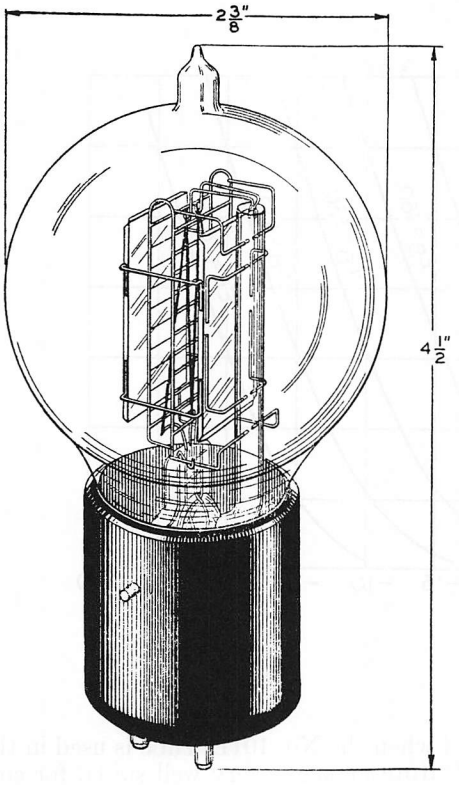
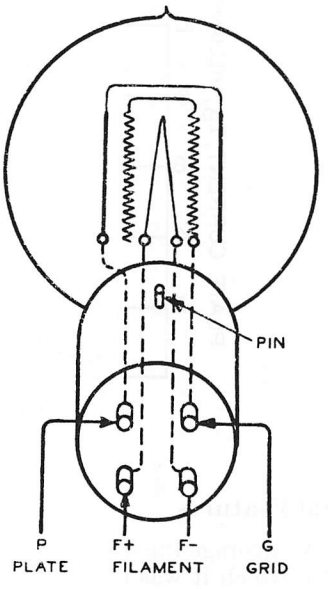
101D Vacuum Tube





Classification

The No. 101D Vacuum Tube is a three-element filamentary type tube for use where small amounts of output power are required.

Base and Socket

The No. 101D Vacuum Tube employs a four-prong bayonet pin type base suitable for use in a Western Electric 100L (front panel mounting), 100R (rear panel mounting), or similar type socket.

Rating and Characteristic Data

Filament Current				1.0 Amperes
Filament Voltage				4.5 Volts
Plate Voltage	130	130	160	190 Max.
Grid Voltage	—9	—9	—14	—18
Average Plate Current—Milliamperes	7.4	7.4	7.35	8.35
Average Amplification Factor	6.0	6.0	6.0	5.95
Average Plate Resistance—Ohms	5700	5700	5800	5600
*Average Power Output—Milliwatts	65	60	135	230
Second Harmonic—% of Fundamental	5	3	4	5
Third Harmonic—% of Fundamental	0.4	0.2	0.4	0.5
Load Resistance—Ohms	5700	11400	11600	11200

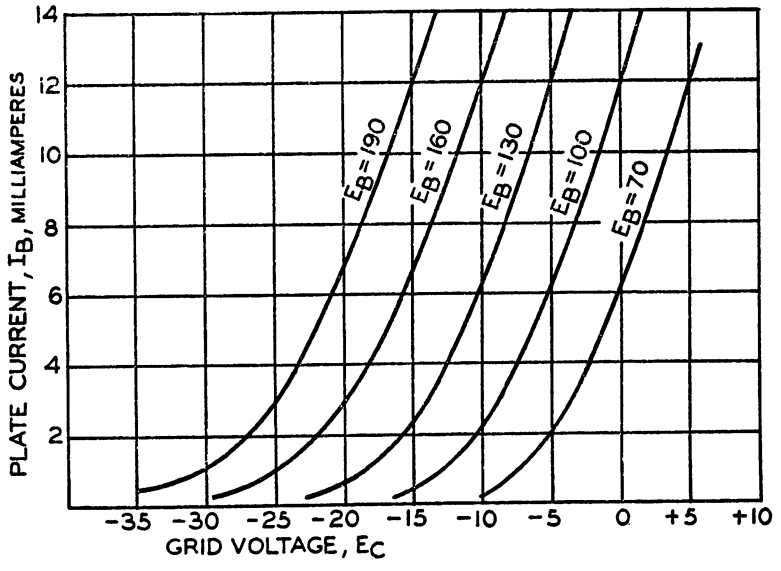
*Input in peak values is equal to grid voltage.

Approximate Direct Interelectrode Capacities (measured without socket)

Plate to Grid	5.0 MMF
Plate to Filament	2.0 MMF
Grid to Filament	3.7 MMF

Average Static Characteristics

The accompanying curves give the average static characteristics of the No. 101D Vacuum Tube.



General Features

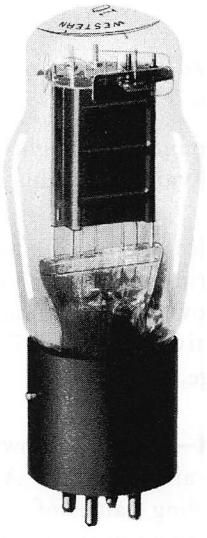
An average life of 40,000 hours is obtained when the No. 101D Tube is used in the equipment for which it was designed. This long life feature makes it very well suited for continuous operation where long uninterrupted service is desired.

The electrical characteristics for this tube are such that moderate power outputs are obtainable with small plate currents and with plate voltages under 200 volts. The characteristics of the No. 101D Tube are similar to those of the No. 101F, however, the No. 101D operates at a filament current of 1.0 ampere instead of 0.5 ampere.

Western Electric

101D Vacuum Tube

(Dome)



Classification—Low-Power, Filamentary Triode

This tube replaces the D-86326 tube and has been assigned the old code number 101D. It includes an improved filament, a new mechanical design using transverse mica supports and is mounted in a dome type bulb. The electrical characteristics are essentially the same as for the D-86326 tube.

Applications—Voice frequency and carrier-frequency amplifier for telephone repeater equipment and other applications where small power outputs are required.

Modulator and demodulator in carrier-systems.

Oscillator in voice and carrier frequency applications.

Dimensions and Connections—Figures 1 and 2 show the outline diagrams of the tube and base, giving the dimensions and the arrangement of the electrode connections to the base terminals.

Base and Mounting—This vacuum tube employs a medium, four-pin bayonet type base having special contact metal at the ends of the pins. It is suitable for use in a Western Electric 100L, 100R, or similar type socket, preferably provided with contact-metal contacts.

The tube may be mounted in either a vertical or horizontal position. If mounted in a horizontal position the plane of the filament, which is indicated in Figure 2, should be vertical. To assure adequate ventilation the tubes should be mounted with not less than 2⅝ inches between centers when two or more tubes are used.

Average Direct Interelectrode Capacitances

Grid to Plate	6.4 $\mu\mu$f
Grid to Filament	4.4 $\mu\mu$f
Plate to Filament	2.9 $\mu\mu$f

These values are for a based tube without socket.

Filament Rating

Filament Current	1.0 ampere, d.c.
Nominal filament voltage	4.5 volts

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

The filament resistance of this tube increases slightly during the first 2000 hours of operation. The voltage given above is the nominal value after this resistance change has stabilized.

Characteristics—Figure 3 shows typical curves of plate current as a function of grid voltage for several values of plate voltage. The grid and plate voltages are measured from the negative end of the filament. Figures 4, 5 and 6 show corresponding amplification factor, plate resistance and transconductance characteristics respectively. Figure 7 shows plate current as a function of plate voltage for several values of grid voltage.

Operating Conditions and Output—Figure 3 shows the range of permissible operating plate and grid voltages included within the area ABCD. A number of recommended and maximum operating conditions and the corresponding values of amplification factor, plate resistance, transconductance and performance data 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.

The performance data shown include the fundamental power output in milliwatts and the second and third harmonic levels in db below the fundamental for values of load resistance equal to the plate resistance and for a load resistance of 12000 ohms. The peak value of the sinusoidal input voltage E_{gm}, which gives the indicated output P_m, and harmonic levels F_{2m}, and F_{3m}, in each case is numerically equal to the grid bias. For a smaller input voltage E_g, the approximate levels may be computed from the following relations:

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

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

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

Microphonic Noise

For a plate voltage of 130 volts, a grid bias of −9 volts, and a load resistance of 100,000 ohms, the mean microphonic output level of this tube, measured in a laboratory reference test set is 32 db below 1 volt. The range of levels of individual tubes extends from 20 to 40 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.

TABLE

	Plate Voltage	Grid Bias	Plate Current	Amplification Factor	Plate Resistance	Transconductance	Load Resistance	Power Output	Second Harmonic	Third Harmonic
	Volts	Volts	Milliamperes		Ohms	Micromhos	Ohms	Milliwatts	db	db
Recommended Operating Conditions	100	−4	8.1	6.2	5700	1090	5700	14	38	61
							12000	12	45	73
	130	−12	4.7	6.2	6800	900	6800	91	22	35
							12000	89	28	44
	130	−9	7.7	6.2	5800	1070	5800	65	31	48
							12000	58	37	57
	130	−6	11.2	6.2	5100	1220	5100	34	38	60
							12000	29	45	68
	160	−16	5.6	6.1	6500	940	6500	172	20	32
							12000	161	27	40
	160	−12	9.9	6.2	5300	1170	5300	121	29	46
							12000	108	37	56
Maximum Operating Conditions	160	−10	12.5	6.2	4900	1270	4900	93	33	53
							12000	79	41	64
	190	−20	6.4	6.1	6200	990	6200	263	19	30
							12000	250	26	37
	190	−18	8.7	6.2	5600	1100	5600	248	23	35
							12000	224	31	46
	190	−16	11.0	6.2	5100	1210	5100	223	26	42
							12000	187	35	54

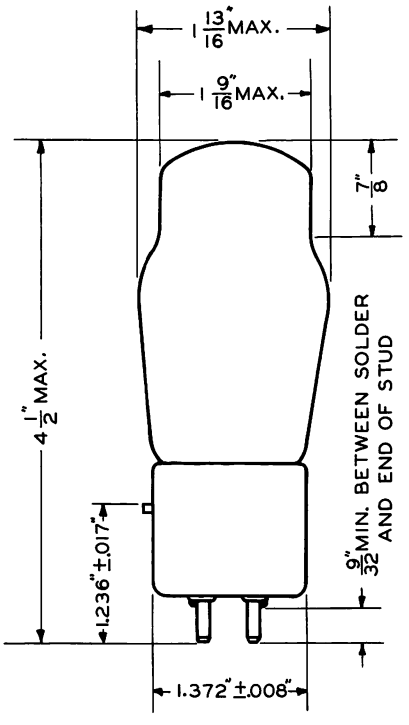


FIG. 1

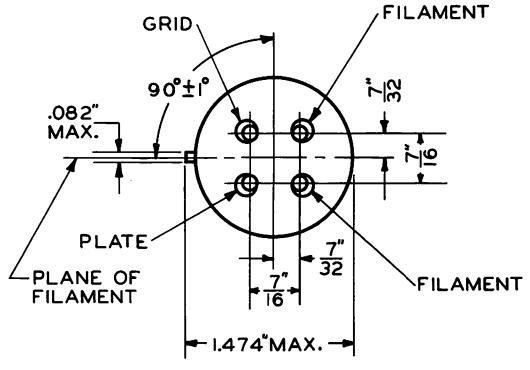


FIG. 2

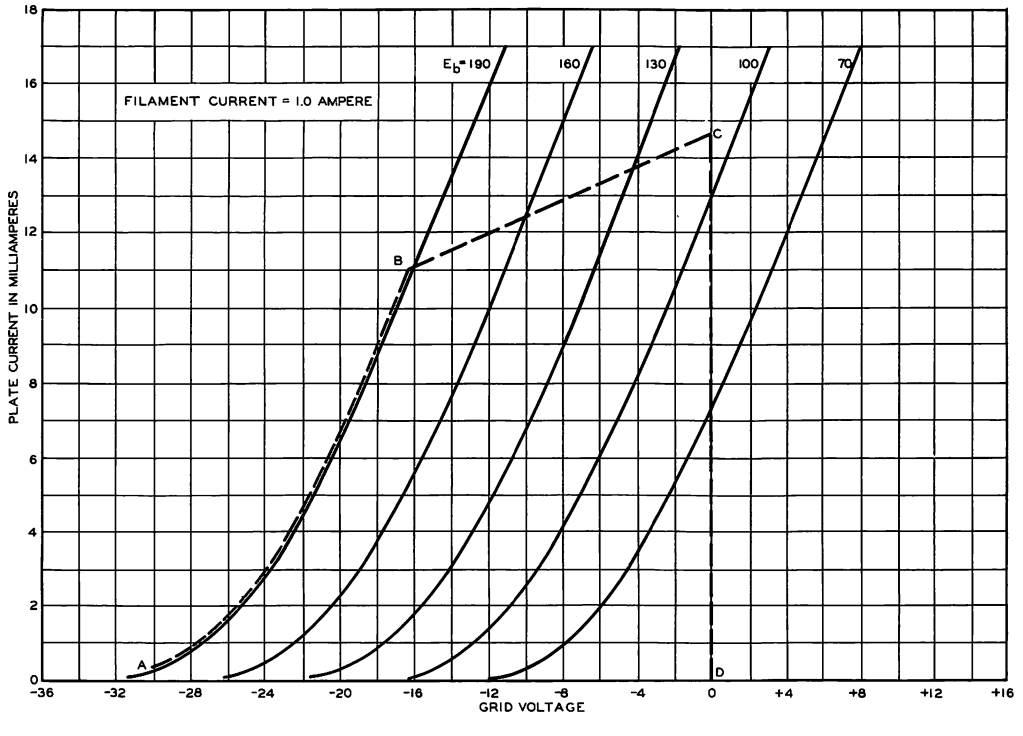


FIG. 3

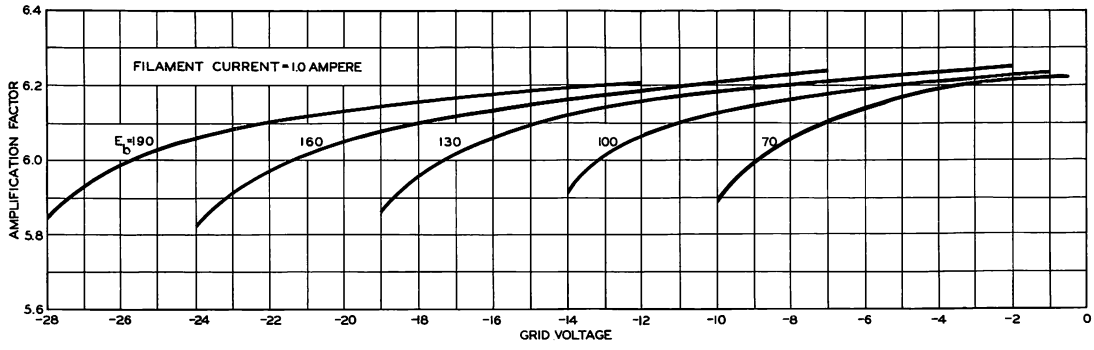


FIG. 4

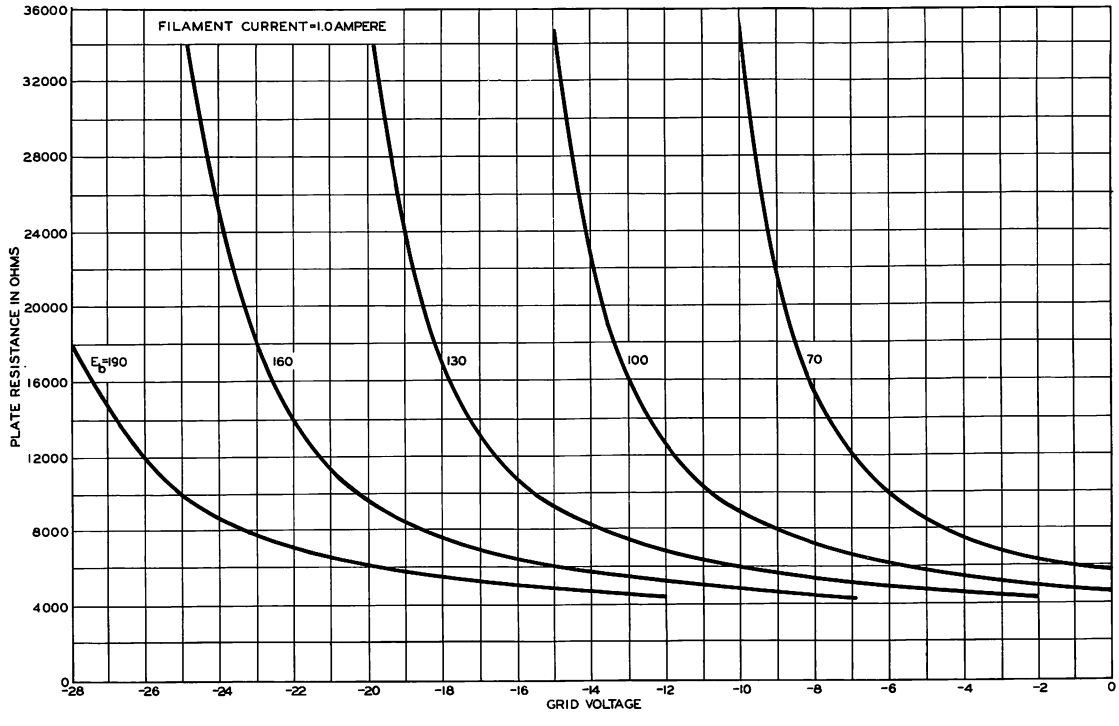


FIG. 5

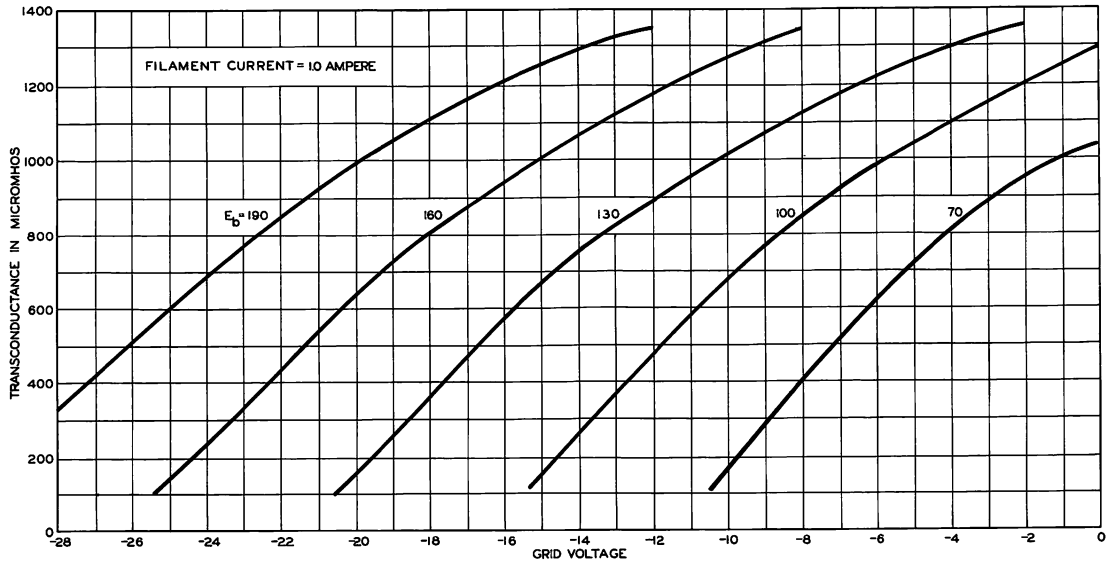


FIG. 6

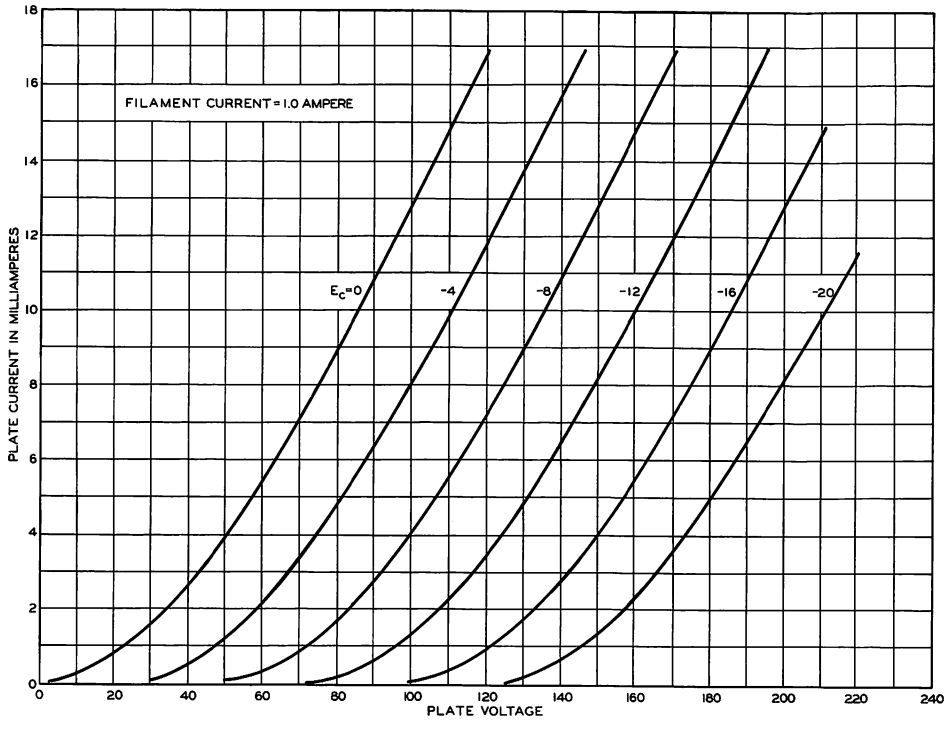


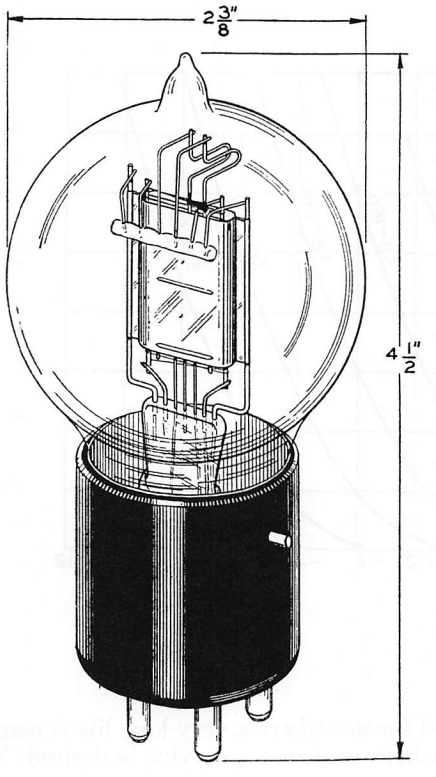
FIG. 7

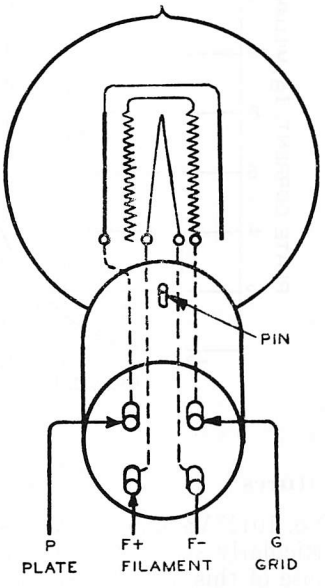
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V. T. DATA SHEET 101D
ISSUE 1

101F Vacuum Tube





Classification

The No. 101F Vacuum Tube is a three-element filamentary type tube for use where small amounts of output power are required.

Base and Socket

The No. 101F Vacuum Tube employs a four-prong bayonet pin type base suitable for use in a Western Electric No. 100L (front panel mounting), No. 100R (rear panel mounting), or similar type socket.

Rating and Characteristic Data

Filament Current				.50 Ampere
Filament Voltage				4.1 Volts
Plate Voltage	130	130	160	190 Max.
Grid Voltage	—8	—8	—12	—16
Average Plate Current—Milliamperes	6.0	6.0	6.7	7.5
Average Amplification Factor	6.5	6.5	6.5	6.5
Average Plate Resistance—Ohms	5900	5900	5600	5400
*Average Power Output—Milliwatts	60	55	135	240
Second Harmonic—% of Fundamental	5	2	3	4
Third Harmonic—% of Fundamental	0.5	0.2	0.3	0.5
Load Resistance—Ohms	5900	11800	11200	10800

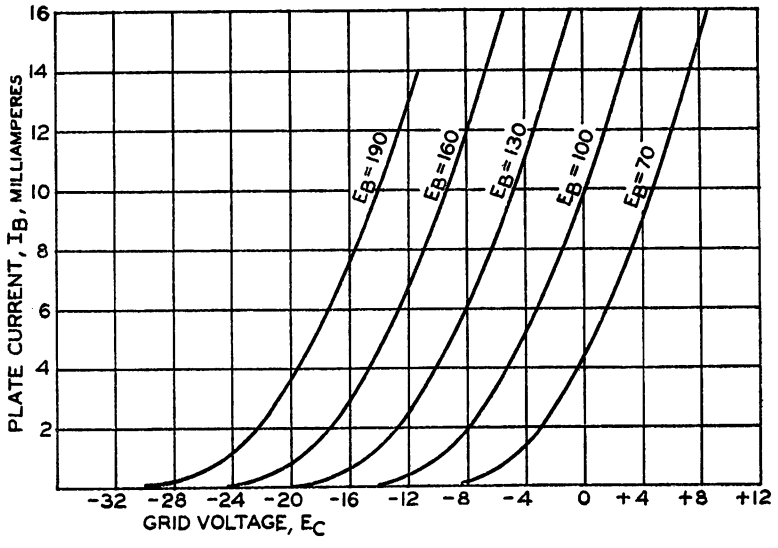
*Input in peak values is equal to grid voltage.

Approximate Direct Interelectrode Capacities (measured without socket)

Plate to Grid	5.9 MMF
Plate to Filament	3.7 MMF
Grid to Filament	5.2 MMF

Average Static Characteristics

The accompanying curves give the average static characteristics of the No. 101F Vacuum Tube.



General Features

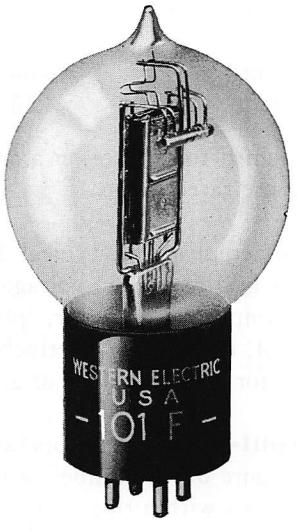
The No. 101F Vacuum Tube was designed for use where a very long life is essential. This makes it particularly suitable for applications where continuous service is desired. The microphonic response of this tube is low.

The electrical characteristics are such that moderate power outputs are obtainable with small plate currents and with plate voltage under 200 volts.

The characteristics are similar to those of the No. 101D, however, the No. 101F operates at a filament current of 0.5 instead of 1.0 ampere.

Western Electric

101F Vacuum Tube



Classification—Low-power, filamentary triode

Applications

Voice-frequency and carrier-frequency amplifier for telephone repeater equipment and other applications where small power outputs are required.

Modulator and demodulator in carrier systems.

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—Four-pin, bayonet type, having special contact metal at the ends of the contact pins.

Socket—Four-contact, bayonet-slot type, preferably provided with contact-metal contacts, such as the Western Electric 100L for front of panel mounting or 100R for rear of panel mounting.

Mounting Positions—Either vertical or horizontal. If mounted in a horizontal position, the plane of the filament, which is indicated in Figure 2, should be vertical.

Average Direct Interelectrode Capacitances

	A	B	C
Grid to plate, $\mu\mu f$	5.9	5.7	5.8
Grid to filament, $\mu\mu f$	5.2	5.6	6.1
Plate to filament, $\mu\mu f$	3.7	5.1	5.4

Column A—Based tube without socket.

Column B—Tube alone when measured in 100L socket mounted on a metal plate; socket and mounting plate connected to filament.

Column C—Tube alone when measured in 100R socket mounted in a metal plate; socket and mounting plate connected to filament.

Filament Rating

Filament current	0.50 ampere, d.c.
Nominal filament voltage	4.15 volts

The filament of this tube is designed to operate on a current basis and should be operated at a current not appreciably exceeding the rated value.

Characteristics—Grid-plate characteristics of a typical 101F tube are shown in Figure 3 for several values of plate voltage. The grid and plate voltages are measured from the negative end of the filament. Corresponding amplification-factor, plate-resistance, and transconductance characteristics are shown in Figures 4, 5 and 6, respectively, as functions of grid voltage. Plate characteristics are given in Figure 7 for several values of grid bias.

Operating Conditions and Output—Permissible operating grid and plate voltages are included within the area, ABCD, in Figure 3. A number of recommended and maximum operating conditions, represented by selected points within this area, and the corresponding values of amplification factor and plate resistance are given in the table below. 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 fundamental power output in milliwatts and the second and third harmonic levels in db below the fundamental, corresponding to the recommended and maximum operating conditions, are given in the latter part of the table for values of load resistance, R, both equal to and double the value of the plate resistance, r_p. The peak value of the sinusoidal input voltage, E_{gm}, which gives the indicated power output, P_m, and harmonic levels, F_{2m} and F_{3m}, in each case, is numerically equal to the grid bias. For a smaller input voltage, E_g, the approximate levels may be computed from the following relations:

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

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

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

Microphonic Noise—For a plate voltage of 130 volts, a grid bias of −8 volts, and a load resistance of 100,000 ohms, the mean microphonic output level of the 101F tube, measured in a laboratory reference test set, is 19 db below 1 volt. The range of levels of individual tubes extends from 8 to 30 db below 1 volt. Since microphonic noise output depends on the type and intensity of the mechanical disturbances which produce 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.

