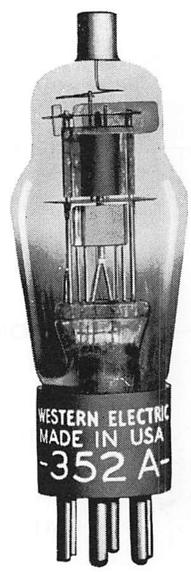
# Western Electric

## 352A Vacuum Tube




**Classification—Duodiode triode with an indirectly heated cathode**

The 352A tube comprises three distinct vacuum tube units which are independent of each other except that sections of a single cathode structure supply electron emission for all three. Two of these units are diodes. The other is a triode.

**Applications—**Diode detector, diode rectifier for automatic volume control voltage, and triode audio-frequency amplifier. If desired the two diodes may be used for full-wave rectification or they may be connected in parallel to provide a lower impedance half-wave rectifier. The former connection requires about twice as high an input voltage as the latter to give equal detector output.

**Dimensions and Connections—**Outline diagrams of the tube and base giving the dimensions and the arrangement of the electrode connections to the base terminals are shown in Figures 1 and 2.

**Base and Mounting—**This tube employs a small six-pin thrust type base suitable for use in a Western Electric 144B or similar socket. The base pins are silver plated. The triode grid terminal is a small metal cap located at the top of the bulb.

This tube may be mounted in any position.

### Average Direct Interelectrode Capacitances

| | | |
|---|---|---|
| Triode grid to plate | 1.5 | $\mu\mu f$ |
| Triode grid to cathode and heater | 1.6 | $\mu\mu f$ |
| Triode plate to cathode and heater | 3.8 | $\mu\mu f$ |
| Both diodes to triode grid | 0.015 | $\mu\mu f$ |
| Both diodes to triode plate | 1.4 | $\mu\mu f$ |
| Both diodes to cathode and heater | 6.5 | $\mu\mu f$ |

### Heater Rating

| | |
|---|---|
| Heater voltage | 10.0 volts, a.c. or d.c. |
| Nominal heater current | 0.32 ampere |

The heater of this tube is designed to operate on a voltage basis and should be operated at as near the rated voltage as practicable.

**Cathode Connection**—Where alternating heater voltage is used the cathode should preferably be connected directly to the mid-point of the heater transformer winding or to the mid-point of a low resistance connected across the heater terminals. For direct current operation the cathode may be connected to either end of the heater. If voltage is applied between the heater and cathode, it should be kept low and must not exceed 50 volts.

**Triode Characteristics**—Typical curves showing triode plate current as a function of grid voltage for several values of plate voltage are shown in Figure 3. Corresponding amplification factor, plate resistance and transconductance characteristics are given in Figures 4, 5 and 6 respectively. Figure 7 shows plate current as a function of plate voltage for several values of grid voltage.

### Triode Operating Conditions and Output

Permissible operating plate and grid voltages are included within the area, ABCD, in Figure 3. Amplification factor, plate resistance, transconductance and performance data for a number of typical operating conditions are given in the table. Recommended conditions or others of no greater severity should be selected in preference to maximum conditions wherever possible. The life of the tube at maximum operating conditions will be shorter than at less severe conditions.

In the last four columns of the table are given the fundamental power output, $P_m$, in milliwatts, the fundamental voltage output, $E_{pm}$, in peak volts and the second and third harmonic levels, $F_{2m}$ and $F_{3m}$, in db below the fundamental, for the indicated values of load resistance. The peak value of the sinusoidal input voltage, $E_{gm}$, is numerically equal to the grid bias in each case. Where the level of the third harmonic is lower than 45 db below the fundamental, its value may be widely different from tube to tube. The values given represent a typical tube.

