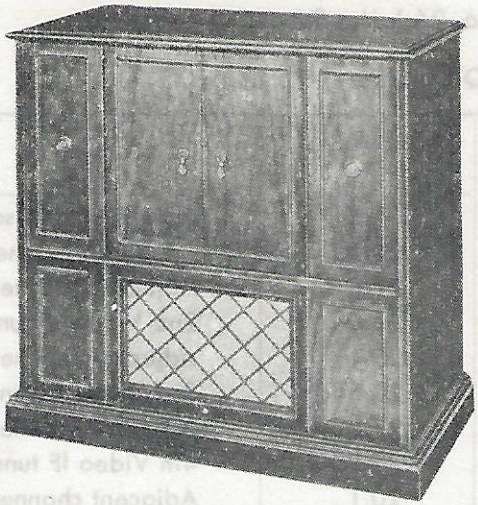
SERVICE DATA

VR1629 **PR2549**



GENERAL DESCRIPTION

The Models VR1629 and PR2549 are console models incorporating a Television receiver of the projection type, utilizing a complement of 37 tubes (including 5 rectifier tubes and the picture tube), also a 5 tube standard band broadcast receiver. (Refer to page 48 for service data on the radio receiver.)

Features of the television receiver include the Protelgram Television Projection System; a 2½" aluminized screen picture tube utilizing electromagnetic focusing and deflection; a 12-channel selector; automatic frequency control for stabilization of the horizontal deflection circuits; a protective tube circuit to safeguard the picture tube; a high-fidelity FM audio system for Television sound reproduction.

ELECTRICAL AND MECHANICAL SPECIFICATIONS OF TELEVISION RECEIVER

OVERALL DIMENSIONS (inches):—Height: 39", Width: 38¼", Depth: 20¾".

POWER SUPPLY RATING:—25 or 60 cycles, 110 volts. Television receiver 3 amperes.

ANTENNA REQUIREMENTS:—Folded dipole or equivalent, to 300 ohm balanced input terminals of television receiver.

RADIO FREQUENCY RANGE:

Channel Selector Position No.	Frequency Range Mc.	Picture Carrier Frequency Mc.	Sound Carrier Frequency Mc.	Receiver R.F. Oscillator Freq. Mc.
2	54-60	55.25	59.75	81.35
3	60-66	61.25	65.75	87.35
4	66-72	67.25	71.75	93.35
5	76-82	77.25	81.75	103.35
6	82-88	83.25	87.75	109.35
7	174-180	175.25	179.75	201.35
8	180-186	181.25	185.75	207.35
9	186-192	187.25	191.75	213.35
10	192-198	193.25	197.75	219.35
11	198-204	199.25	203.75	225.35
12	204-210	205.25	209.75	231.35
13	210-216	211.25	215.75	237.35

INTERMEDIATE FREQUENCIES: Video, 26.1 Mc; Sound, 21.6 Mc.

STAGGER-TUNED AND TRAP FREQUENCIES:

Coil Assembly	Slug Location	Freq. Mc.	Function
1st-L17	Top	21.6	Accompanying sound trap and sound take-off.
1st-L16	Bottom	22.15	1st Video IF tuned circuit.
2nd-L27	Top	27.6	Adjacent channel sound trap.
2nd-L26	Bottom	25.65	2nd Video IF tuned circuit.
3rd-L29	Top	20.1	Adjacent channel video trap.
3rd-L28	Bottom	22.65	3rd Video IF tuned circuit.
4th-L31	Top	27.6	Adjacent channel sound trap.
4th-L30	Bottom	25.55	4th Video IF tuned circuit.
5th-L33	Top	20.1	Adjacent channel video trap.
5th-L32	Bottom	23.75	5th Video IF tuned circuit.

VIDEO RESPONSE: To 4 Mc.

PICTURE SIZE:

On picture tube face—Height 1.4 inches, Width 1.86 inches.
On Viewing screen—Height 12 inches, Width 16 inches.
Magnification approximately 8.6 times. Picture area 192 square inches, with square corners.

AUDIO POWER OUTPUT: 3 watts for 10% distortion (nominal value).

LOUDSPEAKER: 8 inch diameter, 6.8 oz. Alnico 5 Permanent Magnet.
3.2 ohms impedance at 400 cycles.

SCANNING: 525 lines, interlaced.

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

VERTICAL SCANNING FREQUENCY: 60 c.p.s.

FRAME FREQUENCY: 30 c.p.s. (picture repitition rate).

SWEEP DEFLECTION: Electromagnetic.

FOCUS: Electromagnetic.

TUBE COMPLEMENT

Symbol	Function	Type	Symbol	Function	Type
V1	R. F. Amplifier	6J6	V7	4th Video IF Amplifier	6AG5
V2	Converter	6J6	V8	Video Detector and AGC Detector	6AL5
V3	Oscillator	6J6			
V4	1st Video IF Amplifier	6AG5	V9	1st Video Amplifier	6AU6
V5	2nd Video IF Amplifier	6AG5	V10	Video Output	6V6
V6	3rd Video IF Amplifier	6AG5	V11	Picture Tube (CRT)	3NP4

Tube Complement (continued)

Symbol	Function	Type	Symbol	Function	Type
V12	AGC Amplifier	6AT6	V24	Reactance Tube	6AC7
V13	DC Restorer and AGC Limiter	6AL5	V25	Horizontal Sweep Oscillator	6K6GT
V14	1st Sound IF Amplifier	6BA6	V26	Horizontal Sweep Output	6BG6G
V15	2nd Sound IF Amplifier	6BA6	V27	Horizontal Reaction Scanning	5V4G
V16	Limiter	6AU6	V28	Vertical Blocking Oscillator	6J5
V17	Discriminator	6AL5	V29	Vertical Sweep Output	6K6GT
V18	1st Audio Amplifier	6SQ7	V30	CRT Protective Tube	6SC7
V19	Audio Output	6V6	V31	High Voltage Blocking Oscillator	6SR7
V20	1st Sync Amplifier	6SK7			
V21	Sync Separator	6SH7			
V22	2nd Sync Amplifier and Horizontal Discharge	6SN7GT	V32	High Voltage Driver	6BG6G
			V33, V34, V35	High Voltage Rectifiers (3)	EY51
V23	Horizontal Sync Discriminator	6AL5	V36, V37	Low Voltage Rectifiers (2)	5U4G

CONTROLS

Function	Location	Description	
Channel Selector	Front Panel	Dial Knob (Operating)	Dual
Tuning	Front Panel	Bar Knob (Operating)	
Brilliance	Front Panel	Round Knob (Operating)	Dual
On-Off and Volume	Front Panel	Bar Knob (Operating)	
Focus	Front Panel	Round Knob (Operating)	Dual
Contrast	Front Panel	Bar Knob (Operating)	
Auxiliary Focus	Rear Apron of Tuner Chassis	Large Knurled (Service)	
Horizontal Centering	Sweep Chassis Panel	Large Knurled (Service)	Dual
Vertical Centering	Sweep Chassis Panel	Small Knurled (Service)	
Vertical Linearity	Sweep Chassis Panel	Large Knurled (Service)	Dual
Vertical Sync	Sweep Chassis Panel	Small Knob (Operating & Service)	
Vertical Size	Sweep Chassis Panel	Large Knurled (Service)	
Horizontal Size	Sweep Chassis Panel	Slotted Stud (Service)	
Horizontal Linearity	Sweep Chassis Panel	Slotted Stud (Service)	
Horizontal Linearity (Drive)	Sweep Chassis Panel	Slot-head Screw (Service)	
Horizontal Sync	Sweep Chassis Panel	Hexagonal-head screw (Service)	
Horizontal Phasing	Inside Sweep Chassis rear apron	Hexagonal-head screw (Service)	

HIGH VOLTAGE WARNING

Operation of this receiver outside its cabinet or with covers removed, involves a shock hazard from the power supplies. Regular B+ voltages used are in some cases higher than ordinarily encountered in standard radio equipment. The horizontal frame assembly (housing the horizontal output tube and transformer) should not be operated with the cover removed as *several thousand volts* are generated in this circuit.

The 25,000 volts from the high voltage driver unit to the anode of the picture tube, while normally capable of only low current upon accidental contact, could result in injury due to involuntary movement or other secondary reaction. Only personnel thoroughly familiar with the handling of high voltage equipment should attempt work on the receiver.

PICTURE TUBE HANDLING AND OPERATING PRECAUTIONS

TUBE BREAKAGE:

Extreme care must be used in handling these tubes. Although this size tube is less dangerous to handle than the larger ones used in Direct-View receivers, it must always be borne in mind that they are subjected to considerable pressure by the surrounding atmosphere and mis-handling could cause them to shatter.

Gloves should be worn to protect the hands and shatter-proof goggles to protect the eyes during installation or removal of the tube. Do not strike or scratch the tube, nor attempt to force it into the coil assembly if it fails to slide in easily.

X-RAY RADIATION:

Bombardment of the face plate of the tube by a 25 kv electron beam produces soft X-Rays which are absorbed to approximately 1/60 of the recognized safe minimum value by the protecting optical box when the tube is in its normal position. Without this shielding, free radiation will result, prolonged exposure to which could prove harmful to personnel. As a consequence, it is recommended that the tube be operated as little as possible outside the optical box.

INSTALLATION INSTRUCTIONS

ANTENNA REQUIREMENTS

A careful television antenna installation is required, consisting of an antenna of a type suited to the local television reception conditions, complete with grounded mast and lightning arrester, and correctly matched to a suitable transmission line or lead-in properly terminated to the antenna terminals of the receiver.

LOCATION OF RECEIVER

A location should be chosen convenient to an electrical outlet supplying 110 volts, 25 or 60 cycles, and to the antenna lead-in and ground leads.

Consideration should be given to convenient seating for proper viewing.—

Avoid placement where direct sunlight or lamp illumination will fall upon the screen. Moderate room lighting, or a shaded lamp placed several feet to either side of the receiver, is recommended for best viewing. A completely darkened room is undesirable.

Adequate ventilation is provided by openings in the cabinet back and bottom, and care should be taken to keep these openings uncovered and free from obstructions. Maintain a space of a few inches between the cabinet back and the wall.

SETTING UP THE RECEIVER

After removing the receiver from the packing case and taking off the shipping skids:

1. Remove the cabinet back covers.
2. Carefully remove the two packing bolts which are located in the top rear rail of the cabinet.
3. Remove the tape and the wooden packing block from the optical box assembly.
4. Remove any accumulated dust from the underside surface of the large cabinet mirror, *using only a camel's-hair brush* as this is a *front-surfaced mirror.* (Refer to section "Servicing the optical box and Mirrors" if dirt other than loose dust is to be removed).
5. Unfold the black cloth dust shield which is shipped folded down on top of the corrector lens. Support the top of the shield by the two brackets on the rear of the tuner chassis, and by the two clamps located on the cabinet rail below the mirror.

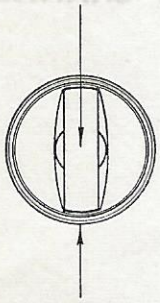
6. See that all the tubes are properly seated in their sockets.
7. Release the speaker baffle board by unscrewing the six wing nuts that hold it in position. Slide the baffle and speaker toward the power supply chassis, engaging the top edge of the baffle in the supporting bracket in order to hold the baffle upright.
8. Replace the receiver back covers. (The lower one can be held in place temporarily without replacing all the screws, as it will be necessary to remove it again in order to restore the speaker baffle to its correct position after installation adjustments are completed.)
9. Connect antenna transmission line lead-in to the receiver antenna terminals.
10. Insert the power cord plug into the electrical outlet. (110 volts, 25 or 60 cycles).
11. Proceed to tune the receiver as outlined under "OPERATING INSTRUCTIONS".
12. Set all controls and adjustments for correct operating positions as detailed under "INSTALLATION AND SERVICE ADJUSTMENTS AND INSTALLATION OF 3NP4 TUBE AND OPTICAL ADJUSTMENTS".
13. Disconnect the antenna transmission line lead-in and remove lower back cover of receiver. Slide the speaker baffle into place over its six mounting screws and secure it with the wing nuts. Replace lower back cover and reconnect antenna transmission line lead-in.

OPERATING INSTRUCTIONS

FRONT PANEL CONTROLS:—

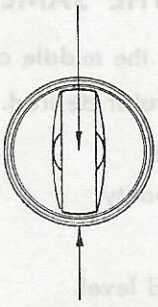
There are three dual controls on the front panel, making a total of six operating controls. The function of each control is indicated by markings on the front panel. The "Circle" indicates the round outer knob, the "Bar" indicates the bar-shaped inner knob.

OFF-VOLUME
Turns set ON and OFF and adjusts volume of sound.



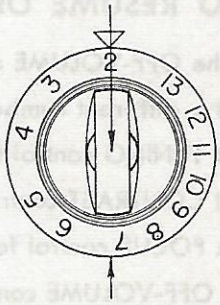
BRILLIANCE
Sets picture brightness.

CONTRAST
Sets picture quality, correct shadings from black to white.



FOCUS
Sharpens detail, gives clear-cut unblurred lines.

TUNING
Tunes receiver for best sound and picture.



CHANNEL
Channel selector and indicator.

HOW TO OPERATE THE TELEVISION RECEIVER

1. Turn the BRILLIANCE control to the full counterclockwise position.
2. Turn the CONTRAST control to the full counterclockwise position.
3. Turn the OFF-VOLUME control from its "OFF" position to the right. After the click of the switch is heard, continue to turn the control to approximately the middle of its range. Allow about half a minute for the tubes of the receiver to warm up.

4. Select the CHANNEL control number corresponding to the channel number of the desired station.
5. Turn the BRILLIANCE control to the right until light becomes just visible on the screen.
6. Advance the CONTRAST control to the right until a picture or activity is seen on the screen.
7. Adjust the TUNING control for the best sound. If the sound becomes too loud during tuning, turn the OFF-VOLUME control to the left until the sound is at a low level, then adjust the TUNING control for best sound and minimum noise. The best picture quality will coincide with this setting of the TUNING control, with freedom from moving shadow bars (sound bars) in the picture.
8. Adjust the FOCUS control for sharpest detail. Either side of the correct setting will result in a blurring of the picture. The fine horizontal lines of the "raster" should be clearly visible over the picture area.

GENERAL INFORMATION

As the BRILLIANCE control and the CONTRAST control both function for the best picture quality, it may be possible to improve the picture by a slight readjustment of them. In general, the best setting for the BRILLIANCE control is slightly to the left of the position at which the white diagonal "retrace" lines appear. The best setting for the CONTRAST control is the position giving the correct shade gradations from white to light gray, medium gray and black. Too low a setting may permit the picture to be unsteady, too high a setting may cause the picture to twist out of shape, and also have a black and fuzzy appearance. Too high a setting of either the CONTRAST or BRILLIANCE controls will necessitate too frequent readjustment of FOCUS control.

After the receiver has been in operation for some time it may be necessary to readjust the TUNING control for best sound quality.

To turn the receiver "OFF", rotate the OFF-VOLUME control to the extreme counterclockwise position until the switch clicks "OFF". No other controls need be touched.

TO RESUME OPERATION ON THE SAME OR A DIFFERENT CHANNEL

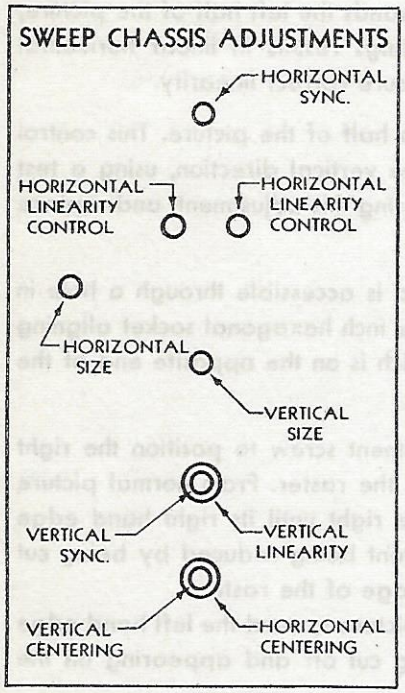
1. Turn the OFF-VOLUME control to the right to the middle of its range.
2. Select a different number on CHANNEL control if desired.
3. Adjust TUNING control for best sound quality.
4. Adjust CONTRAST control for best picture quality.
5. Check FOCUS control for best setting.
6. Reset OFF-VOLUME control for desired sound level.

NOTE: It will not be possible to operate the television receiver unless the "ON-OFF" control of the Radio receiver is in the "OFF" position. Therefore, the position of the *Radio* ON-OFF Switch should be checked, and turned to "OFF", if the Television receiver does not function within half a minute after switching it on. This interlocked switching feature is provided so that only one receiver can be operated at a time.

INSTALLATION AND SERVICE ADJUSTMENTS

TUNER CHASSIS:

Auxiliary Focus Control (on rear apron): Adjust this control for correct *electrical focus* when the *front panel* focus control is set at the approximate centre of its range. The picture and raster scanning lines should appear clear and sharply defined. (The *optical focus* of the projection system must be in correct adjustment also, for optimum results).



SWEEP CHASSIS:

The following controls will be accessible upon removal of the wooden panel located at the bottom right front corner of the cabinet (directly below the Radio compartment). The panel may be pulled out by means of the small metal tab at its top edge. Position of the controls is shown on the chart beside the controls as indicated to the left.

Horizontal Centering Control: Clockwise rotation moves picture from right to left on screen. Re-set after linearity and size control adjustments, if required.

Vertical Centering Control: Clockwise rotation moves picture upward on screen, Re-set after linearity and size control adjustments, if required.

Horizontal Size Control: To be adjusted until picture width exceeds screen width by approximately ½ inch (¼ inch at each side). Clockwise rotation of slug screw increases picture width.

Vertical Size: To be adjusted until picture height exceeds screen height by approximately ½ inch (¼ inch above, ¼ inch below). Clockwise rotation increases picture height.

Horizontal Sync (or "Hold") Control: This control is adjusted by using a 3/16 inch hexagonal socket aligning tool, insulated type. From normal picture setting, clockwise rotation of the adjusting screw will affect the picture as follows:

1. Shift it slightly to the left without distortion, then
2. Distortion or "stretch" the picture toward the left, then
3. "Tear" the picture into uneven diagonal bars, first broad in structure, then narrower as the mis-adjustment is continued.

From normal picture settings, counterclockwise rotation of the control screw results in similar changes occurring in the opposite direction.

Conversely to the above description, if, instead of normal picture, the diagonal bars appear, correct frequency adjustment will be obtained by turning the adjustment screw *in a direction that increases the width of the diagonal bars,* and continuing until the picture becomes normal. For most stable operation, adjustment should be continued until the picture starts to move out in the opposite direction, then returned to a setting half-way between the two "tear out" positions.

NOTE: If the picture or pattern is moving in a vertical direction also, it will be necessary to adjust the Vertical Sync Control, as outlined below.

Vertical Sync (or "Hold") Control: This control is equipped with a knob for the set owner's convenience. From normal picture setting, clockwise rotation of the control causes the picture to move downward off screen ("roll out"). To set correctly from a mis-adjusted position:

1. Turn the control slowly throughout its range until picture stops moving.
2. Turn in a clockwise direction to allow the picture to move down *slowly.*
3. Turn counterclockwise *slightly* past the setting at which picture stops moving.

Horizontal Linearity Controls: Two controls are used to adjust horizontal linearity, one in the form of a slug screw, the other a trimmer condenser screw (the horizontal drive adjustment). Clockwise rotation of the *slug screw* expands approximately the left hand quarter and the right hand half of the picture and compresses

the remaining quarter. Clockwise rotation of the *trimmer condenser screw* expands the left half of the picture, with slight compression of the right side. The correct combination of settings results in linear horizontal scanning. It is essential to use a test pattern during these adjustments to ensure correct linearity.

Vertical Linearity Control: Clockwise rotation of this control expands the top half of the picture. This control and the vertical size control must be co-ordinated for correct linearity in the vertical direction, using a test pattern to ensure proper results. (Remove knob from Vertical Sync Control during this adjustment, and replace it afterward).

Phasing Adjustment: This adjustment is located inside the sweep chassis, and is accessible through a hole in the chassis rear apron. The adjusting screw can be turned by means of a 5/16 inch hexagonal socket aligning tool, *insulated type* (as used to adjust the Horizontal Sync Control screw which is on the opposite end of the same transformer).

After the Sync Controls have been set correctly, adjust the Phasing Adjustment screw to position the right hand edge of the picture correctly with respect to the right hand edge of the raster. From normal picture setting, clockwise rotation of the adjusting screw will move the picture to the right until its right hand edge comes even with the raster edge. Further rotation results in the picture content being reduced by being cut off at the raster edge and also a dark bar will appear at the left hand edge of the raster.

Counterclockwise adjustment from the normal picture setting moves the picture toward the left hand edge of the raster and, if continued, will result in a portion of the picture being cut off and appearing on the right hand side of the raster.

When correctly adjusted, the right hand edge of the picture content should be approximately 5/16 inch from the right hand edge of the raster, disregarding any intervening shadings that follow the picture content edge.