TABLE

	Plate Voltage	Grid Bias	Plate Current	Amplification Factor	Plate Resistance	Load Resistance	Power Output	2nd Harmonic	3rd Harmonic
	Volts	Volts	Milliamperes		Ohms r_p	R	Milliwatts	db	db
Recommended Operating Conditions	100	− 4	5.5	6.5	5800	$R = r_p$	16	32	55
						$R = 2r_p$	14	38	65
	130	−10	4.0	6.4	6900	$R = r_p$	80	22	36
						$R = 2r_p$	75	28	46
	130	− 8	6.0	6.5	5800	$R = r_p$	62	26	46
						$R = 2r_p$	55	33	55
	130	− 4	10.9	6.6	4600	$R = r_p$	20	37	60
						$R = 2r_p$	18	43	65
	160	−14	4.8	6.4	6500	$R = r_p$	170	20	32
						$R = 2r_p$	160	26	42
	160	−10	9.3	6.5	4900	$R = r_p$	120	28	47
						$R = 2r_p$	110	34	55
Maximum Operating Conditions	160	− 8	11.9	6.6	4400	$R = r_p$	85	32	55
						$R = 2r_p$	75	37	60
	190	−18	5.5	6.4	6300	$R = r_p$	275	17	29
						$R = 2r_p$	255	24	37
	190	−16	7.5	6.5	5400	$R = r_p$	270	22	35
						$R = 2r_p$	250	28	45
	190	−14	10.0	6.5	4800	$R = r_p$	250	25	43
						$R = 2r_p$	215	31	50

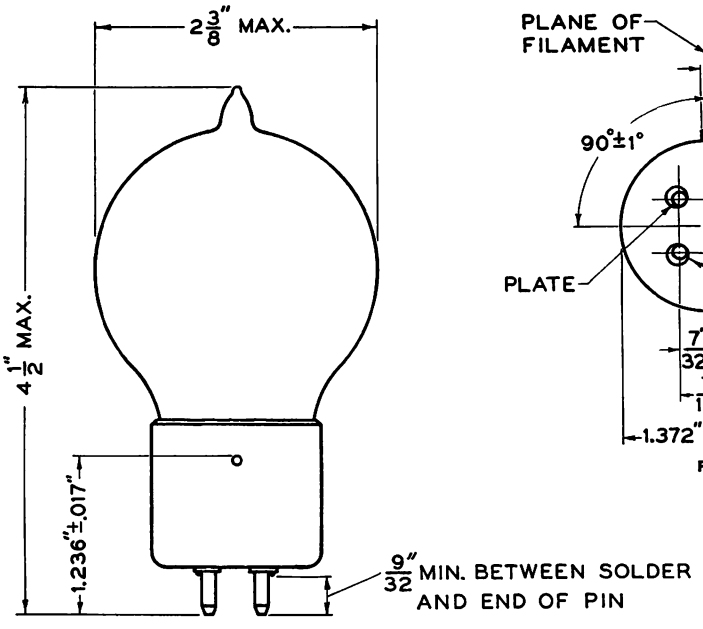


FIG. 1

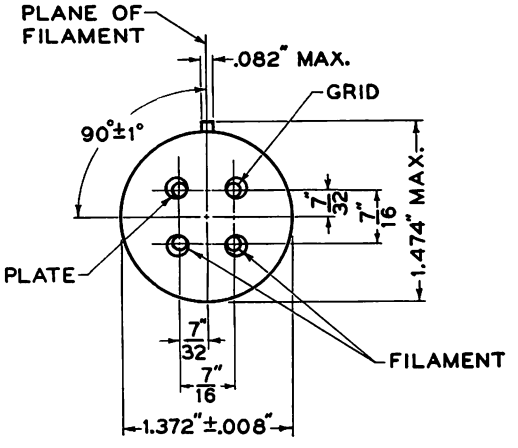


FIG. 2

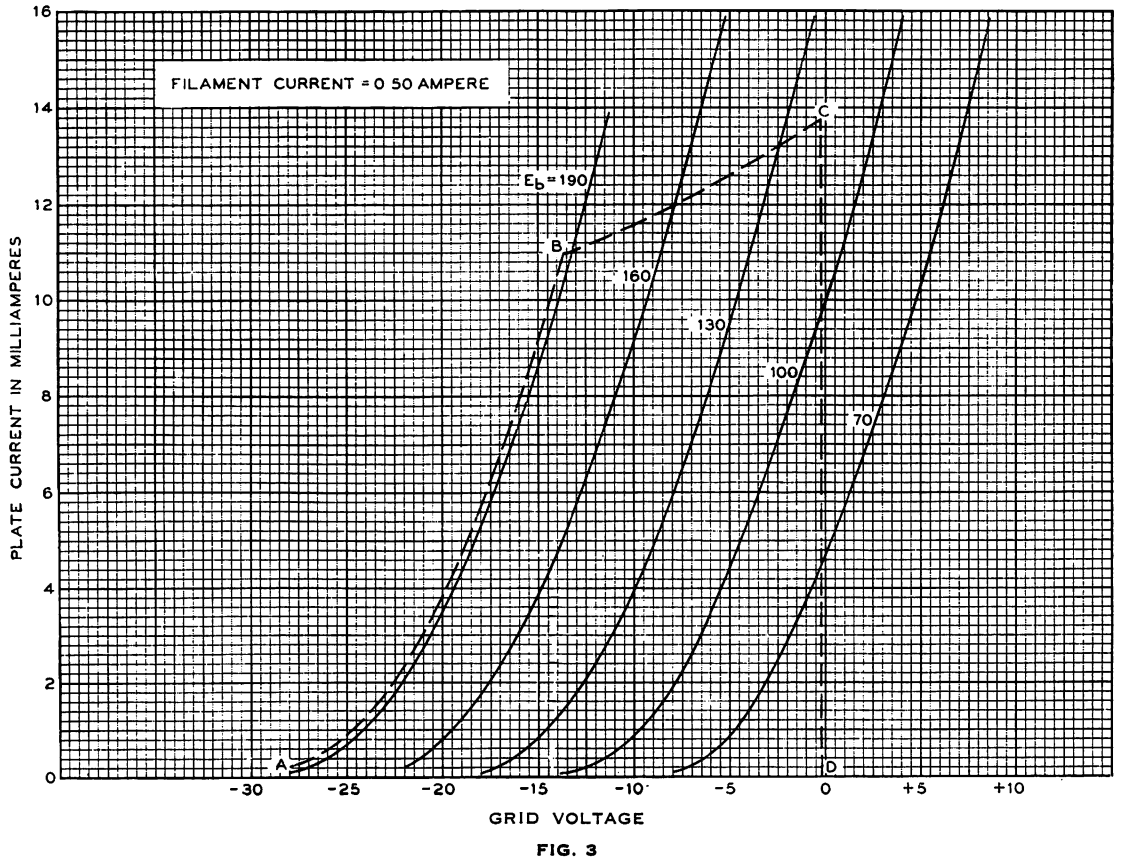


FIG. 3

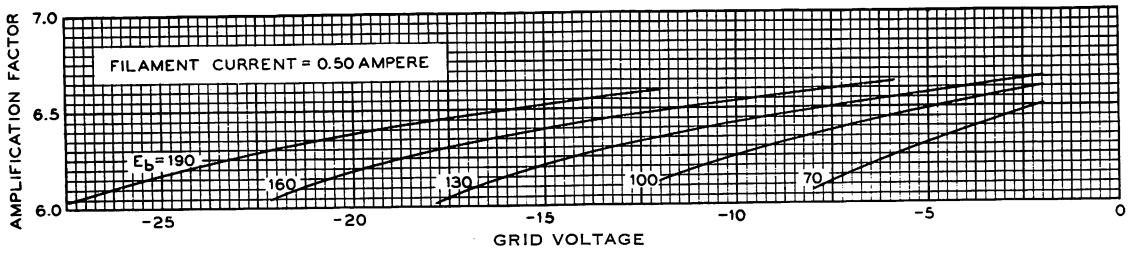


FIG. 4

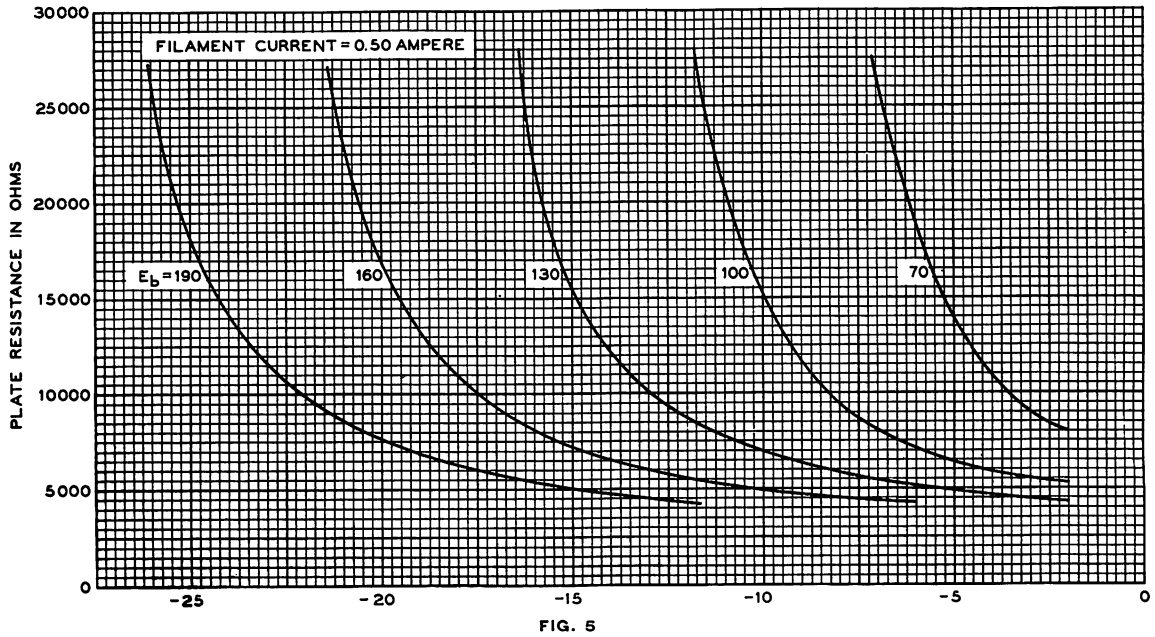


FIG. 5

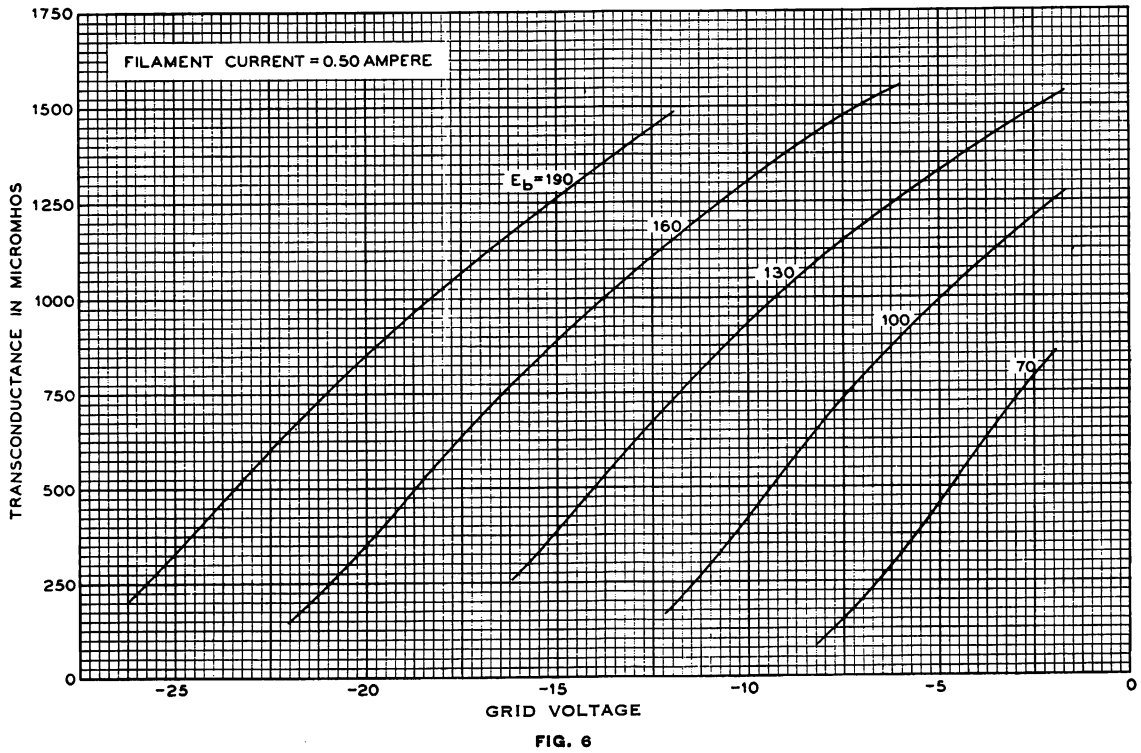


FIG. 6

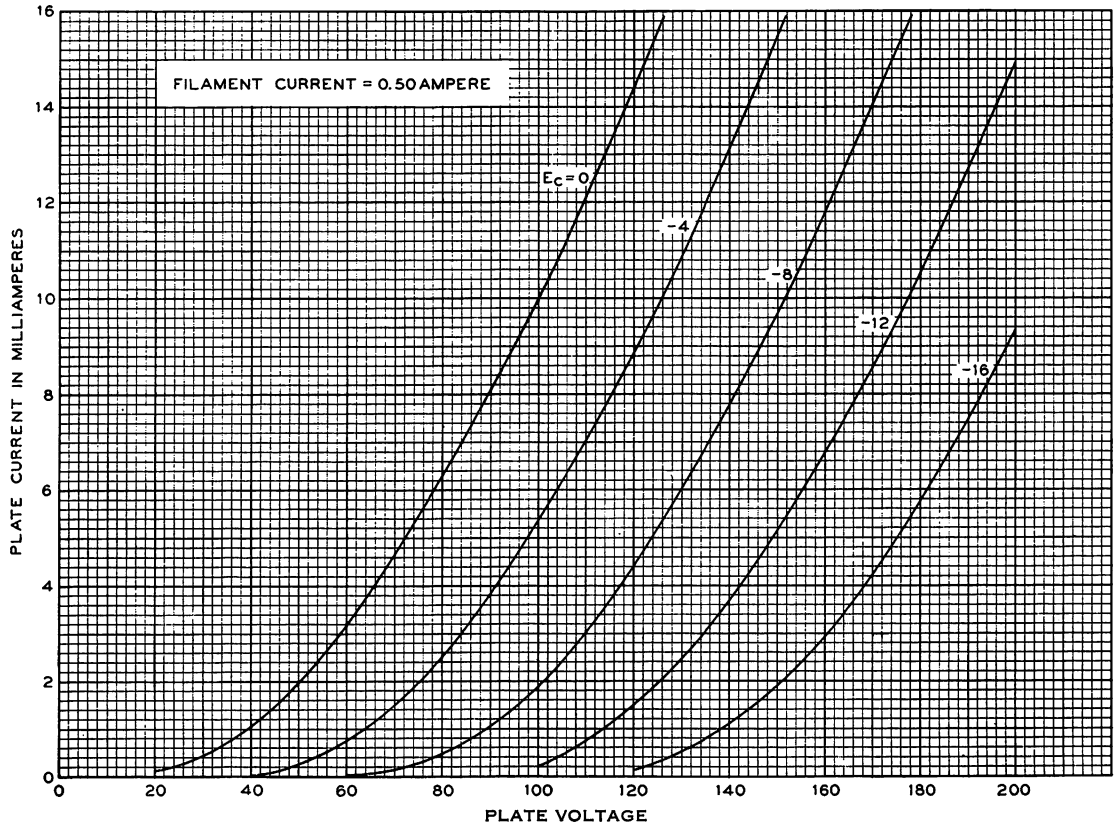
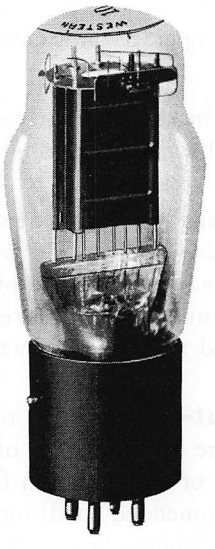

FILAMENT CURRENT = 0.50 AMPERE
$E_C = 0$
-4
-8
-12
-16
PLATE CURRENT IN MILLIAMPERES
0
2
4
6
8
10
12
14
16
0
20
40
60
80
100
120
140
160
180
200
PLATE VOLTAGE

FIG. 7

Western Electric

101F Vacuum Tube
(Dome)



Classification—Low-power, filamentary triode

This tube replaces the old design 101F tube. It includes an improved filament, a new mechanical design using transverse mica supports and is mounted in a dome type bulb. The electrical characteristics are practically identical with the previous 101F tube. Due to the improved insulation between elements, it is suitable for use in place of the 101J tube.

Applications—Voice frequency and carrier-frequency amplifier for telephone repeater equipment and other applications where small power outputs are required.

Modulator and demodulator in carrier-systems.

Oscillator in voice and carrier frequency applications.

Dimensions and Connections—The 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 vacuum tube employs a four-pin bayonet type base having special contact at the ends of the pins. It is suitable for use in a Western Electric 100L, 100R, or similar type socket, preferably provided with contact-metal contacts.

The tube may be mounted in either a vertical or horizontal position. If mounted in a horizontal position the plane of the filament, which is indicated in Figure 2, should be vertical. To assure adequate ventilation the tubes should be mounted with not less than 2⅝ inches between centers when two or more tubes are used.

Average Direct Interelectrode Capacitances

Grid to plate	5.9 μμf
Grid to filament	4.2 μμf
Plate to filament	2.7 μμf

These values are for a based tube without socket.

Filament Rating

Filament current	0.50 ampere, d.c.
Nominal filament voltage	4.15 volts

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

The filament resistance of this tube increases slightly during the first 2000 hours of operation. The voltage given above is the nominal value after this resistance change has stabilized.

Characteristics—Typical curves showing plate current as a function of grid voltage for several values of plate voltage are shown in Figure 3. The grid and plate voltages are measured from the negative end of the filament. Corresponding amplification factor, plate resistance and transconductance characteristics are given in Figures 4, 5 and 6 respectively. Plate current as a function of plate voltage for several values of grid voltage is shown in Figure 7.

Operating Conditions and Output—Permissible operating plate and grid voltages are included within the area, ABCD in Figure 3. A number of recommended and maximum operating conditions and the corresponding values of amplification factor, plate resistance and performance data are given in the table below. 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 less severe conditions.

The performance data shown includes the fundamental power output in milliwatts and the second and third harmonic levels in db below the fundamental for values of load resistance equal to the plate resistance and for a load resistance of 12000 ohms. The peak value of the sinusoidal input voltage E_{gm}, which gives the indicated output P_m, and harmonic levels F_{2m} and F_{3m}, in each case is numerically equal to the grid bias. For a smaller input voltage E_g, the approximate levels may be computed from the following relations:

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

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

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

Microphonic Noise

For a plate voltage of 130 volts, a grid bias of −8 volts, and a load resistance of 100,000 ohms, the mean microphonic output level of this tube, measured in a laboratory reference test set is 30 db below 1 volt. The range of levels of individual tubes extends from 20 to 40 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.

TABLE

	Plate Voltage	Grid Bias	Plate Current	Amplification Factor	Plate Resistance	Load Resistance	Power Output	Second Harmonic	Third Harmonic
	Volts	Volts	Milliamperes		Ohms	Ohms	Milliwatts	db	db
Recommended Operating Conditions	100	−4	6.2	6.5	5900	5900	15	35	60
						12000	13	42	65
	130	−10	4.8	6.5	6600	6600	79	24	38
						12000	75	30	46
	130	−8	6.8	6.5	5800	5800	60	30	48
						12000	53	37	60
	130	−4	11.7	6.6	4700	4700	18	41	70
						12000	15	50	75
	160	−14	5.4	6.5	6300	6300	155	21	32
						12000	145	27	41
	160	−10	10.0	6.5	5000	5000	100	30	48
						12000	90	40	60
Maximum Operating Conditions	160	−8	12.5	6.5	4600	4600	70	34	55
						12000	65	44	70
	190	−18	6.1	6.5	6100	6100	250	19	30
						12000	245	26	39
	190	−16	8.4	6.5	5300	5300	240	22	40
						12000	220	32	48
	190	−14	10.9	6.5	4900	4900	205	27	43
						12000	180	37	55

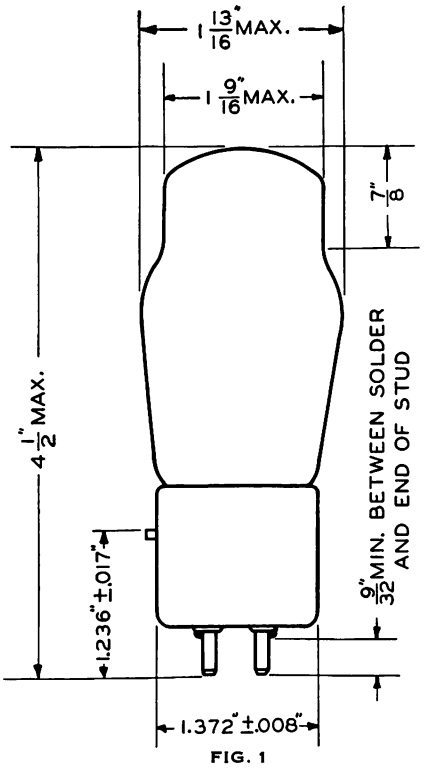


FIG. 1

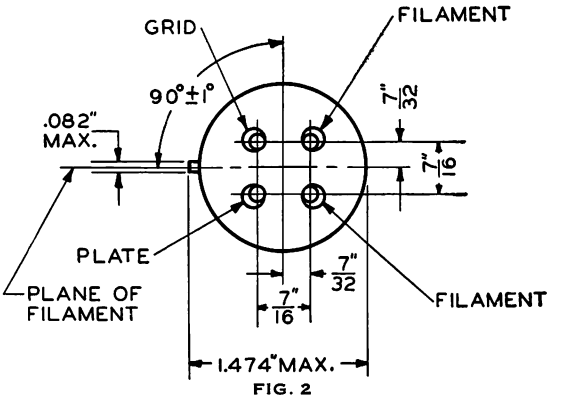


FIG. 2

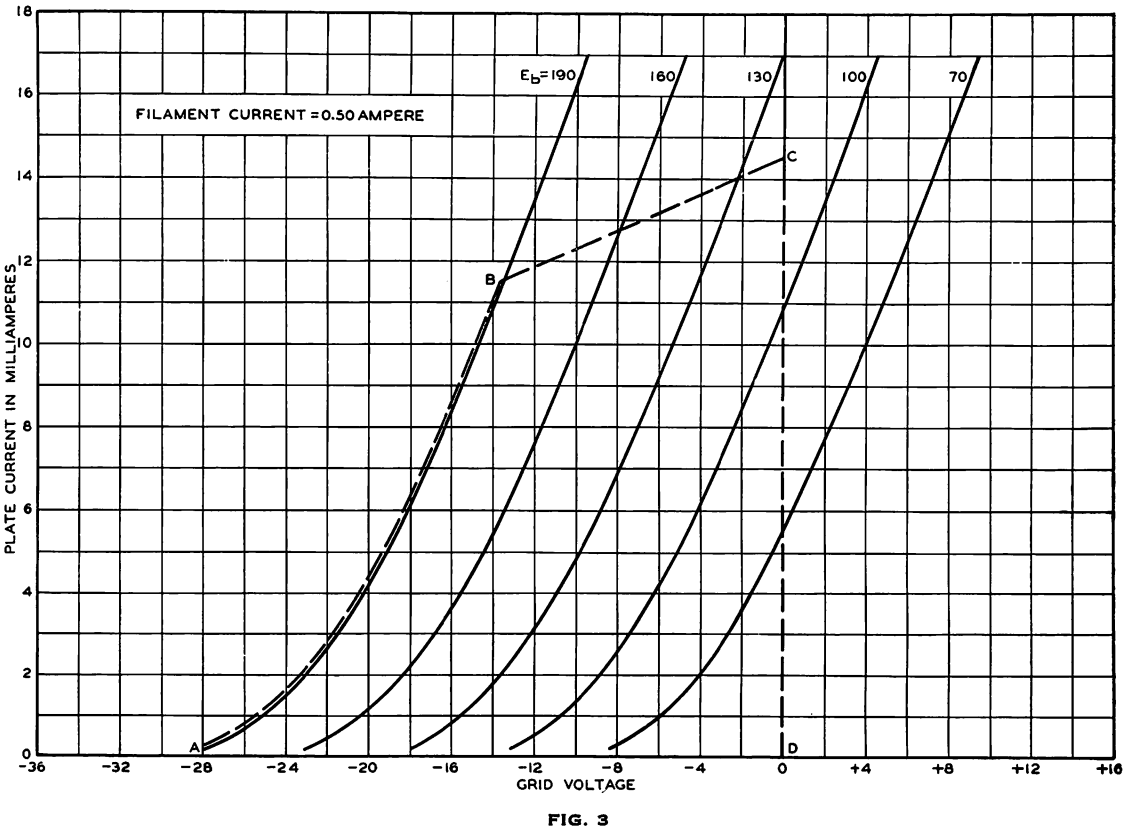


FIG. 3

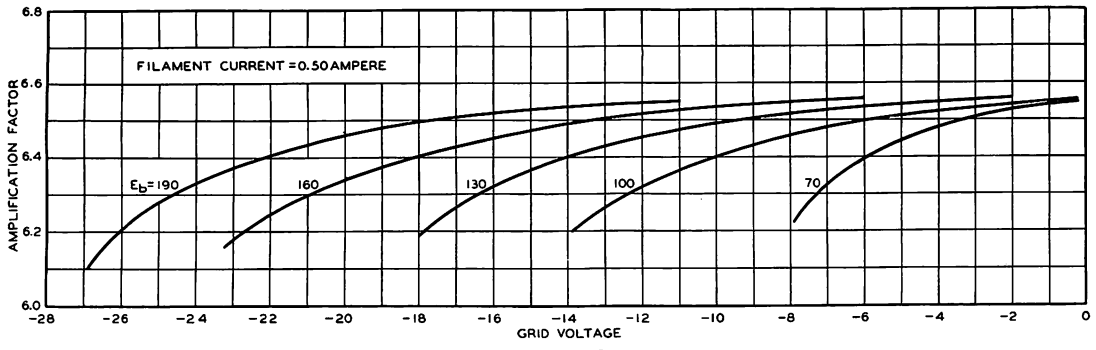


FIG. 4

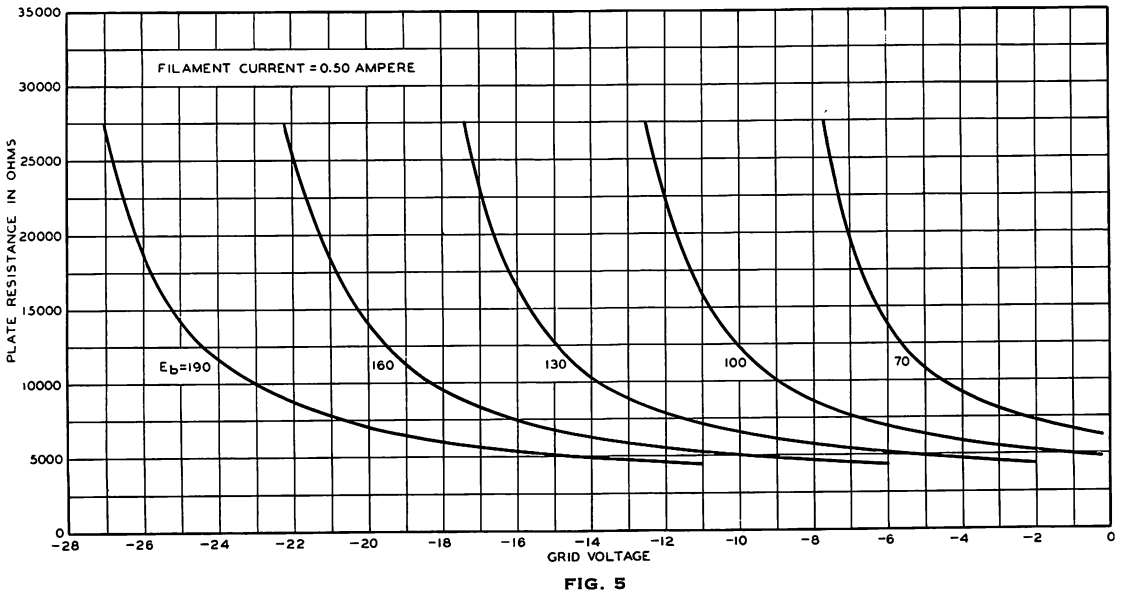


FIG. 5

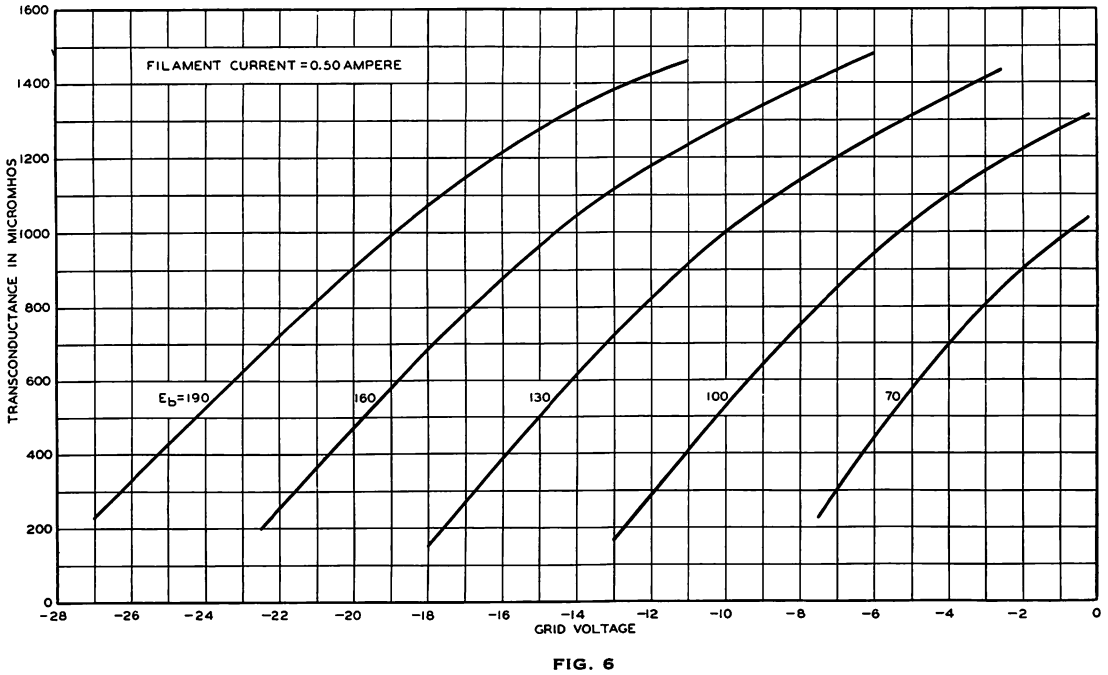


FIG. 6

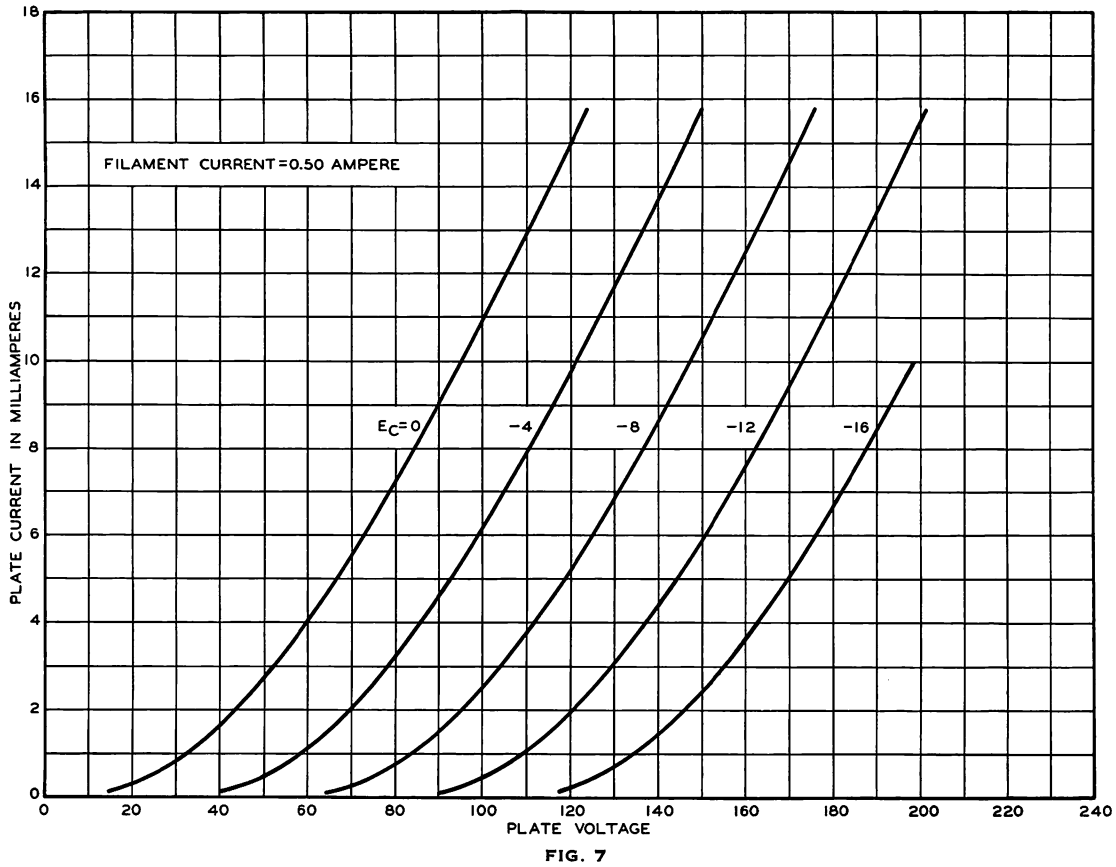
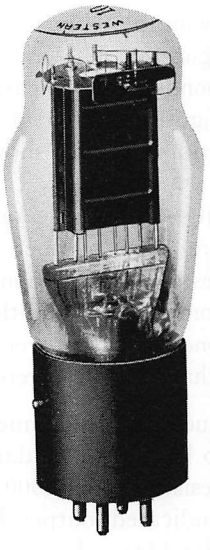

FILAMENT CURRENT=0.50 AMPERE
E_C=0
-4
-8
-12
-16
PLATE CURRENT IN MILLIAMPERES
PLATE VOLTAGE
0
2
4
6
8
10
12
14
16
18
0
20
40
60
80
100
120
140
160
180
200
220
240

FIG. 7

Western Electric

101FA Vacuum Tube



Classification—Low-power, filamentary triode

This tube is similar to the 101F (dome) tube except for modifications in the characteristics to obtain higher gain.

