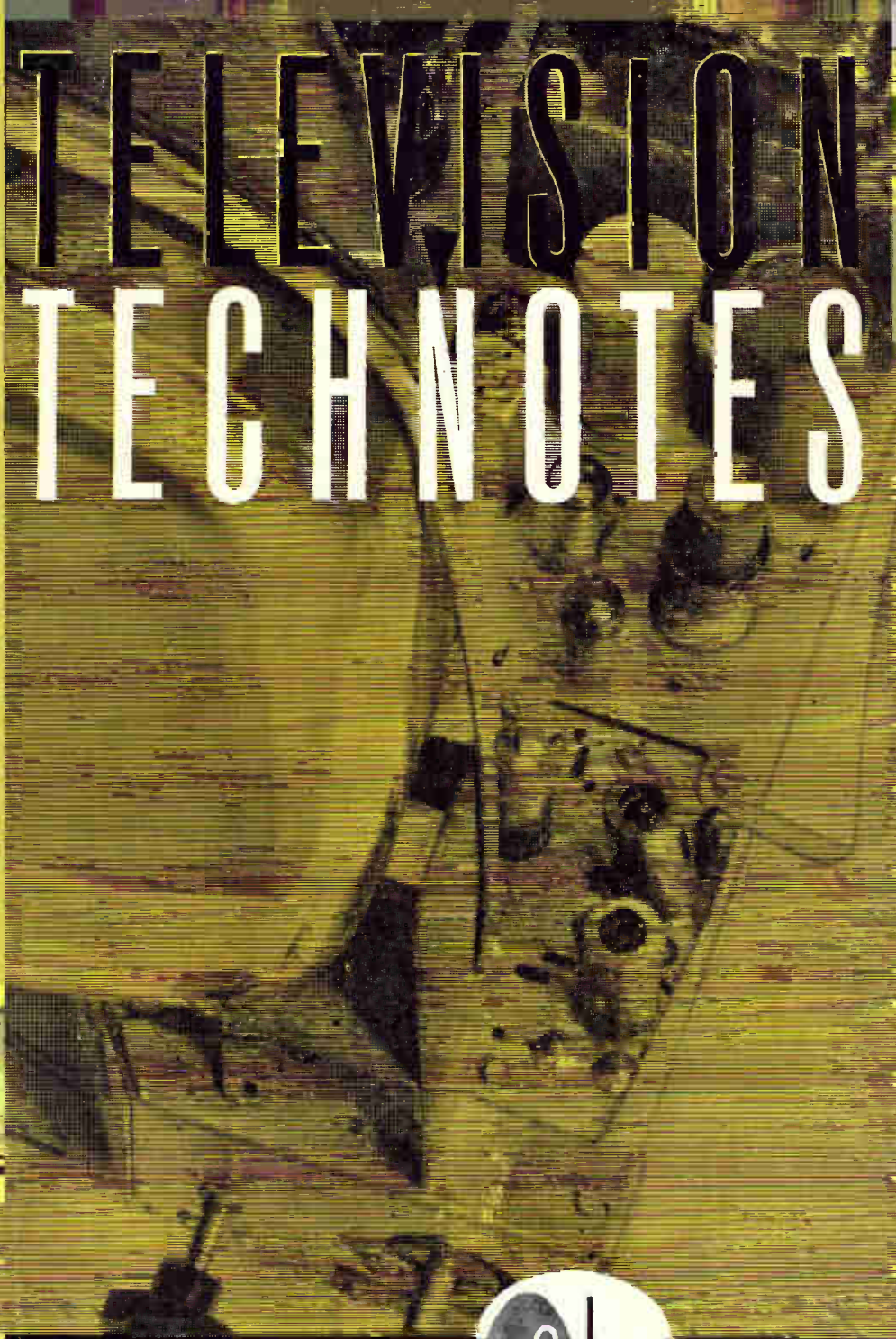
TELEVISION TECHNOTES



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TELEVISION TECHNOTES

edited by

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Television Technotes

Introduction

OVER a period of time, different makes and models of television receivers are likely to develop traits or operating irregularities peculiar only to that particular model. In many cases, familiarity with these peculiarities or symptoms of trouble will save a great deal of time which otherwise might be spent in routine trouble-shooting. For example, a receiver brought in with the complaint "no high voltage, sound O.K." would warrant an immediate check of the high-voltage filter capacitor if this particular model were known for its tendency to blow out filters. Similarly, a model which invariably overloads or cross-modulates on strong local signals would suggest the proper procedure.

Although some of the troubles listed in the following pages apply specifically to the receivers named, there are many cases in which similar troubles will appear in other makes and models. For this reason, diagrams of the affected stage or circuit are included so that comparisons can be made in similar complaints. *Code numbers, part numbers, and chassis numbers on the diagrams are those of the manufacturer and may not agree with numbers on diagrams printed by other publishers of service information.*

This is not a theoretical book. It is a practical one. It is written for the technician engaged in the business of servicing television receivers, and is phrased for the technician who has equipped himself with a background of radio theory. Therefore each technote has been made as short and compact as possible.

In this book in all instances effort has been made to help the service technician locate various components as quickly as possible. For example, if capacitor C54 is discussed, its value and location are given. Where a simple description of the location of a part is not possible, the technote is accompanied by a circuit diagram. While complete schematics of a television receiver are useful and helpful, an experienced service technician in most cases should be able to locate the parts described in the technotes without reference to schematics.

In producing this book, elementary troubles were weeded out, while moderately difficult and extremely difficult servicing problems were retained. The service technician does not have to be told to adjust the focus control if the picture seems blurred. Such an adjustment is obvious. But if adjustment of the focus potentiometer does not produce a sharp picture, then the trouble may no longer be simple, but difficult to find. And that is the purpose of this book—to help you solve servicing problems that are not easy—or obvious.

Problems such as improved vertical linearity, removal of sync buzz, vertical and horizontal jitter, i.f. oscillation, a.g.c. difficulties, picture bulge, horizontal oscillator drift (just to mention a few) are often time-consuming in their solution. Since time is part of the service technician's stock-in-trade, and as much a commodity as replacement parts on a shelf, it is the intent of this book to save as much servicing time for the technician as possible.

This book is based upon actual experiences of scores of television service technicians. While we cannot list them all by name, we express appreciation for their co-operation.

Much of the material for this book was obtained from the service organizations of the various television manufacturers and from RADIO-ELECTRONICS Magazine. Our sincere thanks go to those who realize the need for supplying technicians with all possible service data.

Martin Clifford

Admiral

T10

Dark horizontal strip (4 inches wide) across top of picture; bottom of picture light. If dark strip moves down slowly, check for cathode-heater short in one of the video amplifier or video i.f. stages. If dark strip is stationary, check filter capacitors.

19A11

Picture off center to right; horizontal centering control has no effect. Defective centering control. Defective 5V4-G. Open or shorted capacitor in horizontal deflection circuit.

20A1, 20B1

Horizontal jitter. Picture is very good on all channels and because of the a.g.c. system the contrast control needs no adjustment, except on channel 4. This channel comes in very strong and appears to be over-modulated. When it is tuned in, a horizontal jitter appears which can be cured by resetting the horizontal hold control. In some cases the rear adjustment must be used. If channel 4 is synchronized properly, all other stations are out of sync.

The solution lies in the sync separator circuit. On channel 4 the strong signal apparently overdrives the 6AU6 used as sync-separator tube. To avoid this, the manufacturer has made a change in later production runs which completely eliminates the jitter. A 47,000-ohm resistor goes from the screen (pin 6) of the 6AU6 to ground and an 82,000-ohm resistor to B-plus, as shown. If the 47,000-ohm resistor is removed and the 82,000-ohm resistor is connected to the centertap of the contrast control, the screen voltage will be decreased as the contrast is decreased.

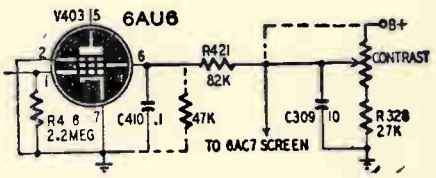

Fig. 1. Circuit for removal of jitter.

This prevents overdriving the sync separator even at the strongest signals and eliminates the horizontal jitter.

20A1, 20B1, 21A1

Adjacent channel interference. In areas where two adjacent channels may be received, the sound from the lower may interfere with the picture on the upper channel. This type of interference may be reduced or eliminated by adding a sound trap to the second video i.f. amplifier.

Obtain a sound trap (part No. 72A 88-1) and remove two turns from the coil at the end farthest from the slug screw, then resolder the coil to the lug. Do not remove the capacitor. Clip the white lead and bare tinned lead from the coil.

Remove the cover from the video i.f. strip and locate T302, the second video i.f. transformer. Wind 1½ turns (approximately 3 inches) of No. 24 or 26 insulated wire in a clockwise direction around the small-diameter portion of T302 at the end farthest from the slug screw. Loop one end of the wire under itself to hold the coil in place in a manner similar to the coupling coil on T301. Connect one end of the 1½-turn loop to the ground connection on T302

Admiral

On some chassis, there is a $\frac{1}{4}$-inch hole between the second and third video i.f. tubes. If the hole is not there, drill one and insert the new trap. Connect the *black* lead from the new trap to ground and connect the loose end of the $1\frac{1}{2}$-turn coupling coil to the other lug on the trap.

Realign the video i.f. stages. Because of the shape of the video i.f. curve, it

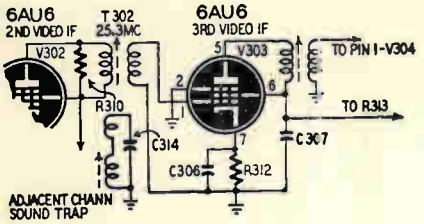

Fig. 2. Addition of sound trap.

is difficult to set the new trap to 27.25 mc with a signal generator. Adjust the slug in the trap for minimum interference in the picture. Use a scope and sweep generator to make sure the video i.f. bandpass has not been affected by the trap adjustment. The sketch shows the connections for the trap.

20A1, 20T1, 21A1

Open high-voltage fuse. If the $\frac{1}{4}$-amp high-voltage fuse blows after the set has warmed up, look for a thermal short between heater and cathode of the 6W4-GT damper tube. In these and several other models, the cathode is nearly 400 volts positive while one side of the heater is grounded.

20T1, 21B1

Excessive warmup period. A poor connection between the plate-cap lead and the plate cap to the 6BQ6-GT may cause an excessively long warmup period before the raster appears. Touching a hot soldering iron to the joint inside the plate cap will often help.

20T1 series

Excessive picture height. Due to the increased efficiency of the deflection yokes and power transformers of these chassis, it may be impossible, in some instances, to reduce the height of the picture with the height control. Correct this condition by removing capacitor C431 or replacing R408 (1-meg) with a 2.2-meg resistor. C431, .02 μf, is shunted across the width control. R408 is connected to the vertical height control.

20T1 and 20V1 chassis

Horizontal *tearing* or *bending*. A strong signal may cause tearing or bending of the picture in some sets. An excessively strong signal at the video amplifier may result in loss of sync pulses due to clipping. Condition can be prevented by increasing the a.g.c. voltage. To do this, remove R302 from the circuit at test point T. R302 is 680,000 ohms in early sets and 1.2 meg in later sets. This resistor is part of the picture a.g.c. network.

Veiling or horizontal foldover. This will usually be apparent when the station sync pulses are not positioned correctly on the blanking pulses. A phase change in the sync pulses (or reference voltage) applied to the horizontal control circuit could also be the cause of veiling or foldover. Disconnecting R443 (560,000 ohms, one side con-

nected to plate, pin 5, of 6W4-GT damper tube, V407) will remove the horizontal output reference voltage with very little change in the operation of the circuit. Short-circuiting R323 (10,000 ohms, part of the network between the sync separator control grid, pin 2, 12AU7, and 6AU6 video-amplifier plate, pin 5) will minimize any phase change of the sync pulses. These two changes will eliminate veiling or horizontal foldover in most instances.

20V1 chassis

Replacing picture tubes. Due to the difference in manufacturing tolerance between various brands of picture tubes, replacing one brand with another can result in too much brightness, even with the brightness control turned fully off. Correct by connecting a 470,000-ohm, ½-watt resistor across capacitor C308 (0.1 μf). One side of C308 is connected to the control grid, pin 1, of the 6AU6 video amplifier (V305). The resistor places a negative bias on the video-amplifier tube, and decreases the current through this tube. By connecting the resistor across C308 instead of between the grid of the video amplifier and ground, the d.c. reinsertion is also improved. The 470,000-ohm resistor is included in the 20V1 chassis, commencing with run 3, code OP. All 20T1 chassis have this resistor.

20X1, 20Y1, and 20Z1

Sync buzz due to transmitting station. If proper alignment fails to reduce sync buzz, the fault may be due to the video modulation system used at the transmitter. This type of buzz can usually be identified by its appearance at intervals when there is a large amount of white in the picture. Reduce this buzz to a minimum by modifying the first sound i.f. tube circuit:

1. Remove C202, 120 μμf, connected between L201 and pin 1 of the 6AU6 (V201) and replace it with a short length of wire.
2. Remove R201, 1 megohm, connected between pin 1 of the 6AU6 (V201) and ground. Also remove all connections from pin 7 of this tube.
3. Connect an 82-ohm, ½-watt resistor between pin 7 and ground.
4. Realign the receiver.

20X122

Mechanical vibration. The built-in antenna fits rather loosely in the cabinets of some models, causing the picture to distort when anyone walks across the floor or shakes the set. Cure this by taping the antenna firmly to the cabinet with a good adhesive.

20T1, 20V1, 21D1, 21E1, 21H1, and 21J1 chassis

Vertical foldover. Foldover appears as a horizontal white line, at the bottom of the picture, when the height and linearity controls are adjusted for correct picture size and linearity. Line voltage of 105 or lower can cause foldover in a normal set. Always check line voltage first. If foldover occurs at normal line voltage, it may be corrected by *making one or more of the following changes in the order shown below:*

1. *Tubes.* Some sets use a 6S4 for a vertical output tube. Weak 6S4 ver-

tical output tubes frequently cause foldover, and a number of new tubes should be tried. Low B-plus caused by a weak 5U4-G rectifier tube will also cause foldover. In all chassis, *except the 21D1 and 21E1*, try replacing the horizontal output tube and the damper tube.

2. *Resistor changes in 20T1 and 20V1 chassis.* Change grid resistor R408 from 1 meg to 3.3 meg, and change decoupling resistor R439 from 1,000 to 500 ohms. R408 is connected to the vertical height control and R439 is tied to the number 1 terminal of the horizontal output transformer.

3. *Capacitor across width control in all chassis.* An additional capacitor, .01 μf to .05 μf, placed across the width control will decrease the second anode voltage by several hundred volts and give more sweep without foldover. The decrease in brightness is not noticeable.

4. *Deflection yoke—all chassis.* The cores of all the 70° deflection yokes consist of two pieces of iron, each semicircular in shape. These two core pieces should fit closely together with the air gaps as small as possible. Inspect the yoke to see if the air gap is at minimum. If the air gap is more than 1/32 inch, tighten the collar. If this does not reduce the gap, remove the collar and the iron core, and smooth over the insulation so that the gap can be closed to a minimum. Previously, the two core halves were of different types of iron, one being powdered iron, and the other ceramic iron. The powdered iron has a polished metallic finish, while the ceramic iron is dull. A yoke with both halves of ceramic iron will give increased sweep without foldover. The additional piece of ceramic iron can be obtained from a defective 70° yoke. Some yokes are made so that the fiber sleeve must be clipped away with a pair of diagonal cutters before the collar and iron cores can be removed. Present service yokes use ceramic iron only.

20T1, 20V1, 21B1, 21C1, 21E1, 21H1, 21J1 chassis

Inadequate reception in weak-signal areas. In weak-signal areas, where the noise level is high, the a.g.c. diode, V304, develops an a.g.c. voltage which is proportional to the peak-to-peak noise voltage. When the high a.g.c. voltage is applied to the controlled stages, the gain of the receiver is controlled by the noise level and not the sync-pulse level. This may result in loss of sync, poor contrast, or low sound level. Correct this situation by using the voltage developed across the video detector load for a.g.c. instead of the normal a.g.c. voltage developed by the a.g.c. diode. This change should *not* be made where strong signals may be received or overloading will result. The circuit diagrams on page 11 show the changes to be made.

Circuit change for 20T1 and 20V1 chassis:

1. Locate V304 (6AL5), video detector and a.g.c. tube.

2. Disconnect R314 (680,000 ohms) from pin 7 of V304.

3. Connect R314 as shown in Fig. a.

4. Remove tuner a.g.c. lead (white) from a.g.c. lug and ground the wire to the chassis.

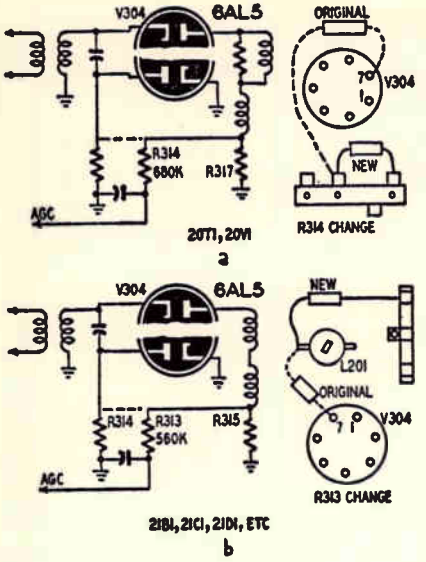

Fig. 3. Changes for fringe reception.

Circuit change for 21B1, 21C1, 21E1, 21H1, and 21J1 chassis:

1. Locate V304 (6AL5).
2. Disconnect R313 (560,000 ohms) from pin 7 of V304.
3. Connect R313 as shown in Fig. b.
4. Remove tuner a.g.c. lead (white) from a.g.c. lug and ground the wire to the chassis.

20T1 and 21B1 chassis

Horizontal sync instability. Indicated by tearing or bending of the picture horizontal sync instability may be caused by loss of sync pulses at the video amplifier. This may be the result of improper a.g.c. action. Check the r.f. amplifier and the i.f. amplifier tubes for leakage between control grid and other elements. A high-resistance leak between control grid and screen or cathode will cause incorrect a.g.c. voltage and probably result in overloading at the video amplifier.

Increasing audio gain in fringe areas. To bring up the audio change the sound takeoff connections as follows:

20T1 series:

1. Disconnect audio lead from pin 2 of 6AL5 video detector (V304).
2. Connect this lead to pin 5 of 6AU6 video amplifier (V305).
3. Retune L201 sound takeoff coil. Make this adjustment using a station signal.

21B1 series:

1. Disconnect audio lead from pin 2 of video detector (V304).
2. Connect this lead to pin 8 of 6AC7 video amplifier (V305).
3. Retune L201 sound takeoff coil. Make this adjustment using a station signal.

20T1, 20V1, 21B1, 21C1, 21D1, 21H1, 21J1

Vertical bars in picture. Shadow type vertical bars usually appearing at the left of the raster can be reduced by moving the picture-tube cathode lead (yellow) away from the horizontal output tube.

21 series chassis

Hum. Caused by glass 6SQ7 used in place of the metal type. The glass 6SQ7, due to lack of shielding picks up considerable vertical sync, resulting in 60-cycle sync buzz and hum. Reduce the hum by shielding the 6SQ7 glass tube with part No. 87A8 shield and adding a 0.47-μf, 400-volt capacitor across C211. C211 also 0.47 μf is con-

nected to the *cold* side of R210, plate-load resistor for the sound-amplifier tube, 6AV6.

21B1 chassis

Tube replacement. Type 12H6 tubes were used in approximately 40,000 receivers, and service replacements may be difficult to obtain since this tube is no longer manufactured. A type 6H6 tube may be used in place of the 12H6 if the following changes to the heater circuit are made:

1. Remove the wire from pin 7 of the 12H6 (V404) socket.

2. Tape the wire to prevent it from shorting to the chassis.

3. Connect a wire from pin 7 of V404 socket to pin 7 of V401 socket. V401 is the vertical oscillator and sync inverter tube (6SN7-GT).

Poor picture contrast. You can get more contrast by increasing the value of the video-detector and video-amplifier load resistances. This change results in a loss of high-frequency response (definition) and should not be used unless the signals are too weak to provide enough contrast. However, when the signals are weak, the change will often improve reception because the high-frequency noise pulses will not appear on the picture. You can make this change by connecting a 3,900-ohm, 1-watt resistor in series with R315, and a 3,900-ohm, 1-watt resistor in series with R322 (at the junction of R322 and R326). R315, 680,000 ohms, is connected to pin 7 of the 6AL5 video detector. R322, 5,600 ohms, is connected to the screen grid, pin 6, of the 6AU6 video amplifier.

21B1 and 21C1 chassis

To improve noise immunity in the horizontal sync circuit. In some areas where the noise level is high, the noise peaks may affect the sync circuit and cause the picture to shake horizontally or lose horizontal sync. A change in resistor value and an additional filter in the sync circuit has been incorporated to reduce this trouble. The circuit change is effective with run 2 of 21B1 chassis and run 5 of 21C1 chassis.

Early production receivers may be modified by following this procedure and the circuit diagram:

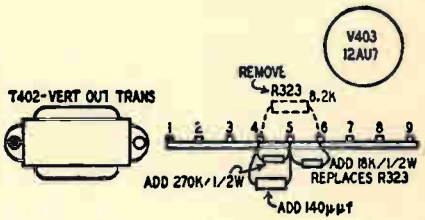

Fig. 4. Improved noise immunity in sync.

1. Locate the 9-lug terminal strip adjacent to vertical output transformer T402.

2. Remove R323 (8,200 ohms) from lugs 4 and 6.

3. Connect an 18,000-ohm, ½-watt resistor between lugs 5 and 6.

4. Connect a 140-$\mu\mu$f capacitor, with a 270,000-ohm, ½-watt resistor in parallel between lugs 4 and 5.

Second-anode lead arcing to lead support. A wire lead support, part No. 19A66, is used to hold the picture-tube second-anode lead on 21B1 and 21C1 chassis. The wire support was 3-7/16 inches long in early production.

This placed the end of the support close enough to the picture-tube second-anode connector to result in corona and arcing. The support was revised to 3-3/16 inches in length in later production. The early, longer type can be removed entirely or replaced with the later, shorter type.

21B1, 21C1, 21D1, 21E1, 21H1 and 21J1 chassis

Insufficient picture width. If it is not possible to obtain sufficient width by replacing tubes in the horizontal sweep and B-plus circuits, replace capacitor C433, .0022 μf, with a .0047-μf 600-volt capacitor. One side of C433 is grounded, the other side is connected to pin 8 of the horizontal output transformer. The larger capacitor will reduce the picture-tube second-anode voltage, but the decrease in brightness is not noticeable.

Increasing sensitivity for weak-signal areas. The sensitivity may be increased by as much as 100% by connecting a 470,000-ohm resistor between test point T and ground. It is not necessary to remove the chassis to install the resistor. Solder one end of the resistor to a banana plug and insert the banana plug into test point T socket. Solder the other end of the resistor to the chassis.

Test point T may be found by viewing the chassis from the rear and locating a four-hole socket at the center of the left-hand side of the chassis. Test point T is the socket hole nearest the front of the chassis. Don't make this change in a strong signal area, as the result will be picture shake and poor-quality pictures. However, a switch may be installed in the ground end of the resistor to remove the resistor from the circuit when a strong station is being received.

Tube substitution. 6AG5 substitution for 6AU6, third video i.f. tube. A simple modification permits the use of a 6AG5 tube in place of the 6AU6 (V303) third-video i.f. tube, if a 6AU6 is not available for replacement. (6AG5 tubes should not be used for the first- and second-video i.f. amplifiers.)

Clip the ground lead between pin 2 and the center socket shield on the third-video i.f. tube socket. Connect an 18,000-ohm, ½-watt resistor between pin 1 and ground, making the leads as short as possible. Solder a tube shield base (part No. 87A7-6) over the top of the tube socket. Insert a 6AG5 tube in the socket and place a tube shield (part No. 87A7-7) over the tube. Check the i.f. alignment and make any necessary adjustments.

21B1 through 21Q1 chassis

Change in tuner resistor to increase sensitivity. The B-plus voltage on the tuner side of R303 (1,000 ohms, in series with B-plus to plate and screen of r.f. amplifier in front end) should be approximately 125 volts, with tubes in sockets. Sometimes this voltage may be as low as 105 volts when R303 is 1,000 ohms, resulting in a decrease in receiver sensitivity. When the tuner voltage is found to be low, R303 should be replaced with a 470-ohm, ½-watt resistor.

Curvature at top of picture. Resistor R417 (18,000 ohms, one end grounded, other end to plate, pin 1, 12AU7, V403,

sync separator and clipper) may be 20,000 ohms in some receivers. If this resistor changes value to 22,000 ohms or more, curvature at the top of the picture will take place when the contrast is turned counterclockwise. When this occurs, R417 should be replaced with an 18,000-ohm, ½-watt resistor.

Horizontal *wiggle* moving up and down the picture. In some areas, where the local power supply is not in phase with the television transmitter, a horizontal wiggle may appear on the picture. To eliminate, replace capacitor C416 (.047 μf) with a 0.22-μf capacitor. One side of C416 is grounded. The other side goes to the control grid, pin 1, of the 6SN7-GT horizontal oscillator, V405. In some instances a smaller capacitor such as a 0.1-μf may be satisfactory, and this value should be tried, since the smaller capacitor will provide better a.f.c. action.

21B1 (run 11 or higher); 21F, G, K, L, P, and Q1 (run 2 or higher), 21M and N1, all chassis

Vertical roll of the picture in fringe areas. In weak-signal areas noise pulses may cause vertical picture roll, and it may not be possible to obtain maximum contrast unless the contrast control is turned back from the full on position. To correct this:

1. Remove resistor R422 (15,000 ohms, 1 watt) from the circuit. One side of R422 is connected to R424, (2,200 ohms) part of the cathode resistor network, pin 6, of the 6SN7-GT sync inverter.

2. Disconnect the two B-plus leads connected to pin 6 of V305 (6AC7) video amplifier. Solder these two leads together and insulate the connection with tape.

3. Connect a 27,000-ohm, ½-watt resistor between pin 2 of V303 (6AU6) third picture i.f., and pin 6 of V305 (6AC7) video amplifier.

4. Connect a 0.1-μf, 400-volt paper capacitor between pin 6 of V305 (6AC7) and chassis ground.

21D1

Vertical roll. In some sets enough ripple from the vertical output stage may be present in the B-plus supply to appear in the sync circuits. This ripple voltage will occasionally be strong enough to trigger the vertical oscillator. If this ripple voltage has shifted in phase with respect to the original vertical output signal, it will cause vertical roll. To correct, change the B-plus connections of the 6W6-GT vertical output tube, as follows:

1. Locate red wire going from the vertical output transformer to the 80-μf filter capacitor, C407C.

2. Disconnect this red wire from filter capacitor.

3. Connect the red wire to junction of C427 and L403 through a decoupling resistor. The decoupling resistor may be a 5,000-ohm, 5-watt resistor, or three 15,000-ohm, 2-watt resistors connected in parallel. The value of decoupling resistance is not critical. L403 is the horizontal linearity coil. C427, .02 μf, is connected to terminal 1 of the flyback transformer.

4. Connect an additional 20-μf, 450-volt capacitor from the junction of the red wire and decoupling resistor to ground.

Vertical foldover or poor vertical linearity (early production). Replace R411, 820 ohms, with a 680-ohm, 1-watt resistor. One side of R411 is grounded. The other side of R411 is connected to R410, vertical linearity control. This change was made in later production, 21D1 and 21E1 chassis.

24D1

Horizontal instability (jitter). May be caused by a horizontal signal fed to the grids of the first and second i.f. stages with the a.g.c. voltage. This signal, which has shifted in phase with respect to the horizontal oscillator, will modulate the video signal and cause horizontal instability when fed back through the sync circuits. Correct by connecting a 0.1-μf capacitor from the junction of R434 and R435 to ground. R434 is 100,000 and R435 is 27,000 ohms, and both are part of the picture a.g.c. network.

24D1, 24E1, 24F1, 24G1, 24H1 chassis

Vertical white bars at left of picture. Reduce these to a minimum by inserting a filter circuit between the horizontal output transformer and the yoke. The filter consists of the following parts wired in parallel:

Width coil, part No. 94A4, used in 30 series chassis, .01-μf., 600-volt capacitor, part No. 64B5-10, 470-ohm, 1-watt resistor, part No. 60B14-471.

Connect the filter in series with the lead between terminal 4 on the horizontal output transformer and pin 5 of damper tube V408. Adjust the coil slug until the white vertical bars are reduced to a minimum. In some instances, leaving the 470-ohm resistor off may provide a greater reduction. Don't confuse this trouble with vertical lines produced by misadjustment of the horizontal drive.

Strong 60-cycle hum. Strong 60-cycle hum in the 24D1, 24E1, 24F1, 24G1, and 24H1 chassis is generally caused by one of the following, and can be corrected easily:

1. The cold side of the volume control may be connected to the grounded heater lug of the first a.f. amplifier tube instead of to the grounded cathode lug on the same socket. Make sure that the volume control grounds to the cathode lug.

2. The a.c. leads to the switch on the volume control may be too close to the grid lead of the first a.f. tube. Dress the a.c. leads well away from the grid lead. Later production models have a retaining lug to keep the a.c. leads dressed against the chassis.

3. The coupling capacitor between the volume control and first a.f. grid may be reversed.

Arcing in vertical output stage. In earlier models, the 6S4 vertical output plate terminal often arced to ground. Remedy: Replace tube socket with high-quality type. Also replace resistor R417 even though it checks good. (Later models use a low-loss socket.) R417 is 2,200 ohms, 1 watt, and is connected to height-control potentiometer R409.

26X36N (chassis 24D1)

Horizontal pulling toward left (top of picture only). Improper adjustment of

horizontal hold control. Defective horizontal output tube (earlier models use a 6BG6-G, later models a 6CD6-G).

30A1

Microphonics. Microphonic 6J6. Loose tube socket of shield base. (Spot-solder these to tuner chassis. This applies also to models using a 6C4 oscillator.) Loose or dirty fine-tuning control. Improper lead dress in *sound* i.f. stages. Binding of control shafts or knobs to receiver cabinet. In stubborn cases, shock-mount the speaker and chassis.

Pulling to right (top of picture only). In earlier models, remove the two 470,000-ohm plate resistors R413 and R414 in the horizontal sync discriminator stage and replace with two 180,000-ohm resistors. Readjust horizontal oscillator if necessary.

No raster. Complaints of no raster when the sound section of the set is O.K. are often caused by failure of the horizontal-discharge section of the 6SN7-GT, V403B. If this tube is bad, check the 6BG6-G output tube. The latter may have been ruined by excessive plate dissipation due to lack of drive when the 6SN7-GT failed.

15.75-kc radiation (horizontal oscillator). Whistles throughout the broadcast band can be caused by radiation from the horizontal sweep circuit of a television receiver using a metal-cone picture tube. These tubes do not have an Aquadag coating on the inner and outer surfaces of the cone as glass tubes do. These coatings act as an additional filter for the second-anode supply and reduce radiation. Add a 500-$\mu\mu$f, 20-kv capacitor from the second-anode lead to ground (after the filter capacitor in the high-voltage housing). This will reduce the radiation appreciably on receivers using metal cone tubes. Connections between the second-anode lead and the bypass capacitor should be made carefully to avoid corona. Obtain additional attenuation of the radiation by installing a 0.1-μf, 600-volt capacitor from each side of the a.c. line to ground.

Intermittent contacts on color television socket. Intermittent contact between the color plug and socket can cause:

1. No sound.
2. No sync.
3. No picture, sound, or raster.

If the socket is suspected, the plug should be removed and the socket contacts tightened with a pair of pliers.

Adding phono to Admiral TV. A 3-pole double-throw switch must be installed. One section transfers the input of the a.f. amplifier from the low-impedance ratio detector to the high-impedance phonograph pickup. The second section disables the vertical os-

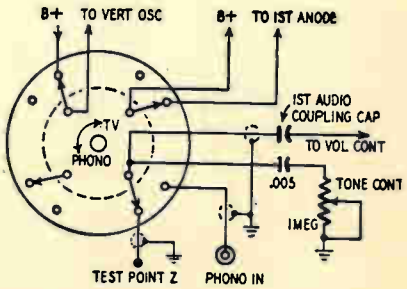

Fig. 5. Adding phono to Admiral TV.

cillator to prevent its radiations from entering the audio circuits when the first a.f. amplifier operates with a high-impedance input. The third section of the change-over switch breaks the B-plus lead to the first anode and prevents a bright horizontal line from appearing on the screen of the picture tube and possibly burning it.

A tone control can be conveniently added to the circuit while the phono connections are being added. A control which operates with the switch in the PHONO or TV position may consist of a .005-μf capacitor and 1-megohm variable resistor in series between ground and the hot lead to the volume control. Choose a tone control with "tone" taper.

The diagram shows how the switch and tone control are connected. A Mallory 3242J or equivalent switch is used for change-over between TV and phonograph. The fourth section of this switch can be used to apply power to the phono motor. The switch and tone control should be mounted in a small plastic or metal box which can be placed on the rear of the receiver in an accessible position.

Elimination of retrace lines. In weak-signal areas, the best pictures are often obtained by operating the set with contrast reduced and brightness turned up. Under these conditions, several bright retrace lines may be visible in the picture. By feeding a portion of the vertical oscillator voltage to the grid or cathode of the picture tube, the brightness control can be turned up without retrace lines appearing.

On the 20A1, 20B1, 20T1, 20V1, 21A1, 21B1, and similar chassis, connect a 270,000-ohm, $\frac{1}{2}$-watt resistor in series with the lead going from the grid (pin 2) of the picture tube to the junction of the arm of the brightness control and its bypass capacitor (see *b* in the figure). Connect a .05-μf capacitor from the grid of the picture tube to the junction of wave-shaping network shown at *a*.

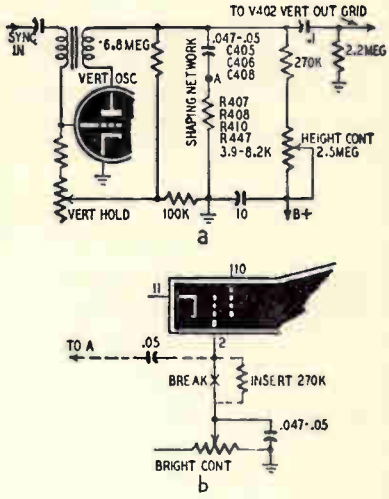

Fig. 6. Elimination of retrace lines.

Diagrams shown in Fig. 6 are typical Admiral vertical oscillator and brightness-control circuits. Pertinent codes used in the models discussed are:

C405—Models 20A1, -B1, -T1, 20V1 and 21A1.

C406—Models 24D1, -E1, -F1, -G1, and 20H1, and 21B1.

C408—Models 20X1, 20Y1 and 20Z1.

R408—Models 20A1, 20B1, and 21A1.

R410—Models 24D1, -E1, -F1, -G1, and 24H1.

R447—Models 20X1, 20Y1, and 20Z1.

Admiral; Air-King

On the 24D1, -E1, -F1, -G1, and -H1 chassis, connect the 270,000-ohm resistor as shown at *b*. Reverse the connections of the vertical wave-shaping network (R410 and C406) so the capacitor connects to the grid of V402 and the resistor connects to ground. Connect a .05-μf capacitor from the grid of the picture tube to the junction of R410 and capacitor C406 to the wave-shaping network as described in the preceding paragraph.

To modify the 20X1, 20Y1, and 20Z1, connect the 270,000-ohm resistor as shown at *b* in the illustration. Replace the 3,900-ohm vertical wave-shaping resistor (R447) with an 8,200-ohm, $\frac{1}{2}$-watt unit. Connect a .05-μf capacitor between the grid of the picture tube and the junction of C408 and R447.

In the 30A1, 30B1, and 30D1 chassis, insert a 47,000-ohm, $\frac{1}{2}$-watt resistor in series with the lead from the cathode (pin 11) of the picture tube to the arm of the brightness control and the cathode bypass capacitor C325. Connect a .05-μf capacitor between the cathode of the picture tube and the green lead of the vertical output transformer.

Although retrace elimination is desirable in fringe-areas, the modification described in the preceding paragraphs can also be used for receivers located in moderately-strong signal areas. Many set owners prefer operating receivers with the brightness control as wide open as the existence of retrace lines permits. The modification is relatively simple to make.

The suppression or elimination of retrace lines is also described on page 102 and on page 111.

Air-King (CBS- Columbia)

700 series

Audio buzz or hum. Audio buzz or hum in some chassis of the 700 series is due to poor contact of the Aquadag coating of the Hytron 16RP4 tubes with the grounding strap. Under certain conditions of humidity, the binder used in the Aquadag will form a chalky coating which prevents proper contact between the Aquadag and the grounding strap. Be sure power is off and high-voltage supply is discharged. Carefully wash the area around and under the contact spring, using a cloth moistened with water. After washing and drying, blacken the area by applying graphite from a very soft pencil No other type picture tube should be washed in this manner because most standard Aquadag coatings are water-soluble and would be removed if washed.

700-10 chassis or later series

Horizontal foldover. When the a.f.c. control is correctly adjusted, the picture will fall into horizontal sync in-

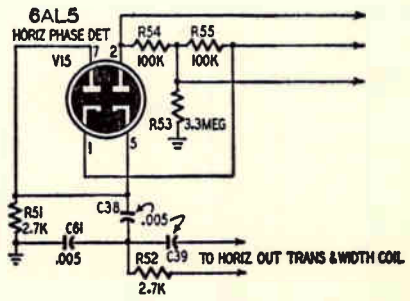

Fig. 7. Circuit for removal of foldover.

stantly when changing from station to station and should be stable. Sometimes this cannot be brought about without causing a foldover on either the right or the left side of the picture. When this condition is present, it is an indication of unstable horizontal hold due to incorrect phasing from the transmitter. At certain adjustments of the a.f.c. control the picture will jitter violently. To correct this condition, the 2,700-ohm phasing resistor R52 will have to be increased to approximately 5,000 ohms if the foldover is on the left side of the picture or decreased to about 1,000 ohms if the foldover is on the right side of the picture. See the circuit diagram. One side of R52 is connected to pin 6 of the horizontal output transformer and width coil L10.

Model 16K1 (6-way combination); Chassis 700–50, –92

Hum. To eliminate audio hum replace these 2 leads with shielded ones:

1. Orange-colored wire running from the switch on chassis 703 to pin 7 on the plug. Ground the shield close to the switch.

2. Wire, usually yellow, running from pin 7 of the socket on the side of the chassis to the junction of the 60-ohm and 220-ohm resistors (R29 and R82) in the upper right-hand corner of the chassis. Ground shield at the end closest to the junction of the two resistors.

700–90 schematic

To improve vertical sync stability. The following changes, as shown, will help improve the vertical sync stability.

