PHILCO SERVICE

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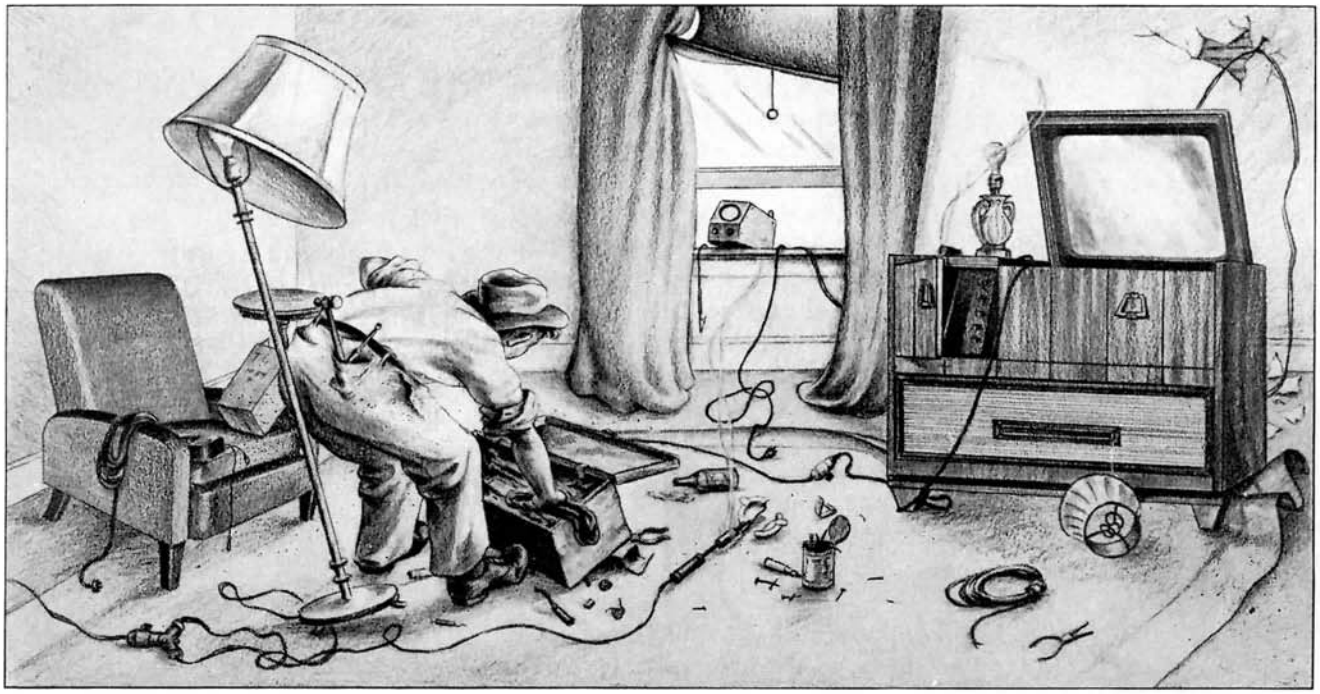
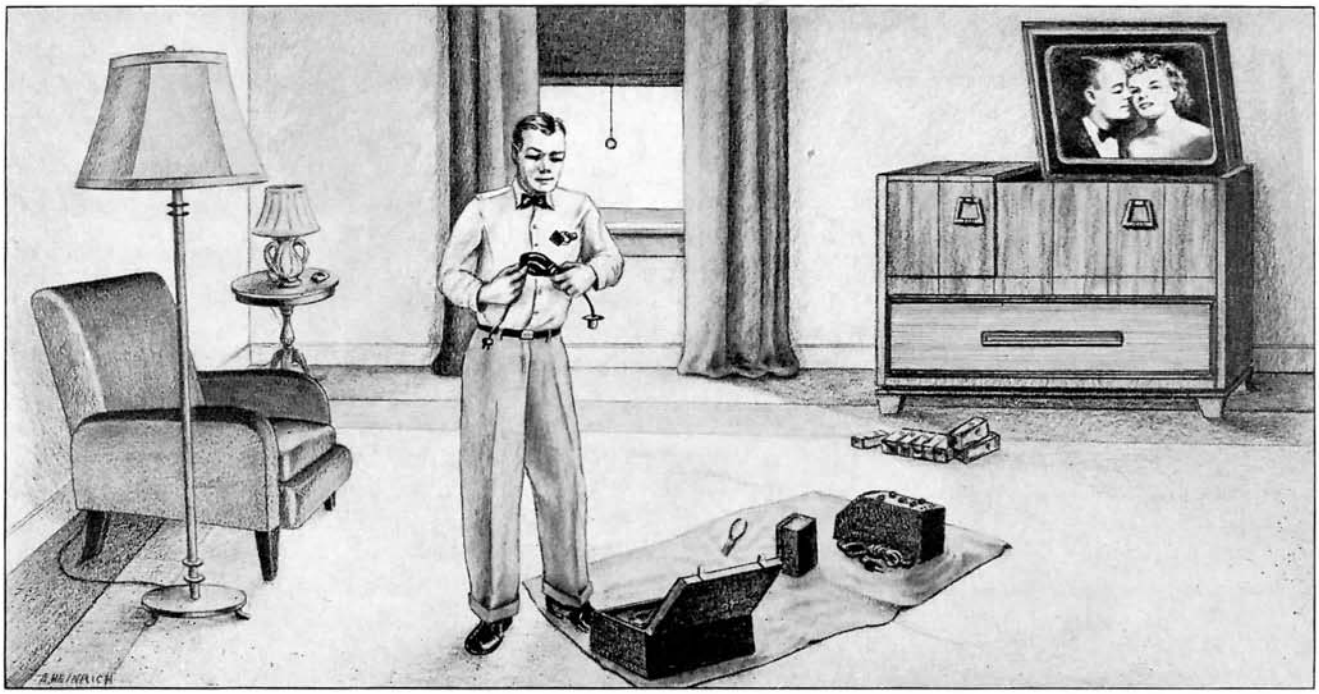
PHILCO PROJECTION TELEVISION RECEIVER MODEL 48-2500



WHICH WOULD YOU PREFER IN YOUR OWN HOME?



SUGGESTIONS FOR THE SERVICEMAN

THE IMPORTANT factor in your success as a television serviceman, aside from your technical skill, is the impression you make on the customer. You must always be courteous, neat, and clean. In addition to your professional attitude, your general appearance determines to a great extent whether your services will be in demand, or whether you will be considered a hit-and-miss serviceman who will be called only as a last resort.

In keeping with your personal appearance, your work in the customer's home should always be done carefully and neatly. Your customer regards his home as his most valuable possession. He has purchased a television receiver to improve his home and to provide increased pleasure for his family and friends. Any damage which he can trace to your careless workmanship will neither be overlooked nor forgotten. It may become the basis of a claim for the cost of repairs, or, at least, the customer will remember, every time he views the television receiver.

For that reason, unpack the television receiver on the porch or in the basement. If it must be unpacked in the living room, spread a heavy cover on the floor. Then you can unpack and assemble the instrument on this cover, and thus avoid littering the customer's home with splinters and packing material.

Place your tool box on the floor—never on the furniture. Keep your tools in an orderly arrangement in the box—not scattered over the floor. Also, put a cloth under your tool box so that it cannot soil the rug nor scratch the floor. In addition, place the soldering iron carefully, so that it cannot fall off its stand and scorch the rug nor char the floor.

When you are obliged to move furniture, be very careful that you do not mar either the furniture or the floor. You would be wise to check the position of articles in the room before you begin to work. Thus, you can decide which articles you can move safely and which floor lamps you should place, so that you will not knock them over accidentally.

The proper performance of the receiver requires that the customer know how to adjust the operating controls and how to recognize a good picture. You must also explain the operation of each control and then hand the customer his Users' Instructions for reference. Avoid mentioning interference problems, unless an interference pattern is present, and be especially careful to avoid giving a lecture on the theory and principles of television operation—just to show how much you know. Professional men always explain technical matters simply and briefly.

In making conversation with a customer, avoid any mention of politics, religion, or obvious personal matters. More ill will has been created by such chance remarks than you can possibly imagine.

When you are making aerial installations, walk around the roof as little as possible, so that you may avoid causing leaks or ceiling cracks. Be sure to obtain permission before you drill into a chimney to mount the aerial. Also, be particularly careful to follow Underwriters' regulations and local ordinances in making installations. Before you drill any holes, survey the location thoroughly, so that you may avoid drilling through the roof or into such objects as furniture, radiators, or rugs. Make transmission lines slightly longer than is necessary, so that the receiver can be moved aside when the room is being cleaned.

Before you leave the customer's home, view the receiver from all possible locations, to make certain that the picture is clear from all positions. After you have completed your work, clean the rug or floor of any dirt you have created, fluff up the chair cushions, straighten the covers, and replace doilies on the furniture. Make the customer see that you are careful to leave both the room and the outside of the house as neat and clean as they were before you did your work. As you leave, wish the owner many happy hours with his new television receiver and assure him of your desire to help him in any way you can.

Many other precautions will occur to you, if you are an alert serviceman—these precautions will pay dividends in the form of good will toward Philco and in the customer's personal recommendations to other potential buyers.

GENERAL DESCRIPTION

PHILCO PROJECTION TELEVISION RECEIVER MODEL 48-2500 is a 29-tube console model employing a combination video and audio superheterodyne receiver and the new Philco Micro-Lens Projection System. The Micro-Lens Screen is mounted inside the lid of the cabinet, and a lid switch is provided so that the receiver cannot be operated unless the lid is in viewing position. The projection system produces a brilliant 15 x 20-inch picture that permits comfortable viewing by a relatively large audience at distances of from 10 to 30 feet.

Outstanding circuit advancements, developed by Philco Engineers, include:

a. The Philco Precision Channel Selector, a self-contained r-f unit, which provides high gain with good channel selectivity, and which is especially designed to prevent interference with nearby television receivers.

b. Automatic Tuning with Electronic Control, an exclusive Philco feature, which provides automatic tuning of the television receiver; this feature compensates for any undesirable changes in frequency, and produces clear, firmly synchronized pictures.

c. Automatic Level Control of Picture and Sound, which compensates for changes in the level of the received signal that might cause undesirable picture flicker, and which eliminates the need for any manual adjustment of volume after the desired sound level has been selected.

These outstanding features, combined with precision construction, reduce the number of operating controls to five, and greatly simplify the operation of the receiver.

The Philco Micro-Lens Projection System features the light-collecting properties of modern, astronomical optical systems and an improved correcting lens to furnish brilliant, true picture reproduction on the Micro-Lens Screen. This "television screen with a million lenses" is another Philco first, and is a high-gain, directional viewing screen designed on the cylindrical field-lens principle; outside light is deflected by the screen so that it cannot affect the brightness of the picture. The directional properties of the viewing screen produce a maximum of picture-light concentration which, together with the efficiency of front-projection, provides a picture of unexcelled brilliance.

Specifications

CABINET:
Modern style, mahogany-finish console

PICTURE SIZE:
15 x 20 inches (projected)

FREQUENCY RANGE:
Television broadcast channels 1 through 13

CHANNEL TUNING:
Eight-position Philco Precision Channel Selector supplied with snap-in coils for television channels allocated to area in which Receiver is to be used

INTERMEDIATE FREQUENCIES:
Video I.F.—26.6 megacycles, adjacent-channel sound trap 28.1 megacycles
Audio I.F.—22.1 megacycles

AERIAL:
Provision for two aerials, one for low-frequency television channels (1 to 6 inclusive), and one for high-frequency television channels (7 to 13 inclusive)

TRANSMISSION LINE:
Non-resonant, 300-ohm, balanced type

VACUUM TUBES (29):

LOKTAL	OCTAL	MINIATURE	CRT
1-7AD7	3-1B3GT	6-6AG5	1-TP400
1-7B4	2-5U4G	3-6AL5	
2-7B5	1-6AS7G	1-6J6	
1-7B6	1-6BG6G		
1-7F8	2-6SL7GT		
2-7W7	1-6V6GT		

AUTOMATIC TUNING WITH ELECTRONIC CONTROL:
Automatic frequency control of oscillator

AUTOMATIC LEVEL CONTROL OF PICTURE AND SOUND:
Amplified automatic gain control

DETECTOR:
Audio, ratio-type FM, 500-kc. peak-to-peak band width
Video, diode-type AM

TONE CONTROL:
Continuously variable, treble to bass

BASS COMPENSATION:
Tap on volume control

AUDIO OUTPUT:
2.5 watts

SPEAKER:
Dynamic, 10-inch, permanent-magnet type, 3.2-ohm voice coil

PHILCO MICRO-LENS PROJECTION SYSTEM:
Front-Projection type, 15 x 20-inch picture projected on Micro-Lens Screen in lid of cabinet
Modified, wide-aperture, Schmidt optical system, using 12-inch spherical mirror and 7-inch corrector lens, throw of 33.5 inches
Four-inch projection tube, using magnetic deflection and combined electro and permanent-magnet focus

DC RESTORATION:
Diode type

DEFLECTION GENERATORS:
Hard-tube horizontal and vertical-sweep oscillators

OPERATING VOLTAGE:
110–120 volts, 60 cycles, a.c.

POWER CONSUMPTION:
320 watts

POWER SUPPLIES:
325 volts, d.c. at 300 ma., unregulated 18,000 to 20,000 volts, d.c. at 70 to 80 microamperes, unregulated

VIDEO RESPONSE:
30 cycles to 4.0 mc.

SCANNING:
525 lines, interlaced

HORIZONTAL-SCANNING FREQUENCY:
15,750 c.p.s.

VERTICAL-SCANNING FREQUENCY:
60 c.p.s.

FRAME FREQUENCY:
30 c.p.s.

DIMENSIONS:
Cabinet (outside): height, 33 5/16 inches; width, 39 1/16 inches; depth, 21 1/16 inches
Chassis (over-all): height, 10 inches; depth, 17⅞ inches; width, 18½ inches

SHIPPING WEIGHT:
256 pounds

FUNCTION OF TUBES:

TYPE	FUNCTION
1B3GT	High-voltage rectifier
1B3GT	High-voltage rectifier
1B3GT	High-voltage rectifier
5U4G	Low-voltage rectifier
5U4G	Low-voltage rectifier
6AG5	R-f amplifier
6AG5	Mixer
6AG5	Input i-f amplifier
6AG5	First video i-f amplifier
6AG5	Second video i-f amplifier
6AG5	First video amplifier
6AL5	D-c restorer
6AL5	Discriminator (FM detector and a.f.c.)
6AL5	Video detector and a-g-c rectifier
6AS7G	Horizontal-damping tube
6BG6G	Horizontal-sweep output
6J6	Oscillator and oscillator control
6SL7GT	Vertical-sweep generator
6SL7GT	Horizontal-sweep generator
6V6GT	Vertical-sweep output
7AD7	Video output
7B4	First audio amplifier
7B5	Audio output
7B5	Sync separator
7B6	A-g-c amplifier
7F8	Vertical-sync amplifier and horizontal-sync amplifier
7W7	First audio i-f amplifier
7W7	Second audio i-f amplifier
TP400	Picture tube

Installation-Information Reference

Complete installation details for Model 48-2500 are given in "Installation Instructions for Philco Projection Television Receiver Model 48-2500," Part No. PR-1446.

Television-Aerial Information

A good aerial installation, with proper aerial adjustment and orientation, is required to secure the best possible performance from Model 48-2500. Complete aerial-installation instructions are given in "Installation Instructions for Philco Television and FM Aerials," Part No. 39-8595, which is included with each aerial kit.

The following aerial kits and parts are available:

Philco Broad-Band Television Aerial Kit, Channels 1 through 6, Part No. 45-1563.
Reflector Kit for Broad-Band Television Aerial, Channels 1 through 6, Part No. 45-1564.
Philco Broad-Band Television Aerial Kit, Channels 7 through 13, Part No. 45-1561.
Reflector Kit for Broad-Band Television Aerial, Channels 7 through 13, Part No. 45-1562.
Philco Aerial Mast Kit, Part No. 45-1560.
Philco Aerial Mast Mounting Bracket Kit, Part No. 45-1551-1 (for vertical wall mounting).
Philco Aerial Mast and Bracket Assembly, Part No. 45-1551-2 (for locations where self-supporting masts are required).
Sloping Roof Mast Mounting Bracket, Part No. 28-3757-1.
Peaked Roof Mast Mounting Bracket, Part No. 28-3758-1.

Electrical-Control Functions

A number of controls and adjustments are located on the front, rear, and top of the receiver chassis. Only five of these controls (located on the front panel) are to be operated by the user; the remaining controls are adjusted by the serviceman at the time of installation, or while he is testing and aligning the Receiver. Figure 1 shows the front-panel controls, and figure 2 indicates the rear-of-chassis adjustments. The top-of-chassis adjustments are shown in the alignment adjustments photograph, figure 70. A summary of the controls and adjustments by name, reference symbol, and function is outlined in the following chart:

CONTROL	REFERENCE SYMBOL	FUNCTION
Philco Precision Channel Selector	Z400 Z401	Eight-position rotary turret; selects proper aerial, r-f, mixer, and oscillator coils for desired television channel.
OFF-ON-TONE	S101 R214	Line switch operated by turning shaft of tone control in clockwise direction from OFF position. Tone control operates from treble to bass over remainder of rotation.
VOLUME	R213	Controls input voltage to audio-amplifier stages.
BACK-GROUND	R337	Sets d-c bias level of picture tube. Adjust together with CONTRAST control for pleasing picture. See figure 3.
CONTRAST	R333	Determines cathode bias of video output tube to control output level of video signal. This control primarily determines range of gray shades in picture; however, together with BACKGROUND control, it also determines sharpness (focusing) of picture. Adjust both controls alternately until pleasing picture is obtained. See figure 4.

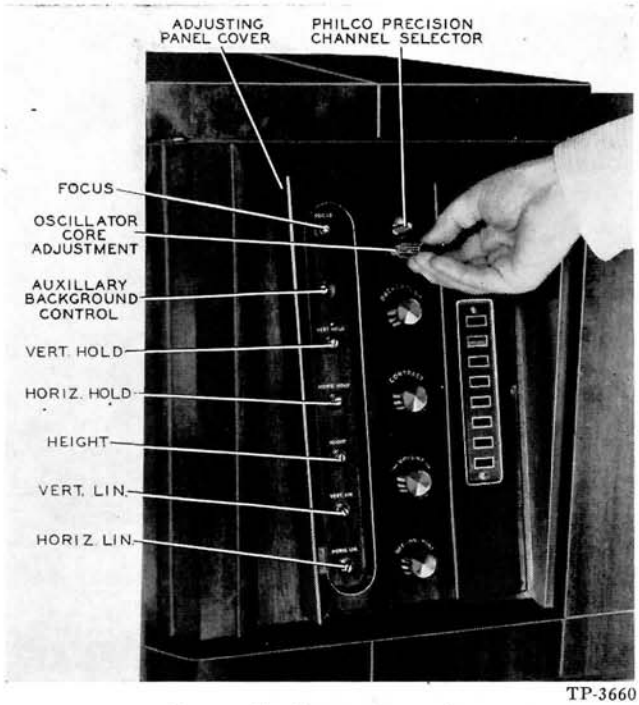


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Figure 1. Front Controls

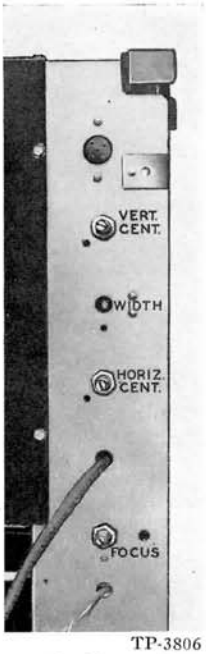

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Figure 2. Rear Controls

CONTROL	REFERENCE SYMBOL	FUNCTION
FOCUS (front panel)	R546	Determines current flow through focus coil. See focus adjustment, page 37. See figure 5.
FOCUS, auxiliary (rear of chassis)	R545	Connected in series with front-panel FOCUS control; fixes range of this control. See focus adjustment, page 37.
AUX. BACK-GROUND	R336	Connected in series with BACKGROUND control. Set for beam current of 70—80 microamperes. See Beam Current Check, page 37.
VERT. HOLD	R521	Controls frequency of vertical-sweep generator. Adjust to center of range over which picture remains vertically stationary. See figure 6.
HORIZ. HOLD	R532	Controls frequency of horizontal-sweep generator. Adjust to center of range over which picture remains horizontally stationary. See figure 7.
HEIGHT	R517	Controls vertical-sweep amplitude. Adjust so that picture fills screen vertically. See figure 8.

CONTROL	REFERENCE SYMBOL	FUNCTION
WIDTH	L502 A&B	Determines current flow through horizontal-deflection coils. Adjust so that picture fills screen horizontally. See figure 9.
VERT. CENT.	R525	Controls amplitude and polarity of centering current applied to vertical-deflection coils. Adjust for vertically centered picture. See figure 10.
HORIZ. CENT.	R548	Controls amplitude and polarity of centering current applied to horizontal-deflection coils. Adjust for horizontally centered picture. See figure 11.
VERT. LIN.	R523	Sets bias on vertical-output tube. Adjust for vertically symmetrical pattern. See figure 12.
HORIZ. LIN.	R540	Controls horizontal-damping tube which determines sweep linearity. Adjust for horizontally symmetrical pattern. See figure 13.
Oscillator Core Adjustment	L400A	Adjusts oscillator coil for correct inductance. See Alignment Procedure, page 36.
Automatic Level Control of Picture and Sound	R321	Determines bias on a-g-c amplifier tube to control a-g-c range. See page 37.

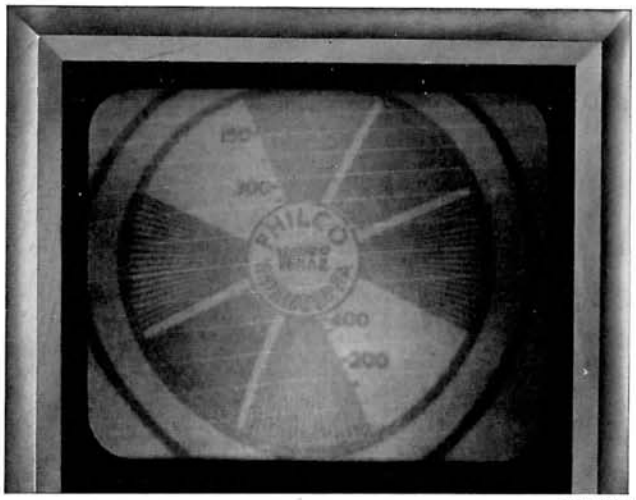

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Figure 3. BACKGROUND Control Requires Adjustment

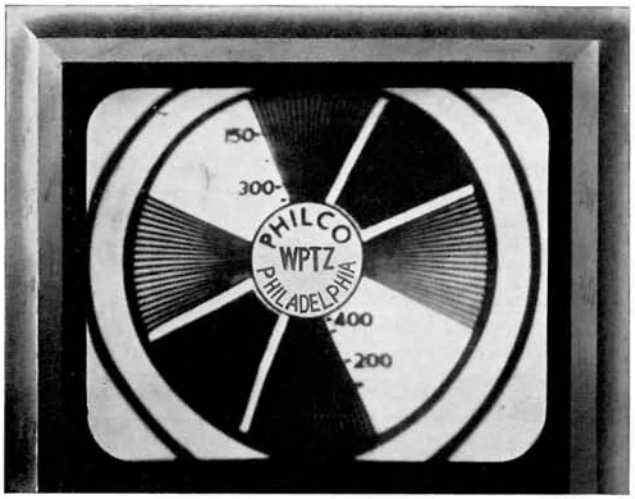

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Figure 4. CONTRAST Control Requires Adjustment

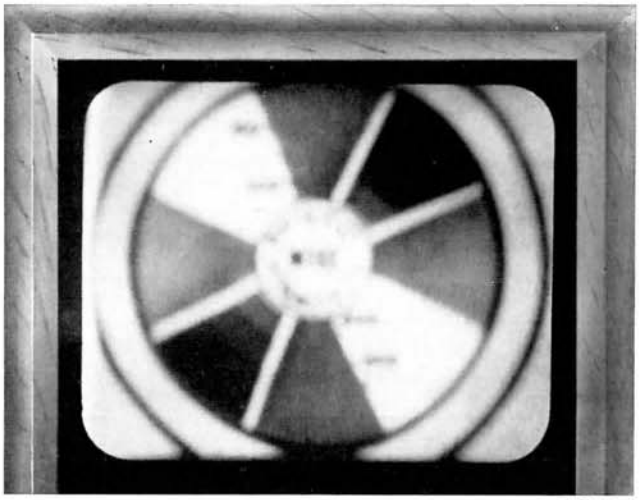

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Figure 5. FOCUS Control Requires Adjustment

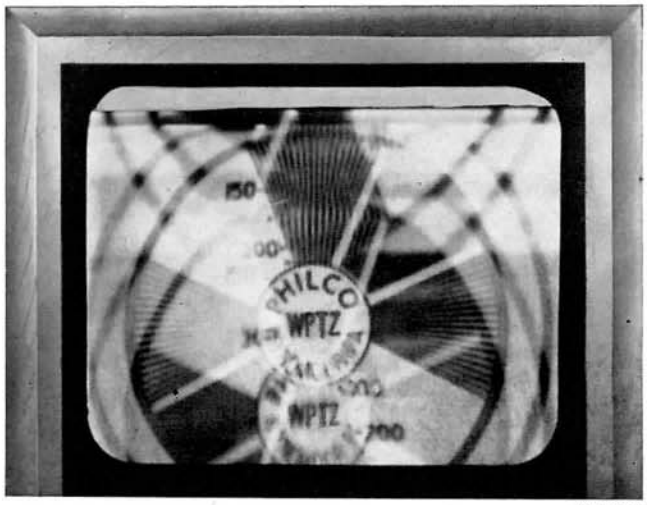

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Figure 6. VERT. HOLD Control Requires Adjustment

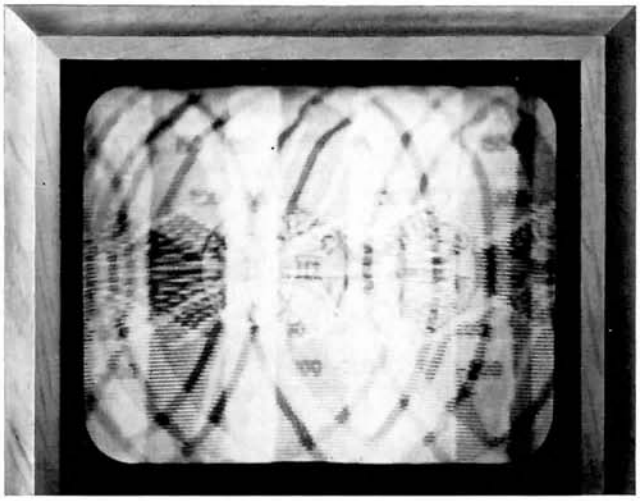

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Figure 7. HORIZ. HOLD Control Requires Adjustment

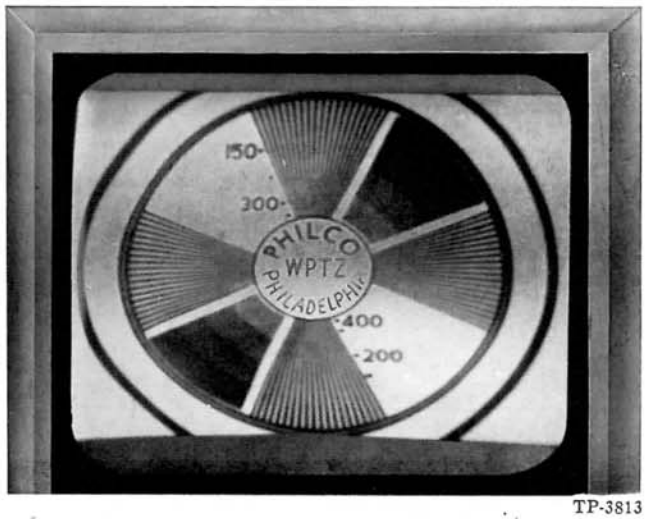

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Figure 8. HEIGHT Control Requires Adjustment

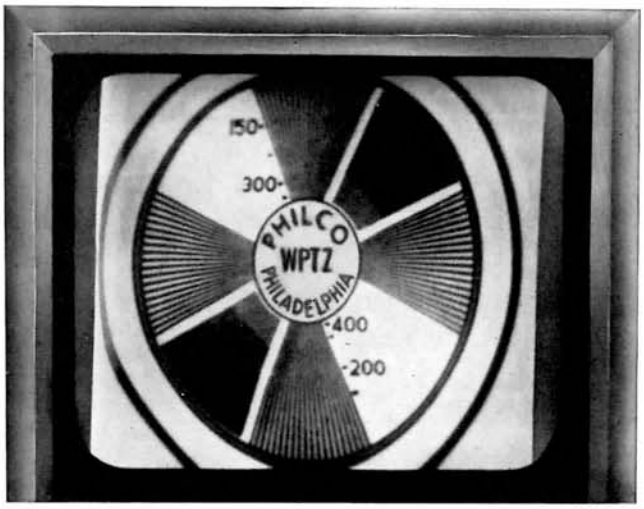

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Figure 9. WIDTH Control Requires Adjustment

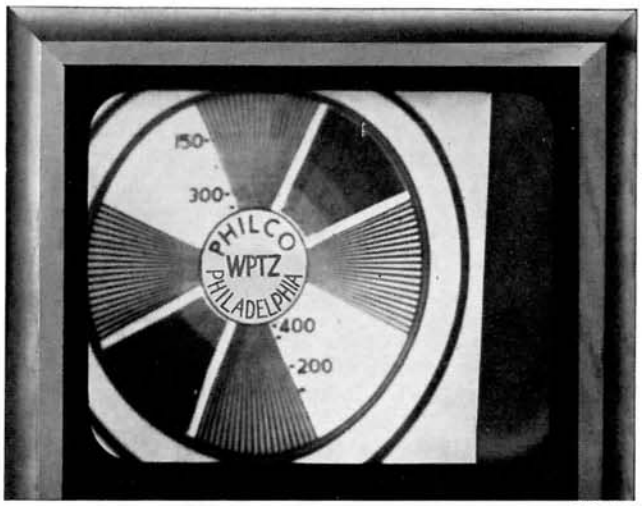

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Figure 11. HORIZ. CENT. Control Requires Adjustment

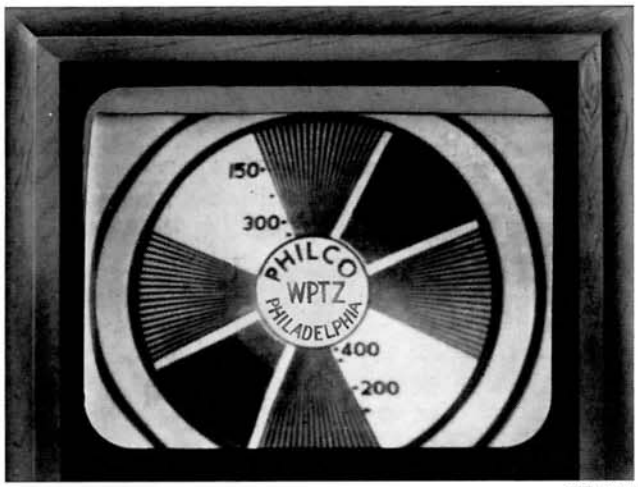

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Figure 10. VERT. CENT. Control Requires Adjustment

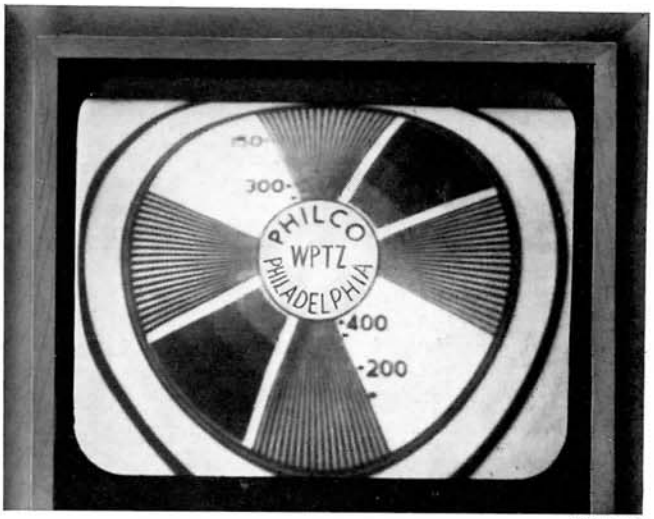

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Figure 12. VERT. LIN. Control Requires Adjustment

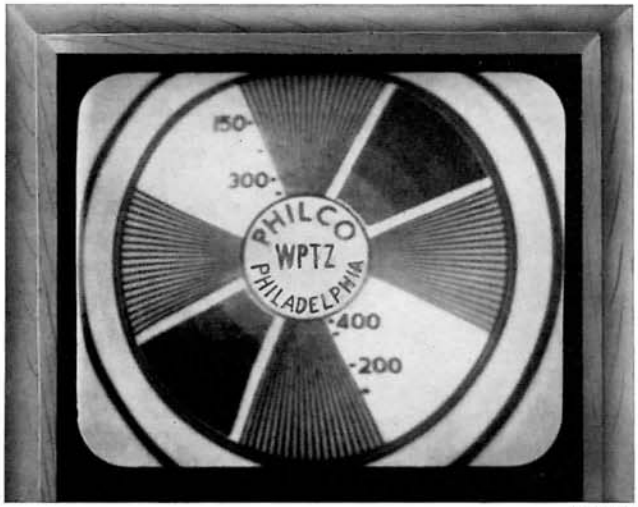

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Figure 13. HORIZ. LIN. Control Requires Adjustment

CIRCUIT DESCRIPTION

General

The Model 48-2500 receiver is designed to obtain the maximum sensitivity and selectivity consistent with the six-megacycle band width required for a television channel.