Applications—Voice-frequency repeaters and other telephone equipment requiring higher gain than can be obtained from the 101F tube.

Dimensions and Connections—The 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 vacuum tube employs a four-pin bayonet type base having special contact metal at the ends of the pins. It is suitable for use in a Western Electric 100L, 100R, or similar type socket, preferably provided with contact-metal contacts.

The tube may be mounted in either a vertical or horizontal position. If mounted in a horizontal position the plane of the filament, which is indicated in Figure 2, should be vertical. To assure adequate ventilation the tubes should be mounted with not less than $2\frac{5}{8}$ inches between centers when two or more tubes are used.

Average Direct Interelectrode Capacitances

Grid to plate	5.1 $\mu\mu$f
Grid to filament	4.9 $\mu\mu$f
Plate to filament	2.7 $\mu\mu$f

These values are for a based tube without socket.

Filament Rating

Filament current	0.50 ampere, d.c.
Nominal filament voltage	4.15 volts

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

The filament resistance of this tube increases slightly during the first 2000 hours of operation. The voltage given above is the nominal value after this resistance change has stabilized.

Characteristics—Typical curves showing plate current as a function of grid voltage for several values of plate voltage are shown in Figure 3. The grid and plate voltages are measured from the negative end of the filament. Corresponding amplification factor, plate resistance and transconductance characteristics are given in Figures 4, 5 and 6 respectively. Plate current as a function of plate voltage for several values of grid voltage is shown in Figure 7.

Operating Conditions and Output—Permissible operating plate and grid voltages are included within the area, ABCD in Figure 3. A number of recommended and maximum operating conditions and the corresponding values of amplification factor, plate resistance and performance data are given in the table below. 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 less severe conditions.

The performance data shown includes the fundamental power output in milliwatts and the second and third harmonic levels in db below the fundamental for values of load resistance equal to the plate resistance and for a load resistance of 12000 ohms. The peak value of the sinusoidal input voltage E_{gm}, which gives the indicated output P_m, and harmonic levels F_{2m} and F_{3m}, in each case is numerically equal to the grid bias. For a smaller input voltage E_g, the approximate levels may be computed from the following relations:

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

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

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

Microphonic Noise

For a plate voltage of 130 volts, a grid bias of −8 volts, and a load resistance of 100,000 ohms, the mean microphonic output level of this tube, measured in a laboratory reference test set is 30 db below 1 volt. The range of levels of individual tubes extends from 20 to 40 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.

TABLE

	Plate Voltage	Grid Bias	Plate Current	Amplification Factor	Plate Resistance	Load Resistance	Power Output	Second Harmonic	Third Harmonic
	Volts	Volts	Milliamperes		Ohms	Ohms	Milliwatts	db	db
Recommended Operating Conditions	100	−4	5.3	9.0	5400	5400	30	28	47
						12000	25	33	55
	130	−8	4.4	8.9	6100	6100	94	20	34
						12000	91	26	43
	130	−6	7.5	9.0	4900	4900	72	26	44
						12000	63	34	55
	130	−4	11.6	9.2	4200	4200	39	34	55
						12000	30	43	70
	160	−10	6.6	8.9	5400	5400	170	21	35
						12000	150	28	45
Maximum Operating Conditions	160	−8	10.4	9.1	4500	4500	140	26	43
						12000	115	35	55
	190	−14	5.6	8.8	5800	5800	285	16	29
						12000	260	22	34
	190	−12	9.0	9.0	4800	4800	275	20	34
						12000	255	29	46

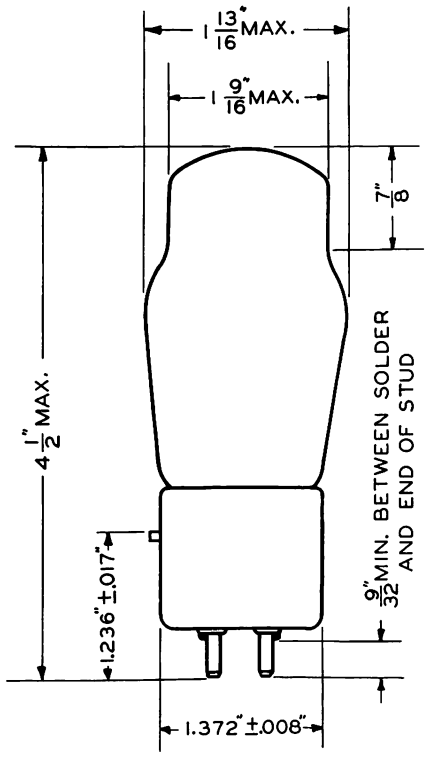


FIG. 1

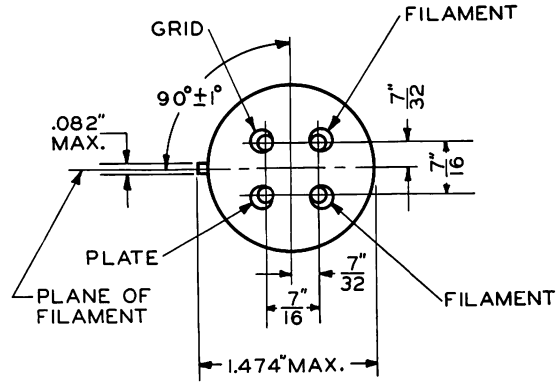


FIG. 2

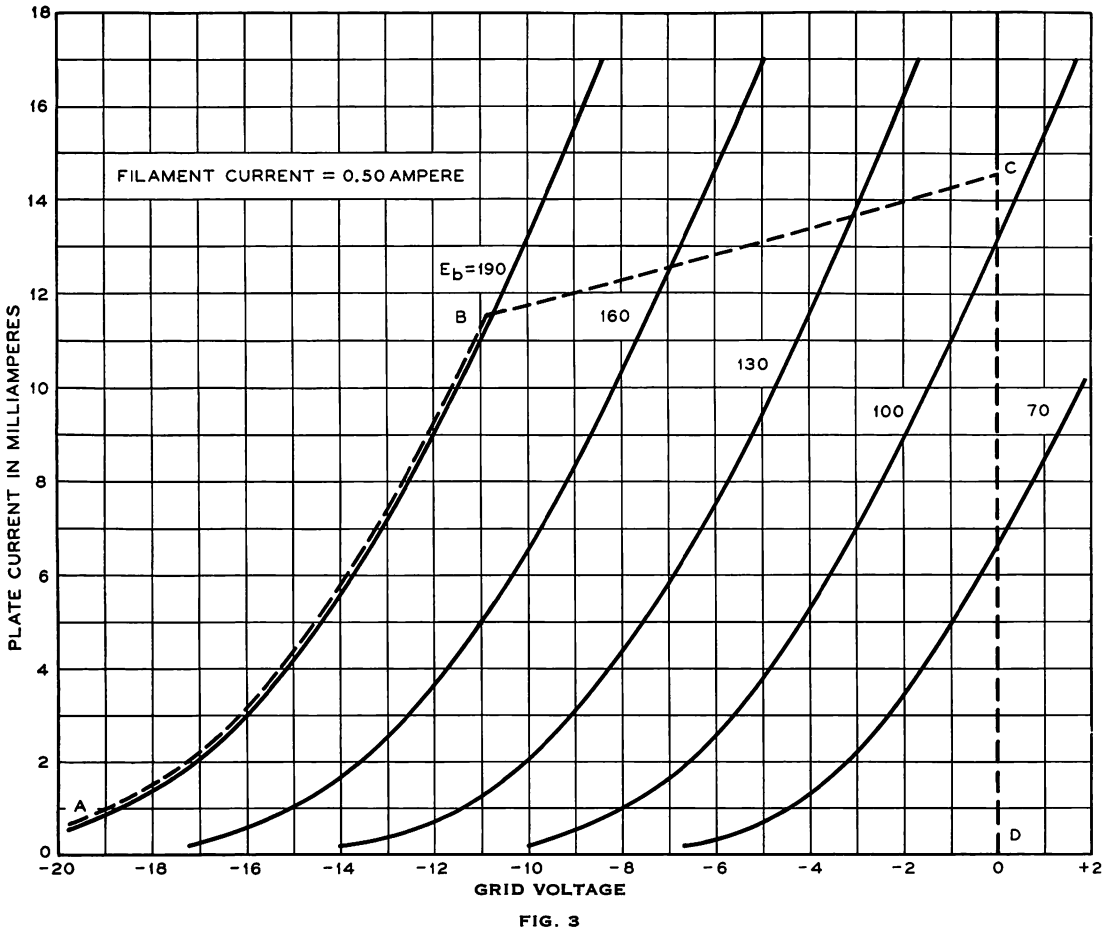


FIG. 3

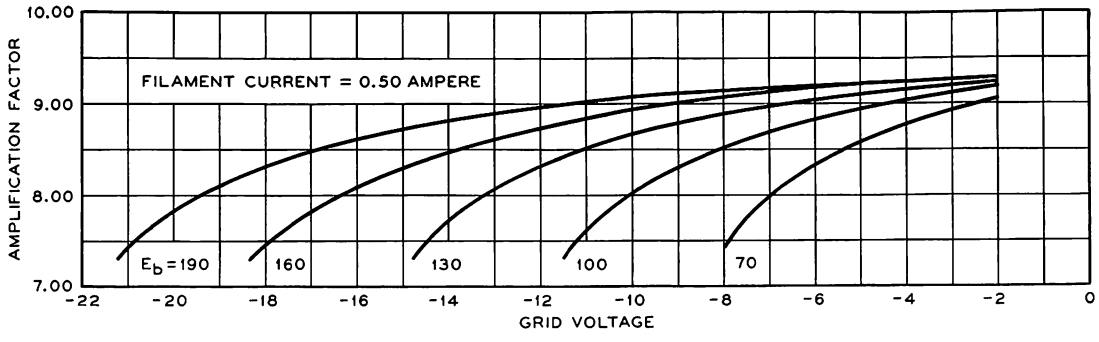


FIG. 4

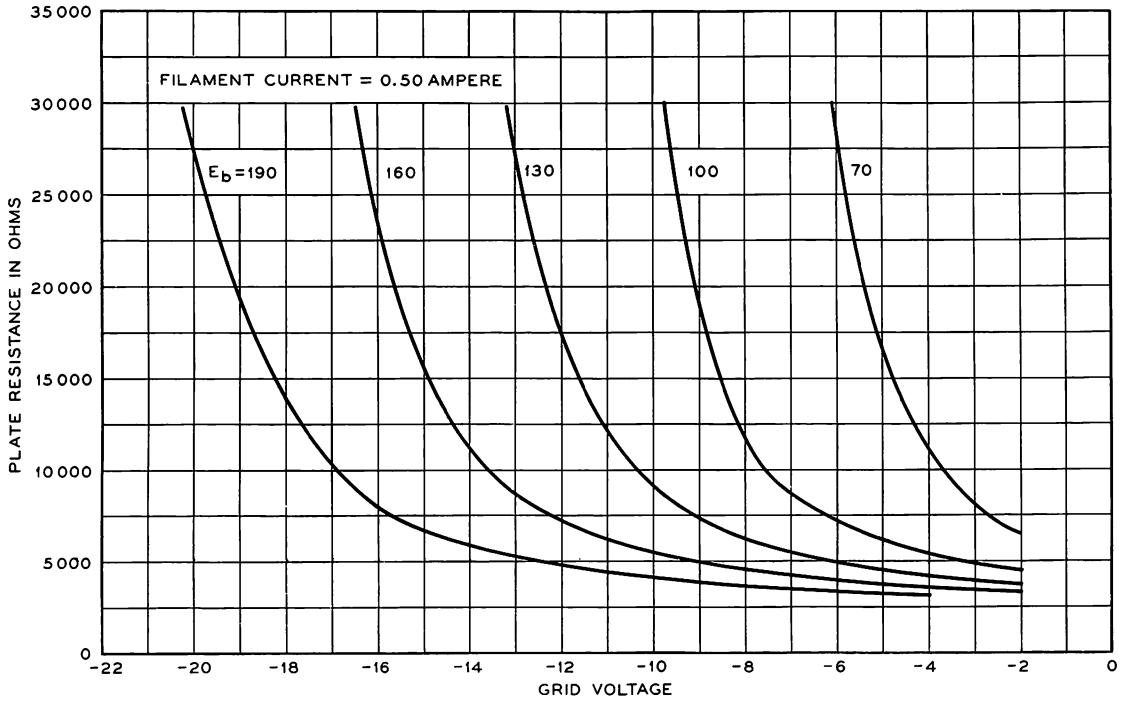


FIG. 5

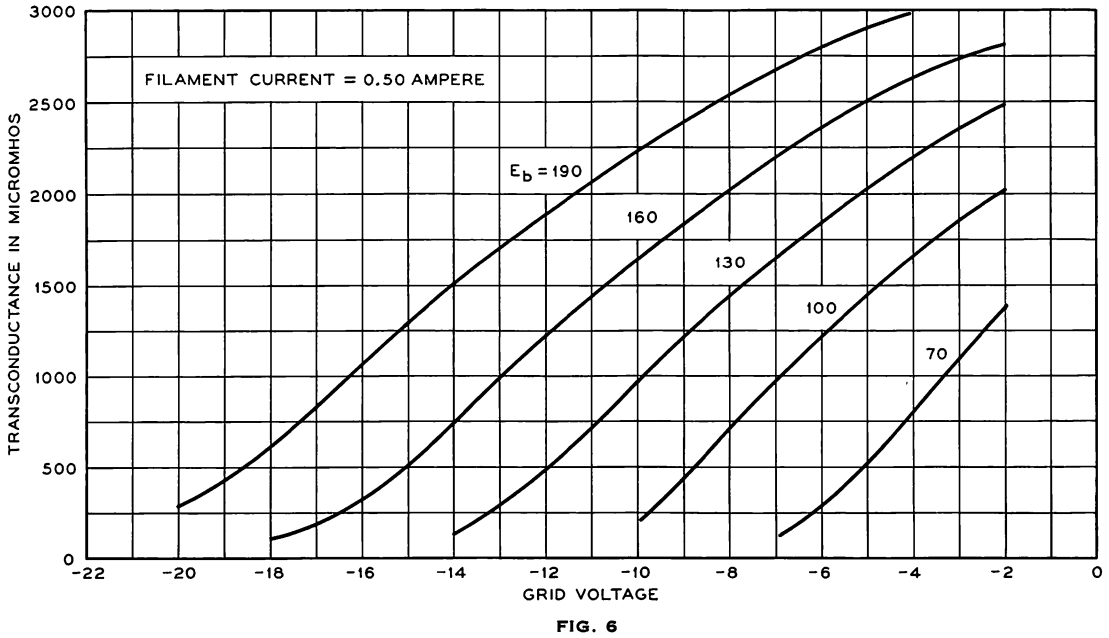


FIG. 6

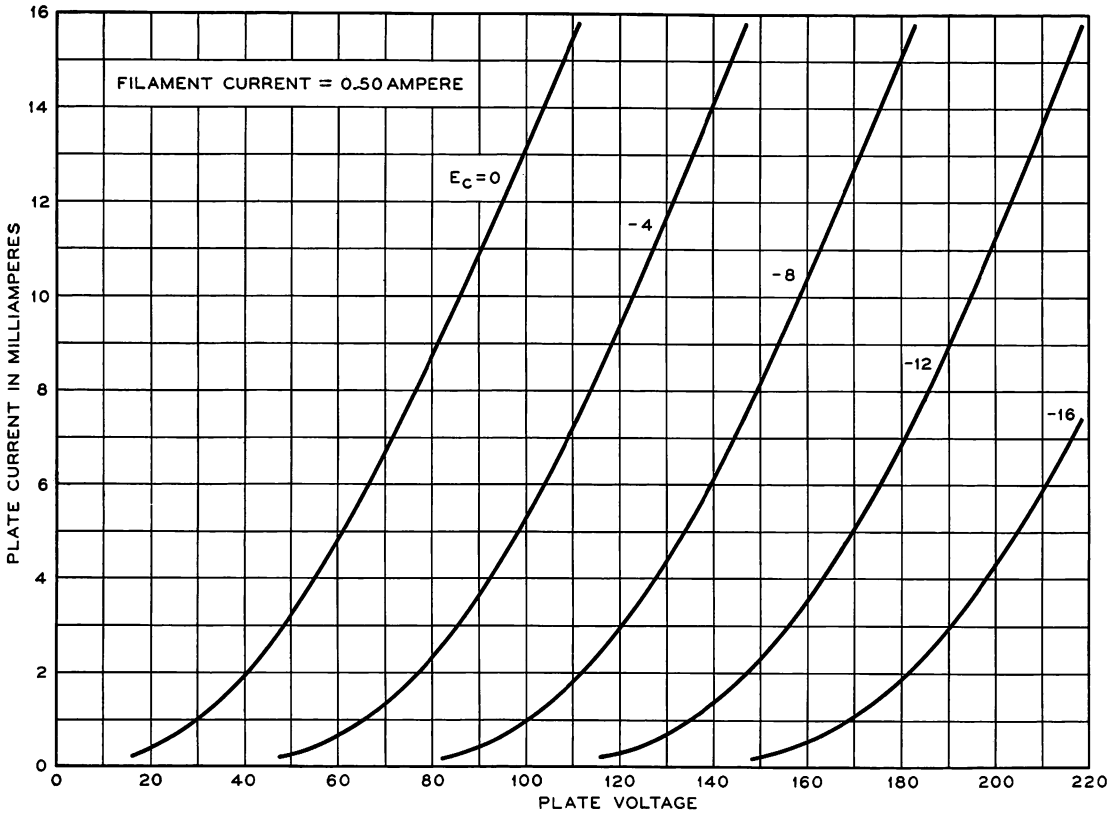
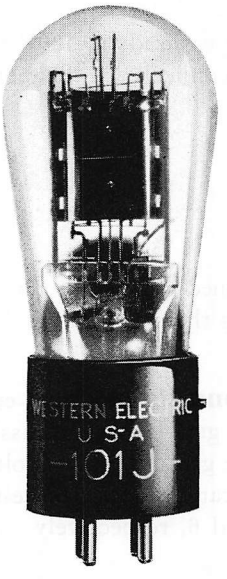

FILAMENT CURRENT = 0.50 AMPERE
$E_C = 0$
-4
-8
-12
-16
PLATE CURRENT IN MILLIAMPERES
PLATE VOLTAGE
0
2
4
6
8
10
12
14
16
0
20
40
60
80
100
120
140
160
180
200
220

FIG. 7

Western Electric

101J Vacuum Tube



Classification—Low-power filamentary triode

The 101J tube is similar in characteristics to the 101F, but is contained in a pear-shaped bulb and has higher insulation between elements.

Applications

Modulator and demodulator in carrier systems.

Voice-frequency and carrier-frequency amplifier for telephone repeater equipment and other applications where small power outputs are required.

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—Four-pin, bayonet type, having special contact metal at the ends of the contact pins.

Socket—Four-contact, bayonet-slot type, preferably provided with contact-metal contacts, such as the Western Electric 100L for front of panel mounting or 100R for rear of panel mounting.

Mounting Positions—Either vertical or horizontal. If mounted in a horizontal position, the plane of the filament, which is indicated in Figure 2, should be vertical.

Average Direct Interelectrode Capacitances

	A	B	C
Grid to plate, $\mu\mu f$	6.5	6.1	6.2
Grid to filament, $\mu\mu f$	4.2	4.9	5.3
Plate to filament, $\mu\mu f$	1.7	3.7	4.1

Column A—Based tube without socket.

Column B—Tube alone when measured in 100L socket mounted on metal plate; socket and mounting plate connected to filament.

Column C—Tube alone when measured in 100R socket mounted in metal plate; socket and mounting plate connected to filament.

Filament Rating

Filament current	0.50 ampere, d.c.
Nominal filament voltage	4.15 volts

The filament of this tube is designed to operate on a current basis and should be operated at a current not appreciably exceeding the rated value.

Characteristics and Operating Conditions—Plate-current characteristics of a typical 101J tube are shown in Figure 3 as functions of grid bias. Permissible operating grid and plate voltages are included within the area ABCD. The grid and plate voltages are measured to the negative end of the filament. Corresponding amplification-factor, plate-resistance, and transconductance characteristics are given in Figures 4, 5, and 6, respectively. Plate-current characteristics are given as functions of plate voltage in Figure 7.

A number of recommended and maximum operating conditions and the corresponding values of amplification factor and plate resistance are given in the table on page 3. 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.

Power Output and Distortion—The fundamental power output in milliwatts, and the second and third harmonic levels in db below the fundamental, corresponding to the recommended and maximum operating conditions, are given in the latter part of the table for values of load resistance, R, both equal to and double the value of the plate resistance, r_p. The peak value of the sinusoidal input voltage, E_{gm}, which gives the indicated power output, P_m, and harmonic levels, F_{2m} and F_{3m}, in each case, is numerically equal to the grid bias. For a smaller input voltage, E_g, the approximate levels may be computed from the following relations:

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

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

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

Microphonic Noise—With a plate voltage of 130 volts, a grid bias of −8 volts, and a load resistance of 100,000 ohms, the mean microphonic noise output level of the 101J tube, measured in a laboratory reference test set, is 26 db below 1 volt. The range of levels of individual tubes extends from 14 to 34 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.

Table

	Plate Voltage	Grid Bias	Plate Current	Amplification Factor	Plate Resistance	OUTPUT R = r_p			OUTPUT R = $2r_p$		
						Power Output	Second Harmonic	Third Harmonic	Power Output	Second Harmonic	Third Harmonic
	Volts	Volts	Milliamperes		Ohms	Milliwatts	db	db	Milliwatts	db	db
Recommended	100	−4	6.3	6.6	5,750	16	32	55	14	38	65
Operating	130	−10	4.8	6.5	6,500	80	22	36	75	28	46
Conditions	130	−8	7.0	6.5	5,600	62	26	46	55	33	55
	130	−4	11.9	6.6	4,800	20	37	60	18	43	65
	160	−14	5.4	6.5	6,500	170	20	32	160	26	42
	160	−10	10.0	6.6	5,000	120	28	47	110	34	55
Maximum	190	−18	6.2	6.5	6,100	275	17	29	255	24	37
Operating	190	−16	8.4	6.5	5,450	270	22	35	250	28	45
Conditions	190	−14	10.9	6.6	5,000	250	25	43	215	31	50

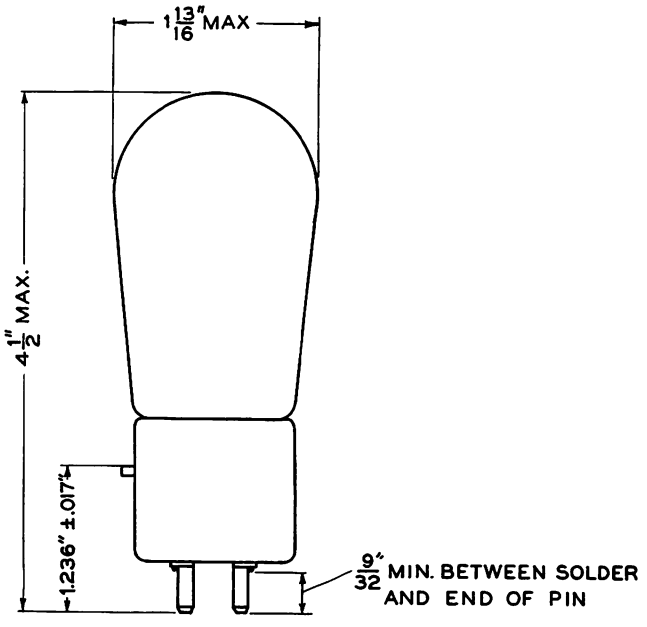


FIG. 1

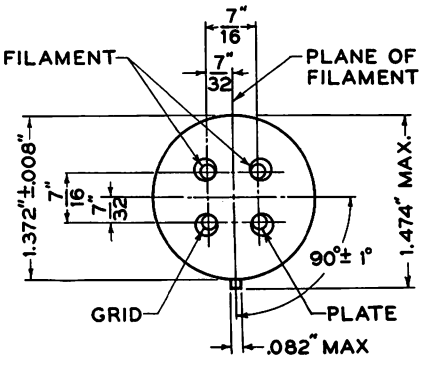


FIG. 2

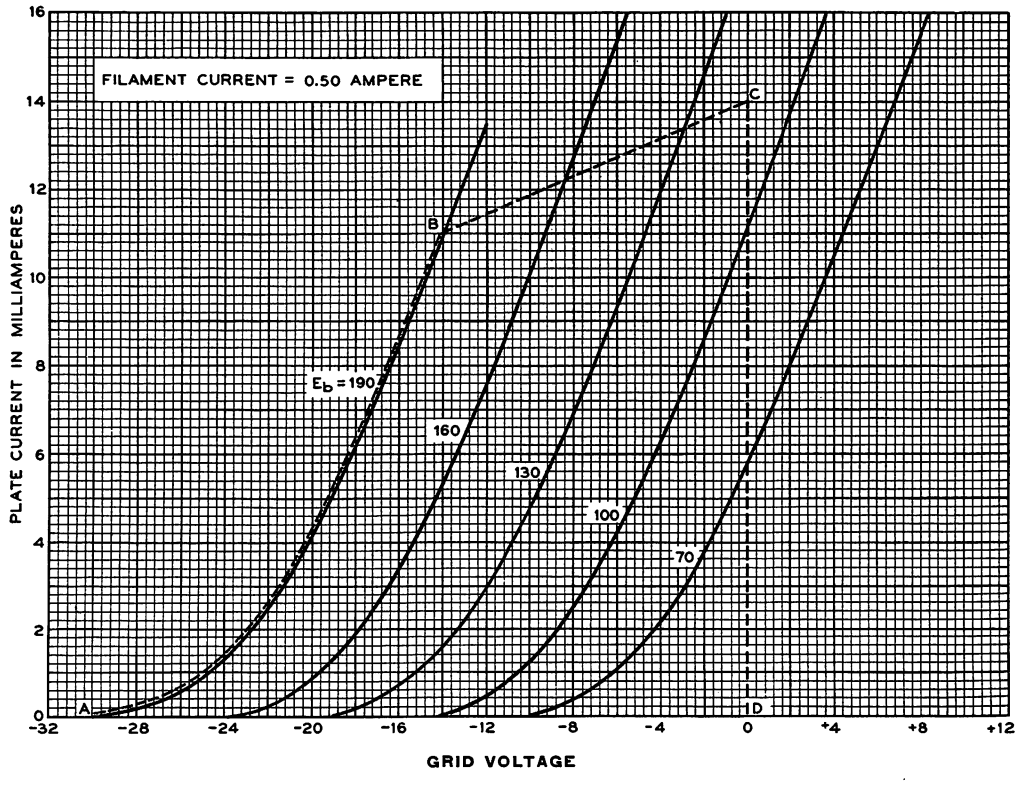


FIG. 3

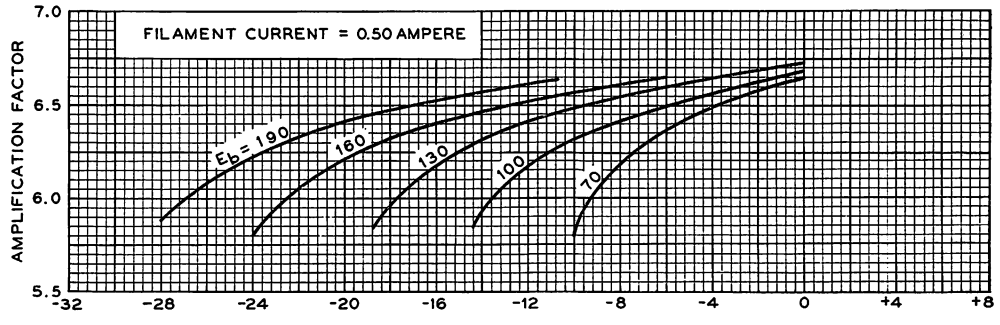


FIG. 4

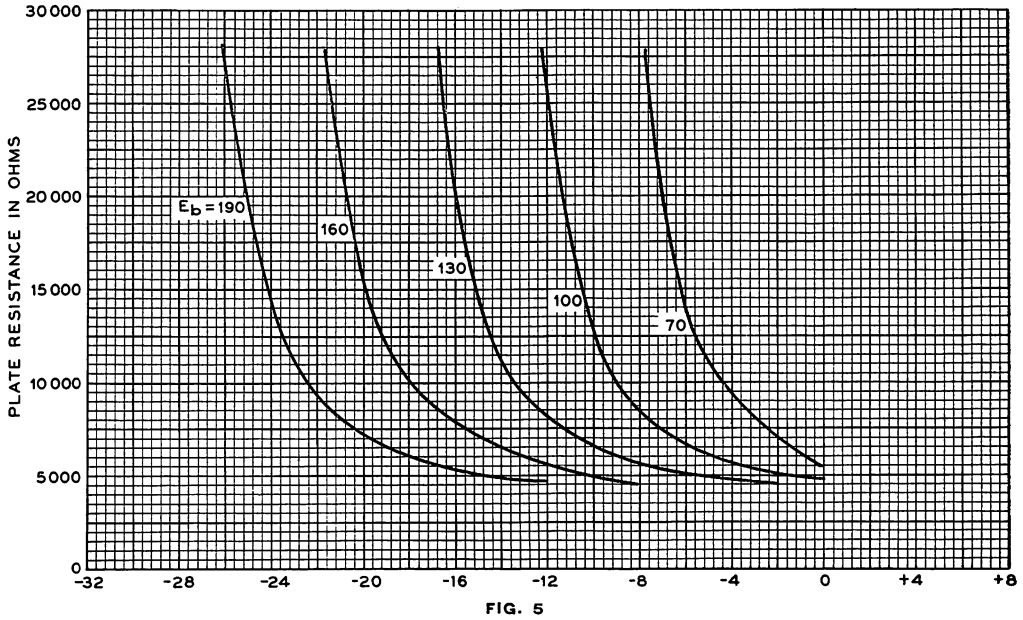


FIG. 5

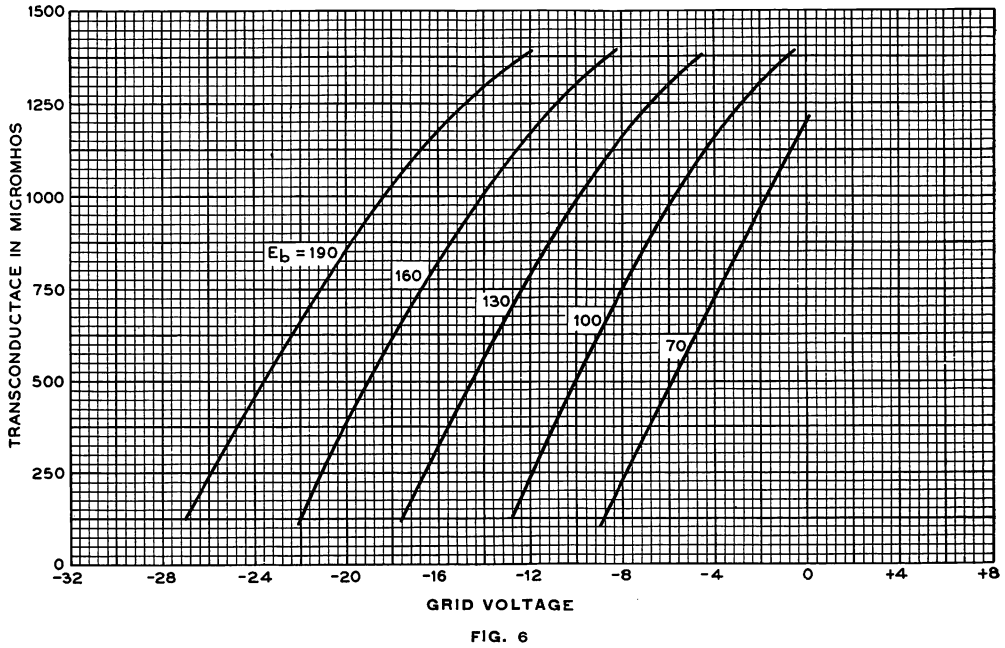


FIG. 6

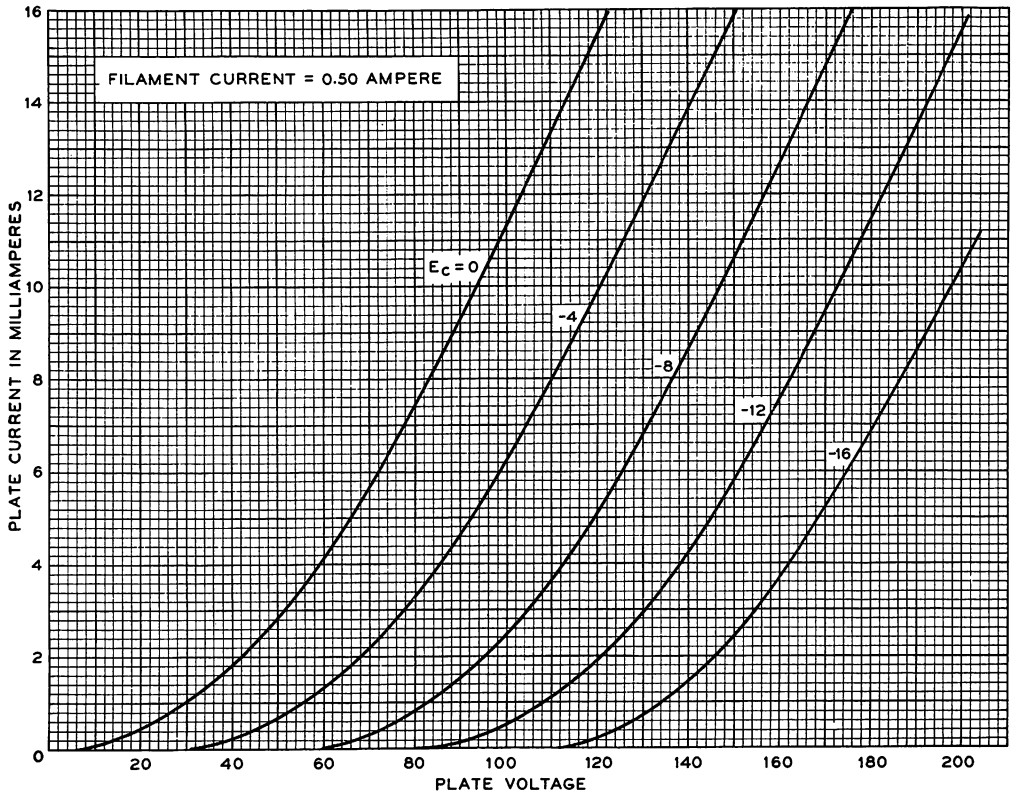
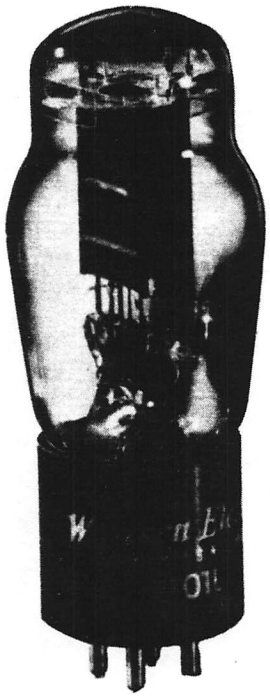

