Western Electric

340A Vacuum Tube

Classification—Filamentary water-cooled triode

This tube may be used as an audio-frequency amplifier or as a radio-frequency oscillator, amplifier or modulator.

Dimensions—Dimensions and outline diagrams are shown in Figure 1. The overall dimensions are:

Maximum overall length	$21\frac{15}{16}''$
Diameter of bulb	$4\frac{1}{8}''$

Mounting—The tube should be mounted only in a vertical position with the anode end down in a Western Electric 132A, 133A or similar socket.

Filament—Tungsten

Filament voltage	20.0 volts, a.c.
Nominal filament current	72.0 amperes
Average thermionic emission	10.0 amperes

Average Direct Interelectrode Capacitances

Plate to grid	25 $\mu\mu f$
Grid to filament	26 $\mu\mu f$
Plate to filament	2.1 $\mu\mu f$

Characteristics—Performance data given below are based upon a typical set of conditions. Variations can be expected with different circuits and tubes.

Figure 2 gives the static characteristics of a typical tube plotted against grid and plate voltages. In Figure 3 the constant plate and grid current curves are shown. The total emission and filament resistance characteristics are given in Figure 4.

Average Characteristics at plate voltage of 15,000 and plate current of 1.30 amperes

Amplification factor	40
Plate resistance	5860 ohms
Grid to plate transconductance	6820 micromhos

Operation

Maximum Ratings

Max. direct plate voltage	20,000 volts
Max. direct plate current	2.5 amperes
Max. plate dissipation	25,000 watts
Max. grid dissipation	600 watts
Max. r-f grid current	60 amperes
Max. frequency for the above ratings	10 megacycles
Max. plate voltage for upper frequency limit of 23 Mc	15,000 volts

Max. plate voltage for frequencies between 10 and 23 Mc in proportion.

Class B Audio Amplifier or Modulator for Balance 2 Tube Circuit.

Direct plate voltage	15,000	12,500 volts
Grid bias	−200	−160 volts
Direct plate current per tube		
No drive	0.40	0.35 ampere
Max. drive	1.6	1.6 amperes
Plate dissipation, per tube	9,000	7,200 watts
Load resistance, plate-to-plate	9,600	7,680 ohms
Load resistance, per tube	2,400	1,920 ohms
Approximate maximum output—2 tubes	30,000	24,000 watts
Recommended power for driving stage	1,000	1,000 watts

Class B Radio-Frequency Amplifier

Direct plate voltage	18,000	12,500 volts
Direct plate current for carrier conditions	1.5	1.4 amperes
Grid bias	−450	−300 volts
Approx. carrier watts for use with 100% modulation	9,000	5,800 watts

Class C Radio-Frequency Oscillator or Power Amplifier—Unmodulated

Direct plate voltage	18,000	15,000 volts
Direct plate current	2.5	2.5 amperes
Grid bias	−675 to −900	−550 to −750 volts
Nominal power output	30,000	25,000 watts

Class C Radio-Frequency Amplifier—Plate Modulated

Direct plate voltage	12,500	10,000 volts
Direct plate current	1.2	1.5 amperes
Grid bias	−600	−500 volts
Max. direct grid current	250	250 milliamperes
Nominal carrier power output	10,000	10,000 watts

Operating Precautions

Mechanical—Figure 1 shows the overall dimensions and basing arrangement for the tube.

The tubes should not be subjected to mechanical shock or excessive vibration. Mechanical vibration may cause breakage of the tungsten filaments. Care should always be used in handling the tube to avoid scratches as these may develop into cracks which result in leaks.

A free circulation of air must be provided to insure adequate cooling of the glass during operation.

Adjacent tubes should not be closer than 15 inches on centers and no circuit element, except connections and necessary electrostatic shielding, should be closer than 12 inches to the glass.

The cooling water should be of sufficient purity to retard the tendency toward 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 for the water 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 6 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 that the water flows in at the center port of the tube socket.

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 cut-off of the filament and plate voltages if the circulating 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.

