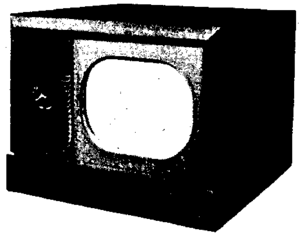

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## SPECIFICATIONS

| | |
|---|---|
| **OVER-ALL DIMENSIONS:** | Height . . . 16 1/16 inches<br>Width . . . 21 inches<br>Depth . . . 19 5/8 inches |
| **ELECTRICAL RATING:** | Frequency . . . 60 cycles<br>Voltage . . . 115 volts<br>Wattage . . . 220 watts |
| **INTERMEDIATE FREQUENCIES:** | Video (Carrier Equivalent) . . . 26.3 MC<br>Audio . . . 21.8 MC |

**R-F FREQUENCY RANGE:**

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

| | |
|---|---|
| **AUDIO POWER OUTPUT:** | Undistorted . . . 1.5 watts<br>Maximum . . . 4 watts |
| **LOUDSPEAKER:** | Type . . . Oval Alnico V PM<br>Impedance at 400 cycles . . 3.2 ohms |
| **PICTURE SIZE:** | Height . . . 7 11/16 inches<br>Width . . . 10 1/2 inches |
| **ANTENNA REQUIREMENTS:** | Type . . Folded Dipole or Equivalent<br>Characteristic Impedance . . . 300 ohms |

**TUBES**

| Symbol | Purpose | Type |
|---|---|---|
| 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 and Clipper Rectifier | 6AL5 |
| V7 | Video Limiter and Video Amplifier | 12AU7 |
| V8 | Picture Tube | 12KP4 |
| V9 | Vertical Sweep Generator | 6SN7GT |
| V10 | Vertical Sweep Output | 6V6GT/G |
| V11 | Phase Inverter and Clipper | 6SN7GT |
| V12 | Horizontal AFC and Sweep Generator | 6SN7GT |
| V13 | Horizontal Sweep Output | 6BG6/G |
| V14 | Hi-Voltage Rectifier | 1B3GT/8016 |
| V15 | Horizontal Damping (Early, and "R" Production) | 5V4G |
| V15 | Horizontal Damping ("T" Production) | 6W4GT |
| V16 | Power Rectifier (high voltage) | 5U4G |
| V17 | Audio I-F Amplifier | 6AU6 |
| V18 | Audio FM Limiter | 6SH7 |
| V19 | Audio FM Discriminator and Amplifier | 6AQ7 |
| V20 | Audio Output | 6K6 |
| V21 | Power Rectifier (low voltage) | 5Y3GT |
| V22 | Audio I-F Amplifier | 6AU6 |

## GENERAL INFORMATION

The General Electric Model 830 television receiver is a table model type, using 22 tubes to provide reception on all of the 12 commercial television channels. The television picture is reproduced on a 12-inch electromagnetically deflected picture tube.

### 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 A FATAL BURN OR SHOCK. HOWEVER, SECONDARY HUMAN REACTIONS TO OTHERWISE HARMLESS SHOCKS HAVE BEEN KNOWN TO CAUSE INJURY. SINCE THE HIGH VOLTAGE IS OBTAINED FROM THE B+ VOLTAGE, CERTAIN PORTIONS OF THE HIGH VOLTAGE GENERATING CIRCUIT ARE DANGEROUS AND EXTREME PRECAUTIONS SHOULD BE OBSERVED.

THE PICTURE TUBE IS HIGHLY EVACUATED AND IF BROKEN, GLASS FRAGMENTS WILL BE VIOLENTLY EXPELLED IN ALL DIRECTIONS. IF IT IS NECESSARY TO CHANGE THE PICTURE TUBE, USE SAFETY GOGGLES AND GLOVES. ALWAYS WEAR GOGGLES WHEN CHASSIS IS REMOVED FROM THE CABINET.

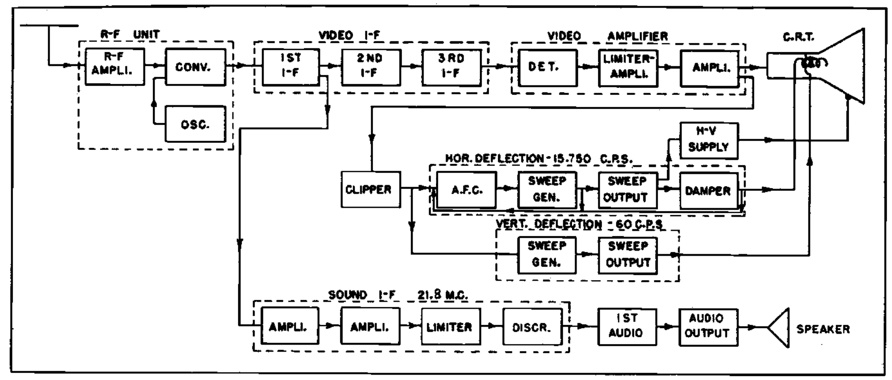



Fig. 1. Block Diagram, Model 830

Features of this television receiver include a constant input impedance r-f amplifier, balanced input, a safe high voltage power supply for the picture tube, automatic frequency control for horizontal sweep synchronization, 12-inch picture tube with aluminized screen and a high fidelity FM audio system.

## INSTALLATION AND OPERATION INSTRUCTIONS

Installation and operation instructions for the Model 830 television receiver are supplied, in separate pamphlets, as follows:
1—Installation Instructions . . . ER-A-830
2—Operation Instructions . . . ER-I-830

## DESCRIPTION—TELEVISION RECEIVER CIRCUITS

The Model 830 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. Some of the following circuits are somewhat modified in the later production of receivers. The first modified production incorporates the addition of an Automatic Gain Control circuit and these chassis are identified by the letter "R" stamped upon the front apron adjacent to the contrast control. A second modification of circuit in production has, in addition to Automatic Gain Control, a new type Horizontal Group Sweep transformer and circuit. This production chassis is similarly marked, with a "T" stamping. Discussion of Production Changes will be found on page 14. A separate schematic diagram for early production, "R" chassis, and "T" chassis, will be found on pages 18, 19 and 20, respectively.

A block diagram of the Model 830 receiver is shown in Figure 1 to assist in signal tracing and to better visualize the operation of the receiver.

## DESCRIPTION—TELEVISION RECEIVER CIRCUITS

**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.

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

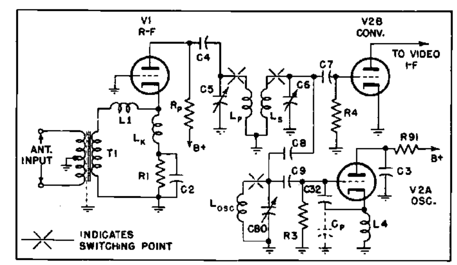



Fig. 2. R-F Amplifier, Converter and Oscillator

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. (See schematic diagram, Figure 40, page 18, for channel switching.)

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. A 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 requencies.

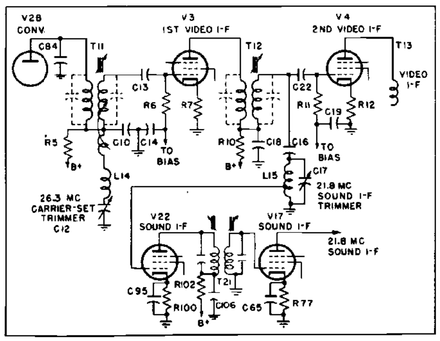



**Fig. 3. Video and Audio I-F Amplifier**

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 tub., V22. Additional i-f gain and selectivity is provided by the two stages of 21.8 mc i-f 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.

**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).

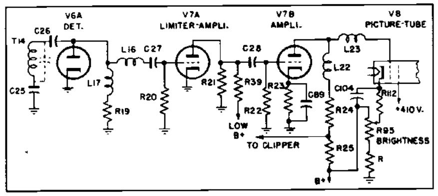



**Fig. 4. Video Detector and Amplifier**

**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.

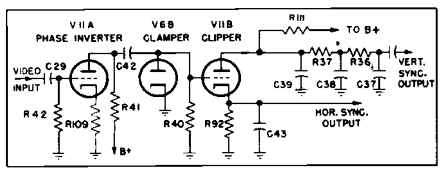



**Fig. 5. Sync Separator Circuit**

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.

**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.

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 in 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.

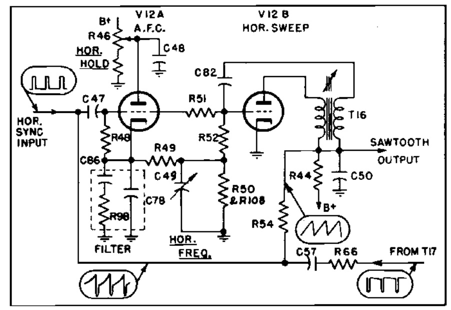



**Fig. 6. Horizontal Sweep and AFC Sync**

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.

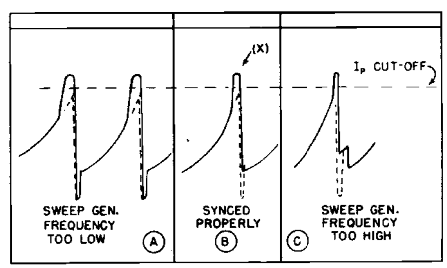



**Fig. 7. AFC Waveshapes**

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. This is a variable iron core adjustment normally set for the proper free-running speed of the blocking oscillator as described in Preset Controls, page 11, for T16 adjustment.

**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.

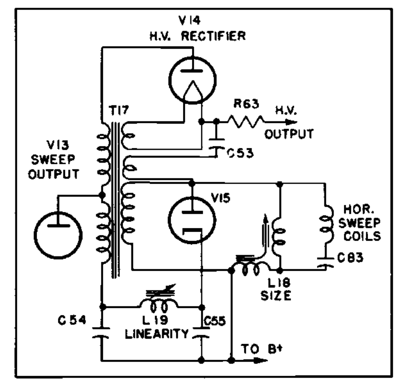



**Fig. 8. Horizontal Sweep Output**

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 maximum 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 6SN7GT 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

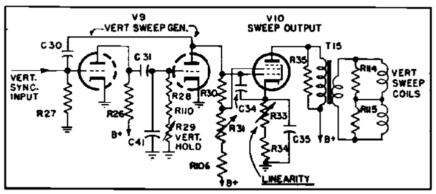



Fig. 9. Vertical Sweep and Output

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 effected. The amount of the correction voltage is controlled by the vertical linearity potentiometer, R33, in the cathode of V10.

**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 autotransformer 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 for the lower voltage supply, the current through it being controlled by the Focus Control potentiometer, R72.

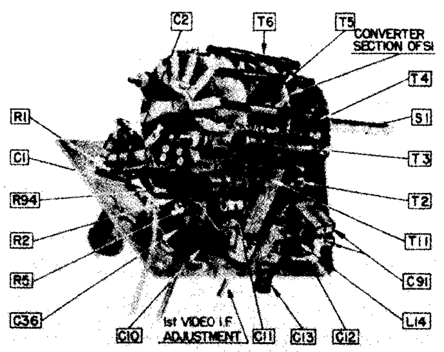



Fig. 10. R-F Head-end Assembly, Oblique View

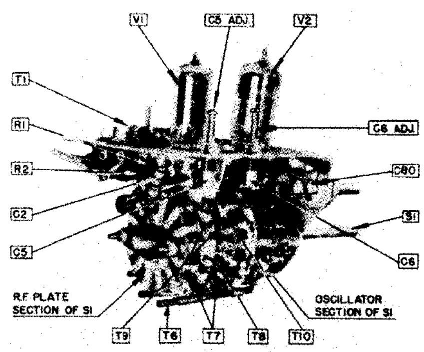



Fig. 11. R-F Head-end Assembly, Side View

## TELEVISION ALIGNMENT

**GENERAL**—A complete alignment of the 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 Adjustments.

The alignment procedure is shown in table form on pages 6 through 9. Read the following detailed instructions before attempting alignment as given in the table.

