Western Electric

303A Vacuum Tube

Classification—Duodiode triode with indirectly heated cathode

The 303A 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. Except for the heater rating the 303A tube is similar to the 292A.

Applications—Diode detector, diode rectifier for automatic volume control voltage, and triode audio-frequency amplifier. If desired, both diodes may be used for detection, connected either in parallel for half-wave rectification or in push-pull for full-wave rectification. The latter connection requires about twice as high an input voltage as the former to give equal detector output. An alternative use of the triode unit is as a direct-current amplifier for the automatic volume control voltage.

Dimensions—Dimensions, outline diagrams of the tube and base, and the arrangement of the electrode connections to the base terminals are shown in Figures 1 and 2.

Base—Medium six-pin type. Small metal cap triode grid terminal at the top of the bulb.

Socket—Standard six-contact type, such as the Western Electric 144B socket.

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Mounting Positions—The 303A tube may be mounted in any position.

Average Direct Interelectrode Capacitances

Triode grid to plate	1.3 μμf.
Triode grid to cathode and heater	1.4 μμf.
Triode plate to cathode and heater	3.7 μμf.
Both diodes to triode grid	0.02 μμf.
Both diodes to triode plate	1.3 μμf.
Both diodes to cathode and heater	6.2 μμf.

Heater Rating

Heater voltage	2.0 volts, a.c. or d.c.
Nominal heater current	1.60 amperes

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

Cathode Connection—Preferably direct to the heater. If voltage must be applied between the cathode and heater, it should be kept as low as possible and should never exceed 90 volts.

Triode Characteristics—Plate current characteristics of the triode section of a typical 303A tube are shown in Figure 3 as functions of grid bias for several values of plate voltage. Corresponding amplification-factor, plate-resistance, and transconductance characteristics are given in Figures 4, 5, and 6 respectively. Plate current characteristics as functions of plate voltage for several values of grid bias are shown in Figure 7.

Triode Operating Conditions and Output—Permissible operating grid and plate voltages are included within the area, ABCD, in Figure 3. Values of amplification factor and plate resistance and typical performance data are given in the table below for recommended and maximum operating conditions represented by selected points within this area. 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 may be shorter than at the recommended conditions.

The performance data include the fundamental voltage output, E_{pm}, in peak volts, the corresponding power output, P_m, in milliwatts, and the second and third harmonic levels, F_{2m} and F_{3m}, in db below the fundamental for the indicated values of input voltage and load resistance. Where the level of the third harmonic is lower than 45 db below the fundamental, its value may be widely different for different tubes. The values given represent a typical tube. The input voltage, E_{gm}, in peak volts, is numerically equal to the grid bias for each operating condition. For a smaller input voltage E_g, the voltage output, power output, and second and third 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 Volts	Grid Bias Volts	Plate Current Milliamperes	Amplification Factor	Plate Resistance Ohms	Load Resistance Ohms	Input Peak Volts	Voltage Output Peak Volts	Power Output Milliwatts	Second Harmonic db	Third Harmonic db
Recommended Operating Conditions	135	— 4.5	3.0	14.1	17000	20000	4.5	34	29	24	55
						35000	4.5	43	26	27	50
						50000	4.5	47	23	28	50
	135	— 6.0	2.0	13.5	21000	20000	6.0	40	40	19	50
						35000	6.0	51	38	22	60
						50000	6.0	58	33	24	50
	135	— 7.5	1.1	12.7	27000	20000	7.5	42	44	14	37
						35000	7.5	55	43	17	41
						50000	7.5	63	40	19	45
	180	— 7.5	3.2	13.5	17000	20000	7.5	55	75	21	55
						35000	7.5	68	66	24	50
						50000	7.5	76	58	26	50
	180	— 9.0	2.2	13.0	20000	20000	9.0	59	88	17	42
						35000	9.0	75	81	20	55
						50000	9.0	85	73	23	60
	180	—10.5	1.3	12.5	26000	20000	10.5	60	91	13	35
						35000	10.5	78	87	16	38
						50000	10.5	90	81	19	45
Maximum Operating Conditions	200	— 9.0	3.2	13.2	18000	20000	9.0	65	105	20	50
						35000	9.0	82	94	23	55
						50000	9.0	90	81	25	45
	200	10.5	2.2	12.8	21000	20000	10.5	68	114	16	39
						35000	10.5	87	108	20	50
						50000	10.5	97	95	22	55

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 303A tube, measured in a laboratory reference test set, is 44 db below 1 volt. The range of levels of individual tubes extends from 20 to 64 db below 1 volt. Since microphonic noise output 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 types of tubes which have been tested in the same way.

