Beam Power Tube

CERAMIC-METAL SEALS — **52.5-WATTS CW INPUT**
"ONE-PIECE" ELECTRODE DESIGN — **27-WATTS CW OUTPUT AT 400 Mc**
CONDUCTION COOLED — **15-WATTS CW OUTPUT AT 1200 Mc**
COAXIAL-ELECTRODE STRUCTURE — **3.2-WATTS CW OUTPUT AT 3000 Mc**

UNIPOTENTIAL CATHODE

GENERAL DATA

Electrical:

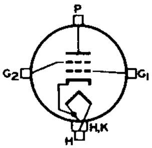
Heater, for Unipotential Cathode:		
Voltage (AC or DC)[a]	12.6 ± 10%	volts
Current at 12.6 volts	0.5	amp
Minimum heating time	40	sec
Mu-Factor, Grid No.2 to Grid No.1 for plate volts = 250, grid-No.2 volts = 250, and plate ma. = 35	30	
Direct Interelectrode Capacitances:[b]		
Grid No.1 to plate	0.025 max.	μμf
Grid No.1 to cathode & heater	9.5	μμf
Plate to cathode & heater	0.004 max.	μμf
Grid No.1 to grid No.2	17	μμf
Grid No.2 to plate	2.2	μμf
Grid No.2 to cathode & heater	0.18 max.	μμf

Mechanical:

Operating Position	Any
Maximum Overall Length	1.195"
Greatest Diameter (See *Dimensional Outline*)	0.740"
Weight (Approx.)	0.5 oz

Terminal Connections (See *Dimensional Outline*):

G_1 - Grid-No.1-Terminal Contact Surface
G_2 - Grid-No.2-Terminal Contact Surface
H - Heater-Terminal Contact Surface



H,K - Heater- & Cathode-Terminal Contact Surface
P - Plate-Terminal Contact Surface

Thermal:

Terminal Temperature (Plate, grid No.2, grid No.1, cathode, and heater)	250 max.	°C

Cooling, Conduction:

The plate terminal must be thermally coupled to a constant-temperature device (heat sink—solid or liquid) to limit the plate terminal to the specified maximum value of 250° C. The grid-No.2, grid-No.1, cathode, and heater terminals may also require coupling to the heat sink to limit their respective terminal temperature to the specified maximum value of 250° C.

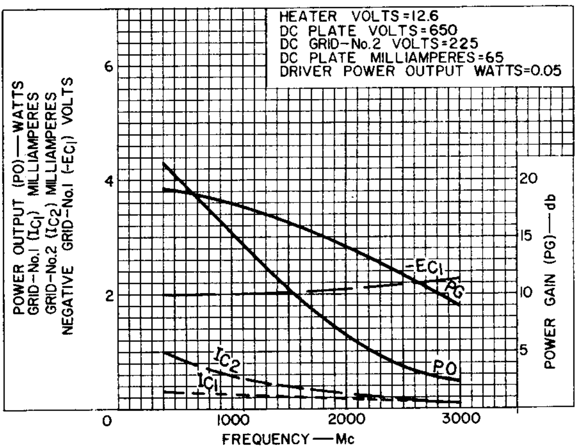
RF POWER AMPLIFIER & OSCILLATOR — Class C Telegraphy
and
RF POWER AMPLIFIER — Class C FM Telephony

Maximum CCS[c] Ratings, *Absolute-Maximum Values:*

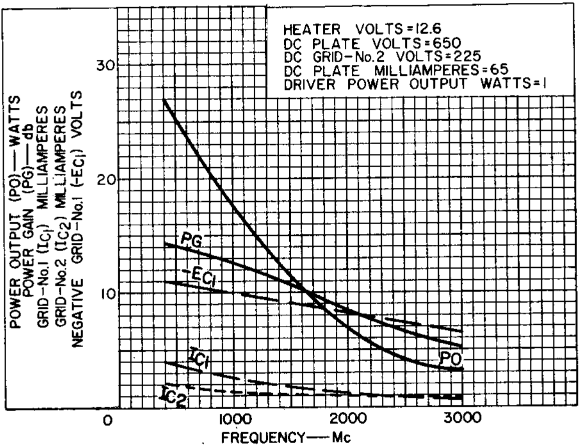
DC PLATE VOLTAGE	750	max.	volts
DC GRID-No.2 VOLTAGE	250	max.	volts
DC GRID-No.1 VOLTAGE	-100	max.	volts
DC PLATE CURRENT	70	max.	ma
DC GRID-No.1 CURRENT	15	max.	ma
PLATE INPUT	52.5	max.	watts
GRID-No.2 INPUT	2	max.	watts
PLATE DISSIPATION	d		

