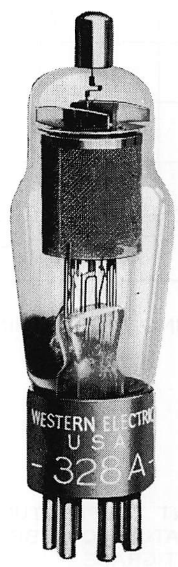
Western Electric

328A Vacuum Tube



Classification—Voltage-amplifier, suppressor-grid pentode with indirectly heated cathode

The electrical characteristics of the 328A tube are identical with those of the 310A tube except for the heater voltage and current.

This tube is intended primarily for use in audio, carrier and radio-frequency voltage amplifiers, oscillators or modulators. The connection for the suppressor grid has been brought out to an external terminal, thus making the tube more flexible in its applications.

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—Small, six-pin thrust type with pins silver-plated. A small, metal cap control-grid terminal is located at the top of the bulb.

Socket—Standard, six-contact type, preferably provided with silver-plated contacts such as the Western Electric 144B socket.

Mounting Positions—This tube may be mounted in any position.

Average Direct Interelectrode Capacitances

	A	B	
Control grid to plate	0.025	0.007	$\mu\mu$f.
Suppressor grid to plate	12.5	12.5	$\mu\mu$f.
Plate to heater, cathode and screen grid	2.2	3.2	$\mu\mu$f.
Control grid to suppressor grid	1.8	1.3	$\mu\mu$f.
Control grid to heater, cathode and screen grid	4.0	6.5	$\mu\mu$f.
Suppressor grid to heater, cathode and screen grid	7.5	14.5	$\mu\mu$f.

Column A—Without shield.
Column B—With close-fitting metal shield connected to cathode.

Heater Rating

Heater voltage	7.5 volts, a.c. or d.c.
Nominal heater current	0.425 ampere

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—Preferably direct to the heater. If voltage must be applied between the cathode and heater, it should not exceed 150 volts.

Characteristics—Plate current and screen-grid current characteristics of a typical 328A tube are shown in Figures 3 and 4, respectively, as functions of control-grid voltage for several values of screen-grid and plate voltage and zero suppressor-grid voltage. The screen-grid voltage for these characteristics is equal to the plate voltage. Corresponding amplification factor, plate resistance, and transconductance characteristics are given in Figures 5, 6 and 7. Plate current and screen-grid current characteristics as functions of plate voltage are given in Figures 8 and 9, respectively, for several values of control-grid voltage, a screen-grid voltage of 135 volts, and zero suppressor-grid voltage. Corresponding amplification factor, plate resistance, and transconductance characteristics are shown in Figures 10, 11 and 12. Plate current, screen-grid current, plate resistance, and transconductance characteristics are shown in Figures 13, 14, 15 and 16 as functions of plate voltage for several values of suppressor-grid voltage, a screen-grid voltage of 135 volts, and a control-grid voltage of -3 volts. These last characteristics are of particular interest in modulator applications where separate inputs are applied to the control and suppressor grids.

Limiting Conditions for Safe Operation

Maximum plate voltage	250 volts
Maximum screen-grid voltage	180 volts
Maximum cathode current (screen-grid current plus plate current)	10 milliamperes
Maximum screen-grid current	2.5 milliamperes

Operating Conditions and Output—Nominal performance data are given in the table below for a number of typical operating conditions. 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 voltage or power output for the indicated values of load resistance and input voltage, and the maximum second and third harmonic levels for input voltages no greater than the indicated values. The voltage output is given in peak volts, the power output in milliwatts, and the harmonic levels in decibels below the fundamental.

TABLE

Plate Voltage	Screen-Grid Voltage	Control-Grid Bias	Suppressor-Grid Voltage	Plate Current	Load Resistance	Input Voltage	Output Voltage	Output Power	Second Harmonic	Third Harmonic
Volts	Volts	Volts	Volts	Milliamperes	Ohms	Peak Volts	Peak Volts	Milliwatts	db	db
135	135	−3	0	5.4	20,000	3.00		250	22	30
					60,000	1.60		130	26	28
					60,000	0.95		60	35	45
					60,000	1.15	100		33	39
					100,000	0.57	75		35	50
					100,000	0.40	50		40	55
180	135	−3	0	5.4	40,000	2.70		340	26	28
					100,000	1.50	175		26	30
225	135	−3	0	5.5	60,000	2.70		425	27	27
					100,000	1.80	220		27	31
*250	135	−3	0	5.5	60,000	2.70		480	26	30
					60,000	1.20		110	30	55
					100,000	2.10	250		26	29
					100,000	1.50	200		30	43

*Maximum operating conditions.