Before making this adjustment shift the raster slightly to the left by clockwise rotation of the Horizontal Centering Control in order to conveniently view the right hand edge of the raster.

Reduce the setting of the Contrast Control from normal position, and readjust the Brilliance and Focus controls to positions that show clearly the picture and raster edges during the adjustment.

Re-center the raster when Phasing adjustment is completed. It will be necessary to readjust the Horizontal Sync Control during the Phasing adjustment as inter-action normally results.

High Voltage Driver:

No installation adjustment. For servicing, refer to oscillator adjustment under the heading of HIGH VOLTAGE DRIVER UNIT.

Optical Box:

Refer to the information under the headings of:—

1. Installation of 3NP4 Tube and Optical Adjustment.
2. Servicing the Optical Box and Mirrors.

NOTE: Test pattern photographs on pages 34 to 37 illustrate the effects of many of the misadjustments referred to above.

CIRCUIT OUTLINE

R-F AMPLIFIER, CONVERTER AND OSCILLATOR:

Each function is performed by a 6J6 tube operating in a balanced push-pull circuit. The input to the R.F. Amplifier stage is a balanced 300 Ω untuned circuit. Inductive link coupling is utilized between stages. Suitable

inductance and capacity values for these stages are selected by operation of the CHANNEL SELECTOR, and accurate adjustment of the oscillator is accomplished by the TUNING control.

All circuit components and in addition the balanced antenna trap and 1st Video I.F. transformer, are incorporated in the R.F. TUNER UNIT sub-chassis, which in turn is mounted in the TUNER CHASSIS.

SOUND CHANNEL:

A tap on the accompanying sound trap, incorporated in the 1st Video I.F. transformer, serves as a take-off point for the 21.6 Mc sound I.F. signal. This signal is then amplified by two transformer-coupled I.F. stages using 6BA6 tubes, and a 6AU6 Limiter. Demodulation is accomplished by a conventional discriminator with a peak to peak band width of approximately 200 kc (6AL5 tube). The triode section of a 6SQ7 tube functions as 1st A.F. amplifier, and a 6V6 tube as audio output to the PM-type dynamic speaker.

VIDEO CHANNEL:

The 26.1 Mc Video I.F. signal is amplified by four stages utilizing 6AG5 tubes in staggered tuned circuits. Five trap coils are used, tuned to Accompanying sound, Adjacent Sound and Adjacent Video frequencies. A 6AL5 tube functions as Video Detector and AGC Detector. The detected Video Signal is amplified by the 6AU6 and 6V6 amplifiers in which series and shunt peaking are used. A 6AL5 tube functions for D.C. restoration and AGC limiting. The Video output signal is applied to the grid of the 3NP4 picture tube. The AGC detector output is amplified by a 6AT6 tube and applied to the R.F. Amplifier and the 1st and 3rd Video I.F. Amplifiers. AGC voltage to the I.F. stage is held to the desired value by the operation of the AGC Limiter diode.

SYNC AMPLIFIERS AND SYNC SEPARATOR:

The 1st Sync Amplifier (6SK7GT) amplifies the signal fed from the DC Restorer and also reduces any noise peaks that are greater amplitude than the Sync pulses. The next stage functions as a Sync Separator (6SH7) with only the Sync pulses being amplified as the blanking and Video portions of the signal do not exceed the operating bias. The 2nd Sync Amplifier (half of 6SN7GT) serves as a clipper to remove amplitude variations between Sync pulses, and also delivers the signal in the correct polarity for control of the Sweep Oscillators. At the output of this stage the horizontal Sync pulses are fed through a differentiating network to the Horizontal Sync Discriminator circuit, and the signal containing both vertical and horizontal Sync pulses is fed to the integrating network. This network functions as an RC low-pass filter, attenuating the horizontal Sync pulses and passing the vertical Sync pulses to the vertical Blocking Oscillator circuit.

VERTICAL SWEEP CIRCUITS:

A 6J5 tube functions as the Vertical Blocking Oscillator, whose grid circuit is triggered by the Vertical Sync pulses. The desired output voltage waveform is produced by this oscillator in conjuction with the R.C. discharge and peaking network across its plate load. The 6K6GT Vertical Sweep Output amplifies this waveform to the value required for Vertical deflection of the beam. Matching to the deflection coils is accomplished by means of the vertical output transformer. Vertical Sync, Size, and Linearity are adjusted by Variable resistor controls used to set the operating conditions of the 6J5 and 6K6GT tubes.

HORIZONTAL SWEEP CIRCUITS:

The Horizontal Sweep Oscillator uses the cathode, grid, and screen grid of a 6K6GT to generate a sine-wave 15,750 c.p.s. output. Synchronizing is accomplished by closely coupling the oscillator inductance to a

secondary winding and using a 6AL5 tube as a phase discriminator. By comparing the phase of the applied oscillator voltage and the horizontal sync pulse voltage at the discriminator, zero output will be obtained when the oscillator frequency is correct, and either a positive or negative voltage output if incorrect. This voltage controls a 6AC7 tube used as a variable reactance in the oscillator circuit and operates to correct the oscillator frequency. The moveable slugs in the two windings of the phase discriminator serve as adjustments to set the horizontal sync and phasing correctly.

The 6K6GT output is applied to the 6SN7GT triode which functions as a discharge tube in a circuit that produces the saw-tooth voltage required to drive the Horizontal output tube (6BG6G). The 6BG6G operates to supply sufficient current of the proper waveform to the horizontal sweep deflection coils. The 5V4G Reaction scanning (or "damper") tube controls the damping-out of the oscillations in the horizontal deflection coils and thus contributes to the correct waveform. The 5V4G tube also functions to raise the B+ voltage at a point in the circuit that results in an increased B+ supply to the 6BG6G Horizontal Output tube.

POWER SUPPLY CIRCUITS:

Two conventional power supplies are used. All heater, filament and B++ voltages are provided for the Sweep Chassis and the High Voltage Driver Unit by one supply. B++ is 365 volts D.C. at 225 mA, using a 5U4G rectifier tube with choke-input filter. The other supply provides these voltages for the Tuner Chassis, with B+ 250 volts DC at 210 mA, using a 5U4G rectifier tube with capacity-input filter. A selenium rectifier provides—110 volts DC bias at 7 mA to both the Tuner and Sweep Chassis.

HIGH VOLTAGE DRIVER CIRCUIT:

The triode section of the 6SR7 tube operates as a conventional blocking oscillator, whose frequency is 1000 ± 70 cycles. The saw-tooth voltage which it generates, is applied between the control grid and cathode of the 6BG6G driver tube, which is biased beyond cut-off. The driver tube plate-current flows through a portion of the primary of the high-voltage transformer, in pulses corresponding to the saw-tooth peaks of the input signal. The top end of the primary is connected to the voltage tripler circuit. The peak voltage across the high-voltage winding is approximately 8.5 kv. Three indirectly heated rectifier tubes, which have been developed for pulse operation, are used in the voltage multiplier circuit. The heating power is derived from individual windings on the high-voltage transformer. Because the transformer is self-resonant to approximately 25 kc/s, each 1000 cycle pulse will start a damped train of high voltage transient oscillations whose frequency is 25 kc/s and whose initial peak amplitude is approximately 8.5 kv. The amount of power supplied to the heaters of the rectifier tubes is a function of the frequency. Therefore, in order to maintain the proper operating temperature on the rectifier heaters, the blocking oscillator frequency must be held to 1000 ± 70 cycles. A trimmer condenser C304 which is accessible through a hole in the side of the chassis serves to adjust this frequency.

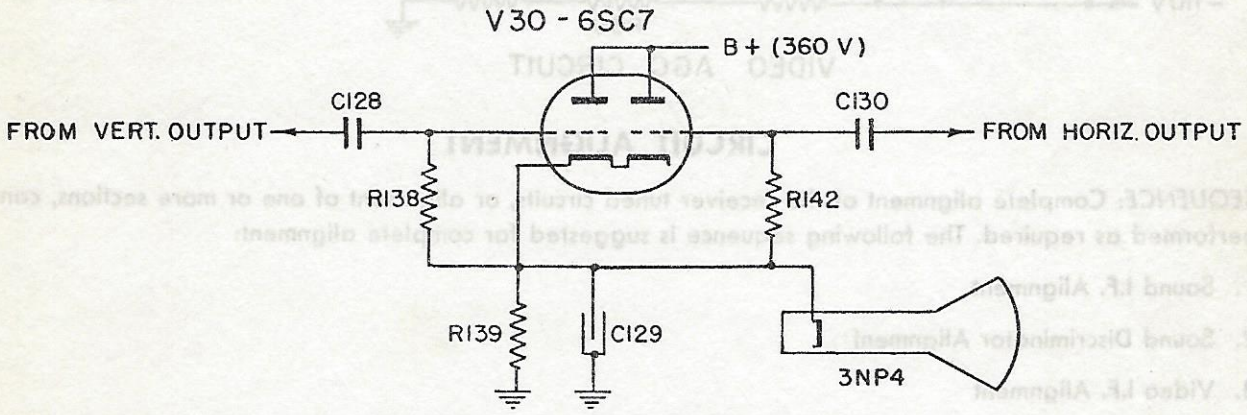
Automatic control of the driver tube bias, by means of a control voltage derived from the voltage peaks across the resonant circuit provides a most effective method of obtaining high power efficiency and good regulation. The control voltage is obtained from a separate winding on the high voltage tripler transformer and is rectified by the diode sections of the 6SR7 tube. The rectified control voltage is filtered by the network consisting of C308, C307, and R308, and then applied to the driver grid circuit across resistor R307. The use of this method of automatic voltage control of the driver tube provides a regulation characteristic which is substantially flat within the desired operating range. The output voltage falls off very rapidly beyond this range. This is a very desirable feature from the viewpoint of protection against external short circuits. It also reduces the accidental shock hazard. Despite this, *USE EXTREME CARE WHEN WORKING ON THE HIGH VOLTAGE CIRCUITS.* (Refer to High Voltage Driver Schematic Diagram.)

PICTURE TUBE PROTECTION CIRCUIT:

Since a special high-voltage unit is incorporated which does not depend in any way upon the sweep circuit operation, a permanent burn on the face of the cathode-ray tube could occur in the event of any sweep failure for a period of a few seconds. The failure of a vacuum tube, resistor, or condenser, etc. can induce a cathode-ray tube failure, requiring a relatively expensive replacement.

The protection circuit is shown below. Positive horizontal pulses are taken from the secondary of the horizontal output transformer and applied through a condenser to the grid of one triode section of the control tube. This grid-cathode circuit operates as a diode and forms grid leak bias which, for all practical purposes, cuts off this triode section when horizontal sweep output voltage exists.

Positive vertical pulses are applied to the other section of this dual triode protection tube, which functions in substantially the same manner. In the event that one or both of these signals disappear, the associated triode section draws a fairly large plate current, which increases the cathode voltage. This cathode voltage biases off the picture tube, since it is applied to its cathode.

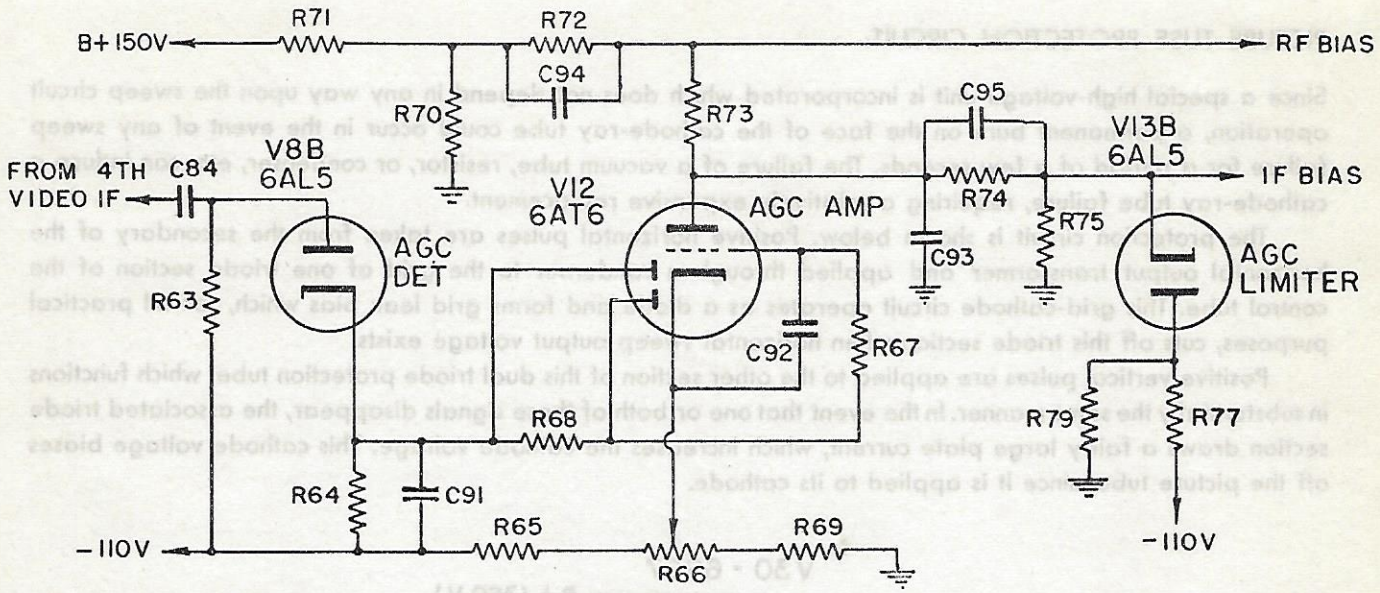


PICTURE TUBE PROTECTION CIRCUIT

VIDEO AGC CIRCUIT:

The AGC Detector rectifies the video I.F. signal coupled to it from the 4th video I.F. stage. The positive potential developed at the Detector cathode is applied to the 6AT6 diodes, which function as clippers to reduce any noise peaks that may be present. This voltage is fed, through an R-C network for further filtering of noise pulses, to the grid of the 6AT6 triode. This triode functions as a controlled D.C. amplifier of which the negative D.C. voltage output is applied to the RF and IF stages as "automatic gain control" bias voltage. The operating bias of this triode determined by the setting of the front panel Contrast control is likewise amplified and added to the AGC bias voltage. In this manner the Contrast control serves as a manual gain control.

This triode amplifier supplies two separate AGC outputs, one to the RF stage, and the other to the IF stages. The AGC voltage applied to the IF amplifier is initially higher than that to the RF amplifier and increases with increasing signal up to approximately 3 volts negative, after which the RF AGC voltage is progressively higher. The reason for this crossover is that the AGC limiter diode (V13B) shunting the IF AGC circuit starts to conduct at 3 volts negative and loads down the IF AGC circuit. Thus at lower signal strengths the RF amplifier operates at higher gain for better signal-to-noise ratio and at higher signal strengths the RF amplifier is biased sufficiently to prevent overload.



VIDEO AGC CIRCUIT

CIRCUIT ALIGNMENT

SEQUENCE: Complete alignment of the receiver tuned circuits, or alignment of one or more sections, can be performed as required. The following sequence is suggested for complete alignment:

1. Sound I.F. Alignment
2. Sound Discriminator Alignment
3. Video I.F. Alignment
4. R.F. Oscillator Adjustment
5. Antenna Trap Adjustment

Detailed description of the alignment procedure should be followed carefully, and the alignment table used only as a guide, or after becoming thoroughly familiar with the various operations through practice.

TEST EQUIPMENT: The following test equipment is recommended for proper alignment and testing of the receiver:

1. R.F. Sweep Generator capable of constant output of not less than .1 volt maximum, and with dependable attenuator, covering the ranges of:
   (a) 20 to 30 Mc, with 1 Mc and 10 Mc sweep widths.
   (b) 50 to 90 Mc, with 10 Mc sweep width.
   (c) 170 to 220 Mc, with 10 Mc sweep width.
2. R.F. Signal Generator having good frequency stability and accurate dial calibration for the following frequencies:
   (a) Picture and Sound Carrier Frequencies for all channels – No. 2 to No. 13 inclusive.
   (b) Picture and Sound Intermediate Frequencies and Trap Frequencies ranging from 20.1 Mc to 27.6 Mc. (See detailed lists under ELECTRICAL AND MECHANICAL SPECIFICATIONS.)

3. Heterodyne Frequency Meter or Crystal Calibrator with which to check calibration points on the R.F. Signal Generator.
4. Cathode-Ray Oscilloscope with a wide-band frequency response on vertical deflection. (This feature is required when analyzing the waveform patterns shown on pages 38 to 40).
5. Electronic Voltmeter, one range of which will read not more than 3 volts D.C. at full scale, and preferably 1 volt D.C. full scale.

ALIGNMENT SET-UP: Use of these recommended accessories and observance of the outlined precautions preparatory to, and throughout, alignment of the Tuner Chassis, will assure satisfactory and trouble-free results.

1. Place a plate of sheet copper upon the top of the bench and group the test equipment around the end and back edges, bonding each piece of equipment to the plate by means of a *short* piece of copper strap or braid. Group signal generating equipment at one side and indicating equipment at the opposite side to reduce the possibility of coupling due to input and output lead crossings, etc.
2. Set the POWER SUPPLY CHASSIS on the plate (left of center) and stand the TUNER CHASSIS *on end* (R.F. TUNER UNIT *down*) with the bottom facing toward the operator. A convenient position is with the chassis end making contact to the plate and the mounting flange projecting downward over the edge of the bench, to which it may be secured by means of two wood screws. If a different method is used to support the chassis, be certain to bond the chassis to the metal plate.
   This position permits convenient adjustment of both top and bottom alignment slugs, and connections to input and output points. The adjustment location drawings are oriented to conform to this position for convenience of the operator.
3. Join together the two Eby Connectors on the short 2-wire cables coming through the POWER SUPPLY CHASSIS apron, insert into the 11 prong socket, an 11 prong shorting plug made by connecting terminals No. 10 and No. 11 together, and insert the 8 prong plug of the TUNER CHASSIS CABLE into the 8 prong socket. The A.C. primary circuit is now completed, independently of all other cabling and switching. *Remove the 5U4G rectifier tube* located next to the largest power transformer, leaving in only the 5U4G rectifier tube nearest the A.C. interlock connector. This renders the B++ supply inoperative. Connect the A.C. interlock to the 117 volt, 25 or 60 cycle power supply outlet by means of a short power cord when ready to turn chassis on.
4. Connect the speaker to the TUNER CHASSIS by means of leads terminated by a phono-type male connector. Remove the short length of 300 Ω line from the antenna input circuit lugs *at the R.F. TUNER UNIT* so that the signal generator may be connected directly to these lugs when required. It will not be necessary to connect or terminate any of the remaining sockets or plugs.
5. A convenient method of feeding in the signal for I.F. alignment, is by the use of an adaptor converter tube. This is easily made by bending out the cathode pin (pin No. 7) of a 6J6 tube and soldering one end of a 75 Ω resistor to it. The converter tube may be removed and the adaptor tube substituted for it during I.F. alignment. The free end of the 75 Ω resistor should be connected to the chassis with a "touch" of solder or a small clip, as close to the tube as possible.
   The signal generator may now be connected across this resistor, giving correct termination for the generator cable and cathode injection of the signal at the converter.
   An alternate method of connection is to leave the original converter tube in place, slide over it a close-fitting metallic tube shield, and connect the generator between the tube shield and chassis. The tube shield must not touch the chassis, and care must be taken so that erratic results will not be obtained.

6. Use of a simple de-coupling network between the desired output point and the oscilloscope probe, or the meter lead, will reduce the possibility of undesired R.F. coupling. Connect a 10,000 Ω composition type resistor and a 1000 uufd mica or ceramic condenser in series, and connect the resistor lead to the desired output point and the condenser lead to the chassis. The scope or meter may now be connected from the junction of the resistor and condenser to chassis.
7. Two alignment tools are required, a screwdriver consisting of an insulated rod with small metal blade, preferably with a sleeve around the tip, to adjust the Video I.F. slugs, and a small fibre or plastic screwdriver to adjust the Sound I.F. slugs.

ALIGNMENT PROCEDURE

GENERAL:

1. Turn CHANNEL SELECTOR to No. 12.
2. Set VOLUME, BRILLIANCE and CONTRAST controls to full clockwise positions.
3. Remove 6AT6 AGC Amplifier tube (V12).
4. Apply -3 volts battery bias to prong No. 1 of 6AL5 AGC Limiter tube (V13B) socket. (+ side returned to chassis.) (Not required if only sound I.F. and Discriminator are to be aligned.)
5. Remove 6J6 Converter tube (V2) and replace with converter adapter tube.