Typical CCS Operation in Cathode-Drive Circuit:

Shown Graphically in the following three Charts 92CS-10945, -10944, and -10942



92CS-10945



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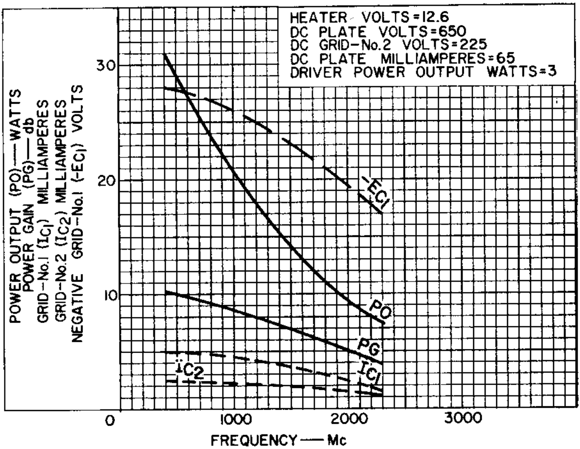


92CS-10942

PLATE-MODULATED RF POWER AMPLIFIER — Class C Telephony

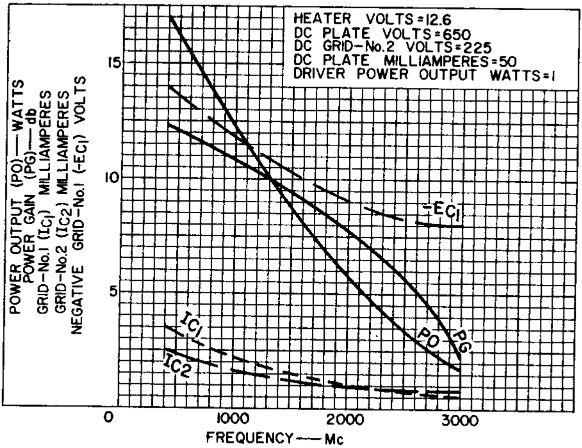
Carrier conditions per tube for use with a maximum modulation factor of 1

Maximum CCS[c] Ratings, *Absolute-Maximum Values:*

DC PLATE VOLTAGE	750	max.	volts
DC GRID-No.2 VOLTAGE	250	max.	volts
DC GRID-No.1 VOLTAGE	-100	max.	volts
DC PLATE CURRENT	60	max.	ma
DC GRID-No.1 CURRENT	15	max.	ma
PLATE INPUT	45	max.	watts
GRID-No.2 INPUT	2	max.	watts
PLATE DISSIPATION	d		

Typical CCS Operation in Cathode-Drive Circuit:

Shown Graphically in the following Chart 92CS-10943



92CS-10943

AF POWER AMPLIFIER & MODULATOR and LINEAR RF POWER AMPLIFIER
Single-Sideband Suppressed-Carrier Service

Maximum CCS[c] Ratings, *Absolute-Maximum Values:*

DC PLATE VOLTAGE	750	max.	volts
DC GRID-No.2 VOLTAGE	250	max.	volts
MAX.-SIGNAL DC PLATE CURRENT[e]	70	max.	ma
MAX.-SIGNAL DC GRID-No.1 CURRENT[e]	15	max.	ma
MAX.-SIGNAL PLATE INPUT[e]	52.5	max.	watts

MAX.-SIGNAL GRID-No.2 INPUT[e]	2	max.	watts
PLATE DISSIPATION[e]	[d]		

RF POWER AMPLIFIER — Class B Telephony

Maximum CCS[c] Ratings, ***Absolute-Maximum Values:***

DC PLATE VOLTAGE	750	max.	volts
DC GRID-No.2 VOLTAGE	250	max.	volts
DC PLATE CURRENT	35	max.	ma
DC GRID-No.1 CURRENT	8	max.	ma
PLATE INPUT	52.5	max.	watts
GRID-No.2 INPUT	2	max.	watts
PLATE DISSIPATION	[d]		

Maximum Circuit Values:

Grid-No.1-Circuit Resistance under any condition	30000 max.[f]	ohms

[a] Because the cathode is subjected to considerable back bombardment as the frequency is increased with resultant increase in temperature, the heater voltage should be reduced depending on operating conditions and frequency to prevent overheating the cathode and resultant short life.

