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SERVICING TV RECEIVERS

• SYLVANIA ELECTRIC PRODUCTS INC.

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The information in this manual is furnished without assuming any obligations.

SYLVANIA ELECTRIC PRODUCTS INC.
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ACKNOWLEDGEMENTS

Grateful acknowledgement is made to WCBS, WPIX and WABD for their assistance and cooperation, and for their permission to use the test patterns illustrated.

The photographs of the test patterns used in this book exemplify improper functioning of television receivers and they do not in any way reflect upon the operation of the television broadcast stations whose test patterns are used for purposes of illustration.

PREFACE

This book has been prepared to aid the television repairman in determining the causes of faulty reception in a TV receiver. Since many television set defects appear on the screen, knowledge of these defects may be obtained through close observation. Illustrations of common faults have been included; their causes and remedies explained. Reference to the examples shown and the circuit diagrams should help the serviceman to reduce his service time considerably.

A general description of the television receiver is included, together with a detailed discussion of each of the 6 major sections. A circuit diagram of a typical commercial television receiver is shown and smaller diagrams of each section with a brief description are included. Reference to the circuit diagram, or to one supplied by the manufacturer of a particular receiver, together with the illustrations and explanations contained here, should enable the serviceman to effect a substantial saving in time expended on trouble shooting. The words "test" and "check" used under "Remedies", refer to those components found in that particular section of the receiver under discussion. The reference symbols in parenthesis apply to the circuits, or schematics, used as examples. Although the circuits and schematics are similar in many sets, it is best to check the specified schematic supplied by the manufacturer of the set to be serviced for the appropriate component equivalent.

In the preparation of this book the Sylvania Television Receiver Model 075 and the circuit diagrams pertaining to this set were used as an example of a typical television receiver. Where differences exist in the various receivers on the market suitable references have been made.

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2. Check antenna connections.
3. Check for loose wires or broken contacts.
4. Test Tubes.
5. Check deflection yoke.
6. Check focus coil.
7. Check manufacturer's guide and alignment notes.

SERVICING PRECAUTIONS

Only qualified service personnel should be present when servicing television receivers, particularly when removing or replacing the picture tube.

The picture tube mounting is constructed to provide adequate protection against implosion while the tube is in the receiver. Caution should be exercised when the removal or installation of the picture tube becomes necessary (i.e., wear heavy gloves and shatterproof goggles, etc.).

When removal of chassis from cabinet is necessary, the following precautionary measures should be taken:

1. Shut off power.
2. Do not rest picture tube in the deflection yoke.
3. Considerable care should be taken to protect the picture tube from injury.
4. Rough handling, accidental shock, or a slight scratch on the surface of the tube may result in implosion.

All high voltage precautions must be taken because of the dangerous potentials present while the receiver is operating. These should also be observed for a short period after the receiver has been turned off.

The following precautions should be observed when taking high voltage measurements:

1. Shut off power.
2. Use a well insulated wire and hooded test clips.
3. Connect the meter (Kilovoltmeter).
4. Restore power for voltage readings.
5. All lead wires should be insulated for the voltage encountered. (Commercial test instruments may be assumed to have the proper voltage insulation for which they are designed.)

HOW TELEVISION WORKS

The function of a television receiver is to extract from the air the signal transmitted by a television station, amplify it, and use it, to produce visible pictures and audible sound, which are in conformity with the original scene.

A basic knowledge of the television signal is essential to the understanding of television receiver operation. The television signal is made up of two separate and distinct signals, one for the picture and one for the sound. The sound signal is a frequency modulated wave, which has a frequency of 4.5 Mc. higher than the picture signal. The picture signal contains all the information necessary to produce a picture. One portion varies in amplitude, in accordance to the light requirements of the picture: the other portions contain voltage pulses which are used to synchronize the operation of the receiver with the operation of the transmitter so that an intelligible picture will be produced. These pulses are called the vertical synchronizing pulses and the horizontal synchronizing pulses. There are also a number of equalizing pulses, but these need not concern us here.

The television receiver is broken down into a number of relatively simple circuits, each with a specific function, yet depending on the others for perfect operation. Listed below are the six basic circuits of the average television receiver.

1. RF Section
2. Video Section (video if, video detector, video amplifier).
3. Sound Section.
4. Deflection Circuits.
5. Picture tube and associated components.
6. Power supplies (Low and High Voltage).

The signal transmitted from the station is received by the antenna, which transmits this signal to the set through a connecting transmission line to the rf section.

The composite signal is fed into the rf section where it is amplified as a whole, then it is passed into a video if section, the first stage of which is a conveter. Here, as in a superheterodyne receiver, the signal is beat against the signal from a local oscillator and the resultant signal is at the intermedi-

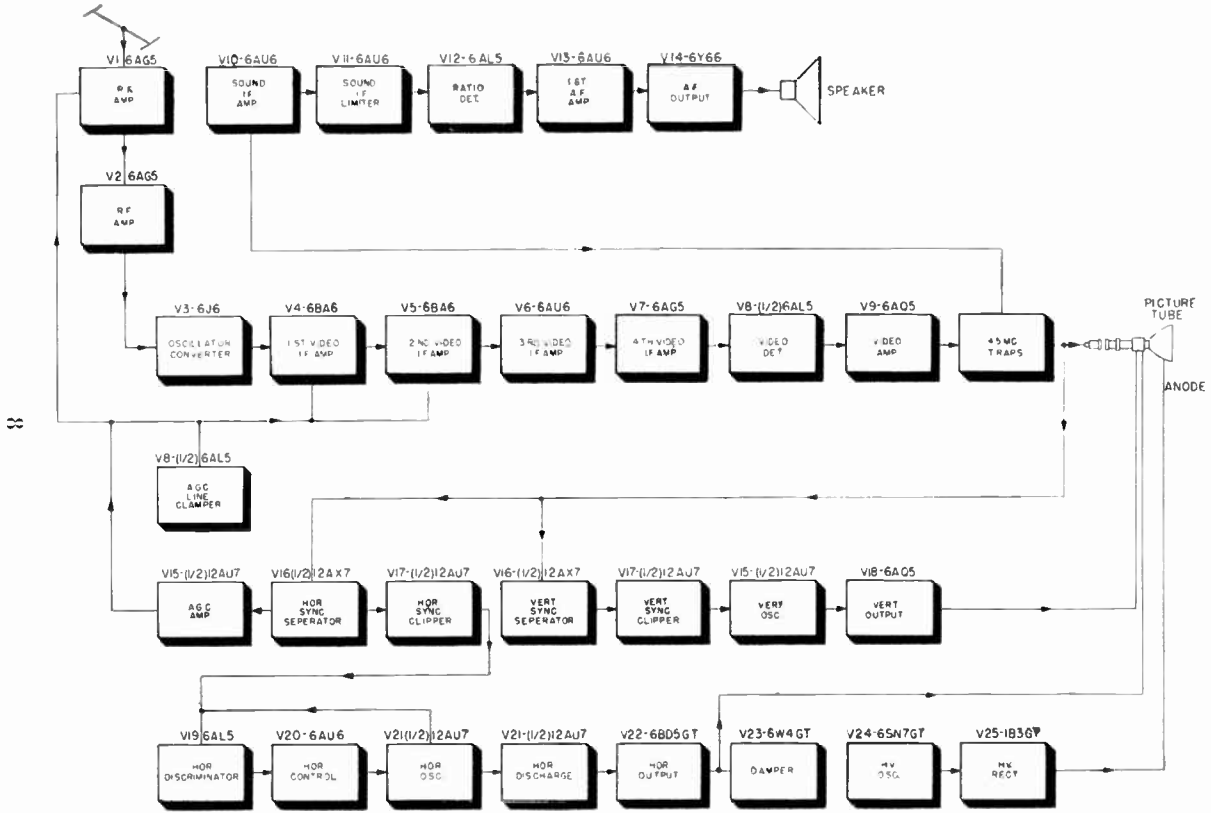


Figure 1. Block diagram of a typical television receiver.

ate frequency. In a number of receivers, the sound signal is separated from the picture signal at this point and fed into the sound if section, detector, audio amplifier and to the loudspeaker. In other receivers, the complete signal is fed through the video if stages for further amplification. After video detection, the sound signal is separated from the main signal, and then fed through the audio channel. This is known as the "inter-carrier" sound system. This system has the advantage of saving audio if stages, with the consequent reduction in cost, and more efficient operation of the receiver.

At the end of the video if section, the sychronizing pulses are removed and fed into the deflection circuits. The picture signal, controlling the light intensity of each element of the picture, is then fed to the control grid of the picture tube. The voltage on the control grid of the picture tube controls the intensity of the cathode-ray beam as it travels to the picture tube screen. To produce an intelligible picture, the motion of the cathode-ray beam, as it scans the screen, must be exactly synchronized with the motion of its counterpart in the camera tube at the television studio. This is accomplished by means of the synchronizing pulses which form part of the composite television signal as it is broadcast.

The vertical and horizontal synchronizing pulses are separated from each other and each is used to control the operation of their respective deflection circuits. The outputs of the deflection circuits are saw-tooth waves which are applied to the deflection coils on the picture tube.

The frequency of the vertical deflection wave is 60 cycles inasmuch as 60 fields are produced each second. There are 30 frames per second, each frame made up of two fields whose lines are interlaced to produce a complete picture. The frequency of the horizontal deflection wave is 15,750 cycles. That many horizontal lines are scanned each second. Thus, all the elements to make an intelligible picture are made to arrive at the picture tube at the correct time.

THE TEST PATTERN

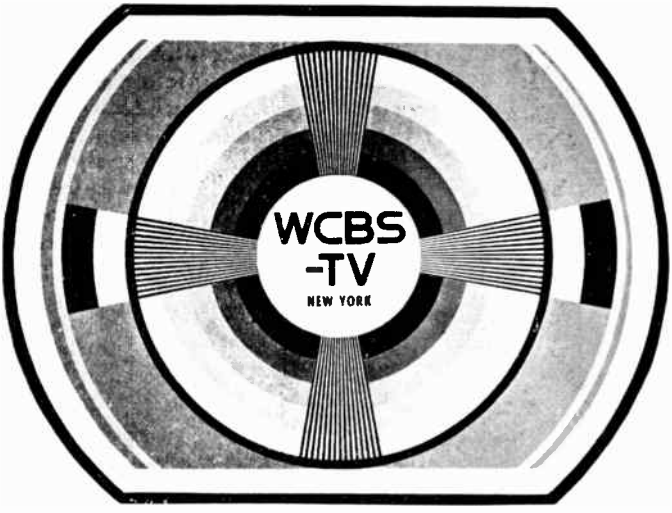


Figure 2.

The test patterns, as broadcast regularly by most television stations, contain specific geometric designs calculated to aid the serviceman in trouble-shooting and adjusting receivers.

For example, the CBS test pattern, illustrated here, can be used as a guide to check the following:

1. The four points marked 2, 5, 7, and 11, are located where the pattern should touch the sides of the screen. The height and width should be adjusted to conform, if they are "off". When these points touch, correct picture size and aspect ratio have been obtained.
2. To check contrast and brightness, observe the concentric circles marked 6. These are of different shades, from light grey to black. A receiver having the contrast and brightness controls set correctly will show these tone variations.
3. The center of the pattern marked 1, which is a large white circle, is used to determine proper adjustment of the focus control. This circle should be perfectly round and sharp.

THE TEST PATTERN

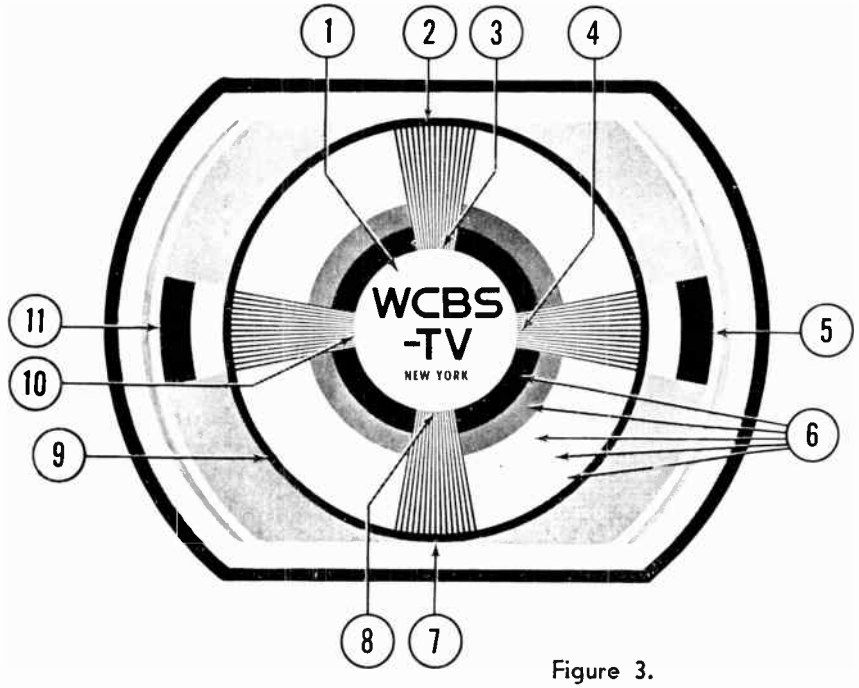


Figure 3.

4. The horizontal wedges marked 10 and 4 will enable the serviceman to determine the vertical resolution. If the lines in the wedges are partially or completely blurred there is a partial loss of resolution.
5. Similarly, the vertical wedges marked 3 and 8 can be used to determine horizontal resolution.
6. The large black circle, marked "9", is used to determine vertical and horizontal linearity. When perfect linearty is present, the circle is perfectly round.

These principles of the test pattern analysis can be applied to any test pattern with equal effectiveness. A careful examination of these patterns will give many hints and save many hours of service time.

DEFLECTION CIRCUITS

The video signal consists of two separate characteristics, picture signal and synchronization pulses, after it has passed through the video section. The complete picture signal travels directly to the picture tube, but the sync pulses are fed to the sweep circuits to be separated and amplified.

The sync amplifier in the sweep circuits separates the sync pulses from the video.

The horizontal pulses are fed through the horizontal deflection circuits and the vertical through the vertical deflection circuits. They are then amplified and forwarded to the scanning coils of the picture tube.

These pulses are used to keep the picture on the screen in perfect synchronization with the scene at the television studio.

For explanation and corresponding wave forms of call-outs shown on the circuit diagram on the following page and on the complete circuit diagram, see Waveform Notes, *pages 94-97*.

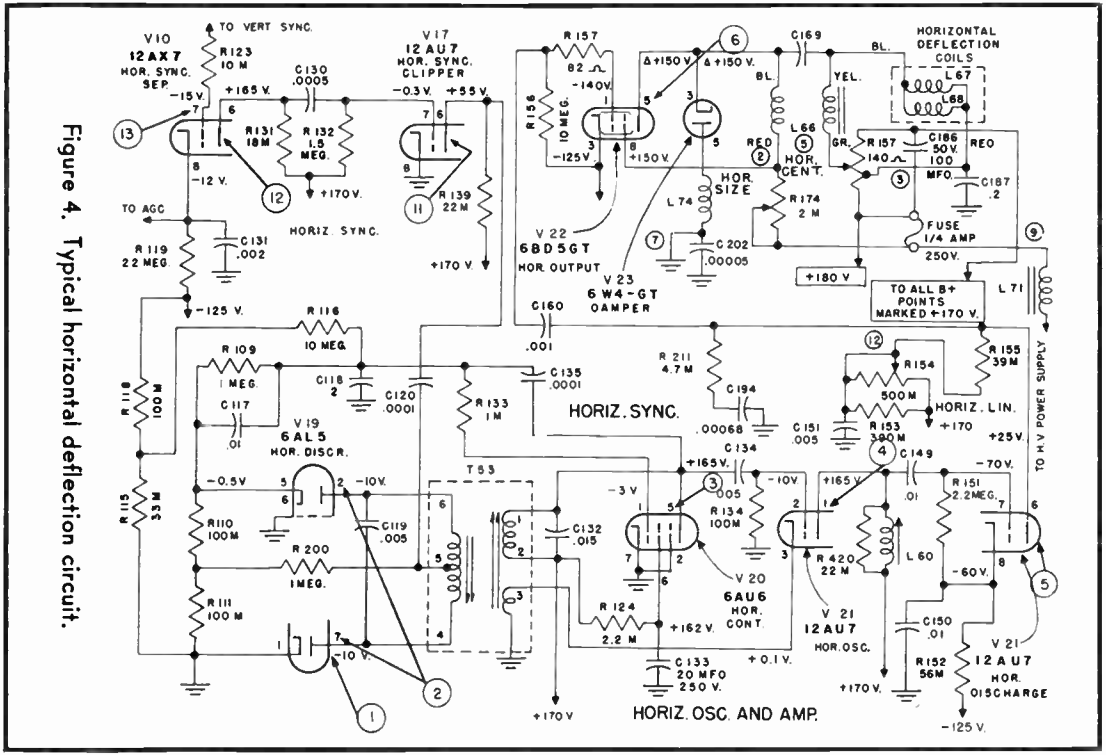


Figure 4. Typical horizontal deflection circuit.

HORIZONTAL BARS ACROSS SCREEN

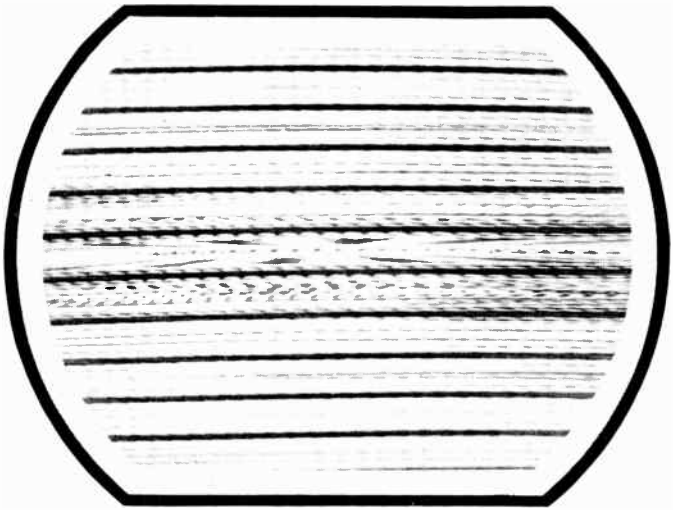


Figure 5.

Characteristics

1. Poor horizontal synchronization.

Cause	Remedy
Misadjustment of horizontal hold control.	Adjust and reset horizontal hold control.
Improper setting of discriminator transformer in horizontal sync circuit (T53).	Reset oscillator control (T53) until picture is synchronized.
Open or shorted windings in discriminator transformer (T53).	Check resistances of windings with ohmmeter. Replace defective components. Also check for short with ohmmeter having transformer leads disconnected.

HORIZONTAL BARS ACROSS SCREEN

Cause	Remedy
Improper voltages in horizontal sync section of circuit.	Check voltages at key points with Polymeter as suggested by manufacturer's drawings.
Open or shorted resistor, or improper value of a resistor (R123, R131, R132, R139, R115, R116, R117, R118, R109, R110, R111, R133, R124) in horizontal sync section.	Check resistance values with ohmmeter in horizontal sync circuit, or by substitution method. Replace defective components.
Open, shorted or leaky condenser in horizontal sync section, (C130, C131, C117, C118, C119. C120, C133, C134, C135).	Check condensers with ohmmeter or by substitution method. Replace defective condensers.
Defective tubes in horizontal sync section (12AX7, 12AU7, 6AL5, 6AU6) (V16, V17, V19, V120).	Test sync tubes with tube tester. Replace defective tubes.

