VACUUM TUBE BULLETIN
WESTERN ELECTRIC VACUUM TUBE
NO. 240A

CLASSIFICATION

THE 240A VACUUM TUBE IS A THREE-ELEMENT, WATER-COOLED TUBE INTENDED PRIMARILY FOR USE AS A HIGH-FREQUENCY OSCILLATOR OR AMPLIFIER. IT MAY ALSO BE USED AS A MODULATOR OR LOW-FREQUENCY AMPLIFIER. THE WATER JACKET IS INTEGRAL WITH THE TUBE.

MAXIMUM OVERALL DIMENSIONS

THE MAXIMUM OVERALL DIMENSIONS ARE GIVEN IN FIG. 1. THEY ARE:

MAXIMUM OVERALL LENGTH	25 17/32"
DIAMETER	4 1/16"

INSTALLATION

DURING THE USE AND INSTALLATION OF THE TUBE IT SHOULD BE SUBJECTED TO THE LEAST POSSIBLE VIBRATION. EXCESSIVE MECHANICAL SHOCK WILL CAUSE FAILURE. THE TUBE SHOULD BE MOUNTED ONLY IN A VERTICAL POSITION. THERE SHOULD BE A FREE CIRCULATION OF AIR AROUND THE TUBE. NO OBJECT SHOULD TOUCH THE GLASS BULBS. THE TYPE OF MOUNTING RECOMMENDED IS SHOWN IN FIG. 1.

WATER-COOLING SYSTEM

THE COOLING WATER SHOULD BE OF SUFFICIENT PURITY TO RETARD THE TENDENCY FOR THE FORMATION OF SCALE ON THE ANODE. FORMATION OF SCALE WOULD HAVE THE EFFECT OF INSULATING THE ANODE FROM THE WATER AND THE INEFFECTIVE COOLING OF THE ANODE WOULD RESULT IN FAILURE OF THE TUBE. IT IS THEREFORE RECOMMENDED THAT DISTILLED WATER BE USED IN THE COOLING SYSTEM.

THE TEMPERATURE OF THE WATER AND RATE OF FLOW SHOULD BE SUCH THAT THERE IS NO TENDENCY TO BOIL, AS INDICATED BY A HISSING SOUND, UNDER MAXIMUM DISSIPATION. IN GENERAL THE OUTLET WATER TEMPERATURE SHOULD NOT EXCEED 75° C AND THE RATE OF FLOW SHOULD BE NOT LESS THAN 3 GALLONS PER MINUTE. THE MINIMUM LENGTH OF HOSE WHICH CAN BE USED TO INSULATE THE PLATE FROM THE WATER SUPPLY WHICH IS USUALLY GROUNDED, WILL DEPEND UPON THE RESISTIVITY OF THE WATER USED AND THE LEAKAGE CURRENT THAT CAN BE TOLERATED. IN NO CASE MUST THIS BE LESS THAN 15 FEET. THE HOSE CONNECTIONS MUST ALWAYS BE MADE SO THE WATER FLOWS UPWARD THROUGH THE JACKET.

PROVISION SHOULD BE MADE IN THE CIRCUIT TO SAFEGUARD AGAINST THE FILAMENT AND PLATE VOLTAGES BEING APPLIED UNTIL THE COOLING WATER IS CIRCULATING AT THE PROPER RATE AND TEMPERATURE, AND FOR THE IMMEDIATE CUTOFF OF THE FILAMENT AND PLATE VOLTAGES IF THE CIRCULATION RATE FALLS BELOW THE ALLOWED MINIMUM OR THE TEMPERATURE EXCEEDS THE ALLOWABLE MAXIMUM. A MOMENTARY INTERRUPTION OF THE WATER CIRCULATION DURING OPERATION OF THE TUBE MAY CAUSE IMMEDIATE FAILURE.

FILAMENT RATING AND SUPPLY

THE FILAMENT OF THIS TUBE IS DESIGNED TO OPERATE ON A VOLTAGE BASIS. THE VOLTMETER CONNECTIONS SHOULD BE MADE AT THE TERMINALS OF THE TUBE. THE PLATE AND GRID RETURNS SHOULD BE CONNECTED TO THE POSITIVE SIDE OF THE FILAMENT WHEN DIRECT-CURRENT SUPPLY IS USED. WHEN THE SYSTEM WILL ALLOW THE USE OF ALTERNATING-CURRENT SUPPLY, THE PLATE AND GRID CIRCUIT RETURNS SHOULD BE CONNECTED TO A CENTER TAP ON THE SECONDARY OF THE FILAMENT TRANSFORMER.

