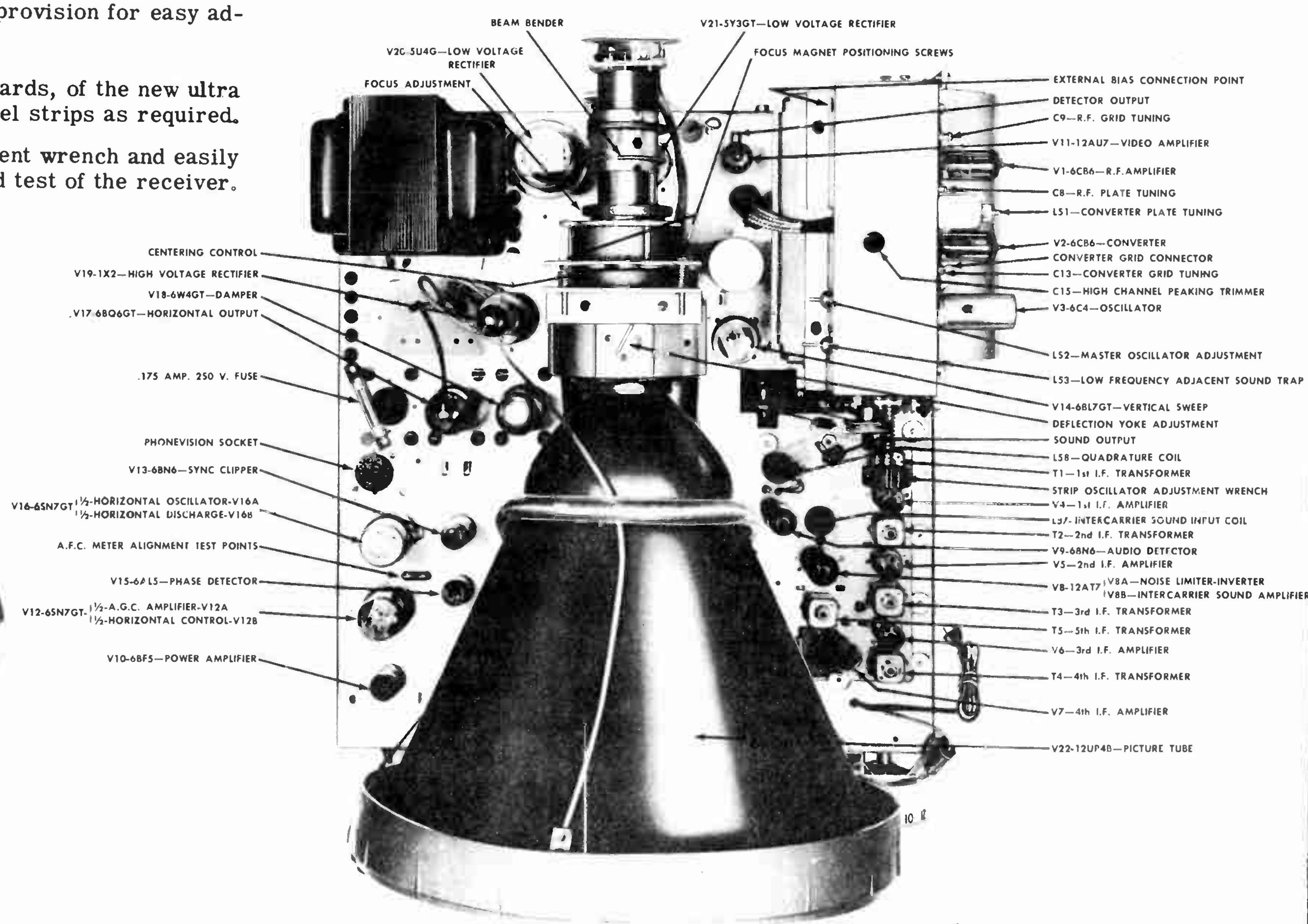


Fig. 1 Top View 22H20 Chassis.

MODELS H2226R, H2227R, H2227E, H2250R, H2255E, Ch. 22H20; H2328EZ, H2328RZ, H2352RZ, H2353EZ, Ch. 23H22Z; H2437E, H2437R, H2438R, H2439R, H2449E, H3267R H3469E, H3475R, Ch. 24H20; H2445R, H2447R, H3477R, H3478E, Ch. 24H21; 23H22

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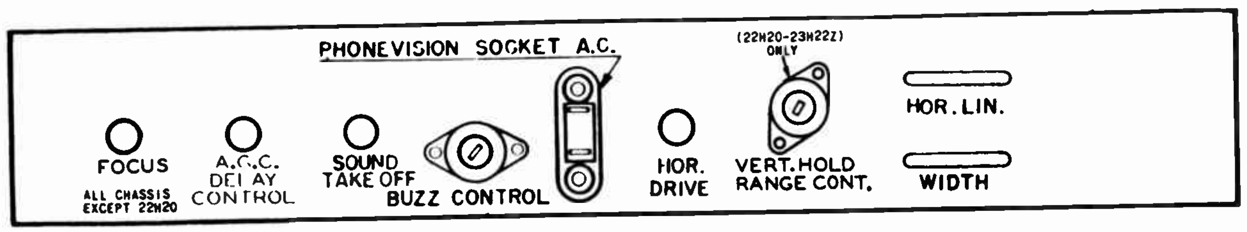
MODEL*	SCREEN	TV CHASSIS	RADIO CHASSIS	SPEAKER	TYPE OF SET
H2226R	12-1/2" Circular	22H20	None	5-1/4"	Table-Mahogany
H2227R	12-1/2" Circular	22H20	None	5-1/4"	Table-Mahog-Pyroxylin
H2227E	12-1/2" Circular	22H20	None	5-1/4"	Table-Blonde-Pyroxylin
H2250R	12-1/2" Circular	22H20	None	10"	Console-Mahogany
H2255E	12-1/2" Circular	22H20	None	10"	Console-Blonde
H2328EZ	16" Rectangular	23H22Z	None	5-1/4"	Table-Blonde
H2328RZ	16" Rectangular	23H22Z	None	5-1/4"	Table-Mahogany
H2352RZ	16" Rectangular	23H22Z	None	10"	Console-Mahogany
H2353EZ	16" Rectangular	23H22Z	None	10"	Console-Blonde
H2437E	16" Circular	24H20	None	10"	Console-Blonde
H2437R	16" Circular	24H20	None	10"	Console-Mahogany
H2438R	16" Circular	24H20	None	10"	Console-Mahogany
H2439R	16" Circular	24H20	None	12"	Console-Mahogany
H2449E	16" Circular	24H20	None	12"	Console-Blonde
H2445R	19" Circular	24H21	None	10"	Console-Mahogany
H2447R	19" Circular	24H21	None	10"	Console-Mahogany
H3267R	16" Circular	24H20	8H20	12"	Radio-Ph.-TV-Mahog.
H3469E	16" Circular	24H20	10H20	12"	Radio-Ph.-TV-Blonde
H3475R	16" Circular	24H20	10H20	12"	Radio-Ph.-TV-Mahog.
H3477R	19" Circular	24H21	10H20	12"	Radio-Ph.-TV-Mahog.
H3478E	19" Circular	24H21	10H20	12"	Radio-Ph.-TV-Blonde

*All model numbers with the suffix letter "Q" identify receivers equipped with the S17268 Remote Control Unit.

Power Consumption: 22H-Series 225 Watts; 23H-Series 250 Watts; 24H-Series 275 Watts

Antenna Impedance - 300 Ohms

Power Supply - 110 V 60 Cycles AC
Audio Output-TV Undistorted 1.8 Watts
Maximum 3.2 Watts



CONTROLS AT REAR OF CHASSIS

CONTROLS AND FUNCTIONS

Location of the various receiver controls is shown in Fig. 2 After the receiver has been properly adjusted, the serviceman should remove the Horizontal Hold, Brightness, Fine Tuning, Vertical Hold, and Contrast Control knobs and re-position them so that the white dot stamped on the outer edge of each knob faces upward. (As in Fig. 2). The positioning of the knobs will aid the customer in resetting the controls should they be accidentally moved. A brief description of each control follows:

CHANNEL SELECTOR SWITCH: Switches into operating position the pre-tuned RF strip for reception of the particular channel desired.

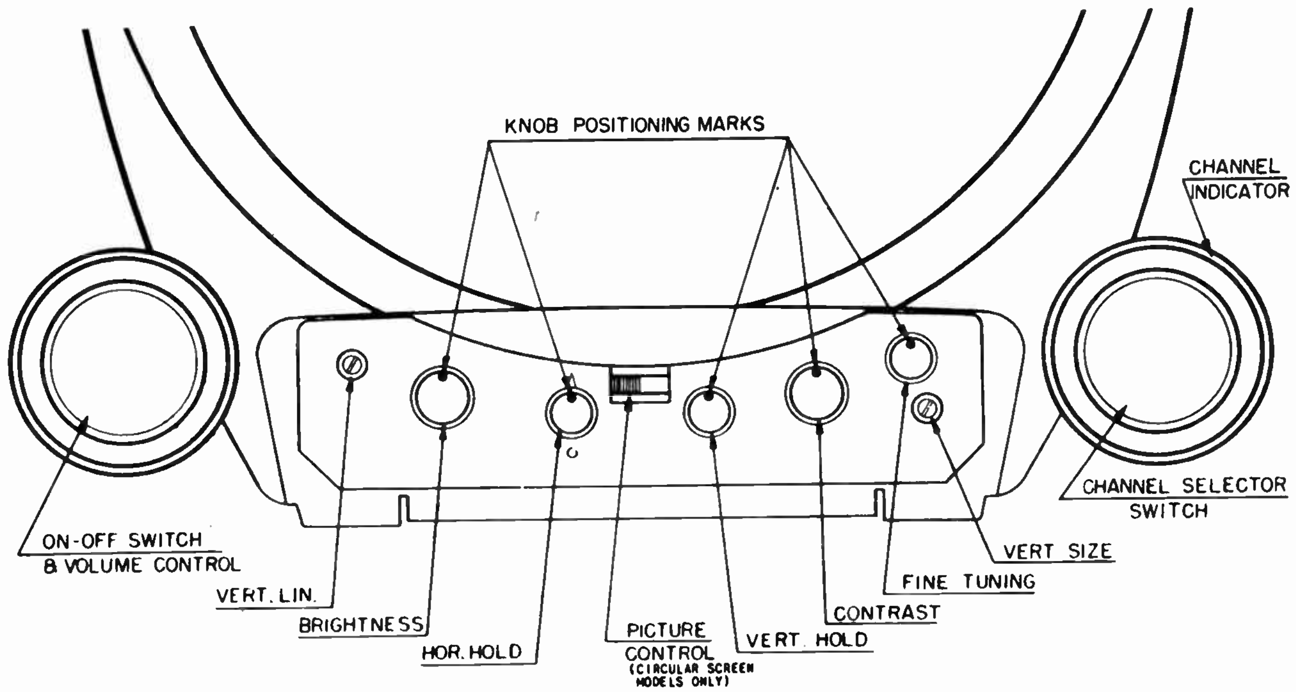
FINE TUNING CONTROL: Provides a means of varying the frequency of the local oscillator to compensate for any frequency deviation which may result from tube and circuit variations. In operating this control it will be found that the range of sound is quite broad. Proper setting is the point where the best picture is obtained within the range of best sound.

VERTICAL HOLD CONTROL
VERTICAL HOLD RANGE CONTROL: The combination of these controls provide a means of changing the cathode resistance of the vertical oscillator to effect synchronization of the vertical sweep with the transmitted sync pulses. Adjustment is made by setting the vertical hold control in the center of its range and adjusting the vertical hold range control for proper sync. Improper adjustment will cause the picture to "roll" vertically.

BRIGHTNESS CONTROL: Controls the cathode voltage of the picture tube to afford control of picture brilliance. Must be operated in conjunction with the Contrast Control for maximum picture clarity.

CONTRAST CONTROL: Control is in the plate circuit of the 12AU7 second video amplifier. It regulates the magnitude of video signal applied to the picture tube.

PICTURE CONTROL SWITCH: The Picture Control Switch changes the magnitude of the sweep voltage into the vertical deflection coils thereby allowing the choice of either a Giant Circle or "conventional" picture.



FRONT PANEL CONTROLS

Fig. 2 Controls

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HORIZONTAL HOLD CONTROL: The Horizontal Hold Control is used to tune the horizontal oscillator to the frequency of the transmitted sync pulses.

VERTICAL SIZE CONTROL: The Vertical Size Control is part of the vertical oscillator plate load. It is used in conjunction with the vertical linearity control to adjust the size of the picture vertically.

VERTICAL LINEARITY CONTROL: The Vertical Linearity Control is in the cathode circuit of the vertical output tube and is used to shift the operating point of the tube so that the sweep is amplified along that portion of the plate current curve which results in a linear output.

HORIZONTAL DRIVE CONTROL: Regulates the magnitude of the horizontal sweep voltage applied to the grid of the horizontal output tube. Care must be exercised not to advance this control to a point where the right side of picture begins to fold.

HORIZONTAL LINEARITY CONTROL: The Horizontal Linearity Control should be adjusted for best horizontal symmetry while observing a test pattern on the screen. The position of the horizontal drive and width controls also affect linearity and possible interaction of these controls must be taken into consideration when making linearity adjustments.

WIDTH CONTROL: A variable inductance L75 shunted across a portion of the secondary winding of the horizontal output transformer T14. Varying this shunt inductance changes the magnitude of the sweep voltage across the horizontal deflection coils thus causing the picture to widen or narrow accordingly.

FOCUS CONTROL: (22H20) A mechanical shunt which regulates the flux density of the ring type permanent magnet to effect proper focus.

FOCUS CONTROL: (23H & 24H series) A combination electro-permanent magnet is used. Focus is accomplished electrically by adjustment of the Focus Control at the rear of the chassis.

TUBE COMPLEMENT CHASSIS 22H20 - 23H22* - 23H22Z*

SYMBOL	TUBE	FUNCTION
V1	6CB6	RF Amplifier
V2	6CB6	Converter
V3	6C4	Oscillator
V4	6AU6	1st IF Amplifier
V5	6AU6	2nd IF Amplifier
V6	6AU6	3rd IF Amplifier
V7	6AU6	4th IF Amplifier
V8	12AT7	V8A Noise Limiter Inverter V8B Intercarrier Sound Amp.
V9	6BN6	Sound Detector and Limiter
V10	6BF5	Audio Output
V11	12AU7	V11A 1st Video Amplifier V11B 2nd Video Amplifier
V12	6SN7GT	V12A AGC Amplifier V12B Horizontal Control
V13	6BN6	Sync Clipper
V14	6BL7GT	V14A Vertical Oscillator V14B Vertical Output
V15	6AL5	Phase Detecter
V16	6SN7GT	V16A Horizontal Oscillator V16B Horizontal Discharge
V17	6BQ6GT	Horizontal Output
V18	6W4GT	Damper
V19	1X2	High Voltage Rectifier
V20	5U4G	Low Voltage Rectifier
V21	5Y3GT	Low Voltage Rectifier
V22	12UP4B	Picture Tube

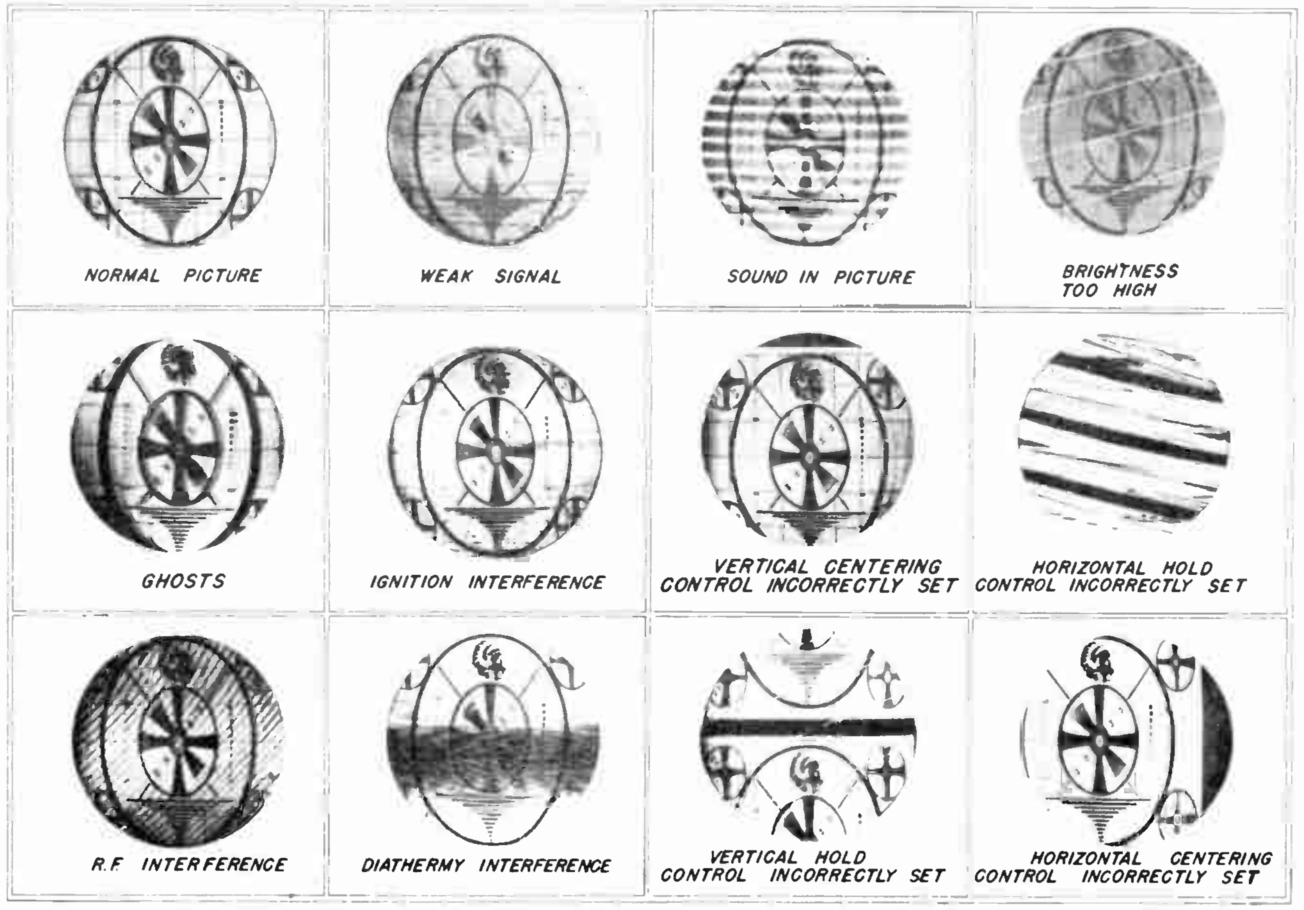
*Tube complement same as for 22H20 chassis except that V22 is a 17BP4 and two 6BQ6GT tubes are used in the horizontal output circuit. Chassis 23H22Z is the same as 23H22 except that V22 is a 16TP4. V19 on 23H22 and 23H22Z chassis can be 1X2 or 1B3GT.

TUBE COMPLEMENT CHASSIS 24H20 - 24H21*

SYMBOL	TUBE	FUNCTION
V1	6CB6	RF Amplifier
V2	6CB6	Converter
V3	6C4	Oscillator
V4	6AU6	1st IF Amplifier
V5	6AU6	2nd IF Amplifier
V6	6AU6	3rd IF Amplifier
V7	6AU6	4th IF Amplifier
V8	12AT7	V8A Noise Limiter Inverter V8B Intercarrier Sound Amp.
V9	6BN6	Sound Limiter Detector
V10	6BF5	Audio Output
V11	12AU7	V11A 1st Video Amplifier V11B 2nd Video Amplifier
V12	6SN7GT	V12A AGC Amplifier V12B Horizontal Control
V13	6BN6	Sync Clipper
V14	6SN7GT	Vertical Oscillator
V15	6SN7GTA	Vertical Output
V16	6AL5	Phase Detector
V17	6SN7GT	V17A Horizontal Oscillator V17B Horizontal Discharge
V18	6BQ6GT	Horizontal Output
V19	6W4GT	Damper
V20	1B3/8016	High Voltage Rectifier
V21	5U4G	Low Voltage Rectifier
V22	5Y3GT	Low Voltage Rectifier
V23	16GP4	Picture Tube
V24	6BQ6GT	Horizontal Output

*Same as 24H20 except V23 is 19AP4A

TEST PATTERNS ON CIRCULAR SCREEN MODELS



CHANNEL	FREQ BAND	PICTURE CARRIER	SOUND CARRIER	RECEIVER LOCAL OSCILLATOR
1				
2	54-60-MC	55.25 MC	59.75 MC	101 MC
3	60-66	61.25	65.75	107
4	66-72	67.25	71.75	113
5	76-82	77.25	81.75	123
6	82-88	83.25	87.75	129
7	174-180	175.25	179.75	132.5
8	180-186	181.25	185.75	138.5
9	186-192	187.25	191.75	144.5
10	192-198	193.25	197.75	150.5
11	198-204	199.25	203.75	156.5
12	204-210	205.25	209.75	162.5
13	210-216	211.25	215.75	168.5

Fig. 3 Television Channels and Corresponding Receiver Oscillator Frequencies.

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ADJUSTMENTS AND ALIGNMENT

FOCUS AND CENTERING ADJUSTMENTS

The 22H series receivers incorporate mechanical means of centering and focusing while the 24H series utilize mechanical centering and electrical focus.

The centering control lever is used for centering the picture both vertically and horizontally. An up-down movement of the lever moves the picture horizontally while a left-right movement shifts it vertically.

Complete focus, centering and beam bender adjustments are made as follows:

1. Loosen the deflection yoke adjustment locknut (See Fig. 4) and move the yoke as far as possible toward the front of the picture tube. Check for picture tilt and tighten locknut.

2. Adjust the magnet positioning screws until the assembly is approximately 1/8" from the yoke. Be certain that the focus coil sleeve is inserted inside the magnet assembly for proper mechanical centering of the picture tube.

3. Set the centering lever to a position where the locking screw is centered inside its slot.

4. Rotate and slide the beam bender along the neck of the tube for a raster of maximum brilliance. (The beam bender has an identifying arrow which must point towards the front of the picture tube when installed. On double ring type beam benders, the air gaps should be 180° removed with the heavier ring nearest the picture tube socket.)

5. Adjust the focus shunt ring (22H series only), or the focus control for sharpest picture definition.

6. With the centering lever, center the picture vertically and horizontally. A slight readjustment of the beam bender may be necessary to obtain a full raster of maximum brilliance.

After adjustments are made, tighten the centering lever locknut.

BULLS EYE TUNER ADJUSTMENTS

With an intercarrier receiver of this type, a VTVM cannot be effectively used as a resonance indicator when oscillator adjustments are made with the built-in wrench.

Satisfactory adjustments can be made by setting the fine tuning control in the center of its range, observing a test pattern and adjusting the oscillator for best sound and picture. It will be noted that tuning to one side of resonance results in a faded, washed-out picture with the spacings between the wedge lines fogged and tuning in the opposite direction causes the spaces

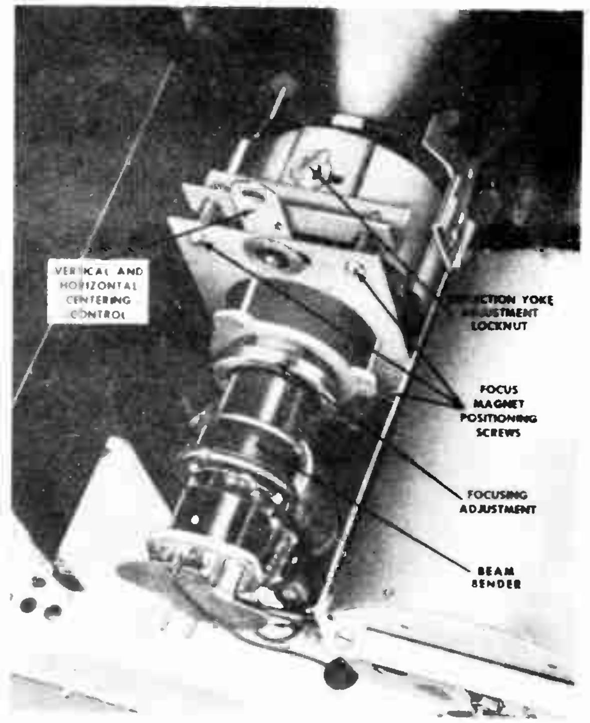


Fig. 4 Adjustments on Neck of Picture Tube.

between the lines to clear up. However, going beyond this point causes the picture to take on a "wormy" appearance from sound getting into the picture. Correct adjustment is obtained by tuning to the "wormy" picture and then backing the control off slightly until the picture clears up.

AFC ADJUSTMENTS

The AFC adjustment can effectively be made by setting the horizontal hold control (L74) to a position where it is virtually impossible to "throw" the receiver out of horizontal sync when switching from channel to channel.

AGC ADJUSTMENTS

Connect the calibrated oscilloscope through a 10K isolation resistor to the grid (Pin 7) of the 12AT7 limiter-inverter. Select the strongest TV signal and observe the deflection on the scope screen. Adjust the AGC delay control R50 for 2.5V peak output.

Satisfactory adjustment can also be made by observing the picture and backing off the AGC control from its maximum clockwise position to a point comfortably below the level of intercarrier buzz, picture distortion, improper sync or excessive contrast at maximum contrast setting.

CAUTION: Misadjustment of the AGC delay control can result in a washed-out picture, distorted picture, buzz in sound OR COMPLETE LOSS OF PICTURE AND SOUND.

SOUND ALIGNMENT

Proper alignment of the 4.5 Mc intercarrier sound channel can only be obtained if the signal to the receiver antenna terminals is reduced to a level below the limiting point of the 6BN6 Gated Beam Detector. This level can be easily identified by the "hiss" which then accompanies the sound.

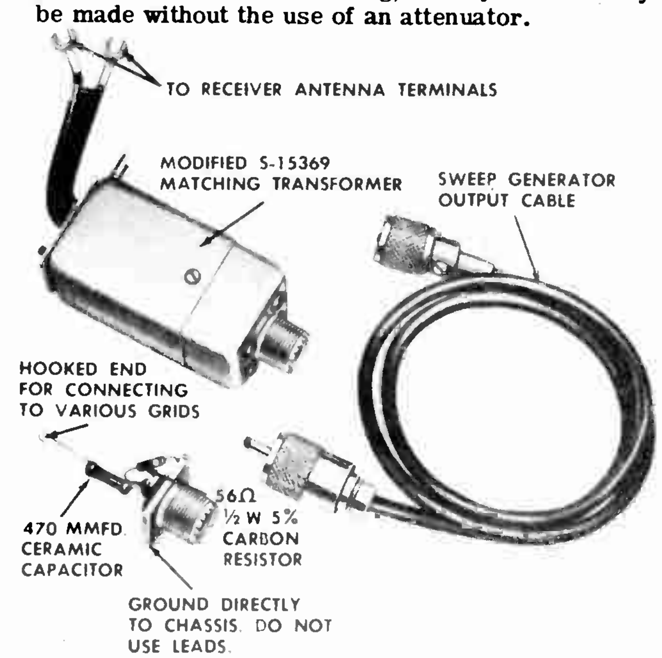
Various methods may be used to reduce the signal level, however, it is recommended that a S17203 step attenuator be used for most satisfactory results. To prevent leakage, certain precautions must be taken when connections are made. Use as short a lead as possible between the attenuator and receiver antenna terminals and approximately 6 feet of 300 ohm shielded line between the antenna transmission line and the attenuator. The shield from the transmission line should be connected to the attenuator and the attenuator itself grounded to the TV chassis under test.

After the connections are made, proceed as follows:

1. Tune in a tone modulated TV signal and adjust the step attenuator until the signal is reduced to a level where "hiss" is heard with the sound.

2. Adjust the sound take-off coil L60, input coil L57, quadrature coil L58 and buzz control R19 for the cleanest sound and minimum buzz. It must be remembered that any of these adjustments may cause the "hiss" to disappear and further reduction of the signal is necessary so that the "hiss" never disappears during alignment.

In weak signal areas, where the signal amplitude is not sufficient to cause limiting, the adjustments may be made without the use of an attenuator.



If intercarrier buzz is in evidence, after all normal sound adjustments have been made, the cause may be attributed to one or more of the following.

1. Improper adjustment of the AGC delay control.
2. Defective 12AT7 inverter-limiter tube.
3. Extremely high signal levels which require attenuation in the antenna circuit.
4. Transmitter overmodulation.

CALIBRATING THE OSCILLOSCOPE

When aligning RF-IF stages and when making AGC adjustments, it is necessary to measure detector peak output voltage. This may be done with an oscilloscope which has been calibrated with a known DC voltage. To calibrate any oscilloscope proceed as follows:

Connect the ground lead of the scope vertical input cable to the negative side of a 3 volt battery supply. Turn the horizontal gain control fully counter-clockwise. With the "hot" lead, make a momentary contact to the positive connection on the battery and observe the instantaneous spot deflection on the screen. Discharge the scope input capacitor by shorting out the leads and then repeat the procedure, each time readjusting the scope vertical gain until the spot deflects 3 large divisions on the screen. Each division will then represent 1 volt peak. The position of the vertical gain control must be noted for future reference.

IF ALIGNMENT

When aligning the 40 Mc IF, it is of utmost importance to keep the sweep generator connections as short as possible. (See Fig. 5). Clip the negative lead of a 4.5V battery to test point "A" and the positive lead to chassis. Connect the oscilloscope to the grid (Pin 7) of the 12AT7 limiter-inverter through a 10K isolation resistor. During alignment keep the output from the sweep generator at a level which develops approximately 3V peak output at the detector as viewed on the calibrated oscilloscope. It is important that the voltage be maintained at this 3V level.

After the bias and scope connections have been made and the receiver allowed a 15 minutes warm-up period, proceed as follows:

1. Feed the output from the sweep generator through a connector, as shown in Fig. 5, into the converter grid (terminal "F"). This terminal is immediately adjacent to the 6CB6 converter tube.

2. Remove oscillator tube V3 and switch channel selector to channel 12.

3. Adjust the IF transformers to obtain an overall pattern of maximum amplitude with linearity, similar to the illustration in Fig. 6. It will be noted that adjustment of L51, T1 and T3 will have maximum effect on the low frequency portion of the pattern (42.75 - 43.5 Mc) whereas adjustment of T2 and T4 will have

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maximum effect on the high frequency side (45.75 and 45 Mc.) T5 tilts the top and is adjusted to obtain best symmetry.

After the correct overall pattern is obtained, turn the channel selector to channel 2 and inject a 47.25 Mc marker into the sweep. Adjust the low channel adjacent sound trap L53 for minimum indication on the scope or on a VTVM connected to the video detector.

4. Feed a 4.5 Mc crystal calibrated signal to terminal "C" Fig. 20 and connect the RF probe of a VTVM to the cathode (Pin 11) of the picture tube. Advance the contrast control for approximately 1 volt indication on the meter and adjust trap L63 for minimum indication.

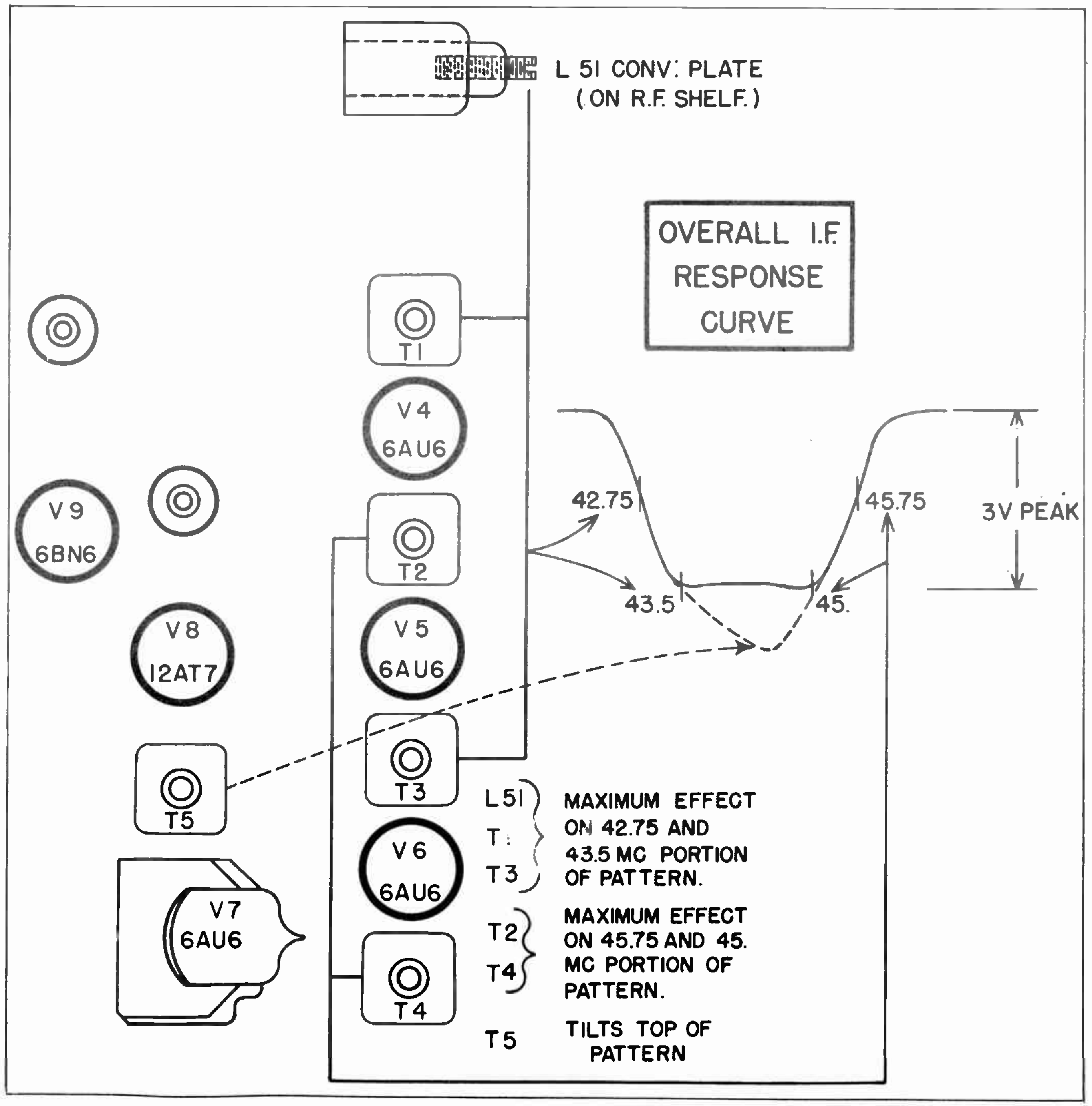

Fig. 6 IF Alignment Guide

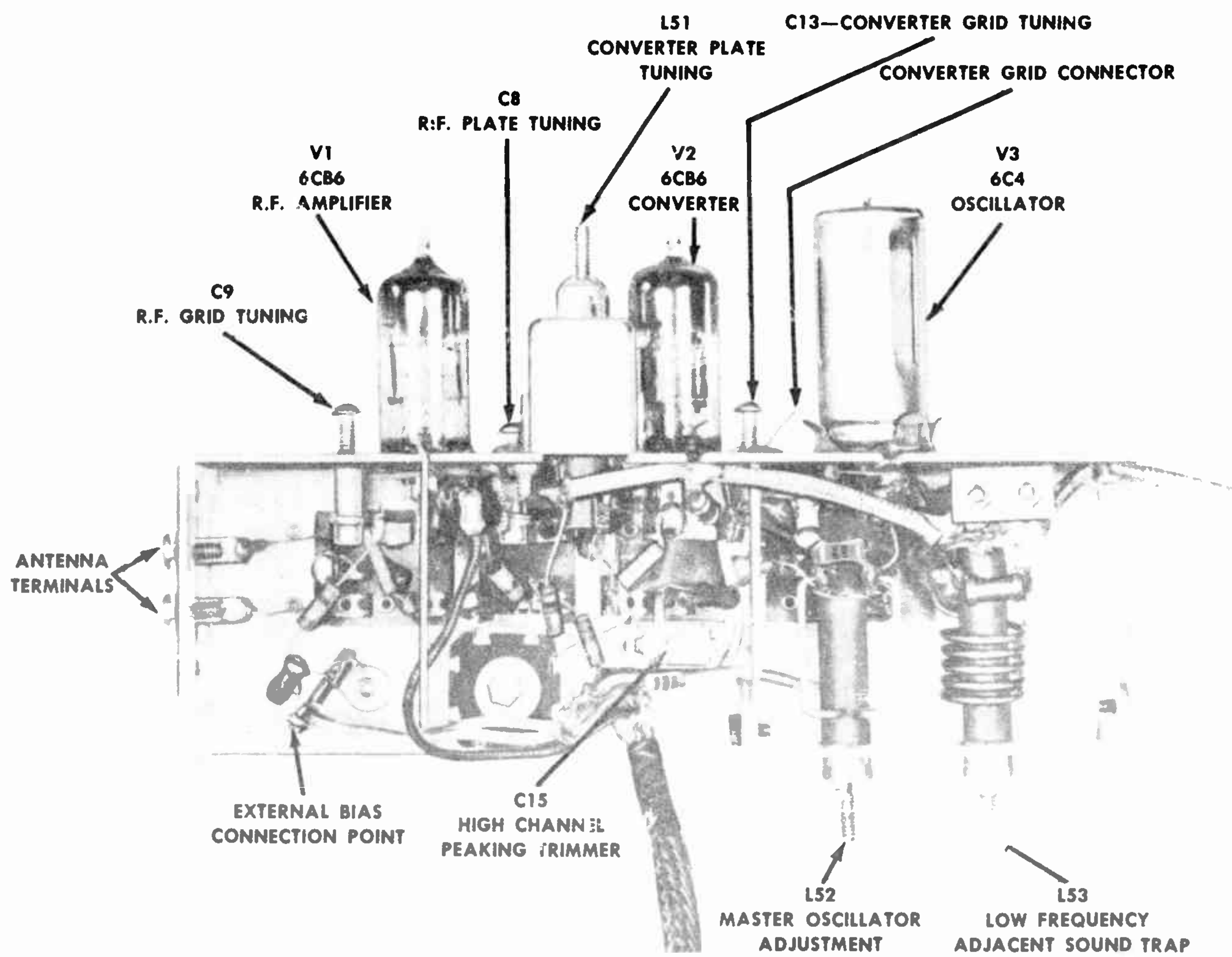

Fig. 7 RF Shelf

MASTER OSCILLATOR ALIGNMENT

The 6C4 master oscillator operates above the incoming frequency on the low channels (2-6) and below on the high channels (7-13). Slug L52 is used to pre-set the master oscillator on channel 7 since the channel 7 strip itself does not have an oscillator adjustment.

The master oscillator adjustment is to be made only if resonance cannot be obtained with the strip oscillator adjustment wrench when the fine tuning control is in its center position (open end of pulley on the RF shelf facing up) and after it has been determined that the channel strip itself is not at fault.

Although it is possible to set the master oscillator L52 by tuning in a station and alternating the master and strip oscillator adjustments until proper tuning results, the use of the Mega-Sweep and Mega-Marker Sr. is preferred. The Mega-Marker Sr. is provided with crystals for the sound carrier frequencies of all 12 existing channels. The sound carrier frequencies can be used in adjusting the master oscillators, however, it is recommended that the Mega-Marker Sr. be equipped with a crystal for the picture carrier frequency for channel 7 (175.25 Mc). This crystal may be inserted into one of the extra positions and adjustments made as follows:

1. Connect the negative lead of a 4.5V battery to point "A" (See Fig. 20) and the positive lead to chassis.

2. Feed the signal generator through a S-15369 matching transformer to the antenna terminals of the receiver. Fig. 5.

3. Set the channel selector to channel 7 and turn the fine tuning control until the open end of the RF shelf pulley faces upward.

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4. Adjust the sweep generator for an RF response curve (similar to Fig. 6). Set the Mega-Marker Sr. on channel 7 and observe the video marker on the response curve. Adjust L52 until this marker falls at approximately 50% on the response curve.

In adjusting the master oscillator on the sound carrier frequency for channel 7, the above procedure is followed, with the exception that the sound marker is placed at approximately 20 times down on the response curve.

TURRET TUNER AND RF SHELF ALIGNMENT

The RF shelf adjustments are made at the factory and normally do not require readjustment unless the unit has been tampered with. If adjustments become necessary, they are made as follows:

1. Connect the negative lead of a 4.5V bias supply to point "A" (See Fig. 20) and the positive lead to chassis. Connect the oscilloscope through a 10K isolation resistor to terminal "C" and chassis.

2. Feed the output of the Mega-Sweep through a S-15369 matching transformer to the antenna terminals of the receiver.

3. Adjust the Mega-Sweep and check the RF response curve (See Fig. 6) on each channel. If all the response curves are tilted approximately the same amount, first check the IF response to see that it has a reasonably flat top (See Fig. 6) before an attempt is made to adjust the RF trimmers. If the IF response is correct, set the channel selector switch to channel 4 and adjust the RF grid (C9), RF plate (C8), converter grid (C13) for symmetry and amplitude of the response curve.

4. If the receiver sensitivity is satisfactory on the low channels (2 to 6) and is down on the high channels, adjust the high channel peaking trimmer (C15) for maximum sensitivity with band pass.

SERVICE HINTS

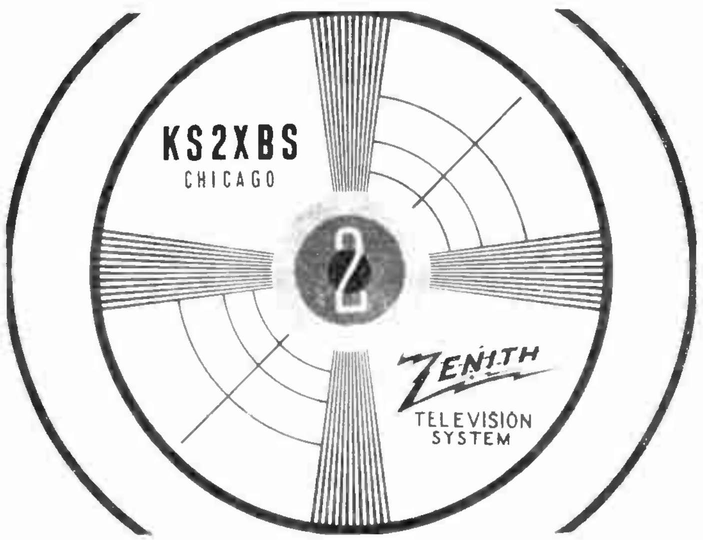
FRINGE RECEPTION - Vertical synchronization in weak signal areas may be improved by lowering the value of the resistor in the grid circuit of the sync clipper from its normal 1 Meg. value. Values as low as 10,000 ohms may be used, however, care must be exercised as too great a reduction of this resistance may introduce horizontal distortion into the picture on some signals.

POOR VERTICAL LINEARITY - (22H20 - 23H22Z) If this condition cannot be corrected by adjustment of the vertical linearity and height adjustments, the fault will probably lie in a defective 6BL7GT vertical sweep tube.

S-17268 REMOTE CONTROL UNIT - Locking of the manual control can be caused by failure of the worm drive gear to disengage. This condition can be the result of a weak solenoid armature actuating spring or misalignment of the magnet mounting bracket. It will be noted that the solenoid mounting bracket has slotted mounting holes which allows for horizontal as well as vertical alignment. Improper seating of the solenoid clapper plate on the magnet core will cause excessive buzz.

IMPORTANT: Any receiver equipped with the remote control unit must be perfectly "bulls eyed" to insure its most satisfactory operation with the remote control unit.

TESTING GERMANIUM CRYSTALS - If, after all normal adjustments have been made, the picture appears washed out, the cause may be low detector output due to a defective germanium crystal. The crystal may be disconnected and tested with an ohmmeter for front-to-back ratio. The resistance in one direction should be lower than 400 ohms and at least 25 times this resistance (10,000 ohms) or higher in the other direction. Any ratio less than 25 to 1 would indicate a below standard crystal.



Rectangular Screen Models properly adjusted on Test Pattern.

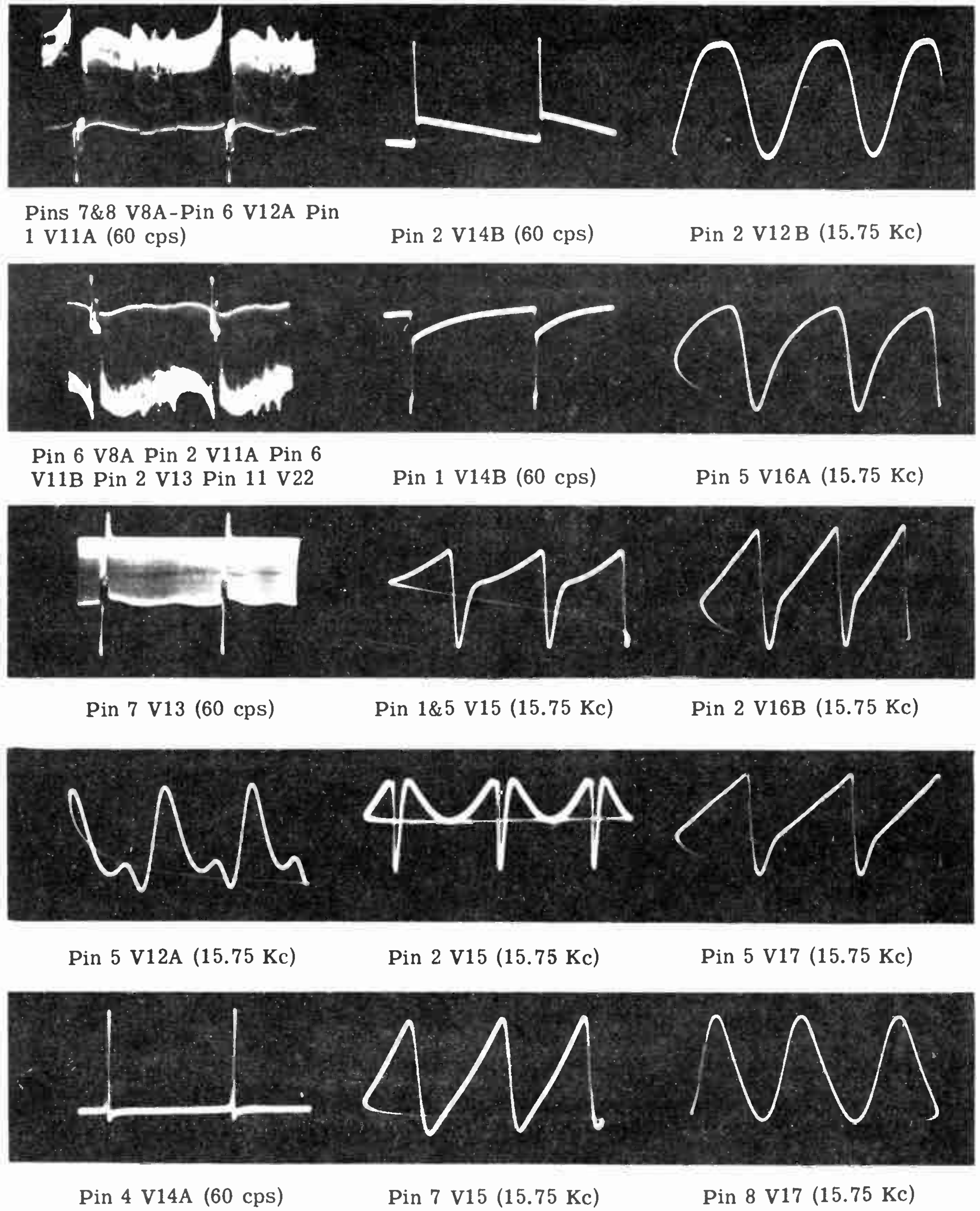


Fig. 8 Wave Forms 22H20 Chassis. Also representative for 23H22Z and 24H20-21 Chassis.

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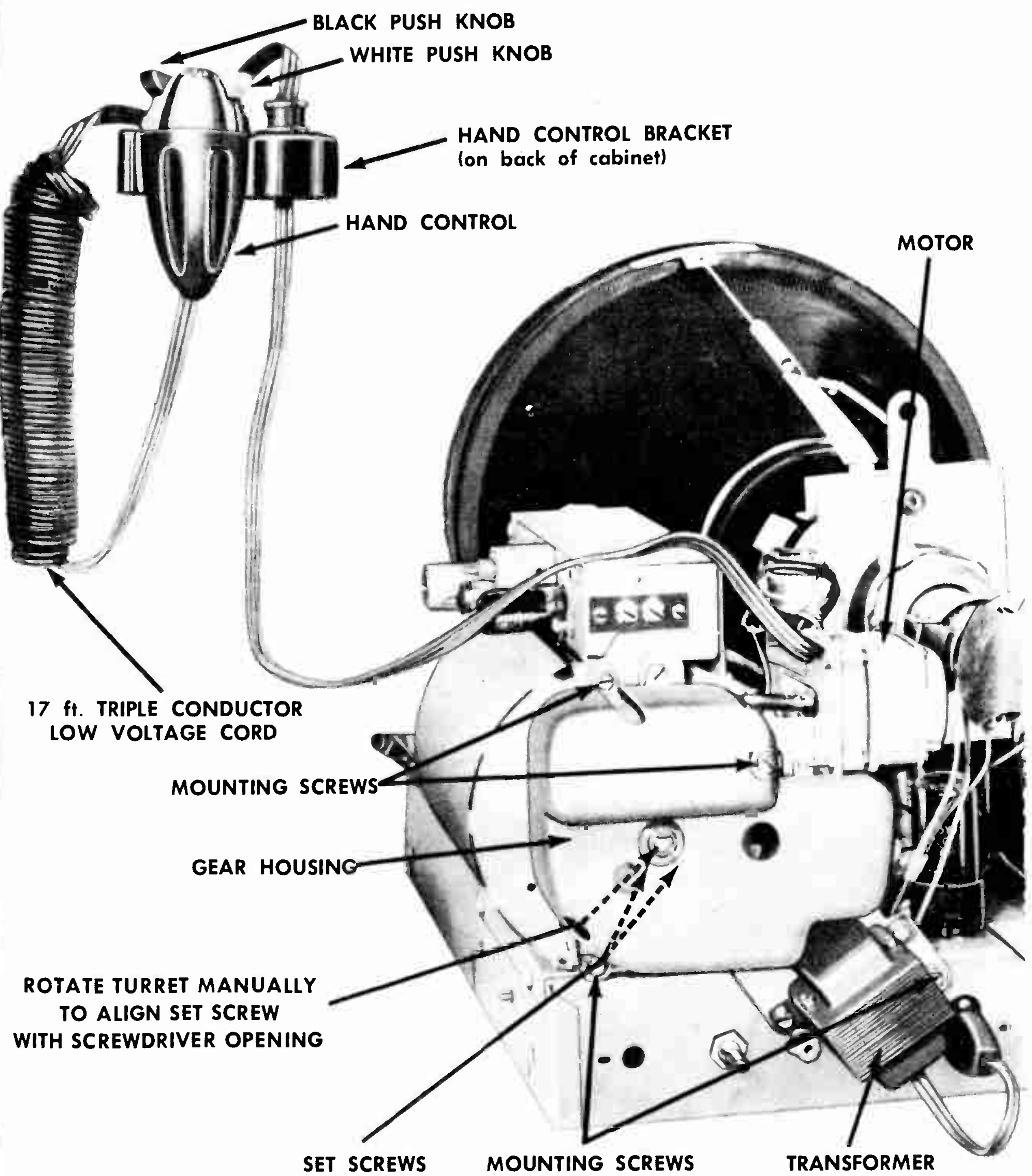

Fig. 9 Remote Control Unit.

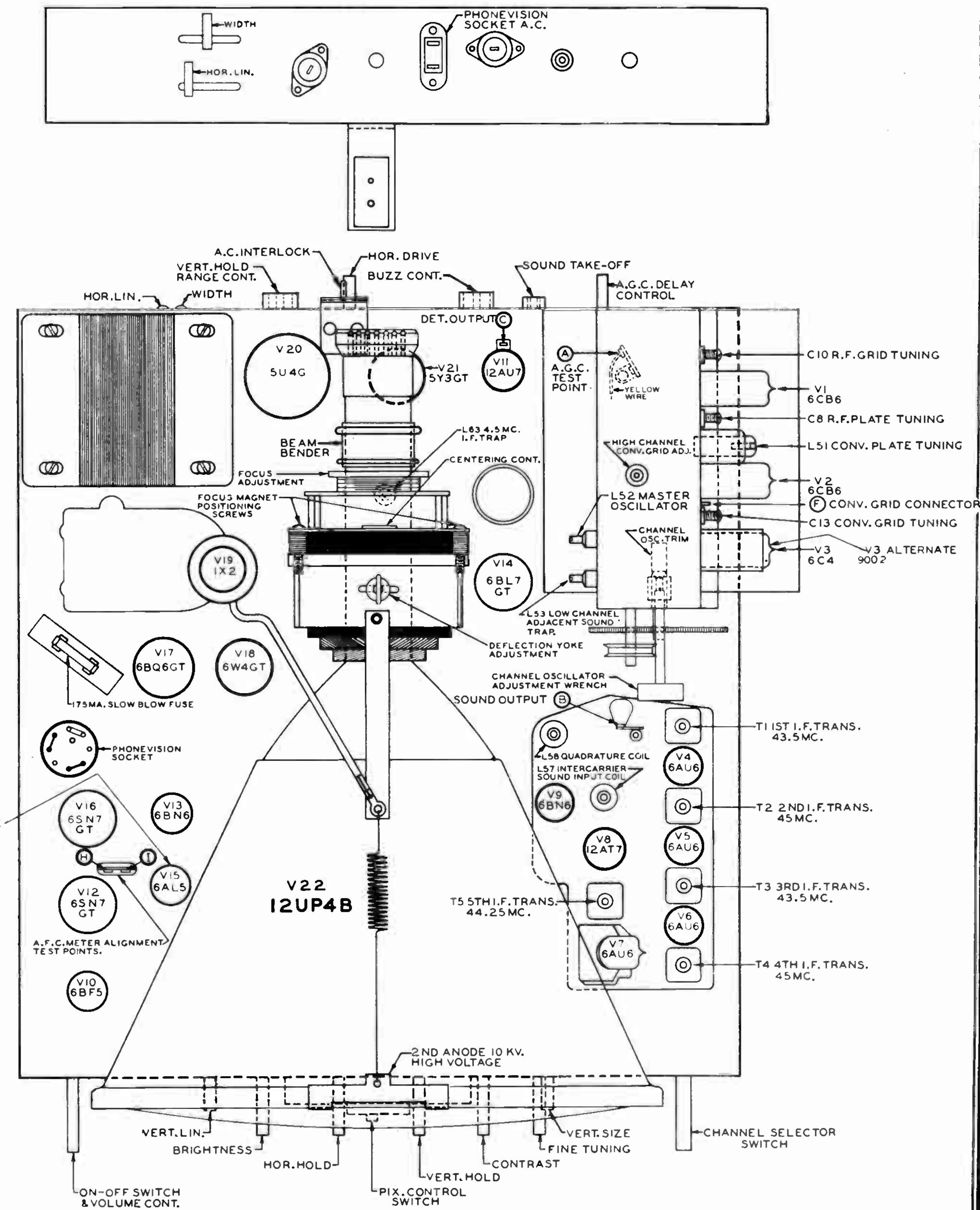

Fig. 10 Tube and Trimmer Layout 22H20 Chassis.