The Philco Precision Channel Selector employs snap-in coils so that the receiver may be readily adapted to receive any eight of the thirteen television channels. Since the FCC limits any one area to a maximum of seven channels, the receiver provides more than adequate selection of channels within any given area.

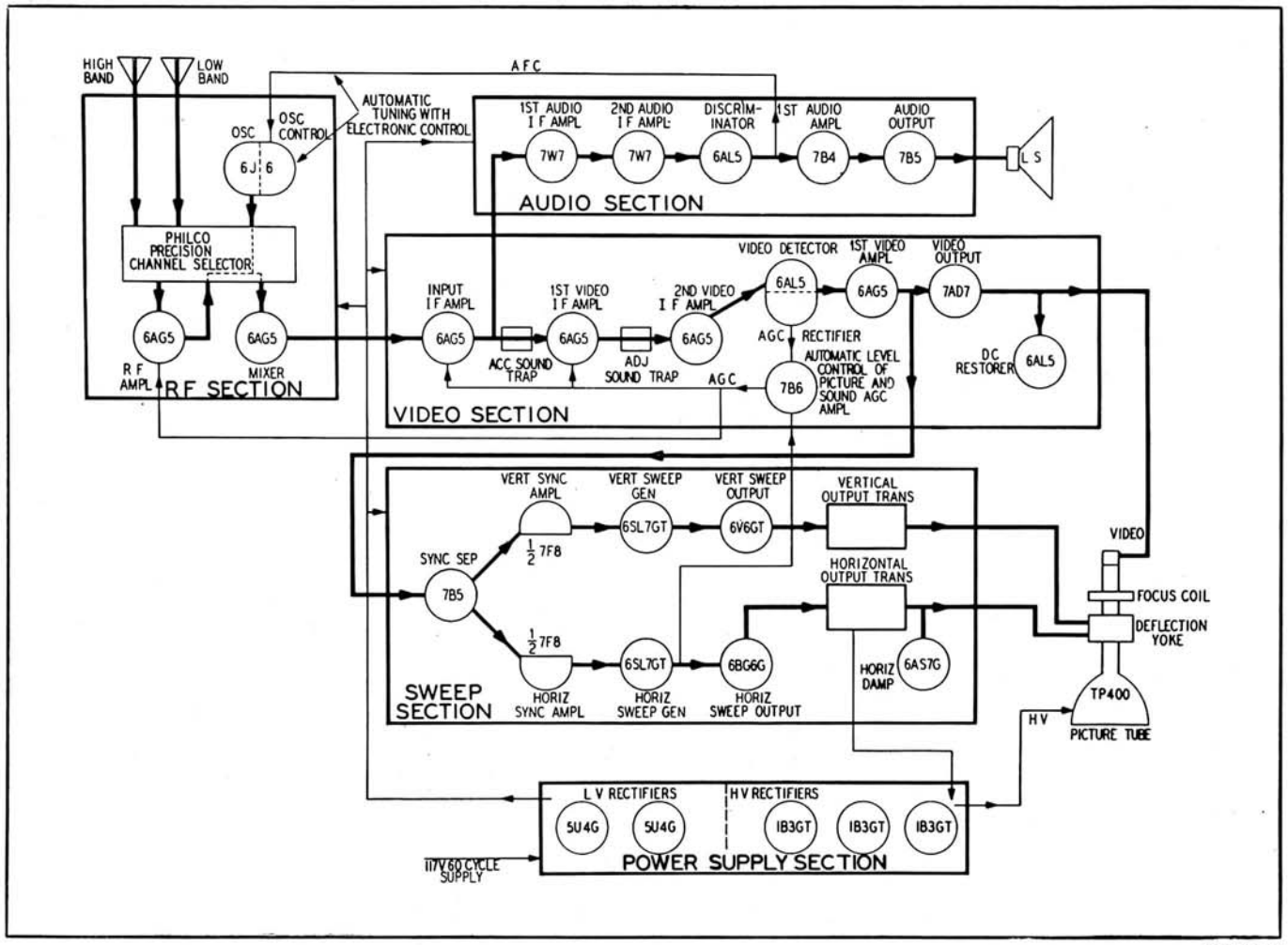
Provision is made for two aerials, one for the low-frequency band and the other for the high-frequency band. When set to the desired channel, the Channel Selector automatically selects the proper aerial, aerial coil, r-f coil, mixer coil, and oscillator coil. In special installations, as many as four aerials may be used by a simple modification of the aerial input circuit. Instructions for such connections are included with each Philco television aerial kit.

The use of Automatic Tuning with Electronic Control (a.f.c.) insures that the receiver is properly tuned at all times for maximum clarity of picture and sound. Automatic Level Control of Picture and Sound (a.g.c.) insures against fading of picture or sound, and is set for optimum operation at each location.

The schematic diagram of the complete receiver, shown in figure 45 (fold-out), is divided into five sections: the Power-Supply Section, the Audio Section, the Video Section, the R-F Section, and the Sweep Section. The interrelation of circuit functions for these sections is shown clearly in the block diagram, figure 14.

R-F Section

The entire radio-frequency assembly is contained on a separate sub-chassis, which is shock-mounted onto the main chassis. The Precision Channel Selector is divided into two compartments, Z400 and Z401. Z400 contains the oscillator and mixer coils, and Z401 contains the r-f and aerial coils. The r-f and aerial coils are wound on the same snap-in coil form, and are inductively coupled. C401B is used only on those channels for which the capacitance of C412 is too



TP-4044G

Figure 14. Model 48-2500, Block Diagram

small to tune the circuit properly. Trimmer condensers C410 and C412 tune the receiver input. (Special test equipment must be used to obtain the proper adjustment of these trimmers. If the factory settings are disturbed, the picture signal will be clipped and distorted. These trimmers should not be adjusted unless the proper test equipment is available.)

The output of the r-f amplifier is impedance-coupled to the mixer. The mixer and oscillator coils are wound on the same snap-in coil form, and are inductively coupled on channels 1 to 6 and capacitively coupled on channels 7 to 13 to secure the proper amount of oscillator injection. The triode oscillator, which is of the Colpitts type, is shunted by a reactance tube (osc. control), which is controlled by the d-c voltage obtained from the output of the FM ratio detector. When a positive voltage is applied to the grid of the reactance tube, the oscillator frequency is decreased; conversely, with a negative voltage the frequency is increased. Since the output of the FM detector, at the point from which the control voltage is taken, varies in polarity from a negative maximum through zero to a positive maximum in accordance with the frequency of the signal, any change in oscillator frequency changes the frequency of the sound-carrier i.f. and produces a correction voltage. In this manner, the oscillator is maintained constantly at the correct frequency, and a maximum of stability is obtained, regardless of the aging of tubes or other components.

The output of the mixer is applied to the input i-f impedance coupler (Z300). The various frequencies existing in the receiver, when it is correctly adjusted for each channel, are outlined below for easy reference.

Channel No.	Band (mc.)	Video-Carrier Frequency (mc.)	Audio-Carrier Frequency (mc.)	Local-Osc. Frequency (mc.)	Video I.F. (mc.)	Audio I.F. (mc.)	Adjacent-Audio I.F. (mc.)
1	44-50	45.25	49.75	71.85	26.6	22.1	none
2	54-60	55.25	59.75	81.85	26.6	22.1	32.1
3	60-66	61.25	65.75	87.85	26.6	22.1	28.1*
4	66-72	67.25	71.75	93.85	26.6	22.1	28.1*
5	76-82	77.25	81.75	103.85	26.6	22.1	32.1
6	82-88	83.25	87.75	109.85	26.6	22.1	28.1*
7	174-180	175.25	179.75	201.85	26.6	22.1	none
8	180-186	181.25	185.75	207.85	26.6	22.1	28.1*
9	186-192	187.25	191.75	213.85	26.6	22.1	28.1*
10	192-198	193.25	197.75	219.85	26.6	22.1	28.1*
11	198-204	199.25	203.75	225.85	26.6	22.1	28.1*
12	204-210	205.25	209.75	231.85	26.6	22.1	28.1*
13	210-216	211.25	215.75	237.85	26.6	22.1	28.1*

* Adjacent-channel audio-i-f signal falls within the receiver pass band, and is rejected by the adjacent-channel sound trap.

Video Section

The intermediate-frequency signals present in the plate circuit of the mixer are selected by the input i-f impedance coupler (Z300) and are applied to the grid of the input i-f amplifier. The amplified i-f signal in the plate circuit of the input i-f amplifier consists of both video and audio-i-f signals, together with adjacent-channel audio-i-f signals, if present (adjacent-channel video-i-f signals, when present, are not within the receiver pass band). The plate and grid windings of the first video-i-f impedance coupler (Z301) are adjusted to accept the video-i-f signal, while the sound trap (L301B) is adjusted to reject the audio-i-f signal (22.1 mc.). Since the plate supply to the input i-f amplifier is connected through the first audio-i-f transformer (Z200), the audio-i-f signal is transferred to the first audio-i-f stage, and very little, if any, of the audio-i-f signal remains in the video section.

The video-i-f signal is amplified by the first video-i-f amplifier stage, and passed through the second video-i-f impedance coupler (Z302). This transformer is tuned to pass the video signal, but is peaked at different frequencies to achieve the desired pass band. The adjacent-channel-sound trap (L302B) is tuned to the adjacent-channel audio-i-f signal (28.1 mc.), and offers a high impedance to the adjacent-channel audio-i-f signal, if present. (Because of channel allocation, the adjacent-channel sound appears on some channels as a 32-mc. i.f. Since this frequency is not within the pass band of the receiver, no interference results.) The amplified video-i-f signal is applied to the third video-i-f impedance coupler (Z303), which is tuned to slightly different frequencies than Z302. In later Receivers, an additional sound trap (L309 and C324) has been included. Electrically, this additional trap is in series with L303B and the detector diode, through capacitor C323. The trap is tuned to 22.1 mc. to afford further protection against any audio-i-f signal which may have passed the first sound trap (L301B). The video detector rectifies the negative portion of the

video-i-f signal. The resultant negative video signal is amplified by the first video amplifier and the video output tube, and is applied to the grid of the picture tube. The first video-amplifier circuit contains a sharply tuned rejector trap, adjusted for 4.5 mc. This trap is placed in the plate circuit of the first video amplifier to eliminate interference that might be produced by the beating together of the sound and picture carriers, which on all channels are 4.5 mc. apart. High and low-frequency compensation is employed to provide a video response from approximately 30 cycles to 4 mc. D-c restoration is accomplished by using a diode to establish a d-c bias according to picture content on the grid of the picture tube, thus insuring that the picture brightness changes only with each change of scene—not with each frame.

Automatic Control of Picture and Sound (a.g.c.) is achieved by using the sync tips to provide a control voltage. Since the sync tips are always at the same modulation level but vary in amplitude with the strength of the signal, they provide a suitable reference for a.g.c. One half-section of the video-detector diode is used to rectify the sync tips and to furnish the control voltage for the a-g-c amplifier tube. The a-g-c amplifier is supplied with a portion of the horizontal-sweep-generator voltage, which it amplifies and rectifies under control of the a-g-c voltage output from the a-g-c rectifier. Enough a-g-c voltage is available at all times to regulate the gain of the r-f amplifier, input i-f amplifier, and first video-i-f amplifier stages, so that any fading or change in strength of the incoming signal is compensated for by a change in the gain of these stages. The level-control potentiometer (R321) is adjusted at the time of installation to produce a 2-volt output (peak-to-peak) from the detector.

Audio Section

The audio section employs two audio-i-f stages tuned to the accompanying-sound frequency of 22.1 mc., an improved FM ratio detector, and two stages of audio amplification. The audio section can supply an undistorted output of approximately 2.5 watts to the 10-inch permanent-magnet dynamic loud-speaker.

The discriminator band width is approximately 500 k.c. (peak to peak), and permits the reception of high-quality FM sound. The point at which the audio is taken from the discriminator is also brought out to the a-f-c test jack for test purposes, and the voltage at this point is passed through a two-section r-c filter and applied to the grid of the oscillator-control tube. This tube controls the oscillator frequency as explained in the discussion of the R-F Section.

Bass compensation of the audio signal is obtained through a tap on the volume control, and the tone control operates in the conventional manner to attenuate the highs and boost the lows.

Sweep Section

A portion of the video signal is taken from the screen of the first video amplifier and is applied to the grid of the sync-separator tube so that the synchronizing-pulse portion of the video signal may be used to control the horizontal and vertical-sweep generators. The sync-separator-tube potentials are such that the video portion of the composite video signal applied to its input circuit is insufficient to operate the tube, and only the "blacker-than-black" portion of the television signal is passed. This blacker-than-black portion contains the horizontal and vertical synchronizing and blanking signals, each of which is greatly different in duration and recurrence rate from the others. The output of the sync separator is applied to the vertical-sync amplifier and the horizontal-sync amplifier through separate r-c coupling circuits, each with a different time constant. C510 and R526 form a differentiating network which is affected only by the short-time horizontal synchronizing pulses, so that sharp negative pips are produced. These pips are amplified and inverted by the horizontal-sync amplifier and are applied to the grid of the horizontal-sweep generator. The sweep generator is a blocking oscillator operating at a free-running frequency slightly lower than the horizontal-sweep rate of 15,750 c.p.s. When the pips are applied to the grid, the blocking oscillator operates in synchronism with the horizontal-sync pulses. Potentiometer R532, the horizontal-hold control, determines the free-running frequency of the blocking oscillator, and is adjusted to lock in the picture so that it will not move horizontally. The output of the horizontal-sweep generator is applied to the grid of the horizontal-sweep output tube, which, through a special output transformer, supplies the horizontal-sweep current to the horizontal-deflection coil, and which also furnishes a high voltage for the picture-tube anode.

C502 and R507 form a long-time-constant circuit, which accepts both vertical and horizontal-synchronizing pulses and applies them to the vertical-sync amplifier grid. These signals are amplified and applied to an integrating network consisting of C504 and C505, and then to the vertical-sweep-generator grid. The horizontal-sync pulses, being of short duration, have little effect on the voltage build-up in the integrating network, whereas the long, serrated, vertical-sync pulses have a maximum effect, and trigger the vertical-sweep generator (which is also a blocking oscillator) in synchronism with the vertical-sweep pulses at 60 c.p.s. The output of the vertical-sweep generator is applied to the grid of the vertical-sweep output tube, which, through vertical-sweep output transformer T501, supplies the proper saw-tooth current for vertical deflection. The height control (R517) determines the amplitude of the input voltage to the vertical-sweep output tube, and is adjusted for the desired picture height. The vertical linearity control (R523) determines the cathode bias of the vertical-sweep output tube; therefore, it controls the operating point and linearity of the sweep output. Vertical centering is achieved by connecting the vertical-deflection-coil return through the rotor and center of the vertical-centering control (R525), so that a direct current, the polarity of which is variable over a small range either side of center, is passed through the vertical-deflection coil.

Horizontal centering is controlled by potentiometer R548, which is in series with the entire B supply of the receiver. The voltage drop across this control produces a direct current through the horizontal-deflection coil, and deflects the beam to the right or left of

center, as desired, in order to properly center the picture on the tube face or screen.

Focusing is achieved by regulating the current flow through the focus coil. R546 is the focus control; R545, the auxiliary focus control, is used to set the range over which R546 operates. In later models, low-resistance focus controls are used, and the source is taken from a low-voltage point in the power supply. Operation is the same in all models except that drift is less in later models. The focus coil is augmented by a permanent magnet enclosed in the same housing.

Power-Supply Section

The power-supply section contains two power supplies; one is a low-voltage high-current supply for the receiver circuits, and the other a high-voltage low-current supply for the high-voltage anode of the picture tube.

The low-voltage supply employs a conventional full-wave rectifier using 5U4G tubes with their plates connected in parallel to meet the high current requirements. The output of the rectifier is filtered by a conventional low-pass filter.

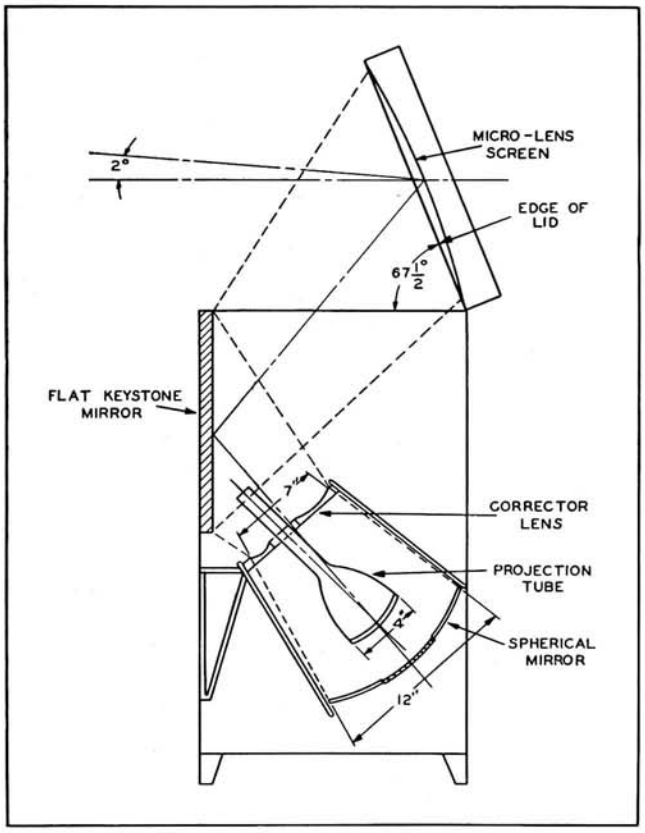
The high-voltage anode supply consists of a voltage-tripling circuit using 1B3GT half-wave rectifier tubes. The power source is obtained from the horizontal-sweep circuit through sweep transformer T503. The sweep transformer consists of a split primary winding and four secondary windings. One half of the primary is used to develop the sweep voltage, while the other half acts as an autotransformer to increase the sweep voltage to approximately 7000 volts. One secondary winding is used for sweep output, while the other three windings supply filament power, at the sweep frequency, to each of the rectifier-tube filaments. The 7000-volt sweep pulse is applied to a tripler-type rectifier, which supplies approximately 18,000 to 20,000 volts (at a maximum current of 100 microamperes) to the picture tube. The capacitance of the picture-tube anode (approximately 500 mmf.) and the r-c tripler circuits provide sufficient filtering of the high-frequency audio ripple voltage.

The low-current output of the high-voltage power supply and the current-limiting properties of the 2-megohm resistors (R101 and R102) eliminate the danger to life in case of accidental contact. A further safeguard is provided by interlocks which remove the primary a-c voltage when the back of the receiver is removed, when the lid is closed, or when the picture-tube deflection-coil-cable connector is disconnected from the receiver. The picture-tube interlock also prevents damage to the receiver which would occur if it were operated with the load disconnected from the sweep circuits.

The Philco Micro-Lens Projection System

The optical portion of the Receiver consists of a modified wide-aperture Schmidt optical system, utilizing an improved-type corrector lens and a flat mirror, arranged so that the picture is projected on the front of the Philco Micro-Lens Screen. This type of front projection produces a 15 x 20-inch picture of high contrast and extreme brilliance.

A side view of the projection system, outlining the general location and arrangements of components, is shown in figure 15. A TP400 projection-type picture tube is mounted at a slight angle to the axis of the spherical mirror to provide proper optical positioning. The mounting of the tube is such that for correct optical focusing it can be moved through three axes: The "Z" axis (in and out), the "Y" axis (top and bottom), and the "X" axis (side to side). This projection tube produces an image which is approximately fifteen times more brilliant than that of a direct-viewing picture tube. Such extreme brilliance is required because of unavoidable reduction of light intensity in the optical system.



TP-4044F

Figure 15. Philco Micro-Lens Projection System

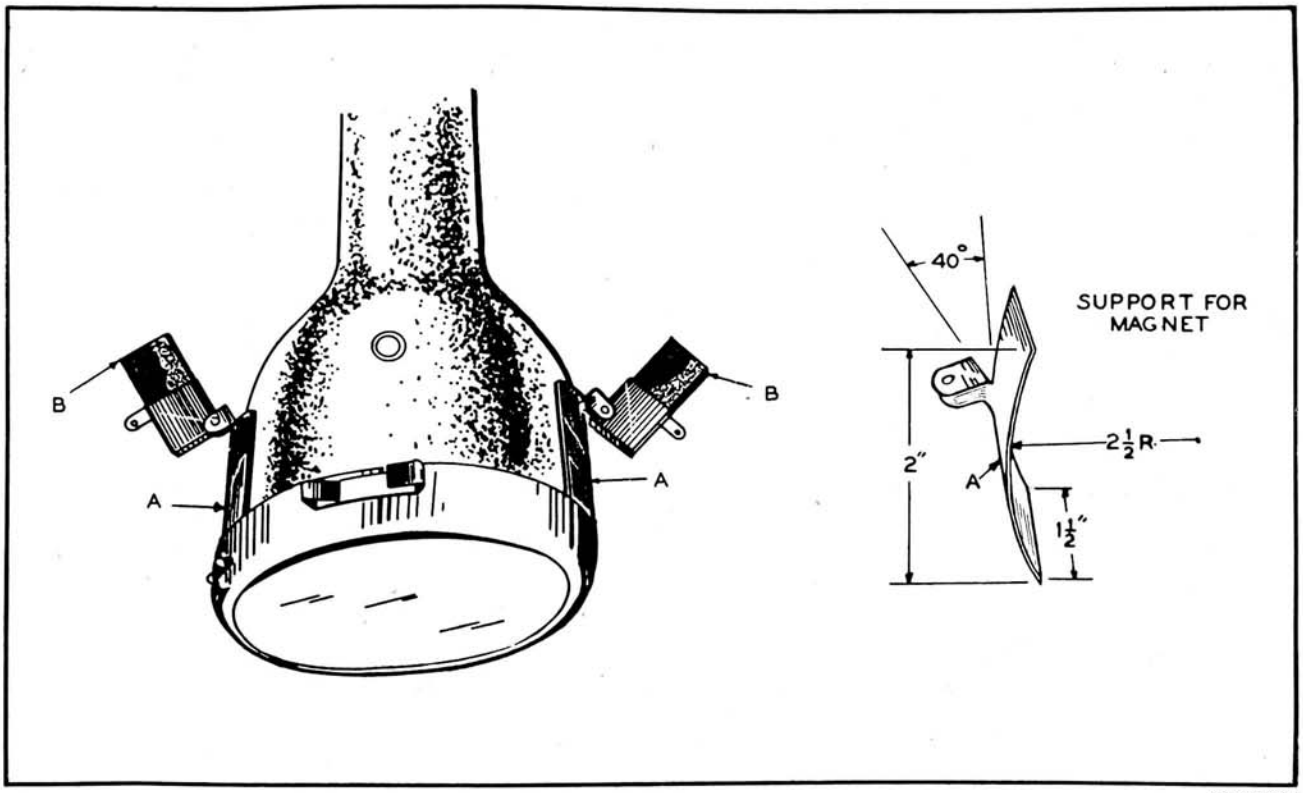
A correcting lens is located at the center of curvature (radius of curvature is approximately 11 inches) of the spherical mirror. The surface of this lens is flat on the side toward the mirror, and is curved on the opposite side so that any spherical aberration (focus-error) introduced by the spherical mirror is corrected by an aberration of equal value but of opposite sign. The light emitted axially from the front of the picture tube should not be permitted to be reflected back from the mirror to the tube face or the contrast of the picture will be reduced. To prevent this condition, the center of the spherical mirror is painted black.

As the picture is projected on the reflecting portions of the spherical mirror, the effect is as though the picture were reflected by thousands of tiny mirrors at different angles. As these rays pass through the corrector lens, the focus error caused by the spherical mirror is corrected, and these rays are directed onto a flat mirror and reflected to a focus on the surface of the screen. Since the projection tube is located out of

the field of these rays, the effect is to produce a picture unshadowed and, to all appearances, unaffected by the physical presence of the tube in the center of the projection system.

Since the optical system is mounted at an angle and projects on the screen at an angle, a rectangular picture projected from the face of the picture tube would appear on the screen as a trapezoid (pattern with sloping sides and bottom smaller than top). Conversely, when a trapezoid is projected from the face of the picture tube, it appears on the screen as a rectangle. Trapezoid (keystone) projection is used in the Philco system. Forming of the trapezoid pattern (keystoning) is achieved by applying a magnetic field at right angles to the electron beam. To produce this magnetic field, two oppositely polarized permanent magnets are mounted diametrically opposite each other on the edges of the projection tube. See figure 16. An iron pole piece (curved to fit the sides of the tube) is attached to each magnet, and is used to produce a strong concentration of field to deflect the electron beam upward near the tube face. The oppositely polarized ends of the magnets farthest from the tube face cause a lesser and downward deflection of the beam before it is deflected upward. The result is the same as that which would be produced if the face of the tube were tilted inward; the distance the beam travels to the bottom of the picture is reduced, and the distance to the top is increased. This action creates the trapezoidal pattern. The keystoning magnets are adjusted for the proper keystone pattern by moving them toward (parallel with the tube neck) or away from the tube (at right angles to the tube neck). Perfect keystoning is obtained when the pattern has a $2\frac{31}{32}$" top, a $2\frac{9}{16}$" bottom, and slant sides of $2\frac{1}{16}$". Normally, a slight amount of pincushioning (upward bowing of the bottom of the screen pattern) results. However, this effect is so slight that it can easily be corrected by aligning the magnets above or below the center line of the tube. When projected on the screen, a properly keystoned picture appears with straight edges, as if no predistortion existed.

The optical system has a throw of 33.5 inches (distance from corrector lens to screen). By utilizing the efficiency of front projection (picture is reflected from front of screen) and the directional characteristics of the screen (secured by slight grooving and cylindrical shaping), a gain in illumination of 17.2 is obtained. The directivity of the screen is concentrated within a vertical angle of 10 degrees and a horizontal angle of 30 degrees each side of center. The principal direction of light is tilted about 2 degrees above horizontal. The directional characteristic of the screen produces a viewing cone of approximately two feet in the vertical plane at a distance of ten feet from the Receiver, and approximately four feet at a distance of twenty feet from the Receiver. The light-concentrating properties of the optical system and the directional-viewing characteristic of the screen are further supplemented by the unique design of the screen. The Philco Micro-Lens Screen is made of metal with random vertical grooves, and is coated with a special material. This construction reduces the effect of random light and presents an evenly illuminated picture with a brilliance and contrast that is practically unaffected by external light; the effect is as if the picture were produced by millions of tiny lenses. The picture can be viewed in full daylight or in a brightly lighted room.



TP-4044M

Figure 16. Magnets and Supports

THE PHILCO TROUBLE-SHOOTING PROCEDURE FOR TELEVISION RECEIVERS

The Philco trouble-shooting procedure for television receivers is logical, thorough, and easy to follow. The receiver circuit is divided into five functional sections, or blocks of circuits, as follows:

Section 1—power-supply circuits
Section 2—audio circuits
Section 3—video circuits
Section 4—r-f circuits
Section 5—sweep circuits

The parts in the schematic diagram, base layouts, and replacement parts list are symbolized according to the section numbers, and a trouble-shooting chart is given for each section. Each sectional chart refers to one or more "major" test points (numbers within stars) and a subordinate group of "key" test points (letters within circles), which are indicated on the schematic diagram and base layout.

The basis of any effective method of trouble shooting is:

First, localization of the trouble to a functional section, or block of circuits.

Second, isolation of the faulty circuit, or stage, within that section.

Third, location of the defective part within that circuit.

In the Philco trouble-shooting procedure, localization of the trouble to a functional section is accomplished, if possible, by an operational check. Special operational analysis charts are furnished to help the serviceman make this check quickly and accurately. Practically all of the troubles which occur in a television receiver cause abnormal indications on the screen or from the speaker, or both. By simply looking and listening, the serviceman often can localize the trouble to a block of circuits immediately, without needless testing.

If the trouble cannot be localized by the operational check, a few tests at the "major" test points throughout the receiver, as directed in the trouble-shooting charts, will definitely localize the trouble to a particular section, and eliminate other sections from suspicion. For convenience, all of the major tests are grouped together in an auxiliary chart.

After the trouble has been localized to a section, a few additional tests at the "key" test points, specified in the chart for that section, will isolate the faulty circuit. The defective part can then be located by simple voltage and resistance measurements or, in some circuits, by waveform checks.

OPERATIONAL CHECK

If the complaint indicates that the receiver cannot be turned on without risk of further damage, inspect the set for any odor of overheated parts and signs of charred parts or insulation; also, check for shorted leads and broken connections.