FILAMENT VOLTAGE	21.5 VOLTS
NOMINAL FILAMENT CURRENT	41 AMPERES
AVERAGE THERMIONIC EMISSION	7 AMPERES

A 5% DECREASE IN FILAMENT VOLTAGE REDUCES THE THERMIONIC EMISSION APPROXIMATELY 35%.

SOME PROVISION SHOULD BE MADE TO LIMIT THE INITIAL CURRENT, WHEN THE FILAMENT IS COLD, TO A VALUE NOT GREATER THAN 100 AMPERES. THIS MAY BE DONE BY INSERTING ADDITIONAL RESISTANCE WHEN STARTING OR BY USING A TRANSFORMER HAVING SUFFICIENTLY HIGH REACTANCE.

STATIC CHARACTERISTICS

THE CURVES IN FIG. 2 GIVE THE STATIC CHARACTERISTICS OF A TYPICAL 240A VACUUM TUBE. THESE CURVES ARE TAKEN WITH THE FILAMENT OPERATING ON ALTERNATING CURRENT AND WITH THE GRID AND PLATE CIRCUITS CONNECTED TO THE MID-POINT OF THE FILAMENT TRANSFORMER.

WITH A PLATE VOLTAGE OF 10,000 VOLTS AND A GRID VOLTAGE OF -50 VOLTS

PLATE CURRENT	.625 AMPERES
AMPLIFICATION FACTOR	40
PLATE RESISTANCE	9000 OHMS
MUTUAL CONDUCTANCE	4450 MICROMHOS

THE RELATIVE AMOUNT OF SECONDARY EMISSION FROM THE GRID IS INDICATED FOR A TYPICAL 240A TUBE BY THE CURVE IN FIG. 3.

INTERELECTRODE CAPACITIES

THE AVERAGE VALUES OF THE DIRECT CAPACITIES BETWEEN THE ELECTRODES OF 240A VACUUM TUBES AS MEASURED AT THE TERMINALS ARE:

PLATE TO GRID, C_{PG}	26 MMF.
PLATE TO CATHODE, C_{PC}	5 MMF.
GRID TO CATHODE, C_{GC}	10 MMF.

OPERATING LIMITS

WHEN THE TUBE IS USED AS AN OSCILLATOR OR RADIO-FREQUENCY AMPLIFIER THE FOLLOWING LIMITS SHOULD BE OBSERVED:

MAXIMUM MODULATED PLATE VOLTAGE (D.C.)	9000 VOLTS
MAXIMUM NON-MODULATED PLATE VOLTAGE (D.C.)	12,000 VOLTS
MAXIMUM A.C. PLATE VOLTAGE (R.M.S.)	12,000 VOLTS
MAXIMUM PLATE CURRENT (D.C.)	1.7 AMPERES
MAXIMUM PLATE DISSIPATION	10,000 WATTS
MAXIMUM GRID DISSIPATION	300 WATTS

FREQUENCY

THE OPERATING LIMITS SPECIFIED APPLY FOR ALL FREQUENCIES BELOW 20,000 KILOCYCLES.

FOR HIGHER FREQUENCIES IT IS NECESSARY TO REDUCE THE PLATE VOLTAGE. A ROUGH INDICATION OF THE PERMISSIBLE PLATE VOLTAGE FOR ANY FREQUENCY HIGHER THAN 20,000 KILOCYCLES IS GIVEN BY THE FOLLOWING RELATION:

$$E_{B_{HF}} = E_{B_{20,000\ K.C.}} \times \frac{20,000}{HF \quad IN \quad KC}$$

HF = HIGHER FREQUENCIES

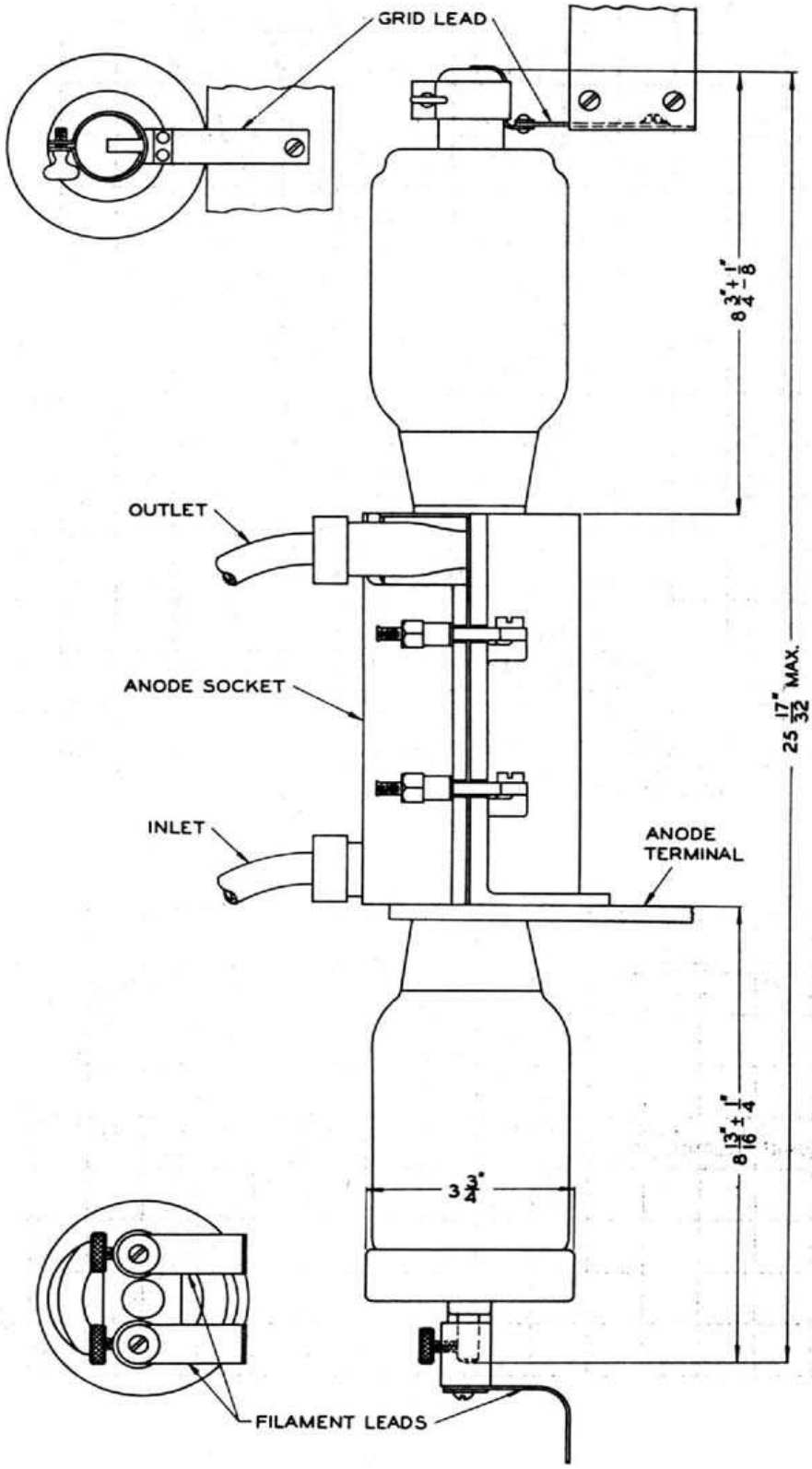
GRID LEAD
OUTLET
ANODE SOCKET
INLET
ANODE TERMINAL
FILAMENT LEADS
8 3/4" ± 1/8"
25 17/32" MAX.
8 13/16" ± 1/4"
3 3/4"

