TENTATIVE DATA

EITEL-McCULLOUGH, INC.

SAN BRUNO, CALIFORNIA

4W20000A

POWER TETRODE

The Eimac 4W20000A is a high-power, water-cooled transmitting tetrode having a maximum plate dissipation rating of 20 kilowatts. This tube will operate efficiently as a power-amplifier at frequencies up to 250 Mc. A single 4W20000A operating as a television visual r-f amplifier will deliver a synchronizing power output of 20 kilowatts at 216 Mc., with a 5-Mc. bandwidth.

The coaxial terminal arrangement of the tube is ideally suited for use in cavity circuits. The cathode is a unipotential thoriated tungsten cylinder of rugged construction, heated by electron bombardment.

GENERAL CHARACTERISTICS

ELECTRICAL

Cathode: Unipotential, thoriated tungsten. Heated by electron bombardment.		
D-C Voltage (Approx.)	1650	volts
D-C Current (Approx.)	1.8	amperes
Filament: Pure Tungsten, Helical		
Voltage	10	volts
Current	30	amperes
Maximum allowable starting current	50	amperes
Direct Interelectrode Capacitances (Average)		
Grid-Plate	0.5	$\mu\mu$fd
Input	125	$\mu\mu$fd
Output	23	$\mu\mu$fd
Screen-Grid Amplification Factor (Average)	5.5	
Transconductance (I_b=6.6 A., E_b=3.0 kV., E_{c2}=1200 V.)	75,000	μmhos

MECHANICAL

Base	Special, Concentric
Mounting Position	Vertical, base down or up
Cooling	Water and Forced Air
Maximum Overall Dimensions	
Length	17 inches
Diameter	4.7 inches
Net Weight	7.6 pounds
Shipping Weight	40 pounds

RADIO FREQUENCY POWER AMPLIFIER

MAXIMUM RATINGS (per tube)

D-C PLATE VOLTAGE	8 MAX. KV.
D-C PLATE CURRENT	15 MAX. AMP.
PLATE DISSIPATION	20 MAX. KW.
SCREEN DISSIPATION	200 MAX. WATTS
GRID DISSIPATION	60 MAX. WATTS

TYPICAL OPERATION

Class-C Telegraphy or FM Telephony (Per tube—220 Mc.)

D-C Plate Voltage	5000	6000	7000	Volts
D-C Screen Voltage	1200	1200	1200	Volts
D-C Grid Voltage	—350	—370	—400	Volts
D-C Plate Current	3.6	3.6	3.4	Amps.
D-C Screen Current (approx.)*	167	167	167	Ma.
D-C Grid Current (approx.)	50	50	50	Ma.
Peak R-F Input Voltage	455	475	505	Volts
Driving Power (approx.)*	750	780	830	Watts
Screen Dissipation	200	200	200	Watts
Plate Power Input	18	21.6	23.8	Kw.
Plate Dissipation	7.0	8.6	8.0	Kw.
Useful Power Output	9.2	11.5	13.0	Kw.

*The performance figures listed above are obtained by calculation from the characteristic tube curves and confirmed by direct tests. The driving power and output power allow for losses associated with practical resonant circuits.

TYPICAL OPERATION

Class-B Linear Amplifier—Television Visual Service
(Per tube, 5-Mc. Bandwidth, 216 Mc.)

Peak Synchronizing Level		
Load Impedance	400	Ohms
Effective Length of Plate Line	1/4	Wave
D-C Plate Voltage	5500	Volts
D-C Screen Voltage	1200	Volts
D-C Control Grid Voltage	—240	Volts
D-C Plate Current	7.1	Amp.
D-C Screen Current (approx.)	500	Ma.
D-C Control Grid Current (approx.)	140	Ma.
Peak R-F Grid Input Voltage	430	Volts
Driving Power (approx.)	1500	Watts
Plate Power Input	39.1	Kw.
Plate Dissipation	16.5	Kw.
Useful Plate Power Output	20.1	Kw.
Black Level		
D-C Plate Current	5.3	Amp.
D-C Control Grid Current (approx.)	50	Ma.
Peak R-F Grid Input Voltage	330	Volts
Driving Power (approx.)	875	Watts
Plate Power Input	29.2	Kw.
Plate Dissipation	18.0	Kw.
Useful Power Output	11.2	Kw.

