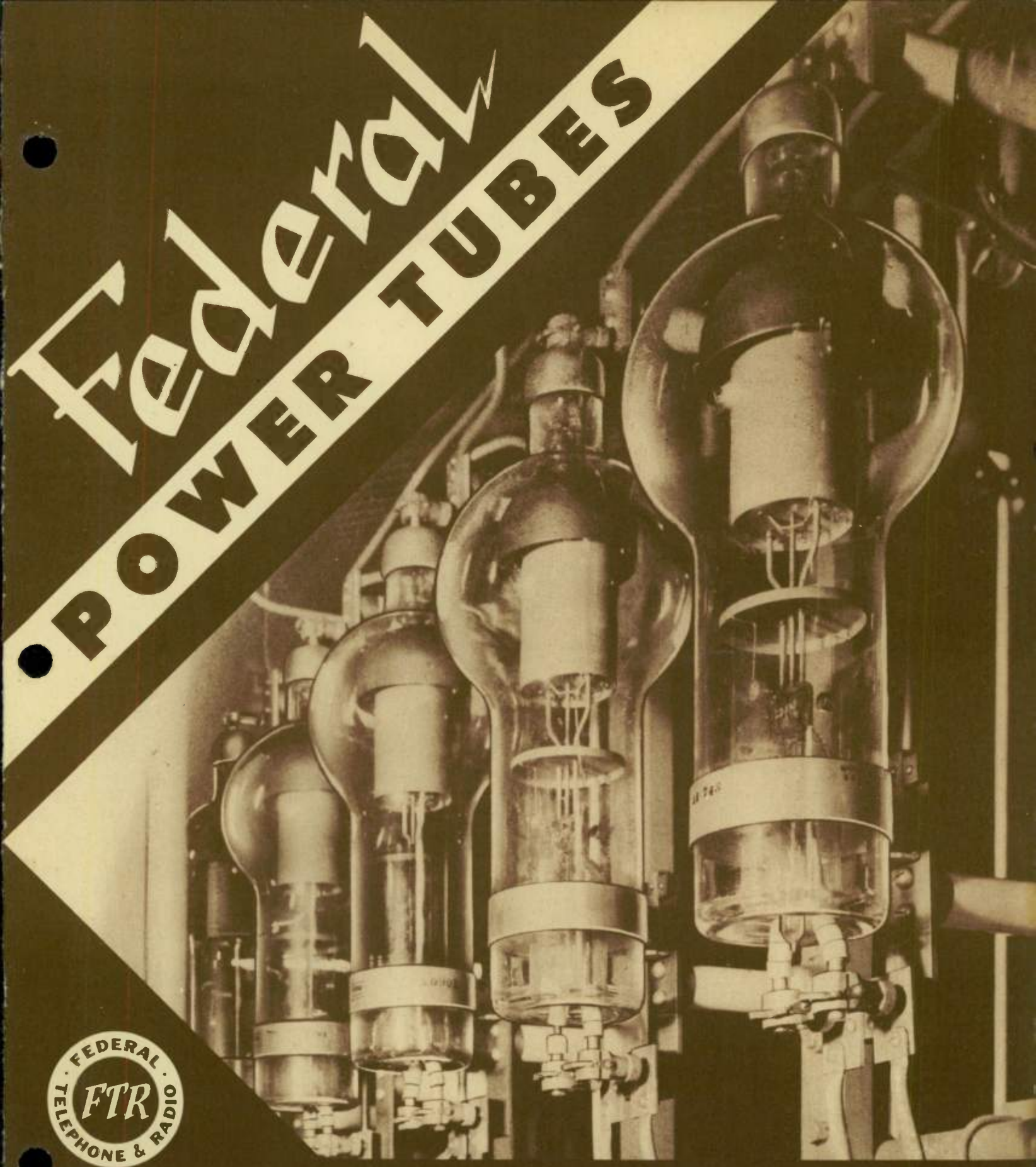
Federal POWER TUBES



FEDERAL TELEPHONE & RADIO FTR

Federal Telephone and Radio Corporation

591 BROAD STREET, NEWARK 2, NEW JERSEY, U. S. A.

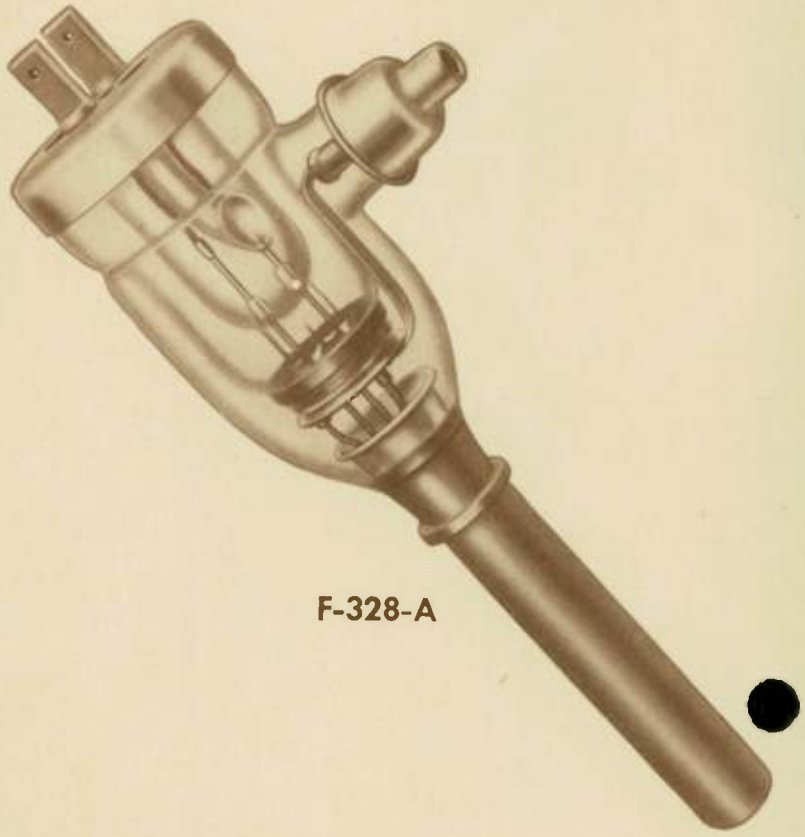
An IT&T ASSOCIATE

TRANSMITTING — INDUSTRIAL TUBES

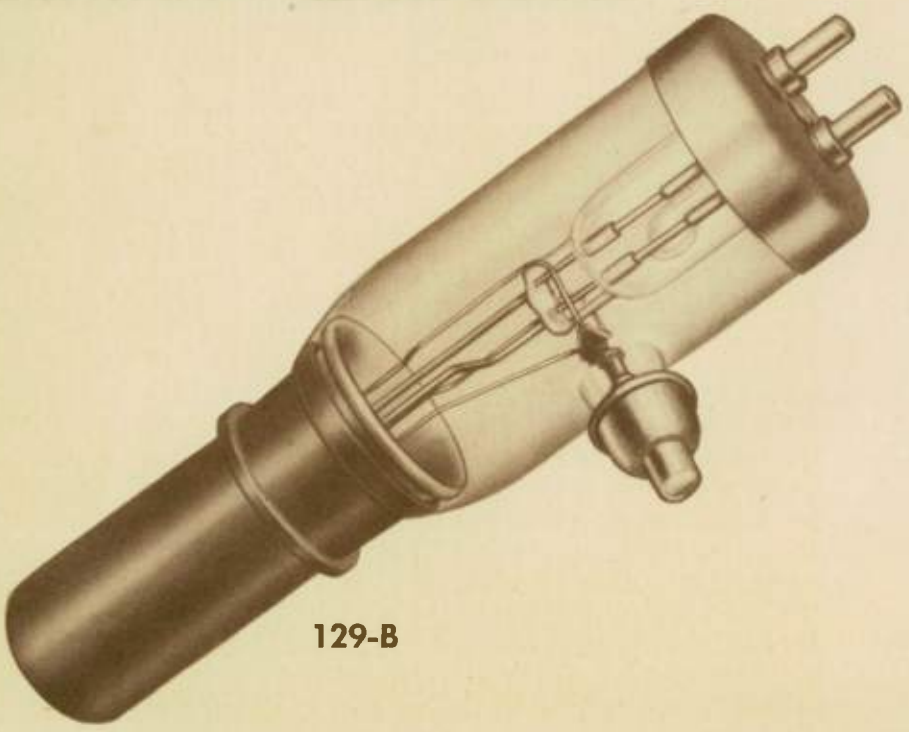
WATER COOLED — 5 KW PLATE DISSIPATION

TYPE	F-328-A	F-328-B	129-B
DESCRIPTION	GENERAL PURPOSE	GENERAL PURPOSE	HIGH FREQ. R.F. AMPLIFIER
MAX. PLATE DISSIPATION	5 KW	5 KW	5 KW
MAX. PLATE INPUT	10 KW	10 KW	18 KW
MAX. D.C. PLATE VOLTAGE	8000 V	8000 V	12,000 V
MAX. D.C. PLATE CURRENT	1.5 A	1.5 A	2.0 A
MAX. FREQUENCY FOR MAX. RATINGS	3 MC	3 MC	50 MC
AMPLIFICATION FACTOR (MU)	16	16	26
FILAMENT VOLTAGE	21.5 V	21.5 V	18 V
DIMENSION A	17 11/16"	17 5/16"	13 5/8"
DIMENSION B	7 1/16"	7 1/16"	4 15/16"
DIMENSION C	7 3/16"	7 3/16"	4"
DIMENSION D	1.480"	1.480"	2.022"
DIMENSION E	6"	6"	4 5/16"

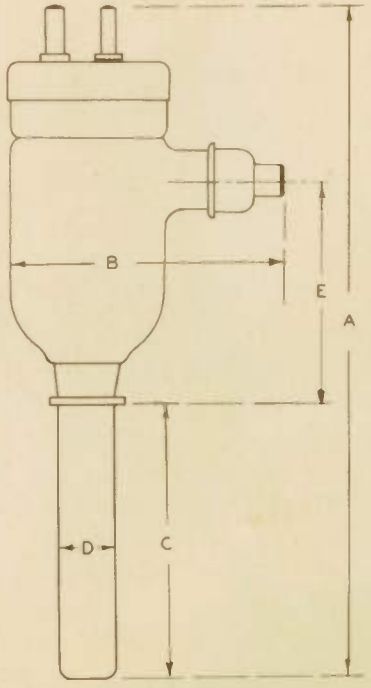
RATINGS FOR CLASS C TELEGRAPH OPERATION



F-328-A

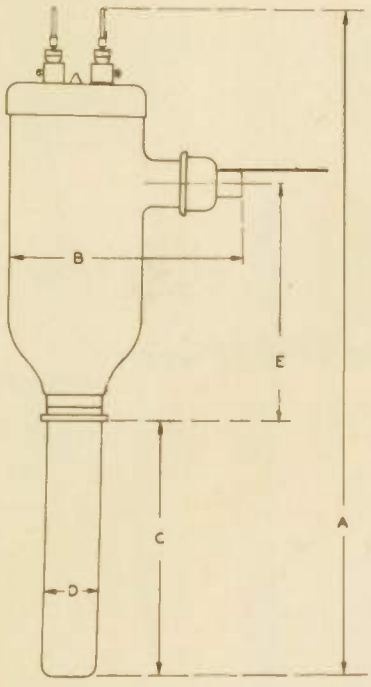


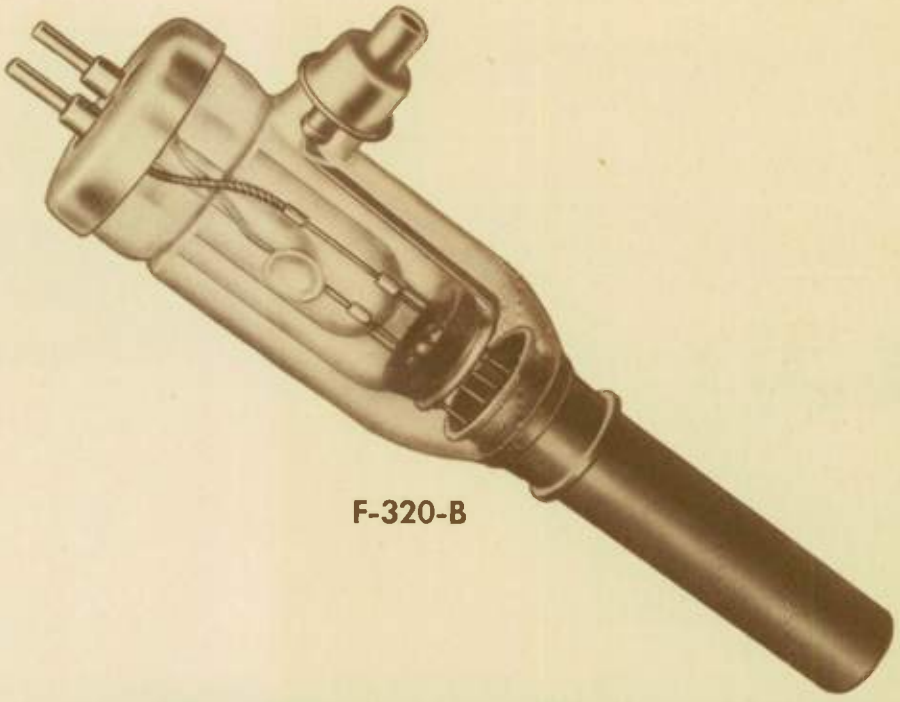
129-B



F-328-B

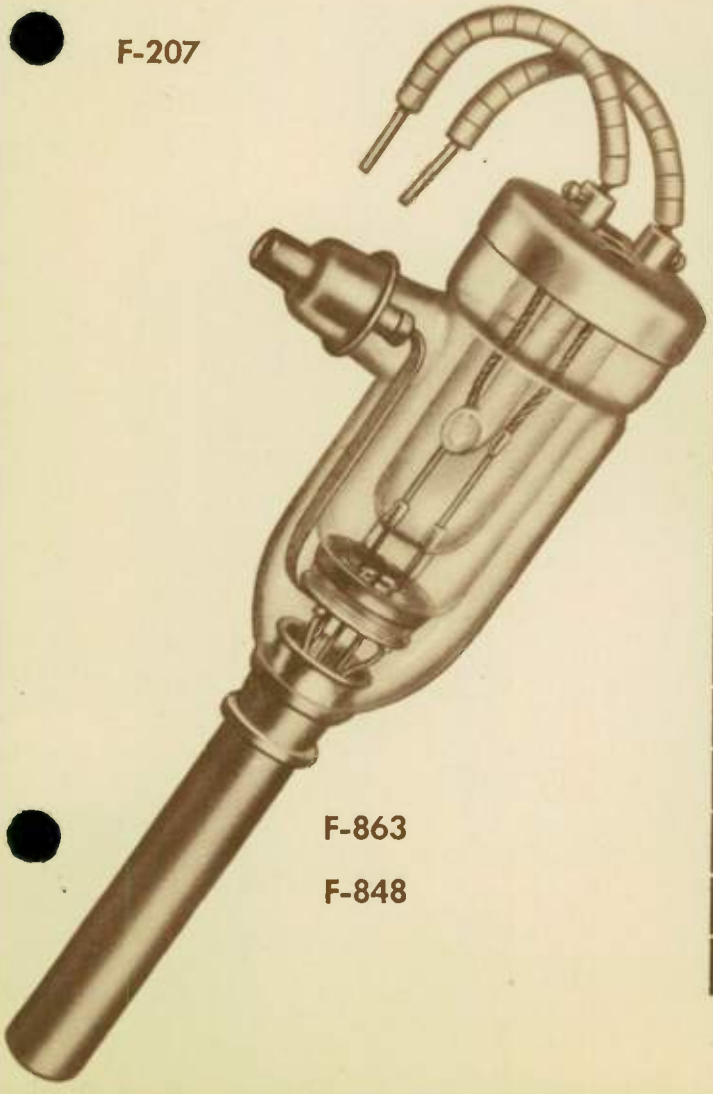
WATER COOLED 6 AND 10 KW PLATE DISSIPATION





F-320-B

F-207



F-863

F-848

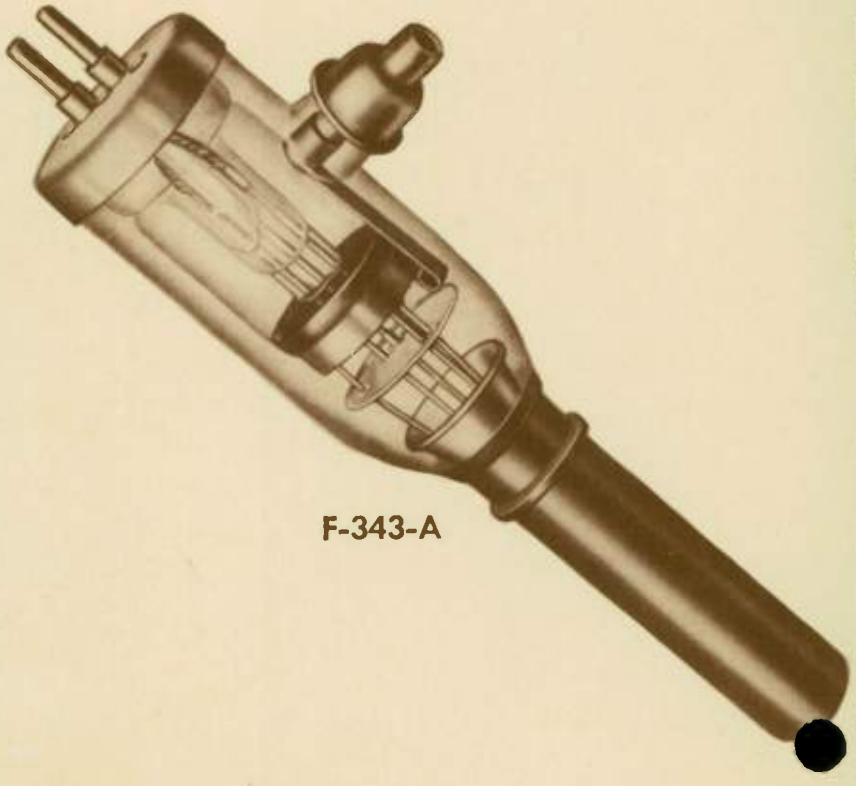
TYPE	F-207	F-848	F-863	F-320-B
DESCRIPTION	GENERAL PURPOSE	MODULATOR OR R.F. AMPLIFIER	R.F. AMPLIFIER OR CLASS B MODULATOR	GENERAL PURPOSE
MAX. PLATE DISSIPATION	10 KW	6 KW	10 KW	10 KW
MAX. PLATE INPUT	30 KW	18 KW	30 KW	22.5 KW
MAX. D.C. PLATE VOLTAGE	15,000 V	12,000 V	15,000 V	15,000 V
MAX. D.C. PLATE CURRENT	2.0 A	2.0 A	2.0 A	1.5 A
MAX. FREQUENCY FOR MAX. RATINGS	1.5 MC	1.6 MC	1.5 MC	4.0 MC
AMPLIFICATION FACTOR (MU)	20	8	50	40
FILAMENT VOLTAGE	22 V	22 V	22 V	21.5 V
DIMENSION A	27 5/16"	27 5/16"	27 5/16"	20"
DIMENSION B	7 1/16"	7 9/16"	7 9/16"	7 1/16"
DIMENSION C	8 1/16"	8 1/16"	8 1/16"	7 7/32"
DIMENSION D	1.580"	1.580"	1.580"	2.022"
DIMENSION E	7 9/16"	7 9/16"	7 9/16"	7 17/32"

RATINGS FOR CLASS C TELEGRAPH OPERATION

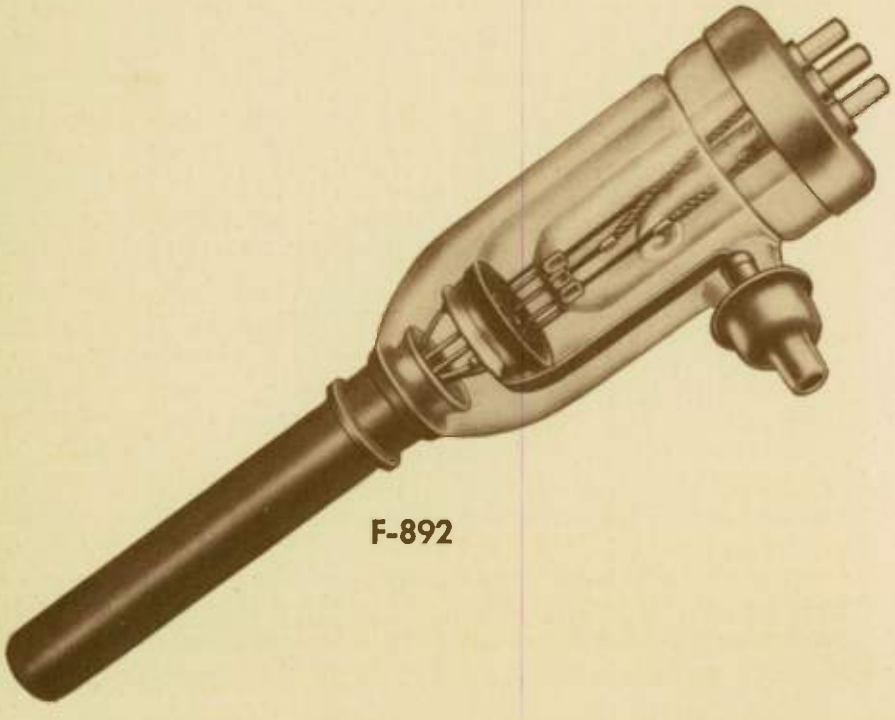
WATER COOLED 6 AND 10 KW PLATE DISSIPATION

TYPE	F-343-A	F-891	F-892
DESCRIPTION	GENERAL PURPOSE	MODULATOR OR R.F. AMPLIFIER	R.F. AMPLIFIER OR CLASS B MODULATOR
MAX. PLATE DISSIPATION	10 KW	6 KW	10 KW
MAX. PLATE INPUT	25 KW	18 KW	30 KW
MAX. D.C. PLATE VOLTAGE	15,000 V	12,000 V	15,000 V
MAX. D.C. PLATE CURRENT	2.0 A	2.0 A	2.0 A
MAX. FREQUENCY FOR MAX. RATINGS	4.0 MC	1.6 MC	1.5 MC
AMPLIFICATION FACTOR (MU)	40	8	50
FILAMENT VOLTAGE	21.5 V	11/22 V	11/22 V
DIMENSION A	20 7/32"	19 7/8"	19 7/8"
DIMENSION B	7 1/16"	7 1/16"	7 1/16"
DIMENSION C	7 7/32"	8 1/16"	8 1/16"
DIMENSION D	2.022"	1.580"	1.580"
DIMENSION E	7 3/8"	7 9/16"	7 9/16"

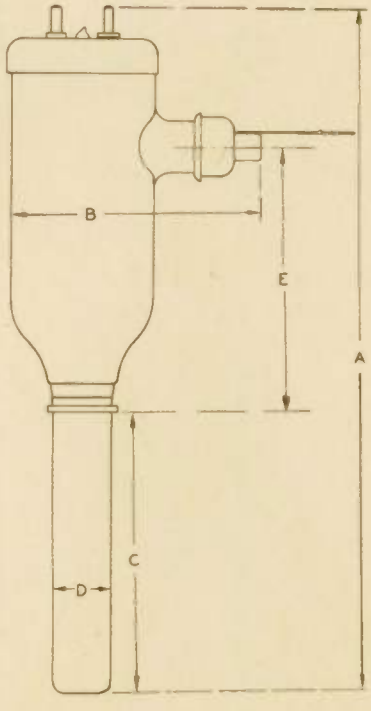
RATINGS FOR CLASS C TELEGRAPH OPERATION



F-343-A

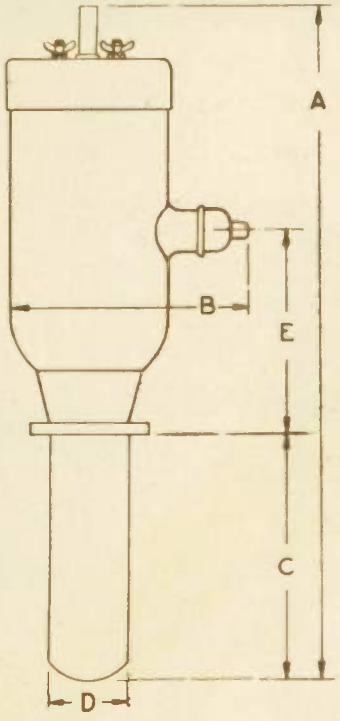


F-892



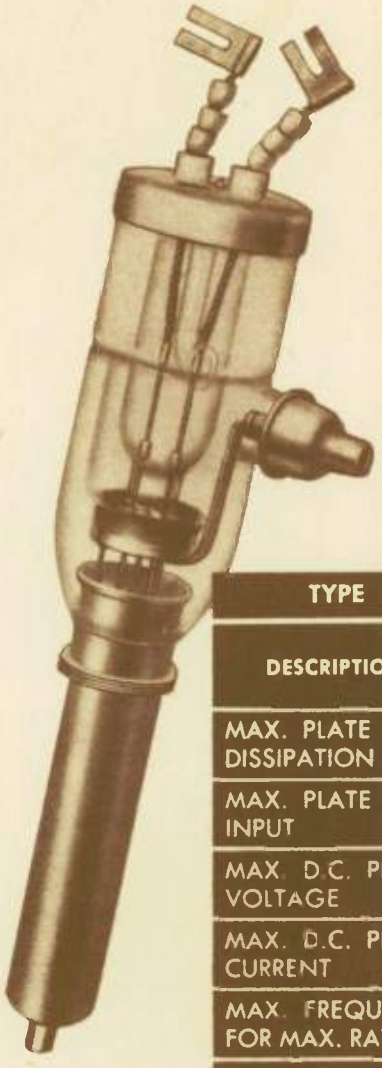
F-891

WATER COOLED 20 AND 25 KW PLATE DISSIPATION



F-893

F-858



F-110-X

F-342-A

TYPE	F-893	F-858	F-342-A	F-110-X
DESCRIPTION	GENERAL PURPOSE	OSCILLATOR OR R.F. AMPLIFIER	GENERAL PURPOSE	R.F. AMPLIFIER & OSCILLATOR
MAX. PLATE DISSIPATION	20 KW	20 KW	25 KW	25 KW
MAX. PLATE INPUT	70 KW	40 KW	50 KW	50 KW
MAX. D.C. PLATE VOLTAGE	20,000 V	20,000 V	20,000 V	20,000 V
MAX. D.C. PLATE CURRENT	4.0 A	2.0 A	3.0 A	2.5 A
MAX. FREQUENCY FOR MAX. RATINGS	5 MC	1.5 MC	4.0 MC	3 MC
AMPLIFICATION FACTOR (MU)	36	42	40	40
FILAMENT VOLTAGE	10 V per strand	22 V	20 V	28 V
DIMENSION A	25 5/8"	24 1/2"	21 9/32"	23"
DIMENSION B	9 1/16"	8 1/4"	7 3/16"	7 1/16"
DIMENSION C	9 1/4"	9 1/4"	7 7/32"	8 3/4"
DIMENSION D	3 3/16"	3 3/16"	2.022"	2.000"
DIMENSION E	7 3/4"	7 7/8"	9 9/16"	6 1/4"

RATINGS FOR CLASS C TELEGRAPH OPERATION

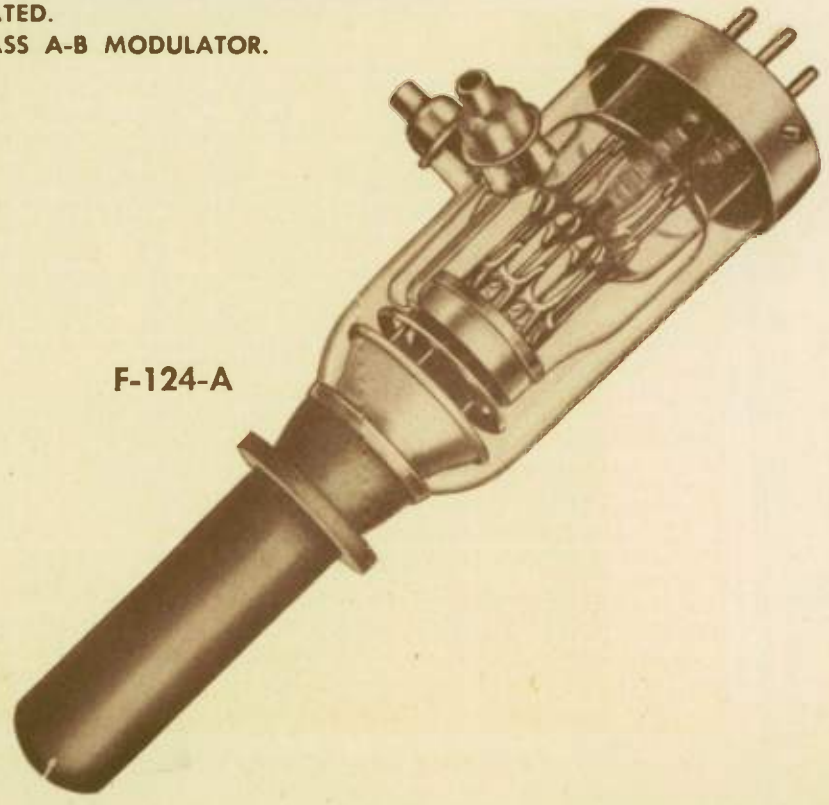
WATER COOLED 40 AND 100 KW PLATE DISSIPATION

TYPE	F-124-A	F-125-A*	F-862
DESCRIPTION	GENERAL PURPOSE	AUDIO AMPLIFIER	R.F. AMPLIFIER OR CLASS B MODULATOR
MAX. PLATE DISSIPATION	40 KW	40 KW	100 KW
MAX. PLATE INPUT	135 KW	100 KW	200 KW
MAX. D.C. PLATE VOLTAGE	20,000 V	15,000 V	20,000 V
MAX. D.C. PLATE CURRENT	7.0 A	10.0 A	10.0 A
MAX. FREQUENCY FOR MAX. RATINGS	20 MC		1.6 MC
AMPLIFICATION FACTOR (MU)	42	4.75	48
FILAMENT VOLTAGE	13.6 V per strand	13.6 V per strand	33 V
DIMENSION A	25 11/16"	25 11/16"	60 3/8"
DIMENSION B	8 7/8"	8 7/8"	10"
DIMENSION C	9 1/4"	9 1/4"	37 1/4"
DIMENSION D	3 1/4"	3 1/4"	4 3/16"
DIMENSION E	7 3/4"	7 3/4"	13"

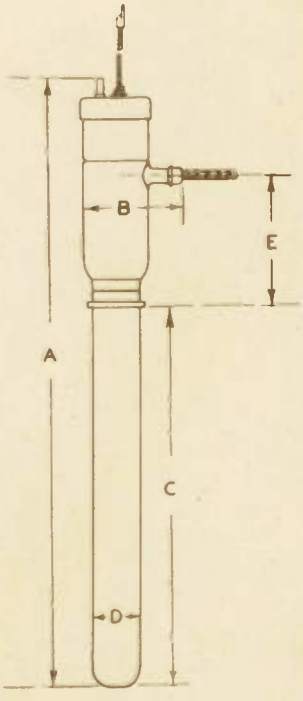
RATINGS FOR CLASS C TELEGRAPH OPERATION UNLESS OTHERWISE STATED.

*RATINGS FOR CLASS A-B MODULATOR.