If the complaint indicates that the receiver can be turned on without risk of further damage, turn on the receiver and set the channel selector to receive a television station which is on the air. Either the picture or the sound, or both, may be unsatisfactory. If both are unsatisfactory, connect an AM signal generator to the aerial receptacle to produce audio output from the speaker and modulation bars on the screen. If both are satisfactory, check the aerial installation. If either the sound or picture is unsatisfactory, disconnect the signal generator and refer to the classified portions of the OPERATIONAL ANALYSIS charts. When more than one sectional trouble-shooting chart is referenced, use the SUMMARY OF MAJOR TESTS chart for convenience.

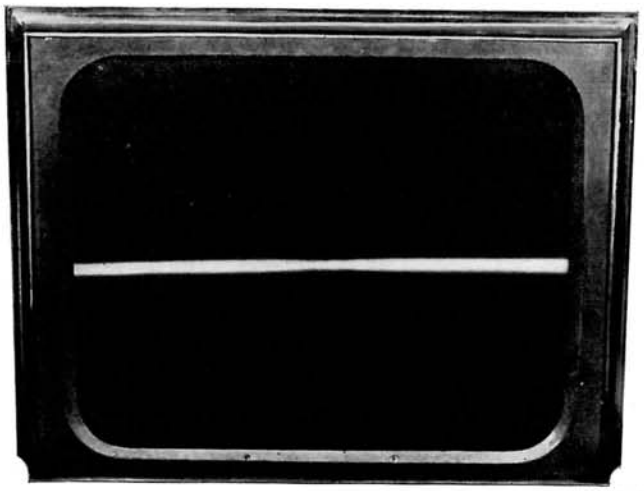
OPERATIONAL ANALYSIS OF ELECTRICAL SYSTEM

SOUND PRESENT, BUT PICTURE MISSING

INDICATION	PROBABLE TROUBLE	REFERENCE
Only bright, horizontal line appears on screen and picture tube.	Defective vertical-sweep circuit.	Refer to Section 5 trouble-shooting chart. See figure 17.
No picture, but sound is good, and raster appears.	Trouble in video section, except input i-f stage.	Refer to Section 3 trouble-shooting chart. See figure 18.
Sound good, but picture tube and screen unlighted.	Defective high-voltage power supply or horizontal-sweep circuit.	Refer to Section 1 and Section 5 trouble-shooting charts.

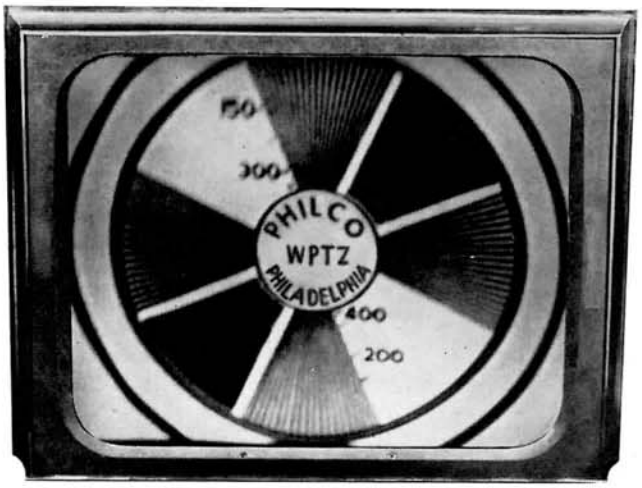
PICTURE PRESENT, BUT SOUND MISSING

INDICATION	PROBABLE TROUBLE	REFERENCE
Picture good, but no sound.	Trouble in audio section.	Refer to Section 2 trouble-shooting chart.



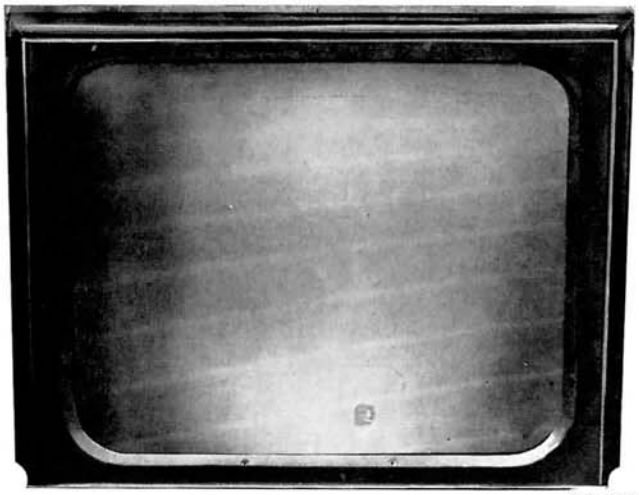
TP-4206

Figure 17. No Vertical Sweep



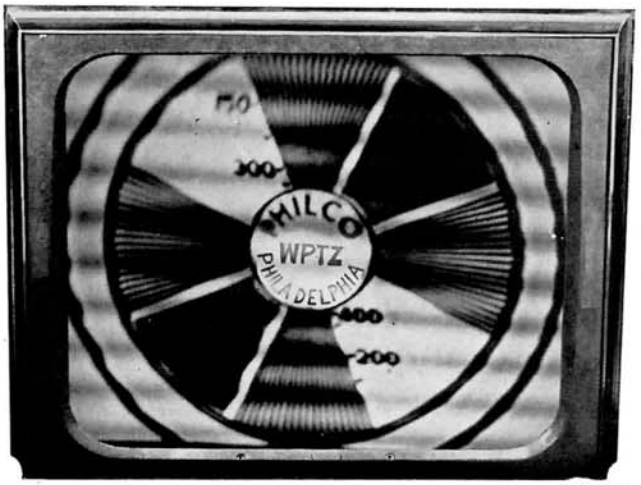
TP-4203

Figure 20. Beat Pattern



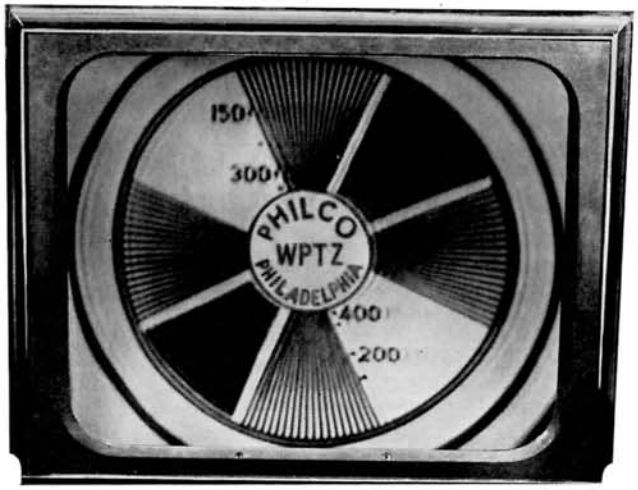
TP-4200

Figure 18. No Video Signal



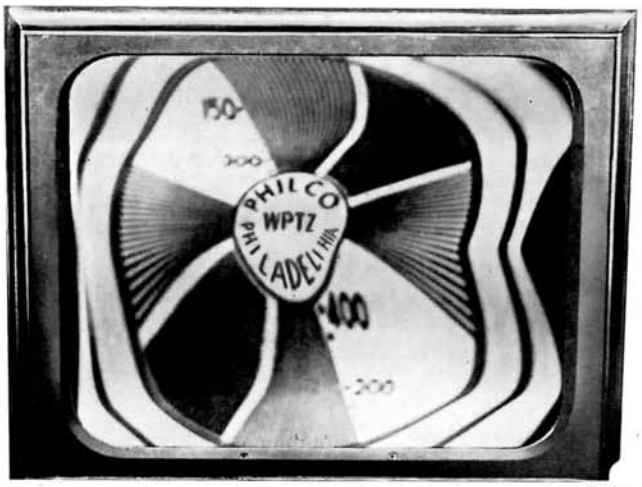
TP-4191

Figure 21. Sound in Picture



TP-4205

Figure 19. Reflections (Ghosts)



TP-4201

Figure 22. Hum in Deflection Coil

BOTH SOUND AND PICTURE MISSING

INDICATION	PROBABLE TROUBLE	REFERENCE
Set dead (no picture or sound), but raster appears.	Defective 7B6 a-g-c tube, causing cut-off of input i.f. Defective r-f, mixer, oscillator, input i-f stage, or a-g-c circuit.	Refer to Section 3 and Section 4 trouble-shooting charts. See figure 18.
Set completely dead (no picture, sound, or raster).	Defective low-voltage power supply.	Refer to Section 1 trouble-shooting chart.
Flashes in raster with aerial disconnected.	High-voltage power supply arcing over (corona discharge).	Refer to Section 1 and Section 5 trouble-shooting charts. Check lead dress of high-voltage circuit.

PICTURE NOT CLEAR

INDICATION	PROBABLE TROUBLE	REFERENCE
Sound and picture weak.	A-g-c control incorrectly set, or defective 7B6 tube, causing over-bias of input i.f.	Refer to Section 3 trouble-shooting chart.
Picture too dark.	A-g-c control incorrectly set, or defective 7B6 tube causing no a.g.c.	Refer to Section 3 trouble-shooting chart.
Multiple images (ghosts) appear.	Defective aerial installation, or incorrect orientation of aerial. Standing waves on transmission line.	Check aerial and transmission line. See figure 19.
Insufficient contrast in picture (when a-g-c control is properly adjusted).	Insufficient gain in video section, or defective picture tube.	Refer to Section 3 trouble-shooting chart. Similar to figure 3.
Beat pattern (fine, weaving, meshed lines).	Improperly aligned 4.5-mc. trap.	Refer to 4.5-mc. trap adjustment, page 37. See figure 20.
Sound in picture (horizontal bars following modulation).	L301B (and L309 in code 122) accompanying sound trap incorrectly adjusted, microphonic tubes, or oscillator-core adjustment incorrectly set.	Refer to trap adjustments, page 38. See figure 21.
Picture lacks sharpness of detail.	Defective focus circuits, or weak focus-assembly magnet. Failure or poor band width of r-f, i-f, or video stages.	Refer to Section 5 trouble-shooting chart. Refer to Sections 3 and 4 trouble-shooting charts and to alignment chart.
Poor resolution of picture.	Misalignment of receiver, or defective aerial system.	Refer to alignment chart. Check aerial system.
Picture background unstable.	Trouble in d-c restorer.	Refer to d-c reinsertion check, page 37.

PICTURE DOES NOT REMAIN STATIONARY

INDICATION	PROBABLE TROUBLE	REFERENCE
Unable to sync picture vertically and horizontally.	Defective sync-separator tube or associated circuit, or weak signal with high noise level.	Refer to Section 5 trouble-shooting chart. See figures 6 and 7.
Unable to sync picture vertically.	Defective vertical-sync amplifier or vertical-sweep-generator tube, or associated circuits.	Refer to Section 5 trouble-shooting chart. See figure 6.
Unable to sync picture horizontally.	Defective horizontal-sync amplifier or horizontal-sweep generator tube, or associated circuits.	Refer to Section 5 trouble-shooting chart. See figure 7.

IMPROPER PICTURE SIZE

INDICATION	PROBABLE TROUBLE	REFERENCE
Unable to reduce width of raster with WIDTH control.	Defective horizontal WIDTH control or associated circuit, or low anode voltage.	Refer to Section 5 trouble-shooting chart.
Raster too small, either vertically or horizontally.	Low output from low-voltage power supply, weak vertical or horizontal-output tube, or insufficient drive on output tubes.	Refer to Section 5 trouble-shooting chart. See figures 8 and 9.

PICTURE DISTORTED

INDICATION	PROBABLE TROUBLE	REFERENCE
Picture is S-shaped on side.	Hum in horizontal-deflection coils.	Check power-supply filters. Refer to Section 1 trouble-shooting chart. See figure 22.
Picture is folded in horizontal plane.	Defective 6AS7G damping tube or associated circuit.	Refer to Section 5 trouble-shooting chart. See figure 23.

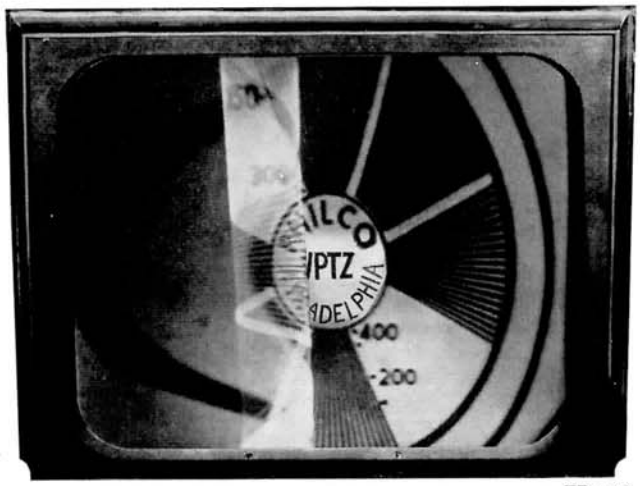
RECEIVER DOES NOT OPERATE ON ALL CHANNELS

INDICATION	PROBABLE TROUBLE	REFERENCE
Trouble on one channel only (stations available on other channels).	Improper adjustment of oscillator for defective channel, or open oscillator or r-f coil.	Refer to step 11 of alignment chart.

OPERATIONAL ANALYSIS OF OPTICAL SYSTEM

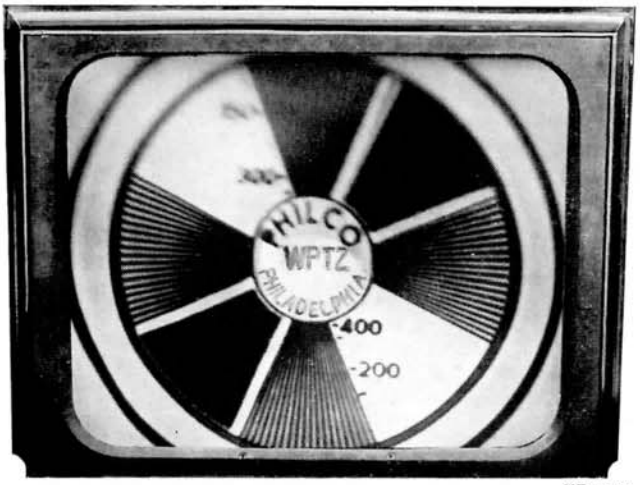
PICTURE NOT CLEAR

INDICATION	PROBABLE TROUBLE	REFERENCE
Picture on screen not clear, but picture on picture tube clear (resolution of at least 350 lines).	Trouble in projection system.	Refer to Projection System Optical Adjustments, page 38. See figure 5.
Picture not clear on any part of screen, but picture on picture tube clear.	Improper adjustment of "Z" axis (mechanical-focus lever).	Refer to focus adjustment (in and out) of Projection System Optical Adjustments, page 38. See figure 5.
Picture improperly focused at top of screen.	Improper adjustment of "Y" axis.	Refer to focus adjustment (top to bottom) of Projection System Optical Adjustments, page 38. See figure 24.
Picture on screen not equally focused on each side.	Improper adjustment of "X" axis.	Refer to focus adjustment (side to side) of Projection System Optical Adjustments, page 39. See figure 25.
Picture on screen not in focus from all viewing positions.	Warped flat mirror, or strain on flat mirror, preventing absolutely flat surface.	Loosen clamps slightly to make sure mirror is not in strain. In extreme cases substitution of mirror may be necessary.
Picture on screen does not always reach sharp focus when lid is raised.	Angle of lid not set properly, possibly caused by binding hinge or defective lid mechanism. Dome stop may have become damaged by rough handling.	Check lid angle for 67.5 degrees. Inspect hinge, lid mechanism, and counterbalance springs.
Picture on screen cloudy in appearance.	Excessive dust deposit on corrector lens.	Using a light brushing motion, clean lens with soft cloth (use care to make sure lens is not scratched).



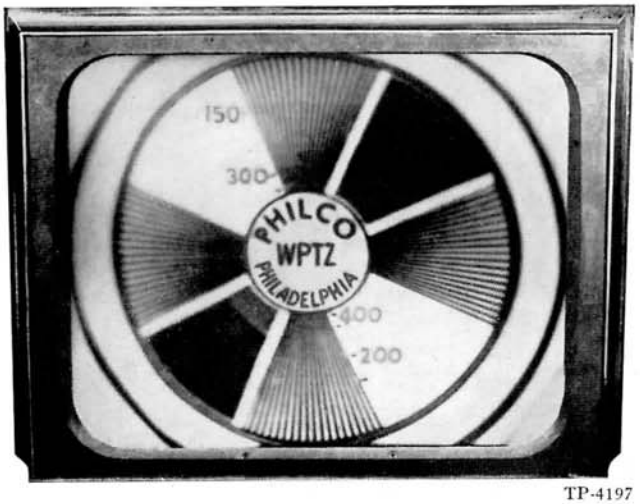
TP-4207

Figure 23. Defective Horizontal-Damping Tube



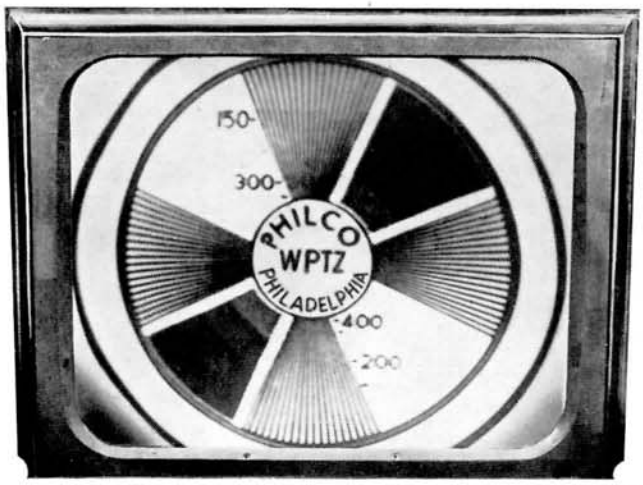
TP-4198

Figure 24. "Y" Axis Requires Adjustment



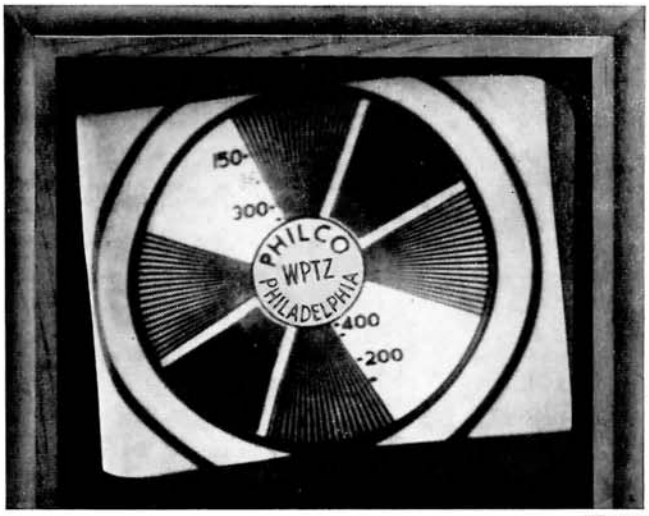
TP-4197

Figure 25. "X" Axis Requires Adjustment



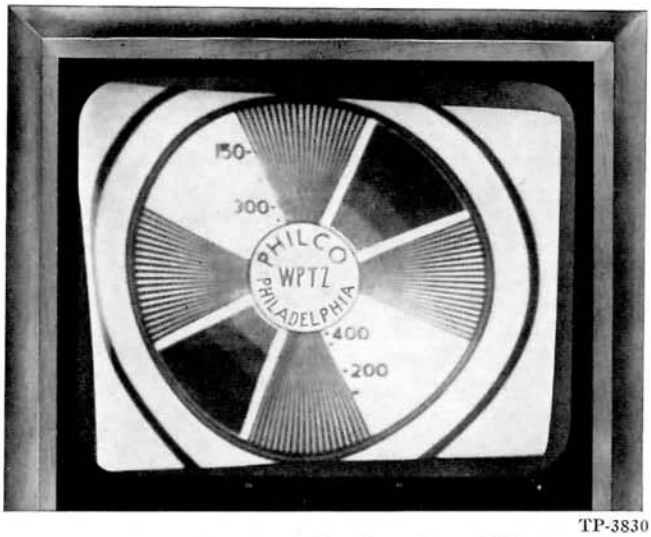
TP-4204

Figure 26. Optical Housing Requires Alignment



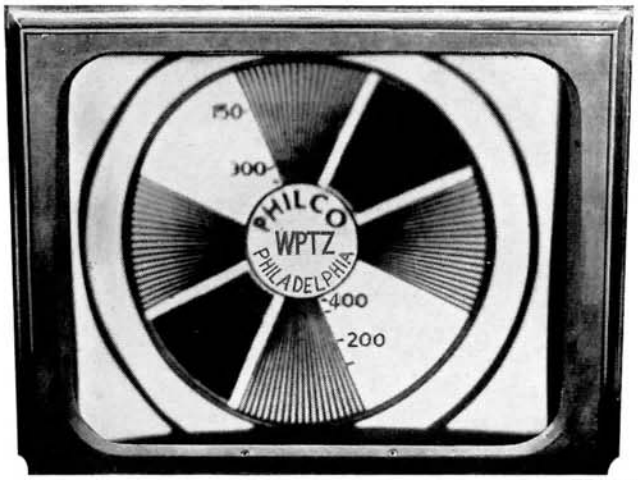
TP-3819

Figure 27. Deflection Yoke Requires Adjustment



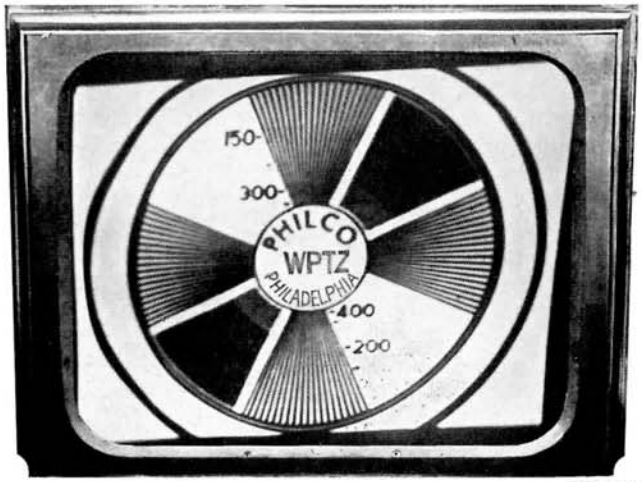
TP-3830

Figure 28. Picture Tube Requires Adjustment



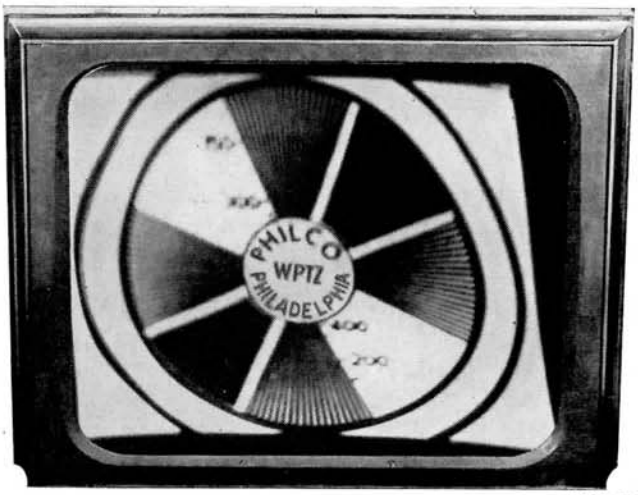
TP-4194

Figure 29. Pincushioning at Bottom of Picture



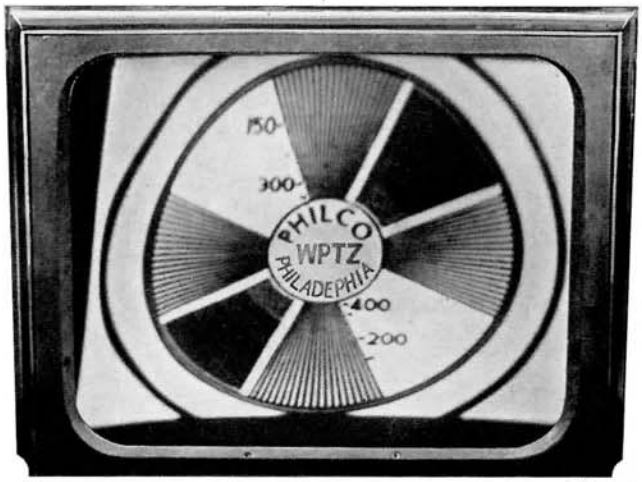
TP-4192

Figure 31. Right Magnet Underkeystoned



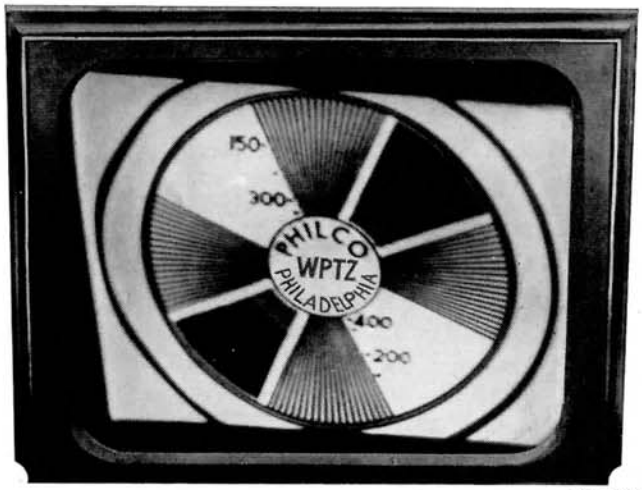
TP-4196

Figure 30. Right Magnet Overkeystoned



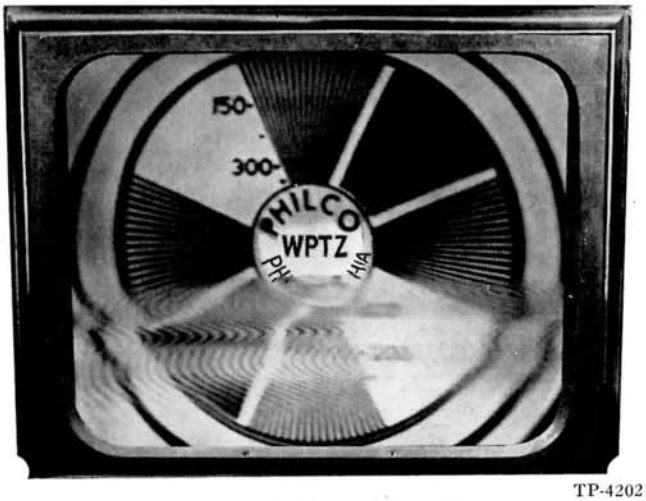
TP-4193

Figure 32. Left Magnet Overkeystoned



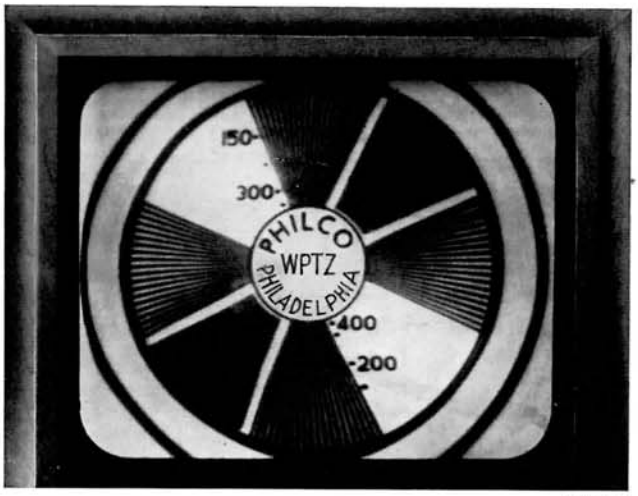
TP-4199

Figure 33. Left Magnet Underkeystoned



TP-4202

Figure 34. Diathermy Interference



TP-3808

Figure 35. Properly Adjusted Picture

SHADOW AT CORNERS OF PICTURE

INDICATION	PROBABLE TROUBLE	REFERENCE
Shadow at lower corners of screen.	Improper adjustment of optical housing with respect to cabinet.	Refer to optical-housing adjustment, page 39. See figure 26.

PICTURE NOT ORIENTED PROPERLY ON SCREEN

INDICATION	PROBABLE TROUBLE	REFERENCE
Edges of complete picture not parallel with edges of screen.	Deflection assembly improperly oriented in optical housing.	Refer to deflection-yoke adjustment, page 39. See figure 27.

PICTURE DISTORTED

INDICATION	PROBABLE TROUBLE	REFERENCE
Top and bottom edges of picture on screen not parallel.	Picture tube and magnet assembly improperly rotated with respect to yoke, or shorted turns in yoke assembly.	Refer to deflection-yoke adjustment, page 39. See figure 28.
Picture on screen has curvature at bottom (pincushion effect).	Keystone magnets not in same plane (too far above or below horizontal center line).	Refer to pincushioning adjustment, page 40. See figure 29.
Sides of picture on screen not parallel with each other.	Keystone magnets improperly adjusted.	Refer to keystoning adjustment, page 40. See figures 30, 31, 32, and 33.

TEST EQUIPMENT FOR TROUBLE SHOOTING

The following test equipment and parts are required to perform the trouble-shooting tests:

VTVM (or 20,000-ohms-per-volt voltmeter) with 25,000-volt multiplier

OSCILLOSCOPE with broad-band amplifiers

SIGNAL GENERATORS

Audio signal generator

AM signal generator covering 20 to 30 mc.; and sound-and-picture carriers of local television stations

FM signal generator (center frequency range of 20 mc. to 30 mc., and sweep range of 250 kc.)

