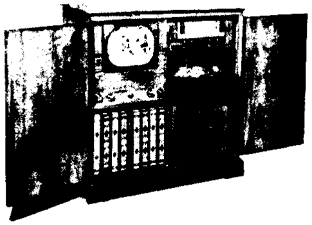

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SPECIFICATIONS

OVER-ALL DIMENSIONS:	Height .... 38 inches Depth .... 17¼ inches Width .... 37⅞ inches
ELECTRICAL RATING:	Frequency .... 60 cycles Voltage .... 115 v. Wattage (Television Op.) .. 300 w. Wattage (Radio Op.) ...... 85 w.
INTERMEDIATE FREQUENCIES:	Television Video .... 26.3 MC Television Audio .... 21.8 MC Radio, AM .... 455 KC Radio, FM .... 10.7 MC
AUDIO POWER OUTPUT:	Undistorted .... 3.0 watts Maximum .... 5.0 watts
LOUDSPEAKER:	Type .... Alnico PM Dynamic Cone Diameter .... 12 inches Voice Coil Impedance ... 3.2 ohms
PICTURE SIZE:	Height .... 7⅞ inches Width .... 10¼ inches
RECORD PLAYER:	Type ...... Dual speed (Type P8) Pick-up .. Plug in GE Variable Reluctance Pick-up Impedance .... 230 ohms
ANTENNA REQUIREMENTS:	Type. Folded dipole or equivalent Impedance .... 300 ohms
PILOT LAMPS:	Type .... Mazda #47

R-F FREQUENCY RANGE:

Selector Switch Position	Frequency Range MC	Picture Carrier MC	Sound Carrier MC
Radio	.54-1.6		
FM	88-108		
No. 2	54-60	55.25	59.75
No. 3	60-66	61.25	65.75
No. 4	66-72	67.25	71.75
No. 5	76-82	77.25	81.75
No. 6	82-88	83.25	87.75
No. 7	174-180	175.25	179.75
No. 8	180-186	181.25	185.75
No. 9	186-192	187.25	191.75
No. 10	192-198	193.25	197.75
No. 11	198-204	199.25	203.75
No. 12	204-210	205.25	209.75
No. 13	210-216	211.25	215.75

TUBES:

Symbol	Purpose	Type
	Television Chassis	
V1	R-F Amplifier	6AU6
V2	Converter-Oscillator	12AT7
V3	1st Video I-F Amplifier	6AU6
V4	2nd Video I-F Amplifier	6AU6
V5	3rd Video I-F Amplifier	6AU6
V6	Video Detector-Clipper Rectifier	6AL5
V7	Video Amplifier-Limiter	12AU7
V8	Picture Tube	12KP4
V9	Vertical Sweep Generator	6SN7GT
V10	Vertical Sweep Output	6V6GT
V11	Phase Inverter-Clipper	6SN7GT
V12	Hor. AFC and Sweep Generator	6SN7GT
V13	Hor. Sweep Output	6BG6-G
V14	High-Voltage Rectifier	1B3GT/8016
V15	Horizontal Damping	5V4G
V16	Rectifier	5U4G
V17	Audio I-F Amplifier	6AU6
V18	Audio I-F Limiter	6SH7
V19	Audio Discriminator	6AQ7/GT
V21	Rectifier (low-voltage)	5Y3GT
V22	Audio I-F Amplifier	6AU6
	Radio Chassis	
V1	Converter	6BE6
V2	R-F and I-F Amplifier	6BA6
V3	I-F Amplifier	6BA6
V4	FM Limiter	6AU6
V5	AM Detector, FM Discriminator, and Audio Amplifier	6T8
V6	Power Output	6V6GT
V7	Rectifier	5Y3GT
V8	Phono Preamplifier	6SC7

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 (11,000 V.) AT THE PICTURE TUBE ANODE WILL GIVE AN UNPLEASANT SHOCK BUT DOES NOT SUPPLY ENOUGH CURRENT TO GIVE 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. ALWAYS WEAR GOGGLES WHEN CHASSIS IS REMOVED FROM CABINET.

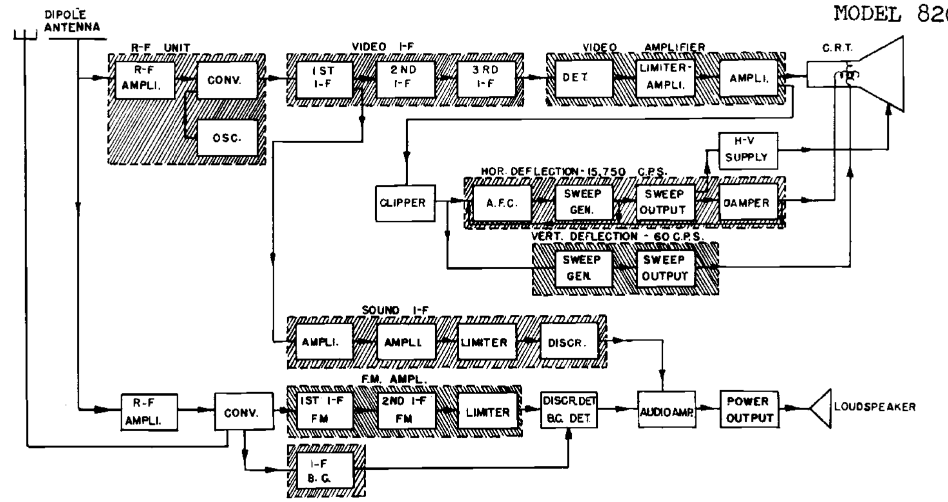


Fig. 1. Block Diagram, Model 820

GENERAL INFORMATION

The General Electric Model 820 is a television-radio receiver and phonograph (console type), 29-tube instrument providing reception of all 12 commercial television channels, radio reception in the Broadcast and FM bands using a 324 Radio chassis, and dual-speed phonograph operation (33⅓ rpm and 78 rpm) using the new G-E Variable Reluctance Pick-ups. The television picture is reproduced on a 12-inch electromagnetically deflected picture tube. The phonograph makes use of a dual-speed automatic record changer that will handle 12-inch and 10-inch standard groove and micro-groove (L-P) records.

The instrument contains one television chassis, one radio chassis with loudspeaker which is used for both radio and television operation, and a record changer chassis with 2 plug-in pickup heads (red and tan).

Features of the television receiver include a constant input impedance r-f amplifier with a balanced input, safe high-voltage power supply, automatic frequency control for horizontal synchronization, twelve-inch picture tube with aluminized screen and a high fidelity FM audio system. On FM, the set uses a reflex circuit, the Armstrong type discriminator, and a special limiter circuit.

The service information on the Model 820 record changer is contained in the publication ER-S-P8.

INSTALLATION AND OPERATION INSTRUCTIONS

Installation and operation instructions for the Model 820 television receiver are supplied, in separate pamphlets, as follows:

1—Installation Instructions ER-A-820
2—Operation Instructions ER-I-820

DESCRIPTION—TELEVISION RECEIVER CIRCUITS

The Model 820 television receiver circuits are divided into the following sections:

1. R-F Amplifier, Oscillator, and Converter (Head-End).
2. Video and Audio I-F Amplifier.
3. Video Detector and Video Amplifier.
4. Horizontal and Vertical Sync. Pulse Separator.
5. Horizontal Sweep Generator and AFC.
6. Horizontal Sweep Output.
7. Vertical Sweep Generator and Vertical Sweep Output.
8. High Voltage Power Supply for Picture Tube.
9. Low Voltage Power Supply.

A brief description of the operation of each circuit is given in the following paragraphs. This is supplemented by simplified circuit diagrams of each portion of the circuit under discussion. Reference is also made to the complete schematic diagram shown on page 15.

A block diagram of the Model 820 receiver is shown in Figure 1 to assist in signal tracing and to better visualize the operation of the receiver.

1. R-F AMPLIFIER, CONVERTER, AND OSCILLATOR (SEE FIGURE 2).

The r-f amplifier makes use of a Type 6AU6 pentode tube connected as a grounded grid triode amplifier. The antenna is connected into the cathode circuit of the tube through a transformer, T1, so as to provide a substantially constant input impedance of 300 ohms to the antenna and transmission line at all frequencies. The transformer, T1, is balanced to ground in the primary winding which provides cancellation of noise pickup on the transmission line. An electrostatic shield is incorporated between the primary and secondary winding of T1 to prevent noise from being transferred from primary to secondary by capacity effect. R1 is the normal bias resistor for V1. A choke (L_K in Figure 2) is placed in series with this cathode resistor to prevent the input impedance from being lowered by shunting effect of the cathode bias resistor and the by-pass capacitor, R1 and C2. L_K also neutralizes the total cathode capacity, thus preventing it from affecting the input impedance. The choke value is changed when switching from the lower five to the upper seven channels. L1 is a series compensating choke which prevents a loss in gain on the high frequency channels.

The r-f amplifier is coupled to the converter by a wide-band transformer consisting of windings L_p and L_s. The windings are self-tuned by the distributed and tube capacities to provide optimum gain. Variable trimmers C5 and C6 are shunted across the primary and secondary windings, respectively, of the r-f transformer to permit compensation for misalignment resulting from differences of tube capacities when a tube change is necessary. On Channel #2, the transformer is triple-tuned to provide better image frequency attenuation of the 88–108 mc FM band. Three of the r-f transformers are used to cover the upper six channels. Each of these transformers is made sufficiently broad-band to accept two television channels.

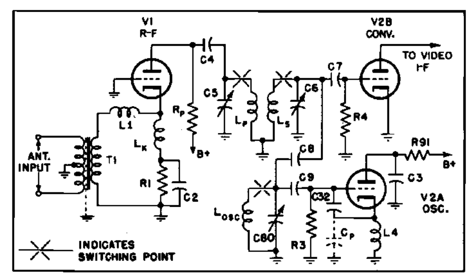


Fig. 2. R-F Amplifier, Converter, and Oscillator

The triode converter is one section of a Type 12AT7 dual triode, V2B. Bias for this section (V2B) is developed by the oscillator voltage appearing in the grid of V2B, causing grid rectification and charging the grid resistor-capacitor combination, R4 and C7.

The remaining triode section of the 12AT7 (V2A) is used as the oscillator, and is capacity coupled to the converter tube grid through the capacitor, C8. The oscillator is a modified Colpits oscillator, oscillation being produced by the grid-to-cathode capacitor, C32, and the plate-to-cathode interelectrode capacity, C_p, of the oscillator tube. The choke, L4, provides a d-c ground to the cathode of the oscillator tube and 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 channels. Three oscillator coils (L11, L12, and L13) are used to cover the upper six channels, the frequency range of the oscillator circuit at each coil switching is sufficient to tune two channels. Capacitor C80 is the tuning capacitor used to tune the oscillator on the lower six switch positions to the individual channels and on the upper three switch positions C80 tunes the oscillator to one or the other channel covered by that switch position.

To prevent hum modulation by the local oscillator when operating on the high frequency channels, the filament supply to V2A is rectified by a selenium rectifier, SR1, and filtered by C102.

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

2. VIDEO AND AUDIO I-F AMPLIFIERS (SEE FIGURE 3).

The video i-f amplifier is a three-stage band-pass amplifier, using three Type 6AU6 tubes. The video i-f transformers, T11, T12, T13, and T14 are overcoupled and then loaded with resistance in the secondary circuits to give an adequate band-pass frequency characteristic. A single movable powdered iron core is used in transformers T11, T12, and T13, for tuning of the secondary. Transformer T14 uses two tuning slugs to tune the primary and secondary. At tertiary winding is incorporated on T11 which connects to a series resonant trap circuit to permit adjustment of the slope of the high frequency end of the band-pass. It is adjusted so that 26.3 mc will fall at 50 per cent point on the curve to compensate for the sesqui side-band transmission of the video carrier frequencies.

A series tuned circuit consisting of C16, and the parallel combination of L15 and C17 is connected across the secondary of T12 and tuned for maximum attenuation of the 21.8 mc in the video amplifier. This prevents the 21.8 mc sound i-f from being passed through the video amplifier and affords a tap on L15 for taking off the sound i-f and passing it through to the grid of the sound i-f amplifier tube, V22. Additional i-f gain and selectivity is provided by the two stages of amplification. Since the television audio is frequency modulated, the transformer T19 functions with the diode sections of V19 as the discriminator.

Bias voltage derived from the grid return circuit of the horizontal blocking oscillator is applied to the grid circuits of the video i-f amplifier tubes, V3, V4, and V5 and the converter grid, V2. A potentiometer (Contrast Control) permits this bias to be changed on the grids of V2, V3 and V4 so as to vary the gain of the video i-f amplifier. In the "R" and "T" version the bias voltage is taken from the clipper (V11B) grid in an automatic gain control circuit.

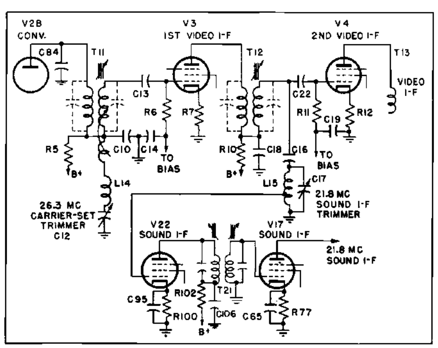


Fig. 3. Video and Audio I-F Amplifier

3. VIDEO DETECTOR AND AMPLIFIER (SEE FIGURE 4).

The video i-f amplifier output is applied to one section of a 6AL5 dual diode (V6A) which is connected as a shunt diode to develop a negative-going signal across the diode load resistance R19. The signal is then amplified by two triode amplifier stages using a Type 12AU7 dual triode tube, V7. L16 and L23 are series compensating coils while L17 and L22 are shunt compensating coils. These are used to obtain good high-frequency response and provide sharp cut-off at frequencies above the useable pass-band. L16 also prevents the i-f frequency from being passed through the video amplifier.

In addition to amplification, the first video amplifier tube, V7A, operates as a noise limiter. The B+ voltage applied to V7A is low and the video signal from the detector is negative-going; therefore, any large excursions of voltage above sync level, such as noise, will drive the grid to plate current cut-off. Thus, the interference will be limited close to the level of the super sync signal. This improves the signal to transient noise interference ratio without affecting the video signal.

The use of capacity coupling in the video amplifier necessitates that the d-c component of the video signal be restored to maintain proper background illumination. This is accomplished in the grid circuit of V7B. The video signal at this grid is positive-going so that with the resultant grid current flow, the capacitor C28 will be charged up to the peak value of the sync pulse. Since this charge will vary with the amplitude of the pulse, the resulting bias change will provide the required d-c restoration. This restoration in the grid circuit of V7B necessitates direct coupling of the picture tube, V8, grid to the plate circuit of V7B. By connecting the cathode of V8 to a variable B+ source, the proper bias may be maintained on the picture tube and the brilliance may be controlled. The control is effected by R95 (Brightness Control).

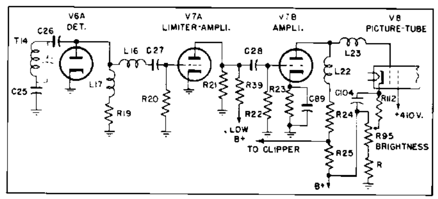


Fig. 4. Video Detector and Amplifier

4. SYNC SEPARATION (SEE FIGURE 5).

Amplification and separation of the sync pulse from the composite video signal is accomplished by tube sections, V11A, V6B, V11B. The triode section V11A is used to amplify and invert the phase of the composite video signal applied to its grid circuit and also to further limit the transient noise. This produces a video signal in the plate of V11A wherein the sync pulses are the most positive portion of the voltage waveform. This positive-going signal is applied across the diode section, V6B, which rectifies the positive portion and charges the capacitor C42 negatively in proportion to the amplitude of the sync pulses. This diode thus establishes a bias for tube V11B and, also, clamps the sync so that each recurring pulse originates at the zero voltage axis.

The clamped composite video waveshape applied to the grid of tube section V11B, which is biased by the diode V6B, causes the negative portion of this waveshape to be cut off in the cathode circuit of V11B, leaving only sync pulses. V11B is connected as a cathode follower with the horizontal sync pulses being taken off from resistor R92 and the vertical sync pulses being taken off from the plate of V11B.

An integrating network, consisting of R37, C39, C38, R36, and C37, is a low-pass filter used to remove the horizontal sync from the vertical sync pulses before passage of the sync signal to the vertical sweep generator.

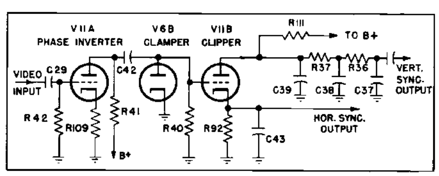


Fig. 5. Sync Separator Circuit

5. HORIZONTAL SWEEP GENERATOR AND AFC SYNC (SEE FIGURE 6).

The horizontal sawtooth generator makes use of one section of a Type 6SN7GT tube, V12B, connected in a blocking oscillator type circuit. Instead of its frequency being controlled directly by the horizontal sync pulses, it is controlled by a d-c voltage on its grid which is the resultant of the phase difference between the incoming sync signal and a voltage wave derived from the output of the sweep generator. The resultant d-c voltage produced by the tube V12A is called an automatic frequency control (AFC) voltage.