These 216 Mc. typical performance figures were obtained by direct measurement in test equipment. The output power is useful power measured in a load circuit. The driving power is that taken by the tube and a practical resonant grid circuit. These figures are subject to variation and in many cases, with further refinement and improved techniques, better performance might be obtained.

TENTATIVE DATA

APPLICATION

Cathode Heating Power—The cathode of the 4W20000A is a unipotential, thoriated tungsten cylinder, heated by electron bombardment of its inner surface. Bombardment is obtained by using the cylindrical cathode as the anode of a diode. A helical filament is mounted on the axis of the cathode cylinder to supply the bombarding electrons. A d-c potential of approximately 1650 volts is applied between the filament and the cathode cylinder, and the recommended cathode heating power of 3000 watts is obtained with approximately 1.8 amperes.

The inner filament is designed to operate under space-charge limited conditions so that the cathode temperature may be varied by changing the voltage applied between the inner filament and the cathode cylinder.

Since the cathode is connected to the negative terminal of the main plate supply, the inner filament may be at considerable negative potential with respect to ground. The filament transformer supplying the heating for the inner filament should be adequately insulated for this voltage.

Filament Operation—For maximum tube life the filament voltage as measured directly at the socket should be the rated voltage of 10 volts. The filament voltmeter should be capable of indicating within 1% accuracy and unavoidable voltage variations should be within the range of ± 2%. If a voltage regulator is used, the voltmeter should be a dynamometer type capable of reading correct RMS voltage with distorted wave forms.

Caution: It must be kept in mind that the filament is at a potential of 1650 volts d-c with respect to ground. The filament transformer and voltmeter must be adequately insulated for this voltage.

Anode Cooling—The water-cooled anode requires 8 gallons per minute of cooling water for the rated 20 kilowatts of plate dissipation. This corresponds to a pressure drop of 7 pounds per square inch across the water jacket. The inlet water pressure must not exceed a maximum of 50 pounds per square inch.

The outlet water temperature must not exceed a maximum of 70°C. under any conditions.

Seal Cooling—The following notes will be clarified by reference to the drawing showing the 4W20000A in a typical 216-Mc. resonant cavity amplifier.

The grid and screen tube contact surfaces and adjacent glass must be cooled by high-velocity air which is accomplished by means of ring manifolds, as shown in the drawing. The quantity, velocity and direction of air must be adjusted to limit the maximum seal temperatures to 150°C.

The cathode and filament-stem also require forced-air cooling. A minimum of 30 cubic feet per minute must flow into the space enclosed by the outer filament spring collet connection. Part of this air flows through the three air holes provided in the center of the base of the tube. This air cools the filament stem and vents through the nine holes in the base inside the cathode terminal.

The filament spring collet fingers should be adequately spaced to allow approximately three-quarters of the air to flow through the collet. A cylindrical duct of non-metallic material, approximately 2½ inches in diameter, should be placed around the cathode connecting collet to guide the air along the cathode contacting surface and onto the cathode to glass seal. The temperature of the seals should not exceed 150°C.

