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1949

Television

Servicing Information

THEORY
PRACTICE
EXPERIENCE

Compiled by

M. N. BEITMAN

VOLUME TV-3

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SUPREME PUBLICATIONS

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FOREWORD

This new 1949 Television manual includes factory data on popular and interesting sets of the more important manufacturers. The material included has been selected with care, so that it will not only give specific instructions on the service of receivers covered, but will also serve as a course of study in modern television. You will note that various techniques of servicing are presented under different receiver descriptions and the receiver circuits incorporated in this manual are so varied as to give you a complete cross section of modern television receivers. Sets of other makes not included may be almost identical to units covered by this manual, while identical tuners have been used by several manufacturers in a great many models.

Our sincere thanks is extended to the television set manufacturers whose products are described in this manual. It is the cooperation and courtesy of these firms that made possible the publication of this manual.

M. N. Beitman

July 1, 1949
Chicago.

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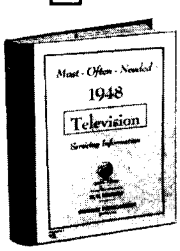
☐ 1948 TELEVISION SERVICING



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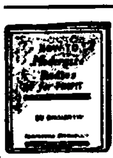

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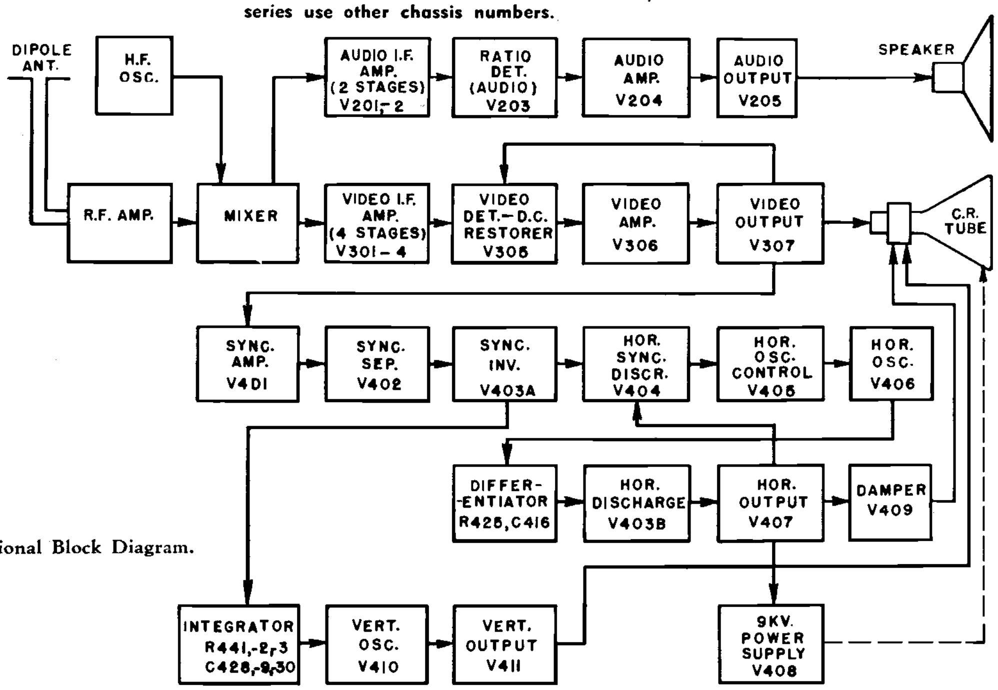
MOST-OFTEN-NEEDED 1949 TELEVISION RECEIVERS

Admiral Corporation 30A1, 30B1, 30C1, 30D1 and 4H1 CHASSIS

This SECTION applies to the following models:

4H15S or SN	4H137S or SN	4H167S or SN	30A12
4H16S or SN	4H145S or SN	30B15S or SN	30A13
4H17S or SN	4H146S or SN	30B16S or SN	30A14
4H18S or SN	4H147S or SN	30B17S or SN	30A15
4H19S or SN	4H155S or SN	30C15S or SN	30A16
4H115S or SN	4H156S or SN	30C16S or SN	8C11
4H116S or SN	4H157S or SN	30C17S or SN	8C12
4H117S or SN	4H165S or SN	30A14SA	8C13
4H126S or SN	4H166S or SN	30A15SA	

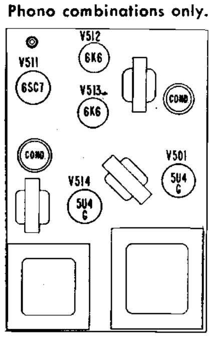
NOTE: Some models (not listed above) in the "4H," "30B" and "30C" series use other chassis numbers.



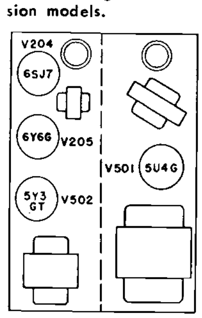
Functional Block Diagram.

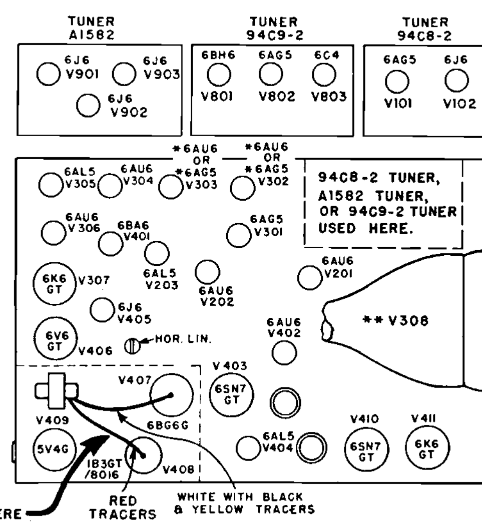
TUBE LOCATIONS

This power supply used in "4H1" Telev.-Radio-Phono combinations only.



This power supply is used in 8C11, 8C12, 8C13 combinations and in all straight television models.





ANOTHER 1B3GT/8016 (V412) HERE IN 30D1 CHASSIS.

* 30D1 chassis uses 6AG5 only. 30A1, 30B1, 30C1 chassis uses 6AG5 or 6AU6. Tubes not directly interchangeable; see "Production Changes", paragraph 15, page 1-8.

** 16" picture tube not mounted on chassis; mounted in separate assembly. Different 12" pictures tubes used in 30C1 chassis.

MOST-OFTEN-NEEDED 1949 TELEVISION RECEIVERS

INSTALLATION AND SERVICE ADJUSTMENTS

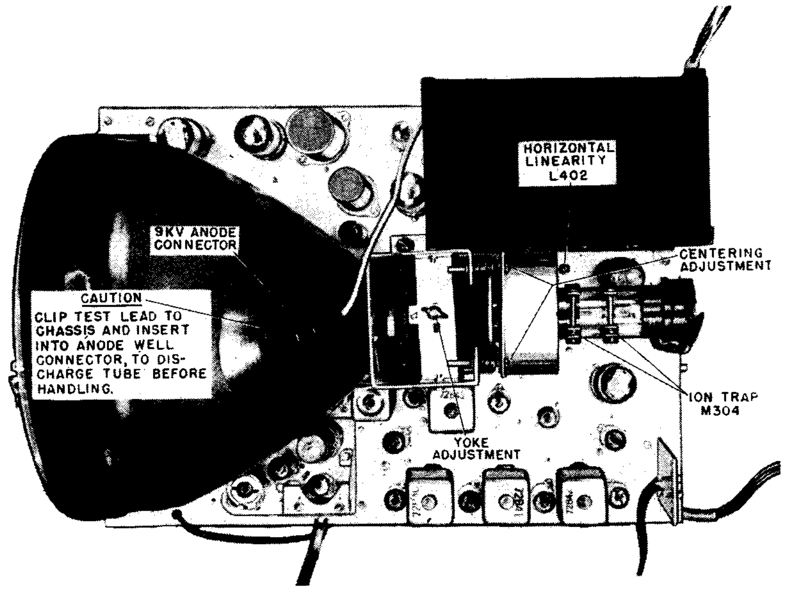


Fig. 5-14. Receiver Chassis, Top View Showing 10" or 12" Picture Tube
Models with 16" picture tube (30D1 chassis) have picture tube in separate assembly.

ION TRAP ADJUSTMENT

The double magnet ion trap (used with types 10BP4 and 12BP4 picture tubes) should be located with the black (sleeve) magnet toward the tube base.

Alternate 12" picture tubes use a single magnet ion trap, or no ion trap. The 16" picture tube also uses a single magnet ion trap.

If no ion trap is required, do not use one. For tubes with the single magnet ion trap, the blue (sleeve) end of the magnet should be located at the left side of the tube, viewing back of the chassis. The ion trap is adjusted by viewing its effect on a picture, pattern or raster. Move the trap assembly back and forth with a slight rotary motion. Adjust for brightest raster on the screen. Reduce the brightness control until the raster is barely visible. Adjust the focus control for clearest trace lines and readjust the ion trap for maximum brightness. The final adjustment should be made with the brightness control at the maximum position at which good trace line focus can be maintained.

FOCUS COIL ADJUSTMENT

If the picture is not centered on the screen (Figures 5-15 and 5-16), it may be corrected by adjusting the screws holding the focus coil assembly (see Figure 5-14 or 5-20). Should the focus coil require excessive tilting to obtain proper centering, it may be necessary to slightly orient (reposition) the deflection yoke bracket.

WARNING

When carrying out this adjustment, extreme care should be exercised so that no abnormal pressure is exerted on the neck of the picture tube.

DEFLECTION YOKE ADJUSTMENT

If picture appears tilted (Figure 5-17), loosen adjustment on top of deflection yoke and turn the yoke for correct orientation and then tighten the adjustment.

HEIGHT AND VERTICAL LINEARITY ADJUSTMENT

a. Adjust height (Figures 5-18 and 5-19) control R449 (Figure 5-20) to just fill picture tube mask.

b. Adjust vertical linearity (Figure 5-21) control R455 (Figure 5-20) for best vertical linearity. Distance AB should then equal DE; BC should equal CD (Figure 5-23).

c. Alternate readjustment of these controls may be necessary to obtain best vertical linearity. This is due to control interaction.

WIDTH AND HORIZONTAL LINEARITY ADJUSTMENT

a. Adjust horizontal drive control R429 (Figure 5-20) for best linearity. Distances FG should then equal HK; GC should equal CH (Figure 5-23). Horizontal drive control R429 should be as far clockwise as possible, consistent with good linearity.

b. If horizontal non-linearity (Figure 5-22) cannot be corrected by horizontal drive control adjustment, further adjustment can be obtained by means of horizontal linearity control L402 (Figure 5-14).

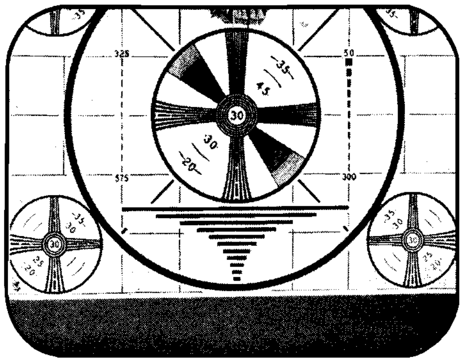


Fig. 5-15. Picture Too High or Too Low; Adjust Mechanical Position of Focus Coil

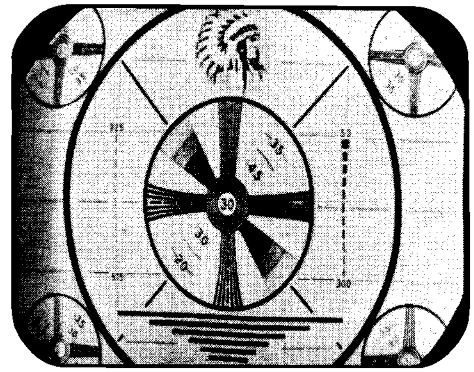


Fig. 5-19. Too Much Height; Adjust HEIGHT Control

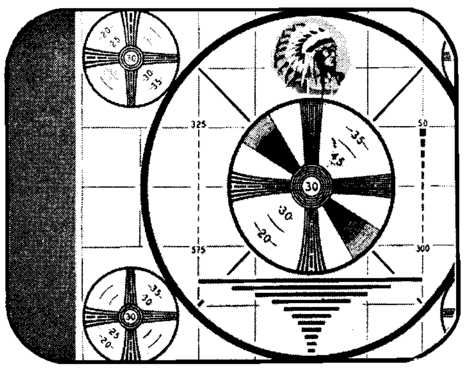


Fig. 5-16: Picture Too Far to Right or Left: Adjust Mechanical Position of Focus Coil

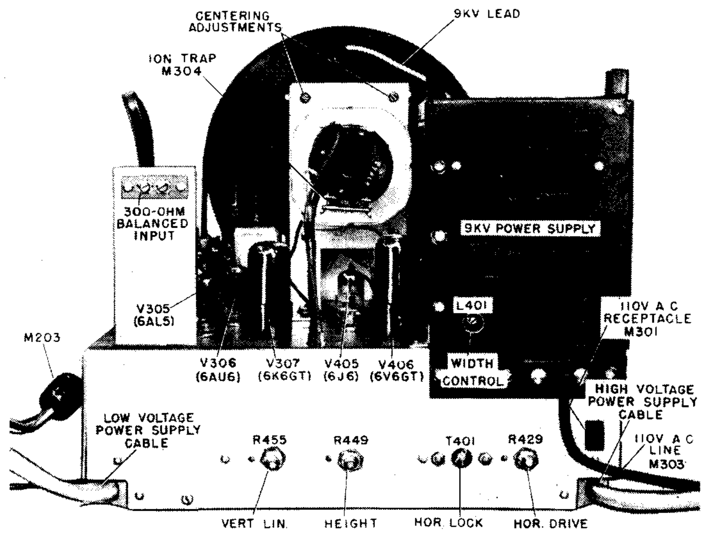


Fig. 5-20. Receiver Chassis Showing Rear Panel Adjustment Controls For All Sets.

NOTE: Picture tube mounting arrangement for 10″ and 12″ picture tubes only shown above. The 16″ picture tube is not mounted on chassis. Later production uses single cable arrangement for High and Low Voltage Power Supply connections.

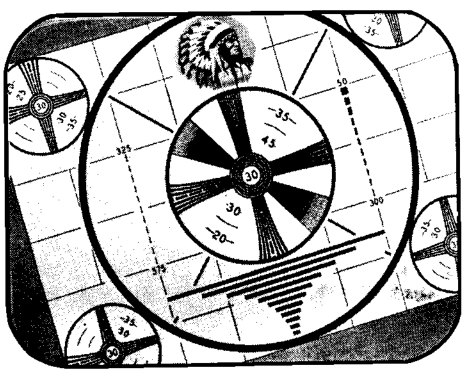


Fig. 5-17. Picture Tilted; Adjust Electromagnetic Deflection Coil

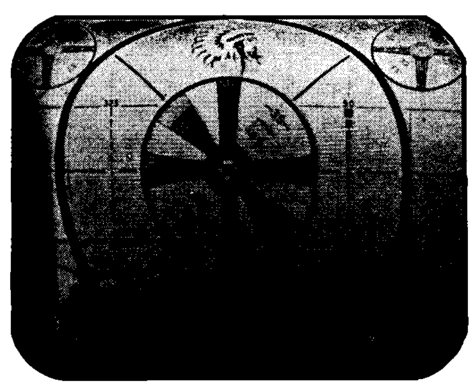


Fig. 5-21. Non-Linear Vertically; Adjust VERT. LIN. Control

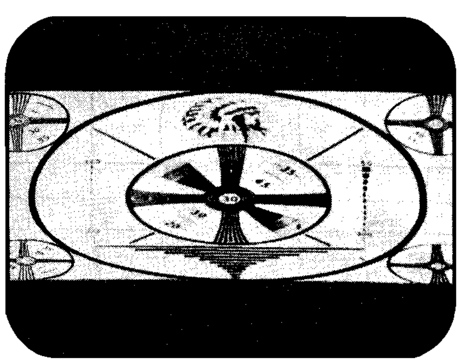


Fig. 5-18. Lack of Height; Adjust HEIGHT Control

(L402 has the greatest effect on the center of the pattern.)

c. Alternate readjustment of these controls may be necessary to obtain best horizontal linearity. This is due to control interaction.

d. Adjust width (Figure 5-24a and 5-24b) control L401 (Figure 5-20) until the best pattern just fills the picture tube mask.

e. Center as per paragraph on "Focus Coil Adjustment".

With correct horizontal and vertical linearity and correct size adjustment, the circles in the test pattern should appear round. The test patterns used by different stations vary. For example, the outer circle may be cut off at A and E while points F and K are at the edges of the picture tube mask (Figure 5-23). The four small circles in the corners of the pattern illustrated are not always used.

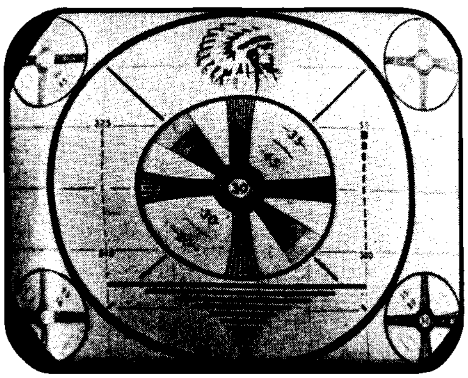


Fig. 5-22. Non-Linear Horizontally; Adjust HOR. DRIVE Control

If more than one station is on the air when making linearity, size and centering adjustments; check receiver adjustment on all stations. This is necessary since all TV stations are not perfectly linear at all times.

Tube aging may make horizontal linearity adjustment impossible. In some instances this difficulty may be overcome by changing the tap on damping resistor R435 (located inside the 2nd anode supply shield). After changing the tap on R435, readjust horizontal linearity, horizontal drive and width controls as per instructions. If correct horizontal linearity (and width) cannot be obtained, refer to the trouble-shooting chart.

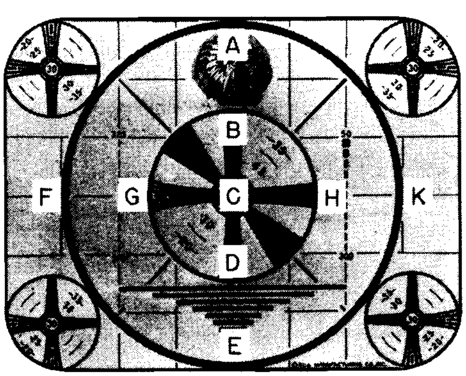


Fig. 5-23. Correct Width and Horizontal Linearity

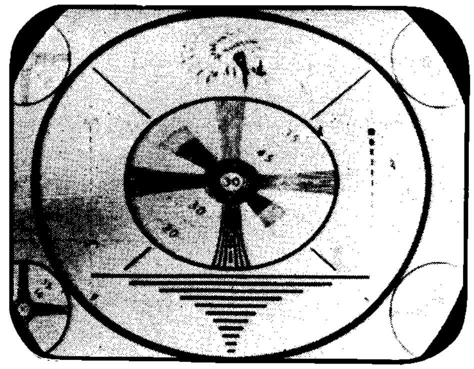


Fig. 5-24a. Too Much Width

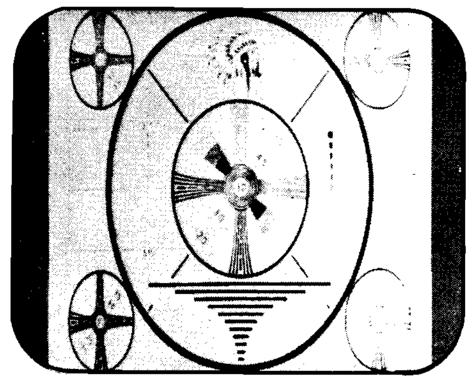


Fig. 5-24b. Insufficient Width

HORIZONTAL OSCILLATOR ADJUSTMENT

If it is difficult to hold the picture in horizontal sync (see Figure 5-5), proceed as follows:

a. Turn horizontal hold control R421A on the front of the chassis to the extreme counter-clockwise position.

b. Turn the horizontal lock T401 (Figure 5-20) clockwise until the pattern falls out of synchronization.

c. Then turn the horizontal lock counter-clockwise until the pattern just falls back into synchronization.

d. Turn the horizontal hold control fully clockwise and turn the channel switch to the next highest channel, and then back to the original channel. The test pattern should return in synchronization. Should the pattern be broken up, slowly turn the horizontal hold control counter-clockwise until the picture just falls into synchronization. It should not be necessary to rotate this control more than 25% to obtain synchronization and

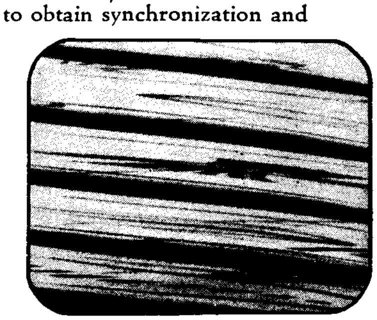


Figure 5-5. Horizontal movement; adjust HORIZONTAL control.

MOST-OFTEN-NEEDED 1949 TELEVISION RECEIVERS

TELEVISION ALIGNMENT PROCEDURE

GENERAL

Complete alignment consists of the following individual procedures. Alignment should be performed in this sequence.

a. IF Amplifier and Trap Alignment (Video and Sound IF).
b. Tuner RF and Mixer Alignment.
c. Tuner High Frequency Oscillator Alignment.

Under normal use or operating conditions, tuner misalignment with age will be slight. The RF and mixer stage components as well as coil assemblies have been designed for stable band-pass operation and under normal conditions will seldom require realignment. The HF oscillator however, may require some slight readjustment, if the oscillator-mixer tube or individual channel snap-in coils have been replaced.

Do not attempt alignment until all possible causes of trouble have first been investigated. Do not attempt alignment unless suitable test equipment is available.

HIGH VOLTAGE WARNING

Operating or servicing television receivers with cabinet removed involves shock hazard. Exercise all normal High Voltage precautions.

Picture tube, including all cables, must be connected to television chassis for 30D1 models during alignment. Anode voltage for 16" picture tubes is approximately 12 KV.

ALIGNMENT TOOL KIT (#98A30-3)

An Alignment Tool Kit consisting of 2 screwdrivers is available. Order part #98A30-3 from Admiral Distributor.

TEST EQUIPMENT

To properly service this receiver, it is recommended that the following test equipment be available.

RF Sweep Generator
18 to 30 MC range: 10 MC sweep width.
50 to 90 MC range: 10 MC sweep width.
170 to 225 MC range: 10 MC sweep width.
Output: adjustable; one-tenth volt minimum.
Output impedance: 300 ohms balanced to ground for RF ranges.

Marker Generator
18 to 30 MC frequency range.
50 to 90 MC frequency range.
170 to 225 MC frequency range.
Must be extremely accurate or have built-in crystal calibrator for checking accuracy of calibration.

Crystal Calibrator
Check points from 18 to 225 MC. Not required if marker or sweep generators have built-in calibration crystals.

Signal Generator
Accurate signal generator, range 18 to 225 MC, with low impedance output and calibrated output attenuator.

Oscilloscope
Standard oscilloscope, preferably with a wide band vertical deflection, vertical sensitivity at least .5 volt peak-to-peak per inch, and input calibrator.

Vacuum-Tube Voltmeter
Vacuum-tube voltmeter or 20,000 ohms per volt DC meter. Preferably one with low range (3 volt) DC zero center scale.

ALIGNMENT ADJUSTMENT IDENTIFICATION

For sets with 94C8-2 (turret type) tuner only.

Adj.	Symbol	Function	Adj.	Symbol	Function	Adj.	Symbol	Function
A1	L106 / §L706	21.25 MC Trap Coil	A9	L301	1st IF Coil (Video)	A14	C102	Trimmer Condenser (RF amp.)
A2	T301	21.25 MC Trap (IF Trans.)	A10	L105	Mixer Coupling Coil (late circuit)	A15	C104	Trimmer Condenser (RF amp.)
A3	T201	1st IF Transformer (Sound)	A10	§L705	Mixer Plate Coil (early circuit)	A16	C107	Trimmer Condenser (Mixer)
A4	T201	1st IF Transformer (Sound)						
A5	T202	Ratio Detector Transformer						
A6	T202	Ratio Detector Transformer	A11	T301	2nd IF Transformer (Video)	A17	L102	HF Osc. Coils (all channels)
A7	T302	27.25 MC Trap (IF Trans.)	A12	T302	3rd IF Transformer (Video)	A18	C110	Trimmer Condenser (Oscillator)
A8	T303	19.75 MC Trap (IF Trans.)	A13	T303	4th IF Transformer (Video)			

§Part of T701, early circuit.

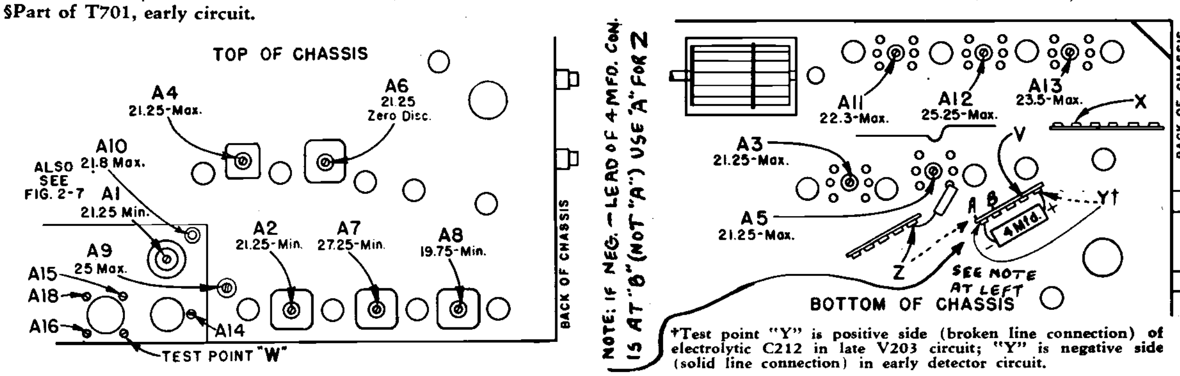


Figure 2-1. Trimmer Locations

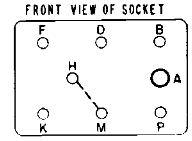
CONNECTIONS FOR 4H1 MODELS

Set "Tel-Phono-Radio" switch on 4H1 radio tuner for television operation.

The 4H1 radio tuner must be connected to power supply during alignment unless a jumper or adapter plug is inserted in the radio tuner power supply socket M512 to complete the B+ circuit. See adjoining illustration. Order adapter plug (#98A30-4) from Admiral Distr.

For 4H1 model with 16" picture tube (30D1 television chassis), remove the complete picture tube and mounting board assembly. The picture tube including all connecting cables must be connected to the television chassis during alignment.

M512
FRONT VIEW OF SOCKET



IF AMPLIFIER AND TRAP ALIGNMENT

For sets with 94C8-2 (turret type) tuner only.

- Allow about 15 minutes for receiver and test equipment to warm up.
- Disconnect antenna from receiver.
- Set Channel Selector to channel 13 or other unassigned high channel (to prevent signal interference during IF alignment).
- Connnect RC filter of 10,000 ohm resistor and 330 mmfd. condenser in series from point "X" to chassis. See figure 2-2. Leave connected for all steps in this alignment.
- Connect signal generator high side to tube shield of 6J6 oscillator-mixer tube. Be sure to insulate tube shield from chassis. Connect signal generator low side to chassis close to 6J6 tube base.
- Set Contrast control for —3 volts (read at arm of control). Retain this setting for all IF and trap adjustments.
- Use VTVM on lowest scale. (3 volts DC preferred.) Note: A 20,000 ohm-per-volt meter can also be used.
- Use a NON-METALLIC alignment screwdriver.
- Refer to figure 2-1 and 2-2 for alignment adjustment and test point locations.

Step	Signal Gen. Frequency (MC)	Connect VTVM to	Test Connections and Instructions	Adjust
1	*21.25	High side to junction of resistor and condenser of RC filter connected to "X" (video detector V305 circuit); common to chassis. See figure 2-2.	Use lowest signal generator output for adequate meter indication, then gradually increase generator output as VTVM reading decreases.	**A1 and A2 for minimum.
2	*21.25	† High side to "Y", common to chassis.	While peaking, keep reducing signal generator output so VTVM reading is approx. 1.5 volts.	A3, A4 and A5 for maximum.
3	*21.25	High side to "Z" (ratio detector V203 circuit). Common to "V" in late ratio detector V203 circuit; common to chassis in early V203 circuit.	Use 3 volt zero center scale if available.	A6 for zero reading between a positive and negative peak.
4	*27.25	High side to junction of resistor and condenser of RC filter connected to "X" (video detector V305 circuit); common to chassis. See figure 2-2.	Use lowest signal generator output for adequate meter indication, then gradually increase generator output as VTVM reading decreases.	A7 for minimum.
5	*19.75	"	"	A8 for minimum.
6	25.0	"	While peaking, keep reducing signal generator output so VTVM reading is approximately 1 volt.	A9 for maximum.
7	21.8	"	"	**A10 for maximum.
8	22.3	"	"	A11 for maximum.
9	25.25	"	"	A12 for maximum.
10	23.5	"	"	A13 for maximum.

† Test Point "Y" is positive side of electrolytic C212 in late detector (V203) circuit; "Y" is negative side in early detector circuit. See Fig. 2-1.

* Before proceeding, be sure to check the signal generator used in alignment against a crystal calibrator or other frequency standard for absolute frequency calibration required for this operation.

** See Figures 2-6 and 2-7 for alternate locations of A1 and A10.

OVER-ALL VIDEO IF RESPONSE CURVE CHECK

(Using sweep generator and Oscilloscope)

1. Disconnect signal generator and VTVM (if used in previous alignment).
2. Connect oscilloscope between point "X" and chassis ground through a decoupling filter (see figure 2-2). Keep leads away from receiver.
3. Connect sweep generator high side to point "W" on tuner, low side to chassis ground. Set sweep generator to sweep the video IF pass band (19 to 29 MC).
4. Loosely couple marker generator high side to the sweep generator lead connected to point "W" on tuner, low side to chassis ground.

Important

To avoid distortion of the response curve, keep the sweep generator and marker generator outputs at a very minimum. Marker pip (25.75 MC) should be just kept barely visible. Setting sweep generator output for VTVM reading from .5 to 1 volt DC (measured from decoupling network at point "X" and chassis, figure 2-2) will avoid distortion of response curve.

5. Check curve obtained against the ideal over-all video IF amplifier response curve shown in figure 2-3, also check trap and video IF carrier points by means of marker generator. It is important that Marker pips be in the proper location on the response curve as shown in figure 2-3. Correct location of 25.75 MC marker, should be 6db below

peak (50% point on slope of curve). With correct trap adjustments, markers at 27.25 MC, 21.25 MC and 19.75 MC points should not be visible generally. Consistent with proper band-width and correct location of markers, the response curve should have maximum amplitude and flat top appearance.

If necessary to correct band-width and flat top appearance, retouch (stagger tune) A10, A11, A12 and/or A13 as required.

For retouching traps A1, A2, A7 and/or A8, it will be necessary to use signal generator and VT-VM, and repeat steps under "IF Amplifier and Trap Alignment".

AUDIO IF ALIGNMENT CHECK

(Using sweep generator and oscilloscope)

1. Disconnect signal generator and VTVM; if used in previous alignment.
2. Connect oscilloscope between point "Z" and chassis ground (see figure 2-1). Keeps leads away from receiver.
3. Connect sweep generator high side to point "W" on tuner, low side to chassis ground. Set sweep generator to sweep the audio IF pass band (20.25 to 22.25 MC). NOTE: If sweep generator does not have sufficient output for oscilloscope trace, connect between grid No. 1 of V201 to chassis, thru 200 mmfd. condenser.
4. Loosely couple marker generator high side to the sweep generator high side, low side to chassis ground.

Important

To avoid distortion of the response curve, keep sweep generator and marker generator outputs at a very minimum. Marker pips should be kept just barely visible.

5. Observe ratio detector response (figure 2-4). Since the sweep signal is fed through the entire audio IF system for this check, mis-alignment of the audio IF's will affect this curve. This provides an overall audio IF response check. The shape of the curve should be such as to provide a minimum vertical voltage slope of 50 KC to each side of the 21.25 MC marker (cross over point). Maximum size and linearity of the straight portion of the curve is ideal. The non-symmetrical form of the ratio detector response curve at the high frequency end is normal with the type of ratio detector circuit used in later production. Note that the ratio detector circuit used in early production gives a symmetrical "S" pattern (dotted line in Figure 2-4). Check for linearity between the markers indicated on the curve. The response curves obtained may appear inverted and/or reversed (end for end) depending on the sweep generator and oscilloscope used.
6. If correct response is not obtained, repeat alignment steps for slugs A3, A4, A5 and A6 under "IF Amplifier and Trap Alignment".

INDIVIDUAL CHANNEL ADJUSTMENT USING TELEVISION SIGNAL

(Can be performed in some sets without removal of chassis from cabinet)

a. Allow 15 minutes for set to warm up. Remove Channel and Sharp Tuning knobs. Remove channel-indicating escutcheon if set has removable escutcheon, otherwise remove chassis to reach oscillator slugs. With slight pressure, pull escutcheon away from cabinet and slide the escutcheon and spring to the left or to the top, and pry the right side away from the cabinet.

b. Set channel switch on station with test pattern or program with sound. Set Contrast control for normal picture.

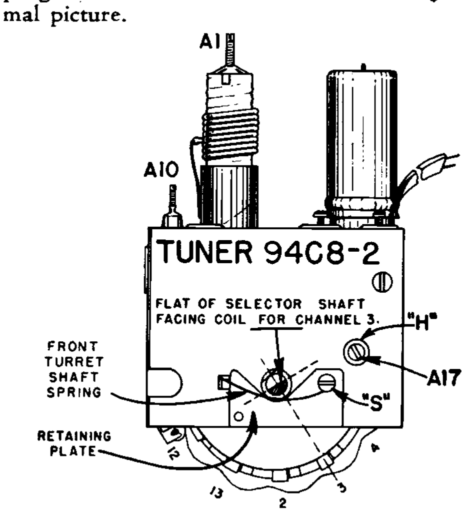


Figure 2-8. Front View of 94C8-2 Tuner With Sharp Tuning Rotor Inside Chassis.

c. Set Sharp Tuning control at electrical center:

For tuners with sharp tuning rotor assembled **inside** of tuner chassis (see figure 2-8), rotate Sharp Tuning control counter-clockwise until rotor engages stop screw "S" and oscillator slug (A17) can be reached through cut-out "H" in tuner front. In some tuners it will be necessary to back screw "S" out a few turns to slightly increase rotation of rotor until oscillator slug is accessible.

For tuners with sharp tuning rotor assembled **outside** of tuner chassis (see figure 2-9), rotate Sharp Tuning control approximately 150° or half rotation as shown in Figure 2-9.

d. Insert NON-METALLIC screwdriver (1/8" blade) in the 3/8" hole ("H") in tuner at right of Sharp Tuning control. Tune oscillator slug for best sound. Do this carefully as only a slight rotation of slug may be required.

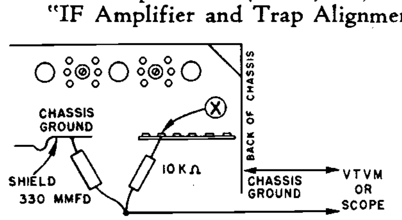


Figure 2-2. VTVM or Scope Connections.

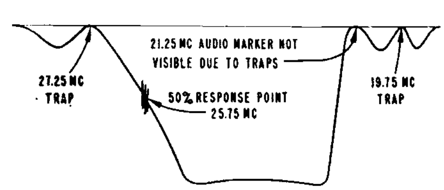


Figure 2-3. Overall Video IF Response Curve.

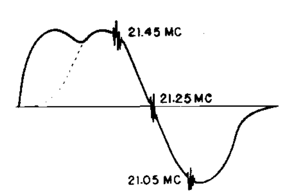


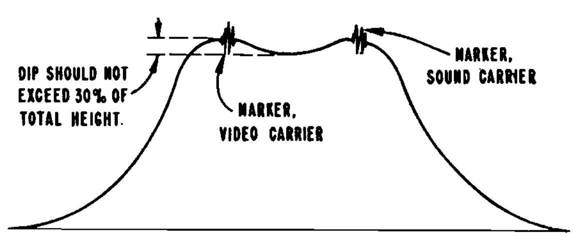
Figure 2-4. Alternate Ratio Detector Response Curves.

RF AND MIXER ALIGNMENT

For sets with 94C8-2 (turret type) tuner only.

- See "Connections for 4H1 Models"
- Disconnect antenna from receiver.
- Before starting alignment, allow about 15 minutes for receiver and test equipment to warm up.
- Connect sweep generator to antenna terminals.
- Loosely couple marker generator to antenna terminal (to obtain marker pips of video and sound RF carriers). To avoid distortion of the response curve, keep marker generator output at a minimum, marker pips just barely visible.
- Connect oscilloscope through 10,000 ohm resistor to point "W" (Figure 2-6). Keep oscilloscope leads away from chassis.
- Set Contrast control to —1.5 volts (read at arm of control).

Step	Marker Gen. Freq. (MC)	Sweep Gen. Frequency	Adjust
1	*205.25 **209.75	Sweeping Channel 12	Check for curve resembling RF response curve shown in figure 2-5. If necessary, adjust A14, A15 and A16 (Figure 2-6) as required. Consistent with proper band width and correct marker location, response curve should have maximum amplitude and flat top appearance.
2	211.25 215.75	13	Check each channel for curve resembling RF response curve shown in figure 2-5. In general, the adjustment performed in step 1 is sufficient to give satisfactory response curves on all channels. However, if reasonable alignment is not obtained on a particular channel, (a) check to see that coils have not been intermixed, or (b) try replacing the pair of coils for that particular channel, or (c) repeat step 1 for the weak channel as a compromise adjustment to favor this particular channel. If a compromise adjustment is made, other channels should be checked to make certain that they have not been appreciably affected.
3	199.25 203.75	11	
4	193.25 197.75	10	
5	187.25 191.75	9	
6	181.25 185.75	8	
7	175.25 179.75	7	
8	83.25 87.75	6	
9	77.25 81.75	5	
10	67.25 71.75	4	
11	61.25 65.75	3	
12	55.25 59.75	2	



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

Figure 2-5. RF Response Curve.

* Picture Carrier Frequency (MC) ** Sound Carrier Frequency (MC)

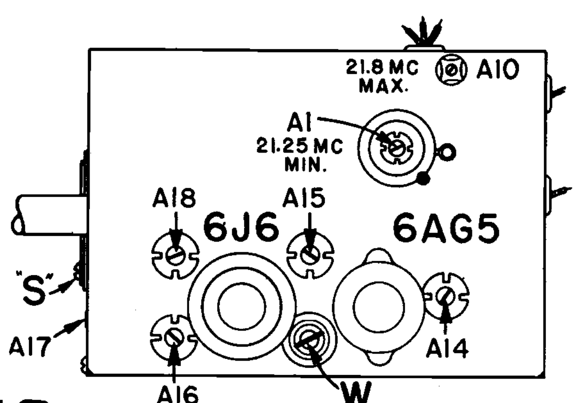


Figure 2-6. Top View of 94C8-2 Tuner.

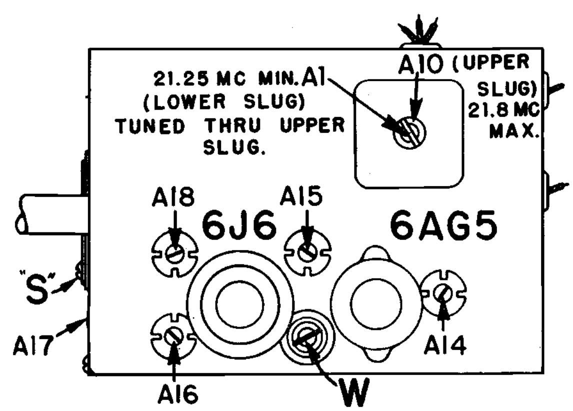


Figure 2-7. Top View of 94C8-2 Tuner, showing Alternate A1 and A10 Arrangement.

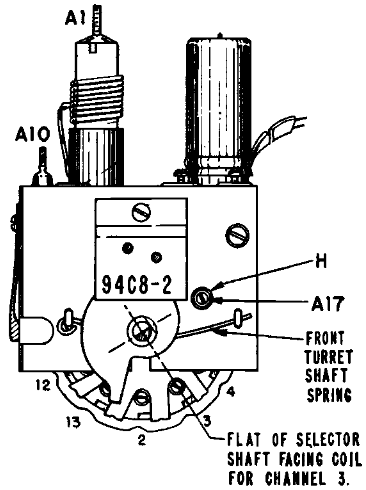


Figure 2-9. Front View of 94C8-2 Tuner With Sharp Tuning Rotor Outside Chassis.

OVER-ALL OSCILLATOR ADJUSTMENT (A18)

Over-all oscillator adjustment should only be necessary when tubes or other components in the oscillator circuit have been replaced. (When replacing the oscillator-mixer tube (6J6), it is recommended that several tubes be tried to select one which causes least frequency shift.)

This over-all adjustment can be made using a VTVM and signal generator, or using a television signal.

a. Remove chassis from cabinet.

b. Set selector to channel 13 or other high channel.

c. **When using a signal generator,** follow steps (a), (b), (c), (d) under "Individual Channel Adjustments Using Signal Generator and VTVM", then adjust A18 (Figure 2-6) for zero VTVM reading between a positive and a negative peak.

OR

c. **When using a television signal,** follow steps (b) and (c) under "Individual Channel Adjustment Using Television Signal", then adjust A18 (Figure 2-6) for best sound and clearly defined picture.

d. Recheck adjustment of individual channels and touch-up (A17) if necessary.

ADDITIONAL TROUBLE-SHOOTING DATA

FREQUENCY DRIFT IN 94C8-2 TUNERS

High ambient temperatures encountered under certain operating conditions may result in excessive oscillator frequency drift in some 94C8-2 tuners. Under such conditions, frequent readjustment of the Sharp Tuning Control may be necessary. In some cases, oscillator drift may even go beyond the normal tuning range of the Sharp Tuning Control.

This condition is most probable in 30D1 (16") chassis due to higher operating temperatures in this model.

When excessive oscillator frequency drift is encountered in a 94C8-2 tuner, the following part change will usually correct this condition:

Replace old part, C109 (10 mmfd., —300 temp. coef., ceramic) with new part C109, #65B6-33 (10 mmfd., —750 temp. coef., ceramic).

In some sets, condenser C109 is accessible by removing the cover plate located on the side of the chassis pan, next to the tuner. Condenser C109 is connected between terminal #2 on the turret contact block and ground.

Replacement of C109 will require realignment of Overall Oscillator Adjustment (A18) and then individual channel oscillator adjustments.

LOSS OF HORIZONTAL SYNC (In Early Production 30A1 only)

Loss of horizontal sync in early 30A1 receivers has in many cases been due to dielectric leakage or breakdown of coupling condensers V407 or V408 (100 mmfd.), used in V403A plate and cathode circuits.

Early sets used a 100 mmfd. ceramic condenser, which was replaced in later production by a 100 mmfd., 10%, mica condenser, part #65B5-17, to correct this trouble.

AUDIO BUZZ (Chassis 30B1, 30C1 or 30D1 only)

In some localities audio or station buzz may be apparent on some channels.

Early production 30B1, 30C1 or 30D1 chassis have the 6.3 volt heater lead from the TV tuner (94C8-2) connected to pin 4 of V401 (6BA6). Changing the TV tuner heater connection to pin 7 of V411 (6K6GT) will eliminate this trouble in most cases.

PULLING AT TOP OF PICTURE

In some television receivers, pulling shows up across the top of the picture or pattern and extends approximately one inch down from the top. Vertical lines in the picture or pattern will pull to the right or left.

This trouble is caused by vertical synchronizing pulses "riding through" the horizontal sync discriminator circuit and momentarily upsetting the horizontal oscillator. Since vertical sync pulses occur at the frame frequency (during the vertical blanking period), the pulling exists immediately after the vertical blanking period and shows up only in the top portion of the picture.

The low frequency response of the horizontal sync discriminator can be reduced to overcome this problem. It is recommended that resistors R413 and R414 be changed from 470,000 ohms each to 180,000 ohms each (180,000 ohms, ½ watt, part number 60B8-184).

CAUTION: With R413 and R414 reduced in value, the circuit becomes critical to tolerance variations. **Tolerance on R413 and R414 must be within 5 per cent of each other.** This tolerance limit can be met by selecting a matched pair from stock resistors.

After changing the resistor values of R413 and R414, the horizontal oscillator must be readjusted as described.

WAVEFORM ANALYSIS

SERVICING BY WAVEFORM ANALYSIS

After a circuit defect has been localized to the video or sweep sections of a television receiver (see trouble-shooting chart), localization to a single stage can be accomplished by use of the test points (figure 5-25) and waveforms shown in figures 5-26 to 5-52. Voltage or resistance measurements can then be used to locate the defective part in a conventional manner.

The waveforms shown for the first ten test points (figures 5-26 to 5-44) are obtained only with a video RF signal input to the receiver. Since the remainder of the waveforms shown are taken from the sweep circuits of the receiver, a video RF signal input is not necessary for these tests (TP11 to TP18).

Two separate waveforms are shown for the first nine test points. Two different oscilloscope sweep frequencies were used in order to show up the vertical and horizontal pulses at each test point (both cannot be locked in at the same sweep frequency due to the great difference in, and non-integral relationship of, the vertical and horizontal pulse frequencies).

The peak-to-peak voltages indicated for the various test points were measured by calibrating the oscilloscope used to observe the waveforms. Such peak-to-peak voltage measurements provide a check on the voltage gain per stage. For example: the peak-to-peak voltage readings at test points TP1 and TP2 are 1 and 9 volts, respectively. A voltage gain of 9 is indicated for the video amplifier stage V306 (6AU6).

The contrast control of the television receiver is set for a peak-to-peak reading of one volt at TP1 as a matter of convenience in measuring stage gain and providing a standard of comparison.

A change in waveform may be noticed at the first four test points when the receiver is switched to a different television station. This is true since some variations in the transmitted waveform are tolerated at the television transmitter. All waveforms and peak-to-peak voltage readings are subject to modification due to the response of the oscilloscope used for test. Due to parts and manufacturing tolorances, variations in peak-to-peak voltages between television receivers are a normal condition. Hence, when using waveforms and peak-to-peak voltage readings for quick trouble shooting, these variations should be kept in mind to avoid erroneous conclusions.

WARNING

Care should be exercised when taking measurements on the horizontal output stage. No connections should be made to the plate of the V407 (6BG6G) or to any connections on the rectifier tube (1B3GT/8016) as the high voltages at these points are dangerous.

TEST POINT LOCATIONS

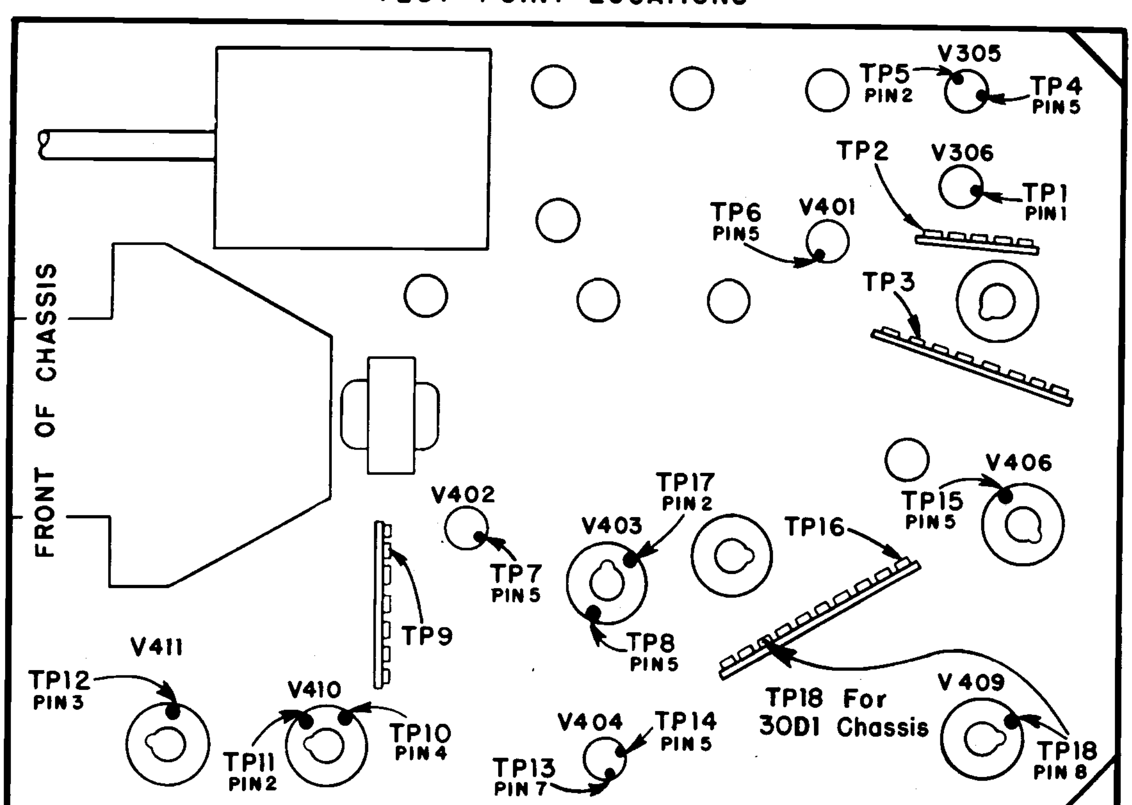


Fig. 5-25. Test Point Locations

FIG. 5-26 VERTICAL PULSE
1 Volt PP

TP1
Input to Video Amplifier
Pin 1 of V306 (6AU6)

FIG. 5-27 HORIZONTAL PULSE
1 Volt PP

FIG. 5-28 VERTICAL PULSE
9 Volts PP

TP2
Output of Video Amplifier
Junction of L308 and L309

FIG. 5-29 HORIZONTAL PULSE
9 Volts PP

FIG. 5-30 VERTICAL PULSE
28 Volts PP

TP3
Output of Video Output
Junction of L310,
L311 and C323

FIG. 5-31 HORIZONTAL PULSE
28 Volts PP

FIG. 5-32 VERTICAL PULSE
20 Volts PP

TP4
Cathode of D.C. Restorer
Pin 5 of V305 (6AL5)

FIG. 5-33 HORIZONTAL PULSE
18 Volts PP

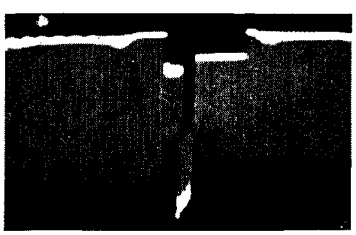


FIG. 5-34 VERTICAL PULSE
6.8 Volts PP

TP5
Plate of D.C. Restorer
Pin 2 of V305 (6AL5)

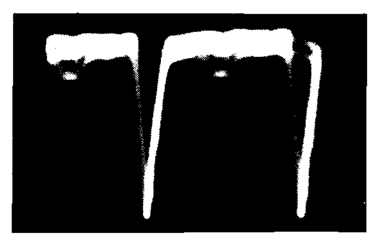


FIG. 5-35 HORIZONTAL PULSE
5 Volts PP

FIG. 5-36 VERTICAL PULSE
25 Volts PP

TP6
Output of Sync. Amplifier
Pin 5 of V401 (6BA6)

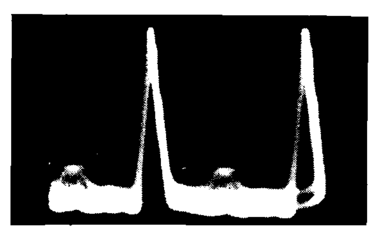


FIG. 5-37 HORIZONTAL PULSE
15 Volts PP

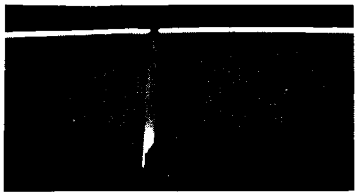


FIG. 5-38 VERTICAL PULSE
70 Volts PP

TP7
Output of Sync. Separator
Pin 5 of V402 (6AU6)

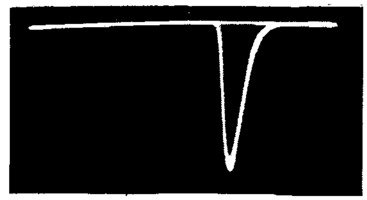


FIG. 5-39 HORIZONTAL PULSE
70 Volts PP

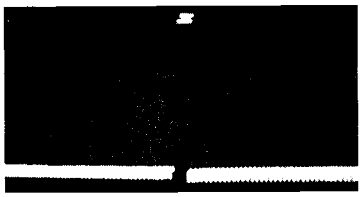


FIG. 5-40 VERTICAL PULSE
14 Volts PP

TP8
Output of Sync. Inverter
Pin 5 of V403A (6SN7GT)

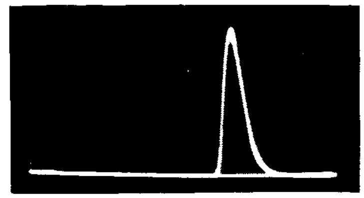


FIG. 5-41 HORIZONTAL PULSE
8 Volts PP

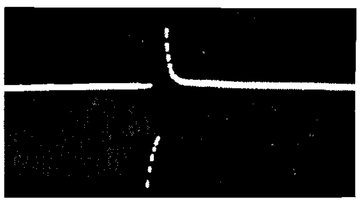


FIG. 5-42 VERTICAL PULSE
1.6 Volts PP

TP9
Input to Integrating Circuit
Junction of R440, R441, C427
If couplate is used for integrating circuit this test point is not accessible.

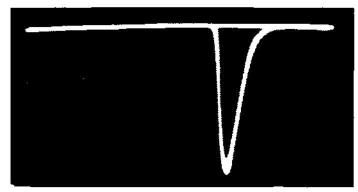
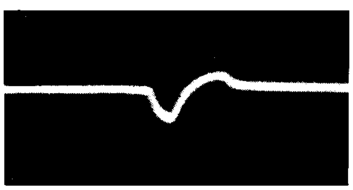


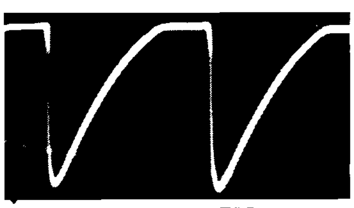
FIG. 5-43 HORIZONTAL PULSE
1.0 Volts PP



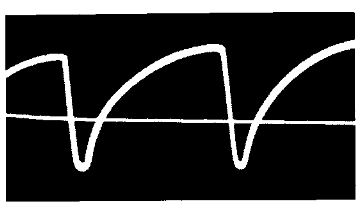
TP10 FIG. 5-44
.3 Volts PP
Input to Vertical Osc.
Pin 4 of V410 (6SN7GT)

TP11 FIG. 5-45
60 Volts PP
Output of Vertical Osc.
Pin 2 of V410 (6SN7GT)

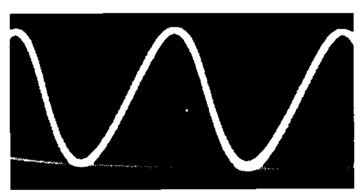
TP12 FIG. 5-46
340 Volts PP
Plate of Vertical Output
Pin 3 of V411 (6K6GT)



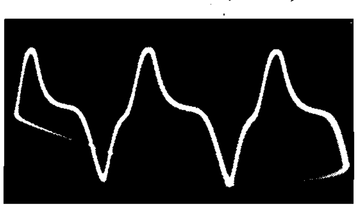
TP13 FIG. 5-47
30 Volts PP
Plate of Hor. Sync. Disc.
Pin 7 of V404 (6AL5)



TP14 FIG. 5-48
20 Volts PP
Cathode of Hor. Sync. Disc.
Pin 5 of V404 (6AL5)

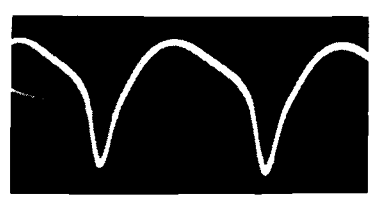


TP15 FIG. 5-49
52 Volts PP
Grid of Hor. Osc.
Pin 5 of V406 (6V6GT)



TP16 FIG. 5-50
80 Volts PP
Output of Differentiator
Junction of C416, R425, C417

TP17 FIG. 5-51
80 Volts PP
Plate of Hor. Discharge
Pin 2 of V403B (6SN7GT)
Amplitude and shape will vary with horizontal drive setting.



TP18 FIG. 5-52
52 Volts PP
Cathode of Damper
Pin 8 of V409 (5V4G)
On 30D1 chassis, TP18 is junction of L405 and C444; voltage is 15V.

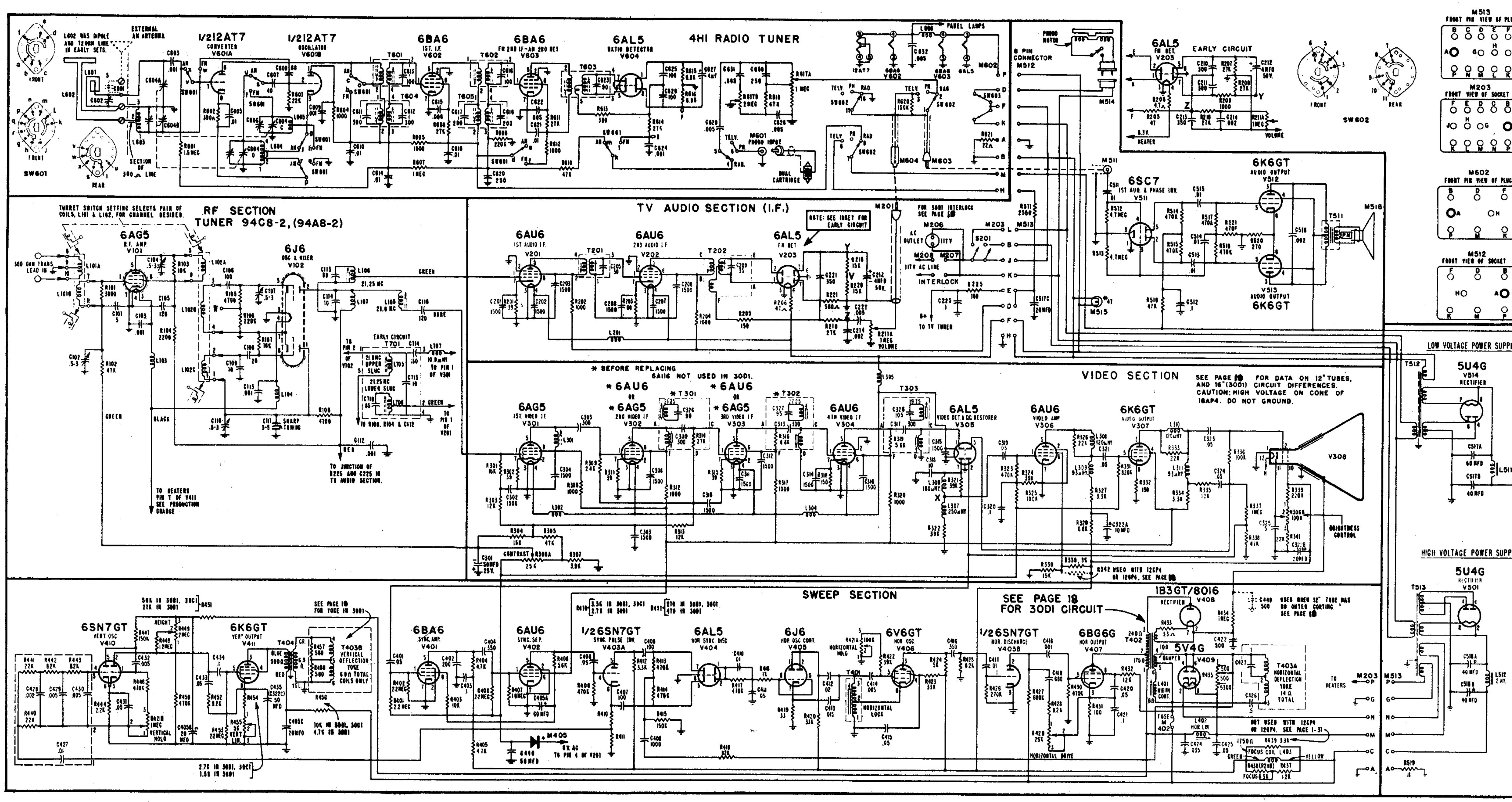


Figure 1-21. Schematic Diagram for 4H1 Radio Tuner Chassis, and 30B1, 30C1, or 30D1 Television Chassis. (For all "4H" Radio-Phono-Television combinations with 10", 12" and 16" picture tubes.)

Television (only) type sets, and models 8C11, 8C12, and 8C13 combinations, essentially correspond to sections of this schematic, but are not the same in all respects.

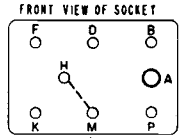
Some production changes are given in the text.

Circuit changes for different 12" tubes are tabulated on page 18.

Circuit differences for 30D1 chassis (using 16" picture tube) are shown on page 18 of the text.

MOST-OFTEN-NEEDED 1949 TELEVISION RECEIVERS
VOLTAGE DATA

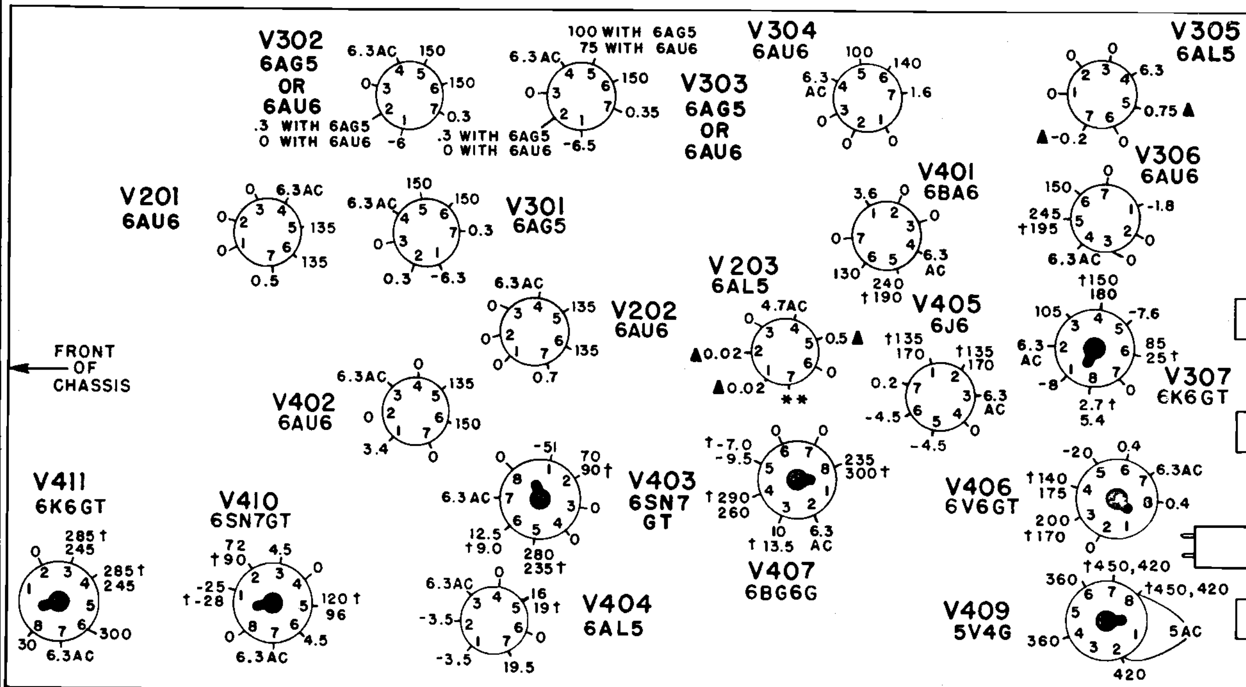
- For combination models, 4H1 Radio Tuner must be connected to power supply unless a jumper or adapter plug (part number 98A-30-4) is inserted in the radio tuner power supply socket M512 to complete the B+ circuit. See adjoining illustration.
- Line voltage, 117 Volts, AC.
- Voltages measured with a vacuum tube voltmeter, between tube socket terminals and chassis, unless otherwise indicated.
- Antenna disconnected from television receiver.
- All front controls except Contrast set at approximately half rotation; Contrast set at minimum (all the way to the left).
- All rear panel controls, except HOR. LOCK, HOR. LIN., and WIDTH, set at approximately half rotation. (Do not disturb HOR. LOCK, HOR. LIN., and WIDTH settings.)



- Channel selector on channel 2. (Channel 1 for sets with A1582 Tuner, Figure 1-13).

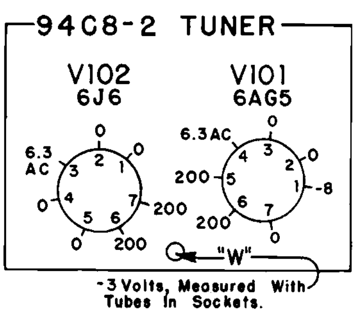
CAUTION: Pulsed high voltages are present on the cap of V407 (6BG6G) tube, and on the filament terminals and cap of V408 (or V412 in 30D1) 1B3/8016 tube. NO ATTEMPT SHOULD BE MADE TO TAKE MEASUREMENTS FROM THESE POINTS.

Picture tube 2nd anode voltage can be measured at the high voltage cap of picture tube (V308) and should be taken only with a high voltage instrument such as a kilovoltmeter. Voltage for 2nd anode of 10" or 12" tube is approximately 9KV, for 16" tubes, 12KV. Proper filament voltage check of V408 (and V412) 1B3/8016 tube may be made by observing filament brilliancy as compared with that obtained with a 1.5 volt dry cell battery.

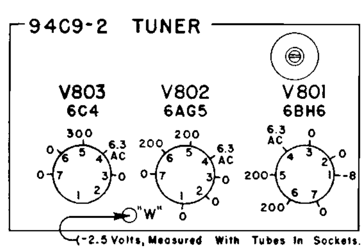


* ▲ Indicates contact potential which may vary widely.
† Indicates 30D1 voltages.

** Zero volts in chassis with late V203 circuit. —0.5 volts (contact potential) in chassis, with early ratio detector V203.



Voltages taken from top, tubes removed.



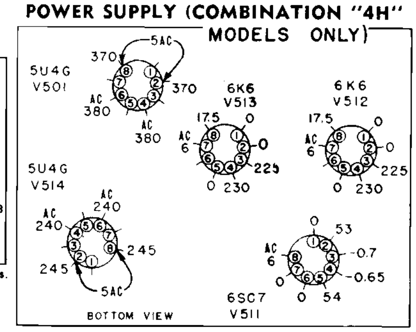
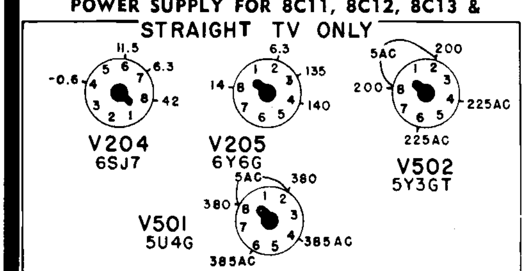
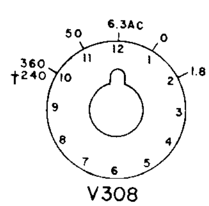
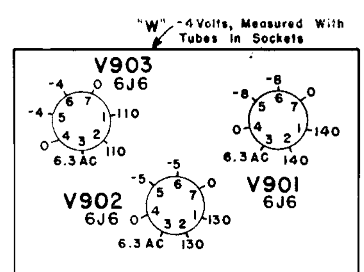


Figure 1-17. Voltage Charts.





† Indicates 30D1 voltage.



MOST-OFTEN-NEEDED 1949 TELEVISION RECEIVERS

DIFFERENT 12" PICTURE TUBES USED IN 30C1 CHASSIS

Different 12" picture tubes (listed below) have been used in the 30C1 chassis. The tube used in a particular chassis is indicated by the "WIRED FOR —— " stamp on the rear of the chassis. (In some chassis, this stamp was not applied.) The various tube types used require different chassis wiring and ion traps. Data on circuit requirements for the different tubes is tabulated below and shown in figures 1-20 and 1-21.

IMPORTANT: When replacing a 12" picture tube with another type, be sure to check existing chassis wiring and if required, make the necessary changes as listed in the tabulation below. Also, mark rear of chassis accordingly if a different picture tube is used.

NOTE: All brands of 12LP4 and 12BP4 tubes can be used without circuit change in sets wired for 12TP4.

Tube	Ion Trap	*R439 is	R329 is	C448 is	2nd Anode Connector
12BP4	Dual Type 94B6	*3900 ohm, 2 W. (60B20-392)	3000 ohm, 15 W. Wire wound (61A1-9)	Not used	Use male connector, 88A16-1
**12LP4	Same as above	Same as above	Same as above	See note ** below	Same as above
12TP4	Same as above	Same as above	Same as above	See note † below	Same as above
12KP4	Not used	Not used. Remove from chassis.	See note § below	Not used	Use male connector, 88A16-1
12QP4	Single Type 94A15-2	Not used. Remove from chassis.	See note § below	See note † below	Use female connector, 88A16-3

*R439 resistor is connected across the yellow and green leads from the focus coil L403.

**Some brands of type 12LP4 tubes do not have the outer conductive coating which functions as a second anode supply filter condenser. Type 12LP4 tubes WHICH DO NOT HAVE the outer conductive coating require the addition of C448 (500 mmfd., 10,000 volt; part number 65A11-1) to the second anode power supply filter circuit, same as for type 12TP4 tube. To add C448, see note † below; also see schematic for circuit location of C448. Type 12LP4 tubes WHICH HAVE the outer conductive coating are directly interchangeable with the 12BP4 tube. Chassis wired for 12LP4 tube without the outer conductive coating are stamped at rear of chassis "Wired for 12LP4-IC". Chassis wired for 12LP4 with coating are stamped "Wired for 12LP4-OC".

†Add condenser C448 (500 mmfd., 10,000 volt) to the second anode supply filter circuit. See schematic.

Locate C448 inside the second anode supply housing. Mount it on the perforated side, between the 1B3/8016 and 6BG6 tubes. Connect a wire lead from the remaining ungrounded end of C448 to the tie point connecting the second anode lead to the corona ring under the 1B3/8016 tube socket.

§Add R342 (12,000 ohm, 2 W; part number 60B20-123) in parallel with R329. R329 (3000 ohm, 15 watt) is the front wire wound resistor on the under side of the chassis pan.

CIRCUIT DIFFERENCES BETWEEN 30D1 CHASSIS and 30B1, 30C1 CHASSIS

(Use illustrations below with Figure 1-21.)

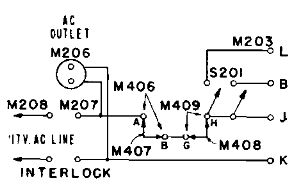


Figure 1-22. 117V, AC Interlock Circuit (30D1).

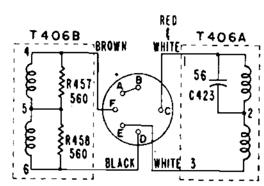


Figure 1-23. Deflection Yoke Connector (early type). Pin View M407, Bottom View M406.

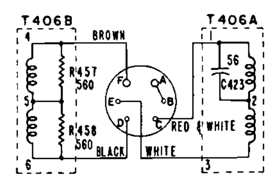


Figure 1-24. Deflection Yoke Connector (late type). Pin View M407, Bottom View M406.

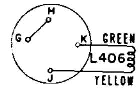


Figure 1-25. Focus Coil Connector. Pin View M408, Bottom View M409.

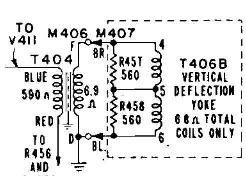


Figure 1-26. Vertical Deflection Yoke Circuit (30D1).

NOTE: R465 is 12,000 ohms in later sets. See paragraph 21, page 1-8.

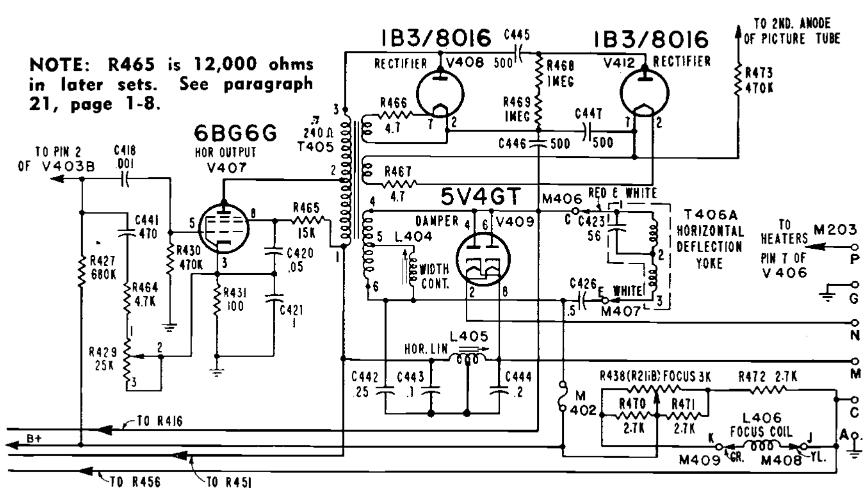


Figure 1-27. 2nd Anode Supply Circuit for 30D1; use with Figure 1-21.

Bendix Radio
AND TELEVISION

MODELS 235M1 235B1 and 325M8

The following are the voltages that can be expected at the various test points listed.

Note: All voltage readings are taken at minimum contrast which occurs at full counterclockwise position of control.

	TEST POINT	VOLTAGE	REMARKS
Boosted B+	pin #3, V21	+ 275 to + 325 V	DC
	pin #3, V23	+ 230 to + 290 V	DC
+ 165V Bus	lug 3, R87	+ 140 to + 190 V	DC
B-	Hor. Center terminal "E"	- 115 to - 145 V	DC
RF Bias	terminal "S"	- 18 to - 25 V	DC
IF Bias	terminal "Q"	- 7 to - 9 V	DC
Hor. Drive	pin #5, V19 (6BG6) or pin #6 of V18 or V19 (7A5)	55 to 75 V Peak to Peak	Use Scope
Vert. Drive	junction C94 & C95	20 to 25 V	Use Scope
		Peak to Peak	

ANTENNA WAVETRAP ADJUSTMENT

A wavetrap consisting of a series resonant circuit for each side of the balanced antenna line is mounted near the chassis antenna receptacle for the purpose of eliminating any undesired signal in the IF band (30 to 40 MC). To avoid blocking any signal in the low television band, this trap is usually set for the FM band (88 to 108 MC) when there is no interfering IF signal. It is possible for the wavetrap to be adjusted to block the audio signal of one of the low band television channels, which results in obtaining a good picture but no sound. If such a condition exists, adjust trimmers to a position 4 to 5 turns out from maximum clockwise position. This is the point of minimum capacitance and the trap is then harmlessly set in the FM band.

When a signal, such as a police call, causes interference in the IF band, adjust trimmers C141 and C142 of the wavetrap as follows:

a. Set both trimmers fully clockwise (maximum capacitance).

b. Turn capacitor C141 counterclockwise 1/4 turn, and then turn capacitor C142 counterclockwise 1/4 turn.

c. Follow procedure of "b" until interference disappears.

MA, MB, MC, AND MD CHASSIS CODES

The following chart provides the chassis differences between the four chassis codes MA, MB, MC, and MD. Refer to the Schematic Diagram, Fig. 6, which is based on the code MD chassis. Both RF and main chassis are coded by a large block letter within a square stamped in ink on each chassis. The IF-RF chassis code is usually found near V12, and on the main chassis the code letter is stamped on the rear apron. The component revisions effected by the various changes are listed in the second left hand column. Under the right hand columns headed MA, MB, MC, and MD are listed the revisions as applied to each chassis code. Refer to Preliminary Service Manual for chassis codes A, B, C, D, E, F, G, H, J, K, L, and M.

Chassis	Description (Chassis Differences)	Main Chassis & IF-RF Chassis Codes			
		MA	MB	MC	MD
Main	Chassis includes Resistor R74, 1.8K 1W, connected in plate circuit of V15A.	Yes	No	No	No
Main	Value of Resistor R65, ±10% 1W, in plate circuit of V15A.	1.8K	3.3K	3.3K	3.3K
Main	Chassis includes Capacitor C135, .02 mfd 400V, connected in plate circuit of V15A.	No	Yes	Yes	Yes
Main	Chassis includes Resistor R95, 22K ±10% 1/2W, connected in plate circuit of V15A.	No	Yes	Yes	Yes
IF-RF	Chassis includes Coil L21 connected to pins #5 and #6 of V9.	Yes	Yes	No	No
IF-RF	Chassis includes Coil L26 connected to pins #5 and #6 of tube	V10	V10	V9	V9
IF-RF	Chassis includes Coil L19 connected to pins #5 and #6 of tube	V4	V4	V10	V10
IF-RF	Chassis includes Resistor R66, 100 ohms 1/2W, connected to terminal 2 of Transformer T3 and pin #1 of V4.	Yes	Yes	No	No
IF-RF	Chassis includes transformer T3 connected to plate circuit of tube a. Grid circuit of V11. b. Plate circuit of V4.	a	a	b	b
IF-RF	Chassis includes Capacitor C50 a. 10 mmf 500V, connected to pin #5 of V4. b. 27 mmf ±10% 500V, connected to terminal 1 of T3 and ground.	a	a	b	b
IF-RF	Chassis includes Resistor R22, 56K ±10% 1/2W a. Connected to pin #1 of V5 and ground. b. Connected to terminal 1 of T3 and ground.	a	a	b	b
IF-RF	Chassis includes Capacitor C133, 2.7 mmf connected between pins #5 and #6 of V4.	No	No	Yes	Yes
IF-RF	Chassis includes Coil L22 connected in grid circuit of tube	V10	V10	V11	V11
IF-RF	Chassis includes sound take-off Transformer T9 in grid circuit of V10.	No	No	Yes	Yes

Chassis	Description (Chassis Differences)	Main Chassis & IF-RF Chassis Codes			
		MA	MB	MC	MD
IF-RF	Chassis includes Resistor R38, 1000 ohms 1/2W, connected to pin #6 of V11.	Yes	Yes	No	No
IF-RF	Value of Resistor R46 connected in IF circuit (ohms 1/2W).	1000	1000	220	220
IF-RF	Chassis includes Resistor R35, 220 ohms 1/2W, connected to: a. Junction of C120 and R37. b. Between pin #6 of V10 and pin #6 of V11.	a	a	b	b
IF-RF	Chassis includes Capacitors C63, 2700 mmf, and C64, 680 mmf, connected to pin #6 of V11 and ground.	Yes	Yes	No	No
IF-RF	Chassis includes Capacitor C120, .001 mmf, connected to: a. Junction of R35 and R37 to ground. b. Pin #6 of V11 to ground.	a	a	b	b
IF-RF	Chassis includes Resistor R33, 220 ohms 1/2W, connected to: a. Pin #6 of V9. b. Pin #6 of V11 and junction of R39 and B+.	a	a	b	b
IF-RF	Chassis includes Resistor R37, 220 ohms 1/2W, connected to: a. Pin #6 of V10 and junction of C120 and R35. b. Pin #6 of V9 and pin #6 of V10.	a	a	b	b
IF-RF	Chassis includes Resistor R32, 220 ohms 1/2W, connected: a. To pin #6 of V8 and R33. b. To pin #6 of V8 and pin #6 of V9.	a	a	b	b
IF-RF	Value of Resistor R43 connected in IF bias circuit (ohms 1/2W).	220	220	10K	10K
IF-RF	Value of Resistor R48 connected in grid circuit of V11 (ohms 1/2W).	39K	39K	12K	12K
IF-RF	Chassis includes Resistor R67, 8.2K ±10% 1/2W, connected to pins #5 and #6 of V11.	No	No	Yes	Yes
IF-RF	Value of Resistor R51 connected to pin #1 of V11 (ohms 1/2W).	12K	12K	39K	39K
IF-RF	Alignment frequency of Coils L20 and L24 (megacycles).	35.7	35.7	35.9	35.9
IF-RF	Value of Resistor R44 connected to pin #1 of V9 (ohms ±5% 1/2W).	8.2K	8.2K	5.1K	5.1K
IF-RF	Chassis includes IF test point and accompanying Resistor R129, 100K 1/2W, connected to plate circuit of V3.	No	No	Yes	Yes

235M1, 235B1, 325M8

Chassis	Description (Chassis Differences)	Chassis Codes	
		MA, MB	MC, MD
IF-RF	Value of Resistor R56 connected to pin #4 of V12 (ohms 1/2W).	220K	47K
Main	Chassis includes socket and tube V18 (6AL5) with the accompanying components: Resistor R68, 2.2 meg ±10% 1/2W, and Capacitor C134, .05 mfd 600V.	No	Yes
Main	Value of Capacitor C88 connected to terminal "N".	680 mmf	.05 mfd
Main	Chassis includes Capacitor C134, .05 mfd 600V, connected between terminal 7 of Transformer T7 and pin #7 of tube V18 (6AL5).	No	Yes
Main	Value of Resistor R120 (ohms 1/2W)	12K	22K
IF-RF	Chassis includes Resistor R16, 100 ohms 1/2W, connected to terminal "R".	Yes	No (MD) Yes (MC)
IF-RF	Chassis includes Resistor R10: a. 33K 1/2W, connected to pin #5 of V2. b. 220K 1/2W, connected to ground and junction of R12 and R13.	a	a (MC) b (MD)
IF-RF	Chassis includes Resistor R3, 6.2K ±5% 1/2W, connected: a. In parallel with Coil L2 and C9. b. To Switches S1 and S2 moveable arm terminals.	a	a (MC) b (MD)
IF-RF	Chassis includes Resistor R4, 47 ohms 1/2W, connected between pin #7 of V1 and ground.	No	Yes (MD) No (MC)

IF ALIGNMENT PROCEDURE

FOR CODE MC AND MD CHASSIS

Briefly, the detailed procedure may be analyzed as follows: connect the high side of the signal generator to IF Test Input (see Fig. 5) and the grounded side of the generator is connected directly to receiver chassis ground. The first adjustment is made at 34.5 megacycles, adjusting L29 for maximum output with the vacuum tube voltmeter connected between terminals "G" and "E" on the terminal strip of the IF sub-chassis assembly. The input signal should be adjusted to produce a 1-1/2 to 2-1/2 volt reading on the VTVM. The signal generator is then adjusted to 32.9 MC and L14, and L23 adjusted to produce the maximum output voltage.

The signal generator is then adjusted to 31.625 MC and L26 adjusted to produce a maximum voltage at "G" and "E". If L54 is adjusted near the minimum point, it may be very difficult to obtain a satisfactory reading between "G" and "E" when adjusting L26. This again is not important, for L26 will be rechecked and adjusted when the voltmeter is connected to the output of the sound discriminator. With L26 peaked roughly to 31.625 MC, adjust L54 to produce a minimum voltage between terminals "G" and "E". Then connect the VTVM from terminal "A" to chassis and peak L26, L54, L28, L27 and L16 to 31.625 MC. The signal input level should be adjusted to maintain a maximum of 4 volts from "A" to chassis at all times, to prevent limiting. These adjustments should be repeated several times to be sure that all coils are peaked at exactly the same frequency. If they are badly out of adjustment, it is advisable to return the VTVM to terminals "G" and "E" and check L54 to be sure that it is adjusted to produce a minimum voltage at exactly this same frequency.

Oscillation within the receiver circuits may be detected by an excessive and unstable voltage output at terminals "G" and "E" exceeding 5 or 6 volts as a minimum and very often exceeding 10 volts. To be sure the set is not oscillating and adjustments made to produce this oscillation rather than eliminate it, vary the signal generator input and notice if the voltage output varies correspondingly with the signal input. If it does not, some circuit must be oscillating.

After L29, L14, L23, L26, L54, L27, L28, and L16 have all been adjusted as outlined above, change the VTVM to terminal "B" and chassis and turn signal generator completely off. Note reading on VTVM. (Antenna input should be shorted to prevent any signal pickup through the RF stage.) Turn signal generator on and adjust L17 to produce the same voltage on the VTVM noted when no signal was applied. This point should occur approximately in the center (zero voltage) of the voltmeter reading, as it passes sharply from a positive to a negative voltage. Adjustment of L17 to this zero voltage should also produce a minimum of background noise and best tone quality from an FM signal of 31.625 MC center frequency.

The VTVM should be connected from "A" to ground when making the final adjustment on L26, since L54 has been adjusted to minimum response with the VTVM connected from "G" to "E". If L26 requires considerable adjustment in order to peak it, check L54 again with the VTVM connected between "G" and "E". This voltage should be a minimum after L26 is peaked to a maximum. Now adjust the signal generator to 35.9 MC, and adjust L24 for maximum output with the VTVM connected from "G" to "E". Change the signal generator frequency to 37.625 MC and adjust L19 for maximum voltage between "G" and "E". If L22 is correctly adjusted for minimum response, it may be impossible to obtain a satisfactory reading at "G" and "E" for adjustment of L19. Therefore, L22 should be detuned slightly, but be very careful not to detune it any great amount, for it must be tuned finally to an absolute minimum, and if its adjustment is changed greatly after L19 is peaked, the initial adjustment of L19 will be altered. In other words, adjust L19 for maximum output with L22 adjusted to as near a minimum output as is possible to obtain a satisfactory reading between "G" and "E".

L19 should be rechecked to be sure that it is at maximum response and L22 at minimum.

Alignment of the mixer output stage L14 may be accomplished roughly by applying the signal to the mixer tube V3. But since access to this tube is rather difficult with the picture tube in place, it is suggested that the signal be applied to the antenna input directly. However, if any difficulty is encountered in adjustments, indicating that it is badly out of adjustment or that oscillation is taking place in the RF stage, then go back to V3 and apply the signal generator output to the tube shield of this tube in a similar manner as was done throughout the previous IF alignment. Erratic meter readings may be caused by the signal generator not being firmly grounded to the TV chassis especially when the generator is connected to the antenna input terminals. A good ground connection must be maintained between the signal generator and the TV chassis at all times. With the signal generator applied to the antenna output, adjust its frequency to 32.9 MC and adjust L14 and recheck L23 for maximum voltage output on VTVM connected from "G" to "E". Return the signal generator setting to 35.9 MC and recheck L24 and L20 for maximum output. Normally no difficulty should be encountered in feeding an IF signal through from the antenna terminals into the IF; but in case the antenna wavetraps (C141, C142, L50 and L51) are turned to the particular frequency one is attempting to apply to the IF, a very strong signal may be necessary unless the antenna plug is pulled out of the RF chassis and the signal generator input applied directly to the chassis jack. Even though the signal generator output is unbalanced to ground, this will make no difference as far as IF alignment is concerned, but it should be balanced when making RF adjustments.

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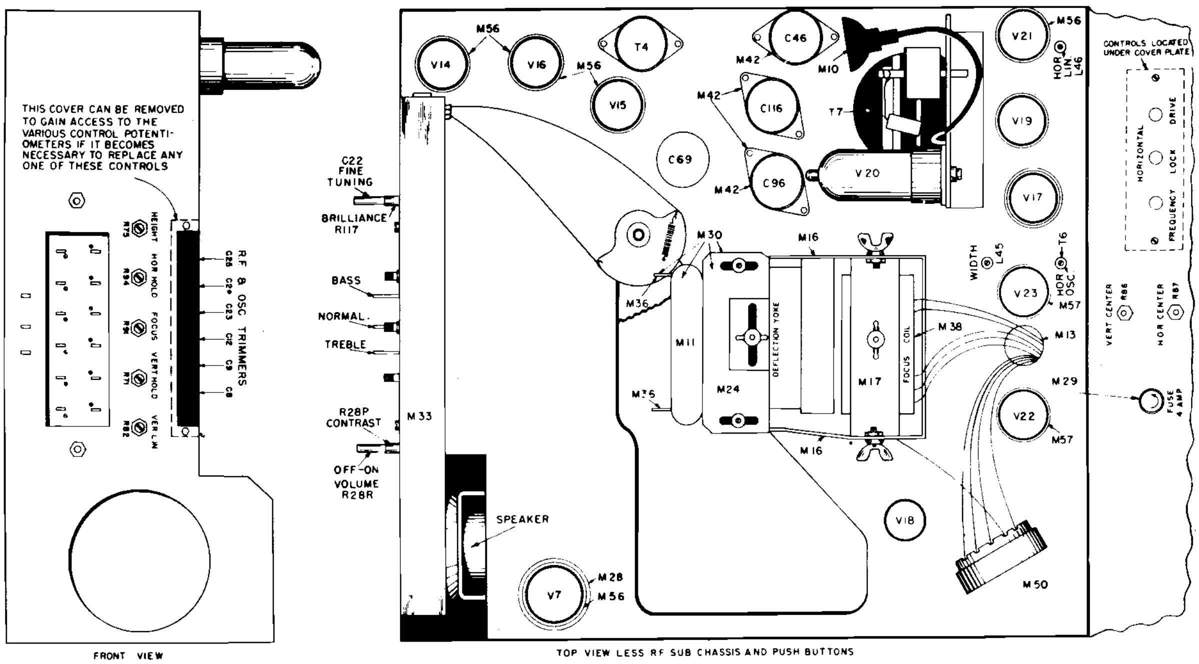


Fig. 4 - COMPONENT DIAGRAM - TOP VIEW OF MAIN CHASSIS, CODES MC AND MD

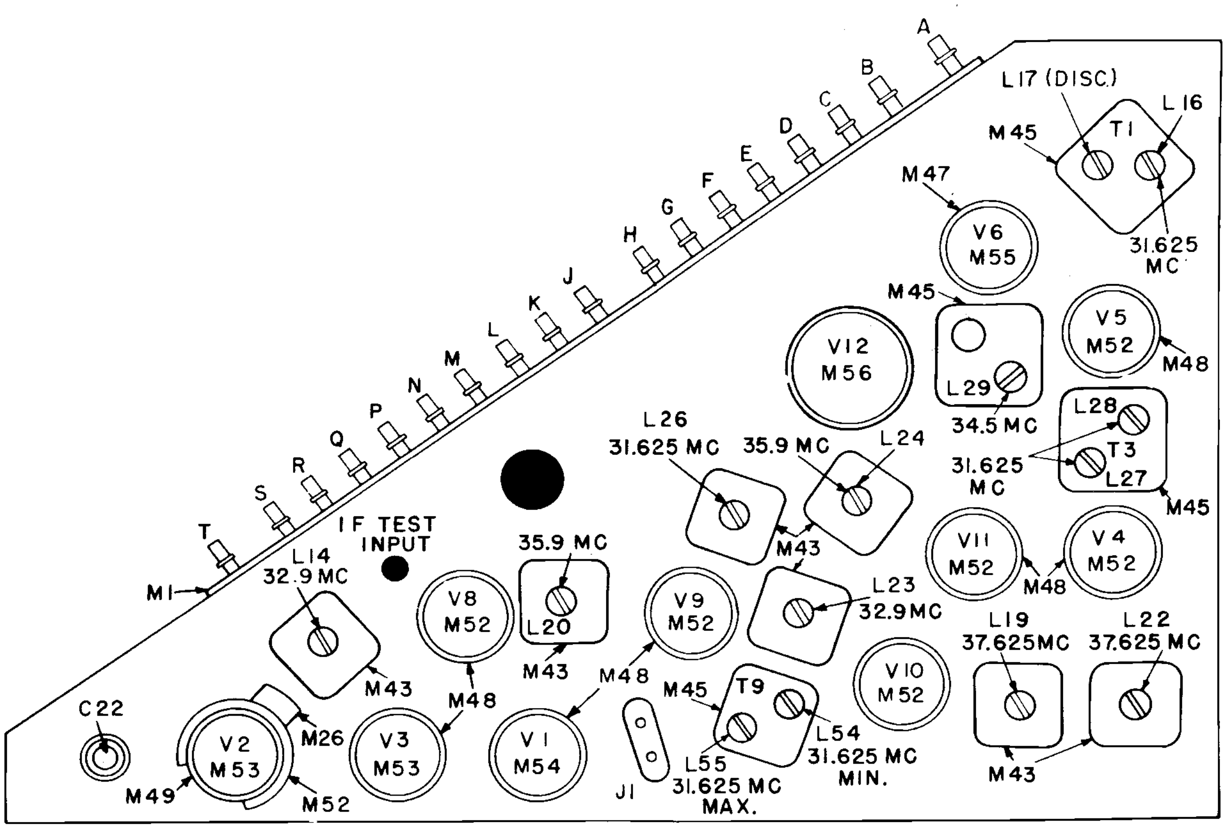
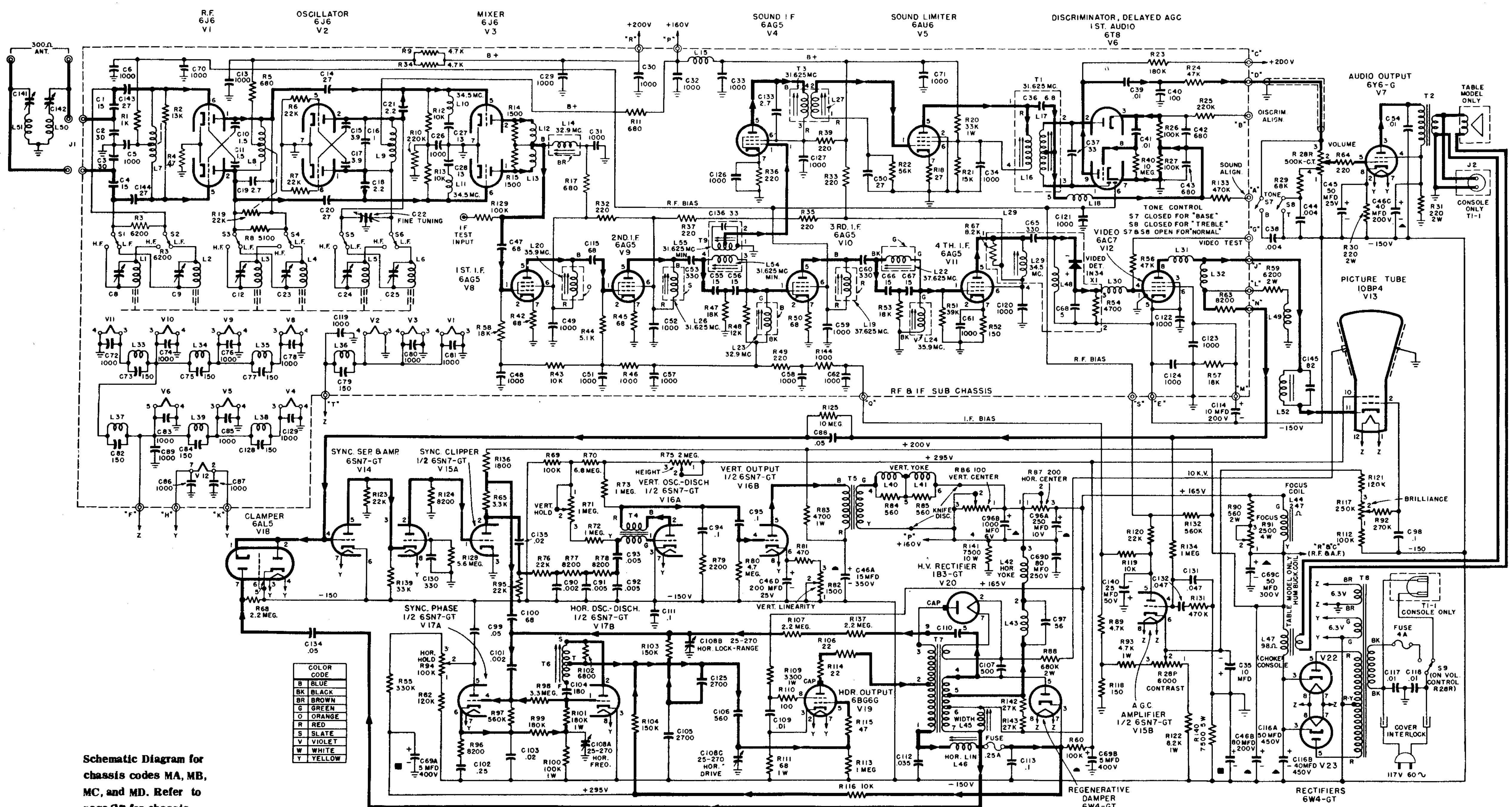


Fig. 5 - COMPONENT DIAGRAM - TOP VIEW RF CHASSIS, CODES MC AND MD



Schematic Diagram for chassis codes MA, MB, MC, and MD. Refer to page 20 for chassis differences.

Fig. 6 - SCHEMATIC DIAGRAM, BENDIX MODELS 235M1, 235B1, AND 325M8

PRACTICAL TROUBLE SHOOTING HINTS

Bendix Television Models 235M1, 235B1, 325M8

If R16 and R17, plate circuit of mixer tube V2, are burned, check RF oscillator operation before replacing these resistors.

If response is peaked on high frequency side, as viewed with an oscilloscope, check coils L10 and L11.

If container of electrolytic capacitor C46 shows disfiguration, look for B+ (+200 volts) to be shorted at some point to the chassis before attempting to replace this capacitor.

If the picture indicates a non-linear vertical sweep, examine the lugs on electrolytic capacitor C69 to be sure of good contact.

If IF tubes keep burning out, check IF bias with VTVM to determine if its potential is not more positive than -1.5 volts. If bias is more positive, examine all bias circuit components and IF coupling capacitors. Check also voltage from chassis ground to B- to determine if it is less negative than -115 volts, which would cause the IF bias to be more positive.

If the center tap of the volume control is shorted to chassis, the sound and picture will be distorted and the picture may, possibly, be eliminated when the volume control is rotated.

If the sound is weak and distorted, check V7 cathode by-pass electrolytic capacitor C45.

If there is evidence of speaker rattle, the cause may be the shielded audio lead touching speaker cone.

Hum in picture and sound may be caused by the lead of coil L39 (filament choke) shorting to pin #6, tube V6 (RF bias).

Insufficient vertical size could be caused by R83, plate circuit of V16B, increasing in value.

Lack of vertical sweep could be caused by:

a. Loose or broken knife disconnects in vertical yoke leads.

b. Defective V16 tube (6SN7GT).

c. Defective transformer T4 or T5.

d. Defective vertical yoke winding.

e. Open wiring to potentiometers located on front panel.

No Raster: Examine tube V20 (1B3). If the filament is lit, then it is safe to assume the horizontal sweep circuits are functioning and the trouble can be in the picture tube, picture tube circuits, video amplifier, or AGC circuit.

A picture tube (V13) that draws too much 2nd anode current will cause a reduction of the high voltage (10KV). The voltage difference between cathode, pin #11 of V13, and grid, pin #2 of V13, should not be less than 15 volts when Brilliance control is set at maximum, or there will be a reduction in the high voltage.

MOST-OFTEN-NEEDED 1949 TELEVISION RECEIVERS

235M1, 235B1, 325M8

If the raster fails to disappear when the Brilliance control is in the minimum (counterclockwise) position, check:

a. **The voltage between grid, pin #2, and cathode, pin #11, of V13 should be approximately 70 volts. If the reading is less, then examine the associated circuit and B- (-150 volts).**

b. If B- and B+ voltages appear normal, then shorting out resistor R112 connected to Brilliance potentiometer may correct the voltage condition between grid and cathode of V13.

c. If the grid to cathode voltage is above 70 volts, the picture tube should be replaced.

If C108C (horizontal drive trimmer) is turned so far clockwise that it is extremely tight (maximum capacity point) and left in this position, the horizontal output tube or tubes and associated plate circuits will slowly burn.

If unstable sync is noted:

a. Turn C108A and C108B (horizontal frequency and lock range trimmers) counterclockwise one half turn to a full turn.

b. Use substitution method to check for leakage in capacitor C110 connected between terminals 4 and 9 of the high voltage transformer.

The following are the voltages that can be expected at the various test points listed.

Note: All voltage readings are taken at minimum contrast which occurs at full counterclockwise position of control.

	TEST POINT	VOLTAGE	REMARKS
Boosted B+	pin #3, V21	+ 275 to + 325 V	DC
	pin #3, V23	+ 230 to + 290 V	DC
+ 165V Bus	lug 3, R87	+ 140 to + 190 V	DC
B-	Hor. Center terminal "E"	- 115 to - 145 V	DC
RF Bias	terminal "S"	- 18 to - 25 V	DC
IF Bias	terminal "Q"	- 7 to - 9 V	DC
Hor. Drive	pin #5, V19 (6BG6) or pin #6 of V18 or V19 (7A5)	55 to 75 V Peak to Peak	Use Scope
Vert. Drive	junction C94 & C95	20 to 25 V	Use Scope
		Peak to Peak	

If sound cuts on and off or takes 3 to 15 minutes to reach proper level, replace coil L18 connected to terminal 5 of discriminator transformer T1.

Du Mont Teleset

Model RA-105

DESCRIPTION OF SET

The Model RA-105 Teleset is produced in the following styles:

CABINET	SERVICES	PICTURE TUBE	SPEAKER
Stratford (Table top)	FM & TV	15 inch	6 inch
Westbury (Console)	FM & TV	15 inch	12 inch
Whitehall (Console)	FM & TV	15 inch	12 inch
Colony (Console)	AM, FM, TV & Phono	15 inch	12 inch

Two chassis incorporating the necessary circuits for F.M. and T.V. reception are used in all models of the RA-105. These are referred to in this manual as the Receiver Main Chassis (Fig. 1) and the Flyback Power Supply (Fig. 2). In the Colony Model a separate chassis (Fig. 3) for reception of A.M. is used. An automatic record changer is included in this model.

An external record player may be used with the Stratford, Westbury and Whitehall if so desired. A jack at the rear of the main receiver chassis, and the Phono position of the Service Selector Switch makes this possible.

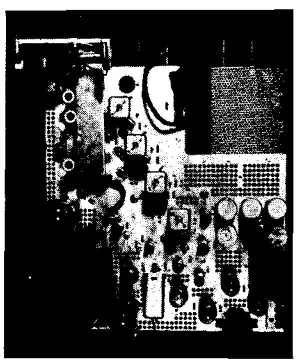


Figure 1

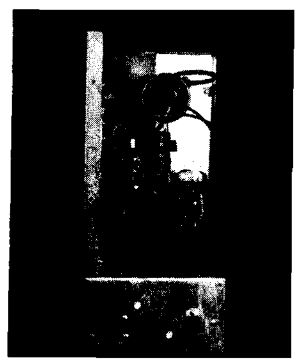


Figure 2

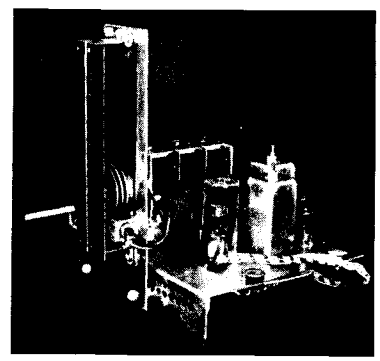


Figure 3

DESCRIPTION OF CIRCUITS

Reference Fig. 4 Block Diagram also Schematic Diagram

RF TUNING ASSEMBLY

The RF Tuner used in all post-war Du Mont Telesets constitutes an assembly identified as the Inputuner. The circuits are developed around a three gang variable inductor called the "Mallory-Ware Inductuner". This inductor consists of L102A, L102B and L102C on the Schematic diagram.

This Inputuner is a continuous type tuner covering the range of frequencies from 44 MC to 216MC. This range covers the twelve television channels, the standard FM band plus other short wave facilities in this range.

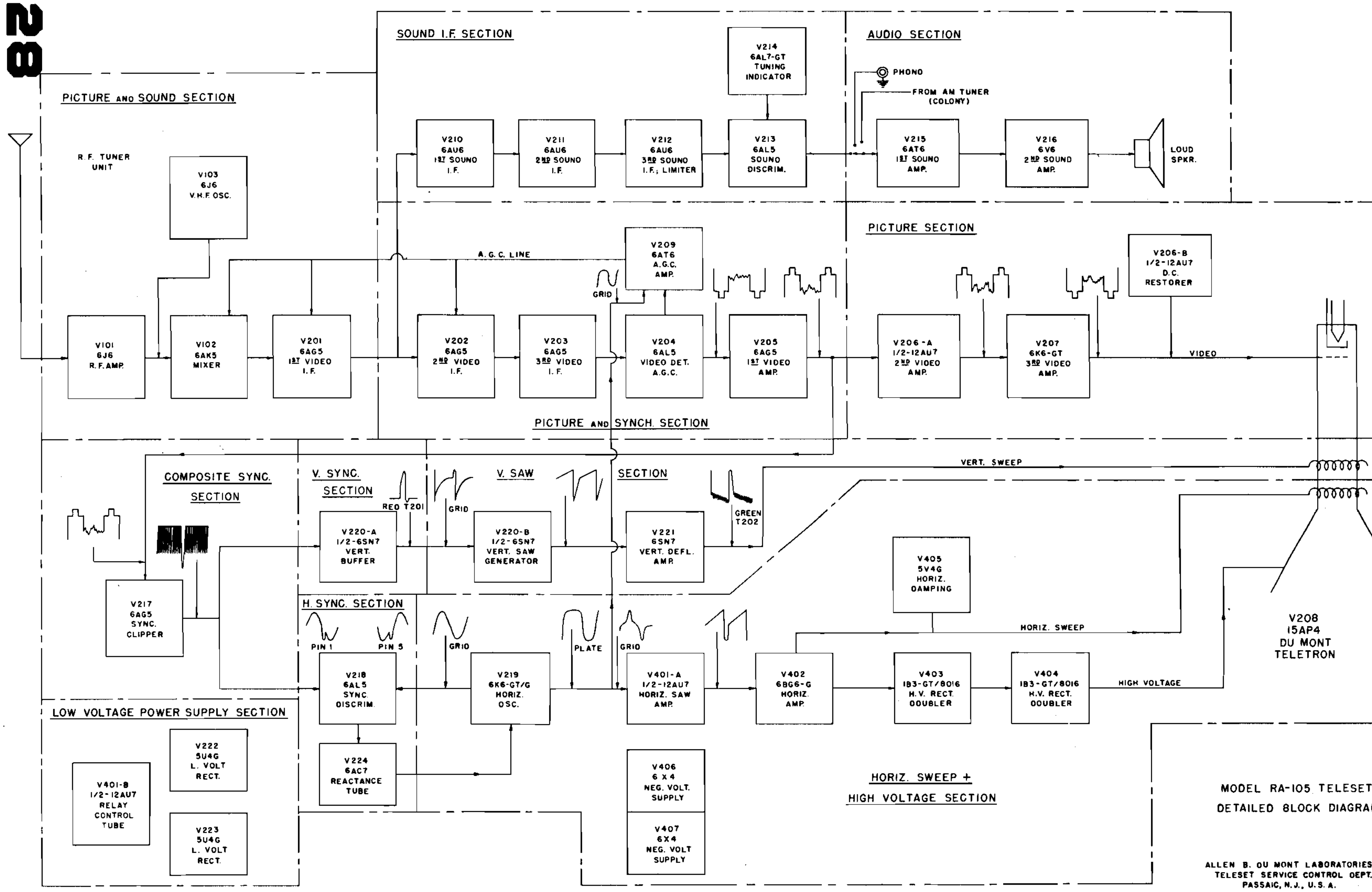
The input impedance of this tuner is approximately 73 ohms, therefore, coaxial transmission line such as RG-59/U should be used with Du Mont Telesets.

The transmission line is capacitively coupled to the input circuit through C101. Inductance L106 in parallel with the antenna input provides a high pass, radio frequency filter to suppress broadcast band or other low frequency cross modulation interference which may arise when the Teleset is located in an extremely intense field of a local AM broadcast station or other radiator.

The plates of the 6J6 RF Amplifier (V101) are coupled to the grid of the 6AK5 mixer tube (V102) by means of a six megacycle wide broad-band coupling network. The variable series coil combinations consisting of L101-L102A and L105-L102B tune to the desired signal frequency in conjunction with the associated tube capacities and the coupling network consisting of C105, C106 and C107. Resistors R110 and R104 reduce the "Q" of the respective coils considerably in order for the coupling network to maintain the very wide pass band.

The VHF oscillator utilizes one section of the twin triode 6J6 (V103) in a modified Colpitts Oscillator circuit. The feedback voltage from the plate to the grid of the oscillator tube is accomplished by means of the interelectrode capacity of the vacuum tube. The oscillator frequency is adjusted by movement of the tap on the coil L102C which short circuits a portion of the coil.

The oscillator output is coupled to the grid of the mixer tube V102 by means of capacitor C112. Both the incoming signal and the oscillator voltages are fed into the grid of the mixer tube V102. The plate of V102 feeds into the first video IF transformer.



MODEL RA-105 TELESET
DETAILED BLOCK DIAGRAM

ALLEN B. DU MONT LABORATORIES, INC
TELESET SERVICE CONTROL DEPT.
PASSAIC, N.J., U. S. A.

Figure 4

USE OF DETAILED BLOCK DIAGRAM

The purpose of this block diagram is to assist the serviceman, especially the inexperienced man, in rapidly localizing troubles.

The large, or section blocks, have been designated according to the function of the Teleset that will be affected if a defect occurs in that section. For example: One section has been referred to as the Picture and Sync section. The reason it was so identified is that certain defects in the circuits could affect both picture and sync.

Following is a list of troubles with the section in which they normally would occur. Only one trouble at one time is anticipated.

1. No picture and no sound or weak picture and weak sound. *Location*: Picture and Sound Section.
2. Picture normal but no sound. Tuning indicator does not function as channel is tuned. *Location*: Sound IF Section.
3. Picture normal but no sound. Tuning indicator functions normally with tuning. *Location*: Audio Amplifier Section. Note: In the case of the Colony, the AM or Phono would not work either.
4. Sound normal. No picture, but raster is synchronized. (See Fig. 87). Picture Section.
5. Sound normal. No picture, raster is not synchronized. *Location*: Picture and Sync Section.
6. Sound normal. Picture rolls vertically. *Location*: Vertical Sync Section.
7. Sound normal. Picture out of sync both horizontally and vertically. *Location*: Composite Sync Section.
8. Sound normal. Picture out of Sync horizontally. *Location*: Horizontal Sync Section.
9. No Raster. Sound normal. *Location*: Horizontal Sweep and Hi Voltage section.
10. No Sound. No Raster. Tuning Indicator does not glow. *Location*: Low Voltage Section.
11. Sound normal. Horizontal bright line on face of CRT. *Location*: Vertical Saw Section.

When properly tuned to a channel, the heterodyning action between the incoming signal and the locally generated oscillation in the mixer, will produce the sound and the video IF signals. These signals will be present in the plate circuit of the 6AK5 mixer.

The gain of the mixer stage is controlled by the A.G.C. voltage applied to the grid circuit. This control voltage is fed back from the AGC circuit located on the Main Chassis.

VIDEO IF AMPLIFIERS

The video IF strip used in the RA-105 Telesets consists of three stages of amplification incorporating 6AG5 tubes. The serviceman who has worked on the Du Mont RA-103 Telesets will notice a very definite similarity between this IF amplifier strip and that used in the RA-103.

One item that should be noted by the serviceman is the means used for controlling the gain of the IF strip. The contrast control is no longer located in the grid circuits of the first two video IF stages. Instead of the manually operated contrast control, a control voltage is developed in an automatic gain control circuit (to be discussed later) and fed back to the grid circuits of the first two IF stages and the mixer.

The 21.9 Mc sound IF signal is taken off at the grid of the 2nd video IF and fed to the primary of the first sound IF transformer Z201.