Electrical—Overload protection should always be provided for the plate circuit. A suitable fuse or circuit breaker should remove the plate voltage if the plate current exceeds 4 amperes. Although the tube is sufficiently rugged to withstand momentary overloads, a prolonged overload

caused by inefficient adjustment of the circuit, may damage the tube. When adjusting a new circuit or installing a new tube, reduced plate voltage or a series resistance of 1000 to 5000 ohms in the plate circuit should be used until it is operating properly.

The filament should always be operated at the rated voltage, measured at the tube terminals. A 5% decrease in filament voltage reduces the thermionic emission approximately 35%. If satisfactory operation can be obtained at lower than the rated voltage an increase in filament life may be obtained. Either direct or alternating current may be used for heating the filament. If direct current is used, the plate and grid circuit returns should be connected to the positive filament terminal. Also the connections to the filament terminals should be reversed periodically. If alternating current is used, the circuit returns should be connected to the center tap of the filament heating transformer winding or to the center tap of a resistor placed between the filament terminals. A resistance of 50 to 75 ohms of 250 watt rating is suitable.

Some provision should be made to limit the initial filament current to less than 150 amperes, when the filament is cold. This may be done by inserting additional resistance in the filament circuit when voltage is first applied or by using a transformer having sufficiently high reactance.

Audio Amplifier or Modulator

Class B—Grid bias practically at cut-off and grid driving voltage higher than the bias.

Two tubes may be used in a balanced circuit. An adequate driving stage and an input transformer with good regulation must be used so that the grid current drawn during positive grid swings does not produce appreciable distortion. The output transformer must transform the load impedance to the proper value. The power output obtainable will be determined by the quality of the transformer used and the amount of distortion which can be tolerated. The output can be increased or the distortion decreased by the use of degenerative feedback. The grid bias must be held constant and therefore cannot be obtained by grid leak or series resistor methods. A source having good regulation is necessary.

The power required of a modulator for complete modulation of a Class C amplifier is one-half the direct power input to the plates of the Class C amplifier.

Radio-Frequency Oscillator or Power Amplifier

Class B—Radio Frequency Amplifier—Grid bias practically at cut-off.

The Class B radio-frequency amplifier is used to amplify a modulated radio-frequency carrier wave without appreciable distortion. It operates similarly to the Class B audio amplifier except that only a single tube need be used, the tuned output circuit serving to preserve the wave shape. The push-pull circuit, however, eliminates the even order harmonics and thus increases the efficiency slightly.

Class C—Radio-Frequency Oscillator or Power Amplifier—Grid Bias below Cut-off.

Unmodulated

This type of operation is suitable for telegraphy, or the production of a continuous flow of radio-frequency power for purposes other than communication.

Plate Modulated

This type of operation is for use when the modulating voltage is superimposed on the plate supply voltage and to obtain good quality the output power should vary as the square of the plate voltage. For complete or 100% modulation, the plate voltage varies from zero to twice the applied direct value during a cycle of the audio frequency. With no modulation applied the plate voltage is, of course, the direct value and the carrier power output is one-fourth of the peak power output under 100% modulation. In this case, since the plate voltage varies with modulation, the direct value must be rated lower than for other types of operation.

High Frequency Ratings

The frequency limits specified under maximum ratings are based on the tube being used as an oscillator. The tube may be used at full rating up to 10 megacycles. When operating at higher frequencies, the dielectric losses, charging currents and lead-in heating may be increased to an excessive degree. Accordingly, the plate voltage and consequently the plate input must be reduced to values specified for the upper frequency limit, and for frequencies between these two limits the plate voltage should be proportionately reduced.

