After the voltage drop of the resistor is determined, we merely use Ohms law to solve for current since we know the size of the resistor and the voltage drop across it. (I equals E/R.)

3. DISTORTION INDICATING DEVICE:

If the output of some receiver is distorted and perhaps the audio section is suspected as the cause of the distortion, a sine wave at an audio frequency can be fed to the input of the audio section and a scope can be connected in turn to each of the stages, to find at which point the distortion is being introduced.

4. FREQUENCY MEASUREMENT:

When an alternating voltage is applied to both vertical and horizontal input circuits of the oscilloscope and the frequency of either one is changed, the pattern on the scope screen will change accordingly. It might seem that the shifting patterns are without rhyme or reason. Actually this is not the case. Many of these patterns, if carefully studied will indicate the frequency or phase relationship between the voltages applied to the vertical and horizontal plates and perhaps the waveform of the voltages as well.

We know for instance that if a sawtooth voltage is applied to the horizontal input of the scope, and a sine wave of the same frequency is applied to the vertical input, the results will be the appearance of a single cycle of the sine wave voltage on the screen.

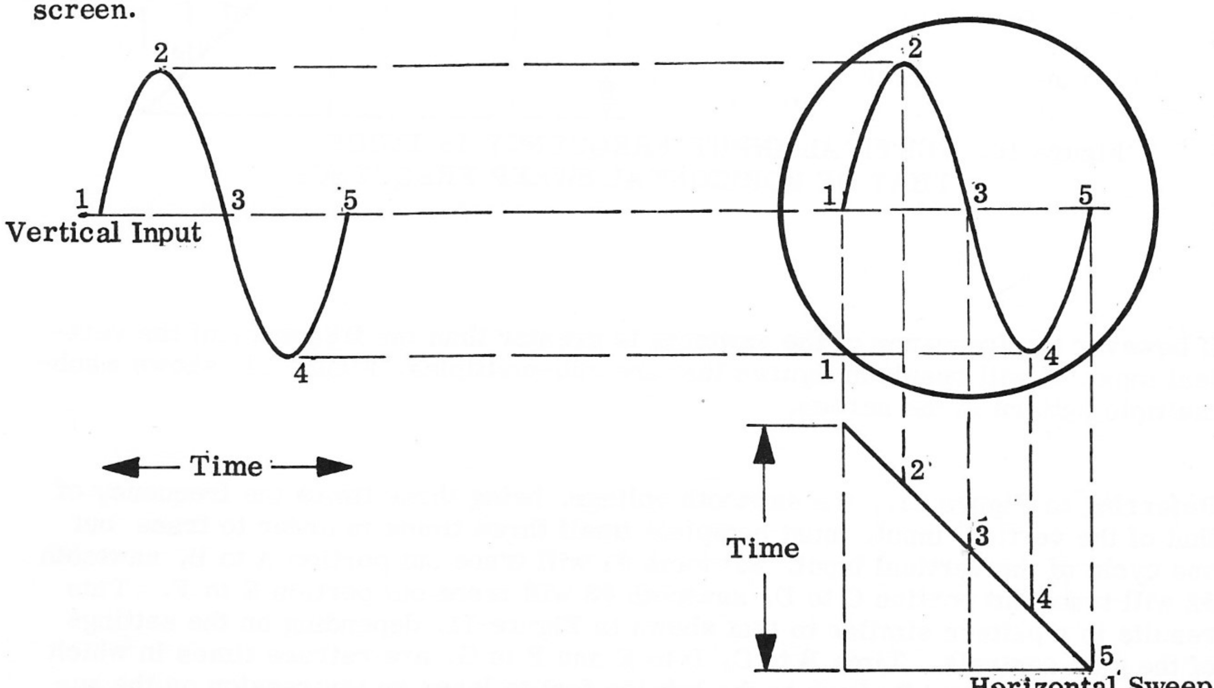

Figure 9. HORIZONTAL SWEEP & VERTICAL INPUT FREQUENCY ARE EQUAL

If the sine wave input is double in frequency (or if the frequency of the sawtooth is cut in half) the resulting image will consist of two cycles.

