GENERAL ELECTRIC

SERVICE DATA

FOR

TELEVISION-FM-AM RADIO RECEIVER & PHONOGRAPH MODEL 901

AND

TELEVISION-FM-AM RADIO RECEIVER MODEL 910

SPECIFICATIONS

CABINET DIMENSIONS (Model 901):

Height.......................................$41\frac{7}{16}$ inches
Width.......................................47 inches
Depth.......................................$24\frac{5}{8}$ inches

CHASSIS DIMENSIONS (Model 901 and 910):

Chassis	Height	Length	Depth	Weight
Receiver	$9\frac{1}{8}$ inches	$22\frac{3}{4}$ inches	$16\frac{1}{2}$ inches	40 lb
Power Supply	12 inches	$16\frac{1}{2}$ inches	$16\frac{1}{4}$ inches	50 lb
Optical Unit	37 inches	$25\frac{3}{8}$ inches	$23\frac{1}{16}$ inches	150 lb

ELECTRICAL RATING:

Volts.......................................115 volts
Frequency.......................................60 cycles
Wattage (Television).......................................380 watts
Wattage (Radio).......................................160 watts
Wattage (Phono) (901 only).......................................180 watts

R-F FREQUENCY RANGE:

TELEVISION

Channel Selector	Frequency Range Mc	Picture Carrier Mc	Sound Carrier Mc
1	44–50	45.25	49.75
2	54–60	55.25	59.75
3	60–66	61.25	65.75
4	66–72	67.25	71.75
5	76–82	77.25	81.75
6	82–88	83.25	87.75
7	174–180	175.25	179.75
8	180–186	181.25	185.75
9	186–192	187.25	191.75
10	192–198	193.25	197.75
11	198–204	199.25	203.75
12	204–210	205.25	209.75
13	210–216	211.25	215.75

RADIO

FM1.......................................42–50 mc
FM2.......................................88–108 mc
Phono.......................................
Standard Broadcast.......................................540–1600 kc
Short Wave 1.......................................9.4–9.9 mc
Short Wave 2.......................................11.6–12.1 mc

INTERMEDIATE FREQUENCIES:

Television Video.......................................22.4–26.4 mc
Television Audio.......................................21.9 mc
FM.......................................10.7 mc
AM.......................................455 kc

AUDIO POWER OUTPUT:

Undistorted.......................................18 watts
Maximum.......................................25 watts

TUBE COMPLEMENT: (43 including rectifiers)

Symbol	Purpose	Type
(V1)	Television R-F Amplifier	6AU6
(V2)	Television Converter—Oscillator	7F8
(V3)	1st Video I-F Amplifier	6AC7
(V4)	2nd Video I-F Amplifier	6AC7
(V5)	3rd Video I-F Amplifier	6AC7
(V6)	4th Video I-F Amplifier	6AC7
(V7)	Video Detector—D-c Restorer	6H6
(V8)	Video Amplifier	6AG7
(V9)	Picture Tube	5TP4
(V10)	Clipper	6SH7
(V11)	Horizontal Sweep Amp—Vertical Sweep Generator	6SN7GT
(V12)	Horizontal Phase Det.—Vert. Sync. Amplifier	6SL7GT
(V13)	Horizontal Phase Det.—D-c Amplifier	6SL7GT
(V14)	Horizontal Sweep Generator	6SN7GT
(V15)	Phase Inverter—Cathode Follower	6SN7GT
(V16)	Vertical Sweep Output	6L6G
(V17)	Television Audio I-F	6SG7
(V18)	Television Audio Limiter	6SV7
(V19)	Television Audio Discriminator	6H6
(V20)	Radio R-F Amplifier	6AG5
(V21)	Radio Oscillator	6AK5
(V22)	Radio Converter	6AK5
(V23)	Radio 1st I-F Amplifier	6SG7
(V24)	Radio 2nd I-F Amplifier	6SV7
(V25)	Radio AM Detector—FM Limiter	6SV7
(V26)	FM Discriminator—Audio Cathode Follower	6AQ7
(V27)	Audio Amplifier	6SL7GT
(V28)	Audio Output	6V6GT
(V29)	Audio Output	6V6GT
(V30)	Audio Output	6V6GT
(V31)	Audio Output	6V6GT
(V32)	Tuning Indicator	6AL7GT
(V33)	Phono Preamplifier	6SC7
(V201)	Rectifier	5U4G
(V202)	Rectifier	5U4G
(V203)	Rectifier	5U4G
(V204)	Horizontal Sweep Output	6BG6G
(V205)	Horizontal Sweep Output	6BG6G
(V206)	Horizontal Damping	6AS7G
(V207)	High Voltage Rectifier	1B3GT
(V208)	High Voltage Rectifier	1B3GT
(V209)	High Voltage Rectifier	1B3GT
(V210)	High Voltage Rectifier	1B3GT

RECORD PLAYER:

Type.......................................Automatic
Pickup.......................................G-E Variable Reluctance
Pickup Impedance.......................................230 ohms

LOUDSPEAKERS:

Type.......................................(2) Alnico "PM" Dynamic
Size.......................................10 inches
Voice Coil Impedance (400 cycles).......................................8 ohms

PICTURE SIZE:

Height.......................................18 inches
Width.......................................24 inches

ANTENNA REQUIREMENTS:

Type.......................................Folded Dipole
Impedance.......................................300 ohms

CAUTION NOTICE

THE REGULAR B+ VOLTAGES ARE DANGEROUS AND PRECAUTIONS SHOULD BE OBSERVED WHEN THE CHASSIS IS REMOVED FROM THE CABINET FOR SERVICE PURPOSES. THE HIGH VOLTAGE SUPPLY (27,000 V.) AT THE PICTURE TUBE ANODE WILL GIVE AN UNPLEASANT SHOCK BUT DOES NOT SUPPLY ENOUGH CURRENT TO GIVE A FATAL BURN OR SHOCK. HOWEVER, SECONDARY HUMAN REACTIONS TO OTHERWISE HARMLESS SHOCKS HAVE BEEN KNOWN TO CAUSE INJURY. SINCE THE HIGH VOLTAGE IS OBTAINED FROM THE B+ VOLTAGE, CERTAIN PORTIONS OF THE HIGH VOLTAGE GENERATING CIRCUIT ARE DANGEROUS AND EXTREME PRECAUTIONS SHOULD BE OBSERVED.

THE PICTURE TUBE IS HIGHLY EVACUATED AND IF BROKEN, GLASS FRAGMENTS WILL BE VIOLENTLY EXPELLED. IF IT IS NECESSARY TO CHANGE THE PICTURE TUBE, USE SAFETY GOGGLES AND GLOVES. NEVER HANDLE THIS TUBE BY THAT PART OF THE BULB HAVING THE INSULATING COATING (SEE FIGURE 34). FINGERPRINTS OR DUST ON THE INSULATING COATING MAY CAUSE ELECTRICAL BREAKDOWN DURING HUMID WEATHER. IF AN ADJUSTMENT IS REQUIRED WHEN THE POWER MUST BE ON, HANDLE THE TUBE BY ITS NECK ONLY, AS EXTREMELY HIGH VOLTAGES ARE ENCOUNTERED ON THE OTHER SURFACES OF THE TUBE.

GENERAL INFORMATION

The General Electric Model 901 television-FM-AM radio receiver and phonograph is a console type 43 tube instrument providing reception of all 13 commercial television channels, 2 frequency modulation bands, the standard broadcast band, and 2 short wave bands. In addition phono operation is available using an automatic record changer.

The General Electric Model 910 television-FM-AM receiver is a complete assembly of units intended for custom installation into the permanent structure of the installation premises. The Model 910 receiver assembly is supplied in essentially the same chassis units, optical unit, chassis cables, and speakers as are used with the Model 901 receiver. Unlike the Model 901, in this receiver assembly, the console cabinet and record changer are excluded.

Features of the two receivers include a constant input impedance R-F amplifier, safe high voltage power supply, automatic frequency control for horizontal synchronization, high fidelity FM and audio system, optical system of high efficiency, and large picture area of 18x24 inches.

The service information on the Model 901 automatic record changer is contained in Service Note ER-S-P4.

INSTALLATION AND OPERATING INSTRUCTIONS

Installation and operating instructions are supplied in separate pamphlets as follows:

1. Installation Instructions, Model 901............ER-A-901
2. Operating Instructions, Model 901.............ER-I-901
3. Installation Instructions, Model 910.................. ....ER-A-901 and ER-A-910
4. Operating Instructions, Model 910.............ER-I-901

In general, it is pointed out that for the most part the Model 901 publications also apply to the Model 910. The reader should bear in mind, however, that the receiver cabinet and phono operation are a part of the Model 901 *only* and do not apply to the Model 910 which is designed for permanent installation into premises and is supplied less cabinet and record changer.

DESCRIPTION—TELEVISION CIRCUITS

To acquaint you with the more important radio and television circuits, a brief description of the operation of each of the below listed sections is described. This will be supplemented by a comprehensive television training course in publication, RSM-4-TV.

Many of the radio circuits are similar to the standard combination FM and AM broadcast receiver circuits and will not be described. However, many of the television circuits are new and will be described under the following heading:

1. FM-AM broadcast amplifier, converter and oscillator
2. FM-AM broadcast I-F amplifier
3. Television R-F amplifier, converter, and oscillator
4. Television video and sound I-F
5. Video detector and amplifier
6. Sync pulse clipper-amplifier
7. Horizontal sweep generator and AFC sync
8. Horizontal sweep output
9. Vertical sweep generator and output
10. High voltage power supply (H.V. supply)

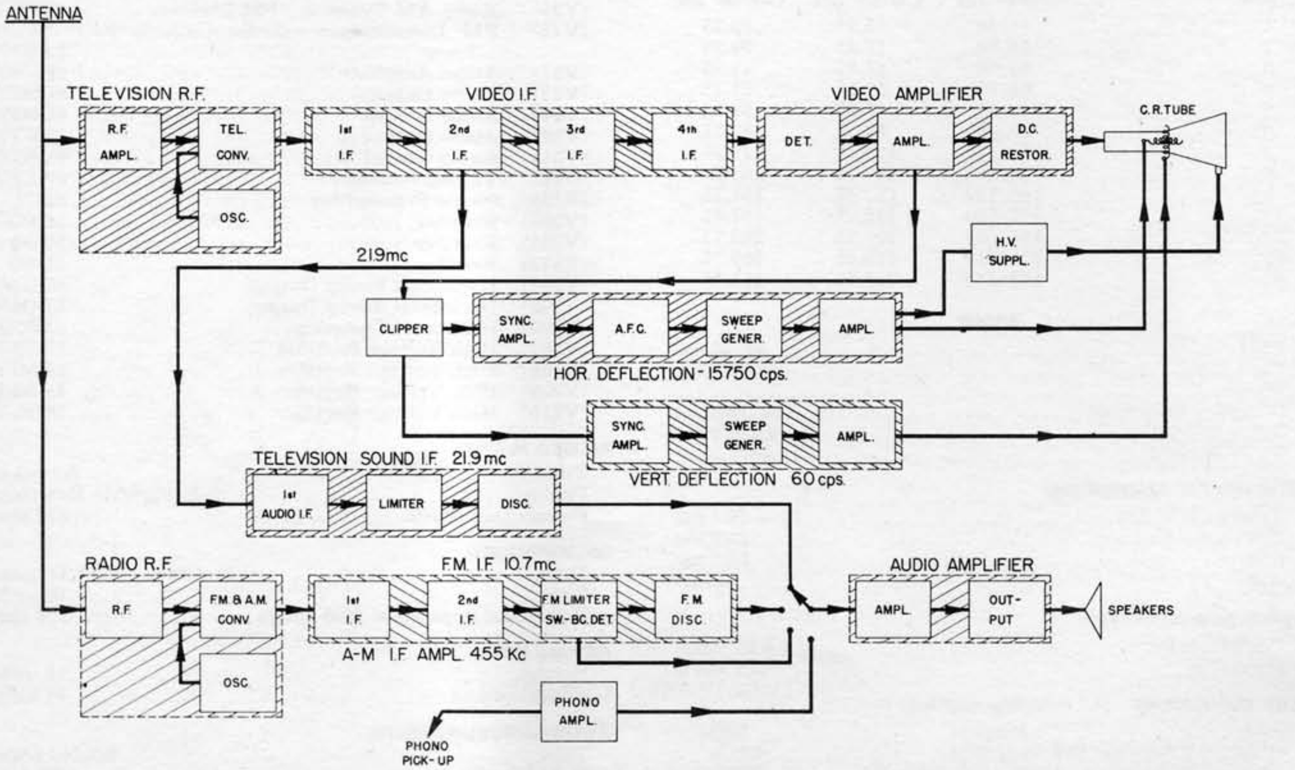


Fig. 1. Block Diagram, Model 901 and 910

11. Low voltage power supply (L.V. supply)
12. Picture tube

A block diagram of the complete receiver is shown in Figure 1 to assist in signal tracing and to better visualize the operation of the receiver as a whole. Most paragraphs have a simplified circuit diagram accompanying the description. Reference is also made to the main schematic diagram in Figure 48.

1. FM-AM R-F AMPLIFIER, CONVERTER, AND OSCILLATOR (SEE FIGURE 48)—The tubes V20, V22, V21 and their associated circuits comprise the r-f amplifier, converter and oscillator which is assembled wired and tested as a separate unit and in turn, mounted and wired to the main receiver chassis. Variable inductance tuning is employed instead of using the conventional tuning capacitor. The design of the unique "Guillotine Tuner" provides a high efficiency circuit in the 88 to 108 megacycle range which would not be possible with the more conventional methods of tuning and also provides stable short wave spread bands which tune as easily as the broadcast band.

Guillotine tuners T18, T16, and T37 are used as the tuned circuits for the r-f amplifier, converter and local oscillator respectively in both FM bands. In the higher frequency band (FM2), the tuners T18, T16, and T37 are used with only the small alignment trimmers C58, C81, and C153 respectively. These are the alignment trimmers for the FM2 band. In addition, C69 is connected in series with C68 for r-f coupling between the r-f amplifier, V20, and the converter V22. The oscillator (V21) cathode return is made through the switch and L14.

In the lower FM frequency band (FM1) the higher value trimmer C59 and capacitor C57, trimmer C71, and trimmer C156 with capacitors C157 and C155 are used to tune the r-f, converter, and oscillator circuits respectively. In addition, the oscillator cathode return is made through switch contact FM1 and L21.

Bandspread tuning in the short wave bands is obtained in the converter and oscillator by inserting the "Guillotine" tuners T16 and T37 each, in series with the larger inductances L33 and L12 respectively so that the two inductances T16 and L33 together form the "L" part of the tuned converter circuit while inductances T37 and L12 form a similar "L" circuit to tune the oscillator. For selection of the desired short wave band and alignment, the shunt trimmers C73 or C72 are added across the tuning circuit of L33 and T16 in the converter depending on which of the two short wave bands is used. In a similar manner the oscillator tuned circuit, comprising L12 and T37 is tuned by either C148 or C149 depending on the shortwave band selected. Additional oscillator coupling capacitors C159 or C154 are also added to compensate for the lower coupling through C151 when the higher shunt tuning capacitors are in the circuit. In the r-f stage a section of the loop, L6, is used as the tuned grid circuit. It is tuned for resonance in the higher frequency short wave band by the shunt trimmer capacitor C79 and shunt inductance L24. For tuning the circuit to the lower frequency short wave band, L16 shunted by C63 is substituted for L24 and is connected across the loop, L6. Because a tuned circuit of this type is inherently broad, tuning through the relatively narrow spreadband offers little advantage and is not done and the guillotine tuner, T18, in the r-f section is not used in the short wave positions.

In the standard broadcast band position, the slug tuned circuits T17, T14, and T15 tune the r-f amplifier, converter and oscillator respectively. Trimmers C80, C78, and C76 are their respective shunt capacitors to adjust circuit capacity for proper "L" to "C" ratio in receiver alignment. In the oscillator tuned circuit T15, the slug tuned inductance L13 serves as the shunt tuning inductance or padder which is adjusted for correction of nonlinear oscillator tracking at the low frequency end of the band. Loop antenna operation is obtained by way of antenna loop L6 and low impedance coupling to T17, the r-f amplifier tuned grid circuit. Choice of an external antenna is also available and may be coupled to the r-f tuned circuit by means of C61.

2. FM-AM BROADCAST I-F AMPLIFIER (SEE FIGURE 48)—The I-F amplifier consists of a composite 455 kilocycle AM and 10.7 megacycle FM circuit, V23 and V24, first and second I-F amplifiers respectively. The 455 kc and 10.7 mc primary windings of each coupling transformer form a series circuit. In the same respect the secondary windings form a series circuit. The 455 kc trimmers because of their high capacity value offer no impedance at 10.7 megacycles and, by the same token, the low inductance of the 10.7 mc windings has no effect on signals of 455 kc. The electrical changes required to transfer between AM and FM service are made by the service selector switch, S2.

When the switch, S2, is either in the FM1 or FM2 position, the amplifier operates at 10.7 megacycles. The 10.7 mc secondary winding of T19 is connected to the grid of V23 in the first amplifier stage, the AVC circuits are connected to ground, and "B+" voltage is applied to the screen grid of V25 so that this tube functions as an FM limiter. Audio input to the triode section of V26, first audio cathode follower is coupled to the discriminator output of V26 at the junction of C123 and R153, the discriminator's audio output. The high frequency audio de-emphasis network C123 and R153 serve to attenuate the high frequency audio to its original level before pre-emphasis at the FM transmitter.

For AM operation the 10.7 mc secondary winding of T19 is shorted to ground, the AVC circuits are restored and the screen circuit of V25 is disconnected from B+ voltage so that the stage now operates as a diode AM detector, its grid now functioning as the detector's anode. Audio output is developed across the diode load R145 followed by the i-f filter C126, R144, and C100..

It might be of interest to note that the radio receiver circuits, excepting the audio section, are separate from and independent of the television circuits.

3. TELEVISION R-F AMPLIFIER, CONVERTER AND OSCILLATOR (SEE FIGURE 2)—The r-f amplifier makes use of a type 6AU6 tube connected as a triode grounded-grid amplifier. The anntena is connected into the cathode circuit so as to provide a substantially constant input impedance of 300 ohms to the antenna at all frequencies. With a 300 ohm antenna system, this coupling arrangement permits optimum transfer of signal from antenna to r-f amplifier for all 13 channels and also prevents reflections from being set up on the transmission line. R154 is the normal bias resistor. A choke, Lk, is placed in series with this cathode resistor to prevent the input impedance from being lowered by the shunting effect of the total stray capacity to ground of the cathode of the tube. The choke value is changed with frequency.

The r-f amplifier is coupled to the converter tube by a wide band transformer consisting of windings Lp and Ls. The windings are self-tuned by the distributed and tube capacities to provide optimum gain. On channels No. 1 and No. 2, the transformer is triple tuned to prevent the image frequencies of the 88–108 mc FM band from interfering with these two channels. The triode converter is one section of a Type 7F8 dual triode tube V2A. Bias for this tube is provided by the oscillator voltage appearing in the grid of V2A causing grid rectification, charging the grid resistor-condenser combination, R1 and C5.

The oscillator makes use of the remaining half of the Type 7F8 tube, V2B and is inductively coupled to the converter grid by locating the oscillator coil on the same coil form as the converter grid coil, Ls. The oscillator is a modified Colpits oscillator, the oscillation being produced by the cathode-to-grid, Cg shunted by C41, and the cathode-to-plate, Ck, interelectrode capacities of the oscillator tube. The choke, L3, provides a d-c path to ground to the cathode of the oscillator but maintains the cathode off-ground at the r-f frequencies. The oscillator operates on the high frequency side of the r-f signal on all bands.

The r-f amplifier, converter and oscillator is constructed as a complete unit subassembly which can be readily demounted from the main chassis.

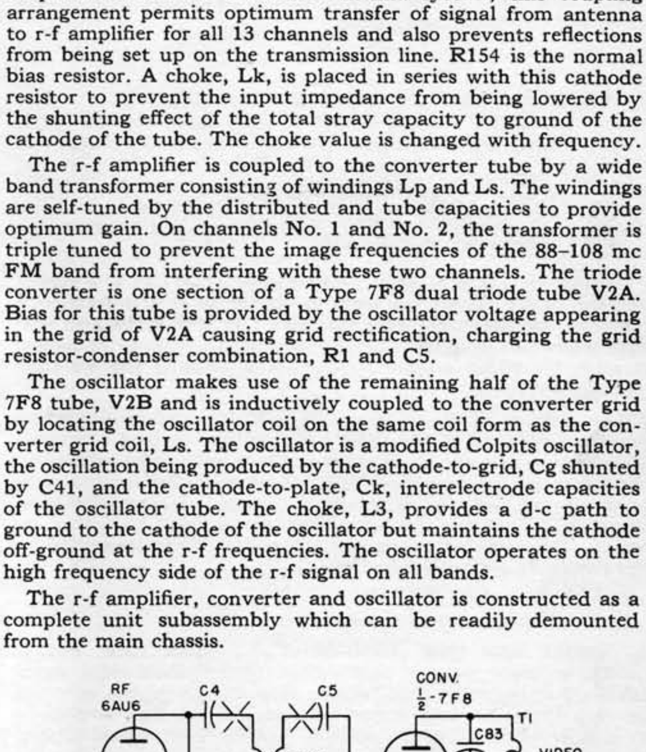


Fig. 2. Television R-F Amplifier, Converter and Oscillator

4. TELEVISION VIDEO AND SOUND I-F AMPLIFIERS (SEE FIGURE 3—The video i-f amplifier consists of a four-stage band-pass amplifier using four type 6AC7 tubes. The transformers T1, T2, T3, T4 and T5, are overcoupled and then loaded with resistance to give adequate band pass frequency characteristics. A third winding is added to T2 and T3 and tuned to trap out the adjacent audio and tuned for audio take off respectively. The trap at T2 is tuned to 27.9 mc to provide rejection of the adjacent channel audio i-f, while the traps at T3, T4, and T5 are tuned to 21.9 mc to provide rejection of the same channel audio. A series trap is used at T4 and T5 to tune out the associated audio interference. Although a trap circuit consisting of C192, C175, and a winding on T1 is incorporated at the 1st i-f transformer; its chief function is to place the 26.4 mc marker at the proper point in the i-f band pass response curve.

The audio i-f frequency is developed by taking the 21.9 mc signal from across the trap circuit on T3 and applying it to the grid of the audio i-f amplifier tube V17. Since the sound portion is frequency modulated, the tube V18 is connected as a limiter tube and it in turn feeds the discriminator transformer and tube, T10 and V19.

A low negative voltage derived from the grid circuit of the horizontal sweep generator tube V14 is applied to the contrast control. The output of the contrast control which develops a variable negative bias voltage, is applied to the grids of video i-f amplifier tubes V3, V4, and V5. Fixed negative bias is applied to the grid of the television sound i-f amplifier tube, V17. The control (contrast) is manually operated to change bias on the tubes and therefore the i-f gain.

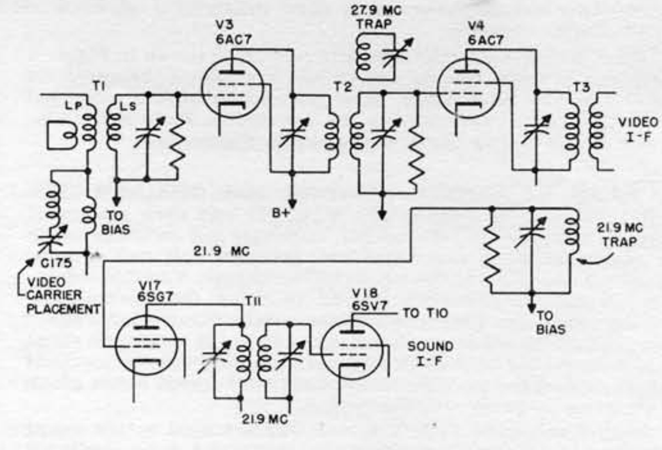


Fig. 3. Television-Video and Sound I-f

5. VIDEO DETECTOR AND AMPLIFIER (SEE FIGURE 4)—The video i-f amplifier output is applied to a diode rectifier V7A, and the diode load, R21, is connected so as to develop a negative going super-sync at this point. The signal is amplified by the pentode amplifier tube, V8, and then applied through coupling capacitor, C187, to the cathode of the picture tube, V9. The remaining diode section of V7 is used to provide d-c restoration to the picture at the picture tube.

The choke, L5, is a series-peaking coil, while L22 is a shunt-peaking choke. These are used to obtain good high-frequency response. L4, L17 and the capacitors C17 and C313 also prevent harmonics of the i-f amplifier frequencies from being passed through the video amplifier. R58+R59+R56 is the V8 tube plate load resistor.

The cathode of the picture tube is maintained at a positive potential by virtue of its return to B+ by way of the d-c restorer. This necessitates that a variable positive voltage be applied to the control grid of the picture tube, V9, for control of brightness or beam current. As long as this grid voltage is less positive than the cathode voltage, the tube beam current will be within its rating. This positive voltage on the grid of V9 is controlled by the Brilliance potentiometer, R83.

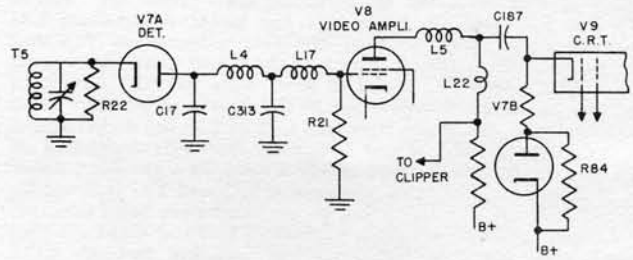


Fig. 4. Video Detector and Amplifier

6. CLIPPER AND SYNC AMPLIFIER—The pentode tube, V10, is used to separate the sync pulses from the composite video signal taken off at the video load resistor. The clipper tube is operated at very low plate and screen voltages and its bias is derived by grid rectification of the positive polarity video signal applied to the grid. Thus, conduction in V10 will occur only during the sync pulse intervals which are the most positive components of the video signal.

Tube V11A is a horizontal synchronizing amplifier which operates into the AFC input transformer, T6. This transformer, by virtue of its center-tapped secondary, permits both positive and negative horizontal sync pulses, when used in combination with the output sawtooth voltage from the sweep transformer and phase detectors, V12A and V13A, to form the control voltage which is amplified by V13B and applied to the horizontal multivibrator, V14.

The vertical synchronizing amplifier tube, V12B, receives the sync pulse at its grid through a three-section integrating circuit. This integrating circuit accepts the wide vertical sync pulses and shapes them for triggering purposes while the horizontal sync pulses do not have sufficient energy to charge the integrating circuit and are, thereby, attenuated. A positive going vertical sync pulse is developed in the plate circuit of V12B which is used to trigger the vertical sweep generator, V11B.

