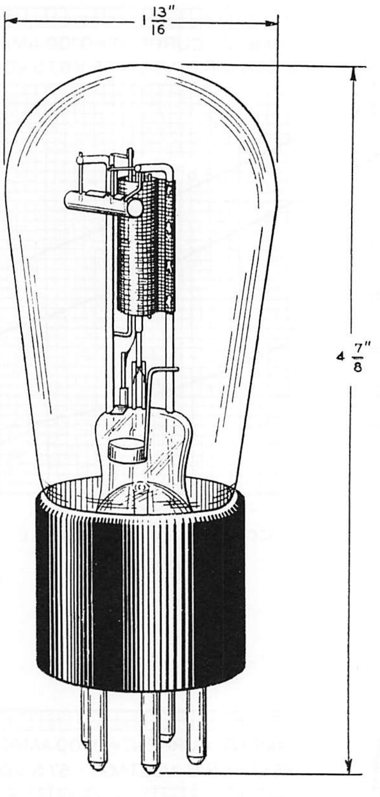
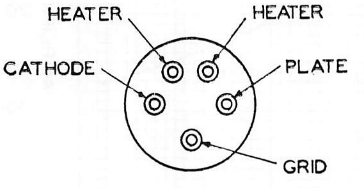
247-A Vacuum Tube





Classification

The No. 247A Vacuum Tube is a general purpose tube having an indirectly heated cathode which permits operation of the heater element directly on alternating current. The tube is for use as an audio-frequency amplifier in intermediate stages but may also be used satisfactorily as a detector or as a power amplifier tube for applications requiring small values of output power.

Base and Socket

The No. 247A Vacuum Tube employs a standard five-prong base suitable for use in a Western Electric No. 134A (cushion) or No. 137A (rigid) socket or similar type socket. The arrangement of electrode connections to the base terminals is shown above.

Rating and Characteristic Data

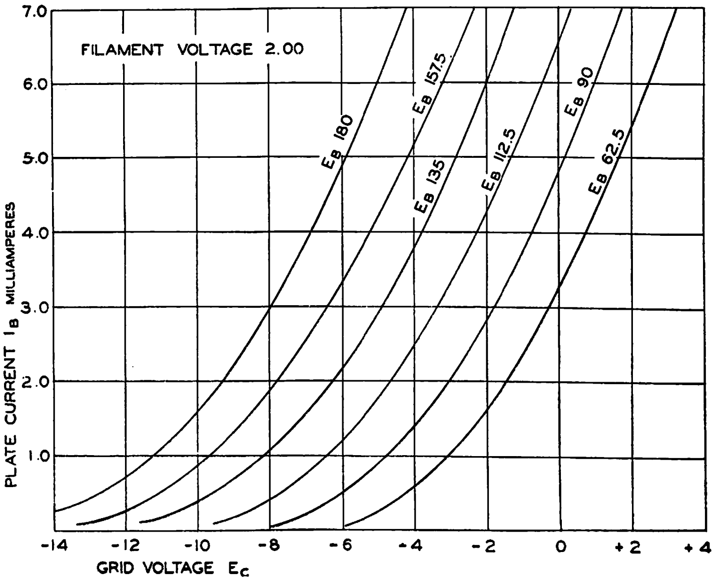
Heater Voltage		2 Volts, AC or DC
Average Heater Current		1.6 Amperes
Plate Voltage	135	180 Volts
Grid Voltage	—4.5	—7 Volts
Average Plate Current	3.25	3.80 Milliamperes
Average Plate Resistance	16,200	16,000 Ohms
Average Amplification Factor	14.9	14.6

Approximate Direct Interelectrode Capacities

Plate to Grid	3.2 MMF
Plate to Cathode	2.7 MMF
Grid to Cathode	3.4 MMF

Average Static Characteristics

The accompanying curves give the average static characteristics of the No. 247A Vacuum Tube.



General Features

The low plate current drain of the No. 247A Vacuum Tube makes it particularly adaptable for use in intermediate stages of audio-frequency amplifiers when resistance coupling is used. However, its plate resistance is sufficiently low that it is also well adapted for use with transformer coupling.

