This relationship will hold ONLY if the spot has been centered exactly on the screen, that both amplifiers have been adjusted to give the same deflection and that the calibrated scale has been adjusted to coincide exactly with the vertically displaced signal.

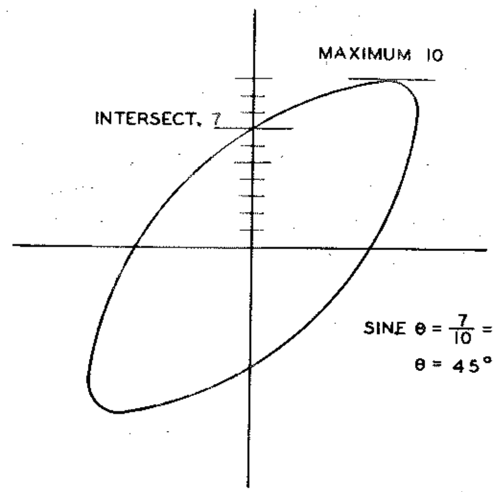


**Figure 16**

**Method of Calculating Phase Shift**

## C. AUDIO AMPLIFIER TESTING

Many characteristics of performance and operation of audio amplifiers can be determined by use of a cathode ray oscilloscope.

1. Phase Shift & Distortion

A convenient method is shown in Figure 17 for quickly checking the general overall distortion and phase shift characteristics of an audio system.

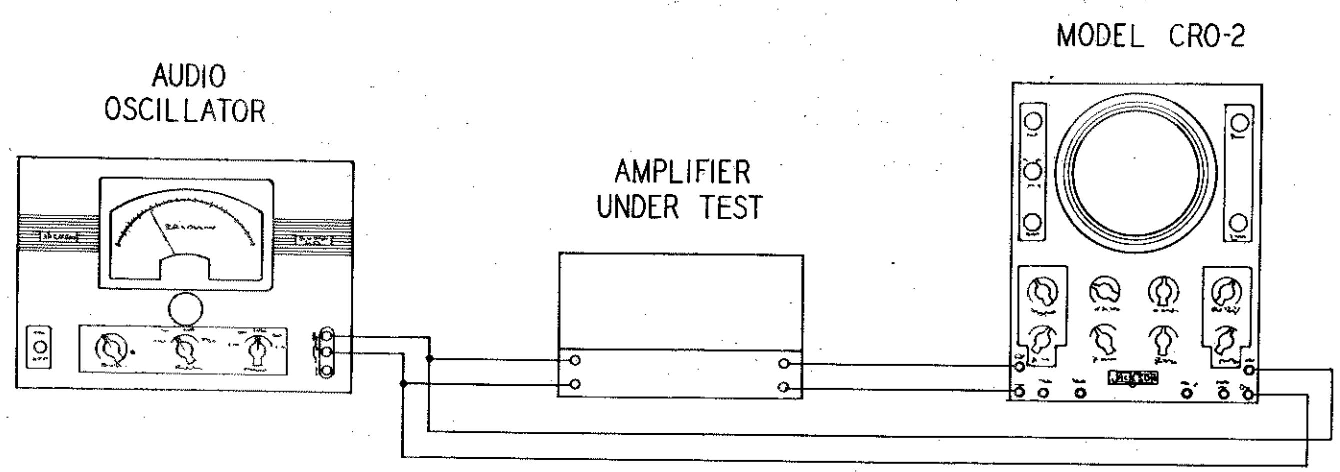


**Figure 17**

**Connections for checking Audio Amplifier for Phase Shift and Distortion**

Referring to the section on "Phase Difference Patterns", the amount of phase shift may be calculated for any number of desired frequencies. The procedure



is simple:

1. Set the audio oscillator at some frequency. As an example: 1,000 cycles
2. Turn the Horizontal Input Control to Internal Sweep.
3. Set the Saw-Tooth Sweep Frequency Range to 100-500.
4. Turn the Synchronizing input control to INT.
5. Vertical Input Control to Wide Band and Attenuator ratio chosen will depend on the output voltage of the audio amplifier under test.
6. Adjust the VERNIER until 2 or 3 waveforms appear on the screen.
7. If necessary, readjust the audio oscillator gain and the CRO-2 Vertical Gain until the typical sine wave pattern appears on the screen. This adjustment is important so as to be sure the system under test is not distorted by overloading the input of either the amplifier or the oscilloscope by too great a voltage.
8. Turn the Horizontal Input Control to External position by choosing the attenuator setting and Horizontal gain setting to give some convenient pattern size.

Typical resultant patterns are shown in Figure 18.

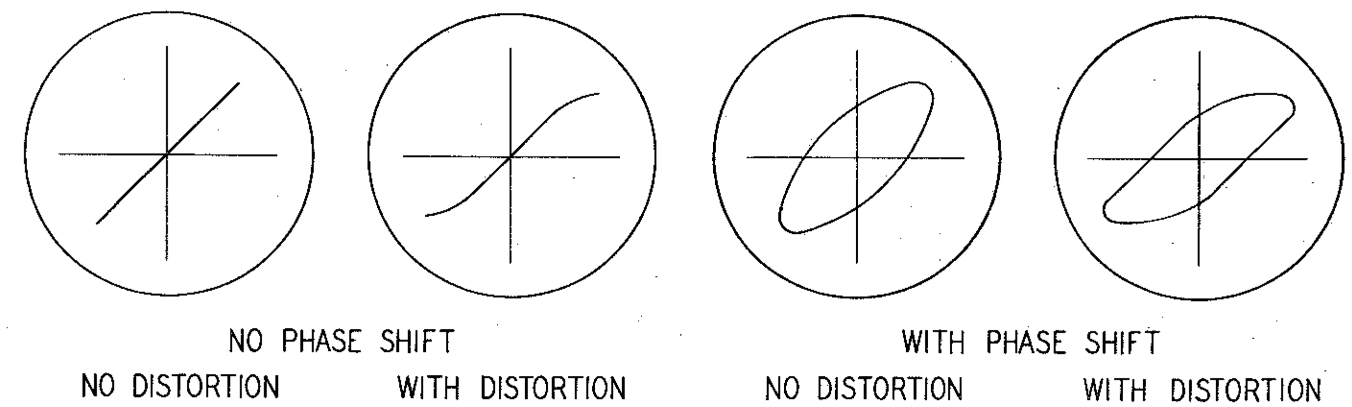


**Figure 18**

**Resultant Phase Shift Patterns**

2. Square Wave Testing

More detailed information about a given audio system may be obtained by feeding a square wave into the amplifier and observing the output pattern on the oscilloscope screen. A square wave of desired frequency may be obtained by audio oscillator and wave clipper or square wave generator.

Usually square wave tests are made at a low frequency of 60 cycles, and one at high frequency, about 2000 or 3000 cycles.