**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 17 Figure 39.

*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.

**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 1st sound i-f secondary, discriminator secondary, and the last video i-f primary. The location of the adjustments is shown in Figure 37 and 38. 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. The diagram of alignment and waveshapes, Figure 39, page 17, will be found helpful in alignment procedure.

**(1) SOUND I-F ALIGNMENT**—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 12-A. With input at 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 of 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 sweep signal input, as shown in Figure 12-B.

### SOUND I-F ALIGNMENT CHART

| STEP NO. | SIGNAL GENERATOR FREQUENCY | 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 No. 4 | L21 for max. amplitude and symmetry about marker. | See Fig. 12(A) for resultant curve. |
| 2 | 21.8 MC marker | 21.8 MC with 1 MC sweep | Grid (Pin 1) of V22 through 500 mmf | | | 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 | | | 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 | Grid (Pin 1) of V22 through 500 mmf | | | T19 primary slug for max. peak-to-peak amplitude and symmetry of peaks about base line. | See Fig. 12(B) for resultant curve. |
| 5 | Recheck Steps 3 and 4. | | | | | | |

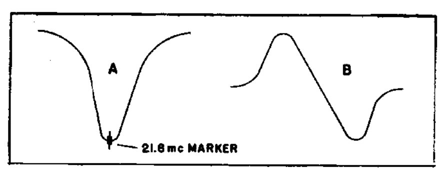



Fig. 12. Audio I-F Curves

*2. Video I-F Alignment*—The video i-f amplifier uses transformers which are coupled and loaded to give the proper band-pass characteristics.

*IMPORTANT—On early production receivers, the contrast control should be set at −4 volts bias measured at the junction of R6, R8, and C14 with a vacuum tube voltmeter. For i-f alignment of receivers incorporating Automatic Gain Control, marked "R," or "T" it is necessary to apply a −4 volts battery bias 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 mfd capacitor and the contrast control adjusted to produce the required −4 volts as measured with a vacuum tube voltmeter at the junction of R6 and R11.*

Stage-by-stage alignment should be performed so as to duplicate as closely as possible the curves as shown in Figure 13A, 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 and the oscilloscope to the junction of L16 and C27 in series with a 10,000 ohm resistor. Set the channel selector switch to channel #4. 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 preferably 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 approximately 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 windings, 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.

When making the video i-f alignment, the 26.3 mc marker should be at 50% or slightly lower than 50% for maximum picture 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 13 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.

## VIDEO I-F ALIGNMENT

| STEP NO. | SIGNAL GENERATOR FREQUENCY | SWEEP GENERATOR FREQUENCY | SIGNAL INPUT | CONNECT OSCILLOSCOPE TO CHASSIS AND JUNCTION OF | CHANNEL SWITCH | ADJUST | REMARKS |
|---|---|---|---|---|---|---|---|
| 6 | 22.9 MC<br>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. 13(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. For "R" and "T" chassis, see text note "Important." |
| 7 | 22.9 MC<br>25.55 MC<br>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. 13(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<br>23.4 MC<br>25.55 MC<br>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. 13(C). | |
| 10 | 22.9 MC<br>23.4 MC<br>25.55 MC<br>26.3 MC | 20-30 MC | Grid (Pin 7) of V2 through MC mmf | | | Adjust slug of T11 for max. amplitude and flat response with markers as shown in Fig. 13(C). | Turn carrier set trimmer C12 to min. capacity. Replace tube V2. |
| 11 | 22.9 MC<br>23.4 MC<br>25.55 MC<br>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. 13(D). | |

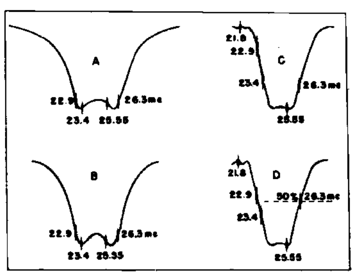



Fig. 13. Video I-F Curves

*3. R-F Alignment*—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 16, 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 inductance of the individual coils. Except for the Channels #2 and #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 14. 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 is increased by inserting a tertiary link winding between the coils. By adjusting the link, the mutual 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 15. 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 16-A and 16-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 coils to change frequency. Spreading turns results in a raising of the frequency; while squeezing turns lowers the frequency.

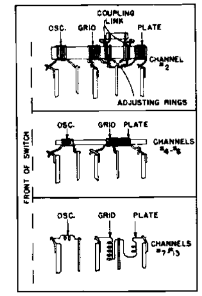



Fig. 14. R-F Coil Assembly

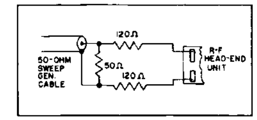



Fig. 15. Sweep Generator Termination

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 difference 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.

## R-F ALIGNMENT CHART

| STEP NO. | SIGNAL GENERATOR FREQUENCY | 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 | | |
| 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 | Check and adjust inductance if necessary for max. amplitude and flat response with correct markers. | See Fig. 16(B) 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. 16(A) for resultant alignment curve. |
| 17 | 175.25 MC and 179.75 MC | 177.5 MC with 15 MC sweep | | | Channel -7 | | Adjust inductance by brass screws in coils. See Fig. 16(B) for resultant curve. |

## R-F ALIGNMENT CHART (Continued)

| STEP NO. | SIGNAL GENERATOR FREQUENCY | 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. 16(C) for resultant curve. |
| 20 | 205.25 MC and 215.75 MC | 210.5 MC with 25 MC sweep | | | Channels #12–#13 | | |

*4. Oscillator Adjustments*—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.

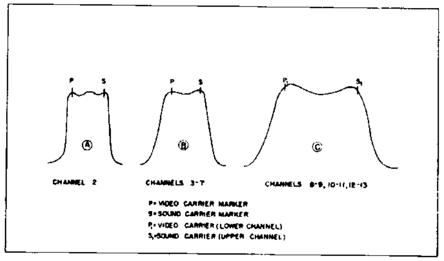



Fig. 16. R-F Alignment Curves

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 14 and 10 respectively.

## OSCILLATOR ALIGNMENT CHART

| STEP NO. | SIGNAL GENERATOR FREQUENCY | 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. | |

## MISCELLANEOUS INSTALLATION AND SERVICE ADJUSTMENTS

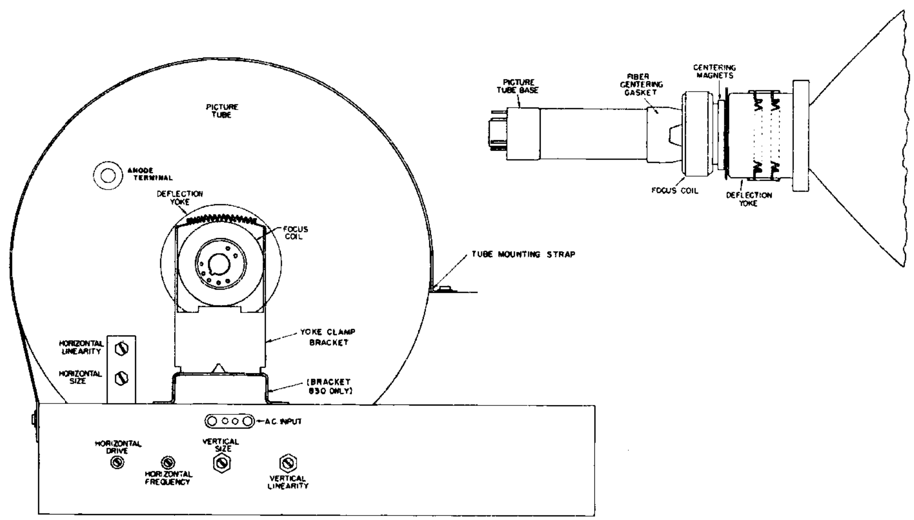



Fig. 17. Location of Preset Adjustment Controls

**NOTE: The unpacking, set-up instructions, antenna installation, and installation adjustments for the Model 830 receiver are covered in the INSTALLATION INSTRUCTIONS, ER-A-830. Some of this data is repeated in this publication.**

### REPLACEMENT OF PICTURE TUBE.

*Precaution—Do not handle, remove, or install a picture tube unless shatterproof goggles and heavy gloves are worn.*

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, and then partially loosen the setscrews that clamp the picture tube front mounting strap. The fiber centering gasket should be slid off from the neck of the picture tube. Carefully pull the picture tube out through the focus and deflection coils.

Install the new picture tube from the front of chassis by inserting the base of tube through the deflection yoke and focus coil assembly. The tube should be moved back so that the front surface of the picture tube is approximately 1⅝ inches in front of the chassis front apron. The rim of the bulb should rest on the channel rubbers and then the tube is clamped firm but not tight in place by the picture tube mounting strap. The picture tube should be rotated until the keyway at the base of the tube points approximately towards the Vertical Linearity control, as shown in Figure 17. Install the high voltage anode cap onto the high voltage anode of the picture tube.

Replace the chassis in the cabinet and secure by the cabinet mounting screws. Now push the picture tube forward on the chassis until the face of the tube is tight within the picture tube mask. Push the deflection yoke assembly forward as far as it will go. The front of the deflection coil should butt up against the bulb portion of the picture tube. Insert the fiber gasket between the neck of the picture tube and the focus coil, as shown in Figure 17. This centers the neck of the tube where it passes through the deflection yoke assembly. Install the picture tube socket onto the base of the picture tube.

Wipe the screen surface of the picture tube so as to remove finger marks and dirt.

### VENTILATION PRECAUTION.

Air circulation about the chassis is provided through ventilation slots cut in the bottom, side, and back cover of the cabinet. Do not cover or partially obstruct these slots in any way.

### 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 installation is covered thoroughly in the Installation Instructions, ER-A-830, 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.

Stock No. 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.

Stock No. 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.

Stock No. UKR-007 is a stacked array antenna which gives considerable signal gain over the above antennas. This antenna gives uniform reception of most of the lower frequency channels and is used on fringe areas where the above antennas are not quite adequate.

A lightning arrester, Stock No. REM-001, should be installed for each antenna installation made on the outside of the house. If the mast is metal, this should be grounded as directly as possible. Use a metal strap or a heavy cable for grounding.

### PICTURE CENTERING ADJUSTMENT.

The picture centering assembly is shown in Fig. 17 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 to, 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 CONTROL.***

This adjustment must be made with the cabinet back removed. If the picture is slightly tilted and does not square with the picture tube mask, rotate the deflection yoke in its clamp bracket until it is aligned. The deflection yoke is held in its clamp bracket by spring pressure.

***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 of 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 1/4 to 1/2 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 1/8 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 adjustment 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 making it necessary to re-adjust the Vertical Size control.

***VERTICAL SIZE.***

This control changes the picture height. When adjusted to the correct height, the picture should extend for approximately 1/8 inch beyond the edge of the picture tube mask so that the top and bottom edges of the picture are not visible.