F-125-A

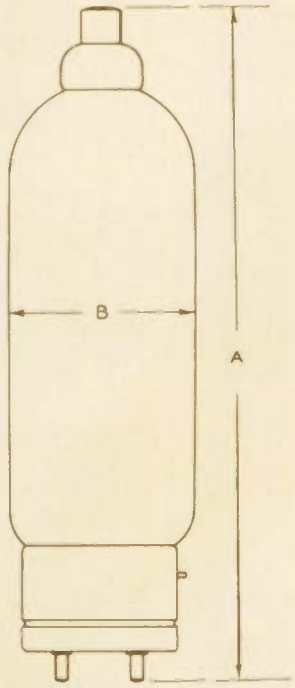


F-124-A



F-862

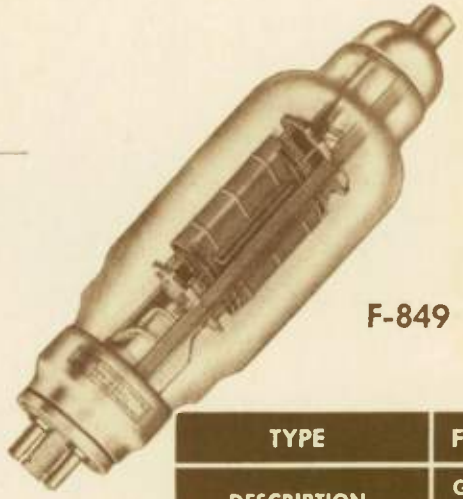
AIR COOLED — 125 TO 400 W. PLATE DISSIPATION



F-123-A

F-127-A

F-204-A



F-849

F-212-E

TYPE	F-123-A	F-127-A	F-204-A	F-212-E	F-849
DESCRIPTION	GENERAL PURPOSE	GENERAL PURPOSE	GENERAL PURPOSE	GENERAL PURPOSE	GENERAL PURPOSE
MAX. PLATE DISSIPATION	125 W	200 W	250 W	275 W	400 W
MAX. PLATE INPUT	375 W	950 W	690 W	700 W	875 W
MAX. D.C. PLATE VOLTAGE	2000 V	3000 V	2500 V	2000 V	2500 V
MAX. D.C. PLATE CURRENT	.250 A	.325 A	.275 A	.350 A	.350 A
MAX. FREQUENCY FOR MAX. RATINGS	30 MC	30 MC	3 MC	4.5 MC	3.0 MC
AMPLIFICATION FACTOR (MU)	14.5	38	23	16	19
FILAMENT VOLTAGE	10 V	10 V	11 V	14 V	11 V
DIMENSION A	8 1/2"	9 5/8"	14 1/4"	13 5/8"	14 1/4"
DIMENSION B	2 5/16"	3 1/32"	4 1/16"	3.421"	4 1/16"

RATINGS FOR CLASS C TELEGRAPH OPERATION

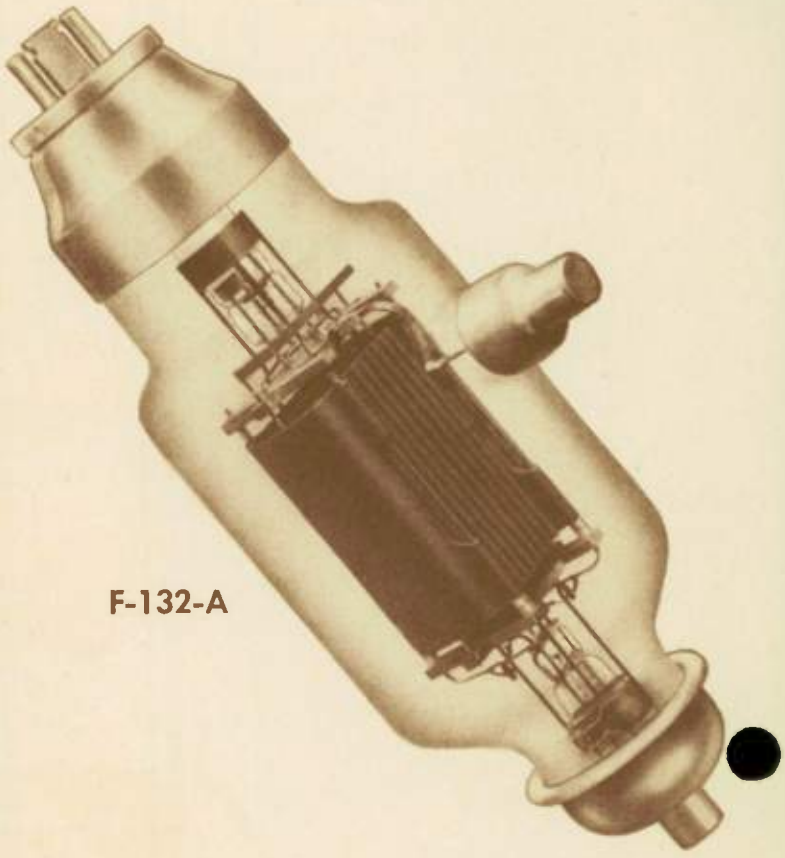
TRANSMITTING — INDUSTRIAL TUBES

AIR COOLED — 450 TO 700 W. PLATE DISSIPATION

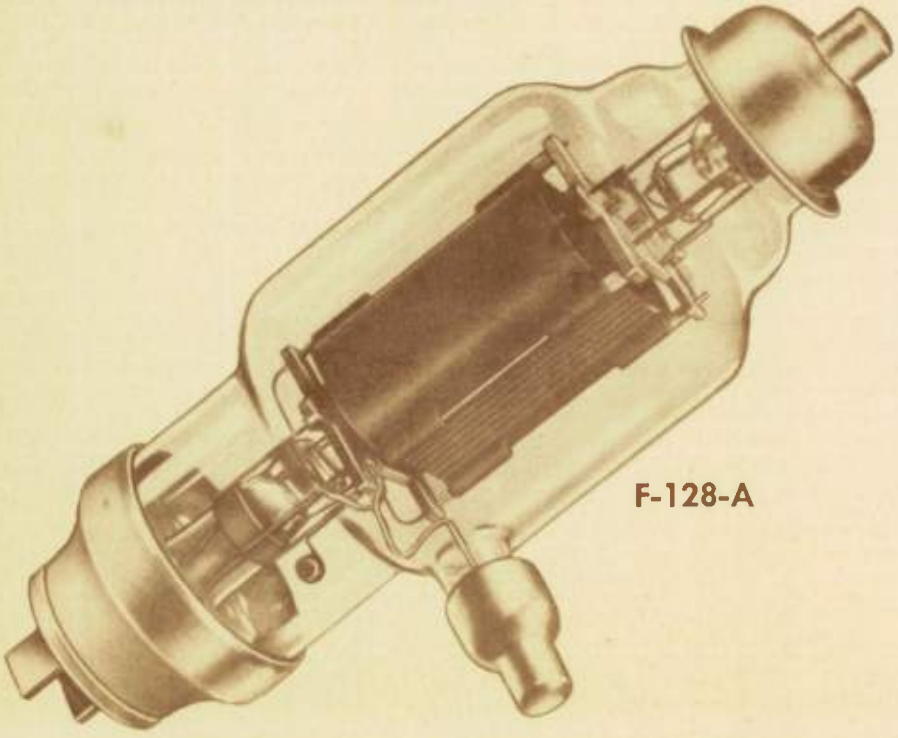
TYPE	F-450 TH	F-128-A	F-132-A*
DESCRIPTION	GENERAL PURPOSE	OSCILLATOR OR R. F. AMPLIFIER	AUDIO AMPLIFIER
MAX. PLATE DISSIPATION	450 W	700 W	600 W
MAX. PLATE INPUT	2500 W	3000 W	
MAX. D.C. PLATE VOLTAGE	6000 V	3500 V	3500 V
MAX. D.C. PLATE CURRENT	.500 A	1.0 A	
MAX. FREQUENCY FOR MAX. RATINGS	40 MC	30 MC	
AMPLIFICATION FACTOR (MU)	38	36	10
FILAMENT VOLTAGE	7.5 V	11 V	11 V
DIMENSION A	12 7/8"	15 1/2"	15 1/2"
DIMENSION B	5 1/32"		
DIMENSION C	5 1/16"	6 1/2"	9"
DIMENSION D	—	8"	8"

RATINGS FOR CLASS C TELEGRAPH OPERATION UNLESS OTHERWISE STATED

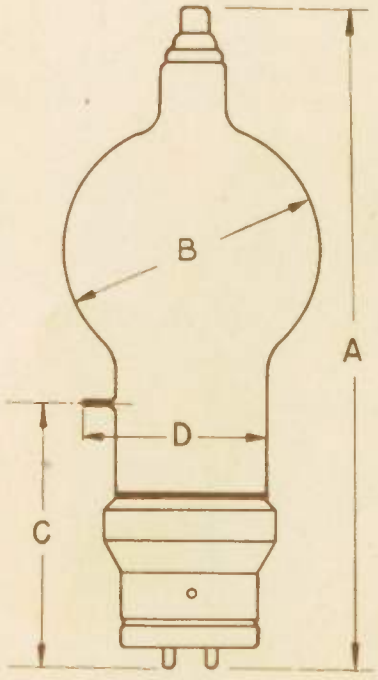
*MAXIMUM RATINGS FOR USE AS PUSH PULL CLASS A DRIVER FOR 2 TYPE F-125-A TUBES.



F-132-A

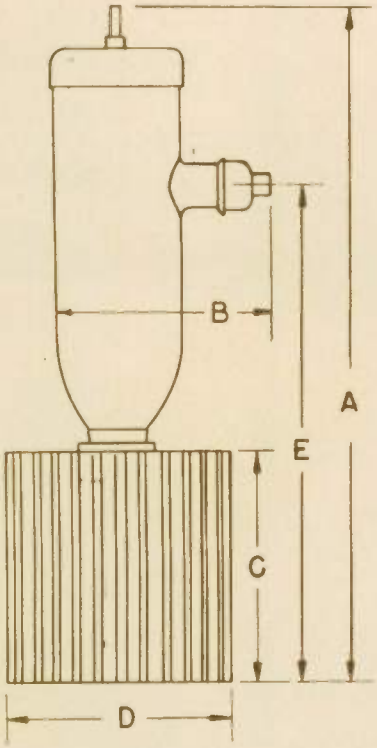


F-128-A



F-450 TH

AIR COOLED — 4 TO 10 KW PLATE DISSIPATION



F-343-R

F-891-R

F-129-R

F-892-R

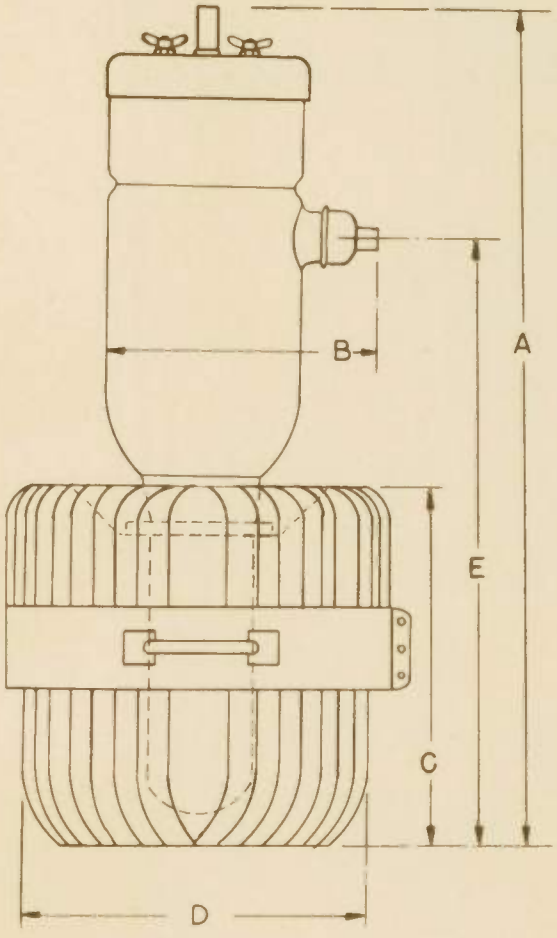
TYPE	F-129-R	F-891-R	F-892-R	F-343-R	F-342-R
DESCRIPTION	HIGH FREQUENCY R. F. AMPLIFIER	MODULATOR OR R. F. AMPLIFIER	R. F. AMPLIFIER OR CLASS B MODULATOR	GENERAL PURPOSE	GENERAL PURPOSE
MAX. PLATE DISSIPATION	5 KW	4 KW	4 KW	10 KW	10 KW
MAX. PLATE INPUT	18 KW	15 KW	18 KW	25 KW	50 KW
MAX. D.C. PLATE VOLTAGE	12,000 V	10,000 V	10,000 V	15,000 V	20,000 V
MAX. D.C. PLATE CURRENT	2.0 A	2.0 A	2.0 A	2.0 A	3.0 A
MAX. FREQUENCY FOR MAX. RATINGS	50 MC	1.6 MC	1.5 MC	4.0 MC	4.0 MC
AMPLIFICATION FACTOR (MU)	26	8	50	40	40
FILAMENT VOLTAGE	18 V	11/22 V	11/22 V	21.5 V	20 V
DIMENSION A	14 1/8"	21 1/16"	21 1/16"	20 15/32"	21 17/32"
DIMENSION B	4 15/16"	7 1/16"	7 1/16"	7"	7"
DIMENSION C	5 1/2"	10"	10"	7 15/32"	7 15/32"
DIMENSION D	5 7/8"	7 1/2"	7 1/2"	7 7/32"	7 7/32"
DIMENSION E	8 13/16"	16 13/16"	16 13/16"	14 27/32"	17 1/32"

RATINGS FOR CLASS C TELEGRAPH OPERATION

TRANSMITTING — INDUSTRIAL TUBES

AIR COOLED — 20 KW PLATE DISSIPATION

TYPE	F-893-R
DESCRIPTION	GENERAL PURPOSE
MAX. PLATE DISSIPATION	20 KW
MAX. PLATE INPUT	70 KW
MAX. D.C. PLATE VOLTAGE	20,000 V
MAX. D.C. PLATE CURRENT	4.0 A
MAX. FREQUENCY FOR MAX. RATINGS	5 MC
AMPLIFICATION FACTOR (MU)	36
FILAMENT VOLTAGE	10 V per strand
DIMENSION A	26 7/8"
DIMENSION B	9 1/16"
DIMENSION C	12 7/8"
DIMENSION D	11 5/8"
DIMENSION E	18 1/4"



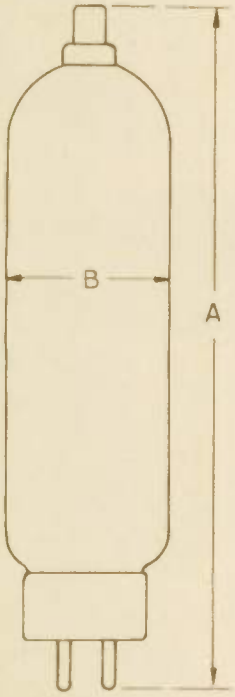
F-893-R

RECTIFYING TUBES

MERCURY VAPOR — 5 VOLT FILAMENT

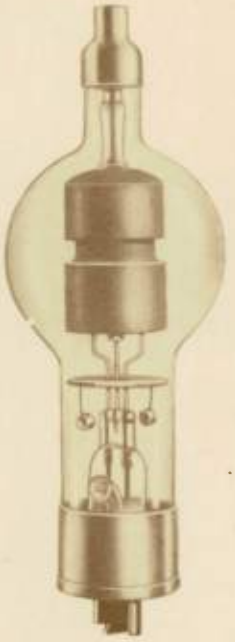
TYPE	F-8008	F-267-B	F-872-A	F-315-A	F-375-A	F-869-B	F-857-B	F-266-B
MAX. PEAK INVERSE VOLTAGE	10,000 V	10,000 V	10,000 V	12,500 V	12,500 V	20,000 V	22,000 V	22,000 V
MAX. PEAK CURRENT (Amperes)	5.00	5.00	5.00	7.00	7.00	10.00	40.00	40.00
FILAMENT VOLTAGE	5 V	5 V	5 V	5 V	5 V	5 V	5 V	5 V
LENGTH	8 3/4"	8 3/4"	8 1/2"	12 1/4"	10 1/2"	14 1/4"	19 7/8"	21 3/4"
DIAMETER	2 1/4"	2 1/4"	2 1/4"	3 3/4"	3 3/4"	5 1/16"	7 1/8"	7 1/8"

MERCURY VAPOR — 5 VOLT FILAMENT



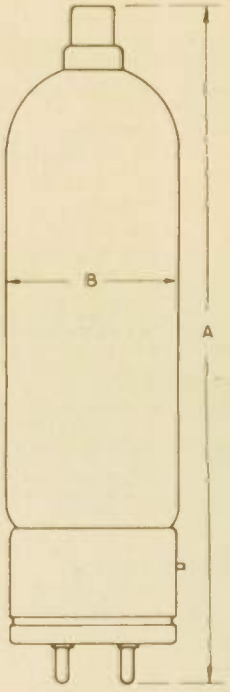
F-267-B

F-266-B



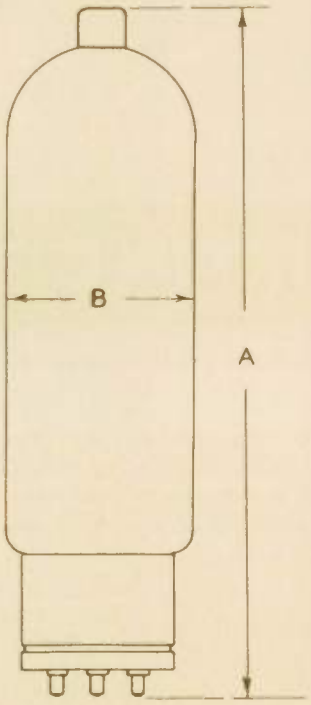
F-869-B

F-857-B



F-8008

F-315-A



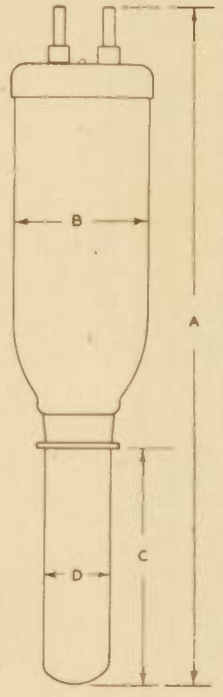
F-872-A

F-375-A

RECTIFYING TUBES

WATER COOLED — HIGH VACUUM

TYPE	F-222-A	F-237-A	F-214-A
MAX. PEAK INVERSE VOLTAGE	50,000 V	50,000 V	50,000 V
MAX. PEAK CURRENT (AMPERE)	5.50	8.00	7.5
FILAMENT VOLTAGE	21.5 V	20 V	22 V
DIMENSION A	20"	20"	20"
DIMENSION B	4 1/16"	4 1/16"	4 1/16"
DIMENSION C	7 7/32"	7 7/32"	8 1/16"
DIMENSION D	2.022"	2.022"	1.580"

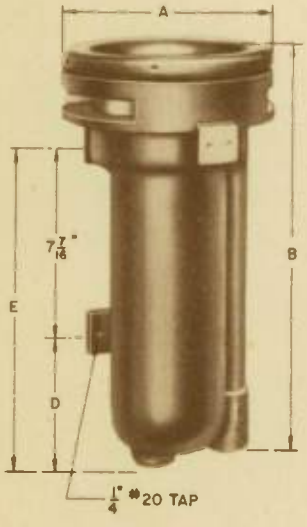


F-222-A

F-237-A

F-214-A

WATER JACKETS



WATER JACKET NUMBER	FITS TUBE TYPES		DIMENSIONS A	B	C	D	E
1000	F-207 F-848 F-863-A	F-891 F-892 F-214-A	6 1/2"	12 5/8"	2 3/4"	1 1/2"	
1001		110-X	6 1/4"	12"	2 1/8"	1 1/2"	
1005	F-320-B F-222-A F-237-A	F-343-A F-342-A	6 1/4"	11 3/4"	2 9/16"	1 1/2"	
1006	F-328-A	F-328-B	5 13/16"	11 7/8"	2 1/4"	1 1/2"	
1010	F-124-A F-893	F-125-A F-858	7 1/2"	15 3/8"	3 7/8"	3 13/32"	
1012	F-129-B		5 3/8"	7 1/2"	2 7/8"		4 7/8"

DIMENSION C = DISTANCE FROM FACE OF MOUNTING TAB TO CENTER LINE OF JACKET.

When Federal transmitting tubes are used in industrial heating oscillator applications the regular Class C Telegraph maximum ratings given in the catalog sheet will apply. THE "MAXIMUM RATINGS" SPECIFIED FOR ANY TUBE TYPE ARE ABSOLUTE MAXIMUM CONDITIONS THAT MUST NOT BE EXCEEDED UNDER ANY LOAD CONDITION TO BE ENCOUNTERED IN THE FIELD. This means that in most industrial heating applications the "normal load" condition must be set at some level considerably below the rated maximum conditions. In practice the actual level of "normal" operation will be determined by the particular circuit design chosen and the protective features incorporated. Particular care should be given to limiting the grid current rise when the plate circuit load is removed as well as to limiting the plate dissipation to a value below the rated maximum for all load conditions to be encountered.

A guarantee can be given only on Federal tubes used in equipment observing the precautions mentioned above.

Printed in U. S. A.

Federal Telephone and Radio Corporation

591 BROAD STREET, NEWARK 2, NEW JERSEY, U. S. A.

An IT&T Associate

TUBE PRICE LIST

Effective April 1, 1946

TRANSMITTING TUBES — WATER COOLED

TYPE	PRICE	DESCRIPTION	Maximum Plate Dissipation	Mu	Maximum Plate Input	Maximum DC Plate Voltage	Maximum Frequency for Maximum Ratings	Filament Voltage
F-328-A	**$249.00**	General Purpose	5 KW	16	8 KW	8,000 V	3 MC	21.5 V
F-328-B	**249.00**	General Purpose (Two Phase Filament)	5	16	8	8,000	3	21.5
F-129-B	**300.00**	VHF Amplifier and Oscillator	5	26	18	12,000	50	18
F-889	**160.00**	VHF Amplifier and Modulator	5	21	16	8,500	50	11
F-891	**170.00**	Modulator or R.F. Amplifier	6	8	18	12,000	1.6	11/22
F-848	**325.00**	Modulator	6	8	18	12,000	1.6	22
F-207	**220.00**	General Purpose	10	20	30	15,000	1.5	22
F-320-B	**290.00**	General Purpose	10	40	22.5	15,000	4.0	21.5
F-343-A	**290.00**	General Purpose	10	40	25	15,000	4.0	21.5
F-863	**325.00**	Modulator or R.F. Amplifier	10	50	30	15,000	1.5	22
F-892	**170.00**	R.F. Amplifier or Modulator	10	50	30	15,000	1.5	11/22
F-893	**450.00**	General Purpose	20	36	70	20,000	5	10 per strand
F-858	**275.00**	Oscillator or R.F. Amplifier	20	42	40	20,000	1.5	22
F-342-A	**480.00**	General Purpose	25	40	50	20,000	4.0	20
F-124-A	**700.00**	General Purpose	40	42	135	20,000	20	13.6 per strand
F-125-A	**800.00**	Audio Amplifier	40	4.75	100	15,000		13.6 per strand
F-862-A	**750.00**	R.F. Amplifier or Modulator	100	48	200	20,000	1.6	33

WATER JACKETS

TYPE	DESCRIPTION	PRICE
F-1000	(For F-207, F-848, F-863, F-891, F-892)	$ 50.00
F-1005	(For F-320-B, F-343-A, F-342-A, F-222-A, F-237-A)	50.00
F-1006	(For F-328-A, F-328-B)	50.00
F-1010	(For F-893, F-858, F-124-A, F-125-A)	150.00
F-1012	(For F-129-B)	50.00

Inquiries are invited concerning tubes for specific applications not included herein.

TUBE PRICE LIST

Effective April 1, 1946

TRANSMITTING TUBES — AIR COOLED

TYPE	PRICE	DESCRIPTION	Maximum Plate Dissipation	Mu	Maximum Plate Input	Maximum DC Plate Voltage	Maximum Frequency for Maximum Ratings	Filament Voltage
F-123-A	$17.50	General Purpose	125 W	14.5	375 W	2,000 V	30 MC	10 V
F-127-A	40.00	General Purpose	200	38	950	3,000	30	10
F-204-A	85.00	Oscillator, R.F. Amplifier, or Modulator	250	23	690	2,500	3	11
F-212-E	70.00	General Purpose	275	16	700	2,000	4.5	14
F-849	120.00	General Purpose	400	19	875	2,500	3.0	11
F-450TH	60.00	General Purpose	450	38	3 KW	6,000	40	7.5
F-128-A	150.00	Oscillator or R.F. Amplifier	600	36	3	3,500	30	11
F-132-A	200.00	Audio Amplifier	600	10	18	3,500		11
7C 25	87.50	Industrial	2.5 KW	25	5.6	4,500	50	11
F-891-R*	315.00*	Modulator or R.F. Amplifier	4	8	15	10,000	1.6	11/22
F-892-R	315.00*	R.F. Amplifier or Modulator	4	50	18	10,000	1.5	11/22
F-129-R*	375.00*	High Frequency R.F. Amplifier	5	26	18	12,000	50	18
F-889-R	280.00*	R.F. Amplifier and Modulator	5	21	16	8,500	25	11
F-343-R	440.00*	General Purpose	10	40	25	15,000	4.0	21.5
F-342-R	630.00*	General Purpose	10	40	50	20,000	4.0	20
F-124-R	950.00*	General Purpose	20	42	100	20,000	20	13.6 per strand
F-893-R	800.00*	General Purpose	20	36	70	20,000	5	10 per strand

*Credit allowed for return of radiator and crate in good condition as follows: in case of F-129-R, F-889-R, $50.00; in case of F-891-R and F-892-R, $100.00; in case of F-342-R and F-343-R, $125.00; in case of F-124-R and F-893-R, $200.00.

RECTIFYING TUBES

TYPE	PRICE	DESCRIPTION	Maximum Peak Inverse Voltage	Maximum Peak Current (Amperes)	Filament Voltage
F-315-A	35.00	Mercury Vapor	15,000	6	5
F-575-A	30.00	Mercury Vapor	15,000	6	5
F-869-B	100.00	Mercury Vapor	20,000	10	5
F-857-B	160.00	Mercury Vapor	22,000	40	5
F-266-B	160.00	Mercury Vapor	22,000	40	5
F-873	12.00	Grid Controlled Mercury Vapor	10,000	10	5
F-214-A	250.00	Water Cooled-High Vacuum	50,000	7.5	22
F-222-A	220.00	Water Cooled-High Vacuum	50,000	5.5	21.5
F-237-A	435.00	Water Cooled-High Vacuum	50,000	8	20

Tubes are sold F.O.B. Factory or Warehouse, 2% — 10 days, net — 30 days.

The foregoing prices do not exceed the applicable maximum prices, established by the O.P.A.

Federal Telephone and Radio Corporation

Vacuum Tube Products — An IT&T Associate — *Newark 4, New Jersey*

Printed in U.S.A.
Form G-100-A Superseding Form G-100

MERCURY VAPOR RECTIFIER TUBES

Suggestions for Use

PRINCIPLES OF OPERATION

The performance of the mercury vapor tube differs from that of the high vacuum thermionic tube principally in that the presence of the mercury vapor permits a comparatively low, and practically constant, voltage drop from anode to cathode in the conducting direction. This voltage drop will hereafter be referred to as the "space charge."

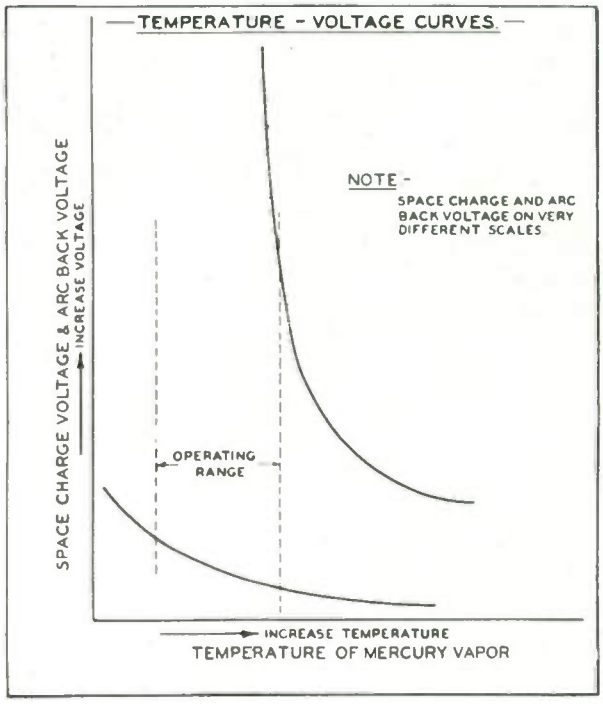
The space charge of the thermionic tube is dependent upon the configuration of the tube elements and the amount of current passing between the anode and cathode. These may result in variations of space charge from a few volts to several thousand volts. In the mercury vapor tube, however, the space charge is largely dependent upon the temperature of the mercury vapor which, within the allowable operating limits, may result in space charges of perhaps 8 to 20 volts regardless of the current drawn.

This space charge effect in the mercury vapor rectifier is, of course, negligible in comparison with the voltage output of a high voltage rectifier. It is important, therefore, only in connection with the effect this space charge may have on the tube itself.

In the lower curve shown in the accompanying illustration it is seen that the space charge is dependent upon the temperature of the mercury vapor in such a manner that the space charge increases as the temperature decreases. The heavy and comparatively immobile positively charged mercury vapor ions normally do not contribute to the space current, but if the vapor temperature becomes so low that the space charge exceeds what is considered a critical value of approximately 22 volts, the ions acquire sufficient velocity in the direction of the cathode to result in a damaging bombardment of the oxide coated cathode. This situation corresponds to a **mercury vapor** temperature somewhat less than 15°C.

If, on the other hand, the mercury vapor temperature is increased to avoid cathode disintegration, the effect of such increased temperature on the so-called "arc-back" voltage must be considered. An arc-back is caused by the inverse voltage to which the tube is subjected during the non-conducting portion of the cycle.

The upper curve illustrated shows qualitatively the relation between mercury vapor temperature and the arc-back voltage. This curve shows that as the temperature is increased beyond a point designated as the maximum allowable temperature, the arc-back voltage decreases very rapidly.



These curves do not have particular values of temperature or voltages noted since they are intended to apply generally to all sizes of mercury vapor tubes. The limiting conditions, however, can be taken from the published data for any particular type of tube.

In practice it is essential to know the relation between actual mercury vapor temperature and bulb temperature or, more specifically, the ambient temperatures and conditions of ventilation. It can be assumed that with unrestricted natural ventilation and with no other heat radiating bodies in the vicinity of the tube, the mercury vapor temperature will be approximately 15°C. higher than the ambient temperature for most tubes. With forced ventilation this difference in temperatures is considerably reduced.

Since most rectifier circuits involve the use of more than one tube, it usually becomes necessary to place one tube quite close to the other in order to conserve space. However, if the glass envelope of one tube is closer

MERCURY VAPOR RECTIFIER TUBES

Suggestions for Use

than about 6" from that of any adjacent tube, heat radiation from both tubes is unfavorably affected and must be considered in relation to the range of ambient temperatures to which the rectifier will be subjected.

It is apparent from the two curves shown that if the temperature range is narrowed by the use of forced draft ventilation and control of air temperature, the factors of safety will be greatly increased. In certain applications forced ventilation is provided by simply using a propeller type fan. For installations where quite high voltages are involved, which is usually the case where the larger sizes of mercury vapor rectifier tubes are used, forced ventilation is best provided by a centrifugal blower whose output is distributed through metal tubing in such a manner that an air blast is directed on each tube in the vicinity of the glass just above the base.

To avoid distortion of the electrostatic field about the tubes, a piece of insulating tubing should be used for the section of pipe that is adjacent to the glass wall of each tube. Where several tubes are used, the air should be distributed evenly between the various outlets.

Since the presence of the ionized mercury vapor serves only to reduce the space charge, the source of electronic current must come from the cathode itself. The cathodes are designed to furnish ample emission for the peak current values published. If for any reason the emission is reduced, the space charge will increase as the actual emission is exceeded, and may result in disintegration of the cathode.

A more common cause of low filament emission is improper cathode temperature. Hence, it becomes extremely important that the filament shall always be maintained at its correct operating voltage when the plate voltage is applied. In installations where the source of power cannot be relied upon to maintain its voltage within plus or minus 5%, including the effect of regulation due to variations in load upon the rectifier, it is desirable to employ some form of automatic voltage regulator in the filament primary power supply.

The mercury vapor within the tubes is capable of ionization, not only by the electrostatic field between anode and cathode, but by electrostatic fields introduced by extraneous forces. These may have an objectionable effect upon the operation of the tube, particularly if they are due to a field varying at a radio frequency rate. Such a field may be produced either by direct radiation from a radio transmitter or antenna system, or by radio frequency currents introduced in leads involving the rectifier circuit. The installation of composite equipment consisting of the rectifier and some piece of radio equipment should be made, therefore, with provisions for shielding the mercury vapor tubes from radio frequency fields. Radio frequency filters should be installed where necessary to isolate the rectifier circuit from radio frequency circuits.

Installation

The tube should be mounted in a vertical position with the filament (large base) end down. It will fit readily into a standard socket. The mounting should be so arranged as to prevent mechanical shocks or vibration from being transmitted to the tube.

Except as otherwise noted the tube is designed to operate satisfactorily when the ambient temperature is not less than 15°C. (59°F.) and not more than 50°C. (122°F.). Ambient temperatures are measured, where a natural air circulation installation is made, with thermometers placed at various points opposite the filament base at distances of 3 to 6 feet.

If forced draft cooling is used, the ambient temperature is measured by a thermometer placed in the cooling air stream before the air reaches the tube. The glass bulb of the tube should not be near nor in contact with any metallic body or inflammable material, nor should it be subjected to drops or spray of any liquid.

