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LABORATORIES
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THE NATIONAL RESEARCH COUNCIL OF CANADA
RADIO AND ELECTRICAL ENGINEERING DIVISION



ANALYZED

RADIO MULTIMETER FOR SIGHTLESS OPERATORS

OTTAWA
MAY, 1948

N.R.C. NO. 1521

Laboratories
of
The National Research Council of Canada
Radio and Electrical Engineering Division

RADIO MULTIMETER FOR SIGHTLESS OPERATORS

by
J.C. Swaile.

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Ottawa, May, 1948.

RADIO MULTIMETER FOR SIGHTLESS OPERATORS

1. Introduction.

The radio multimeter is designed to read voltage, current, and resistance on a raised scale. A pointer is moved across the dial and a balance is indicated by an auditory mull in the headphones. The scale is divided into ten main divisions indicated by double dots; single dots mark the sub-divisions.

The instrument is supplied with 110-volt, 60-cycle power. The a-c and d-c voltage ranges are 0 - .1, 0 - 1, 0 - 10, 0 - 100, 0 - 300, 0 - 500, and 0 - 1,000 volts. The current ranges are, 0 - .1, 0 - 1, 0 - 10, 0 - 100, 0 - 300, 0 - 500, and 0 - 1,000 milliamperes. When measuring resistance, the ranges are 0 - 100, 0 - 1,000, 0 - 10,000, 0 - 100,000, 0 - 1,000,000, and 0 - 10,000,000 ohms. The accuracy of this meter is approximately one per cent on voltage and resistance scales, and two to three per cent on the current scale.

2. Physical Description.

The unit is built into a metal cabinet measuring 8 by 8 by 8 inches. The front panel is a sloping panel with the braille scale mounted at its center. The scale is three inches in radius, giving it an over-all length of fourteen inches. Mounted below the dial are the range switch, the input terminals and the balance and gain controls (see fig. 4). Power and headphone connections are made at the rear.

3. Circuit Description.

Resistance Bridge.

The resistance bridge is essentially a Wheatstone bridge with a voltage of from 1 to 100 volts supplied across it, depending on the resistance range. The variable resistance is a straight-line potentiometer attached to a pointer on the braille scale. Instead of taking the reading directly across the bridge, as in the conventional circuit, the output voltages are fed to the grids of two 6K6 tubes, connected as cathode followers. A single-pole, double-throw vibrator is connected across the cathodes of these. If there is a difference in potential between the cathodes, an audio signal is produced between the arm of the vibrator and ground. When the bridge is balanced this signal disappears. An audio amplifier increases the signal level before it is fed to the headphones in order to increase the sensitivity of the instrument. In order to give the bridge an initial balance, the voltage on the screens of the 6K6 tubes is varied by a potentiometer.

Voltage Bridge.

In the voltage bridge the input potential is fed to the grid of one 6K6 tube, while the grid of the other is furnished with a

standard voltage, which is varied by the standard potentiometer. The remainder of the circuit is similar to that used in the resistance bridge. The impedance of the input is ten megohms, up to one hundred volts; on the higher ranges series dropping resistors are used to reduce the voltage on the grid to one hundred volts at most. When a-c voltages are to be measured, a probe employing a diode rectifier is used. This gives accurate readings well into the r-f region.