Located between the 2nd video IF and the 3rd video IF are two parallel resonant circuits that merit some discussion. The combination of L210 and C208 form a parallel resonant circuit at a frequency of 21.9 Mc. This circuit offers high attenuation to 21.9 Mc which is the frequency of the sound accompanying the picture being received. Thus, signals of this frequency are prevented from getting to the picture tube and causing interference.

The parallel combination of L209 and C209 is resonant at a frequency of 27.9 Mc. The purpose of this "trap" is to prevent the sound of the lower adjacent channel from getting through to the picture tube and causing interference.

All the adjustments in the video IF strip are variable inductances except for C213. This variable capacitor is used to control the bandwidth of the coupling network with which it is used.

AUTOMATIC GAIN CONTROL

One of the features of the Du Mont Model RA-105 Teleset is the use of an Automatic Gain Control circuit. This AGC circuit automatically controls the gain of the first two video IF stages plus the gain of the mixer stage.

One half of a 6AL5, (V204) and a 6AT6, (V209) are the tubes used in this circuit.

The video IF signal is applied to the plate (pin #2) of the 6AL5 (V204).

During the positive half cycle of the video IF signal this tube will conduct on the sync pulses. The voltage developed at the cathode is coupled to the grid of V209 through an RC filter. This filter will tend to smooth out the pulsating signal so that the voltage applied to the control grid is essentially a DC voltage. The amplitude of this voltage will change with any change in amplitude of the incoming signal. The polarity of this signal is positive. This DC voltage is used to control the gain of the triode section of V209.

The signal from the plate of the horizontal oscillator V219 is also fed to the grid circuit of V209.

This signal from the plate of the 6K6 is essentially a square wave at a frequency of 15,750 cps.

This horizontal signal is amplified by the triode section of the 6AT6. The gain of this triode depends on the bias voltage which is supplied from the half of the 6AL5.

The horizontal signal in the plate circuit of V209 is coupled from the plate of the triode to the diode plate in the same tube. This signal is then rectified by the diode section, and a negative voltage is available across R246 and R247 to ground. A filter consisting of R244 and C226 remove any variations so that the signal fed back to the 1st and 2nd video IF stages is essentially a smooth DC.

When the signal presented to the antenna tends to increase, the DC developed in the AGC diode becomes more positive. This increases the gain of the triode section of V209. Thus, the signal in the plate circuit of this stage is increased and the negative AGC voltage is also increased, thereby reducing the gain of the mixer and video IF amplifiers.

This AGC voltage is fed to the grid of the mixer through the filter consisting of R245 and C227.

VIDEO DETECTOR AND VIDEO AMPLIFIERS

The output from the 3rd video IF is fed to one half of V204, the video detector. The other half of this tube is used in the AGC circuit.

The waveform of the voltage observed at pin #7 is essentially as shown in Fig. 5 (exact waveforms can be seen in the Service Section of this manual). Since the sync pulses are extending in a negative direction, the polarity of this signal is said to be "black negative". This means that the portion of the signal corresponding to the "blacks" in the picture is in the negative direction.

Coils L213 and L214 are used to improve the high frequency response of this circuit.

Coil L220 and C215 are used to prevent any video IF from appearing at the grid of the first video amp.

The video signal is now amplified by the first video amplifier V205 using a 6AG5. As shown in Figure 6, the polarity has been reversed by the action of the amplifier. Since the "blacks" are extending in a positive direction, the signal is said to be "black" positive.

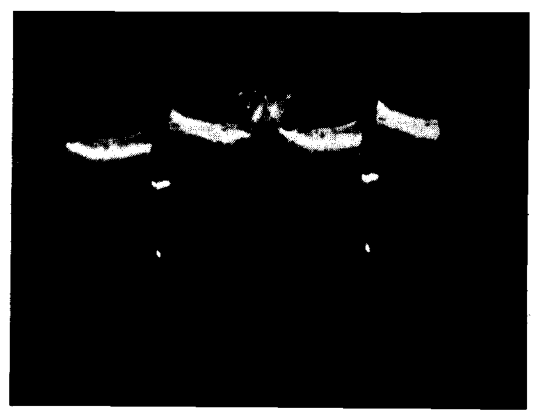


Figure 5. Video Signal at Pin #7 (plate) of V204

Since direct coupling was used between the video detector and 1st video amplifier, no provisions were needed to take care of the low frequency response. In this stage, a 10 mfd. capacitor is used as the screen bypass capacitor to provide good low frequency response. Plate compensation for low frequency response is provided by the use of R224 and C214-B.

L215 is used to improve the high frequency response of this circuit.

The parallel combination of L216, R280 and C216 forms a resonant circuit at 4.5 Mc. This circuit is called a "grain

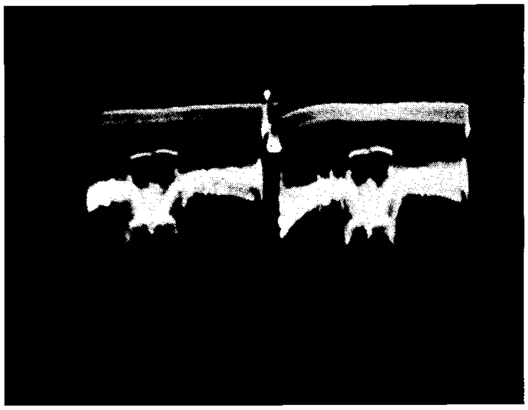


Figure 6. Video Signal at pin #5 (plate) V205 1st video amplifier

trap". The purpose of this trap is to prevent the 4.5 Mc "beat" frequency between the picture IF frequency and sound IF frequency from getting through to the picture tube.

Although V206-A is identified as the 2nd video amplifier, no gain is realized by this stage. The circuit used here is called a Cathode Follower. The signal is applied to the control grid as usual, but it is taken out at the cathode. The plate is at AC ground potential. This is accomplished by connecting a 10 mfd. capacitor, C220-B to ground from the plate.

The contrast control is located in the Cathode circuit of this stage. The action of this control is to adjust the amplitude of the signal being applied to the control grid of V207 and subsequently to the grid of the Cathode Ray Tube.

Observation of waveforms in this stage indicate there is no reversal of polarity between the signal applied to the grid and that taken out at the Cathode. (Fig. 7.) This is characteristic of Cathode Followers. The amplitude of the signal observed at the cathode is lower than that at the grid.

The third video amplifier V207 uses a 6K6. The screen grid of this stage is also heavily by-passed using a 10 mfd. 450V capacitor to provide good low frequency response.

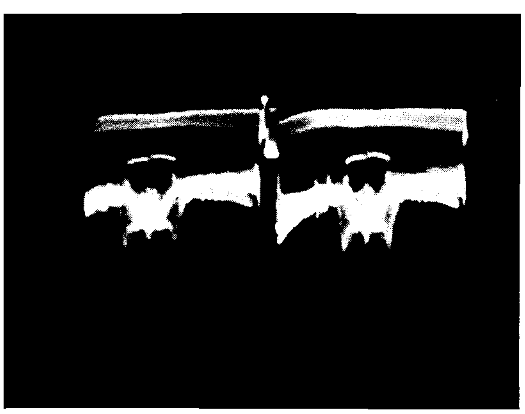


Figure 7. Signal observed at cathode of V206-A. 2nd Video amp.

*L217 is a series peaking coil and L218 is a shunt peaking coil, both of which are used to improve the high frequency response of this circuit.

The video signal is amplified and inverted by this stage and applied to the grid of the Cathode Ray tube as shown in Fig. 8. Note the polarity is "black negative". This indicates that the dark or black portions of the signal cause the grid to be driven negative, reducing the current in the beam of the CRT and thus reducing the intensity on the screen. The white portions of the signal drive the grid less negative increasing the beam current and thus brightening the picture.

*L217 *has been deleted in later models.*

A DC restorer circuit incorporating the second half of V206-B the 12AU7 is used in the grid circuit of the 15AP4 Teletron. This circuit rectifies the video signal and reinserts its DC component at this point.

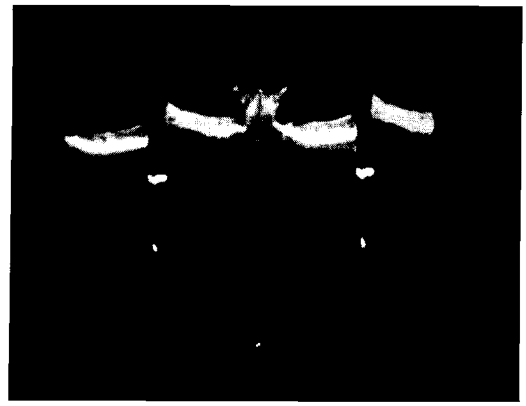


Figure 8. Signal Observed at Grid of CRT

SYNC CLIPPER

The video signal is fed from the plate circuit of the first video amplifier to the grid of the Sync Clipper V217. The purpose of this stage is to remove the composite sync signal from the video signal by means of a clipping action. This clipping action is acomplished by using low screen voltage and low plate voltage.

Figures 9 and 9A shows the effect of passing the video signal through the Sync Clipper.

Figure 9 is essentially the waveform that is applied to the grid of the sync clipper. The sync signals that are necessary for synchronization of the sweep circuits are those signals shown above the black level.

Figure 9A is called the composite sync signal because it is composed of horizontal sync pulses plus the sequence of pulses that occur at the end of a field (bottom of the picture). This sequence consists of 6 equalizing pulses, followed by the vertical sync pulse interval which is comparable to 6 equalizing pulses turned upside down, then followed by 6 more equalizing pulses, after which the horizontal sync pulses again appear.

There is actually no 60 cycle signal present in this waveform as shown, since the frequency of the equalizing pulses and the pulses used in the vertical sync pulse interval is 31,500 cps.

However, this sequence occurs every 1/60 of a second. The integrator, located in the plate circuit of the vertical buffer, will derive a 60 cycle positive pulse from this composite sync. This positive pulse will be used to synchronize the Vertical Saw Generator.

VERTICAL BUFFER

The purpose of the vertical buffer stage V220A is to amplify the composite sync signal fed to it from the Sync Clipper V217. In the plate circuit of the vertical buffer is a circuit consisting of R304, C271, R305, and C272. This circuit is called an integrator and its purpose is to derive a single 60 cycle pulse from the sequence of pulses that occurs at the end of a field. The action of this circuit is readily seen by the waveforms observed and presented in the Service Section.

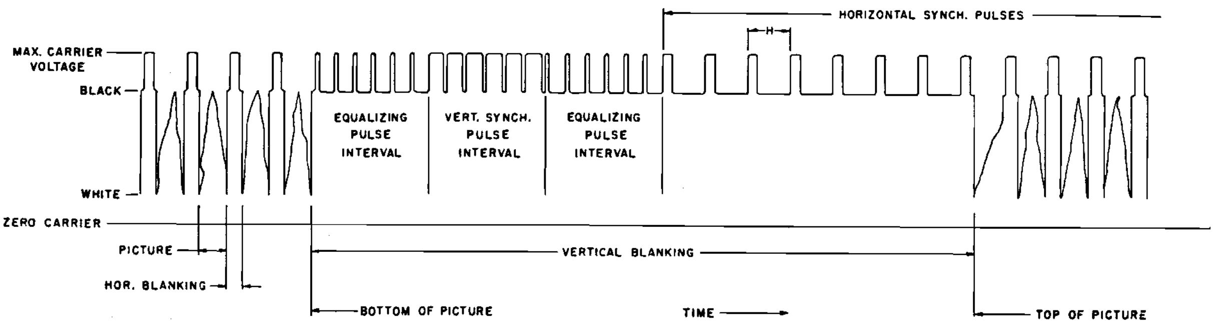


Figure 9. Composite Video Signal at Grid of Sync Clipper.

Figure 9A. Composite Synchronizing Signals at Plate of Sync Clipper.

VERTICAL SAW GENERATOR

The Vertical Saw Generator utilizes one half of a 6SN7 identified as V220-B. This blocking tube oscillator circuit is non-conducting during the time corresponding to the vertical trace and conducting heavily during the vertical retrace time.

The free running frequency of this circuit is controlled by C273, R307 and the vertical hold control R308. Normally, the free running frequency is adjusted lower than 60 cycles. This permits proper synchronization when the vertical sync pulse from the integrator circuit is inserted.

During the period corresponding to the vertical trace time when V220-B is non-conducting, capacitor C275 located in the plate circuit is charged through resistors R309, R310 and R311 to form the vertical sawtooth voltage. When V220-B conducts heavily, capacitor C275 discharges through the plate cathode circuit of V220-B and R311. The heavy discharge current flowing through R311 develops a negative spike across this resistor.

The waveform produced by this action in the plate circuit of V220-B is ideal for use in the vertical deflection circuit. As will be seen in the Service Section of this manual, it consists of a sawtooth voltage during the trace time and a negative pulse during the retrace time.

VERTICAL DEFLECTION AMPLIFIER

This voltage is applied to the grid circuit of the vertical deflection amplifier V221, a 6SN7 with both halves in parallel. In this stage the sweep signal is amplified and inverted in polarity.

Transformer T202 matches the impedance of the deflection yoke coils to the tube to obtain maximum transfer of energy. Since this is essentially an output transformer, high current and low voltage are desirable in the secondary. For this reason the voltage on the secondary is much lower than that on the primary.

HORIZONTAL SAW FORMING CIRCUITS

The horizontal saw voltage is developed by the joint operation of the horizontal oscillator V219 and the horizontal saw maker stage V401-A (located on the power supply chassis.)

The horizontal oscillator is a continuous wave oscillator operating at a frequency of 15,750 cycles per second. The circuit used is an electron coupled oscillator, wherein the cathode, control grid and screen grid (acting as the plate) form the triode oscillator. The circuit is essentially a Hartley Oscillator, with the free running (not synchronized) frequency determined primarily by the constants of the transformer Z205. (Synchronization will be discussed later.)

The Oscillator voltage developed in the grid circuit is of sufficient amplitude to overdrive this tube. The waveform of the signal that appears at the plate of the 6K6 approaches that of a square wave.

This signal is fed through a cable to the Flyback Power Supply Chassis. The waveform of this voltage undergoes a complete change as it is passed through a differentiator circuit consisting of capacitor C401 and resistor R401. (See WAVEFORM OBSERVATIONS in Service Section).

The differentiator circuit output consists of positive and negative pulses. A bias voltage at the grid of the horizontal saw maker is developed by grid rectification of these pulses.

This bias is sufficient to keep the tube operating beyond cut-off during the time corresponding to the horizontal trace.

This allows capacitor C413 located in the plate circuit of V401A to charge through resistors R403, R404 and R405.

The positive pulses from the differentiator overcome the cut-off bias and cause the tube to conduct heavily during the retrace time. This allows C413 to discharge rapidly through R404, R405 and the plate cathode circuit of V401A.

Since R404 and R405 are connected between C413 and AC ground the voltage waveform will not only have a sawtooth form, but during the retrace time will consist of a negative pulse. The amplitude of this pulse if determined by the setting of the horizontal drive control.

HORIZONTAL SYNC CIRCUITS

The method used to synchronize the horizontal oscillator is a form of Automatic Frequency Control.

The Sync circuits utilize a 6AC7 reactance tube and a 6AL5 Sync Discriminator circuit.

The purpose of the sync discriminator is to compare the locally generated 15,750 cps sine wave with the incoming horizontal sync pulses. If the locally generated signal is out of phase with the sync signal from the transmitter, then a DC voltage will be fed to the 6AC7 reactance tube. Upon receipt of this signal, the 6AC7 will act to correct the frequency of the horizontal oscillator.

The 6AC7 reactance tube is connected across the oscillator transformer and will cause the frequency of the horizontal oscillator to change if the DC voltage at its (6AC7) control grid is varied. This is possible because the coupling between the green lead of Z205 and the cathode of V224 consists of a phase shifting network (C286 and R326) that causes an approximate 90° phase difference to exist between the plate voltage and plate current of the 6AC7, thus causing the tube to act like a reactance.

The 15,750 cps sine wave is coupled from the oscillator circuit through transformer Z205 to the two cathodes of the 6AL5 discriminator circuit. With no station being received, the sine wave at each cathode with respect to ground is of equal amplitude but 180° out of phase with each other.

Resistors R296 and R297 are connected between the plates of this tube, and the center point of these resistors is returned to the center tap on transformer Z205. Thus, as each section of the 6AL5 conducts the voltage developed across the above resistors will be of equal amplitude but opposite polarity with respect to ground. Therefore, the DC output voltage of this circuit will be zero. This output is coupled from Pin #7 of V218 through a filter to the grid of the reactance tube V224. As long as no change in the DC is fed to the reactance tube, the frequency of the oscillator will not be affected.

The Sync signal is applied from the plate of the Sync Clipper V217 to the center tap (white lead) of Z205. Applying the signal to the center tap means that the polarity of the pulse at either end of the winding will be the same (in this case it will be negative.)

With the frequency control (top of can) and phase adjustment (bottom of can) properly set (see section on Adjustments) the waveform on pin #1 (V218) will be approximately that seen in Fig. 10 and the voltage on pin #5 (V218) will be approximately that seen in Fig. 11.

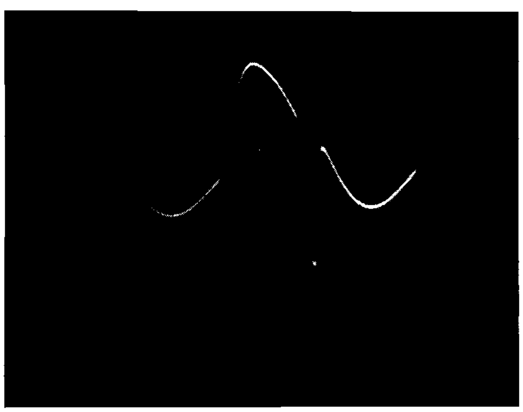


Figure 10

With the signals at the two cathodes as shown, both tubes will still conduct the same amount and the DC voltage variation at pin #7 of V218 will be approximately zero.

However, if the locally generated signal tends to drift out of phase with the sync pulses, then the pulse will change position on the sine wave so that one half of the diode will conduct more than the other. This will develop a DC voltage at Pin #7, the plate of the 6AL5 with respect to ground. This voltage fed to the grid of the 6AC7 will cause the reactance tube to correct the frequency of the horizontal oscillator.

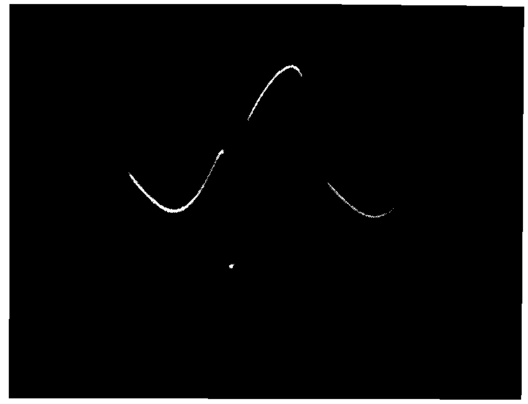


Figure 11

The polarity of the discriminator output voltage depends upon which half of the 6AL5 conducts greatest. This, in turn, is a function of the direction (high or low) that the frequency of the local oscillator drifts.

HORIZONTAL SWEEP AMPLIFIER

The saw voltage developed in the plate circuit of the horizontal saw maker is coupled to the grid of the horizontal sweep amplifier V402.

The purpose of this stage, utilizing a 6BG6, is to provide sufficient current of the proper waveform to the horizontal deflection coils. This is necessary to scan the CRT horizontally.

The output of this stage is transformer coupled to the horizontal deflection coils. This transformer (T-401) matches the impedance of the deflection coils to the 6BG6, but it is also used in producing the high positive voltage used on the CRT.

A 5V4G rectifier tube is connected across the secondary of T-401 and is used as a damper tube. It is used to dampen any oscillation that may occur during the flyback time. When the tube conducts, it will charge capacitor C409 directly and C408 through L402.

This voltage thus developed and filtered by C408, C409 and L402 is in series with the B+ voltage that is applied to the horizontal saw maker and the horizontal sweep amplifier. This voltage derived from the energy in the output circuit provides additional voltage for the horizontal saw maker and the horizontal sweep amplifier.

Resistor R413 connected across V405 is used to provide good horizontal linearity.

The effect of the width and linearity controls will be covered in the Section on ADJUSTMENTS.

HIGH VOLTAGE SUPPLY

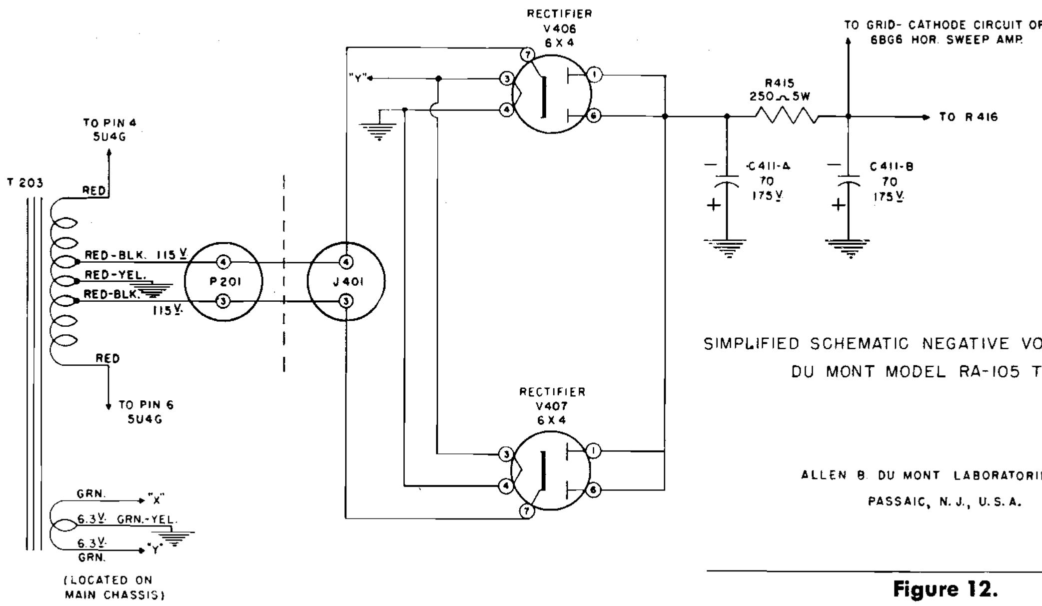
This circuit uses two 1B3-GT/8016 in what may be called a pulsed cascade doubler. The high voltage output is developed across C407 and C410 to ground.

Two separate filament windings are used for these tubes.

The voltage is developed when the magnetic field surrounding the horizontal deflection coil collapses at the end of a scanning line. This causes a positive pulse to appear at the 6BG6 plate which is stepped up by the autotransformer action of the transformer primary. This voltage is rectified by the two 1B3's filtered and then applied to the Teletron. In this doubler circuit the output voltage is approximately 12,000 V. DC.

NEGATIVE VOLTAGE SUPPLY

A pair of 6X4 miniature rectifier tubes are used in a full wave rectifier circuit. A simplified schematic for this circuit



SIMPLIFIED SCHEMATIC NEGATIVE VOLTAGE SUPPLY
DU MONT MODEL RA-105 TELESET

ALLEN B. DU MONT LABORATORIES INC.
PASSAIC, N. J., U. S. A.

Figure 12.

is shown in Fig. 12. The tubes are located on the power supply chassis and the 115V AC is obtained from two taps, off center on the low voltage power transformer located on the main chassis.

The purpose of this circuit is to make available additional voltage to provide a greater horizontal sweep amplitude. This is accomplished by returning the grid-cathode circuit of the horizontal sweep amplifier and horizontal saw maker to this circuit. Since the effective plate voltage is that measured between plate and cathode, this will provide a greater difference in potential between these elements. (On some of the early models, the grid-cathode circuit of the horizontal saw maker is returned to ground instead of to the negative voltage supply.)

LOW VOLTAGE POWER SUPPLY

The low voltage power supply located on the main chassis utilizes two 5U4G rectifiers in a conventional full wave circuit.

A condenser input filter is used with a single series choke L219.

The 117 volt AC is applied to the primary of the power transformer T203 from the Flyback Power Supply Chassis. The 4 amp. fuse is located on the power supply chassis.

RELAY CONTROL CIRCUIT

A time delay circuit is used to prevent the application of high surge voltages to the input capacitors C281 and C282 in the low voltage power supply filter.

This circuit consists of relay K201, and the Relay Control tube V401-B, one half of a 12AU7. The relay is located on the Main Chassis whereas the tube is located on Power Supply Chassis.

The 12AU7 section is connected up as a diode. The cathode is returned to the negative voltage supply through resistor R416. A 10 ohm resistor is connected in series with the filament to ground.

The plate of the 12AU7 is wired through the connectors J402 and P202 and the cable between the power snpply and Main Chassis to one side of the coil on K201. The other side of this coil goes to ground through the cable between J204 and P604.

The contacts on the relay are located between the filaments of the 5U4G rectifiers and the junction of R318 and C281. Thus, if the contacts are open no voltage is applied to the filter input.

When the set is turned on, these contacts are open as the relay is not energized. The 10 ohm resistor in series with the 12AU7 filament delays the heating of this filament. This allows sufficient time for the filaments of the other tubes in the Teleset to come up to operating temperature. At the end of approximately 15 seconds, the 12AU7 cathode will emit. Since the cathode of the 12AU7 is connected to the negative supply and the plate goes to ground, the tube will conduct.

The current flowing through the relay will energize it, close the contacts and apply the positive voltage to the filter. Since all the tubes in the receiver are warmed up they will draw current, thus reducing the surge voltage applied to the input condensers.

SOUND IF AMPLIFIERS

The 21.9 Mc Sound IF Signal is fed from the grid circuit of the 2nd video IF stage to Z201 the input transformer to the sound IF strip.

Three stages, using 6AU6's comprise the sound IF strip. The first two stages are straight amplifiers while the third stage functions not only as an amplifier but also as a limiter. Inasmuch as the discriminator circuit used here will detect amplitude variations as well as frequency variations the signal presented to the discriminator should be of constant amplitude. The purpose of the limiter is to clip the signal of any amplitude variation so the signal presented to the discriminator will be of constant amplitude varying only in frequency.

When using the Teleset on FM an AVC voltage is fed back to the grid of the mixer from the grid of V212.

To assist in tuning the receiver a tuning indicator V214 is connected across the output of the discriminator. The audio signal out of the discriminator is applied to the service selector switch.

SERVICE SECTION

INTER-CHASSIS CABLING

The inter-chassis cabling of the RA-105 Telesets should present no particular problem to the Serviceman as long as he is careful in handling the plugs during removal from their respective sockets.

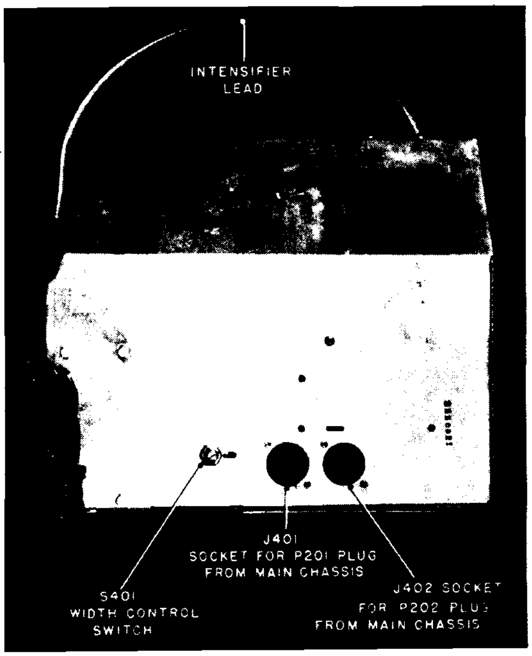


Figure 14. Flyback Power Supply, socket identification.

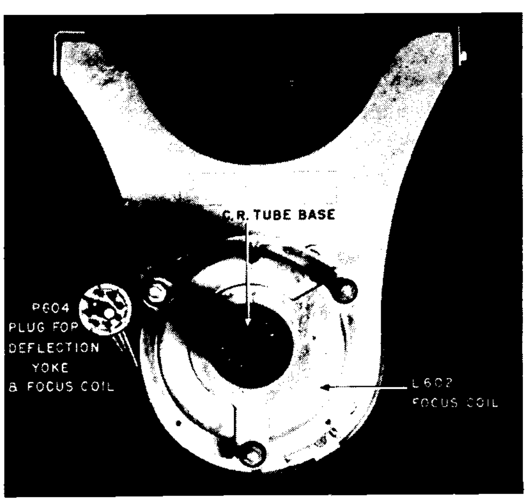


Figure 15. Teletron Assembly Plug and Socket Identification.

To assist in the identification of the plugs and connectors used in this cabling, the following figures are presented. The circuits brought to the pins of these connectors and sockets are designated on the various schematics.

The AM Tuner connectors are not shown here because the AM Tuner socket is specifically identified on the Main Chassis schematic.

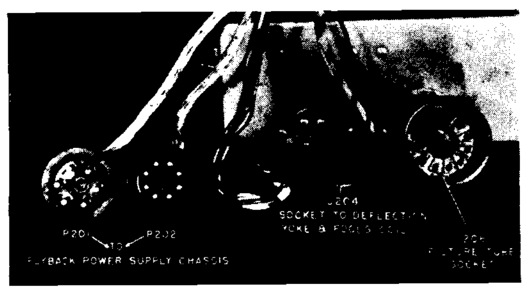


Figure 16. Main Chassis. Plug and socket identification.

COMPONENT LOCATION

The following illustrations are presented to assist the serviceman in the location of specific components. All the small parts are not identified on these illustrations. In seeking unidentified parts, the serviceman should look for those parts associated wtih the desired components.

Improvements in future production runs may obsolete certain parts. In some cases these improvements may cause the addition of other components. The serviceman should take this into consideration when looking for components.

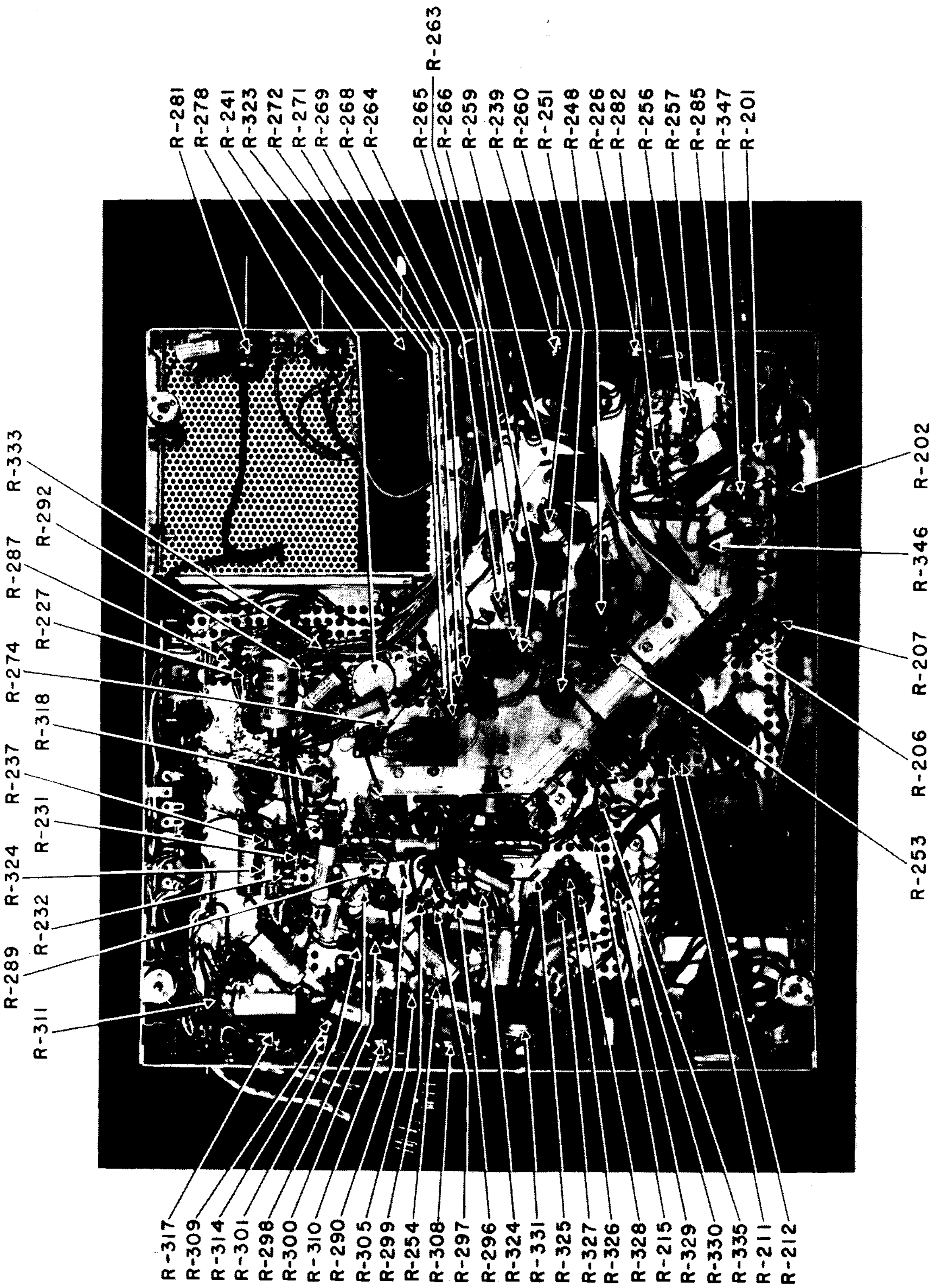


Figure 17. Main Chassis Resistor Location.

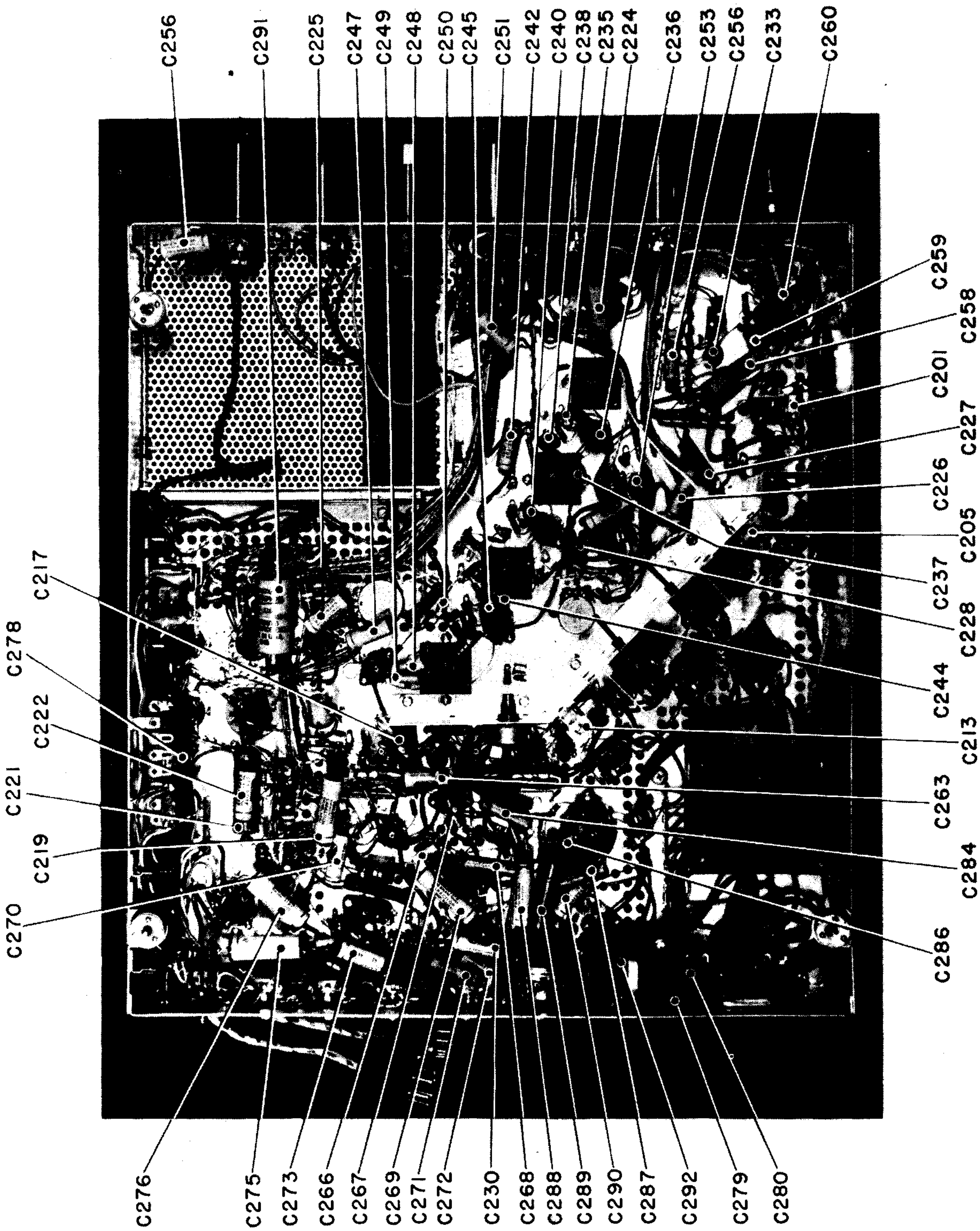


Figure 18. Main Chassis Capacitor Location

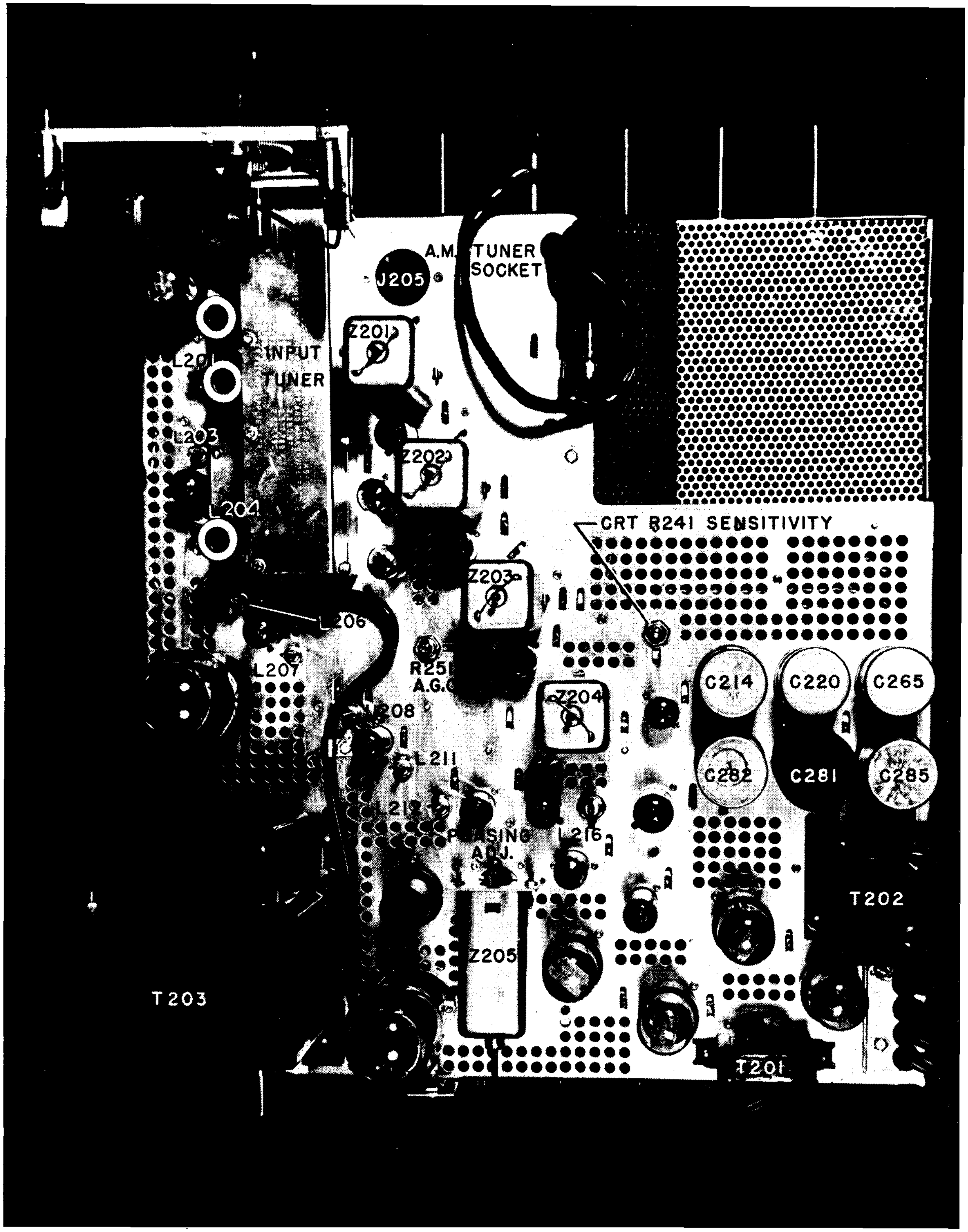


Figure 19. Main Chassis, top view.

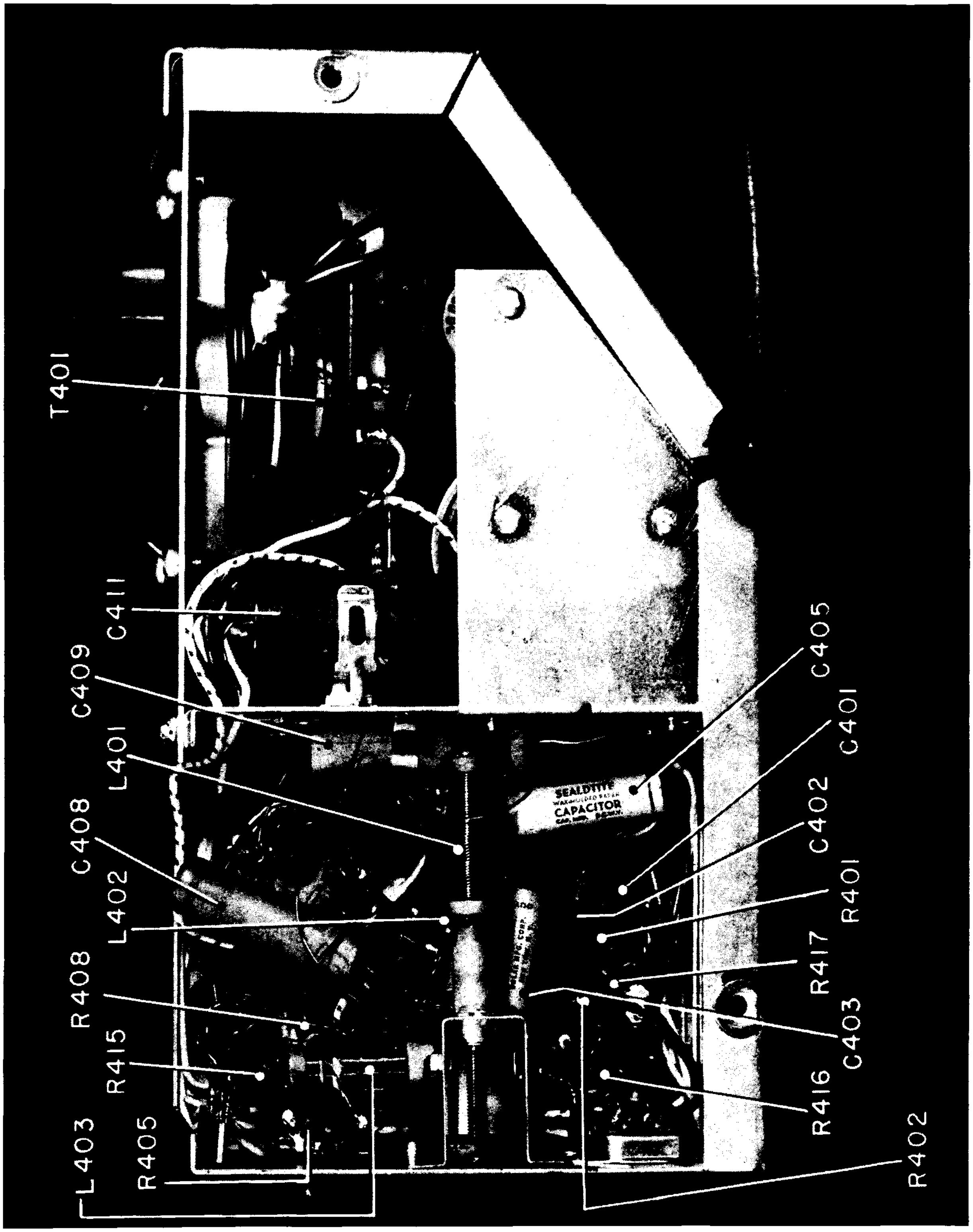


Figure 20. Flyback Power Supply, bottom view.

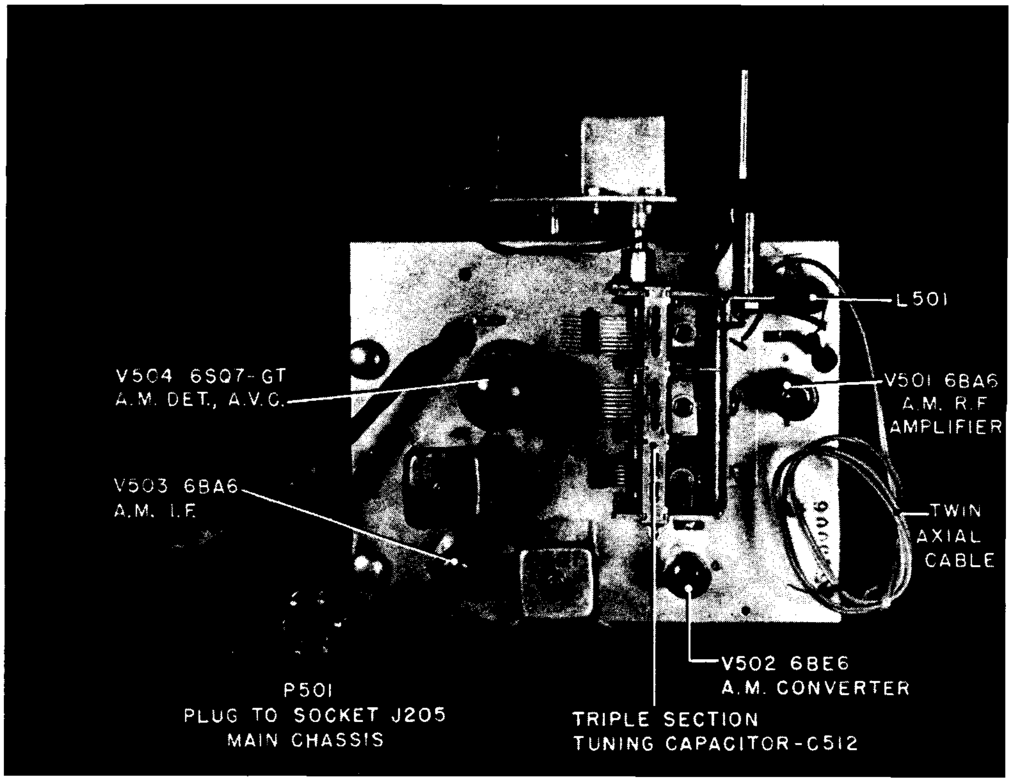


Figure 24. AM Tuner, Top View.

ADJUSTMENT OF CONTROLS

LOCATION OF CONTROLS

To facilitate locating the various controls on the RA-105 Telesets, these illustrations are presented.

For location of non-operational adjustments on top of Main Chassis, refer to Fig. 19.

For location of the width control switch, refer to Fig. 14.

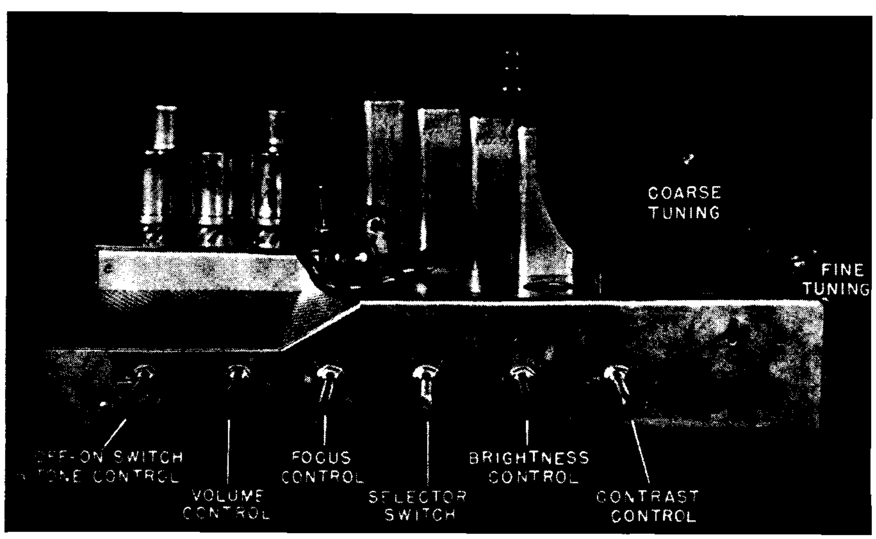


Figure 25. Main Chassis.
Front Panel Operational Controls

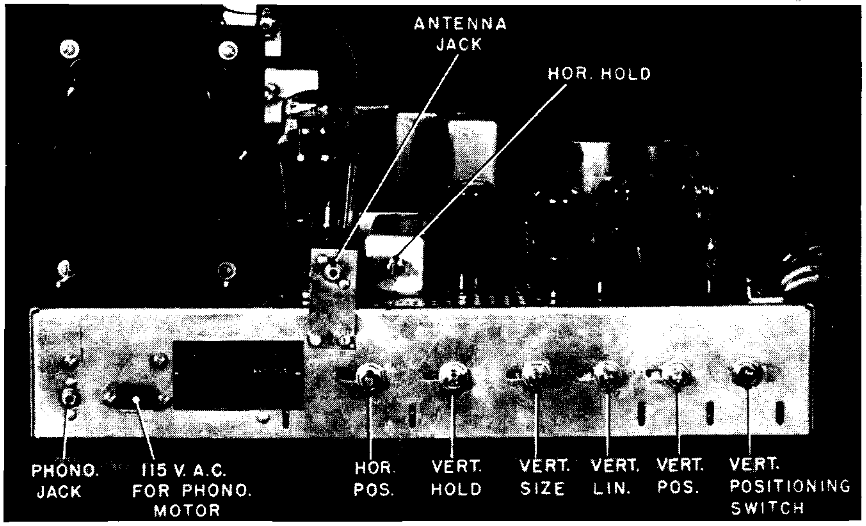


Figure 26. Main Chassis.

Non-operational Controls at rear.

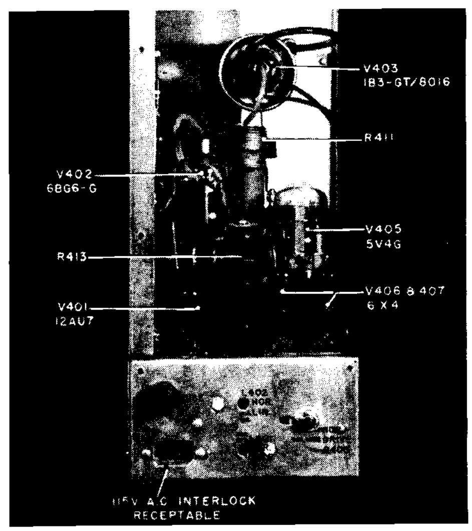


Figure 27. Power Supply Chassis.

HORIZONTAL CONTROLS

Correct picture width 12¾ inches.

Control	*Part*	*Effect*
Horizontal positioning	R331	Positions picture in the horizontal direction.
Horizontal phase	Z205	Adjusts phasing to obtain equal blanking on each side of the picture.
Horizontal frequency	Z205	Adjusts frequency of horizontal Oscillator for proper synchronization.
Horizontal size	L401	Controls the horizontal size of the picture and linearity of the right hand side.
Horizontal size switch	S401	Controls the overall size of the picture (three positions).
Horizontal linearity	L402	Controls the linearity of the center of the picture.
Horizontal drive	R405	Controls the size and linearity of the left side of the picture.

PROCEDURES FOR MAKING HORIZONTAL ADJUSTMENTS

Horizontal frequency adjustment

Rotate the horizontal frequency control until the picture falls out of sync. Adjust the control to bring the picture back into sync and note the point at which this occurs. Repeat the above but in direction opposite to that just described. The correct setting is halfway between the two points where the picture falls into sync.

Horizontal phasing adjustment

Reduce the horizontal size until both edges of the picture are in view. Turn up the brightness control and reduce the contrast so that the normally blanked borders of the raster are visible. Adjust the phasing control so that the normally blanked border on one side is equal in width to that on the other side.

Size and Linearity Adjustments

The horizontal size of the picture is controlled by the horizontal size switch S401 plus the horizontal size control. For large changes in size use the horizontal size switch. For small changes in horizontal size use the horizontal size control.

If any non-linearity in the horizontal direction is observed, the horizontal drive and horizontal linearity controls should be readjusted.

VERTICAL CONTROLS

Correct picture height 9½ inches

Control	*Schematic Designation*	*Effect*
Vertical positioning	R317	Positions picture in the vertical direction
Vertical positioning switch	S203	Permits greater vertical positioning of raster.
Vertical hold	R308	Adjusts frequency of Vertical Saw Generator for proper synchronization.
Vertical size	R310	Controls vertical size of picture. Varies the time constant of the saw forming circuit.
Vertical linearity	R314	Spreads out or contracts the top half of the raster. Electrically varies the operating point of the Vertical deflection amplifier by adjusting its bias voltage.

PROCEDURES FOR MAKING VERTICAL ADJUSTMENTS

Proper adjustment of Vertical hold control

Rotate hold control until picture falls out of sync. Adjust control to bring picture back into sync and note point where this occurs. Rotate hold control until picture goes out of sync in direction opposite to that just described. Adjust control and note point where picture falls into sync. Correct setting is between the two points where picture falls into sync.

If any non-linearity in the vertical direction is observed, readjustment of the vertical linearity and vertical size controls will have to be made.

MISCELLANEOUS ADJUSTMENTS

The following control should be adjusted only when Teletron is changed.

Control	*Designation*	*Effect*
CRT Cutoff	R241	Adjusts the correct cut off point of the CRT.

Procedure for Adjusting

Rotate contrast control completely CCW. Connect DC voltmeter between arm of brightness control and ground. Adjust brightness control until meter reads 45 volts. Adjust R241 the CRT cutoff control until the illumination on screen just disappears.

AGC Threshold Adjustment

Control	*Designation*	*Effect*
AGC	R251	Adjusts the bias on the 6AT6 to cut-off.

This control should be readjusted if it becomes necessary to replace the 6AT6 AGC tube.

Procedure for adjustment in the Shop

Disconnect antenna from the Teleset. Connect VTVM across C226 to ground. Rotate R251 completely counter-clockwise. At this setting the meter will read approximately 1 Volt. Rotate control slowly clockwise. It will be noticed that this AGC Voltage will be constant over part of the range of this pot and will, near mid range, begin to increase fairly abruptly. The AGC voltage should be set at the point at which the abrupt increase begins.

Procedure for Adjustment in the Field

Disconnect antenna. Turn up the contrast control fully and adjust the brightness control so that a raster can be seen. Rotate R251 completely counter-clockwise. At this position a considerable amount of "noise" will be visible on the face of the CRT. Rotate the control clockwise slowly. It will be noticed that over a portion of the range, the amount of noise is not affected. This is comparable to the condition in the shop, where over the same range of the control, the meter reading is not affected. As the control is further adjusted, it will be noticed that a point is found when the noise starts to decrease and beyond this point decreases very rapidly. The correct setting for the control is immediately before the point where the affect upon the noise is observed.

REMOVAL AND REPLACEMENT OF CATHODE RAY TUBE

In the event the Teletron becomes defective, a recommended procedure for the removal and replacement of same is depicted in the following series of illustrations.

Step No. 1. Fig. 28. Remove the back panel by removing the 9 screws. Be careful that the base of the tube is not hit during this step.

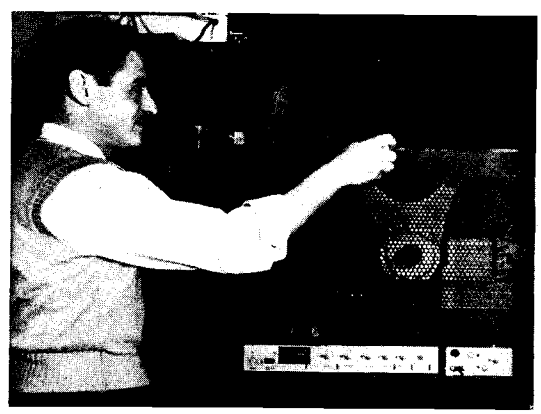


Figure 28

Step No. 2. Fig. 29. Removing the Flyback Power Supply Chassis. Remove the two plugs from the sockets on the Flyback Power Supply. Remove the high voltage lead from the cathode ray tube by grasping the connector between the fingers and gently remove. Do not pull on the high voltage lead. Remove the two cap screws that fasten the Flyback Power Supply to the cabinet. This will free the chassis and it may be removed as shown below by withdrawing to the rear.

Step No. 3. Fig. 30. Removing the Main Chassis. Remove all knobs from the front of the cabinet. Disconnect the speaker. Remove the socket from the base of the cathode ray tube. Re-

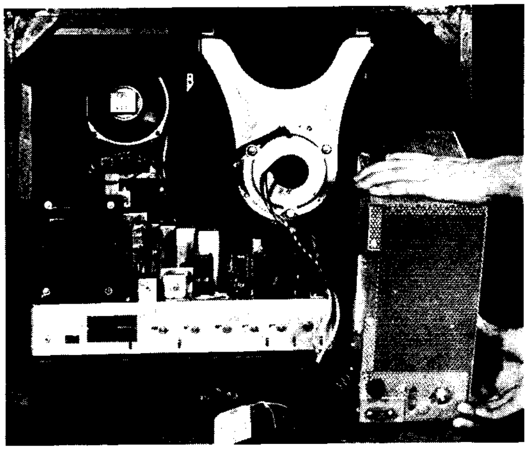


Figure 29

move the socket from the deflection yoke plug. Remove the tuning indicator from its clip. Remove the 4 cap screws that fasten the Main Chassis to the cabinet. The chassis may now be removed by raising slightly and withdrawing to the rear.

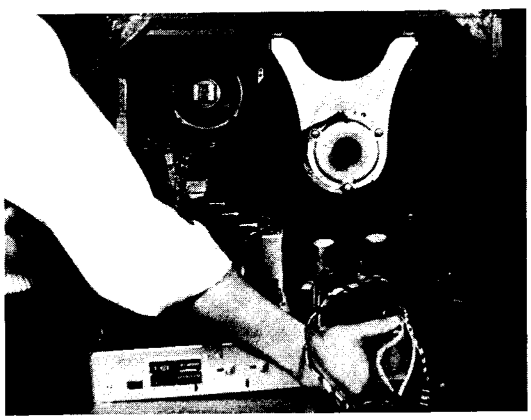


Figure 30

Step No. 4. Fig. 31. Disengaging the Cathode Ray Tube Assembly from its track. The removal of two phillips-head machine screws will free the assembly from the track and permit the removal of same.

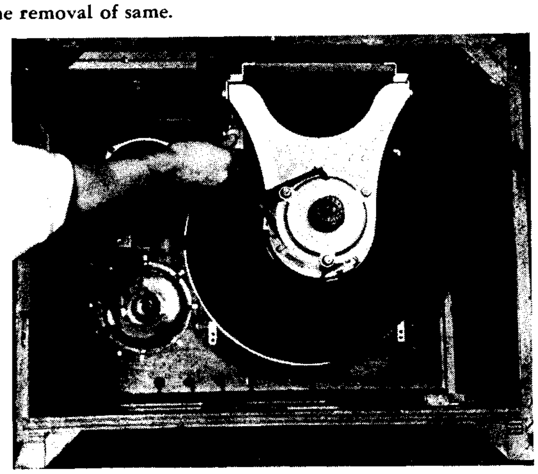


Figure 31

Step No. 5. Fig. 32. Removal of Cathode Ray Tube Assembly from cabinet. This step should be undertaken by two men. The assembly should be grasped as shown below and carefully removed by sliding to the rear.

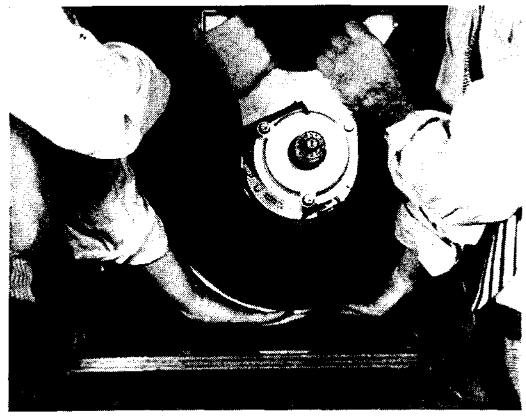


Figure 32

Step No. 6. Fig. 33. The tube should be placed face down on the work bench. Obviously there should be no tools or other objects under the face of the tube. In this position the face of the tube will not touch the bench as it is supported by the assembly frame.

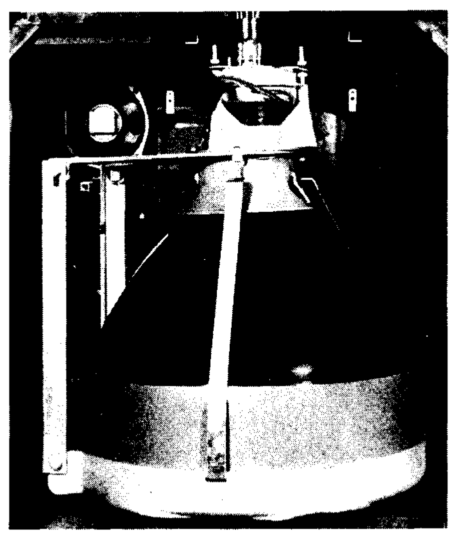


Figure 33

Step No. 7. Fig. 34. Removal of Deflection Yoke and Focus Coil Assembly. This assembly may be removed by removing the three nuts that hold the assembly in place. Care should be taken when removing this assembly that no force is exerted on the neck of the tube.

Step No. 8. Remove the assembly to which the Deflection Yoke and Focus Coil Assembly was fastened. This is accomplished by removing the two bolts that fasten this piece to the upright angle irons and disengaging the three side bands by unscrewing the machine screws.

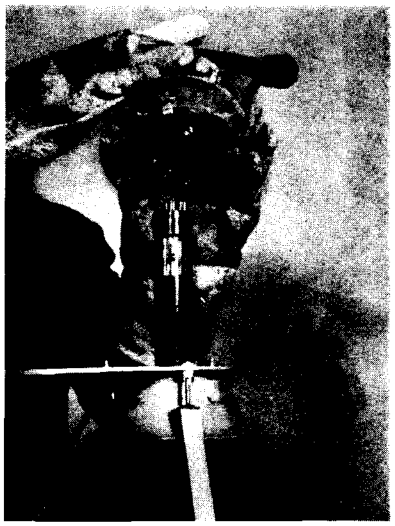


Figure 34

Figure 36. Inside of assembly showing front C.R.T. cushion.

Step No. 9. Fig. 35. Removing the tube. With the help of an assistant, tilt the assembly towards you. The tube should then be tilted in its assembly by pressure from underneath. The tilt should be enough to allow the gloved hands to reach underneath, grasp the face and gently remove the tube.

Figure 35

REPLACING THE C.R.T.

Step No. 1. With the face of the frame on a flat table as in Fig. 35, place the new tube into the assembly. The tube should be so oriented that the high voltage cap is located between the two angle iron rails.

Step No. 2. Fig. 37. Replace the assembly to which the rails and the side clamps were fastened.

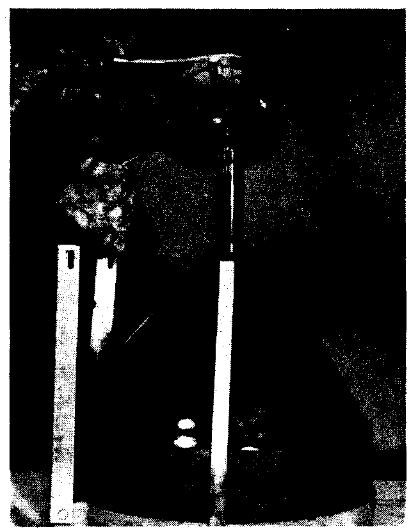


Figure 37.

Step No. 3. Fig. 38. (Note the protective covering around neck of tube.) Using a square as shown in this figure, the angle between the face of the tube and the rails should be 90°. This is important.

The clamps should now be fastened to the piece mentioned in step No. 2 and should be tightened by tightening the machine screws. While tightening these screws, the rails should be maintained at the 90 degree angle with the face. Care should be taken when tightening these clamps that the face of the tube is not forced against the metal front of the assembly.

After the clamps have been tightened evenly and the tube is properly centered in the rear collar, the four rail bolts should be tightened.

Step No. 4. Replacing the Yoke and Focus Assembly. (Orient assembly so the plug is at left when viewed from the rear of the cabinet.)

This step is the reverse of step No. 7 on removal. Care should be taken that the neck is not damaged when this step is made.

The remaining steps are the reverse of those starting with Fig. 5 of the removal procedure.

Figure 38.

WAVEFORM OBSERVATIONS

The trained television serviceman, with the aid of an oscilloscope, can reduce the time necessary to locate trouble in a television receiver by the investigation of questionable circuits and interpreting the wave shapes observed.

The waveforms presented on these pages were observed at the points indicated and under the conditions described herein.

In observing these waveforms, the receiver was broken down into a number of sections. As will be seen later in the section on Trouble Shooting, this practice is a definite aid in localization of troubles.

The equipment used was a Du Mont 208-B Oscillograph, and a Du Mont Type 264-A Voltage Calibrator. The calibrator was used to measure the amplitude of the observed signal. RG-59/U co-axial cable was used for the necessary test leads. This equipment is shown in Fig. 39.

NOTE: *In all cases, the line voltage was adjusted to* 117 *volts, A.C. All observations were made from the "Point of Observation" to ground.*

Fig. 39, illustrates the correct settings of the sweep frequency controls on the Oscillograph when observing signals whose frequency is 15,750 cps (Horizontal frequency).

Fig. 39A, illustrates the correct settings of the sweep frequency controls on the Oscillograph when observing signals whose frequency is 60 cps (Vertical frequency).

At each of the figures representing the waveforms observed in the video detector and video amplifier circuits the word "line" or "field" appears.

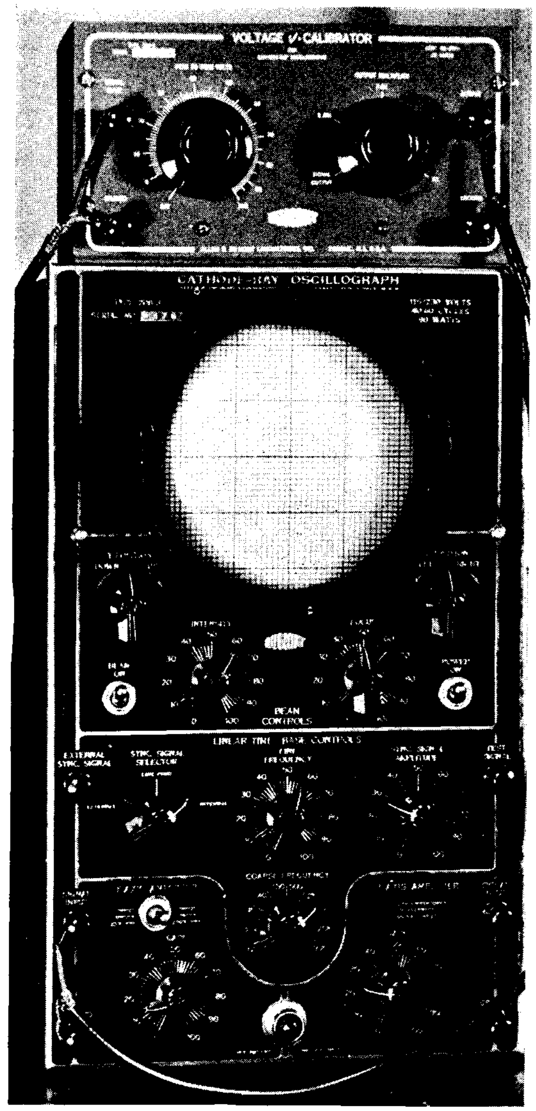


Figure 39. DuMont 208-B Oscillograph and 264-A Voltage Calibrator adjusted for observation of horizontal frequency voltages.

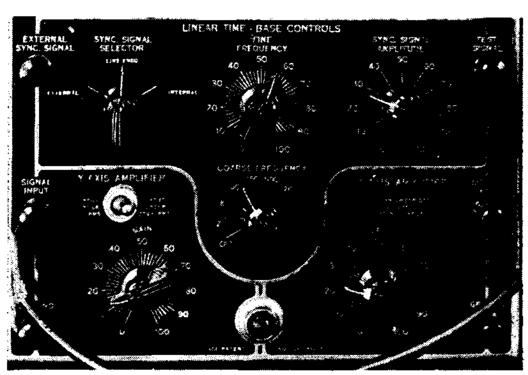


Figure 39A. DuMont 208-B Oscillograph adjusted for vertical or field frequency.

The word "line" indicates that the waveform shown represents the signal necessary to reproduce the information in a horizontal scanning line as transmitted by the television station. The scanning line constitutes an excursion of the electron beam in the CRT. This excursion starts at the left side of the CRT, progresses at a constant rate until it reaches the right side of the CRT and then rapidly returns to the left side. 525 of these lines are used in completely scanning a scene.

The frequency of occurrence of these "lines" is 15,750 cps. Obviously, for the "line" waveforms, the horizontal settings of the oscilloscope should be used.

The word "field" indicates that the waveform presented represents approximately 262½ scanning lines. The term "field" is sometimes defined as the scanning of half the picture area. To further clarify this definition, consider the picture area to be separated into 525 horizontal lines or strips. The electron beam, starting at the top of the picture, progresses towards the bottom at a 60 cycle rate, but at the same time the horizontal scanning lines at 15,750 cycles per second are being formed. The field represents every other line from top to bottom of the picture.

When observing the waveforms where the word "field" appears, use the vertical settings on the oscilloscope.

Figure 40
Pin No. 7 V204
(Video detector plate)
(Field) 1.4V p-p.

Fig. 40. The amplitude of this signal is determined by the operation of the AGC Circuit. The amplitude is, therefore, essentially constant for all channels. Since the sync pulses are in a negative direction, the polarity of the signal is black negative.

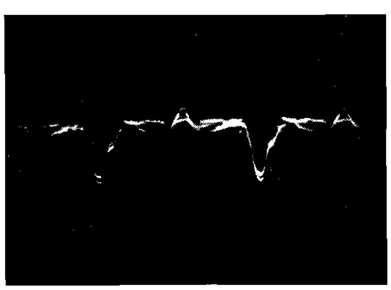


Figure 41
Same point as Fig. 40. (Line)
1.4V p-p.

Fig. 41. The waveform shown here represents a single horizontal line of video information. This oscilloscope does not present a true picture of this waveform. The reason is that the response of the 208-B is quite low compared to what it should be to reproduce the horizontal blanking and sync pulses.

Figure 42
Pin No. 1. V205 (Grid 6AG5
1st video amp.) (Field) IV p-p.

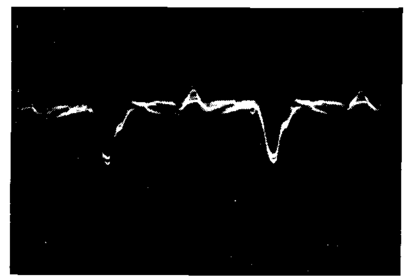


Figure 43
Same point as Fig. 42 (Line)
1V p-p.

Fig. 42 and 43. Note that the waveform has been reduced somewhat in amplitude after passing through the coupling circuit.

Figure 44
Pin No. 5 V205 (Plate 6AG5
1st video amp.) (Field) 16V p-p.

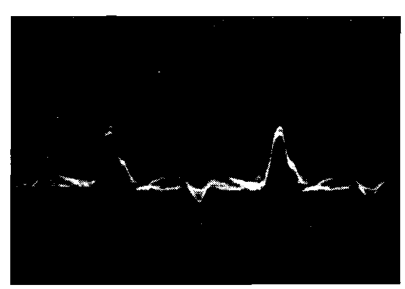


Figure 45
Same point as Fig. 44
(Line) 16V p-p.

Fig. 44 and 45. Notice that the polarity of the signal has been reversed. Since the sync pulses extend in a positive direction, the signal may be referred to as "black positive". The gain of this stage, obtained by dividing the amplitude of this waveform by the amplitude of the signal on the grid, is approximately 16.

Figure 46
Pin No. 3 V206A (Cathode 2nd video amp. ½12AU7) 10v p-p.

Figure 47
Same point as Fig. 46 (Line)
10V p-p.

Fig. 46 and 47. Note here that the polarity of the signal is still black positive indicating no reversal of polarity through the tube. This condition is true of all Cathode Followers. Note also that a decrease in amplitude occurs. The gain of this stage is, therefore, less than 1. It is approximately .6 in this case.

Fig. 48 and 49. The amplitude of this signal depends upon the setting of the contrast control. At maximum contrast, the amplitude will be the same as that observed at the cathode of the 2nd video amplifier.

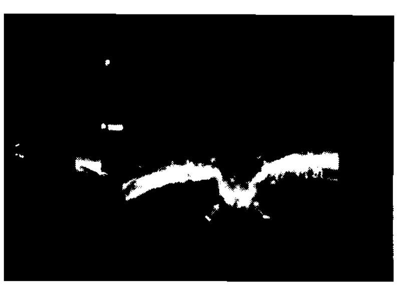


Figure 48
Pin No. 5 V207
(Grid 3rd video amplifier)
10V p-p.

Figure 49
Same point as Fig. 48 (Line)
10V p-p.

Figure 50
Pin No. 3 V207 (Plate 3rd video amp. 6K6) 47V p-p.

Figure 51
Same point as Fig. 50 (Line)
47V p-p.

Fig. 50 and 51. Again the amplitude depends on the setting of the contrast control. The contrast control is set at maximum for these measurements. Note also the signal is amplified and inverted. The gain of this stage is approximately 5.

NOTE: *At the grid of the CRT the signal is essentially the same as that measured at the plate of the third video amplifier.*

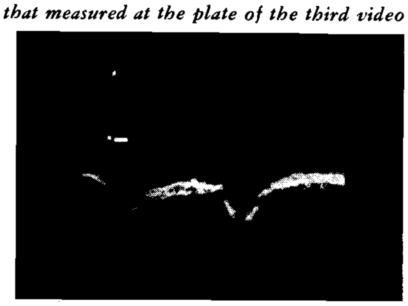


Figure 52
Junction of L215-R223 plate circuit of V205, 1st video amplifier
(Vertical) 16V p-p.

DESCRIPTION OF COMPOSITE SYNC WAVEFORMS

Figure 53
Same point as Fig. 52
(Horizontal) 16V p-p.

Fig. 52 and 53. This signal observed in the plate circuit of the first video amplifier is fed the sync clipper.

Figure 54
Pin No. 1 217 (Grid sync clipper 6AG5) (Vertical) 12V p-p.

Figure 55
Same point as Fig. 54 (Horizontal) 12V p-p.

Fig. 54 and 55. Note that at this point the amplitude of the signal is slightly decreased because of the drop across R289.

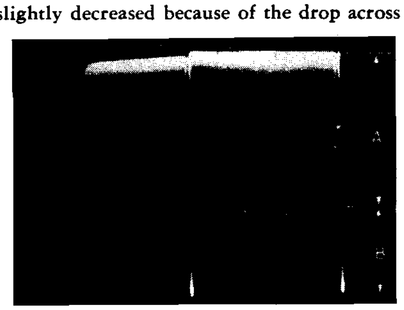


Figure 56
Pin No. 5 V217 (Plate 6AG5 sync clipper) (Vertical)
A—23V B—15V

Fig. 56. The purpose of the Sync Clipper stage is to remove or clip the composite sync from the Video signal. The waveform shown here is the composite sync. This spike that shoots below the horizontal sync portion is composed of pulses that occur during the vertical sync pulse interval.

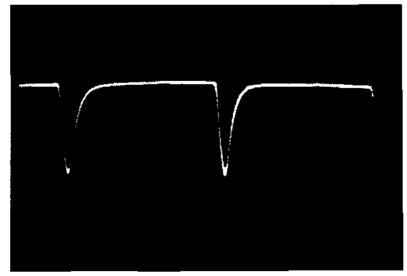


Figure 57
Same point as Fig. 56
(Horizontal) 23V p-p.

Fig. 57. This waveform is that of the horizontal sync pulse. This is part of the composite sync as seen in Fig. 56.

DESCRIPTION OF VERTICAL SYNCHRONIZING WAVEFORMS

The following waveforms were observed in the vertical synchronizing circuits. All observations made in this section using 60 cycle sweep on the oscilloscope.

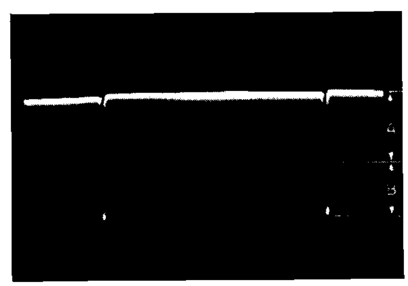


Figure 58
Pin No. 4 V220A.
(Grid 6SN7 vertical buffer)
A—19V B—19V

Fig. 58. This waveform is that of the composite sync again and is essentially the same as was observed at the plate of the sync clipper.

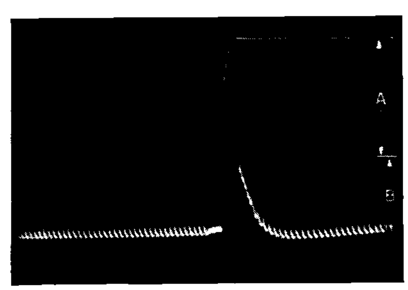


Figure 59
Pin No. 5 V220A. (Plate 6SN7 vertical buffer)
A—55V B—40V

Fig. 59. In order to observe the same amount of detail as seen in the illustration, the horizontal gain control on the scope should be so adjusted as to spread out the waveform. Note how the waveform rises in amplitude during the vertical sync pulse interval.

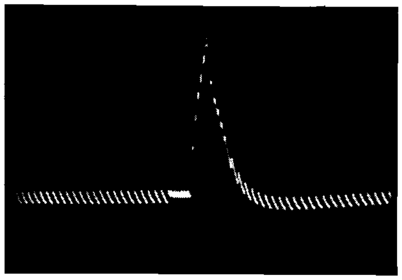


Figure 60
Junction R304-R305 plate circuit of V220A. 55V p-p.

Fig. 60. The circuit consisting of R304, C271, R305, and C272 in the plate circuit of V220A is called an integrator circuit. The purpose of this circuit is to develop a single pulse at 60 cps, for synchronizing the vertical saw generator. This pulse is developed when the sequence of pulses that occur at the end of a field is applied to this circuit. The left-hand side of the pulse (as seen in the diagram) is produced by the charging of C271 through R304. This voltage builds up across C271 only during the Vertical Sync pulse interval. This occurs because the width of the positive portion of the cycle is wider than the negative portion. In the illustration, the stepping up of the voltage across C271 can be readily seen at the left side of the pulse. The waveform of the horizontal signals is such that a small charge is taken on C271 during the positive pulse and then completely discharged during the negative portion. Thus no accumulation of charge takes place during the horizontal or equalizing pulses.

Figure 61
Junction R305-R306 plate circuit of V220A. 35V p-p.

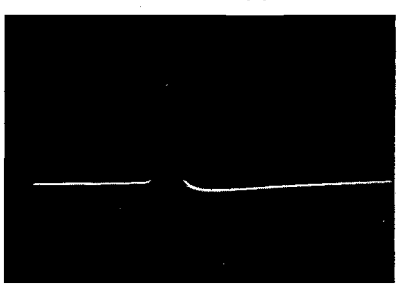


Figure 62
Junction R306 and red lead of T201. 32V p-p.

Fig. 61. After passing through the second section of the integrator, the waveform is smoothed out. Notice also that the amplitude has decreased considerably.

Fig. 62. The "pip" seen in the leading edge (left side of the pulse) is from the vertical saw generator. Adjusting the vertical hold control will affect its position.

DESCRIPTION OF VERTICAL SWEEP SECTION WAVEFORMS

All observations were made in this section using 60 cycle sweep on the oscilloscope. Controls adjusted for normal size picture 9½ inches high.

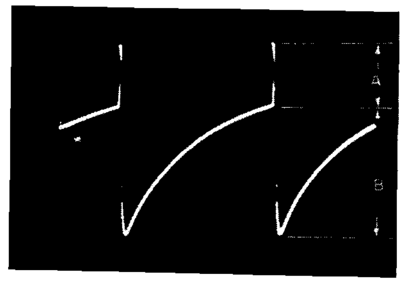


Figure 63
Pin No. 1 V220B (Grid 6SN7 vertical saw generator)
A—24V B—50V

Fig. 63. This waveform is typical of the type that is present in the grid circuit of a blocking oscillator. The curved portion of this waveform is formed by capacitor C273 discharging through R307, and R308 the vertical hold control. The free running frequency of the oscillator is determined by the rate of this discharge. The curve actually represents the instantaneous value of grid voltage. Throughout the time indicated by the slope, the tube is beyond cutoff. When this grid voltage either reduces to a value below cutoff or is driven below cutoff by the sync pulse, the tube goes into oscillation and conducts heavily as indicated by the positive pulse at the end of the slope.

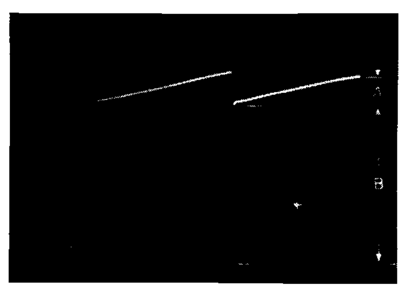


Figure 64
Pin No. 2 V220B (Plate vertical saw generator)
A—10V B—110V

Fig. 64. This waveform represents the signal that is developed in the plate circuit of the vertical saw generator. The saw tooth portion is developed when capacitor C275 is charged through R309, R310 and R311. The capacitor charges when the tube is beyond cutoff. The negative spike occurs when C275 discharges through R311. This discharge occurs when the tube conducts heavily.

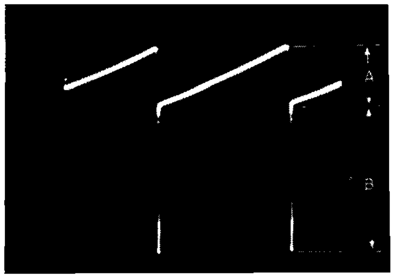


Figure 65
Junction C275, C276, R309.
A—16V B—50V

Fig. 65. Note that the amplitude is apparently reduced to approximately half of the original. The spike is reduced to approximately half the amplitude measured in Fig. 64. The saw portion apparently gains a few volts.

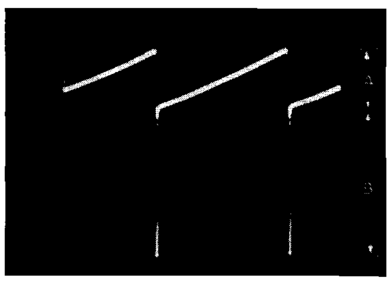


Figure 66
Pin No. 1 V221 (Grid 6SN7 vertical deflection amplifier)
A—16V B—50V

Fig. 66. This waveform is essentially the same as that measured at the junction of C275, C276 and R309. (Fig. 65.)

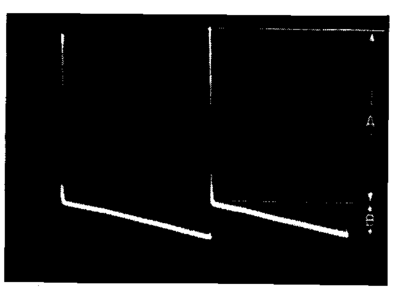


Figure 67
Pin No. 2 (Plate vertical deflection amplifier)
A—830V B—120V

Fig. 67. Note that the amplitude is increased considerably and the signal is inverted in polarity. The gain of this stage is approximately 15.

Fig. 68. Note that there is no reversal of polarity through the transformer. The signal has been reduced to approximately 1/10 of the voltage across the primary. The high frequency signals superimposed on the saw portion are from the horizontal circuits.

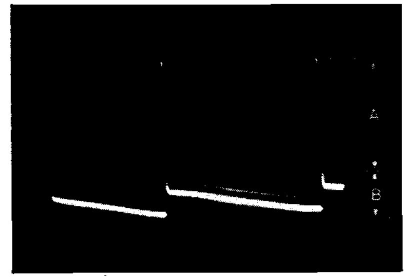


Figure 68
Green lead, secondary of vertical output transformer, T202.
A—60V B—35V

DESCRIPTION OF HORIZONTAL SWEEP WAVEFORMS

All observations were made in this section using the oscilloscope settings for horizontal frequency. Adjustments set for normal size picture unless otherwise noted. Width of picture is 12¾ inches.

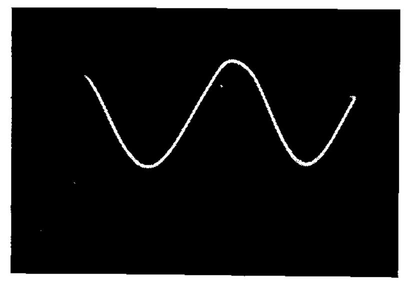


Figure 69
Pin No. 5 V219
(Grid 6K6 horizontal oscillator)
126V p-p.

Fig. 69. This sine wave at a frequency of 15,750 cps is produced by the oscillator.

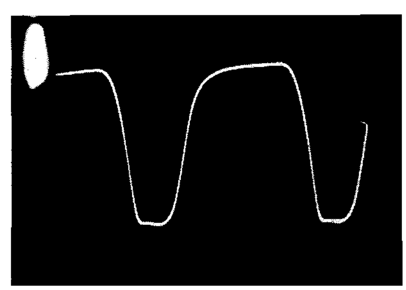


Figure 70
Pin No. 3 V219 (Plate horizontal oscillator) 200V p-p.

Fig. 70. The sine wave developed at the grid overdrives this tube. Therefore, this signal at the plate approaches a square waveform.

Fig. 71. R401 and C401 constitute a circuit known as a differentiator. This circuit will produce a signal in its output when a change in the applied voltage occurs. Thus, during the sharp rise and fall of the applied signal, a positive and negative pulse, as shown by this figure, will appear.

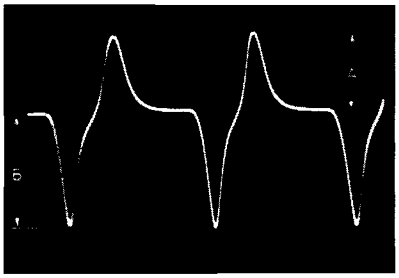


Figure 71
Junction C401, C402, R401.
A—34V B—43V

HORIZONTAL SWEEP WAVEFORMS

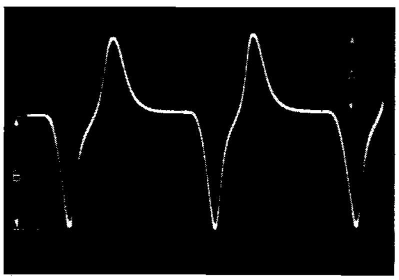


Figure 72
Pin No. 2 V401A (Grid 12AU7 horizontal saw maker)
A—34V B—43V

Fig. 72. This waveform is practically identical to that observed at Fig. 71.

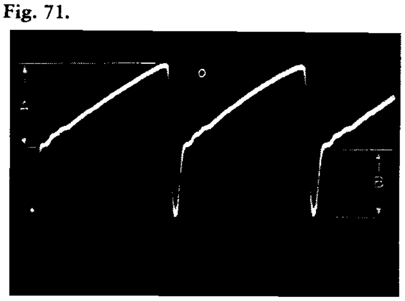


Figure 73
Pin No. 1 V401A (Plate horizontal saw maker)
A—39V B—30V

Fig. 73. This waveform is that of the sawtooth voltage developed by charging capacitor C413 through resistors R403, R404 and R405. The saw is produced when V401A is held beyond cut off and the negative pulse is produced when C413 is discharged through V401A, R404 and R405.

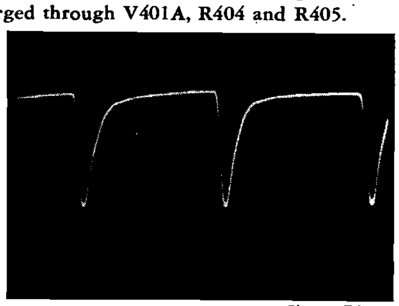


Figure 74
Same point as Fig. 73. Drive control set at maximum counter-clockwise position. 186V p-p.

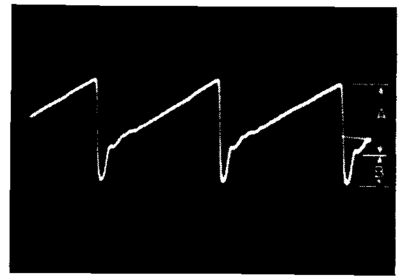


Figure 75
Same point as Fig. 73. Drive control set at maximum clockwise position.
A—35V B—25V

Figs. 74 and 75. These waveforms are shown, to assist the serviceman to determine whether or not the drive control is working properly.

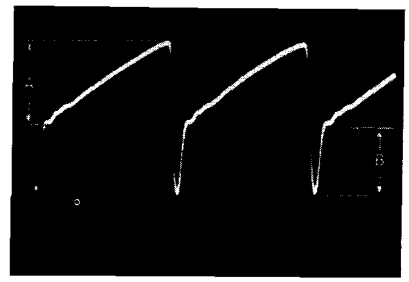


Figure 76
Pin No. 5 V402 (Grid 6BG6 horizontal sweep amplifier)
A—38V B—27

Fig. 76. This waveform is essentially the same as that observed at Fig. 73. The amplitude, however, is slightly lower.

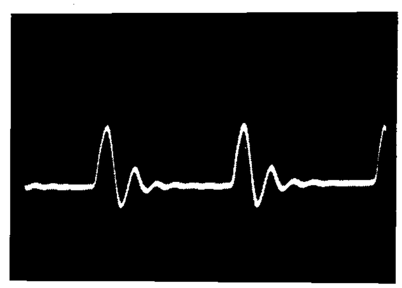


Figure 77
Radiation adjacent to flyback transformer.

Fig. 77. This waveform was observed by holding the oscilloscope lead adjacent to the underside of the flyback transformer. This signal is radiated by the transformer.

DESCRIPTION OF HORIZONTAL SYNC SECTION WAVEFORMS

All observations were made in this section using the oscilloscope settings for horizontal. The circuits will be upset when the measurements are taken. It will be necessary to readjust the frequency and phase controls with the leads attached to obtain these waveforms.

Figure 78
Pin No. 1 V218 (Cathode 6AL5 sync discriminator)
A—5V B—5V

Fig. 78. This signal was observed with the Teleset tuned to a channel. The sync pulse is inserted at the correct point on the sine wave.

Figure 79
Same point as Fig. 78. Signal observed when not tuned to a channel. 5V—p-p.

Fig. 79. With the Teleset not tuned to a channel only the sine wave from the oscillator will be seen.

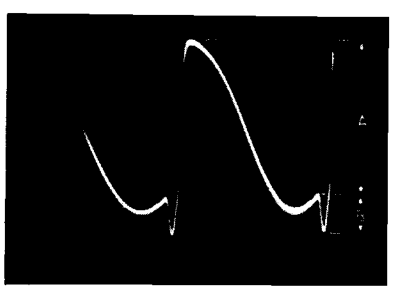


Figure 80
Pin No. 5 V218 (Cathode 6AL5 sync discriminator).
A—5.8V B—2V

Fig. 80. This waveform is similar to that of Fig. 78. However, with the oscilloscope leads attached, it is difficult to adjust the controls to obtain the desired pattern. Note also that the pulse is located on the slope of the sine wave opposite that of Fig. 78.

Fig. 81. This waveform is similar to that of Fig. 79. However, the sine wave at this point is 180 degrees out of phase with the sine wave seen at Fig. 79 with respect to ground.

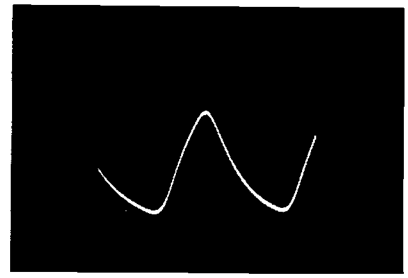


Figure 81
Same point as Fig. 80. Signal observed when not tuned to a channel. 5V—p-p.

TROUBLE SHOOTING

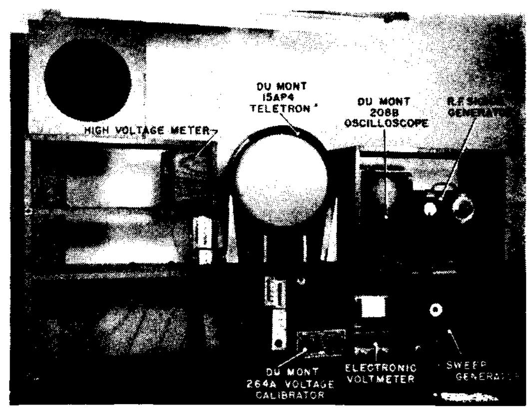


Figure 82.

TEST EQUIPMENT

As to test equipment, Fig. 82 illustrates a test bench with a set of test equipment that is being used to service the RA-101 and the RA-105 Telesets.

The 15-inch tube is permanently mounted, making it unnecessary to remove the tube from the cabinet of the defective Teleset. Special extension cables are used so the various interchassis connections can be made.

The test equipment shown represents an optimum selection that is needed for servicing.

The equipment and their uses follow:

DU MONT 208 B OSCILLOGRAPH

Very helpful in localizing troubles to a definite stage once the section in which the trouble exists has been determined. It is also necessary for visual alignment of the IF stages.

Although not designed for the observation of high frequency signals, it is very good as an all round oscillograph. Most of the type troubles that could occur can be located by the use of this instrument. If, however, an oscillograph that can reproduce a more accurate version of the high frequency pulses is desired, the Du Mont type 224 (3" tube) or 241 (5" tube) are excellent.

DU MONT 264A VOLTAGE CALIBRATOR

Since the amplitude of the waveform under observation is very important, this calibrator is needed with the oscillograph for such measurements.

RF SIGNAL GENERATOR

This generator serves two purposes. It can be used to determine stage gains of the video or sound IF strips or the front end of the receiver. It is also used as a marker generator with the sweep generator when aligning the teleset.

SWEEP GENERATOR

This generator is used in the alignment of the Teleset.

ELECTRONIC VOLTMETER

A very important item in making voltage and resistance measurements. Especially valuable in making voltage measurements in high impedance circuits.

HIGH VOLTAGE METER

Used for measuring the high voltage that is applied to the accelerating anode of the CRT.

SERVICING PROCEDURE

To establish a procedure for servicing the RA-105 Teleset, the receiver has been broken down into a number of sections.

The sections are as follows:

1. Picture and sound section.
2. Sound IF section.
3. Audio section.
4. Picture and sync section. See Fig. 4
5. Picture section.
6. Composite sync section.
7. Vertical sync section.
8. Horizontal sync section.
9. Vertical saw section.
10. Horizontal sweep and high voltage section.
11. Low voltage power supply section.

The method of using this block diagram for localizing troubles is described on the diagram proper.

A logical procedure that may be followed in servicing this Teleset follows:

1. Observe all indications of faulty operation.
2. Based on the observations made in step No. 1, the trouble should be localized to one of the sections previously noted.
3. The trouble should be further localized to the defective stage by means of signal tracing with an oscilloscope. (See Waveform Observation Section.)
4. Once the trouble has been localized to a definite stage, replace the tube with a tube that has been working in the same type circuit.
5. If the trouble is not remedied by step No. 4, then voltage and resistance measurements should be made in order to locate the defective part.
6. If step No. 5 does not reveal any discrepancy, a defective component, whose type of defect will not noticeably affect the voltage and resistance readings should be looked for. For example, an open by-pass condenser or a coil with shorted turns.

In following step No. 3 as noted above, considerable care should be taken when observing waveforms. Not only should the waveshape be noted, but the peak to peak amplitude should be measured. This is where a calibrator is needed.

The importance of waveform measurements in a TV receiver cannot be overemphasized. The serviceman should study the use of his oscilloscope in order that he can obtain the maximum possible results from its application.

Occasionally a receiver may come into the shop with the complaint that the picture quality is poor. It may be that the high frequency response is poor, as indicated by poor reproduction of the wedges on the test pattern.

One of the first things that most servicemen would try is to align the receiver. Before attempting alignment, the serviceman should carefully check the receiver to be certain that misalignment is the cause of the defect.

One quick way to check the alignment is to examine the overall response of the video IF strip. This can be accomplished by feeding a sweep generator signal into the mixer and observing the response with an oscilloscope at the output of the detector. The observed response should be compared to that recommended by the manufacturer. (See alignment section).

Obviously any great deviation from the observed response will indicate the need for alignment.

If the response is satisfactory, then the peaking coils in the video amplifier section should be investigated.

If the above mentioned items check OK, then the response of the front end of the receiver should be investigated.

RECORDS

One practice that is followed by some shops, and which is recommended for general use, is the recording of various troubles encountered in specific receivers.

This practice could be readily applied to the RA-105 Teleset. For example, a chart could be made up to cover all troubles found in the RA-105. This chart could inclnde several headings as follows:

Indications	*Defective Section*	*Defective Part*	*Frequency of Occurrence*

Following is an example of the recording of information for a certain trouble.

Indications	*Defective Section*	*Defective Part*	*Frequency of Occurrence*
Picture rolls Vertically	Vertical Synch	Open Cathode Resistor R303	1 (7/11)

Information of this type is a definite help to a new man as he can refer to the chart and in many cases will locate the trouble in a much faster time than if he completely checked the receiver.

REPLACEMENT OF PARTS

The serviceman should understand that lead placement is very important in high frequency circuits. Thus, during the replacement of defective parts, the wiring should always be returned to its original layout. Any replaced parts should also be placed in the same physical location and orientation as the original.

TROUBLE SHOOTING PROCEDURES

Following is a list of procedures that can be followed in locating trouble in the Teleset.

It should be understood that only one trouble is assumed to be happening at a time. Thus, under the heading "Indications", only the indication presented describes the fault. For example, if the statement reads "Picture but no Sound", it is to be assumed that everything else is working OK.

See Figure 4.

MOST-OFTEN-NEEDED 1949 TELEVISION RECEIVERS

1. PICTURE AND SOUND SECTION

INDICATIONS	PROCEDURE
1. No picture and no sound, or weak picture and low sound output.	1. Check installation. 2. Replace tubes. 3. Use R. F. generator and signal trace these circuits. 4. Take voltage and resistance readings.
2. Picture and sound fades out, retuning receiver brings them back in.	Replace C114 in the Inputuner. Be sure to replace with a type N-030 as specified on the schematic diagram.
3. Picture jumps as the Teleset is tuned. Sound is noisy at the same time.	The inductuner (adjustable coils) requires cleaning.

Procedure for cleaning follows:

1. Remove the Inductuner cover in a clean, dust free location.

2. Using a small soft brush, clean the wire, end rings and bottom track of all three coils.

3. Lubricate the wire, end rings and bottom track of all three coils with Lubriplate type 105. Use the Lubriplate sparingly.

4. Rotate the Inductuner completely through its range several times to insure a smooth film of lubricant over all the contact surfaces.

5. Replace cover and tighten screws.

CAUTION: *No lubrication other than Lubriplate type* 105 *should be used.*

Note

If you should run into trouble with the Inputuner section that you cannot locate, it is recommended that the Inputuner be returned to us for repair.

REMOVAL AND REPLACEMENT OF THE INPUTUNER

1. Unsolder the four leads coming out of the Inputuner to the receiver chassis. *Do not cut the leads; keep them full length.* Denote the color coding of the wires and terminals from which the wires were removed.

2. Unsolder the Inputuner cable leads at the antenna terminals. Remove the clamp that holds this transmission line to the chassis.

3. Remove the three screws which fasten the Inputuner to the chassis.

4. Lift the Inputuner from the chassis.

5. To put in the new Inputuner, reverse the steps above.

2. SOUND IF SECTION

INDICATIONS	PROCEDURE
Picture normal. No sound or weak sound. Trouble isolated to this stage because the tuning indicator does not function normally as the Teleset is tuned.	1. Test or replace tubes in this section. 2. Signal trace the stages in this section using an RF generator, a crystal probe and an oscilloscope. The crystal probe will have to be used in making measurements within this section. 3. Check voltage and resistance measurements at defective stage. 4. If No. 3 reveals no difficulty, check for an open capacitor or partially shorted transformer. 5. Check the alignment.

3. AUDIO SECTION

INDICATIONS

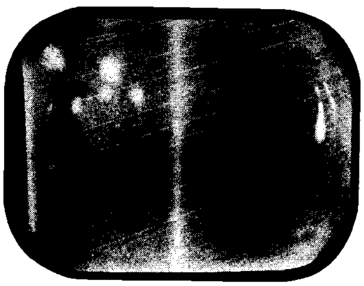
Picture normal. No sound or weak sound. Trouble isolated to this section because the tuning indicator functions normally as the Teleset is tuned. Also, on the Colony, there is no sound or weak sound output when using the record player or AM radio.

PROCEDURE

1. Replace tubes.
2. Tune to a station. With oscilloscope, signal trace these circuits.
3. At defective stage check voltage and resistance measurements.

4. PICTURE AND SYNC SECTION

INDICATIONS



1. Fig. 83. Unsynchronized raster. Sound normal, but no picture or sync.

PROCEDURE

1. Check setting of A.G.C. threshold control. It is possible that gas current in the 6AT6 will make re-adjustment necessary.
2. Replace tubes.
3. Using an oscilloscope and probe detector, signal trace these circuits. The Teleset should be tuned to the strongest station and the A.G.C. control turned completely counter-clockwise during this procedure.
4. Take voltage and resistance measurements at defective stage as located in item No. 3.

2. Picture completely blanked out on strong stations. On the weakest stations, picture is present and synchronized but there is excessive "snow" or "noise". On the other stations of intermediate strength, the picture will not synchronize. These indications resemble what can occur in some locations using an RA-103 Teleset with the contrast on full.

1. Replace 6AT6 AGC tube and readjust the AGC control. If this does not correct the fault, proceed as follows with the antenna removed.
2. Using a voltmeter, run through AGC adjustment to determine if action is normal (See Section on adjustments)
3. If reading remains constant as control is varied check C226 for a short.
4. If reading varies normally, check grid circuits of the AGC controlled stages.
5. If at step No. 3 C226 is okay, observe waveform at pin No. 1 of V209. This waveform should be approximately the same as Fig. 84.
6. Observe the waveform at pins No. 7 and 5 of V209. With the A.G.C. control properly adjusted no waveform should be present at pin No. 7 or pin No. 5.
7. Rotate A.G.C. control completely clockwise. Observe waveforms at pin No. 7 and pin No. 5. These should be approximately the same as Fig. 85 and Fig. 86.
8. Take voltage and resistance readings at portion of circuit where the waveforms are incorrect. If waveforms appear normal, check all voltage and resistance measurements of this circuit.

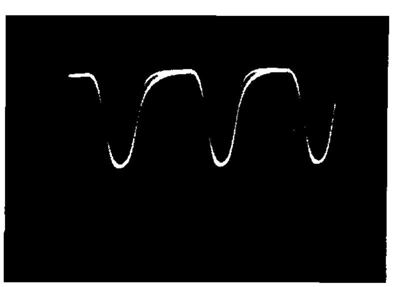


Fig. 84. Pin No. 1 V209 (Horizontal) P-P—2V.

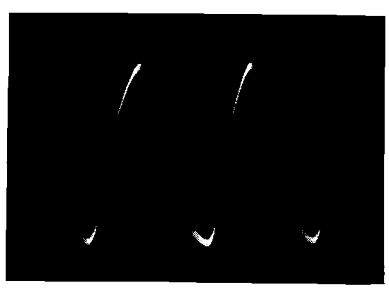


Fig. 85. Pin No. 7 V209 (Horizontal) P-P—6V.

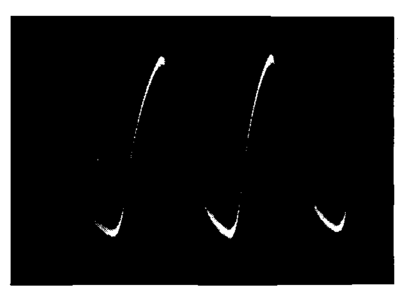
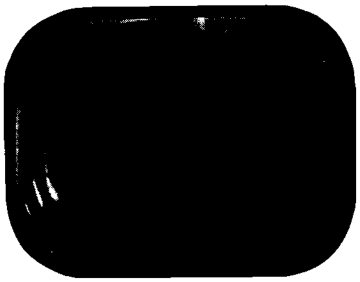
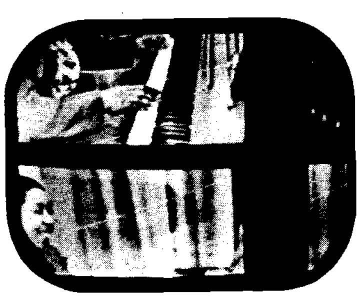


Fig. 86. Pin No. 5 V209 (Horizontal) P-P—6V.

5. PICTURE SECTION

INDICATIONS	PROCEDURE
 1. Fig. 87. Synchronized raster but no picture.	1. Replace tubes. 2. Tune to a TV station. Signal trace section with an oscilloscope. (See Waveform Observation Section). 3. Check E and R measurements. 4. If No. 3 does not reveal discrepancy, look for open coupling capacitor.
2. Picture quality poor. Brightness control works backward.	Check C221, (coupling capacitor between plate of V207 and grid of CRT) for short.
3. Picture too bright. Cannot properly decrease brightness.	POSSIBLE DEFECT Defective CRT. (Grid-cathode shorted). Shorted C224. (Cathode of CRT to ground).

6. COMPOSITE SYNC SECTION

INDICATIONS	PROCEDURE
 Fig. 88. Picture out of sync both horizontally and vertically.	1. Replace V217. 2. Observe waveforms. 3. Make necessary voltage and resistance measurements. 4. Check C263.

7. VERTICAL SYNC SECTION

INDICATIONS

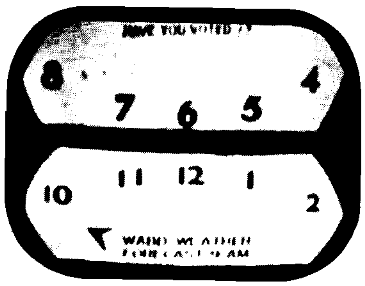


Fig. 89.
Picture Rolls Vertically

PROCEDURE

1. Adjust vertical hold control.
2. Replace the tube in this section.
3. Check waveforms. (See Waveform Observation Section).

If the above procedure does not disclose the trouble, the defect may be in the Vertical Saw Generator. (See below).

The trouble may be the free running frequency of the Vertical blocking oscillator cannot be adjusted close enough to 60 cycles.

Fig. 90.
Vertical free running frequency too high.

1. Note Fig. 90. If by adjustment of the vertical hold control, the indications on the CRT approach this figure, and it is not possible to get one complete picture manually, the free running frequency is too high.

2. Note Fig. 91. If by adjustment of the vertical hold control, the indications on the CRT are similar to this figure, and it is not possible to get one complete picture manually, the free running frequency is too low. This figure indicates there are approximately one and one half frames in view at one time. A more extreme condition of this would be when two complete pictures one above the other are visible.

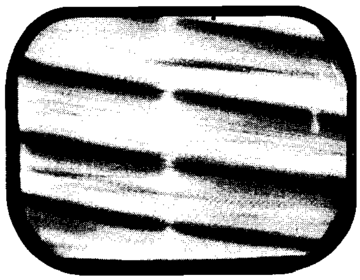
Fig. 91.
Vertical free running frequency too low.

In either of the above two cases, investigate the grid circuit of the vertical blocking oscillator. Check C273, R307 and R308.

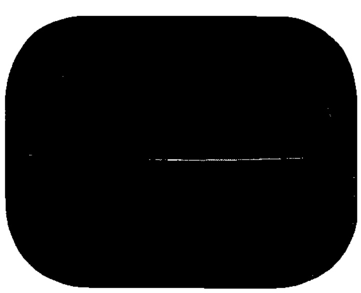
If the free running frequency is too high and cannot be adjusted low enough, the value of one of the above must be much lower than normal.

If the frequency is too low, the defective component will have increased in value.

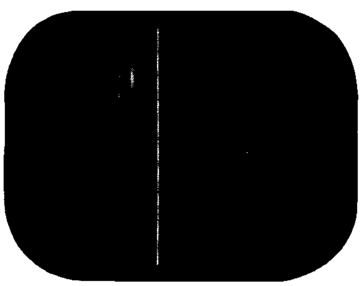
8. HORIZONTAL SYNC SECTION

INDICATIONS	PROCEDURE
 1. Fig. 92. No Horizontal Sync  Fig. 93. After frequency control has been adjusted.	1. Adjust the horizontal frequency control, until a complete picture is seen on the screen. The entire picture will move sideways as shown at Fig. 93. 2. Replace 6AC7 and then the 6AL5. 3. Observe waveforms. (See Waveform Observation Section). 4. Check Voltage and resistance measurements. If the above check reveal no discrepancy proceed as follows: 1. Connect a high impedance voltmeter from grid to ground at the 6AC7 reactance tube. Try to manually synchronize the horizontal oscillator by carefully adjusting the horizontal frequency control. If the correction voltage is being applied to the grid of the reactance tube, the meter pointer will swing one way as the frequency shifts in one direction and the opposite way as the frequency shifts in the other direction. The magnitude of this variation in voltage will be at least three volts in each direction. If this variation is present, then the reactance tube circuit is defective. If not, then the same check should be made at pin No. 7, of the sync discriminator. The results of the test at this point will reveal whether or not the defective circuit is the sync discriminator, or the filter circuit between the discriminator and the reactance tube.
2. Top of picture tries to tear out. Ignition noise causes tearing out of the picture.	Replace C288. (The .1 ufd capacitor at junction of R324 and R325. Capacitor is open.)
3. Several pictures appear side by side. Not possible to obtain a single picture regardless of horizontal frequency adjustment.	Check transformer Z205 for broken slug. Check C268 and R299.

9. VERTICAL SAW SECTION

INDICATIONS	PROCEDURE
 1. Fig. 94. No Vertical Sweep.	Check the following items in the order given: 1. Tubes. 2. Waveforms. 3. Voltage and resistance measurements. If the fault is not located after the regular procedure, check the deflection yoke.
2. Insufficient Vertical Size.	Use procedure as above. In addition to procedure check C285C and C265A for open.
3. Poor Vertical linearity. Adjustment of linearity control has no effect.	Check C285C for possible short or leakage.

10. HORIZONTAL SWEEP AND HIGH VOLTAGE SECTION

INDICATIONS	PROCEDURE
1. No Raster, sound is normal.	1. Replace 1B3's. 2. Replace 6BG6, 12AU7, 6K6, 5V4. 3. Observe waveforms. 4. Take voltage and resistance measurements. 5. Observe if the filament of the CRT is lit.
 2. Fig. 95. Fold over in the horizontal sweep. Note the horizontal size is reduced considerably.	Check capacitors C408 and C409 for open.
 Fig. 96. Same trouble as Fig. 95 showing effect on raster alone.	Same as above.
3. Very poor horizontal linearity. Picture stretched out on left side.	If adjustments are correct, then check R413 for an open.
4. Insufficient horizontal size.	Adjust size control switch, and size control. Replace V401 and V402. Check R403, C413, R404 and R405 for correct value. Observe waveforms in the circuits of V401-A and V402. Take voltage and resistance measurements in questionable portion of the circuit.