***HOR. FREQUENCY.***

This is a coarse adjustment that supplements the Horizontal Hold control adjustment on the front panel. It is adjusted to the position which permits the Horizontal Hold control on the front panel to go through its proper adjustment at about its mid-rotation position.

***T16 ADJUSTMENT.***

The core of the blocking oscillator transformer T16 changes the frequency of this circuit. Its adjustment for early production receivers 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, R46, 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 (chassis marked "R"); reference to, and measurement of the −12 volts developed 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.

## PICTURE DEFECTS

The following illustrations show picture defects which are caused by incorrect setting of the operating and/or preset controls or by interference picked up by the antenna. The correction is indicated for each control maladjustment.

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

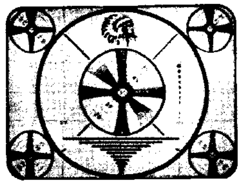


**FIG. 18**
**NORMAL PICTURE**

The normal picture should show good focus and a good contrast between black and white picture elements with the intermediate shades of gray. The picture should not tend to either move vertically or horizontally.

**FIG. 19**
**BLURRED PICTURE**

This indicates that the picture is out of focus. Adjust Focus control until the picture detail is sharp and clear.

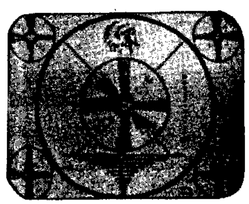


**FIG. 20**
**TOO LITTLE CONTRAST**

The picture seems to be composed entirely of grays. Turn the Contrast control slightly clockwise and/or turn Brightness control slightly counterclockwise until a good contrast ratio exists between the black and white picture elements.

## PICTURE DEFECTS (Cont'd)

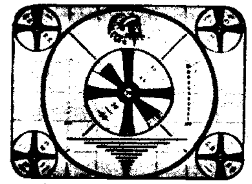


**FIG. 21**
**TOO MUCH CONTRAST**

In this illustration the intermediate shades of contrast are dark and do not contrast with the shades which are a true representation of the black picture elements.

Turn Contrast control slightly counterclockwise and/or turn Brightness control clockwise.

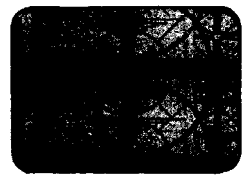


**FIG. 22**
**PICTURE MOVES UP OR DOWN**

Adjustment of Vertical Hold control will stop any vertical roll of picture.

**FIG. 23**
**PICTURE TILTS OR MOVES SIDEWAYS**

Adjust Horizontal Hold until picture straightens up and locks into position so there is no sideways motion. If movement persists, adjust the Horizontal Frequency control.

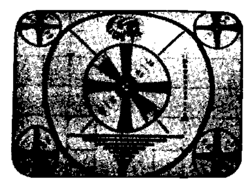


**FIG. 24**
**PICTURE NOT LINEAR VERTICALLY**

Adjust Vertical Linearity control so that the vertical radius from top to center and center to bottom radius are equal. This adjustment may alter the vertical size.

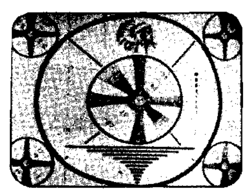


**FIG. 25**
**PICTURE NOT LINEAR HORIZONTALLY**

Adjust Horizontal Linearity control so that the horizontal radius from center to left side is equal to radius from center to right side. This may alter the horizontal size.

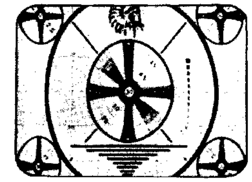


**FIG. 26**
**PICTURE TOO TALL**

Adjust Vertical Size control so that the top and bottom picture edges are just covered by mask.

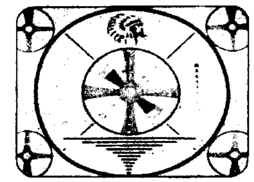


**FIG. 27**
**PICTURE TOO WIDE**

Adjust Horizontal Size control so that the right and left picture edges are just covered by the mask.

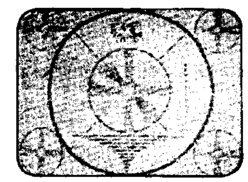


**FIG. 28**
**HERRINGBONE PATTERN OVER PICTURE**

This is caused by r-f interference such as that created by "amateur" stations.

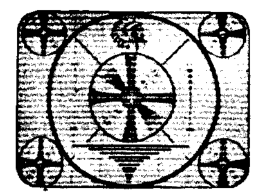


**FIG. 29**
**HORIZONTAL BARS ON PICTURE**

This interference is caused by adjacent channel sound or microphonics in the receiver.

**FIG. 30**
**INTERFERENCE**

This is representative of diathermy interference being picked up by the antenna. Nothing can be done at receiver to eliminate it.

## PICTURE DEFECTS (Cont'd)

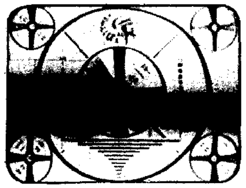


FIG. 31
INTERFERENCE

This can be the same type of interference as illustrated in Figure 30; however, it is of much greater intensity. It may also be due to hum pickup in receiver.

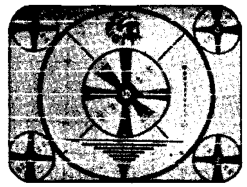


FIG. 32
IGNITION INTERFERENCE

Ignition interference from trucks, automobiles and airplanes may be identified by the splashes of white on the picture. This interference is usually most severe from trucks.

## 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.

*3. Plate Lead of 6K6*—The plate lead (blue) of 6K6 should be dressed as far away from the 6AQ7GT 1st audio circuit as possible.

*4. Electrolytic C102*—When replacing this V2 filament rectifier electrolytic capacitor, C102, connect the ground lug of the capacitor as directly to chassis ground as possible.

*5. Picture Tube Anode Lead*—Lead must clear aquadag coating of picture tube and all objects for isolation to prevent corona, causing eventual breakdown in lead. Orient tube position to allow lead to be dressed away from all component parts.

## 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.<br>b. V14, 1B3GT rectifier tube.<br>c. Filter circuit of V14.<br>d. V8 picture tube.<br>e. For open circuit in second of T17 and R62.<br>f. V13, 6B6-G tube and sawtooth generator V12B, 6SN7GT by oscilloscope waveform measurement.<br>g. Contact of high voltage anode capacitor to terminal of V8, picture tube.<br>h. Brightness control, R5, for open circuit, or R32 or R43.<br>i. V7-B, 12AU7 tube.<br>j. For continuity of deflection yoke or shorted turns.<br>k. For continuity of Horizontal Size control in T17 circuit. | b. If filament glows orange high voltage is being generated. See step (d).<br>f. If there is no waveform at T17.<br>j. In case of anode voltage very low. |
| 2. Raster normal. No picture or sound. | a. V2-A, 12AT7 oscillator tube.<br>b. Oscillator coil resonates outside of channel.<br>c. Antenna or lead-in.<br>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.<br>b. Speaker.<br>c. V2-A, 12AT7 oscillator tube. | c. Oscillator off-frequency. |
| 4. Raster normal. Sound normal. No picture. | a. 2nd, 3rd video i-f amplifier.<br>b. V7, 12AU7 tube.<br>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.<br>b. V7A, 12AU7 plate circuit components. | |

## TROUBLE SHOOTING (Continued)

| SYMPTOM | CHECK | REMARKS |
|---|---|---|
| 6. Picture normal. No vertical sync. | a. Grid (1) of V9, 6SN7GT.<br>b. Frequency of vertical sweep generator (V9).<br>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.<br>b. V12A—6SN7GT tube and its circuit components.<br>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.<br>b. For gassy or noisy V13, 6BG6G.<br>c. Noisy tubes of sweep or sync circuits.<br>d. Excess noise over antenna system. | a. Probably too high setting. |
| 10. Poor picture detail. | a. For mismatch maintenance and lead-in system.<br>b. For misalignment of i-f and r-f circuits.<br>c. For defective video chokes.<br>d. Focus control.<br>e. For overloading video amplifier.<br>f. Contrast control. | d. Should go through focus. |
| 11. Hum modulation. | a. Filter capacitor, C102.<br>b. Rectifier, SR1. | |
| 12. Audio motor boating. | a. V20 plate lead (blue wire). | a. Dress as far away as possible from V19B tube circuit components. |
| 13. Audible click when tuning. | a. C115, V18 B+ r-f by-pass (C113 was not used in some early production). | a. Connect a 5000 mmf ceramic capacitor from junction R81 and R82 to ground. |
| 14. Low sensitivity "R" receivers. | a. R8 (R8 was 1000 ohms in early "R" chassis receivers) | a. If R8 is 1000 ohms, replace with 100 ohms. |
| 15. Buzz modulation. | a. Excessive signal to converter grid.<br>b. Sound i-f alignment of T21. | a. Reduce signal by antenna pad.<br>b. Realign i-f circuit. |

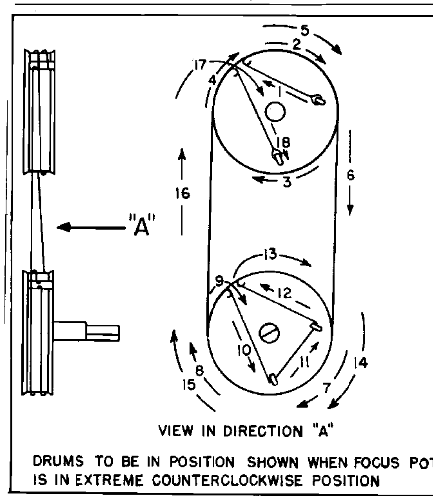



Fig. 33. Focus Control Stringing

## PRODUCTION CHANGES

**CHASSIS IDENTIFICATION**—To identify the receiver chassis incorporating major modifications in production, the chassis are identified by a letter stamped upon the front chassis apron adjacent to the Contrast Control shaft. The following identifications are given with respective modification and schematic diagram reference.

| CHASSIS STAMP | MODIFICATION | SCHEMATIC REFERENCE |
|---|---|---|
| No marking | None (early production) | Figure 40, page 18 |
| "R" | Automatic Gain Control added | Figure 41, page 19 |
| "T" | AGC plus improved Hor. Sweep Transformer and circuit | Figure 42, page 20 |

## AUTOMATIC GAIN CONTROL (AGC)

Automatic Gain Control is incorporated in the most part of the Model 830 production except for an approximate 1000 early production units.

Figure 34 shows a simplified schematic of the AGC circuit. All parts with the value of component indicated are common to the AGC circuit only. The dash line and associated components shown in phantom represent bias to the converter grid which was used on some receivers.

