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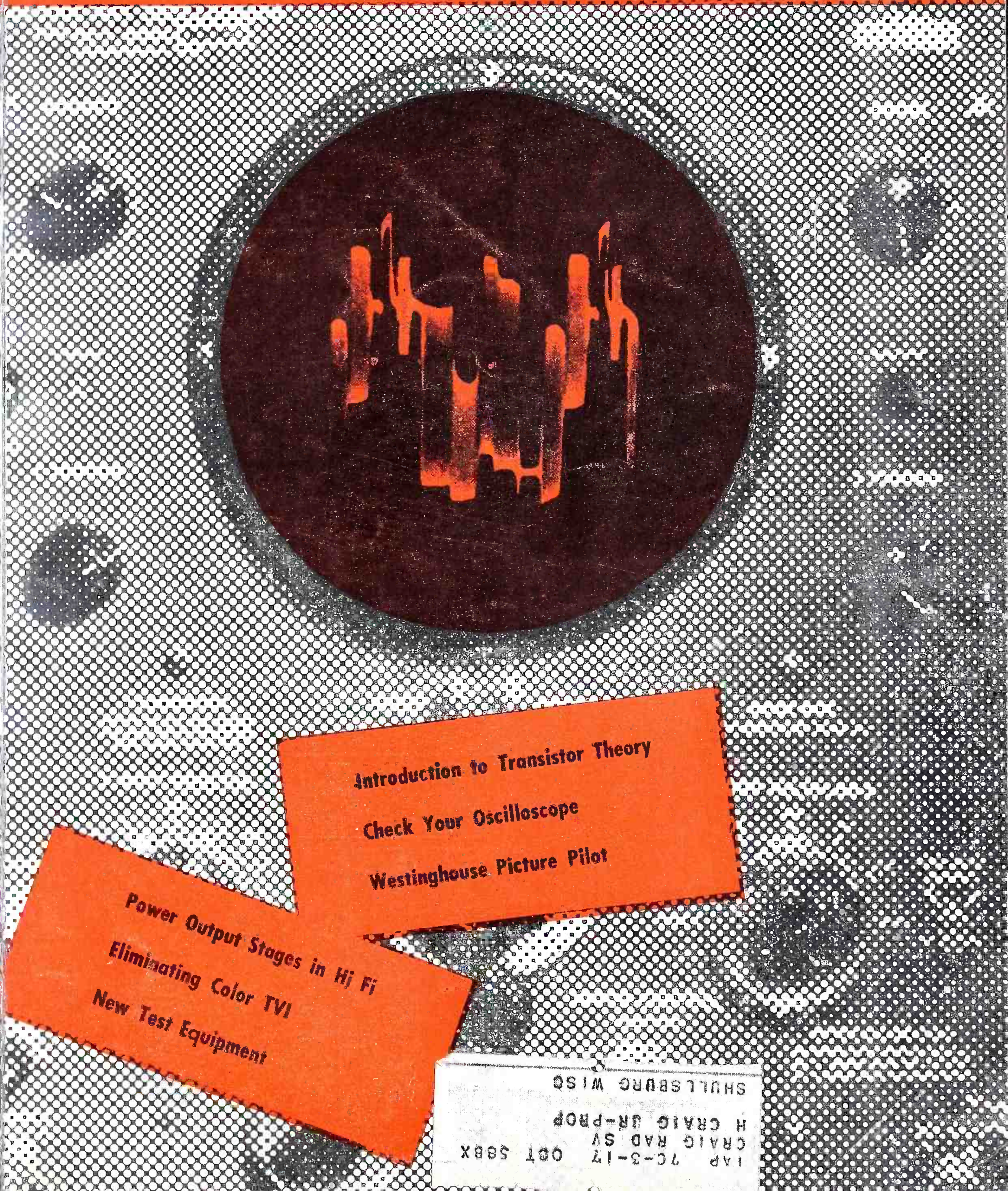

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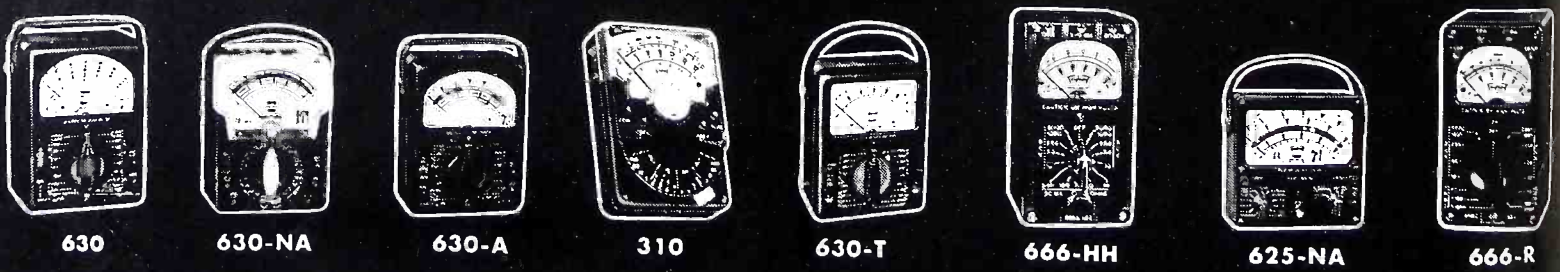

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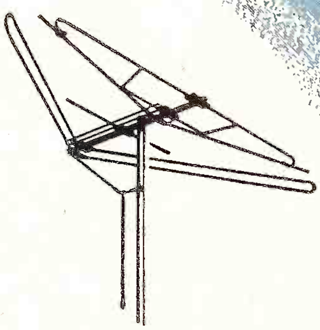

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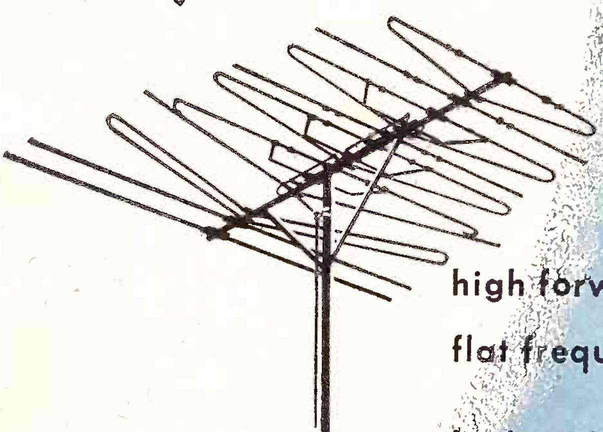

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ELECTRONIC SERVICING

VOL. 18, NO. 11 Member NOVEMBER, 1957

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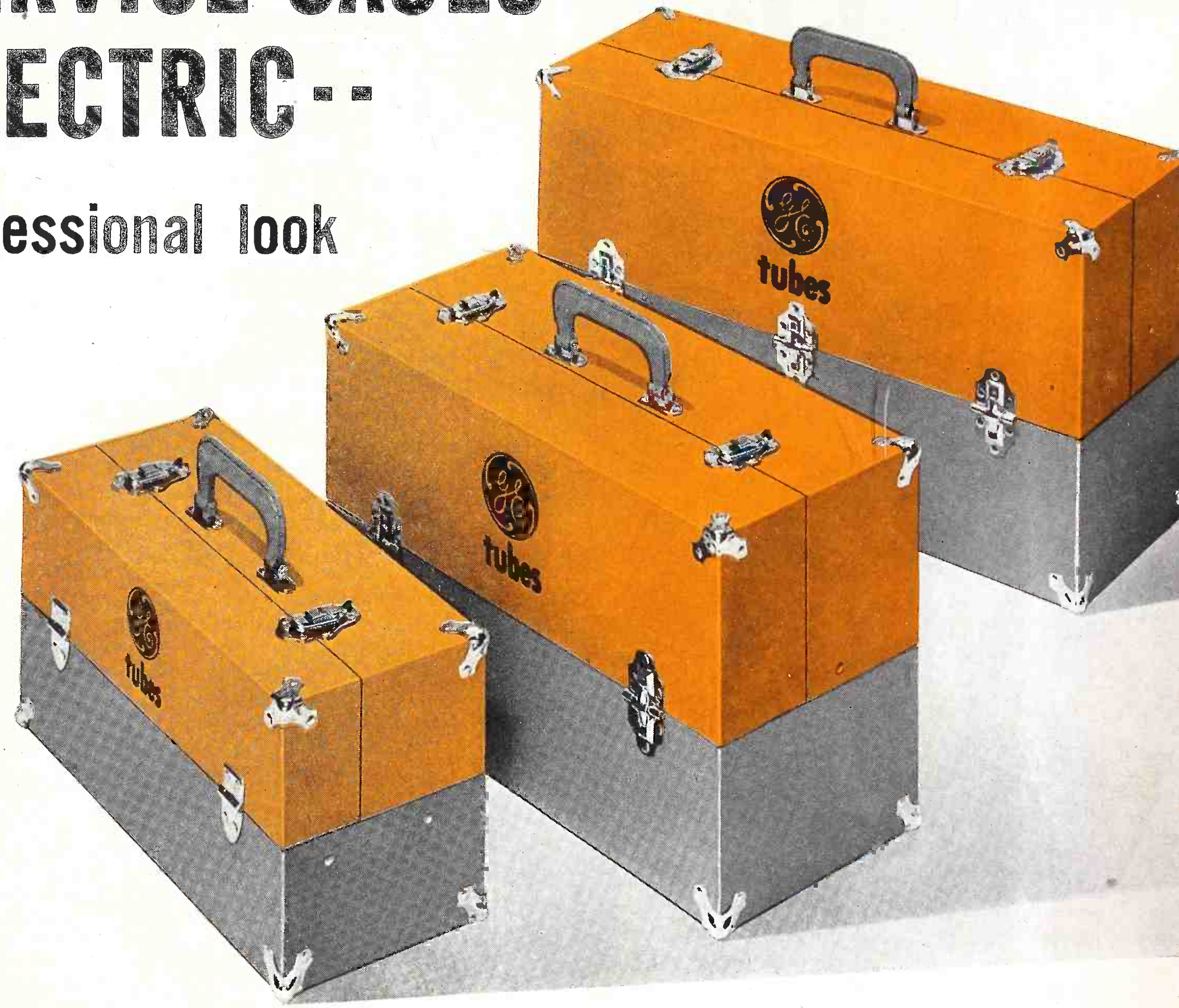

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Introduction To Transistor Theory

Part 4

by GEORGE BROWNE

This installment deals with the categories of transistor applications and manufacturing processes for producing desired characteristics.

In the previous installment transistor action was explained using a junction transistor connected so that the base was common to both input and output signals as shown in *Fig. 1.*

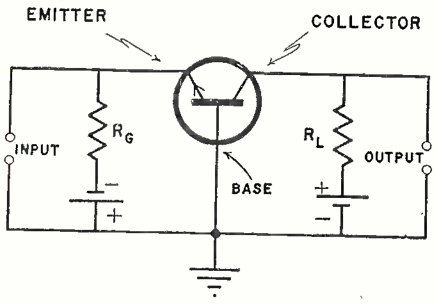

Fig. 1—Junction transistor in the common base connection

It is helpful to think of the action as one in which the carriers injected into the emitter are electrons in an NPN unit and holes in a PNP unit.

Alpha is the ratio of collector current change to emitter current change produced by a small signal at the emitter. Amplification in a transistor is roughly a function of the product of the collector to emitter impedance ratio multiplied by alpha. In junction transistors alpha is some fraction approaching unity, but never equal to unity. However, the collector to emitter impedance ratio being comparatively high, a voltage step-up between input and output is obtained.

Transistor Application Categories

Transistors are made in a wide variety of forms and with varying characteristics in order to meet a wide variety of circuit applications. These applications may be roughly grouped into three basic categories, namely:

1. Audio and power
2. R. F.
3. Computer

Power transistors, at the present writing are being used in low frequency applications, principally in audio output stages. These differ from ordinary audio transistors in their ability to handle power and dissipate heat. The latter characteristics are made possible by constructing the device so that the base is connected to a large, fluted, heat conducting surface which helps dissipate the heat developed in the transistor as shown in *Fig. 2.* This conducting surface is called a "heat sink" because of its property of transferring the internally developed heat to some external dissipating medium such as a chassis, etc.

The main difference between audio and *rf* transistors is in their frequency handling capabilities. The difference between *rf* and computer transistors, as two distinct groups, is in their relative quality and reliability. Because of their use in switching circuits, in which transmission of high frequency information is required, computer transistors must have good high frequency characteristics.

Fig. 2—Large radiating surface dissipates heat in power types.

The ability to amplify high frequency signals is one of the important characteristics of a transistor. One of the reasons for the great number of transistor types is largely a result of the widespread effort on the part of researchers in their quest for transistors with higher operating frequencies.

The upper frequency limit of a transistor depends mostly on its shunt resistance and capacitance, and transit time limitations of the carriers as they proceed through the transistor. A junction transistor of the type previously discussed is limited in its amplification of very high frequency signals primarily because of three effects. The first is due to the capacitances across the emitter-base and collector-base junctions. (See *Fig. 3*). The second is a resistance effect called the "base spreading" resistance, which is related to the base region, and which when combined with the above mentioned capacitance and other transistor resistances, forms a low pass filter. The base spreading resistance is proportional to the resistivity of the base material and inversely proportional to the base width. Thus, for better frequency response the base should have a low resistivity and narrow cross section. The third effect occurs as a result of the fact that carriers in semi-conductors (holes and electrons) do not move as rapidly as carriers (electrons) in vacuum tubes. The result is that transit time effects (the delay between the time the signal appears at the emitter and the time it appears at the collector), produce phase

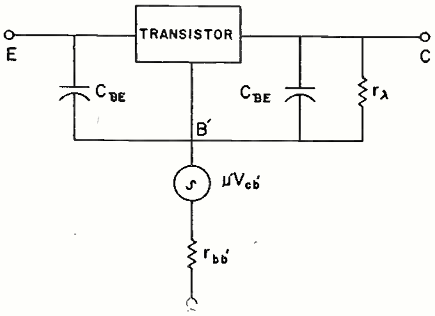

Fig. 3—Base spreading resistance and shunt capacitance.

[*Continued on page 41*]

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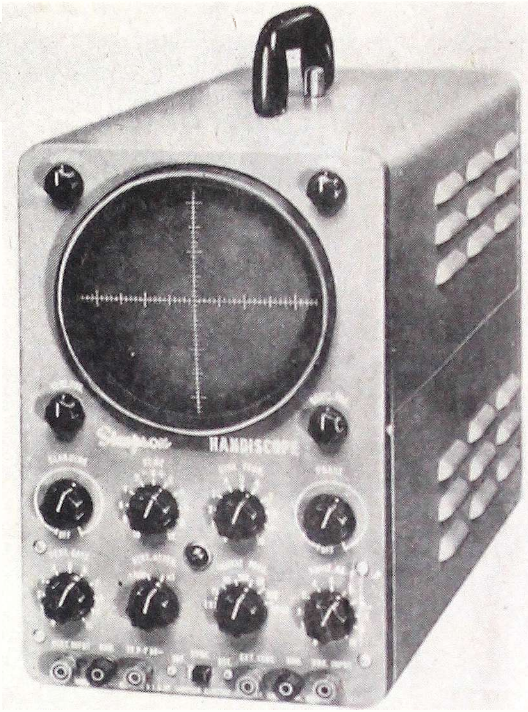

by Robert G. Middleton
International Director—Radio
Electronic Television Schools

Part 2

Procedures to be used for testing oscilloscope input impedance, astigmatism, overload and high frequency unbalance are dealt with in this installment.

LAST month we discussed the techniques used for testing oscilloscope sensitivity, frequency response, deflection linearity, amplifier balance, and decading. Let us now turn our attention to some other tests and measurements of scope performance.

Importance of Input Impedance

When a scope is used with a low-capacitance probe, it is essential that the input impedance remain constant at each step of the coarse attenuator. Should it vary, waveform distortion will occur on the steps which have off-values of input impedance. The input impedance is rated by the scope manufacturer in terms of input resistance and capacitance. For example, your scope may be rated at 20 *mmf* of input capacitance and 3 megohms of input resistance. In such case, it is important that you find 20 *mmf* and 3 megohms on *each* of the attenuator steps.