PART OF PICTURE BLACKED OUT— SIDES OF PICTURE CURVED

Figure 6.

Characteristics

1. Heavy bars (white) across blacked out part of picture.
2. Picture simulates rolling waves.
3. Poor or no horizontal hold.

Cause	Remedy
Hum or ac in picture.	Hum may be caused by an open filter condenser or a shorted tube (i.e., cathode-to-filament short).
Horizontal synchronization poor.	Check suspected components or tubes by substitution method, or with oscilloscope in the horizontal sync section.

See also page 81.

SIDES OF PICTURE CURVED

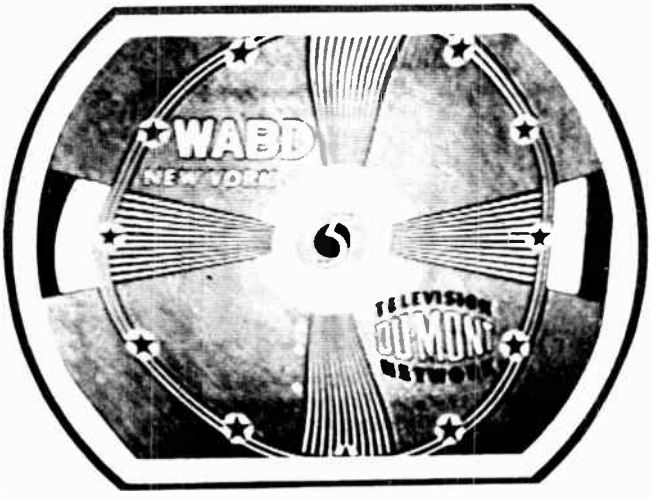


Figure 7.

Characteristics

1. Picture not symmetrical.

Cause	Remedy
Ripple or hum present in the dc voltage being supplied by the power supply.	Check the dc voltage being supplied with an oscilloscope for ripple. Test suspected components by substitution method (i.e., open condenser, shorted tube, shorted filter condenser, etc.).

See also page 82.

BLANK SCREEN

Characteristics

1. No raster—sound normal.

Cause	Remedy
Short circuit in the high voltage power supply, horizontal output, or damping sections of the sweep circuit.	Check with ohmmeter for a short in the horizontal amplifier circuit. Replace defective component.
Tube drawing excessive current in the horizontal amplifier section (6BD5, 6SN7) (V22, V24).	Test the horizontal amplifier tubes and the high voltage oscillator tubes in the section, with tube tester, Replace defective tubes.
No horizontal drive being supplied to the grid of the horizontal output tube (6BD5) (V22).	Check the grid drive of the horizontal output tube with an oscilloscope. Refer to waveform photos for proper amplitude and form as supplied by manufacturer.
Shorted coupling condenser (C160).	Check condenser with ohmmeter. Refer to manufacturer's schematic for proper voltage. Replace if defective.

See also pages 62, 72, 86.

VERTICAL LINE ON SCREEN

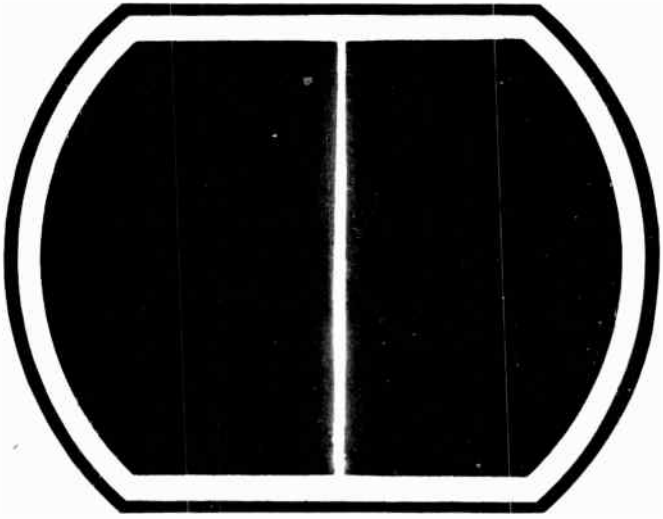


Figure 8.

Characteristics

1. Picture has no width.
2. Horizontal sweep signal missing

Cause	Remedy
Open or shorted deflection coil in the horizontal oscillator and amplifier section (L67, L68).	Check deflection coil for continuity with an ohmmeter. Replace if necessary.
Improper voltages in horizontal sync circuits.	Check voltages at key points of circuit with Polymeter, referring to manufacturer's drawing for values.
Open horizontal size control potentiometer (R174).	Check with ohmmeter for defective component. Replace if necessary.

VERTICAL LINE ON SCREEN

Cause	Remedy
Defective horizontal oscillator or horizontal output tube (V21, V22).	Check tubes in horizontal oscillator and amplifier circuits with tube tester, or by substitution method. Replace if necessary.
Open fuse.	Replace fuse.

OVERLAPPING OF PICTURE HORIZONTALLY (FOLDOVER)

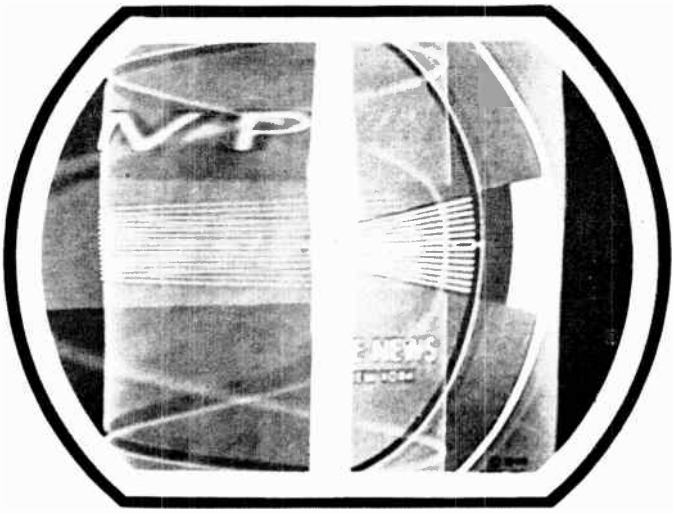


Figure 9.

Characteristics

1. Picture folds over in center of screen.

Cause	Remedy
Open coil (L74) in series with damper tube, in damper circuit of the horizontal oscillator amplifier section.	Check coil with ohmmeter for continuous or open winding. Replace if defective.
Defective damper tube (6W4GT) (V23).	Check tube with tube tester or by substitution method. Replace if necessary.

LONG, NARROW PICTURE

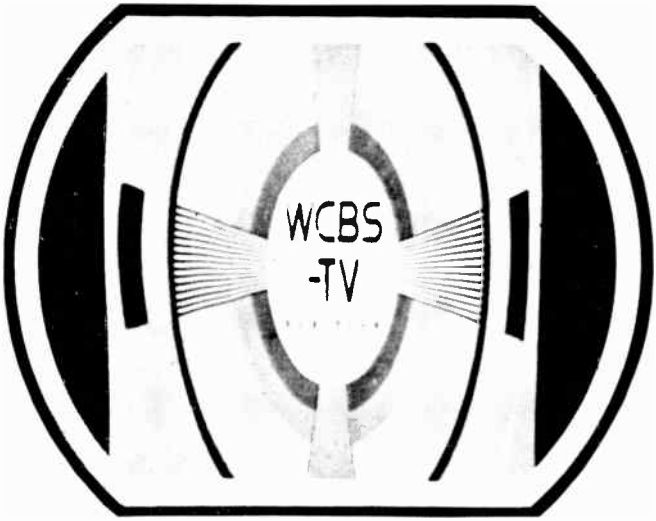


Figure 10.

Characteristics

1. Picture not wide enough.
2. Dark areas on both sides of screen.
3. Picture is elongated.

Cause	Remedy
Width control potentiometer not set properly (R174).	Set control manually and adjust until picture is of proper width.
Improper dc voltages in the horizontal amplifier circuits.	Check dc voltages at key points in circuit with Polymeter, and replace defective components.
Shorted horizontal deflection coil (L67, L68) in horizontal amplifier section.	Check with ohmmeter for continuity or for a short in the circuit.

LONG, NARROW PICTURE

Cause	Remedy
Shorted output transformer (L66).	Check horizontal amplifier section with ohmmeter for continuity or short.
Open or shorted resistors in horizontal amplifier section.	Check resistance values in circuit with ohmmeter. Refer to the manufacturer's notes.
Open or shorted condensers in horizontal amplifier section.	Check with ohmmeter or by substitution method for a short. Replace defective component.
Defective horizontal oscillator and discharge tube, or horizontal output tube (6BD5, 12AU7) (V21, V22).	Test tubes by substitution method or with a tube tester.

SPLIT PICTURE (HORIZONTALLY)

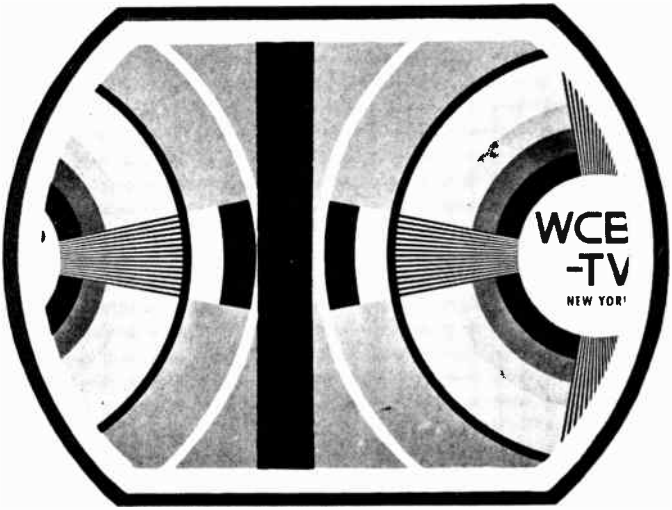


Figure 11.

Characteristics

1. Bar in center of picture.
2. Half of picture on each side of bar.
3. Horizontal sync voltage not in correct phase.
4. Picture sections back to back.

Cause	Remedy
Discriminator transformer (T53) in horizontal oscillator section misadjusted.	Adjust iron slug in transformer until picture is centered properly.
Shorted turns in windings of discriminator transformer (T53).	Check resistance values of windings with ohmmeter.
Improper value resistor in horizontal discriminator circuit.	Check by substitution or with ohmmeter. Replace where necessary.

SPLIT PICTURE

Cause	Remedy
Open or shorted condenser in horizontal discriminator circuit (C119, C134, C132, C135).	Check with ohmmeter or by substitution for leakage or short. Check with a condenser tester, or by substitution. Questionable condensers should be replaced.
Defective horizontal discriminator tube (6AL5) (V19).	Check by substitution or with tube tester. Replace where necessary.

OVERLAPPING OF PICTURE VERTICALLY (FOLDOVER)

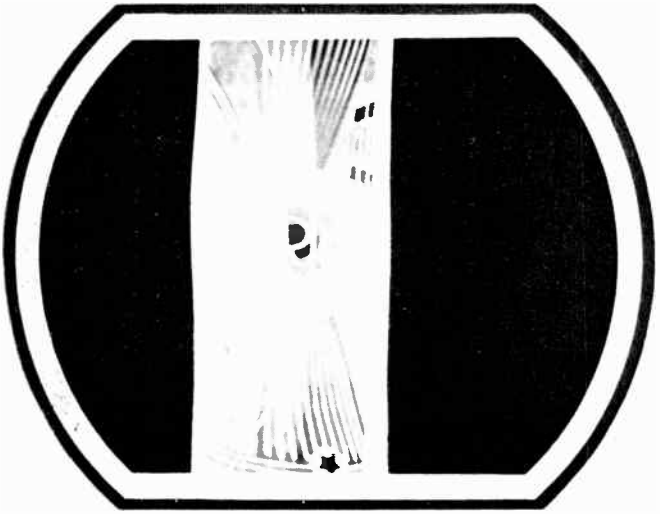


Figure 12.

Characteristics

1. Picture folds over vertically in center of screen.
2. Bright vertical lines on left side of picture.
3. One side of picture horizontally longer than the other.
4. Picture folded over on sides (either or both sides).

Cause	Remedy
Potentiometer (R154), in horizontal oscillator and amplifier circuit, not properly set.	Adjust and reset, or replace resistor (R154).
Leaky or shorted condensers in horizontal oscillator and amplifier section (C149, C150, C151, C160).	With an ohmmeter, check condensers for a short. Replace when necessary.

OVERLAPPING OF PICTURE VERTICALLY

Cause	Remedy
Open or shorted coil (L60) in horizontal oscillator and amplifier circuit.	Check with ohmmeter for continuity or break. Replace component where necessary.
Wrong value resistor (R140, R134, R152, R153, R156, R157).	Check resistance values with ohmmeter, replace defective resistors.
Improper voltages being supplied by the low voltage power supplies through the horizontal oscillator and amplifier section.	Check circuit with Polymeter, referring to manufacturer's schematic for correct values.
Defective tubes (horizontal discharge or horizontal output) (12AU7, 6BD5) (V21, V22).	Check tubes with tube tester. Replace defective tubes.

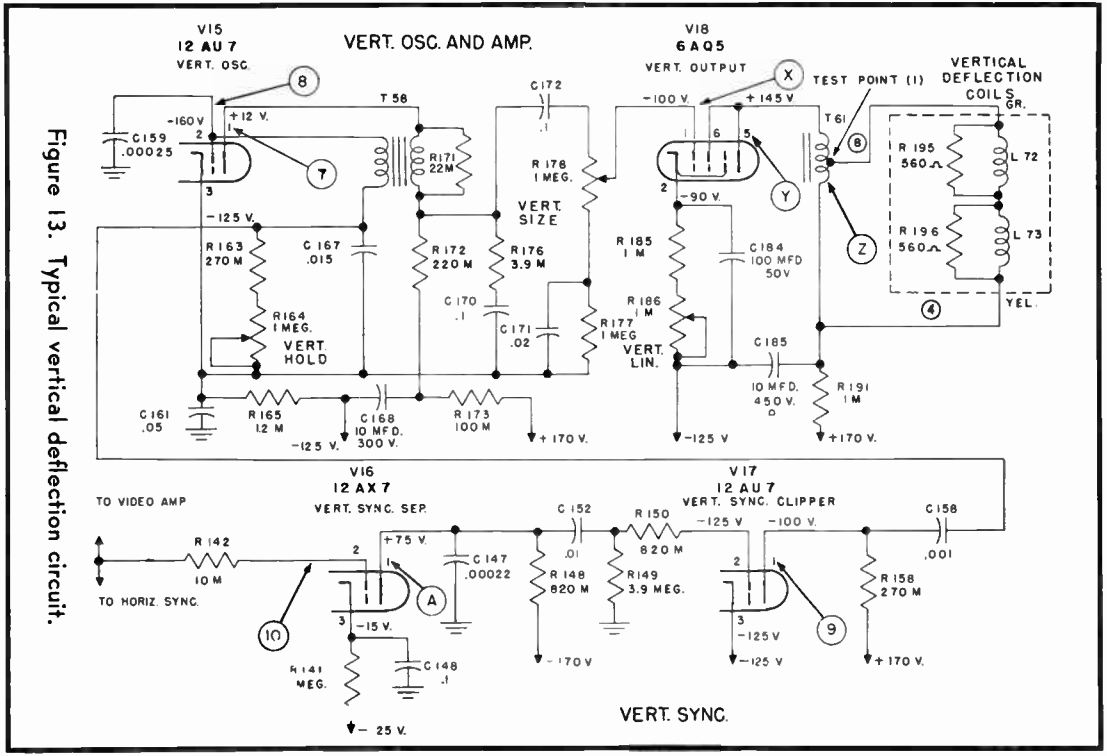


Figure 13. Typical vertical deflection circuit.

ROLLING PICTURE (UP AND DOWN)

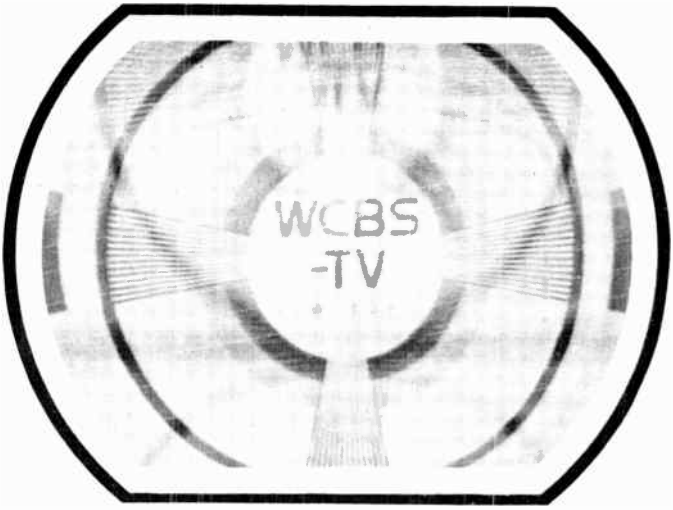


Figure 14.

Characteristics

1. Multiple images.

Cause	Remedy
Improper setting of vertical hold control (R164) in vertical sync section.	Reset vertical hold control manually until picture is locked in place.
Open, leaky or shorted condensers in vertical sync section (C147, C148, C152, C158).	Check vertical sync circuit for short by ohmmeter, or by substitution method. Replace if defective.
Resistor of improper value in vertical sync circuit (R141, R142, R148, R149, R158).	Test components in circuit for resistances with ohmmeter. Replace defective parts.

ROLLING PICTURE

Cause	Remedy
Improper voltages in vertical sync section supplied by power supply.	Test voltages in circuit, using Polymeter. Refer to manufacturer's schematics.
Defective tube (vertical sync clipper, 12AX7 or 12AU7) (V16, V17).	Test vertical sync tubes with tube tester, and replace defective tubes.

WHITE HORIZONTAL LINE IN CENTER OF SCREEN

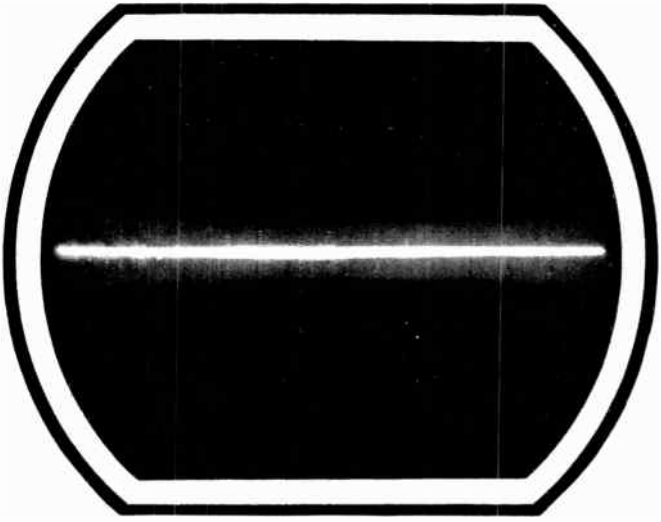


Figure 15.

Characteristics

1. No raster or picture.
2. Picture has no height.

Cause	Remedy
No vertical drive supplied to vertical amplifier tube (6AQ5) (V18).	Check grid of tube with oscilloscope, referring to wave forms in manufacturer's service guide for proper shape and amplitude.
Open or shorted output transformer (L61) in vertical amplifier section.	Check for continuity or short with ohmmeter. Replace if defective.