The total electron emission of the cathode is very large compared with the maximum space current drain. This together with special features of design and careful control of the manufacturing processes enables this tube to meet exacting service requirements throughout a very long life.

Western Electric

247A Vacuum Tube

Classification—Low-power triode with indirectly heated cathode

For most applications, the heater element of the 247A tube may be operated on alternating current.

Applications

Audio-frequency voltage amplifier.

Audio-frequency power amplifier where small amounts of power are required.

Oscillator.

Detector.

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, five-pin type.

Socket—Standard, five-contact type, such as the Western Electric 141A socket.

Mounting Positions—The 247A tube may be mounted in any position.

Average Direct Interelectrode Capacitances

	A	B
Grid to plate, $\mu\mu$f	3.4	3.3
Grid to heater and cathode, $\mu\mu$f	3.2	3.3
Plate to heater and cathode, $\mu\mu$f	2.7	3.2

Column A—Based tube without socket.

Column B—Tube alone when measured in 141A socket mounted in metal plate; mounting plate connected to heater and cathode.

Heater Rating

Heater voltage	2.0 volts, a.c. or d.c.
Nominal heater current	1.6 amperes

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

Cathode Connection—When the heater is operated on alternating current, a reduction of hum in the tube may usually be obtained by connecting the cathode to a center tap on the secondary of the heater transformer or to the center point of a suitable resistance connected across the heater terminals. If voltage must be applied between the heater and cathode, it should be kept as low as possible and should not exceed 90 volts.

Characteristics—Plate current characteristics of a typical 247A tube are shown in Figure 3 as functions of grid voltage 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 are shown as functions of plate voltage for several values of grid voltage in Figure 7.

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 are given in the table on pages 3-4 for a number of typical operating conditions represented by selected points within this area. The less severe operating conditions should be selected in preference to maximum operating conditions wherever possible. The life of the tube at maximum conditions may be shorter than at less severe conditions.

The performance data include the fundamental power or voltage output and the second and third harmonic levels for the indicated values of load resistance. The fundamental output is given in terms of the power, P_m, in milliwatts for values of load resistance, R, equal to and double the value of the plate resistance, r_p, and in terms of the voltage, E_{pm}, in peak volts for values of load resistance five times the plate resistance. The second and third harmonic levels, F_{2m} and F_{3m}, are given in decibels below the fundamental in each case. The peak value of the sinusoidal input voltage, E_{gm}, is numerically equal to the grid bias for each operating condition. For a smaller input voltage, E_g, the output and harmonic levels are given approximately by the following relations:

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

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

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

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

Microphonic and Sputter Noise—With a plate voltage of 135 volts, a grid bias of −4.5 volts, and a load resistance of 100,000 ohms, the mean microphonic noise output level of the 247A tube, measured in a laboratory reference test set, is 32 decibels below 1 volt. The range of levels of individual tubes extends from 24 to 43 decibels 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.

Improvements in the design of the 247A tube have practically eliminated both the disagreeable sputtering sounds and the isolated microphonic noise impulses which sometimes occur spontaneously at random intervals in tubes of this general type. When the tube is shielded from external microphonic noise stimuli, it is quiet in operation and can be used for the audio-frequency amplification of exceptionally low level signals.

TABLE

Plate Voltage	Grid Bias	Plate Current	Amplification Factor	Plate Resistance	Transconductance	Input Voltage	Load Resistance	Power Output	Voltage Output	Second Harmonic	Third Harmonic
Volts	Volts	Milliamperes		Ohms	Micromhos	Peak Volts	R	Milliwatts	Peak Volts	db	db
60	−2	1.2	15.3	21500	710	2	$R=r_p$	5.5		28	39
							$R=2r_p$	5.0		32	42
							$R=5r_p$		24	35	42
75	−2	2.0	15.7	18100	860	2	$R=r_p$	6.8		31	41
							$R=2r_p$	6.1		37	42
							$R=5r_p$		25	43	43
90	−3	2.0	15.3	18800	810	3	$R=r_p$	14		27	40
							$R=2r_p$	12.5		31	43
							$R=5r_p$		37	36	45
105	−4	2.0	14.9	19000	780	4	$R=r_p$	24		24	42
							$R=2r_p$	21		28	46
							$R=5r_p$		51	33	50
105	−2	3.8	15.9	14800	1070	2	$R=r_p$	9		39	44
							$R=2r_p$	8		47	45
							$R=5r_p$		26	60	46
120	−6	1.3	14.2	23500	600	6	$R=r_p$	40		18	37
							$R=2r_p$	36		23	45
							$R=5r_p$		73	27	60
120	−4	2.8	15.2	16900	900	4	$R=r_p$	28		26	42
							$R=2r_p$	25		30	45
							$R=5r_p$		51	35	48
120	−2	4.8	16.0	13700	1170	2	$R=r_p$	10		42	45
							$R=2r_p$	9		55	46
							$R=5r_p$		26	55	46
135	−7.5	1.0	13.8	26700	520	7.5	$R=r_p$	54		16	35
							$R=2r_p$	48		21	42
							$R=5r_p$		90	26	55
135	−6	2.0	14.5	19600	730	6	$R=r_p$	50		20	32
							$R=2r_p$	45		25	48
							$R=5r_p$		75	30	65