CAUTION: *When replacing any components in the high voltage section of the power supply, the dressing of leads is very important. To prevent corona (arcing) there should be no sharp bends in the high voltage circuit leads. These leads should be kept away from the metal chassis as well as possible. Also if it is necessary to do any soldering in this section be careful to "ball" the solder joint. Any sharp metal points that are at a high voltage will cause corona to issue from them. This corona causes a hissing noise and if the circuit is closely examined, sharp needles of purple flame will be seen to issue forth from these points.*

11. LOW VOLTAGE POWER SUPPLY SECTION

INDICATIONS	PROCEDURE
No Raster, no picture and no sound. Tuning indicator fails to glow.	1. Check to see if the filaments of the tubes are lit. If not, check the fuse and the A.C. connections. 2. If the tubes are lit then replace the 12AU7 relay control tube in the Flyback Power supply chassis. 3. Check relay K201. 4. Check resistors R415, R416 and R417.

ALIGNMENT PROCEDURE

The alignment of a Television receiver is a procedure that must be followed very carefully in order that the end result is comparable to that obtained when aligned at the factory.

Before attempting to align, the serviceman must be sure that alignment is required.

If there is any doubt in the serviceman's mind regarding the need for alignment, a quick check can be made by viewing the overall response of the video IF strip. This is accomplished by performing step No. 9 in the alignment procedure.

EQUIPMENT NEEDED

SWEEP GENERATOR

This generator should be capable of putting out a band of frequencies from about 20 to 30 megacycles. Some means for identifying the frequency of various parts of the response curve must be available. To effect this, the sweep generator must either have an internal marker circuit or an external RF generator to perform the same function, will have to be used.

In the alignment table under the heading "Type of Input Signal Required", the description "Wobb and unmodulated RF signal" means that both the sweep generator output (wobbulator) and the unmodulated RF generator are to be fed into the point designated. It should be understood that both these units will have to be used if the sweep generator does not have an internal marker generator. (Fig. 97.)

If, however, the sweep generator has an internal marker

Fig. 97. Alignment using sweep generator with external marker generator.

Fig. 98. Alignment using sweep generator with self-contained marker generator.

generator, (Fig. 98) only the output from this one unit need be fed into the designated point.

OSCILLOSCOPE

An oscilloscope is used as a means of visually indicating the response of the stage or stages under observation.

All of this equipment must be securely grounded to the receiver being aligned. This grounding can be accomplished by using a metal top bench, preferably copper. If such a bench is not available, these units should be bonded together by the use of heavy metal braid between the chassis. Ordinary wire is not enough to effectively place all units at the same potential.

Once the equipment is set in place, the generators and receiver should be allowed to run at least 15 minutes before starting to align.

Additional equipment necessary for alignment is what is referred to as a 6AK5 adapter tube. This is simply a 6AK5 with a fine wire soldered to pin No. 1. It may be necessary to fasten this wire to the side of the tube with scotch tape to prevent it shortening against the bottom of the shield. This tube is used to permit feeding the generator output into the grid of the mixer stage without disturbing the inputuner.

In the procedure, reference is made to the use of a "Probe Detector". This device is merely a crystal rectifier with the necessary filter. (Fig. 99). Its purpose is to permit the observation of the response of a single stage when viewed ahead of the video detector.

VIDEO IF ALIGNMENT TABLE

Step No.	To Adjust	Type of Input Signal Required	Connect Generator Leads Across	Connect Output Leads Across	Feed Output leads directly into Oscillograph or into Oscillograph via Probe Detector	Adjust to Conform to response. Curve Shown in	Remarks
1.	C213 L211 L212	Wobb and unmodulated R.F. signal.	Pin 1 (grid) V203 and chassis	Pin 1 (grid) V205 and chassis	Direct	Fig. 100	C213 adjusts curve for double peak. L211 and L212 adjusts markers. L209 should be shorted to ground.
2.	R251 AGC						Set for 3.2V. At junction of R246 and C226.
3.	L210 Z201 (top)	Mod. signal at 21.9 mc.	Pin 1 (grid) V201 and chassis	Pin 1 (grid) V205 and chassis	Direct	None	Adjust both for minimum output.
4.	L209	Mod. signal at 27.9 mc.	Pin 1 (grid) V201 and chassis	Pin 1 (grid) V205 and chassis	Direct	None	Adjust for minimum output.
5.	L207 L208	Wobb and unmodulated R.F. signal.	Pin 1 (grid) V202 and chassis	Pin 1 (grid) V205 and chassis	Direct	Fig. 101	
6.	L204 L206	Wobb and unmodulated R.F. signal.	Pin 1 (grid) V201 and chassis	Pin 5 (plate) V202 and chassis	Probe Detector	Fig. 102	
7.	To check 1st, 2nd and 3rd Video IF stages	Wobb and unmodulated R.F. signal.	Pin 1 (grid) V201 and chassis	Pin 1 (grid) V205 and chassis	Direct	Fig. 103	If necessary readjust L204 and L206
8.	L201 L203	Wobb and unmodulated R.F. signal.	Pin 1 (grid)* V102 and chassis	Pin 5 (plate) V201 and chassis	Probe Detector	Fig. 104	Grid of V202 should be grounded.
9.	Check overall Video IF stages	Wobb and unmodulated R.F. signal.	Pin 1 (grid) V102 and chassis	Pin 1 (grid) V205 and chassis	Direct	Fig. 105	If necessary readjust L206, L204.

SOUND IF ALIGNMENT TABLE

Step No.	To Adjust	Type of Input Signal Required	Connect Generator Leads Across	Connect Output Leads Across	Feed Output leads directly into Oscillograph or into Oscillograph via Probe Detector	Adjust to Conform to response. Curve Shown in	Remarks
1.	Z203	Wobb and unmodulated R.F. signal at 21.9 mc.	Pin 1 (grid) V211 and chassis	Pin 5 (plate) V212 and chassis	Probe Detector	Fig. 106	Adjust for a symmetrical response.
2.	Z202	Wobb and unmodulated R.F. signal at 21.9 mc.	Pin 1 (grid) V210 and chassis	Pin 5 (plate) V212 and chassis	Prohe Detector	Fig. 107	Adjust for a symmetrical response.
3.	Z201 bottom coil	Wobb and unmodulated R.F. signal at 21.9 mc.	Pin 1 (grid)* V201 and chassis	Pin 5 (plate) V212 and chassis	Probe Detector	Fig. 108	Adjust for a symmetrical response. (If AGC is set too high the 1st video IF tube will cut off, resulting in no signal.
4.	Z204 top coil (sec.) bottom coil (pr.)	Wobb and unmodulated R.F. signal at 21.9 mc.	Pin 1 (grid) V201 and chassis	Junction of R274 and and C250	Direct	Fig. 109	Center the 21.9 mc marker on S response curve with secondary control. Then adjust for maximum response with primary control.

GRAIN TRAP ADJUSTMENT

Step No.	To Adjust	Type of Input Signal Required	Connect Generator Leads Across	Connect Output Leads Across	Feed Output leads directly into Oscillograph or into Oscillograph via Probe Detector	Adjust to Conform to response. Curve Shown in	Remarks
1.	L216	Modulated R.F. at 4.5 mc.	Pin 1 (grid) V205 and chassis	At grid, pin 2 CRT	Probe Detector		Adjust for minimum output. (Contrast control at maximum setting.)

*Use 6AK5 adaptor. Connect hot lead of generator to the wire on Pin No. 1.
After completing the alignment, be sure to properly adjust the AGC control.

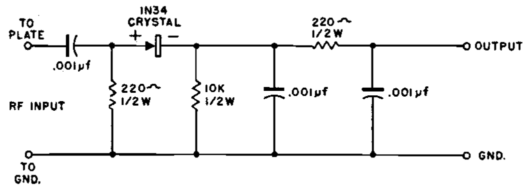


Figure 99

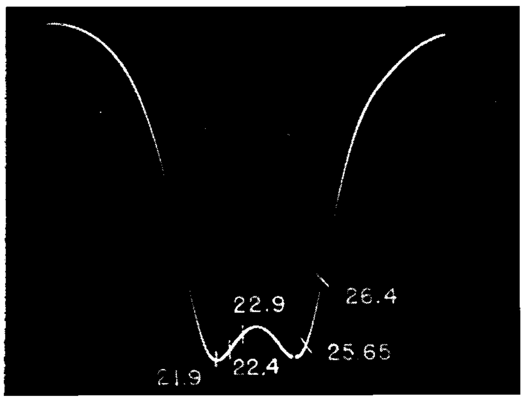


Figure 100

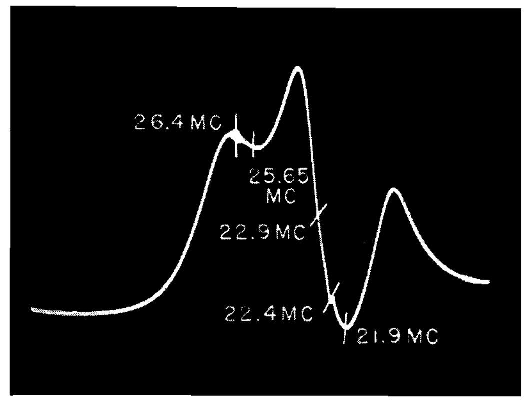


Figure 102. Frequencies shown above are in reverse order, which merely indicates that the response was observed when sweep generator was sweeping from high to low end.

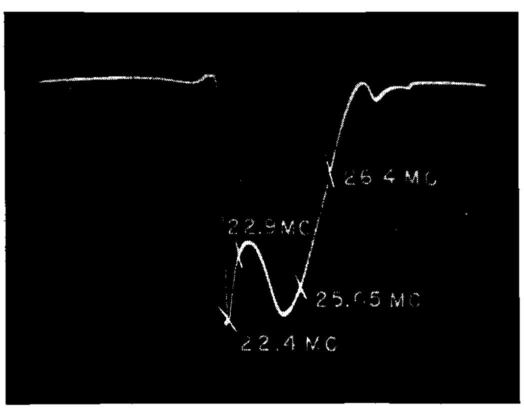


Figure 101

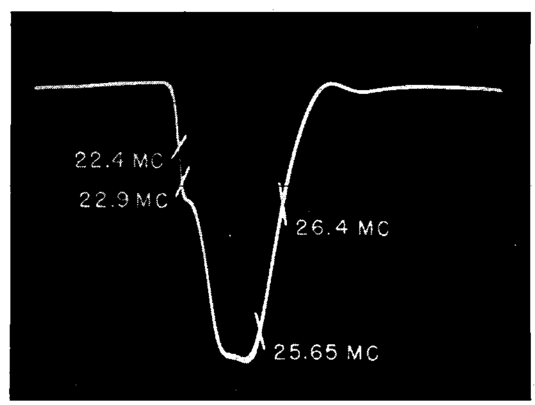


Figure 103

CAUTION

When removing or replacing picture tube in owner's home, be sure that only authorized service personnel are present in the room. Serious injury may result from flying glass if CRT should shatter.

Do not leave CRT in any spot where it may fall or be struck.

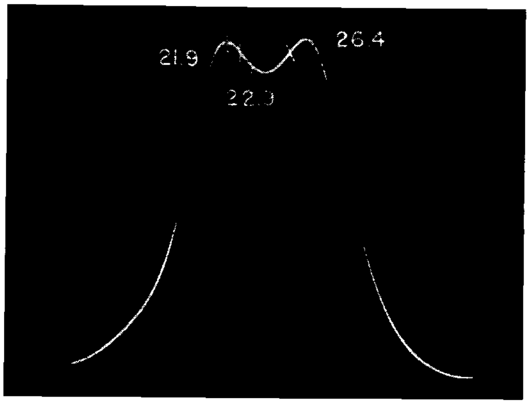


Figure 104. The two unidentified markers are at 22.4 MC and 25.65 MC.

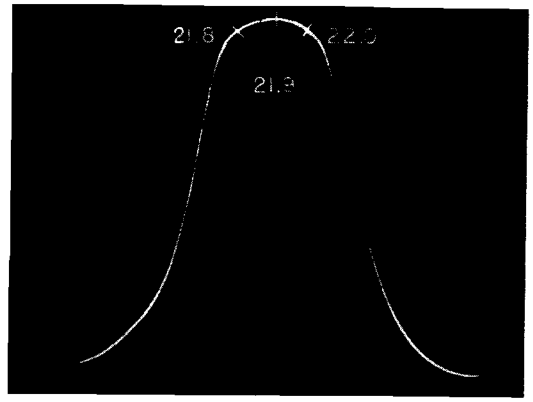


Figure 107.

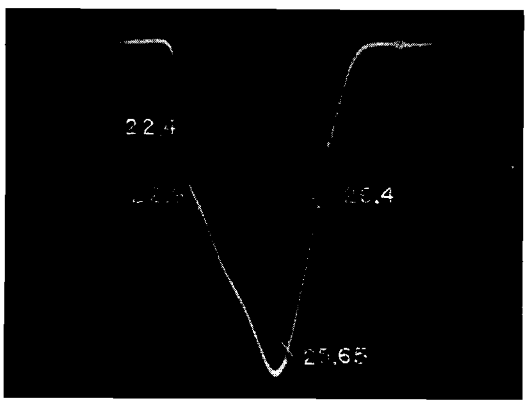


Figure 105.

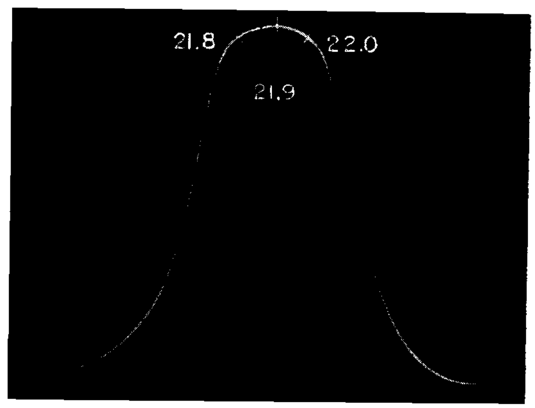


Figure 108.

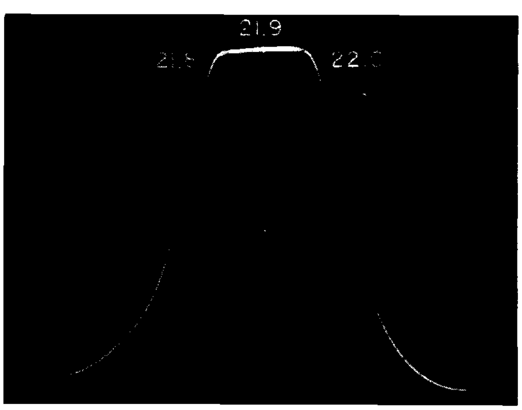


Figure 106.

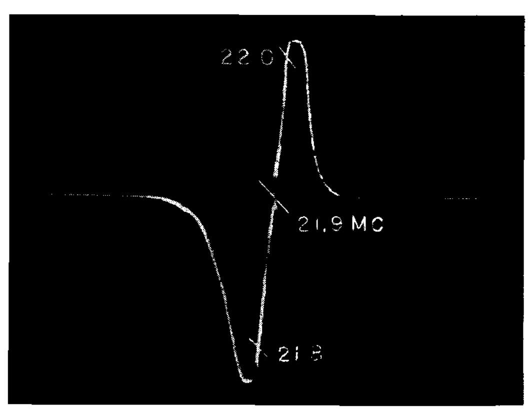
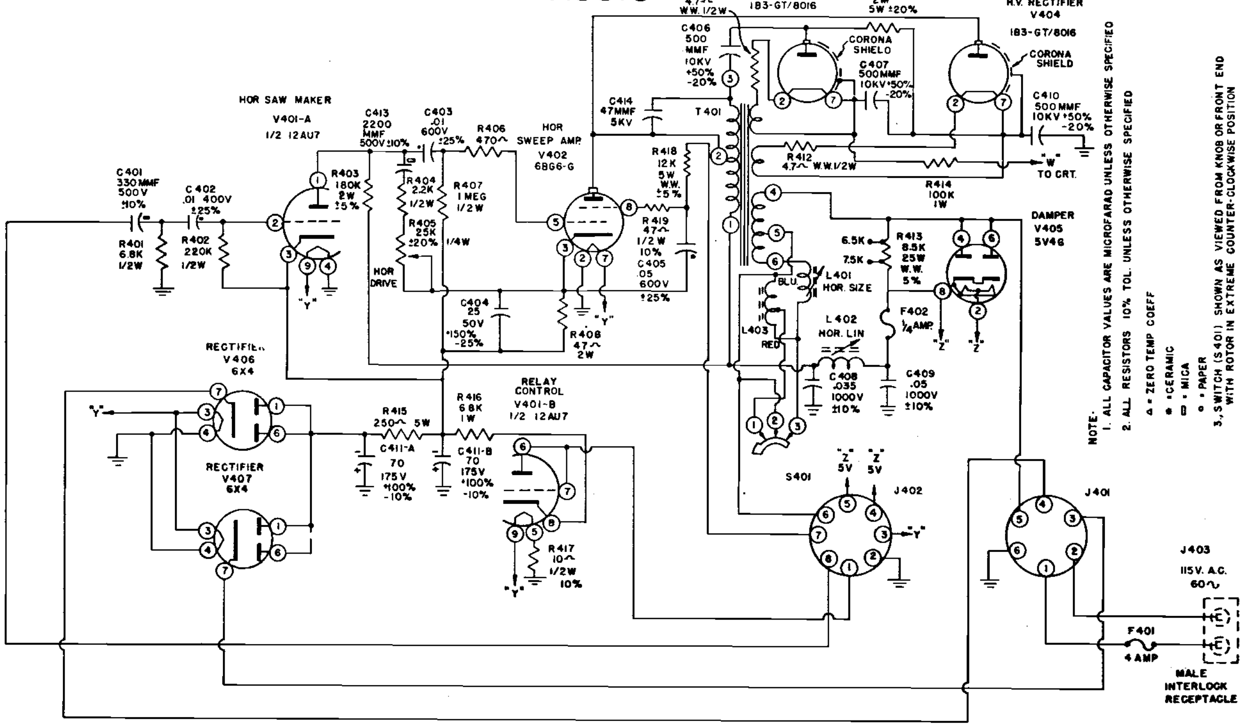


Figure 109.

MODEL RA-105 TELESET

FLYBACK POWER SUPPLY CHASSIS



TYPICAL VOLTAGE READINGS

Line 117V Picture adjusted for normal size. RCA Voltomyst Model 195A used. All readings to chassis.

Tube	1	2	3	4	5	6	7	8	9	Top Cap
** V401	100V	-140V	-95V	0	0	-37V	-37V	-42V	6	
V402	190V	0	-85V		110V	-110V	6.3 Vac	190V		560V
V403		11KV					11KV			4.6KV
V404		4.6KV					4.6KV			560V
V405		4.60V		390V		390V		470V		
V406	-120V		Vac 6.3	0		-120V	115 Vac			
V407	-120V		Vac 6.3	0		-120V	115 Vac			

**On the early models, R402 and the cathode of V401-A are returned directly to ground. On these sets, R403 is a 220K 2W resistor. The following readings will apply only to these sets:

Tube	1	2	3	4	5	6	7	8	9	Top Cap
V401	180V	-41V	0	0	1.2 Vac	-37V	-37V	-41V	6.2 Vac	

TYPICAL RESISTANCE READINGS

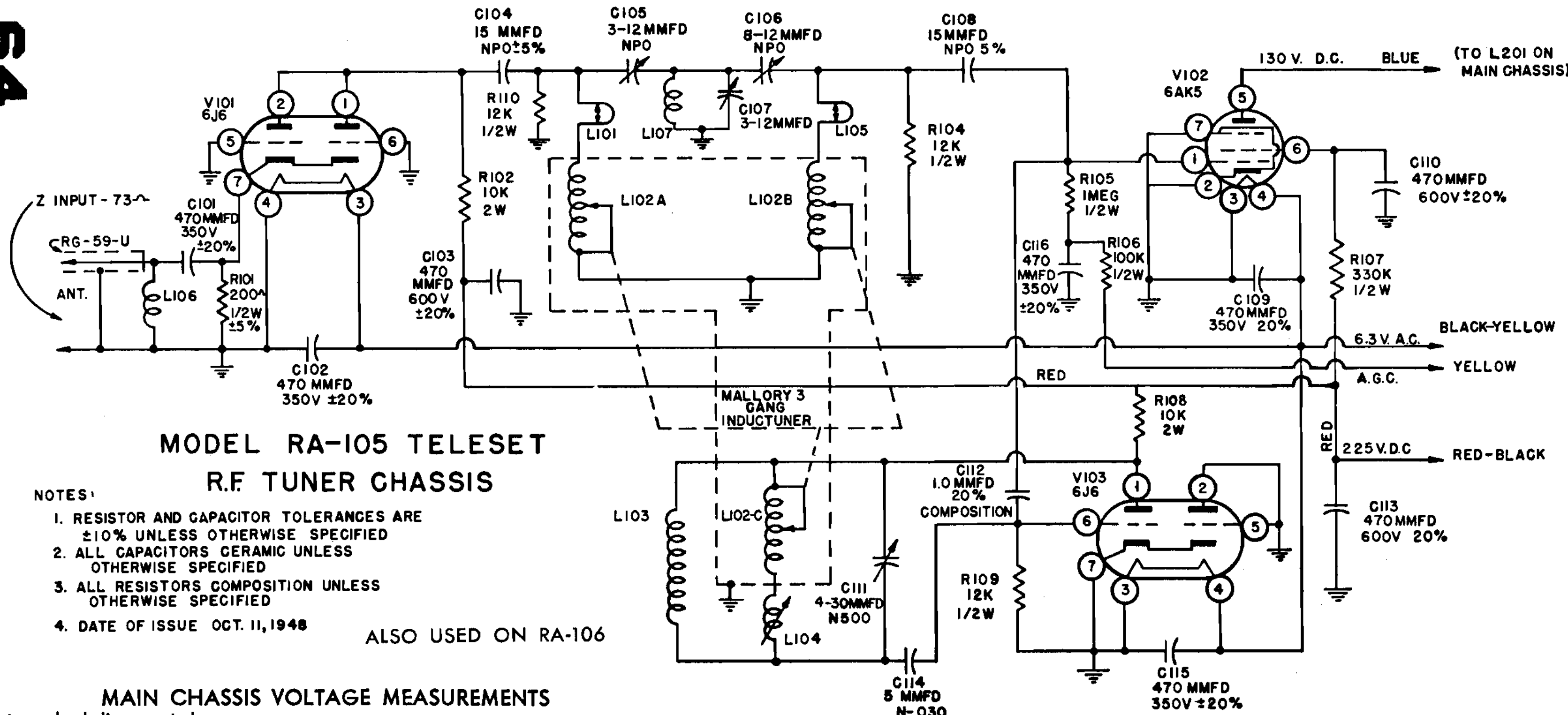
All readings in ohms unless otherwise indicated. M=1 million K=1 thousand

Tube	1	2	3	4	5	6	7	8	9
† V401	210K	2.5M*	2M*	0	5.5	5K	5K	300K	
V402	21K	0	2M*	6.5	3.8M*	3.8M*	.1	23K	—
V403	Inf.	Inf.	Inf.	Inf.	Inf.	Inf.	Inf.	Inf.	
V404	Inf.	Inf.	Inf.	Inf.	Inf.	Inf.	Inf.	Inf.	
V405	Inf.	22K	Inf.	5K	Inf.	5.8K	Inf.	22K	—
V406	3.5M*	4.5M	0.05	0	4.1M	3.5M*	4.5	—	—
V407	3.5M*		0.05	0	500K*	3.5M*	4.5	—	—

†On the early models, R402 and the cathode of V401-A are returned directly to ground. On these sets, R403 is a 220K 2W resistor. The following readings will apply only to these sets.

Tube	1	2	3	4	5	6	7	8	9
V401	220K	220K	0	0	5.5	5K	5K	300K*	0.05

*Readings were observed after the capacity in the circuit was charged.



MODEL RA-105 TELESET

R.F. TUNER CHASSIS

NOTES:

1. RESISTOR AND CAPACITOR TOLERANCES ARE ±10% UNLESS OTHERWISE SPECIFIED
2. ALL CAPACITORS CERAMIC UNLESS OTHERWISE SPECIFIED
3. ALL RESISTORS COMPOSITION UNLESS OTHERWISE SPECIFIED
4. DATE OF ISSUE OCT. 11, 1948

ALSO USED ON RA-106

MAIN CHASSIS VOLTAGE MEASUREMENTS

Antenna lead disconnected.
All readings are in volts. Line 117V.

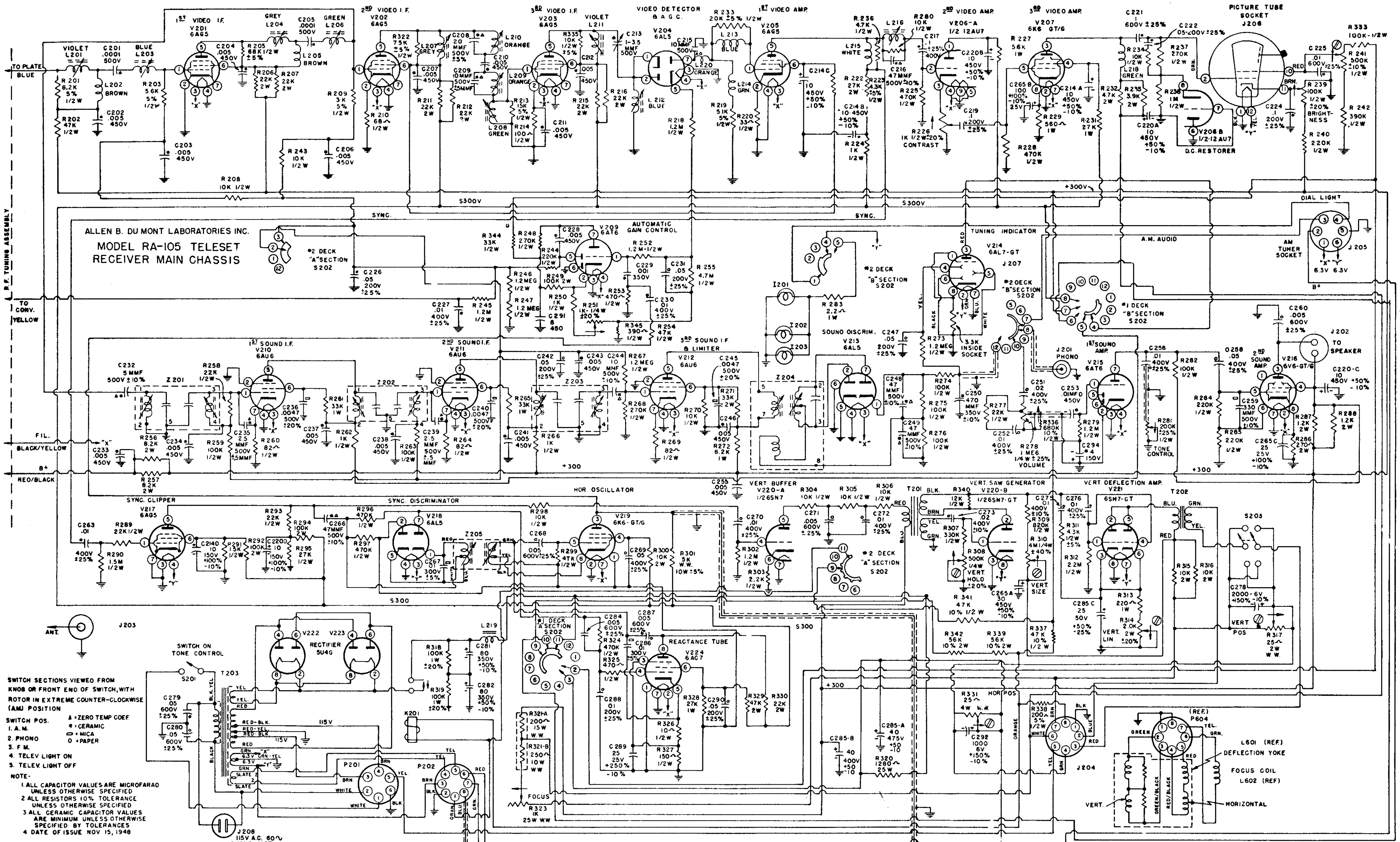
Tube	1	2	3	4	5	6	7	8	9
V201	-1.4	NC	6.3AC	0	180	180	0		
V202	-1.4	.5	6.3AC	0	190	190	.5		
V203	0	1.3	6.3AC	0	150	150	1.8		
V204	0	0	0	6.3AC	.9	NC	-.05		
V205	-.05	.2	6.3AC	0	260	150	NC		
V206	240	0	8.5	6.3AC	6.3AC	0	0	1.4	0
V207	NC	0	290	190	0	NC	6.3AC	13.5	
V209	.7	6	0	6.3AC	-.8	0	250		
V210	-.3	0	6.3AC	0	295	180	1.1		
V211	-.3	0	6.3AC	0	285	165	1		
V212	-.4	0	6.3AC	0	240	52	.25		
V213	.5	-5.2	6.3AC	0	0	0	-13		
V214	1.6	6.3AC	290	-2.7	0	0	0	1.6	
V215	-.5	0	0	6.3AC	NC	NC	115		
V216	NC	6.3AC	255	270	0	NC	0	13	
V217	-.9	NC	0	6.3AC	15	18	0		
V218	6.8	0	6.3AC	0	6.8	NC	-.6		
V219	NC	0	220	225	-46	NC	6.3AC	.5	
V220	-33	13.5	0	0	200	7.5	0	6.3AC	
V221	0	330	14	0.1	330	14	6.3AC	0	
V223	NC	430	NC	400AC	NC	400AC	NC	430	
V224	NC	6.3AC	1	0	1	100	0	200	

MAIN CHASSIS RESISTANCE MEASUREMENTS

All readings are in ohms unless otherwise stated.
(M=Million K=Thousand)

Tube	1	2	3	4	5	6	7	8	9
V201	2.1M	0	0.2	Gnd	28K	28K	0		
V202	2.5M	68	0.2	Gnd	40K	40K	0		
V203	0.2	100	0.2	Gnd	36K	36K	100		
V204	0.3	0.3	Gnd	0.2	5.9M	NC	5.2K		
V205	5.2K	33	0.2	Gnd	26K	66K	33		
V206	26K	470K	1K	0.2	0.2	Gnd	Gnd	1M	Gnd
V207	NC	Gnd	17K	40K	470K	NC	0.2	5[illegible]0	
V209	5.8M	2.25K	Gnd	0.2	2.7M	Gnd	370K		
V210	1.6M	Gnd	0.2	Gnd	15K	50K	82		
V211	1.2M	Gnd	0.2	Gnd	15K	50K	82		
V212	270K	Gnd	0.2	Gnd	17K	9K	82		
V213	200K	100K	0.2	Gnd	Gnd	Gnd	100K		
V214	3.3K	0.1	14K	14M	Gnd	Gnd	Gnd	3.3K	
V215	1.3M	Gnd	Gnd	0.2	NC	NC	[illegible]0K		
V214	NC	0.2	5K	14K	440K	220K	Gnd		
V217	[illegible]5M	Gnd	Gnd	0.1	16K	14K	Gnd		
V218	500K	0	0.2	Gnd	500K	NC	1M		
V219	Gnd	Gnd	[illegible]0K	25K	47K	500K	0.2	Gnd	

Main chassis is shown on blueprint.



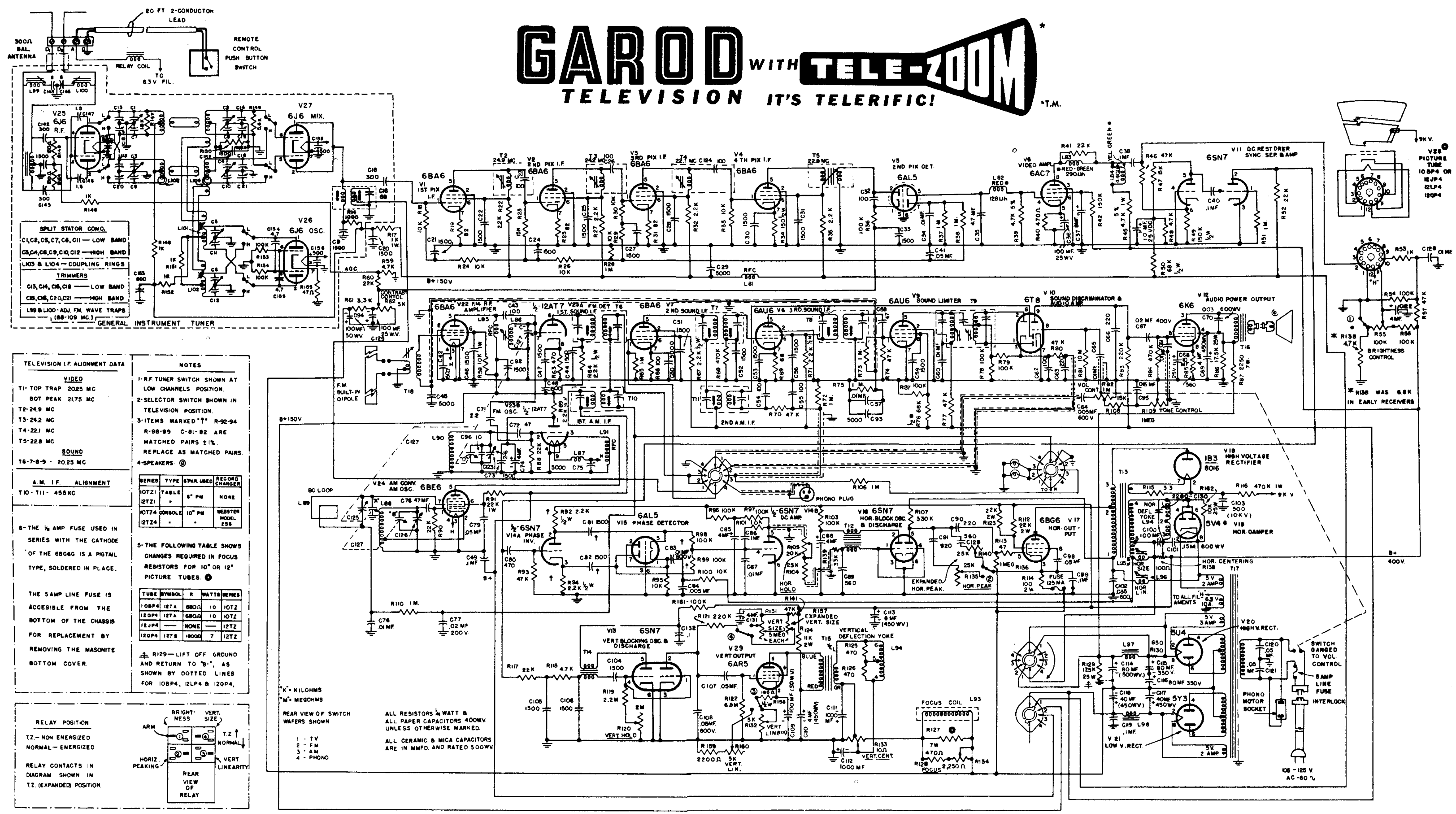
ALLEN B. DU MONT LABORATORIES INC.
TELESET SERVICE CONTROL DEPT.
2 MAIN AVE. PASSAIC, N.J.

ALSO USED ON RA-106

This drawing is to be used when servicing those RA-105 Telesets starting approximately with serial No. 8,501,001. When servicing those sets whose serial number is lower than this number, please see main chassis schematic dated Oct. 8, 1948.

The serviceman should realize that circuit changes on future and previous sets that differ from this schematic may cause certain of these measurements to be apparently in error.

All readings to chassis.
Selector switch in TV position.
RCA 195A Voltohmyst used.



SERIES

10TZ1	10"	TABLE	
10TZ3	10"	CONSOLETTE	
12TZ1	12"	TABLE	
12TZ3	12"	CONSOLETTE	
10TZ4	10"	CONSOLE	
12TZ4	12"	CONSOLE	
12TZ6	12"	DELUXE CONSOLE	WITH AUDIO AMPLIFIER
15TZ6	15"	DELUXE CONSOLE	WITH AUDIO AMPLIFIER

CIRCUIT SCHEMATIC DIAGRAM

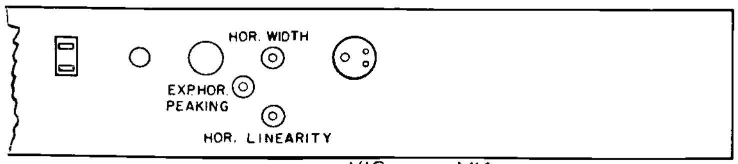
GAROD RADIO CORPORATION
BROOKLYN 1, NEW YORK

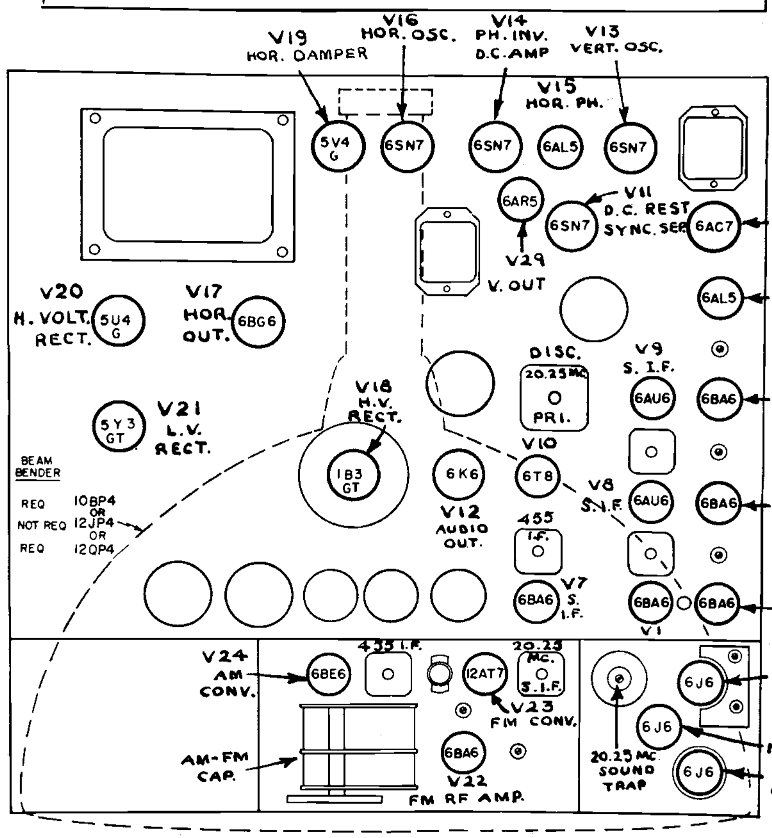
GAROD TELEVISION

Models 10TZ1, 10TZ3, 10TZ4, 12TZ1, 12TZ3, 12TZ4, 12TZ6, 15TZ6.

With Telezoom feature.

REAR VIEW





TUBE PLACEMENT - TOP VIEW

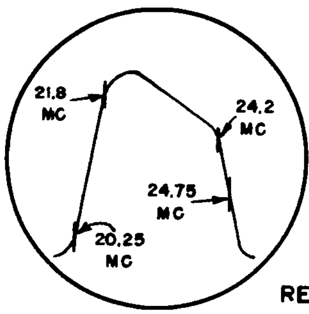


FIG. 1

TV IF RESPONSE

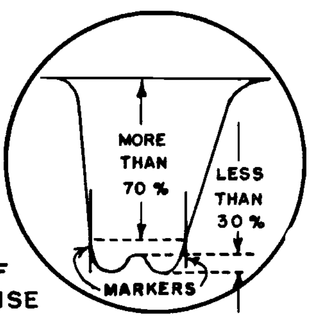


FIG. 2

TV RF RESPONSE

CIRCUIT ALIGNED	STEP	SELECTOR SWITCH	CHANNEL	SIGNAL GENERATOR CONNECTIONS	SIGNAL GENERATOR FREQ.	CONNECT VTVM	ADJUST	METER INDICATION
TV SOUND	1	FOLLOW PROCEDURE FOR FM - IF & DISCRIMINATOR ADJUSTMENT, STEPS 2,3, & 4 AS SHOWN ON AM-FM ALIGNMENT* CHART.						
TV IF	2	TV	8	ACROSS CENTER TAP OF MIX. GRID COILS & GND. (R150)	22.8 MC	ACROSS 4.7K LOAD RES. (R39)	T5	MAX. DEFL
	3	"	"	"	22.1 MC	"	T4	"
	4	"	"	"	24.2 MC	"	T3	"
	5	"	"	"	24.9 MC	"	T2	"
	6	"	"	"	21.75 MC	"	T1 (BOT.)	"
	7	"	"	"	20.25 MC	"	T1 (TOP)	MIN. DEFL

*Use identical signal generator frequencies as in Steps 2,3, & 4, of F.M. I.F. alignment.

AM-FM RECEIVER ALIGNMENT CHART SERIES 10TZ, 12TZ, & 15TZ TELEVISION RECEIVERS

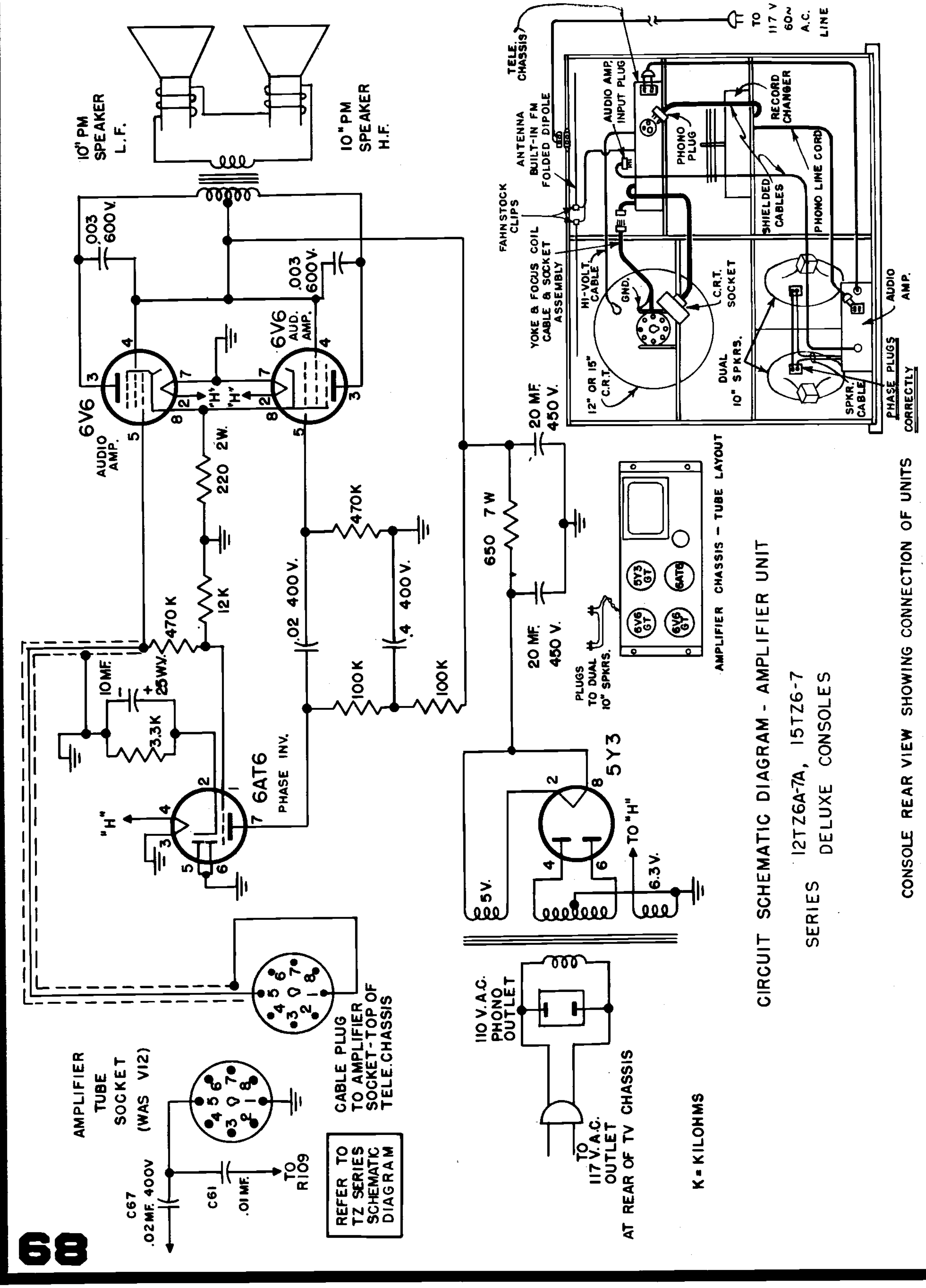
CIRCUIT ALIGNED	STEP	SELECTOR SWITCH POS.	R'C'V'R DIAL SET TO	SIGNAL GENERATOR		METER		COMPONENT ADJUSTED	METER INDICATION	REMARKS
				FREQUENCY	CONNECTIONS	TYPE	CONNECTIONS			
BC I.F.	1	BC	1650 KC	455 KC 30% MOD.	THRU .1MFD TO 6BE6 GRID PIN #1	A C OUTPUT	ACROSS VOICE COIL	TOP AND BOTTOM OF T-10, T11	MAXIMUM DEFLECTION	
FM I.F.	2	FM	108.5 MC	20.25 MC. UN MOD.	THRU .01MFD. TO GRID OF 12AT7 (PIN #7)	D C VTVM	FROM LIMITER GRID, PIN 1 OF 6AU6 AND GROUND.	TOP AND BOTTOM OF T6, T7, T8	"	
FM DISC.	3	"	"	"	"	"	FROM DISC. CATHODE, PIN 3 OF 6T8 AND GROUND.	TOP OF T9	MAX. DEFLECTION OF EITHER POLARITY	
	4	"	"	"	"	"	"	BOTTOM OF T9	0 VOLTS	ADJUST FOR ZERO BETWEEN PLUS AND MINUS PEAKS
BC OSC	5	BC	1650 KC	1650 KC 30% MOD.	COUPLED TO R'C'V'R LOOP BY 2 OR 3 TURNS	A C OUTPUT	ACROSS VOICE COIL	C-126	MAXIMUM DEFLECTION	
BC RF	6	"	1500KC	1500 KC 30% MOD.	"	"	"	C-125	"	
FM OSC	7	FM	108.5 MC	108.5 MC UN MOD.	THRU BALANCED 300 Ω DUMMY ANT. TO F.M. ANT & GND.	D C VTVM	FROM LIMITER GRID PIN 1 OF 6AU6 AND GROUND.	C-123 2-6 MMF. TRIMMER ADJ. ACENT TO TUNING GANG	MAXIMUM DEFLECTION	
	8	"	87.5 MC.	87.5 MC. UNMOD.	"	"	"	OSC. COIL CORE L90	"	REPEAT STEPS 7 & 8 AS NECESSARY
FM R.F.	9	"	95 MC.	95 MC UNMOD.	"	"	"	RF COIL CORE L 86	"	
	10	"	"	"	"	"	"	ANT. TRANS. CORE T-18	"	

TV RF ALIGNMENT

DUMMY ANTENNA	STEP	SIGNAL GENERATOR CONNECTIONS	SIGNAL GENERATOR FREQUENCY (10 MC SWEEP)	MARKER GENERATOR FREQUENCY	CHANNEL	CONNECT SCOPE	ADJUST	REMARKS
ONE 150 Ω CARBON RESISTOR IN SERIES WITH EACH LEAD.	8	ANTENNA TERMINALS	213 MC	211.25 MC & 215.75 MC	13	VERT. AMPLIFIER ACROSS CENTER TAP OF MIX. GRID COILS & GND. (ACROSS R150 & C152).	C15, C16 C20, C21 (SEE FIG.2)	ADJUST FOR RESPONSE APPROX. AS SHOWN BELOW, WITH MARKERS MORE THAN 70% OF PEAK AMPLITUDE. KEEP THE RF AND MIXER TRIMMER PAIRS IN APPROX. THE SAME RELATIVE POSITION.
"	9	"	177 MC	175.25 MC & 179.75 MC	7	"	L103, L104	ADJUST RINGS FOR WAVEFORM AS SHOWN BELOW.
"	10	"	183 MC	181.25 MC & 185.75 MC	8	"		CHECK RESPONSE ON ALL CHANNELS. SLIGHT ADJUSTMENT OF C15, C16, C20 OR C21 MAY BE REQUIRED TO OBTAIN OPTIMUM RESPONSE ON ALL CHANNELS.
"	11	"	189 MC	187.25 MC & 191.75 MC	9	"		
"	12	"	195 MC	193.25 MC & 197.75 MC	10	"		
"	13	"	201 MC	199.25 MC & 203.75 MC	11	"		
"	14	"	207 MC	205.25 MC & 209.75 MC	12	"		
"	15	"	85 MC	83.25 MC & 87.75 MC	6	"	C13, C14 C18, C19	ADJUST FOR RESPONSE APPROX. AS SHOWN BELOW.
"	16	"	79 MC	77.25 MC & 81.75 MC	5	"		CHECK RESPONSE ON ALL CHANNELS. SLIGHT ADJUSTMENT OF C13, C14, C18, OR C19 MAY BE REQUIRED TO OBTAIN OPTIMUM RESPONSE ON ALL CHANNELS.
"	17	"	69 MC	67.25 MC & 71.75 MC	4	"		
"	18	"	63 MC	61.25 MC & 65.75 MC	3	"		
"	19	"	57 MC	55.25 MC & 59.75 MC	2	"		

TV OSC. ALIGNMENT

DUMMY ANTENNA	STEP	SIGNAL GENERATOR CONNECTIONS	SIGNAL GENERATOR FREQUENCY	CHANNEL	CONNECT VTVM DC PROBE	ADJUST	REMARKS
SAME AS ABOVE	20	ANTENNA TERMINALS	215.75 MC	13	ACROSS 6AU6 LIM. GRID (PIN 1) & GND.	L102	ADJUST FOR MAXIMUM DEFLECTION.
"	21	"	87.75 MC	6	"	L101	"
"	22	CHECK TO SEE THAT ALL OTHER CHANNELS ARE RECEIVED WELL WITHIN THE LIMITS OF THE FINE TUNING CONTROL. IF NOT, SOME COMPRIMISE MAY BE MADE BY ADJUSTING L102 FOR HIGH CHANNELS AND L101 FOR LOW CHANNELS.					



AMPLIFIER CHASSIS - TUBE LAYOUT

CONSOLE REAR VIEW SHOWING CONNECTION OF UNITS

CIRCUIT SCHEMATIC DIAGRAM - AMPLIFIER UNIT

SERIES 12TZ6A-7A, 15TZ6-7 DELUXE CONSOLES

GENERAL ELECTRIC

MODEL 809
TELEVISION RECEIVER

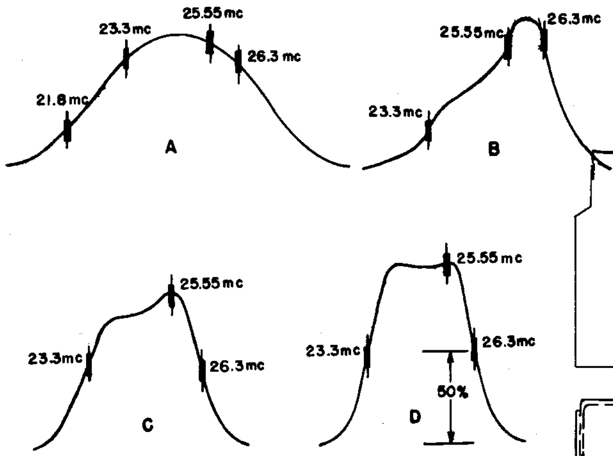


FIG. 2. VIDEO I-F ALIGNMENT CURVES

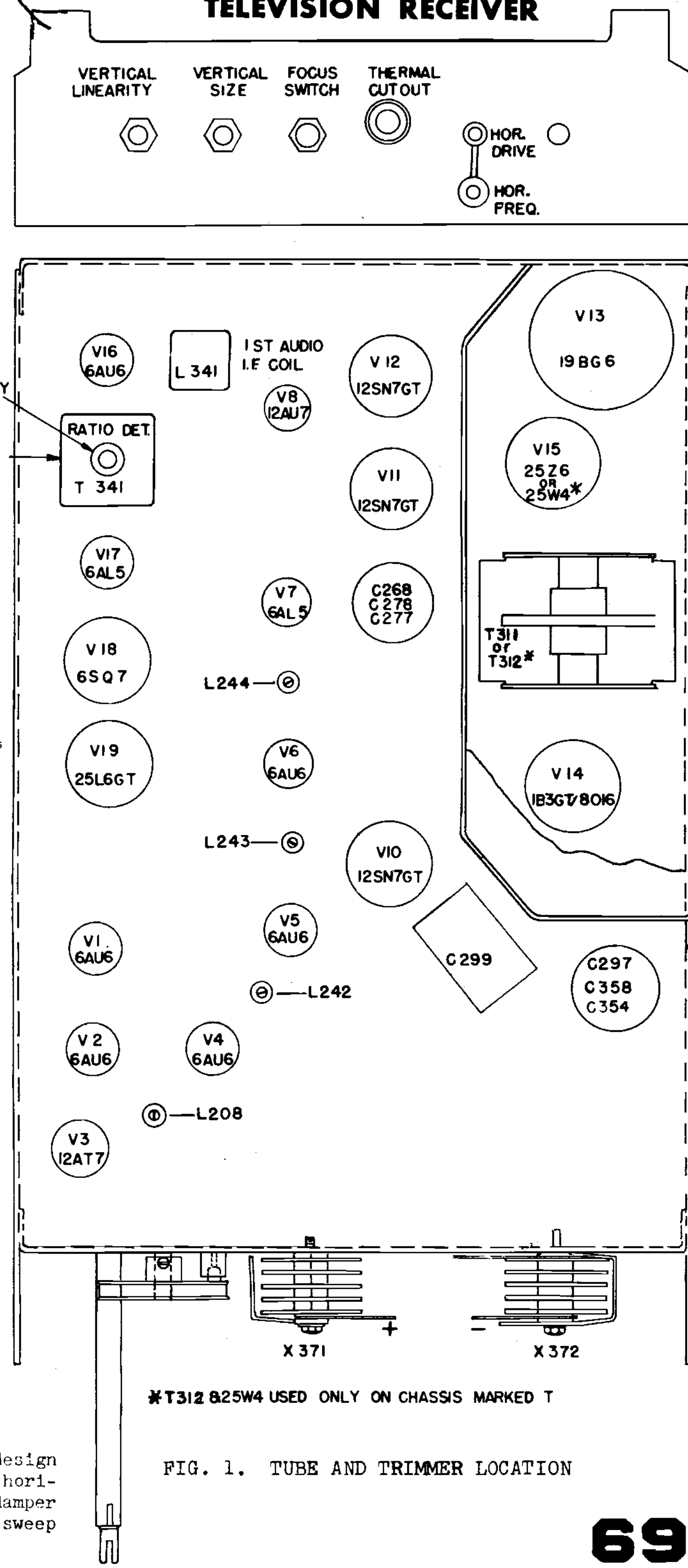
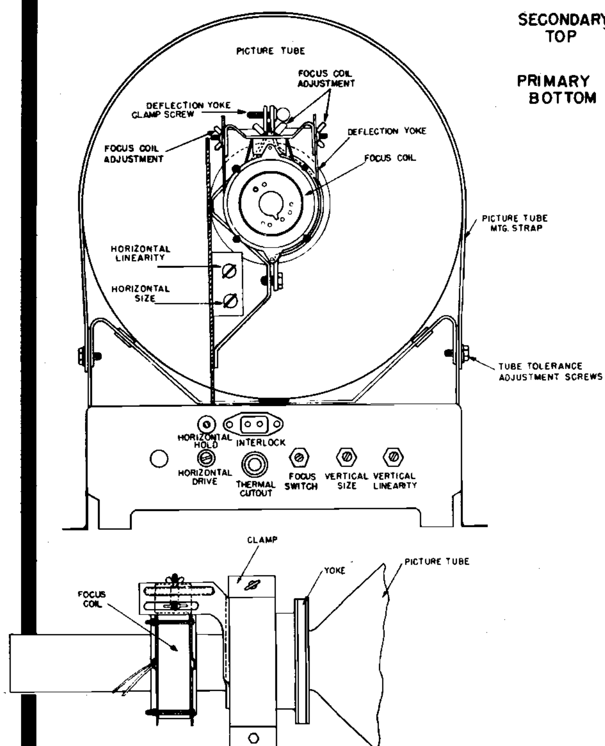


FIG. 1. TUBE AND TRIMMER LOCATION



Preset (occasional adjustment) controls

Late production chassis is identified by "T" ink-stamped on the chassis front apron. Early production sets are similar to Models 805, 806, & 807 of the next section.

NOTE: Late production 809 receivers used a new design horizontal sweep transformer, deflection yoke, horizontal size, and linearity controls. The 25Z6 damper tube was replaced with a 25W4 when this new sweep transformer was added.

ALIGNMENT NOTES

Always use an isolation transformer when servicing this receiver.

All alignment adjustments are shown in the tube and trimmer location. This television receiver uses stagger tuning of the i-f stages to achieve its band-pass characteristics; i.e. each i-f coil is aligned to a slightly different frequency. The resultant curves for each stage of the video alignment curve are shown in Figure 2. In the overall i-f alignment curve, Figure 2(D), the 26.3 mc marker should be at the 50% mark from the base line to the top of the i-f curve. This receiver uses an intercarrier sound system for audio i-f amplification. The difference frequency (4.5 mc) between the audio and the video carriers is detected in the video detector and is tapped off at the plate of the last video amplifier. V16 is an audio i-f amplifier and limiter. A ratio detector (T341 and V17) is used to detect the frequency-modulated 4.5 mc audio i-f. NOTE: The secondary of T341 must be aligned exactly to 4.5 mc to prevent hum. In cases where the difference frequency of the video and audio carriers varies slightly from 4.5 mc, hum will be evident in the audio output.

When making video alignment, set the band switch to Channel #5 or #6 to avoid oscillator interference. Set the contrast control to obtain -4 v. d-c bias at the junction of R243 and R241, as measured on a VTVM. Remove VTVM leads during alignment.

When making r-f alignments, the contrast control should be set to give a bias at V2 grid (pin 1) of -2 volts approximately or measured on a VTVM. Shunt L208 with a 220 ohm, 1/2 watt resistor.

ALIGNMENT

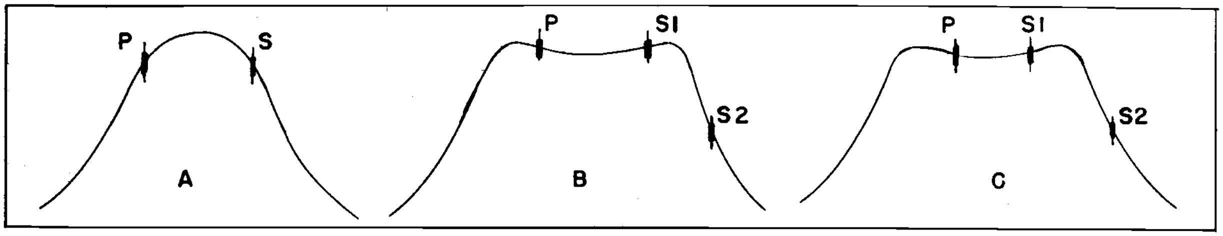
Step	Marker Generator Frequency	Sweep Generator Frequency	Signal Input Point	Connect Oscilloscope Between	Channel Switch Setting	Adjust	Remarks
				VIDEO I-F ALIGNMENT			
1	21.8 MC 23.3 MC 25.55 MC 26.3 MC	20-30 MC	V6 grid (Pin 1) and (B2-)	Plate (V8A) (Pin 1) and B3-	5 or 6	Brass screw of L244 for curve of Fig. 2(A).	L244 may be adjusted to level the top of the curve, as in Fig. 2(C). L208 tends to reduce the valley at the top of the curve of Fig. 2(D), as the screw is turned into the coil.
2	23.3 MC 25.55 MC 26.3 MC	20-30 MC	V5 grid (Pin 1) and (B2-)	Plate (V8A) (Pin 1) and B3-	5 or 6	Brass screw of L243 for curve of Fig. 2(B).	
3	23.3 MC 25.55 MC 26.3 MC	20-30 MC	V4 grid (Pin 1) and (B2-)	Plate (V8A) (Pin 1) and B3-	5 or 6	Brass screw of L242 for curve of Fig. 2(C).	
4	23.3 MC 25.55 MC 26.3 MC	20-30 MC	V3A grid Pin 7thru 27K and) head-end grd.	Plate (V8A) (Pin 1) and B3-	5 or 6	L208 and L244 for curve of Fig. 2(D).	
				AUDIO I-F ALIGNMENT			
1	4.5 MC at 1/10 volt approx.	—	Grid of V8 (Pin 7) and head-end grd.	—	—	Secondary of T341 for approx. 1/4v. measured on a VTVM.	Connect a vacuum tube voltmeter to junction of R343 and R346, and head-end grd.
2	4.5 MC	—	Grid of V8 (Pin 7) and head-end grd.	—	—	Primary of T341 for max. reading on VTVM.	
3	4.5 MC	—	Grid of V8 (Pin 7) and head-end grd.	—	—	Adjust core of L341 for max. readings on VTVM.	
4	4.5 MC	—	Grid of V8 (Pin 7) and head-end grd.	—	—	Adjust secondary of T341 for min. reading on VTVM.	

MOST-OFTEN-NEEDED 1949 TELEVISION RECEIVERS

A L I G N M E N T — CONTINUED.

Step	Signal Generator Frequency	Sweep Generator Frequency	Signal Input Point	Connect Oscilloscope to Head-End Chassis and	Channel Switch Setting	Adjust	Remarks
				VIDEO I-F ALIGNMENT			
1	21.8 MC 23.3 MC 25.55 MC 26.3 MC	20-30 MC	V6 grid (Pin 1) and (B2-)	Plate (V8A) (Pin 1) and B3-	5 or 6	Brass screw of L244 for curve of Fig. 2(A).	L244 may be adjusted to level the top of the curve, as in Fig. 2(C). L208 tends to reduce the valley at the top of the curve of Fig. 2(D), as the screw is turned into the coil.
2	23.3 MC 25.55 MC 26.3 MC	20-30 MC	V5 grid (Pin 1) and (B2-)	Plate (V8A) (Pin 1) and B3-	5 or 6	Brass screw of L243 for curve of Fig. 2(B).	
3	23.3 MC 25.55 MC 26.3 MC	20-30 MC	V4 grid (Pin 1) and (B2-)	Plate (V8A) (Pin 1) and B3-	5 or 6	Brass screw of L242 for curve of Fig. 2(C).	
4	23.3 MC 25.55 MC 26.3 MC	20-30 MC	V3A grid Pin 7thru 27K and) head-end grd.	Plate (V8A) (Pin 1) and B3-	5 or 6	L208 and L244 for curve of Fig. 2(D).	
				AUDIO I-F ALIGNMENT			
1	4.5 MC at 1/10 volt approx.	—	Grid of V8 (Pin 7) and head-end grd.	—	—	Secondary of T341 for approx. 1/4v. measured on a VTVM.	Connect a vacuum tube voltmeter to junction of R343 and R346, and head-end grd.
2	4.5 MC	—	Grid of V8 (Pin 7) and head-end grd.	—	—	Primary of T341 for max. reading on VTVM.	
3	4.5 MC	—	Grid of V8 (Pin 7) and head-end grd.	—	—	Adjust core of L341 for max. readings on VTVM.	
4	4.5 MC	—	Grid of V8 (Pin 7) and head-end grd.	—	—	Adjust secondary of T341 for min. reading on VTVM.	
7	175.25 MC and 179.75 MC	15 MC sweep	Antenna term-inals at head-end	Junction R209 and L208.	Channel #7	—	
8	83.25 MC and 87.75 MC	15 MC sweep	Antenna term-inals at head-end	Junction R209 and L208.	Channel #6	Screws of L226 to place 83.25 MC and L236 to place 87.75 MC markers, as shown in Fig. 3(B).	Video marker should fall on the top of the curve. The audio marker should fall at least one-half the way up the side of the curve. It may be necessary to slightly read-just Channel #6 for proper track-ing on #4, #5, and #6.
9	77.25 MC and 81.75 MC	15 MC sweep	Antenna term-inals at head-end	Junction R209 and L208.	Channel #5	—	
10	67.25 MC and 71.75 MC	15 MC sweep	Antenna term-inals at head-end	Junction R209 and L208.	Channel #4	—	

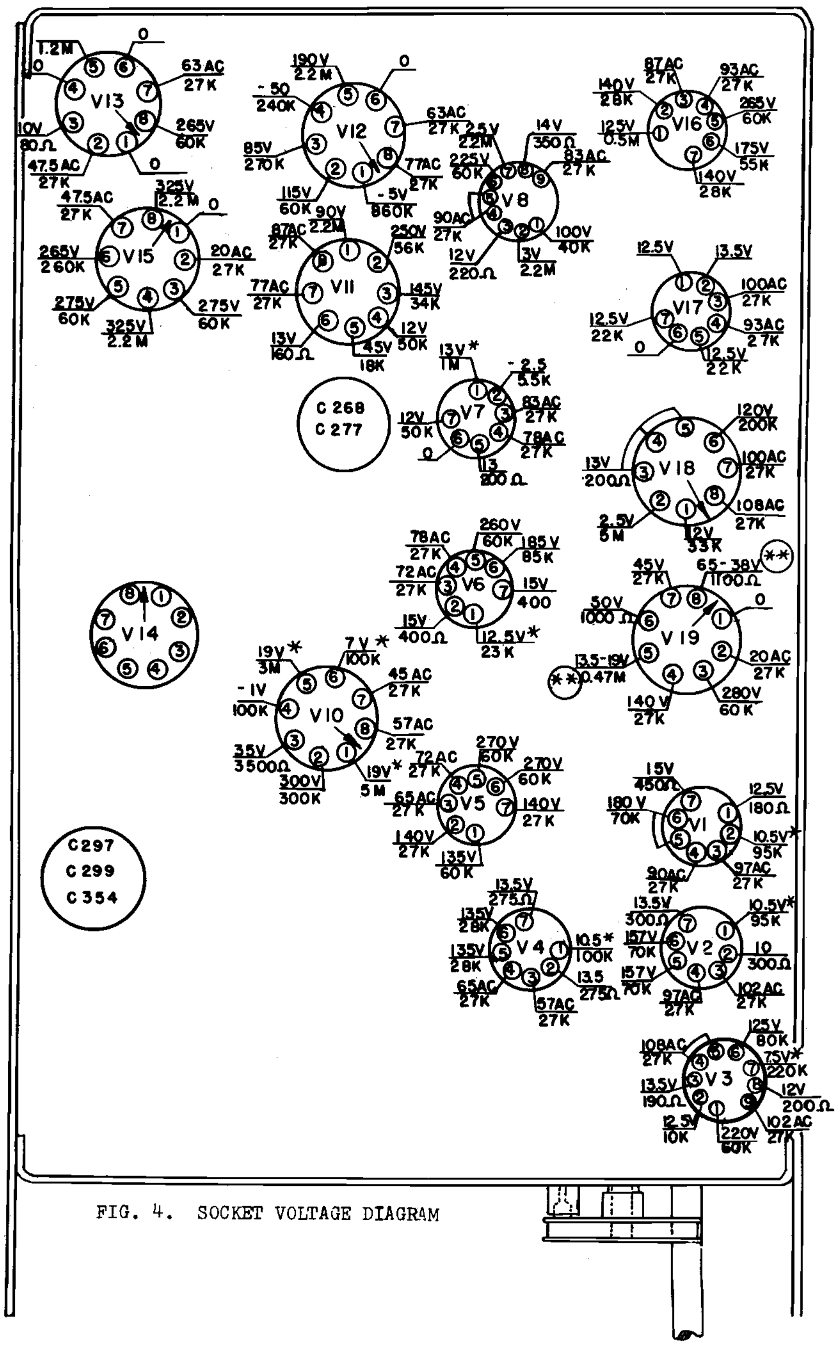
11	61.25 MC and 65.75 MC	15 MC sweep	Antenna term-inals at head-end	Junction R209 and L208.	Channel #3	Screws of L223 to place 61.25 MC and L233 to place 65.75 MC markers, as shown in Fig. 3(C).	Video marker should fall on the top of the curve. The audio marker should fall at least one-half the way up the side of the curve. It may be necessary to slightly read-just Channel #3 for proper track-ing on #2 and #3.
12	55.25 MC and 59.75 MC	15 MC sweep	Antenna term-inals at head-end	Junction R209 and L208.	Channel #2	—	
				OSCILLATOR ADJUSTMENTS			
1	237.55 MC	—	Antenna term-inals at head-end	Junction R209, L208 and C216	13	L215 by spreading or squeezing turns for zero beat.	Set tuning capacitor at mid-position. Adjust for zero beat, on scope, of signal gen. freq. & osc. freq. Check Channels #12 thru #7 to see that zero beat is at least 1/3 of a rotation from either end of the tuning knob rotation.
2	231.55 MC	—	Antenna term-inals at head-end	Junction R209, L208 and C216	12	—	
3	225.55 MC	—	Antenna term-inals at head-end	Junction R209, L208 and C216	11	—	
4	219.55 MC	—	Antenna term-inals at head-end	Junction R209, L208 and C216	10	—	
5	213.55 MC	—	Antenna term-inals at head-end	Junction R209, L208 and C216	9	—	
6	207.55 MC	—	Antenna term-inals at head-end	Junction R209, L208 and C216	8	—	
7	201.55 MC	—	Antenna term-inals at head-end	Junction R209, L208 and C216	7	—	
8	109.55 MC	—	Antenna term-inals at head-end	Junction R209, L208 and C216	6	Adjust screw in L213 for zero beat.	The oscillator adjustments for Channels #2 thru #6 should be made with the tuning knob set at least 2/3 of a rotation from either end of its rotation.
9	103.55 MC	—	Antenna term-inals at head-end	Junction R209, L208 and C216	5	Adjust screw in L212 for zero beat.	
10	93.55 MC	—	Antenna term-inals at head-end	Junction R209, L208 and C216	4	Adjust screw in L211 for zero beat.	
11	87.55 MC	—	Antenna term-inals at head-end	Junction R209, L208 and C216	3	Adjust screw in L210 for zero beat.	
12	81.55 MC	—	Antenna term-inals at head-end	Junction R209, L208 and C216	2	Adjust screw in L209 for zero beat.	



P= Picture carrier marker

S1–S2 =Sound carrier marker limits

FIG. 3. R-F ALIGNMENT CURVES



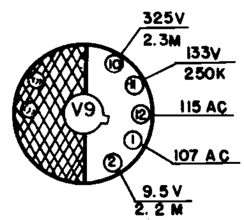


FIG. 4. SOCKET VOLTAGE DIAGRAM

VOLTAGES

CONTROLS SET AT
- VOLUME - MIN.
- FOCUS - NORMAL
- H. HOLD - NORMAL
- V. HOLD - NORMAL
- BRIGHTNESS - MIN.
- CONTRAST - MAX.

METERS
- AC 1000Ω/V
- DC 20,000Ω/V

* USE SCALE 50V OR HIGHER

(* *) MIN. + MAX. OF FOCUS CONTROL

LINE VOLTS - 117V

RESISTANCE

CONTROLS SET AT

VOLUME	- MIN. SW. OFF
FOCUS	- MAX.
H. HOLD	- MAX.
V. HOLD	- MAX.
BRIGHTNESS	- MIN.
CONTRAST	- MAX.
FOCUS SW.	- TAP 4

METER

20,000Ω/V

MOST-OFTEN-NEEDED 1949 TELEVISION RECEIVERS

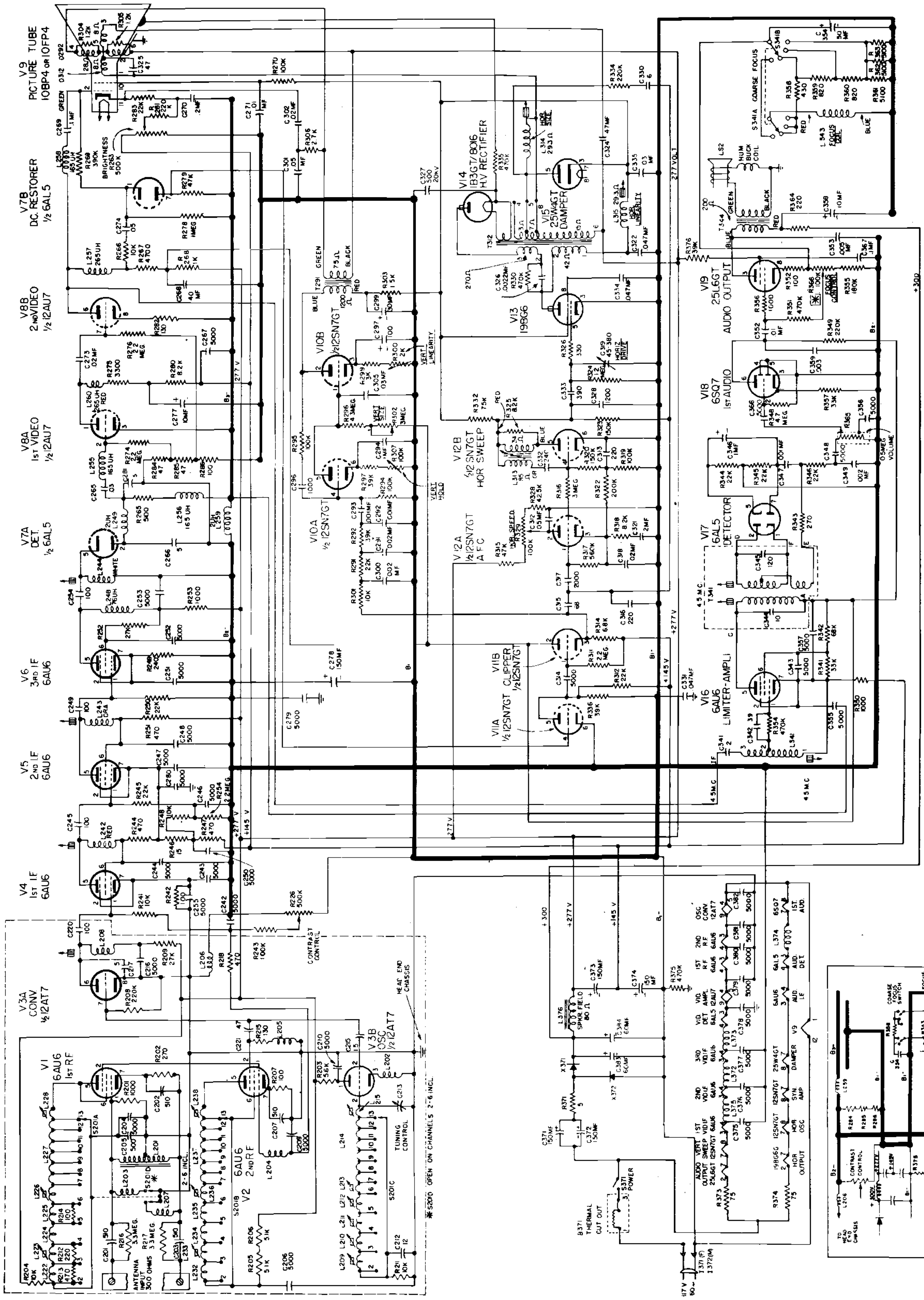
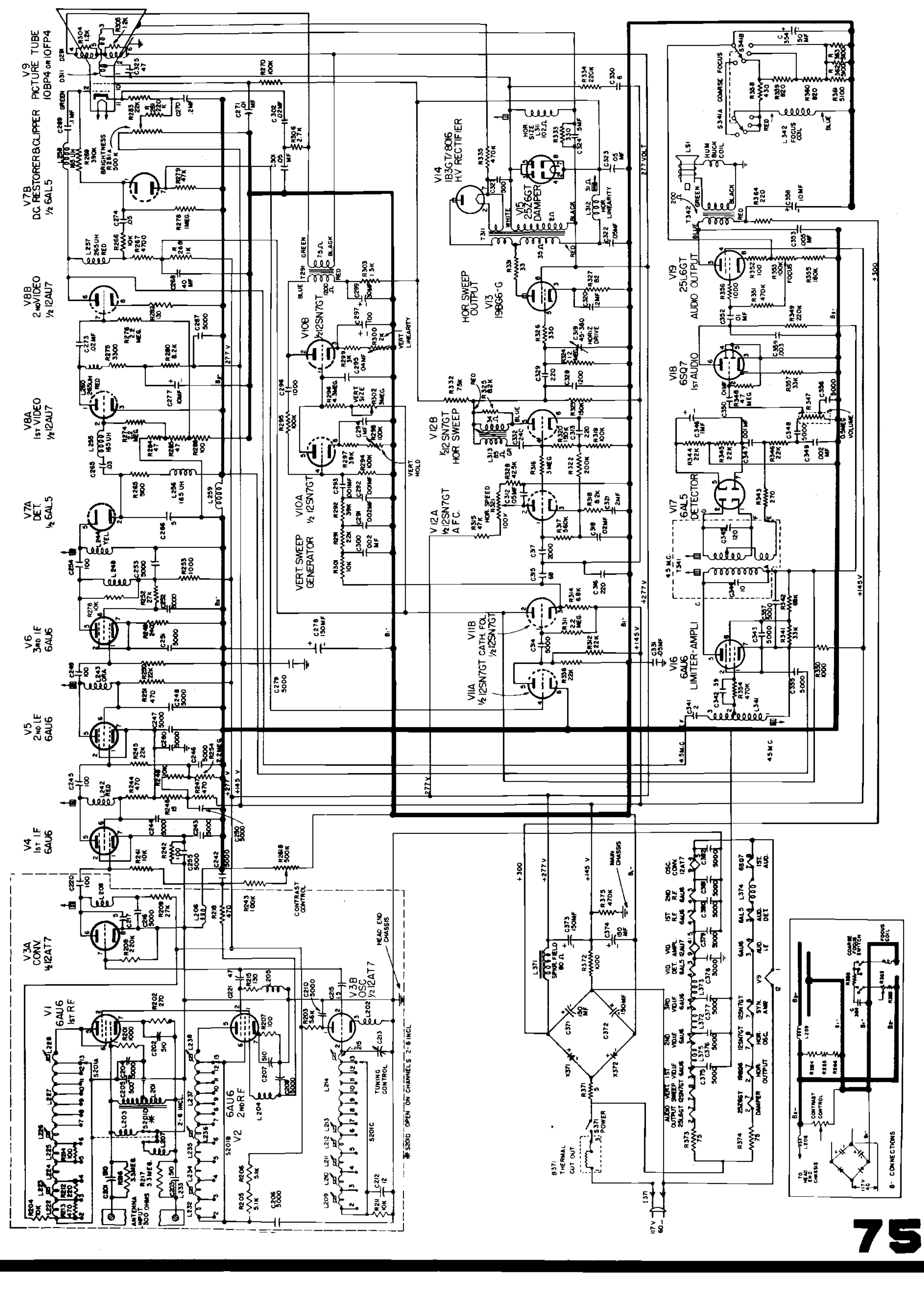


FIG. 6. SCHEMATIC DIAGRAM (T)

The diagram on this page covers late production 809 receivers identified by the letter "T" ink-stamped on the chassis front apron. Early production sets are similar to Model 805.

General Electric Models 805, 806, and 807



MOST-OFTEN-NEEDED 1949 TELEVISION RECEIVERS

GENERAL ELECTRIC

MODELS 805, 806 & 807

Alignment data given under Model 809, may be applied to Models 805, 806, & 807.

Early production Model 809 is very similar to Models 805, 806, and 807.

SOCKET VOLTAGE CHART

Tube No.	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Pin 9	Pin 10	Pin 11	Tube Type
V1	12.5V	10.5V	-	-	180V	180V	15V					6AU6
V2	10.5V*	10V	-	-	157V	157V	13.5V					6AU6
V3	220V	12.5V	13.5V	-		125V	7.5*	12V				12AT7
V4	10.5V*	13.5V	-	-	135V	135V	13.5V					6AU6
V5	135V	140V	-	-	270V	270V	140V					6AU6
V6	12.5V*	15V	-	-	260V	185V	15V					6AU6
V7	13V*	-2.5V	-	-	13V	-	12V					6AL5
V8	100V	3V	12.5V	-	-	225V	2.5V	14V	--			12AU7
V9	-	9.0V	-	-	-	-	-	-	-	325V	133V	10BP4 or 10FP4
V10	19V*	300V	35V	-1V	19V*	7V*	-	-				12SN7GT
V11	90V	250V	145V	12V	45V	13V	-	-				12SN7GT
V12	-5V	115V	8.5V	-50V	190V	-	-	-				12SN7GT
V13			10.V					265V				19BG6-G
V14												1B3GT/8016
V15			275V	325V	275V	265V		325V				25Z6
V16	125V	140V	-	-	265V	175V	140V					6AU6
V17	12.5V	13.5V	-	-	12.5V		12.5V					6AL5
V18	12V	2.5V	13V	13V	13V	122V	-	-				6SQ7
V19			280V	140	19V*	50V		65V**				25L6GT

Measurements taken on a 20,000 ohm-per-volt meter.
Line volts 117 v. a-c.
Measure between tube pin and B_1- buss.
Volume control at minimum setting.
Brightness control set at minimum.
Contrast control set at maximum.
Focus control set at maximum clockwise.
Horizontal Hold normal setting.
Vertical Hold normal setting.
Voltages marked with a single asterisk (*) must be measured on a 50-volt scale of meter.
Voltages marked with two asterisks (**) must be measured on a 250-volt scale.

GENERAL ELECTRIC

SERVICE DATA
FOR
TELEVISION RECEIVER
MODEL 814

Models 810 and 811 are very similar to Model 814 described.

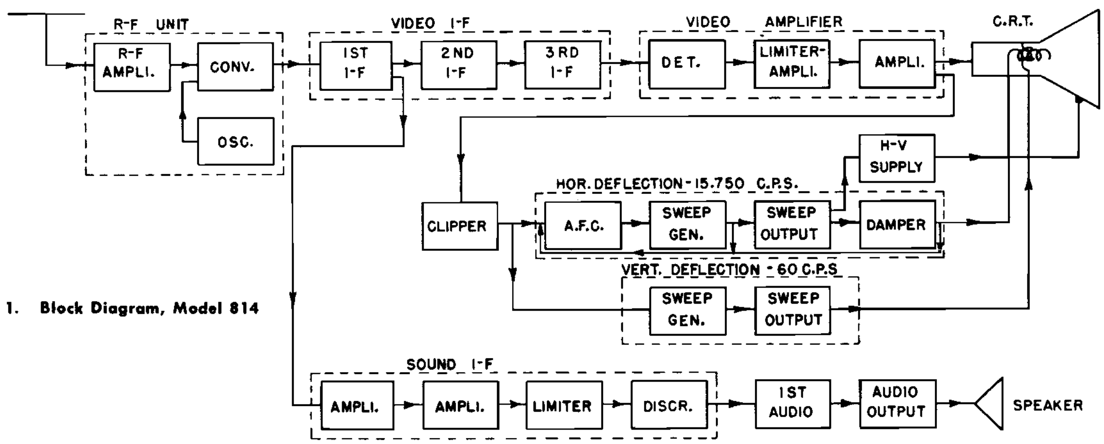


Fig. 1. Block Diagram, Model 814

DESCRIPTION—TELEVISION RECEIVER CIRCUITS

The Model 814 television receiver circuits are divided into the following sections:

1. R-F Amplifier, Oscillator, and Converter (Head-End).
2. Video and Audio I-F Amplifier.
3. Video Detector and Video Amplifier.
4. Horizontal and Vertical Sync. Pulse Separator.
5. Horizontal Sweep Generator and AFC.
6. Horizontal Sweep Output.
7. Vertical Sweep Generator and Vertical Sweep Output.
8. High Voltage Power Supply for Picture Tube.
9. Low Voltage Power Supply.

A brief description of the operation of each circuit is given in the following paragraphs. This is supplemented by simplified circuit diagrams of each portion of the circuit under discussion. Reference is also made to the complete schematic diagram

A block diagram of the Model 814 receiver is shown in Figure 1 to assist in signal tracing and to better visualize the operation of the receiver.

1. R-F AMPLIFIER, CONVERTER, AND OSCILLATOR (SEE FIGURE 2).

The r-f amplifier makes use of a Type 6AU6 pentode tube connected as a grounded grid triode amplifier. The antenna is connected into the cathode circuit of the tube through a transformer, T1, so as to provide a substantially constant input impedance of 300 ohms to the antenna and transmission line at all frequencies. The transformer, T1, is balanced to ground in the primary winding which provides cancellation of noise pickup on the transmission line. An electrostatic shield is incorporated between the primary and secondary winding of T1 to prevent noise from being transferred from primary to secondary by capacity effect. R1 is the normal bias resistor for V1. A choke (LK in Figure 2) is placed in series with this cathode resistor to prevent the input impedance from being lowered by shunting effect of the cathode bias resistor and the by-pass capacitor, R1 and C2. LK also neutralizes the total cathode capacity, thus preventing it from affecting the input impedance. The choke value is changed when switching from the lower five to the upper seven channels. L1 is a series compensating choke which prevents a loss in gain on the high frequency channels.

The r-f amplifier is coupled to the converter by a wide-band transformer consisting of windings L_p and L_s. The windings are self-tuned by the distributed and tube capacities to provide optimum gain. Variable trimmers C5 and C6 are shunted across the primary and secondary windings, respectively, of the r-f transformer to permit compensation for misalignment resulting from differences of tube capacities when a tube change is necessary. On Channel #2, the transformer is triple-tuned to provide better image frequency attenuation of the 88–108 mc FM band. Three of the r-f transformers are used to cover the upper six channels. Each of these transformers is made sufficiently broadband to accept two television channels.

The triode converter is one section of a Type 12AT7 dual triode, V2B. Bias for this section (V2B) is developed by the oscillator voltage appearing in the grid of V2B, causing grid rectification and charging the grid resistor-capacitor combination, R4 and C7.

The remaining triode section of the 12AT7 (V2A) is used as the oscillator, and is capacity coupled to the converter tube grid through the capacitor, C8. The oscillator is a modified Colpits oscillator, oscillation being produced by the grid-to-cathode capacitor, C32, and the plate-to-cathode interelectrode capacity, C_p, of the oscillator tube. The choke, L4, provides a d-c ground to the cathode of the oscillator tube and maintains the cathode off ground at the r-f frequencies. The oscillator operates on the

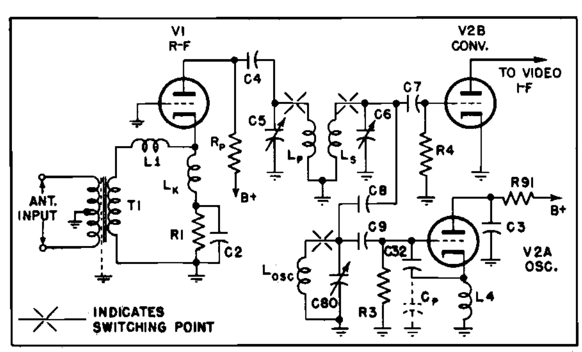


Fig. 2. R-F Amplifier, Converter and Oscillator

high frequency side of the r-f signal on all channels. Three oscillator coils (L11, L12, and L13) are used to cover the upper six channels, the frequency range of the oscillator circuit at each coil switching is sufficient to tune two channels. Capacitor C80 is the tuning capacitor used to tune the oscillator on the lower six switch positions to the individual channels and on the upper three switch positions C80 tunes the oscillator to one or the other channel covered by that switch position.

To prevent hum modulation by the local oscillator when operating on the high frequency channels, the filament supply to V2A is rectified by a selenium rectifier, SR1, and filtered by C102.

The r-f amplifier, converter and oscillator section is constructed as a complete sub-assembly which can be readily demounted from the main chassis.

2. VIDEO AND AUDIO I-F AMPLIFIERS (SEE FIGURE 3).

The video i-f amplifier is a three-stage band-pass amplifier, using three Type 6AU6 tubes. The video i-f transformers, T11, T12, T13, and T14 are overcoupled and then loaded with resistance in the secondary circuits to give an adequate band-pass frequency characteristic. A single movable powdered iron core is used in transformers T11, T12, and T13, for tuning of the secondary. Transformer T14 uses two tuning slugs to tune the primary and secondary. At tertiary winding is incorporated on T11 which connects to a series resonant trap circuit to permit adjustment of the slope of the high frequency end of the band-pass. It is adjusted so that 26.3 mc will fall at 50 per cent point on the curve to compensate for the sesqui side-band transmission of the video carrier frequencies.

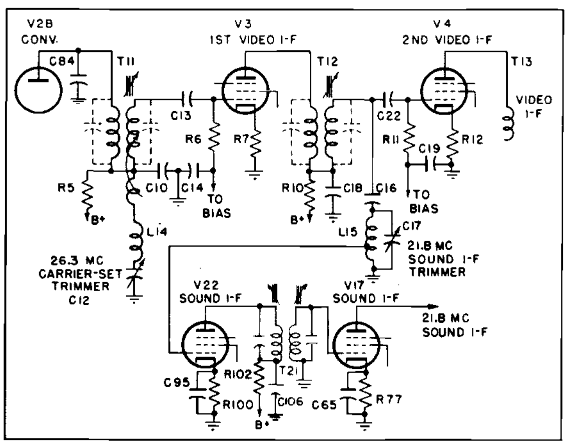


Fig. 3. Video and Audio I-F Amplifier

A series tuned circuit consisting of C16, and the parallel combination of L15 and C17 is connected across the secondary of T12 and tuned for maximum attenuation of the 21.8 mc in the video amplifier. This prevents the 21.8 mc sound i-f from being passed through the video amplifier and affords a tap on L15 for taking out the sound i-f and passing it through to the sound i-f amplifiers. The sound i-f is taken off at this tap on L15 and then applied directly to the grid of the sound i-f amplifier tube, V22. Additional i-f gain and selectivity is provided by the two stages of single-tuned impedance coupled amplification. Since the television audio is frequency modulated, the transformer T19 functions with the diode section of V19 as the discriminator.

Bias voltage derived from the grid return circuit of the horizontal blocking oscillator is applied to the grid circuits of the video i-f amplifier tubes, V3, V4, and V5. A potentiometer (Contrast Control) permits this bias to be changed on the grids of V3 and V4 so as to vary the gain of the video i-f amplifier.

3. VIDEO DETECTOR AND AMPLIFIER (SEE FIGURE 4).

The video i-f amplifier output is applied to one section of a 6AL5 dual diode (V6A) which is connected as a shunt diode to develop a negative-going signal across the diode load resistance R19. The signal is then amplified by two triode amplifier stages using a Type 12AU7 dual triode tube, V7. L16 and L23 are series compensating coils while L22 is a shunt compensating coil. These are used to obtain good high-frequency response and provide sharp cut-off at frequencies above the useable pass-band. L16 also prevents the i-f frequency from being passed through the video amplifier.

In addition to amplification, the first video amplifier tube, V7A, operates as a noise limiter. The B+ voltage applied to V7A is low and the video signal from the detector is negative-going; therefore, any large excursions of voltage above sync level, such as noise, will drive the grid to plate current cut-off. Thus, the interference will be limited close to the level of the super sync signal. This improves the signal to transient noise interference ratio without affecting the video signal.

The use of capacity coupling in the video amplifier necessitates that the d-c component of the video signal be restored to maintain proper background illumination. This is accomplished in the grid circuit of V7B. The video signal at this grid is positive-going so that with the resultant grid current flow, the capacitor C28 will be charged up to the peak value of the sync pulse. Since this charge will vary with the amplitude of the pulse, the resulting bias change will provide the required d-c restoration. This restoration in the grid circuit of V7B necessitates direct coupling of the picture tube, V8, grid to the plate circuit of V7B. By connecting the cathode of V8 to a variable B+ source, the proper bias may be maintained on the picture tube and the brilliance may be controlled.

4. SYNC SEPARATION (SEE FIGURE 5).

Amplification and separation of the sync pulse from the composite video signal is accomplished by tube sections, V11A, V6B,

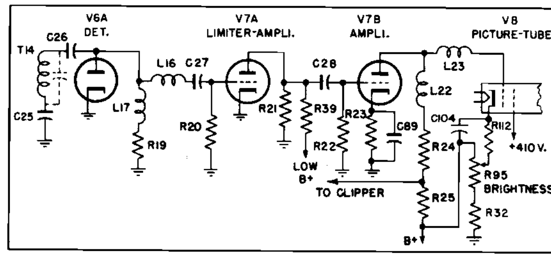


Fig. 4. Video Detector and Amplifier

V11B. The triode section V11A, is used to amplify and invert the phase of the composite video signal applied to its grid circuit and also to further limit the transient noise. This produces a video signal in the plate of V11A wherein the sync pulses are the most positive portion of the voltage waveform. This positive-going signal is applied across the diode section, V6B, which rectifies the positive portion and charges the capacitor C42 negatively in proportion to the amplitude of the sync pulses. This diode thus establishes a bias for tube V11B and, also, clamps the sync so that each recurring pulse originates at the zero voltage axis.

The clamped composite video waveshape applied to the grid of tube section V11B, which is biased by the diode V6B, causes the negative portion of this waveshape to be cut off in the cathode circuit of V11B, leaving only sync pulses. V11B is connected as a cathode follower with the horizontal sync pulses being taken off from resistor R92 and the vertical sync pulses being taken off from the plate of V11B.

An integrating network consisting of R37, C39, C38, R36, and C37, is used to separate the horizontal sync from the vertical sync pulses before passage of the sync signal to the vertical sweep generator.

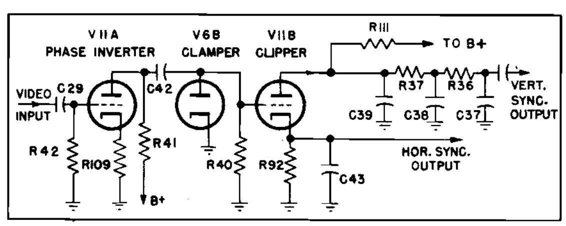


Fig. 5. Sync Separator Circuit

5. HORIZONTAL SWEEP GENERATOR AND AFC SYNC (SEE FIGURE 6).

The horizontal sawtooth generator makes use of one section of a Type 6SN7GT tube, V12B, connected in a blocking oscillator type circuit. Instead of its frequency being controlled directly by the horizontal sync pulses, it is controlled by a d-c voltage on its grid which is the resultant of the phase difference between the incoming sync signal and a voltage wave derived from the output of the sweep generator. The resultant d-c voltage produced by the tube V12A is called an automatic frequency control (AFC) voltage.

The tube V12A obtains its operating bias through its connection to the grid circuit of the blocking oscillator tube, V12B, through resistor R51. The blocking oscillator produces a large negative bias in its grid circuit during its normal operating cycle. When the horizontal sync pulses or the combined output voltage (shown at lower left of Figure 6) are impressed separately on the grid of V12A, they do not have sufficient positive amplitude to cause appreciable plate current flow in tube V12A. However, if they are combined and phased properly as shown in Figure 7A, 7B, or 7C, their composite amplitude is sufficient to cause plate current flow during that portion of the cycle where the waveshape is above the dash line axis in Figure 7. During the time that conduction takes place, the capacitors C86 and C78 become charged positive in respect to ground, the magnitude of the charge and the resultant voltage thereon being dependent upon the duration of the flow of current in tube V12A. Since the resistor R50 is in the bleeder circuit across the filter and also forms a part of the grid return circuit for the sweep generator tube V12B, any change in voltage across R50 will result in a change of frequency in the horizontal sweep generator. Thus, if the contributing voltage of R50 makes the grid of V12B less negative, the frequency will be raised; likewise, if the contributing voltages make the grid of

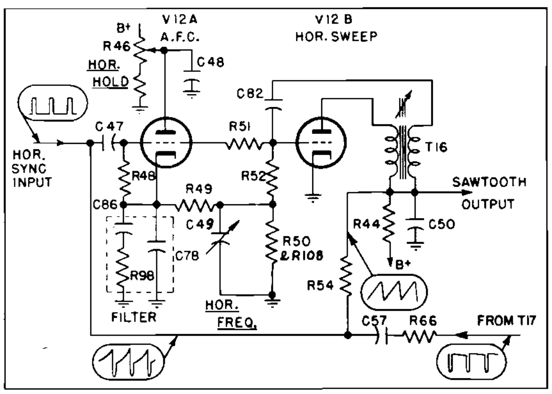


Fig. 6. Horizontal Sweep and A.F.C. Sync

V12B more negative, the frequency will be lowered. Thus, it will be seen that the longer the conduction period of tube V12A, the higher will be the frequency of the blocking oscillator and its sawtooth output.

Referring to Figure 7, the B curve shows a sync pulse phased so that about 50 per cent of the pulse width is riding on top of the integrated sawtooth, while the remainder of the pulse after point (X) falls down into the trough, making the conducting portion have a width which is average between curves represented by (A) and (C). If each successive sync pulse falls in the same phase relation as shown in curve (B), the Horizontal Hold Control which controls the amount of current flow through V12A is set so that this phase relation does not change. This would cause the sweep generator V12B to run at the same frequency as that of the transmitted signal. Under this condition, if the sweep generator tends to run slower than the incoming sync signal, the conduction period will be made longer through tube V12A because the pulse will move forward in relation to the integrated sawtooth wave with a result as shown in Figure 7(A). It will be noted that the conduction pulse is of greater duration (wider) than in curve (B). Therefore, tube V12A will conduct for a greater period of time, thus raising the positive potential across R50. This greater conduction period causes the sweep generator to speed up until it attains the condition in B. Likewise, if the sweep generator is operating at too high a frequency, the pulse will advance along the integrated sawtooth wave until a large portion of it falls down into the trough of the waveshape, as shown in Figure 7(C), with the resultant shortening (narrowing) of the conducting pulse. This causes the frequency of the sweep generator to be reduced until the condition in Figure 7(B) is again restored.

The Horizontal Frequency Control capacitor (C49) forms a part of the discharge circuit in the grid of the blocking oscillator, V12B. By varying its value, the free-running speed of this oscillator can be adjusted to supplement and act as a course control for the Horizontal Hold Control on the front panel. The free-running speed of the blocking oscillator is also adjusted by the inductance variation of the blocking oscillator coil, T16. This is a variable iron core adjustment normally set for the proper free-running speed of the blocking oscillator with both C49 and R46 (horizontal frequency and horizontal controls, respectively) set to their mid-positions assuring their having adequate range for operating and service adjustment.

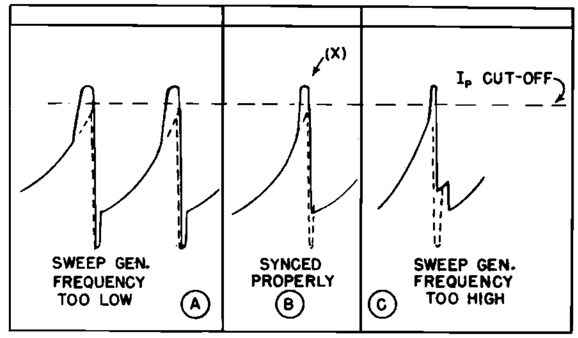


Fig. 7. A.F.C. Waveshapes

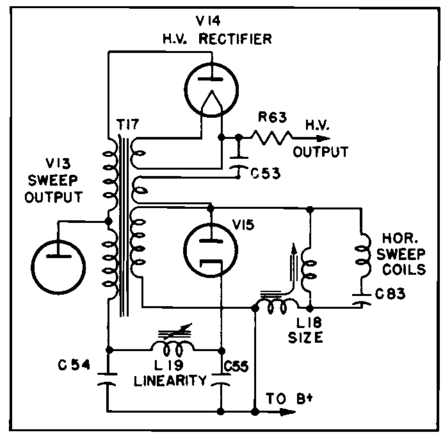


Fig. 8. Horizontal Sweep Output

6. HORIZONTAL SWEEP OUTPUT (SEE FIGURE 8).

The horizontal sawtooth voltage generated by the blocking oscillator, V12B, is shaped and then amplified a by Type 6BG6 tube, V13. The output of this tube is coupled to the horizontal deflection coils, D2, through an impedance-matching transformer, T17. The damping diode, V15, is used principally to remove a transient oscillation created by the rapid retrace of the current in the high inductance of T17 and still retain the positive overshoot in the primary winding for use in the high voltage supply. It also is used to provide a linear trace and to recover some of the energy from the inductive kick-back, and use it to help supply the B+ requirements of the output tube. During conduction of V15, capacitors C54 and C55 are charged up and since they are in series with the B+ voltage to tube V13, they contribute a sizeable portion of the plate voltage. The variable inductance, L19 and C54, constitutes a phase shift network which alters the phase of the ripple voltage developed across C55. This means of changing the ripple voltage which also supplies part of the B+ to the output tube provides a method of controlling the linearity.

A horizontal drive control, C81, forms a capacity voltage divider in conjunction with capacitor C51 so as to control the amount of sawtooth voltage supplied to the grid of V13. This permits adjustment of the grid sawtooth voltage to compensate for variations in output tubes.

The Horizontal Width Control, L18, forms a series parallel circuit in respect to the output of the yoke. The inductance is variable in both coils of this control; the inductance of the series choke is maximum when the parallel choke inductance is minimum and vice-versa. The parallel circuits shunts the current around the deflection coil, depending upon its inductance, and the series coil attenuates the current by changing the impedance of the series circuit. This type of control provides a uniform impedance to the output transformer over a wide range of adjustment.

7. VERTICAL SWEEP GENERATOR AND OUTPUT (SEE FIGURE 9).

The vertical sawtooth voltage is generated by a Type 6NS7GT tube, V9, connected as a multivibrator. This voltage is coupled directly to a Type 6V6G vertical sweep output amplifier tube, V10, and then to the vertical sweep yoke, D1, through the impedance matching transformer T15. Vertical speed is controlled by changing the time constant of the multivibrator grid circuit by potentiometer, R29. Sweep size or height of picture is changed

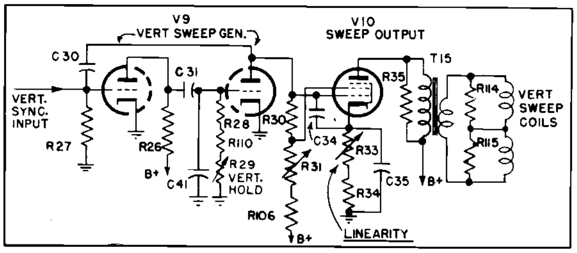


Fig. 9. Vertical Sweep and Output

by the potentiometer, R31, which changes the B voltage applied to the charging (R30, C34) of tube V9 simultaneously with the screen voltage on tube V10. Vertical linearity is controlled by feeding back correcting voltage developed in the cathode circuit of V10 through C34 into the grid circuit of the output tube, V10. The cathode voltage of V10 which is fed back through C34 has an opposite curvature corresponding to the non-linear portion of the generating sawtooth output of V9 so that by combining these voltages in the grid of V10 correction may be affected. The amount of the correction voltage is controlled by the vertical linearity potentiometer, R33, in the cathode of V10.

8. HIGH VOLTAGE SUPPLY (SEE FIGURE 8).

The high voltage for the second anode of the picture tube is derived by making use of the inductive "kick" voltage produced during retrace in the horizontal output transformer, T17. This kick voltage has a magnitude of several thousand volts and is positive-going, appearing between the plate of V13 and ground. Since this voltage in itself is not sufficient to produce the required anode potential, an additional winding connected electrically and magnetically with the primary is added to provide further step-up of this voltage. The top of this auto-transformer is connected to the plate of a rectifier tube V14. This tube is a Type 1B3GT1 8016 which derives its filament voltage from the horizontal sweep transformer T17 by a single turn around the core. Since the frequency supplied the rectifier tube is high (15,750 cps), a 500 mmf. filter capacitor is more than adequate to give a smooth d-c output. Due to the small capacity of the filter, this supply is relatively safe to handle.

9. LOW VOLTAGE POWER SUPPLY.

Two rectifier tubes, V16 and V21 (Types 5U4G and 5Y3GT, respectively), are used to supply the required plate current for the receiver. Each tube is used in a separate and complete rectifier circuit to supply two values of output B+ voltage, 290 volts and 380 volts. The focus coil, which is a combination permanent and electromagnet, is connected in series with a portion of the output current path for the lower voltage supply, the current through it being controlled by the Focus Control potentiometer, R72.

CIRCUIT ALIGNMENT

GENERAL—A complete alignment of the receiver tuned circuits consists of the following individual alignment procedures. These are listed below in the correct sequence of alignment. However, any one section alignment may be performed without the necessity of realignment of any one of the other sectional alignments.

1. Sound I-F Alignment.
2. Video I-F Alignment.
3. R-F Alignment.
4. Oscillator Adjustments.

The alignment procedures is shown in table form on pages 9 through 11. Read the following detailed instructions before attempting alignment as given in the table.

TEST EQUIPMENT—To provide alignment as outlined above, the following test equipment is required:

1. *R-F Sweep Generator.*
   - (a) Frequency Requirements.
     - 20 to 30 mc with 10 mc sweep width.
     - 40 to 90 mc with 15 mc sweep width.
     - 170 to 220 mc with 25 mc sweep width.
   - (b) Constant output over sweep width range.
   - (c) At least 0.1 volt output.

2. *Signal Generator*—Must have good frequency stability and be accurately calibrated. It should be capable of tone modulation over the following frequency ranges.
   21.8 mc for sound i-f.
   22.9 mc for video i-f marker.
   23.4 mc for video i-f marker.
   25.55 mc for video i-f marker.
   26.3 mc for video i-f marker.
   45–88 mc and 174–216 mc for oscillator adjustment and markers for the r-f channel bandwidth measurements.

3. *Oscilloscope*—This oscilloscope should preferably have a 5-inch screen and have good wide-band frequency response on the vertical deflection. Although the high frequency response is unnecessary for alignment, it will be useful when making the waveform measurements on pages 19, 20 and 21.

4. *Crystal Calibrator*—This unit is essential to establish calibration check points for the signal generator so as to provide good accuracy of calibration.

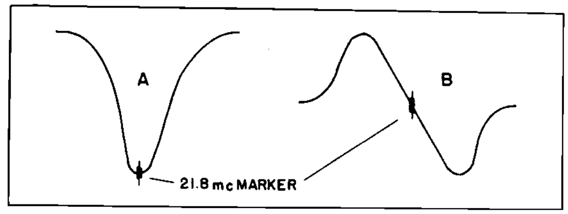


Fig. 10. Audio I-F Curves

5. *Wave Traps*—Accurately calibrated wave traps may be used to supply markers in place of the signal generator for video i-f and r-f alignment purposes.

ALIGNMENT SUGGESTIONS—All alignment adjustments in the sound and video i-f amplifier are available from the top of the chassis, with the exception of the sound discriminator secondary adjustment and the last video i-f stage. The location of the adjustments is shown in Figure 16. Remove the chassis from the cabinet. When it is necessary to make adjustment from the bottom of the chassis, the chassis may be rested on its side so that the power transformer is down. The following suggestions apply to each individual alignment procedure.

1. *Sound I-F Alignment*—The sweep generator is connected through a 500 mmf. capacitor to the grid of the tube preceding the sound i-f coil to be aligned. Connect the oscilloscope through a 100,000-ohm resistor across the resistor, R104, in the limiter tube, V18 grid. Insert a 21.8 mc marker signal from an unmodulated signal generator into the grid of V3. Keep the marker signal attenuated so that it just shows a marker on the sweep curve. Adjust L21 and L5, respectively, as you advance progressively one stage at a time, for maximum gain and symmetry of the response curve about the 21.8 mc marker. The curve should be similar to that shown in Figure 10-A. With input at the first audio i-f, V22, the bandwidth should be approximately 300 kc at the 70% response point.

Keep the input of the sweep generator low enough so that the sound i-f amplifier does not overload, otherwise the response curve will broaden out permitting slight misadjustment. Check by increasing the output of the sweep; the response curve on the scope should increase in size proportionally. Adjust the signal input to each stage to develop ¾ volt peak at the limiter grid (junction of R104 and C100), as measured by a calibrated oscilloscope, with a contrast bias of −4 volts.

For discriminator alignment, the secondary core of the discriminator transformer, T19, is aligned by using a tone modulated 21.8 mc amplitude modulated signal and listening to the tone at the loudspeaker. This adjustment is made for a minimum tone signal output. Apply the signal generator input to the grid of V22. If the sweep is used for the secondary alignment, the cross-over should be symmetrical about a 21.8 mc marker and should be a straight line between the alternate peaks, as shown in Figure 10-B. For the discriminator transformer primary alignment, connect the oscilloscope to the junction of C74 and R86. With the same sweep input as in Step 1, adjust the primary adjustment screw for a maximum peak-to-peak amplitude of the response curve, as shown in Figure 10-B.

2. Video I-F Alignment—The video i-f amplifier uses transformers which are coupled and loaded to give the proper band-pass characteristics.

Stage-by-stage alignment should be performed so as to duplicate as closely as possible the curves as shown in Figure 11-A, -B, -C, and -D. The markers supplied by an accurately calibrated signal generator are used to establish the correct bandwidth and frequency limits. Adjust the signal input to each stage to develop ¾ volt peak at the video detector (junction of L16 and C27), as measured by a calibrated oscilloscope, with a contrast bias of −4 volts.

Connect the sweep generator to the tube grid preceding the transformer to be aligned. Adjust the sweep width for a minimum of 10 mc about the center frequency of the video response curve. The sweep output cable should be shielded and preferably terminated in its characteristic impedance and then connected with as short a lead as possible through a 500 mmf. capacitor; the ground lead of the cable should be short and grounded to the chassis as near as possible to where the signal is applied. Sufficient marker signal may be supplied in most cases, except at the last stage by merely connecting the high side of the signal generator to the television chassis. At last stage, couple the marker generator through a small capacitor in parallel with the sweep input; keep the input low enough so that it doesn't influence the shape of the response curve.

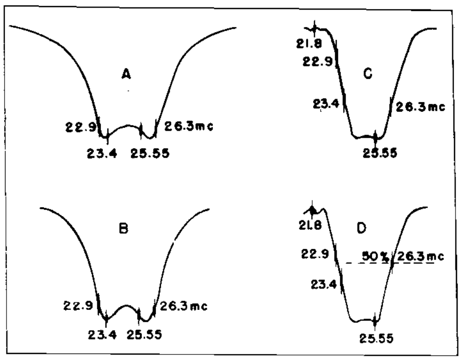


Fig. 11. Video I-F Curves

The primary of the transformer preceding the grid where the signal is applied will act as a tuned trap, placing a dip in the alignment curve, as viewed on the scope, unless it is detuned sufficiently to throw it out of the video i-f pass-band. To detune this transformer, merely remove the tube which feeds the primary winding, as indicated in Steps 1, 2, and 4. ***Be sure to replace the tube after the stage is aligned.*** Another method of detuning is to slip an iron core slug in the primary side of the i-f transformer. The audio take-off trap trimmer C17 should be aligned for minimum 21.8 mc audio i-f frequency in the video i-f amplifier, as in Step 3 of Video I-F Alignment.

The Contrast Control should be set a −4 volts bias measured at the junction of R6, R8, and C14 with a vacuum tube voltmeter. The sweep generator should then be set to give ¾ volt peak-to-peak, or .27 volts rms, as measured on a vacuum tube voltmeter between the junction of L16 and C27 and chassis with a −4 volts bias at R6, R5, and C14 junction. When making the video i-f alignment, the 26.3 mc marker should be at 50% or slightly lower than 50% for maximum detail. The 26.3 mc marker should never be more than 50% of the distance from the base line to the flat portion of the curve. Prior to the alignment of transformer T11 in Step (5), turn the carrier set trimmer, C12, to its minimum capacity.