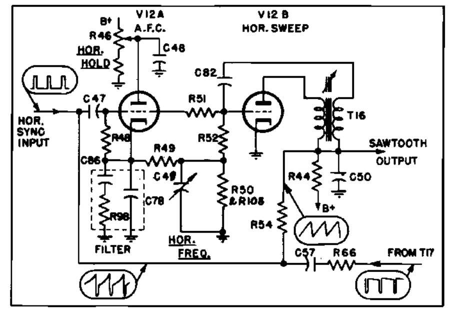


Fig. 6. Horizontal Sweep and AFC Sync

The tube V12A obtains its operating bias through its connection to the grid circuit of the blocking oscillator tube, V12B, through resistor R51. The blocking oscillator produces a large negative bias in its grid circuit during its normal operating cycle. When the horizontal sync pulses or the combined output voltage (shown at lower left of Figure 6) are impressed separately on the grid of V12A, they do not have sufficient positive amplitude to cause appreciable plate current flow in tube V12A. However, if they are combined and phased properly as shown in Figure 7A, 7B, or 7C, their composite amplitude is sufficient to cause plate current flow during that portion of the cycle where the waveshape is above the dash line axis in Figure 7. During the time that conduction takes place, the capacitors C86 and C78 become charged positive in respect to ground, the magnitude of the charge and the resultant voltage thereon being dependent upon the duration of the flow of current in tube V12A. Since the resistor R50 is in the bleeder circuit across the filter and also forms a part of the grid return circuit for the sweep generator tube V12B, any change in voltage across R50 will result in a change of frequency in the horizontal sweep generator. Thus, if the contributing voltage of R50 makes the grid of V12B less negative, the frequency will be raised; likewise, if the contributing voltages make the grid of V12B more negative, the frequency will be lowered. Thus, it will be seen that the longer the conduction period of tube V12A, the higher will be the frequency of the blocking oscillator and its sawtooth output.

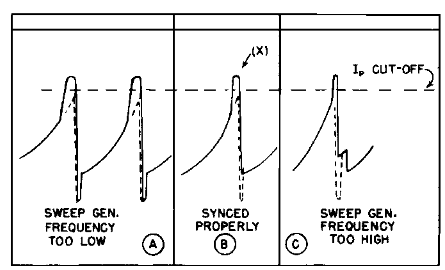


Fig. 7. AFC Waveshapes

Referring to Figure 7, the B curve shows a sync pulse phased so that about 50 per cent of the pulse width is riding on top of the integrated sawtooth, while the remainder of the pulse after point (X) falls down into the trough, making the conducting portion have a width which is average between curves represented by (A) and (C). If each successive sync pulse falls in the same phase relation as shown in curve (B), the Horizontal Hold Control which controls the amount of current flow through V12A is set so that this phase relation does not change. This would cause the sweep generator V12B to run at the same frequency as that of the transmitted signal. Under this condition, if the sweep generator tends to run slower than the incoming sync signal, the conduction period will be made longer through tube V12A because the pulse will move forward in relation to the integrated sawtooth wave with a result as shown in Figure 7(A). It will be noted that the conduction pulse is of greater duration (wider) than in curve (B). Therefore, tube V12A will conduct for a greater period of time, thus decreasing the negative potential across R50. This greater conduction period causes the sweep generator to speed up until it attains the condition in (B). Likewise, if the sweep generator is operating at too high a frequency, the pulse will advance along the integrated sawtooth wave until a large portion of it falls down into the trough of the waveshape, as shown in Figure 7(C), with the resultant shortening (narrowing) of the conducting pulse. This causes the frequency of the sweep generator to be reduced until the condition in Figure 7(B) is again restored.

The Horizontal Frequency Control capacitor (C49) forms a part of the discharge circuit in the grid of the blocking oscillator, V12B. By varying its value, the free-running speed of this oscillator can be adjusted to supplement and act as a coarse control for the Horizontal Hold Control on the front panel. The free-running speed of the blocking oscillator is also adjusted by the inductance variation of the blocking oscillator coil, T16.

For detailed description of T16 adjustments see page 12.

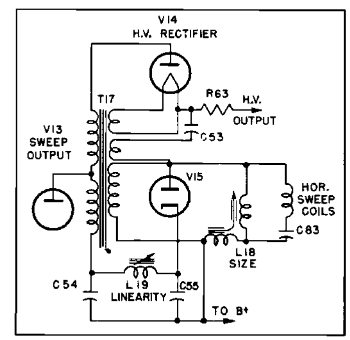


Fig. 8. Horizontal Sweep Output

6. HORIZONTAL SWEEP OUTPUT (SEE FIGURE 8).

The horizontal sawtooth voltage generated by the blocking oscillator, V12B, is shaped and then amplified by a Type 6BG6 tube, V13. The output of this tube is coupled to the horizontal deflection coils, D2, through an impedance-matching transformer, T17. The damping diode, V15, is used principally to remove a transient oscillation created by the rapid retrace of the current in the high inductance of T17 and still retain the positive overshoot in the primary winding for use in the high voltage supply. It also is used to provide a linear trace and to recover some of the energy from the inductive kick-back, and use it to help supply the B+ requirements of the output tube. During conduction of V15, capacitors C54 and C55 are charged up and since they are in series with the B+ voltage to tube V13, they contribute a sizeable portion of the plate voltage. The variable inductance, L19 and C54, constitutes a phase shift network which alters the phase of the ripple voltage developed across C55. This means of changing the ripple voltage which also supplies part of the B+ to the output tube provides a method of controlling the linearity.

A horizontal drive control, C81, forms a capacity voltage divider in conjunction with capacitor C51 so as to control the amount of sawtooth voltage supplied to the grid of V13. This permits adjustment of the grid sawtooth voltage to compensate for variations in output tubes.

The Horizontal Width Control, L18, forms a series parallel circuit in respect to the output of the yoke. The inductance is variable in both coils of this control; the inductance of the series choke is minimum when the parallel choke inductance is minimum and vice-versa. The parallel circuit shunts the current around the deflection coil, depending upon its inductance, and the series coil attenuates the current by changing the impedance of the series circuit. This type of control provides a uniform impedance to the output transformer over a wide range of adjustment.

7. VERTICAL SWEEP GENERATOR AND OUTPUT (SEE FIGURE 9).

The vertical sawtooth voltage is generated by a Type 6NS7GT tube, V9, connected as a multivibrator. This voltage is coupled directly to a Type 6V6G vertical sweep output amplifier tube, V10, and then to the vertical sweep yoke, D1, through the impedance matching transformer T15. Vertical speed is controlled by changing the time constant of the multivibrator grid circuit by potentiometer, R29. Sweep size or height of picture is changed by the potentiometer, R31, which changes the B+ voltage applied to the plate of tube V9 simultaneously with the screen voltage on tube V10. Vertical linearity is controlled by feeding back correcting voltage developed in the cathode circuit of V10 through C34 into the grid circuit of the output tube, V10. The cathode voltage of V10 which is fed back through C34 has an opposite curvature corresponding to the non-linear portion of the generating sawtooth output of V9 so that by combining these voltages in the grid of V10 correction may be affected. The amount of the correction voltage is controlled by the vertical linearity potentiometer, R33, in the cathode of V10.

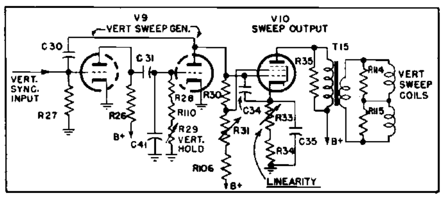


Fig. 9. Vertical Sweep and Output

8. HIGH VOLTAGE SUPPLY (SEE FIGURE 8).

The high voltage for the second anode of the picture tube is derived by making use of the inductive "kick" voltage produced during retrace in the horizontal output transformer, T17. This kick voltage has a magnitude of several thousand volts and is positive-going, appearing between the plate of V13 and ground. Since this voltage in itself is not sufficient to produce the required anode potential, an additional winding connected electrically and magnetically with the primary is added to provide further step-up of this voltage. The top of this auto-transformer is connected to the plate of a rectifier tube V14. This tube is a Type 1B3GT/8016 which derives its filament voltage from the horizontal sweep transformer T17 by a single turn around the core. Since the frequency supplied the rectifier tube is high (15,750 cps), a 500 mmf. filter capacitor is more than adequate to give a smooth d-c output. Due to the small capacity of the filter, this supply is relatively safe to handle.

9. LOW VOLTAGE POWER SUPPLY.

Two rectifier tubes, V16 and V21 (Types 5U4G and 5Y3GT, respectively), are used to supply the required plate current for the receiver. Each tube is used in a separate and complete rectifier circuit to supply two values of output B+ voltage, 290 volts and 380 volts. The focus coil, which is a combination permanent and electromagnet, is connected in series with a portion of the output current path in the lower voltage supply, the current through it being controlled by the Focus Control potentiometer, R72.

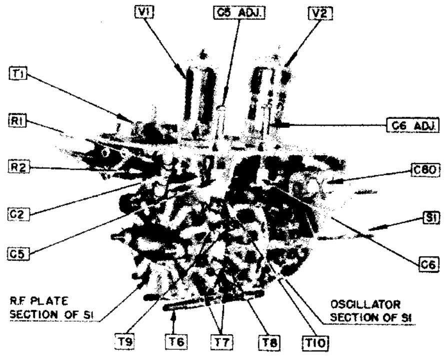


Fig. 10. R-F Head-end Assembly, Side View

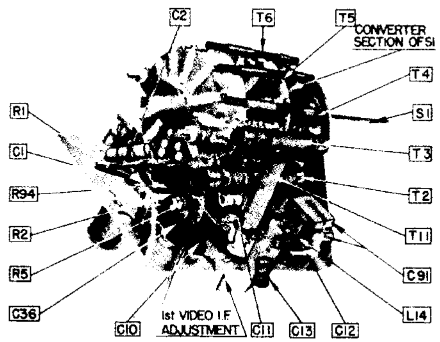


Fig. 11. R-F Head-end, Oblique View

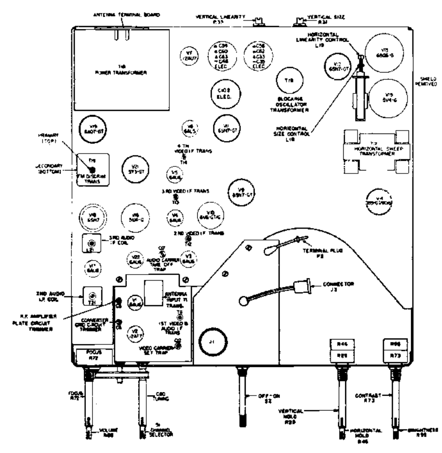


Fig. 12. Component and Trimmer Location

TELEVISION ALIGNMENT

GENERAL

A complete alignment of the television-receiver tuned circuits consists of the following individual alignment procedures. These are listed below in the correct sequence of alignment. However, any one section alignment may be performed without the necessity of realignment of any one of the other sectional alignments.

1. Sound I-F Alignment.
2. Video I-F Alignment.
3. R-F Alignment.
4. Oscillator Adjustment.

ALIGNMENT DIAGRAM

The alignment procedure is shown in table form on pages 6 through 9. In order to accelerate the whole procedure, the alignment diagram (Figure 30) should be consulted.

ALIGNMENT SUGGESTIONS—All alignment adjustments in the sound and video i-f amplifier are available from the top of the chassis, with the exception of the sound 1st i-f secondary, discriminator secondary, and the last video i-f primary. The location of the adjustments is shown in Figures 12 and 30. Remove the chassis from the cabinet. The deflection yoke and focus coil assembly must be connected to the circuit to obtain proper B+ voltages during alignment. When it is necessary to make adjustment from the bottom of the chassis, the chassis may be rested on its side so that the power transformer is down. The following suggestions apply to each individual alignment procedure.

TEST EQUIPMENT—To provide alignment as outlined above, the following test equipment is required:

1. *R F Sweep Generator.*
   (a) Frequency Requirements.
   20 to 30 mc with 10 mc sweep width.
   40 to 90 mc with 15 mc sweep width.
   170 to 220 mc with 25 mc sweep width.
   (b) Constant output over sweep width range.
   (c) At least 0.1 volt output
2. *Signal Generator*—Must have good frequency stability and be accurately calibrated. It should be capable of tone modulation over the following frequency ranges.
   21.8 mc for sound i-f.
   22.9 mc for video i-f marker.
   23.4 mc for video i-f marker.
   25.55 mc for video i-f marker.
   26.3 mc for video i-f marker.
   54–88 mc and 174–216 mc for oscillator adjustment and markers for the r-f channel bandwidth measurements
3. *Oscilloscope*—This oscilloscope should preferably have a 5-inch screen and have good wide-band frequency response on the vertical deflection. Although the high frequency response is unnecessary for alignment, it will be useful when making the waveform measurements on page 19.
4. *Crystal Calibrator*—This unit is essential to establish calibration check points for the signal generator so as to provide good accuracy of calibration.
5. *Wave Traps*—Accurately calibrated wave traps may be used to supply markers in place of the signal generator for video i-f and r-f alignment purposes.

1. SOUND I-F ALIGNMENT

GENERAL—The sweep generator is connected through a 500 mmf. capacitor to the grid of the tube preceding the sound i-f coil to be aligned. Connect the oscilloscope through a 100,000-ohm resistor across the resistor, R104, in the limiter tube, V18 grid. Insert a 21.8 mc marker signal from an unmodulated signal generator into the grid of V3. Keep the marker signal attenuated so that it just shows a marker on the sweep curve. Adjust L21 and T21, respectively, as you advance progressively one stage at a time, for maximum gain and symmetry of the response curve about the 21.8 mc marker. The curve should be similar to that shown in Figure 13-A. With the signal connected to the grid of the first audio i-f, V22, the bandwidth should be approximately 300 kc at the 70% response point.

Excessive sweep generator input will cause the sound i-f amplifier to overload and the response curve to broaden, resulting in slight misadjustment of the tuned circuits. During each alignment, keep the signal input to each stage limited at a value which develops not more than a ¾ volt peak at the limiter grid (junction R104 and C100), as measured by a calibrated oscilloscope. For discriminator alignment, apply the signal generator output to the grid of V22 and connect the oscilloscope to the junction of C74 and R86. The secondary core of the discriminator transformer, T19, is aligned by using an amplitude-modulated signal. The adjustment is made for minimum output, as indicated visually at the oscilloscope or by merely listening for the tone modulation at the speaker. The discriminator primary slug is adjusted for a maximum peak-to-peak amplitude response curve of the frequency-modulated signal input, as shown in Figure 13-B.

SOUND I-F ALIGNMENT CHART (See Fig. 30, Page 19)

Step No.	Signal Gen. Freq.	Sweep Generator Frequency	Signal Input	Connect Oscilloscope to Chassis and Junction of	Channel Switch	Adjust	Remarks
1	21.8 MC marker	21.8 MC with 1 MC sweep	Grid (Pin 1) of V17 through 500 mmf.	Junction R104 and C100 through 100K-ohm resistor.	Channel #4	L21 for max. amplitude and symmetry about marker.	See Fig. 13(A) for resultant curve.
2	21.8 MC marker	21.8 MC with 1 MC sweep				T21 pri. and sec. for max. amp. and symmetry about marker.	
3	21.8 MC with modulation	Not used	Grid (Pin 1) of V22 through 500 mmf.	Junction C74 and R86 through 10K-ohm resistor.		T19 secondary slug for min. amplitude.	Min. output can also be checked with vol. control advanced, and listening for speaker output.
4	Not used	21.8 MC with 1 MC sweep				T19 primary slug for max. peak-to-peak amplitude and symmetry of peaks about base line.	See Fig. 13(B) for resultant curve.
5	Recheck Steps 3 and 4.						

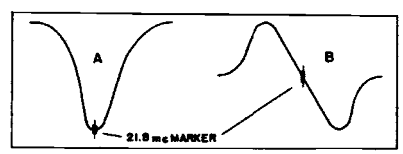


Fig. 13. Audio I-F Curves

2. VIDEO I-F ALIGNMENT

GENERAL—The video i-f amplifier uses transformers which are coupled and loaded to give the proper band-pass characteristics.

Stage-by-stage alignment should be performed so as to duplicate as closely as possible the curves as shown in Figure 14-A, -B, -C, and -D. The markers supplied by an accurately calibrated signal generator are used to establish the correct bandwidth and frequency limits.

Connect the sweep generator to the tube grid preceding the transformer to be aligned. Adjust the sweep width for a minimum of 10 mc about the center frequency of the video response curve. The sweep output cable should be shielded and perferably terminated in its characteristic impedance and then connected with as short a lead as possible through a 500 mmf. capacitor; the ground lead of the cable should be short and grounded to the chassis as near as possible to where the signal is applied. Sufficient marker signal may be supplied in most cases, except at the 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 capacitor (approx. 50 to 100 mmf.) in parallel with the sweep input; keep the input low enough so that it doesn't influence the shape of the response curve.

The primary of the transformer preceding the grid where the signal is applied will act as a tuned trap, placing a dip in the alignment curve, as viewed on the scope, unless it is detuned sufficiently to throw it out of the video i-f pass-band. To detune this transformer, merely remove the tube which feeds the primary winding, as indicated in Steps 6, 7, and 8. ***Be sure to replace the tube after the stage is aligned.*** Another method of detuning is to slip an iron core slug in the primary side of the i-f transformer. The audio take-off trap trimmer C17 should be aligned for minimum 21.8 mc audio i-f frequency in the video i-f amplifier, as in Step 8 of Video I-F Alignment.

The Contrast Control should be set a −4 volts bias measured at the junction of R6, R8, and C14 with a vacuum tube voltmeter. The sweep generator should then be set to give ¾ volt peak, as measured on a calibrated oscilloscope between the junction of L16 and C27 and chassis. When making the video i-f alignment, the 26.3 mc marker should be at 50% or slightly lower than 50% for maximum detail. The 26.3 mc marker should never be more than 50% of the distance from the base line to the flat portion of the curve. Prior to the alignment of transformer T11 in Step (10), turn the carrier set trimmer, C12, to its minimum capacity.

The response curves shown in Figure 14 are obtained on an oscilloscope connected at the junction of L16 and C27. Use a 10,000 ohm resistor in series with the input lead to the oscilloscope for isolation purposes. Set the Channel Selector switch to receive Channel #4.

If the response is peaked on low frequency end of response curve and cannot be brought down to the proper relationship with high frequency end by means of the tuning slug, change the 6AU6 tube into which the signal is fed. It may be that the 6AU6 has an above average plate capacity which would cause this trouble.