SOUND I.F. AND DISCRIMINATOR:

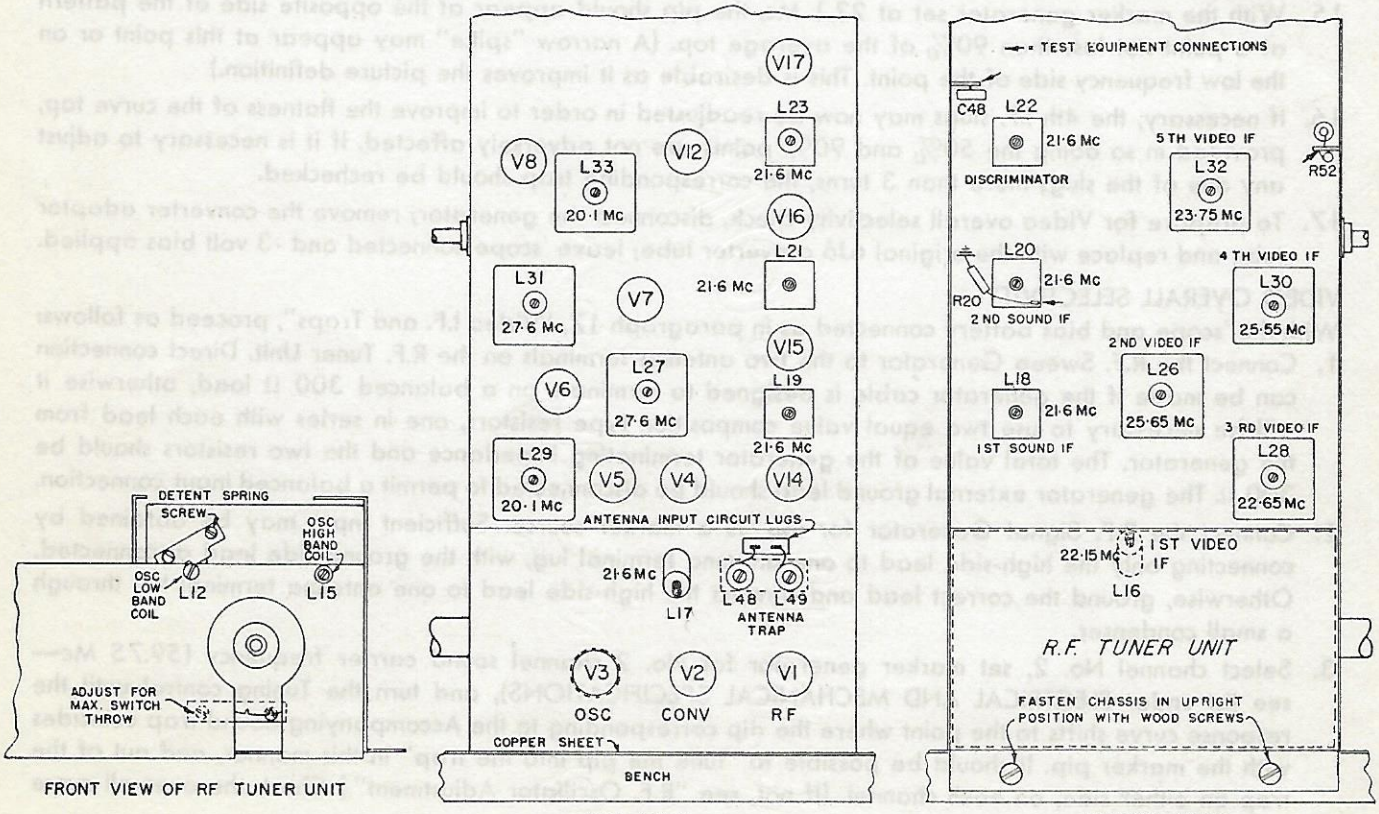
1. Connect R.F. Sweep Generator across 75 Ω resistor of converter adapter. Set sweep for approximately 1 Mc width with the centre frequency approximately 21.6 Mc.
2. Connect R.F. Signal Generator through a small condenser to the same points as in 1. Set at 21.6 Mc as Sound Marker signal. (Determine accuracy of *all* R.F. Signal Generator frequencies used by comparison with the Crystal Calibrator.)
3. Connect scope (through de-coupling network) to 6AU6 Limiter tube grid resistor and chassis (across R20, 22K Ω resistor).
4. Adjust L21 (top) and L20 (bottom) slugs and L19 (top) and L18 (bottom) slugs, in that order, for maximum amplitude consistent with good symmetry. Repeat as required. The marker "pip" should remain at the center of the peak of the response curve after each adjustment, and when the sweep input signal is increased approximately 10 times.
5. Connect scope between the junction of R24, C48, and C49, and chassis (across 150 uufd condenser C48).
6. Adjust L23 (top) and L22 (bottom) slugs until "S" Curve appears.
7. Adjust L22 (bottom) slug for maximum peak-to-peak amplitude of "S" curve.
8. Adjust L23 (top) slug for minimum size of marker pip. This corresponds to minimum output from speaker when checked with marker generator modulation turned on.
9. Repeat 7. and 8. as required. The peak to peak bandwidth should be approximately 200 kc. This can be checked by changing the marker generator frequency to 21.5 Mc and 21.7 Mc and noting the positions of the marker pip relative to the straight portion of the response curve. (Return the marker generator to 21.6 Mc after checking.) The linear portion must be a minimum of ± 75 kc from the center frequency of 21.6 Mc.
10. Connect 'scope to the de-coupling network at the Limiter grid resistor and check for symmetry of the I.F. response. Re-adjust L21 (top) and L20 (bottom) slugs if necessary.
11. Disconnect 'scope and de-coupling network.

VIDEO I.F. AND TRAPS:

1. Connect R.F. signal generator across 75 Ω resistor of converter adapter tube. (If continuing sequence after aligning sound I.F., remove R.F. sweep generator and connect R.F. signal generator without series coupling condenser).
2. Connect the Electronic Voltmeter (through the de-coupling network) across the 3900 Ω load resistor (R52) of the 6AL5 Video Detector tube (V8A) (Junction of R52 and the shunt Peaking Coil, and to chassis). Switch meter to lowest D.C. range (negative reading polarity). Throughout alignment, always switch to lowest range usable, depending upon control over minimum output and residual noise level.
3. Turn all Trap Slugs and I.F. Slugs full out (full counterclockwise).
4. Set R.F. Signal Generator to 21.6 Mc. Adjust input for approximately full-scale reading on Electronic Voltmeter. Adjust 1st trap (top of L17) for minimum output (the *first* dip). This trap must be very carefully adjusted. As the output reading decreases, increase the input signal, otherwise residual noise read on the meter will mask the "maximum dip", and result in mis-alignment. (This applies to the adjustment of each trap.)

   Follow the same procedure for each trap:

   A high reading on the meter with no input signal applied indicates oscillation occuring in the Video I.F. stages, possibly due to two or more stages being tuned to approximately the same frequency. Should this condition develop during alignment, increase the battery bias above -3 volts until the output drops to zero, apply the required input signal, and proceed with the alignment sequence. Check with bias reduced to -3 volts after each adjustment and continue alignment with this normal bias when the condition clears.
5. With generator at 27.6 Mc adjust 2nd and 4th traps (top of L27 and L31) for dip.
6. With generator at 20.1 Mc adjust 3rd and 5th traps (top of L29 and L33) for dip.



7. With generator at 22.15 Mc, adjust input for reading just above noise level. Adjust 1st I.F. (bottom of L16, located inside shield cover on bottom of R.F. Tuner Unit) for maximum output (the first peak). This I.F. must be very carefully adjusted, as follows: Continue to turn the slug after maximum output is indicated (to be certain the peak has been reached), then turn counterclockwise until the output begins to drop quickly. Turn clockwise again to the point where the rapid change ceases and leave it at this setting. Disregard the fact that a very slight (and broad) increase could be obtained beyond this point.

   It is advisable, each time a different frequency is chosen during the alignment sequence, to turn the R.F. Signal Generator attenuator to zero and then increase its setting until the desired output is obtained, otherwise an overload condition may exist, resulting in mis-alignment.
8. With Generator at 25.65 Mc, adjust the 2nd I.F. (bottom of L26) for peak.
9. With Generator at 22.65 Mc, adjust the 3rd I.F. (bottom of L28) for peak.
10. With Generator at 25.55 Mc, adjust the 4th I.F. (bottom of L30) for peak.
11. With Generator at 23.75 Mc, adjust the 5th I.F. (bottom of L32) for peak.
12. Recheck all traps (repeat steps 4, 5 and 6). No change in slug position should be required when rechecking the *1st* trap. If it does require a different setting, it indicates an incorrect initial setting of the 1st trap or 1st I.F. and *both* slugs should be turned full counterclockwise and then readjusted as in 4 and 7.
13. In order to observe and touch up the I.F. response curve, connect the R.F. Sweep Generator across the 75 Ω resistor of the converter adapter tube; loosen the coupling of the R.F. Signal Generator by placing a small condenser in series (as it will be used as a marker generator with which to check the Video Carrier and bandwidth points), and replace the Electronic Voltmeter with the 'scope. Set the Sweep for approximately 10 Mc width with the center frequency approximately 26.1 Mc. Both the Sweep and Marker Generator outputs should be kept below the level at which they begin to distort the pattern shown on the 'scope.
14. Set the marker generator at 26.1 Mc (Video I.F. carrier frequency) and observe the position of the marker pip, which should be within 40 to 60% of the average level of the response curve top (nominal 50%).
15. With the marker generator set at 22.1 Mc, the pip should appear at the opposite side of the pattern at a point not less than 90% of the average top. (A narrow "spike" may appear at this point or on the low frequency side of the point. This is desirable as it improves the picture definition.)
16. If necessary, the 4th I.F. slugs may now be readjusted in order to improve the flatness of the curve top, provided in so doing the 50% and 90% points are not adversely affected. If it is necessary to adjust any one of the slugs more than 3 turns, the corresponding trap should be rechecked.
17. To prepare for Video overall selectivity check, disconnect the generator; remove the converter adaptor tube and replace with the original 6J6 converter tube; leave 'scope connected and -3 volt bias applied.

VIDEO OVERALL SELECTIVITY:

With the 'scope and bias battery connected as in paragraph 17, "Video I.F. and Traps", proceed as follows:

1. Connect the R.F. Sweep Generator to the two antenna terminals on the R.F. Tuner Unit. Direct connection can be made if the generator cable is designed to terminate on a balanced 300 Ω load, otherwise it will be necessary to use two equal value composition type resistors, one in series with each lead from the generator. The total value of the generator terminating impedance and the two resistors should be 300 Ω. The generator external ground lead should be disconnected to permit a balanced input connection.
2. Connect the R.F. Signal Generator for use as a marker source. Sufficient input may be obtained by connecting only the high-side lead to one antenna terminal lug, with the ground-side lead disconnected. Otherwise, ground the correct lead and connect the high-side lead to one antenna terminal lug through a small condenser.
3. Select channel No. 2, set marker generator for No. 2 channel sound carrier frequency (59.75 Mc—see list under ELECTRICAL AND MECHANICAL SPECIFICATIONS), and turn the Tuning control until the response curve shifts to the point where the dip corresponding to the Accompanying Sound trap coincides with the marker pip. It should be possible to "tune the pip into the trap" in this manner, and out of the trap on either side, on each channel. (If not, see "R.F. Oscillator Adjustment".) Check the over-all curve for normal reponse.

4. Select each channel in turn, set marker for the correct sound carrier frequency in each case, see that the sound pip can be "tuned through", and that the response curve is acceptable as determined by the requirements outlined in "VIDEO I.F. AND TRAPS", Para. 14, being applied here for overall selectivity. Repeat these checks with -3 volts bias removed. If the set is normal the shape of the response curves will remain approximately the same.
5. Disconnect all test equipment from the chassis, remove the -3 volt battery bias, and replace the 6AT6 AGC Amplifier tube. If no additional measurements are to be made (such as overall sound and video sensitivities) re-connect the short section of 300 ohm line to the antenna terminals of the RF TUNER UNIT.

R.F. OSCILLATOR ADJUSTMENT:

If it is not possible to "tune through" sound on each channel, it will be necessary to adjust the slug in the oscillator coil concerned. The low band oscillator coil (channels, No. 2 to No. 6 inclusive) is tuned by a slug which is accessible through a hole in the chassis above and to the left of the CHANNEL SELECTOR shaft, while that for the high band (channels No. 7 to No. 13 inclusive) is above and to the right of the shaft.

To correct the oscillator frequency:

1. Select the channel affected (as determined in 3. and 4. above).
2. Turn the Tuning Control one complete rotation, and observe where the marker pip is located with respect to the sound trap, and note the range of travel of the pip. Stop the pip approximately in the middle of its travel range and leave the Tuning Control at this setting, which will be approximately the middle of its tuning range.
3. With an *insulated* screwdriver, turn the oscillator slug in the correct direction to move the marker pip into the trap.
4. Turn the TUNING control throught its range and see if the marker pip can be moved approximately the same distance either side of the trap. If not, repeat 2. and 3.
5. Check all other channels of the same band to see that the TUNING control tunes the marker pip through the sound trap in each case. It may be necessary to readjust the oscillator slug slightly so that all channels may be "tuned through" with some safety factor.

Station Selector Knob Adjustment:

If the station selector knob indicates the wrong channel, it may be due to the slipping of the brass bushing which is secured to the selector shaft by two Allen-head set screws. To correct this condition, set unit on Channel 2, remove the selector knob, loosen the Allen set screws on the brass bushing and replace selector knob loosely on loosened bushing and rotate until the knob marker indicates Channel 2. Remove knob carefully and tighten two Allen set screws. The selector knob will now be oriented properly with the shaft.

High-Low Band Switch Adjustment:

A switch is incorporated in the tuner to transfer both the coils and the variable gang tuning condenser from low to high channels. This switch functions with the rotation of the selector knob in either direction, clockwise or counterclockwise. The switch is actuated by the cam of the detent plate. The displacement is so designed as to make the switch action positive. Should a switch become improperly adjusted, the condition is corrected by setting the selector knob to Channel 7, loosening the two screws shown on alignment diagram marked "Adjustment for Maximum Switch Throw", slide the bar slightly left or right. It will be necessary to watch the switch contacts to assure correct position. Tighten the screws and check for operation, that is, switch from 7 to 6 and back. Also check at 13 and 2.

NOTE: It is not intended that any other adjustments on the R.F. TUNER UNIT be made in the field. Any Unit known to be defective should be returned to the factory for replacement or repair.

ANTENNA TRAP:

This balanced trap, connected to the antenna terminal lugs of the R.F. TUNER UNIT, can be tuned to reject, or reduce, an interfering signal of between 95 Mc and 130 Mc for any one channel. Tune in the interfering signal and adjust both slug screws for minimum output. A convenient method for the usual case is to tune the interfering signal as a sound output, switching the CHANNEL SELECTOR between detents if necessary, and adjust for minimum output.

SOUND I.F. AND DISCRIMINATOR ALIGNMENT

Step No.	Sweep Generator (1 Mc Sweep)		Signal Generator (Marker)		'Scope Connect to	Adjust	Remarks
	Connect to	Freq.	Connect to	Freq.			
1.	Converter adapter tube and chassis	21.6 Mc center	Converter adapter tube and chassis	21.6 Mc	Limiter grid resistor (R20) and chassis	Bottom L21 Top L20	Maximum amplitude, symmetrical to marker
2.	"	"	"	"	"	Bottom L19 Top L18	" (repeat 1 & 2)
3.	"	"	"	"	Junction of R24, C48 & C49 and chassis (across C48)	Top L23 Bottom L22	For "S" Curve
4.	"	"	"	"	"	Bottom L22	Maximum Peak to Peak amplitude of "S" Curve
5.	"	"	"	"	"	Top L23	Minimum Marker size (Repeat 4 & 5)
6.	"	"	"	"	Limiter grid resistor (R20)	Bottom L21 Top L20	If required

CONDITIONS: 1. AC Line Voltage: 117 volts.
2. Select CHANNEL No. 12.
3. Remove 6AT6 Tube V2.
4. Install Converter Adapter Tube.

VIDEO I.F. AND TRAPS ALIGNMENT

Step No.	Signal Generator		Electronic Voltmeter	Adjust	Remarks
	Connect to	Freq.	Connect to		
1.	Converter adapter tube and chassis	21.6 Mc	Video Detector load resistor (R52) & chassis	Top L17	Tune for minimum output (first dip) Must be accurate
2.	"	27.6 Mc	"	Top L27 Top L31	Tune for minimum output (first dip)
3.	"	20.1 Mc	"	Top L29 Top L33	"
4.	"	22.15 Mc	"	Bottom L16 (inside shield)	Tune through maximum and back, then return to point where peak *begins* to flatten out.
5.	"	25.65 Mc	"	Bottom L26	Tune for maximum output (first peak)
6.	"	22.65 Mc	"	Bottom L28	"
7.	"	25.55 Mc	"	Bottom L30	"
8.	"	23.75 Mc	"	Bottom L32	"
9.	"	21.6 Mc	"	Top L17	Should be correct for minimum output. If not, turn top and bottom L17 and L16 full out and repeat 1. and 4.
10.	"		"		Repeat 2. and 3.

CONDITIONS: 1. AC Line Voltage: 117 volts.
2. Select CHANNEL No. 12.
3. Remove 6AT6 Tube V2.
4. Install converter adapter tube.
5. Apply -3 volts bias to socket prong No. 1 of 6AL5 tube V13B.
6. Set VOLUME, BRILLIANCE & CONTRAST controls full clockwise.
7. Turn all TRAP slugs and I.F. slugs full out.

VIDEO I.F. RESPONSE CHECK

Step No.	Sweep Generator (10 Mc Sweep)		Signal Generator (Marker)		'Scope Connect to	Adjust	Remarks
	Connect to	Freq.	Connect to	Freq.			
1.	Converter Adapter Tube and chassis	26.1 Mc Center	Converter Adapter Tube and chassis	26.1 Mc	Video Detector load resistor (R52) & chassis		Marker pip should be 50% of response curve
2.	"	"	"	22.1 Mc	"		Marker pip should be 90% of response curve
3.	"	"	"		"	Bottom of L26*, L28*, L30*, L32*	If required for flat top. 50% and 90% points must be acceptable.

* = If more than 3 turns required, the corresponding trap must be checked.

CONDITIONS: Same as for "VIDEO I.F. AND TRAPS ALIGNMENT".

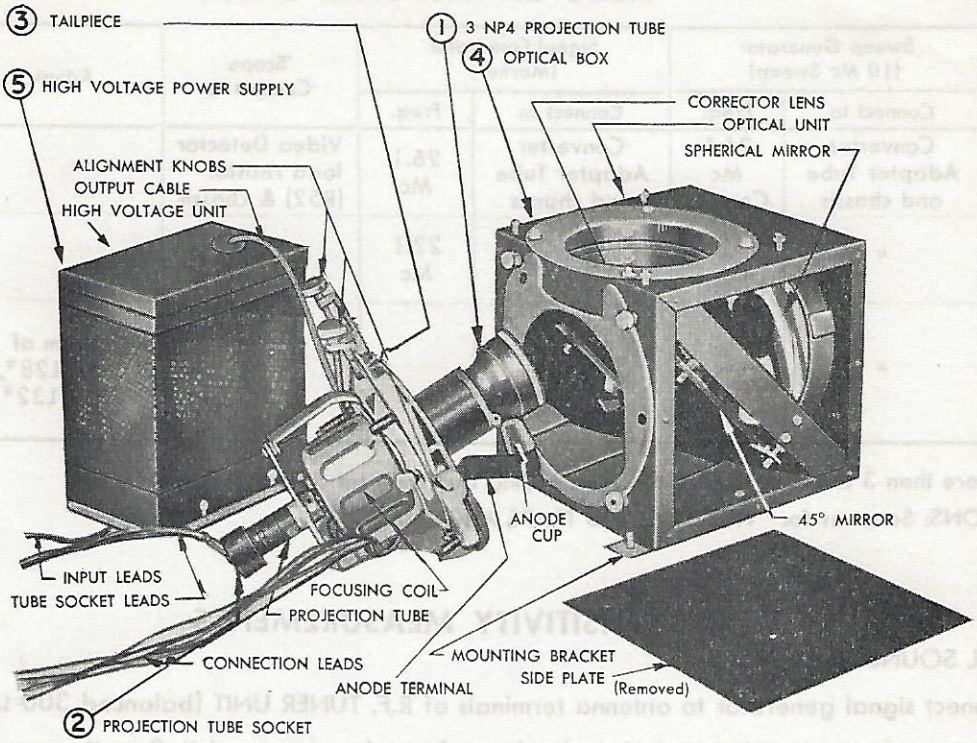
SENSITIVITY MEASUREMENTS

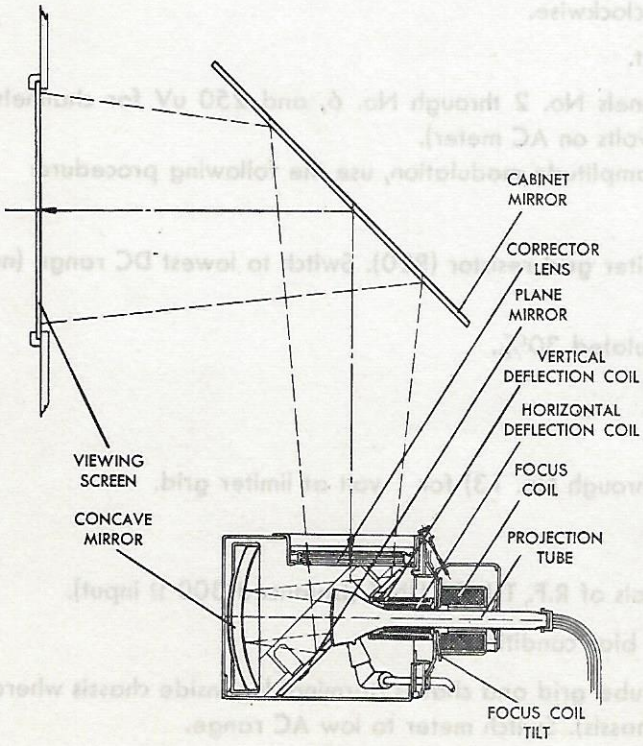
OVERALL SOUND SENSITIVITY

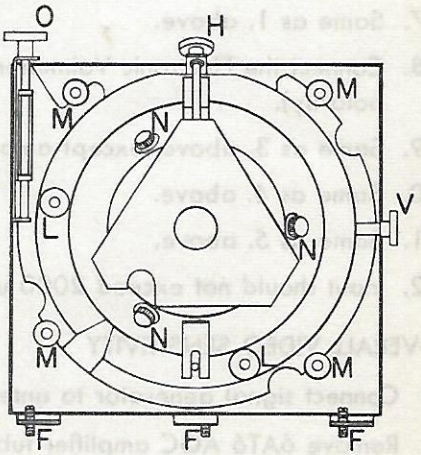
1. Connect signal generator to antenna terminals of R.F. TUNER UNIT (balanced 300 Ω input).
2. Connect output meter, set at 4 ohms, in place of speaker. (or use 4 Ω, 2 watt composition type resistor in parallel with AC Voltmeter).
3. Set input at sound carrier frequency, frequency modulated 30% (7½ kc deviation) at 400 cycles.
4. Set VOLUME and CONTRAST controls full clockwise.
5. Adjust TUNING control for maximum output.
6. Input should not exceed 150 uV for channels No. 2 through No. 6, and 250 uV for channels No. 7 through No. 13, for 500 mW output (1.4 volts on AC meter).
   When signal generator incorporates only amplitude modulation, use the following procedure:
7. Same as 1. above.
8. Connect the Electronic Voltmeter across limiter grid resistor (R20). Switch to lowest DC range (negative polarity).
9. Same as 3. above, except amplitude modulated 30%.
10. Same as 4. above.
11. Same as 5. above.
12. Input should not exceed 2000 uV (No. 2 through No. 13) for 1 volt at limiter grid.