Circuit Requirements

Proper overload protection against excessive currents, and safety interlock circuits to safeguard personnel should be employed in proportion to the power and voltage involved in the rectifier installation.

Proper overload protection involves the following relays which act to open the circuit breaker in the primary of the high voltage transformers: (1) Instantaneous overcurrent relays in the primary supply line which, in a three phase system, are placed in two of the three phase leads to insure operation when any one phase of the primary is overloaded, (2) an instantaneous over-

MERCURY VAPOR RECTIFIER TUBES

Suggestions for Use

current relay in the grounded side of the output (DC) circuit to operate in case of a 100% overload, and (3) a time delay overcurrent relay in the grounded side of the output circuit to operate on continued overload.

If the rectifier tubes are operated at peak inverse voltages exceeding 10,000 volts, the voltage to the primary of the high voltage transformers should be applied in steps. This may be accomplished through the use of an induction type regulator. As an alternate arrangement, the main high voltage contactor may close the primary circuit through a resistance bank which is subsequently shorted out, after a pre-determined period, by a second contactor operated by a delay relay whose delay should be set for at least 5 seconds.

The rectifier filaments should be maintained at constant voltage rather than at constant current. Adjustments of the filament voltage may be made with a rheostat in the primary circuit of the filament transformer while observing a filament voltmeter, which should be connected to a separate voltmeter winding, or across the primary terminals of the filament transformer. With the high voltage transformer primaries open circuited, the rectifier filament voltages should be measured directly at the tube terminals to make certain that the voltage measured is that which is actually across the filament. The relation between this voltage and the corresponding reading of the installed filament voltmeter should be noted. If possible, the filament voltage should be finally adjusted to its proper value for each individual tube when the rectifier is operating under normal conditions.

CAUTION: The rectifier filament terminals may be at high voltage to ground when the rectifier is in operation and hence direct measurements of filament voltage should not be made when the high voltage transformers are excited. The filament connections should be large in order to assure a good contact. A relay, operating from the filament supply circuit, should be installed so that it will open the high voltage primary circuit in case the filament voltage fluctuates beyond the limits of plus or minus 5%. This relay should have a time delay of not more than 2 seconds to avoid opening of the circuit on transients.

When starting up the rectifier the filaments of the tubes must be lighted first, and the high voltage should not be applied until the filaments have had time to reach normal operating temperature. This condition is best obtained by the use of a time delay relay operating from the filament primary power supply and having a delay period adjustable to the value recommended for the particular type of tube used. The contact of this delay relay should be in series with the start circuit of the high voltage primary contactors. If it is necessary to decrease the heating time to a minimum, the time delay necessary for the particular installation may be determined in the following manner.

With the tube in the actual circuit under consideration, a DC voltage of at least 45 volts is connected between anode and cathode in series with a resistor sufficient to limit the current to .3 ampere. The anode is connected to the positive terminal of the DC voltage source and a voltmeter is connected between anode and cathode. The filament supply switch is closed and, assuming that the tube was cold at the start, the time required for the DC voltage drop across the tube to reach a constant value is noted. This time is measured for each of the rectifier tubes. The longest time measured is increased by 50% to give the shortest possible delay period permissible for the particular installation.

The space charge of a mercury vapor rectifier tube increases with age and this fact affords a means for anticipating the end of useful life of any particular tube. A record of the increase in space charge from day to day may be obtained by a simple arrangement in which a source of at least 20 volts direct current with a current capacity equal to that of the peak current rating of the rectifier tube can be connected to the anode of each tube in succession after the high voltage has been removed and the filament of the tube lighted at normal voltage. When the space charge reaches 18 to 20 volts, with the space current adjusted to the rated peak value, it may be an indication that the end of useful life for this tube is being approached.

The initial filament current when starting may be objectionably large if a current limiting reactor or resistance

MERCURY VAPOR RECTIFIER TUBES

Suggestions for Use

is not used. It is recommended, therefore, that a time delay device be used so that the initial application of filament voltage can be made through a current limiting device which, in turn, is subsequently shorted out after a delay of a few seconds. The peak rms value of current through the filament should be limited to something less than twice the normal filament current rating.

Operation

When the tube is first received it will undoubtedly have mercury deposited on all parts within the tube due to handling in shipment. A deposit of mercury on the plate or filament reduces the arc-back voltage. To avoid permanent injury, therefore, a slow treating schedule should be followed.

The new tube should be tested as described herein, and the same tests should be followed each time the tube is handled in such manner as to cause mercury to be deposited on the plate or filament. After the mercury has been properly distributed by the slow treating schedule, the tube should be mounted in a rack in its operating position (the filament end down). It should not be laid on its side in the rectifier unit. The tube will then be ready for replacement use by simply operating at rated voltage for the length of time specified, for the particular tube used, before applying the operating voltage.

The treatment prescribed in the following paragraph is intended particularly for new tubes which are to be placed in operation for the first time. It is suggested that this treatment be applied also to new tubes not placed in immediate service, and that the treatment be repeated every three months on tubes held in storage. The same treatment applies also where a tube has been operated improperly and shows a tendency to arc-back, since its condition may be much improved thereby.

The filament must be lighted at rated voltage for 15 minutes without any applied plate voltage in order to distribute the mercury to the tube properly. The supply voltage should be reduced to give a peak inverse voltage of approximately 4,000 volts, the high voltage primary circuit closed, and the rectifier operated for 5 minutes, after which the output potential should be increased gradually during a 15 minute period to obtain the normal operating value.

If the equipment does not permit of this procedure, the full plate voltage should be applied intermittently until the tube operates normally. If the tube gives evidence of flashing, the treating period should be prolonged so that stable operation may be obtained without injury to the tube. Then the tube should be operated under normal conditions for 15 minutes.

The peak inverse voltage will vary with the type of circuit and the wave shape. It should always be evaluated from a knowledge of these factors. The maximum rating of the tube refers to the actual inverse voltage and not to the calculated values. Therefore a cathode ray oscillograph, or spark gap, connected across the tube should be used to determine the actual voltage conditions.

The maximum peak current and voltage ratings must not be exceeded during operation and rectifiers must be designed accordingly. Where higher voltages are required than can be secured without exceeding the rating of the tube it is recommended that independent rectifiers be connected in series. This practice is to be preferred to that of connecting the tubes in series, since the resistance of the tube in the reverse direction may be variable and thus prevent equal voltage distribution.

For greater output currents, tubes may be connected in parallel. Balancing resistors should then be placed in series with each tube so that each tube carries its share of the load.

The published ratings and basic tube information are based upon use at frequencies less than 150 cycles per second. For use at higher frequencies the manufacturer should be consulted.

The inside surfaces of the glass of most types of mercury vapor rectifier tubes tends to darken with age in service. Excessive blackening of the tube envelope, while not of itself an indication of approaching failure, is a signal to increase the frequency of voltage drop measurements as outlined above. Likewise, any sudden change in the color of the mercury vapor discharge will aid in judging when to remove a tube.

Federal Telephone and Radio Corporation

Vacuum Tube Products — An IT&T Associate — Newark 4, New Jersey

Printed in U.S.A. Form F-202

THERMIONIC RECTIFIER TUBES

Suggestions for Use

Installation

In accordance with generally accepted practice, tubes should be mounted with the filaments in a vertical position. It is highly desirable that tubes be stored in racks which are protected from vibration as well as from moisture and extreme temperature changes.

During operation, water cooled tubes are naturally held in the correct vertical position, with the glass end up, by the water jackets designed to protect the tubes and effectively cool the anodes.

Installation of water cooled tubes is fairly simple if accomplished with reasonable care. Three gaskets are supplied with each tube to obviate the necessity of ever using gaskets other than those supplied with the tube. After placing the proper gasket on the anode, the tube should be placed in the water jacket very carefully and turned gently to make sure that the flange seats properly in the jacket. The tube should then be secured in the jacket by tightening the clamps just enough to prevent any water leaks, otherwise the flange may be distorted.

Following correct adjustment and clamping of the tube in the jacket, the filament leads should be connected so that no strain is placed upon them. These leads should always be disconnected before unclamping the tube and removing it from the water jacket. The moving parts of the water jacket should be kept covered with a film of oil to prevent corrosion and sticking.

Cooling

A water circulating system capable of passing a sufficient quantity of water through the water jacket and returning it to the source for recooling must, of course, be provided for cooling the anode of the tube.

Where few water cooled tubes are in service, the cooling system may consist of a fan cooled radiator, a pump and the water jacket interconnected in a closed circulating system. Such a system is usually insulated from the ground and has a water gauge to indicate the height of water in the radiator as well as a thermometer for recording the water temperature at the outlet of the water jacket. Where many water cooled tubes are employed, water is usually obtained from a large storage tank, a well, or from water mains — whichever is available.

In order to insure an adequate supply, water is circulated under pressure through an interconnected piping system and lengths of rubber hose carry the water from a grounded position in the system to and from the water jackets. It is extremely important that the hose be of sufficient length to reduce to a minimum the possibility of current leakage. The hose (connected both at the inlet and outlet sections of the water jacket) should be not less than fifteen feet each in length.

It is recommended that a supply of water be used having a specific resistance of not less than 4000 ohms. Distilled water or rain water caught in a storage tank is highly recommended. Water obtained from wells or water mains should be analyzed to determine the amount of carbonates, sulphates, etc., it contains. When the hardness of the water flowing through the cooling system is greater than 10 grains per gallon and the plate dissipation, water flow and outlet water temperature are normal, there is always the possibility of scale formation on the anode of the tubes.

Scale formation prevents proper cooling of the tubes, and this may damage them. Scale should be eliminated by the use of distilled water or a water softener. In emergency cases where it is absolutely necessary to use water which forms a scale on the anode, a regular

THERMIONIC RECTIFIER TUBES

Suggestions for Use

schedule should be adopted for cleaning the scale from the anode by means of dipping the anode in a 10% solution of hydrochloric acid until the scale is dissolved. Following this, the anode should be thoroughly rinsed in water. Care should be taken to prevent the acid solution from coming in contact with the anode near the region of the copper-to-glass seal. Since this procedure necessitates frequent removal of the tubes from the water jackets and increases the danger of accidental breakage, it should be avoided wherever possible.

The flow of water through the water jacket should consist of a thin stream evenly distributed over the anode to insure adequate cooling. It should be fast enough to prevent steam bubbles from forming on the surface of the anode. The water flowing through the water jacket should never reach the boiling point and in fact should never exceed 70°C. at the water outlet. The recommended flow is usually sufficient, but if a scale formation is present, better results will be obtained by a faster flow. A flowmeter may be installed, provided a location is selected in which air traps may be avoided. The filament and plate supply must always be interconnected with the water supply, so that in the case of water failure for any reason, the filament and plate voltages cannot be applied to the tubes. The heat from the filament alone is sufficient to cause serious damage.

In all cases the glass bulb of the tube should not be in contact with nor near any metallic body nor inflammable material, nor should it be subjected to drops or spray of any liquid.

Circuit Requirements

Inasmuch as the circuits in which these tubes operate comprise high powered, high voltage systems, proper overload protection against excessive currents and safety interlock circuits, to safeguard personnel, should be employed in proportion to the power and voltage involved in the rectifier installation. These involve relays described in pages featuring "Mercury Vapor Rectifier Tubes."

Since the filament circuit must carry a fairly large current, every precaution should be taken against voltage losses due to poor connections. Filament connections should be large, and securely fastened to insure good contacts. All wires and connections should be placed as far as possible from the glass of the tube in order to avoid the possibility of bulb puncture from corona discharges.

Operation

In order to insure satisfactory serviceability when needed, tubes should be tested and inspected immediately upon arrival. For tubes placed in storage this should be repeated approximately every three months. Best results are obtained by placing tubes in an actual working rectifier unit.

Essentially rectifier tubes are limited in two respects: **First,** by the maximum instantaneous peak current that the tube will pass. **Second,** by the maximum peak inverse voltage that can safely be applied while the tube is preventing the flow of current in the inverse direction.

Federal Telephone and Radio Corporation

Vacuum Tube Products — An IT&T Associate — Newark 4, New Jersey

Printed in U.S.A. Form F-195

WATER COOLED and AIR COOLED TUBES

Suggestions for Use

Water Cooled Tubes

In accordance with generally accepted practice, tubes should be mounted with the filaments in a vertical position. It is highly desirable, therefore, that tubes be stored in racks which are protected from vibration as well as from moisture and extreme temperature changes. In the case of water cooled tubes with flexible leads, care should be taken to prevent the filament leads from striking the glass with the resultant possibility of breakage.

During operation these tubes are naturally held in the correct vertical position with the glass end up, by the water jackets, since these are designed to protect the tubes and effectively cool the anodes.

Installation of water cooled tubes is fairly simple if accomplished with reasonable care. Spare gaskets are supplied with each tube to obviate the necessity of ever using gaskets other than those supplied with the tube. After placing the proper gasket on the anode the tube should be placed in the water jacket very carefully and turned gently to make sure that the flange seats properly in the jacket. The tube should then be secured in the jacket by tightening the clamps just enough to prevent any water leaks, otherwise, the flange may be distorted.

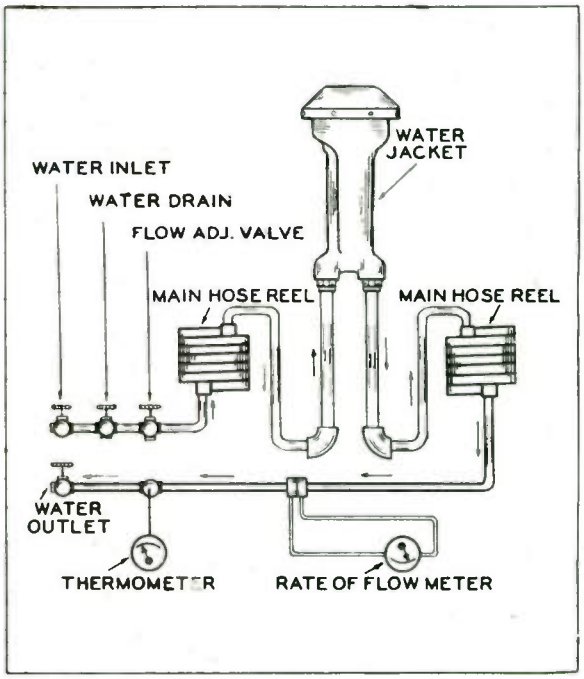
After correct adjustment and clamping of the tube in the jacket, the filament and grid leads should be connected in such a way that no strain is placed upon them. These leads should always be disconnected before unclamping the tube and removing it from the water jacket.

It is highly desirable that all the moving parts of the water jacket should be kept covered with a film of oil to prevent corrosion and sticking.

Cooling

A water circulating system capable of passing a sufficient quantity of water through the water jacket and returning it to the source for recooling must, of course, be provided for cooling the anode of the tube.

Where a small number of water cooled tubes is in service, the cooling system may consist of a fan cooled radiator, a pump and the water jacket interconnected in a closed circulating system. Such a system is usually insulated from the ground, and has a water gauge to indicate the height of water in the radiator as well as a thermometer for recording the water temperature at the outlet of the water jacket.



Where a number of water cooled tubes is employed, the water is usually obtained from a large storage tank, a well or from water mains, whichever is available. In order to insure an adequate supply, the water is circulated under pressure through an interconnected piping system and lengths of rubber hose or ceramic pipes carry the water from a grounded position in the system to and from the water jackets.

It is extremely important that the hose be of sufficient length to reduce the possibility of current leakage to a minimum. It is suggested that the hose (connected both at the inlet and outlet sections of the water jacket) be not less than fifteen feet each in length.

It is recommended that a supply of water be used having a specific resistance of not less than 4000 ohms. Distilled water or rain water caught in a storage tank is highly recommended. Where water is obtained from wells or water mains, it is suggested that it be analyzed to determine the amount of carbonates, sulphates, etc. contained in it. When the hardness of the water flowing through the cooling system is greater than ten grains per gallon and the plate dissipation, water flow and outlet water temperature are normal, there is always the possibility of scale formation on the anode of the tubes.

Scale formation prevents proper cooling of the tubes and may result in damage to them. It should be avoided,

WATER COOLED and AIR COOLED TUBES

Suggestions for Use

therefore, by the use of distilled water or a water softener. In emergency cases where it is absolutely necessary to use water which forms a scale on the anode, a regular schedule should be adopted for cleaning the scale from the anode by means of dipping the anode into a 10% solution of hydrochloric acid until the scale is dissolved. Following this the anode should be thoroughly rinsed in water.

Care should be taken to prevent the acid solution from coming into contact with the anode near the region of the copper to glass seal. Since this procedure necessitates frequent removal of the tubes from the water jackets and increases the danger of accidental breakage, it should be avoided wherever possible.

The flow of water through the water jacket should consist of a thin stream evenly distributed over the anode to insure adequate cooling, and the stream should be fast enough to prevent steam bubbles from forming on the surface of the anode. The water flowing through the water jacket should never reach the boiling point. In fact, it should never exceed 70°C. at the water outlet. Localized boiling may be detected by a singing noise.

The amount of water required will depend upon the design of the jackets used. Water jackets designed by Federal Telephone and Radio Corporation provide rates of flow as shown in the table below which may be used as a guide.

TABLE OF RECOMMENDED WATER FLOW

Tube Type	Water Jacket Type	Minimum Flow (Gal. per Min.)
F 207, F 848, F 863, F 891, F 892	F 1000	5
F 320 B, F 222 A, F 343 A	F 1005	5
F 237, F 342 A	F 1005	10
F 328 A, F 328 B	F 1006	3
F 124 A, F 125 A, F 858, F 893	F 1010	15
F 129 B	F 1012	3

The amount of pressure required may be approximated from the following formulas:

Pounds per sq. in. drop $= Kf^2$ per ft. length of hose

f = water flow gal./min.

K = .00065 for 1" hose
.00315 for ¾" hose
.0145 for ½" hose
.055 for water jacket

The filament and plate supply must always be interconnected with the water supply so that in case of water failure the filament and plate voltages cannot be applied to the tubes. The heat from the filament alone is sufficient to cause serious damage.

In all cases the glass bulb of the tube should not be near nor in contact with any metallic body or inflammable material, nor should it be subjected to drops or spray of any liquid.

Circuit Requirements

The circuit in which this tube operates is a high powered, high voltage system and should be thoroughly protected in the proper manner for such systems. Proper overload protection to protect the tube and equipment against excessive currents, and safety interlocking means to protect personnel, should be installed.

An instantaneous overload relay should be in the ground lead of the plate return to protect the tube from drawing a large plate current. The relay should be set for slightly higher than normal plate current and will then operate to open the circuit in the rectifier transformer primary in case of an overload.

All wires and connections must be installed so that they are a proper distance from the glass of the tube, otherwise the bulb is almost certain to be punctured from corona discharges. All connections must be made so that there will be no strains on any of the metal-glass seals.

The filament of the tube should be maintained at constant voltage rather than constant current. A rheostat or equivalent means of control should be provided in the primary of the filament transformer to facilitate maintaining correct supply voltage. The filament voltage should always be measured at the tube terminals making sure that the voltage measured is that which is actually across the filament. The filament circuit must carry a fairly large current. In consequence, every precaution should be taken against voltage losses due to poor connections. The filament connections should be large and be securely fastened to insure good contact.

In the case of multiphase tube types such as the F 893 and F 862 the phase voltages should not differ by more than 0.5% if maximum tube life is to be obtained. The

WATER COOLED and AIR COOLED TUBES

Suggestions for Use

hairpin type of multiphase filaments used in tube types F 124 A and F 125 A will permit a maximum phase voltage unbalance of 1.0%. Single phase operation of all multiphase filaments is recommended.

Operation

It is suggested that tubes be tested and inspected immediately upon arrival, and if in storage at periods of three months, in order to assure complete serviceability and availability when required for use. This is best done by operating the tube in the transmitter in the following manner: Light the filament and permit it to burn at rated voltage for five minutes before applying plate voltage. Reduce the plate supply voltage to as low a value as possible and apply it to the plate of the tube. Increase the plate voltage carefully and slowly to the desired operating value and permit the tube to operate under normal load conditions for a period of about thirty minutes.

The filament should always be operated at constant voltage, and its normal operating temperature always should be reached before applying plate voltage. When using the tube at reduced power the filament voltage may be reduced slightly, but care must be taken that sufficient electron emission is provided in order to insure stable operation and prevent the plate dissipation from being exceeded.

If the tube is to be removed from the circuit immediately after operation, time should be permitted for the inner electrodes to cool before shutting off the water. Extreme care must be exercised when removing the tube from the jacket so that no strains will be placed upon the metal-glass seals.

Whenever circuit adjustments are necessary it is desirable to begin by operating the tube at reduced plate voltage and to increase it in steps, always adjusting for optimum operating conditions at each step. Should the tube be severely overloaded and gassed while making circuit adjustments it is sometimes possible to effect electrical cleanup of the gas by operating the tube as an oscillator or radio frequency power amplifier at reduced plate voltage, gradually increasing the voltage to maximum after permitting the tube to reach stable operation on each step. Bright tungsten filaments do not lose their emission when overloaded and should operate satisfactorily with only slight emission reduction until actually burned out.

AIR COOLED TUBES

As previously mentioned, tubes not used immediately should be stored in suitable racks free from shock, vibration, moisture and excessive temperature changes. It is advisable to be particularly careful in handling tubes to avoid scratching the glass. A small scratch will weaken the glass envelope materially, possibly causing a crack during subsequent heating or cooling cycles.

Mountings should be constructed so that the tube itself is not under strain when installed. The tube should also be so located that the glass envelope cannot come into contact with any metallic body or inflammable material, nor be subject to drops or spray of any liquid.

Clips and sockets should be of such design that good contact is provided without undue force being necessary to install or remove the tube. When a mounting similar to a fuse clip is used on a single terminal, it is essential that the terminal should **not** be snapped into place. The resultant jar may be sufficient to break some of the internal tube parts and render it inoperative.

The contact surfaces on the bases and caps are designed large enough to provide for carrying currents both R.F. and DC within the rating of the tube, but the conditions of operation should be taken into consideration in order to allow sufficient current carrying capacity in the mounting connections to prevent undue heating. The wiring of associated circuits and the placing of associated parts should provide generous clearance to obviate the possibility of corona discharges puncturing the glass envelope.

In designing a cooling system for forced-air cooled tubes, provision should be made for the immediate removal of all voltages from the tube elements when the flow of air falls below a safe minimum value. This can be accomplished by the use of a small vane or paddle mounted in the cooling air stream and mechanically connected to an interlock switch. Another very desirable safety precaution is to install a thermal cut-out on the tube fin or core assembly so that electrode voltages will be immediately removed if the tube temperature should exceed a predetermined value. Air flow should be started before application of any voltages and should continue for at least ten minutes after removal of all voltages.

WATER COOLED and AIR COOLED TUBES

Suggestions for Use

Cooling

In designing equipment to use the larger sizes of air cooled tubes, it is essential that proper ventilation be provided. Artificial cooling means are not necessary if free circulation of air all around the tube is available. If it is necessary to enclose a tube in a compartment, however, two methods are left open; **One** to provide a forced draft from a fan so directed as to cool the entire tube as uniformly as possible; **Two**, to provide ventilation ducts to take full advantage of the chimney effect of the heat from the tube itself.

Circuit Requirements

The circuit in which tubes operate is a high powered, high voltage system and should be thoroughly protected. Proper overload protection (as previously described for the tubes and equipment) as well as safety interlocking means to protect personnel should be installed.

The entire plate circuit should be designed to minimize the effects of transients caused by interruptions or flash-overs.

The filament supply should be provided with means of adjusting and reading the filament voltage. If the circuit is metered elsewhere than directly at the terminals of the tube, correction for lead drops should be made.

Operation

It is suggested that tubes be inspected and tested immediately on receipt and, if in storage, at three month intervals to insure complete serviceability. The procedure is identical with that described for water cooled tubes.

In the case of bright tungsten filaments, an increase in life may be realized under light load conditions by operating the filament at reduced voltage. Bright tungsten filament tubes may be operated in such a manner that the required peak currents are practically equal to the emission available from the filament. Consequently, the filament voltage may be reduced until distortion or reduced power output is observed. In applications where the distortion is an important factor, great care should be exercised to avoid flattening of the plate current pulses due to lack of emission. The operation should always be performed in conjunction with accurate distortion measuring equipment. When on stand-by service, bright tungsten filaments may be operated at any reduced voltage that effects a good compromise between power economy and delay in arriving at the operating point. Under no circumstances should they be operated above the rated voltage. A slight increase in voltage will result in a marked decrease in life.

Thoriated tungsten filaments should always be operated at the rated voltage when other voltages are applied to the tube. No improvement in life may be expected by operating at reduced filament voltages. In fact, under-voltage is fully as deleterious to life as over-voltage. For satisfactory life results the filament voltage should not be allowed to vary more than plus or minus 5% during the time that plate voltage is applied.

In cases where lengthy stand-by periods are experienced, a reduced filament voltage may be used for power economy. In such cases the timing of the relay system should be such that the filaments are at full brilliance before the plate voltage is applied.

If at any time a thoriated filament tube should be severely overloaded, causing loss of emission, the filament may be reactivated by burning for several hours at rated voltage with no other voltages applied to the tube. If the overload has been sufficient to gas the tube appreciably, there is little chance of recovery. Small amounts of gas quickly destroy the emission of a thoriated filament when plate voltage is applied to the tube.

CAUTION: The glass envelopes on all transmitting tubes become quite hot during operation. If it should become necessary to remove a tube from its socket before it has had time to cool, care should be taken that it is not put down on any metallic, cold or heat conducting surface. The sudden temperature change may strain the glass to such a point that it will crack.

Federal Telephone and Radio Corporation invites further inquiries concerning the various applications to which these tubes may be adapted.

Printed in U.S.A.—Form F-214

WATER JACKETS FOR WATER COOLED TUBES

DESIGN FEATURES

- Precision built of the finest materials.
- Designed to facilitate flow of fast, thin stream of water evenly over anode of tube to insure adequate cooling.
- Interior constructed to prevent the anode of the tube from contact with the jacket interior wall, thereby insuring free circulation of water at all times.
- Clamping ring used in mounting the tube in the water jacket designed to act also as corona shield.
- Both inlets and outlets for water placed at the bottom of the water jacket to facilitate connection with water supply.
- Connection with water hose is made with a union supplied with the water jacket to eliminate the necessity of breaking the hose in order to disconnect the water supply.
- Mounting pads, each with two tap holes to facilitate mounting, are an integral part of the casting.
- Water jacket proper consists of one piece of cast alloy to insure ruggedness and long life.

WATER JACKETS FOR WATER COOLED TUBES

AVAILABLE TYPES OF WATER JACKET WITH RECOMMENDED FLOW

Water Jacket	Minimum Flow Gal. per Min.	Tubes
1000	5	F-207
	5	F-848
	5	F-863
	5	F-891
	5	F-892
1005	5	F-320-B
	5	F-222-A
	10	F-237-A
	5	F-343-A
	10	F-342-A
	10	9C23
1006	3	F-328-A
	3	F-328-B
1010	15	F-124-A
	15	F-125-A
	15	F-858
	15	F-893
1012	3	F-129-C

The amount of pressure required may be approximated from the following formulas:

Pounds per sq. in. drop $= Kf^2$ per ft. length of hose

$f =$ water flow gal./min.

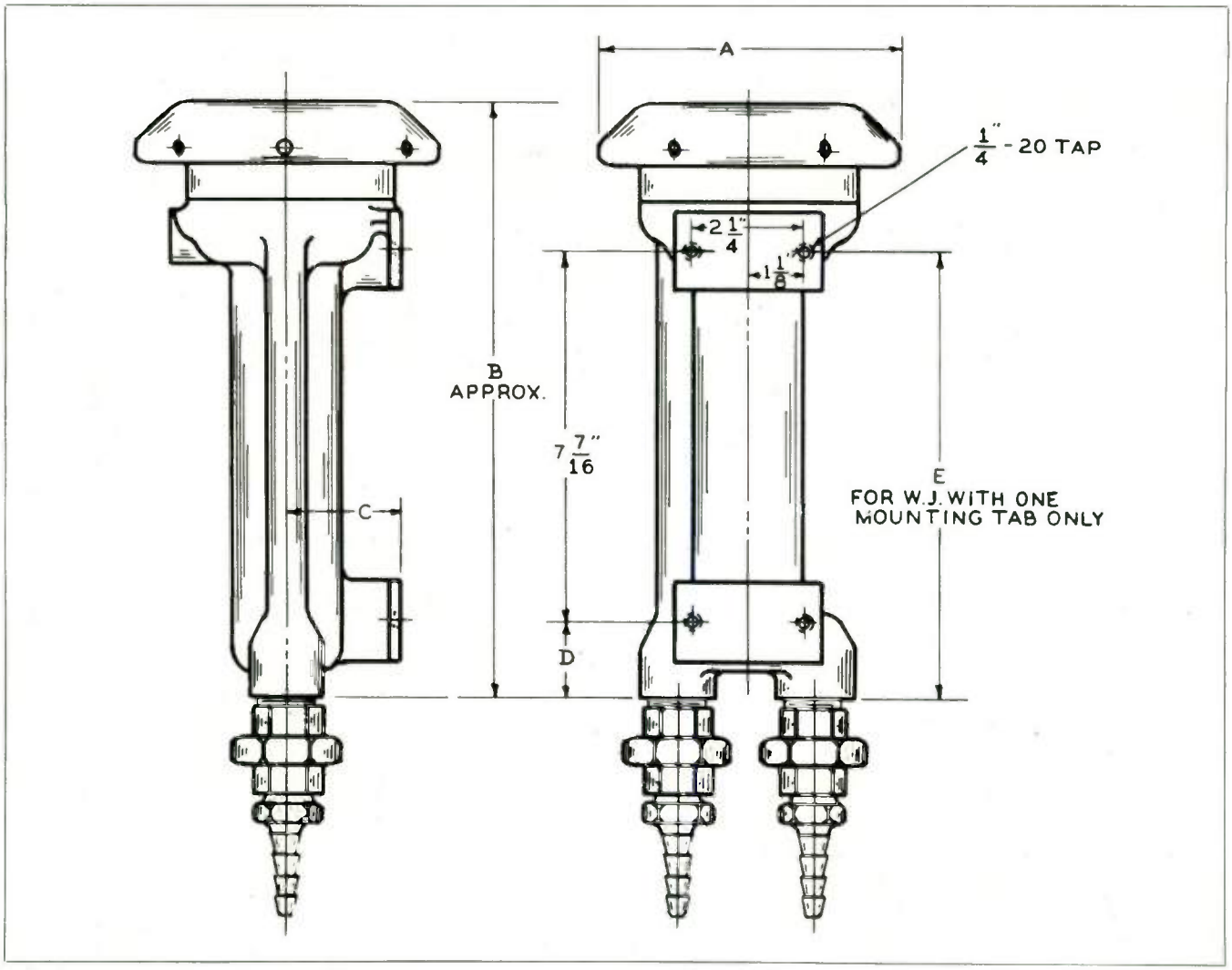
$K =$ .00065 for 1" hose

.00315 for ¾" hose

.0145 for ½" hose

.055 for water jacket

WATER JACKETS FOR WATER COOLED TUBES



MOUNTING DIMENSIONS OF STANDARD WATER JACKETS

REFERENCE TABLE

Water Jacket	A	B	C	D	E
1012	5 3/8"	7 1/2"	2 7/8"	——	4 7/8"
1010	7 1/2"	15 3/8"	3 7/8"	3 13/32"	——
1006	5 13/16"	11 7/8"	2 1/4"	1 1/2"	——
1005	6 1/4"	11 3/4"	2 9/16"	1 1/2"	——
1000	6 1/2"	12 5/8"	2 3/4"	1 1/2"	——

Hose nipples supplied with these water jackets are available in three sizes for ½ inch, ¾ inch and 1 inch hose respectively. Unless otherwise specified, nipples for ¾ inch hose are furnished.

WATER JACKETS FOR WATER COOLED TUBES

APPROXIMATE NET WEIGHTS

1000	20 lbs.
1005	21 lbs.
1006	18 lbs.
1010	44 lbs.
1012	11 lbs.

For further information see sheet entitled "Water Cooled and Air Cooled Tubes, Suggestions for Use."

