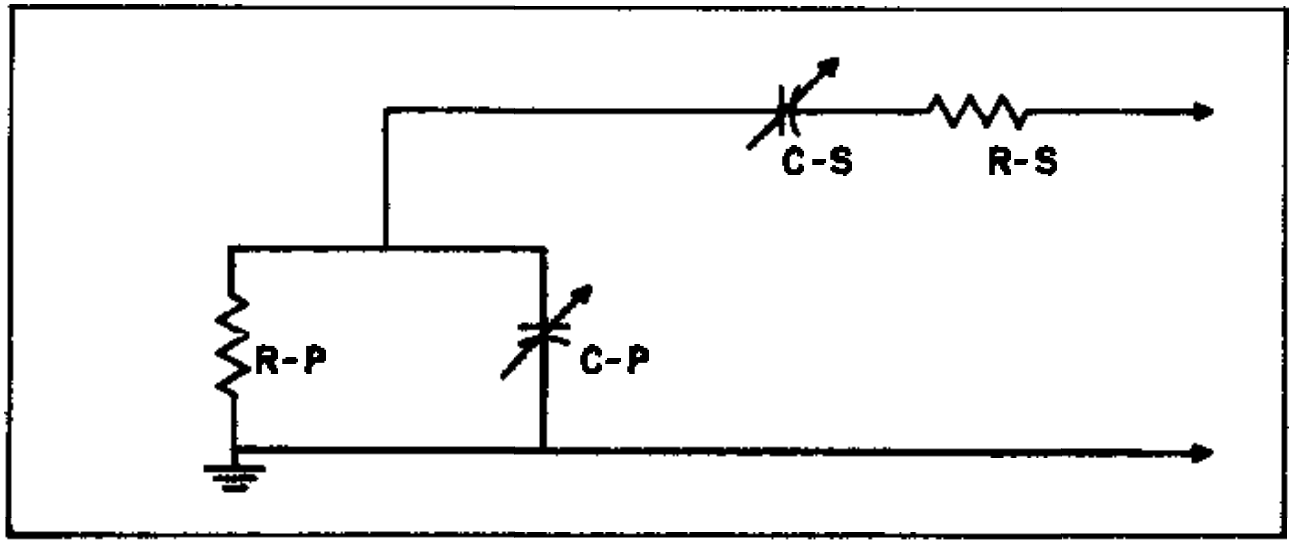

FIG. 11

NEGATIVE FEED-BACK AND AUTOMATIC AMPLITUDE LIMITOR: As may be seen in Fig. 12, the negative feed-back voltage used in the oscillator section is derived from the output of the second oscillator tube, V2, and is fed back to the cathode of the first oscillator tube, V1. The magnitude of the negative feed-back is determined by a resistor network, one element of which is the incandescent lamp, 356. A property of this lamp is that it has a positive temperature coefficient; however it possesses sufficient thermal inertia so that its temperature is substantially constant at all audio frequencies. Because of the lamp's positive temperature coefficient, the oscillations can not build up to a value in excess of the tube's handling capacity. This is so because the resistance of the lamp increases with increased current. As a result the degeneration in the cathode circuit of V1 increases, causing less amplification in the oscillator section. Thus, the lamp serves as an automatic amplitude limitor. Pot R9 is set at calibration for the proper negative feed-back.