OVERALL VIDEO SENSITIVITY

1. Connect signal generator to antenna terminals of R.F. TUNER UNIT (balanced 300 Ω input).
2. Remove 6AT6 AGC amplifier tube for zero bias condition.
3. Connect the Electronic Voltmeter to picture tube grid and chassis (terminal lug inside chassis where 3NP4 cable red lead [grid lead] starts, and to chassis). Switch meter to low AC range.
4. Same as 4, and 5 above for "OVERALL SOUND SENSITIVITY".


3 TAILPIECE
1 3 NP4 PROJECTION TUBE
4 OPTICAL BOX
5 HIGH VOLTAGE POWER SUPPLY
CORRECTOR LENS
OPTICAL UNIT
SPHERICAL MIRROR
ALIGNMENT KNOBS
OUTPUT CABLE
HIGH VOLTAGE UNIT
ANODE CUP
45° MIRROR
INPUT LEADS
TUBE SOCKET LEADS
FOCUSING COIL
PROJECTION TUBE
CONNECTION LEADS
MOUNTING BRACKET
SIDE PLATE (Removed)
ANODE TERMINAL
2 PROJECTION TUBE SOCKET


CABINET MIRROR
CORRECTOR LENS
PLANE MIRROR
VERTICAL DEFLECTION COIL
HORIZONTAL DEFLECTION COIL
FOCUS COIL
PROJECTION TUBE
VIEWING SCREEN
CONCAVE MIRROR
FOCUS COIL TILT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5. With input amplitude modulated 30% at 400 cycles, set the signal generator to the Video carrier frequency, then increase frequency until maximum output is indicated on the Electronic Voltmeter (approximately 1 to 2 Mc above the Video carrier frequency).
6. The input should not exceed 50 uV at this setting (the "top" of the response curve) for an output of 3 volts RMS.

NOTE: It is usually only necessary to check sensitivities on one or two channels of each band, or on certain channels used in the locale.

INSTALLATION OF 3NP4 TUBE AND OPTICAL ADJUSTMENTS

(A) 1. Loosen the 4 nuts "M" which hold the tailpiece to the optical box.
2. Rotate the tailpiece to the left and
3. Pull-out the tailpiece.

NOTE: This operation should be done with care to prevent the tube from hitting the 45° plane mirror.

(B) 1. Loosen the screw on the tube clamp and the 2 screws which center the tube neck in the hole in the triangular endplate.
2. A light-shield and rubber-band are packed with the tube. Place light-shield over top of tube locating it over the 2 projecting lugs on the tube and hold it in place with the rubber-band.
3. Insert the tube through the deflection yoke, keeping the anode cup "down". The 2 springs "S" must make good contact with the aquadag (black coating) on the outside of the tube. Therefore, the springs must be kept clear of the light-shield or under it.
4. Tighten the screw in the tube-clamp at the same time keeping the tube held firmly in the deflection yoke. To avoid breaking the neck of the tube, do not tighten the screw with undue force.

   Then tighten the 2 screws on the face of the triangular endplate keeping the neck of the tube in the center of the hole.

CAUTION: In this operation or in any subsequent operations, *do not* hold the tailpiece assembly by grasping the deflection yoke.

(C) 1. Place H.V. connector at end of H.V. cable in anode cup of tube, with the connector making contact to the metal button.
2. Loosen 2 screws holding H.V. cable clamp and insert cable through hole in plastic strip. Push clamp inward and tighten 2 screws.
3. Carefully insert tailpiece in optical box. Be sure that the position of the light-shield is not disturbed and that the tube clears the opening in the 45° plane mirror. *It is essential that the position of the tube in the tailpiece is not disturbed. The tube must be kept back snugly in the deflection yoke.*
4. Rotate tailpiece to the right until the slots in the tailpiece engage under the 4 nuts "M". Keep the bottom of the triangular endplate parallel to the bottom of the optical box and hand tighten the 4 nuts "M".
5. Place tube socket over end of tube. *Hold neck of tube so as to avoid pushing the tube in.*

(D) *ELECTRICAL ADJUSTMENTS:*

1. Plug in line-cord and tune receiver to a transmitted test pattern. Look down into the optical box at the pattern reflected from the 45° plane mirror.

2. Adjust the electrical controls of the receiver as described in the receiver Service Notes and place the pattern, properly focused, on the center of the tube so that each corner of the pattern just touches the edge of the tube face.

(E) 1. Now look at viewing screen. Loosen two nuts "L" which lock the overall adjustment "O". Bring the center of the picture in focus on the viewing screen by adjusting the knob "O". Then lock the two nuts "L".

2. Adjust the three tilt screws "F" to center the pattern on the viewing screen. The pattern should overlap the screen by ¼ to ½ inch.

3. The correct positioning of the pattern on the screen is also adjusted by slightly rotating the tailpiece. To do this loosen 4 screws "M" and tighten after proper positioning of the tailpiece.

CAUTION: The image seen in the projection box is extremely brilliant. Set the "brilliance" control for minimum required for a clear picture, and use care when looking into the projection unit. If desired, dark glasses may be used to protect the eyes.

(F) Look at the viewing screen while making the following adjustments. (Turn down contrast control on receiver and look at lines on the raster.)

1. Slightly loosen 2 nuts "L" and 3 nuts "N".
2. Adjust overall focus "O" and focus center of raster only.
3. Adjust horizontal focus "H" so that both sides of raster focus equally well.
4. Adjust vertical focus "V" so that top and bottom of raster focus equally well.
5. Re-check overall adjustment "O".
6. Repeat steps 2, 3, 4 and 5 if necessary.
7. Hand-tighten 3 nuts "L" and 2 nuts "P".
8. Wipe off any dust accumulation on the corrector lens with a soft cloth. Provision has been made to permit the adjustments outlined in (E) and (F) (above) to be made from the front of the receiver cabinet. This is accomplished by removing the 6 wing nuts holding the speaker baffle in place and sliding the baffle to the right of the opening (as viewed from back of cabinet). A metal bracket is provided to hold the baffle in an upright position. The necessary controls can be reached through the remaining opening.

NOTE: Make certain that the dust shroud is fitted securely around the optical box and does not interfere with the light-rays from the corrector lens.

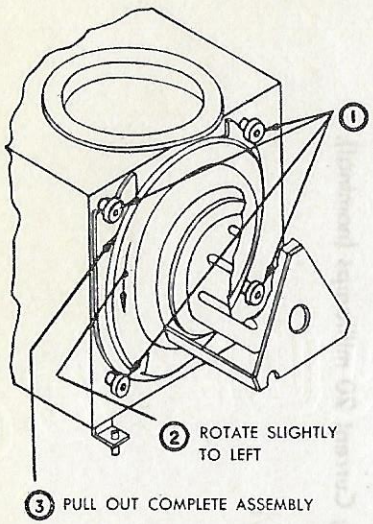
WARNING: Bombardment of the face plate of the tube by a 25 kv electron beam produces soft x-rays which are well absorbed by the projection unit when the tube is in its normal position. Without this shielding, free radiation will result, prolonged exposure to which could prove harmful to personnel. As a consequence, it is recommended that the tube be operated outside the projection unit only as little as is required for test purposes, then face the tube away from the operator, and view the tube face by means of a mirror.

Description of Mechanical Operation of Optical Adjustments

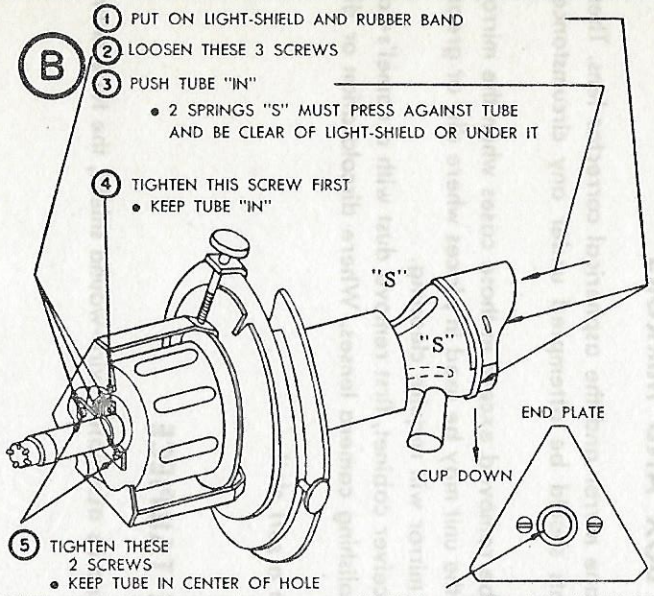
The 3NP4 cathode-ray tube face plate is part of an accurately defined spherical surface. It is the first lens in the projection system and must be precisely located within the fixed optical triangle (concave mirror, 45° mirror, and corrector lens) to obtain satisfactory optical resolution on the viewing screen. Three thumbscrew adjustments are provided for this purpose. The principal adjustment moves the tube in a longitudinal direction, towards and away from the concave mirror, and provides an overall focusing control. The other two

PROTELGRAM TUBE INSTALLATION AND ADJUSTMENTS

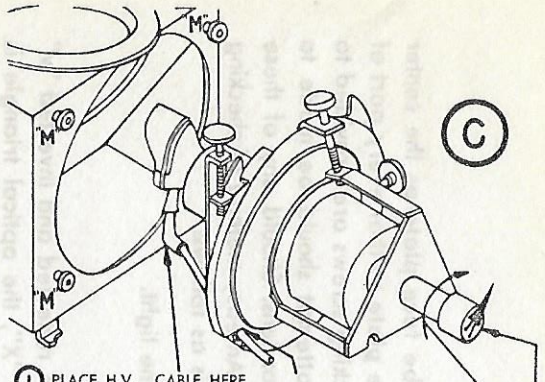
A



B



C

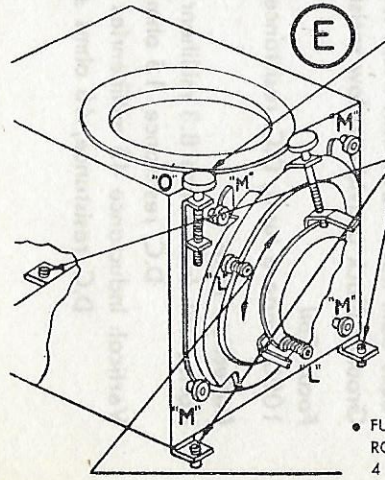


1. PLACE H.V. CABLE HERE
2. PLACE H.V. TERMINAL HERE
3. INSERT COMPLETE ASSEMBLY GENTLY IN BOX
   - WATCH CLEARANCE BETWEEN LIGHT-SHIELD AND INSIDE MIRROR
   - KEEP TUBE AND L'T-SHIELD IN PLACE
   - ROTATE ASS'Y TO RIGHT UNTIL BOTTOM OF ENDPLATE IS PARALLEL TO BOTTOM OF BOX
   - TIGHTEN 4 SCREWS "M"
4. PLACE TUBE SOCKET OVER END OF TUBE

D — ELECTRICAL ADJUSTMENTS

1. PROPERLY TUNE RECEIVER TO TRANSMITTED TEST PATTERN
   LOOK DOWN INTO BOX AT PATTERN REFLECTED FROM 45° MIRROR
2. ADJUST ELECTRICAL CONTROLS OF RECEIVER TO OBTAIN NORMAL AND PROPERLY FOCUSED PATTERN ON TUBE FACE AS DESCRIBED IN SERVICE NOTES
3. ADJUST SIZE OF PATTERN AND CENTER SO THAT EACH CORNER JUST TOUCHES EDGE OF TUBE FACE

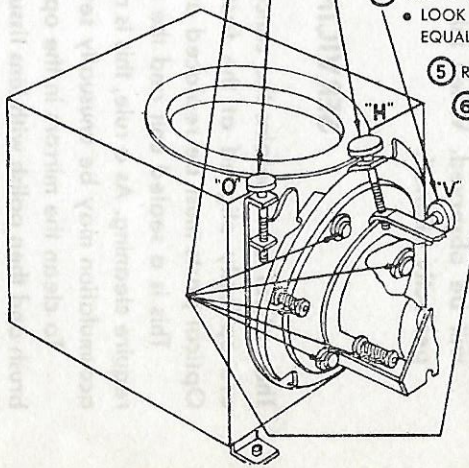
E



1. LOOK AT VIEWING SCREEN
   - LOOSEN 2 LOCK-NUTS "L" ADJUST OVER-ALL FOCUS "0" AND BRING CENTER OF PICTURE IN FOCUS
2. ADJUST 3 TILT SCREWS AND CENTER PATTERN ON VIEWING SCREEN
   - PATTERN SHOULD OVERLAP SCREEN BY ¼" TO ½"

- FURTHER ADJUSTMENT MAY BE MADE BY ROTATING ASSEMBLY AFTER LOOSENING 4 SCREWS "M"

F — LOOK AT VIEWING SCREEN WHILE MAKING THESE ADJUSTMENTS



1. SLIGHTLY LOOSEN 5 THUMB-NUTS
2. THIS IS *OVERALL* FOCUS "0"
   - WATCH CENTER OF PICTURE ONLY AND BRING INTO FOCUS
3. THIS IS *HORIZONTAL* FOCUS "H"
   - LOOK AT SIDES OF PICTURE ONLY AND BRING BOTH SIDES IN FOCUS EQUALLY WELL
4. THIS IS A *VERTICAL* FOCUS "V"
   - LOOK AT TOP AND BOTTOM AND BRING IN FOCUS EQUALLY WELL
5. RE-CHECK "0" AFTER ADJUSTING "H" AND "V"
6. REPEAT 2, 3, 4 AND 5 IF NECESSARY
7. TIGHTEN 5 NUTS
8. WIPE OFF ANY DUST ACCUMULATION WITH SOFT CLOTH

adjustments rotate the tube vertically and horizontally with the center of the tube face plate as the center of rotation. These adjustments determine the position of the outer edges of the face plate so that every part of it may be precisely located in relation to the rest of the optical system. Five locking screws are provided to secure the alignment assembly after the adjustments have been made. No attempt should be made to replace or adjust the concave mirror, the 45° mirror or the aspherical corrector lens. Should any of these parts require replacement or realignment, ship the projection unit to the factory. An easy method of checking the alignment of the parts comprising the optical triangle in the projection unit is as follows:

1. Place the optical unit beneath a light source, with the corrector lens facing the light.
2. Moulded in the center of the aspherical corrector lens is a small "v" mark.
3. Look down into the unit from a little to one side through the corrector lens. A reflected and inverted "v" will be observed. When this combines with the moulded "v" to form an "X", the optical triangle is perfectly aligned.

SERVICING THE OPTICAL BOX AND MIRRORS

The optical box contains the concave mirror, the 45° plane mirror and the aspherical corrector lens. These are optically aligned at the factory and no adjustments should be attempted under any circumstances. Optical parts must be replaced at the factory.

This is a sealed unit and the side plates should not be removed except in those cases when the mirrors require cleaning. As a rule, this is not required. However, the unit may be used in places where dirt or grease accumulation may be unusually severe. In such cases, the mirror will require cleaning.

To clean the mirrors in the optical box and in the receiver cabinet, first remove dust with a camel's-hair brush and then polish with lens tissue, such as is used for polishing camera lenses. Where discoloration or dirt is excessive, apply a spray such as "Windex".

The top of the corrector lens should be cleaned with a *soft* cloth.

SERVICING THE TAILPIECE

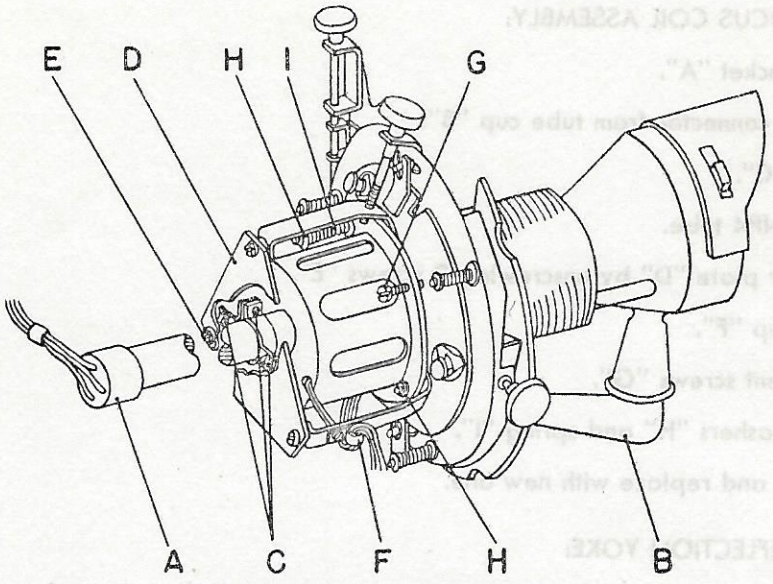
The tailpiece includes the focus coil, the deflection yoke and its associated wire-wound shield, the tube clamp assembly and the optical focusing adjustments.

SPECIFICATIONS:

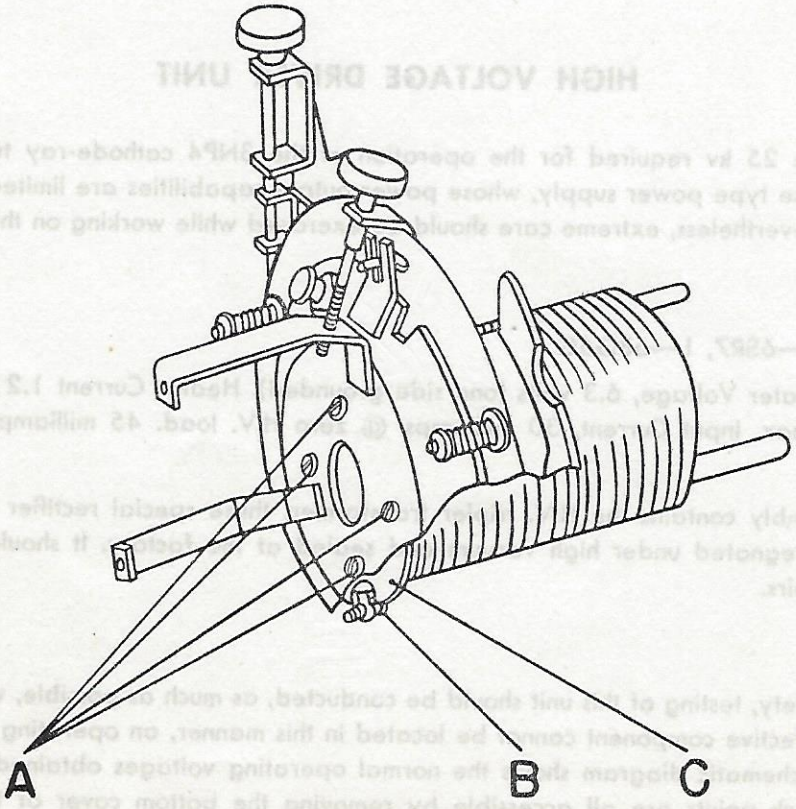
Wiring Color Code
Horizontal Deflection Coil: Orange with white tracer, orange with black tracer.
Vertical Deflection Coil: Blue with white tracer, blue with black tracer.
Focus Coil: Red, Black with white tracer.
Ground: Black provides a low resistance connection to all other grounded chassis in system.