1. Add a 27,000-ohm resistor (R82) from pin 1 to pin 3 of V13, 12BH7, d.c. restorer, sync clipper.

2. Change cathode resistor R36 from 2,700 ohms to 3,300 ohms.

3. Change plate-load resistor R37 from 3,900 ohms to 8,200 ohms. To further increase the vertical sync stability, insert a .002-μf capacitor between the 22,000-ohm resistor shown

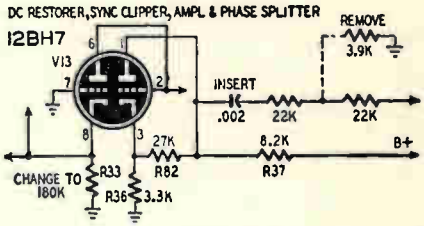

Fig. 8. Changes shown in circuit above will help improve the vertical sync stability.

in the diagram and the plate, pin 1, of the sync amplifier and phase-splitting tube, V13. In conjunction with this change, remove the 3,900-ohm resistor from the junction of the 22,000-ohm resistor to ground. For more vertical sync stability in strong-signal areas, change the 270,000-ohm grid resistor, R33, of V13, to 180,000 ohms. These are production changes.

700–93 chassis

Hum or buzz. A considerable amount of hum or buzz may be noticed in some of the 700-93 chassis. To cure, place a shield over the glass 6SQ7 if it is the type which has a metal-ring base. If not, substitute a metal 6SQ7. When using a metal 6SQ7, always ground pin 1.

Andrea

Intermittent picture tube. Intermittent conditions in picture tubes in many cases have been traced to intermittent contact at the picture tube socket or a poor soldering contact on the tube pins. Before removing picture tubes from sets, check for intermittent conditions at the tube socket. Also apply a hot soldering iron to each of the tube pins to be sure of a good soldered connection.

If moving the socket slightly results in an intermittent picture, the trouble is due to poor contact between tube pins and socket. Clean pins and replace socket, if necessary.

Arcing. Whenever any work has to be done on the high-voltage section of the chassis or when a tube has to be removed from this section, be extremely careful to prevent connecting wires to the caps of the tubes from touching any part of the metal compartment or any other parts. Failure to observe this precaution may cause arcing and burning. Although the sketch shows a VL-16 chassis, the information applies to all similar power supplies. Wires 1, 2, 5, 6, and 7 should be kept in free space. Except where properly connected, do not let them rest on other parts or side of compartment. Whenever parts are replaced, make all wires as short and direct as possible without putting a strain on the parts. Do not pull filament wires 3 and 4 too tightly. Do not turn the slug of the width coil (8) too far out, as this will give a lowered impedance, possibly causing the coil to overheat or burn. Be sure to round off soldering connections on any work done.

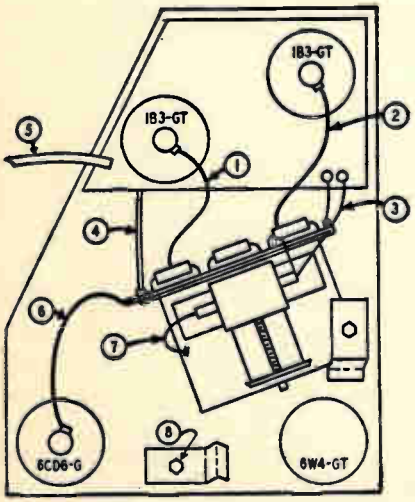

Fig. 9. Physical layout of parts and critical wiring in the high-voltage cage.

Removing back panel. When removing back panel from any cabinet, especially model CO-VL 19 (Caronia) use extreme care to prevent panel from falling on neck of picture tube.

Removing chassis from cabinet. To service Fleetwood and Caronia 19-inch chassis when removed from the cabinet, it is not necessary to take the PHONO-TV switch out of the cabinet. Just place a jumper across the phono terminals to complete the audio circuit.

VL–16 chassis

To improve a.g.c. On some of the early VL-16 chassis using a.g.c., R38 and R35 were 27,000 ohms and 22,000 ohms respectively. Change these to 33,000 ohms. Do not rely on the resistor color code. Be sure to check the new resistors with an ohmmeter.

Arvin

Chassis TE 286, TE 300, TE 302, and TE 315

To improve noise rejection in fringe areas. Improve the noise-rejection characteristics of the sound section of the custom chassis (in fringe areas) by touch-up alignment of the sound i.f. strip. This can be done on the station signal. The only equipment necessary is a v.t.v.m., or a meter having a sensitivity of 20,000 ohms per volt. Use a 27,000-ohm isolating resistor on the end of the voltmeter lead.

The station should be correctly tuned in and the voltmeter connected across R107 in the grid circuit of the 6AU6 limiter, V3. R107 is 22,000 ohms. Adjust the top of L101 (plate circuit of 6AU6, first sound i.f.), top and bottom of T101 (T101 transformer couples the second sound i.f., V2, to the limiter tube, V3), and L108 (4.5-mc trap connected to the control grid, pin 4, 6AC7, video amplifier, V12). Make these adjustments for maximum meter deflection.

With the voltmeter connected to the junction of R111 and R112 (series 100,000-ohm resistors in the cathode circuit of the 6AL5 discriminator, V4) adjust the bottom of T102 for maximum. T102 transformer couples the limiter to the discriminator. Connect voltmeter to junction of R112 and R113 (27,000 ohms) and adjust top of T102 for zero reading on the voltmeter. This adjustment can also be made by adjusting the top of T102 for minimum noise in the sound.

The two adjustments on T102 are very delicate and will rarely require more than ¼ turn for proper adjustment.

Because of the high sound sensitivity of this set it can be slightly out of alignment and there still will be ample amount of sound. However, by correct alignment there will be more limiting done by the limiter and consequently better noise rejection.

To improve vertical stability when vertical hold control is near end of its range. To shift stable position of hold control to center of its range, decrease value of R181 (1.5 meg) in series with the vertical hold control. On 16-inch sets (chassis TE 286) replace R181 with a 1-meg resistor. On 17 inch, 20 inch, and 21 inch sets (chassis TE 300, TE 302, and TE 315) replace R181 with a 1.2-meg resistor.

Chassis TE 289–3, TE 290–2, and TE 290–3

To increase sound sensitivity and reduce overmodulation buzz. In some areas where signal strength is low, or where the station sometimes tends to overmodulate, it may be desirable to increase sound sensitivity of the deluxe chassis which have the 4.5-mc trap (L120) in the video-amplifier plate circuit. This can be done by reversing the connections on the trap. There is a certain amount of inductive coupling between L101 (sound takeoff) and L120 (4.5-mc trap). Reversing the connections on the trap will cause the stray field of the trap to be additive with the sound takeoff coil. This change under extreme conditions will increase sound and will reduce buzz due to station overmodulation.

Realign the trap after the connections are reversed. Connect a 4.5-mc signal (crystal calibrated) to pin 4 of the video amplifier and a VTVM to pin 7 of the ratio detector (V2), 6AL5. Adjust the 4.5-mc trap for maximum meter deflection. If a calibrated test signal isn't available, tune in any available television station and adjust both L101 and L120 for maximum meter deflection. The VTVM should be set on the low-voltage, d.c. scale. If the meter reads backwards, reverse the test leads.

Chassis TE 290–2

To improve vertical stability and eliminate jitter under impulse-noise conditions. Add a 10,000-ohm resistor in series with the lead that connects to the junction of R117 and R118. R117 is 3,300 ohms, R118 is 2,200 ohms. One side of R117 connects directly to the output of the low-voltage power supply (red lead). The 10,000-ohm resistor acts as a noise suppressor, most effective under weak-signal conditions in the presence of impulse type noises.

Change R154 from 15,000 ohms to 47,000 ohms. R154 is connected to the plate, pin 6, of the 12AU7 sync separator. This change increases the vertical sync injection to V3B, 12AU7, sync inverter and clipper.

These two changes result in a cleaner vertical pulse input to the integrating network, improving the vertical stability under weak-signal and impulse-noise conditions. Chassis TE 290-3 incorporate these changes.

For additional case histories of vertical jitter consult pages 29, 31, 41, and 67.

Models 2120, 2121, 2123, 2124, 2126, 2160, 2161, 2162, 2164; chassis TE 289–2 and TE 290–2

Sync buzz in the audio. Occasionally, buzz will be heard in the sound. First, make sure that buzz is not caused by overmodulation by TV station. If set is at fault, slight adjustment of the ratio detector transformer, T101, and the first i.f. transformer, T103, may eliminate the buzz. Use the following procedure:

1. Adjust the tuning for best picture. Turn the tuning control clockwise until the picture begins to deteriorate and then turn it back carefully counterclockwise to the best picture setting. This locates the picture carrier properly on the i.f. response.

2. Adjust top of T101 for minimum buzz, maintaining reasonably strong sound.

3. If buzz is still present, keep the tuning set as in step 1. Adjust the top of T103 for minimum buzz, maintaining reasonably strong sound. Do not turn this slug more than 1 turn either way.

If more adjustment appears necessary, i.f. alignment with test instruments will be necessary.

To increase the apparent sensitivity of channel 7 on the deluxe chassis in fringe areas. Improve the performance of the deluxe chassis for channel 7 in fringe areas by lengthening the 300-ohm twin lead-in between the tuner and the antenna terminals and rerouting it. If the 300-ohm lead-in is close to the i.f. strip, a harmonic of the i.f. is coupled into the lead causing the picture to appear snowy. The lead

should be lengthened 8 inches and rerouted as far away from the i.f. strip as possible, not using the 300-ohm lead standoff which is on the chassis. A convenient method is to staple the lead to the side of the cabinet, preventing any possibility of the lead accidentally falling near the chassis.

Model 4162; chassis TE–286

To reduce video ringing and improve impulse-type noise immunity:

1. Connect a 10,000-ohm, ½-watt resistor in parallel with L109, R126. L109, R126 connect to pin 8 of V12, video-output stage. This reduces the high-frequency peaking in the video-output stage and eliminates excessive ringing which appears as white shadow following black in the picture.

Excessive peaking is caused by the high Q of peaking coil, L109. Shunting the 10,000-ohm resistor across the coil has the effect of lowering the Q. With a lower Q, the coil will not produce as much gain at the 4-mc end of the video signal. Video ringing is also discussed on page 97.

2. Connect a 0.1-μf, 200-volt capacitor in parallel with R160. R160, 22,000 ohms, connects to pin 2 of V13, 6AV6, a.g.c. cathode follower. This change effectively increases the time constant to make this circuit more immune to impulse-type noises. With the original shorter time constant, fast impulse-type noises caused white streaks in the picture. The increased time constant is very effective in reducing these white streaks.

These changes were incorporated in late production.

Belmont (see also Raytheon)

16AY28, 16AY211, 17AY21, 17AY24 chassis

Horizontal nonlinearity, sometimes called left-hand bulge, stretched or egg-shaped test pattern. If adjustment of the controls does not produce results, incorporate the following modification to remedy horizontal nonlinearity.

1. Replace .05-μf capacitor (C106) across horizontal-linearity coil with a .02-μf capacitor.

2. Connect a jumper wire across the 10-ohm resistor (R95) on horizontal linearity coil.

3. Replace horizontal linearity coil core with the same type core as in horizontal size coil (51A-16945).

4. Connect a 10,000-ohm, 1-watt resistor in parallel with the 20-μf, 150-volt electrolytic (C-115).

5. Replace 470-μμf mica capacitor (C135) with an 820-μμf capacitor.

6. Connect a 0.15-μf capacitor in series with the low side of the horizontal yoke winding.

(a) *16AY28 and 17AY21 chassis.* Remove three red leads and 220,000-ohm resistor from pin 1 of yoke socket and connect to pin 4 of damper socket. Connect 0.15-μf capacitor between pin 1 of yoke socket and pin 4 of damper socket.

(b) *16AY211 and 17AY24 chassis.* Remove jumper wire from pin 1 to pin 4 of yoke socket. Connect 0.15-μf capacitor between pin 1 and pin 4 of yoke socket.

7. Follow adjustment procedure. Use test pattern and adjust horizontal

size control until entire screen is filled horizontally. Turn drive control clockwise until trimmer is tight. Set horizontal linearity control to left end of slot (toward vertical controls). Turn horizontal drive control counterclockwise until left half circle is approximately ¼ inch shorter than right half circle. Adjust horizontal linearity control for proper linearity. If adjustment of horizontal linearity control produces drive bars, turn horizontal drive control slightly clockwise.

20-inch receivers

Low line-voltage areas. An additional adjustment terminal is provided on the C-201-19999 high-voltage deflection transformer to give an increase in horizontal scan when the receiver is used in low line-voltage areas. The 20-inch receivers installed in low line-voltage areas may have insufficient horizontal scan or inadequate horizontal size range. This condition can be remedied by connecting the horizontal yoke winding to the unused primary terminal of the high-voltage deflection transformer. Use extreme care when working around the high-voltage deflection transformer.

When additional horizontal scan is required, remove the chassis from the cabinet and remove the high voltage shield can cover, carefully handling the 6BQ6-G plate lead. Unsolder the blue lead from terminal 4 and reconnect to terminal 5.

As a precautionary measure, to reduce future service on the 20-inch receivers, the .01-μf, 600-volt capacitor C56 (first anode bypass) should be removed from ground and connected to the nearest 350-volt B-terminal lug.

Poor vertical sync accompanied by horizontal *pulling* or improper horizontal operation. May be caused by a.g.c. plate pulse pickup at the grid of the sync separator. To remedy this condition, dress capacitor C103 (470 $\mu\mu$f, pin 1 of sync. sep.) and its leads close to the chassis and separate resistor R82 (1 meg) as far away from the capacitor as possible.

These modifications were incorporated in chassis stamped with RTMA date code numbers 124113 and up.

22A21 chassis

No raster, sound O.K. Check the .001-μf filter capacitors in the high-voltage rectifier circuit. One of these capacitors has been shorted in several sets. Replace the defective unit with a high-grade .001-μf capacitor having a working voltage of 5,000 or higher.

Blooming. Improper dressing of the 1X2 filament leads (C-201-19533 and C-201-19533-1 high-voltage deflection transformers) may cause frequent tube failures or poor high-voltage regulation, resulting in blooming (picture expansion as brightness or contrast control is increased). Dress the 1X2 filament leads as far away from the coil as possible. The leads should overlap and be tight against the terminal board. Use coil dope to secure the leads in place. Keep the coil leads to terminals 1, 2, 4, and 6 as far away from the filament leads as possible.

For additional cases of blooming, refer to page 93 and page 96.

Intermittent 6J6 or early 12AT7 tuners. In the case of intermittent tuner

trouble the eyelet shown in illustration *a* may not be making a good electrical

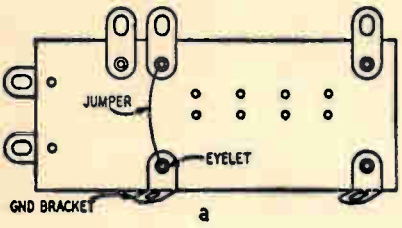

Fig. 10. Solder eyelet shown above.

connection with the ground bracket at high frequencies, causing an intermittent condition. To eliminate the possibility of a poor ground connection:

1. Remove the tuner cover.

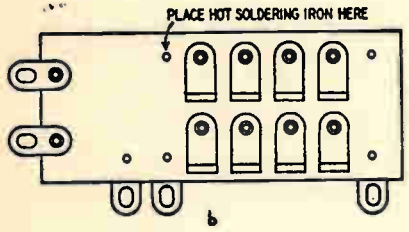

Fig. 11. Place hot solder at point shown.

2. Place a hot soldering iron at the point shown in illustration *b*.

3. Allow sufficient time for heating.

4. Run solder between the eyelet and the ground bracket.

An intermittent condition can also be caused by defective contacts, and open or high-resistance ground or cold solder connections.

To improve fringe-area reception. Make these adjustments only on 16- and 17-inch sets which will be used in fringe areas, or a definite decrease in picture quality will be noticed in local-signal areas.

1. A-13A-19514 sound pick-off coil (T-8) must be in set. If not, change.

2. Turn second (L-12) and fourth (L-14) i.f. coil cores ½ turn into coil.

3. If the above step does not produce enough improvement, follow steps 5, 6, and 7.

4. If the original sound pick-off coil was removed and the A-13A-19514 coil was added, follow steps 5, 6, and 7.

5. Peak the sound pick-off coil (T-8) for maximum sound.

6. Adjust the ratio detector (T-2) primary (bottom of coil) for maximum sound.

7. Adjust the ratio detector (T-2) secondary (top of coil) for best noise rejection. Do not make these adjustments on the 20-inch sets.

Picture tube handling. A production change was incorporated in 16- and 17-inch television receivers to prevent the possibility of the cathode-ray tube sliding forward or shifting in shipment.

The rubber sponge pad was cemented only to the front mounting brackets in the past. Rubber sponge pads are now being cemented both to the brackets and the glass of the cathode-ray tube.

If the removal of the cathode-ray tube is necessary, use care to loosen the tube from the pad before removing the tube from the chassis. In most cases a slight amount of pressure between the chassis and the tube will release the adhesion.

Do not gouge the sponge rubber pad as it is required as a support for the picture tube.

Note: Do not force removal of the tube as an implosion may result.

Bendix

Models 2025, 2051, 2070, 3033, 3051, 6001, 6002, 6003, 6100, 7001

No vertical sweep. If the vertical-output transformer is not defective, check C25 (.03 μf, connected to blue lead of vertical-output transformer) for short or leakage. If shorted, or if leakage is excessive, replace R42 and check value of R69. R42 is 33,000 ohms and is part of the vertical oscillator circuit. R69 is a 2,200-ohm, 2-watt damping resistor connected to the cathode (pin 3) of the 6W4-GT damper tube. Disconnect R69 from the circuit before checking value. Also check V9 (6K6-GT vertical output tube) and V11 (6SN7-GT, sync clipper and vertical oscillator).

No control of vertical sync. Check C26 (2,700-μμf capacitor in grid circuit of 6SN7-GT vertical oscillator) by replacement, preferably using a mica capacitor. Do not use a ceramic.

Receiver blows 0.15-ampere fuses. Check C25 (.03 μf connected to blue lead of vertical output transformer) for short. Check V8 (audio-output tube, 6AS5), V9 (6K6-GT vertical output tube), V11 (combined sync clipper and vertical oscillator, 6SN7-GT) and V16 (horizontal damper tube, 6W4-GT). Make sure that the fuse has a minimum rating of 150 milliamperes. Do not use a fuse having a higher current rating. Check to make sure that fuse ends are not contacting the chassis.

Picture blooms. The vertical-output tube, the horizontal-output tube, or the high-voltage rectifier tube, may be gassy. Test the horizontal damper tube (V16, 6W4-GT) by replacement. The screen-dropping resistors, R66 and R67 (each 4,700 ohms), for the 6BQ6-GT horizontal-output tube should be checked for correct value. R71 and R73, 680,000 ohms, 2 watts, series resistors connected to pin 2 of the 1B3-GT should also be tested.

Noise in picture. Can be caused by arcing of high voltage or corona in the cage. Check C38 (220 μμf connected to pin 4 of V14, horizontal oscillator and phase detector, 6SN7-GT) for an intermittent short. Noise in the picture can also be due to a defective contrast control.

Smear. If smear appears in the picture, realign L452 to 25 megacycles. L452 connects to pin 2 (plate) of the 6J6 mixer in the front end. Test C411 (10 μμf connected to L452) for leakage and L2, L3, L4, and L5 for an open. These are the peaking coils. The 1N60 crystal detector may have a low front-to-back ratio. The picture i.f. tubes should also be tested by replacement.

No control of vertical or horizontal sync. R4, 2,700-ohm plate-load for the sync clipper (pin 2 of V11A, 6SN7-GT) may be open or out of tolerance value. Also check C9 (.05 μf connected to pin 1 of 6AU6 sync limiter, V10) for either an open or shorted condition. Test the sync limiter (V10) and the sync clipper (V11) tubes.

Sound but no high voltage. Always remember to put the plate cap clip back on the 6BQ6-GT horizontal output tube. Test the picture tube for a cathode-to-filament short. Examine

the second-anode lead to the picture tube.

Hum in sound. Hum can be caused by a number of simultaneous troubles, not necessarily by any one thing. Make sure that the vertical output transformer laminations are tight. Check the lead dress of the vertical output transformer, keeping hot leads as near the chassis as possible. The line-cord power leads should be kept away from all grid leads. Also dress away from audio leads.

Check C18 (10 μf connected to plate pin 2 of ratio detector, V7) for leakage. The ratio-detector tube, V7, 6T8 (19T8) should be checked for filament-to-cathode leakage. Realign the ratio detector (T3) secondary.

Raster and sound, but no picture. Check C30, 0.2 μf coupling capacitor connected to cathode (pin 11) of picture tube for open.

Receiver dead. If the line cord is in good condition, examine the interlock on the back of the chassis. Rectifier tube, V13 (5U4-G) may have an open filament. Run a continuity check from the power line to the primary winding of the power transformer, T6. Measure power transformer (T6) secondary voltages, also look for shorts in filament circuits and B-plus shorts in low-voltage filter circuits.

Sound, but no raster. Readjust ion trap. Check C49, 470-$\mu\mu$f, 10-kv capacitor (connected to pin 2 of 1B3-GT high-voltage rectifier tube) for short. Test T8, horizontal output transformer, for open circuit primary and secondary. Try replacing the 6BQ6-GT. Also try replacing the horizontal oscillator and phase detector, 6SN7-GT. Check continuity of T7, synchro-guide coil. Lift top end of R62 (6,800 ohms, connected to plate, pin 5, of 6SN7-GT horizontal oscillator and phase detector, V14) when this check is made. Test the sync limiter, V10 (6AU6). Check C40, 1,200 $\mu\mu$f. This capacitor connects to a tap on T7. The most effective test is by replacement. Also test C38, 220 $\mu\mu$f for short or leakage. C38 is connected to pin 4, control grid of V14, 6SN7-GT, horizontal oscillator and phase detector.

Insufficient vertical size. If the vertical oscillator and output tubes are O.K., and T5, the vertical output transformer, is not defective, check C25 for leakage. C25 is .03 μf and connects to blue lead of vertical-output transformer. Run a resistance check of R46. R46 is 680,000 ohms and connects to pin 5 (plate) of the vertical oscillator tube.

Picture, but no sound. Check all audio tubes including the sound i.f. Inspect all connections on T3, ratio-detector transformer. Test C10 for open. C10, 1.5-$\mu\mu$f, 500-volt ceramic, is the sound takeoff capacitor and is connected to plate, pin 5, of V5, 6AU6, video amplifier. If there is still no sound, disconnect the speaker and continuity-test the voice coil. Make sure the phono switch is in the proper position. Also test L6, the 4.5-mc transformer.

Weak sound, normal picture. Use the same trouble-shooting procedure as in the preceding technote. The over-all sound alignment should be investigated. Check C1 for leakage. C1,

68 $\mu\mu$f, is connected to pin 4 of the 6CB6, first picture i.f., V3.

No control of horizontal sync. C34 may be open. C34, 47 $\mu\mu$f, is connected to the plate, pin 2, of 6SN7-GT sync clipper, V11A. Check the auto synchroguide transformer, T7, to make sure that its adjustment is correct. Resistance test R52, 330,000 ohms; R54, 120,000 ohms; and R56, 120,000 ohms. R52 and R54 are connected to the horizontal hold control. R56 is connected to R52. Also, all resistors in the horizontal oscillator circuit should be tested, as they may be out of tolerance.

Models 2051, 3051, 6001, and 6100 (T5 chassis)

Bending at top of picture. A production change was made in the T5 chassis beginning with the above models to correct an undesirable bending at the top of the picture.

1. The value of the sync-coupling capacitor was changed from 68 $\mu\mu$f to 47 $\mu\mu$f.

2. The sync limiter, V10 (6AU6 or 6AG5) cathode bypass capacitor C21 was changed from 0.2 μf to 2μf electrolytic (negative to ground).

3. Resistor R8 located in the a.g.c. string was changed from 470,000 ohms to 1.5 megohms.

Insufficient width. In areas where low line voltage may exist there might arise an insufficient width condition in the T5 chassis. A production change to increase width in this chassis changed R63 from 470,000 ohms to 120,000 ohms, $\frac{1}{2}$ watt, $\pm 10\%$. This is the grid resistor for the 6BQ6-GT (V15) horizontal output tube and is located across the terminals of the horizontal drive trimmer C42. In the event this resistor is changed, readjust the horizontal drive trimmer C42. Do this with an oscilloscope connected to pin 5 of the 6BQ6-GT and adjust the drive trimmer for maximum pulse amplitude.

2051

Picture will not center. If you experience trouble in centering the picture, remove R80, 22-ohm resistor. One side of R80 goes to pin 7 of J6. This in turn connects to the horizontal yoke. Also check selenium rectifier, SR1, negative terminal connected to R80. R80 and SR1 are in series. The 0.5-μf capacitor, C58, shunting R80 and SR1 may be defective.

If this receiver has centering trouble, but did not originally have R80, insert this resistor.

3001U

Loss of horizontal sync. This fault can be traced to a change in the value of the screen-dropping resistor for the 6BG6-G horizontal output tube. This resistor is made up of three series-connected 4,700-ohm resistors which have a total nominal value of 15,000 ohms. A pulse is taken off between the first and second resistor and applied to the phase detector in the a.f.c. circuit. A change in value of any of these components will usually cause the sync circuit to fail. The three resistors should be replaced.

Since carbon resistors are usually affected by high temperatures, be sure to wire in the series screen resistors away from sources of heat.

Capehart-Farnsworth

CX–31

Horizontal sweep will not lock in. Defective 6SN7-GT horizontal oscillator-a.f.c. tube.

Unstable horizontal sync. Changes in values of components in this circuit may cause the oscillator to shift frequency, making it harder for the control circuit to maintain the oscillator within sync range. Change the 180-$\mu\mu$f capacitor (connected between pin 4 of the 6SN7-GT horizontal oscillator V14 and the horizontal oscillator transformer) and the 390-$\mu\mu$f capacitor (coupling capacitor between the horizontal oscillator transformer and the 6BG6-G horizontal output tube, V15) to silver mica capacitors of the same value.

CX–33

Whistle in sound and/or lines in picture (similar to Barkhausen oscillation). Additional bypassing may be needed in the B-minus circuit. Add a 0.1-μf, 200-volt capacitor from the –90 volt point to chassis ground (near 6BG6-G tube, junction of R291, 220-ohm cathode resistor and R290, 1-meg-ohm grid resistor).

Vertical picture jitter. Check C235, 100 $\mu\mu$f, between sync amp and sync clipper, for leakage.

Intermittent vertical sync buzz. Can be caused by overmodulation at TV transmitter. May also be due to insufficient drive at ratio detector. Check sound alignment.

Small section of picture shifts horizontally. Leaky capacitor, C278, 30 $\mu\mu$f, 6 kv. One side of C278 goes to pin 3, cathode, 6W4-GT damper (V220).

Inability to phase picture correctly. Change C253 from .0047 μf to .001 μf and R282 from 560,000 ohms to 100,000 ohms. One side of C253 is connected to pin 1, control grid, 6SN7-GT horizontal oscillator. R282 is connected to C253. Also check the horizontal oscillator tube. C251, 100 $\mu\mu$f (plate of reactance tube) may be open.

High-voltage circuit arcing or corona. Check lead dress around 1B3 socket. Check dress of horizontal output transformer leads (T210).

Picture blooming. Connect in series with the cathode of the CRT (pin 11) a 100,000-ohm resistor and a 0.1-μf, 200-volt capacitor in parallel.

Blocking on strong signals. Check setting of a.g.c. control. Remove present leads from plus terminals of C242B, connect together and insulate. C242B, 40 μf, is in the low voltage power supply. Connect a 5,000-ohm, 7-watt, wire wound resistor between plus terminal of C243C and C242B. C243C, 10 μf, is also in the low voltage power supply. Remove R236 and R306 from plus 135 volts and connect to C242B. R236, 27,000 ohms, is connected to the brightness control and R306, 5,000 ohms, 7-watt, wire wound resistor, is in the control grid circuit of the 12AU7 (V212) pre-sync sep.-a.g.c. det. Add a 20-μf, 450-volt capacitor from plus 135 volts to chassis ground.

Corner-cutting of picture. Reposition focus coil by loosening 4 self-tapping

screws which hold focus coil in bracket. Loosen deflection yoke mounting bracket and push yoke as far forward as possible. Adjust ion trap magnet within range of maximum brilliance to eliminate corner cutting.

Unable to properly align sound takeoff transformer (T204). Possible that due to material variation the tuning range has drifted. If so, connect a 5-$\mu\mu$f capacitor between terminals 3 and 4 of T204.

Improper focus. Check adjustment of focus control and position of focus coil. Check resistance of focus coil (should be 470 ohms). Connect a 2,200-ohm, 2-watt resistor in parallel with R297 and R296B. R296B, 680 ohms, 5 watts, wire wound, is connected to the center arm of the focus control. R297, 4,500 ohms, is also connected to the focus control.

Snow in moderate signal areas. Check value of R252, R250, and R248. Must be within 5 % tolerance. Replace R252 with a 2.2-meg resistor. If snow is still excessive use a 2.0-meg resistor. R248, 24,000 ohms, is connected (through R203, 15,000 ohms) to pin 1, control grid of the 6AG5 (V201) first picture i.f. R252, 2.4 megohms and R250, 120,000 ohms are both connected to diode plates, pin 5 and pin 6, of the 6AV6 (V209) first audio amplifier and a.g.c. clamp.

Vertical instability. R269, 38,000 ohms, temp. compensated, changed value. R256, 3.9 megohms, decreased in value. R269 is connected to one side of the vertical hold control. R256 is connected to pin 1, control grid of the 6SN7-GT sync clipper (V214A).

Intermittent horizontal sync. C247 partially shorted. C247, 100 $\mu\mu$f, is connected to terminal E on T209, horizontal a.f.c. transformer.

Premature failure of 6BG6-G tubes. Intermittent decrease in horizontal scan. Change the value of the 6BG6-G cathode resistor to 220 ohms, 4 watts. This can be done by adding a 110-ohm, 2-watt resistor in series (or two 220-ohm, 1-watt resistors in parallel) with the present cathode resistor (R291 and 292 in parallel). Change the 6BG6-G screen grid resistor to a total of 12,000 ohms, 2 watts. These changes make the 6BG6-G bias less dependent on horizontal drive. Horizontal oscillator tube 6SN7-GT may be removed from its socket and the 6BG6-G cathode current will rise only slightly.

Ringing effect. Jagged picture edges. Correct this condition by adding a 10,000-ohm resistor in series with the 56-$\mu\mu$f capacitor connected across one-half of the horizontal winding of the deflection yoke. The addition of the resistor will decrease the width of the picture by approximately 1 inch; however, sufficient width will still be available.

The 10,000-ohm resistor can have a $\frac{1}{2}$-watt rating. In soldering to the 56-$\mu\mu$f capacitor be careful that no short results from this change. If in doubt, place a length of sleeving over the resistor (or cover with tape) so that the resistor ends are not exposed. The other half of the winding need not be touched.

GV-260

Insufficient width. Complaints of insufficient width can be handled simply

by connecting three .001-μf, 600-volt capacitors in series across the 1,500-

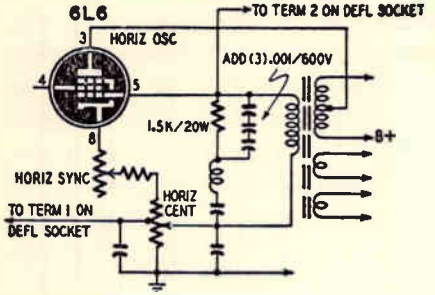

Fig. 12. Circuit change to boost width.

ohm, 20-watt resistor connected to the grid of the 6L6 horizontal oscillator tube, as illustrated. This change increases the width enough to spread both sides beyond the edges of the mask.

461P, 501P, 502P, 504P

No high voltage, no horizontal deflection. Open h.v. winding on horizontal output transformer (terminals 2 and 3).

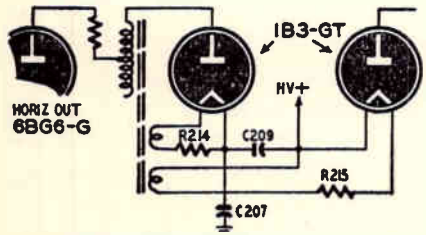

Fig. 13. Circuit check for no high voltage.

Defective 1B3-GT (check by substitution; tube may check good, yet be gassy). Open 1B3-GT filament circuit. Shorted capacitors C209 or C207. Open resistors R214 or R215. (See illustration, Fig. 13, shown above.)

Vertical jitter. Excessive contrast setting. Noise in vertical sync circuit. Cold-soldered connections in vertical oscillator circuit.

Picture smear. Insufficient bias on video amplifiers, resulting in grid current on video signal. Defective cou-

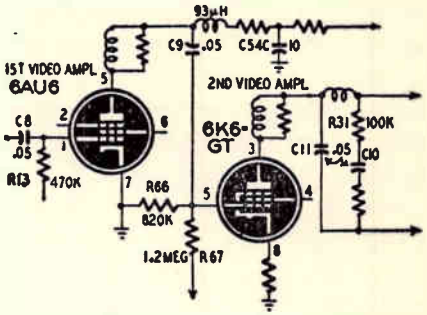

Fig. 14. Check this circuit for smear.

pling or grid-load resistor. Check R13, R67, R66, R31; C8, C9, C10, C11, C54C. (See illustration above.)

Vertical nonlinearity. Incorrect adjustment of vertical linearity control. Defective 6K6-GT vertical output. Defective vertical output transformer. Defective resistor R88; capacitors C16,

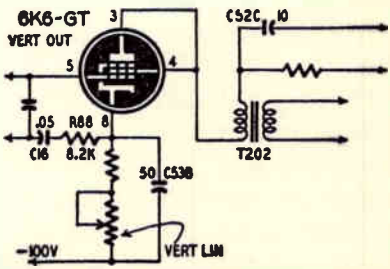

Fig. 15. Checks for vertical nonlinearity.

C53B, or C52C. (See illustration above.)

Horizontal nonlinearity. Incorrect adjustment of horizontal linearity control.

2. C19, cathode bypass capacitor across the cathode resistor for the 6BQ6-GT horizontal output tube, may have changed value or become shorted. C19 should be 10 μf, 50 v.

3. R12 and R14 should be checked and measure within 5% of each other. These resistors are 1,500 ohms, $\frac{1}{2}$ watt. R14 is connected to the cathode, pin 3, and R12 is connected to the plate, pin 1, of the 12AU7 sync separator.

4. Check R16 and R17 to see that they are within 5% of each other. R16 and R17 are each 100,000 ohms and are connected to C7 and C8.

The resistors specified in paragraphs 3 and 4 should be within 10% of their resistance values. Also check the 6BQ6-GT and the 6W4-GT by substitution.

Vertical roll. If picture rolls vertically, and the hold control has reached the end of its range, check the 6SN7-GTA vertical oscillator tube by substitution. If this does not correct the condition, it is probably due to a defective vertical blocking oscillator transformer. Replace with a new part (part No. 19S601). A temporary remedy that will put the set back in service can be made by changing the value of R48, 1.5 megohms, by either adding or subtracting resistance. R48 is connected to the vertical hold control. *Note:* this is a temporary remedy and should only be used as such.

Dim picture; picture shrinks in size; oscillation of upper part of picture (hula effect); distorted sound; nauseating odor. Faulty selenium rectifiers. Replace as a set. Available as an assembly (part No. 25A051) consisting of four selenium rectifiers and their mounting bracket. When replacing selenium rectifiers, check for shorts and high current drain in the power supply.

Low B plus. Low B plus in the 130-volt section of the power supply is generally due to a shorted 6AU6 tube in the keyed a.g.c. circuit. Check by substitution.

Horizontal oscillator interference. Interference generated by the horizontal oscillator system and broadcast through the power line can be eliminated by connecting a .01-μf, 600-volt capacitor to each side of the power line. Disconnect the socket in the high-voltage cage and ground the other side of these capacitors to the grounding ring on the 6BQ6-GT horizontal output tube socket.

Neck shadow; picture cannot be centered on the face of the tube. Check the picture tube by substitution if possible. If this is not feasible, extend the high-voltage lead with a piece of well-insulated wire and rotate the picture tube 180 degrees. If neck shadow and picture placement are on the same side of the tube, it indicates that the picture tube gun is parallel with the face of the tube. Remove the picture tube and check the alignment of the yoke with the focus coil. If they are not in perfect alignment, loosen the bolts that hold the focalizer in place and shift it around until perfect alignment is obtained. Observe the action of the focalizer shunt ring and see if there are any burrs or binding which would prevent the adjustment from going through its complete range. Replace the picture tube, making sure

by connecting three .001-μf, 600-volt capacitors in series across the 1,500-

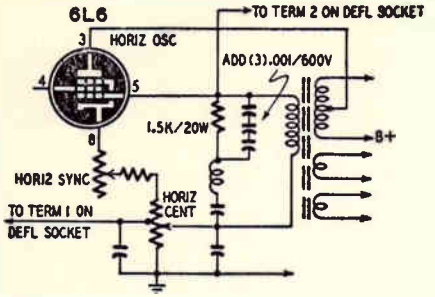

Fig. 12. Circuit change to boost width.

ohm, 20-watt resistor connected to the grid of the 6L6 horizontal oscillator tube, as illustrated. This change increases the width enough to spread both sides beyond the edges of the mask.

461P, 501P, 502P, 504P

No high voltage, no horizontal deflection. Open h.v. winding on horizontal output transformer (terminals 2 and 3).

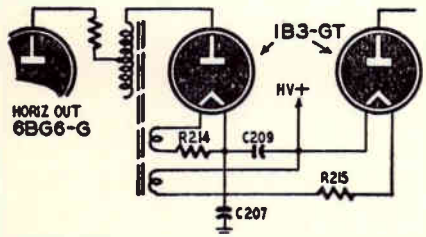

Fig. 13. Circuit check for no high voltage.

Defective 1B3-GT (check by substitution; tube may check good, yet be gassy). Open 1B3-GT filament circuit. Shorted capacitors C209 or C207. Open resistors R214 or R215. (See illustration, Fig. 13, shown above.)

Vertical jitter. Excessive contrast setting. Noise in vertical sync circuit. Cold-soldered connections in vertical oscillator circuit.

Picture smear. Insufficient bias on video amplifiers, resulting in grid current on video signal. Defective cou-

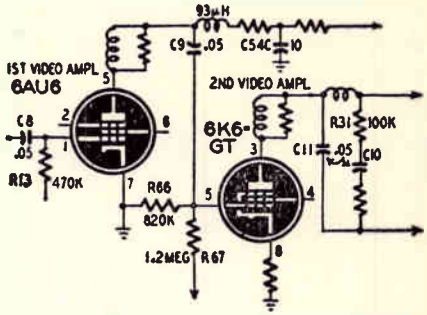

Fig. 14. Check this circuit for smear.

pling or grid-load resistor. Check R13, R67, R66, R31; C8, C9, C10, C11, C54C. (See illustration above.)