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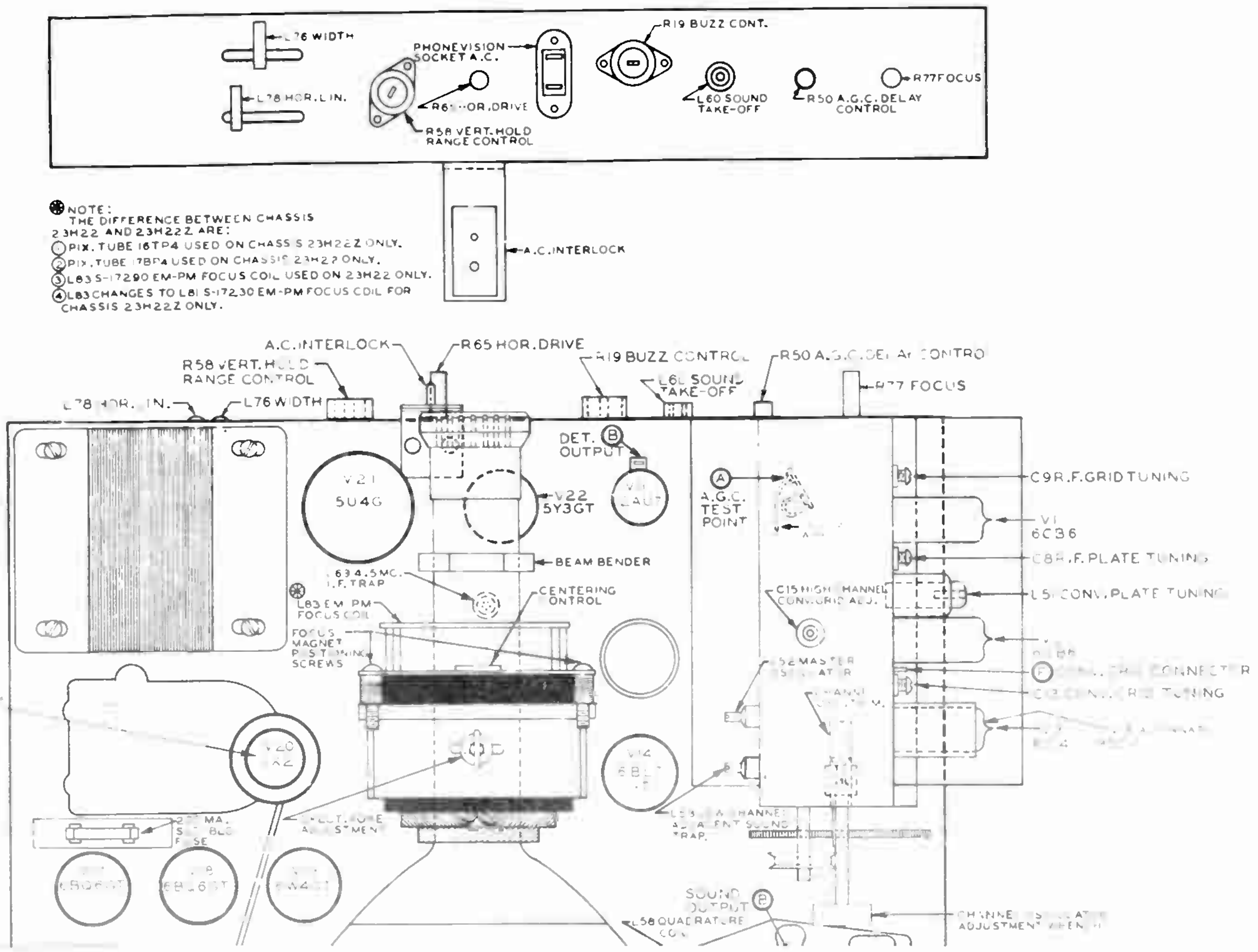
CHASSIS 22H20, 23H22, 23H22Z, 24H20, 24H21



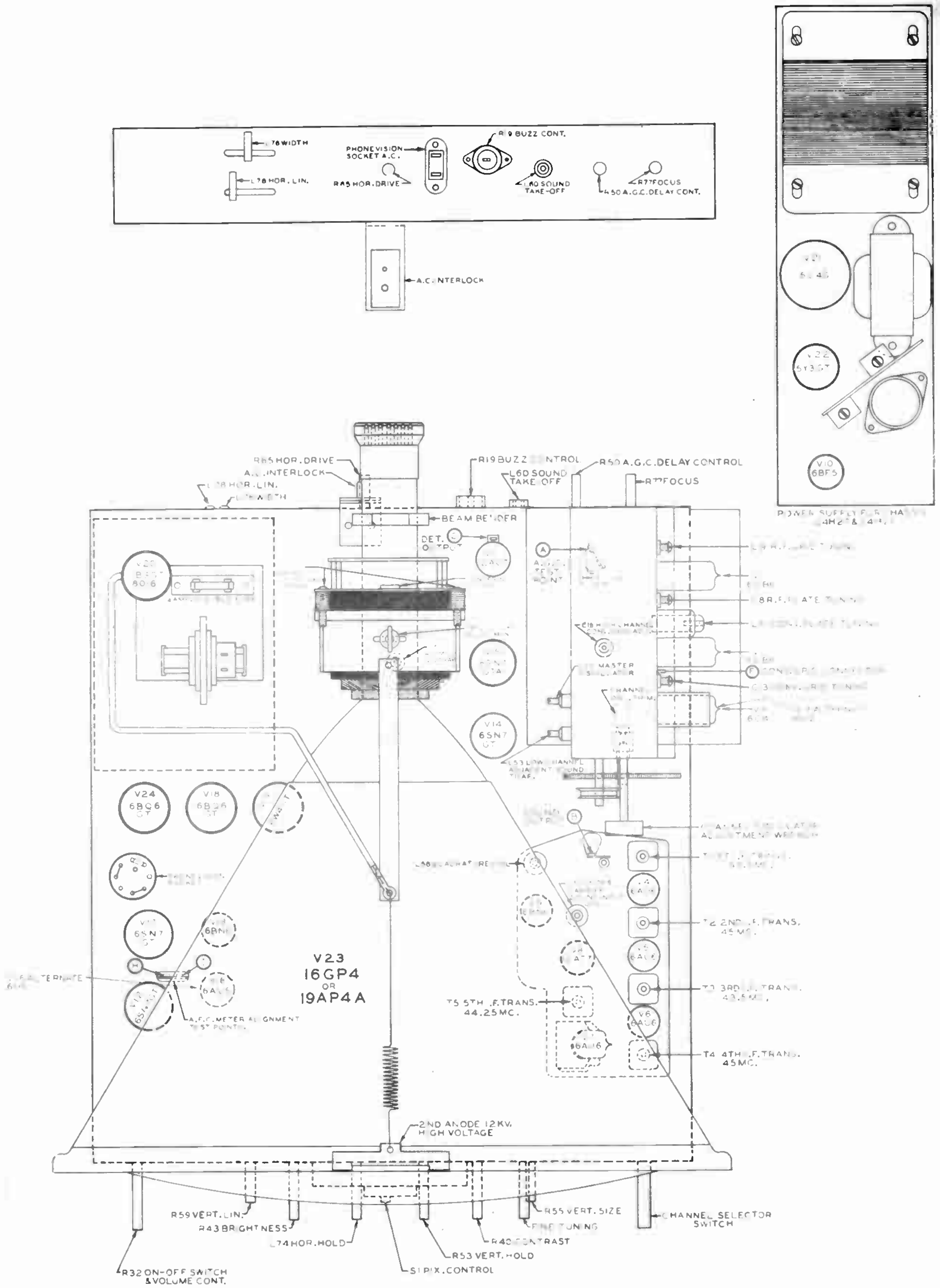


Fig. 12 Tube and Trimmer Layout 24H20-21 Chassis.

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DESK CALENDARS

Style	Number	Size	Description	Refill Pads only Style	Refill Pads only Number
P 422	SD-466	4" x 6¾"	Walnut or steel gray plastic base with rubber feet. Pad has date, past, current and following month on each sheet. 12-month calendar at top.	Perfection 42	SD-460*
P 522	SD-524	5" x 8"	Walnut or steel gray plastic base with rubber feet. Pad has date, past, current and following month on each sheet. 12-month calendar at top.	Perfection 52	SD-570*

DIARIES

Number	Size	Description
648	4½" x 2¾"	Dark blue leather, 22 carat gold stamped. 1 week to each opening. Blue bond pages, gold edged.
385	6⅞" x 4¼"	Red moire cloth, full bound. 1 day to page. A to Z index in front. Faint line ruled, white ledger paper.
387	7⅞" x 5½"	"
389	9" x 6⅛"	"
900	6⅞" x 4¼"	Blue imitation leather, stiff covers. 1 day to page. Ruled for half-hour appointments.
949	7⅞" x 5½"	Black Levant leather, flexible covers, gold edges. 1 day to page, ruled for quarter-hour appointments.
354	13¾" x 8½"	Red back and corners, black cloth sides. Stiff covers. Year in gold on backbone. 1 day to page. Die-cut A to Z index in front. Faint line ruled white ledger pages with green edges.

*Add letter "G" for 23 carat gold edges instead of mottled edges.

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Fig. 13 Circuit Legend.

CIRCUIT LEGEND

DIAG. NO.	PART NO.	DESCRIPTION	CHANNEL STRIPS	R.F. SHELF	I.F. STRIP	MAIN CHASSIS	POWER SUPPLY
C1	22-1894	8 MMF. 500 V.	ABCD				
C2	22-1879	1-7.5 MMF. Slug Tuned Cap.	ABCD				
C3	22-1951	4.5 MMF. 500 V.	ABCD				
C4	22-2139	2 MMF. 500 V.	ABCD				
C5	22-2205	21 MMF. 500 V.	ABCD				
C6	22-1892	7 MMF. 500 V.	ABCD				
C7	22-2206	24 MMF. 500 V.	ABCD				
C8	22-2093	1-3.5 MMF. Trim. Capacitor		ABCD			
C9	22-2093	1-3.5 MMF. Trim. Capacitor		ABCD			
C10	22-2050	5 MMF. Cer. 500 V.		ABCD			
C11	22-2219	470 MMF. Cer. 500 V.		ABCD			
C12	27-82	600 MMF. Sparkplate		ABCD			
C13	22-2093	1-3.5 MMF. Trim. Capacitor		ABCD			
C14	27-69	475 MMF. Sparkplate		ABCD			
C15	22-2220	14-24 MMF. Trim.Capacitor		ABCD			
C16	22-1891	2.5 MMF. Cer. 500 V.		ABCD			
C17	22-2207	4.5 MMF. Cer. 500 V.		ABCD			
C18	22-2204	20 MMF. Cer 500 V.		ABCD			
C19	22-1876	47 MMF. Cer. 500 V.		ABCD		ABCD	
C20	22-2051	6 MMF. Cer. 500 V.		ABCD			
C21	22-2155	26 MMF. Cer. 500 V.		ABCD			
C22	22-2216	500 MMF. Cer. 500 V.		ABCD	ABCD		
C24AA	22-2154	10 MFD. Electro 250 V.				ABCD	
C25	22-2217	470 MMF. Cer. 500 V.			ABCD		
C26	22-2143	470 MMF. Cer. 500 V.			ABCD		
C27	22-4	.004 MFD. Cer. 500 V.			ABCD	ABCD	
C28	22-1874	7 MMF. Cer. 500 V.			ABCD		
C29	22-3	.01 MFD. Cer. 500 V.			ABCD	ABCD	
C30	22-1761	50 MMF. Cer. 500 V.			ABCD		
C31	22-2106	10 MMF. Cer. 500 V.			ABCD		
C32	22-2218	.001 MFD. 500 V.			ABCD		
C34	22-1842	4700 MMF. 10% 200 V.				B	
C35	22-1782	.0047 MFD. 600 V.				ABCD	
C36AD		15 MFD. Electro 475 V.				ABCD	
C36BD	22-2122	80 MFD. Electro 300 V.				ABCD	
C36CD		40 MFD. Electro 50 V.				ABCD	
C36DD		15 MFD. Electro 475 V.				ABCD	
C37AD		40 MFD. Electro 300 V.				ABCD	
C37BD	22-2223	80 MFD. Electro 25 V.				ABCD	
C37CD		100 MFD. Electro 50 V.				ABCD	
C37DD		20 MFD. Electro 475 V.				ABCD	
C38AD		20 MFD. Electro 450 V.				A D	BC
C38BD	22-2224	20 MFD. Electro 200 V.				A D	BC
C38CD		20 MFD. Electro 25 V.				A D	BC
C38DD		40 MFD. Electro 450 V.				A D	BC
C39	22-1844	.047 MFD. 600 V.				ABCD	
C40	22-2233	20 MMF. Cer. 10% 500 V.				ABCD	
C41	22-2234	100 MMF. 5% 500 V.				ABCD	
C42	22-2264	.015 MFD. 10% 600 V.				A D	
C43	22-2248	.0033 MFD. 10% 600 V.				BC	
C44	22-1843	.01 MFD. 10% 600 V.				BC	
C45	22-5	110 MMF. 500 V.				A C	
C46	22-1775	.047 MFD. 400 V.				A D	
C47	22-2166	.15 MFD. 10% 200 V.				A D	
C49	22-2128	.001 MFD. 10% 600 V.				ABCD	
C50	22-1880	1200 MMF. 10% 600 V.				A D	
C51	22-1841	0.1 MFD. 600 V.				ABCD	
C52	22-365	100 MMF. 10% 500 V.				ABCD	
C53	22-2162	130 MMF. 5% 500 V.				ABCD	
C54	22-2071	.022 MFD. 200 V.				ABCD	
C55	22-2078	.047 MFD. 10% 600 V.				BC	
C57	22-1138	470 MMF. 10% 500 V.			ABCD	ABCD	
C58	22-1845	2200 MMF. 600 V.				ABCD	
C59	22-2163	.001 MFD. 10% 500 V.				ABCD	
C60	22-1849	.0047 MFD. 10% 600 V.				C	
C61	22-470	150 MMF. 500 V.				ABCD	
C62	22-1846	.01 MFD. 400 V.				ABCD	
C63	22-2034	680 MMF. 5% 500 V.				ABCD	
C64	22-1814	2200 MMF. 10% 600 V.				ABCD	
C65	22-1851	.001 MFD. 1K V.				ABCD	
C66	22-2146	.47 MFD. 200 V.				AD	
C67	22-2061	0.1 MFD. 400 V.				ABCD	
C68	22-2098	.47 MFD. 200 V.				AD	
C69	22-2261	0.15 MFD. 400 V.				BCD	
C70	22-2120	500 MMF. 10K V.				A	
C71	22-2112	.001 MFD. 500 V.			A C	ABCD	
C72	22-1777	0.1 MFD. 200 V.			B	ABCD	
C73	22-1810	0.1 MFD. 10% 200 V.				ABCD	
C74	22-2168	33 MMF. 10% 500 V.				ABCD	
C75AB	22-2232	20 MFD. Electro 300 V.				BC	
C75BB		15 MFD. Electro 475 V.				BC	
C76AA	22-2225	20 MFD. Electro 300 V.				BC	
C79	22-2159	.33 MFD. 200 V.				BC	
C81	22-2244	0.47 MFD. 200 V.				BC	
C82	22-1832	500 MMF. 20K V.				BC	
C83	22-2127	.001 MFD. 600 V.					BC
C84	22-1645	330 MMF. 10% 500 V.				ABCD	
C85	22-1137	150 MMF. 10% 500 V.				ABCD	
C86A		120 MMF. Sparkplate				ABCD	
C86B	27-160	150 MMF. Sparkplate				ABCD	
C86C		150 MMF. Sparkplate				ABCD	
W1	S-17195	Power Supply Cable					BC
CX		Supplied with deflection yoke					
PL-1	100-67	Pilot Light				ABCD	
S1	85-488	Picture Control switch				ABC	
A1	87-1	Integrator				ACD	
A2	103-1	Germanium Diode crystal(IN64)			ABCD	B	
	49-624	12" P.M. Speaker used in Models H3375					
	49-649	10" P.M. Speaker used in Models H2250 - H2255E H2337 - H2338 - H2352 H2353E					
	49-678	12" P.M. Speaker used in Models H2339 - H2349					
	49-696	5 1/4" P.M. Speaker used in Models H2328R					
R1	63-1750	150 Ohm 10% 1/2W.			ABCD		
R2	63-1827	10K Ohm 10% 1/2W.		ABCD			
R3	63-1967	1500 Ohm 10% 1W.		ABCD			
R4	63-1933	3.3 Megohm 20% 1/2W.		ABCD		BC	
R5	63-1855	47K Ohm 10% 1/2W.		ABCD		ABCD	
R6	63-1785	1000 Ohm 10% 1/2W.		ABCD	ABCD	BC	
R7	63-1702	10 Ohm 20% 1/2W.		ABCD			
R8	63-1835	15K Ohm 20% 1/2W.		ABCD			
R9	63-1736	68 Ohm 10% 1/2W.			ABCD		
R10	63-1849	33K Ohm 20% 1/2W.			ABCD		
R11	63-1834	15K Ohm 10% 1/2W.				C	
R12	63-1743	100 Ohm 10% 1/2W.			ABCD	BC	
R13	63-1772	470 Ohm 20% 1/2W.			ABCD		
R17	63-1926	2.2 Meg. 20% 1/2W.				ABC	
R18	63-1912	1.0 Meg. 20% 1/2W.			ABCD	ABCD	
R19	63-2050	500 Ohm Buzz Control				ABCD	
R20	63-1982	100K Ohm 10% 2W.				ABCD	
R21	63-1771	470 Ohm 10% 1/2W.			ABCD	ABCD	
R22	63-1890	330K Ohm 10% 1/2W.			ABCD	ABCD	
R23	63-1799	2200 Ohm 10% 1/2W.			ABCD		
R24	63-1764	330 Ohm 10% 1/2W.				A D	BC
R25	63-1870	100K Ohm 20% 1/2W.				ABCD	
R26	63-2023	3500 Ohm 10% 10W.				A D	
R27	63-2022	10K Ohm 10% 5W.				A D	BC
R28	63-1571	6800 Ohm 10% 2W.				A D	
R29	63-1761	270 Ohm 10% 1/2W.				A	
R30	63-2077	400 Ohm 10% 5W.				A D	
R31	63-1744	100 Ohm 20% 1/2W.				ABCD	
R32	63-2125	500K Volume control				ABCD	
R33	63-1782	820 Ohm 10% 1/2W.			ABCD	ABCD	
R34	63-1838	18K Ohm 10% 1/2W.				ABCD	
R35	63-1806	3300 Ohm 10% 1/2W.				ABCD	
R36	63-1768	390 Ohm 10% 1/2W				ABCD	
R37	63-1841	22K Ohm 10% 1/2W.				ABCD	
R38	63-943	4700 Ohm 10% 1W.				ABCD	
R39	63-1845	27K Ohm 10% 1/2W.				ABCD	
R40	63-2123	150K Contrast Control				ABCD	
R41	63-2172	2K Vertical linearity control				BC	
R42	63-1883	220K Ohm 10% 1/2W.				ABCD	
R43	63-2126	100K Brightness Control				ABCD	
R45	63-1911	1.0 Meg. 10% 1/2W.				ABCD	
R46	63-1869	100K Ohm 10% 1/2W.		ABC		ABCD	
R47	63-1862	68K Ohm 10% 1/2W.			ABCD	ABCD	
R48	63-1898	470K Ohm 20% 1/2W.				ABCD	
R49	63-1884	220K Ohm 20% 1/2W.			ABCD	ABCD	
R50	63-2153	25K A.G.C. Delay Control				ABCD	
R51	63-1820	6800 Ohm 10% 1/2W.			ABCD		
R52	63-2127	200K Vertical Hold Control				A D	
R53	63-2173	750K Vertical Hold Control				BC	
R54	63-1449	470 Ohm 20% 1W.				BC	
R55	63-2110	7.5 Meg. Vertical size Cont.				ABCD	
R56	63-1863	68K Ohm 20% 1/2W.				ABCD	
R57	63-1975	12K Ohm 10% 1W.				A	
R58	63-2159	4K Vertical hold range cont.				AD	
R59	63-1674	5K Vertical Linearity cont.				AD	
R60	63-1775	560 Ohm 10% 1/2W.				ABCD	
R61	63-1813	4700 Ohm 10% 1/2W.			ABCD	ABCD	
R62	63-1826	10K Ohm 5% 1/2W.				BC	
R63	63-957	33K Ohm 10% 1W.				ABCD	
R64	63-1901	560K Ohm 10% 1/2W.				AC	
R65	63-1675	25K Horizontal drive control				ABCD	
R66	63-1160	56K Ohm 10% 1W.				A	
R67	63-1751	150 Ohm 20% 1/2W.				ABCD	
R68	63-1578	150 Ohm 20% 2W.				A	
R69	63-2128	15K Ohm 10% 7W.				A	
R70	63-2129	1.2 Ohm 10%				A	
R71	63-2150	4700 Ohm 10% 4W.				A	
R72	63-1919	1.5 Meg. 20% 1/2W.				ABCD	
R73	63-2145	10K Ohm 20% 2W.				A	
R74	63-1876	150K Ohm 10% 1/2W.				ABD	
R75	63-2137	100K Ohm 10% 1W.				ABCD	
R76AB	63-2103	200 Ohm 10% 3W.				BC	
R76BB		200 Ohm 10% 3W.				BC	
R77	63-2090	20K Focus Control				BCD	
R78	63-2017	4000 Ohm 10% 5W.				BCD	
R79	63-1065	15K Ohm 10% 1W.				ABCD	
R80	63-1807	3300 Ohm 20% 1/2W.				BC	
R81	63-2134	150 Ohm 20% 5W.				BCD	
R82	63-1983	47 OH 20% 2W.				BC	
R83	63-2425	15K Ohm 10% 7W.				BCD	
R84	63-2076	3.3 Ohm 20% 1/2W.				B	
R85	63-2171	1800 Ohm 10% 4W.				BC	
R86	63-2136	3500 Ohm 10% 7W.					BC
R87	63-1814	4700 Ohm 20% 1/2W.					BC
R88	63-1997	6800 Ohm 10% 2W.					BC
R89	63-1848	33K Ohm 10% 1/2W.				ABCD	
R90	63-1758	220 Ohm 20% 1/2W.				AD	
R91	63-1754	180 Ohm 10% 1/2W.			ABCD	A	
R93	63-1979	68K Ohm 10% 1W.			ABCD	D	
R94	63-1778	680 Ohm 10% 1/2W.				B	
R95	63-1904	680K Ohm 10% 1/2W.				BD	
R96	63-970	47 Ohm 10% 1W.				D	
R97	63-1620	1800 Ohm 10% 2W.				D	
R98	63-1581	4.7 Ohm 10% 1/2W.				CD	
R99	63-1101	8200 Ohm 10% 2W.			ABCD		
ST-13	S-16873	Channel strip assem. #13	ABCD				
ST-12	S-16872	Channel strip assem. #12	ABCD				
ST-11	S-16871	Channel strip assem. #11	ABCD				
ST-10	S-16870	Channel strip assem. #10	ABCD				
ST-9	S-16869	Channel strip assem. #9	ABCD				
ST-8	S-16868	Channel strip assem. #8	ABCD				
ST-7	S-16867	Channel strip assem. #7	ABCD				
ST-6	S-16866	Channel strip assem. #6	ABCD				
ST-5	S-16865	Channel strip assem. #5	ABCD				
ST-4	S-16864	Channel strip assem. #4	ABCD				
ST-3	S-16863	Channel strip assem. #3	ABCD				
ST-2	S-16862	Channel strip assem. #2	ABCD				
L1	S-16842	R.F. Antenna coil	ABCD				
L2		R.F. Grid coil	ABCD				
L3	S-16857	R.F. Plate coil	ABCD				
L4		Converter Grid coil	ABCD				
L5	S-16843	R.F. Antenna coil	ABCD				
L6		R.F. Grid coil	ABCD				
L7	S-16858	R.F. Plate coil	ABCD				
L8		Converter grid coil	ABCD				
L9	S-16844	R.F. Antenna coil	ABCD				
L10		R.F. Grid coil	ABCD				
L11	S-16859	R.F. Plate coil	ABCD				
L12		Converter grid coil	ABCD				
L13	S-16845	R.F. Antenna coil	ABCD				
L14		R.F. Grid coil	ABCD				
L15	S-16860	R.F. Plate coil	ABCD				
L16		Converter grid coil	ABCD				
L17	S-16846	R.F. Antenna coil	ABCD				
L18		R.F. Grid coil	ABCD				
L19	S-16861	R.F. Plate Coil	ABCD				
L20		Converter grid coil	ABCD				
L21	S-16304	Oscillator coil assembly	ABCD				
L22	20-310	R.F. Antenna coil	ABCD				
L23	S-16847	R.F. Grid coil	ABCD				
L24	20-312	R.F. Plate coil	ABCD				
L25	20-319	Converter grid coil	ABCD				
L26	S-16848	R.F. Grid coil	ABCD				
L27	20-313	R.F. Plate coil	ABCD				
L28	20-320	Converter Grid coil	ABCD				
L29	S-16305	Oscillator coil assembly	ABCD				
L30	S-16849	R.F. Grid coil	ABCD				
L31	20-314	R.F. Plate coil	ABCD				
L32	20-321	Converter Grid coil	ABCD				
L33	S-16306	Oscillator coil assembly	ABCD				
L34	S-16850	R.F. Grid coil	ABCD				
L35	20-315	R.F. Plate coil	ABCD				
L36	20-322	Converter Grid coil	ABCD				
L37	S-16307	Oscillator coil assembly	ABCD				
L38	S-16851	R.F. Grid coil	ABCD				
L39	20-316	R.F. Plate coil	ABCD				
L40	20-323	Converter Grid coil	ABCD				
L41	S-16308	Oscillator coil assembly	ABCD				
L42	S-16852	R.F. Grid coil	ABCD				
L43	20-317	R.F. Plate coil	ABCD				
L44	20-324	Converter Grid coil	ABCD				
L45	S-16309	Oscillator coil assembly	ABCD				
L46	20-311	R.F. Antenna coil	ABCD				
L47	S-16853	R.F. Grid coil	ABCD				
L48	20-318	R.F. Plate coil	ABCD				
L49	20-325	Converter Grid coil	ABCD				
L50	S-16310	Oscillator coil assembly	ABCD				
L51	S-17104	Converter plate coil		ABCD			
L52	S-16265	Oscillator coil assembly		ABCD			
L53	S-16501	Trap coil assembly		ABCD			
L54	S-17504	Series detector peaking coil			ABCD		
L55	S-15128	B - Choke coil assembly			ABCD		
L56	S-16011	Shunt peaking coil			ABCD		
L57	S-16738	Intercarrier sound I.F. coil			ABCD		
L58	S-16013	Quadrature coil assembly			ABCD		
L59	95-1170	Filter choke				A	
L60	S-16855	Sound takeoff coil				ABCD	
L62	S-17053	2nd Video shunt peaking coil				ABCD	
L63	S-17116	4.5 MC. Video trap assembly				ABCD	
L64	S-17052	2nd Video series peaking coil				ABCD	
L65	S-17132	Picture control coil				A	
L66	IN T12	1/2 Vertical deflection coil				A	
L67	IN T12	1/2 Vertical deflection coil				A	
L68	IN T12	1/2 Horiz. deflection coil				A	
L69	IN T12	1/2 Horiz. deflection coil				A	
L70	IN T13	1/2 Vertical deflection coil				C	
L71	IN T13	1/2 Vertical deflection coil				C	
L72	IN T13	1/2 Horiz. deflection coil				C	
L73	IN T13	1/2 Horiz. deflection coil				C	
L74	S-17114	Horiz. oscillator coil				ABCD	
L75	S-17112	Width control				A	
L76	S-17175	Width control				BCD	
L78	S-17176	Horiz. linearity control				ABCD	
L79	S-17400	Picture control coil				BC	
L80	95-1218	Filter choke					BC

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L81	S-17230	Em. - PM. Focus coil				C	
L82	S-17173	Antenna coil assembly		ABC			
L83	S-17290	EM. - PM. Focus coil				B	
L84	S-16984	Filament choke assembly			ABCD		
L85	S-17505	Inverter plate peaking assembly			ABC		
L86	IN T15	1/2 Vertical deflection coil				D	
L87	IN T15	1/2 Vertical deflection coil				D	
L88	IN T15	1/2 Horiz. deflection coil				D	
L89	IN T15	1/2 Horiz. deflection coil				D	
L90	IN T19	1/2 Vertical deflection coil				B	
L91	IN T19	1/2 Vertical deflection coil				B	
L92	IN T19	1/2 Horiz. deflection coil				B	
L93	IN T19	1/2 Horiz. deflection coil				B	
L94	95-1271	Filter choke				D	
L95	S-17861	EM-FM Focus coil				D	
T18	S-17435	Horiz. sweep transformer				D	
T17	95-1260	Power transformer				D	
T16	S-17233	Horiz. sweep transformer				CB	
T15	95-1263	Deflection yoke				BD	
T14	S-17130	Horiz. sweep transformer				A	
T13	95-1246	Deflection yoke				C	
T12	95-1241	Deflection yoke				A	
T11	95-1240	Vertical output transformer				BC	
T10	95-1239	Vertical output transformer				AD	
T9	95-1245	Power transformer					BC
T8	95-1242	Power transformer				A	
T7	95-1247	Output transformer					BC
T6	95-1238	Output transformer				AD	
T5	S-17613	5th Video I.F. transformer			ABCD		
T4	S-16605	4th Video I.F. transformer			ABCD		
T3	S-16604	3rd Video I.F. transformer			ABCD		
T2	S-16275	2nd Video I.F. transformer			ABCD		
T1	S-16274	1st Video I.F. transformer			ABCD		

"A" INDICATES CHASSIS 22H20
"B" INDICATES CHASSIS 24H21
"C" INDICATES CHASSIS 24H20
"D" INDICATES CHASSIS 23H22

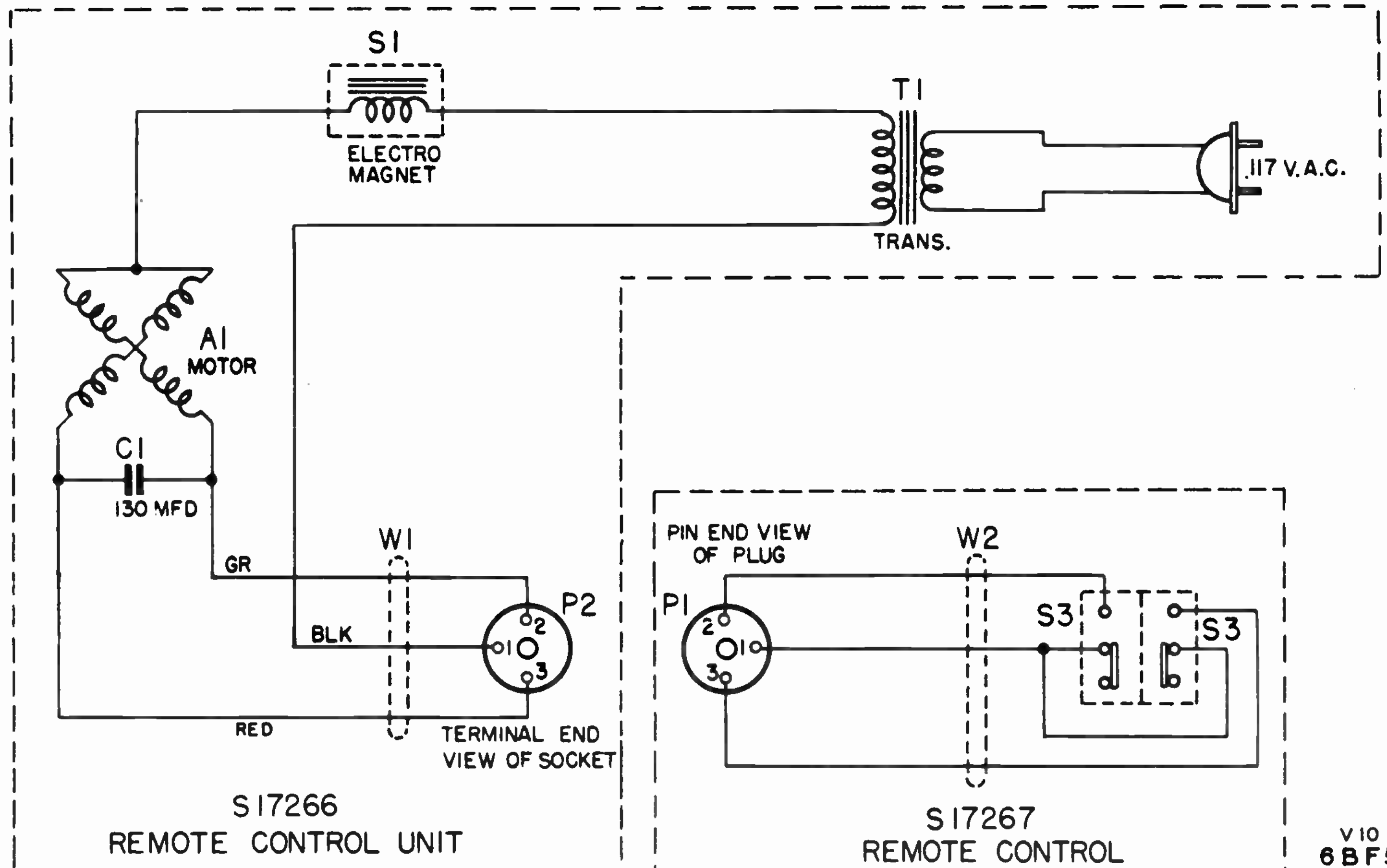
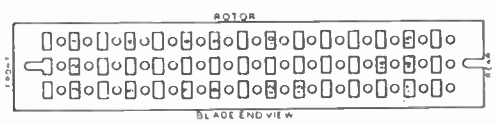


Fig. 14 Schematic Diagram Remote Control Tuner.

ITEM	PART NO.	DESCRIPTION
A1	141-130	27 V.A.C. MOTOR
C1	22-2252	130 MFD ELECTRO. 40 V.A.C.
S1	20-332	ELECTRO-MAGNET
S3	85-492	CONTROL SWITCH
T1	95-1255	TRANSFORMER
W1	S-17324	CABLE ASSEMBLY
W2	52-596	CABLE & PLUG ASSEM.
P1	58-194	MINIATURE PLUG
P2	78-901	MINIATURE SOCKET



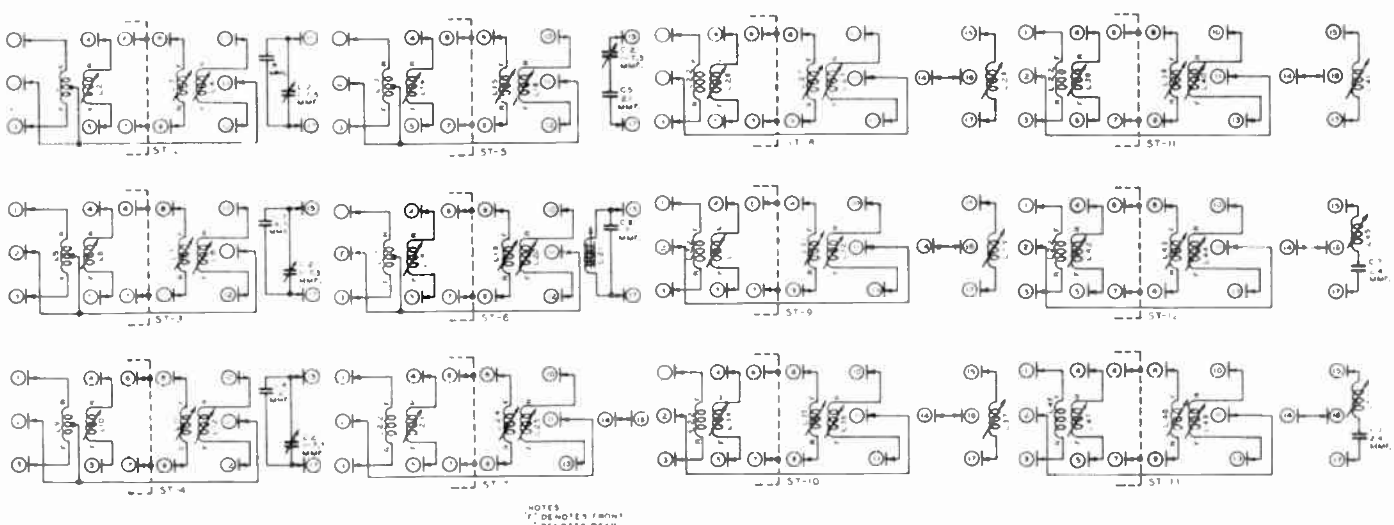


Fig. 15 Channel Strips S-17100 Turret Tuner.

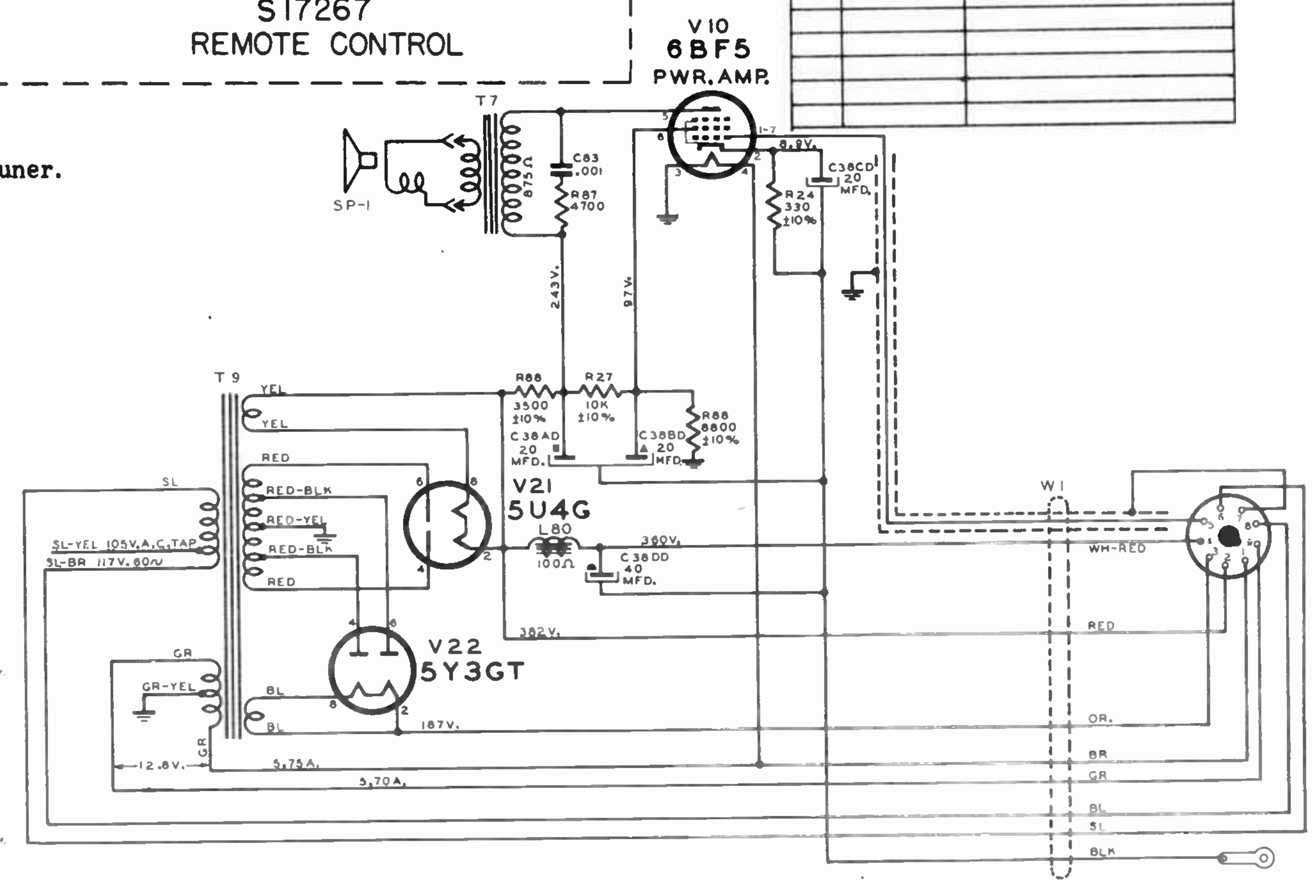


Fig. 16 Power Supply For 24H20-21 Chassis.

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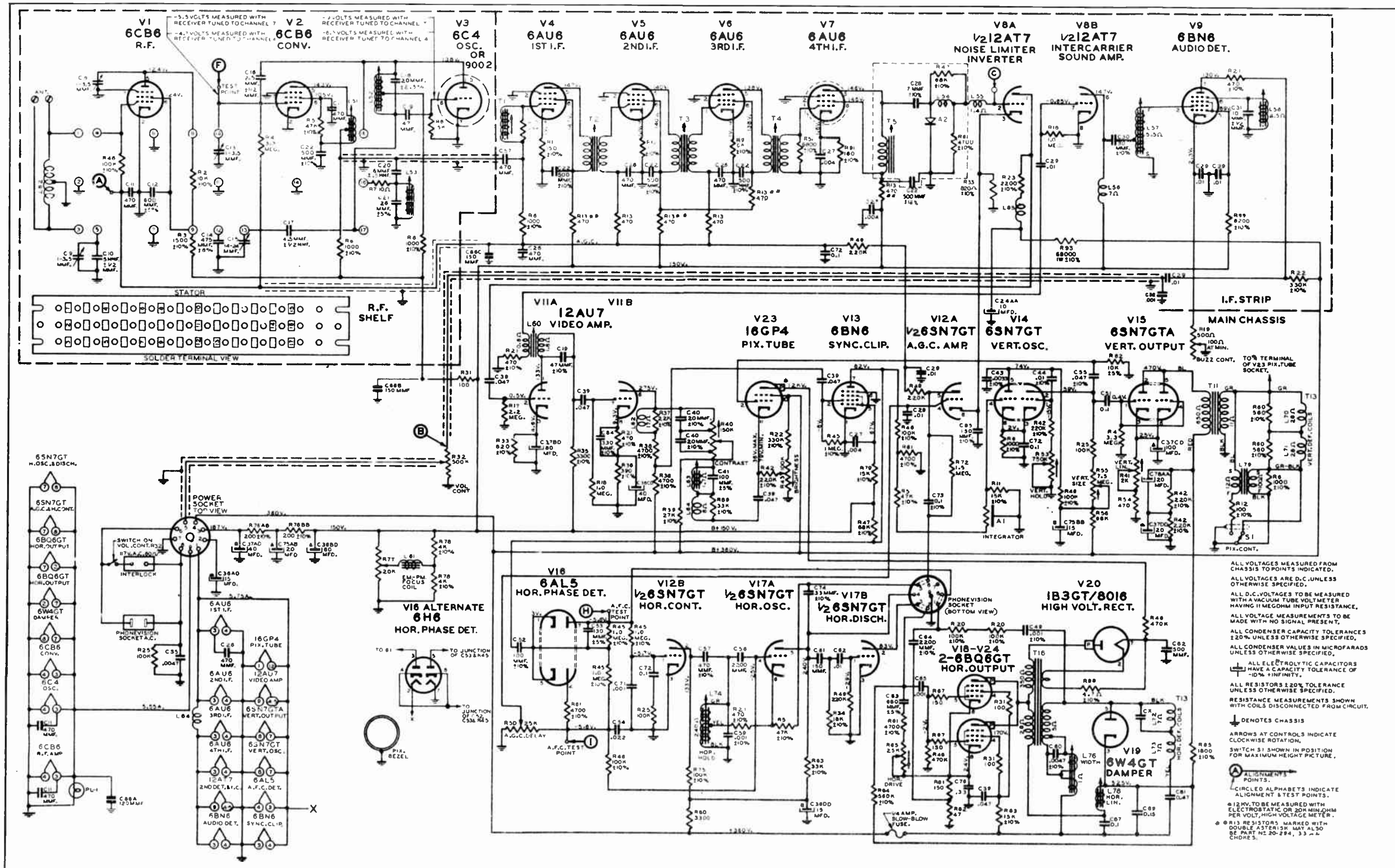

Fig. 17 Schematic Diagram 24H20 Chassis.

MODELS H2437E, H2437R, H2438R, H2439R, H2449E, H3267R, H3469E, H3475R, Ch. 24H20

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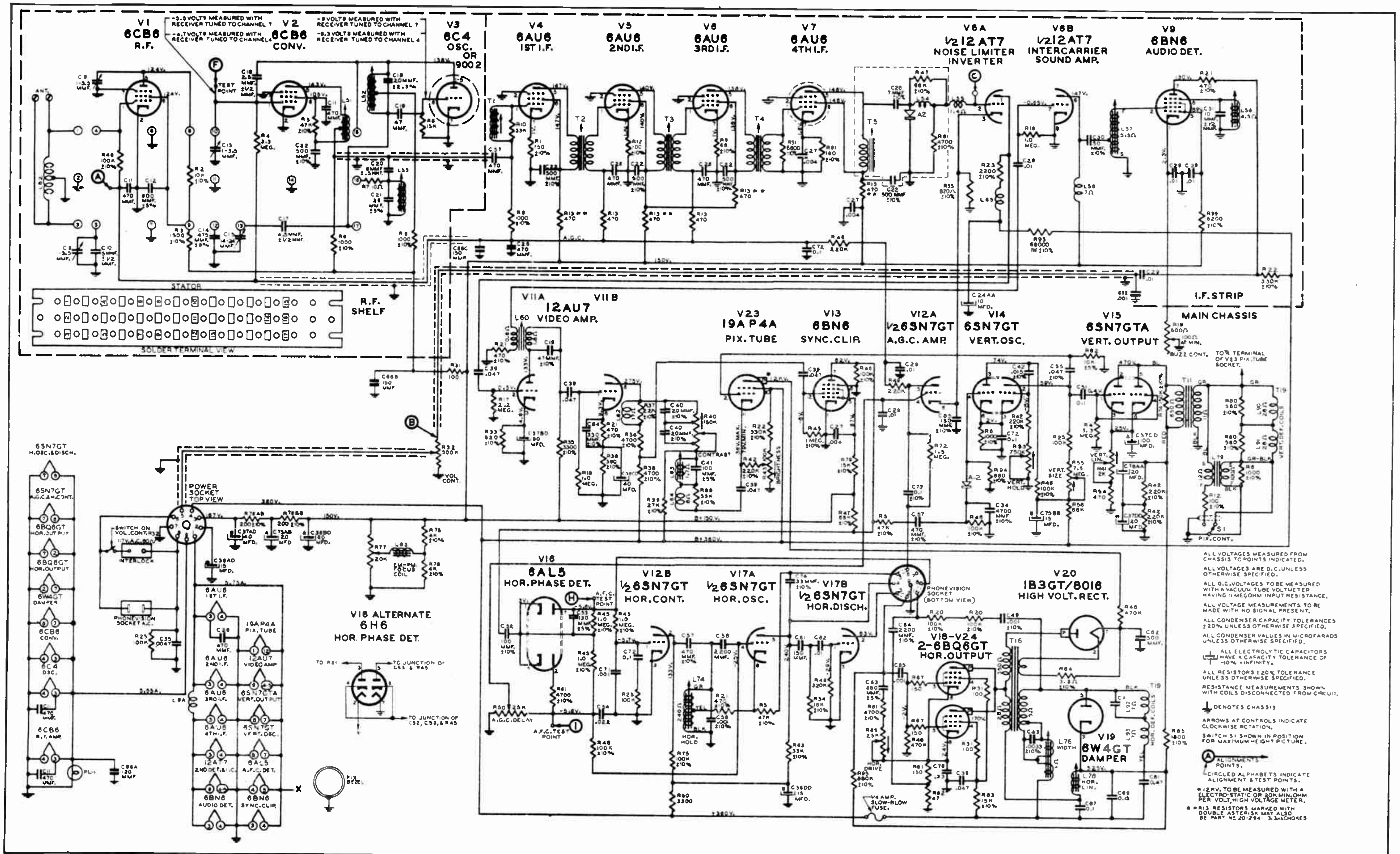

Fig. 18 Schematic Diagram 24H21 Chassis.

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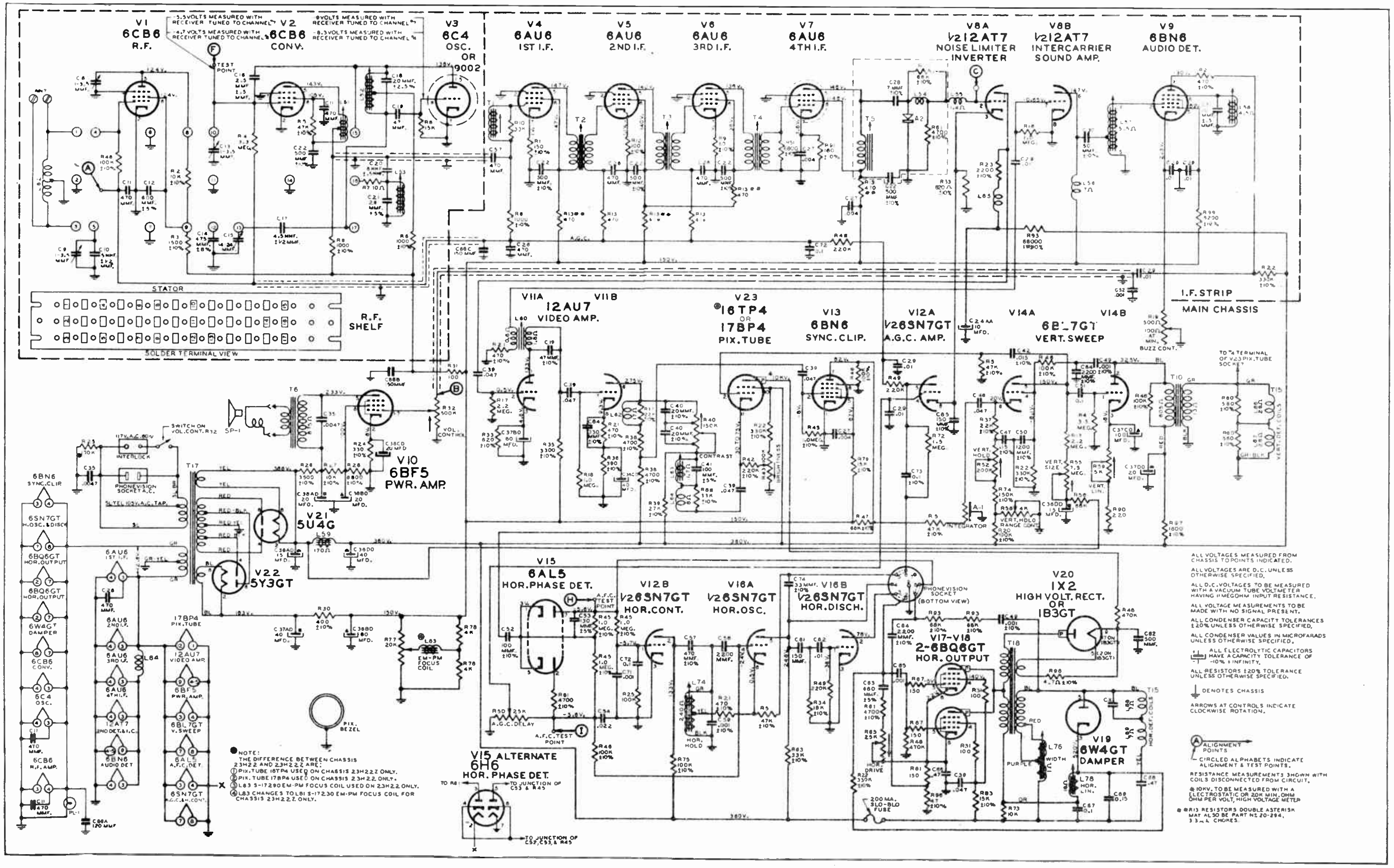

Fig. 19. Schematic Diagram, Chassis 23H22 and 23H22Z.
Chassis 23H22Z same as 23H22 except for picture tube.