.1-mf., 600-volt paper condenser

50-mmf. condenser (mica, 2000-volt rating)

.002-mf. condenser (mica, 2000-volt rating)

1000-ohm resistor

Special line cord to fit Receiver interlock connector (use shell flange 56-4346 and plug 27-6217 on one end, and regular line plug on other end)

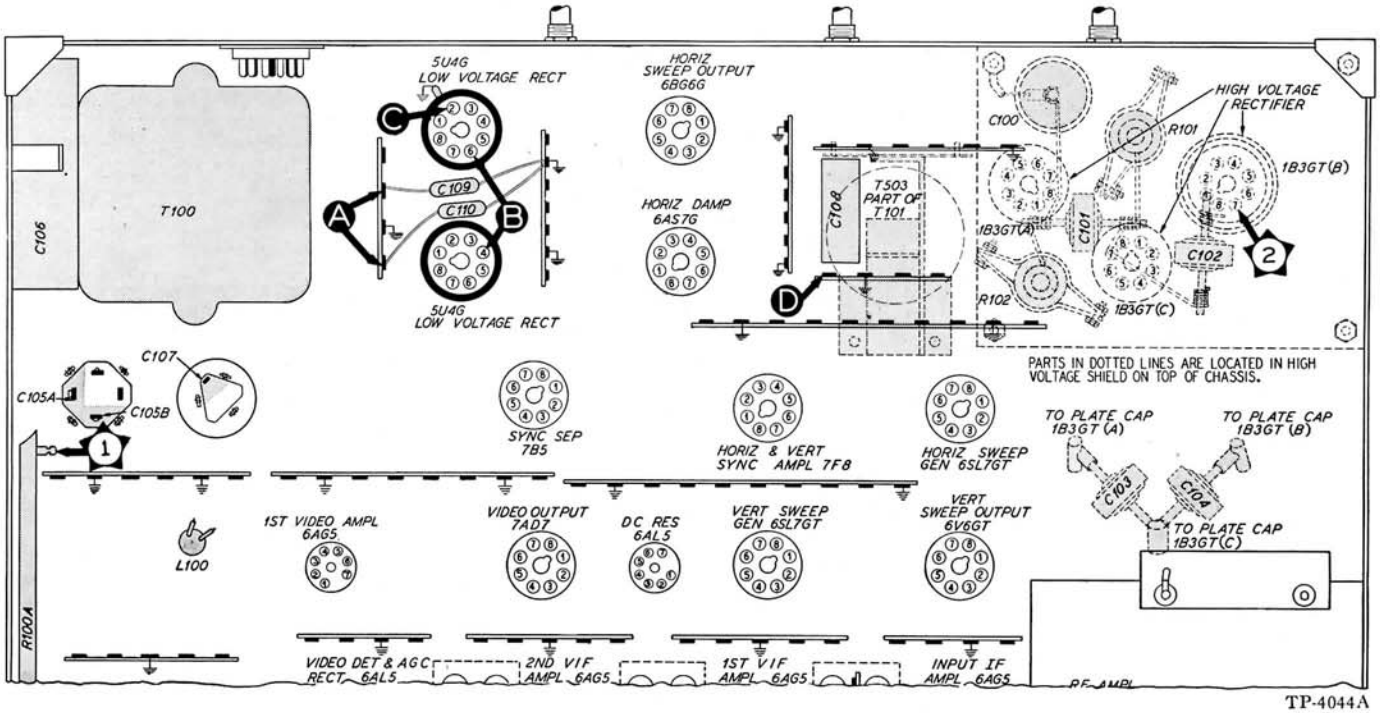
TROUBLE SHOOTING SECTION 1—POWER SUPPLY CIRCUITS

For all steps except step 7, connect VTVM or 20,000-ohms-per-volt voltmeter between test point and ground. Note: For step 7, connect 20,000-ohms-per-volt voltmeter with 25,000-volt multiplier between test point and ground.

STEP	TEST POINT	NORMAL INDICATION	ABNORMAL INDICATION	POSSIBLE CAUSE OF ABNORMAL INDICATION
1	⑴	+255 volts d.c.		If normal indication is obtained, proceed to step 7. If abnormal indication is obtained, proceed to step 2.
2	Ⓐ	110 to 120 volts a.c.	Low voltage No voltage	Incorrect power source. Defective: S100, S101, P100, J100, W100, J500, P500.
3	Ⓑ Remove 5U4G tubes.	720 volts a.c.	Low voltage No voltage	Defective: T100. Shorted filament circuit. Defective: T100.
4	Ⓒ Replace 5U4G tubes.	+360 volts d.c.	High voltage Low voltage No voltage	Open: L100, R548, R100A. Defective: 5U4G. Open: C106, C107. Shorted or leaky: C106, C107, C105B, C105A, C221B. Shorted: C106, C107.
5	Ⓓ	−21 volts d.c.	High voltage No voltage	Open: R525, T501, L500C, L500D. Shorted: C108.
6	⑴	+255 volts d.c.	High voltage Low voltage No voltage	Trouble not in this section. Shorted: C105A. Trouble in other sections. Open: R100, R548.

DANGER—HIGH VOLTAGE

7 See Note above.	⑵	17,000 to 20,000 volts d.c. CONTRAST and BACKGROUND controls set at minimum.	No voltage Low voltage	Defective: horizontal-sweep circuit, 1B3GT, T503. Open: C100, C101, C102, C103, C104, R101, R102.



TP-4044A

Figure 36. Bottom View of Chassis, Showing Section 1 Test Points

TROUBLE SHOOTING SECTION 2—AUDIO CIRCUITS

Set VOLUME control to maximum and TONE control fully clockwise.
Connect FM signal generator, set to 22.1 mc., between test point and ground.

Note 1: AM (400-cycle modulated) signal generator may be used if FM signal generator is not available. When AM signal generator is used, it should be adjusted slightly below 22.1 mc.

Note 2: Connect r-f signal generator (AM or FM) between test point and ground for steps 1, 5, 6, and 7; use .1-mf. condenser in series with signal lead.

Note 3: Connect audio signal generator set at 400 cycles and use .1-mf. condenser in series with signal lead between test point and ground for steps 2, 3, and 4.

STEP	TEST POINT	NORMAL INDICATION	POSSIBLE CAUSE OF ABNORMAL INDICATION
1 See Notes 1 and 2.	⑤	Loud, clear audio signal.	Trouble in this section; proceed to step 2.
2 See Note 3.	Ⓐ	Clear audio signal, weaker than in step 1	Defective: LS200, T200, C222, 7B5. Open: C221A, R221, R220. Leaky: C221B.
3 See Note 3.	Ⓑ	Clear audio signal, louder than in step 2.	Open: C220, R218, R219. Defective: 7B4.
4 See Note 3.	Ⓒ	Clear audio signal, weaker than in step 3.	Shorted: C213, C214, C212. Open: C215, C216, R212. Defective: R213.
5 See Notes 1 and 2.	Ⓓ	Clear audio signal, louder than in steps 2, 3, or 4.	Defective: 6AL5 discriminator, 7W7 2nd a.i.f., Z202. Open: L204, R208, R207, R206, C207, C206. Shorted: C209, C207.
6 See Notes 1 and 2.	Ⓔ	Clear audio signal, louder than in step 5.	Defective: 7W7 1st a.i.f., Z201. Open: R204, R203, C204, R202, L203. Shorted: C205, C204.
7 See Notes 1 and 2.	⑤	Loud, clear audio signal.	Defective: Z200. Open: R201. Shorted: C203.

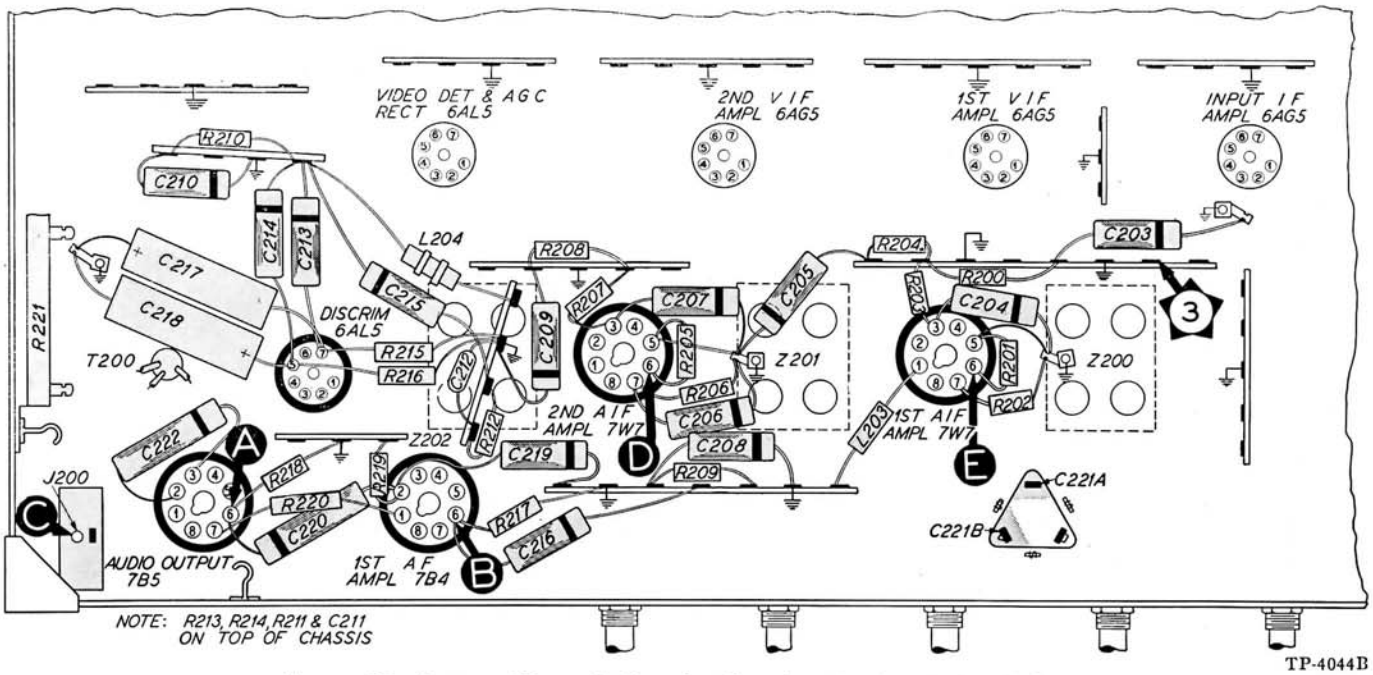


Figure 37. Bottom View of Chassis, Showing Section 2 Test Points

TROUBLE SHOOTING SECTION 3—VIDEO CIRCUITS

Set CONTRAST control fully clockwise.

Set BACKGROUND control so raster is faintly visible on picture tube.

Note 1: Connect audio signal generator, set at 400 cycles and using .1-mf. condenser in series with signal lead, between test point and ground for steps 2, 3, and 4.

Note 2. Connect AM signal generator, set at 26.6 mc. and modulated at 400 cycles, between test point and ground for steps 1, 5, 6, 7, 8, and 9.

STEP	TEST POINT	NORMAL INDICATION	POSSIBLE CAUSE OF ABNORMAL INDICATION	SPECIAL NOTES
1 See Note 2.	④	Strong, alternate white and black bars on picture tube and screen.	Trouble in this section; proceed to step 2.	
2 See Note 1.	Ⓐ	Alternate white and black bars, with much greater signal-generator output than in step 1.	Defective: TP400. Open: C333, L314.	See figures 51, 52, 53, and 54.

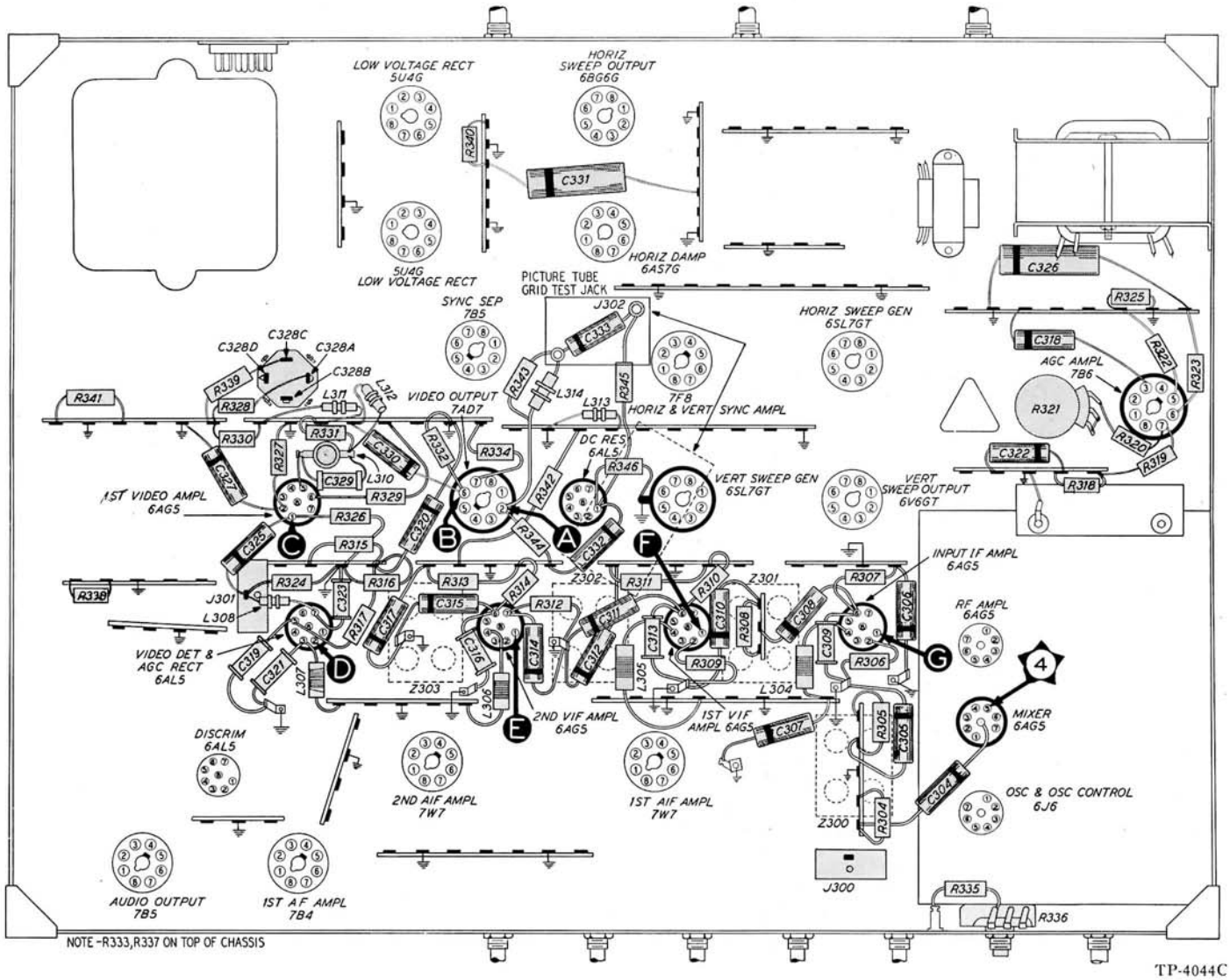


Figure 38. Bottom View of Chassis, Showing Section 3 Test Points

TROUBLE SHOOTING SECTION 3—Continued

STEP	TEST POINT	NORMAL INDICATION	POSSIBLE CAUSE OF ABNORMAL INDICATION	SPECIAL NOTES
3 See Note 1.	B	Same as step 2, except stronger bars, with less signal-generator output than in step 2.	Defective: 7AD7. Open: R341, R342, L313, R333, R334. Shorted: C328C, C328D.	See figures 49 and 50.
4 See Note 1.	C	Same as step 2, except stronger bars with less signal-generator output than in step 3.	Defective: 6AG5 video amplifier. Open: L310, L311, L312, R327, R328, R329, R331, C330. Shorted: C328A, C328B.	See figures 46, 47, and 48.
5 See Note 2.	D	Same as step 2 with less signal-generator output than in step 4.	Defective: 6AL5 video detector. Open: L308, C325, R324, L307.	See figures 46 and 47.
6 See Note 2.	E	Same as step 2 with less signal-generator output than in step 5.	Defective: 6AG5 2nd video i.f., Z303. Open: R313, R314, L306, R312. Shorted: C317, C315, C316.	
7 See Note 2.	F	Same as step 2 with less signal-generator output than in step 6.	Defective: 6AG5 1st video i.f., Z302. Open: R310, R311, L305, R309. Shorted: C311, C313, C312.	
8 See Note 2.	G	Same as step 2 with less signal-generator output than in step 7.	Defective: 6AG5 input i.f., Z301. Open: R200, R307, R306, L304. Shorted: C308, C309, C307.	
9 See Note 2.	4	Same as step 1.	Z300.	

TROUBLE SHOOTING SECTION 4—R-F CIRCUITS

Set channel selector to desired channel (be certain that proper coils are inserted in channel selector), and turn VOLUME control fully clockwise.

For all steps except step 2, connect AM signal generator, set to audio-carrier frequency of desired channel (see page 9 for frequency chart), between test point and ground. Loose coupling should be used in steps 1 and 5.

Note: For step 2, connect voltmeter (VTVM, or 20,000-ohms-per-volt voltmeter with 1000-ohm resistor in series with negative lead) between test points (pins 6 and 7 of oscillator tube).

STEP	TEST POINT	NORMAL INDICATION	ABNORMAL INDICATION	POSSIBLE CAUSE OF ABNORMAL INDICATION
1	5	Loud, clear audio signal.	Weak or no output.	Trouble in this section; proceed to step 2.
2 See Note above.	A	2.5 volts negative bias.	No bias.	Defective: 6J6, Z400. Open: L402, R405, R401, C404. Shorted: C409, C404, C403, C402.
3	B	Loud, clear audio signal.	Weak or no output.	Oscillator off frequency. Defective: 6AG5 input i.f., 6AG5 mixer, Z300. Open: R304, R408, R409. Shorted: C304, C420, C421, C411, C419.
4	C	Loud, clear audio signal.	Weak or no output.	Defective: 6AG5 r-f amplifier, Z400. Open: C413, R406, R411, R412. Shorted: C417, C418.
5	5	Loud, clear audio signal.	Weak or no output.	Defective: Z401.

TROUBLE SHOOTING SECTION 4—Continued

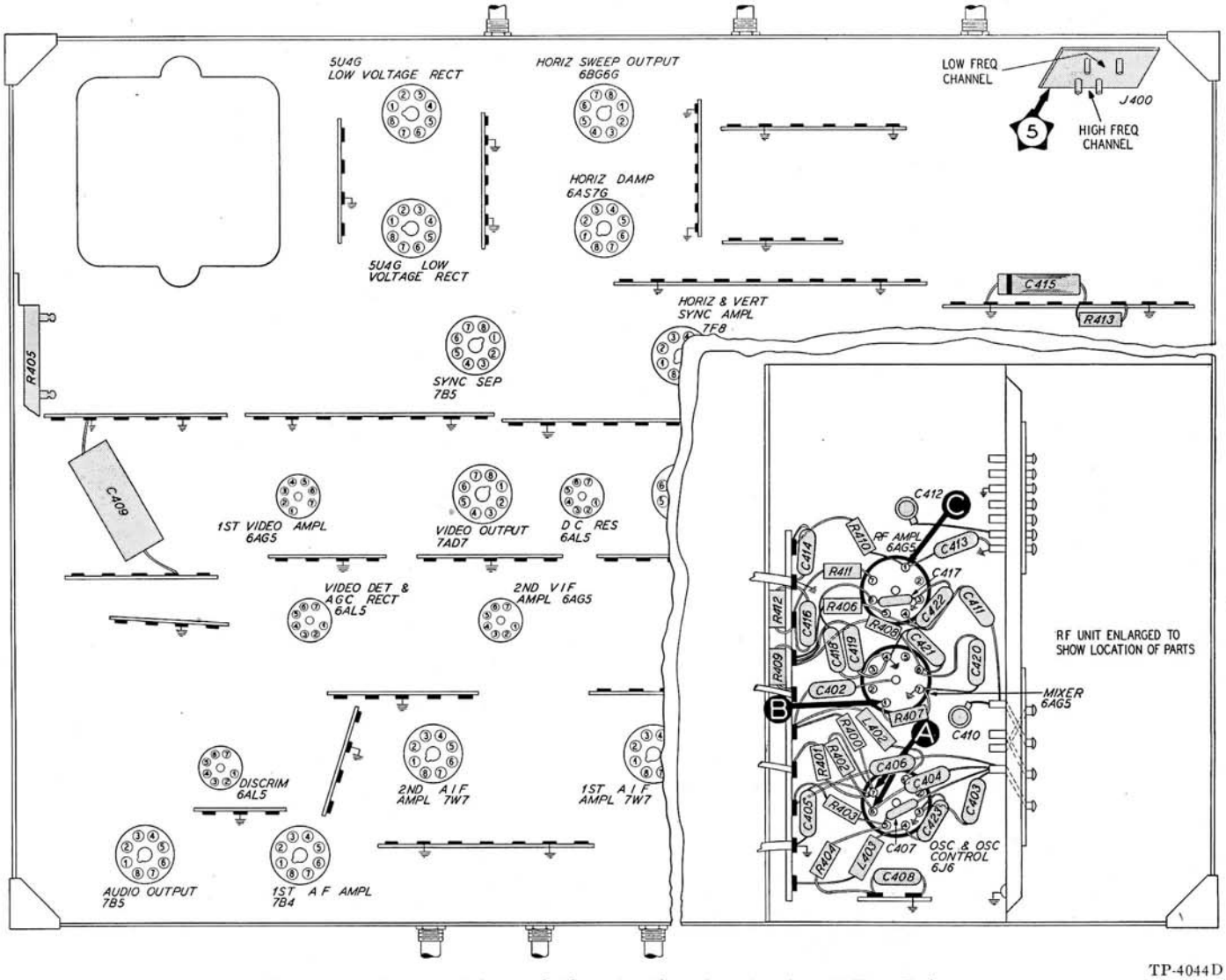


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Figure 39. Bottom View of Chassis, Showing Section 4 Test Points

TROUBLE SHOOTING SECTION 5—SWEEP CIRCUITS

Connect vertical plates ("Y" axis) of oscilloscope between test point and ground, except in steps 1, 2, 6, 9, and 10.

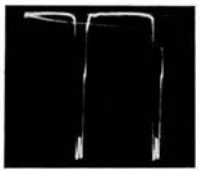
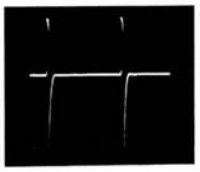
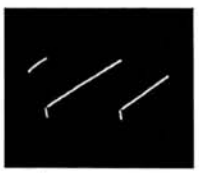
Note 1: Connect capacitance voltage divider (50-mmf. and .002-mf. condensers in series) between pins 3 and 9 of J500 for steps 1 and 6, with oscilloscope across .002-mf. condenser.

Note 2: Connect capacitance voltage divider (50-mmf. and .002-mf. condensers in series) between pins 1 and 8 of J500 for steps 2 and 10, with oscilloscope across .002-mf. condenser.

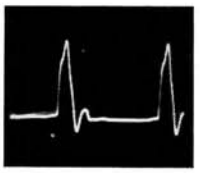
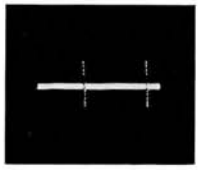
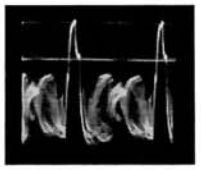
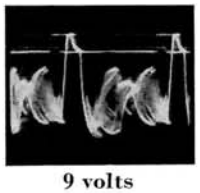
Note 3: Connect capacitance voltage divider (50-mmf. and .002-mf. condensers in series) from plate cap of 6BG6G to ground, with oscilloscope across .002-mf. condenser for step 9.

The oscilloscope must be synchronized at approximately half vertical-sweep rate for vertical waveforms, and at approximately half horizontal-sweep rate for horizontal waveforms. These tests must be made with a standard RMA television signal applied to the receiver input. The test-chart signal from a television station may be used.

The voltage values indicated under each waveform in the "NORMAL INDICATION" column are peak-to-peak values.

STEP	TEST POINT	NORMAL INDICATION	POSSIBLE CAUSE OF ABNORMAL INDICATION	SPECIAL NOTES
1 See Note 1.	⑥	 24 volts	Trouble in vertical-sweep circuit; proceed to step 3.	
2 See Note 2.	⑦	 450 volts	Trouble in horizontal-sweep circuit; proceed to step 7.	
3	Ⓐ	 250 volts	Defective: 6SL7GT vertical-sweep generator, T500. Open: R521, R520, R512, R513. Shorted: C505, C506A, C507, C504.	See also figures 60 and 61.
4	Ⓑ	 30 volts	Open: R516, R515, R514, R517, R518. Shorted: C506B, C508.	See also figures 62 and 63.
5	Ⓒ	 180 volts	Defective: 6V6GT, T501, R525. Open: C509, C508, R519, R522, R524, R523, L500A, L500B. Shorted: C506C, C509.	See also figure 64.

TROUBLE SHOOTING SECTION 5—Continued

STEP	TEST POINT	NORMAL INDICATION	POSSIBLE CAUSE OF ABNORMAL INDICATION	SPECIAL NOTES
6 See Note 1.	⑥	Same as step 1.	Defective: Z500.	
7	Ⓓ	 100 volts	Defective: 6SL7GT horizontal-sweep generator, T502. Open: C514, R530, R529, R531, R532. Shorted: C514, C513A.	
8	Ⓔ	 100 volts	Open: R533, C515. Shorted: C515, C516.	
9 See Note 3.	Ⓕ	 3080 volts	Defective: 6BG6G, T503, 6AS7G. Open: C516, R539, R537, R538, R548, L500C, L500D. Shorted: C517, C513B.	See also figures 68 and 69.
10 See Note 2.	⑦	Same as step 2	Defective: Z500.	
11	⑧ Remove vertical-sweep generator tube.	 22 volts	Trouble in vertical-sync circuits; proceed to step 12.	
12	Ⓖ Replace tube.	 14 volts	Trouble in Section 3. Refer to Section 3 trouble-shooting procedure.	
13	Ⓗ	 9 volts	Open: C500, R501, R502. Shorted: C500.	See also figures 55, 56, and 57.

TROUBLE SHOOTING SECTION 5—Continued

STEP	TEST POINT	NORMAL INDICATION	POSSIBLE CAUSE OF ABNORMAL INDICATION	SPECIAL NOTES
14	J	 5 volts	Defective: 7B5 sync sep. Open: R505, R504, R506, R503, C502. Shorted: C502, C501.	See also figures 58 and 59.
15	8 Remove vertical-sweep generator tube.	Same as step 11	Defective: 7F8. Open: C504, R510, R511, R509. Shorted: C503.	

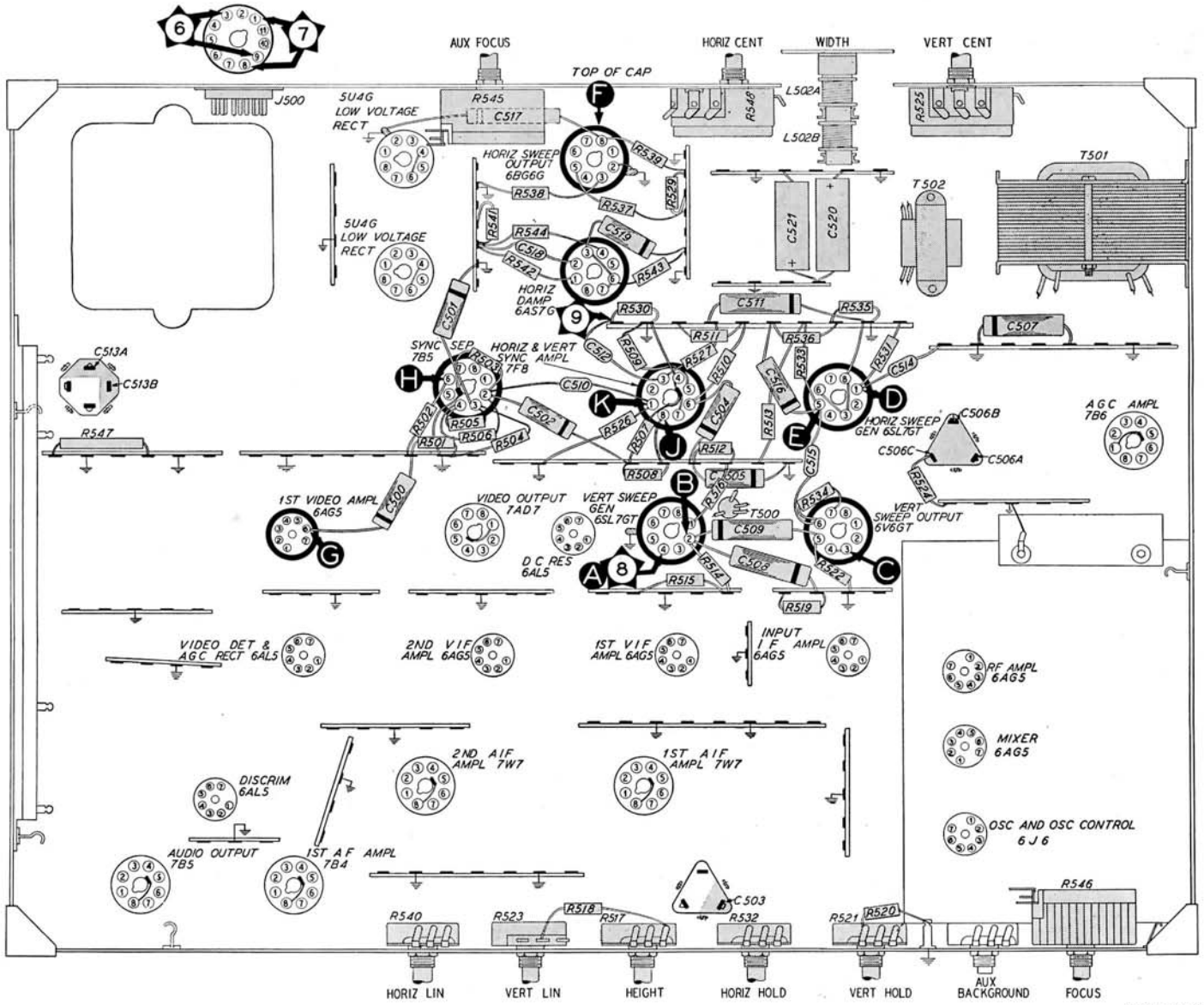


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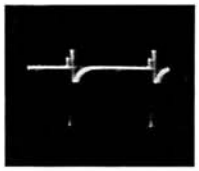
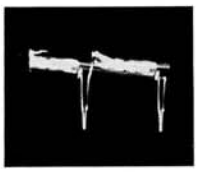
Figure 40. Bottom View of Chassis, Showing Section 5 Test Points

TROUBLE SHOOTING SECTION 5—Continued

STEP	TEST POINT	NORMAL INDICATION	POSSIBLE CAUSE OF ABNORMAL INDICATION	SPECIAL NOTES
16	⑨ Replace tube.	 15 volts	Trouble in horizontal-sync circuits; proceed to step 17.	
17	Ⓚ	 5 volts	Open: C510, R526.	See also figures 65, 66, and 67.
18	⑨	Same as step 16.	Defective: 7F8. Open: C512, R527, R528. Shorted: C511, C512.	

SUMMARY OF MAJOR TESTS

SECTION	TEST POINT	INSTRUCTIONS	NORMAL INDICATION	REFERENCE
1	①	Connect 20,000-ohms-per-volt voltmeter between +255-volt bus and ground.	+255 volts, d.c.	If normal indication is obtained, proceed with major test ②
1	②	Connect 20,000-ohms-per-volt voltmeter (with 25-kv. multiplier) between 20,000-volt bus and ground.	17—20 kilovolts, d.c.	If normal indication is obtained, proceed with major test ③
2	③	Apply 22.1-mc. FM or AM signal to audio i-f input (orange lead of Z200).	Loud, clear audio signal.	If normal indication is obtained, proceed with major test ④
3	④	Connect AM signal generator, set to 26.6 mc. to plate of mixer.	Strong alternate black-and-white bars on picture tube.	If normal indication is obtained, proceed with major test ⑤
4	⑤	Couple AM signal generator to aerial circuit (set at audio carrier frequency of any channel).	Loud, clear audio signal.	If normal indication is obtained, proceed with major test ⑥
5	⑥	Connect oscilloscope across vertical-deflection coils (pins 3 and 9 of J500). (Use capacitance voltage divider.)	Waveform as shown in step 1 of Section 5 trouble-shooting chart.	If normal indication is obtained, proceed with major test ⑦
5	⑦	Connect oscilloscope across horizontal-deflection coils (pins 1 and 8 of J500). (Use capacitance voltage divider.)	Waveform as shown in step 2 of Section 5 trouble-shooting chart.	If normal indication is obtained, proceed with major test ⑧

SUMMARY OF MAJOR TESTS—Continued

SECTION	TEST POINT	INSTRUCTIONS	NORMAL INDICATION	REFERENCE
5	⑧	Connect oscilloscope to pin 4 of vertical-sweep generator (with tube removed.)	Waveform as shown in step 11 of Section 5 trouble-shooting chart.	If normal indication is obtained, proceed with major test. ..... ⑨
5	⑨	Connect oscilloscope to white lead of horiz.-sweep-generator transformer T502.	Waveform as shown in step 16 of Section 5 trouble-shooting chart.	If normal indication is obtained, proceed with step 17 of Section 5 trouble-shooting chart. Check optical adjustments and all cabling and plugs.