The AGC voltage is derived from the diode detector and clipper

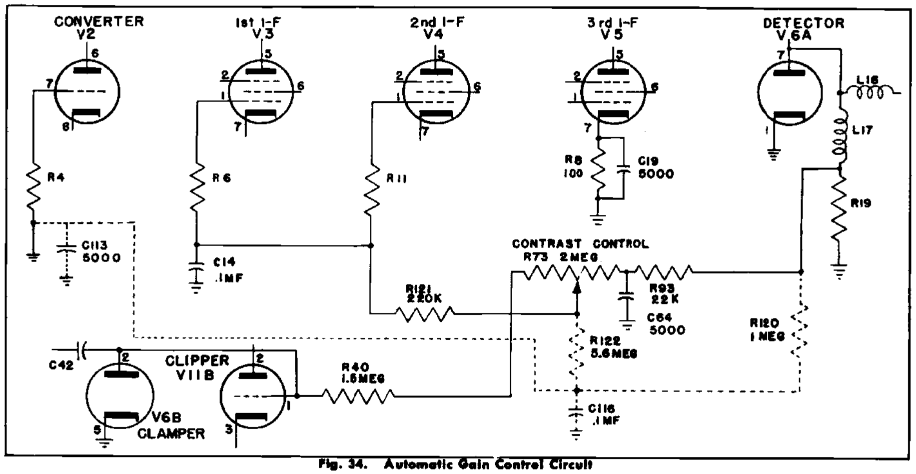



Fig. 34. Automatic Gain Control Circuit

grid circuit. By connecting the contrast control into the clipper grid circuit, it provides a source of high bias voltage which varies directly with the amplitude of the video carrier. The other end of the contrast control connects to the video detector load resistor to provide a lower potential bias source with the same characteristic so that it will provide for a minimum AGC bias when operating at weak signal strengths.

AGC provides for greater ease in tuning, as it eliminates to a large extent the necessity of resetting the contrast control each time a new station is selected. It minimizes airplane flutter and other signal strength changes which would otherwise affect the picture. BIAS RESISTOR, R8, OF V5—On some "R" chassis receivers, the bias resistor R8 was 1000 ohms. This was decreased to 100 ohms to increase receiver sensitivity.

## HORIZONTAL SWEEP OUTPUT CIRCUIT

The use of a new and improved sweep output transformer and associated circuit was introduced after the "R" chassis production change. All parts with the value indicated in Figure 35 are common to the "T" chassis only.

This new transformer is an open coil type assembly with a ceramic iron core, in contrast to the earlier type molded coil assembly with laminated core used in the early and "R" production chassis. The high voltage tertiary winding is placed over the primary and secondary so that its distance to the core is increased, thus minimizing the probability of insulation breakdown and corona effect. The special core, composed of iron oxides suspended in a ceramic material, is more efficient in reduction of power losses than the more conventional solid metallic transformer cores used in earlier sweep output circuits. In addition, the core itself is an insulator.

***ADDITION OF C117, R123, AND C118***—The addition of these components were added in the greater part of "T" chassis production to improve horizontal sweep output phasing.

The components R123 and C118 are connected in the sweep output circuit at the damper tube, V15, plate as shown in the schematic of Figure 35.

The capacitor C117 is connected across the cathode resistor R109 of the Phase Inverter Tube, V11A. See Figure 42, page 20, Schematic Diagram of "T" Chassis.

***PICTURE TUBE BRIGHTNESS***—R53, part of the picture tube brightness control circuit in "T" chassis receivers, was changed during this production to fix the minimum bias on the picture tube. This resistor, shown in Figure 36 connected from the Brightness Control to ground, was changed to 220,000 ohms. This change prevents: blooming of the picture (excess brightness), and change in picture size, as the Brightness control is advanced to maximum at the clockwise position.

***REMOVAL OF RETRACE LINES (R118, R119, C85 AND C110)***—The components R118, R119, C85 and C110 were added during "T" chassis production and are connected as shown in Figure 36, Brightness Control Circuit for "T" Receivers. The addition of these components results in a relatively high positive voltage supplied to the picture tube cathode from the vertical sweep output circuit during vertical retrace. The picture tube is biased to cut-off, resulting in most of the retrace lines being eliminated from the screen. This is an operating advantage since it eliminates the need for readjustment of the Brightness or Contrast Control, to remove retrace lines which oftentimes accompany a change in cameras or program material that takes place at the transmitter.

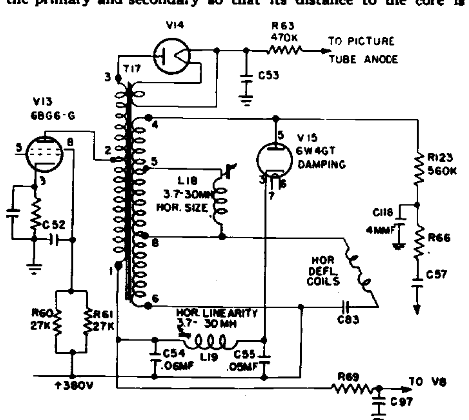



Fig. 35. Horizontal Sweep Output ("T" production)

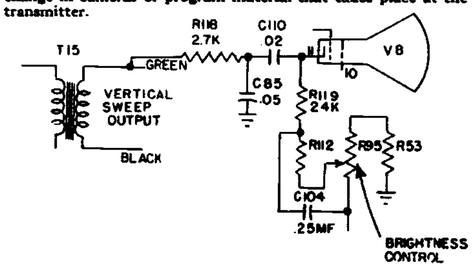



Fig. 36. Brightness Control and Vertical Retrace Blanking ("T" production)

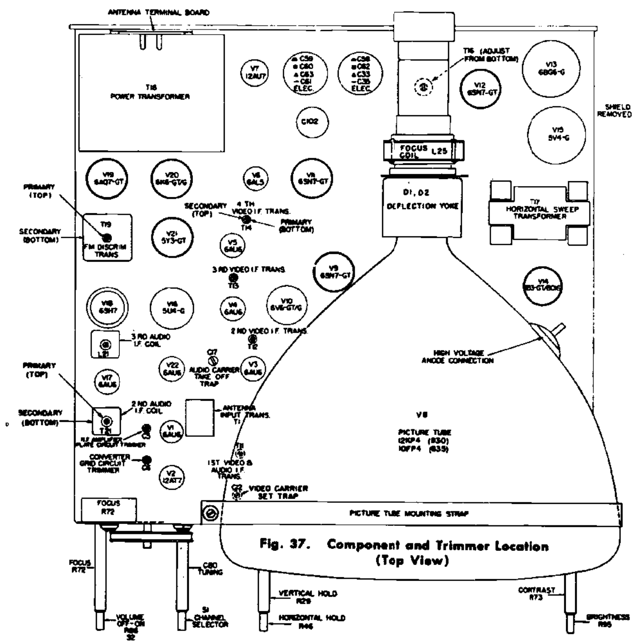



Fig. 37. Component and Trimmer Location (Top View)

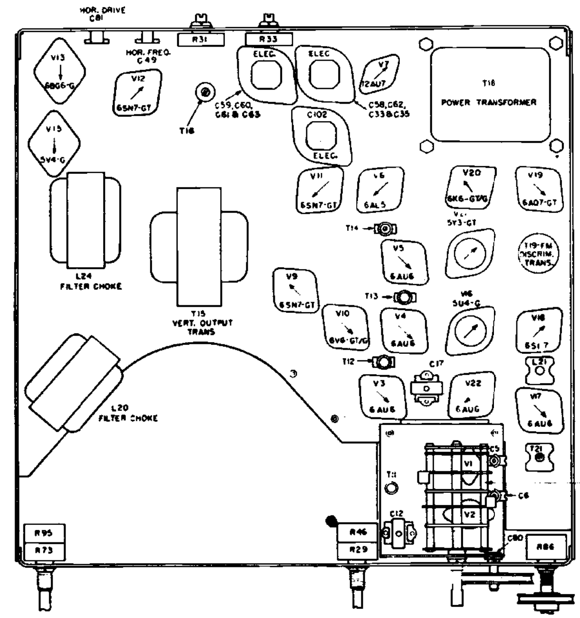



Fig. 38. Component and Trimmer Location (Bottom View)