WHITE HORIZONTAL LINE

Cause	Remedy
Shorted or open deflection coil (L72, L73) in vertical amplifier section.	Check for continuity or break with ohmmeter. Replace defective component.
Improper voltages supplied by low voltage power supply to vertical amplifier section.	Check voltages being supplied with Polymeter, referring to manufacturer's schematic for proper voltages. Replace defective components.
Shorted or open vertical blocking oscillator transformer (T58) in vertical amplifier section.	Check for short with ohmmeter. Replace if necessary.
Open resistor or control in vertical amplifier section (R163, R164, R171, R172, R173, R176, R177, R178, R165, R186, R191).	Check resistances in circuit with ohmmeter, referring to manufacturer's notes for correct values. Replace if necessary.
A shorted condenser in vertical amplifier section (C189, C170, C161, C158, C159, C185).	Check for short in circuit with ohmmeter. Replace defective component.
Defective vertical oscillator or amplifier tube (12AU7 or 6AQ5) (V15, V18) in vertical amplifier section.	Test tubes in circuit with tube tester. Replace defective tube.

VERTICALLY VIBRATING PICTURE (PICTURE JUMPS)

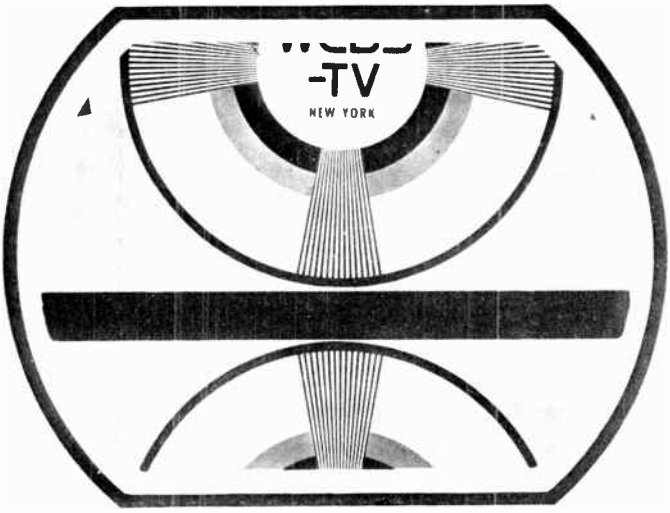


Figure 16.

Characteristics

1. Picture is unsteady and jumps up and down.

Cause	Remedy
Hum (ac) present in dc voltage supplied to vertical sync section by low voltage power supply.	Check incoming wave forms with oscilloscope. Compare with manufacturer's notes for proper wave form, and follow recommended procedure.
Excessive ignition noises or external electrical interference.	Relocate antenna to minimize external interference (use coaxial cable if necessary).

NOTE: AC may be present in circuit due to open filter condenser, shorted choke, or shorted tube (i.e., cathode to filament short). Replacement is indicated by use of scope or by substitution method.

IMPROPER HEIGHT OF PICTURE

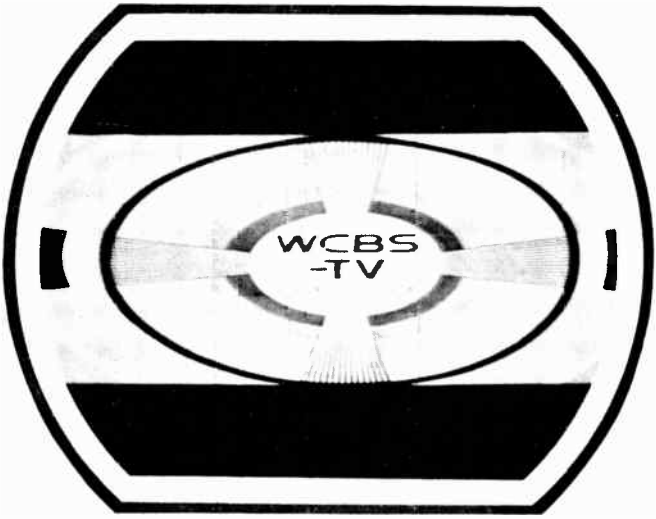


Figure 17.

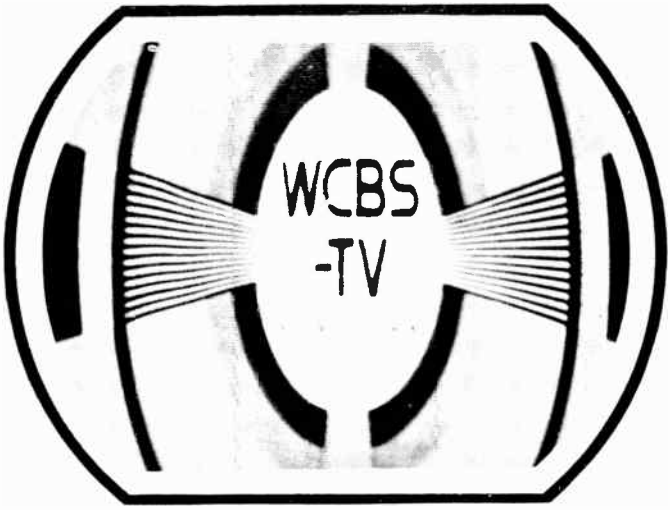


Figure 18.

IMPROPER HEIGHT OF PICTURE

Characteristics

1. Picture is vertically too large or too small.

Cause	Remedy
Vertical size control improperly set (R178).	Manually reset vertical size control.
Improper voltages being supplied by low voltage power supply to vertical oscillator and amplifier section.	Test voltages with Polymeter, referring to manufacturer's service guide.
Resistor changed in value (R165, R172, R173, R191) (in vertical oscillator and amplifier section).	Check resistance values in vertical oscillator and amplifier circuits with ohmmeter. Replace defective components.
Defective vertical oscillator or amplifier tube (12AU7, 6AQ5) (V15, V18).	Check tubes with tube tester, replace defective tubes.

UNEVENLY PROPORTIONED PICTURE

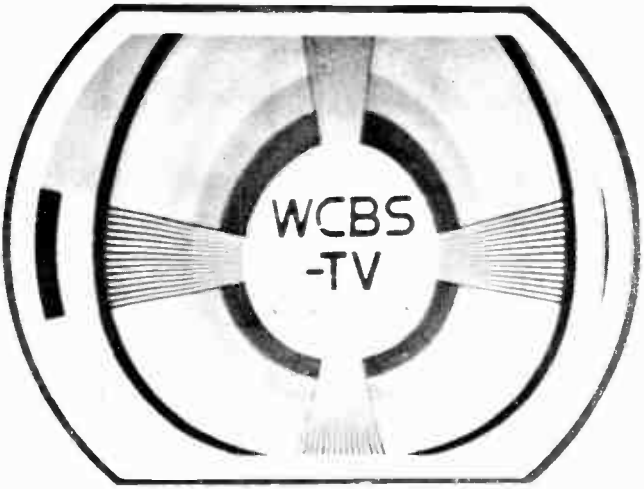


Figure 19.

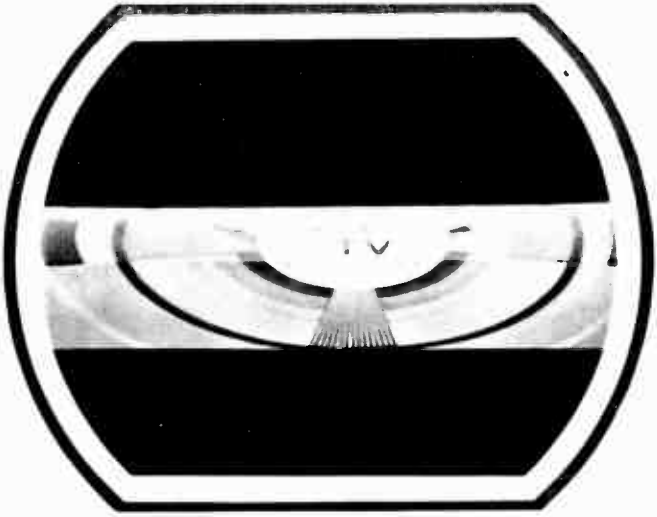


Figure 20.

UNEVENLY PROPORTIONED PICTURE

Characteristics

1. Top and bottom of picture out of proportion.
2. Sides of picture vertically uneven.
3. Lack of vertical linearity.

Cause	Remedy
Open, shorted or leaky condenser in the vertical oscillator amplifier section (C184, C172, C170).	Check with ohmmeter or by substitution method for a short in circuit. Replace defective condenser.
Improper setting of linearity control (R186).	Reset control manually.
Resistor changed in value in vertical oscillator, amplifier section (R185, R186, R176).	Check resistance values in circuit with ohmmeter. Replace defective resistors.
Defective vertical amplifier tube (6AQ5) (V18).	Check tube with tube tester. Replace if necessary.

SPLIT PICTURE (VERTICALLY)

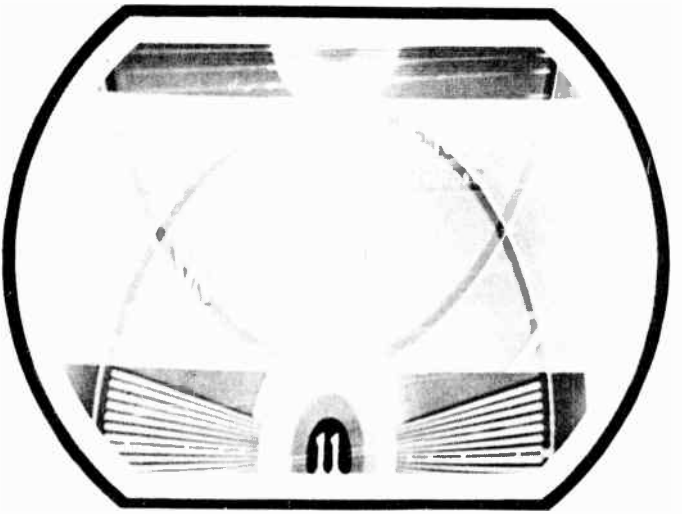


Figure 21.

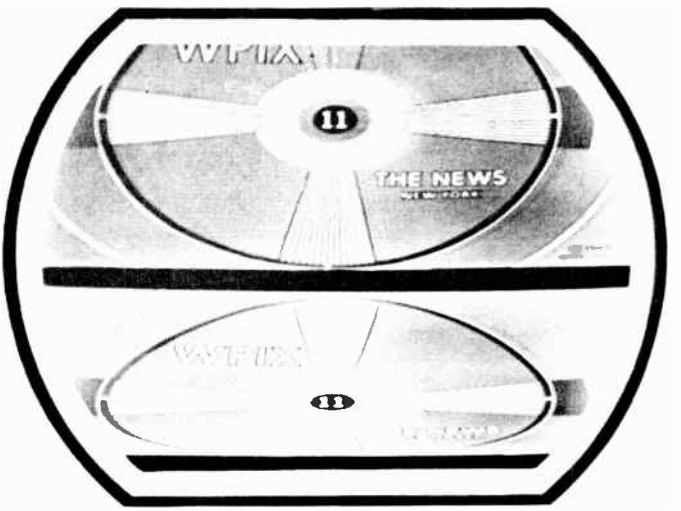


Figure 22.

SPLIT PICTURE

Characteristics

1. Horizontal bar in center of screen.
2. Half of picture on each side of bar.
3. Picture sections top on bottom.
4. Two pictures vertically in a single frame.
5. Vertical frequency too high or too low.

Cause	Remedy
Vertical hold control not properly set (R164).	Manually reset vertical hold control.
Resistor in vertical oscillator amplifier section is changed in value (R163).	Check for resistance value with ohmmeter referring to manufacturer's service guide.
Shorted or leaking condenser (C167) in vertical oscillator amplifier circuit.	Check for short in circuit with ohmmeter. Replace defective component.
Shorted turns in vertical locking oscillator transformer (T58).	Check transformer for continuity or a short with ohmmeter. Replace if defective.

ANTENNAS

Installation of a proper antenna is extremely important to good reception. In general, an antenna should have broad band response so that adjacent channels can be received with equal clarity. To insure strong, clear signals, the antenna should have good directional characteristics.

Many different types of antennas are now on the market. A specific receiver location and local reception problems will ultimately determine which type is best. Many receivers today feature a built-in antenna. This type of receiver eliminates the need of an outdoor antenna in many locations, but an outside antenna is usually preferable for best reception, and is almost a necessity in fringe areas where reception is difficult.

In general, the decision as to the best type of antenna installation can be left to the judgment of the individual serviceman, who knows the local problems involved in television reception.

NO PICTURE—WEAK SOUND

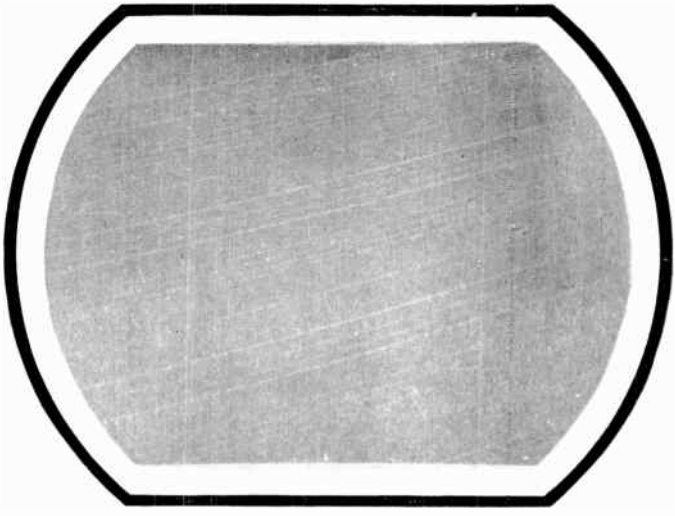


Figure 23.

Characteristics

1. A raster is present.
2. The sound is distorted and weak.

Cause	Remedy
Antenna is disconnected.	Connect the antenna.
A break is present in the antenna lead.	Connect the antenna leads on the roof and test with ohmmeter for continuity. Connect the break in wire or replace lead-in wire.
Short in the antenna lead.	Clear the short circuit or replace lead.

See also pages 49, 62, 75.

WEAK PICTURE—NORMAL SOUND

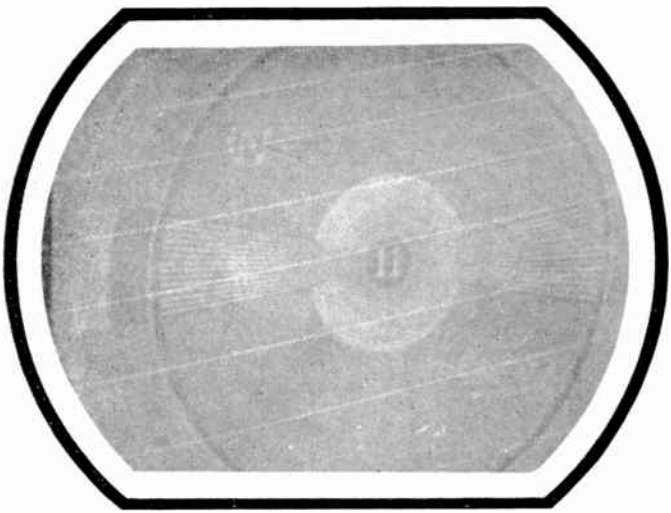


Figure 24.

Characteristics

1. Picture is snowy, weak or hazy.

Cause	Remedy
Antenna oriented in wrong direction.	Manually reorient antenna.
Antenna arms not of proper size or length.	Replace antenna arms.

See also pages 51, 55, 60.

GHOST IN PICTURE—NORMAL SOUND

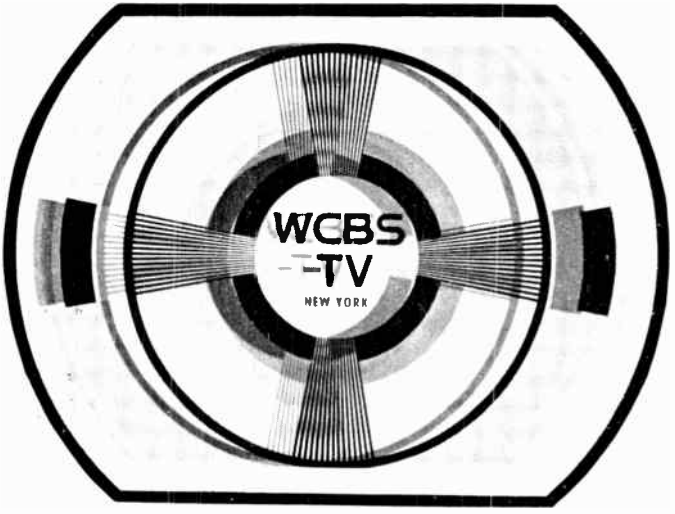


Figure 25.

Characteristics

1. Picture details weak.
2. Reflections or shadows in picture (ghosts).

Cause	Remedy
Antenna is improperly oriented.	Manually reorient the antenna.
Antenna is improperly located.	Select proper location by walking with the antenna to different points on the roof, until the best results are obtained.
Reflections of the signal from nearby buildings or obstructions.	Although there is no remedy, the effect can be minimized by a careful probing of the roof for the best antenna position.

SHADED PICTURE—NORMAL SOUND

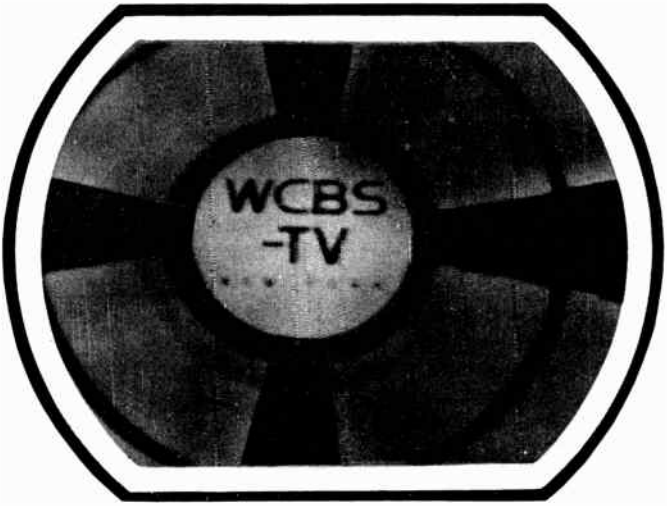


Figure 26.

Characteristics

1. Shading present on right side of picture.

Cause	Remedy
Mismatch of the lead-in line to the antenna.	Replace line using the proper lead-in.
Mismatch of the lead-in line to the receiver.	Replace using the proper lead-in line.

JUMPING PICTURE—NOISY SOUND

Figure 27.

Characteristics

1. Picture is unsteady, jumps and is erratic.
2. Thin white horizontal lines through picture.
3. Sound is distorted by noise.

Cause	Remedy
A loose connection in antenna system.	Check and tighten all connections of the antenna system.
Lead-in wire is touching or shorting against the side of the building (Insulation frayed at point of contact).	Replace lead-in wire, or insulate lead-in wire, at the point of contact.
Excessive pickup of electrical noise (outside) by receiver.	Relocate antenna after probing the roof for the most advantageous position where electrical noises are minimized.