MODELS H2328EQ, H2328RZ, H2352RZ, H2353EZ, Ch. 23H22, 23H22Z

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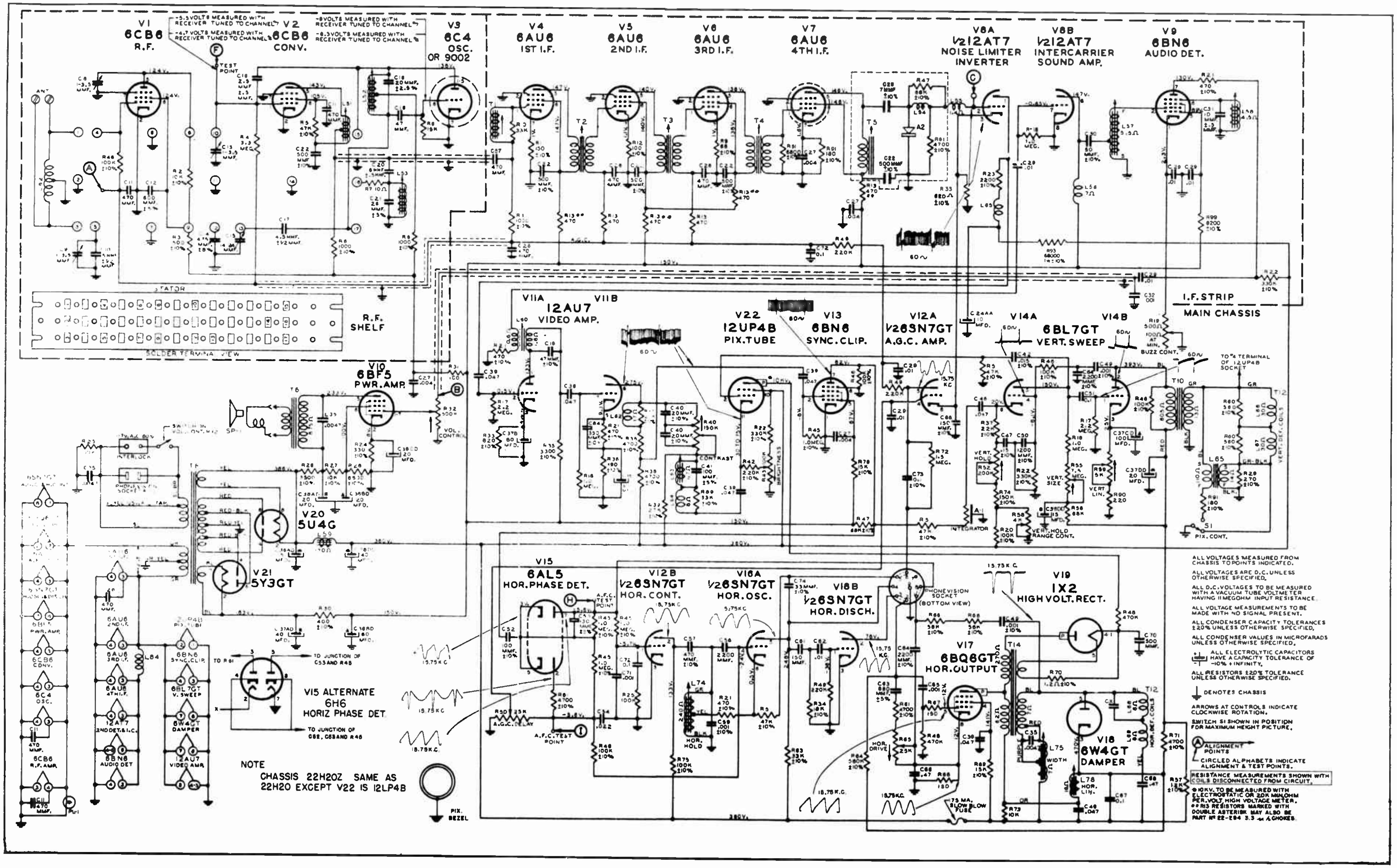

Fig. 20 Schematic Diagram 22H20 Chassis (Wave Forms Shown Also Representative For 23H22Z, 24H20 and 24H21).

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NUMERICAL PARTS LIST

MODELS. H2226E - H2226R & RQ - H2227E & EQ
H2227R & RQ - H2250R & RQ - H2255E & EQ
CHASSIS 22H20

MAIN CHASSIS

Diag. No.	Part No.	Description
	12-1756	Pilot Light Bkt.
	19-166	Coil Mtg. Clip (used on S-1714)
	19-175	Coil Mtg. Clip (1 ea. used on S-17176- S-17112 S-16855 S-17116)
	19-206	Coil Mtg. Clip (used on S-17132)
	19-207	C.R. Tube Mtg. Clip
C29	22-3	.01 Mfd. Ceramic (Disc) (2 used) 500V
C27	22-4	.004 Mfd. Ceramic (Disc) (2 used) (or 22-1706) 500V
C45	22-5	110 Mmf. 500V
C52	22-365	100 Mmfd. Mica (molded) 500V
C61	22-470	150 Mmfd. Mica (molded) 500V
C22	22-2216	500 MMF Cer. 500V 500V
C57	22-1138	470 Mmfd Mica (molded) 500V
	22-1645	330 Mmfd. Mica (molded) 500V
C46	22-1775	.047 Mfd. Mica (molded) (2 used) 400V
C72	22-1777	0.1 Mfd. 200V
C35	22-1782	.0047 Mfd. (molded) (2 used) 600V
C73	22-1610	0.1 Mfd. 200V
C64	22-1814	.0022 Mfd. (molded) (2 used) 600V
C51	22-1841	.1 Mfd. (molded) 600V
C82	22-1832	500 Mmfd. 20KV
C34	22-1842	4700 Mmf. 10% 200V
C44	22-1843	.01 Mfd. 10% 600V
C39	22-1844	.047 Mfd.(Molded) 600V (5 used)
C58	22-1845	.0022 Mfd. 600V
C62	22-1846	.01 Mfd. (molded) 400V
C60	22-1849	.0047 Mfd. 10% 600V
C65	22-1851	.001 Mfd. (molded) 1000V
C19	22-1876	47 Mmfd. Ceramic 500V
C50	22-1880	.0012 Mfd. (molded) 600V
C63	22-2034	680 Mmfd (molded) 500V
C67	22-2061	.1 Mfd. (molded) 400V
C54	22-2071	.022 Mfd. (molded) 200V
C55	22-2078	.047 Mfd. 10% 600V
C68	22-2098	.47 Mfd. (molded) 200V
C71	22-2112	.001 Mfd. Ceramic 500V
C70	22-2120	500 Mmfd (molded) 10,000 (Special)
C36AD BD-CD DD	22-2122	Elect. 15 Mfd. 475V 15 Mfd 475V - 40 Mfd 50V 80 Mfd 300V
C49	22-2128	.001 Mfd. (molded) (2 used) 600V
C56	22-2133	500 Mmf 10% 500V
C4	22-2139	2 Mmf. 500V
C66	22-2146	.47 Mfd. 200V
C24AA	22-2154	Elect. 10 Mfd. 250V
C79	22-2159	.33 Mfd. 200V
C53	22-2162	130 Mmfd - Mica 500V
C59	22-2163	1000 Mmfd - Mica 500V
C47	22-2166	.15 Mfd. 200V
C74	22-2168	33 Mmfd Ceramic 500V
C37AD BD-CD DD	22-2223	Elect. 20 Mfd. 475V - 40 Mfd. 300V - 80 Mfd. 25V - 100 Mfd 50V
C38AD BD-CD DD	22-2224	Elect. 20 Mfd. 200V - 20 Mfd. 450V - 40 Mfd. 450V - 20 Mfd 25V
C78AA	22-2225	20 Mfd. Electro 300V
C75AB	22-2232	20 Mfd. Electro 300V
C75BB		15 Mfd. Electro 475V
C40	22-2233	20 Mmfd Ceramic 500V (2 used)
C41	22-2234	100 Mmfd - Ceramic 500V
C81	22-2244	.47 Mfd. 200V
C80	22-2245	.062 Mfd. 10% 600V
C43	22-2248	.0033 Mfd. 10% 600V
C69	22-2261	.15 Mfd. 400V
C43	22-2264	.015 Mfd 600V
	34-163	Turret Drive Gear
	52-591	Insulated Shielded Lead
	54-139	3/8-32x9/16" Hex Pal-nut (7 used on controls)
	57-1675	Shaft Retaining Plate
	58-188	Two Prong Plug
	58-191	Nine Prong Adapter Plug
R38	63-943	4700 Ohm 1W 10% Ins. Res. (2 used)
R63	63-957	33K ohm 1W 10% Ins. Res.
R79	63-1065	15K Ohm 1W 10% Ins. Res.
R66	63-1160	56K Ohm 1W 10% Ins. Res. (2 used)
R54	63-1449	470 Ohm 20% 1W
R28	63-1571	6800 Ohm 2W 10% Ins.Res.
R68	63-1578	150 Ohm 2W 20% Ins. Res.
R85	63-1620	1800 Ohm 10% 8W
R59	63-1674	Vertical Linearity Control
R65	63-1675	25K Horiz. Dr. Control
R31	63-1744	100 Ohm 1/2W 20% Ins.Res.
R67	63-1751	150 Ohm 1/2W 20% Ins. Res.
R91	63-1754	180 Ohm 1/2W 10% Ins.Res.
R90	63-1758	220 Ohm 1/2W 20% Ins.Res.
R29	63-1761	270 Ohm 1/2W 10% Ins.Res.
R24	63-1764	330 Ohm 1/2W 10% Ins. Res.
R36	63-1766	390 Ohm 1/2W 10% Ins. Res.
R21	63-1771	470 Ohm 1/2W 10% Ins.Res.
R60	63-1775	560 Ohm 1/2W 10% Ins. Res. (used on 95-1241 - 2 used)
R94	63-1778	680 Ohm 10% 1/2
R33	63-1782	820 Ohm 1/2 W 10% Ins.Res.
R35	63-1806	3300 Ohm 1/2W 10% Ins.Res.
R80	63-1807	3300 Ohm 1/2W 20% Ins. Res.
R61	63-1813	4700 Ohm 1/2W 10% Ins.Res. (2 used)
R88	63-1826	10K Ohm 1/2W 5% Ins. Res.
R34	63-1838	18K Ohm 1/2W 10% Ins.Res.
R37	63-1841	22K Ohm 1/2W 10% Ins. Res. (2 used)
R92	63-1844	27K Ohm 1/2W 5% Ins.Res.
R39	63-1845	27K Ohm 1/2W 10% Ins.Res.
R89	63-1848	33K Ohm 1/2W 10% Ins.Res.
R5	63-1855	47K Ohm 1/2W 10% Ins. Res. (3 used)
R47	63-1862	68K Ohm 1/2W 10% Ins.Res.
R56	63-1863	68K Ohm 1/2W 20% Ins.Res.
R46	63-1869	100K Ohm 1/2W 10% Ins. Res. (4 used)
R25	63-1870	100K Ohm 1/2W 20% Ins.Res. (2 used)
R74	63-1876	150K Ohm 1/2W 10% Ins.Res.
R42	63-1883	220K Ohm 1/2W 10% Ins.Res. (2 used)
R49	63-1884	220K Ohm 1/2W 20% Ins.Res. (2 used)
R22	63-1890	330K Ohm 1/2W 10% Ins.Res. (3 used)
R44	63-1894	390K Ohm 1/2W 10%
R48	63-1898	470K Ohm 1/2W 20% Ins.Res. (2 used)
R64	63-1901	560K Ohm 1/2W 10% Ins.Res.
R95	63-1904	680K Ohm 1/2W 10%
R45	63-1911	1 Megohm 1/2W 10% Ins.Res. (4 used)
R18	63-1912	1 Megohm 1/2W 20% Ins.Res. (2 used)
R72	63-1919	1.5 Megohm 1/2W 20% Ins.Res.
R17	63-1926	2.2 Megohm 1/2W 20% Ins.Res. (2 used)
R57	63-1975	12K Ohm 1W 10% Ins.Res.
R20	63-1982	100K Ohm 2W 10% Ins.Res.
R82	63-1983	47 Ohm 2W 20% Ins.Res.
R78	63-2017	4000 Ohm 5W 10%
R27	63-2022	10K Ohm W. W. 5W 10% Ins. Res.
R26	63-2023	3500 Ohm W. W. 10W 10% Ins. Res.
R19	63-2050	Bias Control
R77	63-2099	20K Focus Control
R30	63-2077	400 Ohm W.W. 5W 10% Ins. Res.
R76AB	63-2103	200 Ohm 10% 3W
R76BB		200 Ohm 10% 3W
R55	63-2110	Vertical Size Control
R84	63-2114	2.2 Ohm 1/2W 10% Ins.Res.
R40	63-2123	Contrast Control
R32	63-2125	Vol. Control & Switch
R43	63-2126	Intensity Control
R52	63-2127	Vertical Hold Control
R69	63-2128	15K Ohm W.W. 7W 10% Ins. Res.
R70	63-2129	1.2 Ohm W.W. 1/2W 10% Ins. Res.
R81	63-2134	150 Ohm 5W 20% Ins.Res.
R83	63-2135	15K Ohm 10W 10% Ins.Res.
R75	63-2137	100K Ohm 1W 10% Ins.Res.
R53	63-2140	500K Vertical Hold Control
R73	63-2145	10K Ohm 2W 20% Ins.Res.
R71	63-2150	4700 Ohm W.W. 4W 10%
R50	63-2153	AGC Delay Control
R51	63-2151	150K Ohm 2W 20% Ins.Res.
R58	63-2159	Vert.Hold Range Cont.
	73-114	8-32x5/16" Slab Hd. Set.
	76-605	Horiz. Hold Control Shaft
	78-580	Nine Contact Socket
	78-840	Elect. Cond. Socket
	76-709	Octal Tube Socket
	78-755	Octal Tube Socket (5 used)
	78-807	Miniature Tube Socket
	78-834	Octal Tube Socket
	78-840	Two Contact Socket
	78-875	C.R. Tube Socket
	78-876	Noval Miniature Tube Socket
	78-900	Pilot Light Socket & Wire
	78-908	Miniature Tube Socket
	80-744	PM Focus Mtg. Spring (4 used)
	80-802	Retaining Spring (1 ea. used on 149-100 - 149-101
	80-822	Dial Cord Tension Spring
	80-823	Shaft Guide Spring (used on S-17114)
	80-824	Tube Plate Connector Spring (2 used)
	80-838	C.R. Tube Retaining Sprg.
	83-1837	Anode Lead Support Strip
S1	85-486	Picture Control Switch
A1	87-1	Integrator Unit
	93-2	Brass Washer (used on 22-2154)
	93-525	Fibre Washer (2 used on 78-709)
	93-961	Insulating Washer (Contrast control)
	93-971	Shell Support Washer (horizontal Sweep)
	93-1057	Insulating Washer (Contrast Control)
L59	95-1170	Filter Choke
T6	95-1238	Audio Output Trans.
T10	95-1239	Vertical Output Trans.
T12	95-1241	Deflection Coil
T8	95-1242	Power Trans.
PL1	100-67	Pilot Light
	112-88	Thumb Screw #8-32
	112-758	#4-40x1/4 RHST (used on 85-488)
	114-45	#8x3/8" Hex.Hd. S.T. Screw (2 used on S-17076)
	114-201	#8x5/16" Hex. Hd. S.T. Screw (22 used)
	114-310	#8x5/16" Hex Washer Hd. S.T. (4 used)
	114-336	#10x5/16" Hex.Hd. S.T. (4 used on 95-1242)
	125-26	Rubber Grommet (2 used on 78-709)
	126-643	Fire Shield
	136-21	Fuse 1/4 Amp.
	149-89	Iron Core (2 used on S-16855 & S-17116)
	149-98	Iron Core & Screw (used on S-17132)
	149-100	Iron Core & Spring (used on S-17113)
	149-101	Iron Core & Spring (used on S-17113)
	149-102	Iron Core & Screw (Used on S-17114)
	188-131	Retaining Ring (used on S-17097)
	188-137	Retaining Ring (used on S-17362)
	196-145	Plastic Gasket
	196-152	C.R. Tube Support Gasket
	199-124	Focus Coil Sleeve
	S-16020	PM Focus & Centering Assy.
	S-17461	Beam Bender unit all 16" including rectangular tubes.
	S-16207	Deflection Yoke Mtg. Brkt. Assy.
	S-16209	Wire and Eyelet Assy.
L60	S-16855	Sound Trap Coil Assy.
L64	S-17052	2nd Video Series Peaking Coil Assy.
L62	S-17053	2nd Video Shunt Peaking Coil Assy.
	S-17064	Video IF Strip Assy. (Complete)
	S-17076	Gasket Reinforcing Brkt Assy.
	S-17081	C.R. Tube Socket & Wire Assy.
	S-17084	Shaft-Gear & Coupling Assy.
	S-17096	Dial Cord & Eyelet Assy. (Fine Tuning)
	S17097	Brkt. Pulley & Gear Assy.
	S-17100	RF Shelf & Turret Assy.
L75	S-17112	Horiz. Size Control Coil Assy.
	S-17113	Horiz. Linearity & Size Control & Brkt. Assy. (Includes L75, L77)
L74	S-17114	Horiz. Osc. Coil Assy.
L63	S-17116	4.5 Mc Video Trap Coil Assy.
	S-17121	Rectifier Mtg. Plate Assy.
	S-17127	Plug & Brkt Assy.
T14	S-17130	Horiz. Sweep Trans. Assy. (or S-17265)
L65	S-17132	Picture Control Coil Assy.
L77	S-17176	Horiz. Linearity Control Coil Assy.
	S-17362	Indicator Drum & Shaft Assy.
	S-17377	Contrast Control Shaft & Bushing Assy.
	S-17409	Insulator Strip & Terminal Assy.
	S-17425	Fine Tuning Ext.Shaft & Coupling Bushing.
	S-17428	Anode Lead & Wire Assy.
	S-17164	Beam Bender unit all 12" and 19" tubes.

TUBES

1 - 1X2	1 - 6BQ6GT
1 - 5U4G	2 - 6SN7GT
1 - 5Y3GT	1 - 6W4GT
1 - 6AL5	1 - 12AU7
1 - 6BF5	1 - 6BL7GT
1 - 6BN6	1 - 12UP4B

TURRET TUNER ASSEMBLY

Diag. No.	Part No.	Description
	6-65	Ball Bearing
C2	22-1879	Slug Tuned Trimmer Cond. (4 used)
C6	22-1892	7 Mmfd. Ceramic 500V
C1	22-1894	8 Mmfd Ceramic 500V
C3	22-1951	4.5 Mmfd Ceramic 500V
	22-2139	2.0 Mmfd Ceramic 500V
C5	22-2205	21 Mmfd Ceramic 500V
C7	22-2206	24 Mmfd Ceramic 500V
	46-779	Adjusting Wrench Knob and Set Screw
	56-263	Groove Pin 1/8" dia. x 1/4" lg.
	57-1428	Bearing Plate
	57-1676	Bearing Plate
	68-12	Adjusting Wrench
	73-114	8-32x5/16 Slab Hd. Set Screw (2 used on S15024)
	80-697	Adjusting Wrench Return Spring
	94-734	Bearing Retaining Bushing
	114-201	#8x5/16" Hex.Hd S.T. Screw (4 used on S15022)
	184-14	Steel Ball 1/8" Dia. (9 used)
	S-15022	Turret Cover Assy.
	S-15024	Gear & Bushing Assy.
ST2	S-16862	Channel Strip Assy. #2
ST3	S-16863	Channel Strip Assy. #3
ST4	S-16864	Channel Strip Assy. #4
ST5	S-16865	Channel Strip Assy. #5
ST6	S-16866	Channel Strip Assy. #6
ST7	S-16867	Channel Strip Assy. #7
ST8	S-16868	Channel Strip Assy. #8
ST9	S-16869	Channel Strip Assy. #9
ST10	S-16870	Channel Strip Assy. #10
ST11	S-16871	Channel Strip Assy. #11
ST12	S-16872	Channel Strip Assy. #12
ST13	S-16873	Channel Strip Assy. #13
	S-17092	Turret Housing Assy.
	S-17098	Turret Tuner Assy. (Mechanical)
	S-17445	Bearing and Brkt. Assy.
	S-17446	Turret Detent Spring Assy.

RF SHELF ASSEMBLY

Diag. No.	Part No.	Description
	19-166	Coil Mtg. Clip (1 ea. used on S-16265 & S-16501)
	19-179	Coil Mtg. Clip (used on S-17104)
C19	22-1876	47 Mmfd Ceramic 500V
C16	22-1891	2.5 Mmfd Ceramic 500V
C10	22-2050	5 Mmfd Ceramic 500V
C20	22-2051	6 Mmfd Ceramic 500V
C8-9-13	22-2093	Trimmer Cond. (3 used)
C21	22-2155	26 Mmfd 500V
C18	22-2204	20 Mmfd Ceramic 500V
C17	22-2207	4.5 Mmfd Ceramic 500V
C22	22-2216	500 Mmfd Ceramic 500V
C11	22-2219	470 Mmfd Ceramic (4 used) 500V
C15	22-2220	Trimmer Cond.
C14	27-69	Silver Mica Disc.
C12	27-82	Silver Mica Disc.
	54-293	Locknut (1 used on ea. 22-2093)
	57-1689	Insulating Plate (Spark Plate) (2 used)
R7	63-1702	10 Ohm 1/2W 10% Ins.Res.
	63-1785	1000 Ohm 1/2W 10% Ins.Res.
R2	63-1827	10K Ohm 1/2W 10% Ins.Res.
R8	63-1835	15K Ohm 1/2W 20% Ins.Res.
	63-1855	47K Ohm 1/2W 10% Ins.Res.
	63-1869	100K Ohm 1/2W 10% Ins.Res.
R4	63-1933	3.3 Megohm 1/2W 20% Ins. Res.
R3	63-1967	1500 Ohm 1W 10% Ins.Res.
	69-11	6-32x 3/4" RHMS Steel (1 used on ea. 22-2093)
	78-885	Miniature Tube Socket (molded)
	78-886	Miniature Tube Socket
	78-888	Miniature Tube Socket
	80-736	Shaft Tension Spring
	83-1570	Antenna Terminal Strip
	93-1053	Bakelite Washer
	112-768	Spark Plate Mtg. Screw
	126-622	Tube Shield
	126-638	RF Shelf Shield
	149-74	Iron Core (used on S-17173)
	149-75	Iron Core & Screw (used on S-16265)
	149-92	Iron Core (used on S-17104)
	149-97	Iron Core & Screw (used on S-16501)
L52	S-16265	Oscillator Coil Assy.
L53	S-16501	Trap Coil Assy.
	S-16651	Tuning Shaft & Cam Assy.
	S-17099	RF Shelf Assy. (Complete)
L51	S-17104	Converter Plate Coil Assy.
L82	S-17173	Antenna Coil Assy.
	S-17191	Shielded Cable Assy.
	S-17194	Tuning Shaft & Pulley Assy.

TUBES

2 - 6CB6 1 - 6C4

S-17064 VIDEO I.F. ASSEMBLY
(Also refer to S-17635 Parts List.

Diag. No.	Part No.	Description
	19-209	Coil Mtg. Clips (5 used)
C29	22-3	.01 Mfd. Ceramic (Disc) (4 used) 500V
C27	22-4	.004 Mfd. Ceramic (Disc) (2 used) (or 22-1706) 500V
C30	22-1761	50 Mmfd Ceramic 500V
C72	22-1777	0.1 Mfd. 200V
C28	22-1874	7 Mmfd. Ceramic 500V
C31	22-2106	10 Mmfd Ceramic 500V
C26	22-2143	470 Mmfd Ceramic (4 used) 500V
C22	22-2216	500 Mmfd Ceramic (4 used) 500V
C25	22-2217	470 Mmfd Ceramic 500V
C32	22-2218	.001 Mfd Ceramic 500V
	54-271	#6-32x1/4" Hex.Pal-nut Inverted Type (2 used on ea. IF)
	63-1571	6800 Ohm 2W 10% Ins.Res.
R12	63-1743	100 Ohm 1/2W 10% Ins.Res. (3 used)
R91	63-1754	180 Ohm 1/2W 10% Ins.Res.
R21	63-1771	470 Ohm 1/2W 10% Ins.Res.
R13	63-1772	470 Ohm 1/2W 20% Ins.Res. (6 used)
R33	63-1782	820 Ohm 1/2W 10% Ins.Res.
R6	63-1785	1000 Ohm 1/2W 10% Ins.Res.
R23	63-1799	2200 Ohm 1/2W 10% Ins.Res.
R35	63-1806	3300 Ohm 1/2W 10% Ins.Res.
R61	63-1813	4700 Ohm 1/2W 10% Ins.Res.
R11	63-1834	15K Ohm 1/2W 10% Ins.Res. (4 used)
R5	63-1855	47K Ohm 1/2W 10% Ins.Res.
R16	63-1859	56K Ohm 1/2W 10% Ins.Res.
R47	63-1862	68K Ohm 1/2W 10% Ins.Res.
R49	63-1884	220K Ohm 1/2W 20% Ins.Res..
R22	63-1890	330K Ohm 1/2W 10% Ins.Res..
R18	63-1912	1 Megohm 1/2W 20% Ins.Res..
	78-905	Miniature Tube Socket (5 used)
	78-906	Miniature Tube Socket (9 Contact)
	94-538	Tuning Slug Insert (1 ea. used on S-16013 & S-16738)
	94-706	Tuning Slug Insert (1 ea. used on S-16275 - S-16604 S-16605
	94-742	Tuning Slug Insert (1 ea. used on S-16274 - S-17472
	103-1	Crystal Diode (1N64)
	125-69	Rubber Grommet (2 used)
	149-71	Iron Core (used on S-16984)
	149-89	Iron Core (used on S-16738 & S-16013)
	149-96	Iron Core (used on S-16275 - S-16604-05 - S-16274 - S-17062
L55	S-15128	Grid Coil Assy.
L56	S-16011	Shunt Peaking Coil Assy.
L58	S-16013	Quadrature Coil Assy.
T1	S-16274	1st Video IF Trans.Assy.
T2	S-16275	2nd Video IF Trans. Assy.
T3	S-16604	3rd Video IF Trans. Assy.
T4	S-16605	4th Video IF Trans. Assy.
L57	S-16738	Intercarrier Sound IF Coil Assy.
L84	S-16984	Filament Choke Coil Assy.
	S-17064	Video IF Strip Assy. (Comp)
L54	S-17504	Detector Peaking Coil Assy.
T5	S-17472	5th Video IF Trans. Assy.
	S-17505	Inverter Plate Peaking Coil Assy.

TUBES

4 - 6AU6
1 - 6BN6
1 - 12AT7

CHASSIS 22H20, 23H22, 23H22Z, 24H20, 24H21

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World Radio History

MODELS: H2449E & EQ - H2437E & EQ - H2437R & RQ - H2438R & RQ - H2439R & RQ
CHASSIS 24H20
MAIN CHASSIS

Diag. No.	Part No.	Description
	12-1736	Pilot Light Brkt.
	15-98	Socket Cap (used on S-17140)
	19-166	Coil Mtg. Clip (used on S-17114)
	19-175	Coil Mtg. Clip (4 used)
	19-206	Coil Mtg. Clip (used on S-17400)
	19-207	C.R. Tube Mtg. Clip
C29	22-3	.01 Mfd. Ceramic (Disc) (2 used) 500V
C27	22-4	.004 Mfd. Ceramic (Disc) (2 used) (or 22-1706) 500V
C52	22-365	100 Mmfd. Mica (molded) 500V
C61	22-470	150 Mmfd. Mica (molded) 500V
	22-1137	150 Mmfd Mica 500V
C57	22-1138	470 Mmfd Mica (molded) 500V
	22-1645	330 Mmfd Mica 500V
C72	22-1777	.1 Mfd. (2 used) 200V
C35	22-1782	.0047 Mfd.(molded) 600V
C73	22-1810	.1 Mfd. 200V
C64	22-1814	.0022 Mfd. 600V
C82	22-1832	500 Mmfd (molded) (Special) 20,000V
C51	22-1841	.1 Mfd. (molded) 600V
C44	22-1843	.01 Mfd. (molded) 600V
C39	22-1844	.047 Mfd. (molded) (5 used) 600V
C58	22-1845	.0022 Mfd. 600V
C62	22-1846	.01 Mfd. (molded) 400V
C60	22-1849	.0047 Mfd. (molded) 600V
C65	22-1851	.001 Mfd. (molded) 1000V
C19	22-1876	47 Mmfd Ceramic 500V
C63	22-2034	680 Mmfd(molded) 500V
C67	22-2061	.1 Mfd. (molded) 400V
C54	22-2071	.022 Mfd.(molded) 200V
C55	22-2078	.047 Mfd 600V
C71	22-2112	.001 Mfd Ceramic 500V
C36AD	22-2122	Elect. 15 Mfd. 475V
BD-CD		15 Mfd 475V 40 Mfd
DD		50V 80 Mfd 300V
C49	22-2128	.001 Mfd (molded) 600V
C24AA	22-2154	Elect. 10 Mfd 250V
C79	22-2159	.33 Mfd. (molded) 200V
C53	22-2162	130 Mmfd Mica 500V
C59	22-2163	1000 Mmfd Mica 500V
C74	22-2168	33 Mmfd Ceramic 500V
C22	22-2216	500 Mmfd Ceramic 500V
C37AD		Elect. 20 Mfd. 475V 40 Mfd
BD-CD-DD	22-2223	300V 80 Mfd. 25V 100 Mfd. 50V
C78AA	22-2225	Elect. 20 Mfd 300V
C75AB C75BB	22-2232	Elect. 20 Mfd 300V 15 Mfd. 475V
C40	22-2233	20 Mmfd Ceramic (2 used) 500V
C41	22-2234	100 Mmfd Ceramic 500V
C81	22-2244	.47 Mfd 200V
C43	22-2248	.0033 Mfd 600V
C69	22-2261	.15 Mfd 400V
	24-554	Fire Shield Rear Cover
	52-591	Insulated Shielded Lead
	52-592	Insulated Shielded Lead
	54-139	3/8-32x9/16" Hex Pal-nut (8 used to mt. controls)
	57-1675	Shaft Retaining Plate (used on 76-604)
	58-191	Nine Prong Adapter Plug
R63	63-957	33K Ohm 1W 10% Ins.Res.
R79	63-1065	15K Ohm 1W 10% Ins.Res.
	63-1201	1800 Ohm W.W. 3W 10% Ins.Res.
R54	63-1449	470 Ohm W.W. 1W 20% Ins. Res.
	63-1565	4700 Ohm 1W 20% Ins.Res. (2 used)
R59	63-1674	Vertical Linearity Control
R50	63-1675	Horiz. Drive Control
R12	63-1743	100 Ohm 1/2W 10% Ins.Res. (3 used)

Diag. No.	Part No.	Description
R31	63-1744	100 Ohm 1/2W 20% Ins.Res.
R67	63-1751	150 Ohm 1/2W 20% Ins.Res. (2 used)
R36	63-1768	390 Ohm 1/2W 10% Ins.Res.
R21	63-1771	470 Ohm 1/2W 10% Ins.Res. (2 used)
R60	63-1775	560 Ohm 1/2W 10% Ins.Res. (used on 95-1246)(2 used)
R33	63-1782	820 Ohm 1/2W 10% Ins.Res.
R6	63-1785	1000 Ohm 1/2W 10% Ins.Res.
R35	63-1806	3300 Ohm 1/2W 10% Ins. Res.
R80	63-1807	3300 Ohm 1/2W 20% Ins.Res.
R61	63-1813	4700 Ohm 1/2W 10% Ins.Res. (3 used)
R62	63-1826	10K 1/2W 5% Ins.Res.
R11	63-1834	15K Ohm 1/2W 10% Ins.Res.
R34	63-1838	18K Ohm 1/2W 10% Ins.Res.
R37	63-1841	22K Ohm 1/2W 10% Ins.Res.
R39	63-1845	27K Ohm 1/2W 10% Ins.Res.
R89	63-1848	33K Ohm 1/2W 10% Ins.Res.
R5	63-1855	47K Ohm 1/2W 10% Ins.Res. (2 used)
R47	63-1862	68K Ohm 1/2W 10% Ins.Res.
R56	63-1863	68K Ohm 1/2W 20% Ins. Res.
R46	63-1869	100K Ohm 1/2W 10% Ins. Res. (3 used)
R25	63-1870	100K Ohm 1/2W 20% Ins.Res. (3 used)
R42	63-1883	220K Ohm 1/2W 10% Ins.Res. (3 used)
R49	63-1884	220K Ohm 1/2W 20% Ins.Res. (2 used)
R22	63-1890	330K Ohm 1/2W 10% Ins.Res.
R44	63-1894	390K Ohm 1/2W 10% Ins.Res.
R48	63-1898	470K Ohm 1/2W 20% Ins.Res. (2 used)
R64	63-1901	560K Ohm 1/2W 10% Ins.Res.
R45	63-1911	1 Megohm 1/2W 10% Ins.Res. (4 used)
R18	63-1912	1 Megohm 1/2W 20% Ins.Res.
R72	63-1919	1.5 Megohm 1/2W 20% Ins.Res.
R17	63-1926	2.2 Megohm 1/2W 20% Ins.Res.
R4	63-1933	3.3 Megohm 1/2W 20% Ins.Res.
R20	63-1982	100K Ohm 2W 10% Ins.Res. (2 used)
R82	63-1983	47 Ohm 2W 20% Ins.Res.
R78	63-2017	4000 Ohm W.W. 5W 10% Ins. Res. (2 used)
R19	63-2050	Bias Control
R77	63-2099	Focus Control
R76AB R76BB	63-2103	400 Ohm W.W. (Center Tapped)
R55	63-2110	Vertical Size Control
R98	63-1581	4.7 ohm 1/2W 10% Ins.
R40	63-2123	Contrast Control
R32	63-2125	Vol. Control & Switch
R43	63-2126	Intensity Control
	63-2130	150K Ohm 1W 10% Ins.Res.
R81	63-2134	150K Ohm 5W 20% Ins.Res.
R83	63-2135	15K Ohm 10W Candohm
R75	63-2137	100K Ohm 1W 10% Ins.Res.
R53	63-2140	VerticalHold Control
	63-2153	AGC Control
	73-112	#8-32x1/2" Slab. Hd. Set Screw (2 used on S-17093)
	73-114	#8-32x5/16" Slab Hd. Set. Screw (2 used S-17083 and 4 used S-16529)
	76-604	Fine Tuning Extension Shaft
	76-605	Horiz. Hold Control Shaft
	78-250	Elect. Cond. Socket
	78-580	Nine Contact Socket
	78-706	Octal Socket
	78-709	Octal Tube Socket
	78-755	Octal Tube Socket (5 used)
	78-807	Miniature Tube Socket(2 used)
	78-834	Octal Tube Socket
	78-840	AC Socket
	78-875	CR Tube Socket
	78-876	Noval Miniature Tube Socket
	78-883	Nine Contact Socket
	78-900	Pilot Light Socket & Wire
	80-744	Focus Mtg. Spring (4 used)
	80-802	Retaining Spring (1 ea. used on 149-100 & 149-101)
	80-822	Dial Cord Tension Spring
	80-823	Shaft Guide Spring
	80-824	Tube Plate Connector Spring (2 used)

Part No.	Description
80-825	C.R. Tube Retaining Spring
83-1802	Fuse Mtg. Strip
85-488	Picture Control Switch
87-1	Integrator Unit
93-2	Brass Washer (used on 22-2154)
93-525	Fibre Washer (2 used on 78-709)
93-961	Insulating Washer (used on Contrast Control)
93-971	Shell Support Washer (used on Horiz. Sweep)
93-1057	Insulating Washer (used on Contrast Control)
95-1240	Vertical Output Trans.
95-1246	Deflection Coil
100-67	Pilot Light
112-88	Thumb Screw #8-32 (Deflection Coil)
112-758	#4-40x1/4" RHST (used on 85-488)
114-45	#8x3/8" Hex Hd. S.T. Screw (2 used on S-17138)
114-268	#6x1/4" Hex. Hd. S.T. (2 used on 24-554)
114-310	#8x5/16" Hex. Washer Hd.S.T.
114-310	#8x5/16" Hex Washer Hd. S.T. (4 used on Turret and 2 used Deft. Coil)
125-26	Rubber Grommet (2 used on 78-709)
136-22	Fuse 1/4 Amp.
149-89	Iron Core (1 ea. used on S-16855 & S-17116)
149-98	Iron Core & Screw (used on S-17400)
149-100	Iron Core & Spring (used on S-17177)
149-101	Iron Core & Spring (used on S-17177)
149-102	Iron Core & Screw (used on S-17114)
188-131	Retaining Ring (used on S-17097)
188-137	Retaining Ring (used on S-17362)
196-146	Plastic Gasket
196-152	C.R. Tube Support Gasket
199-124	Focus Coil Sleeve
S-16855	Sound Trap Coil
S-17052	2nd Video Series Peaking Coil Assy.
S-17053	2nd Video Shunt Peaking Coil Assy.
S-17064	Video IF Strip Assy.(Complete)
S-17083	Gear Bushing & Set Screw Assy.
S-17084	Shaft Gear & Coupling Assy.
S-17096	Dial Cord & Eyelet Assy.
S-17097	Brkt., Pulley & Gear Assy.
S-17100	RF Shelf & Turret Assy. (Complete)
S-17114	Horiz. Osc. Coil Assy.
S-17116	4.5 Mc Video Trap Coil Assy.
S-17127	Plug & Bracket Assy.
S-17138	Gasket Reinforcing Brkt. Assy.
S-17140	Horizontal Sweep Transformer Assy.
S-17174	Deflection Yoke Mtg. Brkt Assy.
S-17175	Horizontal Size Control Assy.
S-17176	Horiz. Linearity Control Coil Assy.
S-17177	Horiz. Size Control & Horiz. Linearity Control & Brkt. Assy.
S-17178	Fire Shield Assy.
S-17179	Horiz. Sweep Trans. Mtg. Plate Assy.
S-17185	C.R. Tube & Socket Assy.
S-17187	Insulator Strip & Terminal Assy.
S-17230	Mechanical ing & Focus Assy.
S-17362	Indicator Drun. haft Assy.
S-17377	Contrast Control Shaft & Bushing Assy.
S-17400	Picture Control Coil Assy.
S-17425	Fine Tuning Shaft & Bushing Assy.

Part No.	Description
S-17429	Anode Lead & Eyelet Assy.
S-17461	Beam Bender Unit

TUBES

1 - 16GP4B	3 - 6SN7GT
1 - 1B3GT	1 - 6SN7GTA
1 - 6AL5	1 - 6W4GT
1 - 6BN6	1 - 12AU7
2 - 6BQ6GT	

S-17189 POWER SUPPLY

Part No.	Description
22-2127	.001 Mfd. (Molded) 600V
	Elect. 20 Mfd. 200V - 20 Mfd
22-2224	450V 40 Mfd. 450V 20 Mfd 25V
54-42	10-32x5/16x3/32 Hex. Nut Steel N.P. (4 used 95-1245)
58-172	Nine Prong Plug
63-1764	330 Ohm 1/2W 10% Ins.Res.
63-1814	4700 Ohm 1/2W 20% Ins. Res.
63-1997	6800 Ohm W.W. 2W 10% Ins. Res.
63-2022	10K Ohm W.W. 5W 10% Ins. Res.
63-2136	Candohm
78-274	Elect. Cond. Socket
78-755	Octal Tube Socket (2 used)
78-810	Miniature Tube Socket
93-127	#10 Int. Shakeproof Lockwasher (4 used on 95-1245)
95-1218	Filter Choke
95-1245	Power Transformer
95-1247	Output Transformer
114-43	10-32x3/8" Hex. Sl. Washer Hd. M. S. (4 used on 95-1245)
114-297	#6x1/4" Hex. Hd. Sl.S.T. (2 used on 126-604)
125-69	Rubber Grommet
126-604	Heat Shield
S-17189	Power Supply (Complete)
S-17195	Cable Assembly

TUBES

1 - 6BF5
1 - 5U4G
1 - 5Y3GT

S-17230 CENTERING & FOCUS ASSY

Part No.	Description
57-1548	Centering Plate
57-1549	Focusing Coil Mtg. Plate
57-1684	Magnet End Plate
93-951	Spring Washer - Shakeproof - Blued
93-1006	.0359x.1561 Dx1/2" O.D. Steel
93-1007	.0359x.1561 Dx1" O.D. Steel
93-1009	Spring Washer - Blued
114-48	#6-32x1/4" Hex. Hd. Sl. M.S. (2 used)
S-17230	Mechanical Centering & Focus Assy. (Complete)
S-17332	Focusing Coil Assy.

S-17268 TV REMOTE CONTROL KIT

Part No.	Description
6-66	Ball Bearing (2 used)
12-1783	Latch Bracket
15-97	Control Cap (used on S-17267)
16-663	Packing Carton (S-17267)
16-664	Packing Carton (S-17268)
19-214	Coupling Sleeve Retaining Clip (2 used)
20-332	Magnet Coil
22-2252	Elect. 130 Mfd. 40V
34-213	Worm Drive Gear
43-193	Control Housing (used on S-17267)
46-897	Push Knob - White
46-898	Push Knob - Black
52-596	Cable and Plug (used on S-17267)
	#6-32x1/4"x3/32" Hex

Diag. No.	Part No.	Description
	54-34	Nut (4 used on Elect. & Motor Mtg.)
	57-1681	Worm Latch Plate
	57-1683	Switch Mtg. Plate (used on S-17267)
	58-194	Three Prong Plug (Part of 52-596)
	72-3	#5x5/8" Flat Hd. W. S. Steel N.P. (2 used)
	73-136	#8-32x1/2" Hex.Hd. Sl. Set Screw (2 used on S-17378)
	78-901	Three Contact Socket and Ring
	80-833	Knob Tension Spring
	80-834	Worm Latch Spring
	83-1817	Magnet Insulator Strip
	85-492	Push Switch (2 used S-17267)
	93-125	#6 Int. Shakeprf Lockwasher (1 used with ea. 54-34)
	93-1062	1/16x.169x.310 Bakelite Washer (used on S-17392)
	93-1064	.010x.169x1/2" Fishpaper Washer (used on S-17392)
	93-1066	Bearing Washer
	93-1067	Magnet Shading Washer
	93-1068	Worm Thrust Washer
	94-295	Mtg. Bushing (2 used on S-17268)
	94-738	Bearing Bushing
	94-740	Motor Mtg. Bushing (4 used)
	95-1255	Step Down Trans.
	97-398	Worm Latch Stud (2 used)
	113-8	#6-32x1/4" Hex.Hd. Sl. M.S. Steel Shakeproof (3 used on S-17312 & 2 used on 95-1255)
	113-24	#8-32x3/8" Hex.Hd. Sl. M.S. (Part of S-17392)
	113-40	#6-32x1/4" Phill. RHMS Steel Shakeproof (2 used on S-17267)
	113-41	#2-56x3/16" RHMS Steel Shakeproof (2 used on 15-97 and Knobs)
	113-42	#2-56x5/16" Phill. Pan Hd. M.S. (Black Nickle) (used 2 on S-17267)
	114-199	#6-3/16" Hex. Hd. Sl. S. T. (used on 12-1783)
	114-358	#6x1/2" Hex. Hd. Sl.S.T. (4 used on S-17268 Mtg.)
	125-17	Rubber Grommet (4 used)
	141-130	Drive Motor
	149-106	Magnet Core
	199-140	Coupling Sleeve
	202-849	Instruction Book
	S-17266	Remote Control Assy. (Complete)
	S-17267	Hand Control & Cable Assy. (Complete)
	S-17268	Remote Control & Hand Control & Cable Assy. (Comp.)
	S-17211	Planetary Gear & Yoke Assy.
	S-17312	Housing & Bearing Bushing Assy.
	S-17317	Drive Gear Assy.
	S-17324	Cable, Socket & Brkt Assy.
	S-17378	Output Gear & Set Screw Assy.
	S-17392	Magnet & Brkt. Assy.

ALL MODELS WITH SUFFIX LETTER "Q" ARE EQUIPPED WITH THE S-17268 REMOTE CONTROL ASSEMBLY AND UTILIZE THE FOLLOWING ADDITIONAL PARTS:

Part No.	Description
72-3	#5x5/8" Flat Hd W.S. Steel N.P. (2 used)
94-295	Mounting Bushing (4 used)
114-358	#6x1/2" Hex.Hd. Sl. S.T. (4 used)
202-849	Instruction Book(Remote Control)
S-17266	Remote Control Assy.
S-17267	Hand Control & Cable Assy.

CABINET PARTS H2226E

Diag. No.	Part No.	Description
	11-106	Line Cord & Plug 9' lg.
	12-1797	Clamping Guide Brkt. (Esc. Mtg.)
	14-1264E	Cabinet for H2226E Table Model
	16-649	Packing Carton
	24-446	AC Line Cord Plug Cover
	24-555	Control Cover (use S-17497)
	46-833	Volume Control Knob
	46-885	Contrast Control Knob
	46-887	Horiz. Hold Knob
	46-889	Channel Selector Knob
	46-893	Brightness Control Knob
	46-895	Fine Tuning Knob
	46-896	Vertical Hold Knob
SP1	49-679	Speaker 5-1/4" PM ZC 5093 Cone
	56-286	Cover Hinge Pin
	57-1481	Esc. Clamping Plate (3 used)
	57-1670	Glass Retaining Plate (2 used)
	57-1672	Nameplate (use S-17497)
	57-1673	Escutcheon
	57-1678	Escutcheon (Vol. Control)
	57-1679	Escutcheon (Channel Selector)
	70-3	#5x1/2" RHWS Steel N.P. (2 used to mt. S-17306)
	70-86	#6x5/8" Washer Hd Wood Screw St.Br. (5 used to mt. S-17333)
	72-81	#8x3/4" Phill. Flt. Hd. Wood Screw St. Br.(4 used to mt. S-17307)
	74-58	Ventilating Screen
	78-787	Two Contact Socket (used with 11-106)
	80-826	Grounding Spring
	80-828	Door Return Spring
	112-758	4-40x1/4" RHST Cad (6 used on Esc. mt.)
	114-80	1/4-20x1-3/8" Hex Washer Hd. M.S. (4 used chassis mtg.)
	114-341	#6x3/8" Hex. Hd S.T. (used on 80-826)
	114-353	#6x1/4" Hex.Hd S.T. Cad. (4 used on Esc. Mtg.)
	192-136	Protective Glass
	196-148	Glass Gasket
	196-160	Rubber Gasket
	202-829	Instruction Book
	S-17306	Antenna Terminal & Wire Assy.
	S-17307	Cabinet Antenna Assy. (Complete)
	S-17333	Cabinet Back Assy. (Complete)
	S-17497	Cover and Nameplate Assy.

CABINET PARTS H2226R & RQ

Model H2226R is the same as H2226E except for the following:

OMIT:

Part No.	Description
14-1264E	Cabinet for H2226E Table Model
46-833	Vol. Control Knob
46-889	Channel Selector Knob

ADD:

Part No.	Description
14-1264R	Cabinet for H2226R Table Model
46-888	Channel Selector Knob
46-890	Vol. Control Knob.

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Diag. No.	Part No.	Description

CABINET PARTS H2227E & EQ

Diag. No.	Part No.	Description
	11-106	Line Cord & Plug 9' lg.
	12-1797	Clamping Guide Brkt.
	14-1266E	Cabinet for H2227E Table Model
	16-651	Packing Carton
	24-446	AC Line Cord Plug Cover
	24-555	Control Cover (use S-17497)
	46-833	Vol. Control Knob
	46-885	Contrast Control Knob
	46-887	Horiz. Hold Knob
	46-889	Channel Selector Knob
	46-893	Brightness Control Knob
	46-895	Fine Tuning Knob
	46-896	Vertical Hold Knob
	49-679	5-1/4" PM Speaker ZC5093 Cone
	56-286	Cover Hinge Pin
	57-1481	Esc. Clamping Plate (3 used)
	57-1670	Glass Retaining Plate
	57-1672	Nameplate (use S-17497)
	57-1673	Escutcheon
	57-1678	Esc. (Vol. Control)
	57-1679	Esc. (Channel Selector)
	70-3	#5x1/2" RHWS Steel N.P. (2 used to mt. S-17306)
	70-86	#6x5/8" Washer Hd. Wood Screw St.Br.(5 used to mt. S-17347)
		#8x3/4 Phill. Flt. Hd. Wood
	72-81	Screw St. Br. (4 used to mt. S-17307)
	74-58	Ventilating Screen
	78-787	Two Contact Socket
	80-826	Grounding Spring.
	80-828	Door Return Sprng
	112-758	4-40x1/4" RHST Cad. (8 used on Esc. mtg)
		1/4-20x1-3/8" Hex. Washer
	114-80	Hd. M. S. (4 used chassis Mtg.)
	114-341	#6x3/8" Hex. Hd. S.T. Cad. (used on 80-826)
	114-353	#6x1/4" Hex.Hd. S.T. Cad. (used 4 on Esc. Mtg.)
	192-136	Protective Glass
	196-148	Glass Gasket
	196-160	Rubber Gasket
	202-829	Instruction Book
	S-17306	Antenna Terminal & Wire Assy.
	S-17307	Cabinet Antenna Assy.
	S-17347	Cabinet Back Assy. (Complete)
	S-17497	Cover & Nameplate Assy.

CABINET PARTS H2227R & RQ

Model H2227R is the same as H2227E except for the following:

OMIT:

Part No.	Description
14-1266E	Cabinet for H2227E Table Model
46-833	Volume Control Knob
46-889	Channel Selector Knob

ADD:

Part No.	Description
14-1266R	Cabinet for H2227R Table Model
46-888	Channel Selector Knob
46-890	Vol. Control Knob

CABINET PARTS H2250R & RQ

Diag. No.	Part No.	Description
	11-106	Line Cord & Plug 9' lg.
	12-1797	Clamping Guide Brkt. (2 used)
	14-1260R	Cabinet for H2250R
	16-640	Packing Carton
	24-446	AC Line Cord Plug Cover
	24-555	Control Cover (use S-17497)
	46-885	Contrast Control Knob
	46-887	Horizontal Hold Knob
	46-888	Channel Selector Knob
	46-890	Volume Control Knob
	46-893	Brightness Control Knob
	46-895	Fine Tuning Knob
	46-896	Vertical Hold Knob
SP1	49-649	10" PM Speaker ZC10161 Cone
	56-286	Cover Hinge Pin
	57-1481	Esc. Clamping Plate (3 used)
	57-1670	Glass Retaining Plate
	57-1672	Nameplate (use S-17497)
	57-1673	Escutcheon
	57-1678	Escutcheon (Vol. Control)
	57-1679	Escutcheon (Channel Selector)
	70-3	#5x1/2" RHWS Steel N.P. (2 used to mt. S-17305)
		#6x5/8" Washer Hd. Wood
	70-86	Screw St.Br. (5 used on Esc. Mtg.)
		#8x3/4" Phil. Flt. Hd.
	72-81	Wood Screw St. Br. (5 used on Esc. mtg.)
	74-58	Ventilating Screen
	78-787	Two Contact Socket
	80-826	Grounding Spring
	80-828	Door Return Spring
	112-758	4-40x1/4" RHST Cad.(8 used Esc. mtg.)
	114-80	1/4-20x1-3/8" Hex. Washer Hd. M.S. (4 used chassis mtg)
	114-341	#6x3/8" Hex. Hd. S.T. (used on 80-826)
	114-353	#6x1/4" Hex. Hd. S.T. (4 used on Esc. Mtg.)
	165-9	Metal Glide (4 used)
	192-136	Protective Glass
	196-148	Glass Gasket
	196-160	Rubber Gasket
	202-829	Instruction Book
	S-17198	Cabinet Back Assy.(Comp.)
	S-17305	Antenna Terminal & Wire Assy.
	S-17444	Cabinet Antenna Assy. (Complete)
	S-17497	Cover & Nameplate Assy.

CABINET PARTS H2255E & EQ

Model H2255E is the same as H2250R except for the following:

OMIT:

Part No.	Description
14-1260R	Cabinet for H2250R Console Model
16-640	Packing Carton
46-888	Channel Selector Knob
46-890	Vol. Control Knob
165-9	Metal Glide (4 used)

ADD:

Part No.	Description
14-1256E	Cabinet for H2255E Console Model
16-635	Packing Carton
46-833	Vol. Control Knob
46-889	Channel Selector Knob
165-13	Metal Glide (4 used)

CABINET PARTS H2437E

Part No.	Description
11-106	Line Cord & Plug - 9' lg.
14-1258E	Cabinet for H2437E Console Model.
16-637	Packing Carton
24-446	AC Line Cord Plug Cover
40-89	Cabinet Door Hinge (2 used)
46-833	Volume Control Knob
46-885	Contrast Control Knob
46-887	Horizontal Hold Knob
46-889	Channel Selector Knob
46-893	Brightness Control Knob
46-895	Fine Tuning Knob
49-649	10" PM Speaker ZC10161 Cone
56-286	Cover Hinge Pin
57-1270	Strike Plate
57-1481	Esc. Clamping Plate (3 used)
57-1670	Glass Retaining Plate (4 used)
57-1671	Escutcheon
57-1678	Esc. (Vol. Control)
57-1679	Esc. (Channel Selector)
70-3	#5x1/2" RHWS Steel (2 used to mt. S-17305)
	#6x5/8" Washer Hd.
70-86	Wood Screw St. Br. (4 used to mt. S-17192)
74-58	Ventilating Screen
78-787	Two Contact Socket
80-826	Grounding Spring
80-828	Door Return Spring
112-813	4-40x5/16" RHST (8 used on Esc. mtg.)
	1/4-20x1-3/8" Hex. Washer Hd. M.S. (4 used to mt.
114-80	chassis & 2 used to mt. power supply.)
114-201	#8x5/16" Hex. Hd. Sl. S.T. (used on power supply)
114-313	#8x1/2" Hex.Hd. S.T. (3 used on Esc. Mtg.)
114-341	#6x3/8" Hex. Hd. S.T. (used on 80-826)
156-33	Bullet Catch
165-13	Metal Glide (4 used)
166-57	Tack Bumper (2 used)
192-137	Protective Glass
196-149	Glass Gasket
202-829	Instruction Book
S-17189	Power Supply (Complete)
S-17192	Cabinet Back Assy.
S-17305	Antenna Terminal & Wire Assy.
S-17444	Cabinet Antenna Assy. (Complete)
S-17497	Cover & Nameplate Assy.

CABINET PARTS H2437R

Model H2437R is the same as H2437E except for the following:

OMIT:

Part No.	Description
14-1258E	Cabinet for H2437E Console Model
40-89	Cabinet Door Hinge (2 used)
46-833	Volume Control Knob
46-889	Channel Selector Knob
57-1270	Strike Plate
156-33	Bullet Catch
166-57	Tack Bumper

ADD:

Part No.	Description
14-1258R	Cabinet for H2437R Console Model
40-90	Cabinet Door Hinge (2 used)
46-888	Channel Selector Knob
46-890	Volume Control Knob
57-1284	Strike Plate
156-35	Bullet Catch
166-55	Tack Bumper

CABINET PARTS H2438R

Part No.	Description
11-106	Line Cord & Plug - 9' lg.
14-1259R	Cabinet for H2438R Console Model
16-638	Packing Carton
24-446	AC Line Cord Plug Cover
46-885	Contrast Control Knob
46-887	Horizontal Hold Knob
46-888	Channel Selector Knob
46-890	Volume Control Knob
46-893	Brightness Control Knob
46-895	Fine Tuning Knob
46-896	Vertical Hold Knob
49-649	10" PM Speaker ZC10161 Cone
56-286	Cover Hinge Pin
57-1481	Esc. Clamping Plate (3 used)
57-1670	Glass Retaining Plate (4 used)
57-1671	Escutcheon
57-1678	Escutcheon (Vol. Control)
57-1679	Escutcheon (Channel Selector)
70-3	#5x1/2" RHWS Steel N.P. (2 used S-17305)
	#6x5/8" Washer Hd. Wood
70-86	Screw Stat. Br. (4 used on S-17192)
	#8x3/4 Phillips Flt. Hd.
72-81	Wood Screw Stat. Br. (4 used on S-17444)
78-787	Two Contact Socket
80-826	Grounding Spring
80-828	Door Return Spring
112-813	4-40x5/16" RHST Cad. (8 used on Esc. Mtg.)
114-80	1/4-20x1-3/8" Hex Washer Hd. M.S. (4 used chassis mtg. (3 used pwr supply mtg.)
114-201	#8x5/16" Hex. Hd. Sl. S.T. (used on Power Supply)
114-313	#8x1/2" Hex.Hd. S.T. (3 used on Esc. Mtg.)
114-341	#6x3/8" Hex. Hd. S.T. (used on 80-826)
165-13	Metal Glide (4 used)
192-137	Protective Glass
196-149	Glass Gasket
202-829	Instruction Book
S-17189	Power Supply (Complete)
S-17192	Cabinet Back Assy. (Complete)
S-17305	Antenna Terminal & Wire Assy.
S-17444	Cabinet Antenna Assy.
S-17497	Cover & Nameplate Assy.