The response curves shown in Figure 11 are obtained on an oscilloscope connected at the junction of L22 and R24. Use a 10,000 ohm resistor in series with the input lead to the oscilloscope for isolation purposes. Set the Channel Selector switch to receive Channel #4.

If the response is peaked on low frequency end of response curve and cannot be brought down to the proper relationship with high frequency end by means of the tuning slug, change the 6AU6 tube into which the signal is fed. It may be that the 6AU6 has an above average plate capacity which would cause this trouble.

3. R-F Alignment—The r-f coil and switch assembly is designed for stable band-pass operation and under normal conditions will seldom require adjustment. In cases where it is definitely known that alignment is necessary (such as when the present coil is damaged and has been changed), do not attempt the adjustment unless suitable equipment is available.

The minimum requirements for correct r-f alignment are (1) to provide the correct bandwidth, (2) for the response curve to be centered within the limit frequencies shown for each of the

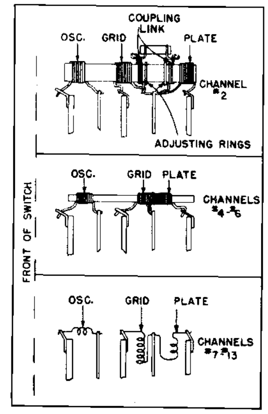


Fig. 12. R-F Coil Assembly

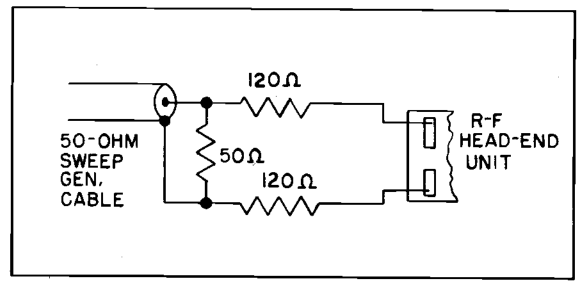


Fig. 13. Sweep Generator Termination

individual channels, as in Figure 14, and (3) for the response curve to be adjusted for maximum amplitude consistent with correct bandwidth. To provide these minimum requirements, the r-f coils are overcoupled and loaded with resistance. Tuning of the coils is affected by changing inductances of the individual coils. Except for the Channel #2 and the Channel #3 coils, the coupling is fixed by the design of the coil and switch wafers.

The physical assembly of the coils in the band switch locates the r-f amplifier plate coil at the rear of the switch assembly, while the oscillator coil is switched by the front wafer. Three different types of coils are used. These are shown in Figure 12. On all channels except Channels #7 through #13, the r-f, converter, and oscillator coils are wound on a single coil form. Mutual inductance between turns of the converter and r-f coils provides the desired coupling. On Channel #2, the converter and r-f coils are spaced for loose coupling and the mutual is increased by inserting a tertiary link winding between the coils. By adjusting the link, the mutual can be changed and better image rejection of the FM band (88 to 108 mc) signals results. Tuning of the link circuit is accomplished by adjusting two movable copper rings. The Channel #3 plate and grid coils are overcoupled by spacing of the two coils in relationship to each other and are tuned by spacing of the component turns. The Channels #4 through #6 transformers are wound so that the converter and r-f coils are wound as a continuous winding, the a-c ground return for the two coils being a tapped turn on this winding. This tight spacing

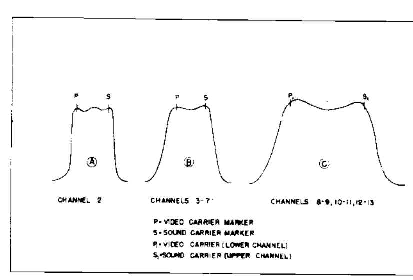


Fig. 14. R-F Alignment Curves

affords a good uniformity in mutual coupling. The tuning is accomplished by moving turns. The upper six channels, #7 through #13, are tuned by four sets of coils. Each converter and r-f coil is overcoupled to give adequate bandpass so that two channels may be covered by each set of coils except Channel #7. Instead of magnetically coupling the r-f and converter coils in relation to each other, they are physically located on the channel switch so that the only coupling is afforded by the common a-c ground return of each coil. This ground return is made through a special shaped metal wafer on the channel switch.

The input sweep signal is applied to the antenna terminal board at the r-f unit. Disconnect the 300-ohm cable between the antenna terminal board and the r-f amplifier input. To prevent distortion of the r-f response curve by standing waves, the unbalanced shielded cable of the signal generator should be terminated as shown in Figure 13. The resistors used should be non-inductive. The marker signal generator may be loosely coupled through a small capacitor to the same point of input as the sweep generator.

The output r-f response curve is taken off at the junction of R5 and C10 through a 10,000 ohm resistor. Disconnect C10. The Contrast control is set for a minimum for all r-f alignments.

For Channels #2 and #3, the r-f coils should be aligned to give approximately the curve shown in Figure 14-A and 14-B. The "P" marker represents the video carrier marker, while the "S" marker is the sound marker. The frequency of these markers is indicated for each step of the alignment procedure. Adjustment of the bandwidth is made by moving the plate coil closer to the grid coil or vice-versa. On Channel #2 the sliding of the copper rings will give both the required bandwidth and the frequency adjustment. Spread or squeeze turns in plate and grid coils to change frequency. Spreading turns results in a raising of the frequency; while squeezing turns lowers the frequency.

For Channels #4 through #6, the coupling is fixed by the tight coupling between the primary and secondary turns. However, this can be controlled to a certain degree along with the frequency by either spreading or squeezing the end turns of the combination converter and r-f coil. On the upper four coil assemblies covering the Channels #7 through #13, the coupling cannot be changed as it is fixed by the common ground wafer located between the r-f and converter coil switching wafer. This ground wafer is cut to give the proper amount of coupling at the time of manufacture.

Tuning of these upper frequency coils is affected by the brass adjustment screws which form a shorted turn in the coil. The further the screw is introduced into the coil field, the higher wlil be the frequency and vice-versa.

The variable capacitors C5 and C6 are used to compensate for the slight differences in tube capacities which affect tuning when it is necessary to change the r-f or converter tube in the field. These trimmers are adjusted for Channel #6, as indicated in the Alignment Table, and then are not readjusted until a new tube is substituted for either V1 or V2.

> *Note:* When making r-f alignment, the tuning control should be set so that the oscillator frequency is approximately correct. This may be checked by tuning in the sound frequency for that particular channel for maximum audio output. A 200 to 300 ohm resistor should be shunted across the primary of T11 or R103. This is done to prevent the oscillator voltage from upsetting the r-f alignment curve.

4. Oscillator Adjustments—The oscillator coils for Channels #2 through #7 are adjusted so that the Tuning control, C80, will tune the station at the mid-rotation position for each of these channels. Since the other remaining six channels, #8 through #13, are combined so as to be covered by only three switching positions, the oscillator coils are adjusted so that the Tuning control will tune in the two channels assigned each switch position at two points equi-distant from the two extremes of its rotation. With the Tuning control set to its mid-position, the oscillator coil is adjusted to give a maximum output when a modulated r-f signal at the test frequency specified is fed into the antenna terminals. The oscillator coils are adjusted by spreading turns to raise frequency or compressing turns to lower frequency.

Apply the signal generator with tone modulation to the antenna input terminals and set the generator to the frequency specified in the Alignment Table for each switch position. The signal generator must be very accurately calibrated. This can be done by beating its output against a known channel carrier, or use a station operating on the channel and then tune in the sound.

For output indication, advance the volume control about to mid-position so that the tone modulation or audio modulation on the station may be heard through the loudspeaker.

The oscillator coil is located on the coil form or switch assembly nearest to the front of the r-f unit. This is shown in Figures 12 and 17

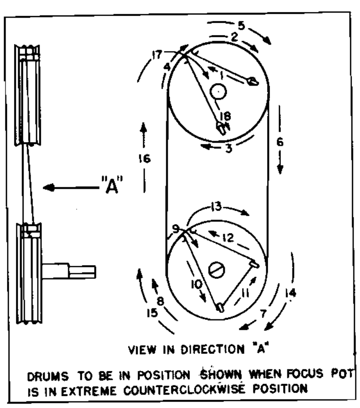


Fig. 15. Focus Control Stringing

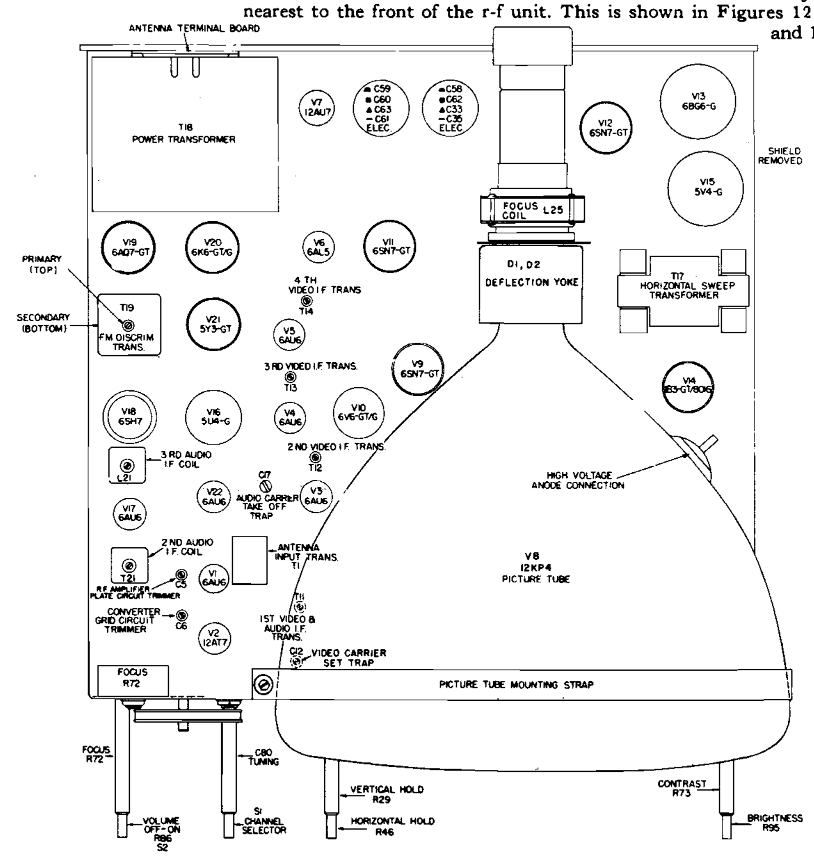


Fig. 16. Component and Trimmer Location

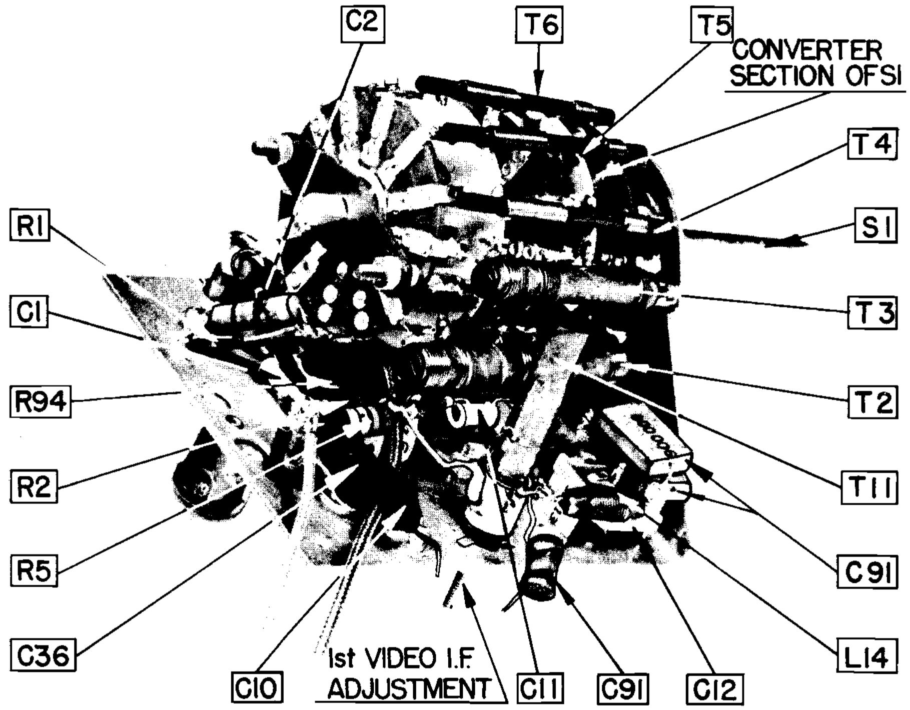


Fig. 17. R-F Head-end Assembly, Oblique View

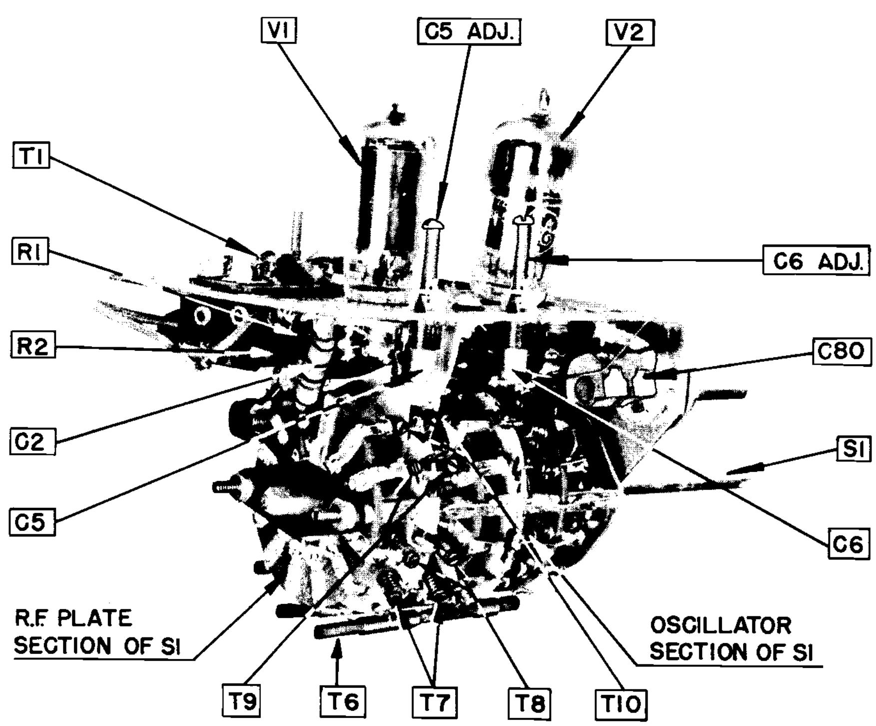


Fig. 18. R-F Head-end Assembly, Side View

ALIGNMENT TABLE

Before attempting the following tabular alignment procedure, read the preceding section "Alignment Suggestions"

STEP NO.	SIGNAL GEN. FREQ.	SWEEP GENERATOR FREQUENCY	SIGNAL INPUT POINT	CONNECT OSCILLOSCOPE TO CHASSIS AND	CHANNEL SWITCH SETTING	ADJUST	REMARKS
				(1) SOUND I-F ALIGNMENT			
1	21.8 MC marker	21.8 MC with 1 MC sweep	Grid of V17 thru 500 mmf.	Junction of R104 and C100 thru 100K resistor	Channel #4	L21 for max. amplitude and symmetry about marker.	See Fig. 10A for resultant curve.
2	21.8 MC	21.8 MC with 1 MC sweep	Grid of V22 thru 500 mmf.	Junction of R104 and C100 thru 100K resistor	Channel #4	Top and bottom tuning cores of T21 for maximum amplitude and symmetry about marker.	
3	21.8 MC with 400-cycle tone modulation	Not used	Grid (1) of V22 thru 500 mmf.	C74 and R86 thru 10,000-ohm resistor	Channel #4	Secondary slug of T19 for min. sine wave amplitude or listen for min. tone.	Turn volume control to mid-position.
4	Not used	21.8 MC with 1 MC sweep	Grid (1) of V22 thru 500 mmf.	C74 and R86 thru 10,000-ohm resistor	Channel #4	Primary slug of T19 for max. peak-to-peak amplitude and symmetry about base line.	See Fig. 10B for resultant curve.
5	Recheck Steps 3 and 4.						
				(2) VIDEO I-F ALIGNMENT			
1	22.9 MC 26.4 markers	20-30 MC	Grid (1) of V5 thru 500 mmf.	L16 and C27 thru 10,000-ohm resistor	Channel #4	Adjust primary and secondary slugs of T14 for max. amplitude and flat response with markers as shown in Fig. 11A.	Remove tube V4
2	22.8 MC 25.55 MC 26.3 MC markers	20-30 MC sweep	Grid (1) of V5 thru 500 mmf.	L16 and C27 thru 10,000-ohm resistor	Channel #4	Adjust slug of T13 for max. amplitude and flat response with markers as shown in Fig. 11B.	Remove tube V3 and replace V4
3	21.8 MC with 400-cycle modulation	—	Grid (1) of V3 thru 500 mmf.	L16 and C27 thru 10,000-ohm resistor	Channel #4	Adjust C17 for min. 400-cycle amplitude.	
4	22.9 MC 23.4 MC 25.55 MC 26.3 MC markers	20-30 MC	Grid (1) of V3 thru 500 mmf.	L16 and C27 thru 10,000-ohm resistor	Channel #4	Adjust T12 for max. amplitude and flat response with markers as shown in Fig. 11C.	Remove V2 and replace V3.
5	22.9 MC 23.4 MC 25.65 MC 26.3 MC	20-30 MC	Grid (7) of V2 thru 500 mmf.	L16 and C27 thru 10,000-ohm resistor	Channel #4	Adjust slug of T11 for max. amplitude and flat response with markers as shown in Fig. 11C.	Turn carrier set trimmer to minimum capacity. Replace tube V2.
6	22.9 MC 23.4 MC 25.55 MC 26.3 MC	20-30 MC	Grid (7) of V2 thru 500 mmf.	L16 and C27 thru 10,000-ohm resistor	Channel #4	Adjust C12 until 26.3 MC marker is 50% above base line. 25.55 MC and 22.9 MC markers should be as shown in Fig. 11D.	
				(3) R-F ALIGNMENT			
1	83.25 MC and 87.75 MC	Channel #6 with 15 MC sweep	Antenna terminals at r-f amplifier	R5 and C10 thru 10,000-ohm resistor. Disconnect C10.	Channel #6	C5 and C6 for max. amplitude and flat response with correct markers location.	See Fig. 14B for proper alignment curve.

ALIGNMENT TABLE (Continued)

STEP NO.	SIGNAL GEN. FREQ.	SWEEP GENERATOR FREQUENCY	SIGNAL INPUT POINT	CONNECT OSCILLOSCOPE TO CHASSIS AND	CHANNEL SWITCH SETTING	ADJUST	REMARKS
				(3) R-F ALIGNMENT (Continued)			
2	77.25 MC and 81.75 MC	Channel #5 with 15 MC sweep	Antenna terminals at r-f amplifier	R5 and C10 thru 10,000-ohm resistor. Disconnect C10.	Channel #5	Check and adjust inductance if necessary for max. amplitude and flat response with correct markers.	See Fig. 14B for proper alignment curve.
3	67.25 MC and 71.75 MC	Channel #4 with 15 MC sweep	Antenna terminals at r-f amplifier	R5 and C10 thru 10,000-ohm resistor. Disconnect C10.	Channel #4	Check and adjust inductance if necessary for max. amplitude and flat response with correct markers.	See Fig. 14B for proper alignment curve.
4	61.25 MC and 65.75 MC	Channel #3 with 15 MC sweep	Antenna terminals at r-f amplifier	R5 and C10 thru 10,000-ohm resistor. Disconnect C10.	Channel #3	Check and adjust inductance if necessary for max. amplitude and flat response with correct markers.	See Fig. 14B for proper alignment curve.
5	55.25 MC and 59.75 MC	Channel #2 with 15 MC sweep	Antenna terminals at r-f amplifier	R5 and C10 thru 10,000-ohm resistor. Disconnect C10.	Channel #2	Check and adjust inductance if necessary for max. amplitude and flat response with correct markers.	Adjust inductance by moving copper rings. See Fig. 14A for proper alignment curve.
6	175.25 MC and 179.75 MC	Channel #7 with 15 MC sweep	Antenna terminals at r-f amplifier	R4 and C10 thru 10,000-ohm resistor. Disconnect C10.	Channel #7	Check and adjust inductance if necessary for max. amplitude and flat response with correct markers.	Adjust inductance by brass screws in coils. See Fig. 14B for proper curve.
7	181.25 MC and 191.75 MC	186.5 MC with 25 MC sweep	Antenna terminals at r-f amplifier	R5 and C10 thru 10,000-ohm resistor. Disconnect C10.	Channel #8–#9	Check and adjust inductance if necessary for max. amplitude and flat response with correct markers.	Adjust inductance by brass screws in coils. See Fig. 14C for proper curve.
8	193.25 MC and 203.75 MC	198.5 MC with 25 MC sweep	Antenna terminals at r-f amplifier	R5 and C10 thru 10,000-ohm resistor. Disconnect C10.	Channel #10–#11	Check and adjust inductance if necessary for max. amplitude and flat response with correct markers.	Adjust inductance by brass screws in coils. See Fig. 14C for proper curve.
9	205.25 MC and 215.75 MC	210.5 MC with 25 MC sweep	Antenna terminals at r-f amplifier	R5 and C10 thru 10,000-ohm resistor. Disconnect C10.	Channel #12–#13	Check and adjust inductance if necessary for max. amplitude and flat response with correct markers.	Adjust inductance by brass screws in coils. See Fig. 14C for proper curve.
				(4) OSCILLATOR ADJUSTMENTS			
1	59.75 MC with tone modulation	—	Antenna terminals	—	Channel #2	Squeeze or spread turns of oscillator coil of T2.	Volume control at mid-position. Set tuning control at mid-position of travel. Use sound output as indicator.
2	65.75 MC with tone modulation	—	Antenna terminals	—	Channel #3	Squeeze or spread turns of oscillator coil T3 for maximum.	Volume control at mid-position. Set tuning control at mid-position. Use sound output as indicator.
3	71.75 MC with tone modulation	—	Antenna terminals	—	Channel #4	Squeeze or spread turns of oscillator coil of T4.	
4	81.75 MC with tone modulation	—	Antenna terminals	—	Channel #5	Squeeze or spread turns of oscillator coil of T5.	
5	87.75 MC with tone modulation	—	Antenna terminals	—	Channel #6	Squeeze or spread turns of oscillator coil of T6.	

ALIGNMENT TABLE (Continued)

STEP NO.	SIGNAL GEN. FREQ.	SWEEP GENERATOR FREQUENCY	SIGNAL INPUT POINT	CONNECT OSCILLOSCOPE TO CHASSIS AND	CHANNEL SWITCH SETTING	ADJUST	REMARKS
(4) OSCILLATOR ADJUSTMENTS (Continued)							
6	179.75 MC with tone modulation	—	Antenna terminals	—	Channel #7	Squeeze or spread turns of oscillator coil of L10.	Volume control at mid-position. Set tuning control at mid-position. Use sound output as indicator
7	188.75 MC with tone modulation	—	Antenna terminals	—	Channel #8–#9	Squeeze or spread turns of oscillator coil L11.	
8	200.75 MC with tone modulation	—	Antenna terminals	—	Channel #10–#11	Squeeze or spread turns of oscillator coil of L12.	
9	212.75 MC with tone modulation	—	Antenna terminals	—	Channel #12–#13	Squeeze or spread turns of oscillator coil of L13.	

MISCELLANEOUS INSTALLATION AND SERVICE ADJUSTMENTS

REPLACEMENT OF PICTURE TUBE.

To replace the picture tube it is necessary to remove the chassis from the cabinet. Remove the picture tube socket, the high-voltage anode cap, and then partially loosen the setscrews that clamp the picture tube front mounting strap. The fiber centering gasket (see Figure 20) should be slid off from the neck of the picture tube. Carefully pull the picture tube out through the focus and deflection coils.

Install the new picture tube from the front of chassis by inserting the base of tube through the deflection yoke and focus coil assembly. The tube should be moved back so that the front surface of the picture tube is approximately 1⅝ inches in front of the chassis front apron. The rim of the bulb should rest on the channel rubbers and then the tube is clamped firm but not tight in place by the picture tube mounting strap. The picture tube should be rotated until the keyway at the base of the tube points approximately as shown in Figure 20. Install the high voltage anode cap onto the high voltage anode of the picture tube.

Replace the chassis in the cabinet and secure by the cabinet mounting screws. Now push the picture tube forward on the chassis until the face of the tube is tight within the picture tube mask. Push the deflection yoke assembly forward as far as it will go. The front of the deflection coil should butt up against the bulb portion of the picture tube. Insert the fiber gasket between the neck of the picture tube and the focus coil, as shown in Figure 20. This centers the neck of the tube where it passes through the deflection yoke assembly. Install the picture tube socket onto the base of the picture tube.

Wipe the screen surface of the picture tube so as to remove finger marks and dirt. *Precaution—Do not handle, remove, or install a picture tube unless shatterproof goggles and heavy gloves are worn.*

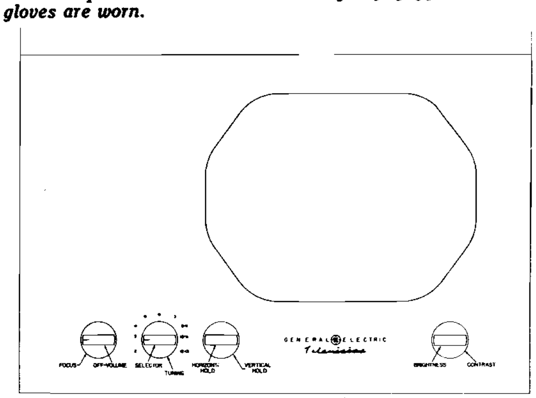
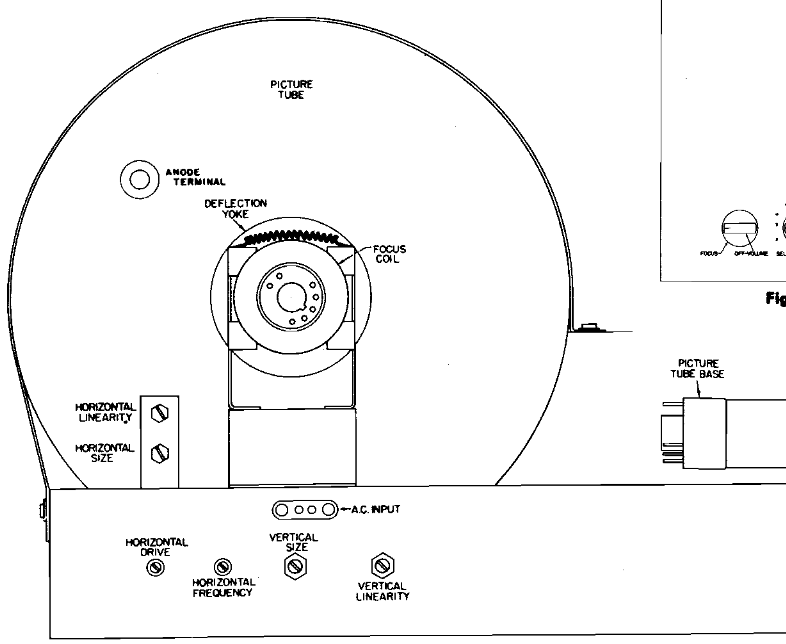


Fig. 19. Knob Control Location



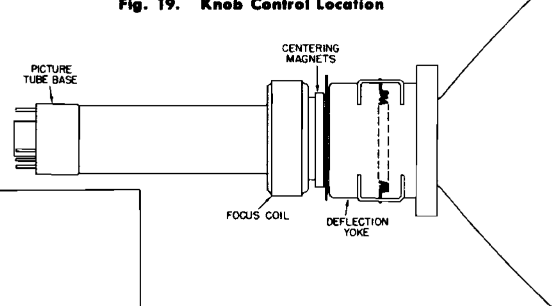


Fig. 20. Location of Preset Adjustment Controls

PICTURE CENTERING ADJUSTMENT.

The cabinet back cover must be removed to make this adjustment. The centering magnet assembly is located between the Focus Coil and Deflection Yoke, as shown in Figure 20, and is used to center the picture within the tube mask.

The larger magnet ring can be rotated 180° and pushed closer to or farther from the smaller ring magnet which is soldered inside of the sleeve. In one position the outside magnet is aiding the inside magnet and rotated 180° it is opposing the inside magnet. To get maximum deflection of the electron beam, it is necessary to have the two magnets aiding and close together. To get minimum deflection, the outside magnet must be rotated 180° (opposing). Therefore, to center the electron beam, move the outside magnet away from the inside magnet (towards the focus coil). Rotate the whole centering assembly until the beam moves in the proper direction, then move the magnets together, either aiding or opposing until the desired correction is obtained.

TILT CONTROL.

This adjustment must be made with the cabinet back removed. If the picture is slightly tilted and does not square with the picture tube mask, rotate the deflection yoke in its clamp bracket until it is aligned. The deflection yoke is held in its clamp bracket by spring pressure.

HORIZONTAL LINEARITY AND HORIZONTAL DRIVE.

These controls are used to adjust the linearity. Adjust the horizontal drive control to a minimum capacity setting (counterclockwise), which is just before a vertical white line appears. Turn the horizontal drive control clockwise until this line just disappears. With Horizontal Size at approximately its correct setting, adjust the Horizontal Linearity until the picture shows correct horizontal proportions. A maladjustment shows up as an elongation or crowding of either side of the picture. This is best adjusted when a test pattern is being broadcasted by adjusting the control until the distance from the center of the test pattern to the left-hand and right-hand edges measures the same. If the Horizontal Linearity control will not give the proper linearity adjustment, turn the Horizontal Drive control slightly clockwise and repeat adjustment of Horizontal Linearity. Always leave the Horizontal Drive control at maximum counterclockwise position consistent with good linearity. If there is any fold-over of pattern at center of picture which shows up as a lighter area about ¼ to ½ inch wide running vertically on screen, the Horizontal Drive control should be turned clockwise until it disappears.

HORIZONTAL SIZE.

This control changes the horizontal size of the picture. When adjusted to the recommended width, the picture should extend for approximately ⅛ inch beyond the edge of the picture tube mask so that the left and right edges of the picture are not visible. In the picture showing incorrect adjustment of the Width control, it will be noted that this conditions makes the inner circle of the test pattern an egg shape instead of a perfect circle.

VERTICAL LINEARITY.

This control gives the proper vertical proportions to the picture. Improper adjustment will either crowd the lower or upper half of the picture, as shown in the illustration. This is best adjusted on the test pattern by adjusting the Vertical Linearity control until the distance from the center of the test pattern to the top or bottom edges measures the same. The adjustment of this control will alter the height of the picture slightly so as to necessitate the adjustment of the Vertical Size control simultaneously with it.

VERTICAL SIZE.

This control changes the picture height. When adjusted to the correct height, the picture should extend for approximately ⅛ inch beyond the edge of the picture tube mask so that the top and bottom edges of the picture are not visible.

HORIZONTAL FREQUENCY.

This is a coarse adjustment that supplements the Horizontal Hold control adjustment on the front panel. This control should be adjusted to give approximately 13 volts bias measured across the Contrast control (R74 to ground) with a vacuum tube voltmeter.

T16 ADJUSTMENT.

The core of the blocking oscillator transformer T16 changes the frequency of this circuit. Its adjustment is made as follows: Connect a VTVM to measure the voltage from the junction of R74 and potentiometer R73 to ground. Tune the receiver to any suitable television signal. Set the front panel Horizontal Hold control, R46, to the midpoint of its resistance range, then adjust the iron core of the blocking oscillator transformer T16 and the setting of the Horizontal Frequency control trimmer C49 to bring the picture into horizontal synchronization and to develop −12 1.0 volts across the contrast control, as measured by the VTVM. The iron core adjustment and the trimmer setting are interlocking and, therefore, it will be necessary to readjust each of these controls in turn to bring the picture in sync and, also, to obtain −12 volts.

The sync range should fall in the approximate center of the front panel Horizontal Hold control range, and it should be possible to throw the circuit out of sync by turning the control to either end of its range.

CRITICAL LEAD DRESS AND COMPONENT REPLACEMENT

Since the operating frequencies are relatively high in a television receiver, it is essential that all components be replaced in exactly the same position they occupied when they left the factory, all leads be made as short as possible and exact replacement parts be used when service is required. Leads in wiring between components are usually critical as to placement against chassis or proximity to other components. Some of critical wiring precautions are listed below:

1. *Discriminator (T19) Leads*—Dress primary and secondary leads of the discriminator transformer close to chassis.

2. *Head-end Unit*—All leads which run between head-end unit coil assembly and front apron of chassis should be dressed as far as possible from the oscillator coils.

3. *Plate Lead of 6K6*—The plate lead (blue) of 6K6 should be dressed as far away from the 6AQ7GT 1st audio circuit as possible.

4. *Electrolytic C102*—When replacing this V2 filament rectifier electrolytic capacitor, C102, connect the ground lug of the capacitor as directly to chassis ground as possible.

TROUBLE SHOOTING

The following is a listing of possible troubles and their cures. This is not intended as a comprehensive coverage but will merely serve as a guide in locating some of the more difficult problems that may be experienced. From time to time this information will be supplemented by a service bulletin.

1. NO RASTER ON PICTURE TUBE.

(a) Check for waveform on oscilloscope at output of T17. If present, the trouble is probably in the Type 1B3GT rectifier tube, filter circuit, or picture tube. Check for open circuit in high voltage winding or R62 of T17. If the filament of V14 glows orange, high voltage is being generated and the trouble will possibly exist in the picture tube, V8.

(b) If there is no waveform at output of T17, check operation of V13, and sawtooth generator, V12B, by oscilloscope waveform measurement.

(c) Check that high voltage anode cap is contacting the anode terminal of the picture tube.

(d) Open in Brightness control. R95 or R32 or R43.

(e) Defective V7B tube.

(f) If anode voltage is very low, check deflection yoke for continuity or shorted turns, check Horizontal size control for continuity.

2. RASTER NORMAL, NO PICTURE OR SOUND.

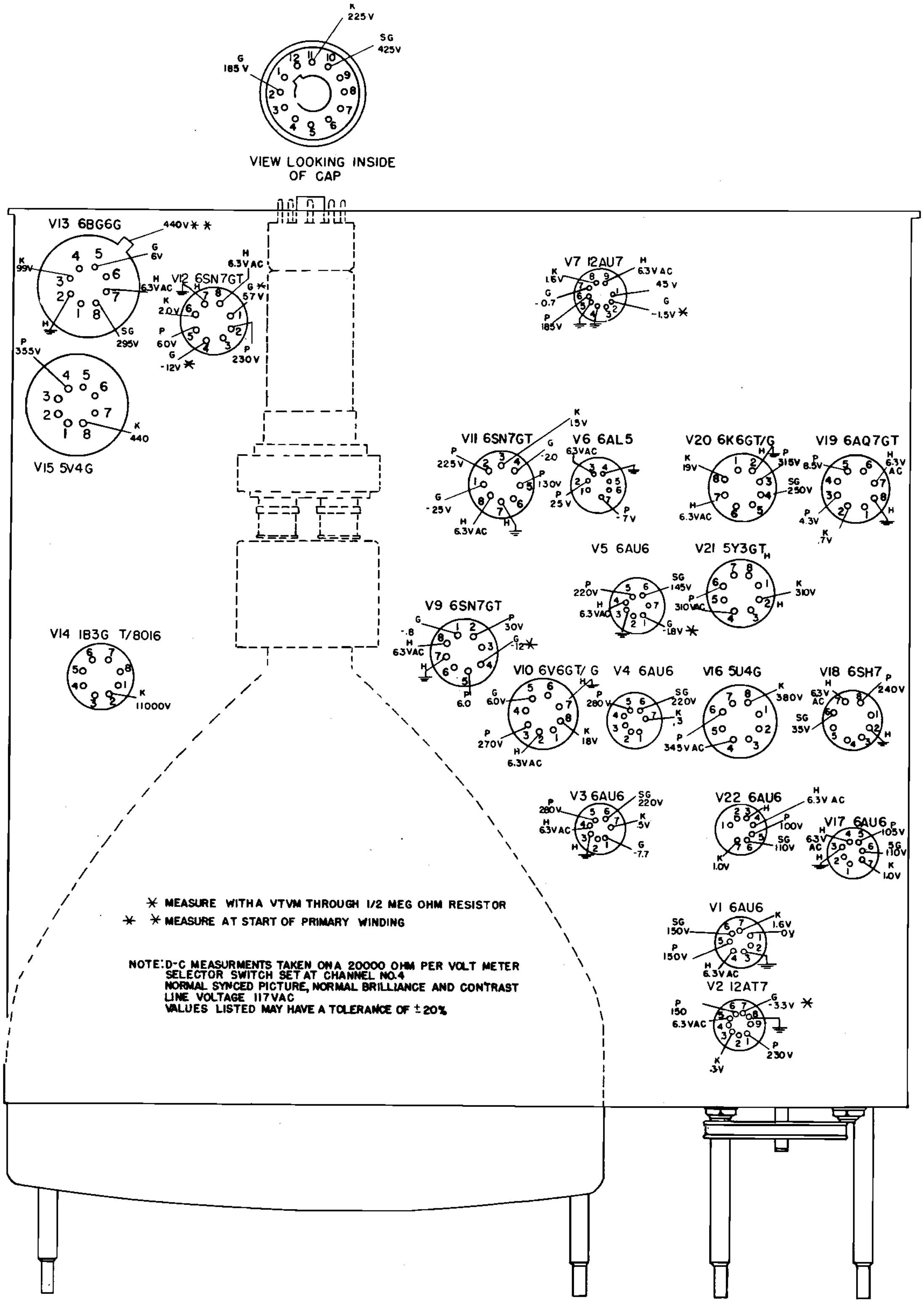
(a) Oscillator V2A defective, or oscillator coil resonates outside of channel.

(b) Defective antenna or lead-in. With contrast full up if antenna system is working satisfactorily, noise pattern should be seen on screen and heard in speaker.

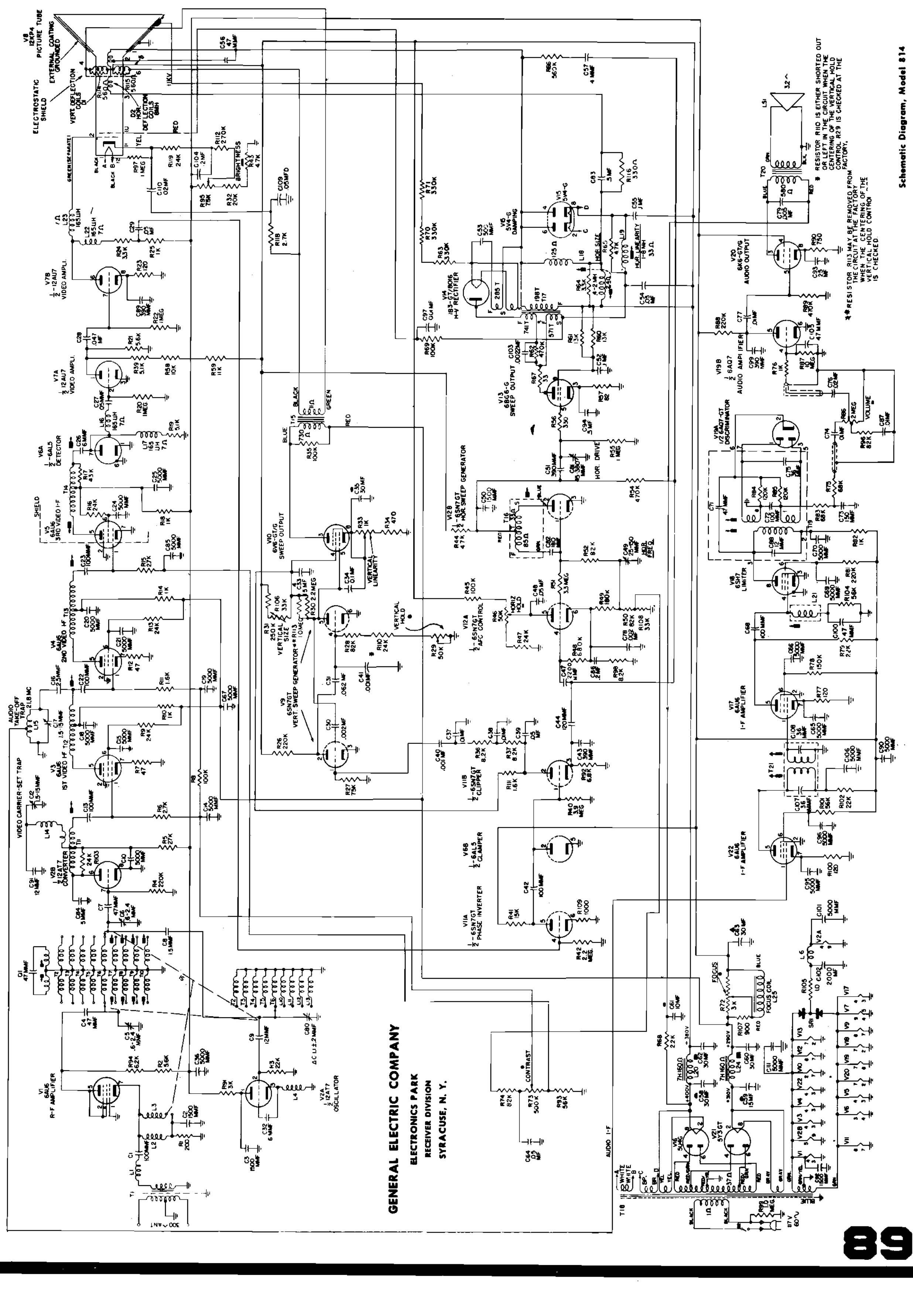
(c) Converter, r-f amplifier, or first video i-f amplifier stage defective.

(Continued on page 91)

MOST-OFTEN-NEEDED 1949 TELEVISION RECEIVERS



Socket Voltage Diagram


GENERAL ELECTRIC COMPANY
ELECTRONICS PARK
RECEIVER DIVISION
SYRACUSE, N. Y.
Schematic Diagram, Model 814

MOST-OFTEN-NEEDED 1949 TELEVISION RECEIVERS

PICTURE DEFECTS

The following illustrations show picture defects which are caused by incorrect setting of the operating controls and/or preset controls or by interference picked up by the antenna. The correction is indicated for each control maladjustment.

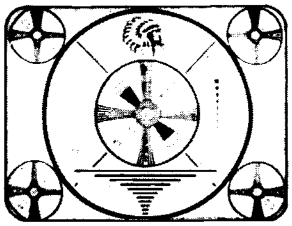


Fig. 22

NORMAL PICTURE

The normal picture should show good focus and a good contrast between blacks and whites with the intermediate shades of gray. The picture should not tend to either move vertically or horizontally.

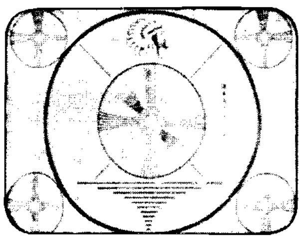


Fig. 24

PICTURE TOO LIGHT

Turn the Contrast control slightly clockwise and/or turn Brightness control slightly counterclockwise until a good contrast ratio exists between the black and white picture elements.

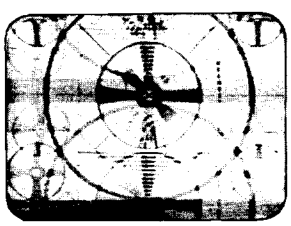


Fig. 26

VERTICAL PICTURE MOVEMENT

Adjustment of Vertical Hold control at the receiver front panel will stop any vertical roll of picture.

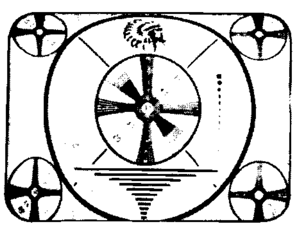


Fig. 28

PICTURE ELONGATED VERTICALLY

Adjust Vertical Linearity control so that the vertical radius from top to center and bottom radius are equal. This adjustment may alter the vertical size.

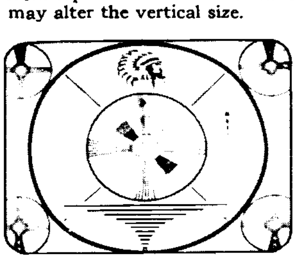


Fig. 30

PICTURE TOO WIDE

Adjust Horizontal Width control so that the right and left picture edges are just covered by the mask.

The adjustment of the controls is most efficiently accomplished by the use of a test pattern, similar to that illustrated, which is normally transmitted just prior to the scheduled program.

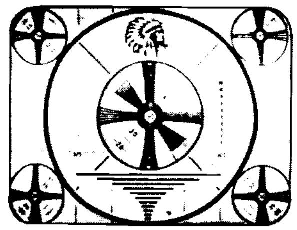


Fig. 23

PICTURE TOO DARK

Turn Contrast control slightly counterclockwise and/or turn Brightness control clockwise.

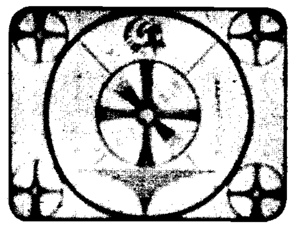


Fig. 25

BLURRED PICTURE

This indicates that the picture is out of focus. Adjust Focus control until the picture detail is sharp and clear.

Fig. 27

PICTURE TILTS OR MOVES SIDEWAYS

Adjust Horizontal Hold until picture straightens up and locks into position so there is no sideways motion.

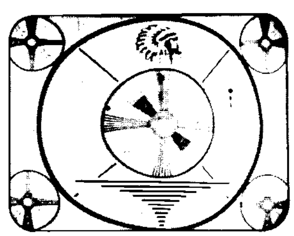


Fig. 29

PICTURE ELONGATED HORIZONTALLY

Adjust Horizontal Linearity control so that the horizontal radius from center to left side is equal to radius from center to right side. This may alter the horizontal size.

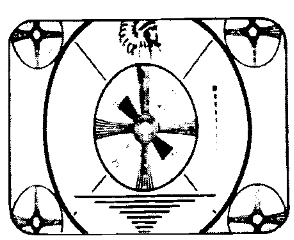


Fig. 31

PICTURE TOO TALL

Adjust Vertical Height control so that the top and bottom picture edges are just covered by mask.

3. PICTURE NORMAL, NO SOUND.

(a) Audio i-f amplifier, audio discriminator detector, or audio amplifier defective.

(b) Defective speaker.

(c) Oscillator V2A off frequency.

4. RASTER NORMAL, SOUND NORMAL, NO PICTURE.

(a) Video i-f amplifier (after 1st i-f) inoperative.

(b) Video amplifier tube V7 defective.

(c) Grid lead to picture tube open.

5. NORMAL PICTURE AND SOUND, NO HORIZ. OR VERT. SYNC.

(a) Check for signal waveform at grid (4) of V11A and grid (1) of V11B

(b) Tube V7A plate circuit components improper value.

6. PICTURE NORMAL, NO VERTICAL SYNC.

(a) Check grid (1) of V9 for vertical sync pulses.

(b) Check frequency of vertical sweep generator. This should be capable of free running frequency of slightly less than 60 cps.

(c) Check sweep generator tube, V9, components.

7. PICTURE NORMAL, NO HORIZONTAL SYNC.

(a) Check grid (4) of V12A for horizontal sync pulse. Disconnect leads from R54 and C57 to examine this.

(b) Check tube V12A and its circuit components.

(c) Check sweep generator V12B and circuit components.

8. RASTER EDGE NOT STRAIGHT—KEYSTONING.

(a) Defective deflection yoke.

(b) Defective sweep transformer.

9. PICTURE JUMPY.

(a) Operation at too high a Contrast control setting.

(b) Gassy or noisy 6BG6G (V13) or 6V6GT (V10) tubes.

(c) Noisy sweep or sync circuit tubes.

(d) Excess noise received by antenna system.

10. POOR PICTURE DETAIL.

(a) Mismatch in antenna and lead-in system.

(b) Misalignment of i-f and r-f circuits.

(c) Defective video chokes.

(d) Make sure focus control goes through focus.

(e) Overload of video amplifier. Check contrast control operation.

11. AUDIO MOTOR BOATING.

(a) Dress V20 plate lead (blue) as far away as possible from V19B tube circuit components.

WAVEFORM MEASUREMENTS

The waveform shown in Figures 36 through 51 represent measurements on an average receiver wherein the controls have been adjusted for a normal picture with correct Contrast, Height, Width and Linearity. Most measurements must be made when a signal is being received.

The oscilloscope where the vertical deflection amplifier has been precalibrated is used to make measurements at the point indicated in the wave form boxes. The oscilloscope sweep frequency is indicated in the waveform title.

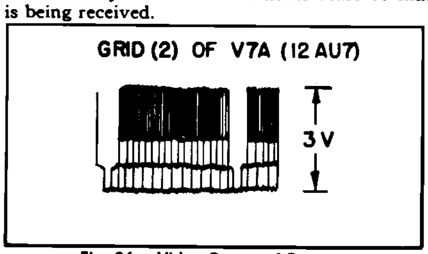


Fig. 36. Video Output of Detector
(Osc. Synced at Half of Vertical Sweep Speed)

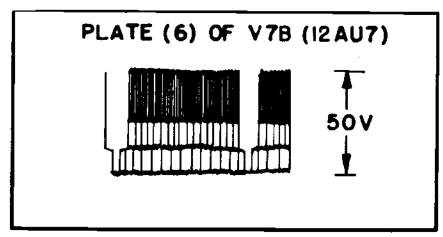


Fig. 37. Video Output
(Osc. Synced at Half of Vertical Sweep Speed)

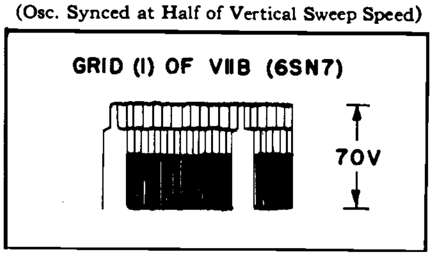


Fig. 38. Clipper Grid
(Osc. Synced at Half of Vertical Sweep Speed)

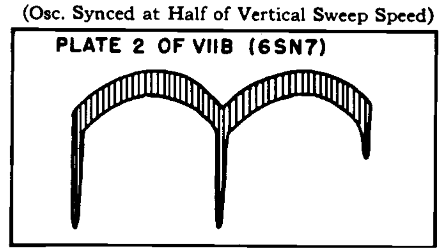


Fig. 39. Clipper Vert Sync. Pulse
(Osc. Synced at Half of Vertical Sweep Speed)

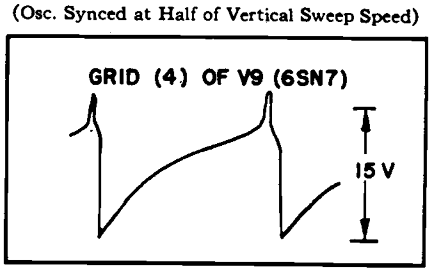


Fig. 40. Vertical Multivibrator
(Osc. Synced at Half of Vertical Sweep Speed)

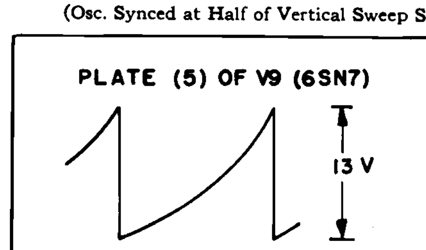


Fig. 41. Vertical Multivibrator
(Osc. Synced at Half of Vertical Sweep Speed)

MOST-OFTEN-NEEDED 1949 TELEVISION RECEIVERS

WAVEFORM MEASUREMENT (Cont'd)

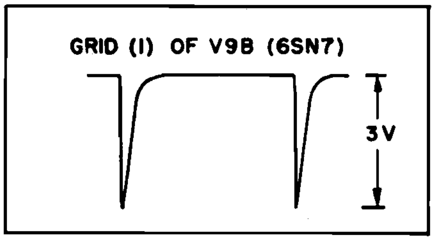


Fig. 42. Vertical Multivibrator
(Osc. Synced at Half of Vertical Sweep Speed)

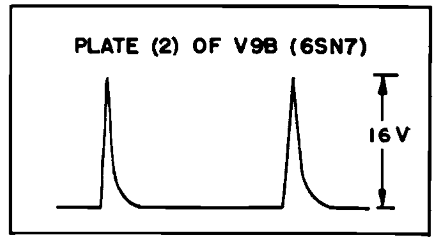


Fig. 43. Vertical Miltivibrator
(Osc. Synced at Half of Vertical Sweep Speed)

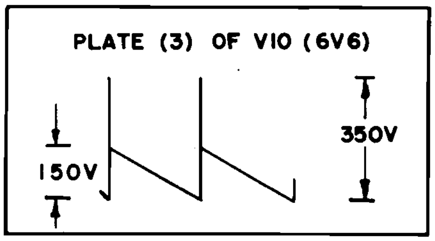


Fig. 44. Vertical Sweep Output
(Osc. Synced at Half of Vertical Sweep Speed)

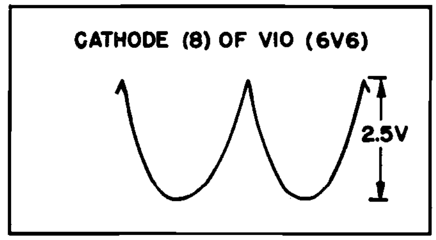


Fig. 45. Cathode of Vertical Output
(Osc. Synced at Half of Vertical Sweep Speed)

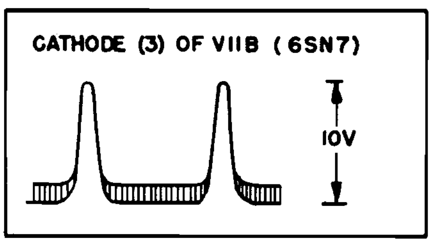


Fig. 46. Clipper Cathode Horizontal Sync. Pulse
(Osc. Synced at Half of Horizontal Sweep Speed)

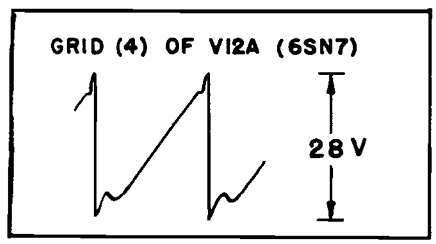


Fig. 47. Horizontal A.F.C. Grid
(Osc. Synced at Half of Horizontal Sweep Speed)

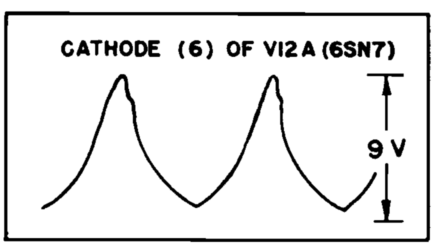


Fig. 48. Horizontal A.F.C. Cathode
(Osc. Synced at Half of Horizontal Sweep Speed)

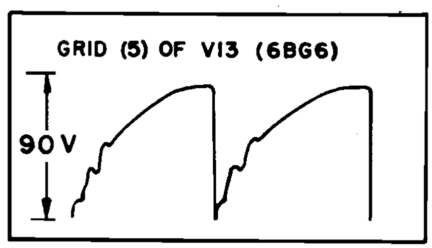


Fig. 49. Grid of Horizontal Sweep Generator
(Osc. Synced at Half of Horizontal Sweep Speed)

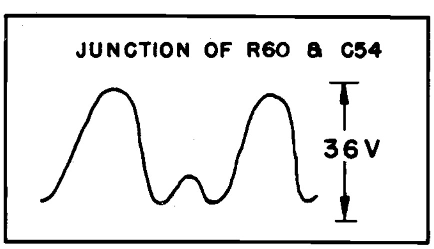


Fig. 50. Start of Primary of Sweep Transformer
(Osc. Synced at half of Horizontal Sweep Speed)

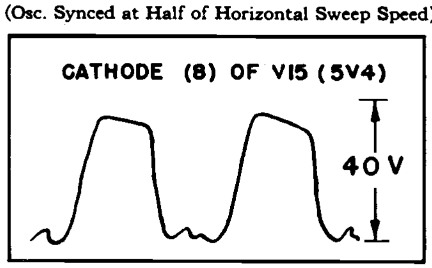
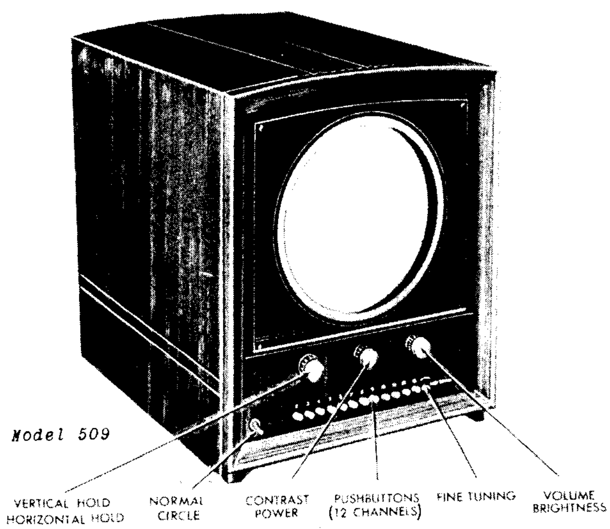


Fig. 51. Cathode of Damping Tube
(Osc. Synced at Half of Horizontal Sweep Speed)

MOST-OFTEN-NEEDED 1949 TELEVISION RECEIVERS

the hallicrafters co.

MODELS T-64, 509 AND 510



Model Differences. . . . . Model T-64 - custom installation (chassis unit)
Model 509 - Wood cabinet
Model 510 - Plastic cabinet

CARE OF THE KINESCOPE WINDOW

The window in front of the picture tube is made of safety glass, hence may be cleaned by any of the conventional window cleaning processes. Abrasive or strong solvent type cleaning solutions that may scratch the glass or damage the cabinet finish, however, should be avoided.

HIGH VOLTAGE WARNING

Operation of the receiver chassis outside of the cabinet involves a shock hazard. An interlock in the line cord disconnects the power when the back cover is removed. The HIGH VOLTAGE supply, while of low current capacity, operates at a 9,000 volt potential. Exercise all normal HIGH VOLTAGE precautions while working with this equipment.

KINESCOPE HANDLING PRECAUTIONS

The kinescope housing provides adequate protection against possible tube implosure while in the cabinet. Do not expose the kinescope or handle it in any way without providing personal protection in the form of shatterproof goggles and heavy gloves. The kinescope should be handled by qualified personnel only.

The kinescope envelope encloses a high vacuum and with the large surface area of glass involved, the stresses set up, particularly at the front rim of the tube, are considerable. An abnormal handling stress, accidental blow at a highly stressed surface, or even a scratch on the surface of the tube could cause it to implode or collapse with destructive violence.

NON-OPERATING CONTROL ADJUSTMENTS

The "non-operating" or screw-driver adjustments normally will require an occasional minor adjustment if any circuit work or tube changing is required. A test pattern, generated either locally in the shop or obtained from a television station is recommended for best results. Normal picture contrast and brightness should be maintained during the following adjustments for best results.

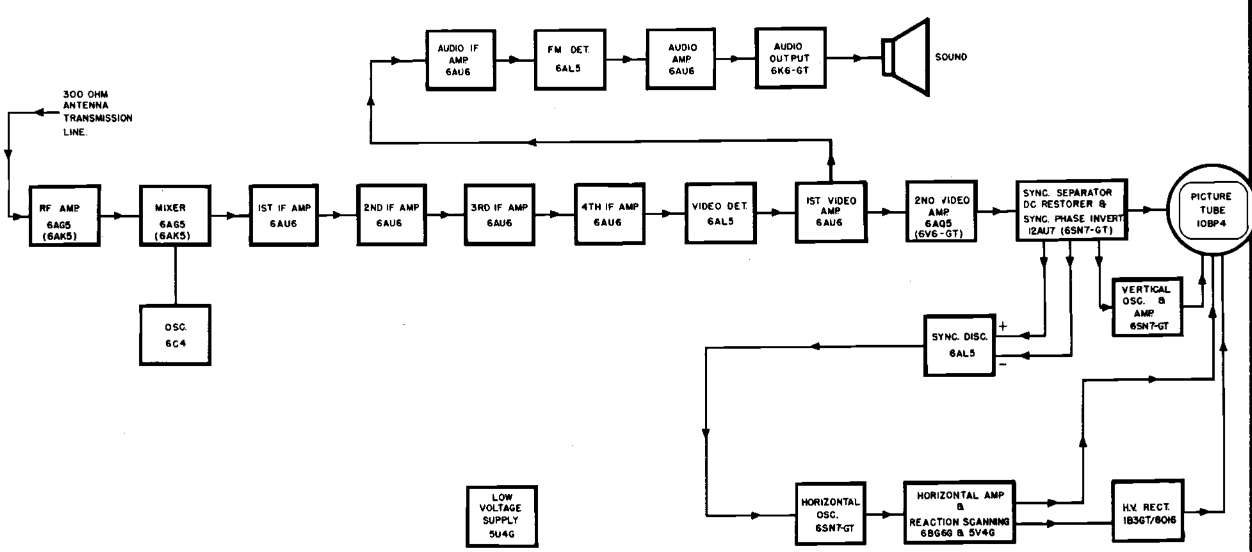


Fig. 1. Functional block diagram.

Note that the following adjustments are made with the NOR-MAL/CIRCLE switch set at NORMAL.

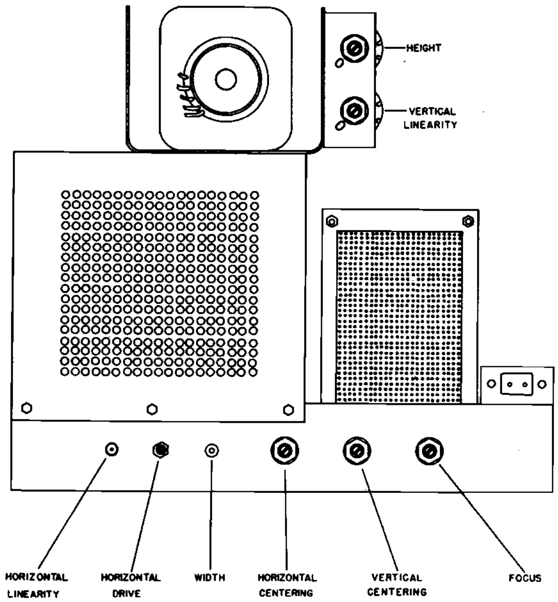


Fig. 2. Rear chassis view, location of non-operating controls.

2. Set the WIDTH and HORIZONTAL CENTERING controls so that the test pattern fits and centers in the horizontal dimension of the kinescope mask.

HORIZONTAL CENTERING CONTROL MISADJUSTMENT

Figure 5.

3. Set the HORIZONTAL LINEARITY control so that the test pattern is symmetrical from left to right. A slight readjustment of the HORIZONTAL DRIVE control may be necessary when making this adjustment.

HORIZONTAL LINEARITY CONTROL MISADJUSTMENT

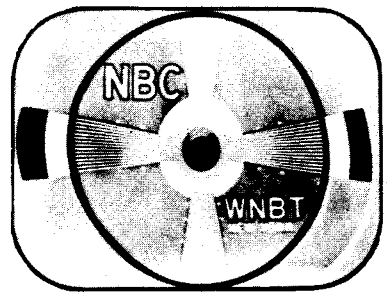


Figure 6.

HORIZONTAL-OSC.,-DRIVE,-LINEARITY, CENTERING AND WIDTH ADJUSTMENTS

1. Advance the HORIZONTAL DRIVE control (clockwise) as far as possible without causing crowding of the right hand side of the test pattern or producing picture instability. Insufficient horizontal drive will cause the raster to fall short of filling the mask horizontally. Should the HORIZONTAL HOLD control fail to hold the test pattern in the normal manner, set the HORIZONTAL HOLD control in the middle of its range and adjust the HORIZONTAL OSC. ADJ. screw for horizontal sync. (See Fig. 11 for location).

HORIZONTAL DRIVE CONTROL MISADJUSTMENT

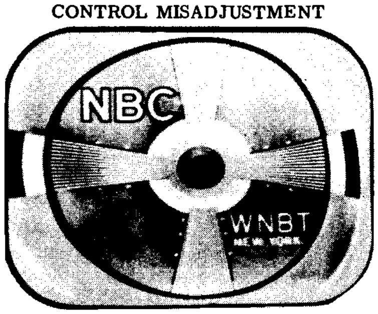


Figure 3.

WIDTH CONTROL MISADJUSTMENT

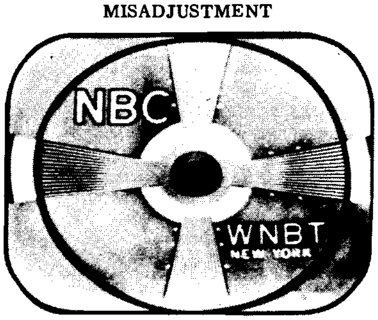


Figure 4.

VERTICAL-CENTERING,-LINEARITY, AND HEIGHT ADJUSTMENTS

HEIGHT CONTROL MISADJUSTMENT

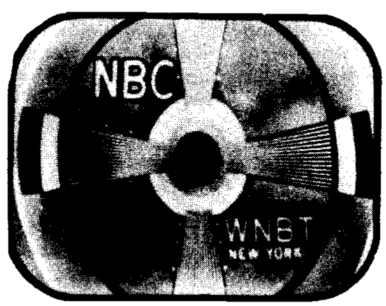


Figure 7.

1. Set the HEIGHT and VERTICAL CENTERING controls so that the test pattern fits and centers in the vertical dimension of the kinescope mask.

VERTICAL CENTERING CONTROL MISADJUSTMENT

Figure 8.

Photos by RCA Service Co.

VERTICAL LINEARITY
CONTROL MISADJUSTMENT

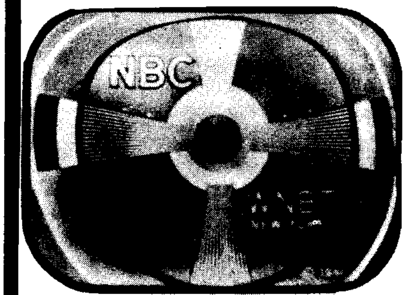


Figure 9.

2. Set the VERTICAL LINEARITY control for a symmetrical test pattern in the vertical dimension. A slight readjustment of the HEIGHT and VERTICAL CENTERING controls may be required when making this adjustment

Note - The sequence of "non-operating" control adjustments outlined above is suggested as a convenient method of approach and not an arbitrary procedure. Variations of the procedure is permitted to obtain the final result.

DISMANTLING FOR KINESCOPE REPLACEMENT OR ALIGNMENT ADJUSTMENTS

1. Remove the three front panel control knobs by pulling them straight from their shafts. The two dual control knobs must be removed in two pieces, removing the center unit first.
2. Remove the back cover. Note that the line cord and half of the interlock connector will come along with the back cover.
3. Disconnect and remove the speaker to provide clearance for the kinescope tube mounting.
4. Release the two chassis units by removing the eigh mounting screws at the base of the cabinet and pull the chass clear of the cabinet. The kinescope tube is now accessible for replacement or adjustment.
5. Reconnect the interlock connector for power while making the non-operating control adjustments or alignment adjustments on the bench.

REMOVING THE KINESCOPE

Refer to the warning KINESCOPE HANDLING PRECAUTIONS. Follow the dismantling instructions above to expose the tube and proceed as follows:

1. Disconnect the tube socket connector at the base of the tube and the high voltage anode lead. (Snap on connector).
2. Remove the ION TRAP slipping it from the neck of the tube past the tube socket.
3. Measure the distance from the front face of the RUBBER BOOT to the front of the control plate. Keep this dimension handy for the installation of a new tube.
4. Loosen the steel band at the front rim of the tube and slip the tube with the rubber boot out through the steel band.

INSTALLING THE KINESCOPE

1. Slip the RUBBER BOOT over the front rim of the kinescope tube and position the tube so that the anode contact is at the top and slightly to the right of the center as viewed from the screen of the tube.

2. Slip the tube through the front rim (socket first) and on through the REAR SUPPORT, DEFLECTION YOKE and FOCUS COIL and seat the tube firmly against the REAR SUPPORT. If the tube fails to slip into place smoothly, investigate and remove the cause of the trouble. Do not force the tube. Check the distance from the front face of the RUBBER BOOT to the front of the control plate. Refer to the measurement made in step 3 above. If this dimension is off; loosen the two REAR SUPPORT MTG. screws, position the tube correctly and fasten the front rim firmly about the RUBBER BOOT.

3. The REAR SUPPORT must seat firmly against the flare of the tube and be securely anchored in place by the two REAR SUPPORT MTG. screws. Check the two SPRING CONTACTS grounding the outer coating of the kinescope tube. A high potential is developed on the outer coating of the tube if these contacts are faulty.

4. The DEFLECTION YOKE must seat firmly against the flare of the tube. Check by loosening the single DEFLECTION YOKE ADJ. screw and pushing the DEFLECTION YOKE housing forward as far as it will go. Take up on the mounting screw temporarily to hold the coil in place.

5. Slip the ION TRAP over the neck of the tube. If it is the ring type, the arrow points toward the front of the tube; if it is of the clamp type, the blue coded clamp is toward the front.

6. Connect the tube socket and anode connector to the kinescope and turn on the receiver.

7. After allowing a few minutes for warm up, turn up the brightness control and set the ION TRAP for maximum raster brilliance, backing off the brightness control adjustment as the maximum point is approached. The ION TRAP must be rotated about the axis of the tube as well as shifted along the neck of the tube to obtain the proper setting. The arrow on the ring type ion trap will generally point at the HV anode connector when properly positioned as far as rotation is concerned, hence a rough setting may be obtained immediately with this type of trap.

With the BRIGHTNESS control set for slightly above average brilliance and the CONTRAST control full counterclockwise, adjust the FOCUS control until the line structure of the raster is clearly visible and readjust the ION TRAP for maximum raster brilliance. The final touches on this adjustment should be made with the brightness control at the maximum position with which good line focus can be maintained.

8. Set the HORIZONTAL and VERTICAL CENTERING controls at mid-position. If a corner of the raster is shadowed, it indicates that the electron beam is striking the neck of the tube. Loosen the FOCUS COIL ADJ. screws and rotate the coil about its vertical and horizontal axis until the entire raster is visible, approximately centered and with no shadowed corners. Tighten the adjustments with the coil in this position.

9. If the lines of the raster are not horizontal or square with the picture mask loosen the DEFLECTION YOKE ADJ. screw and rotate the DEFLECTION YOKE until this condition is obtained. Tighten the adjustment.

10. Follow the procedure under NON-OPERATING CONTROL ADJUSTMENTS and make any minor adjustments of the FOCUS COIL or DEFLECTION YOKE necessary to obtain the desired results. A slightly better average focus may be obtained by sliding the FOCUS COIL back and forth along the kinescope neck while adjusting the FOCUS control and watching the test pattern. The final adjustment of the focus coil should leave the raster approximately centered.

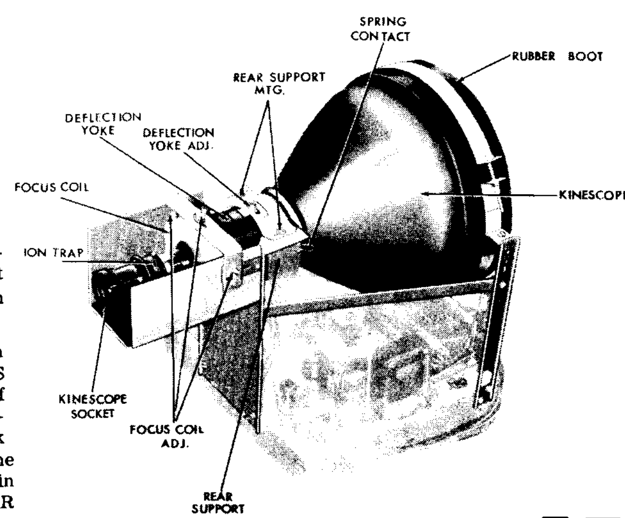


Fig. 10. Kinescope mounting detail.

MEASUREMENT OF H.V. POTENTIAL ON KINESCOPE ANODE

The second anode potential will be approx. 9,000 V. on a receiver that is functioning properly. Since the high potential for the kinescope anode is obtained from the horizontal output transformer, the "non-operating" control adjustments outlined above must be made or be known to be in proper adjustment before the H.V. measurement will have any meaning. Improper operation of the horizontal sweep circuit or circuit faults in the high voltage filter will generally account for an abnormal anode potential. If the anode potential is low, check the HORIZONTAL DRIVE adjustment outlined above.

CAUTION HIGH VOLTAGE

Do not use hand held flexible test leads when making the following measurement. Keep the hands clear of the circuit during measurement. A 9,000 V. potential exists in this circuit. Exercise all normal high voltage precautions.

1. Connect a 50-megohm resistor string in series with a 200 microampere meter. Connect the free meter terminal to the chassis and the high side of the resistor string to the anode cap of the kinescope. The connection to the anode cap may be made with a fine wire slipped under the connector. Make up the resistor string with 10-megohm one or two watt resistors to provide a safety factor for voltage breakdown. If 10-megohm resistors are used, a total of five will be required to obtain the 50 megohms. Make the setup self-supporting and allow adequate clearance between the resistor string and chassis parts to prevent high voltage breakdown.
2. Turn on the receiver and set the BRIGHTNESS and CONTRAST controls at minimum. The microammeter will read approx. 180 microamperes or 9,000 V. at the kinescope anode. The anode potential is measured in this manner (CONTRAST and BRIGHTNESS controls at minimum; meter current approx. 200 microamperes) to simulate the kinescope load on the high voltage power supply.

ALIGNMENT PROCEDURE

Note.- The following alignment adjustments do not require the use of the kinescope tube. It is recommended that the tube be removed if extensive alignment adjustments are to be made.

CAUTION - Removal of the kinescope tube exposes the HIGH VOLTAGE anode connector contact. Keep this lead and contact clear of personnel servicing equipment and grounded objects on the service bench. Exercise all normal high voltage precautions while working with the exposed units.

EQUIPMENT REQUIRED

Signal generator covering 4 mc to 30 mc
Signal generator covering 40 mc to 215 mc
Electronic voltmeter
Two 150-ohm carbon resistors
One .01 mfd. 600 V. tubular paper condenser

F-M SOUND CHANNEL ALIGNMENT

1. Connect the low frequency signal generator output between the control grid (pin 1) of the 6AU6 1st VIDEO AMP. tube (V-9) and chassis ground.
2. Connect the electronic voltmeter between pin 7 of the 6AL5 FM DET. tube (V-16) and chassis ground.
3. With the signal generator (unmodulated) set at 4.5 mc, set the 4.5 MC LIMITER GRID ADJ. and FM DET. PRI. ADJ. for maximum d-c voltage as measured by the electronic voltmeter. Adjust the limiter grid coil (L-14) before adjusting the f-m detector transformer (T-1) primary. Use just enough signal generator output to obtain approximately one volt at the electronic voltmeter.
4. Connect the electronic voltmeter across the 1,000 mmf condenser (C-17) at the output of the f-m detector stage and adjust the FM DET. SEC. ADJ. of the f-m detector transformer (T-1) for the null.
5. Shift the frequency of the signal generator either side of 4.5 mc and touch up the FM DET. PRI. ADJ. for approximately equal peaks. Use just enough signal generator output to obtain one volt peaks for best results.

I-F AMPLIFIER ALIGNMENT CHART

1. Connect the electronic voltmeter across the 5600-ohm resistor (R-57) in the plate circuit of the 6AL5 VIDEO DET. tube (V-8). This resistor is located on the terminal strip between the 6AU6 4th IF AMP. tube (V-7) and the 6AL5 VIDEO DET. tube (V-8).
2. Connect the output of the low frequency signal generator to the receiver's antenna input through two 150-ohm carbon resistors, one connected in each conductor of the transmission line.
3. Set the signal generator output (unmodulated) to develop two volts at the electronic voltmeter and adjust the five i-f amplifier coils, according to the following chart, for maximum d-c voltage as measured by the electronic voltmeter. Readjust the signal generator output as required to maintain the two volt potential at the electronic voltmeter.

I-F AMPLIFIER ALIGNMENT CHART

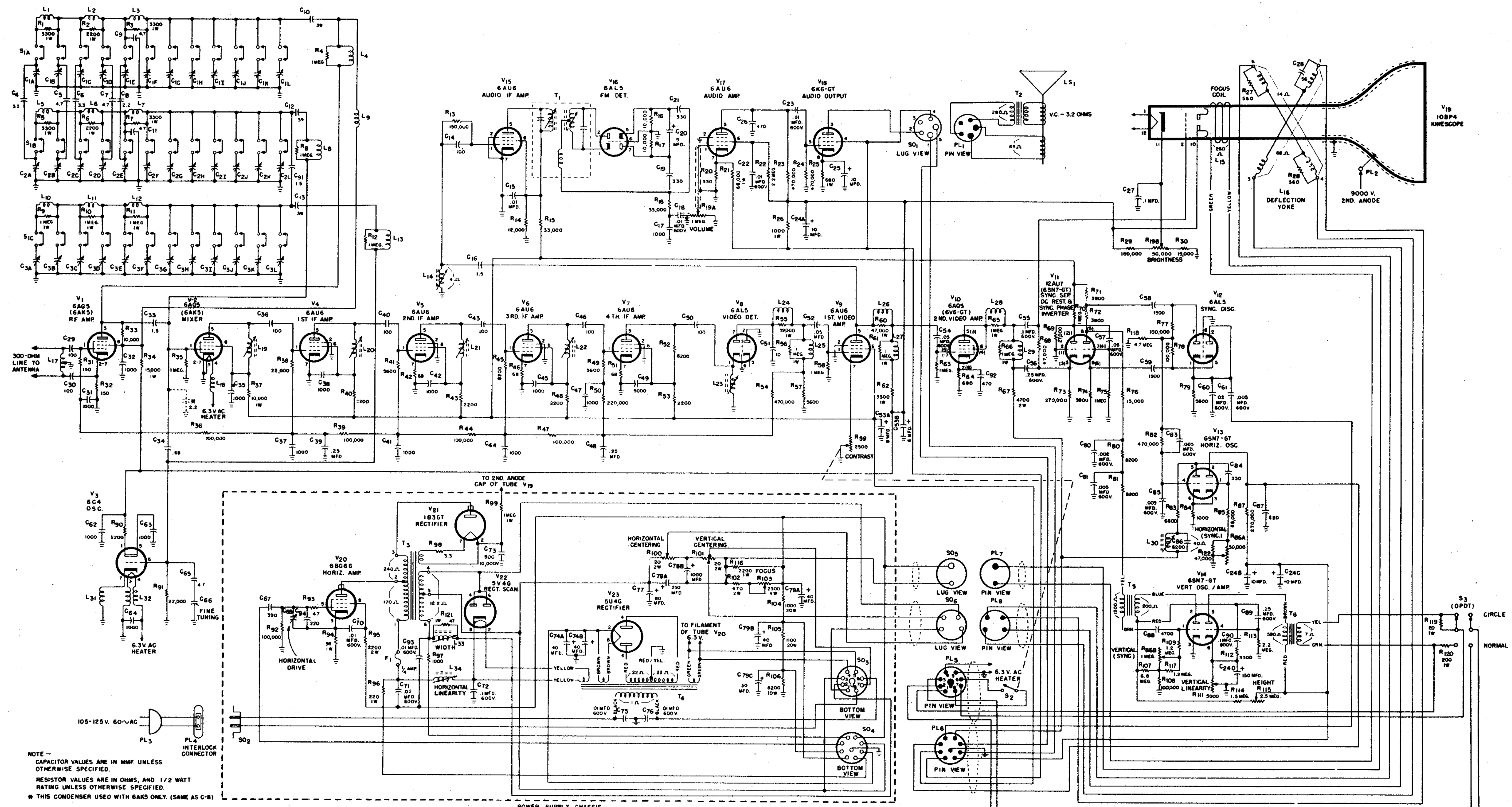
Signal Generator Frequency (No Modulation)	Adjustment (Refer to Fig. 11)	Stage Adjusted
26.2 mc	26.2 MC IF ADJ.	Mixer
25.5 mc	25.5 MC IF ADJ.	1st IF amp.
23.5 mc	23.5 MC IF ADJ.	2nd IF amp.
23 mc	23 MC IF ADJ.	3rd IF amp.
22.2 mc	22.2 MC IF ADJ.	Video detector

4. Set the signal generator at 26.2 mc. Reduce the signal generator output until the electronic voltmeter reads one volt and readjust the 26.2 MC IF ADJ. for maximum output voltage at the electronic voltmeter. Readjust signal generator output to maintain a one volt peak for this adjustment.
5. Check the i-f amplifier frequency response by tuning the signal generator from 21 mc through 26.25 mc and observing the change in d-c voltage at the electronic voltmeter. If the signal generator output is set for an electronic voltmeter reading of 1.5 volts at the peak i-f amplifier response, the d-c voltage should not drop below one volt between the two peaks normally obtained with this i-f amplifier. If the response is unsatisfactory, repeat steps 3 and 4 or try slight modifications of the recommended settings to obtain the desired response. Avoid resonating the coils with the iron core at the bottom end of the coil form. (Adjustment screw near limit of its travel.) Check the two carrier i-f responses, 21.75 mc and 26.25 mc. The 21.75 mc response will be approximately 20 db below the peak response (Approx. 0.15 volt) and the 26.25 mc response will fall approximately 6 db. below the peak (Approx. 0.4 volt). Refer to Fig. 12.

The average i-f amplifier sensitivity when feeding the signal generator output through the antenna input as described above will run approximately 600 to 3,000 microvolts for the one volt d-c peak measured at the 5600-ohm resistor (R-57). (Receiver's oscillator operating on channel 6.)

STATION CHANNEL ALIGNMENT

1. Due to the broad frequency response of the i-f amplifier, it is necessary to use a 24.5 mc signal generator or oscillator (unmodulated) as a beat frequency oscillator (BFO) in order to locate the center frequency of the i-f amplifier response for the correct local oscillator adjustment. This "BFO" generator should be loosely coupled by means of a wire from the generator output placed in close proximity to the 6AL5 VIDEO DET. tube (V-8).
2. Connect the high frequency signal generator output to the receiver's antenna transmission line through the two 150-ohm carbon resistors, one connected in each conductor of the transmission line.
3. Connect the electronic voltmeter across the 5600-ohm resistor (R-57) in the plate circuit of the 6AL5 VIDEO DET. tube (V-8) as for the i-f amplifier alignment.



NOTE —
CAPACITOR VALUES ARE IN MMF. UNLESS OTHERWISE SPECIFIED.
RESISTOR VALUES ARE IN OHMS, AND 1/2 WATT RATING UNLESS OTHERWISE SPECIFIED.
* THIS CONDENSER USED WITH 6AK5 ONLY. (SAME AS C-8)

LAST R SYMBOL - R122
LAST C SYMBOL - C94
LAST L SYMBOL - L34

Fig. 18. Schematic diagram.

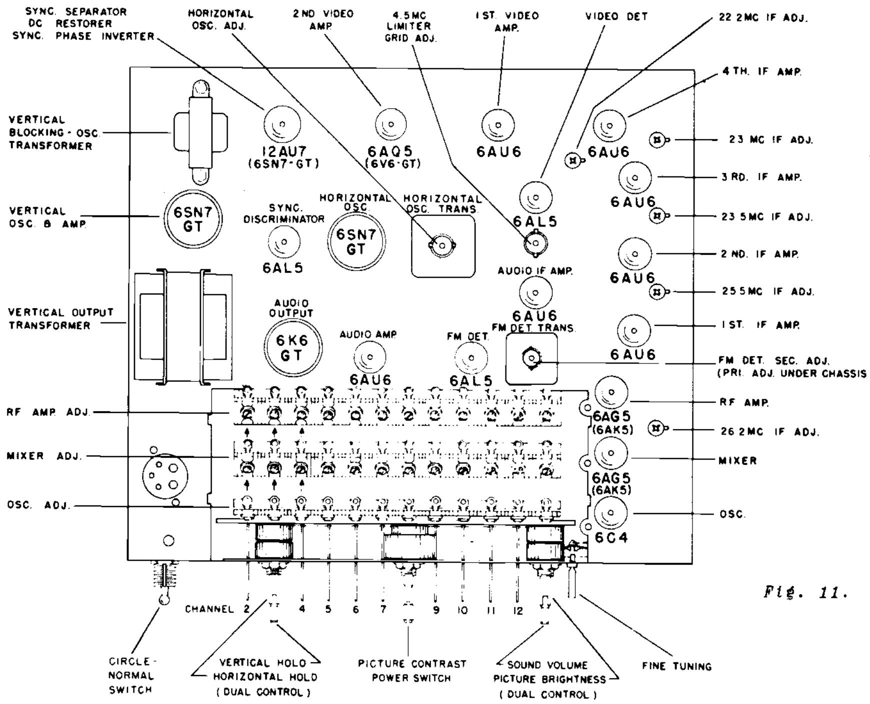


Fig. 11. Top view, alignment points.

4. Each channel may be aligned independently without affecting the alignment of the others. Alignment of the individual channels is carried out as follows:

(a) Set the FINE TUNING control condenser in the center of its capacity range.

(b) Press the channel button corresponding to the channel number to be aligned.

(c) Set the "BFO" generator at 24.5 mc (No modulation).

(d) Set the high frequency signal generator per the alignment chart. (No modulation).

(e) Clip on a .01 mfd condenser between pin 2 of the 10BP4 kinescope (V-19) and pin 1 of the 6AU6 AUDIO AMP tube (V-17) and adjust the OSC. ADJ. trimmer corresponding to the channel being aligned for a rough audio beat note, using the speaker as a detector. The connection at pin 2 of the kinescope can be made at the terminal strip under the chassis provided for the socket leads of this tube.

(f) Disconnect the .01 mfd condenser, shut off the "BFO" signal generator, and adjust the MIXER ADJ. and RF AMP ADJ. trimmers for maximum d-c voltage as measured by the electronic voltmeter. Use just enough signal generator output to obtain approximately one volt at the electronic voltmeter. This completes the alignment of any one channel, and all others are to be treated in the same manner.

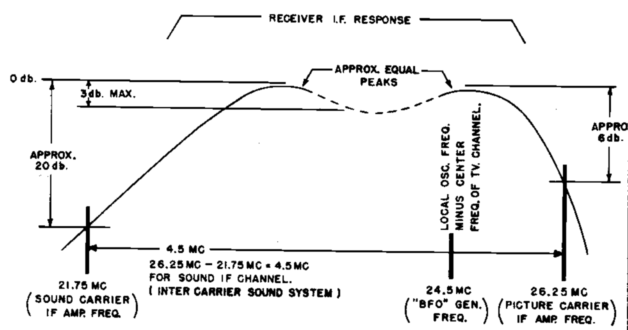
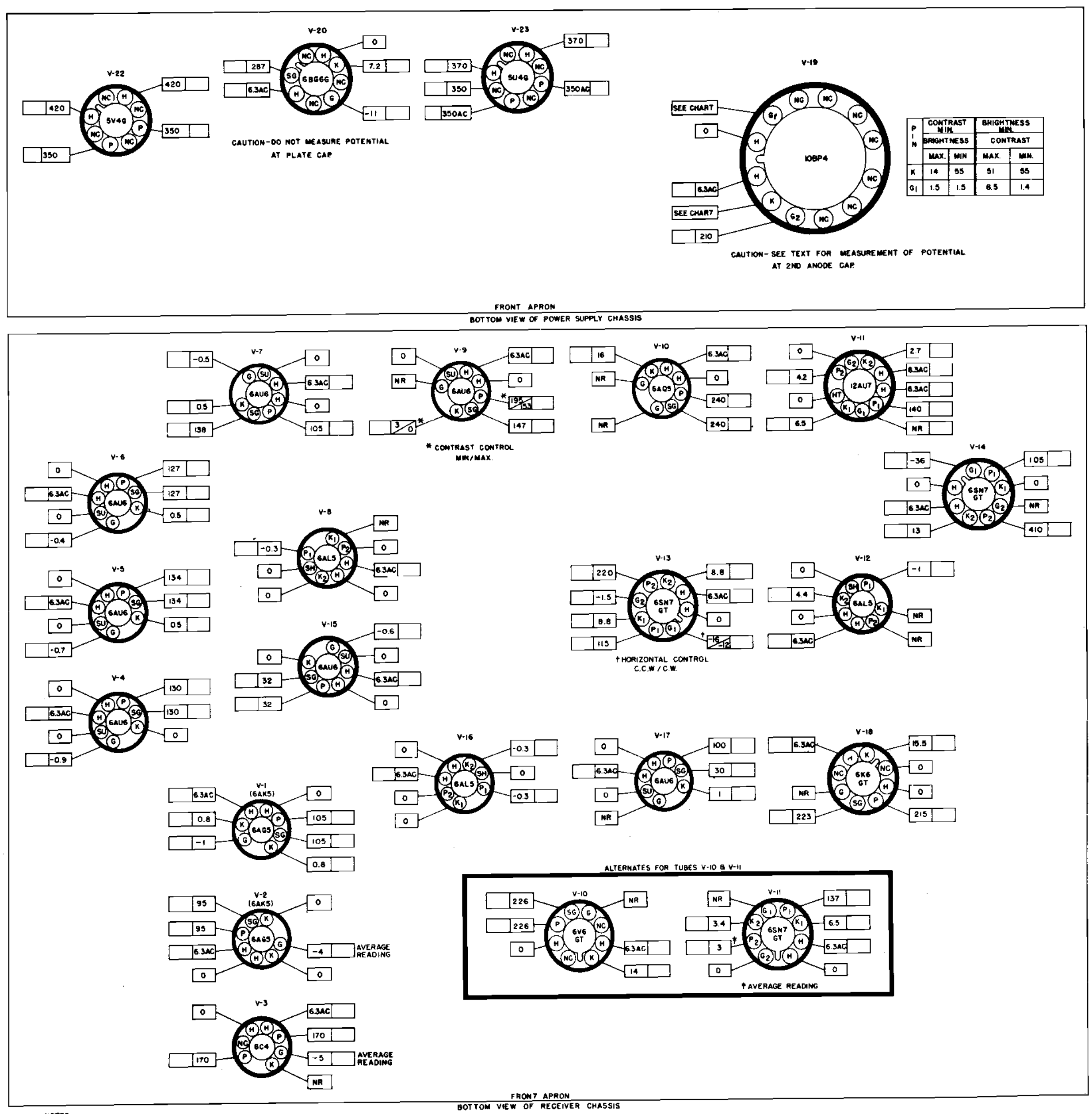


Fig. 12. I-F Amplifier response.

CHANNEL ALIGNMENT CHART

Channel No.	Channel Freq. (mc)	H.F. Signal Generator Freq. (No modulation)	Channel No.	Channel Freq. (mc)	H.F. Signal Generator Freq. (No modulation)
2	54-60	57 mc	8	180-186	183 mc
3	60-66	63 mc	9	186-192	189 mc
4	66-72	69 mc	10	192-198	195 mc
5	76-82	79 mc	11	198-204	201 mc
6	82-88	85 mc	12	204-210	207 mc
7	174-180	177 mc	13	210-216	213 mc

The overall sensitivity for the receiver will run approximately 100 to 200 microvolts for one volt DC at resistor R-57 when measured in the above manner.



NOTES-
1. SOCKET VIEWS ARE BOTTOM VIEWS.
2. ALL VOLTAGES ARE MEASURED BETWEEN TUBE SOCKET TERMINALS & CHASSIS WITH ZERO SIGNAL INPUT.
3. LINE VOLTAGE-117 V. AC.
4. ALL VOLTAGES SHOWN ARE DC UNLESS OTHERWISE SPECIFIED.
5. DC VOLTAGES SHOWN WERE MEASURED WITH AN ELECTRONIC VOLTMETER.
6. "NC" NO CONNECTION. VOLTAGE SHOWN FOR THIS TERMINAL ONLY WHEN TERMINAL IS USED AS A TIE LUG.
7. "NR" NOT READABLE. VOLTAGES MEASURED AT THESE TERMINALS GENERALLY MEANINGLESS.
8. ALL VOLTAGES ON V-19 WERE TAKEN AT TIE POINTS OF TUBE SOCKET LEADS.
9. MEASUREMENT OF 2ND ANODE POTENTIAL AT 10BP4 IS RECOMENDED FOR CHECK ON 1B3GT RECTIFIER.
10. ▭ SPACE PROVIDED FOR SERVICE METER READINGS.
11. CONTROLS SET FOR NORMAL PICTURE UNLESS OTHERWISE SPECIFIED.

Fig. 17. Tube socket voltage chart.

MAGNAVOX CT 214-218-221 TELEVISION

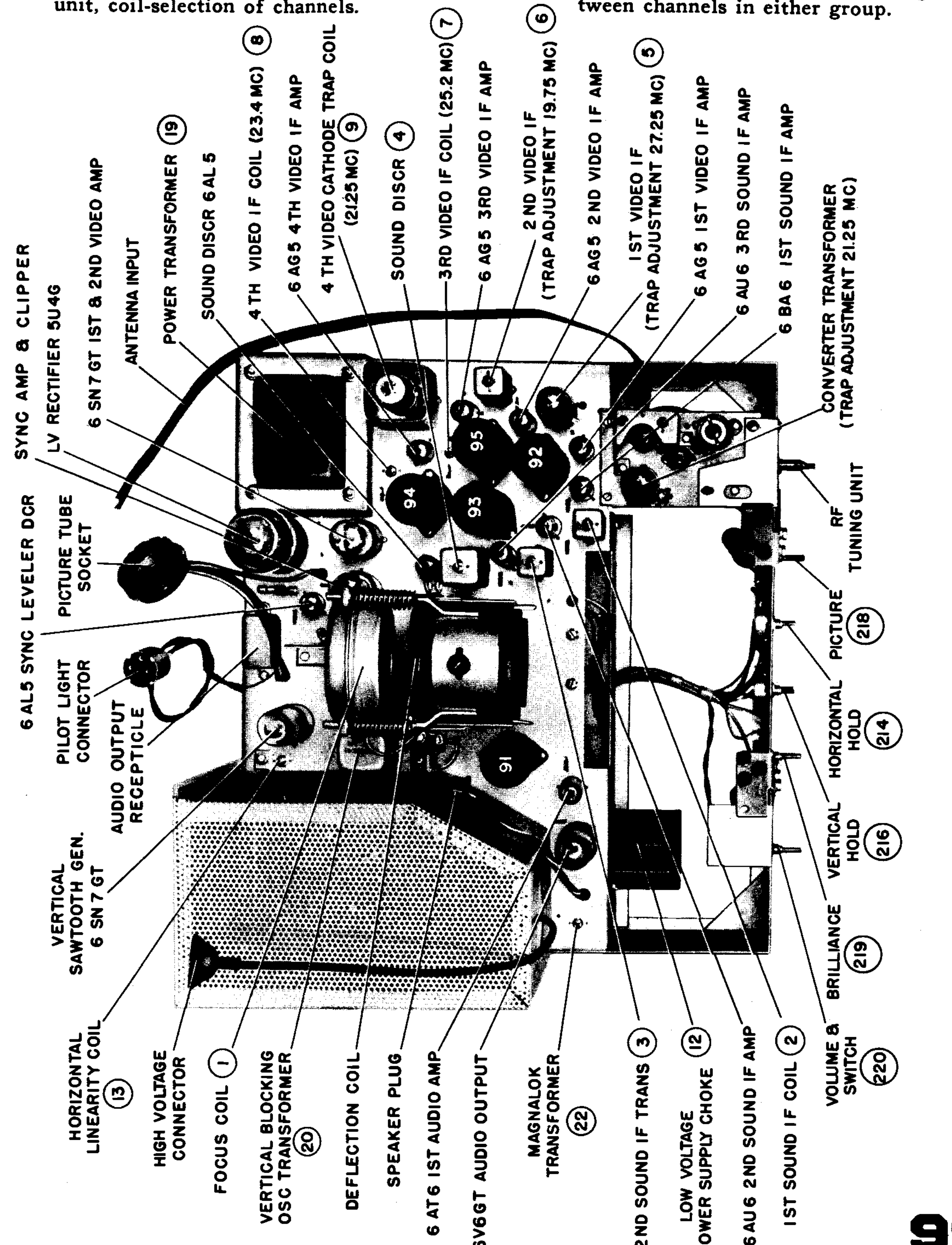
The Magnavox CT 214-218-221 chassis is a 23 tube receiver incorporating either a 10″ or 12½″ direct viewing picture tube, optional without electrical or mechanical modifications. The three chassis are identical excepting the R-F unit sub-assembly.

CT 214 Television chassis with 13 channel R-F unit, coil-selection of channels.

CT 218 Television chassis with 12 channel R-F unit, coil-selection of channels, adjustment of coils in the upper channels by compression of coils. Underside of unit is enclosed by a metallic shield.

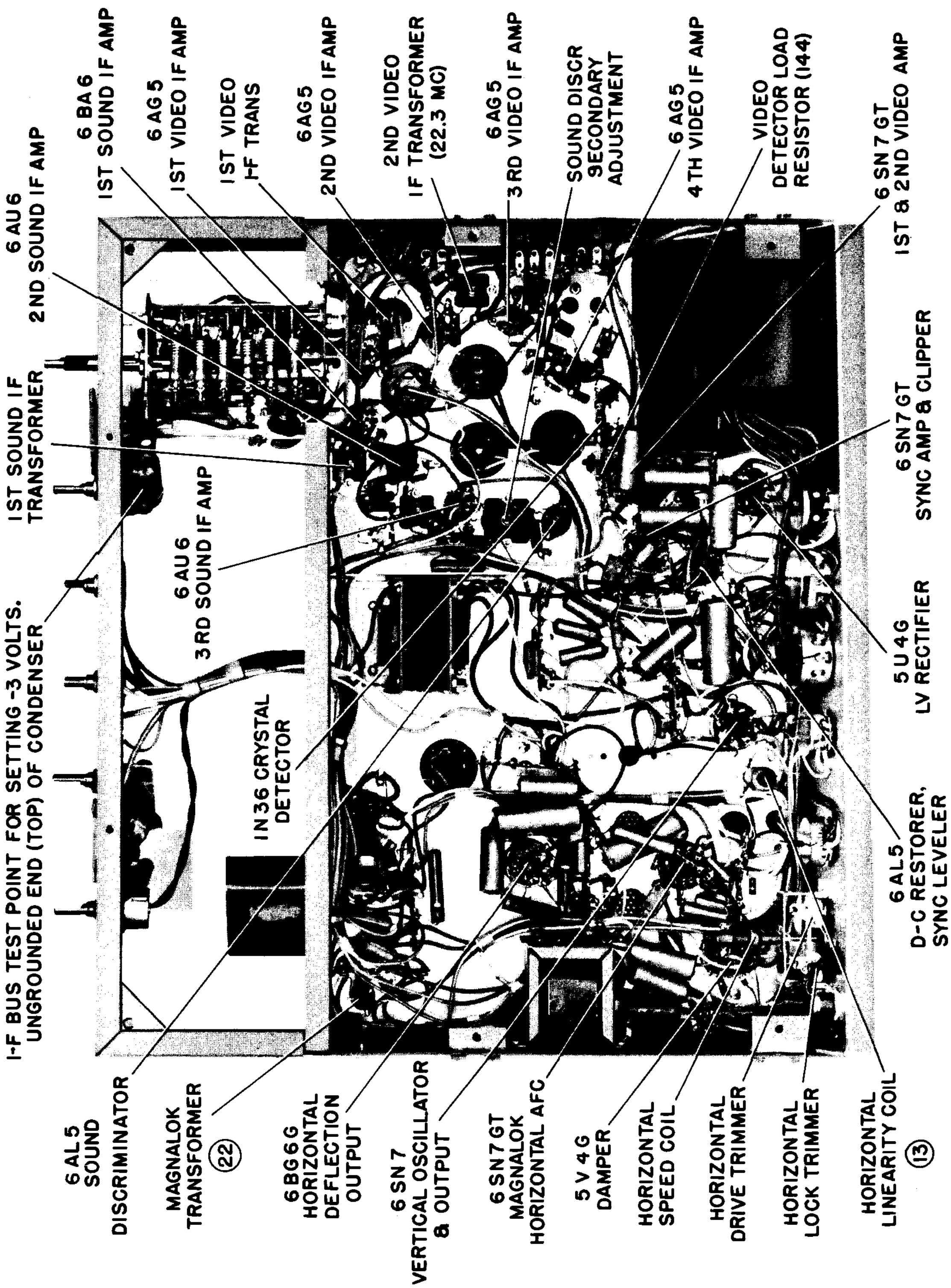
CT 221 Television chassis with 12 channel R-F unit, continuous condenser-tuning between channels in either group.

PARTS IDENTIFICATION

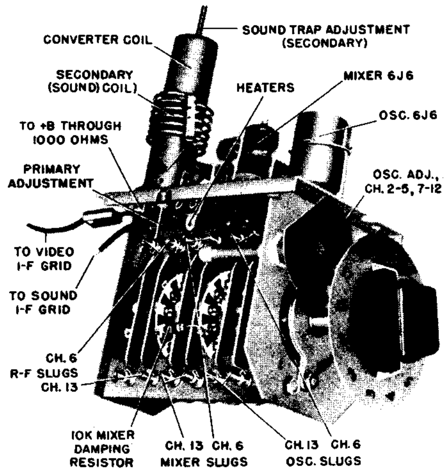


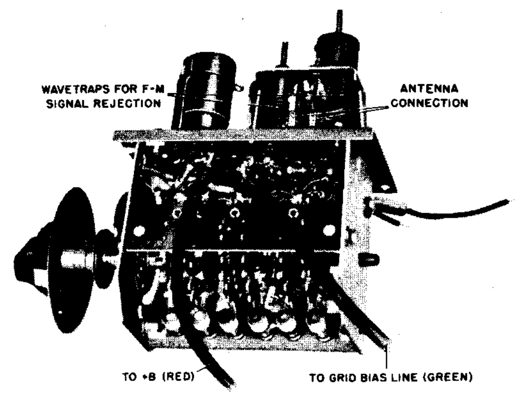
TOP VIEW, CT 214 CHASSIS

MAGNAVOX CT 214-218-221 TELEVISION

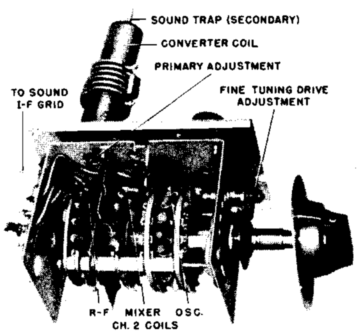


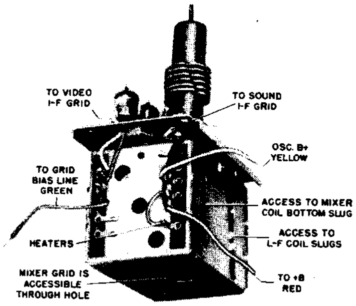
BOTTOM VIEW, CT 214 CHASSIS

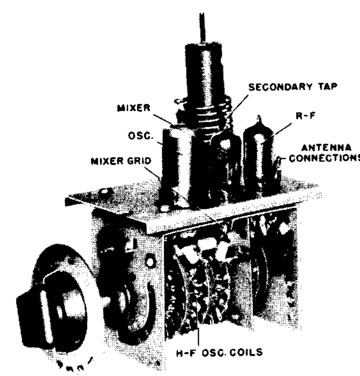




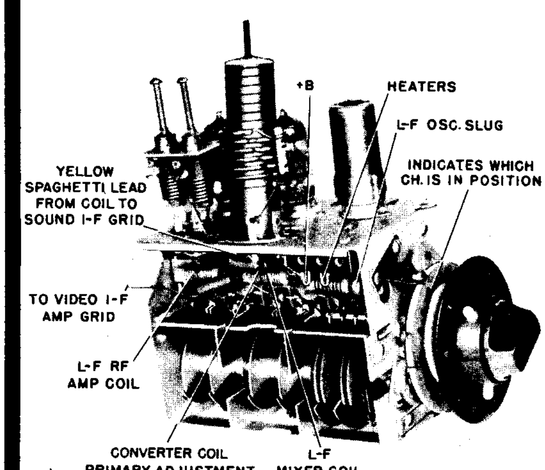
R-F UNIT OF THE CT 214 CHASSIS

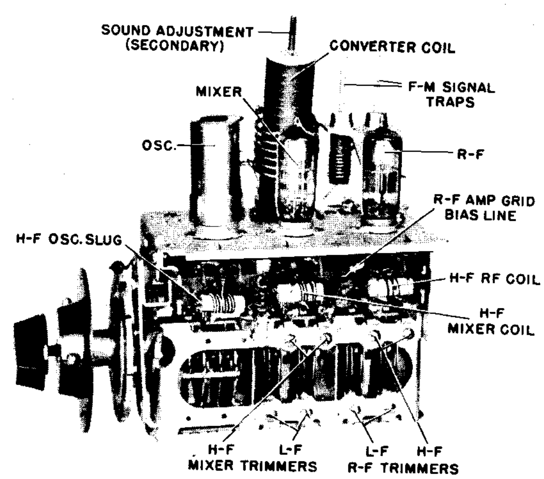






R-F UNIT OF THE CT 218 CHASSIS





R-F UNIT OF THE CT 221 CHASSIS

MAGNAVOX CT 214-218-221 TELEVISION

I-F, R-F ALIGNMENT

In aligning the amplifiers, it must be remembered that feedback between output and input circuits leads to regeneration and, if feedback be appreciable, to oscillation. It may be determined whether the amplifier is oscillating as follows:

Increasing signal generator output by a factor of (for example) two should result in a rise in output voltage in approximately the same degree. If, instead, a decrease in output with increased input is noted and if there be a steady output voltage as indicated on the V.T.V.M. even without input signal, the circuit is oscillating.

Regeneration insufficient to cause oscillation gives rise to distortion of the reproduced response curve, and proper alignment is not possible in such event.

Regeneration may be caused by poor bonding between the chassis of the receiver and of test equipment being used. Connection should be made by short, heavy leads. Many service organizations use a metallic sheet (galvanized iron is satisfactory) atop the bench which affords good R-F grounding between chassis, even though they are not conductively connected thereto.

After the several connections of equipment are made and a pattern being reproduced, it must be possible to place the hand at various points of the equipment chassis and along the interconnecting cables, with no visible change in output potential or wave form. Failure to attain this probably means that regeneration is present, better grounding is necessary and subsequent alignment adjustments are questionable.

It may be necessary, to realize such a condition in the absence of a metal-topped bench, to employ two or more short bonding wires between chassis, connected at different points.

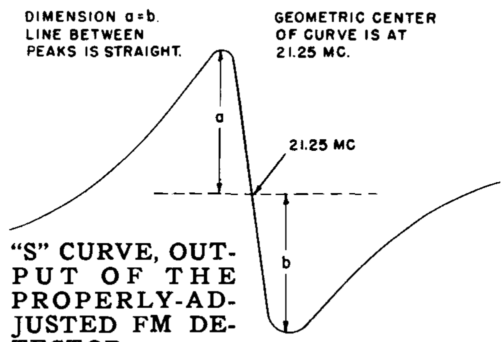
SOUND DISCRIMINATOR ALIGNMENT

Connect output of the signal generator to the third I-F grid and set output of signal generator for approximately one volt at 21.25 mc. Connect Voltohmyst Jr. in series with one megohm resistor to junction of diode load resistors (174) and (175). Adjust primary core of 3rd Sound I-F Transformer (4) for maximum d-c output. Move Voltohmyst to output of discriminator (V7 Pin 1) and adjust secondary core of 3rd Sound I-F Transformer (4) for zero d-c output. Readjust transformer (4) primary for symmetrical plus or minus d-c output on either side of 21.25 mc.

The sweep, in conjunction with marker signals, can also be used to align the discriminator but the center cannot be set as accurately using this method.

The peak to peak bandwidth of the discriminator should be approximately 350 kc and it should be linear from 21.175 mc to 21.325 mc.

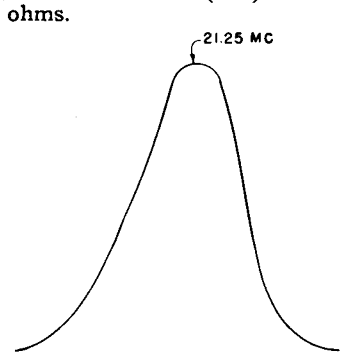
To observe the response curve on the oscillograph, connect the sweep generator to the 3rd I-F grid and the oscilloscope to the audio takeoff point, pin 1 of the 6AL5 discriminator, V-7. The sweep should center at 21.25 mc, with sweep width sufficient to produce the "S" curve.



"S" CURVE, OUTPUT OF THE PROPERLY-ADJUSTED FM DETECTOR

SOUND I-F ALIGNMENT

Connect sweep output to first I-F grid. Connect oscilloscope to third I-F grid return (high end of resistor 162) and adjust transformers (2) and (3) for maximum gain at 21.25 mc and symmetry about 21.25 mc. The output level from the sweep should be set to produce approximately 0.3 volt peak to peak at the third sound I-F grid return. The bandwidth at seventy per cent response from the first sound I-F grid to the third sound I-F grid should be approximately 200 kc. If a 60 cycle sweep rate is used, it will be necessary to reduce the time constant in the second sound I-F grid circuit in order to reproduce the response curve. To do this, shunt resistor (162) with approximately 5600 ohms.



PASSBAND OF SOUND I-F AMPLIFIERS

R-F UNIT ALIGNMENT

Since there are represented, three distinctly separate R-F units, alignment procedures must be covered in three parts. However, basic considerations remain throughout, common between the three.

For example, local oscillator adjustment is made by inserting into the antenna terminals an R-F signal of frequency equal to that of the sound carrier of the particular channel being aligned.

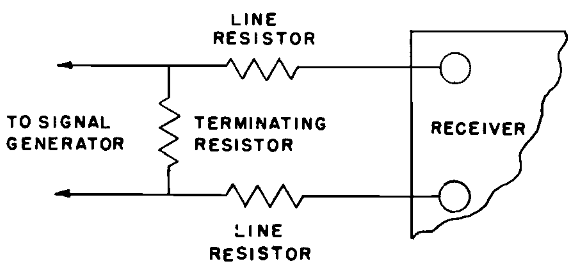
Assuming that the sound discriminator has been previously carefully aligned, adjustment is such that the converted R-F signal falls at the center of the discriminator "S" curve. It should, thus, be converted to precisely 21.25 mc. Local oscillator tuning is to zero discriminator output, between two peaks, indicated either by listening to the speaker (using an A-M generator), or by measure of D-C discriminator output (using unmodulated signal generator).

CONNECTING THE GENERATOR

If generator output is not a 300 ohm balanced circuit, a balanced condition for push-pull operation as shown below should be established.

The terminating resistor is equal to the cable impedance and the two line resistors are such that the receiver "sees" about 300 ohms. For example, given generator cable of 50 ohms, the line resistors should total 250 ohms, or 125 ohms each.

By such padding, both signal generator and receiver "look into" resistance equal to their respective impedances, and a nearly balanced (push-pull) condition is established.



Normally, only the oscillator will require the attention of the service technician with respect to alignment. Although adjustments are provided for the R-F amplifier and converter circuits, these are broadly-tuned and factory-adjustments should suffice for the life of the instrument.

It is well to remember that local oscillator frequency is subject to variation in exchange of oscillator tubes. Therefore, trial of several tubes (even of the same manufacturer) is sometimes necessary before finding one which does not materially change oscillator frequency, in the event that replacement is necessary. Should all channels appear to be detuned (the effect of off-capacity tubes is greatest on the higher frequency channels) as evidenced by optimum sound reproduction near the end of rotation of the fine tuning control, tube-exchange should be made until correct tuning is realized.