MODEL 830

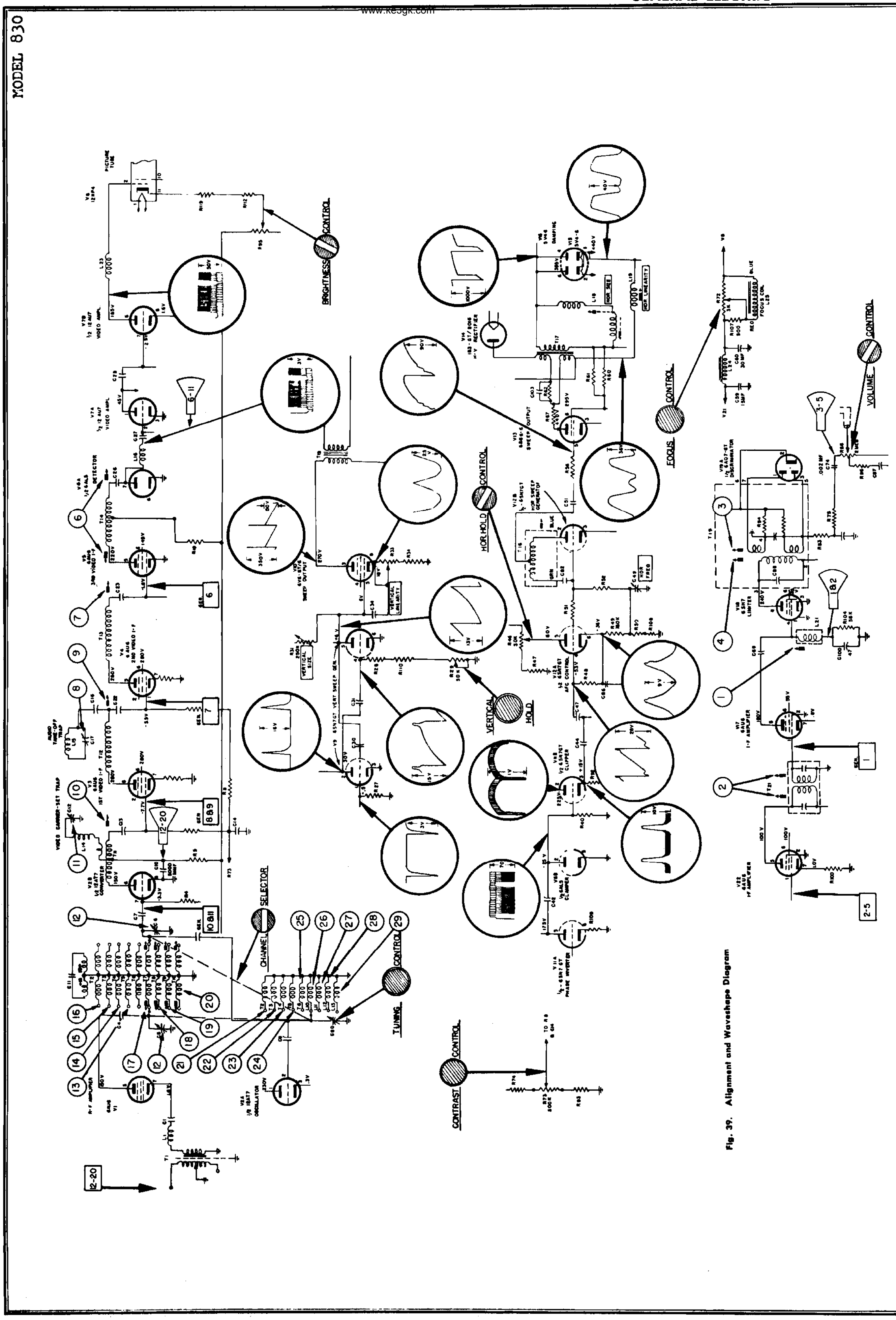



Fig. 39. Alignment and Waveshape Diagram

MODEL 830

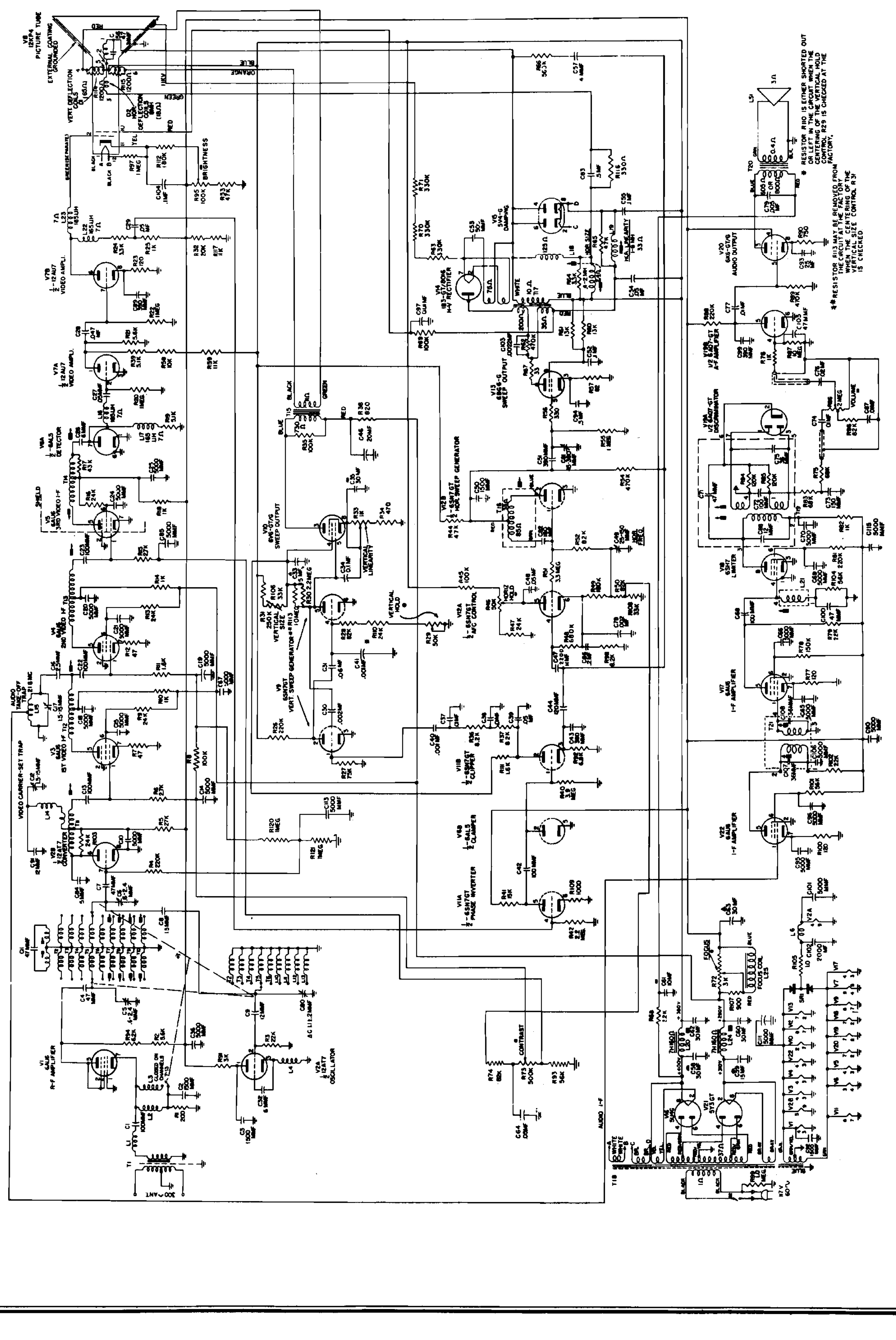


Fig. 40. Schematic Diagram, Early Production Receivers

MODEL 830

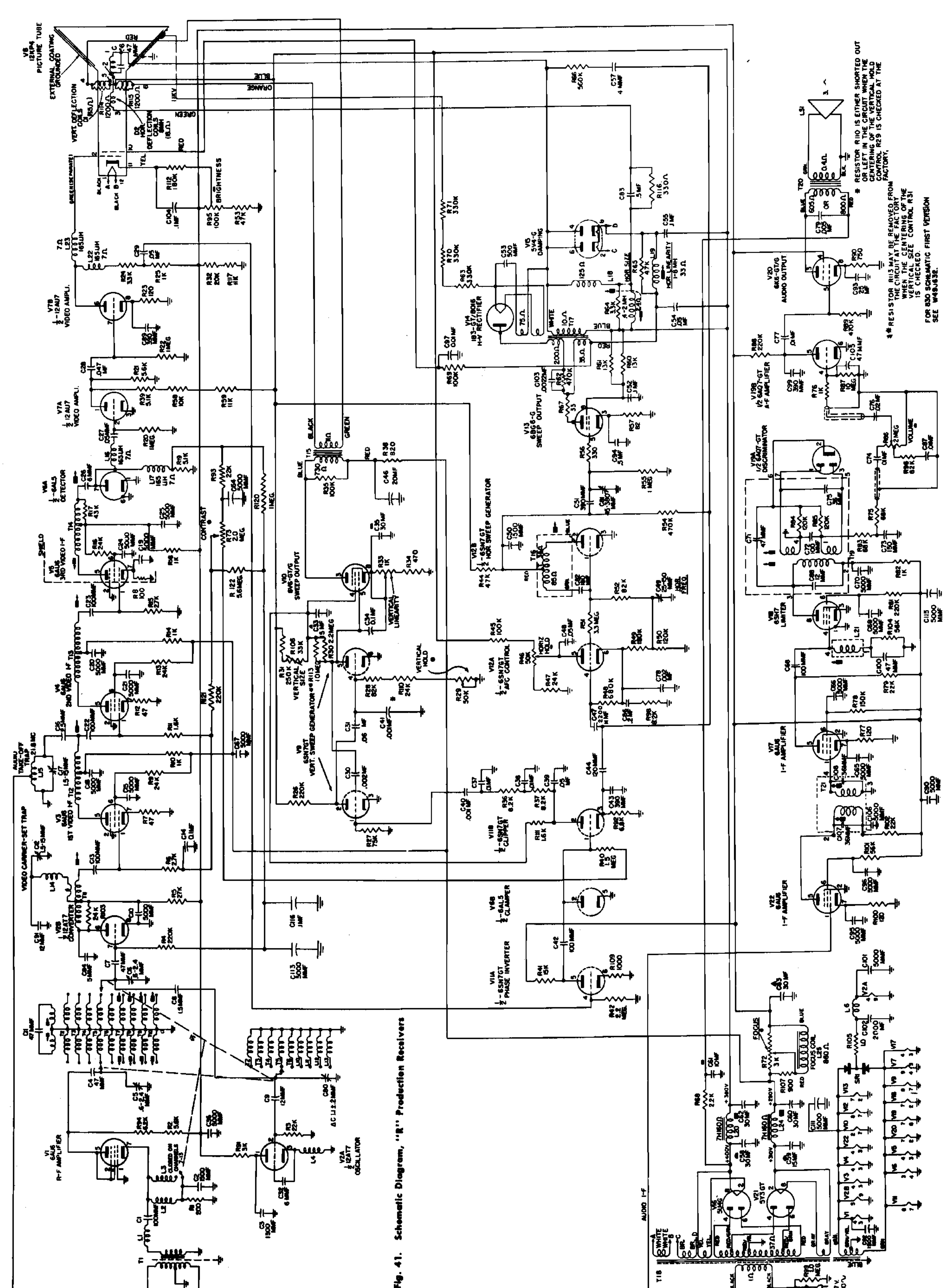



Fig. 41. Schematic Diagram, "R" Production Receivers

MODEL 830

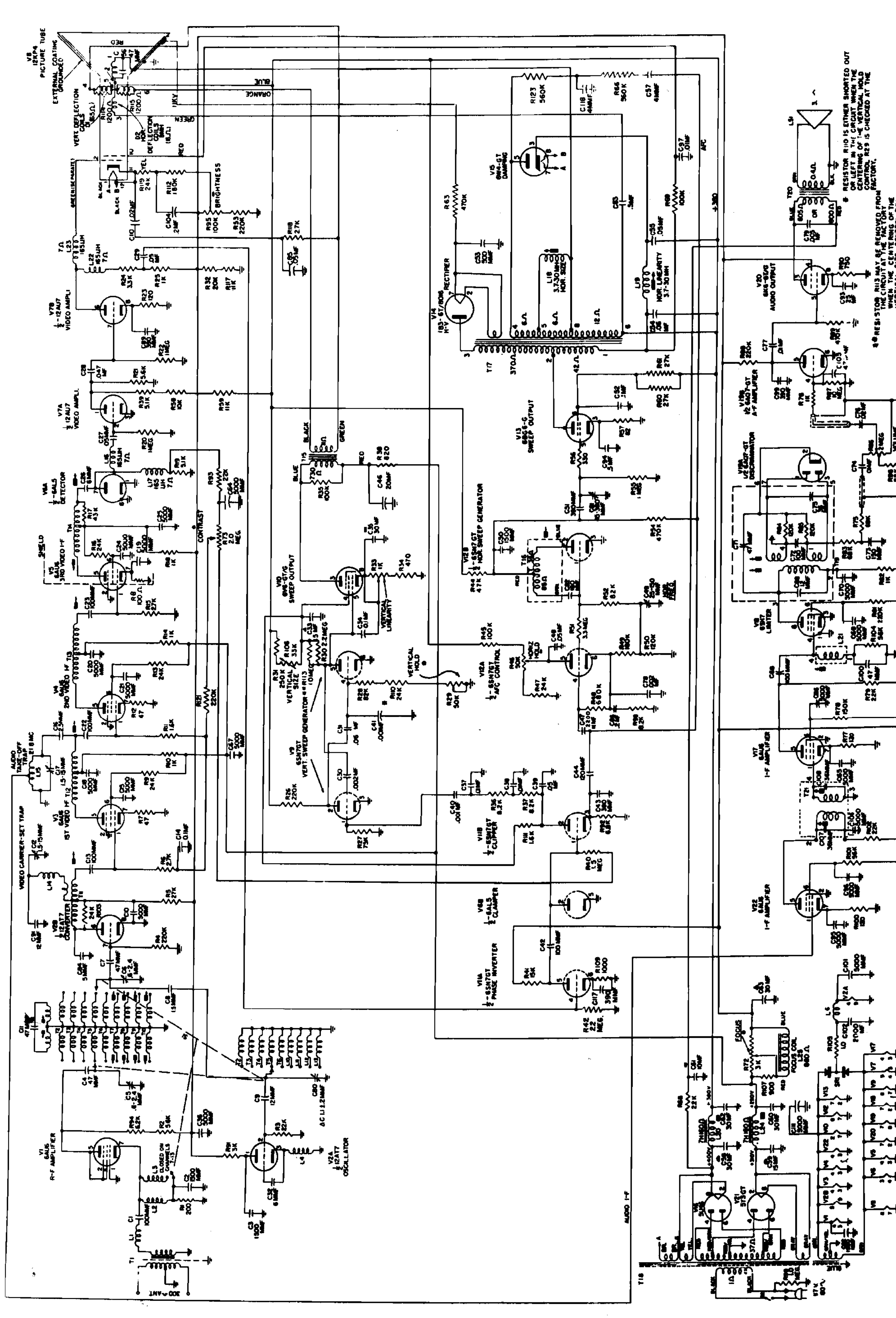


Fig. 42. Schematic Diagram, "T" Production Receivers

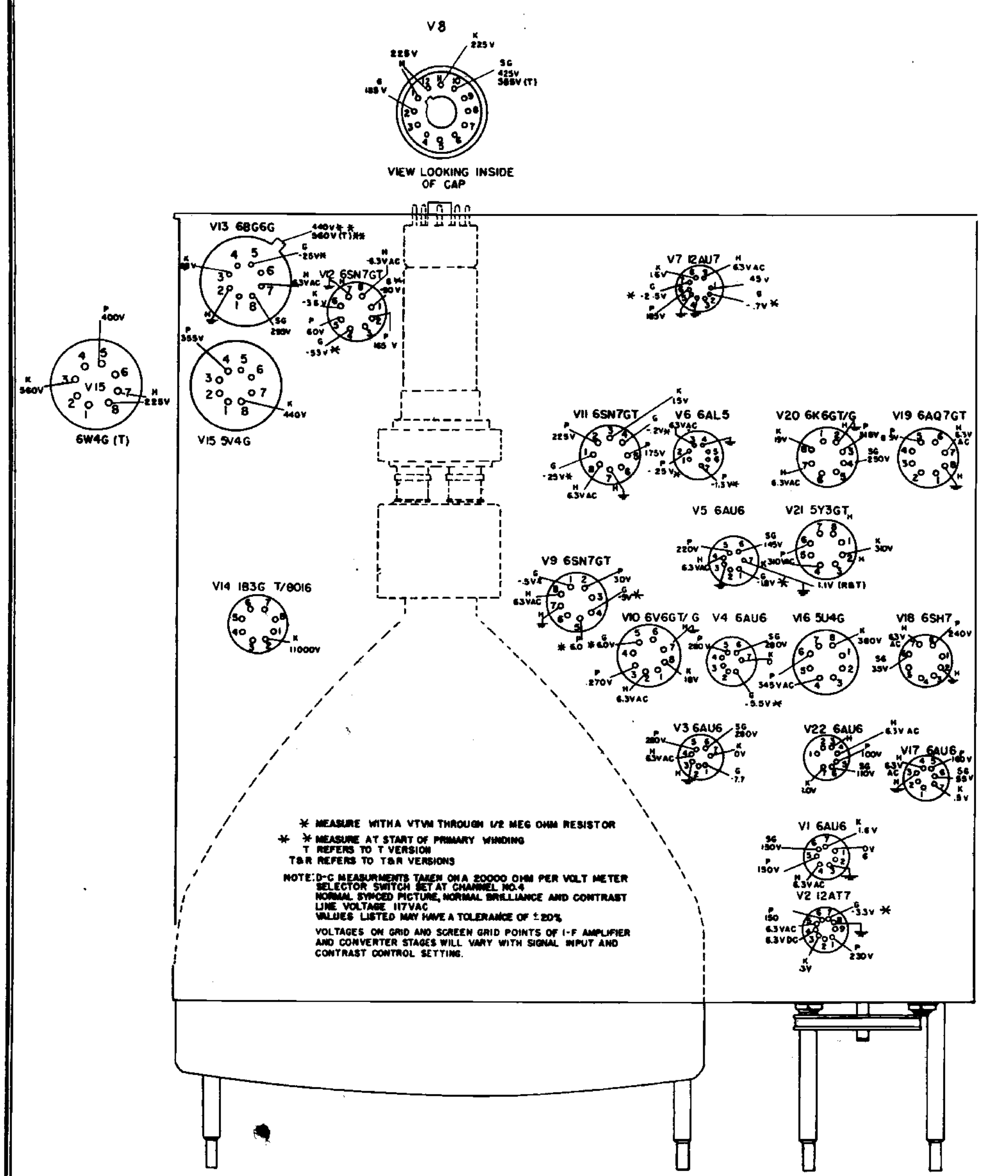



Fig. 43. Socket Pin Voltages

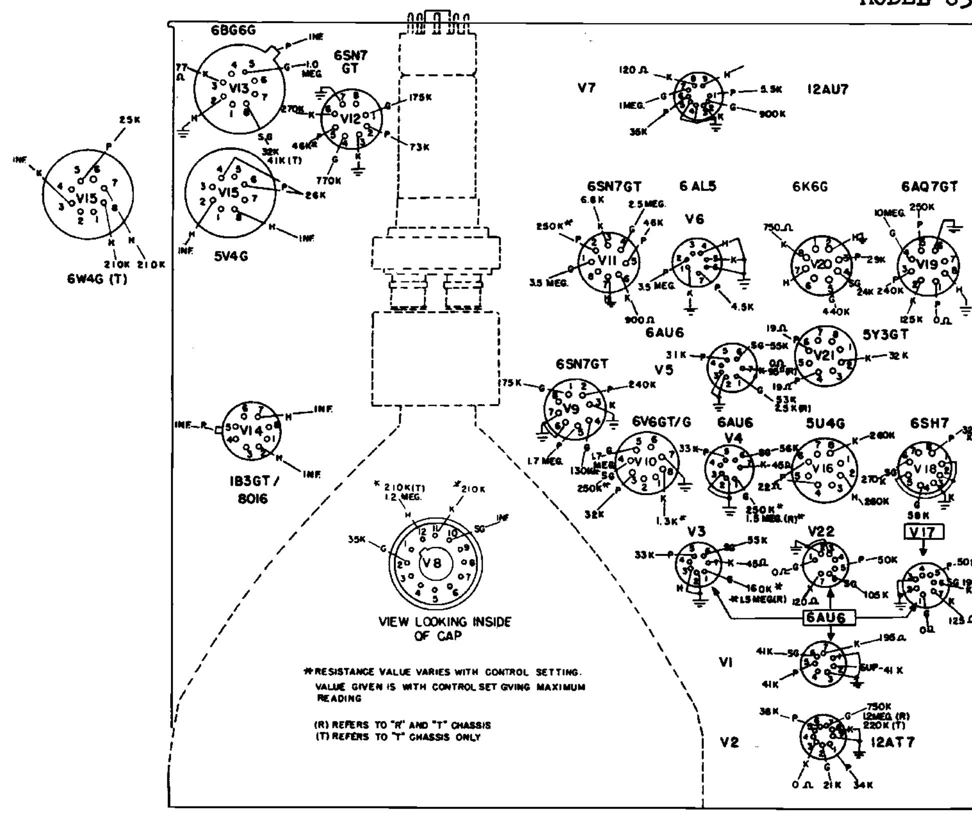



Fig. 44. Socket Pin Resistances



## MODEL 830—REPLACEMENT PARTS LIST

### UNIVERSAL REPLACEMENT PARTS

| Cat. No. | Symbol | Description | Cat. No. | Symbol | Description |
|---|---|---|---|---|---|
| UCC-014 | C86 | CAPACITOR—.2 mfd., 200 v., paper | URD-025* | R8 | RESISTOR—100 ohms, ½ w., carbon |
| UCC-018 | C40, 41 | CAPACITOR—.001 mfd., 400 v., paper | URD-037 | R56, 116‡ | RESISTOR—330 ohms, ½ w., carbon |
| UCC-621 | C78 | CAPACITOR—.002 mfd., 600 v., paper | URD-043 | C114, 115 | RESISTOR—560 ohms, ½ w., carbon |
| UCC-630 | C37, 38, 74, 87 | CAPACITOR—.01 mfd., 600 v., paper | URD-049 | R10, 14, 18, 76, 82, 109 | RESISTOR—1000 ohms, ½ w., carbon |
| UCC-631 | C76, 110 ⊕ | CAPACITOR—.02 mfd., 600 v., paper | URD-059 ⊕ | R118 | RESISTOR—2700 ohms, ½ w., carbon |
| UCC-635 | C27, 29, 39, 48, 54‡, 64†, 55 ⊕, 85 ⊕ | CAPACITOR—.05 mfd., 600 v., paper | URD-065 | R65 | RESISTOR—4700 ohms, ½ w., carbon |
| | | | URD-069 | R92 | RESISTOR—6800 ohms, ½ w., carbon |
| | | | URD-071 | R36, 37, 98 | RESISTOR—8200 ohms, ½ w., carbon |