Vertical nonlinearity. Incorrect adjustment of vertical linearity control. Defective 6K6-GT vertical output. Defective vertical output transformer. Defective resistor R88; capacitors C16,

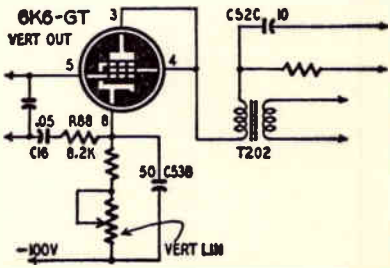

Fig. 15. Checks for vertical nonlinearity.

C53B, or C52C. (See illustration above.)

Horizontal nonlinearity. Incorrect adjustment of horizontal linearity control.

Defective 6BG6-G horizontal output, 5V4-G damper, or 6AS7-G reaction scanner. Defective horizontal output transformer. Defective resistor R201, R219, R220, R223, or R224; capacitors C201, C211, or C212.

Picture out of phase horizontally. Incorrect adjustment of horizontal sync

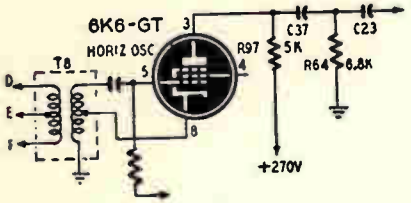

Fig. 16. Analysis for wrong phase picture.

discriminator phase control. Reversal of leads D and F on sync discriminator transformer. Defective resistor R97 or R64. (See illustration above.)

Raster nonsymmetrical. Improper adjustment of focus coil. Defective deflection coils.

610P, 651P, 661P

Horizontal nonlinearity. Change in resistance, capacitance, or inductance values in grid circuit of beam relaxer; check values against schematic. Shorted turns in horizontal deflection coils or transformer.

Stretching at top of picture (wide spacing of several lines). Open .05-μf coupling capacitor or open 5,600-ohm resistor in vertical oscillator. Open cathode bypass capacitor in vertical amplifier. Defective vertical output transformer.

Black bars on left side of picture. Defective 6L6 horizontal oscillator, causing spurious oscillation.

Poor horizontal sync (lines similar to auto ignition interference). High-voltage corona affecting sync. Check spacing of 1B3-GT tube socket lugs. Re-dress wiring away from h.v. bleeder circuit.

Horizontal sync drifts. Defective 6SN7-GT or 6K6 on sync chassis. Defect in horizontal a.f.c. circuit.

Picture size changes when vertical centering control is adjusted (jumpy movement of center of picture only). Defective centering capacitor across vertical centering potentiometer.

White bar at bottom of picture. Overloading of vertical amplifier. Defective vertical amplifier tube.

Portions of picture tear out. Excessive contrast setting. Excessive signal at antenna. Strong outside interference. Defective 6L6 horizontal oscillator. Audio leaking through to picture-tube grid (check i.f. sound trap).

No focus (picture size changes when focus control is adjusted). Open focus coil. Poor solder joint or connection at coil or plug socket.

No picture, focus and width controls run hot. Breakdown of filter capacitor or other h.v. components (or wiring), causing B-plus short to ground. Arc-over in 6L6 socket. Use ceramic socket for replacement. Re-dress wiring around socket.

No picture or sound, oscillation in system. Poor or improper grounding in shields and r.f. subassembly, or in underchassis i.f. shields. These shields must be well grounded with every nut screwed down tight *at only* the points provided. Touching the shield to another ground point can cause oscillation.

651P

Microphonic howl. Defective 6J6 mixer, 6J6 oscillator, 6J6 r.f., or one of the 6AC7 i.f. amplifiers. If a 6AC7 is causing trouble, try a lead damping weight on top of tube. This applies to receivers using tubes such as 12AT7, etc.

Try replacing the above-named tubes one at a time. Tapping the tubes gently with the rubber end of a pencil sometimes helps determine which of the tubes is the culprit. Note that replacement of the 6J6 oscillator (if found to be microphonic) may mean that the oscillator section in the front end will have to be realigned. If you wish to avoid this, try a number of different 6J6's until you find one that will not be microphonic and will also not require realignment.

Also check the number 1 pin of the 6AC7 i.f. amplifier tubes to make sure that it is connected to ground. Make a bare spot on the 6AC7's by scraping the paint at the top and run a temporary wire from the bare spot to the chassis. If the signal strength increases, either the number 1 pin is not grounded or the internal shield of the tube is not connected to the number 1 pin.

Microphonic howl can be caused by speaker vibration. To test if speaker is the cause, remove speaker, but keep it connected to the audio output by long extension leads. If test shows microphonics are due to speaker, shock mount speaker by inserting rubber washers (not fiber) between speaker rim and cabinet. Do not mount speaker on chassis.

Make sure tubes sit firmly and properly in sockets.

Craftsmen

RC–100–A models

Horizontal drift. To eliminate horizontal drift, change the following capacitors:

1. Replace C67 with a 470-$\mu\mu$f ceramic capacitor having a negative 5250 parts per million shift (part No. 18X619). One side of C67 is connected to the cathode, pin 7, 6AH6, horizontal automatic phase control tube.

2. C68 is a paper capacitor and should be replaced with a mica (or a good grade plastic capacitor if mica is not available). C68 is .015 μf for earlier models, .01 μf for later RC-100-A models, and is shunted across C67.

3. Replace C76 with a Mallory type WP510. If not available, a 300-μf, 15-volt tubular can be substituted. One side of C76 is grounded, the other side connecting to pin 2, suppressor grid of the 6AH6.

4. After changing these capacitors, run the set for ten to twenty hours to stabilize it.

RC–101, RC–200, and RC–201 models

Poor picture linearity. Compression on the right-hand side of the picture is generally due to a fault in one of the following components:

1. C7 or C8, open or changed in value. C7 and C8 are 1000-$\mu\mu$f, 500-volt mica capacitors and are in the horizontal sync discriminator circuit. C7 is connected to the plate, pin 7 of the 6AL5 sync discriminator and C8 is connected to the cathode, pin 5, of this tube.

2. C19, cathode bypass capacitor across the cathode resistor for the 6BQ6-GT horizontal output tube, may have changed value or become shorted. C19 should be 10 μf, 50 v.

3. R12 and R14 should be checked and measure within 5% of each other. These resistors are 1,500 ohms, ½ watt. R14 is connected to the cathode, pin 3, and R12 is connected to the plate, pin 1, of the 12AU7 sync separator.

4. Check R16 and R17 to see that they are within 5% of each other. R16 and R17 are each 100,000 ohms and are connected to C7 and C8.

The resistors specified in paragraphs 3 and 4 should be within 10% of their resistance values. Also check the 6BQ6-GT and the 6W4-GT by substitution.

Vertical roll. If picture rolls vertically, and the hold control has reached the end of its range, check the 6SN7-GTA vertical oscillator tube by substitution. If this does not correct the condition, it is probably due to a defective vertical blocking oscillator transformer. Replace with a new part (part No. 19S601). A temporary remedy that will put the set back in service can be made by changing the value of R48, 1.5 megohms, by either adding or subtracting resistance. R48 is connected to the vertical hold control. *Note:* this is a temporary remedy and should only be used as such.

Dim picture; picture shrinks in size; oscillation of upper part of picture (hula effect); distorted sound; nauseating odor. Faulty selenium rectifiers. Replace as a set. Available as an assembly (part No. 25A051) consisting of four selenium rectifiers and their mounting bracket. When replacing selenium rectifiers, check for shorts and high current drain in the power supply.

Low B plus. Low B plus in the 130-volt section of the power supply is generally due to a shorted 6AU6 tube in the keyed a.g.c. circuit. Check by substitution.

Horizontal oscillator interference. Interference generated by the horizontal oscillator system and broadcast through the power line can be eliminated by connecting a .01-μf, 600-volt capacitor to each side of the power line. Disconnect the socket in the high-voltage cage and ground the other side of these capacitors to the grounding ring on the 6BQ6-GT horizontal output tube socket.

Neck shadow; picture cannot be centered on the face of the tube. Check the picture tube by substitution if possible. If this is not feasible, extend the high-voltage lead with a piece of well-insulated wire and rotate the picture tube 180 degrees. If neck shadow and picture placement are on the same side of the tube, it indicates that the picture tube gun is parallel with the face of the tube. Remove the picture tube and check the alignment of the yoke with the focus coil. If they are not in perfect alignment, loosen the bolts that hold the focalizer in place and shift it around until perfect alignment is obtained. Observe the action of the focalizer shunt ring and see if there are any burrs or binding which would prevent the adjustment from going through its complete range. Replace the picture tube, making sure

that the deflection coil is pushed as far forward as is possible against the neck of the tube. When replacing the ion trap, try the magnet over both flags of the tube. Use the placement that gives the least neck shadow.

If these remedies do not cure the trouble, replace the deflection yoke with part No. 5X813C. This is a shorter yoke with a cosine winding distribution and will make it easier to eliminate neck shadow. After replacing the yoke, adjust the horizontal size and linearity controls.

Hum. Observe if hum level is the same for all stations being received. If the hum level is the same on all stations and persists after the volume control is turned down to a minimum setting, it is generally in the audio cable that runs down to the volume control. Remedy by grounding the shield of the audio cable at a ground near the volume control.

If the hum is only on certain stations, connect a 5,000-$\mu\mu$f ceramic or mica capacitor across the antenna terminals. If this reduces the hum, it is safe to assume that the hum is being generated in the tuner. Check the a.g.c. circuit and observe whether R36 and R37 are the same value. These series resistors are in the plate circuit of the 6AU6, keyed a.g.c. circuit. R37 may be 47,000 ohms. If so, change R37 to 68,000 ohms, ½ watt, 10%. R36 should also have this value. This correction will change the bias on the tuner and eliminate the hum in most cases. Also check the 6AU6 keyed a.g.c. tube by substitution to see if it is introducing any hum due to leakage between elements.

Premature failure of 6BQ6-GT horizontal output tube. This is caused by exceeding tube rating due to imperfect horizontal output transformer. A new type horizontal output transformer (part No. 19SO12A) is available which will remedy this condition.

Chirps or birdies. Eliminate this sound coming from the horizontal output system by replacing R21, 8,200-ohm resistor with a 6,800-ohm resistor, ½ watt, 10%. R21 is connected to the plate, pin 1 of the 12AU7 horizontal oscillator.

RC–200 models

Off-center picture, poor focus, neck shadow. Take care that the metal sleeve of the metal picture tube does not come in contact with any strong magnets such as are found in the focusing assembly, since a magnetized tube sleeve might prevent the picture from being centered on the tube face.

The deflection and focusing units must be carefully aligned along the tube axis and kept forward against the tube flare as far as possible to obtain optimum focus, picture linearity, and freedom from neck shadow.

Improper horizontal hold. In some cases the horizontal hold control range cannot be set properly by adjusting the horizontal oscillator-coil screw. Reducing the horizontal drive control (counter-clockwise rotation) will restore correct horizontal hold operation.

For additional case histories concerning horizontal hold action be sure to consult pages 62, 71, 74, 98, 106, and 111. Also consult index for horizontal circuit troubles.

Crosley

307–TA

No raster. Defective 6SN7-GT horizontal discharge. Check by substitution only.

321, 321–1, 321–2, 331, 331–1, 331–2

Insufficient picture width. If it is necessary to increase the width of the picture beyond the range of the width control, remove R214, 15,000-ohm resistor and connect a wire from lug 2 to lug 3 of the horizontal output transformer (T107). One side of R214 is connected to the plate (cap) of the 6BQ6-GT; the other side goes to terminal 3 of horizontal output transformer, T107. Also connect a 220-$\mu\mu$f, 2,000-volt capacitor (part No. 137498-62) from lug 6 to lug 8 of the same transformer.

9–403 and 9–413

Intermittent horizontal tear-out. When tube replacement and horizontal discriminator alignment do not cure intermittent horizontal tear-out, try replacing the 120-$\mu\mu$f coupling capacitor C60 between the sync separator and horizontal oscillator. This capacitor may check good on a bridge and still break down in the circuit. This trouble is hard to locate because all voltages are normal.

9–408

No raster. Defective 1B3-GT or 6BG6-G. Shorted filter capacitor. Check .005-μf, 10,000-volt filter for open or high-leakage.

9–409 and 9–419

Weak sound. Critical contrast and vertical sync. The LD models such as the 9-409M3LD, 9-419-M1LD, and others are designed especially for fringe-area reception. When these sets are

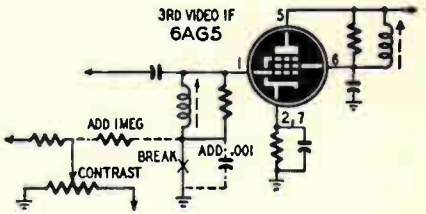

Fig. 17. Improved sound, contrast, and sync.

operated in areas where one or more stations are exceptionally strong, the contrast and vertical sync controls may be critical and the sound output weak. These conditions may be corrected by adding variable bias to the third video i.f. stage. With this added circuit, the gain of the video i.f. stage can be adjusted for best results with either a strong or a weak signal.

Disconnect the third i.f. grid coil from ground. Connect a .001-μf capacitor between the low side of the grid coil and ground. Connect a 1-megohm resistor between the low side of the third i.f. grid coil and the arm of the contrast control. The pertinent parts of the circuit are shown in the diagram. The resistor and capacitor which are added are shown in dashed lines.

Varying picture brightness. If the picture brightness fluctuates with line-voltage changes, disconnect the 470,000-ohm picture-tube grid resistor from the cathode of the 6AL5 d.c. restorer and connect it to the chassis.

10–401, –404, –412, –414, –416, –418

Neck shadow. Neck shadow on the picture tube in these models may be caused by reversed polarity of the focus coil. Wrong polarity causes the fields of the focus coil and the ion trap to interact to produce neck shadow and make centering difficult.

If this fault is suspected, reverse the current through the coil by interchanging the focus coil leads at the points where they are soldered under the chassis. If centering is easier and neck shadow diminished, and if the angle the focus coil makes with the neck of the tube is nearer 90°, this is the correct connection. When the coil is connected correctly, the current will produce a north pole on the face of the coil nearest the tube socket.

Horizontal oscillator drift. The horizontal oscillator has a tendency to drift, causing the receiver to lose horizontal sync after it has warmed up. If the horizontal sync adjustment is made after the set has warmed up, the picture will not fall in sync when the receiver is cold.

This trouble is caused by a molded capacitor C160 (.01 μfd) which may change capacitance with temperature. The capacitance change is sufficient to cause the receiver to lose horizontal sync. C160 is part of the horizontal oscillator transformer assembly, T106.

Correct the trouble by replacing C160 with a .01-μf, 600-volt paper capacitor.

Horizontal sweep sing. Horizontal sweep sing can be caused by the bracket of the horizontal output transformer vibrating at a subharmonic of the 15,750-cycle horizontal sweep frequency. Transformers in later sets do not cause this trouble because their cores and brackets have been dipped in wax.

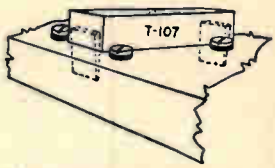

Fig. 18. Elimination of horizontal sweep sing.

This trouble can be corrected by inserting small wedges between each end of the transformer and the chassis as shown.

Models 10–404MU, 10–404M1U, 10–412, 10–418

To increase vertical size. If you cannot get sufficient vertical height:

1. Change R171 from a 5,600-ohm resistor to a 4,700-ohm, ± 10%, 1-watt resistor.

If this change does not provide enough height, the vertical height may be further increased as follows:

2. Change T105 to an autotransformer by connecting the secondary winding in series with the primary, as shown in the illustration on page 38.

   a. Remove the red lead of the primary winding of T105 at the terminal board where it is soldered beneath the chassis. There is another lead to this lug which is colored red with a white tracer.

   b. Move it to the adjacent lug to which two green leads (one from the transformer secondary and one from the deflection coil) are connected.

c. Remove the yellow lead of the T105 secondary winding and the

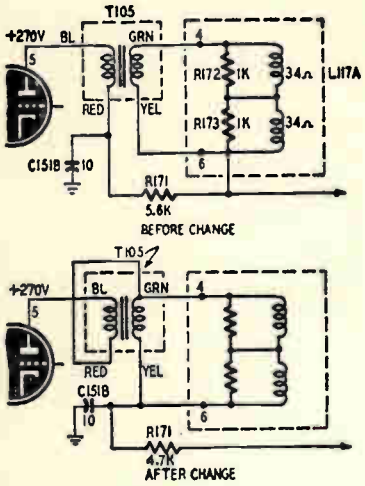

Fig. 19. Modification to increase vertical size.

yellow lead of the deflection yoke from the lug of the terminal board nearby where they are both soldered.

d. Move these two leads to the lug where the red lead of T105 was formerly connected.

10–414 and 10–416

Unstable picture. A few of these models produce an unstable picture because of an incorrect connection in the a.g.c. system. If this condition is encountered, check the polarity of the connections between the horizontal deflection transformer T107 and the a.g.c. amplifier tube V107B. The two leads from the transformer lugs 9 and 10 to pin 6 of V107B and to the junction of R156 and C114 may need to be reversed.

To determine if the leads are correctly polarized, connect a scope from the plate (pin 6) of V107B to ground. A positive pulse will be observed if polarity is correct. If unknown, check polarity of the scope with a battery across the vertical input terminals.

10–421MU

Excessive horizontal drive. An 18,000-ohm, ½-watt resistor, R210, has been connected in parallel with the 18,000-ohm resistor, R197, to increase the horizontal drive in some sets. R197 is connected through a 1,000-ohm resistor (R196) to the cathode, pin 3, of the 6W4-GT damper tube, V118. This may produce excessive horizontal drive when the sets are used in some areas. When this condition is experienced, remove R210.

Preventing corona or arcing on glass portion (behind metal bell) of 16- or 19-inch metal picture tube. To retard the accumulation of dust collecting on the glass area behind the metal bell of the picture tube, this area was sprayed with silicon lacquer. In some cases this lacquer was hygroscopic, permitting moisture to be absorbed which resulted in corona or arcing. When this condition is experienced, thoroughly clean all the silicon lacquer from the tube with acetone.

1951 Television Receivers

Hum or buzz. To reduce hum or buzz:

1. Make certain that electrolytic capacitor, C120, has a good ground connection by soldering a wire from the chassis to one of the ground lugs on the capacitor. This should be done on all

sets to prevent trouble developing as the set ages.

2. Make certain that the sections of the electrolytic capacitor, C120, are properly connected. C120 is a three-section electrolytic, 4 μf, 10 μf, and 40 μf.

3. If the shield in back of the contrast control has been removed, be sure to replace it.

4. On sets equipped with a resistor-capacitor unit (part No. W-149881), dress the coupling capacitor C122 as far as possible away from the resistor-capacitor unit. C122, .05 μf, is in the plate circuit of the video amplifier.

5. If necessary, remove resistor R141. R141, 22 ohms, is in the center-tap lead of the secondary of the ratio-detector transformer.

6. Adjust the ratio-detector transformer (T102) secondary for minimum hum or buzz, while the set is tuned to the station. Only a slight adjustment is required. If the screw is turned too far, the result may be weak or distorted audio output.

7. Check over-all alignment.

Reducing sweep radiation which interferes with radio reception.

1. With glass-type picture tubes, make sure that the tube has a good coating of Aquadag. If the tube has no coating, it may be necessary to replace the tube. If the Aquadag is peeling or is missing from some portion where it is required, repair the Aquadag with "Television Tube Koat-No. 49-2," manufactured by the General Cement Mfg. Co., Rockford, Illinois. Also be sure the Aquadag is grounded to yoke with ground clip.

2. With Scotch tape, fasten one end of a sheet of aluminum foil (approximately 10 inches × 10 inches) to the Aquadag on the top area of the picture tube. Ground the other end of the foil under the tube strap.

3. Line the inside of the cabinet (area surrounding chassis) by cementing foil to the cabinet and grounding it to the sides of the chassis. Be sure to cut the foil away from any ventilation opening in the cabinet. In some cases it may be necessary to also place the foil completely across the chassis mounting shelf, underneath the chassis. After lining the cabinet with foil the built-in antenna is no longer effective and should be grounded to the chassis. Therefore, it will be necessary to use either an external indoor or outdoor type antenna.

4. Sometimes it may be necessary to make a shield out of copper screen to fit over the horizontal-output and damper tubes.

Tuner alignment. An orange dot next to the oscillator-mixer tube socket indicates that the tuner was aligned at the factory for a 12AV7 tube in place of a 12AT7.

When it is necessary to replace the oscillator-mixer tube in tuners marked with the orange dot, always use a 12AV7 tube, otherwise realignment is necessary.

Voltage breakdown. To prevent breakdown between the plate leads of the 6BG6-G and the damper tube, install 3¼ inches of Fiberglas sleeving over the 6BG6-G plate lead toward the ter-

minal on the horizontal deflection transformer.

Tube replacement. Early sets were equipped with a 6AK5 mixer tube. To replace this with a 6CB6, solder socket lug 7 to the chassis. Later sets have a 6CB6 mixer. 6AK5's can be used in these sets without alterations.

11–441MU, 11–461WU, 11–471BU

White vertical line in picture. The horizontal drive is a trimmer adjustment located on the rear chassis apron. This control should normally be all the way out (minimum capacitance in this position). In some receivers, a white vertical line may appear in the raster under this condition. If so, turn the trimmer screw in just far enough to eliminate. After setting the drive trimmer, the width control may need adjusting to either reduce or increase the horizontal size.

DU–20 DPM

Hum. If hum is encountered in receivers using a ten-inch electromagnetic speaker with a variable resistor mounted on the speaker frame, reduce the hum by adjusting the variable resistor with a screwdriver.

Receiver overloads. Tune in a station with a weak signal and adjust the a.g.c. threshold level control on the rear chassis apron to a point where the receiver will just begin to overload with contrast set at maximum. If the receiver overloads on a strong signal, turn the contrast toward minimum to prevent overload. The threshold level control determines the receiver sensitivity.

Du Mont

RA–102

AM tuner birdies (heterodyne), evenly spaced carriers every 17 kc across broadcast band. (H.v. r.f. oscillator or horizontal sweep generator is in free-running condition). Defective cathode resistor, grid resistor in h.v. oscillator. Dirty contacts of beam cutoff relay. Improper adjustment of armature return spring tension.

No high voltage. Defective 1B3-GT or 807 in power supply. Defective h.v. transformer.

Horizontal *wobble* in picture. Defective 6AC7 video amplifier. Defective 807 horizontal output. Defective 6SN7-GT first sync amplifier.

Arc between 807 plate cap and power cable wiring. (This cable tends to work its way close to the plate of the 807 sweep amplifier.) See that cable runs directly to chassis plug and is clear of all tubes on receiver chassis.

Abnormal noise flashes on screen (in high-humidity and salt-water areas). Corona discharge in h.v. r.f. power supply. Remedy: Dress leads to lengthen discharge path, paint exposed h.v. points with insulating compound, install insulating sleeving on leads.

Low picture i.f. sensitivity (picture level drops when sound carrier is properly tuned in). Weak i.f. tubes. Defective 1N34 video detector. Defective tube in Inputuner.

Notches in picture or raster (moving up and down). Defective 6AS7. Check by tube substitution.

Poor definition. Defective 1N34 crystal video detector.

RA–102, –103D, –104D, –110A

Vertical jitter (bounce) in strong signal areas. Modification of vertical-oscillator circuit helpful; contact nearest Du Mont distributor or service organization for details.

RA–103, –105

No picture or sound, or very weak picture and sound (early models only). Breakdown of 125-$\mu\mu$f capacitor C113 in Inductuner. Breakdown due to defect in particular manufacturer's item, replaced by different manufacturer's capacitor in later sets.

Flicker (jumping or pumping); lack of sharpness or definition. Fluctuating or low line voltage. Install Sola constant-voltage transformer. RA-108A models have self-regulating power transformers and are not affected by line-voltage fluctuations.

RA–103, –104, –110

Erratic picture framing (requiring frequent adjustment of the vertical hold and size controls). Caused by a defective 30-μf, 450-volt filter capacitor (C208-A) connected from the B-plus side of the vertical size control to ground. Replacing this capacitor will clear up the trouble.

RA–104A, –110A

One or more black vertical lines on left side of raster (caused by Barkhausen oscillation). Improper adjustment of horizontal drive control. Defective 6BG6-G. Improper antenna lead-in (use coax line only). Transmission-line pickup from power supply. *Note:* Route lead-in as far away from power supply chassis as possible; ground power supply and main chassis together by anchoring to a common copper plate.

RA–105

A.g.c. drift (change of sensitivity as set is operating). Defective 6AT6 a.g.c. amplifier. When this tube is replaced, always readjust the a.g.c. setting.

Low sensitivity (new set). Check a.g.c. adjustment. This may have been jarred accidentally during shipment.

RA–105B, –108A

Hook (top portion of picture leans to left). Change .01-μf capacitor C263 (in grid circuit of sync clipper V217) to .05 μf or 0.1 μf (0.1 μf is preferable if heavy ignition noise is not encountered). Later models are modified to allow selection of .01 μf or 0.1 μf value as desired.

Vertical jitter (compression of sync in narrow-band sync amplifier). Where sync compression is cause of jitter, change the 6AU6 narrow-band sync amplifier (V225) to a 6BA6 and change resistor R363 from 22,000 to 15,000 ohms. Remove 100-ohm resistor R356 (connected from pin 7 to ground) and install a 68-ohm resistor in series with a 220-ohm resistor from pin 7 to ground. Bypass the 220-ohm resistor with a .01-μf capacitor and realign narrow-band amplifier.

Du Mont

For increased gain, replace all 6AG5's with 6BC5's. (A 6BC5 has a higher gain than a 6AG5.) No wiring changes are necessary.

Microphonic condition. Defective 6AB4 oscillator. Replace tube, or try reversing speaker leads.

Hum in audio. Heater-cathode short in 6AL7-GT tuning indicator.

RA–109A, –111A

Low sensitivity on high channels (low oscillator injection voltage). Remedy: Remove Inputuner and dress 1-$\mu\mu$f capacitor C115 as far as possible from bottom of Inputuner chassis. Place close to standoff insulator between 6AK5 converter and 6AB4 oscillator. Do not disturb the position of other Inputuner components.

Weak picture (very snowy); weak sound. Defective 6SN7-GT a.g.c. clamp. If this tube is in a nonconducting condition, the effect may not be apparent immediately but may cause the 6J6 r.f. or 6AK5 mixer to become defective.

Replacement fuse blows. Check deflection yoke.

Insufficient picture size (horizontal and vertical). Focus control at extreme of range. Defective 5U4-G low-voltage rectifier.

Overloading with normal contrast (near station). Insufficient a.g.c.; signal is overdriving receiver. Check setting of a.g.c. control.

Tearing out (top of picture). Insufficient a.g.c. Check control setting.

Attenuation of weak stations. Excessive a.g.c. Reduce.

RA–111A

Improving sensitivity or signal-to-noise ratio in fringe areas. In some fringe-area installations, it is necessary to make minor changes in these sets to improve sensitivity or signal-to-noise ratio. Replace the first and second video i.f. tubes (6AU6's) with 6BC5's. If this change does not produce the desired results, make the following alterations in the order shown:

1. Replace the fourth video i.f. with a 6BC5.
2. Remove the ground connection from pin 2 of this socket.
3. Replace transformer Z208 with a new transformer, part No. 2000-5241.
4. Realign this stage, using procedures described in the manufacturer's instructions.

If these changes cause regeneration in the video i.f., make these additional changes:

1. Connect a 68,000-ohm, $\frac{1}{2}$-watt resistor across terminals 1 and 2 of Z208.
2. Remove the .005-μf capacitor from pin 4 of the 6T8 and connect it between the ungrounded heater pin of V207 (the third video i.f.) and ground.
3. Redress and shorten the lead from R237 and C276, in the cathode circuit of the video amplifier V210, to the contrast control R239A. Keep this lead away from the Inputuner.
4. Disconnect the filament lead which runs from the first video i.f. (V205) to the filament tie point of the Inputuner. Reconnect heaters of V205 and V206, connecting the ungrounded heater pin

of V206 (second video i.f.) to the ungrounded heater pin of the third video i.f. (V207). See Fig. 20, shown below.

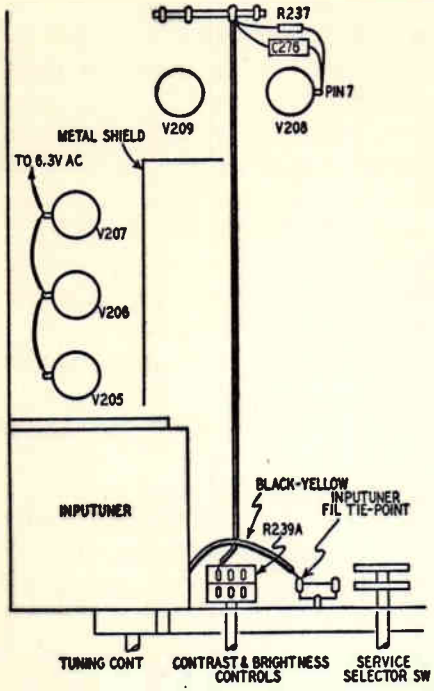

Fig. 20. Improving sensitivity or signal-to-noise ratio in fringe areas.

The diagram shows the rerouting of the contrast-control lead and the modification of the heater circuit.

Beat interference (black horizontal streaks) on channel 7. Eighth harmonic (175.2 mc.) of sound i.f. (21.9 mc.) beating against video carrier (175.25 mc.) of channel 7 to produce a 50-kc beat. Remedy: Remove filament connection between 6T8 first sound amplifier and 6AQ5 second sound amplifier. Reconnect filament of 6AQ5 to filament tie-point of Inductuner (located near chassis front end, between band switch and contrast control). Connect a 5,000-$\mu\mu$f capacitor between 6T8 filament (pin 4) and ground. Note: Beat can also be eliminated by shifting i.f. from 21.9 to 21.75 mc.

Bright flashes on screen when tuning (most evident on high channels). Noisy Inputuner. Remedy: Lubricate with Lubriplate No. 105 (available from distributor of manufacturer). Apply only to contact rings of Inputuner.

RA–112A, –113, –117

Improving picture strength in weak-signal areas. In some weak-signal areas it is impossible to obtain a satisfactory picture, even with a very good antenna system. By narrowing the bandwidth and increasing the gain of the video amplifier in these models, it is often possible to obtain a satisfactory picture where one could not be obtained previously. The original circuit is shown

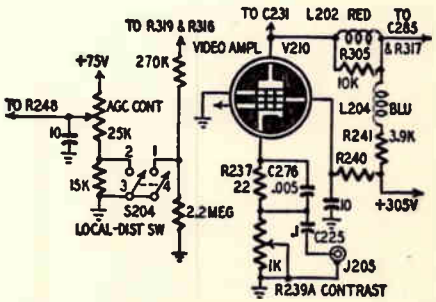

Fig. 21. Video amplifier in RA-112A, -113, -117 receivers.

in Fig. 21, modified circuit in Fig. 22 and component location after modification in Fig. 23. The LOCAL-DISTANCE

switch is rewired so as to obtain normal bandwidth and resolution on strong

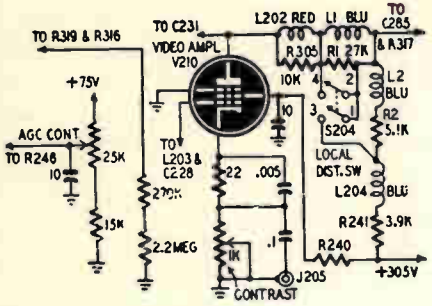

Fig. 22. Modification for picture improvement in fringe areas.

signals. Make the following changes:

1. Remove the black lead which runs from ground to terminals 3 and 4 of the LOCAL-DISTANCE switch S204.

2. Remove the orange lead between terminal 2 of S204 and the a.g.c. control.

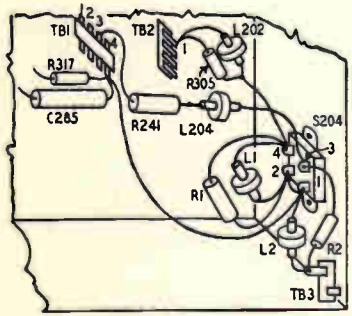

Fig. 23. Revised video amplifier layout.

3. Disconnect L202, R305, and L204 from the junction of R317 and C285.

4. Connect the free ends of L202 and R305 together and connect to terminal 4 of S204.

5. Connect R1 (27,000 ohms, ½ watt, 10%) and L1 (peaking coil, part No. 21 006 627) in parallel between terminals 2 and 4 of S204.

6. Disconnect the junction of L204 and R241 from the terminal strip.

7. Connect L204 between the free end of R241 and terminal 3 of S204.

8. Mount a single-terminal tie-point in the corner of the chassis nearest S204.

9. Connect switch terminals 1 and 2 together and to the junction of C285 and R317.

10. Connect R2 (5,100 ohms, 2 watts, 5%) and peaking coil L2 (part No. 21 006 627) to the tie-point added in step 8.

11. Connect the free ends of R2 and L2 to terminals 3 and 1 respectively of S204.

12. Dress all components and leads for minimum capacitance.

The LOCAL-DISTANCE switch should be placed in the LOCAL position when receiving strong stations.

RA–113

No high voltage. If a set of this model comes in with no high voltage, turn on the set and remove the damper tube (6W4-GT) from its socket. If the raster appears with heavy foldover on it, the trouble can be traced to a leaky capacitor (C291) in the boosted-voltage circuit. Replace this with a .02-μf, 600-volt capacitor to prevent future breakdown of this component.

All models

Flashing on the screen. The cover of the yoke connector intermittently contacts the focus-coil case. While both are grounded, there is enough potential difference between them to cause this

difficulty. The cure is to redress the yoke cable.

Snow. Sometimes a picture will get snowy after the set has been operating several hours. Check all tubes and components in the video i.f. strip and video amplifier. If all components check good, open up the Inputuner and check the 10,000-ohm resistor in the plate circuit of the 6J6 r.f. amplifier. This resistor sometimes increases to several times its original value, thus reducing the gain of the amplifier.

This trouble originating in the front end can sometimes be detected by the fact that the low channels are snowy and the high channels come through with fairly good signal strength. This effect is probably caused by the higher frequencies being bypassed around the r.f. circuit by the stray wiring capacitance and interelectrode capacitance of the 6J6.

RA–112A, RA–113, RA–117A, RA–120A

Picture overloads on strong signal. If picture is unstable, and a.g.c. control has little effect, test C237, .05-μf capacitor in a.g.c. voltage divider circuit. This capacitor may be leaky. If so, replace.

Heavy raster foldover on right side. C249, 270-$\mu\mu$f coupling capacitor to grid of V215 may be leaky. Replace.

RA–119A

Alternate white and dark horizontal bars in picture. The bars are approximately $\frac{1}{4}$-inch wide. The bars can be caused by a microphonic 6AU5, vertical deflection amplifier tube. Check by substitution.

600, 639

Insufficient picture size. Defect in low-voltage supply (check for open or

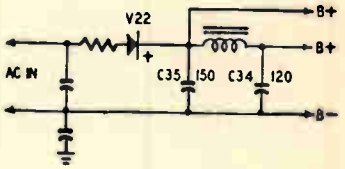

Fig. 24. Low-voltage power supply circuit.

decreased value in filter capacitors C34 (120 μf) and C35 (150 μf).

Hum. Audio hum is usually caused by misalignment of the sound trap in the second video amplifier circuit. Adjust this trap to remedy the trouble.

609

Loss of brilliance (areas of severe dust accumulation). Dirt in projector unit. To clean mirrors, remove one side panel of projection unit. Do not wipe dust; remove with camel's-hair brush and polish with soft lens tissue. Use cleaning spray if discoloration is excessive. Clean top of corrector lens with soft lint-free cloth or tissue. Do not use alcohol or other solvents which might damage or loosen the lens cement.

No high voltage. Defective 6SR7 high-voltage oscillator. Defective 6BG6-G. Shorted h.v. capacitors .005 or .0025 μf. Defective EY51 high-voltage rectifiers. (The h.v. power transformer, filter capacitors and EY51 tubes are in a sealed can. A defective unit requires replacement of the entire can).

Emerson

614D, 637A; chassis 120095B

Reduction of buzz. To reduce buzz, change capacitor C15 to 220 $\mu\mu$f from 1500 $\mu\mu$f. This is the cathode bypass capacitor of the sound mixer 12AT7 (V4). This change was made in later production.

614D, 637A, 650D, 654D, 655B, 650F, 654F, 655F; chassis 120095B, 120123B, 120138B

Improved receiver performance. Performance can frequently be improved if the 25.75 mc picture i.f. marker, and the 22.5 mc i.f. bandpass marker appear at the 50% response point instead of the 75% down point. When modified the over-all i.f. response curve should appear as shown in the illustration.

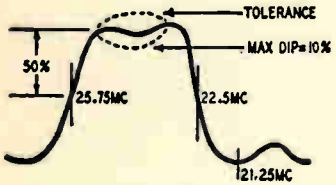

Fig. 25. Over-all i.f. response curve.

With 10 mc sweep width, the output from the sweep generator should be adjusted to produce about 0.5 volts d.c. across the detector load (R39, 4700 ohms). The above is particularly helpful when other expedients fail to minimize effects caused by station modulation variations. Note that the maximum dip in the response curve, as shown in the illustration above, should not exceed 10%.

The frequency of 21.25 mc shown on the curve is the sound i.f.

629D, 651D, 658B, using chassis 120124B

To improve sync stablity for fringe-area performance.

1. Chassis having no Triangle code or coded with Triangle 1 have an 18-$\mu\mu$f, 6,000-volt capacitor, C91, connected between the 6BG6-G plate tap on the horizontal output transformer and chassis. Remove this capacitor from the circuit.

2. Chassis coded with Triangle 1A have this same capacitor connected between the horizontal output tap feeding the deflection yoke (also connects to pin 3 of 6W4-GT and chassis). Remove this capacitor from the circuit.

3. In any of the above models, especially those chassis with no Triangle code or Triangle 1 code, connect the shield of the high-voltage lead at the end closest to the picture tube to the chassis (not the tuner chassis) by means of a short piece of grounding braid. Caution should be taken so as not to damage the polystyrene insulation.

637D; chassis 120095

Bright noise streaks. Models coded Triangle 1 have this circuit change incorporated:

The 22-ohm resistor connected between tuner frame and B minus has been removed and replaced with a jumper wire.

644D, 650D, 655B using chassis 120123B

Reduction of stray audio pickup:

1. Connect a 0.1-μf 200-volt capacitor between the junction of R68, center

tap of R92 (vertical linearity) and B neutral. R68 is one megohm and is connected to the slide arm of the vertical linearity control.

2. Add a 0.25-μf capacitor from B neutral to chassis.

These changes can also be incorporated in models 614D, 637A, chassis 120095B.

Model 649, projection consolette, chassis 120094A

60-cycle buzz. In the event that there is a considerable 60-cycle buzz present even at low settings of the volume control, take these precautions:

1. Dress all leads to the kinescope socket as far from the 6T8 tube as possible. This can be done by securing the green grid lead wire to the side of the cabinet.