Modern service scopes usually have a four-step decade attenuator with X1, X10, X100, and X1000 positions.

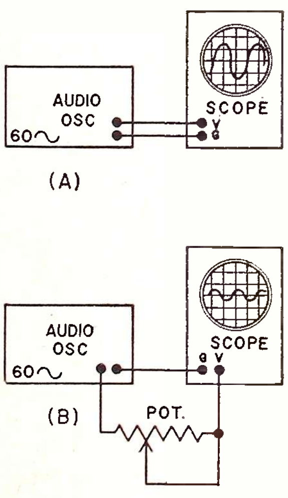

Fig. 1—Test set-up for checking scope input impedance.

Checking Input Impedance

This test is made with the aid of an audio oscillator, a potentiometer, and a trimmer capacitor with a capacity of about 30 *mmf*. The audio oscillator is set to a frequency of 60 *cps* and connected directly to the scope as indicated in *Fig. 1A*.

Then set the output from the audio oscillator for any convenient deflection on the scope screen, such as three inches. Next, insert a 5-meg potentiometer in series with the vertical input terminal of the scope, as shown in *Fig. 1B*. Without changing the output from the audio oscillator, adjust the potentiometer to obtain one-half the deflection which was obtained in the first test. That is, if we originally obtained three inches of deflection, the potentiometer is adjusted to obtain 1½ inches of deflection in the second step. Under this condition, the *resistance inserted by the potentiometer* is equal to the input resistance of the scope. By measuring the potentiometer resistance with an ohmmeter, we can determine its exact value.

To determine whether the scope has the same value of input resistance at each step of the coarse attenuator we repeat the test at *each step* of the attenuator. If the scope has the same input resistance at each step, the same value of potentiometer resistance will reduce the scope deflection to one-half. However, if we should find that a *different* value of potentiometer resistance is required to obtain half-deflection at some step of the attenuator, we may conclude that the input resistance at this step is incorrect. Should this be the case, check the resistors in the step attenuator and replace any that are off-value. The proper values are usually indicated in the instruction manual.

Note that checks of input resistance are made at 60 cycles. It is necessary to use a low frequency because the tests would otherwise indicate capacitive factors. By making these tests at 60 cycles, we measure only the *resistive* elements in the step attenuator.

Input Capacitance

To check the input *capacitance* of scope, we operate the audio oscillator

[*Continued on page* 12]

OSCILLOSCOPE

[*from page* 10]

at a *high* frequency, such as 100 or 200 *kc*. The output from the audio oscillator is again applied directly to the vertical-input terminals of the scope, as in *Fig. 1A*. Set the output from the oscillator once more for any convenient deflection on the scope screen, such as three inches. The next step is to connect the trimmer capacitor in series with the vertical-input terminal of the scope. Adjust the trimmer capacitor to obtain *one-half* the deflection which was observed with direct feed. (Do not change the output level from the oscillator in this test.)

The capacitance value of the trimmer is now equal to the input capacitance of the scope. We can measure the trimmer capacitance on a capacitance bridge or on a capacitance meter to determine its exact value.

To determine whether the scope has the *same* value of input capacitance at each step of the coarse attenuator, we repeat the test at *each step* of the attenuator. If the scope has the same input capacitance at each step, the same value of trimmer capacitance will bring the scope deflection to one-half in each case.

If we should find that a *different* value of trimmer capacitance is required to obtain half-deflection at some step of the attenuator, we then know that the input capacitance at this step is incorrect. Should this be the case, check the capacitors in the step attenuator and replace any defective or off-value components. You will find both fixed and adjustable capacitors in the step-attenuator network. The adjustable capacitors must be set to obtain the correct response. The values of the fixed capacitors and the adjustment procedures are usually indicated in the instruction book for the scope.

Astigmatism Test:

A scope should have little or no astigmatic distortion. Astigmatism means the inability to satisfactorily focus a *circle* on the scope screen. If astigmatism is present, you may notice that the focus control can be adjusted to obtain a sharp trace along the top of the circle, but a blurred trace will be obtained along the sides. Conversely, if the sides are focussed, the top and bottom of the circle may be blurred. The test set-up shown in *Fig. 2* is

[*Continued on page* 54]

The Westinghouse Picture Pilot Remote Control

By Sol Libes

The operation and servicing procedures for this remote control unit are treated in addition to a description of constructional details for a simple test unit.

THE Model H-988 Picture Pilot is a wireless remote control system designed for use with Westinghouse television receivers using the following chassis:

V-2372-27	V-2382-204
V-2372-67	V-2382-602
V-2382-202	V-2382-604

The Picture Pilot provides the user with remote control of channel selection and muting of sound. Remote fine tuning control of the television receiver is not necessary since all the above chassis employ the new Westinghouse Automatic Fine Tuning system.

Basic Operation

The Picture Pilot consists of a transmitter and receiver. The receiver unit is mounted on the tuner mounting bracket of the television receiver chassis. The transmitter unit is held by the user at any convenient location in the room. The transmitter power cord is merely inserted into an *ac* power outlet and the Picture Pilot is ready for use. Installation and operating instructions for the unit are included with it.

The *ac* power line is used as the transmission line between the transmitter and receiver units. The television receiver and Picture Pilot transmitter must both be connected to the same *ac* circuit.

The Picture Pilot can be operated on any one of four different frequencies—A, B, C or D. The procedure for setting these frequencies will be found in the installation instructions that come with the unit.

The frequencies are as follows:

A—73.5 Kilocycles
B—57.5 Kilocycles
C—52.5 Kilocycles
D—67.5 Kilocycles

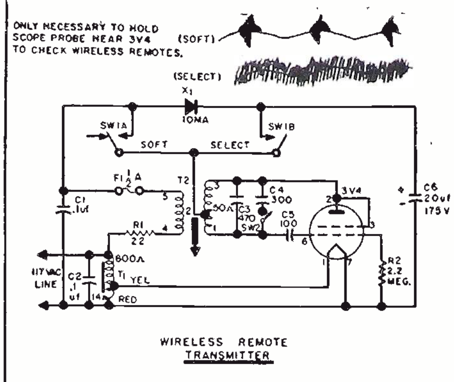

Fig. 1—Schematic diagram of the remote control transmitter unit.

The Transmitter

The Picture Pilot transmitter is basically a Hartley type oscillator. [See *Fig. 1*.] When the control knob on the unit is in the "select" position a continuous *cw* signal at one of the above frequencies is generated and coupled to the *ac* power line. When the control knob is rotated to the "soft" position the generated signal is modulated at the 60 cycle line frequency.

The frequency of the oscillator is determined by the primary of transformer *T-2* and capacitors *C-3* and *C-4*. The unit is set at the factory to operate on frequency "A" (73.5*kc*). In this position switch *SW-2* is open. When switch *SW-2* is closed, capacitor *C-4* is placed in parallel with capacitor *C-3* lowering the oscillator to frequency "B" (57.5*kc*). Frequency "C" is obtained by tuning transformer *T-2* to frequency "C" (52.5*kc*). Now when switch *SW-2* is opened, the unit is tuned to frequency "D" (67.5*kc*).

The primary of transformer *T-2* is tapped ⅓ the total number of turns from the grid end to reduce harmonic output. Coupling to the line is by means of a non-resonant secondary with capacitor *C-1* acting as a blocking capacitor. Resistor *R-1* and capacitor *C-2* are an *RC* filter for reduction of harmonic radiation. The value of *R-1* also determines the power output of the transmitter since it is in series with the line impedance.

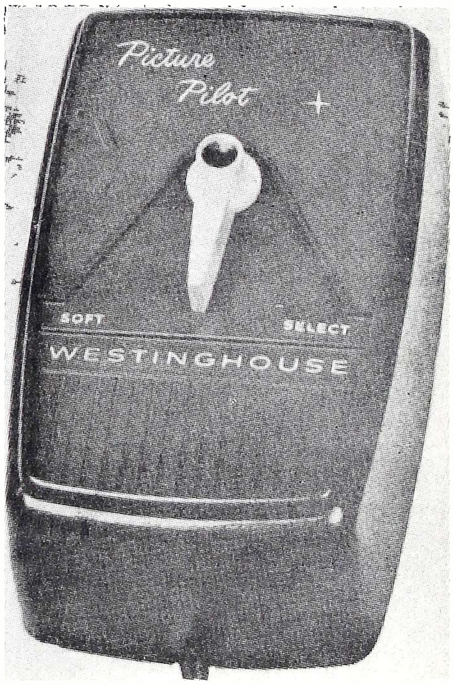

Fig. 2—Transmitter control box with switch in the rest position.

The transmitter is housed in a small plastic case with a plastic control knob. [See *Fig. 2*.] When the knob is in its center resting position, switches *SW-1B* and *SW-1A* are open and no plate voltage is applied to the 3V4 oscillator tube. When the knob is rotated to the right, switch *SW-1B* is closed and B-plus is applied to the plate of the tube causing *cw* oscillation. The

[*continued on page* 16]

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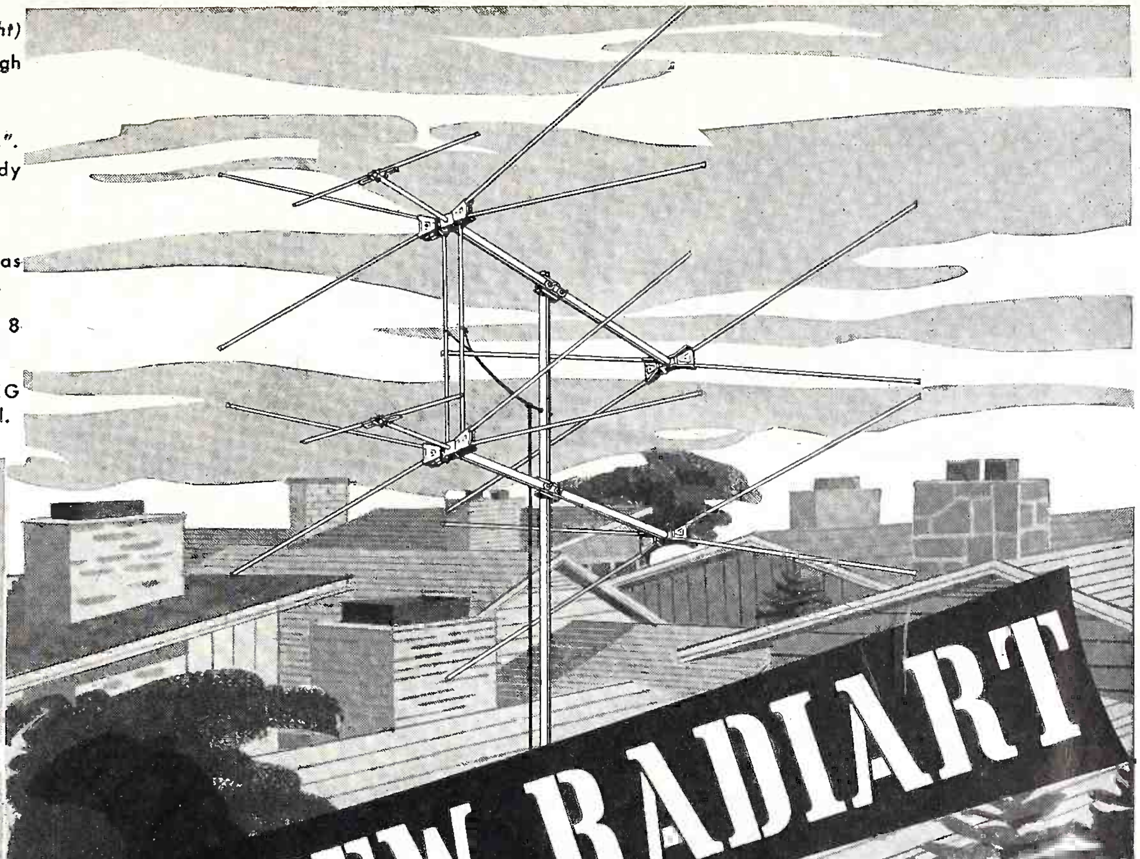

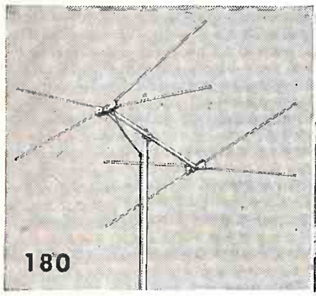

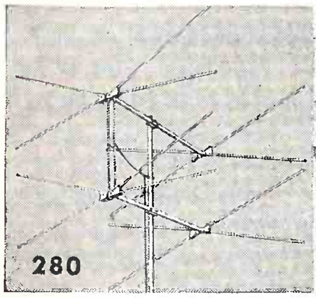

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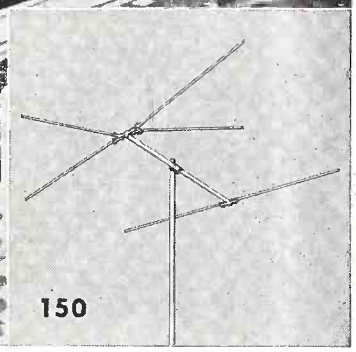

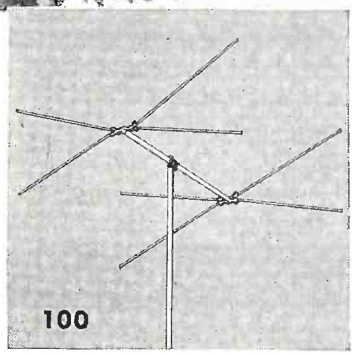

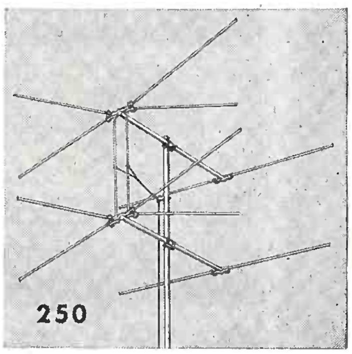

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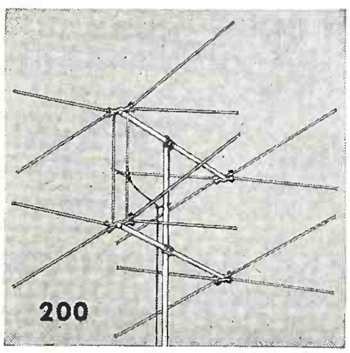

LZX 100 single array
LZX 101 single array, unassembled
LZX 200 8 element conical completely assembled, stacked array
LZX 201 8 element conical unassembled, stacked array
LZX 150 single array
LZX 151 single array, unassembled
LZX 250 6 element conical assembled, stacked array
LZX 251 6 element conical unassembled, stacked array

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PICTURE PILOT

[*from page* 14]

switches are lever operated with a spring return in the "select" direction and a latching position in the "soft" direction.

When the knob is rotated to the left, switch *SW-1A* is closed and the 117 volts *ac* is applied to the plate of the oscillator. When the *ac* voltage goes in a positive direction the tube oscillates, producing a signal modulated at 60 cycles. The signals are coupled to the *ac* line by the secondary winding of transformer *T-2*.

To check the operation of the transmitter unit measure the voltage at the grid of the 3V4. With switch *SW-1* in the "select" position a negative voltage should be measured at this point. The voltage will be somewhat less in the "soft" position due to the 60 cycle modulation. Another good check is to hold an oscilloscope probe near the 3V4 tube, in which case the wave shapes shown on the schematic should be observed.

If the oscillator fails to oscillate check the 3V4 tube, plate voltage, oscillator transformer continuity, etc.

If the unit oscillates but does not activate the receiver unit, check to be sure the transmitter and receiver units are operating on the same frequencies. Check to be sure that both units are connected to the same *ac* power line. Check to be sure that the receiver unit is properly connected and operating.

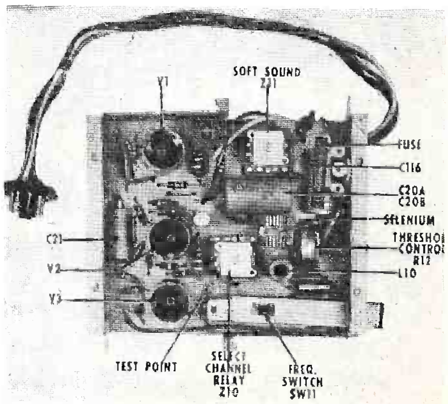

Fig. 3—A view of the receiver showing controls and test points.