| UCC-640 | C14*, 34, 52, 55‡, 104, 116* | CAPACITOR—.1 mfd., 600 v., paper | URD-081* | R93 | RESISTOR—22,000 ohms, ½ w., carbon |
| UCU-1506 | C91 | CAPACITOR—12 mmf., mica | URD-091 | R93†, 101, 104 | RESISTOR—56,000 ohms, ½ w., carbon |
| UCU-1528 | C42, 68 | CAPACITOR—100 mmf., mica | | | |
| UCU-1530 | C44 | CAPACITOR—120 mmf., mica | URD-093 | R75†, 83 | RESISTOR—68,000 ohms, ½ w., carbon |
| UCU-1532 | C73 | CAPACITOR—150 mmf., mica | | | |
| UCU-1542 | C43, 51, 89, 99, 117 ⊕ | CAPACITOR—390 mmf., mica | URD-095 | R74†, 96 | RESISTOR—82,000 ohms, ½ w., carbon |
| UCU-2534 | C82 | CAPACITOR—180 mmf., mica | URD-097 | R8†, 35, 110 | RESISTOR—100,000 ohms, ½ w., carbon |
| UCU-2560 | C47 | CAPACITOR—2200 mmf., mica | | | |

## MODEL 830—REPLACEMENT PARTS LIST (Continued)

### UNIVERSAL REPLACEMENT PARTS (Continued)

| Cat. No. | Symbol | Description |
|---|---|---|
| URD-099 | R50*, 84, 85 | RESISTOR—120,000 ohms, ½ w., carbon |
| URD-101 | R78 | RESISTOR—150,000 ohms, ½ w., carbon |
| URD-103 | R112 | RESISTOR—180,000 ohms, ½ w., carbon |
| URD-105 | R81, 88, 121*, 53 ⊕ | RESISTOR—220,000 ohms, ½ w., carbon |
| URD-113 | R54, 62, 63 ⊕, 89 | 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, 120, 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 | R87, 113 | 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-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, 90, 103, 110, 119 ⊕ | RESISTOR—24,000 ohms, ½ w., carbon |
| URD-1085 | R108† | RESISTOR—33,000 ohms, ½ w., carbon |
| URD-1088 | R17 | RESISTOR—43,000 ohms, ½ w., carbon |
| URD-1089‡ | R53 | RESISTOR—47,000 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 |