Focus Coil
1000 Ampere turns; D.C. resistance 11,000 ohms ± 10%; Current 20 milliamps (nominal).

Deflection Yoke
Horizontal: Inductance 8.3 millihenries ± 10% @ 1000 c/s
D.C. resistance, 15 ohms (approx.)
Vertical: Inductance 45 millihenries ± 10% @ 1000 c/s
D.C. resistance, 68 ohms ± 10%



FOCUS COIL ASSEMBLY



DEFLECTION YOKE

REPLACEMENT OF FUCUS COIL ASSEMBLY:

1. Disconnect tube socket "A".
2. Disconnect anode connector from tube cup "B".
3. Loosen 3 screws "C".
4. Gently remove 3NP4 tube.
5. Remove triangular plate "D" by unscrewing 3 screws "E".
6. Loosen cable clamp "F".
7. Loosen 2 adjustment screws "G".
8. Remove 2 snap washers "H" and spring "I".
9. Remove focus coil and replace with new one.

REPLACEMENT OF DEFLECTION YOKE:

1. Remove 3NP4 tube and focus coil. (See Replacement of Focus Coil Assembly.)
2. *Carefully note the mounting position of the yoke to be removed.*
3. Unscrew 4 screws "A".
4. From opposite side remove the ground lug screw "B".
5. Remove the plastic insulating disc "C".

HIGH VOLTAGE DRIVER UNIT

WARNING:

This unit supplies the 25 kv required for the operation of the 3NP4 cathode-ray tube. Although it is a reduced-hazard, pulse type power supply, whose power output capabilities are limited to the requirements of the 3NP4 tube, nevertheless, extreme care should be exercised while working on this unit.

SPECIFICATIONS:

Tube Complement: 1—6SR7, 1—6BG6G.

Electrical Ratings: Heater Voltage, 6.3 volts (one side grounded). Heater Current 1.2 amps. Input Voltage, 345 volts ± 10% max. Input Current, 30 milliamps @ zero H.V. load. 45 milliamps @ 120 microamps H.V. load.

H.V. Can: This assembly contains the H.V. tripler transformer, three special rectifier tubes and H.V. filter capacitors. It is impregnated under high vacuum and sealed at the factory. It should be returned to the factory for any repairs.

SERVICING NOTES:

In the interests of safety, testing of this unit should be conducted, as much as possible, with the power supply turned off. If the defective component cannot be located in this manner, an operating voltage check should prove helpful. The schematic diagram shows the normal operating voltages obtained with a vacuum tube voltmeter. These check points are all accessible by removing the bottom cover of the unit where, *under normal circumstances,* no voltages in excess of those externally applied are present.

If failure occurs, first check the 6SR7 and the 6BG6G tubes by replacing them. If this does not correct the difficulty, check to see that the blocking oscillator is functioning as evidenced by a bias of approximately —50 volts, on the grid of the 6SR7 tube.

When replacing the 6BG6G tube, care must be taken to dress the 6BG6G plate lead away from all other connections and grounds. This lead should clear all objects by at least ¼" to prevent corona discharge, as some radio interference may result.

When placing the cover on the high-voltage unit, make certain that it is not reversed. The 25 kv lead must go directly up through the cover and not cross over inside the box. Severe arcing and sparking may result if the cover is reversed.

The following conditions could indicate failure of the sealed H.V. can:—
Reduced picture brightness.
Excessive sweep width and height.
No picture. ("No picture" might also indicate action of the picture tube protection circuit.)

REPLACEMENT OF SEALED CAN:

Remove bottom of chassis by removing 4 screws. Unsolder 3 leads from terminal strip on underside of chassis and black lead from chassis.

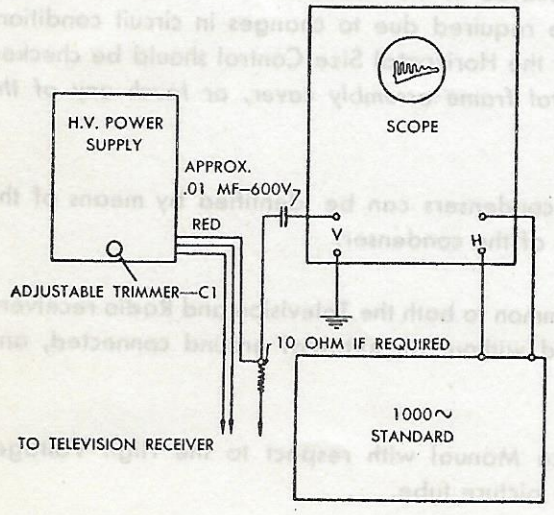
Do not unsolder leads from top of can. *Do not* unscrew gland (anode lead) at top of can.

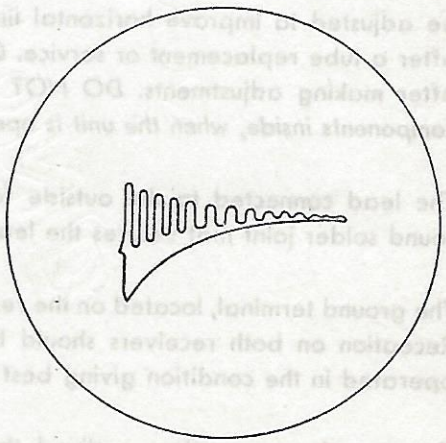
Loosen 2 nuts on underside of chassis thus releasing the 2 clamps. Replace new can by inserting 4 leads through holes in top of chassis. Tighten nuts on underside of chassis holding the 2 clamps. Solder 4 leads to terminal strip on underside of chassis and solder black lead to chassis.

OSCILLATOR ADJUSTMENT:

The frequency of the blocking oscillator in the high-voltage supply must be maintained at 1000 ± 70 cycles. Adjustment should not be necessary unless a frequency determining element such as the blocking oscillator transformer has been replaced or altered. *The 1000 cycle adjustment has negligible effect on either the output voltage or current regulation and should not be tampered with in an attempt to rectify failure.* Its only function is to provide the proper frequency which determines just the proper amount of power to the heaters of the three high-voltage rectifier tubes inside the sealed can, to assure maximum life of these tubes.

Adjust C304 with an oscilloscope and a dependable 1000 cycle generator. Sufficient blocking oscillator voltage can usually be obtained from the B++ red lead to operate the vertical amplifier of the





LISSAJOU FIGURE FOR 1000 CYCLE ADJUSTMENT

oscilloscope. If sufficient voltage cannot be obtained from the red lead to produce a signal on the oscilloscope, a resistor of about 10 ohms should be soldered in series with the red lead. An increased oscillator signal can be obtained from H.V. driver side of the resistor. *Be sure to remove this resistor after the frequency is set.* With the 1000 cycle signal from the generator applied to the horizontal sweep amplifier of the oscilloscope, adjust C until a single stable Lissajou figure is obtained.

SERVICE NOTES

1. The 6SC7 tube used in the CRT protection circuit should be checked whenever the set requires service. It is possible this tube may have failed and the set is operating without the protective feature. With the receiver operating turn the BRILLIANCE control full counterclockwise, remove the 6J5 Vertical Blocking Oscillator tube (V28) and slowly turn the BRILLIANCE Control clockwise. No trace, or at most a faint horizontal line, should appear on the screen, indicating correct operation of the protective circuit when Vertical Sweep is interrupted. Turn the BRILLIANCE control full counterclockwise and replace the 6J5 tube (V28).

   Repeat this procedure for a check of the horizontal sweep circuit by removing the 6K6GT Horizontal Sweep Oscillator tube (V25) and observing the screen for no trace or at most a faint vertical line. Turn the BRILLIANCE control full counterclockwise and replace the 6K6GT tube (V25).

2. The receiver operates normally on AC line voltages ranging from 105 volts to 125 volts. If a low line voltage area is encountered where the line voltage is *below 105 volts at all times,* the tap on the B++ power transformer (L401) should be used. Unsolder the Black and Yellow transformer lead from the terminal lug and substitute the Black and Red transformer tap lead in its place. Tape up the unused lead.

   A tag should be tied to the plug end of the receiver power cord, stating that this change has been made. The normal connection should be restored before the set is again operated on 105 volts or higher (new area, or corrected line voltage in same area).

3. It is important that the Blue lead from the 3NP4 socket be securely fastened under the screw head on the High Voltage Driver Unit. This lead connects to a "Spark Shield" located between anode and grid in the 3NP4 picture tube, and protects the tube against arc-over when correctly terminated.

4. The slider on the adjustable damping resistor (R152), located in the horizontal frame assembly, may be adjusted to improve horizontal linearity. This may be required due to changes in circuit conditions after a tube replacement or service. Correct operation of the Horizontal Size Control should be checked after making adjustments. *DO NOT remove the horizontal frame assembly cover, or touch any of the components inside, when the unit is operating.*

5. The lead connected to the outside foil of the moulded condensers can be identified by means of the round solder joint that secures the lead close to the body of the condenser.

6. The ground terminal, located on the rear cabinet rail, is common to both the Television and Radio receivers. Reception on both receivers should be checked with and without an external ground connected, and operated in the condition giving best results.

7. Observe the precautions outlined throughout this Service Manual with respect to the High Voltages encountered, and the safe handling and operation of the picture tube.

TUNER CHASSIS VOLTAGE CHART

Symbol	Tube Type	Function	Tube Socket Pin No.							
			1	2	3	4	5	6	7	8
V 4	6AG5	1st Video I.F. Amp.	-3	.3	6.3*	0	115	105	0	
V 5	6AG5	2nd Video I.F. Amp.	0	.5	6.3*	0	110	110	0	
V 6	6AG5	3rd Video I.F. Amp.	-.2	.3	6.3*	0	105	120	0	
V 7	6AG5	4th Video I.F.	0	1.3	6.3*	0	95	135	0	
V 8	6AL5	Video Det. and AGC Det.	0	-120	6.3*	0	-115	0	-.4	
V 9	6AU6	1st Video Amp.	-.5	0	6.3*	0	140	155	0	
V10	6V6	Video Output	0	0	145	250	0	0	6.3*	11
V12	6AT6	AGC Amp.	-110	-110	0	6.3*	-110	-115	-.2	
V13	6AL5	DC Restorer & AGC Limiter	-.5	20	6.3*	0	-.1	0	-2	
V14	6BA6	1st Sound I.F. Amp.	0	0	0	6.3*	125	125	1.5	
V15	6BA6	2nd Sound I.F. Amp.	0	0	0	6.3*	125	125	1.5	
V16	6AU6	Limiter	-.2	0	0	6.3*	50	50	0	
V17	6AL5	Discriminator	0	-.4	6.3*	0	0	0	-.4	
V18	6SQ7	1st Audio Amp.	0	0	0	0	0	100	0	6.3*
V19	6V6	Audio Output	0	0	230	230	0	0	6.3*	10

CONDITIONS: All voltages measured between tube socket pins and chassis, using a 20,000 ohm per volt meter, except those indicated by *, which are AC.

Line Voltage: 117 volts. CHANNEL SELECTOR at No. 13. Antenna terminals shorted.

3NP4 Tube beam current: 100 uA (by BRILLIANCE control setting).

VOLUME, CONTRAST and FOCUS controls full clockwise.

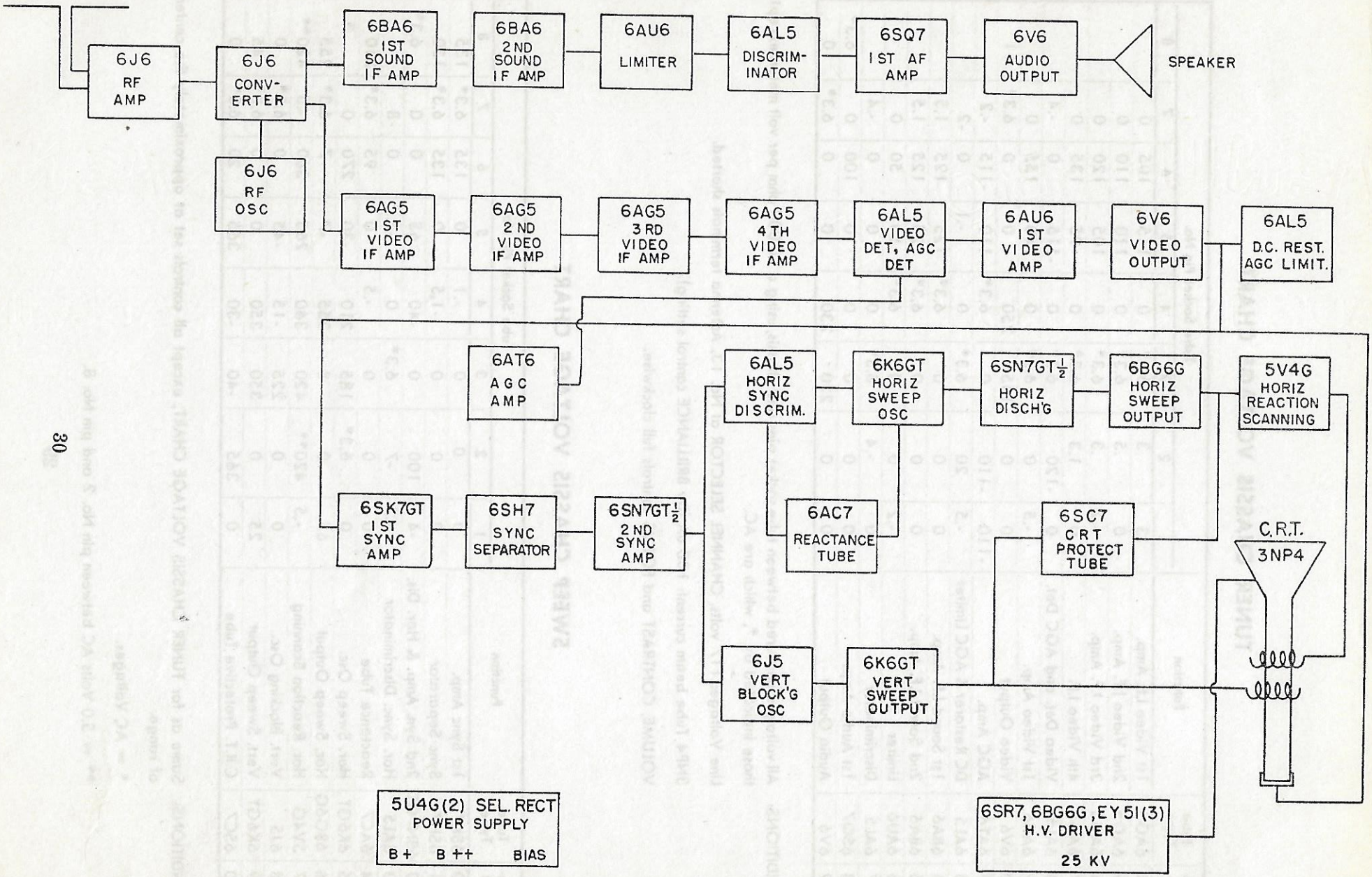
SWEEP CHASSIS VOLTAGE CHART

Symbol	Tube Type	Function	Tube Socket Pin No.							
			1	2	3	4	5	6	7	8
V20	6SK7	1st Sync Amp.	0	0	0	-.1	0	135	6.3*	135
V21	6SH7	Sync Separator	0	0	0	-1.5	0	135	6.3*	130
V22	6SN7GT	2nd Syn. Amp. & Hor. Dis.	-4	100	0	-40	65	0	0	6.3*
V23	6AL5	Hor. Sync. Discriminator	-.3	-7	6.3*	0	-1.5	0	-8	
V24	6AC7	Reactance Tube	0	0	0	-.5	0	95	6.3*	210
V25	6K6GT	Hor. Sweep Osc.	0	6.3*	185	210	-30	270	0	.3
V26	6BG6G	Hor. Sweep Output	65	0	8	355	-7	-7	6.3*	255
V27	5V4G	Hor. Reaction Scanning	-.5	420**	420	360	265	360	-.5	420**
V28	6J5	Vert. Blocking Osc.	0	0	225	-15	-45	0	6.3*	0
V29	6K6GT	Vert. Sweep Output	25	0	350	350	0	0	6.3*	45
V30	6SC7	C.R.T. Protective Tube	0	365	-40	-30	365	20	6.3*	0

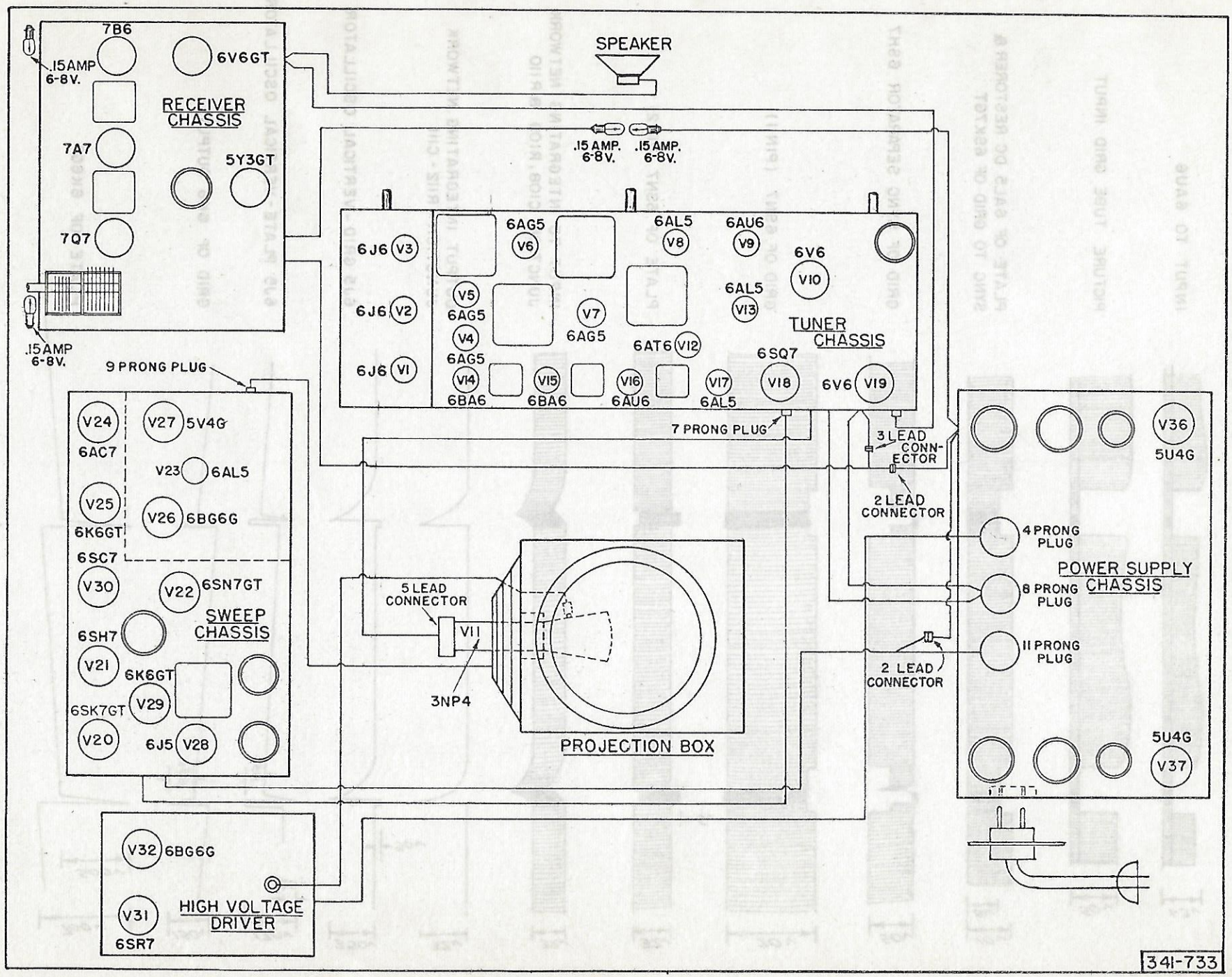
CONDITIONS: Same as for TUNER CHASSIS VOLTAGE CHART, except all controls set at approximately the center of range.