Curves showing the fundamental power and voltage output and the second and third harmonic levels as functions of input voltage for a number of values of load resistance and a typical operating condition are given in Figures 17, 18, 19 and 20.

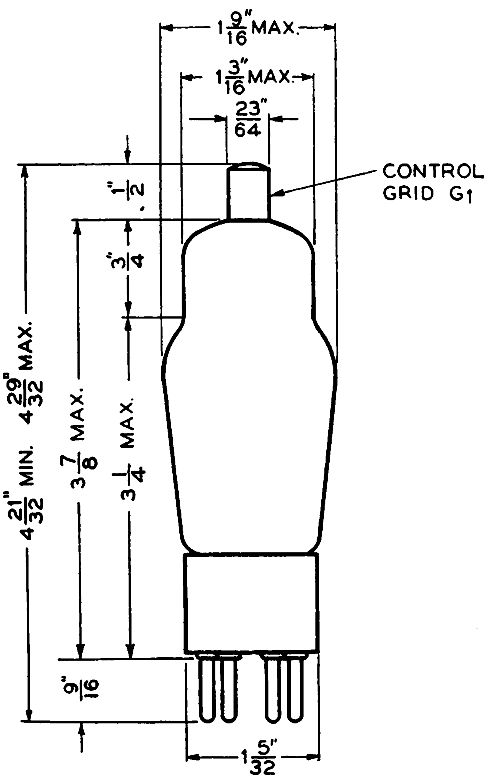


FIG. 1

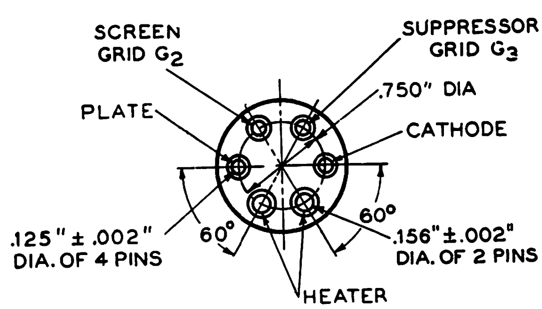


FIG. 2

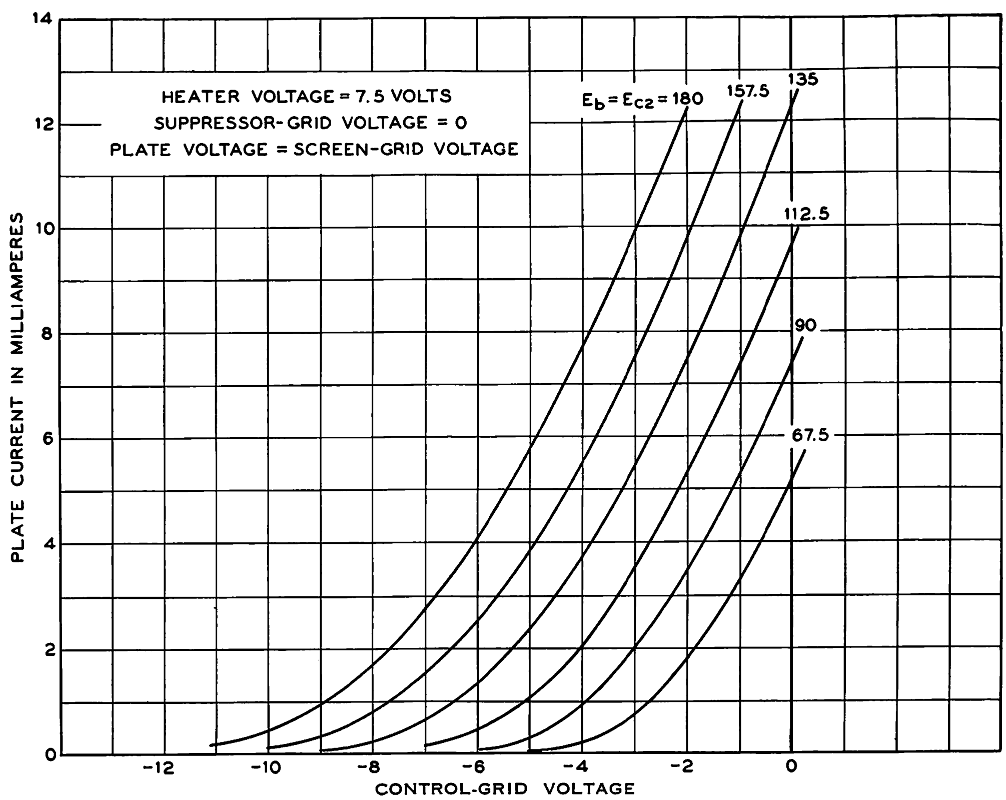

HEATER VOLTAGE = 7.5 VOLTS
SUPPRESSOR-GRID VOLTAGE = 0