| Cat. No. | Symbol | Description |
|---|---|---|
| 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-013 | R67 | RESISTOR—33 ohms, 1 w., carbon |
| URE-041 | R34 | RESISTOR—470 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, 1 w., carbon |
| URE-097 | R45 | RESISTOR—100,000 ohms, 1 w., carbon |
| URE-109‡ | R63, 70, 71 | RESISTOR—330,000 ohms, 1 w., carbon |
| URE-1046 | R90 | RESISTOR—750 ohms, 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 |
| URE-1133 | R51 | RESISTOR—3.3 meg., 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-1057 | R68 | RESISTOR—2200 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, 117 | 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-091 | | CABINET BACK |
| RAG-020 | | GRILLE—Cabinet grille |
| RAV-082 ★ | | CABINET |
| RAX-025 | | CENTERING RING AND SUPPORT ASSEMBLY |
| RCC-016 | C83, 94 | CAPACITOR—.5 mfd., 200 v. |
| RCC-039 | C79 | CAPACITOR—.005 mfd., 600 v., paper (oil) |
| RCC-040 | C77, 97 | CAPACITOR—.01 mfd., 600 v., paper (oil) |
| RCC-045 | C31 | CAPACITOR—.05 mfd., 600 v., paper (molded) |
| RCC-097 | C30 | CAPACITOR—.002 mfd., 600 v., paper (molded) |
| RCE-076 | C33, 35, 58, 62 | CAPACITOR—15 mfd., 450 v.; 30 mfd., 50 v.; 30 mfd., 450 v.; 30 mfd., 450 v.; electrolytic |
| RCE-077 | C59, 60, 61, 63 | CAPACITOR—15 mfd., 450 v.; 30 mfd., 450 v.; 10 mfd., 450 v.; 30 mfd., 450 v.; electrolytic |
| RCE-083 | C102 | CAPACITOR—2000 mfd., electrolytic |
| RCE-086 | C93 | CAPACITOR—25 mfd., 25 v., electrolytic |
| RCE-093 | C46 | CAPACITOR—20 mfd., 450 v., electrolytic |
| RCN-014 | C28 | CAPACITOR—.047 mfd., 600 v., paper (molded) |
| RCN-019 | C103 | CAPACITOR—.0022 mfd., 1000 v., paper |
| RCN-020 | C57, 118 ⊕ | CAPACITOR—4 mmf., 800 v., mica |
| RCN-021 | C56 | CAPACITOR—47 mmf., 800 v., mica |
| RCN-023 | C53 | CAPACITOR—500 mmf., 20,000 v. (molded) |
| RCU-285 | C50 | CAPACITOR—1500 mmf., mica |
| RCW-026 | C2, 3, 92 | CAPACITOR—1500 mmf., ceramic |
| RCW-066 | C88 | CAPACITOR—12 mmf., ceramic |
| RCW-1002 | C26 | CAPACITOR—6 mmf., ceramic |
| RCW-1043 | C100, 105 | 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 |

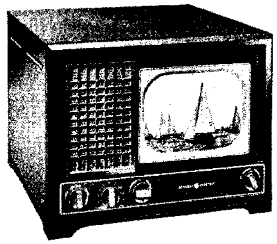
| Cat. No. | Symbol | Description |
|---|---|---|
| RCW-2006 | C9 | CAPACITOR—12 mmf., ceramic |
| RCW-2010 | C11, 71 | CAPACITOR—47 mmf., ceramic |
| RCW-2019 | C75 | CAPACITOR—36 mmf., ceramic |
| RCW-2030 | C32 | CAPACITOR—6 mmf., ceramic |
| RCW-2035 | C84 | CAPACITOR—5 mmf., ceramic |
| RCW-3014 | C10, 14†, 15, 18, 19, 20, 21, 24, 25, 36, 64*, 65, 66, 67, 69, 70, 85†, 90, 95, 96, 101, 106, 111, 113,‡ 115* | CAPACITOR—5000 mmf., ceramic |
| RCW-3017 | C16 | CAPACITOR—2.5 mmf., ceramic |
| RCY-045 | C49 | CAPACITOR—25-150 mmf., mica trimmer |
| RCY-046 | C80 | CAPACITOR—1.1 mmf., variable tuning capacitor |
| RCY-047 | C12, 17 | CAPACITOR—1.5-15 mmf., mica trimmer |
| RCY-048 | C5, 6 | CAPACITOR—0.6-2.4 mmf., trimmer |
| RCY-054 | C81 | CAPACITOR—45-380 mmf., trimmer |
| RDC-032 | | CORD—[illegible] focus and tuning control drive (25 yds. bulk) |
| RDE-047 | | ESCUTCHEON—Knob escutcheon on cabinet |
| 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—On-Off switch and volume, channel selector control knobs |
| RDW-018 | | SAFETY GLASS—Picture tube safety glass |
| 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 |

### SPECIALIZED REPLACEMENT PARTS (Continued)

| Cat. No. | Symbol | Description |
|---|---|---|
| REI-016 | | CORE—Tuning core for T11, T12, T13, T14 secondary 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—Tuning core for primary of T14 |
| REI-027 ⊕ | | CORE—Adjustment core for horizontal linearity and horizontal size control, L18, L19 |
| RER-003 | SR1 | RECTIFIER—Selenium rectifier |
| RHM-025 | | WASHER—"C" washer, retains tuning shaft or focus control shaft |
| RHM-054 | | SLEEVE—Fibre sleeve centers focus coil and deflecting yoke with tube neck |
| RHM-057 | | CENTERING RING—Larger and removable ring for picture centering |
| RHX-014 | | LEAD TUBE CAP—Cap and spring used on 12AT7 tube, V2 |
| RJC-001 | | CONNECTOR—Speaker connector |
| RJC-008 ⊕ | | CONNECTOR—Picture tube anode connector |
| RJC-010‡ | | CONNECTOR—Picture tube anode connector |
| RJF-003 | | CONNECTOR—Connector cap for V13 and V14 |
| RJJ-007 | | RECEPTACLE—A-c power receptacle |
| RJS-003 | | SOCKET—Tube socket for V9, V10, V11, V18, V19, and V20 |
| 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-120 | | SOCKET—Tube socket for V7 |
| RJS-126 | | SOCKET—Tube socket for picture tube, V8 |
| RJS-127 | | SOCKET—Tube socket for V2 |
| 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 (Channels 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-010 | D1, 2 | SWEEP YOKE—Vertical and horizontal deflection coils |
| RLD-014 ⊕ | L18, 19 | COIL—Horizontal linearity and horizontal size control |
| RLF-017 | L25 | 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 choke |

| Cat. No. | Symbol | Description |
|---|---|---|
| RLI-019 | L4 | CHOKE—V2-A oscillator cathode |
| RLI-038 | L16, 17, 22, 23 | CHOKE—Video circuit chokes (165 microhenries) |
| RLI-059 | L20 | CHOKE—7 henry, high voltage supply filter |
| RLI-060 | L24 | CHOKE—7 henry, low voltage supply filter choke |
| RLI-061 | L15 | CHOKE—Audio take-off trap |
| RLT-004‡ | T17 | COILS—Primary and secondary windings only, for horizontal sweep and high voltage |
| RMB-015 | | BALL—Detent spring index ball for channel selector |
| RMF-003 | | CLAMP—Tube clamp for V13 and V16 |
| RMF-012 | | PICTURE TUBE STRAP—Metal strap around bell of picture tube |
| RMM-084 | | CUSHION—Rubber cushion for picture tube mounting |
| RMM-094 | | RUBBER CUSHION—For picture tube mounting, 11 5/16 x ¼ x 3/16 in. |
| RMM-095 | | RUBBER CUSHION—For picture tube mounting, 11 5/16 x ¼ x 3/16 in. |
| RMM-096 | | RUBBER CUSHION—For picture tube mounting, 12 15/16 x ¼ x 3/16 in. |
| RMS-164 | | SPRING—Detent spring, on channel selector switch shaft |
| RMU-043 | | SHAFT—Tubular shaft for focus control |
| RMU-047 | | SHAFT—Channel selector switch shaft |
| RMU-048 | | SHAFT—Tubular shaft for tuning control |
| RMW-045 | | PULLEY—Pulley and hub assembly on tuning shaft of C80 |
| RMW-048 | | PULLEY—Pulley and hub assembly (drive on focus potentiometer shaft) |
| RMW-049 | | PULLEY—Pulley and hub assembly (drive on tubular shaft of focus control) |
| ROP-017 | | LOUDSPEAKER |
| RRC-084 | | POTENTIOMETER—250,000 ohms (vertical size) |
| RRC-086 | R33 | POTENTIOMETER—1000 ohms, 2 w., w.w. (vertical linearity) |
| RRC-090 | R29, 46 | POTENTIOMETER—50,000 ohms—50,000 ohms (Dual, vertical hold—horizontal hold) |
| RRC-091 | R86, S2 | POTENTIOMETER—2 meg. (Volume control and On-Off switch S2) |
| RRC-101† | R73, 95 | POTENTIOMETER—500,000-100,000 ohms (Dual, contrast-brightness) |
| RRC-105* | R73, 95 | POTENTIOMETER—2 meg.—100,000 ohms (Dual, contrast-brightness) |
| RRW-033 | R72 | POTENTIOMETER—3000 ohms, 25 w., w.w. (focus) |
| RRW-034 | R105 | RESISTOR—1.0 ohm, ½ w., w.w. |
| RRW-035 | R107 | RESISTOR—900 ohms, 7 w., w.w. |
| RTD-007 | T19 | TRANSFORMER—Audio discriminator |
| RTL-081 | T11 | TRANSFORMER—1st video I-F |
| RTL-082 | T12 | TRANSFORMER—2nd video I-F |
| RTL-083 | T13 | TRANSFORMER—3rd video I-F |
| RTL-085 | L21 | TRANSFORMER—Audio, 2nd I-F |
| RTL-089 | T14 | TRANSFORMER—4th video I-F |
| RTL-090 | T21 | TRANSFORMER—Audio, 1st I-F |
| RTM-003 | T16 | TRANSFORMER—Horizontal sweep blocking oscillator |
| RTO-052 | T20 | TRANSFORMER—Audio output |
| RTO-053 | T15 | TRANSFORMER—Vertical sweep output |
| RTO-068 ⊕ | T17 | TRANSFORMER—Horizontal sweep and high voltage |
| RTP-066 | T18 | TRANSFORMER—Power transformer, 60 cycles |
| RTP-301 ⊕ | T18 | TRANSFORMER—Power transformer, 60 cycles |
| RWL-019 | | POWER CORD AND PLUG—Includes outlet plug and chassis interlock plug |

NOTE: The following notes of catalogue numbers and listed values are given below:
†Not used in chassis marked "R" or "T."
‡Not used in chassis marked "T."
*Used only in chassis marked "R" or "T."
⊕Used only in chassis marked "T."
§Used only in chassis marked "R."
★Special discount applies.



## SPECIFICATIONS

**OVER-ALL DIMENSIONS:**

Height ........ 14⅞ inches
Width ........ 19 inches
Depth ........ 20⅛ inches

**ELECTRICAL RATING:**

Frequency ........ 60 cycles
Voltage ........ 115 volts
Wattage ........ 220 watts

**R-F FREQUENCY RANGE:**

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

**INTERMEDIATE FREQUENCIES:**

Video (Carrier Equivalent) ........ 26.3 mc
Audio ........ 21.8 mc

**AUDIO OUTPUT:**

Undistorted ........ 1.5 watts
Maximum ........ 4.0 watts

**LOUDSPEAKER:**

Type ........ Alnico PM Dynamic
Cone Diameter ........ 5¼ inches
Voice Coil Impedance (400 cycles) ........ 3.2 ohms

**PICTURE SIZE:**

Height ........ 6⅜ inches
Width ........ 8½ inches

**ANTENNA REQUIREMENTS:**

Type ........ Folded dipole or equivalent
Impedance ........ 300 ohms

**TUBE COMPLEMENT (22, INCLUDING RECTIFIERS)**

| *Symbol* | *Purpose* | *Type* |
|---|---|---|
| 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 | 10FP4 |
| V9 | Vertical Sweep Generator | 6SN7GT |
| V10 | Vertical Sweep Output | 6V6GT |
| V11 | Phase Inverter—Clipper | 6SN7GT |
| V12 | Horizontal AFC—Sweep Generator | 6SN7GT |
| V13 | Horizontal 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—Amplifier | 6AQ7GT |
| V20 | Audio Output | 6K6GT/G |
| V21 | Rectifier | 5Y3GT |
| V22 | Audio I-F Amplifier | 6AU6 |

## GENERAL INFORMATION

The General Electric television receiver is a table model type, using 22 tubes to provide reception in the 12 commercial television channels. The television picture is reproduced on a 10-inch electromagnetically deflected picture tube.