2. Properly set the fine-tuning control for best picture (this should be the point of minimum buzz). If the buzz is still at an annoying level, the sound, or possibly the video i.f.'s and sound traps, may have to be realigned.

No picture, sound O.K. Before removing the chassis or testing the tubes, check the 3NP4 projection tube for an open heater. In one instance, an arcing sound heard in the Protelgram power supply unit indicated an open load circuit.

Be sure to discharge the anode before handling the 3NP4 or you may be in for the shock of your life.

650, 654; chassis 120118B

Loss of horizontal sync. If the picture falls out of horizontal sync and the procedure for this alignment as outlined in the service manual fails, then one of the following procedures will very often remedy the trouble.

1. Replace horizontal oscillator and control tube (V13, 12SN7-GT).

2. Replace C47, .002 μf, 400-volt capacitor with a 600-volt capacitor of the same value (usually causes a constant and gradual shift of frequency slug adjustment until slug will not make the range). One side of C47 is connected to pin 1, control grid of the 12SN7-GT horizontal oscillator, V13.

3. Replace T7 horizontal oscillator and phasing coils (usually shows up as bad arcing in raster, small irregular raster).

If the picture is out of sync both horizontally and vertically, but can be synchronized manually for short periods of time, the trouble is very likely due to a defect in the sync amplifiers or clipper stages. The above information can also be applied to any Emerson chassis using this method of horizontal a.f.c.

650D, 654D, 655B; chassis 120123B.

To increase sound output. Models coded with Triangle 1 require the following changes:

R24, 470,000-ohm plate-load resistor of the 6S8-GT, is disconnected from the 125-volt B-plus point and connected to the 265-volt B-plus line. This will increase the audio output since it will put the plate of the 6S8-GT at a higher potential. This change can also be made on models 614D and 637A, chassis 120095B. It is not necessary to use a higher wattage resistor.

Emerson

Models 651C, 651D, 658B, 658C using 120124 chassis.

To eliminate interference to AM receivers. Make the following changes:

1. Add a .05-μf, 400-volt capacitor from line switch side of a.c. input plug.
2. Add a 100,000-ohm, 1-watt resistor in parallel with above capacitor.

661, 667, and 668 using chassis 120134B

To eliminate horizontal-sweep pickup in the video amplifier. Change the contrast control wiring:

1. Wire the lead from cathode of video amplifier, 6AC7, V11, pin 5, to the outside lug on the contrast control.
2. Connect the B-minus 155-volt lead in series with a 10-ohm, $\frac{1}{2}$-watt resistor to the rotor lug on the contrast control. Bypass to chassis with a 0.25-μf, 400-volt capacitor.

Sets coded Triangle 6 have these changes.

To improve sync stability in extreme fringe areas. Make the following circuit modifications. The complete change should alter the schematic as shown below.

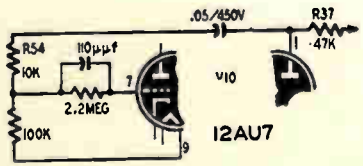

Fig. 26. Improved sync in fringe areas.

1. Change R37 from 10,000 ohms to 47,000 ohms.
2. Remove R56, 3.3 megohms.
3. Remove C55 (220 $\mu\mu$f), R55 (330,000 ohms) and C56 (.01 μf).
4. Add a 2.2-meg resistor in parallel with a 110-$\mu\mu$f capacitor between pin 7 of V10 and R54 (old junction of C55 and R55).
5. Add a .05-μf, 450-volt capacitor between pin 1 of V10 and R54 (10,000 ohms).
6. Add a 100,000-ohm, $\frac{1}{2}$-watt resistor from pin 9 of V10 to junction of R54, the 2.2 meg resistor, and the 110-$\mu\mu$f capacitor. Sets coded Triangle 5 have this modification.

Models 662B, 663B; chassis 120127B, 120128B

Neck shadow—right-hand side of picture. Sometimes it is not possible to center the picture properly without a resultant shadow on the right-hand side of the picture tube (facing the front of the set). If proper adjustment of the beam bender (maximum brightness) focus coil, and deflection yoke (push yoke towards front of picture tube, making sure front of coil rests against kinescope) does not eliminate the shadow:

1. Reverse the electrical connections to the focus coil, making sure the kinescope neck is properly centered in the deflection yoke and focus coil.
2. If step 1 does not eliminate this shadow, then magnetize the molded iron core in the deflection yoke by the following method:

a. Remove the 6BG6-G, the 1B3-GT and the 6W4-GT from their sockets.

b. Remove the white lead from the horizontal deflection yoke at the width coil and connect to B-plus

230-volt point (red lead on electrolytic).

c. Connect the negative terminal of a spare 40-μf, 450-volt electrolytic capacitor to chassis.

d. With the set operating, *momentarily* touch the positive side of this electrolytic to pin 3 of the 6W4-GT damper-tube socket.

e. Discharge and then remove the 40-μf, 450-volt electrolytic from set.

f. Replace tubes and reconnect yoke lead. If shadow persists, repeat this procedure. In extremely stubborn cases, the fault might lie in the kinescope or deflection yoke. Exchanging either of these components will then eliminate the trouble.

Model 664B, chassis 120133P

Unstable horizontal sync. If the horizontal sync is unstable and cannot be corrected by changing the sync amplifier and horizontal oscillator tubes, check the plate voltage at pin 5 of the horizontal oscillator tube. If the voltage is incorrect, check the 150,000-ohm resistor R78 in the plate circuit. This resistor sometimes increases to 200,000 ohms or more. Replacing it with a resistor of the correct value restores the set to perfect operation.

Model 666B using chassis 120135B, 120135G, 120135H

Improved sync stability in fringe areas. Chassis incorporating this change are coded Triangle B for chassis 120135B and Triangle A for chassis 120135G and H.

1. Remove R58, 10,000-ohm, ½-watt resistor, plate load for the 12AU7 sync separator, connected to pin 6.

2. Connect a 4,700-ohm, ½-watt resistor in series with a 2,200-ohm, ½-watt resistor in place of R58.

3. Remove pigtail of C57, .05 μf, which went to pin 6 of the same tube and connect to the junction of the 4,700-ohm and 2,200-ohm resistors.

The following changes were added to further improve the sync stability. Chassis incorporating this addition are coded Triangle C for chassis 120135B, and Triangle B for chassis 120135G and H.

1. Change R61 from 220 ohms to 330 ohms, ½ watt. R61, in series with R63, a 2,200-ohm resistor, is connected to the plate, pin 6, of the 12AU7 sync output-amplifier tube.

To improve sync stability in fringe areas. Chassis already incorporating this change have the capital letter E stamped inside the code triangle.

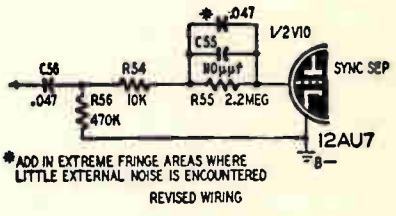

Fig. 27. Modification to improve sync stability

1. Change R56 from 100,000 ohms, to 470,000 ohms, ½ watt, repositioning pigtail from junction of R54 (10,000 ohms), R55 (2.2 meg), C55 (110 $\mu\mu$f) to junction of C56 (.047 μf) and R54 following the illustration.

Vertical foldover. Change R77 from 10,000 ohms, ½ watt, to 12,000 ohms,

½ watt, to prevent vertical foldover. R77 is part of the vertical oscillator discharge circuit. Sets with the letter V at the right-hand side of the coded triangle number have this change.

To improve positioning of vertical sync control. Change R71, 470,000 ohms, ½ watt, to 680,000 ohms, ½ watt, so that vertical synchronization will occur toward the mechanical center position of the vertical hold control. R71 is connected to the control grid, pin 1, of the 6SN7-GT vertical oscillator and discharge tube. Sets marked Triangle A, chassis 120135B, and Triangle 9, chassis 120135G, have this change.

Models 676B, 680B, 681B, 687D, using chassis 120140B, 120140H, 120140G

To reduce excessive vertical size. Sets coded Triangle C have the following changes incorporated to reduce excessive vertical size, especially in areas of high line-voltage conditions.

1. R75 has been changed from 220,000 ohms to 150,000 ohms, ½ watt.
2. R76 has been changed from 150,000 ohms to 220,000 ohms, ½ watt.

R75 and R76 are both connected to the center arm of the vertical size control. This change is merely an exchange of two resistors, therefore no new parts are needed.

676F, 681F, 686F, 687F, 696F, using chassis 120143B, 120143H

Improved performance, especially in fringe areas. These changes have been made to improve performance, by using the following modified a.g.c. system with tuner delay. Sets incorporating this change are coded with a Triangle A.

1. Remove R15 (22,000 ohms, ½ watt) from pins 1 and 2 of V4 (6AL5) replacing it with a jumper wire.
2. Remove R16, 100,000 ohms, connected from pin 7 of V4 to chassis.
3. Remove pigtail of R2 (470 ohms) from lug on terminal board and reconnect to empty lug on same terminal strip.
4. Add a white jumper wire from new position of R2 to the empty lug on the terminal board near sound-output transformer.
5. Add a 1-meg, ½-watt resistor from this empty lug near audio output transformer to pin 1 of V4.
6. Add a 0.25-μf, 400-volt capacitor from above point on terminal strip to chassis.
7. Remove pigtail of C10 (25 μμf) from pin 1 of V4 and connect to pin 7 of V4.
8. Add a 1 meg, ½-watt resistor from pin 1 to pin 7 of V4 (6AL5).
9. Remove all ground connections from pin 5 of V8, connecting center shield pin to pin 6 if not already there.
10. Connect a white jumper lead from pin 5 of V8 to junction of R5 (470 ohms) R11 (1 meg) C4 (0.25 μf) on terminal board near the audio output transformer.
11. Connect 10 meg, ½-watt resistor from above junction on terminal board to pin 6 of V6.

Note: Due to a.g.c. change (Triangle A), the resistance measurements shown at the top of page 51 will change appreciably:

V4, pin 1, 4,700 ohms, pin 7, 900,000 ohms.

V8, pin 5, changed to 1.8 megohms.

Transformerless models

Distorted, narrow picture. This set was one of the transformerless Emerson models which uses a number of selenium rectifiers in the power-supply circuit. It worked O.K. with the exception that the picture was distorted and too narrow. The defect seemed to be in the horizontal output stage. Replacing tubes, checking voltages and resistances, and a thorough visual examination showed nothing wrong. We tried a new deflection yoke and a substitute low-voltage supply without success. Finally we replaced the horizontal output transformer. The set worked perfectly. Apparently, a few turns had shorted out in the secondary of the transformer. This trouble can occur in most TV sets, so if you have the same symptoms and everything checks O.K., try a new horizontal output transformer.

Incidentally, if you are not familiar with the voltage-multiplier circuits used in transformerless TV sets, voltage checks will produce some surprising figures. Always use the service manual when there is any doubt.

Chassis 120109, 120120

High-voltage resistor replacement. The high-voltage resistor (two megohms) is R30 in the 120109 chassis, R46 in the 120120 chassis. When replacement of the resistor in the high-voltage supply becomes necessary, a 680,000-ohm, 2-watt Allen Bradley resistor should be placed in series with the new 2-megohm resistor. The method of mounting is shown in the diagram. The junction of the two resistors should be looped and a large blob of solder used to cover any points or sharp bends. This precaution

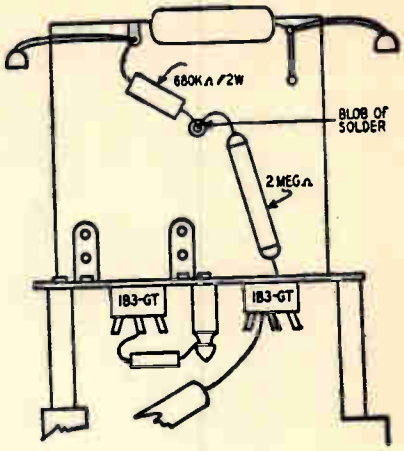

Fig. 28. Replacement of high-voltage resistor.

prevents ionization of the air and arcing.

Chassis 120134G

Poor picture and sound tracking in fringe areas. Due to the additional selectivity provided by the continuous type tuner, it has been found that the

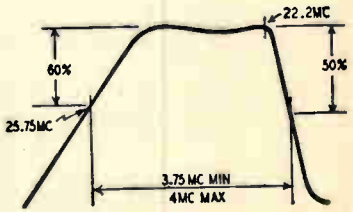

Fig. 29. Modified i.f. curve for fringe reception.

required amount of trap action is sometimes exceeded for good fringe-area sound and picture coincidence. To reduce this trap action where this condition is encountered, place a .01-μf

capacitor across the 21.25-mc sound trap (C5 of T1). If the picture and sound coincidence is still in need of improvement, then the over-all i.f. will have to be realigned to a minimum of 3.75 mc as shown in the illustration at the bottom of page 51.

Models 686L, 687L, 696L, using chassis 120142B

Power transformer protection. Sets coded Triangle G have the following changes incorporated to give added protection to the power transformer in case of rectifier tube failure. This change consists of removing the pigtail of R55, 8.5 ohms, from the chassis, and inserting a ½-amp, 250-volt fuse in series with it. This change can be accomplished by performing these steps.

1. Replace ½-amp fuse with a jumper wire. This fuse is located on the underside of the chassis between the tuner and the high-voltage tubes.

2. Move one end of R55, 8.5 ohms, 5 watts, from chassis and connect to empty lug on terminal strip near power transformer.

3. Add an insulated jumper wire from this point to empty lug on terminal strip mounted on topside of chassis under the deflection yoke. Use hole in chassis between yoke mounting brackets.

4. Add a ½-amp, 250-volt fuse, from this lug under deflection yoke to chassis.

Model 699B, using chassis 120148B

Increased bandwidth. Sets with suffix #1 in code triangle have an added 82-$\mu\mu$f capacitor across T1 primary to increase first i.f. stage bandwidth.

Freed

Models 54, 55, 56, 68, 101, 103, 104; chassis 1620A, 1620B, 1620C, 1900, 1916

Poor horizontal sync lock. Phasing ghost appears in the picture and causes critical horizontal hold. Check 6AC7, 6AL5, and 6K6 tubes in the horizontal circuit. Increase the 5,000-ohm plate-load resistor in the 6K6 horizontal oscillator tube to 10,000 ohms. As an alternative to increasing the 5,000-ohm plate load resistor, replace the plate-load resistor of the last sync amplifier with an 1,800-ohm and a 3,300-ohm resistor connected in series. Solder the 3,300-ohm resistor to the sync-amplifier plate. Remove the 82-$\mu\mu$f capacitor that feeds the sync pulse to the horizontal sync transformer from the sync amplifier plate and connect it to the junction of the two resistors.

Insufficient sensitivity. To increase the sensitivity of the 1620A and 1620B chassis, remove the a.g.c. voltage from the tuner. Do this by disconnecting the front-end a.g.c. lead from the circuit and grounding the lead. You can obtain further gain in sensitivity by changing the 6AG5 tube in the tuner to a 6BC5. Also change the 5Y3 to a 5V4 and realign the set. Be careful that the circuit does not go into oscillation. If it does, do not make all of these changes.

Chassis 1620C, 1900, 1916—Keyed a.g.c. models

Trouble in a.g.c. Indicated by no video when antenna is connected. If the antenna is disconnected and a short

piece of wire is used for an antenna, weak video will be observed. Check the width or a.g.c. coil.

Poor vertical sync (in 1620 chassis). Check the values of the two 4,700-ohm resistors in the plate circuit of the 6SK7 clipper tube.

1900 chassis

Poor focus. If the focus control does not go through the focus position, add a 2-watt, 1,500-ohm resistor across the resistor connected from the focus control to ground.

High-voltage fading. Check the screen resistor of the 6CD6-GT horizontal output tube. This resistor changes value. It should be 22,000 ohms. Use a one-watt resistor. Two 47,000-ohm, ½-watt resistors in parallel, are satisfactory.

Rapid high-voltage collapse. Check the yoke (horizontal deflection winding).

Neck shadow and poor centering. This can be due to a magnetized cathode-ray tube. Rotate tube about 180 degrees. If difficulty is experienced in eliminating neck shadow, remove the two rubber bushings on the deflection yoke assembly and recenter the picture. Move deflection yoke as far forward toward flange of tube as possible. Adjust ion trap for maximum brilliance, reposition focus coil. If shadow still persists, try another cathode-ray tube, since shadow may not be due to magnetization of the tube. If neck shadow disappears with substitution, refer to pages 34, 48, for details on removal of neck shadow using original picture tube.

16-inch and 19-inch sets

Vertical sync buzz. Reduce the loud, 60-cycle sync buzz audible in the speaker by connecting a .03-μf, 400-volt capacitor from the plate of the vertical oscillator tube to ground. Retouch the vertical linearity and size controls for proper height.

Horizontal oscillator damping lines on left side of picture. Check the .05-μf and .033-μf capacitors off the horizontal linearity coil. Replace the deflection yoke. Check the flyback transformer.

Chassis 1620A, B, C

Horizontal pull. Weave or bend in picture. Add another .004-μf capacitor in parallel with present one off pin 1 of 6AL5, horizontal sync discriminator tube. Change value of capacitor connected between the above .004-μf capacitor and ground from .05 μf to .01 μf. In the 1620 chassis not using keyed a.g.c. connect a 4-μf capacitor from the a.g.c. bus to ground (pin 3 of the 6T8).

All models

Corona. Check the lug attachment to the 500-$\mu\mu$f high-voltage capacitor in the 1B3-GT circuit. Round the points on the lug with a drop of solder. Sometimes simply by bending the lug the corona disappears. Re-dress the high-voltage lead. Adjust the horizontal peaking control. The use of a commercially available plastic spray will help.

Corona can also be due to defective high-voltage socket. Replace.

General Electric

10T1, 10T4, 10T5, 10T6, 10C101, 10C102, 12C101, 12C102, 12C105

No sound, no raster. Lack of high and low voltage as indicated by lack of sound and raster is probably caused by an open circuit in the 4.6-ohm current limiting resistor in series with the selenium rectifiers in the low-voltage supply. Use a factory replacement (catalog number RRW-048).

12T3

Intermittent raster. All voltages, socket connections, and tube heaters were

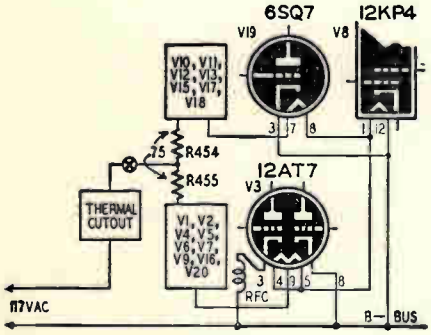

Fig. 30. Intermittent raster test points.

checked for intermittents without finding the trouble. The trouble was traced to an intermittent heater-to-cathode short in the 6SQ7, which short-circuited the heater of the picture tube.

This same condition can be caused by a short between heater and cathode of the 12AT7 in the front end. The same trouble can occur in the 12T4, 12C107, 12C108, and in other models having similar series-parallel heater strings. The diagram shows how the heater of the picture tube can be shorted out by a heater-to-cathode short in the 6SQ7 or 12AT7.

10T– and 12T– series

Failure of 4.5-mc i.f. transformer. Due to faulty lead dress inside the transformer shield in areas of high humidity. Although the leads and winding are insulated, electrolysis takes place under conditions of high humidity, eventually causing a breakdown between the primary winding and the secondary lead. When making a replacement, remove the shield from the replacement transformer, and check secondary lead dress to make certain that these leads do not touch the primary winding.

10T, 12T, and 12K models

Oscillation of horizontal sweep output stage. When the receiver operates satisfactorily until the horizontal sync is momentarily disrupted (switching to another channel), but still cannot be brought back into sync by adjustment of either the front or rear-panel horizontal hold controls, it may be the result of oscillation of the horizontal sweep output stage. The set may usually be re-synchronized by turning off the power switch for an instant. This condition is further confirmed by removing the horizontal oscillator tube for an instant; then if sweep and high voltage still exist, the trouble is definitely established.

This results from a partial voltage breakdown within the 6-$\mu\mu$f capacitor C330 (C369) which, because of its peculiar construction causes the ca-

pacitance to rise to over 200 $\mu\mu$f. (C330 is connected to the width control.) At this high capacitance value, the horizontal output stage oscillates and if a sawtooth is supplied to the grid, the output tube will operate as a controlled oscillator. However, after control is lost it will oscillate at its own frequency, resulting in horizontal oscillation. It is recommended that the voltage rating of the replacement capacitor be changed to 1,500 volts. Use a 6-$\mu\mu$f, 1,500-volt mica.

12T3, 12T4

Audio buzz. (on weak signals or with set adjusted for best picture on low contrast). Caused by 41.25-mc trap in second video i.f. Try shunting trap and tuning capacitor C281 with a 5,100-ohm resistor. (Later models eliminated trap entirely.)

12T7

Excessive contrast. Excessive contrast which cannot be reduced to normal with the picture control is probably caused by a shorted capacitor between the first and second sections of the sync amplifier and clipper stage. This is a .01-μf capacitor connected to pin 1 of the 6SL7-GT. If it opens, the horizontal and vertical sync circuits will fail.

Excessive contrast and a shaky picture will result if the 220-$\mu\mu$f capacitor at pin 5 of the 6SL7-GT is open. If the .02-μf capacitor at pin 4 of the 6SL7-GT is open, bright lines will appear at the top and bottom of the picture.

Excessive contrast is also discussed on page 92.

14C, 14T, 16C, 16K, 16T models

Screen blanked at top of picture. Capacitor C311 produces a rather peculiar effect under high-leakage conditions. Leakage in the order of several megohms results in the screen becoming partially blanked at the top of the picture. As the leakage resistance decreases, more and more of the screen blanks out until finally for leakage values below 1 megohm all of the picture is blanked out. In most cases there is no complete breakdown of the component, but a leakage with characteristics as described above. C311, .01 μf, connects to the control grid, pin 1, of the 12SN7-GT (V9) vertical sweep generator.

14C, 14T, 16C, 16T

Voltage-sensitive "globar" resistor. This resistor, used in the screen circuit in receivers having a type 25BQ6-GT horizontal sweep output tube, is difficult to test with an ohmmeter since its resistance varies greatly according to the voltage applied. Under ordinary no-voltage resistance test, it measures several megohms; while operating in the 25BQ6-GT circuit at 140 volts, its apparent resistance is 10,500 ohms. This resistance is best measured indirectly by measuring the current through the resistor and the voltage drop across it, and then calculating the operating resistance by means of Ohm's law (R=E/I).

14T and 16T models

Curl at the top of picture. Some receivers have shown a small displacement (to the right) of the first few horizontal

scan lines which shows up as a slight curl at the top of the picture. This trouble is caused by a delay in recovery of the horizontal a.f.c. circuit after the occurrence of each vertical sync pulse, and is corrected by feeding a correction voltage of proper magnitude and phase into the a.f.c. circuit to compensate for this deficiency. The circuit revision is shown in the sketch and the procedure is as follows:

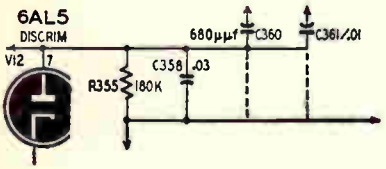

Fig. 31. Circuit revision to remove curl at the top of the picture.

1. Disconnect capacitors C360 and C361 from B-minus and reconnect them to the junction of R355, C358, and the plate (pin 7) of V12, the 6AL5 discriminator.

2. Change the value of C358 from .02 μf to .03 μf.

14T2–T3, 16T3–T4, 16T5–T6

Excessive plate current in sweep-output tube. Failure of the sweep generator or a component which results in a loss of drive voltage on the grid of the sweep-output tube results in excessive plate current in the 25BQ6-GT tube. In some cases, the tube heats enough to cause the plate-cap solder to melt so that it cannot be removed from the tube. To forestall this condition, add a 39-ohm resistor to the cathode circuit as follows:

Remove the yellow wire which connects pin 8 of the sweep-output tube to the B-minus bus. In its place add a 39-ohm, 1-watt resistor. Dress leads away from this resistor so that heat dissipation will not affect adjacent components. This change is incorporated in later production.

800

Modification for automatic black-level d.c. restoration. This receiver and

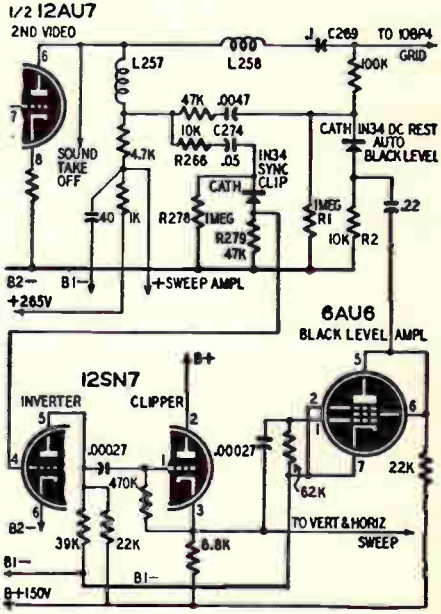

Fig. 32. Modification of circuit to obtain automatic black-level d.c. restoration.

similar models can be modified for automatic black-level d.c. restoration by removing the 6AL5 and rewiring its socket for the 6AU6 black-level amplifier as shown in the illustration. 1N34 germanium crystals replace the detector and sync-clipper diodes. A third

1N34 is installed in place of the 6AL5 as the black-level d.c. restorer.

The 6AU6 amplifies the negative sync pulses to a level higher than those appearing in the video output. These amplified pulses are applied to the anode of the d.c. restorer diode and cause it to detect at the black level or pedestal rather than at the sync tips as in the more conventional circuits. The voltage developed across R1 is a function of pedestal height and not the sync tips. It may be necessary to juggle the value of R2 until you get optimum performance.

800, 805, similar models

Sound bars in picture. Open or decreased capacitance in 5,000-μf capacitor between one end of focus coil and B-minus.

Alternate light and dark bars, accompanied by foldover. Open 150-μf filter capacitor C373, causing reduction of B-plus voltage to horizontal output and damper tubes.

White vertical bar in center of screen, wide black vertical bar on either side. Open in horizontal deflection coils (plate side of damper tube).

Raster normal for several seconds, narrows to vertical line, then blanks out. Open 6BG6-G grid resistor.

801

To increase width. The maximum available width on G-E 801 receivers can be increased by 1 inch when you replace the 5Y3-G (V23) rectifier with a 5V4-G and add an extra 30-μf capacitor in parallel with the 30-μf filter capacitor C63.

801, 802, 803

Picture distortion. The picture may distort when either the brightness or contrast control is advanced after installing a ceramic horizontal output transformer. This trouble occurs when the lead between pins 2 and 5 of the damper tube and terminal 4 of the transformer is too close to the lead between terminal 5 of the transformer and the *blue* side of the width coil. Dressing the lead from terminal 4 along the top of the chassis eliminates the trouble.

810

Horizontal stretching of left side of picture, slight foldover. Change in value of 0.1-μf capacitor C55 in damping-tube cathode circuit.

Light vertical lines. Change in value of 47-$\mu\mu$f capacitor C56 in series with damping tube plate and horizontal deflection coils. Deflection yoke defective (check by substitution).

White vertical bar. A white vertical bar, shaped like a half moon and approximately 1 inch wide, appeared on the screen after the set had operated normally for 15 or 20 minutes. After the shadow appeared, plate and screen voltages on the 6BG6-G were low and anode voltage dropped to 3,000. The blue fluorescence disappeared from the 6BG6-G at the moment that the voltages dropped. The trouble cleared up when the horizontal output transformer was replaced. By applying heat externally to the old transformer, it was found that the primary would open when the unit approached normal operating temperature. The trans-

former cooled so rapidly that the high-resistance open circuit could not be detected.

817, 821

Insufficient width, accompanied by black horizontal bars and decrease in brightness. Shorted 0.47-μf bypass capacitor C324 in series with horizontal deflection coils. (C324 is paralleled with a 1,200-ohm resistor.)

Faint white vertical line in center of picture. Incorrect adjustment of horizontal linearity control. (This can also cause interference to broadcast sets.)

817, 825

Excessive brightness on left side of screen, suggesting form of foldover. (Left side stretched, faint white lines across rest of picture.) Defective 5V4-G damper.

835, similar models

Sound modulation of oscillator tube. Caused by feed-back or mechanical vibration from speaker. Remedy: Shock-mount speaker on rubber grommets or spacers.

Also place lead shield over tube. Tube may have to be changed.

Crystal detector replacement. To remove video detector crystals quickly, bend out the two retainer tabs at the bottom of detector shield can, remove the two nuts which hold the can to the chassis, and remove the can to expose the crystal. The connections soldered under the can do not need to be disturbed.

17T1, 17T2, 17T3, 17C103, 17C104, 17C105, 17C107, 17C108, 17C109

Horizontal bars in picture. Adjacent channel sound or microphonics in receiver. If adjacent channel sound is responsible, readjust adjacent channel traps L227, L253. Adjust cores of traps for minimum output at 47.25 mc. Microphonic video amplifier tube, V7, can also be the cause.

Wavy left or white edges of picture (hum). Check V11, V12, V13 for filament to cathode leakage. V11, 6SL7-GT is the sync amplifier, clipper, V12 is the 6AL5 discriminator, and V13 is the 12SN7-GT, a.f.c., horizontal oscillator. Check C379, 10-μf electrolytic.

Dim picture, poor horizontal linearity, insufficient width and height. Open or low capacity of C377. C377, 0.5 μf, is connected to pin 6, horizontal output transformer.

No vertical sync, vertical hold has no effect, insufficient height. Shorted C306. C306, 0.1 μf, is connected to pin 6, cathode, V9, 12SN7-GT, vertical sweep generator. Check for shorted R305, 125,000-ohm vertical hold control.

Wiggles in picture background, trailing whites on picture, sound normal. Misalignment of r.f., i.f. amplifiers.

Bright picture with black lines. A shorted capacitor, C275, will give a very bright picture with black lines across the picture. Picture control ineffective. C275, 0.1 μf, is the coupling capacitor between the plate, pin 6, of final video amplifier, and the control grid, pin 2, of picture tube.

Hallicrafters

T-54

Failure of sound and video. Failure of sound and video circuits is sometimes caused by a short in the .02-μf capacitor between ground and the plate of the 25L6-GT audio output tube. The short-circuit reduces the plate voltages to the point where the video circuits are inoperative. Replace this capacitor with a .02-μf, 600-volt unit.

Inadequate sensitivity. To improve the sensitivity of this set, remove the 10,000-ohm resistor between the plate and screen grid of the 6AG5 r.f. amplifier.

T-54 and 505

Disappearing raster. Noisy push-button tuner. When the set is first turned on, the raster forms only to disappear after filling half the screen. A sharp click is heard as the raster disappears. This action continues in cycles.

The trouble is caused by arcing between the two high-voltage leads going to the focus control. Separating the leads and covering one of them with a length of high-voltage spaghetti tubing clears up the trouble.

These sets have push-button tuners which are constructed so it is almost impossible to get directly at the contacts to clean them when they become noisy. The problem can be solved by turning the chassis on one end and using an atomizer to spray front and rear of the contacts with Contactene or carbontet. Work each button vigorously as you come to it. Allow the switch assembly to dry thoroughly before aligning the front end.

T-54, -505, -506

No picture (raster and sound O.K.). Defective 6C4 oscillator tube.

Insufficient width, width control ineffective. Open 47,000-ohm plate resistors in 12SN7-GT horizontal amplifier. (See illustration above.)

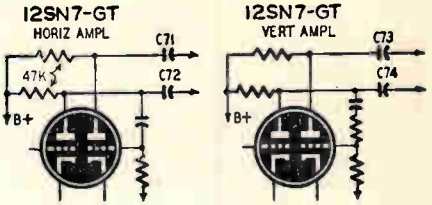

Fig. 33. Horizontal and vertical amplifier circuits.

T-67

Intermittent picture, variation in intensity. Arcing at base of 1B3-GT or picture tube. Intermittent contact between filament leads and base pins of 1B3-GT. Check for evidence of arcing; resolder base pins, socket connections.

T-505

Picture deflected toward upper right of screen (vertical or horizontal centering controls ineffective). Leaky .05-μf, 6-kv coupling capacitor C73 (see illustration), 500-$\mu\mu$f, 6-kv capacitor C72. (A defect in one of the other deflecting capacitors may cause deflections to upper left, lower right, lower left, etc.).

No raster (sound normal). Defective 6C4 r.f. power-supply oscillator. Im-

proper setting of r.f. power-supply trimmer. Check range of capacitor where oscillator falls in and out of oscillation; adjust trimmer to its maximum capacitance within this range. This provides maximum operating stability of r.f. oscillator.

Insufficient picture height. Defective 12SN7-GT vertical oscillator or vertical amplifier. Change in value of vertical height control. Defective plate resistor R78, vertical oscillator.

Erratic picture, crackling in audio. Excessive dirt and moisture on base and socket of picture tube.

H.v. arcing. Impending failure of filter capacitor. Defective (leaky) h.v. oscillator trimmer capacitor.

Kinescopes

Cathode-heater shorts. If a resistance check between these elements shows a low-resistance short, try flashing or burning it out with a temporary application of 110 v.d.c. or other high-voltage low-current source. Typical indication of this trouble is a low-intensity, washed-out picture.

Intermittent reception of sound and picture. Caused by dirty contacts on push-button tuning assembly. Clean entire assembly with carbontet. Work contacts back and forth so that solvent gets into inaccessible spots. Use wooden-handle brush. Brushes with plastic handles will dissolve.

A combined solvent-lubricant is also commercially available. When cleaning the contacts do not bend or force any of the contact units as this may require replacement of the entire tuning assembly.

Midwest

DJ–19, DM–16, DMA–16, DR–16, DX–19, DXA–19

Insufficient width. A weak 6BG6-G tube will cause a narrow picture. Another control over width is provided by placing a .01-μf capacitor across terminals 1 and 2 of the transformer in the metal cage. Addition of this capacitor increases the width.

Insufficient height. Replace the 6BL7-GT tube, as insufficient height is very likely due to this tube.

Faulty picture centering. Considerable help in centering can be obtained by removing the focus unit and turning it 180 degrees so that the centering control stick is below center. The focus unit is held by two nuts only. Pull off the kinescope socket and ion trap and the focus unit can be easily pulled back after removing the two retaining nuts. The brass studs remain in place. To avoid conflict between the focus stick and certain types of ion traps, you can also turn the ion trap around (front to back) so that it operates with the magnet above center.

To improve low-frequency response. Change the 1,000-ohm, 1-watt resistor in the 6AQ5 video tube plate to 1,500 ohms, $\pm$ 10%, 1 watt. This will make a total of 3,000 ohms in the plate load for better low-frequency response.

Change the grid resistor of the third picture i.f. from 12,000 ohms, $\pm$ 10%, to 22,000 ohms. Revise the picture i.f. alignment frequencies:

1st stage ..... 23.4 mc
2nd stage ..... 22.2 mc
3rd stage ..... 25.3 mc

4th stage.....21.0 mc
detector .....25.5 mc

Adjust the first sound trap to slightly less than 21.25 mc to reduce the response below that frequency. This will improve the tuning characteristics.

To improve sync and sensitivity. All receivers identified by a 2 inside a triangle have had the series yoke capacitor removed from the picture-tube pedestal to the inside of the chassis. Pedestals so changed are marked with a 2 inside a square. This allows the easy revision of additional current through the horizontal yoke winding to shift the raster to the right. This change involves the addition of a 5,000-ohm, 10-watt resistor from the 215-volt point to the bottom of the yoke; this revision also improves sync and sensitivity by raising the 100-volt and 215-volt point voltages. If added sensitivity and sync are needed without shifting the raster, place the 5,000-ohm resistor from 385 volts to 215 volts. It is also advisable to change the 0.1-μf capacitor between the bottom of the yoke and 385-volt point to 0.25 μf or 0.5 μf.

Stretched pattern. Persistent and excessive stretch of the pattern on the left side can be due to the 6BG6-G and the 6W4-GT tubes. These tubes may test satisfactorily on a tube checker and still be defective in service. A defective yoke (LD-2) will also cause pattern distortion; however, this is usually characterized by a distortion of the screen pattern into a trapezoid, barrel, or pincushion effect which will also show up without any pattern on the screen. Check the horizontal-output and damper tubes by substitution.

Montgomery-Ward

Models 05BR–3034A, 05BR–3040A, 05BR–3041A, 05BR–3044A and 15BR–3053A

To improve horizontal linearity:

1. Short R95, 10-ohm resistor connected across the inner terminals of the horizontal linearity coil.

2. Change C106, .05-μf capacitor connected across the outer terminals of the horizontal-linearity coil, to a .02-μf, 600-volt capacitor. (.03-μf may be required to give enough range on linearity control in some sets).

3. Interchange the *cores* of the horizontal-linearity and horizontal-size coils.

4. Add a 0.15-μf, 600-volt capacitor in series with the low side of the horizontal deflection yoke. Some sets have a jumper between pin 1 and pin 4 of the yoke socket. On these sets, remove the jumper and connect the 0.15-μf capacitor between pin 1 and pin 4. Other sets have three red leads and a 220,000-ohm resistor attached to pin 1. On these sets remove the three red leads and the 220,000-ohm resistor from pin 1 of the yoke socket and attach to pin 4 of 6W4-GT damper tube. Pin 4 is a blank pin. Connect the 0.15-μf capacitor between pin 4 of the damper and pin 1 of the yoke socket.

5. Turn the set on and adjust the horizontal linearity coil. Then adjust the horizontal drive. Readjust horizontal size, centering, and linearity controls.

In some sets a 5,600-ohm, 3-watt resistor (R132) is connected across the 20-μf, 150-volt capacitor, C115. The

minus side of C115 is wired to pin 5 (plate) of the damper tube. The plus side of C115 is connected to terminal 1 of the flyback transformer. On these sets the horizontal linearity can be further improved:

1. Connect a 10,000-ohm, 1-watt resistor in parallel with R132. Under low line voltage conditions this may reduce picture width.

2. If width is sufficient after this change, remove C135, a 470-$\mu\mu$f capacitor, from terminal 7 of the horizontal output transformer.

Models 05GSE–3020A, B, C; 05GSE–3037A, 05GSE–3042A and 15GSE–3043A

Critical horizontal hold. Inoperative horizontal oscillator. Reports of critical horizontal hold-control action, inability to adjust horizontal hold, or inoperative horizontal oscillator in the above models have been traced to a shorted or leaking feedback coupling capacitor, C61. High-resistance leakage in C61 (see illustration for location of this component) will cause erratic horizontal hold. Lower resistance leakage, or a shorted C61, will place B-plus on R65 and R75, causing these resistors to overheat and change value. Under this condition, the phase detector circuit becomes inoperative and the horizontal oscillator cannot be controlled. This causes an overload on R68 which will also change in value. Check C61 for leakage, and R65, R68, and R75 for correct resistance, as shown on the schematic below.

Models 05WG–3030A, B, C and 05WG–3031A, B

Poor reception. When these sets are operated in low-signal-strength areas (with outside antennas), it has been found that in some instances the built-in antenna absorbs an appreciable amount of the incoming signal, even with this antenna disconnected. Remove the built-in antenna in this and other models.