CABINET PARTS H2439R

Part No.	Description
11-106	Line Cord & Plug - 9' lg.
14-1257R	Cabinet for H2439R console model
16-634	Packing Carton
24-446	AC Line Cord Plug Cover
46-885	Contrast Control Knob
46-887	Horizontal Hold Knob
46-888	Channel Selector Knob
46-890	Volume Control Knob
46-893	Brightness Control Knob
46-895	Fine Tuning Knob
46-896	Vertical Hold Knob
49-687	12" PM Speaker ZC12161 Cone
56-286	Cover Hinge Pin
57-1284	Strike Plate (2 used)
57-1481	Esc. Clamping Plate (3 used)
57-1670	Glass Retaining Plate (4 used)
57-1671	Escutcheon
57-1678	Esc. (Volume Control)
57-1679	Esc. (Channel Selector)
70-3	#5x1/2" RHWS Steel N.P. (2 used on S-17305)
	#6x5/8" Washer Hd. Wood
70-86	Screw St. Br. (4 used on S-17192)
72-81	#8x3/4 Phil. Flt Hd Wood Screw (St.Br.) (4 used on S-1 444)
74-58	Ventilating Screen
78-787	Two Contact Socket
80-826	Grounding Spring
80-828	Door Return Spring
	4-40x5/16" RHST Cad
112-813	(8 used on Esc. Mtg)
	1/4-20x1-3/8" Hex. Washer
114-80	Hd. M.S. (4 used chassis mtg. & 3 used pwr supply mtg.)
114-201	#8x5/16" Hex. Hd. Sl. S.T. (used on Pwr. Supply)
114-313	#8x1/2" Hex.Hd. S.T. Cad. (3 used on esc. mtg.)
114-341	#6x3/8" Hex. Hd. S.T. Cad. (used on 80-826)
156-35	Bullet Catch (2 used)
165-13	Metal Glide (4 used)
166-55	Tack Bumper (2 used)
192-137	Protective Glass
196-149	Glass Gasket
202-829	Instruction Book
S-17189	Power Supply Assy. (Complete)
S-17192	Cabinet Back Assy. (Complete)
S-17305	Antenna Terminal & Wire Assy.
S-17444	Cabinet Antenna Assy. (complete)
S-17497	Cover & Nameplate Assy.

CABINET PARTS H2449E

Part No.	Description
11-106	Line Cord & Plug - 9' lg.
14-1255E	Cabinet for H2449E Console Cabinet.
16-633	Packing Carton
24-446	AC Line Cord Plug Cover
46-833	Volume Control Knob
46-885	Contrast Control Knob
46-887	Horizontal Hold Knob
46-889	Channel Selector Knob
46-893	Brightness Control Knob
46-895	Fine Tuning Knob
46-896	Vertical Hold Knob
49-687	12" PM Speaker ZC12161 Cone
56-286	Cover Hinge Pin
57-1481	Esc. Clamp. Plate (3 used)
57-1670	Glass Retaining Plate (4 used)
57-1671	Escutcheon
57-1678	Esc. (Vol. Control)
57-1679	Esc. (Channel Selector)
70-3	#5x1/2" RHWS Steel N.P. (2 used on S-17305)
	#6x5/8" Washer Hd. Wood
70-86	Screw St. Br. (4 used on S-17192)
70-160	#8x1" Phil. RHWS (4 used on 138-39)
	#8x3/4" Phil. Flt. Hd.
72-81	Wood Screw St. Br. (4 used on S-17444)
74-58	Ventilating Screen
78-787	Two Contact Socket
80-826	Grounding Spring
80-828	Door Return Spring
112-813	4-40x5/16" RHST Cad. (8 used on Esc. Mtg.)
	1/4-20x1-3/8" Hex. Washer
114-80	Hd. M.S. (4 used on chassis mtg. & 3 used pwr. supply)
114-201	#8x5/16" Hex Hd Sl. S.T. (used on pwr supply)
114-341	#6x3/8" Hex Hd. S.T. Cad. (used on 80-826)
125-79	Rubber Grommet (4 used on 138-39)
138-39	Cabinet Grille
165-13	Metal Glide (4 used)
192-137	Protective Glass
196-149	Glass Gasket
202-829	Instruction Book
S-17189	Power Supply Assy. (complete)
S-17192	Cabinet Back Assy. (complete)
S-17305	Antenna Terminal & Wire Assy-
S-17444	Cabinet Antenna Assy. (complete)
S-17497	Cover & Nameplate Assy.

SPECIAL TEST EQUIPMENT FOR TV

Part No.	Description
68-7	Alignment Wrench
68-13	Alignment Tool
68-14	Tuning Wand
68-17	Adjustment Wrench for Master Oscillator and Sound Trap Adjustments
	Trap Adjustments on RF Shelf
68-18	18" Insulated Screwdriver for Hum and AGC adjustments
68-19	Nylon Alignment Wrench
95-1234	250 Watt Isolation Transformer
S-15369	Generator Test Unit
S-15371	Coupling Ring
S-15521	AC Test Cord for TV Chassis
S-15627	Balance Transformer (Ant)
S-15729	Balance Transformer (Receiver)
S-17303	Step Attenuator

PARTS SUPPLEMENT

S-17635 VIDEO I.F. ASSEMBLY

(Also refer to Parts List for S-17064 I.F. Assembly)

The S-17635 Video I.F. Assembly is interchangeable with the S-17064 units used in early production "H" series receivers. The new I.F. can be identified by the oblong shaped can which houses the 5th IF transformer.

Diag. No.	Part No.	Description
	19-209	Coil Mtg. Clip
C29	22-3	.01 Mfd. Ceramic (Disc) (4 used) 500V
C27	22-4	.004 Mfd. Ceramic (Disc) (or 22-1706)(2 used) 500V
C57	22-1138	470 Mfd. Mica (molded) 500V
C30	22-1761	50 Mmfd. Ceramic 500V
C72	22-1777	0.1 Mfd. 200V
C28	22-1874	7 Mmfd. Ceramic 500V
C31	22-2106	10 Mmfd. Ceramic 500V
C26	22-2143	470 Mmfd. Ceramic (4 used) 500V
C22	22-2216	500 Mmfd. Ceramic (4 used) 500V
C32	22-2218	.001 Mfd. Ceramic 500V
	54-271	#6-32x1/4" Hex Palnut Inverted Type (2 used on each I.F.)
	56-292	Coil Insert Ret. Pin
R99	63-1101	8200 ohm 2W 10% Ins.
R9	63-1736	68 ohm 1/2W 10% Ins.
R12	63-1743	100 ohm 1/2W 10% Ins.
R1	63-1750	150 ohm 1/2W 10% Ins.
R91	63-1754	180 ohm 1/2W 10% Ins.
R21	63-1771	470 ohm 1/2W 10% Ins.
R13	63-1772	470 ohm 1/2W 20% (6 used) Ins.
R33	63-1782	820 ohm 1/2W 10% Ins.
R6	63-1785	1000 ohm 1/2W 10% Ins.
R23	63-1799	2200 ohm 1/2W 10% Ins.
R61	63-1813	4700 ohm 1/2W 10% Ins.
R51	63-1820	6800 ohm 1/2W 10% Ins.
R89	63-1848	33K ohm 1/2W 10% Ins.
R10	63-1849	33K ohm 1/2W 20% Ins.
R47	63-1862	68K ohm 1/2W 10% Ins.
R49	63-1884	220K ohm 1/2W 20% Ins.
R22	63-1890	330K ohm 1/2W 10% Ins.
R18	63-1912	1 Megohm 1/2W 20% Ins.
R93	63-1979	68K ohm 1W 10% Ins.
	78-876	Miniature Tube Socket (Nine Contact)
	78-905	Miniature Tube Socket (5 used)
	94-538	Tuning Slug Insert (1 ea. used on S-16013 & S-16738)
	94-706	Tuning Slug Insert (1 ea. used on S-16275 - S-16604 & S-16605)
	94-742	Tuning Slug Insert (used on S-16274)
	94-750	Tuning Slug Insert (used on S-17613)
A2	103-1	Crystal Diode (1N64)
	125-69	Rubber Grommet (2 used)
	126-661	Tube Shield
	149-71	Iron Core (used on S-16984)
	149-89	Iron Core (1 ea. used on S-16738 & S-16013)
	149-96	Iron Core (1 ea. used on S-16274-75 - S-16604-05 & S-17614)
L55	S-15128	B+ Choke Coil Assembly
L56	S-16011	Shunt Peaking Coil Assy.
L58	S-16013	Quadrature Coil Assy.
T1	S-16274	1st. Video I.F. Trans. Assy.
T2	S-16275	2nd. Video I.F. Trans. Assy.

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Diag. No.	Part No.	Description
T3	S-16604	3rd. Video I.F. Trans. Assy.
T4	S-16605	4th. Video I.F. Trans. Assy.
L57	S-16738	Intercarrier Sound I.F. Coil Assembly
L84	S-16984	Filament Choke Coil Assy.
L85	S-17505	Inverter Plate Peaking Coil Assembly
T5	S-17614	5th Video I.F. Trans. Assy.
	S-17635	Video I.F. Strip Assy. (Comolete)

MODEL H3469E & EQ - H3475R & RQ - H3267R & RQ (24H20 & 10H20) (24H20 & 10H20) (24H20 & 8H20)

MODEL H3469E CABINET PARTS

Part No.	Description
2-199	Cabinet Back (Phono Section)
11-106	Line Cord & Plug - 9 ft. lg.
12-1797	ClampingGuide Brkt. (2 used on Esc. Mtg.)
14-1263E	Cabinet for H3469E Console Combination Model
16-644	Packing Carton - Inner Pack
16-645	Packing Carton - Outer Pack
19-9	Cable Clip
19-169	Record Changer Mtg. Clip (2 used)
19-210	Loop Connector Clip (2 used)
24-535	Line Cord Plug Cover
46-833	Volume Control Knob
46-876	Tuning Control Knob
46-885	Contrast Control Knob
46-887	Horizontal Hold Knob
46-889	Channel Selector Knob
46-893	Brightness Control Knob
46-895	Fine Tuning Knob
46-896	Vertical Hold Knob
46-899	Band Switch Knob
49-694	12" P.M. Speaker ZC12161 Cone & Voice Coil
56-286	Cover Hinge Pin
57-1284	Strike Plate (2 used)
57-1481	Escutcheon Clamping Plate (7 used)
57-1666	Radio Dial Esc.
57-1670	Glass Retaining Plate (2 used)
57-1671	Television Esc.
57-1678	Esc. (Vol. Control)
57-1679	Esc. (Channel Selector)
70-86	#6 x 5/8 Washer Hd. Wood Screw - St. Br. (11 used to mt. backs)
72-81	#8 x 3/4" Phillips Flt. Hd. Wood Screw St. Br. (4 used to mt. S-16890)
74-58	Ventilating Screen
74-71	Ventilating Screen
78-787	Two Contact Socket
80-604	Hinge Spring (2 used)
80-826	Grounding Spring
80-828	Door Return Spring
80-830	Record Changer Mtg. Spring
93-168	Rubber Shoulder Washer (4 used)
112-808	#6 x 5/16 Phill. Rd. Hd. S.T. (4 used Mtg. Radio Esc.)
112-809	Record Changer Mtg. Screw (3 used)
112-813	4-40 x 5/16 R.H.S.T. (8 used to mt. TV esc.)
114-201	#8 x 5/16 Hex Hd. S. T. (used on pwr. supply) Chassis & 3 used mtg. pwr. supply)
114-341	#6 x 3/8 Hex Hd. S.T. (used on 80-826)
114-350	#8 x 7/16" Hex Hd. Sl. S. T. (4 used on Radio esc. mtg.)
126-650	Heat Shield
156-35	Bullet Catch (2 used)
159-50	Plug Button (2 used)
165-9	Metal Glide (2 used)
165-14	Metal Glide (2 used)
166-57	Tack Bumper (2 used)

Part No.	Description
188-54	Knob Clamping Ring (46-876)
192-137	Protective Glass (TV)
192-138	Dial Glass (Radio)
196-149	Glass Gasket (TV)
202-829	TV Instruction Book
202-851	Radio-Phono Instruction Book.
S-14029	Variable Speed Record Changer
S-15528	Low Impedance Loop Assy.
S-15536	Record Changer Compt. Hinge Brkt. & Link Assy.(2 used)
S-15780	Cobra Tone Arm Cartridge
S-16419	Record Adapter Plug & Envelope Assembly
S-16890	Cabinet Antenna Assy. (Complete)
S-17005	Record Changer Mtg. Frame Assembly
S-17167	Vol. Control Knob Assy.
S-17189	Power Supply Assy. (Compl)
S-17255	Radiorgan Cable Assy.
S-17264	Cabinet Back Assy. (Compl) (TV)
S-17328	Loop Loading Coil Assy.
S-17497	Cover & Nameplate Assy.
S-17556	Antenna Terminal & Wire Assembly

RADIORGAN ESCUTCHEON PARTS

Part No.	Description
76-444	Radiorgan Knob Shaft
114-297	#6 x 1/4 Hex Hd. Sl. S.T. (2 ea. used on S-17252 & S-17253)
S-14255	Radiorgan Mtg. Brkt. Assy (2 used)
S-17246	Radiorgan Knob & Eyelet Assy. (Treble)
S-17247	Radiorgan Knob & Eyelet Assy. (Voice)
S-17248	Radiorgan Knob & Eyelet Assy. (Alto)
S-17249	Radiorgan Knob & Eyelet Assy. (Bass)
S-17250	Radiorgan Knob & Eyelet Assy. (Lo-Bass)
S-17251	Radiorgan Knob & Eyelet Assy. (Normal)
S-17252	Radiorgan Esc. & Knob Assy. (R.H.)
S-17253	Radiorgan Esc. & Knob Assy. L.H.)

MODEL H3475R CABINET PARTS

Model H3475R is the same as Model H3469E except the following:

OMIT:

Part No.	Description
2-199	Cabinet Back (Phono Section)
14-1263E	Cabinet for H3469E Console Combination Model
16-644	Packing Carton - Inner Pack
16-645	Packing Carton - Outer Pack
46-833	Vol. Control Knob
46-889	Channel Selector Knob
126-650	Heat Shield
166-57	Tack Bumper (2 used)

ADD:

Part No.	Description
2-197	Cabinet Back (Phono Section)
14-1261R	Cabinet for H3475R Console Combination
16-642	Packing Carton - Inner Pack
16-643	Packing Carton - Outer Pack
46-888	Channel Selector Knob
46-890	Vol. Control Knob
126-649	Heat Shield
166-55	Tack Bumper

MODELS H3267 & H3267R CABINET PARTS

Part No.	Description
2-209	Cabinet Back (Phono Section)
11-106	Line Cord & Plug - 9 ft. lg. (TV Back)
11-109	Line Cord & Plug - 3 ft. lg. (Radio Back)
12-1797	Clamping Guide Brkt. (2 used on TV Esc. Mtg.)
14-1271	Cabinet for H3267 Console Combination
14-1271R	Cabinet for H3267R Console Combination
16-654	Packing Carton - Inner Pack
16-655	Packing Carton - Outer Pack
19-169	Record Changer Mtg. Clip (2 used)
24-535	Line Cord Plug Cover
46-873	Tone Control Knob
46-876	Tuning Control Knob
46-885	Contrast Control Knob
46-887	Horizontal Hold Knob
46-888	Channel Selector Knob
46-890	Vol. Control Knob
46-893	Brightness Control Knob
46-895	Fine Tuning Knob
46-896	Vertical Hold Knob
46-899	Band Switch Knob
49-694	12" P.M. Speaker ZC12161 Cone & Voice Coil
56-286	Cover Hinge Pin
57-1284	Strike Plate (2 Used)
57-1481	Esc. Clamping Plate
57-1658	Radio Dial Esc.
57-1670	Glass Retaining Plate (TV)
57-1671	Television Esc.
57-1678	Esc. (Vol. Control)
57-1679	Esc. (Channel Selector)
70-86	#6 x 5/8 Washer Hd. Wood Screw St. Br. (15 used to mt. backs)
72-81	#8 x 3/4" Phill. Flt. Hd. Wood Screw St. Br. (4 used to mt. S-16890)
74-58	Ventilating Screen
74-75	Ventilating Screen
78-787	Two Contact Socket (TV Back)
78-847	Two Contact Socket (Radio Back)
80-604	Hinge Spring (2 used)
80-826	Grounding Spring
80-828	Door Return Spring
80-830	Record Changer Mtg. Spring (4 used)
93-1059	Felt Washer (used on 46-873)
97-293	Chassis Mtg. Insulating Stud (3 used)
100-97	Pilot Light Bulb
112-809	Record Changer Mtg. Screw (3 used)
112-813	4-40 x 5/16" R.H.S.T. (8 used on TV Esc. Mtg.)
114-80	1/4-20 x 1-3/8" Hex Hd. (4 used to mt. TV Chassis) (3 used to mt. Pwr. Supply)
114-128	#10 x 1-1/16" Hex Washer Hd. S.T. (3 used to mt. radio chassis)
114-201	#8 x 5/16 Hex Hd. S. T. (used on pwr. supply)
114-341	#6 x 3/8 Hex Hd. S. T. (used on 80-826)
114-350	#8 x 7/16" Hex Hd. Sl. S. T. (4 used on Radio Esc. Mtg.)
126-648	Heat Shield
156-35	Bullet Catch (2 used)
159-50	Plug Button (2 used)
165-9	Metal Glide (2 used)
165-14	Metal Glide (2 used)
166-55	Tack Bumper (2 used)
188-54	Knob Clamping Ring (46-876)
192-137	Protective Glass (TV)
192-138	Dial Glass (Radio)
196-149	Glass Gasket (TV)
202-829	Television Instruction Book
202-850	Radio-Phono Instruction Book
S-14029	Variable Speed Record Changer
S-15536	Record Changer Compt. Hinge Brkt. & Link Assy. (2 used)
S-15737	Socket Cap & Brkt.
S-15780	Cobra Cartridge
S-16419	Record Adapter Plug & Envelope Assembly
S-16890	Cabinet Antenna Assy.
S-17005	Record Changer Mtg. Frame Assembly
S-17167	Vol. Control Knob
S-17189	Power Supply Assembly (Complete)
S-17218	Low Impedance Loop Assy.
S-17264	Cabinet Back Assy. (TV)
S-17328	Loop Loading Coil Assy.
S-17399	Cabinet Back Assy. (Radio)
S-17497	Cover & Nameplate Assy.
S-17556	Antenna Terminal & Wire Assembly

MODELS H2447R & RQ - H3477R & RQ H3478E & EQ - H2445R & RQ

24H21 Main Chassis

Diag. No.	Part No.	Description	
	12-1756	Pilot Light Brkt.	
	15-98	Socket Cap (used on S-17140)	
	19-166	Coil Mtg. Clip (used on S-17114)	
	19-175	Coil Mtg. Clip (4 used)	
	19-206	Coil Mtg. Clip (used on S-17400)	
	19-207	C.R. Tube Mtg. Clip	
C29	22-3	.01 Mfd. Ceramic (Disc) (2 used)	500V
C27	22-4	.004 Mfd. Ceramic (Disc) (2 used)(or 22-1706)	500V
C52	22-365	100 Mmfd. Mica (Molded)	500V
C61	22-470	150 Mmfd. Mica (Molded)	500V
C85	22-1137	150 Mmfd. Mica	500V
C57	22-1138	470 Mmfd. Mica (Molded) (2 used)	500V
C84	22-1645	330 Mmfd. Mica	500V
C72	22-1777	0.1 Mfd. (2 used)	200V
C35	22-1782	.0047 Mfd. (Molded)	600V
C73	22-1810	.1 Mfd.	200V
C6	22-1814	.0022 Mfd.	600V
C82	22-1832	500 Mmfd. (Molded) (Special)	20,000V
C51	22-1841	.1 Mfd. (Molded)	600V
C34	22-1842	.0047 Mfd.	200V
C39	22-1844	.047 Mfd. (Molded) (5 used)	600V
C58	22-1845	.0022 Mfd.	600V
C62	22-1846	.01 Mfd. (Molded)	400V
C65	22-1851	.001 Mfd. (Molded)	1000V
C19	22-1876	47 Mmfd. Ceramic	500V
C63	22-2034	680 Mmfd. (Molded)	500V
C67	22-2061	.1 mfd. (Molded)	400V
C54	22-2071	.022 Mfd. (Molded)	200V
C55	22-2078	.047 Mfd.	600V
C71	22-2112	.001 Mfd. Ceramic	500V
C36AD	22-2122	15Mfd. Electro	475V
C36BD		80 Mfd. Electro	300V
C36CD		40 Mfd. Electro	50V
C36DD		15 Mfd. Electro	475V
C49	22-2128	.001 Mfd. (Molded)	600V
C24	22-2154	Elect. 10 Mfd.	250V
C79	22-2159	.33 Mfd. (Molded)	200V
C53	22-2162	130 Mmfd. Mica	500V
C59	22-2163	1000 Mmfd. Mica	500V
C74	22-2168	33 Mmfd. Ceramic	500V
C37AD	22-2223	40 Mfd. Electro	300V
C37BD		80 Mfd. Electro	25V
C37CD		100 Mfd. Electro	50V
C37DD		20 Mfd. Electro	475V
C78	22-2225	20 Mfd.	300V
C75AB	22-2232	20 Mfd. Electro	300V
C75BB		15 Mfd. Electro	475V
C40	22-2233	20 Mmfd. Ceramic	500V
C41	22-2234	100 Mmfd. Ceramic	500V
C81	22-2244	.47 Mfd.	200V
C69	22-2261	.15 Mfd.	400V
C42	22-2264	.015 Mfd.	600V
	24-554	Fire Shield Rear Cover	
	52-591	Insulated Shielded Lead	
	52-592	Insulated Shielded Lead	
	54-139	3/8-32x9/16 Hex Palnut (8 used to mount controls)	
	57-1675	Shaft Retaining Plate (used on 76-604)	
	58-188	Two Prong A-C Plug	
	58-191	Nine Prong Adapter Plug	
R38	63-943	4700 ohm 1W 10% (2 used)	Ins.
R63	63-957	33K ohm 1W 10%	Ins.
R79	63-1065	15K Ohm 1W 10%	Ins.
R54	63-1449	470 ohm 1W 20% WW	Ins.
R65	63-1675	Horizontal Drive Control	
R12	63-1743	100 ohm 1/2W 10%	Ins.
R31	63-1744	100 ohm 1/2W 20% (3 used,	Ins.
R67	63-1751	150 ohm 1/2W 20% (2 used)	Ins.
R36	63-1768	390 ohm 1/2W 10%	Ins.
R21	63-1771	470 ohm 1/2W 10% (3 used)	Ins.
R60	63-1775	560 ohm 1/2W 10% (2 used on 95-1246)	Ins.
R94	63-1778	680 ohm 1/2W 10%	Ins.
R33	63-1782	820 ohm 1/2W 10%	Ins.
R6	63-1785	1000 ohm 1/2W 10% (2 used)	Ins.
R35	63-1806	3300 ohm 1/2W 10%	Ins.
R80	63-1807	3300 ohm 1/2W 20%	Ins.
R61	63-1813	4700 ohm 1/2W 10% (2 used)	Ins.
R62	63-1826	10K ohm 1/2W 5%	Ins.
R34	63-1838	18K ohm 1/2W 10%	Ins.
R37	63-1841	22K ohm 1/2W 10%	Ins.
R39	63-1845	27K ohm 1/2W 10%	Ins.
R89	63-1848	33K ohm 1/2W 10%	Ins.
R5	63-1855	47K ohm 1/2W 10% (2 used)	Ins.
R47	63-1862	68K ohm 1/2W 10%	Ins.
R56	63-1863	68K ohm 1/2W 20%	Ins.
R46	63-1869	100K ohm 1/2W 10% (4 used)	Ins.
R25	63-1870	100K ohm 1/2W 20% (3 used)	Ins.
R74	63-1876	150K ohm 1/2W 10%	Ins.
R42	63-1883	220K ohm 1/2W 10% (3 used)	Ins.
R49	63-1884	220K ohm 1/2W 20% (2 used)	Ins.
R22	63-1890	330K ohm 1/2W 10%	Ins.
R48	63-1898	470K ohm 1/2W 20% (2used)	Ins.
R95	63-1904	680K ohm 1/2W 10%	Ins.
R45	63-1911	1 Megohm 1/2W 10% (4 used)	Ins.
R18	63-1912	1 Megohm 1/2W 20%	Ins.
R72	63-1919	1.5 Megohm 1/2W 20%	Ins.
R17	63-1926	2.2 Megohm 1/2W 20%	Ins.
R4	63-1933	3.3 Megohm 1/2W 20%	Ins.
R20	63-1982	100K ohm 2W 10% (2 used)	Ins.
R82	63-1983	47 ohm 2W 20% (or 63-2161)	Ins.
R78	63-2017	4000 ohm 5W 10% (2 used) WW	Ins.
R19	63-2050	Bias Control	
R77	63-2099	Focus Control	
R76	63-2103	400 ohm WW Resistor (Center Tapped)	
R55	63-2110	Vertical Size Control	
R84	63-2076	3.3 ohm 1/2W 20%	Ins.
R40	63-2123	Contrast Control	
R32	63-2125	Volume Control & Switch	
R43	63-2126	Intensity Control	
R81	63-2134	150 ohm WW 5W 20%	Ins.
R75	63-2137	100K ohm 1W 10%	Ins.
R50	63-2153	A.G.C. Control	
R85	63-2171	1800 ohm 4W 10%	Ins.
R41	63-2172	2K Vertical Linearity Control	
R53	63-2173	750K Vertical Hold Coptrol	
R83	63-2425	15K ohm 7W Candohm (or 63-2135)	

24H21 Main Chassis (cont'd.)

Part No.	Description
73-114	8-32x5/16 Slab Hd. Set Screw (2 used S-17083 & 4 used S-16529)
76-604	Fine Tuning Ext. Shaft
76-605	Horiz. Hold Control Shaft
78-250	Elect. Cond. Socket
78-580	Nine Contact Socket
78-706	Octal Socket
78-709	Octal Tube Socket
78-755	Octal Tube Socket (5 used)
78-807	Miniature Tube Socket (2 used)
78-834	Octal Tube Socket
78-840	A.C. Socket
78-875	C.R. Tube Socket
78-876	Noval Miniature Tube Socket
78-883	Nine Contact Socket
78-900	Pilot Light Socket & Wire
80-744	Focus Mtg. Spring (4 used)
80-802	Retaining Spring (1 ea. used on 149-100 & 149-101)
80-822	Dial Cord Tension Spring
80-823	Shaft Guide Spring
80-824	Tube Plate Connector Spring (2 used)
80-825	C. R. Tube Retaining Spring
80-843	Tension Spring
80-846	Fine Tuning Limiting Spring
83-1802	Fuse Mounting Strip
85-488	Picture Control Switch
93-2	Brass Washer (used on 22-2154)
93-525	Fibre Washer (2 used on 78-709)
93-961	Insulating Washer (used on Contrast Control)
93-971	Shell Support Washer (used on Horiz. Sweep)
93-1057	Insulating Washer (used on Contrast Control)
95-1240	Vertical Output Trans.
95-1267	Deflection Coil
100-67	Pilot Light
103-1	Crystal Diode
112-88	Thumb Screw #8-32 (Deflection Coil)
112-758	#4-40x1/4" R.H.S.T. (used on 85-488)
114-45	#8x3/8 Hex. Hd. S. T. (2 used on S-17289)(or 114-313)
114-268	#6x1/4 Hex Hd. S. T. (2 used on 24-554)
114-310	#8x5/16 Hex. Washer Hd. S. T. (4 used S-17100 & 2 used on Defl. Coil Mtg.)
125-26	Rubber Grommet (2 used on 78-709)
126-652	Pilot Light Shield
136-22	Fuse 1/4 amp
149-89	Iron Core (1 ea. used on S-16855 & S-17116)
149-98	Iron Core & Screw (used on S-17400)
149-100	Iron Core & Spring (used on S-17177)
149-101	Iron Core & Spring (used on S-17177)
149-102	Iron Core & Screw (use S-17114)
188-131	Retaining Ring (used on S-17097)
188-137	Retaining Ring (used on (S-17362)
196-147	Plastic Gasket

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24H21 Main Chassis (cont'd.)

Diag. No.	Part No.	Description
	196-164	C.R. Tube Support Gasket
	199-124	Focus Coil Sleeve
	S-16855	Sound Trap Coil Assy.
	S-17052	2nd. Video Series
	S-17053	2nd Video Shunt Peaking Coil Assembly
	S-17064	Video I.F. Strip Assembly
	S-17083	Gear, Bushing & Set Screw Assembly
	S-17084	Shaft Gear & Coupling Assy.
	S-17096	Dial Cord & Eyelet Assy. (Fine Tuning)
	S-17097	Brkt. Pulley & Gear Assy.
	S-17100	R.F. Shelf & Turret Assy. (Complete)
L74	S-17114	Horiz. Oscillator Coil Assy.
	S-17116	4.5 MC Video Trap Coil Assembly
	S-17140	Horiz. Sweep Trans. Assy.
L76	S-17175	Horiz. Size Control Coil Assembly
L76	S-17176	Horiz. Linearity Control Coil Assembly
	S-17177	Horiz. Size & Linearity Control Coil & Brkt. Assy.
	S-17178	Fire Shield Assembly
	S-17179	Horiz. Sweep Trans. Mtg. Plate Assembly
	S-17185	C. R. Tube Socket Assy.
	S-17221	Defl. Yoke Mtg. Brkt. Assy.
	S-17286	Insulator Strip & Terminal Assy.
	S-17289	Gasket Support Plate & Switch Brkt. Assy.
	S-17290	Mechanical Centering & Focus Assembly
	S-17291	A.C. Plug & Brkt. Assy.
	S-17362	Indicator Drum & Shaft Assembly
	S-17377	Contrast Control Shaft & Bushing Assembly
L79	S-17400	Picture Control Coil Assy.
	S-17425	Fine Tuning Shaft & Bushing Assembly
	S-17429	Anode Lead & Eyelet Assy.
	S-17164	Beam Bender Unit

TUBES

1 - 19AP4B	3 - 6SN7GT
1 - 1B3GT	1 - 6SN7GTA
2 - 6BQ6GT	1 - 6W4GT
1 - 6AL5	1 - 12AU7
1 - 6BN6	

For parts on S-17100 R.F. Shelf & Turret Tuner refer to 22H20 Chassis.

Parts for the Video I.F. Assembly are listed under Part Numbers S-17064 or S-17635.

S-17290 MECHANICAL CENTERING & FOCUS ASSEMBLY

Part No.	Description
57-1548	Centering Plate
57-1549	Focusing Coil Mtg. Plate
57-1684	Magnet End Plate
93-951	SpringWasher - Shakeproof Blued
93-1006	.0359x.156 I.D.x1/2" O.D. Steel
93-1007	.0359x.156 I.D.x1" O.D. Steel
93-1009	Spring Washer - Shakeproof Blued
114-48	#6-32x1/4" Hex. Hd. Sl. M.S. (2 used)
S-17290	Mechanical Centering & Focus Assy. (Complete)
S-17332	Focusing Coil Assembly

CABINET PARTS FOR H2447R & RQ

Diag. No.	Part No.	Description
	11-106	Line Cord & Plug 9 ft. lg.

CABINET PARTS FOR H2447R & RQ (cont'd.)

Diag. No.	Part No.	Description
	14-1262R	Cabinet For H2447R & RQ Console Model
	16-646	Packing Carton
	24-446	A.C. Line Cord Plug Cover
	46-885	Contrast Control Knob
	46-887	Horizontal Hold Knob
	46-888	Channel Selector Knob
	46-890	Volume Control Knob
	46-893	Brightness Control Knob
	46-895	Fine Tuning Knob
	46-896	Vertical Hold Knob
	49-649	10" PM Speaker ZC-10161 Cone
	56-286	Cover Hinge Pin
	57-1481	Esc. Clamping Plate (3 used)
	57-1670	Glass Retaining Plate (4 used)
	57-1674	Escutcheon
	57-1678	Esc. (Vol. Control)
	57-1679	Esc. (Channel Selector)
	70-3	#5x1/2 R.H.W.S. Steel N.P. (2 used on S-17305)
	70-86	#6x5/8" Washer Hd. Wood Screw-St. Br. (5 used to mt. S-17303)
	72-3	#5x5/8" Flt. Hd. W. S. Steel (2 used on RQ Model)
	72-81	#8x3/4 Phill. Flt. Hd. Wood Screw - St. Br. (4 used to Mt. S-17293)
	74-58	Ventilating Screen
	78-787	Two Contact Socket
	80-826	Grounding Spring
	80-828	Door Return Spring
	94-295	Mounting Bushing (4 used on RQ Model
	118-813	4-40x5/16" R.H.S.T. Cad. (8 used on Esc. Mtg.)
	114-80	1/4-20x1-3/8" Hex Washer Hd. M.S. (4 used Chassis Mtg.)(3 used Pwr. Supply)
	114-201	#8x5/16" Hex Hd. Sl. S.T. (used on Pwr. Supply)
	114-313	#8x1/2" Hex Hd. S. T. Cad. (3 used on Esc. Mtg.)
	114-341	#6x3/8 Hex Hd. S. T. Cad. (used on 80-826)
	114-358	#6x1/2" Hex Hd. Sl. S. T. (4 used on RQ Models)
	165-13	Metal Glide (4 used)
	192-139	Protective Glass
	196-150	Glass Gasket
	202-829	Instruction Book
	202-849	Instruction Book (RQ Model)
	S-17189	Power Supply Assy. (Comp.)
	S-17266	Remote Control Assembly
	S-17267	Hand Control & Cable Assy.
	S-17293	Cabinet Antenna Assy.
	S-17303	Cabinet Back Assembly
	S-17305	Antenna Terminal & Wire Assembly
	S-17497	Cover & Nameplate Assy.

CABINET PARTS FOR H2445R & RQ

Model H2445R & RQ is the same as H2447R & RQ except the following:

OMIT:

Part No.	Description
14-1262R	Cabinet for H2447R & RQ Console Model
16-646	Packing Carton

ADD:

Part No.	Description
14-1269R	Cabinet for H2445R & RQ Console Model
16-650	Packing Carton
57-1284	Strike Plate (2 used)
74-76	Ventilating Screen
156-35	Bullet Catch
166-55	Tack Bumper (2 used)

CABINET PARTS FOR H3478E & EQ

Part No.	Description
2-207	Cabinet Back (Phono Sect.)
11-106	Line Cord & Plug 9 ft. lg.
14-1270E	Cabinet for H3478E & EQ Console CombinationModel
16-652	Packing Carton - Inner Pack
16-653	Packing Carton - Outer Pack
19-9	Cable Clip
19-169	Record Changer Mtg. Clip (2 used)
19-210	Loop Connector Clip (2 used)
24-535	Line Cord Plug Cover
46-833	Volume Control Knob
46-876	Tuning Control Knob
46-885	Contrast Control Knob
46-887	Horiz. Control Knob
46-889	Channel Selector Knob
46-893	Brightness Control Knob
46-895	Fine Tuning Knob
46-896	Vertical Hold Knob
46-899	Band Switch Knob
49-694	12" PM Speaker ZC12161 Cone & Voice Coil
56-286	Cover Hinge Pin
57-1270	Strike Plate (2 used)
57-1481	Esc. Clamping Plate (7 used)
57-1666	Radio Dial Esc.
57-1670	Glass Retaining Plate (4 used)
57-1674	TV Escutcheon
57-1678	Esc. (Vol. Control)
57-1679	Esc. (Channel Selector)
70-3	#5x1/2" R.H.W.S. Steel N.P. (2 used S-17305 & 1 used 19-9)
70-86	#6x5/8 Washer Hd. Wood Screw - St. Br. (11 used to mt. Backs)
72-3	#5x5/8" Flt. Hd. W. Steel N.P. (2 used on EQ Models)
72-81	#8x3/4" Phill. Flt. Hd. Wood Screw - St. Br. (4 used on S-17293)
74-58	Ventilating Screen
74-71	Ventilating Screen
78-787	Two Contact Socket
80-604	Hinge Spring (2 used)
80-826	Grounding Spring
80-828	Door Return Spring
80-830	Record Changer Mtg. Spring (4 used)
93-168	Rubber Shoulder Washer (4 used)
94-295	Mtg. Bushing (4 used on EQ Models)
112-809	Record Changer Mtg. Screw (3 used)
112-813	4-40x5/16" R.H.S.T. (8 used on TV Esc. Mtg.)
114-80	1/4-20x1-3/8" Hex. Hd. M.S. (4 used Mtg. TV Chassis & 3 used Mtg. Pwr. Supply)
114-201	#8x5/16 Hex. Hd. S. T. (used on Pwr. Supply)
114-341	#6x3/8 Hex Hd. S. T. (used on 80-826)
114-350	#8x7/16" Hex. Hd. Sl. S. T. (used on Radio Esc. Mtg.)
114-354	Radio Chassis Mtg. Screw (4 used)
114-358	#6x1/2" Hex Hd. Sl. S. T. (4 used on EQ Models)
126-653	Heat Shield
156-33	Bullet Catch (2 used)
159-50	Plug Button - Black Oxide (2 used)
165-14	Metal Glide (2 used)
166-57	Tack Bumper (2 used)
188-54	Knob Clamping Ring (46-876)
192-138	Dial Glass (Radio)
192-139	Protective Glass (TV)
196-150	Glass Gasket (TV)

CABINET PARTS FOR H3478E & EQ (cont'd.)

Diag. No.	Part No.	Description
	202-829	Instruction Book (TV)
	202-849	Instruction Book (EQ Model)
	202-851	Instruction Book (Radio-Phono)
	S-14029	Variable Speed Record Changer
	S-15536	Record Changer Compt. Hinge Brkt. & Link Assy. (2 used)
	S-15780	Cobra Tone Arm Cartridge
	S-16419	Record Adapter Plug & Envelope Assembly
	S-17005	Record Changer Mtg. Frame Assembly
	S-17167	Volume Control Knob Assy.
	S-17189	Power Supply Assy. (Complete)
	S-17255	Radiorgan Cable Assy.
	S-17266	Remote Control Assy. (used on EQ Models)
	S-17267	Hand Control & Cable Assy. (used on EQ Models)
	S-17293	Cabinet Antenna Assy.
	S-17305	Antenna Terminal & Wire Assembly
	S-17325	Low Impedance Loop Assembly
	S-17328	Loop Loading Coil Assy.
	S-17351	Cabinet Back (TV)
	S-17497	Cover & Nameplate Assy.

RADIORGAN ESCUTCHEON PARTS

Part No.	Description
76-444	Radiorgan Knob Shaft
114-297	#6x1/4 Hex. Hd. Sl. S. T. (2 ea. used on S-17252 & S-17253)
S-14255	Radiorgan Mtg. Brkt. Assy. (2 used)
S-17246	Radiorgan Knob & Eyelet Assembly (Treble)
S-17247	Radiorgan Knob & Eyelet Assembly (Voice)
S-17248	Radiorgan Knob & Eyelet Assembly (Alto)
S-17249	Radiorgan Knob & Eyelet Assembly (Bass)
S-17250	Radiorgan Knob & Eyelet Assembly (Lo-Bass)
S-17251	Radiorgan Knob & Eyelet Assembly (Normal)
S-17252	Radiorgan Esc. & Knob Assembly (R.H.)
S-17253	Radiorgan Esc. & Knob Assembly (L.H.)

CABINET PARTS FOR H3477R & RQ

Model H3477R & RQ is the same as H3478E & EQ except the following:

OMIT:

Part No.	Description
2-207	Cabinet Back (Phono Section)
14-1270E	Cabinet for H3478E & EQ Console Combination Model
16-652	Packing Carton - Inner Pack
16-653	Packing Carton - Outer Pack
46-833	Volume Control Knob
46-889	Channel Selector Knob
57-1270	Strike Plate (2 used)
156-33	Bullet Catch (2 used)
166-57	Tack Bumper (2 used)
S-17351	Cabinet Back Assy. (TV)

ADD:

Part No.	Description
2-201	Cabinet Back (Phono Section)
14-1267R	Cabinet for H3477R & RQ Console Combination Model
16-647	Packing Carton - Inner Pack
16-648	Packing Carton - Outer Pack
46-888	Channel Selector Knob
46-890	Volume Control Knob
57-1284	Strike Plate

CABINET PARTS H3477R & RQ (cont'd.)

Diag. No.	Part No.	Description
	156-35	Bullet Catch (2used)
	166-55	Tack Bumper (2 used)
	S-17308	Cabinet Back Assy. (TV)

MODELS H2328RZ & RQZ - H2329RZ H2352RZ & RQZ - H2353EZ & EQZ - H2328EZ

23H22Z Main Chassis

Diag. No.	Part No.	Description	
	12-1756	Pilot Light Brkt.	
	15-99	Corona Cap	
	19-166	Coil Mtg. Clip (used on S-17114)	
	19-175	Coil Mtg. Clip (1 ea. used on S-17176 - S-16855 - S-17116 S-17175)	
C29	22-3	.01 Mfd. Ceramic (Disc) (2 used)	500V
C27	22-4	.004 Mfd. Ceramic (Disc) (2 used)	500V
C52	22-365	100 Mmfd. Mica (Molded)	500V
C61	22-470	150 Mmfd. Mica (Molded)	500V
C85	22-1137	150 Mmfd. Mica	500V
C57	22-1138	470 Mmfd. Mica (Molded)	500V
C84	22-1645	330 Mmfd. Mica	500V
C46	22-1775	.047 Mfd. (Molded)	400V
C72	22-1777	0.1 Mfd.	200V
C35	22-1782	.0047 Mfd. (Molded) (2 used)	600V
C73	22-1810	0.1 Mfd.	200V
C64	22-1814	.0022 Mfd. (2 used)	600V
C51	22-1841	.1 Mfd. (Molded)	600V
C39	22-1844	.047 Mfd. (Molded) (5 used)	600V
C58	22-1845	.0022 Mfd.	600V
C62	22-1846	.01 Mfd. (Molded)	400V
C65	22-1851	.001 Mfd. (Molded)	1000V
C19	22-1876	47 Mmfd. Ceramic	500V
C50	22-1880	.0012 Mfd. (Molded)	600V
C63	22-2034	680 Mmfd.	500V
C67	22-2061	.1 Mfd. (Molded)	400V
C54	22-2071	.022 Mfd. (Molded)	200V
C68	22-2098	.47 Mfd. (Molded)	200V
C71	22-2112	.001 Ceramic	500V
C70	22-2120	500 Mmfd. Special (Molded)	10,000V
C36AD	22-2122	15 Mfd.	475V
C36BD		80 Mfd.	300V
C36CD		40 Mfd.	50V
C36DD		15 Mfd.	475V
C49	22-2128	.001 Mfd. (Molded) (2 used)	600V
C66	22-2146	.47 Mfd.	200V
C24AA	22-2154	Elect. 10 Mfd.	250V
C53	22-2162	130 Mmfd. Mica	500V
C59	22-2163	1000 Mmfd. Mica	500V
C47	22-2166	.15 Mfd.	200V
C74	22-2168	33 Mmfd. Ceramic	500V
C37AD	22-2223	40 Mfd.	300V
C37BD		80 Mfd.	25V
C37CD		100 Mfd.	50V
C37DD		20 Mfd.	475V
C38AD	22-2224	20 Mfd.	450V
C38BD		20 Mfd.	200V
C38CD		20 Mfd.	25V
C38DD		40 Mfd.	450V
C40	22-2233	20 Mmfd. Ceramic (2 used)	500V
C41	22-2234	100 Mmfd. Ceramic	500V
C69	22-2261	.15 Mfd.	400V
C42	22-2264	.015 Mfd.	600V
	34-183	Turret Drive Gear	
	52-591	Insulated Shielded Lead	
	54-139	3/8-32x9/16 Hex Palnut (8 used on control)	
	57-1675	Shaft Retaining Plate	
	58-188	Two Prong Plug (Part of S-17127)	
	58-191	Nine Prong Adapter Plug	
R38	63-943	4700 ohm 1W 10% Ins. (2 used)	
R63	63-957	33K ohm 1W 10% Ins.	

23H22Z Main Chassis (cont'd.)

Diag. No.	Part No.	Description
R96	63-970	47 ohm 1W 10% Ins. (or 63-2093)
R79	63-1065	15K ohm 1W 10% Ins.
R28	63-1571	6800 ohm 2W 10% Ins.
R98	63-1581	4.7 ohm 1/2W 10% Ins.
R97	63-1620	1800 ohm 2W 10% Ins. (or 63-1691)
R59	63-1674	Vertical Linearity Control
R65	63-1675	Horiz. Drive Control
R31	63-1744	100 ohm 1/2W 20% Ins. (3 used)
R1	63-1750	150 ohm 1/2W 10% Ins.
R67	63-1751	150 ohm 1/2W 20% Ins. (2 used)
R90	63-1758	220 ohm 1/2W 20% Ins.
R24	62-1764	230 ohm 1/2W 10% Ins.
R36	63-1768	390 ohm 1/2W 10% Ins.
R21	63-1771	470 ohm 1/2W 10% Ins. (3 used)
R60	63-1775	560 ohm 1/2W 10% Ins. (2 used on 95-1263)
R33	63-1782	820 ohm 1/2W 10% Ins.
R35	63-1806	3300 ohm 1/2W 10% Ins.
R61	63-1813	4700 ohm 1/2W 10% Ins. (2 used)
R34	63-1838	18K ohm 1/2W 10% Ins.
R37	63-1841	22K ohm 1/2W 10% Ins. (2 used)
R39	63-1845	27K ohm 1/2W Ins. 10%
R89	63-1848	33K ohm 1/2W 10% Ins.
R5	63-1855	47K ohm 1/2W 10% Ins. (3 used)
R47	63-1862	68K ohm 1/2W 10% Ins.
R56	63-1863	68K ohm 1/2W 20% Ins.
R46	63-1869	100K ohm 1/2W 10% Ins. (4 used)
R25	63-1870	100K ohm 1/2W 20% Ins. (2 used)
R74	63-1876	150K ohm 1/2W 10% Ins.
R42	63-1883	220K ohm 1/2W 10% Ins.
R49	63-1884	220K ohm 1/2W 20% Ins. (2 used)
R22	63-1890	330K ohm 1/2W 10% Ins. (2 used)
R48	63-1898	470K ohm 1/2W 20% Ins. (2 used)
R95	63-1904	680K ohm 1/2W 10% Ins.
R45	63-1911	1 Megohm 1/2W 10% Ins. (4 used)
R18	63-1912	1 Megohm 1/2W 20% Ins.
R72	63-1919	1.5 Megohm 1/2W 20% Ins.
R17	63-1926	2.2 Megohm 1/2W 20% Ins. (3 used)
R93	63-1979	68K ohm 1W 10% Ins. (2 used)
R20	63-1982	100K ohm 2W 10% Ins.
R78	63-2017	4000 ohm WW 5W 10% Ins. (2 used)
R27	63-2022	10K ohm WW 5W 10% Ins.
R26	63-2023	3500 ohm WW 10W 10% Ins.
R19	63-2050	Bias Control
R30	63-2077	400 ohm WW 5W 10% Ins.
R77	63-2099	Focus Control
R55	63-2110	Vertical Size Control
R40	63-2123	Contrast Control
R32	63-2125	Vol. Control & Switch
R43	63-2126	Intensity Control
R52	63-2127	Vertical Hold Control
R81	63-2134	150 ohm WW 5W 20% Ins.
R75	63-2137	100K ohm 1W 10% Ins.
R73	63-2145	10K ohm 2W 20% Ins.
R50	63-2153	A.G.C. Control
R58	63-2159	Vertical Hold Range Control
R83	63-2425	15K ohm 7W 10% Ins.
	73-114	8-32x5/16 Slab Hd. Set Screw (6 used S-17084)
	76-605	Horiz. Hold Control Shaft
	78-580	Nine Contact Socket (Phonevision)

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23H22Z Main Chassis (cont'd.)

Diag. No.	Part No.	Description
	78-640	Elect. Cond. Socket
	78-709	Octal Tube Socket (2 used)
	78-755	Octal Tube Socket (5 used)
	78-807	Miniature Tube Socket (3 used)
	78-834	Octal Tube Socket
	78-840	Two Contact Socket (AC)
	78-875	C.R. Tube Socket
	78-876	Noval Miniature Tube Socket
	78-900	Pilot Light Socket & Wire
	78-908	Miniature Tube Socket
	80-744	PM Focus Mtg. Spring (4 used)
	80-802	Retaining Spring (1ea. Used on 149-100 & 149-101)
	80-822	Dial Cord Tension Spring
	80-823	Shaft Guide Spring (used on S-17114)
	80-824	Tube Plate Connector Spring (3 used)
	80-841	C.R. Tube Grounding Spring
	80-843	Tension Spring
	80-846	Fine Tuning Limiting Spring
	82-25	C.R. Tube Retaining Strap
	83-1802	Fuse Mtg. Strip
	83-1860	Light Shield Strip
	87-1	Integrator Unit
	93-2	Brass Washer (used on 22-2154)
	93-525	Fibre Washer (2 used on ea. 78-709)
	93-961	Insulating Washer (Contrast Control)
	93-971	Shell Support Washer (Horiz. Sweep)
	93-1057	Insulating Washer (Contrast Control)
	94-746	C.R. Tube Support Bushing (2 used)
	95-1170	Filter Choke
	95-1238	Audio Output Trans.
	95-1239	Vertical Output Trans.
	95-1260	Power Trans.
	95-1263	Deflection Coil
	100-67	Pilot Light
	112-88	Thumb Screw #8-32 (Deflection Coil Adj.)
	114-65	#8-32x1-1/2" Hex Hd. Sl. M.S. (used on S.17531)
	114-201	#8x5/16 Hex Hd. S. T. (24 used)
	114-310	#8x5/16 Hex Washer Hd. S.T. (4 used on Turret Tuner & 2 used on 83-1802)
	114-331	8-32x5/16 Hex Hd. S. T. (2 used to mt. S-17097)
	125-26	Rubber Grommet (2 used on ea. 78-709)
	126-643	Fire Shield
	126-652	Pilot Light Shield
	136-20	Fuse
	149-89	Iron Core (1 ea. used on S-16855 & S-17116)
	149-100	Iron Core & Spring (used on S-17175)
	149-101	Iron Core & Spring (used on S-17176)
	149-102	Iron Core & Screw (use S-17114)
	188-131	Retaining Ring (used on S-17097)
	188-137	Retaining Ring (used on S-17362)
	196-164	C.R. Tube Support Gasket
	199-124	Focus Coil Sleeve
	199-145	Rubber Sleeve (used on S-17521)
	199-146	Rubber Sleeve (used on S-17521)
	S-16209	Wire & Eyelet Assembly
	S-16855	Sound Trap Coil
	S-17052	2nd Video Series Peaking Coil Assembly
	S-17053	2nd Vido Shunt Peaking Coil Assembly
	S-17064	Video I.F. Strip Assy.
	S-17084	Shaft-Gear & Coupling Assy.
	S-17096	Dial Cord & Eyelet Assy. (Fine Tuning)
	S-17097	Brkt. Pulley & Gear Assy.
	S-17100	R.F. Shelf & Turret Assy.
	S-17114	Horiz. Osc. Coil Assy.
	S-17116	4.5 McVideo Trap Coil Assy.
	S-17121	Rectifier Mtg. Plate Assy.
	S-17127	A.C. Plug & Brkt. Assy.
	S-17175	Horiz. Size Control Coil Assembly
	S-17176	Horiz. Linearity Control Coil Assy.
L81	S-17861	Mechanical Centering & Focus Assy.
	S-17362	Indicator Drum & Shaft Assy.
	S-17377	Contrast Control Shaft & Bushing Assy.
	S-17425	Fine Tuning Ext. Shaft & Bushing Assembly
	S-17433	Deflection Yoke Mtg. Brkt. Assembly
	S-17435	Horiz. Sweep Trans. Assy.
	S-17447	Anode Clip & Wire Assy.
	S-17461	Beam Bender Unit
	S-17521	C.R. Tube Support & Alignment Brkt. Assy.

TUBES

1 - 16TP4	1 - 6BN6
1 - 1X2	2 - 6BQ6GT
1 - 5U4G	2 - 6SN7GT
1 - 5Y3GT	1 - 6W4GT
1 - 6AL5	1 - 12AU7
1 - 6BF5	1 - 6BL7GT

For parts on S-17100 R.F. Shelf & Turret Tuner refer to 22H20 Chassis

Parts for the Video I.F. Assembly are listed under Part Numbers S-17064 or S-17635.

For parts on S-17230 Mechanical Centering & Focus Assembly, refer to parts list for 24H20 Chassis.

CABINET PARTS H2328RZ & RQZ

Part No.	Description
11-106	Line Cord & Plug 9 ft. lg.
12-1798	Support Brkt. (4 used to mt. 192-140)
14-1278R	Cabinet for H2328RZ & RQZ Table Model
16-665	Packing Carton
19-196	Clip (2 used on 188-134)
24-446	AC Line Cord Plug Cover
43-196	Control Housing
46-885	Contrast Control Knob
46-887	Horiz. Hold Knob
46-888	Channel Selector Knob
46-890	Volume Control Knob
46-893	Brightness Control Knob
46-895	Fine Tuning Knob
46-896	Vertical Hold Knob
49-696	5-1/4" PM Speaker ZC5093 Cone & Voice Coil
54-129	Speed Nut (3 used on 188-133)
54-269	#8-32x11/32 (1 used on ea. S-17422)
56-286	Cover Hinge Pin
57-1481	Clamping Plate (4 used to mt. S-17422)
57-1620	Retaining Plate (used on 188-134)
70-3	#5x1/2" R.H.W.S. Steel N.P. (2 used on S-17306)
70-86	#6x5/8" Washer Hd. Wood Screw St. Br. (5 used to mt. back)
70-153	#5x1/4" R. H. W. S. Steel (2 used on 57-1620)
72-3	#5x5/8" Flt. Hd. W.S. (2 used on QZ Models Only)

CABINET PARTS H2328RZ & RQZ (cont'd.)