* = AC Voltages.

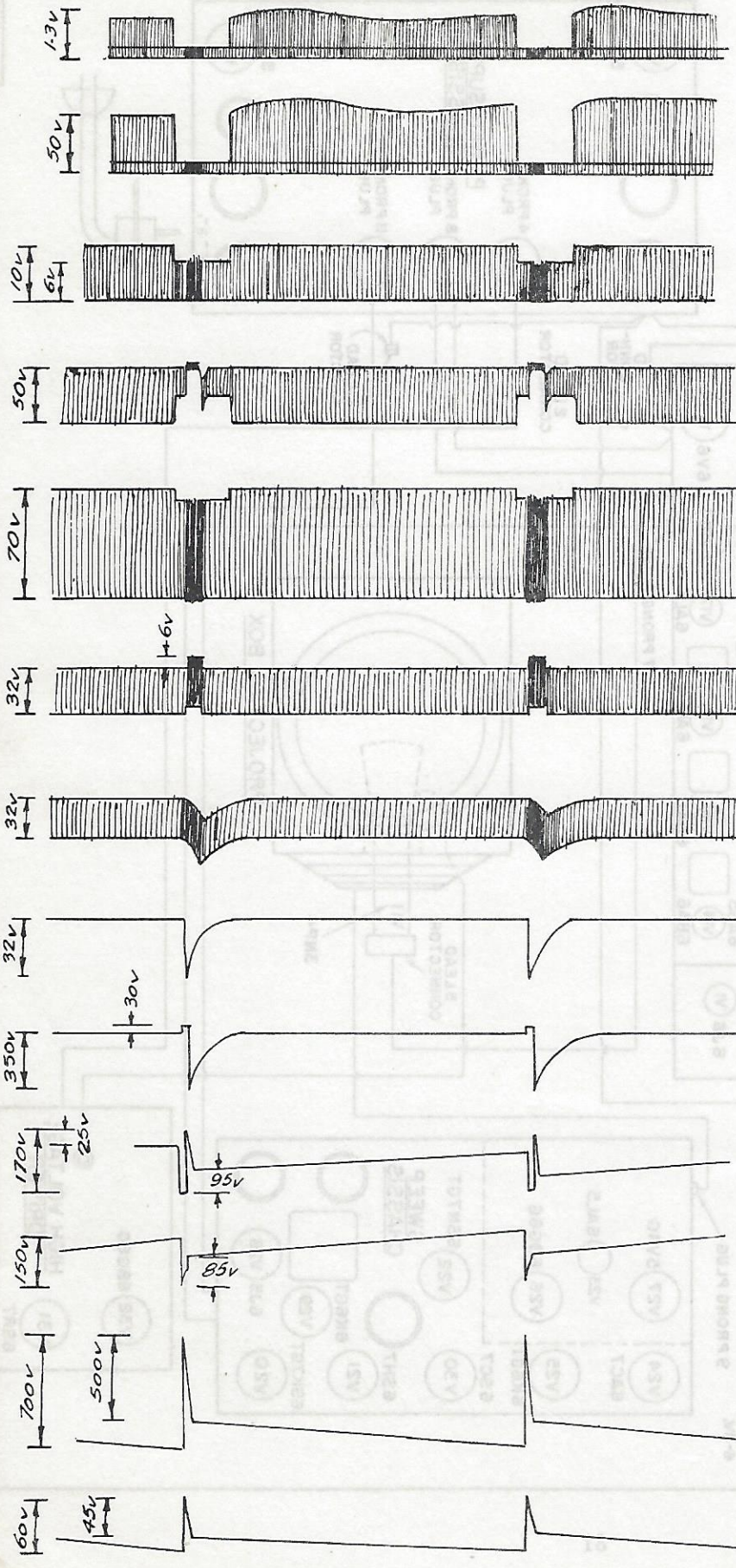
** = 5.0 Volts AC between pin No. 2 and pin No. 8.



BLOCK DIAGRAM OF TELEVISION RECEIVER


7B6
.15AMP 6-8V.
6V6GT
RECEIVER CHASSIS
7A7
5Y3GT
7Q7
.15AMP 6-8V.
SPEAKER
.15 AMP. 6-8V.
.15 AMP. 6-8V.
6J6 V3
6J6 V2
6J6 V1
6AG5 V6
V5 6AG5
V4 6AG5
V7 6AG5
6AL5 V8
6AU6 V9
6V6 V10
6AL5 V13
6AT6 V12
6SQ7 V18
6V6 V19
V14 6BA6
V15 6BA6
V16 6AU6
V17 6AL5
TUNER CHASSIS
9 PRONG PLUG
7 PRONG PLUG
3 LEAD CONNECTOR
2 LEAD CONNECTOR
V24 6AC7
V27 5V4G
V23 6AL5
V25 6K6GT
V26 6BG6G
6SC7
V30
V22 6SN7GT
SWEEP CHASSIS
6SH7
V21
6K6GT
V29
6SK7GT
V20
6J5 V28
5 LEAD CONNECTOR
V11
3NP4
PROJECTION BOX
V36 5U4G
4 PRONG PLUG
8 PRONG PLUG
11 PRONG PLUG
2 LEAD CONNECTOR
POWER SUPPLY CHASSIS
5U4G V37
V32 6BG6G
V31 6SR7
HIGH VOLTAGE DRIVER
341-733

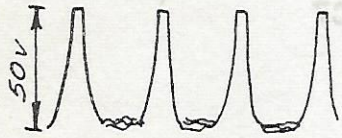
VERTICAL WAVEFORMS



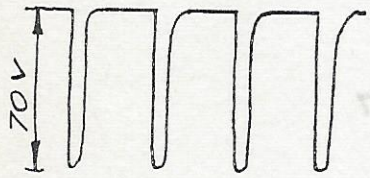
HORIZONTAL WAVEFORMS

INPUT TO PICTURE TUBE GRID

PLATE OF 6AL5 DC RESTORER & GRID OF 6SK7GT



GRID OF 6SH7 SYNC SEPARATOR



GRID OF 6SN7GT (PIN 1)

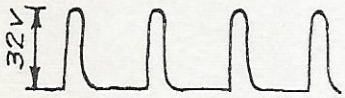
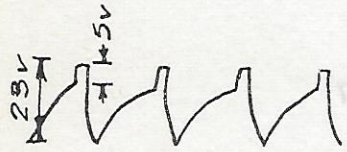


PLATE OF 6SN7GT (PIN 2)

INPUT TO INTEGRATING NETWORK JUNCTION C108, R109 & R110



CENTER TAP SECONDARY DISC (TERM NO. 5)

CATHODE 6AL5 (PIN 1)

CATHODE 6AL5 (PIN 5)

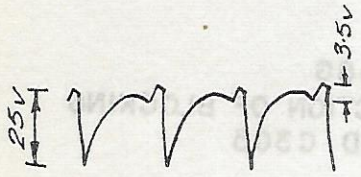


PLATE OF 6AL5 (PIN 7)

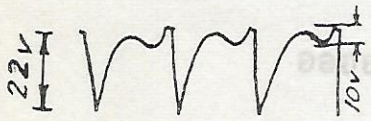
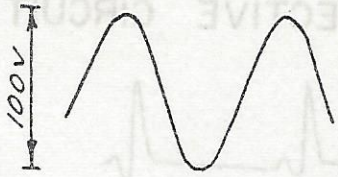


PLATE OF 6AL5 (PIN 2)



HIGH SIDE OF DISC PRIMARY

CATHODE OF 6K6 OSCILLATOR

CATHODE OF 6AC7 REACTANCE TUBE

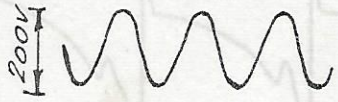
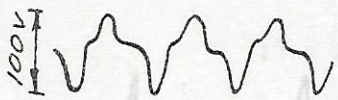


PLATE OF 6K6GT OSCILLATOR



GRID OF 6SN7GT (PIN NO 4)

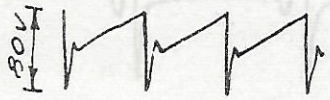


PLATE OF 6SN7GT (PIN NO 5) & GRID OF 6BG6G

CATHODE OF 6BG6G

SCREEN 6BG6G

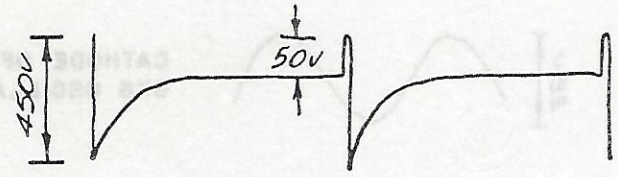
CATHODE OF 5V4G

PLATE OF HORIZONTAL OUTPUT 6BG6G

INPUT TO HORIZ. DEFLECT. COILS

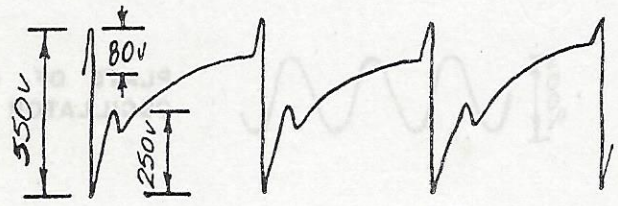
PROTECTIVE CIRCUIT WAVEFORMS

HORIZONTAL
PIN NO. 4 OF 6SC7



VERTICAL
PIN NO.3 OF 6SC7

HIGH VOLTAGE DRIVER WAVEFORMS



GRID OF 6SR7

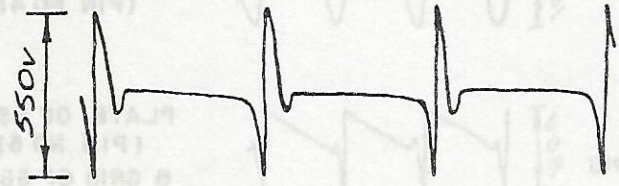
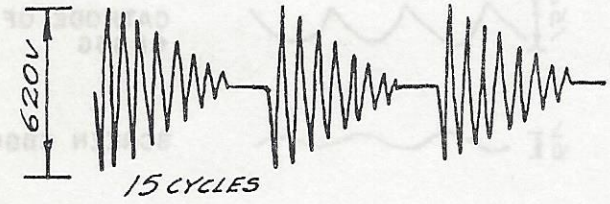
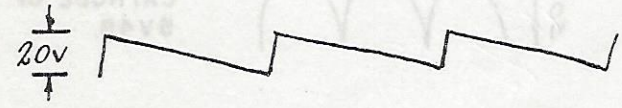


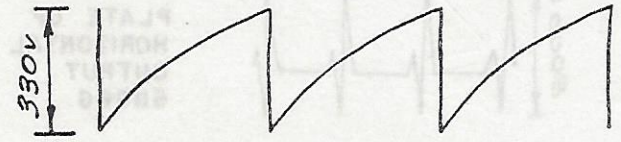
PLATE OF 6SR7



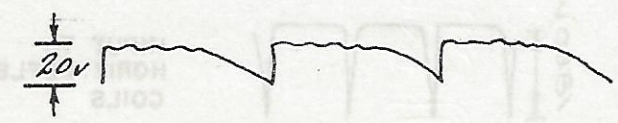
DIODES OF 6SR7



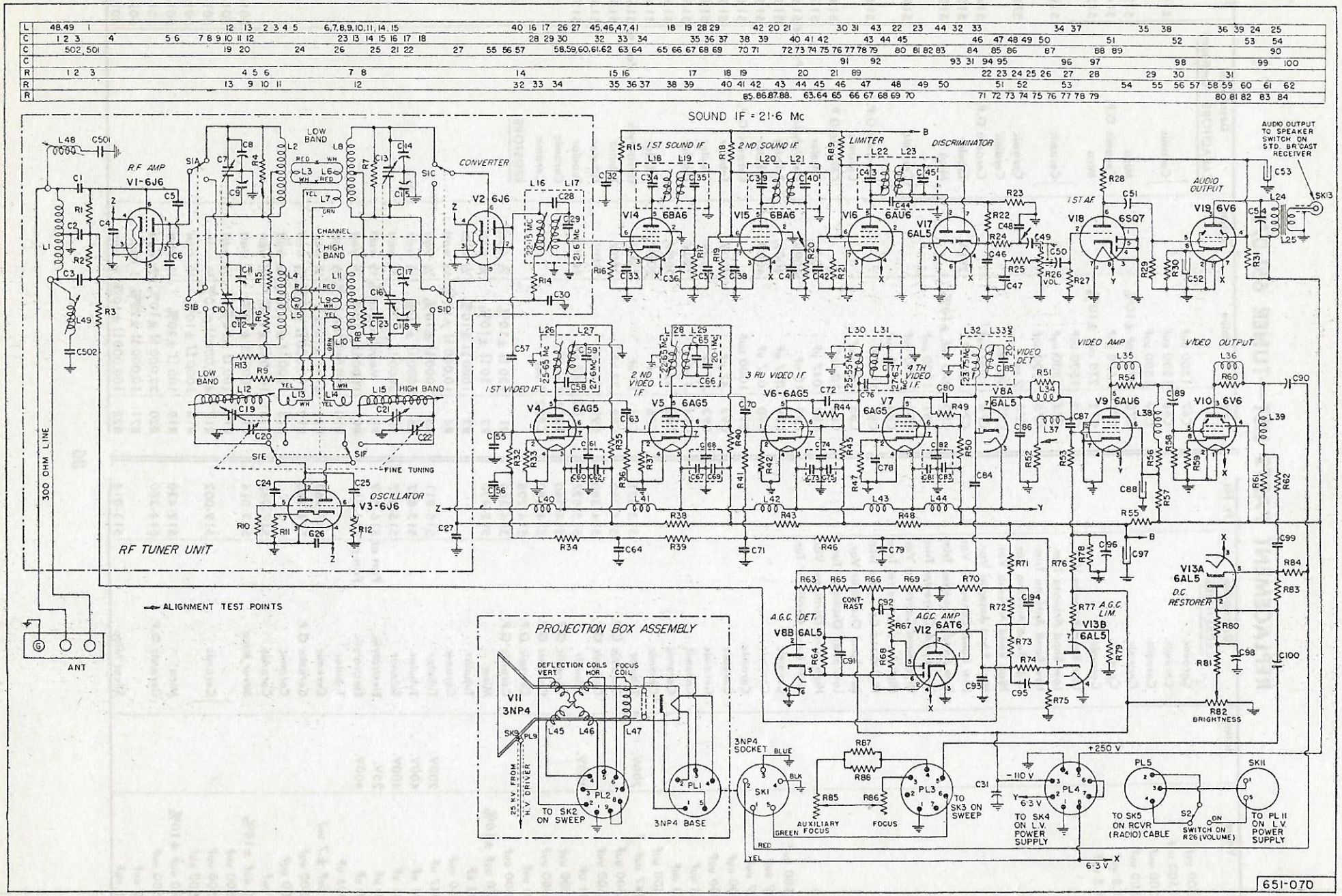
CATHODE OF 6SR7



GRID OF 6BG6G
(SAME AT JUNCTION OF BLOCKING
OSC. COIL AND C305



SCREEN OF 6BG6G



SCHEMATIC DIAGRAM OF TUNER CHASSIS

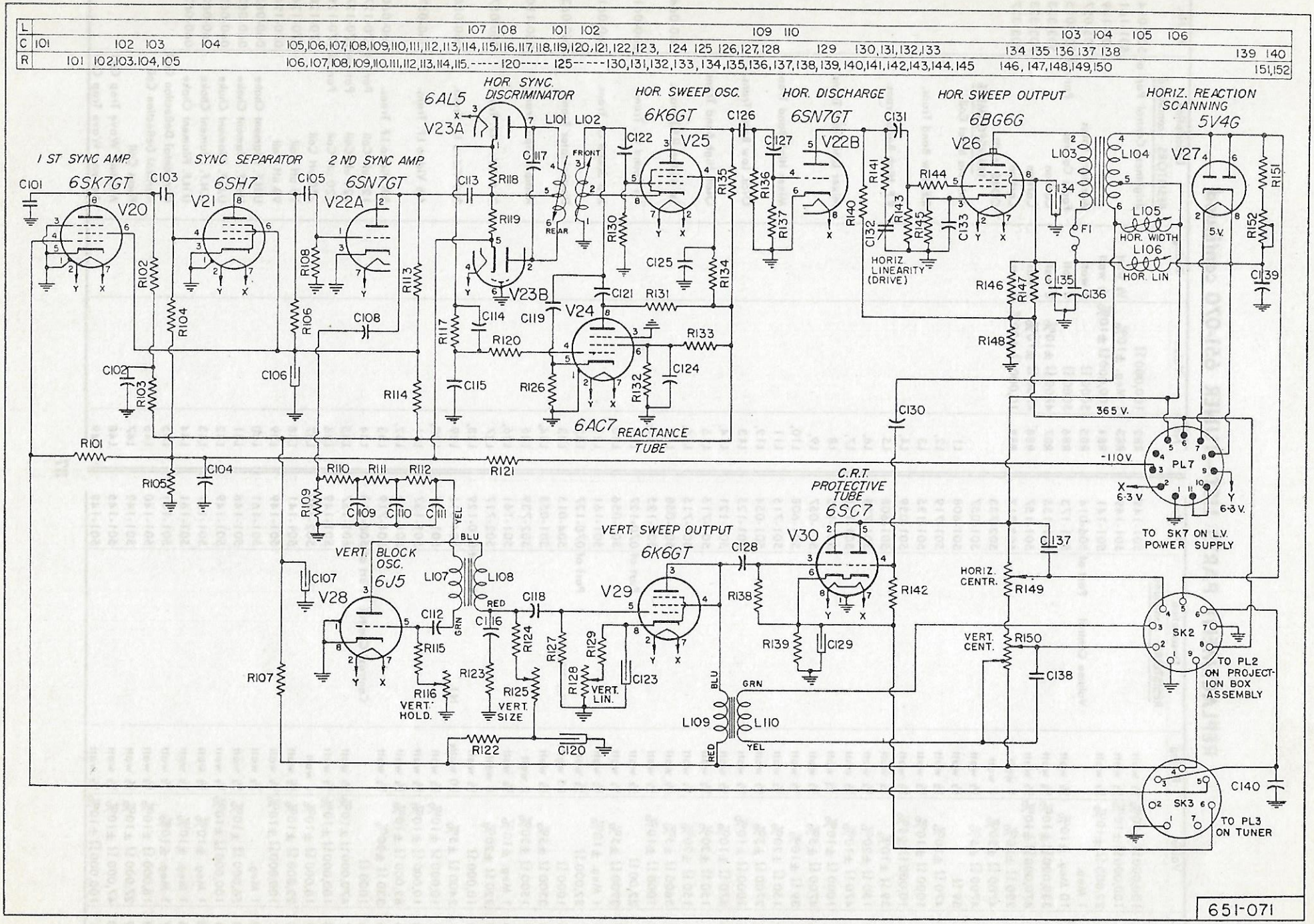
REPLACEMENT PARTS LIST—TUNER 651-070

No.	Value	Rating	Description	Pt. No.
			CAPACITORS	
C1	300 uuF		Ceramic	
C2	1500 uuF		Ceramic	
C3	300 uuF		Ceramic	
C4	500 uuF		Ceramic	
C5	1.5 uuF		Ceramic	
C6	1.5 uuF		Ceramic	
C7			Low Band Antenna Var.	
C8			Low Band Antenna Trim.	
C9			Low Band Antenna Trim.	
C10			High Band Antenna Var.	
C11			High Band Antenna Var.	
C12			High Band Antenna Var.	
C13			Low Band Converter Var.	
C14			Low Band Converter Trim.	
C15			Low Band Converter Trim.	
C16			High Band Converter Var.	
C17			High Band Converter Trim.	
C18			High Band Converter Trim.	
C19			Low Band Oscillator Var.	
C20			Low Band Oscillator Tun.	
C21			High Band Oscillator Var.	
C22			High Band Oscillator Tun.	
C23	1500 uuF		Ceramic	
C24	4.7 uuF		Ceramic	
C25	4.7 uuF		Ceramic	
C26	500 uuF		Ceramic	
C27	500 uuF		Ceramic	
C28	15 uuF		Ceramic	
C29	82 uuF		Ceramic	
C30	1500 uuF		Ceramic	
C31	.047 uF	200V.	Tubular	515-831
C32	1500 uuF		Ceramic G.P.	514-380
C33	1500 uuF		Ceramic G.P.	514-380
C36	.01 uF	400V.	Tubular	515-827
C37	1500 uuF		Ceramic G.P.	514-380
C38	1500 uuF		Ceramic G.P.	514-380
C41	50 uuF		Ceramic G.P.	514-208
C42	1500 uuF		Ceramic G.P.	514-380
C46	270 uuF ±10%		Mica	512-430
C47	.02 uF		Tubular	
C48	150 uuF		Ceramic	
C49	.047 uF	200V.	Tubular	515-811
C50	.01 uF	400V.	Tubular	515-827
C51	.01 uF	400V.	Tubular	515-827
C52	20 uF	25V.	Electrolytic, Part of	516-519
C53	10 uF	400V.	Electrolytic Part of	516-519
C54	.005 uF		Tubular	
C55	7 uuF ±.7 uuF		Ceramic	517-963
C56	1500 uuF		Ceramic G.P.	514-380
C57	300 uuF		Ceramic	
C58	2 uuF		Ceramic	517-962
C59	50 uuF ±10%		Silver Mica	513-014
C60	1500 uuF			
C61	1500 uuF		Ceramic	519-002
C62	1500 uuF			
C63	270 uuF ±10%		Mica	512-430
C64	1500 uuF		Ceramic G.P.	514-380
C65	82 uuF			
C66	15 uuF		Silver Mica	513-014