FILAMENT CURRENT = 0.50 AMPERE
$E_c = 0$
-4
-8
-12
-16
PLATE CURRENT IN MILLIAMPERES
PLATE VOLTAGE
0
2
4
6
8
10
12
14
16
20
40
60
80
100
120
140
160
180
200

FIG. 7



TRIODE
AUDIO-FREQUENCY AMPLIFIER

Western Electric

DESCRIPTION

The 101L is a filamentary type triode. It is designed for use as an audio-frequency amplifier or modulator.

CHARACTERISTICS

Filament Current	250 milliamperes
Maximum Plate Voltage	180 volts
Amplification Factor	6.5

GENERAL CHARACTERISTICS

ELECTRICAL DATA

Filament Current	250 milliamperes
Filament Voltage, Nominal*	4.15 volts
Direct Interelectrode Capacitances	without external shield
Grid to Plate	6.0 uuf
Input	3.9 uuf
Output	2.8 uuf

MECHANICAL DATA

Cathode	Coated Filament
Base	Medium 4-pin type with bayonet pin
Mounting Position	Preferably vertical; if horizontal, pins #1 and #2 must lie in same vertical plane

Dimensions and pin connections shown in outline drawing on Page 5

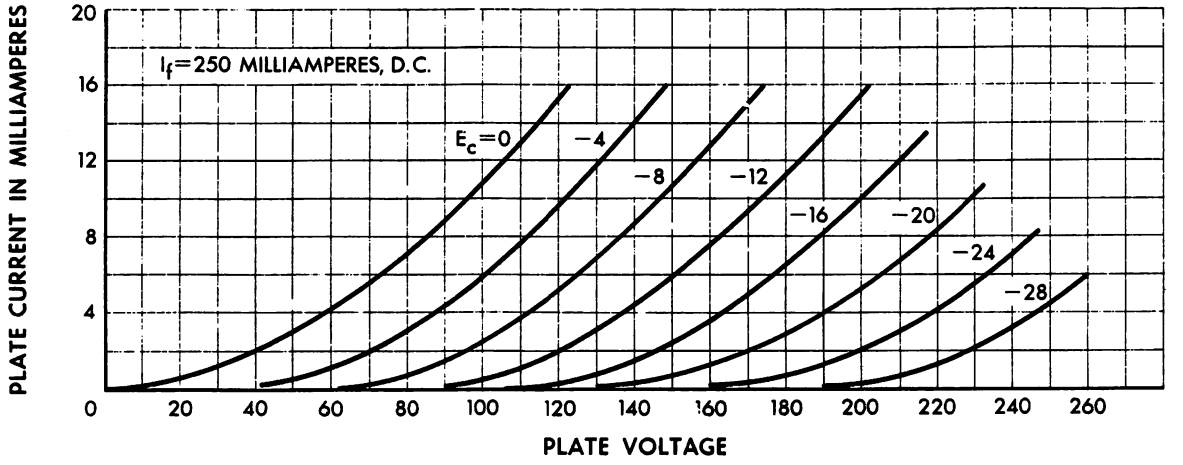
MAXIMUM RATINGS, Design-Center Values

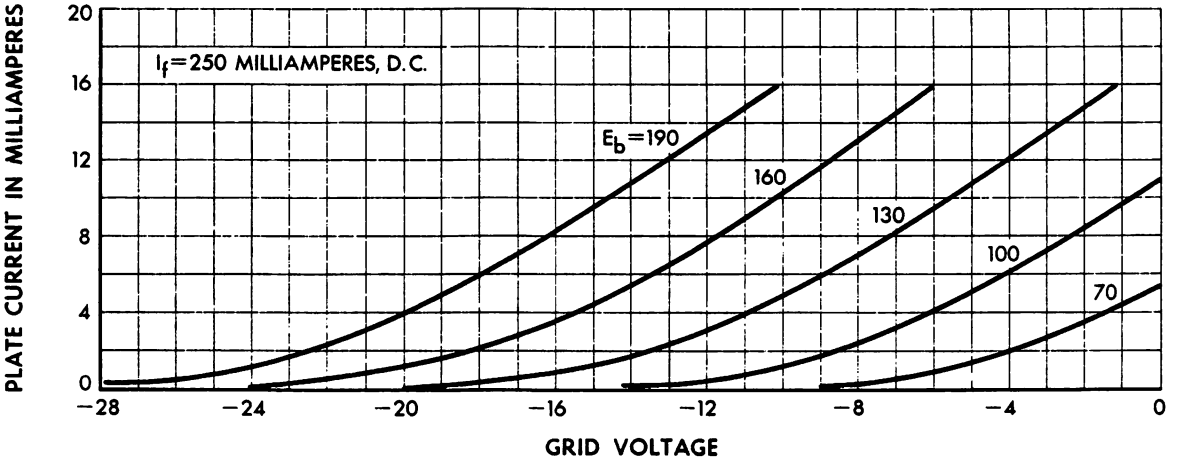
Plate Voltage	180 volts
Plate Dissipation	2.0 watts
Plate Current	15 milliamperes

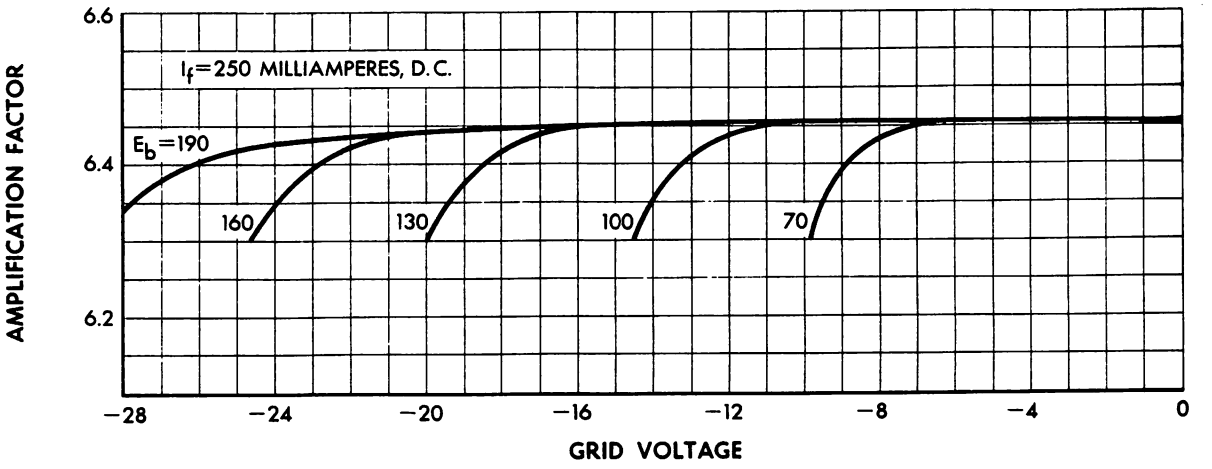
TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS – CLASS A_1 AMPLIFIER

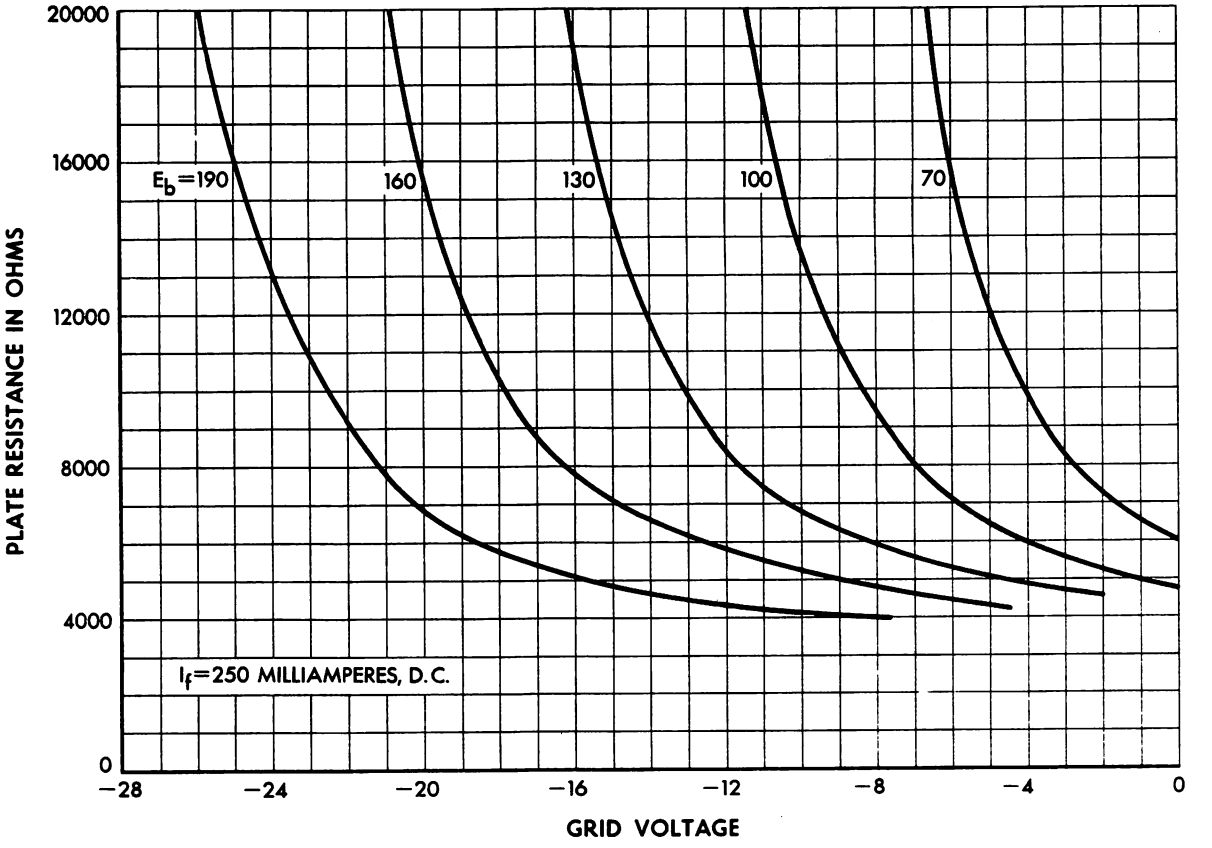
Filament Current, D-C	250	250	milliamperes
Plate Voltage	130	160	volts
Grid Voltage	−8	−10	volts
Peak A-F Grid Voltage	8	10	volts
Plate Current	6.8	10.2	milliamperes
Transconductance	1080	1240	micromhos
Amplification Factor	6.5	6.5	
Plate Resistance	6000	5200	ohms
Load Resistance	6000	5200	ohms
Maximum Signal Power Output	60	100	milliwatts
Total Harmonic Distortion Less Than	3.4	3.2	per cent

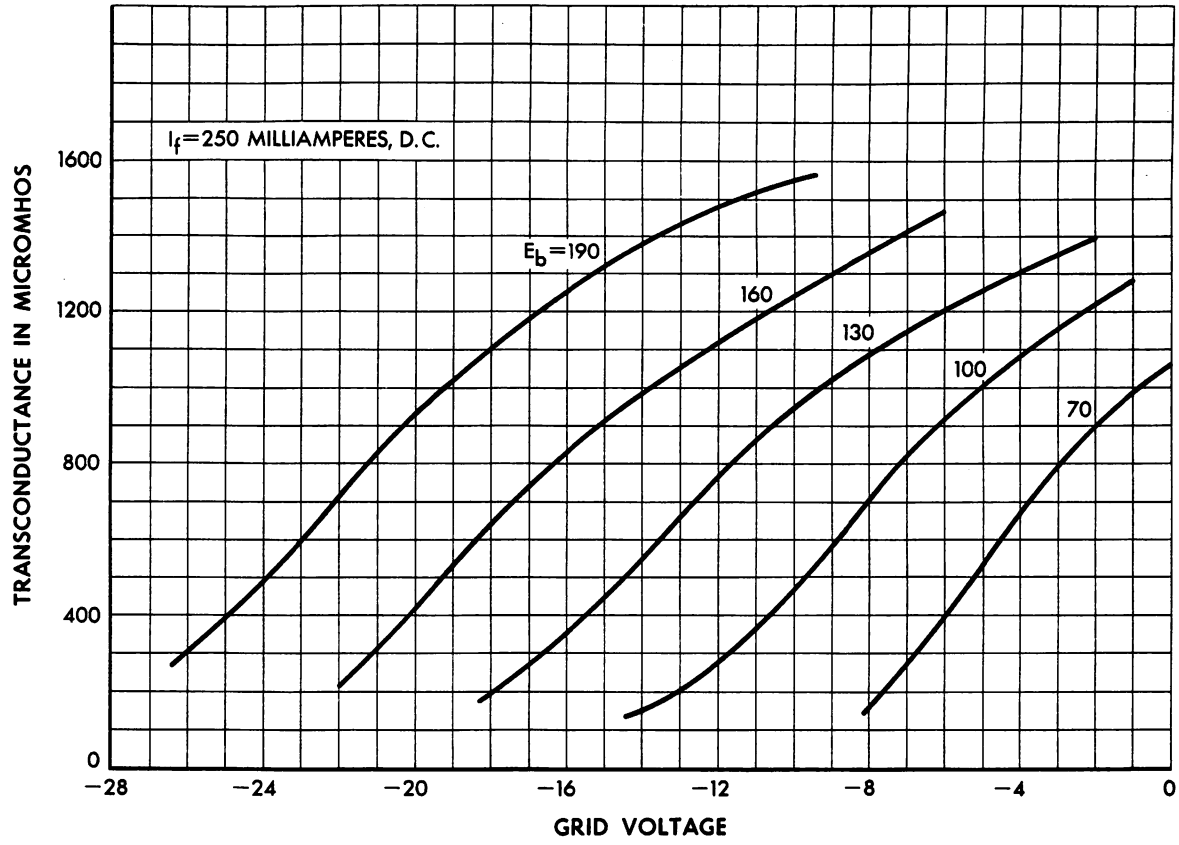
* The filament resistance of this tube increases slightly during the first year of operating life. The voltage given above is the nominal value after the filament resistance has stabilized.

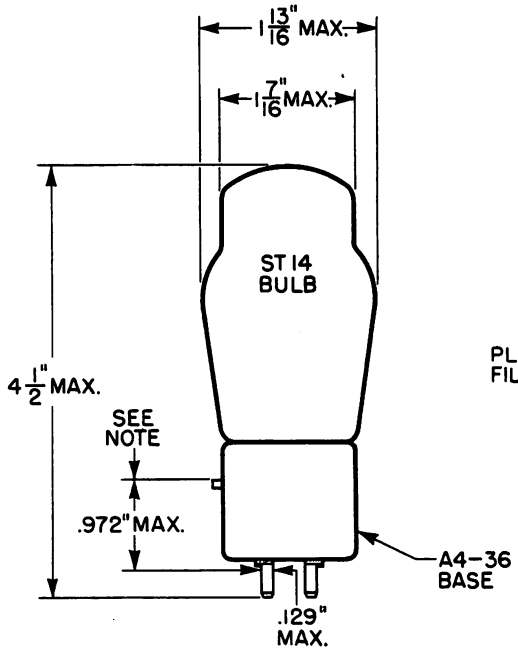

PLATE CURRENT IN MILLIAMPERES
20
16
12
8
4
0
I_f=250 MILLIAMPERES, D.C.
E_c=0
−4
−8
−12
−16
−20
−24
−28
20
40
60
80
100
120
140
160
180
200
220
240
260
PLATE VOLTAGE

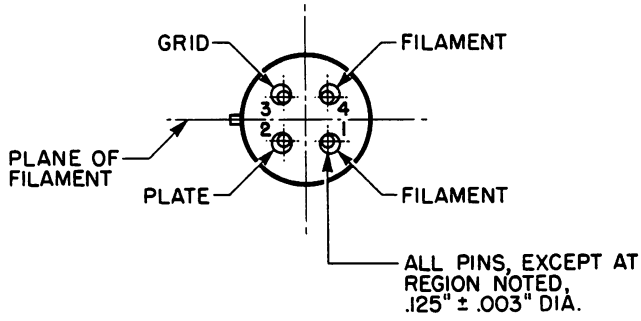

PLATE CURRENT IN MILLIAMPERES
20
16
12
8
4
0
I_f=250 MILLIAMPERES, D.C.
E_b=190
160
130
100
70
−28
−24
−20
−16
−12
−8
−4
0
GRID VOLTAGE


AMPLIFICATION FACTOR
6.6
6.4
6.2
I_f=250 MILLIAMPERES, D.C.
E_b=190
160
130
100
70
−28
−24
−20
−16
−12
−8
−4
0
GRID VOLTAGE


PLATE RESISTANCE IN OHMS
20000
16000
12000
8000
4000
0
E_b=190
160
130
100
70
I_f=250 MILLIAMPERES, D.C.
−28
−24
−20
−16
−12
−8
−4
0
GRID VOLTAGE





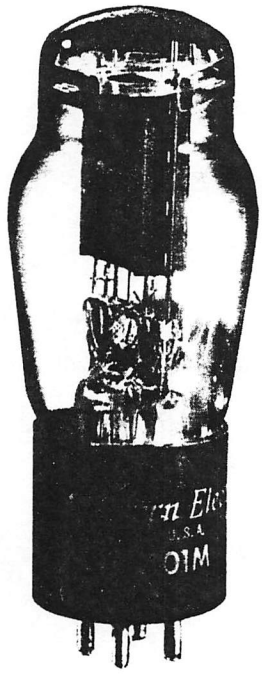


NOTE:
THIS DIMENSION APPLIES FROM THE TOP OF THE BAYONET PIN, TO A POINT ON THE STUD WHERE THE DIAMETER OF THE STUD PLUS SOLDER DOES NOT EXCEED .129 MAX.

Western Electric

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

1-D-50-4 PRINTED IN U. S. A. T-2650



TRIODE
AUDIO-FREQUENCY AMPLIFIER

Western Electric

DESCRIPTION

The 101M is a filamentary type triode. It is designed for use as an audio-frequency amplifier or modulator. This tube is intended for use in equipment where quick filament heating is required. Better thermionic life will be obtained by using other types of the 101 series of tubes when filament heating time is not a factor.

CHARACTERISTICS

Filament Current	250	milliamperes
Maximum Plate Voltage	180	volts
Amplification Factor	6.5	

101M
TRIODE

GENERAL CHARACTERISTICS

ELECTRICAL DATA

Filament Current	250 milliamperes
Filament Voltage, Nominal*	3.75 volts
Direct Interelectrode Capacitances	without external shield
Grid to Plate	6.0 uuf
Input	3.9 uuf
Output	2.8 uuf

MECHANICAL DATA

Cathode	Coated Filament
Base	Medium 4-pin type with bayonet pin
Mounting Position	Preferably vertical; if horizontal, pins #1 and #2 must lie in same vertical plane

Dimensions and pin connections shown in outline drawing on Page 5

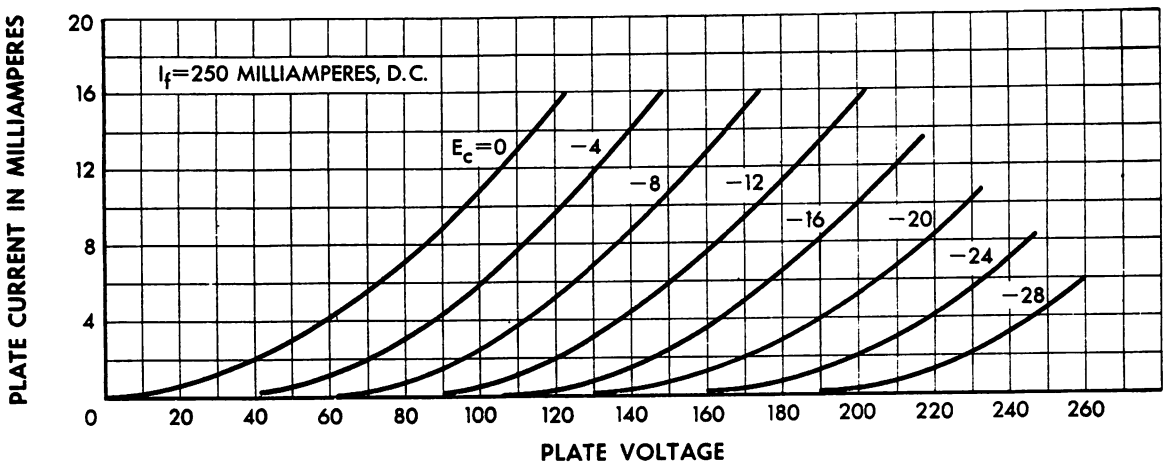
MAXIMUM RATINGS, Design-Center Values

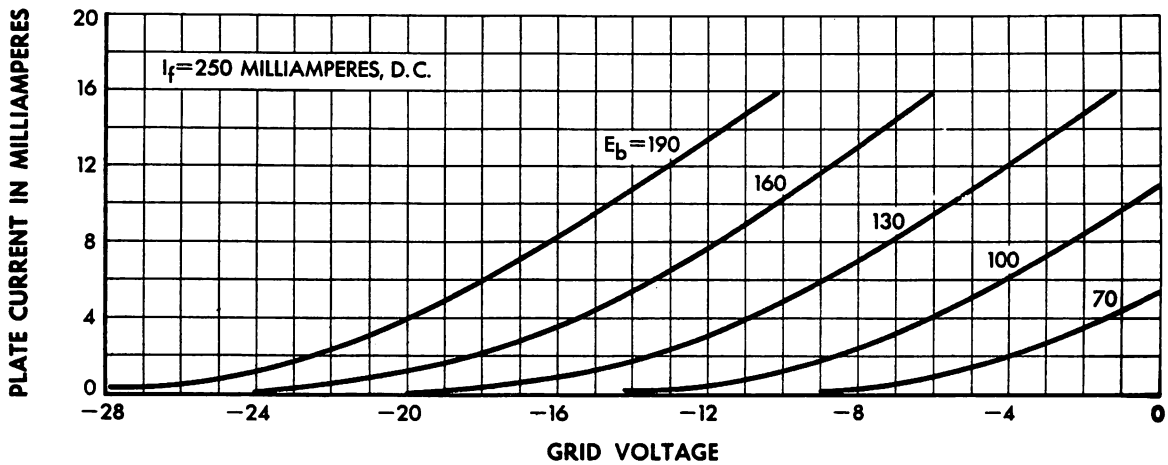
Plate Voltage	180 volts
Plate Dissipation	2.0 watts
Plate Current	15 milliamperes

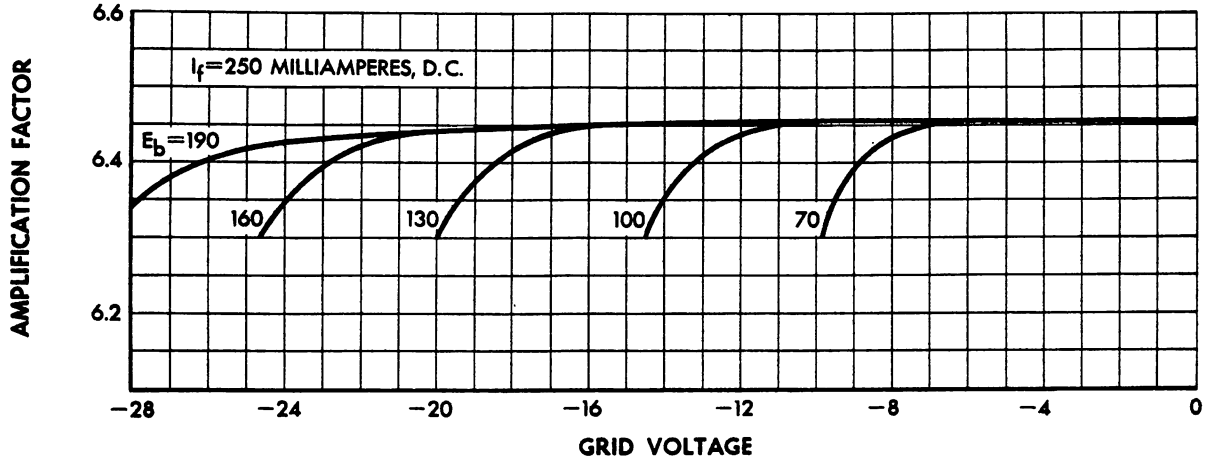
TYPICAL OPERATING CONDITIONS AND CHARACTERISTICS – CLASS A_1 AMPLIFIER

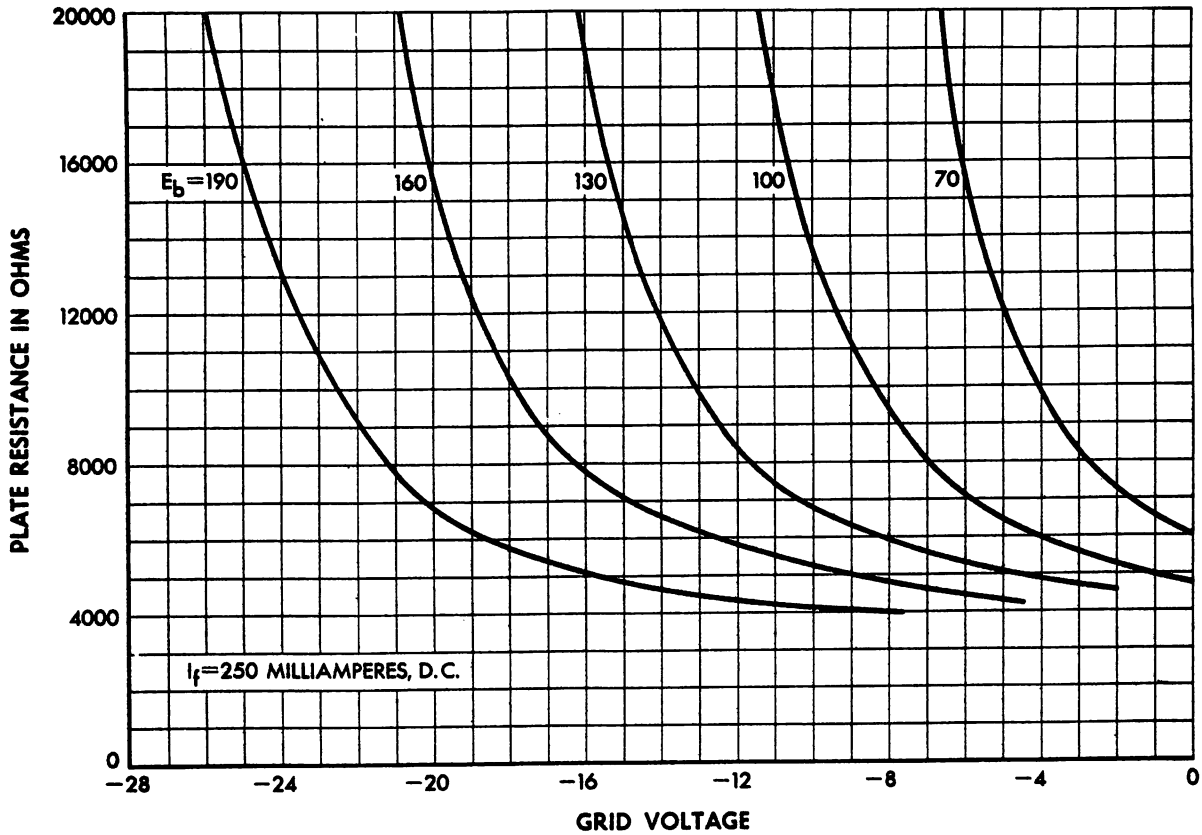
Filament Current, D-C	250	250	milliamperes
Plate Voltage	130	160	volts
Grid Voltage	−8	−10	volts
Peak A-F Grid Voltage	8	10	volts
Plate Current	6.8	10.2	milliamperes
Transconductance	1080	1240	micromhos
Amplification Factor	6.5	6.5	
Plate Resistance	6000	5200	ohms
Load Resistance	6000	5200	ohms
Maximum Signal Power Output	60	100	milliwatts
Total Harmonic Distortion	3.4	3.2	per cent

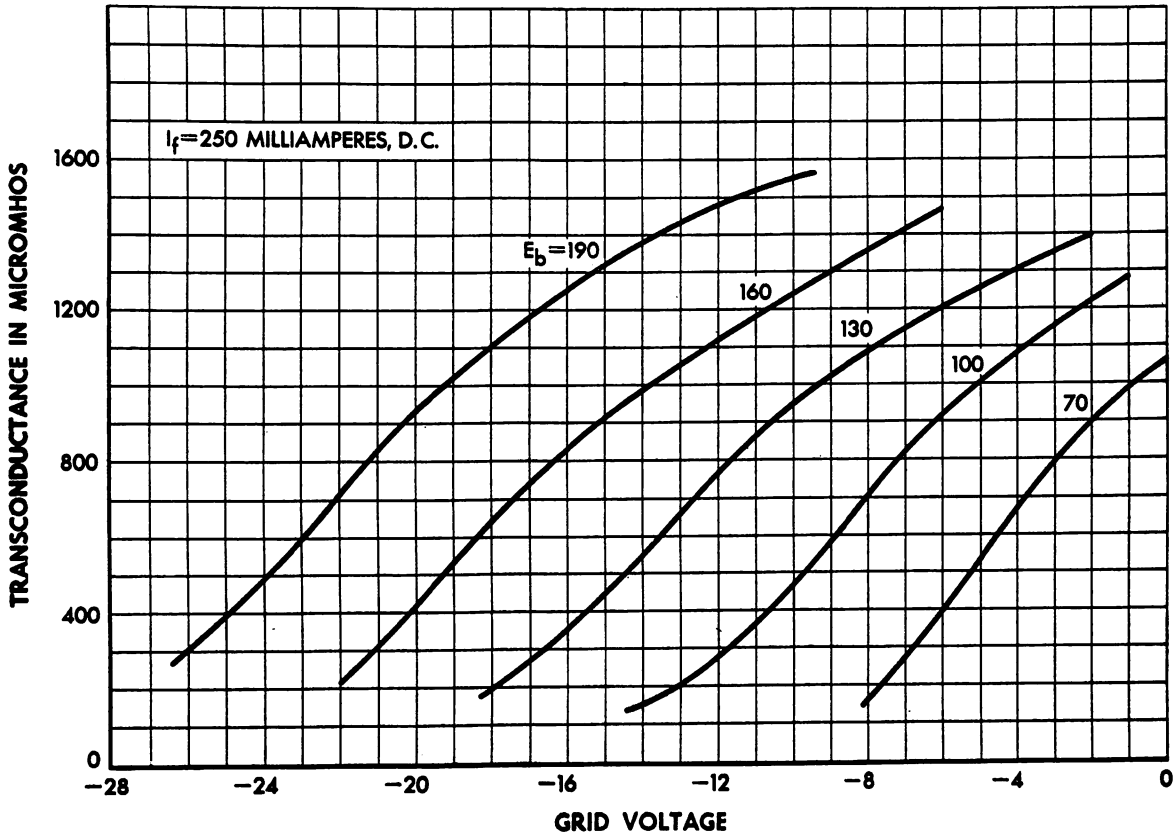
*The filament resistance of this tube increases slightly during the first year of operating life. The voltage given above is the nominal value after the filament resistance has stabilized.