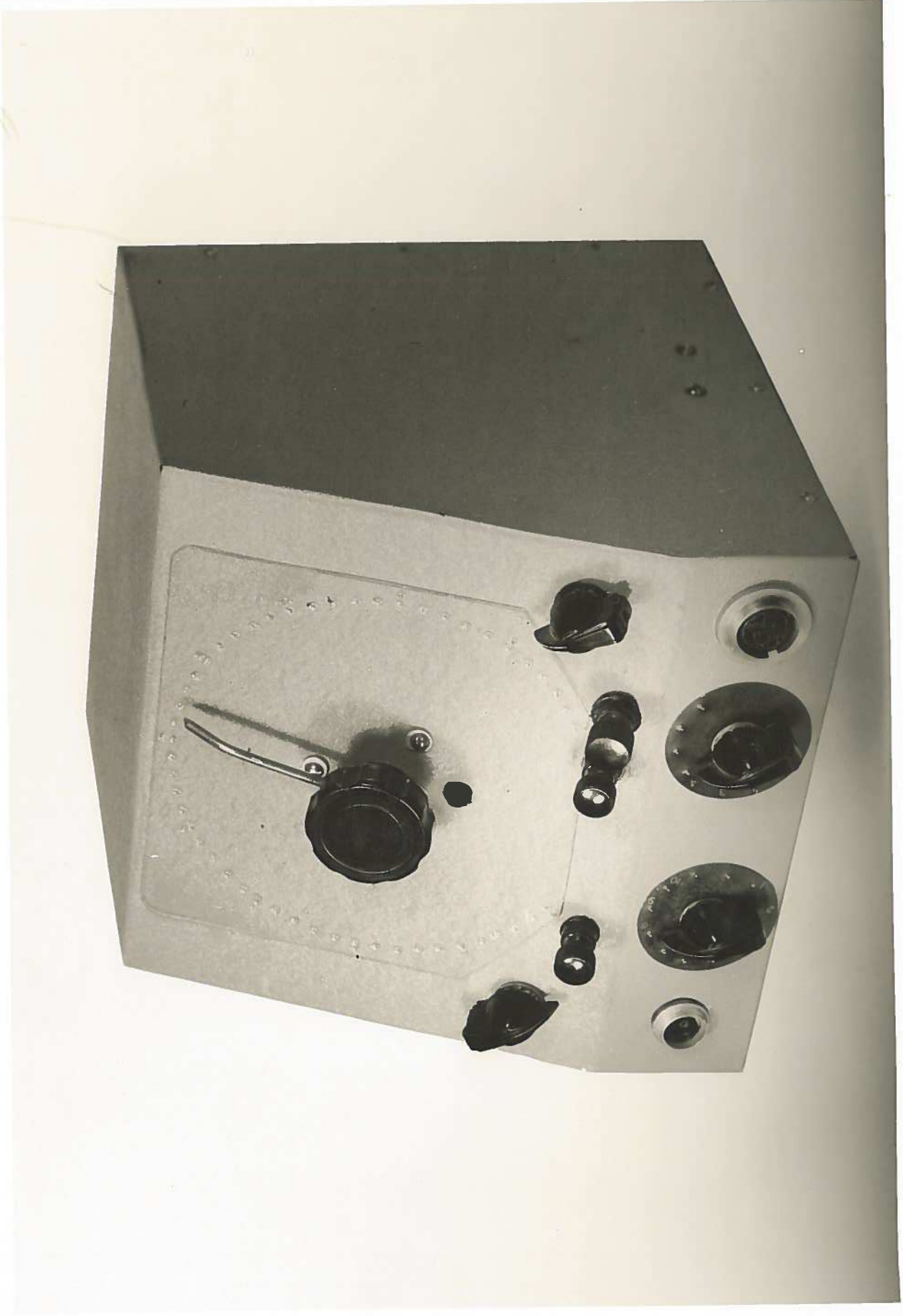
Plug P₂ is provided for external connection of a phototube probe which may be used for checking the position of indicators on the faces of standard meters.

Current Bridge.

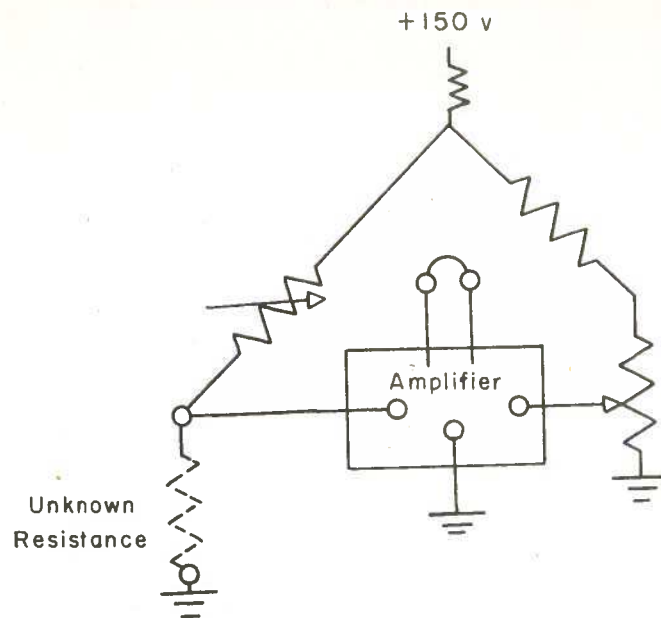
The current bridge is similar in all respects to the voltage bridge, a potential of 0.1 volts being developed across a low resistance shunt.

Power Supply.