7. HORIZONTAL SWEEP GENERATOR AND AFC SYNC (SEE FIGURE 5)—The horizontal sawtooth oscillator makes use of a Type 6SN7G tube, V14, in a conventional cathode-coupled multivibrator. Instead of its frequency being controlled directly by the horizontal sync pulses, it is controlled by a d-c voltage on its controlling grid, the d-c voltage being a resultant of the phase error between the incoming sync signal and a sawtooth voltage derived from the output of the horizontal sweep amplifier. This voltage is called an automatic frequency control (AFC) voltage.

The AFC voltage is developed by the diode connected triodes V12A and V13A by mixing the horizontal sync pulses at the secondary of transformer T6 with a sawtooth voltage waveform derived at the output of the sweep amplifier tubes. When the sync pulse occurs at the time "a" shown in the sawtooth waveform drawing in Figure 5, no voltage will be developed at the output of the filter. However, if the multivibrator runs faster or slower so that the pulse falls at a point other than at "a," a positive or negative voltage will appear at the filter, which will be amplified by the d-c amplifier, V13B, and then applied to the grid of the multivibrator. This change in d-c voltage on the grid of the multivibrator will cause it to speed up or slow down so as to cause the sawtooth wave to combine with the incoming sync pulses until the correction voltage becomes zero. With the filter consisting of C75, C26 and R33, the change is relatively slow in controlling the speed, permitting the equivalent of individual frame synchronization instead of each component line. This gives a picture characterized by greater detail than is possible where random noise triggers the directly synchronized sweep generator. The Horizontal Hold Control, R37, in conjunction with the Horizontal Frequency Control, L20, control the free running speed of the multivibrator. They are adjusted near to the correct frequency during the time when no sync pulses are available.

The output of the horizontal multivibrator is coupled through a cathode follower tube, V15B, to the sweep output circuits which are located on the power unit chassis. The cathode follower permits the sawtooth voltage wave to be transferred through a relatively long cable without deterioration of the waveform.

8. HORIZONTAL SWEEP OUTPUT (SEE FIGURE 6)—The horizontal sawtooth output from the cathode follower tube, V15B, is amplified by two Type 6BG6G tubes, V204 and V205, connected in parallel. The output of these tubes is coupled to the horizontal deflection coils through an impedance matching transformer, T202. An oscillatory voltage, as shown in dotted line in the waveshape at the lower left of Figure 6, which results from the rapid retrace in the transformer, T202, is removed by the damping tube, V206. This tube is a dual triode, Type 6AS7G, and by its use the transient may be dampened, linearity controlled, and the positive overshoot voltage retained for use in the high voltage supply. The linearity of the waveshape is controlled by varying the grid and cathode circuit voltages on the tube V206 by means of three potentiometers, R209, R211 and R212. The horizontal size is controlled by the adjustable iron core inductance L203, which is in series with the output to the horizontal deflection coils.

Centering of the picture is accomplished both in the vertical and horizontal directions by controlling a d-c current through the sweep coils by means of the potentiometers R218 and R44.

9. VERTICAL SWEEP GENERATOR AND OUTPUT (SEE FIGURE 7)—The vertical sawtooth voltage is generated by a Type 6SN7GT tube, V11B, connected in a blocking oscillator circuit. The output voltage is coupled directly to a type 6L6G vertical sweep output tube, V16, and then to the vertical sweep coils through the impedance matching transformer, T8. Vertical speed is controlled by changing the time constant of the blocking oscillator grid circuit by the potentiometer, R49. Sweep size is changed by the potentiometer, R50, which changes B+ voltage applied to the sawtooth charging capacitor, Cc. Vertical linearity is controlled by a correction voltage developed in the cathode of V16 being fed through capacitors C38 and C45 to the grid of output tube, V16. The amount of correction voltage is varied by the variable cathode resistor, R45.

10. HIGH VOLTAGE SUPPLY (SEE FIGURE 8)—The high voltage is derived by making use of the inductive "kick" voltage produced during retrace in the horizontal sweep output transformer, T202. This "kick" voltage is shown in the waveshape shown as "c to b" in Figure 6. This voltage is produced in the primary and is further increased by auto transformer action by adding an additional winding to the transformer which connects to the plate of V207, the first high voltage rectifier tube. The rectifier tubes V207, V208, V209 and V210 are Type IB3GT (8016) which derive their filament voltage from the horizontal sweep transformer, T202, by means of four single turn loops around the transformer. The tubes are used in a voltage quadrupling circuit to provide the necessary 27 kilovolts for use on the high voltage anode of the picture tube. Each section contributes about 7 kilovolts to the final output voltage. A high voltage bleeder, consisting of two 1000 megohm resistors in series, is connected across the output to dissipate any charge after the receiver is turned off.

Because of the high frequency (15,750 cycles/sec) a-c source from which this d-c is derived, 500 mmf capacitors are all that are necessary to provide the necessary filtering (smoothing) of the d-c.

11. LOW-VOLTAGE POWER SUPPLY—Three Type 5U4G rectifier tubes are used to supply the required plate current for the television and radio receiver operation. Two Type 5U4G tubes, V202 and V203, supply the bulk of the current and make use of a capacity inductance filter, consisting of C201A, L200, and

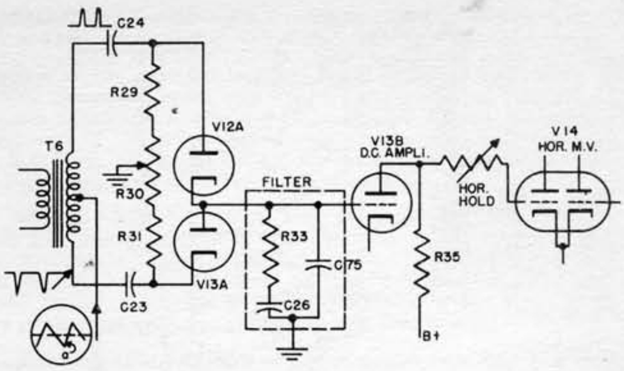


Fig. 5. Horizontal Sweep Generator and AFC Sync

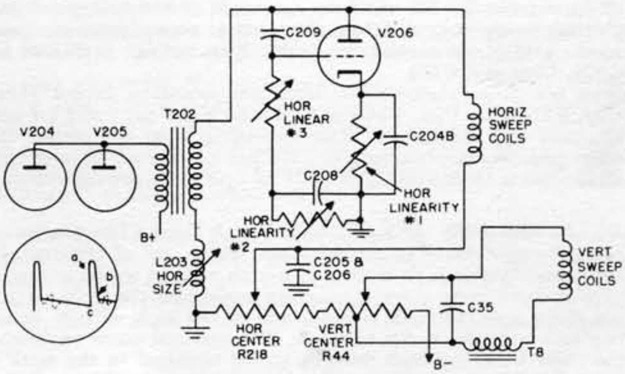


Fig. 6. Horizontal Sweep Output

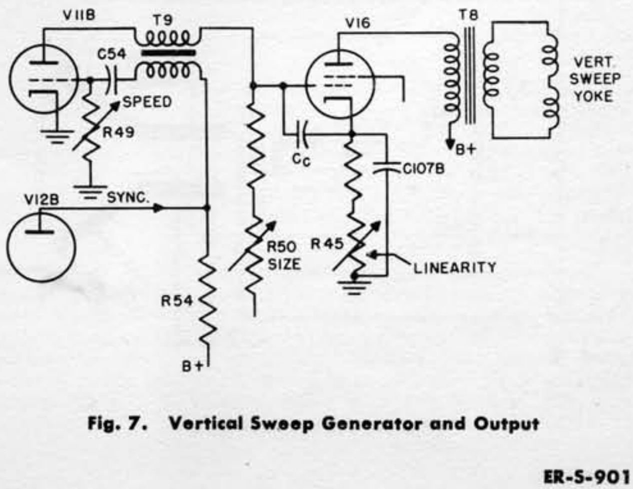


Fig. 7. Vertical Sweep Generator and Output

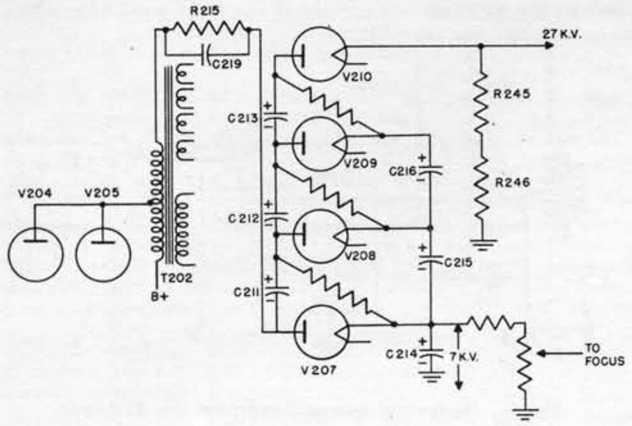


Fig. 8. High Voltage Power Supply

C201B. Another Type 5U4G, V201, whose output is added to that of tubes V202 and V203, is used to supply higher B+ voltage of approximately 480 volts for operation of the horizontal and vertical sweep output tubes, the vertical sweep generator, and screen grid of the cathode ray tube. This voltage is filtered by C202, L201 and C203.

In television position all tubes are operating except tubes V20, V21, V22, V23, V24 and V32 which are the radio r-f and i-f tubes and tuning eye. When operating from any one of the radio positions or phonograph, T201 has its primary open so that all functions dependent upon T201 for operation, are interrupted.

12. *PICTURE TUBE* (SEE FIGURE 9)—A Type 5TP4 projection cathode ray tube, V9, is used. This makes use of electrostatic focus and magnetic deflection at a high voltage anode potential of 27 kilovolts. An inner conducting surface on the bulb extending down into the neck is connected to the high voltage anode cap to act as the anode element. The external outer surface of the tube from the high voltage anode terminal to the neck is covered with a special insulating coating to reduce the possibility of voltage breakdown, from high humidity. *This surface should not be handled during service adjustment.* A very thin layer of sprayed metal on the inner screen surface is used to prevent ions from destroying the screen making an ion trap in this tube unnecessary.

In Figure 9 is shown the approximate voltage applied to each tube element.

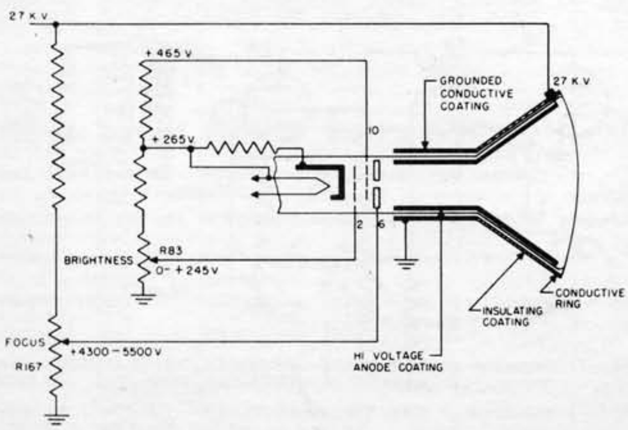


Fig. 9. Picture Tube Circuit

CIRCUIT ALIGNMENT

***GENERAL*—**A complete alignment of the Model 901 television receiver consists of the following individual alignment procedures. These are listed below in the correct sequence of alignment. However, any one alignment may be performed without the necessity of realignment of any one of the other sectional alignments, provided the signal source for television traps and video i-f amplifier is accurately calibrated.

1. Broadcast i-f amplifier.
2. FM i-f amplifier.
3. FM r-f amplifier.
4. SW r-f amplifier.
5. BC r-f amplifier.
6. Television i-f trap alignment.
7. Television video i-f alignment.
8. Television audio i-f alignment.
9. Television oscillator coil alignment.
10. Television r-f coil alignment.

The alignment procedure is in table form on pages 10 through 15. The following paragraphs are important suggestions to be followed when attempting alignment and should be read thoroughly before alignment is attempted.

***TEST EQUIPMENT REQUIREMENTS*—**To perform the over-all alignment as outlined above, the following test equipment is required.

1. Cathode Ray Oscilloscope—This scope should preferably have a 5-inch screen and should have good high frequency response, which will be useful in making the waveform measurements on pages 32, 33, and 34. *Note*—High frequency response is not essential for alignment.

2. Signal Generator—This signal generator must have good frequency stability and be accurately calibrated. It should give good output at the following frequencies with tone modulation where desired.

(a) 455 kc for broadcast i-f.
(b) 550–1600 kc for broadcast r-f.
(c) 9.0–12.5 mc for short wave r-f.
(d) 10.7 mc for FM i-f.
(e) 21.9 mc for sound i-f marker and trap alignment.
(f) 27.9 mc for trap alignment.
(g) 23.0 mc for video i-f marker.
(h) 25.65 mc for video i-f marker.
(i) 26.4 mc for video i-f marker.
(j) 40–130 mc and 174–238 mc for FM r-f alignment and for television oscillator adjustments and markers for television r-f channel bandwidth measurements.

3. R-f Sweep Generator—This should give at least 0.1 volt output with adjustable attenuation of the output. The output should be flat over wide frequency variations. The frequency coverage should be:

(a) 10.7 mc, with 1.0 mc sweep width.
(b) 21.9 mc, with 1.0 mc sweep width.
(c) 20 to 30 mc, with 15 mc sweep width.
(d) 40 to 90 mc, with 25 mc sweep width.
(e) 170 to 220 mc, with 25 mc sweep width.

4. Voltmeter—A combination a-c–d-c meter. A-c meter must have low voltage scale for use as output meter. The d-c section should have 20,000 ohm-volt system.

5. Wavetraps—Accurately calibrated wavetraps may be used to supply markers in place of the signal generator for video i-f and r-f alignment purposes.

***ALIGNMENT SUGGESTIONS*—**All trimmer locations are shown in the drawing of Figures 15 and 16. Remove the radio chassis and power supply chassis from the cabinet and set them up on the test bench. *Precaution*—Since the picture tube anode voltage is not required in circuit alignment, it is desirable to remove the high voltage hazard by removing the horizontal sweep cathode follower, V15B, thus rendering the 27 kv power supply circuit inoperative.

The following suggestions apply to each individual alignment procedure:

1. Broadcast I-f Alignment—Connect signal generator with tone modulation directly to signal grid of radio converter tube V22. The generator lead should be shielded so that not more than 1/16-inch of exposed lead exists. Ground shield of lead to chassis.

Connect a-c meter across the speaker voice coil. Turn volume control nearly to maximum. Keep signal generator output down so that the meter does not indicate more than 1.4 volts during alignment.

Progressively align each transformer from the detector to the converter.

2. *FM I-f Alignment*—Alignment by sweep generator is desirable. Connect the generator through a .01 mfd capacitor to the input points as indicated in the table. Connect the oscilloscope across the limiter resistor, R145, through a 220,000 ohm resistor for steps No. 1 and No. 4. For discriminator alignment, steps No. 2 and No. 3, the oscilloscope is connected at the junction of R153 and C123 to chassis and the series resistor to the scope is reduced to 10,000 ohms.

For steps 1 and 4, insert a 10.7 mc unmodulated signal into the same point of input as the sweep generator. This input, however, must be very loosely coupled so that it doesn't affect the response curve.

Keep the input of the sweep generator low enough so that the response curve should increase proportionally as the sweep output is increased. If it flattens off and won't increase in size, the amplifier is overloaded.

For discriminator alignment, the secondary trimmer, C117, of T36 is aligned by using a tone modulated 10.7 mc signal and observing it on an oscilloscope. The trimmer is adjusted for minimum output. If a sweep is used for secondary trimmer alignment, the crossover should be symmetrical about a 10.7 mc marker and should be a straight line between the alternate positive and negative peaks similar to that shown in Figure 10 for the television sound discriminator. With the same sweep input as in step 1, adjust the primary trimmer, C122, for maximum peak to peak amplitude and symmetry of peaks above and below the baseline similar to that shown in Figure 10.

3. *FM R-f Alignment*—An unmodulated signal is applied to the dipole antenna terminals. A 20,000 ohm/volt meter is connected through a 220,000 resistor to the limiter grid resistor so as to measure the rectified carrier at that point. The resistor must be connected directly to the grid so that the capacity loading will be negligible and so that the meter is isolated from the i-f signal. Keep signal generator voltage down so that the meter indicates not more than 1 volt.

If dial scale is not available, index pointer as follows: Turn pointer to right-hand limit of travel. Mark the dial backplate at a reference edge of the pointer slider. Then set pointer by turning dial knob until the indicated dimensions exist between the reference edge and the mark. Two oscillator settings will give response. The higher frequency response is the correct one; the other is the image. Start with the trimmer completely loosened and adjust for first response.

For alignment of the r-f trimmers, the tuning drive must be moved or "rocked" a small amount back-and-forth through peak output. The object is to find a position of trimmer giving maximum peak output.

4. *SW R-f Alignment*—A signal generator with tone modulation is applied through 400 ohms to the SW antenna terminal. An a-c output meter is connected across the speaker voice coil. Turn the volume control full on. Keep signal generator output down so that the meter indicates not more than 1.4 volts during alignment.

If dial scale is not available index the pointer as outlined under "FM R-F Alignment." Mark dial backplate at a reference edge of the slider. Then set pointer by turning dial knob until the

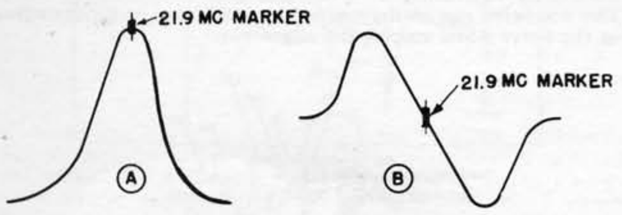


Fig. 10. Television Sound I-f Curves

indicated dimensions exist between the reference edge and the mark. Two oscillator settings will give response. The higher frequency point is the correct one.

For alignment of the r-f trimmers, the tuning drive must be moved or "rocked" a small amount back-and-forth through peak output to find position of trimmer giving maximum peak output.

For alignment of the antenna trimmer the loop antenna must be plugged in.

5. *BC R-f Alignment*—Apply the signal generator input with modulation to the BC antenna terminal through a 200 mmf capacitor. An output meter across the speaker voice coil is used for output indication.

The main iron tuning slugs are suspended from the left side of the tuning "elevator." They are individually adjustable by loosening the lock nut and turning the support screw into which the suspending wire is soldered.

If dial scale is not available index the pointer as outlined under "FM R-F Alignment."

For the alignment of the antenna trimmer, C80, the loop antenna must be plugged into the receiver unit receptacle.

For oscillator shunt coil adjustment at 580 kc, the tuning control must be "rocked" a small amount back-and-forth through peak output to find position of oscillator shunt coil adjustment, L13, giving maximum peak output.

6. *Television I-f Trap Alignment*—The television i-f traps are used to attenuate the sound i-f of the same and adjacent channels to prevent their being detected and reproduced on the picture tube. Misalignment of these traps results in interference patterns which have the appearance of horizontal bars or as a very fine pattern which spoils the contrast. See Figure 30.

Set the contrast control at maximum. Turn the Service Selector switch to TEL and the CHANNEL SELECTOR switch to No. 13. Connect an oscilloscope through a 10,000 ohm resistor to the top of the video load resistor, R59.

Connect the output of an accurately calibrated signal generator (with tone modulation) to the grid of the first video i-f amplifier, V3, through a 200 mmf mica capacitor. The alignment frequencies are:

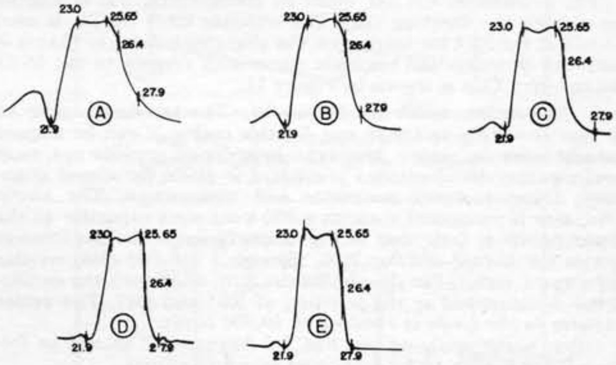


Fig. 11. Video I-f Curves

T5(C169)—21.9 mc
T4(C166)—21.9 mc
T3(C164)—21.9 mc
T2(C178)—27.9 mc

The trimmer C175 is associated with the video carrier placement trap. It is used for the 26.4 mc carrier placement and is adjusted during the alignment of T1.

The trimmers should be aligned for minimum output at their respective alignment frequencies, care being taken to get the lowest possible indication at the output. The input signal should be attenuated below the saturation of the i-f amplifier tubes at start, then raised as signal is attenuated during alignment.

7. *Video I-f Alignment*—The video i-f amplifier uses transformers which are coupled and loaded to give the proper bandpass characteristics. Before attempting alignment of the video i-f, the sound i-f traps should be aligned as in (6), then do not touch the trap trimmers when making the video i-f alignment.

One-stage-at-a-time alignment should be performed so as to duplicate the curves, as shown in Figure 11. The markers are used to establish the correct bandwidth and frequency limits.

Connect the sweep generator through a 200 mmf capacitor to the tube grid preceding the transformer to be aligned. Adjust the sweep width for a minimum of 15 mc about the center frequency of the video i-f frequency. The marker frequencies are supplied by a signal generator and sufficient marker signal may be supplied in most cases except at last stage by merely connecting the high side of the signal generator to the television chassis. At the last stage couple the marker generator through a small mica capacitor to same point as sweep input. ***Make certain generator does not load the circuit.***

The primary of the transformer preceding the grid where the signal is applied will act as a tuned trap, putting a hole in the alignment curve as viewed on the scope unless it is short circuited or detuned. Place a temporary short across the primary as indicated in steps 1, 2 and 3. ***Be sure to remove the short after the stage is aligned.***

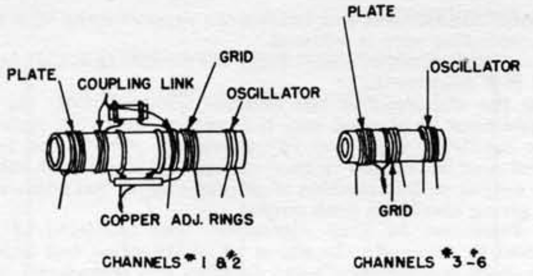


Fig. 12. R-f Coil Assembly

Keep the input to the sweep generator low so as not to overload the video i-f amplifier. The bias voltage specified for contrast control setting may be measured by a vacuum tube voltmeter connected between the center arm of the contrast control and ground. This voltage is approximately correct when the contrast control is about 50% advanced.

The response curves shown in Figure 11 are obtained on an oscilloscope at the junction of R59 and L22. Use a 10,000 ohm resistor in series with the input lead to the scope for isolation.

The primary of the 1st video i-f transformer, T1, is aligned by moving the shorting ring. The trimmer C175 on T1, is used to adjust the 26.4 mc marker on the alignment curve so that it is half-way down on the response curve with respect to the 25.65 mc marker. This is shown in Figure 11.

8. Television Audio I-f Alignment—The television audio i-f is near to critical coupling and for this reason it can be aligned satisfactorily by meter. However, in order to provide optimum performance the alignment procedure is given for visual alignment using a sweep generator and oscilloscope. The sweep generator is connected through a 200 mmf mica capacitor to the input points as indicated in the table. Connect the oscilloscope across the limiter resistor R70, through a 100,000 ohm resistor for steps 1 and 2. For discriminator, T10, alignment the oscilloscope is connected at the junction of R67 and C47. *The series resistor to the scope is reduced to 10,000 ohms.*

Other notes applying to "FM I-f Alignment" should be followed. See Figure 10 for television sound i-f curves.

9. Oscillator Adjustment—The oscillator coil must be adjusted so that the Television Tuning Condenser, C160, will tune the sound carrier of the television signal at the middle of its range. Set the condenser, C160, to mid-position. Then adjust oscıllator coil for channels No. 1 through No. 8 by spreading turns to raise frequency or compressing turns to lower frequency. For channels No. 9 through No. 13, the oscillator coil consists of a single turn. Adjust these coils by spreading the gap to lower frequency or closing the gap to raise frequency in the leads of the coil which run to the terminals.

Apply the signal generator with tone modulation to the antenna input terminals and set the generator to the sound carrier frequency for the channel under alignment. The signal generator must be very accurately calibrated. This can be done by beating its output against a known channel carrier by using a station operating on the channel and tuning in the sound.

For output indication, advance the volume con*rol about to mid-position so that the tone modulation or audio modulation on the channel station may be heard through the loudspeaker.

The oscillator coil is located on the coil form of the assembly nearest to the front of the television channel switch assembly and is wound of heavier wire than the other coils. This is shown in Figure 12.

10. R-f Coil Alignment—The r-f coil assembly is designed for stable, band-pass operation and under normal conditions will seldom require adjustment. In cases where it is definitely known that alignment is necessary (such as when the present coil is damaged and has been changed), do not attempt the adjustment unless suitable equipment is available. When tubes V1 or V2 are changed, alignment of r-f and oscillator may be necessary especially on the higher frequency bands. The minimum requirements for correct r-f alignment is to provide the correct band width, and for the response curve to be centered within the limit frequencies shown for each of the individual bands, as shown in Figure 13. It is also necessary that the curve be adjusted for maximum amplitude consistent with correct band width. To provide these minimum requirements, the r-f coils are over-coupled in a very similar manner to the video i-f transformers. However, instead of adjusting capacity to tune the coils, the inductance is varied by moving a few turns. Coupling is also adjustable by moving the entire coil either away from or toward the adjacent coil on the form.

The physical assembly of the coils in the band switch locates the r-f amplifier plate coil at the rear of the switch and the oscillator coil towards the front end. Two types of coils are used—the Channel No. 1 and No. 2 coils have an additional link circuit between the grid and plate coils to provide better image rejection of the FM band (88 to 108 mc) signals on these two channels. These links are tuned by means of two copper rings which are moved along the coil forms for adjustments.

The input sweep signal is applied to the antenna terminal board at the r-f unit. The 300-ohm cable between the antenna terminal board and r-f amplifier input must be disconnected at the r-f unit when making r-f alignment. The output cable of the signal generator should be terminated into its characteristic impedance. The marker signal generator may be coupled loosely to the antenna input terminals.

The output r-f response curve is taken off at the junction of R4 and a terminal of the 1st video i-f transformer. The Contrast control should be set at minimum for all r-f alignment.