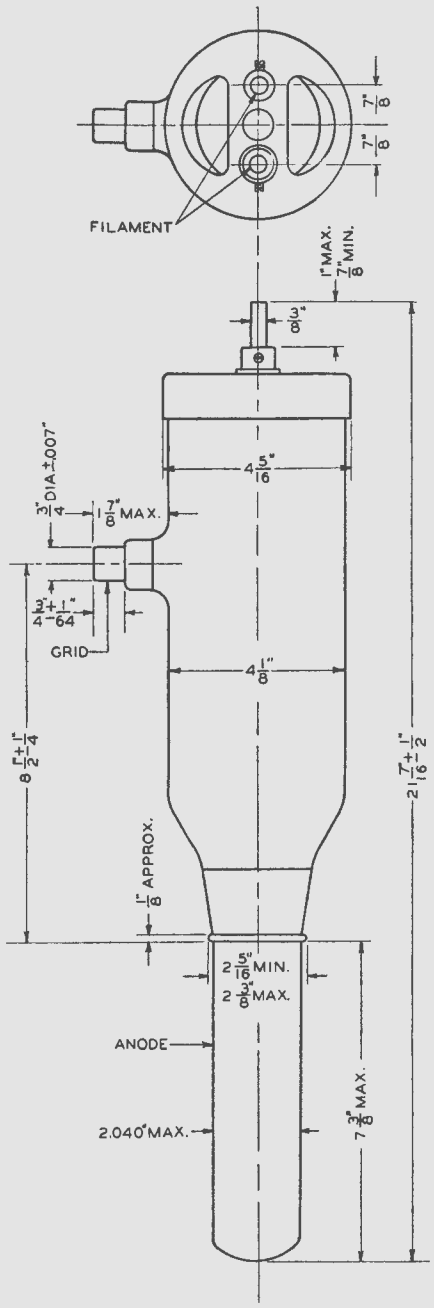

FIG. 1

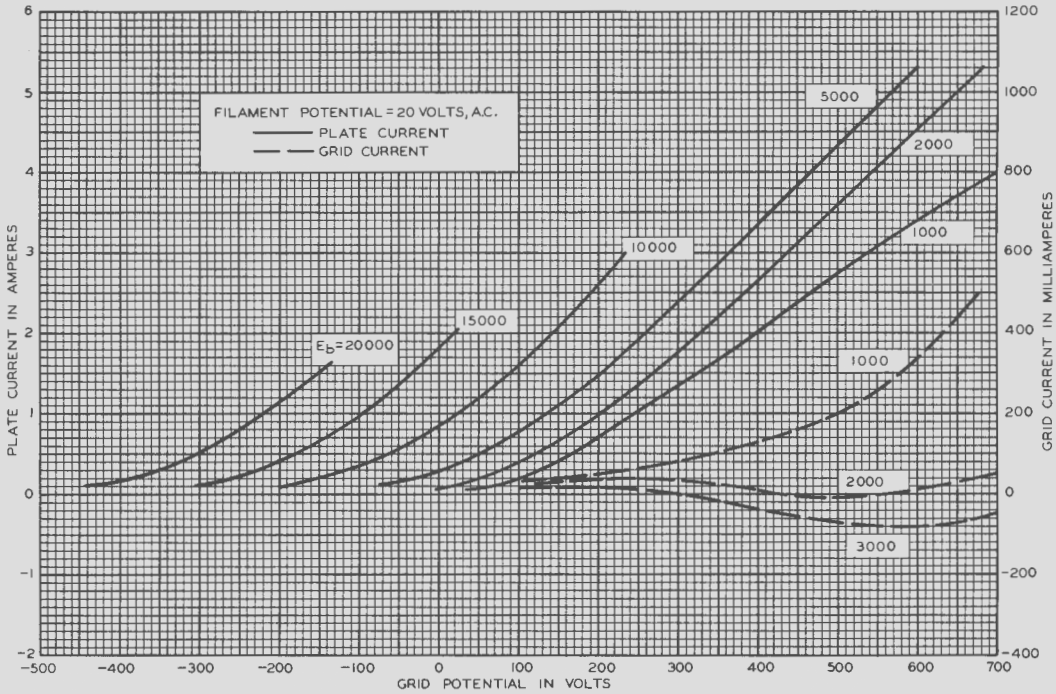
FILAMENT POTENTIAL = 20 VOLTS, A.C.
PLATE CURRENT
GRID CURRENT
E_b=20000
15000
10000
5000
2000
1000
1000
2000
3000
PLATE CURRENT IN AMPERES
GRID CURRENT IN MILLIAMPERES
GRID POTENTIAL IN VOLTS