Part No.	Description
72-81	#8x3/4 Phill. Flt. Hd. Wood Screw St. Br. (4 used on S-17307)
72-90	#4x3/4 Phill. Flt. Hd. Wood Screw St. Br. (4 used to mt. 43-196)
74-58	Ventillating Screen
78-787	Two Contact Socket (Cabt. Backs)
80-828	Cover Return Spring
94-295	Mtg. Bushing (4 used on RQZ Models only)
114-80	1/4-20x1-3/8 Hex Washer Hd. M.S. (4 used Chassis Mtg.)
114-358	#6x1/2" Hex Hd. Sl. S. T. (4 used on RQZ Models only)
188-133	Trim Ring
188-134	Trim Ring
192-140	Protective Glass
196-163	Rectangular Gasket
202-844	Instruction Book
202-849	Instruction Book (RQZ Models only)
S-17266	Remote Control Assy. (used on RQZ Models only)
S-17267	Hand Control & Cable Assy. (used on RQZ Models only)
S-17306	Antenna Terminal & Wire Assembly
S-17307	Cabinet Antenna Assy.
S-17422	Brkt. & Screw Assy. (4 used to mt. 192-140)
S-17443	Cabinet Back Assembly
S-17497	Cover & Nameplate Assy.

CABINET PARTS H2329RZ

Part No.	Description
11-106	Line Cord & Plug 9 ft. lg.
14-1285R	Cabinet for H2329RZ Table Model
16-773	Packing Carton
19-196	Clip (2 used on 188-134)
24-446	AC Line Cord Plug Cover
43-196	Control Housing
46-885	Contrast Control Knob
46-887	Horiz. Hold Knob
46-888	Channel Selector Knob
46-890	Volume Control Knob
46-893	Brightness Control Knob
46-895	Fine Tuning Knob
46-896	Vertical Hold Knob
49-696	5-1/4" PM Speaker ZC5093 Cone & Voice Coil
54-129	Speed Nut (3 used on 188-133)
54-269	#8-32x11/32" Palnut (4 used on dial glass mtg.)
56-286	Cover Hinge Pin
57-1620	Retaining Plate (used on 188-134)
70-3	#5x1/2" R.H.W.S. Steel N.P. (2 used on S-17306)
70-86	#6x5/8" Washer Hd. Wood Screw St. Br (5 used to mt. back)
70-153	#5x1/4" R.H.W.S. Steel (2 used on 57-1620)
72-81	#8x3/4 Phillips Flt. Hd. Wood Screw St. Br. (4 used on S-17307)
72-90	#4x3/4 Phill. Flt. Hd. Wood Screw St. Br. (4 used to mt. 43-196)
74-58	Ventilating Screen
78-787	Two Contact Socket
80-828	Cover Return Spring
83-1844	Trim Strip
112-818	#4-40x1/4" Rd. Hd. S.T. Screw (2 used on S-17510)
114-80	1/4-20x1-3/8" Hex Washer Hd. M.S. (4 used chassis mtg.)
188-133	Trim Ring
188-134	Trim Ring
192-142	Protective Glass
196-166	Rectangular Gasket
202-844	Instruction Book
S-17306	Antenna Terminal & Wire Assembly
S-17307	Cabinet Antenna Assembly
S-17497	Control Cover Assembly
S-17510	Frame & Stud Assembly
S-17616	Cabinet Back Assy.(Compl.)

CABINET PARTS H2352RZ & RQZ

Part No.	Description
11-106	Line Cord & Plug - 9 ft. lg.
14-1282R	Cabinet for H2352RZ & RQZ Console Model
16-771	Packing Carton
19-196	Clip (2 used on 188-134)
24-446	AC Line Cord Plug Cover
43-196	Control Housing
46-885	Contrast Control Knob
46-887	Horiz. Hold Knob
46-888	Channel Selector Knob
46-890	Volume Control Knob
46-893	Brightness Control Knob
46-895	Fine Tuning Knob
46-896	Vertical Hold Knob
49-649	10" PM Speaker ZC10161 Cone & Voice Coil
54-129	Speed Nut (3 used on 188-133)
54-269	#8-32x11/32" Palnut (4 used on dial glass mtg.)
56-286	Cover Hinge Pin
57-1481	Clamping Plate (4 used on glass mtg.)
57-1620	Retaining Plate (used on 188-134)
70-3	#5x1/2" R.H.W.S. Steel N.P. (2 used to mt. S-17556)
70-86	#6x5/8" Washer Hd. Wood Screw St. Br. (7 used to mt. S-17511)
70-153	#5x1/4" R. H.W.S. Steel (2 used on 57-1620)
72-3	#5x5/8" Flt. Hd. W. S. (2 used on RQZ Models only)
72-81	#8x3/4 Phill. Flt. Hd. Wood Screw St. Br. (4 used to mt. S-16890)
72-90	#4x3/4 Phill. Flt. Hd. Wood Screw St. Br. (4 used on 43-196)
74-58	Ventilating Screen
78-787	Two Contact Socket
80-828	Cover Return Spring
83-1844	Trim Strip
94-295	Mtg. Bushing (4 used on RQZ Model only)
112-818	#4-40x1/4" Rd. Hd. S. T. Screw (2 used on glass & gasket mtg.)
114-80	1/4-20x1-3/8" Hex Washer Hd. M.S. (4 used chassis mtg.)
114-358	#6x1/2" Hex. Hd. Sl. S. T. (4 used on RQZ Models only)
165-9	Metal Glide (4 used)
188-133	Trim Ring
188-134	Trim Ring
192-142	Protective Glass
196-166	Rectangular Gasket
202-844	Instruction Book
202-849	Instruction Book (used on RQZ Models only)
S-16890	Cabinet Antenna Assy.
S-17266	Remote Control Assy. (used on RQZ Models only)
S-17267	Hand Control & Cable Assy. (used on RQZ Models only)
S-17497	Control Cover Assy.
S-17510	Frame & Stud Assy.
S-17511	Cabinet Back Assy. (Complete)
S-17556	Antenna Terminal & Wire Assembly

CABINET PARTS H2353EZ & EQZ

Diag. No.	Part No.	Description
	11-106	Line Cord & Plug 9 ft. lg.
	14-1284E	Cabinet for H2353EZ & EQZ Console Model
	16-772	Packing Carton
	19-196	Clip (2 used on 188-134)
	24-446	AC Line Cord Plug Cover
	43-195	Control Housing
	46-833	Volume Control Knob
	46-885	Contrast Control Knob
	46-887	Horiz. Hold Knob
	46-889	Channel Selector Knob
	46-893	Brightness Control Knob
	46-895	Fine Tuning Knob
	46-896	Vertical Hold Knob
	49-649	10" PM Speaker ZC10161 Cone & Voice Coil
	54-129	Speed Nut (3 used on 188-134)
	54-269	#8-32x11/32" Palnut (4 used on glass mtg.)
	56-286	Cover Hinge Pin
	57-1481	Clamping Plate (4 used on glass mtg.)
	57-1620	Retaining Plate (used on 188-134)
	70-3	#5x1/2" R.H.W.S. Steel N.P. (2 used on S-17556)
	70-86	#6x5/8" Washer Hd. Wood Screw St. Br. (7 used to mt. back)
	70-153	#5x1/4" R.H.W.S. Steel Cad. (2 used on 57-1620)
	72-3	#5x5/8" Flt. Hd. W. S. Steel (2 used on EQZ Model only)
	72-81	#8x3/4 Phillips Flt. Hd. Wood Screw St. Br. (4 used on S-16890)
	72-90	#4x3/4 Phill. Flt. Hd. Wood Screw St. Br. (4 used on 43-195)
	74-58	Ventilating Screen
	78-787	Two Contact Socket
	80-828	Cover Return Spring
	83-1844	Trim Strip
	94-295	Mtg. Bushing (4 used on EQZ Models only)
	112-818	#4-40x1/4" Rd. Hd. (2 used on glass & gasket mtg.)
	114-80	1/4-20x1-3/8" Hex Hd. M.S. (4 used chassis mtg.)
	114-358	#6x1/2" Hex Hd. Sl. S. T. (4 used on EQZ model only)
	165-13	Glides (4 used)
	188-133	Trim Ring
	188-134	Trim Ring
	192-142	Protective Glass
	196-166	Rectangular Gasket
	202-844	Instruction Book
	202-849	Instruction Book (used on EQZ models)
	S-16890	Cabinet Antenna Assembly
	S-17266	Remote Control Assy. (used on EQZ Models only)
	S-17267	Hand Control & Cable Assy. (used on EQZ Models only)
	S-17497	Control Cover Assy.
	S-17510	Frame & Stud Assy.
	S-17511	Cabinet Back Assy. (Complete)
	S-17556	Antenna Terminal & Wire Assembly

CABINET PARTS H2328EZ

Diag. No.	Part No.	Description
	11-106	Line Cord & Plug 9 ft. lg.
	14-1278E	Cabinet for H2328EZ Table Model
	16-665	Packing Carton
	19-196	Clip (2 used on 188-134)
	24-446	AC Line Cord Plug Cover
	43-195	Control Housing
	46-833	Volume Control Knob
	46-885	Contrast Control Knob
	46-887	Horiz. Hold Knob
	46-889	Channel Selector Knob
	46-893	Brightness Control Knob
	46-895	Fine Tuning Knob
	46-896	Vertical Hold Knob
	49-696	5-1/4" PM Speaker ZC5093 Cone & Voice Coil
	54-129	Speed Nut (3 used on 188-134)
	54-269	#8-32x11/32" Palnut (4 used on S-17422)
	56-286	Cover Hinge Pin
	57-1481	Clamping Plate (4 used on S-17422)
	57-1620	Retaining Plate (used on 188-134)
	70-3	#5x1/2" R.H.W.S. Steel N.P. (2 used on S-17306)
	70-86	#6x5/8" Washer Hd. Wood Screw St. Br. (5 used to Mt. back)
	70-153	#5x1/4" R.H.W.S. Steel Cad. (2 used on 57-1620)
	72-81	#8x3/4 Phill. Flt. Hd. Wood Screw St. Br. (4 used to mt. S-17307)
	72-90	#4x3/4 Phill. Flt. Hd. Wood Screw St. Br. (4 used on 43-195)
	74-58	Ventilating Screen
	78-787	Two Contact Socket
	80-828	Cover Return Spring
	114-80	1/4-20x1-3/8" Hex Washer Hd. M.S. (4 used chassis mtg.
	188-133	Trim Ring
	188-134	Trim Ring
	192-140	Protective Glass
	196-163	Rectangular Gasket
	202-844	Instruction Book
	S-17306	Antenna Terminal & Wire Assembly
	S-17307	Cabinet Antenna Assy.
	S-17422	Brkt. & Screw Assembly
	S-17443	Cabinet Back Assembly (Complete)
	S-17497	Cover & Nameplate Assy.

H2328R & RQ - H2328E - H2329R & RQ - H2352R & RQ - H2353E & EQ

CHASSIS 23H22

MAIN CHASSIS

Chassis 23H22 is the same as 23H22Z except for the following:

OMIT:

Part No.	Description
94-746	C.R. Tube Support Bushing (2 used)
S-17064	Video I.F. Strip Assy. (Complete)
S-17521	C.R. Tube Support & Alignment Brkt. Assembly

TUBES

1 - 16TP4

ADD:

Part No.	Description
94-745	C.R. Tube Support Bushing (2 used)
S-17531	C.R. Tube Support & Alignment Brkt. Assembly
S-17635	Video I.F. Strip Assy. (Compl.)

TUBES

1 - 17BP4

For parts on S-17635 refer to page 33.

CABINET PARTS H2328R & RQ

Model H2328R & RQ is the same as H2328RZ & RQZ except for the following:

OMIT:

196-163 Rectangular Gasket

ADD:

196-157 Rectangular Gasket

CABINET PARTS H2329R & RQ

Model H2329R & RQ is the same as H2329RZ & RQZ except for the following:

OMIT:

196-166 Rectangular Gasket

ADD:

196-165 Rectangular Gasket

CABINET PARTS H2352R & RQ

Model H2352R & RQ is the same as H2352RZ & RQZ except for the following:

OMIT:

196-166 Rectangular Gasket

ADD:

196-165 Rectangular Gasket

CABINET PARTS H2353E & EQ

Model H2353E & EQ is the same as H2353EZ & EQZ except for the following:

OMIT:

196-166 Rectangular Gasket

ADD:

196-165 Rectangular Gasket

CABINET PARTS H2328E

Model H2328E is the same as H2328EZ except for the following:

OMIT:

196-163 Rectangular Gasket

ADD:

196-157 Rectangular Gasket

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World Radio History

Admiral Ch. 20A1, 20B1, 21A1

R-f oscillation on the a-m band of 4J1 and 4K1 radio tuners usually may be corrected by replacing the a-m peaking coil. The early peaking coil is coded with a blue dot and the new type peaking coil (part no. 73A5-10) is coded with a black dot.

If oscillations are present when the new type peaking coil is used, it is possible that the trouble is caused by the first a-m i-f transformer T604. In some instances the silver mica capacitors in T604 have become open causing the converter to oscillate. The replacement of transformer T604 (part no. 72B92) will cure the trouble.

Under the heading "Tunable Audio Hum," the resistor mentioned should be 22,000 ohms instead of 2,200 ohms.

In areas where any two adjacent channels may be received, the sound transmission from the lower channel may cause interference on the picture of the higher channel. This type of interference may be reduced to a minimum or eliminated by means of an adjacent channel trap fitted to the transformer T302 of the 2nd vidio i-f amplifier.

The trap is constructed by using another sound trap, L308, part number 72A88-1, which should be modified and installed in the receiver in the following manner:

1. Procure this sound trap (part no. 72A88-1) and remove two turns from the coil at the end farthest from the slug screw and resolder the coil to the lug on the form (do not remove the capacitor).
2. Clip the white lead and the bare tinned lead from the coil.
3. Remove the cover from the video i-f strip and locate T302.
4. Procure a short length (approximately 3 inches) of insulated 24- or 26-guage wire and wind approximately 1½ turns in a clockwise direction on T302. These turns should be positioned on the small diameter portion of T302 at the end farthest from the slug screw, with one end of the wire looped under itself to hold the coil in position in a manner similar to the coupling coil of T301.
5. Connect one end of the 1½-turn coil to the ground connection of T302.
6. In a large number of these chassis, an unused ¼-inch hole will be found between V302 and V303, but if the hole has not been punched, one should be drilled and the new trap inserted.
7. Connect the black lead from the new trap to the ground lug of T302 and connect the loose end of the 1½-turn coupling coil to the other lug on the new trap.
8. Realign the video i-f stages. Due to the slope of the video i-f curve, it is difficult to align the new trap to 27.25 Mc with a signal generator, so the slug should be adjusted for minimum interference on the picture. However, care must be used when making this adjustment since it is possible to affect the video i-f bandpass if the adjustment is incorrectly made.
9. Use a sweep generator and scope to check the video i-f bandpass after adjustment to be sure the trap has not affected the i-f bandpass.

Admiral Ch. 20X1

This chassis appears on *pages 4-38 through 4-62 of Rider's TV Manual Volume 4.* Weak sound may be due to the use of an incorrect type speaker or misalignment of the 4.5-Mc sound i. f.

1. 20X1 chassis made for combinations models are wired for permanent-magnet type speakers part number 78B52-1 and these chassis may be identified by the letter "C" stamped on the rear of the chassis.
2. 20X1 chassis made for straight TV models are wired for an electro dynamic speaker part number 78B50-1 or 78B51-1 and these chassis are not stamped with letter "C".

If the electrodynamic type speaker is used with a combination model chassis (stamped with the letter "C"), weak sound will result. If a permanent-magnet speaker is used with a chassis wired for an electrodynamic speaker the chassis will be inoperative. Note that the 20Y1 (12-inch) chassis in straight TV models is wired only for an electrodynamic speaker.

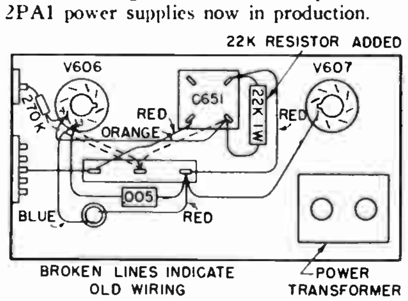
Should the sound level be weak in sets with the correct speaker in use, careful realignment of the 4.5 Mc should be made.

Admiral 32X26, 32X27, 32X35, 32X36, Ch. 20Z1, Radio Ch. 5B2

A change has been made in the 2PA1 power supply filter circuit to reduce residual hum. This power supply is used with the 20Z1 chassis in combination models using the 5B2 radio tuner. The following changes will reduce hum to a low level.

1. Remove the lead that connects pin 4 of V606 to center tap of R638-R639 candohm resistor. Remove lead that connects C651B to center tap of R638-R639.
2. Disconnect 270,000-ohm resistor R635 from center tap of candohm and reconnect to pin 4 of V606. Leave center tap of candohm unconnected.
3. Connect a 1-watt, 22,000-ohm resistor (60B14-223) from C651C to C651B and a lead from C651B to pin 4 of V606, as shown in the accompanying diagram.

These changes have been incorporated in 2PA1 power supplies now in production.



Changes for Admiral Models 32X26, 32X27, 32X35, and 32X36.

Associated Merchants 114C, 114T, 116C, 116CD, 16RCT

The service data for these models are the same as those for Bendix Models 2051, 3051, 6001, 6003, and 6100 except for the parts listed below:

Stock No.	*Description*
BZ0D50	Baffle, wood & grille cloth (16" console w/o doors)
BZ0D51	Baffle, wood & grille cloth (16" console w, w/o doors)
FW0P02	Frame, wood, 16" picture (16" console w, w/o doors)
FW0P03	Frame, wood, 16" picture (16" console comb.)
FW0P05	Frame, wood, 14" picture (14" table model)
FW0P07	Frame, wood, 14" picture (14" console)
HK0R21	Knob, door pull (16" console comb.)
HZ0H21	Handle, door (16" console w doors)
KB0B06	Knob, control channel indicator (all models)
KC0B24	Knob, control, fine tuning (all models except 16" console comb.)
KC0B24	Knob, control, fine tuning, radio tuning (16" console comb.)
KC0B25	Knob, control, hor. hold (all models except 16" console comb.)
KC0B25	Knob, control, hor. hold, TV Vol Radio Vol (16" console comb.)
KC0B26	Knob, control, contrast (all models except 16" console comb.)
KC0B26	Knob, control, TV contrast, radio tone, Radio-Off-TV (16" console comb.)
KC0B27	Knob, control, Off-On-Volume (all models except 16" console comb.)
KC0B29	Knob, control, radio bandswitch (16" console comb.)
S0D15	Socket, dial light (16" console comb.)
ZW1T09	Cabinet (14" table model)
ZW1V10	Cabinet (16" console model w/o doors)
ZW1V11	Cabinet (16" console model w doors)
ZW1V13	Cabinet (16" console comb.)
ZW1V17	Cabinet (14" console model).

Associated Merchants 12T1, 12T2, 12T3, 120C1, 120C2, 120C3, 160C1, 160C2, 160C3

The service data for these models are the same as those for Bendix Models 2025, 3033, and 6002 except for the changes in the parts list that are shown below. For all service data and change notices see Bendix 2025, 3033, and 6002.

Stock No.	*Description*
FP0P07	Frame, paper, decorative (12½" table and console models)
FP0P08	Frame, paper, 12½" picture tube
FW0P05	Frame, wood, 16" picture tube
HP0M08	Plate, metal, decorative (12½" and 16" console models)
KC0B26	Knob, control, contrast
KC0B27	Knob, control, Off-On-Volume
ZW1T06	Cabinet, table model, mahogany
ZE1V08	Cabinet, console model, mahogany (12½")
ZW1V09	Cabinet, console model, mahogany (16").

Automatic P-490, TV-707, TV-709, TV-710, TV-712, TVX313, TVX404

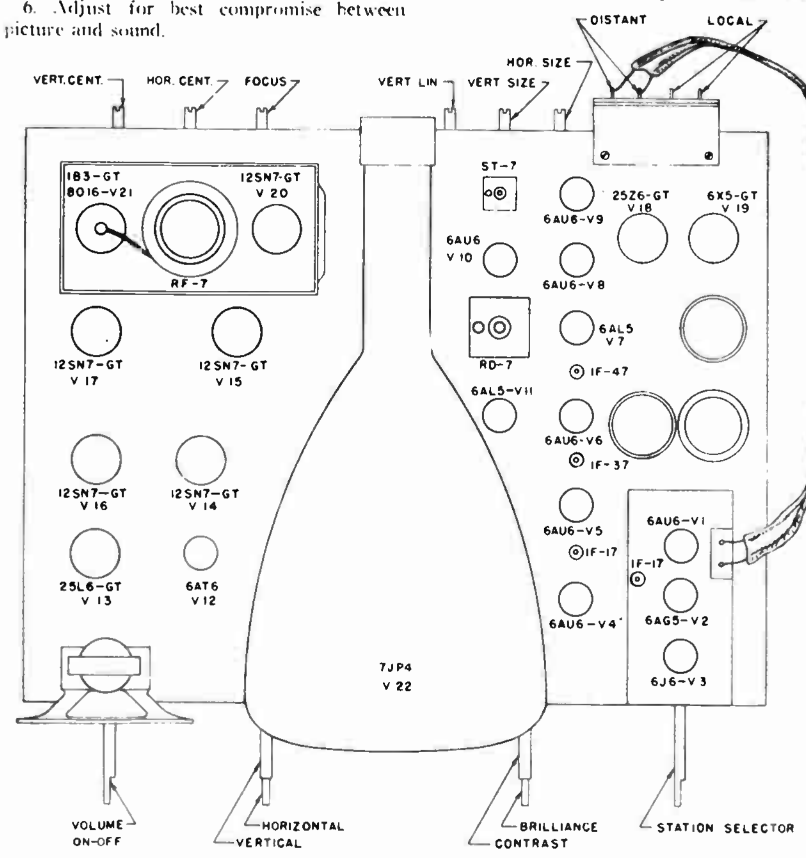
These models all use Chassis AR-TV-709. A final oscillator adjustment for each channel should be made on the receiver at the time of installation and whenever the 6J6 oscillator tube is changed. This oscillator adjustment can be made for each channel without removing the receiver from the cabinet. The following procedure should be followed in setting the oscillator frequency for each channel:

1. Turn channel selector to the required channel.
2. Remove channel selector knob.
3. Remove two wood screws securing channel selector indicating plate.
4. Locate oscillator coil to be adjusted by noting channel number on chassis around switch.
5. Insert fiber or bakelite-type screw driver carefully in slotted brass slug in oscillator coil.
6. Adjust for best compromise between picture and sound.

(Caution: Do not apply excessive pressure while adjusting!)

7. Turn Channel Selector switch to other channels and repeat above procedure.
8. Replace selector plate and knob.

The accompanying figure shows the tube layout.



Tube layout for Automatic Chassis AR-TV-709.

Bendix 2025, 3033, 6002, Codes C and D

In order to improve electrical centering of the raster and to facilitate easier mechanical adjustment of the focus coil, a revision of the horizontal oscillator and phase detector circuit has been made.

1. Remove lead of capacitor C39 from the junction of capacitors C40 and C41.
2. Connect this lead of capacitor C39 to the junction of resistors R59, R60, and R61.
3. Remove lead of resistor R58 from pin number three of V14, 6SN7GT, horizontal oscillator and phase detector.
4. Connect this lead of resistor R58 to the junction of resistor R55 and capacitor C36.

Bendix 2025, 3033, 6002

These models use tuner assemblies AROTO4 (type 1), AROTO5 (type 2) and AROTO3 (type 3) as mentioned in the parts lists for the models. The schematic for AROTO4 and alignment notes are given in the service data for Models 2025, 3033, and 6002. The schematic and alignment notes for tuners AROTO3 and AROTO5 are given in the service data for Models 2051, 3051, 6001, 6003, and 6100.

Belmont M-1101, C-1102, C-1104, M-1105, Ch. 12AX22

This chassis appears on *pages 4-6 through 4-10 of Rider's TV Manual Volume 4.* Model M-1101 "The Suburban" is a table model with a white picture tube. Model C-1102 "The Consolette" is a floor model with a white picture tube. Model C-1104 "The Console" is a floor model with a glareless grey picture tube. Model M-1105 "The Suburban" is a table model with a glareless grey picture tube. As changes were made in the production of the 12AX22 chassis, code numbers were assigned to distinguish the differences in the sets. The differences between the different code numbers are explained below:

Code 1. Code 1 chassis are wired as shown in the schematic diagram in Volume 4, except for the tuner chassis filament wiring. Only terminals 6 and 7 should be connected to H. Terminals 5, 8, and 10 should be grounded. There should be no direct connection between C32 and C31, as indicated in Volume 4, C32 should go directly to terminal 6, and C31 should go directly to terminal 7.

Code 2. A 1,000-μμf capacitor is used in place of C111. The value of resistor R92 is changed from 270,000 ohms to 220,000 ohms, and the lead from R92 now goes to the +350-volt line instead of to the +250-volt line. The value of R63 is changed from 560 ohms to 680 ohms, 1 watt.

Code 3. This is similar to Code 2 except that capacitor C109, 47 μμf has been deleted from pin 1 tube 16 to ground.

Code 4. This is similar to Code 3 except that C117 is no longer connected to terminal 1 of T6. It is now grounded.

Code 5. C111, 680 μμf, and C109, 80-480 (A-8E-18508) are now connected in parallel from the junction of C110 and R95 to ground.

Code 6. C116, 0.2 μμf (coil form, A5D-18507) has been added from pin 3 to tube 9-B, the 6SL7 agc amplifier, to pin 5 of tube 18, the 6W4.

Code 7. R48 is no longer connected to the +350-volt line, instead it now goes directly to tap 3 of T6.

Code 8. R98 now goes to the +350-volt line, instead of to tap 3 of T6. C113 is grounded instead of going to the junction of C114 and the +350-volt line. Capacitor C119, 1,000 μμf, has been added from ground to the junction of C118-A and the lead from C114 that goes to tap 3 of T6.

Code 9. The value of R73 is changed from 100,000 ohms to 68,000 ohms.

The following additions have been made to the parts list in Codes 1 through 9:

Parts No.	*Description*
C-12M-18285	Horizontal-deflection transformer
B-55P-18282	Focus magnet
A-19A-14275	Yoke plug
B-15B-14274	Yoke socket
C-2B-18056	Power-supply shield can
A-5B-18446-74	Knob (5 used)
A-6M-18412	Indicator plate.

The deflection-yoke socket is now numbered in the following way: pin 1 is now designated as pin 4, 2 is now 5, 3 is now 1, 4 is now 2.

Code 10. The value of R47 is changed to 68,000 ohms (C-9B1-84), and a switch on volume-contrast control has been added from R47 to the +250-volt line. R73 is changed to 18,000 ohms (C-9B1-77). R76 is changed to 560,000 ohms (C-9B1-95). R100 has been removed from its position at pin 6 of tube 19 and is now located from the junction of pin 11 of tube 10 and C67 to the tap of R46, brightness control. The value of R100 is 100,000 ohms. R103 is changed to 5,600 ohms, 2 watts (C-9B4-74). R108, 5,600 ohms, 2 watts (C-9B4-74), has been added from C61-D to the +350-volt line. R105 and F-1 have been deleted from the circuit. C118-A is now located from pin 1 of the power-jumper plug to ground; C119 goes from ground to pin 1 of the jumper plug and C114. A ¼-amp fuse has been inserted from pin 6 to pin 1 of the jumper plug.

Code 11. Resistor R107, 3,900 ohms, 2 watts (C-9B4-69) is added from pin 3 of tube 18, the 6W4, to the minus side of C115. The horizontal-deflection transformer T6 has been changed from C-12M-18285 to C-201-18530.

Code 12. Capacitor C120, 7 μf (ceramic, C-8G-11790) has been added in parallel across coil L10.

Code 13. Capacitor C56 has been deleted. R32, contrast control, and R34 are now located as shown in Fig. 1. Additional changes in component location in this circuit are also shown in Fig. 1. The lead from R34 goes to pin 1 of tube 9-B, the agc amplifier. The lead from R37 goes to L16. The lead from pin 1 goes to the junction of C64 and L21. R37 has been relocated, as shown in Fig. 1, and its value is changed from 1,000 ohms to 8,200 ohms. C61-A has been deleted. R35 and C60 have been added. R32, R38, R40, and C63 are changed to 5,000 ohms, 3,300 ohms, 100 ohms, and 22 μμf, respectively. Since the contrast control was moved to a new location after Code 12, the output connection of an oscilloscope or meter will not be connected across the contrast control, but now across resistor R37 (pin 7 of tube 7 to ground).

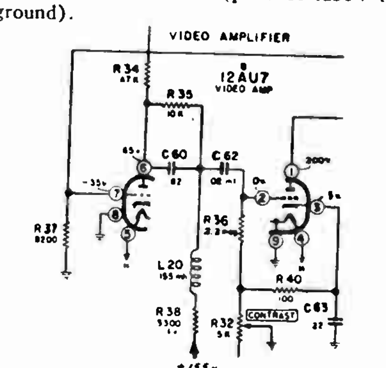


Fig. 1. Changes in the video amplifier circuit of the Belmont 12AX22.

R53 has been deleted and C59 has been added. Additional changes in component location are shown in Fig. 2. The lead from R50 and C59 goes to the agc line. The lead from C71 goes to C116, and the other side of C116 goes to pin 4 of tube 9-A, the 6SL7 sync amplifier. The lead from pin 2 goes to tap 6 (an additional winding which is described below), of T6. C71 is now 1 μμf, and R50 is 2,200 ohms.

R54, which went from R17 to pick-off coil T8, has been deleted. C72 has also been deleted. R99, to tap 5 of T6, has been deleted. T6 has been changed (see parts-list changes listed below), and now has an additional winding which is located between the winding for the filaments on the 1X2 and the winding going to the plate of the 1X2.

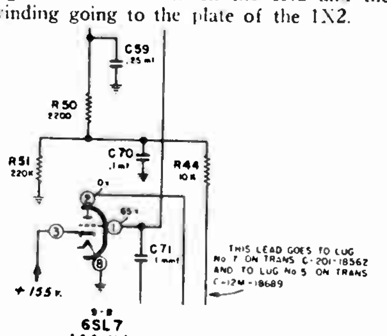


Fig. 2. Changes in the agc circuit of the Belmont 12AX22.

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World Radio History

The value of R82 is changed from 1 megohm to 220,000 ohms, and the lead goes to tap 6 of T6, instead of to tap 5. C98 is changed from 75 $\mu\mu f$ to 82 $\mu\mu f$. R87 is changed from 1.5 megohms to 680,000 ohms. C110 has been relocated and now goes from R87 to the junction of C112, R96, and R97. The value of C110 is changed from 220 $\mu\mu f$ to 22 $\mu\mu f$, 500 volts. R95 has been deleted and the value of C111 is changed from 680 ohms to 820 ohms. Pin 8 of tube 17, the 6BQ6 pulse amplifier, is now tied to pin 2 of the same tube.

The change in parts list is as follows:

Ref. No.	*Part No.*	*Description*
C60	C-8F3-112	82 $\mu\mu f$, mica
C63	C-8F-18569	22 $\mu\mu f$, mica
C70	B-8D-18491	0.1 μf, paper
C71	A-8G-12495-2	1 $\mu\mu f$, ceramic
C98	C-8F3-112	82 $\mu\mu f$, mica
C110	C-8G-11892	22 $\mu\mu f$, 500 volts, ceramic
C111	C-8F6-124	820 $\mu\mu f$, mica
R34	C-9B1-82	47,000 ohms, ½ watt
R35	C-9B1-74	10,000 ohms, ½ watt
R37	C-9B1-73	8,200 ohms, ½ watt
R38	C-9B2-68	3,300 ohms, 1 watt
R40	C-9B1-74	100 ohms, ½ watt
R50	C-9B1-66	2,200 ohms, ½ watt
R82	C-9B1-90	220,000 ohms, ½ watt
R87	C-9B1-96	680,000 ohms, ½ watt
T6	C-201-18562	Horizontal-deflection transformer
	C-12M-18689	Horizontal-deflection transformer, R107 not used with C-12M-18689.

Code 14. R44 is changed from 3.3 megohms to 10,000 ohms, ½ watt (C-9B1-74).

Code 15. The value of R56 is changed from 68 ohms to 120 ohms, ½ watt (C-9B1-51).

Ref. No.	*Part No.*	*Description*
C61	A-8C-18487	30-30 μf x 450 volts, 125 μf x 25 volts
	B-5B-18552-85	Tuning knob (vernier)
	B-2M-18553	Vernier disk
	B-55P-18638	Focus magnet
	A-51A-15713	Iron core, for L4, 8, 9
	A-10B-18794	Vertical size control (screwdriver shaft)
	A-10B-18795	Linearity size control (screwdriver shaft).

In later production, group numbers (chassis identification numbers) were assigned to each set. The production changes made are explained below:

Code 16 or Group Numbers 6,700 to 8,999. Video trap coil L19 was relocated and connected to pin 7 of the 12AU7 video amplifier, tube 8, and L16. Peaking coil L21 (A-16A-17961) was replaced with A-16A-18685 (white dot). The high-voltage capacitor and socket assembly (N-201-18161) was removed and replaced with a wafer tube socket (A-15C-18735), high-voltage ring (A-62C-18734), two insulators (A-5M-18733), and mounting hardware. A 2.2 ohm, ½-watt, wire wound resistor (C-9C1-1067) or a filament choke (A-16A-18785) was added in series with the 1X2 filament lead as shown in Fig. 3.

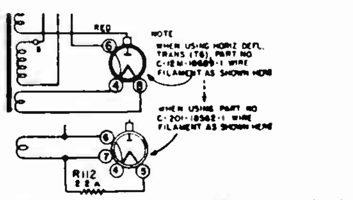

Fig. 3. Wiring for the 1X2 filament lead of the Belmont 12AX22.

Code 17 or Group Numbers 9,000 to 12,399. To reduce "snow" in the pictures, the yellow lead from the tuner (terminal 9) was disconnected from agc and reconnected to ground. To reduce capacitor failures, capacitor C64 is replaced with a 0.01-μf, 600-volt capacitor (C-8D-11128).

Code 18 or Group Numbers 12,400 to 14,199. To reduce horizontal size, the white and black leads to the horizontal-deflection transformer T6, lugs 2 and 3, respectively, were interchanged, black to lug 2 and white to lug 3.

Code 19 or Group Numbers 14,200 and above. Both the C-12M-18689 and C-201-18562 horizontal-deflection transformers were removed and replaced with new transformers. The part numbers are the same with the addition of a dash one (—1). The black and white horizontal-deflection-transformer leads are connected as in Code 17. Resistor R4 is changed to 10,000 ohms. Resistors R8 and R10 are grounded, C33 has been deleted, and the tuner chassis filament wiring has been changed. Pin 4 of the 6AG5 is grounded, pin 3 of the same tube and pin 3 of the 6J6 are tied to tuner terminal 8 and go to H. Pin 4 of the 6J6 is grounded. C30, C31, and C32 have been deleted. C25 has been deleted. The value of R45 is changed to 220,000 ohms (C-9B1-90), and a resistor R110, 220,000 ohms, ½ watt (C-9B1-90) has been added from pin 5 of the 6SL7 sync amplifier, tube 9-A, to ground. R28 is changed to 120 ohms.

To elimihate vertical jitters, R73 is changed to 68,000 ohms (C-9B1-84). R72 is changed to 1.5 megohms (C-9B1-100). C95 is changed to 0.02 μf (C-8D-17607). C106 is changed to 0.1 μf (C-8D-10771). Capacitor C91 is deleted. C90 has been relocated to between R77 and C95, and its value has been changed to 0.005 μf (C-8D-17608). A 27-inch, 300-ohm jumper is connected in parallel between the high- and low-band antenna terminals. The changes applying to C90, C91, C95, C106, R45, R72, and R110 were made to remove horizontal waver and to improve vertical sync. A dual control and switch (A-10A-18441) have been added to the parts list.

Capehart-Farnsworth CX-33

Sometimes a "whistle" occurs in the sound and/or lines (similar to a Barkhausen effect) appear in the picture, although both symptoms do not always appear. The cause in most cases is due to the fact that C-242D (electrolytic, between —90-volt point and chassis ground) has a higher than normal impedance at the horizontal oscillator frequency. To improve by-passing at this frequency, a 0.1-μf, 200-volt capacitor is connected from the —90-volt point (junction of R-291 and R-290 near the 6BG6 tube) and chassis ground. This capacitor will be added in production.

If difficulty is encountered in accurately aligning the primary of transformer T-204, to the 4.5 Mc, it is possible that the tuning range has deviated, due to variations in material. A 5-$\mu\mu f$ capacitor connected from terminals 3 and 4 of T-204 should correct this condition.

If the picture focus lacks sharpness, it may possibly be improved by connecting a 2,200-ohm 2-watt resistor in parallel with R-297 (focus control) and R-296B. This connection can be made at the terminals of the filter capacitors C-243C and C-264B. This change should be tried only after carefully making normal adjustment to obtain proper focus.

Where vertical instability occurs, check capacitor C-230 from the cathode of the 12AU7 pre-sync separator. The lead may have been broken in shipment. Check the value of R-256 grid resistor of the 6SN7 sync-clipper to ground, and if it is higher than 3.9 megohms, replace. Check R-269, the 38,000-ohm temperature compensating resistor in series with the vertical hold control. Its normal value (at 25° C) is 38,000 ohms, plus or minus 20%. As the chassis operating temperature rises, its value will decrease to a minimum of 18,500 ohms, plus or minus 20% (at 65° C). Replace this resistor if it is out of these limits, and especially if it increases in value.

Crosley 10-401

To prevent breakdown due to arcing between the plate leads of the 6BG6 tube and the damper, install 3½ inches of fiberglass sleeving (part no. 39468-14) over the 6BG6 plate lead. This sleeving should be placed toward the terminal on the horizontal deflection transformer.

Horizontal sweep sing can be caused by vibration of the mounting bracket on the horizontal output transformer, T107. This mounting bracket occasionally vibrates at a sub-harmonic of the 15,750-cps horizontal sweep frequency. On later production sets this condition has been corrected by dipping the core and mounting bracket in a high melting point wax. Receivers that do not have this wax treatment can be corrected by inserting small wedges between each end of the transformer and the chassis. It is not necessary to remove the chassis from the cabinet to make this correction.

Crosley 10-414MU, 10-416MU, 10-416MIU, 10-429MU

On later sets resistor R151, 150,000 ohm, 10%, ½ w (part No. 39374-51) was changed to 220,000 ohm, 10%, ½ w (part No. 39374-53). This change was made to increase the horizontal hold control range.

DuMont RA-101B, RA-102, RA-103

If vertical jitter occurs in these chassis the following modification is suggested: (See the schematic for the deflection chassis.)

1. Disconnect the blue lead of the vertical BTO transformer from the B+ supply point.
2. Disconnect the red lead of the vertical BTO transformer from the end of the integrator network, and ground the red lead to the chassis.
3. Connect one terminal of a 0.01-400-v (0.01-450 volt for RA-103 only) paper tubular capacitor to the point from which the red transformer lead was removed in Step 2.
4. Connect the blue transformer lead to the remaining lead of the 0.01 capacitor.
5. Connect a 27,000-ohm, 2-watt carbon resistor to the plate (pin 8) of the vertical sync amplifier V6 (V216-A in RA-103).
6. To the open end of the 27,000-ohm resistor, connect a 4700-ohm, 1-watt, carbon resistor and the positive terminal of an 8-μf, 450-v, electrolytic capacitor.
7. Ground the negative terminal of the 8-μf capacitor to the chassis.
8. Connect the open end of the 4700-ohm resistor to the point from which the blue transformer lead was removed in Step 1.
9. Remove resistor R270, 12,000 ohms. (This step applies to Chassis RA-103 only.)

DuMont RA-101B

The connection from the 4.5-Mc trap (V17) to the junction of L47 and R91 has been deleted. Resistor R91 which goes from L47 to the junction of R89 and R94 has also been deleted.

DuMont RA-109A, RA-111A

Type 6CB6 tubes may be substituted for 6AU6's in the 2nd sound i-f amplifiers of the RA-109A and RA-111A sets. This substitution requires the addition of a tube shield (part number 42002530) and a shield base (part number 42002540). The latter may be readily soldered in place, rather than riveted or bolted.

A 6BC5 may be substituted for the 6AU6 first sync clipper, V219, in the RA-111A set. This change does not require the addition of parts or wiring.

Type 6BA6 tubes may be used in place of the 6AU6's in the 1st and 2nd video i-f of the RA-109A and RA-111A sets, providing both 6AU6's are replaced by two 6BA6's simultaneously. It is not advisable to use one 6BA6 and one 6AU6 in these positions.

DuMont RA-102 Series

These chassis appear on *pages *1-34 through *1-57 of Rider's TV Manual Volume 1.* Low picture i-f sensitivity will cause the picture level to drop when the sound carrier is properly tuned in. The condition will be most apparent on stations with low signal strength. If this occurs, check the vacuum tubes in i-f chain. Also a defective 1N34 video rectifier or a poor vacuum tube in the inputuner may be the cause.

The following list are given as an aid for servicing RA-102 Telesets:

Indication	*Cause*
No bigh voltage.	Defective 8016 or 807 in power supply. Defective high-voltage transformer.
Picture has horizontal wobble.	Defective 6AC7 (video amplifier), 807's (horizontal output stage), or 6SN7 (1st sync amplifier).
Notches in picture or raster (moving up and down).	Bad 6AS7.
Picture size varies excessively during evening's operation.	Improperly adjusted high voltage.
Poor definition.	Bad crystal.

DuMont RA-102

The large amount of noise flashes on the cathode-ray-tube screen has been traced to corona discharge in the high-voltage r-f power supply. The remedies suggested are: (1) lead dressing to lengthen discharge path; (2) insulating sleeving on leads; (3) painting exposed high-voltage points with insulating compound.

Evenly spaced carriers across the broadcast band every 17 kc are caused by continuously running h-v r-f oscillator or horizontal sweep oscillator. Causes may be:

1. Bias on h-v oscillator has dropped so that oscillator is free running without triggering from sweep circuits. Check cathode resistor, grid resistor.
2. Beam cut-off relay not opening when television is switched off. Clean contacts or adjust armature return spring tension.

The front-to-back resistance ratio of the 1N34 crystal rectifier should be at least 100 to 1. If the ratio falls below this, the crystal should be replaced. These resistance ratios may be measured with a common ohmmeter.

Emerson 651C, 651D, 658B, 658C, Ch. 120124

In the event that this chassis causes interference on a-m radio sets, the following change will eliminate it:

1. Add a 0.05-μf, 400-volt capacitor from line switch side of a-c input plug.
2. Add a 100,000-ohm, 1-watt resistor in parallel with above capacitor.

The following changes will reduce internal radiation effects upon sync stability:

1. Remove the lead from junction of R-6 (1000 ohms), R-31 (1 megohm), C-37 (0.25 μf), to V-8 (6T8) pin 6.
2. Add a 1500-$\mu\mu f$ capacitor from the B+ side of fuse F-1, to chassis. The leads should be ¼" long.
3. One side of R-35 (100,000 ohms) now goes to the chassis, instead of to pin 7 (V-4, 6AU6).
4. Remove the 225-volt B+ lead from the fuse to the dummy lug under T-8, the horizontal oscillator transformer.

5. From the fuse on the dummy lug, add a B+ lead through the high-voltage box, along the top of the chassis to the chassis hole near the power transformer, through this hole to the plus terminal of C-51. C-51 is part of C-49 and is designated by a square on the top of the can.
6. Remove the secondary of the vertical output transformer (T-7) leads from the dummy lug under the deflection yoke.
7. Reroute the leads through the high-voltage box and along the top of the chassis, solder back to the same dummy lugs. These lugs also hold leads from the vertical deflection coils L-8.
8. Reroute the lead from the horizontal size coil L-11 to the horizontal deflection coil L-9 through the high-voltage box and along the top of the chassis.
9. Add a metal shield 4" long by 2" along the side of the i-f dummy-lug strip.
10. Change C-73 from 50 $\mu\mu f$, mica capacitor, to 42 $\mu\mu f$, ceramic, 2000 volts, (part #928058).

Sets coded with triangle 4 have all above changes except Step 10.

Sets coded with triangle 5 have all above changes including Step 10.

Emerson 66B, 86B; 611, Ch. 87B

In the Oscillator Alignment Chart, under the column headed VTVM, the VTVM goes to the junction of R41, C28 and C29 for Chassis 66B, only. For Chassis 86B and 87B, the VTVM should go to point C.

Farnsworth B504P16, Ch. U-12

The B504P16 is a television, a-m—f-m radio and phonograph combination similar to the 504P16. The picture tube used in this instrument is the Farnsworth "160" type (16½ inch direct view). The instrument employs the U-12 television chassis, C-265 h-v supply chassis, P7 a-m—f-m chassis with a separate pre-amplified chassis, and the P777 three-speed record changer. The cabinet has been revised from the original 504P cabinet to provide a "truncated circle" opening for the 16½-inch picture tube.

The C-265 h-v supply chassis is identical to the C-266 chassis which is used in Model 462P12. The C-265 version uses the long cables, whereas in the C-266 the power cable, deflection cable and anode connector are of the short type.

Farnsworth, Capehart Models 461P, 501P, 502P, 504P, Ch. U-12

Models 501P, 502P, and 504P use the Capehart P-7 a-m—f-m radio tuner chassis and the Capehart Automatic Intermix Record Changer, Model P-71. Model 461P is a television receiver only, and uses, in conjunction with the U-12 Chassis, the Capehart A-13 Audio Amplifier. The schematic for the A-13 is given in Fig. 1. There have been incorporated in production, three versions of the 12-kv high-voltage supply, which were necessitated by the use of three different focus coils.

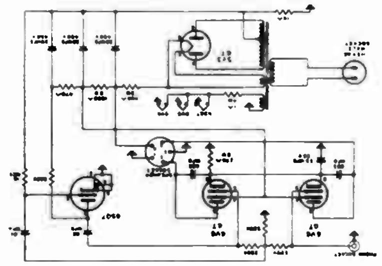

Fig. 1. Schematic diagram for the Capehart A-13 Audio Amplifier.

The focus coil originally used, part number 38955, is an electromagnetic coil. Focus coils part numbers 650001A-1 and 650001A-2 shown in Fig. 2 (for 10- and 12-inch picture tubes, respectively) are part electromagnet and part permanent magnet, therefore the latter two require much less current than the former.

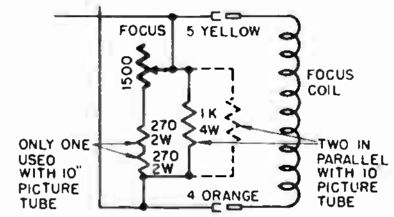

Fig. 2. Focus coils used in the U-12 Chassis.

Two types of r-f sub-assemblies have been incorporated: (1) that switching coils in selection of channels, and (2) that using continuous variable capacitor tuning. The latter, provides 12 channel reception (channel 1 is deleted since this channel is no longer assigned to telecasting service by order of the FCC) and channel identification is by a brass pin extending from the selector switch. The schematic for the 12-channel r-f unit, part number 13900, is shown in Fig. 3.

Additional changes have been made in the U-12 Chassis. A 100,000-ohm resistor has

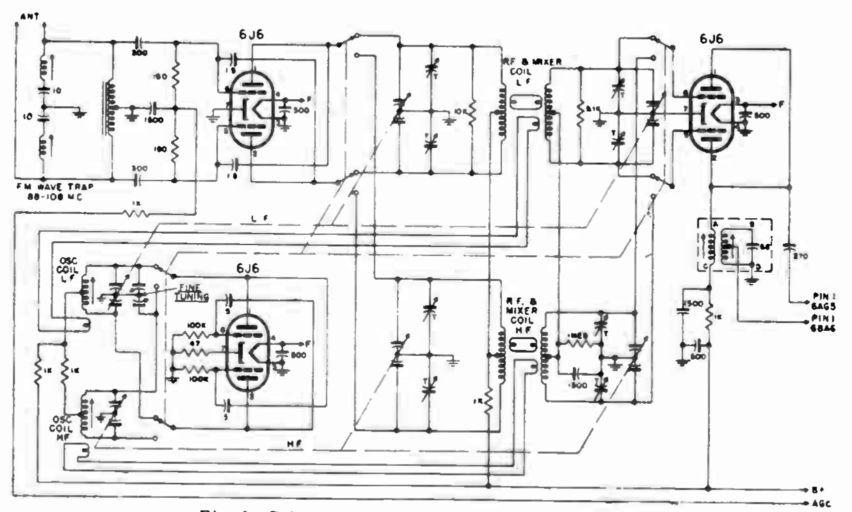

Fig. 3. Schematic for the r-f unit Part No. 13900.

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been inserted from R42 to +270 volts. A 0.2-μf capacitor has been inserted from the junction of the 100,000-ohm resistor and R42 to the 3-megohm volume control and C39. Resistors R204 and R208 have been deleted. A 47-ohm, ½-watt resistor has been inserted from tap 2 of T201 to the plate of the 6BG6 Pin 5 of the audio socket is now connected to the junction of the power transformer and C34, and pin 7 is connected to the junction of the jumper and the transformer. (The jumper is removed on Model 461P.) A 9,000-ohm, 5-watt resistor has been inserted from tap 1 of T201 to the junction of R205 and R209. R203 is now connected to the junction of the ¼-amp fuse and the cathode of the 5V4G. The tube socket voltage readings are shown in the accompanying chart.

Gamble-Skogmo "Preview," 05TV1-43-9002A

The "Preview" model 05TV1-43-9002A is electrically identical to Model 94TV1-43-8940A. The 05TV1-43-9002A replacement parts list is identical to the 94TV1-43-8940A except for cabinet parts which are listed below:

Part No.	*Description*
R-24D-18709	Cabinet
C-2M-18191	Escutcheon
C-2M-18187	Escutcheon mask
B-30M-18201	Picture glass
B-2M-17067-1	Channel indicator plate
B-2M-17068-1	Contrast off-volume plate
B-5B-18552-76	Tuning knob
B3B-18555	Tuning knob bushing
A-2M-18558	Tuning knob spring
A-6M-17803	Indicator, tuning knob
B-5B-17761-76	Knob, volume
B-5B-17762-76	Knob, contrast
B-5B-18244-76	Knob, 3 used
B-2M-18553	Vernier arm
B-3B-18554	Vernier bushing
A-3C-18551	Vernier stud
A-2M-18557	Vernier spring
C-23J-18722	Cabinet back
B-14M-17758	Line cord and plugs
C-18A-18157	10" p-m speaker
N-201-8386	TV Antenna assembly
B-5B-18382-36	Antenna knob.