TABLE (Cont'd)

Plate Voltage	Grid Bias	Plate Current	Amplification Factor	Plate Resistance	Transconductance	Input Voltage	Load Resistance	Power Output	Voltage Output	Second Harmonic	Third Harmonic
Volts	Volts	Milliamperes		Ohms	Micromhos	Peak Volts	R	Milliwatts	Peak Volts	db	db
135	−4.5	3.2	15.2	16000	940	4.5	$R=r_p$	37		26	43
							$R=2r_p$	33		30	47
							$R=5r_p$		58	35	49
135	−3	4.8	15.8	13800	1140	3	$R=r_p$	20		34	43
							$R=2r_p$	18		39	45
							$R=5r_p$		40	47	48
150	−8	1.4	13.9	24100	580	8	$R=r_p$	67		16	35
							$R=2r_p$	60		21	43
							$R=5r_p$		95	26	55
150	−6	2.8	14.8	17400	850	6	$R=r_p$	57		22	41
							$R=2r_p$	52		27	47
							$R=5r_p$		75	32	55
150	−4	4.7	15.4	14000	1100	4	$R=r_p$	35		30	44
							$R=2r_p$	31		34	47
							$R=5r_p$		52	40	49
165	−9	1.4	13.8	24500	560	9	$R=r_p$	84		16	35
							$R=2r_p$	75		21	42
							$R=5r_p$		107	26	55
165	−7	2.8	14.6	17600	820	7	$R=r_p$	75		21	41
							$R=2r_p$	68		26	48
							$R=5r_p$		87	31	65
*165	−5	4.6	15.4	14200	1080	5	$R=r_p$	50		27	44
							$R=2r_p$	45		31	47
							$R=5r_p$		65	36	50
*180	−11	1.0	13.3	31500	430	11	$R=r_p$	96		14	33
							$R=2r_p$	85		19	38
							$R=5r_p$		130	23	45
*180	−9	2.0	14.1	20200	690	9	$R=r_p$	100		18	36
							$R=2r_p$	90		22	45
							$R=5r_p$		108	27	65
*180	−7	3.6	14.9	15700	940	7	$R=r_p$	87		22	32
							$R=2r_p$	78		26	49
							$R=5r_p$		88	31	60

*Maximum operating conditions.