The Receiver

The Picture Pilot receiver, shown in *Fig. 3,* must be mounted on the television receiver chassis with a cable inserted into a receptacle on the tuner support bracket. When the

[*continued on page* 20]

Power Output Stages in Hi-Fi

By Lawrence Fielding

Part 2

A treatment of the circuitry and troubleshooting procedures for electronic regulation of output tube screen voltages. In addition feedback problems are discussed.

CONTINUING our investigation of output stage configurations in popular hi-fi equipment, we come upon voltage regulating circuits, used in high powered amplifiers for the purpose of maintaining precisely calibrated screen voltages at the output stages. You will recall that screen currents vary with increased signal in the power output stage. That is why it was stressed that screen dissipation can easily be exceeded with full signal even though it is within safe limits under quiescent, or no signal conditions. This increase in current tends to limit the power capabilities of an amplifier, as can be shown in *Fig. 3A* and *3B*. Suppose that a pair of tubes in push-pull have 388 volts on their plates and 367 volts on each screen. These voltages are based upon a current flow of 87 *ma* for the two plates plus screens (which results in a 12 volt drop across *R1*, from 400 to 388 volts) and a total of 7 *ma* for the two screens (which represents a further drop across *R2* of 21 volts from 388 to 367 volts). The tube manual may indicate that under such conditions, and with, say, 22 volts of negative bias on the grids (not shown) these tubes will deliver 25 watts with negligible distortion. A further glance at the specifications in the tube handbook tells us that when delivering 25 watts, the screen current will rise to 9 *ma* per tube, or a total of 18 *ma* for the pair. *Fig. 3B* depicts what will happen if we try to duplicate these conditions with the power supply arrangement shown. The increase in screen current flowing through *R1* results in only a small voltage drop and the new plate voltage is now 386.28 volts, or substantially the same as it was before. However, the total voltage drop across *R2* is now 54 volts so that the new screen voltage is only 332.28 volts. With this screen voltage, it is found, the pair of tubes can no longer deliver 25 watts of audio power, and full utilization of their ratings is impossible with this type of power supply.

A glance at the circuit of *Fig. 3B* discloses the fact that *R2* is the culprit. A small change of current across it represents a large voltage drop. Now, if *R2* could in some way be made variable, in such a manner that it automatically lowers its value with increased current through it, the voltage at the screens in this particular circuit could remain virtually constant. *Fig. 4* represents a simplified schematic of the screen voltage regulating section of the Bogen Model DO-70 power amplifier. V1 takes the place of *R2* in *Figs 3A* and *3B*. That is, it acts as a variable resistance in series with the screen current.

Voltage Regulator Operation

Resistors *R1, R2* and *R3* are a bleeder system across the highest supply voltage. The bias of V2 is determined by the setting of *R2* so that a nominal amount of current flows through V2. This current flow pro-

[*continued on page* 49]

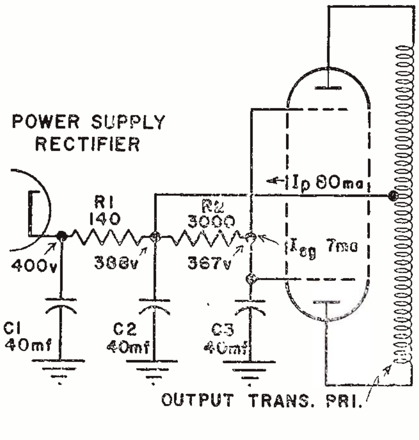

Fig. 3A—Voltage distribution under quiescent conditions.

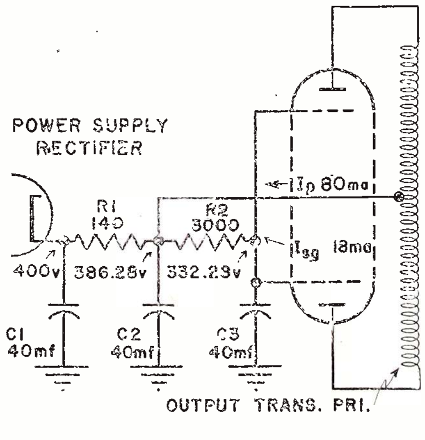

Fig. 3B—Voltage distribution under full output conditions.

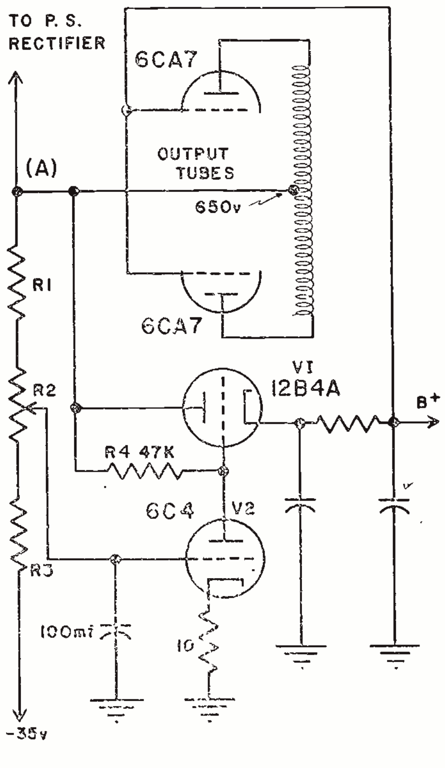

Fig. 4—Typical regulator to stabilize screen voltages.

PICTURE PILOT

[*from page* 16]

plug is inserted into the receptacle the heater string of the Picture Pilot receiver is inserted in series with the heater string of the television receiver. A selenium rectifier in the unit develops B-plus for the unit.

The receiver unit contains three 12BH7A tubes, one tuned circuit, one control and two relays. The unit is built onto a printed board with the components connected to the etched wiring by a dip solder process. [See *Fig. 4.*].

A signal from the transmitter is received from the *ac* power line and appears across the series-tuned circuit composed of coil *L-10* and capacitor *C-13*. Switch *SW-11* is a slide selector switch to select the operating frequency. On frequency "A" only capacitor *C-13* is in the circuit. When frequency "B" is selected *C-10* is placed in parallel with *C-13*. Likewise for frequencies "C" and "D," capacitors *C-11* and *C-12* are placed in parallel with *C-13*.

The signal developed across the tuned circuit is coupled to the grid of the first half of *V-1*, through *C-14*, *R-11* and *R-12*. Resistor *R-11* serves to isolate the grid from the tuned circuit preventing possible detuning and lowering of the circuit "Q" as the threshold control is varied. It also prevents capacitor *C-14* from fully charging, thus allowing the grid of *V-1A* to clip rather than clamp noise pulses providing good noise immunity for the receiver.

Control *R-12* is the threshold control, determining the gain and bandspread of the receiver unit. With the control at minimum resistance, the gain is minimum and selectivity is maximum and vice versa. The potentiometer has a 20% log taper to provide a nearly linear scale which reduces crowding on large signals.

Both sections of *V-1* act as carrier-frequency amplifiers. The *cw* carrier is rectified by peak-rectifier *V-2A*, producing a positive *dc* voltage. The channel select relay stage *V-2B* is biased near cut-off. Positive *dc* output of the peak rectifier, applied to the relay stage grid, increases the plate current to operate the relay. Since the modulated *cw*, used for muting function is also rectified by *V-2A*, the *dc* produced tends to increase the plate current of the channel select relay stage. Because the modulated *cw* has a duty cycle of only 35% and the maximum signal from the plate is limited, its average value can never equal that required to operate the channel select relay. For this reason, there is no possible chance of undesirable cross-function operation.

Capacitor *C-20A* across the channel select relay *Z-10* removes any 60 cycle component which may appear across the relay when the muting function is operated.

For sound muting, *V-1B* acts as a grid-leak detector, rectifying the 60 cycle modulated carrier and providing amplification at 60 cycles. *V-3A* provides an additional stage of amplification to provide the large grid swing required by the muting relay stage *V-3B*.

V-3A is biased near cut-off similar to the channel select relay stage *V-2B*. Its plate current is caused to increase, on the average, by the large 60 cycle signal on its grid. Resistor *R-26* reduces the tendency for *V-3B* to clamp and thus bias the grid negatively. Again, an electrolytic capacitor *C-20B* is used across the relay to remove the 60 cycle component.

The mute relay is deliberately operated while changing channels to prevent sound blasting while tuning through programmed channels. With no input signal the back contact of the channel select relay is closed, grounding the grid return *R-25* of the mute relay stage *V-3B*. Whenever the channel relay operates, a positive *dc* voltage from the voltage divider consisting of resistors *R-20* and *R-23* is applied to the grid of *V-3B* insuring that relay *Z-11* closes.

The closing of the contacts of the

[*continued on page* 53]

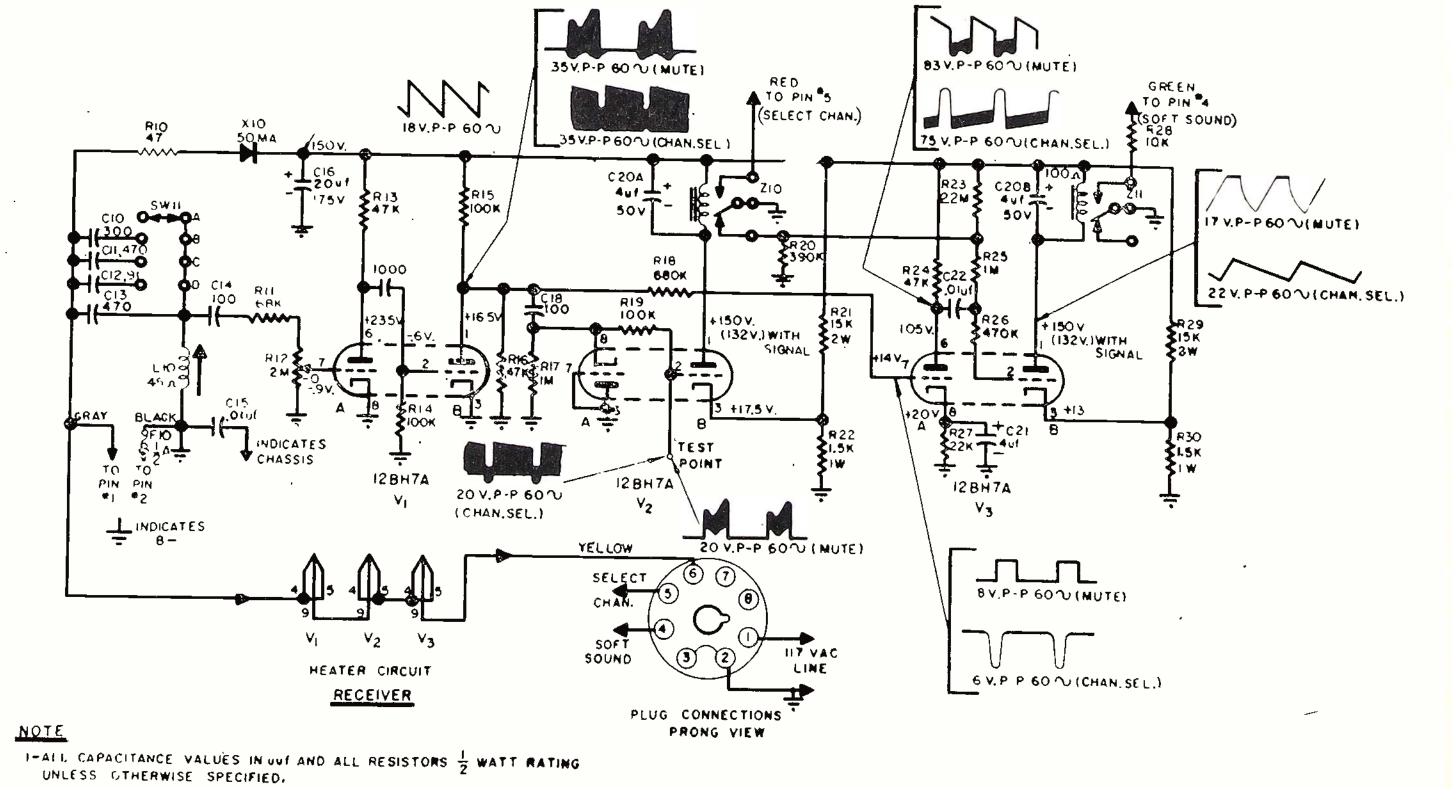

Fig. 4—Schematic of the printed circuit receiver control unit showing the plug wiring and critical waveforms and voltages.

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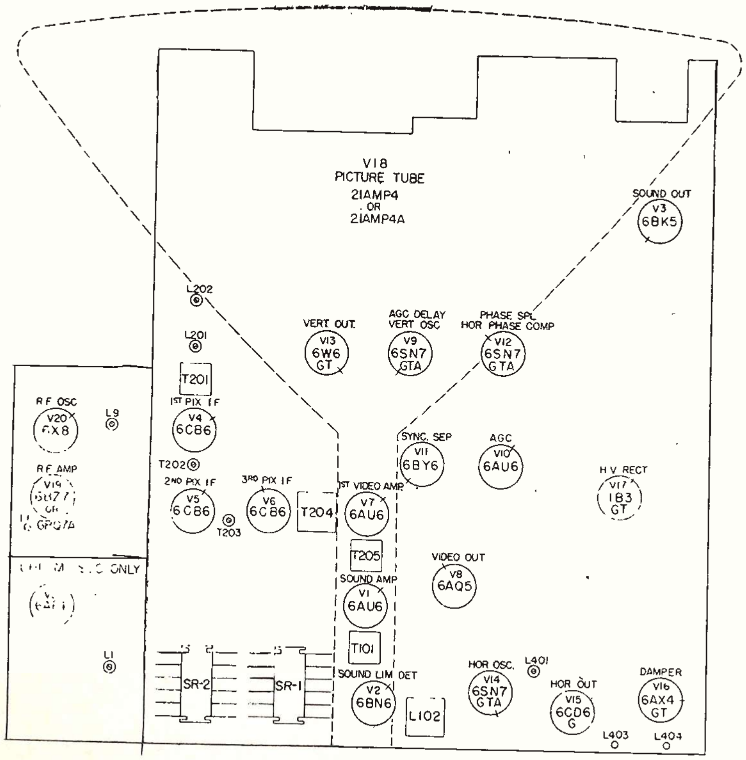
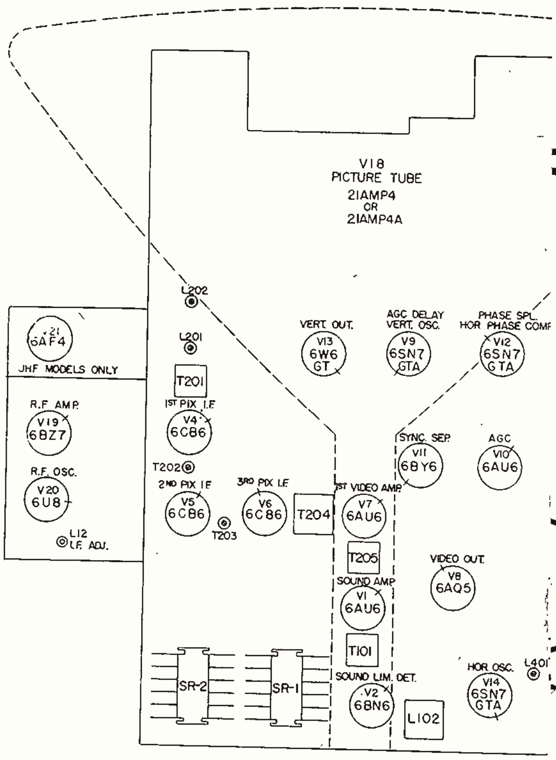
LOCATION OF TUBES

TE 379-1 & 382-1



TE 382-2



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TUBE FAILURE CHECK LIST

SYMPTOM	CHANGE TUBE
-no sound--lighted screen	(UHF V21) V4, 5, 6, 7, 8, 19, 20
icture O.K.	V1, 2, 3
-sound O.K. - no light on screen	V14, 15, 16, 17, 18
-sound O.K.--one horizontal line on screen	V9, 13
l or vertical sychronization--sound O.K.	V11, 12
k, tears on strong signal	V10