[b] Measured with special shield adapter.

[c] Continuous Commercial Service.

[d] Maximum plate dissipation is a function of the maximum plate input, efficiency of the class of service, and the effectiveness of the cooling system. See *Cooling, Conduction* under *General Data,* and also *Cooling Considerations.*

[e] Averaged over any audio-frequency cycle of sine-wave form for *AF Power Amplifier & Modulator Service.*

[f] If this value is insufficient to provide adequate bias, the additional required bias must be supplied by a cathode resistor or fixed supply.

CHARACTERISTICS RANGE VALUES FOR EQUIPMENT DESIGN

	Note	*Min.*	*Max.*	
Heater Current	1	0.44	0.54	amp
Direct Interelectrode Capacitances:				
Grid No.1 to plate	2	–	0.025	μμf
Grid No.1 to cathode & heater	2	8.5	10.3	μμf
Plate to cathode & heater	2	–	0.004	μμf
Grid No.1 to grid No.2	2	14	20.6	μμf
Grid No.2 to plate	2	2.1	2.5	μμf
Grid No.2 to cathode & heater	2	–	0.18	μμf
Grid-No.1 Voltage	1,3	–1	–10	volts
Grid-No.1 Cutoff Voltage	1,4	–	–25	volts
Grid-No.2 Current	1,3	–3	2	ma
Positive Grid-No.1 Voltage	1,5	0	14	volts
Transconductance	1,6	7500	–	μmhos

Note 1: With 12.6 volts ac or dc on heater.

Note 2: Measured with special shield adapter.

Note 3: With dc plate voltage of 750 volts, dc grid-No.2 voltage of 250 volts, and dc grid-No.1 voltage adjusted to give a dc plate current of 35 ma.

Note 4: With dc plate voltage of 750 volts, dc grid-No.2 voltage of 250 volts, and dc grid-No.1 voltage adjusted to give a dc plate current of 1 ma.

Note 5: With dc plate voltage of 300 volts, dc grid-No.2 voltage of 250 volts, and dc grid-No.1 voltage of -100 volts. Rectangular pulses, pulse duration of 4500 to 5000 microseconds and pulse-repetition frequency of 10 to 12 pps. The positive-pulse grid-No.1 voltage is adjusted to give a plate current of 300 ma. at leading edge of pulse.

Note 6: With dc plate voltage of 300 volts, dc grid-No.2 voltage of 150 volts, dc grid-No.1 voltage adjusted to give a dc plate current of 35 ma.

COOLING CONSIDERATIONS

The conduction-cooling system consists, in general, of a constant-temperature device (heat sink) and suitable heat-flow path (coupling) between the heat sink and tube. Careful consideration should be given to the design of a heat-flow path through a coupling device having high thermal conductivity.

Thermal conductivity[g] may be calculated from the equation:

$$K = \frac{W}{A \frac{(T_2 - T_1)}{L}} \qquad (1)$$

where:

- K = thermal conductivity of the material
- W = power transfer in watts
- A = area measured at right angles to the direction of the flow of heat in square inches
- T_1, T_2 = temperature in degrees Centigrade of planes or surfaces under consideration
- L = length of heat path in inches through coupling material to produce temperature gradient

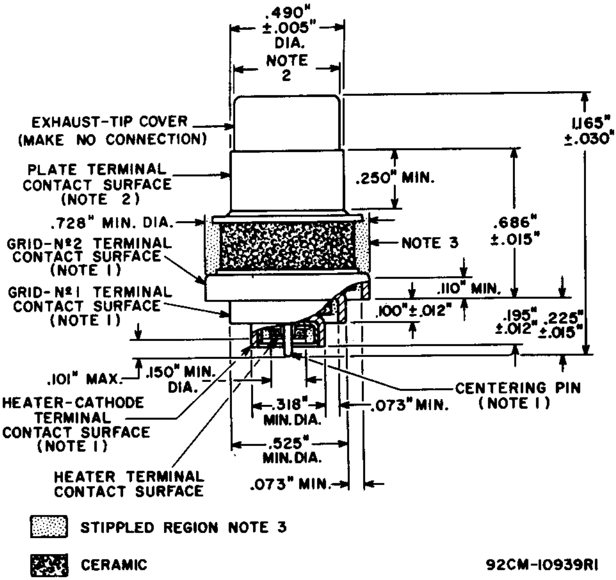
[g] Thermal conductivity is defined as the time rate of transfer of heat by conduction, through unit thickness, across unit area for unit difference of temperature. It is measured in watts per square inch for a thickness of one inch and a difference of temperature of 1^{0} C.