No.	Value	Rating	Description	Pt. No.
			CAPACITORS—continued	
C67	1500 uuF			
C68	1500 uuF		Ceramic	519-002
C69	1500 uuF			
C70	270 uuF ±10%		Mica	512-430
C71	1500 uuF		Ceramic G.P.	514-380
C72	270 uuF ±10%		Mica	512-430
C73	1500 uuF			
C74	1500 uuF		Ceramic	519-002
C75	1500 uuF			
C76	2 uuF		Ceramic	572-962
C77	50 uuF		Ceramic	
C78	1500 uuF		Ceramic G.P.	514-380
C79	.047 uF	200V.	Tubular	515-811
C80	270 uuF ±10%		Mica	512-430
C81	1500 uuF			
C82	1500 uuF		Ceramic	519-002
C83	1500 uuF			
C84	33 uuF		Ceramic G.P.	514-110
C85	100 uuF		Ceramic	
C86	10 uuF		Ceramic G.P.	514-354
C87	.047 uF	200V.	Tubular	515-811
C88	10 uF	400V.	Electrolytic Part of	516-519
C89	.047 uF	400V.	Tubular	515-831
C90	.047 uF	400V.	Tubular	515-831
C91	1000 uuF		Ceramic G.P.	514-378
C92	.47 uF	200V.	Tubular	515-817
C93	.47 uF	200V.	Tubular	515-817
C94	.1 uF	200V.	Tubular	515-813
C95	.22 uF	200V.		515-815
C96	.1 uF	200V.	Tubular	515-813
C97	10 uF	400V.	Electrolytic Part of	516-519
C98	.22 uF	200V.	Tubular	515-815
C99	.047 uF	200V.	Tubular	515-811
C100	.047 uF	200V.	Tubular	515-811
C501	7 uuF		Ceramic	
C502	7 uuF		Ceramic	
			RESISTORS	
R1	150 Ω ±10%	½ watt		
R2	150 Ω ±10%	½ watt		
R3	1000 Ω ±10%	½ watt		
R4	10,000 Ω ±10%	½ watt		
R5	1000 Ω ±10%	½ watt		
R6	1000 Ω ±10%	½ watt		
R7	5600 Ω ±10%	½ watt		
R8	1 Megohm ±10%	½ watt		
R9	1000 Ω ±10%	½ watt		
R10	100,000 Ω ±10%	½ watt		
R11	47 Ω ±10%	½ watt		
R12	100,000 Ω ±10%	½ watt		
R13	1000 Ω ±10%	½ watt		
R14	1000 Ω ±10%	½ watt		
R15	1000 Ω ±10%	½ watt		501-125
R16	100 Ω ±20%	½ watt		501-713
R17	470,000 Ω ±10%	½ watt		501-157
R18	1000 Ω ±10%	½ watt		501-125
R19	100 Ω ±20%	½ watt		501-713
R20	22,000 Ω ±10%	½ watt		501-141
R21	10,000 Ω ±20%	1 watt		502-737
R22	100,000 Ω ±10%	½ watt		501-149

REPLACEMENT PARTS LIST—TUNER 651-070 *continued*

No.	Value	Rating	Description	Pt. No.
			RESISTORS—continued	
R23	100,000 Ω ±10%	½ watt		501-149
R24	100,000 Ω ±10%	½ watt		501-149
R25	22,000 Ω ±10%	½ watt		501-141
R26	1 Meg.		Volume Control Part of	506-014
R27	10 Meg. ±10%	½ watt		501-173
R28	330,000 Ω ±10%	½ watt		501-155
R29	470,000 Ω ±10%	½ watt		501-157
R30	220 Ω ±20%	1 watt		502-717
R31	4700 Ω ±20%	1 watt		502-733
R32	4700 Ω ±5%	½ watt		501-057
R33	39 Ω	½ watt		501-608
R34	470 Ω ±10%	½ watt		501-719
R35	1000 Ω ±10%	½ watt		501-125
R36	10,000 Ω ±5%	½ watt		501-059
R37	39 Ω ±10%	½ watt		501-608
R38	150 Ω ±20%	½ watt		501-715
R39	470 Ω ±10%	½ watt		501-121
R40	1000 Ω ±10%	½ watt		501-125
R41	4700 Ω ±5%	½ watt		501-057
R42	39 Ω ±10%	½ watt		501-608
R43	150 Ω ±20%	½ watt		501-715
R44	2700 Ω ±5%	½ watt		501-054
R45	1000 Ω ±10%	½ watt		501-125
R46	470 Ω ±10%	½ watt		501-121
R47	150 Ω ±20%	½ watt		501-715
R48	150 Ω ±20%	½ watt		501-715
R49	5600 Ω ±5%	½ watt		501-058
R50	1000 Ω ±10%	½ watt		501-125
R51	22,00 Ω	½ watt	Part of	070-127
R52	3900 Ω ±5%	½ watt		501-056
R53	1 Meg. ±10%	½ watt		501-161
R54	22,000 Ω	½ watt	Part of	070-127
R55	1000 Ω	15 watts	Wire Wound	504-015
R56	3300 Ω ±5%	½ watt		501-055
R57	1500 Ω ±20%	1 watt		502-739
R58	1 Meg. ±10%	½ watt		501-161
R59	220 Ω ±20%	1 watt		502-717
R60	10,000 Ω	½ watt	Part of	070-129
R61	2400 Ω ±5%	10 watts	N.I.	504-016
R62	10,000 Ω ±10%	½ watt		501-137
R63	10,000 Ω ±10%	½ watt		501-137
R64	82,000 Ω ±10%	½ watt		501-148
R65	330 Ω ±20%	½ watt		501-719
R66	1000 Ω		Contrast Control Part of	506-015
R67	470,000 Ω ±10%	½ watt		501-157
R68	100,000 Ω ±10%	½ watt		501-149
R69	18,000 Ω ±10%	1 watt		502-640
R70	22,000 Ω ±10%	½ watt		501-141
R71	100,000 Ω ±10%	½ watt		501-149
R72	1 Meg.	½ watt		501-161
R73	56,000 Ω ±10%	½ watt		501-146
R74	100,000 Ω ±10%	½ watt		501-149
R75	1 Meg. ±10%	½ watt		501-161
R76	1 Meg. ±10%	½ watt		501-161
R77	1 Meg. ±10%	½ watt		501-161
R78	18,000 Ω ±10%	½ watt		501-140
R79	27,000 Ω ±10%	½ watt		501-142
R80	47,000 Ω ±10%	½ watt		501-145
R81	100,000 Ω ±10%	½ watt		501-149
R82	100,000 Ω		Brightness Control Part of	506-014
R83	1 Meg. ±10%	½ watt		501-161
R84	100,000 Ω ±10%	½ watt		501-149
R85	5000 Ω	4 watt	Auxiliary Focus	505-027
R86	5000 Ω	4 watt	Focus Control Part of	506-015
R87	4700 Ω ±10%	2 watt	Carbon	503-333
R88	4700 Ω ±10%	2 watt	Carbon	503-333
R89	10,000 Ω ±20%	2 watt	Carbon	503-337
			COILS AND TRANSFORMERS	
L1			Antenna Input Coil	
L2, L3			R.F. Low Band Trans.	
L4, L5			R.F. High Band Trans.	
L6, L7, L8			Mixer Low Band Trans.	
L9, L10, L11			Mixer High Band Trans.	
L12, L13			Oscil. Low Band Trans.	
L14, L15			Oscil. High Band Trans.	
L16, L17			1st Video (I.F.) Trans.	060-064
L18, L19			1st Sound I.F. Trans.	060-061
L20, L21			2nd Sound I.F. Trans.	060-061
L22, L23			Discriminator Trans.	060-062
L24, L25			Audio Output Trans.	050-110
L26, L27			2nd Video I.F. Trans.	060-057
L28, L29			3rd Video I.F. Trans.	060-058
L30, L31			4th Video I.F. Trans.	060-057
L32, L33			5th Video I.F. Trans.	060-060
L34			120 uH Coil Part of	070-127
L35			120 uH Coil Part of	070-127
L36			120 uH Coil Part of	070-129
L37			250 uH Coil	070-128
L38			93 uH Coil	070-126
L39			93 uH Coil	070-126
L40			U.H.F. Filament Choke	060-063
L41			U.H.F. Filament Choke	060-063
L42			U.H.F. Filament Choke	060-063
L43			U.H.F. Filament Choke	060-063
L44			U.H.F. Filament Choke	060-063
L45			Horizontal Deflection Coil	
L46			Vertical Deflection Coil	
L47			Focus Coil	
L48			Antenna Wave Trap Coil	
L49			Antenna Wave Trap Coil	



SCHEMATIC DIAGRAM OF SWEEP CHASSIS

REPLACEMENT PARTS LIST—SWEEP CHASSIS 651-071

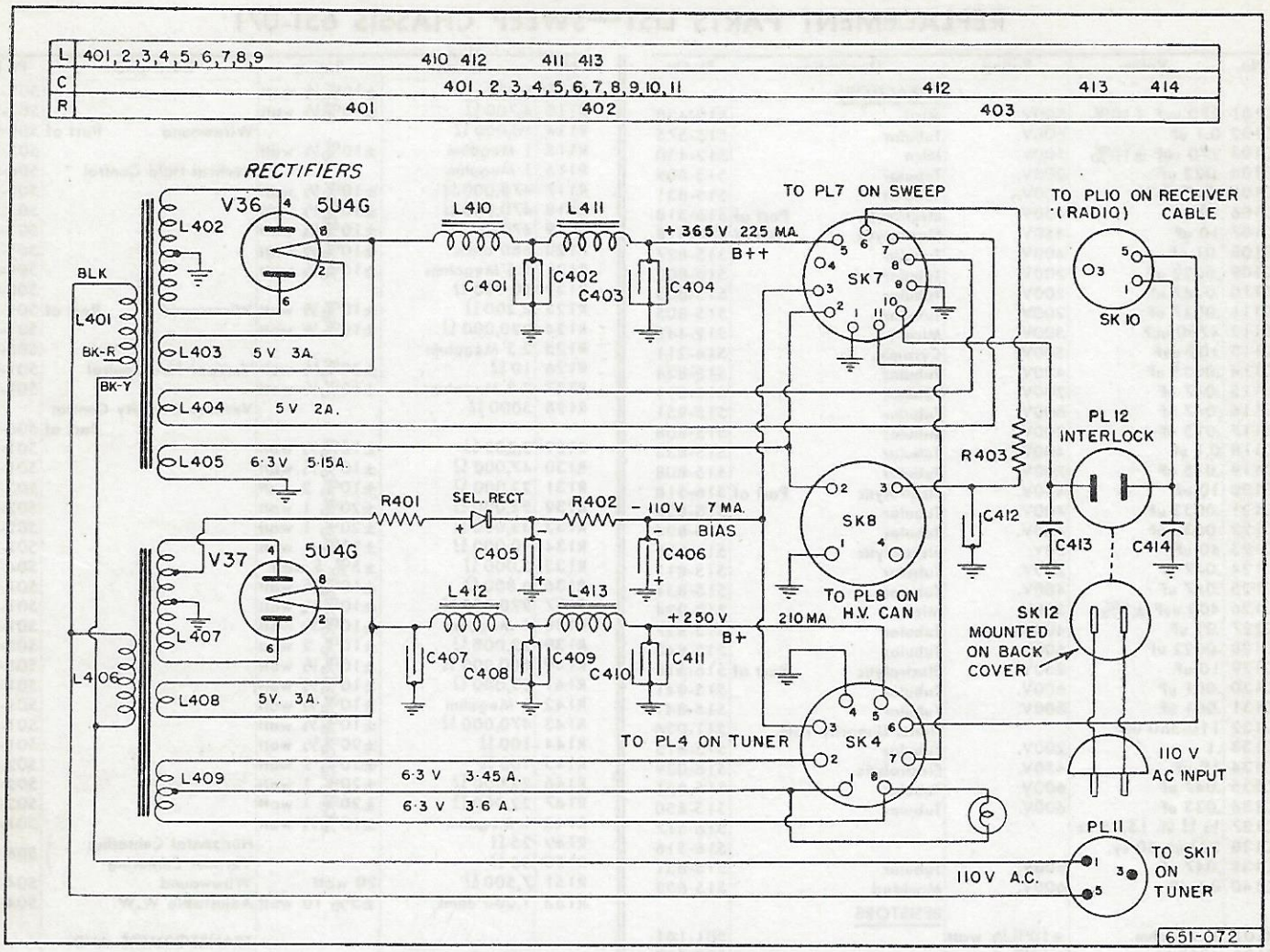
No.	Value	Rating	Description	Pt. No.
			CAPACITORS	
C101	270 uuF ±10%	500V.	Mica	512-430
C102	0.1 uF	600V.	Tubular	515-575
C103	270 uuF ±10%	500V.	Mica	512-430
C104	.022 uF	200V.	Tubular	515-809
C105	.047 uF	400V.	Tubular	515-831
C106	10 uF	450V.	Electrolytic Part of	516-518
C107	10 uF	450V.	Electrolytic Part of	516-518
C108	.01 uF	400V.	Tubular	515-827
C109	.0022 uF	200V.	Tubular	515-803
C110	.0047 uF	200V.	Tubular	515-805
C111	.0047 uF	200V.	Tubular	515-805
C112	4700 uuF	500V.	Mica	512-445
C113	100 uuF	500V.	Ceramic	514-211
C114	.0033 uF	400V.	Tubular	515-824
C115	.047 uF	200V.	Tubular	515-811
C116	.047 uF	600V.	Tubular	515-851
C117	.015 uF	200V.	Tubular	515-808
C118	0.1 uF	400V.	Tubular	515-833
C119	.015 uF	200V.	Tubular	515-808
C120	10 uF	450V.	Electrolytic Part of	516-518
C121	.0033 uF	400V.	Tubular	515-824
C122	.0033 uF	400V.	Tubular	515-824
C123	40 uF	50V.	Electrolytic	516-038
C124	.047 uF	200V.	Tubular	515-811
C125	.047 uF	400V.	Tubular	515-831
C126	400 uuF ±5%	500V.	Mica	512-024
C127	.01 uF	400V.	Tubular	515-827
C128	.0022 uF	600V.	Tubular	515-843
C129	10 uF	250V.	Electrolytic Part of	516-518
C130	.001 uF	600V.	Tubular	515-841
C131	.001 uF	600V.	Tubular	515-841
C132	110-560 uuF		Horiz. Linearity Trim.	511-026
C133	.1	200V.	Tubular	515-813
C134	10 uF	450V.	Electrolytic	516-039
C135	.047 uF	600V.	Tubular	515-851
C136	.033 uF	600V.	Tubular	515-850
C137	½ Ω @ 15.75 kc			516-517
C138	2 Ω @ 60 cy.			516-516
C139	.047 uF	600V.	Tubular	515-851
C140	0.1 uF	600V.	Moulded	515-853
			RESISTORS	
R101	1 Megohm	±10% ½ watt		501-161
R102	4700 Ω	±10% 2 watt		503-333
R103	4700 Ω	±20% 1 watt		502-733
R104	1 Megohm	±10% ½ watt		501-161
R105	22,000 Ω	±10% ½ watt		501-141
R106	6,800 Ω	±10% ½ watt		501-135
R107	1500 Ω		Wirewound Part of	509-001
R108	1 Megohm	±10% ½ watt		501-161
R109	22,000 Ω	±10% ½ watt		501-141
R110	22,000 Ω	±10% ½ watt		501-141
R111	8,200 Ω	±10% ½ watt		501-136

No.	Value	Rating	Description	Pt. No.
R112	8,200 Ω	±10% ½ watt		501-136
R113	4,700 Ω	±10% ½ watt		501-133
R114	10,000 Ω		Wirewound Part of	509-001
R115	1 Megohm	±10% ½ watt		501-161
R116	1 Megohm		Vertical Hold Control	506-017
R117	470,000 Ω	±10% ½ watt		501-157
R118	470,000 Ω	±10% ½ watt		501-157
R119	470,000 Ω	±10% ½ watt		501-157
R120	680 ohms	±10% ½ watt		501-123
R121	1.5 Megohms	±10% ½ watt		501-163
R122	10,000 Ω			509-001
R123	8,200 Ω	±10% ½ watt	Wirewound Part of	501-136
R124	220,000 Ω	±10% ½ watt		501-153
R125	2.5 Megohms			505-028
R126	10 Ω	±20% ½ watt	Vertical Size Control	501-701
R127	2.2 Megohms	±10% ½ watt		501-165
R128	5000 Ω		Vertical Linearity Control Part of	506-017
R129	2,200 Ω	±10% ½ watt		501-129
R130	47,000 Ω	±10% ½ watt		501-145
R131	22,000 Ω	±10% 2 watt		503-141
R132	22,000 Ω	±20% 1 watt		502-741
R133	33,000 Ω	±20% 1 watt		502-743
R134	10,000 Ω	±20% 1 watt		502-737
R135	5,000 Ω	±5% 5 watt		504-014
R136	6,800 Ω	±10% ½ watt		501-135
R137	220,000 Ω	±10% ½ watt		501-153
R138	1 Megohm	±10% ½ watt		501-161
R139	22,000 Ω	±10% 2 watt		503-141
R140	680,000 Ω	±10% ½ watt		501-159
R141	22,000 Ω	±10% ½ watt		501-141
R142	1 Megohm	±10% ½ watt		501-161
R143	470,000 Ω	±10% ½ watt		501-157
R144	100 Ω	±20% ½ watt		501-713
R145	100 Ω	±20% 1 watt		502-713
R146	22,000 Ω	±20% 1 watt		502-741
R147	22,000 Ω	±20% 1 watt		502-741
R148	1 Megohm	±10% ½ watt		501-161
R149	25 Ω		Horizontal Centering	506-016
R150	50 Ω		Vertical Centering	
R151	7,500 Ω	20 watt	Wirewound	504-013
R152	1,000 ohms	±5% 10 watt	Adjustable W.W.	504-031
			TRANSFORMERS AND COILS	
L101, L102			Hor. Sync Disc. Trans.	060-065
L103, L104			Hor. Output Trans.	050-114
L105			Hor. Width Control	060-069
L106			Hor. Linearity Control	060-066
L107, L108			Vertical Block Osc. Trans.	050-112
L109, L110			Vertical Output Trans.	050-111

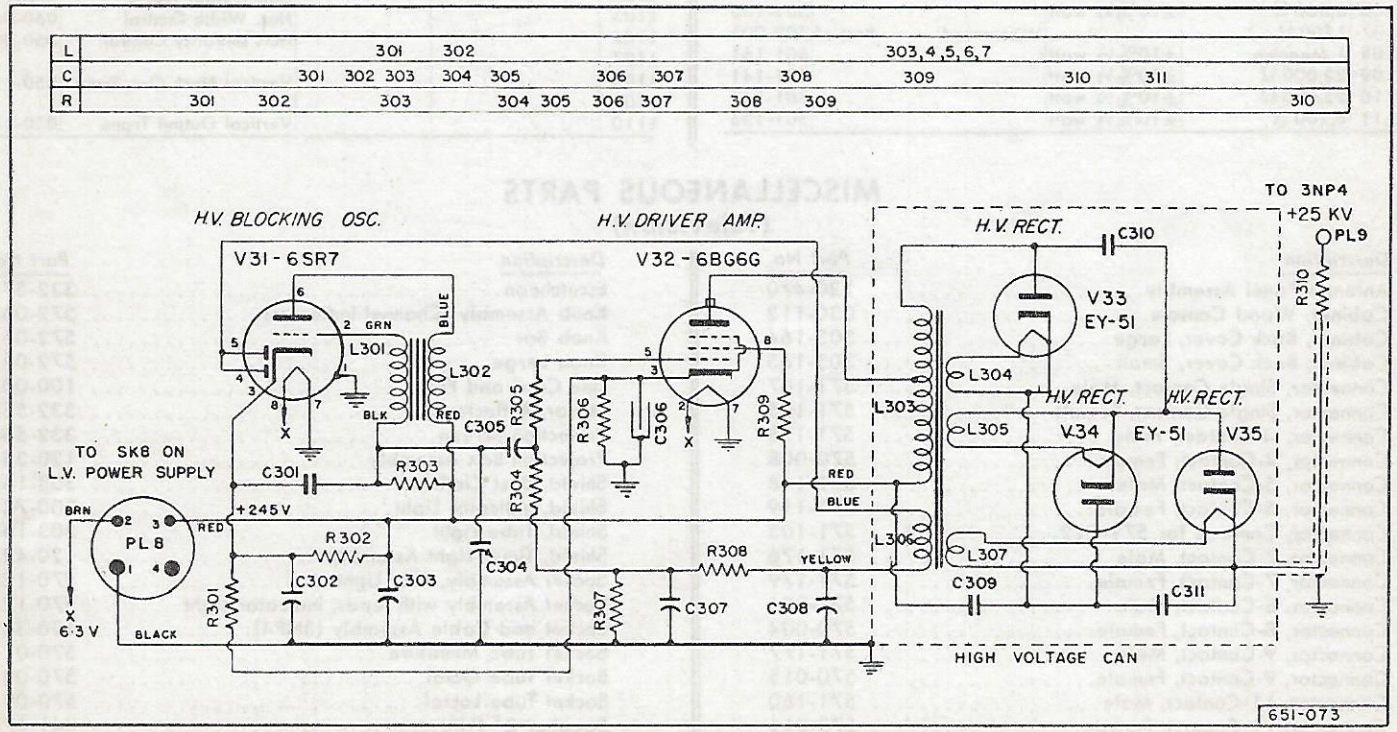
MISCELLANEOUS PARTS
(Television)