Federal Telephone and Radio Corporation

Vacuum Tube Products — An IT&T Associate — Newark 4, New Jersey

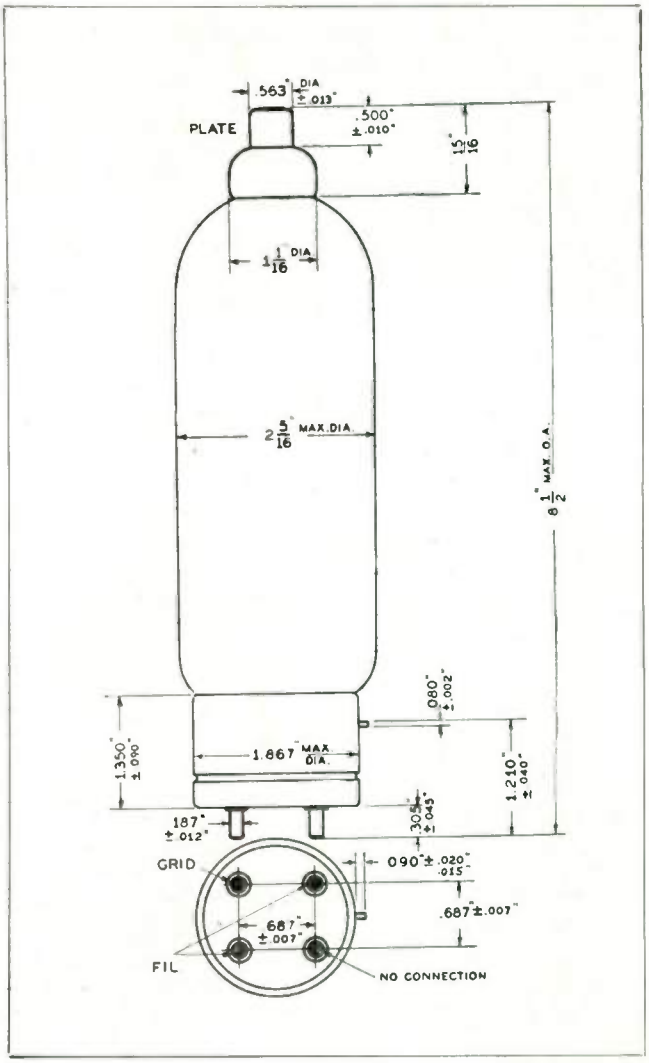
Printed in U.S.A. Form F-201

TRANSMITTING TUBE TYPE F-123-A

125 Watts Plate Dissipation

Technical Data

Main Use	R-F Power Amplifier, Oscillator, Class B Modulator
Number of Electrodes	3
Filament Voltage	10 volts
Current	4 amperes
Type	Thoriated Tungsten
Available Thermionic Emission	1.8 amperes
Amplification Factor	14.5
Approximate Direct Inter-electrode Capacitances	
Plate to Grid	8.5 $\mu\mu f$
Grid to Filament	6.5 $\mu\mu f$
Plate to Filament	3.3 $\mu\mu f$
Type of Cooling	Convection
Type Base	Standard 50 Watt
Mounting Socket	Standard 50 Watt and Anode Clip



TRANSMITTING TUBE TYPE F-123-A

125 Watts Plate Dissipation

Maximum Ratings and Typical Operation Data

For maximum frequency of 30 megacycles

CLASS B AUDIO AMPLIFIER OR MODULATOR

Maximum Ratings

DC Plate Voltage	2,000 volts
Max. Signal DC Plate Current	0.250 ampere
Max. Signal Plate Input	375 watts
Plate Dissipation	125 watts

Typical Operation

Filament Voltage	10 volts
DC Plate Voltage	2,000 volts
DC Grid Voltage	−130 volts (approx.)
Peak A-F Grid Input Voltage	217 volts (approx.)
Zero Signal Plate Current (per tube)	0.030 ampere
Max. Signal Plate Current (per tube)	0.175 ampere
Max. Signal Plate Input (per tube)	350 watts
Max. Signal Driving Power	3.4 watts (approx.)
Effective Load (plate to plate)	13,800 ohms
Power Output (2 tubes)	522 watts (approx.)

CLASS C R-F POWER AMPLIFIER AND OSCILLATOR — TELEGRAPHY

*(Key-down conditions per tube without modulation)**

Maximum Ratings

DC Plate Voltage	2,000 volts
DC Grid Voltage	−500 volts
DC Plate Current	0.250 ampere
DC Grid Current	0.070 ampere
R-F Grid Current	7.5 amperes
Plate Input	375 watts
Plate Dissipation	125 watts

Typical Operation

Filament Voltage	10 volts
DC Plate Voltage	1,500 volts
DC Grid Voltage	−250 volts (approx.)
Peak R-F Grid Input Voltage	400 volts (approx).
DC Plate Current	0.250 ampere
DC Grid Current	0.030 ampere
Driving Power	11 watts (approx.)
Power Output	300 watts (approx.)

*Modulation essentially negative, may be used if the positive peak of the audio frequency envelope does not exceed 115% of the carrier condition value.

CLASS B R-F POWER AMPLIFIER — TELEPHONY

(Carrier conditions per tube for use with modulation factor up to 1.0)

Maximum Ratings

DC Plate Voltage	2,000 volts
DC Plate Current	0.200 ampere
R-F Grid Current	7.5 amperes
Plate Input	185 watts
Plate Dissipation	125 watts

Typical Operation

Filament Voltage	10 volts
DC Plate Voltage	1,500 volts
DC Grid Voltage	−100 volts (approx).
Peak R-F Grid Input Voltage	108 volts (approx.)
DC Plate Current	0.120 ampere
DC Grid Current	0.001 ampere
Driving Power*	6 watts (approx.)
Load Impedance	3,680 ohms
Power Output	65.5 watts (approx.)

*At crest of A-F cycle

CLASS C R-F POWER AMPLIFIER TELEPHONY — PLATE MODULATED

(Carrier conditions per tube for use with modulation factor up to 1.0)

Maximum Ratings

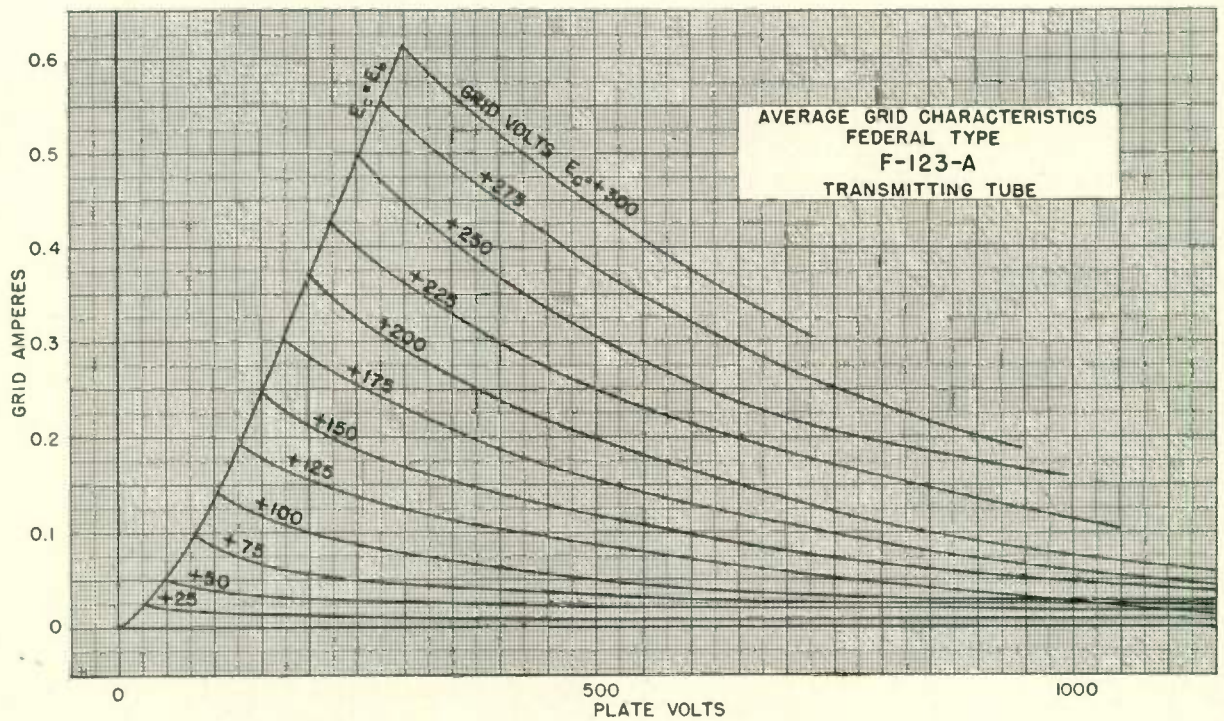
DC Plate Voltage	1,500 volts
DC Plate Current	0.250 ampere
DC Grid Current	0.070 ampere
R-F Grid Current	7.5 amperes
Plate Input	240 watts
Plate Dissipation	85 watts

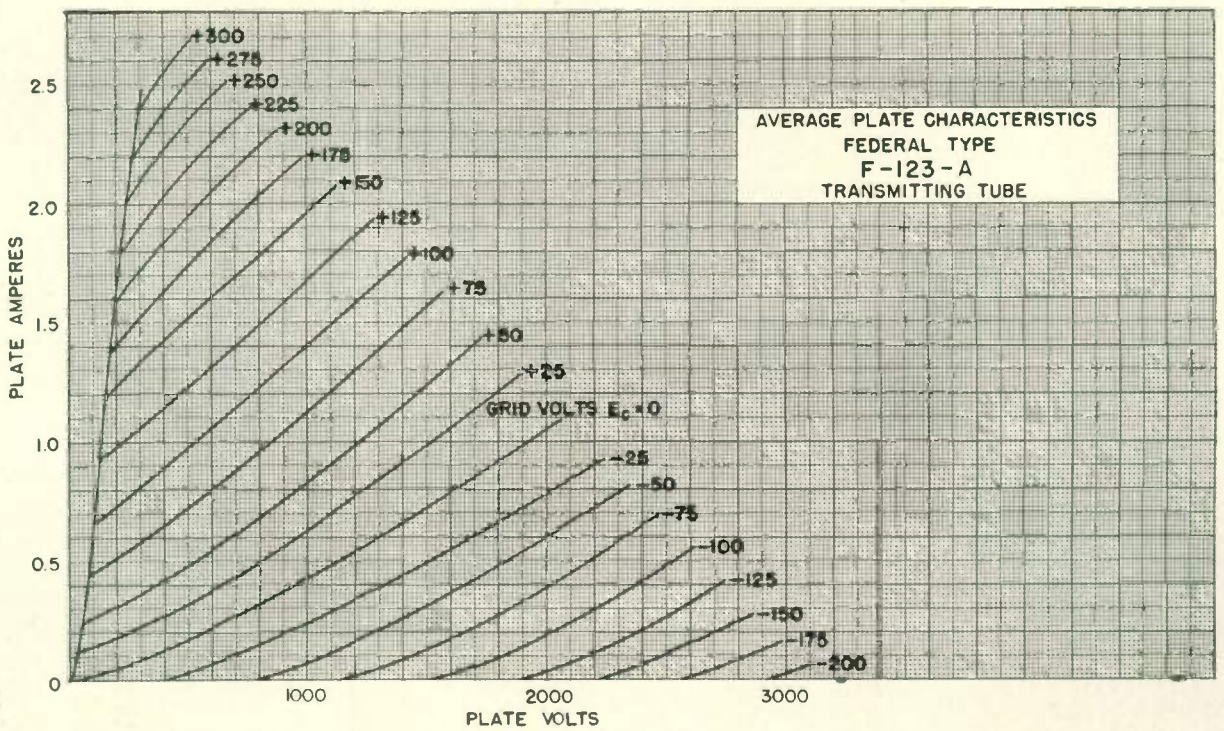
Typical Operation

Filament Voltage	10 volts
DC Plate Voltage	1,500 volts
DC Grid Voltage	−290 volts (approx.)
Peak R-F Grid Input Voltage	410 volts (approx.)
DC Plate Current	0.160 ampere
DC Grid Current	0.025 ampere
Driving Power	10 watts (approx.)
Power Output	200 watts (approx.)

TRANSMITTING TUBE TYPE F-123-A

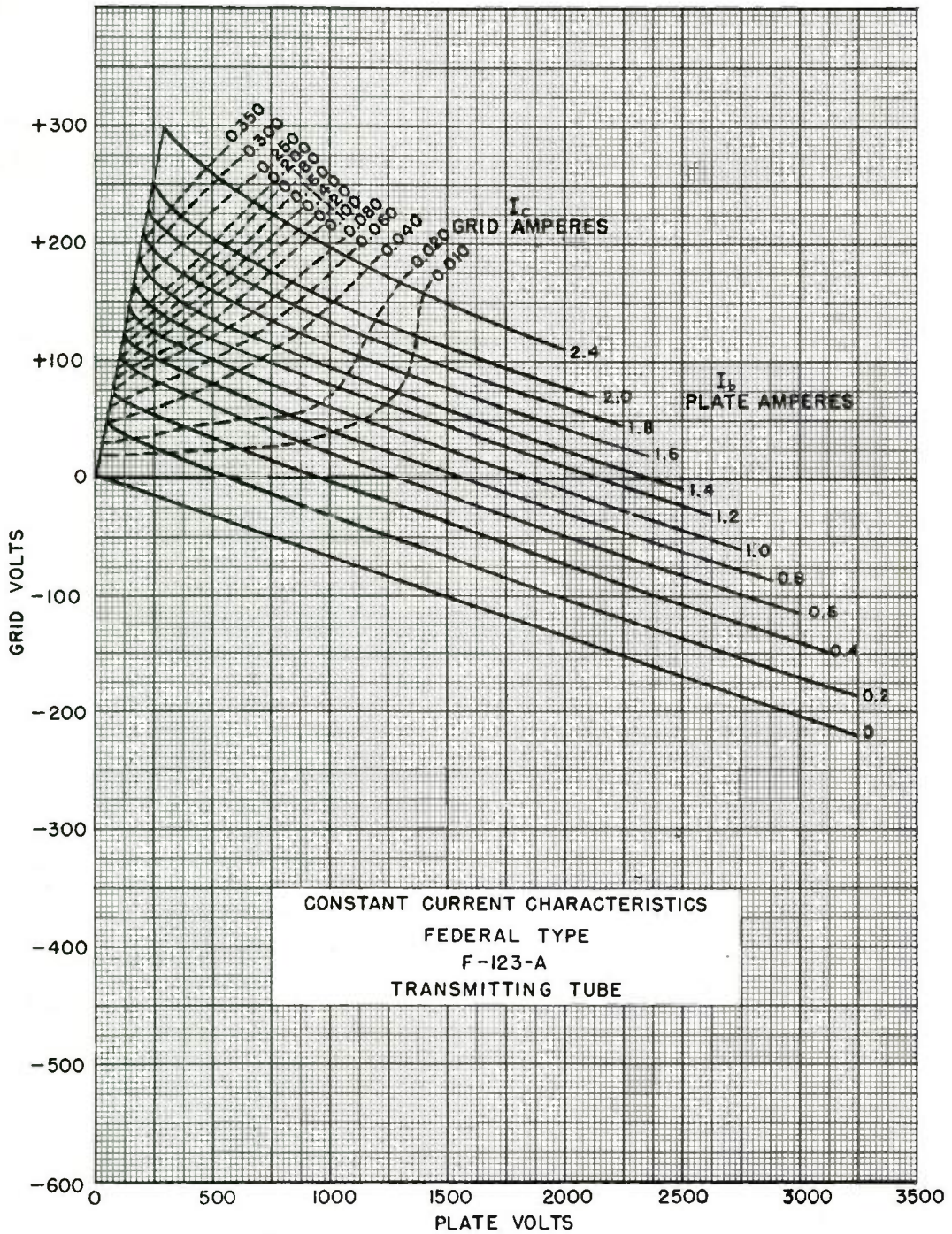
125 Watts Plate Dissipation





TRANSMITTING TUBE TYPE F-123-A

125 Watts Plate Dissipation

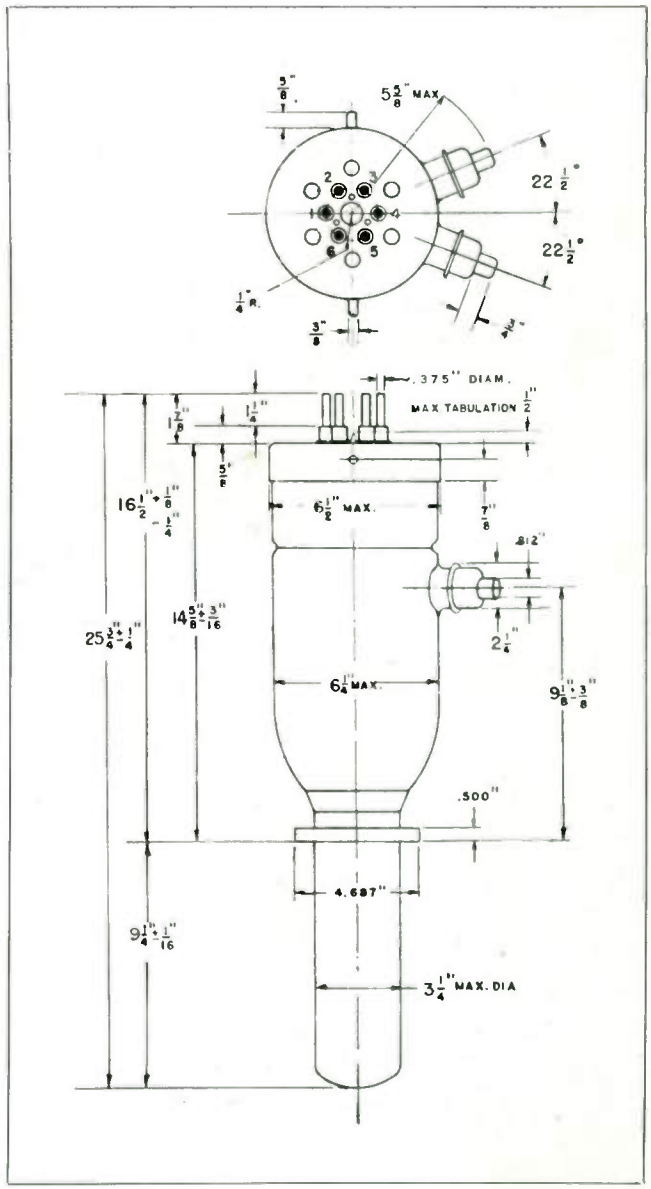


TRANSMITTING TUBE TYPE F-124-A

40 Kilowatts Plate Dissipation

Technical Data

Main Use	R-F Power Amplifier, Oscillator, Class B Modulator
Number of Electrodes	3
Filament Voltage per Strand	13.6 volts
Current per Strand	68.5 amperes
Type	Multistrand Tungsten
Excitation	D-C, 1, 3, or 6 A-C
Thermionic Emission	35 amperes
Amplification Factor	42
Approximate Direct Inter-electrode Capacitances	
Plate to Grid	35 $\mu\mu f$
Grid to Filament	46 $\mu\mu f$
Plate to Filament	5.6 $\mu\mu f$
Type of Cooling	Water
Minimum Flow	15 GPM
Water Jacket	Standard or Federal Type F-1010



TRANSMITTING TUBE TYPE F-124-A

40 Kilowatts Plate Dissipation

Maximum Ratings and Typical Operation Data

For maximum frequency of 20 megacycles

CLASS B AUDIO AMPLIFIER OR MODULATOR

Maximum Ratings

DC Plate Voltage	20,000 volts
Max. Signal DC Plate Current	5.0 amperes
Max. Signal Plate Input	50,000 watts
Plate Dissipation	30,000 watts

CLASS C R-F POWER AMPLIFIER TELEPHONY-PLATE MODULATED

(Carrier conditions per tube for use with modulation factor up to 1.0)

Maximum Ratings

DC Plate Voltage	14,000 volts
DC Plate Current	4.5 amperes
DC Grid Current	1.0 amperes
R-F Grid Current	50 amperes
Plate Input	60,000 watts
Plate Dissipation	30,000 watts

Typical Operation

DC Plate Voltage	12,000 volts
DC Grid Voltage	–725 volts (approx.)
Peak R-F Grid Input Voltage	1,425 volts (approx.)
DC Plate Current	3.31 amperes
DC Grid Current	0.061 amperes
Driving Power	200 watts (approx.)
Power Output	26,200 watts (approx.)

CLASS B R-F POWER AMPLIFIER TELEPHONY

(Carrier conditions per tube for use with modulation factor up to 1.0)

Maximum Ratings

DC Plate Voltage	20,000 volts
DC Plate Current	3.5 amperes
R-F Grid Current	50 amperes
Plate Input	60,000 watts
Plate Dissipation	40,000 watts

Typical Operation

DC Plate Voltage	17,500 volts
DC Grid Voltage	–300 volts (approx.)
Peak R-F Grid Input Voltage	480 volts (approx.)
DC Plate Current	2.1 amperes
DC Grid Current	–0.02 amperes
Driving Power*	100 watts (approx.)
Load Impedance	2,550 ohms
Power Output	13,100 watts (approx.)

*At crest of A-F cycle

CLASS C R-F POWER AMPLIFIER AND OSCILLATOR-TELEGRAPHY

*(Key-down conditions per tube without modulation)**

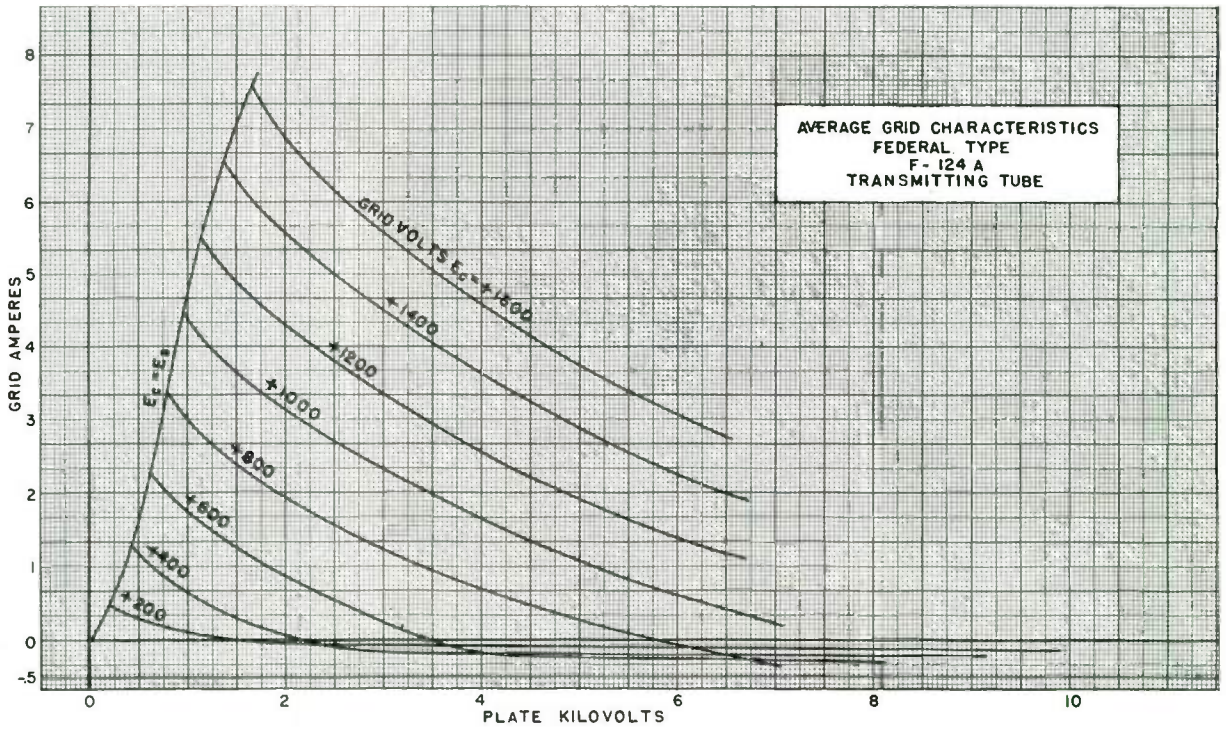
Maximum Ratings

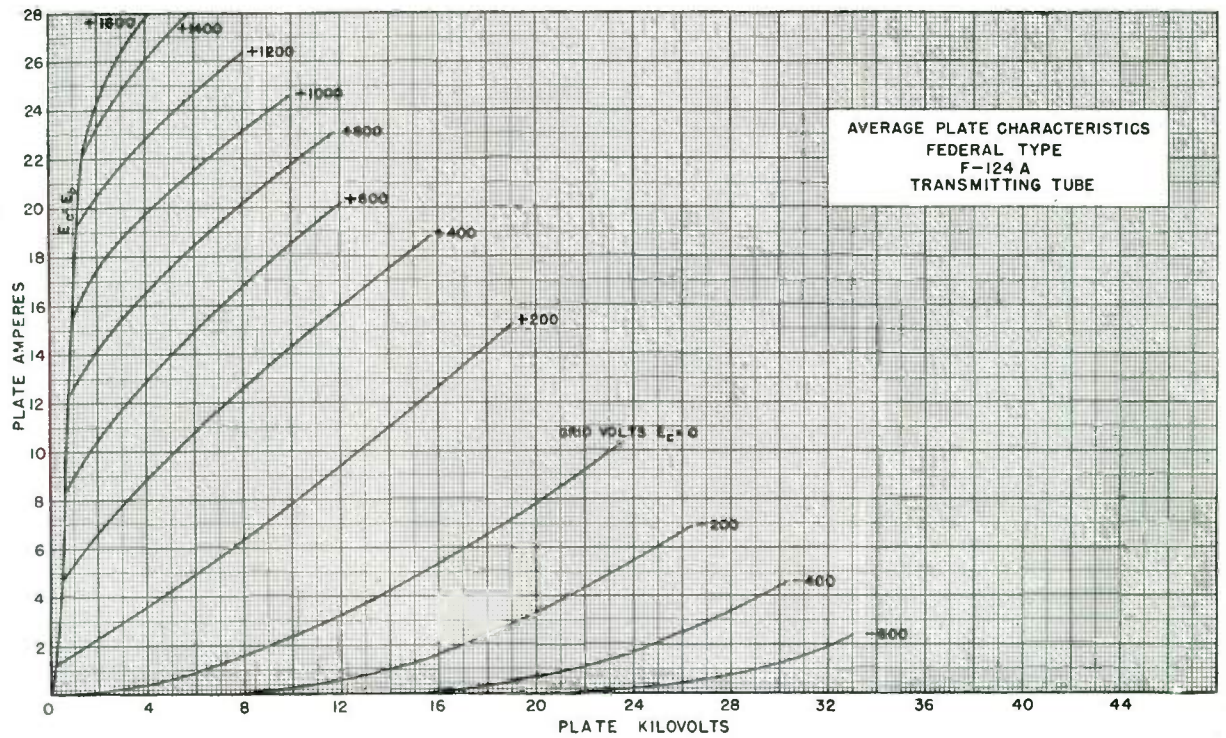
DC Plate Voltage	20,000 volts
DC Grid Voltage	–3,000 volts
DC Plate Current	7.0 amperes
DC Grid Current	2.0 amperes
R-F Grid Current	50 amperes
Plate Input	135,000 watts
Plate Dissipation	40,000 watts

*Modulation essentially negative, may be used if the positive peak of the audio frequency envelope does not exceed 115% of the carrier condition value.

TRANSMITTING TUBE TYPE F-124-A

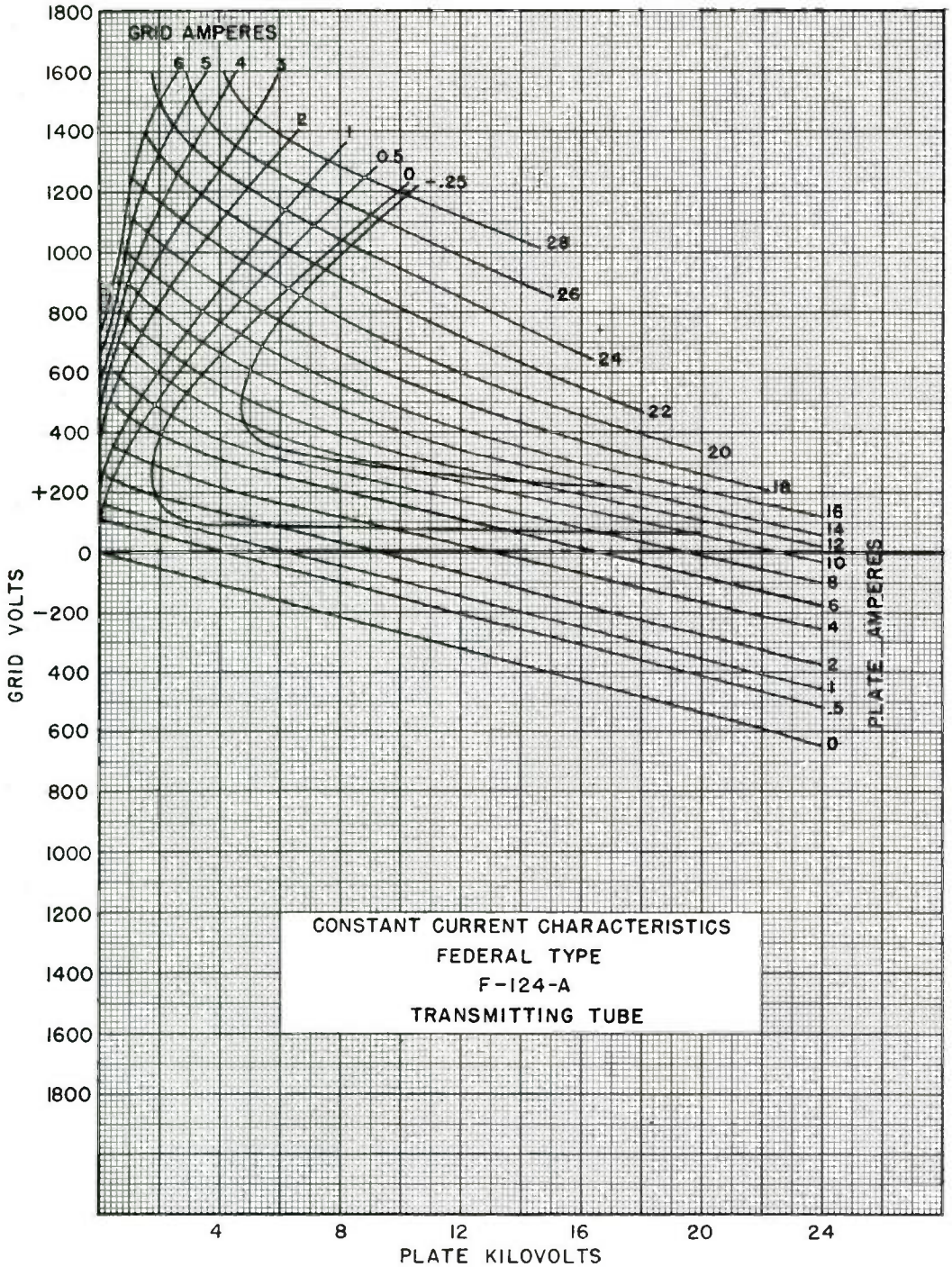
40 Kilowatts Plate Dissipation





TRANSMITTING TUBE TYPE F-124-A

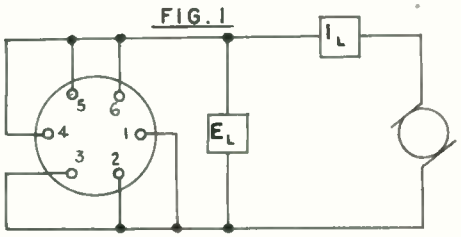
40 Kilowatts Plate Dissipation



TRANSMITTING TUBE TYPE F-124-A

40 Kilowatts Plate Dissipation

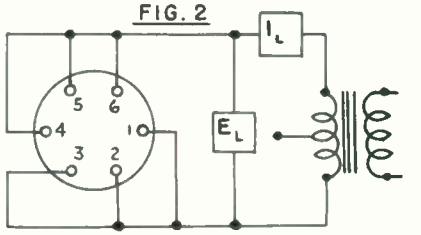
FIG. 1



D.C. CONNECTION

E_L = 'X' VOLTS D.C.
I_L = 'Y' AMPS. D.C.

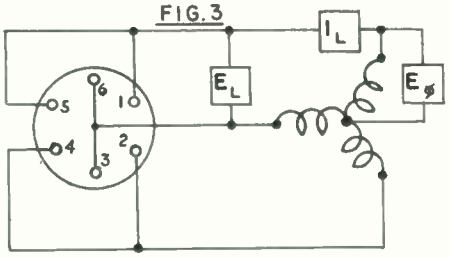
FIG. 2



SINGLE-PHASE A.C. CONNECTION

E_L = 'X' VOLTS A.C.
I_L = 'Y' AMPS. A.C.

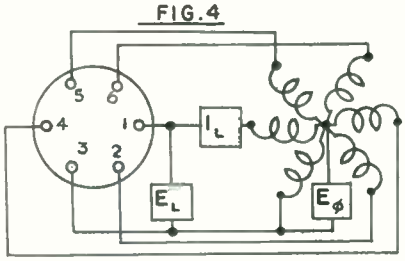
FIG. 3



THREE-PHASE A.C. CONNECTION

E_L = 'X' VOLTS A.C.
I_L = 'Y' AMPS. A.C.
E_ϕ = 'Z' VOLTS A.C.