Diode Characteristics—The current-voltage characteristic of a single diode is shown in Figure 8. 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. 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 a given alternating-voltage input is given by the intercept of the load line corresponding to the load resistance 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.

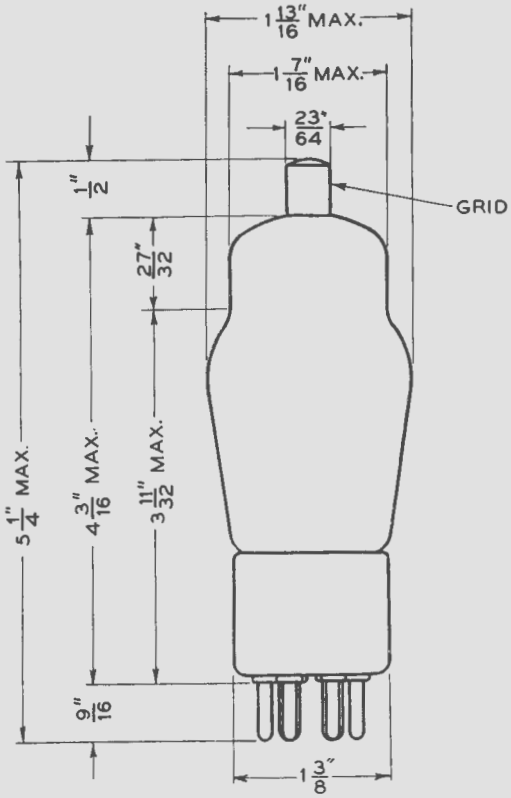

FIG. 1

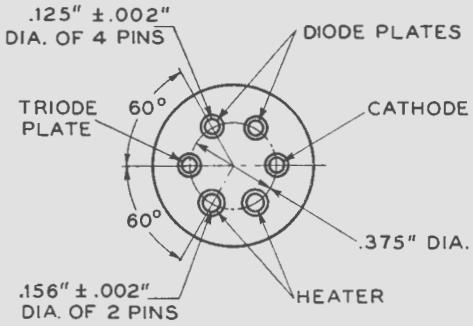

FIG. 2

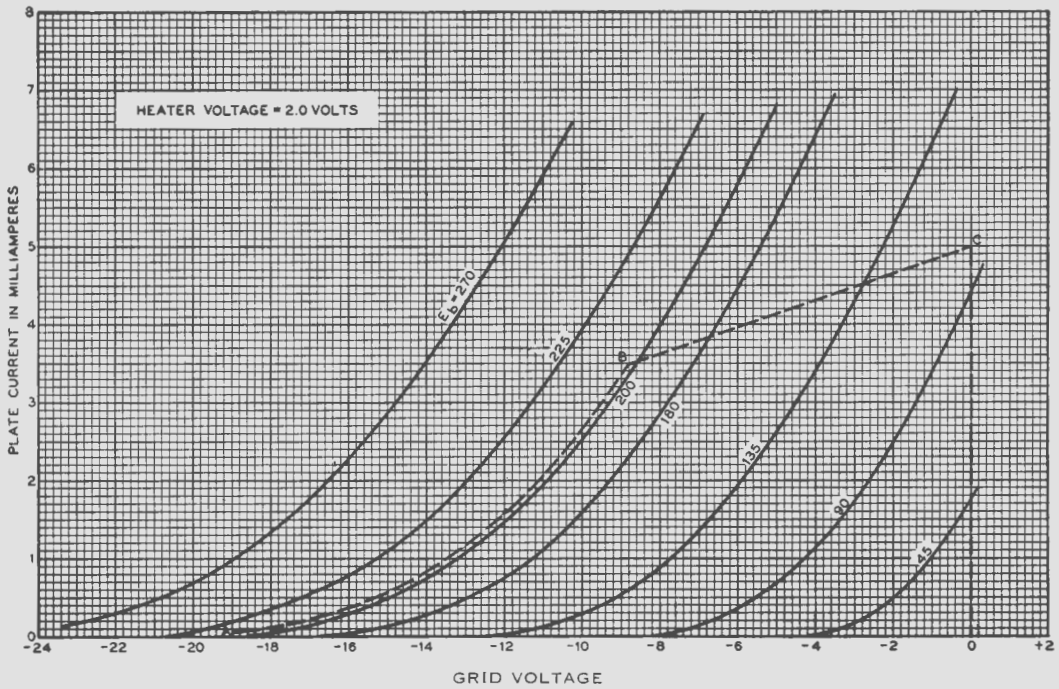