ALIGNMENT OF THE TUNER, CT 214 RECEIVER

This is the tuner having 13-channel positions with coil-selection between channels. It uses 6J6 tubes in balanced circuit. The oscillator tube is covered by a lead microphonic-shield.

OSCILLATOR ALIGNMENT

Oscillator alignment is predicated upon exact alignment of the sound discriminator circuits.

Alignment must start with channel 13 and progress in consecutive channels toward the lowest-frequency channel, since any adjustment to a coil will also affect all channels of lower frequency.

With RF signal supplied to the antenna terminals, set the signal generator (crystal calibrated) to the R-F sound carrier frequency of the channel being aligned. Set the fine tuning control about midway in its rotation. Adjust the oscillator adjustments (slug or screw) so that the sound I-F is 21.25 mc as indicated by

(a) Sound in the speaker, a zero-null between two peaks. In this, an A-M generator is required.

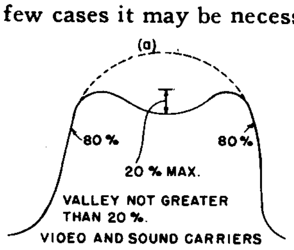
(b) Zero voltage on a V.T.V.M. between a positive and a negative peak. An unmodulated generator should here be used.

Access to oscillator adjustments, with the exception of channels 6 and 13, is from the front of the tuner. These are revealed without necessity for chassis or front-panel removal, by removing the two knobs, CHANNEL and FINE TUNING.

R-F AMPLIFIER, CONVERTER ALIGNMENT, CT 214

1. Connect sweep generator to antenna input, noting the precaution regarding termination. Connect the oscilloscope to the grid of the converter through a 10,000 ohm resistor. Bypass the converter plate circuit to ground through approximately 1000 mfd.
2. With the channel switch in position 13, and the sweep covering this channel (see Part I for frequencies), adjust L25 and L26, L51 and L52 for the normal over coupled circuit curve. As illustrated, the curve should be symmetrical between the sound and video carrier frequency markers, which should occur at approximately the 90 to 100 per cent points. L25 and L26 stud extensions should be maintained approximately equal, to maintain symmetry, as should L51 and L52 adjustments.

Next, channels 12 to 7 should be checked for frequency. Normally, these curves appear somewhat overcoupled or double-humped with a 10 or 15 per cent peak-to-valley excursion. Sound and video markers should occur at approximately 90% response. Tolerances allow some shift in these curves but in no case should the markers fall at less than 70% response points. Channel 7 is generally the worst offender in this respect and in some few cases it may be necessary to compromise



TYPICAL R-F PASSBAND, ALL UNITS
CT 220 IS ROUNDED ON HIGH CHANNELS, AS AT (a).

on the adjustment of channel 13 to realize all markers about the 70% point.

Channel 6 is next aligned as was channel 13, tuning L11 and L12, L37 and L38.

Channels 5 to 2 should then be checked as were 12 to 7, above.

ALIGNMENT OF THE TUNER, CT 218 RECEIVER

This tuner is the 12 channel unit using 6BH6, 6AG5 and 6C4 tubes, with coil-selection between channels. A metallic shield encloses the below-chassis components. Therefore, in alignment, in order to eliminate repeated removal and replacement of the shield during coil adjustment, the fine tuning control may be set about 120° from its mid-position in the direction of less capacity (clockwise in production units, but the split stator fine tuning rotor may be toward the rear of the chassis from the stator plates, making this rotation counterclockwise).

Note that the fine tuning wheel is secured to its shaft by two set-screws. Therefore, if all stations tune toward the end of rotation, it is possible to reset this control by loosening the screws.

OSCILLATOR COILS

Oscillator coils in the five lower channels are tunable by means of slug-adjustments which are sealed in wax. Those of the seven higher channels are variable by adjusting the wire loops, spreading the loop apart or making it smaller. Coils should not be permitted to touch another coil or circuit element, nor to fold back upon itself in mechanical connection, else variable contacts may give rise to intermittent operation.

Alignment is by the same process as was used in connection with the CT 214 chassis:

Connect signal generator to the antenna terminals, set at the sound carrier frequency of the channel being aligned (see Part I) and adjust the coil for zero-null in the sound-discriminator. The discriminator must have been first determined to be properly aligned. Reheat the L-F slugs after adjustment, to secure the adjustments against vibration.

R-F AMPLIFIER, CONVERTER ALIGNMENT, CT 218

Connect sweep generator to the antenna terminals, observing proper termination to the generator cable as outlined in connection with the CT 214 chassis. Connect the oscilloscope to the grid of the 6AG5 converter (pin 1, nearest the right-hand side facing the unit) through a 10,000 ohm resistor.

Through a 1000 mmfd. (approx.) condenser, ground the plate of the 6AG5 mixer. Connection may be made to the plate side of C19 (270 mmfd. coupling to video I-F grid).

With the channel switch in position 13 and the sweep covering this channel, adjust P-13 and G13 (3 turn coils) by spreading or compressing turns for the normal curve as illustrated.

Next, channels 12 to 7 should be checked for frequency response. They should fulfill the limits of the typical curve shown and, if they do not, it will be necessary to readjust P13 and G13.

Channel 6 is next aligned as was channel 13, tuning P6 and G6 (9 turn coils near the switch spacer bars). Check channels 5 to 2 as were 12 to 7 above.

ALIGNMENT OF THE CT 221 RECEIVER

OSCILLATOR ADJUSTMENT

The fine tuning control may be rotated through 360° and it will therefore be found that the sound carrier may be tuned in two positions which should be separated by greater than ½ inch as measured on the circumference of the fine tuning knob. If this condition is not met:

1. An oscillator tube being off-capacity causes all stations to tune near one end of rotation.
2. If the notched dial wheel has been removed and replaced, improper relationship of the gear teeth will cause a like effect, or cause a station to tune on the wrong channel. A like effect is noted if the slotted dial-mount shaft has been rotated before locking with the Allen screws.
3. Tune the oscillator slugs as follows:
   (a) Assuming proper alignment of the discriminator, connect an electronic D-C voltmeter to the sound output point of the discriminator (pin 1 to ground, V7).
   (b) Feed an unmodulated RF signal at the sound carrier frequency of channel 7 (179.95 mc) into the antenna terminals, setting selector to No. 7.
   (c) Tune High-band oscillator slug so that zero output between two peaks is had, when the Fine Tuning is near the center of its range.
   (d) It may be necessary to compromise the setting of Channel 13, to attain the most-uniform positioning on channels 12-7.
   (e) Low-band slug-tuning is by the same process.

The slug is adjusted on channel 2, whose sound carrier lies at 59.75 mc. Again, some compromise may be necessary to approximate center-of-the fine tuning scale on channels 2-6.

There are provided, trimmer condensers for alignment of R-F amplifier and converter stages on both high and low channels. Adjustment is as follows:

(a) Connect sweep and marker generators to the antenna terminals, through a resistor network if necessary as outlined in connection with the CT 214 R-F alignment.

(b) Connect the mixer plate to ground through approximately 1000 mmfd. Access to the plate is at the plate-side of the condenser coupling to the video I-F grid, using a miniature insulated clip and keeping it as far from the coil as possible.

(c) Connect the oscilloscope to the mixer grid coil center-tap, across the grid-leak resistor. Since the two coils have their center-taps connected, scope-connection should be to the coil which is not being used (connect to the low-band coil when checking high bands, etc.).

(d) Adjust R-F amplifier and converter trimming condensers to approximate the typical curve shown. Turn the two condenser screws associated with either circuit by approximately the same amount, to maintain electrical symmetry.

ALTERNATE R-F AMPLIFIER ALIGNMENTS

If the available sweep generator has insufficient output potential to observe a pattern through the R-F amplifier, connection of the oscilloscope may be made to the video detector load resistor, generator to the antenna terminals and the unit aligned by observing the receiver's overall characteristic. On all three types of R-F unit, the curve obtained should approximate that shown. This is based upon assurance that video I-F alignment is correct.

Switch between R-F channels, correcting the sweep generator frequency to correspond. There may be some differential between reproduced curves, which is permissible. If, however, there be major differential, the R-F amplifier is in need of some retouching. It is seldom that R-F amplifier adjustments will require adjustment.

VIDEO I-F ALIGNMENT

Connect the oscilloscope across the video detector load resistor (R144). This is between the "low" end of the green peaking coil of the detector circuit, and ground. (If the signal generator to be used has not provision for amplitude modulation, use a V.T.V.M. instead of the oscilloscope). Apply AM to the generator.

The signal generator is to be connected into the grid of the converter, through a small mica capacitor for D-C isolation. Access to the grids in the three types of R-F unit assemblies is as illustrated.

Set bias on I-F bus by adjusting the picture control to approximately 3 volts. Make the following adjustments, in order:

Gen. Frequency, MC	*Adjust*	*For*
21.25	Converter trap (top slug)	minimum
21.25	Cathode trap, V15 (top)	minimum
19.75	2nd I-F trap (top)	minimum
27.25	1st I-F trap (top)	minimum
21.8	Converter plate (bottom)	maximum
25.3	1st I-F (bottom)	maximum
22.3	2nd I-F (bottom)	maximum
25.2	3rd I-F (top of chassis)	maximum
23.4	4th I-F (top of chassis)	maximum

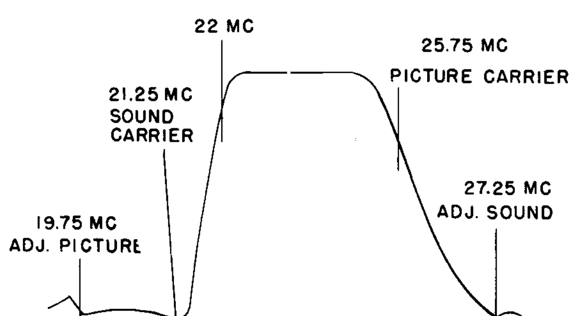
It is necessary from this point in the video I-F alignment, to assume proper alignment of the R-F unit, which is a prerequisite. The local oscillator must be fixed by the fine tuning control, so that an R-F signal at the sound-carrier frequency of one of the lower-frequency channels appears as a null in the speaker, between two peaks (the center of the discriminator "S" curve). Furthermore, the R-F amplifier alignment must be proper, so that the R-F video and sound carriers are above the 90% amplitude points on the R-F response curve.

Connect the oscilloscope across the video detector load resistor (R144) and the R-F sweep generator to the antenna terminals. Observe the connections indicated under "R-F alignment" regarding the use of single-ended signal generator cable.

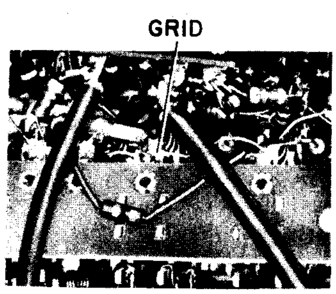
If necessary, retouch the I-F amplifier slugs to give the proper response curve as shown:

In making any final touch-up adjustments, it should be remembered that the converter and 2nd video I-F coils are relatively high "Q" circuits and tend to control the I-F response at the high and low frequency ends of the band respectively, while the 1st and 3rd video I-F coils are low "Q" and tend to control overall response over the center position of the pass band.

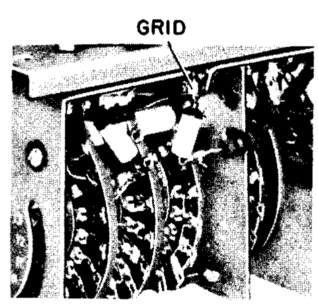
Since there is some slight shift in response with change in bias, the recommended level (-3 volts) should always be used when aligning this circuit.



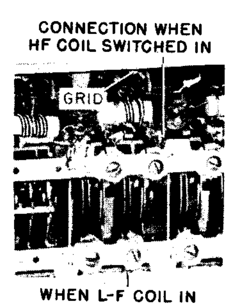
VIDEO-I-F SELECTIVITY CURVE AND OVERALL IF-RF CURVE



CT 214 TUNER



CT 218 TUNER



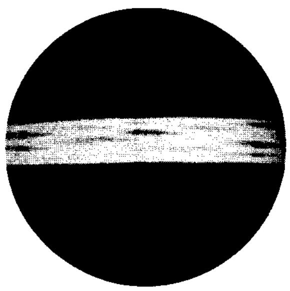
CT 221 TUNER

ACCESS TO CONVERTER GRIDS FOR I-F ALIGNMENT

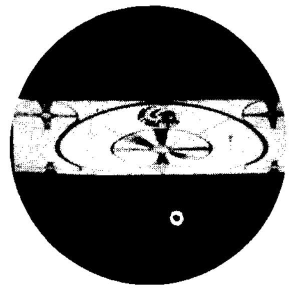
MOST-OFTEN-NEEDED 1949 TELEVISION RECEIVERS

MAGNAVOX CT 214-218-221 TELEVISION

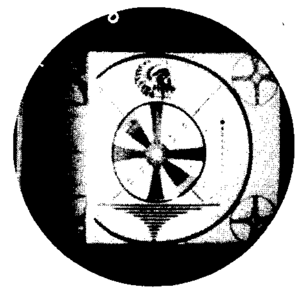
PICTURE DEFECTS



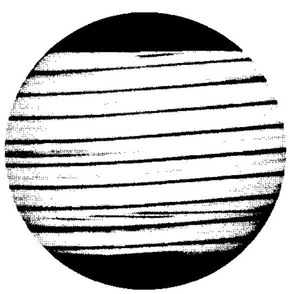
OPEN PEAKING NETWORK VERT. OUTPUT GRID C85, R141



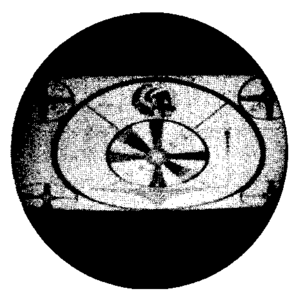
OPEN CATHODE BYPASS, VERT. OUTPUT, C95



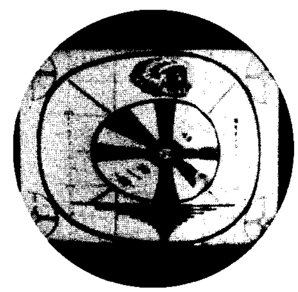
C84 (HORIZ. LINEARITY CIRCUIT) OPEN



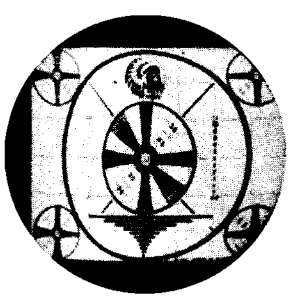
DEFECTIVE DAMPING RESISTOR, HORIZ. OSCILLATOR, R155. UNABLE TO SYNC. HORIZ.



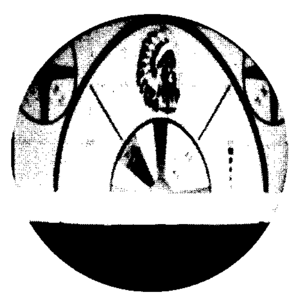
OPEN CATHODE BYPASS, HORIZ. OUTPUT, C90



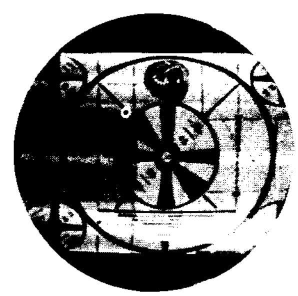
LEAKY SAWTOOTH FORMING CONDENSER, C61



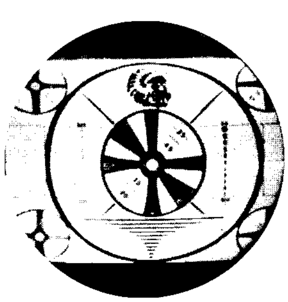
LEAKY COUPLING CONDENSER, GRID OF HORIZ. OUTPUT TUBE, C41



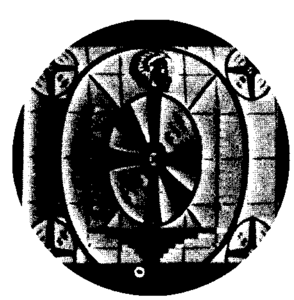
LEAKY COUPLING CONDENSER, VERT. OUTPUT GRID, C89 (FOLDOVER AT BOTTOM)



LEAKY COUPLING CONDENSER, GRID OF 2nd VIDEO AMPL., C80



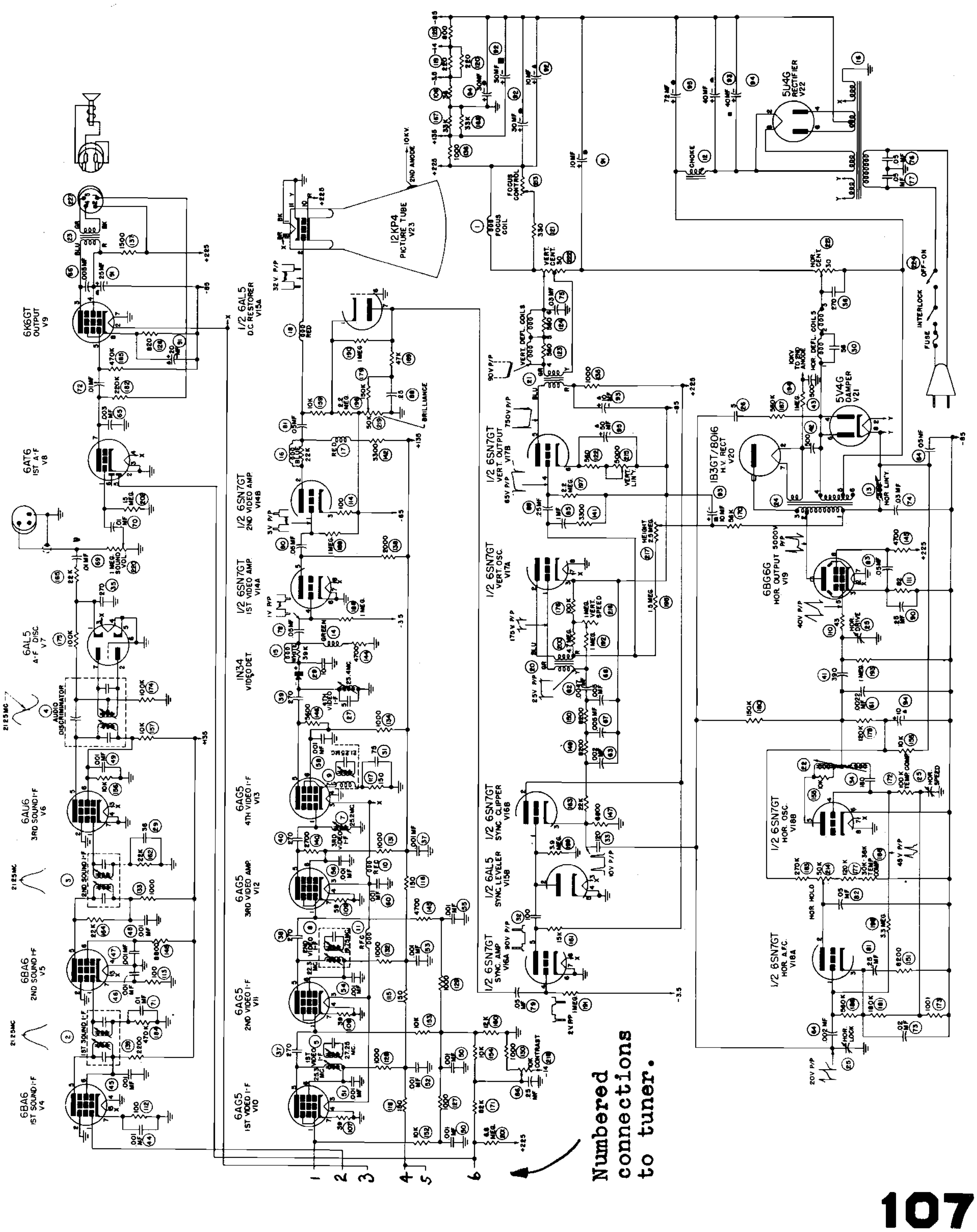
LEAKY COUPLING CONDENSER, 2nd VIDEO AMPL. OUTPUT, C81



IMPROPER VALUE OF PLATE LOAD RESISTOR, 1st VIDEO AMPL. EXPANDED TO BETTER SHOW H.F. PHASE SHIFT, SMEARING.

GROUNDING SPRINGS NOT CONTACTING THE PICTURE TUBE SHELL. PICTURE EXPANDED TO SHOW STREAKING, DISTORTION.

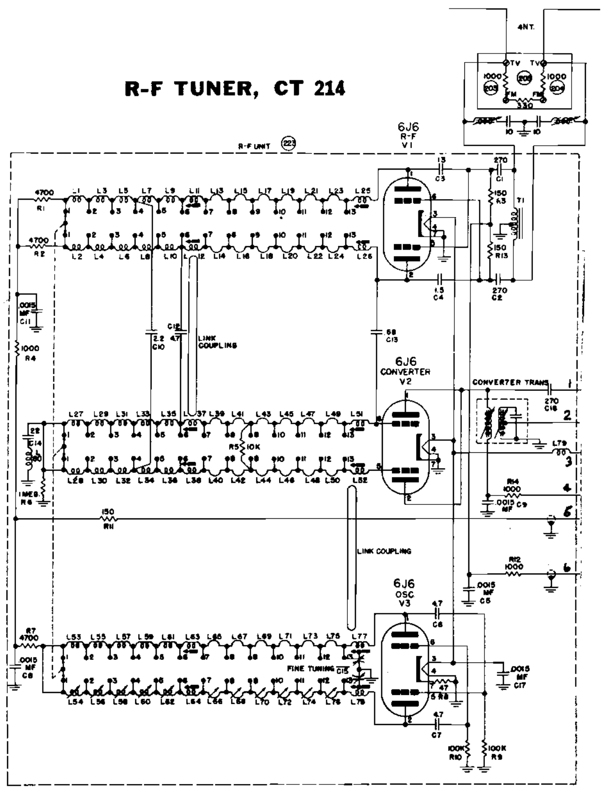
SCHEMATIC DIAGRAM, CT 214A EARLY PRODUCTION

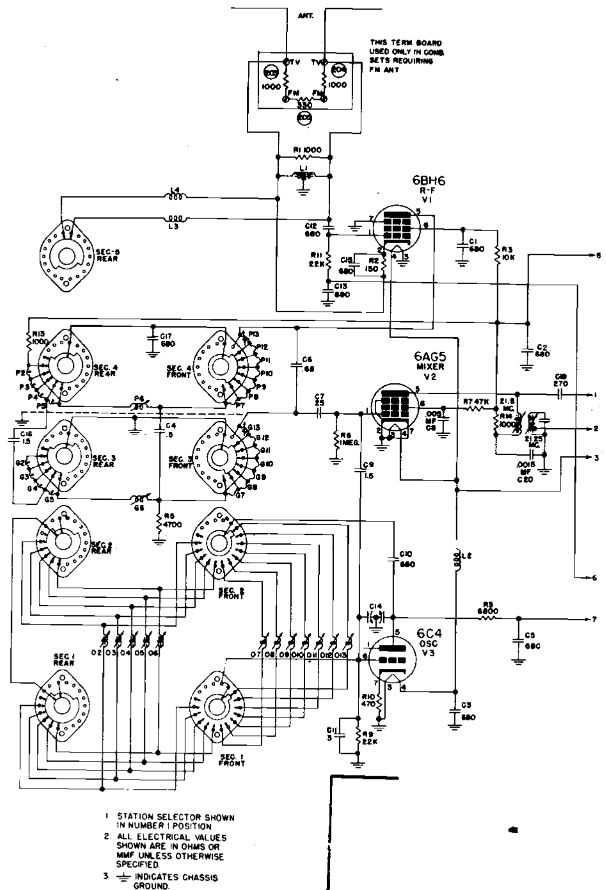


MOST-OFTEN-NEEDED 1949 TELEVISION RECEIVERS

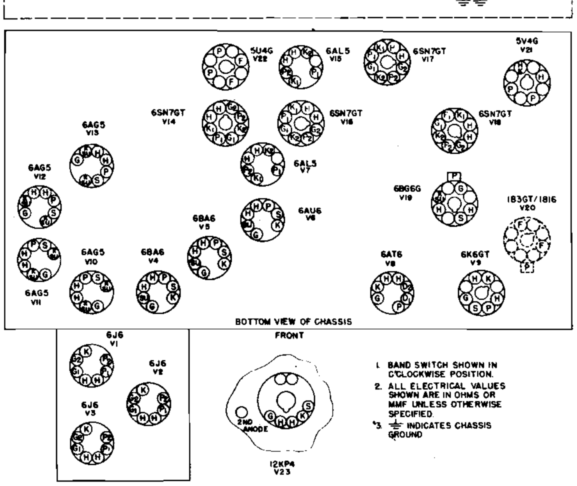
MAGNAVOX CT 214-218-221 TELEVISION

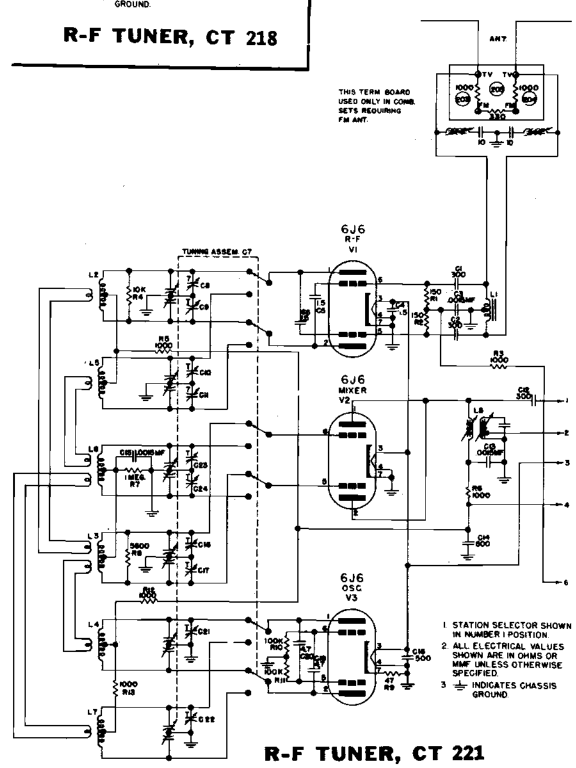
R-F TUNER, CT 214





R-F TUNER, CT 218



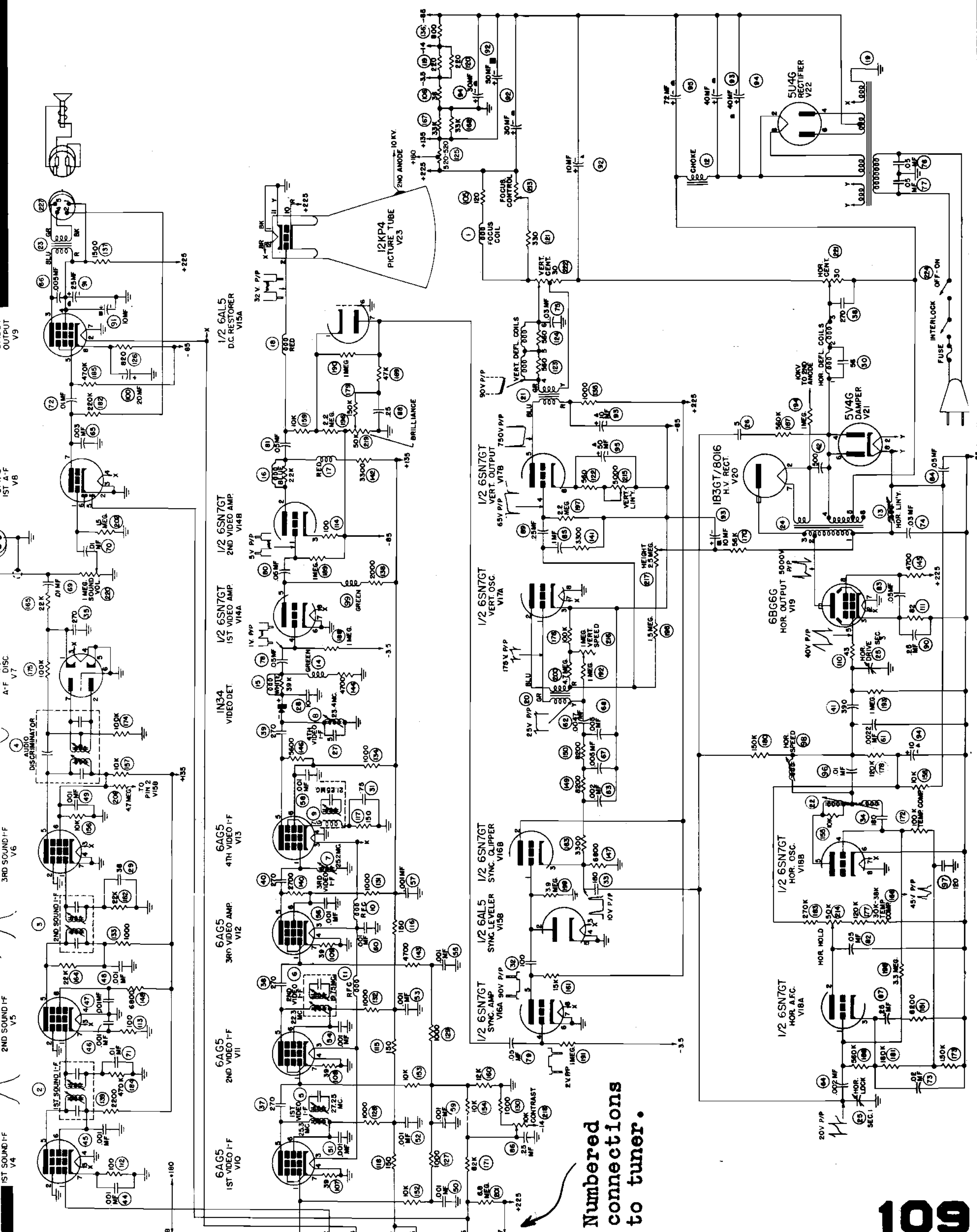


R-F TUNER, CT 221

MOST-OFTEN-NEEDED 1949 TELEVISION RECEIVERS

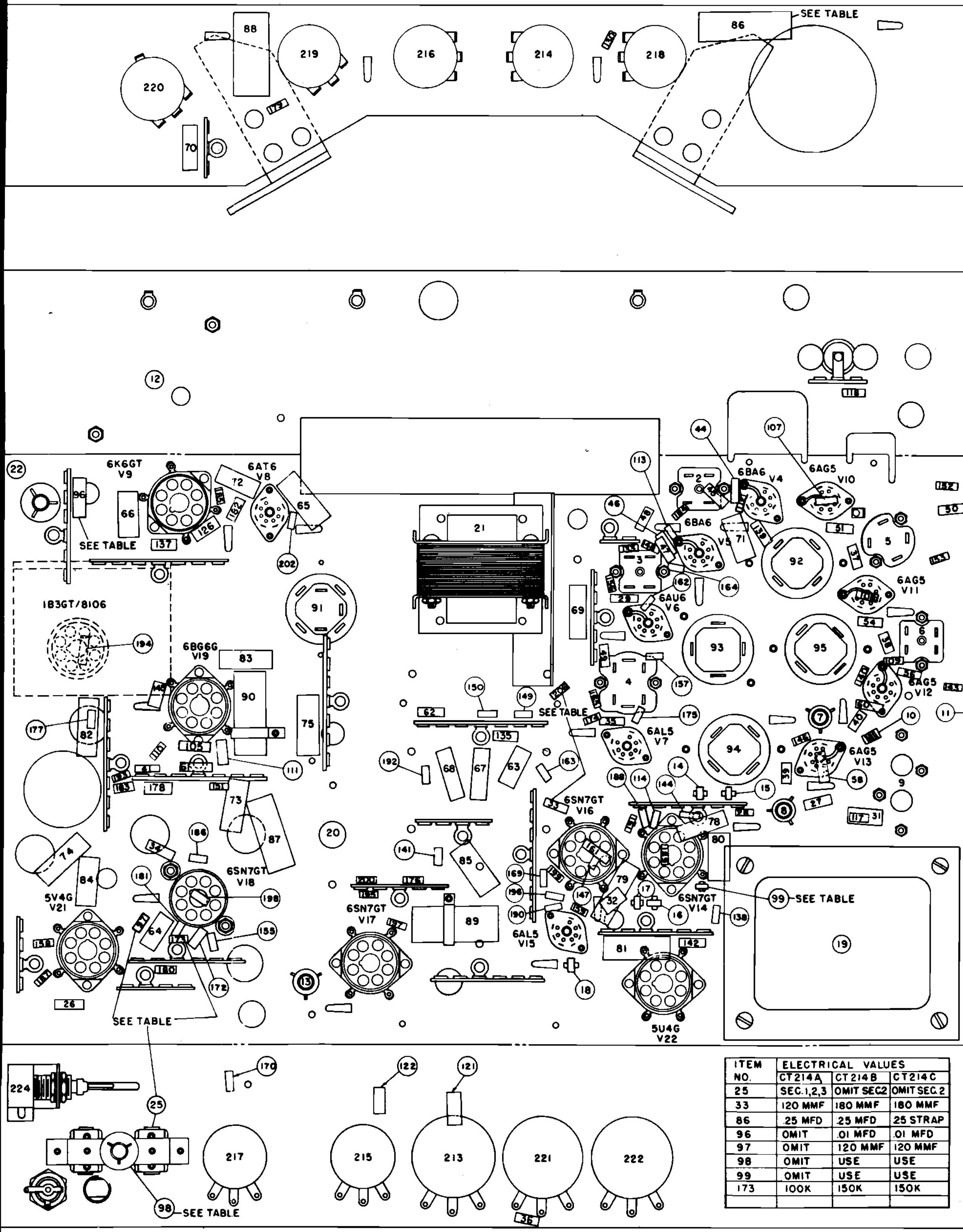
MAGNAVOX CT 214-218-221 TELEVISION

SCHEMATIC DIAGRAM, LATE PRODUCTION



MOST-OFTEN-NEEDED 1949 TELEVISION RECEIVERS

MAGNAVOX CT 214-218-221 TELEVISION



ITEM NO.	ELECTRICAL VALUES		
	CT214A	CT214B	CT214C
25	SEC.1,2,3	OMIT SEC2	OMIT SEC.2
33	120 MMF	180 MMF	180 MMF
86	.25 MFD	.25 MFD	.25 STRAP
96	OMIT	.01 MFD	.01 MFD
97	OMIT	120 MMF	120 MMF
98	OMIT	USE	USE
99	OMIT	USE	USE
173	100K	150K	150K

PARTS IDENTIFICATION

MOST-OFTEN-NEEDED 1949 TELEVISION RECEIVERS

Motorola® Television

SERVICE MANUAL

MODELS		CHASSIS
VT105	This material is presented on pages 111 to 130, inclusive.	TS-9
VT105M		TS-9A
VK106		TS-9B
VK106B		TS-9C
VK106M		TS-9D
VT107		
VT107M		

BRIEF DESCRIPTION OF CHASSIS

Chassis TS-9. This television chassis has 22 tubes plus a 10" picture tube. The picture, sound and scanning circuits, together with their power supply, are contained on a single chassis. Four type 25Z6GT tubes, operating in a bridge circuit, are used to supply "B" power. It is designed to operate on 105 to 125 volts, 60 cycle alternating current.

Chassis TS-9A. Same as Chassis TS-9 except that the four 25Z6GT bridge circuit rectifier tubes are replaced with a conventional power supply circuit using 2 rectifier tubes (5Y3GT & 5U4G). The power transformer in this chassis differs from the one used in Chassis TS-9. A total of 20 tubes plus a 10" picture tube are used in this chassis.

Chassis TS-9B. Same as Chassis TS-9 except that a reflexed type audio circuit was added to obtain greater audio amplification. The 1st sound IF amplifier is used as a combination 21.9 Mc IF amplifier and as an audio amplifier.

Chassis TS-9C. Similar to Chassis TS-9A but has added sound IF stage to reduce variations in sound level with setting of contrast control. This chassis has 21 tubes plus a 10" picture tube.

Chassis TS-9D. A new clipping and horizontal synchronization system was incorporated in this chassis. V-13 (6SN7GT) was replaced by a 12AU7 and an additional 12AU7 and 6AL5 were added bringing the tube total to 23 plus a 10" picture tube. Two trimmer adjustments, "Horiz Lock-in" and "Horiz Fine Freq" were eliminated from the rear of the chassis. The "Horiz Oscillator" adjustment which was formerly on the top of the chassis was placed at the rear, and the "Focus" control pot which replaced the variable resistor in the late TS-9C chassis was retained in the TS-9D.

ANTENNA CONNECTIONS

By means of the four connection antenna receptacle, either a 75 ohm unbalanced, or 300 ohm balanced input is available. This receiver is normally wired to match a 300 ohm balanced line. If the receiver is to be used with a 75 ohm line, rewire the input circuit as shown in Figure 1.

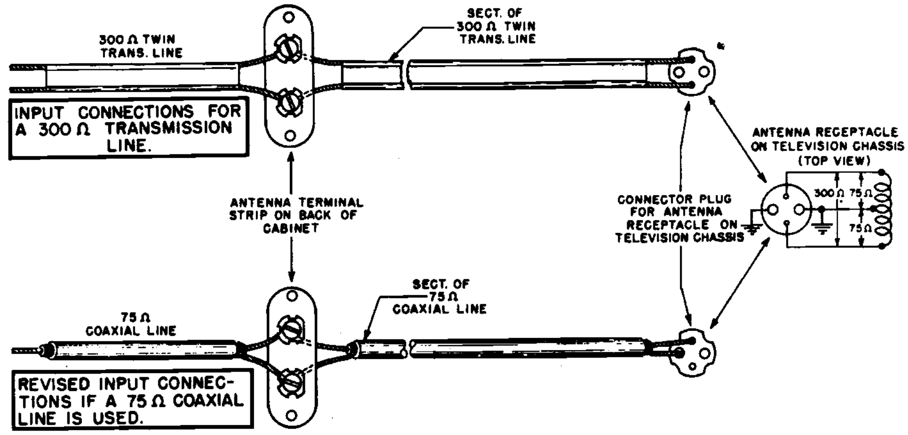


FIGURE 1. ANTENNA CONNECTIONS FOR 300 OR 75 OHM LINES

OPERATING CONTROLS

There are 8 controls on the front panel of your receiver. See Figure 2. Note that each front panel control is a dual control, consisting of a small knob and a large knob. The function of each control is indicated by markings on the front panel; the "circle" indicates the large knob while the "dot" indicates the small knob. See Figure 2 for front panel control functions.

NOTE: O INDICATES LARGE OUTER KNOB. • INDICATES SMALL INNER KNOB.

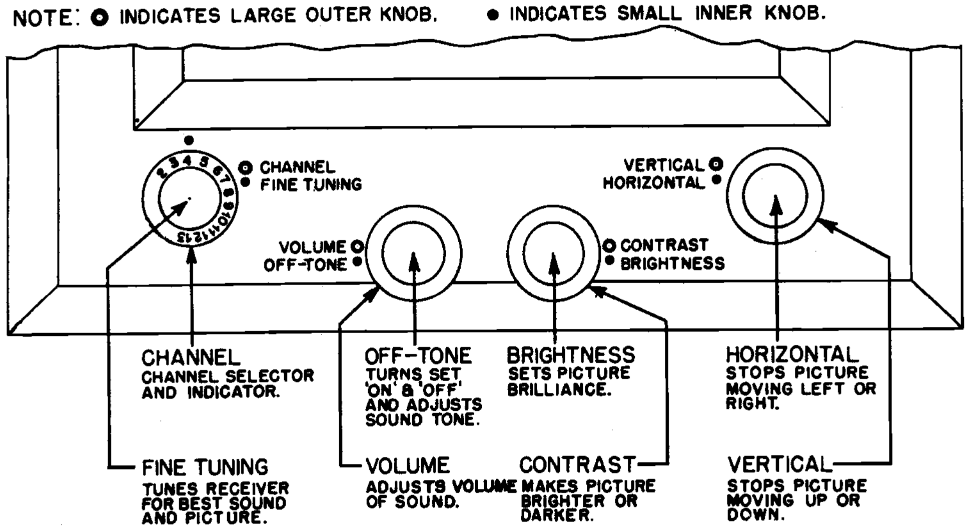


FIGURE 2. OPERATING CONTROLS

SERVICE ADJUSTMENT CONTROLS

The receiver is completely adjusted at the factory, so normally none other than the front panel control operating instructions need be followed in putting the receiver in operation. However, to provide for any misadjustment of the service controls, due to handling, the following instructions are in order. See Figures 3A, B & C for location of service adjustment controls.

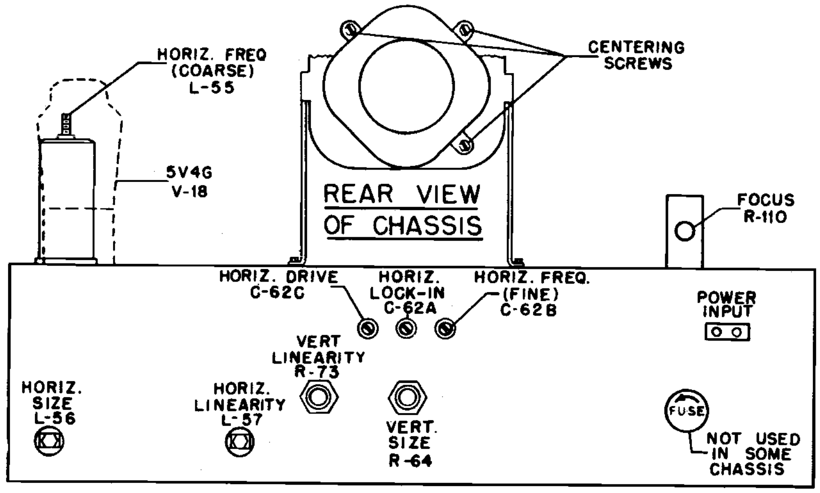


FIGURE 3A. CHASSIS TS-9, A, B & EARLY C SERVICE ADJUSTMENT CONTROL LOCATIONS

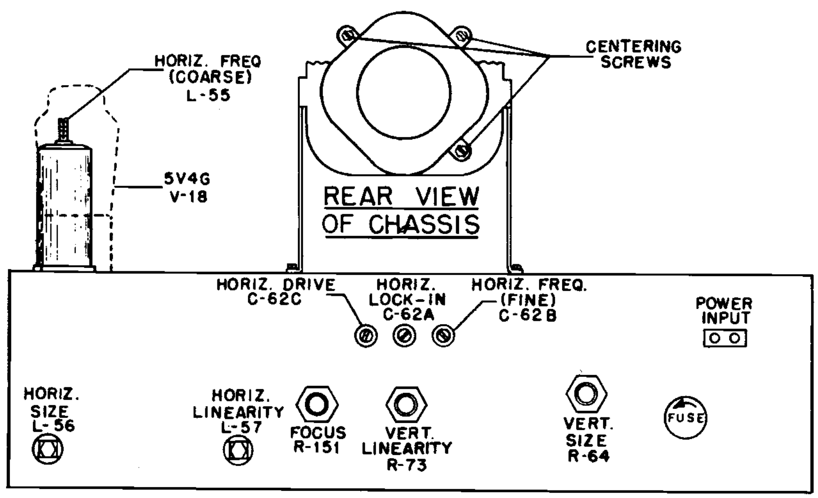


FIGURE 3B. CHASSIS TS-9C (LATE) SERVICE ADJUSTMENT CONTROL LOCATIONS

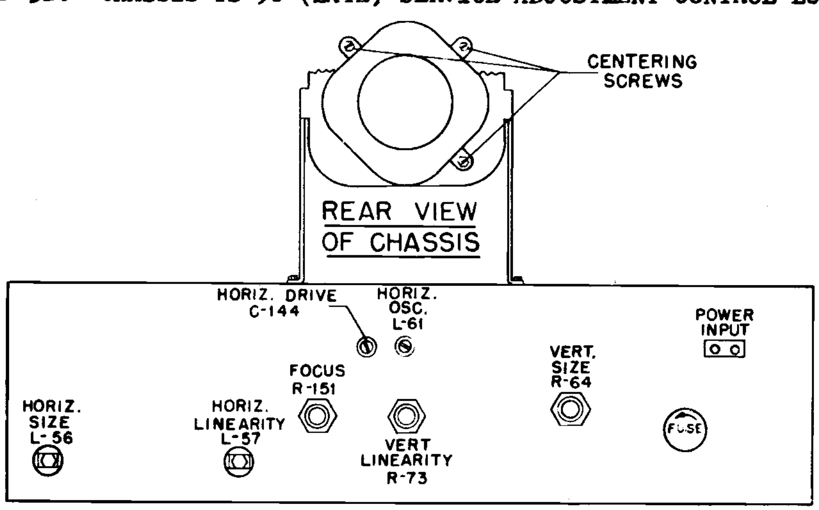


FIGURE 3C. CHASSIS TS-9D SERVICE ADJUSTMENT CONTROL LOCATIONS

FOCUS CONTROL

The FOCUS control should be adjusted until the fine horizontal line structure of the raster is clearly visible over the picture area. The control should be turned through the correct point several times so that optimum focus is obtained.

CENTERING

The picture is centered by positioning the focus coil. By means of three screws, the focus coil can be shifted to center the picture in its mask. These centering screws can be reached by removing the safety screen from back of receiver. A separate line cord, such as Motorola Part No. 30B470756, will be required to supply power to receiver when screen is removed.

VERTICAL SIZE AND VERTICAL LINEARITY ADJUSTMENT

Adjust the VERTICAL SIZE control R-64 until picture fills the mask vertically (6-3/8" minimum). Adjust VERTICAL LINEARITY control R-73 for best overall vertical linearity. Adjustment of the VERTICAL SIZE control will require a readjustment of the VERTICAL LINEARITY control and vice-versa. Center picture with centering screws on focus coil.

HORIZONTAL SIZE, DRIVE AND LINEARITY ADJUSTMENT

Turn HORIZONTAL SIZE control L-56 fully clockwise. Vary HORIZONTAL DRIVE trimmer (C-62C in Chassis TS-9, A, B & C - C-144 in Chassis TS-9D) for best compromise between brightness and horizontal linearity. Clockwise rotation increases picture width. Adjust HORIZONTAL LINEARITY control L-57 for best horizontal linearity on right half of picture. Adjustment of the HORIZONTAL SIZE will require a readjustment of the HORIZONTAL LINEARITY control and vice-versa. Center picture with centering screws on focus coil.

HORIZONTAL OSCILLATOR CHECK

Obtain a picture on the set with approximately normal contrast. Vary the HORIZONTAL HOLD control R-69B from one extreme to the other. The picture should remain in horizontal sync in all positions of the control except the extreme counterclockwise, and there the picture should show a marked tendency to slip to the right. This slippage serves as a reference point to insure the proper range of the hold control to give synchronization under all conditions. If picture fails to show this tendency to slip,

1. Leave the HORIZONTAL HOLD control in the extreme counterclockwise position
2. Adjust the HORIZONTAL FREQUENCY trimmer C-62B until the picture tends to slip to the right.
3. Rotate the HORIZONTAL HOLD control clockwise until the picture falls into sync, then rotate an additional 10-15 degrees clockwise and leave in that position.

When the receiver has been adjusted in this manner, it should be possible to switch off and on the station or to another station and have the picture in synchronism at all times. If this is possible, the horizontal oscillator is properly aligned.

The horizontal oscillator is properly adjusted in the TS-9D chassis if the picture remains in sync in all positions of the HORIZONTAL HOLD control. If this is not the case, adjust HORIZONTAL OSCILLATOR coil L-61 on the rear of the chassis until the picture holds throughout the range of the control.

COMPLETE ALIGNMENT OF HORIZONTAL OSCILLATOR (CHASSIS TS-9, A, B & C ONLY)

If, in the above check, the receiver failed to hold sync over the proper range of the HORIZONTAL HOLD control, the horizontal oscillator should be aligned as follows:

1. Turn CONTRAST CONTROL for about normal picture contrast.
2. Turn HORIZONTAL FREQUENCY trimmer C-62B tight.
3. Adjust HORIZONTAL LOCK-IN trimmer C-62A to about 2 turns from tight.
4. Adjust the horizontal oscillator coil L-55 so that the picture will lock-in over the whole range of the HORIZONTAL HOLD control.
5. If it is not possible to obtain proper syncing in Step 4, back off on HORIZONTAL LOCK-IN trimmer an additional turn, or until it is possible to adjust L-55 to make the picture sync over the whole range of the HORIZONTAL HOLD control.
6. Turn the HORIZONTAL HOLD control to its extreme counterclockwise position.
7. Adjust the HORIZONTAL FREQUENCY trimmer until the picture tends to slip to the right.
8. Rotate the HORIZONTAL HOLD control clockwise 10-15 degrees past the point at which the picture falls into sync, and leave it in that position.

It should now be possible to change stations without losing synchronism.

ADJUSTMENT OF ION TRAP AND DEFLECTION YOKE

Under conditions of rough shipment, it is possible for these parts to become misaligned. The following instructions will enable the service man to bring the parts to their normal setting.

See Figure 4 for adjustment locations. A mirror placed in front of the receiver will help in making these adjustments.

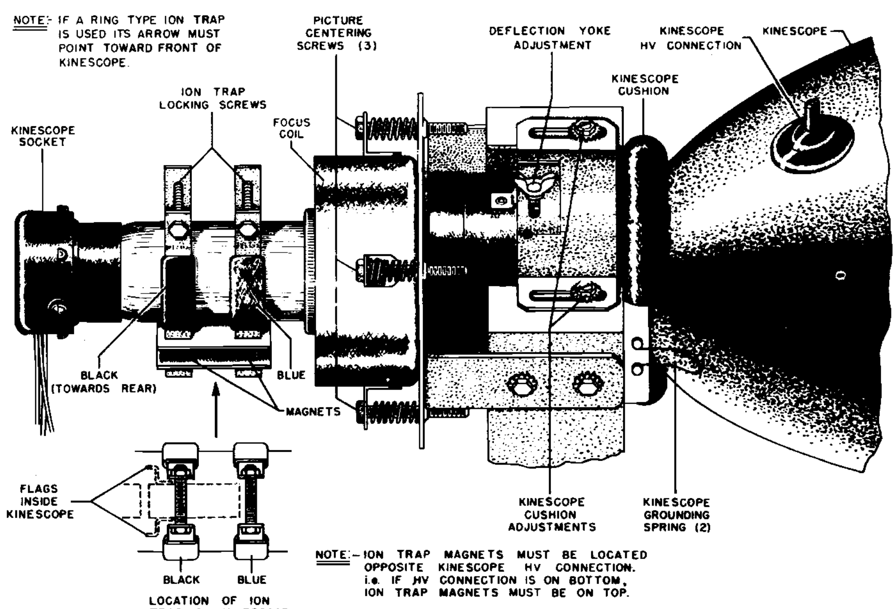


FIGURE 4. KINESCOPE ADJUSTMENT LOCATIONS

ADJUSTMENT OF THE ION TRAP

Two types of permanent magnet ion traps are used on the TS-9 series chassis. One is held in place with two clamps, colored black and blue; and the other slips over the neck of the tube and consists of a large and a small circular magnet.

Shifting of the ion trap will result in poor brilliancy, or shadowing of the corners. The ion trap should be mounted on the neck of the kinescope so that the black end, or large magnet, is toward the rear of the kinescope and approximately over the "flags" on the kinescope's gun structure. While observing the raster on the screen, move the ion trap slightly backward or forward, simultaneously turning it slightly to and fro until the brightest raster is obtained, and one in which none of the four corners are cut off or shadowed. These adjustments should be made with the brightest picture obtainable, consistent with good line focus and a full, square raster. When adjustment is completed, tighten screws to hold ion trap in position.

DEFLECTION YOKE ADJUSTMENT

If the deflection yoke shifts, the picture will be tilted. To correct, loosen the wing nut on top of the deflection yoke and rotate yoke till picture is straight. Before tightening wing nut, make certain that the deflection yoke is as far forward as possible.

ALIGNMENT

GENERAL. The alignment procedure covers all chassis, through TS-9D.

The chassis should be mounted on angle iron brackets (Motorola Part Number 7B484018) so that all connections and adjustments may be made easily. Spurious response trouble may be reduced to a minimum by bonding the chassis and all instruments together with braided metal straps.

A metal screwdriver may be used for making video IF adjustments, but a plastic or fibre screwdriver is required for RF or sound IF alignment.

EQUIPMENT NECESSARY FOR ALIGNMENT

AM Signal Generator: Frequency Range 20-220 mc
Output 0-100,000 microvolts

Electronic Voltmeter

Oscilloscope

Sweep Frequency Generator: Frequency Range 20-30 mc
Sweep Width: 10 mc minimum

VIDEO IF ALIGNMENT PROCEDURE

It will be necessary to remove the kinescope to expose two video IF tuning cores. A short screwdriver of 2 to 3 inches in length is convenient for making the adjustments.

1. Turn the channel selector switch to a blank channel, e.g., the position which would correspond to channel 14 or 15 if there were such marking on the switch. This disables the local oscillator and prevents spurious responses in the IF amplifier.

2. Turn the receiver on, and adjust the contrast control R-76B, for -5 volts bias, as measured from the variable tap of the control to chassis.

3. Apply a -3 volt bias to the mixer grid by means of a dry battery. Connect the positive terminal of the battery to ground and the - 3 volt terminal to the point at which the two 470,000 ohm resistors (R-6 & R-7) in the mixer grid are connected.

4. Connect the signal generator output lead, through a blocking capacitor of 100 mmf to .01 mf, to the grid of the mixer tube V-2 (6J6, pin 5). The low side of the signal generator should be connected to the oscillator coil mounting plate near the mixer tube socket. To avoid regeneration, keep the grid and ground leads to the signal generator as short as possible.

5. Connect the electronic voltmeter across the video detector load resistor, R-48 (4700 ohms). With zero output from the generator, the meter should read less than 1 volt negative contact potential. A voltage appreciably greater than this indicates oscillation in the IF strip; and the generator lead connections, groundings, etc., should be checked.

In the TS-9D the video detector load resistor (R-48) is tied to B- instead of ground as in previous versions. Care should be taken to connect the voltmeter directly across the resistor and not to ground.

6. Adjust the output of the signal generator throughout alignment for no more than 1 volt increase across the detector load resistor to prevent overdriving the IF amplifier. Use the 3 volt range on the electronic voltmeter.

7. Refer to Figures 5 & 6 for location of alignment adjustments and to the following chart for procedure.

STEP	SIG. GEN. FREQ.	ADJUST	REMARKS
1	23.6 mc	L-59 (or T-5)	Adjust for maximum.
2	26.4 mc	T-6	Adjust for maximum.
3	22.9 mc	T-7	Adjust for maximum.
4	25.7 mc	T-8	Adjust for maximum. NOTE: This adjustment will normally tune very broadly, since the core is practically out of coil.
5	21.9 mc (TS-9D,21.7mc)	L-44	Increase generator output about 10 times and adjust for minimum. (Sound trap adjustment).
6	25.7 mc	T-8	Readjust for maximum as in Step 4.
7	24.7 mc	T-9	Adjust for maximum.

The normal video IF sensitivity is less than 400 microvolts at 24.5 mc for an increase of 1 volt above contact potential, across the detector load, R-48, with -3 V. mixer bias and zero contrast bias.

The video IF amplifier response curve is shown in Figure 7. The bandwidth at the 3 db points should be approximately 3.5 mc. To check this with an AM generator, note the signal strength in microvolts necessary to produce an increase of approximately 1 volt above contact potential at 24.5 mc. Increase the generator input by 1.4 times and shift the generator frequency both sides of 24.5 mc until the original detector voltage reading is again obtained. These two new frequencies thus obtained are the 3 db skirt frequencies and should be approximately 22.9 mc and 26.4 mc. This measurement should be made with the -3 volt mixer bias and a -5 volt contrast bias.

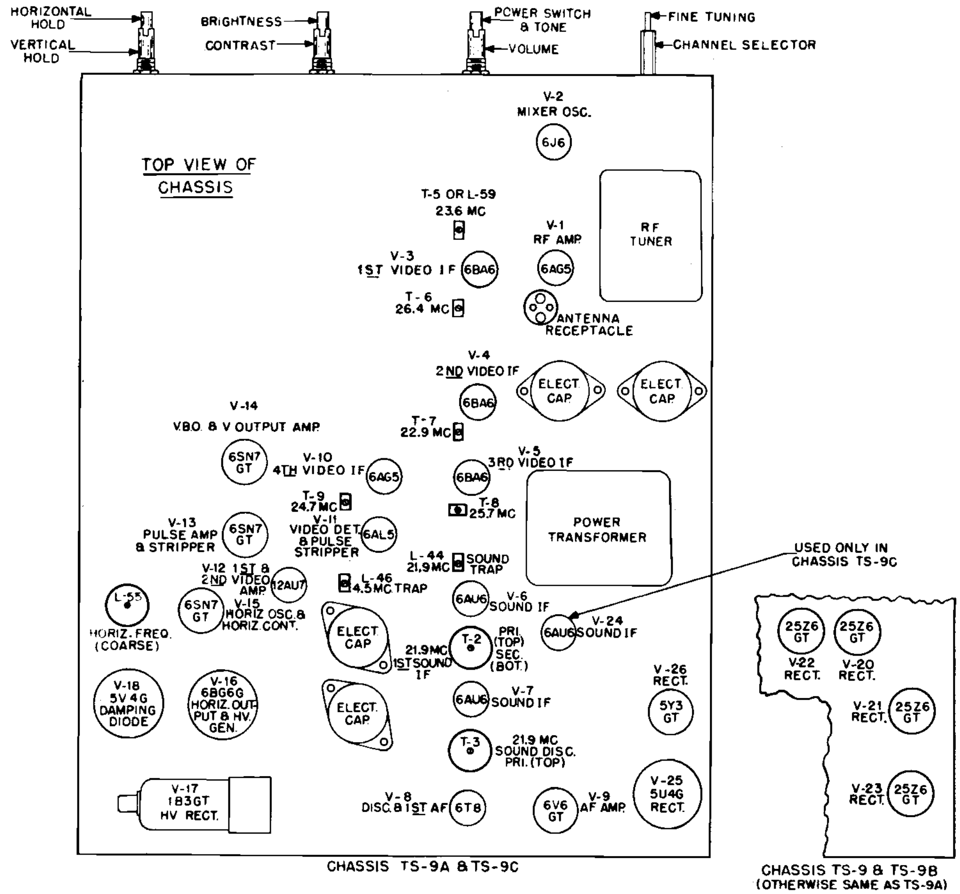


FIGURE 5. CHASSIS TS-9, A, B & C TUBE & IF ADJUSTMENT LOCATIONS

As the video IF in the TS-9D is 26.2 mc instead of 26.4 mc, it will appear slightly above the 3 db point at 26.4 mc. If, when checking the response with a sweep generator, the picture carrier appears too high on the curve, adjustment of the 26.4 mc I.F. (T-6) will bring it down to the desired position.

4.5 MC TRAP ADJUSTMENT

1. Connect the signal generator to the plate of the video detector, V-11, (6AL5, pin 7).

2. Connect the electronic voltmeter and germanium crystal rectifier, as shown in Figure 8, to the plate of the 2nd video amplifier, V-12 (12AU7, pin 6). Use the lowest voltage scale on the meter.

3. With the signal generator set at 4.5 mc and maximum output, adjust trap L-46 for minimum reading on the meter.

An alternate method is to tune in a normal picture and adjust L-46 so that the strippled or half-tone effect in the picture is minimized or eliminated. Make sure the fine tuning control is set on center audio peak while this adjustment is being made. The RF portion of the receiver must, of course, be aligned first before this method of adjusting the sound trap is attempted.

MOST-OFTEN-NEEDED 1949 TELEVISION RECEIVERS

NO	TYPE	FUNCTION
V-1	6AG5	RF AMP
V-2	6J6	MIXER-OSC
V-3	6BA6	1ST VIDEO IF
V-4	6BA6	2ND VIDEO IF
V-5	6BA6	3RD VIDEO IF
V-6	6AU6	SOUND IF
V-7	6AU6	SOUND IF
V-8	6T8	DISC & 1ST AUDIO AMP
V-9	6V6GT	AUDIO AMP
V-10	6AG5	4TH VIDEO IF
V-11	6AL5	VIDEO DET & NOISE LIMITER
V-12	12AU7	1ST & 2ND VIDEO AMP
V-14	6SN7GT	VBO & VERT OUTPUT AMP
V-15	6SN7GT	HORIZ OSC
V-16	6BG6G	HORIZ OUTPUT & H V GEN
V-17	1B3GT	H V RECT
V-18	5V4G	DAMPING DIODE
V-24	6AU6	SOUND IF
V-25	5U4G	RECT
V-26	5Y3GT	RECT
V-27	12AU7	1ST STRIPPER
V-28	12AU7	PULSE AMP & 2ND STRIPPER
V-29	6AL5	PHASE DETECTOR

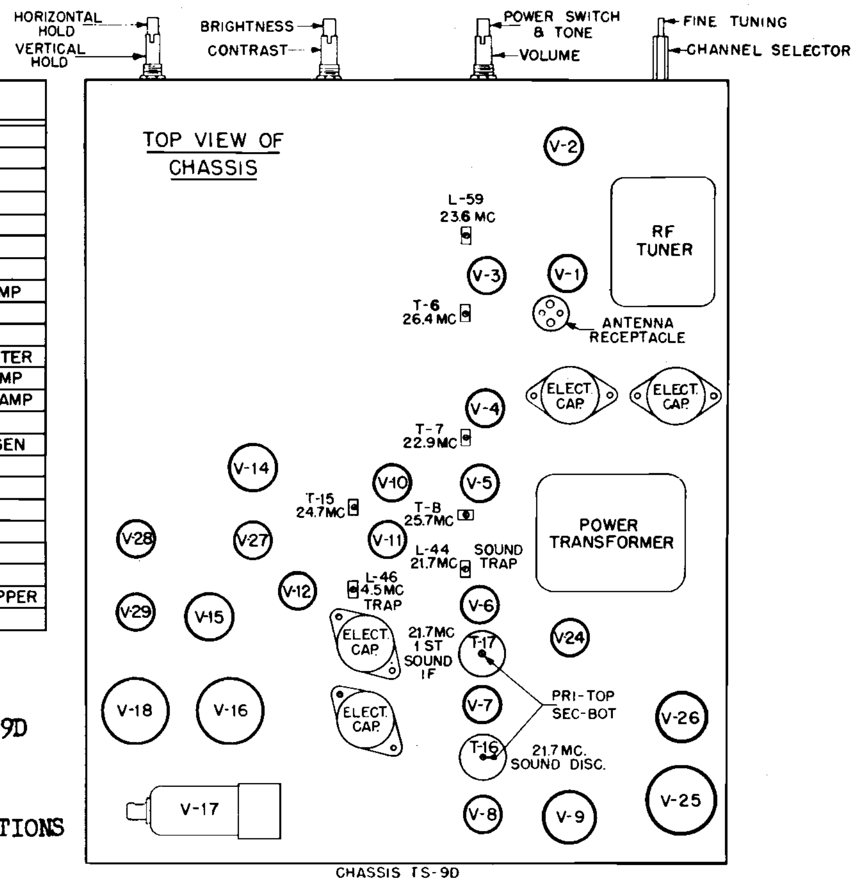


FIGURE 6. CHASSIS TS-9D

TUBE & IF ADJUSTMENT LOCATIONS

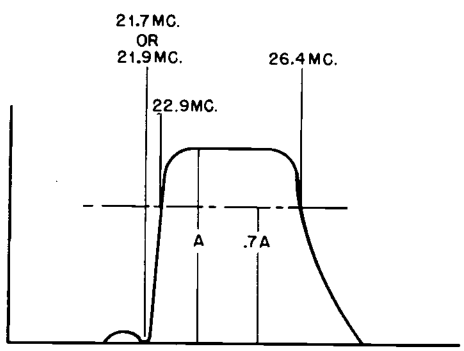


FIGURE 7. VIDEO IF RESPONSE WAVEFORM

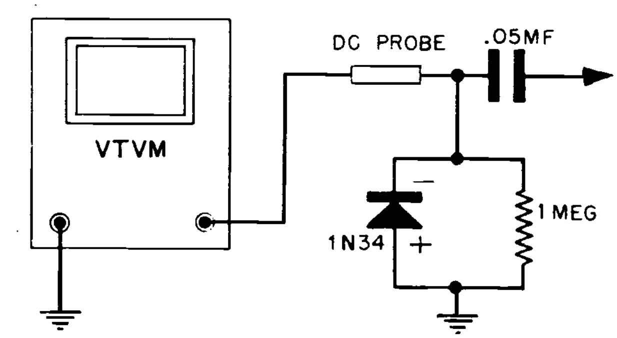


FIGURE 8. ELECTRONIC VOLTMETER CONNECTIONS

CHECK OF VIDEO IF ALIGNMENT WITH SWEEP GENERATOR

Since variations in tube gain and component values cannot be taken into consideration in the single frequency alignment technique, whereas they can be compensated for in a sweep alignment, it is very desirable after AM alignment to check the shape of the IF response curve and to touch up the adjustments by using a sweep generator and an oscilloscope.

1. Turn the channel selector switch to a blank channel (a position corresponding to channels 14 or 15) to disable the local oscillator.

2. Adjust the contrast control for -5 volts bias.

3. Apply a -3V bias to the mixer grid, at the junction of the two 470,000 ohm resistors, R-6 & R-7.

4. Connect the sweep generator output lead, through a blocking capacitor of 100 mmf to .01 mf, to the grid of the mixer tube V-2 (6J6, pin 5). Ground the generator to the oscillator coil mounting plate, again keeping the leads as short as possible.

5. Connect the oscilloscope vertical amplifier input to the grid of the 1st video amplifer, V-12 (12AU7, pin 2), or to the grid of the 2nd video amplifier, V-12 (12AU7, pin 7) if more gain is needed. Run a lead from the scope terminal on the sweep generator to the horizontal input on the oscilloscope; or use the built-in sawtooth, synchronized internally, whichever is preferred.

6. Set the sweep generator for a center frequency of about 24.0 mc, with a deviation of about 10 mc. At all times keep the output below the level at which the IF strip is over-driven, the point at which the response curve begins to change shape as the generator output is increased.

7. Turn on the marker in the sweep generator. If there is no built-in marker in the sweep generator, loosely couple the output of the AM generator to the IF strip, or feed the output to the mixer tube grid through a small capacitor. At all times, keep the marker output low enough to prevent the marker from distorting the response curve. If a wide band scope is used, the marker will be more distinct if a capacitor of 100 mmf to 1000 mmf is placed across the scope input. Use the smallest size possible, since too large a value will affect the shape of the curve.

8. Adjust the sweep and scope until one complete response curve appears on the screen.

9. Compare the curve with the ideal curve in Figure 7, using the marker to locate specific frequencies on the wave. If it is necessary to alter the shape of the curve, readjust the core closest in frequency to the point requiring correction.

SOUND IF ALIGNMENT

1. Make adjustments and connections as described for video IF alignment.

   a. Turn the channel selector switch to a blank channel.

   b. Adjust the contrast control to -5 volts bias.

   c. Apply -3 volts bias to the mixer grid.

   d. Connect the AM generator output lead, through a blocking capacitor, to the grid of V-2 (6J6, pin 5).

2. Refer to Figures 5 & 6 for location of alignment adjustments and to the following chart for procedure.

3. Except in step 1, keep the output of the signal generator low enough to prevent limiting during alignment.

STEP	SIGNAL GENERATOR FREQUENCY	ELECTRONIC VOLTMETER CONNECTED TO	ADJUST	REMARKS
1	21.9 mc	Across video det. load, R-48	L-44	Adjust for minimum. (This step not necessary if performed during video IF alignment).
2	21.9 mc	Across R-122 & R-14 (Junction of R-12 & R-13 on TS-9)	T-2 pri & sec.	Adjust for maximum.
3	-	-	T-3 sec (bottom)	Detune 2 turns counterclockwise.
4	21.9 mc	High side of volume control (Junction of R-17 & R-23 on TS-9B)	T-3 Pri (top)	Adjust for maximum.
5	21.9 mc	Same as Step 4.	T-3 sec (bottom)	Adjust so that the meter indicates zero output as the voltage swings from one polarity to another. This is a very sharp adjustment. Use a fibre screwdriver.

NOTE: On chassis TS-9D, T-2 is T-17 and T-3 is T-16. The signal generator is set at 21.7 mc instead of 21.9 mc.

With -3 V. mixer bias and zero contrast bias, the normal audio sensitivity is as follows:

Chassis TS-9: 400 microvolts for 1/2 V. from junction of R-12 & R-13 (47K) to ground.

Chassis TS-9A: 400 microvolts for 1 V. across R-122 & R-14 (terminal #1 of T-2 to ground).

Chassis TS-9B: 400 microvolts for 1 V. across R-122 & R-14 (terminal #1 of T-2 to ground).

Chassis TS-9C: 100 microvolts for 1 V. across R-122 & R-14 (terminal #1 of T-2 to ground).

Chassis TS-9D: 100 microvolts for 1 V. across R-122 & R-14 (terminal #1 of T-17 to ground).

RF ALIGNMENT PROCEDURE

The locations of the various adjustments are given in Figure 9. It will be noted that the oscillator adjustments are arranged in a counterclockwise sequence on the front side of the chassis, starting with the #2 channel as the first adjustment at the top.

The RF amplifier adjustments are located in a similar manner, starting at the top of the chassis and going around to the bottom. Both coils for each channel are placed together and then apart, alternately, in the channel sequence.

The antenna trimmers are also located in a counterclockwise manner, starting at the top of the chassis with #2 channel and going around to below the chassis.

CHANNEL	FREQ. BAND MC	PICTURE CARRIER	SOUND CARRIER	RECEIVER OSCILLATOR *
2	54-60	55.25	59.75	81.65
3	60-66	61.25	65.75	87.65
4	66-72	67.25	71.75	93.65
5	76-82	77.25	81.75	103.65
6	82-88	83.25	87.75	109.65
7	174-180	175.25	179.75	201.65
8	180-186	181.25	185.75	207.65
9	186-192	187.25	191.75	213.65
10	192-198	193.25	197.75	219.65
11	198-204	199.25	203.75	225.65
12	204-210	205.25	209.75	231.65
13	210-216	211.25	215.75	237.65

* In TS-9D chassis, reduce osc frequencies by 0.2 mc.

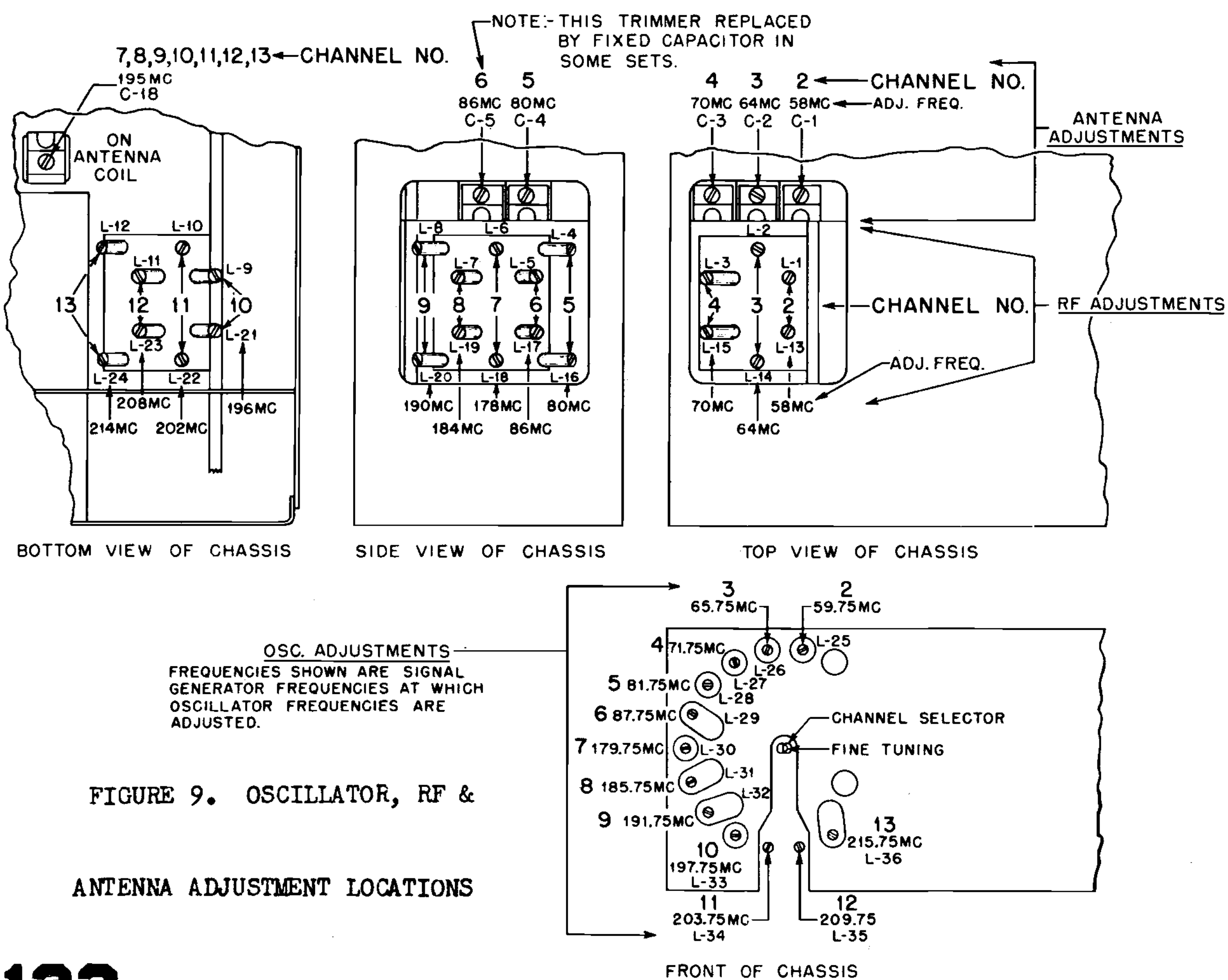


FIGURE 9. OSCILLATOR, RF & ANTENNA ADJUSTMENT LOCATIONS

Procedure:

1. Connect the AM signal generator output cable to the antenna terminals of the receiver. Match the generator to the 300 ohm input impedance of the receiver by using a 100 ohm resistor in series with the output terminal of the generator cable and a 150 ohm resistor in series with the ground terminal. This arrangement is for a 50 ohm generator. If the generator impedance is 30 ohms, use a 120 ohm resistor on the output terminal and 150 ohms in series with the ground terminal.

2. Set the contrast control for -5 volts bias. (Measured from arm of contrast control to chassis).

3. When aligning the oscillator, connect the electronic voltmeter across the volume control (junction of R-17 (100K) & R-23 (47K) on chassis TS-9B).

4. Turn the channel switch to the channel to be aligned.

5. Set the fine tuning capacitor C-13 to half-capacity position.

6. Set the signal generator at the sound carrier frequency of the channel (see above chart) and adjust the signal generator output until a voltage reading is obtained on the electronic voltmeter, connected as in step 3.

7. Locate the oscillator tuning adjustment belonging to the channel being aligned. See Figure 9. With a non-metallic screwdriver, adjust the oscillator frequency until the reading on the meter is zero. The meter reading will change rapidly from one polarity, through zero, to the opposite polarity as the oscillator frequency is adjusted to produce the correct sound IF of 21.9 mc.

8. Proceed as above for each channel; and, if the fine frequency trimmer is left in the same position for each channel when the oscillator adjustments are made, very little retuning of the fine tuning control will be required in changing from one television station to the next.

9. With the oscillator correctly set, the next step is the alignment of the RF amplifier. The RF coils for all channels and the antenna trimmers for the first five channels are aligned at a frequency 1 mc higher than the center frequency of the channel under test; that is, 4 mc above the lower channel limit, or 2 mc below the upper limit. See chart above for channels and Figure 9 for alignment locations and frequencies.

10. Connect electronic voltmeter across the video detector load resistor R-48. In the TS-9D the video detector load resistor(R-48) is tied to B- instead of ground as in previous versions. Care should be taken to connect the voltmeter directly across the resistor and not to ground.

11. Set the signal generator to the RF alignment frequency and adjust the output for a reading on the voltmeter.

12. There are two coils for each RF channel. Using a non-metallic screwdriver, detune one core considerably in a counter-clockwise direction. Then tune the other for maximum output on the meter. Now, retune the first coil for maximum output, and the RF amplifier is aligned. Do not retune the other coil again for maximum, as this will not give a proper bandpass characteristic. Always keep the generator output low enough to prevent saturation.

13. Antenna coil trimmers are provided for channels 2 through 6. See Figure 9 for locations. They are peaked for maximum output on the meter at the same frequencies used for aligning the RF coils.

14. Capacitor C-18 is tuned at 195 mc and has enough bandwidth to work effectively over the high frequency channels.

15. Proceed as above for all channels.

RF ALIGNMENT CHECK

The signal generator is connected to the antenna terminals of the receiver and tuned to the center frequency of each channel. With the contrast control set for maximum gain, the sensitivity should be as follows:

CHASSIS	VOLTMETER CONNECTED TO	VOLTAGE READING	MICROVOLTS CHANNELS 2-6	SENSITIVITY CHANNELS 7-13
		Video Sensitivity		
All TS-9 series	Video Det. Load (R-48)	1.0 V Increase	100	300
		Sound Sensitivity		
TS-9	Junction of R-12 & R-13	.5 V	100	300
TS-9A	Across R-122 & R-14	1.0 V	100	300
TS-9B	Across R-122 & R-14	1.0 V	100	300
TS-9C	Across R-122 & R-14	1.0 V	25	75
TS-9D	Across R-122 & R-14	1.0 V	25	75

The peak value of discriminator audio output voltage should be 1 volt or greater for a ± 25 kc shift, with 1 volt of signal at the limiter grid. One volt exists at the limiter grid when 1 volt is measured across resistors R-122 and R-14 (chassis TS-9A, TS-9B, TS-9C, TS-9D) or 1/2 volt at junction of resistors R-12 and R-13 (chassis TS-9). The electronic voltmeter is connected across the volume control (chassis TS-9, TS-9A, TS-9C, TS-9D), or at the junction of resistors R-17 and R-23 (chassis TS-9B). The signal generator frequency is adjusted until a zero voltage reading is obtained and then is shifted ± 25 kc from zero frequency.

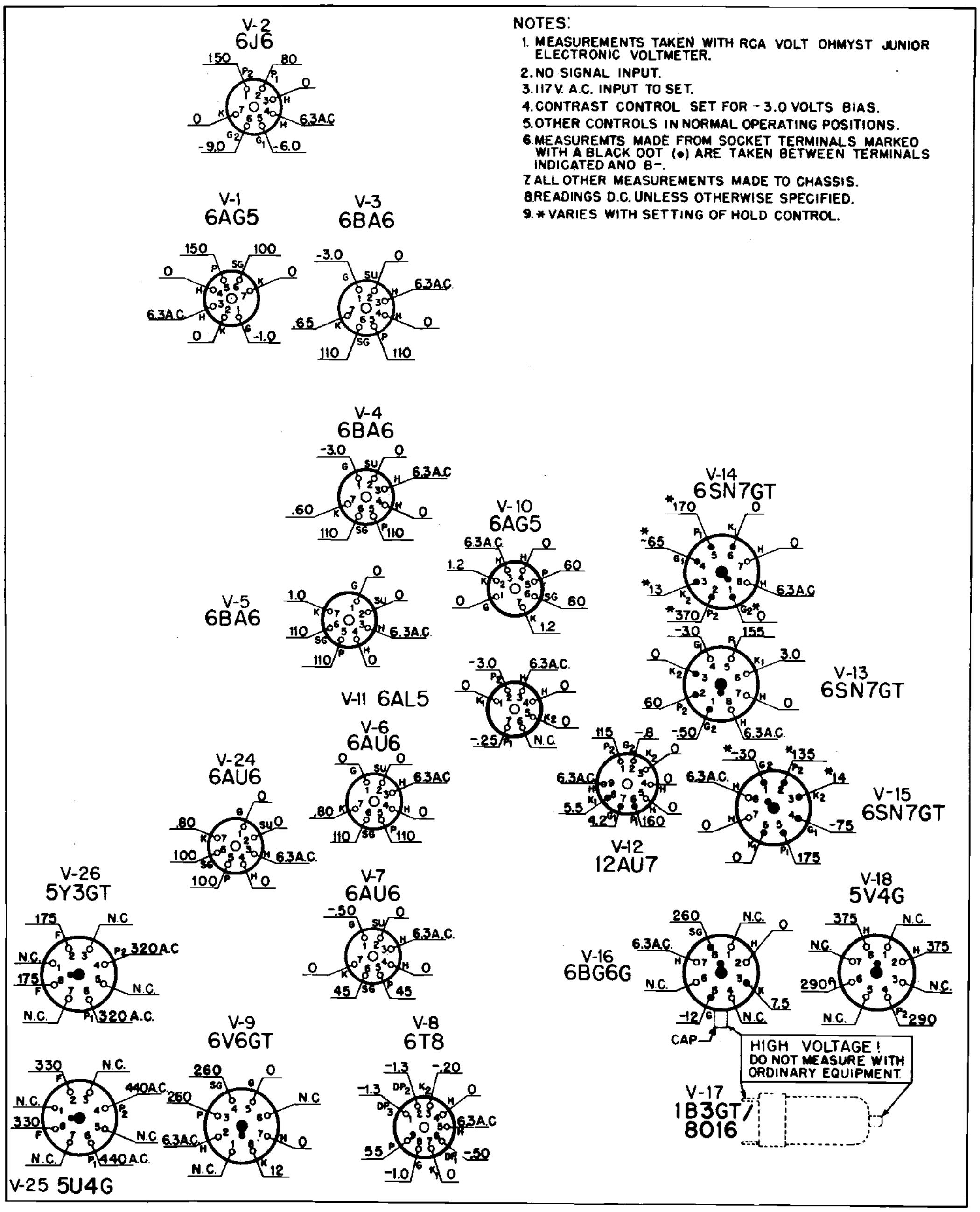
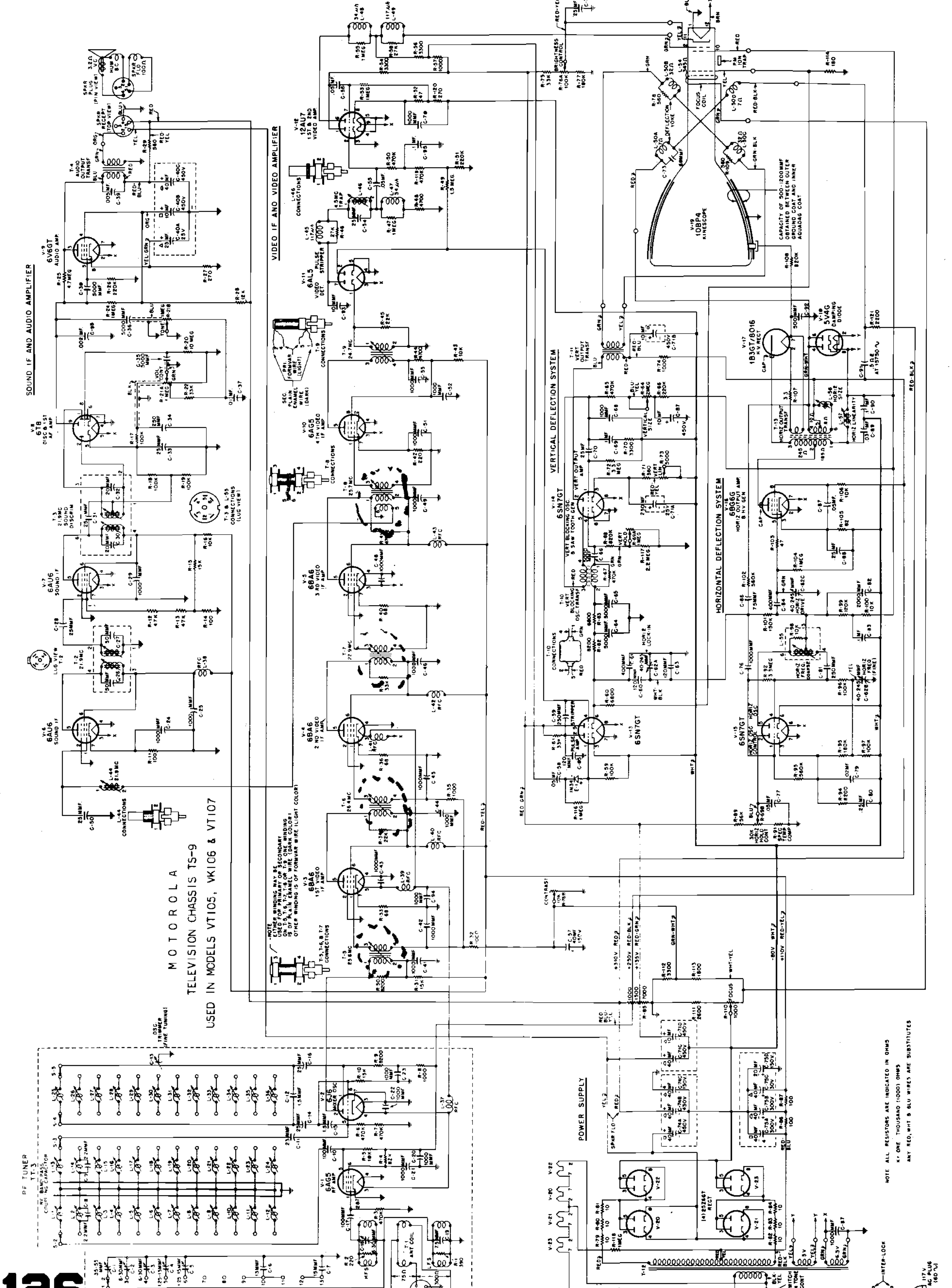
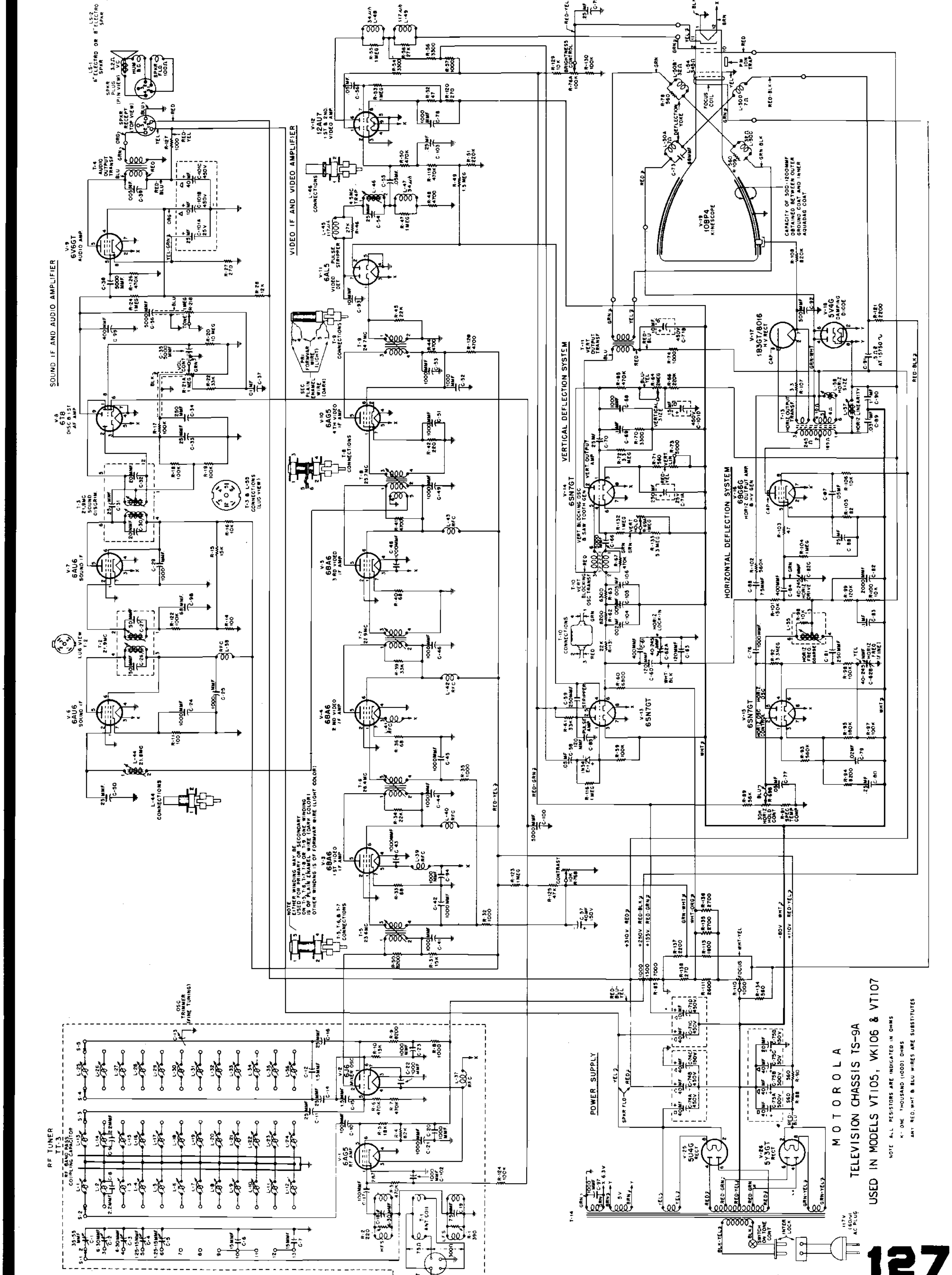


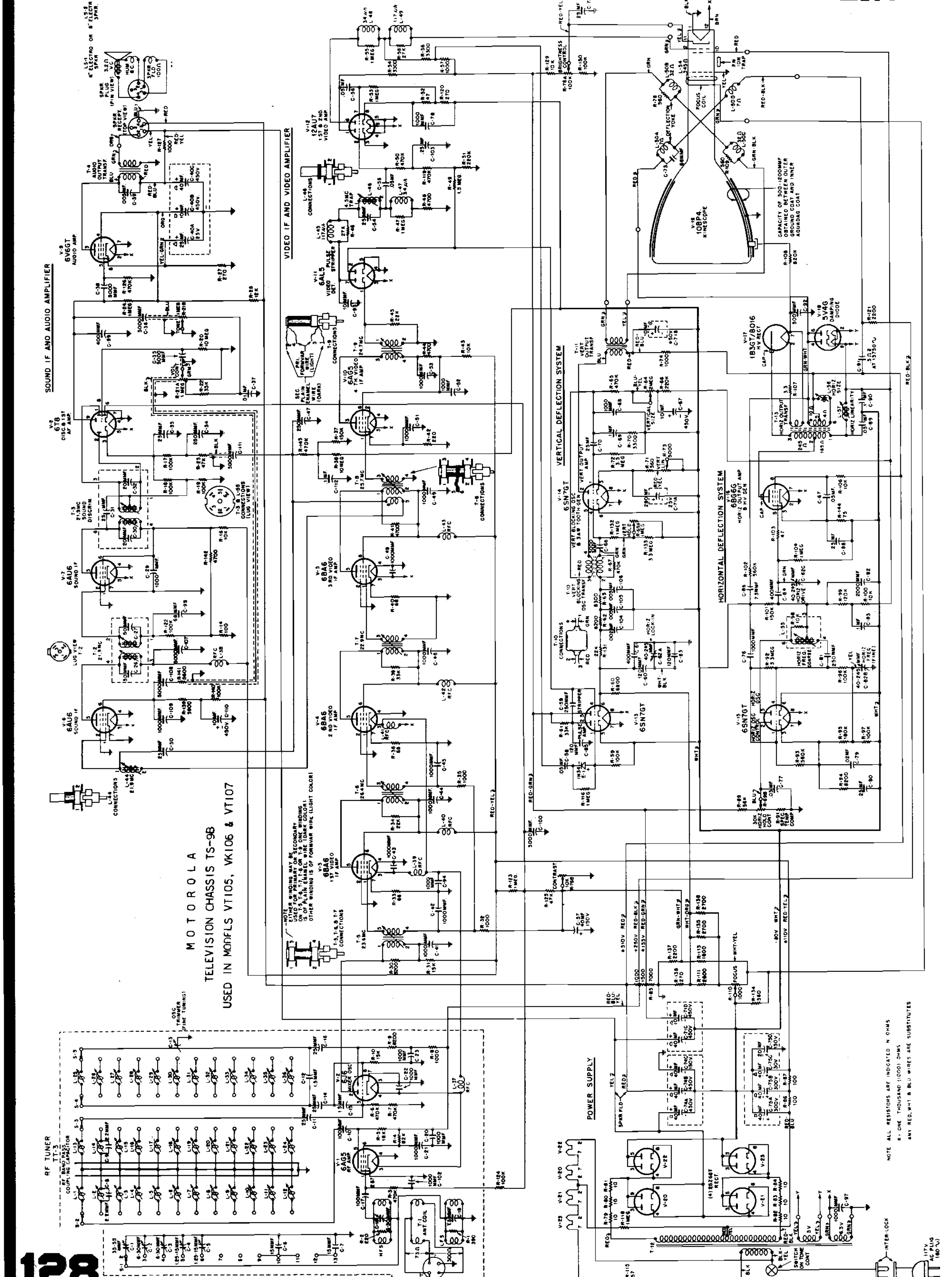
FIGURE 10. CHASSIS TS-9C VOLTAGE DIAGRAM

Material presented on pages 111 to 130 inclusive, covers Motorola Television Models VT105, VT105M, VK106, VK106B, VK106M, VT107, and VT107M, using Chassis TS-9, TS-9A, TS-9B, TS-9C, and TS-9D. There are complete circuits of these different chassis presented on the following five pages.

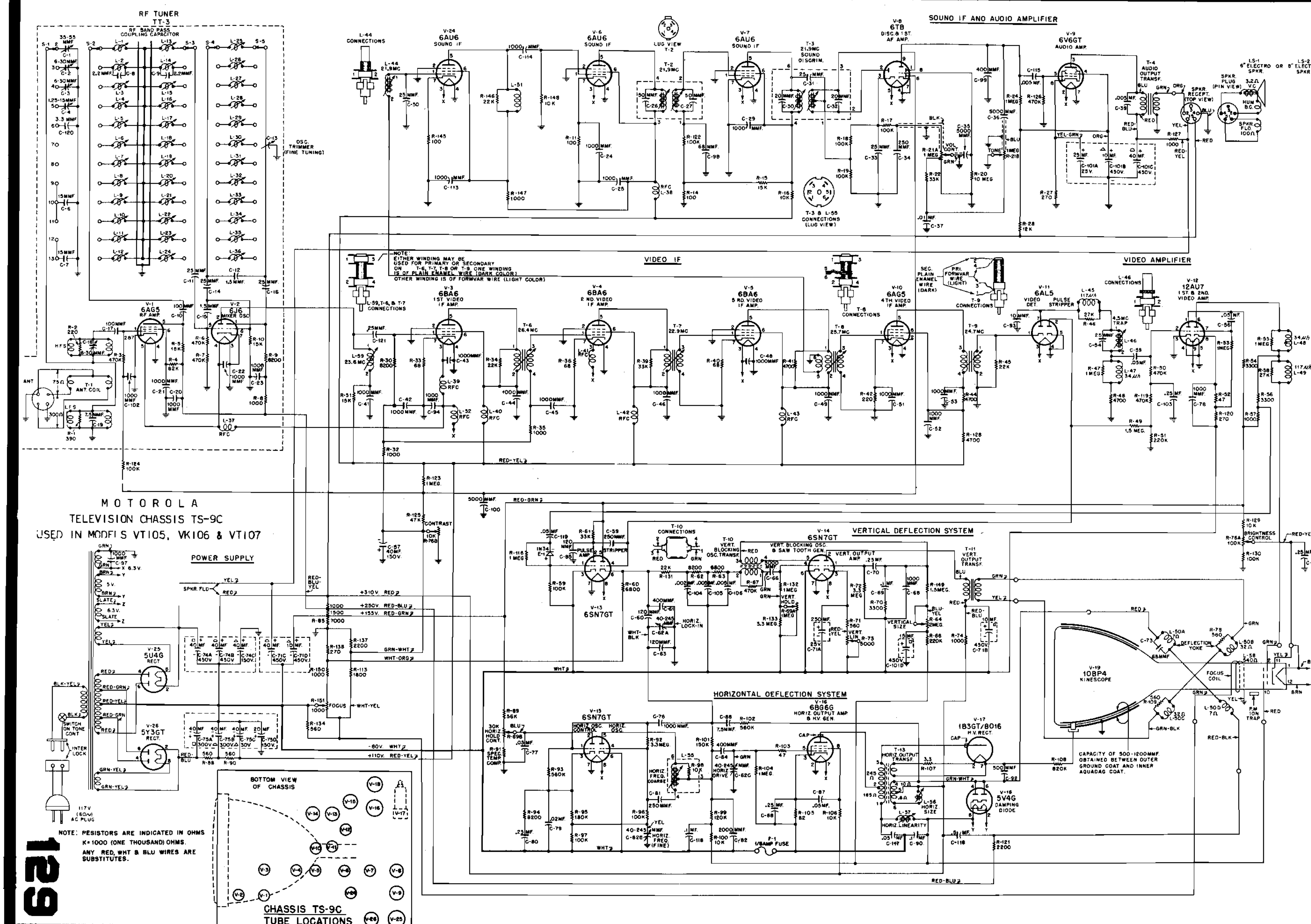

MOTOROLA
TELEVISION CHASSIS TS-9
USED IN MODELS VT105, VK106 & VT107
SOUND IF AND AUDIO AMPLIFIER
VIDEO IF AND VIDEO AMPLIFIER
VERTICAL DEFLECTION SYSTEM
HORIZONTAL DEFLECTION SYSTEM
POWER SUPPLY
RF TUNER
10BP4 KINESCOPE
NOTE ALL RESISTORS ARE INDICATED IN OHMS
K= ONE THOUSAND (1000) OHMS


MOTOROLA
TELEVISION CHASSIS TS-9A
USED IN MODELS VT105, VK106 & VT107
SOUND IF AND AUDIO AMPLIFIER
VIDEO IF AND VIDEO AMPLIFIER
VERTICAL DEFLECTION SYSTEM
HORIZONTAL DEFLECTION SYSTEM
POWER SUPPLY
RF TUNER TT-3

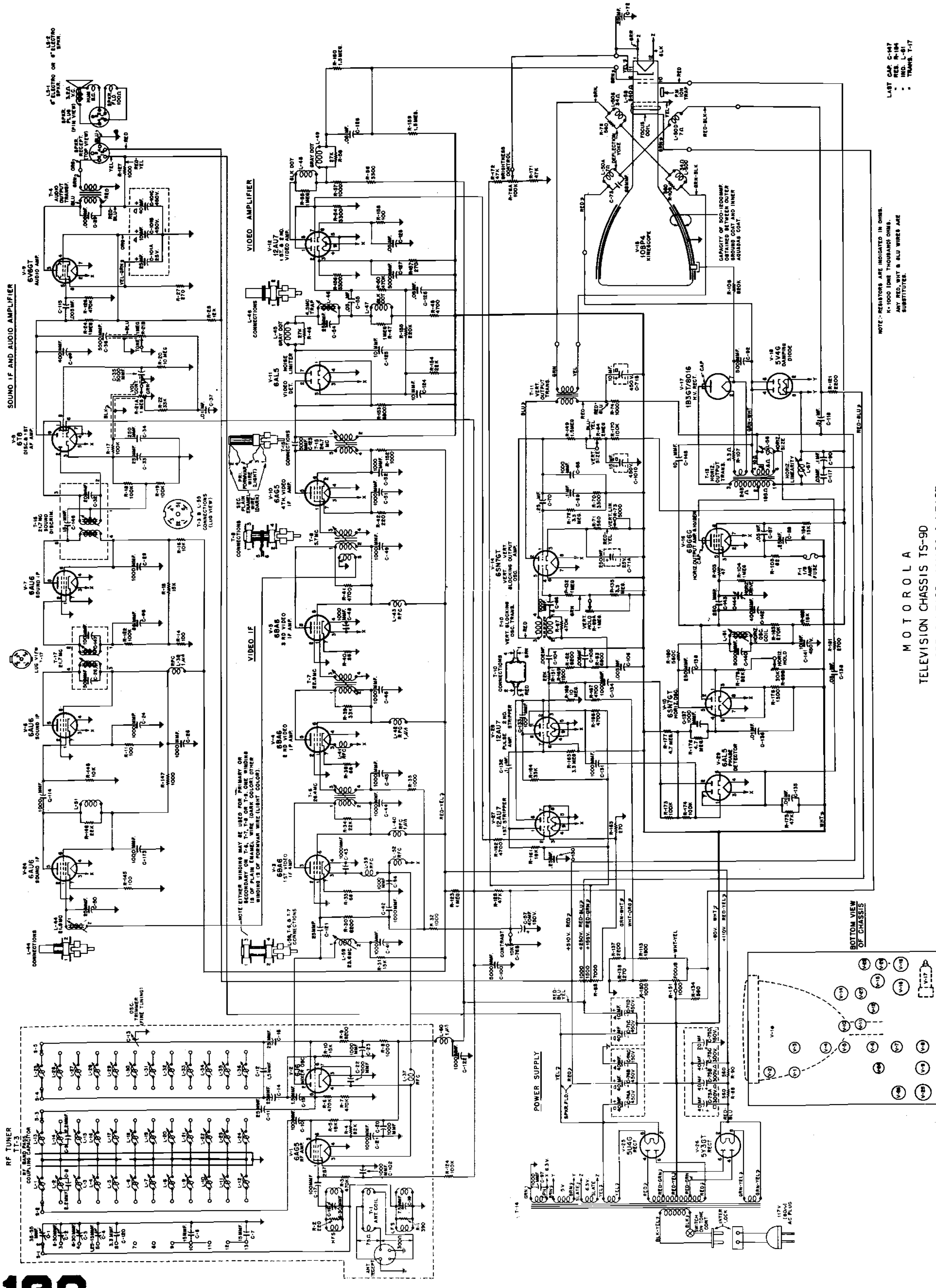
MOST-OFTEN-NEEDED 1949 TELEVISION RECEIVERS



MOTOROLA
TELEVISION CHASSIS TS-9B
USED IN MODELS VT105, VK106 & VT107



MOTOROLA
TELEVISION CHASSIS TS-9C
USED IN MODELS VT105, VK106 & VT107



MOTOROLA
TELEVISION CHASSIS TS-90
USED IN MODELS VT105, VK106 & VT107

PHILCO

TELEVISION-RADIO-PHONOGRAPH MODELS

49-1278, CODE 123 49-1280, CODE 121
49-1279, CODE 122 49-1076, CODE 123
49-1077, CODE 122

TELEVISION RECEIVER MODELS

49-1240, CODE 124 49-1040, CODE 123

CIRCUIT DESCRIPTION

Philco Model 49-1278, Code 123 A or B, is a combination television receiver, AM-FM radio, and phonograph in a modern-style, console-type cabinet. The television receiver employs a 12-inch picture tube, and the phonograph section uses an M-9C Automatic Record Changer, designed with two turntable speeds and two tone arms, for playing either standard or new long-playing records.

Philco Model 49-1279, Code 122 A or B, is identical to Model 49-1278, Code 123 A or B, except for the cabinet. Model 49-1270, Code 122 A or B, is housed in a period-style, console-type cabinet.

Philco Model 49-1280, Code 121 A or B, is the same as Model 49-1278, Code 123 A or B, except that a custom-classical console-type cabinet is used, and the phonograph employs an M-12C Automatic Record Changer.

Philco Model 49-1076, Code 123 A or B, is similar to Model 49-1278, Code 123 A or B, except that a 10-inch picture tube is used, and the high-voltage power supply is designed to deliver a lower voltage.

Philco Model 49-1077, Code 122 A or B, is similar to Model 49-1279, Code 122 A or B, except that a 10-inch picture tube is used, and the high-voltage power supply is designed to deliver a lower voltage.

Philco Model 49-1240, Code 124 A or B, is a consolette television receiver with a chassis similar to the television chassis of Model 49-1278, Code 123 A or B. Provision is made for the connection of an external record player.

Philco Model 49-1040, Code 123 A or B, is similar to Model 49-1240, Code 124 A or B, except that the Receiver employs a 10-inch picture tube, which permits the use of a high-voltage power supply that delivers a lower voltage.

The chassis of the above models are identified as A or B, depending upon their coil complement. Chassis A includes coils for channels 2, 3, 4, 5, 7, 9, 11, and 13. Chassis B includes coils for channels 2, 3, 4, 5, 6, 8, 10, and 12.

TELEVISION-RECEIVER CHASSIS

RADIO-FREQUENCY CIRCUITS

The radio-frequency section is built on a subchassis, and incorporates a 6AG5 r-f amplifier, a 6AG5 mixer, and a 6J6 oscillator and oscillator-control tube. Connections are provided for the connection of both high-frequency and low-frequency aerials.

SOUND CIRCUITS

The sound section, the r-f section, and the first three video-i-f amplifiers, form an improved FM receiver. The sound-i-f signal is taken from the cathode of the third video-i-f amplifier, and is further amplified by two stages of sound-i-f amplification. The signal is then detected by a 6AL5 ratio detector, which provides a-f-c voltage for the oscillator-control tube, and audio voltage for the 6AU6 audio amplifier. This amplifier drives a 6K6GT, which delivers up to 2.5 watts to the p-m speaker.

VIDEO CIRCUITS

The video section is comprised of four i-f stages, a 6AL5 detector, and two stages of video amplification. One section of the 6AL5 is used as an a-v-c (automatic-video-control) rectifier. An a-v-c switch is incorporated to switch the a.v.c. on or off, depending on local receiving conditions. The video output is applied across a d-c restorer to the grid of the picture tube.

SWEEP CIRCUITS

A portion of the composite video signal is taken from the video-output stage, and is amplified by the sync pre-amplifier. Sync pulses are separated from the rest of the composite video signal by a sync-separator stage. Another amplifier inverts these pulses to a positive polarity. The vertical sync pulses are separated from the horizontal sync pulses in an integrating network and applied to the vertical blocking oscillator to control its frequency. The horizontal sync pulses are applied through a voltage divider made up of C509, C510, and C529C to the grid of a phase comparer.

The vertical-sweep circuit consists of a conventional blocking oscillator and a vertical output stage.

Horizontal-sweep voltage is generated by a blocking oscillator with a plate-tickler feedback arrangement. This tube also acts as a discharge tube during the time it is conducting. A sawtooth output of 15,750 cycles is produced as C513 is charged by the B+ voltage through R521 during the quiescent period of the oscillator, and is discharged through the triode during its conduction period. The blocking-oscillator transformer is tuned by C529A to approximately 200 kc., and produces a damped-wave train, which occurs 15,750 times per second. The first positive half cycle of each train occurs while the tube is conducting. Therefore, the discharge time for C513 is 1/100,000 second.

The blocking rate of the oscillator is determined by the r-c time constant of the grid circuit, the grid bias, and the plate voltage. If the grid bias is made more negative, C514 will require a longer period of time to discharge sufficiently for the tube to conduct. Fewer cycles will occur per second, and the blocking rate will be lowered. Conversely, if the grid bias is made less negative, each cycle will require less time, and the blocking rate will be increased.

The blocking rate determines the horizontal-sweep frequency, and is automatically controlled by a bias voltage from the phase-comparer triode. The horizontal sync pulses are applied to the grid of the phase comparer instead of the oscillator. Also applied to the grid of the phase comparer are the following voltages:

1. A negative d-c bias, developed at the grid of the oscillator and applied through R524.
2. A portion of the horizontal sawtooth voltage, fed from the output of the oscillator through R519 and C512.
3. A pulse voltage from the plates of the damper tube, applied through R533 and C519.

The d-c voltage biases the phase comparer, so that it is below cutoff except when the positive tips of the sawtooth voltage and sync pulse are applied to the grid. C529C controls the amplitude of both the sawtooth and pulse applied to this grid.

When the phase and frequency of both the sawtooth and pulse have the correct relationship to each other, the pulse appears during the sawtooth return time. See figure 1A. The voltage from the damper shapes the trailing edge of the sawtooth, so that a portion of the composite voltage of sawtooth plus pulse exceeds the cutoff voltage during part of the normal return time. Plate-current flow through R522 produces a pulsating d-c voltage across this resistor and is of the correct value to produce a 15,750-cycle blocking rate for the oscillator under ordinary conditions. C516, C517, and R527 filters this voltage and eliminates noise pulses.

Any tendency for the sweep to drift lower in frequency will immediately result in a greater portion of the sync pulse being presented to the phase comparer grid. See figure 1B. Consequently, plate current will be increased and the voltage across R522 will also be increased. This decrease in negative voltage on the grid of the oscillator will automatically raise its frequency.

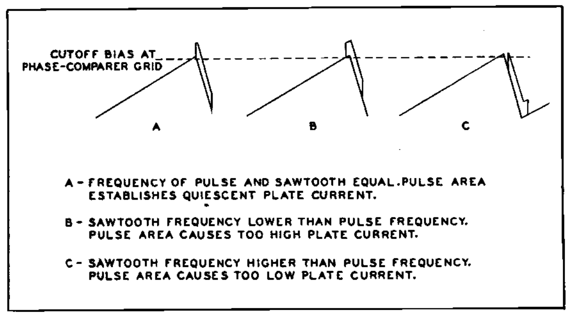


Figure 1. Variations in Waveforms at Phase Comparer Grid

Any tendency for the sweep to drift higher in frequency will instantly result in a smaller portion of the pulse being applied to the phase comparer grid. See figure 1C. The decreased plate current and decreased voltage across R522 will again correct the drift.

The sawtooth voltage across C513 is amplified by a 6BG6G horizontal output stage, and is applied across a damper tube to the horizontal deflection coils. C529B in the grid circuit of the horizontal output stage varies the amount of input applied to the grid.

POWER-SUPPLY CIRCUITS

In Models 49-1278, Code 123A or B, 49-1279, Code 122 A or B, 49-1280, Code 121 A or B, and 49-1240, Code 124 A or B, two 1B3GT rectifiers are used in a voltage-doubler circuit to supply high voltage to the picture tube. In Models 49-1076, Code 123 A or B, 49-1077, Code 122 A or B, and 49-1040, Code 123 A or B, one 1B3GT is used as a half-wave rectifier to supply this voltage.

In all models, a 5U4G full-wave rectifier and a 7Z4 full-wave rectifier supply plate and screen voltages for the rest of the tubes on the television chassis.

RADIO CHASSIS

For AM reception, a built-in loop is normally used. An external AM broadcast aerial may be used if required. For FM reception, the built-in line-cord aerial may be used by plugging the lead into J900; the television dipole aerial may be used by plugging the transmission line from WS1 into J900.

ADJUSTING THE RECEIVER

RADIO AND PHONOGRAPH

After the Receiver has been properly located and the aerial connected, turn the television OFF-ON-VOLUME control to OFF. Then turn the radio OFF-ON-TONE control to ON, and follow the operating procedure given in the user's instructions. Turn the band (BC-FM-PHONO) switch to PHONO, and follow the procedure for proper adjustment and operation given in the user's instructions.

TELEVISION

Provisions are made for connecting separate h-f and l-f television aerials. The upper terminal board is the h-f-aerial input, and the lower terminal board is the l-f-aerial input. Connect the aerials to the proper terminals, and operate the receiver as follows:

1. Turn the television OFF-ON-VOLUME control to ON, and allow the Receiver to warm up for about five minutes.

2. Rotate the BRIGHTNESS control to its maximum clockwise position. Set the beam bender so that the arrow points toward the high-voltage-anode connection on the picture tube. Then move the beam bender forward and backward, to the left and right, until maximum brilliance is obtained over the entire face of the tube. Turn the BRIGHTNESS control counterclockwise, so that the effect of the beam-bender adjustment can be observed.