For a smaller input voltage, $E_g$, the fundamental power and voltage outputs and the harmonic levels are given approximately by the following relations:

$$P = P_m\left(\frac{E_g}{E_{gm}}\right)^2$$

$$E_p = E_{pm}\frac{E_g}{E_{gm}}$$

$$F_2 = F_{2m} + 20\log_{10}\frac{E_{gm}}{E_g}$$

$$F_3 = F_{3m} + 40\log_{10}\frac{E_{gm}}{E_g}$$

TABLE

| Plate Voltage | Grid Voltage | Plate Current | Amplification Factor | Plate Resistance | Transconductance | Load Resistance | Power Output | Voltage Output | Second Harmonic | Third Harmonic |
|---|---|---|---|---|---|---|---|---|---|---|
| Volts | Volts | Milliamperes | | Ohms | Micromhos | Ohms | Milliwatts | Peak Volts | db | db |
| 135 | −4.5 | 3.2 | 14.0 | 17,500 | 800 | 20,000 | 31 | 35 | 25 | 50 |
| | | | | | | 35,000 | 27 | 43 | 28 | 45 |
| | | | | | | 50,000 | 23 | 48 | 29 | 45 |
| 135 | −6.0 | 2.1 | 13.3 | 20,500 | 650 | 20,000 | 42 | 41 | 20 | 55 |
| | | | | | | 35,000 | 40 | 53 | 24 | 55 |
| | | | | | | 50,000 | 34 | 58 | 26 | 50 |
| 135 | −7.5 | 1.3 | 12.7 | 26,000 | 490 | 20,000 | 46 | 43 | 16 | 38 |
| | | | | | | 35,000 | 45 | 56 | 19 | 45 |
| | | | | | | 50,000 | 42 | 65 | 21 | 55 |
| 180 | −7.5 | 3.4 | 13.5 | 18,000 | 750 | 20,000 | 79 | 56 | 22 | 55 |
| | | | | | | 35,000 | 68 | 69 | 25 | 50 |
| | | | | | | 50,000 | 59 | 77 | 28 | 45 |
| 180 | −9.0 | 2.4 | 13.0 | 20,500 | 630 | 20,000 | 90 | 60 | 18 | 45 |
| | | | | | | 35,000 | 85 | 77 | 22 | 55 |
| | | | | | | 50,000 | 76 | 87 | 24 | 55 |
| 180 | −10.5 | 1.5 | 12.7 | 26,000 | 490 | 20,000 | 90 | 60 | 15 | 36 |
| | | | | | | 35,000 | 87 | 78 | 17 | 38 |
| | | | | | | 50,000 | 78 | 88 | 20 | 45 |
| *200 | −9.0 | 3.3 | 13.2 | 18,000 | 730 | 20,000 | 109 | 66 | 20 | 55 |
| | | | | | | 35,000 | 96 | 82 | 24 | 55 |
| | | | | | | 50,000 | 81 | 90 | 26 | 50 |
| *200 | −10.5 | 2.3 | 12.9 | 22,000 | 590 | 20,000 | 112 | 67 | 17 | 40 |
| | | | | | | 35,000 | 106 | 86 | 21 | 50 |
| | | | | | | 50,000 | 90 | 95 | 24 | 60 |

*Maximum operating conditions.

**Triode Microphonic Noise—**With a plate voltage of 135 volts, a grid bias of −6 volts, and a load resistance of 100,000 ohms, the mean microphonic noise output level of the triode section of the tube, measured in a laboratory reference test set, is 45 db below 1 volt. The range of levels of individual tubes extends from 20 to 60 db below 1 volt. Since microphonic noise depends on the type and intensity of the mechanical disturbance which produces it, the values given here are useful chiefly for comparison with the levels of other tubes which have been tested in the same way.

**Diode Characteristics—**The current-voltage characteristic of a single diode is shown in Figure 8. Rectification characteristics for a single diode are shown in Figure 9 for a number of values of impressed alternating input voltage. Each of these characteristic curves gives the relation between the direct voltage impressed on the diode plate and the average diode current as indicated by a direct-current microammeter for a constant impressed alternating input voltage of the value specified. Where the diode is used as a detector with the usual condenser-resistance circuit, the direct component of the voltage developed across the resistance by any alternating-voltage input is given by the intercept of the load line with the rectification characteristic corresponding to the input voltage. Load lines for zero fixed bias are shown in Figure 9 for load resistance values of 0.25, 0.5 and 1.0 megohm.