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, ten-inch picture tube with aluminumized screen and a high fidelity FM audio system. In a later production, automatic Gain Control has been added.

## 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 (9000 V.) AT THE PICTURE TUBE ANODE WILL GIVE AN UNPLEASANT SHOCK BUT DOES NOT SUPPLY ENOUGH CURRENT TO GIVE A FATAL BURN OR SHOCK. HOWEVER, SECONDARY HUMAN REACTIONS TO OTHERWISE HARMLESS SHOCKS HAVE BEEN KNOWN TO CAUSE INJURY. SINCE THE HIGH VOLTAGE IS OBTAINED FROM THE B+ VOLTAGE, CERTAIN PORTIONS OF THE HIGH VOLTAGE GENERATING CIRCUIT ARE DANGEROUS AND EXTREME PRECAUTIONS SHOULD BE OBSERVED.

THE PICTURE TUBE IS HIGHLY EVACUATED AND IF BROKEN, GLASS FRAGMENTS WILL BE VIOLENTLY EXPELLED. IF IT IS NECESSARY TO HANDLE THE PICTURE TUBE, USE SAFETY GOGGLES AND GLOVES. ALWAYS WEAR GOGGLES WHEN CHASSIS IS REMOVED FROM CABINET.

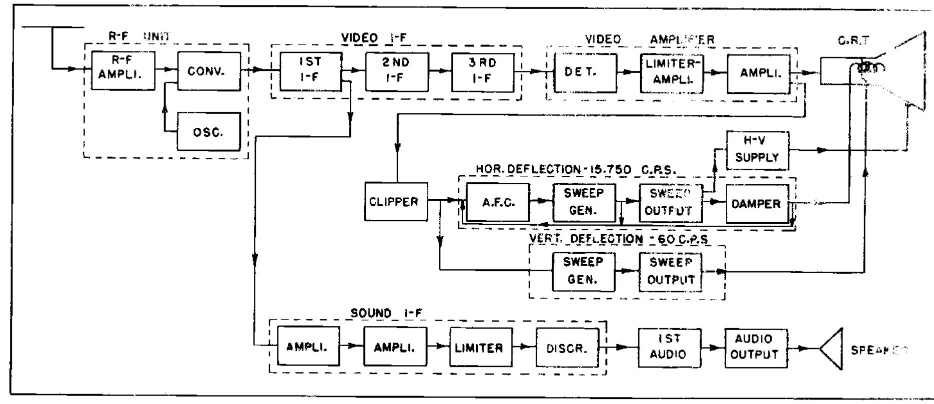



**Fig. 1. Block Diagram, Model 835**

## DESCRIPTION—TELEVISION CIRCUITS

The receiver circuits are divided into the following sections:

1. R-F amplifier, converter and oscillator.
2. Video and audio i-f amplifier.
3. Video detector and amplifier.
4. Sync separation.
5. Horizontal sweep generator and AFC sync.
6. Horizontal sweep output.
7. Vertical sweep generator and output.
8. High voltage power supply.
9. Low voltage power supply.

A brief description of the operation of each section is described 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 as shown in Figure 38.

Some of the following circuits are somewhat modified in the later production of receivers incorporating Automatic Gain Control. These chassis are identified by the letter "R" stamped upon the front apron adjacent to the contrast control shaft.

A block diagram of the complete Model 835 receiver is shown in Figure 1 to assist in signal tracing and to better visualize the operation of the receiver as a whole.

***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 triode grounded grid 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 lead-in at all frequencies. The transformer, T1, is balanced to ground in the primary winding providing cancellation of noise pick-up on the antenna lead-in. An electrostatic shield is incorporated between the primary and secondary windings to prevent noise 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 the shunting effect of the cathode bias resistor and by-pass capacitor, R1 and C2. It 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 tube 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 of the r-f transformer, respectively, to permit compensation for misalignment resulting from differences of tube capacities when a tube change is necessary. On Channel No. 2, Fig. 38, the transformer is triple tuned to provide better image frequency attenuation of the 88-108 mc FM band. Three of the transformers, T8, T9, and T10, are used to cover the upper six channels. Each transformer is made sufficiently broad-band to accept two television channels.

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

The oscillator makes use of the remaining half of the Type 12AT7 tube, V2A, and is capacity coupled to the converter tube 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 being sufficient to tune two channels.

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

The r-f amplifier, converter and oscillator section is constructed as a complete unit 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 makes use of a three-stage bandpass amplifier using three Type 6AU6 tubes. The transformers, T11, T12, T13, and T14, are overcoupled and then loaded with resistance in the

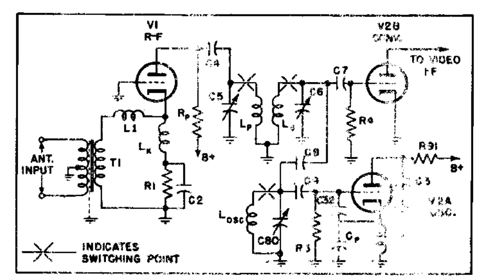



**Fig. 2. R-F Amplifier, Converter and Oscillator**

secondary circuits to give an adequate bandpass frequency characteristic. A single movable powdered iron core is used in transformers, T11, T12 and T13, for tuning. This adjusts the secondary side. The transformer T14 uses two tuning slugs to tune both primary and secondary. A 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 falls at the 50 per cent point on the curve to compensate for the sesqui-sideband transmission of the video carrier frequencies.

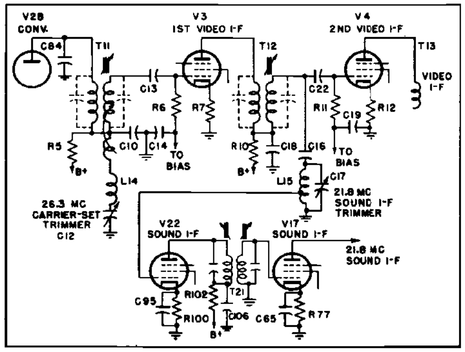



Fig. 3. Video and Audio I-F Amplifier

A series-tuned trap 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 21.8 mc in the video amplifier. This affords the necessary attenuation of the accompanying sound i-f from being passed through the video i-f and in addition is used to take-off the sound i-f for the audio i-f channel. The audio i-f is taken off at a tap on the inductance, L15, and then applied directly to the grid of the audio i-f amplifier tube V22. Additional i-f gain and selectivity is provided by two stages of amplification. Since the television audio is frequency modulated, the transformer T19 functions with the diode section 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. A potentiometer (Contrast) control, permits this voltage to be changed on V3 and V4 so as to vary the gain of the video 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 so as 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 L22 and L17 are shunt compensating coils. These are used to obtain good high frequency response and provide sharp cut-off at frequencies above the usable pass band. L16 also helps prevent harmonics of 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 the plate circuit is low and the video signal from the detector is negative-going. Any large excursions of voltage above sync level such as introduced by transient 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.

With the use of capacity coupling in the video amplifier, the d-c component of the video signal must 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 charges 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 restoration of the d-c. 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 changed.

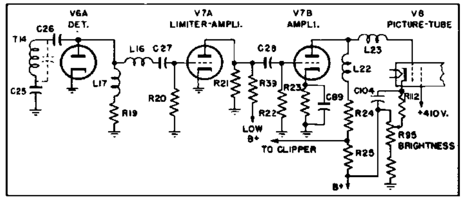



Fig. 4. Video Detector and Amplifier

**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, and V11B.

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 and plate circuits of V11B, leaving only the sync pulses. The horizontal synchronizing pulses are developed across R92 in the cathode of V11B and are positive-going. The vertical pulses are developed at the plate of V11B and are negative-going.

An integrating network consisting of C39, R37, C38, R36, and C37, is used to separate the horizontal sync from the vertical sync pulses before passage of the sync signal to the vertical sweep generator.

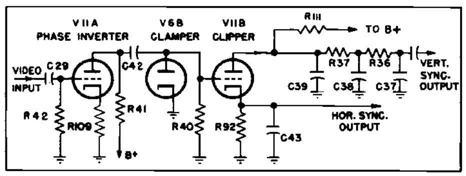



Fig. 5. Sync Separator Circuit

**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 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.

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 tube 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 to 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 plate 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 thus result in a change of frequency in the sweep generator. Thus if the contributing voltage of R50 makes the grid of V12B less

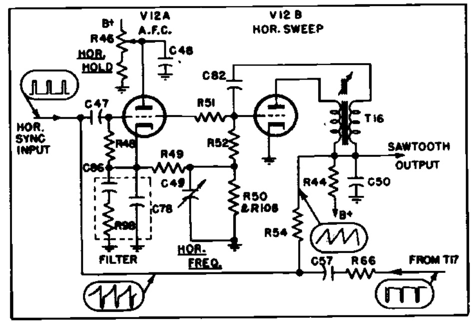



Fig. 6. Horizontal Sweep and A.F.C. Sync

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.

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 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 an 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 be running 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, C49, is a capacitor that 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 course 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.

**6. HORIZONTAL SWEEP OUTPUT** (SEE FIGURE 8)—The horizontal sawtooth voltage generated by the blocking oscillator,

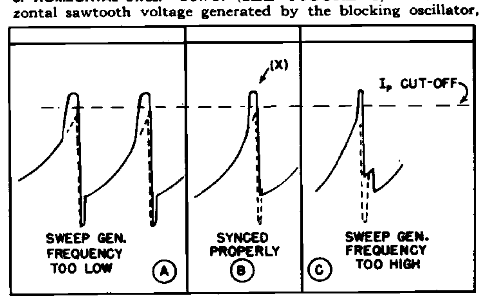



Fig. 7. A.F.C. Waveshapes

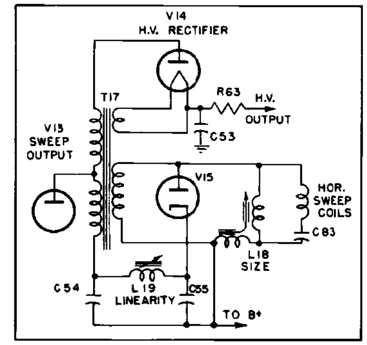



Fig. 8. Horizontal Sweep Output

V12B, is shaped and then amplified by a Type 6BG6G tube, V13. The output of this tube is coupled to the horizontal deflection coils through an impedance matching transformer, T17. The damping tube 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, constitute 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, Fig. 38, 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 to the yoke. The inductance is variable in both coils of this control; the inductance of the series choke is maximum when the parallel choke 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 6SN7GT 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 the potentiometer, R29. Sweep size or height of picture is changed by the potentiometer, R31, which changes the B+ voltage applied to the charging network (R30, C34) 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

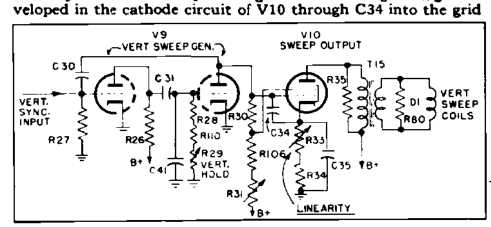



Fig. 9. Vertical Sweep and Output