Description	Part No.
Antenna Panel Assembly	120-470
Cabinet, Wood Console	030-112
Cabinet, Back Cover, Large	303-164
Cabinet, Back Cover, Small	303-165
Connector, Single Contact, Male	571-107
Connector, Single Contact, Female	571-105
Connector, 4-Contact, Male	571-178
Connector, 4-Contact, Female	570-008
Connector, 5-Contact, Male	571-118
Connector, 5-Contact, Female	571-119
Connector, Contacts for 571-119	571-105
Connector, 7-Contact, Male	571-176
Connector, 7-Contact, Female	571-179
Connector, 8-Contact, Male	571-181
Connector, 8-Contact, Female	570-004
Connector, 9-Contact, Male	571-177
Connector, 9-Contact, Female	570-015
Connector, 11-Contact, Male	571-180
Connector, 11-Contact, Female	570-016
Connector, Assembly, (AC) Chassis Male	120-003
Connector, (AC) Body	571-102
Connector, (AC) Cap	571-101

Description	Part No.
Escutcheon	332-574
Knob Assembly (Channel Indicator)	572-067
Knob Bar	572-062
Knob Large	572-063
Line Cord and Plug	100-003
Mirror, Reflector	332-557
Projection Screen	332-558
Projection Box Assembly	120-351
Shield, Dust Cloth	303-163
Shield, Indicator Light	300-785
Shield, Tube Light	303-143
Shield, Tuner Light Assembly	120-427
Socket Assembly, Pilot Light	570-129
Socket Assembly with leads, Indicator Light	570-123
Socket and Cable Assembly (3NP4)	120-347
Socket Tube Miniature	570-017
Socket Tube Octal	570-001
Socket Tube Loctal	570-002
Speaker 8" P.M.	041-076
Speaker Grille Cloth 20" x 15½"	627-039
Speaker Metal Grille	350-044
Speaker Cone and Voice Coil Assembly	041-058



SCHEMATIC DIAGRAM OF LV POWER SUPPLY



SCHEMATIC DIAGRAM OF HV DRIVER AND HV CAN

REPLACEMENT PARTS LIST—LV POWER SUPPLY 651-072

No.	Value	Rating	Description	Pt. No.
			CAPACITORS	
C401	40 uF	450V.	Dual	
C402	40 uF	450V.	Electrolytic	516-512
C403	40 uF	450V.	Dual	
C404	40 uF	450V.	Electrolytic	516-512
C405	40 uF	150V.	Electrolytic	516-019
C406	80 uF	150V.	Electrolytic	516-018
C407	40 uF	450V.	Electrolytic	516-505
C408	40 uF	450V.	Dual	
C409	40 uF	450V.	Electrolytic	516-512
C410	40 uF	450V.	Dual	
C411	40 uF	450V.	Electrolytic	516-512
C412	40 uF	450V.	Electrolytic	516-505
C413	.01 uF	600V.	Paper Tubular	515-847
C414	.01 uF	600V.	Paper Tubular	515-847
			RESISTORS	
R401	330 ohms	10% 1 watt		502-119
R402	3300 ohms	10% ½ watt		501-131
R403	220 ohms	10% 1 watt		502-617
			TRANSFORMERS AND COILS	
L401 to L405			Power Transformer	050-108
L406 to L409			Power Transformer	050-109
L410			Filter Choke	050-107
L411			Filter Choke	050-107
L412			Filter Choke	050-107
L413			Filter Choke	050-107
			MISCELLANEOUS PARTS	
			Selenium Rectifier	130-027

REPLACEMENT PARTS LIST—HIGH VOLTAGE DRIVER AND HV CAN 651-073

No.	Value	Rating	Description	Pt. No.
			CAPACITORS	
C301	2700 uuF 5%	500V.	Mica Moulded	512-056
C302	.1 uF	400V.	Paper Tubular	515-525
C303	.1 uF	600V.	Paper Tubular	515-575
C304	110-560 uuF		Trimmer	511-026
C305	.01 uF	600V.	Paper Tubular	515-563
C306	20 uF	50V.	Electrolytic	516-029
C307	.015 uF	400V.	Paper Tubular	515-515
C308	.033 uF	400V.	Paper Tubular	515-559
C309	5000 uuF	10,000V.	Part of	120-360
C310	2500 uuF	20,000V.	Part of	120-360
C311	2500 uuF	20,000V.	Part of	120-360
			RESISTORS	
R301	18,000 ohms	10% 1 watt		502-140
R302	220,000 ohms	10% 1 watt		502-153
R303	390,000 ohms	5% 1 watt		502-511
R304	330,000 ohms	10% ½ watt		501-155
R305	330,000 ohms	10% ½ watt		501-155
R306	390 ohms	10% 2 watt		503-120
R307	220,00 ohms	5% ½ watt		501-538
R308	47,000 ohms	5% ½ watt		501-539
R309	330 ohms	10% ½ watt		501-119
R310	1.5 megohms	10% 1 watt		502-163
			MISCELLANEOUS PARTS	
L301, L302 L303 to L307			Oscil. Blocking Trans.	050-116
			H.V. Transformer Part of	120-360
			High Voltage Can	120-360

RADIO RECEIVER SERVICE DATA

GENERAL

This is a five tube standard broadcast band receiver. This model is designed for operation on 115 volts, 25 cycles or 60 cycles.

TUBES

7Q7 Pentagrid Converter
7A7 I.F. Amplifier
7B6 Diode Detector, A.V.C. and 1st A.F. Amplifier
6V6GT Audio Power Amplifier
5Y3GT Rectifier

FREQUENCY RANGE: 540 kc. to 1600 kc.

INTERMEDIATE FREQUENCY: 455 kc.

AUDIO POWER OUTPUT: 3 watts undistorted, 6 watts maximum.

CURRENT DRAIN: .5 ampere maximum.

SPEAKER

The speaker is a heavy permanent magnet dynamic type with a curvilinear cone, a voice coil D.C. resistance of 3.0 ohms, and a 400 cycle impedance of 3.2 ohms.

LOOP ANTENNA

The receiver is provided with a built-in loop antenna. If an external antenna is required it should be connected to the terminal post marked "A." If a ground connection is desired it should be connected to terminal "G." The loop antenna *must* remain connected in the normal manner when an external antenna and/or ground is used.

TONE CONTROL SWITCH

As the switch is turned from left to right, the five positions of the switch vary the tonal response as follows:

Position 1—Restricted bass and treble response.
Position 2—Full tonal response.
Position 3—Full treble response with accentuation of bass response.
Position 4—Restricted treble response with accentuation of bass response.
Position 5—Greater restriction of treble response with accentuation of bass response.

TO REMOVE CHASSIS

1. Disconnect plugs from A.C. interlock sockets.
2. Remove the loop and ground connections and external antenna, if used.
3. Remove control knobs.
4. Disconnect television audio cable, speaker leads and indicator lamp.
5. Remove the three nuts at the rear of the chassis securing the chassis to the bottom plate. This allows the chassis to slide out of the cabinet.

ALIGNMENT OF RECEIVER

EQUIPMENT REQUIRED

Signal Generator: Capable of supplying modulated frequencies from 450 kc. to 1700 kc.
Output Indicator: A power output meter or a high resistance A.C. voltmeter.

ALIGNMENT PROCEDURE AND EQUIPMENT CONNECTIONS

Signal Generator: Allow a sufficient length of time after the generator has been turned on for it to become thermally stable before making any tests. Always be sure to use the specified capacitor in series with the signal generator output lead connections, as listed on the alignment procedure chart. Connect the return lead of the signal generator to the ground terminal of the receiver.

Output Indicator: If a power output meter is used adjust it for 4 ohms impedance and connect it across the secondary of the output transformer in place of the speaker voice coil. Do not exceed 500 milliwatts output during alignment. If an A.C. voltmeter is used connect it across the voice coil with the speaker connected and do not exceed 1.5 volts during alignment. As the reading of the test meter increases with alignment, regulate the signal generator attenuator to keep the output within the limits specified above.

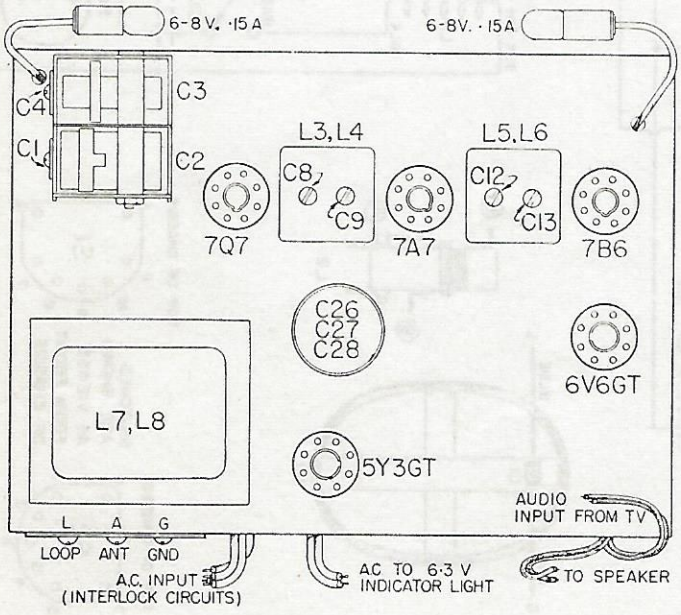
Receiver: With the Radio-Phonograph switch in the radio position, turn the volume control to the full clockwise position, and set the tone switch to the second position. With the gang tuning condenser fully closed, adjust the dial pointer to the alignment mark at the low frequency end of the dial scale.

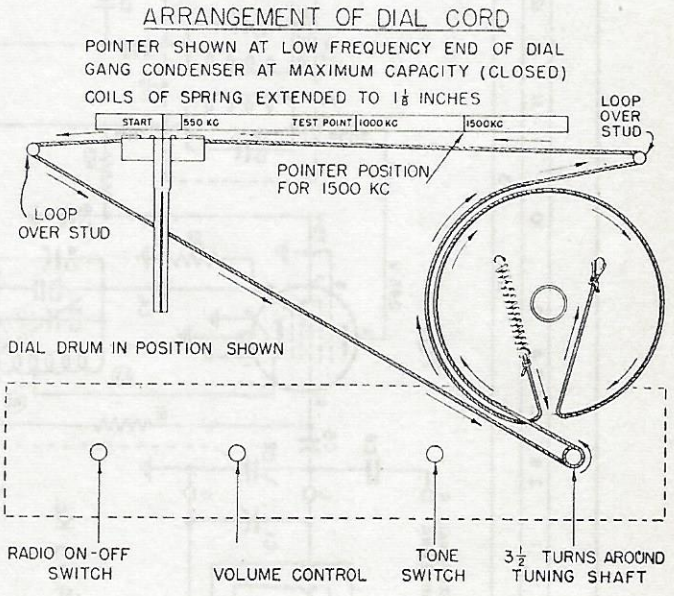
ALIGNMENT PROCEDURE

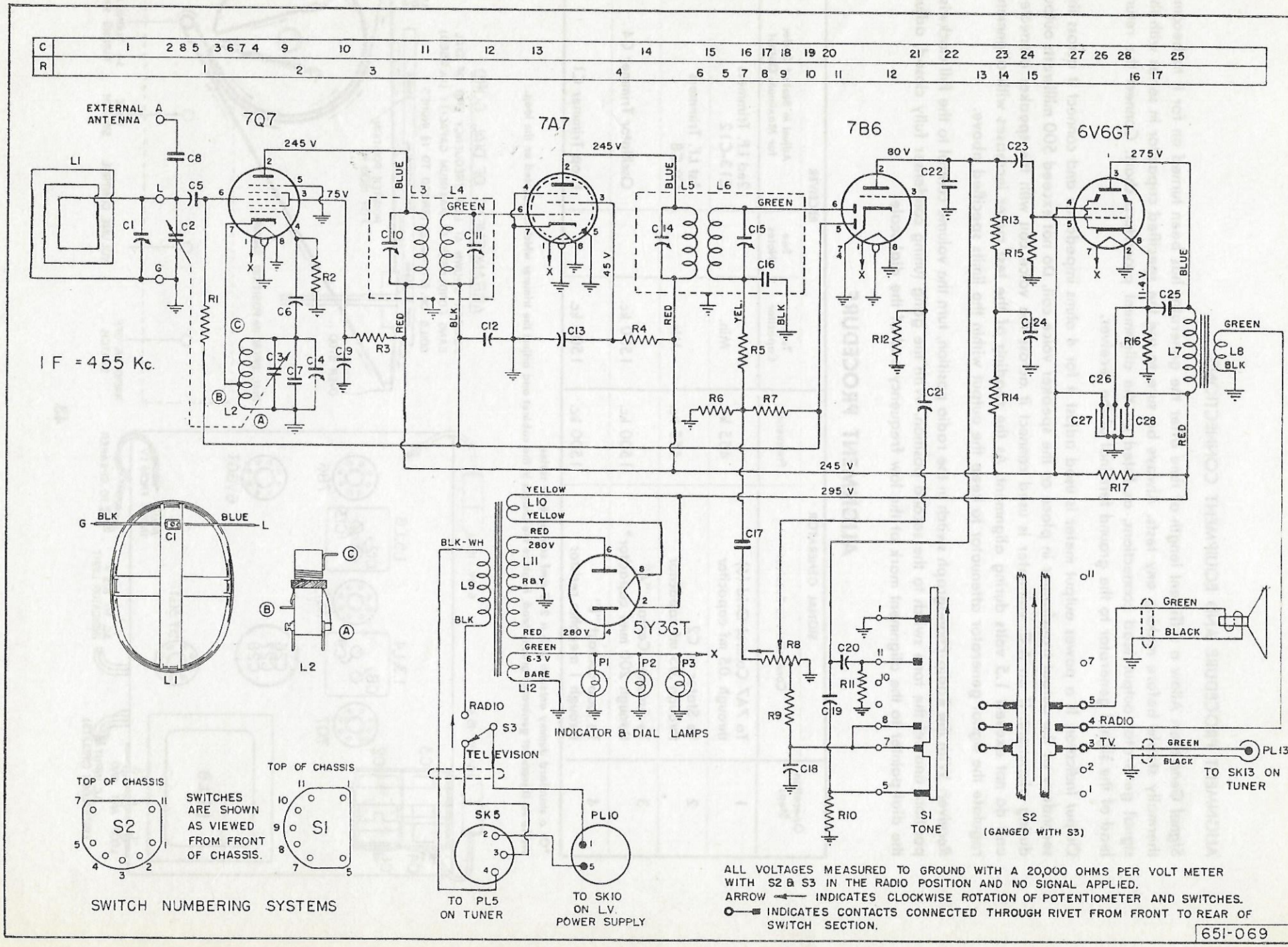
Operation Steps	SIGNAL GENERATOR		RECEIVER		
	Connections to Receiver	Frequency	Tuning Capacitor	See Notes	Adjust in Stated Order for Maximum Output
1	To 7A7 Control Grid (6) through .05 mf capacitor	455 kc.	Min.		2nd I.F. Trimmers C13-C12
2	To Stator of C2 through .05 mf capacitor	455 kc.	Min.		1st I.F. Trimmers C9-C8
3	To Antenna Contact "A" through 200 mmf capacitor*	1500 kc.	1500 kc.		Oscillator Trimmer C4
4	To loop contact "L" through 1 megohm resistor	1500 kc.	1500 kc.	A	Loop Trimmer C1

*Or a standard dummy antenna with a 200 mmf condenser in series.

NOTE A: Disconnect generator ground lead. Replace the chassis in the cabinet and adjust the trimmer which is mounted on the loop.







SCHEMATIC DIAGRAM OF RADIO RECEIVER

REPLACEMENT PARTS LIST—RADIO RECEIVER PARTS LIST 651-069

No.	Value	Rating	Description	Pt. No.
			CAPACITORS	
C1	2-20 uuF		Antenna Trimmer	511-027
C2	452.3 uuF Change		Antenna Sect. of Gang	
C3	180 uuF Change		Oscil. Sect. of Gang	510-034
C4	2-17 uuF		Oscillator Trimmer	
C5	.0056 uF	600V.	Paper Tubular	515-560
C6	100 uuF	500V.	Ceramic	514-569
C7	10 uuF	500V.	Ceramic	514-557
C8	4.7 uuF ±1 uuF	500V.	Ceramic	514-503
C9	.01 uF	400V.	Paper Tubular	515-513
C10	20-150 uuF		Dual I.F. Trimmer	511-002
C11	20-150 uuF		Dual I.F. Trimmer	
C12	.047 uF	200V.	Paper Tubular	515-471
C13	.01 uF	400V.	Paper Tubular	515-513
C14	20-150 uuF		Dual I.F. Trimmer	511-016
C15	20-150 uuF			
C16	100 uuF		By Pass Section on C15	
C17	.01 uF	400V.	Paper Tubular	515-513
C18	.01 uF	400V.	Paper Tubular	515-513
C19	.001 uF	600V.	Paper Tubular	515-551
C20	.0015 uF	600V.	Paper Tubular	515-553
C21	.022 uF	200V.	Paper Tubular	515-467
C22	100 uuF	500V.	Ceramic	514-569
C23	.0056 uuF	600V.	Paper Tubular	515-560
C24	.1 uF	400V.	Paper Tubular	515-525
C25	.0022 uF	600V.	Paper Tubular	515-555
C26	20 uF	25V.		
C27	20 uF	400V.	Triple Electrolytic	516-509
C28	60 uF	450V.		
			RESISTORS	
R1	2.2Meg. ±10%	½ watt	Composition	501-165
R2	22,000 Ω ±10%	½ watt	Composition	501-141
R3	33,000 Ω ±10%	2 watt	Composition	503-143
R4	220,000 Ω ±10%	½ watt	Composition	501-153
R5	47,000 Ω ±10%	½ watt	Composition	501-145
R6	470,000 Ω ±10%	½ watt	Composition	501-157
R7	2.2 Meg. ±10%	½ watt	Composition	501-165
R8	1 Meg.		Volume Control	505-030
R9	39,000 Ω ±10%	½ watt	Composition	501-144
R10	10 Meg. ±10%	½ watt	Composition	501-173
R11	10 Meg. ±10%	½ watt	Composition	501-173
R12	10 Meg. ±10%	½ watt	Composition	501-173
R13	390,000 Ω ±10%	½ watt	Composition	501-156
R14	100,000 Ω ±10%	½ watt	Composition	501-149
R15	470,000 Ω ±10%	½ watt	Composition	501-157
R16	270 Ω ±5%	1 watt	Composition	502-016
R17	3300 Ω ±10%	1 watt	Composition	502-131
			TRANSFORMERS AND COILS	
L1			Loop Antenna Coil	070-131
L2			Oscillator Coil	070-130
L3, L4			1st I.F. Trans. Ass.	060-075
L5, L6			2nd I.F. Trans. Ass.	060-076
L7, L8			Output Transformer	050-097
L9 to L12			Power Transformer	050-096
			MISCELLANEOUS PARTS	
S1			Tone Switch	080-093
S2			Voice Coil Switch	080-094
S3			AC Switch	
P1, P2, P3			Dial Lamps 6-8V.—.15 A	643-002

MISCELLANEOUS PARTS

(RADIO)

Antenna (Loop) Assembly	120-471
Antenna Terminal Panel (on chassis)	571-041
Antenna Terminal Panel (on cabinet)	120-048
Dial Scale, Plastic	331-091
Dial Background	332-549
Dial Lamp Socket Assembly	570-104
Dial Pointer Assembly	110-228
Dial Drive Cord, Length 44"	595-003
Dial Drive Cord Spring	310-005
Knob Assembly	572-061
Knob Assembly with Dot	572-069
Tube Socket, Octal	570-001
Tube Socket, Loctal	570-002
Tuning Shaft Assembly	110-244