DIAGONAL LINES THROUGH PICTURE— NORMAL SOUND

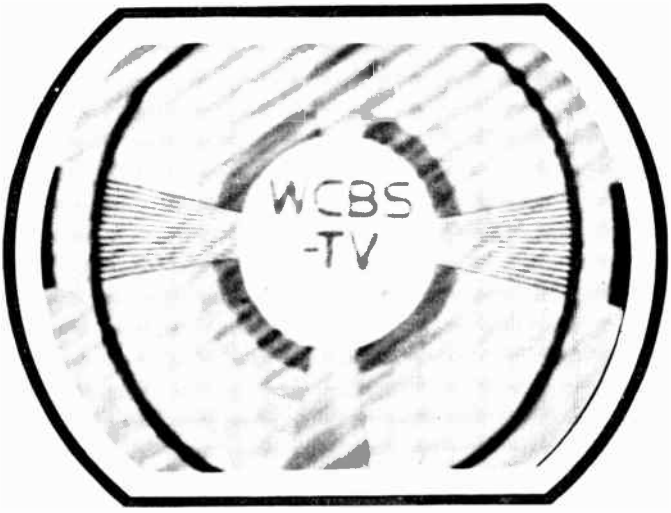


Figure 28.

Characteristics

1. Shaded diagonal lines across picture.

Cause	Remedy
RF interference caused by radiation from another receiver or from another transmitting station.	Install wave traps (interference filters) in antenna system. Relocate antenna for minimum interference (external).

ERRATIC LINES THROUGH PICTURE— NORMAL SOUND

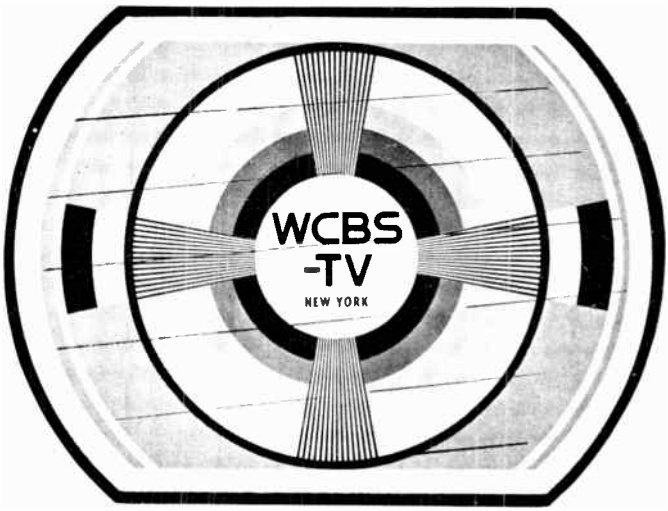


Figure 29.

Characteristics

1. There may be a buzz present.
2. Light and dark spots on picture.
3. Horizontal streaks through picture.

Cause

Electrical disturbances or noises caused by the operation of automobiles, diathermy equipment, or electrical apparatus in the immediate vicinity.

Remedy

There is no remedy other than the installation of filters or shielding in the equipment responsible for this defect. In any event, an attempt should be made to probe the roof for the most effective position of the antenna.

RF SECTION

The TV signal, which consists of sound and video, passes from the antenna, through the connecting transmission line, to the rf section.

The rf amplifier amplifies the signal which is fed to the mixer tube. The rf oscillator generates a signal higher in frequency than the incoming rf signal. These two signals, i.e., the rf signal and the signal generated by the local oscillator, beat together in the input of the mixer stage. The output of the mixer stage is tuned to the difference of these two signals, which then becomes the video frequency and is sent to the video amplifier.

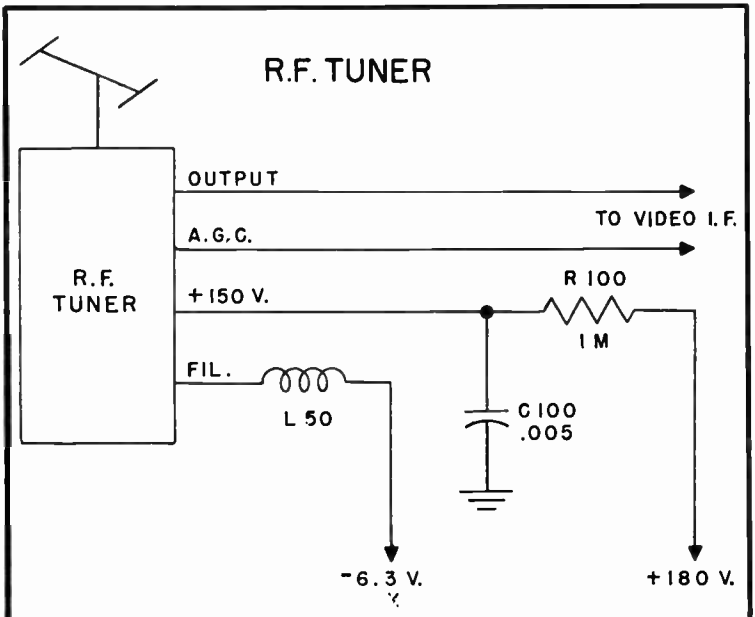


Figure 30. Typical rf circuit.

NO PICTURE—NO SOUND

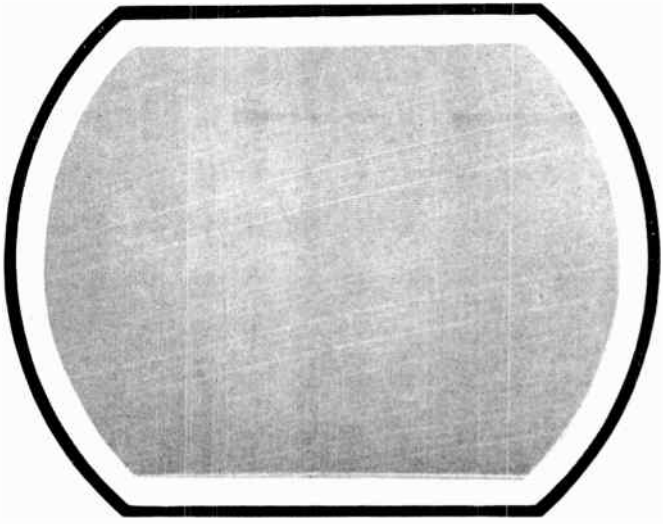


Figure 31.

Characteristics

1. Raster is present.
2. No signal.

Cause	Remedy
Improper voltages being supplied by the low voltage power supply to the rf tuner.	Check voltages in the rf tuner, referring to the drawings of the manufacturer of the specific set.
Shorted condenser in the rf tuner section (C11, C14, C19) (also C30).	Check with an ohmmeter, all condensers in the rf tuner section for a short and replace defective condenser.
Defective rf tubes in this section (6AQ5, 6J6).	Check tubes with tube tester in the rf tuner section, replace defective tubes.

NO PICTURE—NO SOUND

Cause	Remedy
Open coil or resistor (R4, R3, R6, R8, R11, L11).	Check with an ohmmeter, all coils for continuity or breaks, as well as all resistors, for proper resistance values in the rf tuner section. Replace defective coils or resistors.

See also pages 41, 62, 75.

SNOWY PICTURE—WEAK SOUND

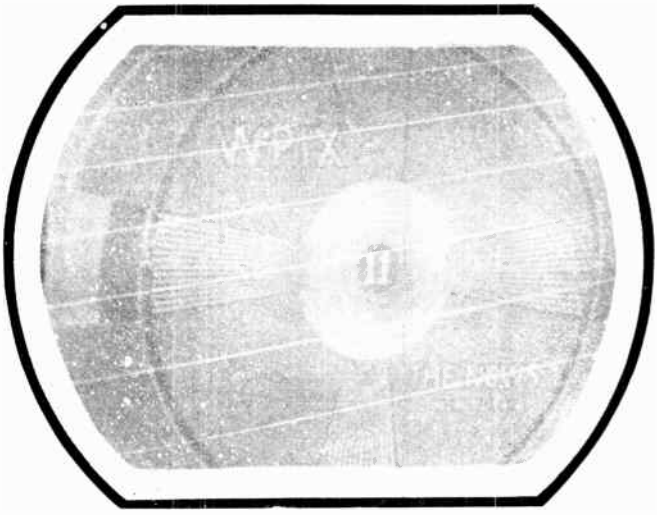


Figure 32.

Characteristics

1. Image is weak.
2. Either no sound or the sound is weak.

Cause	Remedy
Improper Automatic Gain Control voltage being supplied to the rf tuner section.	Check voltages supplied to the rf tuner section with Polymeter, referring to the drawings supplied by the manufacturer of the set. Replace defective components.
Open or shorted rf coil in the tuner section (L4, L5, L6, L7).	Replace tuner in the event that special equipment necessary to repair or realign front ends is not available.
Defective tube in the rf tuner section (6AG5) and (6J6).	Check all tubes with tube tester in rf tuner section. Replace defective tubes.

See also pages 42, 55, 60.

VIDEO SECTION

The video portion of the signal, received by the video if amplifier from the rf section, is passed on to the video detector after it has been amplified.

The video detector separates the video and pulse signals from the carrier wave by demodulation.

The video signal present at this point is then amplified by the video amplifier and readied for the picture tube. Trouble in the video section may not necessarily affect the sound sections of the receiver.

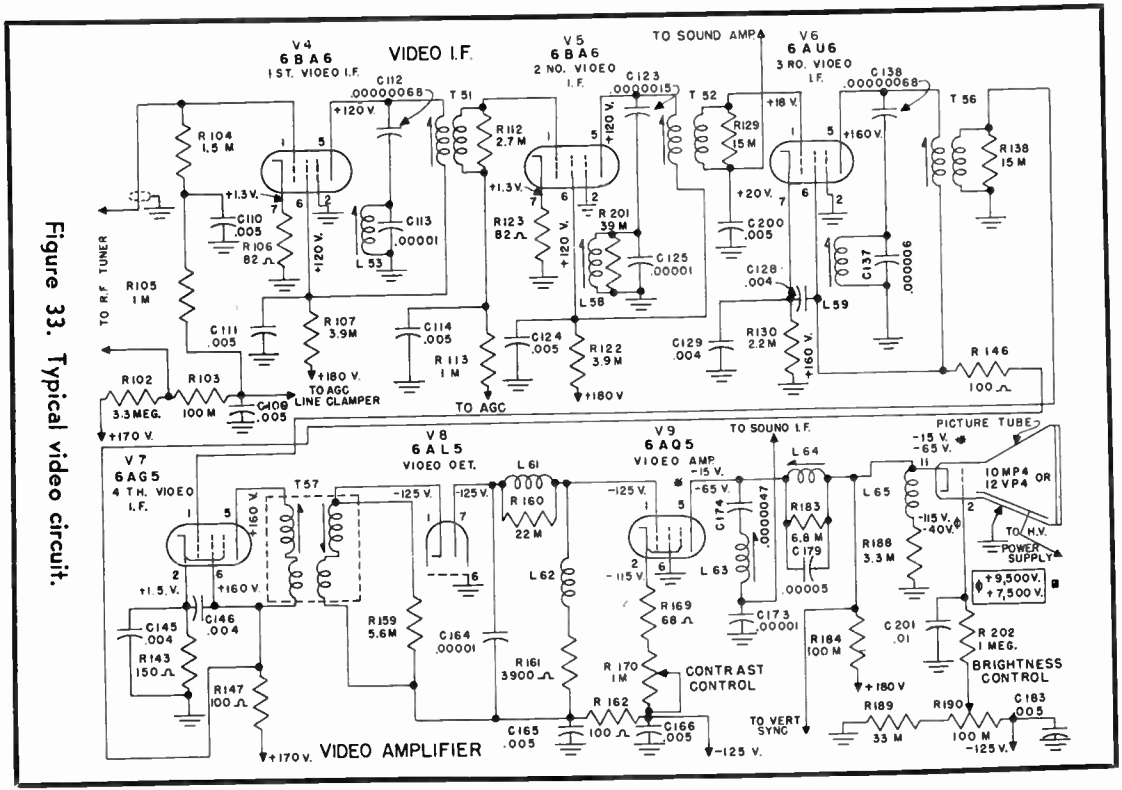


Figure 33. Typical video circuit.

NORMAL PICTURE—NO SOUND

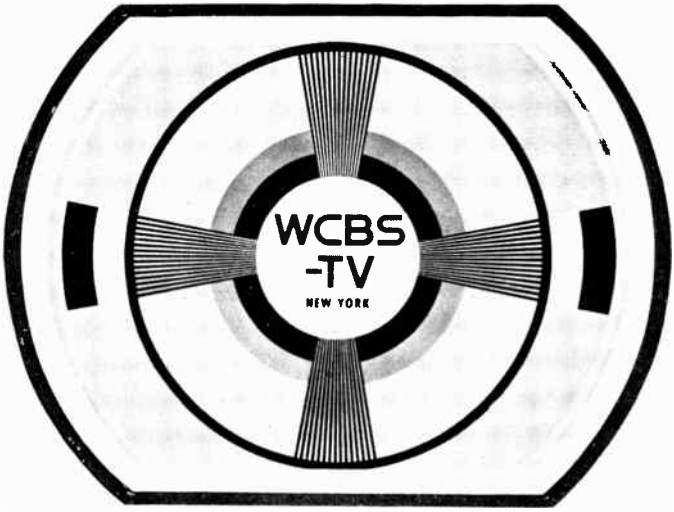


Figure 34.

Characteristics

1. Picture clear and distinct.
2. No sound.

Cause	Remedy
Open or shorted coil (L63) in the video amplifier section.	Check with ohmmeter for continuity or break of coil in the video amplifier section. Replace defective coil.
Any defect common to audio circuits.	Use normal audio service technique.

HAZY PICTURE—GOOD SOUND

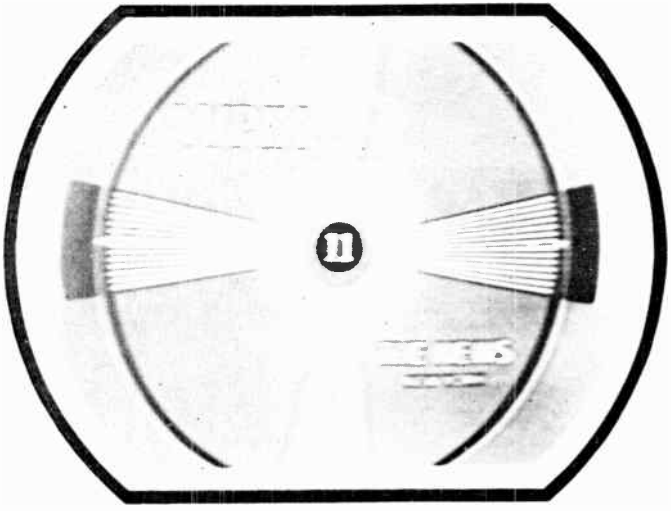


Figure 35.

Characteristics

1. Loss of fine details.
2. Hazy stripes diagonally across picture.
3. White shadings on right side of picture.
4. Dark shadings on right side of picture.

Cause	Remedy
Improper alignment in video if section.	Check if (video) section and align set referring to procedure suggested by the manfacturer of the set.

See also pages 42, 51, 60.

VERY DARK PICTURE—HUM IN SOUND

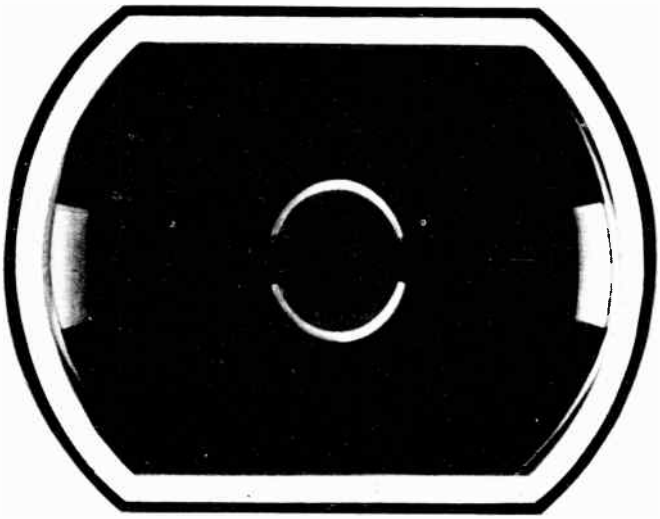


Figure 36.

Characteristics

1. Picture dark or almost blacked out.
2. Sound may be distorted—hum present in sound.

Cause	Remedy
Shorted condenser in the video if (AGC) section (C110, C114, C126, C109).	Check with ohmmeter for a short in the video if (AGC) circuit. Replace defective components.
Improper voltages are being supplied by the low voltage power supply to the video if (AGC) section.	Check voltages supplied to video if (AGC) circuit with a Polymeter, referring to drawings supplied by the manufacturer of set. Replace parts.

VERY DARK PICTURE—HUM IN SOUND

Cause	Remedy
Resistor may have changed in value (R102, R103, R114, R121, R120) in video if (AGC) section.	Check with ohmmeter for resistance values in the video if (AGC) circuit, referring to manufacturer's drawings. Replace defective resistors.
Defective tube (AGC amplifier 12AU7) (V15) in video if (AGC) section.	Test tubes with tube tester and replace defective tubes in video if (AGC) circuit.

SMEARED PICTURE—GOOD SOUND

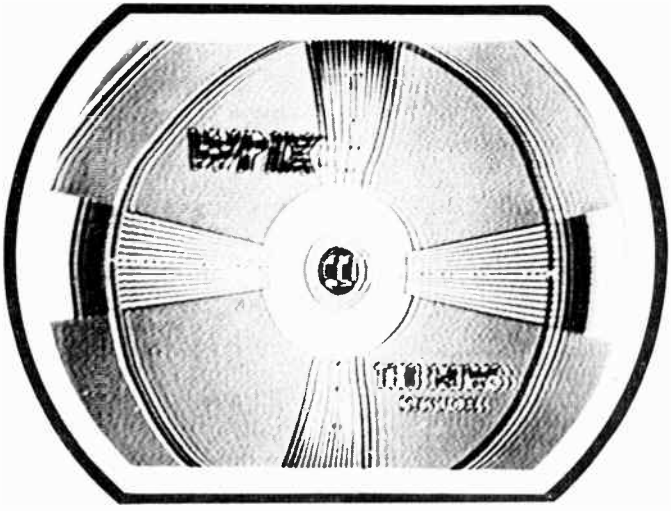


Figure 37.

Characteristics

1. Picture is distorted and wavy.

Cause	Remedy
Open peaking coil (L61, L64) in the video amplifier section.	Check with ohmmeter for continuous windings or open windings (break) in the video amplifier circuit.

WHITE DIAGONAL LINES THROUGH PICTURE—NORMAL SOUND

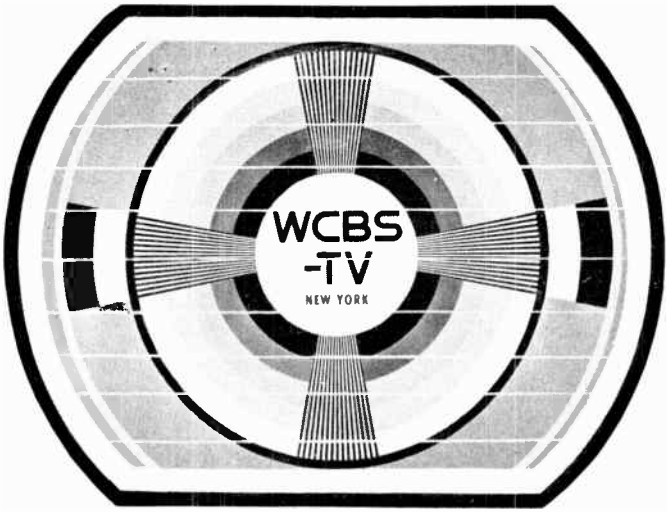


Figure 38.