Response patterns similar to those shown in Figure 19 may be obtained.

A. Is a typical square wave shape obtained from Audio Oscillator and wave clipper or a square wave generator.

B. Indicates poor low frequency response characteristics.

C. Shows effects of good low frequency but high frequency cut-off.

D. Indicates excessive high frequency response or even oscillations at high frequencies.

E. Indicates poor transmission of test frequency in relation to other frequency passed.

F. Shows higher transmission of test frequency than other passed frequencies.

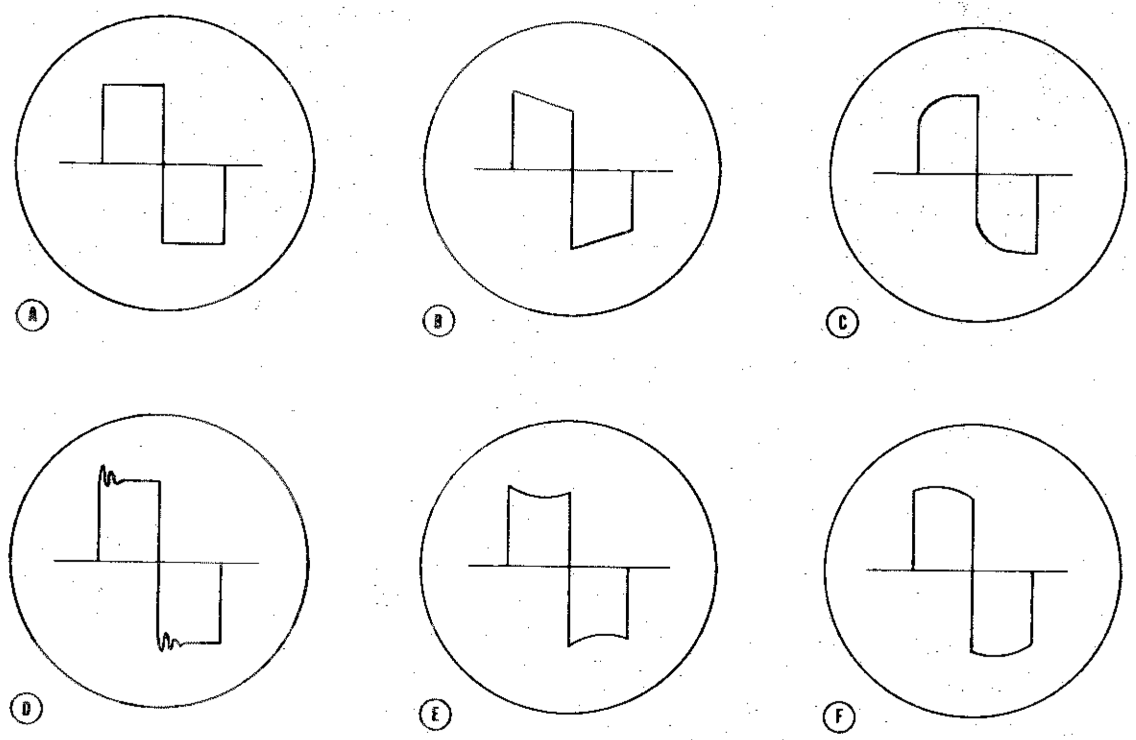


**Figure 19**
**Typical Square Wave Test Patterns**

## D. VIDEO AMPLIFIER TESTING.

The same procedure as outlined for testing of audio amplifiers may be applied to video amplifiers as found in television receivers.

Poor frequency response or excessive phase shift can account for lack of detail, smearing and black edging on white lines and black edging on white lines. The following general tests will give a quick check of the causes of many of these difficulties.

Using the connections shown in Figure 17, the video amplifier can be checked for phase shift and a number of frequencies. The phase shift will be different for each frequency but the shift should be linear with frequency. When a graph is drawn, plotting frequency vs. phase shift, the curve should approach a straight line. Further details can be found in any good text on television.

The square wave method of checking can also be applied to video amplifiers by



the same procedure of feeding in a square wave and observing the output pattern on the oscilloscope. The test frequencies might be approximately 60 cycles for the low and 25 kilocycles for the high. The patterns shown in Figure 19 will also apply to these tests.

## E. "SIGNAL TRACING" IN TELEVISION RECEIVERS

A sensitive wide band cathode ray oscilloscope such as the CRO-2 is a most valuable instrument in adapting signal tracing to television. This method of checking is one of the most simple and fastest ways of isolating trouble.

Individual set instruction books usually provide information on waveforms and their peak to peak voltages, particularly in the horizontal and vertical deflection sections.

The use of the oscilloscope is not limited to these circuits. In fact, much of its usefulness is in determining and isolating difficulties in the Video I. F. Amplifier, video detector, and video amplifier circuits.

Figure 20 shows a typical television receiver in block form and the generalized wave shape to be found at each point.

R.F.-I.F. MEASUREMENTS, USING DEMODULATION PROBE (TYPE CR-P)

By using the transmitted signal from a station:

1. Connect the set to the antenna and turn on.
2. Connect a demodulation probe to the VERTICAL INPUT terminal of the CRO.
3. Set VERTICAL INPUT CONTROL to "High Sensitivity" ratio and advance VERTICAL GAIN CONTROL near maximum.
4. Set the HORIZONTAL INPUT CONTROL to Internal Sweep.
5. Select the 20-100 Saw-tooth frequency.
6. Turn the SYNCHRONIZING INPUT control to INT.
7. Connect tip of Demodulation probe to plate terminal of converter tube of T.V. Receiver. Ground lead on Probe must be attached to nearby ground point.
8. Adjust both the SYNC and the VERNIER controls until the typical video signal pattern appears stationary.

If the pattern does not appear on the oscilloscope screen, the difficulty would be in the tuning section.

If the video pattern is satisfactory at that point, the demodulation probe is moved to the grid of the first video I.F. Amplifier. If the pattern still appears, the coupling circuit is functioning correctly and the probe can be moved on through the set from plate of one stage to grid of the next.

Adjustments will have to be made in the VERTICAL GAIN and attenuator as each stage, if functioning correctly, adds gain to the signal.

If the pattern is still obtained at the plate of the last video I.F. (Point 4 - Figure 20) Amplifier, it indicates correct operation of each stage in that section of the set.