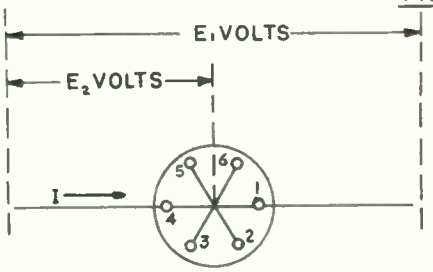
FIG. 4



SIX-PHASE A.C. CONNECTION

E_L = 'X' VOLTS A.C.
I_L = 'Y' AMPS. A.C.
E_ϕ = 'Z' VOLTS. A.C.

FIG. 5



INTERNAL CONNECTION OF FILAMENTS

NUMBERS 1 TO 6 INCLUSIVE ON CONNECTIONS DENOTE BASE TERMINALS.

E_1 = 'U' VOLTS D.C. OR A.C. TERMINAL TO TERMINAL VOLTAGE.

E_2 = 'V' VOLTS D.C. OR A.C. VOLTAGE PER FILAMENT STRAND i.e. FROM TERMINAL TO COMMON TERMINAL CONNECTION.

I = 'W' AMPERES CURRENT PER FILAMENT TERMINAL.

FIG.	'U'	'V'	'W'	'X'	'Y'	'Z'
1				27.2	205.5	
2				27.2	205.5	
3				23.5	137.0	13.6
4				13.6	68.5	13.6
5	27.2	13.6	68.5			

MULTI-PHASE FILAMENT CONNECTIONS

Printed in U.S.A. Form F-132-B

TRANSMITTING TUBE TYPE F-124-R

20 Kilowatts Plate Dissipation

Technical Data

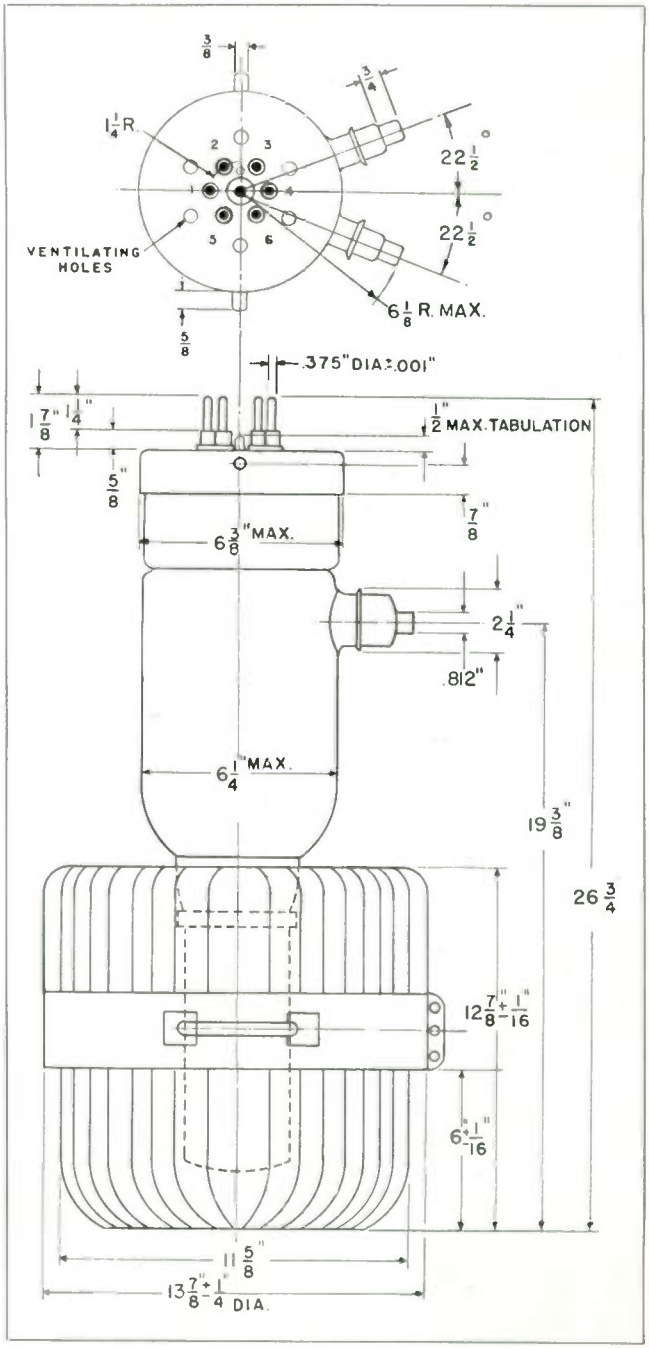
Main Use	R-F Power Amplifier, Oscillator, Class B Modulator
Number of Electrodes	3
Filament Voltage Per Strand	13.6 volts
Current Per Strand	68.5 amperes
Type	Multistrand Tungsten
Excitation	D-C, 1, 3, or 6 A-C
Thermionic Emission	35 amperes
Amplification Factor	42
Approximate Direct Inter-electrode Capacitances	
Plate to Grid	40 $\mu\mu f$
Grid to Filament	46 $\mu\mu f$
Plate to Filament	5.6 $\mu\mu f$
Type of Cooling	Forced Air

Air Requirements Per Tube

Anode Dissipation KW (1)	Minimum Recommended Air Flow Cu. Ft./Min.	Approx. Air Press. (2) In. of water	Air Velocity Through Fin. Assy. Ft./Min.	Approx. Temp. Rise of air Deg. Cent.
5	675	0.22	1365	30
10	950	0.43	1920	30
15	1500	1.10	3030	25
20	2100	2.15	5240	21

(1) This is the anode dissipation exclusive of filament power dissipated through anode.

(2) This pressure is measured at the base of tube mounting. Duct work must be considered to determine pressure against which blower must deliver required amount of air.



TRANSMITTING TUBE TYPE F-124-R

20 Kilowatts Plate Dissipation

Maximum Ratings and Typical Operation Data

For maximum frequency of 20 megacycles

CLASS B AUDIO AMPLIFIER OR MODULATOR

Maximum Ratings

DC Plate Voltage	20,000 volts
Max. Signal DC Plate Current	5.0 amperes
Max. Signal Plate Input	50,000 watts
Plate Dissipation	20,000 watts

CLASS C R-F POWER AMPLIFIER— TELEPHONY — PLATE MODULATED

(Carrier conditions per tube for use with modulation factor up to 1.0)

Maximum Ratings

DC Plate Voltage	14,000 volts
DC Plate Current	4.5 amperes
DC Grid Current	1.0 amperes
R-F Grid Current	50 amperes
Plate Input	60,000 watts
Plate Dissipation	15,000 watts

Typical Operation

Filament Voltage	13.6 volts per strand
DC Plate Voltage	12,000 volts
DC Grid Voltage	—900 volts (approx.)
Peak R-F Grid Input Voltage	1,630 volts (approx.)
DC Plate Current	2.8 amperes
DC Grid Current	0.18 ampere
Driving Power	275 watts (approx.)
Power Output	26,200 watts (approx.)

CLASS B R-F POWER AMPLIFIER TELEPHONY

(Carrier conditions per tube for use with modulation factor up to 1.0)

Maximum Ratings

DC Plate Voltage	20,000 volts
DC Plate Current	3.5 amperes
R-F Grid Current	50 amperes
Plate Input	30,000 watts
Plate Dissipation	20,000 watts

CLASS C R-F POWER AMPLIFIER AND OSCILLATOR-TELEGRAPHY

*(Key-down conditions per tube without modulation)**

Maximum Ratings

DC Plate Voltage	20,000 volts
DC Grid Voltage	—3,000 volts
DC Plate Current	7.0 amperes
DC Grid Current	1.0 amperes
R-F Grid Current	50 amperes
Plate Input	100,000 watts
Plate Dissipation	20,000 watts

*Modulation essentially negative, may be used if the positive peak of the audio frequency envelope does not exceed 115% of the carrier condition value.

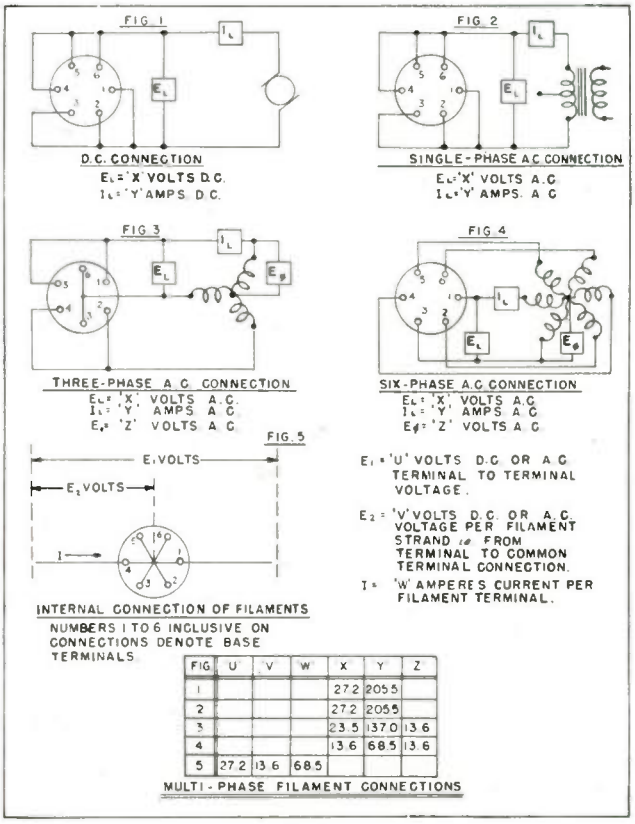
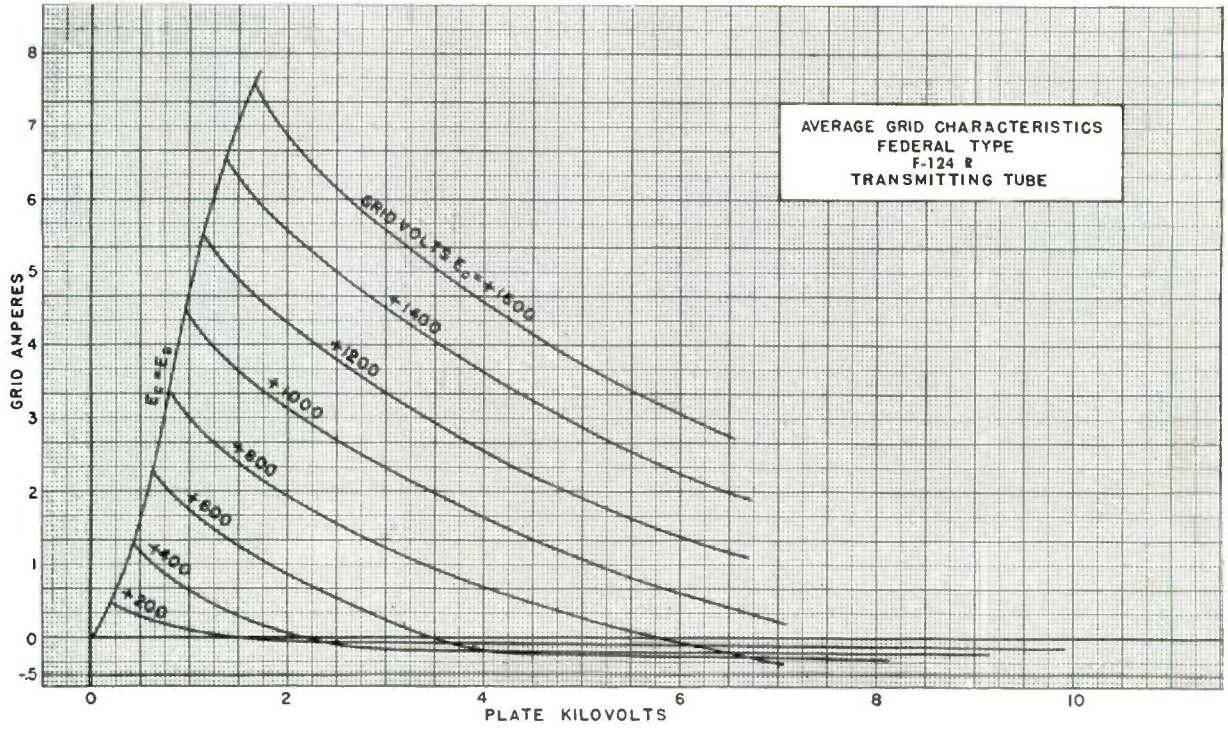


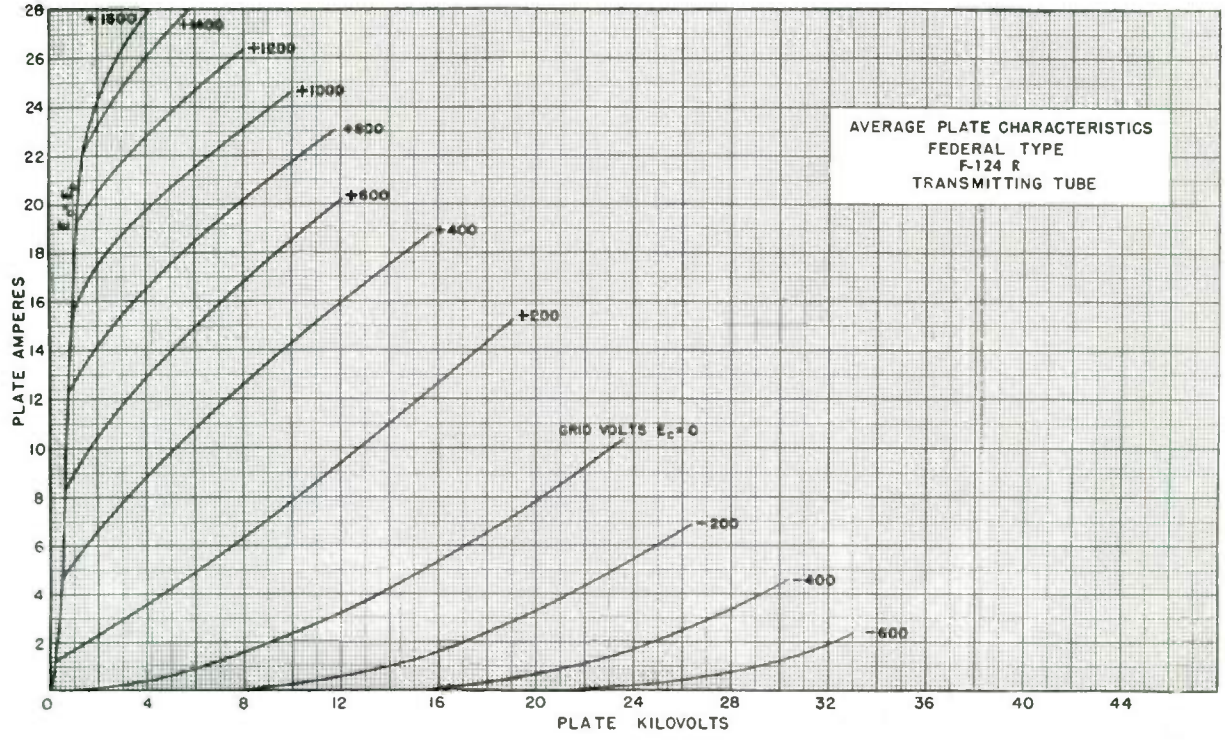
FIG.	U	V	W	X	Y	Z
1				27.2	205.5	
2				27.2	205.5	
3				23.5	137.0	13.6
4				13.6	68.5	13.6
5	27.2	13.6	68.5			

MULTI-PHASE FILAMENT CONNECTIONS

TRANSMITTING TUBE TYPE F-124-R

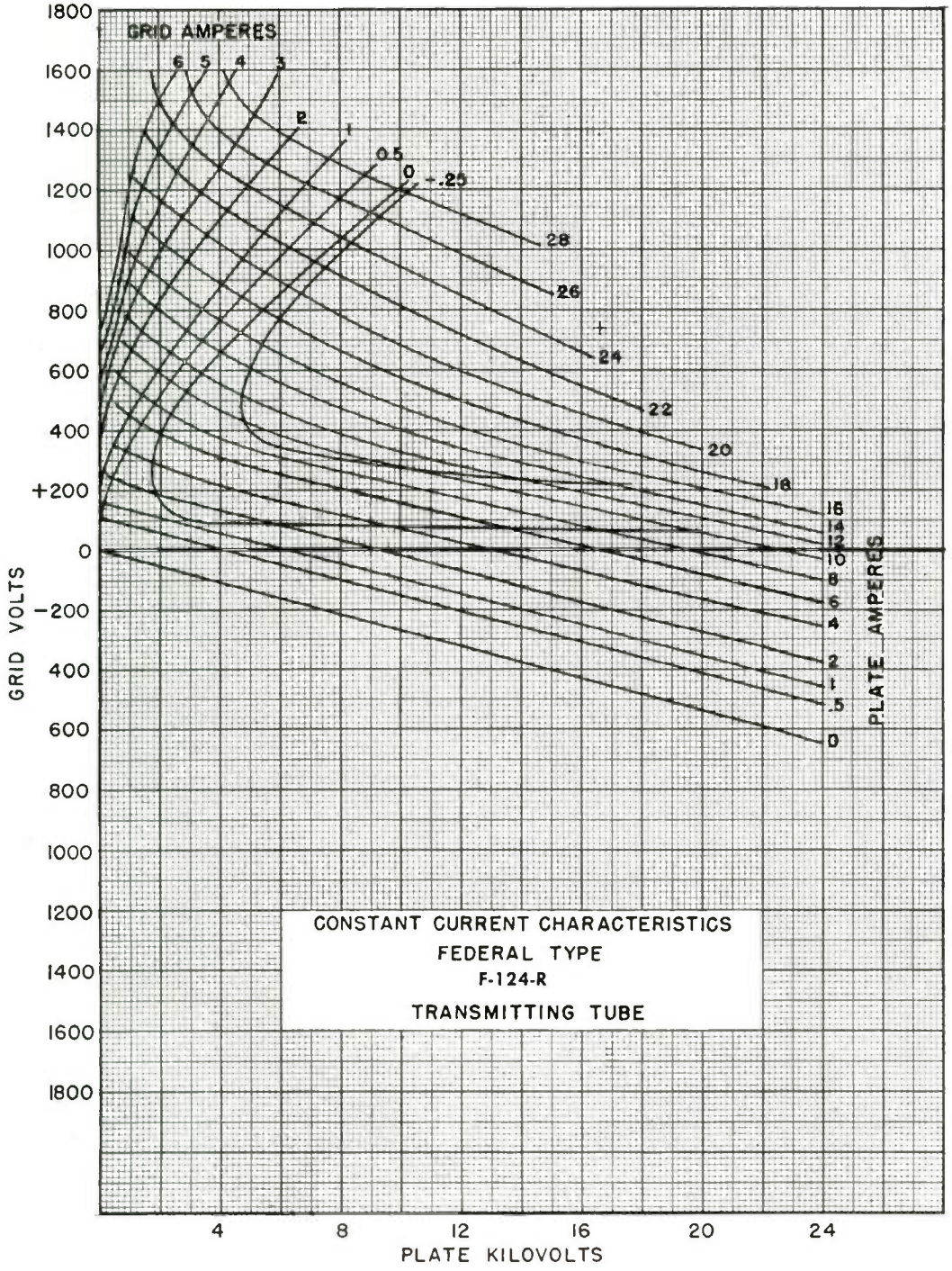
20 Kilowatts Plate Dissipation





TRANSMITTING TUBE TYPE F-124-R

20 Kilowatts Plate Dissipation



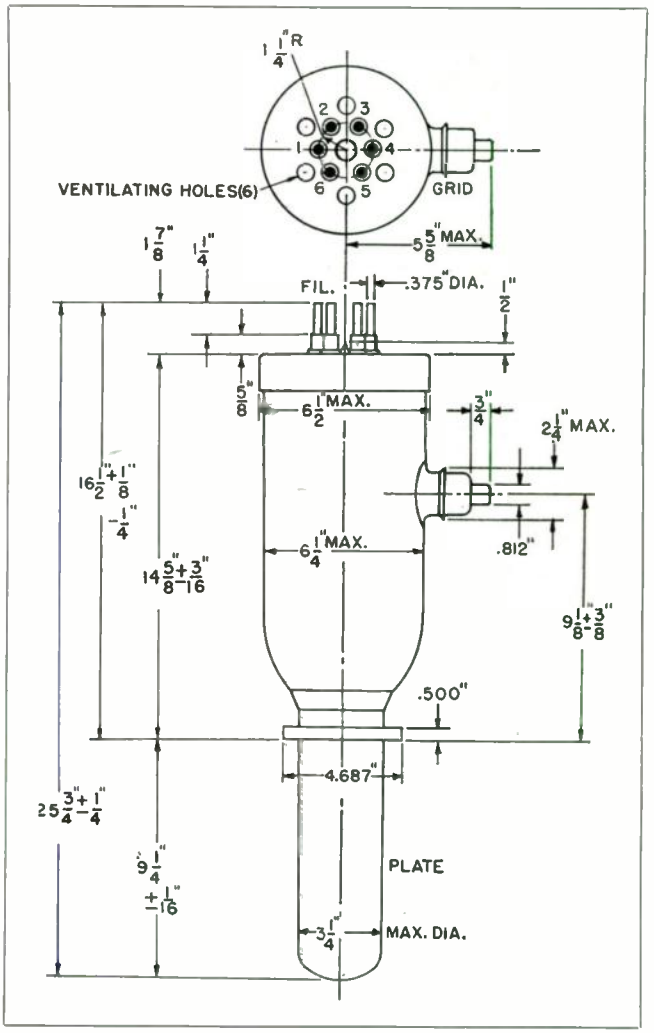
Printed in U.S.A.—Form F-163

TRANSMITTING TUBE TYPE F-125-A

40 Kilowatts Plate Dissipation

Technical Data

Main Use	Modulator
Number of Electrodes	3
Filament Voltage per strand	13.6 volts
Current per strand	65.5 amperes
Type	Multistrand Tungsten
Excitation	DC, 1, 3 or 6Φ AC
Thermionic Emission	35 amperes
Amplification Factor	4.75
Plate Resistance	300 ohms
Approximate Direct Inter-electrode Capacitances	
Plate to Grid	44 μμf
Grid to Filament	56 μμf
Plate to Filament	22 μμf
Type of Cooling	Water
Minimum Flow	15 G.P.M.
Water Jacket	Standard or Federal Type F-1010



TRANSMITTING TUBE TYPE F-125-A

40 Kilowatts Plate Dissipation

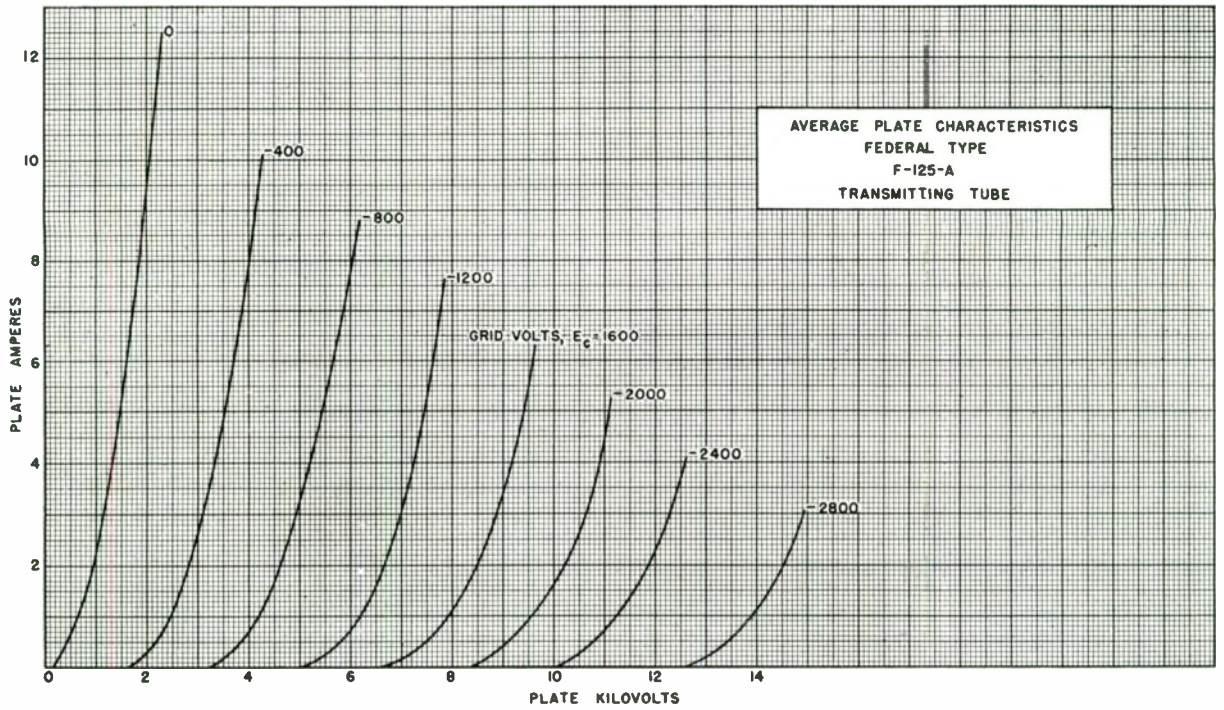
Maximum Ratings and Typical Operation Data

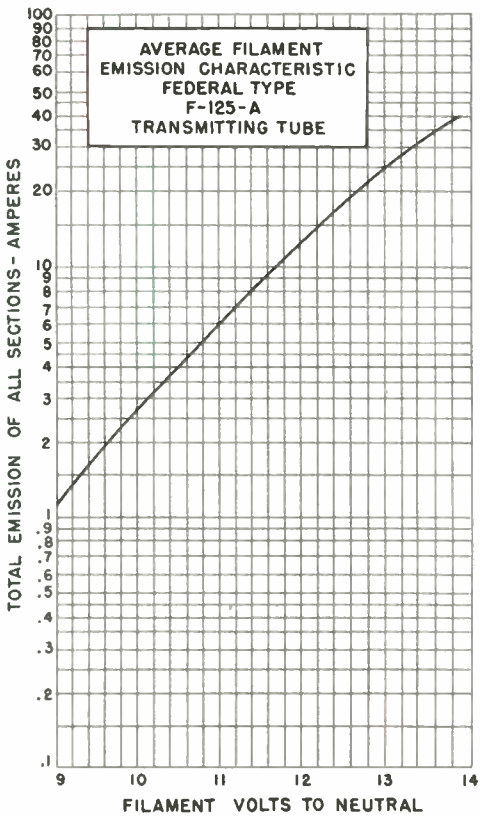
For audio frequency use only

	CLASS AB AUDIO FREQUENCY AMPLIFIER OR MODULATOR	CLASS A AUDIO FREQUENCY AMPLIFIER OR MODULATOR
Maximum Ratings		
DC Plate Voltage	15,000 volts	15,000 volts
Max. Signal DC Plate Current	10 amperes	
Max. Signal Plate Input	100,000 watts	
Plate Input		40,000 watts
Plate Dissipation	40,000 watts	40,000 watts
Typical Operation		
DC Plate Voltage	10,000 volts	12,000 volts
DC Grid Voltage	–2,125 volts (approx.)	–2,600 volts (approx.)
Peak A-F Grid Input Voltage	2,110 volts (approx.)	2,580 volts (approx.)
Zero Signal Plate Current (per tube)	0.7 ampere	0.9 ampere
Max. Signal Plate Current (per tube)	3.05 amperes	2.64 amperes
Max. Signal Plate Input (per tube)	30,500 watts	31,700 watts
Effective Load (plate to plate)	3,100 ohms	5,000 ohms
Power Output (2 tubes)	40,200 watts (approx.)	40,000 watts (approx.)

TRANSMITTING TUBE TYPE F-125-A

40 Kilowatts Plate Dissipation

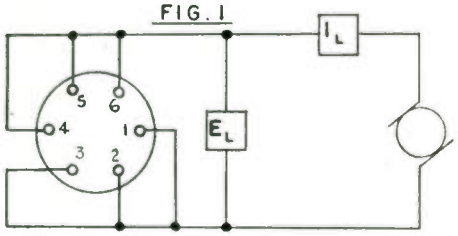




TRANSMITTING TUBE TYPE F-125-A

40 Kilowatts Plate Dissipation

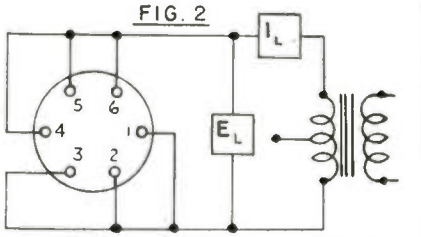
FIG. 1



D.C. CONNECTION

E_L = 'X' VOLTS D.C.
I_L = 'Y' AMPS. D.C.

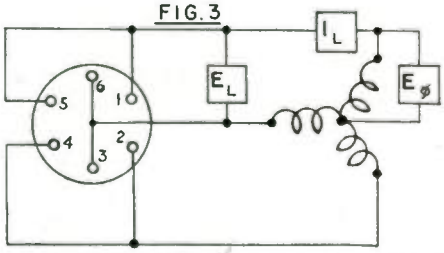
FIG. 2



SINGLE-PHASE A.C. CONNECTION

E_L = 'X' VOLTS A.C.
I_L = 'Y' AMPS. A.C.

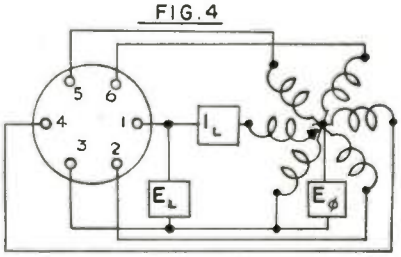
FIG. 3



THREE-PHASE A.C. CONNECTION

E_L = 'X' VOLTS A.C.
I_L = 'Y' AMPS. A.C.
E_ϕ = 'Z' VOLTS. A.C.

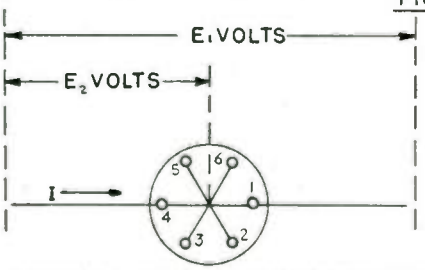
FIG. 4



SIX-PHASE A.C. CONNECTION

E_L = 'X' VOLTS A.C.
I_L = 'Y' AMPS. A.C.
E_ϕ = 'Z' VOLTS. A.C.

FIG. 5



INTERNAL CONNECTION OF FILAMENTS

NUMBERS 1 TO 6 INCLUSIVE ON CONNECTIONS DENOTE BASE TERMINALS.

E_1 = 'U' VOLTS D.C. OR A.C. TERMINAL TO TERMINAL VOLTAGE.

E_2 = 'V' VOLTS D.C. OR A.C. VOLTAGE PER FILAMENT STRAND *i.e.* FROM TERMINAL TO COMMON TERMINAL CONNECTION.

I = 'W' AMPERES CURRENT PER FILAMENT TERMINAL.