The potential of each diode plate with respect to the cathode on the positive swing of the input voltage should be limited to a maximum value of +10 volts.

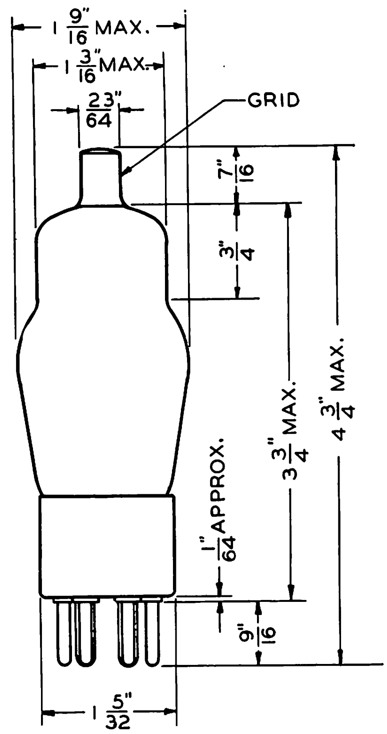



FIG. 1

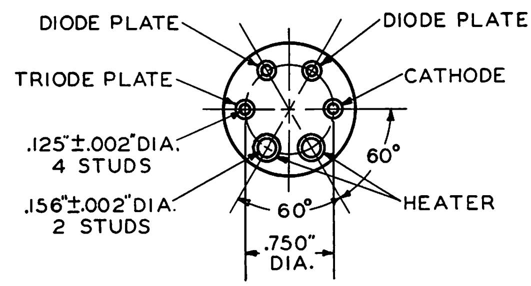



FIG. 2

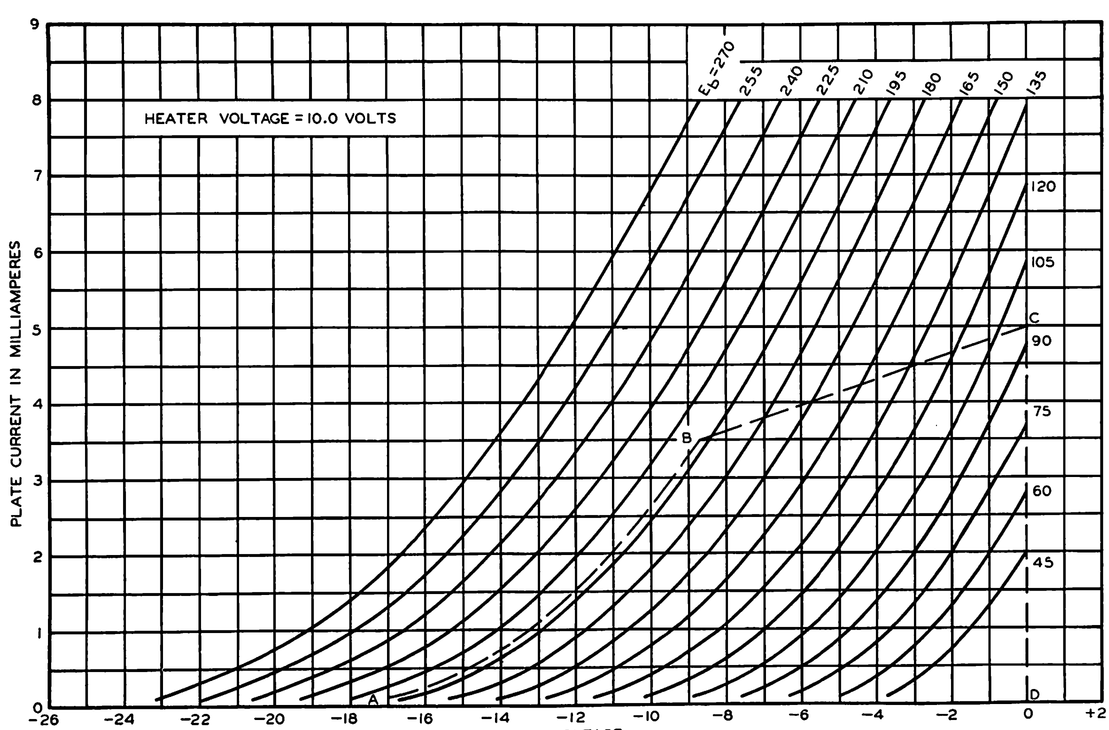



FIG. 3

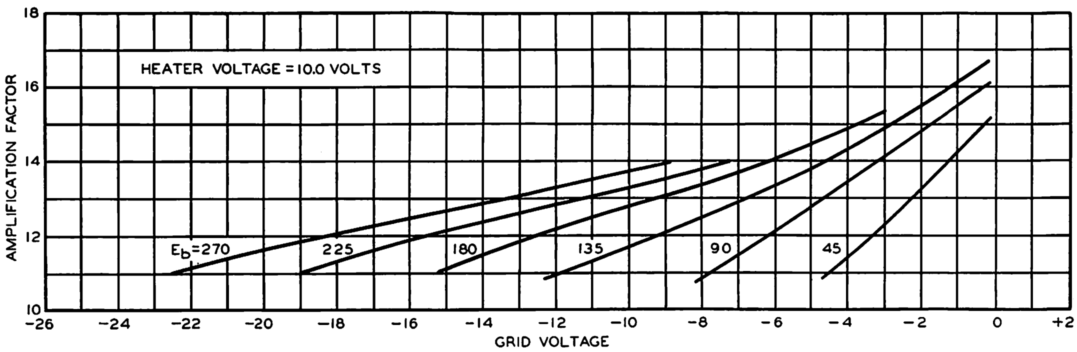



**FIG. 4**

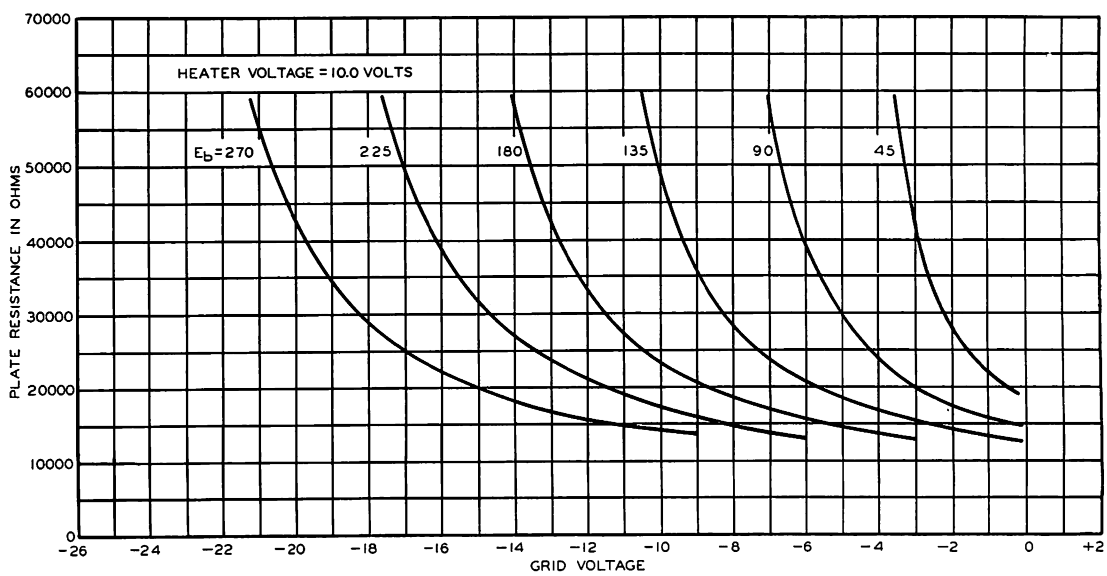



**FIG. 5**

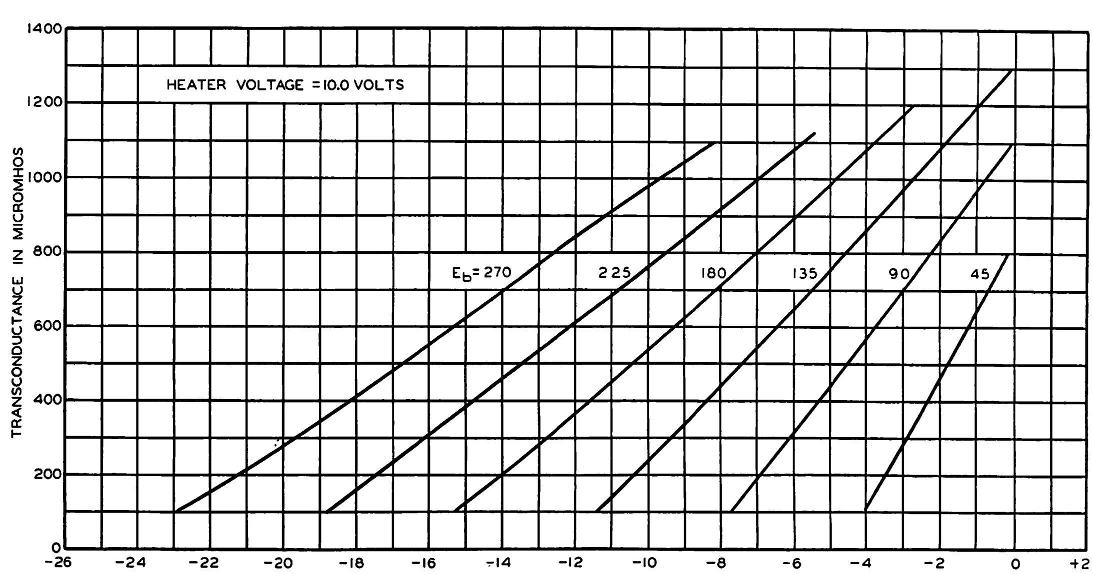