Characteristics

1. No control of contrast.
2. Image clear except for diagonal lines.

Cause	Remedy
Shorted or leaky condenser in the video amplifier section (C183, C201).	Check with ohmmeter for short in the video amplifier circuit. Replace defective condenser.
Defective picture tube.	Check picture tube by the substitution method.

WEAK PICTURE—WEAK SOUND

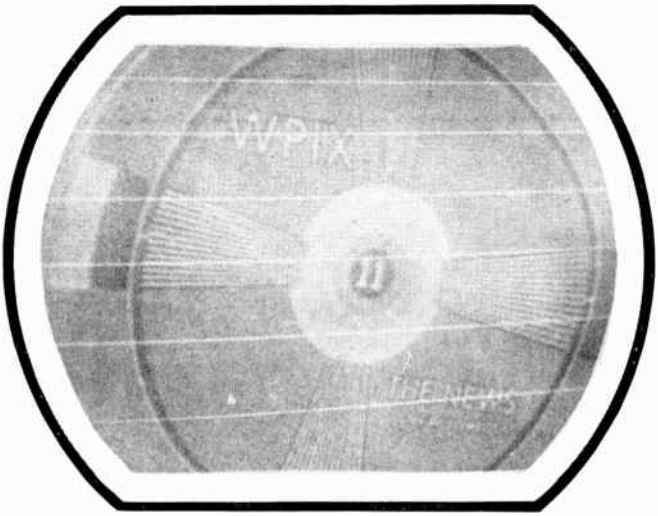


Figure 39.

Characteristics

1. Thin white diagonal lines in weak picture.
2. Sound is muffled.

Cause	Remedy
Improper voltages are supplied by the low voltage power supply to the video amplifier section.	Test voltages in the video amplifier circuit with a Polymeter, using manufacturer's schematic for reference. Replace defective components.
Defective amplifier tube (6AQ5) (V9).	Test video amplifier tubes with tube tester. Replace defective tube.

WEAK PICTURE—WEAK SOUND

Characteristics

1. Picture is hazy, indistinct and cloudy.
2. Sound is ruffled and weak.

Cause	Remedy
Improper voltages are being supplied by the low voltage power supply to the AGC circuit.	Check voltages in the AGC Circuit with a Polymeter, referring to the schematic supplied by the manufacturer of the set. Replace defective components.
Resistor may have changed in value in the AGC section (R102, R103, R114, R120, R121).	Check with ohmmeter for resistance values, referring to proper values as shown on schematic supplied by manufacturer.

See also pages 42, 51, 53.

NO PICTURE—NO SOUND

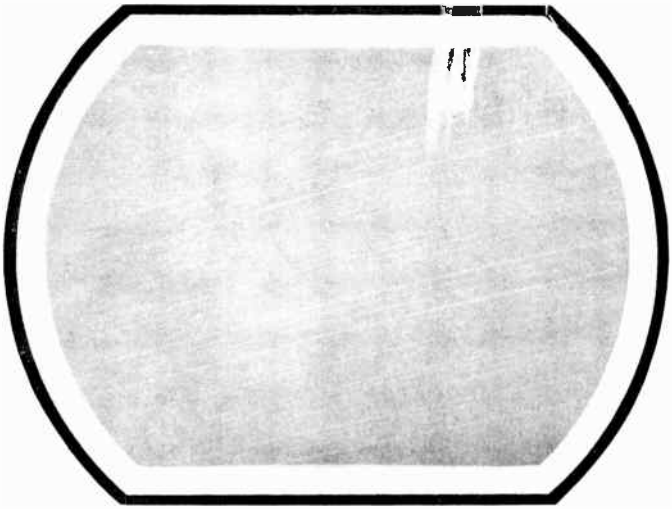


Figure 40.

Characteristics

1. A raster is present.

Cause	Remedy
Improper voltages are being supplied by the low voltage power supply in the video section.	Check voltages with Polymeter in the video circuit, referring to the schematic supplied by the manufacturer.
Shorted condensers in the video if section (C111, C124, C128, C146).	Check with ohmmeter, the video if circuit for a shorted condenser. Replace defective part.
Open resistor in video if circuit (R107, R122, R146, R147).	Check with ohmmeter in the video if circuit for resistance values referring to manufacturer's drawings. Replace defective resistor.

NO PICTURE—NO SOUND

Cause	Remedy
Defective transformer in video if section (T51, T52, T56, T57).	Check with ohmmeter, the video if circuit for continuity or short, replace defective components.
Defective tube in video if section (6BA6, 6AU6, 6AQ5, 6AL5) (V4, V5, V6, V7, V8).	Test tubes in video if section with tube tester, replacing defective tubes.

Characteristics

1. Raster is present.
2. There is no signal.

Cause	Remedy
Improper voltages being supplied by low voltage power supply to the video amplifier section.	Test voltages in this section with a Polymeter, using schematics supplied by manufacturer of set for reference.
Open resistor in the video amplifier section (R184, R169, R170).	Check with ohmmeter in video amplifier section for resistance values, referring to manufacturer's drawings. Replace defective resistors.
Defective video amplifier tube (6AQ5) (V9).	Test tubes in video amplifier section with tube tester. Replace defective tubes.

Characteristics

1. A raster is present.
2. Applicable only with intercarrier systems.

Cause	Remedy
Open resistor in the Automatic Gain Control section (R102, R121).	Check resistance values in the AGC circuit referring to the schematic supplied by the manufacturer of the set, with an ohmmeter.

See also pages 41, 49, 75.

NO PICTURE—NORMAL SOUND

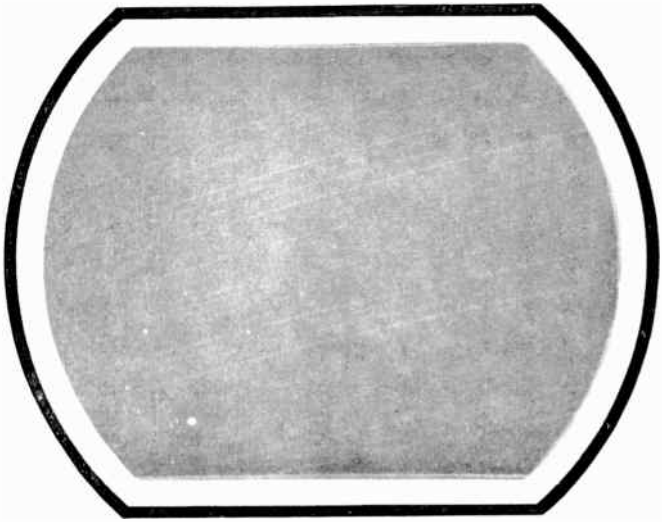


Figure 41.

Characteristics

1. A blank screen—no raster.

Cause	Remedy
Open coil in video amplifier section (L65).	Check video amplifier section with ohmmeter for continuity or a break. Replace defective components.
Open resistor in video amplifier section (R188).	Check with ohmmeter the resistances in the video amplifier section, referring to manufacturer's drawing, for values. Replace defective resistors.
Defective picture tube.	Check the effectiveness of the picture tube by the substitution method.

See also pages 18, 72, 86.

SOUND IF SECTION

The sound portion of the signal, after it is separated from the video section is transmitted to the sound if amplifier, the first stage of the sound channel. Then it is amplified and passed on to the frequency detector.

The detector os discriminator circuit converts the FM signal to the usable audio signal and transmits it to another amplifier and finally, to the speaker.

Trouble in the sound section may not necessarily affect the video circuits of the receiver.

Defects in the sound system are generally remedied by using standard FM servicing procedures.

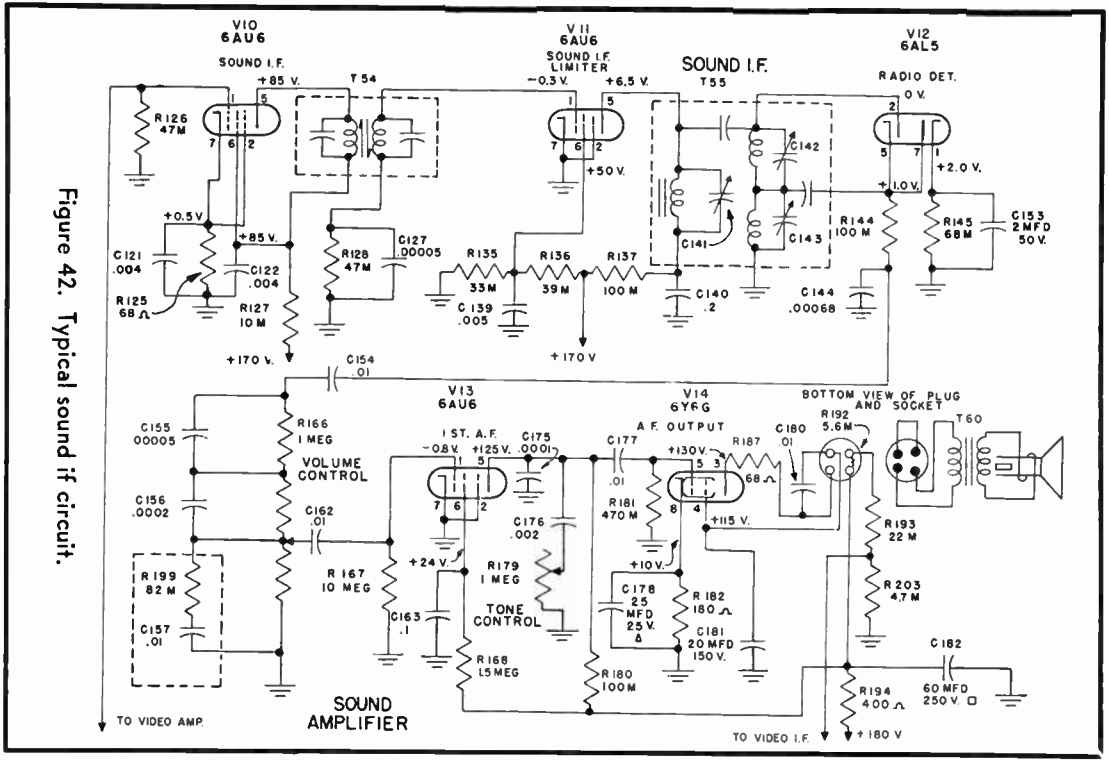


Figure 42. Typical sound if circuit.

NO SOUND

Characteristics

1. Normal picture.

Cause	Remedy
Improper voltages being supplied by the low voltage power supply to the sound if section.	Check voltages supplied to the sound if section with a Polymeter, referring to the drawings supplied by manufacturer of set. Replace defective components.
Defective sound if transformer (L63, T54, T55).	Check with an ohmmeter for the continuity of the transformer, or for a short, and replace if defective.
Shorted condenser in the sound if section (C173, C122, C140).	Check condensers with an ohmmeter in the sound if section for a short. Replace defective condenser.
Defective sound if tube (6AU6, 6AL5) (V10, V11, V12).	Check tubes in the sound if section with tube tester. Replace defective tube.
Improper voltages supplied by low voltages power supply to the sound amplifier section.	Test with Polymeter for improper voltages in the sound amplifier circuit, referring to the schematic supplied by the manufacturer for the correct values.
Volume control defective (R166).	Check with ohmmeter and replace if necessary (for resistance).
Shorted condenser in the sound amplifier section (C163, C175, C181, C180, C182).	Check with ohmmeter for a short in the sound amplifier circuit. Replace defective components.

NO SOUND—Continued

Cause	Remedy
Open or shorted output transformer (T60).	Check with ohmmeter for continuity or short. Replace defective components.
Defective tube in the sound amplifier section (6AU6, 6Y6G) (V13, V14).	Check tubes in sound amplifier circuit with tube tester. Replace tubes if necessary.

WEAK SOUND

Cause	Remedy
Open condenser in the sound amplifier section (C154, C162, C177).	Test condensers in sound amplifier section for a short with a capacity meter or by substitution method.
Improper voltages supplied by low voltage power supply to the sound amplifier section.	Check circuit with Polymeter referring to schematic supplied by manufacturer for correct values.
A resistor changed value in the sound amplifier section (R167, R168, R180, R181, R182, R193, R203).	Check with ohmmeter for resistances in the circuit (sound amplifier), referring to the manufacturer's drawing for values.
Defective tube in the sound amplifier section (6AU6, 6Y6G) (V13, V14).	Test tubes in sound amplifier circuit with tube tester. Replace defective tubes.

Cause	Remedy
Sound if section improperly aligned.	Check alignment of the sound if circuit, referring to suggested procedure by manufacturer.

WEAK SOUND—Continued

Cause	Remedy
Defective tube in sound if section (6AU6, 6AL5) (V10, VII, V12).	Check tubes in sound if circuit with tube tester. Replace defective tubes.

DISTORTED SOUND

Cause	Remedy
Defective discriminator transformer in sound if section (T55).	Check with ohmmeter for continuity or short in transformer (T55).
Improper alignment of discriminator transformer (T55) in sound if section.	Check alignment, referring to alignment procedure suggested by manufacturer.
Defective tube in sound if section (6AL5) (V12).	Check with tube tester for defective tubes. Replace if necessary.

Cause	Remedy
Shorted condenser in the sound amplifier section (C177, C178, C154).	Test with ohmmeter for a short in the sound amplifier circuit. Replace defective component.
Improper voltages being supplied by the low voltage power supply to the sound amplifier section.	Check with Polymeter, referring to schematics supplied by the manufacturer for correct values.
Defective tube in the sound amplifier section (6AU6, 6Y6G) (V13, V14).	Check tubes in sound amplifier circuit with tube tester. Replace defective tubes.

POWER SUPPLY
LOW VOLTAGE AND HIGH VOLTAGE

A large range of voltages are necessary to power the various sections of a television receiver. These are provided by the power supply.

The video, audio and sweep circuits require low voltage (from 200-400 volts), and the picture tube requires extremely high voltage (10-12000 volts). These power supplies are usually maintained as two separate and distinct units.

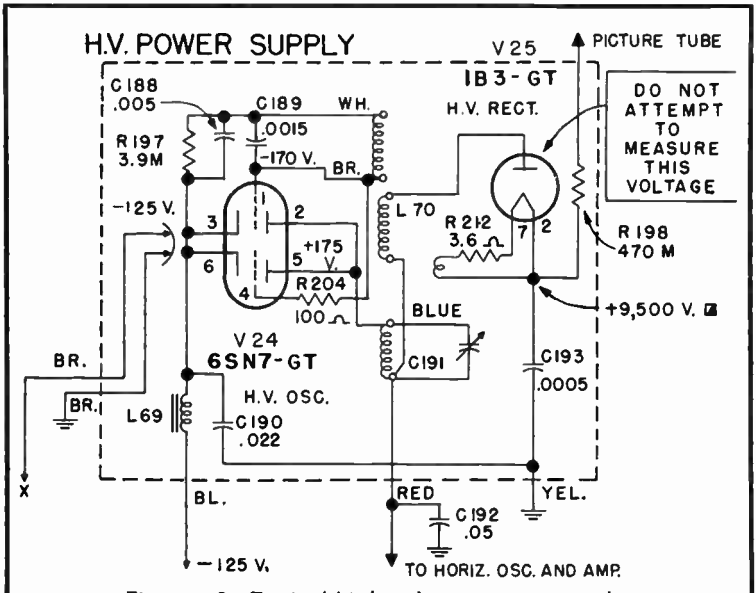


Figure 43. Typical high voltage power supply.

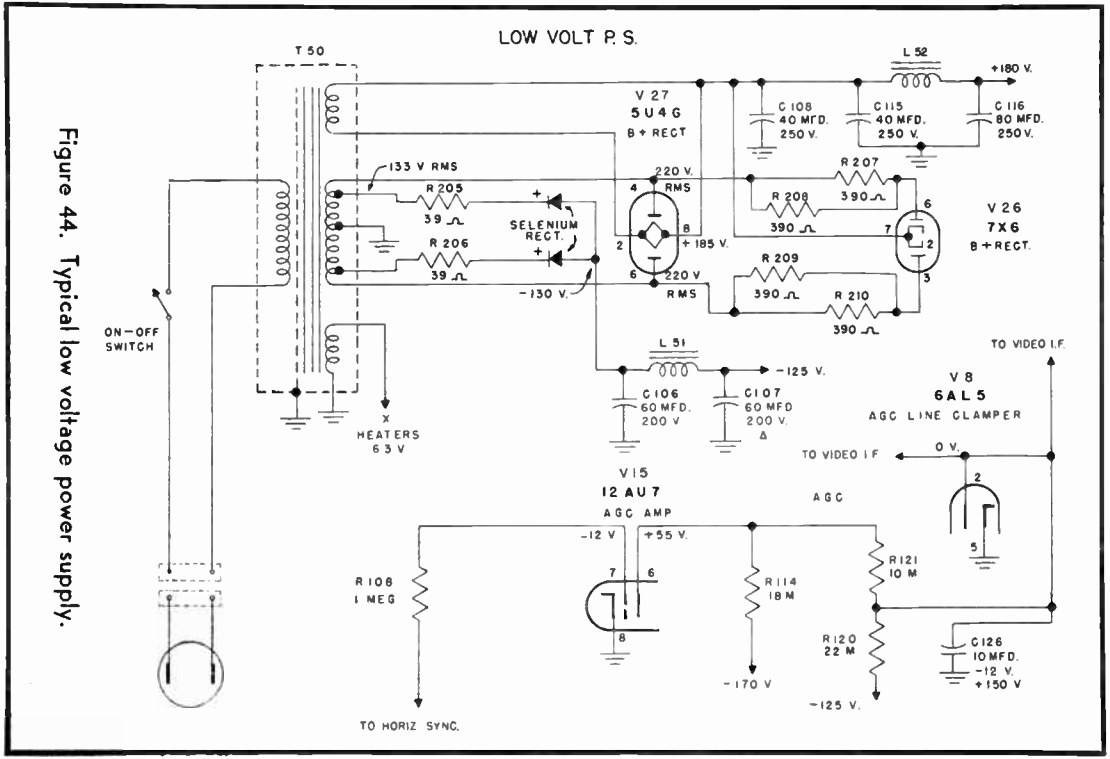


Figure 44. Typical low voltage power supply.

NO RASTER

Characteristics

1. No high voltage.
2. Blank screen.

Cause	Remedy
Defective high voltage oscillator coil (L70) in high voltage power supply section.	Disconnect coil and check circuit with ohmmeter for continuity or break in windings. Replace if defective.
Open, shorted or leaky condenser (C188, C189, C190, C191, C192, C193) in high voltage power supply section.	Check condensers with ohmmeter for short, or by substitution method. Replace defective components.
Improper value resistor (R197, R204, R198, R212) in high voltage power supply section.	Check resistances in circuit with ohmmeter, referring to manufacturer's drawings. Replace defective component.
Open coils (L69, L71).	Check with ohmmeter for short. Replace defective component.
Defective tube in high voltage power supply section (V25, V24).	Check tubes in section with tube tester. Replace defective tubes.

Characteristics

1. No raster.
2. No bias voltage.

Cause	Remedy
Defective selenium rectifiers in low voltage power supply section.	Check with ohmmeter for short or break in circuit and replace defective components.