After the beam-bender adjustment is completed, leave a raster of low brilliance on the face of the picture tube. Check the position of the deflection yoke to make sure that it is all the way forward against the bell of the tube.

3. Set the AVC ON-OFF switch to the ON position, and the CONTRAST and VOLUME controls to approximately three-quarters of maximum. Turn the Philco Precision Channel Selector to a station, preferably one showing a test pattern. Remove the channel-selector knobs, and adjust the oscillator tuning core until the sound is clearly heard and a picture appears on the screen.

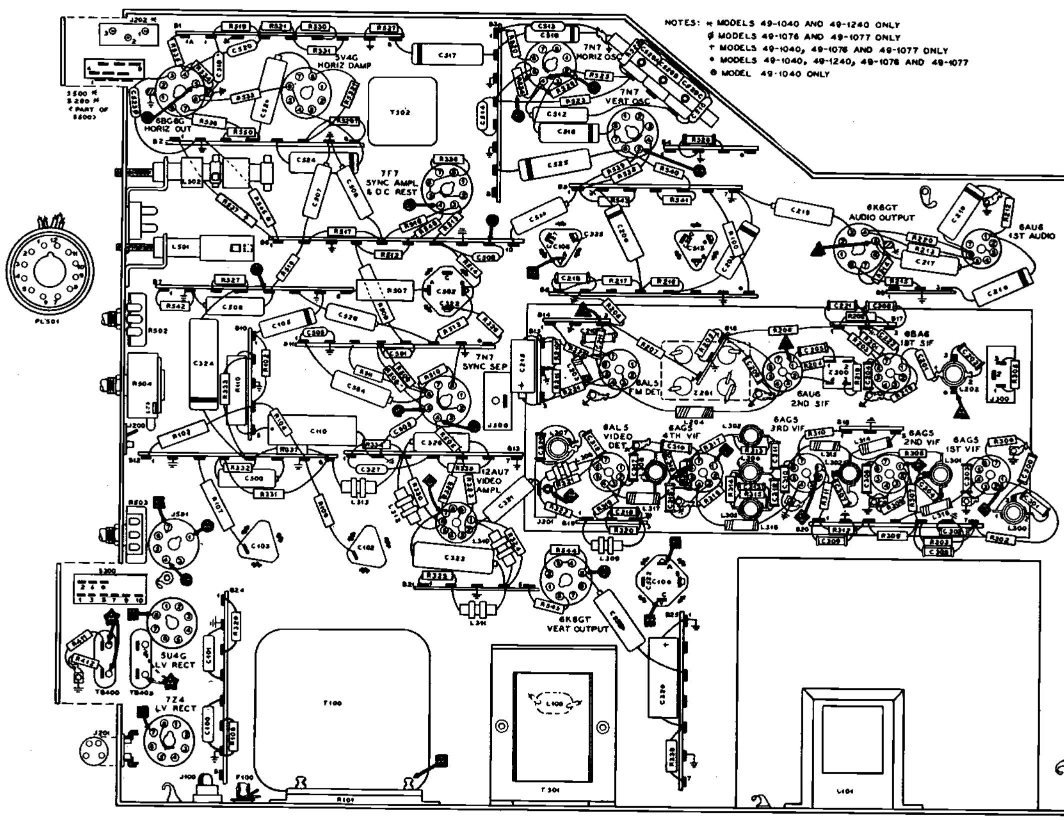


Figure 2. Bottom View of Television Chassis

4. Adjust the VERT. HOLD control (center knob of dual control on front of Receiver) to the center of the range through which the picture is vertically stationary.

5. Set the HORIZ. HOLD control (bar of dual control) to the center of the range through which the picture is horizontally stationary.

6. Adjust the FOCUS control for a sharp, well-defined picture.

7. If the edges of the picture are not parallel to the mask, loosen the deflection-yoke clamp and position the yoke so that the edges of the picture are parallel to the mask. Keep the yoke all the way forward. Then, tighten the clamp.

8. If the picture is not perfectly centered, loosen the two hex-head bolts on the bar of the centering wobble plate. Move the centering wobble plate back and forth for proper vertical centering, and up and down for proper horizontal centering. Tighten the bolts.

9. Adjust the CONTRAST and BRIGHTNESS controls for a pleasing range of grays. These controls are dependent upon each other in determining the strength and clarity of the picture.

10. Adjust the HEIGHT control until the picture covers the face of the tube vertically.

11. Adjust the VERT. LIN. control for a symmetrical vertical pattern.

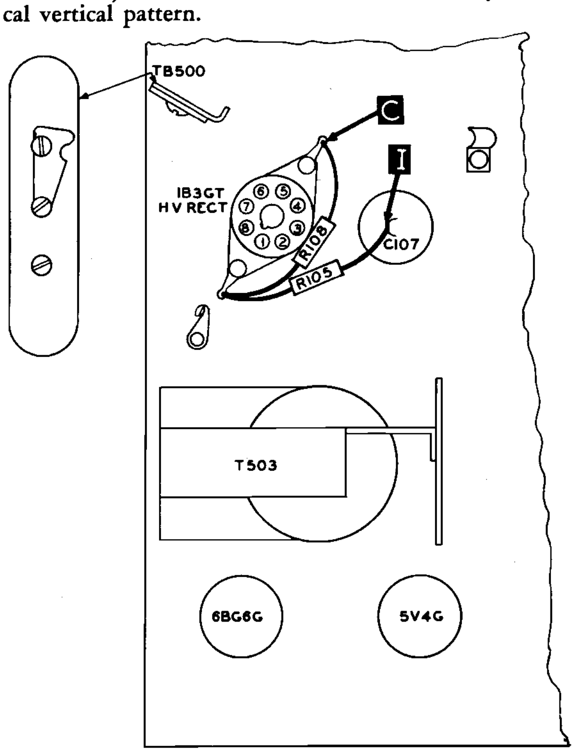


Figure 3. Top View of Television Chassis for 10-Inch Models, Showing High-Voltage Power Supply

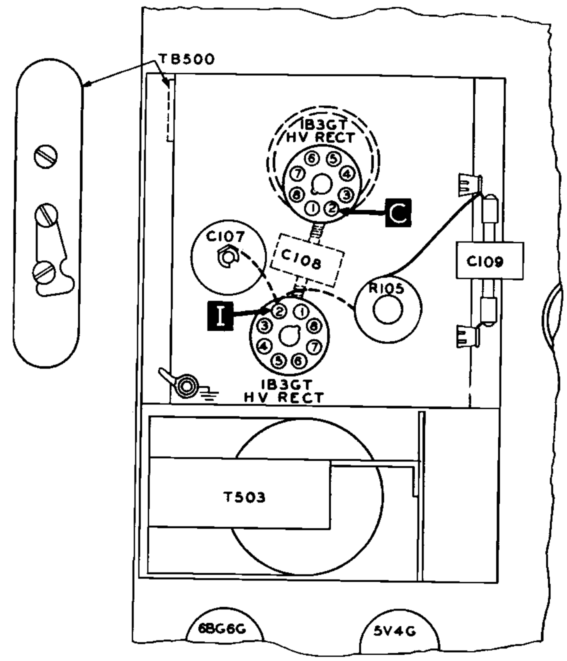


Figure 4. Top View of Television Chassis for 12-Inch Models, Showing High-Voltage Power Supply

12. Repeat steps 10 and 11 until no further improvements are obtained.

13. Adjust the WIDTH control, until the picture covers the face of the tube horizontally. If further adjustment is required, the taps on the width-adjustment-coil assembly may be switched by changing the link located on TB500. The downward position of the link affords the greatest width. The WIDTH control is used for the fine adjustment, regardless of the position of the link.

14. Adjust the HORIZ. LIN. control for a symmetrical horizontal pattern.

15. Repeat steps 13 and 14 until no further improvement is obtained.

16. Before adjusting the frequency of the local oscillator, allow the Receiver to warm up for at least 20 minutes. Connect a 20,000-ohms-per-volt, d-c voltmeter to the A-F-C TEST jack. Remove the Philco Precision Channel Selector knobs. Turn the core of the oscillator coil in a clockwise direction for a positive voltage indication; then turn it in a counterclockwise direction for a negative indication. Note the zero or crossover point. Adjust the core for a .5-volt indication in the positive direction.

17. Repeat the adjustment in step 16 for each station in the area. Replace the Philco Precision Channel Selector knobs.

18. Check all stations with the AVC ON-OFF switch in both the ON and the OFF positions, to determine which position gives the best over-all results. In normal

locations and for average signal strength, leave the AVC ON-OFF switch in the ON position. In noisy locations, peaks of noise may produce such a high a-v-c voltage that the resulting bias on the i-f amplifiers will cause the loss of a few lines of picture information. In locations where there is an exceptionally strong signal, the amplifiers may become overloaded. In either case, leave the AVC ON-OFF switch in the OFF position. In this position, a-v-c action is removed and the CONTRAST control is switched so that, in effect, it governs the over-all gain of the r-f stage and the first three stages of video-i-f amplification. This arrangement gives very good control over a wide range of signal strengths, although the CONTRAST control will probably require readjustment for each station received.

19. Reset the BRIGHTNESS and CONTRAST controls if necessary. See step 9.

20. Make certain that the VERT. HOLD and HORIZ. HOLD controls are adjusted correctly. Recheck all other control adjustments for the best picture quality.

21. Replace the cabinet back and the Philco Precision Channel Selector knobs.

22. Misadjust the Receiver by use of the front-panel controls, then bring it back to normal. At the same time, explain to the owner the function, purpose, and correct sequence of adjustment of each control.

23. Give the owner the instruction booklet; request him to read it carefully, and to practice operating all

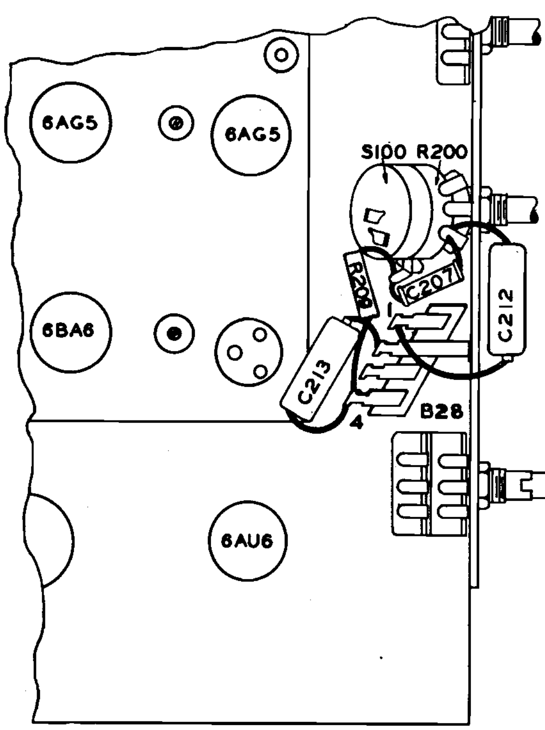


Figure 5. Top View of Television Chassis for Television Receiver Models, Showing Volume Control and Associated Parts

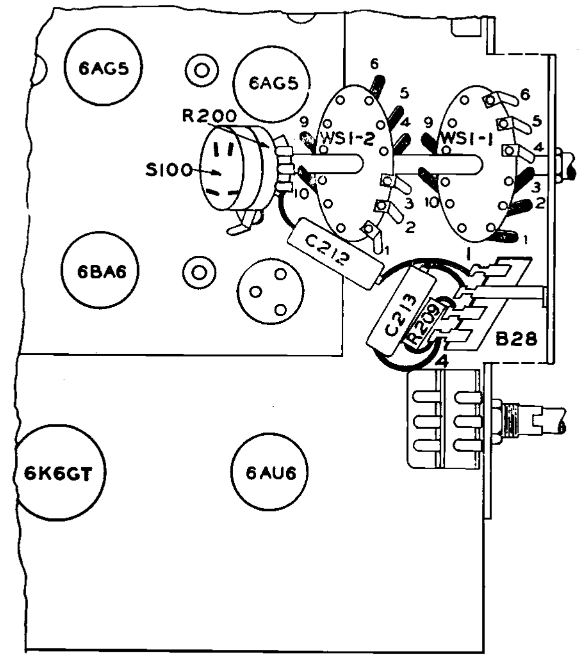


Figure 6. Top View of Television Chassis for Television-Radio-Phonograph Models, Showing Volume Control and Wafer Switch

front-panel controls. Specifically emphasize that only those on the front should be touched.

24. Turn the television OFF-ON-VOLUME control to OFF.

HORIZONTAL-HOLD ADJUSTMENT

Ordinarily, the range of the HORIZ. HOLD control potentiometer is sufficient to compensate for normal variations and provide horizontal synchronization. If for some reason, such as replacement of tubes or components, synchronization cannot be obtained within the range of the HORIZ. HOLD control, make the following horizontal-hold adjustment:

1. Preset the adjustments as follows:

a. Frequency trimmer C529A, 1½ turns counterclockwise from the maximum clockwise position.

b. Drive trimmer C529B, 2 turns counterclockwise from the maximum clockwise position.

c. Lock-in trimmer C529C, ½ turn counterclockwise from the maximum clockwise position.

d. HORIZ. HOLD control, to approximately the center of its range.

2. Tune in a station, and adjust TC500 until the picture is brought into sync.

3. Turn the AVC OFF-ON switch to OFF, and adjust the CONTRAST control for normal contrast.

4. Turn the HORIZ. HOLD control fully clockwise.

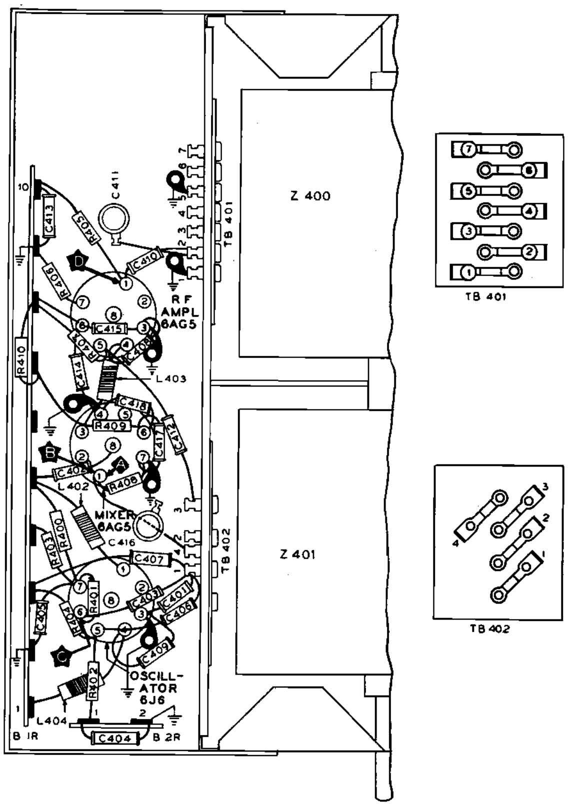


Figure 7. Top View of Tuner Unit, Cover Removed

5. Adjust TC500 until 8 to 10 stationary blanking bars appear, sloping downward from the left side of the picture tube. If this cannot be accomplished, turn C529A another full turn counterclockwise, and repeat this step.

6. Turn the HORIZ. HOLD control counterclockwise until the picture is brought into sync; continue to rotate this control until the picture falls out of sync. In some cases, the picture will not go out of sync, even though the HORIZ. HOLD control is turned to its extreme counterclockwise position. If this is the case, turn the CONTRAST control counterclockwise until the picture is removed; then turn it clockwise until the picture reappears out of sync.

7. Slowly turn the HORIZ. HOLD control clockwise, and note the change in the number of blanking bars on the picture tube. The number of bars should decrease as the sync position is approached. Just before the picture falls into sync, there should be 3½ to 4½ bars, sloping upward from the left side of the picture tube. If there are more than 4½ bars, turn C529C another 1/4 turn clockwise, and repeat steps 4, 5, 6, and 7. If there are less than 3½ bars, turn C529C another 1/4 turn counterclockwise, and repeat steps 4, 5, 6, and 7.

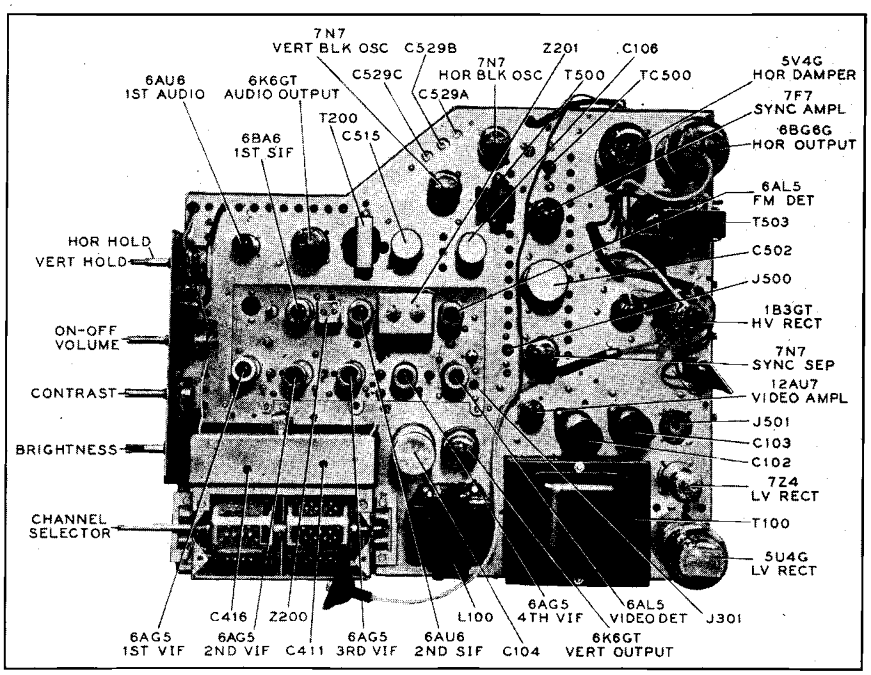


Figure 8. Top View of Television Chassis

PHILCO TROUBLE-SHOOTING PROCEDURE

The Philco trouble-shooting procedure for television receivers and television-radio-phonograph combinations is logical, thorough, and easy to follow.

In a combination which contains two separate receiver chassis, make an operational check on both chassis to determine in which the trouble is located or whether the trouble is common to both.

Both receiver schematics are divided into sections as follows:

TELEVISION-RECEIVER CHASSIS

Power-supply circuits	Section 1
Sound circuits	Section 2
Video circuits	Section 3
R-f circuits	Section 4
Sweep circuits	Section 5

RADIO CHASSIS

The radio chassis is divided into four sections, but data on these sections will not be included in this manual.

In the procedure, master test points are given for localizing trouble to a particular section. Additional test points are provided for isolating trouble to the faulty stage. After the faulty stage has been determined, locate the defective part as follows:

1. Test the tube, or substitute another one known to be good.

2. If the tube is not defective, measure the tube-electrode voltages, and compare them with those given on the schematic diagram to determine the faulty circuit.

3. Measure circuit resistances, and substitute condensers until the defective part is located. Correct the trouble before testing further.

PRELIMINARY CHECKS

To avoid possible damage to the receiver, the following checks should be made, and any trouble revealed should be corrected before either the television receiver or the radio is turned on:

1. Inspect both the tops and bottoms of the chassis. Make sure that all tubes are secure and in the proper sockets. Look for any broken or shorted connections, burned resistors, and other obvious indications of trouble.

2. On the television-receiver chassis, measure the resistance between test point **D** and ground, and test point **G** and ground. After the filter condensers have had time to charge, the resistance at test point **D** should not be less than 2000 ohms and the resistance at test point **G** should not be less than 3000 ohms. If lower readings are obtained, check the filter condensers for leakage or shorts.

On the radio chassis, measure the resistance between test point **C** and the B– bus. If the reading obtained is lower than 3000 ohms, check the filter condensers.

The resistance values given are much lower than normal and do not represent quality checks of the filter condensers. The values given are the lowest at which the rectifier will operate safely while trouble-shooting tests are being performed.

3. If the complaint indicates that the receiver may be turned on without risk of further damage, make an operational check on each chassis.

TROUBLE SHOOTING — TELEVISION RECEIVER

POWER-SUPPLY CIRCUITS — SECTION 1

WARNING: Use extreme caution when making high-voltage measurements in this section. Turn the receiver OFF, and discharge the high-voltage circuit with a well-insulated wire and hooded test clips. Connect the meter. Then turn the receiver ON, and read the voltage.

The following test equipment is required for trouble shooting this section:

1. 20,000-ohms-per-volt d-c voltmeter
2. 10,000-volt multiplier
3. 20,000-volt multiplier

Turn the OFF-ON VOLUME control fully clockwise, and set the BRIGHTNESS control fully counterclockwise. To connect a-c power when the high-voltage shield is open, use line cord and plug Part No. 41-3865.

Make all voltage measurements with a 20,000-ohms-per-volt d-c voltmeter. To measure high voltages between 6000 and 10,000 volts, use a 10,000-volt multiplier with the voltmeter. To measure voltages over 10,000 volts, use a 20,000-volt multiplier with the voltmeter.

To determine whether there is trouble in this section, make the tests (see figure 9) at master test point **A**, **B**, and **C**, consecutively, unless the indication at one of these test points is abnormal. If the indication at test point **A** is abnormal, proceed with the tests at test points **D**, **E**, and **F**. If the indication at test point **B** is abnormal, proceed with the tests at test points **G** and **H**. If the indication at test point **C** is abnormal, proceed with the test at test point **I**. If the indications at all master test points are normal, proceed with the tests for Section 2.

TROUBLE SHOOTING — TELEVISION RECEIVER

POWER-SUPPLY CIRCUITS — SECTION 1 (Cont.)

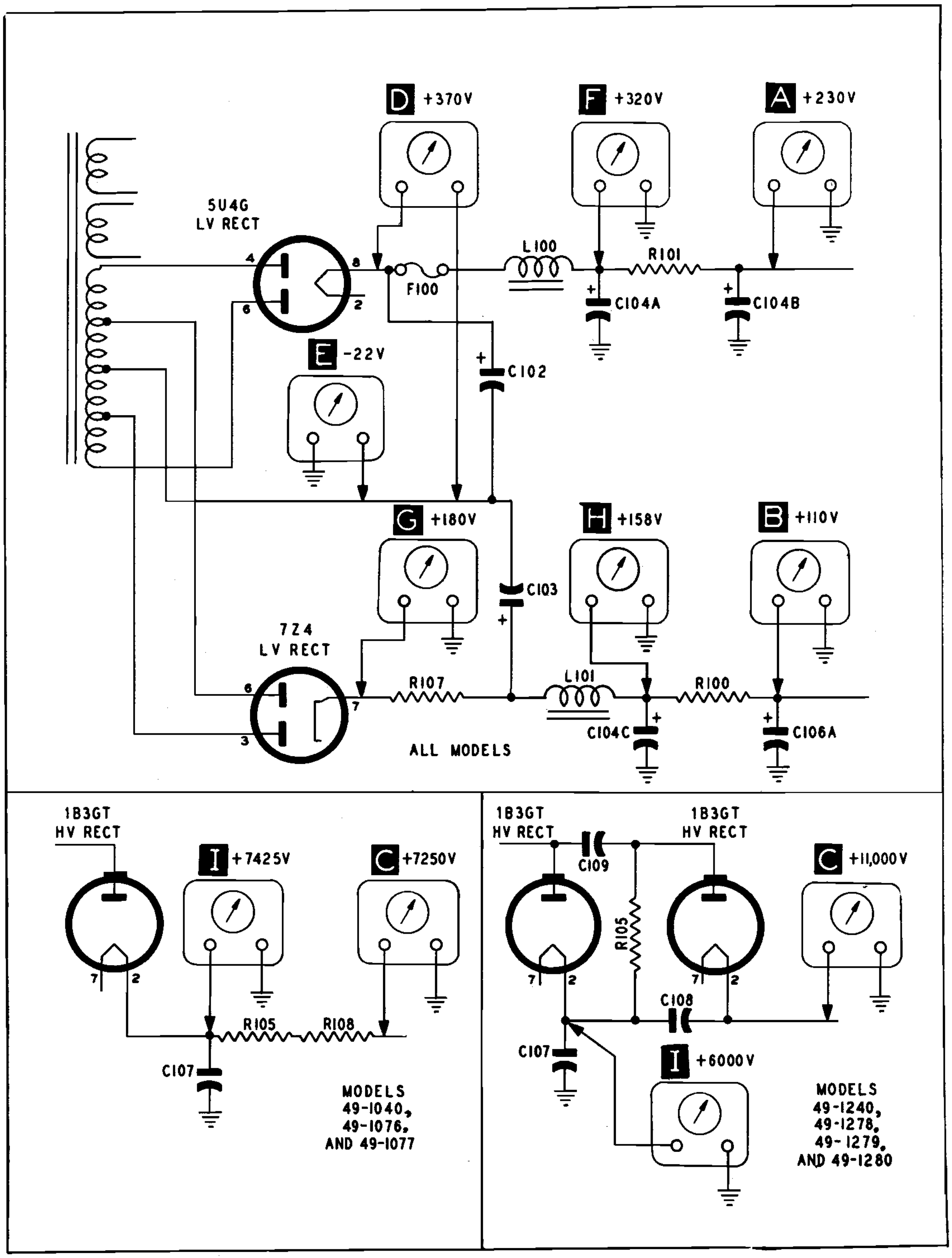


Figure 9. Simplified Trouble-Shooting Diagram for Section 1

TROUBLE SHOOTING — TELEVISION RECEIVER

SOUND CIRCUITS — SECTION 2

The following test equipment is required for trouble shooting this section:

1. R-f signal generator capable of supplying a 22.1-mc. signal modulated with 400 cycles
2. Audio signal generator
3. .1-mf. condenser

Turn the OFF-ON VOLUME control fully clockwise.

To determine whether there is trouble in this section, make the test at master test point A first. See figure 10. If the indication is normal, proceed with the tests for Section 3; if not, proceed with the test at test point B. If the indication for test point B is abnormal, proceed with the test at test point C to isolate the faulty stage. If the indication for test point B is normal, proceed with the test at test point D to isolate the faulty stage.

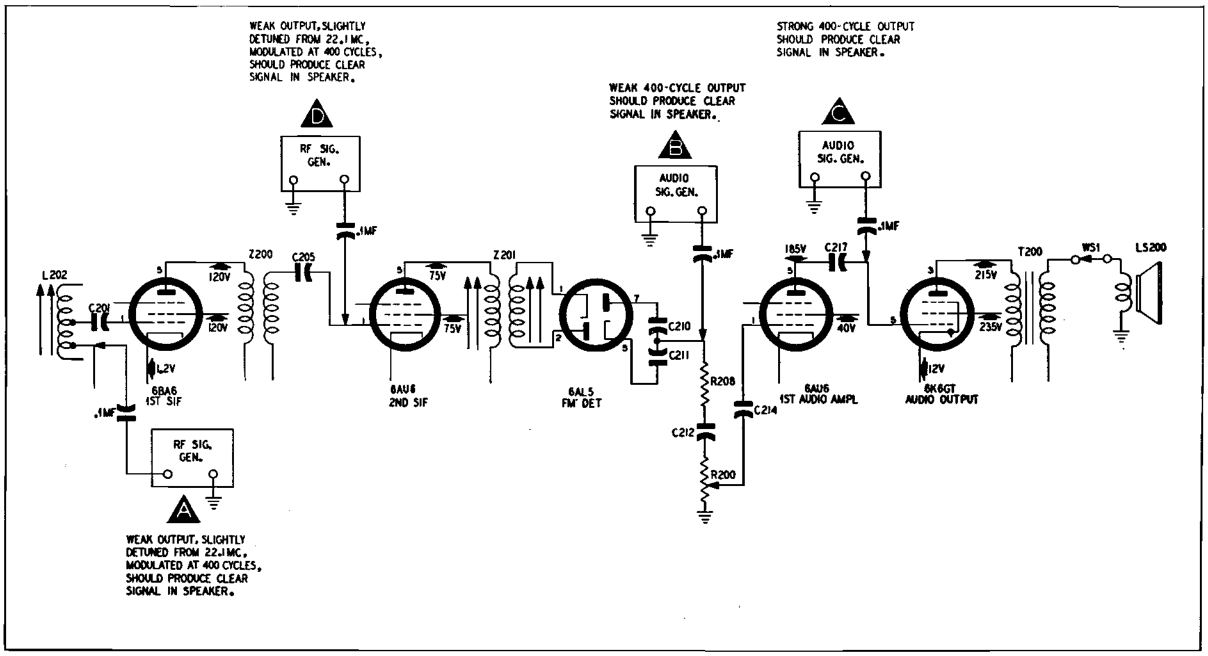


Figure 10. Simplified Trouble-Shooting Diagram for Section 2

TROUBLE SHOOTING — TELEVISION RECEIVER

VIDEO CIRCUITS — SECTION 3

The following test equipment is required for trouble shooting this section:

1. R-f signal generator capable of supplying a 24-mc. signal modulated with 400 cycles
2. R-f signal generator capable of supplying a 100-kc. signal
3. .1-mf. condenser
4. 20,000-ohms-per-volt d-c voltmeter

Turn the CONTRAST control fully clockwise, and set the AVC ON-OFF switch to ON.

To determine whether there is trouble in this section, make the test at master test point A first. See figure 11. If the indication is normal, proceed with the tests for Section 4; if not, make the test at master test point B. If the indication for test point B is normal, proceed with the test at test point C to isolate the faulty stage. If the indication for test point B is abnormal, proceed with the tests at test point D, E, F, and G, in alphabetical order, until the faulty stage is isolated.

TROUBLE SHOOTING — TELEVISION RECEIVER

VIDEO CIRCUITS — SECTION 3 (Cont.)

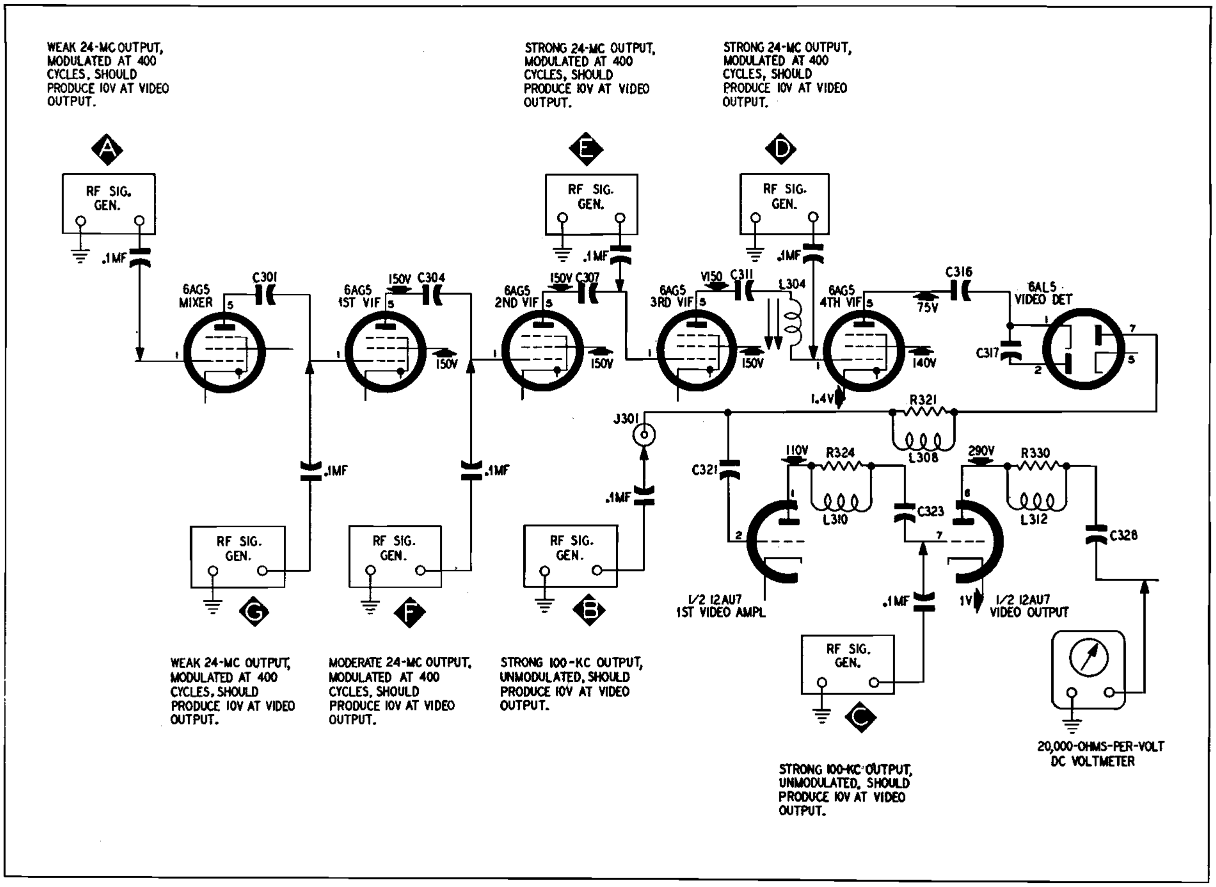


Figure 11. Simplified Trouble-Shooting Diagram for Section 3

TROUBLE SHOOTING — TELEVISION RECEIVER

R-F CIRCUITS — SECTION 4

The following test equipment is required for trouble shooting this section:

1. R-f signal generator capable of supplying signals (modulated with 400 cycles) covering the frequencies of the television channels
2. 10-mmf. condenser
3. 20,000-ohms-per-volt d-c voltmeter
4. 120,000-ohm resisto.·

Set the channel selector control to the channel which appears to be giving trouble. If the trouble is common to all channels, it may be set to any channel. Turn the CONTRAST control fully clockwise, and set the AVC ON-OFF switch to ON.

To determine whether there is trouble in this section, make the test at master test point A. See figure 12. If the indication is normal, proceed with the tests for Section 5; if not, proceed with the tests at test points B, C, and D, in alphabetical order, until the faulty stage is isolated.

TROUBLE SHOOTING — TELEVISION RECEIVER

R-F CIRCUITS – SECTION 4 (Cont.)

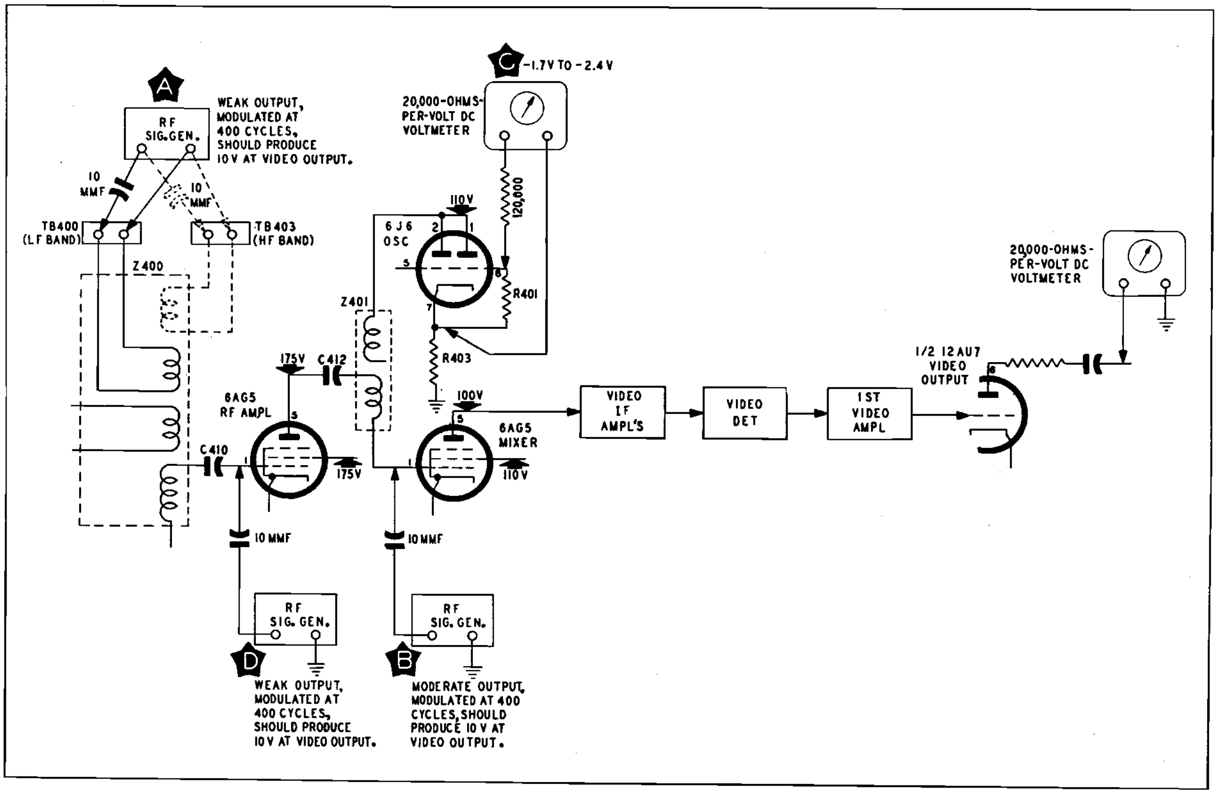


Figure 12. Simplified Trouble-Shooting Diagram for Section 4

TROUBLE SHOOTING — TELEVISION RECEIVER

SWEEP CIRCUITS – SECTION 5

WARNING: Use extreme caution when making high-voltage measurements in this section. Turn the receiver OFF, and discharge the high-voltage circuit with a well-insulated wire and hooded test clips. Connect the oscilloscope, and then turn the receiver ON.

A cathode-ray oscilloscope is required for trouble shooting this section. For viewing wave forms in the vertical sync and sweep circuits, adjust the oscilloscope sweep to 30 c.p.s. (one half the vertical sweep rate). For viewing wave forms in the horizontal sync and sweep circuits, adjust the oscilloscope sweep to 7875 c.p.s. (one half the horizontal sweep rate).

The wave forms given in figure 13 indicate the correct shapes, but are not intended to illustrate relative amplitudes. The approximate peak-to-peak voltage is given under each wave form. The peak-to-peak voltages for the wave forms in the sync circuits were obtained with the CONTRAST control adjusted to give 1 volt peak-to-peak at VIDEO TEST jack J301, and with all other controls set for normal operation.

To determine whether there is trouble in this section, observe the picture-tube screen. If there is no horizontal sweep, make the test at master test point Ⓐ. See figure 13. If there is no vertical sweep, make the test at master test point Ⓑ. If there is a lack of either vertical or horizontal sync, make the tests at master test points Ⓒ and Ⓓ

If the indication for the test at test point Ⓐ is abnormal, proceed with the tests at test points Ⓔ, Ⓕ, and Ⓖ to isolate the faulty stage. If the indication for test point Ⓑ is abnormal, proceed with the tests at test points Ⓗ and Ⓘ to isolate the faulty stage. If the indication for either test point Ⓒ or Ⓓ is abnormal, proceed with the tests at test points Ⓙ, Ⓚ, and Ⓛ to isolate the faulty stage.

TROUBLE SHOOTING — TELEVISION RECEIVER

SWEEP CIRCUITS — SECTION 5 (Cont.)

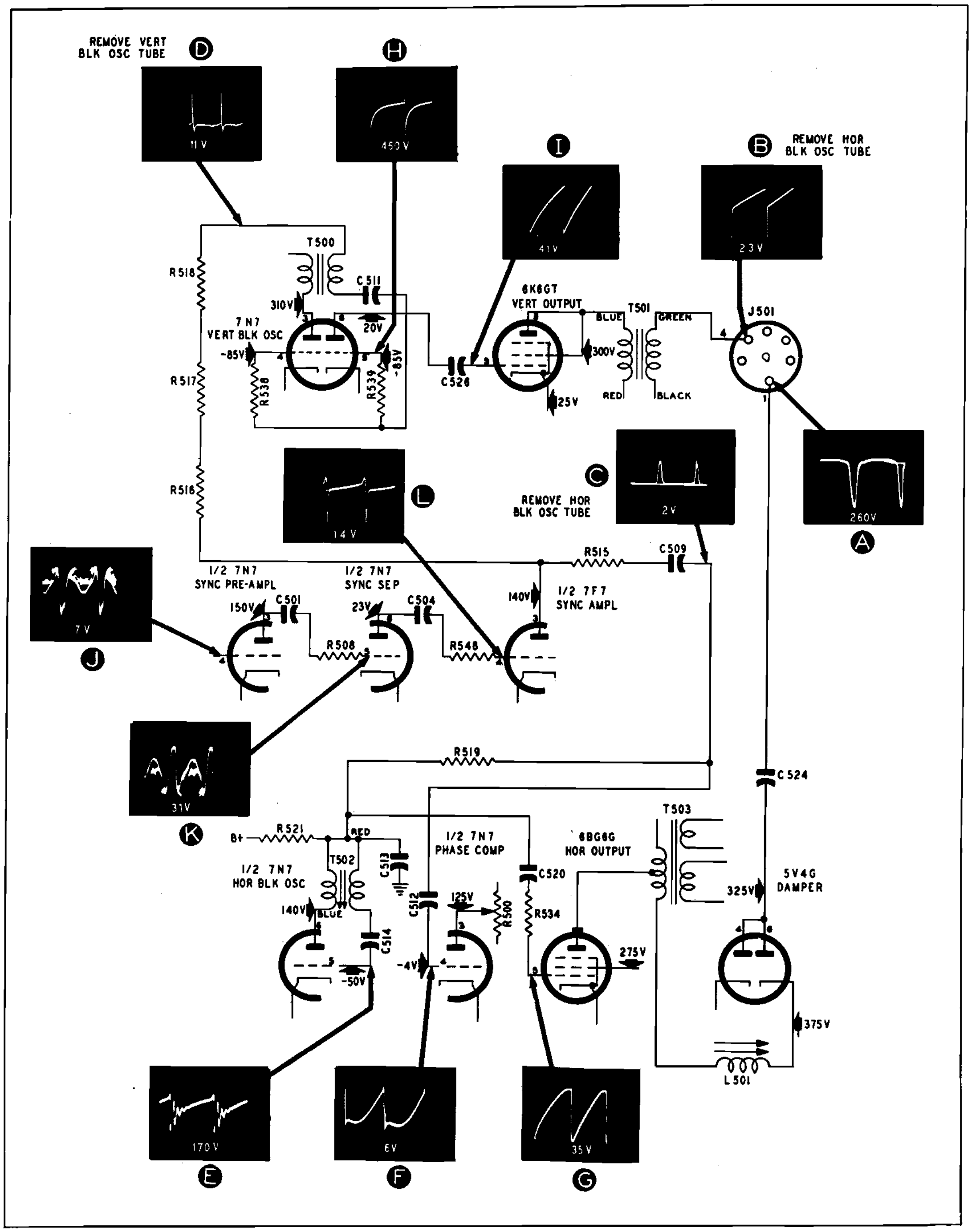
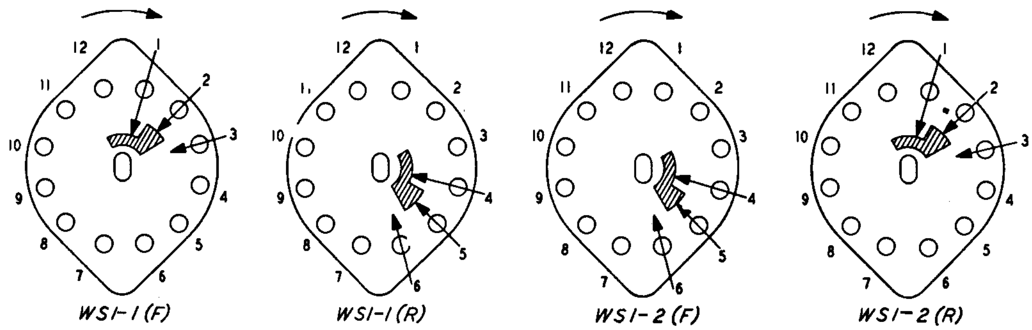
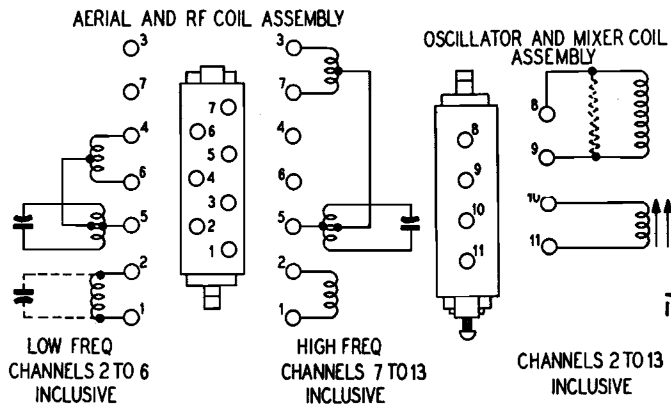
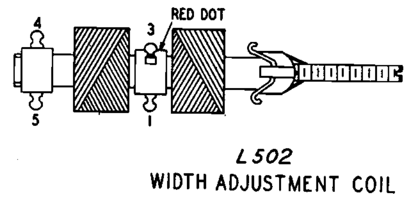


Figure 13. Simplified Trouble-Shooting Diagram for Section 5



RADIO-TELEVISION WAFER SWITCH (PART OF OFF-ON VOLUME CONTROL) SHOWN IN RADIO POSITION AS VIEWED FROM FRONT WITH CHASSIS INVERTED.
WAFERS SYMBOLIZED WS1-1 AND WS1-2 FROM FRONT TOWARD REAR.
(F) INDICATES CONTACTS ON FRONT OF WAFER LOOKING FROM FRONT.
(R) INDICATES CONTACTS ON REAR OF WAFER LOOKING FROM FRONT.





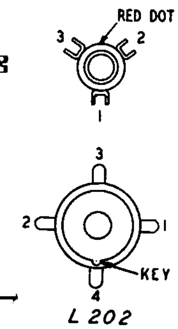
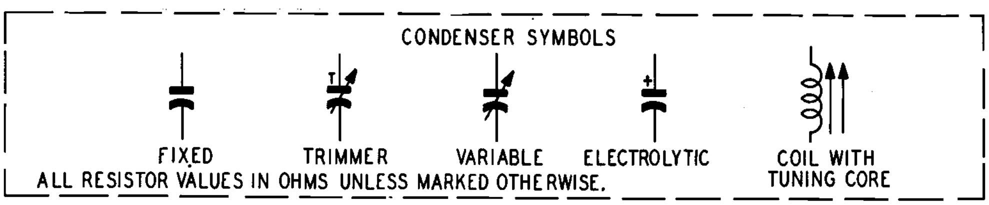


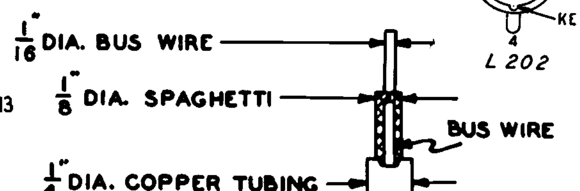
Figure 14A. Wafer Switches, Notes, Tuners, etc.

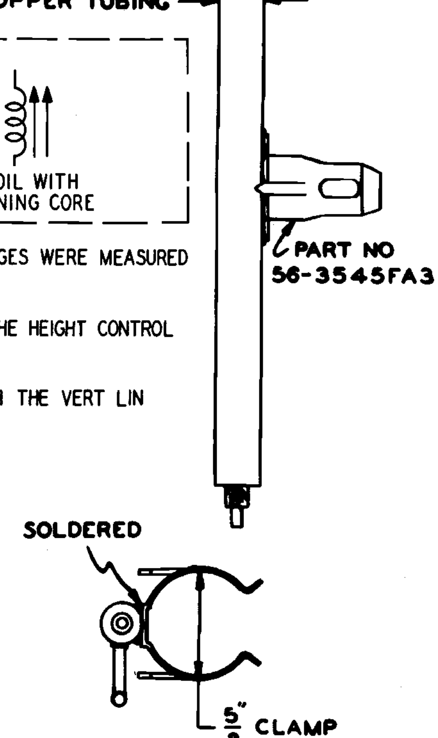


NOTE: VOLTAGES GIVEN AT THE PINS OF THE VIDEO-AMPLIFIER AND VIDEO-OUTPUT STAGES WERE MEASURED WITH THE CONTRAST CONTROL FULLY CLOCKWISE.

VOLTAGES GIVEN AT THE PINS OF THE VERTICAL OSCILLATOR WERE MEASURED WITH THE HEIGHT CONTROL FULLY CLOCKWISE.

VOLTAGES GIVEN AT THE PINS OF THE VERTICAL-OUTPUT STAGES WERE MEASURED WITH THE VERT LIN CONTROL FULLY CLOCKWISE.





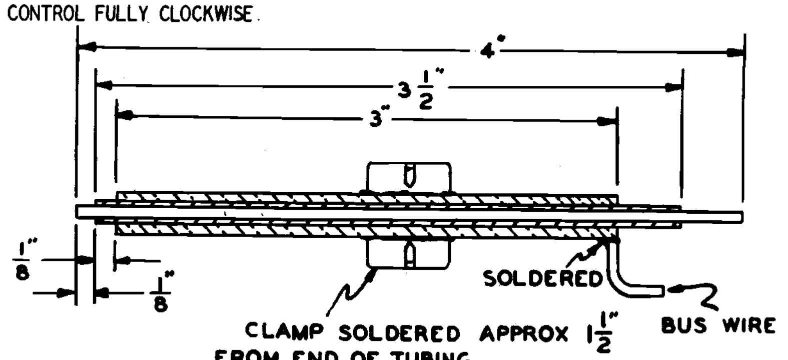


Figure 15. I-F Alignment Jig

TELEVISION RECEIVER ALIGNMENT

WARNING! Dangerous potentials are present in the receiver when it is operating and for a short time after it has been turned off.

GENERAL

The intermediate frequencies for the television chassis are 22.1 mc. for the sound channel and 26.6 mc. for the video channel. Alignment of circuits operating at these high frequencies requires careful workmanship and good equipment.

1. Top of work bench must be metallic, and the test equipment and television-receiver chassis must make a good metal-to-metal contact with the bench top.

2. During alignment, the signal-generator output should be attenuated to keep the output indication below 2 volts, peak-to-peak.

3. Never disconnect the picture tube, picture-tube yoke, or speaker while the television receiver is turned on.

4. Allow the television receiver and test equipment to warm up for 15 minutes before proceeding with the alignment.

5. Insert a 10,000-ohm resistor in series with the oscilloscope lead.

6. If additional attenuation of the marker signal is required, insert a 10,000-ohm resistor in series with the output lead of Model 7008 Visual Alignment Generator.

7. Set the television controls as follows:

   a. OFF-ON-VOLUME control fully clockwise.

   b. AVC ON-OFF switch to OFF.

   c. CONTRAST control fully clockwise. (When starting the alignment, it may be necessary to retard the CONTRAST control slightly to prevent regeneration.)

   d. BRIGHTNESS control to give a dim raster.

8. Preset C200A and C200B fully clockwise.

TEST EQUIPMENT REQUIRED FOR TELEVISION ALIGNMENT AND ADJUSTMENTS

The following test equipment is recommended for aligning the television receiver:

1. Philco Precision Visual Alignment Generator for Television and FM, Model 7008; this instrument has the following features:

FM signal generator — Ranges, 4—120 mc., and 144—260 mc., with a maximum deviation of 15 mc.

AM (marker) signal generator — Ranges, 3.2—7.5 mc., 6.4—15 mc., 14.5—36 mc., 69—125 mc., and 138—250 mc.

Built-in oscilloscope — Sensitivity, 25 millivolts; 3-inch cathode-ray tube; crosshatch screen.

2. Vacuum-tube voltmeter or a 20,000-ohms-per-volt voltmeter.

3. If separate signal generators and oscilloscope are used, these instruments should have the following characteristics:

FM signal generator — Deviation, ± 4 mc.; center-frequency ranges, 20 mc. to 30 mc.; sweep-sync output with either built-in or separate phase corrector.

AM signal-generator — Carrier frequency ranges, 20 mc. to 30 mc.; dial should be suitable for setting and resetting accurately to the frequencies specified in the ALIGNMENT CHART.

Oscilloscope — Calibrated; vertical sensitivity of 1 volt (peak-to-peak) per inch, or better.

NOTE: When using a separate AM r-f signal generator to obtain marker pips, couple the output lead of this generator to the output lead of the FM generator, using just sufficient coupling to obtain a suitable pip.

ALIGNMENT JIGS

Figure 17 shows a jig which is recommended for coupling the signal generator to the mixer grid, to provide short connections and good grounding. To construct this jig, remove the coil form and windings from an oscillator snap-in coil, Philco Part No. 32-4222. Solder in a length of coaxial cable, as shown in figure 17. To use this jig, insert it into an empty compartment in the mixer-oscillator section of the turret tuner. Rotate the turret until the contact points on the jig are engaged with the oscillator-mixer contact panel.

Figure 15 shows a jig which is recommended for coupling the signal generator to the various i-f grids. The following parts are necessary for the construction of this jig.

1. 3-inch length of 1/4-inch-diameter tubing
2. 3½-inch length of 1/8-inch-diameter spaghetti
3. 4-inch length of No. 12 or No. 14 bus wire
4. Clamp, Philco Part No. 56-3545FA3

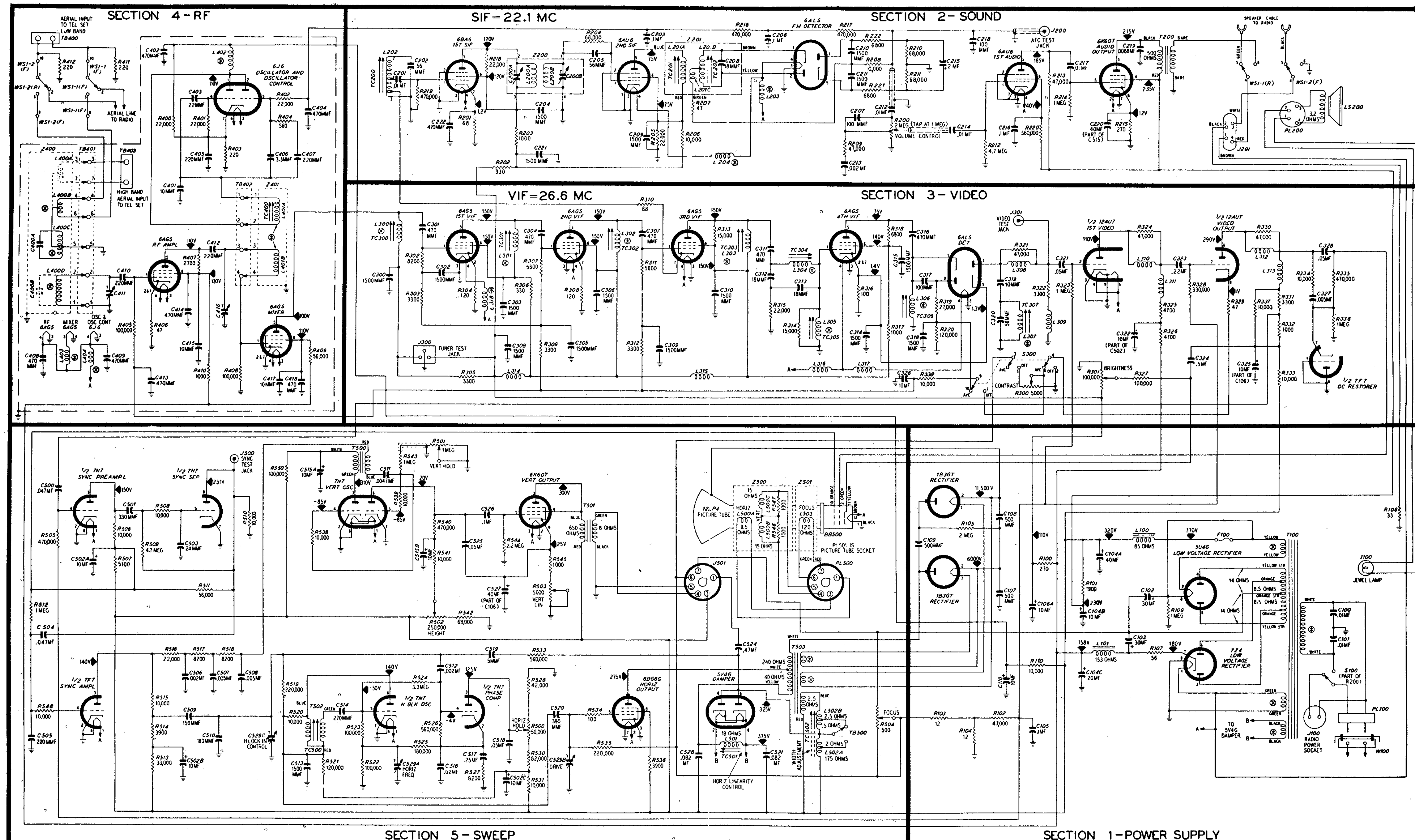


Figure 14. Model 49-1278, Code 123, Complete Sectionalized Television Schematic Diagram

Construct the jig as follows:

1. Insert the spaghetti into the tubing. Allow 1/8 inch to extend from one end of the tubing.

2. Insert the bus wire into the spaghetti. Allow 1/8 inch to extend from one end of the spaghetti.

3. Crimp one end of the tubing to secure the spaghetti and bus wire.

4. Solder the clamp to the middle of the tubing.

5. If Model 7008 Visual Alignment Generator is used, solder a short piece of bus wire to the tubing to provide a convenient ground connection for the output-cable terminating box.

The connections to the video-i-f amplifier grids are available, from the top of the chassis, through small holes near the tube shields. To use the jig, slide the clamp over the tube shield, and insert the probe end of the jig into the hole; adjust the height to insure good contact with the grid connection.

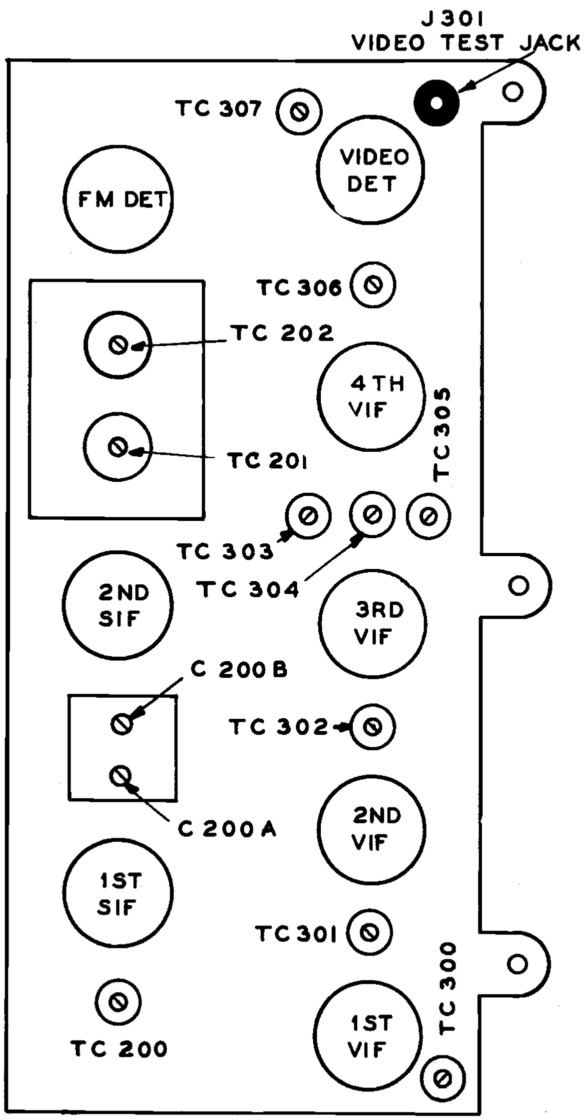


Figure 16. I-F Strip, Showing Trimmer Locations

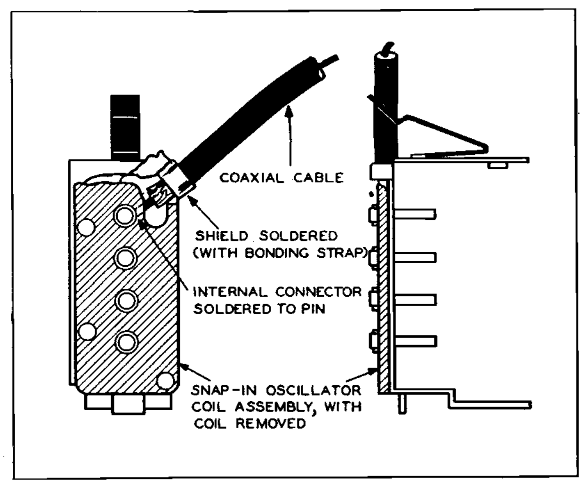


Figure 17. Mixer Alignment Jig

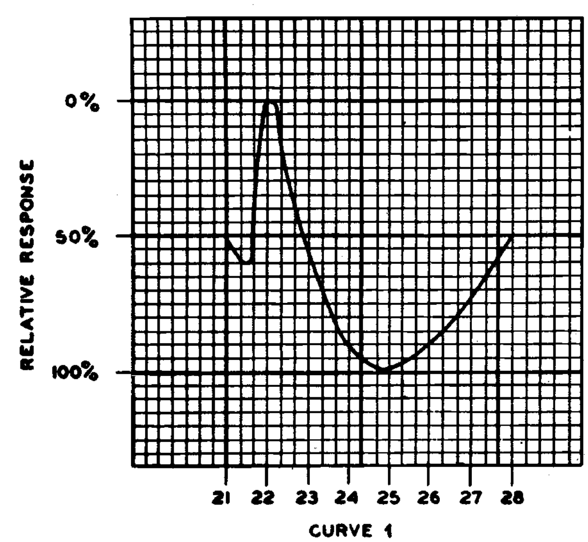


Figure 18. Response Curve for 4th Video-I-F Stage

TELEVISION ALIGNMENT CHART

VIDEO I-F

STEP	SIGNAL-GENERATOR CONNECTION	OUTPUT-INDICATOR CONNECTION	SIGNAL-GENERATOR SETTING	SPECIAL INSTRUCTIONS	AD-JUST
1	Connect output of AM signal generator through i-f jig to grid (pin 1) of 4th video-i-f tube.	Connect vertical input of oscilloscope to ALIGN TEST jack J301.	Set AM generator to 22.1 mc. (modulated).	Adjust TC307 for minimum indication.	TC307
2	Connect outputs of AM and FM signal generators through i-f jig to grid (pin 1) of 4th video-i-f tube.	Same as step 1.	Set FM generator to 25 mc. ± 4 mc. deviation. Set AM generator (unmodulated) to 24.9 mc. to produce a marker pip on response curve.	Adjust TC306 for curve similar to figure 18.	TC306
3	Connect output of AM signal generator through i-f jig to grid (pin 1) of 3rd video-i-f tube.	Same as step 1.	Set generator (modulated) to 28.1 mc.	Adjust TC304 for minimum indication.	TC304
4	Connect outputs of AM and FM signal generators through i-f jig to grid (pin 1) of 3rd video-i-f tube.	Same as step 1.	Set FM generator to 25 mc. ± 4 mc. deviation. Set AM generator to 23.9 mc. to produce marker pip on response curve.	Adjust TC303 and TC305 for curve similar to figure 19.	TC305 TC303
5	Connect output of AM signal generator through i-f jig to grid (pin 1) of 2nd video-i-f tube.	Same as step 1.	Same as step 1.	Adjust TC200 for minimum indication.	TC200
6	Connect outputs of AM and FM signal generators through i-f jig to grid (pin 1) of 2nd video-i-f tube.	Same as step 1.	Set FM generator to 25 mc. ± 4 mc. deviation. Set AM generator to 26.3 mc. (unmodulated) to produce marker pip on response curve.	Adjust TC302 for curve similar to figure 20.	TC302
7	Connect outputs of AM and FM signal generators through i-f jig to grid (pin 1) of 1st video-i-f tube.	Same as step 1.	Set FM generator to 25 mc. ± 4 mc. deviation. Set AM generator to 25.8 mc. (unmodulated) to produce marker pip on response curve.	Adjust TC301 for curve similar to figure 21.	TC301
8	Connect outputs of AM and FM signal generators through mixer jig to grid (pin 1) of mixer tube.	Same as step 1.	Set FM generator to 25 mc. ± 4 mc. deviation. Set AM generator to 23 mc., 24 mc., 25.2 mc., and 26.6 mc. to produce marker pips on response curve as required.	Adjust TC300 for curve similar to figure 22. It may be necessary to readjust TC301, TC302, TC303, and TC305 in order to obtain this curve.	TC300

SOUND I-F

9	Same as step 8.	Connect vertical input of oscilloscope to AFC TEST jack J200.	Set FM generator to 22.1 mc., ± 1 mc. deviation. Set AM generator (modulated) to 22.1 mc.	Adjust C200A and C200B slightly counterclockwise until an indication is observed on the oscilloscope.	C200A C200B
10	Same as step 8.	Same as step 9.	Same as step 9.	Adjust TC202 for minimum amount of AM indication (see note). Adjust TC201 for symmetrical pattern (equal peaks).	TC202 TC201
11	Same as step 8.	Same as step 9.	Set FM generator to 22.1 mc., ± 1 mc. deviation. Turn AM generator OFF.	Adjust C200A and C200B for maximum peaks and symmetrical pattern.	C200A C200B

TELEVISION ALIGNMENT CHART (Cont.)

FINAL I-F CHECK

STEP	SIGNAL-GENERATOR CONNECTION	OUTPUT-INDICATOR CONNECTION	SIGNAL-GENERATOR SETTING	SPECIAL INSTRUCTIONS	AD-JUST
12	Same as step 1.	Connect vertical input of oscilloscope to ALIGN TEST jack J301. Connect VTVM (0—10v range) to AFC TEST jack J200.	Set AM generator (modulated) to 22.1 mc. (minimum indication on oscilloscope).	When indication on oscilloscope is minimum, the VTVM reading should be zero. If reading is not zero, adjust TC202. If the adjustment requires more than one-half turn, repeat step 10.	TC202

NOTE: The AM signal will appear as a series of sine waves superimposed on the discriminator curve.

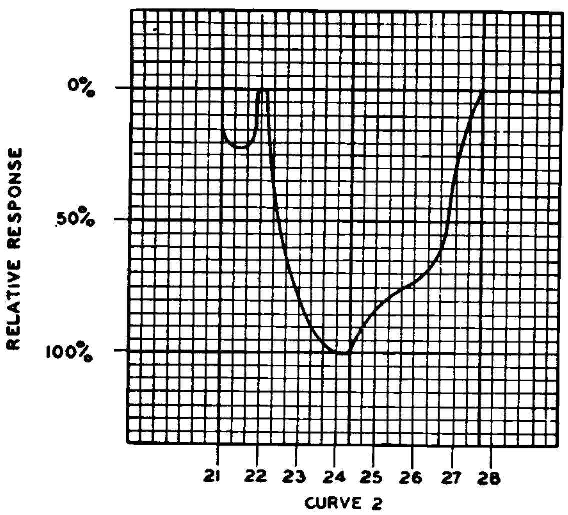


Figure 19. Response Curve for 3rd Video-I-F Stage

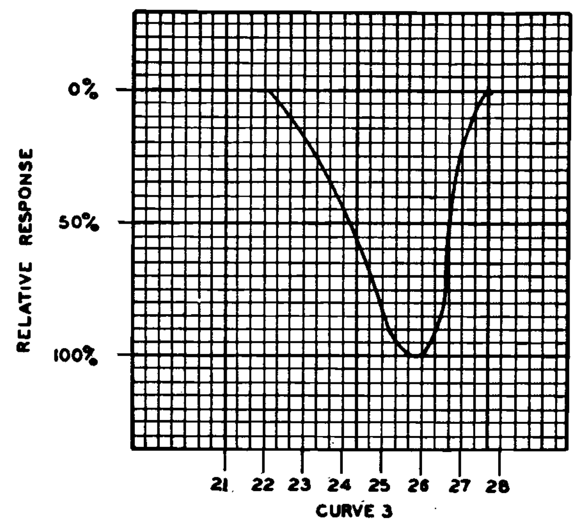


Figure 21. Response Curve for 1st Video-I-F Stage

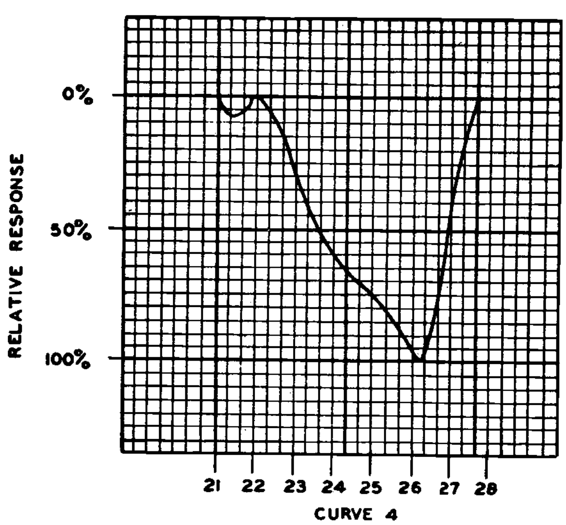


Figure 20. Response Curve for 2nd Video-I-F Stage

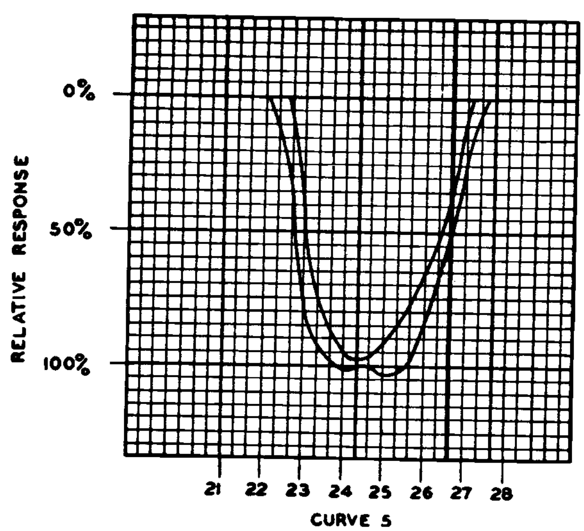


Figure 22. Over-all Video-Response Curve

Television Carrier Frequencies

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

USING THE ALIGNMENT CURVES

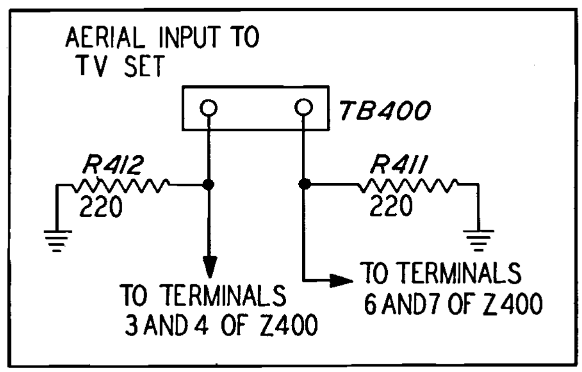
Figures 18, 19, 20, and 21 show the approximate i-f response curves that should be obtained at the VIDEO TEST jack when sweep signals are applied to the grids of the fourth, third, second, and first video-i-f grids, respectively. Figure 22 shows the over-all video-i-f curve, and gives the upper and lower limits of relative response at any frequency over its range. When the television receiver is properly aligned, all points on the over-all curve should fall between these limits.

Each curve is shown on a Crosshatch Screen, Philco Part No. 54-4545, from the Model 7008 Visual Alignment Generator. They are specifically drawn for convenient use with this equipment.

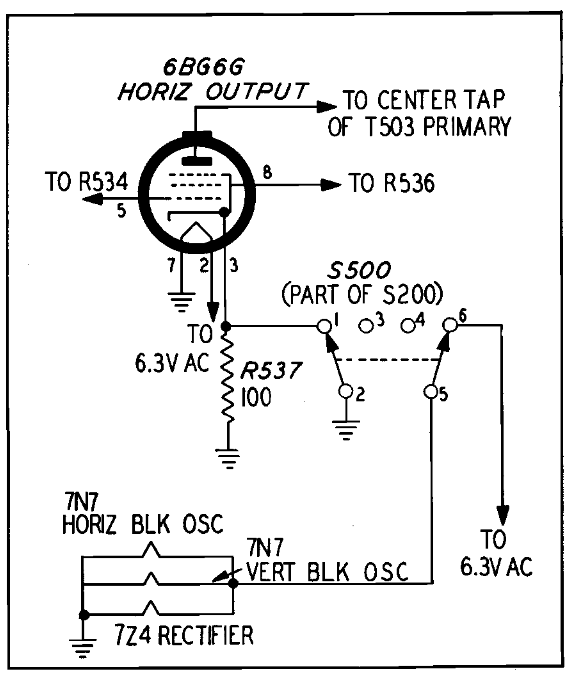
To use these curves with Model 7008, the sweep width and the centering and gain controls should be adjusted to give patterns which are proportional to the curves shown.

CIRCUIT VARIATIONS

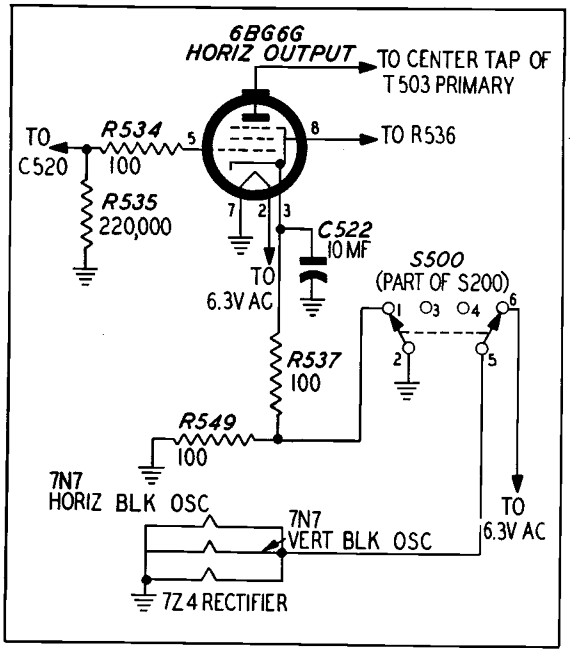
The television schematic diagram for Model 49-1278, Code 123, also applies to Models 49-1279, Code 122, and 49-1280, Code 121. The television circuits for Models 49-1040, Code 123, 49-1076, Code 123, 49-1077, Code 122, and 49-1240, Code 124, are similar to those for Model 49-1278, Code 123. Variations in the circuits are shown in the following schematic inserts. In addition, Models 49-1040, Code 123, 49-1076, Code 123, and 49-1077, Code 122, have a 15,000-ohm resistor R529 and an 18,000-ohm resistor R532 between pins 6 and 8 of the 5V4G damper tube.



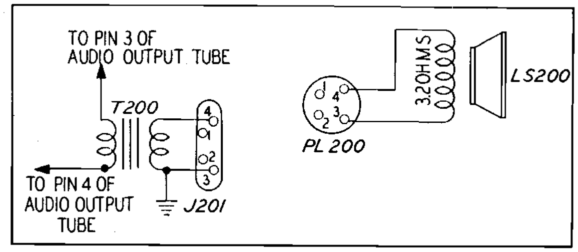
Model 49-1040, Code 123, and Model 49-1240, Code 124



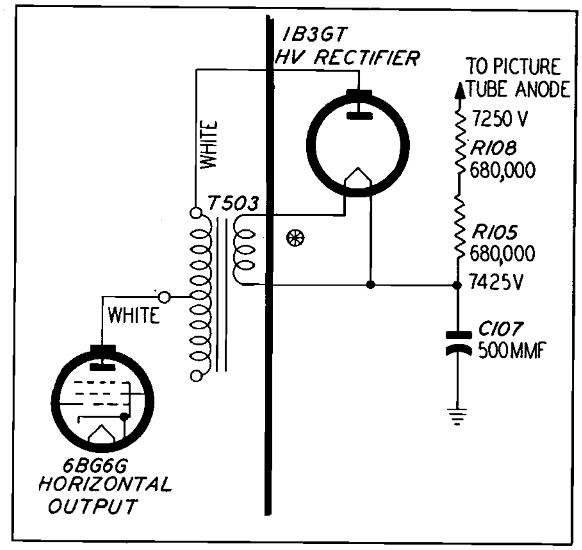
Model 49-1240, Code 124



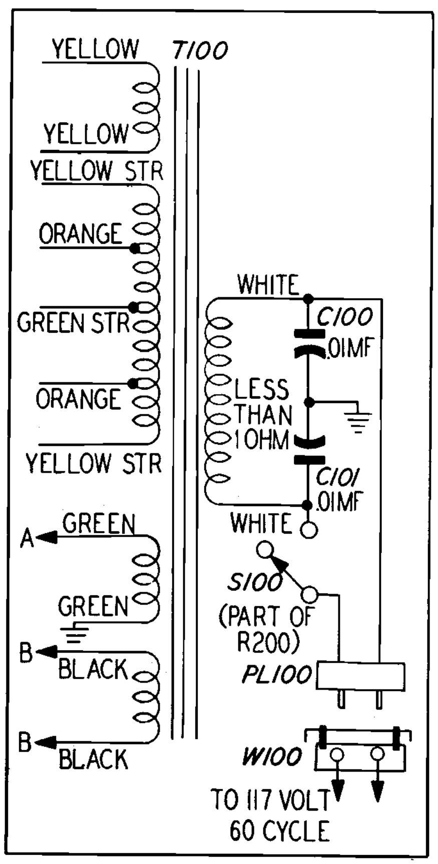
Model 49-1040, Code 123



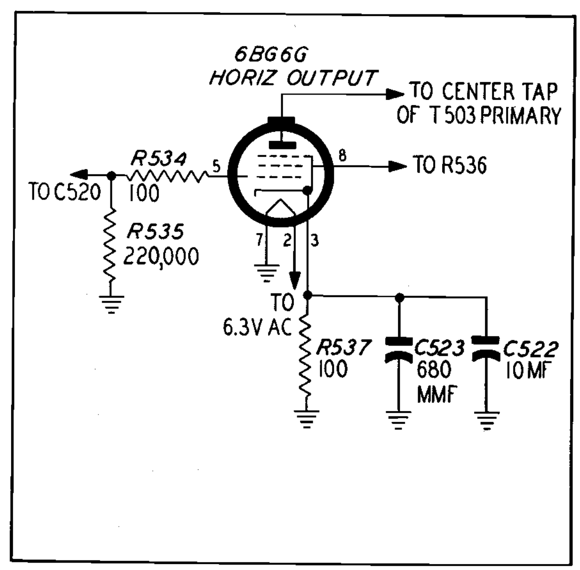
Model 49-1040, Code 123, and Model 49-1240, Code 124



Model 49-1040, Code 123, Model 49-1076, Code 123, and Model 49-1077, Code 122



Model 49-1040, Code 123, and Model 49-1240, Code 124



Model 49-1076, Code 123, and Model 49-1077, Code 122

MOST-OFTEN-NEEDED 1949 TELEVISION RECEIVERS

TELEVISION-RECEIVER CHASSIS

Model 49-1240, Code 124, Model 49-1278, Code 123, Model 49-1279, Code 122, and Model 49-1280, Code 121

RUN NO.	DESCRIPTION OF CHANGE	NEW OR ADDED PART NO.	OLD OR REMOVED PART NO.	REASON FOR CHANGE
2	C511 changed from .0047 mf. to .0056 mf.	45-3500-7	45-3502	To improve vertical sync.
3	.001-mf. condenser added in parallel with C419.	45-3500-5		To reduce video modulation in local oscillator.
4	150-mmf. condenser added between pin 6 of vertical-blocking-oscillator tube and ground.	60-10155407		To reduce hum radiation.
5	R538 changed from 10,000 ohms to 68,000 ohms.	66-3688340	66-3108340	To improve vertical linearity.

Model 49-1040, Code 123, Model 49-1076, Code 123, Model 49-1077, Code 122, Model 49-1240, Code 124, Model 49-1278, Code 123, Model 49-1279, Code 122, and Model 49-1280, Code 121

TUNER UNIT

RUN NO.	DESCRIPTION OF CHANGE	NEW OR ADDED PART NO.	OLD OR REMOVED PART NO.	REASON FOR CHANGE
2	Choke added in the B+ lead to the local oscillator, between the ungrounded end of C419 and the junction of L402 and C402.	32-4112-11		To reduce video modulation in local oscillator.
3	C401 changed to a special temperature-coefficient condenser.	30-1224-51	30-1224-39 or 62-010009001	To reduce local-oscillator drift.

I-F STRIP

RUN NO.	DESCRIPTION OF CHANGE	NEW OR ADDED PART NO.	OLD OR REMOVED PART NO.	REASON FOR CHANGE
2	R220, 6800-ohm resistor, added in the lead between the ungrounded end of R210 and the junction of C210 and pin 7 of the FM-detector tube.	66-2688340		To reduce harmonic beat.
2	R221, 6800-ohm resistor, added in the lead between the ungrounded end of R211 and the junction of C211 and pin 5 of the FM-detector tube.	66-2688340		To reduce harmonic beat.
3	L300 changed to an improved coil.	32-4359-4	32-4359-2	To increase video-i-f gain.
4	4.7-ohm resistor added in the lead between pin 3 of the FM-detector tube and ground.	66-9478340		To reduce hum.
5	C222, 470-mmf. condenser, added between pin 7 of the first sound-i-f tube and ground.	62-147001001		To increase sound-i-f gain.
6	10-mmf. condenser added in parallel with C303.	62-010009001		To prevent oscillation of video-i-f stage.
6	10-mmf. condenser added in parallel with C306.	62-010009001		To prevent oscillation of video-i-f stage.

Philco Models 49-1040, 49-1076, 49-1077, 49-1240, 49-1278, 49-1279, and 49-1280, are described on pages 131 to 150 of this manual. You will find Models 49-1075 and 49-1275 almost the same as the models described, while many other 1949 Philco television and television combinations are very similar in many respects to models described.

RCA VICTOR

TELEVISION RECEIVERS

MODELS 8T241, 8T243, 8T244

Chassis No. KCS28

Models 8T241, 8T243 and 8T244 are "10 inch" table model television receivers. These receivers employ twenty-one tubes plus 2 rectifiers and a 10BP4 kinescope. The receivers are identical except for cabinets.

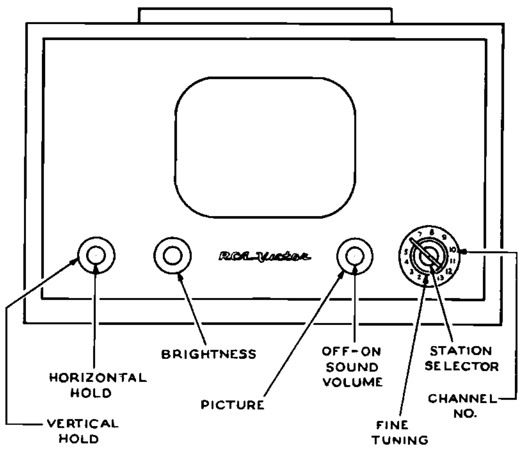


Figure 1—Receiver Operating Controls

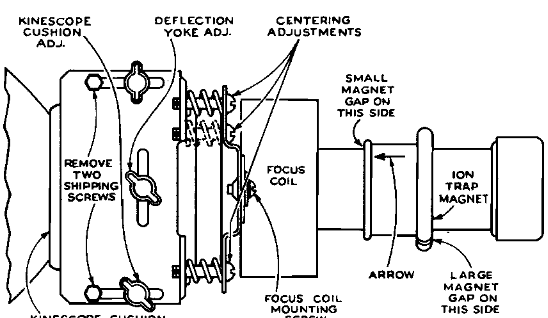


Figure 3—Yoke and Focus Coil Adjustments

ION TRAP MAGNET ADJUSTMENT.—Looking at the kinescope gun structure, it will be observed that the second cylinder from the base inside the glass neck is provided with two small metal flags, as shown in Figure 5.

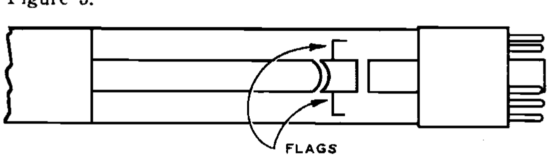


Figure 5—Ion Trap Flags

The ion trap rear magnet poles should be approximately over the ion trap flags. Starting from this position adjust the magnet by moving it forward or backward at the same time rotating it slightly around the neck of the kinescope for the brightest raster on the screen. Reduce the brightness control setting until the raster is slightly above average brilliance. Adjust the focus control (R191 on the chassis rear apron) until the line structure of the raster is clearly visible. Readjust the ion trap magnet for maximum raster brilliance. The final touches on this adjustment should be made with the brightness control at the maximum position with which good line focus can be maintained.

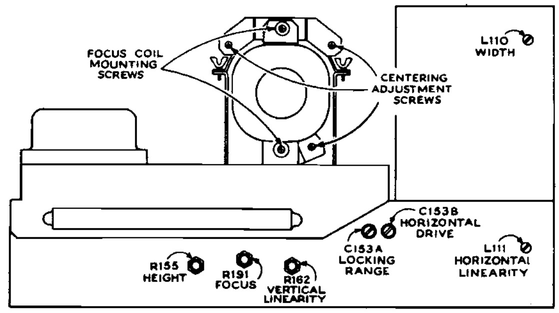


Figure 6—Rear Chassis Adjustments

DEFLECTION YOKE ADJUSTMENT.—If the lines of the raster are not horizontal or squared with the picture mask, rotate the deflection yoke until this condition is obtained. Tighten the yoke adjustment wing screw.

PICTURE ADJUSTMENTS.—It will now be necessary to obtain a test pattern picture in order to make further adjustments.

If the Horizontal Oscillator and AGC System are operating properly, it should be possible to sync the picture at this point. However if, the AGC threshold control is misadjusted, and the receiver overloading, it may be impossible to sync the picture.

If the receiver is overloading, turn R138, on top of the chassis, counter-clockwise until the set operates normally and the picture can be synced.

CHECK OF HORIZONTAL OSCILLATOR ALIGNMENT.—Turn the horizontal hold control to the extreme counter-clockwise position. The picture should remain in horizontal sync. Momentarily remove the signal by switching off channel then back. Normally the picture will be out of sync. Turn the control clockwise slowly. The number of diagonal black bars will be gradually reduced and when only 3 bars sloping downward to the left are obtained, the picture will pull into sync upon slight additional clockwise rotation of the control. Pull in should occur when the control is approximately 90 degrees from the extreme counter-clockwise position. The picture should remain in sync for approximately 90 degrees of additional clockwise rotation of the control. At the extreme clockwise position, the picture should be out of sync and should show 1 vertical or diagonal black bar in the raster.

If the receiver passes the above checks and the picture is normal and stable, the horizontal oscillator is properly aligned. Skip "Alignment of Horizontal Oscillator" and proceed with "Centering Adjustment."

ALIGNMENT OF HORIZONTAL OSCILLATOR.—If in the above check the receiver failed to hold sync with the hold control at the extreme counter-clockwise position or failed to hold sync over 90 degrees of clockwise rotation of the control from the pull in point, it will be necessary to make the following adjustments.

8T241, 8T243, 8T244

Horizontal Frequency Adjustment.—Turn the horizontal hold control to the extreme clockwise position. Tune in a television station and adjust the T109 horizontal frequency adjustment (under the chassis) until the picture is just out of sync and the horizontal blanking appears as a vertical or diagonal black bar in the raster.

Horizontal Lock in Range Adjustment.—Set the horizontal hold control to the full counter-clockwise position. Momentarily remove the signal by switching off channel then back. Slowly turn the horizontal hold control clockwise and note the least number of diagonal bars obtained just before the picture pulls into sync.

If more than 3 bars are present just before the picture pulls into sync, adjust the horizontal locking range trimmer C153A slightly clockwise. If less than 3 bars are present, adjust C153A slightly counter-clockwise. Turn the picture control counter-clockwise, momentarily remove the signal and recheck the number of bars present at the pull in point. Repeat this procedure until 3 bars are present.

Repeat the adjustments under "Horizontal Frequency Adjustment" and "Horizontal Locking Range Adjustment" until the conditions specified under each are fulfilled. When the horizontal hold operates as outlined under "Check of Horizontal Oscillator Alignment" the oscillator is properly adjusted.

If it is impossible to sync the picture at this point and the AGC system is in proper adjustment it will be necessary to adjust the Horizontal Oscillator by the method outlined in the alignment procedure.

CENTERING ADJUSTMENT.—No electrical centering controls are provided. Centering is obtained by mechanically orienting the focus coil with the three adjustment screws shown in Figure 3. Center the picture on the screen by adjustment of these screws. The focus coil should be concentric around the neck of the kinescope to prevent curvature of the raster.

FOCUS COIL ADJUSTMENTS.—If, after making the centering adjustments in the above paragraph, a corner of the picture is shadowed, it will be necessary to loosen the focus coil mounting screws (shown in Figure 3) and change the position of the coil to eliminate the shadow. Recenter the picture by adjustment of the centering screws.

Recheck the position of the ion trap magnet to insure that maximum brilliance is obtained.

HEIGHT AND VERTICAL LINEARITY ADJUSTMENTS.—Adjust the height control (R155 on chassis rear apron) until the picture fills the mask vertically (6⅜ inches). Adjust vertical linearity (R162 on rear apron), until the test pattern is symmetrical from top to bottom. Adjustment of either control will require a readjustment of the other. Adjust vertical centering to align the picture with the mask.

WIDTH, DRIVE AND HORIZONTAL LINEARITY ADJUSTMENTS.—Adjust the horizontal drive control C153B to give a picture of maximum width within the limits of good linearity. Adjust the horizontal linearity control L111 to provide best linearity. Adjust the width control until the picture just fills the mask.

Adjustments of the horizontal drive control affect horizontal oscillator hold and locking range. If the drive control was adjusted, recheck the oscillator alignment.

FOCUS.—Adjust the focus control (R191 on chassis rear apron) for maximum definition in the test pattern vertical "wedge" and best focus in the white areas of the pattern.

CHECK TO SEE THAT THE CUSHION AND YOKE THUMBSCREWS AND THE FOCUS COIL MOUNTING SCREWS ARE TIGHT.

AGC THRESHOLD CONTROL.—The AGC threshold control R138 is adjusted at the factory and normally should not require readjustment in the field.

To check the adjustment of the AGC Threshold Control, tune in a strong signal, sync the picture and turn the picture control to the maximum clockwise position. Turn the brightness control counter-clockwise until the vertical retrace lines are just invisible. Momentarily remove the signal by switching off channel then back. If the picture reappears immediately, the receiver is not overloading due to improper setting of R138. If the picture requires an appreciable portion of a second to reappear, R138 should be readjusted.

Set the picture control at the maximum clockwise position. Turn R138 fully counter-clockwise. The top one-half inch of the picture may be bent slightly. This should be disregarded. Turn R138 clockwise until there is a very, very slight bend or change of bend in the top one-half inch of the picture. Then turn R138 counter-clockwise just sufficiently to remove this bend or change of bend.

If the signal is very weak, the above method may not work as it may be impossible to get the picture to bend. In this case, turn R138 clockwise until the snow in the picture becomes more pronounced, then counter-clockwise until the best signal to noise ratio is obtained.

The AGC control adjustment should be made on a strong signal if possible. If the control is set too far clockwise on a weak signal, then the receiver may overload when a strong signal is received.

Replace the cabinet top. On Model 8T241, recheck picture centering after the top is replaced. Replace the cabinet back.

CHECK OF R-F OSCILLATOR ADJUSTMENTS.—Tune in all available stations to see if the receiver r-f oscillator is adjusted to the proper frequency on all channels. If adjustments are required, these should be made by the method outlined in the alignment procedure.

The adjustments for channels 2 through 5 and 7 through 12 are available from the front of the cabinet by removing the station selector escutcheon as shown in Figure 7. Adjustment for channel 13 is on top of the chassis and channel 6 adjustment is in the kinescope well. See Figures 11 and 12 for their location.

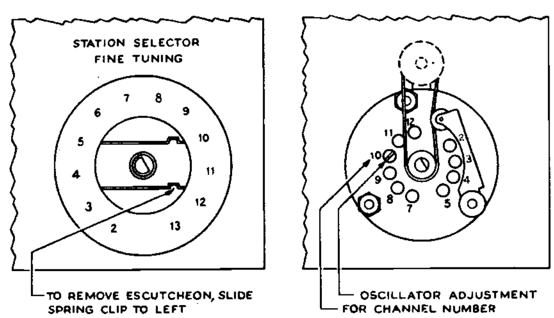


Figure 7—R-F Oscillator Adjustments

PICTURE I-F FREQUENCIES

Picture Carrier Frequency	25.75 Mc.
Adjacent Channel Sound Trap	27.25 Mc.
Accompanying Sound Traps	21.25 Mc.
Adjacent Channel Picture Carrier Trap	19.75 Mc.

SOUND I-F FREQUENCIES

Sound Carrier Frequency	21.25 Mc.
Sound Discriminator Band Width between peaks	350 kc

VIDEO RESPONSE .... To 4 Mc.

ALIGNMENT PROCEDURE

TEST EQUIPMENT.—To properly service the television chassis of this receiver, it is recommended that the following test equipment be available:

R-F Sweep Generator meeting the following requirements:

(a) Frequency Ranges
- 20 to 30 mc., 1 mc. and 10 mc. sweep width
- 50 to 90 mc., 10 mc. sweep width
- 170 to 225 mc., 10 mc. sweep width

(b) Output adjustable with at least .1 volt maximum.
(c) Output constant on all ranges.
(d) "Flat" output on all attenuator positions.

Cathode-Ray Oscilloscope, preferably one with a wide band vertical deflection, an input calibrating source, and a low capacity probe.

Signal Generator to provide the following frequencies.

(a) I-F frequencies
- 19.75 mc. adjacent channel picture trap
- 21.25 mc. sound i-f and sound traps
- 22.05 and 25.0 mc. conv. and first pix i-f trans.
- 25.9 mc. second picture i-f transformer
- 24.6 mc. fourth picture i-f transformer
- 22.0 mc. third picture i-f transformer
- 22.5 mc. fifth picture i-f transformer
- 25.75 mc. picture carrier
- 27.25 mc. adjacent channel sound trap

(b) R-F frequencies

Channel Number	Picture Carrier Freq. Mc.	Sound Carrier Freq. Mc.
2	55.25	59.75
3	61.25	65.75
4	67.25	71.75
5	77.25	81.75
6	83.25	87.75
7	175.25	179.75
8	181.25	185.75
9	187.25	191.75
10	193.25	197.75
11	199.25	203.75
12	205.25	209.75
13	211.25	215.75

(c) Output on these ranges should be adjustable and at least .1 volt maximum.

Heterodyne Frequency Meter with crystal calibrator if the signal generator is not crystal controlled.

Electronic Voltmeter of Junior "VoltOhmyst" type and a high voltage multiplier probe for use with this meter to permit measurements up to 10 kv.

Service Precautions.—If necessary to remove the chassis from cabinet, the kinescope must first be removed. See Figures 3 and 5. If possible, the chassis should then be serviced without the kinescope. However, if it is necessary to view the raster during servicing, the kinescope should be inserted only after the chassis is turned on end. The kinescope should never be allowed to support its weight by resting in the deflecting yoke. A bracket should be used to support the tube at its viewing screen.

By turning the chassis on end with the power transformer down, all adjustments will be made conveniently available. Since this is the only safe position in which the chassis will rest and still leave all adjustments accessible, the trimmer location drawings are oriented similarly for ease of use.

CAUTION: Do not short the kinescope second anode lead. Its short circuit current is approximately 3 ma. This represents approximately 9 watts dissipation and a considerable overload on the high voltage filter resistor R189.

Adjustments Required.—Normally, only the r-f oscillator line will require the attention of the service technician. All other circuits are either broad or very stable and hence will seldom require re-adjustment.

The oscillator line is relatively non critical. When oscillator tubes are changed, in all probability it will be necessary to adjust only C6 in order to bring the entire line into adjustment.

ORDER OF ALIGNMENT.—When a complete receiver alignment is necessary, it can be most conveniently performed in the following order:

(1) Sound discriminator
(2) Sound i-f transformers
(3) Picture i-f traps
(4) Picture i-f transformers
(5) R-F and converter lines
(6) R-F oscillator line
(7) 4.5 mc. video trap
(8) Sensitivity check

SOUND DISCRIMINATOR ALIGNMENT.—Set the signal generator for approximately .1 volt output at 21.25 mc. and connect it to the second sound i-f grid.

Detune T113 secondary (bottom).

Set the "VoltOhmyst" on the 10 volt scale.

Connect the meter in series with a one megohm resistor to the junction of diode resistors R203 and R204.

Adjust the primary of T113 (top) for maximum output on the meter.

Connect the "VoltOhmyst" to the junction of C183 and R203. Adjust T113 secondary (bottom). It will be found that it is possible to produce a positive or negative voltage on the meter dependent upon this adjustment. Obviously to pass from a positive to a negative voltage, the voltage must go through zero. T113 (bottom) should be adjusted so that the meter indicates zero output as the voltage swings from positive to negative. This point will be called discriminator zero output.

Connect the sweep oscillator to the grid of the second sound i-f amplifier.

Adjust the sweep band width to approximately 1 mc. with the center frequency at approximately 21.25 and with an output of approximately .1 volt.

Connect the oscilloscope to the junction of C183 and R203. The pattern obtained should be similar to that shown in Figure 15. If it is not, adjust the T113 (top) until the wave form is symmetrical.

The peak to peak band width of the discriminator should be approximately 350 kc. and it should be linear from 21.75 mc. to 21.325 mc.

SOUND I-F ALIGNMENT.—Connect the sweep oscillator to the first sound i-f amplifier grid.

Connect the oscilloscope to the second sound i-f grid return (terminal A T112) in series with a 33,000 ohm isolating resistor.

Insert a 21.25 mc. marker signal from the signal generator into the second sound i-f grid.

Adjust T112 (top and bottom) for maximum gain and symmetry about the 21.25 mc. marker. The pattern obtained should be similar to that shown in Figure 16.

The output level from the sweep should be set to produce approximately .3 volt peak-to-peak at the second sound i-f grid return when the final touches on the above adjustment are made. It is necessary that the sweep output voltage should not exceed the specified values otherwise the response curve will be broadened, permitting slight misadjustment to pass unnoticed and possibly causing distortion on weak signals.

The band width at 70% response from the first sound i-f grid to the second i-f grid should be approx. 200 kc.

PICTURE I-F TRAP ADJUSTMENT.—Connect the "VoltOhmyst" to the junction of R135 and R136.

Remove the 6SN7GT AGC Amplifier tube V107. Connect a 250,000 ohm potentiometer between pins 5 and 6 of the V107 socket. Adjust the potentiometer until the "VoltOhmyst" reads approximately -4.5 volts.

Set the channel switch to the blank position between channel numbers 2 and 13.

Connect the "VoltOhmyst" across the picture detector load resistor R119. Under this condition, both leads of the meter are at approximately -120 volts. In making this measurement, care should be taken not to touch the case of the meter or to permit the meter case to become grounded.

Connect the output of the signal generator to the grid of the converter tube V2. To do this, remove the tube from the socket and fashion a clip by twisting one end of a small piece of wire around pin number 1. Replace the tube in the socket leaving the end of the wire protruding from under the tube. Connect the signal generator to this wire through a 1,500 mmf capacitor keeping the leads as short as possible.

Set the generator to each of the following frequencies and with a thin fiber screwdriver tune the specified adjustment for minimum indication on the "VoltOhmyst." In each instance the generator should be checked against a crystal calibrator to insure that the generator is exactly on frequency

(1) 21.25 mc.—T103 (top)
(2) 21.25 mc.—T105 (top)
(3) 27.25 mc.—T102 (top)
(4) 27.25 mc.—T104 (top)
(5) 19.75 mc.—T106 (top)
(6) 19.75 mc.—T101 (top)

In the above transformers using threaded cores, it is possible to run the cores completely through the coils and secure two peaks or nulls. The correct position is with the cores in the outside ends of the coils. If the cores are not in the correct position, the coupling will be incorrect and it will be impossible to secure the correct response.

PICTURE I-F TRANSFORMER ADJUSTMENTS.—Set the signal generator to each of the following frequencies and peak the specified adjustment for maximum indication on the "VoltOhmyst." During alignment, reduce the input signal if necessary to prevent overloading.

22.5 mc.—T106 (bottom)
24.6 mc.—T104 (bottom)
22.0 mc.—T103 (bottom)
25.9 mc.—T102 (bottom)

T1 and T101 are coupled by a link and in combination constitute an overcoupled transformer. The characteristics of such a transformer are such that it is impossible to adjust it to a single frequency.

To sweep align T1 and T101, connect a 330 ohm composition resistor across the primary coils of T102, T103, T104 and T106.

Connect the "VoltOhmyst" to the junction of R135 and R136. Adjust the 250,000 ohm potentiometer for -2.0 volts on the meter.

Connect the oscilloscope to the plate of the first video amplifier, pin 1 of V106.

Connect a sweep generator to the converter grid through a 1,500 mmf capacitor. Set the generator to sweep from 20.0 mc. to 30.0 mc. and adjust the output to provide a 4 volt peak to peak signal on the scope.

Connect the signal generator loosely to the converter grid and adjust to provide markers at 21.95 mc. and 24.8 mc.

Adjust T1 (top) and T101 (bottom) to obtain the response shown in Figure 17. The T1 core must penetrate to the terminal board end of the coil in order to obtain the correct response.

Remove the 330 ohm resistors from across T102, T103, T104 and T106.

Adjust the 250,000 ohm potentiometer for a 15 volt peak to peak signal at the plate of the first video amplifier. The bias as measured by the "VoltOhmyst" should be -4.5 volts or less.

Observe and analyze the response curve obtained. The response will not be ideal and the i-f adjustments must be retouched in order to obtain the desired curve. See Figure 18.

On final adjustment the picture carrier marker must be at approximately 45% response. The curve must be approximately flat topped, with the 22.1 mc. marker at approximately 95% response and the 25.0 mc. marker below 90% response.

The most important consideration in making the i-f adjustments is to get the picture carrier at the 45% response point. If the picture carrier operates too low on the response curve, loss of low frequency video response, of picture brilliance, of blanking, and of sync may occur. If the picture carrier operates too high on the response curve, the picture becomes smeared. In making these adjustments, care should be taken that no two transformers are tuned to the same frequency as i-f oscillation may result.

Disconnect the bias potentiometer and replace V107.

Remove the converter tube and take off the clip to pin number 1. Replace the tube in the socket.

Picture I-F Oscillation.—If the receiver is badly misaligned and two or more of the i-f transformers are tuned to the same frequency, the receiver may fall into i-f oscillation. I-F oscillation shows up as a voltage across the picture detector load resistor that is unaffected by r-f signal input. If such a condition is encountered, it is sometimes possible to stop oscillation by adjusting the transformers approximately to frequency by setting the adjustment cores of T101, T102, T103, T104, T105 and T106 to be approximately equal to those of another receiver known to be in proper alignment. If this does not have the desired effect, it may now be possible to stop oscillation by increasing the grid bias. If so, it should then be possible to align the transformers by the usual method. Once aligned in this manner, the i-f should be stable with reduced bias.

If the oscillation cannot be stopped in the above manner, shunt the grids of the first three pix i-f amplifiers to ground with 1,000 mmf. capacitors. Connect the signal generator to the fourth pix i-f grid and align T106 to frequency. Progressively remove the shunt from each grid and align the plate coil of that stage to frequency.

If this does not stop the oscillation, the difficulty is not due to i-f misalignment as the i-f section is stable when properly aligned. Check all i-f by-pass condensers, transformer shunting resistors, tubes, socket voltages, etc.

ANTENNA, R-F AND CONVERTER LINE ADJUSTMENT.—In order to align the r-f tuner, it will first be necessary to set the channel 13 oscillator to frequency. The shield over the bottom of the r-f unit must be in place when making any adjustments.

The channel 13 oscillator may be aligned by adjusting it to beat with a crystal calibrated heterodyne frequency meter, or by feeding a signal into the receiver at the r-f sound carrier frequency and adjusting the oscillator for zero output from the sound discriminator. In this latter case the sound discriminator must first have been aligned to exact frequency. Either method of adjustment will produce the same results. The method used will depend upon the type of test equipment available. Regardless of which method of oscillator alignment is used, the frequency standard must be crystal controlled or calibrated.

If the receiver oscillator is to be adjusted by the heterodyne frequency meter method, couple the meter probe loosely to the receiver oscillator.

If the receiver oscillator is adjusted by feeding in the r-f sound carrier signal, connect the signal generator to the receiver antenna terminals. Connect the "VoltOhmyst" to the sound discriminator output (junction of C183 and R203).

Set the receiver channel switch to 13.

Adjust the frequency standard to the correct frequency (237 mc. for heterodyne frequency meter or 215.75 mc. for the signal generator).

Set the fine tuning control to the middle of its range while making the adjustment.

Adjust C6 for an audible beat on the heterodyne frequency meter or zero voltage from sound discriminator.

Now that the channel 13 oscillator is set to frequency, we may procede with the r-f alignment.

Connect the oscilloscope to the test connection at R13 in the r-f tuning unit.

Connect the "VoltOhmyst" to the junction of R134 and R222. Adjust the bias potentiometer for -1.5 volts on the meter.

Connect the r-f sweep oscillator to the receiver antenna terminals. The method of connection depends upon the output impedance of the sweep. The P102 connection for 300 ohm balanced or 72 ohm single-ended input are shown in the circuit diagram in Figure 81. If the sweep oscillator has a 50 ohm single-ended output, 300 ohm balanced output can be obtained by connecting as shown in Figure 10.

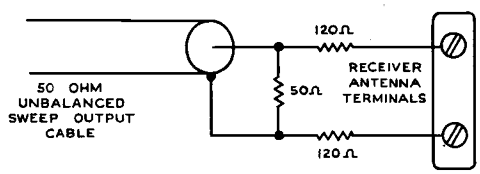


Figure 10—Unbalanced Sweep Cable Termination

Connect the signal generator loosely to the receiver antenna terminals.

Since channel 7 has the narrowest response of any of the high frequency channels, it should be adjusted first.

Set the receiver channel switch to channel 7 (see Figure 14 for switch shaft flat location versus channel).

Set the sweep oscillator to cover channel 7.

Insert markers of channel 7 picture carrier and sound carrier 175.25 mc. and 179.75 mc.

Adjust C10 and C14 until the curve falls symmetrically with the sound and picture carrier markers. Adjust C11 to give the proper bandwidth. Roughly peak L6 in conjunction with slight adjustments of C10 and C14 for a flat-topped, response curve with the sound and picture carriers at 90% to 95% response points on this curve. See Figure 19, channel 7.

Switch to channel 12 and adjust L6 for maximum response and minimum top slope of the curve.

Check the response of channels 7 through 13 by switching the receiver channel switch, sweep oscillator and marker oscillator to each of these channels and observe the response obtained. See Figure 19 for typical response curves. It should be found that all these channels have the proper shaped response with the markers above 80% response. If the markers do not fall within this requirement on one or more high frequency channels, since there are no individual channel adjustments, it will be necessary to readjust L6, C10, C11 and C14, and possibly compromise some channel slightly in order to get the markers up on other channels. Normally, however, no difficulty of this type should be experienced since the higher frequency channels become comparatively broad and the markers easily fall within the required range.

Channel 6 is next aligned in the same manner.

Set the receiver to channel 6.

Set the sweep oscillator to cover channel 6.

Set the marker oscillator to channel 6 picture and sound carrier frequencies.

Adjust L9, L13, L66 and C12, for an approximately flat-topped response curve located symmetrically between the markers. L9, L13 and L66 are the center frequency adjustments. C12 is the band width adjustment.

Check channels 5 down through channel 2 by switching the receiver, sweep oscillator and marker oscillator to each channel and observing the response obtained. In all cases, the markers should be above the 80% response point. If this is not the case, L9, L13, L66 and C12 should be retouched. On final adjustment, all channels must be within the 80% specification.

Following an r-f alignment, the oscillator alignment must be checked.

R-F OSCILLATOR LINE ADJUSTMENT.—The r-f oscillator line may be aligned by adjusting it to beat with a crystal calibrated heterodyne frequency meter, or by feeding a signal into the receiver at the r-f sound carrier frequency and adjusting the oscillator for zero output from the sound discriminator. In this latter case the sound discriminator must first have been aligned to exact frequency. Either method of adjustment will produce the same results. The method used will depend upon the type of test equipment available.

Regardless of which method of oscillator alignment is used, the frequency standard must be crystal controlled or calibrated. If the receiver oscillator is to be adjusted by the heterodyne frequency meter method, the calibration frequency listed under R-F Osc. Freq. must be available.

If the receiver oscillator is adjusted by feeding in the r-f sound carrier frequency, the frequencies listed under Sound Carrier Freq. must be available.

Channel Number	Receiver R-F Osc. Freq. Mc.	R-F Sound Carrier Freq. Mc.	Channel Oscillator Adjustment
2	81	59.75	L24
3	87	65.75	L23
4	93	71.75	L22
5	103	81.75	L21
6	109	87.75	L20-L31
7	201	179.75	L19
8	207	185.75	L18
9	213	191.75	L17
10	219	197.75	L16
11	225	203.75	L15
12	231	209.75	L14
13	237	215.75	C6

If the heterodyne frequency meter method is used, couple the meter probe loosely to the receiver oscillator.

If the r-f sound carrier method is used, connect the "VoltOhmyst" to the sound discriminator output (junction of C183 and R203).

Connect the signal generator to the receiver antenna terminals. The order of alignment remains the same regardless of which method is used.

The shield over the bottom of the r-f unit must be in place when making adjustments.

Since lower frequencies are obtained by adding steps of inductance, it is necessary to align channel 13 first and continue in reverse numerical order.

Set the receiver channel switch to 13.

Adjust the frequency standard to the correct frequency (237 mc. for heterodyne frequency meter or 215.75 mc. for the signal generator).

Set the fine tuning control to the middle of its range while making the adjustment.

Adjust C6 for an audible beat on the heterodyne frequency meter or zero voltage from sound discriminator. Oscillator adjustments L1 and L2 shown on the schematic are factory control adjustments and should not be touched in the field.

Switch the receiver to channel 12.

Set the frequency standard to the proper frequency as listed in the alignment table.

Adjust L14 for indications as above.

Adjust the oscillator to frequency on all channels by switching the receiver and the frequency standard to each channel and adjusting the appropriate oscillator trimmer for the specified indication. It should be possible to adjust the oscillator to the correct frequency on all channels with the fine tuning control in the middle third of its range.

After the oscillator has been set on all channels, start back at channel 13 and recheck to make sure that all adjustments are correct.

AGC THRESHOLD ADJUSTMENT.—The AGC threshold adjustment can be made by the method outlined in the Installation Instructions. However, a more accurate adjustment can be obtained by the use of an oscilloscope.

Tune in a station and advance the picture control to the maximum clockwise position. Connect the low capacity probe from the oscilloscope to terminal "A" of L104. Adjust the oscilloscope to observe the vertical sync pulse.

Turn the AGC threshold control R138 fully counterclockwise, then slowly clockwise. As the control is turned clockwise, the receiver gain will increase slowly, increasing the size of the pattern on the oscilloscope. R138 should be turned clockwise until the receiver begins to overload as indicated by clipping of the sync. The control should be left in the maximum gain position in which no clipping of sync is observed. See Figure 20 for proper waveforms.

HORIZONTAL OSCILLATOR ADJUSTMENT.—Normally the adjustment of the horizontal oscillator is not considered to be a part of the alignment procedure, but since the oscillator waveform adjustment requires the use of an oscilloscope, it can not be done conveniently in the field. The waveform adjustment is made at the factory and normally should not require readjustment in the field. However, the waveform adjustment should be checked whenever the receiver is aligned or whenever the horizontal oscillator operation is improper.

Horizontal Frequency Adjustment.—With a clip lead, short circuit the coil between terminals C and D of the horizontal oscillator transformer T109. Tune in a television station and sync the picture if possible.