FIG. 3

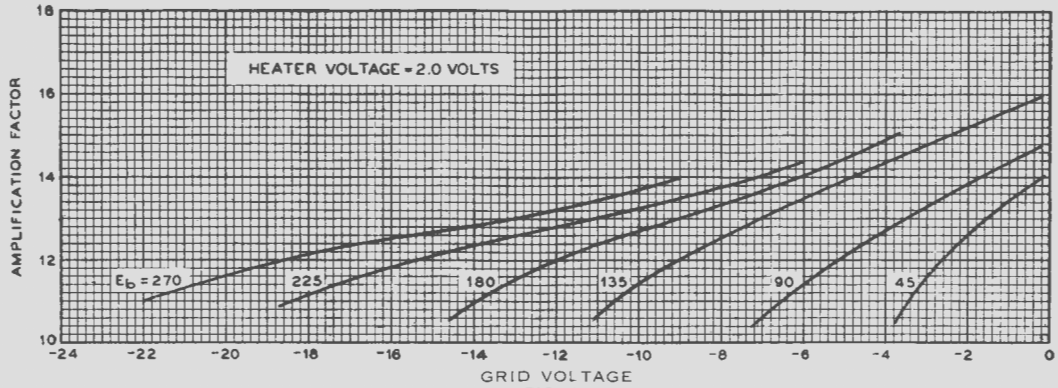

FIG. 4

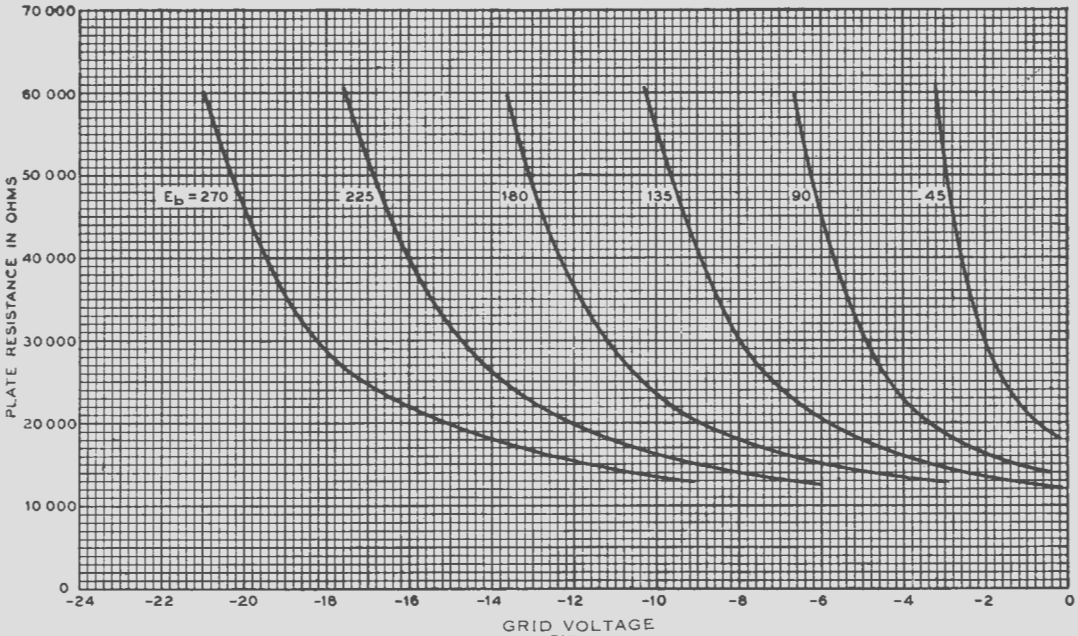

FIG. 5

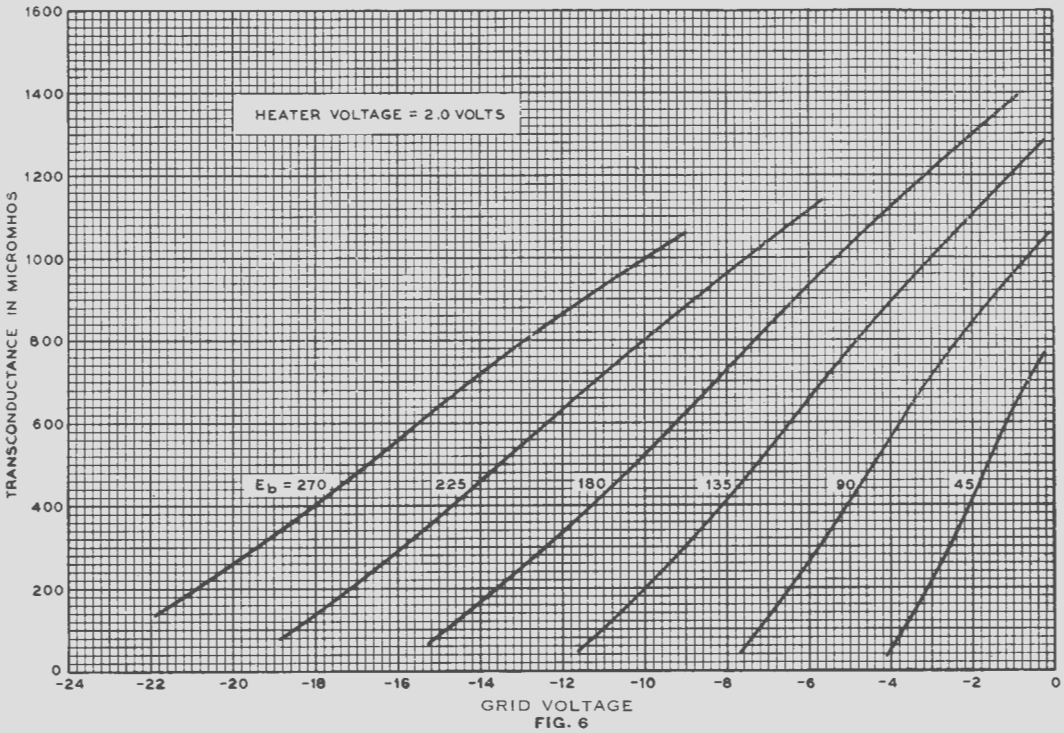

FIG. 6

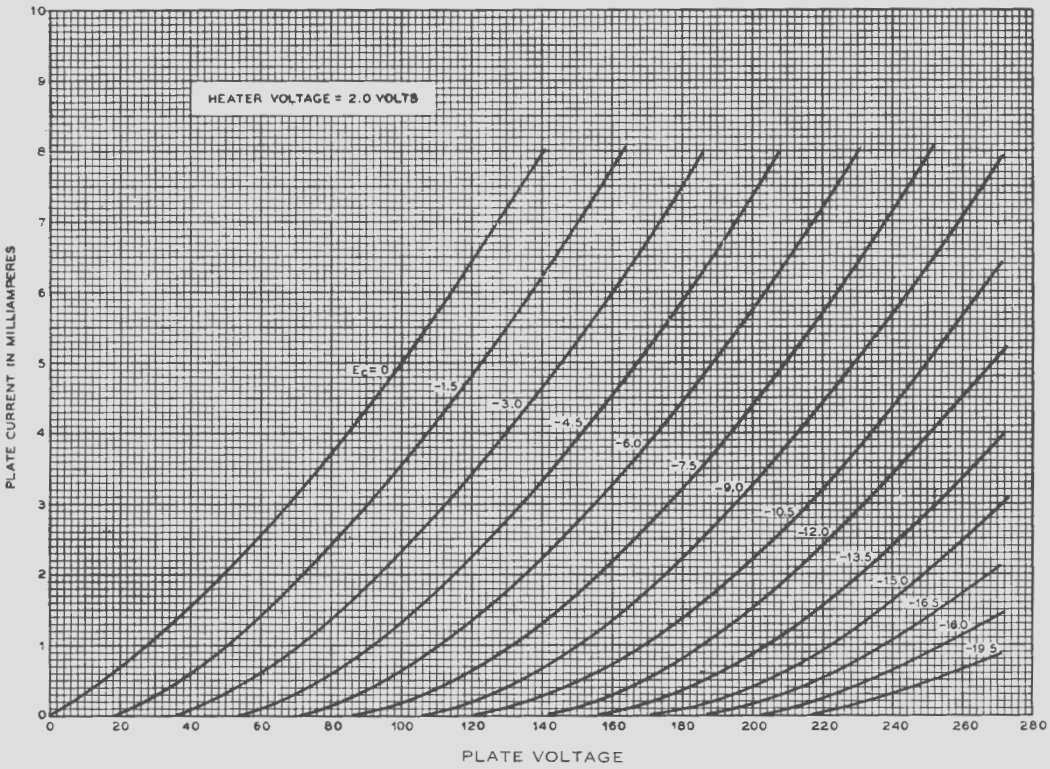
HEATER VOLTAGE = 2.0 VOLTS