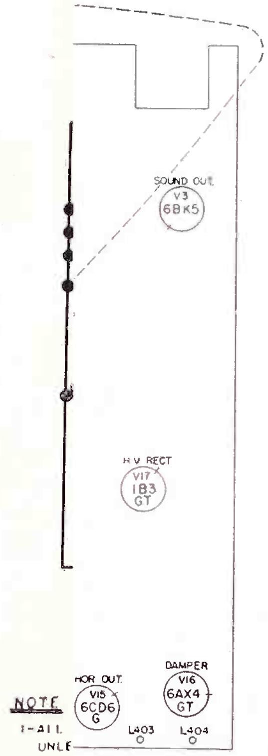
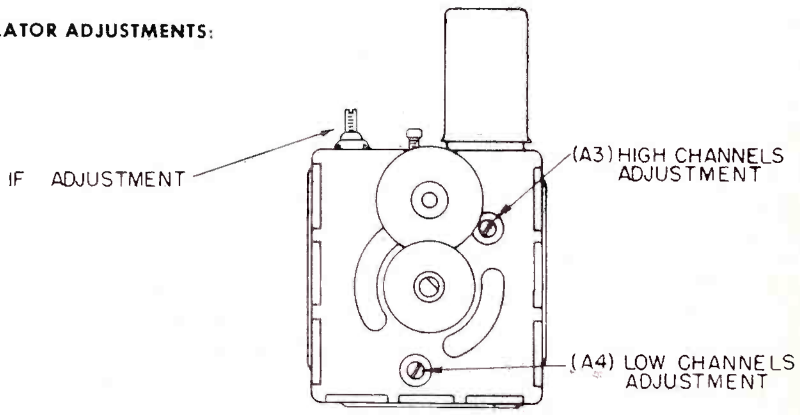
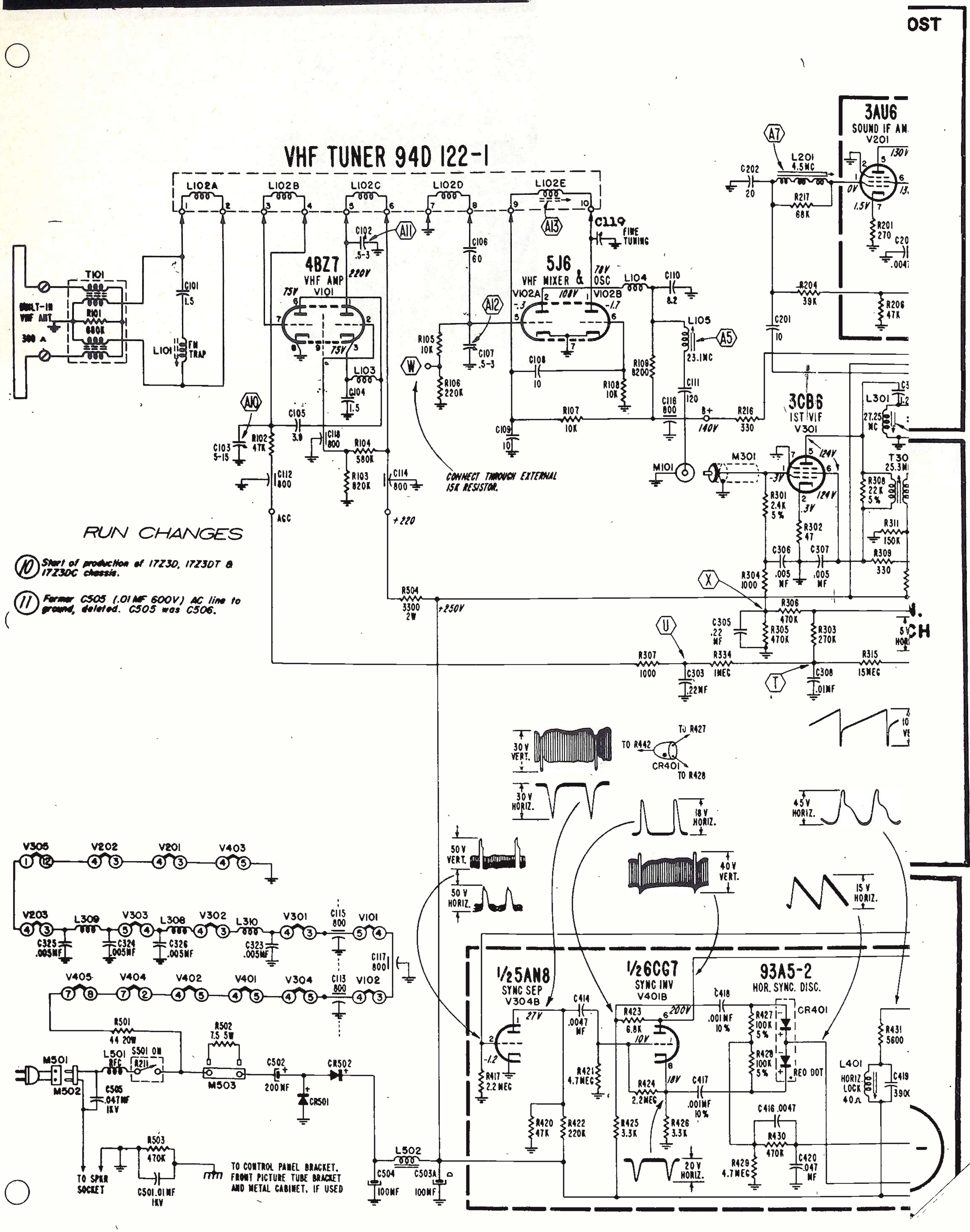


Fig. 4—S

OSCILLATOR ADJUSTMENTS:



VHF TUNER (FRONT)



RUN CHANGES

(10) Start of production of 17Z3D, 17Z3DT & 17Z3DC chassis.

(11) Former C505 (.01MF 600V) AC line to ground, deleted. C505 was C506.

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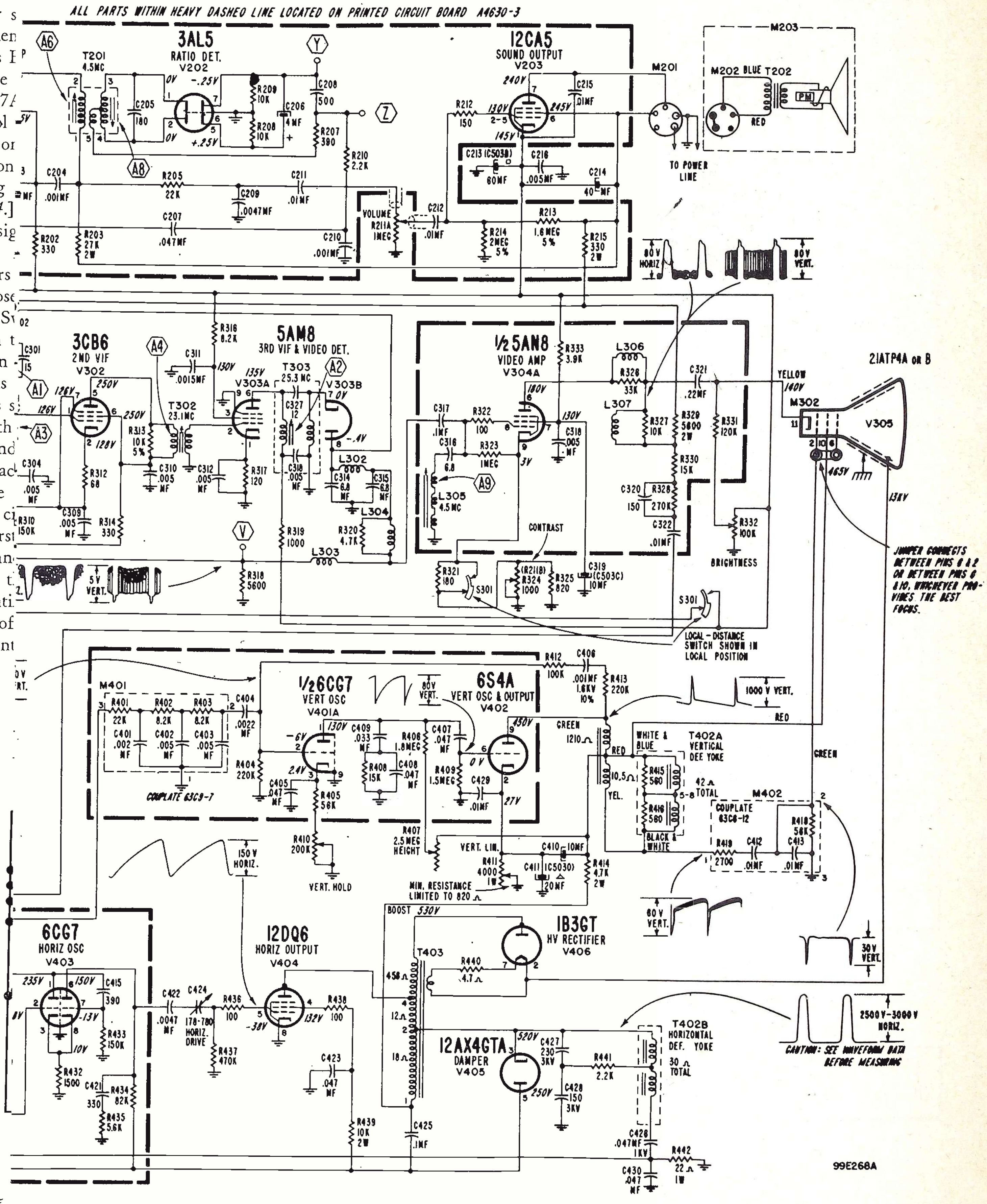

NOTE
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Fig. 4—S...ervice of Cowan Publishing Corp. by special arrangement with John F. Rider, Publisher.

Mfr: GE **Chassis No.** 9T001

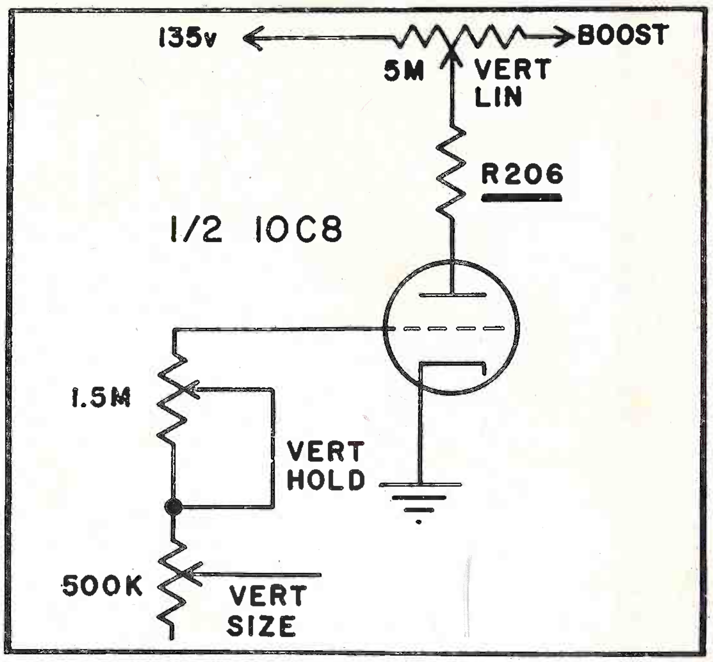
Card No: GE 9T001-1

Section Affected: Raster.

Symptoms: Poor vertical linearity.

Reason for Change: Circuit improvement. (Production change)

What To Do:
Change *R206* from 8.2 meg to 5.6 meg.



Mfr: GE **Chassis No.** 9T001

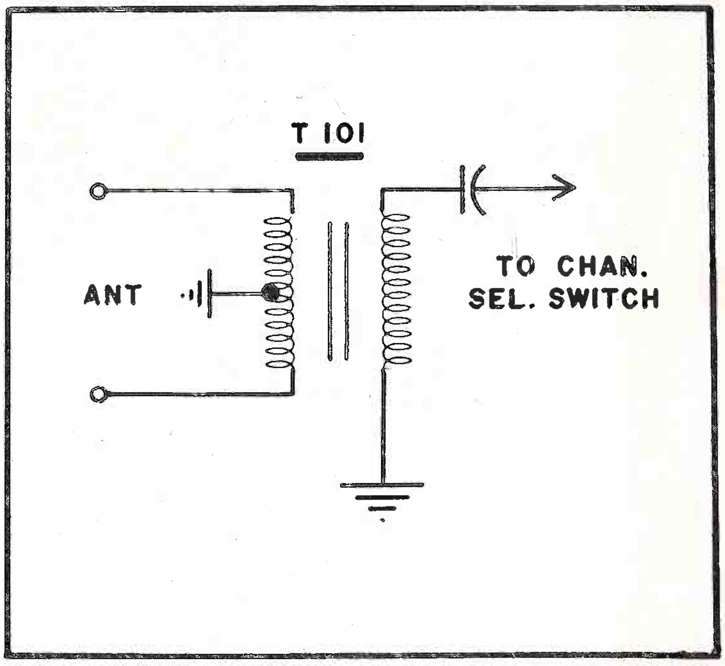
Card No: GE 9T001-2

Section Affected: Pix.

Symptoms: Low signal strength. Snow.

Cause: Open antenna input transformer *T101*.

What To Do:
Repair or replace *T101*.



Mfr: GE **Chassis No.** 9T001

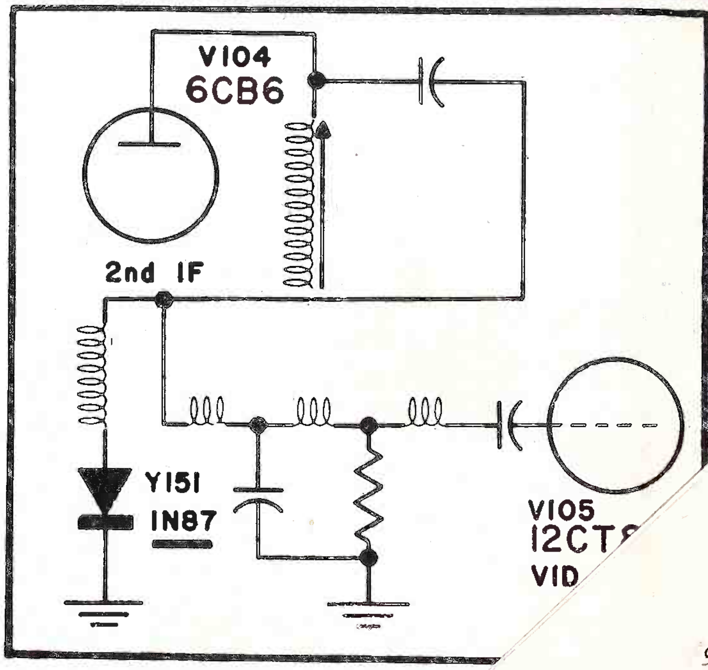
Card No: GE 9T001-3

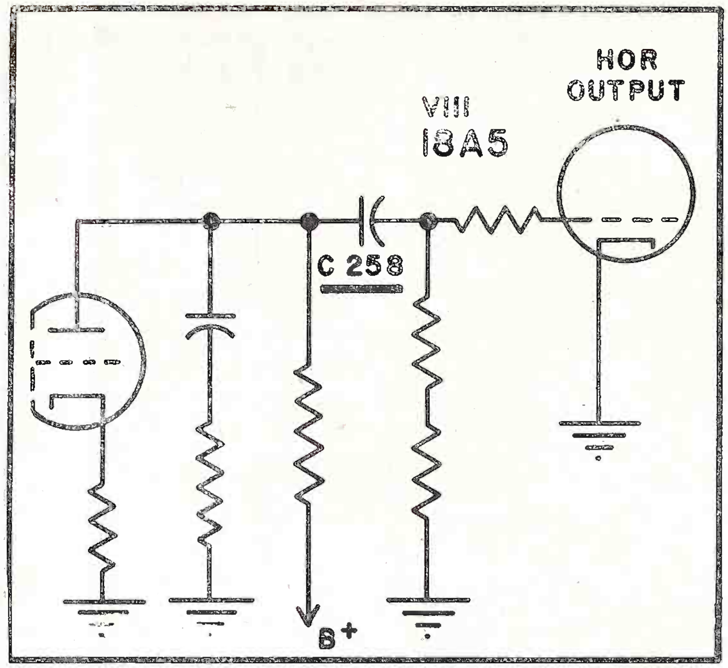
Section Affected: Pix.