FIG. 1

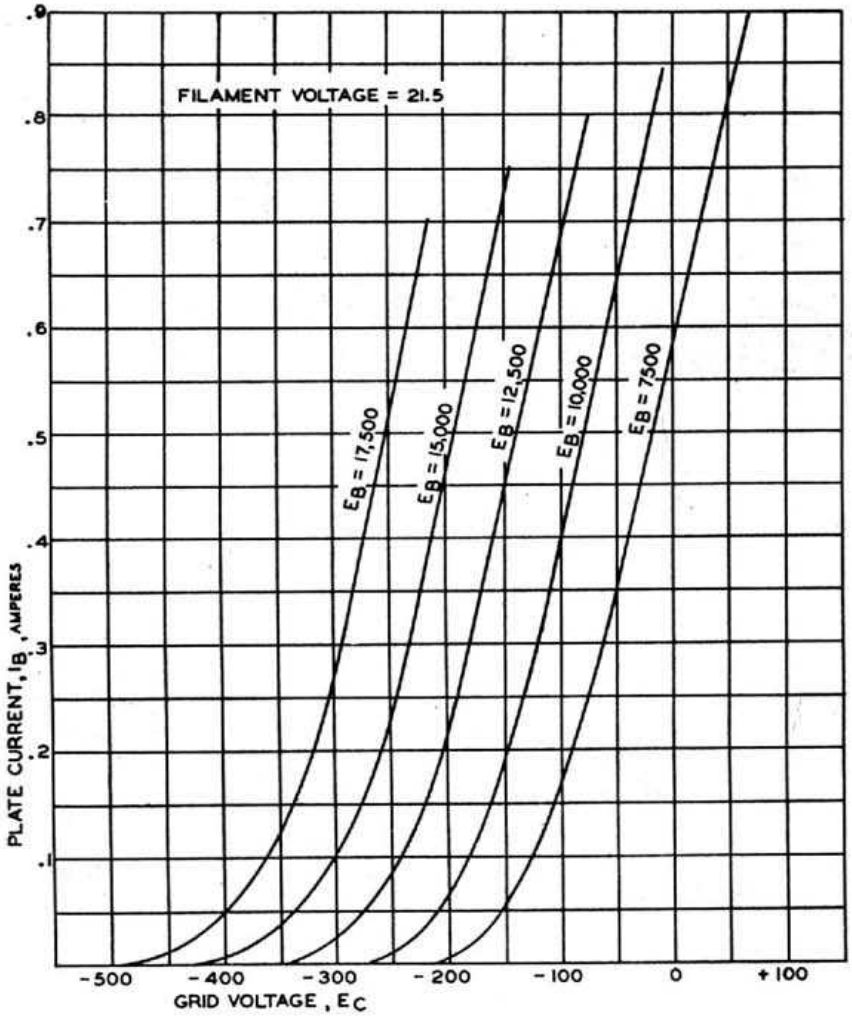

FIG. 2

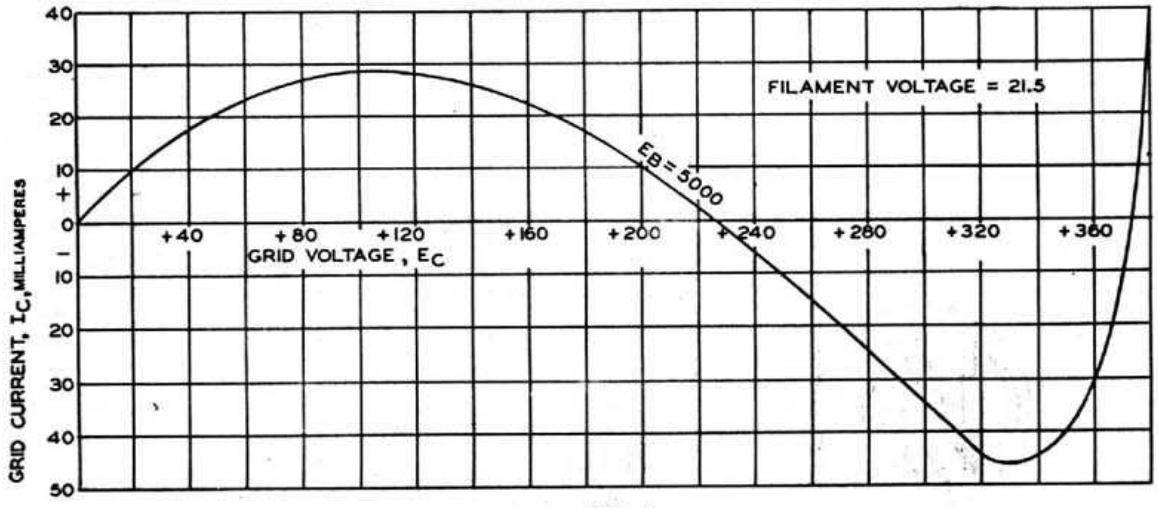

FIG. 3

THIS BULLETIN IS PREPARED AND DISTRIBUTED BY THE VACUUM TUBE DEVELOPMENT DEPARTMENT OF BELL TELEPHONE LABORATORIES

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