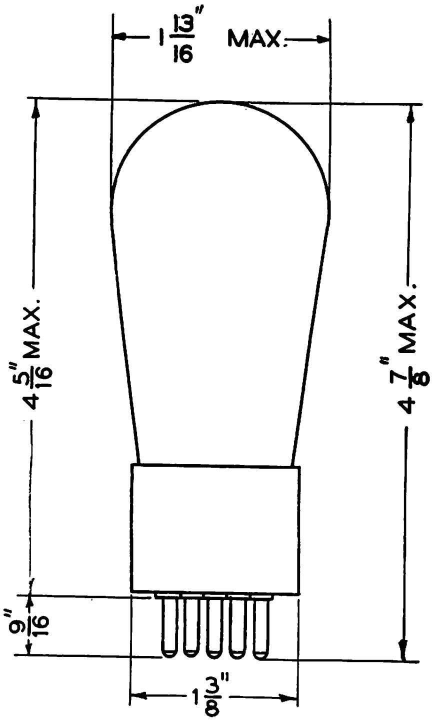


FIG. 1

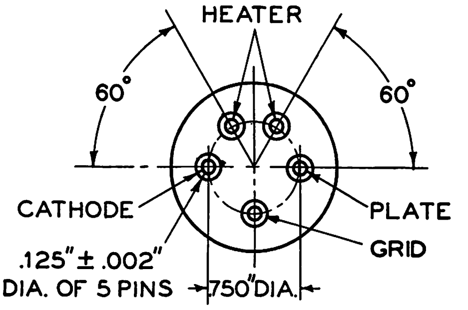


FIG. 2

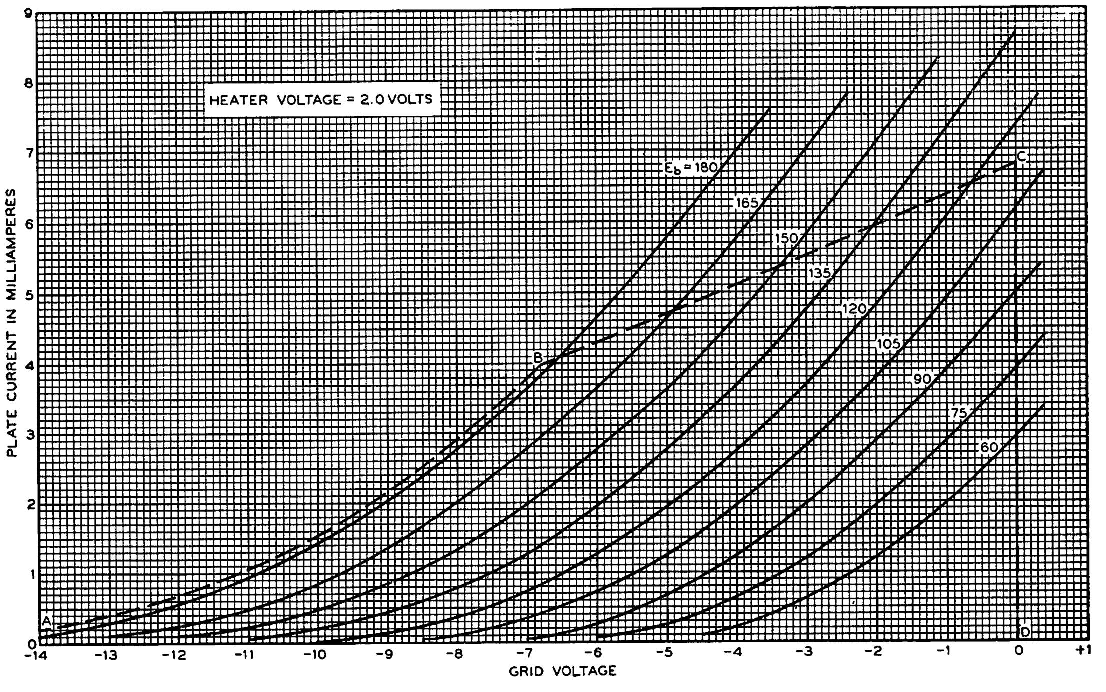