For Channels No. 1 and No. 2, the r-f coils should be aligned to give approximately the curve shown in Figure 13A. The "P" marker represents the video carrier marker while the "S" marker is the high frequency or sound marker. As shown in the amplitude

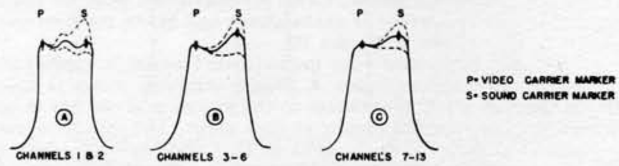


Fig. 13. R-f Alignment Curves

limits of the curves, with the "P" marker as reference no portion of the curve should be any more than 25 per cent higher or 12 per cent lower than this reference point. The markers should be located on the inside of the humps of the curves. Adjustment of the band width is made by moving the plate coil closer to the grid coil or vice-versa. In most cases, the sliding of the copper rings will give both the required bandwidth and the frequency adjustment. Spread or squeeze turns in plate and grid coils if the frequency cannot be obtained by sliding the rings. Spreading turns results in a raising of the frequency; while squeezing turns lowers the frequency.

For the remainder of the channels, the adjustment of the plate coil in relation to the grid coil changes the bandwidth, while the spreading or squeezing of the plate and grid coil results in the raising or lowering of frequency. Only when the plate and grid coils are tuned to the same frequency will the amplitude be greatest with the correct bandwidth. The outside peaks of the r-f response curve should be aligned to the carrier markers.

The upper channel coils (No. 12 and No. 13) have the plate winding reversed from the winding direction of the plate coil of the other transformers. In this case, the bandwidth will be increased by separating the plate and grid coils and vice-versa. This condition can be determined by inspection or by the effect on the curve when making the alignment.

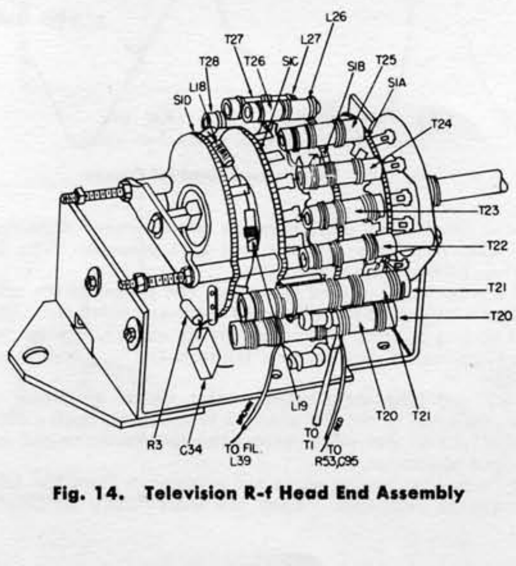


Fig. 14. Television R-f Head End Assembly

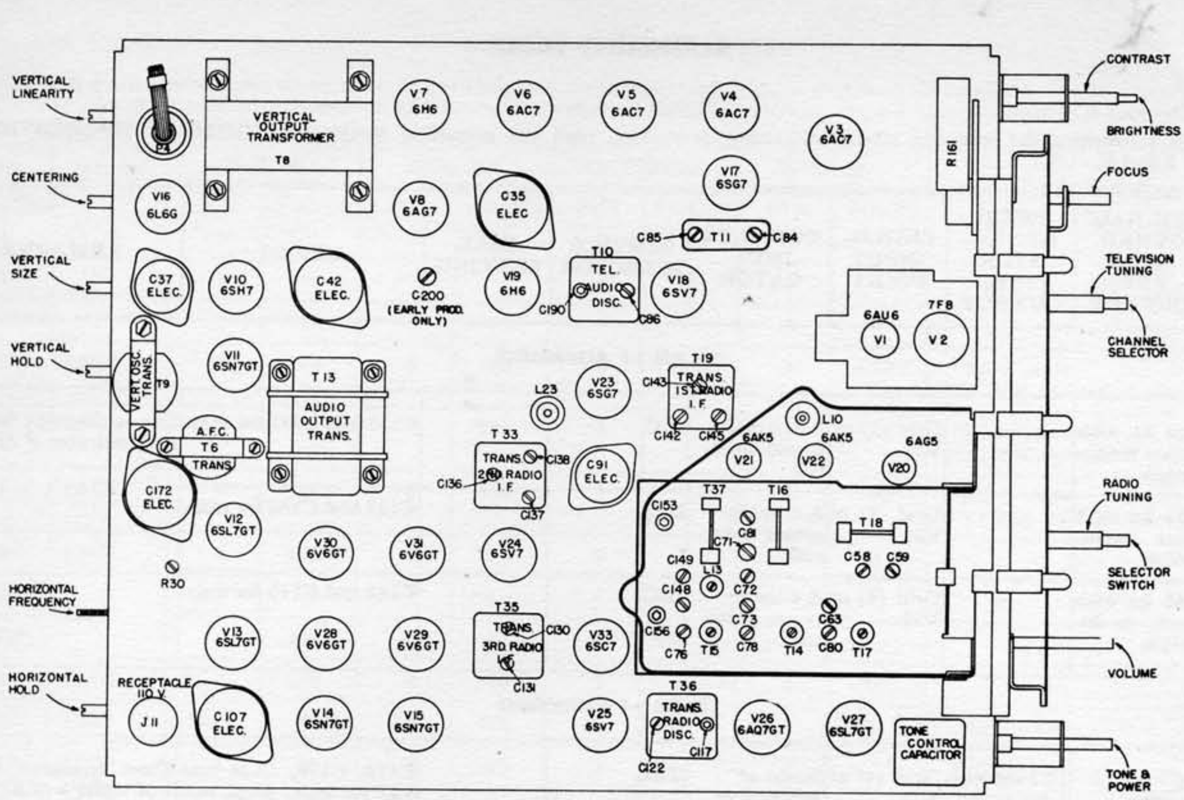


Fig. 15. Top View—Component Location of Receiver Chassis

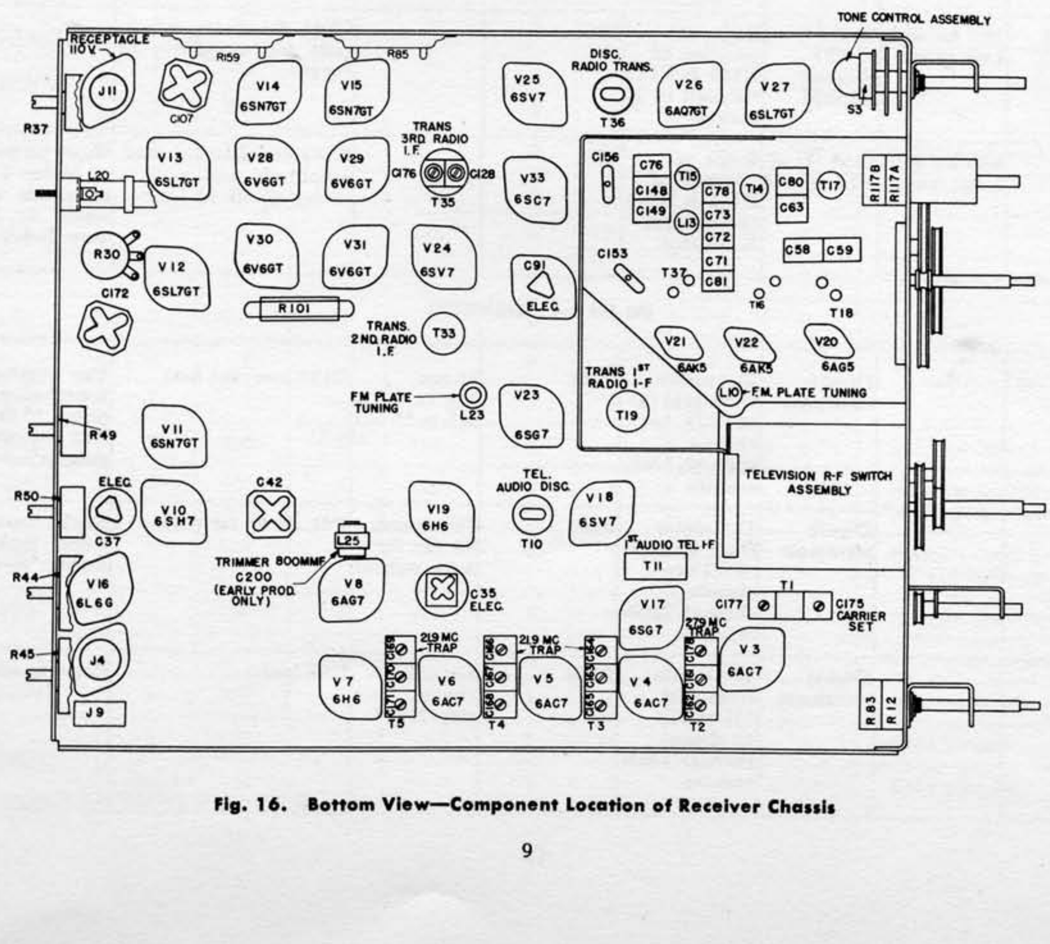


Fig. 16. Bottom View—Component Location of Receiver Chassis

ALIGNMENT TABLE

Before attempting the following tabular alignment procedure, read the preceding section "ALIGNMENT SUGGESTIONS" on pages 5 and 6.

STEP NO.	SIGNAL GENERATOR FREQUENCY	SWEEP GENERATOR FREQUENCY	SIGNAL INPUT POINT	CONNECT INDICATOR	SERVICE SELECTOR	DIAL SETTING	ADJUST	REMARKS
(1) AM I-F ALIGNMENT								
1	455 kc with tone modulation	—	Grid (1) of V22	A-c meter across voice coil	B-C	—	C130 and C131 for max.	Use oscilloscope for output indicator if desired.
2	455 kc with tone modulation	—	Grid (1) of V22	A-c meter across voice coil	B-C	—	C137 and C138 for max.	
3	455 kc with tone modulation	—	Grid (1) of V22	A-c meter across voice coil	B-C	—	C142 and C145 for max.	
(2) FM I-F ALIGNMENT								
1	10.7 mc marker	10.7 mc with 1 mc sweep	Grid (4) of V23 through .01 mfd	Scope at junction of R145 and R146 through 220K resistor	TEL	—	C128, C176, C136 and L23 for max. ampl and symmetry about 10.7 mc	Short terminals 1 and 2 of wafer 3 of S2
2	10.7 mc with tone modulation	—	Grid (4) of V23 through .01 mfd	Scope at junction of R153 & C123 through 10K resistor	FM2	—	C117 for minimum response	
3	Not used	10.7 mc with 1 mc sweep	Grid (4) of V23 through .01 mfd	Scope at junction of R153 & C123 through 10 K resistor	FM2	—	C122 for max. amplitude and symmetry of curve	
4	10.7 mc marker	10.7 mc with 1 mc sweep	Grid (1) of V22 direct	Scope at junction of R145 & R146 through 220 K resistor.	TEL	—	C143 and L10 for max. amplitude and symmetry about 10.7 mc	Short terminals 1 and 2 of wafer 3 of S2, also terminals 9 and 10 of wafer 6. Make short very direct
(3) FM R-F ALIGNMENT								
1	98 mc	—	Dipole terminals	D-c meter from grid (2) of V25 to chassis through 220K resistor	FM2	98 mc 3½ in. 3 19/32 in.**	C153 (osc) for max	Use trimmer setting at lowest capacity response point. ** See text under FM r-f alignment for pointer index
2	98 mc	—	Dipole terminals	D-c meter from grid (2) of V25 to chassis through 220K resistor	FM2	*Rock near 98 mc for max. output	C81 (R-F) for max.	Rock tuning control when making alignment. *See text.
3	98 mc	—	Dipole terminals	D-c meter from grid (2) of V25 to chassis through 220K resistor	FM2	Do not change from step No. 2	C58 (ant.)	Same as step No. 1

ALIGNMENT TABLE (Cont'd)

STEP NO.	SIGNAL GENERATOR FREQUENCY	SWEEP GENERATOR FREQUENCY	SIGNAL INPUT POINT	CONNECT INDICATOR	SERVICE SELECTOR	DIAL SETTING	ADJUST	REMARKS
(3) FM R-F ALIGNMENT (Cont'd)								
4	46 mc	—	Dipole terminals	D-c meter from grid (2) of V25 to chassis through 220K resistor	FM1	46 mc $3\frac{1}{2}$ in. — $3\frac{19}{32}$ in.**	C156 (osc) for max.	Use trimmer setting at lowest capacity response point. **See text under FM r-f alignment for pointer index
5	46 mc	—	Dipole terminals	D-c meter from grid (2) of V25 to chassis through 220K resistor	FM1	*Rock near 46 mc for max. output	C71 (r-f) for max.	Rock tuning control when making alignment. *See text.
6	46 mc	—	Dipole terminals	D-c meter from grid (2) of V25 to chassis through 220K resistor	FM1	Do not change from step No. 5	C59 (ant.) for max.	Same as step No. 4
(4) SW R-F ALIGNMENT								
1	11.8 mc with tone modulation	—	SW antenna terminal through 400 ohms	A-c meter across voice coil	SW2	11.8 mc $4\frac{1}{2}$ in. — $4\frac{19}{32}$**	C148 (osc) for max.	Use trimmer setting at lowest capacity response point. **See text under SW r-f alignment for pointer index.
2	11.8 mc with tone modulation	—	SW antenna terminal through 400 ohms	A-c meter across voice coil	SW2	*Rock tuning near 11.8 mc for max output	C73 (r-f) for max.	Rock tuning control when making alignment. *See text.
3	11.8 mc with tone modulation	—	SW antenna terminal through 400 ohms	A-c meter across voice coil	SW2	Do not change from step No. 2	C79 (ant.) for max.	Loop antenna must be plugged in.
4	9.6 mc with tone modulation	—	SW antenna terminal through 400 ohms	A-c meter across voice coil	SW1	9.6 mc $4\frac{1}{2}$ in. — $4\frac{19}{32}$ in.**	C149 (osc) for max.	Use trimmer setting at lowest capacity response point. **See text under SW r-f alignment for pointer index.
5	9.6 mc with tone modulation	—	SW antenna terminal through 400 ohms	A-c meter across voice coil	SW1	*Rock tuning drive near 11.8 mc for max. output	C72 (r-f) for max.	Rock tuning control when making alignment. *See text.
6	9.6 mc with tone modulation	—	SW antenna terminal through 400 ohms	A-c meter across voice coil	SW1	Do not change from step No. 5	C63 (ant.) for max.	Loop antenna must be plugged in.
(5) BC R-F ALIGNMENT								
1	1620 kc with tone modulation	—	BC ant. terminal through 200 mmf	A-c meter across voice coil	B-C	Max. frequency setting	C76 (osc) for max.	

ALIGNMENT TABLE (Cont'd)

(5) BC R-F ALIGNMENT (Cont'd)

STEP NO.	SIGNAL GENERATOR FREQUENCY	SWEEP GENERATOR FREQUENCY	SIGNAL INPUT POINT	CONNECT INDICATOR	SERVICE SELECTOR	DIAL SETTING	ADJUST	REMARKS
2	1620 kc with tone modulation	—	BC ant. terminal through 200 mmf	A-c meter across voice coil	B-C	Max. frequency setting	C78 (r-f) for max.	
3	1620 kc with tone modulation	—	BC antenna terminal through 200 mmf	A-c meter across voice coil	B-C	Max. frequency setting	C80 (ant.) for max.	Loop antenna must be plugged in.
4	1500 kc with tone modulation	—	BC antenna terminal through 200 mmf	A-c meter across voice coil	B-C	1500 kc $1\frac{13}{32}$ in. — $1\frac{1}{2}$ in.**	Slug in T15 (osc) for max.	The slug is adjusted by turning the supporting screw into which the suspending wire is soldered. **See text under BC r-f alignment for pointer index.
5	1000 kc with tone modulation	—	BC antenna terminal through 200 mmf.	A-c meter across voice coil	B-C	Tune for max. output	Slug in T14 (r-f) for max.	Same as noted in step No. 4.
6	1000 kc with tone modulation	—	BC antenna terminal through 200 mmf.	A-c meter across voice coil	B-C	Do not change from step No. 5	Slug in T17 (ant.) for max.	Loop antenna must be plugged in. Also slug is adjusted as in step 4.
7	580 kc with tone modulation	—	BC antenna terminal through 200 mmf	A-c meter across voice coil	B-C	Tune near 580 kc for max.	*L13 for max.	*Rock tuning control through peak while adjusting for max.

(6) TELEVISION I-F TRAP ALIGNMENT

STEP NO.	SIGNAL GENERATOR FREQUENCY	SWEEP GENERATOR FREQUENCY	SIGNAL INPUT POINT	CONNECT INDICATOR	SERVICE SELECTOR	DIAL SETTING	ADJUST	REMARKS
1	21.9 mc with tone modulation	—	Grid (4) of V3 through 200 mmf.	Scope at junction of L22 and R59*	TEL No. 13	—	C169 on T5 for min.	*10,000 ohms in series with scope input.
2	21.9 mc with tone modulation	—	Grid (4) of V3 through 200 mmf.	Scope at junction of L22 and R59*	TEL No. 13	—	C166 on T4 for min.	
3	21.9 mc with tone modulation	—	Grid (4) of V3 through 200 mmf.	Scope at junction of L22 and R59*	TEL No. 13	—	C164 on T3 for min.	
4	27.9 mc with tone modulation	—	Grid (4) of V3 through 200 mmf.	Scope at junction of L22 and R59*	TEL No. 13	—	C178 on T2 for min.	

(7) VIDEO I-F ALIGNMENT

STEP NO.	SIGNAL GENERATOR FREQUENCY	SWEEP GENERATOR FREQUENCY	SIGNAL INPUT POINT	CONNECT INDICATOR	SERVICE SELECTOR	DIAL SETTING	ADJUST	REMARKS
1	23 mc, 25.65 mc and 26.4 markers	20–30 mc	Grid (4) of V6 through 200 mmf.	Scope at junction of L22 and R59 thru 10,000 ohms	TEL No. 13	—	C170 and C171 on T5 for max. amplitude, bandwidth, and position of markers	Short C167 on T4.

ALIGNMENT TABLE (Cont'd)

STEP NO.	SIGNAL GENERATOR FREQUENCY	SWEEP GENERATOR FREQUENCY	SIGNAL INPUT POINT	CONNECT INDICATOR	SERVICE SELECTOR	DIAL SETTING	ADJUST	REMARKS
(7) VIDEO I-F ALIGNMENT (Cont'd)								
2	23 mc, 25.65 mc and 26.4 markers	20–30 mc	Grid (4) of V5 through 200 mmf.	Scope at junction of L22 and R59 thru 10,000 ohms	TEL No. 13	—	C167 and C168 on T4 for max. amplitude, bandwidth, and position of markers	Remove short from C167 Short C163 on T3. Contrast control set for −5 v. d-c.
3	23 mc, 25.65 mc and 26.4 markers	20–30 mc	Grid (4) of V4 through 200 mmf	Scope at junction of L22 and R59 thru 10,000 ohms	TEL No. 13	—	C163 and C165 on T3 for max. amplitude, bandwidth, and position of markers	Remove short from C163. Short C161 on T2. Contrast control set for −5 v. d-c.
4	23 mc. 25.65 mc and 26.4 markers	20–30 mc	Grid (4) of V3 through 200 mmf	Scope at junction of L22 and R59 thru 10,000 ohms	TEL No. 13	—	C161 and C162 on T2 for max. amplitude, bandwidth, and position of markers	Remove short from C161. Place 100 mmf between pin (6) of V2 and hot side of C7. Contrast control set for −5 v. d-c.
5	23 mc, 25.65 mc and 26.4 markers	20–30 mc	Grid (8) of V2 through 200 mmf.	Scope at junction of L22 and R59 thru 10,000 ohms	TEL No. 13	—	C177 and shorting ring on T1 for max. amplitude, bandwidth, and position of markers	Remove shunt applied in step No. 4. Contrast control set for −5 to −7 volts d-c.
6	23 mc, 25.65 mc and 26.4 markers	20–30 mc	Grid (8) of V2 through 200 mmf	Scope at junction of L22 and R59 thru 10,000 ohms	TEL No. 13	—	C175* (See "Remarks")	Adjust to bring 26.4 mc marker half-way down on response curve with respect to 25.65 mc.
7	4.5 mc	Not used	Grid (4) of V8	See "Remarks"	TEL No. 13	—	C200 for min. (C200 is not shown on schematic. This capacitor is in plate circuit of V8)	Connect VTVM good for 4.5 mc response to pin (11) of 5TP4. This adjustment is on early production receivers only.
(8) TELEVISION AUDIO I-F ALIGNMENT								
1	21.9 mc marker	21.9 mc with 1 mc sweep	Pin (4) of V17 through 200 mmf	Scope at junction R70 and C51 thru 100 K resistor	TEL No. 13	—	C84 and C85 for max. amplitude and symmetry at 21.9 mc	
2	21.9 mc marker	21.9 mc with 1 mc sweep	Pin (4) of V4 through 200 mmf	Scope at junction R70 and C51 thru 100K resistor	TEL No. 13	—	Retrim C164 for max. amplitude and symmetry at 21.9 mc if necessary.	If C164 was properly aligned under "Trap Alignment," adjustment will not be necessary.
3	21.9 mc with tone modulation	Not used	Pin (4) of V4 through 200 mmf	Scope at junction of R67 and C47 thru 10K resistor	TEL No. 13	—	Tune C190 for min. tone.	Volume control at 50%. Speaker connected.
4	Not used	21.9 mc with 1 mc sweep	Pin (4) of V4 through 200 mmf.	Scope at junction of R67 and C47 thru 10K resistor	TEL No. 13	—	C86 for max. peak-to-peak amplitude and symmetry	
5	Repeat steps 3 and 4.							
(9) TELEVISION OSCILLATOR ADJUSTMENTS								
1	49.75 mc with tone modulation	—	Antenna terminals	—	TEL and Channel No. 1	—	Turns of osc coil T20 for max.	Volume control at mid-position. Make sure C160 is at mid-position of travel. Use sound output as indicator.

ALIGNMENT TABLE (Cont'd)

STEP NO.	SIGNAL GENERATOR FREQUENCY	SWEEP GENERATOR FREQUENCY	SIGNAL INPUT POINT	CONNECT INDICATOR	SERVICE SELECTOR	DIAL SETTING	ADJUST	REMARKS
				(9) TELEVISION OSCILLATOR ADJUSTMENTS (Cont'd)				
2	59.75 mc with tone modulation	—	Antenna terminals	—	TEL and Channel No. 2	—	Turns of osc coil T21 for max.	Volume control at mid-position. Make sure C160 is at mid-position of travel. Use sound output as indicator.
3	65.75 mc with tone modulation	—	Antenna terminals	—	TEL and Channel No. 3	—	Turns of osc coil T22 for max.	
4	71.75 mc with tone modulation	—	Antenna terminals	—	TEL and Channel No. 4	—	Turns of osc coil T23 for max.	
5	81.75 mc with tone modulation	—	Antenna terminals	—	TEL and Channel No. 5	—	Turns of osc coil of T24 for max.	
6	87.75 mc with tone modulation	—	Antenna terminals	—	TEL and Channel No. 6	—	Turns of osc coil of T25 for max.	
7	179.75 mc with tone modulation	—	Antenna terminals	—	TEL and Channel No. 7	—	Turns of osc coil of T26 for max.	
8	185.75 mc with tone modulation	—	Antenna terminals	—	TEL and Channel No. 8	—	Lead gap of osc coil of T27 for max.	
9	191.75 mc with tone modulation	—	Antenna terminals	—	TEL and Channel No. 9	—	Lead gap of osc coil of T28 for max.	
10	197.75 mc with tone modulation	—	Antenna terminals	—	TEL and Channel No. 10	—	Lead gap of osc coil of T29 for max.	
11	203.75 mc with tone modulation	—	Antenna terminals	—	TEL and Channel No. 11	—	Lead gap of osc coil of T30 for max.	
12	209.75 mc with tone modulation	—	Antenna terminals	—	TEL and Channel No. 12	—	Lead gap of osc coil of T31 for max.	
13	215.75 mc with tone modulation	—	Antenna terminals	—	TEL and Channel No. 13	—	Lead gap of osc coil of T32 for max.	
				(10) TELEVISION R-F COIL ALIGNMENT				
1	Markers 45.25 mc and 49.75 mc	Channel No. 1 with 25 mc sweep	Antenna terminals at r-f amplifier	Scope at junction of R4 and T1	Channel No. 1	—	For max. amplitude and recommended response with correct marker placement	See Fig. 13A for resultant alignment curve. Contrast at minimum
2	Markers 55.25 mc and 59.75	Channel No. 2 with 25 mc sweep	Antenna terminals at r-f amplifier	Scope at junction of R4 and T1	Channel No. 2	—	For max. amplitude and recommended response with correct marker placement.	See Fig. 13A for resultant alignment curve. Contrast at minimum
3	Markers 61.25 mc and 65.75 mc	Channel No. 3 with 25 mc sweep	Antenna terminals at r-f amplifier	Scope at junction of R4 and T1	Channel No. 3	—	For max. amplitude and recommended response with correct marker placement.	See Fig. 13B for resultant alignment curve. Contrast at minimum
4	Markers 67.25 mc and 71.75 mc	Channel No. 4 with 25 mc sweep	Antenna terminals at r-f amplifier	Scope at junction of R4 and T1	Channel No. 4	—	For max. amplitude and recommended response with correct marker placement.	See Fig. 13B for resultant alignment curve. Contrast at minimum

ALIGNMENT TABLE (Cont'd)

STEP NO.	SIGNAL GENERATOR FREQUENCY	SWEEP GENERATOR FREQUENCY	SIGNAL INPUT POINT	CONNECT INDICATOR	SERVICE SELECTOR	DIAL SETTING	ADJUST	REMARKS
(10) TELEVISION R-F COIL ALIGNMENT (Cont'd)								
5	Markers 77.25 mc and 81.75 mc	Channel No. 5 with 25 mc sweep	Antenna terminals at r-f amplifier	Scope at junction of R4 and T1	Channel No. 5	—	For max. amplitude and recommended response with correct marker placement.	See Fig. 13B for resultant alignment curve. Contrast at minimum
6	Markers 83.25 mc and 87.75 mc	Channel No. 6 with 25 mc sweep	Antenna terminals at r-f amplifier	Scope at junction of R4 and T1	Channel No. 6	—	For max. amplitude and recommended response with correct marker placement.	See Fig. 13B for resultant alignment curve. Contrast at minimum
7	Markers 175.25 mc and 179.75 mc	Channel No. 7 with 25 mc sweep	Antenna terminals at r-f amplifier	Scope at junction of R4 and T1	Channel No. 7	—	For max. amplitude and recommended response with correct marker placement	See Fig. 13C for resultant alignment curve. Contrast at minimum
8	Markers 181.25 mc and 185.75 mc	Channel No. 8 with 25 mc sweep	Antenna terminals at r-f amplifier	Scope at junction of R4 and T1	Channel No. 8	—	For max. amplitude and recommended response with correct marker placement.	See Fig. 13C for resultant alignment curve. Contrast at minimum
9	Markers 187.25 mc and 191.75 mc	Channel No. 9 with 25 mc sweep	Antenna terminals at r-f amplifier	Scope at junction of R4 and T1	Channel No. 9	—	For max. amplitude and recommended response with correct marker placement	See Fig. 13C for resultant alignment curve. Contrast at minimum
10	Markers 193.25 mc and 197.75 mc	Channel No. 10 with 25 mc sweep	Antenna terminals at r-f amplifier	Scope at junction of R4 and T1	Channel No. 10	—	For max. amplitude and recommended response with correct marker placement	See Fig. 13C for resultant alignment curve. Contrast at minimum
11	Markers 199.25 mc and 203.75 mc	Channel No. 11 with 25 mc sweep	Antenna terminals at r-f amplifier	Scope at junction of R4 and T1	Channel No. 11	—	For max. amplitude and recommended response with correct marker placement.	See Fig. 13C for resultant alignment curve. Contrast at minimum
12	Markers 205.25 mc and 209.75 mc	Channel No. 12 with 25 mc sweep	Antenna terminals at r-f amplifier	Scope at junction of R4 and T1	Channel No. 12	—	For max. band width and recommended response with correct marker placement.	See Fig. 13C for resultant alignment curve. Contrast at minimum
13	Markers 211.25 mc and 215.75 mc	Channel No. 13 with 25 mc sweep	Antenna terminals at r-f amplifier	Scope at junction of R4 and T1	Channel No. 13	—	For max. band width and recommended response with correct marker placement.	See Fig. 13C for resultant alignment curve. Contrast at minimum

PRESET CONTROLS

The preset controls are located at the rear of the Receiver chassis (see Figure 17), and at the rear of the Power chassis (see Figure 18). For adjustments, they are available through holes in the back cover without removing the cabinet back. Slotted shafts permit ease in adjustments by means of a screwdriver.