For a given system Equation (1) must be integrated to consider changes in area (A) dependent on the coupling configuration and changes in thermal conductivity (K) dependent on various coupling materials and interfaces. Equation (1) may now be reduced to the following:

$$K_S = \frac{W_P}{T_2 - T_1} \qquad (2)$$

where:

- K_S = thermal conductance of the system
- W_P = maximum permissible plate dissipation in watts
- T_2 = temperature in degrees Centigrade at tube terminal
- T_1 = temperature in degrees Centigrade of heat sink

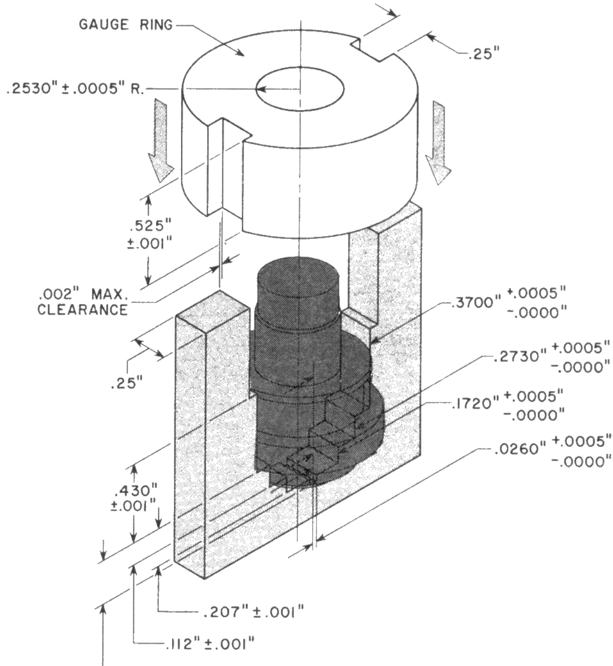


NOTE 1: WITH THE CYLINDRICAL SURFACES OF THE GRID-No.2 TERMINAL, GRID-No.1 TERMINAL, HEATER-CATHODE TERMINAL, AND CENTERING PIN CLEAN, SMOOTH, AND FREE OF BURRS, THE TUBE WILL ENTER A GAUGE AS SHOWN IN SKETCH G_1.

NOTE 2: WITH THE TUBE SEATED IN GAUGE AND WITH THE PLATE TERMINAL CLEAN, SMOOTH, AND FREE OF BURRS, THE GAUGE RING WILL SLIP OVER PLATE TERMINAL SHOWN IN SKETCH G_1 AND NOT EXTEND ABOVE GAUGE. THE TUBE WILL ROTATE 360° FREELY AND WILL NOT EXTEND ABOVE GAUGE RING.

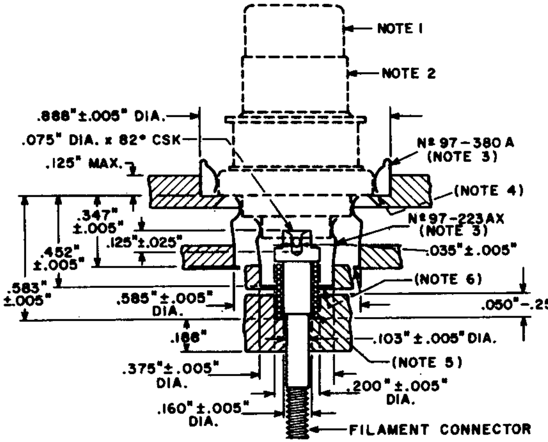
NOTE 3: KEEP ALL STIPPLED REGIONS CLEAR. DO NOT ALLOW CONTACTS OR CIRCUIT COMPONENTS TO PROTRUDE INTO THESE ANNULAR VOLUMES.

SKETCH G_1



92CM-10948

SUGGESTED MOUNTING ARRANGEMENT & LAYOUT OF ASSOCIATED CONTACTS



NOTE 1: MAKE NO CONNECTION.