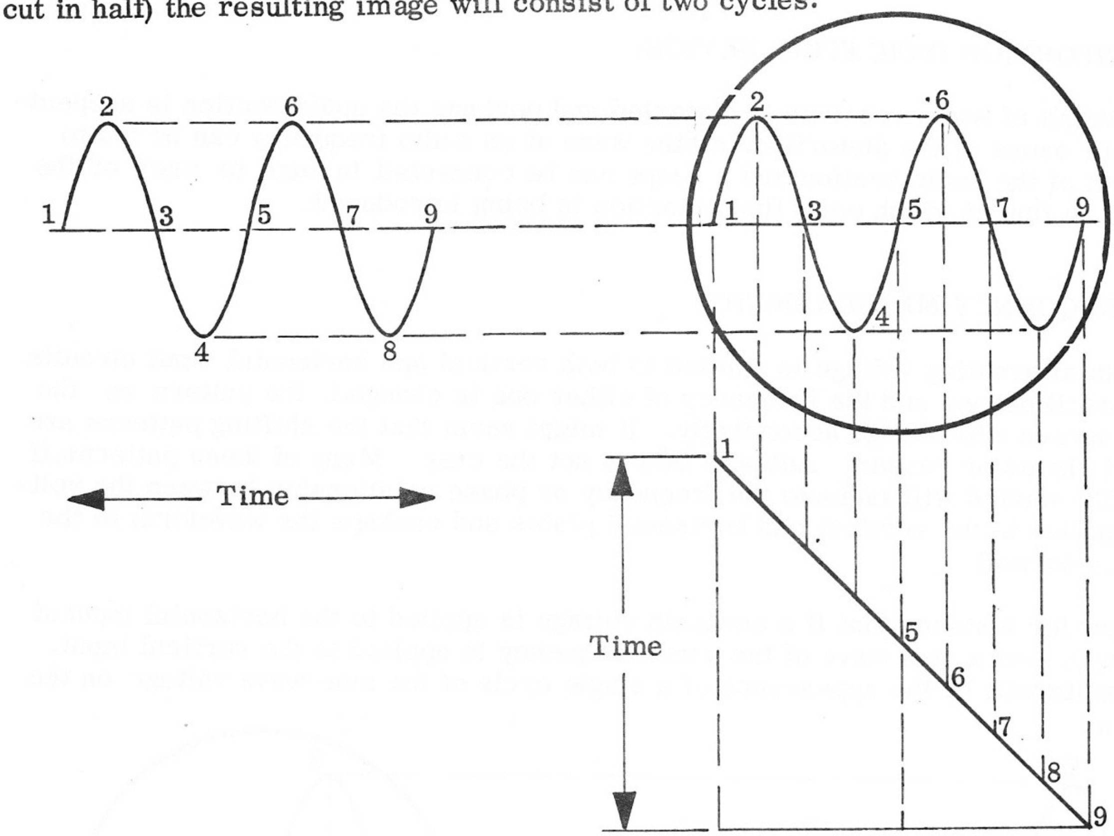

Figure 10. VERTICAL INPUT FREQUENCY IS TWICE THAT OF HORIZONTAL SWEEP FREQUENCY

If however the frequency of the sawtooth is greater than the frequency of the vertical input, it will result in figures that are sub-multiples. Figure 11. shows a sub-multiple pattern in the screen.

Referring to Figure 11., the sawtooth voltage, being three times the frequency of that of the vertical input, must complete itself three times in order to trace out one cycle of the vertical input. Sawtooth #1 will trace out portion A to B, sawtooth #2 will trace out portion C to D, sawtooth #3 will trace out portion E to F. This results in a pattern similar to that shown in Figure 11. depending on the settings of the gain controls. Time B to C, D to E and F to G, are retrace times in which the beam moves rapidly back to the left too fast to leave an impression on the screen.