PLATE VOLTAGE = SCREEN-GRID VOLTAGE
$E_b = E_{c2} = 180$
157.5
135
112.5
90
67.5
PLATE CURRENT IN MILLIAMPERES
0
2
4
6
8
10
12
14
-12
-10
-8
-6
-4
-2
0
CONTROL-GRID VOLTAGE

FIG. 3

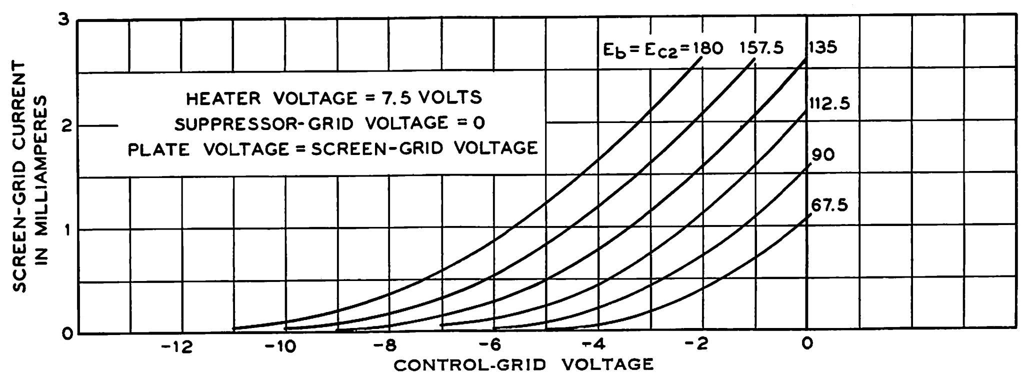

HEATER VOLTAGE = 7.5 VOLTS
SUPPRESSOR-GRID VOLTAGE = 0
PLATE VOLTAGE = SCREEN-GRID VOLTAGE
$E_b = E_{c2} = 180$
157.5
135
112.5
90
67.5
SCREEN-GRID CURRENT IN MILLIAMPERES
0
1
2
3
-12
-10
-8
-6
-4
-2
0
CONTROL-GRID VOLTAGE