FIG. 3

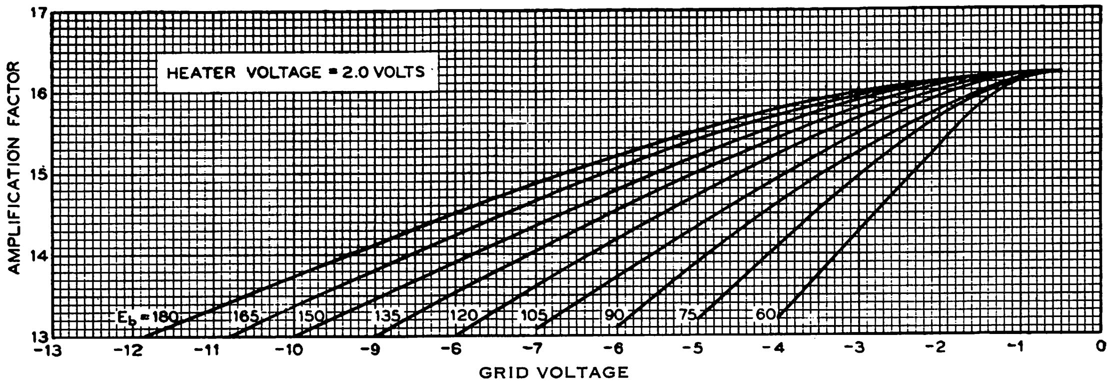


FIG. 4

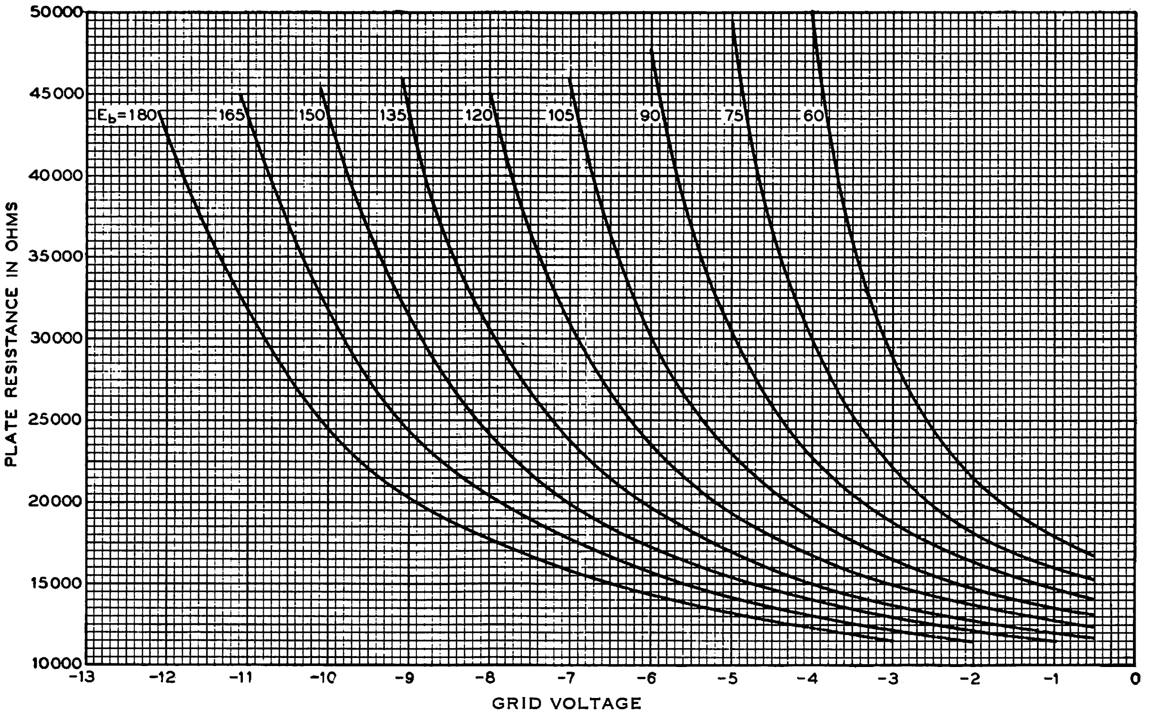


FIG. 5