Symptoms: Negative picture on all channels.

Cause: Defective component.

What To Do:
Replace diode, IN87.





Mfr: GE **Chassis No.** 9T001

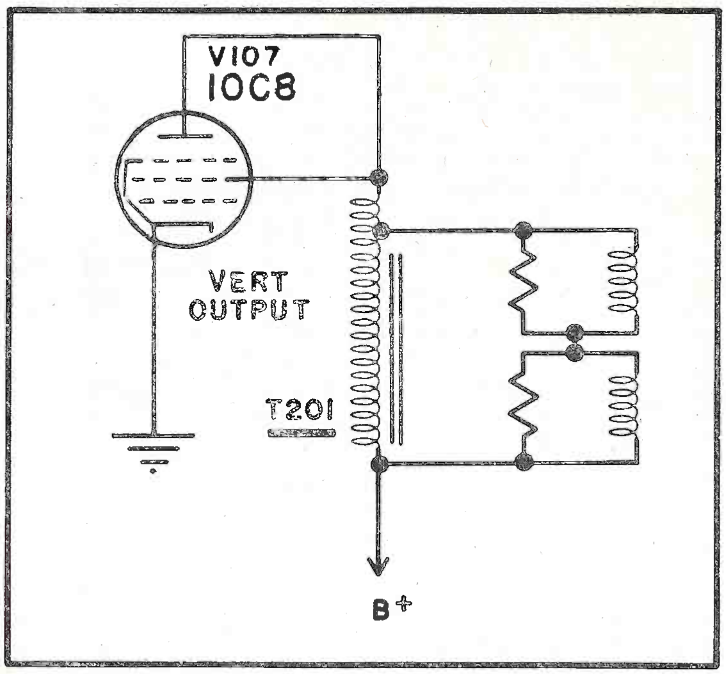
Card No: GE 9T001-4

Section Affected: Raster.

Symptoms: Lack of width.

Cause: Defective component.

What To Do:
Replace *C258*, .01 *mfd*.



Mfr: GE **Chassis No.** 9T001

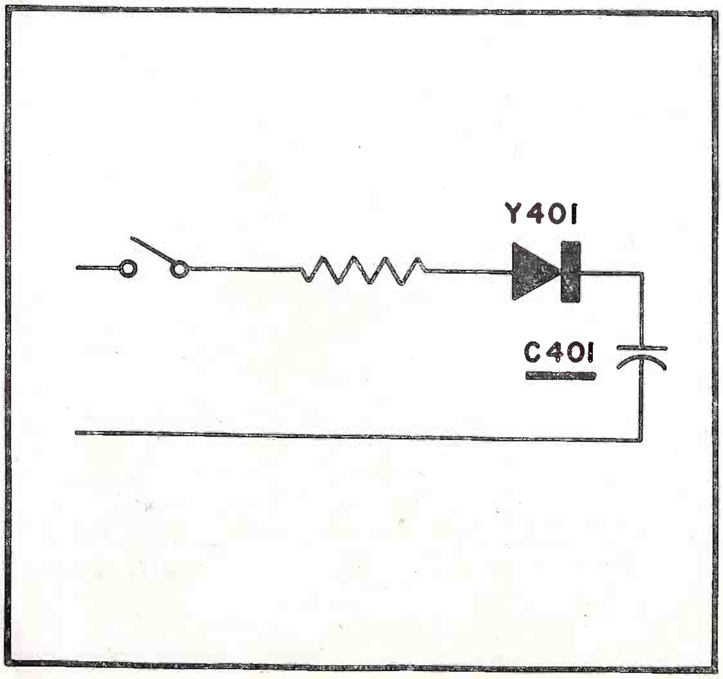
Card No: GE 9T001-5

Section Affected: Raster.

Symptoms: Poor vertical linearity and fold over.

Cause: Defective component.

What To Do:
Replace vertical output transformer *T201*.



Mfr: GE **Chassis No.** 9T001

Card No: GE 9T001-6

Section Affected: Raster.

Symptoms: Small raster, horizontally and vertically.

Cause: Defective component.

What To Do:
Replace *C401*, a 300 *mfd* 150 volt and/or *Y401* a 300 *ma* selenium.

Mfr: Admiral **Chassis No.** 14UYP3B, C

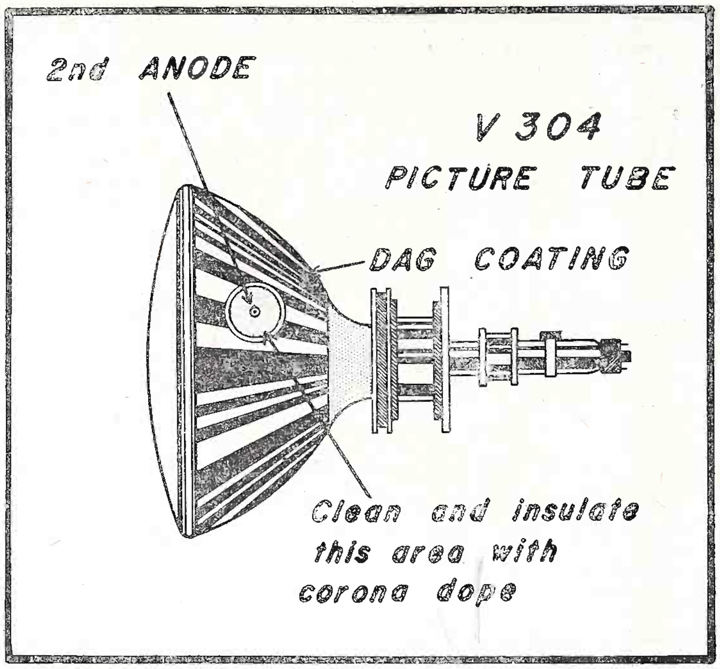
Card No: AD-14UYP3B, C-1

Section Affected: Picture Tube.

Symptoms: Corona discharge.

Cause: Dirt or dampness surrounding 2nd anode button.

What To Do:
Discharge picture tube (short 2nd anode to dag coating). Clean surrounding area with carbon tet. When dry, paint the area between anode cap and dag coating with corona dope.



Mfr: Admiral **Chassis No.** 14UYP3B, C

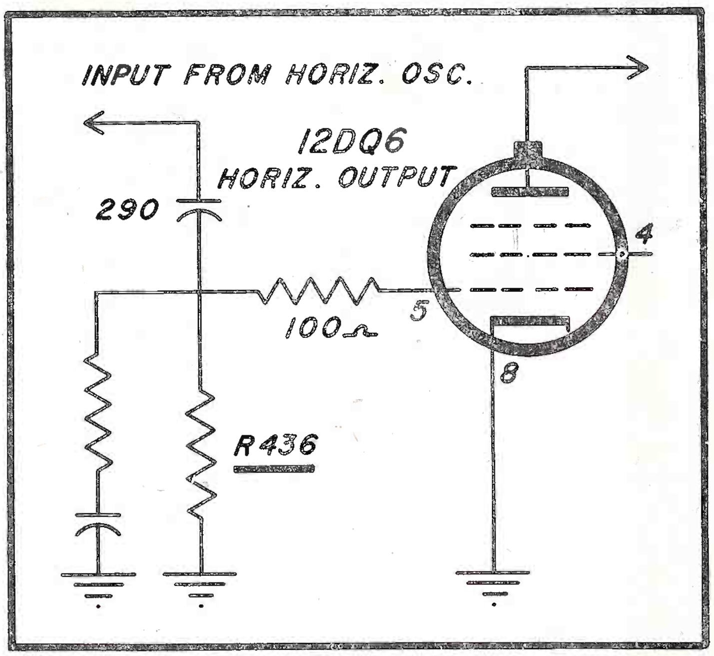
Card No: AD-14UYP3B, C-2

Section Affected: Pix.

Symptoms: Horizontal drive lines in pix.

Cause: Excessive output from horizontal oscillator tube 6CG7 or horizontal output tube 12DQ6.

What To Do:
Change *R436* (470K, ½ watt) to 330K.
Note: Drive lines appearing only in raster are normal providing they disappear when pix is tuned in.



Mfr: Admiral **Chassis No.** 14UYP3B, C

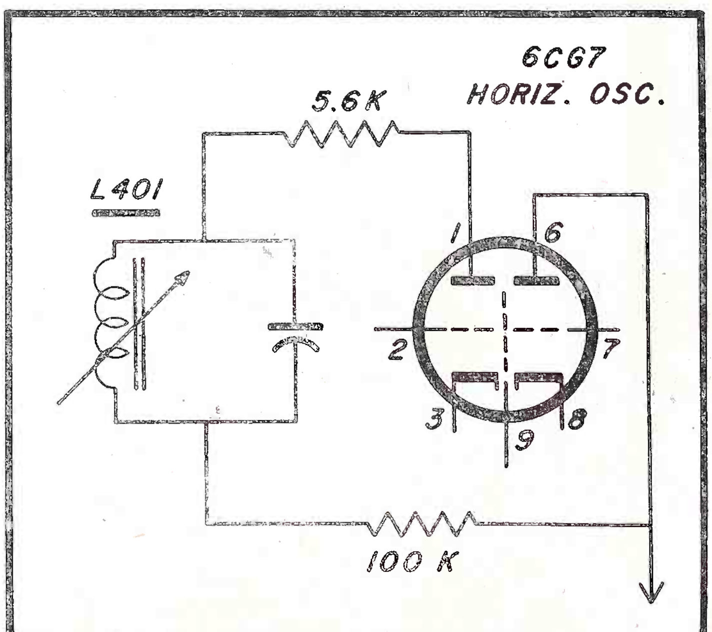
Card No: AD-14UYP3B, C-3

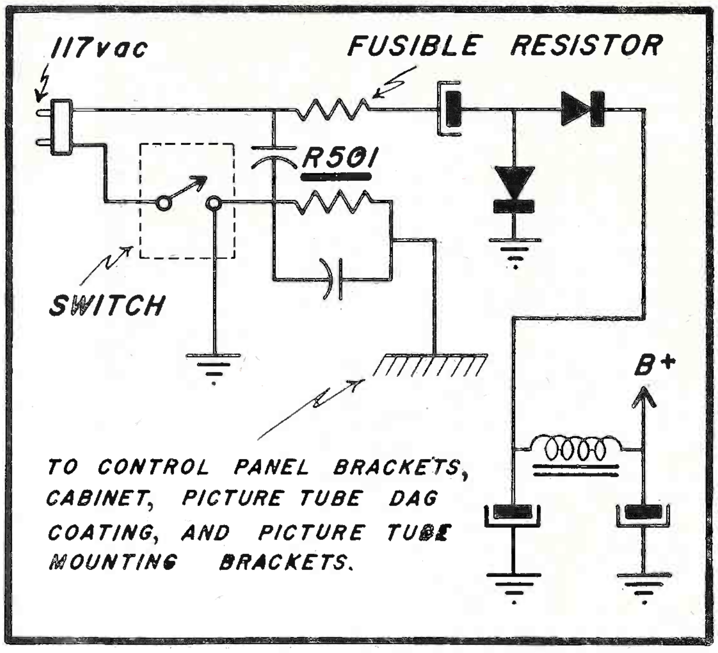
Section Affected: Sync.

Symptoms: Frequent drift, (tearing).

Reason For Change: To improve horizontal sync stability.

What To Do:
Change capacitor *C416* (.0039 mf) from paper tubular type to a mica type.





Mfr: Admiral **Chassis No.** 14UYP3B, C

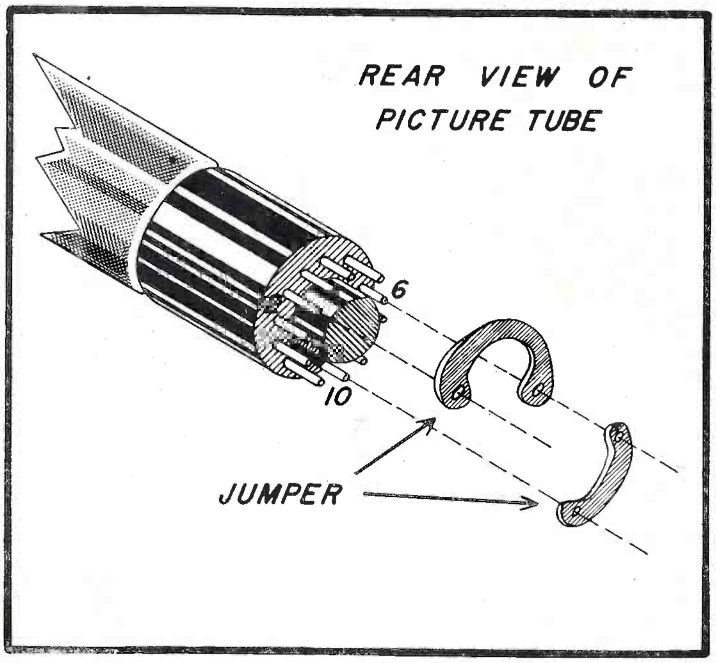
Card No: AD-14UYP3B, C-4

Section Affected: Chassis, cabinet and picture tube brackets.

Symptoms: Static discharge.

Cause: Resistor between control panel bracket and chassis is broken or disconnected.

What To Do:
Replace or reconnect *R501* (470K).



Mfr: Admiral **Chassis No.** 14UYP3B, C

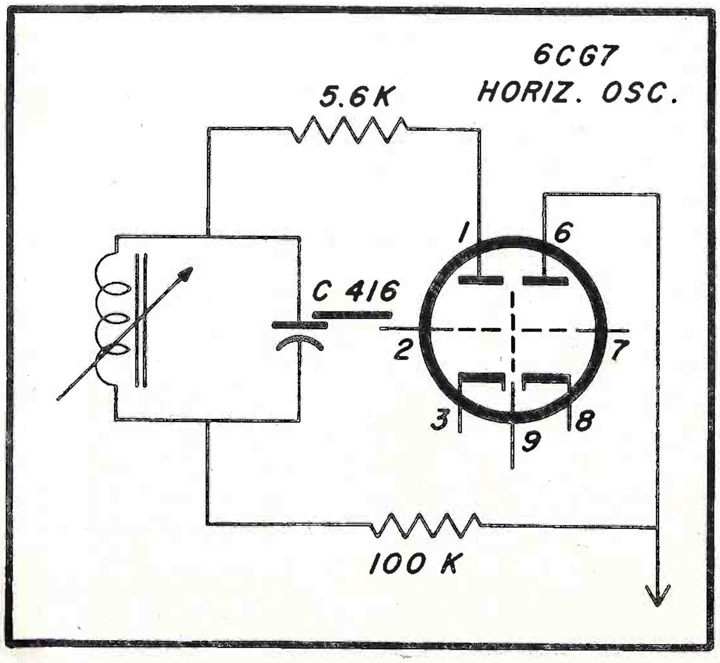
Card No: AD-14UYP3B, C-5

Section Affected: Raster.

Symptoms: Poor focus.

Cause: Picture tube requires better focusing.

What To Do:
Put a jumper strip (part #18A134) across pins 6 and 2, or pins 6 and 10 on the base of the picture tube; leave it in the position which provides the best focus.
Caution: Focus also varies with ion trap adjustment.



Mfr: Admiral **Chassis No.** 14UYP3B, C

Card No: AD-14UYP3B, C-6

Section Affected: Sync.

Symptoms: Horizontal lock coil requires frequent adjustments.

Cause: Horizontal lock coil is connected wrong.

What To Do:
Check to see that the bottom lead (start) from coil *L401* is connected to B plus 250 volts; the top lead (finish) goes to 5.6K resistor.

The ANSWERMAN

Mr. Answerman:

A set I have been trying to service has the following symptom. In the customer's home the picture pulls at the top and drifts in horizontal sync in both directions. However, on the service bench the picture is completely stable and never drifts. The only difference between the two locations is the antenna. I have examined the customer's antenna for opens, etc., and it appears to be in proper condition.