These controls are adjusted for optimum performance at the factory and should require very little attention after installation and over very long periods of operation. However, all controls should be adjusted at the time of installation to correct for any shift in control settings during shipment. Study the illustrations, shown in Figures 19 through 32, for maladjustment of the various controls and their means of remedy. These adjustments must be made during the transmission of a test pattern, as shown in the illustrations.

HORIZONTAL HOLD—This control locks the horizontal picture elements in synchronism with the transmitted picture. Improper adjustment will result in the loss of picture intelligence as shown in a picture under Figure 24. Although this control holds over a relatively wide range, for optimum performance the adjustment should be made with care. The following checks should be made after the picture is synchronized by the adjustment of this control.

1. With the picture being received, switch the Channel Selector to a channel having no program and then back to the desired channel. The picture should immediately lock into position.
2. With the picture being received, turn the television receiver power "off" for two or three seconds and then turn it back "on" again. The picture should come into synchronization within ten seconds after the picture tube has been illuminated.
3. Turn the Service Selector to the "radio" position and allow the television receiver to transfer for two or three minutes to Broadcast reception and then return to the television channel transmitting a picture. The picture should synchronize within 10 seconds upon showing illumination.
4. Turn power off for three or four minutes and then "on." The picture should lock in horizontally within ten seconds after the raster becomes illuminated.

VERTICAL HOLD—This control is used to lock the picture in synchronism with the transmitted picture in the vertical direction. When the control is maladjusted, the picture will slide vertically out of frame, giving overlapping images or even double images in the vertical direction. After the picture is locked in vertically on a normal picture, reduce the Contrast control until the picture

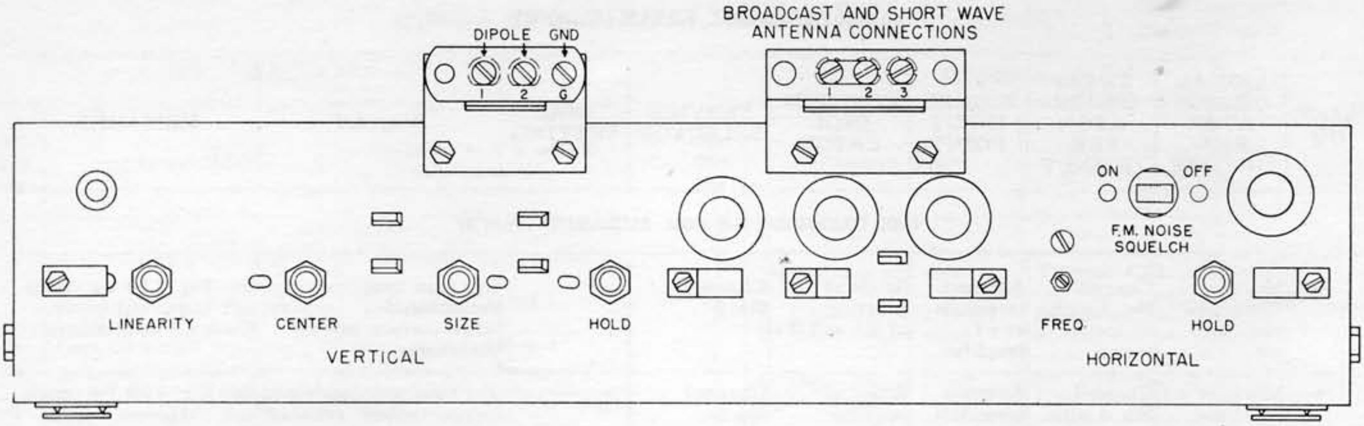


Fig. 17. Preset Adjustment Controls, Rear of Receiver Chassis

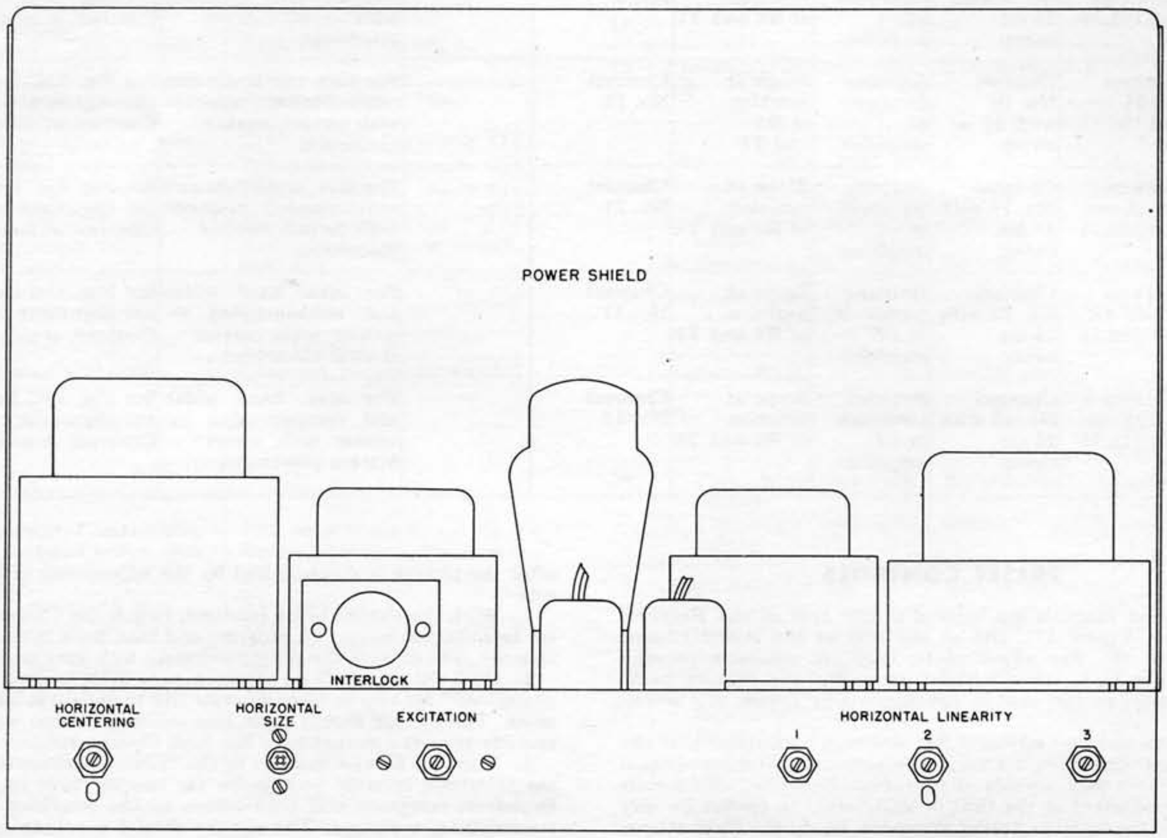


Fig. 18. Preset Adjustment Controls, Rear of Power Supply Chassis

is barely visible, then readjust the Vertical Hold control until the picture holds in frame. The object is to adjust the Vertical Hold control to the center of the range over which the picture is synchronized at a minimum setting of the Contrast control that will still allow the picture to hold.

VERTICAL CENTERING—Adjustment of this control moves the picture in a vertical direction. Adjust Vertical Centering so that the picture is centered vertically within the area of the viewing screen.

HORIZONTAL CENTERING—Adjustment of this control moves the picture in a horizontal direction. Adjust Horizontal Centering so that the picture is centered horizontally within the area of the viewing screen.

HORIZONTAL SIZE—As the name implies, this slug-tuned control varies the horizontal size or width of the picture and is adjusted so the horizontal picture size corresponds with the width of the viewing screen. To increase size, screw the adjustment control clockwise; and to decrease size, adjust counterclockwise.

HORIZONTAL LINEARITY—There are three Horizontal Linearity adjustment controls marked 1, 2, and 3, respectively. Their function is to adjust the horizontal linearity of the picture. The effect of improper adjustment is shown in the photo of Figure 26, where a crowding of picture elements will be seen in a section of the picture. The optimum adjustment of these controls will result in a horizontally symmetrical test pattern picture. The following procedure is recommended.

Beginning with Control 1 in the full clockwise position, adjust Controls 3 and 2, first one and then the other, for best linearity at each small increment of a counterclockwise setting of Control 1.

It will be found that Control 2 will have somewhat the same effect as Control 3, except that it will also affect the extreme right-hand side of the picture with some positions of Control 3. Control 3 will have its effect primarily on the second quarter of the picture, counting the quarters from the left. Control 1 will squeeze or stretch the left-hand half of the picture. Control 1 should be as far clockwise as possible consistent with good linearity, for maximum picture size. After the linearity is corrected, it may be necessary to adjust the Horizontal size.

VERTICAL LINEARITY AND SIZE—As the names suggest, the Vertical Linearity control is adjusted for a vertically symmetrical picture pattern, while the Vertical Size control is adjusted so the picture size will correspond with the height of the vertical area of the viewing screen. These two controls interact on each other and must, therefore, be adjusted together to obtain proper size and linearity.

PICTURE TILT—Squaring up the picture with respect to the viewing screen is accomplished by first loosening the two ¼–20 round head screws (1 and 2 of Figure 35) just enough to allow the deflecting coil yoke to be rotated. After rotating the yoke for proper framing, tighten the two ¼–20 screws firmly.

SPECIAL PRESET CONTROLS

The following adjustments are not described in the installation instructions ER-A-901 and ER-A-910 since they are not normally termed installation controls. However, these controls are brought out as adjustments on the chassis and may have to be reset as service adjustments. In each case the chassis in which the control appears must be removed from the cabinet as test connections to under chassis components are necessary.

POTENTIOMETER, R30—This phase detector balance control is located at the rear top deck of the receiver chassis adjacent to the radio antenna terminal strip and should only require adjustment after circuit components have been changed in the horizontal AFC circuit. To adjust: (1) Tune in a television signal; (2) Remove tube V15; (3) Connect a 20,000 ohm/volt 150 volt meter between pin 2 of V13B and ground; (4) With a clip lead intermittently short pin 4 of V10 to ground, simultaneously adjusting Control R30 until voltmeter reads the same voltage with short "on" and "off"; (5) Replace V15.

HORIZONTAL FREQUENCY, L20—This control is adjusted in conjunction with the Horizontal Hold control and should only have to be changed when a tube or circuit component is changed in the horizontal multivibrator circuit. To adjust, proceed as follows: (1) Tune in a television signal for optimum sound and adjust for normal contrast; (2) Remove clipper tube, V10; (3) Short L20 out of circuit by placing a clip lead across its terminals; (4) Adjust the Horizontal Hold control, R37, until the picture is approximately held in frame horizontally. (NOTE—With the clipper tube, V10, removed, the sweep generators are free-running and must be manually controlled vertically and horizontally); (5) Remove short circuit across L20; (6) Adjust iron core in L20 until the picture is approximately held in frame horizontally; (7) Replace clipper tube, V10, and readjust Horizontal Hold control if necessary.

EXCITATION, S201—This control is factory adjusted and should not require adjustment in receiver installation or field service. For service adjustment, it is necessary to remove the power chassis from the receiver cabinet and connect a measuring instrument to the circuit, as described below.

Clockwise rotation of this control increases the high voltage on the picture tube anode. With the 5TP4 picture tube biased so that the screen is not illuminated, the anode voltage should be 27,000 volts. This voltage is approximately correct when the d-c voltage at pin 7 of the 1st high-voltage rectifier tube V207 reads 7000 volts. This voltage may be read on an electrostatic voltmeter or a 20,000 ohm/voltmeter with suitable multiplier.

PICTURE MALADJUSTMENT OR INTERFERENCE

The following illustrations show picture defects which are caused by incorrect setting of the operating controls or by interference picked up by the antenna.

The adjustment of the controls is most efficiently accomplished by the use of a test pattern, similar to that illustrated, which is normally transmitted just prior to the scheduled program.

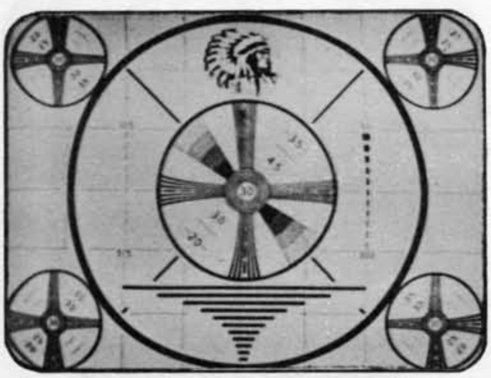


Fig. 19. Normal Picture

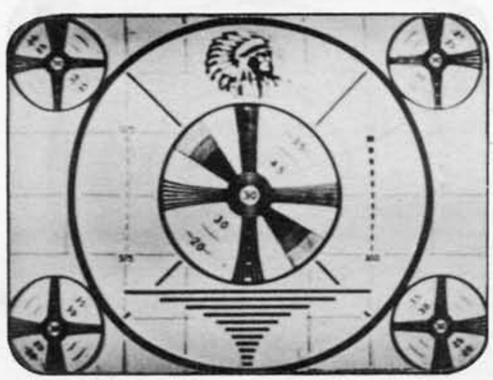


Fig. 20. Contrast Too High

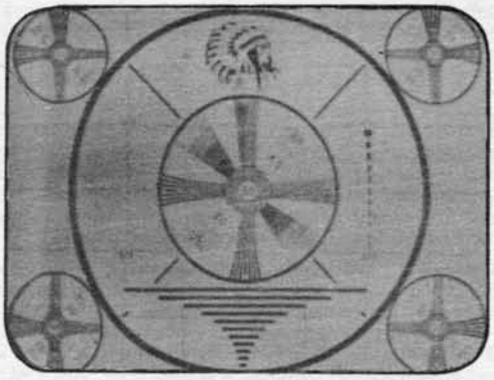


Fig. 21. Contrast Too Low, Brightness Too High

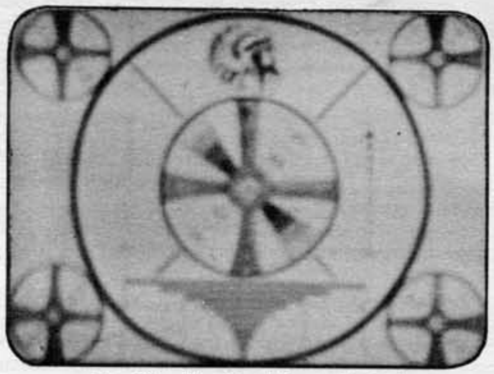


Fig. 22. Electrical Focus Control Misadjusted

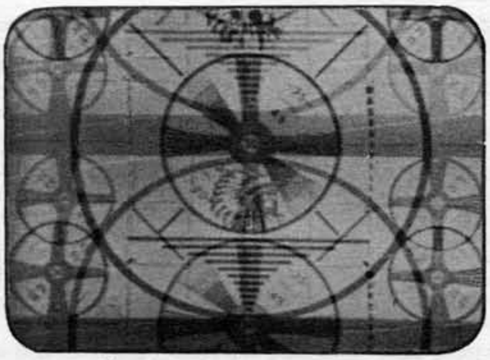


Fig. 23. Vertical Hold Control Misadjusted

Fig. 24. Horizontal Hold Control Misadjusted

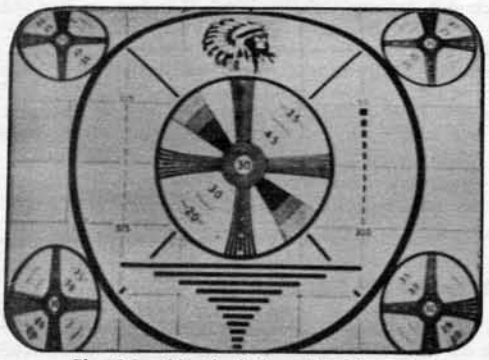


Fig. 25. Vertical Linearity Control Misadjusted

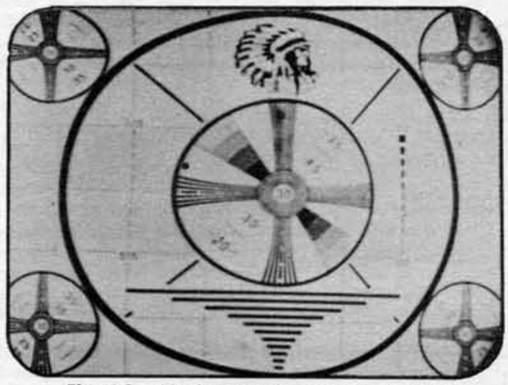


Fig. 26. Horizontal Linearity Controls Misadjusted

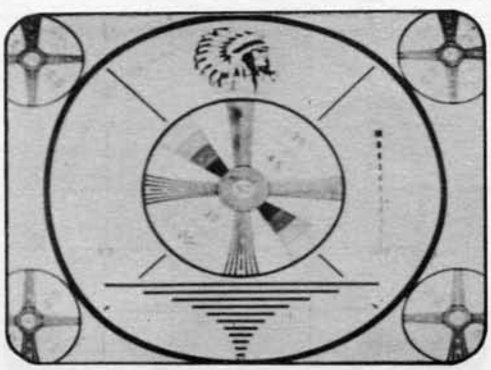


Fig. 27. Horizontal Width Control Misadjusted

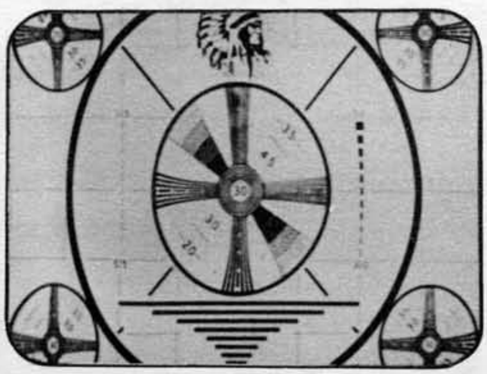


Fig. 28. Vertical Height Control Misadjusted

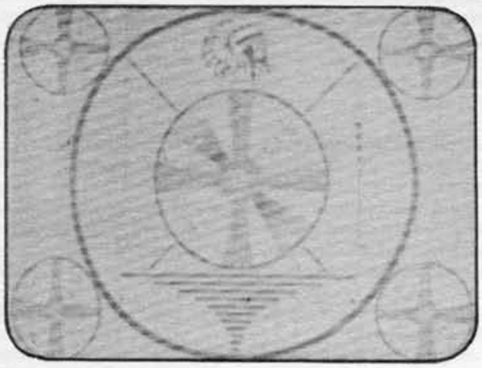


Fig. 29. R-f Interference Pickup on Antenna

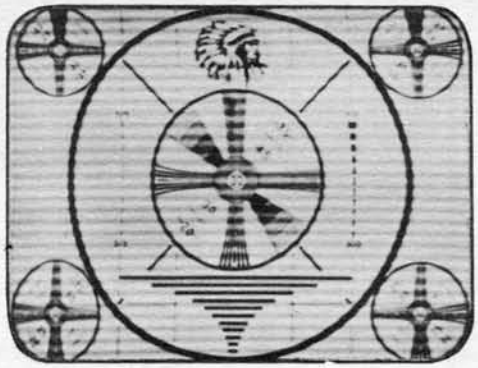


Fig. 30. Sound Bar Interference Such as Adjacent Channel or Microphonics

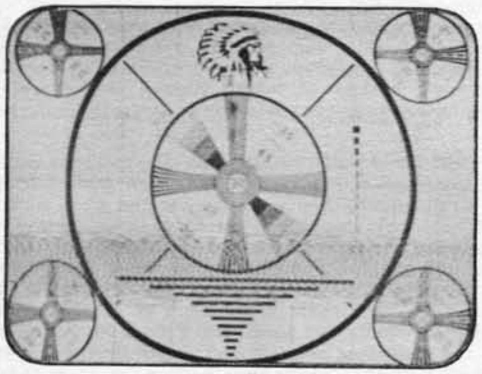


Fig. 31. Weak Diathermy Interference

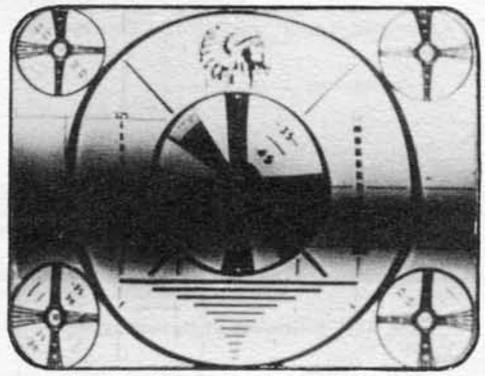


Fig. 32. Strong Diathermy or Hum in Video I-f, Detector, or Video Output

DESCRIPTION—OPTICAL SYSTEM

Projection television, as the name implies, makes use of an optical system to enlarge the image formed on the screen of the picture tube to the size as it is viewed on the screen. The design of this optic system must have as high a light gathering efficiency as is practical and must be free from optical defects as normally encountered. A lens system may be used; however, it requires expensive correcting measures to produce a picture of high efficiency with small optical defects. Another method of enlargement with high light efficiency is by the use of a concave spherical mirror. Although this system must also be optically corrected, the treatment is less expensive and may be easily mass-produced. The Models 901 and 910 use this latter method (commonly called Schmidt Optical System) in conjunction with a 5-inch Type 5TP4 projection tube.

In order to understand this system, a few fundamental optical laws might be stated here. If a ray of light falls on a flat mirror it is reflected at the same angle with the surface as the incident ray. A plane mirror reflects all rays at the same angle and the picture reflected is, therefore, of the same size as the object. If, however, the reflecting surface is made concave, the image can be larger than the object. If we choose as a reflecting surface a sphere and use for convenience only part of it, we obtain the usual spherical mirror. It produces an enlarged image on a flat screen if the initial image is formed on the curved surface. The rays of light produce an enlarged image without passing through a glass lens and, therefore, the loss of energy is small and the efficiency of this system high. Due to the fact that all the picture elements of the image to be enlarged do not fall on the principal axis, the converging rays of light are not reflected to one single point (focal point) but to a small circle, and the picture obtained is blurred. This effect is called spherical aberration and it can be corrected easily by inserting in the light path an aspheric corrector lens.

Figure 33 shows all the components of the optical system. In order to understand the principle, we follow a ray of light produced by the picture tube. An element "A" of the picture on the tube is reflected by the spherical mirror at A1 and A. Its center is non-reflectant so that light will not be reflected back onto the face of the picture tube which would result in reduction of picture contrast. The reflected ray "A1" passes through the corrector lens and reaches the reflector mirror at A1. Then the ray is reflected by the mirror to A on the viewing screen. If we follow the reflected ray A2 on the left side of the spherical mirror we see that it passes through the corrector lens and hits the reflecting mirror at A2 and is then reflected to the same point A on the viewing screen. Without the corrector lens the second ray would not hit the viewing screen at the same point A, causing a blurred image due to spherical aberration. If we take a picture element B on the left side of the picture and follow the path of the ray, we note that the two rays B1 and B2 follow a similar path as the rays of the right picture element A and we obtain the second point B on the viewing screen.

The picture elements between the points A and B on the picture tube are thus enlarged to the distance AB on the viewing screen. This system provides good enlargement, and due to the fact that it uses only two reflecting surfaces and one lens the efficiency is very high.

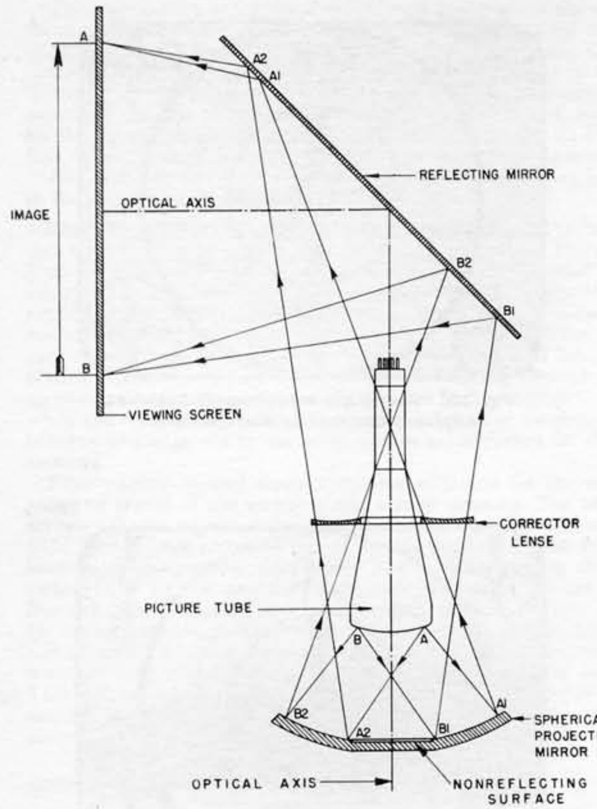


Fig. 33. Schematic of Optical System

REPLACEMENT OF OPTICAL UNIT COMPONENTS

As in most precision instruments and because of the nature of this unit, certain precautions and technical requirements are necessary when replacing a component part. Outlined below are the procedures for replacing a damaged picture viewing screen, flat mirror, picture tube, corrector lens, and spherical mirror. After replacement has been made, a quality check should be run by viewing a picture to determine whether the accuracy of the original optical adjustments have been impaired. In some cases it will be found necessary to realign the complete or part of the optical system. This is especially true if the picture tube is replaced when it is necessary to readjust the focal alignment of the tube.