For i-f alignment of "R" or "T" chassis receivers, it is necessary to apply a −4 volts battery to the 1st and 2nd video i-f tubes at the junction of R6 and R11. If a battery is not available, C42 may be shunted with a .1 mmf. capacitor and the contrast control adjusted to produce −4 volts, as measured with a vacuum voltmeter at the junction of R6 and R11.

VIDEO I-F ALIGNMENT CHART (See Fig. 30, Page 19)

Step No.	Signal Gen. Freq.	Sweep Generator Frequency	Signal Input	Connect Oscilloscope to Chassis and Junction of	Channel Switch	Adjust	Remarks
6	22.9 MC 26.3 MC	20-30 MC	Grid (Pin 1) of V5 through 500 mmf.			Adjust primary and secondary slugs of T14 for max. amplitude and flat response with markers as shown in Fig. 14(A).	Contrast control set at −4 volts bias. Steps 6 through 11. Bias measured with VTVM at junction of R6, C14, and R8. Remove tube V4.
7	22.9 MC 25.55 MC 26.3 MC	20-30 MC	Grid (Pin 1) of V4 through 500 mmf.			Adjust slug of T13 for max. amplitude and flat response with markers as shown in Fig. 14(B).	Remove tube V3 and replace V4.
8	21.8 MC with 400 cycle modulation		Grid (Pin 1) of V3 through 500 mmf.	Junction L16 and C27 through 10K-ohm resistor.	Channel #4	Adjust C17 for min. 400 cycles amplitude.	Replace V3 and remove V2.
9	22.9 MC 23.4 MC 25.55 MC 26.3 MC	20-30 MC	Grid (Pin 1) of V3 through 500 mmf.			Adjust slug of T12 for max. amplitude and flat response with markers as shown in Fig. 14(C).	
10	22.9 MC 23.4 MC 25.55 MC 26.3 MC	20-30 MC	Grid (Pin 7) of V2 through 500 mmf.			Adjust slug of T11 for max. amplitude and flat response with markers as shown in Fig. 14(C).	Turn carrier set trimmer C12 to min. capacity. Replace tube V2.
11	22.9 MC 23.4 MC 25.55 MC 26.3 MC	20-30 MC	Grid (Pin 7) of V2 through 500 mmf.			Adjust C12 until 26.3 MC marker is at a point 50% along i-f slope. 25.55 and 22.9 MC should be as shown in Fig. 14(D).	

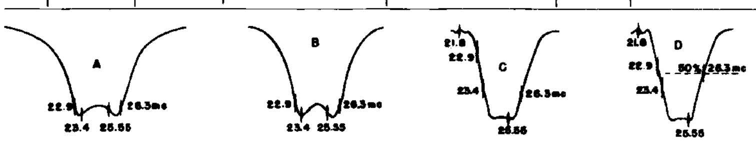


Fig. 14. Video I-F Curves

3. R-F ALIGNMENT

GENERAL—The r-f coil and switch 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.

The minimum requirements for correct r-f alignment are (1) to provide the correct bandwidth, (2) for the response curve to be centered within the limit frequencies shown for each of the individual channels as in Figure 17, and (3) for the response curve to be adjusted for maximum amplitude consistent with correct bandwidth. To provide these minimum requirements, the r-f coils are overcoupled and loaded with resistance. Tuning of the coils is affected by changing inductances of the individual coils. Except for the Channel #2 and the Channel #3 coils, the coupling is fixed by the design of the coil and switch wafers.

The physical assembly of the coils in the band switch locates the r-f amplifier plate coil at the rear of the switch assembly, while the oscillator coil is switched by the front wafer. Three different types of coils are used. These are shown in Figure 15. On all channels except Channels #7 through #13, the r-f, converter, and oscillator coils are wound on a single coil form. Mutual inductance between turns of the converter and r-f coils provides the desired coupling. On Channel #2, the converter and r-f coils are spaced for loose coupling and the mutual inductance is increased by inserting a tertiary link winding between the coils. By adjusting the link, the mutual inductance can be changed and better image rejection of the FM band (88 to 108 mc) signals results. Tuning of the link circuit is accomplished by adjusting two movable copper rings. The Channel #3 plate and grid coils are overcoupled by spacing of the two coils in relationship to each other and are tuned by spacing of the component turns. The Channels #4 through #6 transformers are wound so that the converter and r-f coils are wound as a continuous winding, the a-c ground return for the two coils being a tapped turn on this winding. This tight spacing affords a good uniformity in mutual coupling. The tuning is accomplished by moving turns. The upper six channels, #7 through #13, are tuned by four sets of coils. Each converter and r-f coil is overcoupled to give adequate bandpass so that two channels may be covered by each set of coils except Channel #7. Instead of magnetically coupling the r-f and converter coils in relation to each other, they are physically located on the channel switch so that the only coupling is afforded by the common a-c ground return of each coil. This ground return is made through a special shaped metal wafer on the channel switch.

The input sweep signal is applied to the antenna terminal board at the r-f unit. Disconnect the 300-ohm cable between the antenna terminal board and the r-f amplifier input. To prevent distortion of the r-f response curve by standing waves, the unbalanced shielded cable of the signal generator should be terminated as shown in Figure 16. The resistors used should be non-inductive. The marker signal generator may be loosely coupled through a small capacitor to the same point of input as the sweep generator.

The output r-f response curve is taken off at the junction of R5 and C10 through a 10,000 ohm resistor. Disconnect C10. The Contrast control is set for a minimum at all r-f alignments.

For Channels #2 and #3, the r-f coils should be aligned to give approximately the curve shown in Figure 17-A and 17-B. The "P" marker represents the video carrier marker, while the "S" marker is the sound marker. The frequency of these markers is indicated for each step of the alignment procedure. Adjustment of the bandwidth is made by moving the plate coil closer to the grid coil or vice-versa. On Channel #2 the sliding of the copper rings will give both the required bandwidth and the frequency adjustment. Spread or squeeze turns in plate and grid coil to change frequency. Spreading turns results in a raising of the frequency; while squeezing turns lowers the frequency.

For Channels #4 through #6, the coupling is fixed by the tight coupling between the primary and secondary turns. However, this can be controlled to a certain degree along with the frequency by either spreading or squeezing the end turns of the combination converter and r-f coil. On the upper four coil assemblies covering the Channels #7 through #13, the coupling cannot be changed as it is fixed by the common ground wafer located between the r-f and converter coil switching wafer. This ground wafer is cut to give the proper amount of coupling at the time of manufacture. Tuning of these upper frequency coils is affected by the brass adjustment screws which form a shorted turn in the coil. The further the screw is introduced into the coil field, the higher will be the frequency and vice-versa.

The variable capacitors C5 and C6 are used to compensate for the slight differences in tube capacities which affect tuning when it is necessary to change the r-f or converter tube in the field. These trimmers are adjusted for Channel #6, as indicated in the Alignment Table, and then are not readjusted until a new tube is substituted for either V1 or V2.

Note: When making r-f alignment, the tuning control should be set so that the oscillator frequency is approximately correct. This may be checked by tuning in the sound frequency for that particular channel for maximum audio output. A 200 to 300 ohm resistor should be shunted across the primary of T11 or R103. This is done to prevent the oscillator voltage from upsetting the r-f alignment curve.

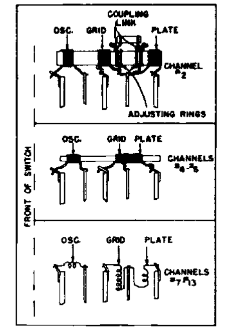


Fig. 15. R-F Coil Assembly

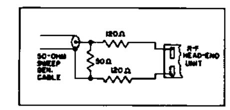


Fig. 16. Sweep Generator Termination

R-F ALIGNMENT CHART (See Fig. 30, Page 19)

Step No.	Signal Gen. Freq.	Sweep Generator Frequency	Signal Input	Connect Oscilloscope to Chassis and Junction of	Channel Switch	Adjust	Remarks
12	83.25 MC and 87.75 MC	85.5 MC with 15 MC sweep			Channel #6	C5 and C6 for max. amplitude and flat response with correct markers	
13	77.25 MC and 81.75 MC	79.5 MC with 15 MC sweep			Channel #5	Check and adjust inductance if necessary for max. amplitude and flat response with correct markers.	
14	67.25 MC and 71.75 MC	69.5 MC with 15 MC sweep	Primary of antenna input transformer T1	Junction R5 and C10 through 10K-ohm resistor. Disconnect C10.	Channel #4		See Fig. 17 (E) for resultant alignment curve.
15	61.25 MC and 67.75 MC	63.5 MC with 15 MC sweep			Channel #3		
16	55.25 MC and 59.75 MC	57.5 MC with 15 MC sweep			Channel #2		Adjust inductance by moving copper rings. See Fig. 17(A) for resultant alignment curve.
17	175.25 MC and 179.75 MC	177.5 MC with 15 MC sweep			Channel #7		

R-F ALIGNMENT CHART (CONT'D)

Step No.	Signal Gen. Freq.	Sweep Generator Frequency	Signal Input	Connect Oscilloscope to Chassis and Junction of	Channel Switch	Adjust	Remarks
18	181.25 MC and 191.75 MC	186.5 MC with 25 MC sweep			Channels #8-#9		
19	193.25 MC and 203.75 MC	198.5 MC with 25 MC sweep	Primary of antenna input transformer T1	R5 and C10 through 10K-ohm resistor. Disconnect C10.	Channels #10-#11	Check and adjust inductance if necessary for max. amplitude and flat response with correct markers.	Adjust inductance by brass screws in coils. See Fig. 17(C) for resultant curve.
20	205.25 MC and 215.75 MC	210.5 MC with 25 MC sweep			Channels #12-#13		

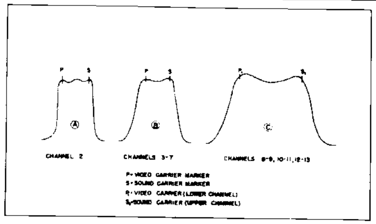


Fig. 17.

R-F Alignment Curves

4. OSCILLATOR ADJUSTMENT

GENERAL—The oscillator coils for Channels #2 through #7 are adjusted so that the Tuning control, C80, will tune the station at the mid-rotation position for each of these channels. Since the other remaining six channels, #8 through #13, are combined so as to be covered by only three switching positions, the oscillator coils are adjusted so that the Tuning control will tune in the two channels assigned each switch position at two points equidistant from the two extremes of its rotation. With the Tuning control set to its mid-position, the oscillator coil is adjusted to give a maximum output when a modulated r-f signal at the test frequency specified is fed into the antenna terminals. The oscillator coils are adjusted by spreading turns to raise frequency or compressing turns to lower frequency.

Apply the signal generator with tone modulation to the antenna input terminals and set the generator to the frequency specified in the Alignment Table for each switch position. The signal generator must be very accurately calibrated. This can be done by beating its output against a known channel carrier, or use a station operating on the channel and then tune in the sound.

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

The oscillator coil is located on the coil form or switch assembly nearest to the front of the r-f unit. This is shown in Figures 10, 11 and 15.

OSCILLATOR ADJUSTMENT CHART (See Fig. 30, Page 19)

Step No.	Signal Gen. Freq	Signal Input	Channel Switch	Adjust	Remarks
21	59.75 MC with tone modulation		Channel #2	Squeeze or spread turns of osc. coil of T2.	
22	65.75 MC with tone modulation		Channel #3	Squeeze or spread turns of osc. coil of T3.	
23	71.75 MC with tone modulation		Channel #4	Squeeze or spread turns of osc. coil of T4.	
24	81.75 MC with tone modulation	Antenna dipole terminals	Channel #5	Squeeze or spread turns of osc. coil of T5.	Volume control at mid-position. Set Tuning control at mid-position of travel. Use sound output as indicator.
25	87.75 MC with tone modulation		Channel #6	Squeeze or spread turns of osc. coil of T6.	
26	179.75 MC with tone modulation		Channel #7	Squeeze or spread turns of osc. coil of L10.	
27	188.75 MC with tone modulation		Channels #8-#9	Squeeze or spread turns of osc. coil of L11.	
28	200.75 MC with tone modulation		Channels #10-#11	Squeeze or spread turns of osc. coil of L12.	
29	212.75 MC with tone modulation		Channels #12-#13	Squeeze or spread turns of osc. coil of L13.	

INSTALLATION AND SERVICE ADJUSTMENTS

NOTE: The unpacking, set-up instructions, antenna installation, and installation adjustments for the Model 820 receiver are covered in the INSTALLATION INSTRUCTIONS, ER-A-820. Some of this data is repeated in this publication.

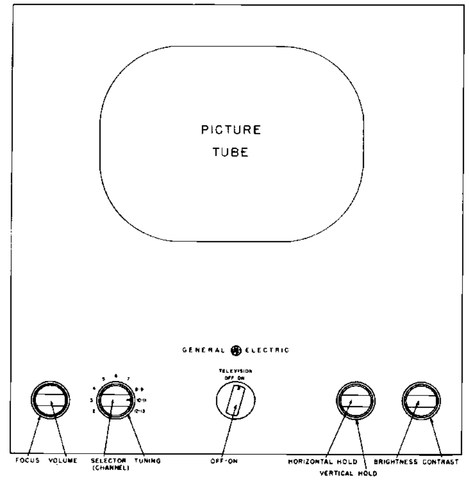


Fig. 18. Knob Control Location

RECEIVER CONTROLS

The radio broadcast receiver controls and operating procedures are conventional. These are explained separately in publication ER-I-820 which may be found packed with each Model 820 instrument.

There are two sets of controls used for adjusting the picture details for television operation. These are the normal Television Front Panel Operating Controls, Figure 18, and the Preset Adjustment Controls, Figure 20, located at the rear of the television chassis.

TELEVISION OPERATING CONTROLS

All the operating controls necessary to tune a television program are arranged on the front panel of the cabinet behind the left-hand cabinet door. The control knobs are grouped beneath the television picture tube, as shown in Figure 18. Four of the five controls are dual, making a total of nine adjustment knobs. They are as follows:

VOLUME—The center or smaller knob at the extreme left is the volume control knob and adjusts the television sound to the required listening level. Volume is at a minimum in the counter-clockwise position and increases as the control knob is advanced to maximum in the clockwise position.

FOCUS—The outside or larger knob at the left is the focus control. This control focuses the received picture on the picture tube screen. It is merely necessary to adjust this control until the picture is no longer blurred, but becomes sharp in detail.

CHANNEL SELECTOR—The center knob of the second control from the left permits selection of the desired television channel. The selector positions numbered No. 2 through No. 13 correspond to the channels assigned to television stations as they appear in the newspaper program schedule. The channel selector knob is turned so that its index is adjacent to the channel number desired.

NOTE—The three extreme clockwise positions are dual in that they will preset the tuned circuits for either of the two channels indicated. This selection of the channel adjusts the tuning circuits approximately. For fine adjustment the television tuning control, described in a following paragraph, must be properly adjusted.

The channel selector positions assigned station channel numbers, and their frequency coverage are given below.

SELECTOR POSITION	CHANNEL	FREQUENCY BAND
2	2	54– 60 MC
3	3	60– 66 MC
4	4	66– 72 MC
5	5	76– 82 MC
6	6	82– 88 MC
7	7	174–180 MC
8–9	8	180–186 MC
8–9	9	186–192 MC
10–11	10	192–198 MC
10–11	11	198–204 MC
12–13	12	204–210 MC
12–13	13	210–216 MC

TUNING—The outside or larger knob of the second control from the left is the fine adjustment for tuning your receiver to the television frequency being received. Correct adjustment is essential for optimum picture detail and satisfactory sound reproduction. With the selector switch set to receive the desired channel and volume control advanced about half-way, the tuning control should be adjusted to that point where the sound reproduction of the program is the clearest. In general, this is the point where the program is the loudest and clearest and, also, extraneous noise is the least. This tuning point for sound automatically insures the proper adjustment of the vision channel for maximum picture detail. In many localities, three separate tuning points of maximum sound closely spaced may be heard. The center point of maximum is the correct tuning point. *Important: Never reduce sound volume by detuning your receiver. Reduce the volume control setting to the desired sound level.*

OFF-ON—The off-on power control knob is the single control located at the center of the television group. The control position is indicated by the knob index. Power is on when turned to the right and off when turned to the left.

HORIZONTAL HOLD—The smaller and center knob of the second dual control from the right "holds" or "locks in" the picture to remain stationary from left to right. It should be adjusted until the picture does not move sideways and is centered in the picture viewing frame.

VERTICAL HOLD—This is the larger and outside knob of the second dual control from the right. Its operation is similar to the horizontal hold control except that it controls the picture to lock-in vertically. The control should be adjusted until the picture no longer moves up or down.

CONTRAST—This is the larger and outside knob of the dual control on the extreme right and its adjustment is dependent upon the strength of the television program signals being received. For a weak signal, it may be necessary to operate the control nearly full clockwise, while for a strong local station the control may be set almost to fully counterclockwise or at minimum. As the name suggests, this control adjusts the black and white contrast between the various picture elements. Turn this control clockwise, after the horizontal and vertical hold controls have been correctly set, until the picture remains stationary on the screen, but not so high that the gradation between black and white is lost. Too much contrast is apparent when the picture is lacking in gradations between black and whites or the picture loses form. Too little contrast setting causes the picture to appear faded so that it seems composed entirely of grays. A properly adjusted picture is shown in the photo for a Normal Picture in the accompanying photo illustrations for Picture Defects (Fig. 31).

BRILLIANCE—The center and smaller control knob of the dual control at the extreme right regulates the brilliance of the received picture. It should be adjusted simultaneously with the contrast control as too much brilliance will have the same effect as too little contrast, making it advisable to strike a proper balance between the contrast control and brilliance control settings.

MODEL 820

PRESET CONTROLS

The preset controls are located at the rear and top of the chassis (see Figure 20). All of the controls, except for the centering and tilt, are available through holes in the back cover without removing the cabinet back.