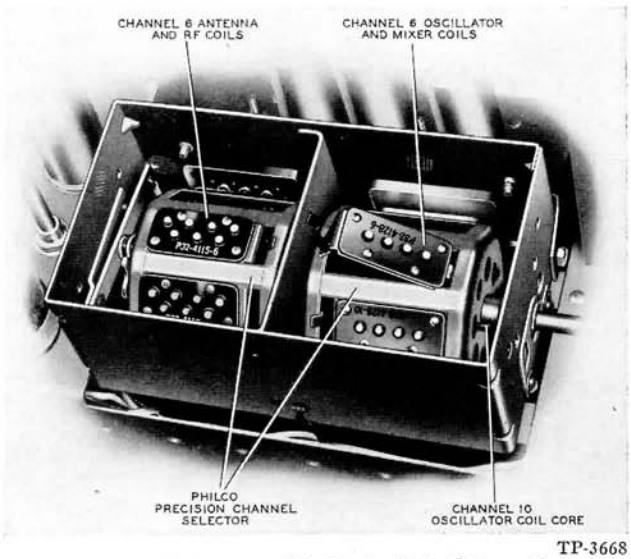


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Figure 41. Proper Method of Coil Insertion

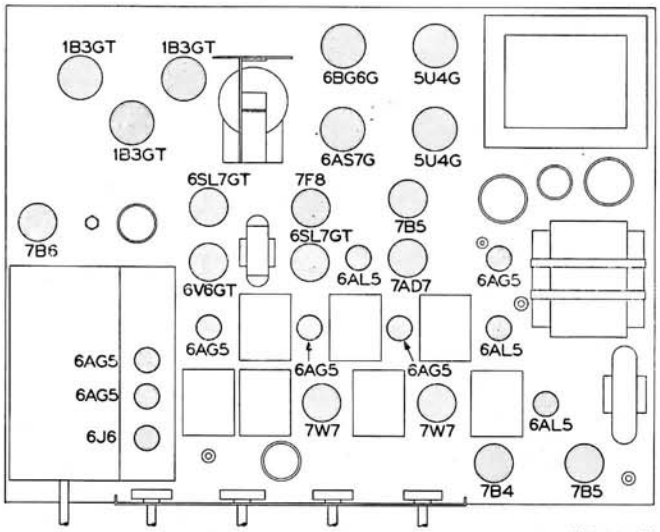

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Figure 42. Tube-Location Chart

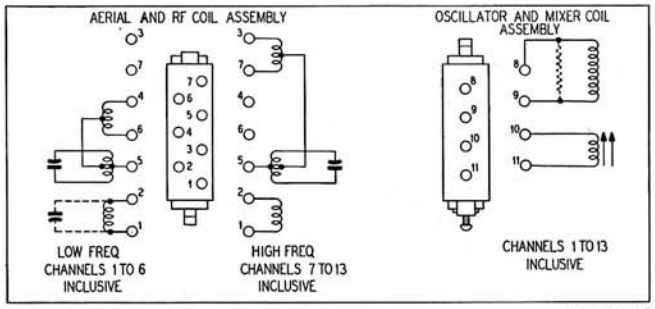

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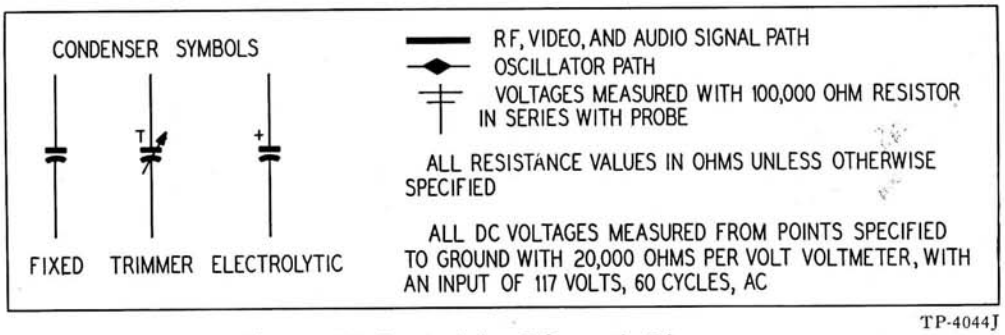
Figure 43. Low and High-Frequency-Channel Coil Connections



TP-4044J

Figure 44. Legend for Schematic Diagram

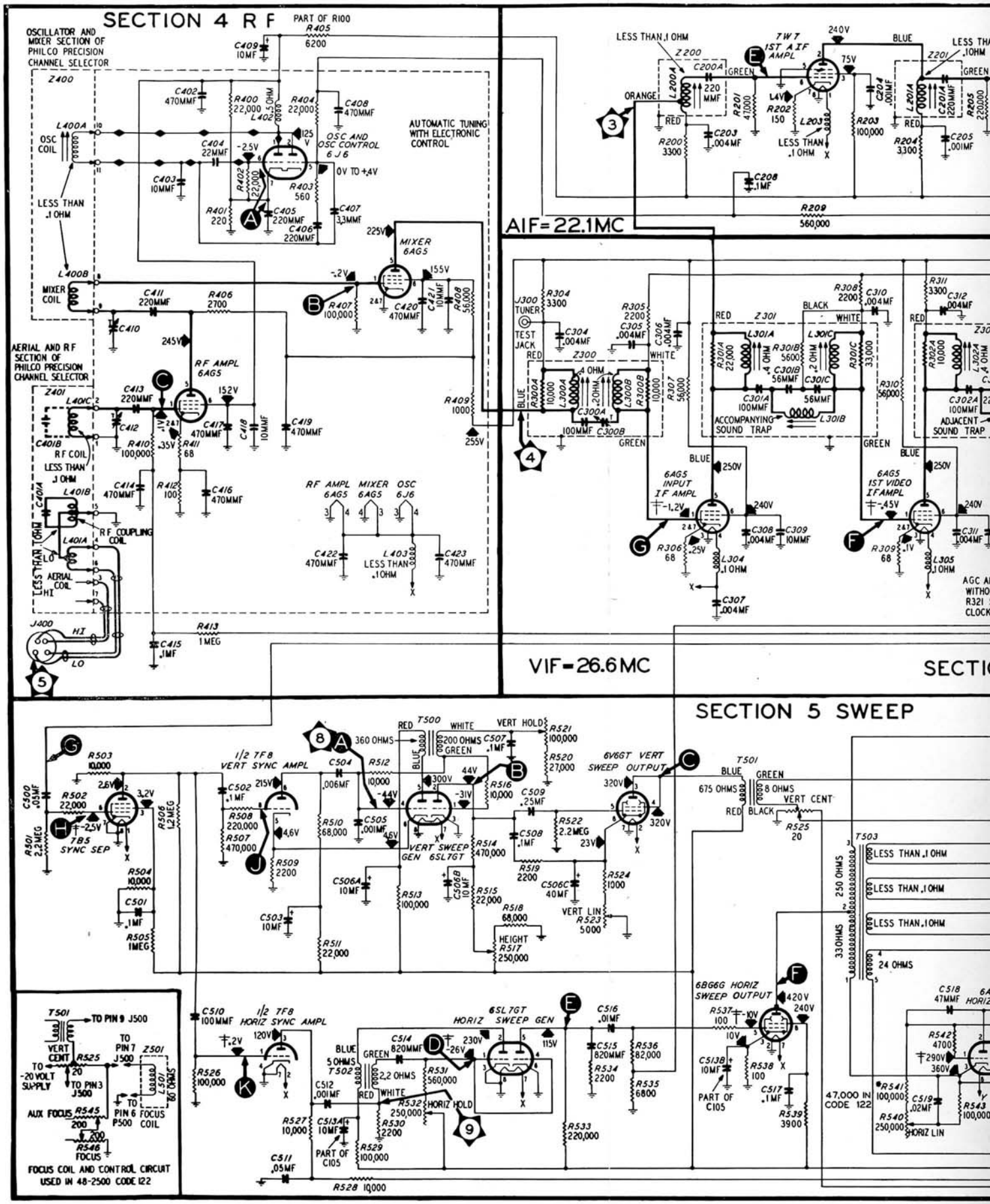
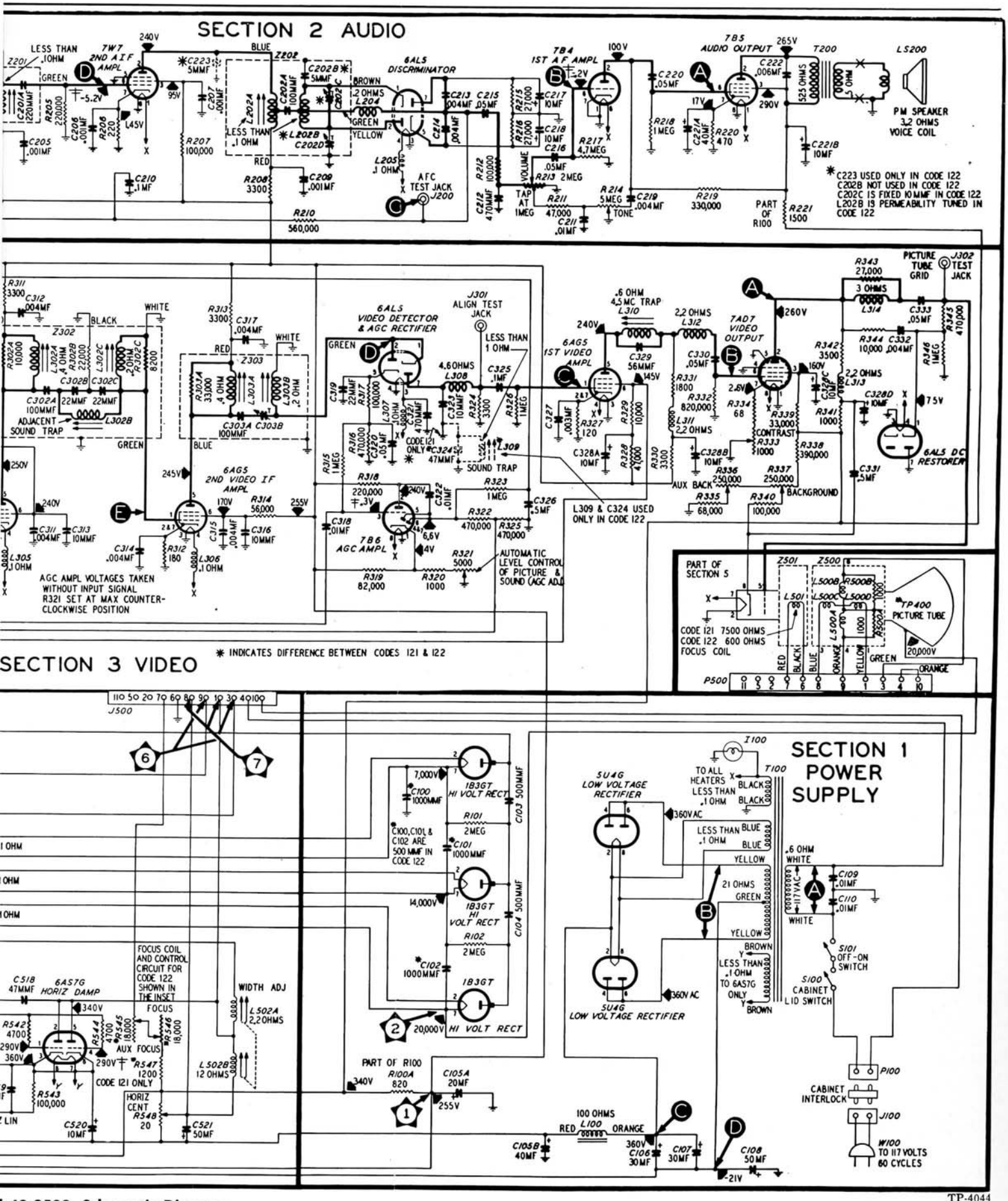


Figure 45. Model 48-250



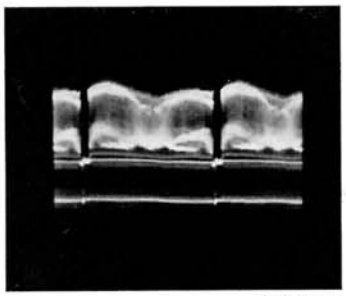
1 48-2500, Schematic Diagram

TP-4044

SUPPLEMENTARY WAVEFORMS

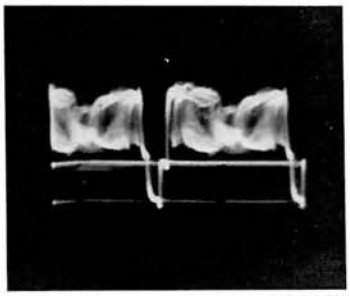
The following waveform photographs supplement Section 3 and Section 5 trouble-shooting procedures. The oscilloscope was synchronized at half the vertical-sweep rate for vertical waveforms and at half the horizontal-sweep rate for horizontal waveforms.

The station was transmitting a standard test chart. Note that the picture waveform content will appear different if other than the test chart is being transmitted; however, the blanking and synchronizing pulses will be unchanged.



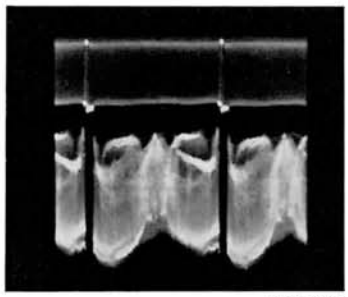
TP-4238

Figure 46. Detector Waveform (Vertical) at "Align" Test Jack



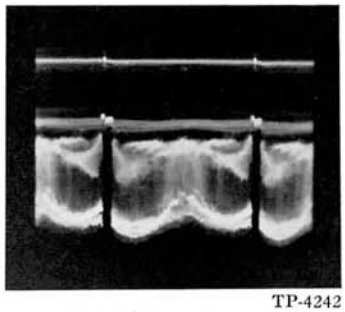
TP-4239

Figure 47. Detector Waveform (Horizontal) at "Align" Test Jack



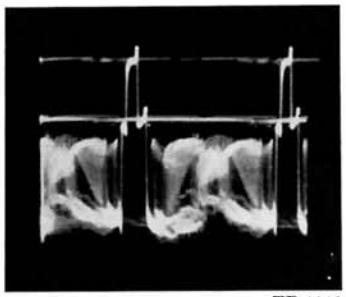
TP-4240

Figure 48. Screen Waveform (Vertical) at Pin 6 of First Video Amplifier



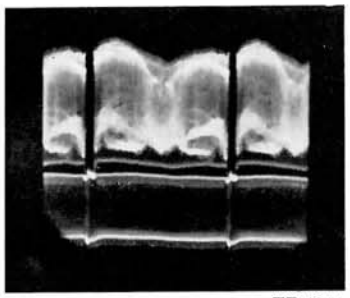
TP-4242

Figure 49. Grid Waveform (Vertical) at Pin 6 of Video Output



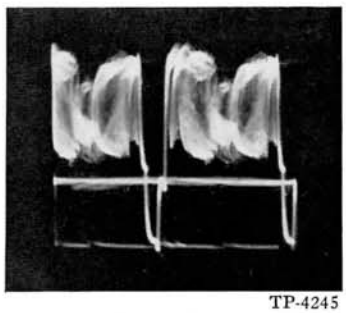
TP-4243

Figure 50. Grid Waveform (Horizontal) at Pin 6 of Video Output



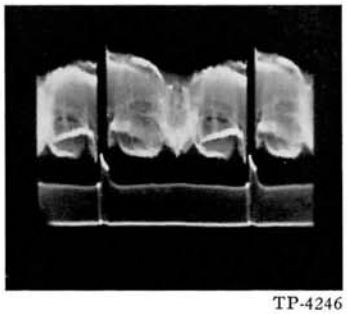
TP-4244

Figure 51. Grid Waveform (Vertical) at Picture-Tube Grid Test Point



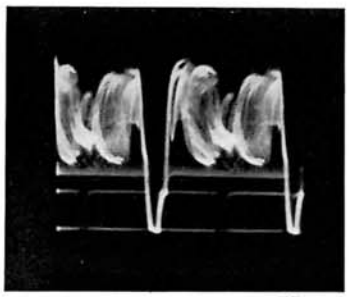
TP-4245

Figure 52. Grid Waveform (Horizontal) at Picture-Tube Grid Test Point



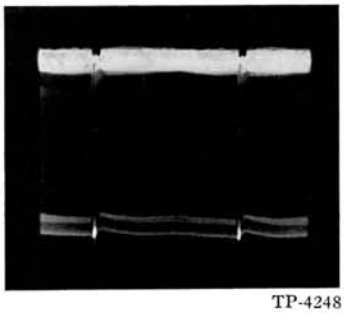
TP-4246

Figure 53. Cathode Waveform (Vertical) at Pin 1 of D-C Restorer



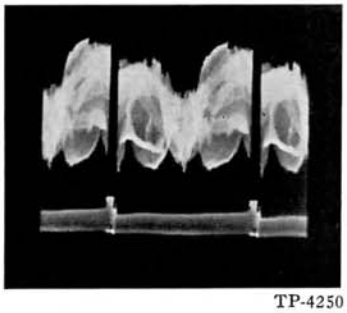
TP-4247

Figure 54. Cathode Waveform (Horizontal) at Pin 1 of D-C Restorer



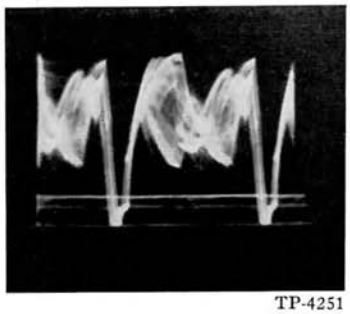
TP-4248

Figure 55. Grid Waveform (Vertical) at Pin 6 of Sync Separator



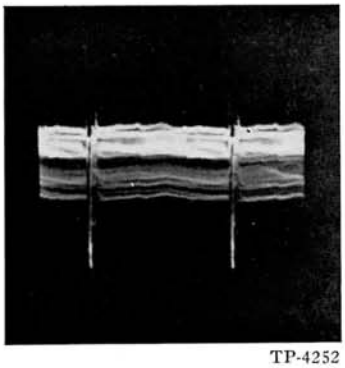
TP-4250

Figure 56. Plate Waveform (Vertical) at Pin 2 of Sync Separator



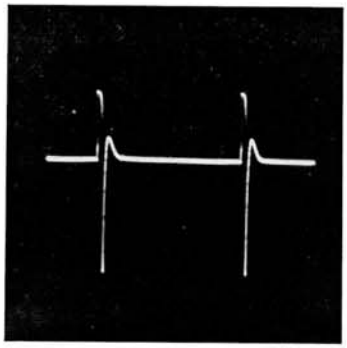
TP-4251

Figure 57. Plate Waveform (Horizontal) at Pin 2 of Sync Separator



TP-4252

Figure 58. Grid Waveform (Vertical) at Pin 8 of Sync Amplifier

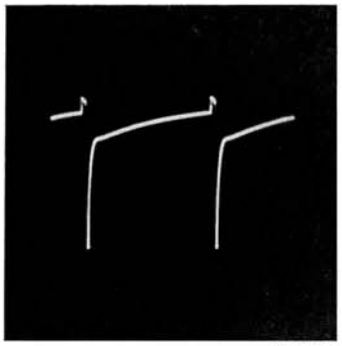


TP-4254

Figure 59. Plate Waveform (Vertical) at Pin 6 of Sync Amplifier

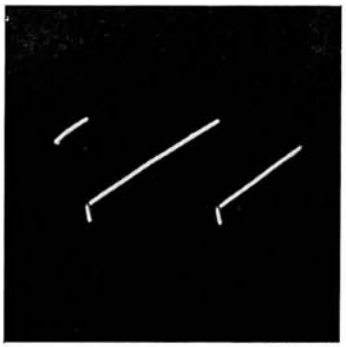
TP-4256

Figure 60. Plate Waveform (Vertical) at Pin 5 of Vertical-Sweep Generator



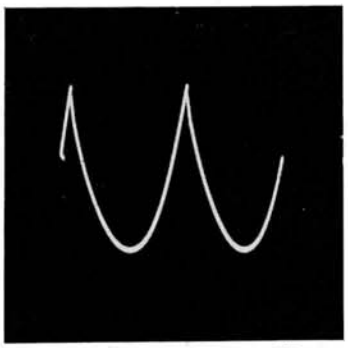
TP-4257

Figure 61. Grid Waveform (Vertical) at Pin 1 of Vertical-Sweep Generator



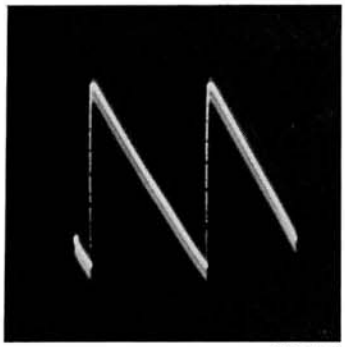
TP-4259

Figure 62. Grid Waveform (Vertical) at Pin 5 of Vertical-Sweep Output



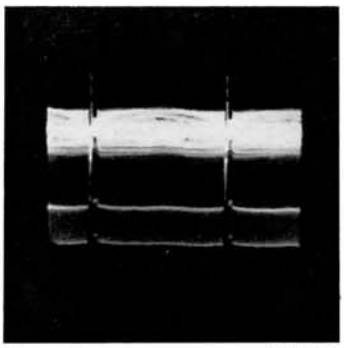
TP-4260

Figure 63. Cathode Waveform (Vertical) at Pin 8 of Vertical-Sweep Output



TP-4263

Figure 64. Sweep-Current Waveform (Vertical) Between VERT. CENT.-Control Rotor and Tap

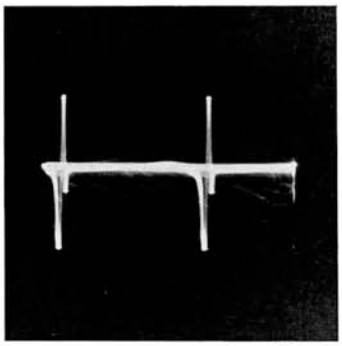


TP-4264

Figure 65. Grid Waveform (Vertical) at Pin 1 of Horizontal-Sync Amplifier

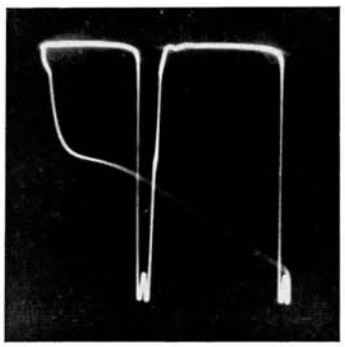
TP-4266

Figure 66. Plate Waveform (Vertical) at Pin 3 of Horizontal-Sync Amplifier



TP-4267

Figure 67. Plate Waveform (Horizontal) at Pin 3 of Horizontal-Sync Amplifier



TP-4272

Figure 68. Plate Waveform (Horizontal) at Pin 2 or 5 of Horizontal-Damping Tube

TP-4273

Figure 69. Cathode Waveform (Horizontal) at Pin 3 or 6 of Horizontal-Damping Tube

ALIGNMENT AND ADJUSTMENTS

CAUTION

Dangerous potentials are present in the receiver when it is operating, and for a short time after it has been turned off.

General

The intermediate frequencies of the receiver are 22.1 megacycles for the audio channel and 26.6 megacycles for the video channel. The alignment of circuits operating at these high frequencies requires accurately calibrated equipment and extreme care in the making of adjustments. The following precautions must be observed.

The top of the work bench should be metallic, or a separate metal plate should be available; the receiver chassis and signal generator must make good metal-to-metal contact with the bench top or plate.

All leads from the signal generator must be shielded. The unshielded length of signal lead must be kept very short and the shield must be clipped to the receiver chassis at a point close to the signal-lead connection. The signal-generator output lead should be terminated with a resistor equal to its characteristic impedance.

The signal-generator output must be kept low enough to prevent overloading of the receiver circuits. Limiting action produced by overloaded circuits causes incorrect response curves.

All adjustments should be made with low-loss, non-metallic alignment tools.

Never disconnect the picture tube, picture-tube yoke, or loud-speaker while the receiver is turned on. The yoke plug acts as an interlock which disconnects the primary supply of the receiver if the plug is not connected. If it is necessary, for special purposes, to operate the receiver without the speaker and the picture-tube assembly, remove the vertical and horizontal sweep-generator tubes and the audio-output tube before turning on the receiver.

Test Equipment

Special test equipment for television-receiver alignment will be available in the near future. Such equipment may combine several of the test instruments listed below. The information given for each instrument is generalized so that the serviceman can determine whether his present equipment is adequate.

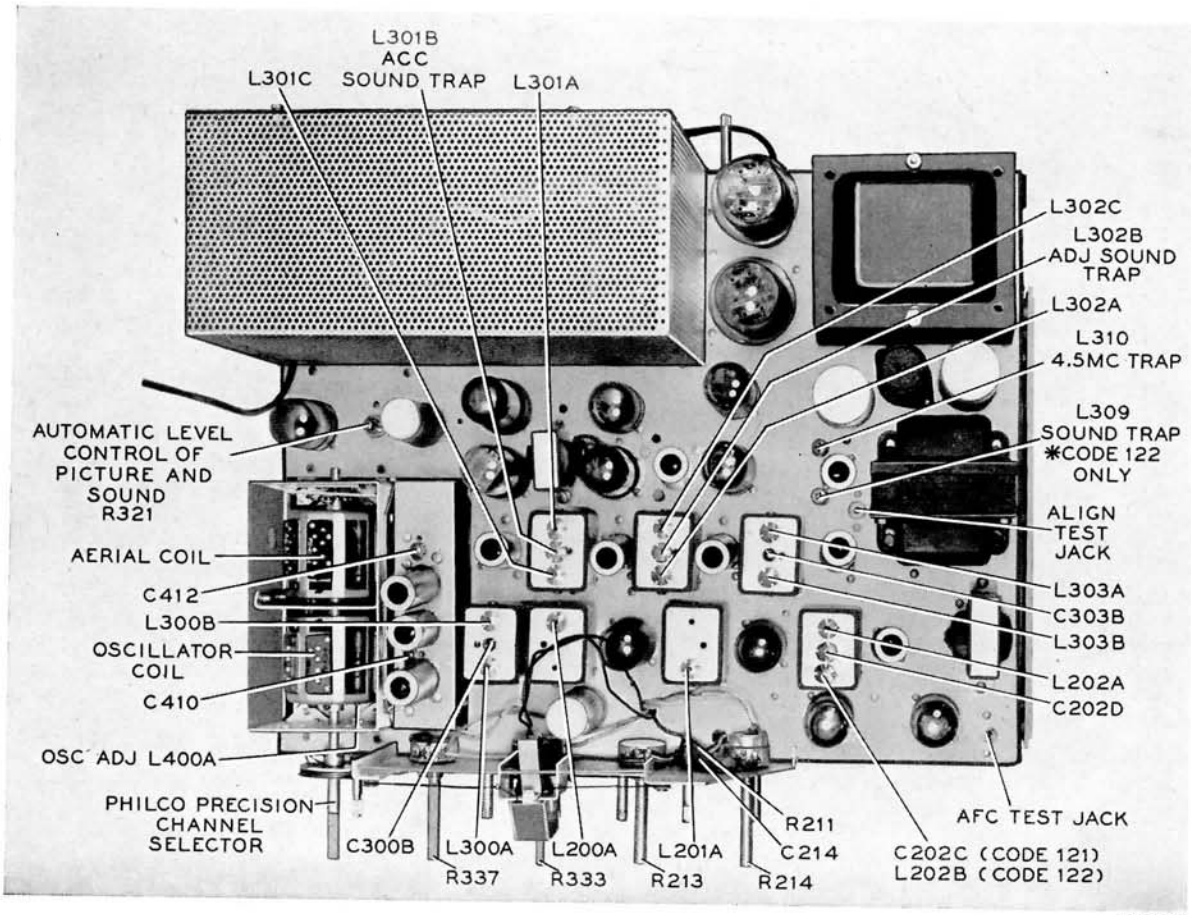
The following equipment is necessary to properly align and adjust the receiver:

1. FM signal generator
   Deviation, ±4 mc.; center frequency ranges, 20 mc. to 30 mc. and 180 mc. to 200 mc.; sweep-sync output with either built-in or separate phase corrector.
2. AM signal generator
   Carrier-frequency ranges, 20 mc. to 30 mc. and 190 mc. to 200 mc. (accurately calibrated); accurate output indicator (either calibrated attenuator or separate output meter); known modulation percentage (variable up to 100% is preferred).
3. Voltmeter
   Vacuum-tube voltmeter or 20,000-ohms-per-volt voltmeter, with ranges of 0-1, 0-10, and 0-600 volts a.c. and d.c.
4. Oscilloscope
   Calibrated; vertical sensitivity of 1 volt (peak-to-peak) per inch, or better.

ALIGNMENT CHART

STEP	SIGNAL-GENERATOR CONNECTION	SIGNAL-GENERATOR SETTING	OUTPUT-INDICATOR CONNECTION	ADJUST
1	None.	None.	None.	Turn C303B (figure 70) fully counterclockwise (minimum capacitance).
2	Connect FM signal generator to pin 1 (grid) of 2nd video-i-f amplifier. Connect AM signal generator to pin 1 (grid) of mixer.	Set FM signal generator to 25 mc. center frequency, deviation ±3 mc. Set AM signal generator to 27.1 mc., with modulation off.	Connect oscilloscope vertical input to "align" test jack (J301). Connect horizontal input to FM signal-generator sweep-output connection.	Adjust L303A and L303B for peak at 27.1 mc. as indicated by the marker pip from the AM signal generator.
3	Same as step 2.	Leave FM signal generator set as in step 2. Set AM signal generator to 23.25 mc.	Same as step 2.	Adjust C303B for second peak at 23.25 mc. See curve A in figure 71.
4	Disconnect FM signal generator only.	Set AM signal generator to 28.1 mc., with modulation on.	Same as step 2.	Adjust L302B for minimum output.
*4A	Same as step 4.	Set AM signal generator to 22.1 mc., with modulation on.	Same as step 2.	Adjust L309 for minimum output.

* Make adjustment on Code 122 only.