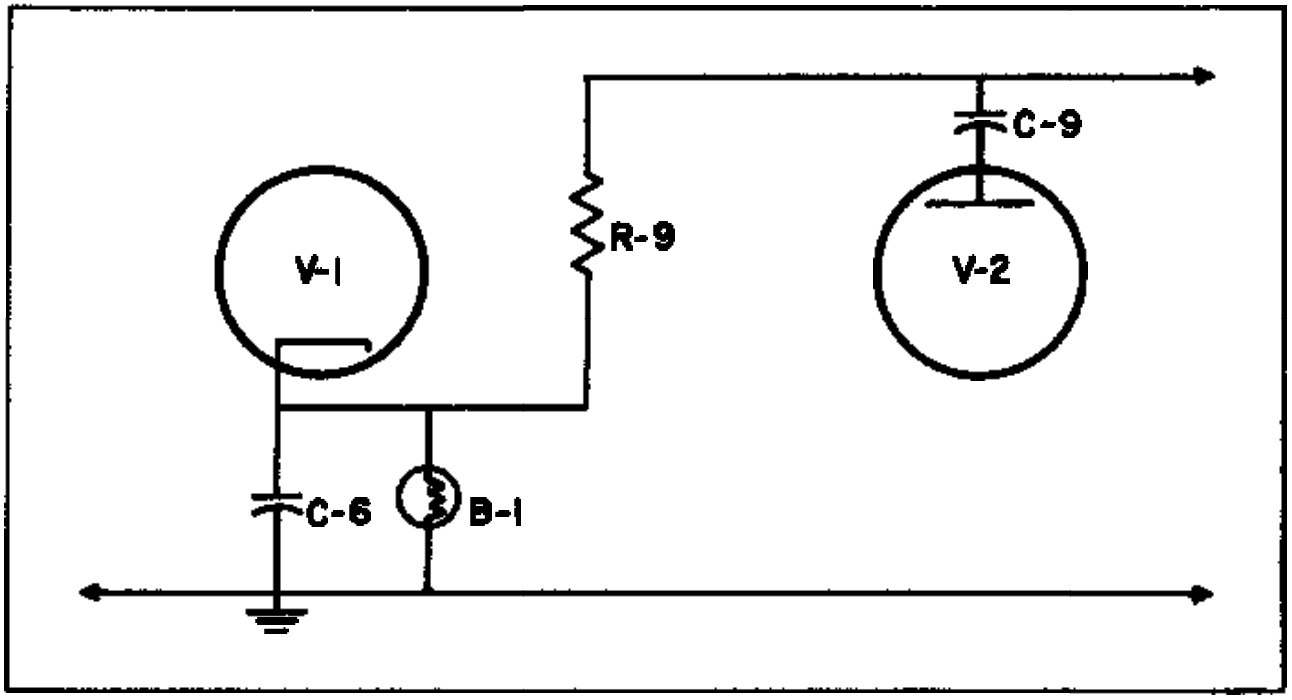

FIG. 12

THE SQUARE WAVE SHAPING CIRCUIT: (See Fig. 13) The square wave is formed from the sine wave output of the oscillator section. The sine wave is fed to the grid circuit of V3 (left-half), where grid limiting occurs. This is due to the flow of grid current through R19 on the positive half-cycles, causing a voltage drop across R19 opposing the original signal voltage. As this opposing voltage increases with increasing positive signal, clipping occurs and the waveform at the grid is as shown. While the grid waveform is independent of cathode-plate conduction through the tube, the plate waveform is not. As the grid voltage dips below the cut-off point on the negative half-cycles, cut-off limiting occurs and the negative half of the plate waveform is flattened. The right half of V3 follows the plate of the left half. In this section, the rounded bottom of the wave is clipped, and the resulting square wave amplified. The squareness of the wave is increased in both sections of the tube due to the non-linear tube characteristic.