FIG.	'U'	'V'	'W'	'X'	'Y'	'Z'
1				27.2	196.5	
2				27.2	196.5	
3				23.5	131.0	13.6
4				13.6	65.5	13.6
5	27.2	13.6	65.5			

MULTI-PHASE FILAMENT CONNECTIONS

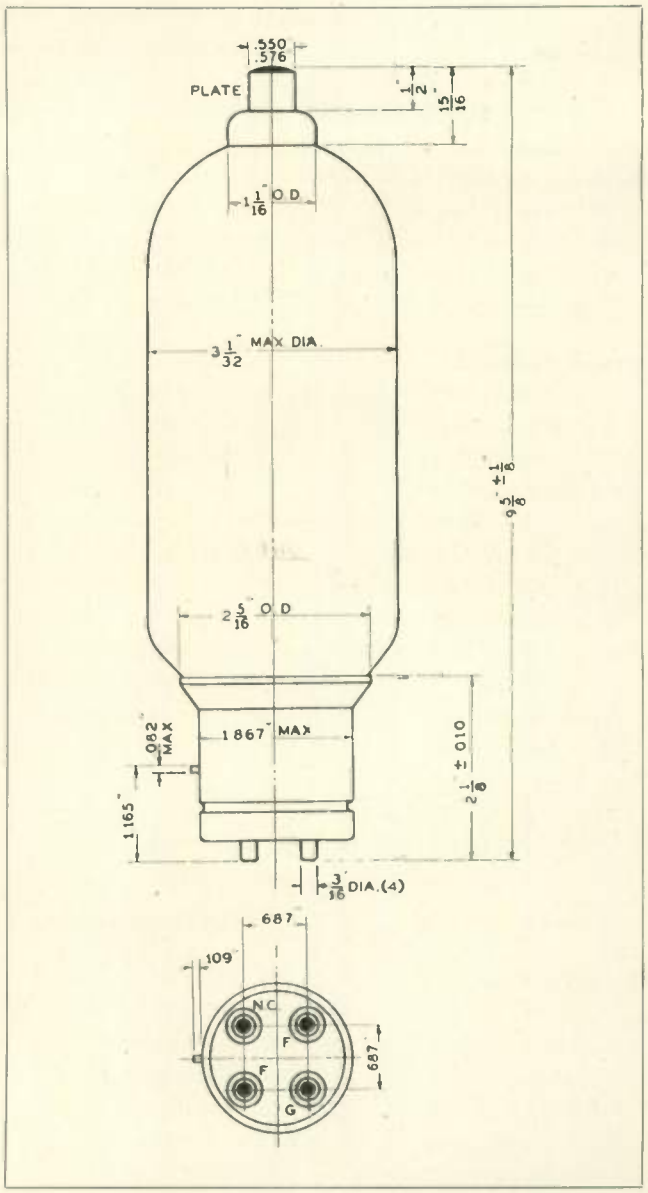
Printed in U.S.A. Form F-181

TRANSMITTING TUBE TYPE F-127-A

200 Watts Plate Dissipation

Technical Data

Main Use	R-F Power Amplifier, Oscillator, Class B Modulator
Number of Electrodes	3
Filament Voltage	10 volts
Current	6 amperes
Type	Thoriated Tungsten
Available Thermionic Emission	2 amperes
Amplification Factor	38
Approximate Direct Inter-electrode Capacitances	
Plate to Grid	4 $\mu\mu f$
Grid to Filament	13 $\mu\mu f$
Plate to Filament	13 $\mu\mu f$
Type of Cooling	Convection
Type Base	Standard 50 Watt
Mounting Socket	Standard 50 Watt and Anode Clip



TRANSMITTING TUBE TYPE F-127-A

200 Watts Plate Dissipation

Maximum Ratings and Typical Operation Data

For maximum frequency of 30 megacycles

CLASS B AUDIO AMPLIFIER OR MODULATOR

Maximum Ratings

DC Plate Voltage	3,000 volts
Max. Signal DC Plate Current	0.325 amperes
Max. Signal Plate Input	600 watts
Plate Dissipation	200 watts

Typical Operation

*(Key-down conditions per tube without modulation)**

Filament Voltage	10 volts
DC Plate Voltage	2,800 volts
DC Grid Voltage	75 volts
Peak A-F Grid Input Voltage	175 volts (approx.)
Zero Signal Plate Current	0.010 amp. (per tube)
Max. Signal Plate Current	0.200 amp. (per tube)
Max. Signal Plate Input	560 watts (per tube)
Max. Signal Driving Power	6.65 watts
Effective Load	16,600 ohms (plate to plate)
Power Output	820 watts (2 tubes, approx.)

CLASS C R-F POWER AMPLIFIER TELEPHONY-PLATE MODULATED

(Carrier conditions per tube for use with modulation factor up to 1.0)

Maximum Ratings

DC Plate Voltage	2,500 volts
DC Plate Current	0.275 amperes
DC Grid Current	0.070 amperes
R-F Grid Current	7.50 amperes
Plate Input	550 watts
Plate Dissipation	150 watts

Typical Operation

Filament Voltage	10 volts
DC Plate Voltage	2,500 volts
DC Grid Voltage	–300 volts (approx.)
Peak R-F Grid Input Voltage	450 volts (approx.)
DC Plate Current	0.200 amperes
DC Grid Current	0.058 amperes
Driving Power	25.2 watts (approx.)
Power Output	420 watts (approx.)
Grid Resistor	5,000 ohms

CLASS C R-F POWER AMPLIFIER AND OSCILLATOR-TELEGRAPHY

*(Key-down conditions per tube without modulation)**

Maximum Ratings

DC Plate Voltage	3,000 volts
DC Grid Voltage	–500 volts
DC Plate Current	0.325 amperes
DC Grid Current	0.070 amperes
R-F Grid Current	7.50 amperes
Plate Input	950 watts
Plate Dissipation	200 watts

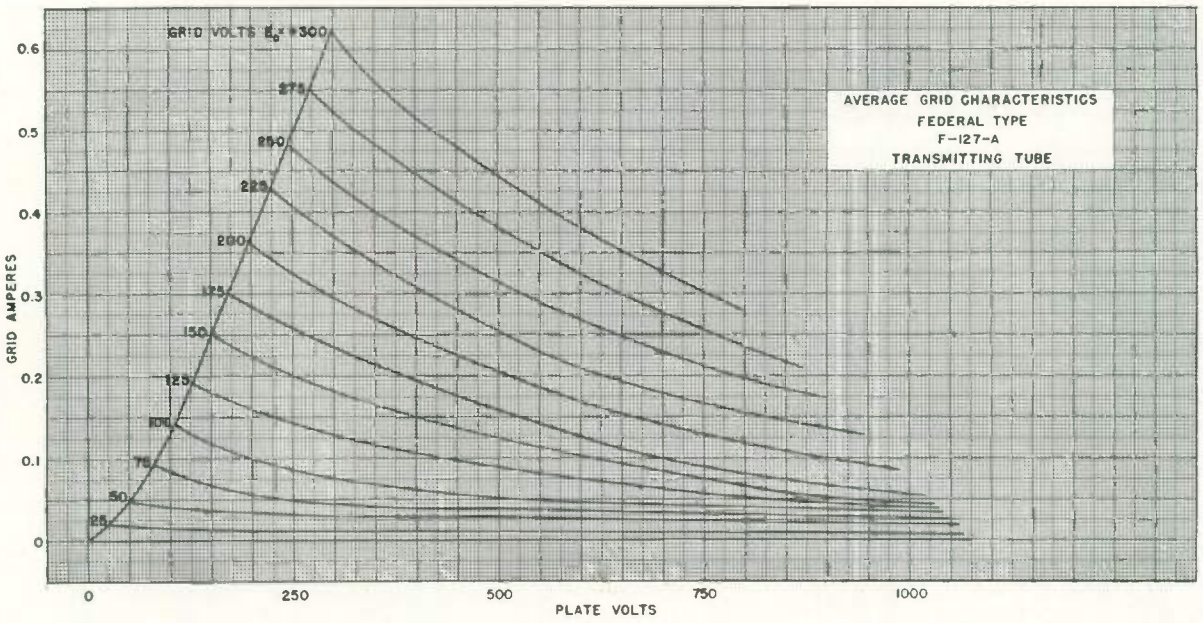
Typical Operation

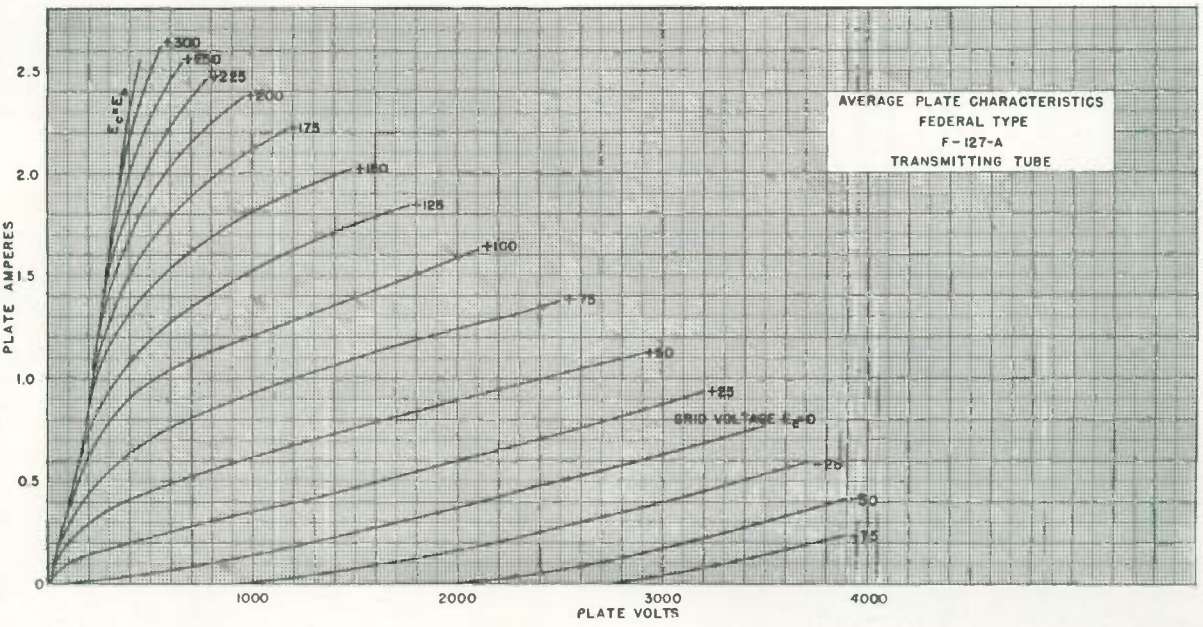
Filament Voltage	10 volts
DC Plate Voltage	3,000 volts
DC Grid Voltage	–250 volts (approx.)
Peak R-F Grid Input Voltage	400 volts (approx.)
DC Plate Current	0.250 amperes
DC Grid Current	0.047 amperes
Driving Power	18 watts (approx.)
Power Output	600 watts (approx.)

*Modulation essentially negative, may be used if the positive peak of the audio-frequency envelope does not exceed 115% of the carrier condition value.

TRANSMITTING TUBE TYPE F-127-A

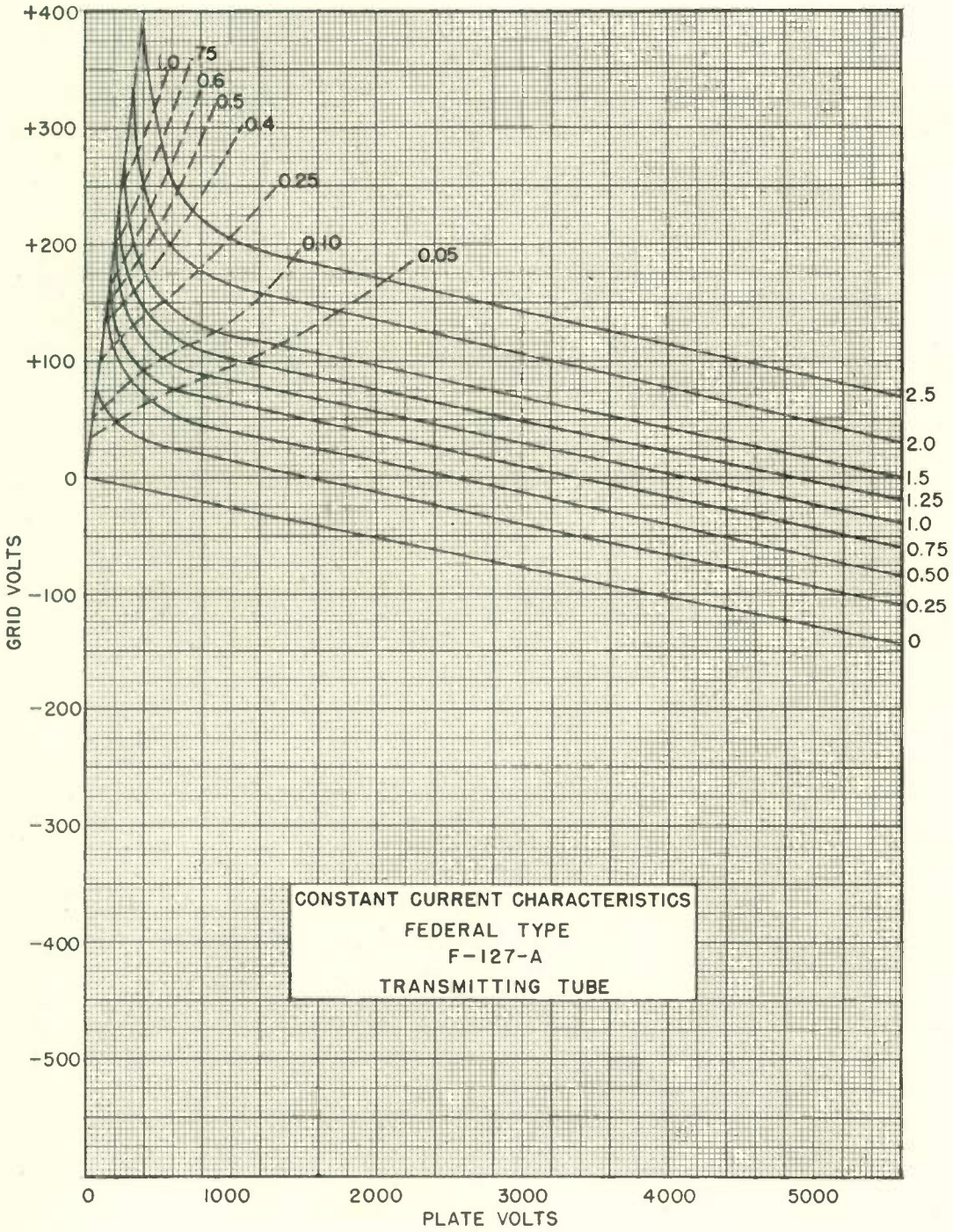
200 Watts Plate Dissipation





TRANSMITTING TUBE TYPE F-127-A

200 Watts Plate Dissipation

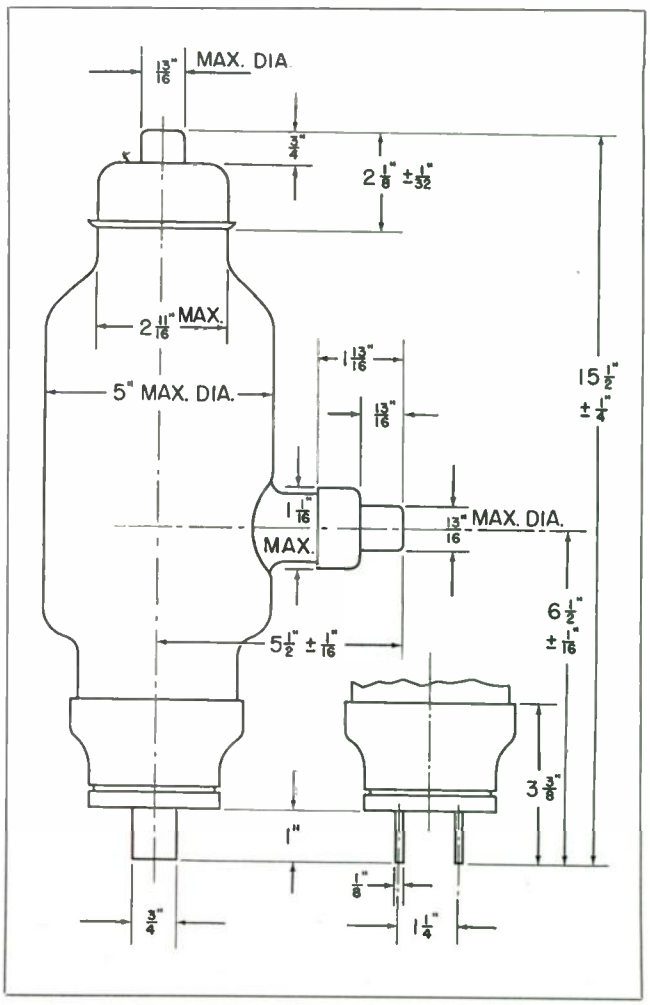


TRANSMITTING TUBE TYPE F-128-A

600 Watts Plate Dissipation

Technical Data

Main Use	R-F Power Amplifier, Oscillator, Class B Modulator
Number of Electrodes	3
Filament Voltage	11 volts
Current	13 amperes
Type	Thoriated Tungsten
Available Thermionic Emission	6 amperes
Amplification Factor	36
Approximate Direct Inter-electrode Capacitances	
Plate to Grid	15.5 $\mu\mu f$
Grid to Filament	12.0 $\mu\mu f$
Plate to Filament	4.5 $\mu\mu f$
Type of Cooling	Convection
Type Base	Federal
Mounting Socket	Federal Type 1003-A and Anode Clip



TRANSMITTING TUBE TYPE F-128-A

600 Watts Plate Dissipation

Maximum Ratings and Typical Operation Data

For maximum frequency of 30 megacycles

CLASS B AUDIO AMPLIFIER OR MODULATOR

Maximum Ratings

DC Plate Voltage	3,500 volts
Max. Signal DC Plate Current	0.600 ampere
Max. Signal Plate Input	1,800 watts
Plate Dissipation	600 watts

Typical Operation

DC Plate Voltage	3,000 volts
DC Grid Voltage	—80 volts (approx.)
Peak A-F Grid Input Voltage	250 volts (approx.)
Zero Signal Plate Current (per tube)	0.050 ampere
Max. Signal Plate Current (per tube)	0.600 ampere
Max. Signal Plate Input (per tube)	1,800 watts
Max. Signal Driving Power	8.5 watts (approx.)
Effective Load (plate to plate)	5,400 ohms
Power Output (2 tubes)	2,400 watts (approx.)

CLASS C R-F POWER AMPLIFIER AND OSCILLATOR—TELEGRAPHY

*(Key-down conditions per tube without modulation)**

Maximum Ratings

DC Plate Voltage	3,500 volts
DC Grid Voltage	—600 volts
DC Plate Current	1.000 ampere
DC Grid Current	0.175 ampere
R-F Grid Current	15 amperes
Plate Input	3,000 watts
Plate Dissipation†	700 watts

Typical Operation

DC Plate Voltage	3,500 volts
DC Grid Voltage	—400 volts (approx.)
Peak R-F Grid Input Voltage	680 volts (approx.)
DC Plate Current	0.854 ampere
DC Grid Current	0.107 ampere
Driving Power	73 watts (approx.)
Power Output	2,360 watts (approx.)

*Modulation essentially negative, may be used if the positive peak of the audio frequency envelope does not exceed 115% of the carrier condition value.

†Duration of key-down conditions not to exceed five minutes.

CLASS B R-F POWER AMPLIFIER—TELEPHONY

(Carrier conditions per tube for use with modulation factor up to 1.0)

Maximum Ratings

DC Plate Voltage	3,500 volts
DC Plate Current	0.500 ampere
R-F Grid Current	15 amperes
Plate Input	900 watts
Plate Dissipation	600 watts

Typical Operation

DC Plate Voltage	3,000 volts
DC Grid Voltage	—85 volts (approx.)
Peak R-F Grid Input Voltage	117 volts (approx.)
DC Plate Current	0.292 ampere
DC Grid Current	0 ampere
Driving Power**	6.3 watts (approx.)
Load Impedance	2,790 ohms
Power Output	303 watts (approx.)

**At crest of A-F cycle Driver stage must have a tank circuit of good regulation and must be capable of delivering 235 volts at 0.200 amperes.

CLASS C R-F POWER AMPLIFIER—TELEPHONY —PLATE MODULATED

(Carrier conditions per tube for use with modulation factor up to 1.0)

Maximum Ratings

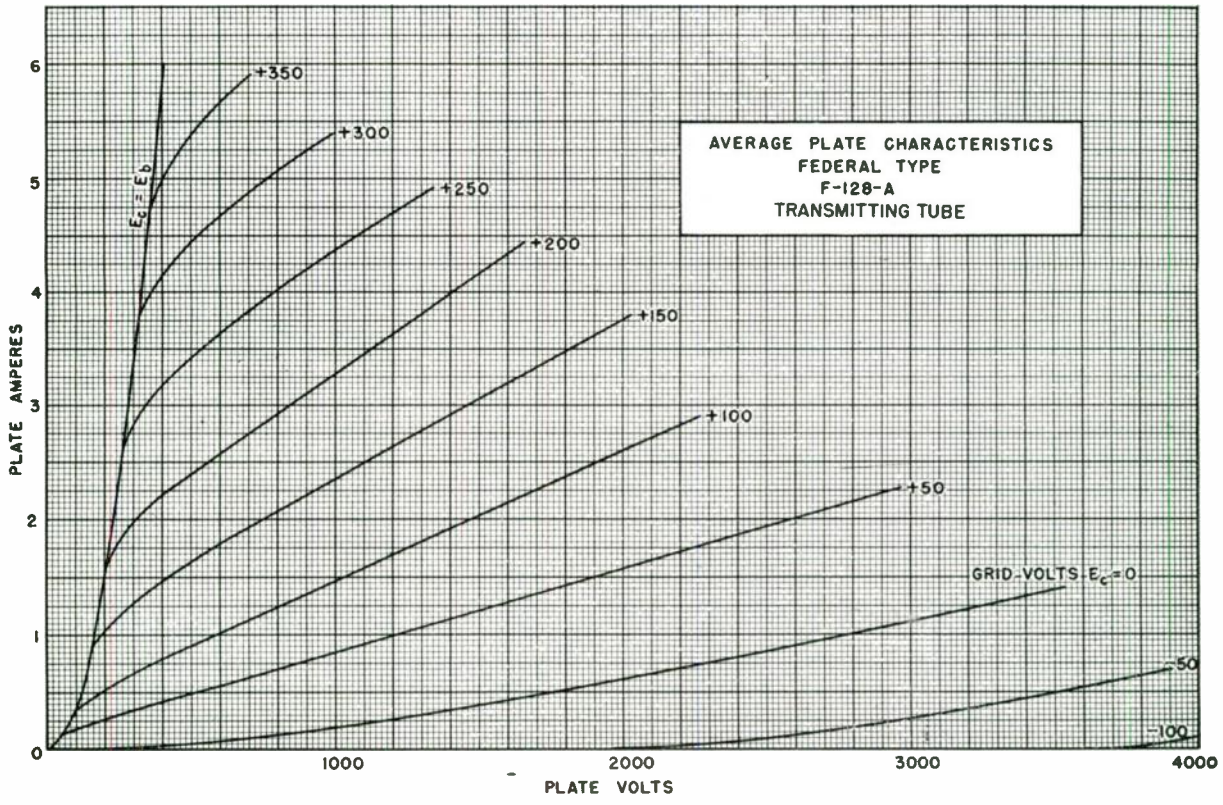
DC Plate Voltage	3,000 volts
DC Plate Current	0.700 ampere
DC Grid Current	0.150 ampere
R-F Grid Current	15 amperes
Plate Input	1,800 watts
Plate Dissipation	600 watts

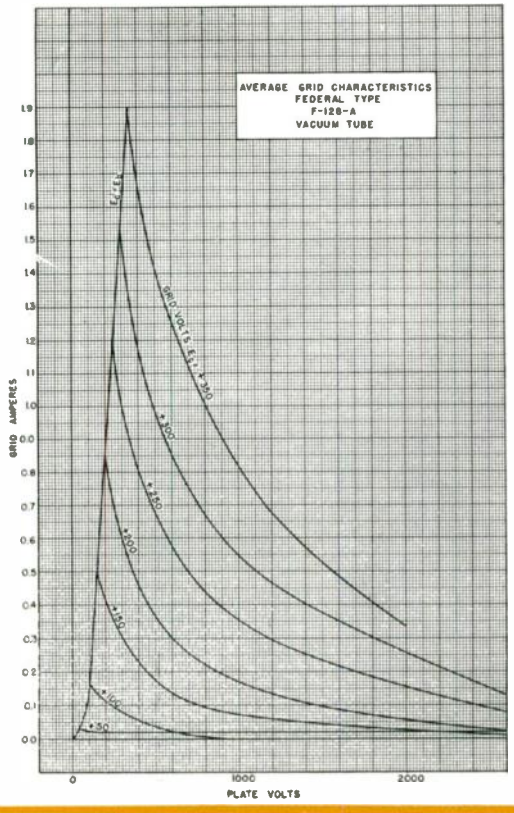
Typical Operation

DC Plate Voltage	3,000 volts
DC Grid Voltage	—300 volts (approx.)
Peak R-F Grid Input Voltage	500 volts (approx.)
DC Plate Current	0.511 ampere
DC Grid Current	0.038 ampere
Driving Power	19 watts (approx.)
Power Output	1,150 watts (approx.)

TRANSMITTING TUBE TYPE F-128-A

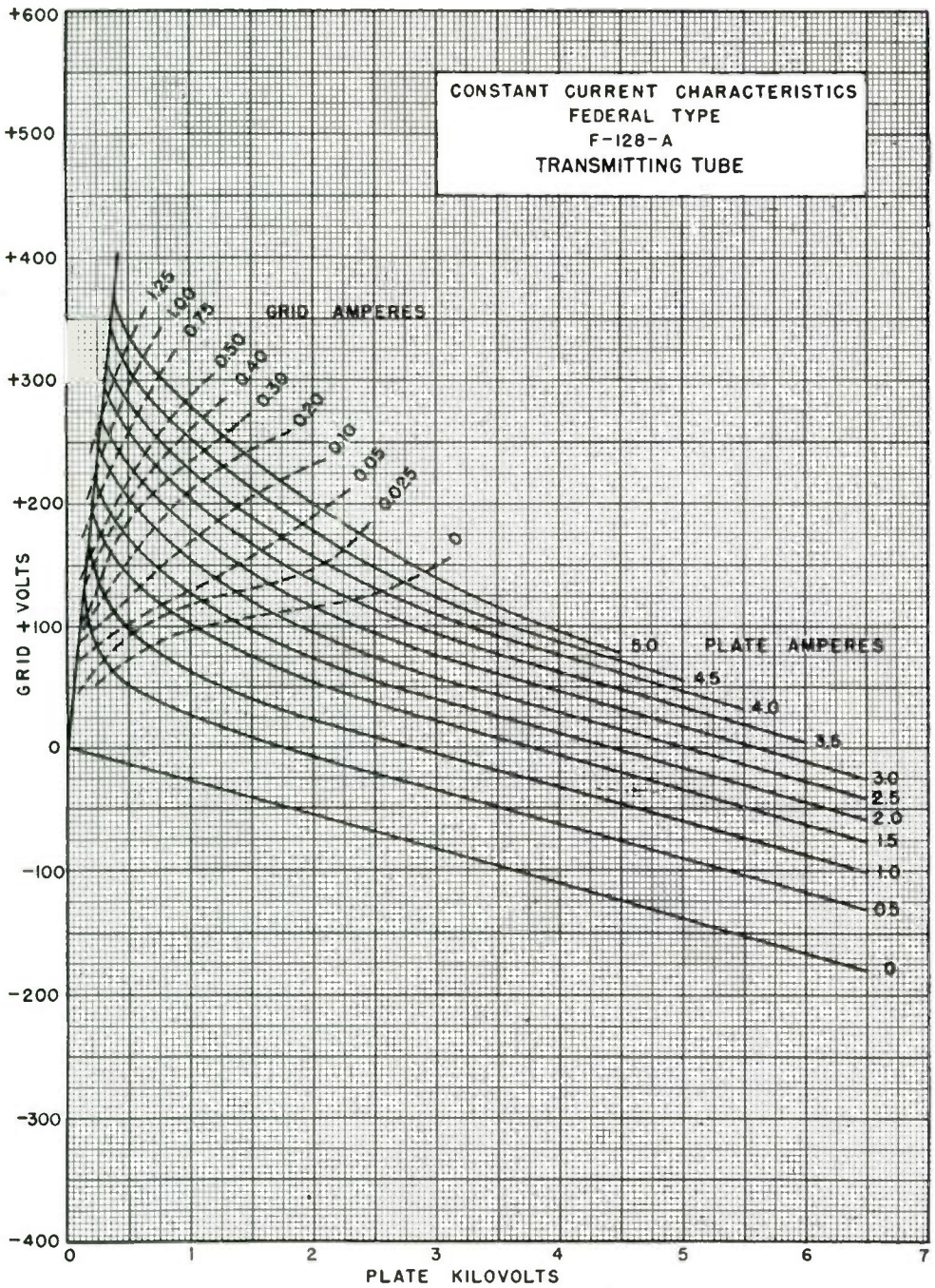
600 Watts Plate Dissipation





TRANSMITTING TUBE TYPE F-128-A

600 Watts Plate Dissipation

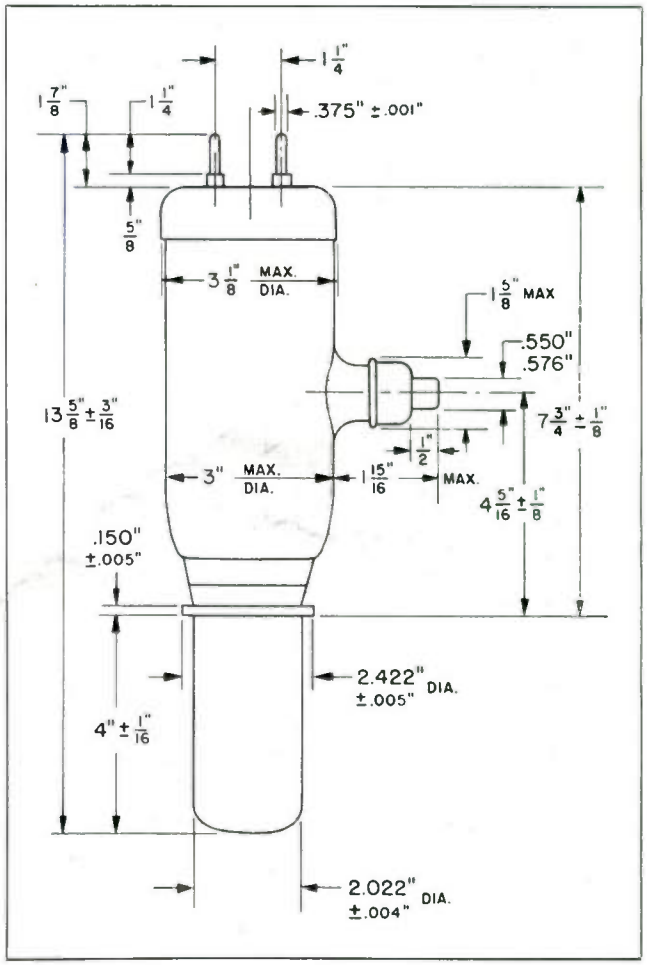


TRANSMITTING TUBE TYPE F-129-B

5 KW Plate Dissipation

TECHNICAL DATA

Main Use	R-F Power Amplifier Oscillator
Number of Electrodes	3
Filament Voltage	18 volts
Current	58 amperes
Type	Tungsten
Thermionic Emission	9.5 amperes
Amplification Factor	26
Approximate Direct Inter-electrode Capacitances	
Plate to Grid	10.0 $\mu\mu f$
Grid to Filament	11.0 $\mu\mu f$
Plate to Filament	1.5 $\mu\mu f$
Type of Cooling	Water
Minimum Flow	3 G.P.M.
Water Jacket	Federal Type F-1012



TRANSMITTING TUBE TYPE F-129-B

5 KW Plate Dissipation

Maximum Ratings and Typical Operation Data

For maximum frequency of 50 megacycles

CLASS C R-F POWER AMPLIFIER— TELEPHONY—PLATE MODULATED

(Carrier conditions per tube for use with modulation factor up to 1.0)

Maximum Ratings

DC Plate Voltage	10,000 volts
DC Plate Current	1.5 amperes
DC Grid Current	0.25 amperes
R-F Grid Current	30 amperes
Plate Input	9,000 watts
Plate Dissipation	5,000 watts

Typical Operation

DC Plate Voltage	8,000 volts
DC Grid Voltage	—920 volts (approx.)
Peak R-F Grid Input Voltage	1,500 volts (approx.)
DC Plate Current	0.817 amperes
DC Grid Current	0.097 amperes
Driving Power	140 watts (approx.)
Power Output	5,260 watts (approx.)