FIG. 4

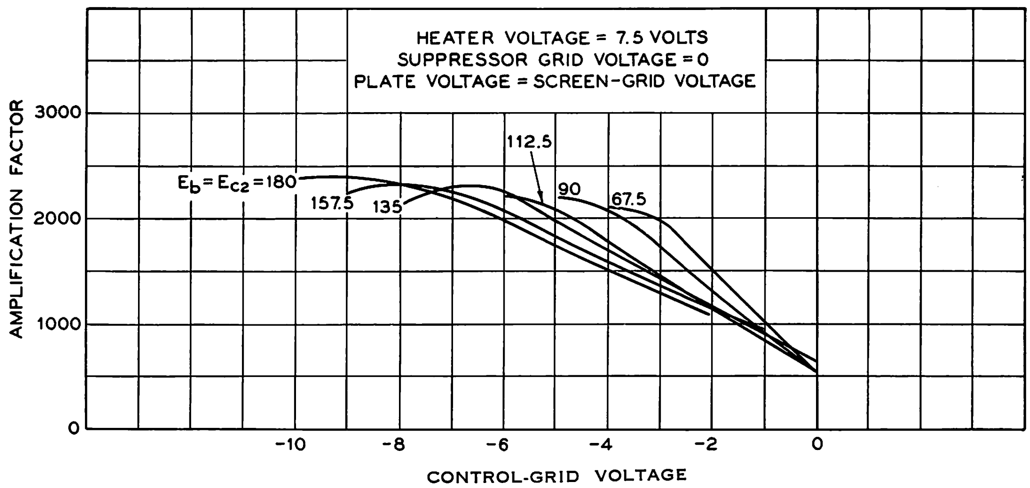


FIG. 5

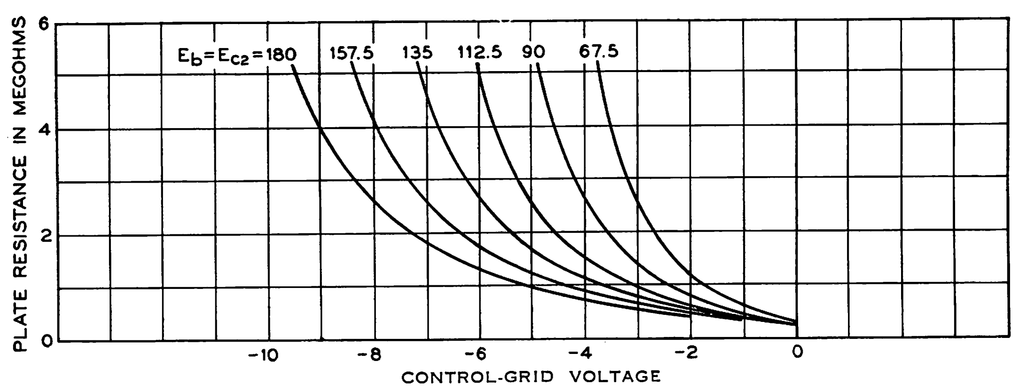


FIG. 6

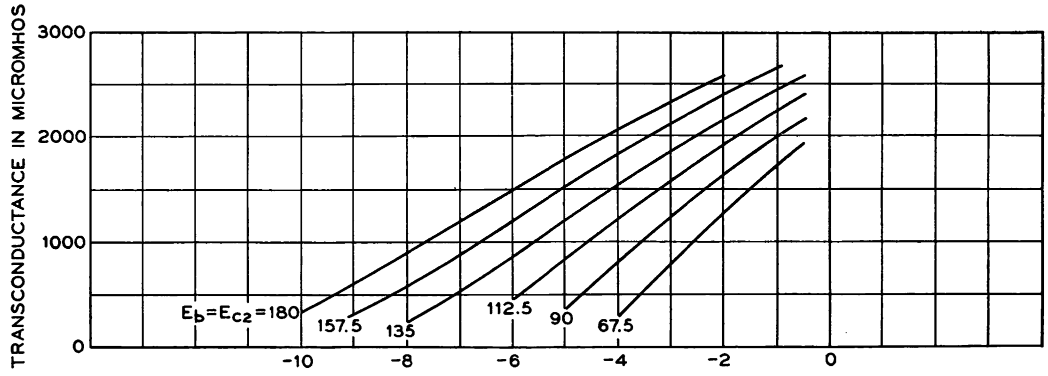


FIG. 7

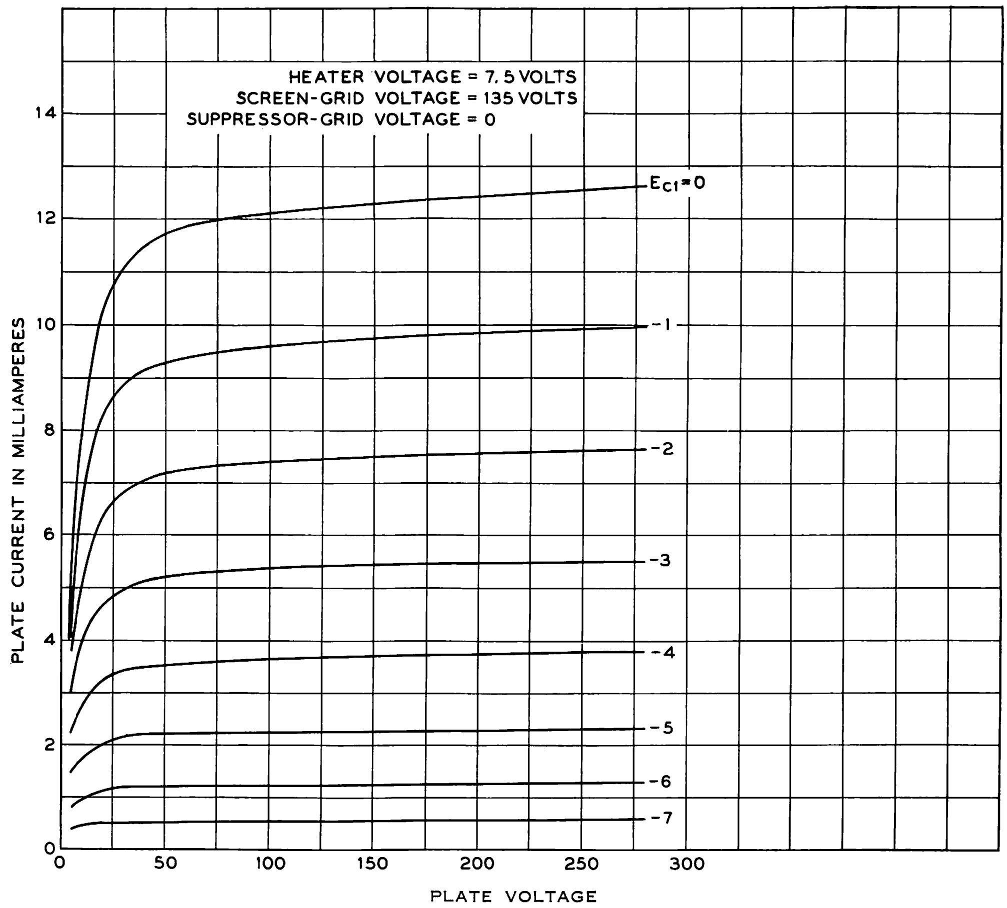

HEATER VOLTAGE = 7.5 VOLTS
SCREEN-GRID VOLTAGE = 135 VOLTS
SUPPRESSOR-GRID VOLTAGE = 0
PLATE CURRENT IN MILLIAMPERES
PLATE VOLTAGE