These preset controls are adjusted at the factory and should require very little adjustment upon installation and over very long periods of operation. Study the illustrations for maladjustments (Page 20 and 21) and their means of remedy. These adjustments must in most cases be made during the transmission of a picture, preferably a test pattern, as shown in the illustrations.

HORIZONTAL LINEARITY AND HOR. DRIVE—These controls are used to adjust the linearity. First, adjust the Hor. Drive control to minimum capacity setting (full counterclockwise). With Horizontal Size at approximately its correct setting, adjust the Horizontal Linearity until the picture shows correct horizontal proportions. A maladjustment shows up as an elongation or crowding of either side of the picture. This is best adjusted when a test pattern is being broadcasted by adjusting the control until the distance from the center of the test pattern to the left-hand and right-hand edges measures the same. If the Horizontal Linearity control will not give the proper linearity adjustment, turn the Hor. Drive control slightly clockwise and repeat adjustment or Hor. Linearity. Always leave the Hor. Drive control at maximum counterclockwise position consistent with good linearity. If there is any fold-over of pattern at center of picture which shows up as a lighter area about ¼ to ½ inch wide running vertically on screen, the Hor. Drive control should be turned clockwise until it disappears.

HORIZONTAL SIZE—This control changes the horizontal size of the picture. When adjusted to the recommended width, the picture should extend for approximately ⅛ inch beyond the edge of the picture tube mask so that the left and right edges of the picture are not visible. In the picture showing incorrect adjustments of the width control, it will be noted that this condition makes the inner circle of the test pattern an egg shape instead of a perfect circle.

VERTICAL LINEARITY—This control gives the proper vertical proportions to the picture. Improper adjustment will either crowd the lower or upper half of the picture, as shown in the illustration. This is best adjusted on the test pattern by adjusting the vertical linearity control until the distance from the center of the test pattern to the top or bottom edges measures the same. The adjustment of this control will alter the height of the picture slightly so as to necessitate the adjustment of the vertical size control simultaneously with it.

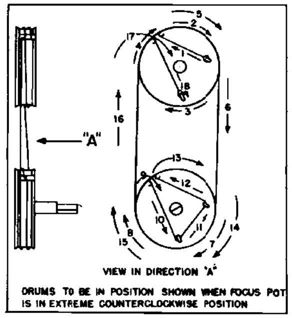


Fig. 19. Focus Control Stringing

VERTICAL SIZE—This control changes the picture height. When adjusted to the correct height, the picture should extend for approximately ⅛ inch beyond the edge of the picture tube mask so that the top and bottom edges of the picture are not visible.

CENTERING—The picture centering assembly is shown in Figure 20 and is located on the neck of the picture tube between the focus coil and deflecting yoke. The assembly consists of a metal sleeve with two tabs at its end, adjacent to the deflecting yoke. Two centering magnet rings complete the assembly, one being the larger and movable ring over the sleeve while the smaller ring is soldered within and at the tab end of the sleeve. Normal range of deflection is attained when the flux fields of the two magnets are opposing (open ends of rings adjacent to each other). For an extended range in deflection, the larger and movable ring may be turned 180 degrees so that its open end is opposite that of the smaller ring and the ring fluxes are aiding.

With the large magnet ring set for normal deflection, rotate the assembly by its tabs to the point where proper direction of centering is obtained, and then slide the magnet ring closer, or further from, the fixed smaller ring until picture is centered. Should the normal deflection range be inadequate to bring the picture to center, rotate the larger and movable ring 180 degrees to produce aiding magnetic fluxes and extended deflection range. Center picture by rotating assembly and sliding movable ring as given for normal setting of magnet rings.

TILT—If the picture is slightly tilted and does not square with the picture tube mask, loosen the wing nut of the deflection yoke clamping screw and rotate deflection yoke in its clamp bracket until picture is squared within the viewing mask. Tighten wing nut to hold deflecting yoke.

HORIZONTAL FREQUENCY CONTROL—This is a coarse adjustment that supplements the Horizontal Hold control on the front panel. It should be adjusted to the position which will allow the Horizontal Hold control on the front panel to go through its proper adjustment at about its mid-position.

T16 ADJUSTMENT.

The core of the blocking oscillator transformer T16 changes the frequency of this circuit. Its adjustment is made as follows: Connect a VTVM to measure the voltage from the junction of R74 and potentiometer R73 to ground. Tune the receiver to any suitable television signal. Set the front panel Horizontal Hold control, R45, to the mid-point of its resistance range, then adjust the iron core of the blocking oscillator transformer T16 and the setting of the Horizontal Frequency control trimmer C49 to bring the picture into horizontal synchronization and to develop -12 ± 1.0 volts across the contrast control, as measured by the VTVM. The iron core adjustment and the trimmer setting are interlocking and, therefore, it will be necessary to readjust each of these controls in turn to bring the picture in sync and, also, to obtain −12 volts. For later production receivers incorporating Automatic Gain Control (chasis marked "R*"); reference to, and measurement of the −12 volts delevoped by the blocking oscillator is not a part of T16 adjustment procedure. It is only necessary to set the front panel Horizontal Hold control to its mid-point range, the Horizontal Frequency control, C49, to an arbitrary setting of approximately one-half turn from maximum capacity, and adjust core of T16 to bring the picture into sync. The arbitrary setting of C49 is to allow enough range for future readjustment of sync directly from the chassis back apron.

The sync range should fall in the approximate center of the front panel Horizontal Hold control range, and it should be possible to throw the circuit out of sync by turning the control to either end of its range.

REPLACEMENT OF PICTURE TUBE.

To replace the picture tube it is necessary to remove the chassis from the cabinet. Remove the picture tube socket, the high-voltage anode cap. Remove the deflecting coil adjustment screws and nut plate (Figure 20) and set the focus coil and yoke assembly aside and upon the chassis. The television chassis must now be removed by taking out the four, self-tapping screws holding the chassis to the cabinet shelf, and disconnecting the cable and plug connections. With the television-receiver chassis removed, the picture tube can be handled without difficulty. With the one hand, support the tube at the neck and unhook the four springs of the tube harness. Install the new picture tube into place with its face against the picture frame opening in the cabinet and the tube bell resting at the bottom on the two wood cleats. With the one hand, support the tube at the neck and place the tube harness over and past neck of tube. Secure the four mounting springs in each corner bracket inside the cabinet and at the front (first secure the top springs), rotate the tube so that the anode connection and tube base key take the original position (Figure 20), then stretch the harness about the bell of the tube and secure the bottom springs.

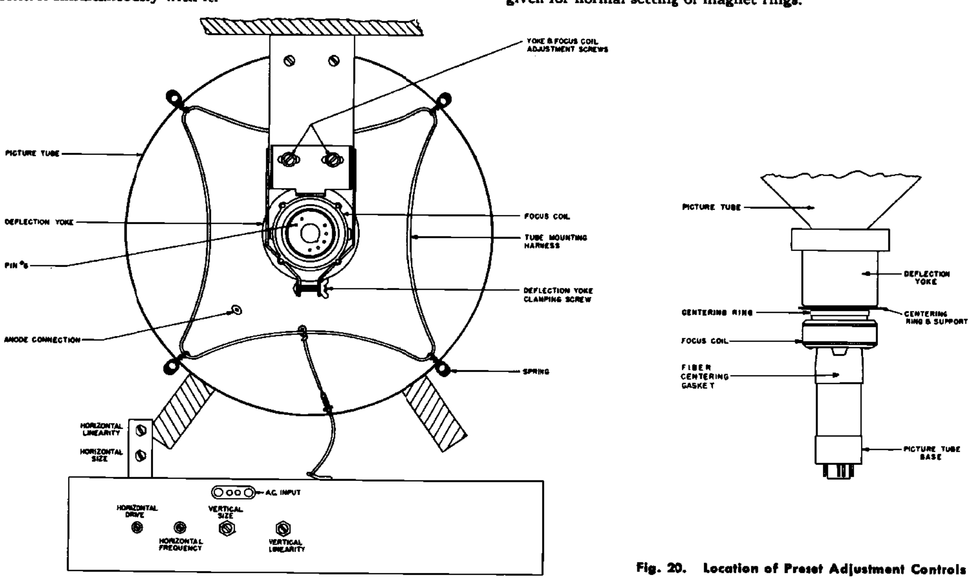


Fig. 20. Location of Preset Adjustment Controls

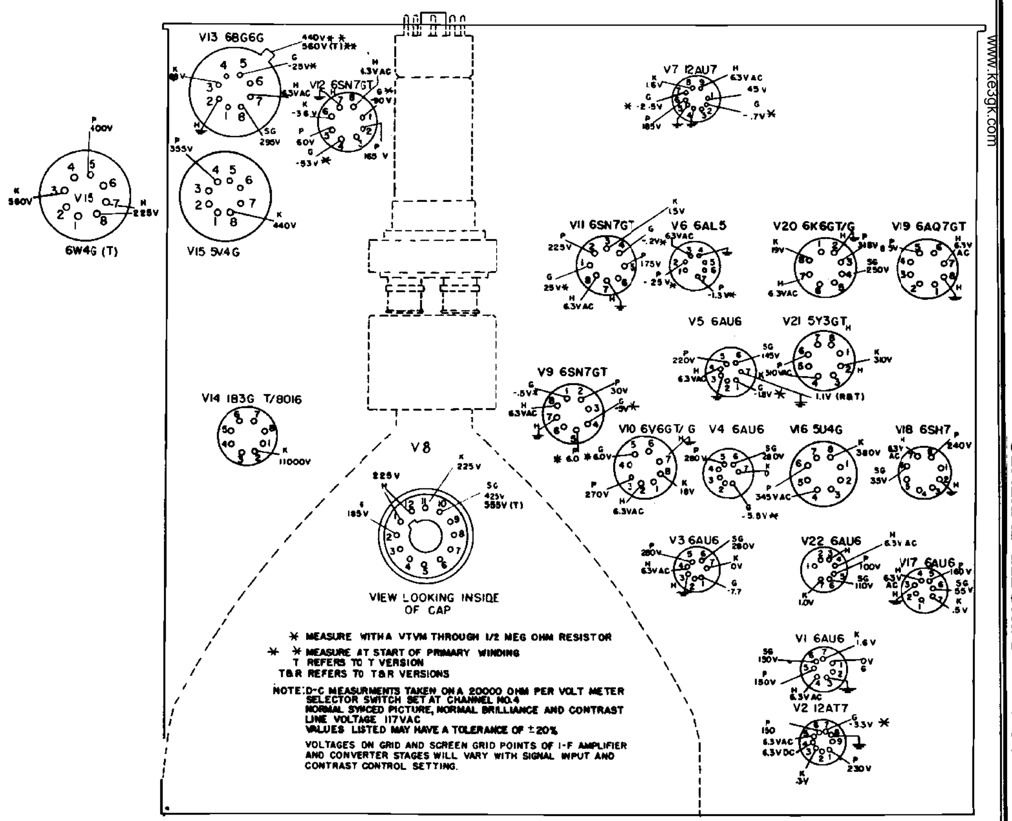


Fig. 21. Socket Voltage Diagram

The harness will now bear upon the picture tube bell, holding tube to the front of the cabinet. Make certain the tube anode connection will sufficiently clear the metal harness at the nearest point for adequate high voltage isolation. With the wing nut of the deflecting yoke clamping screw loosened, replace deflecting yoke and focus coil assembly over the picture tube neck and reassemble to the metal bracket at top of cabinet with the yoke and focus coil adjusting screws and nut plate. Push the complete focus coil and deflecting yoke assembly forward as far as it will go to bear against the bell of the picture tube. Tighten the wing nut to hold the deflecting coil in place.

Wipe the screen surface of the picture tube so as to remove fingermarks and dirt. *Precaution*—Do not handle, remove, or install a picture tube unless shatterproof goggles and heavy gloves are worn.

VENTILATION PRECAUTION.

Leave about a three-inch air space between the wall and receiver. This provides essential ventilation and permits better sound reproduction.

ANTENNA

The proper antenna and lead-in installation is of the utmost importance in order to obtain optimum signal strength with freedom from noise and clarity of picture. This problem is covered thoroughly in the Installation Instruction ER-A-820 and the booklet accompanying each G-E television antenna. This receiver is designed for use with a 300-ohm balanced antenna and lead-in system. Any one of the following G-E antennas with the G-E 300-ohm television transmission line may be used.

UKA-005 is a simple folded dipole which is easy to install and provides good reception from all twelve channels in medium and high signal strength areas.

UKR-005 makes use of the above antenna with a reflector added. This provides better attenuation if reflections are encountered and provides more signal gain and noise immunity.

UKR-007 is a stacked array antenna which gives considerable signal gain over the above antennas. This type gives uniform reception of most of the lower frequency channels and is used on fringe areas where the above antennas are not quite adequate.

UKT-002 is a high-frequency adapter kit to be used in conjunction with UKR-005 in those cases where both high and low frequency channel station signals are to be received from the same direction.

UKT-003 is a high-frequency adapter to be used in conjunction with UKR-007 to provide the highest gain on both channels.

UKR-008 is a combination of low- and high-band antenna and reflector.

UKR-009 is a combination of low- and high-band antenna and reflector, a type similar to UKR-008.

UKR-010 is a small indoor antenna which is only suitable where strong signals are available.

A lightning arrestor, REM-001, should be installed for each antenna installation made on the outside of the house. If the mast is metal, it should be grounded as directly as possible. Use for this purpose a metal strap or heavy cable.

CRITICAL LEAD DRESS AND COMPONENT REPLACEMENT

Since the operating frequencies are relatively high in a television receiver, it is essential that all components be replaced in exactly the same position they occupied when they left the factory, all leads be made as short as possible and exact replacement parts be used when service is required. Leads in wiring between components are usually critical as to placement against chassis or proximity to other components. Some of critical wiring precautions are listed below:

1. Discriminator (T19) Leads—Dress primary and secondary leads of the discriminator transformer close to chassis.

2. Head-end Unit—All leads which run between head-end unit coil assembly and front apron of chassis should be dressed as far as possible from the oscillator coils.

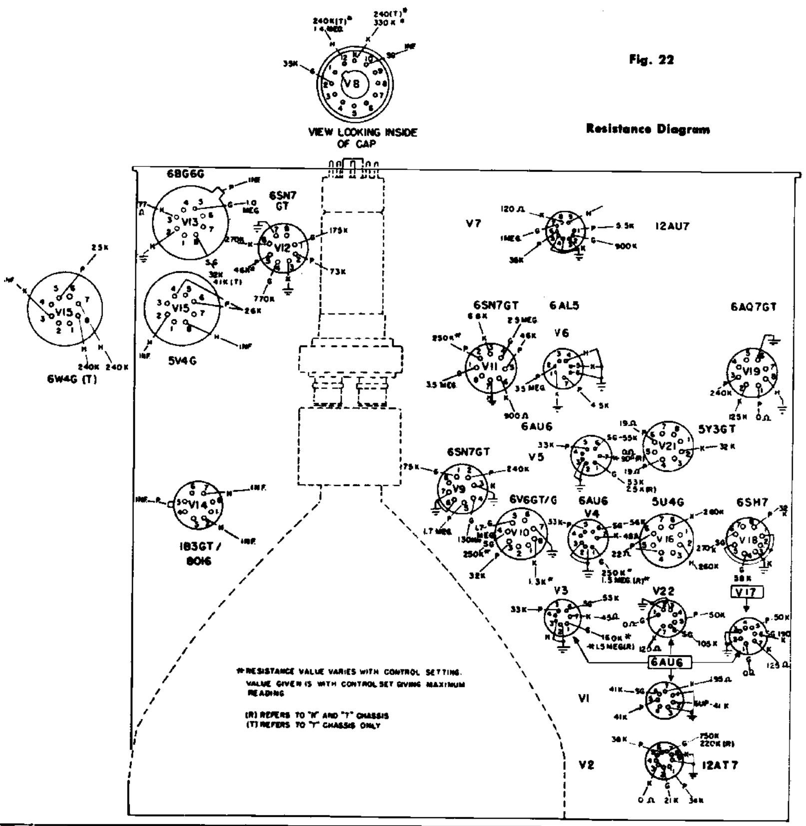


Fig. 22

Resistance Diagram

TROUBLE SHOOTING

The following is a listing of possible troubles and their cures. This is not intended as a comprehensive coverage but will merely serve as a guide in locating some of the more difficult problems that may be experienced. From time to time this information will be supplemented by a service bulletin.

SYMPTOM	CHECK	REMARKS
1. No raster on picture.	a. Waveform at output of T17. b. V14, 1B3GT rectifier tube. c. Filter circuit of V14. d. V8 picture tube. e. For open circuit in second of T17 and R62. f. V13, 6B6-G tube and sawtooth generator V12B, 6SN7GT by oscilloscope waveform measurement. g. Contact of high voltage anode capacitor to terminal of V8, picture tube. h. Brightness control, R5, for open circuit, or R32 or R43. i. V7-B, 12AU7 tube. j. For continuity of deflection yoke or shorted turns. k. For continuity of Horizontal Size control in T17 circuit.	b. If filament glows orange, high voltage is being generated. See step (d) f. If there is no waveform at T17. j. In case of anode voltage very low.
2. Raster normal. No picture or sound.	a. V2-A, 12AT7 oscillator tube. b. Oscillator coil resonates outside of channel. c. Antenna or lead-in. d. V2-B, 12AT7 converter tube or V1, 6AU6 r-f amplifier tube or V3, 6AU6 first video amplifier tube.	c. With contrast full-up if antenna system is working satisfactorily; noise pattern should be seen on screen and heard in speaker.
3. Picture normal. No sound.	a. Audio i-f amplifier. b. Speaker. c. V2-A, 12AT7 oscillator tube.	c. Oscillator off-frequency.
4. Raster normal. Sound normal. No picture.	a. 2nd, 3rd video i-f amplifier. b. V7, 12AU7 tube. c. Grid lead to picture tube.	
5. Normal picture and sound. No horizontal or vertical sync.	a. Signal waveform at grid (4) of V11A, 6SN7GT and grid (1) of V11B. b. V7A, 12AU7 plate circuit components.	
6. Picture normal. No vertical sync.	a. Grid (1) of V9, 6SN7GT. b. Frequency of vertical sweep generator (V9). c. Components of V9 circuit.	b. Free-running frequency slightly less than 60 cps.
7. Picture normal No horizontal sync.	a. Grid (4) of V12A, 6SN7GT for horizontal sync. b. V12A—6SN7GT tube and its circuit components. c. V12B—6SN7GT tube and circuit components.	a. Disconnect leads from R54 and C57 to examine this.
8. Raster edge not straight, keystoning.	a. Deflecting yoke.	
9. Picture jumpy.	a. Contrast control. b. For gassy or noisy V13, 6BG6G. c. Noisy tubes of sweep or sync circuits. d. Excess noise over antenna system.	a. Probably too high setting.
10. Poor picture detail.	a. For mismatch in antenna or lead-in system. b. For misalignment of i-f and r-f circuits. c. For defective video chokes. d. Focus control. e. For overloading video amplifier. f. Contrast control.	d. Should go through focus.
11. Hum modulation.	a. Filter capacitor, C102. b. Rectifier, SR1.	