Fringe-area signal improvements. To get better reception in *weak*-signal areas:

1. Disconnect a.g.c. from the tuner unit. Remove the yellow lead between terminal 9 of the tuner and the tie strip. Ground tuner terminal 9 to the chassis.

When making connections to the chassis, use an iron that will supply sufficient heat, or the result will be a cold-soldered joint. This may result in intermittent a.g.c. action.

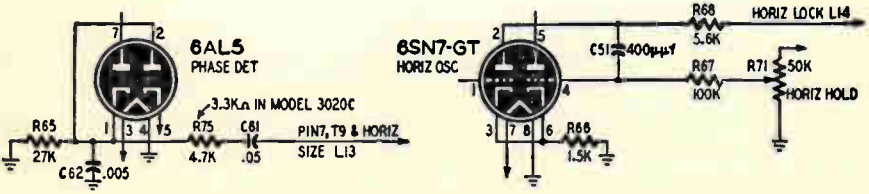

Fig. 34. Check the circuits shown above if the horizontal oscillator stops working or if the horizontal hold becomes critical. If the horizontal hold is erratic, check C61, .05 μf, by substitution.

2. Increase high-band sensitivity by removing the jumpers between the high- and low-band antenna terminals and replace with a 25-inch piece of 300-ohm line. The antenna transmission line should then be connected to the low-band terminals (lower terminal strip). Dress the loop *down* and away from the chassis. *Do not* curl it up in the cabinet or drape it over the cabinet back.

Model 15BR–3048A

Horizontal output transformer failure. Failure of this transformer is first evidenced by defocusing of the picture and excessive blooming when the brightness control is advanced to maximum. This is caused by loss of high voltage. If the set is left operating, the lower winding of the horizontal output transformer may show discoloration due to overheating. These troubles are due to solid high-voltage can covers. Scrap this cover (do not return to factory) and replace with a new, ventilated high-voltage can cover available from factory on a no-charge basis.

Model 15BR–3035A

Vertical oscillator failure. The vertical oscillator tube may stop operating after 5 to 20 minutes. This results in a horizontal white line (no vertical deflection) on the picture tube. If the set is allowed to operate, with reduced brightness, for an additional 2 to 10 minutes, the set will return to normal and will operate satisfactorily thereafter. If it does not return to normal after 15 minutes, replace the 6SN7-GT vertical oscillator tube.

Models 84HA–3010A, B, C

To improve horizontal sync. Install a 47-$\mu\mu$f ceramic capacitor between pin 2 and pin 4 of the 6SN7-GT horizontal oscillator. Change R83 in the horizontal oscillator circuit from 5,600 ohms, $\frac{1}{2}$ watt, to 6,800 ohms, 1 watt. This resistor is connected to pin 5 of the horizontal oscillator tube.

To improve horizontal linearity. Install a 20,000- to 30,000-ohm, 10-watt resistor between pin 4 (or pin 6) and pin 8 of the damper tube if a non-correctible bulge appears on left-hand side of test pattern.

To improve definition. Some sets do not have a 470-$\mu\mu$f mica capacitor in parallel with the cathode resistor for the second video amplifier. Install this capacitor if not in the set.

4.5-mc hash in picture. Reduce signal hash by installing a $1\frac{1}{2} \times 4$-inch metal shield between the discriminator transformer and the tuner chassis. Ground the discriminator coil slug. Realign the discriminator transformer after making this change.

Trapezoid effect-keystoning. Apparent deflection-yoke failure, as evidenced by reduced over-all width and trapezoid effect (keystone—with bottom width less than top). Caused by defective 47-$\mu\mu$f capacitor wired internally across one-half of the horizontal section of the yoke. This capacitor is of the uninsulated ceramic type. Incorrect lead dress may cause it to short. Replace capacitor if necessary, or re-dress leads.

Insulate replacement capacitor and leads, if necessary, to prevent shorting.

Montgomery-Ward

Models 94BR–3021A, 94BR–3024A

Premature failure of 6BQ6–GT. This is evidenced by foldover, or bright vertical line on right edge of raster, resulting in loss of 1 to 4 inches of scanning on right side of picture. Also evidenced by 6BQ6-GT plate glowing and overheating, failure of high voltage or blown fuse. Can be due to improper setting of the horizontal-drive adjustment. To correct, remove the tube, unscrew the drive adjustment to give minimum capacitance, replace the horizontal-output tube, and screw the drive in until the bright vertical line near the left edge of the raster *just disappears. Do not* turn the drive adjustment any further, as this reduces the drive and the effective 6BQ6-GT grid bias below a safe value, resulting in overloading. Also inspect the 6W4-GT damper. This tube should have a color-coded dot on the bottom and the name Raytheon either preceded or followed by the letter A. If any 6W4-GT is found without these markings, it should be replaced.

Excessive width and/or horizontal nonlinearity on left side of picture. Failure of 6BQ6-GT (on sets marked code 12 and up). This condition may be encountered on some sets when operated on higher than normal line voltages.

1. Transpose the black and white leads going to the horizontal output transformer.

2. Install a 3,900-ohm, 2-watt resistor in parallel with C115. C115, 10-μf, 150-volt capacitor, is connected between pin 3 and pin 4 of the horizontal output transformer.

In sets with horizontal output transformers having molded powdered iron cores (race-track shape) there is a 3,900-ohm resistor installed at this point. In these sets, parallel this resistor with another 3,900-ohm, 2-watt resistor.

Squegging. This trouble (receivers having code 13 and up) is recognized by horizontal picture shift when the contrast or fine-tuning control is moved, loss of or critical horizontal sync, horizontal tearing of picture (diagonal white lines), ringing in the speaker, singing of the horizontal output transformer or chassis. Can be caused by oscillation in the 6SL7-GT (sync and a.g.c. amplifier) due to inter-electrode capacitance in the tube. The last three types of squegging trouble may also cause premature failure of the 6BQ6-GT, the 6W4-GT, and the high-voltage rectifier, 1X2, if the oscillation of the 6SL7-GT is allowed to continue for any length of time.

To neutralize this inter-element tube capacitance, C71 (1 $\mu\mu$f) and C116 (0.2 $\mu\mu$f) were included in the circuit. C71 is connected to pin 1, and C116 is connected to pin 4 of the 6SL7-GT. Oscillation can occur if these components and other leads are not correctly positioned. To correct squegging:

1. Take set out of cabinet, disconnect speaker and antenna, and remove fourth i.f. amplifier tube (6AU6, V6). Set contrast control approximately one-third on.

2. Connect a VTVM ($\pm$10-volt scale) at junction of R88 and R89. One side of R89 (220,000 ohms) is wired to pin 4 of the 6SN7-GT horizontal multivibrator. The other end of this resistor forms a junction with R88 (33,000

ohms). Ground pin 5 of the 6SL7-GT and turn the set on. The VTVM should not read more than ± 1 volt. If more than this, check resistor R87 (1.5 megohms, connected to pin 5 of damper tube), and R82 (1 megohm, connected to terminal 5 of the horizontal output transformer). Also test C99 (220 $\mu\mu$f) and C100 (680 $\mu\mu$f), both connected to pin 1 of 6AL5 a.f.c. discriminator. Check C101 (680 $\mu\mu$f) and C102 (220 $\mu\mu$f), both connected to pin 5 of the same tube.

3. Remove the ground connection from pin 5 of the 6SL7-GT and note the VTVM reading. If reading is positive, move C71 and C116 closer together to reduce this voltage to zero. If this is insufficient, spread the black and blue leads connected to pin 2 and pin 4 of the 6SL7-GT. If the voltage reading is negative, make adjustments opposite of above. When VTVM reading is zero, the receiver is properly neutralized. Some tubes may not neutralize. If so, replace with a different tube and repeat the procedure.

Do not discard any tubes causing squegging or oscillation, since these tubes may be perfectly satisfactory in some other circuit in the receiver.

Model 94BR–3017B

Dark horizontal bars of varying width. When sound is at maximum, sound bars may move from bottom to top. With a screwdriver, turn station selector screw counterclockwise only far enough to remove the sound bars. The selector screw is in the front end, facing the panel. Do not force the screw in either direction if difficult to turn, since it may have reached end of its travel.

Motorola

TS–5

No raster. Misadjustment of ion trap. Defective 6V6-GT horizontal oscillator, 6J5 horizontal discharge, 6BG6-G horizontal output, or 1B3-GT h.v. rectifier. Open or shorted primary in horizontal output transformer. Open 1B3-GT filament winding.

Small raster. Weak 6BG6-G. Weak 5U4-G low-voltage rectifier. Shorted .03-μf horizontal deflection coupling capacitor C122 or .05-μf C123. Shorted vertical deflection coupling capacitors C86B (50 μf) or C87B (10 μf). Low line voltage.

Trapezoidal or nonsymmetrical raster. Improper ion trap adjustment. Incorrect focus coil adjustment. Defective deflection yoke.

Wrinkles on left side of raster. Defective 5V4-G damper.

Picture smear. Low bias on 6AU6 first video amplifier or 6AC7 second video

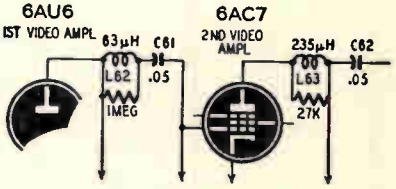

Fig. 35. Defects in video amplifiers cause smear.

amplifier. Leaky .05-μf video amplifier coupling capacitors C61 or C62. (See illustration above.)

Poor resolution (picture stable). R.f. tuner or video i.f. badly out of alignment. Open peaking coils in 6AL5

video detector plate (L59 or L60), or in first or second video-amplifier plates (L62 or L63).

TS–5 (VK–101)

Sound bars (stippled effect) in picture. Improper adjustment of fine-tuning control. Low-frequency trap L50 open, shorted, or misadjusted. Open or

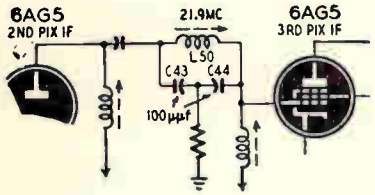

Fig. 36. Check circuit above to remove sound bars.

shorted 100-$\mu\mu$f parallel-trap capacitors C43 or C44. (See illustration.)

Poor focus. Low line voltage. Open 1,000-ohm resistor R116 in series with focus coil and focus control.

Vertical black lines in picture. Defective 6BG6-G horizontal output or 6V6-GT horizontal oscillator. B+ lead to tuner picking up horizontal pulses. Replace with shielded lead and reroute so that 250-volt end ties to terminal strip end of 39,000-ohm resistor R67 in the screen-grid lead of V14. Ground the shield at several points.

TS–9

Loss of brightness. Defective 1B3-GT or 6BG6-G. Open or leaky h.v. filter capacitor.

Low brilliance. Low brilliance on these and similar chassis may be caused by an increase in value of the high-voltage filter resistor R108 (820,000 ohms). When the resistance of this unit increases, picture brightness will fall off because of a substantial decrease in accelerating voltage.

If necessary, replace resistor with one-watt unit. Mount clear; keep away from heat.

TS–9D, TS–15B.

No high voltage. If no high voltage is present in these and similar models, pull the 6AL5 phase detector tube. If high voltage returns without horizontal sync, replace the .05-μf, 600-volt capacitor (connected to pins 6 and 7 of the 6AL5) with one having a higher voltage rating. If a positive voltage can be measured at pins 5 or 7 of the 6AL5, it indicates that the capacitor has shorted and must be replaced.

TS–14, TS–23

Insufficient picture height. Most cases of insufficient picture height can be traced to heating of the .05-μf, 600-volt charge-discharge capacitor C70 connected in the plate circuit of the 6J5-GT vertical sweep-generator tube. This capacitor is located between the chassis and the filament transformer for the 6W4-GT damper tube.

When replacing this capacitor, anchor one end on pin 6 of the 6W4-GT socket and then connect it to the plate of the 6J5-GT. Connect the other end to the ungrounded end of R56, the 8,200-ohm resistor associated with it. The new location is cooler and the capacitor will be less likely to change its value.

TS–14B, TS–23B, TS–52B

Sync buzz. Sync buzz may be annoying when the contrast control is turned a little above normal on Motorola sets using TS-14B, TS-23B, TS-52B, and similar chassis. This trouble can be cleared up by making a minor change in the biasing arrangement for the video amplifier. Disconnect the lower end of the 1-megohm grid resistor from the arm of the contrast control and connect it to the cathode of the audio amplifier. By providing a cleaner source of bias for the video amplifier, this circuit modification minimizes sync buzz.

TS–18

Poor vertical linearity. Defective 6SL7-GT vertical output. Defective 22-meg feedback resistor R61 (vertical output to vertical oscillator). (See illustration.)

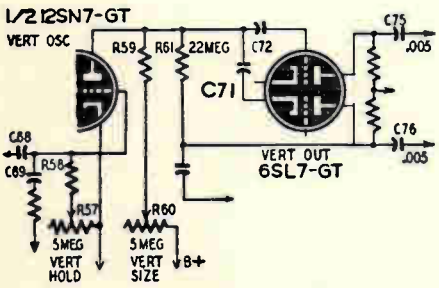

Fig. 37. Check circuit above for vertical nonlinearity.

Loss of vertical sync. (Not corrected by adjustment of vertical hold control or replacement of vertical oscillator and amplifier tubes.) Check value of 1,000-$\mu\mu$f grid capacitor C69. (See illustration.)

No vertical deflection. Defective 12SN7-GT vertical oscillator or 6SL7-GT vertical amplifier. Defective .05-μf coupling capacitor C72 or .01-μf charging capacitor C71. Failure of vertical hold or vertical size controls R57 and R60. (See illustration.)

Insufficient height. Defective 6SL7-GT vertical output tube. Defective vertical size control R60. Open h.v. coupling capacitors C75 or C76 (.005-μf, 6,000 v.) from vertical amplifier plates. Shorted 250-$\mu\mu$f r.f. filter capacitor C77. Shorted ballast tube, causing excessive heater voltage on vertical amplifier. (See illustration.)

Vertical jitter. Vertical hold control needs readjusting. Defective 250-$\mu\mu$f vertical oscillator coupling capacitor C68. (See illustration.)

Poor vertical sync. H.v. corona arcing. Open .01-μf integrating capacitors in 12SN7-GT sync clipper output.

Vertical bars on left half of picture. Defective damping resistors R88 or R51 across primary and secondary of horizontal blocking transformer T5. (See illustration left column, page 68.)

Poor horizontal linearity. Defective horizontal sawtooth capacitors C62 (680-$\mu\mu$f) or C63 (900-$\mu\mu$f). (See illustration left column, page 68.)

No horizontal deflection. Defective 12SN7-GT horizontal oscillator. Defective horizontal hold or horizontal size control (R49 or R53). Failure in horizontal oscillator blocking transformer T5. Shorted horizontal sawtooth capacitors C62 or C63 (680 and 900-$\mu\mu$f). (See illustration left column, page 68.)

Motorola

Insufficient width. Defective 12SN7-GT horizontal oscillator, defective horizontal size control R53. Open h.v. coupling capacitors C64 or C65 (.001-μf, 6,000 volts) going to horizontal deflection plates. Open .03-μf capacitor C58 across horizontal hold control and series resistor. Defective ballast tube, causing low heater voltage on horizontal oscillator. (See illustration.)

Horizontal foldover (left of picture). Incorrect setting of horizontal hold control. Increased values in horizontal saw-

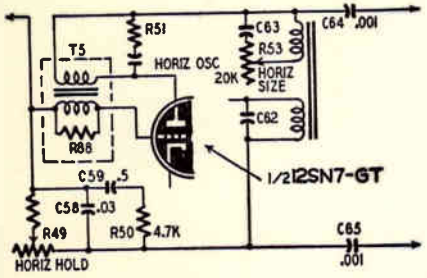

Fig. 38. Analyze this circuit for horizontal foldover.

tooth capacitors C62 or C63 (680 and 900-$\mu\mu$f). (See illustration above.)

Excessive picture size, low brightness. Defective 25L6-GT h.v. supply oscillator or 1B3-GT h.v. rectifier.

TS–101 and TS–119

Sound interference. Some cases of sound interference in the picture are caused by pickup from the discriminator circuit. If careful lead dress does not cure the condition, check capacitor C44 across the secondary of the transformer. This unit, a 150-$\mu\mu$f, 500-volt ceramic tubular capacitor, should be connected so the outside plate goes to the low side of the coil. In strong signal areas, the simplest cure is to slightly detune the *primary* of the discriminator transformer. Do not do this

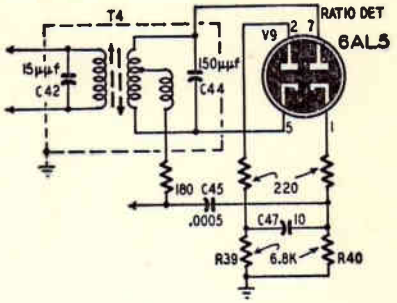

Fig. 39. Sound interference from discriminator.

in fringe areas because the gain is reduced.

In fringe-area installations, the condition should be remedied by inserting suppressor resistors in series with each diode of the 6AL5 ratio detector. The circuit changes are shown in the diagram. Remove all wiring from pins 1 and 2 of the 6AL5 (V9). Connect a 220-ohm resistor to each of these pins. The leads which were disconnected from pins 1 and 2 are then connected to the other ends of the resistors.

Compression at top and bottom of picture. These models may exhibit top and bottom compression difficult to remove with settings of the vertical linearity and vertical size controls. Add a 22,000-ohm, $\frac{1}{2}$-watt resistor (as illustrated) from the high side of the vertical yoke winding to the high side of the peaking resistor R64 to remedy this condition. In installing this resistor, use the terminal strip which serves to effect the junction between the green yoke lead and the yellow transformer

lead. Connect the resistor between this lug and the adjacent lug on the same strip which is at present unused. Then run a wire from this point to the terminal-strip lug which forms the junction for R64, the peaking resistor, and C60.

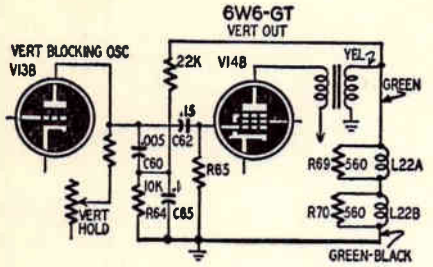

Fig. 40. Removal of picture compression.

Take care not to break the terminal on the 4.5-mc trap coil, L19, by careless movement of coupling capacitor, C64 (0.1 μf) to the picture-tube cathode.

10VK12

Poor vertical linearity. Defective linearity control. Shorted 100-μf cathode capacitor in vertical output stage.

12VK11RA

Black horizontal line at bottom of picture. Improper adjustment of vertical hold or vertical centering controls; defective vertical hold control. Defective 6SN7-GT clipper, 6J5-GT vertical oscillator, or 6V6-GT vertical output.

VT-71M

"Pie-crust" oscillation covering entire screen. Picture-tube mount touching shield cover of r.f. h.v. power supply. Insulate with cardboard or fiber strip.

Horizontal white line (stationary). Defect in h.v. supply; open or leaky filter or bypass capacitors. Check to see that line is not a burn-in from a possible previous failure of vertical scan.

VT-105, 107; VK-106

Horizontal white line (moves with adjustment of vertical hold control). Defective 6SN7-GT vertical oscillator or vertical amplifier. Defective vertical coupling or sweep discharge capacitors.

17F1, 17F2

Hum. Speaker hum may be noticed even when the a.c. power switches on both radio and TV chassis are off. Remedy is to reverse leads at the speaker pin jacks.

When reinstalling AM-FM chassis that has been removed for servicing, plug speaker leads in so the ground wire from the radio chassis plugs into the pin jack which is tied to terminal 2 on the socket for the speaker plug from the TV chassis. This terminal corresponds to the ground connection on the TV chassis.

TS-314B, TS-315B, TS-325, TS-326, TS-351

Poor picture quality, instability, or buzzing sound. A three-position area selector switch on the back of these chassis adapts them to varying receiving conditions in different localities. Turning the switch from local toward fringe, progressively reduces the a.g.c. voltage, and by grounding the video amplifier grid resistor, improves noise limiting action. Incorrect switch setting may produce poor picture quality, instability or buzz. Set switch in position which gives clearest, most stable picture.

Olympic

Models TV-246, TV-944, DX-214, DX-215, DX-950

Sound distortion, weak sound, sound i.f. oscillation, critical adjustment of fine tuning control, microphonic on some stations.

1. Remove the ground lead of the mica bypass capacitor (270 $\mu\mu$f or 330 $\mu\mu$f) connected from pin 1 to ground on V7, 6AL5 discriminator and solder it to the chassis near the riveted end of the voltage divider 8,200-ohm section. Keep leads as short as possible and dress capacitor close to chassis.

2. Remove the ground lead of the B+ bypass capacitor connected from B+ side of first sound i.f. coil (L18 on TV-246 models, L1 on DX models). Solder the lead to the center shield of V4, 6BA6 first sound i.f. tube socket. The small ground strap between the center shield and rivet on socket V4 should be soldered to the rivet, and the head of the rivet should be soldered to the chassis on the top side. Ground leads from socket lugs to existing ground points should be made as short as possible and should be soldered to the chassis as close to the socket as possible. This is important on all sound i.f. sockets (V4, V5, V6, V7). Align all sound adjustments.

3. Change the value of the 22,000-ohm grid resistor (R4 on DX models, R16 on TV-246 models) connected from pin 1 to ground on second sound i.f. amplifier V5 to 47,000-ohms, ½-watt, to provide increased sound. If oscillation occurs after complete alignment of sound i.f., change resistor back to original 22,000 ohms.

4. In some chassis, it is possible to replace V4 and V5 (6BA6) with 6AU6 tubes and obtain increased sound, provided an additional 1,500-$\mu\mu$f ceramic bypass capacitor is connected from pin 7 (cathode) to center shield ground on V5. Shorten all ground leads as explained in paragraph 2. Align all sound traps and sound i.f. adjustments after making any of the above changes.

All 700 series receivers

Fuse in horizontal-output transformer circuit blows on line-voltage surge resulting in small picture, foldover on both sides and damping bars. Remove fuse from present circuit and then remove green lead from terminal 1 on TR-2293 horizontal output transformer and connect to terminal 8. Connect fuse between terminal 8 and terminal 1. Remove yellow wire from terminal 8 and connect to terminal 7. Dress fuse away from high-voltage terminals.

Insufficient width. Connect a .05-μf, 400-volt capacitor across width control (terminals 5 and 6 on transformer). In severe cases of low line voltage a 0.1-μf, 400-volt capacitor may be used. Change 6BQ6-GT. Also see pages 23, 28, 31, 57, 58, 59, 60, 80, 82, 85, 86, 109.

Vertical retrace lines visible at low contrast. May be due to low transmitter sync level or variations in picture-tube characteristics. Connect a .05-μf, 600-volt capacitor from green lead of vertical output transformer (TR-2189) to yellow lead (pin 11, V13 kinescope). These leads run to adjacent tie points on the terminal strip near the vertical output transformer.

Beat interference, hash in picture or sound, or separation of sound and picture on high band. Oscillation in sound i.f. Ground the cathode resistor (R1, 150 ohms) directly to center shield of V3 (6AU6 or 6BA6) socket first sound i.f. amplifier, instead of terminal-strip ground. Connect a 1,500-$\mu\mu$f ceramic capacitor between pin 7 (cathode) and socket center shield. Check alignment of sound i.f., sound traps and discriminator.

Models 752, 753, 755, 764, 766 and 767

Insufficient height and width in areas of low line voltage. To increase the picture width, change R76, 56,000 ohms, 1 watt, to 22,000 ohms, 1 watt. R76 is connected to terminal D of L17, horizontal oscillator coil. To increase picture height, R55 and R56 which total 6,500 ohms, 10 watts, should be replaced by one 3,300-ohm, 2-watt resistor. R55 and R56, series resistors are connected to the red lead of the vertical output transformer. A parallel resistor combination may be used as an equivalent of a 3,300-ohm, 2-watt resistor. These changes were made in production.

Improved vertical hold control range. R50, 6.8 meg, going to the vertical hold control is not used in all sets. It was eliminated for better range of the vertical hold control.

Distortion or picture tearing in strong-signal areas. Erratic horizontal hold. Remove resistor R26, 330,000 ohms, $\frac{1}{2}$ watt, located on peaking coil terminal strip adjacent to V11, 6AL5 video detector. Removal of this resistor provides higher a.g.c. voltage for picture i.f. tubes. Weak or gassy picture i.f. tubes, V8, V9, or V10 will cause similar trouble.

Picture dark or shaded on left side of screen. Change R57, 100,000 ohms, $\frac{1}{2}$ watt, to 47,000 ohms, $\frac{1}{2}$ watt. This resistor is located between two lugs on horizontal linearity control L18. Make certain that red lead to pin 10 on kinescope socket V13 is free and clear of the other leads to socket.

Horizontal tearing. If tearing occurs, especially in fringe areas, resulting in a distorted picture when contrast control is advanced, check for a short, leaky, or open .05-μf capacitor (C37) and low capacitance in C38 (220-$\mu\mu$f mica capacitor). C37 is connected to pin 1, control grid, of 6SN7-GT sync amplifier and separator. C38 is connected to pin 2, plate, of the same tube.

When horizontal tearing of the picture occurs at high or medium contrast control setting, R36, 1,000-ohm resistor, should be reduced to 700 or 800 ohms. When tearing or distortion occurs at low contrast setting, R36 is too low and should be increased to 1,200 ohms. R36 is connected to R34, 680 ohms, part of the plate load for the second video-amplifier tube.

To improve vertical height. Try replacing the vertical output tube, V15, which may be either a 6SN7-GT or a 12BH7.

Horizontal frequency drift. Any tendency of the horizontal oscillator to drift to a lower frequency may be attributed to the capacitor connected between terminals C and D on the horizontal oscillator transformer. Drift to a lower frequency is indicated by

bars sloping downward to the left, or inability to sync picture even with the horizontal control turned clockwise. This may occur when a cold receiver is turned on, or after operation for several hours.

The capacitor (.01 μf, 600 volts) used is a black, molded, oil-filled unit with capacitance and ratings indicated by color bands. Use only the same type of capacitor for replacement purposes or where horizontal frequency drift occurs. If an exact duplicate is not obtainable, an oil-filled, .01-μf, 600-volt capacitor, plus or minus 10%, also may be used. Adjust the horizontal oscillator in accordance with the procedure given in Olympic service bulletin 50-2 after replacing the capacitor.

Models 752, 752U, 753, 753U, 755, 755U, 764, 764U, 766, 766U, 767, 769

Picture changes vertical size or develops foldover on bottom. Vertical linearity and height adjustments need frequent resetting on chassis using 12BH7 in V15 (vertical) socket.

1. Replace 12BH7.

2. Replace C47, 4-μf, 450-volt electrolytic with 20-μf or 40-μf, 450-volt electrolytic. Change R55, 3,300-ohm, 2-watt resistor (circuit DG-2346-2), or R55 and R56, each 3,300-ohm, 2-watt resistors on circuit DG-2346-1, to a 1,000-ohm, 1-watt resistor. C47 and R55 are connected to the red lead of the vertical output transformer. In some chassis wired per diagram DG-2346-1, R55 and R56 are used as a single resistor, 6,500 ohms, 10 watts. Actual values of resistors as wired in receivers may vary somewhat from that specified above; therefore, when making this change, make sure that the total effective resistance between the red lead of the vertical output transformer and the 540-volt B-plus point (pin 3 on V19, the 6W4-GT damper tube) is 1,000 ohms, 1 watt.

3. Change R53, 2.2-meg, ½-watt resistor, to 1.0 meg, ½ watt. This resistor is connected from pin 7 (grid of V15, vertical oscillator and vertical output tube) to ground.

4. When insufficient width occurs, change R76, 56,000 ohms, 1 watt, to 33,000 ohms, 1 watt. R76 is connected to the horizontal-oscillator coil. Adjust horizontal oscillator.

5. Some chassis use a 6SN7-GT tube in socket V15, in which case the same changes can be made, taking care to observe that the pin numbers on the 12BH7 and 6SN7-GT are different.

Models 762, 783, 967, 968, 970

Arcing, corona in high-voltage cage. Under conditions of unusually high humidity and heat, some arcing and corona discharge may occur on the underside of the 1B3-GT socket assembly. To correct this condition:

1. Remove screws holding high-voltage cage to chassis; remove tube clip leads and high-voltage clip lead. It is unnecessary to unsolder any leads.

2. Turn cage over. Remove two screws holding bakelite plate to side of cage and mount two ceramic insulators to plate. Fasten two spade bolts to opposite ends of ceramic standoffs and mount assembly to end of cage in approximately the same former position.

3. Solder the tube socket retainer

ring to the nearest corona button. Reassemble cage to chassis.

4. Check rubber cover on high-voltage capacitor and on second-anode lead for dust and moisture. Dress leads carefully.

Horizontal-oscillator drift (picture turns into bars sloping downward to left).

1. Replace C75, 150-$\mu\mu$f mica capacitor with 150-$\mu\mu$f $\pm$10% negative temperature coefficient ceramic capacitor (part No. CCD-U181K). This capacitor is connected from terminal F of horizontal oscillator coil TR-2294 to pin 4 of V18 (6SN7-GT).

2. Reset horizontal oscillator.

DX–950

Vertical damping bar on left of screen. Defective 6BG6-G horizontal output or 6W4-GT damper. Misadjustment of horizontal drive control. Insufficient value in deflection yoke capacitor (replace original 47-$\mu\mu$f unit with higher capacitance, up to about 100 $\mu\mu$f). Insufficient shielding between deflection-yoke and video-amplifier stages. Yoke leads too close to other kinescope leads.

DX–16" and DX–19" models.

Foldover at left side of picture. (This change has been made in DX-16-inch and DX-19-inch tube models, effective serial numbers K-209,000 on DX-16-inch and L-211,250, DX-19-inch.)

1. Remove red lead of V16 kinescope socket (No. 10 terminal) from center terminal of vertical height control and connect to pin 6 of 6W4-GT socket, V23.

2. Connect a 100,000-ohm, $\frac{1}{2}$-watt resistor from pin 4 to pin 6 on 6W4-GT socket.

3. Connect a 100,000-ohm, $\frac{1}{2}$-watt resistor from pin 6 of 6W4-GT socket to dummy lug on horizontal linearity control, L21. This dummy lug is junction of 2 blue leads and a 22,000-ohm resistor, R89.

4. Make sure red lead to kinescope is clear and not tangled with other leads to socket, or wiring under chassis.

5. Remove C87, 4-$\mu\mu$f capacitor and R91, 560,000-ohm resistor, and check adjustment of horizontal oscillator. These two parts are in series. C87 connects to plate pin 5, of 6W4-GT damper tube, V23.

All XL models

Audio buzz. To eliminate audio buzz:

1. Remove R25, 1-meg resistor
   Remove R26, 3.9-meg resistor
   Remove R29, 3,300-ohm resistor
   Remove C27, 220-$\mu\mu$f capacitor (mica)
   Remove C28, 1,500-$\mu\mu$f capacitor (ceramic)

All of the above parts are located on V11 socket (6AL5), except R26 and R29 which are at the contrast control.

2. Disconnect and remove the long white wire running from pin 5 of V11 (6AL5) to terminal strip near the contrast control. Connect pin 5 to chassis ground.

3. Disconnect R24, 1-meg resistor, from pin 2 of 6AL5 (V11) and connect to junction of L12 (peaking coil) and R27, 5,600-ohm resistor.

4. Disconnect green wire from pin 5 of V6 (6AT6) and connect green wire

to pin 2 of V11 (6AL5). Connect pin 5 of V6 (6AT6) to chassis ground.

5. It will be necessary to realign L10, pix i.f. coil (bottom adjustment) due to the removal of capacitance loading in the detector circuit. Usually this can be done by turning the brass screw of L10 clockwise in about 1½ or 2 turns. A signal generator and electronic voltmeter should be used to set the frequency to 25.75 mc.

To further reduce the hum, a shield has been mounted against the front edge of the chassis around the volume control and capacitor to shield these parts from hum radiating from the picture tube. Hum from the picture tube will result on 12½-inch XL and DX models if the outer Aquadag coating on the tube is not grounded properly.

Models TV–947, TV–949, TV–949G, TV–950G

Insufficient width. If adjustment of drive control not sufficient, measure voltage at high-voltage fuse. If less than + 330 volts, horizontal sweep will be insufficient. Replace 6BG6-G, 6W4-GT. Check whether B+ of set is + 235 volts and B– 100 volts. Check horizontal output transformer, deflection yoke. Defective C78, 47 $\mu\mu$f, across half of horizontal deflection coil.

Picture smear. Check peaking coils, L10, L12, L13. Check alignment, especially of L5 at 25.3 mc and L7 at 25.2 mc. These are picture i.f. transformers. Defective C33 or C34. C33, .05 μf, connects to plate, pin 7, of 6AL5 video detector. C34, .05 μf, connects to pin 7, control grid, 12AU7, video amplifier.

Philco

48–700,–1000,–1001,–1050, etc.

Weak reception, instability. Defective 6J6. Dirty, loose contacts on turret tuner. Defective contact springs on turret.

Intermittent picture and sound. Same as above. Look also for cold-solder joints in tuner.

48–1000, 48–1001

High-voltage breakdown. If these sets break down in the high-voltage section, check the lead between the plate cap of the 6BG6-G and the terminal board. If the lead is too near the metal shield of the high-voltage compartment, current will arc through the insulation to ground. Replace the lead and dress it away from the shield. Check the 6BG6-G because it is likely to have shorted if the set was left on too long after the arc-over occurred.

48–1000,–1050

Weak sound and picture. Defective 6J6. Shorted 10-μf 6J6 plate filter capacitor C409 or 22-$\mu\mu$f grid-coupling capacitor C404.

48–1001

Vertical black line on picture. Caused in early models by regeneration from the 0.1-μf capacitor connected from the 6BG6-G screen to ground. Remove capacitor entirely (this has been done in all later production models).

Critical horizontal hold. Unstable sync. Horizontal hold control critical

to adjust and picture jumps out of sync at irregular intervals.

Tests with a Variac showed that a 1- or 2-volt drop in line voltage would cause the picture to jump after approximately 20 seconds. The horizontal multivibrator tube was replaced with one having reserve emission. The selection was made on the basis of satisfactory operation as the line voltage was reduced. With a good tube, these sets will operate without adjustment as the line voltage is varied between 135 and 90 volts. The picture goes from almost black to a washed-out white, but the sweeps don't even quiver.

Dim picture, no vertical sync. The set came into the shop with a very dim picture, no vertical sync, and a loud popping sound from the high-voltage cage. A check showed a steady 8,000 volts at the filament of the high-voltage rectifier. There were a few faint sparks around the base of the 1B3-GT. We cleared these up by removing the unused pins from the rectifier socket. The original troubles remained. Finally we checked the high-voltage filter resistor and found it open. We soldered a 1-megohm, 1-watt resistor, across the old one and the set's performance returned to normal. We shunted the old resistor instead of removing it, because the filament leads are very brittle and break easily.

No vertical deflection. The trouble was loss of vertical deflection caused by a shorted vertical-deflection coil. When the C-R tube was removed, the coil showed the normal 30-ohm resistance. Replacing the tube caused the short to return. We found that the tube pushed the 1,000-ohm shunt resistors against the deflection coil which is grounded. A few strips of fiber were interposed between the resistors and the deflection coil windings and held in place by a few dabs of cement. After the coil was remounted on the picture tube the deflection was normal.

48–1075

Picture jumps, tears horizontally (to right). Defective 6BG6-G. Defective leads on 0.5-μf capacitor C522 connected from 5V4-G damper to horizontal deflection coils.

48–2500 (Projection)

Poor linearity on background objects. Improper adjustment of keystone magnets inside optical barrel. Adjust according to manufacturer's specifications.

48 Series

Sound bars on channel 4. If bars are eliminated when one of the sound i.f. tubes is removed, they are being caused by a beat between channel 4's video carrier and third harmonic of sound i.f. Realign sound i.f. at 22.0 mc and realign video i.f. 100 kc lower.

49–1475

Fine-tuning control ineffective. Defective 6AL5 picture discriminator which controls automatic tuning.

48 and 49 Series

Receiver drift. Defective 6J6 oscillator. Improper alignment of sound i.f. Signal too weak to operate a.f.c. In

earlier models, drift can be reduced by installing improved discriminator transformer and 10-$\mu\mu$f negative-coefficient oscillator grid-tank compensating capacitor (available in kit form as Philco part No. 45-9535).

50–T1400 series

Gunboating. Starting with the 50-T1400 series, code 125 TV receivers, a blocking-type horizontal oscillator with a stabilizing section is used in all sets. When this oscillator is improperly adjusted a shrill sound of approximately 1,000 cycles may be heard and the picture will lose sync. This condition—called gunboating—is the result of double firing of the horizontal oscillator. It usually occurs when the horizontal hold control is in the extreme clockwise or counterclockwise position.

To prevent this trouble, turn the horizontal hold control *fully clockwise*, then adjust the horizontal frequency control (in the core of the transformer) to obtain five blanking bars sloping to the right. If gunboating is still apparent, rotate the *hold control* in the opposite direction then return it to the extreme clockwise position. Try resetting the frequency control on the blocking transformer.

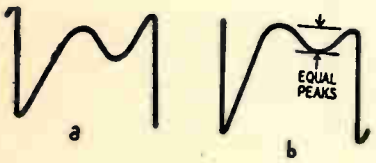

Fig. 41. Waveforms at pin 3 of horizontal test jack.

In areas having moderately strong noise-free signals, the tendency to gunboat is reduced by adjusting the stabilizing core in the horizontal blocking transformer so the top of the rounded portion of the oscillator waveform is below the narrow pointed peak as shown at *a* in the diagram. The drawing at *b* shows the waveform which should be obtained when the oscillator circuit is adjusted for reception in weak- or noisy-signal areas. These waveforms are viewed by connecting a scope to pin 3 of the horizontal test jack (J600 on most diagrams).

Insufficient picture height. Before tearing into the circuit in an effort to find the cause of insufficient picture height, try replacing the 5U4-G rectifier. When the emission drops off the picture height shrinks.

If 5U4-G replacement does not restore height, check vertical output tube and transformer. Check vertical peaking resistor and discharge capacitor. For additional information on insufficient height, consult pages 25, 81, and 85.

51–T1443 series

Filament protective fuse. The filament protective fuse is a length of No. 26 copper wire in series with one of the filament leads (black) from the power transformer. This fuse wire is between pin 3 of the 5AX4-GT (low-voltage rectifier) and pin 6 of the chassis power socket, J101. Always use No. 26 copper wire when replacing this fuse.

Do not attempt to make a filament protective fuse using a larger gauge of wire, such as No. 24 or No. 22, since this will not supply the necessary protection.

RCA

2T, 6T, and 9T series

Noise in sound (fringe areas).

1. Add a 1500-$\mu\mu$f capacitor from connection point of R192 (22,000 ohms) on TV-PHONO switch to ground (all models except combinations).