TUBE SOCKET VOLTAGE READINGS

TELEVISION CHASSIS

TUBE & FUNCTION	Contrast Control at	1	2	3	4	5	6	7	8	9
6J6 r.f. amplifier	Minimum Maximum	pl. 135 63	pl. 108 82	htr. 6.3 a.c. 6.3 a.c.	htr. 0 0	c.g. −29 −0.4	c.g. −29 −0.4	k. 0 0	———	———
6J6 r.f. converter	Minimum Maximum	pl. 130 95	pl. 130 95	htr. 6.3 a.c. 6.3 a.c.	htr. 0 0	c.g. −2.5 to −9.0 −2.1 to −7.2	c.g. −2.6 to −6.0 −2.2 to −5.4	k. 0 0	———	———
6J6 r.f. oscillator	Minimum Maximum	pl. 108 82	pl. 108 82	htr. 6.3 a.c. 6.3 a.c.	htr. 0 0	c.g. −2.5 to −9.0 −2.1 to −7.2	c.g. −2.5 to −9.0 −2.1 to −7.2	k. .26 .18	———	———
6BA6 1st. sound i.f. amplifier	Minimum Maximum	c.g. 0 0	sup.g. 0 0	htr. 6.3 a.c. 6.3 a.c.	htr. 0 0	pl. 125 108	s.g. 125 108	k. 1.9 1.6	———	———
6BA6 2nd. sound i.f. amplifier	Minimum Maximum	c.g. 0 0	sup.g. 0 0	htr. 0 0	htr. 6.3 a.c. 6.3 a.c.	pl. 128 110	s.g. 120 105	k. 2.0 1.7	———	———
6AU6 3 rd. sound i.f. amplifier	Minimum Maximum	c.g. −.35 −.35	sup.g. 0 0	htr. 6.3 a.c. 6.3 a.c.	htr. 0 0	pl. 52 44	s.g. 44 38	k. 0 0	———	———
6T8 sound discr. & 1st. audio amplifier	Minimum Maximum	d.d.pl. −4.6 −4.6	diode pl. −8.0 −8.0	diode k. 0 0	htr. 0 0	htr. 6.3 a.c. 6.3 a.c.	d.d.pl. ——— ———	d.d.t.k. 0 0	d.d.t.c.g. −1.04 −1.04	d.d.t.pl. 86 86
6AG5 1st. pix. i.f. amplifier	Minimum Maximum	c.g. −8.8 −1.0	k.&sup. ——— ———	htr. 6.3 a.c. 6.3 a.c.	htr. 0 0	pl. 130 90	s.g. 130 90	k.&sup. 0 .2	———	———
6AG5 2nd. pix. i.f. amplifier	Minimum Maximum	c.g. −8.8 −1.0	k.&sup. ——— ———	htr. 6.3 a.c. 6.3 a.c.	htr. 0 0	pl. 130 95	s.g. 130 95	k.&sup. 0 .2	———	———
6AG5 3rd. pix. i.f. amplifier	Minimum Maximum	c.g. −8.8 −1.0	k.&sup. ——— ———	htr. 6.3 a.c. 6.3 a.c.	htr. 0 0	pl. 130 86	s.g. 130 100	k.&sup. 0 .28	———	———
6AH6 4th. pix. i.f. amplifier	Minimum Maximum	c.g. 0 0	sup.g. .96 .8	htr. 6.3 a.c. 6.3 a.c.	htr. 0 0	pl. 77 65	s.g. 105 90	k. .96 .8	———	———
6AL5 video detector & AGC rectifier	Minimum	k. 0	pl. −115	htr. 6.3 a.c.	htr. 0	k. −112	shield 0	pl. −.4	———	———
6AU6 1st. video amplifier	Minimum Maximum	c.g. −2.1 −2.2	sup.g. 0 0	htr. 6.3 a.c. 6.3 a.c.	htr. 0 0	pl. 248 260	s.g. 135 115	k. 0 0	———	———
6K6 GT 2nd. video amplifier	Minimum Maximum	shield ——— ———	htr. 0 0	pl. 105 95	s.g. 137 117	c.g. −7.8 −8.0	n.c. ——— ———	htr. 6.3 a.c. 6.3 a.c.	k.&sup. 3.9 2.8	———
6AT6 AGC amplifier	Minimum Maximum	c.g. −112 −107	k. −112 −110	htr. 6.3 a.c. 6.3 a.c.	htr. 0 0	diode −112 −112	diode −112 −112	pl. −42 0	———	———
½6AL5 AVC limiter	Minimum Maximum		pl. −9 −3	htr. 0 0	htr. 6.3 a.c. 6.3 a.c.	k. −8.7 −1.0	shield 0 0		———	———
½6AL5 d.c. restorer	Background Minimum Background Maximum	k. −100 0						pl. −110 0	———	———
6SK7 1st. sync. amplifier	Minimum Maximum	shield 0 0	htr. 6.3 a.c. 6.3 a.c.	sup.g. 0 0	c.g. −4.2 −4.4	k. 0 0	s.g. 126 109	htr. 0 0	pl. 180 210	———
6SH7 sync. separator	Minimum Maximum	shield 0 0	htr. 6.3 a.c. 6.3 a.c.	k.&sup. ——— ———	c.g. −5.1 −10.0	k.&sup. 0 0	s.g. 137 117	htr. 0 0	pl. 137 117	———
6SN7 GT sync. amp. & horiz. discharge	Minimum Maximum	c.g. −150 −150	pl. −84 −84	k. −115 −115	c.g. −0.8 −2.6	pl. 89 79	k. 0 0	htr. 0 0	htr. 6.3 a.c. 6.3 a.c.	———
6J5 vertical osc. & discharge	Minimum	shield 0	htr. 6.3 a.c.	pl. 53	n.c. ———	c.g. −153	n.c. ———	htr. 0	k. −113	———
6K6 vert. output	Minimum	shield ———	htr. 6.3 a.c.	pl. 185	s.g. 185	c.g. −95	n.c. ———	htr. 0	k. −78	———
2-5U4 G rectifiers	Minimum	n.c. ———	htr. 325	n.c. ———	pl. 390 a.c.	n.c. ———	pl. 390 a.c.	n.c. ———	htr. 325	———
6AC7 hor. osc. control	Minimum	shield 0	htr. 6.3 a.c.	sup.g. 0	c.g. −1.65	k. .08	s.g. 100	htr 0	pl. 165	———
6AL5 hor. sync. discriminator	Minimum	k. −1.8	pl. −5.2	htr. 0	htr. 5.1 a.c.	k. −2.4	shield 0	pl. −5.4	———	———
6K6 hor. oscillator	Minimum	shield ———	htr. 6.3 a.c.	pl. 198	s.g. 205	c.g. −25.7	n.c. ———	htr. 0	k. .28	———

12 KV SUPPLY CHASSIS

										PLATE CAP
2-6BG6 G hor. output	Minimum	n.c. ———	htr. 0	b.f.pl.&k. −100	n.c. ———	c.g. −115	n.c. ———	htr. 6.3 a.c.	s.g. 200	Do Not Measure*
5V4 G hor. damper	Minimum	n.c. ———	htr. 380	n.c. ———	pl. 310	n.c. ———	pl. 310	n.c. ———	htr. 380	———
6AS7 G hor. damper	Minimum	c.g. 130	pl. 310	k. 310	c.g. 130	pl. 310	k. 310	htr. 380	htr. 380	———
1B3 GT h.v. rectifier	Background Minimum	n.c. ———	htr. 8000	n.c. ———	n.c. ———	n.c. ———	n.c. ———	htr. 8000	n.c. ———	Do Not Measure**
1B3 GT h.v. rectifier	Background Minimum	n.c. ———	htr. 12000	n.c. ———	n.c. ———	n.c. ———	n.c. ———	htr. 12000	n.c. ———	Do Not Measure*

*Has a.c. component of approx. 6000 volts.
**Has a.c. component of approx. 10000 volts.
All voltages measured from terminal to ground.
Line voltage, 117 volts, 60 cycles a.c.

Power transformer tap switch set to 115 volt position.
All controls set for normal operation except where otherwise specified.
No signal received.
All voltages measured with Vacuum-Tube-Voltmeter.

Gamble-Skogmo 05TV1-43-8940B, 05TV1-43-9002B

These models are similar to Model 94TV1-43-8940A and Model 05TV1-43-9002A except for the following changes. Models 8940B and 9002B are 12½-inch television receivers, and the 9002B employs a 10-inch p-m speaker. A chassis identification number is assigned to each receiver in production. After identification number (group number) 14,200, a wiring change was made to improve the vertical sync, reduce "snow" in the picture, and to remove the tendency toward horizontal wavering. This wiring change was accompanied by a model number series change from A to B in both the 8940 and 9002 receivers.

The models 8940B and 9002B are identical to the 8940A and 9002A with the exception of the tuner input wiring and the changes listed for Model 94TV1-43-8940A. The changes in the parts lists are as follows:

Ref. No.	*Part No*	*Description*
R4	C-9B1-74	10,000 ohms, ½ watt, 10%
	A-7M-15511-1	Trimmer plate
	A-2H-12337	Tube shield base
	A-7M-15510-1	Coil alignment strip
	A-2J-16310	Sliding contact
	A-5F-16311	Contact holder
	B-200-17086	Switch lever assembly
	C-2E-15486-1	Cover
	A-49A-15993	Take-up spring
	A-49A-15988	Tuner shaft spring
	A-55C-15496	Steel ball
	A-2C-16446	Retainer plate
	B-3B-18554	Vernier bushing
	N-23M-18571	Drive screw
	A-3C-18551	Vernier stud
	A-2M-18557	Vernier spring
	N-211-17078-1	Tuner assembly
C63	C-8F-18569	22 $\mu\mu f$
C85		.01 μf
C90	C-8D-17608	.005 μf
C93	C-8D-14461	.05 μf, 400 volts
C95	C-8D-17607	.02 μf
C105	C-8D-17785	.005 μf, 200 volts
C110	C-8G-11892	22 $\mu\mu f$, 500 volts, ceramic
C111	C-8F6-124	820 $\mu\mu f$
C116	A-5D-18507	.2 $\mu\mu f$ (coil form)
C120	C-8G-11790	7 $\mu\mu f$, ceramic
R28-56	C-9B1-51	120 ohms, ½ watt, 10%
R32-61	A-10B-18441	Dual control, and switch
R35	C-9B1-74	10K ohms, ½ watt, 10%
R38	C-9B2-68	3300 ohms, 2 watts, 10%
R45-82, 92	C-9B1-90	220K ohms, ½ watt, 10%
R73	C-9B1-84	68K ohms, ½ watt, 10%
R50-81	C-9B1-66	2200 ohms, ½ watt, 10%
R63	C-9B2-60	680 ohms, 1 watt, 10%
R72	C-9B1-100	1.5 megohms, ½ watt, 10%
R79	C-9B1-13	1000 ohms, ½ watt, 20%
R87	C-9B1-96	680K ohms, ½ watt, 10%
R110	C-9B1-54	220 ohms, ½ watt, 10%
R103, R107, R108	C-9B4-71	5600 ohms, 2 watt, 10%
R109	C-9B1-77	18K ohms, ½ watt, 10%
R112	C-9B1-102	2.2 ohms, ½ watt, 10%
T6	C-12M-18689-1	Horizontal deflection transformer
T7	C-12A-18839	Power transformer
	B-15B-14274	Yoke socket
	A-19A-14275	Yoke plug
	A-15C-18735	1X2 tube socket
	A-5M-18733	Standoff insulator
	A-62D-18734	H-v ring
	B-201-16153	H-v cable assembly
	C-2B-18056	Shield can
	R-24D-18709	Cabinet (9002)
	C-18A-18157	10" PM speaker (9002)
	C-23J-18722	Back cover (9002)

Gamble-Skogmo 94TV1-43-8940A

Improper neutralization of the sync amplifier may result in a severe horizontal shift of the entire picture with contrast control adjustments and may also start hunt oscillation (squegging) of the horizontal afc circuit. Squegging, evidenced by white lines or streaks running diagonally across the picture, ringing from the speaker, or singing from the horizontal deflection transformer, may cause damage to the 6BQ6, 6W3, 1X2, or horizontal deflection transformer. If this condition is noticed, it will be necessary to adjust the neutralization of the sync amplifier as shown below:

1. Disconnect the antenna.
2. Ground pin 5 of V7.
3. Rotate the contrast control to its normal operating position.
4. Connect a vtvm (±10-volt range) across capacitor C-106 (near pin 4 of horizontal multivibrator 6SN7).
5. Short pin 5 of 6SL7 to ground.
6. Turn set on and check vtvm reading. (Should be within ±0.5 of zero volts. If not within this, check capacitors C-99, C-100, C-101, C-102, and resistors R-82 and R-87.)
7. Remove the short at pin 5 of 6SL7 from ground and note vtvm reading. If the voltage goes positive, move the two neutralizing capacitors C-71 and C-116 closer together to reduce the voltage to zero. Should this adjustment be insufficient, spread the black and blue leads connected to pins 2 and 4 of the 6SL7. If the voltage is negative, do the opposite.
8. When the vtvm reading is zero, the receiver is properly neutralized.

Garod 12T6, 14C4, 14T2, 14T6, 16C6, Series 94

Except for cabinet designs or picture tube size, Models 12T6, 14T2, and 14T6 are the same as Model 12T2, Model 14C4 is the same as Model 12C4, and Model 16C6 is the same as 16C4.

General Electric 814, 820, 830, 840

A new ceramic-core sweep transformer, Stock No. RTO-071, is recommended as a substitute for the original molded horizontal-sweep output transformers for these models. It has several electrical design improvements over the originally specified transformer, among them are higher efficiency and better high-voltage insulation.

The transformer is equipped with a 470,000-ohm resistor in shunt with a 0.0022-μf capacitor, connected between the primary and high-voltage windings. In order to provide identical electrical characteristics to the original transformers, a few circuit revisions are necessary when the substitution is made. Kits

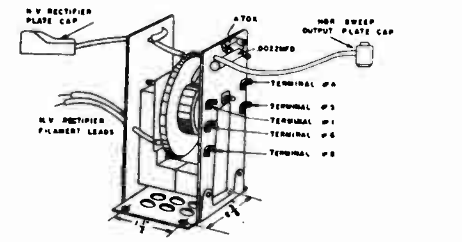

Fig. 1. RTO-071 transformer used in General Electric Models 814, 820, 830, and 840.

are available which contain all the additional components, except transformers or tube, which are required to make the conversions. Fig. 1 is a sketch of the RTO-071 transformer.

Fig. 2 shows the seven steps required to change the circuit for the use of the substitute transformer. The procedure is as follows:

1. Disconnect leads of defective sweep output transformer, including filament loop for 1B3GT rectifier tube. Note that R67, R62, and C103 contained in lead of sweep transformer are removed and discarded.
2. Remove old size control L18 and its shunt resistor R64. Replace it with the new horizontal size control (Stock No. RLD-014). Before installing new control, the mounting hole will have to be enlarged to accommodate the shoulder of RLD-014.
3. Remove old linearity control L19 and its shunting resistor, R65. Replace it by the new linearity control (Stock No. RLD-014).
4. Mount new sweep output transformer (Stock No. RTO-071) in place. See sketch for lead identity so as to effect most satisfactory placement of transformer. Wire the new transformer to the circuit according to the diagram, Fig. 2.
5. Remove type 5V4G tube, V15, and discard. Reconnect V15 socket for new type 6W4GT tube as shown on diagram. Connect the heater of the 6W4GT tube in parallel with the picture tube heater winding. Note: If line voltage remains above 105 volts, the filament of the 6W4GT tube may be connected to the 5-volt winding that supplied the 5V4G damper tube.
6. Remove R60 and R61. Replace them with two 27,000-ohm resistors connected in parallel.
7. Reconnect the h-v capacitor, C53, so that the connection from the stand-off which was disconnected in Step 1, reconnects to chassis ground as shown in Fig. 2.

The conversion components required are:—
1 Stock RTO-071 transformer
1 Type 6W4GT tube
1 Stock RKT-004 kit.
The kit consists of:—
2 URF-083, 27,000, 2 watts, carbon
2 RLD-014, controls.

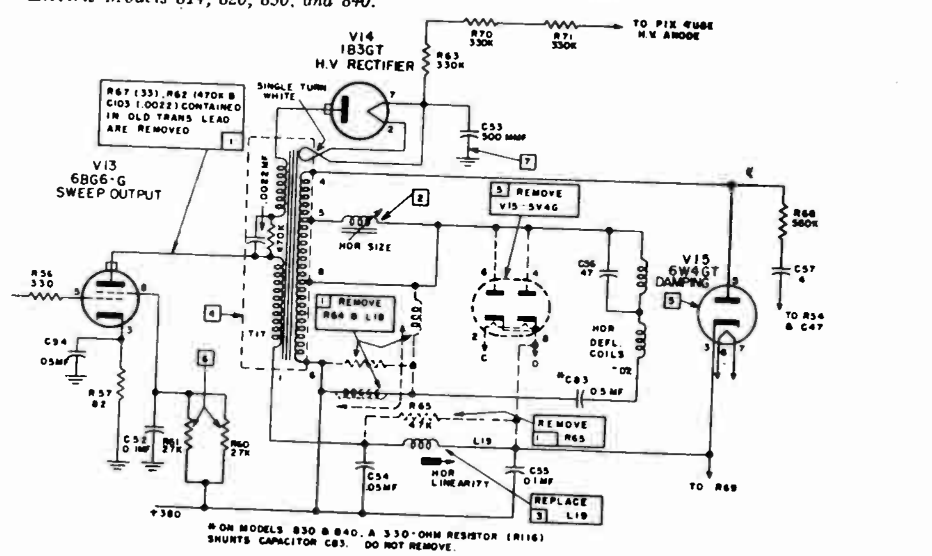

Fig. 2. The seven steps required to change the circuit of General Electric Models 814, 820, 830, and 840, for the use of transformer RTO-071.

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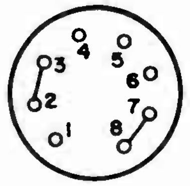
General Electric 12K1, 818

An adapter plug may be made which makes it unnecessary to remove the television chassis when service has to be rendered on the radio chassis only of Models 818 and 12K1. A standard octal tube base is wired as shown in the sketch below. A jumper is connected between pins 7 and 8 and also between pins 2 and 3. This plug is then inserted into the J-4 socket on the radio chassis to re-instate audio continuity and to energize the tube filaments when the radio is separated from the TV chassis. A-c power is furnished at pin 3-4 of P3 or with a suitable plug in receptacle J-2. *Precaution*—When using the latter point for power connection, it requires a male pin jack which makes the pins "hot" at 110 volts.



Wiring for standard octal tube base for General Electric 12K1 and 818.

The plug shown above may also be used when servicing the television chassis separated from the radio chassis. When this plug is inserted into the octal socket J5 on the television chassis, it permits application of power to the television chassis for alignment or trouble shooting purposes.

General Electric 810, 811, 835

A new ceramic-core sweep transformer, Stock No. RTO-071, is recommended as a substitute for the original molded horizontal sweep output transformers for these models. It has several electrical design improvements over the original specified transformer, among them are higher efficiency and better high-voltage insulation.

The transformer is equipped with a 470,000-ohm resistor in shunt with a 0.0022-μf capacitor, connected between the primary and high-voltage windings. In order to provide identical electrical characteristics to the original transformer, a few circuit revisions are necessary when the substitution is made. Kits are available which contain all the additional components, except transformers or tube, which are required to make the conversions. Fig. 1 is a sketch of the RTO-071 transformer.

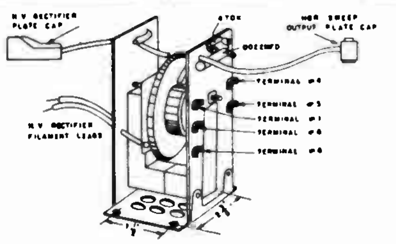


Fig. 1. RTO-071 transformer used in General Electric Models 810, 811, and 835.

Fig. 2 shows the five steps required to change the circuit for the use of the substitute transformer. The procedure is as follows:

1. Disconnect leads of defective sweep output transformer, including filament loop for 1B3GT tube. Notice that R67, R62, and C103 are removed with it. Mount new transformer on chassis. See Fig. 1 for lead identity to effect most satisfactory placement of transformer. Wire new transformer into the circuit according to the diagram in Fig. 2.
2. Add a 27,000-ohm resistor, URF-083, in parallel with R60 and R61 as shown.
3. Disconnect the white lead of the horizontal size control, L18, that connects to pins 4 and 6 of V15, and reconnect it to terminal 8 of the sweep transformer. Make sure that the leads from the horizontal size coil do not short to the frame of the sweep transformer. Connections from terminals 5 and 8 of the high-voltage transformer should be made with the high-voltage insulation wire.
4. Connect the 1,200-$\mu\mu$f capacitor, UCU-2054, in series with the 1,500-$\mu\mu$f capacitor, RCU-285. This series combination is then connected between terminals 6 and 8.
5. Remove the 4,700-ohm resistor, R65, from across the horizontal linearity control L19.

The conversion components required are:
1—Stock RTO-071 transformer
1—Stock RKT-003 kit.

The kit consists of:
1—URF-083, resistor, 27,000 ohms 2 w, carbon
1—USU-2054 capacitor, 1,200 $\mu\mu$f, mica
1—RCU-285, capacitor, 1,500 $\mu\mu$f mica.

Readjustment of the blocking oscillator transformer, T16, may be necessary. In some cases, if proper centering of the horizontal hold control cannot be had, it may be necessary to reduce or increase the value of R52 somewhat to effect the correct adjustment of the blocking oscillator transformer. This change should be limited to values between 35,000 and 82,000.

There will probably be two settings of the horizontal linearity control which will be found to give good linearity. The proper setting is the one with the slug withdrawn from the center of the coil, or minimum inductance. The other position may cause some "squaring" of the outside circle of a test pattern.

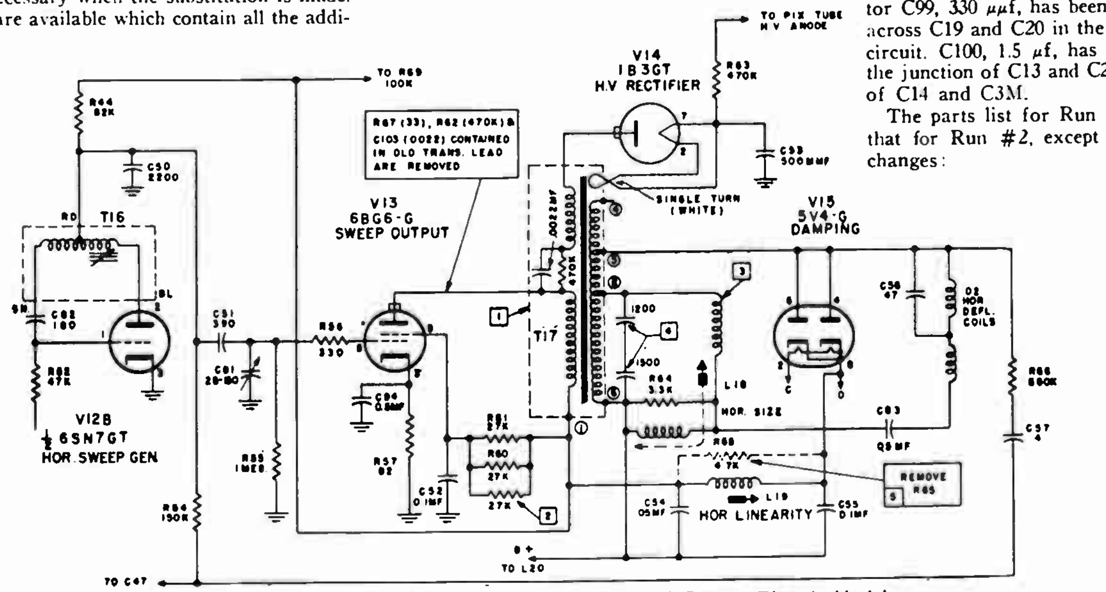


Fig. 2. The five steps required to change the circuit of General Electric Models 810, 811, and 835, for the use of transformer RTO-071.

General Electric 810, 814, 820, 830, 835, 840

The following miscellaneous repair parts are added for the head-end unit of the above receivers:

Part No.	Description
RBI-001	Strip, textolite bearing strip for selector switch shaft
RHM-070	Washer, oversize "C" washer (47 mils) to remove end play from the switch shaft
RSC-001	Wafer, front switch wafer of head-end unit
RSC-002	Wafer, center switch wafer of head-end
RSC-003	Wafer, rear switch wafer of head-end unit.

General Electric 817, 821

Under PRESET CONTROLS, the description of the TILT control was omitted. The following should be added:

TILT—if raster is slightly tilted and does not square with the picture-tube mask, rotate the deflection yoke in its clamp bracket by loosening the wing screw.

Hallicrafters T-54, 505, 506, Run #3

Model 506 is the same as Models T-54 and 505. Run #3 is the same as Run #2 except for the following changes:

Resistor R29 from pin 5 to pin 6 of the r-f amplifier, V5, has been deleted. C61, a 0.005-μf capacitor in the vertical oscillator circuit has been deleted. C23, a 0.05-μf capacitor connected from ground to the volume control has also been deleted. R119, a 220,000-ohm resistor has been added in place of C23, from the volume control to ground. Capacitor C99, 330 $\mu\mu$f, has been added in parallel across C19 and C20 in the f-m detector, V2, circuit. C100, 1.5 μf, has been added from the junction of C13 and C2M to the junction of C14 and C3M.

The parts list for Run #3 is the same as that for Run #2, except for the following changes:

Hallicrafters Ref. No.	Part No.	Description
C1, 2	44B358	Trimmer assembly, mixer and r-f amp. stage, 13 sections
C3	44B357	Trimmer assembly, osc. stage, 13 sections
C100	47A160-3	1.5 $\mu\mu$f, 500 v, bakelite
C51, 66	46AU503J	0.05 μf, 200 v, tubular
C101	47A168	5,000 $\mu\mu$f, 500 v, ceramic
R120	RC20AE101M	100 ohms, ½ w, carbon
R119	RC20AE224K	220,000 ohms, ½ w, carbon.

Hallicrafters T-54, 505, Run #2

Run #2 is similar to Run #1 except for the following changes:

Tube V3, the audio amplifier has been changed for a 6SH7 to a 6AV6; and R22, 680,000 ohms, and C24, 0.05 μf, that were connected to pin 6 of the 6SH7 have been deleted. The tap from the volume control goes to pin 1 of the 6AV6. R20 goes from ground to the cathode, and R21 goes from the cathode to the 110-volt bus. The value of R23 has been changed from 100,000 ohms to 470,000 ohms. Capacitor C98, 10 μf has been added in parallel across cathode resistor (V4) R25.

Tubes 1, 7, 8, 9, 11, have been changed from type 6SH7 to type 6AU6. R33, connected to pin 1 of V7, has been changed from 27,000 ohms to 18,000 ohms. R39, connected to pin 1 of V8, has been changed from 27,000 ohms to 12,000 ohms. R40, connected to pin 1 of V9 has been changed from 27,000 ohms to 18,000 ohms. L24 has been deleted from the 3rd i-f circuit and R117, 6,800 ohms, substituted in its place, from pin 5 to pin 6 of V9. The value of C52, connected from pin 1 of V12 to pin 5 of VII, has been changed from 0.25 μf to 0.1 μf. The value of C17, connected from pin 3 of V12 to pin 2 of V13, has been changed from 0.25 μf to 0.1 μf.

R55 in the cathode circuit of the picture tube V13, has been changed from 150,000 ohms to 470,000 ohms. R11, 5,600 ohms, connected from ground to the brightness control R56, has been deleted. R56 now goes directly to ground.

R116, 6,800 ohms, in the circuit of V14 and in parallel with R58, has been deleted. The value of R58 has been changed from 6,800 ohms to 3,300 ohms. The value of R83, connected from pin 4 of V18 to the vertical hold, has been changed from 680,000 ohms to 560,000 ohms. The values of C73 and C74, connected to pins 2 and 5, respectively, of V20, have been changed from 0.05 μf to 0.03 μf. The value of R108, connected from pin 3 to pin 4 of V12, has been changed from 68 ohms to 120 ohms.

The following changes in the parts list for Run #1 should be made for Run #2:

Hallicrafters Ref. No.	Part No.	Description
C17,52	46AU104J	0.1 μf, 200 v, tubular
C73,74	46B149	0.03 μf, 6000 v, tubular
C98	45A121	10 μf, 25 v, electroytic
R39	RC20AE123K	12,000 ohms ½ w, carbon
R23,55	RC20AE474M	470,000 ohms ½ w, carbon
R33,40	RC20AE183K	18,000 ohms ½ w, carbon
R83	RC20AE564M	560,000 ohms ½ w, carbon
R117	RC20AE682M	6,800 ohms ½ w, carbon
R58	24BG332E	3,300 ohms 10 w, ww
R108	RC40AE121M	120 ohms 2 w, carbon
V1,7,8, 9, 11	90X6AU6	Type 6AU6, audio i-f; 1st, 2nd and 3rd i-f amp; video amp
V3	90X6AV6	Type 6AV6, audio amp.

Hoffman CT800, CT801, CT802, CT900, CT901, Ch. 135

The following trouble symptoms and their probable causes also apply to Model CT902, Ch. 141, and Models CT816, CT817, Ch. 145.

Trouble	Cause
A. No raster, Sound o.k.	1. Fuse blown. (Usually caused by shortened V126 or shorting T109.) 2. Shorted or open V126. 3. Open V127. 4. Open or shorted V120B. 5. Shorted C176. 6. Shorted C187. 7. Open or intermittent R235. (Causes picture to bloom when defective.) 8. Defective picture tube. 9. Shorted V128. 10. T109 open or shorted. 11. Check leads going to V126 and V127 in h-v cage to see that they are not touching each other or not arcing to metal cage. 12. Defective V125. 13. Open R199 or R200. 14. Check high-voltage lead going to picture tube. (Voice coil open.)
B. No sound, weak or distorted sound. Picture o.k.	1. Defective or open V104, V105, V106, V107, V108, or V109. 2. Defective speaker. Voice coil open.) 3. Defective T114. 4. Open C206. 5. Defective C208 or C209.
C. A film-like distortion on left side of picture as contrast turned up.	Usually one turn of primary sync lock transformer will phase correctly. This adjustment of sync transformer is under chassis.
D. Picture unstable horizontally.	1. Defective V124. 2. R200 changed value. 3. Open C170—gives sawtooth effect throughout picture. 4. Weak V123. 5. R188 changed value. 6. Arcing under V126. 7. T108 frequency off. 8. Defective C169 and C171. 9. Defective C144. 10. Defective V118-V119. (Usually causes picture to travel sideways.)
E. No picture. Raster o.k. Sound o.k.	1. Shorted C116, C123, C128, C134, C138, or C140. 2. Open L187, L190, or L192. 3. Defective V110, V111, V112, V113, V114, V115, or V116. 4. R127, R134, or R140. If any of these resistors burned, check for cause.
F. Hum.	1. If hum is caused by head end use 5,000-ohm resistor from test loop to ground. 2. V108 for bad contact. 3. 6J6 oscillator. 4. V107, V108, V109. 5. C208 leaky. 6. 6J6 oscillator may induce a slow starting motor-boating effect and increase rapidly until maximum is reached, then become normal.
G. Vertical sync.	1. Defective R171, R166, R167. 2. Defective V121. 3. Defective C151, C152, C153. 4. R162, R163, R164, R165 off value. 5. C149 open.
H. Noisy or chattering sound.	1. Be sure tubes are tight. 2. Check tightness of T111, T112, and T113. 3. Check contact of r-f tubes to bead-end sockets. 4. V108, V109 intermittent. 5. Breaking down of C208 and C209. 6. Control shafts rubbing against front metal plate.
I. Hum in picture.	1. Shorted V116 or V114. 2. Loose grid connections on V110, V111, V112, V113. 3. Faulty C224, C223.
J. Insufficient width.	1. Weak V126. Also causes fold over of picture. 2. T109 defective. 3. Open C180. 4. If all above is o.k. then proceed as follows: a. Add 0.05-400v across terminals 5 and 6 of T109. b. Open width coil at terminal 5. This removes shunting effect of width coil.
K. Insufficient height.	1. Leaky C157 and C158. 2. R177 changes value. 3. Weak V122. 4. If vertical linear circuit is normal, parallel R177 with like value for more height.
L. Picture blooms and goes out.	1. R235 intermittent. 2. 1B3 defective. 3. Check high-voltage through following parts: V126, T109, V120, R204.
M. Sound in picture after adjustments made on cathode trap and converter coil.	1. Microphonic V124. 2. V119, V118, V121, V122. 3. Microphonic tubes in r-f unit. 4. Microphonic tubes in picture circuit.
N. Horizontal white line. No picture.	1. Defective V121, V122. 2. If both tubes o.k., check connections under same tubes.
O. Horizontal white line through picture. Also in raster.	1. Irregular characteristic of V122; replace. 2. Replace V121.
P. Horizontal white line accompanied by white flashes.	1. Intermittent V126. 2. Also causes small sawtooth noticeable on black border of pattern.
Q. Dark vertical lines left side of picture on high channels.	1. Replace 6BG6, V126. Lines caused by transients at start of sweep.

Hoffman 820, 821, 822, Ch. 146

These models appear on *pages 3-1 through 3-19 of Rider's TV Manual Volume 3*. Natural springiness of the backboard on Models 820, 821 and 822 tends to pull the power plug from the interlock socket even when all parts are in their normal positions. To prevent the plug from unintentionally being removed from the socket, sets manufactured after Serial No. E 906729 will have a redesigned power-plug mounting.

On sets of prior manufacture, the problem can be satisfactorily solved by putting an additional wood screw, #6-1" length through the backboard and into the wood chassis shelf at a point below the power plug. This additional screw will spring the backboard in, and hold the power plug firmly in place.

Hoffman 826, 827, 828, Ch. 143

A vertical white line sometimes appears in the left portion of the picture, about two- to four-inches in from the left side on some receivers with 16-inch picture tubes. The vertical disturbance may appear in any form from two light, slightly displaced traces to a broad, fuzzy band. The actual condition is a foldover of the raster, and the edge of the raster appears as if it were behind the picture a few inches from the edge. If the horizontal sync pulses are viewed on an oscilloscope, the position of the vertical line will be indicated by two small pips on the sawtooth portion of the horizontal sync trace.

The coupling capacitor C161, to the grid of the 6BG6G horizontal output tube, is at present a 0.01-μf, 400-v paper tubular capacitor (part no. 4112). A capacitor change to 0.001-μf, 500-v, ceramic tubular capacitor will eliminate most cases of the left-side vertical white line. Do not decrease the capacity below 0.001 μf, as coupling capacitance below this value tends to cause a right side foldover. The part number of the new capacitor is 4025.

This also applies to Models 830 and 831, Ch. 151 and Models 917 and 918, Ch. 152.

Hoffman Ch. 140, 142, 143, 146, 147

The video i-f string may be peaked for additional gain at a sacrifice of bandwidth to aid reception in low-signal areas.

The procedure is set up on the basis that the adjustments may be made in the field without the aid of a sweep generator or 'scope. All adjustments on the i-f coils are reached from the top of the chassis and may be accomplished without removing the chassis from the cabinet, in sets produced prior to Serial No. E 906732

Ref. No.	Circuit Position	Adjustment
L102	Plate circuit 2nd video i-f	Counterclockwise, 1½ turns
L103	Plate circuit 3rd video i-f	Clockwise ½ turn
L104	Plate circuit 4th video i-f	Counterclockwise, 1 turn.

Fine trimming of the i-f tuning may be accomplished with a sweep generator and 'scope. The resultant i-f characteristic will have approximately twice the gain of the normal amplifier, and will have a bandpass of about 3 megacycles between 50% points. This bandpass characteristic applies to all sets, regardless of sound i-f take-off point.

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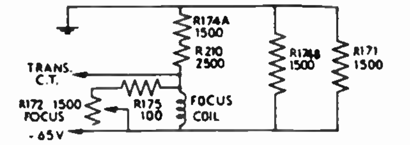
World Radio History

Hoffman 612, Ch. 142; 820, 821, 822, Ch. 146

Insufficient adjustment range of the focus control R172 has occurred in 12-inch chassis using the DuMont 12QP4 picture tube. The 12QP4 tube requires more focusing current through the focus coil than other 12-inch tube types, and maximum counterclockwise rotation of the focus control will not bring the tube to its optimum focus.

Circuit changes to increase the amount of current through the focus coil can be accomplished by changing one resistor and adding another resistor, as shown in the accompanying diagram.



Circuit changes for Hoffman Chassis 142 and 146.

The 2,500-ohm resistor formerly used as R171 may be used as R210. The 1,500-ohm resistor now used as R171 should be the wire-wound type. R174A and B are a single large Candohm resistor, center tapped to form the two sections.

Old Part	New Part	Difference
R171 (4714)	R171 (4715)	Decreased from 2,500 ohms to 1,500 ohms 5 watts
——	R210 (4714)	Added 2,500 ohms in series with R174A (1,500 ohms)

These changes will increase the current through the focus coil, and bring the adjustment of the focus control near the center of its range. These changes have been made on all sets produced after Serial No. H 913661.

This also applies to Models 601, Ch. 154; 613, Ch. 149, 914, 915, Ch. 150.

Hoffman Service Hints

Symptom: Quivering of the picture due to partial loss of both vertical and horizontal sync pulses has been observed in strong signal areas. This occurs when a strong signal overloads the video i-f amplifiers and a limiting action occurs which clips the sync pulses. *Remedy*: An increase in the agc action, which will produce more agc bias with strong signals, can be accomplished by decreasing the delay bias voltage on the agc diode. This delay bias voltage is derived from the plate, pin 2 of V113A, 2nd sync separator.

Reference to the circuit diagram for Chassis 140, 142, and 146 on *page 3-8*, and for Chassis 143 and 147 on *page 3-9 of Rider's TV-Manual Volume 3*, will show that a 10,000-ohm plate stabilizing resistor, R150, is connected from pin 2 to ground. A smaller diode delay bias can be obtained by effectively tapping down on this resistor.

R150 at present is a 10,000-ohm, ½-watt, 10%, composition resistor. Remove this resistor from the circuit and replace with two 4700-ohm, ½-watt, 10%, composition resistors in series. The junction of the two new resistors provides a centertap for connection of the delay bias lead, a green wire from pin 5 of V110. This green wire is at present connected to pin 2 of V113.

This modification can be made on any Hoffman receiver produced with signal keyed agc and will aid materially in the stabilizing of picture sync in strong signal areas. Factory modification has been accomplished on all sets produced after Serial No. J 921278.

Industrial Television Ch. IT-21R

This Chassis appears on *pages 4-1 through 4-6 of Rider's TV Manual Volume 4.* The following is recommended in all cases where trouble is experienced with hum or buzz in audio, and will eliminate such trouble and improve the quality of sound and picture:

1. Disconnect primary of T1 from plate circuit of V9.
2. Connect L17 direct to pin 8 of V9.
3. Remove jumper from pin 6, V9 and junction of R51-52 and R53.
4. Connect terminal of T1 which previously was connected to pin 8, to pin 6 of V9.
5. Connect terminal of T1 which previously connected to L17 to junction of R51-52 and R53.
6. Connect 20,000-ohm-per-volt meter across C51, and with meter on 10-volt range, antenna in local plug, and signal tuned in, readjust the top and bottom slugs of T1 for maximum voltage across C51.

Majestic 12T6, 14C4, 14T2, 14T6, 16C6, Series 94

Except for cabinet designs or picture tube size, Models 12T6, 14T2, and 14T6 are the same as Model 12T2, Model 14C4 is the same as Model 12C4, and Model 16C6 is the same as 16C4.

Majestic 14CT4, 16CT5, 19C6, 19C7, 1671, 1672, 1673, 1674, 1675, 1900, 1974, 1975, 16CT4, 97 & 98 Series

Model 14CT4 is a consolette with a mahogany finish and employs a 14" rectangular picture tube. Model 1671 has a table cabinet with a mahogany finish and employs a 16" rectangular tube. Models 16CT4 and 16CT5 are consolettes using 16" round tubes. Model 16CT4 has a mahogany finish, while Model 16CT5 has a bleached finish. Model 1900 is also a consolette with a mahogany finish, although it employs a 19" round tube. A total of 20 tubes including the picture tube is used in these receivers.

The service data for these models in the 97 and 98 Series are the same as the data for the 94 and 97 Series except for the differences and additions mentioned in the following paragraphs.

Under the section titled "Picture Tube Installation in 16" Receivers," add:

For receiver Models 1672 or 1673, remove the two screws which hold the front mask assembly. These pass through the two corner blocks on the inside of the cabinet at the top. When these screws are removed, the front panel may be lifted out. For receiver Models 1671, 1674, or 1675, remove the four decorative screws which hold the front panel and mask assembly. These pass through the four corners of the picture frame. Carefully lift out the front panel and mask assembly. For Model 1671, loosen the two screws which fasten the metal picture-tube retaining band sufficiently so that the picture tube may be slipped through the opening. The high-voltage connector should be located on the right side of the chassis, as viewed from the front. Secure the metal band over the top of the tube by tightening the two screws alternately and evenly, so that the rectangular picture tube is not forced to rotate or twist in its mounting.

The picture tube installation in 19" receivers is as follows:

The bulblike glass separation between the neck of the picture tube and its metal cone is treated with an anti-corona coating to reduce high-voltage leakage under humid atmospheric conditions. Avoid touching this treated area since perspiration may reduce its effectiveness. If handled accidentally, wash with water or mild soap and water. Remove all traces of soap. Use no chemical solvents or abrasives for cleaning.

1. Remove the slotted head P.K. screws retaining the back and release with the interlocked line cord.

2. Remove the bag containing the beam bender, the hardware for deflection and focus coil assembly, and the front plug buttons, if used.

3. Remove the deflection and focus coil assembly which is fastened to a shelf for shipping purposes. Remove retaining wires that are wrapped around focus coil adjustment screws.

4. Carefully slide the deflection yoke and focus coil assembly over the neck of the picture tube, so that the deflection yoke adjustment thumb screw faces the top of the cabinet.

5. Assemble the deflection yoke and focus coil assembly to the support bracket using the hardware provided. See Fig. 1 for proper hardware assembly and mounting procedure.

6. Remove the 6-32 grounding screw from the yoke frame (see Fig. 1 for location). Attach the ground lug on the brown wire coming from the chassis, and replace the screw.

7. Slide the beam bender over the neck of the picture tube.

8. Connect the picture tube socket to the tube base.

9. Connect the male octal plug from the deflection yoke and focus coil assembly to the female octal socket from the chassis.

The rear panel adjustments that are illustrated for Models 1672, 1673, 1674, 1675, 19C6, 19C7, 1974, and 1975 apply to the other models mentioned in this article. The location of the front panel controls are shown for Models 1974 and 1975 in Fig. 2, and for the rest of the models in Fig. 3.

The circuit description for these models is the same as that for the 94 Series, except that in the section titled "Vertical Deflection Circuit (Block H)," the generated sawtooth voltage is amplified by the 6K6 output tube (V20), rather than the "other half of the 6SN7 duo-triode (V14)."

The Alignment Procedure, Video I-F and Sound Alignment, and the R-F and Oscillator Alignment for the 97 and 98 Series is the same as that found for the 94 Series. The Voltage Chart for all models except 14CT4, 1674, and 1900, is the same as that shown on page 5-13. The voltage readings for Model 1900 are the same as those shown on page 5-13, except for the following changes: Picture tube (V1)—pin 2 is 2 v, pin 10 is 230 v. Audio output (V4, 6V6)—pin 1 is N.C., pins 5 and 6 are —6 v. Ratio detector driver (V6, 6AU6)—pin 1 is 4.5 v, pin 7 is 5 v. The voltages on pins 5 and 6 of the 1st, 2nd, and 3rd video i-f tubes (V7 6AU6, V8 6AG5, V9 6AG5) are 115 v. Video amplifier (V11, 6AC7)—pins 3 and 5 are 0.2 v, pin 4 is —2 v, pin 6 is 145 v, and pin 8 is 115 v. D-c restorer-clipper-separator-amplifier (V12, 12AU7)—pin 1 is 90 v, pins 2 and 6 are 24 v, and pin 3 is 25 v. Vertical sweep oscillator (V14, 6C4)—no voltage on pin 1, pin 5 is 100 v, and pin 6 is —25 v. Horizontal sweep output (V16, 6BQ6-GT)—pins 3 and 4 are 155 v, pins 5 and 6 are —26 v, and pin 8 is 7 v. High-voltage rectifier (V17, 1B3)—pins 2, 6, and 7 are 11.5 kv. Horizontal damper (V18, 6W4)—pins 2 and 4 are N.C., pin 3 is 370 v, pins 5 and 6 are 210 v, pin 7 is 6.3 vac, and pin 8 is 0 v. Power rectifier (V19, 5U4G)—pins 2 and 8 are 380 v, and pins 4 and 6 are 365 vac. Vertical output (V20, 6K6)—pin 1 is 0 v.

The voltage readings for Models 14CT4 and 1674 are the same as those on page 5-13 except for the following changes: Picture tube (V1)—pin 2 is 4.3 v, pin 10 is 245 v, and pin 11 is 17 v. Oscillator-converter (V3, 6J6)—pin 1 is —0.7 v, pin 2 is 0 v. Audio output (V4, 6V6)—pin 1 is —138 v, pin 3 is 195 v, pin 4 is 210 v, and pins 5 and 6 are —9 v. Ratio detector-audio amplifier (V5, 6T8)—pin 6 is —0.5 v, pin 9 is 115 v. Ratio detector driver (V6, 6AU6)—pin 1 is 8 v, pin 2 is 8.5 v, pin 5 is 220 v, pin 6 is 105 v, and pin 7 is 9 v. Third video i.f. (V9, 6AG5/6BC5)—pin 7 is 1.2 v. D-c restorer-clipper-separator-amplifier (V12, 12AU7)—pins 2 and 6 are 160 v, pin 3 is 162 v. Horizontal phase detector (V13, 6AL5)—pin 1 is 6 v, pin 2 is —6 v. Horizontal sweep oscillator (V15, 6SN7)—pin 5 is 100 v. Horizontal sweep output (V16, 6BQ6-GT)—pins 3 and 4 are 210 v, pin 5 is 48 v, no voltage on pin 6, and pin 8 is 72 v. High-voltage rectifier (V17, 1B3)—pins 2, 6, and 7 are 10.1 kv. Horizontal damper (V18, 6W4)—pin is —85 v, pins 5 and 6 are 225 v.

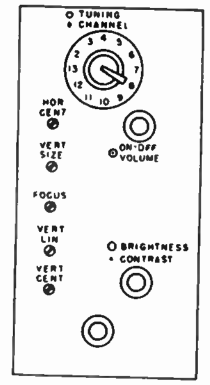


Fig. 2. Front panel layout for Models 1974 and 1975.

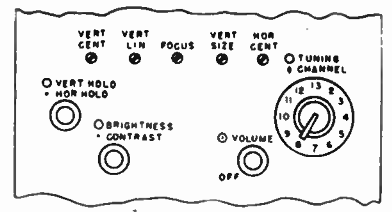


Fig. 3. Front panel layout for Series 97 and 98.

Model 1671 uses a single 5" p-m speaker. Models 16CT4 and 16CT5 use a single 10" p-m speaker. The schematic for Series 97 and 98 is the same as that which appears on page 5-14 except for the following changes in the ratio detector driver stage. A 100-ohm resistor, R10, is inserted from the junction of R28 and C49 to pin 1 of V6, the 6AU6 ratio detector driver. Capacitor C55, the 0.02-μf capacitor connected from pin C of ratio detector transformer T6 to ground, has been relocated and now goes from pin C to pin 7 of V6, the ratio detector driver. The value of C55 has been changed to 5000 μμf. A 5000-μμf capacitor C32 has been added from pin 7 to pin 2 of V6. An 82-ohm resistor R26 has been inserted from pin 7 to R27, the 1,000-ohm grid resistor.

The schematic for models 14CT4 and 1674 is the same as that described above for Series 97 and 98 except for a change in the sweep circuit. Resistor R18, 390,000 ohms now goes from the junction of R83, 100,000 ohms, and C79, 13 μμf, 2 kv, to the junction of R48 (the 250-ohm resistor going from ground to pin 8 of the horizontal sweep output tube V16) and R80 (mentioned below), instead of from R83 and C79 to ground. Resistor R80, that was connected from ground to capacitor C92 (connected to pin 8 of V16), was relocated and now goes from the junction of R18 and R84 to R85 (mentioned below), and the value of R80 has been changed from 47 ohms to 470 ohms, 7 watts. Resistor R85, the 30,000-ohm resistor that was connected in parallel with R87 (30,000 ohms) going to the +360-volt buss, has been relocated. It noes goes from ground to R80, and the value has been changed to 100 ohms, 2 watts. The value of R87 has been changed from 30,000 ohms, 2 watts, to 12,000 ohms, 2 watts.

The schematic for Model 1900 is the same as that for the 97 and 98 Series appearing on page 5-14 except for the following changes. The value of C88, connected to pin 2 of V10A, the 1/2-6AL5 video detector, has been changed from 10 μμf to 15 μμf. Capacitor C67, 10 μf, 150 v, connected to pin 6 of the video amplifier V11 and ground has been removed, and C77C, 10 μf, 450 v, inserted in its place. The value of R108 connected to pin 8 of V12A, the 1/2-12AU7 d-c restorer sync clipper, has been changed from 8,200 ohms to 7,000 ohms; and the value of resistor R52, connected from R53 to the +360-volt buss in the same circuit has been changed from 12,000 ohms to 11,000 ohms. The value of resistor R100, connected from the junction of pin 2 of V12B and pin 6 of V12A to R116 has been changed from 1 megohm to 2.2 megohms. The 470,000-ohm resistor R116 has been deleted from the circuit and a direct connection used in its place.

Model 1900 is the only receiver which is not equipped with a built-in antenna. The two connections from the terminal strip go to the tuner. Since the built-in high-frequency antenna is not used, the 300-ohm transmission-line matching section, the two 5000-μμf capacitors C112 and C113 attached to this section, and the line choke L21 (that are shown in the schematic on page 5-14) are also omitted in this model. In place of C114 and C115, 5000 μμf, two 0.01 μf capacitors, C78 and C79 are connected from the terminals of the primary of T11 to ground. The vertical centering control R14, 10 ohms, has been relocated as shown in Fig. 4. On all other models in the 97 and 98 Series it goes from coil L12, connected to the power rectifier, to the yellow lead of focus coil L14. In Model 1900 L12 is connected directly to the junction of C81A and the yellow lead of the focus coil, and capacitor C89, 500 μf, that was connected in parallel across the vertical centering coil, has been deleted. The vertical centering coil is connected, as shown in Fig. 4, from ground to the 3.3-ohm resistor R60 (going to the —2.5-volt line). The taps from the vertical centering control are connected as in the 97 and 98 Series schematic.

Additional changes in Model 1900 are shown in Fig. 4. The lead from C77B and C goes directly to the green lead of the focus coil. The lead and the 270,000-ohm resistor R79, from the yellow lead of the focus coil to pin 5 of V15 the horizontal sweep oscillator, have been deleted. The lead from the horizontal size coil L10 and capacitor C79 to R83 have been deleted. Tap 2 or T12 goes to the 470,000-ohm resistor R96, the lead from pin 1 of V15 goes to the junction of C100 and R90. C74 goes to the red lead of the vertical oscillator transformer T8, R74 goes to the red lead of T9, and R85 and R87 go to the tap on the horizontal centering control R12.

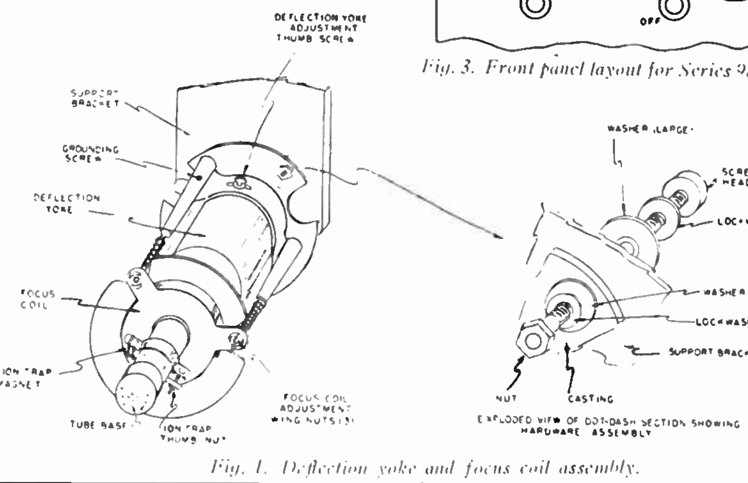


Fig. 1. Deflection yoke and focus coil assembly.

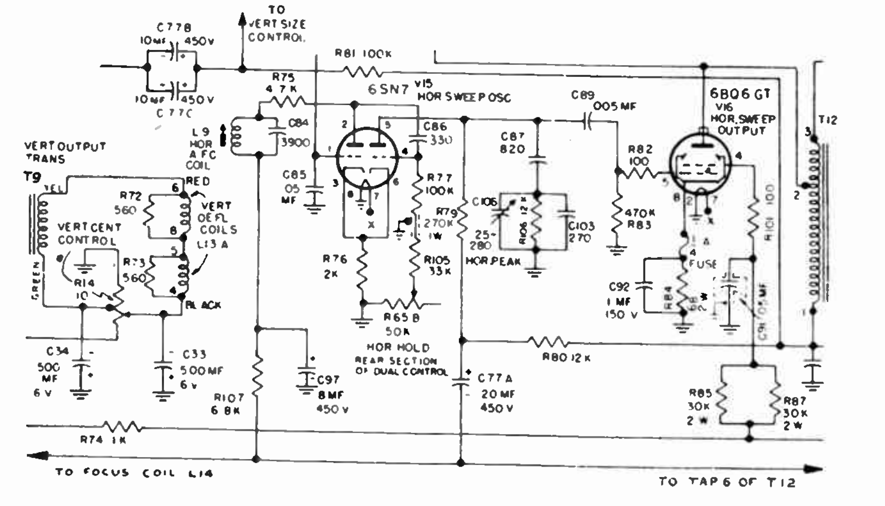


Fig. 4. Additional circuit changes for Majestic Series 97 and 98.

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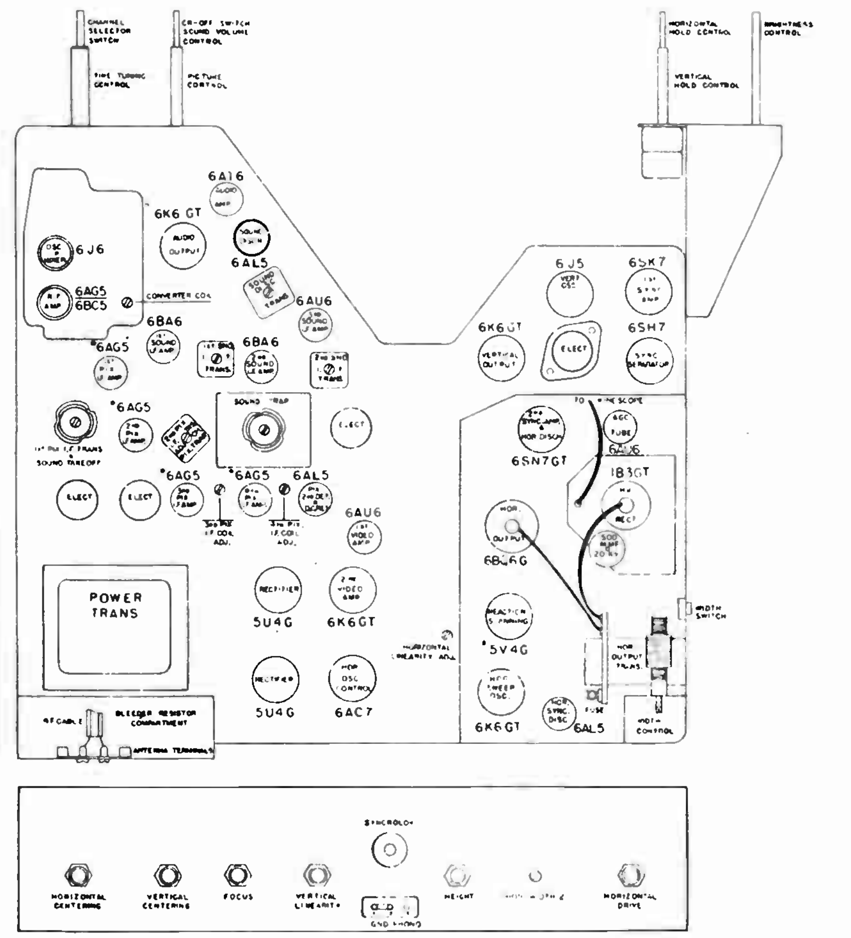
Mars Dartmouth, Hampton, Oriental, Versailles, Ch. K-2

The chassis layout for the K-2 chassis is shown in the accompanying figure. 6CB6 tubes can be substituted for the 6AG5 tubes shown marked with asterisks, and a 6W4GT can be substituted for the 5V4G reaction scanning tube. The rear chassis controls are shown at the bottom of the illustration.



Chassis layout and rear chassis controls for Mars K-2.

Montgomery Ward 94WG-3006B, 94WG-3009B

Models 94WG-3006B and 94WG-3009B are similar to Models 94WG-3006A and 94WG-3009A except for the following information which replaces the Response Curves section and the R-F Response Curves section for these latter models. All other service information for Models 94WG-3006A and 94WG-3009A is applicable to Models 94WG-3006B and 94WG-3009B.

R-F Response Curves—The response curves shown in Figure 18, for the "A" Series" may be observed by connecting the sweep generator and the marker signal generator (loosely coupled) to the antenna input and by connecting the oscilloscope to the TEST POINT (junction of R-6 and R-7) on the tuner. This TEST POINT is accessible from the top of the tuner chassis and appears as a small insulated tip between the oscillator and mixer tubes as shown in Fig. 1, shown below. An S-25A3 tuner may be used in these models.