MODEL 820

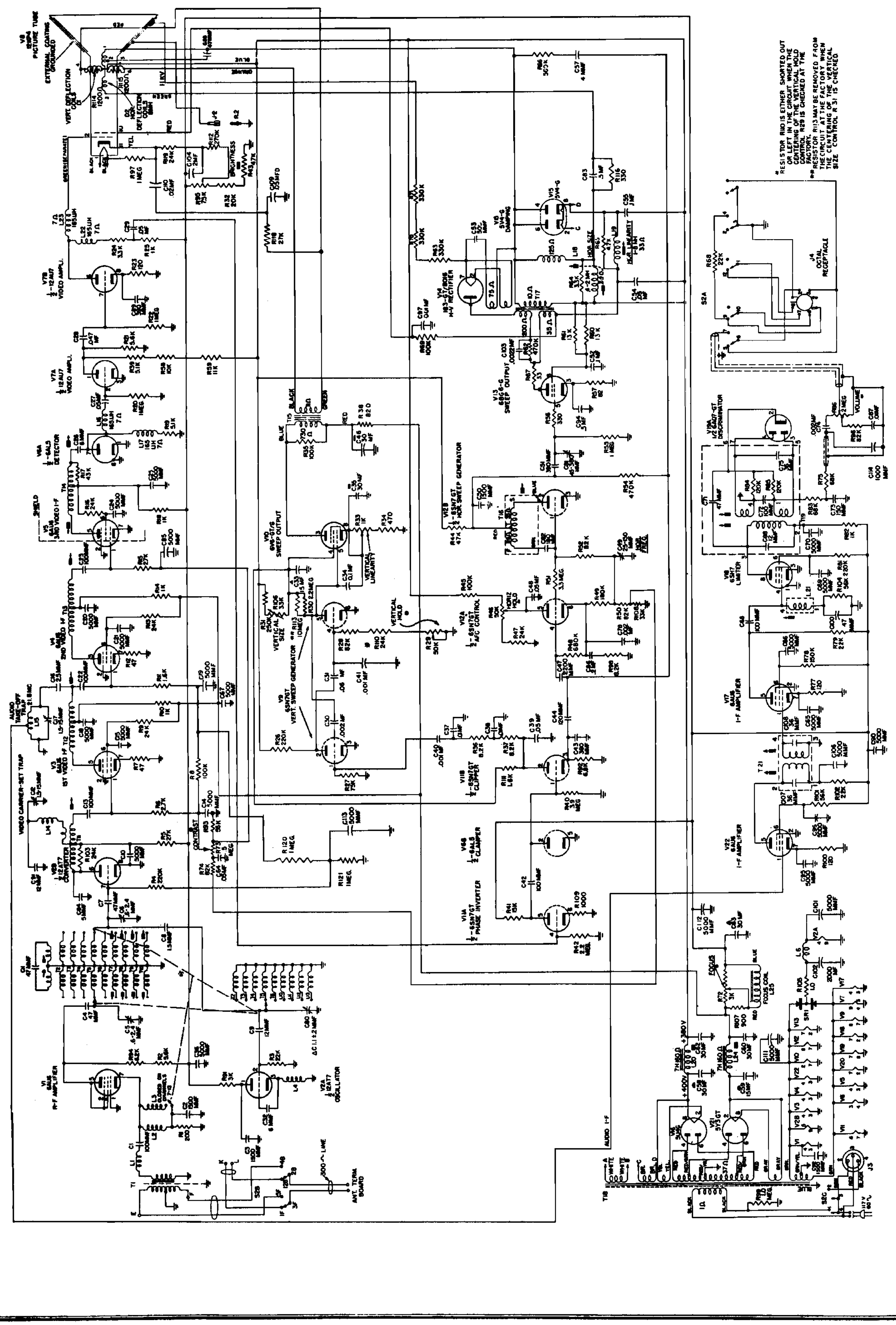


Fig. 23. Schematic Diagram 820, Television Chassis

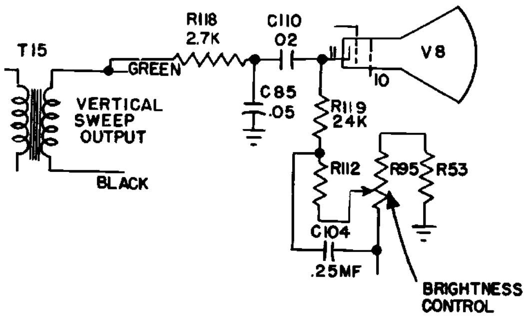


Fig. 24. Brightness Control Circuit

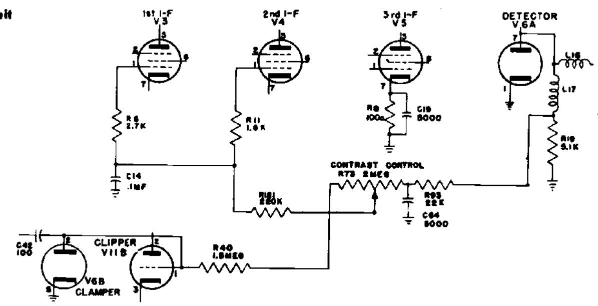


Fig. 25. AGC Diagram (R-Chassis)

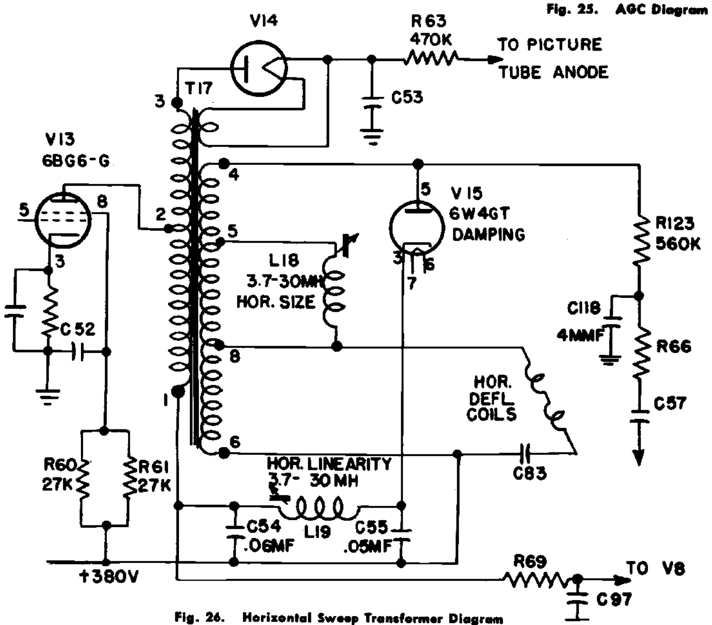


Fig. 26. Horizontal Sweep Transformer Diagram (T-Chassis)

PRODUCTION CHANGES

The following production changes have taken place up to the time that this service data was compiled.

1. AUDIO I-F REGENERATION.

Audio regeneration which causes a click in the speaker as the tuning control is tuned through the station can be eliminated by the use of a 5000 mmf. capacitor, RCW-3014, across the audio i-f B+ lead. This capacitor is connected between the B+ and ground terminals at the terminal board located between the limiter tube socket, V18, and the discriminator transformer, T19.

2. AUTOMATIC GAIN CONTROL (AGC). (FIG. 25)

This circuit is used to make for greater ease in operation, as it eliminates to a large extent the necessity of changing the Contrast control each time that a stronger or weaker station is selected. It always produces a picture even in the extreme minimum setting and does not tend to overload on strong signals when in the maximum contrast position.

Chassis using AGC will be identified by the letter "R" stamped in ink, located on the chassis front apron and adjacent to the Contrast-Brightness control shaft.

3. AUDIO FREQUENCY RESPONSE.

In order to extend the high frequency audio response and to reduce some of the "boom" base compensation, the following components should be removed:

C87, .01 mfd., paper capacitor (Cat. No. UCC-630)
C114, 1000 mmf., mica capacitor (Cat. No. UCU-052)
R96, 82,000 ohm resistor (Cat. No. URD-095)

4. REMOVAL OF RETRACE LINES.

This circuit is used to eliminate the need for readjustment o the Brightness or Contrast control to remove retrace lines from the background of the picture when a change in cameras or program material takes place at the transmitter. The circuit is shown in Fig. 24.

5. NEW HORIZONTAL SWEEP OUTPUT TRANSFORMER. (FIG. 25)

In late production receivers the Horizontal Sweep Output Transformer was changed from the molded coil and laminated iron core type to an open coil and ceramic iron type core. In this new type the danger of insulation breakdown is greatly reduced. The non-metallic core is composed of iron oxides embedded in a ceramic base. The core losses at the comparatively high scanning frequency of 15,750 cps are very low because the magnetic energy absorbed by the iron core is extremely small. The high voltage tertiary winding is wound over the primary and secondary winding, increasing its distance to the core, and further minimizes the probability of insulation breakdown and corona effects.

All receivers incorporating this new transformer will have a letter "T" stamped on the front apron of the chassis. This letter supersedes the "R" stamping (see paragraph 2).

5. DRESS OF PICTURE TUBE ANODE LEAD.

The hi-voltage lead connecting between the picture tube anode and the 1B3GT rectifier tube should not touch the aquadag coating of the picture tube. This tube should be so oriented that it does not pull this lead taut. In order to avoid any corona, this hi-voltage lead should be dressed away as far as possible from any surrounding object.