NOTE 2: IF A CLAMP IS USED, IT MUST BE ADJUSTABLE IN A PLANE NORMAL TO THE MAJOR TUBE AXIS TO COMPENSATE FOR VARIATIONS IN CONCENTRICITY BETWEEN THE PLATE TERMINAL AND THE REMAINING CONTACT TERMINALS.

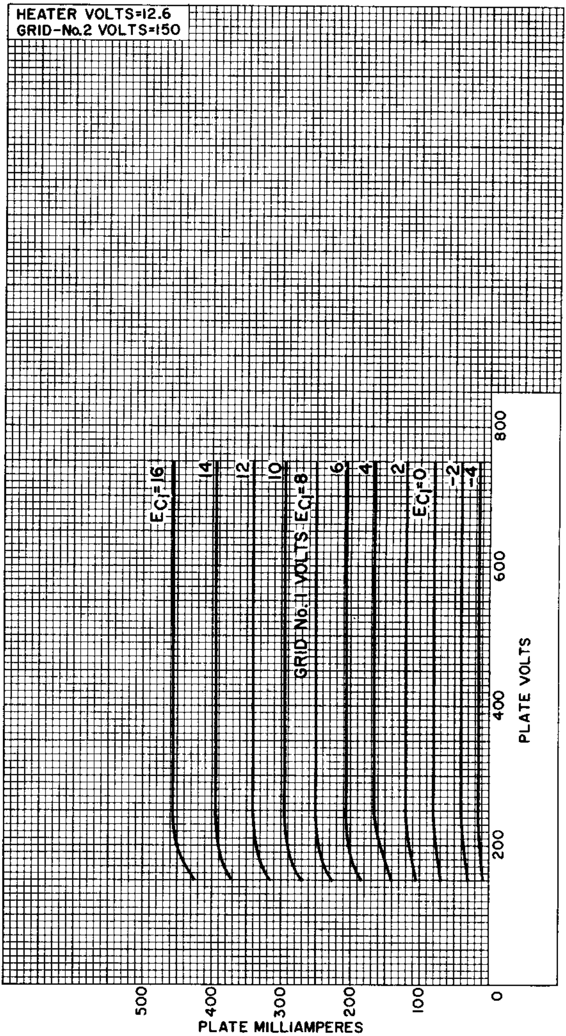
NOTE 3: MADE BY INSTRUMENTS SPECIALTIES COMPANY, LITTLE FALLS, NEW JERSEY.

NOTE 4: SEAT TUBE SUCH THAT GRID-No.2 TERMINAL EDGE MAKES A POSITIVE STOP ON SHOULDER.

NOTE 5: SPRING IS 0.600 INCH IN LENGTH AND 30 TURNS PER INCH OF 0.015-INCH-DIAMETER STEEL MUSIC WIRE.

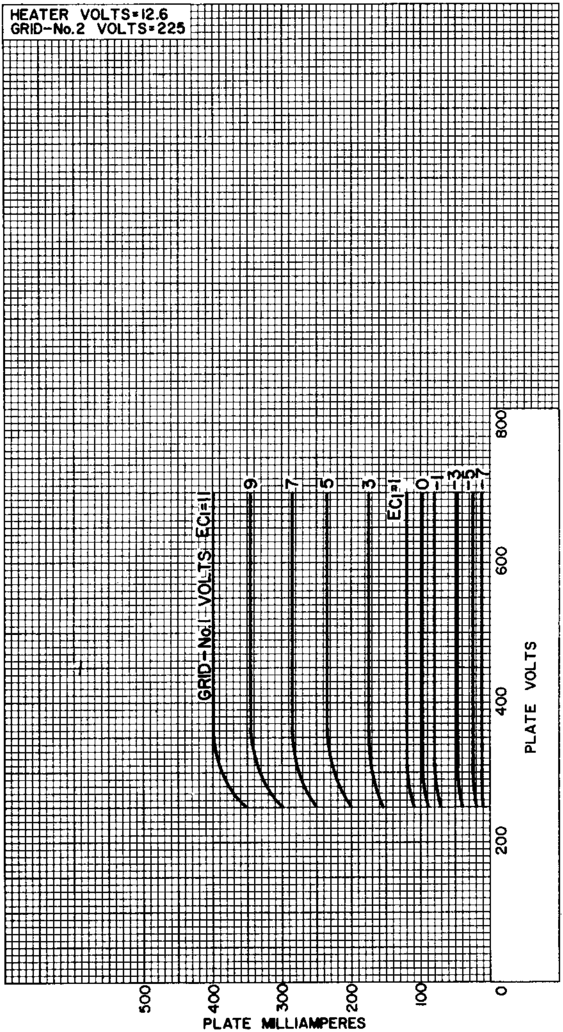
NOTE 6: FINGER STOCK TO SEAT ON 0.013-INCH LIP.