H. M.
Los Angeles, Cal.

The symptom that the receiver exhibits may very easily be due to the antenna leadin being located too near a 60 cycle power line. Perhaps the antenna leadin is strung through a basement and up through the floor to the receiver. If the lead is in close proximity to a power cable, a 60 cycle voltage can be induced into it that would be coupled into the tuner along with the received signals. If the induced signal is large enough, it can affect the horizontal circuits of some receivers so that pulling and instability at the top of the picture results. Improper antenna lead dress can just as easily cause picture pulling as a small cathode to filament leak in an *rf* amplifier tube.

Dear Sir:

I have an intermittent condition in the horizontal deflection and high voltage section of a Magnavox 650 series chassis. The Horizontal deflection transformer has been replaced but the condition still exists. I have gone over the circuitry and am unable to locate anything that is likely to be causing this trouble. The symptoms are intermittent complete collapse of the horizontal deflection and loss of high voltage.

E. H.
Washington, D.C.

A close inspection of the leads connected to the yoke will probably reveal that a lead is arcing through its insulation to a yoke terminal or a yoke terminal is biting into the insulation of one of the leads, thus causing the intermittent short. It is suggested that all the yoke leads be inspected and any burned or pitted lead portions be removed. Insulated sleeves should be installed on the leads that pass close to terminals that carry high pulse voltages.

Answerman:

An RCA KCS-100J chassis exhibits vertical lines on the left side of the raster. Aside from these lines there doesn't seem to be anything wrong in the set. The circuitry has been thoroughly checked. Do you have any idea as to how to eliminate these vertical lines.

R. T.
Philadelphia, Pa.

Most probably, the vertical lines are the result of ringing which is occuring in the horizontal deflection circuit. Reducing the series capacitance in association with the horizontal deflection coils will generally prevent this type of ringing in the horizontal deflection circuits. Change *C175,* as shown in *Fig. 1,*

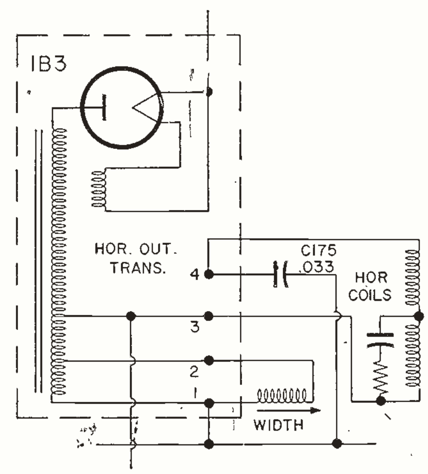


Fig. 1 — Partial schematic of the RCA KCS 100J horizontal circuit.

from .033 *uf* to .027 *uf*. This decrease in series capacitance will shift the resonant condition so that it no longer causes the deflection circuit ringing and the vertical lines. ■ ■

TRANSISTORS

[*from page 7*]

cancellation of the signal at the collector.

As a result of these three effects the use of normal junction transistors is limited to frequencies up to about 500 *kc*. This frequency limit is expressed by a term called "high frequency alpha cutoff" which defines the frequency at which alpha is reduced to .707 of its low frequency level.

Significantly, it is found that the high frequency response is inversely proportional to the square of the thickness of the base material. Thus, the thinner the base section, the higher is the possible operating frequency of the transistor. The search for transistors that will operate at higher frequencies has resulted in a variety of manufacturing methods and techniques: These include (1) processing the raw materials from which the intrinsic material is obtained; (2) adding controlled amounts of inpurities to obtain N and P materials of desired conductivities; and, (3) joining together N and P type semiconductors to obtain NP junctions with desired characteristics.

Future discussions will reveal how the different operating characteristics of the various types of transistors depend on the basic materials used in making the transistors and the differences in their construction, particularly with regard to the *types* of NP junctions formed.

Preparation of Base Materials

The principal base materials used in transistors are germanium and silicon. Germanium is much easier to work with than silicon; however, silicon can withstand much higher operating temperatures. Because it is more difficult to process, silicon results in a more expensive transistor. Thus, because they are more economical germanium transistors are generally used at normal temperatures. However, where higher operating temperatures are encountered silicon transistors are employed.

The preparation of base materials such as germanium and silicon involves their purification to an extremely high degree. This means removing foreign elements contained in the material to a degree higher than that obtained by ordinary chemical means. The first step in the preparation of germanium is to reduce commercially available powdered

The Work Bench

by PAUL GOLDBERG

THIS month's installment is devoted to portable sets.

Philco Chassis 7E10 (Portable)

The receiver was turned on and it was observed that the picture was tearing horizontally. An adjustment of the horizontal hold control would only cause the picture to syncronize momentarily, after which it would fall out of horizontal sync. The 7AU7 horizontal oscillator tube was replaced, but had no effect. This type of receiver utilizes a cathode coupled multivibrator and receives its correction voltage from the phase comparer, RECW, a selenium dual diode. The output of the dual diode is fed through the printed filter network #30-6016 as shown in *Fig. 1*. The horizontal sync pulse is fed to the selenium diodes through *C1*, 82 *mmf* and the reference or comparison voltage is fed back from the output circuit of the 7AU7 through *C2*, .001 *mf*. The selenium diode was checked first because of its history of chronic failure. The dual diode used in this receiver is similar to two 1N60 diodes tied back to back. However, in this dual diode the breakdown rating is better. The dual selenium diodes should measure (on a 20,000 ohms per volt meter) about 6,000 ohms front resistance to about 1.5 meg to 2 meg back resistance. Knowing these facts the dual diode was clipped out of the circuit leaving half of the pigtails in the printed circuit board to facilitate the reinstallation. The resistance of each half of the dual diode was

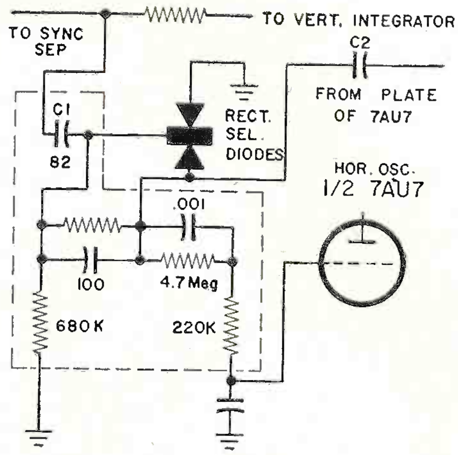


Fig. 1—AFC circuit of Philco 710.

checked. Each diode measured 30,000 ohms front resistance and 60,000 ohms back resistance. The dual diode was obviously bad and a new one was installed. The receiver now functioned properly.

Admiral 14YP3B (Portable)

The receiver was turned on and it was observed that the picture was tearing horizontally and rolling vertically. Because this type receiver trouble was a composite sync problem the 5U8, V201B, sync inverter and the 6BA8, V303B, a sync separator, were replaced individually but had no effect. In this receiver the composite sync pulse is fed through *C315*, (see *Fig. 2*) .01 *mf*; from the plate circuit of video amplifier V303A, ½ 6BA8A to the grid of V303B, sync separator. Due to the grid leak action of *C315* and *R418*, and the low plate voltage created by *R419*, a 47K and *R420*, a 330K, only the horizontal and vertical sync tips will appear in the output circuit. The plate of V303B is directly coupled to the grid of the sync inverter V201B. The vertical sync pulse is taken from the plate of V201B through *R401* while horizontal sync pulses opposite in phase are taken from the plate and cathode of V201B and fed to the horizontal phase detector. A waveform check was then made at pin 2 of V303B. Here the waveform was correct. A waveform was next taken at pin 3, the plate of V303B. The waveform showed sync pulses of insufficient amplitude. A voltage check was next made at the plate pin 3 of V303B and in-

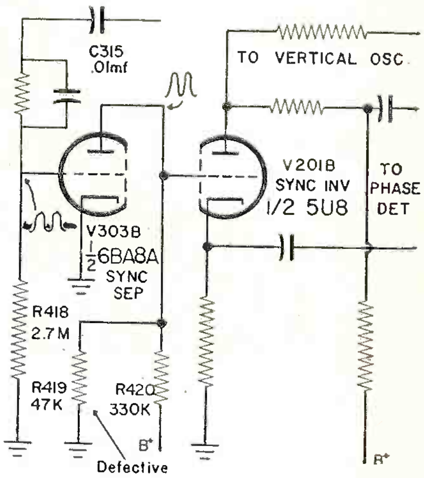


Fig. 2—Sync separator in 14YP3B.

dicated 8 volts instead of 25 volts. *R420* and *R419* were measured and *R420* checked correctly while *R419* measured 9,000 ohms instead of 47K. Replacing *R419* solved the problem. ■ ■

TRANSISTORS

[*from page* 41]

germanium oxide to germanium. This is generally done in a hydrogen furnace.

Zone Refining

After this initial purification, the material is given a very high degree of purification by a process called zone refining. This process is used for silicon as well as germanium. The germanium, which is now in a polycrystalline bar form, is carried in a boat along the coil axis of an *RF* heating unit as shown in *Fig. 4*.

The boat is then moved along from one end of the coil to the other. During this process the portion of the bar

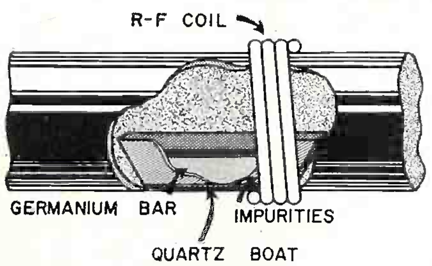


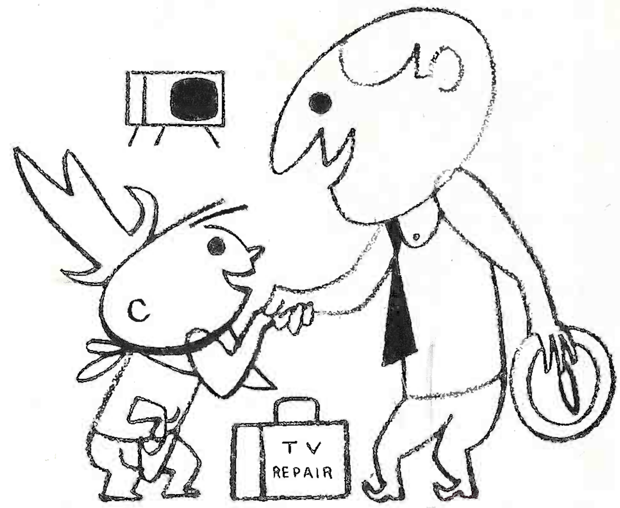
Fig. 4 — Purification of germanium by the zone refining process.

directly under the influence of the coils becomes semi-molten. Impurities have a characteristic of preferring to dissolve in the molten state of a substance rather than in its solid state. Thus, impurities contained in the bar move to the molten portion and are dissolved in the melt. Now, as the boat moves from one end of the coil to the other, the impurities are trapped in the molten portion underneath the coil. Finally, at the end of the bar travel a molten section of bar remains which contains all of the impurities. The final result of this operation is a relatively pure bar of germanium for most of its length with a small piece at the end containing the concentrated impurities. This piece is removed.

[*Continued on page 48*]

Reputation Builder #3: it pays to be neat

- Treat a set-owner's home like a dog house and you're likely soon to be living in one



- BUT . . . treat his possessions as you would your own, and you'll always be an honored guest

it pays to replace with Sprague Atom® Miniature 'Lytics

- Another way to build and hold a reputation is to insist on top quality replacement parts. Callbacks due to replacement failures not only cost you *money* . . . they also cost you customers! Replace with less than the best and you place your reputation at stake. In capacitors, the best is *Sprague.*

- Take Atom Tubular Electrolytics, for example. The smallest TV 'lytics made, they're the only small ones for 85°C (185°F) up to 450 VDC. Guaranteed for low leakage and long shelf life, they withstand high temperatures, high ripple currents, high surge voltages. From crowded TV chassis to jam-packed portables, Sprague Atoms fit them all.

- Get your copy of Sprague's latest radio and TV service catalog, C-456. Write Sprague Products Co., Distributors' Division of Sprague Electric Company, 71 Marshall Street, North Adams, Mass.

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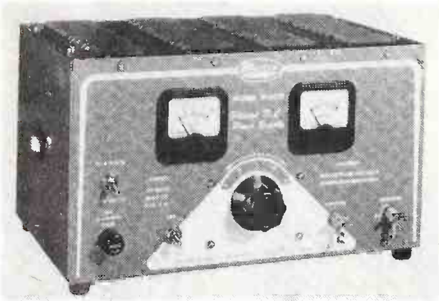
Test Equipment

ELECTRO D612-T DC POWER SUPPLY



The Electro model D-612T *dc* power supply was designed both for the operation and testing of transistor type automobile radios and also for testing conventional tube type auto radios, battery charging, telephone circuits, model trains, electroplating and any other operation requiring 0 to 16 volts *dc*.

The power supply must be operated with an input of no more than 110 to 120 volts *ac* at 50 to 60 cycles. The power consumption at maximum load is approximately 250 watts. A variable control and range switch provides voltage ranges of 0 to 8 volts and 0 to 16 volts with a ripple factor that is less than ½ per cent for current loads up to 6 amperes and less than 2 per cent for current loads of 10 amperes. The output voltage and current are indicated by a separate ammeter and voltmeter mounted on the front panel. The meters are rectangular and measure 2 inches by 2 inches. The entire unit is protected by a 3 ampere fuse which is readily accessible since it is mounted on the front panel.

The selenium rectifiers are mounted against the sides of the cabinet thereby providing conduction cooling. This produces many times the cooling surface of the standard selenium plate thus providing a margin of safety, longer rectifier life and greater current carrying capacity. The unit also uses the "chimney" effect for additional cooling.

The circuit diagram of the D612T is shown in *Fig. 1*. With S2 in the left position one half of the secondary of T is used and two of the selenium rectifiers provide full wave rectification. When the switch is thrown to the right the full secondary voltage is fed to a bridge rectifier, producing a 16 volt output. The output ripple frequency is the same for both switch positions.

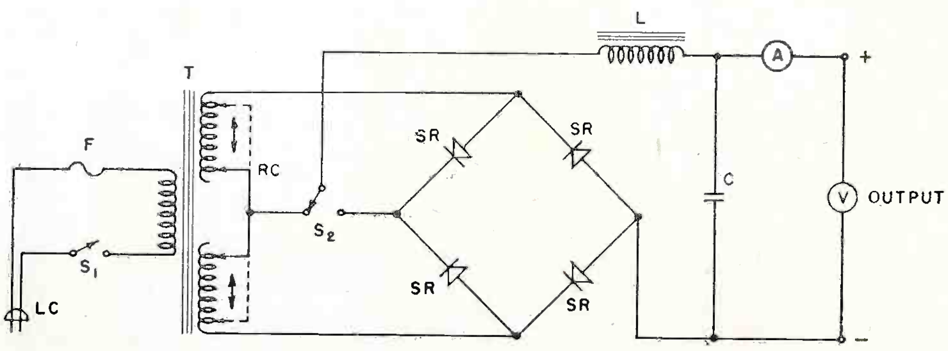


Fig. 1—Schematic diagram of the D612-T low voltage DC power supply.

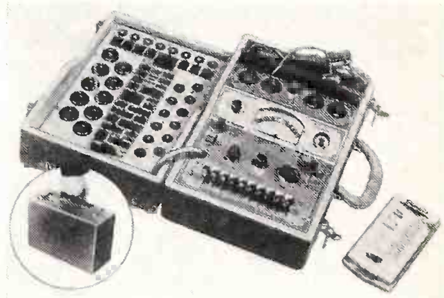
SECO MODEL 107 TUBE TESTER

The Seco Model 107 Tube Tester has been designed to provide a rapid comprehensive test for tubes. This instrument provides three major test functions. These are:

1—Grid circuit test
2—Dynamic Mutual Conductance
3—Cathode Emission

In addition to the listed tests the checker has several other features. It provides for the instantaneous testing of shorts and indicates their presence through the use of a tuning eye tube. The line adjustment, once set, need not be readjusted for various tube types due to an automatic compensating circuit.

A prewired panel mounted in the cover permits a mutual conductance test to be run with a setting of only a filament switch and load control. The



test voltages are prewired to each socket. The filament and load control settings are marked alongside the prewired sockets.