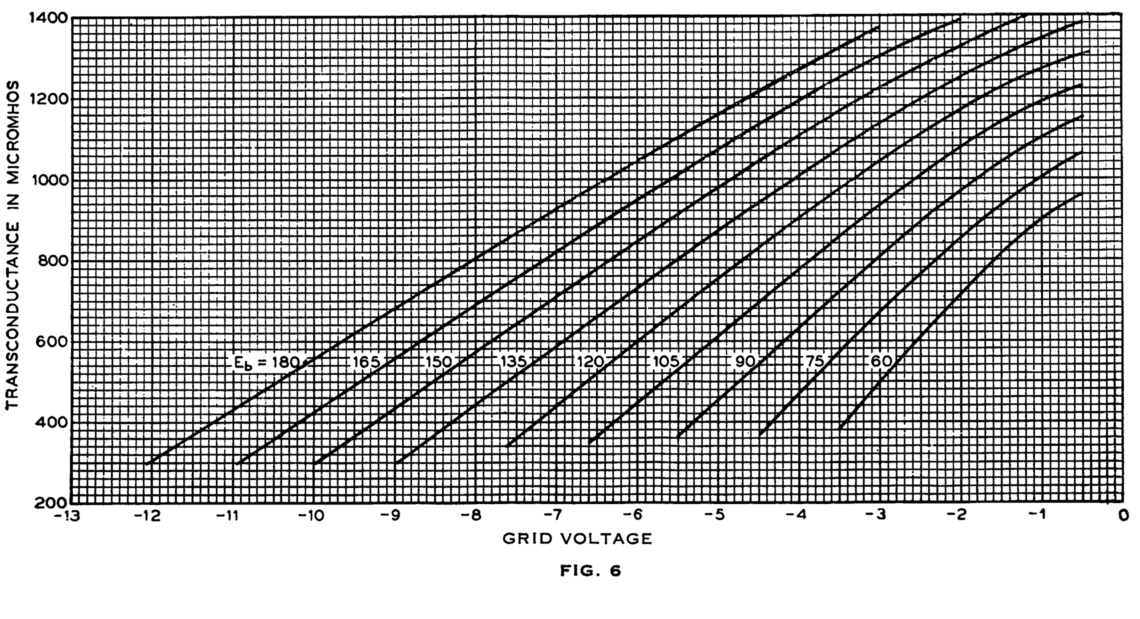


FIG. 6

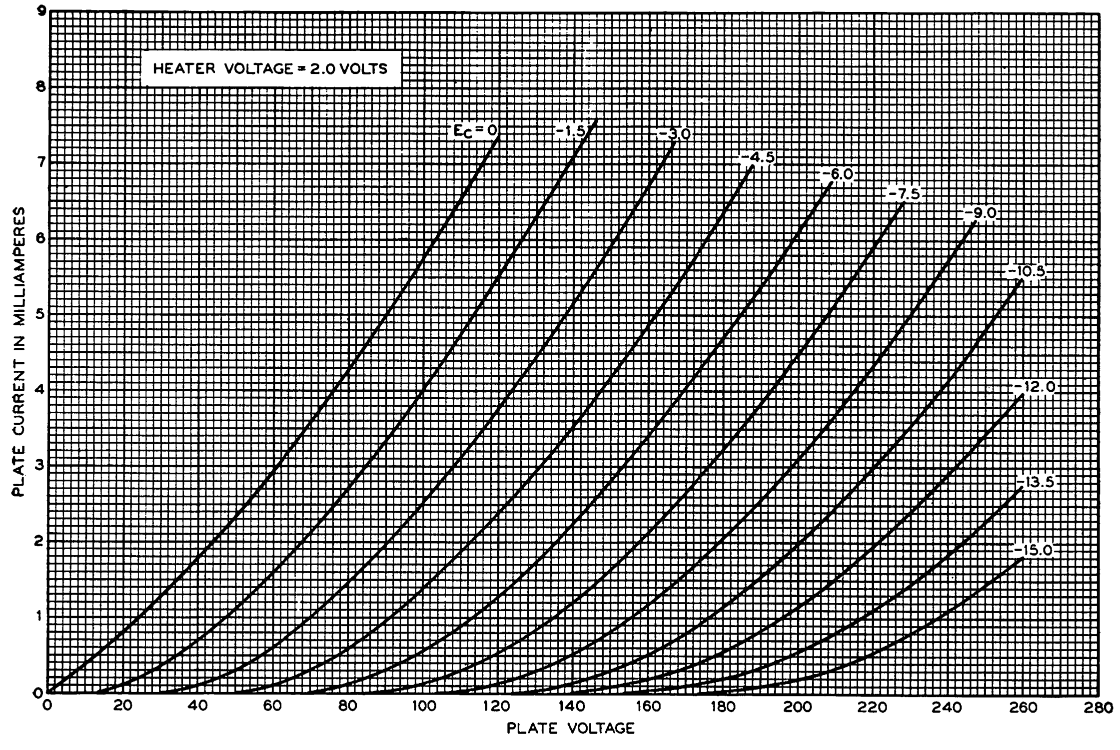


FIG. 7

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