TP-3679

Figure 70. Location of Adjustments for Alignment of Receiver

STEP	SIGNAL-GENERATOR CONNECTION	SIGNAL-GENERATOR SETTING	OUTPUT-INDICATOR CONNECTION	ADJUST
5	Connect FM signal generator to pin 1 (grid) of 1st video-i-f amplifier. Connect AM signal generator to pin 1 (grid) of mixer.	Set FM signal generator to 25 mc. center frequency, deviation ±3 mc. Use AM signal generator to furnish marker pips to check 23.75-mc. peak and 26.75-mc. fall-away point.	Same as step 2.	Adjust L302A and L302C to obtain curve B in figure 71.
6	Disconnect FM signal generator only.	Set AM signal generator to 22.1 mc., with modulation on.	Same as step 2.	Adjust L301B for minimum output.
7	Same as step 6.	Same as step 6.	Connect voltmeter between pin 7 diode plate of 6AL5 discriminator and chassis.	Adjust L202A, L201A, and L200A for maximum meter indication.
8	Connect FM signal generator to pin 1 (grid) of input-i-f amplifier. Connect AM signal generator to pin 1 (grid) of mixer.	Set FM signal generator to 25 mc. center frequency, deviation ±3 mc. Use AM signal generator to furnish marker pips to check curve at 22.75 mc., 24.25 mc., and 27.0 mc.	Same as step 2.	Adjust L301A and L301C for curve A in figure 72.
9	Connect FM signal generator to pin 1 (grid) of mixer. Loosely couple AM signal generator to pin 1 (grid) of mixer.	Set FM signal generator to 25 mc. center frequency, deviation ±3 mc. Use AM signal generator to check curve at 22.6 mc., 23.75 mc., and 26.6 mc.	Same as step 2.	Adjust C300B, L300A, and L300B for curve B in figure 72.

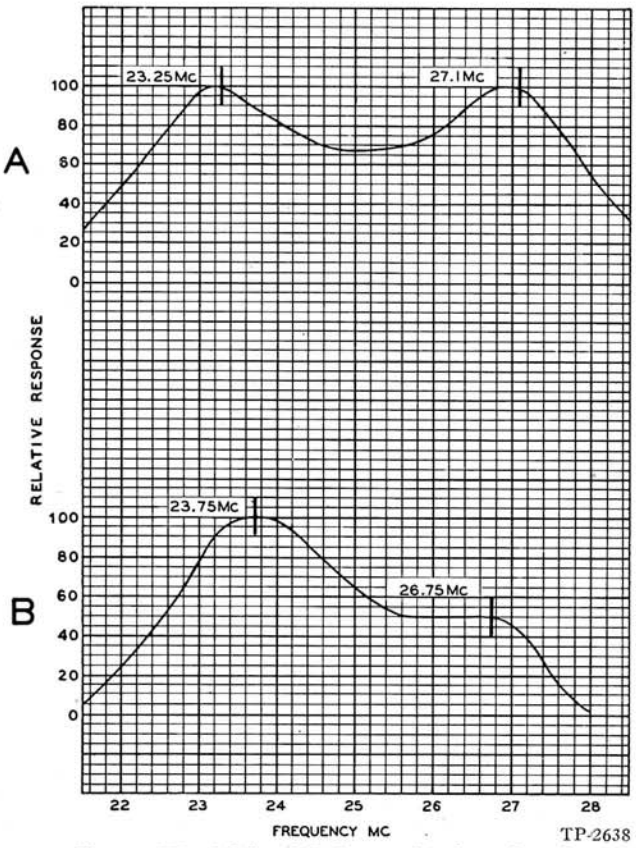


Figure 71. Video-I-F Curve (2nd and 3rd V-I-F Couplers)

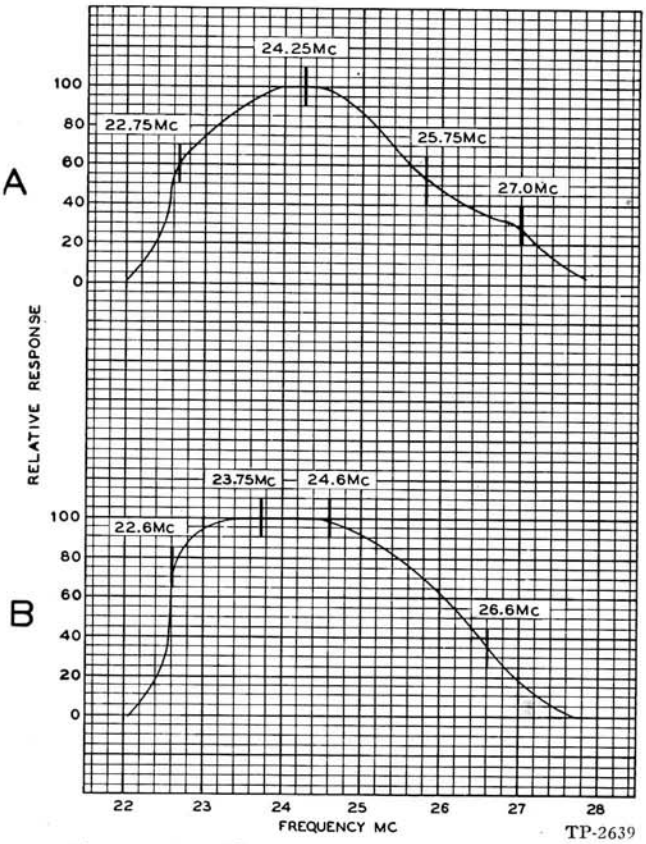


Figure 72. Video-I-F Curve (Input and 1st V-I-F Couplers)

STEP	SIGNAL-GENERATOR CONNECTION	SIGNAL-GENERATOR SETTING	OUTPUT-INDICATOR CONNECTION	ADJUST
10	Connect FM signal generator to pin 6 (grid) of 1st audio-i-f amplifier. Connect AM signal generator to pin 1 (grid) of mixer. Note: Keep output of AM signal generator as low as possible.	Set FM signal generator to 22.1 mc. center frequency, deviation ±1 mc. Use AM signal generator to furnish a marker pip to set FM signal generator to exact center frequency.	Connect oscilloscope vertical input to J200. Connect horizontal input to FM signal-generator sweep-output connection.	Adjust C202D for minimum capacitance. Adjust C202C (L202B in Code 122) for center frequency crossover at 22.1 mc. (See Note 1.) Adjust L202A and C202C (L202B in Code 122) for symmetrical response, and alternately adjust C202C (L202B in Code 122), L202A, and C202D for curve in figure 73. C202D affects the slope of the curve between the two peaks.
11	Disconnect FM signal generator. Connect AM signal generator to J400.	Set AM signal generator to audio carrier frequency of each channel to be used.	Connect voltmeter, set to low range, to J200.	Adjust oscillator slug L400A on each channel used (see figure 70) for zero center reading on voltmeter (Receiver should have been operating for at least 20 minutes). Then set for +.5 volt.
12	Connect FM signal generator to J400. Leave AM signal generator connected as in step 11.	Set FM signal generator to 195 mc., deviation ±4 mc. Set AM signal generator to 193.25 mc.	Same as step 2, except short "a-f-c" test jack (J200) to chassis to prevent interaction from a.f.c.	Adjust C410 and C412 for curve B in figure 72. Note: The marker at 193.25 mc. will correspond to 26.6 mc. in figure 72.

Note: It is possible to apparently secure the proper curve when making this adjustment, and yet be phased so as to throw the oscillator out of tune so that it cannot lock in. To avoid this difficulty, check the phasing by observing the polarity of the discriminator output voltage. When the audio-i.f. is lower than the center frequency, a negative output voltage should be produced, and conversely when higher than the center frequency a positive voltage should be produced.

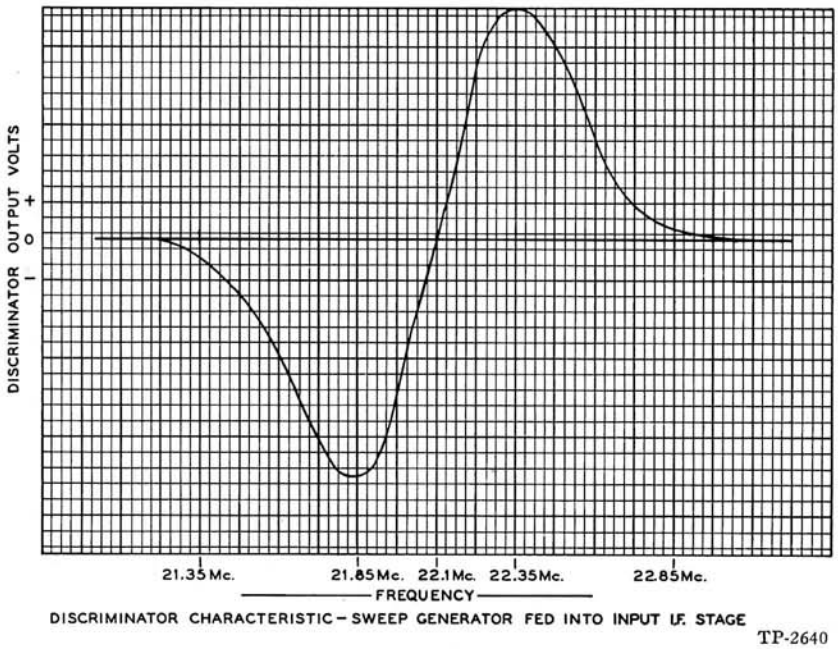


Figure 73. Discriminator-Response Curve

ELECTRICAL-SYSTEM ADJUSTMENTS

Video (4.5-MC.)—Trap Adjustment

Connect an AM signal generator to pin 1 of the 1st video amplifier. Set the signal generator very accurately to 4.5 mc. Turn the signal-generator modulation on. Connect the vertical plate of the oscilloscope (or a VTVM) to J302 (picture tube grid test jack), located underneath the chassis. Adjust the 4.5-mc. trap (L310 shown in figure 70) for minimum signal on the oscilloscope (or VTVM).

Automatic Level Control of Picture and Sound (A-G-C) Adjustment

Connect an AM signal generator to J400 (aerial jack) and set it to any picture carrier frequency for which coils are provided. Adjust the signal generator for 100% modulation (if possible), and an output level of 500 microvolts.

Connect a calibrated oscilloscope to J301 and adjust a-g-c control R321 (see figure 70) to obtain a 2-volt peak-to-peak reading on the oscilloscope.

If the signal generator is not capable of 100% modulation, but the modulation percentage is known (check by trapezoid method), set the a-g-c adjustment to the same percentage of the 2-volt reading as the generator modulation percentage. For example, if the generator is 30% modulated, set the a-g-c adjustment for 30% of 2 volts peak to peak, which is 0.6 volt peak to peak.

The a-g-c setting is now approximately the same as when the Receiver leaves the factory. However, this adjustment is reset at the time of installation to adjust the Receiver to the optimum point for reception in the locality where it is to be used. At installation, the Receiver is set for approximately 2 volts peak to peak on the local television station, or, if more than one station is available, it is set for approximately 2 volts peak to peak on the weakest and strongest signals. By this means overloading of the receiver video circuits or sync drop-out is prevented. If the 2-volt peak-to-peak signal cannot be obtained, trouble in the antenna installation is indicated.

Video-Amplifier-Gain Check

Leave the AM signal generator connected to J400 and adjusted the same as in the a-g-c adjustment. Connect the calibrated oscilloscope to J302. Set the CONTRAST control fully clockwise. A peak-to-peak voltage of approximately 140 volts, indicating a gain of approximately 70 in the video-amplifier stages, should be obtained.

This gain check is also repeated at the time of installation of the Receiver. At that time the check is made, using the local television station to furnish an input signal instead of a signal generator. Should the 2-volt peak-to-peak detector output be obtained, but with low video-amplifier gain, replace the video tubes or check for trouble in Section 3.

D-C Reinsertion Check

With the CONTRAST control turned fully clockwise, connect a 20,000-ohms-per-volt voltmeter between J302 and the chassis. The voltage measured at this point should be approximately 35 to 50 volts positive.

Should the proper video-amplifier gain be obtained, but with a lower-than-normal voltage in the d-c-reinsertion check, trouble is indicated in the d-c-reinsertion circuit.

Beam-Current and Focus Adjustment

With the Receiver off, connect a test cable, about 10 inches long (see figure 74), between the base of the picture tube and the picture-tube cable connector. Connect a 250-microampere meter to the cable test leads. Turn the Receiver on, and make the preceding

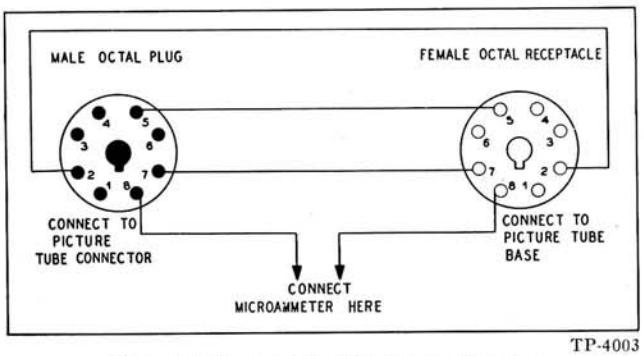


Figure 74. Test-Cable Connections

a-g-c, gain, and d-c-reinsertion checks, using either a signal generator or a television station as the signal source. Turn the BACKGROUND, FOCUS, and CONTRAST controls to ¾ of their maximum clockwise rotation. Adjust the AUX. BACKGROUND control for a beam current of 70 to 80 microamperes. Observe the face of the picture tube and adjust the auxiliary FOCUS control on the rear of the chassis for clear, sharp sweep lines in the picture. Turn the Receiver off, and remove the test connections and test cable.

Trap Adjustments

If the alignment procedure was followed carefully, and if an accurately calibrated signal generator was used, there should be no sound or beat interference patterns (see figures 20 and 21) visible in the picture. If either of these patterns is obtained when a television station is being received and cannot be eliminated by trap realignment (see steps 4 and 6 of alignment chart and video trap adjustment), readjust the traps to the Receiver i.f. Mark the trap-adjustment settings and detune L301B slightly, counting the number of turns and observing closely whether the interference pattern becomes more or less noticeable. Leave L301B set at the point of minimum interference. Then check L302B similarly, and set it for minimum interference. Should the trouble still persist, check the adjustment of the oscillator-coil core. If the core is set too far from the cross-over point, the video and audio intermediate frequencies and the unwanted sound frequencies will change from those listed in the frequency chart (page 9). Therefore, since the traps are tuned to other frequencies, the sound will not be rejected.

Should the interference be a 4.5-mc. beat pattern (closely spaced vertical lines), the Receiver adjustment can also be corrected by marking the accompanying sound trap (L301B) setting, and then detuning it for aggravated sound interference, counting the number of turns; a stronger beat signal with the video i.f. will be produced, hence a stronger beat pattern will appear in the picture. Then adjust the 4.5-mc. video trap (L310) for minimum beat pattern; when the accompanying-sound trap is returned to its original setting, the beat pattern will disappear.

When accompanying sound is encountered in Code 121, and cannot be eliminated by the sound-trap adjustments explained above, it is advisable to insert the additional sound trap (L309 and C324) as shown in the schematic diagram under changes in Code 122.

OPTICAL-SYSTEM ADJUSTMENTS

Micro-Lens-Screen Adjustment

The lid containing the Philco Micro-Lens Screen must be adjusted to an angle of 67½ degrees for proper viewing. Open the lid and place a protractor on the top of the console, against the side of the lid. Loosen the lock nuts on the rear rail of the cabinet, and turn the adjusting screw until the proper angle is obtained; then tighten the locking nuts.

Make sure that the lid rests securely against the metal stop, and is held firmly in place by spring tension. Otherwise, loose spring tension may cause an improper viewing angle. Also check the lid hinges to see that the hinge arms do not bear against the hinge pins. If the arms do bind, file away the protruding portion or press the hinge arms together until they do not bind. Adjust the spring tension by placing the spring adjusting screw in other holes in the frame, or make a new eye in the spring.

In homes where furniture is such that the eye level for seated persons is below the normal viewing cone, it is permissible to block up the rear legs so that the screen is still perfectly visible. Make sure that the lid switch operates to remove power from the Receiver when the lid is closed. If it does not operate properly, bend the mechanism as required.

Optical Adjustments

Before any optical adjustments are made, the Receiver must be properly adjusted, and all electrical controls must be properly positioned, so a clearly focused, keystoned picture with approximately 325-line resolution is obtained on the face of the picture tube. The spherical mirror should be in place and clean, and the flat mirror and corrector lens should be clean.

Before it is possible to make any adjustments on the optical housing, the glass dust-cover must be removed from the speaker well. Loosen the two glass dust-cover clamps, and turn them so they are free of the glass. Insert a finger in each cut-out and pull the glass upward slightly. When the glass is free of the frame, move it toward the back of the cabinet, and when free of the top molding, lift it out and place to one side.

"Z"-Axis (In-and-Out) and "Y"-Axis (Top-to-Bottom) Focus Adjustment

Loosen deflection-yoke clamping nuts A and B slightly (figure 75), and move focus lever C back and forth until the picture is as sharp and clear as possible at the bottom of the screen.

Tilt the lid forward slowly; if the sweep lines at the top of the picture improve, loosen locking nuts D and E slightly (figure 75). Loosen adjusting nut F one turn. Readjust focus lever C for the best detail at the bottom of the picture. Continue loosening nut F and readjusting focus lever C until the top of the picture is also in the same sharp focus as the bottom. If the picture does not improve when the lid is tilted forward, follow the procedure above, except tighten rather than loosen nut F.

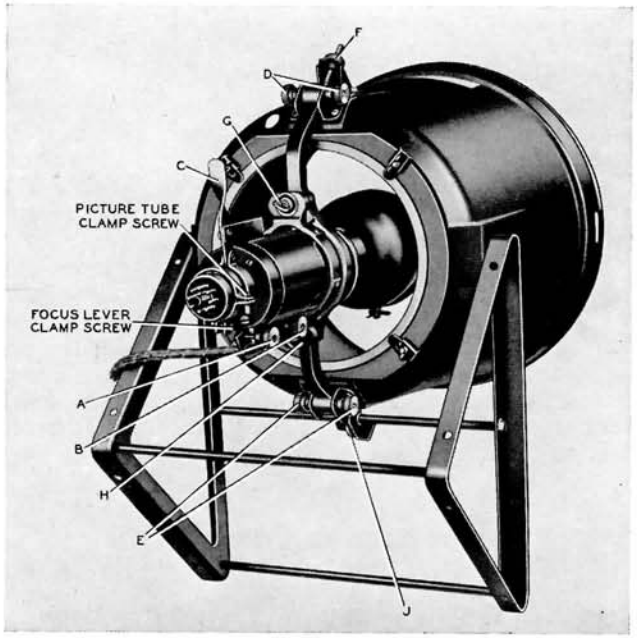


Figure 75. Optical Adjustments TP-3655

NOTE: Always readjust focus lever C for the best detail at the bottom of the picture after nut F is reset.

"X"-Axis (Side-to-Side) Focus Adjustment

Move the lid forward slowly while observing the right-center and left-center portions of the screen. If neither side improves in focus, no further adjustment is required. If only one side improves in focus, loosen nuts G and H, and move the deflection-coil-and-tube support from side to side until both sides of the picture are equally in focus on the screen. Tighten nuts G and H, then make a final check of the "Z" and "Y"-axis adjustments. After all parts of the picture are in focus, tighten locking nuts A, B, D, and E.

NOTE: Move the hand about the dust-cover opening to shade different portions of the screen. If no improvement in picture detail near the moving shadow is noticeable on any part of the screen, the optical adjustments are correct.

Adjustment of Optical Housing With Respect to Cabinet

Improper adjustment of the optical housing with respect to the cabinet will produce shadows in the lower corners of the picture, as shown in figure 26. Loosen knurled nut J (see figure 75), and rotate the eccentric lever until the shadows are removed. Retighten the knurled nut after the adjustment is made. Repeat the adjustments for the "X," "Y," and "Z" axes.

Should the eccentric-lever adjustment be inadequate, loosen the nuts which hold the housing to the cabinet, and shim out the bottom of the housing until the shadows are eliminated. Then repeat the adjustments for the "X," "Y," and "Z" axes.

Picture-Tube and Deflection-Yoke Adjustment

The top and bottom edges of the picture should be parallel with each other. If they are not parallel (see figure 28), loosen the picture-tube clamp and turn the tube slowly until the top and bottom edges are parallel with each other. If they are parallel with each other, but tilted with respect to the screen (see figure 27), loosen deflection-yoke clamping nuts A and B

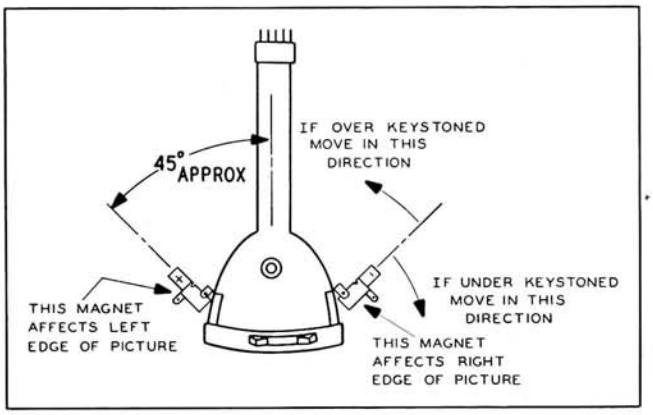


Figure 76. Magnet Positioning TP-4004

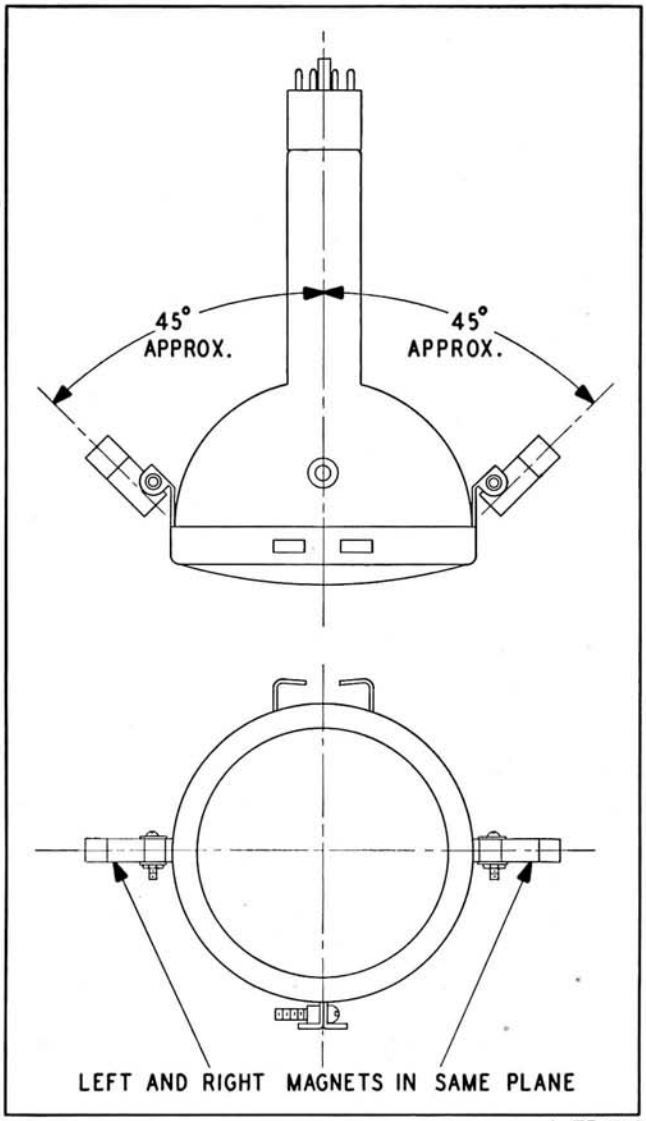


Figure 77. Proper Magnet Alignment TP-4002

and the focus-lever clamp screw sufficiently to turn the tube and yoke. See figure 75. Set the yoke so that the top edge of the picture is parallel with the screen, and then tighten the thumb screws and clamp.

Keystoning Adjustment

The sides of the picture should be parallel with each other and with the frame; if they are not, the picture is either overkeystoned or underkeystoned. To correct this condition, remove the spherical mirror, connect a ground strap from the light-shield assembly to the magnet-band clamp screw, and position the magnets properly. Figure 76 indicates the method of adjusting the magnets. Figures 30, 31, 32, and 33 show underkeystoning and overkeystoning.

NOTE: Before finally replacing the spherical reflector, be certain to remove the ground cable, and clean the mirror.

Pincushioning Adjustment

Should the picture be excessively bowed at the bottom (pincushion effect), as shown in figure 29, axial adjustment of the magnet pole pieces should be made. Check to see that both magnets are centered in the same horizontal plane. If they are not, clip the ground lead to the clamp band, loosen the clamp-band screw sufficiently to permit movement of the pole pieces, and set on the same center line, as shown in figure 77; then tighten the clamp screw and remove the ground lead. The bottom of the picture is normally slightly pincushioned; excessive pincushioning can be easily corrected by moving the magnet pole pieces up or down (above or below the center line), so that the bowed portion is not so excessively curved.

REMOVAL AND REPLACEMENT OF PARTS

Optical-Housing Assembly

To remove the optical-housing assembly, remove the screws from the back cover of the Receiver and take off the back cover. Note the placement of all leads and cables to the picture tube. Remove the spherical mirror as directed under the "Spherical Mirror" paragraph below.

Use the mirror-retaining strap to discharge the high-voltage anode of the picture tube, the keystoning-magnet pole pieces, and the retaining ring, and slide the anode cable through the hole in the top of the housing. Do not change the position of the keystoning magnets. Remove the picture-tube connector, and disconnect the focus and deflection-yoke cable (P500) at the chassis.

While holding the optical housing to prevent it from falling, remove the four hex nuts and the four washers which hold the optical housing to the cabinet, and carefully remove the housing assembly.

To replace the assembly, reverse the above procedure. Be sure to dress the leads properly. Replace the mirror as described under "Spherical Mirror."

Spherical Mirror

To remove the spherical mirror, hold the metal retaining strap so it cannot spring outward, and slide the strap through the top notch in the optical housing. When the strap is free of the housing, remove the strap while holding the mirror so it will not fall. Be careful! The mirror can easily slip out! Hold the mirror with the palm of the hand or by the edges, and lower it from the housing.

Before replacing the mirror, clean it with a soft cloth and a cleansing agent, such as Philco Optical Surface Cleaner. Be careful not to touch the mirror surface because the acid from perspiration will etch finger marks in the surface of the mirror.

When replacing the mirror, insert the metal strap in the bottom slot of the optical housing, as shown in figure 78. Hold the mirror in the palm of the hand as shown in figure 79, and place it in the housing. Slide the metal strap through the top slot to fasten the reflector in place.

Picture Tube

To remove the picture tube, take off the back cover, remove the metal retaining strap, and take out the spherical mirror. Refer to the "Spherical Mirror" paragraph above. Discharge the high-voltage anode and the magnet mounting ring on the picture tube, with the mirror retaining strap. Remove the picture-tube connector from the base of the picture tube. Loosen the picture-tube clamp screw and pull the tube out slowly, rotating it from side to side, if necessary.

The front part of the picture tube is coated to prevent high-voltage arcing; when handling the tube, hold it near the front edge and by the neck to avoid dielectric breakdown of this coating.

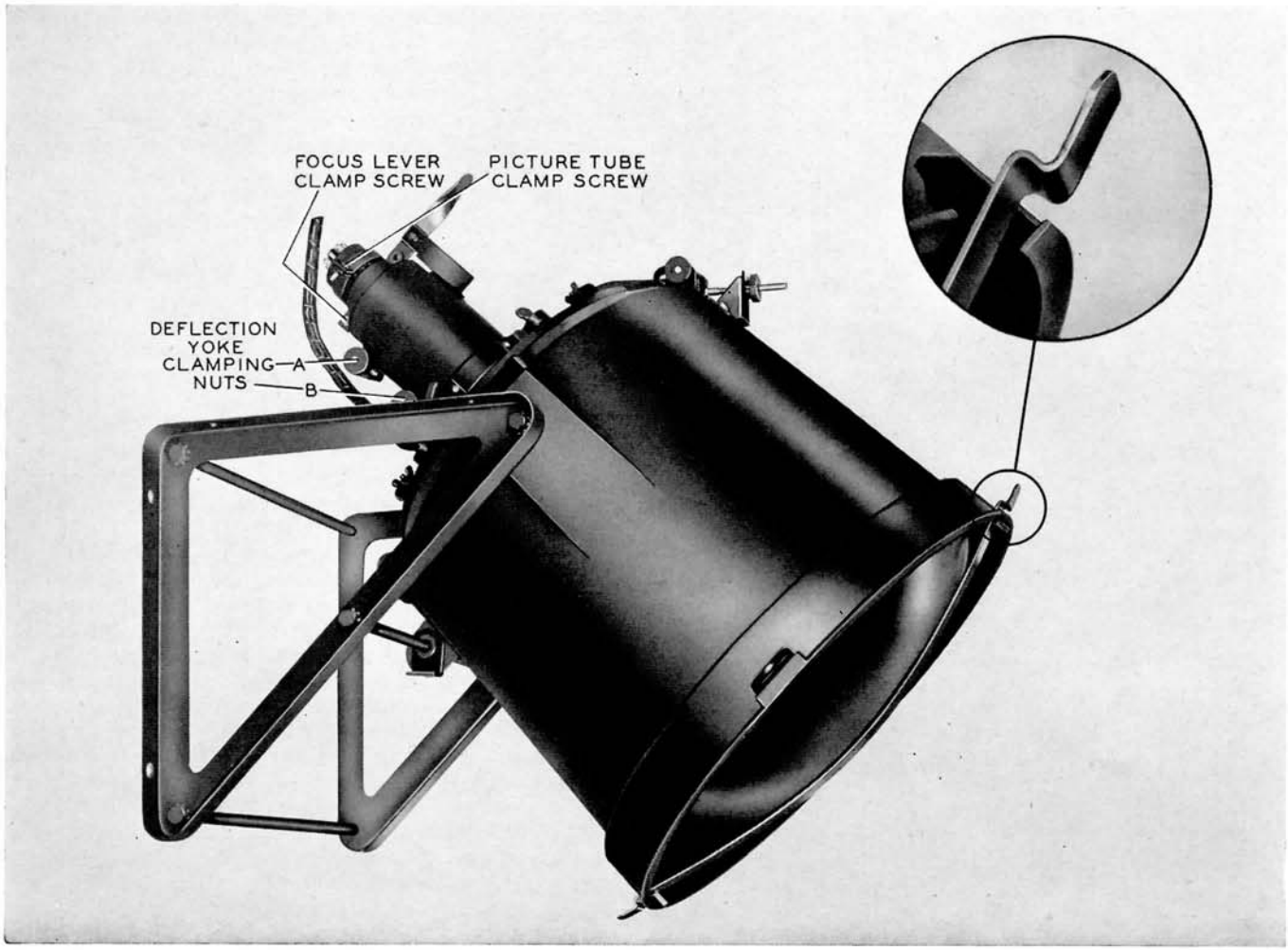
Before replacing the picture tube, be sure that the bronze centering ring is in place in the front end of the deflection yoke, and that the picture-tube clamp is loosened sufficiently.