E c1 = 0
-1
-2
-3
-4
-5
-6
-7
0
2
4
6
8
10
12
14
0
50
100
150
200
250
300

FIG. 8

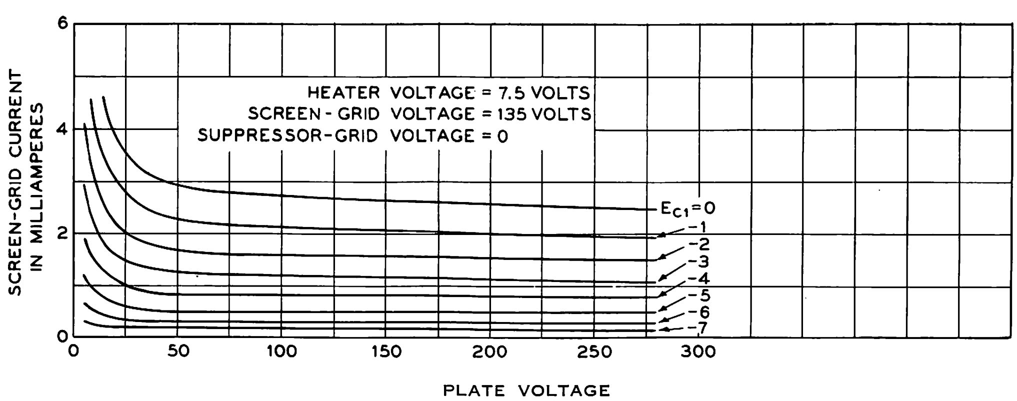

HEATER VOLTAGE = 7.5 VOLTS
SCREEN-GRID VOLTAGE = 135 VOLTS
SUPPRESSOR-GRID VOLTAGE = 0
SCREEN-GRID CURRENT IN MILLIAMPERES
PLATE VOLTAGE
E c1 = 0
-1
-2
-3
-4
-5
-6
-7
0
2
4
6
0
50
100
150
200
250
300