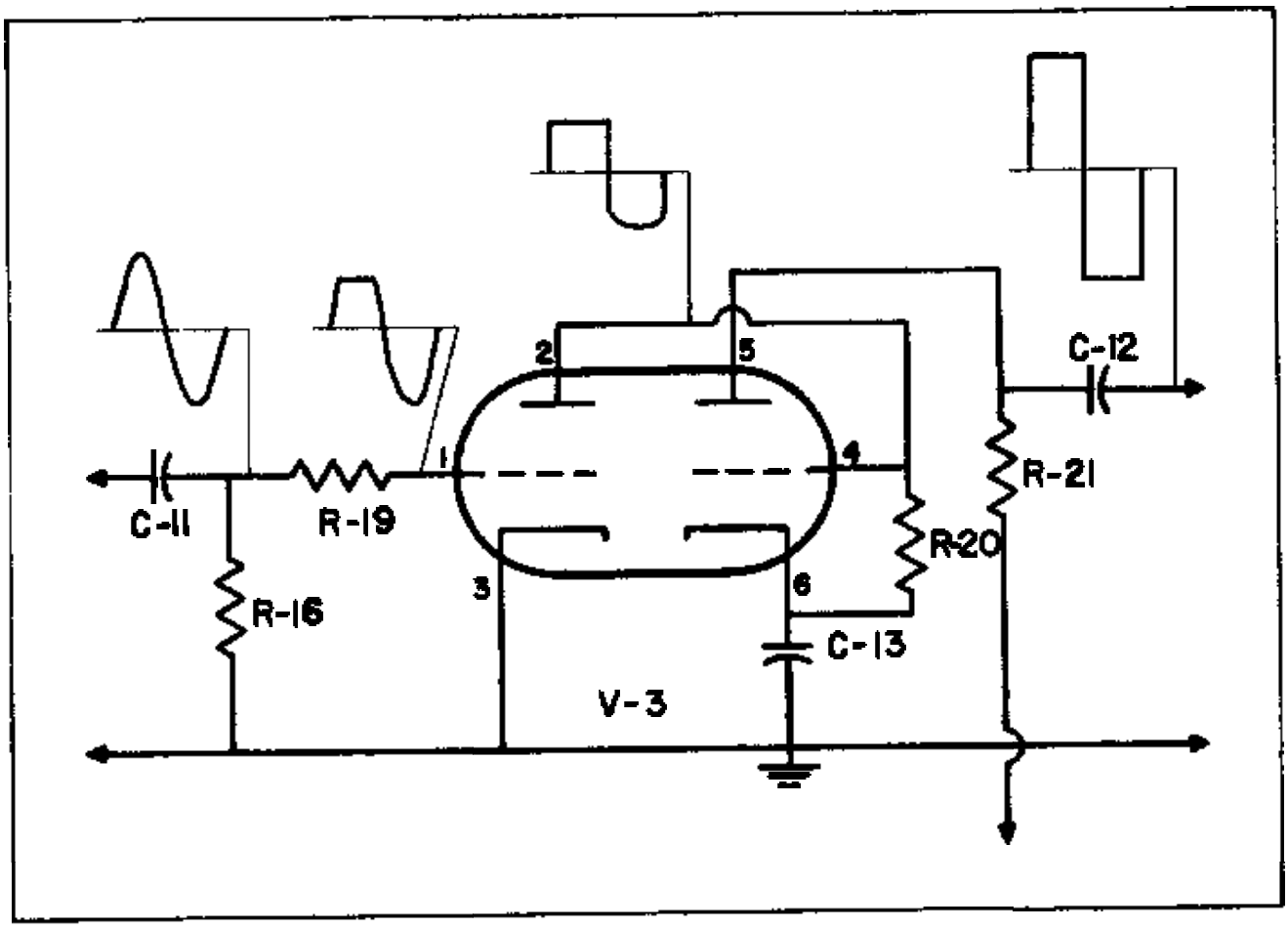

FIG. 13

THE CATHODE FOLLOWER OUTPUT CIRCUIT: (See Fig. 14) In this circuit, the voltage applied to the grid of tube, V4, varies the current through the tube, which in turn varies the voltage across the total cathode resistor (R24 and R25). The output voltage is taken out through the large capacitor, C15, which presents a very low impedance over the entire frequency spectrum. The cathode resistance is split into R24 and R25 to provide the proper bias.