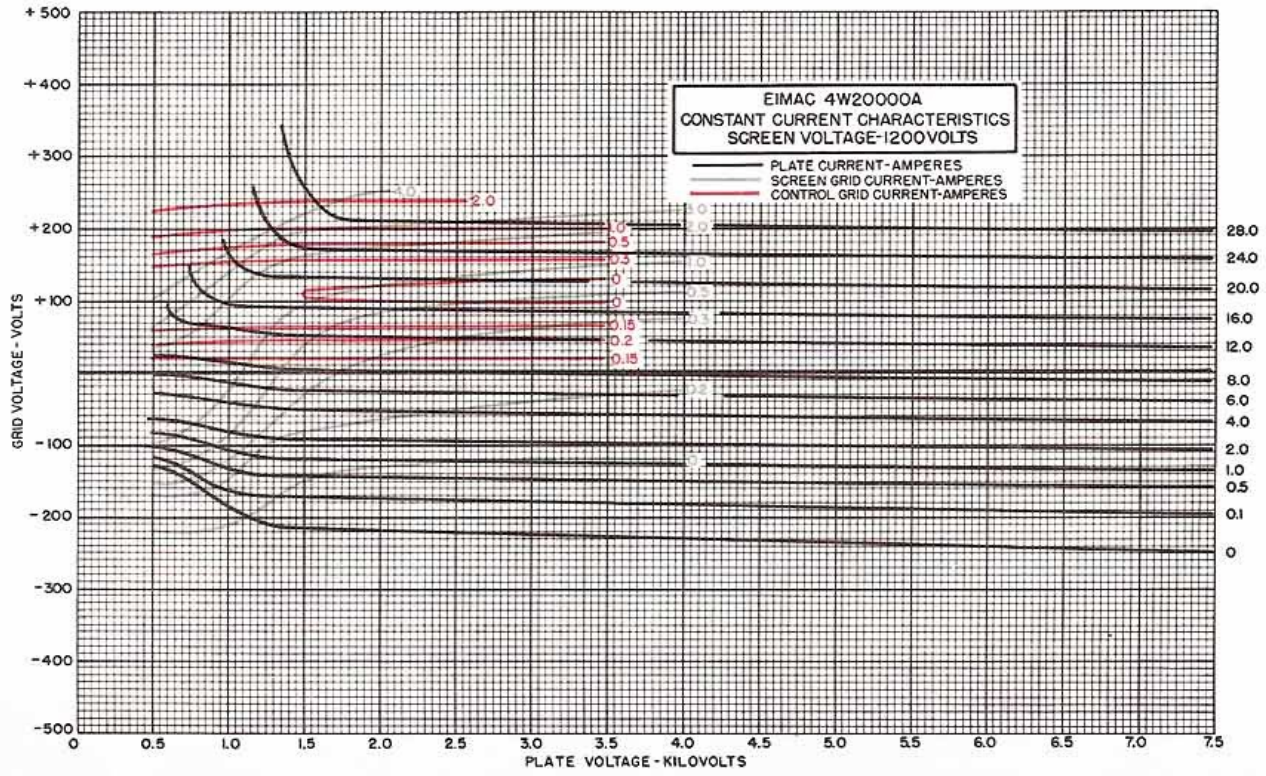
A "Roots-Connersville" Rotary Positive Blower, Type AF, size 36, provides an adequate source of cooling air.