2. Thoroughly check 1,500-$\mu\mu$f plug-in type capacitors for open and leakage. In this condition they contribute to weak and noisy sound.

3. Check 6AU6 second sound i.f. tube. Some of these tubes have been found to have remote cutoff characteristics and cause insufficient limiting in this circuit.

Models 4T101 through 4T141, 7T103 through 7T143, 9T105 through 9T147

To increase sound gain. In fringe areas where additional sound gain is desirable, the following will give up to a 4 to 1 increase in sound gain.

1. Reduce the second picture i.f. grid resistor (R106 in 17-inch and 19-inch models, R107 in 14-inch models) from 8,200 to 4,700 ohms.

2. Increase the third picture i.f. plate-load resistor (R113 in 17-inch and 19-inch models, R115 in 14-inch models) from 1,800 to 8,200 ohms.

3. Change the fourth picture i.f. plate-isolating resistor (R120 in all models) from 6,800 to 1,000 ohms.

4. Remove the fourth picture i.f. plate-load resistor and peaking coil (R119 and L114 in all models). In some cases, L114 is wound on R119.

5. In place of R119 and L114 which were removed, install a 6,800-ohm resistor.

6. Add a 1,500-$\mu\mu$f ceramic capacitor across the second picture i.f. cathode resistor (pin 2 of V102 to ground). Use the shortest possible leads.

7. Realign the picture i.f. amplifier, using the following peak frequencies:

a. Second picture i.f. transformer (T102 all models), 22.5 mc.

b. Third picture i.f. transformer (T103 all models), 21.95 mc.

c. Fourth picture i.f. transformer (T404 all models), 25.3 mc.

d. Fifth picture i.f. coil (L103 in 17 inch and 19 inch, L102 in 14 inch), 23.7 mc.

8. Sweep-align the picture i.f. amplifier. It is recommended that 6 volts of negative bias be applied to the picture i.f. bias bus circuit during alignment.

16" models 6T53, –54, –64, –65, –71, –74, –75, –76, –84, –86, –87, and 19" models 9T57, –77, –79, –89

Picture smear. By smear is meant a washing out of white or black trailing edges so that the trailing edge is not sharply defined, but is smeared out toward the right side of the screen. The initial step in correction is to make certain that the r.f. and i.f. alignment is correct. Additional peaking of the high video frequencies can be obtained in the video amplifier by the following:

1. Add a 1,500-$\mu\mu$f capacitor across R126, 220 ohms, cathode of first video amplifier.

2. Add a 100-$\mu\mu$f capacitor from the junction of R126 and R224 to ground. R126, 220-ohms, cathode resistor of first video amplifier, is in series with R224, 100,000 ohms.

3. Change L105 (grid circuit of first video amplifier) from 120 μh to 500 μh (use stock No. 75252).

4. Move capacitors C190 (.015 μf), C132 (0.1 μf), and C133 (.047 μf) away from each other to reduce coupling. C190 connects to pin 2, control grid of kinescope. C190 and C133 are tied at one end. C132 connects to control grid, pin 7, first video amplifier.

6T54, -64, -65, -71, -74, -75, -76, -84, -86, -87, and 9T57, -77, -79, -89

Increased gain in fringe areas. Additional sound and picture gain for weak-signal areas is made possible by minor modifications.

Change the first and second picture i.f. cathode resistors (R104 and R108 in 12½-inch models or R103 and R107 in 16- and 19-inch models) from 120 to 82 ohms. This provides additional gain through these stages.

Move the point of sound takeoff (connection C) on trap T103 up two turns on the coil. T103 is part of the third pix i.f. transformer. This provides more 21-mc signal for the sound i.f. amplifier.

Carefully realign the sound and picture i.f. stages after making the above changes.

6T74

Shrinking picture. After the set had been in operation for a few minutes, the picture would shrink, leaving a dark strip at top and bottom of the mask. Suspecting trouble in the vertical deflection circuit, we interchanged the 6K6-GT audio-output and vertical-sweep tubes. This cleared up the trouble and the picture filled the screen. After a short period of normal operation the picture shrank again; this time from the sides. Replacing the 5U4-G low-voltage rectifier cleared up the trouble permanently, although again interchanging the 6K6-GT's caused a return of the trouble in the vertical output circuit. Since one of the tubes did not work well in the sweep circuit, we replaced it rather than have trouble later in the audio circuit.

9T57, -77, -79, -89 (19-inch models)

Narrow vertical bars at left-hand side of raster. This interference pattern can be the result of internal corona, or arcing, within the 4.7-μμf capacitor, C198, located in the plate circuit of the horizontal sweep output tube. These bars can be mistaken for Barkhausen oscillation, but none of the normal Barkhausen preventive methods, such as adjusting the drive, placing a magnet over the 6BG6-G, etc., will be effective in eliminating the interference. The cure is to replace capacitor C198.

9T240

Raster, no sound, no picture. All common causes of this trouble were investigated without finding the fault. The trouble was caused by an open heater in the first video amplifier section of the 12AU7. Failure in this section of the tube causes the bias on the a.g.c. line to cut off the common audio-video i.f. amplifier stages, thus killing the sound as well as the picture. This trouble can appear in other RCA sets

which have the same video amplifier and a.g.c. biasing arrangement.

9T240, 9TC240

Poor detail on fine or light parts of picture. Improper setting of focus control. Defective 6AL5 second detector or 12AU7 video amplifier. Misadjustment of video i.f. stages.

No raster. Incorrect ion trap adjustment; magnets reversed (top to bottom or front to back); front magnet improperly oriented. Defective 1B3-GT or 6BG6-G. Shorted 500-$\mu\mu$f h.v. filter capacitor C164. Open 3.3-ohm resistor R187 (1B3-GT filament) or 1-meg anode series resistor R189. R189 is connected to filament, pin 2, of 1B3-GT. Defective 6SN7-GT horizontal oscillator control. Inoperative 5V4-G damper.

No sound (raster and picture normal). Shorted .0047-μf plate bypass capacitor in 6K6-GT audio output.

Picture jitter. Improper adjustment of a.g.c. threshold control R138. R138 is a 200,000-ohm potentiometer. If regular sections at left of picture are displaced, change 6BG6-G.

Light vertical line on left of picture. Defective 5V4-G damper. Defective 56-$\mu\mu$f capacitor C169. C169 is part of the horizontal-deflection-yoke assembly.

9TC245, 9TC247, 9TC249, T121

Poor vertical sync. In a few cases this has been caused by capacitor C136 breaking loose from ground. C136, 0.22-μf cathode bypass, is connected to pin 3, 6SN7-GT sync separator.

Horizontal white line across top of raster. Some vertical-oscillator transformers marked 274011 with too high a Q can cause a white condition at the top of the picture and possible instability of sync. The cure is to lower the transformer Q by connecting a 1-megohm resistor across the green and yellow transformer leads.

Unstable horizontal sync (wavy picture). In a few cases this is caused by wrong values of C135, R144, and R217. C135 should be .01 μf, connected to cathode, pin 6, V108, 6SN7-GT a.g.c. rect. R144 should be 4,700 ohms, connected to the plate, pin 5, of the same tube, and R217 (should be 2,700 ohms) is in cathode circuit of this tube.

9T270

Loss of brightness. All tubes light, sound O.K., picture goes from bright to dim. Upon becoming dim, the picture increases to about $1\frac{1}{3}$ normal size and high voltage reduces from a normal 12,500 to about 9,500.

Inspection revealed that one of the 1B3-GT high-voltage rectifier tubes in the voltage doubler also varied in brightness. The trouble was a defective 3.9-ohm resistor in one leg of the 1B3-GT filament circuit.

9TC272

Sound O.K., no horizontal sync, no raster on screen. Adjusting the horizontal hold did not remedy this condition.

C159, a .01-μf capacitor in the horizontal oscillator, was leaking badly. Replacing it with a new .01-μf, 600-volt capacitor fixed the trouble.

RCA

9T275

Smear. Picture and sound O.K., but when a large white or black object or large lettering appeared on the screen, there was a disturbing smear.

Checked second video amplifier tube circuit, a 6K6-GT, and found an open in L109, 180-μh peaking coil. The smear disappeared when this was replaced.

9X561 and 9X571 series

Hum. When servicing these models for excessive hum, make sure that the shield over the audio-coupling capacitor C13 is correctly dressed and grounded.

TC164, TC165, TC166, TC167, TC168

Insufficient width. In some of these receivers, deflection failures have occurred with the following symptoms:

a. **Insufficient width, keystone raster, arcing, etc.** Generally, this condition is caused by the dress of the leads to terminals 1 and 3 of the horizontal yoke. Shorting of these leads to turns of the horizontal yoke winding will account for a small horizontal raster, and the voltage difference between the turns will account for the arcing.

b. **No horizontal deflection.** In some cases the leads of the horizontal section will make contact with the vertical section of the yoke. Under this condition there will be no horizontal deflection.

There is also a possibility that the saran, or insulating material, between sections will break down, resulting in arcing and no horizontal deflection.

Since the majority of yoke defects are improper lead dress, the repair can often be effected in the field. The following is a logical approach:

Remove the yoke plug from the chassis and make a resistance check to possibly determine the defective section or sections:

Normal readings at plug P106

Pin 4 to pin 8—Measures approximately 40 ohms
Pin 1 to pin 2—Measures approximately 3 ohms
Pin 1 to pin 8—Measures infinity
Pin 4 to pin 2—Measures infinity

If the low resistance readings can be changed by squeezing the bakelite cap of the yoke, this is an indication that lead dress is at fault.

To clear a short, use a long probe and change the lead dress until the resistance readings are normal. Check the lead dress on yoke terminals 1 and 3 first.

If the resistance check is normal and the yoke is still defective, then connect the yoke plug, but do not insert the kinescope. Turn the receiver on and visually note the location of the arc. Once the location of the improper lead dress is determined, clear as before until the arcing condition does not exist. This type of trouble is of course not indicated by a resistance test, but is apparent only by the arcing condition due to the proximity of the wires.

The majority of failures are due to lead dress as pointed out above. However, do not overlook the possibility of defective yoke capacitors and improperly soldered connections.

Regeneration. The 12,000-ohm resis-

tor (R220) across the 4.5-mc trap (L110) was placed in this circuit to reduce regeneration or *ringing* in the video amplifier. Regeneration may still exist at a minimum setting of the contrast control. Change R220 to 10,000 ohms to reduce this tendency. This change has been made in production.

630TS, 8TS30

No high voltage. Defective 6SN7-GT horizontal discharge. Check by substitution even though tube tests good.

Microphonic howl. Defective 6J6 oscillator.

Horizontal sync instability (no lock-in action). Improper adjustment of horizontal frequency control at rear of chassis. Adjust for maximum picture stability at either extreme of horizontal hold control. Check lock-in by switching momentarily to another channel and back.

No sound. No video. The complaint was no sound and no video on any channel. Indications pointed to trouble in the front end. The oscillator plate voltage checked low and there was no measurable voltage on the oscillator grids. A check showed that the oscillator plate resistor R7, normally 4,700 ohms, had increased its value.

Horizontal distortion. Horizontal distortion could not be corrected with the linearity control. This component, L201, was found defective when checked with an ohmmeter (its normal resistance is 37 ohms). A factory replacement restored the set to normal operation.

When horizontal nonlinearity is not caused by a defective control, check

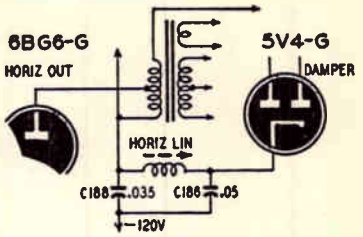

Fig. 42. Check capacitors and linearity coil in cases of horizontal distortion.

capacitors C186 and C188 on a capacitance bridge. Their values should be .05 and .035 μf, respectively as illustrated.

Increased picture height. Replacing the 6K6-GT vertical output tube with type 6Y6-G in 630 TS-type television receivers, or receivers with similar circuit design, will provide increased picture height with good vertical linearity. This change is especially applicable to sets that have been converted from 10- to 12- or 16-inch picture tubes. No other modification is required for extended height. Make sure that the heater winding on the power transformer can take the added drain. The 6Y6-G draws a filament current of 1.25 amperes—slightly more than three times the current of the 6K6-GT.

All models

Picture bending (top of picture). Change cathode resistor of d.c. restorer tube to 820,000 ohms. In 12½-inch models, this resistor is R136. In 16-inch and 19-inch models, R134. This should be done only in strong-signal areas where bending of top of the picture

usually occurs. Changing this resistor in weak-signal areas may decrease the noise immunity of the restorer circuit.

Picture bending (bottom of picture).

a. Change third picture i.f. plate-load resistor from 3,900 to 1,800 ohms (12½-inch model, R115; 16-inch and 19-inch models, R113).

b. Change fourth picture i.f. plate-load resistor from 8,200 ohms to 18,000 ohms (all models, R119). Shunt this resistor with a 36-μh peaking coil (part No. 75299). It is important that this stock number coil be used because of its distributed capacitance. Do not use any other 36-μh coil.

c. Retune the fourth picture i.f. (T104) to 22.5 mc. Retune the fifth picture i.f. (L103) to 24.25 mc. It is important that the i.f.'s be peak-aligned so these two circuits will be tuned to the exact new frequencies before the over-all i.f./r.f. response is touched up to obtain a good response curve.

12-inch, 16-inch, and 19-inch models

Overload of receiver on strong signals. Several cases have been reported where the fifth pix i.f. coils L103 (16-inch and 19-inch models) and L102 (12½-inch models) have been installed in reverse position. Therefore, they were wired incorrectly. Correctly wiring this i.f. coil eliminates this trouble.

16-inch and 19-inch models

Insufficient width. Add a 4.7-$\mu\mu$f capacitor in shunt with the present 4.7-$\mu\mu$f capacitor (C198). This should give a considerable increase in width. C198 is connected to the plate of the 6BG6-G and terminal 2 of the high-voltage transformer.

To improve focus on 16-inch and 19-inch models. Some increase in range of focus magnet shunt can be obtained by the following modification. This is most effective if the present adjustment just misses good focus.

1. Remove C washer from rear end of focus-control screw. This allows control screw to be unscrewed from shunt.
2. Unscrew focus-control screw from shunt.
3. Remove spacers from focus-control screw.
4. Reassemble focus-control screw in shunt and replace C washer in place.
5. Move focus magnet as close to the rear end of yoke as possible by tightening the three screws in the compression springs.

With the spacers removed and the focus magnet moved forward, better focus can be obtained with the increased range of the magnet shunt. This modification cannot be applied to all magnets used with these models. Some magnets do not allow the spacers to be removed from the shunt-control screw. The only remedy, if this type magnet is encountered, is to replace the magnet with one which has more magnetism.

Poor vertical and/or horizontal sync. Some 6CB6 tubes have grid characteristics which result in insufficient linear range for the i.f. signal. This results in limiting. This limiting action on strong signals may compress the sync, causing

poor vertical and/or horizontal sync operation. These effects are particularly true when tubes with abnormal characteristics are used in the last picture i.f. stage. If this condition is encountered, it may be necessary to try several tubes in order to find one that gives optimum operation. Tubes that do not operate satisfactorily in this stage should not be discarded, since they may be entirely satisfactory in either the r.f. or sound picture i.f. stages.

Detent backlash. This trouble is easily recognized, and is generally more pronounced on the high-frequency than on the low-frequency channels. If the fine-tuning control requires different positions of adjustment when the detent is switched clockwise to a channel when compared to switching counterclockwise to the same channel, there is backlash between the detent shaft and the oscillator switch rotor. In severe cases, this play can result in oscillator drift due to rotor movement. In order to make the detent shaft fit the oscillator switch rotor more accurately, it is convenient to apply any quick-drying cement to the detent shaft, building it up. In unusual cases, more than one coat may be necessary. If too much thickness is built up, it may be sanded or filed to the required thickness.

Horizontal oscillator radiation. Investigation of a number of horizontal oscillation radiation complaints has indicated that almost all of the radiation is from the power lines associated with the television receiver. The simplest method for reducing or eliminating this objectionable interference is the installation of a good quality a.c. line filter on the TV set (such as Tobe Filterette, type 1176).

Unstable horizontal sync. For proper a.g.c. control, best sync operation and best noise immunity it is important to accurately align the fifth picture i.f. coil (L102 in 12½-inch models, L103 in 16-inch and 19-inch models) to 22.5 mc. If this is not correct, the receiver may exhibit unstable horizontal sync when operated in noisy areas.

Sound i.f. harmonic interference. When interference is encountered in the picture in the form of cross-hatching or a herringbone pattern which varies with modulation, don't overlook the possibility of harmonics of the sound i.f. radiating from the discriminator circuit and reentering the r.f. stage.

The simplest way to determine this is to pull out the first sound i.f. tube, which removes the signal applied to the discriminator circuit. If this cures the trouble, carefully check the sound i.f. and discriminator transformer shield cans and wiring and make a more positive connection between the shield cans and the chassis itself. You may find it desirable to place some solder on the chassis where the can contacts the chassis so that the can may be pulled into the solder when clamping it into place. Carefully check the lead dress in the discriminator stage, particularly the leads connected to the discriminator transformer.

Lubrication of r.f. tuner detent mechanism. The ball used in the detent mechanism in the r.f. unit can fall out

after a short period of use. It is important that all points of contact between the ball and the detent be carefully lubricated with Lubriplate, Staput No. 512, or equivalent, in order to get smooth action and trouble-free operation.

Coaxial cable to balanced line matching network. In some locations it may be

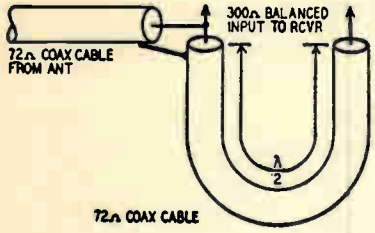

Fig. 43. 72-ohm to 300-ohm matching network.

necessary to use 72-ohm coaxial transmission line between antenna and receiver because of reflection or interference pickup. Some receivers are provided with a 72-ohm input in addition to the usual 300-ohm input. Early receivers employing KRK-2 series r.f. units are provided only with 300-ohm balanced input. To connect the coaxial cable to these early receivers, construct a network as shown in the illustration. The matching section should be an electrical half wavelength long for the picture carrier of the weakest signal received. The matching section can hang loosely behind the receiver.

While this network will improve the impedance match between transmission line and antenna coil primary, you must still make sure that the transmission line matches the antenna impedance.

Raytheon (see also Belmont)

14AX21

Sound in picture. To insure minimum video interference, dress the speaker leads away from the 6AL5 picture detector tube.

16AY28 and 17AY21 chassis

High-voltage power supply. In those cases where it is necessary to work within the high-voltage supply, take these precautions:

1. Terminals on the 1X2 socket must be dressed toward the inside of the corona ring and must be free of sharp protrusions.

2. The corona ring must be dressed in such a way as to make its presence useful; that is, properly centered and about 1/8 inch below the socket terminals.

3. Dress all leads as far away as possible from the transformer winding. Transfer excess lead length to the underside of the chassis.

16AY28, 16AY211, 17AY21, 17AY24, RC–1720A

Loss of horizontal and vertical sync. Very weak video. A defective a.g.c. system may not affect the sound, but can overload the video-amplifier circuit and the result will be a loss of both horizontal and vertical sync and weak video. This condition can easily be noticed and checked by measuring the a.g.c. voltage and the voltage across resistor R37. Under normal operating conditions these two voltages will be approximately the same. A defective a.g.c. system will cause a large increase

in voltage across R37 and a decrease in a.g.c. voltage. R37 is 3,900 ohms and is in the grid circuit (pin 7) of the first video amplifier tube, 12AT7. To determine the cause for trouble, check the 6AU6 tubes, capacitors C59 and C70, and resistors R44, R50, and R51. C70 is 0.1 μf, one end grounded, the other end to pin 8 of the high-voltage transformer. C59 is a 5-μf, 50-volt electrolytic, and is connected to C70 through R50, 2,200 ohms. R51 is 33,000 ohms, and is tied to C59 and R50 through R44, a 68,000-ohm resistor.

To check the a.g.c. winding of the horizontal deflection transformer, place a scope on pin 5 of the a.g.c. tube and a horizontal pulse should be obtained with a peak-to-peak voltage of approximately 400 volts.

1101

Excessive warmup required for sound and sync to reach normal. Weak selenium or low-voltage rectifier. Decrease in capacitance of low-voltage filter capacitors.

Check both of these units by substitution.

No picture, no sound. Continuity check the ¼-amp fuse in low-voltage supply. One side of the fuse goes to filter choke, L28. If replacement also blows, test C94-B, for leakage or short. This is a 60-μf, 450-volt electrolytic. Do not replace fuse with one having a higher current rating. Make sure that side of fuse connected to phone switch is not grounded.

Do not substitute a capacitor having a smaller capacitance or voltage rating.

Sentinel

400–TV

Horizontal nonlinearity. Incorrect adjustment of horizontal linearity control. Defective horizontal oscillator or amplifier. Defective .001-μf horizontal sawtooth capacitor, C7.

No sound or video. If the set is dead with no sound or video, the trouble is likely to be caused by a shorted screen bypass capacitor in the video i.f. circuit. This trouble occurs most frequently in the third i.f. amplifier but it can occur just as easily in the others. Use a 600-volt, .005-μf capacitor as a replacement.

400, 405

Insufficient height, bright lines or bars at top or bottom of screen. Defective 6SN7-GT vertical oscillator or 6SL7-GT vertical amplifier. Open or increased resistance in vertical amplifier plate-dropping resistors (4.7 meg, R23, and R24). Shorted 0.1-μf coupling capacitor C13 or shorted 20-μf cathode bypass capacitor C21 in vertical amplifier.

Insufficient width. Open or increased resistance in horizontal amplifier 100,000-ohm plate-dropping resistors R2 and R5. Open or shorted filter capacitors in medium-h.v. power supply.

No raster, thin white line. Shorted .02-μf vertical oscillator coupling capacitor C11.

No raster, thin vertical line. Defective horizontal oscillator or amplifier tube. Shorted .01-μf horizontal amplifier coupling capacitor. Replace with a

1,200-volt unit. Shorted .0001-μf horizontal oscillator coupling capacitor.

400–TV, 405–TVM

No picture or intermittent picture. Shorted or intermittent screen-bypass capacitors in the 6Y6-G high-voltage oscillator are the cause of no picture or intermittent picture. Replace this unit with a 0.1-μf, 600-volt unit. If the old one was shorted, check the 33,000-ohm screen-dropping resistor because it may have been damaged by the overload. Replacement is always safest.

401, 402, 406, 411

Short life of 6AR5 audio output (glass breakage). Excessive pressure from tube shield; breakage results from heat expansion. Discard shield.

412, 413, 415

To increase focus range. The range of the focus control on all series YA, YB, YC, and early YD chassis (the latter have the YD stamped in ink on the back of the chassis) can be increased by duplicating the production changes which were made. The original circuit is shown at *a* and the modified circuit at *b*.

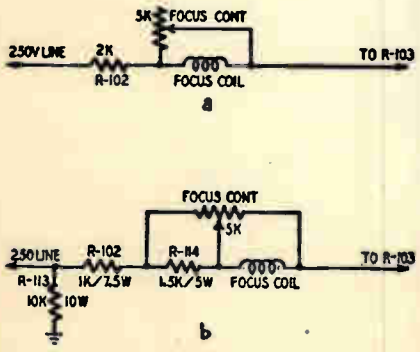

Fig. 44. Modification to increase focus range.

Series resistor R102 was changed from 2,000 to 1,000 ohms. A 1,500-ohm, 5-watt resistor has been added in series with the output side of the focus coil, and a 10,000-ohm, 10-watt bleeder resistor has been connected between ground and the output side of R102. The focus-control circuit is rewired so it is across the focus coil and the 1,500-ohm resistor in series with it. The tap on the control is connected to the output side of the focus coil.

413, 414, 415

Insufficient width. Improper adjustment of width or horizontal drive controls. Open 500-$\mu\mu$f capacitor C73 (6W4-GT plate to width control). Defective 6BG6-G, 1X2, or 6W4-GT. Leaky .05-μf capacitor C74 or shorted 0.1-μf capacitor C75 (both connected to horizontal linearity coil). Open 250-$\mu\mu$f horizontal oscillator capacitor C59.

419, 420, 423, 424, 425, 428

Distorted or weak sound. Distorted or weak sound which shows up a week or 10 days after the set is placed in operation is caused by drift in the discriminator transformer in early production runs of models 419, 420, 423, 424, 425, and 428.

This is easily corrected by adjusting the secondary tuning slug located on top of the discriminator transformer shield can. Make this adjustment for minimum buzz and clearest sound. The

correct position is between the two maximum-buzz peaks which will be noticed when the adjustment is turned right or left from minimum-buzz.

Discriminator transformers used in later models will be given an additional impregnation and baking process which will eliminate drift in this circuit.

420B, 423, 425, 428

Foldover on left side of picture. Foldover on the left-hand side of the picture which shows up as a horizontal V pointing toward the center of the picture or a faint milky-white area between the center and left side of the picture, is caused by the horizontal hold control being out of adjustment.

To clear this trouble, turn the horizontal centering control until the left-hand edge of the picture is visible. Adjust the horizontal hold control until the foldover just disappears. If the extreme top of the picture starts bending or jitter is noticed, adjust the hold control for minimum foldover with acceptable stability. To find this setting, it may be necessary to readjust the horizontal lock control.

Center the picture with the centering control. Do not at any time use the hold control to center the picture.

420–TV

Picture tube replacement. The Sentinel model 420-TV was originally shipped with a 16-inch rectangular picture tube bearing the manufacturer's part number 57E5 or 57E6. When exact replacements are not available, 16TP4 or 16RP4 tubes can be used as replacements.

After installing the 16TP4 or 16RP4, set the horizontal drive control as described on page 4 of the service manual for this model. If neck-shadow is present, remove it by adjusting the four mounting screws on the focus-coil mounting assembly. Adjust the focus control for proper focus.

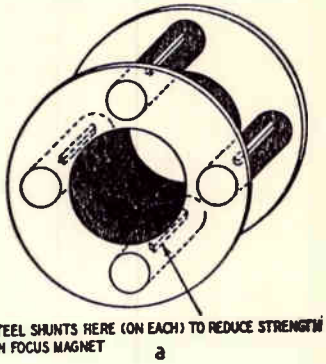

Fig. 45. Technique for reduction of strength of focus magnet.

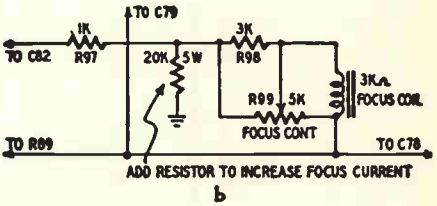

Fig. 46. Circuit change to increase focus coil current.

If focus improves but is not perfect when the control is in the full *counterclockwise* position, the focus magnet is too strong. Correct this by placing four $\frac{3}{4} \times \frac{1}{8} \times 1/16$-inch steel strips around the focus magnet as shown in the drawing at *a*. If these shunts do not bring proper focus within the range of the control, use additional shunts.

Sentinel; Sparton

If you must turn the focus control *clockwise* for improved focus but perfect focus is not attained before the control reaches the full clockwise position, the focus magnet is too weak. Connect a 20,000-ohm, 5-watt resistor between ground and the junction of resistors R97, R98, and R99 as shown in the partial schematic at *b* on page 87.

Addition of the 20,000-ohm, 5-watt resistor will increase the focus coil current. Use of this resistor when focus magnet is weak should permit focus to be obtained when R99, 5,000-ohm focus control, is in center position. In operation, the 20,000-ohm resistor may get warm. This is normal.

Models 438, 439, 440, 441, 443 and 446 using chassis YA, YB, YC, and YD.

Blown fuses. Take a look at the 1-inch-long No. 8 self-tapping screw which holds the back to the chassis near the interlock plug. This screw may be long enough to short to one of the filament pins of the 6W4-GT or 6BY5-G rectifiers. If so, you can eliminate the condition by placing a $\frac{1}{8}$-inch washer or washers under the head of the screw. If the set has a 2.5-ampere Slo-Blo fuse, replace it with a 3-ampere Slo-Blo unit.

A few chassis have a $\frac{1}{2}$-ampere Slo-Blo fuse in the secondary circuit of the power transformer. If the screw touches the rectifier socket on this type chassis, the $\frac{1}{2}$-ampere fuse will not blow. Check this possibility if the power transformer overheats.

If the power transformer has been allowed to overheat for a long time, it may be necessary to replace this unit as the insulation may be destroyed.

Sparton

23TB10 chassis

60-cycle hum. Reduce the hum by adding a shield over the volume control.

23TC10 chassis

Horizontal oscillator drift. This is apparently due to a change in 12AU7 characteristics. In all cases, the drift is such as to require complete counterclockwise rotation of the horizontal hold control. It may be advisable to set the horizontal locking range to a point where there is very little tearing at a maximum clockwise rotation of the hold control so that the drift will not require a service adjustment.

Audio hum. Audio hum in this chassis can be caused by wrong connections to C75, sections A and D, where the 40-μf section is connected to the 6V6 screen grid instead of the B-plus lead to the video amplifiers. The hum is most objectionable on strong signals or high contrast. This has been corrected in production.

Picture smear. Add a 1,000-$\mu\mu$f capacitor across R47 in the cathode circuit of the 6K6 video amplifier. This is a production change.

S distortion. Distortion of the picture with undistorted raster is due to a poor ground connection on C89, electrolytic capacitor, on which the ground lug is being used as a ground point for C116 in the control grid circuit of the horizontal oscillator. Resolder this connection.

All rectangular tube models and 25RD190 (19-inch round)

Failure of horizontal centering controls. Under normal operating conditions, with the arm of the centering control in the position shown by the solid line in the illustration, practically all of the current required by the deflection system flows through the $\frac{3}{8}$-amp fuse while the current required by the audio system is supplied directly from the 330-volt B-plus line through the

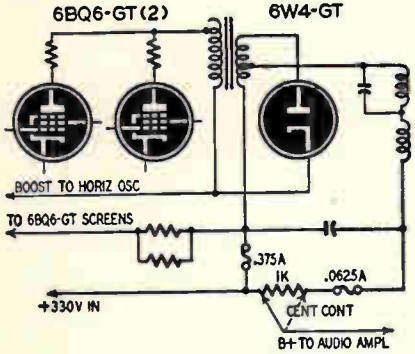

Fig. 47. Horizontal output and centering circuit.

arm of the centering control. With the arm of the control in the position shown by the dotted line, practically all of the current required by the audio system flows through the $\frac{3}{8}$-amp fuse, up through the secondary of the deflection transformer, through the horizontal deflection yoke, through the 1/16-amp fuse, and finally through the arm of the control to the audio amplifier. Assuming a B-plus short occurs in the deflection system, the $\frac{3}{8}$-amp fuse will blow, and the current for the deflection system will then flow through the centering control which is protected by the 1/16-amp fuse. This fuse will blow almost immediately, rendering the set inoperative.

The audio amplifier continues to draw current from the power supply and prevents the B-plus voltage from rising to a point where filter capacitor ratings would be exceeded.

If for any reason the 1/16-amp fuses and $\frac{3}{8}$-amp fuses are interchanged in the circuit, or if the 1/16-amp fuse is replaced by one of higher current rating, centering control burnout is a certainty. For this reason use extreme care when replacing the fuses and make sure that they are of the correct rating and in the proper place. Correct installation of the fuses may be easily checked by visual inspection, making certain that the 1/16-amp fuse is in series with the horizontal centering control. Adequate cabinet opening is provided under the chassis to permit this observation without removing the chassis from the cabinet.

Contrast control protection. Some receivers having model number 25RD190 use a $\frac{1}{4}$-watt (R45), 25,000-ohm contrast control. This requires the addition of a 12,000-ohm resistor in series with the video amplifier (V9) screen (pin 6) to limit the current through the control to a safe value. Remove this 12,000-ohm resistor when a replacement is made with a $\frac{1}{2}$-watt control.

All 16-inch and 17-inch rectangular tube models

Vertical white overdrive lines. In some cases where the vertical overdrive lines cannot be removed by the usual ad-

justment of the horizontal drive trimmer, do the following: First, replace the two 6BQ6-GT horizontal output tubes with a new pair and readjust the horizontal drive trimmer. If maximum capacity of the trimmer is reached before the lines are eliminated, lower the cathode resistor of the horizontal oscillator (R123) to a value which will remove the drive lines—1,000 ohms is the absolute minimum. The 6BQ6-GT cathode current rises as the drive is reduced and at no time should exceed 130 ma. If either of the two limits (130 ma cathode current or 1,000 ohms in the cathode of the horizontal oscillator) is reached and the drive lines remain, replace the horizontal output transformer.

All rectangular tube and 19-inch round models

Horizontal pulling. Pulling of top one-third of raster. Replace 6BQ6-GT horizontal output amplifiers.

Double picture. Horizontal oscillator intermittent or stops completely. Normal a.f.c. R119, 200,000-ohm horizontal oscillator plate (pin 5, 6SN7-GT) resistor increased in value. Replace.

Intermittent black vertical lines left side of raster. Short between terminals 4 and 5 of horizontal deflection transformer. Replace transformer.

Horizontal oscillator inoperative. Defective horizontal oscillator feedback capacitor, C108, 220 $\mu\mu$f. C108 is connected between pins 2 and 4 of 6SN7-GT horizontal oscillator. Replace.

No second-anode kinescope voltage. Everything checks O.K. Flyback resistance checks O.K. Short between primary and secondary of flyback transformer. Replace.

Horizontal overdrive line. Add 3,900-ohm resistor in series with decoupling resistor R114. One side of R114, 10,000 ohms, 2 watts, is connected to pin 6 of the horizontal output transformer. Check 6BQ6-GT by substitution. Readjust drive trimmer.

Flash on raster, similar to interference, often accompanied by blown fuses. Shorted damper tube. Check for flashover across damper socket or internal short within socket to chassis. Replace defective component. Resistance check of damper socket may be O.K. Float tie-point at damper pin 4 away from socket.

Flashing under 1B3-GT socket. Poor solder connections or resistance of R108, 1 megohm, 1 watt, increased in value. Defective C100, high-voltage filter. C100 and R108 are both connected to pin 7, 1B3-GT.

Picture losing sync and vertical flashing accompanied by audible horizontal oscillator whistle. Defective C101, 0.25-μf, 400-volt, damper filter capacitor. C101 is tied to pin 7 of 6W4-GT damper tube.

No raster. Kinescope second anode checks O.K. Defective C51, 0.1-μf, 600-volt decoupling capacitor. Replace. Make sure difficulty is not due to misadjustment of ion trap. One side of C51 is grounded, other side is connected to screen grid, pin 6, 6AU6, a.g.c. tube.

Reduced raster width and horizontal foldover, low brightness. 6BQ6-GT

screen resistors R110, R111 increased in value. R110 is 39,000 ohms, 2 watts. R111 is 33,000 ohms, 2 watts, and is in shunt with R110. Defective C102, .05-μf capacitor, screen bypass for 6BQ6-GT.

Rough raster edges. Bright center. Horizontal sweep frequency out of range of L28 horizontal oscillator tank. Defective 3,900-$\mu\mu$f horizontal oscillator tank capacitor.

Bad foldover. Raster with V23, horizontal oscillator removed from socket. Tunable shading. R112, R116, 100-ohm parasitic suppressors left out of circuit. This usually happens when resistors are damaged by 6BQ6-GT shorts and service technician attempts operation of set with jumper. R112, R116 are connected to the plates (caps) of the 6BQ6-GT horizontal output tubes.

Vertical flashing while tuning. No horizontal sync. Cannot maintain full raster. Appears to be a defective tuner. Check resistance values of vertical integrating network. Check vertical oscillator, 6SN7-GT, V20.

Kinescope brightness drops with increase of brightness control. Kinescope second-anode voltage regulation poor. Defective 1B3-GT high-voltage rectifier. Misadjusted ion trap. Defective picture tube. Defective high-voltage filter capacitor.

No control over kinescope brightness. Defective kinescope (cathode short). Defective C46 or C47, 0.1-μf, 400-volt capacitor. Bad solder connection at R44, C46. R44, 220,000 ohms, and C46 are in shunt, one end tied to cathode, pin 11, of kinescope. C47 is connected to pin 2 of the kinescope.

Poor horizontal sync stability. Pronounced decrease of range in hold control. Check V16, 12AU7 sync stripper amplifier and clipper, and associated components.

No second-anode voltage. Open R113, 100-ohm, 2-watt, 6BQ6-GT cathode resistor. Check for shorted 6BQ6-GT before replacing resistor.

Horizontal raster shift may be gradual with warmup. Check for defective 6BQ6-GT tubes. Replace in pairs. Check R133 and R134, 560-ohm, 2-watt, focus coil shunt resistors.

Double picture. Check V24 (6AL5) horizontal phase detector and associated components.

High-voltage corona discharge between plate cap of 1B3-GT and top of high-voltage cage. May be accompanied by blown fuses. Corona difficult to observe. Place suitable piece of sheet insulation in high-voltage shield-can louvres above 1B3-GT.

Low voltage at 6BQ6-GT and V23, 6SN7-GT horizontal oscillator grids. V23 plate voltage low. Defective drive trimmer.

Vertical foldover. Check V18, 6V6-GT vertical output tube. Check T9 vertical output transformer. Check parts by substitution.

Poor vertical linearity. Check 6SN7-GT, V17 vertical oscillator. Check vertical output transformer, by substitution.

No vertical sync. Test C90, 0.1-μf vertical coupling capacitor. C90 is connected to control grid, pin 5, of 6V6-GT vertical output tube.

Sparton

I.f. coil will not tune to designed frequency. Check iron core for size. The core may be chipped, caused by careless alignment. This is a result of turning the slug too far into the coil.

Negative picture. Check 6AL5, V7 video detector and associated components. Test 6AH6, V9, video amplifier and associated components. Check kinescope by substitution.

Excessive snow on weak signals, accompanied by too much contrast and blackout on strong signals. Defective 6AU6, V8, a.g.c. keying tube. Shorted 6AU6, V8, indicated often by overloaded 5Y3, V25.

No sound. No sync. Raster O.K. Defective 6AU6, V8.

Intermittent sound. Appears to be a defective ratio detector transformer. Check C66, 120 $\mu\mu$f, by substitution. C66 is across secondary of ratio detector.

Picture and sound not together. Snow in pix. I.f. response curve O.K. Check 6CB6, r.f. amplifier by substitution.

Tuner calibration off after tube replacement. Chosen tube should be one which does not affect tuner alignment appreciably. Several tubes of the same type should be tried.

Insufficient horizontal deflection. This can be due to variation in the 6BQ6-GT horizontal output amplifier. Where insufficient deflection is experienced on rectangular tube models, add a 30,000-ohm resistor across R110 and R111, the 6BQ6-GT screen dropping resistors. If this resistor is already present in the circuit and the deflection is greater than necessary, the screen voltage may be reduced by removing the resistor, thereby reducing the horizontal overscan condition.