NO RASTER—Continued

Cause	Remedy
Shorted filter condensers (C106, C107) in low voltage power supply section.	Check low voltage power supply circuit with ohmmeter for a short or break. Replace defective components.
Short in set.	Check all lines connecting low voltage power supply circuit with ohmmeter, referring to manufacturer's schematic and replace defective component.
Defective power transformer (T50) in low voltage power supply circuit.	Check with ohmmeter for continuity or short.

Characteristics

1. No raster.
2. No B+ voltage.

Cause	Remedy
Shorted filter condenser (C108, C115, C116) in low voltage power supply section.	Check condensers in section with ohmmeter for short. Replace defective component.
Short in set.	Check circuit with ohmmeter, referring to manufacturer's schematic. Replace defective components.
Defective power transformer (T50) in low voltage power supply section.	Check with ohmmeter for continuity of winding or for a short. Replace defective component.
Defective rectifier tube (7X6, 5U4) (V26, V27) in low voltage power supply section.	Check tubes in low voltage power supply section with tube tester. Replace defective tubes.

NO RASTER—Continued

NOTE: Power supply is composed of two (2) (B+ and B) sources.

Characteristics

1. No raster.
2. Low B+ voltage.

Cause	Remedy
Shorted filter condenser (C108, C115, C116) in low voltage power supply section.	Check with ohmmeter for short in low voltage power supply section. Replace defective components.
Short in set.	Check all circuit lines connecting to this section, with ohmmeter for short, referring to manufacturer's schematic.
Defective power transformer (T50) in low voltage power supply section.	Check with ohmmeter for continuity or short in transformer (T50). Replace if defective.
Defective rectifies tube (5U4, 7X6) (V26, V27) in low voltage power supply section.	Check tubes in low power supply section with tube tester. Replace defective tube.

See also pages 18, 64, 86.

NO PICTURE

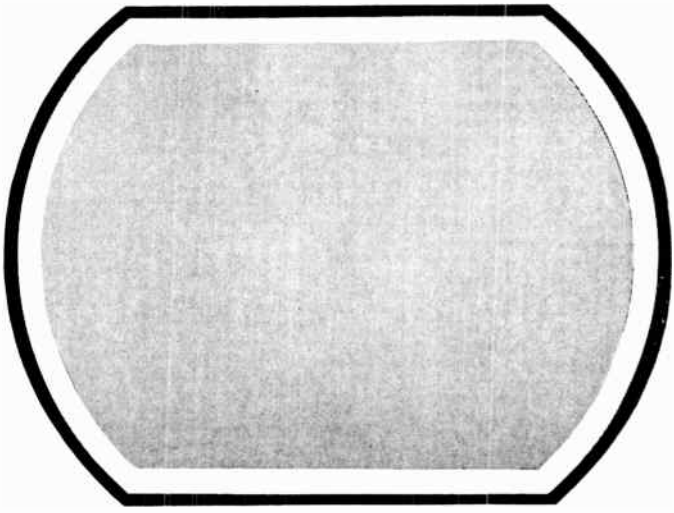


Figure 45.

Characteristics

1. Raster present.

Cause	Remedy
Defective rectifiers in low voltage power supply section.	Check rectifiers with ohmmeter for short or open circuit. Replace defective part.
Shorted filter condensers. (C106, C107).	Check with ohmmeter for a short in low voltage power supply section. Replace defective component.
Short in set.	Check circuit with ohmmeter, referring to manufacturer's schematic. Replace defective component.

See also pages 41, 49, 62.

NO PICTURE—Continued

Cause	Remedy
Defective power transformer (T50).	Check with ohmmeter for a break in continuity or a short in the power transformer (T50). Replace if necessary.

BLOOMING PICTURE

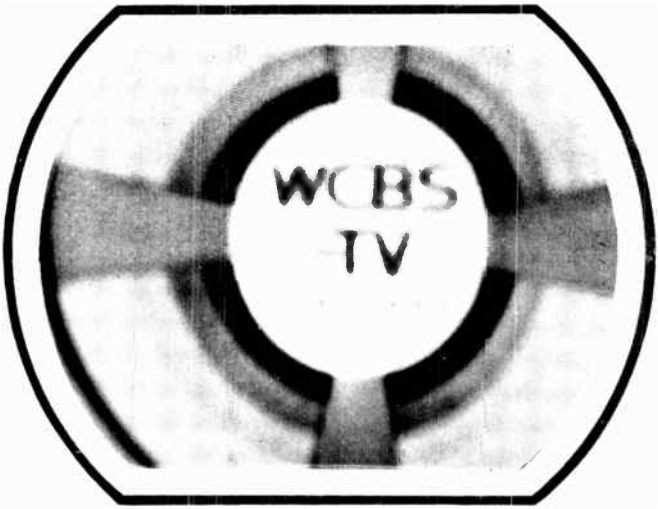


Figure 46.

Characteristics

1. Picture grows very large and loses focus while set is in operation.

Cause	Remedy
Changed value of resistor (R198) in high voltage power supply section.	Check for correct values of resistors as per manufacturer's drawings. Replace defective components.
Defective high voltage rectifier tube (1B3GT) (V25), in high voltage power supply section.	Check high voltage rectifier tube (V25) with tube tester. Replace if defective.

See also pages 79, 87.

FINE LINES THROUGH PICTURE (DIAGONALLY)

Figure 47.

Characteristics

1. Fine lines run through picture horizontally, moving diagonally, up and down.

Cause	Remedy
Shorted resistor (R198) in high voltage power supply section.	Check resistances with ohmmeter referring to manufacturer's drawings for correct values. Replace defective resistors.
The protective cover of the high voltage compartment is off.	Replace cover of the high voltage compartment.

VERY LARGE PICTURE

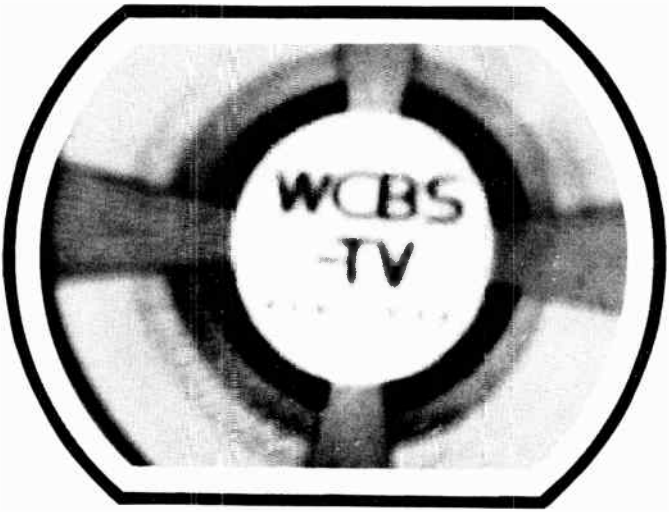


Figure 48.

Characteristics

1. Picture too large and cannot be focussed.

Cause	Remedy
Dc output voltage of high voltage power supply section is too low.	Adjust trimmer condenser (C191) while measuring while measuring with Polymeter. **CAUTION: Use Polymeter *with high voltage probe*, or equal.**

See also pages 77, 87.

SMALL PICTURE

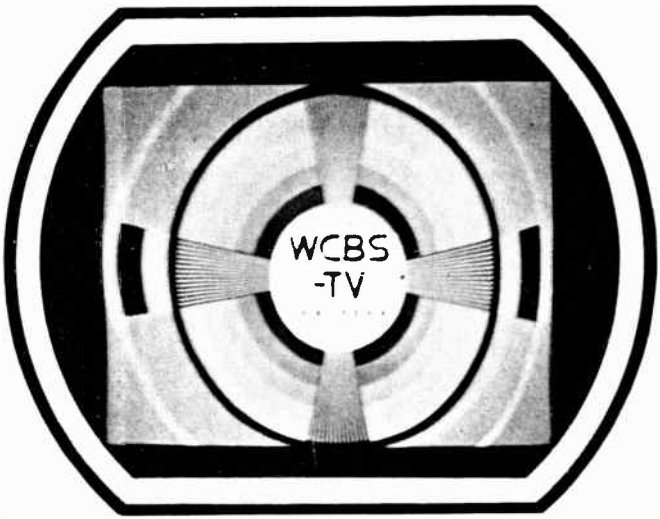


Figure 49.

Characteristics

1. Picture too small and cannot be focused.

Cause	Remedy
Dc output voltage of high voltage power supply section is too high.	Adjust trimmer condenser (C191) while measuring output with voltmeter. **CAUTION: Use Polymeter *with high voltage probe*, or equal.**

SEMI-BLACK OUT OF PICTURE

Figure 50.

Characteristics

1. Picture curved and distorted.
2. Top or bottom half of picture blacked out.

Cause	Remedy
Open filter condenser in low voltage power supply section (C108, C116, C115).	Check with capacity meter for proper capacity, referring to manufacturer's drawing, or by substitution method, in the low voltage power supply circuit. Replace defective components.

See also page 16.

CURVED AND DISTORTED PICTURE

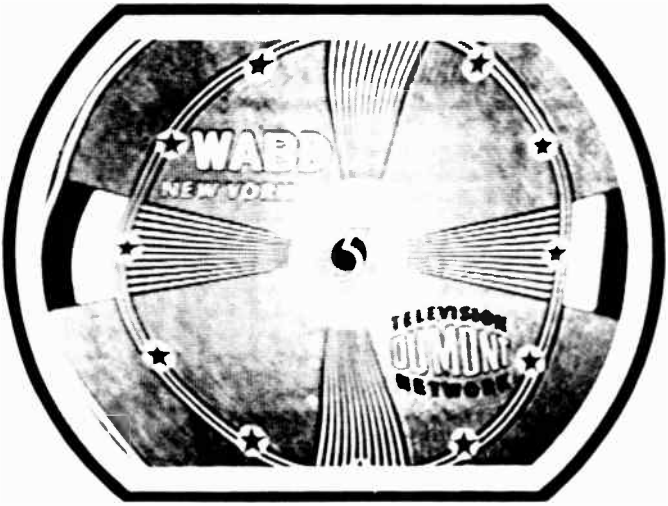


Figure 51.

Characteristics

1. Ripple in low voltage power supply.
2. Sides and face of picture out of focus.

Cause	Remedy
Open filter condenser (C106, C107) in low voltage power supply section.	Check with capacity meter, or by substitution method, the circuit of the low voltage power supply for a short. Replace defective component.

See also page 17.

DESCRIPTION OF PICTURE TUBE

The cathode ray tube, most commonly referred to as the picture tube, consists of a glass or metal envelope, an electron gun assembly and coated screen. Accessories for the picture tube include ion trap, focus coil and deflection yoke.

The video signals coming from the final amplifier in the video section are applied to the grid of the picture tube. These signals control an electron beam which is projected by the electron gun to the screen.

The horizontal and vertical motion of the electron beam is controlled by the sweep circuits.

Above is a representative group of Sylvania television picture tubes. Reading from left to right is the 7JP4, 10BP4, 12LP4, all glass tubes, 16AP4 glass and metal tube and 19AP4 glass and metal tube.

The 7JP4 is an electro-static type cathode ray tube. The others are electro-magnetic tubes. These use the ion trap which prevents screen burns.

DARK, DULL PICTURE

Figure 52.

Characteristics

1. Insufficient brightness.

Cause	Remedy
Ion trap not set properly.	Reset ion trap manually, refer to manufacturer's drawings.
Improper voltages being supplied by the high or low voltage power supply to the picture tube.	Test voltages with Polymeter, referring to manufacturer's drawings. **CAUTION: Use Polymeter *with high voltage probe*, or equal.**
Defective picture tube.	Check tube by substitution method. Replace if necessary.

NO PICTURE

Characteristics

1. No raster present.

Cause	Remedy
Ion trap not set properly.	Reset ion trap manually, according to manufacturer's drawings.
Improper voltages being supplied by either the high or low voltage power supply, to the picture tube.	Test voltages with Polymeter, referring to manufacturer's schematic for correct value. **CAUTION: Use Polymeter *with high voltage probe,* or equal.**
Defective picture tube.	Test tube by substitution method. Replace is necessary.

See also pages 18, 62, 72.

DULL AND INDISTINCT PICTURE

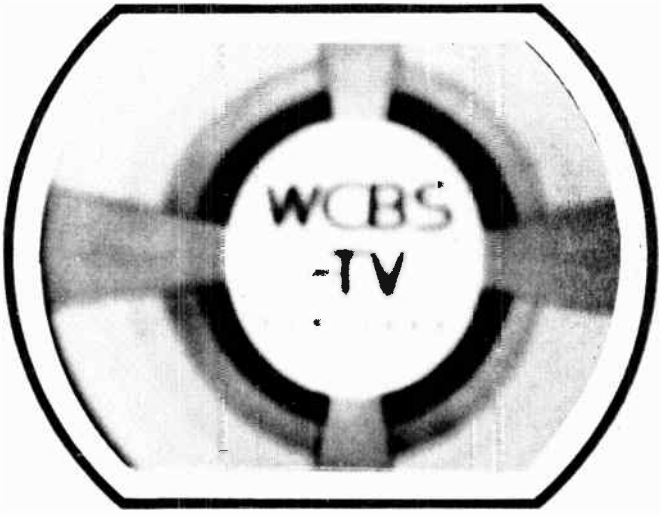


Figure 53.

Characteristics

1. Picture out of focus and appears indistinct.

Cause	Remedy
Focus control set improperly.	Reset focus magnet (coil) manually, according to instructions supplied by manufacturer.
Improper voltages being supplied by either the high or low voltage power supply to the picture tube.	Test voltages in picture tube circuit with Polymeter, referring to manufacturer's drawings for correct values. **CAUTION: Use Polymeter *with high voltage probe.***
Defective picture tube.	Check by substitution and replace if necessary.

See also pages 77, 79.

PICTURE TURNS NEGATIVE

Figure 54.

Characteristics

1. Picture normal with very low contrast setting.
2. Dark areas turn silvery when contrast is advanced.

Cause	Remedy
Defective picture tube.	Check picture tube by substitution method.

WHITE LINES RUNNING THROUGH GOOD PICTURE

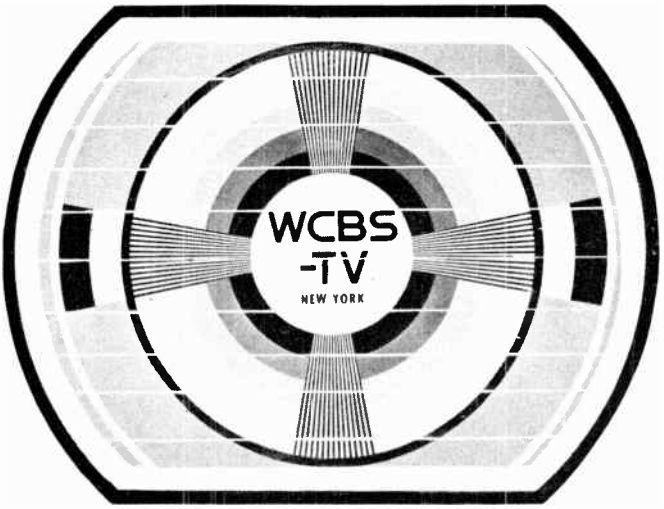


Figure 55.

Characteristics

1. Picture distinct.
2. No control over brightness.

Cause	Remedy
Improper voltages being supplied by low voltage power supply to picture tube section.	Test voltages in picture tube circuit with Polymeter. Refer to manufacturer's drawings. Replace defective components.
Defective picture tube.	Check picture tube by substitution method. Replace if necessary.

ALIGNMENT OF SET

In the alignment of a television set, a number of factors must be considered. The test equipment used should be suitable for this type of work. The oscilloscope should have good low frequency response. The Vacuum Tube Voltmeter used should be either a Sylvania Polymeter or equal. All pertinent data relating to the set to be aligned should be available for reference and the manufacturer's alignment procedure must be followed closely. At the present time, there are two types of alignment procedures in use for the alignment of television receivers; first, "peaking" alignment often used for stagger tuned circuits and second, "sweep" alignment usually required for the band pass type of circuit.

In aligning a stagger tuned circuit, the procedure is fairly simple. A test oscillator is attached to the mixer stage of the set and a Polymeter is attached to the video output of the set. Signals are fed into the set and the individual tuned circuits are adjusted for maximum or minimum output, according to the alignment instructions.

In aligning a band pass circuit, the output of a sweep generator is fed into each stage, an oscilloscope is attached to the video output and the circuit is swept to produce the resultant wave form which is displayed on the oscilloscope. The individual wave forms must conform closely with those shown by the alignment procedure.

The alignment procedure in each case should be carried out in strict adherence to the manufacturer's suggested method. Figures 56a through 56h represents alignment curve responses obtained on the Sylvania Model 075 receiver. The alignment procedure is outlined below. This procedure, while similar with most television sets is not "the standard."

ALIGNMENT RESPONSE CURVES.

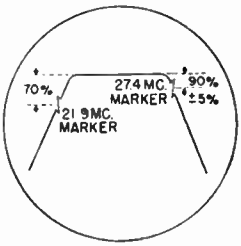


Figure 56a

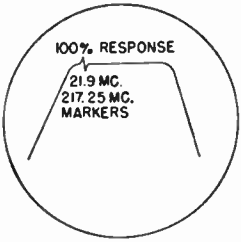


Figure 56e

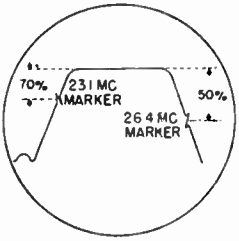


Figure 56b

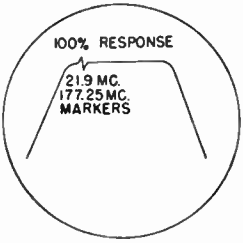


Figure 56f

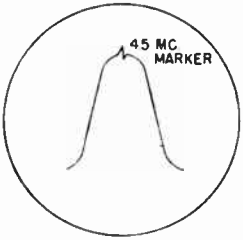


Figure 56c

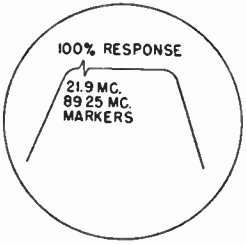


Figure 56g

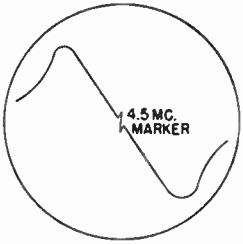


Figure 56d

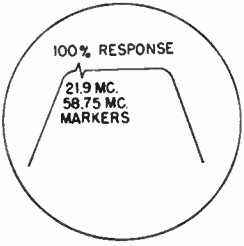


Figure 56h

TELEVISION SET ALIGNMENT

It is wise to check the manufacturer's instructions on any particular set.

In the video if alignment, tune the sweep generator to 24 Mc. with a 10 Mc. sweep and adjust slugs on the video if transformer (T57) for a symmetrical response curve as shown in Figure 56a.

In the video if stage, tune the sweep generator to 24 Mc. with a 10 Mc. sweep and view response curve of the video if transformer on the oscilloscope. See Figure 56b for the desired overall response curve. The video carrier (26.4 Mc.) should be at 50% response, as shown in Figure 56b. Readjust (T56) slightly to obtain this result, if necessary. The band width may be checked by varying the frequency of the marker signal from the high side of the curve until it indicates a 70% response on the opposite side of the curve. The difference between this frequency and 26.4 should be approximately 3.3 Mc. Readjust (T52) to obtain this band width, if necessary slight readjustment of slugs on tuner output transformer (L10) and video if transformer (T51) may be necessary to obtain the symmetrical characteristics as shown in Figure 56b.