FIG. 9

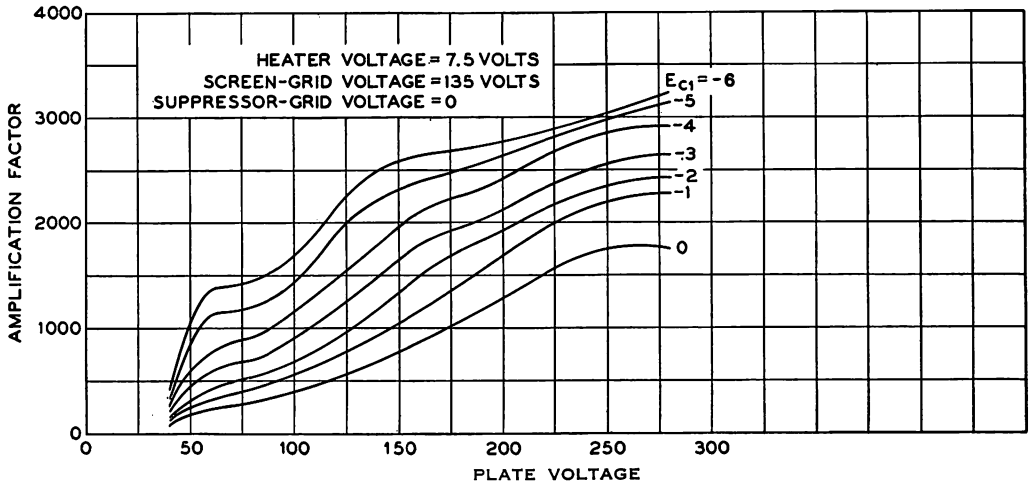


FIG. 10

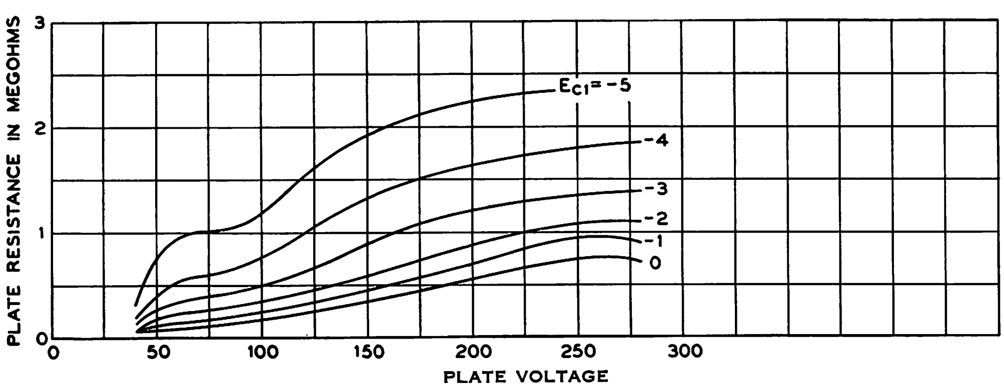


FIG. 11

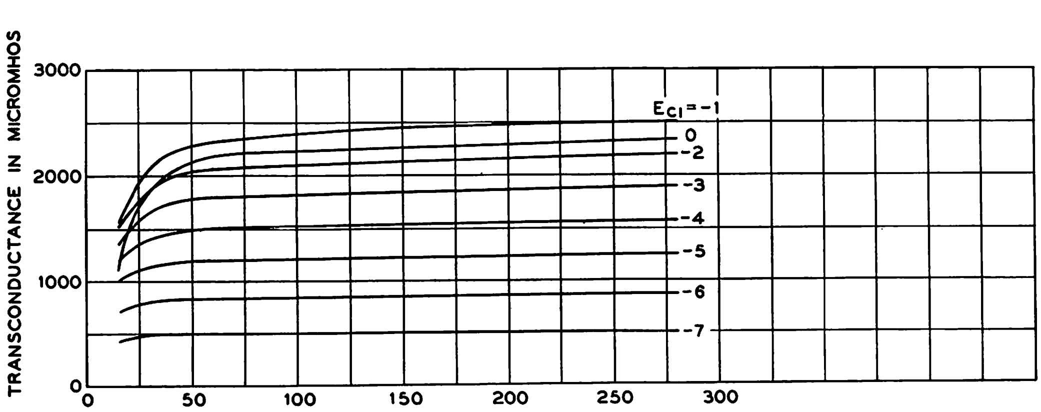


FIG. 12

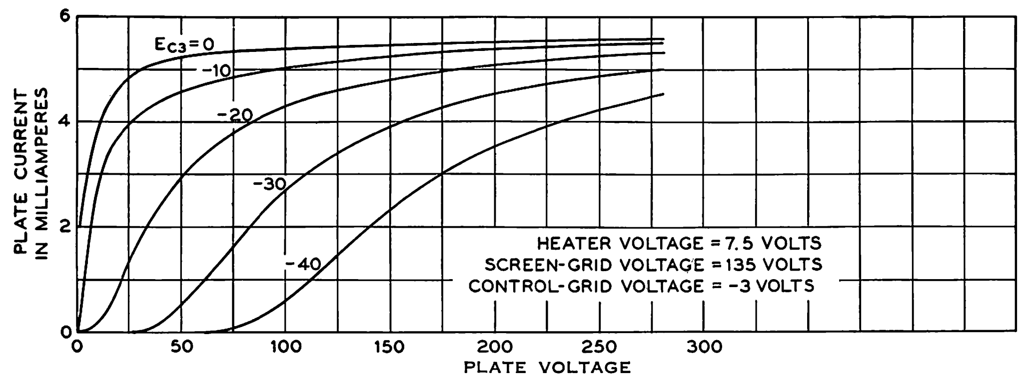