CLASS C R-F POWER AMPLIFIER AND OSCILLATOR-TELEGRAPHY

*(Key-down conditions per tube without modulation)**

Maximum Ratings

DC Plate Voltage	12,000 volts
DC Grid Voltage	—1,500 volts
DC Plate Current	2.0 amperes
DC Grid Current	0.25 amperes
R-F Grid Current	30 amperes
Plate Input	18,000 watts
Plate Dissipation	5,000 watts

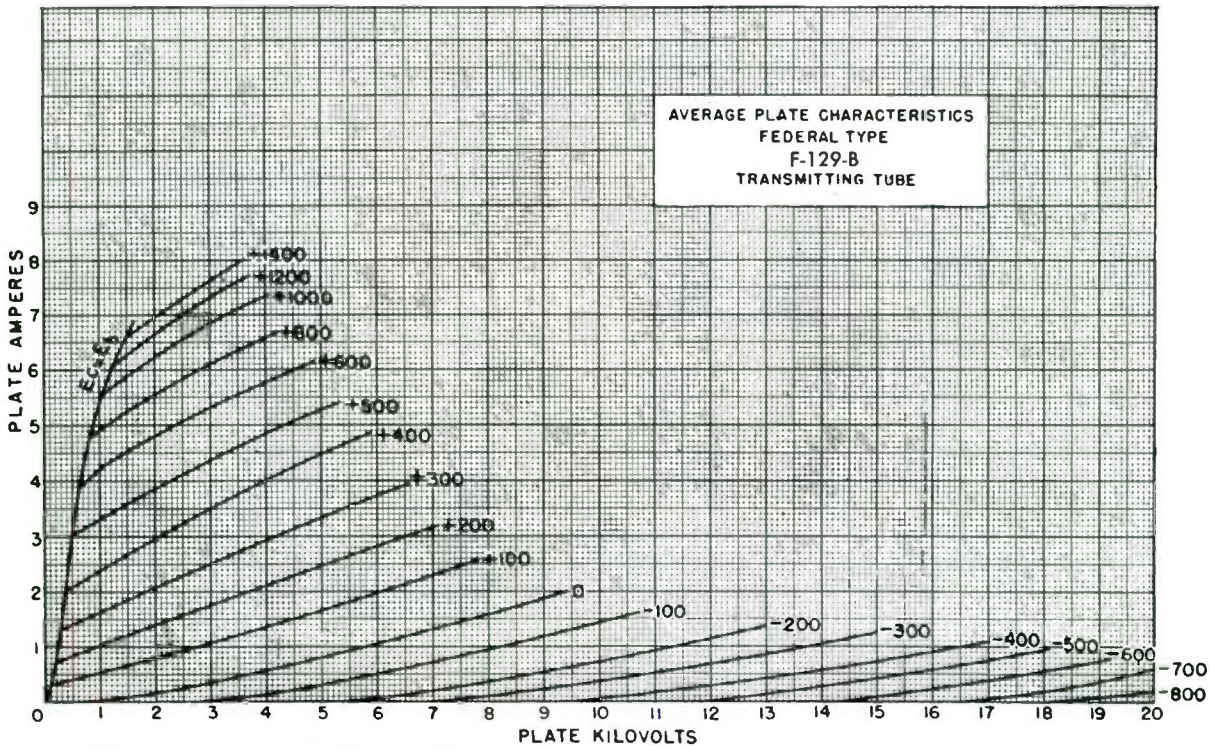
Typical Operation

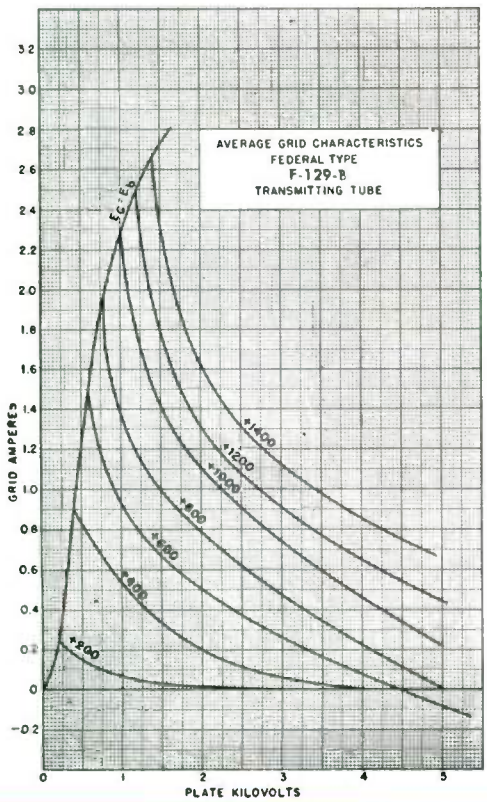
DC Plate Voltage	12,000 volts
DC Grid Voltage	—1,300 volts (approx.)
Peak R-F Grid Input Voltage	2,200 volts (approx.)
DC Plate Current	1.42 amperes
DC Grid Current	0.11 amperes
Driving Power	230 watts (approx.)
Power Output	12,000 watts (approx.)

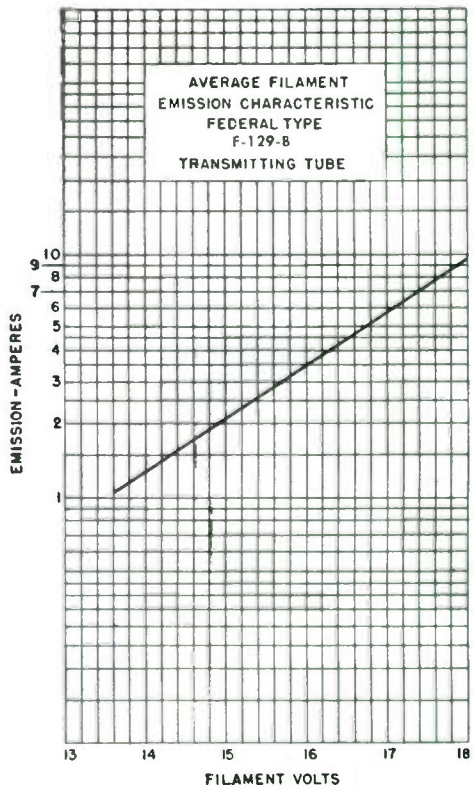
*Modulation essentially negative, may be used if the positive peak of the audio frequency envelope does not exceed 115% of the carrier condition value.

TRANSMITTING TUBE TYPE F-129-B

5 KW Plate Dissipation

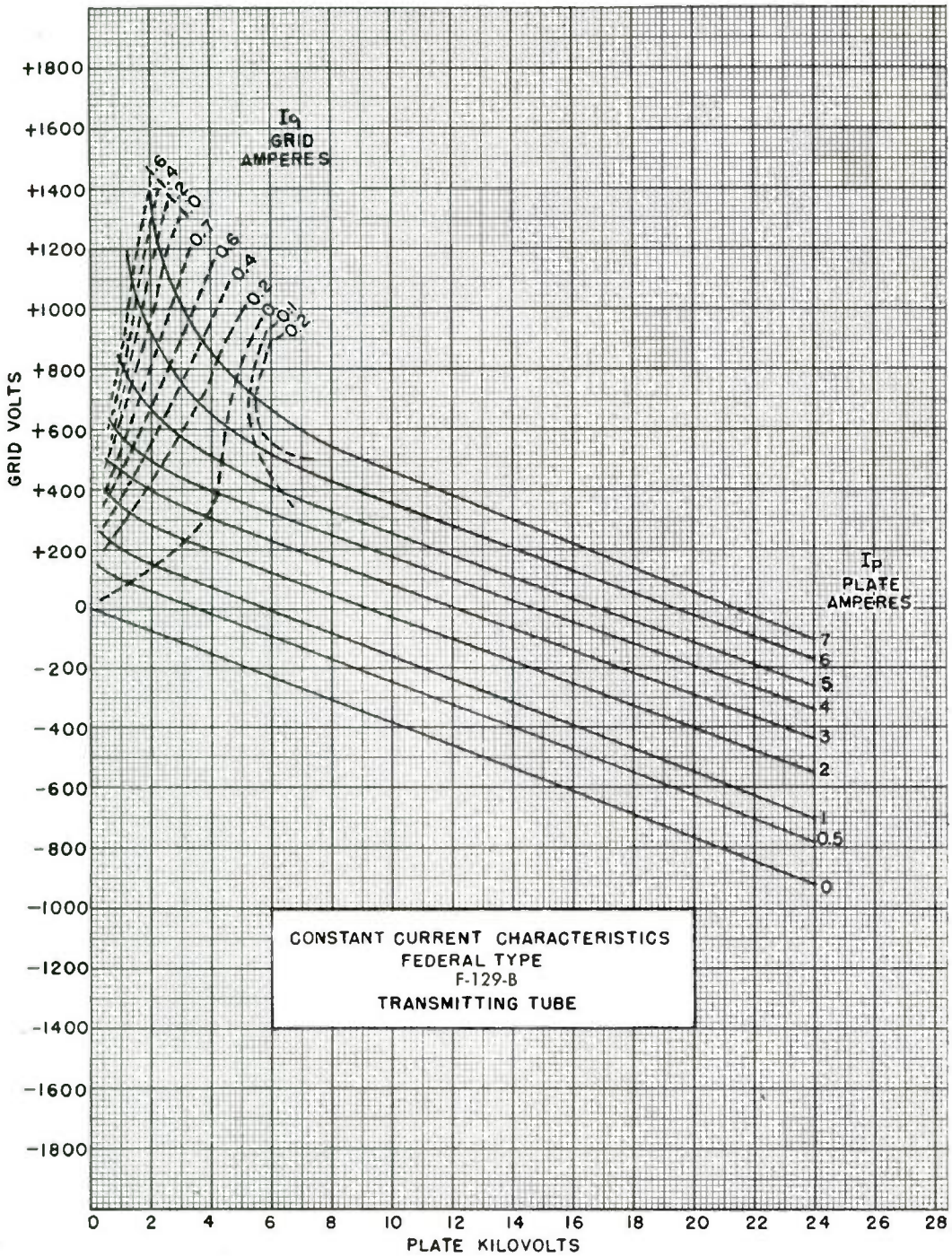






TRANSMITTING TUBE TYPE F-129-B

5 KW Plate Dissipation

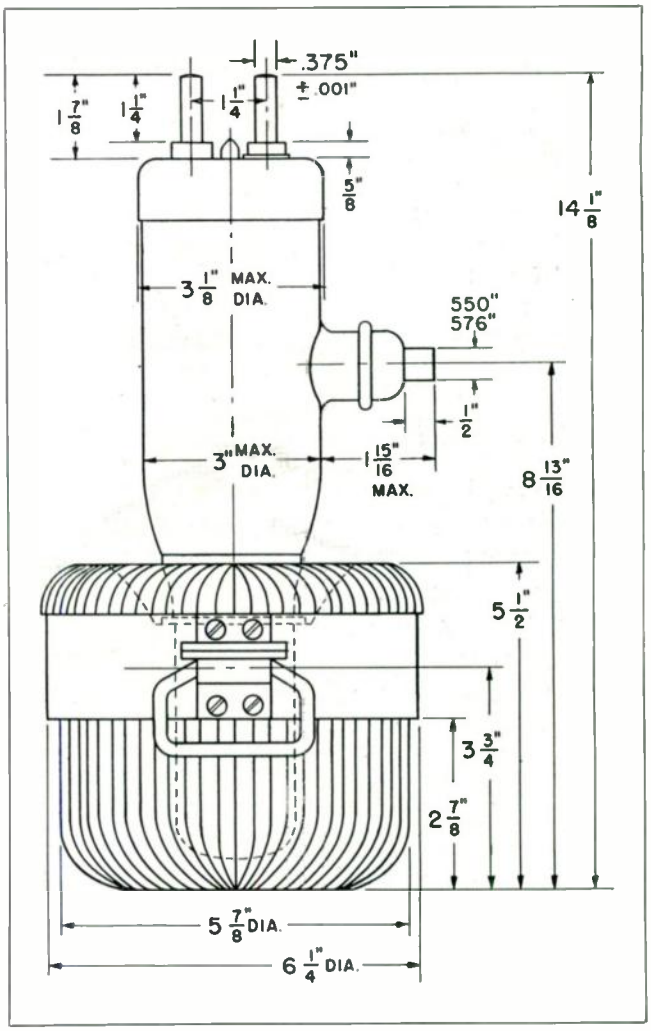


TRANSMITTING TUBE TYPE F-129-R

5 Kilowatts Plate Dissipation

Technical Data

Main Use	R-F Power Amplifier, Oscillator
Number of Electrodes	3
Filament Voltage	18 volts
Current	58 amperes
Type	Tungsten
Thermionic Emission	9.5 amperes
Amplification Factor	26
Approximate Direct Inter-electrode Capacitances	
Plate to Grid	11.0 $\mu\mu f$
Grid to Filament	11.0 $\mu\mu f$
Plate to Filament	2.5 $\mu\mu f$
Type of Cooling	Forced Air
Mounting	Special



TRANSMITTING TUBE TYPE F-129-R

5 Kilowatts Plate Dissipation

Maximum Ratings and Typical Operation Data

For maximum frequency of 50 megacycles

CLASS C R-F POWER AMPLIFIER— TELEPHONY-PLATE MODULATED

(Carrier conditions per tube for use with modulation factor up to 1.0)

Maximum Ratings

DC Plate Voltage	10,000 volts
DC Plate Current	1.5 amperes
DC Grid Current	0.25 amperes
R-F Grid Current	30 amperes
Plate Input	9,000 watts
Plate Dissipation	5,000 watts

Typical Operation

DC Plate Voltage	8,000 volts
DC Grid Voltage	—920 volts (approx.)
Peak R-F Grid Input Voltage	1,500 volts (approx.)
DC Plate Current	0.817 amperes
DC Grid Current	0.097 amperes
Driving Power	140 watts (approx.)
Power Output	5,260 watts (approx.)

CLASS C R-F POWER AMPLIFIER AND OSCILLATOR-TELEGRAPHY

*(Key-down conditions per tube without modulation)**

Maximum Ratings

DC Plate Voltage	12,000 volts
DC Grid Voltage	—1,500 volts
DC Plate Current	2.0 amperes
DC Grid Current	0.25 amperes
R-F Grid Current	30 amperes
Plate Input	18,000 watts
Plate Dissipation	5,000 watts

*Modulation essentially negative, may be used if the positive peak of the audio frequency envelope does not exceed 115% of the carrier condition value.

Typical Operation

DC Plate Voltage	12,000 volts
DC Grid Voltage	—1,300 volts (approx.)
Peak R-F Grid Input Voltage	2,200 volts (approx.)
DC Plate Current	1.42 amperes
DC Grid Current	0.11 amperes
Driving Power	230 watts (approx.)
Power Output	12,000 watts (approx.)

Air Requirements Per Tube

Anode Dissipation K W (1)	Minimum Recommended Air Flow Cu. Ft./Min.	Approx. Air Press. (2) In. of water	Air Velocity Through Fin. Assy. Ft./Min.	Approx. Temp. Rise of air Deg. Cent.
INTAKE AIR TEMP. 25°C				
3	300	.34	2550	17.6
4	450	.78	3820	15.7
5	600	1.4	5090	14.7

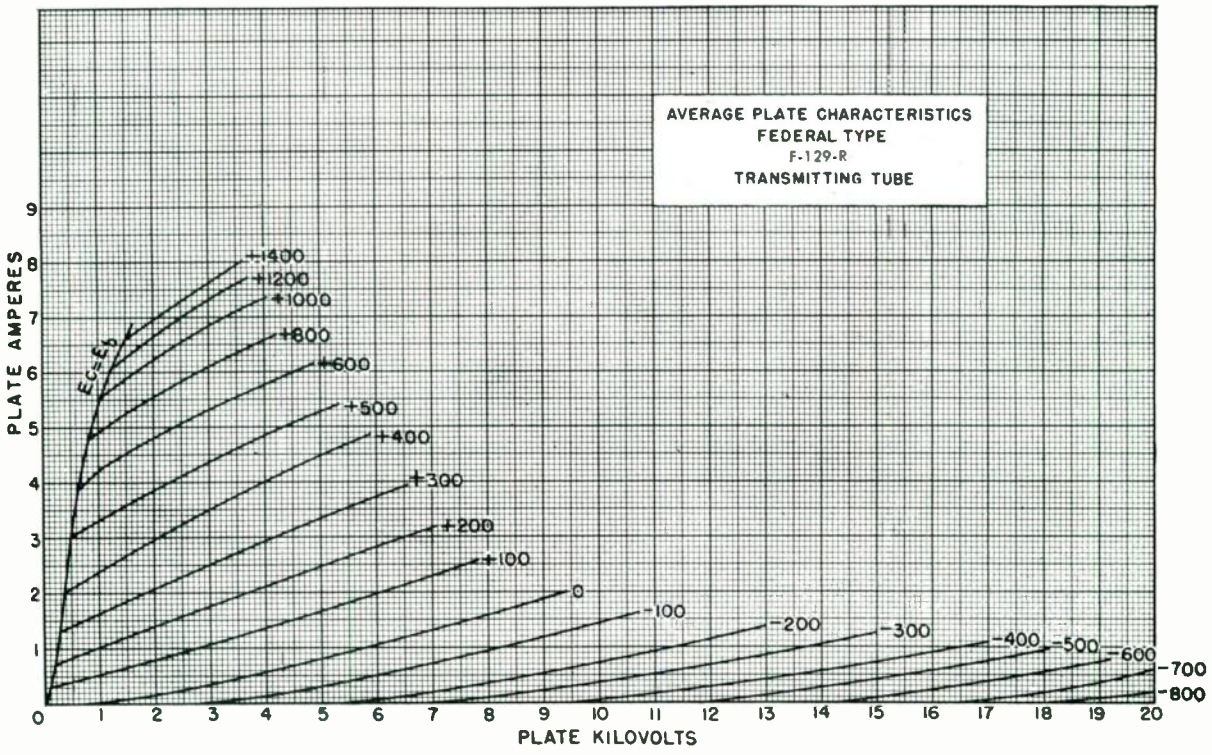
Anode Dissipation K W (1)	Minimum Recommended Air Flow Cu. Ft./Min.	Approx. Air Press. (2) In. of water	Air Velocity Through Fin. Assy. Ft./Min.	Approx. Temp. Rise of air Deg. Cent.
INTAKE AIR TEMP. 45°C				
3	400	.62	3400	14.1
4	575	1.29	4880	13.1
5	800	2.5	6800	11.75

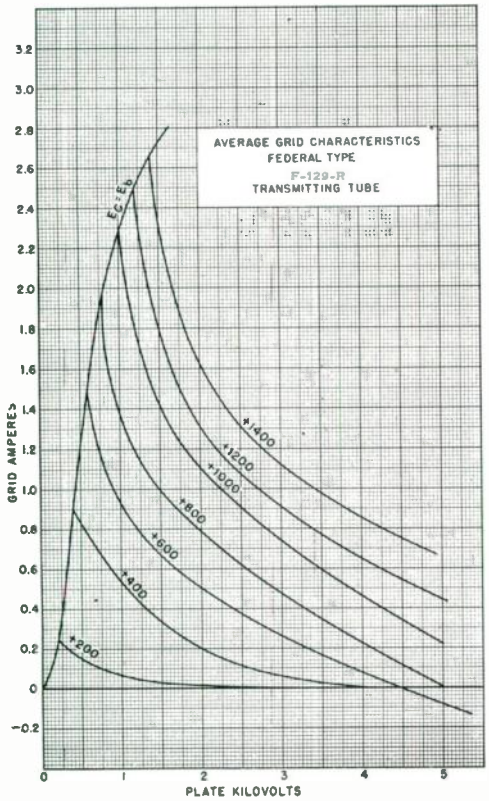
(1) This is the anode dissipation exclusive of filament power dissipated through anode.

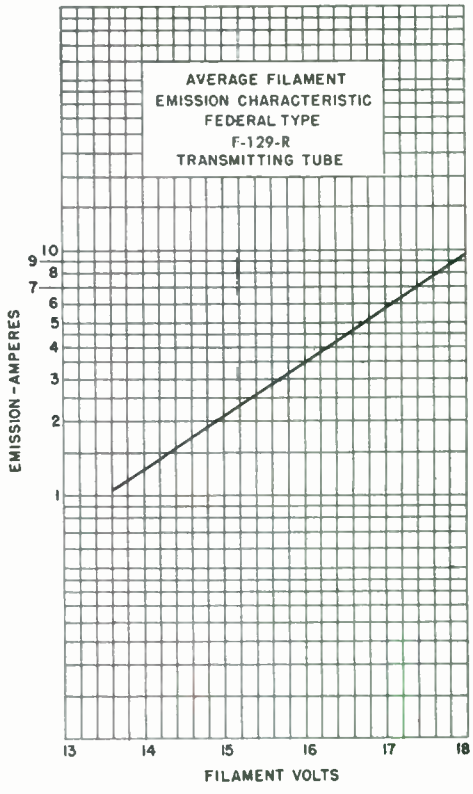
(2) This pressure is measured at the base of tube mounting. Duct work must be considered to determine pressure against which blower must deliver required amount of air.

TRANSMITTING TUBE TYPE F-129-R

5 Kilowatts Plate Dissipation

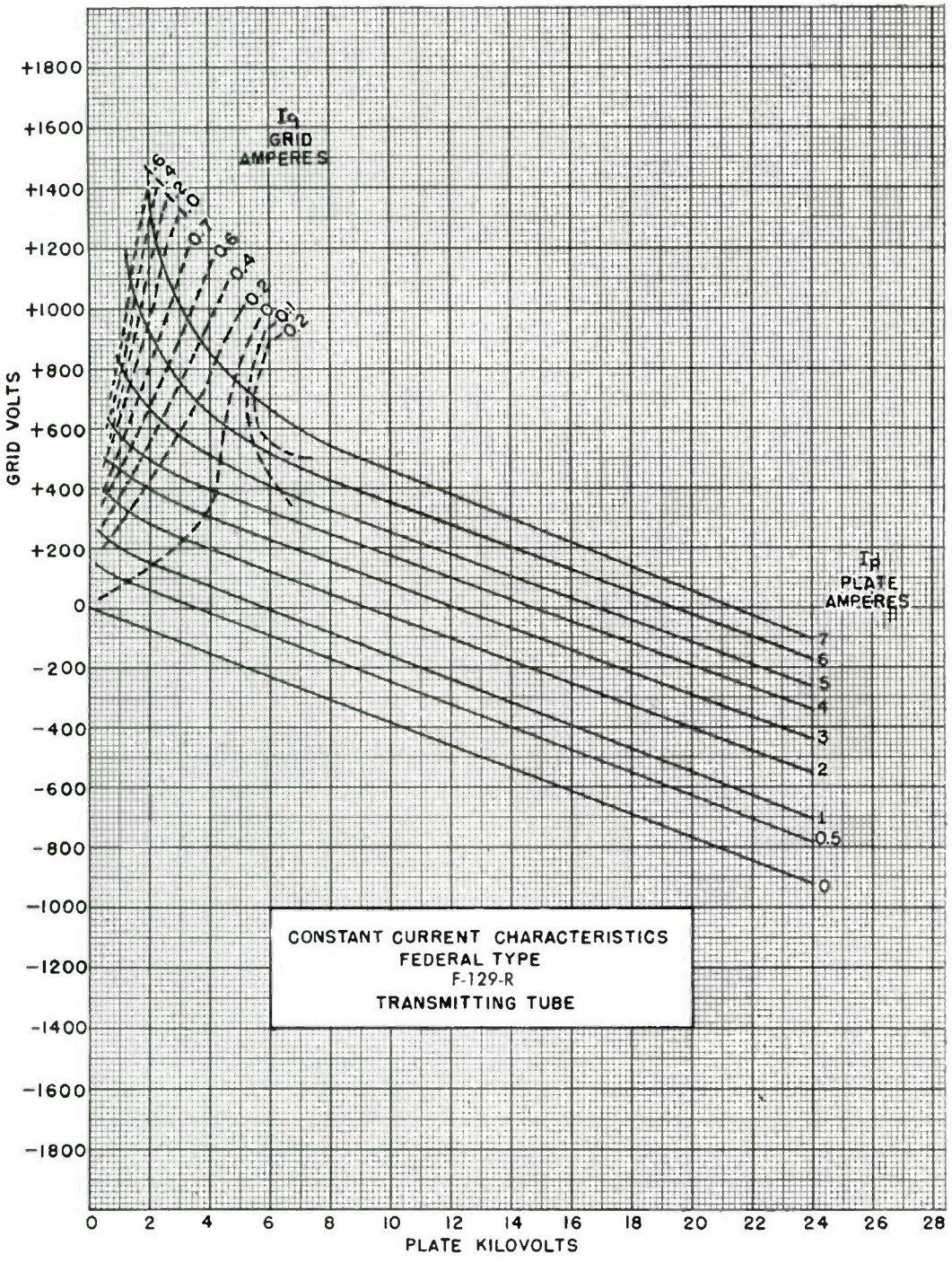






TRANSMITTING TUBE TYPE F-129-R

5 Kilowatts Plate Dissipation



TRANSMITTING TUBE TYPE F-132-A

600 Watts Plate Dissipation

Technical Data

Main Use	Audio Amplifier
Number of Electrodes	3
Filament Voltage	11 volts
Current	13 amperes
Type	Thoriated Tungsten
Available Thermionic Emission	6 amperes

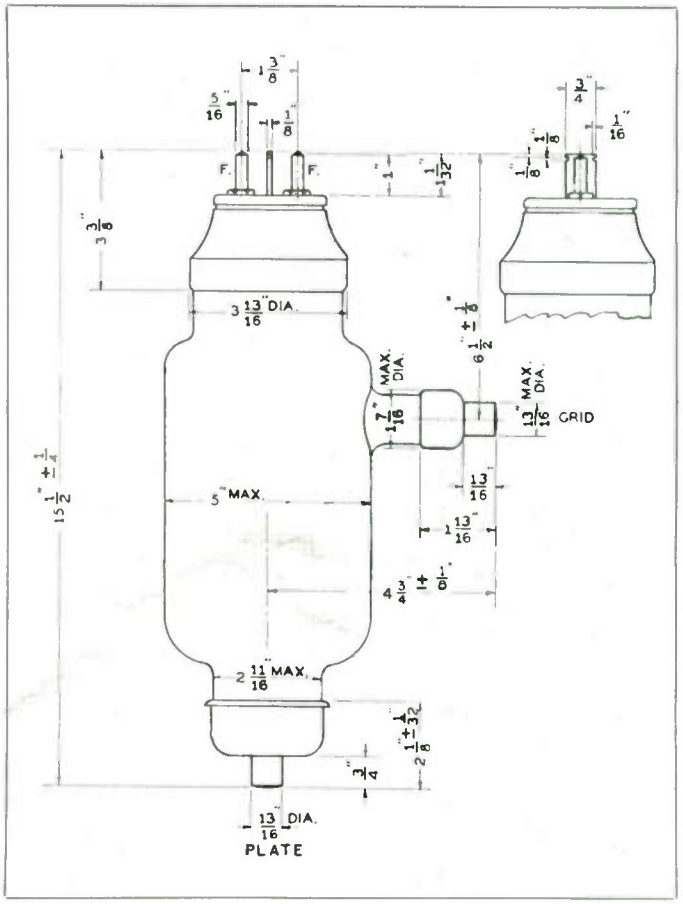
Average Characteristic Values calculated at E_b=3,000 volts, I_b=0.200 amperes, E_f=11 AC volts.

Grid Voltage (approximate)	—250 volts
Amplification Factor	10
Transconductance	6,250 micromhos
Plate Resistance	1,600 ohms

Approximate Direct Inter-electrode Capacitances

Plate to Grid	15.0 $\mu\mu f$
Grid to Filament	12.0 $\mu\mu f$
Plate to Filament	5.5 $\mu\mu f$

Type of Cooling	Convection
Type Base	Standard 250 watt and Grid Cap
Type of Mounting	Standard 250 watt and Grid Clip



Maximum Ratings and Typical Operation Data

Maximum Ratings

CLASS A AUDIO AMPLIFIER

DC Plate Voltage 3500 volts — Maximum Plate Dissipation 600 watts

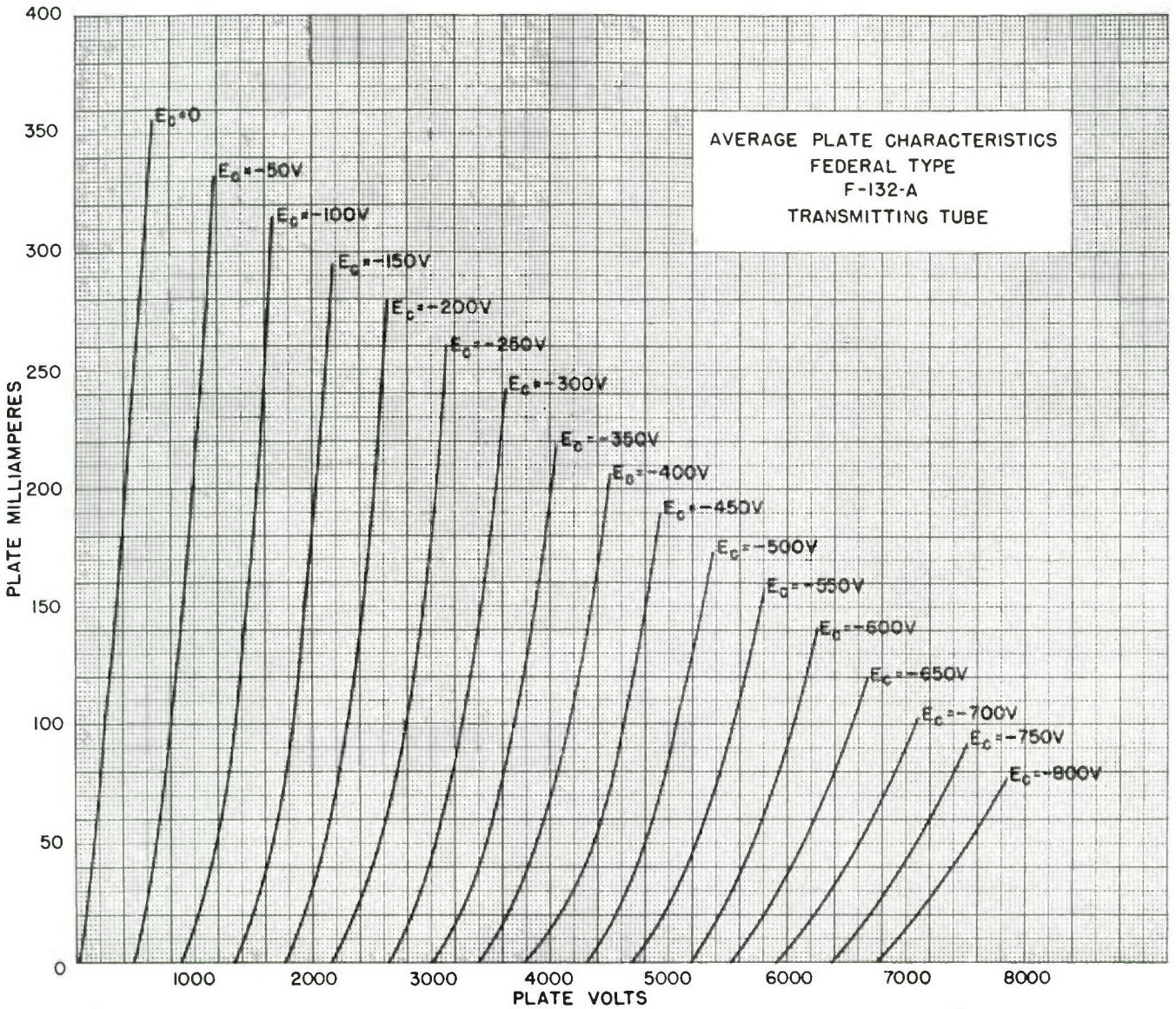
Typical Operation as push pull Class A driver for 2 Type F-125-A tubes.