VIEWING SCREEN REPLACEMENT—CAUTION: Extreme care should be taken not to fingerprint the screen. If the screen becomes dusty, clean with a soft camel's hair brush or dry cotton; if fingerprinted, clean with cotton dampened with windex or water. When cleaning, do not rub hard at any time. Only a *light* rubbing action is necessary. *Do not wash with water.* For removal and replacement of screen, the following procedure is recommended.

1. Elevate screen housing and remove the top rail of screen housing by removing its screws.
2. Remove the tape strip and the three rubber cushions from the top edge of screen.
3. Place the palm of the hand bearing gently upon the screen surface near the top and center, and slide screen upward.
4. Replace screen by inserting into vertical grooves provided, and with the hand placed as in step 3 slide screen downward, finally tapping top edge of screen gently to seat bottom edge into grooved recess.
5. Replace the three rubber cushions and the tape strip on the top edge of screen. Make certain when applying tape it is not visible in picture area.
6. Replace top rail to screen housing and replace screws.

FLAT MIRROR REPLACEMENT—CAUTION: The tissue packing found on the new replacement mirror should not be removed until the mirror installation is completed in the screen housing and is ready to be used. The mounting clamps to be installed should be placed right over the tissue. This precaution is taken to prevent fingerprinting the mirror. If mirror becomes dusty, clean with a soft camel's-hair brush or dry absorbent cotton; if fingerprinted, clean with clear water or windex and absorbent cotton. When cleaning, do not rub hard at any time. Only a *light* rubbing action should be used.

The original flat mirror in each unit installation had been jigged in place at the factory, insuring proper angular alignment to engineering specifications. It is, therefore, most important, when replacement is made that the original positioning of mirror within the screen housing be maintained. The optical system will be defocussed if the mirror is not assembled and installed as described herein. Install mirror with aluminized surface outward.

1. Remove the viewing screen as outlined under "Viewing Screen Replacement."
2. If original mirror is broken but position of mounting clamps has been maintained, measure along its edge to location of clamps.
3. With the measurement data determined in step 2, measure along edge of replacement mirror to locate position of clamps.
4. With clamps fitted to new mirror, install by aligning mounting holes of clamps with original mounting holes in screen housing and fasten using the original mounting screws.

If the position of clamps cannot be determined as above because of mirror being shattered or loosening of clamps, their positioning on the replacement mirror must be determined by a "cut-and-try" method of fitting clamps and checking their mounting hole alignment to coincide with the holes in the screen housing.

PICTURE TUBE REPLACEMENT—CAUTION: The picture tube is a high vacuum tube and, if it is broken, pieces of glass may fly with force in all directions. Any weakening of the glass, such as may be encountered by chipping, scratching, or subjection to more than moderate pressure, may cause this tube to break. The use of gloves and goggles is recommended when it is necessary to remove or replace the picture tube. Do not handle the tube by any surface other than by the neck or by that part of the bulb having a conductive band. See Figure 34. Fingerprints or dust on the insulating coating may cause electrical breakdown during humid weather. Make certain when removing or replacing tube that it is held firmly by the hand when loosened from its mount to prevent its falling onto the spherical mirror and becoming broken.

Fig. 34. Picture Tube Caution

1. Detach anode cap and tube socket.
2. With a screwdriver, loosen the two $\frac{1}{4}$–20 round head screws (1 and 2 of Figure 35) in the tube clamp on both sides of the neck.
3. Using the blade of the screwdriver, spread open the tube clamp. Withdraw the tube downward from the tube clamp and deflecting coil yoke.
4. In replacing new tube make certain the textolite sleeve of the deflecting coil yoke is fitted within the rubber lining on tube clamp.
5. Hold yoke in place while inserting tube from bottom of corrector lens into yoke and tube clamp. Use caution when passing tube base through tube clamp so that strain on the tube base will not cause the base to be loosened from the tube neck. If the tube is difficult to insert, spread tube clamp with screwdriver blade. Wetting of the inner surface of the rubber in tube clamp will also help.
6. Rotate tube so that the anode connection may be made facing the back of the receiver and tighten the two $\frac{1}{4}$–20 screws (1 and 2 of Figure 35) firmly to hold tube in clamp.
7. Attach socket and anode lead.

CORRECTOR LENS REPLACEMENT—CAUTION: As in most components of optical units, care must be exercised to prevent fingerprinting of the lens. Use same procedure for cleaning as outlined for flat mirror.

1. Remove the center screws (13 of Figure 35) and the two adjacent screws holding each end of tube mounting bracket to corrector lens mounting plate.

2. Remove picture tube from tube clamp and tube yoke as outlined in tube replacement. Also remove tube mounting bracket and tube yoke to clear top of corrector lens.

3. Remove lens by removing the three nuts, lock washers, steel washers, and fibre washers used to hold lens to mounting plate.

4. In replacing lens make certain the painted edge and concave surface is at the top. Also make certain the washers and nuts are replaced in sequence so that the fibre washers contact the top edge surface of the lens followed by steel washers, lockwashers, and nuts, respectively.

5. Replace tube yoke, mount tube bracket, and replace picture tube. Note that the small center screw in each end of tube mounting bracket holds bracket fast, while the adjacent screws are just loose enough to serve as guides.

SPHERICAL MIRROR REPLACEMENT—CAUTION: Here, too, extreme caution should be used to prevent fingerprinting of the mirror reflecting surface. If the surface becomes dusty, use a soft camel's-hair brush or absorbent cotton and lightly brush dust to center of black area where it may be picked up with scotch tape. If mirror is fingerprinted, clean with clear water or windex and absorbent cotton.

1. Remove the three screws and clamps holding the spherical mirror to the large mounting plate, while supporting the mirror to prevent its falling.

2. Carefully mount mirror in replacement, making certain rubber cushion inserts fit between clamp and mirror so that cushion bears on mirror edge to cushion for shock. Tighten clamp screws firmly.

OPTICAL SYSTEM ALIGNMENT

GENERAL— To make the various alignments (with the exception of the picture tube focus) the complete optical assembly must be hoisted out of the receiver cabinet in order to make the various adjustment screws available.

Refer to Figure 35 for identification of various adjustments. The numbers in parentheses throughout this text refer to the circled key numbers in the figure drawing.

EQUIPMENT REQUIRED—

1. Sighting jig (available as part No. RZT-001).
2. Small flat mirror (4-inch, square or round).
3. Goose-neck fixture with lamp and cord.
4. Screwdriver.
5. (2) Flat, open-end wrenches for ¼-inch hex nuts.

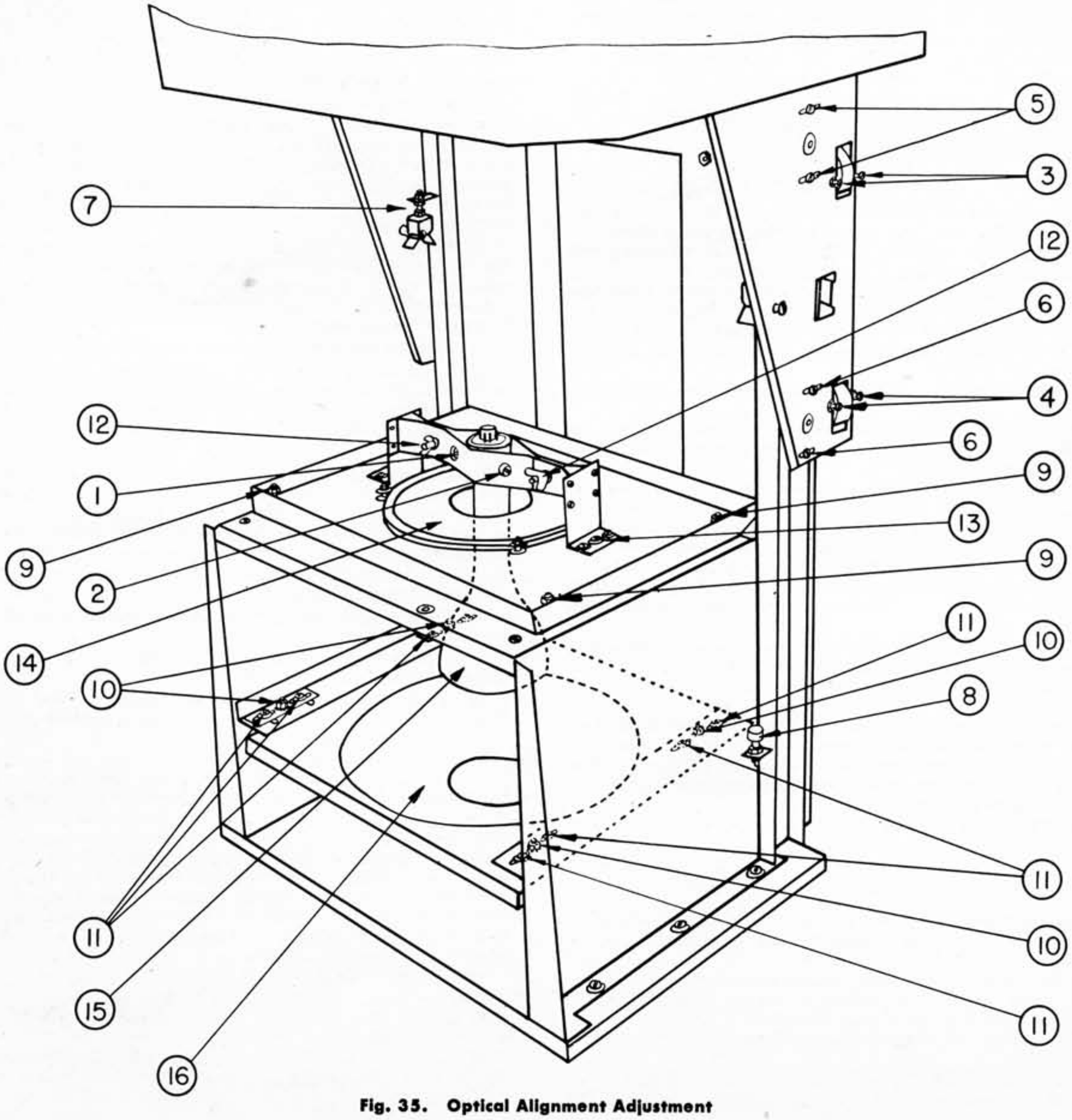


Fig. 35. Optical Alignment Adjustment

The sighting jig is a special instrument and part of the equipment required to make the necessary measurements for correct adjustment of optical system alignment. Two holes aligned concentric with one another are provided at the center of the jig through which the operator makes the sighting measurements described in the alignment procedure. The screen is replaced by the jig so that the bracket at the center of jig with its ⅜-inch hole faces the operator from the front of the optical assembly.

Any ordinary flat mirror of the dimensions specified can be used in the alignment procedure.

SCREEN HOUSING—The screen housing must be aligned to "square up" with respect to the base of the optical assembly. The object is to align the vertical plane of the viewing screen parallel to the upright sections of the screen housing elevator supports and perpendicular to the optical unit base. These measurements can made with the aid of a spirits level. First, level the base of the optical unit and follow by leveling the vertical and horizontal planes of the screen housing. The screen housing elevator roller screws and locknuts (3 and 4) are adjusted for horizontal leveling, while the four screws (5 and 6) on each side of the elevator roller bracket and adjacent to the roller screws are adjusted for vertical leveling.

Four rubber-capped screw stops are adjusted for the vertical range of travel of the elevator and screen housing. The two top screws (7) are adjusted for an over-all measurement of exactly 55½ inches from extreme top of screen housing to the extreme bottom of the optical unit base. The screen housing must be raised fully to the specified dimension to insure optical focus. For the closed position of screen housing, the two bottom screws (8) are adjusted to give an over-all measurement of 37 inches from top of screen housing to base of optical unit. This dimension is nominal and should be checked for the individual cabinet. This closed position dimension is the requirement of receiver cabinet depth so that the cabinet lid over screen housing may be properly closed.

CORRECTOR LENS

1. Remove screen as prescribed previously under "Replacement of Viewing Screen," and insert sighting jig in its place.
2. Remove picture tube from tube clamp and deflecting coil yoke as outlined in "Picture Tube Replacement."
3. Remove entire picture tube mounting bracket by removing the small center screw (13), and its tapped plate beneath, in each end holding bracket to corrector lens mounting plate. Also, remove the two adjacent small screws, with nuts and washers, from each end of bracket.
4. Remove deflecting coil yoke with its felt disk and spring strips.
5. Using the gooseneck fixture lamp, shine light on rear of sighting jig and place small mirror over corrector lens hole so that mirror rests on edges of hole.
6. A black dot should be visible through the sighting jig. This dot is the image of the hole in the center of the sighting jig plate and should appear concentric with this hole. To adjust dot image to align concentric with hole, tilt the corrector lens mounting plate by virtue of the ¼-inch nut adjustments of the four-corner mounting bolts (9) in the mounting plate. This adjustment establishes the correct angular alignment of corrector lens with flat mirror and screen.
7. Remove small mirror from corrector lens and shine light from gooseneck fixture upon corrector lens. As viewed through the sighting jig, the image of the corrector lens hole should appear concentric with hole in sighting jig plate. To adjust corrector lens mounting plate for this condition, loosen all four corner top mounting nut adjustments (9) and move mounting plate laterally in the direction that will center the image upon the hole. This adjustment centers the corrector lens to the axis of the optical system. (See Figure 33.)
8. Tighten all four corner mounting nuts (9) firmly and check steps 6 and 7.

SPHERICAL MIRROR

1. A measurement of exactly 13.5 inches must be maintained from the center of the black surface of spherical mirror to bottom surface of corrector lens. Adjustments to meet this requirement are made by virtue of the nut adjustments of the four-corner mounting bolts (10) of the spherical mirror mounting plate, either lowering, raising, or tilting the plate.
2. Shine light of the gooseneck fixture lamp directed to the top of corrector lens.
3. Looking down directly at corrector lens, an image of its hole should be seen reflected from the spherical mirror. The image should appear concentric with the actual corrector lens hole. To align image to meet this requirement, make certain the two screws (11) in each of the four corners of the spherical mirror mounting plate are loose and move mounting plate laterally in a direction that will align the image to a position concentric with the actual corrector lens hole. This adjustment is extremely critical. If the range of lateral adjustment is not sufficient to attain concentricity, mirror may be tilted by adjustment of the proper corner mounting bolt nuts (10) of the spherical mirror mounting plate.
4. Recheck to make certain dimension of 13.5 inches is maintained between center of black area of spherical mirror and bottom surface of corrector lens.
5. Tighten all adjustment nuts (10) and screws (11) and check for accuracy of all adjustments.
6. Replace deflecting coil yoke into corrector lens hole from top of lens.
7. Replace picture tube mounting bracket, replacing the small center screw (13) and tapped plate beneath, in each end of bracket. Also, replace the two adjacent screws, washers, and nuts in each end of bracket. These screws do not draw up to hold bracket tight but rather serve as guides to lateral movement of bracket for adjustment.
8. Replace picture tube and viewing screen as prescribed for "Picture Tube Replacement" and "Viewing Screen Replacement," respectively.

TUBE FOCUSING—It is necessary to make the following adjustments with the receiver power on. *CAUTION: Due to the extremely high voltages encountered on the tube parts, handle the tube only by its neck and no other part. Do not attempt to use mechanical adjustments of tube for centering. These adjustments are for focusing only.*

1. With the receiver set in operation for television, tune in a monoscope pattern, adjust the brilliance and contrast controls for best pattern, and adjust the electrical focus control for best focus. For the most part of the following procedure the viewing screen must be viewed from the back of the receiver and it will be necessary to cover the screen from in front with some dark cloth or curtain.
2. Make certain the pattern is squared up within the area of the screen. If this condition is not met, loosen the two ¼–20 screws (1 and 2) in the tube clamp on both sides of the tube neck just enough to permit turning of the yoke within the tube clamp to square up the pattern.
3. *Tighten the two tube clamp screws firmly.*
4. Loosen wing nuts on each side of the tube mounting bracket and manually adjust tube and bracket vertically to attain best possible focus.
5. Tighten wing nuts a bit so tube bracket adjustments will not slip.
6. Loosen the one small center screw on each end of tube mounting bracket. These screws hold the mounting bracket to the corrector lens plate. Move entire bracket with tube laterally in the necessary direction until a uniformly defocused pattern is attained. A uniformly defocused pattern is a condition where all points in the pattern at an equal distance from its center are at the same degree of focus.
7. Tighten the small center screws on each end of the tube mounting bracket.
8. Loosen wing nuts on tube mounting bracket once more and adjust bracket and tube vertically for best focus.
9. *Tighten wing nuts firmly* in place and view screen from front to check focus. If focus is not at optimum and uniform, repeat steps 4 through 9.

While a vertical adjustment of the tube and bracket affects the over-all focus of the tube, the lateral adjustment of tube and mounting bracket assembly will affect the uniformity of focus. A very good final check for uniform focus can be made by viewing the screen from its front, having turned the contrast control down and brilliance up so that the interlaced sweep lines can be clearly seen. While the lines in the far corners of the screen may seem a bit fuzzy, nevertheless if they are uniformly so, a correct lateral adjustment of tube and mounting bracket assembly has been made. On an ideally focused receiver, sweep lines should be clearly seen over the entire screen.

10. Center picture on screen by adjusting the horizontal centering control located on the back of the power unit chassis, and the vertical centering control found on the back of the receiver chassis.

If the picture will not center either horizontally or vertically, the picture tube should be rotated 180° in its clamp, refocused, and then centered.

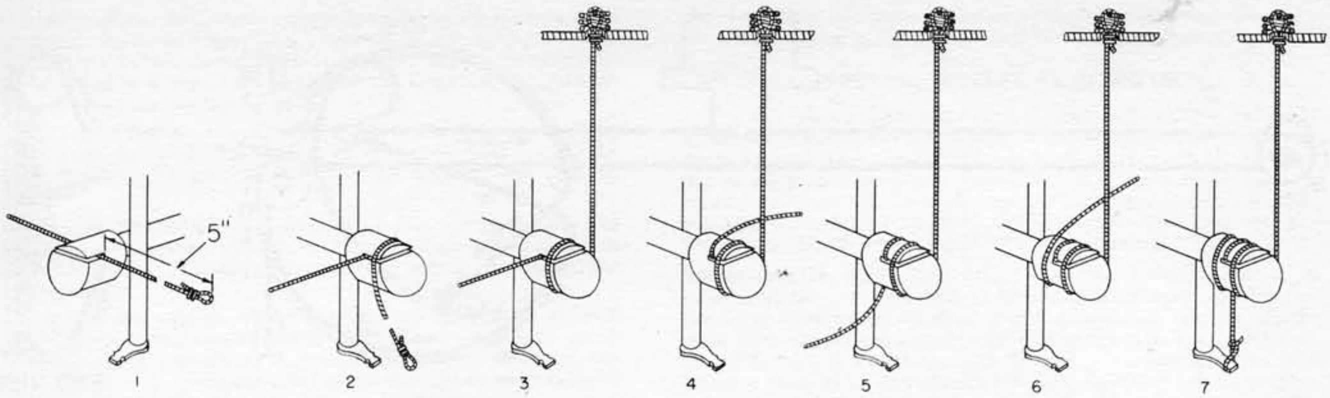


Fig. 36. Elevator Windlass Stringing

REPLACEMENT OF DRIVE CORDS

ELEVATOR STRINGING

The step-by-step procedure for stringing the elevator windlass is shown in Figure 36, a rear view of the mechanism. Start by inserting the metallic cord in slot as shown in Step 1. Observe that the cord is measured five inches from end of loop to where it enters the slot. Now bring the loop end around the pulley counterclockwise, as in Step 2. Next, thread loop through hole in elevator top plate, fastening it to the hoist cord tension spring, as viewed in Step 3. Steps 4, 5, 6, and 7 show how the free end of cord progresses on the pulley, going clockwise and that each turn is laid progressively one in back of the other and in back of the vertical section, going to the tension spring in tuner plate. In Step 6, pass the free end of cord down through the hole in chassis, grasping its end with long-nosed pliers and drawing tension on cord while running elevator completely down to the bottom. Keeping tension on cord and forcing large dial drive drum so that hoist cord spring is compressed, complete Step 7 making a one turn loop of the cord's free end around the lug shown on end of elevator shaft, and solder.

CONCLUDING COMMENTS

After replacing the dial cord or the elevator cord, it may be found that some correction in relative positioning is needed. This can be done by loosening the setscrews in the large drive pulley directly behind the dial scale and repositioning it on the shaft. The object, of course, is to permit the tuning control to drive the elevator through its full tuning range. Slight errors in final setting are not serious since leeway is provided in the location of the dial pointer itself.

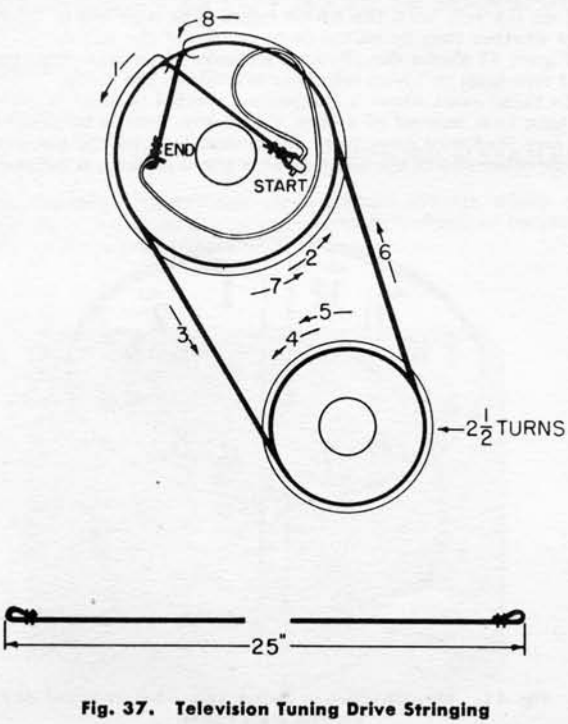


Fig. 37. Television Tuning Drive Stringing

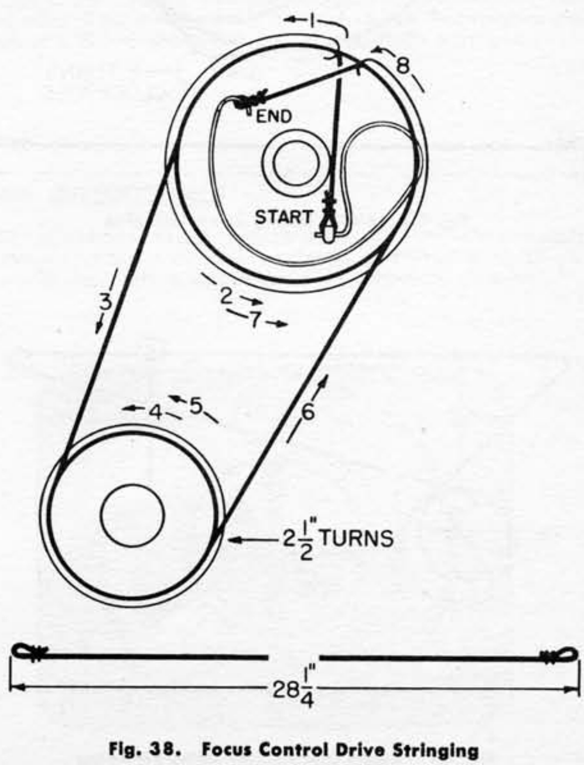


Fig. 38. Focus Control Drive Stringing

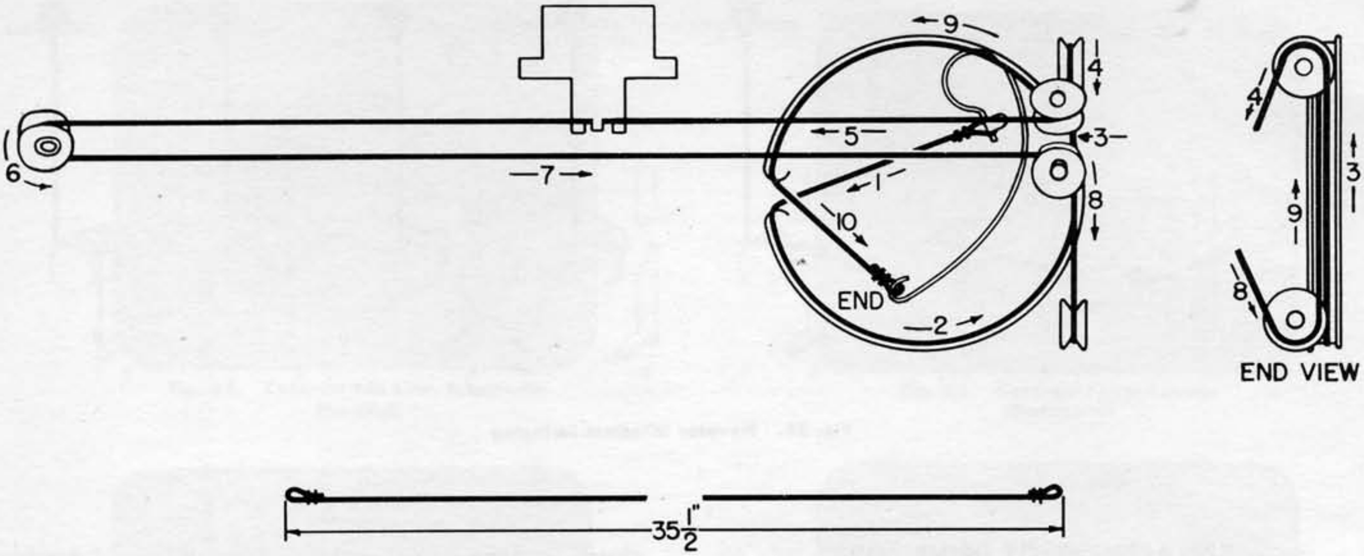


Fig. 39. Television Channel Indicator Drive Stringing

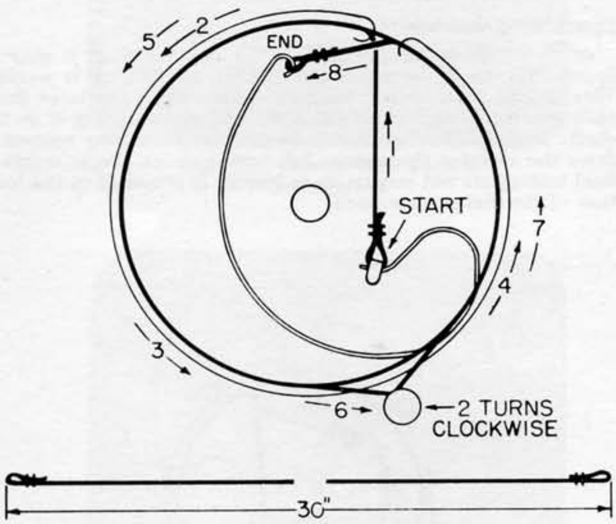


Fig. 40. Radio Tuning Drive Stringing

WIRING OF BAND SWITCH

In order to facilitate repair, replacement, and circuit tracing, a table and diagrams are supplied with reference to the connections made in the band switch. If used properly, these will be of invaluable aid. The remarks which follow are intended to clarify the make-up of the tables and diagrams—read them carefully before using the table.