For all other patterns a direct connecting shielded probe with at least 10 K ohm

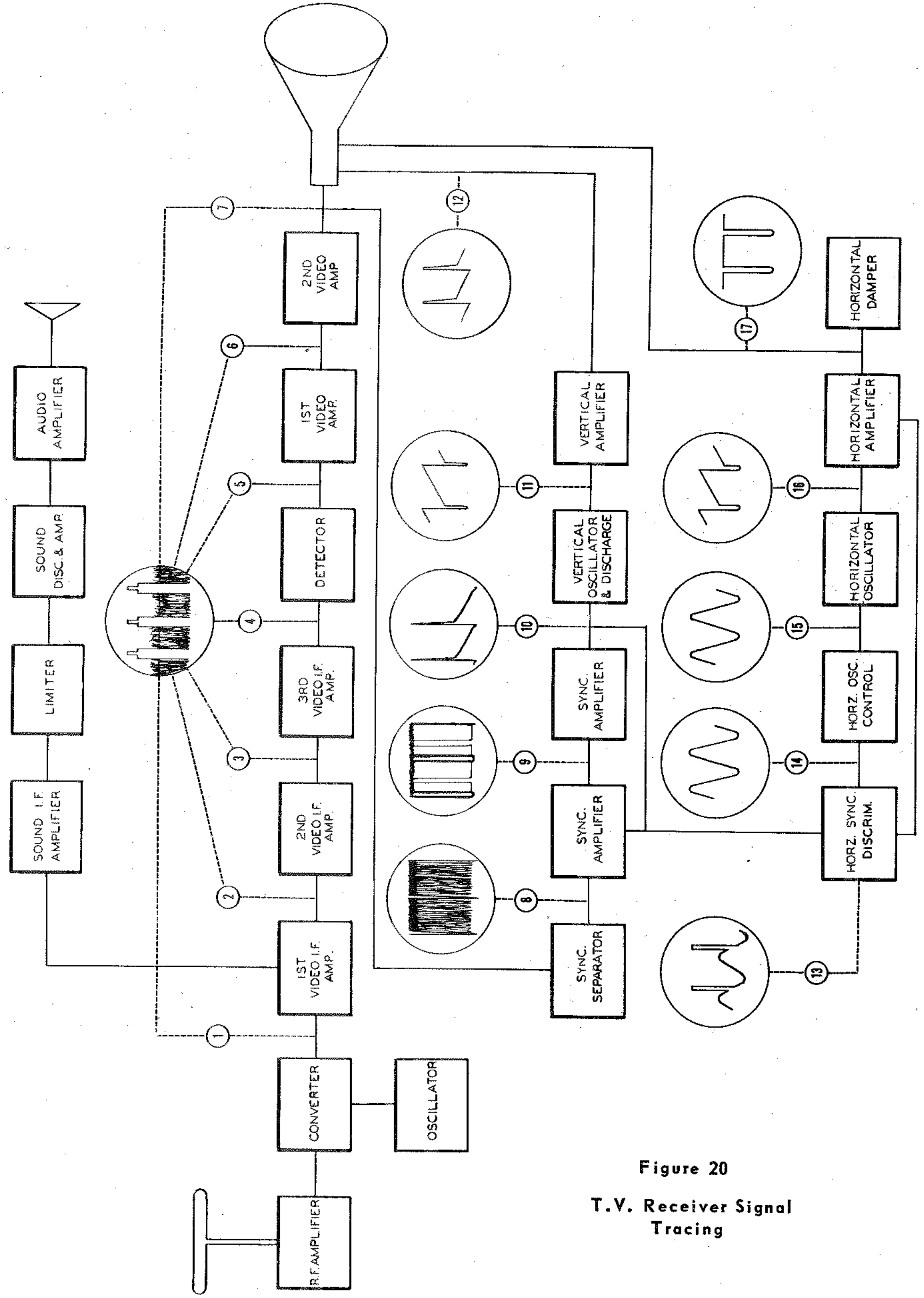


Figure 20

T.V. Receiver Signal Tracing



isolating resistor must be used. The same procedure is followed, checking, point by point, to the grid of the picture tube.

It will be noted that the patterns shown at Points 8 and 9, Figure 20 are different at the input and output of the Sync. Amp. The pattern obtained at Point 8 is with a sweep frequency of 30 cycles to show the vertical synchronizing pulse. At Point 9 the sweep frequency is 7875 cycles (the set horizontal sweep frequency divided by 2) to show the horizontal synchronizing pulses.

Several precautions should be observed in checking the patterns obtained against the illustrations. The VERTICAL INPUT CONTROL should be set to wide band for observation of all synchronizing pulses and deflection oscillator waveforms. The wide band operation is necessary to reproduce the waveforms correctly and there is adequate sensitivity in the CRO-2 to observe these forms at any point in the circuits.

Also the VERTICAL INPUT CONTROL should set at the highest ratio possible to avoid overloading of the input circuits, thereby distorting the waveforms.

Further information on application of Cathode ray oscilloscopes can be obtained from any good text book on television receivers and servicing.

## F. ALIGNMENT OF TELEVISION RECEIVERS

In general the alignment of television receivers follows along the same line as the procedure for an AM receiver. First the IF stages are aligned, then the RF and local oscillator stages.

For television receivers it is precision work and not adapted for field adjustment. The use of a reliable sweep generator is a necessity, and a wide band stable oscilloscope such as the CRO-2 provides a rapid, accurate method of adjustment.

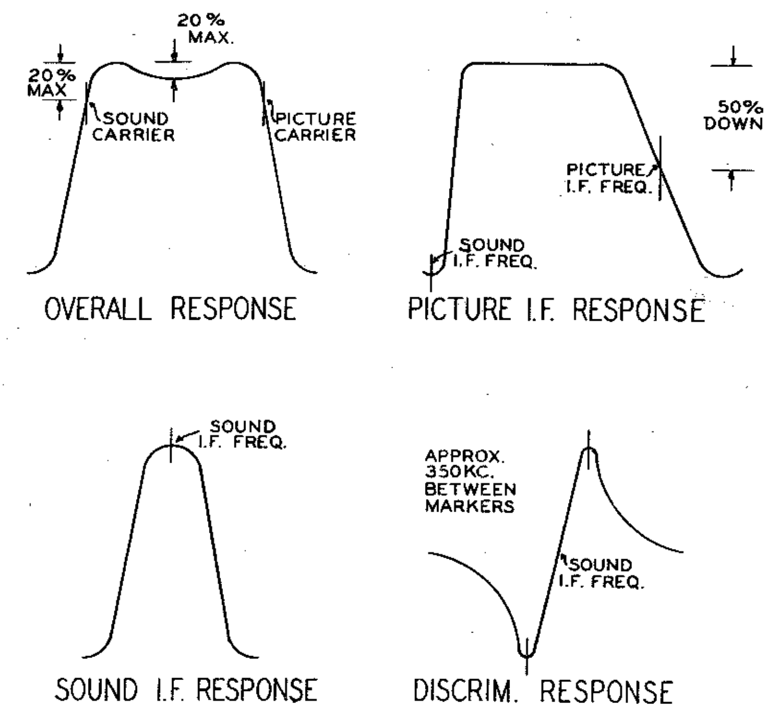


Figure 21

Typical Television Alignment Curves

The specific methods of alignment depend on the receiver, and the manufacturer's service instructions should always be followed. Typical response curves are shown in Figure 21.