FIG. 13

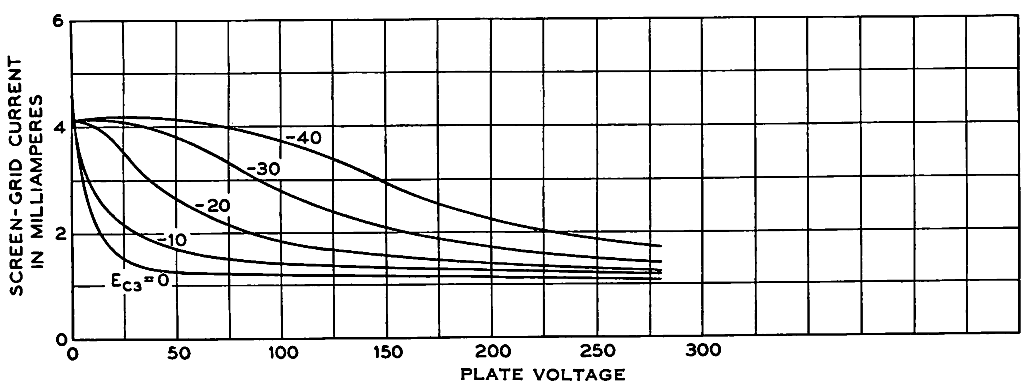


FIG. 14

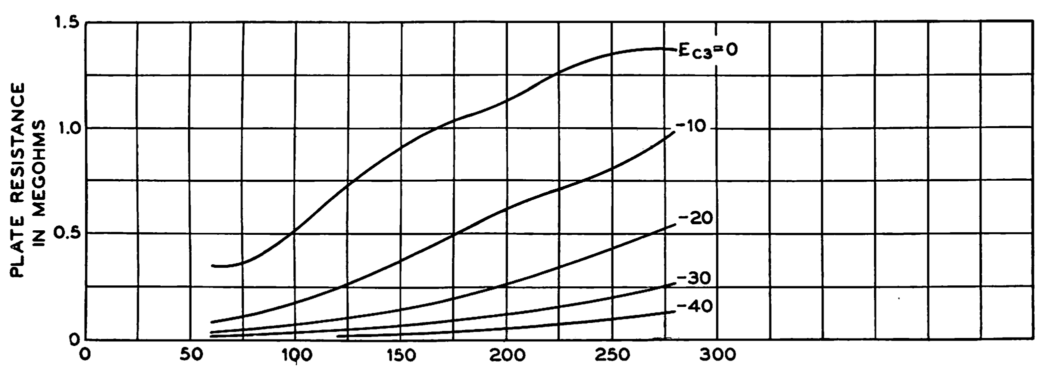


FIG. 15

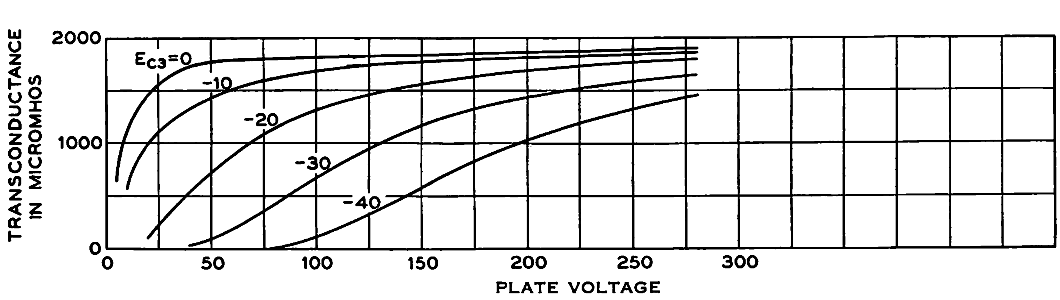


FIG. 16