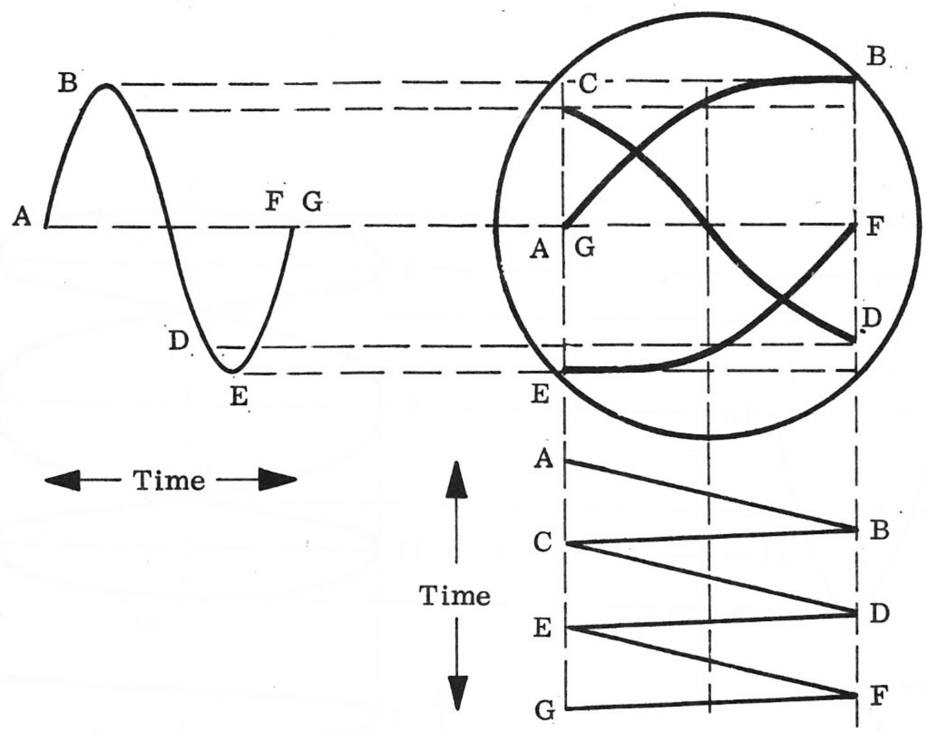

Figure 11. HORIZONTAL SWEEP FREQUENCY IS THREE TIMES THAT OF VERTICAL INPUT FREQUENCY

The pattern created on an oscilloscope when sine wave voltages are applied to both horizontal and vertical plates is called a Lissajous figure. A large variety of patterns may be obtained, depending on the ratio of the frequency applied to the deflection plates. The Lissajous figure is useful in the determination of an unknown frequency by comparison with a standard frequency. The signal of unknown frequency is applied to the vertical amplifier of the oscilloscope. Signals from the generator capable of precise frequency settings are applied to the horizontal amplifier. If the two frequencies are 90 degrees out of phase and if their frequency is the same (that is if the ratio of their frequencies is 1:1) the resultant is a circle on on the screen. However if they are in phase a straight line would appear on the screen. Figure 12. shows a Lissajous pattern when the two frequencies differ.