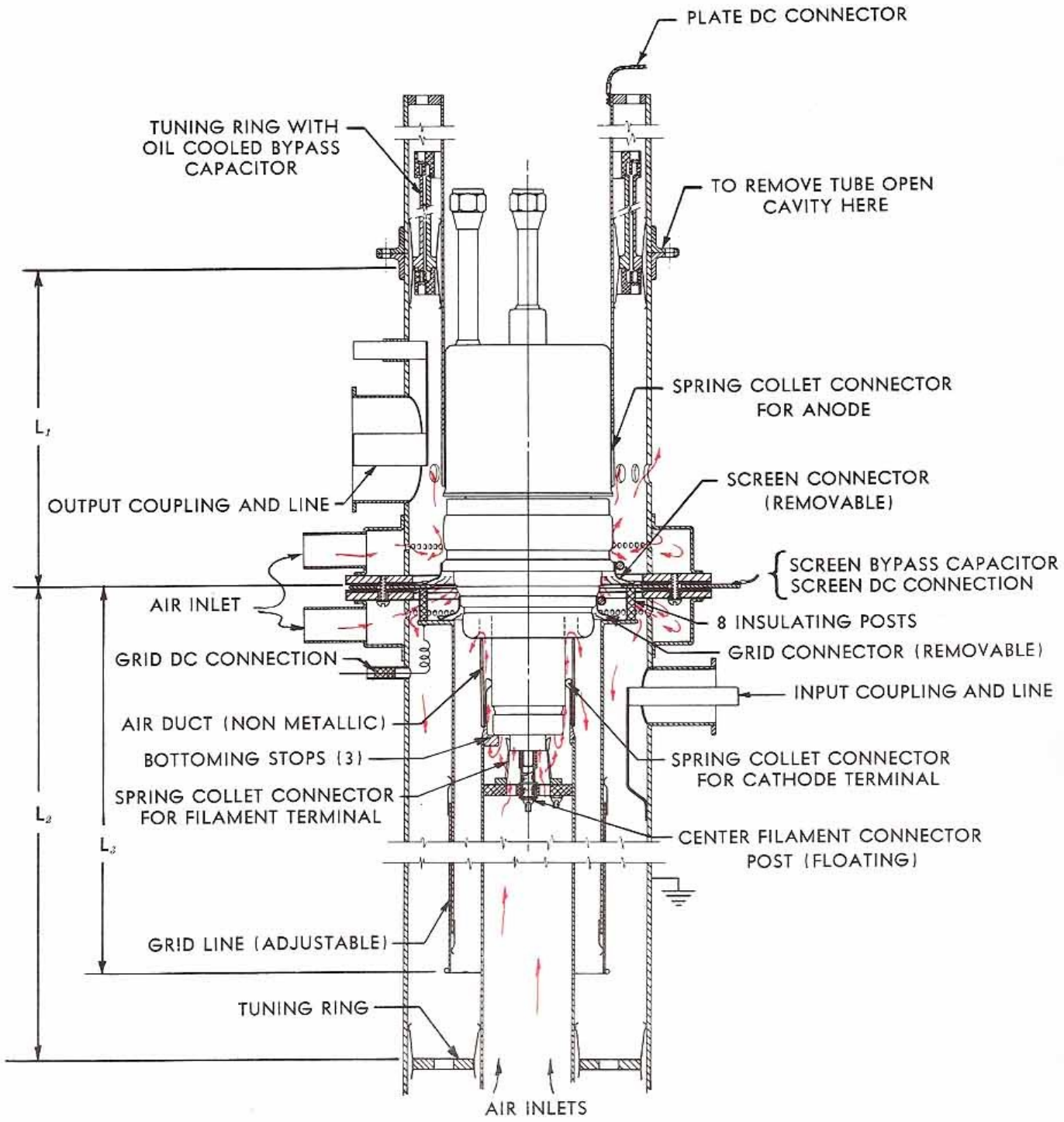
Cooling may be considered adequate when the seal temperatures are maintained as stated above. One method of measuring temperatures is provided by using "Tempilaq", a temperature-sensitive lacquer which melts when a given temperature is reached. This product is obtainable from the Tempil Corp., New York 11, N. Y.

Air and water flow must be started before filament and cathode power are applied and maintained for at least five minutes after the filament and cathode power have been removed.

Cavity—The cavity shown in the drawing is a typical power amplifier cavity for 216 Mc. operation. The grid circuit is an open-ended electrical half-wave line. The screen is returned to the cathode through an electrical half-wave shorted line. The plate-line is an electrical quarter-wave, shorted coaxial line with the plate by-pass capacitor built into the line-shorting ring.

In order to facilitate changing tubes, the plate cavity is made in two sections joined by a flange connection. The upper section, inner plate-line cylinder, and the tube are removed as a unit. The plate-line shorting ring must be in the upper section before opening the cavity. To minimize lost time, the spare tube should be fitted already with screen and grid connectors and water-line extensions.