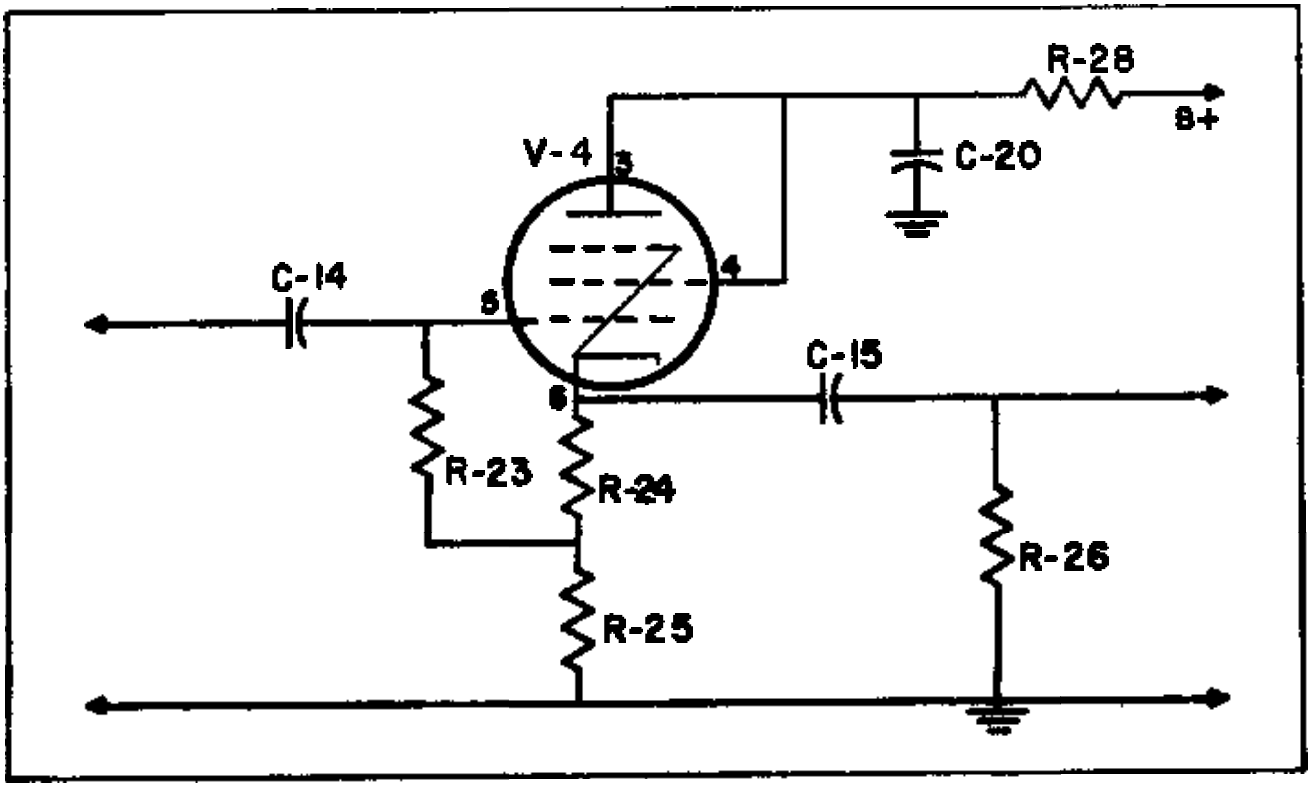

FIG. 14

THE POWER SUPPLY: The power supply is a conventional full wave rectifier circuit, employing a 6X5 tube (V5) and a pi filter consisting of a choke, L1, and two electrolytic capacitors, C16 and C17. This LC network effectively filters the d-c voltage output of the rectifier. The +B voltages for the first oscillator tube, V1, and the cathode follower tube, V4, are additionally filtered by RC circuits. R27 and C18 form an RC filter for V1, and R28 and C19 form an RC filter for V4.