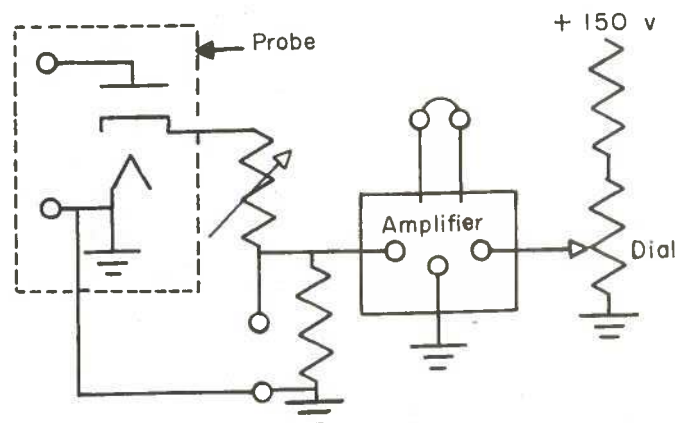
The power supply is controlled by two 6A2 tubes in series, at three hundred volts. The 150-volt tap is used to supply the potential across the bridge circuits.



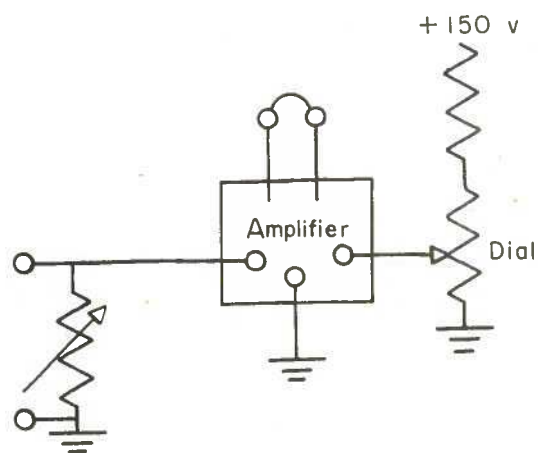
RADIO MULTIMETER FOR SIGHTLESS OPERATORS