The response curves obtained in this check indicate the accuracy of adjustment of the r-f and converter coils. Any appreciable variation from the curves shown in Figure 18

Montgomery Ward 94GSE-3011B

Model 94GSE-3011B differs from Model 84GSE-3011A only in type of cabinet covering and cabinet hardware as listed below:

Part Number	*Description*
MW7E179-3	Cabinet
MW20E449-2	Rear door with hinges, antenna post and line cord
MW20E461	Handle with mounting brackets.

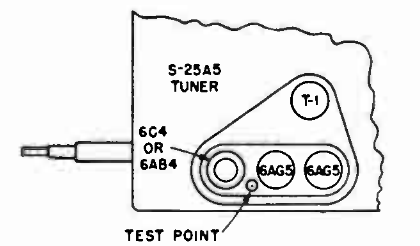


Fig. 1. Test point for Montgomery Ward Models 94WG-3006B and 94WG-3009B.

indicates coil misalignment. To check for correct oscillator coil adjustment on each channel connect the sweep generator and the marker signal generator (loosely coupled) to the antenna input. Connect the oscilloscope to the junction of L-8 and R-51. The response curve should be approximately the same as for the i-f response check. The picture carrier marker should be approximately 45% down and the sound carrier at zero level.

To adjust each oscillator coil, set the Fine Tuning control in the center of its range and adjust each coil screw to properly position the markers.

Montgomery Ward 94WG-3006A, 94WG-3009A

The following information supplements the Picture I-F and Trap Adjustment Alignment Table and replaces the Retouching of Picture I-F Adjustments and Response Curves section.

Checking Picture I-F Adjustments — The response curve, secured after completing steps 5 through 12, may be observed by connecting the sweep generator to the junction of C-31 and R-23 (through hole in tuner side of chassis) and by connecting the oscilloscope to the junction of L-8 and R-51. The marker signal generator should be loosely coupled to the sweep generator output leads.

With the Contrast control set at —3 volts as in Step 5, the response curve should be approximately flat topped as shown in Fig. 1.

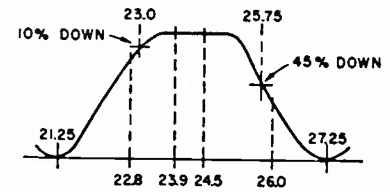


Fig. 1. I-f response for —3 volts on contrast control of Models 94WG-3006A and 94WG-3009A.

A 25.75-Mc (picture carrier) marker signal should appear approximately 45% down, and a 23.0-Mc marker should appear approximately 10% down. A 21.25-Mc signal (sound carrier) and a 27.25-Mc signal (adjacent sound carrier) should have zero response. Some final adjustment of T-1 (bottom), L-5, T-10 (top), and L-7 may be required to secure an ideal response curve. The portions of the curve affected by these adjustments are shown in Fig. 1. Do not change trap adjustments T-1 (top), T-5 or T-10 (bottom) after they have been set according to steps 6, 7 and 8.

In areas of low signal strength it may be desirable to increase the i-f sensitivity by aligning the i-f with a —1 volt setting of the contrast control. If this is done the response curve will be approximately as shown in Fig. 2. The 25.75-Mc (picture carrier) marker and 23.0-Mc marker should have the same relative positions as for —3 volt alignment.

Fig. 2. I-f response for —1 volt on contrast control of Models 94WG-3006A and 94WG-3009A.

R-F Response Curves—The response curves shown in Figure 18 were taken at the input of the converter circuit of the tuner, using a crystal diode probe and a sensitive oscilloscope. Since such equipment is not generally available to the service man these curves cannot be observed. However the over-all response of the set may be observed by connecting the sweep generator and marker signal generator (loosely coupled) to the antenna input and the oscilloscope to the junction of L-8 and R-51. The response curve for each channel should be approximately the same as the i-f response curve, with the picture carrier frequency appearing 45% down and the sound carrier frequency at the zero base line. Be sure the Fine Tuning Control is set in the center of its range. The picture carrier and sound carrier frequencies can be properly positioned for each channel by adjusting the proper oscillator coil screw, as shown in Figure 8.

Note: — All response curves have been shown in the classical manner, with the curve up and the frequency increasing from left to right. The manner in which the curves will appear on any alignment check will depend upon the equipment used, i.e., curves may appear inverted or reversed from the manner shown.

Motorola VT73, VT73A, Ch. TS-4J

Model VT-73 is a portable television receiver which uses chassis TS-4J and is similar to Model VT-71. Model VT-73A is the same as VT-73 except that a fiber-board back cover is used in the VT-73A, while the VT-73 has a metal back cover. The late version TS-4J is the same as the early one except for the following changes:

The value of radio-frequency choke L-34 is 2 μh. Coils L-81 and L-82 have been substituted for L-29 and L-35, respectively. A 10-megohm resistor, R-158, has been added from pin 3 of the 12AT7 converter, V-17A, to tap 2 of T-1. In the video amplifier stage, R-137, R-146, L-58, and L-59 have been deleted and the changes in the schematic are shown in Fig. 1.

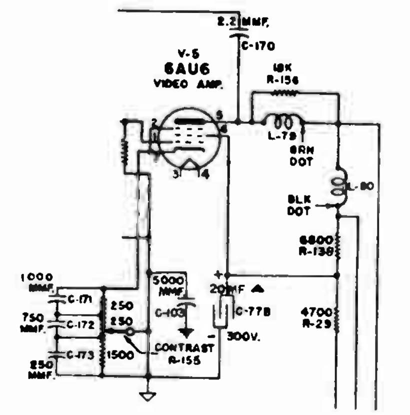


Fig. 1. Circuit changes in the video amplifier stage of Motorola VT73, VT73A,

Ballast tube R-159 has been substituted for R-80. Resistor E has been deleted, and resistors A, B, and D are now connected to pin 6, instead of to 5. The values of the resistors have not been changed.

An 8,200-ohm resistor, R-153, has been substituted for R-134, 10,000 ohms, which was connected from pin 2 of T-8 to the horizontal-hold control. The horizontal-hold control has been changed from R-49, 20,000 ohms, to R-154, 10,000 ohms. Resistor R-132, 220,000 ohms, that goes from pin 1 of the horizontal-sweep oscillator to T-10, has been deleted. Capacitor C-137 is now connected to the high side of R-55, the horizontal-size control, instead of to the brown lead from T-10. Additional circuit changes are shown in Fig. 2.

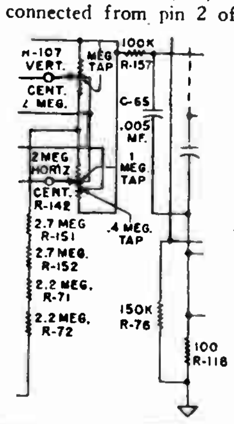


Fig. 2. Circuit changes in the Motorola VT73, VT73A, Ch. TS-4J.

The replacement parts list supplement is as follows:

Ref. No.	*Part No.*	*Description*
C-171	21K780599	Capacitor, ceramic, 1,000 $\mu\mu$f
C-172	21K780598	Capacitor, ceramic, 750 $\mu\mu$f
C-173	21K77375	Capacitor, ceramic, 250 $\mu\mu$f, 20%, 500 v
L-79	24A780602	Video compensating coil, wound on 18,000-ohm resistor
	5K790196	Rivet, bi-furcated, ½" long, polished brass (hinges & catches)
	5A470755	Rivet, shoulder, ⅜" long, (line cord mtg. VT-73)
	5K790482	Rivet, shoulder, ½" long (line cord mtg VT-73A)
	5S7721	Rivet, 0.122 x ¼, brass (line cord clamp mtg VT-73A)
	3S7362	Screw, machine, 6-32 x ½ slotted binderhead, cad pl
	3S7258	Screw, machine, 8-32 x ½ slotted binderhead, cad pl (line cord clamp mtg)
	3S6943	Screw, machine, 8-32 x 1¼ slotted round head, blk nkl (bumper on back cover)
	3K780454	Screw, machine, 8-32 x 1½, (spkr & picture tube mtg)
	3S490333	Screw, sheet metal, #4 x ⅝ PKA slotted acorn head, statuary bronze finish (back mtg)
	3S7453	Screw, sheet metal, #8 x 1 PKZ plain hex head (chassis mtg, 1 used)
	3S7534	Screw, sheet metal, #8 x 1⅜ PKA plain hex head (chassis mtg, 3 used)
	3S7455	Screw, wood, #8 x ⅜ slotted acorn head, antique copper finish
	26K780497	Shield, chassis bottom
	9K790405	Socket, strap, brass
	46K790404	Stud, strap, brass
	4K790402	Washer, finishing, brass (antenna holding strap)
	4S7557	Washer, flat, ⅜ x 11/64 x 0.033 stl, cad pl
	4S1745	Washer, flat, 7/16 x 0.203 x 0.030, antique copper finish
	4S488317	Washer, flat, ⅜ x 0.390 x 0.020, bright brass finish (ant jack)
	4A780458	Washer, insulating (ant jack)
	4A482130	Washer, shoulder, fiber (back cover).
L-80	24A780601	Video compensating coil
L-81	24A780142	R-f coil, channels #12 & 13, less form & core
L-82	24A90197	1st i-f plate coil, less core

Note: All resistors are insulated carbon type unless specified otherwise.

Ref. No.	*Part No.*	*Description*
R-148	6R488252	Resistor, 22 megohms, 10% 1 w
R-153	6R5610	Resistor, 8,200 ohms, 10%, 1 w
R-154	18A780098	Resistor, horizontal-hold control, 10,000 ohms
R-155	18A780359	Resistor, contrast control, 2,000 ohms, tapped
R-156	6R5591	Resistor, 18,000 ohms, 10%, ½ w
R-157	6R6031	Resistor, 100,000 ohms, 10%, ½ w
R-158	6R2109	Resistor, 10 megohms, 20%, ½ w
R-159A, B, C, D	17A485459	Ballast tube
	1X780538	Back cover, bumper & line cord ass'y, metal (VT-73 only)
	1X79494	Back cover & line cord ass'y, fiber board (VT-73A only)
	35A790097	Bumper, rubber & bushing, 1-3/32" x ⅝" (cabinet bottom feet)
	37K790006	Bumper, rubber recess, 1" x ⅜" (back screen)
	35A780453	Bumper, rubber recess, ⅜" x ½", (cabinet back feet)
	38K780468	Button, plug, polished brass
	38K790403	Button, strap, polished brass
	30K780512	Cable, antenna, 20", 300-ohm line with spade lugs on one end
	16F780450	Cabinet, portable, leatherette covered
	3K790197	Catch assembly, polished brass (cover latch)
	42A780491	Clamp, line cord, brass plated (back cover VT-73A)
	5A780439	Eyelet, cabinet, brass (vents on sides of cabinet)
	5S3124	Eyelet, 0.187 x 0.252, brass (back cover VT-73)
	5S3139	Eyelet, 0.202 x 0.475, brass (back cover VT-73A)
	32C471295	Gasket, rubber (picture tube)
	36K790199	Handle, cabinet, complete with posts
	55K790401	Hinge, "come-apart" type, complete, polished brass
	14A482129	Insulator, fiber (on cabinet back VT-73 only)
	9A780457	Jack, antenna plug
	29A790117	Lug, spade (on antenna jack leads)
	2A780465	Nut, knurled, bright dip finish (ant jack)
	35A780119	Pad, tube neck
	64A780440	Plate, jack mtg, cad pl

Motorola Ch. TS-67A

The TS-67A differs from the TS-67 in several tube types and tube functions. A 6AG5 sync segregator was added to replace the sync clipper V-6B (½ 6AL5). The latter became the first of a new two-stage agc circuit. The second stage is a 6AU6 which replaces the 12AX7 of the TS-67. In addition, a sensitivity control was added to the agc circuit. The control, located on the top of the chassis, permits the agc to be pre-set at the desired level. The function of V-15A (½ 6SN7GT) was changed from a squelch diode to a pulse shaper. The chassis contains 24 tubes plus a 19" picture tube.

Information on the TS-67 apply to television chassis TS-67A with the following addition:

Sensitivity Control

The sensitivity control determines the level of the agc curve and is adjusted as follows:

1. Turn receiver to channel on which the strongest signal is received.

2. Turn sensitivity control until the video amplifier overloads (picture starts to tear), and then back off until the picture is stable. The sensitivity control is located on approximately top center of chassis.

3. The audio should also be checked during this adjustment. Although there may be no evidence of tearing in the picture after step 2, the signal may still be strong enough to cause sync buzz. If this is the case, back off the sensitivity control until sync buzz disappears.

Alignment

The alignment procedure for chassis TS-67A is the same as that for TS-67, with the following exceptions:

1.5 Mc Trap Alignment

In step 1. Connect the signal generator to the grid, pin 2 or 5, of the 2nd video amplifier tube V-8 (6AS5).

In step 2. Remove the agc tube V-10 (6AU6).

In step 3. Connect 3 volts of battery bias between the plate, pin 5, of the agc tube V-10 (6AU6) and ground. The positive terminal of the battery is on the plate.

In step 8. Connect an oscilloscope between chassis and the plate, pin 5, of the 1st video amplifier V-7 (6BA6).

The following parts should be added to the parts list. For components not mentioned here, refer to TS-67 Replacement Parts List.

Ref. No.	*Part No.*	*Description*
C-6	21R2748	Mica, 220 $\mu\mu$f, 300v
C-14	20A18355	Trimmer, mica, 1.3-15 $\mu\mu$f
C-31	21K700671	Ceramic, 1.5 $\mu\mu$f, 500v (temp comp)
C-36, 68, 69, 72	21K77373	Ceramic, 47 $\mu\mu$f 500v
C-38	21K470329	Ceramic, 30 $\mu\mu$f 500v
C-65, 71	21R6642	Mica, 68 $\mu\mu$f 500v
C-107	23A790904	Electrolytic, 50 μf 25v
C-129, 130	8R9854	Paper, 0.1 μf 200v
C-132	23K700624	Electrolytic, 1 section; 140 μf, 150v
C-133	8R9856	Paper, 0.25 μf 200v
C-134, 140	8R9874	Paper, 0.1 μf 600v
C-135	21K792438	Ceramic, 100 $\mu\mu$f 3000v
C-136	8R9867	Paper, 0.002 μf 600v
C-137	8R9834	Paper, 0.01 μf 600v
C-138	8R9870	Paper, 0.01 μf 600v
C-139	8R9867	Paper, 0.002 μf 600v
C-141	21R6554	Mica, 100 $\mu\mu$f
R-2	6R3949	470, 20%, ½w
R-13	6R2013	27,000, 10%, 2w

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R-18	6R6117	5600, 10%, ½w
R-35	6R6432	270, 10%, ½w
R-52	6R5660	180, 10%, ½w
R-97	6R2004	8200, 10%, ½w
R-100	6R6969	2200, 10%, ½w
R-101	6R6229	1000, 10%, ½w
R-104	6R6487	39,000, 10%, ½w
R-105	6R5697	560,000, 10%, ½w
R-111	6R5621	10, 10%, ½w
R-115	6R6299	10,000, 10%, 2w
R-120, 121	6R6004	1 megohm, 20%, ½w
100,000, 20%, ½w	R-122	6R6075
R-123	6R6056	47,000, 20%, ½w
R-124	6R2029	3300, 10%, 2w
R-125, 135	6R5631	120,000, 10%, ½w
R-126	18K700626	Sensitivity control, 2000 ohms
R-127	6R2998	22,000, 10%, 2w
R-128	6R6032	470,000, 20%, ½w
R-129	17K700623	Wire wound, 10,000, 10%, 5w
R-130	6R6080	4700, 10%, ½w
R-131	6R6320	10,000, 10%, ½w
R-132	6R6407	220,000, 10%, ½w
R-133	6R6429	820,000, 10%, ½w
R-134	6R6497	3.3 megohm, 10%, ½w
T-9	25C792563	Power Transformer (optional to 25K792564)

Part No.	Description
35A792756	Cushion, focus coil
14K700013	Insulator, high-voltage: small (on high voltage compartment shield)
13D792141	Mask, picture tube: rubber (for 19AP4 only)
13K700678	Mask, picture tube: rubber (for 19AP4A only)
2S7048	Nut, hex: 10-32 x 5/16 stl; cad pl 125K792564 power transformer mtg)
2S7005	Nut, hex: 8-32 x 5/16 stl; cad pl (25C792563 power transformer mtg)
5S7720	Rivet: .088 x ⅛ stl; pol nkl (sensitivity control mounting)
9K700041	Socket, picture tube: 5-pin; with leads
9A780011	Socket, tube: miniature 7-prong (V-10 and V-25)
31A791402	Strip, terminal: 6 ins, #4 gnd; ⅝" spacing
31K4573	Strip, terminal: 3 ins, #3 gnd; ½" spacing
31K31217	Strip, terminal: 1 ins, #2 gnd; ⅝" spacing
9K484579	Wafer, electrolytic mtg: cad pl
4K74579	Washer, fibre (R-91 mtg)
1X792530	Lead, phono: with plugs
1X600118	Lead, phono motor: with receptacle and plug
28K71775	Plug, 1-pin: insulated; ⅝" (short plug on phono lead)
28K22183	Plug, 1-pin: insulated; 15/16" (long plug on phono lead)
28K30736	Plug, 3-pin: 9/16" pins (on phono motor lead)
9A600040	Receptacle, plug: 0.640 diameter, 5/16" contacts (phono motor receptacle)
15K74443	Shell, receptacle: with insulator (on phono motor lead)
15A690616	Shell, receptacle: ⅝" diameter; with insulator on phono motor leads).

Muntz M158, M159, M159A, M159B, M169

Alignment and service data given for Model M169 apply also to the Models M158, M159, M159A, and M159B. The following voltages were taken with the line voltage set at 117 volts, and are subject to ±20%. The meter used is an RCA VoltOhmyst. All voltages were taken from chassis ground to the socket pin contacts.

Pulsed high voltages are present on the cap of the 6BH6 and 1B3 tubes. No attempt should be made to measure voltage at these points. A continuity check of the high-voltage winding will quickly reveal an open winding. Resistance values are given on the various schematics. The high voltage of the picture tube anode can be measured with a kilovoltmeter if necessary. Following is a list of resistances of various components not given on the schematics.

HORIZ. OSC. OUTPUT TRANS. PART #TO-17A

Terminals	*Resistance*
1 — 2	180 ohms
2 — 3	180 ohms
1 — 3	360 ohms
4 — 5	10 ohms
5 — 6	0.9 ohms
4 — 6	11 ohms
Filament	0.2 ohms

VERT. OUTPUT TRANS. PART #TO-16
Primary — 625 ohms Secondary — 8 ohms

FOCUS COIL PART #LC-37
250 ohms

FOCUS COIL PART #LC-45
385 ohms

DISCRIMINATOR COIL PART #LI-44

Terminals	*Resistance*
1 — 2	4.0 ohms
3 — 4	0.8 ohms
4 — 5	0.8 ohms
3 — 5	0.8 ohms

TRAP COIL PART #LO-33 4.5 MC.

Terminals	*Resistance*
Top — Center Tap	4.4 ohms
Bottom — Center Tap	8.5 ohms
Top — Bottom	12.9 ohms

PEAKING COILS

Part #	*Code*	*Value*	*Ohms*
LC-36	Blue	170 Mil-H.	9.0
LC-39	Red	180 Mil-H.	9.5
LC-40	White	260 Mil-H.	12.0
LC-41	Yellow	400 Mil-H.	14.0
LC-44	Green	280 Mil-H.	15.0

The Master Oscillator Frequencies for the r-f curve (Marker Generator Setting Table) for these chassis are the same as those which appear in the R-F Alignment Table for Chassis TV16A1, TV16A2, and TV16A3.

VOLTAGE SOCKET CHART
Muntz M158, M159, M159A, M159B, M169

FUNCTION	TUBE TYPE	SCREEN		CATHODE		GRID		PLATE	
		PIN	Volts	PIN	Volts	PIN	Volts	PIN	Volts
R.F. AMP	6AG5	6	115	7	0	1	-2	5	105
OSC. MIXER	6J6	- -	- -	7 7	0 0	6 5	-3 -2	1 2	105 70
VIDEO. I.F. AMP.	6AU6 6AU6 6AU6	6 6 6	135 135 140	7 7 7	0 .75 .80	1 1 1	-.75 -.75 0	5 5 5	135 135 140
XTAL. DET.	Hot end of XTAL will be approximately -1. to -2.5 Volts.								
VIDEO AMP.	6AU6	6	140	7 7	pic. 0 n. pic. 14	1 1	pic. -1 n. pic. 10	5	90
I.F. SOUND	6AU6	6	290	7	140	1 2	140 140	5	330
FM DET. 1ST AUDIO.	6T8			3 3 7	pic. -10 n. pic. -4 0	8	-.75	1 1 2 2 6 9	n. pic. -4 pic. -9 n. pic. -6 pic. -15 -1.5 60
AUDIO OUTPUT	6AQ5	6	360	2	145	1 7	120 120	5	360
SYNC. LIN. & DC - R.	6AU6	6	140	7 7	pic. 20 n. pic. 4.5	1 1	pic. -10 n. pic. 0	5	110
VERTICAL OSC. & VER. AMP.	6SN7			3 6	0 14	1	V. Hold -8 to -40	2 & 4 5	Height 28 to 42 330
RECTIFIER.	5U4			8	390				
HORZ. OUTPUT OSC	6BG6	8	200	3	0	5	-32		
DIODE DAMPER	6W4			3	420			5	330
HIGH VOLTAGE	1B3								8200

National TV-1601, TV-1602, TV-1625, TV-1627

Models TV-1602 and TV-1627 are similar to Models TV-1601 and TV-1625. The following changes have been made in these National models.

In the audio output circuit (V-22), capacitor C-101, that went from pin 8 to the junction R-106, R-107 and R-108, has been relocated and is now inserted in the lead from pin 8 to R-109. The value of C-101 has been changed from 0.05 μf to 10 μf. R-106 has been removed from its position (from the junction of C-101, R-108, and R-107, to socket X-1 pin 6) and relocated in parallel with C-101. The value of R-106 has been changed from 330,000 ohms to 270 ohms. Resistor R-107, 180,000 ohms, has been removed. In the audio amplifier circuit, R-104, 470,000 ohms, connected from pin 8 of V-21B to R-105, 470,000 ohms, has been removed from the circuit. The value of resistor R-99 connected to pin E of transformer T-5, has been changed from 220 ohms to 120 ohms.

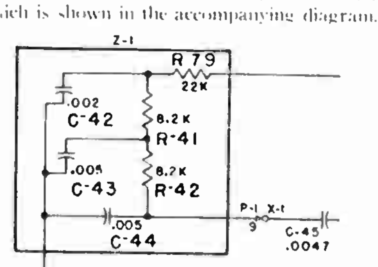
In the ratio-detector driver circuit resistor, R-96, that went from pin 7 of V20 to R-97, 1000 ohms, has been relocated and now is connected in parallel with capacitor C-89, 0.005 μf, from pin 6 to R-97. The value of R-96 has been changed from 68 ohms to 18,000 ohms. Capacitor C-88, 0.005 μf from pin 7 to R-97 has been removed from the circuit and pin 7 is tied directly to R-97.

The value of resistor R-13, connected to the junction of pin 6 of V-3 the first video i.f. and L-8, has been changed from 100 ohms to 220 ohms. The value of resistor R-31, connected to pin 4 of V-8 the video amplifier, has been changed from 120 ohms to 100 ohms. A centering control, R-41, 8200 ohms, has been added from L-18 to socket X-2, pins 2-10. Tap 6 of transformer T-4 is connected to pin 7 instead of to pin 5 of socket X-2. The pins for the X-2 P-2 connections (in the lead that goes to the horizontal deflection coil), are designated 2-10.

Resistor R-48, 470 ohms, has been removed from across the focus control. Capacitor C-58, 20 μf, connected to the vertical size control tap now goes to pin 7 of socket X-2, instead of to ground. A 47-μμf capacitor, C-44, has been added from pin 4 of the horizontal sweep oscillator to ground. Resistor R-62, 22,000 ohms, is now connected to pin 7 of socket X-2 instead of to fuse F-2. The value of R-64 connected to pin 5 of the horizontal sweep oscillator has been changed from 220,000 ohms to 150,000 ohms. The value of resistor R-68, connected to pin 8 of the horizontal sweep output, has been changed from 1500 ohms to 5600 ohms.

The 1000-μμf capacitor C-49, going from tap 5 to tap 8 of T-4, the horizontal output transformer, has been replaced by a direct connection. The value of R-73, connected to pin 2 of the horizontal phase detector, has been changed from 4700 ohms to 10,000 ohms.

The 22,000-ohm resistor, R-79, connected from pin 3 of the sync amplifier-splitter to pin 9 of socket X-1 is now included in Z-1 which is shown in the accompanying diagram.



Circuit changes in National Models.

Connection P-1 X-1 is now located as shown in the accompanying diagram, and pin of the sync amplifier-splitter is connected directly to the 22,000-ohm resistor of Z-1. The value of C-43 has been changed from 0.002 μf to 0.005 μf.

Philco 48-2500

Many cases of apparent lid warpage have been traced to cabinet distortion, which occurs when the cabinet rests on an uneven floor. This distortion may be corrected by simply leveling the cabinet, by placing blocks under the legs.

Before adjusting the keystone magnets, it is advisable to ground the metallic magnet band clamp, to eliminate the static high-voltage charge on the magnets. Where a plastic magnet band clamp is encountered, it is necessary to ground the individual magnets themselves momentarily.

Philco 50-T Series

Operating the 50-T Series with the deflection yoke disconnected removes the load from the 6BG6G tube, causing excessive screen current and damage to the screen dropping resistor. A deflection yoke should always be connected when the receiver is in operation. If a complete picture-tube assembly is not available, a yoke by itself will be satisfactory.

In some cases, horizontal streaks may be caused by video or a-c voltage being fed back into the first v-i-f stage. One cause of this coupling is the leads running to the contrast control, which carry video voltage, being to close to the 28.1-Mc trap. In this case, these wires should be dressed away from the trap, and as close to the chassis as possible. In some extreme cases, it may be necessary to reroute these wires as in later production of Model 50-T1443, Code 123. In this chassis, the wires are routed from the contrast control out through a hole near the control, down the front of the chassis, into a ventilation hole near the bottom-right corner, and thence to the output stage. In all cases, all leads must be dressed away from the 28.1-Mc trap.

Philco 50-T1403, 50-T1404, 50-T1406

The chassis of Models 50-T1403, 50-T1404, and 50-T1406 are similar to that used in Model 50-T1400.

RCA T121, KCS34C

Poor vertical sync may be caused by capacitor C-136 (cathode bypass V-108) breaking loose from ground. Some vertical oscillator transformers, marked 274011, with too high a Q may cause a white condition at the top of the picture and possible instability of sync. If this is the case, lower the transformer Q by connecting a 1-megohm resistor across the green and yellow transformer leads.

Radio Merchandise SP-5

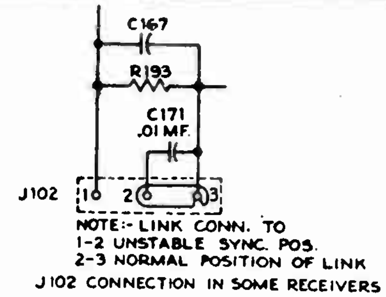
TV booster SP-5 is similar to the SP-4 which appears on *pages 4-1 and 4-2 of Rider's TV Manual Volume 4*. In the SP-5, the one pilot light used is a #47 and is connected directly to pin 4 of the 6AK5.

Regal TV-1030, TV-1031

In later production models, an e-m speaker is employed with a hum-bucking coil and voice coil, whose impedance is 3 ohms. The three-prong plug has been deleted. The jumper across R232 has been deleted.

J104 is now designated as J102. Filter choke 1,200 is now a 62-ohm field. In some receivers C19 is omitted. In some receivers C14 is fixed. R239 is omitted in some receivers.

In some receivers J102 is connected to the cathode lead of V123, 6AL5, horizontal sync discriminator, as shown in the accompanying figure.



Circuit change for Regal TV-1030, TV-1031.

Sears Ch. 101.846, 101.854, 101.864, 101.867, 101.868

Low-frequency microphonics (rumble in sound, little or no disturbance of picture) in Chassis 101.864 and 101.868 can be attributed to oversize inserts in the core slide assembly. The view of the core slide assembly shown in Fig. 1 shows one of the four inserts which is affixed to the core slide. These inserts are assembled on each of the four ends or ears of the slides. Due to the push button pressure exerted against the core slide, there can be no forward or backward play of the core slide to cause vibration. However, occasionally there is a sideward clearance between the core slide and the carriage rod to permit mechanical vibration. This movement is what often produces microphonism.

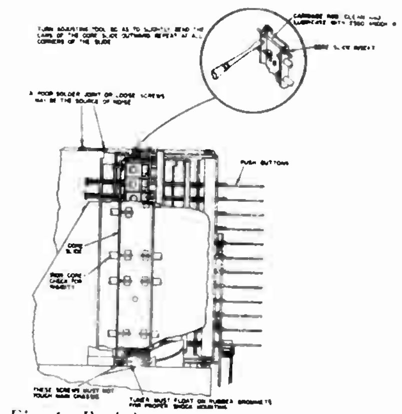


Fig. 1. Push-button tuner for Sears Chassis 101.846, 101.854, 101.864, 101.867, and 101.868.

A very effective and simple remedy can be applied to the tuner without removing it from the main chassis or even removing the tuner cover. Take a 6- to 6½-inch screwdriver having a blade not wider than ¼-inch. File or grind a notch .062- to .067-inch wide and ⅛-inch deep in the end of the blade. Insert the tool into tuner so that the slot in the blade is over one ear of the core slide assembly as shown in Fig. 1. With a slight twisting motion, rotate the tool so the ear of the core slide is bent outward. Only a slight bend should be made insofar as this procedure must be repeated on all four ears or inserts. After each adjustment, work push buttons to make sure core slide will return to normal setting when released. Failure of this will indicate adjustment is too tight. Movement of these slide inserts may necessitate the resetting of the push buttons due to possible shifting of the core slide assembly in relation to the carriage rod supports which also act as stops. If resetting of any push buttons is done, the channel under adjustment should be alternately pushed several times to insure correct setting of the adjusting screw.

Another possible source of low-frequency mircrophonics may come from loose coil dampers on high-band or low-band oscillator coils. Also check all cores, particularly the oscillator cores for rigid mounting.

Three rubber grommets shock mount the push button tuner to the main chassis. Refer to Fig. 1 and note that the grommet mounting nearest the 6AT6 first audio tube may cause the two screws mounted to the tuner to touch the main chassis. If this occurs, add sufficient spacer washers to the grommets to properly shock mount the push button tuner. Likewise the push buttons themselves may make contact with the cabinet escutcheon plate. Remedy by loosening chassis mounting screws and repositioning the chassis so that push buttons are completely free from cabinet.

For the treatment of high-frequency microphonics (high-frequency howl in sound, little or no disturbance of picture), change high-band oscillator tube 7F8. A check should also be made for broken mica on oscillator trimmer.

The following suggestions are offered for the case of noisy tuners in Chassis 101.846, 101.864, 101.867, and 101.868.

Occasionally when the push buttons are actuated, noise may occur due to the grounding braid scraping the chassis base at a different place than where soldered. This grounding braid must make contact with the main chassis only at the soldered joint. Noise will occur particularly at the high-frequency channels.

Another source of noise is the cable clamp shown in Fig. 2. All cables joining at this point have their shields grounded at the antenna coils and also joined together near the clamp itself. However, the shields do not and must not ground to the clamp. Check the cables for frayed insulation. If the insulation needs repair, open the clamp, wrap the cables with insulating tape, and replace the cables in the clamp.

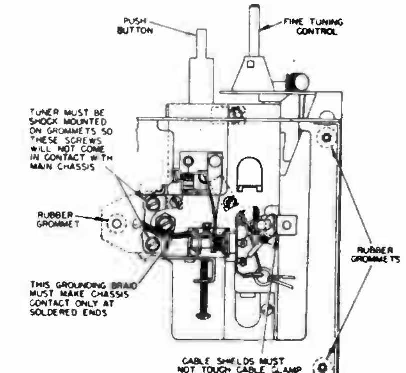


Fig. 2. Tuner for Sears Chassis 101.846, 101.854, 101.864, 101.867, and 101.868.

Check all hold-down screws on the tuner for tightness, especially the screws attaching the cover over the high band coils. Loose screws as well as poor solder joint may be a source of noise.

Sears 125, Ch. 478.257; 9125, Ch. 478.252; 9125A, Ch. 478.253

In some localities due to the degree of modulation of the local stations, a variable amount of buzz will be heard in the sound of these models at certain picture levels during transmission. This buzz can be minimized by the following substitutions:

1. In the video amplifier V9, the plate load resistor R47, a 3,300-ohm resistor, should be changed to 1,800 ohms, ½ w, 10 per cent.
2. In the same tube circuit, the plate resistor R42 should be changed to 4,700 ohms, 1 w, 10 per cent.

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Sears 110.499 Series

Model 9135 employs a 16-inch kinescope, 16AP4, V12. The 16-inch tube has a metal cone that is connected to the high-voltage supply. The tube is insulated from the chassis by mounting it directly to the cabinet. The tube should be installed as follows:

(1) Remove the back cover by removing the screws holding it to the cabinet.

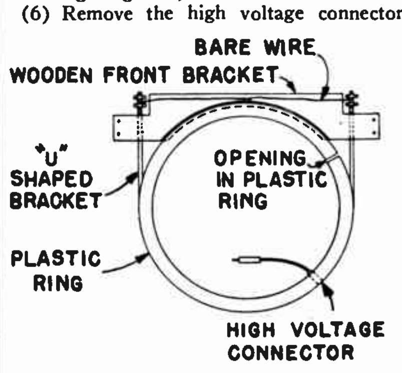
(2) Be sure that the kinescope tube protector (cup) is mounted on the outside of the cabinet back. If it is mounted on the inside, turn it around.

(3) There should be a wooden block mounted in the center of the lower back rail to protect the portion of the kinescope tube extending beyond the cabinet. If it is not there, it will be found in back of the power transformer, remove it, and mount it on the rail.

(4) Unscrew top panel and pull straight out. Do not remove the focus and deflection coils from the panel.

(5) Remove the plastic insulating ring by loosening the two nuts holding the kinescope "U" shape mounting ring and unwrapping the bare wire from the top ends of the mounting ring. (It is not necessary to take the nuts off. Loosen them until you can take the plastic insulating ring out.)

(6) Remove the high voltage connector



TUBE MOUNT

Fig. 1. Front mounting of kinescope, Sears 110.499 Series.

from the ring.

(7) Remove the wire from the plastic ring. The wire will be used later.

(8) Remove the 5U4 tube.

(9) Place plastic ring on kinescope tube with trade mark facing the neck of the tube.

(10) Place high-voltage connector under the plastic ring in the position indicated in Fig. 1.

(11) Place bare wire in the outer groove of the plastic ring and twist, leaving two equal ends as indicated in Fig. 1.

(12) Place kinescope tube and plastic ring into the "U" shaped bracket. The top of the plastic ring will fit into the wooden bracket at the front of the cabinet. Support the tube with your hand.

(13) Slide the top panel into place with the deflection and focus coils over the neck of the tube.

(14) Take up slack in "U" shaped bracket by tightening the nuts.

(15) Wrap one end of the bare wire (circling the plastic ring) around the left-hand end of the "U" shaped bracket, add a second nut and tighten.

(16) Wrap remaining end of bare wire around right end of "U" shaped bracket.

(17) Place terminal lug on one end of ground harness over right end of "U" shaped bracket, add second nut and tighten.

(18) Remove one wing nut from the deflection yoke mounting bracket, place second terminal lug on ground harness under this nut and replace.

(19) Remove one wing nut from the focus coil bracket, place third terminal lug on ground harness under this nut and replace.

(20) Be sure that the remaining end of this ground harness is connected to the chassis.

NOTE: Wire around plastice ring, "U" shaped bracket, deflection and focus coil mounting brackets must all be connected together and grounded to the chassis.

(21) Replace screws in top wooden bracket.

(22) Replace screws in top panel.

(23) Connect high voltage male plug to the female socket coming from the high voltage compartment.

(24) Place ion trap on neck of kinescope tube. (Ion trap will work best near the socket of the kinescope tube.)

(25) Place the socket on the kinescope tube.

(26) Make sure that the hood on the deflection yoke is pushed as far forward as possible.

(27) Push the deflection yoke as far up in the hood as possible.

(28) Place the focus coil as close to the deflection yoke as possible.

(29) Make sure that the focus and deflection cables do not come in contact with the cone of the kinescope tube. (Outer surface of the kinescope is at high potential.)

(30) Proceed with all other adjustments in the same manner as you do on the 10- or 12½-inch models.

Caution: The metal cone of the picture tube is connected directly to the high voltage. Extreme care must be used so as not to come in contact with this cone when the receiver is in operation.

The following changes were made in the schematic diagram of Chassis 110.499, 110.499-1, 110.499-2. The changes are not retroactive, and should not be necessary on early production chassis except for improving a particular function.

Section (2), under Parts Removal, To Remove the Chassis from the Cabinet, should be changed to read: "On all models except 9126 remove the screws holding the antenna terminal strip to the cabinet. On Model 9126 remove the antenna connector plugs connecting the antenna terminal strip and the built-in antenna to the chassis."

The tube chart should have the following changes made:

Tube No.	Pin No.	Old Voltage	New Voltage
V4	5,6	130	140
V5	5,6	132	142
V6	5,6	135	145
V13A	6,7,8	Add 30, 0, 3, respectively, when using new horizontal afc circuit	
V13B	1,2,3	Add 125, 0, 30, respectively, when using new horizontal afc circuit	
V14B	5	350	390
V15	1	3.2	6
	2	-1.6	-6
V16	3,8	10	13
V19	5	—	340
V20	2,8	360	370.

Improve Focus Range

(1.) Change R20 and R85 from 47,000 ohms to 18,000 ohms, 2 watts.

(2) Connect R20 and R85 to the low-voltage side of the focus coil instead of to terminal 3 of the yoke.

(3) Change focus control R38 from 1,500 ohms to 2,500 ohms.

Improve Contrast and Hold in Fringe Area

This change increases the agc delay voltage from 2.5 volts to 5 volts.

(1) Change R15 from 39,000 ohms to 18,000 ohms, 2 watts.

Increase Vertical Height

(1) Change R64 from 6,800 to 3,900 ohms, and R59 from 1.5 megohms to 1 megohm.

Improve Interlace

(1) Move C45, 4,700 $\mu\mu f$, from the grid lead of the vertical oscillator transformer T4 to the grid return lead.

Reduce Drift of Horizontal AFC and the Ratio Detector

(1) Add R91, a 1.1-ohm, 1-watt resistor, in series with the heater of V15, 6AL5, and V10, 6T8.

Changed Fuse Position

(1) Remove all fuses.

(2) Add a ¼-amp pigtail fuse between pin 5 of the 6W4 damper tube and terminal 4 of the horizontal output transformer T6.

Added Horizontal Centering Control

(1) Add horizontal centering control R90, 750 ohms, to rear of chassis.

(2) Run R39, 1,500 ohms, from focus coil to top of horizontal centering control, instead of from focus coils to plus 360 volts.

(3) Connect R81 from screen of 6BG6B to terminal 1 of the horizontal output transformer, instead of to terminal 3 of the yoke.

(4) Connect top of horizontal centering control to terminal 3 of the yoke.

(5) Connect arm of horizontal centering control to plus 360 volts.

(6) Under Adjustments, Focus and Centering, add: "On later model receivers using electrical centering proceed as follows: (1) Swing the focus coils to center the picture vertically. (2) Turn the horizontal centering control R90 to center the picture horizontally. (3) Adjust the focus control R38 on the rear of the chassis until the lines are in sharp focus. It may be necessary to readjust the ion trap magnet as indicated in step 8 above."

Improve Vertical Flutter

(1) Change C43 from 0.005 μf to 0.01 μf.

Additional changes that have been made are as follows: C2, 10 μf, 150 volts, has been removed from the tap of R30A, contrast control and now goes to -2.5 volts. R16 is also connected to -2.5 volts; and C25 and R30A go directly to pin 1 of V7B. L1, L2, L3, L4, L5, and L6, are 0.1 ohms. Figs. 2 and 3 show additions that have been made to the wave forms.

A new horizontal-hold-control circuit is found in all sets having the chassis number 110.499-3 or those having a higher dash number, such as -10, -11, -12, etc. There are, however, a quantity of receivers with the numbers 110.499, 110.499-1, and 110.449-2 that contain the new horizontal hold circuit. These chassis are identified with the stamped or written letter "O" on the rear apron of the chassis. To convert to the new circuit proceed as follows:

(1) Remove C39, a 0.01-μf capacitor.

(2) Remove C38, a 22-$\mu\mu f$ capacitor.

(3) Remove R47, a 1.0-megohm resistor.

(4) Remove R46, a 47,000-ohm resistor.

(5) Remove R69, a 2,200-ohm resistor.

(6) Remove R45 and add R93, a 3.3-megohm resistor in its place.

(7) Remove R68 and add R94, a 1,800-ohm resistor, in its place.

(8) Change C65 from 0.1 μf to 0.05 μf.

(9) Add C71, a 0.005-μf capacitor from pin 3 of the horizontal damper tube, 6W4GT, to pins 5 and 7 of the horizontal phase detector tube, 6AL5.

(10) Connect pin 6 to pin 2 of the 12AU7 d-c restorer, sync clipper, sync amplifier and phase splitter tube.

(11) Add R96, 68,000 ohms across R77.

(12) Short out C49, a 0.01-μf capacitor.

The horizontal linearity control is used in all chassis having the chassis number 110.499-

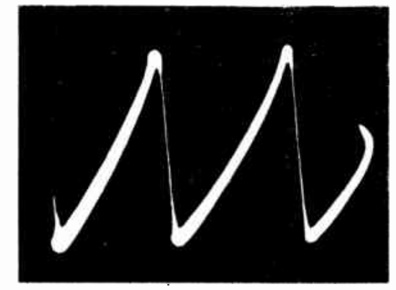


Fig. 2. Waveform at grid of sync amplifier, V13 pin 2, applies to Model 499-3 and all later models.

20 or higher, such as -21, 22, etc, and 110.499-33 including type "A" and "B" only. To add a horizontal linearity coil to other chassis proceed as follows:

(1) Mount the horizontal linearity coil in the hole provided on the top of the main chassis, using the figure showing the top of the chassis as a guide, near the high-voltage shield and the picture tube.

(2) Change C61 from 0.25 μf to 0.1 μf, 600 volts.

(3) Change R87 from a 22,000-ohm resistor to an 18,000-ohm resistor.

(4) Change R75 from 1,500 ohms to 2,200 ohms.

(5) Remove wire from terminal 1 of the horizontal output transformer T6 and pin 3 of the horizontal damper tube 6W4.

(6) Add a 0.05-μf, 600-volt capacitor, C100, from terminal 1 of the horizontal output transformer and chassis.

(7) Add a 36-$\mu\mu f$ capacitor, C110, in series with C57 and C68 so as to reduce the total value to 12 $\mu\mu f$.

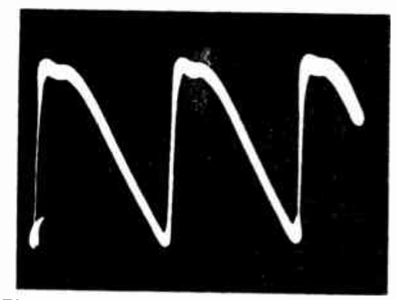


Fig. 3. Waveform of the horizontal phase detector, V15 pins 5 and 7, applies to Model 499-3 and all later models.

(8) Connect one side of the horizontal linearity coil L21 to terminal 1 of the horizontal output transformer T6.

(9) Connect the other side of the horizontal linearity coil to pin 3 of the horizontal damper tube 6W4.

(10) Under Alignment Procedure, Width and Horizontal Drive, add: "(3) On later model receivers having a horizontal linearity control located on top of chassis next to the high voltage shield, adjust this control for the best shaped picture horizontally." When using the horizontal linearity control, use terminal 1 of the horizontal output transformer T6.

A description of the chassis in the 110.499 series is given below.

Chassis No.	Description
110.499	Original 10-in. television chassis with tuner #1
110.499A	Original 10-in. television chassis with tuner #3
110.499B	Original 10-in. television chassis with tuner #4
110.499-1	Original 12½-in. television chassis with tuner #1
110.499-1A	Original 12½-in. television chassis with tuner #3
110.499-1B	Original 12½-in. television chassis with tuner #4
110.499-2	Original 12½-in. television chassis with built in antenna switch and tuner #1
110.499-2A	Original 12½-in. TV chassis with built in antenna switch and tuner #3
110.499-2B	Original 12½-in. TV chassis with built in antenna switch and tuner #4
110.499-3	16-in. round metal tube TV chassis with tuner #1
110.499-3A	16-in. round metal tube TV chassis with tuner #3
110.499-3B	16-in. round metal tube TV chassis with tuner #4
110.499-10	Revised 10-in. TV chassis with new horizontal afc and tuner #1
110.499-10A	Revised 10-in. TV chassis with new horizontal afc and tuner #3
110.499-10B	Revised 10-in. TV chassis with new horizontal afc and tuner #4
110.499-11	Revised 12½-in. TV chassis with new horizontal afc and tuner #1
110.499-11A	Revised 12½-in. TV chassis with new horizontal afc and tuner #3
110.499-11B	Revised 12½-in. TV chassis with new horizontal afc and tuner #4
110.499-12	Revised 12½-in. TV chassis with antenna switch, new horizontal afc, and tuner #1
110.499-12A	Revised 12½-in. TV chassis with antenna switch, new horizontal afc, and tuner #3
110.499-12B	Revised 12½-in. TV chassis with antenna switch, new horizontal afc, and tuner #4
110.499-20	Revised 10-in. TV chassis with horizontal linearity control and tuner #1
110.499-20A	Revised 10-in. TV chassis with horizontal linearity control and tuner #3
110.499-20B	Revised 10-in. TV chassis with horizontal linearity control and tuner #4
110.499-21	Revised 12½-in. TV chassis with horizontal linearity control and tuner #1
110.499-21A	Revised 12½-in. TV chassis with horizontal linearity control and tuner #3
110.499-21B	Revised 12½-in. TV chassis with horizontal linearity control and tuner #4
110.499-22	Revised 12½-in. TV chassis with antenna switch, linearity control, and tuner #1
110.499-22A	Revised 12½-in. TV chassis with antenna switch, linearity control, and tuner #3
110.499-22B	Revised 12½-in. TV chassis with antenna switch, linearity control, and tuner #4
110.499-33	Revised 16-in. TV chassis with round metal tube, linearity control, and tuner #1
110.499-33A	Revised 16-in. TV chassis with round metal tube, linearity control, and tuner #3
110.499-33B	Revised 16-in. TV chassis with round metal tube, linearity control, and tuner #4.

The following list is a supplement to the parts list for the 110.499 series:

Ref. No.	Part No.	Description
•C43	A194-179	Capacitor, paper, 0.01 μf, 600 v, ±10%
C58	A19108	Capacitor, paper, 0.25 μf, 600 v, +30% – 10% 85°C
•C61	A19121	Capacitor, paper, 0.1 μf, 600 v, ±10%, 85°C
•C57, C68		Capacitor, mica, 24 $\mu\mu f$, 1,500 v a.c., 400 v d.c.
C100	A1996	Capacitor, paper, 0.05 μf, 600 v, + 30% — 10%, 85°C
C63	A1998-1	Capacitor, mica, 500 $\mu\mu f$, 10,000 v, 10- & 12½-in set only
C63	A1998	Capacitor, mica, 500 $\mu\mu f$, 15,000 v, 16-in. set only
•C65	A1996	Capacitor, paper, 0.05 μf, 600 v, +30% – 10% 85°C
C70	A194-151	Capacitor, paper, 0.005 μf, 600 v, ±20%
L5	A28253	Coil, i-f choke
L18, L19, L20	A28264	Coil, filament choke
L11	A28273	Coil, focus, p.m., 16-in. set only
L21	A28259	Coil, linearity, horizontal
L14	A28258-1	Coil, width, 10 & 12½-in. set only
L14	A28258-2	Coil, width, 16-in. set only
	A55131	Connector, anode, 16-in. set only
R90	A24106	Control, centering
	A55110	Cord, line, 10- & 12½-in. set only
	A55125	Cord, line, 16-in. set only,
	A54611-1	Cushion tube, strap, 10-in. set only
	A54611-2	Cushion tube, strap, 12½-in. set only
	A59458	Escutcheon, tuner #1 and #4 only
	A59517	Escutcheon, tuner #3 only
F1, F2, F3	A54682	Fuse, ¼ amp, 250 v 3 ag with ½-in. pigtail
	A62256	Glass, safety, 10-in. set only
	A62260	Glass, safety, 12½-in. set only
	A62271	Glass, safety, 16-in. set only
	A3202	Ion trap, magnet (ring type)
	•A39204	Knob, brilliance, contrast, horizontal hold, walnut
	•A39198	Knob, brilliance, contrast, horizontal hold, mahogany
	A39190	Knob, fine tuning
	•A39203	Knob, fine tuning, walnut
	•A39197	Knob, fine tuning, mahogany
	•A39205	Knob, off-on sound, vertical hold, walnut
	•A39199	Knob, off-on sound, vertical hold, mahogany
	•A39202	Knob, selector, walnut
	•A39196	Knob, selector, mahogany
	•A39206	Knob, horizontal hold used with A39204, walnut
	•A39200	Knob, horizontal hold used with A39198, mahogany
	A62257	Mask, kinescope, 10 in.
	A62259	Mask, kinescope, 12½ in.
	A62283	Mask, kinescope, 16 in.
	A62287	Mask, kinescope, Model 9140 only
	A54661	Plug, male, line cord, 10-12½-in. set only
	A55126	Plug, interlock cable assy., 16-in. set only
•R54	A231-1223	Resistor ½ megohm, ½ w, ±10%, carbon
•R15	A233-1179	Resistor, 18,000 ohms, 2 w, ±10%
•R20, R85	A233-1179	Resistor, 18,000 ohms, 2 w, ±10%, carbon
•R64	A232-1163	Resistor, 3,900 ohms, 1 w, ±10%, carbon
•R59	A231-2321	Resistor, 1 megohm, ½ w, ±10%, carbon
•R87	A232-1179	Resistor, 18,000 ohms, ½ w, ±10%, carbon
R91	A23151	Resistor, 1.2 ohms, 1 w, ±10%
R93	A231-1233	Resistor, 3.3 megohms, ½ w, ±10%, carbon
R94	A231-1155	Resistor, 1,800 ohms, ½ w, ±10%, carbon
R95	A232-1167	Resistor, 5,600 ohms, 1 w, ±10%, carbon
R96	A231-1193	Resistor, 68,000 ohms, ½ w, ±10% carbon.
	A18160-1	Socket, kinescope, 10- & 12½-in. set only
	A18160-2	Socket, kinescope, 10- & 12½-in. set only
	A54541	Strap, picture tube, 10-in. set only
	A54509	Strap, picture tube, 12½-in. set only
	A54732-1	Support, yoke and focus coil bracket, 10-in. set only
	A54732-2	Support, yoke and focus coil bracket, 12½-in. set only
	A54771	Support, focus coil bracket, 16-in. set only
T6	A10100	Transformer, horizontal output, 12½- & 16- in. set only
	A54735	R-f tuner #3
	A54796	R-f tuner #4.

•Indicates change in value on later models.

Sears Ch. 101.865, 101.866, 101.867, 101.868

Due to variation in design of horizontal output transformers, in some sets, the voltage output of the high-voltage power supply is reduced by grounding one side of capacitor C102 instead of returning it to the high side (secondary) of the transformer T11. This reduction of the high voltage (about 800 volts) gives wider scan with certain horizontal output transformers.

In some sets resistor R147 is omitted in the screen grid circuit of the 6BG6G horizontal output tube. This results in lower screen voltage on the 6BG6G which also affects the horizontal scan.

If under low-line voltage conditions the picture is too dim and it is difficult to get the correct focus, the grounded side of C102 may be returned to transformer T11 as in the original chassis and R147 installed in its original position in the 6BG6G screen circuit. The high voltage will be back to normal. If insufficient scan is experienced, then the horizontal output transformer will have to be replaced. Transformer #70155 is, in all probability, the only one that will require this replacement. There are two transformers currently used—#70930 and #70372, which will be satisfactory replacements where absolutely necessary.

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World Radio History

Sears Ch. 101.865

The following is a revision and supersedes "Ion Trap Magnet Adjustment" under "Television Service Adjustments":

Loosen thumb nut sufficiently to slip ion trap magnet on neck of picture tube from the rear with the narrow magnet ring toward the front of the tube. Tighten thumb nut as required to make magnet adjustable on neck of picture tube. Position the ion trap magnet so that the open part of the "U" is in the direction of the second anode contact. The ion trap rear ring magnet should be approximately over the ion trap flags in the picture tube. The ion trap flags are small, rectangular plates in the neck of the picture tube about 1 inch from the black base of the tube. Starting from this position, adjust the magnet by moving it forward or backward until the raster is observed. Rotate it slightly around the neck of the picture tube for the brightest raster on the screen, and at the same time reduce the brightness-control setting until the raster is slightly above average brilliance. Adjust the focus control (on rear apron) until the line structure of the raster is clearly visible. Readjust the ion trap magnet for maximum raster brilliance. The final touches on this adjustment should be made with the brightness control at the maximum position with which good line focus can be maintained. Tighten thumb nut to permanently hold magnet in adjusted position. Refrain from tightening too much however, since excess pressure may break neck of picture tube.

Under Step 4 of "*Video I-F Alignment*," the first tuning slug adjustment with the generator set at 23.5 Mc. refers to transformer T8. This transformer should be T9.

The following paragraphs should be added under "Picture Tube Installation":

There are two possible approved methods of installing the web strap around the top of the picture tube. With the picture tube in place, the strap may hang over the flare of the tube. Fasten each end of the strap to the mounting springs attached to the mounting bracket. Carefully pull the strap up the flare of the picture tube until it is in position near the front of the tube. The alternate method is to connect the mounting springs to the strap with the strap in front of the tube. strap with the strap in front of the tube. slip the mounting strap in position around the top of the tube. Never connect one side of the strap and attempt to stretch it around the top of the picture tube before connecting to the other spring.

The following changes have been made to the 101.865 chassis. The Parts List should be revised accordingly.