FIG. 2

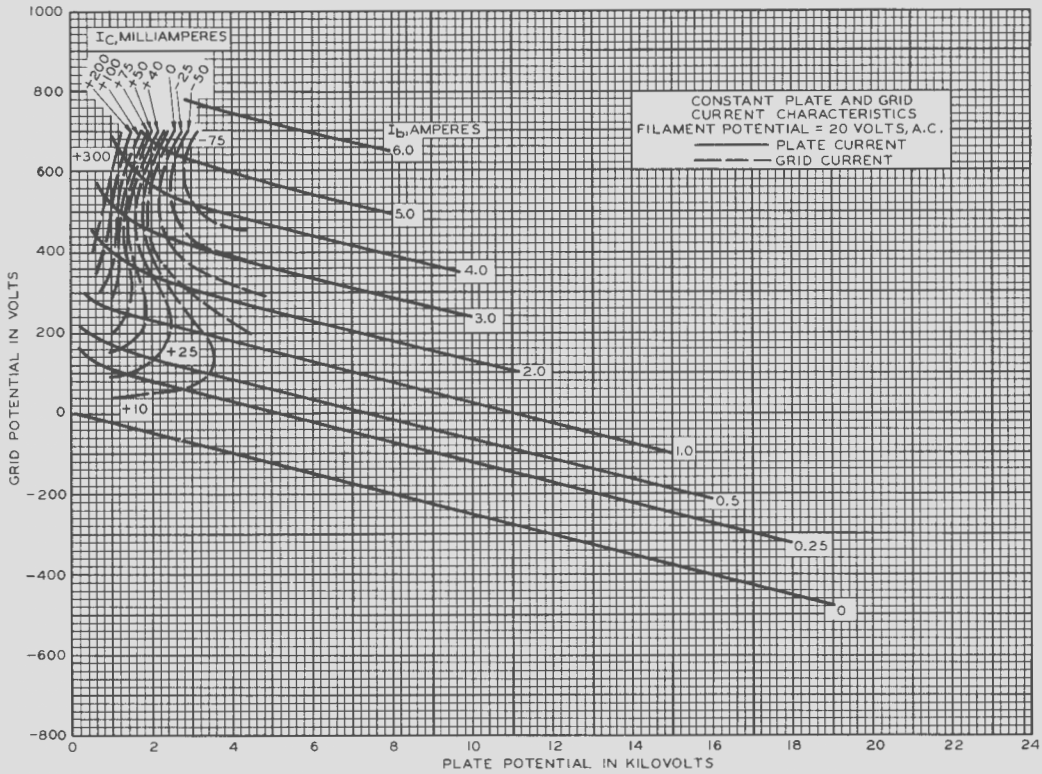
I_c, MILLIAMPERES
+200
+100
+75
+50
+40
0
-25
-50
-75
+300
+25
+10
I_b, AMPERES
6.0
5.0
4.0
3.0
2.0
1.0
0.5
0.25
0
CONSTANT PLATE AND GRID CURRENT CHARACTERISTICS
FILAMENT POTENTIAL = 20 VOLTS, A.C.
PLATE CURRENT
GRID CURRENT
GRID POTENTIAL IN VOLTS
PLATE POTENTIAL IN KILOVOLTS

FIG. 3

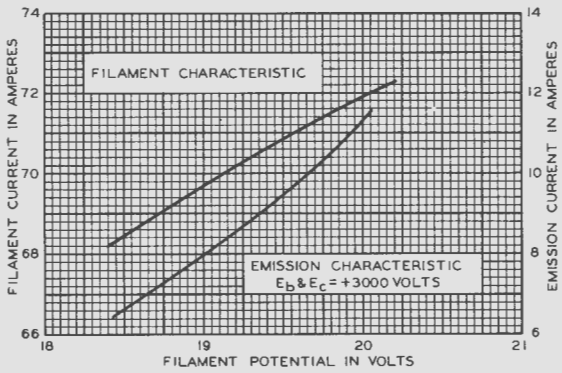

FIG. 4

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