TYPICAL PLATE CHARACTERISTICS



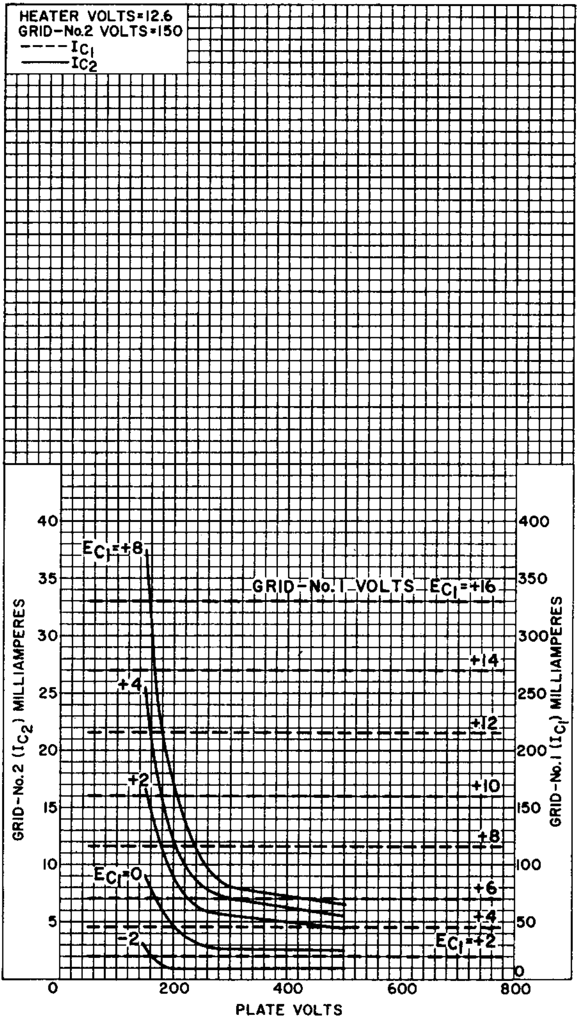
92CM-10949

TYPICAL PLATE CHARACTERISTICS



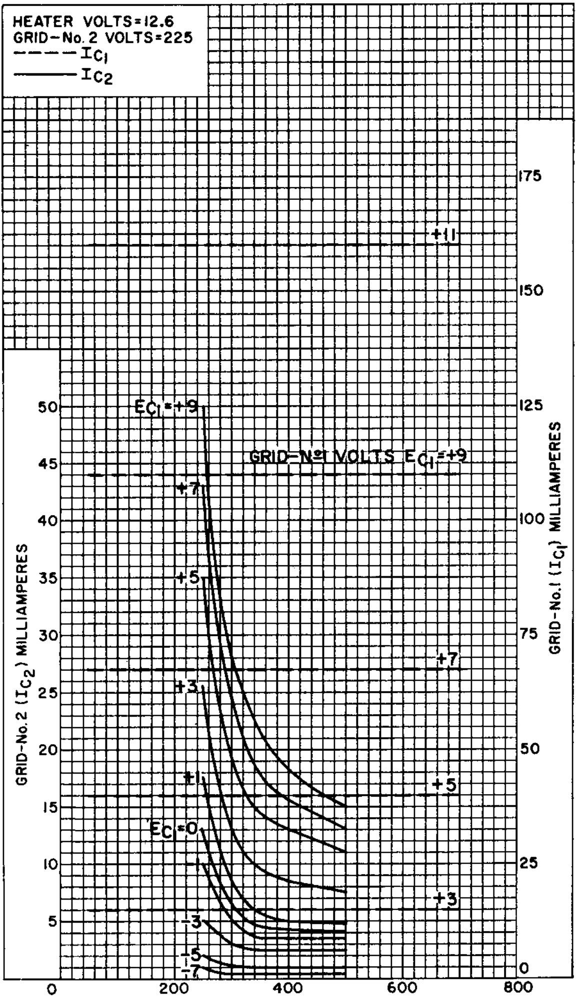
92CM-10951

TYPICAL CHARACTERISTICS



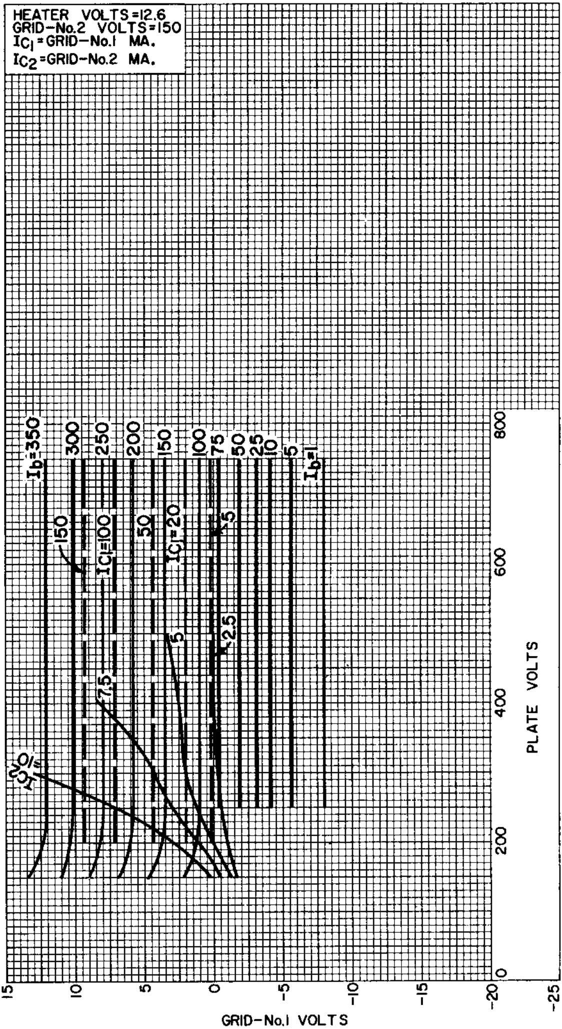