A.—Turn the horizontal hold control R173 to the extreme clockwise position. Adjust the T109 Frequency Adjustment (under the chassis) so that the picture is just out of sync and the horizontal blanking appears in the picture as a vertical bar. The position of the bar is unimportant.

B.—Turn the hold control approximately one quarter of a turn from the extreme clockwise position and examine the width and linearity of the picture. If picture width or linearity is incorrect, adjust the horizontal drive control C153B, the width control L110 and the linearity control L111 until the picture is correct. If C153B, L110 or L111 was adjusted, repeat step A above.

Horizontal Locking Range Adjustment.—Turn the horizontal hold control fully counter-clockwise. Momentarily remove the signal by switching off channel then back. Slowly turn the horizontal hold control clockwise and note the least number of diagonal bars obtained just before the picture pulls into sync.

If more than 9 bars are present just before the picture pulls into sync, adjust the horizontal locking range trimmer C153A slightly clockwise. If less than 7 bars are present, adjust C153A slightly counter-clockwise. Turn the horizontal hold control counter-clockwise, momentarily remove the signal and recheck the number of bars present at the pull in point. Repeat this procedure until 7 to 9 bars are present.

Horizontal Oscillator Waveform Adjustment.—Remove the shorting clip from terminals C and D of T109. Turn the horizontal hold control to the extreme clockwise position. With a thin fibre screwdriver, adjust the Oscillator Waveform Adjustment Core of T109 (on the outside of the chassis) until the horizontal blanking bar appears in the raster.

A.—Connect the low capacity probe of an oscilloscope to terminal C of T109. Turn the horizontal hold control one quarter turn from the clockwise position so that the picture is in sync. The pattern on the oscilloscope should be as shown in Figure 21. Adjust the Oscillator Waveform Adjustment Core of T109 until the two peaks are at the same height. During this adjustment, the picture must be kept in sync by readjusting the hold control if necessary.

This adjustment is very important for correct operation of the circuit. If the broad peak of the wave on the oscilloscope is lower than the sharp peak, the noise immunity becomes poorer, the stabilizing effect of the tuned circuit is reduced and drift of the oscillator becomes more serious. On the other hand, if the broad peak is higher than the sharp peak, the oscillator is overstabilized, the pull-in range becomes inadequate and the broad peak can cause double triggering of the oscillator when the hold control approaches the clockwise position.

Remove the oscilloscope upon completion of this adjustment.

Check of Horizontal Oscillator Adjustments.—Set the horizontal hold control to the full counterclockwise position. Momentarily remove the signal by switching off channel then back. Slowly turn the horizontal hold control clockwise and note the least number of diagonal bars obtained just before the picture pulls into sync.

If more than 3 bars are present just before the picture pulls into sync, adjust the horizontal locking range trimmer C153A slightly clockwise. If less than 3 bars are present, adjust C153A slightly counterclockwise. Turn the horizontal hold control counterclockwise, momentarily remove the signal and recheck the number of bars present at the pull-in point. Repeat this procedure until 3 bars are present.

Turn the horizontal hold control to the maximum clockwise position. The picture should be just out of sync to the extent that the horizontal blanking bar appears as a single vertical or diagonal bar in the picture. Adjust the T109 Frequency Adjustment until this condition is fulfilled.

4.5 MC VIDEO TRAP.—With a strong input from a station, detune the receiver from the correct fine tuning point. Observe the picture for the appearance of a 4.5 mc. beat. If the beat appears in the picture, adjust L104 until the beat is eliminated.

SENSITIVITY CHECK.—A comparative sensitivity check can be made by operating the receiver on a weak signal from a television station and comparing the picture and sound obtained to that obtained on other receivers under the same conditions.

This weak signal can be obtained by connecting the shop antenna to the receiver through a ladder type attenuator pad. The number of stages in the pad depends upon the signal strength available at the antenna. A sufficient number of stages should be inserted so that a somewhat less than normal contrast picture is obtained when the picture control is at the maximum clockwise position. Only carbon type resistors should be used to construct the pad.

RESPONSE CURVES.—The response curves shown on page 14 and referred to throughout the alignment procedure were taken from a production set. Although these curves are typical, some variations can be expected.

The response curves are shown in the classical manner of presentation, that is with "response up" and low frequency to the left. The manner in which they will be seen in a given test set-up will depend upon the characteristics of the oscilloscope and the sweep generator. The curves may be seen inverted and/or switched from left to right depending on the deflection polarity of the oscilloscope and the phasing of the sweep generator.

ALIGNMENT TABLE.—Both methods of oscillator alignment are presented in the alignment table. The service technician may thereby choose the method to suit his test equipment.

8T241, 8T243, 8T244

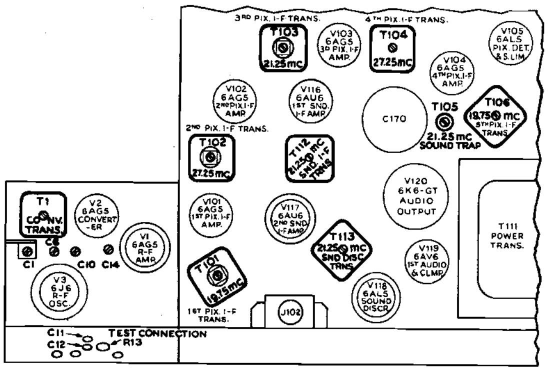


Figure 11—Top Chassis Adjustments

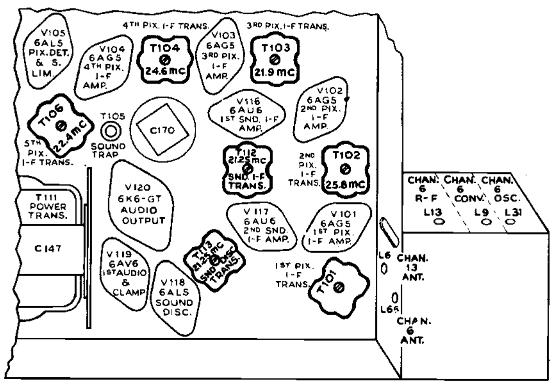


Figure 12—Bottom Chassis Adjustments

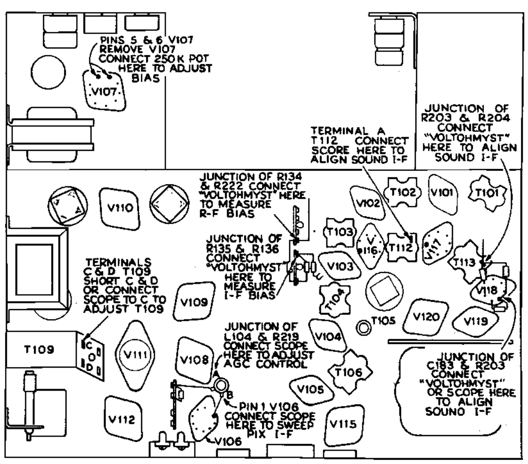
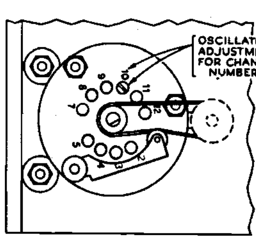


Figure 13—Test Connection Points



OSCILLATOR ADJUSTMENT FOR CHANNEL 13 IS ON TOP OF R-F UNIT AND CHANNEL 6 IS ON SIDE.

Figure 14—R-F Oscillator Adjustments

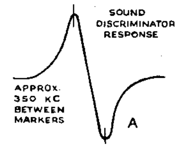


Figure 15
Discriminator
Response

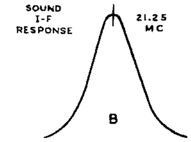


Figure 16
Sound I-F
Response

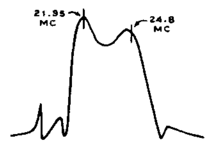


Figure 17
T1 and T101
Response

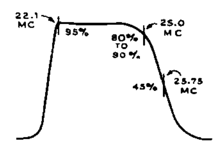


Figure 18
Overall I-F
R-F Response

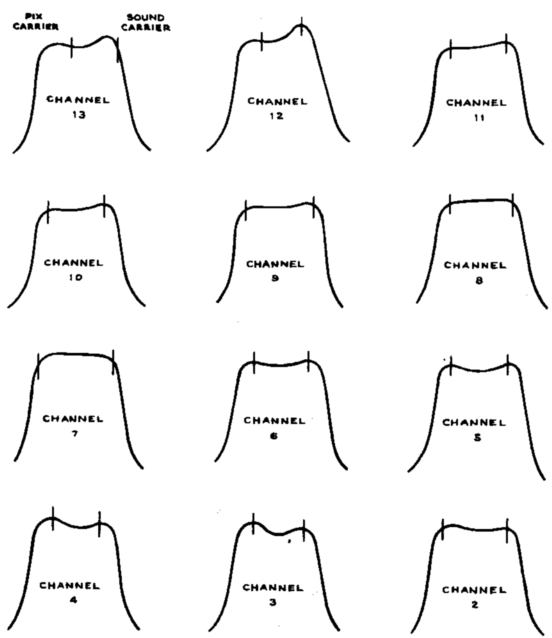


Figure 19—R-F Response

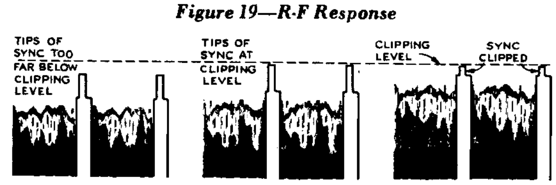


Figure 20—AGC Threshold Adjustment Waveforms

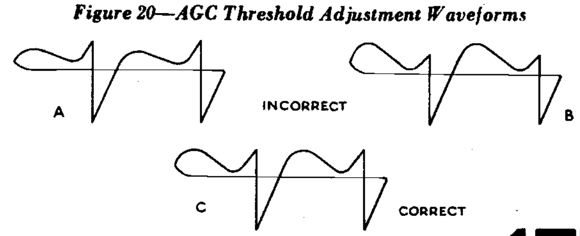


Figure 21—Horizontal Oscillator Waveforms

MOST-OFTEN-NEEDED 1949 TELEVISION RECEIVERS

8T241, 8T243, 8T244

ALIGNMENT TABLE

STEP No.	CONNECT SIGNAL GENERATOR TO	SIGNAL GEN. FREQ. MC.	CONNECT SWEEP GENERATOR TO	SWEEP GEN. FREQ. MC.	CONNECT OSCILLOSCOPE TO	CONNECT "VOLTOHMYST" TO	MISCELLANEOUS CONNECTIONS AND INSTRUCTIONS	ADJUST	REFER TO
				DISCRIMINATOR AND SOUND I-F ALIGNMENT					
1	2nd sound i-f grid (pin 1, V117)	21.25 .1 volt output	Not used		Not used	In series with 1 meg. to junction of R203 & R204		Detune T113 (bot.) Adjust T113 (top) for max. on meter	Fig. 13 Fig. 12 Fig. 11
2	"	"	"		"	Junct. of C183 & R203	Meter on 3 volt scale	T113 (bottom) for zero on meter	Fig. 13 Fig. 12
3	"	"	2nd sound i-f grid (pin 1, V117)	21.25 center 1 mc. wide .1 v. out	Junction of C183 & R203	Not used	Check for symmetrical response waveform (positive & negative). If not equal adjust T113 (top) until they are equal		Fig. 13 Fig. 15
4	1st sound i-f grid (pin 1, V116)	21.25 re-duced output	1st sound i-f grid	21.25 reduced output	Terminal A, T112 in series with a 33,000 ohm resistor.	"	Sweep output reduced to provide .3 volt p-to-p on scope	T112 (top & bot.) for max. gain and symmetry at 21.25 mc.	Fig. 13 Fig. 11 Fig. 12 Fig. 16
				PICTURE I-F AND TRAP ADJUSTMENT					
5	Not Used		Not used		Not used	Junction of R135 & R136	Remove V107. Connect potentiometer between pins 5 & 6 of V107 socket	Adjust potentiometer for −4.5 volts on meter	Fig. 13 Fig. 11
6	Converter grid (pin 1, V2)	21.25	"		"	Junction of L104 & R126	Meter on 3 volt scale. Receiver on channel 13	T103 (top) for min. on meter	Fig. 11 Fig. 13
7	"	21.25	"		"	"	"	T105 (top) for min.	Fig. 13 Fig. 11
8	"	27.25	"		"	"	"	T102 (top) for min.	"
9	"	27.25	"		"	"	"	T104 (top) for min.	"
10	"	19.75	"		"	"	"	T106 (top) for min.	"
11	"	19.75	"		"	"	"	T101 (top) for min.	"
12	"	22.5	"		"	"	"	T106 (bottom) for max. on meter	Fig. 12
13	"	24.6	"		"	"	"	T104 (bottom) for max.	"
14	"	22.0	"		"	"	"	T103 (bottom) for max.	"
15	"	25.9	"		"	"	"	T102 (bottom) for max.	"
16	"	21.95 24.8	Converter grid (Pin 1, V2)	Sweeping 20 to 30 mc.	Pin 1, V105	Junction of R135 & R136	Shunt 300 ohms across pri. T102, T103, T104, T106. Set bias −2 V. Set swp. gen. for 4 V. P-P on scope.	Adjust T1 (top) and T101 (bottom) for proper response	Fig. 12 Fig. 17
17	"		"	"	"	"	Remove shunt resistors. Set bias to give 15 volts P to P on scope.	Adjust T1 (top), T101, T102, T103, T104, T106 (bot.) for proper resp.	Fig. 11 Fig. 12 Fig. 13 Fig. 18
				ANTENNA, R-F AND CONVERTER LINE ALIGNMENT					
18	Antenna terminals	215.75	Not used		Not used	Junction of C183 & R203 for signal gen. method only	Fine tuning centered. Receiver on channel 13. Heterodyne meter coupled to oscillator if used.	C6 for zero on meter or beat on het. feq. meter	Fig. 13 Fig. 11
19						Junction of R134 & R222		Potentiometer for −1.5 volts on meter	Fig. 13 Fig. 11
20	Antenna terminal (loosely)	175.25 & 179.75	Antenna terminals (see text for precaution)	Sweeping channel 7	Test Connection R13	Not used	Receiver on channel 7	L6, C10, C11 & C14 for flat top response between markers. Markers above 90%.	Fig. 13 Fig. 12 Fig. 11 Fig. 19 (7)
21	"	205.25 209.75	"	channel 12	"	"	Receiver on channel 12	L6 for max. response and min. slope of top of curve	Fig. 11 Fig. 19 (12)
22	"	175.25 179.75	"	channel 7	"	"	Receiver on channel 7.	Check to see that response is as above	Fig. 19 (7)
23	"	181.25 185.75	"	channel 8	"	"	Receiver on channel 8	"	Fig. 19 (8)
24	"	187.25 191.75	"	channel 9	"	"	Receiver on channel 9	"	Fig. 19 (9)
25	"	193.25 197.75	"	channel 10	"	"	Receiver on channel 10	"	Fig. 19 (10)

ALIGNMENT TABLE

8T241, 8T243, 8T244

RF AND CONVERTER LINE ALIGNMENT (Cont'd)

STEP No.	CONNECT SIGNAL GENERATOR TO	SIGNAL GEN. FREQ. MC.	CONNECT SWEEP GENERATOR TO	SWEEP GEN. FREQ. MC.	CONNECT OSCILLOSCOPE TO	CONNECT "VOLTOHMYST" TO	MISCELLANEOUS CONNECTIONS AND INSTRUCTIONS	ADJUST	REFER TO
26	"	199.25 203.75	"	channel 11	"	"	Receiver on channel 11	"	Fig. 19 (11)
27	"	205.25 209.75	"	channel 12	"	"	Receiver on channel 12	"	Fig. 19 (12)
28	"	211.25 215.75	"	channel 13	"	"	Receiver on channel 13	"	Fig. 19 (13)
29	If the response on any channel (steps 22 through 28) is below 80% at either marker, switch to that channel and adjust L6, C10, C11 & C14 to pull response up on that channel. Then recheck steps 22 through 28.								
30	Antenna terminals (loosely)	83.25 87.75	Ant. terminals (see text for precaution)	Sweeping chan. 6	Test Connection R13	Not used	Receiver on channel 6	L9, L13, L66 & C12 for response as above	Fig. 19 (6)
31	"	77.25 81.75	"	channel 5	"	"	Receiver on channel 5	Check to see that response is as above	Fig. 19 (5)
32	"	67.25 71.75	"	channel 4	"	"	Receiver on channel 4	"	Fig. 19 (4)
33	"	61.25 65.75	"	channel 3	"	"	Receiver on channel 3	"	Fig. 19 (3)
34	"	55.25 59.75	"	channel 2	"	"	Receiver on channel 2	"	Fig. 19 (2)
35	If the response on any channel (steps 31 through 34) is below 80% at either marker, switch to that channel and adjust L9, L13, L66 & C12 to pull response up on that channel. Then recheck steps 30 through 34.								

R-F OSCILLATOR ALIGNMENT

STEP No.	CONNECT SIGNAL GENERATOR TO	SIGNAL GEN. FREQ. MC.	CONNECT HETERODYNE FREQ. METER TO	HET. METER FREQ. MC.	CONNECT OSCILLOSCOPE TO	CONNECT "VOLTOHMYST" TO	MISCELLANEOUS CONNECTIONS AND INSTRUCTIONS	ADJUST	REFER TO
36	Antenna terminals	215.75	Loosely coupled to r-f osc.	237	Not used	Junction of C183 & R203 for sig. gen. method only	Fine tuning centered. Receiver on channel 13	C6 for zero on meter or beat on het. freq. meter	Fig. 13 Fig. 12 Fig. 11
37	"	209.75	"	231	"	"	Rec. on chan. 12	L14 as above	Fig. 14
38	"	203.75	"	225	"	"	Rec. on chan. 11	L15 as above	"
39	"	197.75	"	219	"	"	Rec. on chan. 10	L16 as above	"
40	"	191.75	"	213	"	"	Rec. on chan. 9	L17 as above	"
41	"	185.75	"	207	"	"	Rec. on chan. 8	L18 as above	"
42	"	179.75	"	201	"	"	Rec. on chan. 7	L19 as above	"
43	"	87.75	"	109	"	"	Rec. on chan. 6	L20, L31 as above	Fig. 12
44	"	81.75	"	103	"	"	Rec. on chan. 5	L21 as above	Fig. 14
45	"	71.75	"	93	"	"	Rec. on chan. 4	L22 as above	"
46	"	65.75	"	87	"	"	Rec. on chan. 3	L23 as above	"
47	"	59.75	"	81	"	"	Rec. on chan. 2	L24 as above	"
48	Repeat steps 36 through 47 as a check.								

AGC THRESHOLD ADJUSTMENT

STEP No.	CONNECT SIGNAL GENERATOR TO	SIGNAL GEN. FREQ. MC.	CONNECT SWEEP GENERATOR TO	SWEEP GEN. FREQ. MC.	CONNECT OSCILLOSCOPE TO	CONNECT "VOLTOHMYST" TO	MISCELLANEOUS CONNECTIONS AND INSTRUCTIONS / ADJUST	REFER TO
49	Not used		Not used		Terminal A of L104	Not used	Tune in station, turn pix control clockwise. Adjust R138 for max. gain without clipping sync on scope.	Fig. 13 Fig. 20

HORIZONTAL OSCILLATOR ADJUSTMENT

STEP No.	
50	Short circuit terminals C and D of T109. Tune in a station.
51	Turn hold control fully clockwise. Adjust T109 Frequency Adjustment until horizontal blanking bar appears in the picture.
52	Turn hold control ¼ turn from clockwise to sync picture. Adjust width (L110), linearity (L111) and drive (C153B) controls until picture is correct. Repeat step 51.
53	Turn hold control fully counterclockwise. Momentarily remove signal. Turn hold control slowly clockwise. Note least number of bars before pull-in. Adjust Locking Range Control (C153A) for 7 to 9 bar pull-in.
54	Remove clip from terminals C and D of T109. Turn hold control fully clockwise. Adjust T109 Oscillator Waveform Adjustment until horizontal blanking bar appears in picture.
55	Connect low capacity probe of oscilloscope to terminal C of T109. Turn hold control ¼ turn from clockwise. Adjust T109 Oscillator Waveform Adjustment until broad and sharp peaks of wave on oscilloscope are same height. Keep picture in sync with hold control during adjustment. Remove oscilloscope.
56	Turn hold control fully counterclockwise. Momentarily remove signal. Turn hold control slowly clockwise. Note least number of bars before pull-in. Adjust Locking Range Control (C153A) for 3 bar pull-in.
57	Turn hold control fully clockwise. Adjust T109 Freq. Adjustment until horizontal blanking appears as single vertical or diagonal bar in pix.

4.5 MC VIDEO TRAP ADJUSTMENT

STEP No.	
58	Tune in a strong station. Detune the fine tuning control. If a 4.5 mc beat appears in picture adjust L104 until beat is eliminated.

8T241, 8T243, 8T244

SERVICE SUGGESTIONS

Following is a list of symptoms of possible failures and an indication of some of the possible faults.

NO RASTER ON KINESCOPE:

(1) Incorrect adjustment of ion trap magnet—Magnets reversed either front to back or top to bottom, front magnet incorrectly oriented.

(2) V112 or V113 inoperative—check voltage and waveform on grids and plates.

(3) No high voltage—If horizontal deflection is operating as evidenced by the correct waveform on terminal 4 of horizontal output transformer, the trouble can be isolated to the 8016 circuit. Either the T110 high voltage winding is open (points 2 to 3), the 8016 tube is defective, its filament circuit is open, C186 is shorted or R187 or R189 open.

(4) V111 circuit inoperative—Refer to schematic and waveform chart.

(5) Damper tube (V114) inoperative.

(6) Defective kinescope.

(7) R131 open (terminal 3 to ground).

(8) No receiver plate voltage—filter capacitor or filter choke shorted—bleeder or filter choke open.

NO VERTICAL DEFLECTION:

(1) V107B or V110 inoperative. Check voltage and waveforms on grids and plates.

(2) T107 or T108 open.

(3) Vertical deflection coils open.

SMALL RASTER:

(1) Low Plus B or low line voltage.

(2) V112 defective.

POOR VERTICAL LINEARITY:

(1) If adjustments cannot correct, change V110.

(2) Vertical output transformer defective.

(3) V107B defective—check voltage and waveforms on grid and plate.

(4) C150, R164, C147B or C148-C defective.

(5) Low bias or plate voltage—check rectifiers and capacitors in supply circuits.

POOR HORIZONTAL LINEARITY:

(1) If adjustments do not correct, change V112 or V114.

(2) T110 or L111 defective.

(3) C164 or C165 defective.

WRINKLES ON LEFT SIDE OF RASTER:

(1) R166, R167 or C169 defective.

(2) Defective yoke.

PICTURE OUT OF SYNC HORIZONTALLY:

(1) T109 incorrectly tuned.

(2) R172, R173 or R174 defective.

TRAPEZOIDAL OR NON-SYMMETRICAL RASTER

(1) Improper adjustment of focus coil or ion trap magnet.

(2) Defective yoke.

RASTER AND SIGNAL ON KINESCOPE BUT NO SOUND:

(1) R-F oscillator off frequency.

(2) Sound i-f, discriminator or audio amplifier inoperative—check V116, V117, V118, V119, V120 and their socket voltages.

(3) T114 or C186 defective.

(4) Speaker defective.

SIGNAL AT KINESCOPE GRID BUT NO SYNC:

(1) AGC threshold control R138 misadjusted.

(2) V105A, V107A, V108 or V109 inoperative. Check voltage and waveforms at their grids and plates.

SIGNAL ON KINESCOPE GRID BUT NO VERTICAL SYNC:

(1) Check V107B and associated circuit—C145, T107, etc.

(2) Integrating network inoperative—Check.

(3) R154, R155, R157, R158 or R159 defective.

SIGNAL ON KINESCOPE GRID BUT NO HORIZONTAL SYNC:

(1) T109 misadjusted—readjust as instructed on page 11.

(2) V111 inoperative—check socket voltages and waveforms.

(3) T109 defective.

(4) C140, C153A, C154, C155, C157 or C166 defective.

(5) If horizontal speed is completely off and cannot be adjusted check C158, C159, R172, R173, R174, R179 and R182.

SOUND AND RASTER BUT NO PICTURE OR SYNC:

(1) Picture i-f, detector or video amplifier inoperative—check V103, V104, V105 and V106—check socket voltages.

(2) Bad contact to kinescope grid.

PICTURE STABLE BUT POOR RESOLUTION:

(1) V105A or V106 defective.

(2) Peaking coils defective—check for specified resistance.

(3) Make sure that the focus control operates on both sides of proper focus.

(4) R-F and I-F circuits misaligned.

PICTURE SMEAR:

(1) R-F or I-F circuits misaligned.

(2) Open peaking coil.

(3) This trouble can originate at the transmitter—check on another station.

PICTURE JITTER:

(1) AGC threshold control R138 misadjusted.

(2) If regular sections at the left picture are displaced change V112.

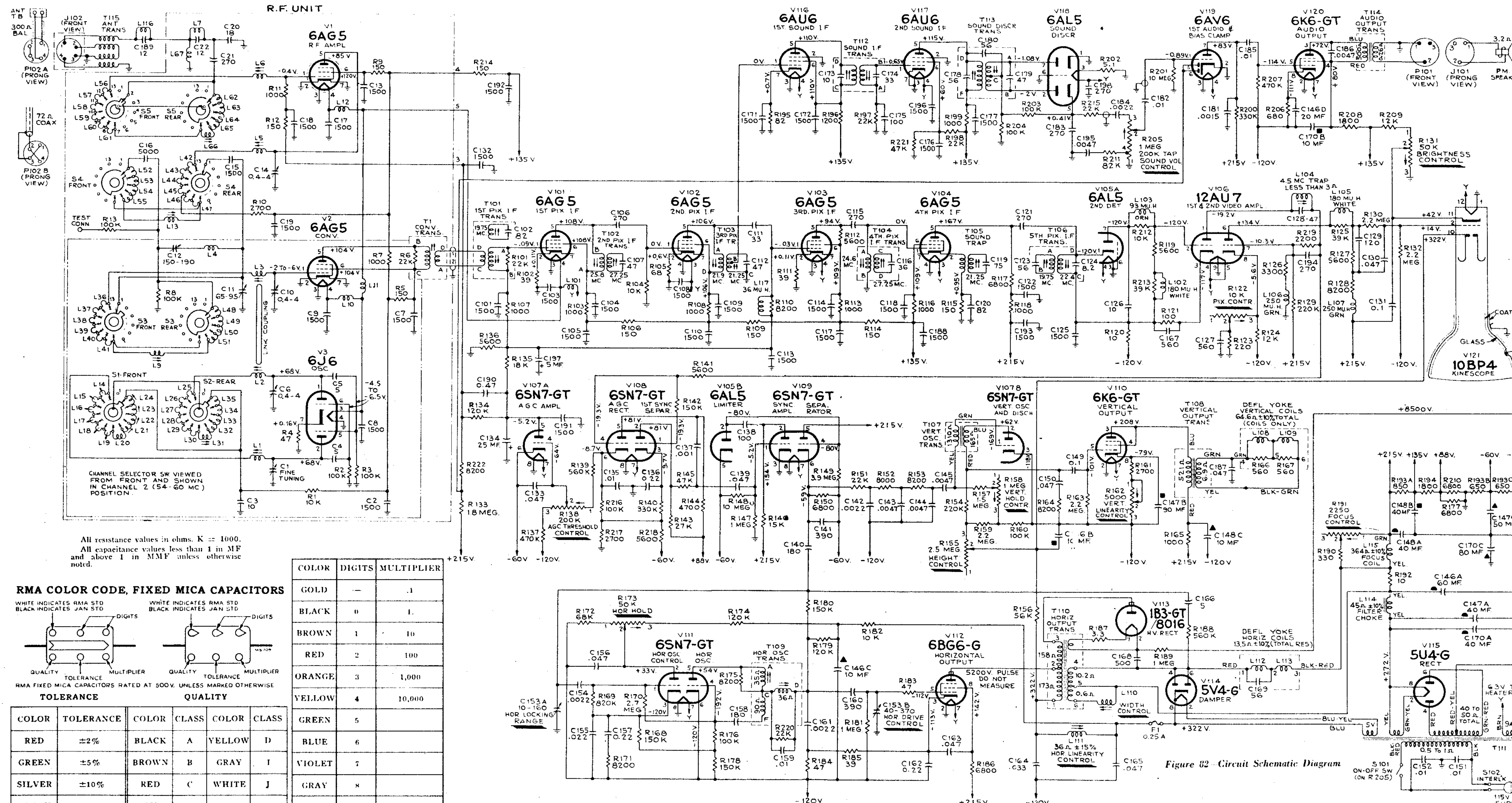


Figure 82—Circuit Schematic Diagram

All resistance values in ohms. K = 1000.

All capacitance values less than 1 in MF and above 1 in MMF unless otherwise noted.

RMA COLOR CODE, FIXED MICA CAPACITORS

RMA FIXED MICA CAPACITORS RATED AT 500V. UNLESS MARKED OTHERWISE

TOLERANCE **QUALITY**

COLOR	TOLERANCE	COLOR	CLASS	COLOR	CLASS
RED	±2%	BLACK	A	YELLOW	D
GREEN	±5%	BROWN	B	GRAY	I
SILVER	±10%	RED	C	WHITE	J
BLACK	±20%	ORANGE	D o		

COLOR	DIGITS	MULTIPLIER
GOLD	—	.1
BLACK	0	1.
BROWN	1	10
RED	2	100
ORANGE	3	1,000
YELLOW	4	10,000
GREEN	5	
BLUE	6	
VIOLET	7	
GRAY	8	
WHITE	9	

Coil resistance values less than 1 ohm are not shown.

Direction of arrows at controls indicates clockwise rotation.

In some receivers, substitutions have caused changes in component lead color codes, in electrolytic capacitor values and their lug identification markings.

All voltages measured with "VoltOhmyst" and with no signal input. Voltages should hold within ±20% with 117 v. a-c supply.

In some receivers, C198 was omitted.

In some receivers R222 was omitted.

In some receivers R124 was 18K.

In some receivers, two .47 mfd capacitors in parallel were used for C197.

In some receivers R142 was 47K.

In some receivers, R117 was 8.2K.

In some receivers, R172 was 82K and R174 was 150K.

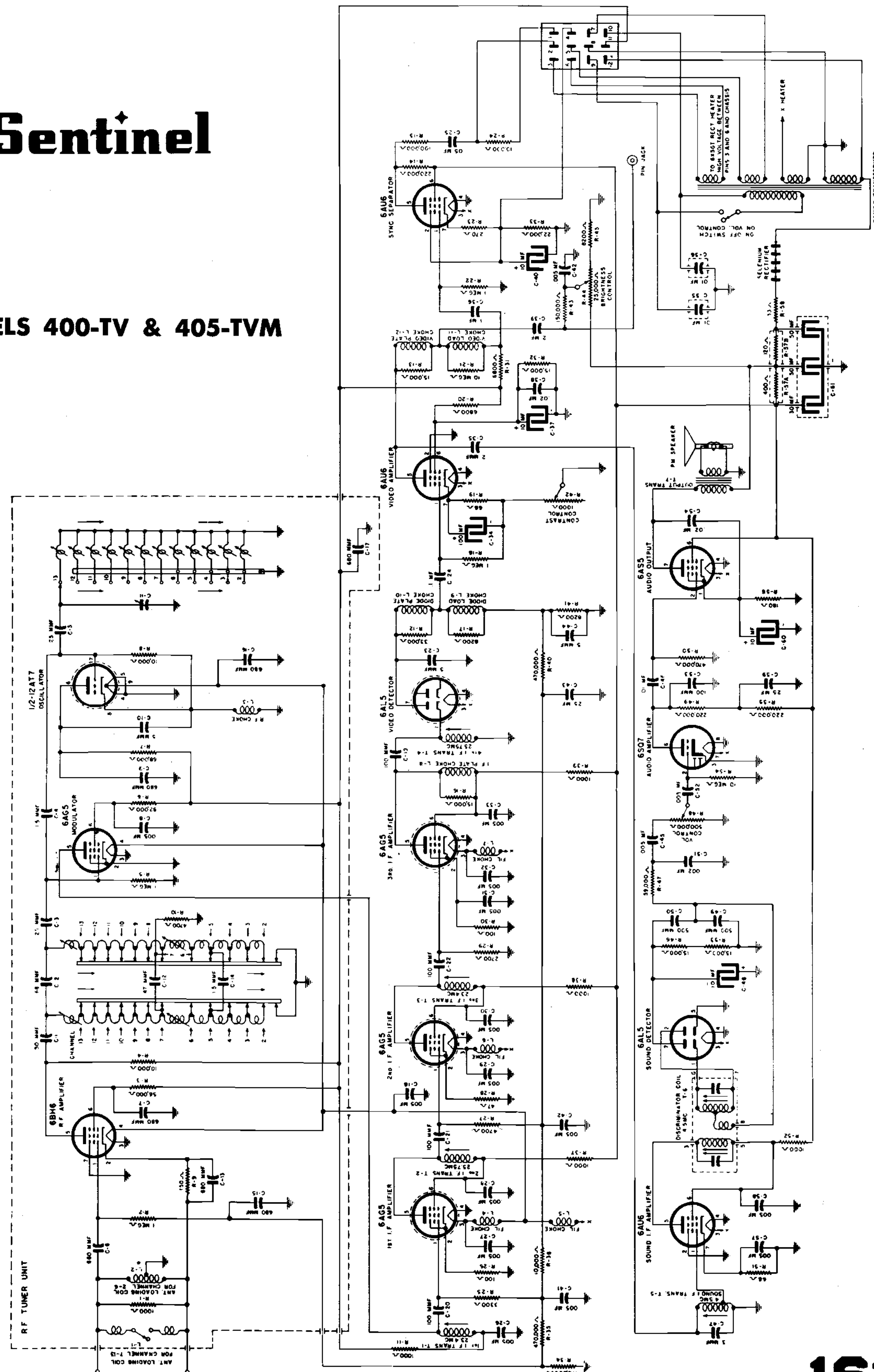
In some receivers, R134 was 100K and R142 was 47K.

In some receivers, R139 is connected between pin 6 of V108 and pin 4 of V107.

R137 is connected between pin 4 of V107 and the arm of R138. Lug 3 of R138 is connected to -120 volts.

Sentinel

MODELS 400-TV & 405-TVM



Sentinel Television

MODELS 400-TV & 405-TVM

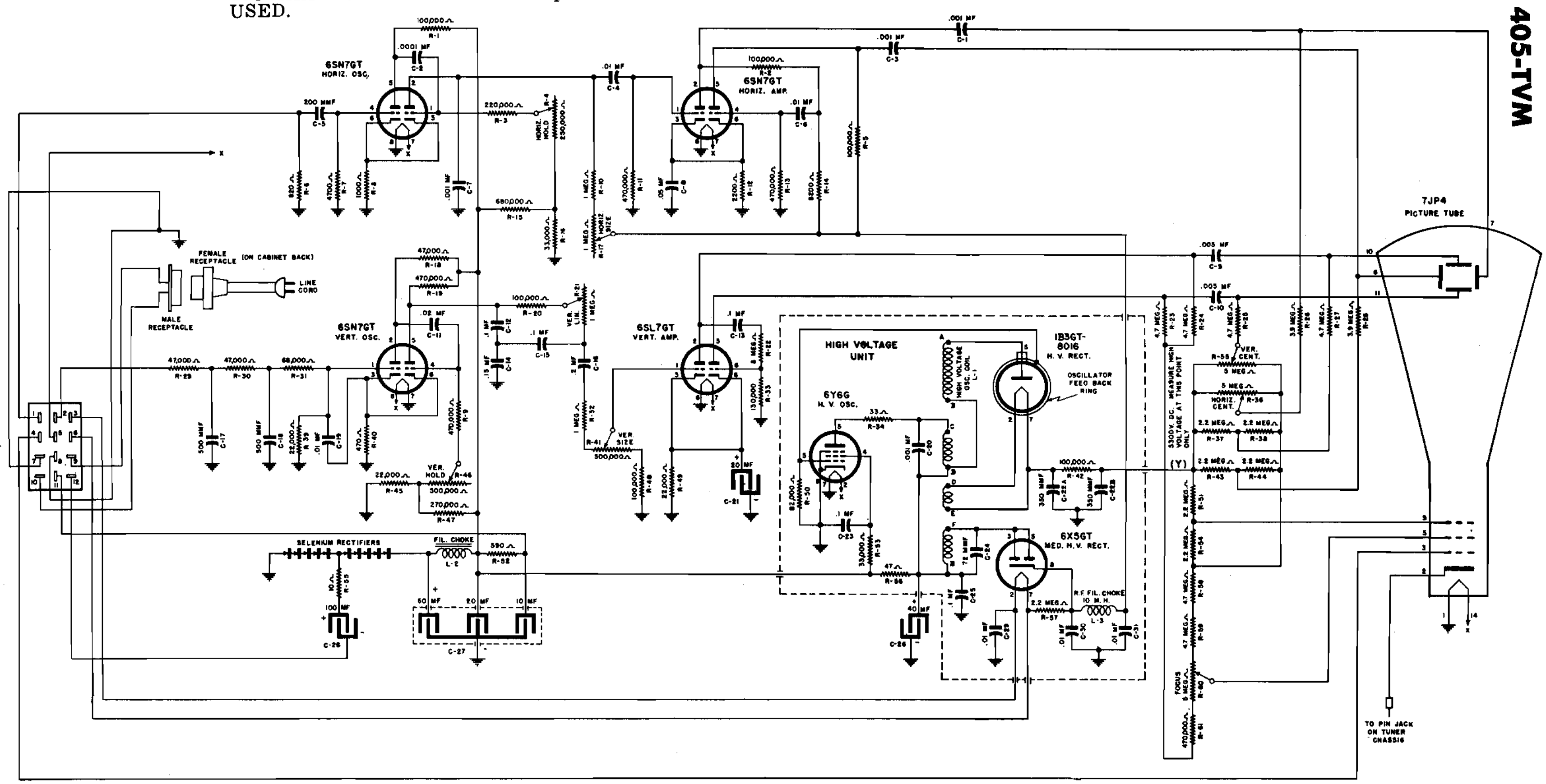
TO CHECK OSCILLATOR TRIMMER ADJUSTMENTS:

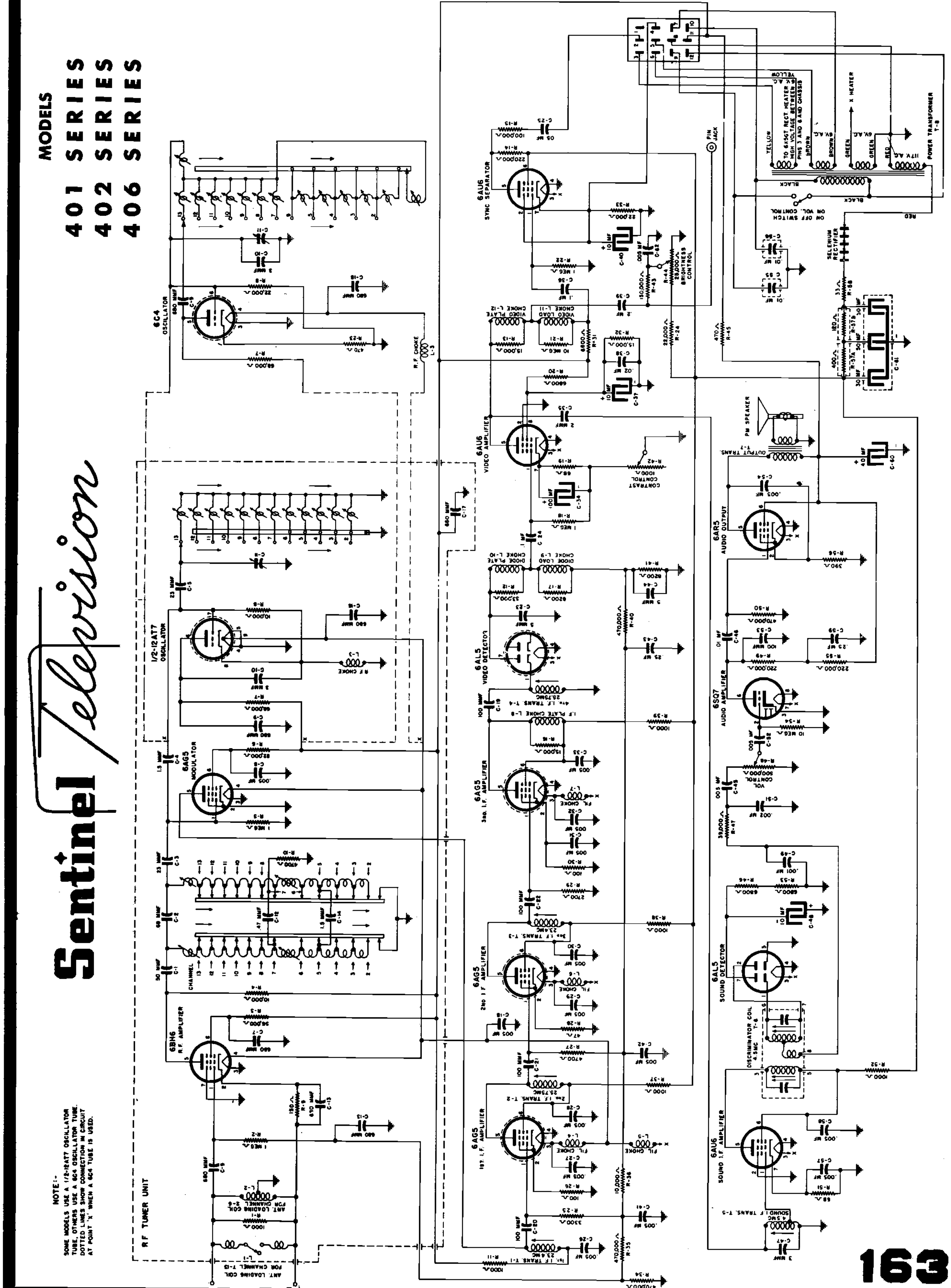
(A) Pull off the four front panel control knobs and remove the escutcheon by unscrewing the 6 screws holding this to the front panel of the cabinet. This will expose the 12 Oscillator Trimmer adjustment screws located around the Channel Selector Switch shaft. Starting with the first adjustment screw at the upper right side of the shaft and reading from right to left (clockwise), the first slotted round-head screw is Channel 13 Oscillator Trimmer adjustment screw. The second screw from the right is Channel 12 Oscillator Trimmer adjustment screw, the third is Channel 11, etc.

(B) Turn receiver Channel Selector Switch to channel on which TV station is transmitting its modulated test pattern and adjust "Contrast" and "Brightness" control for best definition of pattern. IMPORTANT—There are 14 positions on the Channel Selector Switch. The MAXIMUM RIGHT and LEFT positions are NOT USED.

(C) Turn proper Oscillator Trimmer adjustment Screw clockwise until sound appears on pattern—indicated by bars across pattern and/or the lower vertical lines in pattern becoming wavy—then turn SAME Oscillator Trimmer adjustment screw counter-clockwise just to the point where the sound bars and/or wavy lines in pattern disappear.

IF STATION BUZZ is excessive and is NOT DUE to "Contrast" control being too far advanced in clockwise direction, adjust Discriminator Secondary adjustment screw for MINIMUM buzz. MAKE SURE THAT THIS POSITION IS BETWEEN the two MAXIMUM buzz peaks that will be noticed when adjusting screw is turned to the right and left of the MINIMUM buzz position. This screw is located on top of the Discriminator Coil Shield Can which is mounted on Tuner Chassis between 6AL5 Sound Detector tube and 6AU6 Sound I.F. Amplifier tube.

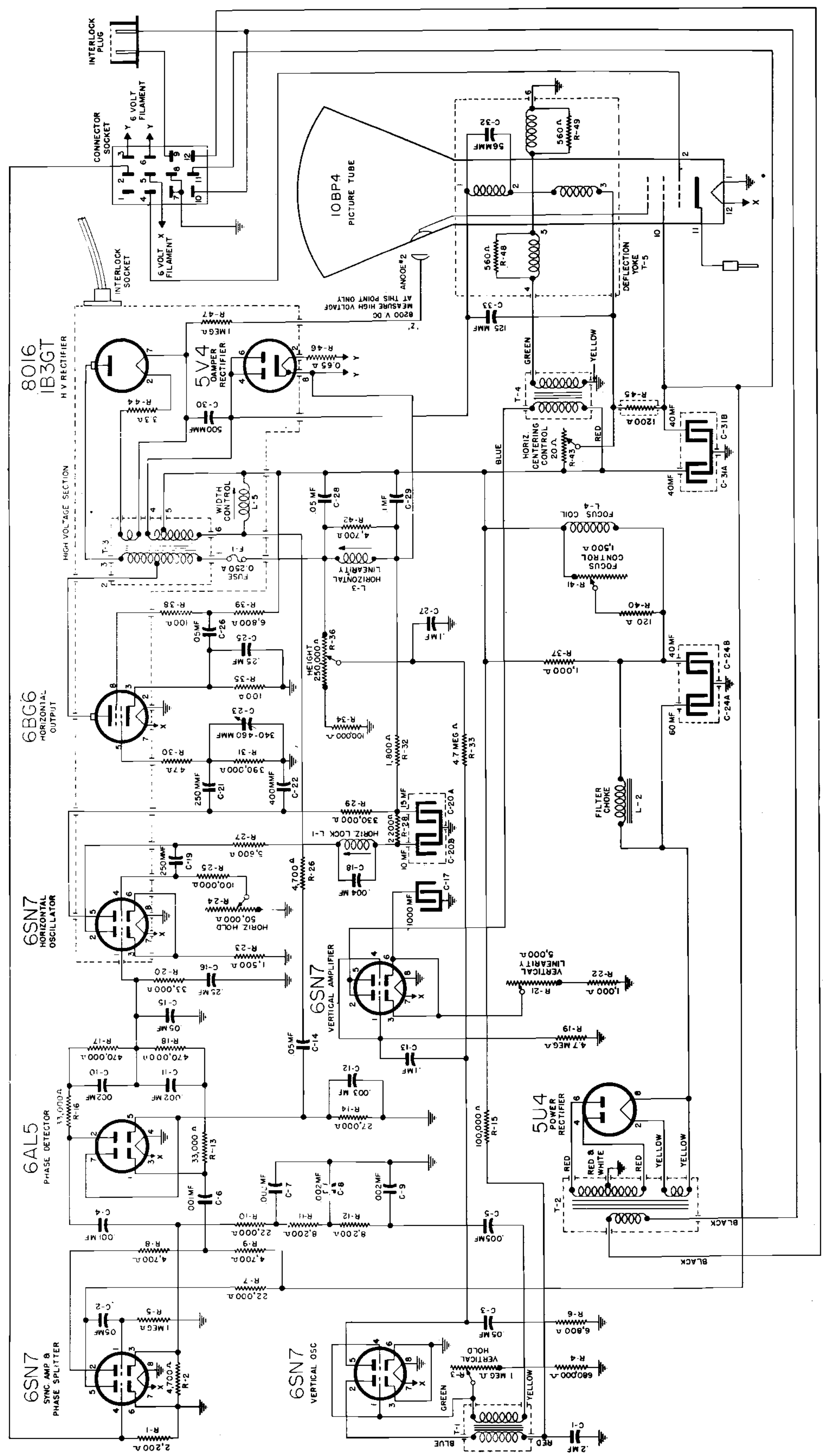



Sentinel Television
MODELS
401 SERIES
402 SERIES
406 SERIES
NOTE:-
SOME MODELS USE A 1/2-12AT7 OSCILLATOR TUBE, OTHERS USE A 6C4 OSCILLATOR TUBE. DOTTED LINES SHOW CONNECTION IN CIRCUIT AT POINT "X" WHEN A 6C4 TUBE IS USED.
RF TUNER UNIT
6BH6 R.F. AMPLIFIER
6AG5 MODULATOR
1/2-12AT7 OSCILLATOR
6C4 OSCILLATOR
6AG5 1st I.F. AMPLIFIER
6AG5 2nd I.F. AMPLIFIER
6AG5 3rd I.F. AMPLIFIER
6AL5 VIDEO DETECTOR
6AU6 VIDEO AMPLIFIER
6AU6 SYNC SEPARATOR
6AU6 SOUND I.F. AMPLIFIER
6AL5 SOUND DETECTOR
6SQ7 AUDIO AMPLIFIER
6AR5 AUDIO OUTPUT
PM SPEAKER
SELENIUM RECTIFIER
POWER TRANSFORMER T-8

These service notes cover two Sentinel television receivers—the major difference between the two chassis is in the size of the picture tube used.

All of the Model 401 and 402 Series use a 10-inch picture tube.

All of the Model 406 Series use a 12-inch picture tube.



MOST-OFTEN-NEEDED 1949 TELEVISION RECEIVERS

ALIGNMENT DATA

Alignment instructions in Paragraphs (1) to (3) inclusive cover procedure for alignment with the following equipment:

D.C. VACUUM TUBE VOLTMETER OF THE VOLTOHMIST TYPE.

MARKER GENERATOR having a coverage from 25.75 M.C. to 23.4 M.C. and 50 M.C. to 216 M.C.

SWEEP GENERATOR capable of covering from 20 M.C. to 30 M.C. and 50 M.C. to 216 M.C. with a 10 M.C. sweep.

OSCILLOSCOPE.

ACCURATELY CALIBRATED AM SIGNAL GENERATOR that will supply a 4.5 M.C. modulated signal **within ¼ of 1% of this frequency.**

6AG5 MODULATOR TUBE ADAPTER with a 1½ volt battery. This adapter may be obtained from the Service Department, Sentinel Radio Corporation, Evanston, Illinois, or one may be made by following construction details in Fig. #1.

(1) **PROCEDURE FOR VIDEO I.F. ALIGNMENT:**

(A) Connect the Vacuum Tube Voltmeter across the 6AL5 video second dectector 8200 Ohm load resistor. This resistor is in the Tuner Chasis and is attached to the center terminal of the 5-terminal tie-lug strip mounted on underside of chasis alongside of power transformer.

(B) Attach the flexible wire of the 6AG5 Adapter to the Grid (Pin #1) of the 6AG5 Modulator tube. Then press adapter down so that ground contact on bottom of adapter clamps to chassis—this will hold adapter in place and provide ground connection.

(C) Connect the Marker Generator leads to the two 6AG5 adapter leads. This adapter will then feed the output of the Marker Generator between the grid (Pin #1) of the 6AG5 Modulator tube and ground, and will apply a 1½ volt negative bias on grid of the 6AG5 Modulator tube.

(D) Set Marker Generator to deliver a 25.75 M.C. signal. KEEP OUTPUT OF GENERATOR SO THAT A READING OF APPROXIMATELY 3 VOLTS IS OBTAINED ON V.T.V.M.

(E) Adjust the fourth (4th) and second (2nd) Video I.F. adjustment screws (in that order) for maximum reading on the V.T.V.M.

The Video I.F. adjustment screws are mounted on top of the Tuner Chassis, adjacent to the three (3) 6AG5 and one (1) 6AL5 tubes. Looking at the front of the Tuner chassis, the first trimmer is the one to use for adjusting the first (1st) Video I.F., the second one for the second (2nd) Video I.F., the third one for the third (3rd) Video I.F. and the fourth one for the fourth (4th) Video I.F.

(F) Set Marker Generator to deliver a 23.4 M.C. signal. KEEP OUTPUT OF GENERATOR SO THAT A READING OF APPROXIMATELY 3 VOLTS IS OBTAINED ON V.T.V.M.

(G) Adjust the third (3rd) and first (1st) Video I.F. adjustment screws (in that order) for maximum reading on the V.T.V.M.

After these adjustments have been completed, remove the 6AG5 Modulator tube adapter.

(2) **PROCEDURE FOR SOUND I.F. ALIGNMENT:**

(A) Connect the V.T.V.M. across the 10 Mfd. electrolytic capacitor. This capacitor is connected between Pin #7 of the 6AL5 Sound Detector (Discriminator) tube sound and ground.

(B) Connect the output leads of an AM Signal Generatoı to Pin #5 (Plate) of the 6AU6 Video Amplifier tube socket, through a .01 Mfd. capacitor, and to chasis.

(C) Set AM Signal Generator to deliver a modulated 4.5 M.C. signal.

IMPORTANT: **This *must* be within ¼ of 1% of 4.5 M.C.**

(D) Adjust the 4.5 M.C. input coil trimmer adjustment screw (this is mounted on top of Tuner Chassis adjacent to the 6AU6 Sound I.F. tube) for maximum reading on the V.T.V.M.

(E) Next adjust the 4.5 M.C. discriminator primary adjustment screw (this is located below the Discriminator Coil shield can and is accessible from bottom side of Tuner Chassis) for maximum V.T.V.M. reading.

(F) Remove the V.T.V.M. leads from the 10 Mfd. electrolytic capacitor and connect these leads between the terminal connected end of the 39,000 ohm discriminator secondary resistor and the center tap of the two resistors in the output of the 6AL5 Sound Detector tube. Looking at the bottom from the rear of the Tuner Chassis, the 39,000 ohm resistor is connected to the third (3rd) terminal of the 6-terminal tie-lug strip that is attached to the right chassis flange below the 6AL5 Sound Detector tube socket. The center tap of the two resistors in the output of the 6AL5 Sound Detector tube is connected to the second (2nd) terminal of the same tie-lug strip.

(G) Adjust the discriminator Secondary adjustment screw for zero V.T.V.M. reading. Make sure that this zero reading is *between* the two peaks that will be noticed when adjustment screw is turned to the right and left of the zero point. This screw is on top of the Discriminator Coil shield can—the shield can is mounted on top of the Tuner Chassis between the 6AL5 Sound Detector tube and 6AU6 Sound I.F. Amplifier tube.

(3) **PROCEDURE FOR OSCILLATOR ALIGNMENT:**

(A) Remove the V.T.V.M. leads from the 39,000 ohm resistor and center tap of the two resistors in the output of the 6AL5 Sound Detector tube.

(B) Connect the Sweep Generator leads to the 300 ohm receiver antenna terminals.

(C) Loosely couple the Marker Generator leads to the Sweep Generator leads—always keep coupling as loose as possible.

(D) Connect the Oscilloscope across the Video second detector 8200 ohm load resistor. This resistor is in the Tuner Chassis and is attached to the center terminal of the 5-terminal tie-lug strip mounted on underside of chassis alongside of power transformer.

(E) Set receiver Channel Switch and Sweep Generator Switch for channel to be aligned.

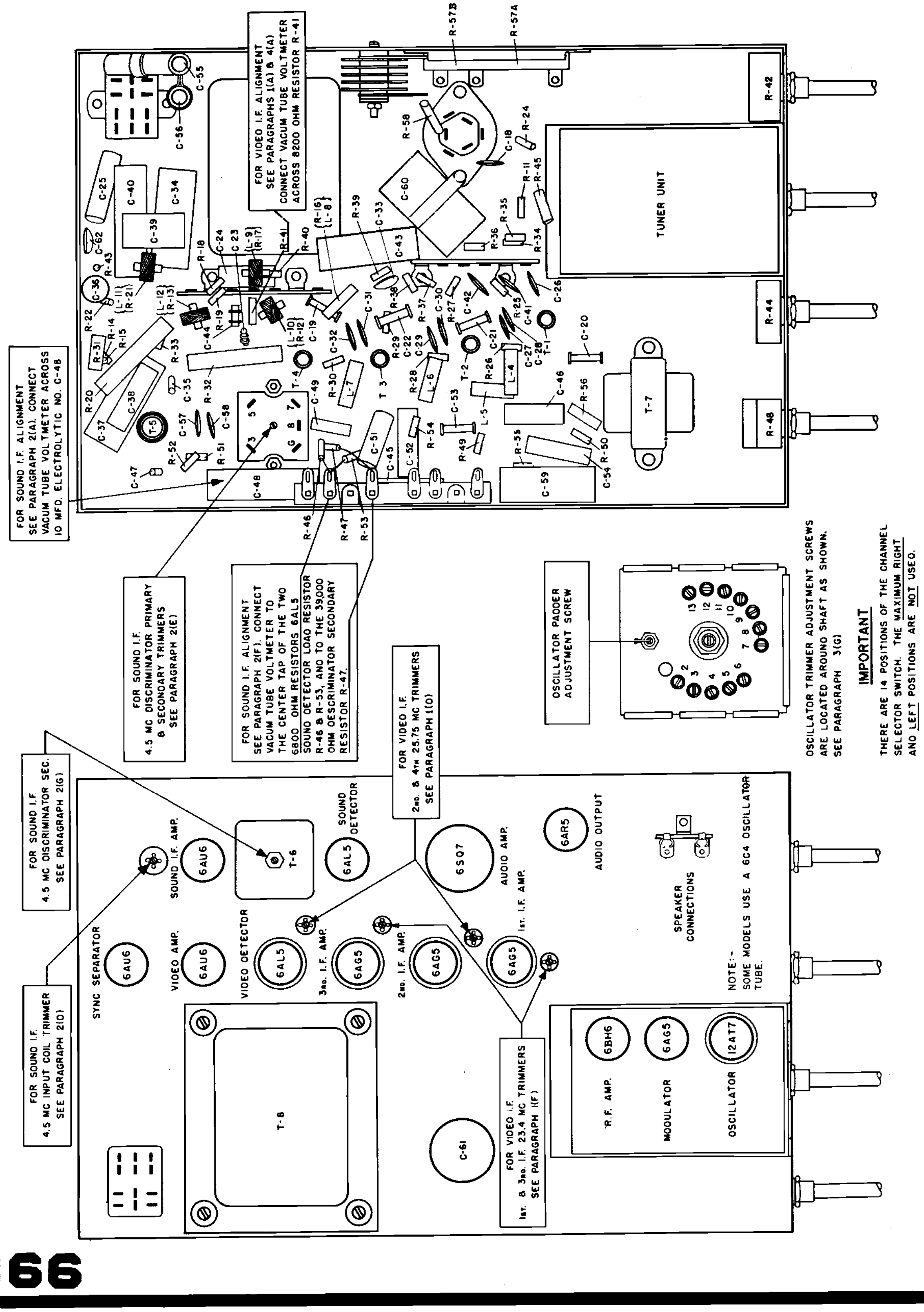
(F) Set Marker Generator to deliver the proper marker pip for the channel to be aligned. See Fig. #3 for proper marker frequency to be used for each of the 12 television channels.

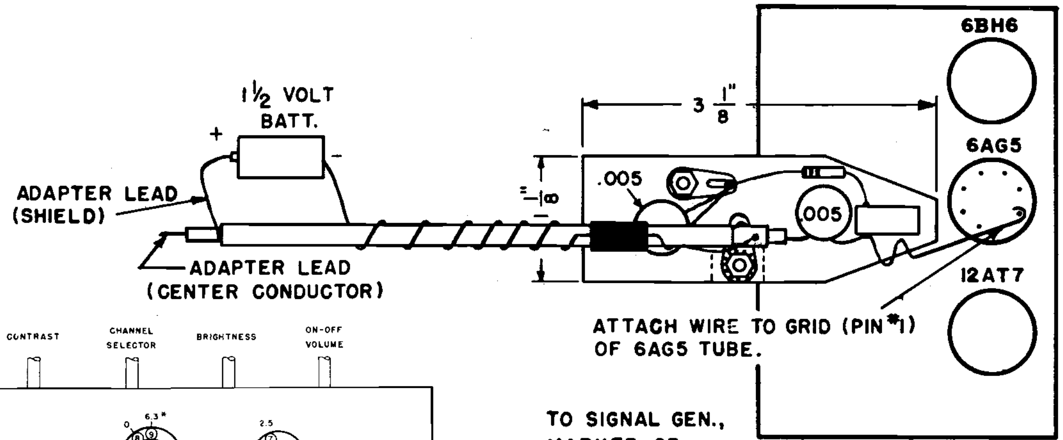
(G) Adjust the proper Oscillator Trimmer screw so that the picture marker pip is 6DB (50%) down from the top peak of the Sweep Generator curve and the sound marker pip is approximately 26DB (95%) down on the opposite side of the curve. See **Fig. #2** for correct positions of pips. The twelve (12) Oscillator Trimmer adjustment screws are located around the Channel Selector Switch shaft, and are accessible through holes in the front of the Tuner Chassis. Looking at the front of the Tuner chassis, and reading from right to left, (clockwise), the first slotted round-head screw is Channel 13 oscillator trimmer adjustment screw. The second screw from the right is Channel 12 oscillator trimmer adjustment screw, the third is Channel 11, etc. The individual channel oscillator trimmer adjustments are independent of each other and can be aligned in any order. However, if any channel cannot be aligned properly, because of insufficient range of its oscillator trimmer adjustment screw, it can be brought in by means of

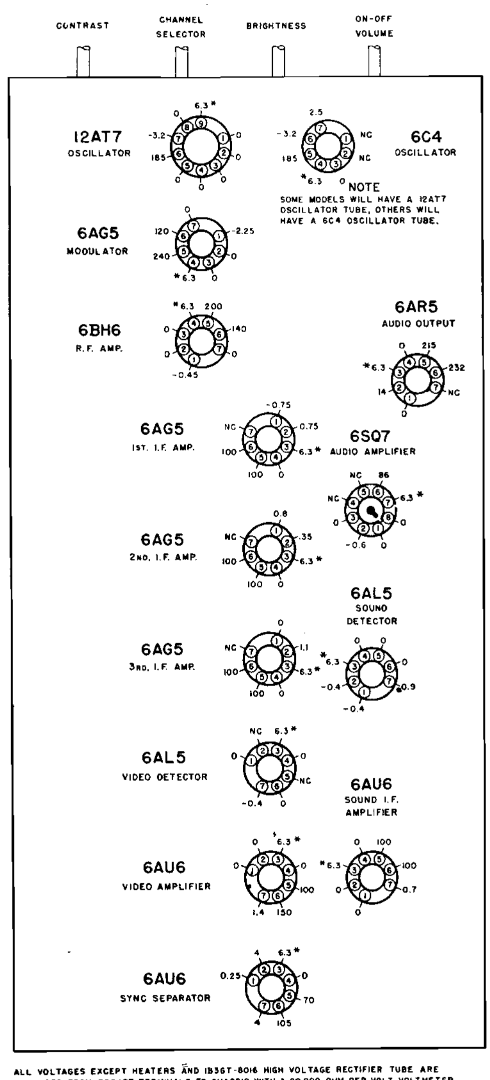
MOST-OFTEN-NEEDED 1949 TELEVISION RECEIVERS

the Padder Trimmer screw located above the Channel Selector Switch shaft. It is very important to remember that adjusting this Padder will necessitate the re-alignment of ALL of the oscillator trimmers.

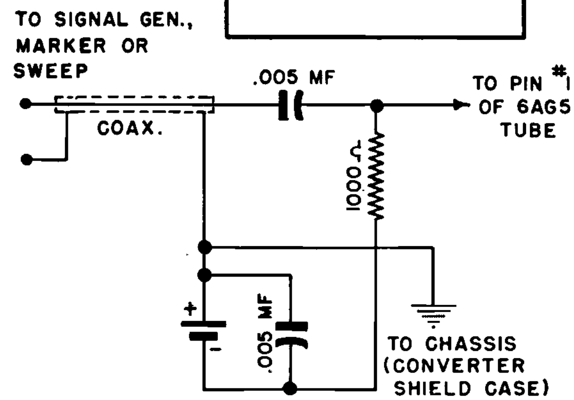
THE ABOVE PROCEDURES COVER ALL ADJUSTMENTS. THE ANTENNA AND R.F. STAGES ARE FACTORY PRE-SET AND, BECAUSE THEY ARE SUFFICIENTLY BROAD, WILL NOT REQUIRE ADJUSTMENT.







ALL VOLTAGES EXCEPT HEATERS AND 1B3GT-8016 HIGH VOLTAGE RECTIFIER TUBE ARE MEASURED FROM SOCKET TERMINALS TO CHASSIS WITH A 20,000 OHM PER VOLT VOLTMETER.



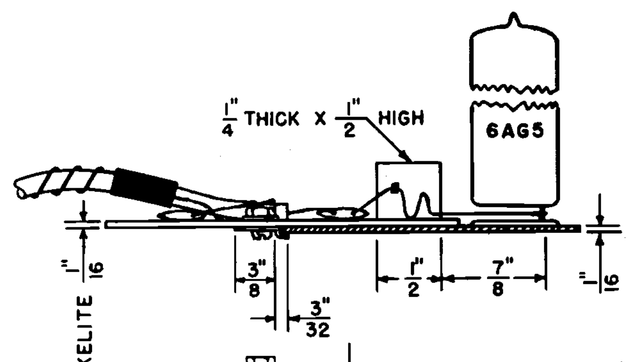
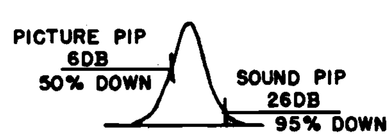


FIG. 1



PICTURE OVERALL RESPONSE CURVE WITH PICTURE AND SOUND CARRIER MARKER PIPS.

FIG. 2

Channel Number	Channel Freq. (Mc)	Picture Carrier Freq. (Mc)	Sound Carrier Freq. (Mc)
1	44-50	45.25	49.75
2	54-60	55.25	59.75
3	60-66	61.25	65.75
4	66-72	67.25	71.75
5	76-82	77.25	81.75
6	82-88	83.25	87.75
7	174-180	175.25	179.75
8	180-186	181.25	185.75
9	186-192	187.25	191.75
10	192-198	193.25	197.75
11	198-204	199.25	203.75
12	204-210	205.25	209.75
13	210-216	211.25	215.75

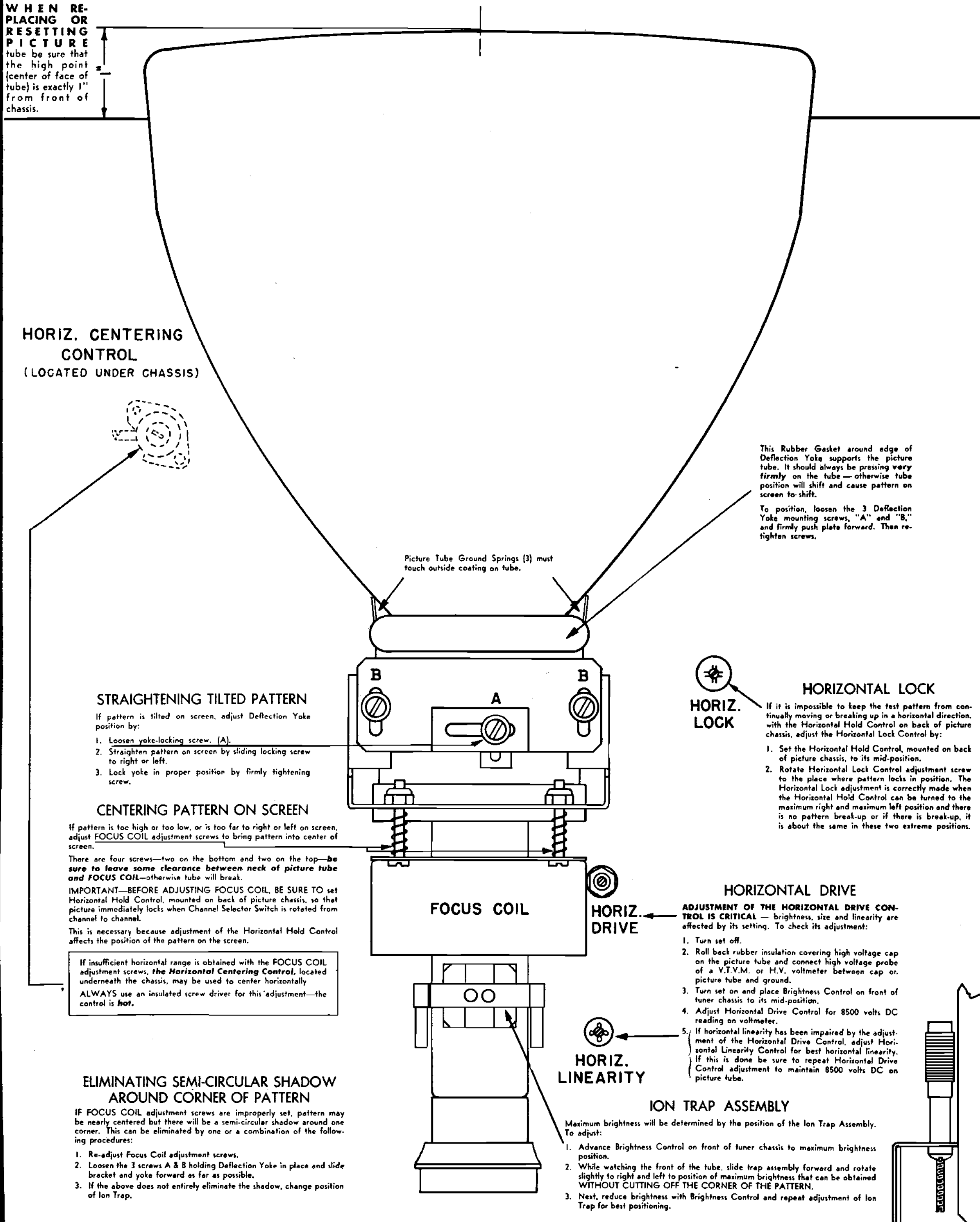
FIG. 3

MOST-OFTEN-NEEDED 1949 TELEVISION RECEIVERS

PICTURE TUBE CHASSIS

DEFLECTION, FOCUS AND ION TRAP ADJUSTMENTS

WHEN REPLACING OR RESETTING PICTURE tube be sure that the high point (center of face of tube) is exactly 1" from front of chassis.



This Rubber Gasket around edge of Deflection Yoke supports the picture tube. It should always be pressing ***very firmly*** on the tube—otherwise tube position will shift and cause pattern on screen to shift.

To position, loosen the 3 Deflection Yoke mounting screws, "A" and "B," and firmly push plate forward. Then re-tighten screws.

STRAIGHTENING TILTED PATTERN

If pattern is tilted on screen, adjust Deflection Yoke position by:

1. Loosen yoke-locking screw. (A).
2. Straighten pattern on screen by sliding locking screw to right or left.
3. Lock yoke in proper position by firmly tightening screw.

CENTERING PATTERN ON SCREEN

If pattern is too high or too low, or is too far to right or left on screen, adjust FOCUS COIL adjustment screws to bring pattern into center of screen.

There are four screws—two on the bottom and two on the top—***be sure to leave some clearance between neck of picture tube and FOCUS COIL***—otherwise tube will break.

IMPORTANT—BEFORE ADJUSTING FOCUS COIL, BE SURE TO set Horizontal Hold Control, mounted on back of picture chassis, so that picture immediately locks when Channel Selector Switch is rotated from channel to channel.

This is necessary because adjustment of the Horizontal Hold Control affects the position of the pattern on the screen.

> If insufficient horizontal range is obtained with the FOCUS COIL adjustment screws, ***the Horizontal Centering Control,*** located underneath the chassis, may be used to center horizontally
>
> ALWAYS use an insulated screw driver for this adjustment—the control is ***hot.***

ELIMINATING SEMI-CIRCULAR SHADOW AROUND CORNER OF PATTERN

IF FOCUS COIL adjustment screws are improperly set, pattern may be nearly centered but there will be a semi-circular shadow around one corner. This can be eliminated by one or a combination of the following procedures:

1. Re-adjust Focus Coil adjustment screws.
2. Loosen the 3 screws A & B holding Deflection Yoke in place and slide bracket and yoke forward as far as possible.
3. If the above does not entirely eliminate the shadow, change position of Ion Trap.

HORIZONTAL LOCK

If it is impossible to keep the test pattern from continually moving or breaking up in a horizontal direction, with the Horizontal Hold Control on back of picture chassis, adjust the Horizontal Lock Control by:

1. Set the Horizontal Hold Control, mounted on back of picture chassis, to its mid-position.
2. Rotate Horizontal Lock Control adjustment screw to the place where pattern locks in position. The Horizontal Lock adjustment is correctly made when the Horizontal Hold Control can be turned to the maximum right and maximum left position and there is no pattern break-up or if there is break-up, it is about the same in these two extreme positions.

HORIZONTAL DRIVE

ADJUSTMENT OF THE HORIZONTAL DRIVE CONTROL IS CRITICAL — brightness, size and linearity are affected by its setting. To check its adjustment:

1. Turn set off.
2. Roll back rubber insulation covering high voltage cap on the picture tube and connect high voltage probe of a V.T.V.M. or H.V. voltmeter between cap or picture tube and ground.
3. Turn set on and place Brightness Control on front of tuner chassis to its mid-position.
4. Adjust Horizontal Drive Control for 8500 volts DC reading on voltmeter.
5. If horizontal linearity has been impaired by the adjustment of the Horizontal Drive Control, adjust Horizontal Linearity Control for best horizontal linearity. If this is done be sure to repeat Horizontal Drive Control adjustment to maintain 8500 volts DC on picture tube.

ION TRAP ASSEMBLY

Maximum brightness will be determined by the position of the Ion Trap Assembly. To adjust:

1. Advance Brightness Control on front of tuner chassis to maximum brightness position.
2. While watching the front of the tube, slide trap assembly forward and rotate slightly to right and left to position of maximum brightness that can be obtained WITHOUT CUTTING OFF THE CORNER OF THE PATTERN.
3. Next, reduce brightness with Brightness Control and repeat adjustment of Ion Trap for best positioning.

STEWART-WARNER

TELEVISION RECEIVER

MODELS [AVT1 CODE 9054-A], [AVC1 CODE 9054-B] & [AVC2 CODE 9054-C]

SEQUENCE OF ALIGNMENT: These procedures should preferably be applied in the order in which they are presented, however, alignment of the Sound Channel or IF Channel may be accomplished individually if desired.

When undertaking alignment of the RF tuner circuits it is vitally important to first check the IF Channel alignment and obtain the proper IF band pass characteristic as results of RF circuit tuning are observed by means of an oscilloscope connected to the output of the detector stage.

REMOVAL OF CHASSIS: The receiver chassis must be removed from the cabinet in order to accomplish alignment of all tuned circuits as there are eight adjustment points located on the underside of the unit.

On table models the chassis should be removed from the cabinet without disturbing the picture tube or speaker. Inter-connection of focus coil, yoke, picture tube, speaker and chassis may be conveniently achieved by using special extension cables which are available for service purposes. These cables can be obtained through the nearest Stewart-Warner distributor by ordering as follows:

507443 High Voltage Ext. Cable & Plugs.
507444 Deflection Yoke Ext. Cable & Plugs.
507445 Picture Tube Ext. Cable & Plugs.
507446 Focus Coil Ext. Cable & Plugs.
507447 Speaker Ext. Cable & Plugs.

On console models the picture tube must be removed from the cabinet before the chassis can be taken out. The picture tube, yoke, focus coil and support frame can be removed as a complete assembly by taking off the wing nuts which hold the frame to top panel of cabinet. Allow speaker to remain in the cabinet. After picture tube and chassis have been removed it will be convenient to inter-connect all units by means of the special extension cables listed above.

CAUTION

The picture tube is highly evacuated and if broken, glass fragments will be violently expelled. Handle with care, using safety goggles and gloves. Avoid contact with high voltage terminal at side of tube even after it has been disconnected from the receiver—this precaution is necessary as inner and outer coatings on the tube form a capacitor which may carry a high voltage.

The metal shield which covers the bottom side of the RF tuner assembly must be left in position throughout the alignment procedure. Injection of generator signals for IF Channel alignment is accomplished through an opening in the bottom of this shield (see Fig. 3).

INSTRUMENTS: The following instruments will be required as signal sources and output indicators during the alignment process. Since accurate alignment of a television receiver is heavily dependent upon the performance of your instruments, it is imperative that they meet the essential specifications described here.

1. **STANDARD SIGNAL GENERATOR** to provide unmodulated (pure RF) signals at the following frequencies. Maximum output on all ranges should be at least .1 volt with provision for attenuation as desired. This instrument must have good frequency stability and be accurately calibrated. Generators which incorporate a separate crystal controlled oscillator and heterodyne circuit are self calibrating and therefore capable of providing the accuracy of frequency calibration required for television circuit alignment.

   a. IF Frequencies:
   4.5 Mc. Sound Channel
   22.25 Mc. Sound IF marker
   23.2 Mc. 1st and 3rd IF stages
   24.7 Mc. 4th IF stage
   26.3 Mc. Converter and 2nd IF stages
   26.75 Mc. Picture IF marker

   b. RF Frequencies:

CHANNEL NO.	PICTURE CARRIER FREQ.	SOUND CARRIER FREQ.
2	55.25 Mc.	59.75 Mc.
3	61.25 Mc.	65.75 Mc.
4	67.25 Mc.	71.75 Mc.
5	77.25 Mc.	81.75 Mc.
6	83.25 Mc.	87.75 Mc.
7	175.25 Mc.	179.75 Mc.
8	181.25 Mc.	185.75 Mc.
9	187.25 Mc.	191.75 Mc.
10	193.25 Mc.	197.75 Mc.
11	199.25 Mc.	203.75 Mc.
12	205.25 Mc.	209.75 Mc.
13	211.25 Mc.	215.75 Mc.

2. **RF SWEEP GENERATOR** to provide frequency modulated signals at the following frequencies:

   4.5 Mc. with 500 Kc. sweep width.
   20 to 30 Mc. with 10 Mc. sweep width.
   54 to 88 Mc. with 10 Mc. sweep width.
   174 to 216 Mc. with 10 Mc. sweep width.

   Output adjustable with at least .1 volt maximum.

   Output should be "flat" (no amplitude variation) for all settings of the sweep width control.

   Provision for connection of generator sweep modulating voltage to horizontal deflection system of an oscilloscope.

   Provision for blanking the output signal on each return sweep so that oscillogram will not show retrace.

3. **CATHODE RAY OSCILLOSCOPE,** preferably a unit with vertical amplifier having wide range frequency response and low capacity pick-up probe.

4. **VACUUM TUBE VOLTMETER.** The lowest voltage range of this instrument should preferably permit a 1.0 volt reading to be indicated at not less than one third of full scale deflection.

INSTRUMENT CONNECTIONS: This chassis has its B— system connected directly to one side of the AC power line. Therefore the following precautions must be observed before making connections to test instruments during service operations. Failure to do so may result in severe shock if contact is made between test equipment and "earth" ground, or a short circuit might occur if ground terminal of test equipment is connected to "earth" ground.

1. Connect an AC voltmeter between B— of receiver chassis and an "earth" ground (radiator, water pipe, etc.). If meter reading is not zero, reverse receiver power cord plug at wall receptacle.

2. Connect an AC voltmeter between ground terminal of test instrument and an "earth" ground (radiator, water pipe, etc.). If meter reads **FULL LINE VOLTAGE,** reverse instrument power

cord plug at wall outlet. If meter reads 60 volts or less, do not disturb instrument power cord plug.

3. Ground terminal of test instrument may now be connected to B— system of receiver.

These instrument connection precautions can be avoided if an isolation transformer is connected between receiver power cord and power supply outlet.

The circuit arrangement, including details of matching and coupling networks, for instruments used in this alignment procedure is given in Figs. 1 to 4 inclusive. Specific instructions for each instrument application will be found in various sections of the alignment charts.

GENERAL INSTRUCTIONS: When aligning IF and RF circuits it is necessary to apply a fixed bias voltage to the AGC system of the receiver. This fixed bias is obtained by using a 1½ volt battery and connecting it as described in Fig. 6.

IMPORTANT

When observing the receiver band pass characteristic on an oscilloscope, it is exceedingly important to avoid distortion of that characteristic which would occur when using a large input signal from the sweep generator or standard generator (marker signal). Always set attenuator on sweep generator so that the reading on a vacuum tube voltmeter, connected across 8200 ohm diode load resistor (symbol 242 on schematic) does not exceed one volt. Standard generator output should also be attenuated so that marker signal does not pull or tear the band pass characteristic as shown on the 'scope.

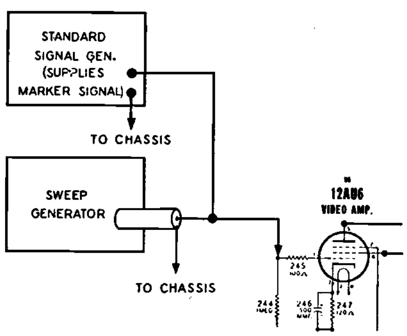


FIG. 1

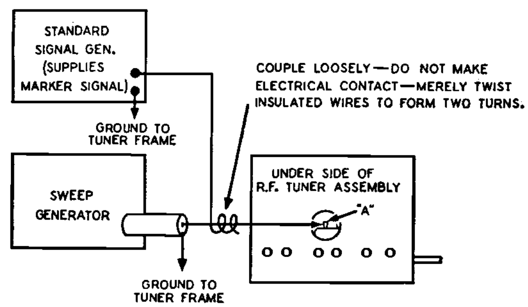


FIG. 3

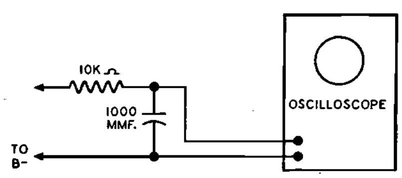


FIG. 2

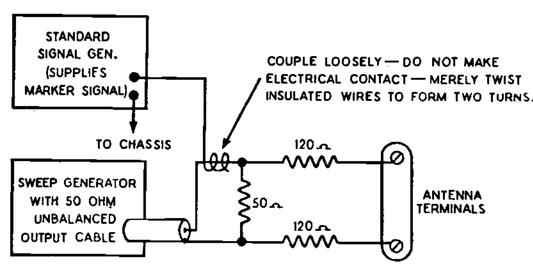
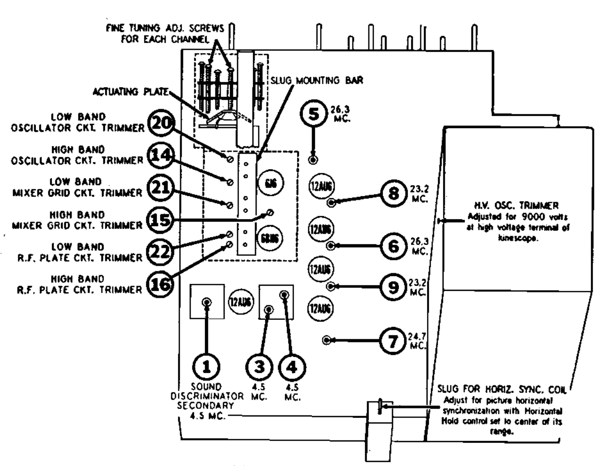
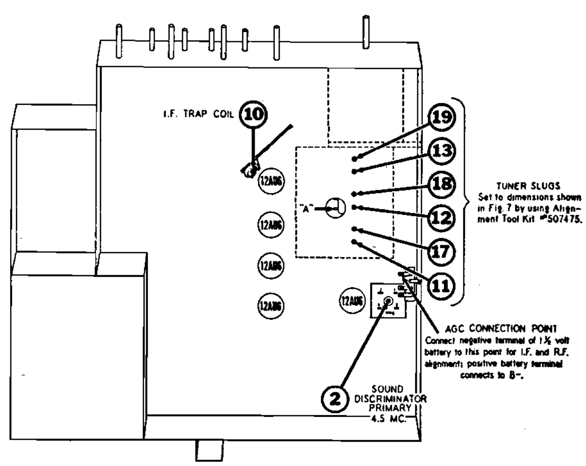


FIG. 4



TOP VIEW OF CHASSIS

FIG. 5



BOTTOM VIEW OF CHASSIS

FIG. 6

MOST-OFTEN-NEEDED 1949 TELEVISION RECEIVERS

SOUND CHANNEL ALIGNMENT PROCEDURE

1. Set Contrast control in maximum clockwise position. Other controls may be left at any desired setting.
2. Two 68,000 ohm resistors will be required for alignment of the discriminator circuit. These resistors must be matched so that their respective resistances do not differ by more than 1%—the accuracy of the total resistance is not critical. Connect the two resistors in series from pin 2 of 19T8 tube to B—.
3. Set receiver Channel Selector to any inactive television channel; also connect a jumper wire between antenna terminals at rear of chassis.
4. A special aligning tool, designed to fit the stems on adjustable cores in the sound take-off transformer, as well as the other IF coils (see points 3, 4, 5, 6, 7, 8 and 9 in Figs. 5 and 6) is available and may be obtained from Stewart-Warner by requesting Alignment Tool Kit #507475. This kit also contains three tools required to position the slugs in the RF tuner assembly.

STANDARD SIGNAL GENERATOR		SWEEP GENERATOR		VTVM CONNECTIONS	OSCILLOSCOPE CONNECTIONS	MISCELLANEOUS INSTRUCTIONS	TRIMMER OR SLUG	TYPE OF ADJUSTMENT AND OUTPUT INDICATION
CONNECTIONS	FREQUENCY	CONNECTIONS	FREQ.					
Connect as shown in Figure 1.	**4.5 MC.** (unmodulated) **IMPORTANT** This signal must be accurate within ¼ of 1% of 4.5 Mc. Check generator calibration against a crystal controlled signal source by "zero beating" (heterodyning) with harmonics of the crystal frequency.	Connect as shown in Fig. 1, but keep instrument power switch turned off during this step.	—	Connect from pin 2 of 19T8 tube to B—. "Common" or "ground" lead of VTVM must connect to B— line in receiver.	Not used	—	#1 Discriminator Secondary	Adjust for maximum reading on VTVM.
							#2 Discriminator Primary	Adjust for maximum reading on VTVM.
							#3 Sound Take-off Transformer	Adjust for maximum reading on VTVM.
							#4 Sound Take-off Transformer	Adjust for maximum reading on VTVM.
Same as above	Same as above	Same as above	—	See note #2 at the head of this chart. After resistors are connected in series between pin 2 of 19T8 tube and B— then connect "common" or "ground" lead of meter to the junction of these resistors. D.C. probe lead of meter should now be connected to tertiary winding of discriminator transformer (see terminal 6 on circuit diagram, also in Fig. 6).	Not used	—	#1 Discriminator Secondary	Note that as slug #1 is rotated, a point will be found where the voltmeter will swing rather sharply from a positive to a negative reading or vice versa. The correct setting of slug #1 is obtained when the meter reads zero as the slug is moved thru this point.
IMPORTANT: Remove the two 68,000 ohm resistors which were used in the preceding step (connected between pin 2 of the 19T8 and B—) for special connection of the VTVM.								
Allow instrument to remain connected as shown in Fig. 1 but keep power switch turned off during this step.	—	Connect as shown in Fig. 1 and set controls for operation as specified in next column.	**4.5 MC.** Sweeping ± 250 Kc.	Not used	Use coupling network shown in Fig. 2. Connect vertical amplifier "high" lead in series with the 10K ohm resistor to high side of receiver volume control (see note "A" in next column). Connect 'scope ground lead to B— line in receiver chassis. — Set vertical amplifier of 'scope for maximum amplification.	A. Note that "audio" socket near the right rear corner of the chassis provides a convenient means of effecting 'scope connection to high side of volume control. B. Synchronize oscilloscope with sweep generator by connecting "horizontal input" terminals of 'scope to source of horizontal sweep modulating voltage on the sweep generator.		A pattern similar to that shown in Fig. 8 should appear on the oscilloscope screen. Check for symmetry about the 4.5 Mc. center point and linearity of the slope for at least 50 Kc. on either side of this point. If the characteristic is not shaped properly, attempt to obtain symmetry by changing the setting of slug #1. Should that fail to produce the desired result, then a slight adjustment of slugs #3 and #4 should be undertaken.

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IF CHANNEL ALIGNMENT PROCEDURE

1. Turn receiver Channel Selector to television channel #13 and short antenna terminals together with a jumper wire.
2. Connect a 1½ volt battery to the receiver AGC system so that negative terminal of battery connects to the AGC line and positive terminal of battery connects to B—. See Fig. 6 for convenient point of connection.
3. Note location of IF Trap Coil #10 by referring to Fig. 6. Before undertaking the alignment of any of the IF stages, Trap Coil #10 must be detuned so that it does not resonate in the IF pass band. Detuning is accomplished by merely compressing the windings so that they are closely spaced. Failure to detune the Trap Coil can cause the IF system to become regenerative thereby preventing alignment.
4. If the IF channel is badly misaligned and two or more immediately adjoining IF stages are tuned to the same frequency, oscillation may occur. Such oscillation shows up as a voltage across the 8200 ohm diode load resistor and is indicated by the VTVM that is connected to this point during alignment. It should be noted that voltage due to IF oscillation is unaffected by strength of signal from the generator.

   Where IF oscillation is encountered, it is generally possible to correct the condition by detuning the IF coils in different directions. If that does not have the desired effect, increase fixed bias on AGC line by using a 3 or 4½ volt battery instead of the 1½ volt battery referred to in instruction #2. After stopping the oscillation in this manner it will then be possible to align all IF stages using the following procedure, however, the AGC bias battery must be changed back to 1½ volts when using the oscilloscope to observe band pass characteristic. Once all stages have been aligned using the 3 to 4½ volt bias, the IF channel should be stable with reduced bias.
5. A special aligning tool, designed to fit the stems on adjustable cores of the IF coils (see points 5, 6, 7, 8 and 9 in Fig. 5), is available and may be obtained from Stewart-Warner by requesting Alignment Tool Kit #507475. This kit also contains three tools required to position the slugs in the RF tuner assembly.

STANDARD SIGNAL GENERATOR		SWEEP GENERATOR		VTVM CONNECTIONS	OSCILLOSCOPE CONNECTIONS	MISCELLANEOUS INSTRUCTIONS	TRIMMER OR SLUG	TYPE OF ADJUSTMENT AND OUTPUT INDICATION
CONNECTIONS	FREQUENCY	CONNECTIONS	FREQ.					
Connect as shown in Fig. 3. The position of terminal "A" on underside of tuner is also illustrated in Fig. 6.	26.3 MC.	Connect as shown in Fig. 3 but keep power switch turned off during this step.	———	Connect a 15K ohm resistor to probe lead of meter and then connect open end of this resistor to junction of .05 Mfd. condenser (#243) and 8.2K ohm resistor (#242) located in the detector plate circuit of the 12AL5 tube. "Common" or "ground" lead of VTVM must be connected to B— line in receiver chassis.	Not used.	———	#5 Converter plate coil	Adjust for maximum reading on VTVM.
							#6 2nd I.F.	Adjust for maximum reading on VTVM.
Same as above.	24.7 MC.	Same as above.	———	Same as above.	Not used.		#7 4th I.F.	Adjust for maximum reading on VTVM.
Same as above.	23.2 MC.	Same as above.	———	Same as above.	Not used.		#8 1st I.F.	Adjust for maximum reading on VTVM.
							#9 3rd I.F.	Adjust for maximum reading on VTVM.
Same as above.	22.25 MC.	With connections made as shown in Fig. 3, turn on this generator and set controls for operation as specified in next column.	25 MC. Sweeping ± 5 Mc.	Same as above.	Use coupling network shown in Fig. 2. Connect vertical amplifier "high" lead in series with the 10K ohm resistor to junction of .05 Mfd. condenser (#243) and 8.2K ohm resistor (#242) located in the detector plate circuit of the 12AL5 tube. Connect 'scope ground lead to B— line in receiver chassis.	IMPORTANT: 1. Adjust output attenuator on sweep generator so that reading on VTVM is one volt. 2. Set attenuator on st'd. signal generator so that 22.25 Mc. marker signal does not distort the pattern on the oscilloscope. 3. Be sure that a 1½ volt battery is connected to AGC line as specified in instruction #2 at the head of this chart. Do not use a battery of any other voltage.	The IF band pass characteristic, now displayed on the 'scope, should be compared with the curve shown in Fig. 9. If top of curve is not properly shaped, make a slight readjustment of slug #7. Should that adjustment fail to yield the desired result, then note whether the curve has a peak on the high or low frequency side. Slugs #5 and #6 control high frequency response (26.3 Mc.) and slugs #8 and #9 affect the low frequency response (23.2 Mc.); by making a small change in the settings of the high or low frequency slugs, it will be possible to obtain correct band pass curve. Sound "plateau" on low frequency side of curve is formed by adjusting trap coil as described in the last paragragh of this chart.	

Set standard signal generator to 26.75 Mc. (picture IF carrier frequency) and this marker signal should now appear at the 50% amplitude position on the side of the band pass characteristic. If the position of the marker appears too high or too low, slight readjustment of slugs #5, 6 and 7 is required. Be sure to use a weak marker signal, otherwise it may distort the curve.

Attenuated area ("plateau") on sound carrier side of IF band pass characteristic (Fig. 9) is obtained by adjusting the spacing of the winding of Trap Coil #10 (see Fig. 6 for location of this coil). By spreading the coil winding a small amount, and observing the response curve on the 'scope, it will be possible to form a "plateau" in the vicinity of 22 to 22.5 Mc. The marker signal for 22.25 Mc. should now appear at a position approximately 20% out on the plateau from the steep side of the characteristic.

RF CHANNEL ALIGNMENT PROCEDURE

1. Connect a 1½ volt battery to the receiver AGC system so that negative terminal of battery connects to the AGC line and positive terminal of battery connects to B— (see Fig. 6 for convenient point of connection).
2. Do not remove the shield on the underside of the RF tuner unit. This shield must remain in position during alignment.
3. Before undertaking alignment of the RF tuner it is necessary to set the tuning slugs to their correct mechanical position as shown in Fig. 7 (see slugs numbered 11, 12, 13, 17, 18 and 19). That is accomplished by first turning the receiver Channel Selector Knob to channel #12 and then using three special tools that are supplied by Stewart-Warner in Alignment Tool Kit #507475. Note that bottom tip of each slug is color coded and that the aligning tools are identified by corresponding colors as the tools differ in length.
   Using the correct color coded tool for a particular slug, insert the tool thru the coil opening in the bottom of the tuner unit so that it engages a slot in the bottom of the slug. Then turn the slug counter-clockwise several times so as to insure that the tool is properly engaging the slug.
   The actuating plate of the tuner mechanism (see Fig. 5) should now be pressed back against its mechanical stop so that the slugs are withdrawn from the coil forms as far as possible. Then, rotate the aligning tool **clockwise** so that it turns the slug in its support bar. By continuing to rotate the slug in a clockwise direction, a position will be reached where the slug disengages from the aligning tool and this automatically determines the correct setting.

All six slug cores in the tuner mechanism should be mechanically set in this manner, using the aligning tool which corresponds in color to the color on the bottom tip of the tuning slug.

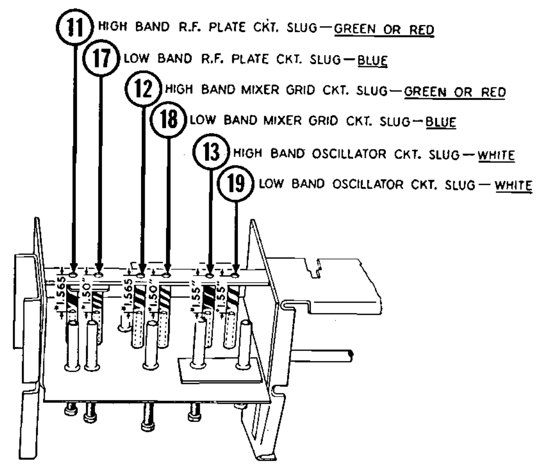


FIG. 7

STANDARD SIGNAL GENERATOR		SWEEP GENERATOR		VTVM CONNECTIONS	OSCILLOSCOPE CONNECTIONS	MISCELLANEOUS INSTRUCTIONS	TYPE OF ADJUSTMENT AND OUTPUT INDICATION
CONNECTIONS	FREQUENCY	CONNECTIONS	FREQ.				
HIGH BAND ALIGNMENT After the tuning slugs have been positioned as described in step #3 at the head of this chart, leave Channel Selector set to **channel #12.** The fine tuning screw in the Channel Selector Mechanism (see Fig. 5) must now be correctly positioned. Turn this screw clockwise until tuner actuating plate (shown in Fig. 5) has moved back as far as it will go and presses against its mechanical stop—do not force screw beyond this point. Then, **back off the fine tuning screw by rotating it counter-clockwise 3 full turns.**							
Connect as shown in Fig. 4.	**205.25 MC.**	Connect as shown in Fig. 4 and set controls for a sweep width of 10 Mc. on television channel specified in the next column.	CHANNEL #12 204 to 210 Mc.	Connect a 15K ohm resistor to probe lead of meter and then connect open end of this resistor to junction of .05 Mfd. condenser (#243) and 8.2K ohm resistor (#242) located in the detector plate circuit of the 12AL5 tube. "Common" or "ground" lead of VTVM must be connected to B— line in receiver chassis.	Use coupling network shown in Fig. 2. Connect vertical amplifier "high" lead in series with the 10K ohm resistor to junction of .05 Mfd. condenser (#243) and 8.2K ohm resistor (#242) located in the detector plate circuit of the 12AL5 tube. Connect 'scope ground lead to B— line in receiver chassis.	Receiver Channel Selector Knob set to **Channel #12.** **IMPORTANT** During this step and thruout all succeeding steps of the RF alignment procedure it is necessary to: 1. Keep output of sweep generator at a level that does not allow reading on VTVM to exceed one volt. 2. Keep output of st'd. signal generator at a level that provides a readable marker but does not distort the curve that is being observed on the 'scope.	**Adjust High Band Oscillator Trimmer #14** so that band pass characteristic appears on the 'scope and marker signal is located at approximately the 50% amplitude position on the low frequency side of the curve. Do not attempt to shape the curve with this trimmer—that must be accomplished with the RF trimmers as described in the next step. Before proceeding with the alignment of channel #12 it is necessary to turn the Channel Selector Knob to channel #13 and determine whether that channel can be received when the sweep generator is set for operation on channel #13; marker generator should be set to indicate position of pix. carrier at 211.25 Mc. Adjust channel #13 fine tuning screw (in Channel Selector Mechanism; see Fig. 5) and note whether band pass curve can be centered on horizontal trace line of 'scope. If channel #13 curve can be tuned in, then return the Channel Selector Knob to channel #12 and proceed with next step. If channel #13 cannot be tuned in, then return Channel Selector Knob to channel #12 and repeat the operation described above under the heading "High Band Alignment," however, back off the fine tuning screw 3½ turns instead of 3 turns as originally specified. Then set oscillator trimmer #14 as described in this step and also recheck to see that channel #13 signal comes in when selector is set to that channel.
Same as above.	**205.25 MC.**	Same as above.	CHANNEL #12 204 to 210 Mc.	Same as above.	Same as above.	Receiver Channel Selector Knob set to Channel #12.	**Adjust High Band RF Trimmers #15 and #16** for properly shaped overall band pass characteristic as illustrated in Fig. 10. If marker signal for picture carrier is not located at the 50% amplitude position, change setting of oscillator trimmer #14 so that pattern shifts in desired direction.

(Continued on next page)

STANDARD SIGNAL GENERATOR		SWEEP GENERATOR		VTVM CONNECTIONS	OSCILLOSCOPE CONNECTIONS	MISCELLANEOUS INSTRUCTIONS	TYPE OF ADJUSTMENT AND OUTPUT INDICATION
CONNECTIONS	FREQUENCY	CONNECTIONS	FREQ.				

(Continued from preceding page)

IMPORTANT: When adjusting trimmers #15 and #16 it will be noted that the band pass characteristic can be broadened by sacrificing amplitude. It is undesirable to overly broaden the curve as that would result in a loss of sensitivity. Band width specified in Fig. 10 must not be exceeded if proper sensitivity is to be achieved.

The band pass characteristics of channels #7, 8, 9, 10, 11 and 13 should now be checked successively without disturbing the settings of the high band trimmers. Adjust the RF sweep generator and marker generator for operation on each of these channels with marker set at picture carrier frequency (see table on first page for pix. carrier frequency of each channel). Band pass characteristic of these channels should conform to the curves shown in Fig. 10. If one or two channels have a slightly peaked response, it is desirable to have the peak fall on the sound carrier side rather than the picture carrier side. A compromise on the magnitude of the peak can be obtained by returning to channel #12 and lowering the response on the side of the characteristic which tends to rise when the tuner was previously set to lower channels.

LOW BAND ALIGNMENT

After the tuning slugs have been positioned as described in step #3 at the head of this chart, leave Channel Selector set to channel #6. The fine tuning screw in the Channel Selector Mechanism (see Fig. 5) must now be correctly positioned. Turn this screw **clockwise** until tuner actuating plate (shown in Fig. 5) has moved back as far as it will go and presses against its mechanical stop—do not force screw beyond this point. **Then, back off the fine tuning screw by rotating it counter-clockwise 1 full turn.**

STD. SIG. GEN. CONNECTIONS	FREQUENCY	SWEEP GEN. CONNECTIONS	FREQ.	VTVM CONNECTIONS	OSCILLOSCOPE CONNECTIONS	MISCELLANEOUS INSTRUCTIONS	TYPE OF ADJUSTMENT AND OUTPUT INDICATION
Connect as shown in Fig. 4.	83.25 MC.	Connect as shown in Fig. 4 and set controls for a sweep width of 10 Mc. on television channel specified in the next column.	CHANNEL #6 82 to 88 Mc.	Connect a 15K ohm resistor to probe lead of meter and then connect open end of this resistor to junction of .05 Mfd. condenser (#243) and 8.2K ohm resistor (#242) located in the detector plate circuit of the 12AL5 tube. "Common" or "ground" lead of VTVM must be connected to B— line in receiver chassis.	Use coupling network shown in Fig. 2. Connect vertical amplifier "high" lead in series with the 10K ohm resistor to junction of .05 Mfd. condenser (#243) and 8.2K ohm resistor (#242) located in the detector plate circuit of the 12AL5 tube. Connect 'scope ground lead to B— line in receiver chassis.	Receiver Channel Selector Knob set to Channel #6. **IMPORTANT** During this step and thruout all succeeding steps of the RF alignment procedure it is necessary to: 1. Keep output of sweep generator at a level that does not allow reading on VTVM to exceed one volt. 2. Keep output of st'd. signal generator at a level that provides a readable marker but does not distort the curve that is being observed on the 'scope.	**Adjust Low Band Oscillator Trimmer #20** so that band pass characteristic appears on the 'scope and marker signal is located at approximately the 50% amplitude position on the low frequency side of the curve. Do not attempt to shape the curve with this trimmer—that must be accomplished with the RF trimmers as described in the next step. Before proceeding with the alignment of channel #6 it is necessary to turn the Channel Selector Knob to channel #2 and determine whether that channel can be received when the sweep generator is set for operation on channel #2; marker generator should be set to indicate position of pix. carrier at 55.25 Mc. Adjust channel #2 fine tuning screw (in Channel Selector Mechanism; see Fig. 5) and note whether band pass curve can be centered on horizontal trace line of 'scope. If channel #2 curve can be tuned in, then return the Channel Selector Knob to channel #6 and proceed with next step. If channel #2 cannot be tuned in, then return Channel Selector Knob to channel #6 and repeat the operation described above under the heading "Low Band Alignment," however, back off the fine tuning screw ¾ turn instead of 1 turn as originally specified. Then set oscillator trimmer #20 as described in this step and also recheck to see that channel #2 signal comes in when selector is set to that channel.
Same as above.	83.25 MC.	Same as above.	CHANNEL #6 82 to 88 Mc.	Same as above.	Same as above.	Receiver Channel Selector Knob set to Channel #6.	**Adjust Low Band RF Trimmers #21** and **#22** for properly shaped overall band pass characteristic as illustrated in Fig. 10. If marker signal for picture carrier is not located at the 50% amplitude position, change setting of oscillator trimmer #20 so that pattern shifts in desired direction.

IMPORTANT: When adjusting trimmers #21 and #22 it will be noted that the band pass characteristic can be broadened by sacrificing amplitude. It is undesirable to overly broaden the curve as that would result in a loss of sensitivity. Band width specified in Fig. 10 must not be exceeded if proper sensitivity is to be achieved.

The band pass characteristic of channels #2, 3, 4 and 5 should now be checked successively without disturbing the settings of the low band trimmers. Adjust the RF sweep generator and marker generator for operation on each of these channels with marker set at picture carrier frequency (see table on first page for pix. carrier frequency of each channel). Band pass characteristic of these channels should conform to the curves shown in Fig. 10. If one or two channels have a slightly peaked response, it is desirable to have the peak fall on the sound carrier side rather than the picture carrier side. A compromise on the magnitude of the peak can be obtained by returning to channel #6 and lowering the response on the side of the characteristic which tends to rise when the tuner was previously set to lower channels.

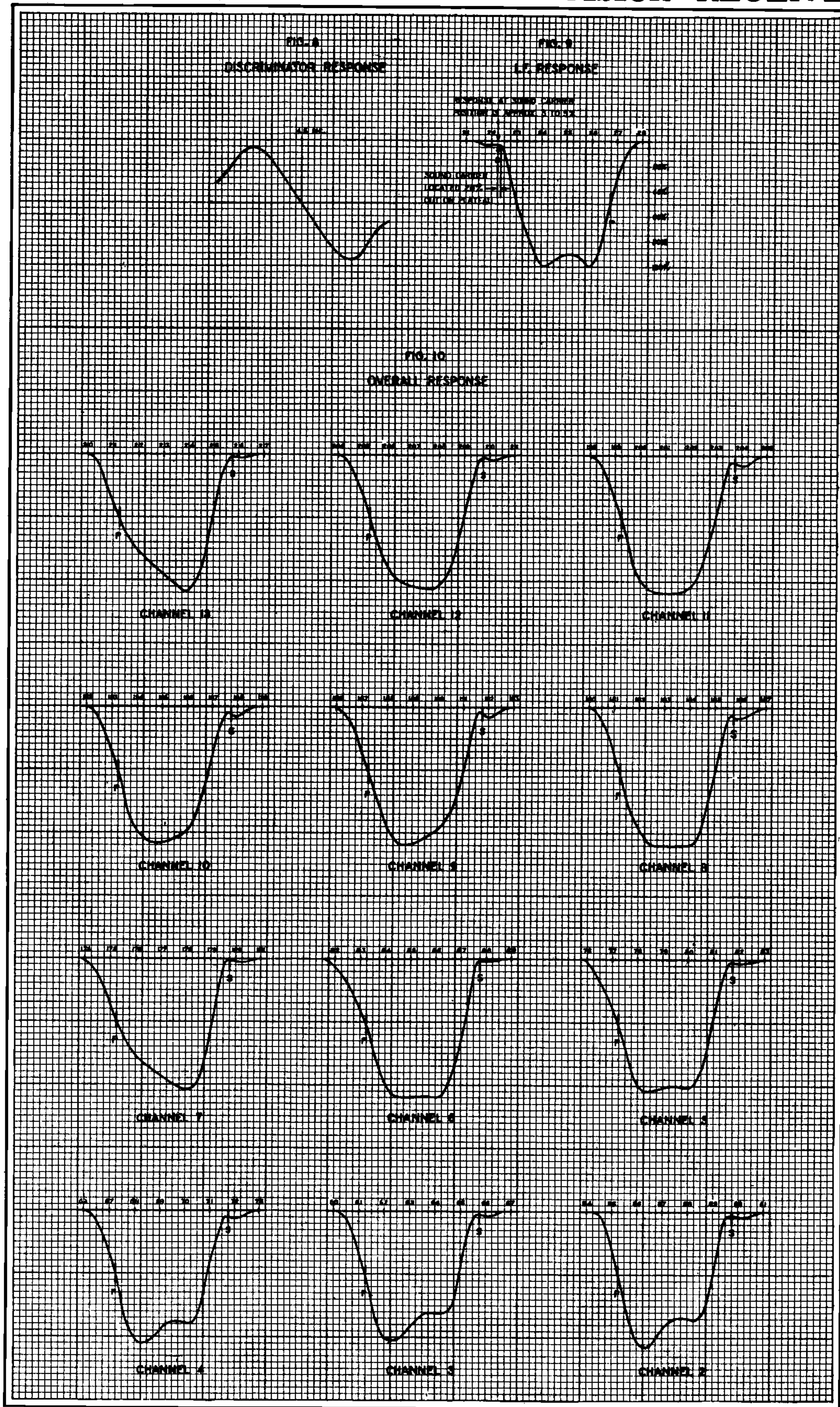
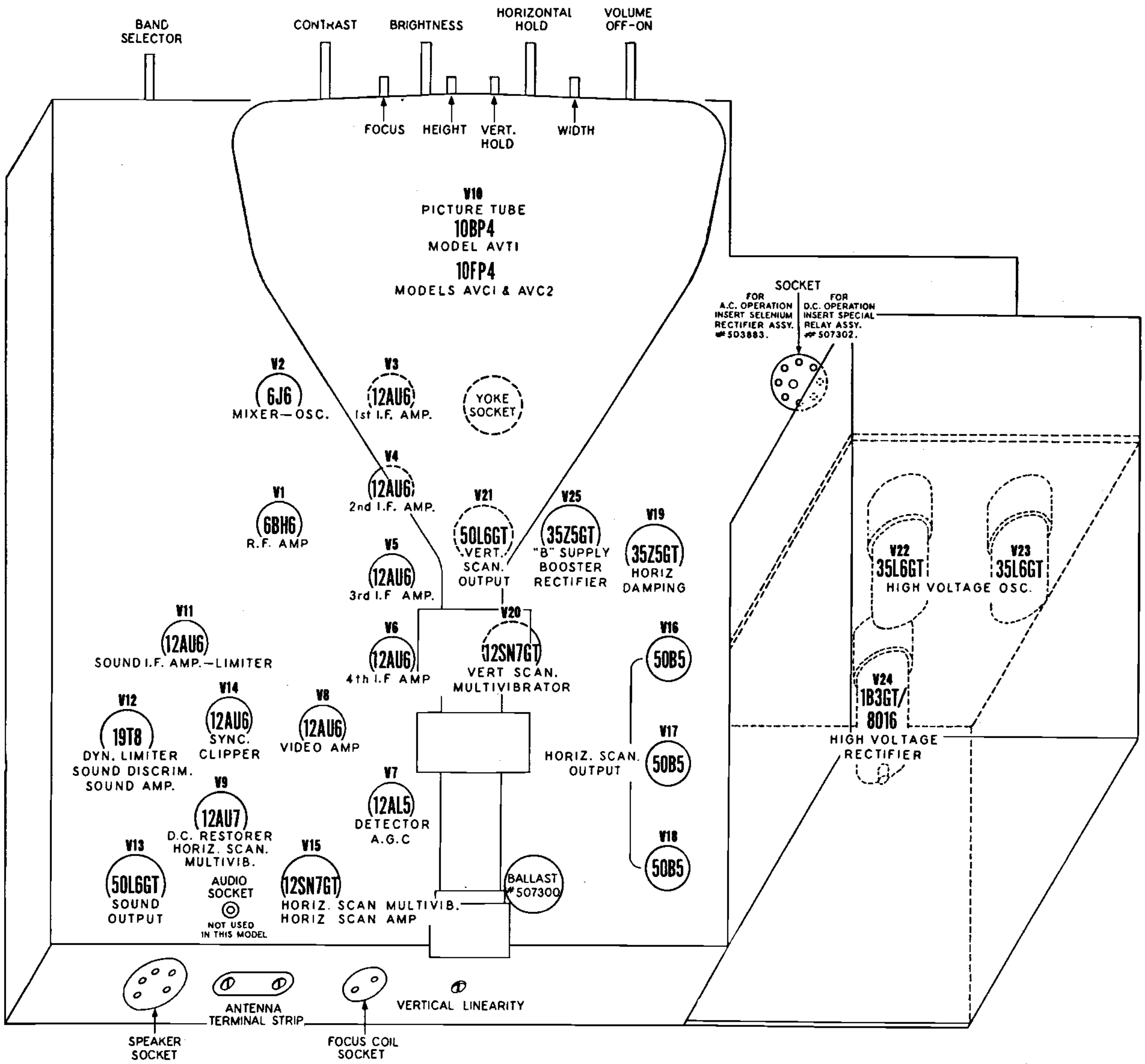


FIG. 8
DISCRIMINATOR RESPONSE
FIG. 9
I.F. RESPONSE
SOUND CARRIER
FIG. 10
OVERALL RESPONSE
CHANNEL 13
CHANNEL 12
CHANNEL 11
CHANNEL 10
CHANNEL 9
CHANNEL 8
CHANNEL 7
CHANNEL 6
CHANNEL 5
CHANNEL 4
CHANNEL 3
CHANNEL 2

MOST-OFTEN-NEEDED 1949 TELEVISION RECEIVERS

TUBE LOCATIONS AND FUNCTIONS



STEWART SW WARNER

CAUTION

This chassis has its B- system connected directly to one side of the AC power line. Therefore the following precautions must be observed before making connections to test instruments during service operations. Failure to do so may result in severe shock if contact is made between test equipment and "earth" ground or, a short circuit might occur if ground terminal of test equipment is connected to "earth" ground.