MAINTENANCE

CALIBRATION: The Model 377 is extremely stable. However, after a long period of use, it may require re-calibration due to aging of the components. The accuracy may be readily restored by using one of the methods below. Re-calibration will also be necessary whenever tubes or other components are replaced. Fig. 15 shows the locations of trimmer C1, pot R9, and the tubes.

The A-C Voltmeter method is satisfactory for general use of the instrument. The Oscilloscope method is preferable, however, as it gives better accuracy. The Frequency Standard method is necessary for work that requires very accurate knowledge of the frequency.

1. A-C VOLTMETER METHOD: This method requires only an a-c voltmeter, preferably one with 1000 ohms/volt sensitivity or more. The procedure is as follows: a) Connect a 1000 ohm resistor across the output terminals of the Audio Generator. b) Connect the a-c voltmeter across the resistor. c) Set the BAND switch at band B and the frequency dial at 200 c.p.s. d) Turn the AMPL. control to the maximum clockwise position. e) Adjust pot R9 for a reading between 10 and 11 volts (r.m.s.) on the meter. f) Turn the frequency dial knob to 2 Kc. g) Loosen or tighten the adjustment screw on

trimmer C1 with an insulated alignment tool until the voltage read on the meter is equal to the voltage read when the frequency dial knob was set at 200 c.p.s.

The instrument is now calibrated. As a check, turn the frequency dial knob back to 200 c.p.s., observing the meter as you do so. The voltage should be nearly constant over the entire frequency range.

2. OSCILLOSCOPE METHOD: This method requires an oscilloscope with a 60 cycle test output and an a-c voltmeter. The procedure is as follows: a) Adjust pot R9 as described in steps a, b, c, d, and e of the A-C Voltmeter method above. b) After pot R9 has been adjusted for a reading between 10 and 11 volts, disconnect the a-c voltmeter (leaving the 1000 ohm resistor). c) Connect the output of the Audio Generator to the vertical input terminals of the 'scope. d) Connect the 60 cycle test terminals of the 'scope to the horizontal input terminals. e) Set the BAND switch of the Audio Generator at band A, and turn the frequency dial knob to 180 c.p.s. f) Adjust the 'scope controls for roughly equal deflections on each axis. g) Loosen or tighten the adjustment screw on trimmer C1 with an insulated alignment tool until the Lissajous figure shown in Fig. 3b (for 3:1 ratio) appears stationary on the screen.

The instrument is now calibrated. As a check, turn the frequency dial knob to 20 c.p.s. The Lissajous pattern shown in Fig. 3e should appear on the screen. Turn the frequency dial knob to 60 c.p.s. One of the Lissajous patterns shown in Fig. 2 (for 1:1 ratio) should be obtained.

3. FREQUENCY STANDARD METHOD: This method requires either a standard audio generator with known accuracy or a fixed frequency standard. Before calibration, allow the Model 377 to heat up for at least thirty minutes. The calibration procedure is the same as described in the OSCILLOSCOPE method above. Instead of the 60 cycle test signal, however, the standard is connected to the horizontal plates of the 'scope.

If a standard generator is used, set it at a frequency of 2 Kc. Set the BAND switch of the Model 377 at band B, and the frequency dial knob at 2 Kc. Adjust the trimmer, C1, until one of the Lissajous patterns shown in Fig. 2 (for 1:1 ratio) appears stationary on the screen. The Medel 377 is now calibrated. As a check, adjust the standard generator and the Model 377 to equal frequencies on their respective dials at two other points in band B aed three points in each of the remaining bands. One of the Lissajous figures for 1:1 ratio should appear on the screen at each point, allowing for the specified accuracy of Medel 377.

If a fixed frequency standard is used, set the Medel 377 at a nominal frequency near the high end of band B that is in the ratio of a whole number or a simple fraction to the fixed standard frequency. Adjust the trimmer, C1, until the appropriate Lissajous figure appears stationary on the screen. The instrument is now calibrated. Check at least two other points on band B and three other points on each of the remaining bands by means of the appropriate Lissajous figures.