<u>About Grounding</u> - The alignment of high frequency circuits is a critical procedure largely because of the behavior of these high frequencies. Oscillations or spurious response can be fairly common if procedures are not strictly adhered to. Such manifestations are always troublesome and may lead to incorrect alignment.

One of the most important considerations for avoiding spurious response is correct ground connections. It is always good practice to ground all equipment to a common ground, although this may not always be necessary. The following recommendations, however, should be followed:

-When connecting the RF leads, make the ground connection as close to the high point of the circuit as possible. This usually means connecting to the same point as that at which the circuit in the television set is grounded.

-Using additional ground straps, reground the original ground point to other points on the chassis, noting whether such additional grounds affect the response pattern on the scope. Continue adding additional grounds until the pattern on the scope screen is no longer affected by such additions.

-Never drape the RF lead over IF cans or circuits other than those under test. Make the connection direct to the point desired, keeping the lead away from other portions of the set under test.

-Never use a higher output than that required for proper alignment. Excessive generator output may cause oscillations or spurious response, resulting in incorrect alignment. Such conditions account for those so-called perfect alignments which result in poor pictures, poor sound, or both.

* * * * * * * *

Important Note: The model CRO-2 is an extremely sensitive high impedance indicating device. In its sensitive position static voltage may be indicated by merely bringing the hand close to the vertical input binding post. Likewise, the use of unshielded leads in connecting the oscilloscope to high impedance circuits will cause static pickup to be superimposed upon the signal under observation. Best practice indicates that shielded leads be used for all measurements.

Strong magnetic field in close proximity to the instrument may also cause deflection of the pattern. It should not be located near large transformers on other sources of strong magnetic fields.



## TUBE VOLTAGE CHART

| Tube Function | Pin 1 | Pin 2 | Pin 3 | Pin 4 | Pin 5 | Pin 6 | Pin 7 | Pin 8 | Pin 9 | Pin 10 | Pin 11 | Pin 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| V1 6C4 Vertical Cathode follower | 210 | - - - | 0 | 5.4 AC | - - - | 0 | 14.2 | - - - | - - - | - - - | - - - | - - - |
| V2 6J6 1st Vertical Amplifier (1) | H.S. 140 W.B. 200 | H.S. 120 W.B. 200 | H.S. 0 W.B. 0 | 5.4 AC | H.S. 65 W.B. 76 | H.S. 48 W.B. 68 | H.S. 65 W.B. 82 | - - - | - - - | - - - | - - - | - - - |
| V3 6J6 2nd Vertical Amplifier (1) | H.S. 150 W.B. 200 | H.S. 150 W.B. 200 | H.S. 0 W.B. 0 | 5.4 AC | H.S. 0 W.B. 0 | H.S. 0 W.B. 0 | H.S. 2.3 W.B. 3.3 | - - - | - - - | - - - | - - - | - - - |
| V4 6C4 Horizontal Cathode follower | - - - | - - - | 0 | 5.4 AC | 160 | 0 | 10 | - - - | - - - | - - - | - - - | - - - |
| V5 6J6 Horizontal Amplifier | 85 | 80 | 0 | 5.4 AC | 0 | 0 | 1.6 | - - - | - - - | - - - | - - - | - - - |
| V6 6J6 Sweep Oscillator (2) | 60 | 100 | 0 | 5.4 AC | 0 | -11 | 1.6 | - - - | - - - | - - - | - - - | - - - |
| V7 5Y3 High Voltage Rectifier (3) | - - - | 730AC 4.4AC | - - - | -1050 | -980 | -1050 | - - - | 730AC 4.4AC | - - - | - - - | - - - | - - - |
| V8 5Y3 Low Voltage Rectifier (3) | - - - | 340 4.4AC | - - - | 310AC | - - - | 310AC | - - - | 340 4.4AC | - - - | - - - | - - - | - - - |
| V9 5UP1 C. R. T. (4) | -960 5.8AC | -880 | -960 | -440 | - - - | 140 | 140 | 185 | 140 | 140 | - - - | -960 5.8AC |
| V10 6C4 Blanking Amplifier | - - - | - - - | 0 | 5.4AC | 37 | 1.6 | 0 | - - - | - - - | - - - | - - - | - - - |

Focus & Brilliance Controls set to Min. Pos., Horizontal Input Control set to Ext. Pos
All voltage readings measured with VTVM to gnd. except otherwise stated. Voltage Readings ± 20%
Note No. 1 Vertical Input Control set to wide Band gives the higher plate voltage readings.
Note No. 2 Set Horizontal Input Control to Int. Pos.
Note No. 3 Filiament Voltages for V7 and V8 measured across pins 2 & 8
Note No. 4 Filiament Voltage for V9 measured across pins 1 & 12

| Ref Symbol | Jackson Stock No. | Name and Description | Function |
|---|---|---|---|
| C1 | 26-94 | CAPACITOR: 0.25 mfd, 600 V,tabular, paper | Vertical input blocking |
| C2 | 3-25 | CAPACITOR: 1-3.5 mmf, ceramic adjuster | Attenuator frequency compensating |
| C4 | 26-100 | CAPACITOR: 250 mmf, mica | Attenuator frequency compensating |
| C5 | 26-68 | CAPACITOR: 25 mfd, 25 V, electrolytic | Vertical cathode follower cathode coupling |
| C6 | 26-90 | CAPACITOR: 10 mfd, 450 V, electrolytic | Vertical cathode follower plate bypass |
| C7 | 26-90 | CAPACITOR: 10 mfd, 450 V, electrolytic | 1st vertical amplifier grid bypass |
| C8 | 26-93 | CAPACITOR: 0.5 mfd, 400 V, tubular, paper | 1st vertical amplifier grid coupling |
| C9 | 26-93 | CAPACITOR: 0.5 mfd, 400 V, tubular, paper | 2nd vertical amplifier grid coupling |
| C10 | 26-93 | CAPACITOR: 0.5 mfd, 400 V, tubular, paper | 2nd vertical amplifier grid coupling |
| C11 | 26-96 | CAPACITOR: 0.1 mfd, 400 V, tubular, paper | Vertical deflection blocking |
| C12 | 26-96 | CAPACITOR: 0.1 mfd, 400 V, tubular, paper | Vertical deflection blocking |
| C13 | 26-96 | CAPACITOR: 0.1 mfd, 400 V, tubular, paper | Horizontal deflection blocking |
| C14 | 26-96 | CAPACITOR: 0.1 mfd, 400 V, tubular, paper | Horizontal deflection blocking |
| C15 | 26-120 | CAPACITOR:.05 mfd, 1600 V, oil impregnated | Intensity modulation blocking |
| C16 | 26-96 | CAPACITOR: 0.10 mfd, 400 V, tubular, paper | Sync. input blocking |
| C17 | 26-94 | CAPACITOR: 0.25 mfd, 600 V, tubular, paper | Horizontal input blocking |
| C18 | 26-68 | CAPACITOR: 25 mfd, 25 V, electrolytic | Horizontal cathode follower cathode coupling |
| C19 | 26-90 | CAPACITOR: 10 mfd, 450 V, electrolytic | Horizontal cathode follower plate bypass |
| C20 | 26-90 | CAPACITOR: 10 mfd, 450 V, electrolytic | Horizontal cathode follower plate decoupling |
| C21 | 26-93 | CAPACITOR: 0.5 mfd, 400 V, tubular, paper | Horizontal amplifier grid coupling |
| C22 | 3-26 | CAPACITOR: 5-20 mmfd, ceramic adjuster | Internal sweep high frequency compensating |
| C23 | 26-93 | CAPACITOR: 0.5 mfd, 400 V, tubular, paper | Saw-tooth osc. blocking |
| C24 | 26-95 | CAPACITOR: 0.25 mfd, 400 V, tubular, paper | Saw-tooth osc. low range discharge |
| C25 | 26-97 | CAPACITOR: .05 mfd, 400 V, tubular, paper | Saw-tooth osc, frequency range |
| C26 | 26-98 | CAPACITOR: .01 mfd, 400 V, tubular, paper | Saw-tooth osc; frequency range |