The table is broken down into seven parts, one for each switch wafer. Section 1 is nearest the front and Section 7 is the rearmost wafer.

Individual lugs on each wafer are numbered from 1 to 12, depending upon their position on the wafer. The method of numbering is illustrated in Figure 42. In determining the number, turn the chassis upside down and look from the front toward the rear of the chassis. Thus, lugs 1 and 12 are the ones which are at the bottom when the set is in its normal position; lugs 3 and 4 are on the side with the broadcast band coils; and lugs 9 and 10 are on the side with the 6AK5 tubes. The numbering refers to lugs whether they be on the front or rear of the wafer.

Figure 43 shows the physical location of various components and terminals to which reference is made in the table.

In those cases where a component symbol number is given in column two, instead of a wire, that component is connected by its own lead wire directly to the switch lug and the connection of the other end of the component is given in the last column.

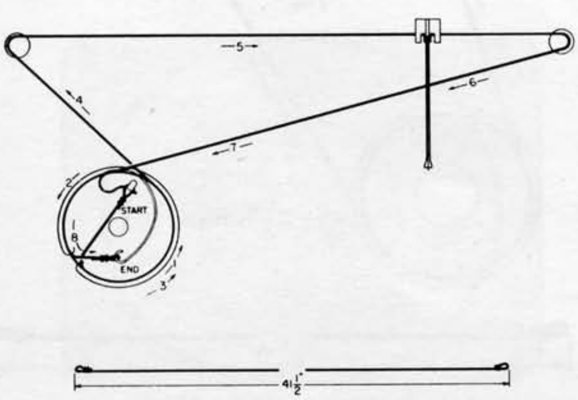


Fig. 41. Radio Dial Pointer Drive Stringing

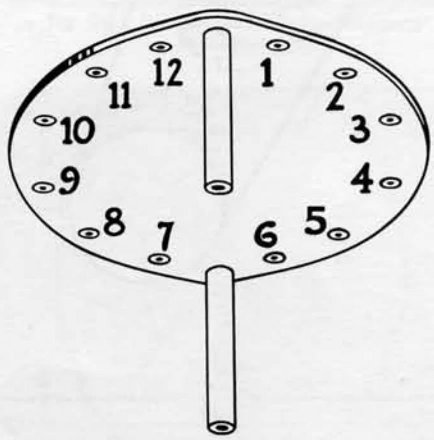
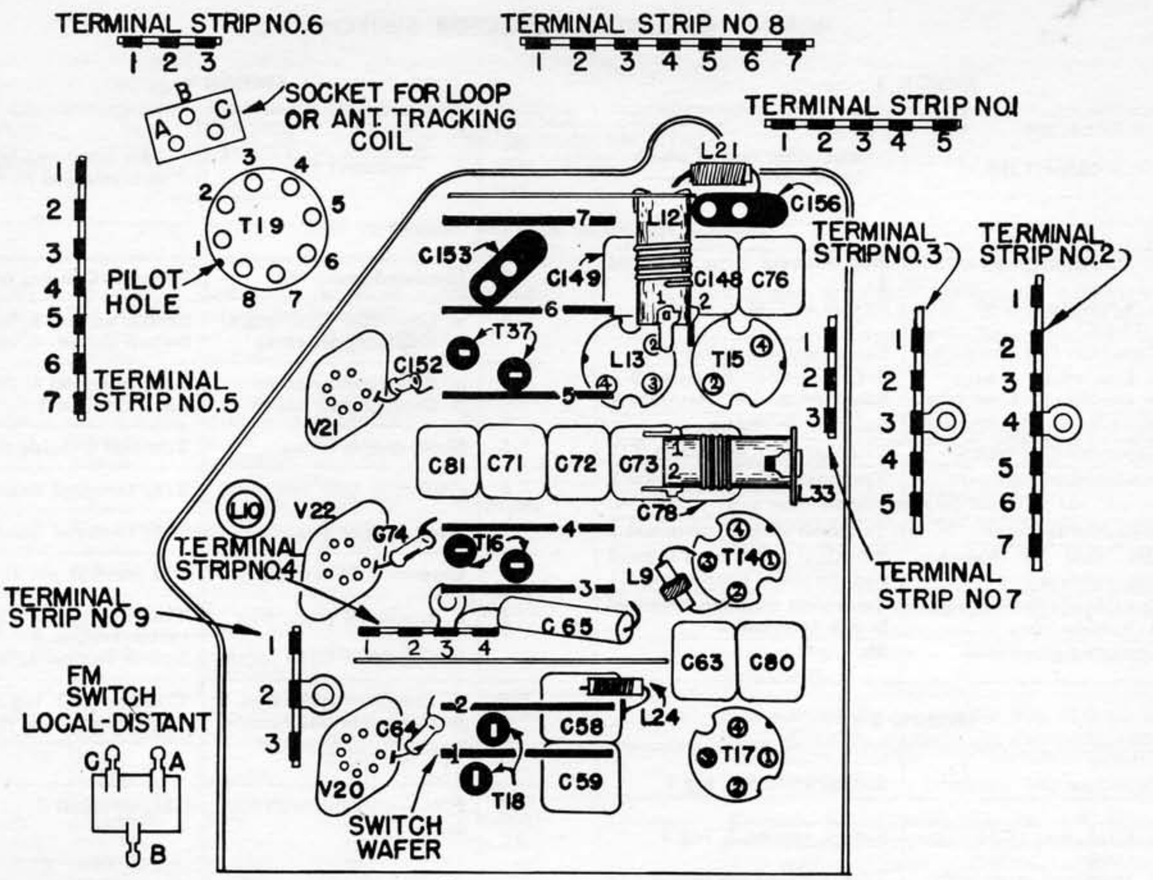


Fig. 42. Identification of Switch Lugs—Set Inverted and Viewed from Panel



BOTTOM VIEW

Fig. 43. Physical Location of Components Listed in Wiring Table

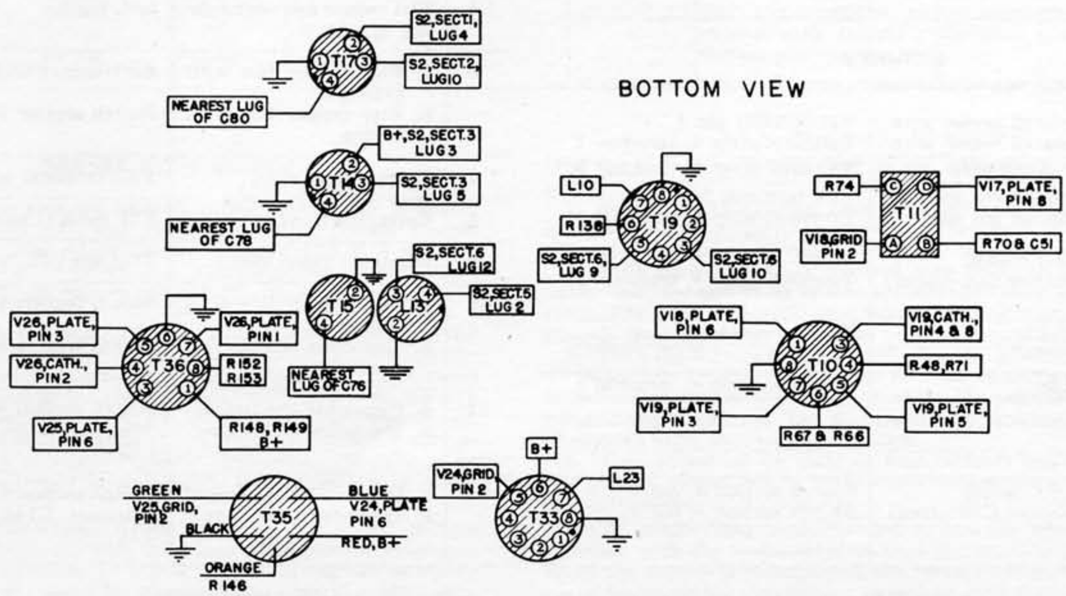


Fig. 44. Terminal Identification of Coils

WIRING OF SERVICE SELECTOR SWITCH

SECTION 1

At this lug	—connect this—	—the other end of which is connected to this—
1		
2	a. Insulated green wire b. Capacitor C60 (ceramic)	B-C antenna strip, terminal 2 Switch section 2, lug 1
3	Capacitor C61 (ceramic)	Switch section 2, lug 3
4	a. Insulated red wire b. Insulated yellow wire	B-C tuner T17, terminal 2 Loop ant. socket, terminal A
5	Short bus with spaghetti	Soldered to chassis
6	Capacitor C57 (mica)	Trimmer C59, lug nearer T17
7	Insulated orange wire	Terminal strip 2, terminal 2
8		
9	Insulated red wire	Terminal strip 7, terminal 2
10	One side of 300-ohm transmission line	Terminal board on TV head end, terminal connecting C1
11	One side of 300-ohm transmission line	Television antenna terminal board, terminal 2
12	Insulated green wire	S5, lug C

SECTION 2

At this lug	—connect this—	—the other end of which is connected to this—
1	Capacitor C60 (ceramic)	Switch section 1, lug 2
2		
3	a. Capacitor C61 (ceramic) b. Insulated green wire	Switch section 1, lug 3 Trimmer C80, lug nearer T17
4	Insulated green wire	Trimmer C63, lug nearer T17
5	L24	Trimmer C63, lug nearer T14
6	Short copper strap	Trimmer C59, lug nearer T18
7	Short copper strap	T18, terminal nearer switch, section 2
8	C64 (ceramic)	V20 (6AG5), pin 1
9		
10	Insulated orange wire	T17, terminal 3
*11	Insulated white wire	Loop ant. socket, terminal C
12		

SECTION 3

At this lug	—connect this—	—the other end of which is connected to this—
1	a. Insulated brown wire b. Insulated brown wire	V21 (6AK5) pin 4 Terminal strip 5, terminal 1
2	Insulated red wire	Terminal strip 8, terminal 5
3	a. Insulated red wire b. Insulated red wire c. L7 (r-f choke) d. Capacitor C65 (paper)	T14, terminal 2 Terminal strip 9, terminal 3 (outer terminal) Switch section 3, lug 11 Terminal strip 4, terminal 3
4		
5	Insulated blue wire	T14, terminal 3
6		
7	Short bus	Terminal strip 4, terminal 4
8		
9		
10		
11	a. L7 (r-f choke) b. Capacitor C70 (mica)	Switch section 3, lug 3 Switch section 4, lug 3
12		

SECTION 4

At this lug	—connect this—	—the other end of which is connected to this—
1		
2	Insulated green wire	Trimmer C78, lug nearer T14
3	a. Capacitor C70 (mica) b. Short copper strap	Switch section 3, lug 11 Switch section 4, lug 4
4	a. Short copper strap b. Short copper strap	Switch section 4, lug 3 L33, terminal 2
* 5	Short copper strap	Trimmer C71, lug nearer T16
6	Capacitor C69 (ceramic)	T16, terminal nearer V22
7	Short copper strap	T16, terminal nearer V22
8	Ceramic C74 (ceramic)	V22 (6AK5) pin 1
9	a. Insulated green wire b. Capacitor C154 (mica)	Trimmer C72, lug nearer switch section 4 Switch section 5, lug 11
*10	a. Insulated green wire b. Capacitor C159 (mica)	Trimmer C73, lug nearer L9 Switch section 5, lug 12
11		
12	Flat copper bus with tubing	L33, terminal 1

SECTION 5

At this lug	—connect this—	—the other end of which is connected to this—
1	a. Flat copper bus with tubing b. Resistor R135	L12, lug 1 Switch section 5, lug 4
2	Insulated green wire	L13, terminal 4
3		
4	Resistor R135	Switch section 5, lug 1
5	Flat copper bus with tubing	L12, lug 2
6	a. Flat copper bus with tubing b. Flat copper bus with tubing	Air trimmer C156, stator lug Switch section 5, lug 10
* 7	Short copper strap	T37, terminal nearer V21
8	Capacitor C152 (ceramic)	V21 (6AK5) pin 1
9	Insulated green wire	Trimmer C76, lug nearer T15
10	a. Flat copper bus with tubing b. Capacitor C157 (ceramic)	Switch section 5, lug 6 Switch section 6, lug 6
11	a. Capacitor 154 (mica) b. Insulated green wire	Switch section 4, lug 9 Trimmer C149, lug nearer L13
12	a. Capacitor C159 (mica) b. Insulated green wire	Switch section 4, lug 10 Trimmer C148, lug nearer T15

* Double lug (front and rear) soldered together.

SECTION 6

At this lug	—connect this—	—the other end of which is connected to this—
1	a. Insulated black wire b. Insulated black wire	Trimmer C149, grounded lug nearer C156 Switch section 7, lug 12
2	Flat copper bus with tubing	L12, lug 2
3		
4		
5		
6	a. Capacitor C157 (ceramic) b. Flat copper bus with tubing c. Capacitor C155 (ceramic)	Switch section 5, lug 10 Air trimmer C156, rotor lug Trimmer C149, grounded lug nearer C156
7	Short copper strap	Air trimmer C153, rotor lug
8	Flat copper bus	V21 (6AK5) pin 7
9	Insulated green wire	T19, terminal 5
10	Insulated white wire	T19, terminal 3
11	a. Insulated white wire b. R177	Terminal strip 4, terminal 1 Switch section 7, lug 1
12	Insulated orange wire	L13, lug 3

SECTION 7

At this lug	—connect this—	—the other end of which is connected to this—
1	a. R177 b. R124 c. Shielded green wire	Switch section 6, lug 11 Switch section 7, lug 11 Terminal strip 1, terminal 4
2	Shielded lavender wire	V33 (6SC7), pin 2
* 3	Shielded green wire	Terminal strip 2, terminal 7
4	Shielded yellow wire	Terminal strip 5, lug 3
5	Shielded green wire with black sleeving	Terminal strip 3, lug 1
6		
7	Insulated lavender wire	Terminal strip 1, terminal 5
8	Insulated black wire	Switch section 7, lug 12
9		
10		
11	a. R124 b. Insulated white wire	Switch section 7, lug 1 Terminal strip 6, terminal 1
12	Insulated black wire	Switch section 6, lug 1

* Double lug (front and rear) soldered together.

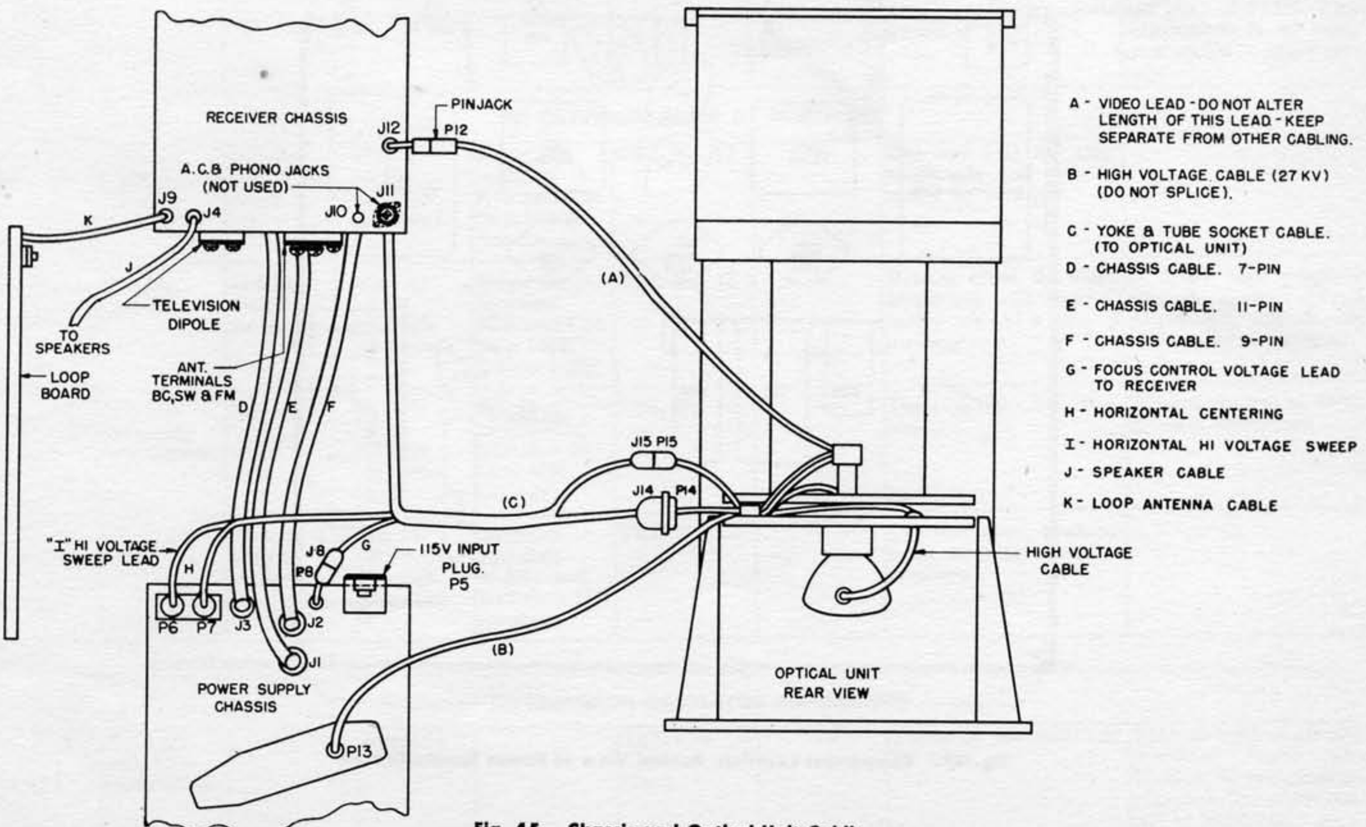


Fig. 45. Chassis and Optical Unit Cabling

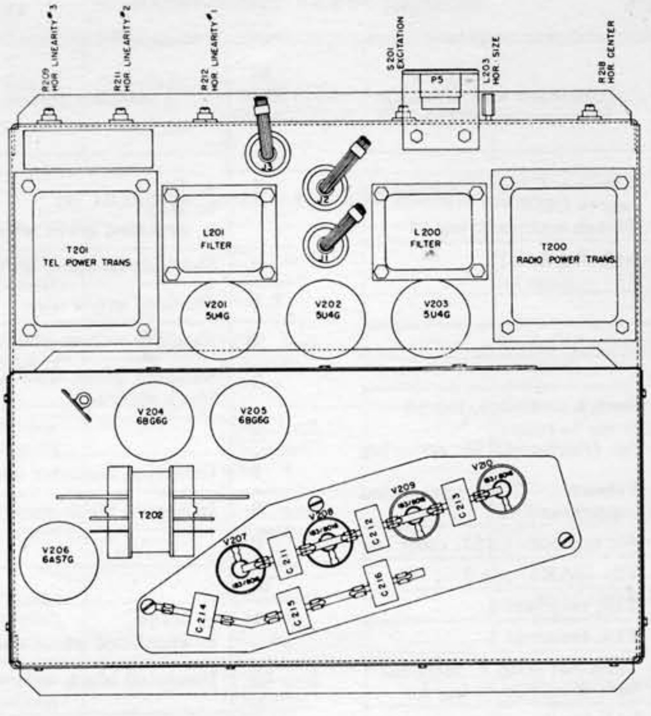


Fig. 46. Component Location, Top View of Power Supply Chassis

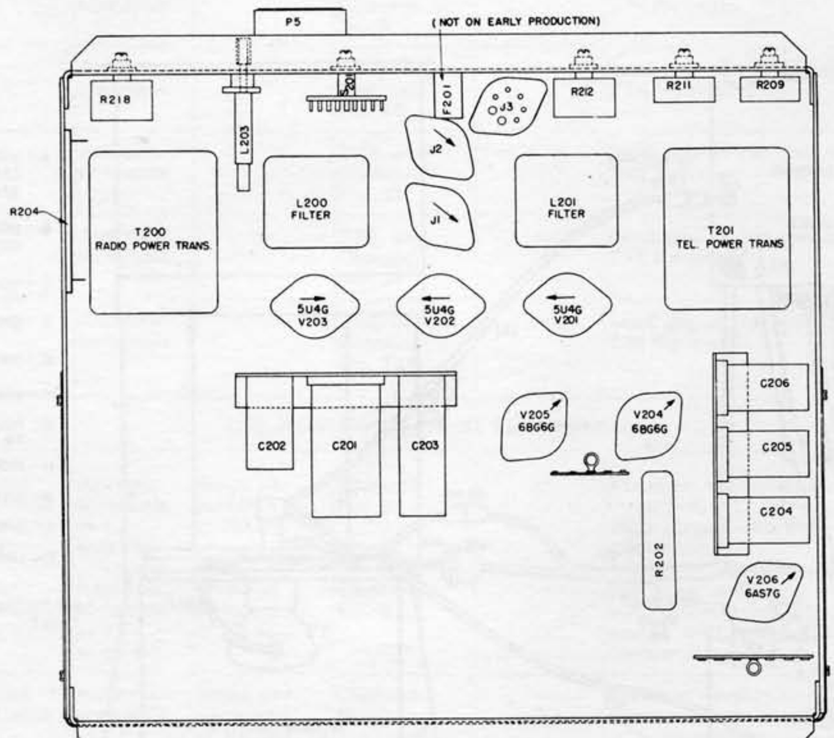


Fig. 47. Component Location, Bottom View of Power Supply Chassis

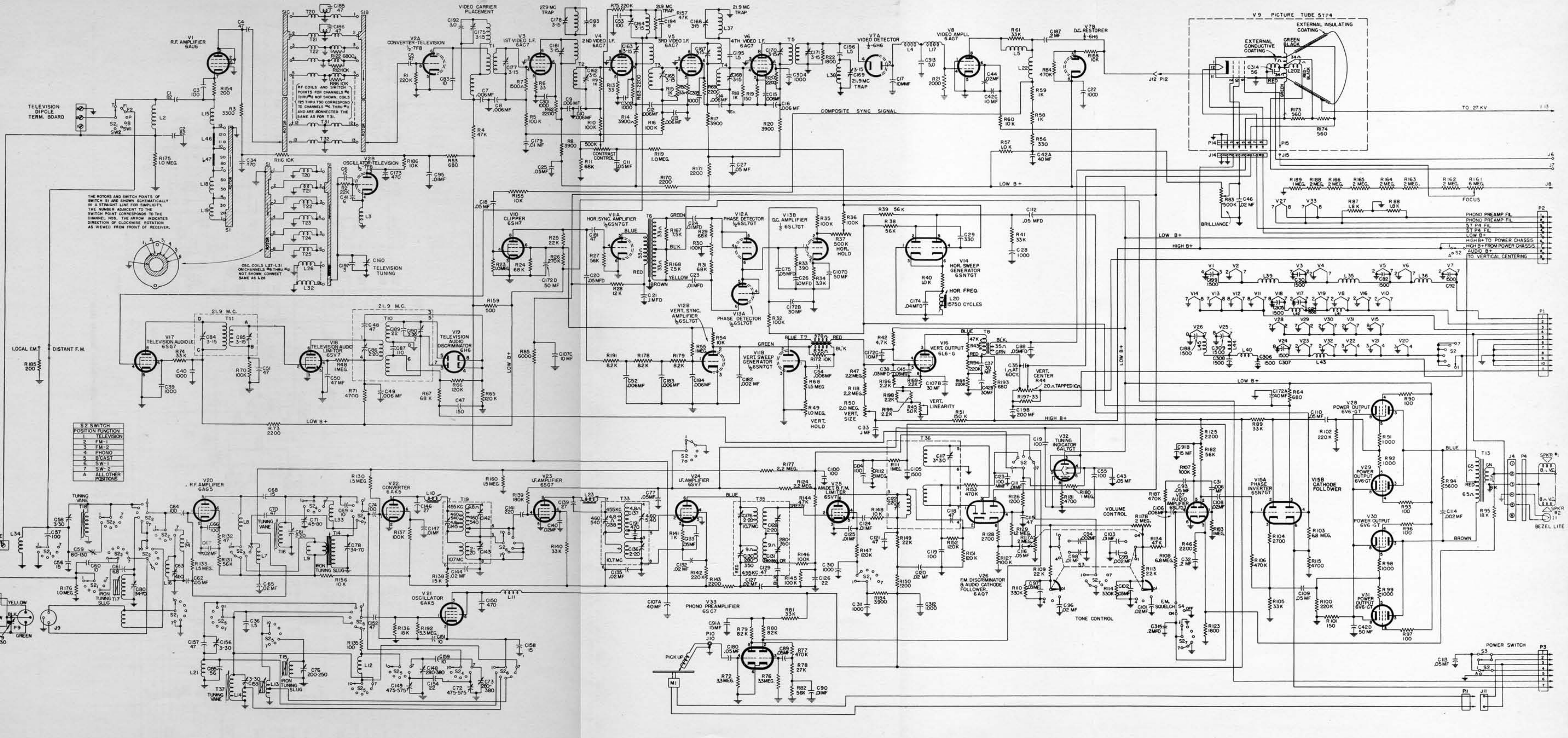


Fig. 48. Schematic—Receiver Chassis

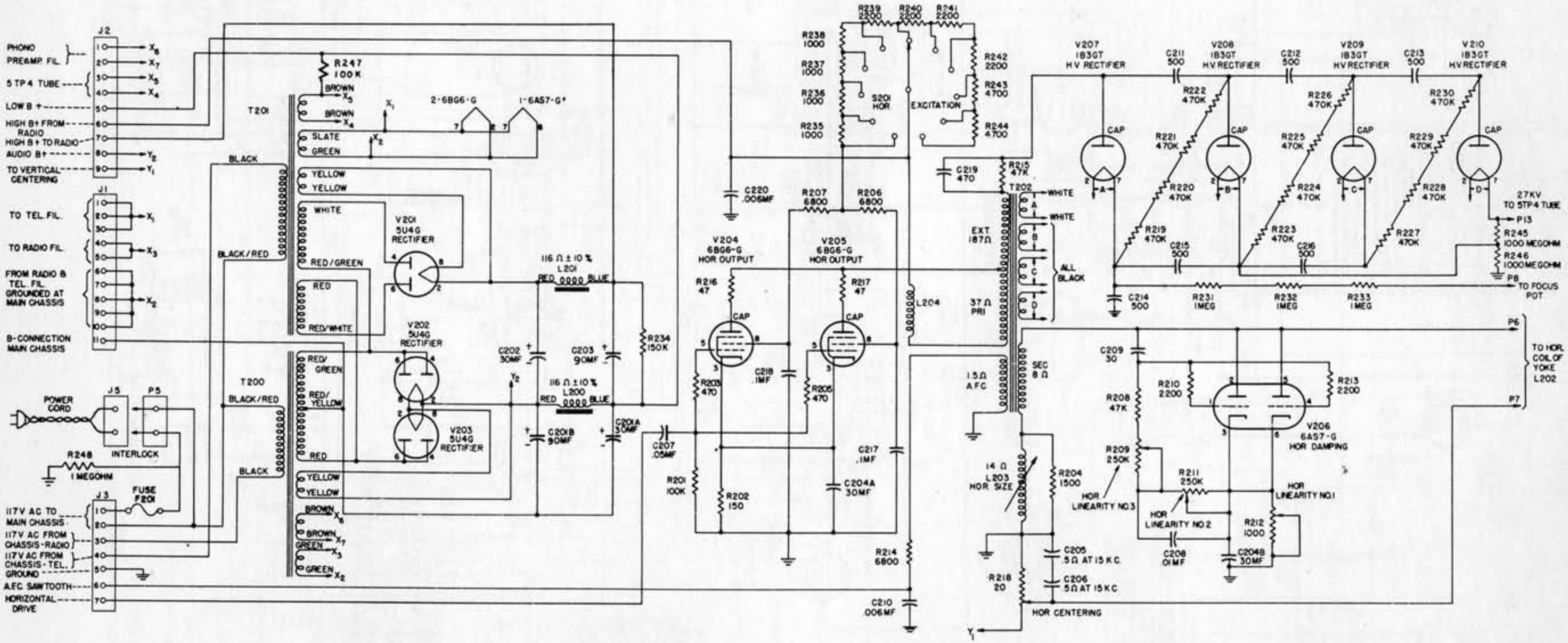


Fig. 49. Schematic—Power Supply Unit

SOCKET VOLTAGE CHART

NOTE—All d-c measurements taken by a 20,000 ohm/volt meter. Channel Selector switch at Channel No. 1 unless noted. Contrast control at maximum. Brilliance at minimum. When making VTVM measurements, a 3-megohm resistor is connected in series for isolation.