Resistance — Metering Circuit



Voltage — Metering Circuit



Current — Metering Circuit

FIG. 1. BASIC CIRCUITS

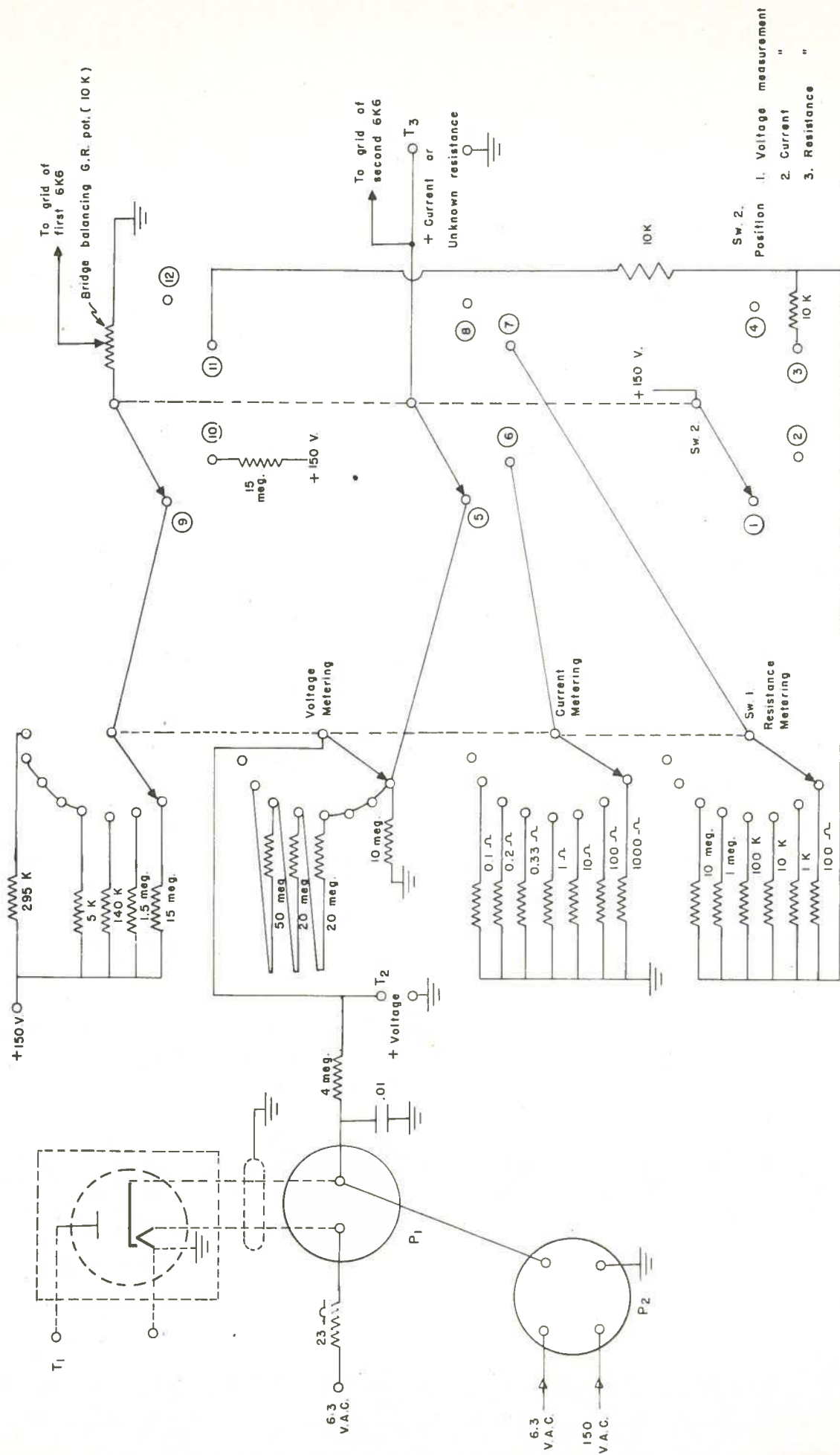