To obtain the 4.5 Mc. trap and sound interstage alignment, tune the sweep generator to 4.5 Mc. with a 500 Kc. sweep and tune slugs on sound if transformer (T54) for response in Figure 56c.

Reduce the generator sweep in the sound discriminator alignment to 300 Kc. and adjust the discriminator trimmers (C141, C142 and C143) so that (1) the 4.5 Mc. marker is exactly in the center of the curve, (2) the curve is linear between 4.55 Mc. and 4.45 Mc. and (3) the amplitude is the greatest obtainable. See Figure 56d for the desired response.

Adjust oscillator trimmer (C22) in the RF tuner align-

ment so that 21.9 Mc. marker and 217.25 Mc. marker coincide at 100% response on the over-coupled response curve shown in Figure 56e.

With an insulated pick, adjust the high band oscillator coil (L8) in the RF tuner alignment, so that 21.9 Mc. marker and 177.25 Mc. marker coincide at 100% on the over-coupled response curve shown in Figure 56f. Spreading apart the coils will increase the oscillator frequency. Making them smaller will lower the frequency.

Adjust the low band oscillator coil (L9), with an insulated pick, so that 21.9 Mc. and 89.25 Mc. markers coincide at 100% response on the over-coupled response curve shown in Figure 56g.

Check the co-incidence of 21.9 Mc. and 58.75 Mc. markers at 100% response on the over-coupled response curve shown in Figure 56h of the low band oscillator. If they are not within $\pm$ 1/2 Mc., the error must be split between the low band and the high band so that channel 6 and 13 are not more than minus 0 plus 1/4 Mc. and channels 2 and 7 are not more than $\pm$ 1/2 Mc.

WAVEFORM NOTES

The waveforms shown on the following pages were obtained from a Sylvania Model 075 television receiver. The waveforms obtained will depend in each case upon the receiver under test and to some extent upon the band width characteristic of the oscilloscope used.

For other television receivers corresponding waveforms may he obtained at similar locations in the circuit as indicated in the manufacturer's service notes.

The term "60 cycle sine wave" refers to the type of oscilloscope horizontal sweep employed.

All waveforms are taken with the oscilloscope horizontal sweep direction from left to right and with upward deflection corresponding to positive polarity.

In some instances, the waveforms obtained will not be identical with those shown due to the electrical characteristics of the oscilloscope used.

All waveforms are measured with respect to chassis unless otherwise specified.

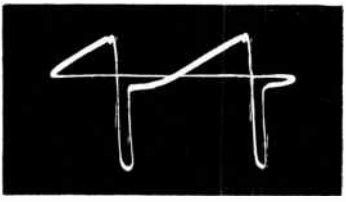


Fig. 57 6AL5 (V19) Horizontal Discriminator Plate (Pin 7) 55 volts P/P (Horizontal)

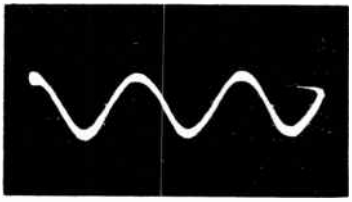


Fig. 58 Plate to Plate (Pin 7 to Pin 2) (Ground side of Oscilloscope input circuit connected to Pin 7) 12 volts P/P (Horizontal)

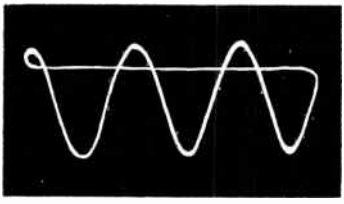


Fig. 59 6AU6 (V20) Horizontal Control Plate (Pin 5) 40 volts P/P (Horizontal)

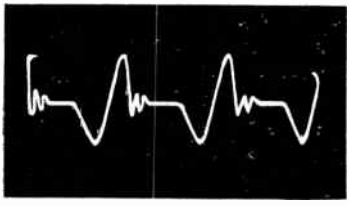


Fig. 60 12AU7 (V21) Horizontal Oscillator Section Plate (Pin 1) 40 volts P/P (Horizontal)

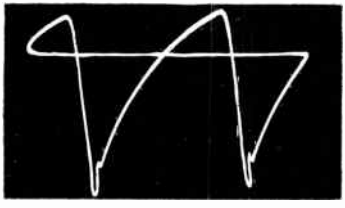


Fig. 61 12AU7 (V21) Horizontal Discharge Section Plate (Pin 6) 85 volts P/P (Horizontal)

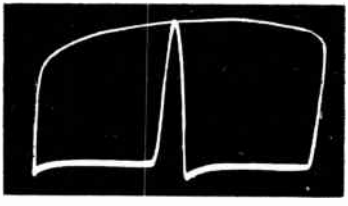


Fig. 62 6BD5GT (V22) Horizontal Output Plate (Pin 5) 1650 volts P/P (Horizontal)

Fig. 63 12AU7 (V15) Vertical Oscillator Section Plate (Pin 1) 135 volts P/P (Vertical)

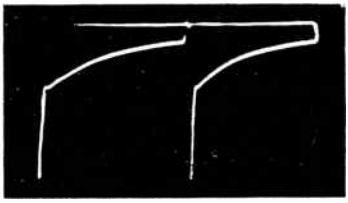


Fig. 64 12AU7 (V15) Vertical Oscillator Section Control Grid (Pin 2) 240 volts P/P Vertical

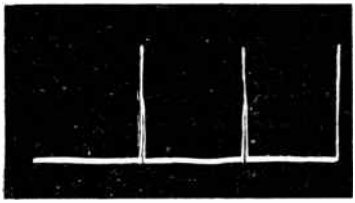


Fig. 65 12AU7 (V17) Vertical Sync Clipper Plate (Pin 1) 130 volts P/P (Vertical)

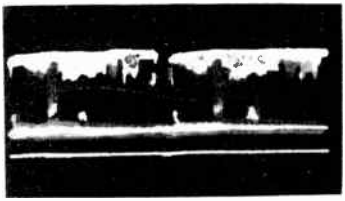


Fig. 66 6AQ5 (V9) video Amplifier Plate (Pin 5) 77 volts P/P (Vertical) Contrast control maximum, brightness control minimum 17 volts P/P (Vertical) Contrast control minimum, brightness control minimum

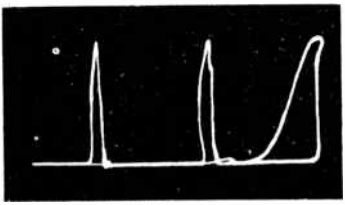


Fig. 67 12AU7 (V17) Horizontal Sync Clipper Plate (Pin 6) 80 volts P/P Horizontal

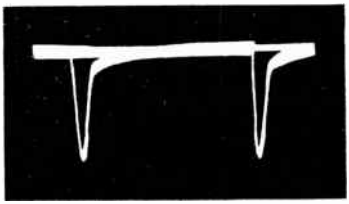


Fig. 68 12AX7 (V16) Horizontal Sync Separator Plate (Pin 6) 13 volts P/P (Horizontal)

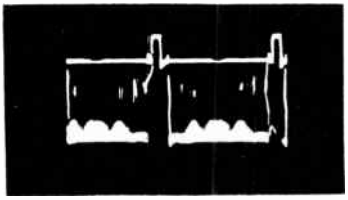


Fig. 69 6AQ5 (V9) Video Amplifier Plate (Pin 5) 77 volts P/P (Horizontal) Contrast control maximum, brightness control minimum 17 volts P/P Contrast control minimum, brightness control maximum

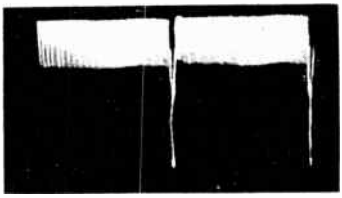


Fig. A 12AX7 (V16) Vertical Sync Separator Plate (Pin 1) 85 volts P/P (Vertical)

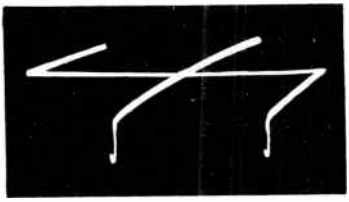


Fig. X 6AQ5 (V18) Vertical Output Control Grid (Pins 1 and 7) 65 volts P/P (Vertical)

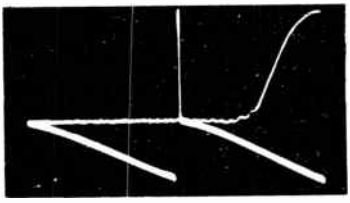


Fig. Y 6AQ5 (V18) Vertical Output Control Plate (Pin 5) 560 volts P/P (Vertical)

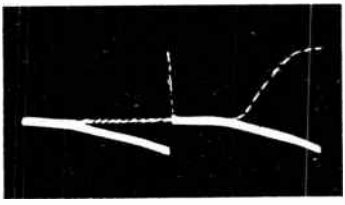


Fig. Z Vertical Yoke Coils Test point 1, see (schematic diagram) 56 volts P/P (Vertical)

ADJUSTMENT OF ION TRAP MAGNET

Of major importance in the installation of a television set is the proper adjustment of the ion trap magnet on the neck of the picture tube. Improper positioning of the magnet may result in circular areas of discoloration developing on the face of the bulb, thus injuring the picture screen, even though the ions developed in the cathode section of the tube have been properly "trapped". When the magnet is not in the correct position, the electron beam, instead of going through the aperture in the anode top disk, bombards the edge of the hole. The heat thus produced vaporizes the metal of the disk (as shown in the illustration) releasing gases which have a harmful effect on the operation of the tube. Some of this vaporized metal may be deposited on the screen of the tube causing darkened areas.

To insure long life and satisfactory operation of the picture tube, the ion trap magnet should be adjusted immediately when the tube is installed in the set and, as a precaution, should be checked when the set is moved to a new

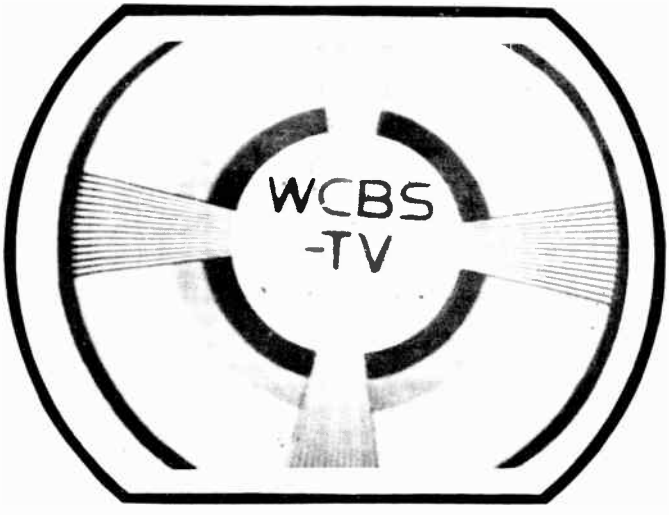


Figure 70. Improper focus.

location. If a permanent magnet type is used, the magnet should be placed on the neck of the tube in the direction indicated by the marking on the magnet (usually an arrow which points toward the picture screen), so that the stronger magnet of the double magnet type is at the base end of the tube. This stronger magnet in the case of the double magnet type (or the only magnet in the case of the single magnet type) should be positioned over the internal pole pieces which are mounted on the gun structure. With the tube operating and with the brightness control adjusted for low intensity, the magnet should be moved a short distance forward and backward, at the same time rotating it to obtain the brightest raster. If, in obtaining the brightest raster, the ion trap magnet has to be moved more than ¼ inch from the internal pole pieces or if it is pushed against the focus coil, the magnet is probably weak and a new magnet should be tried. As a final check, the ion trap magnet should again be adjusted for maximum raster brilliance, this time with the

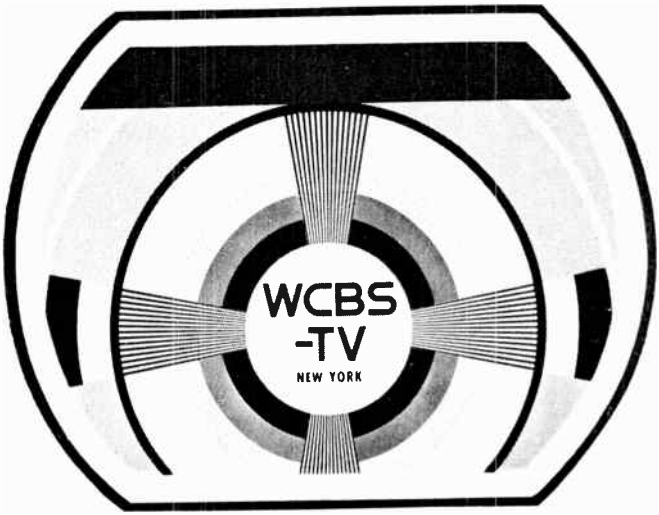


Figure 71. Improper vertical centering.

ADJUSTMENT OF ION TRAP MAGNET

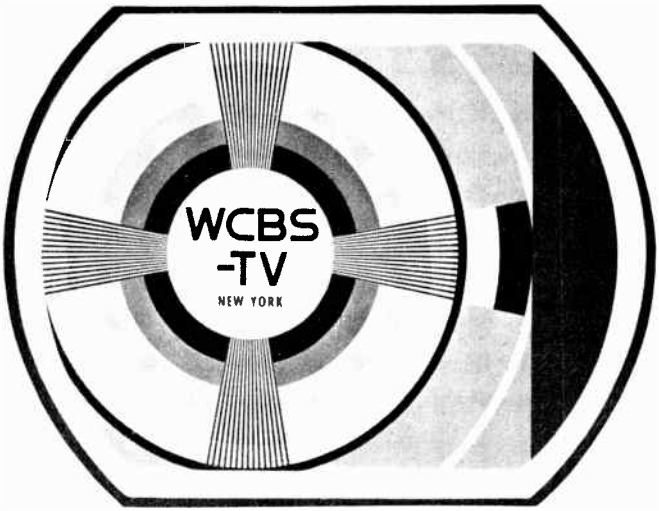


Figure 72. Improper horizontal centering.

brightness control set to obtain a raster of slightly above average brilliance and with the focus adjusted for a clear line structure to simulate actual operating conditions with a picture.

Never move the ion trap magnet to remove a shadow from the raster if by so doing the intensity of the raster is decreased. In such a case the shadow should have been eliminated by moving the focus or deflecting coils. The ion trap magnet should always be in the position to give maximum raster brilliance. Fig. 71 shows ion trap not focused. If the electromagnetic type ion trap magnet is used, it should be placed on the neck of the tube with the larger magnet over the internal pole pieces and nearest the base, and adjustment for brightest raster is obtained by rotating the magnet and adjusting the current through it. The effect of current variation is the same as longitudinal movement of the permanent magnet type. The longitudinal position of the permanent magnet type or the current applied to the electromagnetic type is dependent upon the voltage applied to the tube and

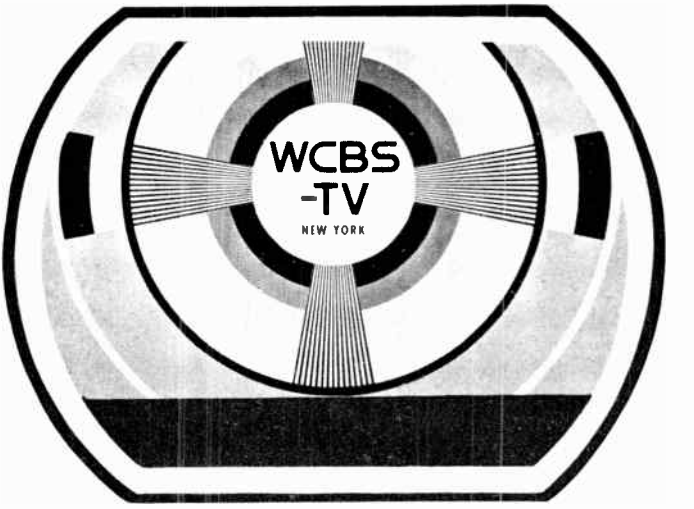


Figure 73. Improper vertical centering.

may vary for the same type of tube from one receiver to another.

(CAUTION: If a raster is not obtained in a few seconds using the above procedure, turn the set off and check to make sure that the ion trap magnet is positioned according to the manufacturer's instructions or markings. If the desired results cannot be obtained, it is suggested that a new magnet be tried.)

If the picture tube has just been installed or the set has been moved, it is imperative that the brightness control be kept low until after the initial adjustment of the magnet and also that adjustment of the magnet be made immediately when the set is turned on. It is important that the intensity of the beam be low when the set starts operating, if the magnet has not yet been adjusted, because tubes have been ruined in 15 seconds of operation due to the ion trap magnet being out of adjustment and the intensity being set too high. By keeping the intensity low, the beam current is low enough so that the electron beam is not likely to damage

the anode top disk before the magnet is adjusted. The amount of damage that is done to the tube is a function also of the voltage applied to the tube; therefore, tube types which operate at high voltages may be ruined more easily than those operated at lower voltages.

In order to assure that the magnet will stay in place after it has been adjusted care should be taken that the magnet fits the neck of the tube securely. If it is at all loose, a small piece of rubber placed under the clamps or a piece of friction tape wound around the clamps should prevent the magnet from slipping.

The procedure for aligning the ion trap magnet should not be omitted just because the set seems to be operating satisfactorily—it is not always safe to assume that the magnet is still in adjustment if the set has been transported. Even with the magnet poorly aligned a good picture can be obtained but within a short time circular darkened areas will appear on the screen.

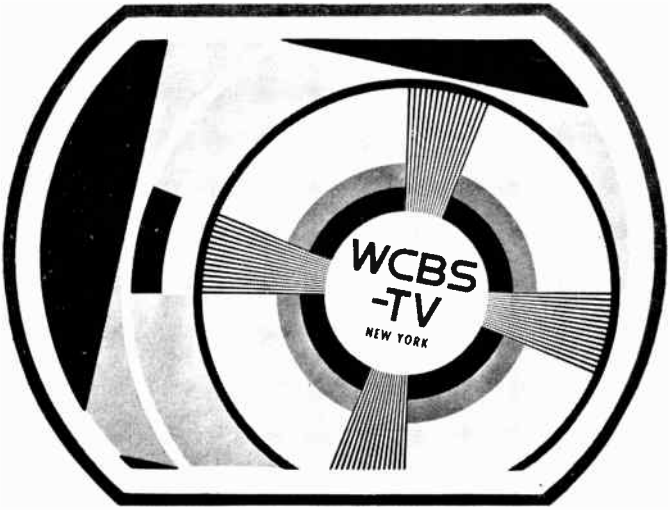


Figure 74. Deflection yoke not set properly and improper vertical or horizontal centering.