| Ref Symbol | Jackson Stock No. | Description | Function |
|---|---|---|---|
| C27 | 26-104 | CAPACITOR: .002 mfd, 400 V, mica | Saw-tooth osc. frequency range |
| C28 | 26-99 | CAPACITOR: 400 mmfd, mica | Saw-tooth osc. frequency range |
| C29 | 26-101 | CAPACITOR: 80 mmfd, mica | Saw-tooth osc. frequency range |
| C30 | 26-90 | CAPACITOR: 10 mfd, 450 V, electrolytic | Vertical amplifier plate decoupling |
| C31 | 26-90 | CAPACITOR: 10 mfd, 450 V, electrolytic | Low B+ filter |
| C32 | 26-90 | CAPACITOR: 10 mfd, 450 V, electrolytic | B+ filter |
| C33 | 26-70 | CAPACITOR: 8 mfd, 450 V, electrolytic | B+ filter |
| C34 | 26-90 | CAPACITOR: 10 mfd, 450 V, electrolytic | B+ filter |
| C35 | 26-91 | CAPACITOR: 0.5 mfd, 2000 V, oil | B- filter |
| C36 | 26-93 | CAPACITOR: 0.5 mfd, 400 V, tubular, paper | CR tube cathode bypass |
| C37 | 26-96 | CAPACITOR: 0.1 mfd, 400 V, tubular, paper | Line filter |
| C38 | 26-96 | CAPACITOR: 0.1 mfd, 400 V, tubular, paper | Line filter |
| C39 | 26-64 | CAPACITOR: .005 mfd, mica | Intensity modulation phase correction |
| C40 | 26-98 | CAPACITOR: .01 mfd, 400 V, tubular, paper | 120 cycle sync. blocking |
| C41 | 26-70 | CAPACITOR: 8 mfd, 450 V, electrolytic | B+ filter |
| C43 | 26-97 | CAPACITOR: 0.05 mfd, 400 V, tubular, paper | Blanking amplifier plate coupling |
| L1 | 15-58 | PEAKING COIL: 60 uhy. on R6 | Vertical amplifier input high frequency peaking |
| L2 | 15-57 | PEAKING COIL: 100 uhy. on 3.3 meg. res. | 1st vertical amplifier high frequency peaking |
| L3 | 15-56 | PEAKING COIL: 100 uhy. on R10 | 1st vertical amplifier high frequency peaking |
| L4 | 15-56 | PEAKING COIL: 100 uhy. on R11 | 1st vertical amplifier high frequency peaking |
| L5 | 15-57 | PEAKING COIL: 100 uhy. on 3.3 meg. res. | 1st vertical amplifier high frequency peaking |
| L6 | 15-57 | PEAKING COIL: 100 uhy. on 3.3 meg. res. | 2nd vertical amplifier high frequency peaking |
| L7 | 15-56 | PEAKING COIL: 100 uhy. on R20 | 2nd vertical amplifier high frequency peaking |
| L8 | 15-55 | PEAKING COIL: 100 uhy. on R21 | 2nd vertical amplifier high frequency peaking |
| L9 | 15-57 | PEAKING COIL: 100 uhy. on 3.3 meg. res. | 2nd vertical amplifier high frequency peaking |
| L10 | 14-46 | CHOKE: 15 hy. | B+ filter |
| R1 | 27-270 | RESISTOR: composition 1.3 megohm | Vertical input attenuator |
| R2 | 27-273 | RESISTOR: composition 0.13 megohm | Vertical input attenuator |

| Red Symbol | Jackson Stock No. | Description | Function |
|---|---|---|---|
| R3 | 27-279 | RESISTOR: composition 15000 ohm | Vertical input attenuator |
| R4 | 27-252 | RESISTOR: composition 10000 ohm | Vertical input cathode follower cathode |
| R5 | 4-65A | POTENTIOMETER: carbon, 10000 ohm | Vertical amplifier gain control |
| R6 | 27-282 | RESISTOR: composition 3900 ohm (part L-1) | |
| R7 | 27-219 | RESISTOR: composition 47000 ohm | Vertical amplifier cathode follower plate load |
| R8 | 27-206 | RESISTOR: Composition 1 megohm | 1st vertical amplifier grid coupling |
| R9 | 27-197 | RESISTOR: composition 5100 ohm | 1st vertical amplifier cathode |
| R10 | 27-214 | RESISTOR: composition 27000 ohm | 1st vertical amplifier peak shunting |
| R11 | 27-214 | RESISTOR: composition 27000 ohm | 1st vertical amplifier peak shunting |
| R12 | 27-214 | RESISTOR: composition 27000 ohm | 1st vertical amplifier plate loading |
| R13 | 27-235 | RESISTOR: composition 2700 ohm | 1st vertical amplifier plate shunting |
| R14 | 27-283 | RESISTOR: composition 2700 ohm | 1st vertical amplifier plate decoupling |
| R15 | 27-214 | RESISTOR: composition 27000 ohm | 1st vertical amplifier plate loading |
| R16 | 27-235 | RESISTOR: composition 2700 ohm | 1st vertical amplifier plate shunting |
| R17 | 27-285 | RESISTOR: composition 200 ohm | 2nd vertical amplifier cathode |
| R18 | 27-231 | RESISTOR: composition 0.47 megohm | 2nd vertical amplifier grid |
| R19 | 27-231 | RESISTOR: composition 0.47 megohm | 2nd vertical amplifier grid |
| R20 | 27-214 | RESISTOR: composition 27000 ohm | 2nd vertical amplifier peak shunting |
| R21 | 27-214 | RESISTOR: composition 27000 ohm | 2nd vertical amplifier peak shunting |
| R22 | 27-214 | RESISTOR: composition 27000 ohm | 2nd vertical amplifier plate loading |
| R23 | 27-235 | RESISTOR: composition 2700 ohm | 2nd vertical amplifier plate shunting |
| R24 | 27-214 | RESISTOR: composition 27000 ohm | 2nd vertical amplifier plate loading |
| R25 | 27-235 | RESISTOR: composition 2700 ohm | 2nd vertical amplifier plate shunting |
| R26 | 27-268 | RESISTOR: composition 3.3 megohm | Horizontal deflection plate isolating |
| R27 | 27-268 | RESISTOR: composition 3.3 megohm | Horizontal deflection plate isolating |
| R28 | 27-268 | RESISTOR: composition 3.3 megohm | Vertical deflection plate isolating |