1. **Connect an AC voltmeter between B- of receiver chassis and an "earth" ground (radiator, water pipe, etc.). If meter reading is not zero, reverse receiver power cord plug at wall receptacle.**
2. **Connect an AC voltmeter between ground terminal of test instrument and an "earth" ground (radiator, water pipe, etc.). If meter reads FULL LINE VOLTAGE, reverse instrument power cord plug at wall outlet. If meter reads 60 volts or less, do not disturb instrument power cord plug.**
3. **Ground terminal of test instrument may now be connected to B- system of receiver.**

The foregoing precautions could be avoided if an isolation transformer is connected between receiver power cord and power supply outlet.

*If receiver is to be used for operation from a DC power supply, remove selenium rectifier assembly (see 288 and 289 on circuit diagram) and insert DC polarizing relay 507302 by plugging it into the same socket.

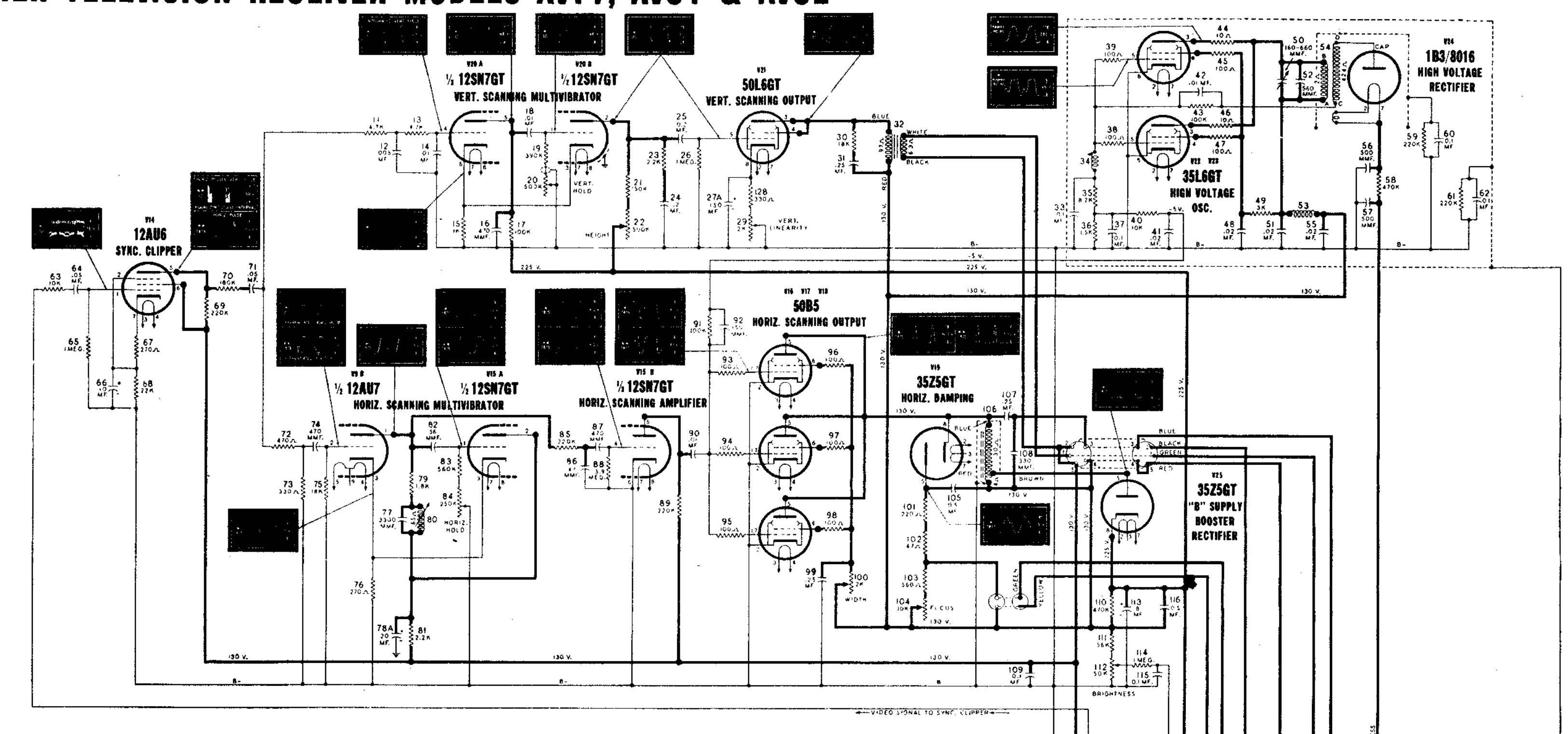
STEWART-WARNER TELEVISION RECEIVER MODELS AVT1, AVC1 & AVC2

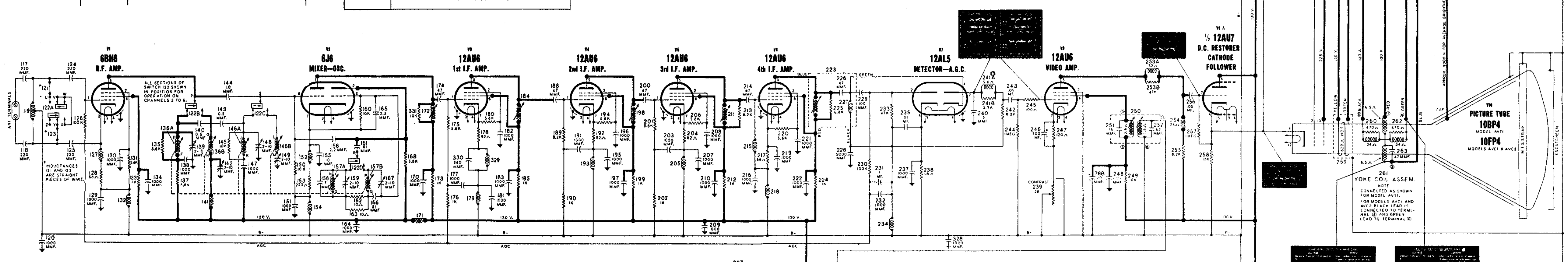
PRODUCTION CHANGES

The following tabulation furnishes complete details on changes which occurred during production. Sequence of these changes is indicated by reverse order alphabetical coding; that is, "SERIES Z", "SERIES Y", etc., stamped on back surface of chassis. Therefore, it should be understood that a "SERIES Y" chassis would be of later type than a "SERIES Z".

The circuit shown on this page applies to "SERIES W" chassis.

CHANGE DESIGNATION STAMPED ON CHASSIS	DESCRIPTION OF CHANGE
UNCODED	INITIAL PRODUCTION
"SERIES Z"	1. Condenser 52 in High Voltage power supply changed from 430 Mmfd to 560 Mmfd. 2. Condenser 92 (150 Mmfd) added in parallel with resistor 91 (100K ohms) in grid circuit of Horizontal Sweep output stage. 3. Resistor 89 in plate circuit of tube V15B (12SN7GT) changed from 33K ohms to 220K ohms. 4. Resistor 85 in grid circuit of tube V15B (12SN7GT) changed from 120K ohms to 220K ohms. 5. Condenser 86 in grid circuit of tube V15B (12SN7GT) changed from 82 Mmfd to 47 Mmfd. 6. Resistor 83 in grid circuit of tube V15A (12SN7GT) changed from 470K ohms to 560K ohms. 7. Resistor 73 in grid circuit of tube V9B (12AU7) changed from 180 ohms to 330 ohms. 8. Resistor 79 in plate circuit of tube V9B (12AU7) changed from 33K ohms to 1.8K ohms. 9. Coil 80 and Condenser 77 (3300 Mmfd), connected in parallel, were added in plate circuit of tube V9B (12AU7). 10. Condenser 228 in output circuit of last I.F. stage changed from 1000 Mmfd to 5000 Mmfd. 11. Choke coil 171 added in series with B+ line to R.F. amplifier and Oscillator stages. 12. Choke coil 270 added in series with filament supply line to tubes V11 (12AU6) and V25 (35Z5GT). 13. Condenser 272 (220 Mmfd) added from pin 3 of tube V11 (12AU6) to ground. 14. Resistor 19 in grid circuit of tube V20B (12SN7GT) changed from 470K ohms to 390K ohms. 15. Movable arm of Vertical Hold potentiometer connected to B— instead of to Cathode (pin 3) of V20 (12SN7GT).
"SERIES Y"	1. Connection from B— to pin 2 of deflection yoke socket (on chassis) was removed. Pins 2 and 5 of this socket were then connected together. This change places vertical deflection coil at same DC potential as horizontal deflection coil, with respect to chassis. 2. Condenser 169 (5 Mmfd) was removed from the circuit. This part was formerly connected from plate (pin 1) of tube V2A (6J6) to chassis ground. 3. Selenium rectifier assembly 288 and 289 was removed from the chassis pan on Console Models AVC1 and AVC2 and mounted on a separate plate which is attached to the cabinet framework. A cable and plug connects rectifiers to socket on chassis.
"SERIES X"	1. Connection of low potential side of Condenser 248 (1000 Mmfd.), located in screen circuit of Video Amplifier tube V8 (12AU6), was changed from B— to chassis ground.
"SERIES W"	1. Resistor 331 (10K ohms) added in parallel with coil 172 (1st I.F.). 2. Trap coil (secondary winding of 2nd I.F. Transformer 184) removed by cutting off top of coil form. Associated condensers 186 (47 Mmfd.) and 187 (trimmer) also removed, thereby eliminating 22.4 Mc trap. 3. Parallel combination of trap coil 329 and condenser 330 (240 Mmfd.) added in cathode circuit of V3 (12AU6), 1st I.F. Amp. stage. 4. Low potential side of resistor 190 (in grid circuit of V4, 12AU6—2nd I.F. Amp.) disconnected from AGC bus and reconnected to B—. 5. Low potential side of resistor 202 (in grid circuit of V5, 12AU6—3rd I.F. Amp.) disconnected from AGC bus and reconnected to B—. 6. Connection from Contrast control 239 to resistors 236 and 238 was removed. This terminal of Contrast control now remains open. 7. Resistor 236 (82K ohms) removed as 130 volt B+ supply to Contrast control is no longer required. 8. Low side of resistor 238 (68 ohms), in cathode circuit of V7, 12AL5, now connected to B—, using pin 2 of V8 (12AU6—Video Amp.) as the B— connection point. 9. Low side of resistor 244 (1 megohm), in grid circuit of V8 (12AU6—Video Amp.), disconnected from cathode return of this tube and reconnected to B—, using suppressor grid, pin 2, as the B— connection point. 10. The following components were relocated and mounted in an auxiliary shield can that attaches to rear surface of chassis; all electrical connections remain unchanged: Horizontal Sync. Coil (80). Condenser (77) 3300 Mmfd. Resistor (79) 1.8K ohms. Condenser (82) 56 Mmfd. Resistor (83) 560K ohms





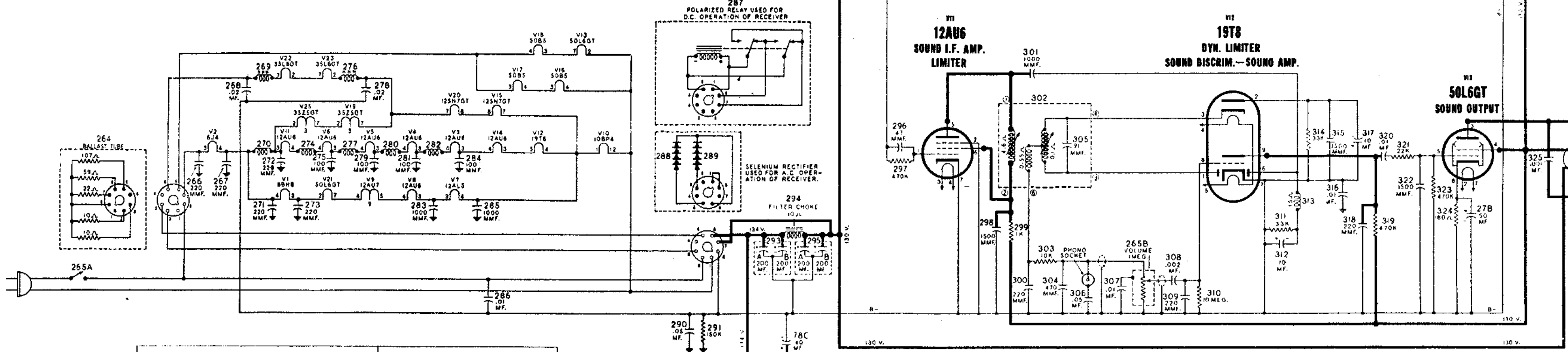
OSCILLOGRAMS

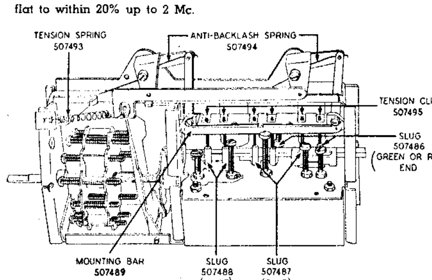
All oscillograms taken with ground lead of 'scope connected to B— (unless otherwise indicated) and with receiver controls set for normal reception of a station transmitting its standard test pattern.

Number appearing below asterisk specifies setting of horizontal sweep frequency control on 'scope.

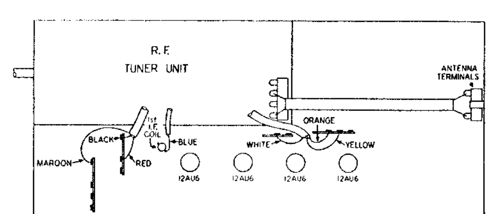
*— This symbol on illustration indicates that wave form was observed on a 'scope whose vertical amplifier had very limited high frequency response (50 to 100 Kc).

**— This symbol indicates that wave form was observed on a 'scope whose vertical amplifier frequency response was flat to within 20% up to 2 Mc.

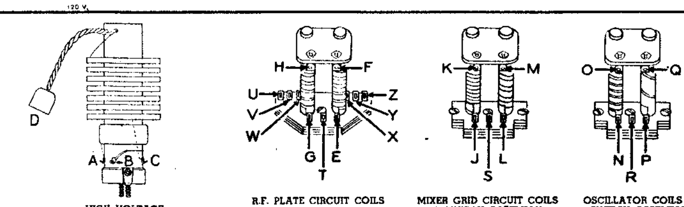




TOP VIEW OF R.F. TUNER UNIT



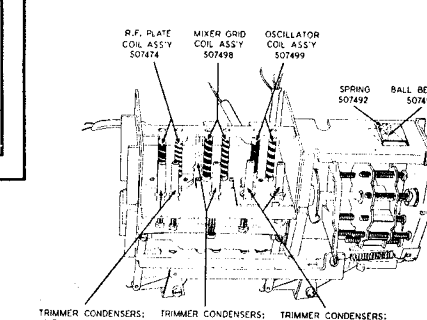
BOTTOM VIEW OF CHASSIS SHOWING CONNECTIONS TO R.F. TUNER UNIT


HIGH VOLTAGE OSCILLATOR COIL 507285

R.F. PLATE CIRCUIT COILS & SWITCH ASSEMBLY 507474

MIXER GRID CIRCUIT COILS & SWITCH ASSEMBLY 507498

OSCILLATOR COILS & SWITCH ASSEMBLY 507499



BOTTOM VIEW OF R.F. TUNER UNIT

MOST-OFTEN-NEEDED 1949 TELEVISION RECEIVERS

ZENITH RADIO CORP.

ZENITH
REG. U. S. PAT. OFF.

TELEVISION RECEIVERS

MODELS 28T925 28T960 28T961 28T962 28T963
CHASSIS 28F20 28F20Z 28F21 28F22

Zenith 28-tube direct view television receivers have many outstanding features. These include gated automatic gain control, turret tuning with replaceable channel strips and main chassis break down into easily interchangeable sub-chassis. Chassis 28F20, 28F21 and 28F22 are identical electrically. The primary differences are in the size and the method of mounting the picture tube. An "A" screen (10FP4, 10BP4) is used in the 28F21 and 28F22 chassis while a "B" screen (12KP4,12LP4) is used in the 28F20 and 28F20Z chassis. Because the 28F22 chassis is used in table model receivers, a specially shielded power transformer is used in the low voltage power supply to prevent magnetic interaction with the receiver sweep circuits.

CONTROLS AND FUNCTIONS

Fig. 2 indicates the various receiver controls. After the receiver has been properly adjusted, the service man should remove the fine tuning, vertical hold, brightness and horizontal hold control knobs. These knobs have a white dot stamped on their periphery and should be re-inserted with the dot facing upward (See fig. 2). This will aid the customer in determining the proper position of the controls should they be accidently moved out of position.

CHANNEL SELECTOR SWITCH. Switches into operating position the R. F. strip which tunes the particular channel selected.

FINE TUNING CONTROL. Provides a means of varying the frequency of the local oscillator to compensate for any frequency changes which may result from tube and circuit variations. When tuning the receiver, three distinct and closely related sound response positions will be found. Adjust the receiver to the center response.

VERTICAL HOLD CONTROL. Provides a means of changing the R. C. time constant in the grid circuit of the vertical blocking oscillator to synchronize the vertical sweep with the transmitted sync pulses. Improper adjustment of this control will cause the picture to roll in the vertical direction.

FOCUS CONTROL. Regulates the magnitude of DC current flow through the focus coil to effect proper focusing of the electron beam on the screen of the picture tube.

VERTICAL CENTERING CONTROL. Regulates the magnitude and polarity of DC current flow through the vertical deflection coils for proper vertical centering of the raster on the picture tube screen.

HORIZONTAL CENTERING CONTROL. Regulates the magnitude and polarity of DC current flow through the horizontal deflection coils for proper horizontal centering of the raster on the picture tube screen.

VERTICAL HEIGHT CONTROL. Effects the vertical sweep amplitude by regulating the plate voltage to the vertical blocking oscillator. This control is used to adjust the vertical size of the raster.

Power Consumption-325 Watts

Antenna Impedance
Balanced 300 ohms.

Power Supply-110V 60 Cycles AC

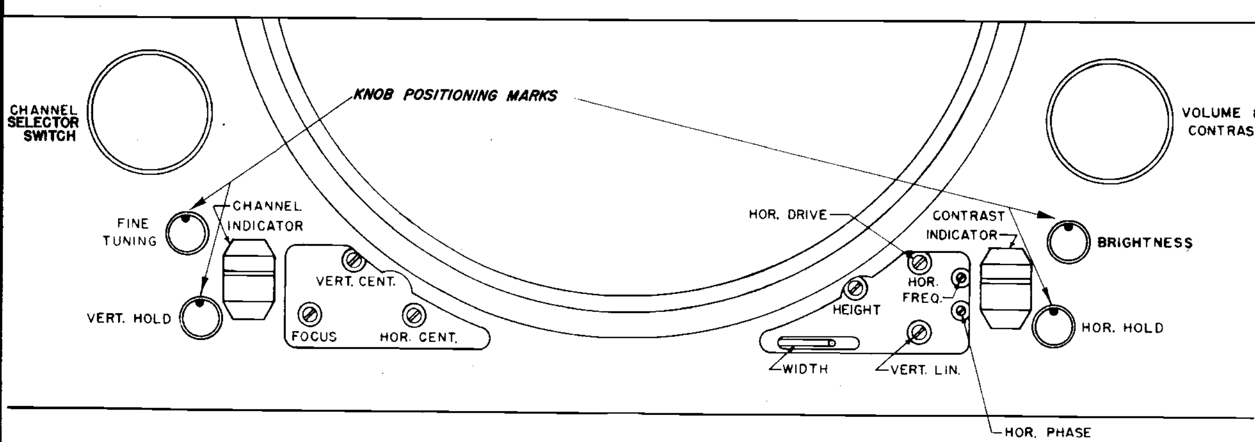


Fig. 2 Front Panel Controls.

CIRCUIT DESCRIPTION

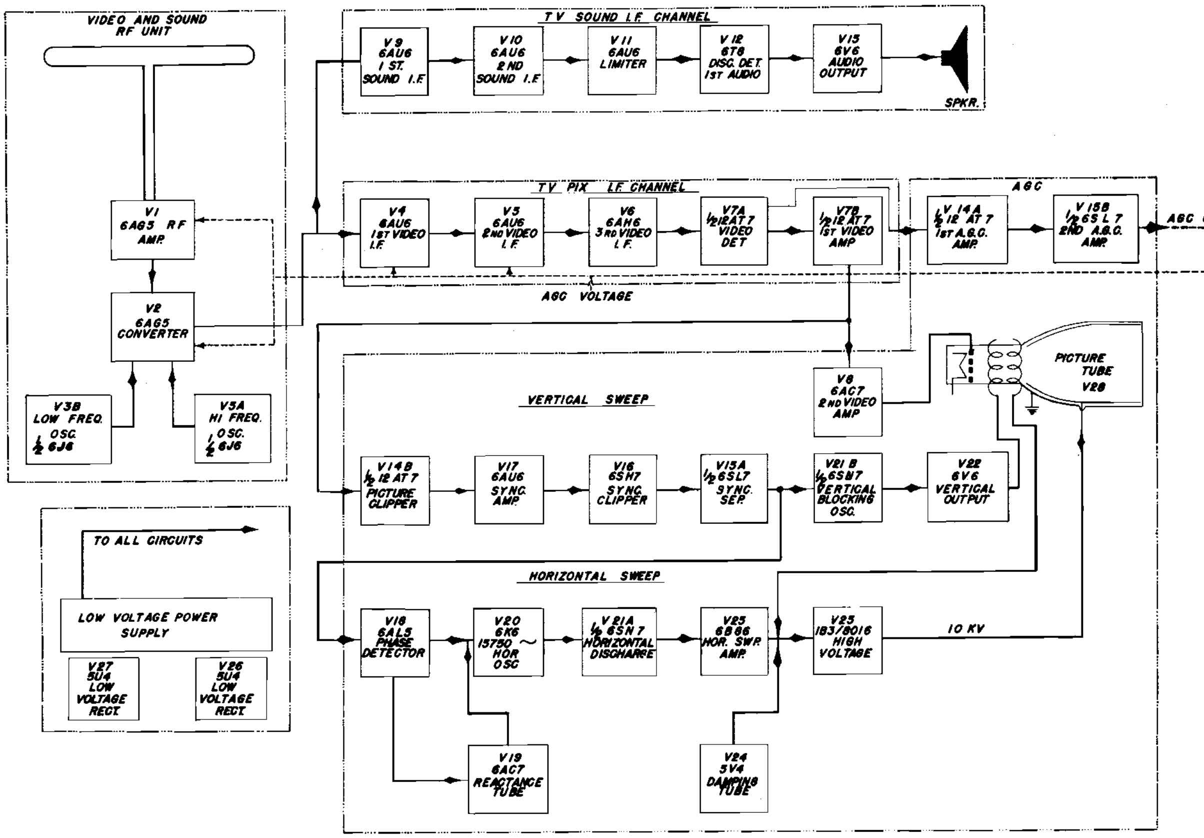


Fig. 16 Block Diagram of Zenith Television Receiver.

THE R. F. SHELF

The three stages of the R. F. shelf consist of a 6AG5 R. F. amplifier V1, 6AG5 converter V2, and a 6J6 R. F. oscillator V3. The 6J6 twin triode tube functions as two separate oscillators. V3A tunes channels 7 to 13 and V3B channels 2 to 6. The oscillator frequency can be changed approximately 1 Mc by the off-set tuning slugs which are attached to the fine tuning shaft. Both the high and the low channel oscillators are pre-set at the factory and adjustment should not be attempted unless a defective part is replaced or the unit has been tampered with. If adjustment becomes necessary, slug L11 trims the low frequency oscillator. The high frequency oscillator trimmer L10 is a slotted disc type control. Adjustment is made by inserting a pointed tool into one of the slots and turning the disc clockwise or counter clockwise (See fig.45). The serviceman is cautioned against making these adjustments unless the oscillator trimmers on the various channel strips cannot be made to resonate at the sound channel frequencies or if the high and low channels cannot be made to fall at the same setting of the fine tuning control.

THE TURRET TUNER

The turret tuner provides a superior method of obtaining positive contact between the various channel strips and the R. F. shelf. The stationary contacts are a part of the R. F. shelf. Guides are provided which properly position the strip contacts prior to their entry into the stationary assembly. The design allows easy replacement of channel strips. When a strip is replaced it should be mechanically aligned with the adjacent strip. If several strips are replaced, the strip positioning guide (See fig. 46), should be adjusted so that it comes in contact with a properly centered strip. This will serve as a guide for any other strip which may be installed. After adjustment, the strip positioning guide must be backed out so that it does not interfere with strip movement.

THE SOUND I. F. CHANNEL

The local oscillator beats against the incoming R. F. signal and produces a sound intermediate frequency of 21.3 megacycles. This signal is coupled through a 21.3 Mc series resonant trap L15, into the sound I. F. amplifier. The small inductance between lugs 2 and 5 of T2 offers a common coupling between the series trap and the sound input coil. The series resonant trap has a very low impedance at the 21.3 Mc frequency, but offers a high impedance to the picture I. F. It thereby serves a dual purpose in that it passes the sound and rejects the picture I. F. The sound I. F. is amplified by the 6AU6 first sound I. F. amplifier V9 and the 6AU6 second sound I. F. amplifier V10. The output from the third I. F. transformer is coupled to the grid of the limiter tube V11 where amplitude variations and noise are removed by driving the tube into plate current saturation so that the input to the discriminator is free from amplitude variations and noise. The discriminator converts the frequency changes into audio, the audio being removed from the full discriminator load, amplified by the 6V6 power amplifier and reproduced by the speaker.

Because the television sound channel is frequency modulated, the intermediate frequency amplifier must be aligned with a FM signal generator to obtain proper band pass with gain.

THE PICTURE I. F.

The picture I. F. sub-chassis consists of a 6AU6 1st picture I. F., 6AU6 2nd picture I. F., 6AH6 3rd picture I. F. and a 12AT7 video detector, 1st video amplifier and noise clipper. Fig. 17 indicates the method of coupling the converter to the 1st picture I. F. It

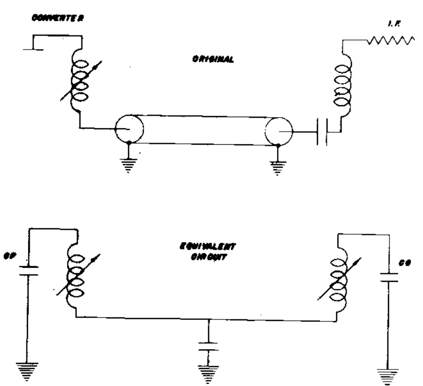


Fig. 17 Converter Coupling into the Picture I. F. Channel.

can be seen that the cable capacity is common to the converter plate and 1st I. F. grid by virtue of the inherent inter-electrode and stray capacities.

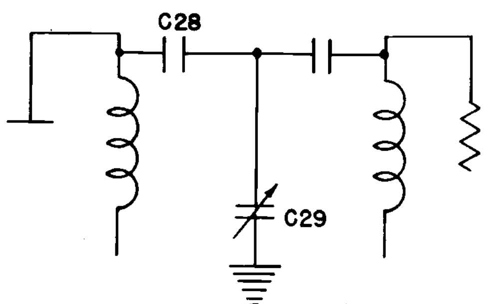


Fig. 18 3rd I. F. Transformer Coupling.

The degree of coupling between the primary and secondary of the 3rd picture I. F. transformer depends on the setting of C29. It can be seen that the I. F. voltage at the plate of V6 is divided across C28 and C29 and the I. F. voltage applied to the grid of the video detector depends on the reactance ratio of the two capacitors. An increase in the capacity of C29 lowers the applied voltage to the grid. While a decrease in capacity increases this volt age.

The 4.5 Mc difference between picture and sound I. F.'s may produce an undesirable voltage into the video amplifier creating a condition where sound could appear in the picture. The 4.5 Mc trap in the cathode circuit of the 1st video amplifier eliminates this possibility.

GATED A.G.C.

The purpose of the automatic gain control is to feed back a negative voltage to the grids of the R. F. and I. F. amplifier tubes to automatically control their gain. Strong signals do not overload the receiver because they develop considerable feedback voltage and reduce the sensitivity of the receiver. Weak signals feed very little voltage to the grids and the sensitivity of the R. F. and I. F. stages is at maximum.

With ordinary A.V.C. circuits, as used in broadcast receivers, the average of the rectified signal voltage is taken from the detector and fed back to the R. F. - I. F. grids. With a television receiver it is impossible to use the average signal because the amplitude is constantly changing with picture content. The components in the video signal which have a relatively constant amplitude are the sync pulses. These are maintained at a level approximately 20 to 25% above the blanking and video level (See fig. 19). Because the amplitude of the sync pulses is relatively constant, they are used to control the gain of a television receiver.

Ordinary methods of A.G.C. have certain disadvantages which have been overcome by using the gated system. If the automatic gain control is not gated, it remains open to noise impulses which can have an amplitude as great, and in some cases, greater than the sync pulses. The average voltage developed by the noise pulses creates a false A.G.C. voltage where the noise rather than the signal can be the controlling factor.

The superior A.G.C. circuit in this receiver consists of a cathode follower V14A, and a cathode coupled grounded grid amplifier V15B, which obtains its plate voltage (15.75 Kc sine wave) from the horizontal oscillator. The sync pulses which are applied to the grid of V14A are negative with respect to its cathode. As the sync pulse amplitude increases, with an increase in signal input, the grid is driven more negative resulting in less plate current flow and consequently less voltage drop across the cathode resistor R40. Since the bias of V15B is developed across this resistor, the reduction of the voltage drop causes V15B to conduct more current which in turn leads to the development of additional negative feedback voltage for application to the R.F. and I. F. grids. The application of the 15.75 Kc sine wave voltage to the plate of V15B, allows the tube to conduct during the positive half cycles. This is an "open gate" condition and exists at any time that the combined sine wave and sync pulse amplitude makes the plate of V15B positive with respect to its cathode. During this conduction period (open gate period) A.G.C. voltage is developed across C53. The brief period of time that the gate is open is slightly longer than the 5 microseconds duration of the horizontal pulse. However, during the comparatively long interval of time between pulses, the gate is closed and noise pulses can have no effect on the A.G.C.

The primary advantage of the gated A.G.C. system is its relative immunity to noise. Another advantage is the fact that short time constants are used which enable the A.G.C. to follow much faster changes in amplitude such as those developed by airplane reflections. The long time constants in conventional A.G.C. systems cannot follow such rapid changes in amplitude and undesirable effects such as picture "breathing" result.

THE SYNC SEPARATOR

The purpose of the sync separator circuit, which consists of V14B

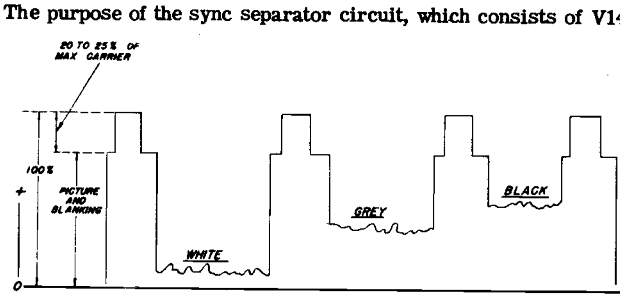


Fig. 19 The Composite Video Signal.

picture clipper, V17 sync amplifier, V16 sync clipper and V15A sync separator, is to remove the picture element from the 60 cycle vertical and 15.75 Kc horizontal sync pulses. The pulses must be free from noise and picture before they are applied to the integrating and differentiating circuits. Since the sync pulses are 20 to 25 per cent higher in amplitude than the blanking-video signal (See fig. 19), the tubes are sufficiently biased so that the lower amplitude picture signal cannot produce a plate current change and consequently does not appear in the output. The higher amplitude sync pulses, however, overcome the bias, produce a change in the plate current and appear in the output. The picture clipper V14B removes the greatest portion of picture signal from the sync pulses. The sync amplifier V17 amplifies and inverts the output from the picture clipper. Some picture and noise is still present in the output, the noise being removed by the 47 MMF high cut capacitor (C61) from plate to cathode of V17. The low frequency boost circuit, which consists of the 10,000 ohm resistor R53 and the .1 MFD capacitor C58 in the plate circuit, raises the plate impedance at the vertical sync frequency in order to clip the vertical sync pulses at a more noise-free level. The input of the sync clipper V16, contains a relatively small amount of picture component. A combination of fixed and self bias causes complete re-

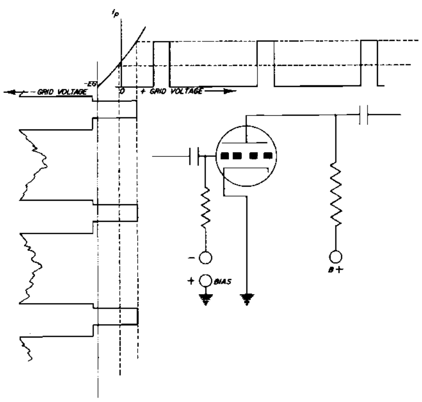


Fig. 20 Stripping Sync Pulses from Picture and Blanking Component.

jection of the picture signal which remains and only the sync pulses appear in the output. The polarity of the output voltage is negative. Because of the reversal through the sync separator tube V15A, the required positive pulses appear at the plate for triggering the blocking oscillator. The horizontal sync input is fed into the phase detector through the 150MMF capacitor (C77) and the vertical input to the integrating circuit through the 10,000 ohm resistor R53.

THE VERTICAL SWEEP

The purpose of the vertical sweep is to gradually move the electron beam from the top to the bottom of the picture tube as it is swept from left to right by the horizontal sweep. It requires approximately 15,500 microseconds for the beam to move from the top of the picture tube to the bottom and approximately 1,166 microseconds to again return to the top for the next field. This period of time is the retrace and is blanked out. The frequency of the vertical sweep is 60 cycles. Because the 15.75 Kc horizontal triggering must never stop, even during the vertical retrace, the vertical pulses are serrated so that they continue triggering the horizontal oscillator. Since the horizontal sweep continues, the beam does not go directly from the bottom of the picture tube to the top during the retrace. It is zig-zagged back to the top by action of the horizontal sweep. The retrace can be observed by reducing the contrast and advancing the brilliance control. Six equalizing pulses precede and follow the serrated vertical pulse to stabilize the circuits before and after the vertical sync pulse.

Both the horizontal and vertical pulses enter the integrating and filter network which consist of three 8,200 ohm resistors R5 and three .0047 MFD capacitors C65. Because of the long time constant in the integrating circuit, the short duration horizontal sync and vertical equalizing pulses have very little effect on developing a charge across the integrating capacitors (See fig. 23). The slight charge that does develop leaks off during the interval of time between pulses and for all practical purposes, has no effect. The serrated vertical pulse, on the other hand, has a time duration of approximately 190 microseconds and very little time interval between pulses. Each pulse charges the integrating capacitor to a higher potential until the voltage becomes high enough, and properly shaped, to trigger the blocking oscillator.

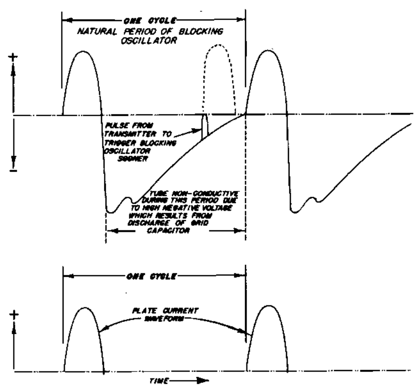


Fig. 21 Grid Voltage and Plate Current Wave Forms of Blocking Oscillator.

The blocking oscillator V21B is designed so that its natural frequency corresponds to the approximate vertical frequency of 60 cycles. Its frequency of oscillation is determined by the RC time constant of the .01 MFD capacitor C66 and the resistance in the grid circuit which consists of the VERTICAL HOLD CONTROL R60 and the 1 megohm resistor R59. The VERTICAL HOLD CONTROL is adjusted to fire the blocking oscillator earlier than at its natural frequency, the time being determined by the vertical sync pulses from the transmitter. The circuits must be arranged so that the oscillator is triggered solely by the vertical synchronizing pulses and not from any other source such as noise, etc. When the positive sync pulse from the integrating and filter circuits appears at the grid of the blocking oscillator, the tube conducts heavily and its plate voltage is induced into the grid by transformer action through T7. This makes the grid more positive and causes grid current flow which develops a bias voltage across the grid resistor, charging the .01 MFD capacitor to the value of the bias voltage. When the bias voltage becomes sufficiently high, plate current cut-off occurs. The charge on the .01 capacitor gradually diminishes but because of the Rc time constant the tube remains cut-off until the next positive pulse starts conduction and the next cycle.

The vertical saw-tooth voltage is developed across the .047 MFD vertical charge discharge capacitor C60. When plate current cut-off occurs, there is no appreciable voltage drop across the plate load resistor, which consists of the VERTICAL SIZE CONTROL R62 and 470,000 ohm series resistor R59. Because there is no voltage drop the capacitor charges to nearly full plate potential in approximately 15,500 microseconds. This is the sweep portion of the saw-tooth voltage. When the vertical sync pulse causes the blocking oscillator to conduct again, the capacitor discharges through the internal resistance of V21B. This is the retrace and occurs in approximately 1,166 microseconds. The 8,200 ohm resistor R47, in series with the charge discharge capacitor, shapes the voltage so that it will have a combination of saw-tooth and pulse which is necessary to produce a saw-tooth

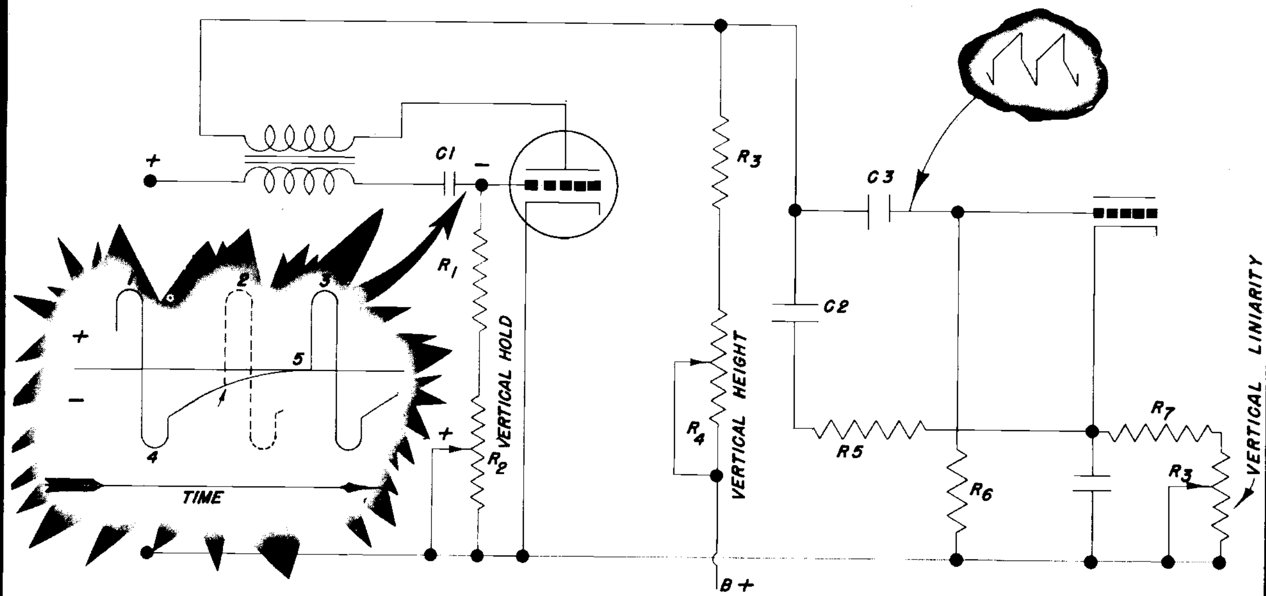


Fig. 22 Development of the Sweep Voltage by the Blocking Oscillator.

current through the deflection coils (See fig.25). The 6V6GT-G vertical amplifier develops the relatively high current for deflecting the beam.

The 5,000 ohm VERTICAL LINEARITY CONTROL R67, shifts the operating point of the tube so that the sweep is amplified along that portion of the plate current curve which results in a linear output.

Because the impedance of the vertical deflection coils is high at the 15.75 Kc horizontal frequency, two 560 ohm damping resistors R38, are shunted with the windings to prevent interaction between the two sweep voltages.

THE HORIZONTAL SWEEP

The purpose of the combined horizontal sweep circuits is to develop a saw-tooth current through the horizontal deflection coils which produces a magnetic field that moves the electron beam horizontally across the picture tube. The horizontal synchronizing pulses from the transmitter must solely control the sweep. Noise pulses must be discriminated against so they are unable to produce triggering, and cause erratic operation and instability. The saw-tooth voltage originates in the plate circuit of the 6SN7GT horizontal discharge tube V21A. The horizontal discharge tube could be triggered by noise as well as sync pulses. This very undesirable factor is overcome by designing the sweep so that the frequency and not the amplitude of the transmitted sync pulses control it. The frequency control circuit consists of a 6K6GT 15.75 Kc horizontal oscillator V20, a 6AL5 phase detector V18 and a 6AC7 reactance tube V19. The reactance tube, which is in parallel with the 15.75 Kc horizontal oscillator resonant circuit, acts as a shunt reactance and affects the frequency of oscillation. The amount of shunt reactance depends on the mutual conductance of the tube, which in turn, is dependent on the grid voltage. A change of .5 volts on the oscillator grid produces a corresponding frequency change of approximately 100 cycles. Normally the reactance tube is biased at -2.4 volts. Study of the circuit indicates that this bias is in series with the DC output from the phase detector V18, and that the phase detector output voltage affects the reactance tube grid voltage.

The sync pulses from the sync separator V15A are applied through the 75 MMFD capacitor C73 to the center tap of the phase detector winding. Fig.24 indicates how the sync pulses are super-imposed on the 15.75 Kc sine wave. Although the amplitude of each individual sine wave and sync pulse remains the same, the combined pulse and sine wave amplitude changes with difference

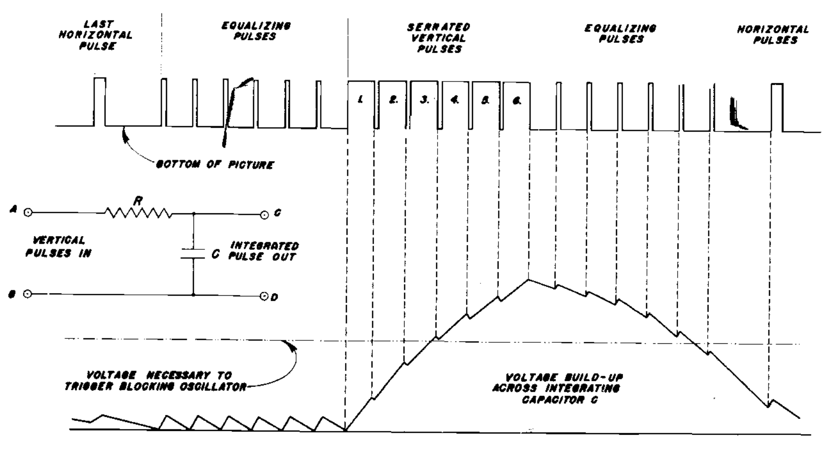


Fig. 23 The Effect of Vertical Synchronizing Pulses on the Integrating Capacitor.

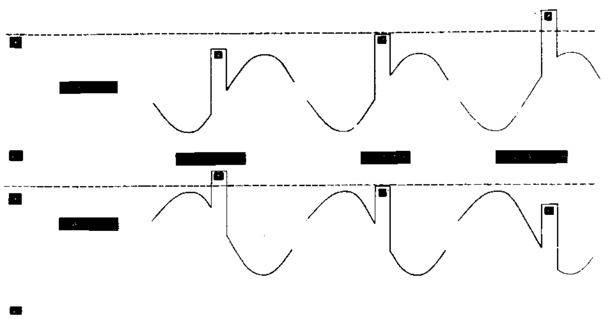


Fig. 24 Voltage at the Plates of the Phase Detector.

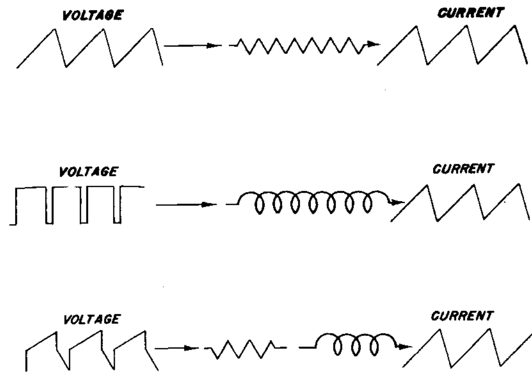


Fig. 25 Voltage Wave Forms Necessary to Produce Saw-Tooth Current Through a Resistance, Inductance and Combination of Resistance and Inductance.

in phase. At resonance, the horizontal oscillator is properly phased with the sync pulses and the amplitude at A and B is equal (reference broken line.) Each diode conducts equally and the DC voltages across the two load resistors are the same but opposite in polarity. The resultant voltage across the full load (cathode to cathode) is zero. Since the output is zero, no change in grid voltage occurs and results in no oscillator frequency change. Under "frequency high" condition, the horizontal oscillator frequency is above that of the incoming sync pulses and the plate of the upper diode has a higher combined sine wave sync pulse amplitude than the lower diode. This results in more current flow in the upper diode circuit and a resultant positive difference voltage across the phase detector load. The positive voltage adds to the -2.4 V fixed bias and makes the grid more negative causing the shunt reactance to increase by the amount necessary to lower the frequency of the horizontal oscillator. Under "frequency low" condition, the lower diode conducts more current and the difference voltage is negative. This voltage subtracts from the -2.4 bias and makes the grid of the reactance tube less negative. A reduction in the shunt reactance occurs causing an increase in the frequency to correspond with the incoming sync pulses.

The HORIZONTAL HOLD CONTROL R73, which is connected from the grid of the horizontal oscillator to chassis, has a slight effect on the natural frequency of the oscillator. It is used to adjust the oscillator frequency to approximately that of the sync pulses after which the phase detector and the reactance tube assume control.

The output from the plate of the horizontal oscillator is a flat topped wave which is differentiated for triggering the discharge tube. A saw-tooth voltage is developed by charging and discharging the 600 MMFD capacitor C79. The capacitor charges when the grid of the V21A becomes highly negative, due to the charge accumulated by the grid capacitor C83, and cuts off plate current flow. Since the tube does not draw plate current when cut off, there is no appreciable voltage drop across the 680,000 ohm plate load resistor R20 and the capacitor charges to approximately full plate potential. It is the linear charge of this capacitor that produces the trace portion of the saw-tooth voltage. When the positive half of the pulse appears at the grid, V21A conducts heavily and C79 discharges through it. The charge of the capacitor is the trace, and the discharge is the retrace. Study of fig. 25 indicates the type of pulses necessary to produce a saw-tooth current through an inductance. The voltage and current through a resistance is in phase and a saw-tooth voltage is necessary to produce a saw-tooth current. Since an inductance has inherent resistance, the voltage wave form must be a combination of saw-tooth and pulse to produce a saw-tooth current through the deflection coils. This wave is formed by the 8,200 ohm resistor R47 which is in series with the charge discharge capacitor C79 and the 25,000 ohm HORIZONTAL DRIVE CONTROL R77.

THE HIGH VOLTAGE POWER SUPPLY

The 10,000 volt DC supply for the second anode of the picture tube is developed by the 6BG6 horizontal sweep amplifier V23, and its associated output transformer and high voltage rectifier. The power supply is the kick back type in which the high voltage is developed during the 7 microsecond retrace of the horizontal sweep when the deflection coil current suddenly collapses. The saw-tooth current which produces the sweep, flows for approximately 53 microseconds. This is the approximate time required to move the beam from the left to the right side of the picture tube. After the sweep reaches the right side of the picture tube, the tube is blanked out and the current suddenly collapses. This sudden collapse of current through the deflection coils generates a 15.75 Kc voltage which is greatly stepped up by auto-transformer action. A low voltage winding supplies filament current for the 1B3GT high voltage rectifier V25, where rectification develops the 10,000 volts DC for the second anode of the picture tube. Because of the high ripple frequency, very little filtering is necessary. The 500 Mmfd 15 Kv capacitor, which is also used to mount the 1B3GT socket, the 470,000 ohm resistor and the capacity formed by the inner and outer coating on the picture tube adequately filter the high voltage.

When servicing the high voltage power supply, extreme care must be exercised to avoid contact with the second anode high potential. A well insulated vacuum tube voltmeter, which has a 10 Kv range, may be used to measure the high potential. Failure in any section of the 15.75 Kc horizontal sweep circuit may cause the supply to be inoperative. If the difficulty is not obvious, circuit tracing should begin at the 6K6 horizontal oscillator, through the 6SN7 horizontal discharge tube and the 6BG6 horizontal amplifier. The 6BG6 plate voltage must be measured at terminal 4 on T 11. Do not measure the voltage at the plate of the tube because the voltage at this point is extremely high due to the inductive build-up through the transformer. The 5V4 damping tube V 24, adds an additional 80 volts to the plate voltage of the 6BG6 horizontal amplifier. Failure of this tube will greatly reduce the high voltage output.

THE DAMPING TUBE

The linear rise of current through the horizontal deflection coils moves the electron beam from the left to the right side of the picture tube in approximately 53 microseconds. The current must then return to its starting value in approximately 7 microseconds to produce the retrace. This sudden collapse of current through an inductance, produces an oscillatory condition (See fig. 26) which would destroy the linearity of the sweep and must be removed by the damping tube V24. When the plate of the damping tube becomes more positive than the cathode, conduction occurs which heavily loads the circuit and prevents the undesirable oscillation. As a result of the conduction, a DC potential of approximately 80 volts is developed and stored in the .25 MFD capacitor. This voltage is added to the plate voltage of the 6BG6 horizontal amplifier and raises its potential from 400 to 480 volts for greater output and better performance.

THE VIDEO AMPLIFIER

The output from the video detector ranges in frequency from 30 cycles to approximately 4 Mc. Since the output is very low, it must be amplified by the video amplifier without appreciable loss to the higher video frequencies. The high frequency response of a video amplifier is limited by the impedance which the inter-electrode and stray capacities of tubes and circuits produce. Since the capacitive reactance decreases as the frequency increases, the higher frequencies could be relatively "shorted out" unless the effect of the undesirable capacities is removed. This is accomplished by inserting series and shunt peaking coils L21. L22, L68, L69 and L70, to cancel the effect of the distributed capacities. The peaking coils form a series resonant circuit in which the capacitive reactance is cancelled by the inductive reactance. In addition to the peaking coils, the plate load resistors are of low value so that their impedance at the highest video frequencies is approximately that introduced by the stray capacities. Use of peaking coils and low plate load resistors allows the video amplifier to have a reasonably flat frequency response to 4 Mc.

The 1st video amplifier V7B also acts as a noise clipper. The tube is biased so that noise pulses do not produce a plate current change and, consequently, do not appear in the output. The video signal, which appears at the grid of the 2nd video amplifier V8, has an AC component (See fig. 27). It must be restored to its DC component before being applied to the picture tube grid. DC restoration is made possible by operating the 2nd video amplifier at zero bias, allowing the video signal to produce proportional grid current flow and develop an automatic bias which allows only the DC component to appear at the output (See fig. 27). In order to maintain the DC component, the plate of the 2nd video amplifier is directly coupled to the grid of the picture tube.

The CONTRAST CONTROL R46, in the plate circuit of the 12AT7 1st video amplifier, regulates the magnitude of the signal applied to the grid of the picture tube. The BRIGHTNESS CONTROL R50, regulates the grid bias of the picture tube. The CONTRAST and BRIGHTNESS controls must be varied simultaneously to obtain the greatest contrast between black and white components of the picture.

THE BEAM BENDER

The electron gun of a picture tube emits both electrons and ions. The ions are much heavier than the electrons and if allowed to bombard the picture tube fluorescent screen, damage in the form of a burn could occur.

Picture tubes, such as the 10FP4 and 12KP4, are constructed with a metal backing directly behind the fluorescent screen. The high velocity electrons penetrate the backing and strike the fluorescent screen. Low velocity ions cannot penetrate the backing and do not reach the fluorescent screen where damage could occur.

Picture tubes, such as the 10BP4 and 12LP4 do not have a metal backing behind the fluorescent screen and if the ions were allowed to bombard the screen, a brown burn spot would result. To prevent this condition, the electron gun of these tubes is slightly bent so that the ion and electron stream is directed at the neck rather than at the screen of the tube. The beam bender, which is a permanent magnet fitted around the neck of the tube, bends the electrons back into their proper axis so that they strike the screen. The heavier ions are not affected by the magnetic field and do not reach the screen.

The beam bender has an identifying arrow stamped on it. When it is installed, the arrow must point towards the face of the picture tube. To make the adjustment, move and slightly rotate the beam bender along the neck of the tube until the brightest picture appears. It may be necessary to readjust the focus and intensity controls during the adjustment.

THE FOCUS COIL

DC current flow through the focus coil develops a magnetic field which is parallel to the electron beam in the picture tube. As long as the parallel condition exists, the magnetic field remains uncut by the electrons and has little effect. If the electrons diverge from the parallel path, the magnetic field is cut and counters to force them back into their proper axis. An improperly adjusted focus coil causes the electron beam to hit the neck rather than the face of the picture tube, causing the corners of the raster to be shadowed. Adjustment of the focus coil is as follows:

When interchanging picture tubes, it may be necessary to change the position of the focus switch (See fig. 1) to affect proper focusing.

1. Check the vertical and horizontal centering to see that the raster is properly centered.

2. Loosen the focus coil wing nuts (See fig. 1) and turn the coil until the full raster, free from corner shadows, appears on the picture tube.

3. Tighten wing nuts after adjustment.

VERTICAL CENTERING CONTROL

The vertical centering control R68 changes the polarity and magnitude of DC current flow through the vertical deflection coils. Current flow develops a magnetic field which shifts the raster in a vertical plane. Since the 20 ohm centering control is in series with the 400 volt supply, current flow through the various circuits in the receiver produces the necessary voltage drop across it.

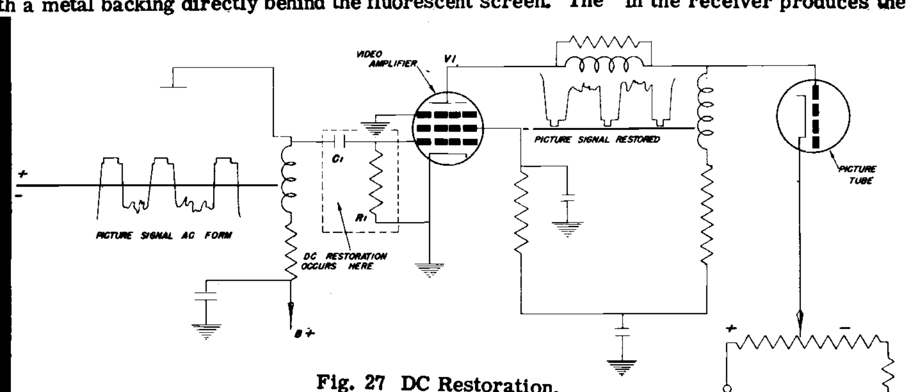


Fig. 27 DC Restoration.

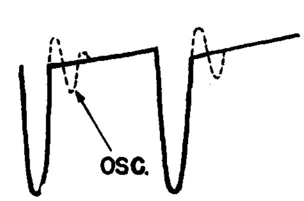


Fig. 26 Oscillation Removed by Damping Tube.

Because the centering voltage is obtained from the center tap and arm of the control, voltage to the deflection coils can be positive, negative or zero, depending on the position of the arm.

THE HORIZONTAL CENTERING CONTROL

The horizontal centering control R81 regulates the polarity and magnitude of DC current flow through the horizontal deflection coils. The current flow develops a magnetic field which shifts the electron beam for proper horizontal centering of the picture. Two voltages which are in opposition, produce the current flow. Voltage #1 is developed by the damper tube V24 and voltage #2 results from the drop across the 100 ohm centering control. Since the voltages are in opposition, current flow can be reversed by adjusting the centering control so that the difference voltage is either negative or positive.

THE WIDTH CONTROL

The horizontal output voltage appears between terminals 1 and 3 on the output transformer T11. A portion of the secondary winding is shunted by a variable inductance L71 which is the width control. Varying the position of the slug changes the shunt inductance and results in changing the magnitude of sweep voltage across the horizontal deflection coils. As the shunt inductance increases, the output voltage increases and the pattern widens horizontally. When the slug is removed from the coil, the shunt inductance is at minimum and the voltage and pattern width is minimum.

ADJUSTMENTS

A.G.C. ADJUSTMENT

The performance of the A.G.C. circuit is checked or adjusted by applying a known value of voltage into the video detector output jack "S" and observing the corresponding voltage at the A.G.C. output jack "C". To make the adjustment proceed as follows:

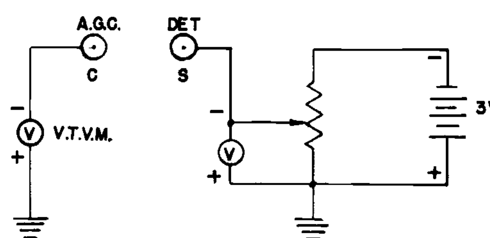


Fig. 28 Connections for A.G.C. Adjustment

1. Turn the station selector switch to an unused (numbered) channel, disconnect the antenna leads and short circuit the antenna terminals.

2. Plug the negative lead of the S-15370 alignment fixture into jack "S" and the positive lead to chassis. The fixture connections remain in this position for the remaining steps.

3. Adjust the fixture control for -1.5V indication at jack "S".

4. Adjust AGC delay control R40 (See fig. 31) for a -3.8V V.T.V.M. indication at jack "C".

5. Readjust fixture voltage at jack "S" to -1V. The corresponding voltage at jack "C" should be -0.5 to -2.

6. Readjust fixture voltage at jack "S" to -2V. The corresponding voltage at jack "C" should be -5 to -7.5V

HORIZONTAL FREQUENCY AND PHASE ADJUSTMENTS

The HORIZONTAL FREQUENCY adjustment L74 (See fig.2 resonates the horizontal oscillator at 15.75 Kc. When properly adjusted, loss of horizontal sync should not occur regardless of the HORIZONTAL HOLD CONTROL setting. To make the adjustment, see that the picture is locked vertically and proceed as follows:

1. Turn the HORIZONTAL HOLD fully counter clockwise.

2. Adjust HORIZONTAL FREQUENCY until the picture "locks" in sync.

3. Turn the HORIZONTAL HOLD fully clockwise and observe that the picture remains "locked". If loss of sync occurs when the selector switch is turned to another channel and returned, a slight readjustment is necessary.

The HORIZONTAL PHASE CONTROL adjusts the phase detector input and affects the position of the picture on the raster. When turning the adjustment screw L73, the picture moves to the left or right side of the raster. Proper adjustment is indicated when the picture is moved farthest to the right. A broad peak is noted at this point.

ALIGNMENT

SPECIAL ALIGNMENT FIXTURES

S-15369 BALANCE TRANSFORMER - Used to match the 50 ohm Mega-Sweep unbalanced output to a 300 ohm receiver antenna input. Can also be used for matching a coaxial type antenna transmission line to a 300 ohm receiver input.

S-15370 BIAS TEST FIXTURE - (Plugs into test jacks at rear of receiver chassis), provides an adjustable bias variable from 0 to 3.0 volts for use during alignment and A.G.C. adjustment.

S-15371 CONVERTER COUPLING RING - Made to fit around converter tube for the purpose of injecting an I. F. signal into the grid during alignment.

S-15372 R. F. ALIGNMENT FIXTURE - Used for the separate alignment of turret tuner R. F. strips.

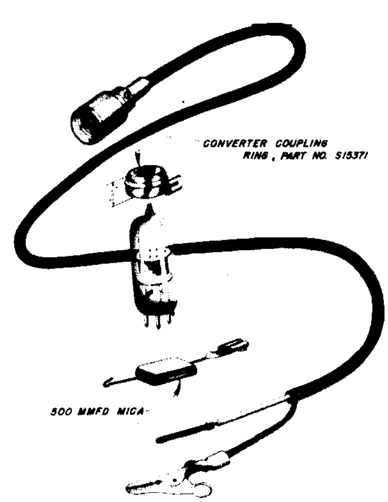
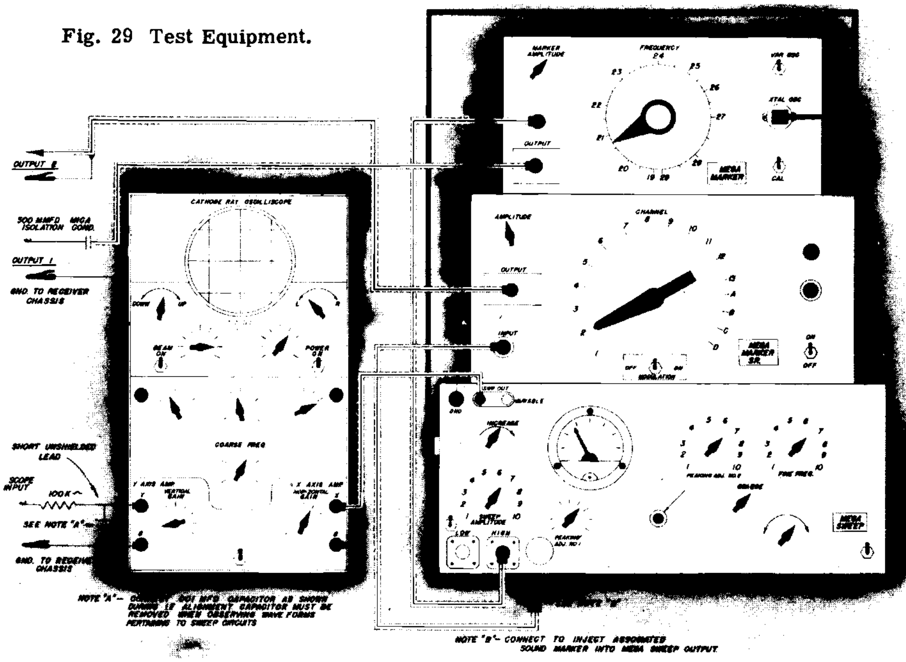
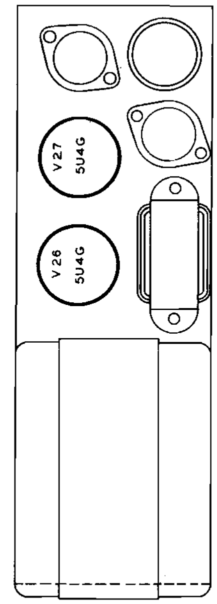


Fig. 30 Connectors.

Fig. 29 Test Equipment.





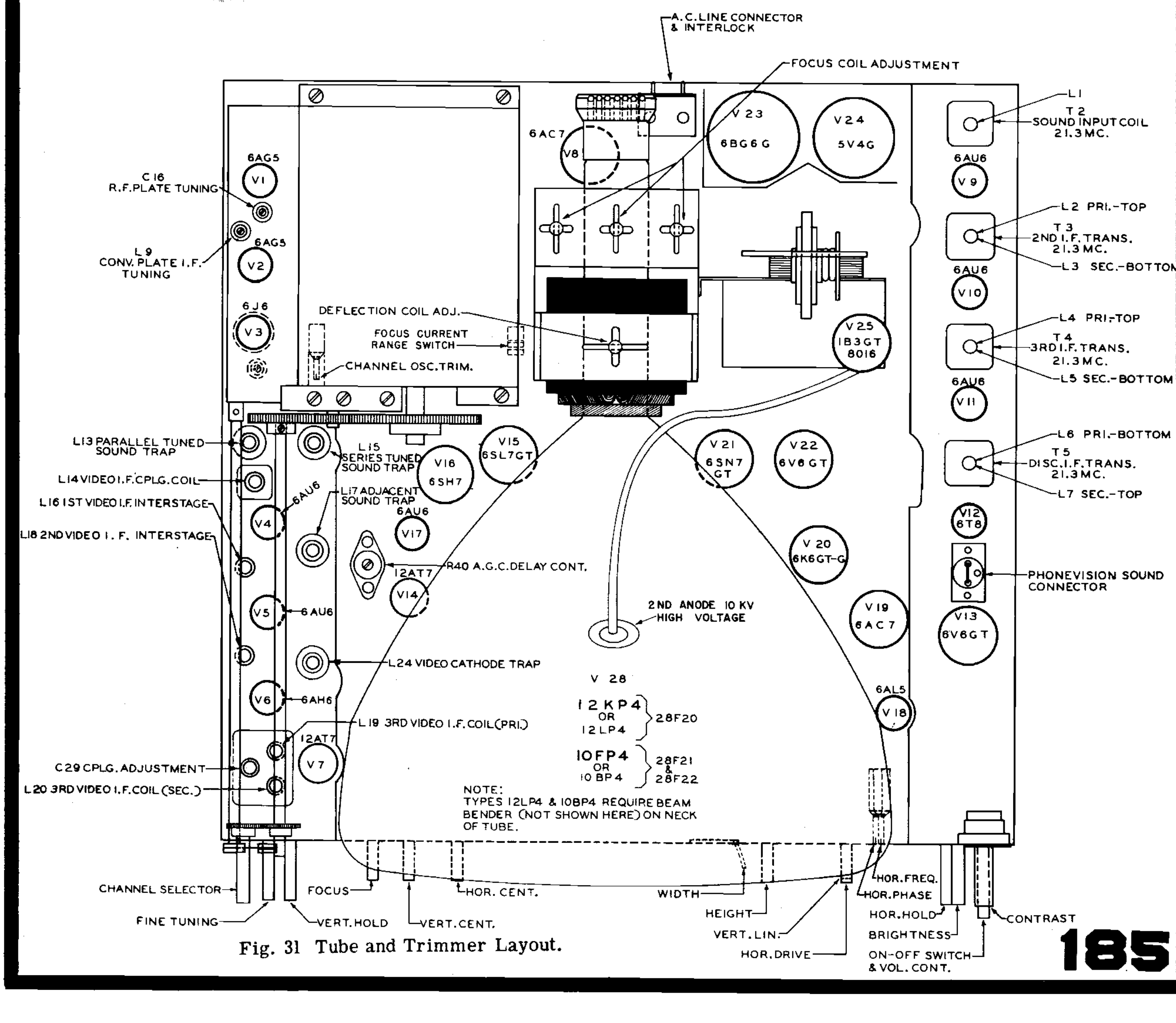
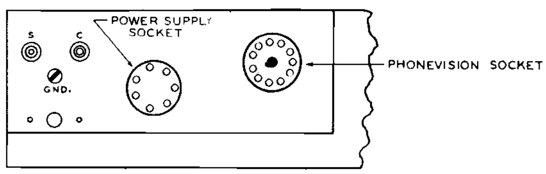


Fig. 31 Tube and Trimmer Layout.

PICTURE I. F. ALIGNMENT

Set up the equipment as indicated in fig.29. Connect output #1 to point F (picture I.F. strip) and chassis. Remove the AGC tube V14 and connect the negative side of a 1.5 volt bias battery to jack "C" and the positive side to chassis. See fig.37 for bias and scope connections. If the S15370 alignment fixture is available it should be adjusted to 1.5 volts and substituted for the battery. Connect the oscilloscope between jack "S" and chassis.



Adjust the Mega-Sweep for maximum output and turn the coarse frequency adjustment control until pattern is centered on the oscilloscope screen. It is possible to get two modes of operation from the Mega-Sweep. Select the mode which sweeps from low to high frequency. When the proper mode is selected the low frequency portion of the I.F. response curve will appear on the left side of the scope screen. Adjust the vertical gain on the scope and the Mega-Sweep sweep amplitude control, until a sizeable pattern is obtained on the oscilloscope screen (See fig.32). The scope vertical gain is now the reference point and must not be changed for the remaining adjustments. The horizontal gain control must be adjusted so that both ends of the sweep are visible on the scope. After these initial adjustments have been made, proceed as follows:

1. Set the Mega-Marker to 21.6 Mc and adjust L19 and L20 until the two over-coupled response curves are equal in amplitude with the low frequency peak corresponding to the 21.6 Mc marker. To avoid distortion, always use minimum marker amplitude. Set the Mega-Marker to 25.9 Mc and adjust C29 until the high frequency peak corresponds to 25.9 Mc. Check the 21.6 Mc peak and repeat operation if necessary.

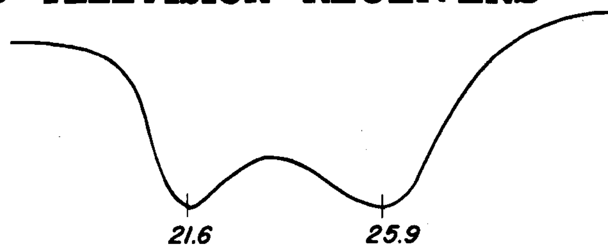


Fig.32 3rd Picture I. F. Response.

2. Connect output #1 between point G and chassis. Reduce the Mega-Sweep gain until the pattern on oscilloscope is the same amplitude as in Step 1. Set the Mega-Marker to 25.3 Mc and adjust L18 until the I. F. peak corresponds to the 25.3 Mc marker.

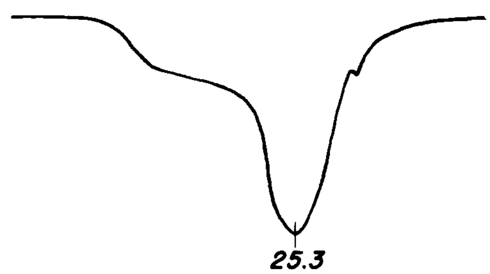


Fig.33 2nd Picture I. F. Response.

3. Connect output #1 between point H and chassis. Reduce the Mega-Sweep gain as in Step 2. Set the Mega-Marker to 22.2 Mc and adjust L16 until the low frequency peak corresponds to 22.2 Mc. The high frequency peak falls at approximately 25.1 Mc. Set the Mega-Marker to 27.3 Mc and adjust trap, L17 for minimum marker indication. Always use maximum marker amplitude for trap adjustments.

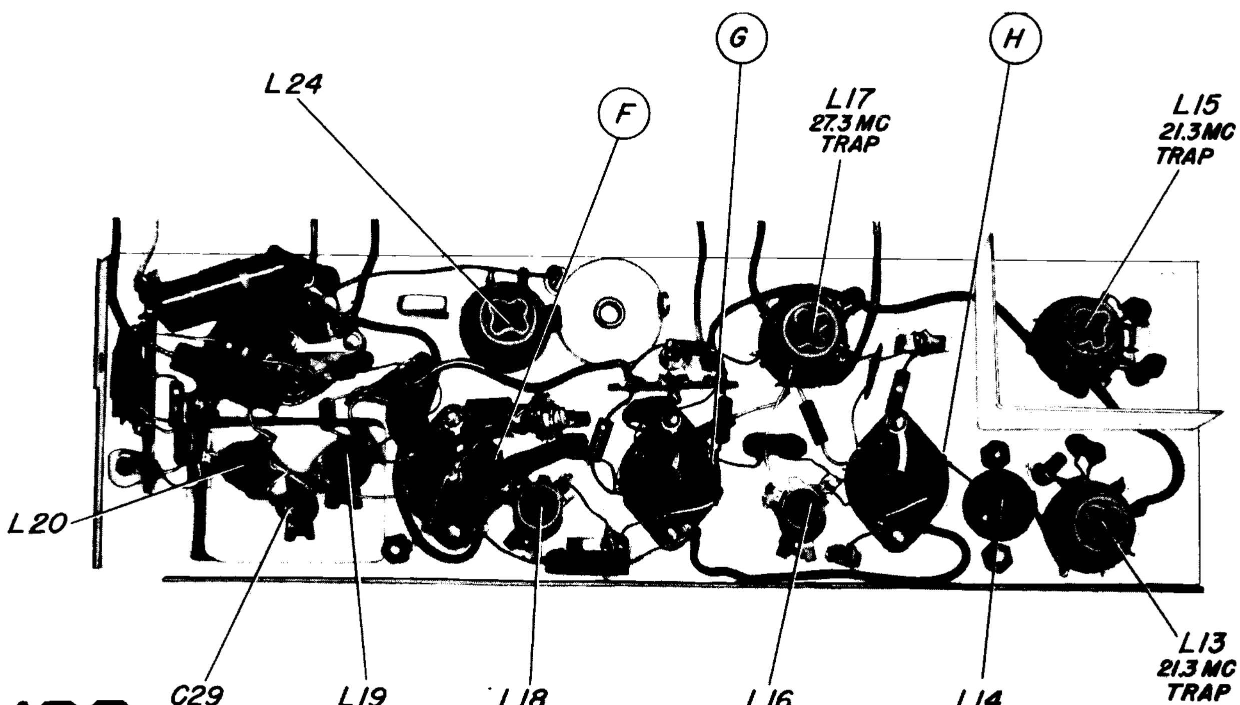


Fig. 35 Picture I. F. Sub-Chassis.

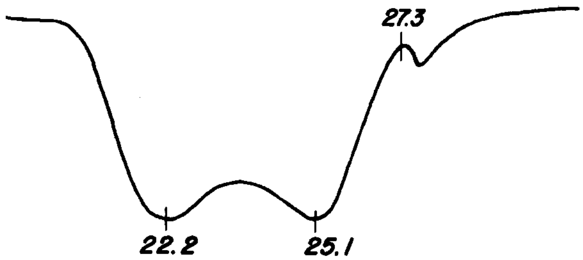


Fig. 34 1st Picture I. F. Response.

4. Connect output #1 to the converter coupling ring, Part #S15371 and fit the ring over the 6AG5 converter tube. Because of the low coupling capacity, it will be necessary to increase the Mega-Sweep output in order to obtain a sizeable pattern on the scope. Set the Mega-Marker to 21.3 Mc and adjust traps L13 and L15 for minimum indication on the scope. Adjust L14 and L9 (on RF shelf) alternately until the response curve has a reasonably flat top. Set the Mega-Marker to 25.8 Mc and check the half-way and other points indicated by the over-all response curve.

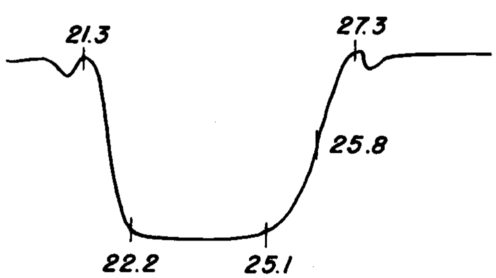


Fig. 36 Over-All Picture I. F. Response.

SOUND I. F. ALIGNMENT

The 21.3 Mc. sound I. F. transformers are of the type indicated in fig. 40. A special adjustment wrench, Part No. 68-7 is available for alignment work. Extreme care must be exercised when aligning these transformers to keep the adjustment slugs in the approximate relationship to the coils as in fig. 40. If care is not exercised, it is possible to advance the top slug beyond and the bottom slug above its associated coil. This would result in an

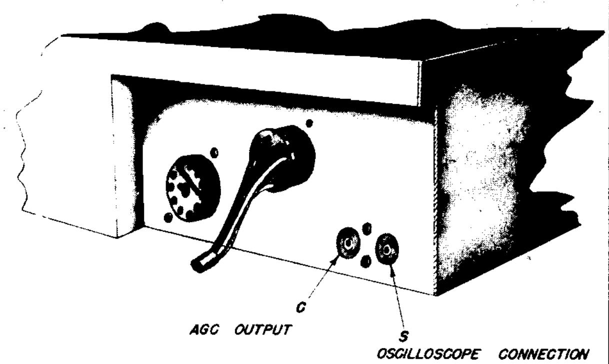


Fig. 37 Test Jacks.

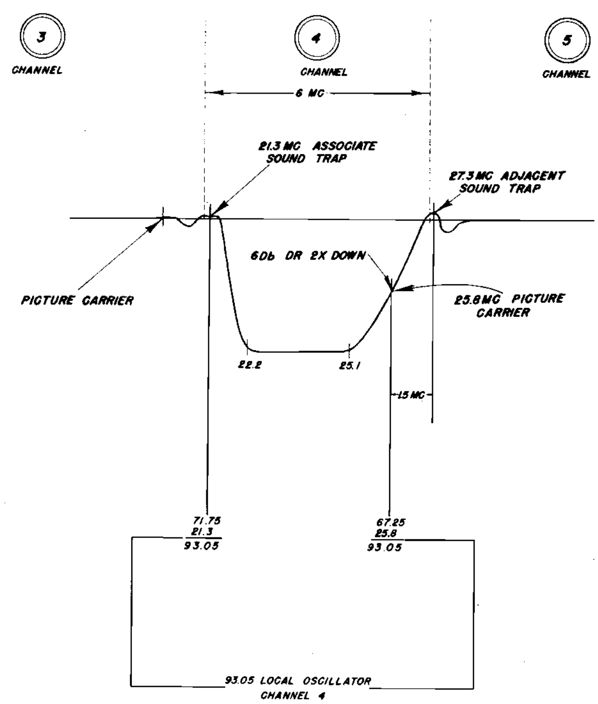


Fig. 38 Converter and I. F. Frequencies.

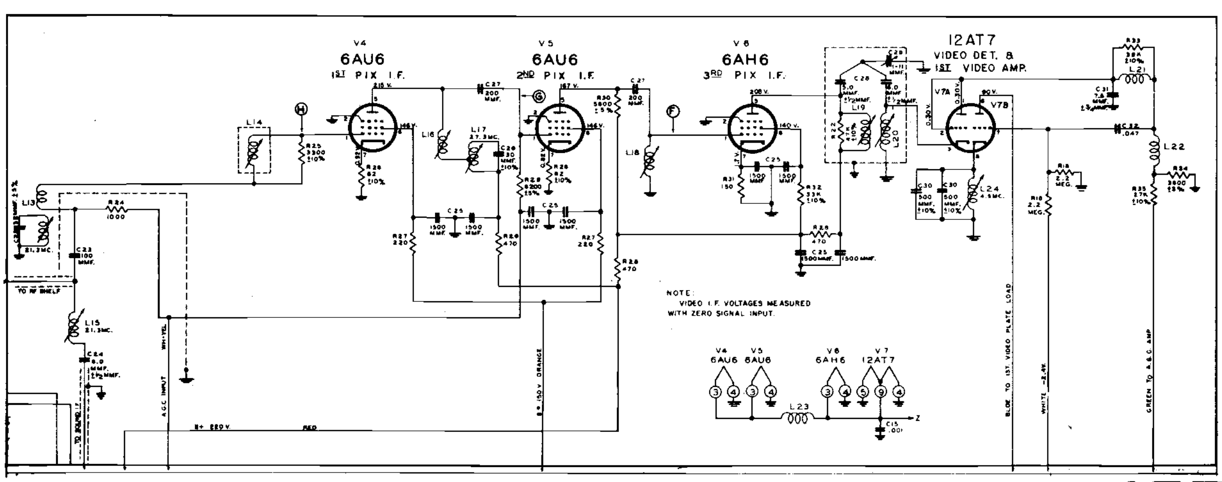


Fig 39 Schematic Diagram Picture I. F. Channel.

incorrect coefficient of coupling, unstable and improper alignment. Always keep the alignment tool in a vertical plane when adjustments are being made. If this is not done the undesirable situation may arise where both slugs are turned simultaneously. To align the sound I. F. channel, set up the equipment as indicated in fig.29 and proceed as follows:

1. Connect the oscilloscope point "A" to chassis (full discriminator load.) Connect output #1 to point "C" and chassis (limiter grid.) Adjust the Mega-Sweep coarse frequency and sweep amplitude controls for a sizeable pattern, (See fig.41) on the scope. Set the Mega-Marker to 21.3 Mc. Always use as little marker amplitude and R. F. input as necessary to obtain a satisfactory indication on the scope. Adjust L6 and L7 to obtain a symmetrical discriminator response curve with the 21.3 Mc marker falling at the center reference line. The peak to peak discriminator width should be approximately 450 Kc.

2. Connect the scope to point "B" and chassis (limiter grid.) Connect output #1 to point "D" (grid, 2nd I. F.) to chassis. Adjust L4 and L5 for symmetry and gain with the 21.3 Mc marker falling at the center of the response curve (See fig.42).

3. The scope connection remains at point "B". Connect output #1 to point "E" (1st I. F. grid) and chassis and adjust L2 and L3 as in Step 2.

4. The scope connection remains at point "B". Connect output #1 to the S-15371 I. F. coupler ring and place coupler over the converter tube. Advance Mega-Sweep gain and adjust L1 as in Step 2.

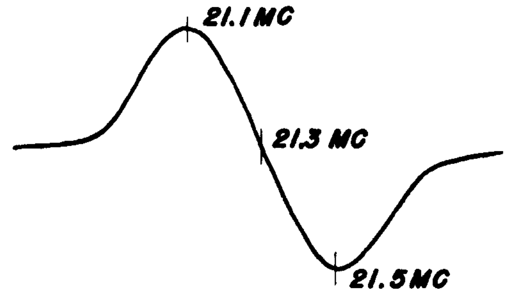


Fig.41 Output From Discriminator

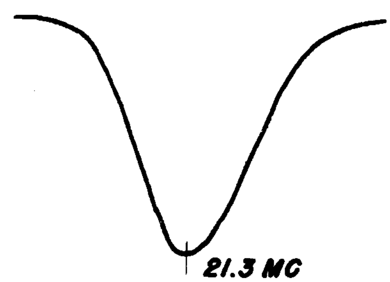


Fig.42 Sound I. F. Response

R. F. OSCILLATOR AND ANTENNA ALIGNMENT

The various oscillator circuits are adjusted by connecting output #2 (See fig.29) to the antenna terminals of the receiver. A vacuum tube voltmeter is connected across the full discriminator load Point "A" (fig.43) to chassis. If the chassis is in the cabinet, the meter can be connected to the phonevision connector on the sound chassis or the white lead on the volume control (rear section of dual control). After the equipment is set up, proceed as follows:

1. Set the receiver channel selector switch and the Mega-Marker Sr. to channel 10. Turn the receiver fine tuning control for zero indication on the meter. It will be noted that the meter indicates a positive or negative voltage as the oscillator is tuned through resonance. Proper adjustment is the zero point between the two peaks.

Normally it will be unnecessary to adjust the high frequency oscillator trimmer L10 (See fig.45). However, if it is impossible to resonate channel 10, with the fine tuning control, a slight adjustment may be necessary. To make this adjustment, turn the receiver fine tuning control until the eccentric tuning slug holding screw faces upward. Insert a pointed tool into one of the adjusting slots and move the disc until resonance is obtained. After channel 10 is adjusted, the position of the fine tuning control must remain unchanged during the remaining adjustments.

2. Set the channel selector and the Mega-Marker Sr. to channel 7. Adjust the strip oscillator trimmer (See fig. 46) for zero indication on the meter. This procedure is followed on channels 8, 9, 11, 12 and 13.

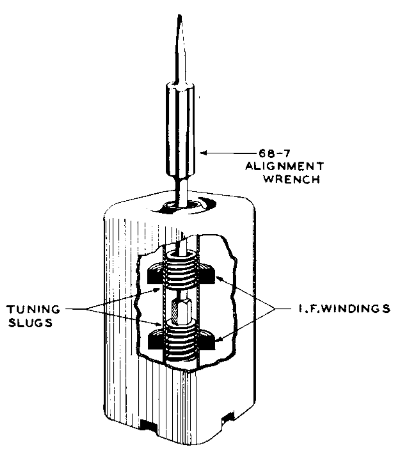


Fig. 40 Sound I. F. Transfomer.

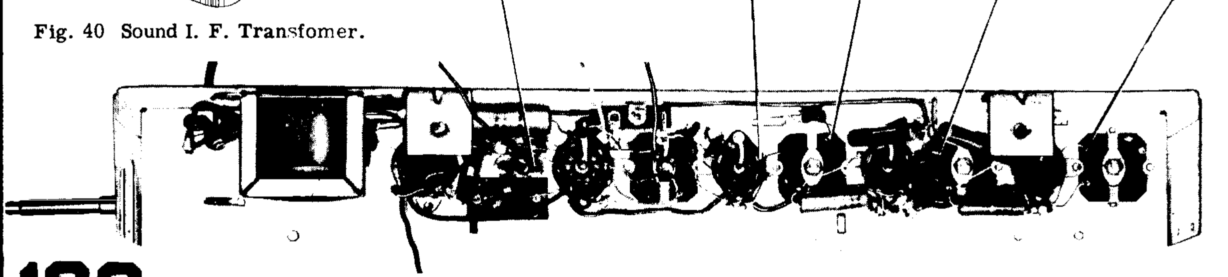


Fig. 43 Sound I. F. Sub-Chassis.

3. Set the channel selector and the Mega-Marker Sr. to channel 4. Adjust the oscillator trimmer for zero indication on the meter as in Step 2. If resonance does not occur, it may be necessary to re-adjust L11 (the low frequency oscillator trimmer) until resonance is obtained. Channels 2, 3, 5 and 6 are then adjusted. If the above adjustments have been properly made it will be unnecessary to adjust the fine tuning control on any channel.

If the television stations are on the air, the same procedure is followed as outlined above except that the transmitted signal is substituted for the Mega-Marker Sr.

After the oscillator adjustments have been made, proceed to align the antenna trimmer of each channel as follows:

1. Remove the A.G.C. tube V14 and connect the negative side of a 1.5 volt battery to tip jack "C" and the positive side to chassis. If the S-15370 alignment fixture is available, it should be adjusted to 1.5 volts and substituted for the battery.

2. Connect output #1 (See fig.29) through the S-15369 impedance matching transformer to the antenna terminals of the receiver.

3. Connect the scope input from tip jack "S" to chassis and adjust the Mega-Sweep coarse frequency and sweep amplitude controls to obtain a pattern similar to fig.47. Always keep the Mega-Sweep output low enough so that the peak to peak voltage, as indicated by the oscilloscope, does not exceed 3 volts. If the oscilloscope is not calibrated, connect a vacuum tube voltmeter to tip jack "S" and chassis. Adjust the Mega-Sweep attenuator for a 1.5 to 2 volt indication on the meter.

4. Adjust the antenna trimmer (fig. 46) for symmetry and gain. This procedure is followed on all channels, the Mega-Sweep coarse frequency control being re-set for each individual channel. If it is impossible to obtain a reasonably flat R. F. characteristic curve on any particular channel, the fault may be in the converter input tuned circuits and replacement of the strip is necessary.

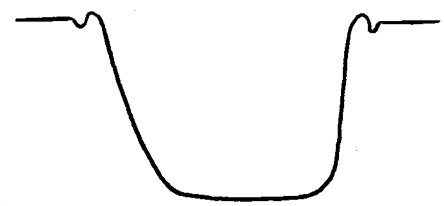
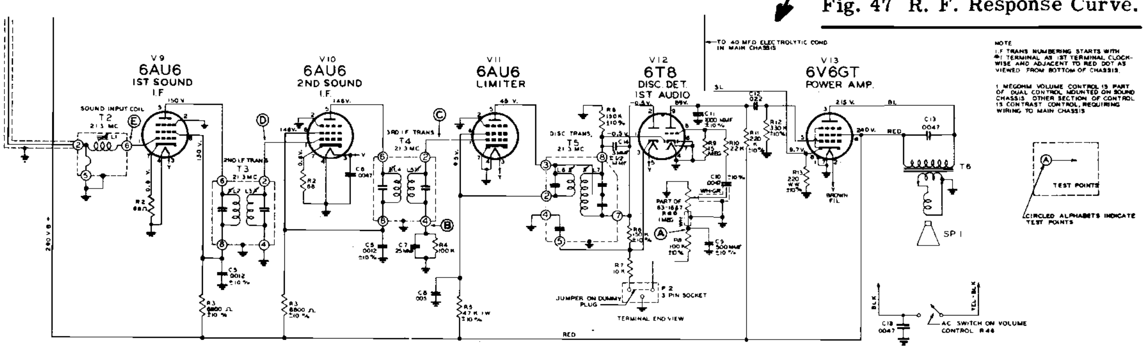


Fig. 47 R. F. Response Curve.

Fig. 44 Sound I. F. Schematic Diagram.



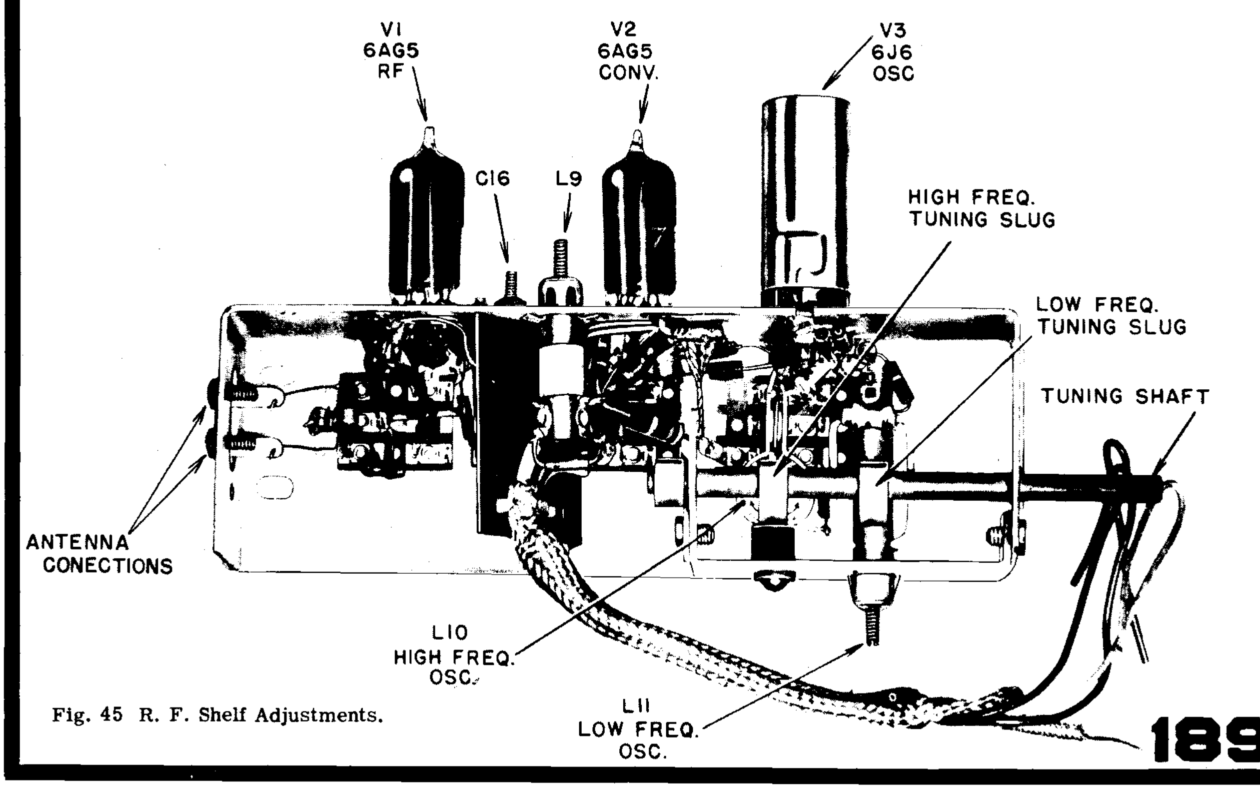


Fig. 45 R. F. Shelf Adjustments.

MOST-OFTEN-NEEDED 1949 TELEVISION RECEIVERS

SERVICE HINTS

TROUBLE SHOOTING

Observation of the picture tube during operation of the receiver can often be of value in determining the particular circuit in which the trouble exists. Subsequent procedure will be the measurement of voltages and observation of wave forms. The receiver wave form and voltage measurement chart, fig. 49, lists the correct readings obtained from a normal receiver. Departure from these normal values will lead to the location of defective components.

The A.G.C. circuit is critical to tube changes, and the replacement of the 12AT7 A.G.C. amplifier will necessitate readjustment of the sensitivity control.

The service man is cautioned against interchanging tubes in the R. F. and I. F. stages of the receiver. When these tubes are tested, care should be exercised so that they are re-inserted into their original sockets.

Effects noted when various receiver stages are disabled by removing the tube:

V1 No picture - No sound.
V2 Weak picture - Weak sound.
V3 No picture - No sound.
V4 No picture - Sound OK.
V5 No picture - Sound OK.
V6 No picture - Sound OK.
V7 No picture - Sound OK.
V8 No picture - Sound OK.
V9 No sound - Picture OK.
V10 No sound - Picture OK.
V11 No sound - Picture OK.
V12 No sound - Picture OK.
V13 No sound - Picture OK.
V14 No picture - Weak sound.
V15 Picture cannot be synced horizontally or vertically - Sound OK.
V16 Picture cannot be synced horizontally or vertically - Sound OK.
V17 Picture cannot be synced horizontally or vertically - Sound OK.
V18 Picture cannot be synced horizontally - Sound OK.
V19 Picture cannot be synced horizontally - Sound OK.
V20 No raster - Sound OK.
V21 No raster - Sound OK.
V22 Raster reduced to thin horizontal line - Sound OK.
V23 No raster - Sound OK.
V24 No raster - Sound OK.
V25 No raster - Sound OK.
V26 Undersized picture - Sound OK.
V27 Undersized picture cannot be synced horizontally - Sound OK.

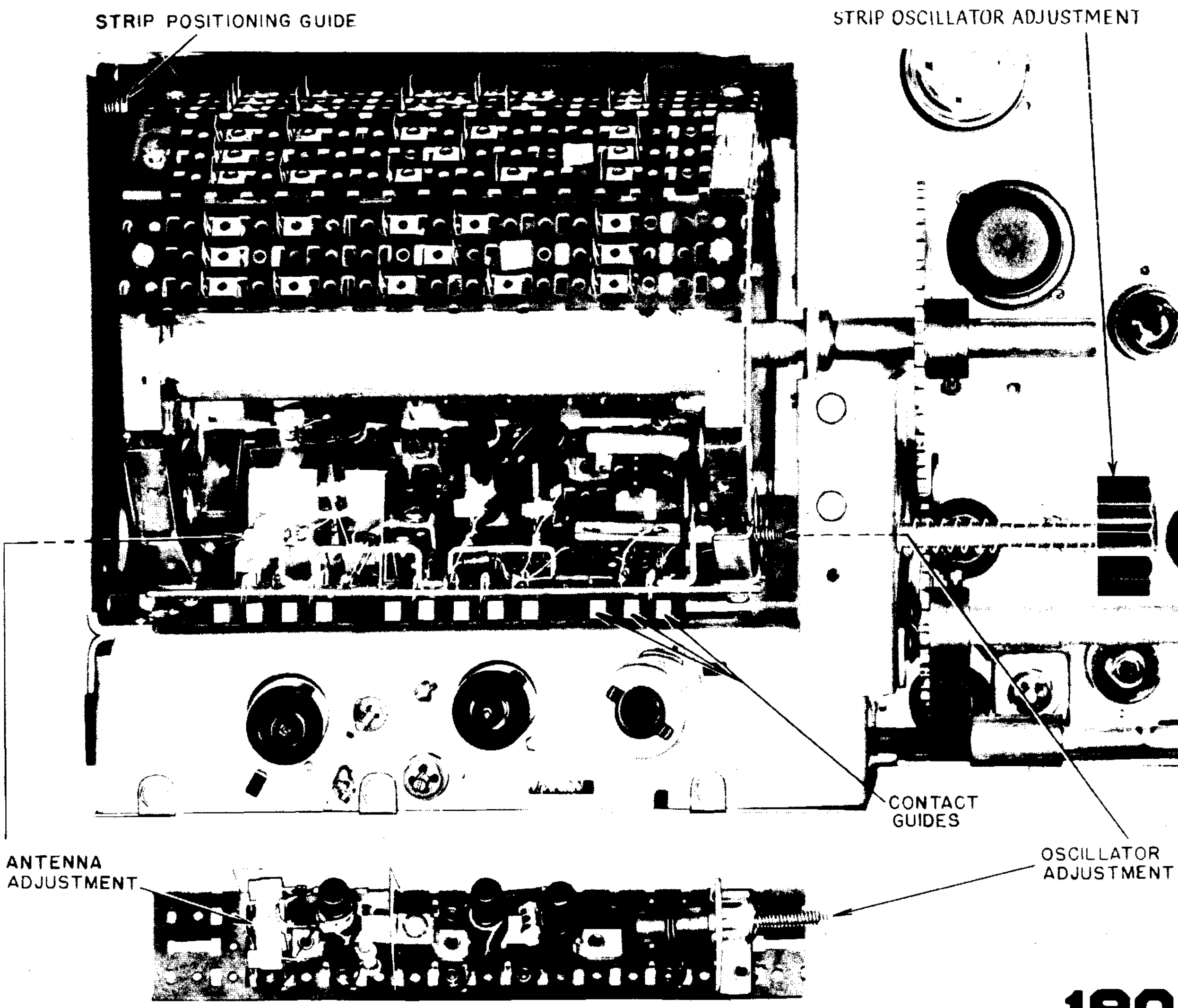


Fig. 46 Adjustment of the Channel Strips.

ADJUSTING THE 4.5 Mc TRAP

The high shunt capacity C30 in the 4.5 Mc resonant circuit insures high frequency stability. Adjustment in most cases is unnecessary unless the unit is tampered with or replaced.

If adjustment becomes necessary, an accurate signal generator, crystal calibrated at 4.5 Mc, and an RF VTVM capable or reading frequencies to 5 Mc is required. The procedure is as follows:

1. Connect the 4.5 Mc signal to the grid (Pin 7) of the 12AT7 1st video amplifier V7B.
2. Connect the probe of the VTVM to the grid of the picture tube.
3. Advance the contrast control for approximately 1 volt indication on the meter.
4. Adjust slug L24 for minimum indication on the meter. A pronounced dip will be noted at resonance.

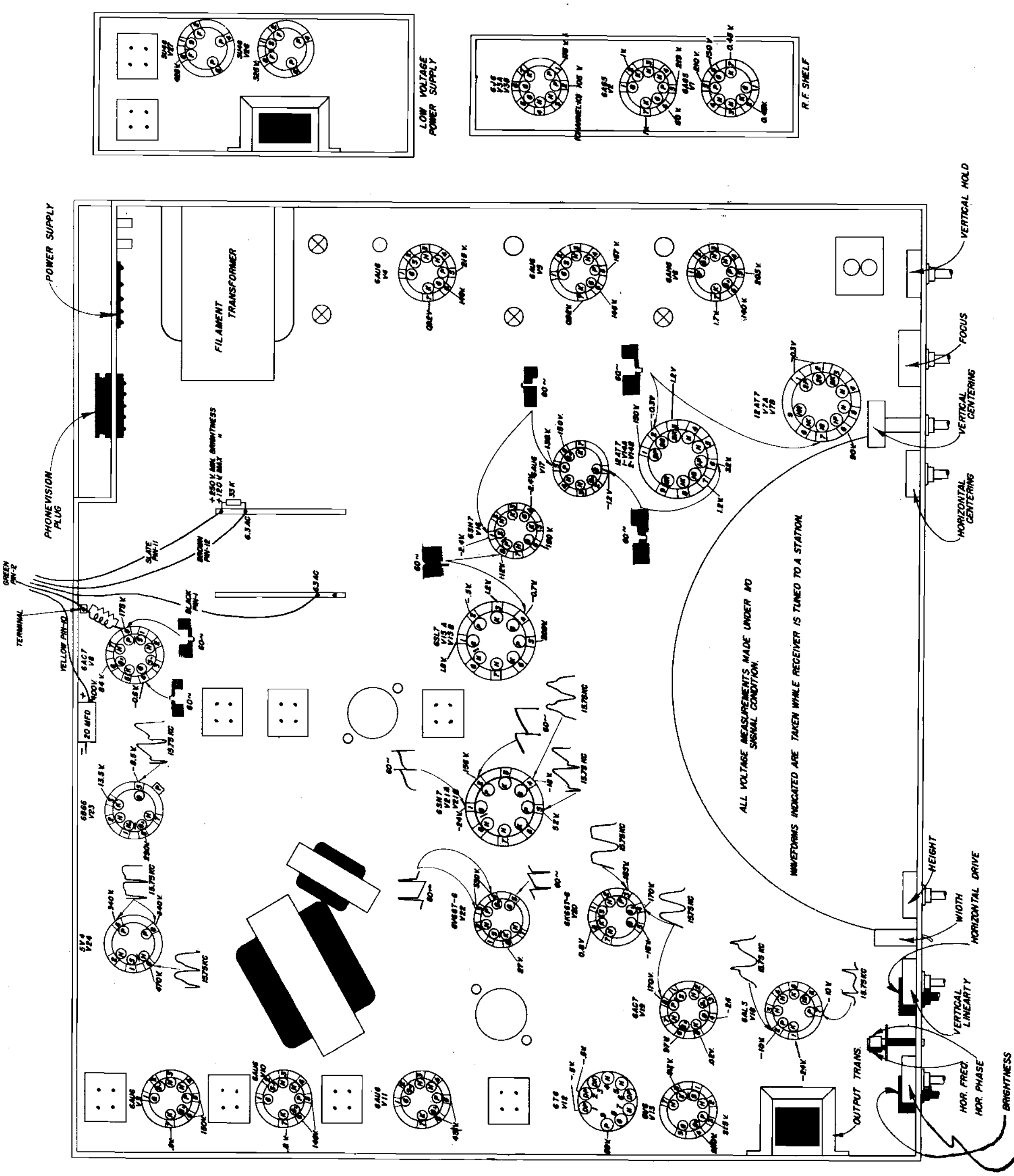
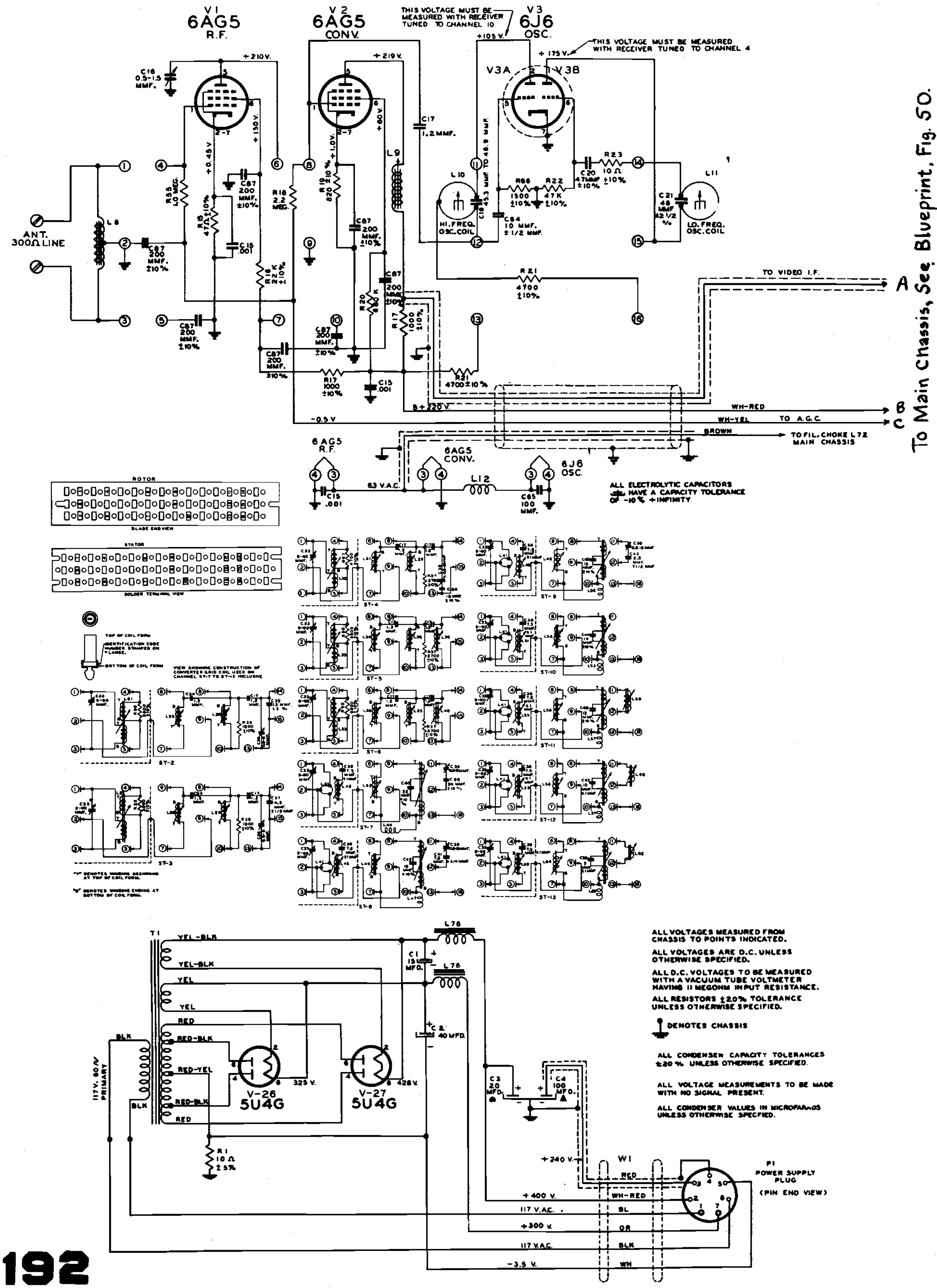


Fig. 49 Wave Forms and Voltage Measurement Chart.


V1 6AG5 R.F.
V2 6AG5 CONV.
V3 6J6 OSC.
THIS VOLTAGE MUST BE MEASURED WITH RECEIVER TUNED TO CHANNEL 10
THIS VOLTAGE MUST BE MEASURED WITH RECEIVER TUNED TO CHANNEL 4
ANT. 300Ω LINE
HI. FREQ. OSC. COIL
LO. FREQ. OSC. COIL
TO VIDEO I.F.
TO A.G.C.
TO FIL. CHOKE L72 MAIN CHASSIS
To Main Chassis, See Blueprint, Fig. 50.
ALL ELECTROLYTIC CAPACITORS HAVE A CAPACITY TOLERANCE OF -10% +INFINITY.
ROTOR
STATOR
V-26 5U4G
V-27 5U4G
117 V. 60~ PRIMARY
P1 POWER SUPPLY PLUG (PIN END VIEW)
ALL VOLTAGES MEASURED FROM CHASSIS TO POINTS INDICATED.
ALL VOLTAGES ARE D.C. UNLESS OTHERWISE SPECIFIED.
ALL D.C. VOLTAGES TO BE MEASURED WITH A VACUUM TUBE VOLTMETER HAVING 11 MEGOHM INPUT RESISTANCE.
ALL RESISTORS ±20% TOLERANCE UNLESS OTHERWISE SPECIFIED.
DENOTES CHASSIS
ALL CONDENSER CAPACITY TOLERANCES ±20% UNLESS OTHERWISE SPECIFIED.
ALL VOLTAGE MEASUREMENTS TO BE MADE WITH NO SIGNAL PRESENT.
ALL CONDENSER VALUES IN MICROFARADS UNLESS OTHERWISE SPECIFIED.

SCHEMATIC DIAGRAM CHASSIS 28F20 and 28F20 Z

(Chassis 28F21 and 28F22 same as 28F20 except V28 is 10FP4 or 10BP4)

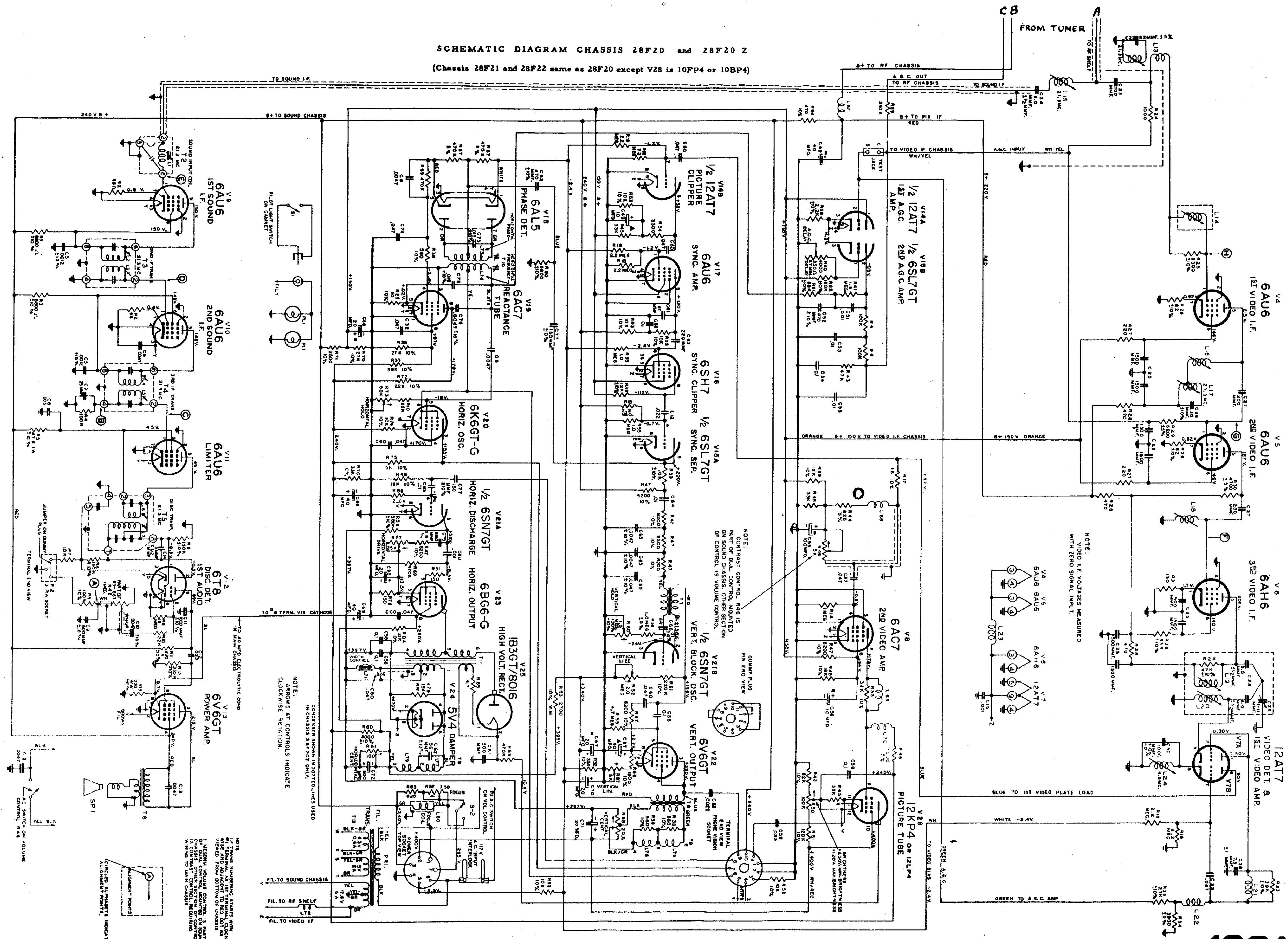


Fig. 50 Schematic Diagram Zenith Television Receiver.

Another

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Service Manual