DEFLECTION YOKE ADJUSTMENT

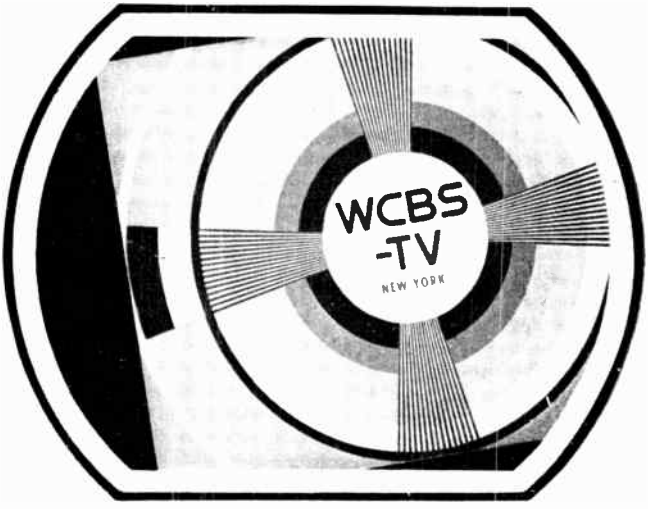


Figure 75. Deflection yoke not set properly and improper vertical or horizontal centering.

The deflection yoke must be positioned against the flare of the picture tube. To do this, loosen the adjustment and push the yoke as far forward as possible. If the picture is not square in the mask (Fig. 74-Fig. 79), rotate the yoke. Raise or lower the yoke, so that the neck of the picture tube will rest parallel with the chassis. Also see Fig. 78 and Fig. 79 for improper yoke adjustments, together with improper vertical or horizontal centering.

SUGGESTIONS FOR HANDLING CATHODE RAY TUBES

To prevent injury from picture tube breakage:

(1) While handling picture tubes it is recommended that safety goggles and gloves be worn for protection in case a tube should implode.

(2) The proper method of removing 5" or larger tubes from the carton is as follows: Lift the tube by the sides, face upward. When inserting horizontally into a socket, grip the neck for guidance only, support most of the weight at the big end.

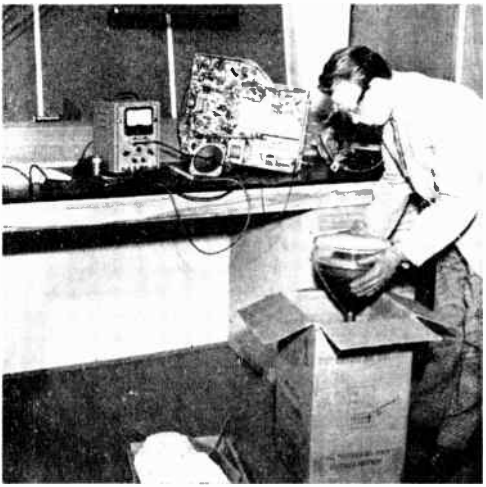


Figure 76. Safe method for unpacking cathode ray tubes.

(3) When not installed, keep any tubes in the shipping cartons with the covers closed. They may easily roll off a table and, when exposed, the glass may get scratched causing a break then or later. For the same reason never place tubes face downward unless on a surface protected by felt or similar material.

(4) If a tube does break and you get a small cut, wash it carefully to be sure all dirt and small particles are removed. While the materials used for coating Sylvania picture tubes are not considered poisonous, one should bear in mind the possibility of an unusual personal sensitivity or allergy.

(5) If you wish to use a display of picture tubes in your window, worn-out tubes may be made relatively safe as follows:

a. Place the tube in the carton, base up, with enough soft packing material under the face to let the base protrude above the folded-in flaps.

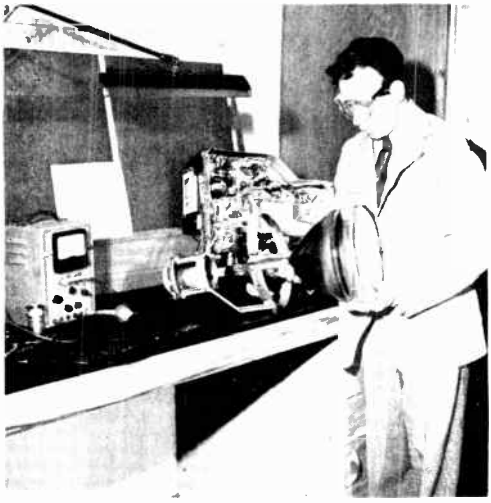


Figure 77. Safe way to insert tube in set.
Note goggles and gloves.

b. Drill a hole about $\frac{1}{4}$" diameter in the end of the locating lug. If desired, the whole lug may be broken off with a sharp blow.

c. With a metal rod like a nail set or small file, break the exhaust tip allowing air to enter. If only the point is broken off and the air is allowed to enter slowly, the

inrush of air which would blow off the screen coating will be avoided. In tubes using a metal exhaust tip, a small three-cornered file will make the small hole required. The bright getter deposit on the neck should change color almost immediately, but to be sure the tube is safe, break the tip completely later on.

Tubes treated this way will be as safe to handle as a fish bowl or other glassware of equal weight. It cannot implode but still should be handled as described in (2).

(6) Use discretion in the breaking up or disposal of picture tubes. Even when put out for the rubbish collector be sure they are broken to avoid their coming into the posses-

Figure 78. Proper method for making worn out picture tube safe for handling.

sion of children, or for that matter, curious adults who may suffer injuries in case of breakage. Keep in mind that you may incur a legal liability if you fail to eliminate the hazard by proper and complete disposal of worn out tubes.

(7) A quick easy method of disposal is to seal the tube

into the carton and then drive a heavy tool, such as a wrecking bar, through the side or bulb end of the case.

To avoid electrical shock:

(1) Do not bypass any safety interlock switches, and when working on equipment see that switches are in order. Your relatives may be sorry if one sticks.

(2) Check the condition of the insulation on the wire in the high voltage circuits. If necessary to change wiring, use insulation rated for the voltage supplied.

(3) Keep one hand in your pocket and be sure you are standing on dry wood, a rubber mat or linoleum when "looking" for trouble in a television circuit.

Figure 79. Proper method for taking high voltage measurements.

(4) Take the extra minute required to make changes the safe way.

(5) Discharge the high voltage condenser after turning the power off and before working on the circuit. The bleeder resistor may be open.

(6) Some large cathode ray tubes, Type 10BP4 for example, have both internal and external coatings on the bulb which form a condenser like the old Leyden Jars. If the tube is removed without discharging this condenser, even a slight unexpected shock from it might cause you to drop the tube.

(7) It is usual, to think of the cathode circuit as harmless (it is in radio) but that is not so in television. Keep the ground lead of the voltmeter on chassis ground and if necessary to read high negative voltages in sets in which the anode is ground, use the meter polarity reversing switch to avoid having the meter case above ground or requiring high voltage insulation for both leads.

TELEVISION FREQUENCY ALLOCATIONS

Channel No.	Megacycles	Channel No.	Megacycles
2	56-60	8	180-186
3	60-66	9	186-192
4	66-72	10	192-198
5	76-82	11	198-204
6	82-88	12	204-210
7	174-180	13	210-216

SYLVANIA TEST INSTRUMENTS

FOR

TELEVISION SERVICING

SYLVANIA TV-FM SWEEP SIGNAL GENERATOR

Type 500

A Compact Sweep Generator for Servicing Television and FM Receivers

The Sylvania TV-FM Sweep Signal Generator Type 500 furnishes both narrow sweep for FM servicing and wide sweep for Television servicing. Both sweeps are electronically controlled, thus eliminating failures inherent in mechanical type sweeps. The instrument provides excellent sweep linearity and consequent distortion-free scope patterns.

All output frequencies in the Sylvania TV Sweep Signal Generator are provided at fundamental. These range from 2 to 230 megacycles in four bands which utilize a push-pull variable frequency oscillator.

Continuous output control from 300 microvolts to the maximum of .1 volt is provided by the smooth attenuator. The voltage regulated power supply insures good frequency

stability. The instrument is double shielded to prevent unwanted signal leakage.

Wide range phasing control permits adequate adjustment for single oscilloscope response curves. Voltage for driving or synchronizing horizontal oscilloscope deflection is also provided.

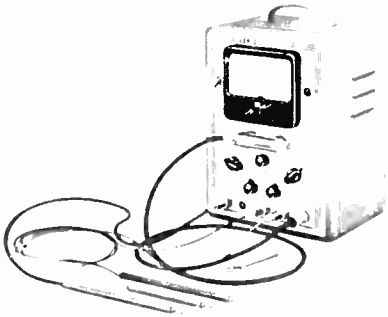
Cabinet for the Sylvania TV-FM Sweep Signal Generator is small and compact. The exterior is pearl-grey-crackle finish on treated mar-resistant steel. Panel is grey with baked-on-enamel green lettering.

The instrument is available through authorized Sylvania Distributors.

SYLVANIA POLYMETER

Type 221

A Unique Vacuum-Tube-Voltmeter for Wide Range Measurements for Voltage, Resistance and Current.



The Sylvania Polymeter Type 221 is a sensitive vacuum-tube-voltmeter designed for use by television and radio technicians. It is ideal for stage signal tracing and general television trouble shooting. This instrument has a useful frequency response from 20 cps to 500 Mc. Six full scale ranges are available for measurement of audio, ac and rf voltages from 20 cps to 300 Mc. with essentially flat frequency response. DC voltages can be measured from 0 to 30,000 volts in seven full scale ranges (30,000 v dc when the Sylvania High Voltage Probe Type 225 is used).

Direct current measurements can be made on seven full scale ranges from 0 ma. to 10 amps. Resistance is measured in six full scale ranges from 1000 ohms to 1000 megohms. The specially engineered Sylvania Subminiature Tube contained in the rf probe permits the exceptionally high frequency range of this instrument at a high input impedance and an unusually low input capacitance. The instrument is housed in an attractive cabinet which is finished in grey crackle. Stray field effects are eliminated through the use of shielded rf and ac test leads. Microphone type panel connectors on the test leads insure firm, long-life connections. The instrument is available through authorized Sylvania Distributors.

SYLVANIA TV OSCILLOSCOPE

Type 400

An Exceptionally High-Gain
Wide-Band Oscilloscope
Designed for
Television Servicing

The Sylvania Television Oscilloscope Type 400 accurately displays any television pulse, wave-shape or signal on a large 7 inch screen. It has excellent tilt, rise-time and over shoot characteristics.

The vertical sensitivity of this instrument is 0.01 volts (10 milli-volts) per inch. The vertical response is useful to 4.0 megacycles. Uniform frequency response is obtained through a three-position frquency compensated attenuator.

Other features of this oscilloscope include: vernier gain control, low internal hum level, dc heated input tube and an internal 60 cycle sine wave sweep which eliminates one set of leads during alignment operations. The instrument has a wide range and constant amplitude phasing control. The linear sweeps are from 10 cycles to 50 kc. and a control is provided for synchronizing either positive or negative signals.

Input impedance is 5 megohms and 26 uufd for negligible circuit loading is usable with any crystal probe, direct probe,

special probe or lead supplied. Other features are: cathode follower input circuit; switching for direct connection to deflection plates: panel connection for intensity (Z axis modulation), built-in calibrating voltage source also useful for Z-axis blanking.

Cathode ray tube supplied is the Sylvania 7JP1 (green). The Sylvania 7JP4 cathode ray tube can be substituted if a white screen is desired.

The instrument is available through authorized Sylvania Distributors.

ALPHABETICAL INDEX

ALPHABETICAL INDEX—Continued

ALPHABETICAL INDEX—Continued

ALL VOLTAGES MEASURE WITH A SYLVANIA POLYMETER TYPE 221 (VACUUM TUBE VOLTMETER) UNLESS OTHERWISE STATED. ANTENNA DISCONNECTED & NO SIGNAL INPUT. LINE POTENTIAL 117 VOLTS 60 CYCLES AC SUPPLY. BRIGHTNESS & CONTRAST CONTROLS AT MINIMUM UNLESS OTHERWISE STATED.

✳ CONTRAST CONTOL AT MAXIMUM

ϕ BRIGHTNESS CONTROL AT MAXIMUM

▽ HIGH PEAK VOLTAGE OF SHORT DURATION (APPROX. 2,000 V.) MAY DAMAGE METER USED FOR THIS MEASUREMENT

USE HIGH VOLTAGE MULTIPLIER PROBE WITH SYLVANIA POLYMETER FOR ALL HIGH VOLTAGE MEASUREMENTS.

V10 6AU6 SOUND I.F. +85 V. T54 R126 47M +0.5 V. +85 V. R125 68Ω C121 .004 C122 .004 R127 10 M C128 47M C127 .00005 +170 V.

V11 6AU6 SOUND I.F. LIMITER -0.3 V. +6.5 V. +50 V. R135 33 M C139 .005 R136 39 M R137 100 M C140 .2 +170 V.

SOUND I.F. T55 C142 C143 C141

V12 6AL5 RATIO DET. 0 V. +2.0 V. T1.0 V. R144 100 M R145 68 M C153 2 MFD 50 V. C144 .00068

C154 .01 C155 .00005 C156 .0002 R199 82M C157 .01 R166 1 MEG. VOL CONTROL C162 .01 R167 10 MEG. C163 .1

V13 6AU6 1ST. A.F. -0.8 V. +125 V. C175 .0001 C176 .002 R179 1 MEG. TONE CONTROL R168 1.5 MEG.

SOUND AMP. C177 .01 R180 100 M R181 470M C178 25 MFD 25 V. R182 180Ω

V14 6Y6G A.F. OUTPUT +130 V. R187 3.3 M +115 V. C181 20 MFD 150 V. C180 .01

BOTTOM VIEW OF PLUG & SOCKET R192 5.6 M R193 22 M R203 4.7 M T60 C182 60 MFD 250 V. R194 400Ω +180 V.

V4 6BA6 1ST. VIDEO I.F. C112 .00000068 T51 R104 1.5 M R106 82Ω C110 .005 C113 .00001 C111 .005 +120 V. R105 1 M R107 3.9 M +180 V.

V5 6BA6 2ND. VIDEO I.F. C123 .0000015 T52 R112 2.7 M R201 39 M C125 .00001 R123 82Ω C124 .005 R122 3.9 M +120 V. +180 V.

VIDEO I.F. V6 6AU6 3 RD. VIDEO I.F. C138 .00000068 T56 R129 5 M C200 .005 C126 .004 C129 .004 R130 2.2 M +160 V. +18 V. +20 V. C127 .000006 L59

V7 6AG5 4TH. VIDEO I.F. T57 R138 15 M +100 V. +160 V. +1.5 V. C146 R143 150Ω .004 C145 .004 R146 100Ω R147 100Ω +170 V.

V8 6AL5 VIDEO DET. -125 V. -125 V. R159 5.6 M C164 .00001

V8 VIDEO AMP. V9 6AQ5 VIDEO AMP. -15 V. -65 V. C174 .0000047 C173 .00001 -125 V. L61 R160 22 M L62 -115 V. R161 3900Ω L63 R169 68Ω R170 1 M CONTRAST CONTROL R162 100Ω C165 .005 C166 .005 -125 V.

L64 R183 6.6M C179 .00005 R184 100 M +180 V. L65 R188 3.3 M -115 V. -40 V. C201 .01 R202 1 MEG. BRIGHTNESS CONTROL R189 33 M R190 100 M C183 .005 -125 V.

10 MP4 12 VP4 OR PICTURE TUBE HV. +9,500 V. +7,500 V.

R.F. TUNER OUTPUT A.G.C. +150 V. R100 1M C100 .005 L50 6.3 V X +180 V. +170 V. R102 3.3 MEG. R103 100 M C109 .005

V8 6AL5 A.G.C. LINE CLAMPER 0 V. C114 .005 R113 1 M C124 .005

T50 LOW VOLT P.S. L52 C115 40 MFD 250 V. C108 40 MFD 250 V. C116 60 MFD 250 V. +180 V. R108 1 MEG. V26 7X6 B+ RECT. R205 39Ω SELENIUM RECT. R206 39Ω R207 390Ω R208 390Ω R209 390Ω R210 390Ω 33 V. RMS 220 V. RMS 130 V. +165 V. -125 V. L51 C106 60 MFD 200 V C107 60 MFD 200 V V27 5U4G B+ RECT. ON-OFF SWITCH HEATERS 6.3 V.

V15 12AU7 A.G.C. R121 10 M R114 18 M R120 22 M -125 V. +170 V. -12 V. +55 V.

V16 12AX7 HOR. SYNC. SEP. R123 10 M C130 .0005 R131 18 M R132 1.5 MEG. C126 10 MFD -12 V. +150 V. HORIZ. SYNC.

V17 12AU7 HOR. SYNC. CLIPPER -0.3 V. +55 V. R139 22 M +170 V.

V16 12AX7 VERT. SYNC. SEP. R142 10 M C147 .00022 +75 V. -15 V. +170 V. C152 .01 R150 820 M R148 820 M R149 3.9 MEG. C148 .1 R141 1 MEG -125 V. VERT. SYNC.

V17 12AU7 VERT. SYNC. CLIPPER -125 V. -100 V. C159 .00025 C158 .001 R158 270M -125 V. +170 V.

V15 12AU7 VERT. OSC. VERT. OSC. AND AMP. -160 V. +12 V. T58 R171 2.2 M R163 270M C167 .015 R164 1 MEG VERT. HOLD R172 220 M C170 .1 C171 .02 R165 1.2 M C161 .05 R173 C168 100M 10 MFD 300 V. +170 V. -125 V.

C172 .1 R178 1 MEG. VERT. SIZE R176 3.9 M R177 1 MEG VERT. LIN.

V18 6AQ5 VERT. OUTPUT -100 V. +145 V. T61 R185 1 M -90 V. -125 V. C184 100 MFD 50 V. C185 10 MFD 450 V. +170 V. R191 1 M

TEST POINT (1) GR. L72 L73 YEL. VERTICAL DEFLECTION COILS R195 560Ω R196 560Ω

DO NOT ATTEMPT TO MEASURE THIS VOLTAGE

H.V. POWER SUPPLY C188 .005 R157 3.9 M C189 WH. .0015 .070 BR. V24 6SN7-GT H.V. OSC. C190 .022 L69 C191 BLUE V25 1B3-GT H.V. RECT. R212 3.6Ω R198 470M +9,500 V. C193 .0005 RED YEL. L70 L71 C192 .05

V4 V5 V6 V7 V8 V23 V19 C101 .001 C102 .001 C103 .001 C104 .001 C105 .005 L54 L55 L56 L57 R101 43Ω

V19 6AL5 HOR. DISCR. C117 .01 R110 100 M R111 1 MEG C119 .005 R200 1 MEG -0.5 V. -10 V. -10 V. T53 C120 .0001 R117 8.2 M R116 10 MEG R109 1 MEG C116 .2 R115 33 M R118 100 M -125 V.

V20 6AU6 HOR. CONT. R133 1 M 185 V. C135 .0001 C134 .005 -3 V. C132 .015 R124 2.2 M C133 20 MFD 250 V. +162 V. +0.1 V. +170 V.

V21 12AU7 HOR. OSC. -10 V. +165 V. R140 22 M C149 .01 L60 +170 V.

V21 12AU7 HOR. DISCHARGE +165 V. -70 V. 2.2 MEG 7 C150 .01 R152 56 M -125 V. R154 500 M R153 390 M C151 .005 +170 V. HORIZONTAL LINEARITY

C194 .00068 R211 4.7 M C160 .001 R157 82Ω -140 V. R156 10 MEG

V22 6BD5GT HOR. OUTPUT V23 6W4-GT DAMPER ▽+150 V. ▽+150 V. -125 V. +150 V. L67 L68 HORIZONTAL DEFLECTION COILS BL. RED GR. L66 R175 40Ω C168 50 V. 100 MFD C187 .2 FUSE 1/4 AMP 250 V. HOR. CENT. SIZE R174 2 M L74 C202 .00005 +180 V. TO ALL B+ POINTS MARKED +170 V.

HORIZ. OSC. AND AMP