**FIG. 6**

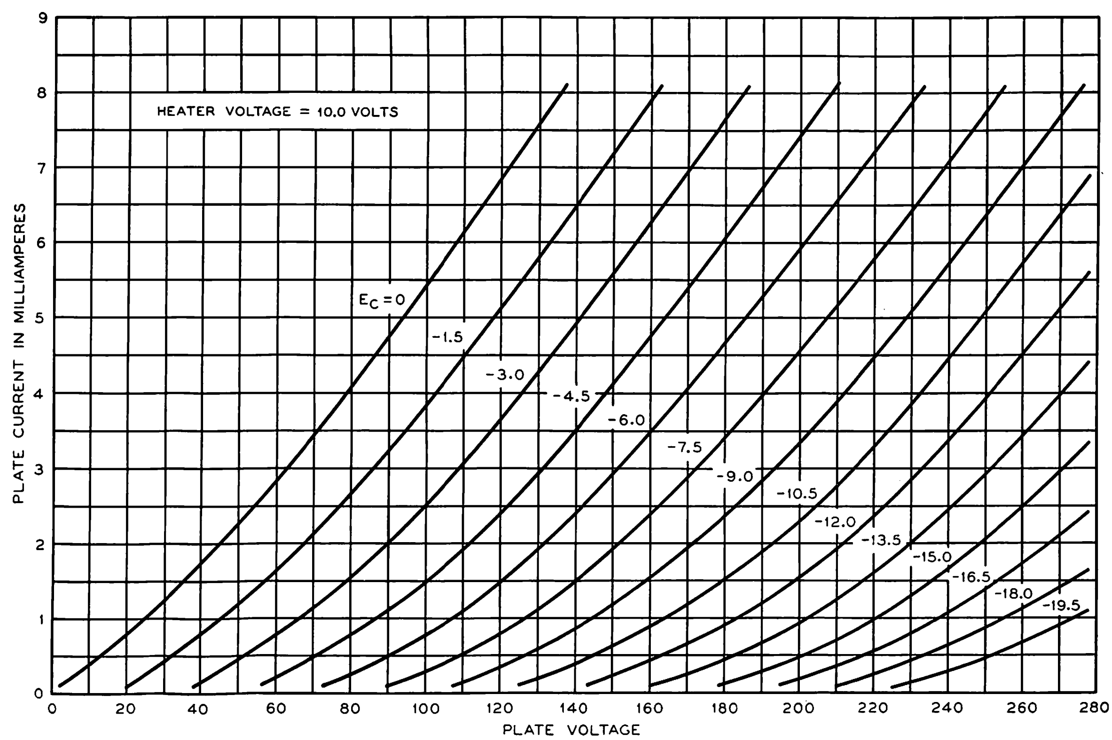

HEATER VOLTAGE = 10.0 VOLTS
PLATE CURRENT IN MILLIAMPERES
PLATE VOLTAGE
$E_C = 0$
-1.5
-3.0
-4.5
-6.0
-7.5
-9.0
-10.5
-12.0
-13.5
-15.0
-16.5
-18.0
-19.5