Ref. No.	*Part No. Delete*	*Description*
C24		Capacitor, 1.5 $\mu\mu f$, ceramic
C33		Capacitor, 680 $\mu\mu f$, ceramic
C41	R70581	Capacitor, 10 μf, 450 v
L24	R65641	Coil, yoke, deflection
	R67849	Glass, picture bezel
	R65489	Magnet, ion trap
R6		Resistor, 1,000 ohm, ½ w
T3	R65427	Transformer, input i-f.

Add

C33		Capacitor, 1.5 $\mu\mu f$, ceramic
C24		Capacitor, 15 $\mu\mu f$, ceramic
C30		Capacitor, 25 $\mu\mu f$, ceramic
C41	R70581	Capacitor, electrolytic, 10 μf, 450 v
L24	R65461	Coil, yoke, deflection
	R67849	Glass, picture bezel, 12½"
	R67863	Glass, picture bezel, 10"
	R70842	Magnet, ion trap
R6		Resistor, 150 ohm, ½ w
	R65473	Socket, tube, 8 prong, octal, ring lock
T3	R70656	Transformer, input i-f.

Sparton 4935, 4942, 4954, 4960, Ch. 23TC10; 5002, 5003, 5006, 5007, Ch. 23TD10

Additional sync amplification and improved receiver performance can be provided for all models using the 23TC10 and 23TD10 chassis by following the procedure outlined below:

On V11 (12AU7 Tube)

1. Disconnect resistors R53 (100,000 ohms), R52 (1.0 megohm) and capacitor C47 (0.05 μf) from pin 8.
2. Connect the 1N34 crystal diode (cathode end) to R52, R53 and C47.
3. Move ground from pin 7 to pin 8.
4. Move C48 (22 $\mu\mu f$) from pin 6 to pin 7.
5. Remove R54 (47,000 ohms) on pin 6.
6. Use new R83 (4,700 ohms) from pin 7 to ground.
7. Connect plate side of 1N34 diode crystal to pin 7.
8. Replace R48 (1.0 megohm) from pin 6 to +135-volt line with new R48 (4,700 ohms).
9. Move R115 (22,000 ohms) from pin 1 to pin 3.

On V16 (6AL5 Tube)

10. Interchange C100 and C101 capacitor leads on pins 5 and 7.

New Parts Required

1. 1N34 Germanium crystal diode (Part No. PA4206).
2. 4,700-ohm resistor, ½ watt (Part No. BR12S-472).

Sparton 5068, 5069, Ch. 24TV9C

Model 5068 and 5069 are consoles using receiver chassis 24TV9C and power supply chassis 3TV9C.

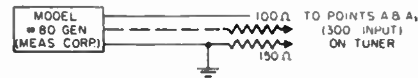
Standard Coil TV-100 Series, TV-201, TV-202, TV-203

In all models C1 is eliminated on some tuners by the use of a 3- to 9-$\mu\mu f$ trimmer at C2.

Description

1. Type of r-f amplifier—6AG5 with double-tuned bandpass coupling to converter grid.
2. Type of converter—Triode using one setting of a 6J6. Oscillator excitation is inductively coupled to the control grid.
3. Type of oscillator—Grounded Cathode Colpitts type using the second section of the 6J6.
4. Type of tuning—Switched inductances in a turret-type tuner. Normal channel sequence is progressive, channel 2 to 13; with clockwise rotation, but due to clip in design of the coil assemblies the channel sequence may be changed at will.
5. Vernier tuning—Vernier oscillator tuning is provided by an auxiliary capacitor shunted across the plate portion of the tank circuit. Average coverage on the low range is ±0.5 megacycles; on the high range, ±1.6 megacycles.

Approximate Gain Readings



	Input	*Output*
Channel 13	7,000 μv	100,000 μv
Channel 12	7,000 μv	100,000 μv
Channel 7	5,500 μv	100,000 μv
Channel 6	4,400 μv	100,000 μv
Channel 2	3,500 μv	100,000 μv.

Output measured on Measurements Corporation VTVM #62 at point C to ground on Tuner. Point C loaded to ground with a 15,000-ohm resistor only no i-f tube in circuit. Points A, A_1 and C shown on schematic.

Channel	*I-F Rejection Ratio*	*Image Rejection Ratio*	*Signal/Noise Ratio*
2	1000:1	2000:1	8.1
6	2000:1	550:1	11.7
7	4000:1	590:1	14.2
12	5000:1	240:1	14.6
13	5000:1	240:1	14.6.

1. Input Balance Ratio

1. Input balance ratios measured:

Channel	*Ratio*	*Channel*	*Ratio*
2	43.5	8	8.37
3	8.42	9	11.1
4	9.76	10	14.8
5	6.9	11	24
6	13.2	12	21
7	1.9	13	22.3.

2. Oscillator Radiation

Radiation as measured at the antenna terminals with a tuned r-f voltmeter.

Channel	*Push-Pull*	*Push-Pull*
2	57,500	17,000
3	28,000	12,000
4	18,000	16,000
5	16,500	16,000
6	75,000	45,000
7	16,000	11,000
8	20,000	22,500
9	30,000	22,000
10	42,000	45,000
11	45,000	40,000
12	100,000	43,000
13	100,000	25,000.

Selectivity

The selectivity of the r-f response shall be defined in terms of the attenuation at a bandwidth of 4.5 Mc and of the bandwidth at an attenuation of 6 db. With a sweep generator connected to the antenna terminals and an oscilloscope connected to terminal G (see schematic), the sound and picture carriers are held to within 3-db attenuation from the peak of the r-f curve. Maximum bandwidth 6 db down is 11 Mc.

Antenna Impedance Match

Channel	*Standing Wave Ratio*
2	2.3:1
6	1.8:1
7	2.5:1
13	2.5:1.

Intermediate Frequencies

TV-101 and TV-103 Tuners

Models are aligned to give frequencies of 21.25 Mc and 25.75 Mc for the sound and picture carriers at the i-f output of the tuner. Split sound i-f assemblies have the following ranges:—

Sound trap: 21.0 Mc to 22.0 Mc
Plate circuit: 19.5 Mc to 27.5 Mc.

Adjustment of the brass-oscillator tuning slugs over plus and minus one turn from the aligned position provide a range of 4 Mc on all channels so that the tuner may be used to produce intermediate frequencies of 21.0 Mc to 22.0 Mc for the sound carrier and 25.5 Mc to 26.5 Mc for the picture carrier.

TV-100 and TV-102 tuners are single peaked at approximately 23 Mc. Tuning range is from approximately 18.0 Mc to 27.0 Mc.

TV-104 and TV-111 are double peaked with peaks tuned to approximately 22 and 25.5 Mc.

Oscillator Characteristics

Stability—After one minute from starting the long time warm-up drift is approximately 150 kc on channel 13 and 50 kc on channel 6.

Switch resetability—Maximum detuning of oscillator circuit when switched is approximately 100 kc on channel 13. Minimum B+ voltage, 120 volts, without loss of gain of tuner. Reduction of B+ to 90 v results in approximately 2:1 loss of gain. Change of oscillator frequency from 150 volts to 90 volts results in slightly detectable change in sound

Torque

Torque is held to a maximum of 90 inch-ounces.

Stromberg-Carlson TC10, TC125 Series

The series capacitors C90 and C91 in the low-band coupling network have been changed from 4.2 $\mu\mu f$ to 4.5 $\mu\mu f$ (part no. 110668).

Capacitor C43 in the horizontal-sweep output stage has been changed from 0.22 μf, 400 volts, to 5 μf, 50 volts (part no. 111030).

Resistor R59 has been changed from 22,000 ohms, ½ watt in TC10 and from 22,000 ohms, 1 watt in TC125, to 22,000 ohms, 2 watts. The required dissipation of about 1 watt was too great for the half-watt value.

A bent metal shield has been added to cover the underside of the first audio-amplifier tube socket to prevent extraneous audio pickup. This shield is designated part number 151104, and mounts with a PK screw which is already in use at that point.

Light vertical fold lines in the picture can usually be corrected by slight readjustment of the horizontal-size-control trimmer capacitor. This capacitor is located in the grid circuit of the 6BG6 horizontal sweep output tubes and bears the symbol of C40. The adjustment is accessible from the underside of the chassis.

To obtain a greater range of contrast, the 750-ohm potentiometer (part no. 145085) has been changed to a 3,000-ohm potentiometer (part no. 145105) in the R19A position. The 3,000-ohm potentiometer will be substituted on all replacement orders in a package assembly, number 81539, which also includes a 47-$\mu\mu f$ capacitor (part no. 110597) and instructions for making the change.

Stromberg-Carlson TC10 Series

The R68, 1-megohm, ½-watt resistor, in series with the high voltage, has been changed to a 680,000-ohm, 1-watt value (part no. 149202). If flashing horizontal streaks or lines are observed in a TC10H picture when the brightness control is advanced, the receiver may have a defective 1-megohm resistor in the R68 position which should be changed to the 680,000-ohm value, even though the resistor outwardly appears to be good. This resistor will be found on the 1B3 socket terminal in the high-voltage case.

A 150,000-ohm, ½-watt resistor (part no. 27640) has been substituted for the 39,000-ohm, 1-watt resistor in the R15 position.

The first i-f screen resistor R23 has been changed from 33,000 ohms, ½ watt, to 56,000 ohms, ½ watt (part no. 28178).

Resistor R66 in the 1B3 filament circuit has been changed from 3.3 ohms to 5.6 ohms (part no. 149271).

Resistor R43 may be a 1.8-megohm or a 1.5-megohm resistor, if the R57 potentiometer in the vertical sweep oscillator is part number 145086 or 145102, respectively.

Stromberg-Carlson TC and TS Series

Following are the part numbers of the movable iron cores and the respective coils used in the tuning assembly on TS and TC receivers:

Low-band oscillator	Core no. 118039 with coil no. 114065
Hi-band oscillator	Core no. 118030 with coil no. 114066
Low-band converter	Core no. 118029 with coil no. 114065
Hi-band converter	Core no. 118035 with coil no. 114066
Low-band r.f.	Core no. 118029 with coil no. 114065
Hi-band r.f.	Core no. 118035 with coil no. 114066.

Note: The glass coil forms are color coded (red, blue, and yellow) to indicate the range of diameter size.

In model TC receivers, to assure maximum sensitivity of the high-band section of the television tuner in TC receivers, a 6BC5 tube (part no. 110675) is being used, in place of the 6AG5 tube in the r-f amplifier position. The circuit remains unchanged.

Stromberg-Carlson TC125 Series

The following modifications have been made to improve the apparent resolution of these instruments:

1. Resistor R14 changed from 56,000 ohms to 680,000 ohms (part no. 149118).
2. Resistor R73, 22,000 ohms (part no. 27407) has been added across the secondary of the video detector transformer.
3. Capacitor C36 has been changed from 0.01 μf to 0.047 μf (part no. 110544).

A 0.0022-μf capacitor (part no. 110536) has been shunted across C30, the 0.0047-μf capacitor, when the R57B potentiometer in the vertical oscillator is part no. 145078. When a 2-megohm potentiometer (part no. 145101) is used, this shunt capacitor is not used.

The 80-μf capacitors (part no. 111067) in the B-plus power supply, and the 2-μf capacitor (part no. 110675) in C7 position in the agc line are now being supported in position by a center mounting strap. Other heavy tubular-type capacitors are being dressed in such a manner as to prevent transit breakage of the capacitor leads.

To obtain sufficient vertical size under low-line voltage conditions, the value of R52 (vertical-oscillator charging resistor) may be changed from 1.8 megohms and 2.2 megohms to 1.5 megohms. This applies to TC125 receivers not having the opera glass feature.

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Stromberg-Carlson TC125

To improve the signal-to-noise level at the ratio-detector stage for clearer audio reproduction, capacitor C56 has been increased from 1 μf to 5 μf, 50 volts (part no. 111030).

Kinescope tubes using the grey-filter face plate (dark-faced) will be used in the subject receivers. These new tube types are identified by the following code numbers: 12½-inch tubes are denoted as 12LP4A (part no. 162075) or 12QP4A (part no. 162080), and the 19-inch tubes as 19AP4A (part no. 162083).

Cases of horizontal instability or jitter in the picture have been encountered where L4, horizontal-oscillator coil (part no. 114069), has developed short-circuited turns. This condition lowers the Q of the coil, in turn lowering the stability of the horizontal oscillator. This situation is best remedied by replacement of the coil.

In the L31 position, focus-coil assembly, part number 114660, is used when a 12LP4 kinescope tube is employed. Focus-coil assembly, part number 114661, is used when a 12KP4 or 12QP4 tube is employed.

Stromberg-Carlson TC125H, TC125L, TC125LM-2, TC125LSM

These models are similar to Model TC125. The following list should be added to the Parts List:

TC125H	TC125L	TC125LM-2	TC125LSM	Part Description
108144	108134	108152	108153	Cabinet assembly, mahogany
108145	108135	—	—	Cabinet assembly, avodire
155101	155129	155154	155129	Speaker
125044*	125044*	125047†	125047†	Escutcheon, tube ring
174007	174007	174012	174012	Mask assembly
138028	138028	138028	138028	Lens
101120	101120	101127	101129	Back panel
134098*	134098*	134115†	134115†	Knob "Tuning"
134103*	134103*	134120†	134120†	Knob "Brightness"
134106*	134106*	134122†	134122†	Knob "Tone"
134101*	134101*	134118†	134118†	Knob "Picture" contrast
134104*	134104*	134121†	134121†	Knob "Volume"
134100*	134100*	134117†	134117†	Knob "7-13, 2-6" range
134099*	134099*	134116†	134123†	Knob "Horizontal"
134102*	134102*	134119†	134119†	Knob "Vertical"
—	—	103018	103018	Telatenna loop support
—	—	139037	139037	Telatenna loop assembly.

*Indicates metallic gold finish
†Indicates metallic brown finish.

Stromberg-Carlson TC125H, TC125L

These models are similar to Model TC125 which appears on *pages 4-5 through 4-8 of Rider's TV Manual Volume 4.* The differences are given on *page 4-5 of the same volume.*

Stromberg-Carlson TS125 Series

The 5.6-ohm resistor R395 has been removed, and the 5.6-ohm resistor R396 has been changed to a 15-ohm, 1-watt value (part no. 149158), to reduce picture background noise.

Microphonics in the TS125H and TS125L models have been encountered when the audio feeds back to the r-f oscillators. It can be eliminated in the following manner:

1. Check that the tuner mounting screws do not clamp the tuner too rigidly to the main chassis.
2. Try substituting 6J6 r-f oscillator tubes. The Sylvania 6J6/TV tubes (part no. 162085) are especially good in these two oscillator positions.
3. To dampen possible movement within the oscillator trimmers, a rubber band or a spring (part no. 29628) may be stretched across the two trimmer shafts that project through the top side of the tuner chassis.

Stromberg-Carlson TS125, TS16 Series

When tolerances accumulate, the 1.5-megohm resistor R403, in the grid circuit of the vertical blocking oscillator, is sometimes too large in value to permit full control range adjustment. In these cases a 10-megohm resistor may be shunted across R403.

The 1,800-ohm, 1-watt resistor, R412, in the cathode of the vertical output tube has been changed to 3,300 ohms, 1 watt (part no. 149181).

Vertical dark lines at the left side of the picture area, caused by Barkhausen oscillations, can usually be eliminated by adjustment of the horizontal drive control. If the lines persist, changing 6BG6 tubes in the horizontal output stage should be tried. Often the lines are present on the raster, but disappear when the picture is present, so be sure to check under picture conditions.

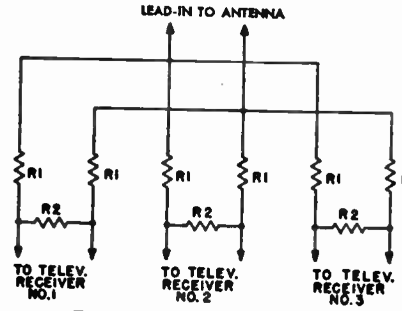
Stromberg-Carlson TV-12 Series

In case noise appears as a growl in the r-f tuner as the tuning shaft is rotated, making it difficult to tune in the desired station, especially in the high-frequency channels, the tuner is in need of cleaning and re-lubrication which is done as follows:

1. Remove the cover from the ganged coils in a clean, dust-free location.
2. With a soft small brush and some carbon tetrachloride, clean all the turns of the coils, the end rings, and the coil tracks.
3. Re-lubricate with a small amount of Lubriplate 105, covering all the surfaces just cleaned.
4. Replace the dust cover.

Stromberg-Carlson TV-12 Series

To connect more than one television receiver to one antenna without the use of switches, resistor pads will be necessary to match the impedance of the lead-in to the impedance of the receiver.



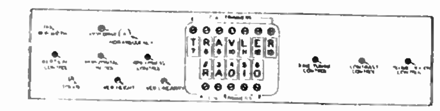
Examples for three receivers.

The table shown below is a chart of the resistors to use with each specified number of receivers. The figures are based on a 75-ohm impedance which is the input impedance of the TV-12 and also the characteristic impedance of the coaxial lead-in (RG-59U or equivalent). Use noninductive carbon resistors and place the pads at the junction point and not at the receiver terminals, as shown in the accompanying figure.

Number of Receivers	R1	R2
2	56	100
3	100	100
4	120	82
5	150	82
6	180	82
7	240	82
8	270	82.

Trav-ler 10T, 12T

Resistor R8, 10,000 ohms, has been removed from the plate circuit of VT2. Capacitor C103, 10 $\mu\mu f$, and L16B have been added from the plate of the picture tube to grid 1 of the same tube. Resistor R102, 22,000 ohms, has been inserted from grid 1 to the plate of VT11. C102, 0.05 μf has been inserted from grid 1 to the junction of R73 and the vertical output transformer. The accompanying diagram shows the placement of the front panel controls.



Front panel controls for Trav-ler 10T and 12T.

Westinghouse H-223, Ch. V-2150-01, V-2150-02, V-2150-04

Chassis V-2150-01, V-2150-02 and V-2150-04 are used in model H-223. The differences in these chassis are in the r-f tuner assembly.

The V-2150-01 chassis uses a tuner assembly marked V-6771-2. The V-2150-02 chassis uses a tuner marked V-6850. This tuner is electrically the same as the V-6771-2 tuner, but one wafer of the channel selector is mounted on the outside of the tuner housing.

The V-2150-04 chassis uses a tuner marked V-6238. This is the same tuner that is used in Model H-251. The high-frequency oscillator alignment procedure given for Model H-223 applies to the V-2150-01 chassis only. For high-frequency oscillator alignment information on the other two chassis refer to the data on Model H-251.

In early chassis, the resistance values of the V 6464 horizontal hold R403 and vertical hold R404 controls are 250,000 ohms for both sections. With these 250,000-ohm controls, the resistors that are connected in series with each control, R433 and R436, should have the resistances 100,000 and 330,000 ohms respectively. However, in later production the hold-control resistance values were changed to 100,000 ohms for R403 and 500,000 ohms for R404. When the 100,000- and 500,000-ohm controls are used, the values indicated for R433 and R436 are not correct; both R433 and R436 should be 220,000 ohms (RC20AE-224J). Since the controls furnished as replacements under part number V-6464 are the later type, R433 and R436 must be 220,000 ohms when a replacement control is installed.

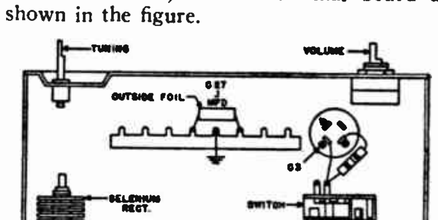
The following changes should be made in the parts list:

Part No.	Description
V-6889-1	Indicator, channel (use with V-2150-01 or V-2150-02 chassis)
V-6282-1	Indicator, channel (use with V-2150-04 chassis only)
V-8200	Tuner assembly, complete less mounting (V-2150-01 and V-2150-02 chassis only)
V-8215	Tuner assembly, complete less mounting (V-2150-04 only).

Westinghouse H-303P4, H-304P4, Ch. V-2153

The chassis used in later production contains modifications that eliminate the possibility of burning out the filament of the 3V4 tube by inserting the a-c plug in position for battery operation with the on-off switch in off position. Sets that contain the modified chassis are identified by a warning label pasted on the inside of the back cover. The warning, which reads, "Always remove plug from wall socket before operating battery change-over switch," serves as a further precaution against damage. Sets that do not contain the revisions can be modified in the following manner:

1. Remove the chassis from the cabinet.
2. Refer to the accompanying figure, and remove enough components from their positions over C3 to permit ease in performing steps 3, 4, and 5.
3. Remove the 3 red B+ wires from the C3 section lug of the filter capacitor.
4. Solder the 3 wires together and apply tape to the joint until they are well insulated.
5. Connect a single red wire between C3 lug and the battery switch terminal to which R16 is connected. The wire should be the same type as the wires that were removed.
6. Connect a 0.1-μf, 200-v, capacitor (C27, RCP10W2104M) to the terminal board as shown in the figure.



Bottom view of Westinghouse Chassis V-2153 showing wiring revisions.

7. Replace the components that were removed in step 2.

Westinghouse H-600T16, Ch. V-2150-61; H-601K12, H-602K12, Ch. V-2150-41

The following changes should be made in the schematic drawings which appear for Chassis V-2150-61 and V-2150-41:

1. In the tube heater schematic in the lower left portion of the drawing, the five filament chokes that are not numbered should be labeled L404, L405, L406, L407, and L408. In addition, the capacitor across the 6AL5 tube heater should be labeled C406, and the capacitor across the 6BJ6 heater is C407. The capacitor across the 6BH6 heater should be deleted.
2. The 6.3-v line that extends from the heater schematic should connect to terminal 5 of the terminal strip in the tuner section rather than to terminal 3. C306 which is connected to this line on the drawing should be connected between terminal 3 and ground.
3. The plate dropping resistor for the 6BH6 2nd audio a-f amplifier should be labeled R214 rather than R219.
4. The capacitor that is connected between the grid of the 6AV6 1st audio amplifier and ground should be labeled C217 rather than C216.
5. The unnumbered resistor that is connected between the horizontal hold control and the grid of the horizontal multivibrator should be labeled R436, 220,000 ohms.

The parts list for the H-600T16 should be changed as follows:

Ref. No.	Change—
R301, R302, L401	Part number to V-9235-2
L404, L405, L406, L407, L408	Part number to V-9099-1
L409, L410, L411, L412	Part number to V-9210-1.

Westinghouse H-604T10, Ch. V-2150-94; H-604T10A, Ch. V-2150-94A

The schematic diagram for these chassis should be altered to show a decoupling network in the B+ supply lead to the h-v power supply. The network consists of a 68-ohm resistor, R505, inserted in series with the B+ lead that connects from the junction of R501 and R524 to ground. These items are added in later production chassis to eliminate diagonal bars in the picture.

The parts list should be altered as follows. Change R504 to read R524. Add:

Ref. No.	Part No.	Description
—	V-9323-2	Pulley assembly, TV antenna (side H-604T10A)
—	V-9324-2	Pulley assembly, TV antenna (top H-604T10A)
C508	RCP10W4104M	Capacitor, 0.1 μf, 400 v
R505	RC20AE680K	Resistor, 68 ohms, ½ w.

Wilcox-Gay G306, G402, G403, G404, G426, G427, G624, G914

Wilcox-Gay Model G306 is similar to Majestic Model 12T6. Model G402 is similar to Majestic 12C4. Model G403 is similar to Majestic 14T2. Model G404 is similar to Majestic 14C4. Model G426 is similar to Majestic 16C4, and Model G427 is similar to Majestic 16C6. Except for cabinet designs or picture tube size, Majestic Models 12T6 and 14T2 are the same as Majestic Model 12T2. Majestic Model 14C4 is the same as Majestic Model 12C4, and Majestic Model 16C6 is the same as 16C4.

Wilcox-Gay Model G624 is similar to Majestic Model 1674, and Model G914 is similar to Majestic Model 1974.

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TEST PATTERNS

Abnormalities in the patterns appearing on the scope can be classified as being caused by either:-

1. Internal effects - i.e. misadjustment of one or more controls, incorrect voltages, deterioration of components, etc., or -
2. External effects - i.e. interfering signals, multiple signals, too strong or too weak a signal, etc.

Many of the internal defects, causing abnormalities in the test pattern can be corrected by the simple adjustment of the pre-set or front panel controls.

The following test patterns have been arranged firstly as to internal and then the external causes for abnormalities. It should be born in mind that whereas only one cause is given for each defect, it is possible to have more than one simultaneously, necessating several adjustments.

These patterns are reproduced through the courtesy of the following companies: Radio Corporation of America, General Electric Company, Allen B. DuMont Laboratories, Inc., Capehart - Farnsworth Corporation, Motorola, Inc., and others

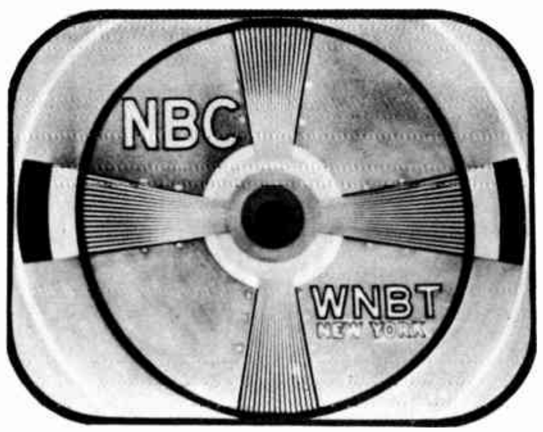

FIG. 1: NORMAL PICTURE

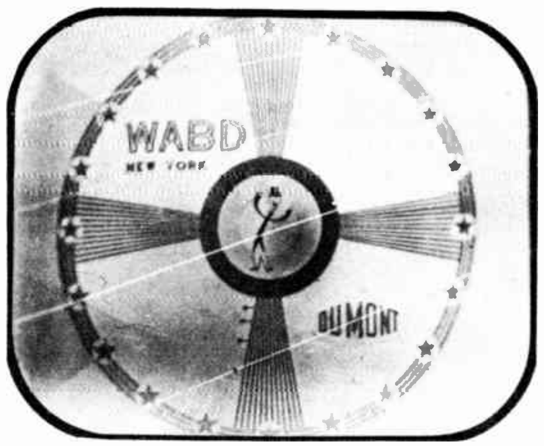

FIG. 2: CONTRAST TOO LOW

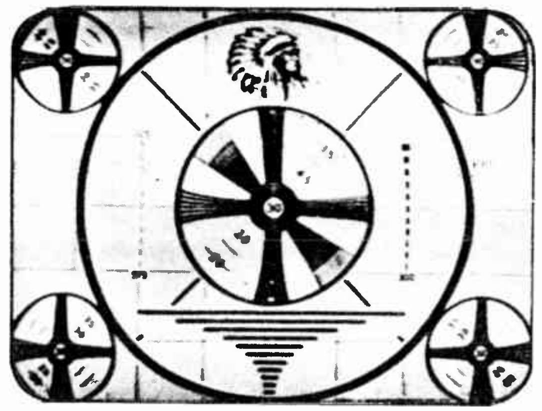

FIG. 3: CONTRAST TOO HIGH

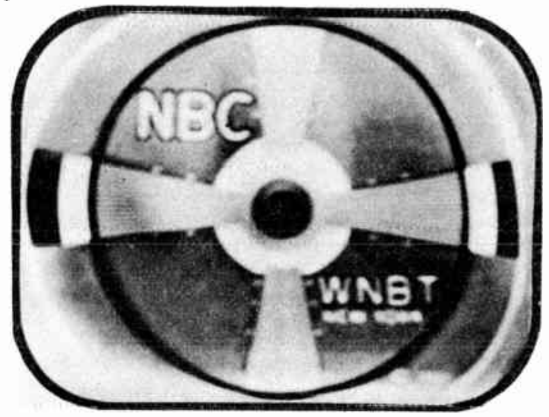

FIG. 4: FOCUS MISADJUSTED

FIG. 5: FOCUS COIL AND ION TRAP MISADJUSTED

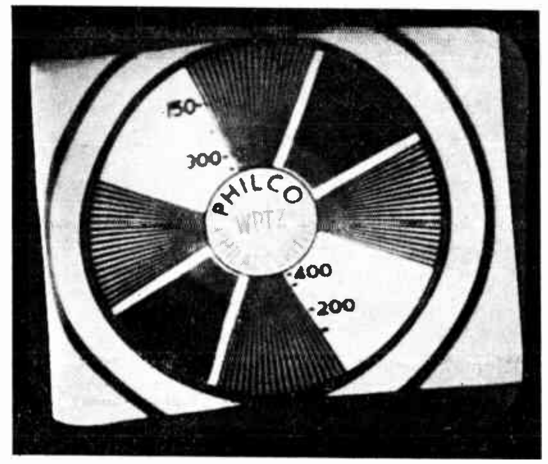

FIG. 6: DEFLECTION YOKE ROTATED

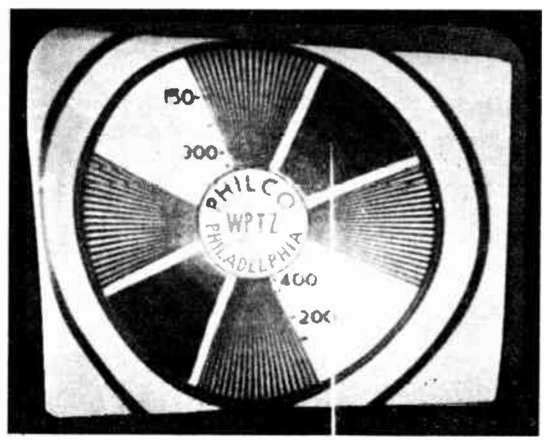

FIG. 7: PICTURE TUBE ADJUSTMENT REQUIRED

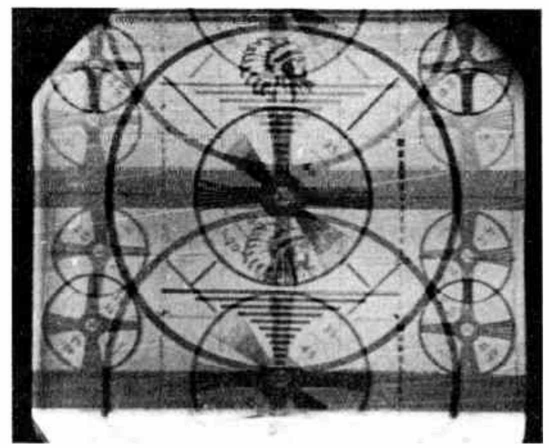

FIG. 8: VERTICAL HOLD MISADJUSTED

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FIG. 9: VERTICAL LINEARITY MISADJUSTED

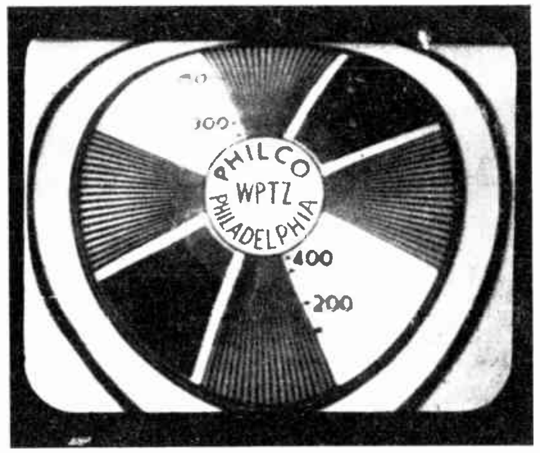

FIG. 10: VERTICAL LINEARITY MISADJUSTED

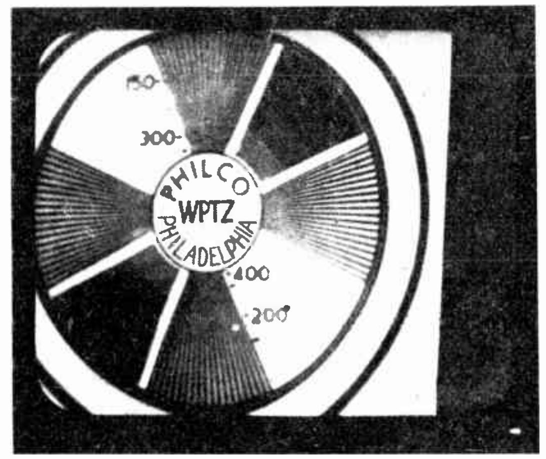

FIG. 15: HORIZONTAL CENTERING MISADJUSTED

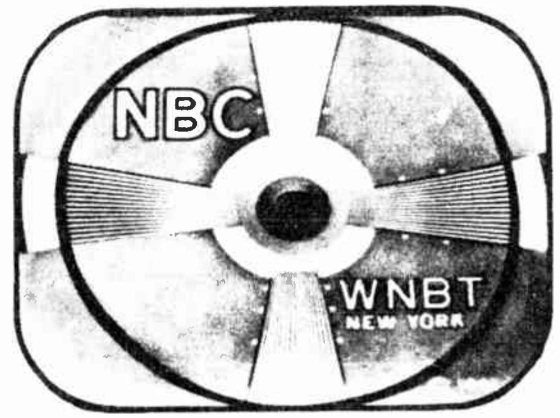

FIG. 16: HORIZONTAL WIDTH TOO WIDE

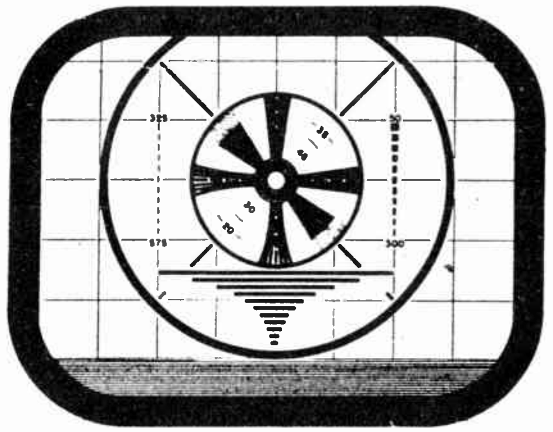

FIG. 11: VERTICAL CENTERING MISADJUSTED

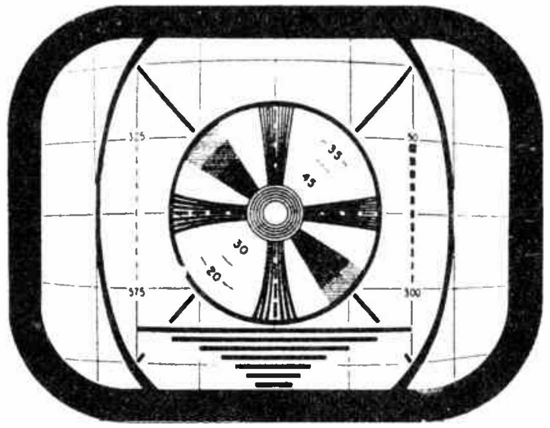

FIG. 12: VERTICAL HEIGHT TOO HIGH

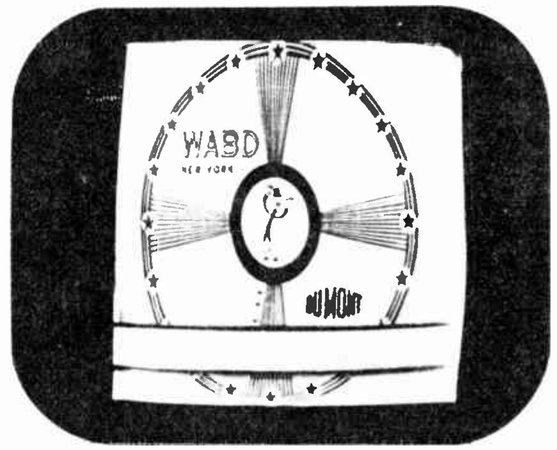

FIG. 17: HORIZONTAL WIDTH TOO NARROW

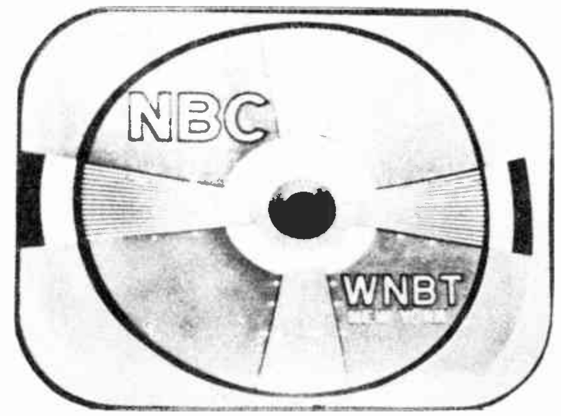

FIG. 18: HOR. LINEARITY MISADJUSTED - BUNCHES RIGHT OR LEFT

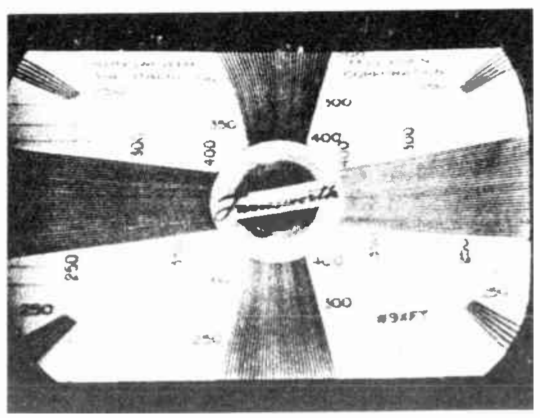

FIG. 13: VERTICAL HEIGHT TOO LOW

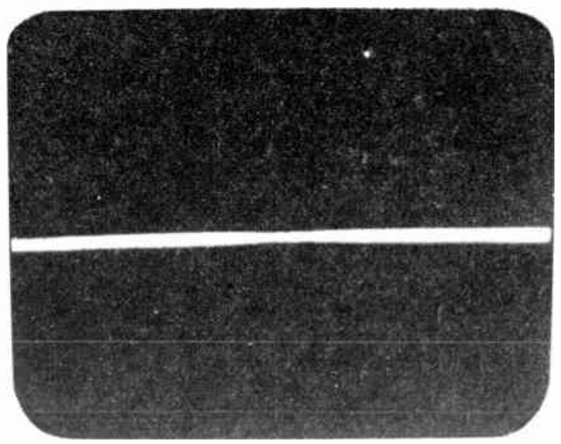

FIG. 14: NO VERTICAL SWEEP

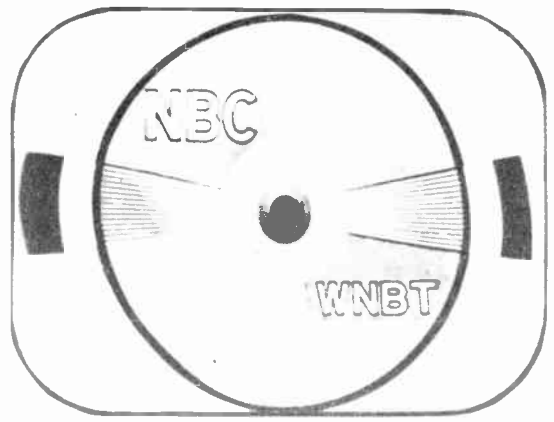

FIG. 19: HOR. LINEARITY MISADJUSTED - BUNCHES TO CENTER

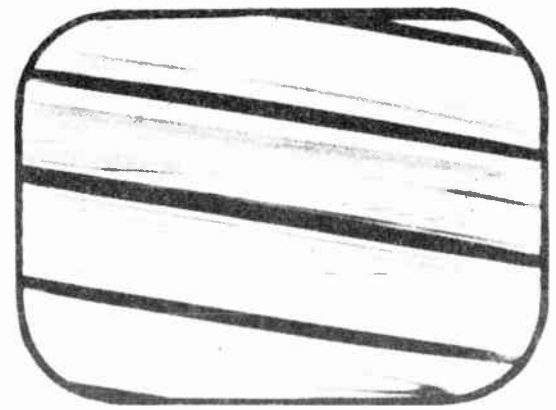

FIG. 20: HOR. SYNC. DISC. XFORMER FREQ. ADJUSTMENT MISADJUSTED

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FIG. 21: HOR. SYNC DISC. XFORMER PHASE ADJUSTMENT MISADJUSTED

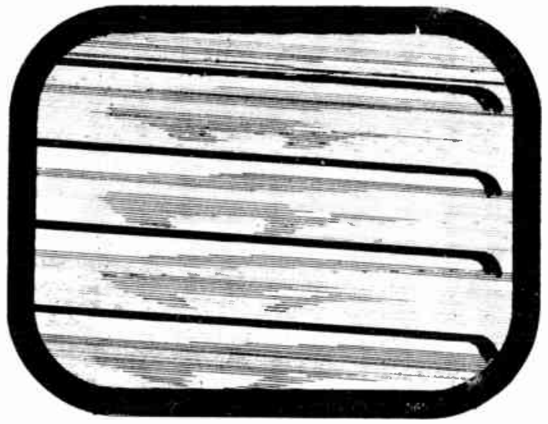

FIG. 22: HORIZONTAL HOLD MISADJUSTED FAST MOVEMENT

FIG. 23: HOR. HOLD MISADJUSTED "TEAR OUT" AT TOP OR BOTTOM

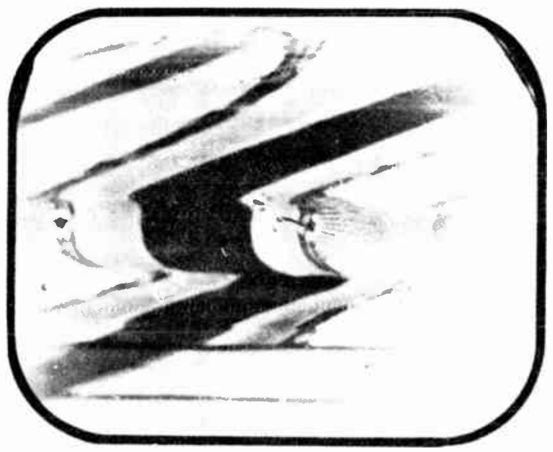

FIG. 24: HORIZONTAL HOLD MISADJUSTED SYNC AFFECTED

FIG. 25: HORIZONTAL HOLI MISADJUSTED

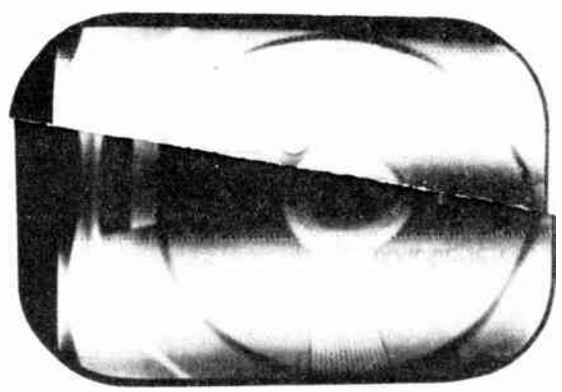

FIG. 26: HUM IN VIDEO AND SYNC

FIG. 27: EXCESSIVE RIPPLE IN VIDEO AMPLIFIER

FIG. 28: EXCESSIVE RIPPLE IN VIDEO AMPLIFIER

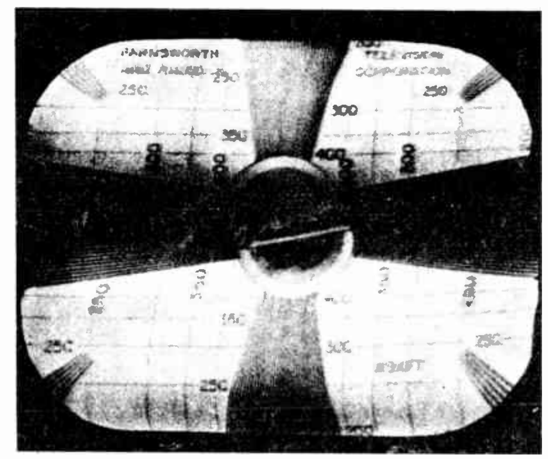

FIG. 29: 120 CYCLE HUM IN VIDEO AND HORIZONTAL SCANNING

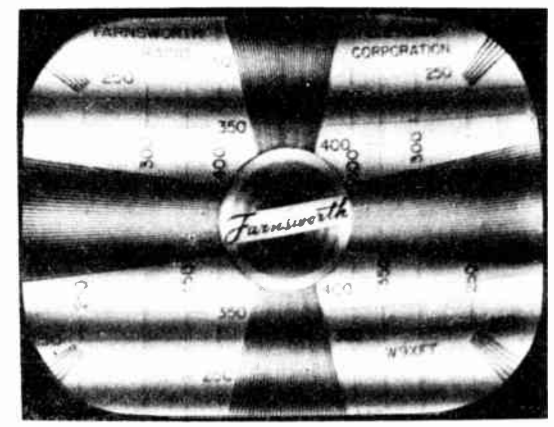

FIG. 30: SOUND BARS OR MICROPHONICS

FIG. 31: SOUND INTERFERENCE - INCORRECT TUNING

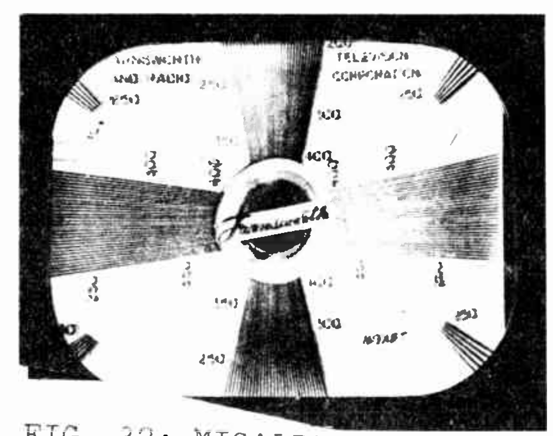

FIG. 32: MISALIGNMENT OR IMPROPER ANTENNA ORIENTATION

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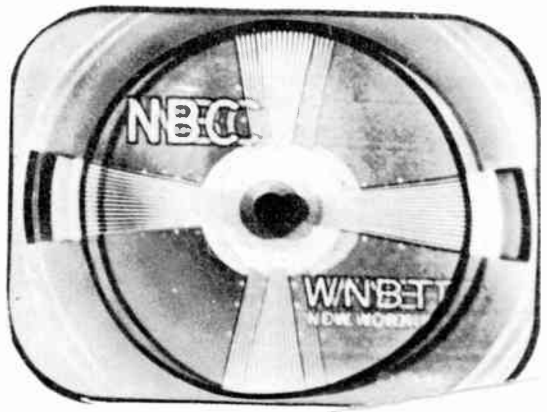

FIG. 33: MULTIPLE IMAGES GHOSTS

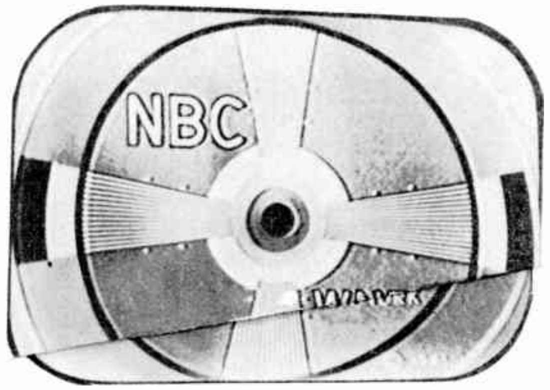

FIG. 34: TRANSIENTS

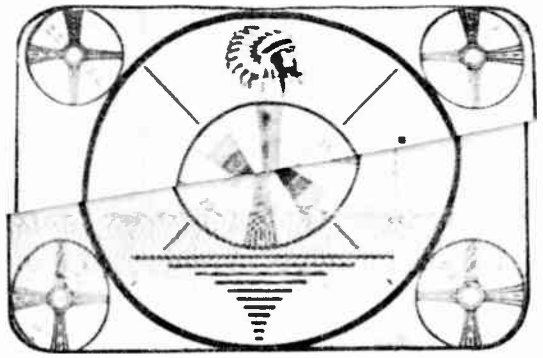

FIG. 39: DIATHERMY INTERFERENCE - WEAK

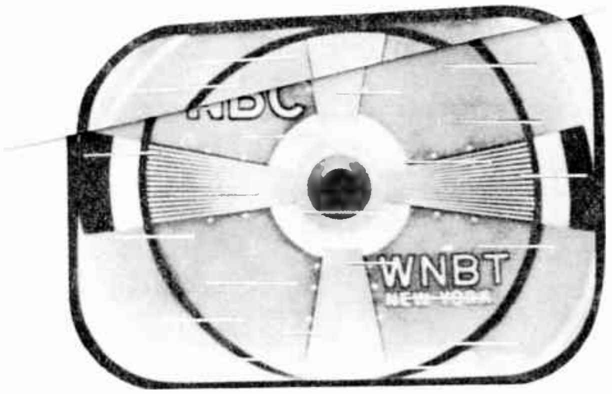

FIG. 40: IGNITION INTERFERENCE - WEAK

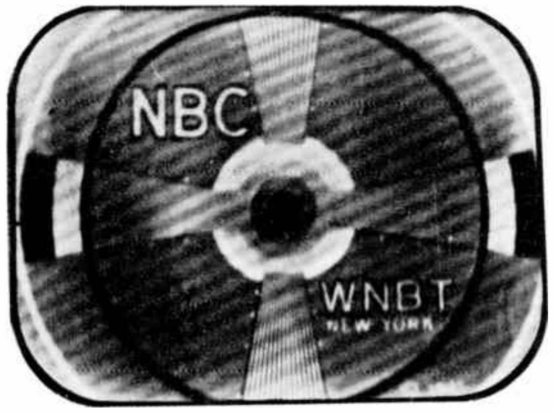

FIG. 35: INTERFERENCE FROM ANOTHER SIGNAL

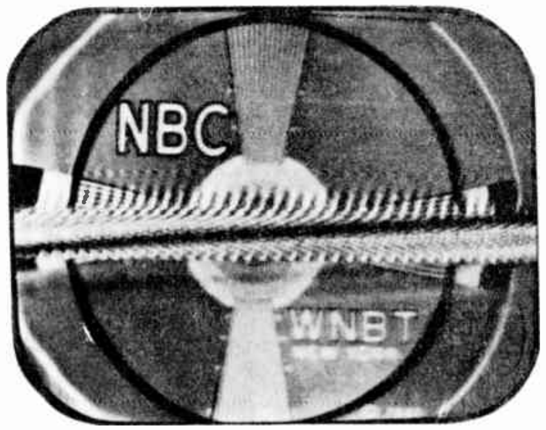

FIG. 36: DIATHERMY INTERFERENCE - HEAVY

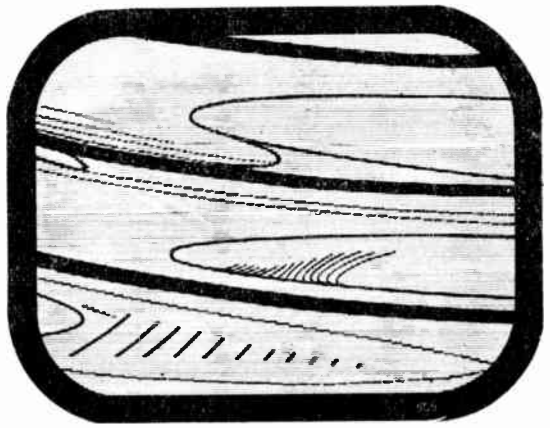

FIG. 41: IGNITION INTERFERENCE - HEAVY

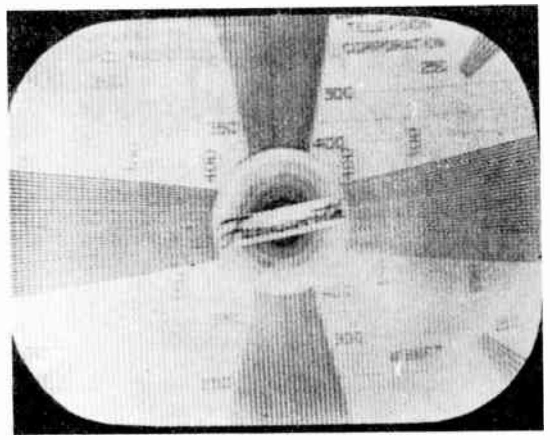

FIG. 42: BEAT FREQUENCY

FIG. 37: DIATHERMY INTERFERENCE - MEDIUM

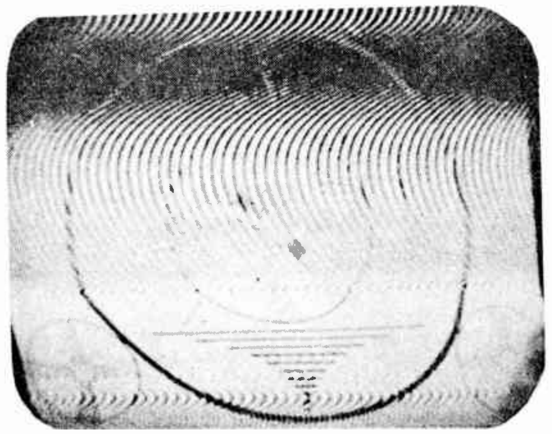

FIG. 38: DIATHERMY INTERFERENCE - LIGHT

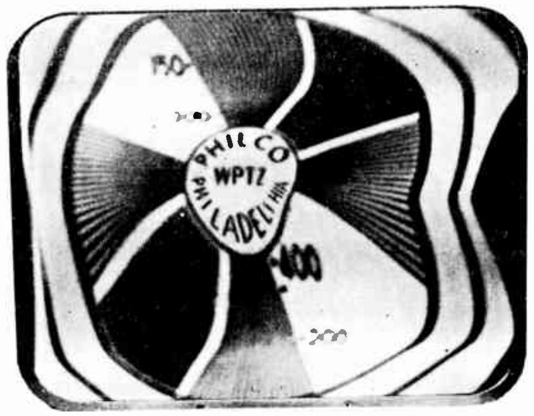

FIG. 43: HUM IN DEFLECTION COIL

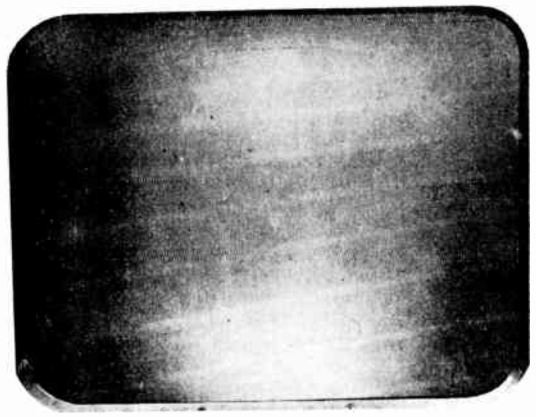

FIG. 44: NO VIDEO SIGNAL

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