Corona at picture tube second-anode connector. Thoroughly clean the area around the second-anode connection on the picture tube, using solvents such as carbon tetrachloride. Apply a thin film of Dow Corning DC4 silicone grease to the glass area of the picture tube around the high-voltage connector but not beyond the circumference of the rubber suction cup. A light film of DC4 may also be applied to the inside surface of the rubber suction cup. Do not apply grease on metal surface of connector assembly or on glass beyond circumference of suction cup. Careless application of DC4 will only aggravate the condition by collecting dust. Replace all rubber suction cups found to be deteriorated or made conductive by the presence of corona.

5006X and 5007X

Weak sound, poor sensitivity. Some models use 6AX5's as low-voltage rectifiers. After a few days the voltage on the 150-volt bus drops to less than 100. Replace the 6AX5-GT with a 6X5-GT. The tubes are interchangeable.

5085 and 5086

Overloading. May be present with high signals. Move a.g.c. line (white wire, r.f. tuner to chassis proper) from its junction with R18 and R19, to junction with R19 and R24. This change moves the white wire from one side of R19, 56,000 ohms, to the other side.

Stewart-Warner

9100A, B, C, and D

Oscillator slug falls into coil form. (Caused by excessive pressure or too many turns during adjustment.) Remove channel coil from turret assembly, lift slug-retaining spring aside, and tap coil form until slug moves forward so that its threads can be engaged by the slug-retaining spring.

Binding (tuner unit). Loosen screw holding tuner to bracket. Reposition tuner and shaft-centering plate so that fine-tuning control rotates freely.

9100E

Intermittent hum (intercarrier type; varies with camera or program changes). Improper adjustment of discriminator stage. Also check picture i.f. alignment.

Series 9120, 9121, 9122

To improve horizontal linearity. On certain 26-tube chassis, it is sometimes difficult to obtain correct horizontal linearity through the adjustment of the horizontal linearity, horizontal drive and width controls. When such cases are encountered, change capacitor C280 in the return lead of the horizontal output transformer, from 0.1 μf to 0.25 μf.

9200 series

To improve vertical hold. In weak-signal areas, or in locations adversely affected by external electrical interference, it is possible to improve the vertical sync stability on 9200 series receivers by making the following modifications:

1. Change resistor R160 in plate circuit of phase-splitter tube 12AU7 from 3,300 ohms to 6,800 ohms.

2. Change resistor R219 in plate circuit of phase-splitter tube 12AU7 from 56,000 ohms to 27,000 ohms.

Horizontal multivibrator squeal. During the warmup period immediately after the receiver is turned on, certain 9200 series receivers emit a high-pitched squeal. This condition can be overcome by incorporating the following circuit changes:

1. Change capacitor C174 in plate circuit of 6SN7-GT horizontal scanning multivibrator from 470 $\mu\mu$f to 390 $\mu\mu$f.

2. Change resistor R177 in plate circuit of 6SN7-GT horizontal scanning multivibrator from 330,000 ohms to 680,000 ohms.

3. Change resistor R235 in plate circuit of 6SN7-GT horizontal scanning multivibrator from 3,900 ohms to 3,300 ohms.

4. Add 270,000 ohms, $\pm$ 10%, $\frac{1}{2}$-watt resistor from pin 5 of 6SN7-GT horizontal scannning multivibrator to 315-volt B+ supply.

High-voltage transformer fuse blowout. Under certain conditions, cumulative effects develop in the horizontal scanning multivibrator stage and cause a momentary surge current in the plate circuit of the 6BQ6-GT output tube which blows the protective fuse. This condition is existent only during the warmup period of the receiver and can be corrected by applying the four changes indicated under "Horizontal

Stewart-Warner

multivibrator squeal," in the right-hand column on page 93.

9203A

No sound, no picture. Check 1-amp fuse between plate winding center tap and ground.

No high voltage. Make sure cap is on the 6BQ6-GT. Check for open 6BQ6-GT screen dropping resistor. Should be 12,000 ohms. If greatly changed in value, replace. Test ¼-amp fuse in series with flyback. Fuse connects to terminal 1 of the transformer. Check 6W4-GT by substitution. Resistance check the one-meg filter resistor connected to pin 2 of the 1X2-A high-voltage rectifier.

Dim picture. Normal sound. Accumulation of dust on the face of the picture tube can obscure the picture. Clean with damp soft cloth.

Horizontal white line across face of picture tube. Shorted .05-μf capacitor across secondary of vertical output transformer. Defective 6BL7-GT vertical output tube. Check by substitution. Primary of vertical output transformer open. Primary should read about 780 ohms. Open 2.2 meg resistor connected to control grid, pin 1, of 6BL7-GT, vertical output tube. Continuity check vertical blocking oscillator transformer. Grid winding should be 1100 ohms, plate winding 170 ohms. Open coupling capacitor, 0.1 μf, connected (by red lead) from blocking oscillator transformer to control grid, pin 1, 6BL7-GT.

Also examine vertical yoke. This winding has two series resistors across it. Continuity check winding and resistors.

Stromberg-Carlson

Model TC receivers

Horizontal instability or jitter. Cases of horizontal instability or jitter in the picture have been encountered where the L4, horizontal oscillator coil (part No. 114069) has developed short-circuited turns. This condition lowers the Q of the coil, in turn lowering the stability of the horizontal oscillator. This situation is best remedied by replacement of the coil.

A leaky 270-$\mu\mu$f capacitor between the No. 1 and 5 pins of the 6SN7-GT horizontal sweep oscillator will produce a similar condition.

Models 16 and 116 receivers

Corona. Picture blooming. The 116 series receivers employ four special 680,000-ohm resistors in series in the voltage-doubler section of the h.v. supply. (Physically these resistors are located on a terminal board between the 1X2 tubes.) The series 16 receivers only employed three of these resistors in series and some field failures have been reported where corona has burned and discolored the body of the top resistor and increased the actual resistance value to a point where the brightness control causes excessive picture blooming.

When servicing series 16 receivers for this reason, it is recommended that four instead of three of these special 680,000-ohm, 2,000-volt type BTAV resistors (S-C part No. 149368) be used to reduce the stress on each resistor and to minimize possible recurrence of this failure.

Improved frequency stability of the horizontal sweep oscillator. Increase the value of R59 in series with the B-plus supply lead to pin 5 of the 6SN7-GT (V2) horizontal sweep oscillator from 2,200 ohms, to 8,200 ohms, 1 watt. This increased value lowers the voltage on pin 5 about 50 to 75 volts, giving increased stability to the oscillator section.

Defective a.f.c. If the automatic frequency control of the horizontal oscillator weakens so that the action of the horizontal hold control is loose or with the picture locked-in out of phase where half of the picture appears on one side of the screen and half on the other side with a black blanking bar running vertically between the two picture halves, the cause is often due to failure of T13, a.f.c. sawtooth coil (S-C part No. 114090). Early designs of this coil had a tendency to develop leakage between primary and secondary windings under humid or damp conditions, causing this receiver condition. A redesigned coil was developed for later production and for replacement purposes, using a black vinyl insulating tape between windings. The redesigned coil can be identified also by a daub of green paint which appears on the body of the adjusting screw.

Model 16T–16C receivers

High-voltage adjustment. The potential to the second anode of the kinescope tube is carefully adjusted at the factory so that it does not exceed 12.5 kilovolts at a line voltage of 117 volts. At the same time the picture is observed for correct width with no foldover.

When making any adjustments of the C40 horizontal drive capacitor to the 6BG6-G grid make sure that the high-voltage does not exceed the specified 12.5 kilovolts at normal line voltage. If this high-voltage is permitted to rise appreciably above 12.5 kilovolts, corona and arc-over will take place in the high-voltage supply with resultant damage to the parts.

Precautions should also be observed when replacing parts or tubes in the high-voltage supply. To minimize corona and arc-over in this supply:

1. Round off soldered joints with no sharp solder or sharp wire points for corona discharges.
2. Dress leads away from ground points, tube envelopes and separate from each other.
3. Insert 6BG6-G tubes so that the glass envelope does not come closer than $\frac{1}{4}''$ to terminal 11 on the horizontal-output transformer.
4. Be sure the caps to the 1X2 tube are not upside down with sharp edges toward the case and that there are no sharp wire points on leads to 1X2 caps or on leads to 1X2 filaments.

16, 116, and 17 series receivers

Improved vertical hold action. You can stiffen the action of the vertical hold control by inserting a 10,000 ohm, $\frac{1}{2}$-watt resistor across the secondary (plate winding) of T2, vertical blocking oscillator transformer. This resistor dampens ringing which might interfere with proper synchronization.

Model 16, 117, and 17 series receivers

Horizontal picture pulling or kinking.

Stromberg-Carlson

Horizontal picture pulling, picture kinking, and critical action of the horizontal hold control can often be corrected by replacing the 6AH6 tube in the fourth i.f. stage. Other than these symptoms, the operation of the faulty 6AH6 tubes appears normal.

Improved picture centering. Improve picture centering by bridging a .005-μf capacitor across the secondary of the a.f.c. sawtooth coil. The secondary connects to pin 1 and pin 2 of the 6AL5 phase detector and to ground. Addition of this capacitor displaces the picture electrically to the right-hand side of the screen.

Model 17 series

Brightness cannot be diminished with brightness control. Cause is often in failure of R70, 220,000-ohm, $\frac{1}{2}$-watt resistor connected in series with the brightness potentiometer. Replacing the resistor corrects the condition.

Improving interlace. Under some operating conditions it may be difficult to obtain and maintain good interlace by adjustment of the vertical-hold control. When this condition is encountered, obtain improvement by shorting the 10,000-ohm resistor (R48) in the vertical sweep circuit, permitting the .033-μf capacitor (C33) to return directly to ground.

Excessive vertical picture size. To permit the vertical size to be reduced sufficiently within the range of the vertical size control, remove the supply voltage to the vertical oscillator from the boosted d.c. and connect to the 410-volt, B-plus line. Circuit-wise, disconnect R131, 2.2-megohm resistor from the boosted d.c. and reconnect to the 410-volt, B-plus. It is recommended that this revision be made if the vertical size cannot be reduced sufficiently with the size control. This was a production change.

Buzz or whistle in high-voltage power supply. Cases of buzz or whistle in the high-voltage power supplies on these models can often be traced to vibration of the bakelite terminal board on the horizontal-output transformer when S-C part No. 161040 is used. These cases can usually be cured by tightening the long brass screw which clamps the assembly together. Apparently with age, the rubber washers used in assembly change resilience and allow the terminal board to become resonant at about 7 kilocycles.

Loss of frequency stability of horizontal sweep oscillator. If the frequency of the 6SN7-GT horizontal oscillator appears unstable with a tendency to lock in at half-frequency where two complete pictures are displayed side by side with a black blanking bar running vertically between the two pictures, or at least with the oscillator running at an audibly lower frequency accompanied by a narrow raster with fewer than normal raster lines, the trouble is usually traceable to R58, the 270,000-ohm resistor in the No. 2 plate circuit of the 6SN7-GT tube. Resistors of a certain manufacture have a tendency to increase their value up to 1 megohm in this position, causing this condition. Replace this resistor. Check with an ohmmeter after wiring in the resistor.

Model 17-RPM receivers

Audio buzz. Some cases of audio buzz with the volume control completely off, have been experienced in these receivers. This condition has been traceable to vertical sync getting into the leads to the tone control and hence into the audio circuits. To eliminate buzz, shield the tone control lead. This was done in production. Receivers not having this shielding can be cured by physically separating the lead wires going to the vertical control and to the tone control.

Model 17 and 116 series receivers

Signal overload. Signal inputs of too high levels may produce overload in turn causing low contrast, washed-out milky pictures accompanied by sound beats in the picture and buzz in the audio. Attenuate the signal by inserting a resistor network pad in series with the antenna lead to the receiver which will reduce the overload condition. Resistor values for this pad are suggested in the installing instruction sheets attached to the rear panel of each receiver when packed.

High-voltage corona and arcing. When corona buzz, sometimes accompanied by the smell of ozone, is present in receivers using all-glass picture tubes, the cause is often traceable to corona discharge between the terminal connector on the high-voltage anode lead and the glass area around the high-voltage pin on the kinescope tube. To correct this condition, which is most noticeable under high humidity or dampness conditions, clean the glass area immediately around the pin connector on the tube with carbon tetrachloride. The soldered joint on the anode lead terminal should be smooth without any sharp points and it may be necessary to add a rubber cap completely over the connection to the tube if the set is not already so equipped. As an extra precaution, paint the cleaned-off glass area around the tube pin with Walsco anti-corona Lacquer —Catalog No. 195 or its equivalent.

Picture blooming. To reduce picture blooming when the brightness control is advanced, insert a 100,000-ohm, ½-watt resistor in series with the picture-tube cathode lead, at the tap arm of the brightness potentiometer R19B. Remove R72, 18,000-ohm resistor so that the end of the potentiometer connects directly to ground.

Model TC19 receivers

Defective focus-coil potentiometer. Always be sure that the octal plug, carrying the focus-coil leads, is plugged into the main chassis when operating the receiver. Failure to observe this precaution will result in damage to the focus-coil potentiometer.

Horizontal instability. In some areas, horizontal jitter and picture pulling have been observed when the incoming signal had lower than normal sync-pulse levels. Improve this situation by increasing the value of R267 from 270,000 ohms to 470,000 ohms. R267 connects between pin 2 and pin 3 of V26B, 12AU7, sync clipper and d.c. restorer.

Poor picture contrast and poor picture holding. When a poorly contrasted, washed-out picture and poor picture

holding develops after the receiver has been in operation for a period of time, the cause has often been traceable to increased resistance value of the R101 and R102, 1,500-ohm, 2-watt resistors in the plate circuit of the video amplifier. The resistors will measure about 1,000 to 2,000 ohms high and will usually have a burned, discolored body if this condition has developed.

Vertical white streaks on right side of picture. The condition of vertical white fold lines on the right side of the picture can usually be corrected by replacing the 100-ohm parasitic resistors (R202 and R203) in the grid circuits of the two 6BG6-G horizontal sweep output tubes.

Focus coil position. A greater in-focus picture area can be obtained if the focus coil assembly is separated by approximately ¾ inch from the deflection yoke on the picture-tube neck. The separation distance is best determined by observing the picture while adjusting the focus-coil position.

Critical horizontal hold control. Many cases of critical horizontal hold in TC-19 receivers have been traced to a change in value of R108, 15,000-ohm resistor from the screen of the 6AU6, first video amplifier, to ground. Replace this ½-watt resistor with a 1-watt unit if the condition is traced to this resistor.

Loss of high voltage. Loss of the anode high voltage to the kinescope tube often occurs because of poor contact at the junction of the male-female high-voltage connectors. Press these connectors firmly together to assure positive contact. In addition, dress this connector lead away from any miniature tubes to prevent heat deterioration of the connector-lead insulation, which could result in shorting of the high voltage. This high-voltage connector lead should be dressed on the side of the multilead cable away from the 12AU7 tubes. The multilead cable is the one that plugs into the top of the main chassis.

TC19, TC125

Loss of horizontal sync. Loss of horizontal sync in the TC19, TC125, and

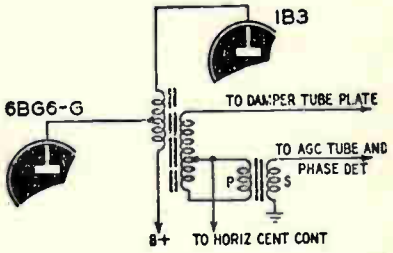

Fig. 48. Loss of sync due to open a.g.c. pulse coil.

similar models is most often caused by an open primary on the a.g.c. pulse coil. This coil is connected across a section of the secondary of the flyback transformer as shown in the diagram. Disconnect one side of this coil from the flyback transformer before checking continuity.

24 and 119 series

Improper action of brightness control. Improper action of the brightness control (the control seems to operate in reverse) in sets of the 24 and 119 series is often due to an open 2.2-megohm resistor (R291) in the grid return of the picture tube.

Increased brightness range. To increase the range of the brightness control in the model 24 series receivers so as to reduce the picture illumination properly, the 150,000-ohm resistor (R294) in series with the feed side of the brightness control should be decreased to 100,000 ohms.

Removing excessive trailing whites. Excessive trailing whites in the picture can be removed by slight revision in the video peaking. These revisions are as follows:

1. Remove peaking coil No. 114716 (red and yellow dot) from the video detector L2 position.

2. Remove peaking coil No. 114717 (on 15,000-ohm resistor form) from the grid circuit of the 6AU6, 1st video amplifier.

3. Connect a new peaking coil, part No. 114704 (blue dot), in the L2 position. That is from pin 2—6AL5—video detector, to pin 1—6AU6, first video amplifier.

4. Then connect R91, the 2,700-ohm diode load resistor also to pin 1 of the 6AU6, first video amplifier.

(Note: peaking coil No. 114704 specified in step 3 was formerly used in the series 17 receivers.)

Greater contrast. To increase contrast, short the 220-ohm resistor (R154) in the cathode of the 6AR5 video amplifier. This permits greater action of the contrast control. Further contrast can be obtained by moving the B-plus supply to the 6AR5, second video amplifier plate and screen sections from its present 300-volt source to a full 410-volt supply point.

119 series

To increase noise immunity. Remove C76, 0.22-μf capacitor from the a.g.c. line to ground and place a 2-μf, 50-volt capacitor in the same position. This increases the noise immunity of these receivers. This change has been made in production.

TC125–"0", 16, 116, and 17 series

Horizontal picture pulling or jittering. Horizontal picture pulling, jittering, or wavering, occurring regardless of contrast control settings, can in most cases be corrected by inserting a 0.47-μf capacitor (S-C part No. 110709) across the 10-μf (C7) capacitor that bypasses the a.g.c. line to ground. The 10-μf electrolytic capacitors do not all have adequate high-frequency bypassing action which is provided by the 0.47-μf capacitor. The pulling effect is more pronounced with strong signal reception and in many cases might be mistaken for overload, but the capacitor addition corrects it.

Model TS125–16 receivers

Sync modification to improve picture pulling condition. The TS125 and TS16 receivers are sometimes subject to picture pulling as the picture control (contrast) is advanced for proper contrast. When this condition is encountered, particularly in strong-signal areas, the following suggestions which have been received from the field will improve this condition by reducing the gain of the first sync-amplifier stage. This gain reduction is accomplished by revising the circuit of this

stage as shown by decreasing the plate load, changing the method of supplying

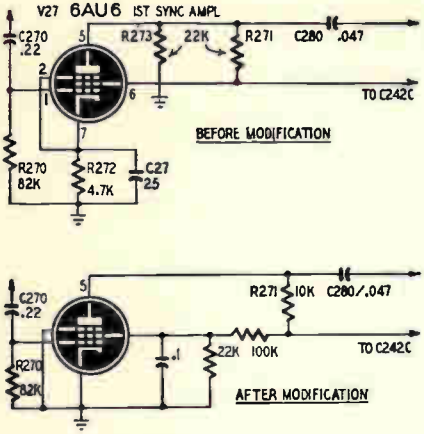

Fig. 49. Modification to improve picture pulling.

screen voltage and removing the cathode resistor and capacitor.

Model 317 series

Excessive sweep ringing. To correct excessive ringing, observable on some 317 receivers as several vertical white bars at the left side of the raster, it has been necessary to use a higher impedance deflection yoke (S-C part No. 114724). This yoke replaces previous part No. 114706 and the higher impedance achieves better match to the horizontal-output transformer thereby correcting the ringing. All connections remain the same except that the heavy insulated red lead from the No. 3 yoke terminal now connects to No. 7 terminal of the horizontal output transformer instead of to No. 5. Receivers dated coded 51-18-3 and later employ the newer yoke.

To improve fringe-area performance. The r.f. tube in the tuner unit is specified as either a 6AG5 or a 6BC5. Either type can be used in this position because they are interchangeable, but the 6BC5 does have higher gain. Where the 6AG5 has been used in this position, and higher gain is desired such as in fringe areas, the 6BC5 can be used and the higher gain achieved.

Bias supply pack for alignment purposes. The following circuit diagram

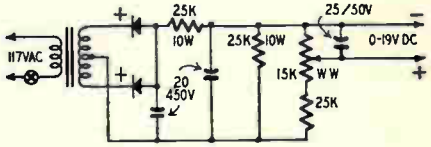

Fig. 50. Bias power supply for alignment.

is taken from the bias packs used in the factory for alignment purposes. This bias supply can also be made up in the field for this purpose, eliminating the necessity of using dry-cell batteries. Factory-built bias packs use "Volt-ohmyst" transformers for a supply source but any similar small, low-voltage transformer is suitable. Component substitutions can also be made as long as good d.c. output is maintained with negligible a.c. ripple content.

A small meter, reading from 0–25 volts, d.c., can be placed from the center arm of the 15,000-ohm control to the top, to give a continuous voltage reading. Do not omit the 25,000-ohm, 10-watt resistor, as this improves the regulation of the unit. This resistor is the bleeder across the output, provides a continuous load, and maintains a steady voltage for each setting.

Sylvania

Model 090, 16-inch receivers

Shock hazard. On early receivers of this model, the polystyrene twin lead from the built-in antenna to the antenna terminal board may come in contact with the 6BQ6-GT tube. The heat generated by the 6BQ6-GT tube will melt the polystyrene insulation on the twin lead. When this occurs, the bare wire may come in contact with the exposed portion of the 6BQ6-GT cap. This will put 305 volts on the antenna lead. If the built-in antenna is connected to the antenna terminal board, the receiver will not operate. However, if an external antenna is used and the built-in antenna is disconnected, the exposed terminals of the built-in antenna will be hot to ground. The remedy is simple. Tack or staple the twin lead to the side of the cabinet in such a manner that it cannot come in contact with the 6BQ6-GT tube. If it is necessary to unfasten the lead from the cabinet to remove the chassis, be sure to re-tack after the chassis has been replaced. In stapling, be sure not to short the transmission line.

Chassis 1–108, 1–139, 1–168, 1–186

Loss of horizontal scan. Check C120, 100 $\mu\mu$f, 500 volts, for leakage. If defective, replace with a mica-type capacitor. C120 is connected to the plate, pin 6, of the 12AU7 horizontal sync clipper.

Instability of horizontal oscillator circuit. A number of cases have been reported where this condition was due to open screen bypass capacitor, C133, on the horizontal control tube.

Horizontal size control burns up frequently. Check for a B– (–125 v) to ground short, particularly through leaky bypass capacitors across these two points. This condition will change the bias of the horizontal output tube sufficiently to draw excessive plate current, burning out the horizontal size control.

Chassis 1–108, 1–139, 1–168, 1–186, 1–227, 1–231

Low or erratic high voltage on chassis using 6Y6-G tube as high-voltage oscillator. Replace the high-voltage oscillator tube with a coated type 6Y6-G. If high voltage is still low, try several tubes. The high-voltage oscillator transformer also may be a cause of low high voltage. The transformer may still be operative but working inefficiently due to reduced Q of the coils caused by shorted turns, damaged insulation, humidity, etc. If the high voltage is erratic, the cause may be a short in the choke in the high-voltage oscillator circuit.

Chassis 1–231

Insufficient horizontal scan. Check high-voltage setting, as it may be too high. Change resistor R203 from 47,000 ohms to 27,000 ohms, 1 watt. R203, 47,000 ohms and R202, 22,000 ohms are shunt-screen-dropping resistors for the 6BQ6-GT. Lowering the value of R203 will reduce the effective total screen-grid resistor of the 6BQ6-GT horizontal output tube from 15,000 ohms to 12,000 ohms.

Sylvania

Chassis 1–260, 1–261, 1–271, 1–274, 1–290, 1–357, 1–366

Spurious oscillation. There have been some cases noted where the tuners are setting up a spurious oscillation when tuned to channel 2. This appears as r.f. interference in the picture. It may be corrected in most cases by moving C3, .000025 μf, or .000029 μf, from its present location on the tuning capacitor side of the slide switch to the other side of the switch, same terminals.

Chassis 1–329, 1–381

Improper a.g.c. action in strong-signal areas. The a.g.c. control setting on the above chassis is extremely critical due to the high gain and sharp cutoff characteristic of the video i.f. tubes. To improve the a.g.c. action in strong-signal areas, remove R132, 6.8-meg, ½-watt resistor by clipping it out of the circuit. One side of R132 is connected to the screen grid, pin 6, of the 6CB6 first video i.f. amplifier. Do NOT replace this resistor or bypass with a jumper. This effectively removes delayed a.g.c. action from the tuner. It should be done only for strong signals, as it will increase the noise factor in weak-signal areas.

I. F. bandpass. Failure to obtain the curve shown in service bulletins may be due to generators having too low an output. For a satisfactory response curve, the d.c. across the video detector diode load should measure about 1 volt. The sweep generator must have a flat response over the desired 10 mc range.

Measure video output with VTVM set to read d.c. volts on lowest scale. Marker of sweep generator should be off.

Chassis 1–387

Suppression of vertical retrace. The changes shown in the diagram have been added to the Sylvania 1-387 chassis to suppress vertical retrace lines.

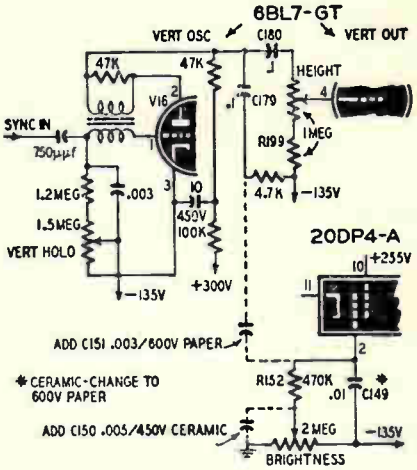

Fig. 51. Circuit changes to suppress vertical retrace.

The changes have been made in chassis bearing codes C03 and later. They can be made in earlier chassis.

Chassis 1–387–1

To improve bandpass response. To improve the bandpass, change R144, secondary load resistor for the video i.f. bandpass transformer, from 6,800 ohms to 8,200 ohms, ½ watt.

Chassis 1–387–1, 1–502–1

One or more vertical lines of black and white dots (salt and pepper) on the left side of the screen. May be introduced, increased or decreased by changing the setting of R153, the brightness control. The factory fix for this inter-

ference is the addition of a 10,000-ohm, ½-watt resistor in series with the high voltage anode lead of the picture tube. This resistor can be placed in the high voltage scan box inside the hole through which the high voltage anode lead passes. If you run into stubborn cases of this interference, use a shielded 300-ohm lead from the antenna terminal board to the tuner.

Chassis 1–502

Increased high voltage. To get increased high voltage, move C213, .0005 μf, from point A on the high voltage scanning assembly over to point H. The other end of the capacitor remains connected to the filament of the 5642 high voltage rectifier tube.

Chassis 1–387–1, 1–502–1

Intermittent foldover on bottom of picture. Correct by removing heater of the 6BL7-GT vertical oscillator and output tube from the filament winding of the power transformer (connected to −135 volts) and transfer to the grounded filament winding. Pin 8 of the 6BL7-GT should be connected to the hot filament bus and pin 7 of this tube should be grounded.

Chassis 1–437–1

To improve video i.f. performance. Change R137, loading resistor for the secondary of the second video i.f. transformer T56, from 27,000 ohms to 22,000 ohms, ½ watt. Do not use a resistor of less than 22,000 ohms as loading will be excessive.

Chassis 1–168

Poor focus or dark picture. These faults can be due to little or no voltage being supplied to the screen grid, pin 10, of the picture tube. Additional symptoms of this condition are that the ion trap magnet adjusts to a position far out of normal and the brightness and contrast controls must be turned full on. Also check the 6X4 picture-tube screen supply rectifier tube.

Blackening of picture tube. Picture tube appears to be turning black after some months of operation. This condition may be caused by an accumulation of dust on the face of the tube and the rear surface of the picture-tube bezel. The following cleaning procedure is recommended:

1. Remove the bezel, wash in soapsuds, but DO NOT rinse. Wipe with a soft, dry cloth. Do NOT RUB. Wipe the front of the picture tube with a soapy cloth and dry. Replace the bezel. Caution: The bezel is made of a soft plastic with unusual light transmission characteristics, and is easily scratched. The surface should be dusted lightly with a soft cloth. The surface must never be rubbed or cleaned with any chemical cleaning agents.

Singing of 6W4-GT damper tube. The singing commonly experienced in the 6W4-GT damper tube is caused by the high-frequency (approx. 15 kc) high-voltage (about 2,000 v peak) electrostatic force field in this tube between the heater and the cathode. When the singing condition is extreme, try a number of tubes to minimize the condition.

Sylvania

Improved sensitivity on older chassis in fringe areas. Sensitivity can be improved in fringe areas on those chassis having an underchassis routing for the 300-ohm lead from the antenna terminal board to the tuner by rerouting the 300-ohm lead over the power transformer, keeping it clear of the chassis and the power transformer.

Horizontal white line in picture. This horizontal white line is often caused by distortion of the vertical sawtooth wave due to secondary emission in the 6AQ5 vertical output tube. If this is the case, eliminate it by changing the tube and/or adding a 25-$\mu\mu$f, 1,000-volt mica capacitor from the plate (pin 5) to grid (pin 1).

Tube replacement. In all Sylvania chassis, the 6AG5 and the 6BC5 tubes are interchangeable. However, it is recommended that only the 6BC5 be used in r.f. tuners using 6AG5's or 6BC5's because of the higher gain characteristics of the 6BC5.

Insufficient horizontal scan. It must be remembered when insufficient horizontal scan is the trouble, that the deflection yoke is not necessarily the cause. There are other items in the horizontal scanning circuit which will cause a collapsed picture. An imperfect 12AU7 has been a recent complaint in this line, where the symptom was insufficient horizontal scan and poor linearity. In this instance, switching the two 12AU7's in the receiver corrected the condition.

Intercarrier buzz. Cases have been reported where intercarrier buzz was caused by a cracked capacitor in the base of the sound-discriminator transformer. These capacitors are built in as part of this transformer and correction of this condition necessitates replacement of the entire discriminator transformer. Re-check alignment of the sound discriminator transformer, particularly the secondary which is somewhat critical.

Varying contrast and horizontal instability. Varying contrast coupled with a tendency for the picture to pull out horizontally though vertical stability is good may be due to defective C168, electrolytic capacitor, 10 μf, 25 volts, in plate of a.g.c. amplifier tube.

Lamination buzz in power transformer. This complaint may be effectively treated by inserting a wooden wedge between the coil and center leg of the core. This can be done without disconnecting the transformer, by removing the transformer bolts and lifting the cover. Be sure to retighten the bolts evenly and securely.

Motor noise interference. Where there is audio noise interference it may be reduced by adding a .008-μf capacitor from the plate of the audio tube to ground. This should be done only where necessary, as it is effectively a fixed tone control, cutting some of the high-frequency response.

Critical vertical hold control. Check r.f. tubes in tuner for heater-to-cathode leakage. Cases have been reported on the 6CB6 where this leakage supplies sufficient hum modulation to trip the vertical sync circuits.

Objectionable audio tone from horizontal scan transformer. C156, 40-μf, 350-volt electrolytic capacitor section

in low-voltage power supply may be open.

Poor horizontal linearity. With the horizontal size control set for approximately the correct picture width, rotate the horizontal linearity control fully counterclockwise. Slowly turn the linearity control clockwise until crowding is visible in the center of the picture. Now carefully turn the control back (counterclockwise) only sufficient to remove the crowding in the picture or pattern. Do *not* operate the receiver with this control misadjusted. On some chassis, it may not be possible to obtain crowding of the picture. In such cases, the control should be set to the fully clockwise position.

For other case histories involving conditions of poor horizontal linearity, consult pages 23, 61, 63, 64, 67, 93, and 108.

Operating precautions. Do *not* operate the receiver under any of the following conditions:

1. Excessive horizontal scan (horizontal size control misadjusted).

2. Horizontal linearity not properly adjusted. See above for adjustments in the event of poor horizontal linearity.

3. High-voltage supply trimmer capacitor misadjusted. Peak voltages in excess of 18 kilovolts can be reached by turning the trimmer counterclockwise. The trimmer should then be turned clockwise to reduce the voltage to 14 kilovolts.

4. Brightness and contrast controls turned to maximum at the same time.

Operating receiver with high-voltage trimmer misadjusted can cause breakdown in high voltage. If possible, measure voltage at picture tube second anode.

Westinghouse

Model H–196

Poor vertical sync. Poor vertical sync in older models can be improved by replacing the 12AU7 sync amplifier with a 12AT7. The latter has higher mu and will provide greater sync amplitude. No wiring changes are required.

Narrow picture. Insufficient picture width under low line voltages, even though the width control is at maximum may be caused by the deflection yoke. Check its code number located under the V number on the yoke. If the number is 98, 108, or 118, replace the yoke with one carrying any other code number. The old yoke will perform satisfactorily with normal line voltages.

Hum. Hum in the a.f. section of this model and the H-207 may be reduced by connecting a 30-μf capacitor across C99 between the screen of the 6AQ5 output tube and ground. This additional capacitor will be found in later models.

Elliptical shadow. An elliptical shadow which produced an eclipse-like effect

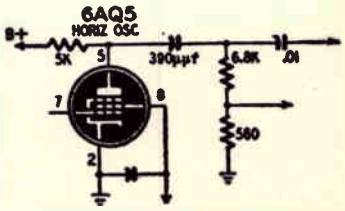

Fig. 52. Plate capacitor can cause shadow.

on the lower left side of the TV picture was finally traced to failure of the

390-$\mu\mu$f capacitor at the plate of the 6AQ5 horizontal oscillator tube. The position of this capacitor is shown in the diagram on page 105. Be sure to check the 6,800-ohm, ½-watt resistor, as it may have been damaged.

H–196, H–208, H–217

Short life of 5Z4 (earlier models). Replace with higher-current 5V4-G.

Fuse in horizontal output circuit blown. Gassy 6BG6-G. Excessive load in horizontal output circuit. (Use only a ¼-amp fuse to protect horizontal-output transformer.)

Overloading on strong signals. Improper adjustment of a.g.c. control. To adjust, tune receiver to dead channel, turn contrast full on and a.g.c. control fully counterclockwise (maximum sensitivity). Turn a.g.c. clockwise until snow on screen just begins to decrease. Lock in this position.

Insensitivity to weak signals. Improper adjustment of a.g.c. control (see above).

No horizontal sync, horizontal hold control ineffective. Defective 6AQ5 horizontal oscillator or 6AC7 horizontal reactance tube.

Poor vertical sync (earlier models). Replace 12AU7 sync amplifier with a 12AT7.

H–600T16

No sound but noticeable hum from speaker, picture showed a crease about 2 inches from the left side. Audio amplifier checked O.K. with an audio oscillator, but no sound was reaching the audio system from the 6AL5 ratio detector. C211, the .01-μf a.f. coupling capacitor, was found shorted. Replacing this corrected the audio trouble and also eliminated the crease in the picture.

Brown spot on cathode-ray tube. After about three or four months of use, the cathode-ray tube in these sets develops a brownish-yellow spot near the center of the screen. This is caused by a charge remaining on the two 500-$\mu\mu$f capacitors in the high-voltage circuit after the set is shut off. This trouble can be eliminated by disconnecting the lead from the 500-$\mu\mu$f capacitor that goes to pin 7 of the 1B3-GT high-voltage rectifier tube. The manufacturer made this change in later models.

Shorted high-voltage oscillator tube. A common fault in this set is the simultaneous burning out of these resistors: R401, a 400-ohm wire-wound focus control; R407, 560 ohms; and R410, 110 ohms. This trouble is caused by an internal short in the 6Y6-G high-voltage oscillator tube. Replace the tube and the resistors. One side of R407 is connected to the vertical output transformer and also to pin 3 of the vertical yoke socket. R410 is connected to R407. The other side of R410 goes to the focus control.

No sound, no video. If a rushing noise comes from the speaker but sound and video signals are absent, try replacing the 6C4 high-frequency oscillator tube.

Erratic picture. An erratic picture which shifts to right or left is often caused by a weak 6AL5 horizontal oscillator control tube.

Small picture, weak sound. Weak sound accompanied by picture shrinkage is often caused by weak 5U4-G low-voltage rectifiers. Replace one or both to restore the set to normal operation.

If the sound is O.K. and there is no raster on the screen, look for the trouble in the high-voltage circuit. You will probably find that the 6Y6-G is shorted or weak.

Bright, horizontal line. A bad or weak 12AU7 vertical multivibrator tube will cause a bright horizontal line to appear on the face of the picture tube. Try replacing this tube.

Sound O.K., thin vertical line on picture tube. The 12AU7 horizontal multivibrator may show a normal sawtooth. Check output of three 7A5 horizontal output tubes. If no signal and no B-plus, test R406, a 5,000-ohm wire-wound variable width control; it may be burned out. Also one of the 7A5's may be shorted.

H–605T12

Sound shaky, raster normal, video signal very erratic. Disconnect outdoor antenna from the set; channels 2 and 4 may work normally with a short piece of wire attached to one of the antenna posts. Test the tubes in the front end. The 6AG5 mixer tube may be found gassy. Set may work normally on all channels when this is replaced.

H–613K16

Sound O.K., no raster, no high-voltage on picture tube. Checking the high-voltage rectifier and the 6Y6-G high-voltage oscillator may show that the 1B3-GT rectifier does not light, though the same tube in another set may work O.K. In a case of this nature, a check showed that two turns of wire on the high-voltage oscillator transformer which supplies filament current for the 1B3-GT had slipped a ½ inch away from the primary. This made the coupling between the two windings too loose for normal operation. Fastening the windings in their proper place with household cement cured the trouble in this instance.

H–626T16, H–630T14

To increase control over picture height. Due to variations in characteristics of 6K6-GT vertical-output tubes, a change has been made in the height-control circuit of later production models to provide increased control over picture height.

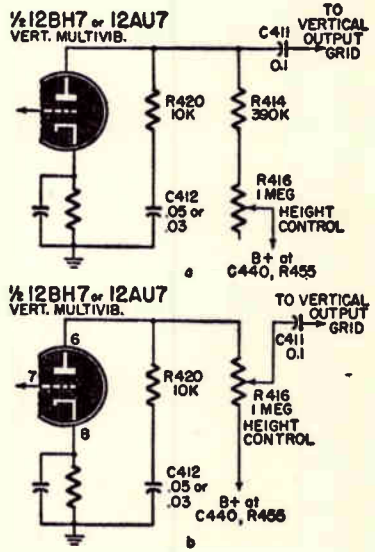

Fig. 53 Modification in height control circuit.

Westinghouse

The original circuit is shown at *a* and the modified circuit at *b*. R414 is removed from the circuit and the height-control wiring changed as shown. In later production, capacitor C412 was changed to .03 μf in the V-2172 chassis only.

Models H–640T17 and H–641K17

To adjust height and width. The lower end of the h.v. filter capacitor (C431) may be returned to one of three points: terminal 7 of the horizontal output transformer, terminal 5 of the transformer, or chassis ground. This connection affects the h.v. applied to the CRT anode and as a result the height and width of the picture. Maximum height and width is obtained with the capacitor returned to ground; less height and width is obtained with the capacitor returned to terminal 5; and the smallest picture results when the capacitor is returned to terminal 7. This connection also affects the picture brightness, which decreases as the picture size is increased.