Insert the base of the tube into the deflection yoke. Be careful not to foul the deflection-coil cable leads inside the yoke. Align the high-voltage anode of the picture tube vertically, and the keystoning magnets horizontally. Push the tube upward, rotating it slightly from side to side until the bell of the tube is firmly seated and touches the deflection coil. Tighten the picture-tube clamp screw. (Tighten the screw only enough to hold tube in place.) Touch the high-voltage anode connector to the optical housing to discharge it. Then insert it through the hole in the housing, and snap it in place on the tube.

Connect the picture-tube connector to the base of the tube. Be careful when connecting the connector to the base, so as to avoid pushing the tube out of the clamp.

Glass Dust Cover

The glass dust cover in the speaker well must be removed when adjustments are being made on the optical system, or when parts of the optical system are being removed or replaced. To remove the dust cover, loosen the two clamps and turn them free of the glass. Insert a finger in each cut-out and pull the glass upward slightly. When the glass is free of the frame,



TP-3656

Figure 78. Method of Inserting Mirror Retaining Strap

move it toward the back of the cabinet, and when it is free of the top molding, lift it out and place it to one side.

Deflection-Yoke and Picture-Tube Mounting Assembly

To remove the deflection yoke, first remove the back cover, the spherical mirror, the picture tube, and the glass dust cover. Then loosen nut F and remove the two "X-axis" clamping nuts and bolts D and E, shown in figure 75, which hold the deflection-yoke and picture-tube mounting assembly to the optical housing. Remove the deflection yoke and picture-tube mounting assembly through the dust-cover opening from the rear (bracket end of housing). Be careful to avoid bumping or scratching the flat mirror.

Loosen and remove the deflection-yoke clamping nuts and bolts A and B, and slide the deflection yoke from the assembly.

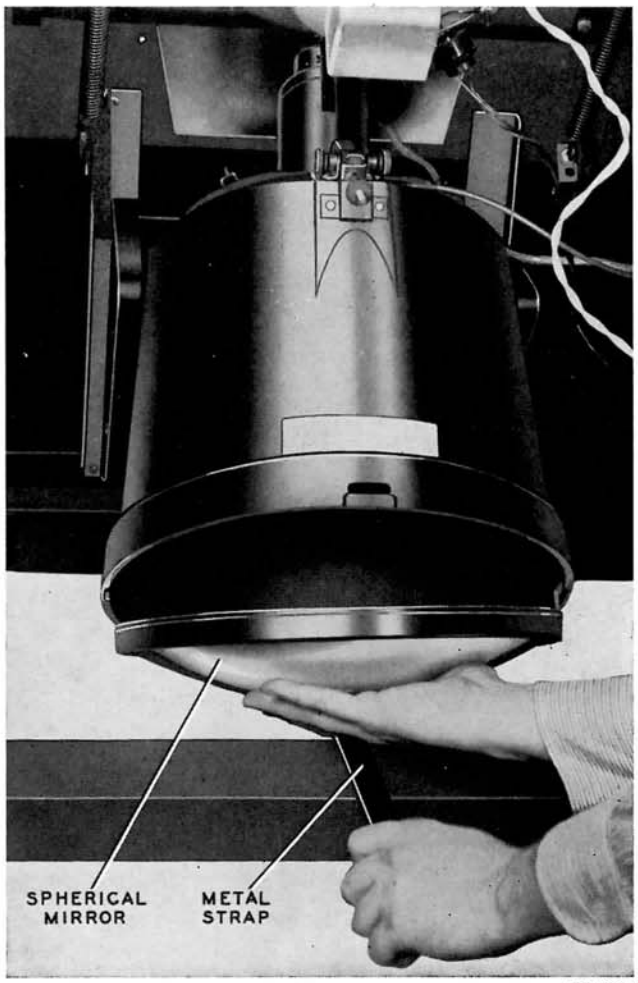
If it is necessary to separate the focus-coil assembly from the deflection-coil assembly, scribe a mark between the focus coil and the deflection coil. Remove the three flat-head screws that hold the assemblies together. Note the lead dress, unsolder the leads from the small terminal panel, and separate the two units. Figure 80 shows the deflection yoke disassembled.

To assemble the two units, solder the focus-coil leads and the deflection-coil leads to the terminal panel. Dress the leads so that the picture tube will not pinch or jam them when it is inserted. Match the focus and deflection assemblies to the scribe marks, and fasten them together with the three screws. Insert the yoke into the picture-tube assembly, being certain that the focus lever engages the hinge pin on the deflection-yoke clamp. Dress the deflection-yoke cable in the slot provided in the mounting assembly.

Replace the deflection-yoke clamping bolts and nuts. Fasten the deflection-yoke and picture-tube mounting assembly to the optical housing, and replace the picture tube and the spherical mirror. Readjust the optical system, and replace the glass dust cover.

Flat Mirror

The flat glass mirror, of slightly keystone shape, is attached to the back of the front panel by three clips, one on each side and one at the bottom. To replace this mirror, remove the glass dust cover from the speaker well and loosen the two side clamps, turning them free of the glass. Hold the mirror, loosen the bottom clamp, and slide the mirror up through the dust-cover opening. Replace the mirror by reversing the above procedure, first being certain that the mirror



TP-3652

Figure 79. Inserting Spherical Mirror

is clean and that the coated surface is facing the optical assembly. If the mirror is not clean, polish it with a soft cloth and a cleansing agent such as Philco Optical Surface Cleaner. After fastening the mirror, remove any smudges or fingerprints that may have been made during this replacement.

Micro-Lens Screen

The Philco Micro-Lens Screen is covered with a special plastic coating. When this coating is badly scratched or chipped because of mishandling, it is necessary to replace the screen. Remove the six screws from the frame which holds the screen in place in the lid. Remove the frame and take out the screen. Replace the screen, handling it carefully (wear cotton gloves) to avoid scratching or marring the coating. Gently press it in shape against the lid. Replace the frame in the lid, and tighten the six screws.

It is permissible occasionally to dust the screen lightly with a soft cloth; however, it is not recommended that dusting be a regular routine, since scratching the screen is more detrimental than any effect of dust.

Corrector Lens

To remove the corrector lens, the optical housing must first be removed as described under "Optical-Housing Assembly"; then the picture tube and the deflection-yoke and picture-tube mounting assembly must be removed. The four wing nuts holding the corrector lens should be loosened and the clips turned so they are free of the corrector lens. Remove the corrector lens (holding it by the edges to avoid scratching or marring the lens).

When replacing the lens, first replace the spherical mirror and clean the lens with a soft cloth and a cleansing agent such as Philco Optical Surface Cleaner. Since the plastic lens is soft, extreme care is necessary to avoid scratching its surface. Hold the lens by the edges and place the flat side toward the spherical mirror. Note that the hole is not in the center of the lens. Align the lens so that the hole is near the bottom edge of the assembly, with the outside scribe mark centered at the bottom of the housing (use the eccentric adjustment as a centering guide). Figure 81 shows the proper alignment of the lens, and the results of correct adjustment.

With the eye about one foot from the lens, and centered over the black, painted center of the spherical mirror, adjust the lens until the black, painted center is spaced evenly between the lower edge of the hole in the lens and the upper edge of the reflected hole. Then shift the lens until the scribe marks on the lens and their reflections in the mirror coincide, forming four single scribe marks instead of eight. (Figure 81 shows the scribe marks separated for clarity of illustration.) At this time the bottom scribe mark will also be centered at the bottom of the housing. When this adjustment is first attempted, some difficulty may be experienced in centering the eye properly, and in distinguishing the reflections from the actual images; the serviceman should repeat the adjustment a few times until he is familiar with the adjustment and is certain that it is properly made.

After the scribe marks are properly aligned, carefully hold the lens in place and tighten the four wing nuts. Remove the spherical mirror, replace the housing in the cabinet, and replace the deflection yoke, the picture-tube mounting assembly, the picture tube, and the mirror. Check the keystoning adjustment and all of the optical adjustments, resetting them if necessary.

Channel-Marker Indicator Cord

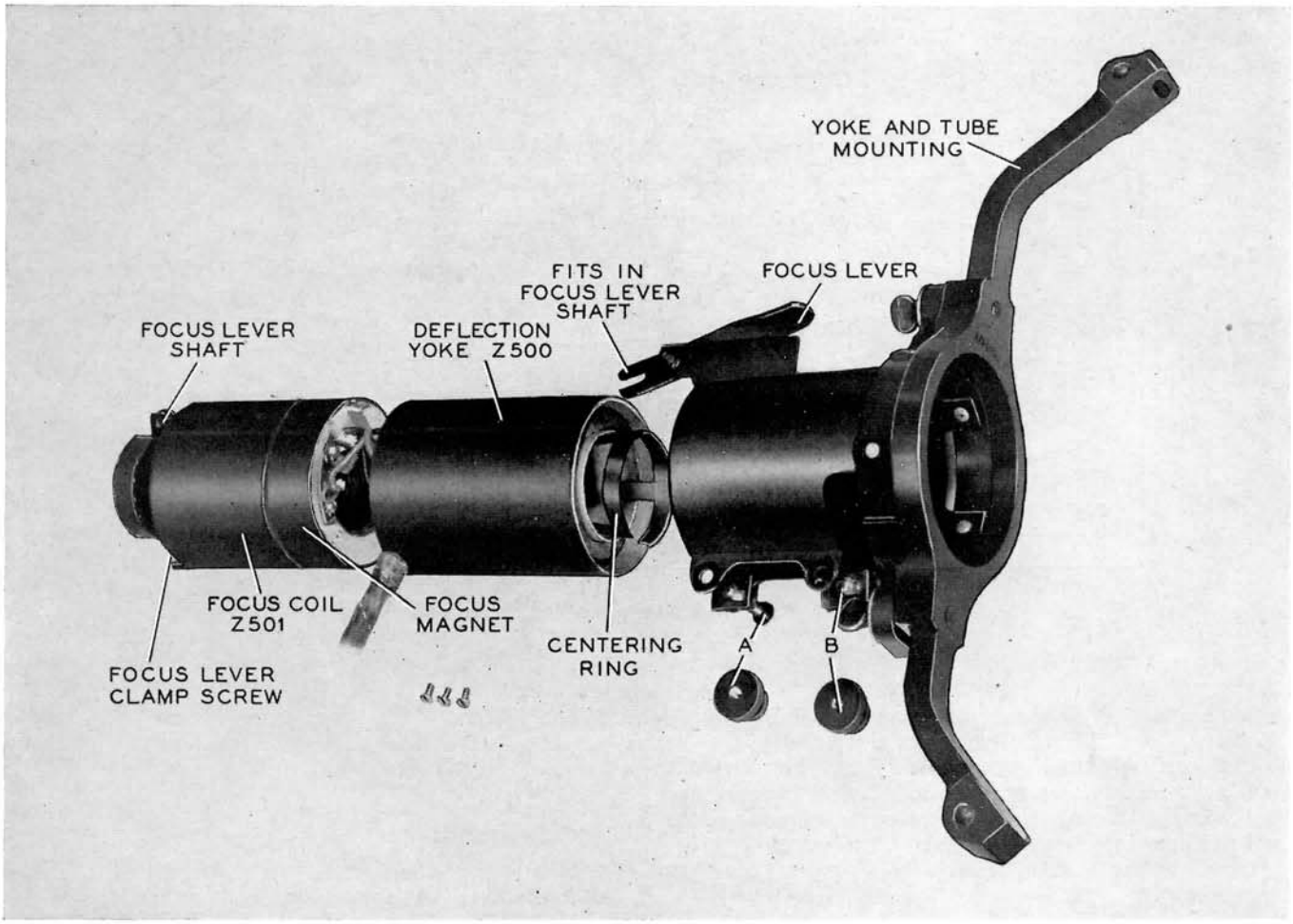
The proper method of stringing the indicator cord is shown in figure 82. With the Precision Channel Selector set at its extreme counterclockwise position, the correct indicator setting is ¼ inch from the right side of the dial plate.

Channel-Marker Indicator Lamp

Unsnap the marker cover, press the lamp assembly together, and remove it from the chassis. Then remove the lamp cover and lamp.

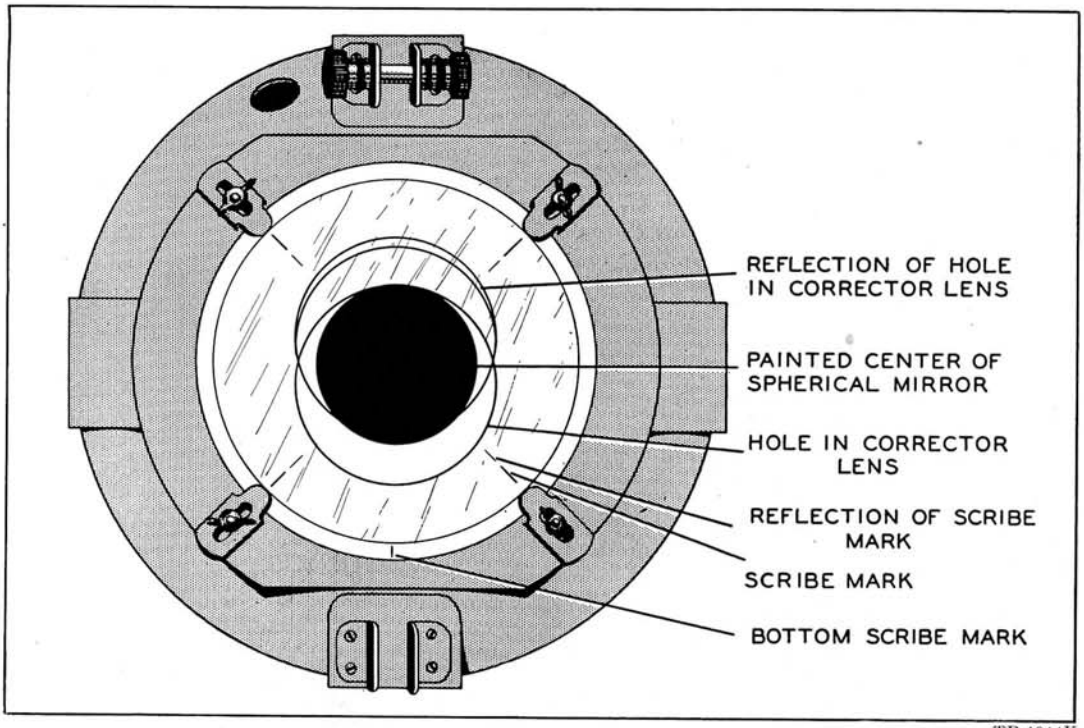
Channel-Marker Assembly

Open the control-panel door, remove the two screws, and take off the channel-marker assembly. Place the correct channel numbers in the positions for which coils are provided, using stars for unused channels. Place the tabs in position on the backing strip, re-



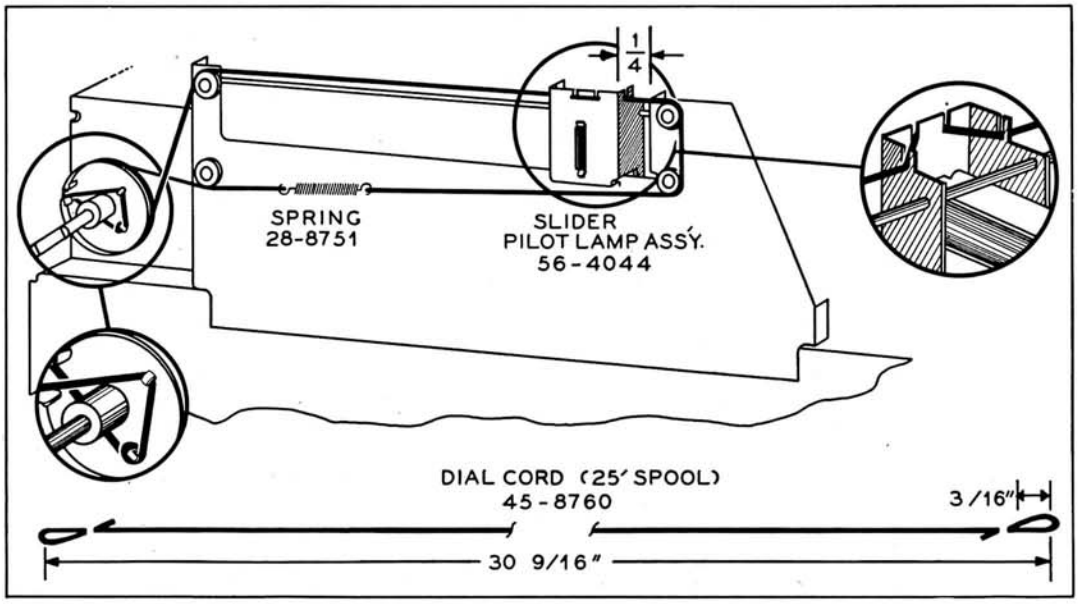
TP-4209

Figure 80. Deflection Yoke Disassembled



TP-4044K

Figure 81. Corrector Lens Adjustment



TP-4044L

Figure 82. Channel-Marker-Indicator-Cord Details

assemble the channel-marker assembly, and fasten it in place.

In early production of Code 122, the channel-marker assembly was redesigned; all that is necessary is to remove the channel-marker cover, slip the channel markers in place, and refasten the cover.

Channel Coils

The proper method of coil insertion is shown in figure 41. The oscillator coil, which is slug-tuned, should be placed in the front of the Precision Channel Selector compartment; the antenna coil, which is fixed-tuned, should be placed in the rear compartment. The coil part numbers should both end with the same suffix numeral. The suffix numeral indicates the television-broadcast channel number; for example, 32-4115-3 and 32-4128-3 are the part numbers of the antenna and oscillator coils for channel 3. Should the oscillator-coil slug be all the way out, it must be turned in until the coil can be properly inserted. Be sure that the coil-holding lip is underneath the edge of the channel-selector rim, as it is possible to snap in the coil with the lip outside. Each pair of coils may be inserted in any one of the eight channels, provided the two coils are inserted in the same channel compartment; if the channel-3 oscillator coil were paired with the channel-4 antenna coil, for instance, no reception could occur.

Keystoning Magnets

If one or both of the keystoning magnets become weak, so that it is impossible to keystone properly, either one or both magnets are replaceable by removing the mirror, discharging the magnet clamp band, and pulling the magnet out of its hinged receptacle. When replacing the magnets, note that each magnet is polarized with a plus and minus mark; insert the magnets so that the proper polarity exists.

Lid Switch

A safety switch is inserted in series with the line so that the Receiver power is off unless the lid is up. In Code 121 Receivers a mercury switch is used; in Code 122 Receivers a toggle switch is used. If the mercury switch gives trouble, it should be replaced by a toggle switch. Use the toggle-switch mounting bracket and discard the mercury-switch bracket; bend the actuating arm to fit the slot in the toggle switch.

Chassis

To remove the chassis, proceed as follows: Remove the speaker plug, the deflection-cable plug, the picture-tube-base connector, and the high-voltage anode cable. Take out the two screws from the metal end plate on the side of chassis; then remove the four screws from the compartment partition, holding the chassis against the baseboard so that it does not fall over on its side.

Speaker

To remove the speaker, disconnect the speaker plug and remove the four nuts and washers while holding the speaker to keep it from falling.

Lead Dress

The high-voltage anode cable is stapled to the cabinet so that it does not hang near any tubes which might burn the insulation and cause arc-over troubles. If the cable is moved from its proper position, be sure to tie

it back to the partition divider board so that it is free of all tubes, and so that it dresses over the top of the partition when the back is replaced.

If noise occurs in the audio section but disappears when the CONTRAST control is turned fully counter-clockwise, redress the yellow lead from the CONTRAST potentiometer so that the video signal is not coupled into the volume-control circuit.

PRODUCTION CHANGES

Code 121

During run number 2 of Code 121, the first and second video-i-f couplers, Z301 and Z302, were redesigned to improve trap stability and allow easy adjustment. The new couplers, Part No. 32-4213 and 32-4213-1, are interchangeable with the old couplers, Part No. 32-4094 and 32-4094-1. Only the new couplers will be supplied for replacement purposes.

Code 122

In Code 121, discriminator transformer Z302, Part No. 32-4101, is tuned by trimmer C202C, while in Code 122, C202C is a 10-mmf. fixed condenser and the transformer is slug-tuned by L202B. Also in Code 122, C202B (5 mmf.) is removed from the secondary winding and a 5-mmf. condenser (C223) is connected between the plate of the 2nd a-i-f tube and ground. The new discriminator transformer, Part No. 32-4214, is directly replaceable in Code 121 receivers, if condenser C223 is added.

During early runs of Code 122, the projection tube was modified so that the high-voltage-anode snap terminal was placed closer to the front of the tube to prevent arc-over or corona to the deflection-yoke and picture-tube mounting assembly. When this was done, the anode snap terminal was too close to the keystone-magnet clamp band. The clamp band was modified temporarily by using a plastic strip at the top of the band, with the band cut out for the anode-terminal clearance.

Effective after 2,000 sets of Code 122, a new all-plastic band was added, to be used with either old, modified, or new tubes. When replacing tubes, use the new tube (TP400A) and the new magnet clamp band, Part No. 76-3298.

When making keystoning adjustments on tubes employing the new band, be sure to ground each magnet before touching, in addition to attaching the ground to the band clamp screw.

During run 2 of Code 122, the 1000-mmf. high-voltage filter condensers, C100, C101, and C102, Part No. 30-1229-1, were replaced by 500-mmf. condensers with the same voltage rating, Part No. 30-1229. Only the 500-mmf. condensers are available as replacement items.

The focus coil and circuit were changed in Code 122 from a high-impedance type to a low-impedance type to provide a more stable circuit. This change is indicated in the lower-left corner of the schematic diagram, figure 45. These focus assemblies are not interchangeable. Use focus assembly Part No. 76-2631 for Code 121 and Part No. 76-2631-1 for Code 122.

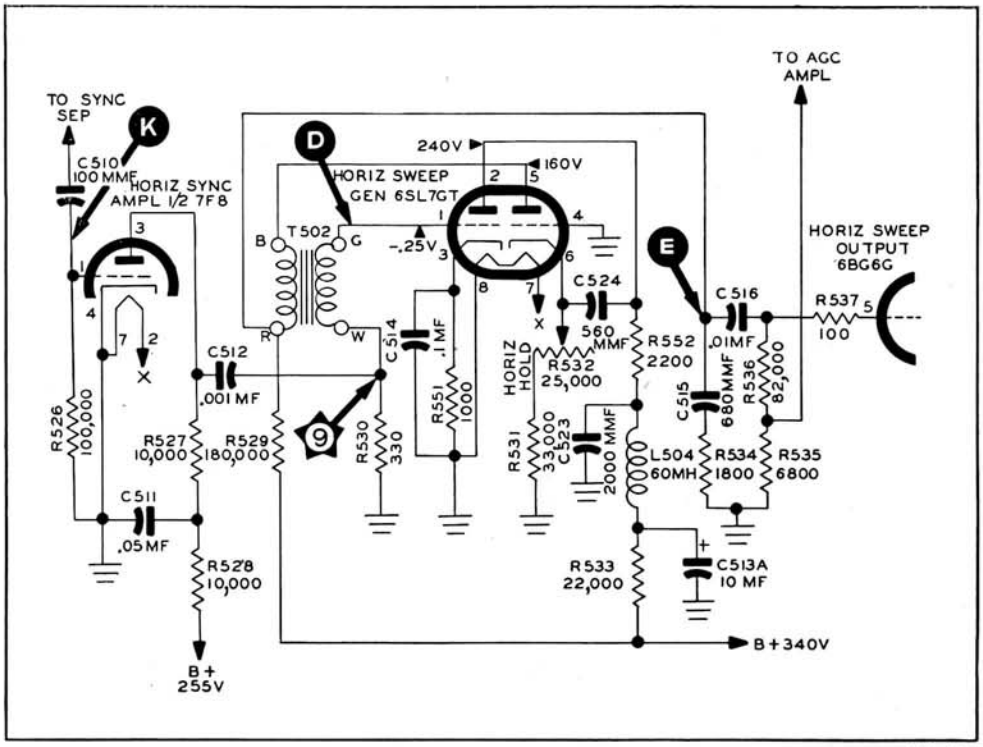
In the later runs of Code 122, an additional accompanying-sound trap, Part No. 32-4218, was added to reduce the possibility of sound in the picture. The ground lead to condenser C323 was disconnected from ground and was connected to the new sound trap (L309 and C324), as shown in the schematic diagram. This trap is effectively in series with the detector input and is tuned to the accompanying-sound frequency of 22.1 mc.

During early production of Code 122, the channel-marker assembly was changed to facilitate removal or replacement of the channel-marker tabs. Instead of pasting the tab on a celluloid backing strip, a new bezel was provided in which the tab could be inserted or removed. The new bezel is Part No. 16616-1, the new tab holder is Part No. 54-4495, and the new tab kit is Part No. 40-6938. The Precision Channel Selector knob was changed to Part No. 76-3185FCP. The old assembly may be replaced with the new assembly. Effective with Code 122, the lid switch was changed from a mercury-contact switch to a toggle switch. Only the new toggle switch is provided for replacement. Order Part No. 42-1811 when replacing the switch in receivers originally provided with the toggle switch, and order the switch, Part No. 42-1811, and the bracket, Part No. 56-4733, when replacing the switch in receivers originally provided with the mercury switch.

In early runs, horizontal-output transformer T503 was Part No. 32-8309; in later runs and for replacement purposes, use Part No. 32-8309-1.

Run number 3 of Code 122 is identified by the letter "S" stamped on the back of the chassis. This run number incorporates extensive changes in the horizontal-sweep circuit, which improve the operation of the horizontal sweep. The changed portion of the horizontal-sweep circuit is shown in figure 83. Test Points D, E, and 9 (steps 7, 8, 16, and 18 of Section 5 Trouble-Shooting Chart) are affected, because different waveforms appear at these points. Sketches of the approximate waveforms are shown in figure 84.

DESCRIPTION OF CHANGE	NEW PART NO.	OLD PART NO.
R529 changed to 180,000 ohms	**66-4183340***	**66-4103340***
R530 changed to 330 ohms	**66-1333340***	**66-2223340***
R531 changed to 33,000 ohms and connected as shown in figure 83	**66-3333340***	**66-4564250**
R532 changed to 25,000 ohms and connected as shown in figure 83	**33-5539-28**	**33-5539-13**
R533 changed to 22,000 ohms and connected as shown in figure 83	**66-3223340***	**66-4224250**
R534 changed to 1800 ohms	**66-2183340***	**66-2223340***



TP-4085

Figure 83. Code 122 Horizontal-Sync-Circuit Change, Schematic Diagram

R551, 1000 ohms, added as shown in figure 83 **66-2103340***

R552, 2200 ohms, added as shown in figure 83 **66-2223340***

C513A connected as shown in figure 83..

C514 changed to .1 mf. and connected as shown in figure 83.. **61-0113*** **60-10825401***

C515 changed to 680 mmf. ±5% and connected as shown in figure 83 ..... **60-10685401*** **60-10825401***

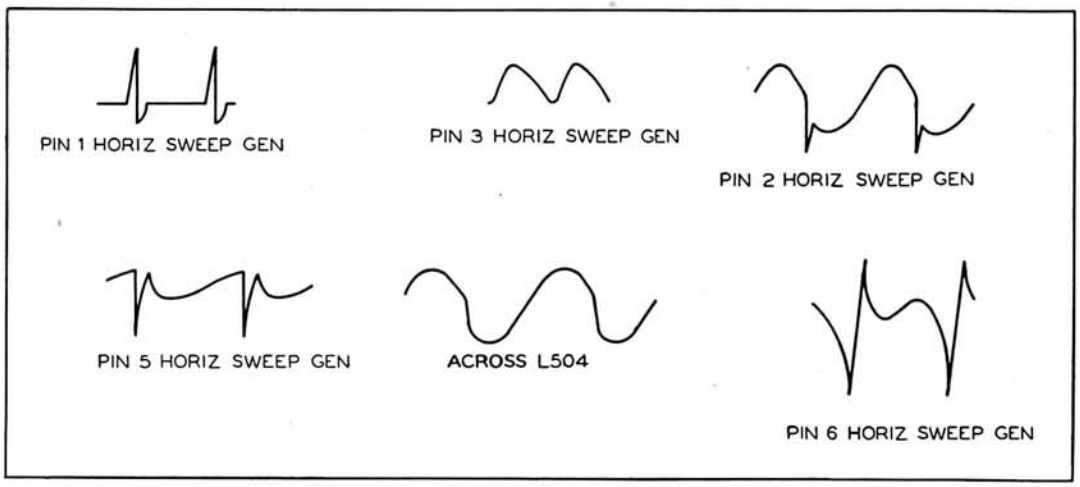
C516 connected as shown in figure 83..

C523, 2000 mmf., added as shown in figure 83 ..... **60-20205304***

C524, 560 mmf., added as shown in figure 83 **60-10565314***

L504, 60 mh. r-f choke added as shown in figure 83 ..... **32-4256**

Four-terminal wiring panel added between vertical output (6V6GT) socket and C506, on bottom of chassis **12W45661**



TP-4086

Figure 84. Code 122 Horizontal-Sync-Circuit Change, Waveforms

Codes 121 and 122

In Code 121 and early Code 122, the deflection-yoke assembly was changed slightly. The new deflection-yoke assembly is Part No. 32-9613, and it has resistors R500A and R500B mounted on the outside of the yoke instead of on the inside. Because of this change, it will be necessary to drill a hole in the optical housing, adjacent to the deflection-yoke cable, if a new yoke assembly is used with an early type of optical-housing assembly. The hole must be large enough to pass the deflection-yoke cable connector.

The new aluminum-backed projection tube TP400A, Part No. 34-2614, is interchangeable with the old tube. The new tube improves picture brightness, and it should be ordered for all replacement purposes, since it will replace the type TP400 in the near future.

SYMBOLIZATION

The components in the Receiver circuit are symbolized according to the types of parts and the sections of the Receiver in which the parts are located. The prefix letter of the symbol designates the type of part, as follows:

C—condenser
I—pilot lamp
J—connector (receptacle)
L—choke or coil
LS—loud-speaker
P—connector (plug)
R—resistor
S—switch
T—transformer
W—power cord
Z—electrical assembly

The number of the symbol designates the section in which the part is located, as follows:

100-series components are in Section 1, the power-supply circuits.
200-series components are in Section 2, the audio circuits.
300-series components are in Section 3, the video circuits.
400-series components are in Section 4, the r-f circuits.
500-series components are in Section 5, the sweep circuits.

A suffix letter identifies the part as a component of the assembly which bears an identical number without a suffix letter, and with perhaps a different prefix letter.

REPLACEMENT PARTS LIST

NOTE

Part numbers marked with an asterisk (*) are general replacement items. These numbers may not be identical with those on factory assemblies; also, the electrical values of some replacement items may differ from the values indicated in the schematic diagram and parts list. The values substituted in any case are so chosen that the operation of the receiver will be either unchanged or improved. When ordering replacements, use only the "Service Part No."