SYM-BOL	TUBE TYPE	PLATE		SCREEN		CATHODE		GRID		COMMENTS
		PIN	VOLTS	PIN	VOLTS	PIN	VOLTS	PIN	VOLTS	
V1	6AU6	5	145	6	145	7	1.5	1	—	
V2A	7F8	6	120	—	—	5	—	8	−4.1*	*VTVM through 3 meg
V2B		3	180	—	—	4	—	1	0	
V3	6AC7	8	185	6	180	5	0.25*	4	−2.7**	*2.5 v. scale **VTVM through 3 meg
V4	6AC7	8	185	6	180	5	0.25*	4	−2.7**	*2.5 v. scale **VTVM through 3 meg
V5	6AC7	8	185	6	180	5	0.25*	4	−2.7**	*2.5 v. scale **VTVM through 3 meg
V6	6AC7	8	175	6	170	5	2	4	0	
V7A	6H6	3	0	—	—	4	0	—	—	
V7B		5	265	—	—	8	270	—	—	
V8	6AG7	8	140	6	100	5	—	4	0	
V9	5TP4	CAP	27 kv	10	465	11	265	2	245	Pin 6—4300–5500 v.
V10	6SH7	8	24	6	25	3	—	4	−.7*	*VTVM through 3 meg
V11A	6SN7GT	5	110	—	—	6	0	4	0	
V11B		2	95	—	—	3	0	1	0	
V12A	6SL7GT	4 and 5	−8	—	—	6	1*	—	—	*10 v. scale
V12B		2	20	—	—	3	0	1	0	
V13A	6SL7GT	4 and 5	1*	—	—	6	8	—	—	*10 v. scale
V13B		2	85	—	—	3	2*	1	1*	*10 v. scale
V14A	6SN7GT	5	125	—	—	6	5.4	4	−30	
V14B		2	110	—	—	3	5.4	1	0	
V15A	6SN7GT	5	265	—	—	6	55	4	50*	*VTVM through 3 meg
V15B		2	95	—	—	3	33	1	10	
V16	6L6	3	425	4	270	8	130	5	90	
V17	6SG7	8	250	6	180	5	0	4	−2.7*	*VTVM through 3 meg
V18	6SV7	6	255	4	35	3	0	2	0	
V19A	6A6	3	0	—	—	4	0	—	—	
V19B		5	0	—	—	8	0	—	—	
V20	6AG5	5	200	6	125	2	0	1	0	Selector Switch—FM1
V21	6AK5	5	160	6	160	2	0	1	−7.3*	Selector Switch—FM1 *VTVM through 3 meg
V22	6AK5	5	185	6	140	2	0	1	−3.2*	Selector Switch—FM1 *VTVM through 3 meg
V23	6SG7	8	280	6	145	5	0	4	0	Selector Switch—FM1
V24	6SV7	6	275	4	155	3	2.8*	2	0	*10 v. scale, FM1 position
V25	6SV7	6	105	4	70	3	0	2	0	FM1 position
V26A	6AQ7	5	155	—	—	6	50	4	0	FM1 position
V26B		1 and 3	0	—	—	2	0	—	—	FM1 position

SOCKET VOLTAGE CHART (Cont'd)

SYMBOL	TUBE TYPE	PLATE		SCREEN		CATHODE		GRID		COMMENTS
		PIN	VOLTS	PIN	VOLTS	PIN	VOLTS	PIN	VOLTS	
V27	6SL7GT	5	85	—	—	6	0	4	0	FM1 position
		2	115	—	—	3	1.3*	1	0	*10 v. scale, FM1 position
V28	6V6	3	300	4	295	8	19	5	0	
V29	6V6	3	300	4	295	8	19	5	0	
V30	6V6	3	300	4	295	8	19	5	0	
V31	6V6	3	300	4	295	8	19	5	0	
V32	6AL7GT	3	285	5 and 6	0	8	1.3*	1	0	*10 v. scale, FM1 position
V33	6SC7	5	70	—	—	6	0	4	0	Phono position
		2	70	—	—	6	0	3	0	Phono position

SOCKET VOLTAGE CHART (Power Supply Chassis)

SYMBOL	TUBE TYPE	PLATE		SCREEN		CATHODE		GRID		COMMENTS
		PIN	VOLTS	PIN	VOLTS	PIN	VOLTS	PIN	VOLTS	
V201	5U4G	4	460 a-c**	—	—	2	490*	—	—	**Volts to B– *Volts to ground
		6	460 a-c**	—	—	8	490*	—	—	**Volts to B– *Volts to ground
(V202 and V203)	5U4G	4	300 a-c**	—	—	2	285*	—	—	**Volts to B– *Volts to ground
		6	300 a-c**	—	—	8	285*	—	—	
V204	6BG6G	CAP	*	8	250	3	19	5	−14	*Do not measure
V205	6BG6G	CAP	*	8	250	3	19	5	−14	*Do not measure
V206	6AS7G	5	*	—	—	6	44	4	*	*Do not measure
		2	*	—	—	3	44	1	*	*Do not measure
{V207, V208, V209, V210}	1B3GT	Do not measure								

WAVEFORM MEASUREMENTS

The waveforms shown in Figures 50 through 70 represent measurements on an average receiver wherein the controls have been adjusted for a normal picture with correct Contrast, Height, Width and Linearity. Most measurements must be made when a signal is being received.

An oscilloscope where the vertical deflection amplifier has been pre-calibrated is used to take measurements at the point indicated in the waveform boxes. The oscilloscope sweep frequency is indicated in the waveform title.

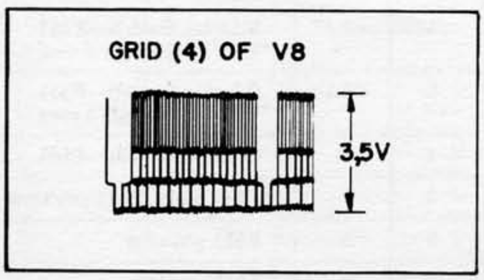


Fig. 50. Video Detector Output (Osc. Synced at Half of Vert. Speed)

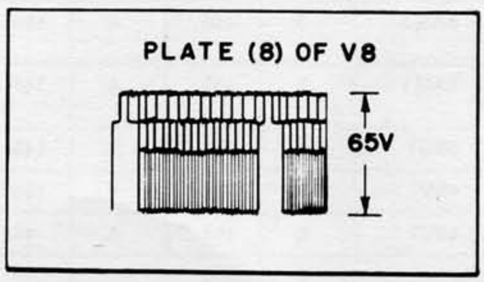


Fig. 51. Video Amplifier Output (Osc. Synced at Half of Vert. Speed)

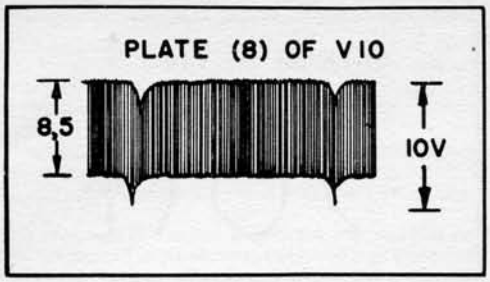


Fig. 52. Clipper Output
(Osc. Synced at Half of Vert. Speed)

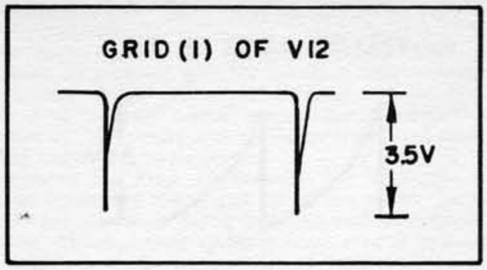


Fig. 53. Vert. Sync Output to V12
(Osc. Synced at Half of Vert. Speed)

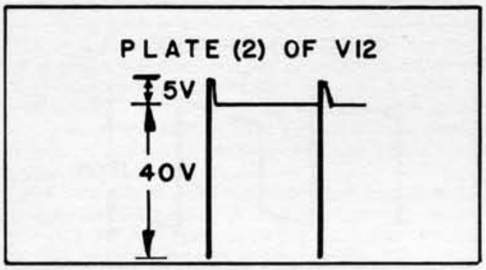


Fig. 54. Vert. Sync Output from V12
(Osc. Synced at Half of Vert. Speed)

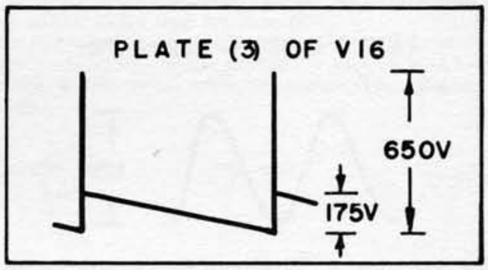


Fig. 55. Vert. Output from V16
(Osc. Synced at Half of Vert. Speed)

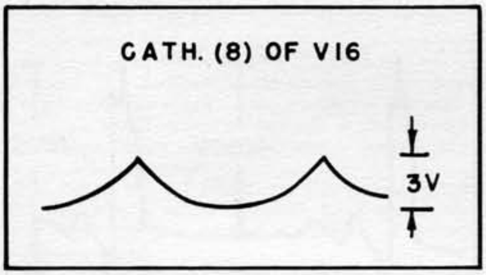


Fig. 56. Vert. Sweep Output Cathode
(Osc. Synced at Half of Vert. Speed)

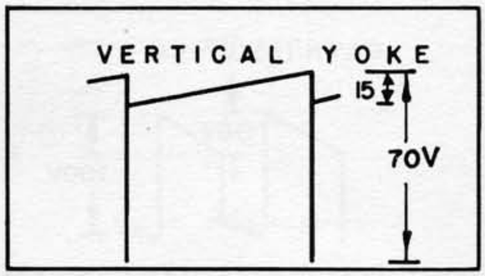


Fig. 57. Vert. Deflecting Yoke Input
(Osc. Synced at Half of Vert. Speed)

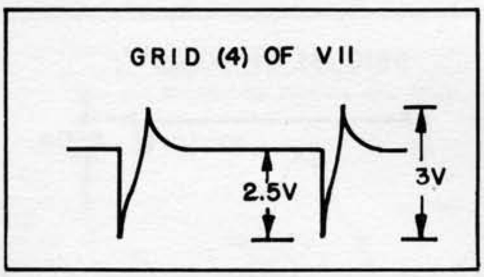


Fig. 58. Input to Hor. Sync. Amplifier
(Osc. Synced at Half of Hor. Speed)

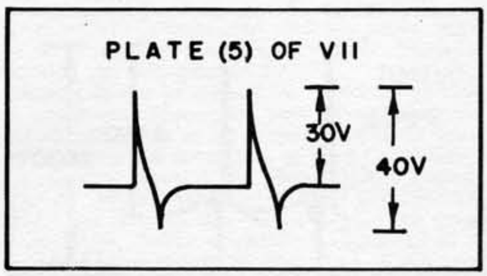


Fig. 59. Output from Hor. Sync. Amplifier
(Osc. Synced at Half of Hor. Speed)

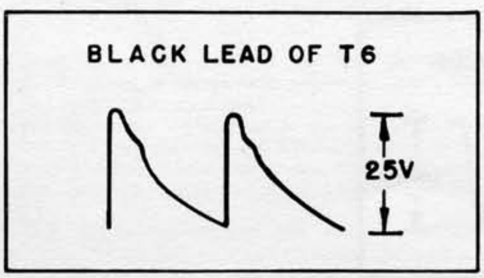


Fig. 60. Center Tap of AFC Transformer
(Osc. Synced at Half of Hor. Speed)

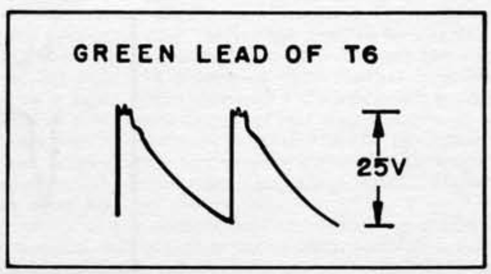


Fig. 61. Positive Going Half of AFC Transformer
(Osc. Synced at Half of Hor. Speed)

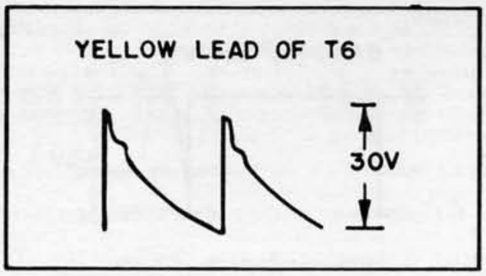


Fig. 62. Negative Going Half of AFC Transformer (Osc. Synced at Half of Hor. Speed)

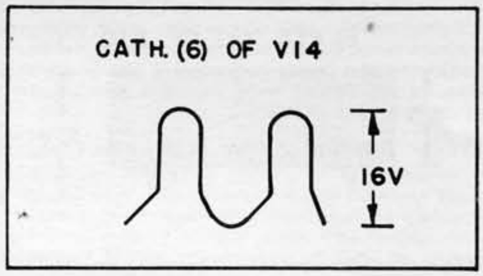


Fig. 63. Cathode of Hor. Multivibrator (Osc. Synced at Half of Hor. Speed)

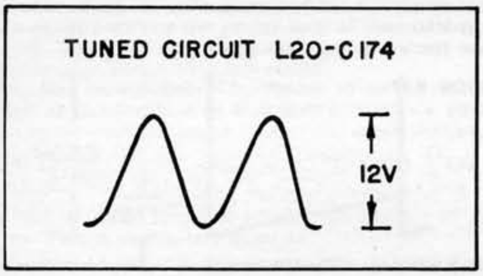


Fig. 64. Output from Hor. Freq. Control (Osc. Synced at Half of Hor. Speed)

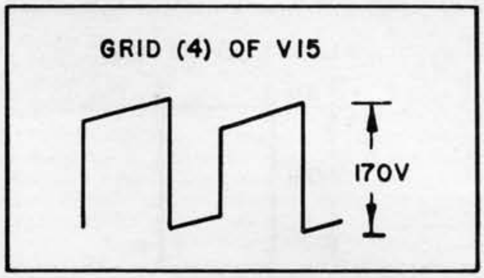


Fig. 65. Output from Hor. Multivibrator (Osc. Synced at Half of Hor. Speed)

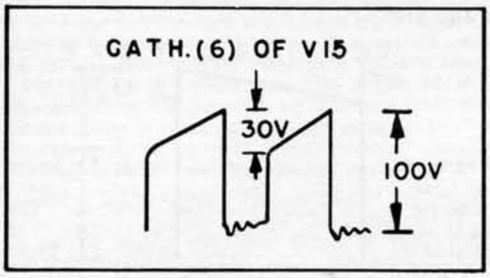


Fig. 66. Output from Hor. Sweep Cath. Follower (Osc. Synced at Half of Hor. Speed)

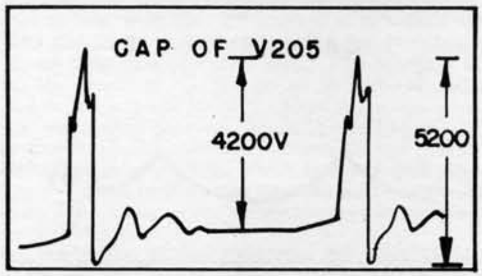


Fig. 67. Plates of Hor. Sweep Output Tubes (Osc. Synced at Half of Hor. Speed)

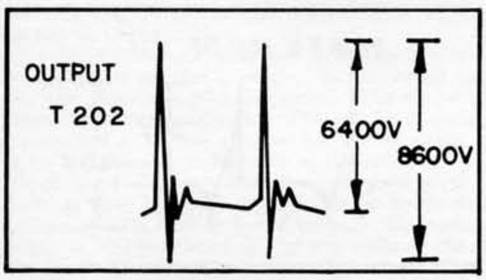


Fig. 68. Output from Hor. Sweep Transformer (Osc. Synced at Half of Hor. Speed)

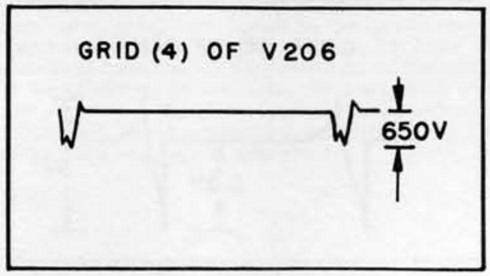


Fig. 69. Grid of Damping Tube (Osc. Synced at Half of Hor. Sweep)

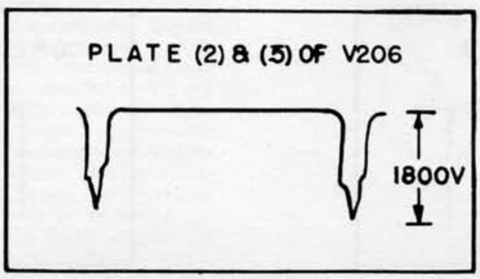


Fig. 70. Input to Hor. Sweep Yoke (Osc. Synced at Half of Hor. Speed)

PRODUCTION CHANGES

The following production changes have taken place up to the time that these service data were compiled. In most cases the change cannot be accurately identified with the serial number chassis. The order of listing below does not indicate the chronological order of the change.

1. LOW VOLTAGE POWER SUPPLY FILTER, C201A AND C201B—In later production units, filter capacitor connections were interchanged so that the 90 mfd. section, C201B, became the input filter and the 30 mfd. section was in turn connected as the output filter. The 90 mfd. value improves the filter of high ripple in the input filter section of the power supply and reduces the possibility of filter capacitor failure. Changes should be made to all receivers not incorporating the wiring of C201A and B, as shown in Figure 49 on page 30.

2. RESISTOR, R247—This resistor has been added in the later production receivers as a protection against opening of the picture tube filament circuit due to a possible cathode-to-ground and filament-to-cathode short condition. Should this occur in earlier production models, B+ current would flow through the picture tube filament winding of T202 (as one side of the winding was then connected to low B+), and through the filament by way of the cathode and to ground, thus causing B+ current to "burn out" the filament. To limit this current to a safe value, it is recommended that earlier receivers be wired incorporating R247 as shown in Figure 49, page 30, in lieu of the earlier direct connection of filament winding to low B+.

3. RESISTOR, R248—Addition of R248 between line side of fuse F201 and ground terminal of potentiometer R212 in the power chassis unit (see Figure 49) provides a safety measure to remove the static charge from the receiver in the event that a good ground is not provided at the installation.

4. CAPACITOR, C315—C315 was added in later production and connected from squelch output terminal of squelch switch S4 to the ground tab on the adjacent electrolytic capacitor, C107. The addition of the .2 mfd. capacitor eliminates "rumble" on the FM bands when the squelch circuit is in use.

5. R11 AND R119—In order to insure contrast cut-off in strong signal areas, these two resistors were changed to 1 megohm and 68,000 ohms, respectively.

6. C22—Addition of a 1000 mmfd. mica capacitor is an early production change and connected from pin 8 of V7B to the ground terminal of the adjacent terminal board of the chassis apron. A copper grounding strap was also added from this terminal to chassis, providing a positive ground. This change suppressed harmonics of the video i-f frequencies from being superimposed on B+ from which sufficient radiation occurred to cause overall regeneration on some television channels.

7. VIDEO I-F TRAP—A 4.5 mc trap consisting of C200 in shunt with L25 was connected between the plate pin (8) of V8 and the choke L5 in the early production sets. This was used to trap out any 4.5 mc resulting from the beat between the video and sound carrier. A change in the trap circuits in the video i-f in late production receivers made this trap unnecessary.

8. RESISTOR R56 AND R60—In later production R56 and R60 were changed in value to 330 ohms, 1 watt, and 10,000 ohms, 1 watt respectively. In early production R56 was 680 ohms, 2 watts, and R60 was 2200 ohms, ½ watt. This change was made to improve the video amplifier response.

9. RESISTOR R27—To improve the shaping of the horizontal sync pulses, R27 was changed in later production from 15,000 ohms to 56,000 ohms.

10. CHOKE L17 AND CAPACITOR C313—The addition of choke L17, 100 mh., and capacitor C313, 5 mmf., in a later circuit change improves the filtering of video i-f harmonics in the video coupling to the video amplifier, V8.

11. CHOKES L5 AND L22—To improve video amplifier response in the output circuit of the video amplifier V8, L5 and L22 were changed in production to 145 mh. and 130 mh. respectively. L5 and L22 were 120 mh. in the earlier production receivers.

12. R198 AND R199—To limit plate current of the vertical sweep output tube, V16, to a safe value through R193 when the vertical linearity control is at a minimum resistance setting, the paralleled resistors, R198 and R199, were added and connected in series with the vertical linearity control and cathode of V16. R198 and R199 are 2200 ohms, 2 watts each.

13. FUSE F201—A fuse holder was added to the power supply chassis in later production to accommodate a Type 3AG, 6-ampere fuse for power circuit overload protection. The fuse is connected in series with the power line between pin 1 of J3 and the terminal of the interlock receptacle, as shown in Figure 49, on page 30.