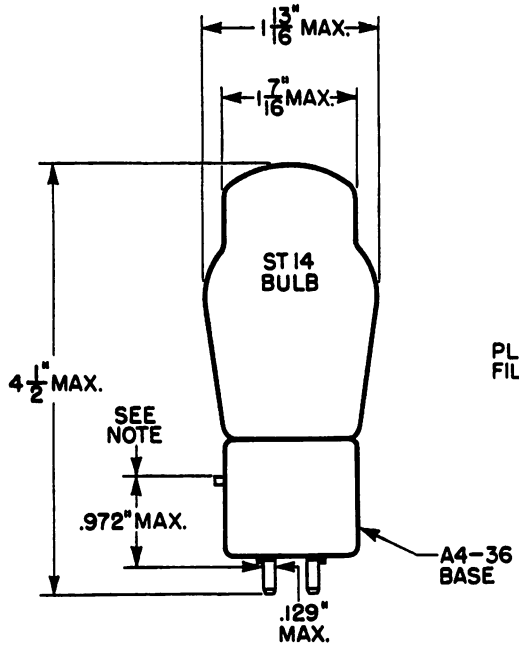

PLATE CURRENT IN MILLIAMPERES
20
16
12
8
4
0
I_f=250 MILLIAMPERES, D.C.
E_c=0
−4
−8
−12
−16
−20
−24
−28
20
40
60
80
100
120
140
160
180
200
220
240
260
PLATE VOLTAGE

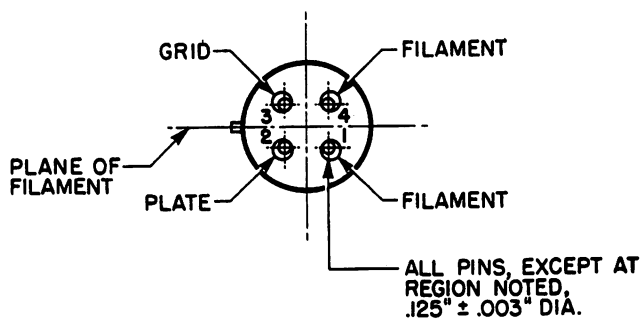

PLATE CURRENT IN MILLIAMPERES
20
16
12
8
4
0
I_f=250 MILLIAMPERES, D.C.
E_b=190
160
130
100
70
−28
−24
−20
−16
−12
−8
−4
0
GRID VOLTAGE


AMPLIFICATION FACTOR
6.6
6.4
6.2
I_f=250 MILLIAMPERES, D.C.
E_b=190
160
130
100
70
−28
−24
−20
−16
−12
−8
−4
0
GRID VOLTAGE


PLATE RESISTANCE IN OHMS
20000
16000
12000
8000
4000
0
E_b=190
160
130
100
70
I_f=250 MILLIAMPERES, D.C.
−28
−24
−20
−16
−12
−8
−4
0
GRID VOLTAGE







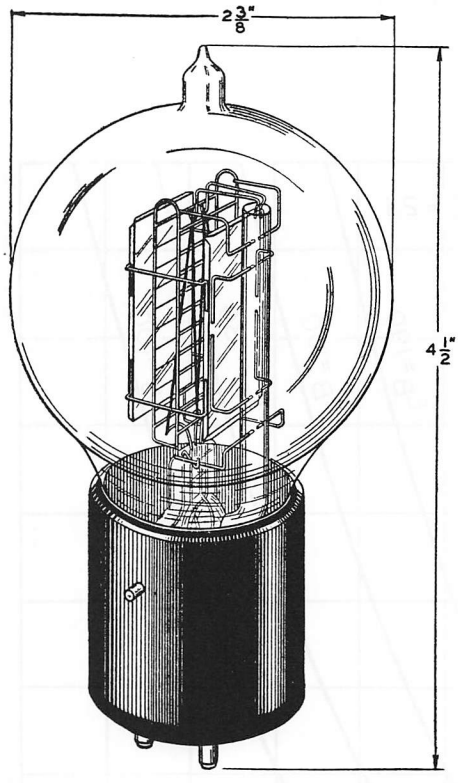
NOTE:
THIS DIMENSION APPLIES FROM THE TOP OF THE BAYONET PIN, TO A POINT ON THE STUD WHERE THE DIAMETER OF THE STUD PLUS SOLDER DOES NOT EXCEED .129 MAX.

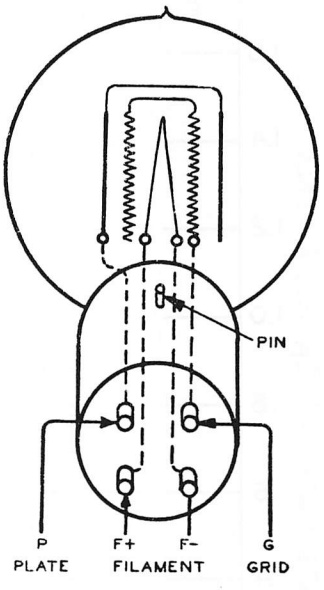
Western Electric

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

1-D-50-4 PRINTED IN U. S. A. T-2645

102D Vacuum Tube





Classification

The No. 102D is a three element filamentary type vacuum tube primarily intended for use as a voltage amplifier. It may also be used as a modulator, detector, or in volume indicator circuits.

Base and Socket

The No. 102D Vacuum Tube employs a four prong bayonet pin type base suitable for use in the Western Electric 100L (front panel mounting), 100R (rear panel mounting), or similar type socket.

Rating and Characteristic Data

Filament Current				1.0 Ampere
Filament Voltage				2.1 Volts
Plate Voltage	130	160	160	190 Max.
Grid Voltage	—1.5	—2	—2	—3
Average Plate Current—Milliamperes	0.6	0.9	0.9	0.9
Average Amplification Factor	30	30	30	29.5
Average Plate Resistance—Ohms	60,000	50,000	50,000	50,000
*Average Peak Voltage Output	30	45	50	65
Second Harmonic—% of Fundamental	3	2	1.5	4
Third Harmonic—% of Fundamental	0.2	0.2	0.1	0.4
Load Resistance—Ohms	175,000	150,000	250,000	150,000

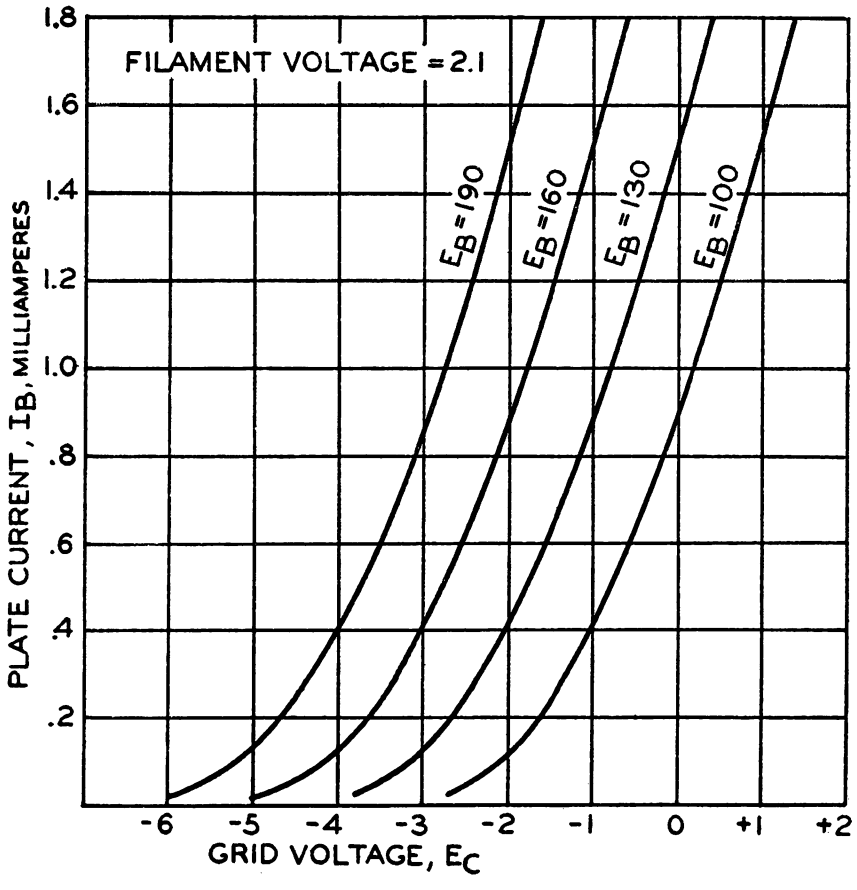
*Input in peak volts is equal to grid voltage.

Approximate Direct Interelectrode Capacities (measured without sockets)

Plate to Grid	5.6 MMF
Plate to Filament	2.3 MMF
Grid to Filament	3.8 MMF

Average Static Characteristics

The accompanying curves give the average static characteristics for the 102D tube. These curves have been obtained with the filament operating on direct current and the grid and plate returns connected to the negative end of the filament.



General Features

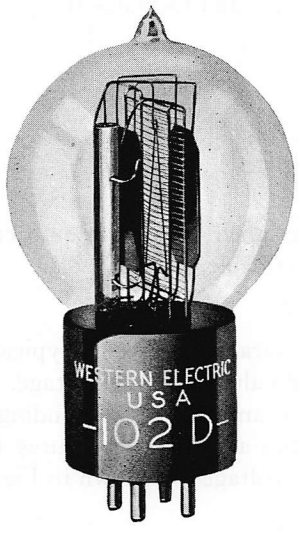
An average life of approximately 70,000 hours is obtained when the tube is used in the equipment for which it was designed. This long life feature makes it well suited for continuous operation where very long uninterrupted service is desired.

The prongs of the base are equipped with special contact metal tips to prevent noise disturbance due to poor electrical contact with the springs of the socket.

The characteristics of the 102D Tube are similar to those of the 102F, however, the 102D operates at a filament current of 1.0 ampere instead of 0.5 ampere.

Western Electric

102D Vacuum Tube



Classification—Filamentary, voltage-amplifier triode

Applications

Audio-frequency voltage amplifier.
Detector or modulator.

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, four-pin, bayonet type having special contact metal at the ends of the contact pins.

Socket—Four-contact, bayonet-slot type, preferably provided with contact-metal contacts, such as the Western Electric 100L for front of panel mounting or 100R for rear of panel mounting.

Mounting Positions—Either vertical or horizontal. If mounted in a horizontal position, the plane of the filament, which is indicated in Figure 2, should be vertical.

Average Direct Interelectrode Capacitances

	A	B	C
Grid to plate, $\mu\mu f$	5.6	5.1	5.1
Grid to filament, $\mu\mu f$	3.8	5.5	5.9
Plate to filament, $\mu\mu f$	2.3	3.7	4.1

Column A—Based tube without socket.

Column B—Tube alone when measured in 100L socket mounted on metal plate; socket and mounting plate connected to filament.

Column C—Tube alone when measured in 100R socket mounted in metal plate; socket and mounting plate connected to filament.

Filament Rating

Filament current	1.0 ampere, d.c.
Nominal filament voltage	2.1 volts

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

Characteristics—Plate current characteristics of a typical 102D tube are shown in Figure 3 as functions of grid voltage for several values of plate voltage. The grid and plate voltages are measured from the negative end of the filament. 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 are shown in Figure 7 for several values of grid voltage.

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 page 3 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 output voltage in peak volts and the second and third harmonic levels in decibels below the fundamental for values of load resistance R, equal to one, three, and five times the plate resistance, r_p. The peak value of the sinusoidal input voltage, E_{gm}, which gives the indicated output voltage, E_{pm}, and harmonic levels F_{2m} and F_{3m}, in each case, is numerically equal to the grid bias. For a smaller input voltage, E_g, the approximate levels may be computed from the following relations:

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

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

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

TABLE

Plate Voltage Volts	Grid Bias Volts	Plate Current Milliamperes	Amplification Factor	Plate Resistance Ohms r_p	Transconductance Micromhos	Input Voltage Peak Volts	Load Resistance R	Output Voltage Peak Volts	Second Harmonic db	Third Harmonic db
130	−2.0	0.36	29.4	80000	370	2.0	$R=r_p$	27	20	41
							$R=3r_p$	38	24	44
							$R=5r_p$	41	25	45
130	−1.5	0.58	29.8	63000	470	1.5	$R=r_p$	20	26	47
							$R=3r_p$	30	31	50
							$R=5r_p$	34	33	55
130	−1.0	0.85	30.1	53000	570	1.0	$R=r_p$	15	33	55
							$R=3r_p$	20	39	60
							$R=5r_p$	23	40	60
160	−3.0	0.34	29.2	81000	360	3.0	$R=r_p$	40	18	36
							$R=3r_p$	57	21	40
							$R=5r_p$	62	22	40
160	−2.0	0.80	29.9	54000	550	2.0	$R=r_p$	28	27	46
							$R=3r_p$	42	33	55
							$R=5r_p$	45	34	55
160	−1.0	1.45	30.3	42000	720	1.0	$R=r_p$	15	38	60
							$R=3r_p$	21	43	65
							$R=5r_p$	24	48	65
*190	−3.0	0.83	29.8	54000	550	3.0	$R=r_p$	42	23	40
							$R=3r_p$	63	28	48
							$R=5r_p$	68	30	50
*190	−2.0	1.46	30.2	43000	700	2.0	$R=r_p$	30	31	50
							$R=3r_p$	43	38	60
							$R=5r_p$	48	41	60

*Maximum Operating conditions.

Microphonic Noise—With a plate voltage of 130 volts, a grid bias of −1.5 volts, and a load resistance of 100,000 ohms, the mean microphonic noise output level of the 102D tube, measured in a laboratory reference test set, is 30 decibels below 1 volt. The range of levels of individual tubes extends from 18 to 38 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.

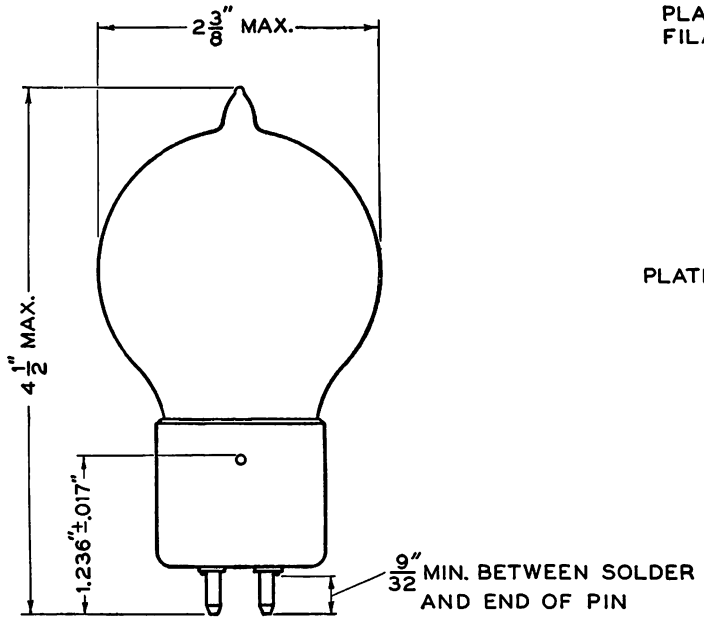


FIG. 1

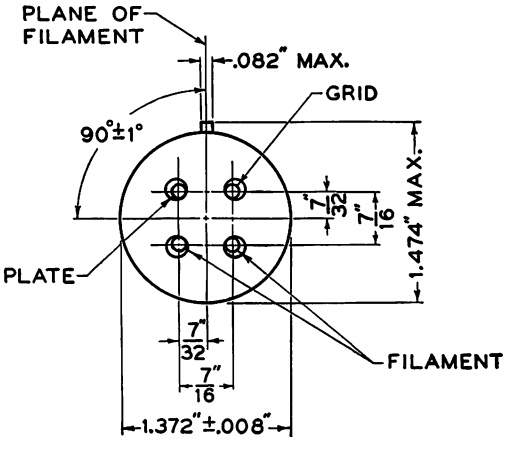


FIG. 2

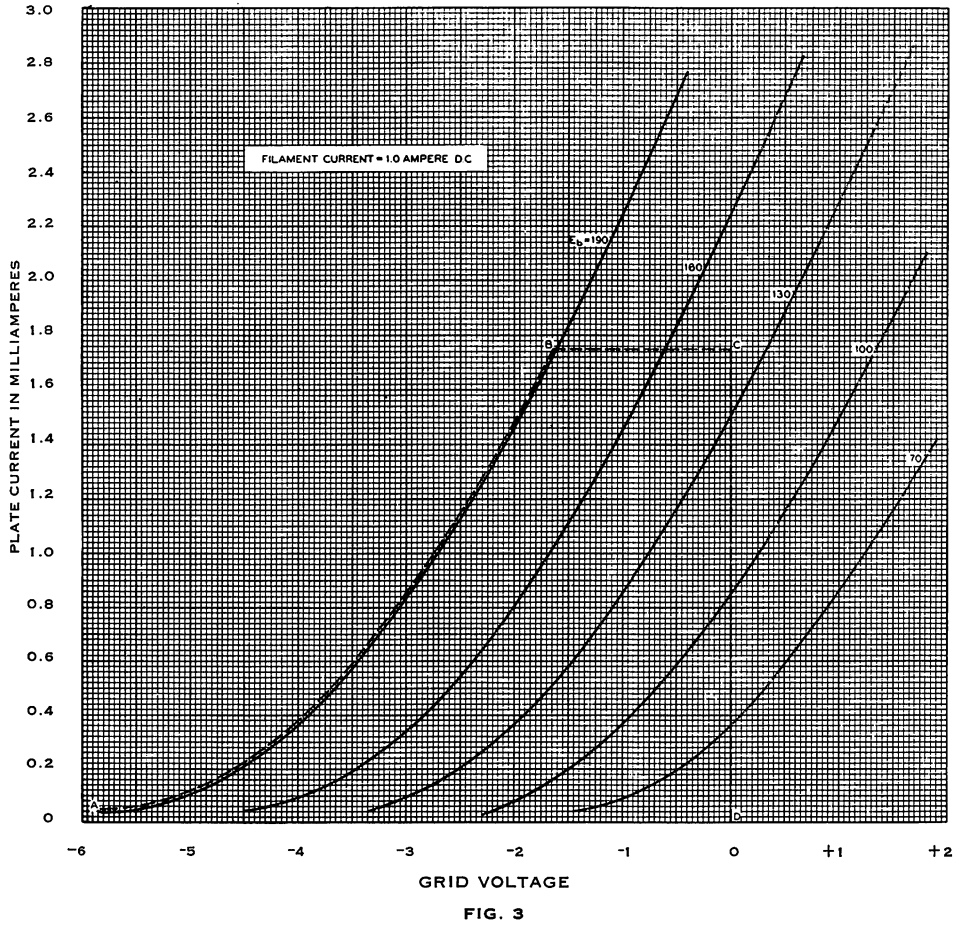


FIG. 3

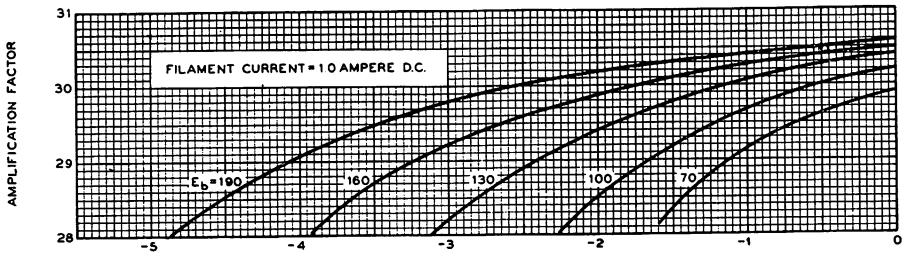


FIG. 4

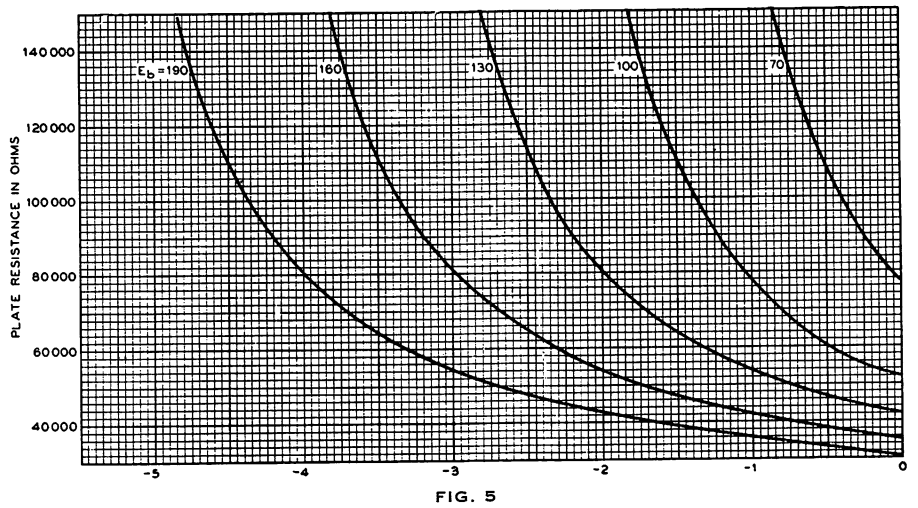


FIG. 5

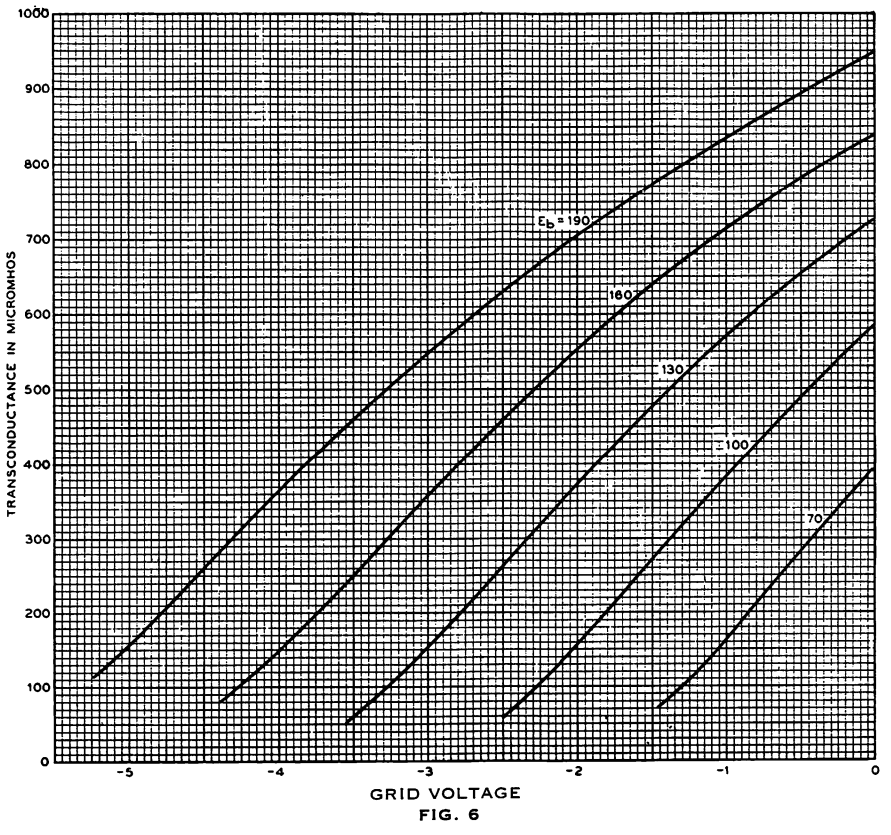


FIG. 6

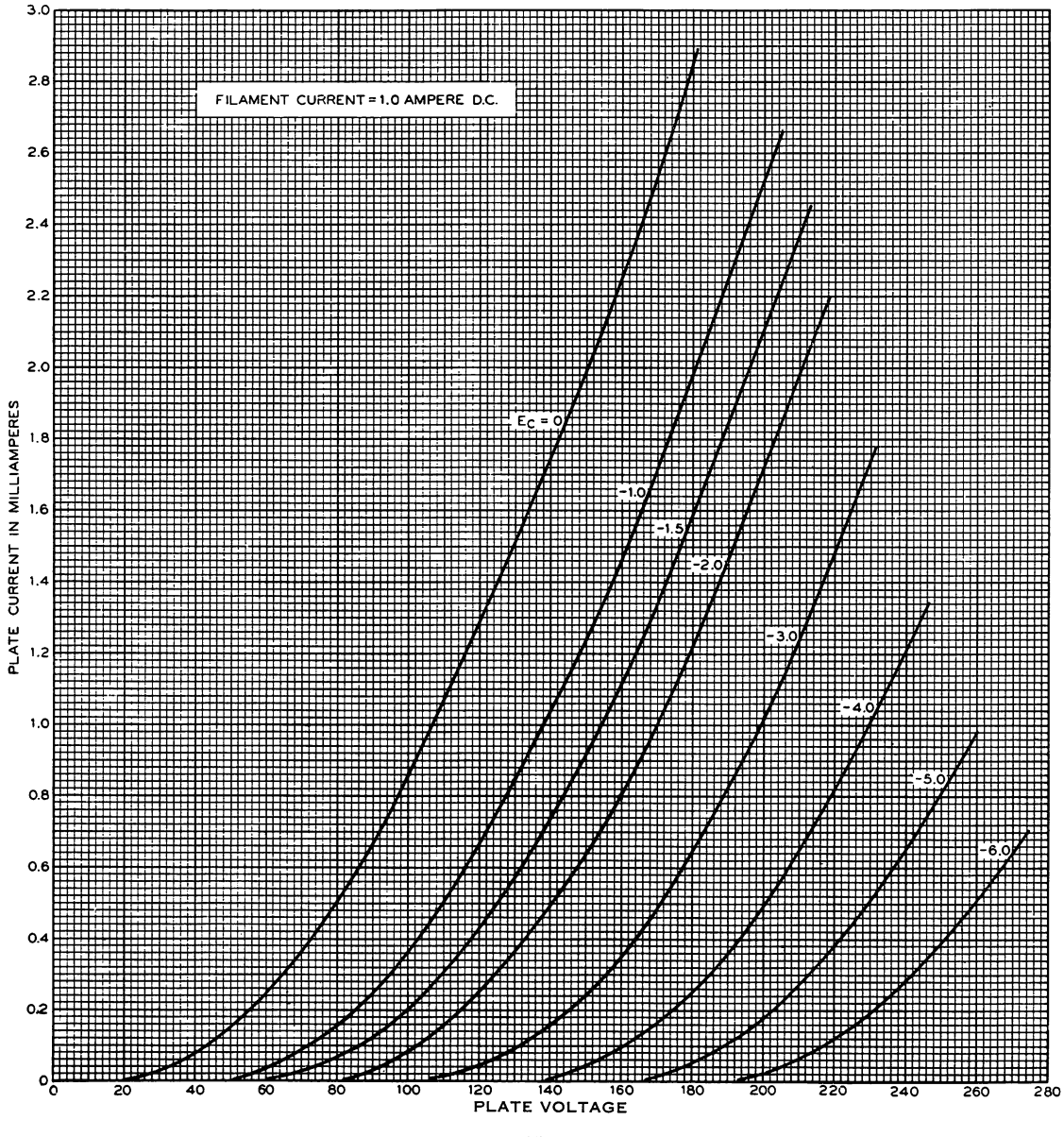
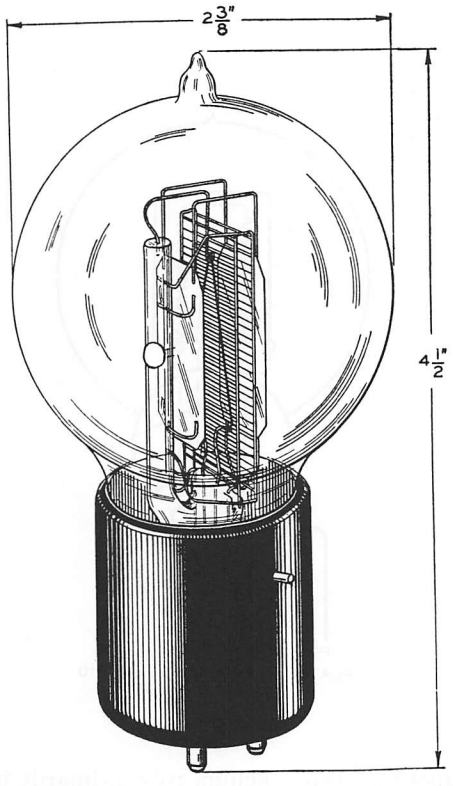
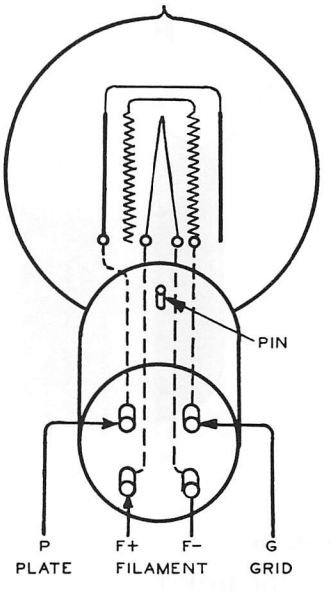

FILAMENT CURRENT = 1.0 AMPERE D.C.
$E_C = 0$
-1.0
-1.5
-2.0
-3.0
-4.0
-5.0
-6.0
PLATE CURRENT IN MILLIAMPERES
PLATE VOLTAGE
0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3.0
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280

FIG. 7

102-E Vacuum Tube

Used with Western Electric Vacuum Tube Sockets Nos. 100-L or 100-R.