PLATE CURRENT IN MILLIAMPERES
PLATE VOLTAGE
$E_c = 0$
-1.5
-3.0
-4.5
-6.0
-7.5
-9.0
-10.5
-12.0
-13.5
-15.0
-16.5
-18.0
-19.5

FIG. 7

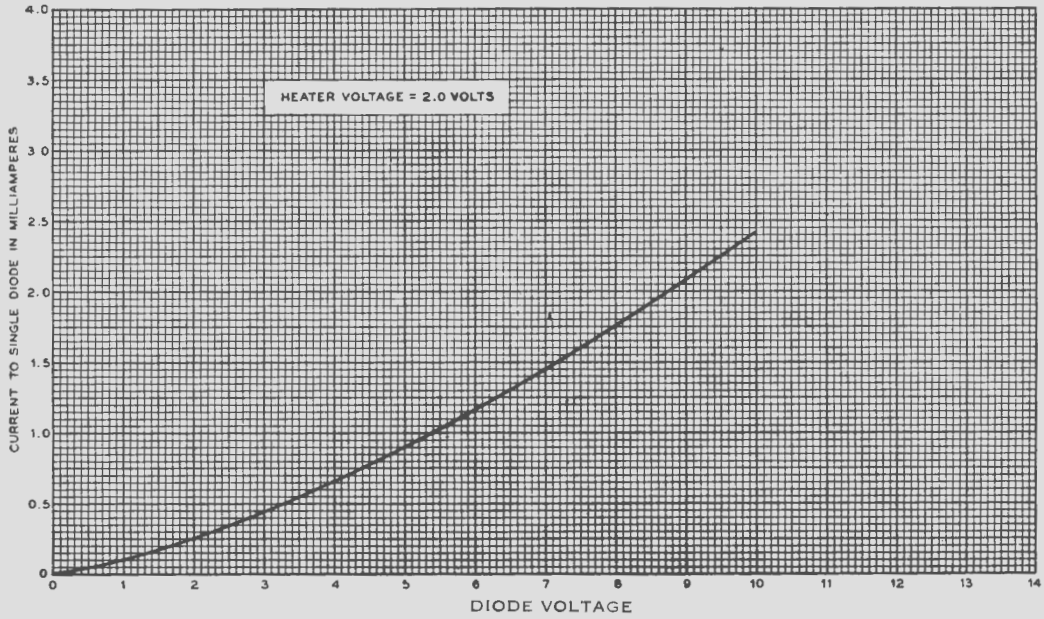
HEATER VOLTAGE = 2.0 VOLTS
CURRENT TO SINGLE DIODE IN MILLIAMPERES
DIODE VOLTAGE