MODEL 901—REPLACEMENT PARTS LIST

Cat. No.	Symbol	Description	Suggested Unit List Price
		UNIVERSAL REPLACEMENT PARTS	
UCC-008	C98, 103, 179	CAPACITOR—.01 mfd., 200 v., paper	$0.25
UCC-014	C32, 187, 315	CAPACITOR—.2 mfd., 200 v., paper	.40
UCC-017	C26	CAPACITOR—1 mfd., 200 v., paper	.75
UCC-630	C23, 24, 90, 95, 111, 124, 125, 208	CAPACITOR—.01 mfd., 600 v., paper	.30
UCC-631	C44, 46, 96, 101, 108, 120, 127, 132, 135, 140, 144	CAPACITOR—.01 mfd., 600 v., paper	.30
UCC-633	C38, 97, 102	CAPACITOR—.03 mfd., 600 v., paper	.35
UCC-635	C11, 18, 20, 25, 27, 43, 45, 75, 77, 88, 89, 93, 109, 110, 112, 113, 116, 133, 180, 207	CAPACITOR—.05 mfd., 600 v., paper	.40
UCC-640	C21, 33, 217, 218	CAPACITOR—.1 mfd., 600 v., paper	.45
UCC-056	C114	CAPACITOR—.002 mfd., 1000 v., paper	.30
UCC-621	C94, 99, 182	CAPACITOR—.002 mfd., 200 v., paper	.25
UCC-626	C7, 8, 9, 10, 12, 13, 14, 15, 16, 31, 49, 52, 54, 106, 183, 184, 210, 220	CAPACITOR—.006 mfd., 600 v., paper	.25
UCC-634	C174	CAPACITOR—.04 mfd., 200 v., paper	.35
UCE-314	C204A, B	CAPACITOR—30 mfd., 25 v.; 30 mfd., 100 v.; electrolytic	1.75
UCU-012	C126	CAPACITOR—22 mmf., mica	.25
UCU-028	C104, 123	CAPACITOR—100 mmf., mica	.25
UCU-520	C121, 70	CAPACITOR—47 mmf., mica	.30
UCU-528	C57, 66	CAPACITOR—100 mmf., mica	.30
UCU-536	C141	CAPACITOR—220 mmf., mica	.30
UCU-544	C191	CAPACITOR—470 mmf., mica	.30
UCU-1044	C219	CAPACITOR—470 mmf., mica	.30
UCU-1052	C22, 28, 39, 40, 301, 302, 303, 304, 310, 311, 312	CAPACITOR—1000 mmf., mica	.40
UCU-1504	C17	CAPACITOR—10 mmf., mica	.35
UCU-1512	C154	CAPACITOR—22 mmf., mica	.35
UCU-1526	C1, 2	CAPACITOR—82 mmf., mica	.30
UCU-1528	C53, 100	CAPACITOR—100 mmf., mica	.30
UCU-1532	C47	CAPACITOR—150 mmf., mica	.30
UCU-1540	C29	CAPACITOR—330 mmf., mica	.35
UCU-1544	C34, 173	CAPACITOR—470 mmf., mica	.35
UDL-005		PILOT LIGHT—6-8 v., .25 amp., frosted	.15
UDL-019		BEZEL PILOT LAMP	.35
UOP-1057		LOUDSPEAKER—10-inch PM DeLuxe	24.75
URD-013	R6, 13, 52	RESISTOR—33 ohms, ½ w., carbon	
URD-017	R132	RESISTOR—47,000 ohms, ½ w., carbon	.13
URD-025	R90, 93, 96, 97	RESISTOR—100 ohms, ½ w., carbon	.13
URD-029	R19	RESISTOR—150 ohms, ½ w., carbon	.13
URD-043	R173, 174	RESISTOR—560 ohms, ½ w., carbon	.13
URD-049	R91, 92, 98, 99, 141	RESISTOR—1000 ohms, ½ w., carbon	.13
URD-051	R28, 126	RESISTOR—1200 ohms, ½ w., carbon	.13
URD-053	R7	RESISTOR—1500 ohms, ½ w., carbon	.13
URD-055	R87, 88, 123	RESISTOR—1800 ohms, ½ w., carbon	.13
URD-057	R46, 62, 63, 69, 73, 120, 125, 143, 150, 210, 213, 239, 240, 241, 242	RESISTOR—2200 ohms, ½ w., carbon	.13
URD-059	R104, 128	RESISTOR—2700 ohms, ½ w., carbon	.13
URD-063	R34, 184	RESISTOR—3900 ohms, ½ w., carbon	.13
URD-065	R42, 71, 181, 243, 244	RESISTOR—4700 ohms, ½ w., carbon	.13
URD-071	R178, 179, 191	RESISTOR—8200 ohms, ½ w., carbon	.13
URD-073	R54, 148, 155, 158, 172	RESISTOR—10,000 ohms, ½ w., carbon	.13
URD-077	R138	RESISTOR—15,000 ohms, ½ w., carbon	.13
URD-083	R78	RESISTOR—27,000 ohms, ½ w., carbon	.13
URD-085	R41, 74, 81, 89, 105	RESISTOR—33,000 ohms, ½ w., carbon	.13
URD-089	R134, 144	RESISTOR—47,000 ohms, ½ w., carbon	.13
URD-091	R27, 38, 39, 82, 182	RESISTOR—56,000 ohms, ½ w., carbon	.13
URD-093	R11, 24, 29, 31, 67	RESISTOR—68,000 ohms, ½ w., carbon	.13

Cat. No.	Symbol	Description	Suggested Unit List Price
		UNIVERSAL REPLACEMENT PARTS (Cont'd)	
URD-095	R79, 80	RESISTOR—82,000 ohms, ½ w., carbon	$0.13
URD-097	R5, 10, 16, 32, 35, 36, 70, 107, 127, 137, 145, 146, 201, 247	RESISTOR—100,000 ohms, ½ w., carbon	.13
URD-099	R65, 66, 151, 152	RESISTOR—120,000 ohms, ½ w., carbon	.13
URD-101	R51, 234	RESISTOR—150,000 ohms, ½ w., carbon	.13
URD-103	R139	RESISTOR—180,000 ohms, ½ w., carbon	.13
URD-105	R75, 100, 102, 142, 194, 195	RESISTOR—220,000 ohms, ½ w., carbon	.13
URD-107	R26	RESISTOR—270,000 ohms, ½ w., carbon	.13
URD-109	R110, 114	RESISTOR—330,000 ohms, ½ w., carbon	.13
URD-113	R77, 84, 106, 153, 187	RESISTOR—470,000 ohms, ½ w., carbon	.13
URD-121	R23, 48, 55, 111, 112, 119, 175, 176, 180, 183, 248	RESISTOR—1 meg., ½ w., carbon	.13
URD-123	R129	RESISTOR—1.2 meg., ½ w., carbon	.13
URD-125	R68	RESISTOR—1.5 meg., ½ w., carbon	.13
URD-129	R47, 118,	RESISTOR—2.2 meg., ½ w., carbon	.13
URD-133	R72, 76	RESISTOR—3.3 meg., ½ w., carbon	.13
URD-141	R103, 108	RESISTOR—6.8 meg., ½ w., carbon	.13
URD-1032	R154, 185	RESISTOR—200 ohms, ½ w., carbon	.17
URD-1039	R33	RESISTOR—390 ohms, ½ w., carbon	.17
URD-1049	R40	RESISTOR—1000 ohms, ½ w., carbon	.17
URD-1056	R21	RESISTOR—2000 ohms, ½ w., carbon	.17
URD-1061	R3	RESISTOR—3300 ohms, ½ w., carbon	.17
URD-1073	R86, 121	RESISTOR—10,000 ohms, ½ w., carbon	.17
URD-1081	R2	RESISTOR—22,000 ohms, ½ w., carbon	.17
URD-1105	R1	RESISTOR—220,000 ohms, ½ w., carbon	.17
URE-037	R56	RESISTOR—330 ohms, 1 w., carbon	.17
URE-045	R53, 64	RESISTOR—680 ohms, 1 w., carbon	.17
URE-049	R235, 236, 237, 238	RESISTOR—1000 ohms, 1 w., carbon	.17
URE-067	R94	RESISTOR—5600 ohms, 1 w., carbon	.17
URE-073	R60, 156	RESISTOR—10,000 ohms, 1 w., carbon	.17
URE-085	R140	RESISTOR—33,000 ohms, 1 w., carbon	.17
URE-089	R43	RESISTOR—47,000 ohms, 1 w., carbon	.17
URE-113	R219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230	RESISTOR—470,000 ohms, 1 w., carbon	.17
URE-1063	R8, 14, 17, 20	RESISTOR—3900 ohms, 1 w., carbon	.23
URE-1073	R116, 186	RESISTOR—10,000 ohms, 1 w., carbon	.23
URE-1121	R189, 231, 232, 233	RESISTOR—1 meg., 1 w., carbon	.23
URE-1128	R162, 163, 164, 165, 166, 188	RESISTOR—2 meg., 1 w., carbon	.23
URF-013	R197	RESISTOR—33 ohms, 2 w., carbon	.25
URF-045	R193	RESISTOR—680 ohms, 2 w., carbon	.25
URF-057	R169, 170, 171, 196	RESISTOR—2200 ohms, 2 w., carbon	.25
URF-065	R115	RESISTOR—4700 ohms, 2 w., carbon	.25
URF-069	R206, 207, 214	RESISTOR—6800 ohms, 2 w., carbon	.25
URF-1049	R57, 58, 59	RESISTOR—1000 ohms, 2 w., carbon	.30
		SPECIALIZED REPLACEMENT PARTS	
RAB-065	L6, P9	CABINET BACK AND LOOP ASSEMBLY—(For 901 only)	$6.95
RAB-066	L6, P9	LOOP BOARD ASSEMBLY—Antenna loop and plug assembly (for 910 only)	12.50
RAL-001		BEZEL—Dark	.10
RAX-008		BRACKET—Bracket and roller fork for elevator shaft	8.75
RCC-041	C65	CAPACITOR—.02 mfd., 600 v., paper	.25
RCE-002	C91A, B	CAPACITOR—15 mfd., 350 v.; 15 mfd., 350 v., electrolytic	1.75
RCE-009	C37, 202	CAPACITOR—30 mfd., 250 v., electrolytic	1.50
RCE-058	C42A, B, C, D; C107A, B, C, D; C172A, B, C, D	CAPACITOR—40 mfd., 350 v.; 30 mfd., 350 v.; 10 mfd., 350 v.; 50 mfd., 50 v., electrolytic	4.35
RCE-060	C203	CAPACITOR—100 mfd., 25 v., electrolytic	2.85
RCE-062	C205, 206	CAPACITOR—.5 ohms @ 15 kc., 3 v., electrolytic	2.10
RCE-063	C35	CAPACITOR—1 ohm @ 60 cycles, 3 v., electrolytic	4.70
RCE-064	C198	CAPACITOR—200 mfd., 25 v., electrolytic	1.65
RCE-072	C201A, B	CAPACITOR—30 mfd., 450 v.; 90 mfd., 450 v.; electrolytic	4.95

SPECIALIZED REPLACEMENT PARTS (Cont'd)

Cat. No.	Symbol	Description	Suggested Unit List Price
RCN-011	C211, 212, 213, 214, 215, 216	CAPACITOR—500 mmf., 20 kv	$3.00
RCN-013	C209	CAPACITOR—30 mmf., 1500 v., mica	.35
RCW-026	C30, 82, 92, 105, 134, 188, 199, 305, 306, 307, 308, 309	CAPACITOR—1500 mmf., ceramic	.60
RCW-1045	C195, 196	CAPACITOR—1.5 mmf., ceramic	.60
RCW-1047	C64, 74, 3	CAPACITOR—100 mmf., ceramic	.60
RCW-1052	C152	CAPACITOR—47 mmf., ceramic	.60
RCW-1058	C69, 151	CAPACITOR—10 mmf., ceramic	.60
RCW-1060	C60	CAPACITOR—10 mmf., ceramic	.60
RCW-1061	C146	CAPACITOR—27 mmf., ceramic	.60
RCW-1065	C19, 55, 119	CAPACITOR—100 mmf., ceramic	.60
RCW-2006	C6	CAPACITOR—12 mmf., ceramic	.35
RCW-2009	C193, 194	CAPACITOR—8 mmf., ceramic	.60
RCW-2010	C185, 186, 157	CAPACITOR—47 mmf., ceramic	.60
RCW-2023	C61	CAPACITOR—6.8 mmf., ceramic	1.00
RCW-2020	C155	CAPACITOR—56 mmf., ceramic	.60
RCW-2027	C56, 68, 158	CAPACITOR—15 mmf., ceramic	.60
RCW-2028	C313	CAPACITOR—5 mmf., ceramic	.60
RCW-2029	C197	CAPACITOR—3 mmf., ceramic	1.15
RCW-2030	C41	CAPACITOR—6 mmf., ceramic	.60
RCX-016	C76, 148, 149	CAPACITOR — 200-250 mmf.; 280-380 mmf.; 475-575 mmf.; trimmer strip	1.50
RCX-022	C71, 72, 73, 78, 81	CAPACITOR—45-80 mmf.; 475-575 mmf.; 280-380 mmf.; 34-70 mmf.; 2-20 mmf.; trimmer strip	2.60
RCX-023	C63, 80	CAPACITOR—4-50 mmf.; 34-70 mmf.; trimmer strip	.85
RCX-024	C58, 59	CAPACITOR—3-30 mmf.; 80-130 mmf.; trimmer strip	.85
RCY-011	C79	CAPACITOR—3-30 mmf., mica	.40
RCY-015	C160	CAPACITOR—Air trimmer for television tuning	1.95
RCY-017	C153, 156	CAPACITOR—3-30 mmf., air trimmer	.75
RDC-019		CORD—Tuning elevator hoist cord, 6½ inches long (metallic)	.20
RDC-021		CORD—Dial drive cord	.35
RDC-033		CORD—Dial cord (nylon covered glass core) NF40	.10 per yard
RDD-007		DRUM—Focus control drive drum (1½ in.) with No. 6-32 x ¼ in. set screws	.95
RDD-011		DRUM—Television selector switch indicator cord drive drum (2⅞ in.) with No. 6-32 x ¼ in. set screws	1.00
RDD-013		DRUM—Elevator tuning drive drum (3⅞ in.) with No. 6-32 x ¼ in. set screws	1.00
RDD-014		DRUM—Radio pointer drive drum (2 9/32 in.) with No. 6-32 x ¼ in. set screws	1.15
RDD-015		DRUM—Television tuning drive cord drum (1 in.) with No. 6-32 x ¼ in. set screws	.70
RDE-029		ESCUTCHEON—Dial scale	8.90
RDE-030		ESCUTCHEON—Knob control escutcheon (metal) (for model 910 only)	4.10
RDK-071		KNOB—Volume control and focus control knobs	.50
RDK-072		KNOB—Radio tuning and television tuning knobs	.90
RDK-073		KNOB—Service selector knob	.75
RDK-074		KNOB—Contrast control knob	.90
RDK-075		KNOB—Brilliance control knob	.75
RDK-117		KNOB—Television channel selector knob	.80
RDK-118		KNOB — Tone control knob and power switch	.95
RDS-059		DIAL SCALE	8.40
RDX-036		POINTER—Radio dial pointer assembly	.65
RDX-037		POINTER—Television channel indicator assembly	.65
REF-004	F201	FUSE—6 amp., power line fuse No. 312006 (3AG)	.15
REI-012		CORE—Powdered iron core for L203	.70
REI-013		CORE—Powdered iron core for horizontal frequency coil L20	.35
REM-003		CONNECTOR—High voltage condenser clip and tube cap assembly for V208 and V209	.35
REM-004		CONNECTOR—High voltage condenser clip and tube cap assembly for V207, V210 and ground end of C214	.30
REM-005		CONNECTOR—High voltage condenser clip and cap for junction of capacitors C215 and C216	.35
REM-006		CONNECTOR—High voltage condenser clip and cap for junction of C216 and R227	.30
REM-007		CONNECTOR—High voltage condenser clip and cap for junction of C214 and C215	.35
REX-002		CORE—Iron core with glass tubing and guide wire for tuning broadcast antenna, r-f, and oscillator coils	.50

SPECIALIZED REPLACEMENT PARTS (Cont'd)

Cat. No.	Symbol	Description	Suggested Unit List Price
RHC-010		SPRING CLIP—Holds FM guillotine tuning coil assembly	$0.10
RHE-001		EYELET—For connecting FM guillotine tuner coil frames	.01
RHM-016		CLIP—Mounting clip for L16 and L24	.02
RHM-026		TUNER FRAME—Rectangular coil link for assembling FM coils T16 and T18	.35
RHM-027		TUNER FRAME—Rectangular coil link for assembling FM coil T37	.45
RHN-004		NUT—Adjusting nut for FM tuner vanes	.02
RII-001		INSULATOR—Mycalex posts for assembling all FM coils	.10
RII-011		INSULATOR—Insulator strip assembled to phono jack J10	.03
RII-012		INSULATOR—High voltage rectifier assembly stand-off insulator (3 in.)	.65
RJC-001		PIN—Speaker lead connecting pin	.05
RJC-005		CONNECTOR—High voltage anode connector for 5TP4 tube	.90
RJJ-003		RECEPTACLE—Tuning eye socket for 6AL7	.30
RJJ-005	P5	PLUG—Interlock plug on chassis	1.75
RJP-004	P10	PLUG—Phono pickup plug	.10
RJP-006	P9	PLUG—Loop antenna lead plug	.15
RJP-015	J5	RECEPTACLE—Interlock plug receptacle on power cord	1.20
RJP-018	J10	JACK—Phono input jack	.20
RJP-019	P4	PLUG—Speaker cable plug, Amphenol 86PM6	.55
RJP-020	P3	PLUG—7-pin power cable plug, Amphenol 86PM7S	.55
RJP-021	P2	PLUG—9-pin power cable plug, Amphenol 86PM9	.70
RJP-022	P1	PLUG—11-pin power cable plug, Amphenol 86PM11	.85
RJP-023	P12	CONNECTOR—Video lead connector pin, Alden No. 201SP	.35
RJP-024	P14	CONNECTOR—8-pin picture tube cable plug, Amphenol No. 86RCP8	.65
RJS-003		SOCKET—Octal base tube socket (small) for V207, V208, V209, and V210	.20
RJS-004		PLATE—Electrolytic mounting plate (textolite, large)	.10
RJS-030		SOCKET—Octal tube socket (standard)	.20
RJS-035		SOCKET—Octal tube socket (mica) for V206	.20
RJS-037		PLATE—Electrolytic mounting plate (metal, small)	.10
RJS-042		SOCKET—Loctal tube socket for 7F8	1.10
RJS-051	J9	SOCKET—Loop antenna plug receptacle	.10
RJS-102		SOCKET ASSEMBLY (Dial light)	1.25
RJS-107		SOCKET—Tube socket for midget tube Type 6AU6, 6AK5, 6AG5	.30
RJS-109	J3	RECEPTACLE—7-pin power cable receptacle, Amphenol 77M1P76	.30
RJS-110	J2	RECEPTACLE—9-pin power cable receptacle, Amphenol 77M1P9	.45
RJS-111	J1	RECEPTACLE—11-pin power cable receptacle, Amphenol 77M1P11	.60
RJS-112	J4	SOCKET—Speaker plug socket, Amphenol 77M1P6	.30
RSJ-113	J12	CONNECTOR—Video lead connector receptacle, Alden No. 201SM	.20
RJS-024		PLATE—Electrolytic mounting plate (textolite, small)	.10
RJS-085		SOCKET—Octal tube socket for 6SC7 phono preamp. tube 6SC7	.20
RJS-103		SOCKET—Tube socket for 5TP4	4.35
RJS-104		SOCKET—Bezel light socket	1.00
RJS-114	J14	CONNECTOR—8-pin picture tube	.65
RJS-115	P6, 7, 8, 13, 15; J8, 15	CONNECTOR—Lead connector and tube cap for V204 and V205	1.40
RLA-009	T17	COIL—Antenna, broadcast tuning coil	4.10
RLA-011	L21, 24	CHOKE—FM band, 2 oscillator	.85
RLB-005	T16, 18	COIL—FM r-f and converter guillotine tuner	1.60
RLB-006	T14	COIL—R-f broadcast band tuning	4.10
RLB-007	L14	COIL—V21 oscillator cathode choke coil (FM band 2)	.75
RLB-008	L7	CHOKE—V20 r-f tube plate choke (SW1 and SW2 band)	1.20
RLB-009	L9	COIL—V20 r-f tube plate dummy load	.80
RLB-010	L8	COIL—FM r-f plate choke	.70
RLC-013	T37	COIL—FM oscillator guillotine tuner	1.80
RLC-014	T15	COIL—Oscillator, broadcast tuning coil	1.65
RLC-015	L12	COIL—V21 oscillator short wave loading coil	.85
RLC-016	L13	"OSC" B-BAND SHUNT COIL	3.35
RLC-017	L33	COIL—V22 converter short wave input loading coil	1.10
RLD-003	L202	YOKE—Deflecting coil yoke assembly	18.50
RLF-007	L35, 36, 39, 40, 41, 42, 43, 44, 45, 204	CHOKE—Filament choke	1.00
RLF-009	L2	COIL—Television antenna input choke	.85
RLF-011	L200, 201	CHOKE—Radio power supply filter choke	8.10
RLI-003	L18	COIL—Television RF, V1, cathode coil	.60

MODEL 901—REPLACEMENT PARTS LIST (Cont'd)

Cat. No.	Symbol	Description	Suggested Unit List Price
		SPECIALIZED REPLACEMENT PARTS (Cont'd)	
RLI-009	L4	COIL—Video detector series peaking coil	$1.45
RLI-019	L3	COIL—Television osc., V2B, cathode coil	.60
RLI-022	T22	COIL—R-f and osc. coil (Channel 3)	1.30
RLI-023	T23	COIL—R-f and osc. coil (Channel 4)	1.30
RLI-024	T24	COIL—R-f and osc. coil (Channel 5)	1.30
RLI-025	T25	COIL—R-f and osc. coil (Channel 6)	1.30
RLI-035	T20	COIL—R-f and osc. coil (Channel 1)	2.70
RLI-036	T21	COIL—R-f and osc. coil (Channel 2)	2.70
RLI-040	L24	COIL—Antenna loop shunt coil (SW band 1)	.45
RLI-041	L16	COIL—Antenna loop shunt coil (SW band 1)	.45
RLI-045	L5	COIL—Video amplifier series peaking coil	.85
RLI-046	L22	COIL—Video amplifier shunt peaking coil	.85
RLI-047	L17	COIL—Video detector series peaking coil	.85
RLI-048	T26	COIL—R-f and osc. coil (Channel 7)	.60
RLI-049	T27	COIL—R-f and osc. coil (Channel 8)	.60
RLI-050	T28	COIL—R-f and osc. coil (Channel 9)	.60
RLI-051	T29	COIL—R-f and osc. coil (Channel 10)	.60
RLI-052	T30	COIL—R-f and osc. coil (Channel 11)	.60
RLI-053	T31	COIL—R-f and osc. coil (Channel 12)	.60
RLI-054	T32	COIL—R-f and osc. coil (Channel 13)	.60
RLI-055	L20	COIL—Horizontal multivibrator cathode coil (horizontal frequency control)	1.75
RLM-012	L203	COIL—Horizontal size control	4.95
RLP-005	L23	COIL—FM 1st i-f plate peaking coil	2.65
RLP-006	L11	COIL—Radio oscillator V21 plate choke	1.05
RLW-002	L38	COIL—Wave trap, 21.9 mc (television diode detector)	.55
RLW-003	L37	COIL—Wave trap, 21.9 mc (television 4th i-f)	.65
RMC-012		CATCH—Radio tuner unit cover catch	.10
RMC-013		CLIP—Holds radio tuner unit cover catch	.05
RMM-010		VANE—Tuner vane for FM coils T16 and T18	.25
RMM-011		VANE—Tuner vane for FM coil T37	.25
RMM-034		SHIELD—Bezel light shield	.05
RMM-056		INSULATOR—High voltage rectifier assembly stand-off insulator (1 ½ in.)	.40
RMM-078		CABLE—Optical unit elevator hoist cable	3.40
RMR-002		ROLLER—Presses against elevator hoist shaft	.10
RMS-042		SPRING—Elevator hoist cord tension spring	.05
RMS-043		SCREW—Adjusting screw for iron core of T14, T15, and T17	.15
RMS-044		SPRING—Tension spring in tuner vane adjustment screw assembly	.03
RMS-076		SCREW—Adjusting screw for FM tuner vanes	.15
RMS-118		SPRING—Dial cord spring for television channel indicator	.10
RMS-119		SPRING—Radio drive cord tension spring	.15
RMS-120		SPRING—Dial cord spring for focus control and for television tuning	.15
RMX-105		DRUM—Television tuning capacitor drive drum	1.00
RMX-115		ROLLER—Roller and mounting bracket assembly (inner track)	4.45
RMX-116		ROLLER—Roller and mounting spring bracket assembly (outer track facing front)	3.10
ROV-001		MIRROR—Flat mirror (in top of optical assembly)	23.50
ROV-002		MIRROR—Spherical mirror	68.50
ROV-003		SCREEN—Picture screen	19.00
ROV-004		LENS—Corrector lens	35.50
RRC-020	R30	POTENTIOMETER—100,000 ohms horizontal phase detector balance control	1.25
RRC-064	R117	POTENTIOMETER—Dual 2 meg. volume control	4.65
RRC-065	R12, 83	POTENTIOMETER—Dual 500,000 ohms brilliance and contrast control	$2.60
RRC-066	R161	POTENTIOMETER—6 meg. focus control	8.95
RRC-067	R37	POTENTIOMETER—500,000 ohms horizontal hold control	1.25
RRC-068	R49	POTENTIOMETER—1 meg., vertical hold control	1.25
RRC-069	R50	POTENTIOMETER—2 meg., vertical size control	1.25
RRC-070	R45	POTENTIOMETER—5000 ohms, vertical linearity control	2.50
RRC-071	R44, 218	POTENTIOMETER — 20 ohms, center tapped, 4 watt, vertical centering and horizontal centering controls	2.30
RRC-072	R212	POTENTIOMETER—1000 ohms, wirewound, horizontal linearity control No. 1	5.90
RRC-073	R209, 211	POTENTIOMETER—250,000 ohms, horizontal linearity control No. 2 and No. 3	1.25
RRN-005	R245, 246	RESISTOR—1000 meg., 27 kv. anode voltage bleeder	5.95
RRW-021	R159	RESISTOR—500 ohms, 6 w., w.w.	.95
RRW-022	R204	RESISTOR—1500 ohms, 5 w., w.w.	1.20
RRW-023	R101, 202	RESISTOR—150 ohms, 6 w., w.w.	.70
RRW-024	R85	RESISTOR—6000 ohms, 6 w., w.w.	1.10
RSS-005	S4, 5	SWITCH—FM squelch switch, and local-distant FM switch	.35
RSW-028	S2	SWITCH—Service selector switch.	9.75
RSW-045	S3	SWITCH—Tone and power switch	3.90
RSW-046	S201	SWITCH—Television anode voltage excitation control	1.80
RSX-015		TELEVISION—R-f head-end assembly (completely aligned, includes tubes)	80.00
RTD-001	T36	TRANSFORMER—FM discriminator	5.05
RTD-003	T10	TRANSFORMER—Television audio discriminator	8.30
RTL-017	T19	TRANSFORMER—1st i-f radio FM and AM	7.15
RTL-022	T33	TRANSFORMER—2nd i-f radio FM and AM	8.15
RTL-045	T35	TRANSFORMER—3rd i-f radio FM and AM	7.30
RTL-065	T1	TRANSFORMER—Television 1st i-f transformer	3.75
RTL-066	T2	TRANSFORMER—Television 2nd i-f transformer	3.75
RTL-067	T3	TRANSFORMER—Television 3rd i-f transformer	3.75
RTL-068	T4	TRANSFORMER—Television 4th i-f transformer	3.75
RTL-069	T5	TRANSFORMER—Television diode detector input i-f transformer	3.75
RTL-070	T9	TRANSFORMER—Vertical sweep generator	4.00
RTL-071	T11	TRANSFORMER—Television audio i-f	3.90
RTM-002	T6	TRANSFORMER—Horizontal sweep AFC phase detector input	7.50
RTO-041	T13	TRANSFORMER—Audio output	11.90
RTO-042	T202	TRANSFORMER—Horizontal sweep output	14.50
RTO-043	T8	TRANSFORMER—Vertical sweep output	15.50
RTP-054	T200	TRANSFORMER—Radio power transformer, 60 cycles	47.50
RTP-055	T201	TRANSFORMER—Television power transformer, 60 cycles	37.50
RWL-004		POWER CORD	.75
RWL-010	J5	CORD AND PLUG—Power cord and female (interlock) receptacle	.75
RYG-001		IDENTIFICATION PLATE—Glass plate carrying identification "GENERAL ELECTRIC TELEVISION"	7.95

NOTE: Prices subject to change without notice.

In some cases where 200-volt and 400-volt rated capacitors are found in production, 600-volt capacitors have been substituted in the replacement parts lists to reduce the necessary amount of stock on hand.

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