FIG. 2. METERING CIRCUITS

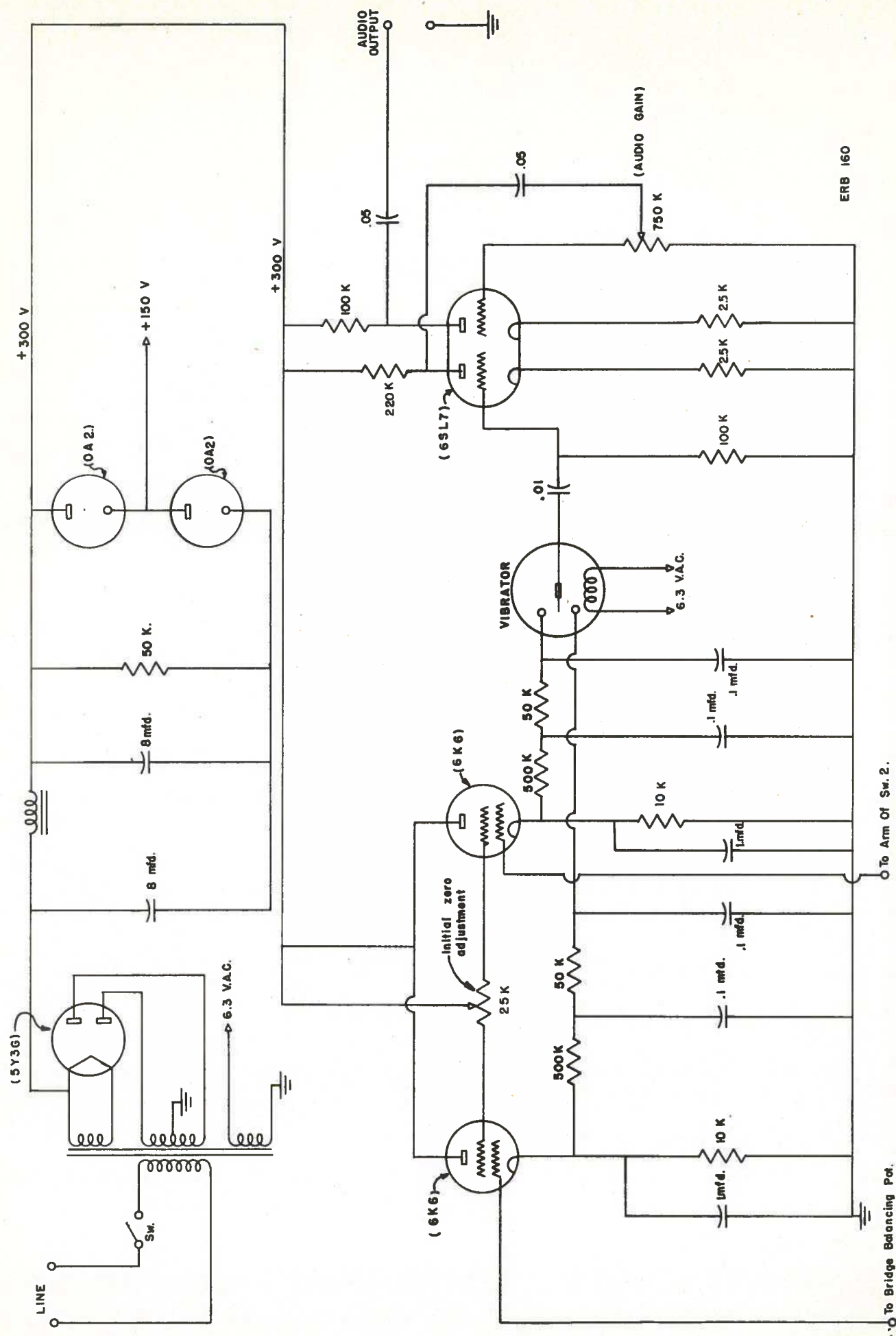


FIG. 3. POWER SUPPLY AND AMPLIFIER

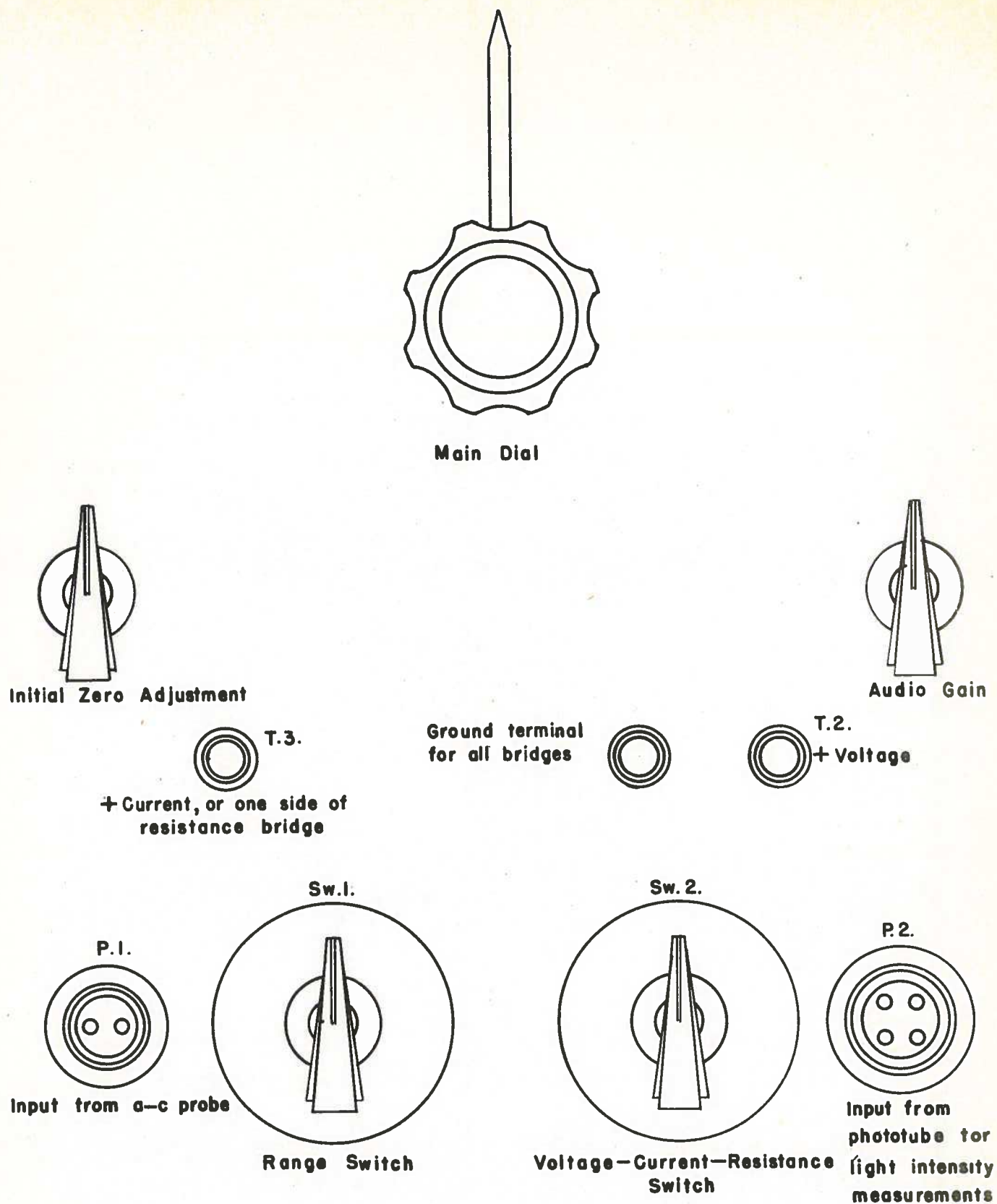


FIG. 4. FRONT PANEL