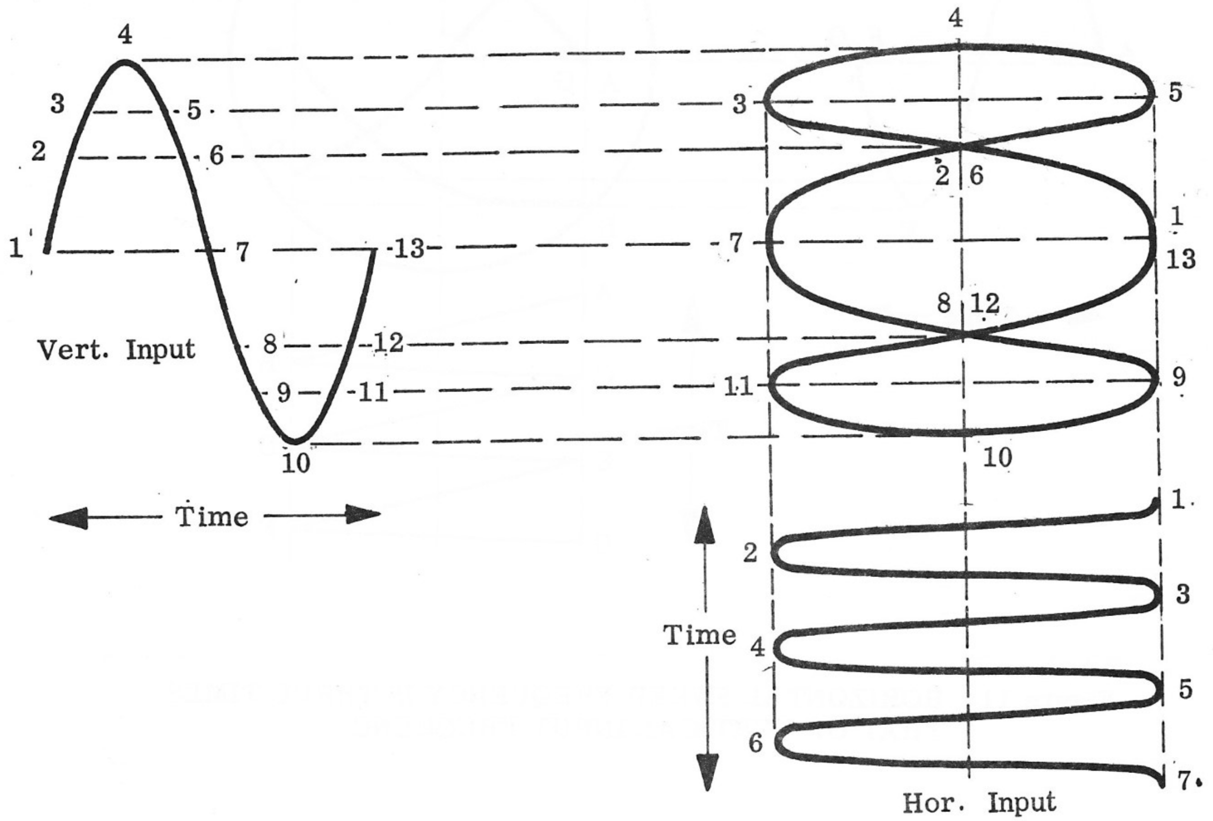

Figure 12. LISSAJOUS FIGURE WITH 3:1 RATIO

Figure 12 shows a Lissajous figure with three loops. This means that one frequency is three times as great as the other. When the loops are in a vertical plane, it means that the horizontal frequency is three times the vertical. If the Lissajous figure was rotated 90 degrees the vertical frequency would be three times the horizontal. The ratio of the frequencies can very simply be determined by counting the number of loops. Four loops, the frequency would have a 4:1 ratio, five, 5:1, etc. Therefore the unknown frequency would be multiple or a fraction of the standard frequency depending on the phase of the Lissajous curve and the factor used to determine the frequency is the number of loops.

5. ALIGNMENT OF TUNED CIRCUITS:

A tuned circuit allows signals of only a certain frequency band to pass. The process by which tuned circuits are adjusted to pass the proper frequency is called alignment. Correct alignment of television or receivers is almost impossible without visual alignment equipment, therefore an instrument such as an oscilloscope is essential.

There are many variations of tuned circuits - some very sharply tuned - some with broad band of resonance. Therefore to precisely align a TV receiver the resonant curve of the particular set should be known.