Cathode emission is tested on the master panel with all settings given in the Flip Chart index. The Flip Chart also indicates which tubes are on the prewired panel.

Grid Circuit Test

The Grid Circuit Test (GCT) is most useful when servicing difficulties involving the *agc* chain. When *if* and *rf* tubes develop positive control grids the tendency is to short circuit or load down the bias supply. The effect of this, on set performance, will be bending, pulling, vertical jitter, sync buzz and any of the other faults created by sync compression. The GCT will indicate when a tube has any of the following failures:

1—Control grid emission
2—Gassy tube
3—Grid to cathode leakage
4—Heater to cathode leakage

After the prewired chassis is set for the mutual conductance test of a tube, the tube need only be inserted in the correct socket for an immediate indication on the tuning eye of all the conditions listed above. If any of the 4 defects are present the eye tube shadow angle will open. In addition the eye will open instantaneously if any shorts are present. Any one of 15 defects or any combination of them will open the eye tube and show defective. For reliable readings tubes should be preheated. Preheating may be accomplished by a brief increase of 20 percent in filament voltage.

Mutual Conductance Test

When a tube passes the grid circuit test it may be checked for mutual conductance. To make this test, the bar knob at the bottom of the prewired panel is pushed upward without any further adjustments. This test is most important for high amplification tubes used in *rf*, *if* and other voltage amplifier circuits. Since the tube currents are relatively low, an emission test is not too important.

The meter scale is not calibrated in micromhos but in percentage and the usual multicolor good-bad scale.

Individual sections of dual and twin type tubes are checked separately. The second section of a tube is checked by depressing the bar knob in the downward direction.

Cathode Emission Test

Power amplifier tubes are not generally called on for high amplification but rather for large currents. Therefore the mutual conductance test is not too significant for tubes used as audio, vertical sweep and horizontal sweep outputs as well as rectifier tubes. To test these heavy current types the cathode emission check is most valid. This test is accomplished on the master panel of the instrument. The control settings are taken from the Flip Chart index.

When the tube is inserted for the emission test, the circuit is so wired that the grid circuit test is performed automatically and the condition is indicated on the eye tube. If a tube passes this test it is then tested for emission.

Obsolescence

Several steps have been taken to prevent obsolescence. Three spare tube sockets have been provided on the prewired panel for future tube types. In addition the etched panel indicating the load and filament settings is removable and may be replaced with an up to date panel. Replacement fillers for the Flip Chart are to be made available to registered owners as new tubes are developed. A simple method of calibrating the tester for new type tubes is described in the instruction manual that accompanies the tube tester. ■ ■

TRADE

"Displays of television receivers and merchandising materials necessary to accompany the displays, are still the best method of inducing prospective customer interest," 55 per cent of the Hotpoint TV receiver owners surveyed stated. Their first interest in Hotpoint TV receivers was the dealer's store displays. According to D. Edward Weston, Jr., general manager, television receiver dept. Hotpoint Co., it's the dealer who displays the merchandise that gets the business.

• • •

The sale of color television receivers is now "beginning to make the difference in the dealer's profit margin," Roger L. Drew, Manager of Color Television Market Development, Radio Corporation of America stated recently. Addressing a meeting of the National Appliance and Radio-TV Dealers Association, Mr. Drew cited high sales records in several cities where RCA is conducting special promotion campaigns, then added: "Even before the promotions, Cincinnati dealers reported that their dollar volume on color amounted to 22 per cent of total RCA Victor TV sales. In Detroit, the ratio was 31 per cent; in Philadelphia, 28 per cent."

• • •

An industry record was established in Syracuse, when the General Electric Co. produced its 1,000,000th portable television set at Electronics Park. The brain child of Dr. W. R. G. Baker, vice-president of General Electric, portable television went into production in Syracuse in the Spring of 1955.

• • •

Simpson Electric Company announced the addition of Frank Hadrick to its engineering staff as Chief Field Engineer (Test Equipment). Mr. Hadrick, formerly Chief Television Field Engineer for Admiral Corporation, was instrumental in developing their Color TV training program. In his new position, he will play an integral part in the design and development of new Simpson test equipment and will be available for consultation concerning television and other electronic testing problems encountered by Simpson customers.

• • •

Radio set shipments to dealers by manufacturers increased considerably in August compared with July and by nearly 300,000 on a cumulative basis over the like eight-month period of last year, the Electronic Industries Association (formerly RETMA) announced.

Manufacturers of television receivers shipped more sets to dealers in August than had been sent in July. TV makers shipped fewer TVs during the first eight months of this year compared with the cumulative totals of last year.

Manufacturers' sales of receiving and TV picture tubes increased in August over July. Sales of both tube types were reported to be under the level of August 1956.

FLASHES

Thirty percent of the TV sets in the United States have yet to be used with an antenna, explaining the unreasonably large volume of complaints received by dealers and servicemen. That figure was disclosed following a year-long survey made by the research department of Snyder Mfg. Co.

Ben Snyder, president, disclosed that even in some rural areas set owners have been depending upon so-called built-in antennas to bring in pictures which are almost illegible. Some set owners (more than 5%) have been attaching bailing wire to their antenna lead-ins and "tossing the wire out of the closest window." Others attached wires to bed springs, rain spouts, or just bought a 98-cent "rabbit ear" which performed much more poorly than a piece of bailing wire "more often than not." The biggest "violators of good entertainment" are in the south and southwest, where some 40% of all returns were due to the fact that the purchaser of the receiver refused to buy any kind of antenna. "Only a top quality antenna, either indoor or outdoor, can take advantage of the power of the modern television receiver and bring in clear, enjoyable pictures," Mr. Snyder added. "The poor serviceman has been taking the brunt of such complaints."

● ● ●

Three new types of consumer service warranty extension plans—covering RCA Victor color television receivers in second-year use—were announced by E. C. Cahill, President, RCA Service Company, Inc. "These warranty extensions," Mr. Cahill said, "reflect our confidence in the efficient and trouble-free operation of color TV receivers."

A $39.95 Warranty Extension Plan extends the initial picture tube warranty for one additional year. The RCA Service Company will install the replacement if the receiver is within a branch service zone.

A second Extension Plan at $34.95, available through RCA Victor television dealers, extends picture tube warranty an additional year. It does not include the cost of service for actually replacing the picture tube.

A $59.95 Plan not only extends picture tube warranty an additional year, but also extends the initial warranty on parts and receiving tubes for an additional twenty-one months. The combination of both features provides protection on the tube and all parts for two years from the date of purchase.

● ● ●

Mr. Harry R. Ashley, President of Electronic Instrument Co., announced an agreement with Hegeman Laboratories, Glen Ridge, New Jersey, for exclusive rights to manufacture and distribute the new Hegeman Standard Speaker System. This system, to be known as the EICO Standard Speaker System, is claimed to be a new milestone in the loudspeaker art. EICO will make this system available in completely finished form in a choice of hand-rubbed fine hardwoods.

TRANSISTORS

[*from page 42*]

Crystal Growing

Germanium crystals required for transistor purposes must be monocrystalline in structure. That is, the atom structure must be arranged so that, in effect, a single crystal exists, otherwise free motion of the carriers will be impeded by the various surfaces and boundaries present in a polycrystalline structure. After the *rf* heating operation, the intrinsic material is still in a polycrystalline form; that is, it consists of a combination of many separate crystals. In order to change polycrystalline germanium to monocrystalline germanium a process such as that shown in *Fig. 5* is used. Here a slowly rotating

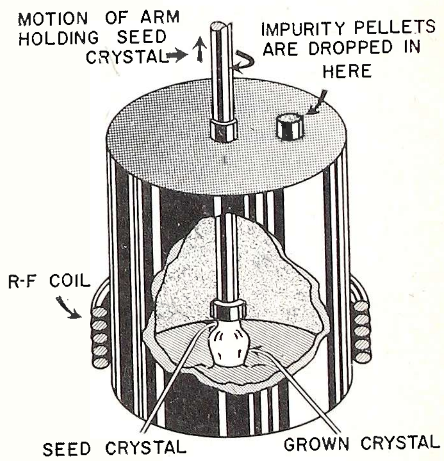


Fig. 5—Process used for growing monocrystalline germanium

rod containing a single crystal of germanium is dipped into a crucible containing molten polycrystalline germanium. As this rod is rotated it is also slowly withdrawn. In doing so, it picks up atoms from the molten germanium, which arrange themselves to form a monocrystalline bar. Practical products of this process are bars of very highly purified germanium about six inches long and one inch in diameter. The same process is used in manufacturing monocrystalline silicon.

The type of material manufactured in this manner is essentially intrinsic and as such cannot be used for diode or transistor application. To be suitable for the latter the semiconductor material required must be either N type or P type. If during the operation described in the previous paragraph, measured impurities of other metals are added to the melt, either N or P type germanium may be produced. Gallium, boron, indium, gold and aluminum may be used to produce P type germanium. Arsenic, antimony, or phosphorus may be used to obtain N type germanium. The completed bar is then sliced into very thin discs. The latter are then diced into small segments approximately 1 mil thick and ten mils square. These segments are used as the base material of the junction type transistors previously discussed.

[*To be continued*]

HI-FI

[*from page 18*]

duces a drop across *R4,* which sets the grid voltage for V1. Now, suppose for some reason the power supply voltage drops (either because of increased load or, because the line voltage has decreased). Then, immediately, the voltage at point "A" decreases slightly. The bias of V2 goes slightly less positive, and that tube conducts less current. The reduction of current through V2 results in less of a voltage drop across *R4,* or, less bias at the grid of V1. Less bias on any tube of this type means that the internal resistance is lowered and with a lowering of this "tube resistance," less voltage drop occurs across V1. Thus the screen voltage, taken at the cathode of V1 remains fixed. You can easily trace the steps that would occur if the screen voltage or line voltage were suddenly to rise beyond proper limits. Just the reverse correction would take place, again tending to restore proper operating voltage to the screens of the output tubes.

Voltage Regulator Types

Occasionally, a type of output tube will be found in which the bias setting for optimum power is quite critical. Under such circumstances, the mere application of fixed bias as shown in *Fig. 2* (see previous article in this series) does not provide sufficiently "stiff" operating conditions. A shift of merely 10 per cent in line voltage is often enough to create operating conditions which exceed the tube ratings (when the shift is upward) or reduce maximum power output of the amplifier (when the shift occurs on the downward side). In such cases, a circuit similar to that shown in *Fig. 5* is employed. The filtered negative voltage, rectified from a tap-point of the power supply has, in shunt, a neon glow tube, whose firing characteristic is very nearly 65 volts. That is, the glow tube, once fired, has a variable internal resistance, determined by current flow, which acts to keep the potential drop across it at a constant 65 volts or so. Components *C1, R2, R3* and *R4* then combine to provide filtering and voltage division to select the actual operating bias voltage. A shift of as great as 10 per cent in *ac* potential at the transformer tap-point will represent less than 1 per cent shift in bias voltage with this arrangement.

Voltage Regulator Troubles

The nice thing about both circuits described is that they have a measure of self-protection in the event of their failure. For example, in *Fig. 5,* if the neon indicator were to fail or open up, a greater bias would appear at the arm of *R3,* resulting in reduced current flow through the output tubes. By the same token, failure of V1 in the circuit of *Fig. 4* would result in no screen voltage and no voltage for the earlier voltage amplifying stages. This is a condition easily detected in servicing with a voltmeter. Failure of V2 would be somewhat more destructive

[*continued on page 52*]

Eliminating Color TVI

Part 2

by The Washington Television Interference Committee

Internal sources of interference and their remedies are discussed in this second installment of the color TVI series.

In the preceding installment of this series, the operation of color TV receiver circuitry was reviewed to serve as a background for this and other material to follow. Let us now examine some of the more common causes of color TVI which may be traced to causes within the receiver itself.

3.58 MC Harmonic Radiation

Since the color television receiver has a 3.58 *mc* oscillator, usually crystal controlled, it is an additional source of an *rf* signal which could result in beats or interference patterns. Most color receivers are adequately shielded and so designed as to keep fundamental and harmonic radiation from this 3.58 *mc* oscillator to a minimum.

However, in isolated cases it is possible for the 13th harmonic (46.54 *mc*) to beat with the picture *if* carrier at 45.75 *mc*, causing interference on all channels. This can be isolated by disabling the 3.58 *mc* oscillator while observing the interference. Ignore any changes in kinescope screen color which may occur as the result of disabling the oscillator. Correction may be difficult, involving lead dress and/or shielding of the oscillator or other leads which may be carrying 3.58 *mc* information. In some cases a short wave receiver with a shielded or coaxial antenna "probe," or a sensitive detector or grid-dip meter, can be used to advantage in locating the circuit or lead which is radiating the 3.58 *mc* or its harmonics.

It is also possible for harmonics of the 3.58 *mc* oscillator to be picked up directly by the antenna lead-in. For example, the 19th harmonic (68 *mc*) can beat with the incoming channel 4 picture carrier (67.25 *mc*) resulting in interference to channel 4. This is particularly possible when the received signal from channel 4 is very weak, or when a "V" type indoor antenna is used. The correction is to use a good antenna to receive the strongest possible station signal, and to re-route or shield the antenna leads to the *rf* unit.

Interference to amateur operations in the vicinity of 3.58 *mc* and its harmonics, or interference to color circuits from local amateur signals near the 3.58 *mc* color sub-carrier may result unless care is taken to prevent radiation from the circuits involved. These are located inside the chassis. For example, the bottom of the receiver chassis may be provided with a bottom plate securely fastened to the chassis at a number of points. When servicing inside the chassis care should be taken to insure that the plate is replaced and fastened at all points at which fasteners may be provided rather than using only a sufficient number of bolts to keep it in place.

Picture IF Harmonics

Since a detector is a non-linear device, it is quite possible for a detector circuit, particularly at a television *if* frequency, to radiate a small amount of energy at the fundamental picture *if* frequency and its harmonics. For example, the 4th or 5th harmonic of the picture *if* may be radiated from the picture *if* second detector circuitry or components, and be picked up by the antenna lead-in or *if* unit, and appear as interference on channels 7, 8 or 13.

This type of interference can be identified because it is tunable with the fine tuning control. It may be particularly noticed where a weak signal is being received from the television station, or where a "V" type indoor antenna is used on top of the receiver.

The correction involves lead dress, shielding, or by-passing of the picture second detector circuitry in order to minimize the harmonic radiation. As a last resort, realignment to a slightly different *if* frequency will shift the interference beat to a frequency where the beat would not be objectionable.

Other Internal Sources of Interference

Interference may also be caused by a condition in the *agc* amplifier where the *rf* bias becomes too high and the *if* bias becomes too low. This condition is usually caused by one or more resistors in the *agc* bias voltage divider network changing value. The bias produced by this change causes a snowy picture with *rf* interference. An open coil in the antenna matching transformer can also produce a snowy picture with noticeable interference. A check for an open matching transformer or open transmission line can be made very easily. Simply slide the hand along the transmission line while watching the picture. If the picture changes greatly when the hand is moved, the line or antenna coil is probably open or it is an indication of a poorly matched antenna or transmission line.

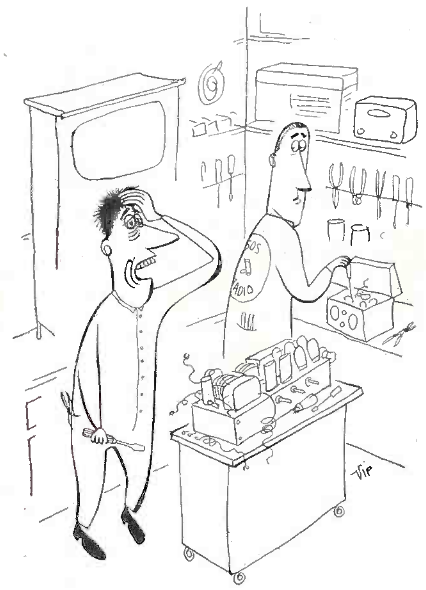
Sound Beat in Picture

It is possible to have a strong sound beat in the picture even when the fine tuning is positioned for best color. When properly tuned in there should be no sound beat in the picture. If it is impossible to tune out the sound beat interference without losing color it is probably due to improper alignment of the picture *if* amplifier or the video amplifier. Alignment is more critical due to complimenting *if* and video responses.