Improved horizontal linearity. Change the capacitance of C427 (680 $\mu\mu$f) in the pin 6 plate circuit of the 12AU7 horizontal multivibrator to 330 $\mu\mu$f.

To reduce horizontal wobble under strong-signal conditions. Increased contrast range. To obtain these results, change the resistance of R437, 5,600 ohms, connected between pins 6 and 7 of the 6AU6 a.g.c. tube to 3,300 ohms.

To improve the signal-to-noise ratio at medium-signal levels. Take out R333, 470,000 ohms, located between the a.g.c. line and ground and change the resistance of R458, 470,000 ohms (in the a.g.c. line) to 10,000 ohms. These changes are effective in medium- or low-signal areas only. If receiver overload occurs in strong-signal areas, R333 should be reinserted and R458 should be 470,000 ohms.

Chassis V–2150–176U and V–2150–177U

To improve horizontal sweep stability. Add a 680-$\mu\mu$f capacitor in parallel with R416, 1,800 ohms, in the cathode circuit of the 12AU7 horizontal multivibrator. Change the resistance of R463 in the plate-supply circuit (pin 1) of the 12AU7 horizontal multivibrator from 33,000 ohms to 47,000 ohms.

V–2170

To increase video i.f. gain. The relatively slight variations that exist between tubes of different makes are important in weak-signal areas where maximum gain is desirable in the video i.f. stages of some Westinghouse sets. The use of some makes of 6CB6's in the V-2170 chassis can cause the i.f. gain to be reduced to about one-half (6 db). Use 6CB6's made by RCA or Raytheon as replacements in the video i.f. strip when maximum gain is required. Tubes of other makes perform satisfactorily in other circuits.

The bandpass of the video i.f. system is affected somewhat by the characteristics of the 6AL5 used in the video detector circuit. Tubes with excessively high perveance cause the i.f. response curve to be round-topped with a narrow bandpass. This condi-

tion is particularly undesirable in fringe areas.

For best results in the Westinghouse V-2172 chassis, use Raytheon 6AL5's as replacements for the video detector. Other 6AL5's are satisfactory elsewhere.

V–2171 chassis

Insufficient picture width. In some V-2171 chassis, a 1.8-μh reactor (L406) in parallel with a 5,600-ohm resistor (R454) is inserted in the line that runs between the horizontal winding of the deflection yoke and C416. If sufficient picture width cannot be obtained in these chassis, the reactor and resistor should be removed from the circuit. In chassis that do not contain the reactor and resistor, L406 and R454 should be added if excessive picture width is experienced.

Chassis V–2172 and V–2176

To stabilize horizontal multivibrator operation. Change R436 in the pin 6 plate circuit of the horizontal multivibrator from 220,000 ohms to 270,000 ohms. Insert a 220,000-ohm resistor in parallel with R434, 680,000 ohms, in the pin 7 grid circuit and change C422, between pin 1 and pin 7 from 68 $\mu\mu$f to 120 $\mu\mu$f. Also change C421 (connected to pin 1 of the 12AU7) from 47 $\mu\mu$f to 120 $\mu\mu$f and increase the value of R446 from 15,000 ohms to 18,000 ohms. R446 is connected between pin 1 and the ringing coil. These were production changes. In some chassis that use a 12BH7 tube as the horizontal multivibrator and which may not contain these changes, add a 1.5-$\mu\mu$f capacitor between pin 6 and pin 7 of the horizontal multivibrator. However, the effect of the capacitor is negligible if the changes have been made.

Noisy volume control. Add a .005-μf capacitor between the high side of the volume control and the junction of C207 and R204. C207, .001 μf, and R204, 68,000 ohms, are both connected to the volume control.

Faint light and dark vertical lines at left side of raster. Add a 5,600-ohm resistor in parallel with the horizontal linearity control. This resistor suppresses the appearance of these lines on the raster by damping out ringing in the control.

Neck shadow. If you experience difficulty in centering the picture or in eliminating neck shadow, check the position of the neck of the cathode-ray tube in the hole of the focalizer mounting bracket. The neck of the picture tube must be centered in the hole of the mounting bracket. Check this by removing the focalizer from its mounting bracket. If the neck is not centered, adjust the length of the stabilizer strap which extends from the picture tube strap to the superstructure until you get true centering. You can then replace the focalizer.

R.f. tweet in picture. Dress the lead-in from the antenna terminals to the tuner away from the i.f. chassis.

Chassis V–2173

Curvature of vertical lines. Add a .001-μf capacitor between pin 7 of the 6C4 phase detector and ground. The additional filtering of the a.f.c. correction voltage that is provided by this

capacitor eliminates an undesirable condition wherein the top 20 lines are horizontally displaced so as to cause a straight vertical line in the picture to appear curved at the top.

Chassis V–2192, V–2192–1, V–2192–2, and V–2192–3

Video i.f. decoupling. To provide increased decoupling of the video i.f. system and to prevent regeneration within the system, change the plate and screen decoupling resistor for the first i.f. amplifier (R306) from 1,000 ohms to 2,700 ohms. Insert a filament reactor (L407) in the filament lead between pin 3 of the 6CB6 first i.f. amplifier and pin 3 of the 6CB6 second i.f. amplifier. This is a production change.

Increased contrast range. To increase the contrast range, change the loading resistor (R314) across the secondary of the third i.f. transformer (T304) from 8,200 to 15,000 ohms. R316, connected to the grid of the video amplifier should be increased from 10,000 ohms to 18,000 ohms. Increase the video-amplifier grid resistor (R317) from 5,600 ohms to 8,200 ohms. Its lower end is to be returned to a voltage divider rather than to ground. The voltage divider consists of a 220,000-ohm resistor (R328) and a 2,200-ohm resistor (R329) connected in series and inserted so that R328 connects to the 120-volt bus for the i.f. stages and R329 connects to chassis ground. The video-amplifier grid resistor, R317, is connected to the junction of R328 and R329.

Video amplifier. In some chassis a 330-$\mu\mu$f capacitor is added from the cathode of the video amplifier to ground. This eliminates degeneration at the high video frequencies, effectively emphasizing the higher frequencies. The resultant peaking improves the picture when a low-resolution picture is transmitted, but may be detrimental when a high-resolution picture is transmitted. Because of the arbitrary benefit, the capacitor is not used in late production.

Improved focus. Obtain improved focus by increasing the voltage applied to the first anode, pin 10, of the cathode-ray tube. This is accomplished by connecting pin 10 of the cathode-ray tube to the junction of C423, R436, R438, and R455 (junction located in the plate-supply circuit for pin 6 of the horizontal multivibrator) rather than to the 320-volt supply line. This is a production change.

Vertical linearity. In some chassis, the vertical discharge resistor R420, in the pin 2 plate circuit of the vertical multivibrator, is changed from 3,300 ohms to 3,900 ohms. In other chassis, R420 is 4,700 ohms. In late production, however, R420 is 4,300 ohms and the tolerance of the resistor is 5%. A lower value of resistance produces compression at the top of the picture, while a higher resistance produces stretching at the top of the picture. The tolerance of the vertical discharge capacitor, C412, while it also affects the linearity, was reduced to 10% in later production.

In some chassis, a 330,000-ohm resistor (R462) is added in parallel with the total resistance of the height control, R416. In later chassis, R462 is changed

to 470,000 ohms for better over-all vertical linearity.

Improved a.g.c. and horizontal sweep. The following changes will improve the stability and holding range of the horizontal multivibrator and improve the a.g.c. filtering:

1. Add a .005-μf capacitor (C446) between the cathode of the 6AU6 keyed a.g.c. tube and ground.

2. Lower the value of the a.g.c. filter resistor (R452) from 22,000 ohms to 2,200 ohms.

3. Change the a.g.c. filter capacitor, C402, from .05 μf to 0.25 μf.

4. R427, connected to the plate of the 6AU6 keyed a.g.c. tube should be increased from 100,000 ohms to 220,000 ohms.

5. Add a 22,000-ohm resistor (R461) in parallel with the horizontal ringing coil (L401) in the plate circuit (pin 1) of the horizontal multivibrator.

6. Add an 800-$\mu\mu$f capacitor (C319) from the junction of R301, R304, and R307 to ground. This is the a.g.c. bus for the first and second i.f. amplifiers.

These changes (with the exception of item 5) are shown in the illustration at bottom of this page. These are production changes.

Chassis V–2192 through V–2192–6

To improve horizontal hold.

1. Reduce C421, connected to pin 1 of the horizontal multivibrator from 120 $\mu\mu$f to 47 $\mu\mu$f.

2. Change C422, between pin 1 and pin 2 of the horizontal multivibrator, from 180 $\mu\mu$f to 120 $\mu\mu$f.

3. Increase the value of R434 from 150,000 ohms to 270,000 ohms. R434 is in series with the horizontal hold control.

4. Add a 0.1-μf capacitor in parallel with the horizontal hold control.

Suppression of retrace lines.

1. Remove C313, 0.1 μf, from its original position at pin 2 of the picture tube.

2. Connect a 470,000-ohm resistor between pin 2 of the picture tube and the junction of C316 (.005 μf) and the arm of the brightness control.

3. Locate R420, 3,300 ohms, and C412, 0.1 μf. These two components are in series, with the capacitor connected to ground and the resistor connected to pin 2 of the 6SN7-GT vertical multivibrator. Change the electrical positions of these two parts, so

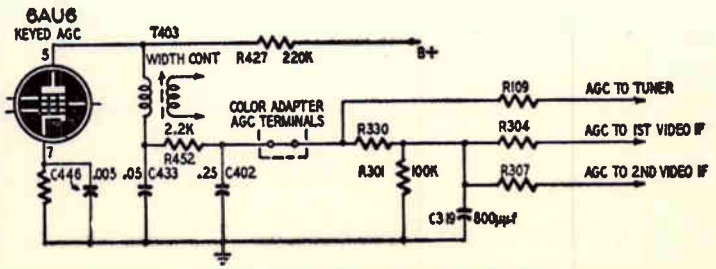

Fig. 54. The modifications shown in the above circuit will improve the stability and holding range of the horizontal multivibrator and improve the a.g.c. filtering.

that C412 connects to pin 2 of the vertical multivibrator and R420 connects to ground.

4. Connect a 0.1-μf capacitor between pin 2 of the picture tube and the junction of C412 and R420.

To improve vertical hold. Change R411 at the input to the integrating network from 1,500 ohms to 1,800 ohms.

Chassis V–2203–1

Critical lead dress. R.f. pickup. R.f. tweet. Leads that are susceptible to r.f. pickup with resulting interaction between stages must be dressed close to the chassis mounting plate. These leads include heater, a.g.c., B-plus, and 125-volt bus leads. Leads must be long enough to permit dressing most of the path length close to the mounting plate. Heater wiring arrangement should not be altered.

Leads associated with the 41.25 mc trap must be short as possible and dressed away from the chassis.

Video peaking coils should be dressed away from the chassis and clear of adjacent parts.

The lead from the width transformer to pin 5 of the 6AU6, a.g.c. keying tube, must be dressed close to the chassis and away from the ringing coil.

The lead-in from the antenna terminals to the tuner must be dressed away from the i.f. chassis to prevent r.f. tweet. Do not dress lead-in close to hot tubes, since this can melt the lead-in plastic.

In replacing components, put new parts in nearly same position as possible. Examine lead dress before removing parts.

Miscellaneous

Shorted cathode-ray tubes. High-resistance shorts between grid and cathode are common troubles in 12JP4 TV picture tubes. They cause loss of sync pulses which thus produces tearing in the picture. In most cases the short can be burned out by applying a high voltage between the shorted elements.

Like most experimenters and service technicians, we did not have a source of voltage which would do the job. We hit on the idea of using an automobile ignition system to supply the voltage. We grounded one of the elements to the frame of the car and held the lead from the other near a spark plug while the motor was running. This method worked three out of four times and enabled us to continue to use tubes which ordinarily would have been discarded.

Cathode-ray tube shock. Be sure to discharge the high-voltage anode on all C-R tubes being removed from or going into receivers. Use a heavy insulated lead to short the anode to the chassis or to the tube coating. These tubes hold a heavy charge for a long time—one good shock can do lots of damage.

Tube substitution. During the temporary shortage of 6BQ6-GT's, 6W6-GT's were tried as replacements in several sets and found to work nicely. The latter type is a single-ended tube; the plate-cap lead was wired to pin 3 on the socket. No other changes were needed.

The 6W6-GT heater draws 50 ma more than the 6BQ6-GT, and its plate,

screen, and bias voltages are lower, so it is advisable to study the circuit, tube characteristics, and operating voltages before making the substitution.

Ion burns. Ion burns on picture tubes can be prevented. Here are some fundamental facts. We know that the ion is an atom with electrons added or removed. If there are fewer negative charges (electrons) than there are positive charges in an atom, the atom is positive-charged and is a "cation." If there are more negative than positive charges, the atom is an "anion."

Ions are always present in cathode-ray tubes. Some "anions" come into the electron beam from the cathode. If they are not diverted—or trapped—they are accelerated to the face of the tube and a phosphor burn may result. Compared to the electrons which normally make up the beam, these "anions" are like A-bombs hitting the anode and screen. They range in size up to 100,000 times the size of the electron.

In electrostatically deflected tubes, ions are deflected equally all over the tube and there is no burn. But in magnetically deflected tubes, because of the field of the yoke, most ions strike approximately the same spot on the screen—and burn.

Remember these four points:

1. Adjust the trap for maximum brightness with the brightness control set halfway.

2. Use the trap recommended by the manufacturer.

3. When using a double-magnet ion trap, set the stronger magnet at the rear (next to the base of the tube).

4. Be sure that there is enough spring in the ion trap so that vibration or jarring does not shift it.

Low picture brightness. When low picture brightness is not caused by a defect in the receiver, check the position of the ion trap. If adjusting the trap does not correct the trouble, possibly metal filings may be short-circuiting the magnets. Remove filings with a magnetized screwdriver.

If there is no evidence of a magnetic short-circuit, the magnets may be weak. Try a new ion trap.

Ignition TVI. Automobile ignition systems and arcs from trolley cars tend to interfere with TV receivers.

Eliminate interference of this type by elevating the TV antenna and moving it to the rear or remote side of a building. Shielded or coaxial transmission line prevents noise pickup on the lead-in. A false ground or reflector made of fine wire mesh will often prevent interference from reaching the antenna proper if it is installed in a horizontal plane below the antenna.

Reduce interference from oil burners, refrigerators, washing machines, etc., by grounding the cabinet or case housing the motor or by grounding the motor frame itself through a .05-μf, 600-volt paper capacitor.

Unusual TVI. Sometimes when tuning the low-band TV channels, a single barber-pole horizontal stripe will drift slowly up and down the picture. This effect is generally seen in weak-signal areas, in the evening when more lights are on.

This trouble is usually caused by a bad light bulb, but it can also be caused

by a high-resistance contact between bulb and socket. Locate the bad one by turning off each light until you find the one which is causing the trouble. If a new bulb doesn't stop the interference, try burnishing the base of the lamp and the socket.

TVI from Christmas tree. During the Christmas holidays, we received a number of complaints of flutter and dark moving horizontal lines on TV sets which had built-in antennas or were used with indoor antennas.

The trouble was traced to the use of metallic tinsel as decoration on Christmas trees. Any slight movement of the tree set the tinsel in motion, causing reflections which produced the symptoms. The trouble was cleared up by moving the set or antenna into another room.

Spot killer. This circuit modification prevents formation of the intense spot

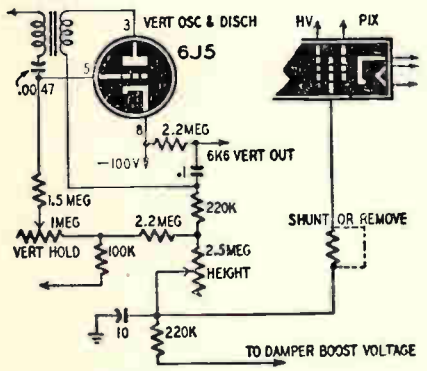

Fig. 55. Circuit to prevent spot formation.

of light that appears in the center of many TV screens immediately after the set is turned off. In most TV sets the picture tube first anode is supplied from some point in the power supply proper. The diagram shows how a popular RCA circuit can be modified so the first anode is supplied directly from the arm of the height control which usually obtains its voltage from the damper-boost circuit. If the original circuit has a resistor in series with the first anode, remove it.

This circuit also aids in eliminating the brown spot seen on kinescope screens after some use. Although the circuit shown is applied to the 630-type set, there is no reason why it cannot be applied in other receivers.

Take care when adding this circuit to sets having large picture tubes, because the boosted voltage may exceed the maximum voltage which may be applied to grid 2. If the voltage exceeds 400, use a voltage divider.

Buzz. An annoying noise which sounds like intercarrier buzz sometimes occurs on split-sound and intercarrier models. In several instances, this trouble has been traced to ineffective grounding of the outer coating on the picture tube caused by bent or missing grounding springs.

This trouble can be cleared up by providing a good connection between ground and the outer coating of the tube.

Hum. Intermittent hum and noise in TV receivers can often be traced to an intermittent short between heater and cathode in the local oscillator tube. Since this short does not always show up on a tube tester, the most reliable test is to substitute a new tube. Because noise and hum of this type seldom appear in the picture, the technician can waste lots of time looking in the a.f. circuits.

To increase picture width. If the width control of a TV set cannot be adjusted

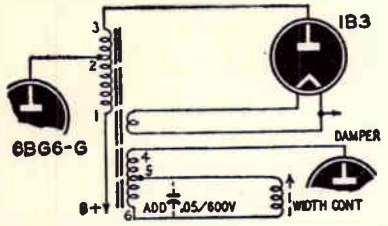

Fig. 56. Capacitor added to increase width.

so the picture completely fills the screen, or if the set has no width control, the picture width can be extended to a satisfactory degree by connecting a .05-μf, 600-volt capacitor across the horizontal output transformer, as illustrated above.

Variable width control. This scheme can be used to increase the width of a

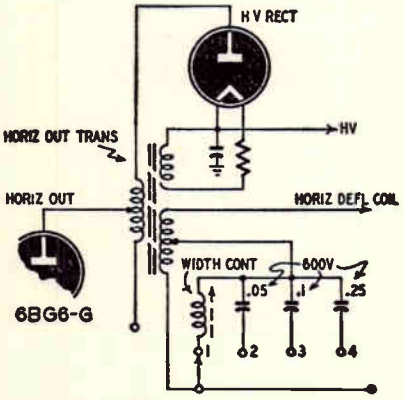

Fig. 57. Technique for variable width.

picture. Disconnect the lower end of the width coil from the transformer and connect it to position 1 of a four-position rotary switch. Connect the capacitors between the switch points and the other end of the width control as shown in the diagram. The width of the picture increases in steps as the switch is advanced.

Tube substitution. Many tubes discarded as being inoperative in certain critical circuits, operate satisfactorily in other circuits in the set that use the same type of tube. For example, a microphonic 6J6 oscillator tube may be entirely satisfactory for use in the r.f. or converter stages of the same r.f. unit. A 6K6-GT tube which may not be entirely satisfactory for use as a video amplifier may be perfectly usable in the sound-output stage. Also, swapping of such types as 6SN7-GT, 6AG5, 6AL5, etc., may provide a simple solution to a complaint.

High-voltage failure. When checking TV receivers for lack of high voltage on the picture tube, it is a good idea to check the setting of the horizontal-drive trimmer capacitor. In many new sets, this trimmer has been turned all the way in to eliminate vertical overdrive lines at the left of the picture. When the receiver ages, there is a lack of horizontal drive on the output tube. This results in little or no high voltage. Sometimes, you may find the trimmer completely shorted to ground.

Vibrating antenna. The reflector of the TV antenna would vibrate when the wind was high. This vibration could be felt all over the house and caused an annoying noise.

The trouble was cured by tying a piece of wire from the ends of the reflector to a point on the boom behind the radiator. This did not affect the picture and the antenna seemed to pick up less noise.

Miscellaneous

Using wire as a tie-down may affect the performance of some antennas. If it does, try using prestretched nylon cord or rope.

Focus magnets. The PM and EM-PM type focus magnet assemblies used in many TV sets can be permanently damaged by improper handling or storage. A slight jar or striking with a metal tool may cause the unit to lose its magnetism and affect its ability to properly focus the electron beam on the screen of the picture tube.

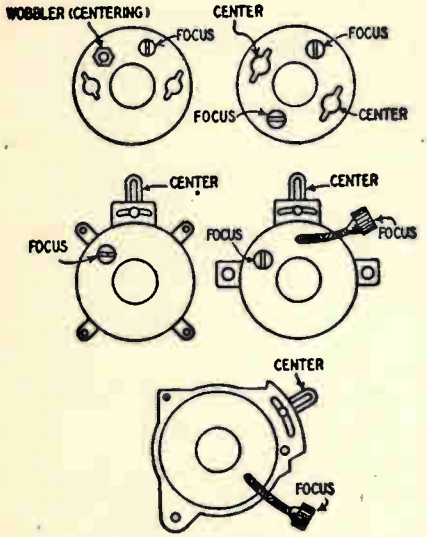

Fig. 58. PM and EM-PM focus assemblies.

Always use a brass or nonmetallic screwdriver when making adjustments on the unit. When storing, do not leave them in contact with each other or with any metal material such as tools, other components, or shelving. Do not store them where they will be subjected to severe mechanical shock or vibration.

Focus magnets are used instead of electrodynamic focus coils in a number of TV receivers. Because centering and focusing adjustments vary with different makes and types of magnets, these outline drawings are reprinted from *Tele-Tone Service Bulletin* to assist the service technician in identifying and adjusting each type.

Germanium crystal detector. The backward resistance should be 300,000 ohms or more and the forward resistance should be approximately 200 ohms. Be careful when working with a soldering iron near the crystal. Heat may permanently damage it. If replacement is necessary, grasp each lead with pliers while soldering into place. The pliers will dissipate the heat and prevent damage to the crystal.

Horizontal oscillator drift. Some manufacturers' types of 6SN7-GT may perform better than others in the horizontal oscillator socket. Excessive drift of the horizontal oscillator circuit may be caused by a weak or defective 6SN7-GT tube.

Cooling a TV set. Before devising this method of cooling, the TV set would get very warm after operating for a couple of hours. A replacement phonograph motor was purchased and fitted with a 4-inch fan. The bottom was cut out of a 5-pound syrup can and the motor mounted in it. Small angle brackets were used to fasten the assembly to the perforated back of the set. With the motor leads connected across the primary of the power transformer, the fan draws out the warm air and set runs cool.

Troubles in a.f.c. circuits. Troubles in a.f.c. circuits can be numerous and may be caused by minor changes in the

values of many components. These few hints are useful when servicing a.f.c. circuits:

1. Always check the damper tube in circuits where the feedback voltage is taken from the plate of the horizontal output or damper tubes.

2. Check the feedback windings for open circuits and shorted turns.

3. When replacing resistors and capacitors in the a.f.c. circuit, always use units having tolerances equal to or closer than those of the original. Check the parts list and diagram to be sure.

4. Check all tubes which are even remotely connected with the horizontal deflection circuit. Sync separators, d.c. restorers, clippers, amplifiers, and clamps can affect the operation of some circuits.

Barkhausen oscillation. The usual effects of Barkhausen oscillation make themselves evident by producing one or more dark, sharply defined vertical lines on the left side of the picture or raster. These lines vary in width and/or intensity from one channel to another and from one brightness level to another. They are usually more apparent on the higher frequency channels and at low brightness settings. In the worst cases, these oscillations tend to upset horizontal synchronization. In the mild cases, they usually annoy the customer more than they injure the set.

The only tube in the set that could cause this interference is the 6BG6-G since it is the only one that has a positive grid to plate potential at any time. The critical voltages are reached just about the time the tube calls for deflection of the beam to the right-hand side of the raster. This happens when the spot is about one-third the way across horizontally.

Following are a few solutions to the problem:

1. Change the drive-control setting.

2. Replace the 6BG6-G with another. (The tube being replaced will probably operate satisfactorily in some other chassis.)

3. Change antenna or antenna lead-in placement.

The first method is critical with respect to line voltage and should be adjusted to give satisfactory operation on all available channels at any line voltage encountered.

The installations using either a built-in antenna or an indoor antenna are often subject to an undue amount of pickup because of their location. The lead-in, if draped near the high-voltage compartment can also cause trouble. The solution for this type of trouble is obvious.

If a severe case of Barkhausen oscillation is encountered, and all normal methods have been unsuccessful in eliminating this trouble, a last resort which is usually successful is the installation of an ion trap magnet of any type over the horizontal power-output tube (6BG6-G or equivalent). Magnets (complete with holders) are also available, made specifically for this purpose. The position of the magnet should be adjusted to eliminate the oscillation.

Normal raster, good sound, no picture. Normally this would indicate trouble after sound take-off. In a number of instances, however, this trouble was found to be due to a defective 1N60

crystal diode video detector. This would not ordinarily be suspected in receivers in which the sound take-off is beyond the detector circuit. Evidently the rectifying action of these crystals can decline considerably but still permit heterodyning of sound and picture signals to secure the necessary 4.5-mc frequency for the sound i.f. stages.

Afterglow. In many receivers afterglow is centered on the screen after the set is shut off, and remains there while slowly dimming out. A very slight rotation of the ion trap a few degrees in one direction or another will alter the afterglow condition, and cause the afterglow to sweep upward and disappear as soon as the set is shut off. There is usually sufficient latitude with regard to a few degrees rotation of the ion trap where brightness is not diminished. This depends on gun structure and circuit design and will not work with all receivers.

Pincushion effect. Barrel effect. Can be caused by a defective deflection yoke. The yoke may have shorted turns. Pincushion and barrel effect can also be caused by a mismatch between the horizontal output transformer and the yoke. Also check to see that there is no magnetic field too close to the picture tube. Make sure the speaker and the transformers are not creating magnetic fields which would cause picture distortion. A small pincushion effect is a normal characteristic of most high-efficiency 70-degree deflection yokes, especially those with cosine-type windings. The picture size is usually adjusted so that the concave edges are outside the mask.

Standard coil tuners. A weak, snowy picture may be caused by an inoperative r.f. stage in sets using these tuners. A common cause of this trouble (other than tube failure) is a shorted screen bypass capacitor. The best way to check for this is to remove the r.f amplifier tube (6AG5, 6BC5 or 6CB6) and check the screen voltage from the top of the chassis. If this voltage is low or zero it will be necessary to remove the turret and replace the defective component.

If the set has been in operation for an extended period of time with the capacitor shorted, it is advisable to replace the two resistors between the r.f. amplifier screen and B+ point, since they probably will have been overheated by the short. Since the short lowers the B-voltage to the 6J6 oscillator-mixer tube it may also not function (unless the resistor connected to the screen has opened because of overheating). In these cases the trouble is apparent because the resistor often breaks in two.

Reducing BCI from TV sets. Whistles throughout the broadcast band can be caused by radiation from the horizontal sweep circuit of a near-by TV receiver. This trouble originates most frequently in sets having metal picture tubes. Conductive coatings of most glass tubes minimize radiation.

The trouble can be reduced or eliminated in sets having metal picture tubes by connecting a 500-$\mu\mu$f, 20-kv filter capacitor between ground and the high-voltage lead running directly to the second anode. The connection to the high-voltage lead should have smooth soldered joints to avoid corona

discharges. A further reduction in 15.75-kc radiation can be obtained in some instances by connecting a 0.1-μf, 600-volt capacitor from each side of the a.c. line to ground.

Adjusting turret tuners. The individual oscillator adjustment screws for each channel of turret tuners often fit so loosely that movement of the channel selector causes some of them to shift and throw the circuit out of alignment, making it difficult to tune in some stations properly with the fine-tuning control. We recommend that you adjust the oscillator trimmer for each channel with the fine-tuning control centered, then apply a drop of cement to each trimmer screw to lock it firmly in place.

Intermittent picture. If the picture on a TV receiver varies in intensity or disappears intermittently, look for arcing at the base of the high-voltage rectifier socket. This condition can best be checked in a dim light. If arcing is noted, lengthen the insulation path by bending the socket prongs and coating them with service cement or coil dope. Replace the socket if continuous arcing has charred it.

TV signal substitution. The problem of isolating a defective stage in a TV receiver can be simplified by using another receiver as a signal source if both receivers have the same intermediate frequency. A length of 300-ohm transmission line and two .01-μf capacitors are required.

Check power plug polarity to ground on both chassis if sets are transformerless.

Use one conductor of the transmission line to connect the two chassis; connect one capacitor to each end of the other conductor. Tune the operating receiver to a station, and connect one capacitor to the *output* of the video amplifier. Use the other capacitor as a probe and feed this signal into the *input* of the video amplifier in the defective set. If the video amplifier is good, you will get the same picture on both sets, assuming that the sweeps are in good order. Proceed in a like manner to the front end of the set or until the defective stage is isolated.

The good receiver can be used as a signal tracer by reversing the process.

Howl. If a set howls when a station is tuned in, the trouble may be traced to a microphonic high-frequency oscillator tube which is affected by vibrations from the speaker. Replace this tube with one which is not microphonic, taking care to select one having similar characteristics so the alignment will not be disturbed.

Deflection circuit failure. A number of television receivers use either 6SN7's, 12SN7's, or 6BL7's in vertical and horizontal sweep and deflection circuits. In the event of either vertical or horizontal oscillator failure, try switching the tubes between the sweep and deflection circuits. A tube which will not work as an oscillator may work quite well as an amplifier. This is an emergency measure, so the defective tube should be replaced as soon as possible.

No high voltage. When checking television receivers for lack of high voltage at the second anode of the picture tube, it is a good idea to check the setting of

the horizontal-drive trimmer capacitor. In many new sets, this trimmer has been turned all the way in to eliminate vertical overdrive line at the left side of the picture. When the receiver gets older, there is a lack of horizontal drive on the horizontal output tube. This results in very little or no high voltage. Sometimes, you may also find the horizontal-drive trimmer capacitor completely shorted to the chassis.

Distortion. Kink in edge of raster. If the metal cone of a 21AP4 or similar type of cathode-ray tube becomes magnetized, it becomes the possible cause of an objectionable distortion taking the form of a kink in the edge of the raster. The magnetism, caused by too close contact with a very strong magnetic field (such as the magnetic field existing around a permanent magnet type of speaker) is usually localized and can be identified by a small pocket-type compass. The magnetism is most disturbing when it occurs in either the middle or at the small end of the cone.

Demagnetize the metal cone of the picture tube with an a.c. electro-magnet made by winding approximately 1,250 turns of No. 24 insulated wire on a 7-inch form. Connect the coil to a 117-volt a.c. line and move its flat side over the magnetized areas. Do not remove the power from the coil until after it has been moved away from the picture tube. Do not attempt to use the coil on a d.c. line.

The coil draws a current of approximately 1 ampere from the power line. The demagnetizing coil will overheat if used continuously.

Picture will not center. When you have trouble in centering a television picture sufficiently to fit the screen, try moving a small permanent magnet around the neck of the picture tube—preferably between the deflection yoke and the focus coil (or focalizer, if one is used). When the picture is properly centered, carefully tape the magnet in place.

Caution: Be careful when trying this suggestion on a metal-type cathode-ray tube. There is danger of permanently magnetizing an area of the metal cone. Magnetization of the metal cone of the picture tube will result in a picture that may be severely distorted. Use care when making the adjustments. Any change in the strength or in the position of the normal magnetic fields of the focus coil or deflection yoke may have a decided effect on the operation of the ion trap, resulting in possible loss of brightness, corner cutting, and ion spot. Make your initial adjustments with the brightness control turned down low. After centering the picture, readjust the ion-trap magnet for the brightest raster, even if this results in corner cutting. As an aid in eliminating neck shadows this measure supplements rotation of the picture tube, and the usual deflection yoke and focus coil adjustment.

Buzz. An annoying buzz is sometimes present in the audio amplifier circuits of television sets which use a 6T8 as a discriminator-type detector and first audio amplifier tube. This buzz, which can be heard with the volume control turned all the way down, is comparatively common when the 6T8 is located

under or close to the television picture tube. The trouble can be eliminated by placing a well-grounded shield over the 6T8. Do not use a shield that is so small in diameter that it requires a force fit over the 6T8, since the tube will crack when it gets hot. The shield should make good contact with the chassis, not just at one point, but completely around the shield base for most effective shielding.

Adjusting turret tuners. The individual oscillator adjustment screws for each channel of turret tuners often fit so loosely that movement of the channel selector causes some of them to shift and throw the oscillator circuit out of alignment, making it difficult to tune in some stations properly with the fine-tuning control. The actual result is a loss of sound and picture coincidence—that is, sound and picture not coming in together. We recommend that you adjust the oscillator trimmer for each channel with the fine-tuning control centered, then apply a drop of cement to each trimmer screw to lock it firmly in place. This will also prevent the oscillator slug from moving when the receiver is returned from the shop to the customer's home. A tiny dab of the cement is sufficient, since it may be necessary at some later date to readjust the oscillator slug once again. This technique also discourages set owners from tampering with oscillator adjustment slugs.

Hum. Intermittent hum and noise in television receivers can often be traced to an intermittent short between the heater and the cathode in the local (high-frequency) oscillator tube. Since this short does not always show up on a tube tester, the most reliable test is to substitute a new tube. Because noise and hum of this type seldom appear in the picture, the service technician can waste lots of time looking for the trouble in the audio-frequency amplifier circuits.

Radiation interference. The next time you have to shield a television or broadcast receiver to prevent the radiation of interference or pickup of shortwave interference, try using Reynolds Wrap or similar aluminum foil. This material is flexible enough to follow the contours of the cabinet and is tough enough to be worked without tearing. The foil can be held in place with thumb tacks. Ground the metal foil to the receiver chassis with a small piece of flexible metal braid. In television sets using metal cone tubes make sure that the metal foil cannot touch the tube cone. A number of receivers use uninsulated metal-cone tubes. These cones are "hot."

Interlock jumper. A 2- or 3-foot piece of line cord with a male plug on one end and a female plug on the other end makes a handy jumper for the interlock switch when it is necessary to adjust the set in the cabinet with the safety cover open. This is convenient in those receivers in which the safety cover is not designed to be removed.

Height and width adjustments. Upon removing the average set from its cabinet, you will probably find the cathode-ray tube covered with a film of dirt and dust except for the portion that was covered and protected by the plastic bezel. If you lightly outline the

mask area with a soft wax crayon, you will be able to check the operation of the width and height controls before the set is returned to the cabinet. When the picture area has been outlined by the crayon, clean the face of the picture tube, being careful not to wipe off the mark left by the crayon.

Ignition TVI. Automobile ignition systems and arcs from trolley cars and automobiles tend to interfere with television reception. You can eliminate interference of this type by elevating the television antenna and moving it to the rear or remote side of a building. Shielded or coaxial transmission line prevents noise pickup on the lead-in. A false ground or reflector (known as a counterpoise) will often prevent interference from reaching the antenna proper if it is installed in a horizontal plane below the antenna. The reflector can be made of fine wire mesh. The reflector should be grounded at one point only. Experiment with different reflector positions until best results are obtained. Also connect the ground point to different parts of the reflector for best rejection of interference.

Interference from oil burners, refrigerators, washing machines, motors of various types, etc., can be reduced or eliminated by grounding the cabinet or case housing the motor or by grounding the motor frame itself through a .05-μf, 600-volt paper capacitor. Connect a similar capacitor to the ungrounded side of the power line going into the receiver.

If the existing lead-in is unshielded 300-ohm transmission line and you wish to substitute coaxial cable in order to minimize interference pickup, refer to page 84 for a means of obtaining an impedance match between 72-ohm coaxial cable and the usual 300-ohm input to most receivers.

Unusual TVI. Look around for old-fashioned clear tungsten lamps when unable to identify or localize the source of television interference. One such lamp caused two entirely different interference patterns on two receivers in one installation. The offending lamp was removed to the service shop where it produced a third interference pattern on a set there. Similar TVI can also be caused by a loose lamp in a socket, or by a lamp whose base has become tarnished. Burnish the lamp base with fine steel wool. Poor power-line connections to any electrical appliance can also cause TVI.

Finding lead-in break. Long TV lead-ins often develop close-gap breaks which affect the performance of the receiver. Since the wire usually breaks while leaving the insulation intact, it is often more economical to replace the line than to spend the time required to locate the break by carefully going over every inch of the transmission line.

Breaks are easy to locate if you put a standard a.c. line plug on one end of the line and a socket and 115-volt bulb on the other. When you insert the plug into the power line, the current will jump across the gaps and develop enough heat to burn the plastic insulation. The breaks can then be spotted by inspection. The breaks should be cleaned, soldered, and taped to restore normal service.

Breaks are usually caused by abrasion of twin-lead against rough brick, mortar, or cement surfaces. To prevent a call-back, check installation to make sure lead-in is clear of any rough building surface.

Noise. Don't overlook the possibility that noise in a television receiver can come from a loose fuse. Check the fuse in the high-voltage supply (unless the fuse is of the pigtail type) and the fuse (or fuses) in the primary of the low-voltage power transformer. Force the fuse holder contacts together slightly if they appear to be sprung.

Increased picture width. To increase the picture width by about one-half inch, get a scrap piece of twin lead (two-wire transmission line) about 18" long. Expose about one-half inch of one of the conductors (at either end) and solder to the plate cap connector of the horizontal output tube. The twin lead can hang free, or it can be tacked on to the side of the cabinet. Just keep the lead away from any hot parts or tubes to prevent the plastic of the twin-lead from melting. This technique can result in foldover, however.

High-voltage pulse test. Use a neon bulb to check for the presence of high-voltage pulses in a television receiver. Bring the bulb close to the cap of the horizontal output tube. The bulb should light fairly brilliantly. If the bulb lights poorly or not at all, then the high voltage pulses are either weak or do not exist. This method is preferable to a screw driver test (touching the plate cap of the horizontal output tube) since it does not load down the high-voltage supply and cannot damage the flyback transformer.

Improving fringe pickup. Television, or FM installations at some distance from the transmitter are often on the fringe of good reception where precise tuning of the antenna system will increase the signal enough to make it usable. A simple method of tuning which may produce satisfactory results is to wrap a piece of tin foil around the lead-in—this idea applies only to ribbon lines—and adjust its size and position for best performance. Fasten it permanently in place with cement or Scotch tape. In television fringe installations, it is usually desirable to have several individually tuned antennas rather than to try to make one work for all stations.

An alternative method is to put a 5- to 25-$\mu\mu$f variable ceramic capacitor in each leg of the transmission line as close to the antenna terminal as possible. Tune in your weakest channel and then adjust each variable capacitor for best reception. Do not readjust these capacitors for any other channel.

Pickup can also be improved by connecting about 18" of twin lead to the antenna posts of the receiver and permitting this twin lead to hang free down the back of the receiver. Tune in your weakest station. Use a sharp razor blade and force the blade across the twin-lead at successive positions along the lead. The blade will short one leg of the twin-lead to the other as you go along. At the spot where the shorting blade produces the best picture, cut the twin-lead and connect the two exposed ends.

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