| Ref Symbol | Jackson Stock No | Description | Function |
|---|---|---|---|
| R29 | 27-268 | RESISTOR: composition 3.3 megohm | Vertical deflection plate isolating |
| R30 | 27-228 | RESISTOR: composition 0.1 megohm | Internal sync. volt divider |
| R31 | 27-206 | RESISTOR: composition 1.0 megohm | Horizontal input attenuator |
| R32 | 27-228 | RESISTOR: composition 0.1 megohm | Horizontal input attenuator |
| R33 | 27-218 | RESISTOR: composition 47000 ohm | Horizontal cathode follower plate load |
| R34 | 27-252 | RESISTOR: composition 10000 ohm | Horizontal cathode follower cathode |
| R35 | 4-65A | POTENTIOMETER: carbon 10000 ohm | Horizontal input gain |
| R36 | 27-206 | RESISTOR: composition 1.0 megohm | Horizontal amplifier grid |
| R37 | 27-295 | RESISTOR: wire wound 220 ohms | Horizontal amplifier cathode |
| R38 | 4-40 | POTENTIOMETER: wire wound 1000 ohm | Calibrate voltage adjusting |
| R39 | 27-291 | RESISTOR: wire wound 470 | Calibrate voltage divider |
| R40 | 27-206 | RESISTOR: composition 1.0 megohm | Horizontal amplifier grid isolating |
| R41 | 27-214 | RESISTOR: composition 27,000 ohms | Horizontal amplifier plate loading |
| R42 | 27-214 | RESISTOR: composition 27,000 ohms | Horizontal amplifier plate loading |
| R43 | 27-206 | RESISTOR: composition 1.0 megohm | 1st vertical amplifier grid isolating |
| R44 | 4-62A | POTENTIOMETER: carbon 0.25 megohm | Ext. sync. gain |
| R45 | 27-284 | RESISTOR: composition 470 ohm | Saw-tooth oscillator cathode |
| R46 | 27-231 | RESISTOR: composition 0.47 megohm | Saw-tooth oscillator output divider |
| R47 | 27-206 | RESISTOR: composition 1.0 megohm | Saw-tooth oscillator output divider |
| R48 | 27-214 | RESISTOR: composition 27000 ohm | Saw-tooth oscillator plate loading |
| R49 | 27-166 | RESISTOR: composition 750 ohm | Saw-tooth oscillator plate loading |
| R50 | 27-301 | RESISTOR: composition 0.68 megohm | Vernier shunting |
| R51 | 4-64A | POTENTIOMETER: carbon 1.0 megohm, dual | Saw-tooth sweep Vernier |
| R52 | 27-232 | RESISTOR: composition 33000 ohm | Saw-tooth oscillator grid |
| R53 | 27-228 | RESISTOR: composition 0.1 megohm | Saw-tooth oscillator plate loading |
| R54 | 27-214 | RESISTOR: composition 27000 ohm | B+ voltage divider |
| R55 | 27-212 | RESISTOR: composition 62000 ohm | B+ voltage divider |
| R56 | 27-212 | RESISTOR: composition 62000 ohm | B+ voltage divider |
| R57 | 27-302 | RESISTOR: wire wound 470 ohm | B+ voltage divider |
| R58 | 27-269 | RESISTOR: composition 3.3 megohm | B- voltage divider |
| R59 | 4-63A | POTENTIOMETER: carbon 2.0 megohm | Focus control |
| R60 | 27-206 | RESISTOR: composition 1.0 megohm | B- voltage divider |
| R61 | 4-61A | POTENTIOMETER: carbon 0.5 megohm | Intensity control |
| R62 | 4-62A | POTENTIOMETER: carbon 0.25 megohm | Vertical centering |

## REPLACEMENT PARTS LIST

| Ref Symbol | Jackson Stock No. | Description | Function |
|---|---|---|---|
| R63 | 4-62A | POTENTIOMETER: carbon 0.25 megohm | Horizontal centering |
| R64 | 27-206 | RESISTOR: composition 1.0 megohm | Intensity modulation bleeder |
| R65 | 27-301 | RESISTOR: composition 0.68 megohm | CR tube grid |
| R67 | 27-268 | RESISTOR: composition 3.3 meghom | Intensity modulation voltage divider |
| R72 | 27-235 | RESISTOR: composition 2700 ohm | 120 cycle sync. voltage divider |
| S1 | 8-96 | SWITCH: two circuit 6 position | Vertical input selector |
| S2 | 8-104 | SWITCH: two circuit 5 position | Sync. input selector |
| S3 | 8-103 | SWITCH: two circuit 2 position | Vertical pattern reversing |
| S4 | 8-79 | SWITCH: toggle S.P.D.T. | Intensity modulation selector |
| S5 | 8-98 | SWITCH: two circuit 4-position | Horizontal input selector |
| S6 | 8-97 | SWITCH: 5-position | Saw-tooth oscillator frequency range |
| S7 | | SWITCH: S.P.S.T. (part of R7) | Line OFF-ON switch |
| T1 | 14-59 | TRANSFORMER: power (special) | High-low voltage power |
| TB1 | | TERMINAL BOARD: 8 Terminal | External deflection plate connecting |
| V1 | 22-35 | TUBE: vacuum type 6C4 | Vertical input cathode follower |
| V2 | 22-42 | TUBE: vacuum type 6J6 | 1st vertical push-pull amplifier |
| V3 | 22-42 | TUBE: vacuum type 6J6 | 2nd vertical push-pull amplifier |
| V4 | 22-35 | TUBE: vacuum type 6C4 | Horizontal input cathode follower |
| V5 | 22-42 | TUBE: vacuum type 6J6 | Horizontal push-pull amplifier |
| V6 | 22-42 | TUBE: vacuum type 6J6 | Saw-tooth (sweep) oscillator |