Various resonant curves are shown in Figures 13, 14, 15

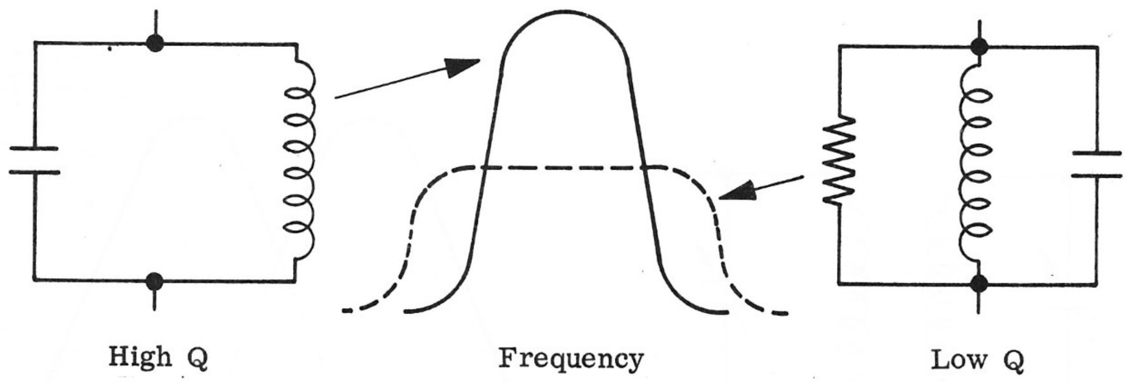

Figure 13.

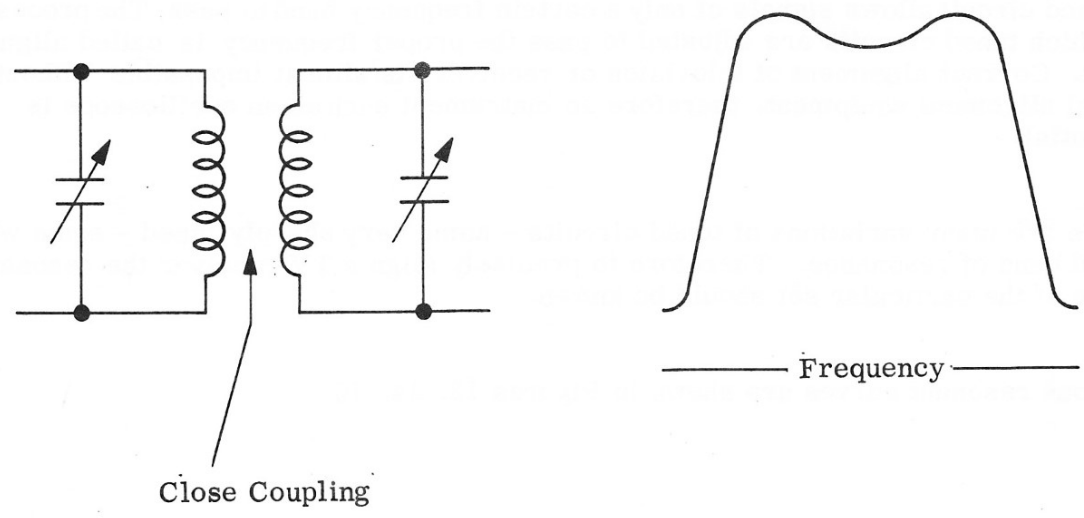

Figure 14.