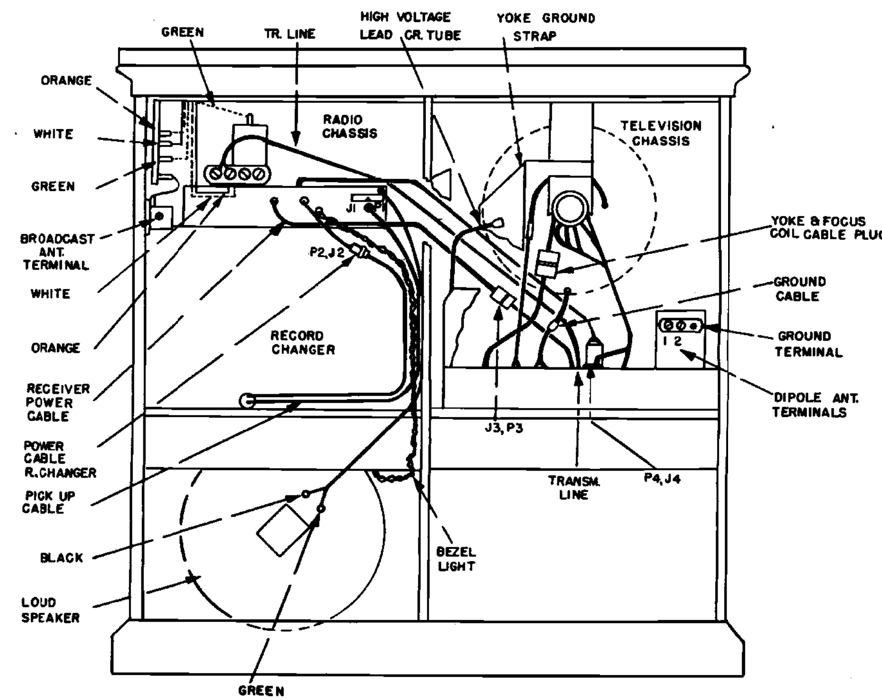


Fig. 27. Cabling Diagram, Model 820

MODEL 820

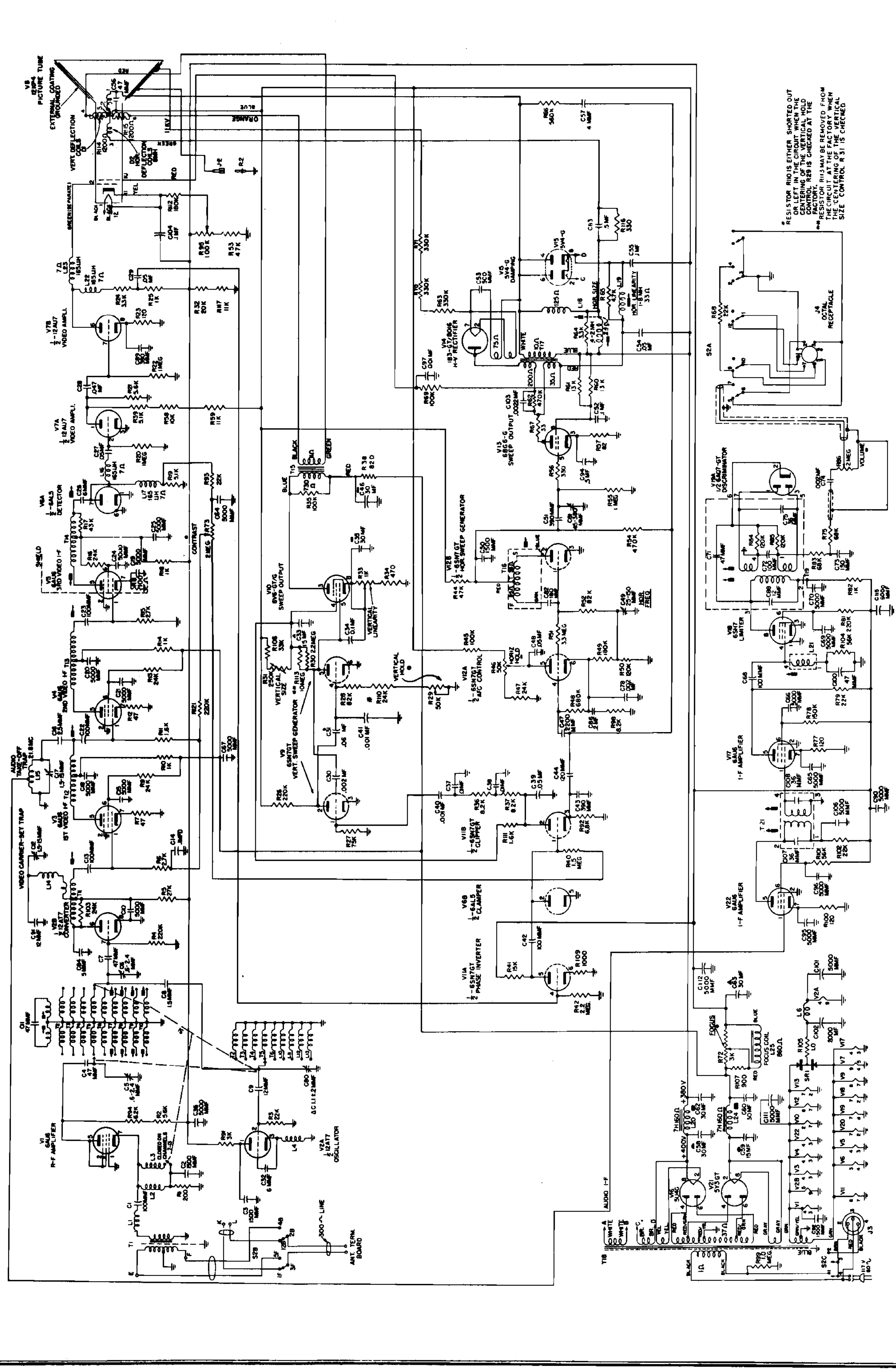


Fig. 28. Schematic Diagram 820, Television R-Version

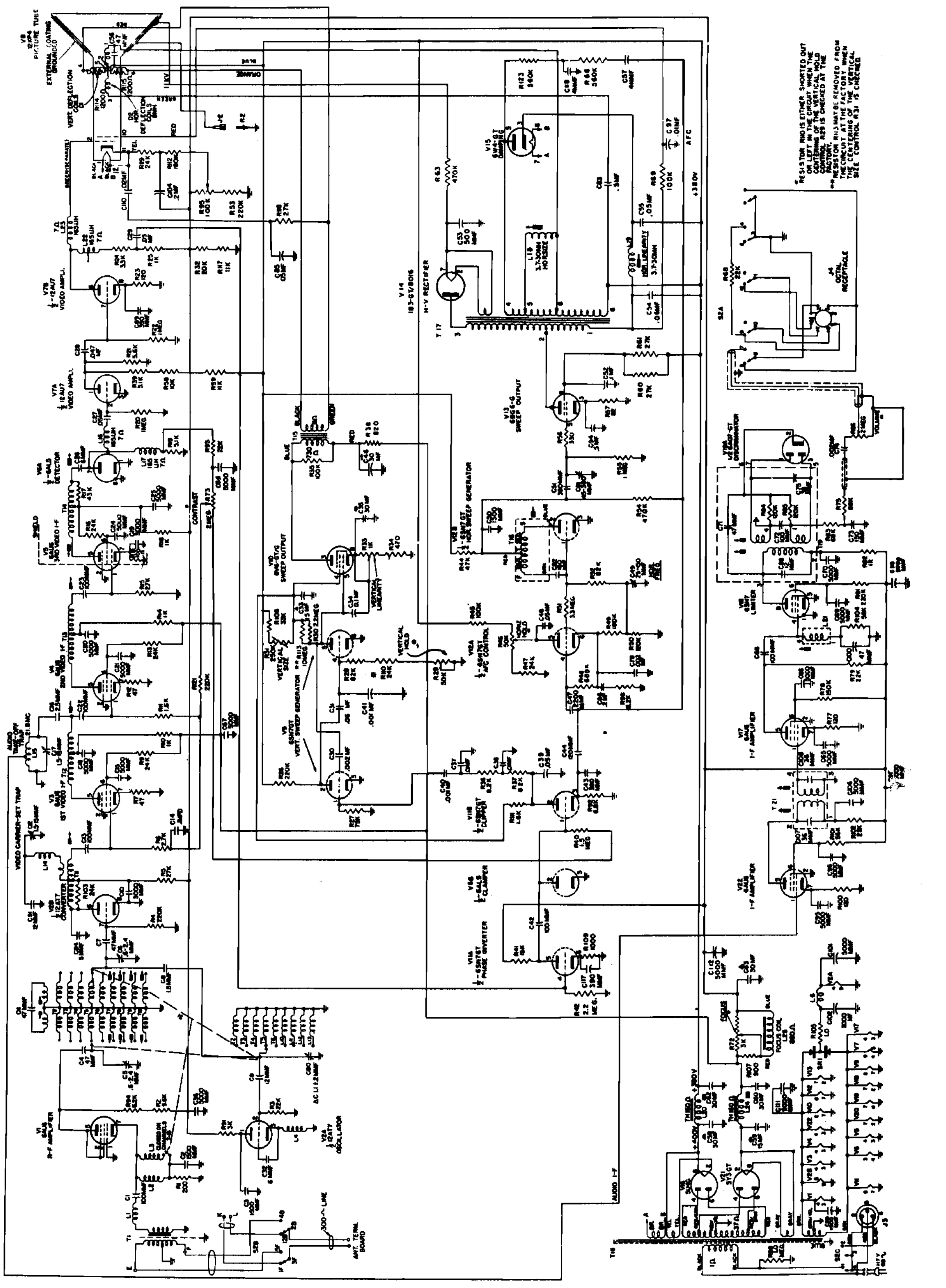
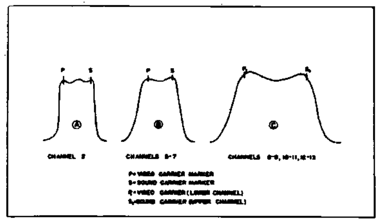
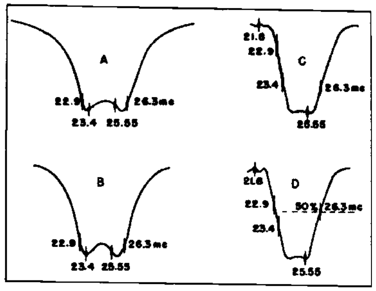


Fig. 29. Schematic Diagram 820, Television Chassis, T-Version

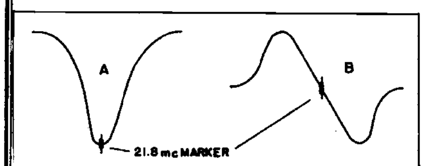
MODEL 820



R-F Alignment Curves



Video I-F Curves



Audio I-F Curves

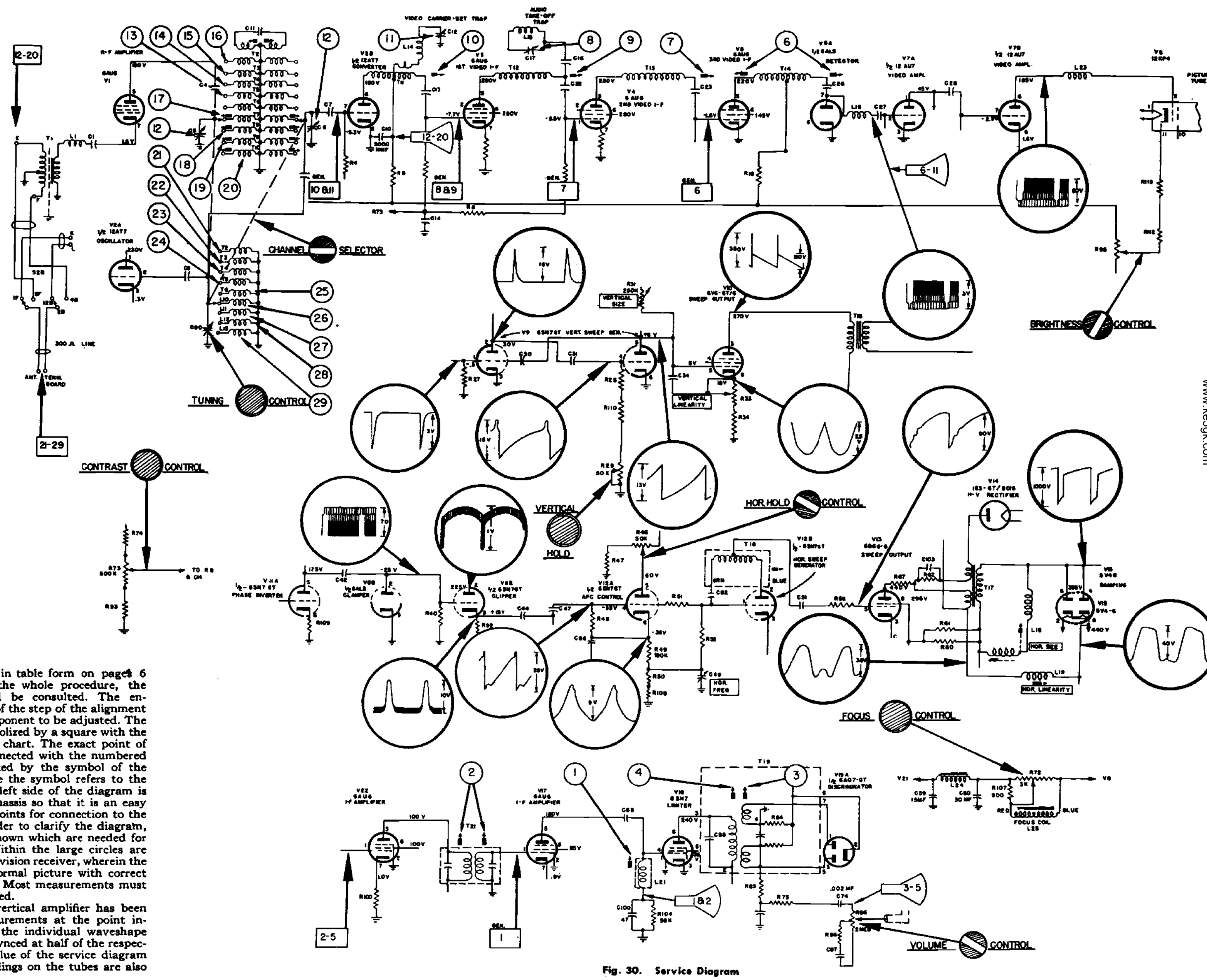


Fig. 30. Service Diagram

SERVICE DIAGRAM

The alignment procedure is shown in table form on pages 6 through 9. In order to accelerate the whole procedure, the service diagram (Figure 30) should be consulted. The encircled numbers indicate the number of the step of the alignment chart and the arrow points to the component to be adjusted. The generator feeding in the signal is symbolized by a square with the number of the step of the alignment chart. The exact point of feed-in is indicated by the arrow connected with the numbered square. The oscilloscope is represented by the symbol of the cathode ray tube. The number inside the symbol refers to the step of the alignment chart. On the left side of the diagram is shown the tube location inside the chassis so that it is an easy matter to locate quickly the correct points for connection to the generator and the oscilloscope. In order to clarify the diagram, only those parts of the circuits are shown which are needed for quick location of the test points. Within the large circles are shown the waveform of an average television 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.

The oscilloscope from which the vertical amplifier has been precalibrated is used to make measurements at the point indicated by the arrow connected to the individual waveshape within the circle. The oscilloscope is synced at half of the respective sweep speed. To increase the value of the service diagram for trouble shooting, the voltage readings on the tubes are also shown.

RADIO RECEIVER

GENERAL

The receiver is designed to operate either from built-in antenna or from an external AM antenna or FM dipole antenna. If an outside antenna is desired for better reception of distant standard wave stations, the antenna lead-in should be fastened under the antenna terminal screw. With the outdoor antenna, a ground wire should be connected to the "G" terminal on the right side of the television receiver back panel to a cold water pipe. In addition, a good type lightning arrester should be used to provide a safety measure against receiver damage from induced voltages upon the antenna system, particularly during electrical storms.

A section of 300-ohm transmission line connected from the On–Off switch in the television chassis is connected to the radio receiver antenna terminal board dipole terminals. This connection makes use of the television dipole antenna for FM reception when the television On–Off switch is at the OFF position.

On AM operation, the set operates as a five-tube set with the signal being fed directly into the converter grid. On FM, the set uses a reflex circuit, the Armstrong type discriminator, and a special limiter circuit.

In the reflex circuit, V2 (6BA6) Fig. 50 acts both as an r-f amplifier and as the 1st i-f amplifier. The r-f signal is fed into the grid of V2 through the secondary of T1. It is amplified by V2 and tuned at the converter grid by L4, C1B, and trimmer C6. In the converter, the r-f is changed to 10.7 mc i-f, and fed into the primary of T1 and again inserted into the grid of V2, which now acts as an i-f amplifier. The i-f signal is fed from the plate of V2 through choke L9 into the second i-f transformer.

L1 and C3 form a 10.7 mc wave trap to eliminate any i-f signal from the antenna circuit to prevent interference. C4 and L2 are designed to peak at 98 mc with strays to increase the FM r-f sensitivity. At the FM r-f frequencies, the capacitor C46 offers little series impedance to the r-f signal. L9 and C7 form a high-pass filter to pass the FM r-f signal into the converter grid and to shunt the FM i-f frequency into the primary of the second FM i-f transformer.

It should be noted that the FM oscillator coil L8 is a section of 300-ohm line shorted at one end to form a one-turn loop. C11 and C10 are tapped in at each side of the shorted end.

L13 and C27 in the cathode circuit of the limiter tube are series tuned to 10.7 mc. This effectively grounds the cathode for IF. The presence of R21, however, provides a highly degenerative condition for any amplitude modulation applied to the limiter grid. The cathode bias developed by R21 is approximately 85 volts, which makes it necessary to insert onto the grid of V4 from B+80 volts through R38.

ALIGNMENT

Two methods of alignment are given: (1) The regular meter alignment as previously used; and (2) Visual alignment, which allows for more precision in aligning the i-f transformers and particularly the discriminator alignment where it is necessary that the negative and positive half cycles of the output wave have equal amplitude and symmetry.

EQUIPMENT REQUIRED FOR METER ALIGNMENT

1. Test oscillator with tone modulation.
2. 20,000 ohm-per-volt voltmeter or microammeter.
3. A-c voltmeter, 2 volts.
4. .01 mfd. paper capacitor.
5. 200,000-ohm resistor, ½ watt.

NOTES IN CONNECTION WITH METER ALIGNMENT CHART

1. Use unmodulated signal.

2. Connect 20,000 ohm-per-volt meter from junction of R26 and R48 to chassis. Use 10-volt scale. Steps 4 and 5.

3. Connect 20,000 ohm-per-volt meter from junction of C40 and R38 to cathode of limiter (Pin 7 of V4) in series with a 200,000-ohm resistor. The resistor must be connected directly to the cathode pin to minimize capacity loading and to isolate the i-f signal from the meter. Keep signal generator down so that meter indicates not more than 1 volt (*5 microamps through 200,000 ohms*).

4. Use 400-cycle modulation.

5. Connect a standard output meter across speaker voice coil. Turn volume control full on. Keep signal generator output down so that output meter indicates not more than ½ watt output during alignment.

METER ALIGNMENT CHART

Step No.	Signal Generator Frequency	Signal Input Point	Band Switch	Dial Setting	Adjust	See Note
		AM-IF ALIGNMENT				
1	455 KC	6BE6 grid (Pin 7 of V1) through .01 mfd.	AM	550 KC	Primary and secondary cores of T5 for maximum	4, 5
2	455 KC		AM	550 KC	Primary and secondary cores of T2 for maximum	4, 5
		FM DISCRIMINATOR AND I-F ALIGNMENT				
3	10.7 MC	6BA6 grid (Pin 1 of V3)	FM	....	T6 secondary core for minimum	4, 5, 8
4	See Note 10		FM	....	Detune signal generator to point of maximum meter reading	1, 2, 10
5	See Note 10		FM	....	T6 primary for maximum	1, 2
6	Repeat Step 3.					
7	10.7 MC		FM	....	Primary and secondary cores of T4 for maximum	1, 3
8	10.7 MC	6BA6 grid (Pin 1 of V2)	FM	....	Primary and secondary cores of T3 for maximum	1, 3
9	10.7 MC	6BE6 grid (Pin 7 of V1)	FM	....	Primary and secondary cores of T1 for maximum	1, 3, 7
		AM-RF ALIGNMENT				
10	1620 KC	Inductively coupled	AM	C1 completely open	Adjust C9 for maximum	4, 5, 6
11	1500 KC		AM	For maximum output	Adjust C5 for maximum while rocking generator. Set pointer to 1500 KC or 161 mark on scale on backplate.	4, 5, 6
		FM-RF ALIGNMENT				
12	108 MC	Dipole terminals	FM	C1 completely open	Adjust C12 for maximum	1, 3, 9
13	108 MC		FM	For maximum output	Adjust C6 for maximum while rocking generator	1, 3, 9
14	10.7 MC		FM	....	Adjust C3 for minimum	1, 3

6. For alignment of the AM oscillator and R-F trimmer, the signal should be inductively coupled to the loop antenna by connecting a four-turn, six-inch diameter loop of bell wire across the signal generator terminals, and then locate the loop about one foot from the radio loop antenna. To prevent possible errors in peak readings, the position of the loop in respect to the radio loop should not be changed during any one set of adjustments.

7. To align the first FM i-f transformer T1, it is necessary to disconnect the copper strap from the band switch to Pin 7 of V1 (6BE6) by unsoldering the strap from the tube pin connection. Resolder the strap after T1 is aligned.

8. When tuning the secondary of T6 three minimum points will be obtained. The center one is the correct setting. As the transformer is tuned either side of 10.7 mc, the meter reading should increase.

9. Termination impedance of signal generator should be 300 ohms.

10. When detuning the signal generator in Step (4), two maximum meter readings will be obtained, one on each side of 10.7 mc. The primary of T6 should be aligned to maximum when the signal generator is tuned to the smaller of these two peaks.

VISUAL ALIGNMENT CHART

Step No.	Signal Generator Frequency	Signal Input Point	Band Switch	Dial Setting	Adjust	See Note
		AM-IF VISUAL ALIGNMENT				
1	455 KC ±20 KC at 60-cycle sweep rate	6BE6 grid (Pin 7 of V1) through .01 mfd.	AM	....	Two slugs of T5 for maximum amplitude and symmetry.	2
2	455 KC ±20 KC at 60-cycle sweep rate		AM	....	Two slugs of T2 for maximum amplitude and symmetry.	2
		FM-IF AND DISCRIMINATOR VISUAL ALIGNMENT				
3	10.7 MC ±300 KC at 60-cycle rate	6BA6 grid (Pin 1 of V2)	FM	....	Two slugs of T4 for maximum amplitude of wave and symmetry.	1
4			FM	....	Two slugs of T3 for maximum amplitude.	1
5		6BE6 grid (Pin 7 of V1). (See Note 7.)	FM	....	Tuning slugs of T1 for maximum amplitude and symmetry of wave.	1, 6
6		6BA6 grid (Pin 1 of V3)	FM	....	Primary of T6 for maximum amplitude.	2
7			FM	....	Secondary of T6 for vertical symmetry with respect to the midpoint horizontal trace.	2
8			FM	....	Primary of T6 for straightest line between positive and negative peaks.	2
9	Recheck Step 7					
		AM-RF VISUAL ALIGNMENT				
10	1620 KC	Inductively coupled	AM	C1 completely open •	C9 for steepest slope of straight-line trace on scope.	2, 3, 7
11	1500 KC ±20 KC at 60 cps sweep rate		AM	For maximum output	C5 for maximum amplitude. Set pointer to 1500 KC or 161 mark on scale on backplate.	2, 3, 7
		FM-RF VISUAL ALIGNMENT				
12	108 MC	Dipole terminals	FM	C1 completely open	C12 for steepest slope of straight line trace on scope.	1, 3, 5
13	98 MC ±300 KC at 60 cps sweep rate		FM	For maximum output	C6 for maximum amplitude and minimum distortion.	1, 3
14	10.7 MC ±300 KC at 60 cps rate		FM	....	C3 for minimum amplitude.	

EQUIPMENT REQUIRED FOR VISUAL ALIGNMENT

1. General Electric YGS-3 AM and FM signal generator, or equivalent.
2. General Electric CRO-5A oscilloscope, or equivalent.
3. 200,000 ohm, ½ watt resistor.
4. 20,000 ohm-per-volt meter.
5. .01 mfd. paper capacitor.
6. 8 to 10 mfd. Pyranol capacitor.

NOTES IN CONNECTION WITH VISUAL ALIGNMENT CHART

1. Connect vertical plates of scope to the limiter cathode (Pins 2 or 7 of V4) through a 200,000-ohm resistor and chassis. Connect an 8 to 10 mfd. pyranol capacitor between junction of C40 and R38 and ground.