92CM-10950

TYPICAL CHARACTERISTICS



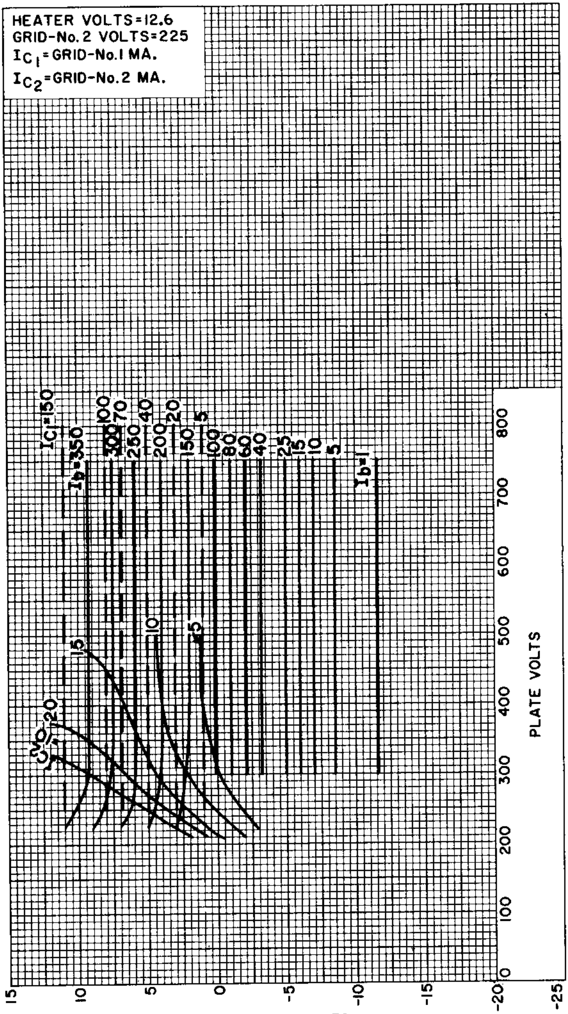
92CM-10954

TYPICAL CONSTANT-CURRENT CHARACTERISTICS



92CM-10952

TYPICAL CONSTANT-CURRENT CHARACTERISTICS



92CM-10958