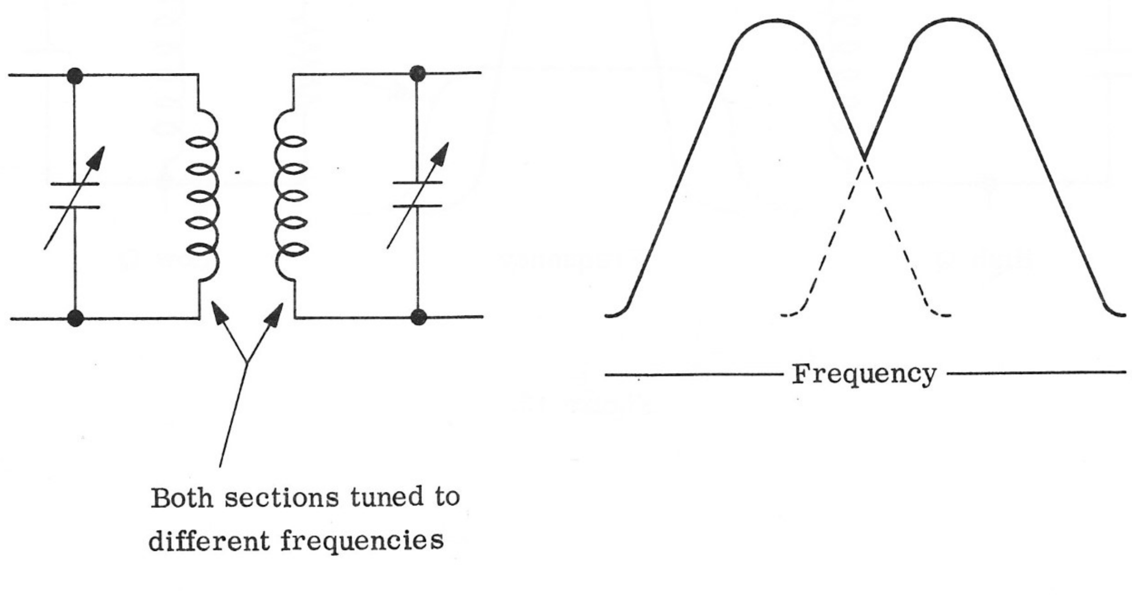

Figure 15.

During the alignment of I. F. or sound section of a receiver it is advisable to short the antenna; this eliminates spurious signals such as might be picked up by the antenna.

Figure 16 shows the proper points to connect the oscilloscope for alignment of I. F. and discriminator circuits.

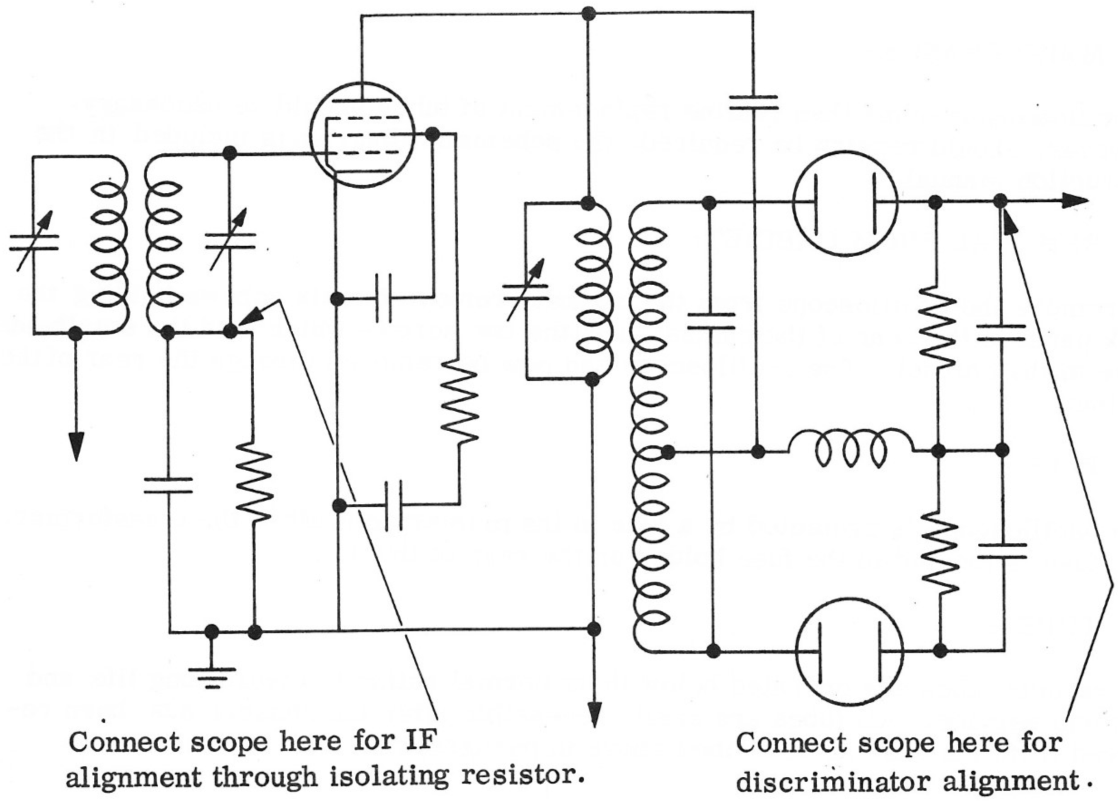

Figure 16. FOSTER SEELEY DISCRIMINATOR

The curve that will be viewed when the discriminator is properly aligned is shown in Figure 17.