SECTION 1

POWER-SUPPLY CIRCUITS

Reference Symbol	Description	Service Part No.
C100	Condenser, high-voltage filter Code 121: 1000 mmf., 10 kv.	30-1229*
	Code 122: 500 mmf., 10 kv.	30-1229
C101	Condenser, high-voltage filter Code 121: 1000 mmf., 10 kv.	30-1229*
	Code 122: 500 mmf., 10 kv.	30-1229
C102	Condenser, high-voltage filter Code 121: 1000 mmf., 10 kv.	30-1229*
	Code 122: 500 mmf., 10 kv.	30-1229
C103	Condenser, high-voltage filter, 500 mmf., 10 kv.	30-1229
C104	Condenser, high-voltage filter, 500 mmf., 10 kv.	30-1229
C105	Condenser, electrolytic, 4-section, includes C105A, C105B, C513A, and C513B	30-2570-8
C105A	Condenser, low-voltage filter, 20 mf.	Part of C105
C105B	Condenser, low-voltage filter, 40 mf.	Part of C105
C106	Condenser, electrolytic, low-voltage filter, 30 mf.	30-2568-9
C107	Condenser, electrolytic, low-voltage filter, 30 mf.	30-2568-9
C108	Condenser, electrolytic, low-voltage filter, 50 mf.	30-2417-2
C109	Condenser, line filter, .01 mf.	30-1226-1
C110	Condenser, line filter, .01 mf.	30-1226-1

SECTION 1 (Continued)

POWER-SUPPLY CIRCUITS (Continued)

Reference Symbol	Description	Service Part No.
I100	Pilot lamp, 6—8 volts	34-2040
J100	Connector, cabinet interlock	27-6217
L100	Filter choke	32-8308
P100	Connector, cabinet interlock	27-6217
R100	Resistor, 3-section, includes R100A, R221, and R405	33-3435-5
R100A	Resistor, voltage dropping, 820 ohms	Part of R100
R101	Resistor, high-voltage current limiting, 2 megohms	33-1338
R102	Resistor, high-voltage current limiting, 2 megohms	33-1338
S100	Safety switch, lid	42-1811
S101	Power switch	Part of R214
T100	Power transformer	32-8303
W100	Power cord	L-2183

SECTION 2

AUDIO CIRCUITS

C200A	Condenser, coupling, 220 mmf.	Part of Z200
C201A	Condenser, coupling, 220 mmf.	Part of Z201
C202A	Condenser, coupling, 100 mmf.	Part of Z202
C202B (Code 121 only)	Condenser, balancing, 5 mmf.	Part of Z202

REPLACEMENT PARTS LIST—Continued

SECTION 2 (Continued)

AUDIO CIRCUITS (Continued)

Reference Symbol	Description	Service Part No.
C202C	Condenser, tuning Code 121: Trimmer	Part of Z202
	Code 122: Loading, 10 mmf.	Part of Z202
C202D	Condenser, balancing	Part of Z202
C203	Condenser, plate by-pass, .004 mf.	61-0179*
C204	Condenser, screen by-pass, .001 mf.	45-3500-5*
C205	Condenser, plate by-pass, .001 mf.	45-3500-5*
C206	Condenser, cathode by-pass, .001 mf.	45-3500-5*
C207	Condenser, screen by-pass, .001 mf.	45-3500-5*
C208	Condenser, a-f-c filter, .1 mf.	61-0113*
C209	Condenser, plate by-pass, .001 mf.	45-3500-5*
C210	Condenser, a-f-c filter, .1 mf.	61-0113*
C211	Condenser, bass compensation, .01 mf.	61-0120*
C212	Condenser, r-f filter, de-emphasis, 470 mmf.	60-10515307*
C213	Condenser, r-f by-pass, .004 mf.	61-0179*
C214	Condenser, r-f by-pass, .004 mf.	61-0179*
C215	Condenser, coupling, .05 mf.	61-0122*
C216	Condenser, coupling, .05 mf.	61-0122*
C217	Condenser, electrolytic, noise suppression, 10 mf.	30-2417-3
C218	Condenser, electrolytic, noise suppression, 10 mf.	30-2417-3
C219	Condenser, tone compensation, .004 mf.	61-0179
C220	Condenser, coupling, .05 mf.	61-0122*
C221	Condenser, electrolytic, 3-section, includes C221A, C221B, and C503	30-2570-16
C221A	Condenser, cathode by-pass, 40 mf.	Part of C221
C221B	Condenser, filter, 10 mf.	Part of C221
C222	Condenser, audio by-pass, .006 mf.	61-0105*
C223 (Code 122 only)	Condenser, plate by-pass, 5 mmf.	30-1224-5
J200	A-f-c test jack	27-6180
L200A	Coil, 1st a-i-f	Part of Z200
L201A	Coil, 2nd a-i-f	Part of Z201
L202A	Discriminator primary	Part of Z202
L202B	Discriminator secondary Code 121: Fixed	Part of Z202
	Code 122: Slug-tuned	Part of Z202
L203	Choke, filament	32-4112-3
L204	Choke, balancing	32-4143-1
L205	Choke, filament	32-4112-3
LS200	Loud-speaker	36-1610-1
R200	Resistor, plate filter, 3300 ohms.	66-2333340*
R201	Resistor, grid, 47,000 ohms.	66-3473340*
R202	Resistor, cathode, 150 ohms.	66-1153340*
R203	Resistor, screen dropping, 100,000 ohms	66-4103340*
R204	Resistor, plate filter, 3300 ohms.	66-2333340*
R205	Resistor, grid, 220,000 ohms.	66-4223340*
R206	Resistor, cathode, 220 ohms.	66-1223340*
R207	Resistor, screen dropping, 100,000 ohms	66-4103340*
R208	Resistor, plate filter, 3300 ohms.	66-2333340*
R209	Resistor, a-f-c filter, 560,000 ohms	66-4563340*
R210	Resistor, a-f-c filter, 560,000 ohms	66-4563340*
R211	Resistor, bass compensation, 47,000 ohms	66-3473340*
R212	Resistor, r-f filter, de-emphasis, 100,000 ohms	66-4103340*
R213	Volume control, 2 megohms.	33-5535-9
R214	Tone control, 5 megohms.	33-5538-9
R215	Resistor, discriminator load, 27,000 ohms	66-3273340*
R216	Resistor, discriminator load, 27,000 ohms	66-3273340*
R217	Resistor, grid, 4.7 megohms.	66-5473340*
R218	Resistor, grid, 1 megohm.	66-5103340*
R219	Resistor, plate load, 330,000 ohms	66-4333340*

SECTION 2 (Continued)

AUDIO CIRCUITS (Continued)

Reference Symbol	Description	Service Part No.
R220	Resistor, cathode bias, 470 ohms	66-1475360
R221	Resistor, plate dropping, 1500 ohms	Part of R100
T200	Transformer, audio output	32-8244-1
Z200	Coupler, 1st a-i-f, 22.1 mc., includes C200A and L200A	32-4100
Z201	Coupler, 2nd a-i-f, 22.1 mc., includes C201A and L201A	32-4099
Z202	Transformer, discriminator, 22.1 mc., includes C202A, C202B, C202C, C202D, L202A, and L202B	32-4214

SECTION 3

VIDEO CIRCUITS

C300A	Condenser, coupling, 100 mmf.	Part of Z300
C300B	Condenser, coupling, trimmer	Part of Z300
C301A	Condenser, coupling, 100 mmf.	Part of Z301
C301B	Condenser, balancing, 56 mmf.	Part of Z301
C301C	Condenser, balancing, 56 mmf.	Part of Z301
C302A	Condenser, coupling, 100 mmf.	Part of Z302
C302B	Condenser, balancing, 22 mmf.	Part of Z302
C302C	Condenser, balancing, 22 mmf.	Part of Z302
C303A	Condenser, coupling, 100 mmf.	Part of Z303
C303B	Condenser, coupling, trimmer	Part of Z303
C304	Condenser, plate by-pass, .004 mf.	61-0179*
C305	Condenser, a-g-c filter, .004 mf.	61-0179*
C306	Condenser, screen by-pass, .004 mf.	61-0179*
C307	Condenser, filament by-pass, .004 mf.	61-0179*
C308	Condenser, screen by-pass, .004 mf.	61-0179*
C309	Condenser, screen by-pass, 10 mmf.	62-010009001
C310	Condenser, a-g-c filter, .004 mf.	61-0179*
C311	Condenser, screen by-pass, .004 mf.	61-0179*
C312	Condenser, plate by-pass, .004 mf.	61-0179*
C313	Condenser, screen by-pass, 10 mmf.	62-010009001
C314	Condenser, cathode by-pass, .004 mf.	61-0179*
C315	Condenser, screen by-pass, .004 mf.	61-0179*
C316	Condenser, screen by-pass, 10 mmf.	62-010009001
C317	Condenser, plate by-pass, .004 mf.	61-0179*
C318	Condenser, coupling, .01 mf.	61-0120*
C319	Condenser, a-g-c filter, 22 mmf.	62-022009001
C320	Condenser, a-g-c filter, .05 mf.	61-0122*
C321	Condenser, filament filter, 470 mmf.	62-147001001
C322	Condenser, coupling, .01 mf.	61-0120*
C323	Condenser, r-f filter, 10 mmf.	62-010009001
C324 (Code 122 only)	Condenser, sound trap, 47 mmf.	Part of L309
C325	Condenser, coupling, .1 mf.	61-0113*
C326	Condenser, a-g-c filter, .5 mf.	61-0133*
C327	Condenser, cathode by-pass, .003 mf.	61-0109*
C328	Condenser, electrolytic, 4-section, includes C328A, C328B, C328C, and C328D	30-2570-10
C328A	Condenser, screen decoupling, 10 mf.	Part of C328
C328B	Condenser, plate decoupling, 10 mf.	Part of C328
C328C	Condenser, screen decoupling, 10 mf.	Part of C328
C328D	Condenser, plate decoupling, 10 mf.	Part of C328
C329	Condenser, 4.5-mc. trap, 56 mmf.	62-056409001
C330	Condenser, coupling, .05 mf.	61-0122*
C331	Condenser, blocking, .5 mf.	45-3500-4*
C332	Condenser, blocking, .004 mf.	61-0179*
C333	Condenser, coupling, .05 mf.	61-0122*

REPLACEMENT PARTS LIST—Continued

SECTION 3 (Continued)

VIDEO CIRCUITS (Continued)

Reference Symbol	Description	Service Part No.
J300	Tuner test jack	27-6180
J301	Align test jack	27-6180
J302	Picture-tube-grid test jack	76-2629
L300A	Coil, plate tuning	Part of Z300
L300B	Coil, grid tuning	Part of Z300
L301A	Coil, plate tuning	Part of Z301
L301B	Coil, trap tuning (accompanying sound)	Part of Z301
L301C	Coil, grid tuning	Part of Z301
L302A	Coil, plate tuning	Part of Z302
L302B	Coil, trap tuning (adjacent sound)	Part of Z302
L302C	Coil, grid tuning	Part of Z302
L303A	Coil, plate tuning	Part of Z303
L303B	Coil, grid tuning	Part of Z303
L304	Choke, filament	32-4112-3
L305	Choke, filament	32-4112-3
L306	Choke, filament	32-4112-3
L307	Choke, filament	32-4112-3
L308	Coil, video peaking	32-4143
L309 (Code 122 only)	Coil, trap tuning (accompanying sound)	32-4218
L310	Coil, trap tuning (video 4.5 mc.)	32-4155
L311	Coil, video peaking	32-4143-1
L312	Coil, video peaking	32-4143-1
L313	Coil, video peaking	32-4143-1
L314	Coil, video peaking	32-4143-3
R300A	Resistor, plate damping, 10,000 ohms	Part of Z300
R300B	Resistor, grid damping, 10,000 ohms	Part of Z300
R301A	Resistor, plate damping, 22,000 ohms	Part of Z301
R301B	Resistor, balancing (sound trap), 5600 ohms.	Part of Z301
R301C	Resistor, grid damping, 33,000 ohms	Part of Z301
R302A	Resistor, plate damping, 10,000 ohms	Part of Z302
R302B	Resistor, balancing (sound trap), 22,000 ohms	Part of Z302
R302C	Resistor, grid damping, 8200 ohms	Part of Z302
R303A	Resistor, plate damping, 33,000 ohms	Part of Z303
R304	Resistor, plate filter, 3300 ohms	66-2333340*
R305	Resistor, a-g-c filter, 2200 ohms	66-2223340*
R306	Resistor, cathode bias, 68 ohms	66-0683340*
R307	Resistor, screen dropping, 56,000 ohms	66-3563340*
R308	Resistor, a-g-c filter, 2200 ohms	66-2223340*
R309	Resistor, cathode bias, 68 ohms	66-0683340*
R310	Resistor, screen dropping, 56,000 ohms	66-3563340*
R311	Resistor, plate filter, 3300 ohms	66-2333340*
R312	Resistor, cathode bias, 180 ohms	66-1183340*
R313	Resistor, plate filter, 3300 ohms	66-2333340*
R314	Resistor, screen dropping, 56,000 ohms	66-3563340*
R315	Resistor, grid load, 1 megohm	66-5103340*
R316	Resistor, diode load, 470,000 ohms.	66-4473340*
R317	Resistor, r-f filter, 100,000 ohms	66-4103340*
R318	Resistor, plate load, 220,000 ohms.	66-4223340*
R319	Resistor, cathode bias, 82,000 ohms	66-3824340*
R320	Resistor, cathode bias, 1000 ohms.	66-2103340*
R321	Resistor, a-g-c control, 5000 ohms.	33-5539-16
R322	Resistor, diode load, 470,000 ohms.	66-4473340*
R323	Resistor, a-g-c filter, 1 megohm	66-5103340*
R324	Resistor, diode load, 3300 ohms	66-2333340*
R325	Resistor, diode load, 470,000 ohms.	66-4473340*
R326	Resistor, grid load, 1 megohm	66-5103340*
R327	Resistor, cathode bias, 120 ohms.	66-1123340*

SECTION 3 (Continued)

VIDEO CIRCUITS (Continued)

Reference Symbol	Description	Service Part No.
R328	Resistor, screen filter, 47,000 ohms.	66-3473340*
R329	Resistor, screen dropping, 10,000 ohms	66-3103340*
R330	Resistor, plate filter, 3300 ohms	66-2333340*
R331	Resistor, plate load, 1800 ohms	66-2183340*
R332	Resistor, grid load, 820,000 ohms.	66-4823340*
R333	Contrast control, 1000 ohms	33-5546-6
R334	Resistor, cathode bias, 68 ohms	66-0683340*
R335	Resistor, voltage divider, 68,000 ohms	66-3683340*
R336	Auxiliary background control, 250,000 ohms	33-5539-25
R337	Background control, 250,000 ohms.	33-5539-17
R338	Resistor, voltage divider, 390,000 ohms	66-4393340*
R339	Resistor, screen dropping, 33,000 ohms	66-3335340*
R340	Resistor, cathode minimum bias, 100,000 ohms	66-4103340*
R341	Resistor, plate filter, 1000 ohms	66-2105340
R342	Resistor, plate load, 3500 ohms	33-1335-75
R343	Resistor, peaker damping, 27,000 ohms	66-3273340*
R344	Resistor, isolating, 10,000 ohms.	66-3103340*
R345	Resistor, grid load, 470,000 ohms.	66-4473340*
R346	Resistor, diode load, 1 megohm	66-5103340*
Z300	Coupler, input-i-f, 22.1 mc. and 26.6 mc., includes C300A, C300B, R300A, R300B, L300A, and L300B	32-4093
Z301	Coupler, 1st v-i-f, 26.6 mc., includes C301A, C301B, C301C, R301A, R301B, R301C, L301A, L301B, and L301C	32-4213
Z302	Coupler, 2nd v-i-f, 26.6 mc., includes C302A, C302B, C302C, R302A, R302B, R302C, L302A, L302B, and L302C	32-4213-1
Z303	Coupler, 3rd v-i-f, 26.6 mc., includes C303A, C303B, R303A, L303A, and L303B	32-4093-1

SECTION 4

R-F CIRCUITS

C401A	Condenser, aerial tuning	Part of Z401
C401B	Condenser, aerial tuning	Part of Z401
C402	Condenser, plate by-pass, 470 mmf.	62-147001001
C403	Condenser, grid by-pass, 10 mmf.	62-010009001
C404	Condenser, blocking, 22 mmf.	62-022009001
C405	Condenser, cathode by-pass, 220 mmf.	62-122001001
C406	Condenser, phase shifter, 220 mmf.	62-122001001
C407	Condenser, frequency compensating, 3.3 mmf.	30-1221
C408	Condenser, a-f-c filter, 470 mmf.	62-147001001
C409	Condenser, plate filter, 10 mf.	30-2417-6
C410	Condenser, plate tuning, trimmer	31-6493
C411	Condenser, blocking, 220 mmf.	62-122001001
C412	Condenser, aerial trimmer	31-6493
C413	Condenser, grid isolation, 220 mmf.	62-122001001
C414	Condenser, a-g-c filter, 470 mmf.	62-147001001
C415	Condenser, a-g-c filter, .1 mf.	61-0113*
C416	Condenser, cathode by-pass, 470 mmf.	62-147001001
C417	Condenser, screen by-pass, 470 mmf.	62-147001001

REPLACEMENT PARTS LIST—Continued

SECTION 4 (Continued)

R-F CIRCUITS (Continued)

Reference Symbol	Description	Service Part No.
C418	Condenser, screen by-pass, 10 mmf.	62-010009001
C419	Condenser, plate by-pass, 470 mmf.	62-147001001
C420	Condenser, screen by-pass, 470 mmf.	62-147001001
C421	Condenser, screen by-pass, 10 mmf.	62-010009001
C422	Condenser, filament by-pass, 470 mmf.	62-147001001
C423	Condenser, filament by-pass, 470 mmf.	62-147001001
J400	Aerial receptacle	27-6214-1
L400A	Coil, oscillator	Part of Z400
L400B	Coil, mixer	Part of Z400
L401A	Coil, aerial	Part of Z401
L401B	Coil, r-f coupling	Part of Z401
L401C	Coil, r-f	Part of Z401
L402	Choke, oscillator plate	32-4112-2
L403	Choke, filament	32-4112-4
R400	Resistor, cathode bleeder, 22,000 ohms	66-3224340
R401	Resistor, cathode bias, 220 ohms	66-1228340*
R402	Resistor, grid leak, 22,000 ohms	66-3228540
R403	Resistor, phase shifter, 560 ohms	66-1568340
R404	Resistor, grid leak, 22,000 ohms	66-3228540*
R405	Resistor, plate filter, 6200 ohms	Part of R100
R406	Resistor, plate load, 2700 ohms	66-2278340
R407	Resistor, grid leak, 100,000 ohms	66-4108540*
R408	Resistor, screen dropping, 56,000 ohms	66-3568340
R409	Resistor, plate filter, 1000 ohms	66-2108540
R410	Resistor, grid leak, 100,000 ohms	66-4108540
R411	Resistor, cathode degeneration, 68 ohms	66-0688340
R412	Resistor, cathode bias, 100 ohms	66-1108340
R413	Resistor, a-g-c filter, 1 megohm	66-5103340*
Z400	Oscillator-and-mixer-coil assembly	
	Channel 1	32-4222-1
	Channel 2	32-4222-2
	Channel 3	32-4222-3
	Channel 4	32-4222-4
	Channel 5	32-4222-5
	Channel 6	32-4222-6
	Channel 7	32-4222-7
	Channel 8	32-4222-8
	Channel 9	32-4222-9
	Channel 10	32-4222-10
	Channel 11	32-4222-11
	Channel 12	32-4222-12
	Channel 13	32-4222-13
Z401	Aerial-and-r-f-coil assembly	
	Channel 1	32-4115-1
	Channel 2	32-4115-2
	Channel 3	32-4115-3
	Channel 4	32-4115-4
	Channel 5	32-4115-5
	Channel 6	32-4115-6
	Channel 7	32-4115-7
	Channel 8	32-4115-8
	Channel 9	32-4115-9
	Channel 10	32-4115-10
	Channel 11	32-4115-11
	Channel 12	32-4115-12
	Channel 13	32-4115-13

SECTION 5

SWEEP CIRCUITS

C500	Condenser, coupling, .05 mf.	61-0122*
C501	Condenser, screen by-pass, .1 mf.	61-0113*

SECTION 5 (Continued)

SWEEP CIRCUITS (Continued)

Reference Symbol	Description	Service Part No.
C502	Condenser, coupling, .1 mf.	61-0113*
C503	Condenser, electrolytic, plate filter, 10 mf.	Part of C221
C504	Condenser, coupling, .006 mf.	45-3500-7*
C505	Condenser, integrating, .001 mf.	45-3500-5*
C506	Condenser, electrolytic, three-section	30-2570-16
C506A	Condenser, plate filter, 10 mf.	Part of C506
C506B	Condenser, plate filter, 10 mf.	Part of C506
C506C	Condenser, cathode by-pass, 40 mf.	Part of C506
C507	Condenser, by-pass, .1 mf.	61-0113*
C508	Condenser, feedback, .1 mf.	61-0113*
C509	Condenser, coupling, .25 mf.	61-0125*
C510	Condenser, differentiating, 100 mmf.	60-10105407
C511	Condenser, plate filter, .05 mf.	61-0122*
C512	Condenser, coupling, .001 mf.	60-20105401*
C513A	Condenser, electrolytic, plate filter, 10 mf.	Part of C105
C513B	Condenser, electrolytic, cathode by-pass, 10 mf.	Part of C105
C514	Condenser, grid, 820 mmf.	60-10825401*
C515	Condenser, high-cut filter, 820 mmf.	60-10825401*
C516	Condenser, coupling, .01 mf.	61-0120*
C517	Condenser, screen by-pass, .1 mf.	61-0113*
C518	Condenser, differentiating, 47 mmf.	60-00515307*
C519	Condenser, cathode filter, .02 mf.	61-0108*
C520	Condenser, electrolytic, cathode filter, 10 mf.	30-2417-3
C521	Condenser, electrolytic, by-pass, 50 mf.	30-2417-2
J500	Receptacle, chassis (deflection-yoke-cable connector)	27-6229
L500A	Vertical-deflection coil	Part of Z500
L500B	Vertical-deflection coil	Part of Z500
L500C	Horizontal-deflection coil	Part of Z500
L500D	Horizontal-deflection coil	Part of Z500
L501	Focus coil	Part of Z501
L502	Width-adjustment coils	32-4163 (Brown Dot) 32-4163-1 (Black Dot) 32-4163-2 (Red Dot)
L502A	Width-adjustment coil	Part of L502
L502B	Width-adjustment coil	Part of L502
P500	Deflection-yoke-plug connector and cable	41-3764-1
R500A	Resistor, damping, 1000 ohms, part of Z500	66-2108540
R500B	Resistor, damping, 1000 ohms, part of Z500	66-2108540
R501	Resistor, grid, 2.2 megohms	66-5223340*
R502	Resistor, current limiting, 22,000 ohms	66-3228540
R503	Resistor, plate bleeder, 10,000 ohms	66-3103340*
R504	Resistor, screen bleeder, 10,000 ohms	66-3103340*
R505	Resistor, screen dropping, 1 megohm	66-5104340*
R506	Resistor, plate load, 1.2 megohms	66-5124340*
R507	Resistor, grid, 470,000 ohms	66-4473340*
R508	Resistor, current limiting, 220,000 ohms	66-4223340*
R509	Resistor, cathode bias, 2200 ohms	66-2223340*
R510	Resistor, plate load, 68,000 ohms	66-3683340*
R511	Resistor, plate filter, 22,000 ohms	66-3223340*
R512	Resistor, grid, 10,000 ohms	66-3103340*
R513	Resistor, plate filter, 100,000 ohms	66-4103340*

REPLACEMENT PARTS LIST—Continued

SECTION 5 (Continued)

SWEEP CIRCUITS (Continued)

Reference Symbol	Description	Service Part No.
R514	Resistor, plate load, 470,000 ohms	66-4473340*
R515	Resistor, plate filter, 22,000 ohms	66-3223340*
R516	Resistor, grid, 10,000 ohms	66-3103340*
R517	Height control, 250,000 ohms	33-5539-13
R518	Height-control bleeder, 68,000 ohms	66-3683340*
R519	Resistor, feedback, 2200 ohms	66-2223340*
R520	Resistor, minimum grid bias, 27,000 ohms	66-3273340*
R521	Vert. hold control, 100,000 ohms	33-5539-15
R522	Resistor, grid, 2.2 megohms	66-5223340*
R523	Vert. lin. control, 5000 ohms	33-5546-3
R524	Resistor, minimum cathode bias, 1000 ohms	66-2103340*
R525	Vert. cent. control, 20 ohms	33-5546-1
R526	Resistor, differentiating, 100,000 ohms	66-4103340*
R527	Resistor, plate load, 10,000 ohms	66-3104340*
R528	Resistor, plate filter, 10,000 ohms	66-3104340*
R529	Resistor, plate filter, 100,000 ohms	66-4103340*
R530	Resistor, sync injection, 2200 ohms	66-2223340*
R531	Resistor, minimum grid bias, 560,000 ohms	66-4564250
R532	Horiz. hold control, 250,000 ohms	33-5539-13
R533	Resistor, plate load, 220,000 ohms	66-4224250
R534	Resistor, high-pass filter, 2200 ohms	66-2223340*
R535	Resistor, voltage divider (a-g-c take-off), 6800 ohms	66-2683340*
R536	Resistor, voltage divider (a-g-c take-off), 82,000 ohms	66-3823340*
R537	Resistor, current limiting, 100 ohms	66-1103340*
R538	Resistor, cathode bias, 100 ohms	66-1105340
R539	Resistor, screen filter, 3900 ohms	66-2395340
R540	Hor. lin. control, 250,000 ohms	33-5539-13
R541	Resistor, differentiating Code 121: 100,000 ohms Code 122: 47,000 ohms	 66-4103340* 66-3473340*
R542	Resistor, parasitic suppressor, 4700 ohms	66-2473340*
R543	Resistor, cathode bias, 100,000 ohms	66-4103340*
R544	Resistor, parasitic suppressor, 4700 ohms	66-2473340*
R545	Resistor, auxiliary focus control Code 121: 18,000 ohms, 50 watts Code 122: 200 ohms, 50 watts	 33-5547-1 33-5547-2
R546	Focus control Code 121: 18,000 ohms, 50 watts Code 122: 200 ohms, 50 watts	 33-5547-1 33-5547-2
R547 (Code 121 only)	Resistor, current limiter, 1200 ohms	66-2125340
R548	Hor. cent. control, 20 ohms	33-5546-1
T500	Transformer, vertical-sweep generator	32-8304
T501	Transformer, vertical-sweep output	32-8306
T502	Transformer, horizontal-sweep generator	32-8307
T503	Transformer, horizontal-sweep output	32-8309-1
Z500	Deflection-coil assembly, includes L500A, L500B, L500C, L500D, R500A, and R500B Code 121 and early-production code 122 Late-production code 122	 32-9608 32-9613
Z501	Focus-coil assembly, includes L501 Code 121 Code 122	 76-2631 76-2631-1

MISCELLANEOUS

Description	Service Part No.
Bracket and pin-jack assembly (video test)	76-2629
Cabinet	10670A
Cabinet Hardware and Parts	
Baffle-and-cloth assembly	40-8545-2
Baffle back	54-7379
Bezel, station selector	54-4464
Bezel, wood, early runs	16611-1
Bezel, wood, late runs	16616-1
Bracket, spring adjustment	56-4573
Bracket-support assembly, LH	76-2872-1
Bracket-support assembly, RH	76-2872
Plug, cabinet interlock, 2-prong male (to line cord)	54-4426-2
Plug, cabinet interlock, 2-prong male (to cabinet)	54-4426-3
Cabinet, back	54-7378
Catch, bullet	45-6002
Clamp-and-spring assembly, dust cover	76-2949
Dome, lid stop	45-6190
Door, control, adjusting panel	45-6400
Door pull (2 required)	56-4420-1
Dust cover, glass	54-7290
Grille, back screen	56-4580FCP
Grille, back	56-4581FJ31
Hinge, butt-back assembly (2 required)	76-3672
Hinge, wood bezel	45-6377-1
Hinge, knife (2 required)	45-6036
Hinge, piano	54-4376
Knob	56-3627-6
Lid-balance assembly	76-2974
Lid frame	219074
Link, a-c interlock switch	56-4732FA3
Mask, bezel	54-7383-1
Mirror retaining strap	56-4439FA15
Mirror clip, code 121 (5 required)	76-2910
Mirror clip, code 122 (5 required)	56-4898
Mirror, flat	54-7263
Molding, dust cover	56-4519
Screen, picture	56-3973
Screen, speaker	56-4452
Screw, adjusting	56-4574
Selector-knob-and-spring assembly Early runs Late runs	 76-2953-1 76-3185
Shell flange, a-c interlock	56-4346
Speaker bolt (4 required)	W1587
Spring	56-4571
Strike plate	45-6003
Support, dust cover	56-4932
Tab holder	54-4495
Tab kit	40-6938
Cable assembly, high voltage	41-3771-1
Cable-and-plug assembly, a-c interlock	
Early runs	41-3784
Late runs	41-3820
Cable-and-socket assembly, picture tube	41-3777
Cable, speaker	41-3738
Channel-Indicator Assembly	
Drive cord (25-ft. spool)	45-8760
Pulley assembly	76-2634
Rod, slider	56-4046
Shield, pilot lamp	56-4528FA3
Slider, pilot-lamp assembly	56-4044
Socket assembly, pilot lamp	76-1179-2
Spring, drive cord	28-8751
Spring, slider	56-4045
Clamp, deflection and focus coil	76-3037
Holder, tube	56-4125FA3
Mounting bolt and washer	76-3037
Optical-Housing Assembly	
Bracket, mounting, optical housing	56-3901
Bracket, magnet mounting (2 required)	56-4142FE6
Cam and lever (eccentric adjustment)	76-2614
Corrector lens	54-7272

REPLACEMENT PARTS LIST—Continued

MISCELLANEOUS (Continued)

Description	Service Part No.
Frame assembly, picture tube (for magnet mounting)	
Plastic	76-3298
Metal	76-2699
Holder, magnet (2 required)	56-4139FE9
Lever, focus adjusting	56-4716FE26
Magnet (2 required)	56-4059
Mirror, concave, 12" spherical	54-7274
Optical housing	56-4298FCP
Ring, adjustable support	56-4472
Strap, mirror retaining	56-4439FA15
Spring, ground	56-4441
Support, adjustable coil and tube	56-4471
Plate, station selector	54-4468
Rubber, chassis mounting	27-4571
Rubber, tuner-assembly mounting	27-4596
Screw, chassis mounting	1W-19779FA3
Shield assembly, high voltage	76-2695
Shield base, miniature	56-3978FA3
Shield, miniature tube	56-3979FA3
Socket, loktal (8 required)	27-6138

MISCELLANEOUS (Continued)

Description	Service Part No.
Socket, miniature, 6J6 tube	27-6203-1
Socket, miniature (9 required)	27-6226
Socket, octal (7 required)	27-6174
Socket, octal-ring mounting, 1B3GT tube (3 required)	27-6231-3
Retaining ring, socket (3 required)	56-4106
Socket, picture-tube cable	27-6229
Socket, plug (1 required)	27-6214-1
Socket, test (3 required)	27-6180
Spring, 6J6 tube	56-4724
Spring, high-voltage condenser mounting	56-4745
Spring, station-selector knob	56-2351-2
Stand-off (2 required)	54-7309-2
Support assembly, chassis	76-2779
Tuner assembly	76-3109
Oscillator and mixer contact panel (4-connection)	76-2678
Aerial and r-f contact panel (7-connection)	76-2664
Shaft-and-drum assembly	76-3110
Washer, chassis mounting	56-4997FA3

NOTES

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