## REPLACEMENT PARTS LIST

| Ref Symbol | Jackson Stock No. | Description | Function |
|---|---|---|---|
| V7 | 22-34 | TUBE: vacuum type 5Y3GT | High voltage rectifier |
| V8 | 22-34 | TUBE: vacuum type 5Y3GT | Low voltage rectifier |
| V9 | 22-44 | TUBE: cathode ray type 5UP1 | |
| V10 | 22-35 | TUBE: vacuum type 6C4 | Retrace blanking amplifier |
| F1 | 5-28 | FUSE: type 3AG, 1½ amp. | AC line |
| F2 | 5-28 | FUSE: type 3AG, 1½ amp. | |
| C44 | 3-26 | CAPACITOR: 5-20 mmfd. ceramic adjuster | Attenuator frequency calibrating |
| C45 | 26-90 | CAPACITOR: 10 mfd. 450 V Electrolytic | Horizontal amplifier plate decoupling |
| C46 | 26-93 | CAPACITOR: .5 mfd. 400 V paper | Horizontal amplifier grid coupling |
| C47 | 26-120 | CAPACITOR: .05 mfd. 1600 V | Oil tubular B-filter |
| R73 | 27-227 | RESISTOR: composition 1000 ohm | Horizontal amplifier plate loading |
| R74 | 27-296 | RESISTOR: composition 4700 ohm | Horizontal amplifier plate coupling |
| R75 | 27-283 | RESISTOR: composition 2700 ohm | Blanking amplifier plate decoupling |
| R76 | 27-306 | RESISTOR: composition .22 megohm | B-filter |
| R78 | 27-345 | RESISTOR: composition 27,000 ohm | Blanking amplifier plate loading |

Manufactured by

THE JACKSON ELECTRICAL INSTRUMENT COMPANY

DAYTON, OHIO U.S.A.