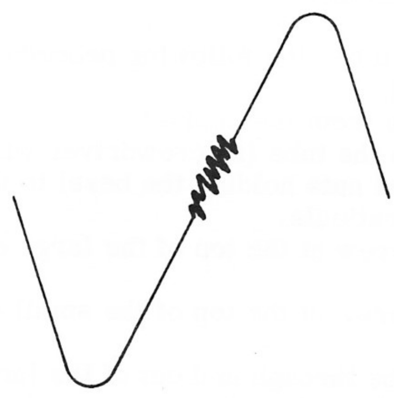

Figure 17. DISCRIMINATOR RESPONSE

SECTION VI - MAINTENANCE

1. MAINTENANCE:

No maintenance other than routine replacement of tubes should be necessary. However, should repairs be required, the schematic diagram is included in the instruction manual.

2. REMOVAL FROM CABINET:

To remove the oscilloscope from the cabinet, remove the six screws holding the back panel to the rear of the cabinet, and the two screws which hold the small side plate to the cabinet. The oscilloscope can now be removed through the rear of the cabinet.

3. FUSES:

The oscilloscope is protected by a fuse in the primary circuit of the transformer. The fuse is located in the fuse holder on the rear of the unit.

4. TUBES:

All vacuum tubes are operated below their normal rating to insure long life and uniform service. All tubes are easily accessible after the chassis has been removed from the case as described above in paragraph 2.

5. CATHODE RAY TUBE:

a) The cathode ray tube type 5DEP1 requires care in use and care in handling. There are three common causes for failure:
   1. Mechanical breakage
   2. Burning of the screen
   3. Loss of emission of the cathode

b) To replace the cathode ray tube, the following procedure should be used:
   1. Disconnect the line cord.
   2. Remove the oscilloscope from the cabinet.
   3. Remove the socket from the tube (a screwdriver will help separate).
   4. Unscrew the four knurled nuts holding the bezel to the front panel.
   5. Remove the bezel and graticule.
   6. Loosen the tightening screw at the top of the large clamp around the face of the cathode ray tube.
   7. Loosen the tightening screw at the top of the small clamp around the base of the tube.
   8. Pass the cathode ray tube through and out of the large hole in the panel.
   9. Reverse this procedure when installing a new cathode ray tube.

6. RE-CALIBRATION NOTE:

Whenever any of the tubes in the vertical amplifier require replacement, it will be necessary to re-calibrate the oscilloscope as outlined below:

Set the vertical gain control to the minimum position (fully counter-clockwise).

Connect a temporary jumper wire between each pin no. 1 of V1 and V2.

Measure the D. C. voltage between this jumper and ground with a meter having a sensitivity of at least 1000 ohms per volt and a range of at least 120 volts D. C. Adjust the BIAS ADJUST control, R7, until the jumper voltage is +115 volts with respect to ground.

Connect the voltmeter across each pin no. 1 of V3 and V4. Adjust the BIAS BALANCE control, R21 for zero volts. Final adjustment should be made with the most sensitive range of the voltmeter. If zero volts cannot be obtained, reverse the two 12BY7 tubes, V3 and V4. The oscilloscope should be allowed to warm up for at least one-half hour and then the previous steps repeated.

After re-calibration, remove the jumper wire between each pin no. 1 of V1 and V2.

Adjust the D. C. balance control, R9, (located through small hole in the front panel) until no vertical shift of the trace occurs during rotation of the vertical gain control from minimum to maximum.