FIG. 8

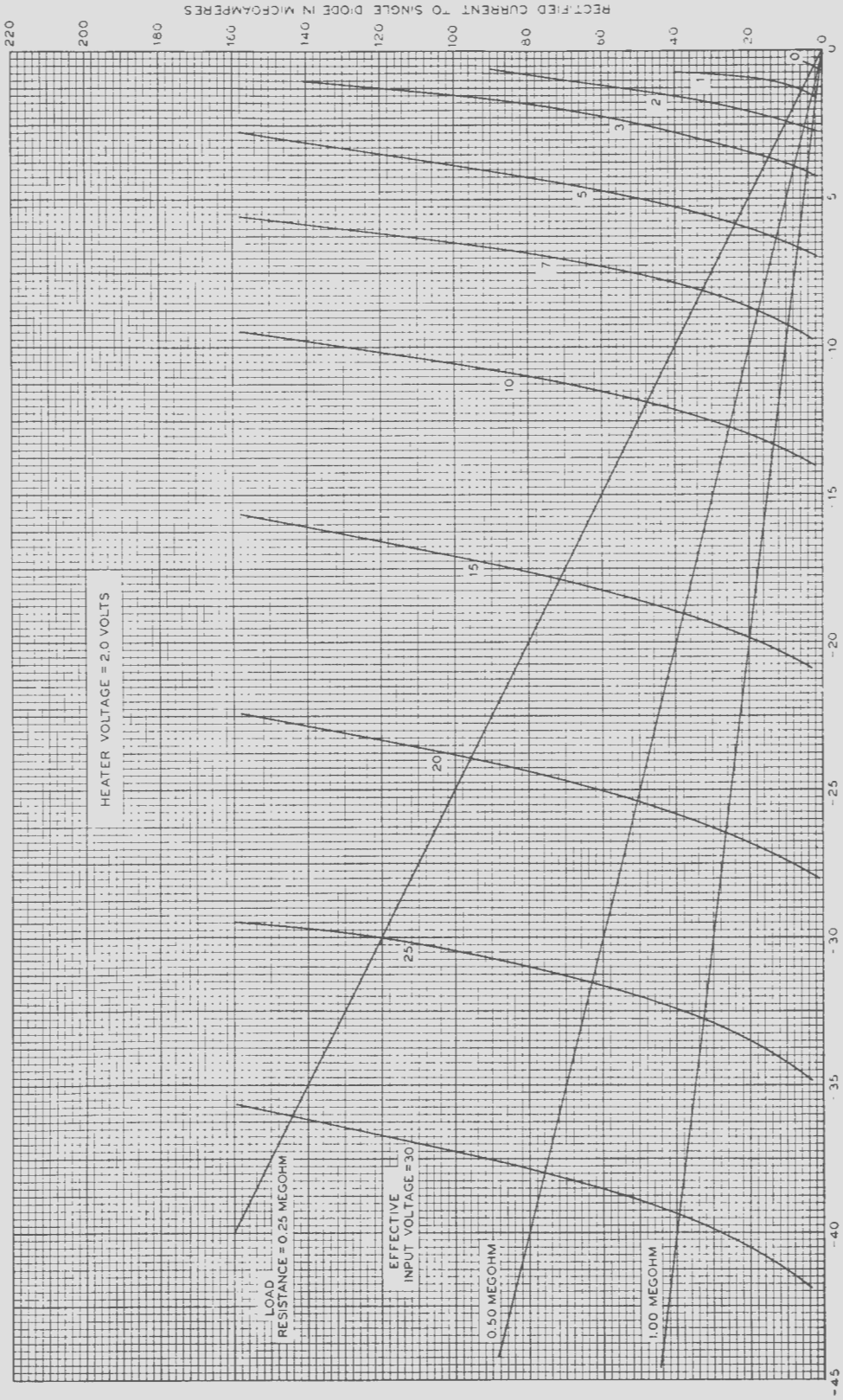

FIG. 9

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