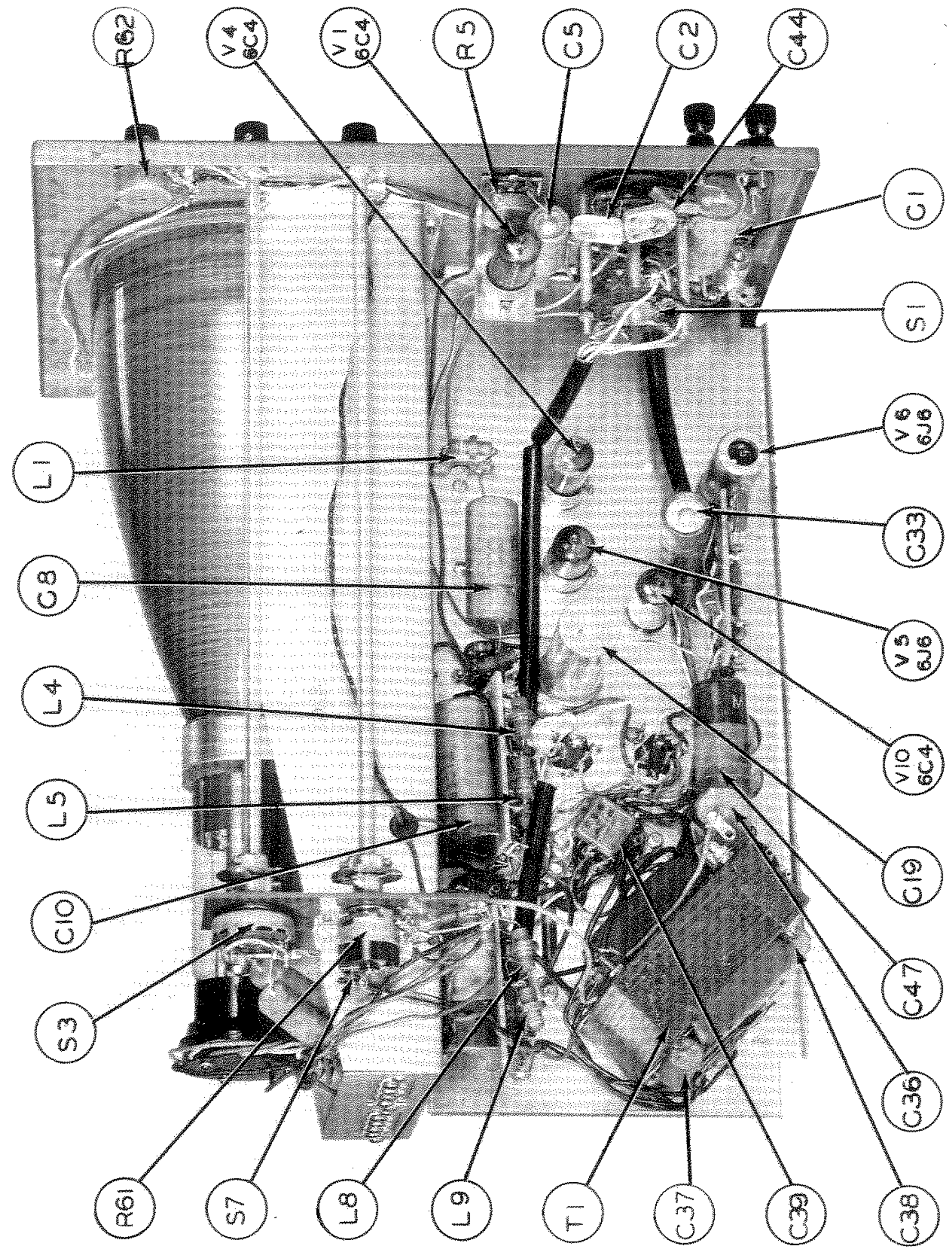


Figure 22
Left Chassis View



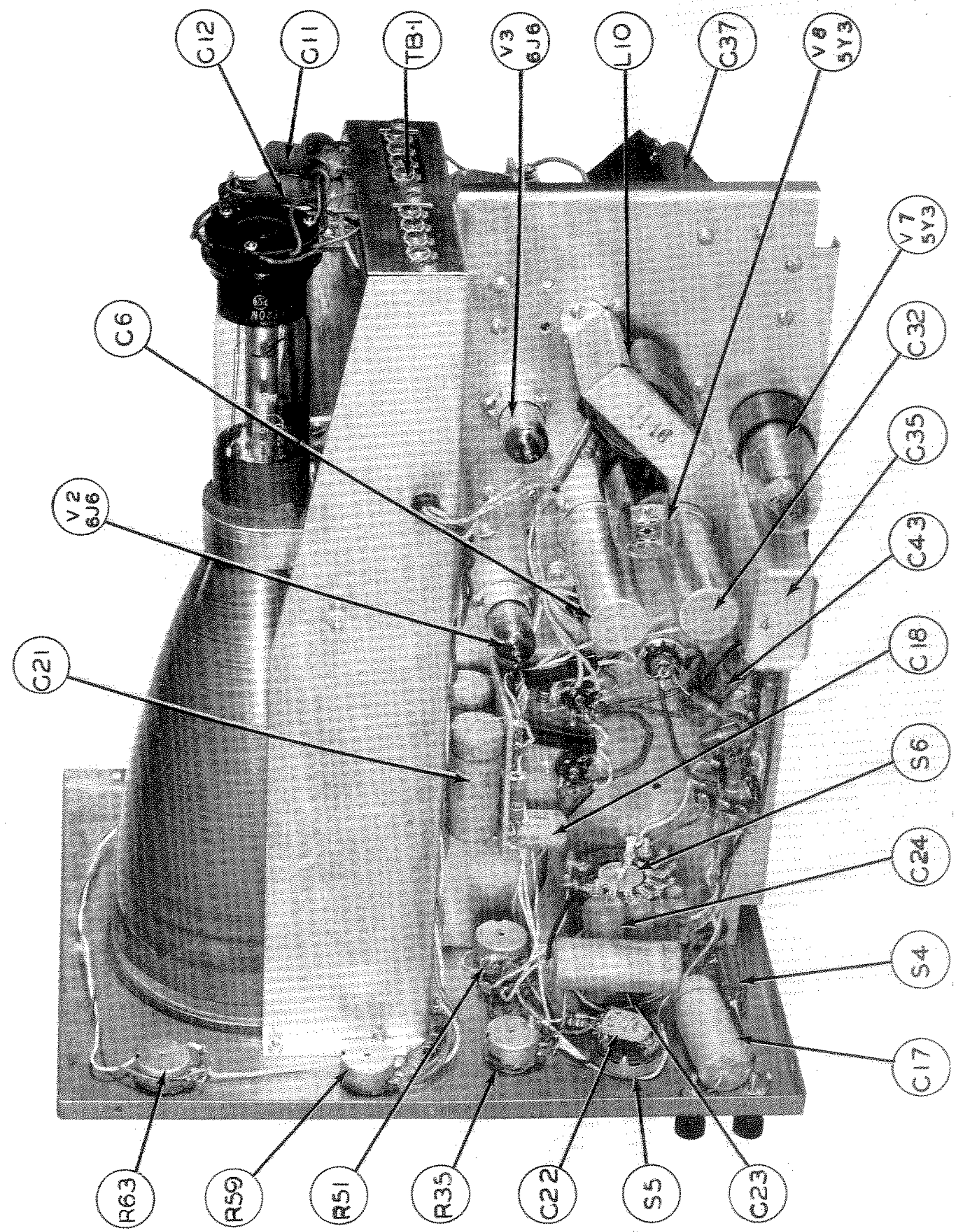


Figure 23
Right Chassis View

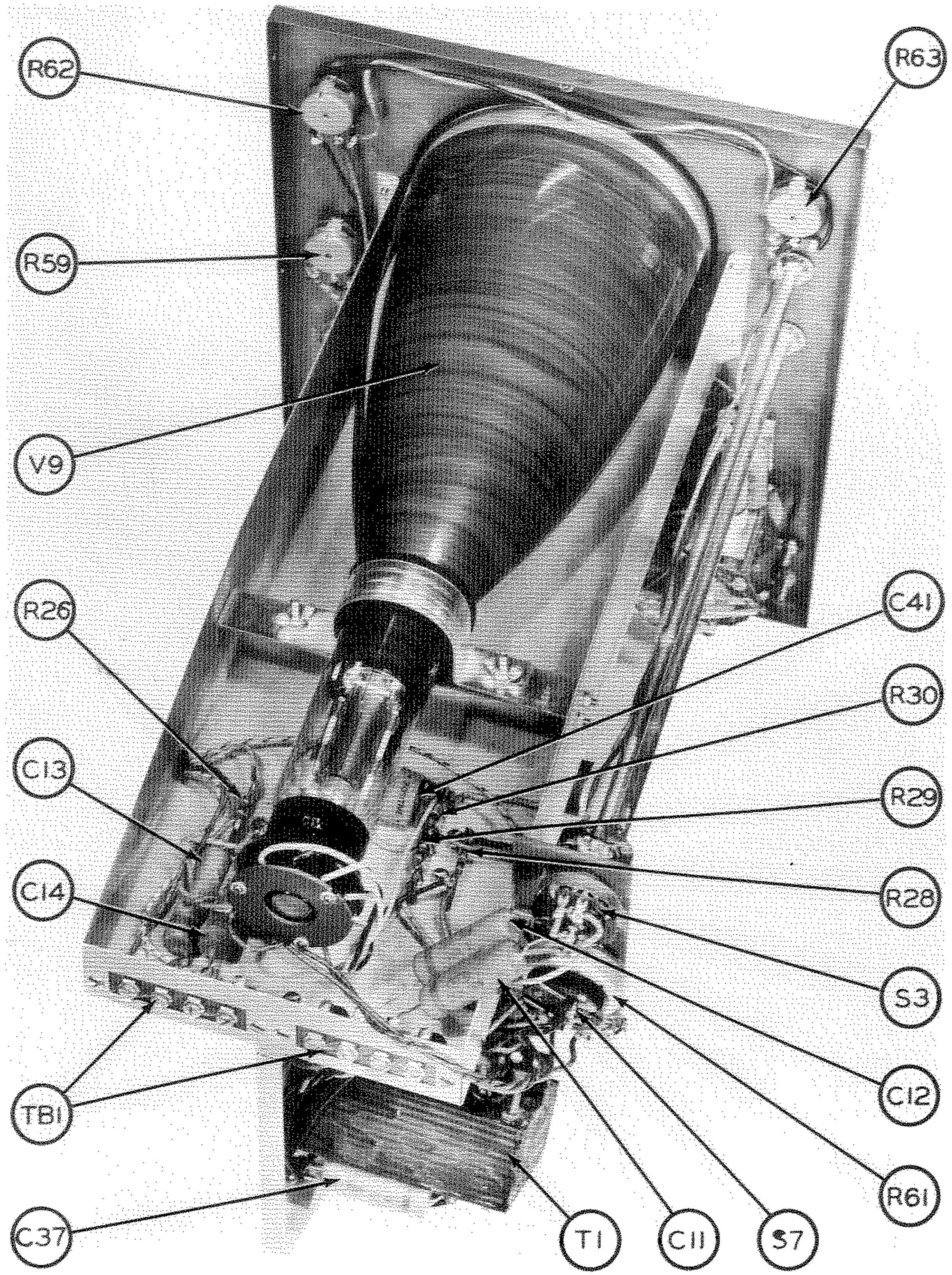


Figure 24
Top Chassis View