USE—DETECTOR—AMPLIFIER

Normal filament current	0.95 ampere
Normal filament voltage	2 to 2.5 volts
Normal plate current	0.3 to 1.5 milliamperes
Normal plate voltage	100 to 150 volts
Maximum safe plate voltage	160 volts
Normal grid voltage	0 to —3 volts
Plate to filament impedance	40,000 to 100,000 ohms
Amplification constant	26 to 34

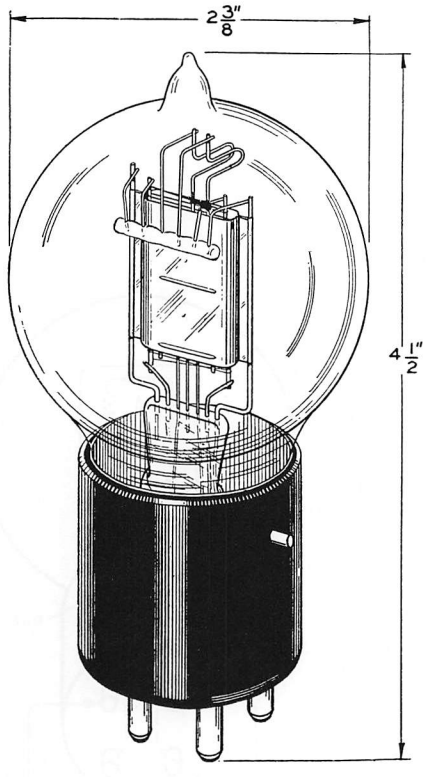
NOTE

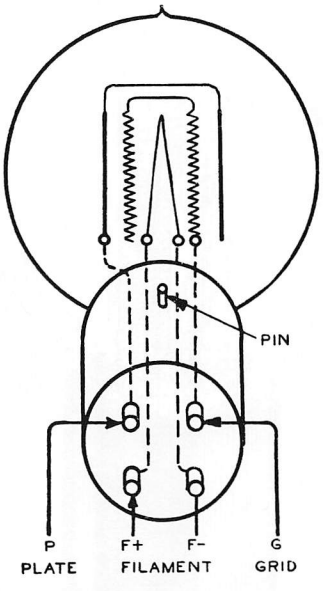
Electrical values given above apply when tube is used as amplifier. When used as a detector or for other purposes, the applied voltages may be varied according to circuit conditions and thus cause a corresponding variation in other electrical values.

For maximum useful life the filament current should be kept as low as possible to secure the desired output.

If 1.15 amperes is exceeded the life will be materially shortened.

102F Vacuum Tube





Classification

The No. 102F Tube is a three element filamentary type vacuum tube primarily intended for use as a voltage amplifier. It may also be used as a modulator, detector, or in volume indicator circuits.

Base and Socket

The No. 102F Vacuum Tube employs a four prong bayonet pin type base suitable for use in the Western Electric 100L (front panel mounting), 100R (rear panel mounting), or similar type socket.

Rating and Characteristic Data

Filament Current				0.5 Ampere
Filament Voltage				2.1 Volts
Plate Voltage	130	160	160	190 Max.
Grid Voltage	—1.5	—2	—2	—3
Average Plate Current—Millamperes	0.6	1.0	1.0	1.0
Average Amplification Factor	30	30	30	30
Average Plate Resistance—Ohms	55,000	50,000	50,000	50,000
*Average Peak Voltage Output	30	45	50	65
Second Harmonic—% of Fundamental	2.5	2.5	2	4
Third Harmonic—% of Fundamental	0.2	0.2	0.2	0.4
Load Resistance—Ohms	165,000	150,000	250,000	150,000

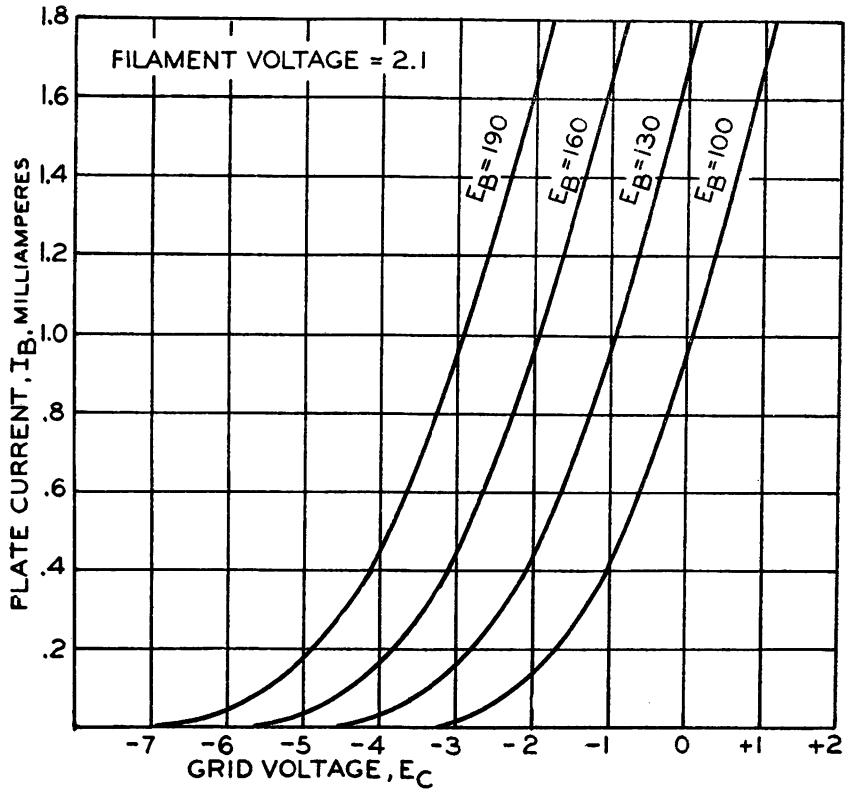
*Input in peak volts is equal to grid voltage.

Approximate Direct Interelectrode Capacities (measured without sockets)

Plate to Grid	9.2 MMF
Plate to Filament	1.5 MMF
Grid to Filament	3.8 MMF

Average Static Characteristics

The accompany curves gives the average static characteristics for the 102F tube. These curves have been obtained with the filament operating on direct current and the grid and plate returns connected to the negative end of the filament.



General Features

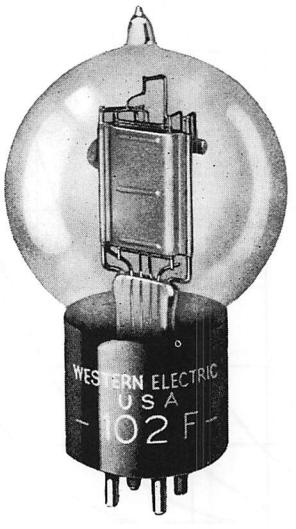
An average life of approximately 70,000 hours is obtained when the tube is used in the equipment for which it was designed. This long life feature makes it well suited for continuous operation where very long uninterrupted service is desired.

The prongs of the base are equipped with special contact metal tips to prevent noise disturbance due to poor electrical contact with the springs of the socket.

The characteristics of the 102F tube are similar to those of the 102D. However, the 102F operates at a filament current of 0.5 ampere instead of 1.0 ampere.

Western Electric

102F Vacuum Tube



Classification—Filamentary, voltage amplifier triode

The 102F tube is designed for the same class of service as the 102D tube but operates with a lower filament power consumption.

Applications

Audio-frequency voltage amplifier.
Detector or modulator.

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, four-pin, bayonet type having special contact metal at the ends of the contact pins.

Socket—Four-contact, bayonet-slot type, preferably provided with contact-metal contacts, such as the Western Electric 100L for front of panel mounting or 100R for rear of panel mounting.

Mounting Positions—Either vertical or horizontal. If mounted in a horizontal position, the plane of the filament, which is indicated in Figure 2, should be vertical.

Average Direct Interelectrode Capacitances

	A	B	C
Grid to plate, $\mu\mu$f	9.2	9.0	9.0
Grid to filament, $\mu\mu$f	3.8	4.3	4.6
Plate to filament, $\mu\mu$f	1.5	2.9	3.2

Column A—Based tube without socket.

Column B—Tube alone when measured in 100L socket mounted on metal plate; socket and mounting plate connected to filament.

Column C—Tube alone when measured in 100R socket mounted in metal plate; socket and mounting plate connected to filament.

Filament Rating

Filament current	0.50 ampere, d.c.
Nominal filament voltage	2.1 volts

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

Characteristics—Plate current characteristics of a typical 102F tube are shown in Figure 3 as functions of grid voltage for several values of plate voltage. The grid and plate voltages are measured from the negative end of the filament. 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 are shown in Figure 7 for several values of grid voltage.

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 page 3 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 output voltage in peak volts and the second and third harmonic levels in decibels below the fundamental for values of load resistance R, equal to one, three, and five times the plate resistance, r_p. The peak value of the sinusoidal input voltage, E_{gm}, which gives the indicated output voltage, E_{pm}, and harmonic levels F_{2m} and F_{3m}, in each case, is numerically equal to the grid bias. For a smaller input voltage, E_g, the approximate levels may be computed from the following relations.

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

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

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

TABLE

Plate Voltage Volts	Grid Bias Volts	Plate Current Milliamperes	Amplification Factor	Plate Resistance Ohms r_p	Transconductance Micromhos	Input Voltage Peak Volts	Load Resistance R	Output Voltage Peak Volts	Second Harmonic db	Third Harmonic db
130	−2.0	0.45	29.7	69000	430	2.0	$R=r_p$	26	21	40
							$R=3r_p$	39	25	44
							$R=5r_p$	42	26	45
130	−1.5	0.7	30.1	54000	550	1.5	$R=r_p$	21	26	48
							$R=3r_p$	32	32	55
							$R=5r_p$	34	33	55
130	−1.0	1.0	30.5	45000	670	1.0	$R=r_p$	15	32	60
							$R=3r_p$	21	38	65
							$R=5r_p$	24	40	65
160	−3.0	0.45	29.5	70000	420	3.0	$R=r_p$	40	18	37
							$R=3r_p$	57	22	40
							$R=5r_p$	63	23	41
160	−2.0	1.0	30.3	46000	660	2.0	$R=r_p$	29	26	47
							$R=3r_p$	43	32	55
							$R=5r_p$	47	33	55
*160	−1.0	1.75	30.8	36000	860	1.0	$R=r_p$	16	37	60
							$R=3r_p$	22	43	65
							$R=5r_p$	25	46	65
*190	−3.0	1.0	30.1	46000	650	3.0	$R=r_p$	42	22	40
							$R=3r_p$	62	28	47
							$R=5r_p$	66	30	50
*190	−2.0	1.75	30.6	36000	850	2.0	$R=r_p$	30	30	50
							$R=3r_p$	43	36	60
							$R=5r_p$	48	39	60

*Maximum operating conditions.

Microphonic Noise—With a plate voltage of 130 volts, a grid bias of −1.5 volts, and a load resistance of 100,000 ohms, the mean microphonic noise output level of the 102F tube, measured in a laboratory reference test set, is 20 decibels below 1 volt. The range of levels of individual tubes extends from 9 to 36 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.

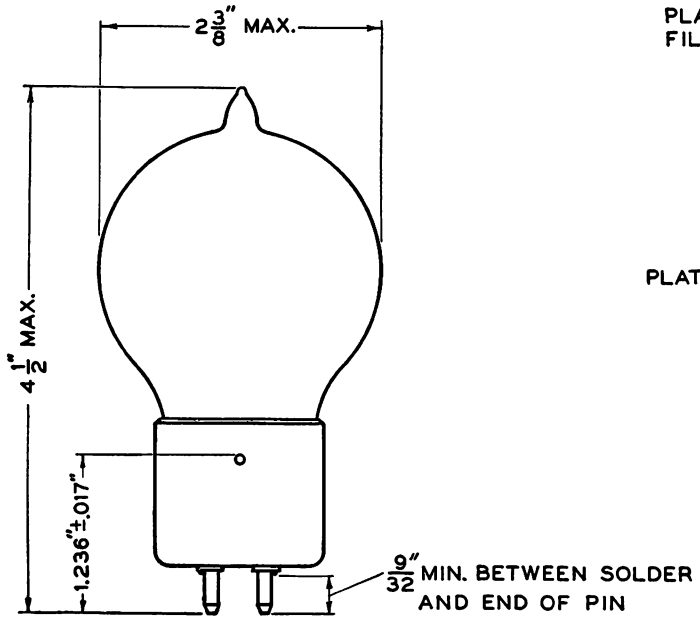


FIG. 1

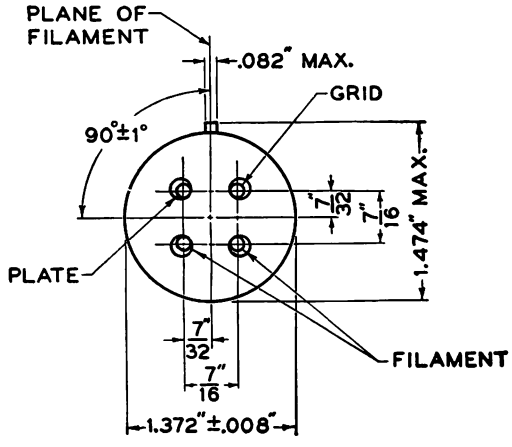


FIG. 2

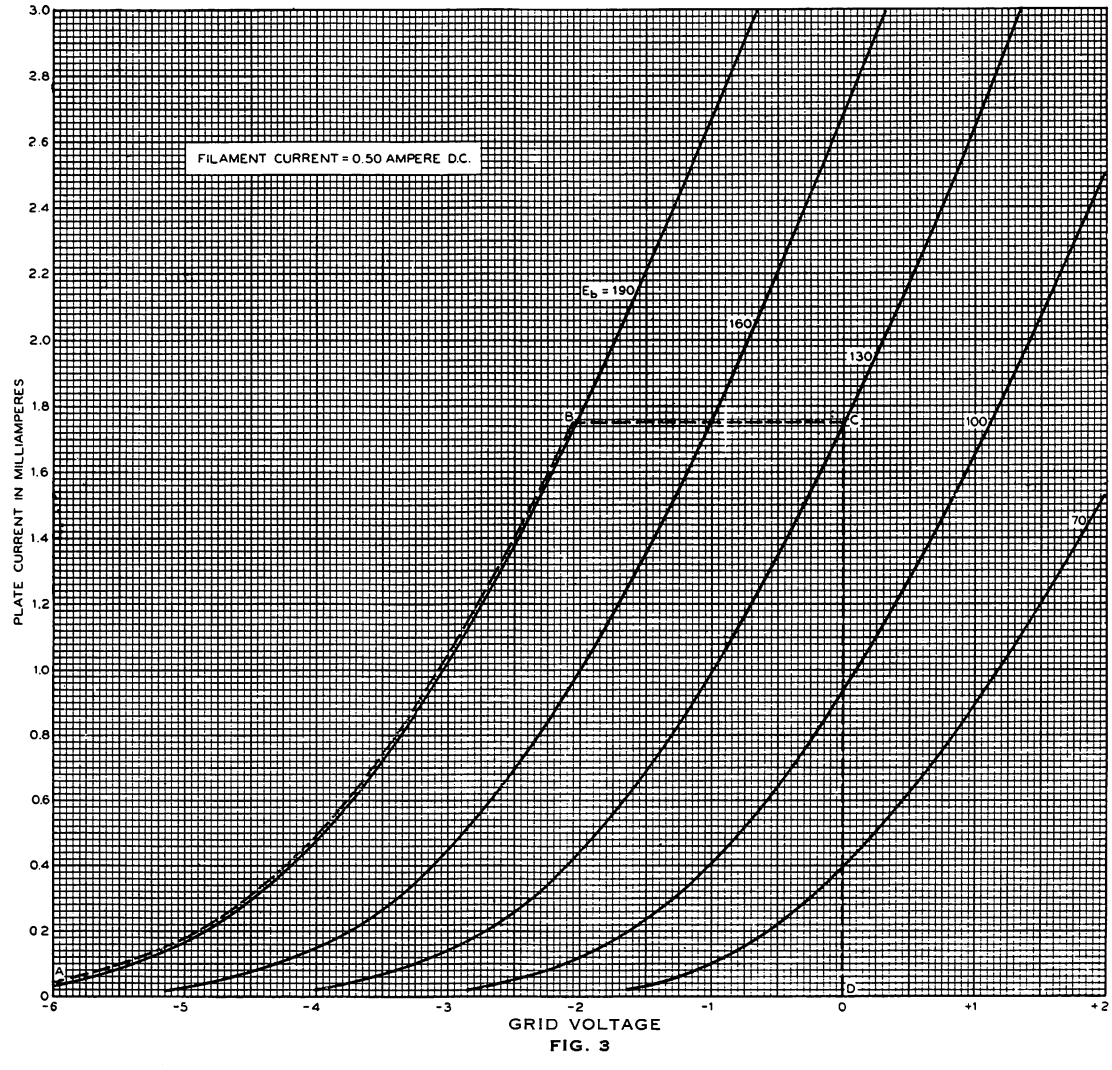


FIG. 3

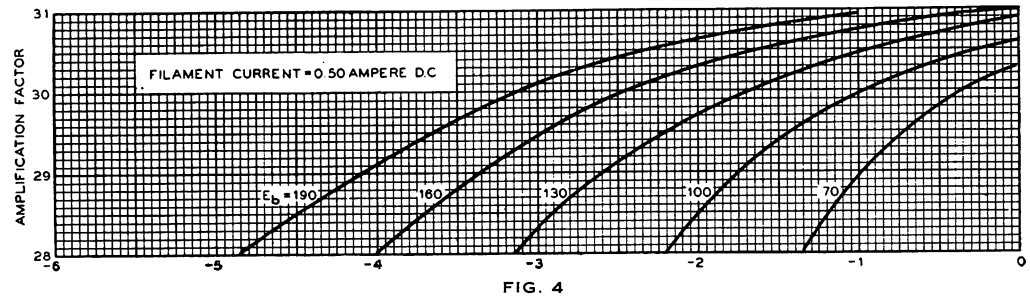


FIG. 4

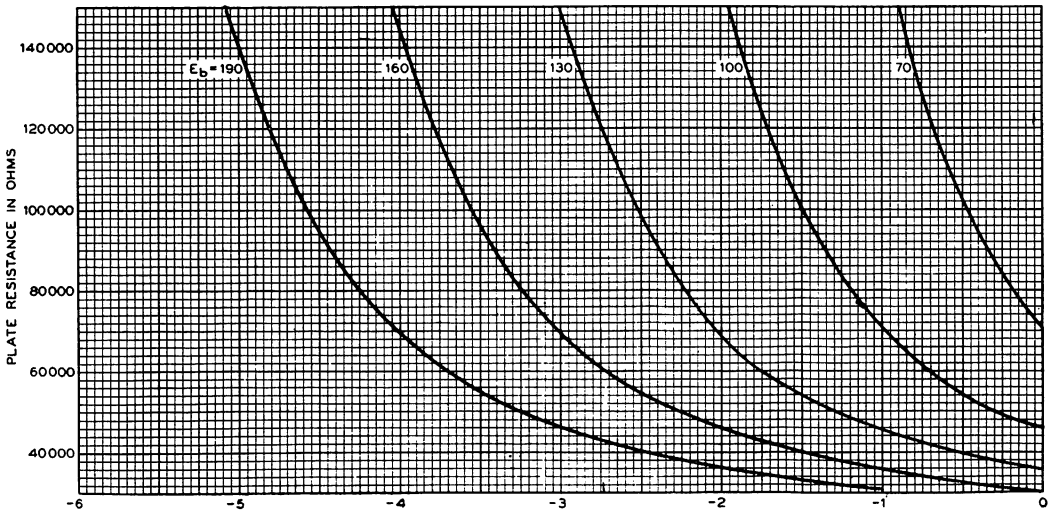


FIG. 5

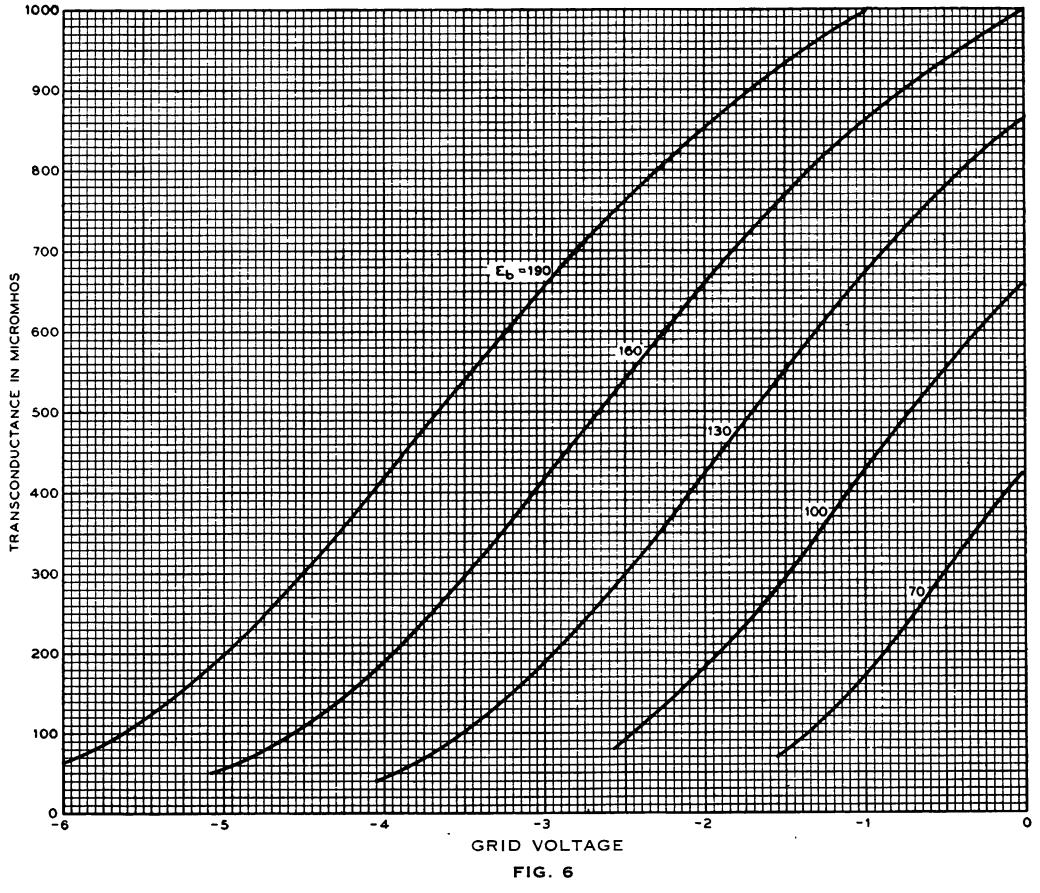


FIG. 6

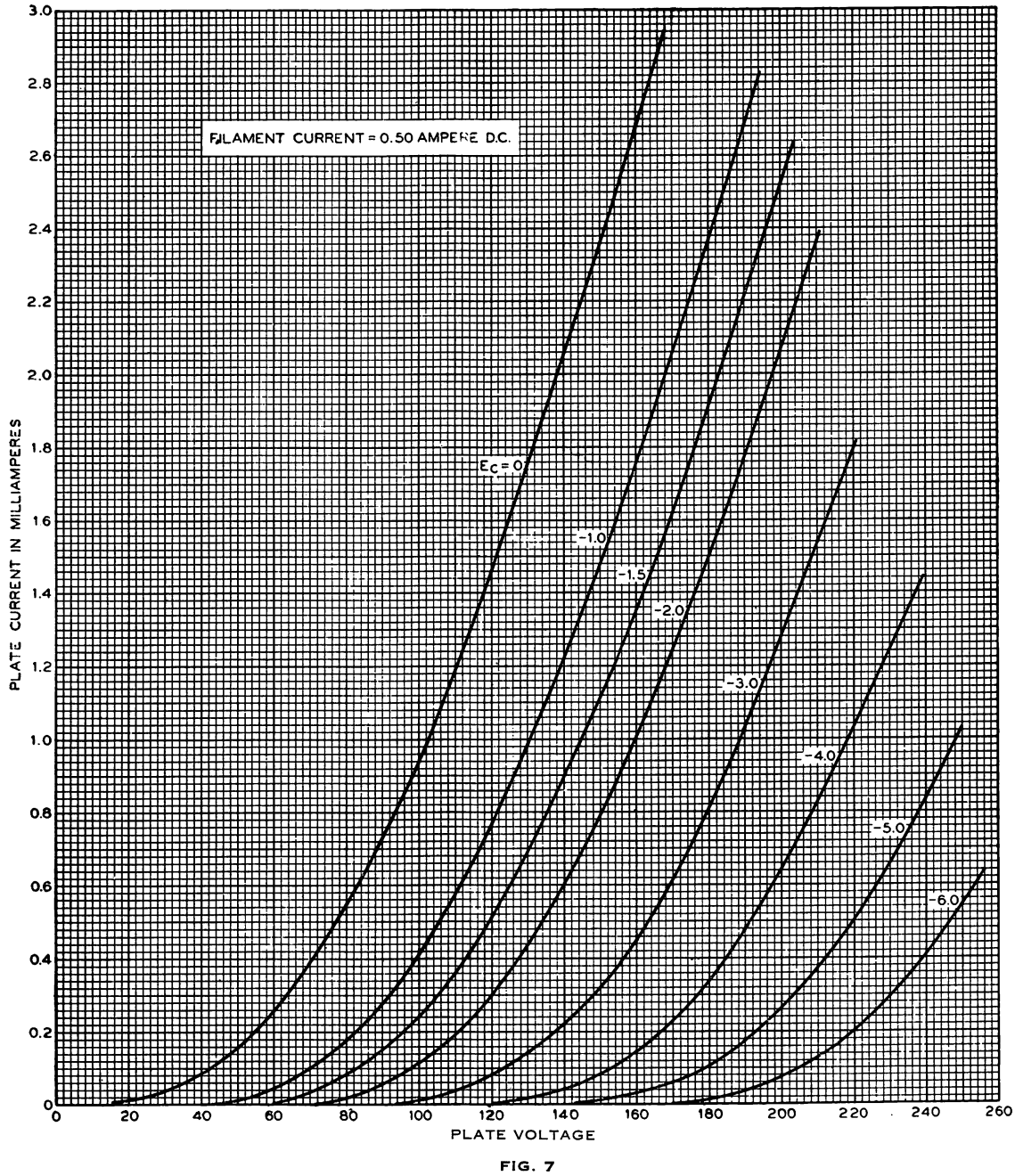
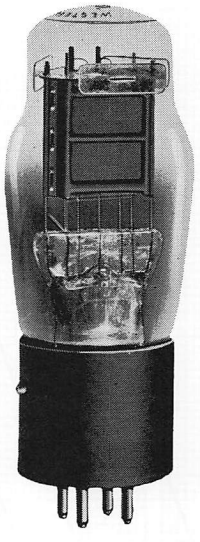

FILAMENT CURRENT = 0.50 AMPERE D.C.
PLATE CURRENT IN MILLIAMPERES
PLATE VOLTAGE
$E_C = 0$
-1.0
-1.5
-2.0
-3.0
-4.0
-5.0
-6.0
0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3.0
0
20
40
60
80
100
120
140
160
180
200
220
240
260

FIG. 7

Western Electric

102F Vacuum Tube
(Dome)



Classifications—Filamentary, voltage amplifier triode

This tube is a redesign of the 102F tube. It includes an improved filament, a new mechanical design using transverse mica supports and is mounted in a dome type bulb. The electrical characteristics are practically identical with the previous 102F tube which it supersedes.

Applications—Voltage amplifier for voice-frequency telephone repeaters and carrier-frequency telegraph equipment.

Detector or modulator.

Dimensions and Connections—The 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 vacuum tube employs a medium, four-pin bayonet type base having special contact metal at the ends of the pins. It is suitable for use in a Western Electric 100L, 100R, or similar type socket, preferably provided with contact-metal contacts.

The tube may be mounted in either a vertical or horizontal position. If mounted in a horizontal position the plane of the filament, which is indicated in Figure 2, should be vertical. To assure adequate ventilation the tubes should be mounted with not less than 2⅝ inches between centers when two or more tubes are used.

Average Direct Interelectrode Capacitances

Grid to plate	5.1 $\mu\mu f$
Grid to filament	4.0 $\mu\mu f$
Plate to filament	2.3 $\mu\mu f$

These values are for a based tube without socket.

Filament Rating

Filament current	0.50 ampere, d.c.
Nominal filament voltage	2.1 volts

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

The filament resistance of this tube increases slightly during the first 2000 hours of operation. The voltage given above is the nominal value after the resistance has stabilized.

Characteristics—Typical curves showing plate current as a function of grid voltage for several values of plate voltage are shown in Figure 3. The grid and plate voltages are measured from the negative end of the filament. Corresponding amplification factor, plate resistance and transconductance characteristics are given in Figures 4, 5 and 6 respectively. Plate current as a function of plate voltage for several values of grid voltage is shown in Figure 7.

Operating Conditions and Output—Permissible operating plate and grid voltages are included within the area, ABCD in Figure 3. A number of recommended and maximum operating conditions and the corresponding values of amplification factor, plate resistance, transconductance and performance data are given in the table below. 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 less severe conditions.

The performance data shown include the fundamental output voltage in peak volts and the second and third harmonic levels in db below the fundamental for values of load resistance equal to the plate resistance and for load resistances of 100,000 and 300,000 ohms. The peak value of the sinusoidal input voltage E_{gm}, which gives the indicated output E_{pm}, and harmonic levels F_{2m} and F_{3m}, in each case is numerically equal to the grid bias. For a smaller input voltage E_g, the approximate levels may be computed from the following relations:

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

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

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

Microphonic Noise

For a plate voltage of 130 volts, a grid bias of −1.5 volts and a load resistance of 100,000 ohms, the mean microphonic output level of this tube, measured in a laboratory reference test set is 33 db below 1 volt. The range of levels of individual tubes extends from 25 to 41 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.

TABLE

Plate Voltage Volts	Grid Bias Volts	Plate Current Milliamperes	Amplification Factor	Plate Resistance Ohms	Transconductance Micromhos	Load Resistance Ohms	Output Voltage Peak Volts	Second Harmonic db	Third Harmonic db
130	−2.0	0.60	30.9	58,000	530	58,000	28	23	39
						100,000	37	28	45
						300,000	49	39	55
130	−1.5	0.85	31.0	50,000	620	50,000	22	30	48
						100,000	30	37	55
						300,000	38	49	65
130	−1.0	1.15	31.0	44,000	700	44,000	14	36	55
						100,000	20	44	60
						300,000	25	56	65
160	−3.0	0.55	30.9	60,000	520	60,000	42	19	33
						100,000	53	23	38
						300,000	71	35	50
160	−2.0	1.15	31.0	45,000	690	45,000	29	30	48
						100,000	39	37	55
						300,000	49	50	65
*160	−1.0	1.85	31.0	39,000	800	39,000	15	41	60
						100,000	21	51	65
						300,000	25	60	65
*190	−3.0	1.15	30.9	45,000	690	45,000	45	26	40
						100,000	62	35	50
						300,000	75	46	60
*190	−2.0	1.85	31.0	39,000	800	39,000	30	35	55
						100,000	41	44	60
						300,000	50	55	65

*Maximum operating conditions.