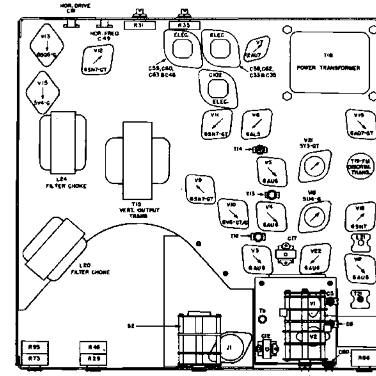
2. Connect vertical plates of scope at junction of R18 and C28 and chassis.

3. Use a 60-cycle, amplitude-modulated signal.

4. In some cases tuning of the converter grid will cause "pulling" of the oscillator and will change the oscillator frequency. After centering the response curve, if peaking of C5 or C6 causes the curve to move off the scope screen, it is necessary to recalibrate the oscillator as in Steps 10 and 12.

5. The termination impedance of the signal generator 300 ohms to properly match the input impedance of this receiver.

6. To align the 1st i-f transformer T1, it is necessary to disconnect the copper strap from Pin 7 of V1 (6BE6) by unsoldering it. Resolder after alignment.



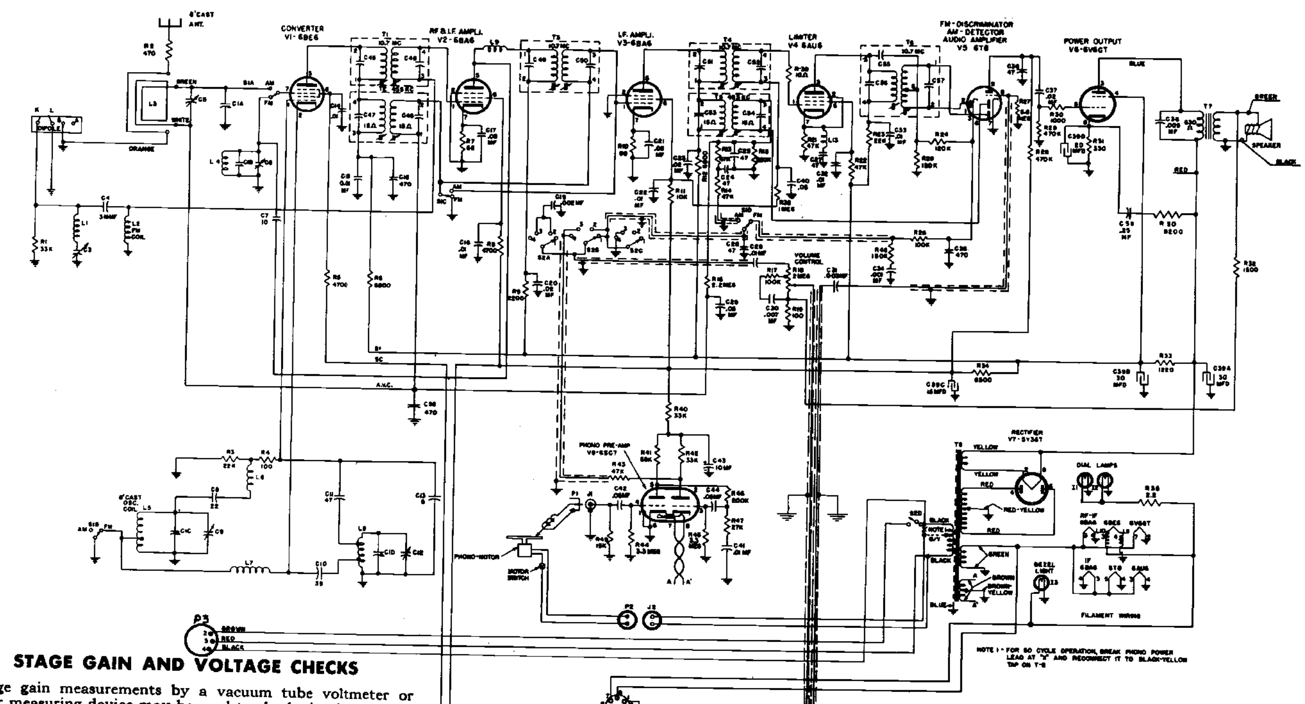
Tube Location

7. For alignment of the AM oscillator and r-f trimmers, the signal should be inductively coupled to the loop antenna by connecting a four-turn six-inch diameter loop of bell wire across the signal generator terminals, and then locate this loop about one foot from the radio loop antenna. To prevent possible errors in peak readings, the position of the loop with respect to the radio loop should not be changed during any one set of adjustments.

8. When using a sweep signal, it is necessary to apply the same sweep voltage to the horizontal plates of the scope as is used to sweep the r-f frequency. It may be necessary to use an RC phase shift network. This may be done by putting a .005 mfd. capacitor across the horizontal plate terminals of the scope and a ½-megohm potentiometer in series with the high side of the horizontal sweep voltage line. The potentiometer should be adjusted for a single trace.

ALIGNMENT DIAGRAM

This diagram is similar to the Television Alignment Diagram. It should be used in conjunction with the alignment chart. The encircled numbers indicate the number of the step of the alignment chart and the arrow points to the component to be adjusted. The generator is symbolized by a square with a number of the step of the alignment procedure. The exact point of feed-in is indicated by the arrow. The amplified signal of the generator input can be fed into a meter or an oscilloscope, the symbol of which contains the step-number. Two alignment charts are provided—one for use with a meter as indicating device, and the other with an oscilloscope as indicator. The single-framed numbers refer to the meter alignment, while the double-framed numbers refer to the visual alignment with an oscilloscope. In all cases where the adjustment points and generator feed-in coincide, the numbers are single framed with heavy lines.



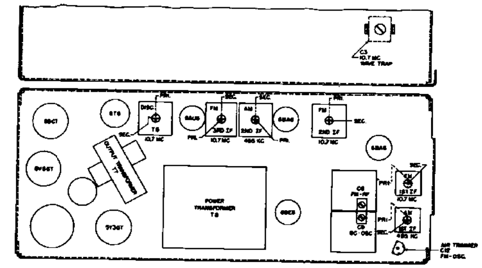


Fig. 47. Tube and Trimmer Location (Radio Chassis)

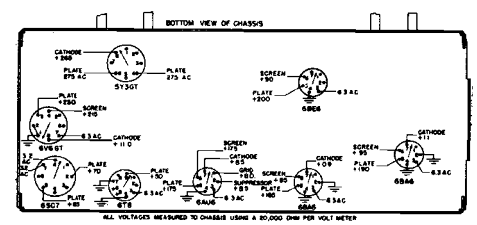


Fig. 48. Socket Voltage Diagram

STAGE GAIN AND VOLTAGE CHECKS

Stage gain measurements by a vacuum tube voltmeter or similar measuring device may be used to check circuit performance and isolate trouble. The gain values listed may have tolerances of ±20 per cent. Readings should be taken with low signal voltage so that AVC is not effective.

1. R-F AND I-F STAGE GAINS

Signal applied through IRE dummy antenna:

Antenna Post to V2 Grid	4 at 1000 kc
V2 Grid to V3 Grid	60 at 455 kc
Dipole Terminals to V2 Grid	1.3 at 98 mc
V2 to V1 Grid	5 at 98 mc
V1 to V2 Grid	2.6 at 10.7 mc
V2 to V3 Grid	18 at 10.7 mc
V3 to V4 Grid	54 at 10.7 mc

2. AUDIO GAIN

0.05 volts at 400 cps across volume control with volume control set at maximum will give approximately ½ watt output across the speaker voice coil.

3. OSCILLATOR GRID BIAS

D-c voltage developed across R3:
6.5 volts at 1000 kc. (Use 220 K resistor to isolate V.T.V.M.)
4.5 volts at 98 mc. (Use 220 K resistor to isolate V.T.V.M.)

4. SOCKET PIN VOLTAGES

Fig. 48 shows typical tube pin voltages. All readings should be made from the pins to ground, unless otherwise indicated.

5. HUM MEASUREMENT

Hum measured across the voice coil of the speaker with volume control at minimum and Band switch on AM should not exceed 7 millivolts.

On FM, ground limiter grid and measure hum across voice coil with volume control at maximum. Hum should not exceed 15 millivolts.

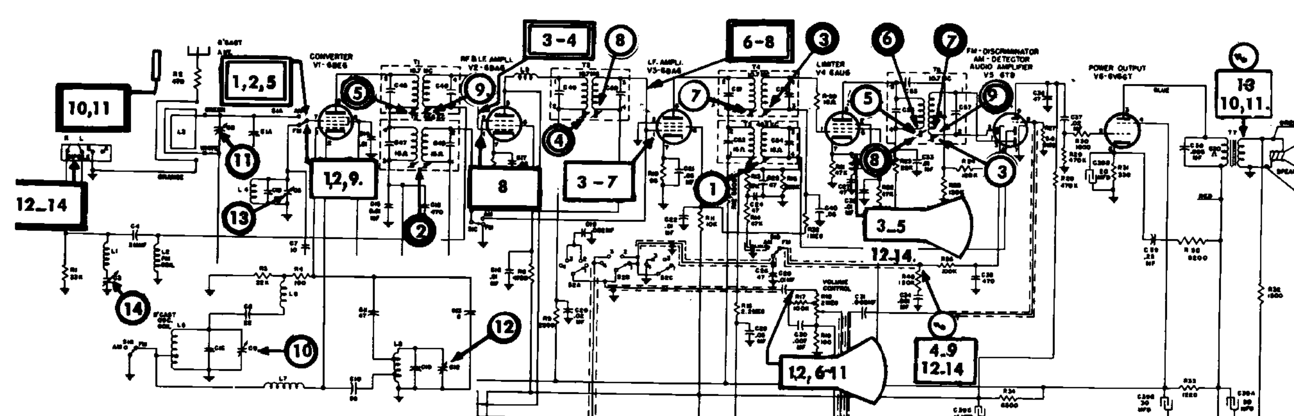


Fig. 46. Alignment Diagram 820, Radio Chassis

UNIVERSAL REPLACEMENT PARTS

Cat. No.	Symbol	Description
UCC-012	C40, 41	CAPACITOR—.001 mfd., 400 v., paper
UCC-014	C86, 104	CAPACITOR—.2 mfd., 600 v., paper
UCC-041	C110	CAPACITOR—.02 mfd., 600 v., paper
UCC-025	C37, 38	CAPACITOR—.01 mfd., 400 v., paper
UCC-621	C30, 78	CAPACITOR—.002 mfd., 600 v., paper
UCC-630	C74, 87	CAPACITOR—.01 mfd., 600 v., paper
UCC-635	C27, 29, 39, 48, 54, 64, 55*, 109	CAPACITOR—.05 mfd., 600 v., paper
UCC-640	C14*, 34, 52, 55	CAPACITOR—0.1 mf., 600 v., paper
UCU-052	C114††	CAPACITOR—1000 mmf., mica
UCU-1506	C91	CAPACITOR—12 mmf., 500 v., mica
UCU-1528	C42, 68	CAPACITOR—100 mmf., 500 v., mica
UCU-1530	C44, 45	CAPACITOR—120 mmf., 500 v., mica
UCU-1532	C73	CAPACITOR—150 mmf., 500 v., mica
UCU-1542	C43, 51, 89, 117*	CAPACITOR—390 mmf., 500 v., mica
UCU-2534	C82	CAPACITOR—180 mmf., mica
UCU-2560	C47	CAPACITOR—2200 mmf., mica
UJB-004		BOARD—Antenna terminal board
URD-037	R56, 116	RESISTOR—330 ohms, ½ w., carbon
URD-049	R8*, 10, 14, 18, 82, 109	RESISTOR—1000 ohms, ½ w., carbon
URD-059	R118	RESISTOR—2700 ohms, ½ w., carbon
URD-065	R65	RESISTOR—4700 ohms, ½ w., carbon
URD-069	R92	RESISTOR—6800 ohms, ½ w., carbon
URD-071	R36, 37, 38	RESISTOR—8200 ohms, ½ w., carbon
URD-081	R93*	RESISTOR—22,000 ohms, ½ w., carbon
URD-091	R93†, 101, 104	RESISTOR—56,000 ohms, ½ w., carbon
URD-093	R75, 83	RESISTOR—68,000 ohms, ½ w., carbon
URD-095	R74†, 96	RESISTOR—82,000 ohms, ½ w., carbon
URD-097	R8†, 35, 69	RESISTOR—100,000 ohms, ½ w., carbon
URD-099	R50*, 84, 85	RESISTOR—120,000 ohms, ½ w., carbon
URD-101	R78	RESISTOR—150,000 ohms, ½ w., carbon
URD-105	R53*, 81, 112*	RESISTOR—220,000 ohms, ½ w., carbon
URD-107	R112†	RESISTOR—270,000 ohms, ½ w., carbon
URD-113	R54, 63*	RESISTOR—470,000 ohms, ½ w., carbon
URD-115	R66, 123*	RESISTOR—560,000 ohms, ½ w., carbon
URD-121	R20, 22, 55, 97, 99, 121†	RESISTOR—1 meg., ½ w., carbon
URD-125	R40*	RESISTOR—1.5 meg., ½ w., carbon
URD-129	R42	RESISTOR—2.2 meg., ½ w., carbon
URD-135	R40†	RESISTOR—3.9 meg., ½ w., carbon
URD-139	R122	RESISTOR—5.6 meg., ½ w., carbon
URD-145	R113	RESISTOR—10 meg., ½ w., carbon
URD-1017	R7, 12	RESISTOR—47 ohms, ½ w., carbon
URD-1027	R23, 77, 100	RESISTOR—120 ohms, ½ w., carbon
URD-1032	R1	RESISTOR—200 ohms, ½ w., carbon
URD-1049	R25	RESISTOR—1000 ohms, ½ w., carbon
URD-1054	R11, 111	RESISTOR—1600 ohms, ½ w., carbon
URD-1059	R6, 15	RESISTOR—2700 ohms, ½ w., carbon
URD-1065	R43†	RESISTOR—4700 ohms, ½ w., carbon
URD-1066	R19	RESISTOR—5100 ohms, ½ w., carbon
URD-1067	R21	RESISTOR—5600 ohms, ½ w., carbon
URD-1081	R3	RESISTOR—22,000 ohms, ½ w., carbon
URD-1082	R9, 13, 16, 47, 103, 110, 119	RESISTOR—24,000 ohms, ½ w., carbon
URD-1088	R17	RESISTOR—43,000 ohms, ½ w., carbon
URD-1094	R27	RESISTOR—75,000 ohms, ½ w., carbon
URD-1095	R28, 50, 52	RESISTOR—82,000 ohms, ½ w., carbon
URD-1103	R49	RESISTOR—180,000 ohms, ½ w., carbon
URD-1105	R4, 26	RESISTOR—220,000 ohms, ½ w., carbon
URD-1117	R48	RESISTOR—680,000 ohms, ½ w., carbon
URD-1129	R30	RESISTOR—2.2 meg., ½ w., carbon
URE-041	R34	RESISTOR—470 ohms, 1 w., carbon
URE-057	R68	RESISTOR—22,000 ohms, 1 w., carbon
URE-077	R41	RESISTOR—15,000 ohms, 1 w., carbon
URE-083	R5	RESISTOR—27,000 ohms, 1 w., carbon
URE-085	R106	RESISTOR—33,000 ohms ±10%, 1 w., carbon
URE-097	R45	RESISTOR—100,000 ohms, 1 w., carbon
URE-109	R63, 70††, 71††	RESISTOR—330,000 ohms, 1 w., ±10%, carbon
URE-133	R51	RESISTOR—3.3 meg., 1 w., carbon
URE-1060	R91	RESISTOR—3000 ohms, 1 w., carbon
URE-1066	R39	RESISTOR—5100 ohms, 1 w., carbon
URE-1067	R2	RESISTOR—5600 ohms, 1 w., carbon
URE-1068	R94	RESISTOR—6200 ohms, 1 w., carbon
URE-1081	R79, 102	RESISTOR—22,000 ohms, 1 w., carbon
URF-047	R38	RESISTOR—820 ohms, 2 w., carbon
URF-061	R64††	RESISTOR—3300 ohms, 2 w., carbon
URF-083	R60*, 61*	RESISTOR—27,000 ohms, 2 w., carbon
URF-1023	R57	RESISTOR—82 ohms, 2 w., carbon
URF-1061	R24	RESISTOR—3300 ohms, 2 w., carbon
URF-1073	R58	RESISTOR—10,000 ohms, 2 w., carbon
URF-1074	R59	RESISTOR—11,000 ohms, 2 w., carbon
URF-1076	R60, 61	RESISTOR—13,000 ohms, 2 w., carbon
URF-1080	R32	RESISTOR—20,000 ohms, 2 w., carbon
URF-1089	R44	RESISTOR—47,000 ohms, 2 w., carbon