Faulty Tubes

Low emission *rf* tubes in the tuner contribute to the susceptibility of a television receiver to interference effects. A systematic check from the antenna through the receiver front end will often disclose the difficulty. In a number of reported interference cases replacing a low emission *rf* tube or low emission or shorted oscillator tube has caused the picture to jump in clear and free of interference and degradation.

[*To be continued*]



"I had a terrible night last night—dreamt we were out of JENSEN NEEDLES."

HI FI POWER AMPLIFIERS

[*from page* 49]

in that absence of current flow through V2 would place the grid of V1 at the

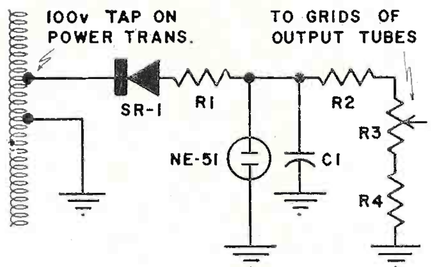


Fig. 5—Schematic diagram of a voltage regulated bias supply.

same positive potential as its plate. V1 would therefore probably "go along for the ride" but no destruction of the expensive power output tubes would take place.

Usually, the voltages which should appear at all points in a voltage regulator circuit are clearly prescribed on the manufacturer's schematic. Some typical problems encountered are: loss of power output, distortion, cherry red plates or screens and frequent replacement of output tubes. Many of these difficulties in the output stage can be traced to some element in the voltage regulator circuitry. With the ever-present race for higher-powered amplifiers in full swing, (justifiably or otherwise) more and more manufacturers will tend to "squeeze the last watt" out of a pair of output tubes and you are likely to run across many variations of the two circuits described, for this reason.

Feedback

We have mentioned feedback previously, but since the most important source of feedback is associated with the output stage and its transformer, it would not be amiss to dwell upon the subject in some detail at this juncture.

The general case of application of feedback to an amplifier is shown diagrammatically in *Fig. 6*. Simply stated, a portion of the output voltage (or current) is fed back to the input (or to a point near the input) to produce one or more of the following beneficial effects:

1. Reduction of distortion.
2. Reduction of hum and noise.
3. Improvement in frequency response.
4. Change or improvement of damping factor or source impedance.

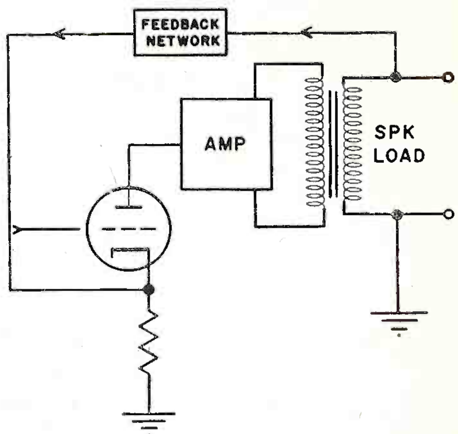


Fig. 6—Block diagram indicating general application of feedback.

While the most common form of feedback is of the negative voltage variety (i.e.—a small *voltage* is fed back out of phase with the point of injection), negative current feedback, positive current feedback and even positive voltage feedback are sometimes employed. Table I lists the various effects produced by the different forms of feedback.

Feedback Problems

In general, any form of oscillation which disappears with the removal of the feedback components in an amplifier can be traced to some phase-shift or change of value of component which has taken place with age of the equipment. A common cause of this

Table I

	Neg Voltage	*Pos Voltage*	*Neg Current*	*Pos Current*
Gain	Decrease	Increase	Decrease	Increase
Distortion	Decrease	Increase	Decrease (For constant load)	Increase (For constant load)
Noise	Decrease	Increase	Decrease	Increase
Damping Factor	Increase	Decrease	Decrease	Increase
Source Impedance	Decrease	Increase	Increase	Decrease
Sensitivity	Decrease	Increase	Increase	Decrease
Stability	Increase (only to a point)	Decrease	Increase	Decrease

type of oscillation could be the deterioration of one of the push-pull pair of output tubes. Sometimes, excessive speaker lead length in a poorly designed amplifier can make it marginally unstable and subject to spurious oscillations. Lead dress of early stages or the feedback elements themselves will often affect stability. Generally, the best way to trouble shoot for instability which appears upon the reconnection of the feedback loop in an amplifier is to apply feedback in "easy stages." That is, start with a smaller amount of feedback than is called for in the schematic. Gradually increase this value until the first signs of instability show up on your oscilloscope. Use a dummy lead when doing this type of work as high-frequency oscillations can easily damage a tweeter voice coil. With the amplifier just on the verge of oscillation, it is much easier to detect the trouble, whether it be lead dress, faulty components, or tubes. As the amplifier is restored to full stability, add in more feedback until it is equal to its originally specified value. In a well designed amplifier it should be possible to further increase feedback until a change of gain of 6 more *db* occurs before the amplifier shows signs of instability.

In the next article of this series we hope to answer the many puzzlers associated with multiple speaker installations. Installing a second speaker in the bedroom or den is a wonderful way to increase the value of a high fidelity system for your customer and an equally simple way to improve your own financial position. That is, providing you understand a few fundamental concepts about impedance matching and speaker switching which will be discussed. [*To be continued*]

WESTINGHOUSE PICTURE TUBE

[*from page* 20]

mute relay mutes the sound by placing resistor *R-28* in parallel with the volume control. When the channel select relay closes the power tuning motor circuit is completed, actuating the motor and tuner drive mechanism.

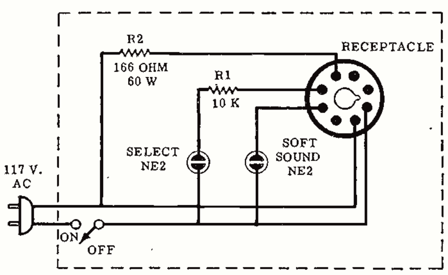


Fig. 5—Schematic diagram of the remote control receiver test unit.

Test Unit

The operation of the receiver unit can be checked whether in the television receiver or out of the receiver by means of the simple test unit shown in *Fig. 5*. The test unit replaces the television chassis when the plug from the receiver unit is inserted into the receptacle. The test unit delivers the necessary supply voltage and indicates when the "select" and "soft sound" relays are activated. Resistor *R-2* drops approximately 100 volts at 600 *ma* and can be made from a 60 watt lamp. Ballast resistors such as are used in Westinghouse television receivers (i.e. two 59 ohm and one 41 ohm, 25 watt resistors) are also suitable.

Receiver Troubleshooting

If the receiver unit fails to operate check to be sure that the transmitter and receiver units are set to the same frequencies. Check the setting of the threshold control. This control must naturally be advanced to increase the gain of the receiver as the tubes age. To check the operation of the first two *rf* stages and the channel select rectifier, connect a VTVM to the test point at the grid of *V-2B* [shown in *Fig. 3*]. This is a terminal on the top of the printed board. Set the meter to read a positive voltage and rotate the control, on the transmitter, to the "select" position. A positive voltage (approximately 22 volts) indicates the receiver is operating to this point. If the voltage does not appear, check the transmitter as well as these stages.

To troubleshoot the receiver measure the *dc* voltages at the points shown on the schematic. If this does not isolate the stage then signal trace with an oscilloscope. To signal trace, hold the transmitter unit control in either the "select" or "soft" position and trace the signal through the unit. Loss of signal or severe distortion of the signal at a particular point indicates the stage is at fault. ■ ■

OSCILLOSCOPE

[*from page* 12]

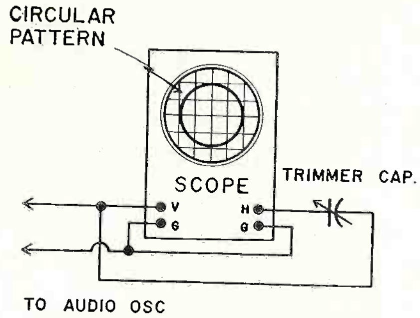


Fig. 2—Circuit used to obtain display of circular pattern.

convenient for obtaining a circular pattern on the scope screen. The audio oscillator may be set for any convenient frequency, such as 1000 *cps*. The trimmer capacitor is adjusted in combination with the horizontal and vertical gain controls of the scope to obtain the circular pattern. If the trimmer capacitor does not have a suitable range, use a lower or higher frequency from the audio oscillator to bring it in range.

When the circle is displayed on the

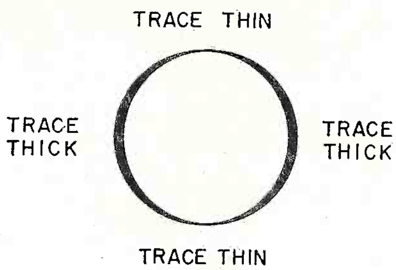


Fig. 3—A pattern displaying severe astigmatic distortion.

scope screen, observe the contour for uniformity. If the circle is alternately thick and thin, as illustrated in *Fig. 3*, astigmatic distortion is present. Most scopes have an astigmatism control which can be adjusted for the most uniform circular trace. Scopes with push-pull amplifiers have inherently less astigmatic distortion than scopes with single-ended amplifiers.

Overload Tests

Overload is displayed as a flattening of the waveform. The circular pattern illustrated in *Fig. 4* provides a good basis for overload tests. Advance the output from the audio oscillator until the circle flattens. When making this check, adjust the horizontal and vertical centering controls to inspect the top, bottom, and sides of the circle, since it is usual to deflect the circle off-screen before overload occurs. However, if the circle flattens *before* off-screen deflection is obtained, it is an indication that an amplifier tube is weak, that the plate-supply voltage is low, or that load resistors do not have correct values.

When flattening of the circle occurs under either condition, the input voltage at the overload point can be measured by means of a VTVM at the output of the audio oscillator, and the maximum input voltage thus determined. This overload check can be made at each position of the attenuator. It will usually be found that overload is encountered at low signal levels when the step attenuator is set to a sensitive position. This fact points up an important operating rule:

Always operate a scope with the fine attenuator set to a relatively high position and the coarse attenuator set to a relatively low position, to obtain the maximum immunity from overload distortion.

Differential overload refers to whether the scope goes into overload at high frequencies before it goes into overload at low frequencies. For this check, a color-bar pattern such as shown in *Fig. 4* provides a useful and convenient check.

The color-bar pattern provides this data, because the waveform contains both low and high frequencies. The burst and chroma bar have a frequency of 3.58 *mc,* while the sync pulse has a fundamental frequency of 15.75 *kc.* To check for differential overload, apply the color-bar signal to the vertical-input terminals of the scope, and observe the pattern proportions when the vertical-gain controls of the scope are set for one or two inches of screen deflection. Next, advance the vertical gain of the scope for full-screen deflection. The pattern proportions should remain the same. However, if the burst now appears attenuated with respect to the sync pulse, or vice versa, differential overload is occurring.

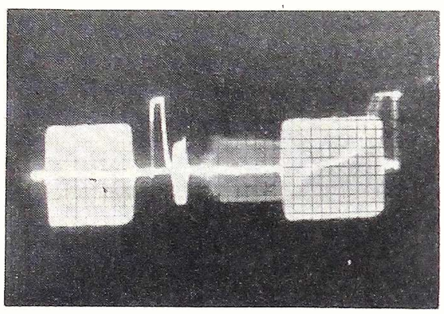


Fig. 4—A color bar pattern for testing differential overload.

Differential overload distortion is caused by stagger peaking of the stages in the vertical amplifier. To eliminate this type of distortion, check the peaking coils and load resistors in each stage of the vertical amplifier. When correct values are used throughout, so that the response of each stage is flat, differential overload distortion does not occur.

High-Frequency Unbalance

High-frequency unbalance shows up in a color-bar pattern as unsymmetrical bursts or color bars. When bursts and color bars do not appear balanced on the screen as the vertical gain is advanced, high-frequency unbalance is indicated.

High-frequency unbalance is usually caused by unequal values of peaking-coil inductance on the two sides of a push-pull stage. That is, one side of the push-pull amplifier has more gain at high frequencies. The fault is more prominent when the vertical deflection is substantial.

[To be continued]

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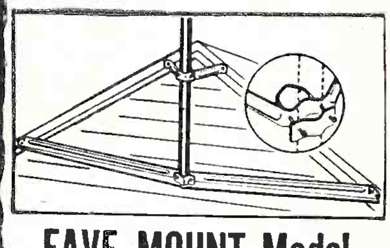

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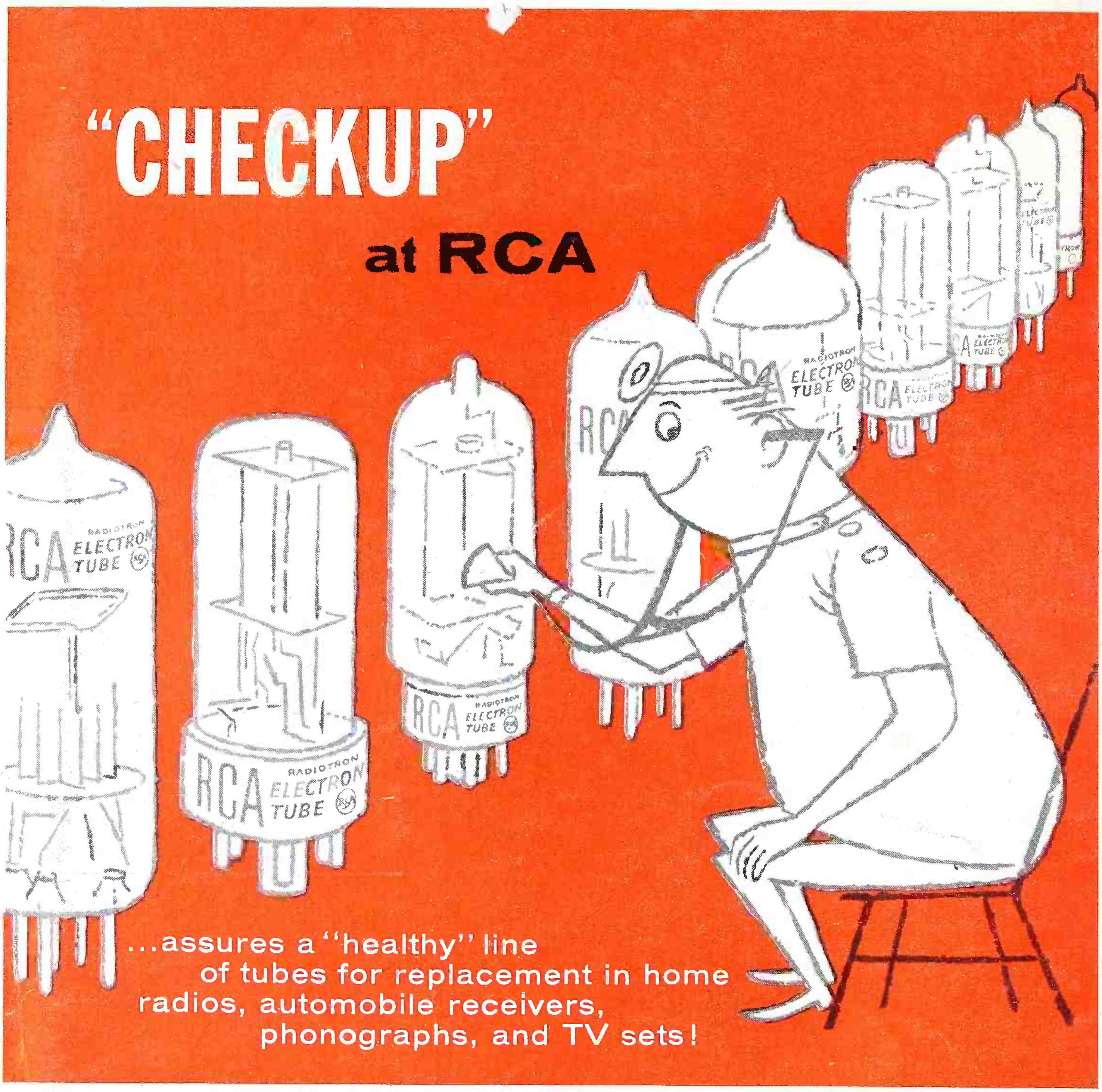

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