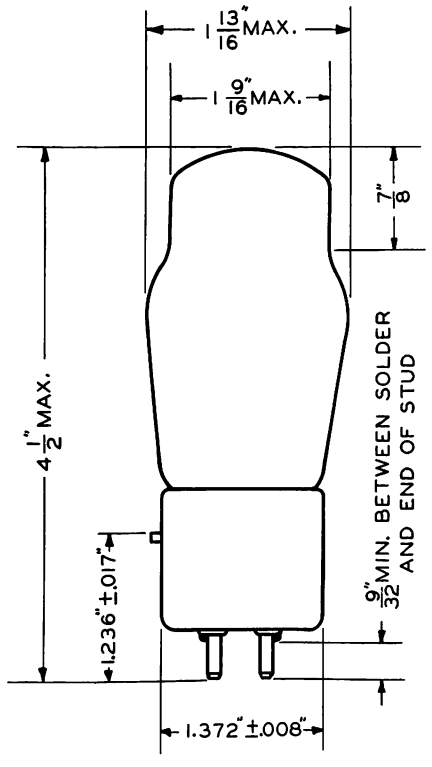


FIG. 1

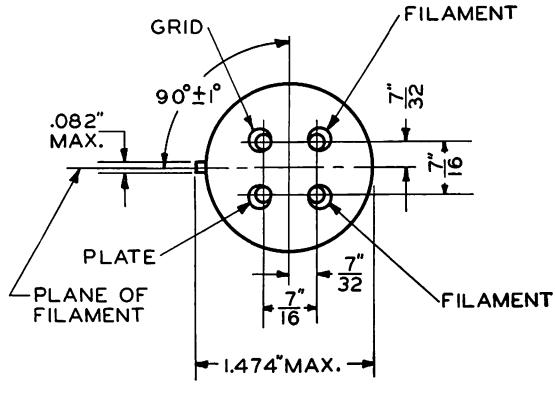


FIG. 2

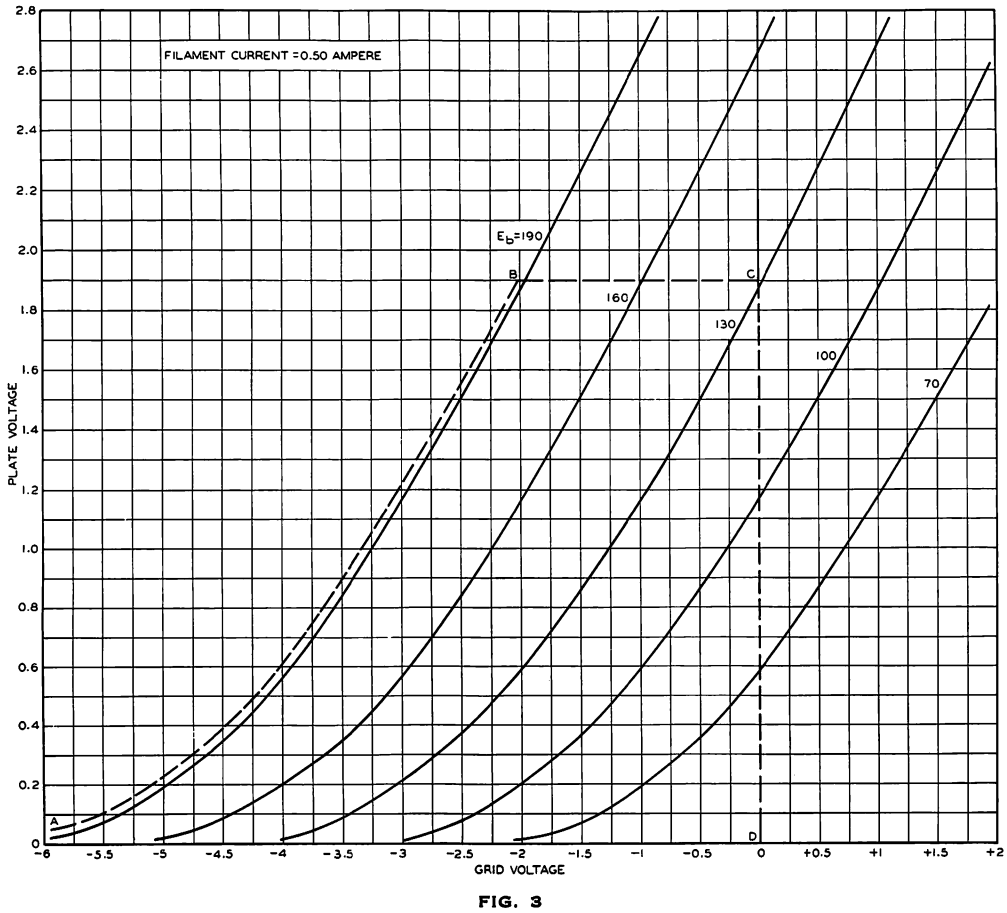


FIG. 3

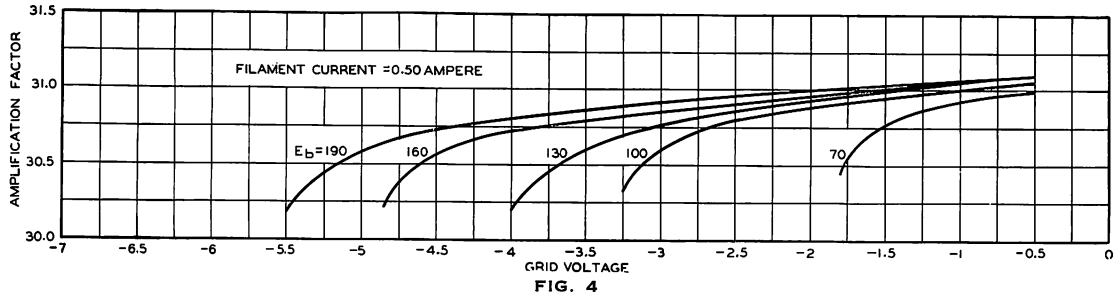


FIG. 4

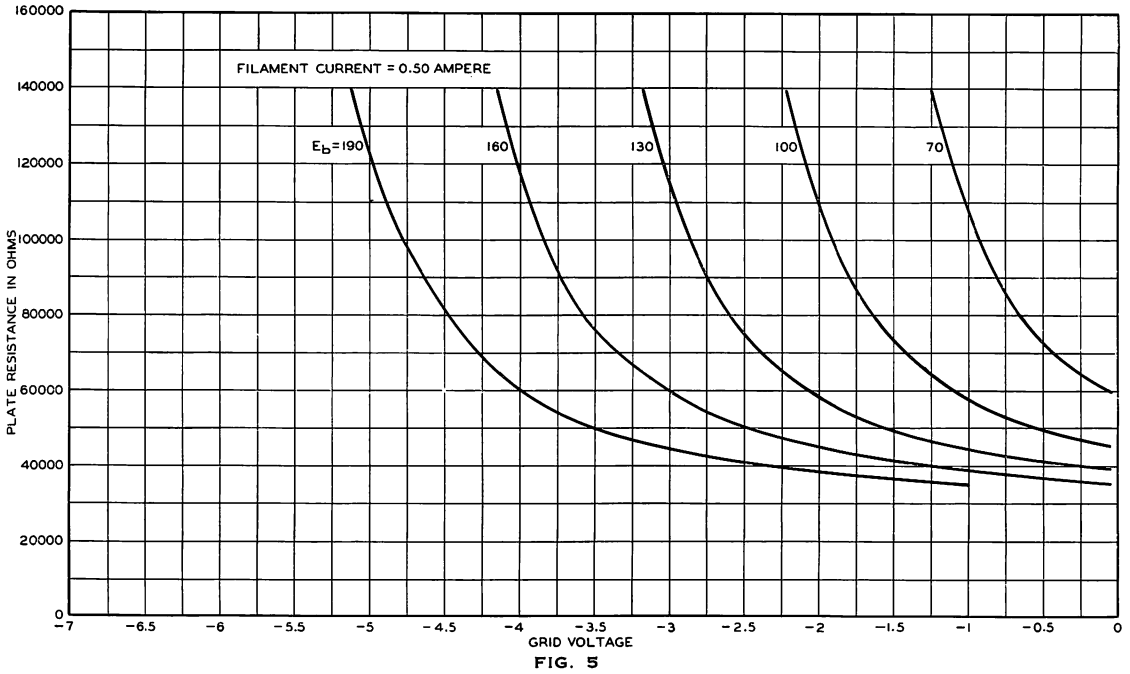


FIG. 5

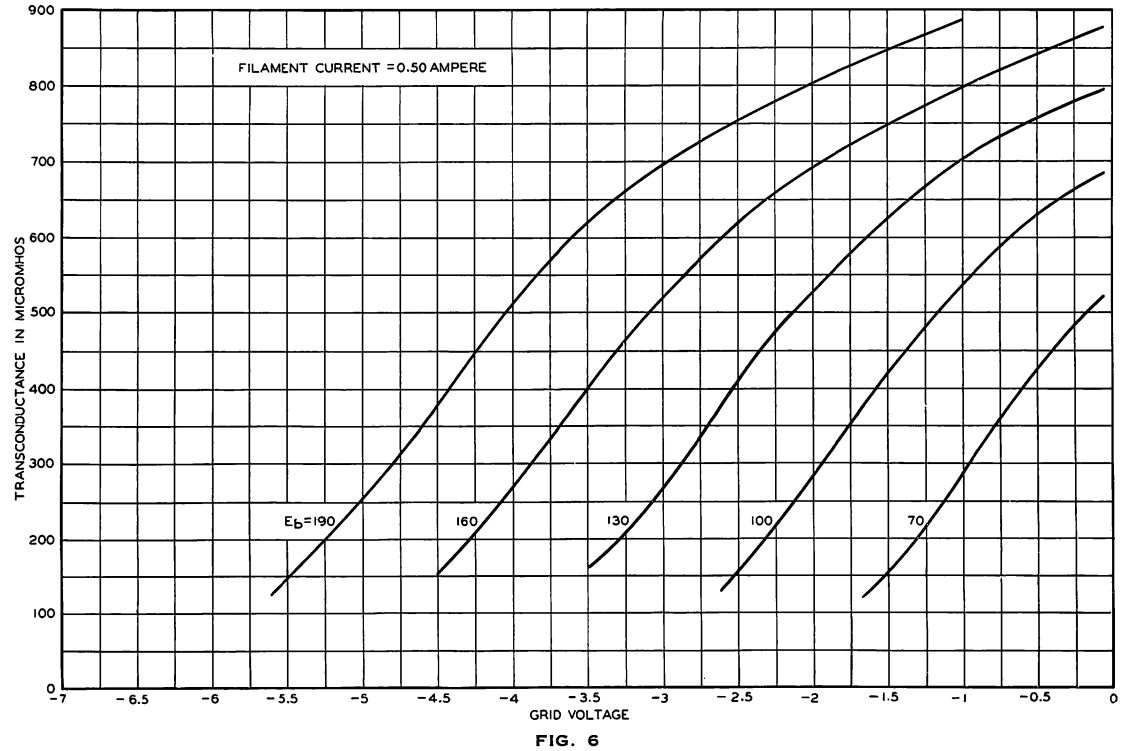


FIG. 6

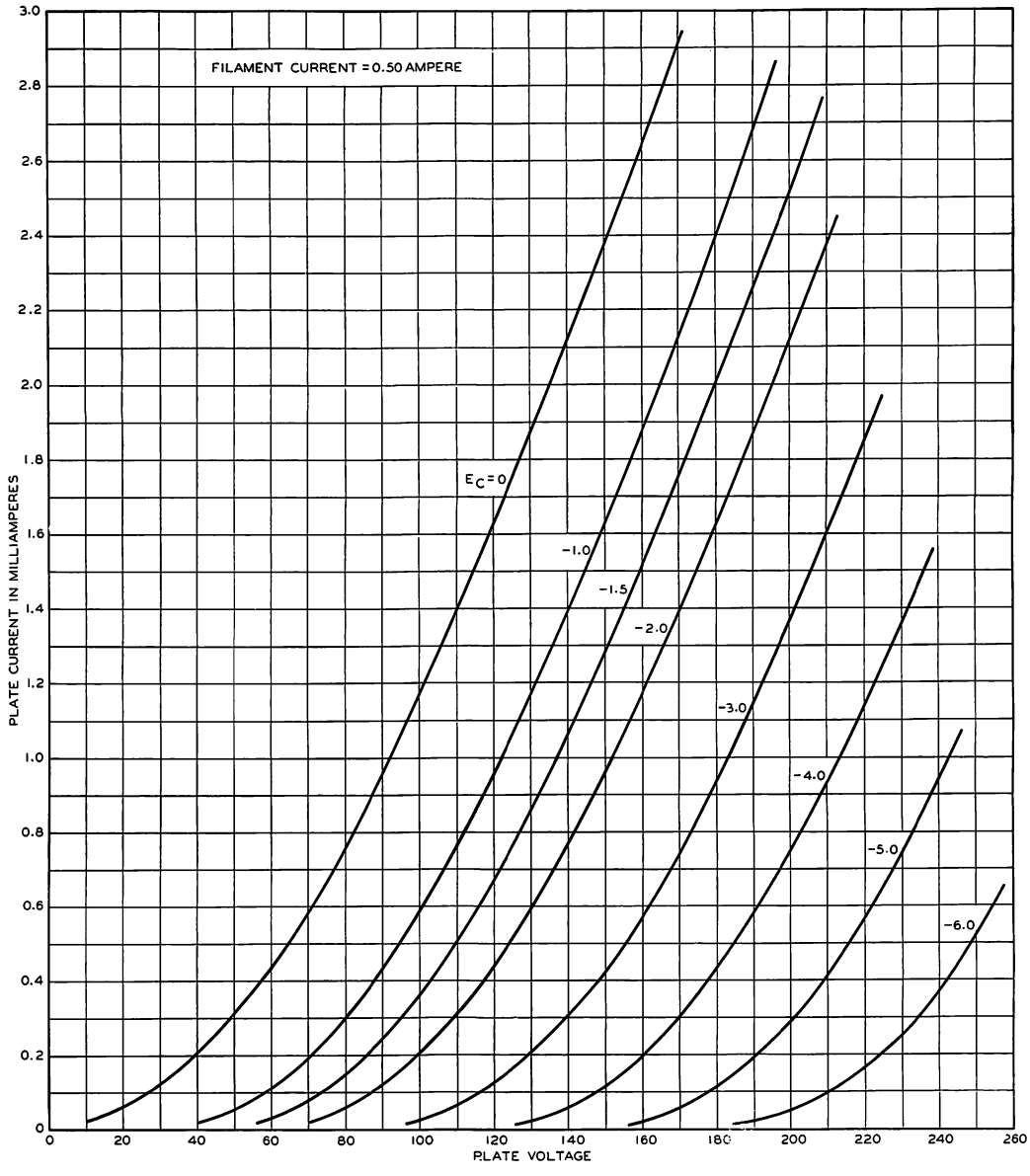
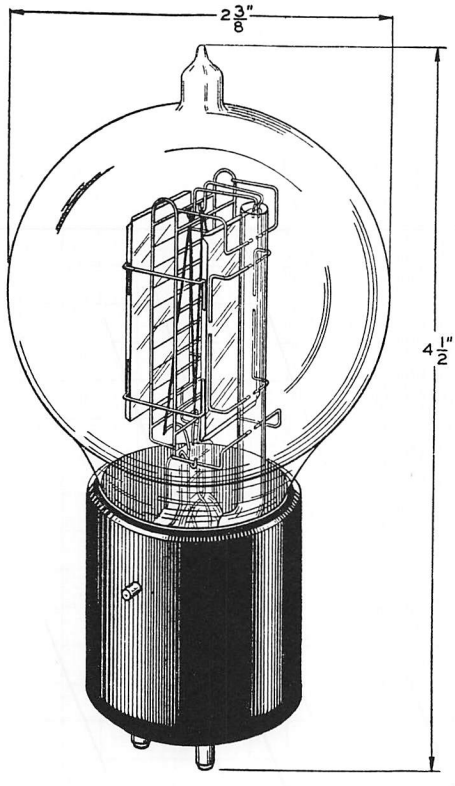
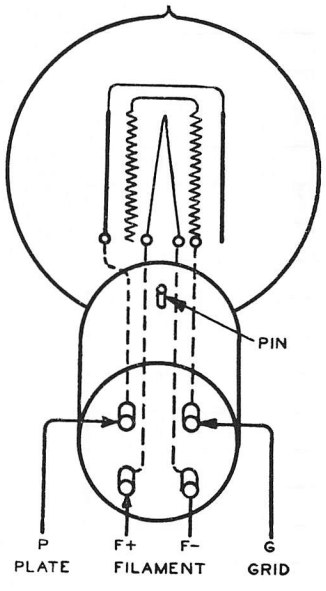

FILAMENT CURRENT = 0.50 AMPERE
$E_C = 0$
-1.0
-1.5
-2.0
-3.0
-4.0
-5.0
-6.0
PLATE CURRENT IN MILLIAMPERES
PLATE VOLTAGE
0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3.0
0
20
40
60
80
100
120
140
160
180
200
220
240
260

FIG. 7

102G Vacuum Tube





Classification

The No. 102G is a three element filamentary type vacuum tube primarily intended for use as a voltage amplifier. It may also be used as a modulator, detector, or in volume indicator circuits.

Base and Socket

The No. 102G Vacuum Tube employs a four prong bayonet pin type base suitable for use in the Western Electric 100L (front panel mounting), 100R (rear panel mounting), or similar type socket.

Rating and Characteristic Data

Filament Current				1.0 Ampere
Filament Voltage				2.1 Volts
Plate Voltage	130	160	160	190 Max.
Grid Voltage	—1.5	—2	—2	—3
Average Plate Current—Millamperes	0.6	0.9	0.9	0.9
Average Amplification Factor	30	30	30	29.5
Average Plate Resistance—Ohms	60,000	50,000	50,000	50,000
*Average Peak Voltage Output	30	45	50	65
Second Harmonic—% of Fundamental	3	2	1.5	4
Third Harmonic—% of Fundamental	0.2	0.2	0.1	0.4
Load Resistance—Ohms	175,000	150,000	250,000	150,000

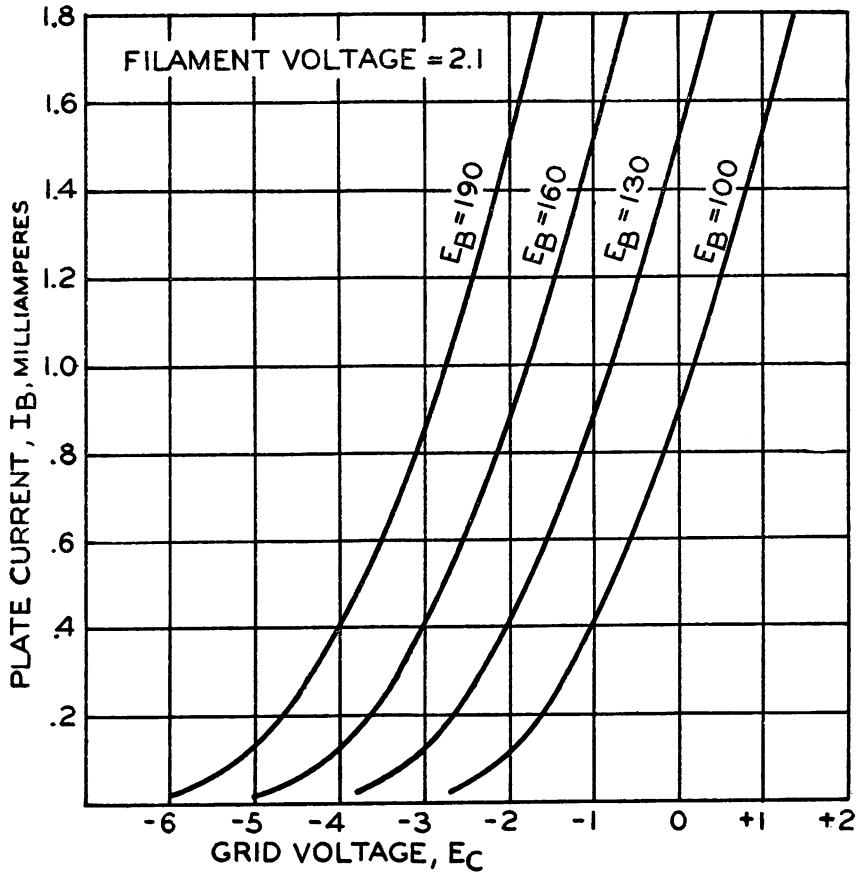
*Input in peak volts is equal to grid voltage.

Approximate Direct Interelectrode Capacities (measured without sockets)

Plate to Grid	5.0 MMF
Plate to Filament	1.7 MMF
Grid to Filament	2.9 MMF

Average Static Characteristics

The accompanying curve gives the average static characteristics for the 102G tube. These curves have been obtained with the filament operating on direct current and the grid and plate returns connected to the negative end of the filament.



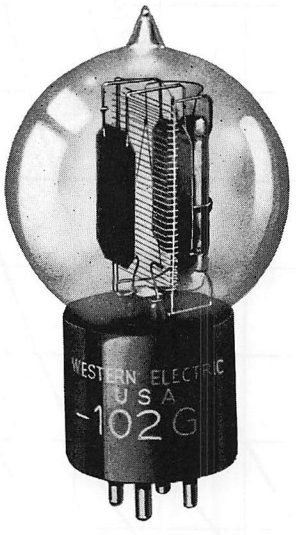
General Features

The 102G tube has an extremely low noise level and is especially recommended for early stages of high gain low frequency amplifiers where unusual freedom from noises due to resistance films and shot effects is required. It differs from the 102D only in the unusually low level of the extraneous noises. In addition, the design is such as to maintain extremely high insulation between elements throughout the life of the tube. The prongs of the base are equipped with special contact metal tips to prevent noise disturbance due to poor electrical contact with the springs of the socket.

This tube has the same long life feature as is obtained in the 102D tube.

Western Electric

102G Vacuum Tube



Classification—Filamentary, voltage amplifier triode

The 102G tube is similar to the 102D tube except that special precautions have been taken in the 102G to minimize insulation leaks and sputter noise in the tube.

Applications

Audio-frequency voltage amplifier.
Detector or modulator.

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, four-pin, bayonet type having special contact metal at the ends of the contact pins

Socket—Four-contact, bayonet-slot type, preferably provided with contact-metal contacts, such as the Western Electric 100L for front of panel mounting or 100R for rear of panel mounting.

Mounting Positions—Either vertical or horizontal. If mounted in a horizontal position, the plane of the filament, which is indicated in Figure 2, should be vertical.

Average Direct Interelectrode Capacitances

	A	B	C
Grid to plate, $\mu\mu f$	5.0	4.7	4.7
Grid to filament, $\mu\mu f$	2.9	4.3	4.6
Plate to filament, $\mu\mu f$	1.7	2.7	3.0

Column A—Based tube without socket.

Column B—Tube alone when measured in 100L socket mounted on metal plate; socket and mounting plate connected to filament.

Column C—Tube alone when measured in 100R socket mounted in metal plate; socket and mounting plate connected to filament.

Filament Rating

Filament current	1.0 ampere, d.c.
Nominal filament voltage	2.1 volts

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

Characteristics—Plate current characteristics of a typical 102G tube are shown in Figure 3 as functions of grid voltage for several values of plate voltage. The grid and plate voltages are measured from the negative end of the filament. 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 are shown in Figure 7 for several values of grid voltage.

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 page 3 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 output voltage in peak volts and the second and third harmonic levels in decibels below the fundamental for values of load resistance, R, equal to one, three, and five times the plate resistance, r_p. The peak value of the sinusoidal input voltage, E_{gm}, which gives the indicated output voltage, E_{pm}, and harmonic levels F_{2m} and F_{3m}, in each case, is numerically equal to the grid bias. For a smaller input voltage, E_g, the approximate levels may be computed from the following relations.

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

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

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

TABLE

Plate Voltage	Grid Bias	Plate Current	Amplification Factor	Plate Resistance	Transconductance	Input Voltage	Load Resistance	Output Voltage	Second Harmonic	Third Harmonic
Volts	Volts	Milliamperes		Ohms r_p	Micromhos	Peak Volts	R	Peak Volts	db	db
130	−2.0	0.36	29.4	80000	370	2.0	$R=r_p$	27	20	41
							$R=3r_p$	38	24	44
							$R=5r_p$	41	25	45
130	−1.5	0.58	29.8	63000	470	1.5	$R=r_p$	20	26	47
							$R=3r_p$	30	31	50
							$R=5r_p$	34	33	55
130	−1.0	0.85	30.1	53000	570	1.0	$R=r_p$	15	33	55
							$R=3r_p$	20	39	60
							$R=5r_p$	23	40	60
160	−3.0	0.34	29.2	81000	360	3.0	$R=r_p$	40	18	36
							$R=3r_p$	57	21	40
							$R=5r_p$	62	22	40
160	−2.0	0.80	29.9	54000	550	2.0	$R=r_p$	28	27	46
							$R=3r_p$	42	33	55
							$R=5r_p$	45	34	55
160	−1.0	1.45	30.3	42000	720	1.0	$R=r_p$	15	38	60
							$R=3r_p$	21	43	65
							$R=5r_p$	24	48	65
*190	−3.0	0.83	29.8	54000	550	3.0	$R=r_p$	42	23	40
							$R=3r_p$	63	28	48
							$R=5r_p$	68	30	50
*190	−2.0	1.46	30.2	43000	700	2.0	$R=r_p$	30	31	50
							$R=3r_p$	43	38	60
							$R=5r_p$	48	41	60

*Maximum operating conditions.

Microphonic Noise—With a plate voltage of 130 volts, a grid bias of −1.5 volts, and a load resistance of 100,000 ohms, the mean microphonic noise output level of the 102G tube, measured in a laboratory reference test set, is 30 decibels below 1 volt. The range of levels of individual tubes extends from 18 to 38 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.

Sputter Noise—A particularly disagreeable type of noise, characterized by an unmusical crackling or sputtering sound, occurs in many vacuum tubes, sometimes as a result of slight mechanical agitation. Such noise is usually due either to discontinuously variable insulation leaks between electrodes or to intermittent contacts involving conducting members such as filament supports which, at times of no contact, are insulated from other parts of the tube. Special precautions have been taken in the design of the 102G tube to eliminate this type of noise.

Fluctuation Noise—An irreducible minimum of noise in a vacuum tube is produced by uncontrollable, minute fluctuations in the rate of flow of electrons to the anode. The level of this noise in the 102G tube is unusually low. With a plate voltage of 130 volts, a grid bias of −1.5 volts, and a load resistance of 100,000 ohms, the mean equivalent fluctuation noise input of the 102G tube for the audio-frequency range from 40 to 10,600 cycles is 122.4 decibels below 1 volt. Individual 102G tubes may differ from this value by as much as 1 decibel. By reducing the grid bias

to −0.5 volt, the mean fluctuation noise level may be reduced by about 0.8 decibel. The equivalent noise input voltage is equal to the measured output voltage divided by the voltage amplification of the tube in the measuring circuit.