FIG. 7

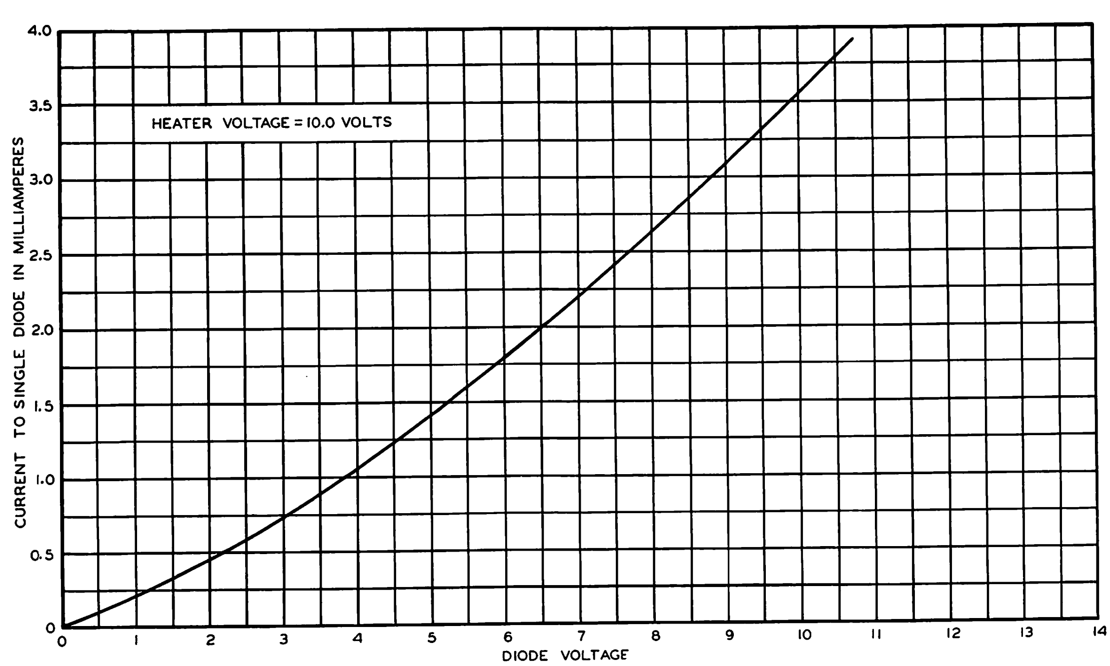

HEATER VOLTAGE = 10.0 VOLTS
CURRENT TO SINGLE DIODE IN MILLIAMPERES
DIODE VOLTAGE

FIG. 8

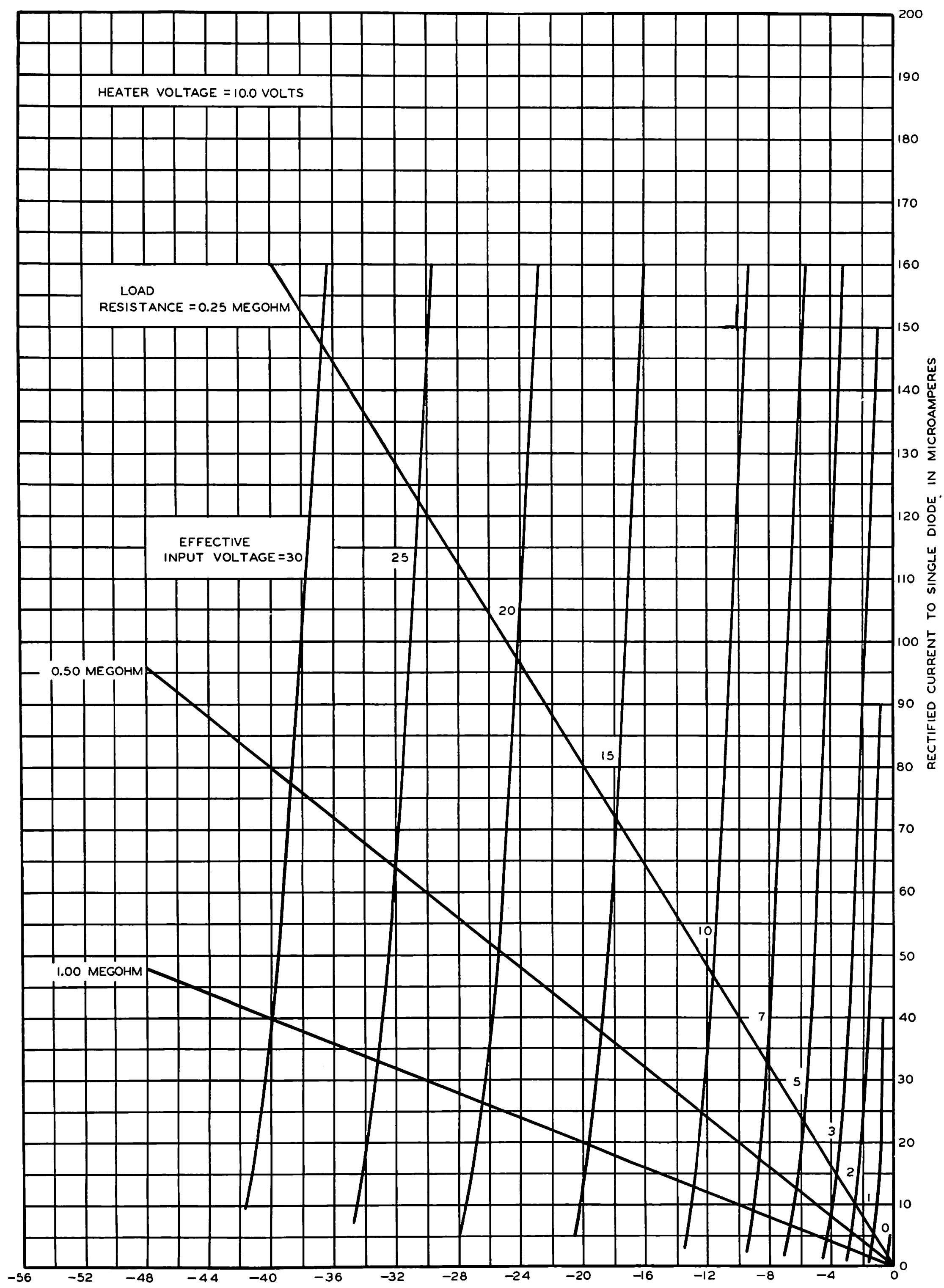



**FIG. 9**

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A development of Bell Telephone Laboratories, Incorporated the research laboratories of the American Telephone and Telegraph Company and the Western Electric Company

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