SPECIALIZED REPLACEMENT PARTS

Cat. No.	Symbol	Description
RAB-086		BACK—Cabinet back
RAV-074		CABINET
RAX-025		CENTERING RING AND SUPPORT ASSEMBLY
RCC-016	C83, 94	CAPACITOR—.5 mfd., 200 v., paper
RCC-040	C97	CAPACITOR—.01 mf., 600 v., paper
RCC-097	C30	CAPACITOR—.002 mf., 600 v., paper
RCC-095	C31	CAPACITOR—.062 mf., 600 v., paper
RCE-076	C33, 35, 58, 62	CAPACITOR—30 x 30 x 15 mf. 450 v., 30 mf., 50 v.
RCE-083	C102	CAPACITOR—2000 mfd., electrolytic
RCE-084	C46, 59, 60, 61, 63	CAPACITOR—30 x 30 x 15 x 30, 450 v., electrolytic
RCN-014	C28	CAPACITOR—.047 mfd., 600 v., paper (molded)
RCN-020	C57, 118*	CAPACITOR—4 mmf., 800 v., mica
RCN-023	C53	CAPACITOR—500 mmf., 20,000 v.
RCN-025	C31	CAPACITOR—.01 mfd., 600 v., paper (molded)
RCU-285	C50	CAPACITOR—1500 mmf., mica
RCW-006	C88	CAPACITOR—12 mmf., ceramic
RCW-026	C2, 3, 92	CAPACITOR—1500 mmf., ceramic
RCW-1002	C26	CAPACITOR—6 mmf., ceramic
RCW-1043	C100	CAPACITOR—47 mmf., ceramic
RCW-1045	C8	CAPACITOR—1.5 mmf., ceramic
RCW-1047	C1, 13, 22, 23, 72	CAPACITOR—100 mmf., ceramic
RCW-1052	C4, 7	CAPACITOR—47 mmf., ceramic
RCW-2006	C9	CAPACITOR—12 mmf., ceramic
RCW-2010	C11, 71	CAPACITOR—47 mmf., ceramic
RCW-2019	C75	CAPACITOR—36 mmf., ceramic
RCW-2030	C32	CAPACITOR—6 mmf., ceramic
RCW-2035	C84	CAPACITOR—5 mmf., ceramic
RCW-3014	C10, 14†, 15, 18,	CAPACITOR—5000 mmf., ceramic
RCW-3014	19, 20, 21, 24, 25, 36, 64*, 65, 66, 67, 69, 70, 85, 90, 95, 96, 101, 106, 111, 113*	CAPACITOR—5000 mmf., ceramic
RCW-3017	C16	CAPACITOR—2.5 mmf., ceramic
RCY-034	C5	CAPACITOR—2-20 mmf., trimmer
RCY-045	C49	CAPACITOR—25-150 mmf., mica trimmer
RCY-046	C80	CAPACITOR—1.1 mmf., variable tuning condenser
RCY-047	C12, 17	CAPACITOR—1.5-15 mmf., mica trimmer
RCY-048	C5, 6	CAPACITOR—0.6-2.4 mmf., trimmer
RCY-051	C81	CAPACITOR—45-380 mmf., mica trimmer
RDC-032		CORD—For focus control drive, 25 yds.
RDC-034		CORD—Dial cord, metallic
RDE-032		ESCUTCHEON—Dial escutcheon
RDK-152		KNOB—Vertical hold, contrast control knobs
RDK-153		KNOB—Horizontal hold, brightness control knobs
RDK-154		KNOB—Focus, tuning control knobs
RDK-155		KNOB—Volume, channel selector control knob (Gold Bar)
RDK-157		KNOB—ON-OFF switch
RDS-074		SCALE—Dial scale
RDW-022		SAFETY GLASS—Cabinet glass protects picture tube
REI-014		SLUG—R-F and converter coil tuning slugs for T7, T8, T9, and T10
REI-015		CORE—Adjustment core for blocking oscillator coil, T16
REI-016		CORE—Tuning core for sec. of T11, T12, T13, T14 video i-f and L5, L21 sound i-f.
REI-017††		CORE—Adjustment core for horizontal linearity L19
REI-018††		CORE—Adjustment core for horizontal size control L18
REI-019		CORE—Tuning core for sound discriminator T19
REI-026		CORE—Primary tuning core for 4th I-F transformer
RER-003	SR1	RECTIFIER—Selenium rectifier
RHM-012		CUSHION—Dial scale cushion
RHM-025		WASHER—"C" washer, retains tuning shaft or focus control shaft
RHM-054		SLEEVE—Centering ring assembly
RHM-057		CENTERING RING
RHM-058		CUSHION—Scale cushion (end)
RHX-016		RING AND SPRING ASSEMBLY
RJC-010		CONNECTOR—Picture tube anode connector assembly
RJJ-007		RECEPTACLE—A-C power receptacle
RJC-001		PLUG—Terminal plug for speaker
RJP-024		PLUG—Male
RJP-027		PLUG—Octal male plug
RJS-003		SOCKET—Tube socket for V9, V10, V11, V18, V19
RJS-015		SOCKET—Tube socket for V12
RJS-017		SOCKET—Tube socket for V13, V15, V16, and V21
RJS-030		SOCKET—Tube socket for V14
RJS-092		SOCKET—Tube socket for V3, V4, V5, V6, V17, and V22
RJS-107		SOCKET—Tube socket for V1
RJS-114		RECEPTACLE
RJS-120		SOCKET—Tube socket for V7 (nine pin)
RJS-127		SOCKET—Tube socket for V2
RJS-128		SOCKET—Picture tube socket
RJX-023		HEAD-END UNIT—R-F head-end unit (includes tubes) completely aligned
RLA-031	T1	TRANSFORMER—Antenna input
RLA-032	T7, 8, 9, 10	COIL—R-F and converter (Channel 7, 8-9, 10-11, 12-13)
RLC-069	T2	COIL—R-F, converter, and oscillator (Channel 2)
RLC-070	T3	COIL—R-F, converter, and oscillator (Channel 3)
RLC-071	T4	COIL—R-F, converter, and oscillator (Channel 4)
RLC-072	T5	COIL—R-F, converter, and oscillator (Channel 5)
RLC-073	T6	COIL—R-F, converter, and oscillator (Channel 6)
RLC-074	L10	COIL—Oscillator (Channel 7) (no code dot)
RLC-075	L11	COIL—Oscillator (Channel 8-9) (red code dot)
RLC-076	L12	COIL—Oscillator (Channel 10-11) (orange code dot)
RLC-077	L13	COIL—Oscillator (Channel 12-13) (yellow code dot)
RLD-004	L18††	COIL—Horizontal size control
RLD-005	L19††	COIL—Horizontal linearity control
RLD-007		SWEEP YOKE—Vertical and horizontal deflecting coils
RLD-014	L18*, 19*	COIL—3.7-30 millihenry sweep output transformer
RLF-021		FOCUS COIL—Coil and PM magnet
RLI-003	L2	CHOKE—R-F choke (V2 cathode)
RLI-005	L6, 14	CHOKE—V2 filament choke, video carrier-set trap
RLI-006	L1, 3	CHOKE—R-F input, V2 cathode
RLI-019	L4	CHOKE—V2A oscillator cathode
RLI-038	L16, 17, 22, 23	CHOKE—Video choke, 165 uh
RLI-059	L20	CHOKE—7 henry, high voltage supply filter choke
RLI-060	L24	CHOKE—7 henry, low voltage supply filter choke
RLI-061	L15	CHOKE—Television audio take-off trap
RLL-030		LOOP—Antenna loop
RLT-004	Includes R67, 62, C103	COILS—Coils for horizontal sweep transformer
RMF-003		CLAMP—Tube clamp for V13 and V16
RMH-058		CUSHION—Scale end cushion
RMM-081		CUSHION—Rubber cushion for picture tube mounting
RMS-165		SPRING—Tube spring
RMU-043		SHAFT—Tubular shaft for focus
RMM-101		BRACKET—Deflection and focus coil bracket
RMM-102		NUT PLATE—Focus coil assembly
RMW-045		PULLEY—Pulley and hub assembly for tuning control
RMW-048		ASSEMBLY—Hub and drum assembly (Focus pot. drive)
RMW-049		ASSEMBLY—Hub and drum assembly (Focus control shaft)
RMX-126		BRACKET—Adjusting and clamping bracket assembly
RRC-040	C97	CAPACITOR—.01 mfd., 600 v., paper
RRC-084	R31	POTENTIOMETER—250,000 ohms, vertical size
RRC-085	R86	POTENTIOMETER—2 meg., volume control
RRC-086	R33	POTENTIOMETER—1000 ohms, 2 w., w.w. (vertical linearity)
RRC-089	R73†, 95†	POTENTIOMETER—500,000 ohms—7500 ohms, composition (Dual, Contrast, and Brightness)
RRC-090	R29, 46	POTENTIOMETER — 50,000 — 50,000 ohms, composition (Dual, Vertical Hold, and Horizontal Hold)
RRC-105	R73*, 95*	POTENTIOMETER—Contrast and brilliance, 2 meg. and 100,000 ohms
RRW-033	R72	RESISTOR—Focus control, 3000 ohms, 25 w.
RRW-034	R105	RESISTOR—1.0 ohm, ½ w., w.w.
RRW-035	R107	RESISTOR—900 ohms, 7 w., w.w.
RSW-063	S2	SWITCH—Selector and ON-OFF switch
RTD-007	T19	TRANSFORMER—Audio discriminator
RTL-081	T11	TRANSFORMER—1st video I-F transformer
RTL-082	T12	TRANSFORMER—2nd video I-F transformer
RTL-083	T13	TRANSFORMER—3rd video I-F transformer
RTL-085	L21	COIL—Television audio 1st I-F, 2nd I-F
RTL-089*	T14	TRANSFORMER—4th video I-F transformer
RTL-90	T21	TRANSFORMER—Audio I-F transformer
RTM-003	T16	TRANSFORMER—Horizontal sweep blocking oscillator
RTO-053	T15	TRANSFORMER—Vertical sweep output
RTO-058††	T17	TRANSFORMER—Horizontal sweep and high voltage
RTO-68*	T17*	TRANSFORMER—Horizontal sweep and high voltage
RTP-066	T18	TRANSFORMER—Power transformer, 60 cycle
RTP-301	T18*	TRANSFORMER—Power transformer, 60 cycle
RWL-019		POWER CORD AND PLUG

NOTE:
* Used in "R" and "T" chassis only.
† Not used on "R" or "T" chassis.
†† Not used on "T" chassis.

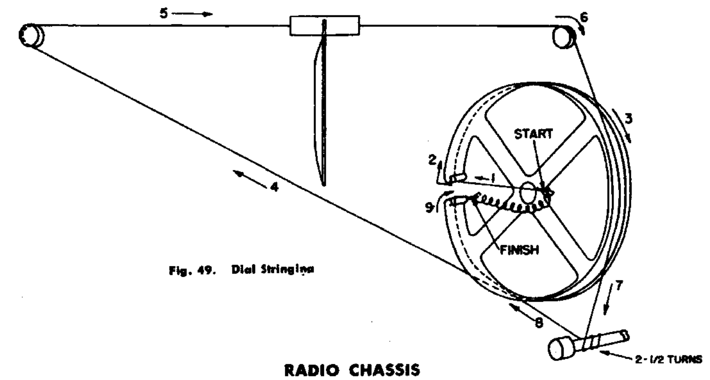


Fig. 49. Dial Stringing

RADIO CHASSIS

UNIVERSAL REPLACEMENT PARTS

Cat. No.	Symbol	Description
UCC-050	C59	CAPACITOR—25 mfd., 600 v., paper
UCC-620	C34	CAPACITOR—.001 mfd., 600 v., paper
UCC-621	C19	CAPACITOR—.002 mfd., 600 v., paper
UCC-623	C31	CAPACITOR—.003 mfd., 600 v., paper
UCC-626	C30	CAPACITOR—.007 mfd., 600 v., paper
UCC-630	C14, 15, 16, 22, 28, 32, 33, 41	CAPACITOR—.01 mfd., 600 v., paper
UCC-631	C20, 23, 37	CAPACITOR—.02 mfd., 600 v., paper
UCC-635	C17, 21, 29, 40, 42, 44	CAPACITOR—.05 mfd., 600 v., paper
UCC-1625	C38	CAPACITOR—.005 mfd., 1600 v., paper
UCU-020	C24, 25, 26, 36	CAPACITOR—47 mmf. ±20%, mica
UCU-044	C35	CAPACITOR—470 mmf. ±20%, mica

UNIVERSAL REPLACEMENT PARTS (CONTD)

Cat. No.	Symbol	Description
UOP-1247		SPEAKER—12-inch PM, same as S1200-D7
URD-001	R39	RESISTOR—10 ohms, ½ w., carbon
URD-021	R7, 10	RESISTOR—68 ohms, ½ w., carbon
URD-025	R4, 19	RESISTOR—100 ohms, ½ w., carbon
URD-041	R2	RESISTOR—470 ohms, ½ w., carbon
URD-049	R30	RESISTOR—1000 ohms, ½ w., carbon
URD-053	R32	RESISTOR—1500 ohms, ½ w., carbon
URD-057	R9	RESISTOR—2200 ohms, ½ w., carbon
URD-065	R5, 8	RESISTOR—4700 ohms, ½ w., carbon
URD-069	R6, 12	RESISTOR—6800 ohms, ½ w., carbon
URD-071	R50	RESISTOR—8200 ohms ±10%, ½ w., carbon
URD-073	R11	RESISTOR—10,000 ohms, ½ w., carbon
URD-081	R3, 23	RESISTOR—22,000 ohms, ½ w., carbon
URD-083	R47	RESISTOR—27,000 ohms ±10%, ½ w., carbon
URD-085	R1, 40, 42	RESISTOR—33,000 ohms, ½ w., carbon
URD-089	R13, 14, 21, 22, 43	RESISTOR—47,000 ohms, ½ w., carbon
URD-093	R41	RESISTOR—68,000 ohms, ½ w., carbon
URD-097	R17, 26	RESISTOR—100,000 ohms, ½ w., carbon
URD-099	R24, 25	RESISTOR—120,000 ohms, ½ w., carbon
URD-101	R48	RESISTOR—150,000 ohms, ½ w., carbon
URD-105	R15	RESISTOR—220,000 ohms, ½ w., carbon
URD-113	R28, 29	RESISTOR—470,000 ohms, ½ w., carbon
URD-121	R38	RESISTOR—1 meg., ½ w., carbon
URD-129	R16	RESISTOR—2.2 meg., ½ w., carbon
URD-133	R44, 45	RESISTOR—3.3 meg., ½ w., carbon
URD-141	R27	RESISTOR—6.8 meg., ½ w., carbon
URD-1094		RESISTOR—75,000 ohms, ½ w., carbon.
URD-1104	R46	RESISTOR—200,000 ohms, 5%, ½ w., carbon
URE-037	R31	RESISTOR—330 ohms, 1 w., carbon
URF-077		RESISTOR—15,000 ohms, 2 w., carbon

SPECIALIZED REPLACEMENT PARTS

Cat. No.	Symbol	Description
RAB-088		BACK—Cabinet back radio section
RAL-001		BEZEL—Pilot light bezel
RCE-029	C39A, B, C, D	CAPACITOR—15 mfd., 400 v.; 20 mfd., 25 v.; 30 mfd., 400 v.; 30 mfd., 400 v., electrolytic
RCE-042	C43	CAPACITOR—10 mfd., 250 v., electrolytic
RCT-033	C1A, B, C, D	CAPACITOR—Tuning capacitor and drum assembly
RCW-176	C18, 58	CAPACITOR—470 mmf ±20%, ceramic
RCW-1043	C11	CAPACITOR—47 mmf. ±20%, max. neg., ceramic
RCW-1053	C8	CAPACITOR—22 mmf. ±20%, max. neg., ceramic
RCW-1057	C10	CAPACITOR—39 mmf. ±10%, max. neg., ceramic
RCW-1060	C7	CAPACITOR—10 mmf. ±20%, zero coef., ceramic
RCW-1066	C4	CAPACITOR—3 mmf. ±10%, zero coef., ceramic

SPECIALIZED REPLACEMENT PARTS (CONTD)

Cat. No.	Symbol	Description
RCW-2010	C27	CAPACITOR—47 mmf. ±5%, zero coef., ceramic
RCW-2033	C13	CAPACITOR—8 mmf. ±10%, max. neg., ceramic
RCY-020	C3	CAPACITOR—Trimmer, 36–146 mmf.
RCY-034	C5	CAPACITOR—Trimmer, 2–20 mmf.
RCY-038	C12	CAPACITOR—Air trimmer, 1 to 8 mmfd.
RDC-033		CORD—Dial drive cord (25 yards.)
RDE-032		ESCUTCHEON—Dial escutcheon
RDK-156		KNOB—Plain volume and tuning
RDK-157		KNOB—With arrow, band switch and OFF-Tone
RDS-074		SCALE—Dial scale
RDX-035		POINTER—Dial pointer assembly
RHC-017		CLIP—To hold coil
RHG-010		GROMMET—Rubber mounting grommet for preamplifier tube
RHG-015		GROMMET—For mounting tuning capacitor
RHJ-006		SPACER—For mounting tuner condenser
RJC-012	P3	PLUG—Power plug (in chassis)
RJJ-003	P4	PLUG—Octal base plug
RJP-003	P2	PLUG—Phono motor plug
RJP-004	P1	PLUG—Phono input plug
RJP-010	J1	JACK—Phono jack
RJS-003		SOCKET—Tube socket for V6 and V7
RJS-049	J2	SOCKET—Phono power female socket
RJS-085		SOCKET—Tube socket for V8
RJS-105		SOCKET—Tube socket for V1, V2, V3, V4
RJS-118		SOCKET—Tube socket for V5
RJS-129		SOCKET—Pilot light
RLA-012	L6	COIL—FM oscillator grid choke
RLB-027	L4	COIL—FM r-f coil
RLC-066	L5	COIL—B-C oscillator coil
RLC-067	L8	COIL—FM oscillator coil
RLI-005	L1, 10, 11	COIL—Choke coil
RLI-044	L12	COIL—FM power line choke coil
RLI-056	L2	COIL—FM antenna choke coil
RLI-057	L7, 9	COIL—FM choke coil
RLI-058	L13	COIL—FM limiter choke
RMS-004		SPRING—Dial cord tension
RMS-155		SPRING—For receiver chassis bin
RMX-109		SHAFT—Tuning shaft assembly
RRC-074	R18	VOLUME CONTROL—2 meg.
RRN-006	R35	RESISTOR—2.2 ohms ±10%, ½ w., carbon
RRT-003	R33, 34	RESISTOR—6500 and 1220 ohms ±10%, w.w.
RSW-048	S2A, B, C, D	SWITCH—Tone control and power switch
RSW-059	S1A, B, C, D	SWITCH—Band change switch
RTD-006	T6	TRANSFORMER—Discriminator transformer
RTL-054	T5	TRANSFORMER—2nd AM i-f transformer
RTL-078	T2	TRANSFORMER—1st AM i-f transformer
RTL-080	T1, 3 4	TRANSFORMER—1st, 2nd, 3rd FM i-f transformer
RTO-051	T7	TRANSFORMER—Output transformer.
RTP-061	T8	TRANSFORMER—Power transformer (60 cy.)