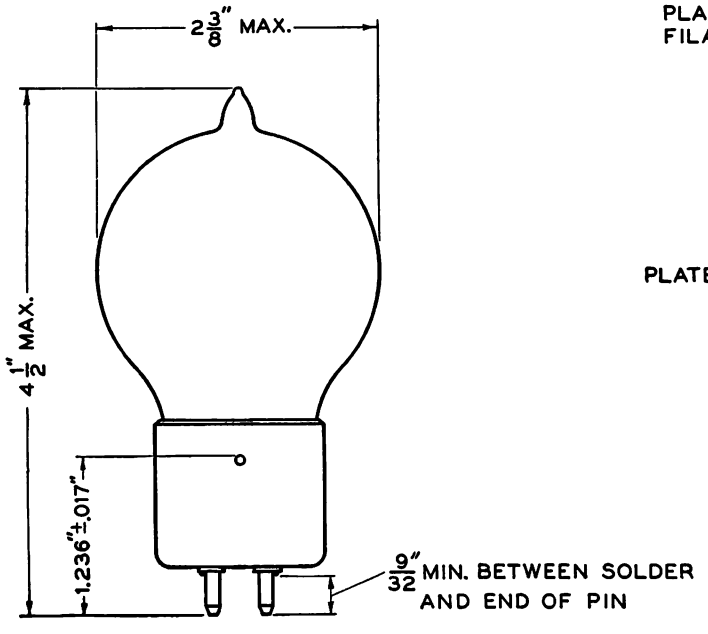


FIG. 1

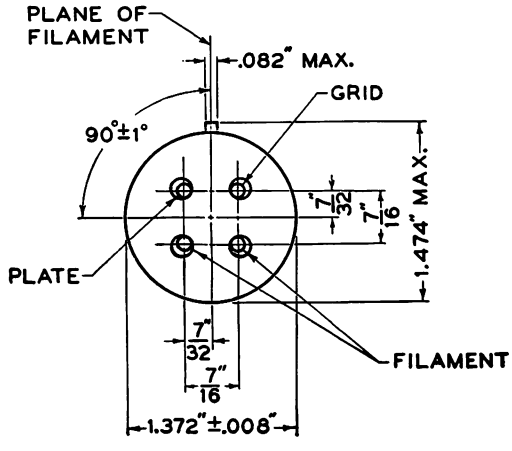


FIG. 2

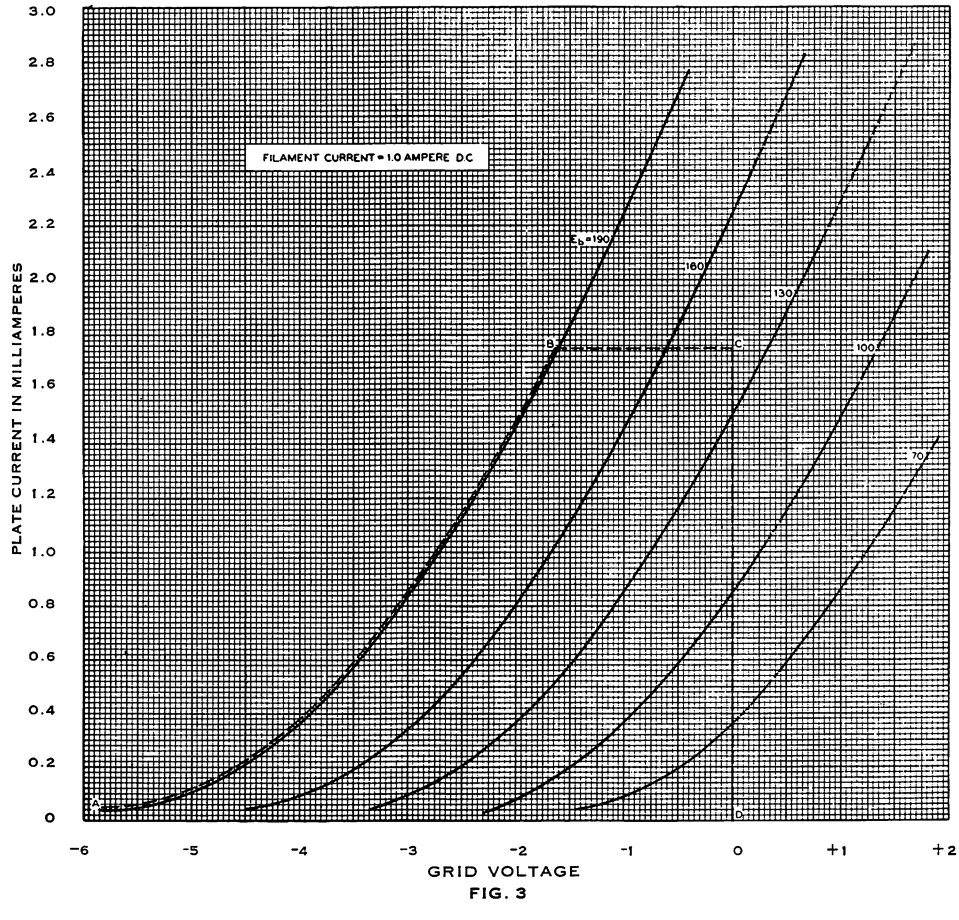


FIG. 3

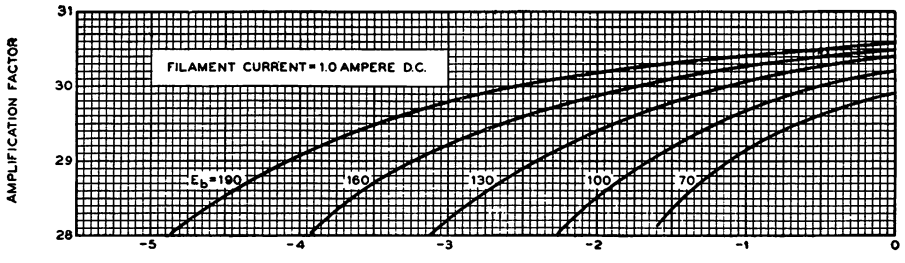


FIG. 4

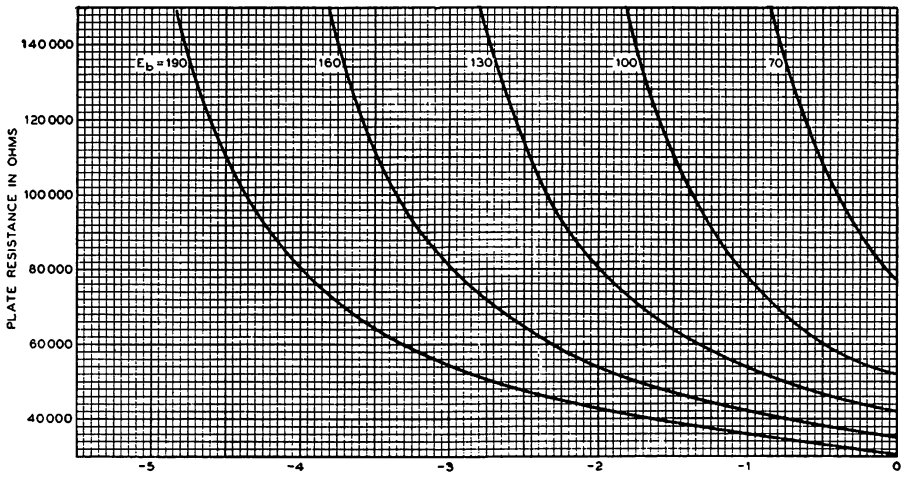


FIG. 5

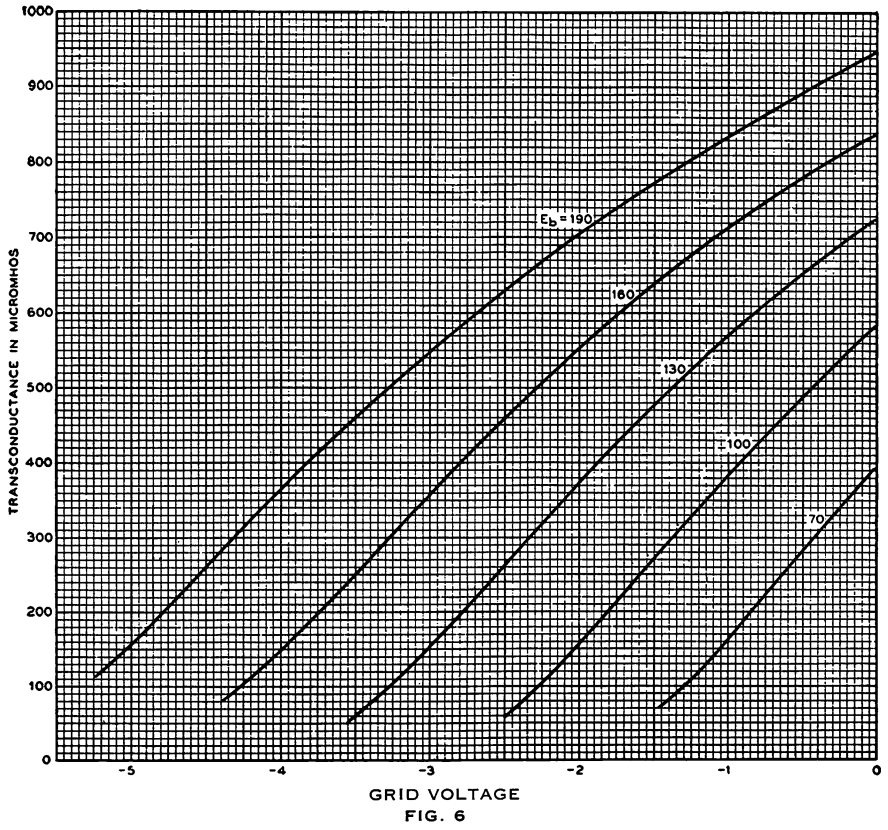


FIG. 6

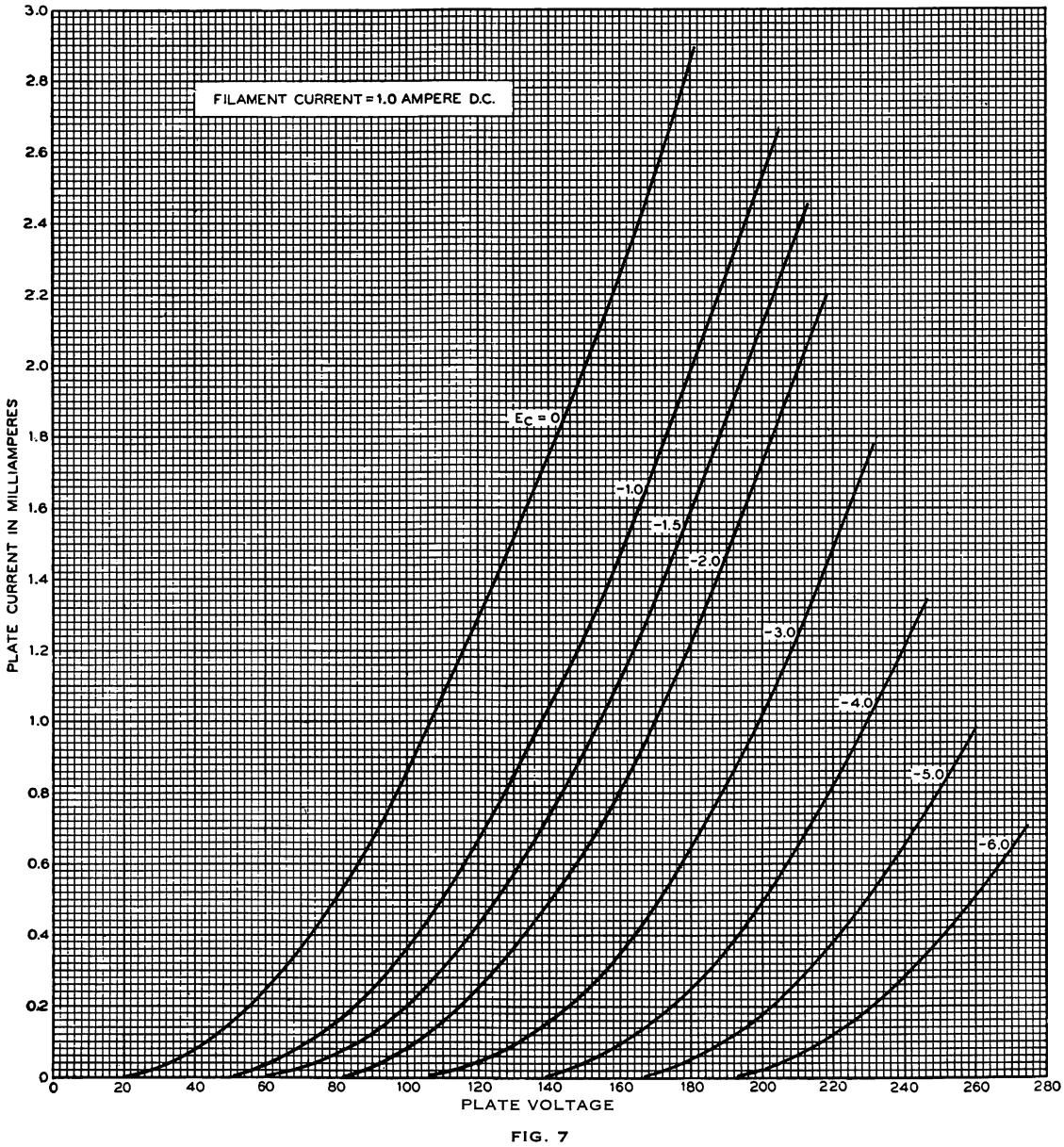
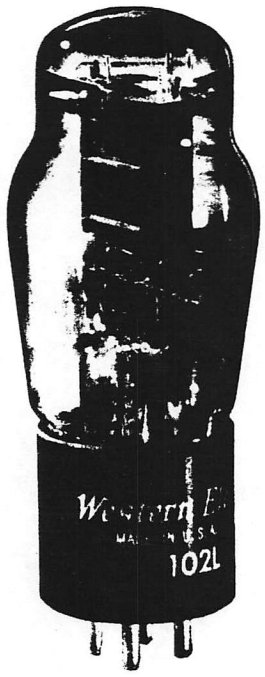

FILAMENT CURRENT = 1.0 AMPERE D.C.
PLATE CURRENT IN MILLIAMPERES
PLATE VOLTAGE
$E_C = 0$
-1.0
-1.5
-2.0
-3.0
-4.0
-5.0
-6.0
0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3.0
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280

FIG. 7



TRIODE
AUDIO-FREQUENCY AMPLIFIER

Western Electric

DESCRIPTION

The 102L is a filamentary type triode. It is designed for use as an audio-frequency voltage amplifier or modulator.

CHARACTERISTICS

Filament Current	250 milliamperes
Maximum Plate Voltage	180 volts
Amplification Factor	30

Western Electric

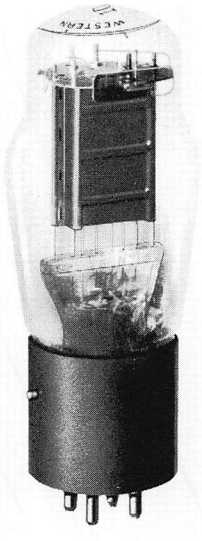
A development of Bell Telephone Laboratories, the research laboratories of the American Telephone and Telegraph Company and the Western Electric Company.

1-D-50-4 PRINTED IN U. S. A. T-2646

Western Electric

104D Vacuum Tube

(Dome)



Classification—Filamentary, power amplifier triode

This tube replaces the D-86327 tube and has been assigned the old code number 104D. It includes an improved filament, a new mechanical design using transverse mica supports and is mounted in a dome type bulb. The electrical characteristics are essentially the same as for the D-86327 tube.

Applications—Voice frequency and carrier frequency amplifier for telephone repeater equipment requiring greater power outputs than can be obtained from the 101D or 101F type tubes.

Volume limiter in carrier telephone equipment.

Amplifier in various testing apparatus.

Dimensions and Connections—The 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 vacuum tube employs a medium, four-pin bayonet type base having special contact metal at the ends of the pins. It is suitable for use in a Western Electric 100L, 100R or similar type socket, preferably provided with contact-metal contacts.

The tube may be mounted in either a vertical or horizontal position. If mounted in a horizontal position the plane of the filament, which is indicated in Figure 2, should be vertical. To assure adequate ventilation the tubes should be mounted with not less than $2\frac{5}{8}$ inches between centers when two or more tubes are used.

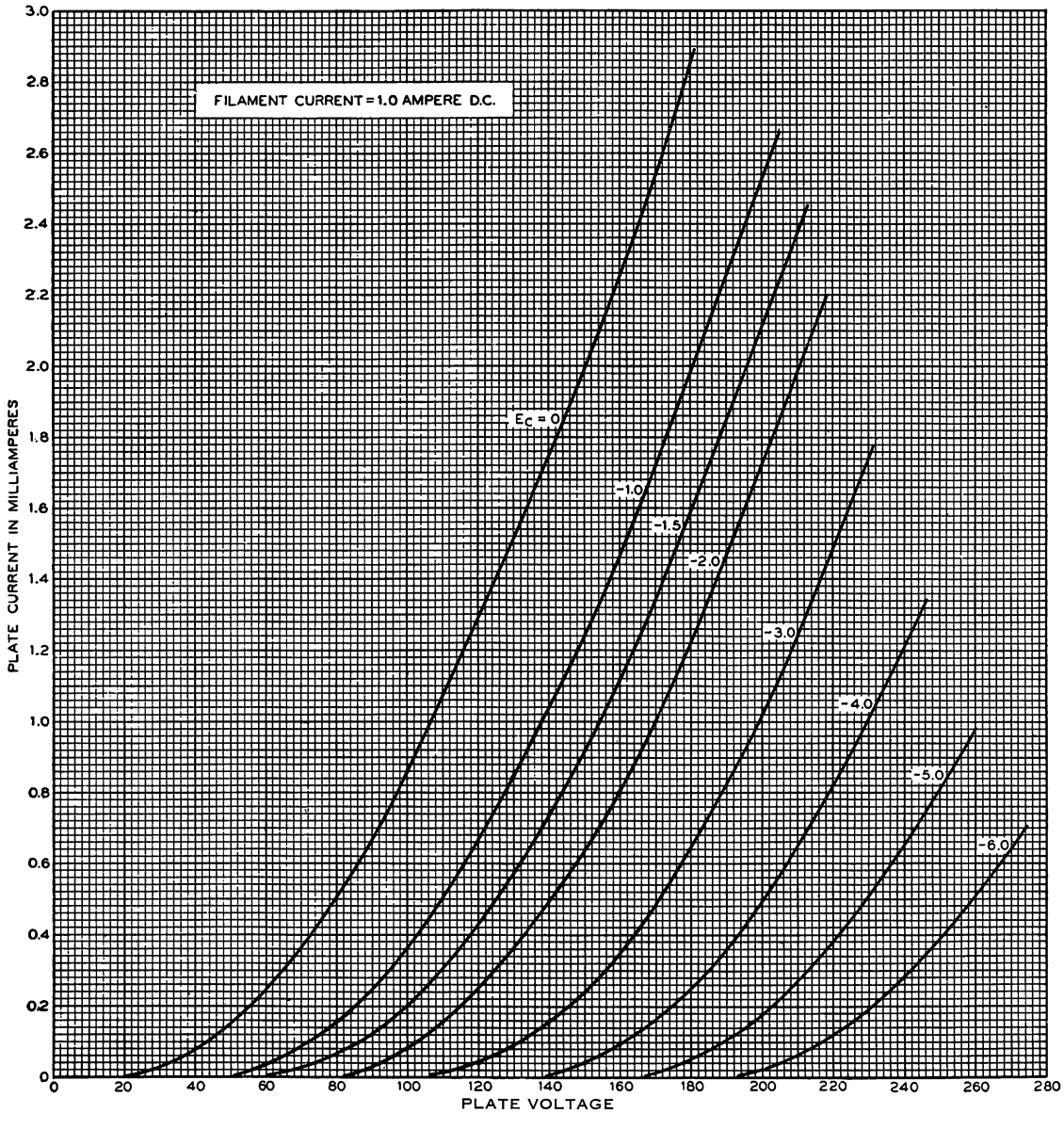

FILAMENT CURRENT = 1.0 AMPERE D.C.
PLATE CURRENT IN MILLIAMPERES
PLATE VOLTAGE
$E_C = 0$
-1.0
-1.5
-2.0
-3.0
-4.0
-5.0
-6.0
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280

FIG. 7

Average Direct Interelectrode Capacitances

Grid to plate	4.9 μμf.
Grid to filament	4.1 μμf.
Plate to filament	3.4 μμf.

These values are for a based tube without socket.

Filament Rating

Filament current	1.00 ampere, d.c.
Nominal filament voltage	4.5 volts

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

The filament resistance of this tube increases slightly during the first 2000 hours of operation. The voltage given above is the nominal value after the resistance has stabilized.

Characteristics—Typical curves showing plate current as a function of grid voltage for several values of plate voltage are shown in Figure 3. The grid and plate voltages are measured from the negative end of the filament. Corresponding amplification factor, plate resistance and transconductance characteristics are given in Figures 4, 5 and 6 respectively. Plate current as a function of plate voltage for several values of grid voltage is shown in Figure 7.

Operating Conditions and Output—Permissible operating plate and grid voltages are included within the area, ABCD in Figure 3. A number of recommended and maximum operating conditions and the corresponding values of amplification factor, plate resistance, transconductance, and performance data 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.

The performance data shown includes the fundamental power output in milliwatts and the second and third harmonic levels in db below the fundamental for values of load resistance equal to the plate resistance and for a load resistance of 5000 ohms. The peak value of sinusoidal input voltage E_{gm}, which gives the indicated output P_m, and harmonic levels F_{2m} and F_{3m}, in each case is numerically equal to the grid bias. For a smaller input voltage E_g, the approximate levels may be computed from the following relations:

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

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

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

Microphonic Noise

For a plate voltage of 130 volts, a grid bias of −20 volts, and a load resistance of 100,000 ohms, the mean microphonic output level of this tube, measured in a laboratory reference test set is 31 db below 1 volt. The range of levels of individual tubes extends from 20 to 40 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.

TABLE

	Plate Voltage	Grid Bias	Plate Current	Amplification Factor	Plate Resistance	Transconductance	Load Resistance	Power Output	Second Harmonic	Third Harmonic
	Volts	Volts	Milliamperes		Ohms	Micromhos	Ohms	Milliwatts	db	db
Recommended Operating Conditions	100	−20	12.5	2.4	2700	890	2700	110	23	50
							5000	100	28	65
	100	−10	22.5	2.6	2200	1160	2200	38	34	60
							5000	32	38	65
	130	−30	14.5	2.3	2600	900	2600	250	22	47
							5000	225	25	75
	130	−20	25.0	2.5	2100	1180	2100	150	28	48
							5000	125	32	58
	130	−10	37.0	2.6	1800	1430	1800	45	38	65
							5000	36	44	70
	160	−45	13.0	2.3	2900	810	2900	475	18	37
							5000	445	21	49
	160	−35	21.5	2.4	2300	1040	2300	390	22	47
							5000	340	27	70
Maximum Operating Conditions	160	−25	33.0	2.5	1900	1300	1900	250	28	49
							5000	210	33	53
	190	−55	15.5	2.3	2800	810	2800	735	18	36
							5000	700	22	48
	190	−45	24.5	2.4	2200	1070	2200	650	22	45
							5000	565	26	65

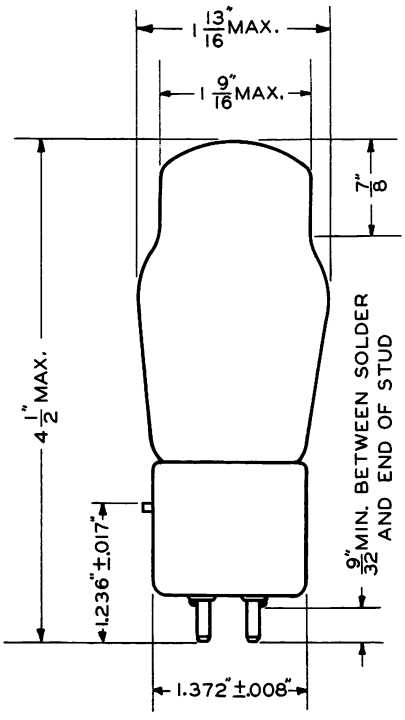
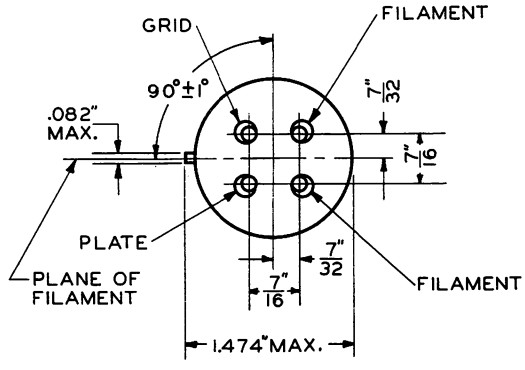


FIG. 1



BOTTOM VIEW

FIG. 2

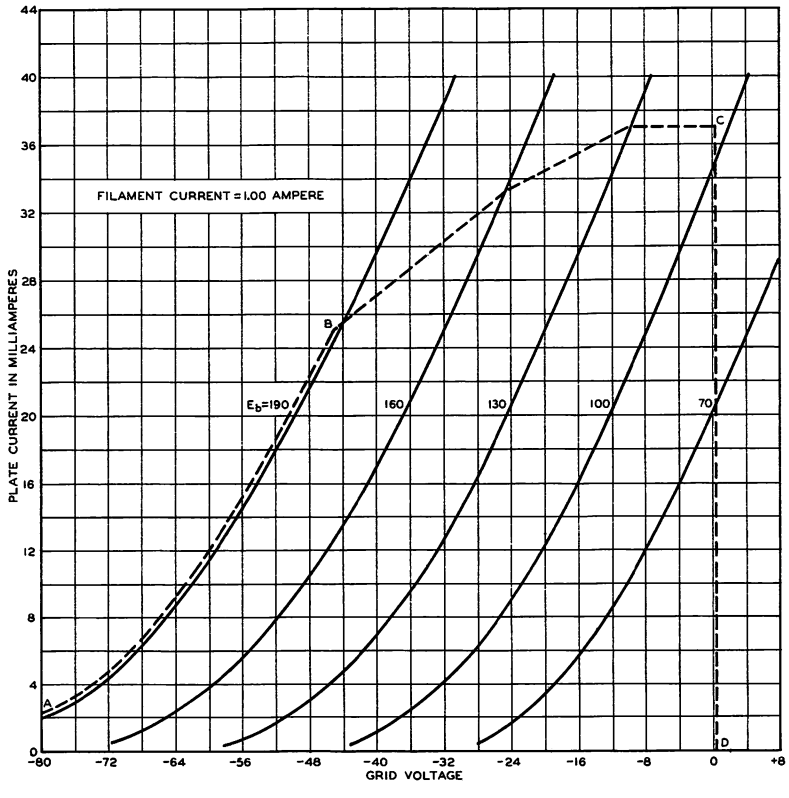


FIG. 3

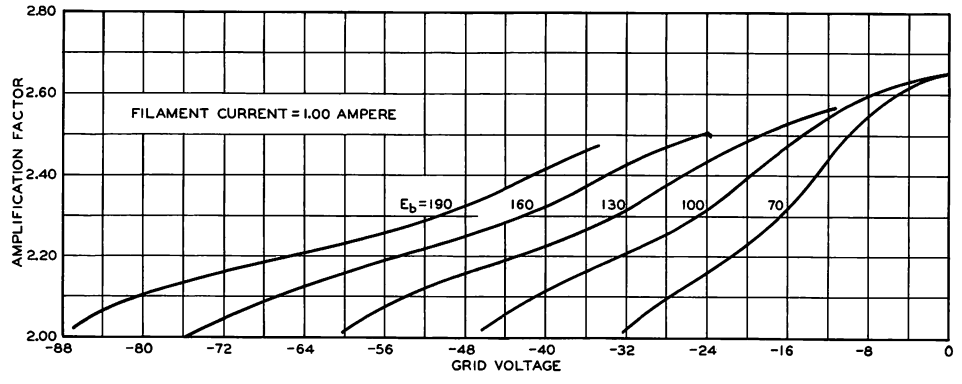


FIG. 4

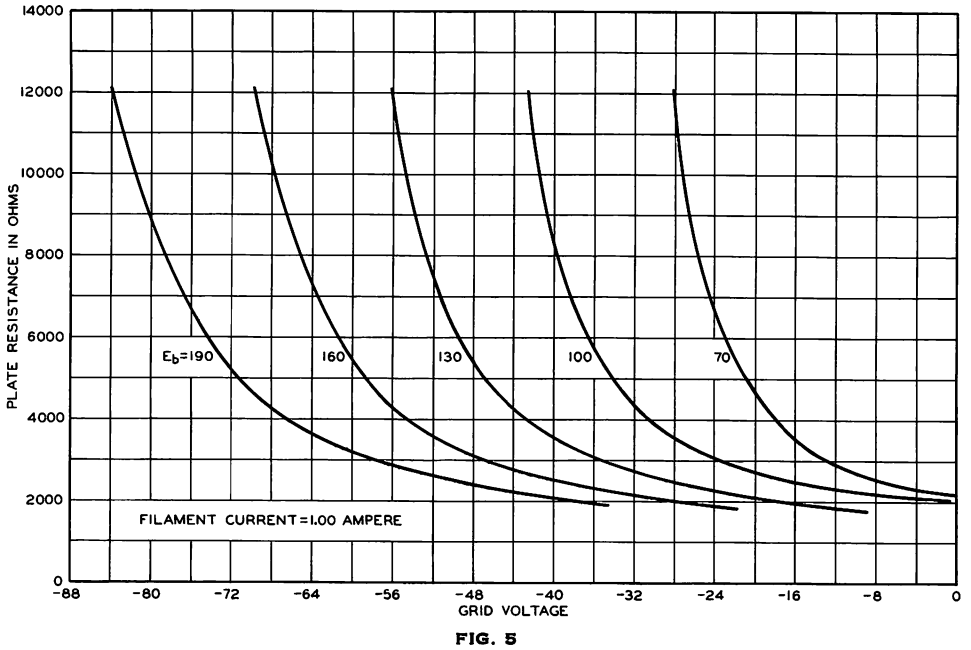


FIG. 5

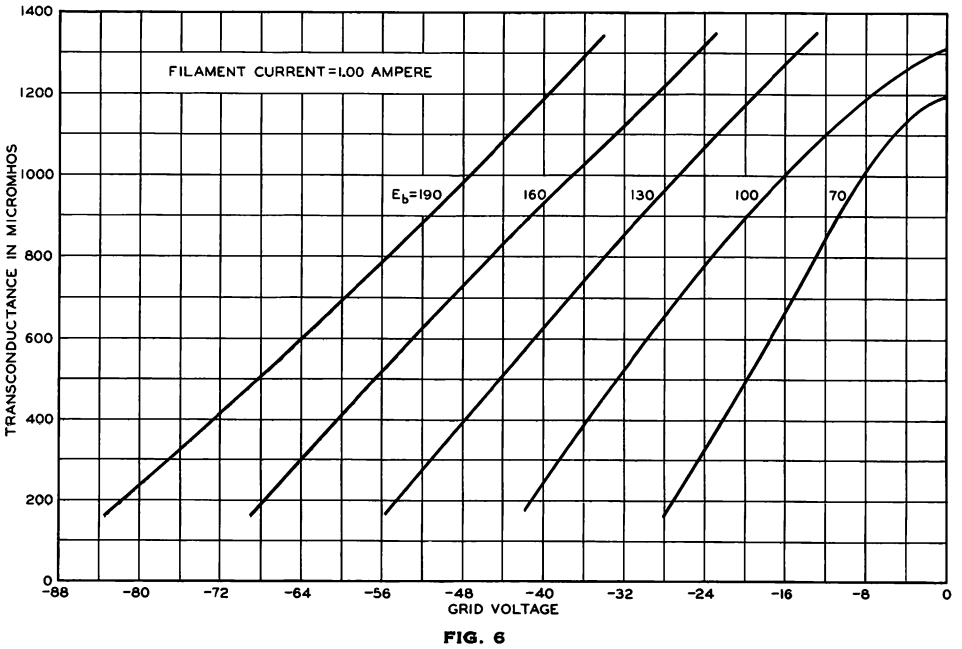


FIG. 6

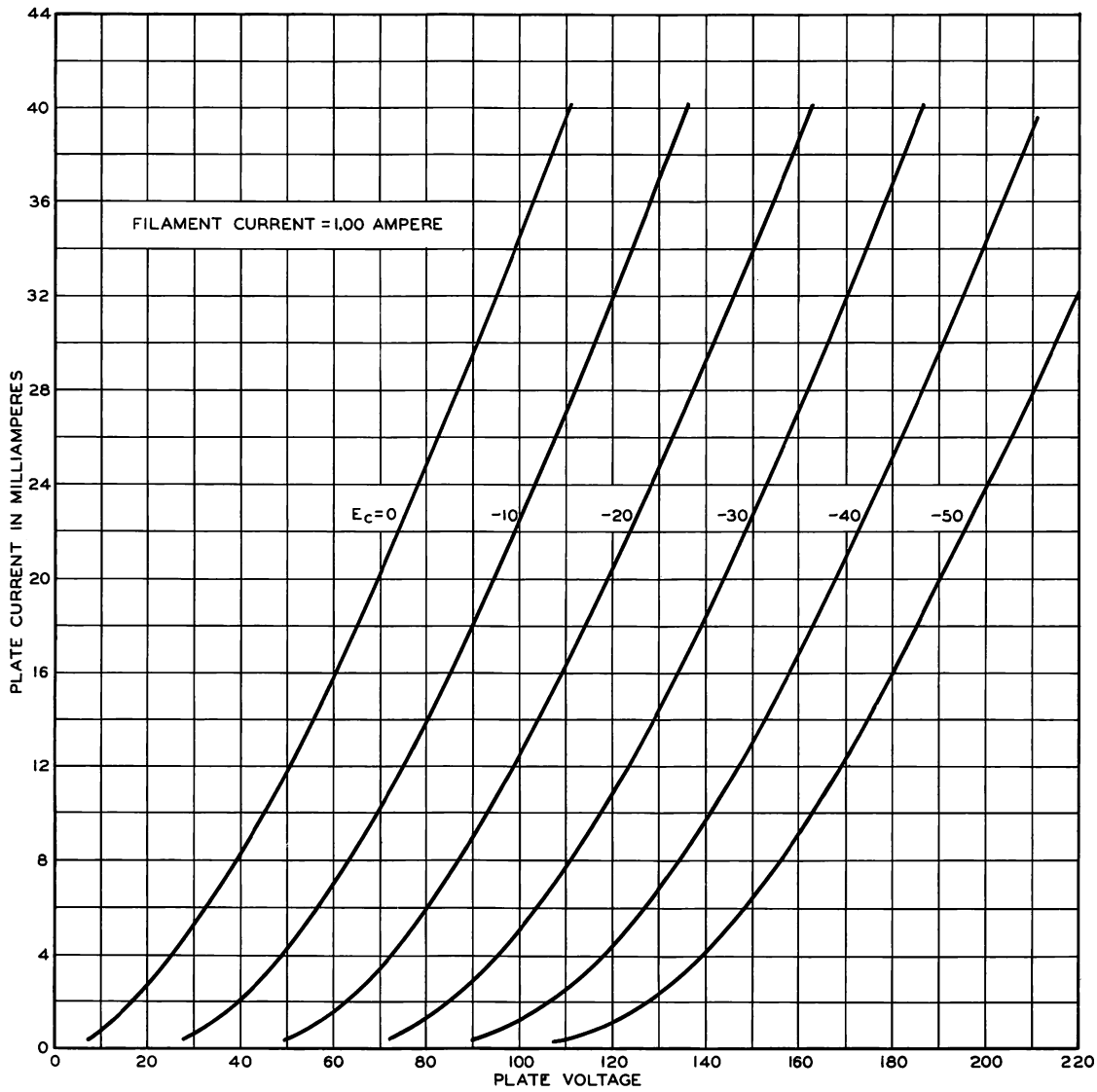

FILAMENT CURRENT = 1.00 AMPERE
E_C=0
-10
-20
-30
-40
-50
PLATE CURRENT IN MILLIAMPERES
PLATE VOLTAGE
0
4
8
12
16
20
24
28
32
36
40
44
0
20
40
60
80
100
120
140
160
180
200
220

FIG. 7