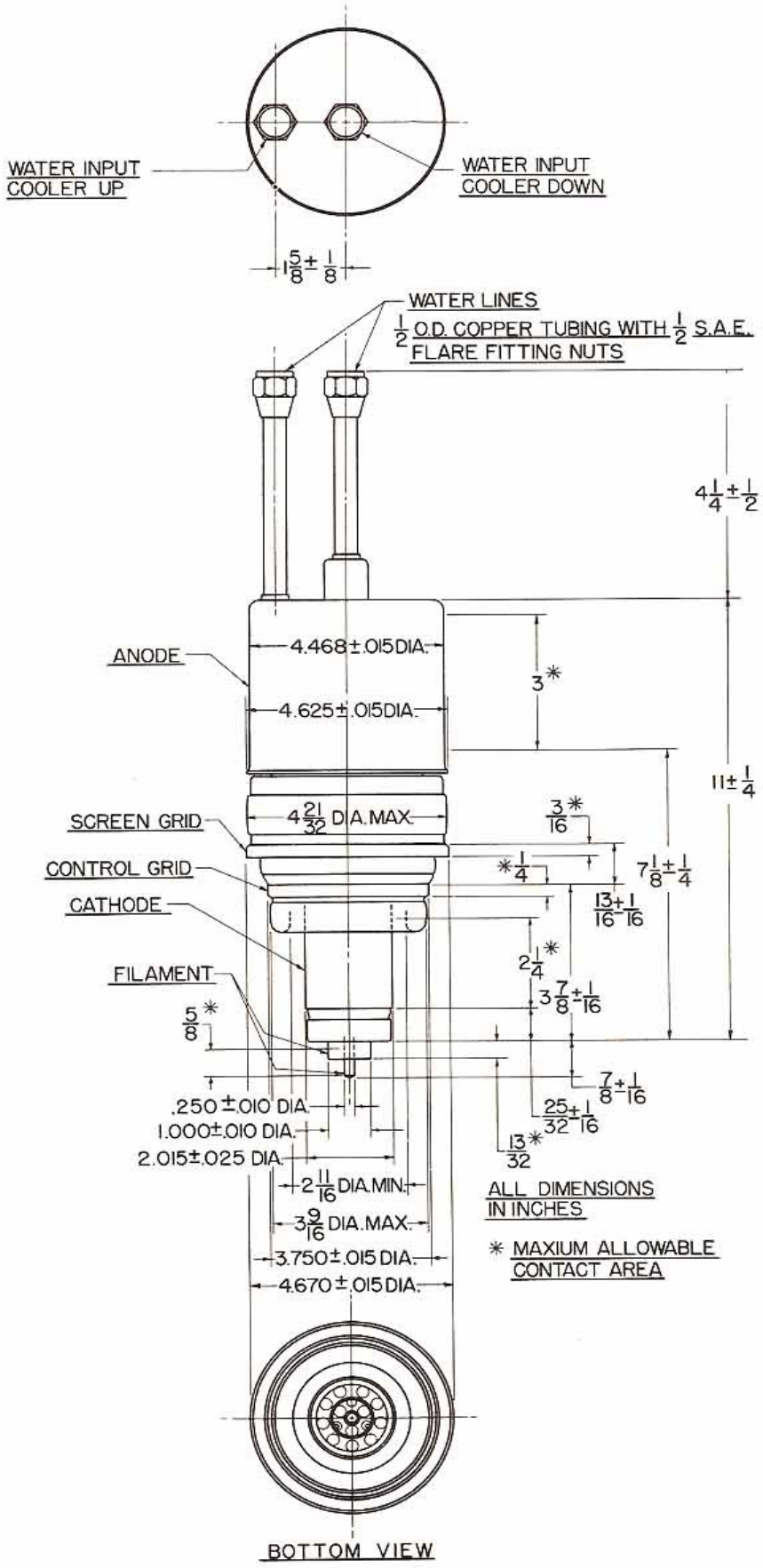




TYPICAL POWER AMPLIFIER CAVITY, TUBE CONNECTORS AND AIR COOLING

APPROXIMATE DIMENSIONS FOR 216 Mc

L_1 = 9"
L_2 = 23"
L_3 = 13"



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