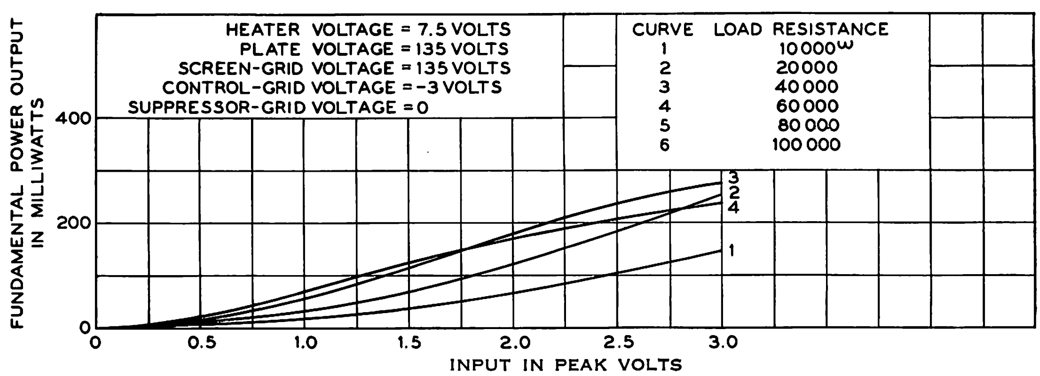


FIG. 17

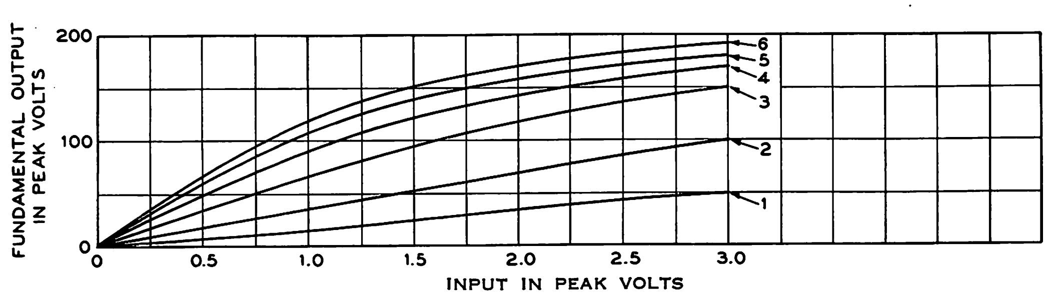


FIG. 18

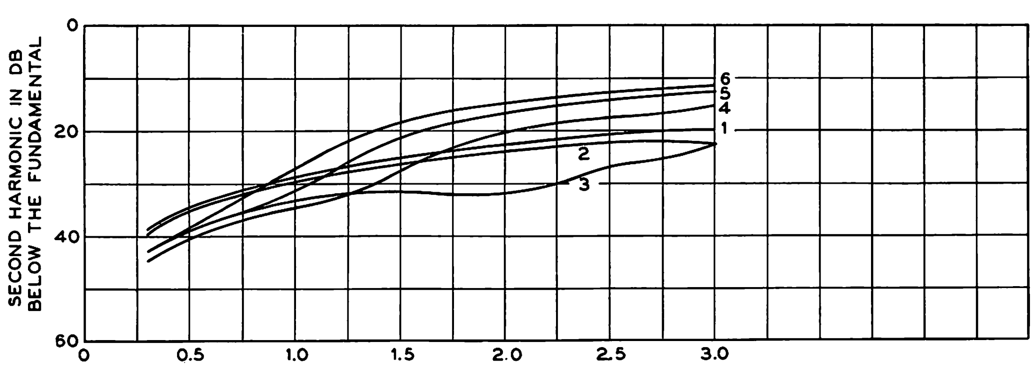


FIG. 19

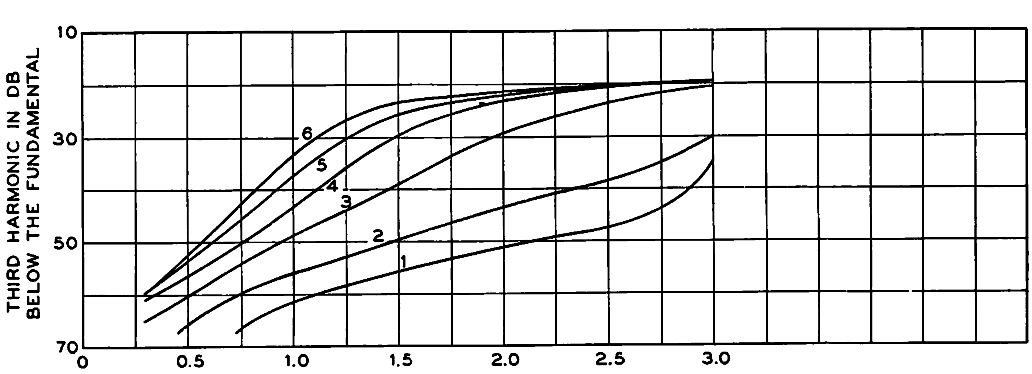


FIG. 20