ALL VALUES FOR TWO TUBES

DC Plate Voltage	3500	2700 volts
DC Grid Voltage	—300	—225 volts
Zero Signal Plate Current	.308	.300 amperes
Max. Signal Plate Current	.317	.307 amperes
Peak Grid to Grid Signal Voltage	590	440 volts
Peak Plate to Plate Output Voltage	5700	4000 volts
Effective Plate to Plate Load Impedance	40,000	35,000 ohms
Output Transformer turns ratio	1:1	1:1.3
Total Harmonic Distortion	2	1 percent

TRANSMITTING TUBE TYPE F-132-A

600 Watts Plate Dissipation



Federal Telephone and Radio Corporation

Vacuum Tube Products — An IT&T Associate — Newark 4, New Jersey

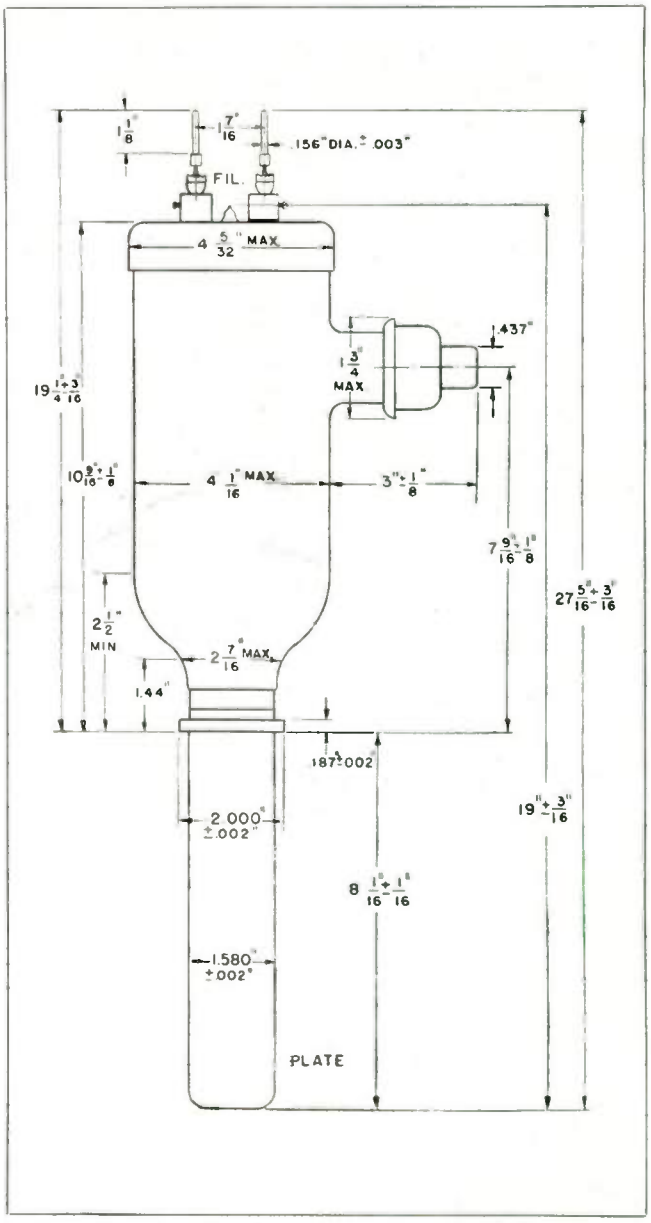
Printed in U.S.A. Form F-194

TRANSMITTING TUBE TYPE F-207

10 Kilowatts Plate Dissipation

Technical Data

Main Use	General Purpose
Number of Electrodes	3
Filament Voltage	22 volts
Current	52 amperes
Type	Tungsten
Thermionic Emission	10 amperes
Amplification Factor	20
Approximate Direct Inter-electrode Capacitances	
Plate to Grid	27 $\mu\mu$f
Grid to Filament	18 $\mu\mu$f
Plate to Filament	2 $\mu\mu$f
Type of Cooling	Water
Minimum Flow	5 G.P.M.
Water Jacket	Standard or Federal Type F-1000



Maximum Rating versus Operating Frequency

Operating Frequency Megacycles	Maximum Permissible Percentage of Maximum Rated Plate Voltage and Plate Input		
	Class B Telephony	Class C Telephony	Class C Telegraphy
1.6	100	100	100
7.5	85	85	75
20	76	75	50

TRANSMITTING TUBE TYPE F-207

10 Kilowatts Plate Dissipation

Maximum Ratings and Typical Operation Data

For maximum frequency of 1.6 megacycles

CLASS B
A-F POWER AMPLIFIER AND MODULATOR

Maximum Ratings

DC Plate Voltage	15,000 volts
Max. Signal DC Plate Current*	2.0 amperes
Max. Signal Plate Input*	20 kw
Plate Dissipation*	7.5 kw

Typical Operation

(Unless otherwise specified, values are for 2 tubes)

DC Plate Voltage	12,500 volts
DC Grid Voltage	–575 volts
Peak A-F Grid-to-Grid Voltage	2,300 volts
Zero Signal DC Plate Current	0.4 amperes
Max. Signal DC Plate Current	2.8 amperes
Load Resistance (per tube)	2,500 ohms
Effective Load Resistance (plate to plate)	10,000 ohms
Max. Signal Driving Power	400 watts (approx.)
Max. Signal Power Output	22.5 kw (approx.)

*Averaged over any audio-frequency cycle.

CLASS B TELEPHONY
R-F POWER AMPLIFIER

(Carrier conditions per tube for use with a maximum modulation factor of 1.0)

Maximum Ratings

DC Plate Voltage	15,000 volts
DC Plate Current	1.0 amperes
R-F Grid Current	24 amperes
Plate Input	15 kw
Plate Dissipation	10 kw

Typical Operation

DC Plate Voltage	14,000 volts
DC Grid Voltage	–650 volts
Peak R-F Grid Voltage	730 volts
DC Plate Current	1.0 amperes
Driving Power**	0 watts (approx.)
Power Output	4 kw (approx.)

**At crest of a-f cycle with modulation factor of 1.0

CLASS C TELEPHONY
PLATE-MODULATED R-F POWER AMPLIFIER

(Carrier conditions per tube for use with a maximum modulation factor of 1.0)

Maximum Ratings

DC Plate Voltage	10,000 volts
DC Grid Voltage	–3,000 volts
DC Plate Current	1.0 amperes
DC Grid Current	0.2 amperes
R-F Grid Current	24 amperes
Plate Input	10 kw
Plate Dissipation	6.6 kw

Typical Operation

DC Plate Voltage	10,000 volts
DC Grid Voltage	–2,000 volts
Peak R-F Grid Voltage	2,660 volts
DC Plate Current	0.75 amperes
DC Grid Current	0.07 amperes (approx.)
Driving Power	185 watts (approx.)
Power Output	6 kw (approx.)

CLASS C TELEGRAPHY
R-F POWER AMPLIFIER AND OSCILLATOR

(Key-down conditions per tube without modulation)†

Maximum Ratings

DC Plate Voltage	15,000 volts
DC Grid Voltage	–3,000 volts
DC Plate Current	2.0 amperes
DC Grid Current	0.2 amperes
R-F Grid Current	30 amperes
Plate Input	30 kw
Plate Dissipation	10 kw

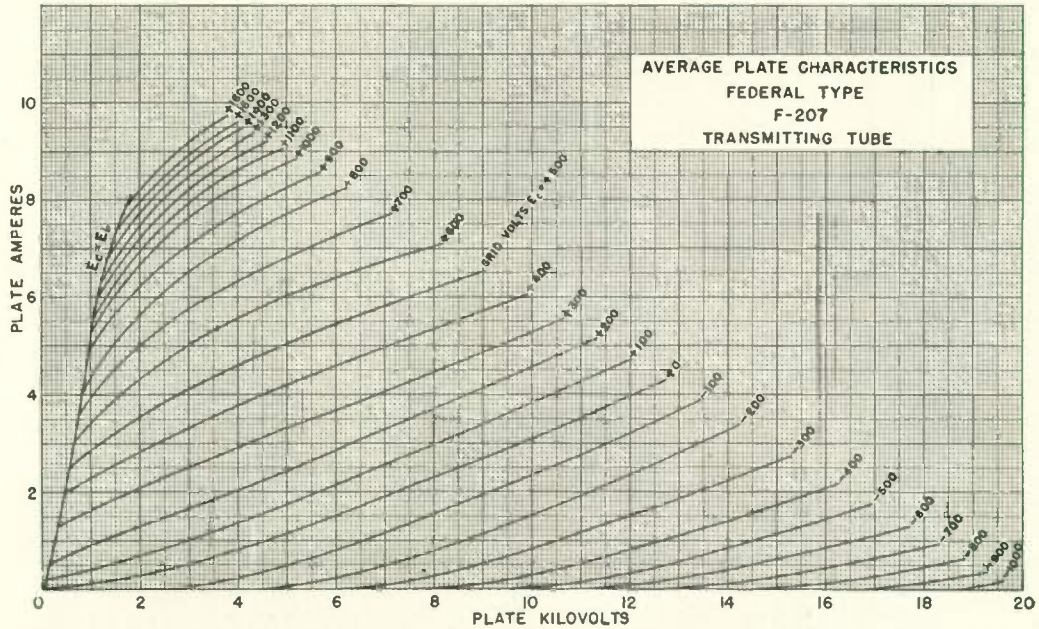
Typical Operation

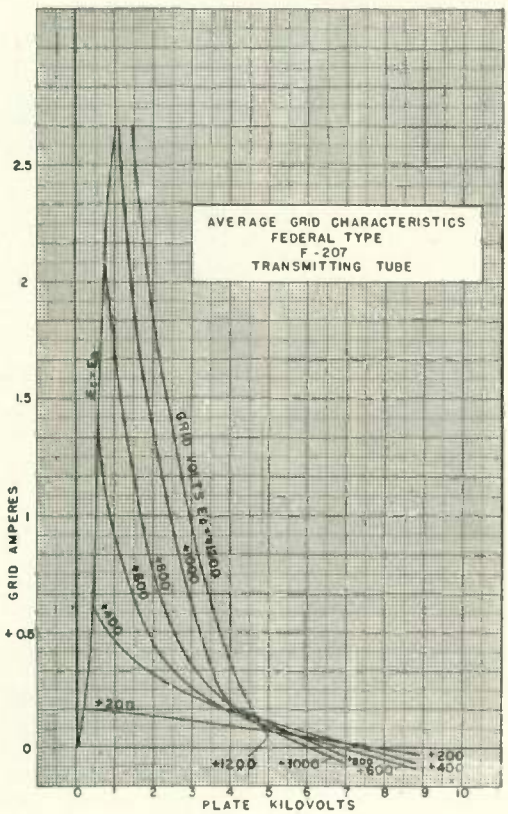
DC Plate Voltage	12,000 volts
DC Grid Voltage	–1,600 volts
Peak R-F Grid Voltage	2,650 volts
DC Plate Current	1.67 amperes
DC Grid Current	0.09 amperes (approx.)
Driving Power	235 watts (approx.)
Power Output	15 kw (approx.)

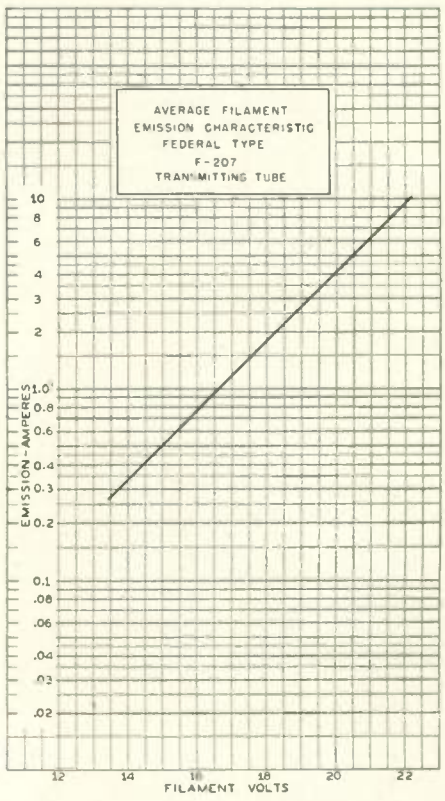
†Modulation essentially negative may be used if the positive peak of the audio-frequency envelope does not exceed 115% of the carrier conditions.

TRANSMITTING TUBE TYPE F-207

10 Kilowatts Plate Dissipation

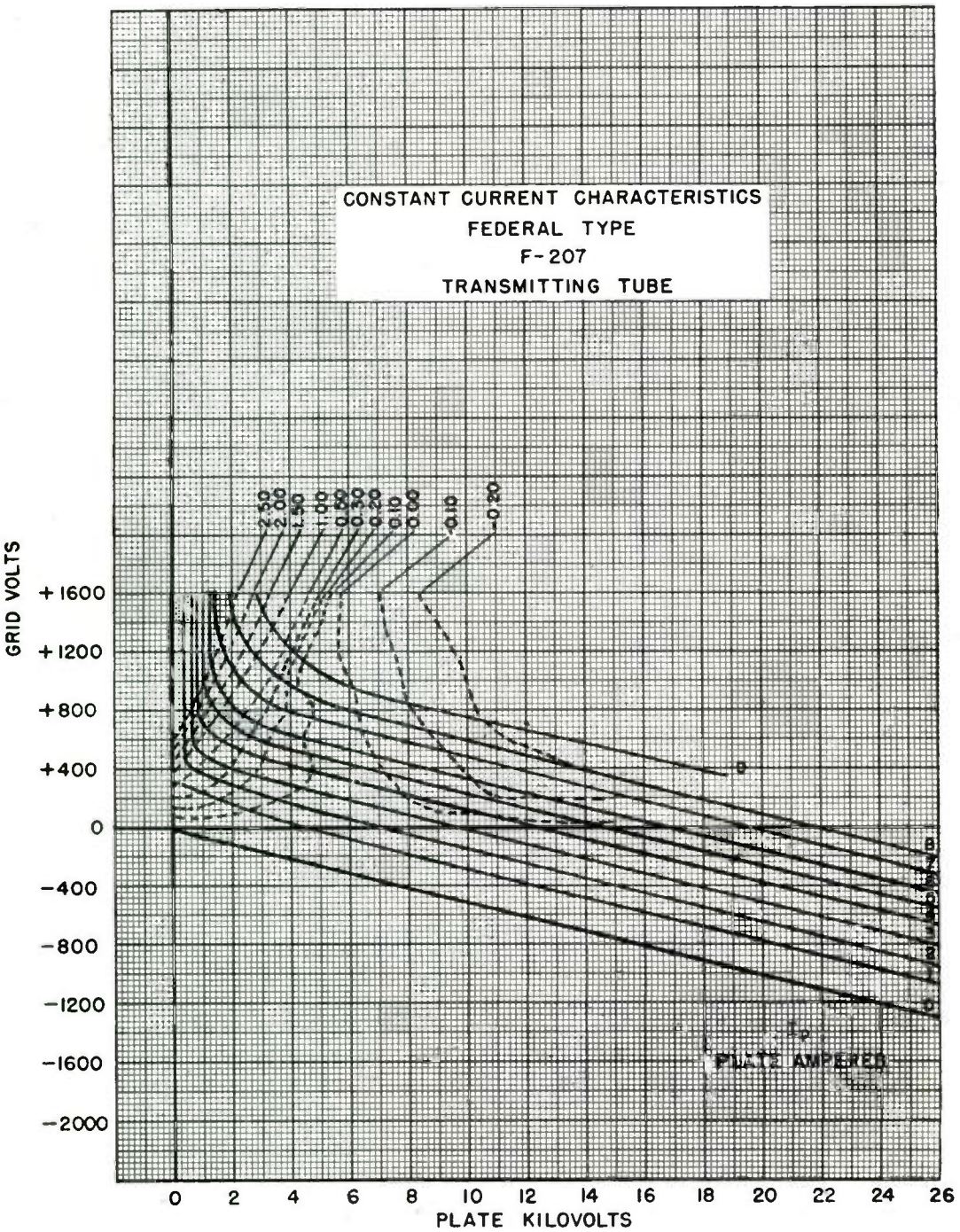






TRANSMITTING TUBE TYPE F-207

10 Kilowatts Plate Dissipation

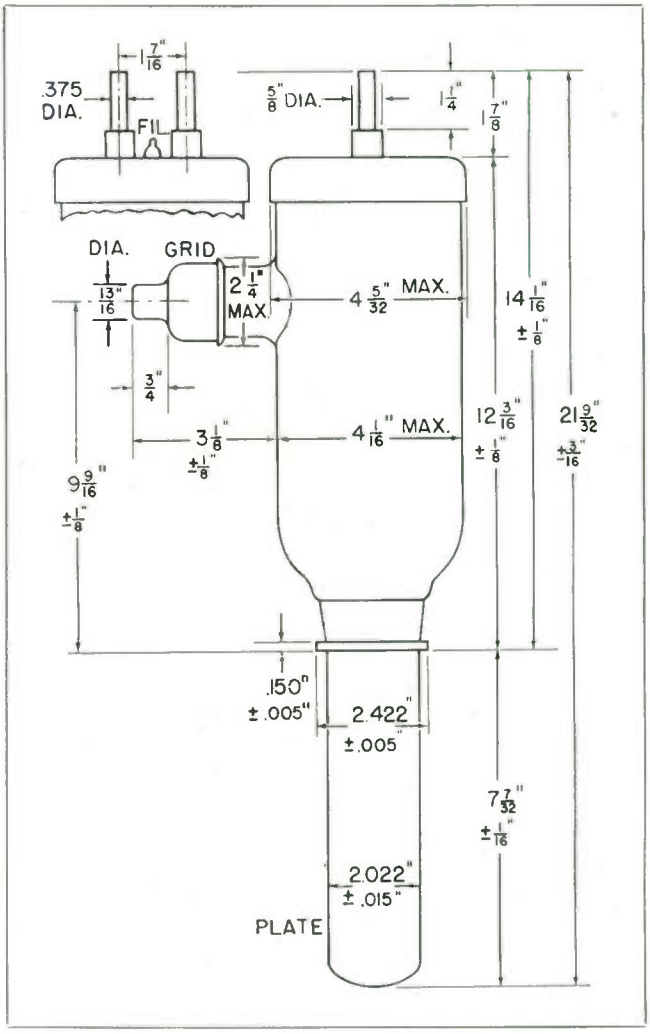


TRANSMITTING TUBE TYPE F-320-B

10 Kilowatts Plate Dissipation

Technical Data

Main Use	General Purpose
Number of Electrodes	3
Filament Voltage	21.5 volts
Current	41 amperes
Type	Tungsten
Thermionic Emission	7.5 amperes
Amplification Factor	40
Approximate Direct Inter-electrode Capacitances	
Plate to Grid	26 $\mu\mu f$
Grid to Filament	20 $\mu\mu f$
Plate to Filament	3 $\mu\mu f$
Type of Cooling	Water
Minimum Flow	5 G.P.M.
Water Jacket	Standard or Federal Type F-1005



TRANSMITTING TUBE TYPE F-320-B

10 Kilowatts Plate Dissipation

Maximum Ratings and Typical Operation Data

For maximum frequency of 4.0 megacycles

CLASS B R-F POWER AMPLIFIER — TELEPHONY

(Carrier conditions per tube for use with modulation factor up to 1.0)

Maximum Ratings

DC Plate Voltage	14,000 volts
DC Plate Current	1.2 amperes
R-F Grid Current	30 amperes
Plate Input	14,000 watts
Plate Dissipation	10,000 watts

Typical Operation

(Carrier conditions per tube for use with modulation factor up to 1.0)

DC Plate Voltage	12,000 volts
DC Grid Voltage	—275 volts (approx.)
Peak R-F Grid Input Voltage	1,080 volts (approx.)
DC Plate Current	0.630 ampere
DC Grid Current	0.081 ampere
Driving Power*	80 watts (approx.)
Load Impedance	5,400 ohms
Power Output	2,500 watts (approx.)

*At crest of A-F cycle.

CLASS C R-F POWER AMPLIFIER AND OSCILLATOR — TELEGRAPHY

*(Key-down conditions per tube without modulation)**

Maximum Ratings

DC Plate Voltage	15,000 volts
DC Grid Voltage	–3,000 volts
DC Plate Current	1.5 amperes
DC Grid Current	0.30 ampere
R-F Grid Current	30 amperes
Plate Input	22,500 watts
Plate Dissipation	10,000 watts

*Modulation essentially negative, may be used if the positive peak of the audio frequency envelope does not exceed 115% of the carrier condition value.

CLASS B AUDIO AMPLIFIER OR MODULATOR

Maximum Ratings

DC Plate Voltage	15,000 volts
Max. Signal DC Plate Current	1.5 amperes
Max. Signal Plate Input	20,000 watts
Plate Dissipation	10,000 watts

Typical Operation

DC Plate Voltage	13,500 volts
DC Grid Voltage	—250 volts (approx.)
Peak A-F Grid-to-Grid Input Voltage	2,100 volts (approx.)
Zero Signal Plate Current (per tube)	0.125 ampere
Max. Signal Plate Current (per tube)	1.25 amperes
Max. Signal Plate Input (per tube)	16,875 watts
Max. Signal Driving Power	450 watts (approx.)
Effective Load (plate to plate)	12,000 ohms
Power Output (2 tubes)	24,000 watts (approx.)

CLASS C R-F POWER AMPLIFIER — TELEPHONY — PLATE MODULATED

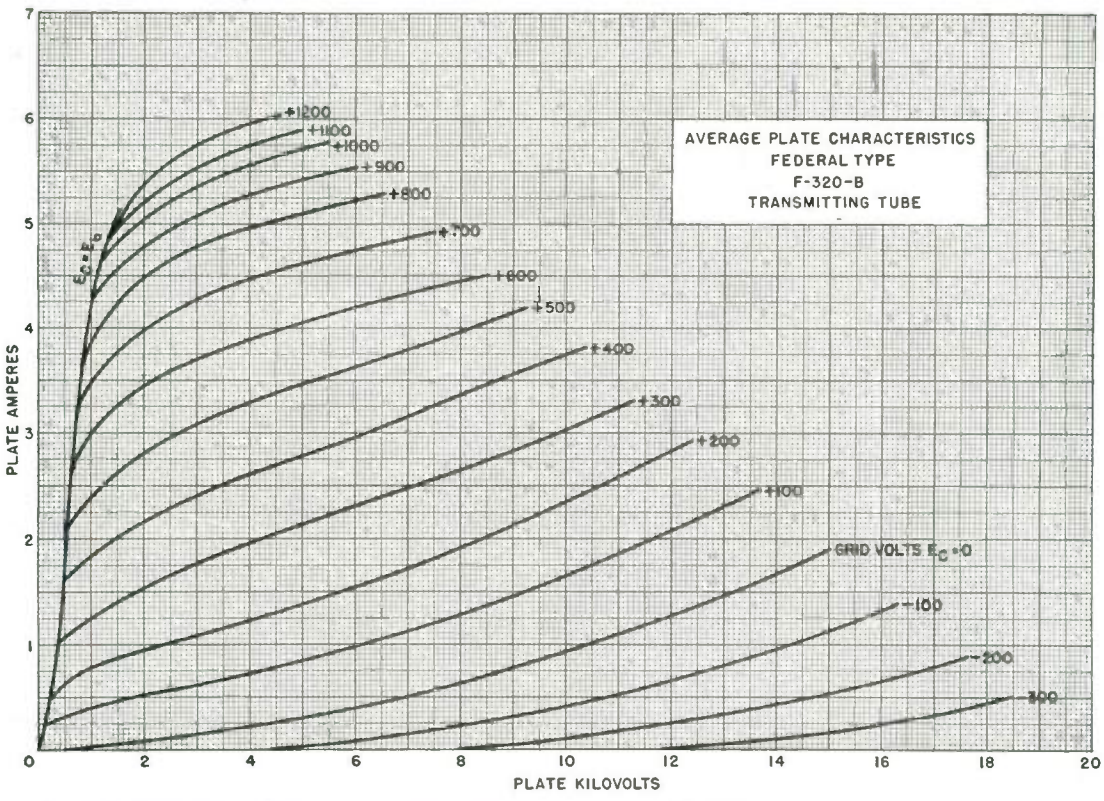
(Carrier conditions per tube for use with modulation factor up to 1.0)

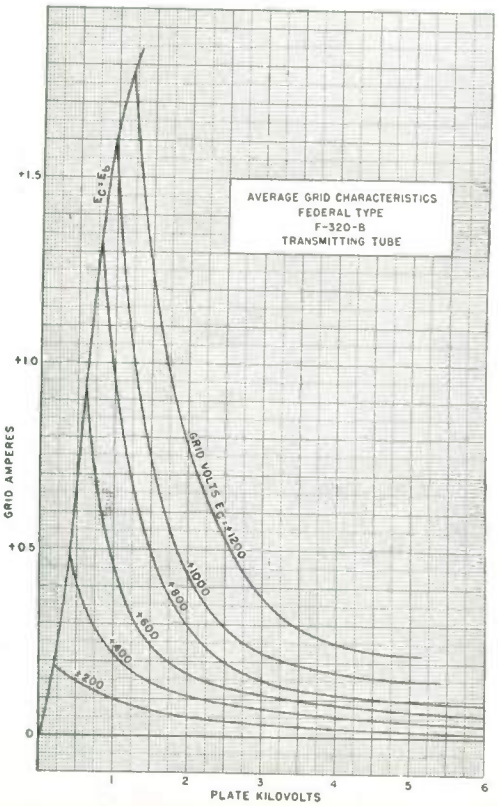
Maximum Ratings

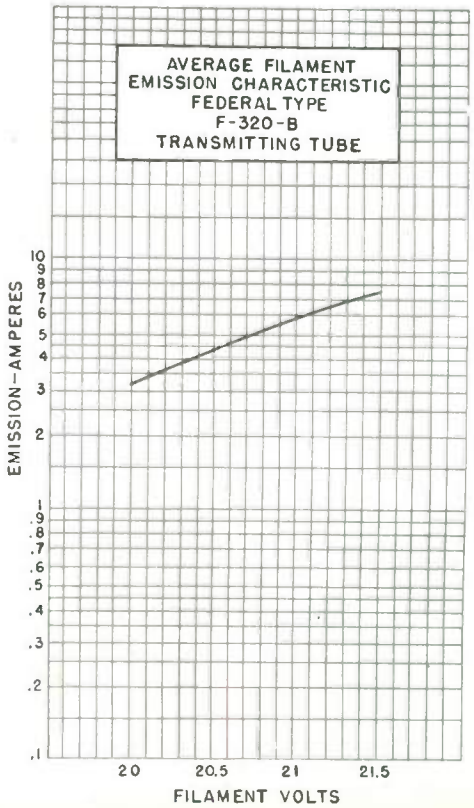
DC Plate Voltage	10,000 volts
DC Plate Current	1.1 amperes
DC Grid Current	0.25 ampere
R-F Grid Current	30 amperes
Plate Dissipation	8,000 watts

TRANSMITTING TUBE TYPE F-320-B

10 Kilowatts Plate Dissipation

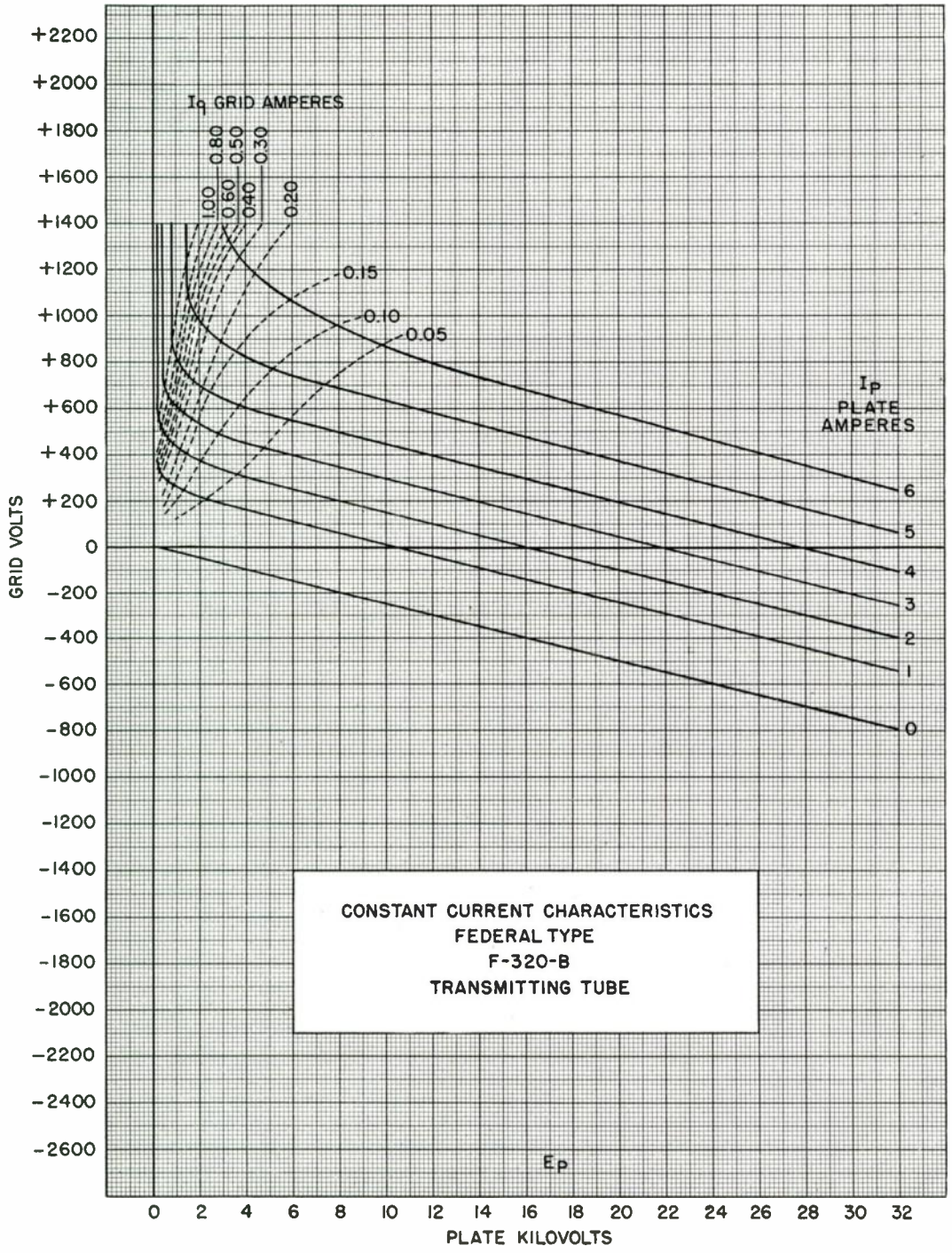






TRANSMITTING TUBE TYPE F-320-B

10 Kilowatts Plate Dissipation

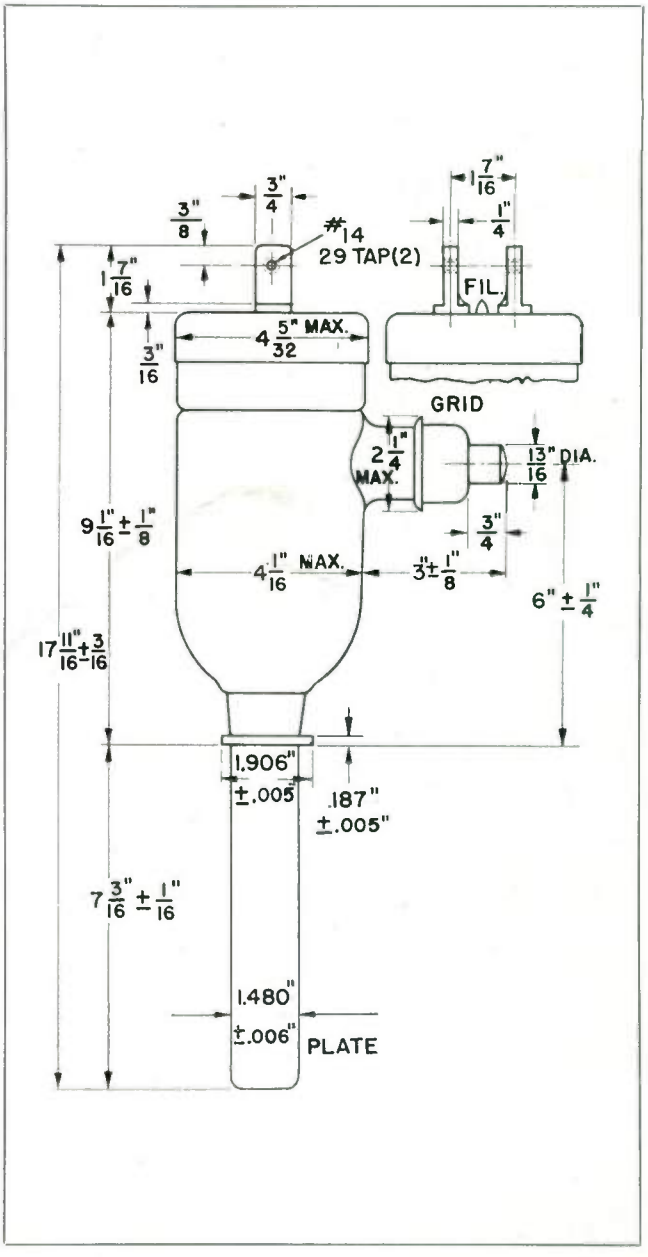


TRANSMITTING TUBE TYPE F-328-A

5 Kilowatts Plate Dissipation

TECHNICAL DATA

Main Use	R-F Power Amplifier, Class B Modulator
Number of Electrodes	3
Filament Voltage	21.5 volts
Current	41 amperes
Type	Tungsten
Thermionic Emission	7.5 amperes
Amplification Factor	16
Approximate Direct Inter-electrode Capacitances	
Plate to Grid	28 $\mu\mu f$
Grid to Filament	20 $\mu\mu f$
Plate to Filament	3 $\mu\mu f$
Type of Cooling	Water
Minimum Flow	3 G.P.M.
Water Jacket	Standard or Federal Type F-1006



TRANSMITTING TUBE TYPE F-328-A

5 Kilowatts Plate Dissipation

Maximum Ratings and Typical Operation Data

For maximum frequency of 3.0 megacycles

CLASS B AUDIO AMPLIFIER OR MODULATOR

Maximum Ratings

DC Plate Voltage	8,000 volts
Max. Signal DC Plate Current	1.0 ampere
Max. Signal Plate Input	8,000 watts
Plate Dissipation	4,000 watts

CLASS C R-F AMPLIFIER— TELEPHONY—PLATE MODULATED

(Carrier conditions per tube for use with modulation factor up to 1.0)

Maximum Ratings

DC Plate Voltage	5,000 volts
DC Plate Current	1.1 amperes
DC Grid Current	0.20 ampere
R-F Grid Current	30 amperes
Plate Input	5,000 watts
Plate Dissipation	3,500 watts

CLASS B R-F POWER AMPLIFIER— TELEPHONY

(Carrier conditions per tube for use with modulation factor up to 1.0)

Maximum Ratings

DC Plate Voltage	8,000 volts
DC Plate Current	1.0 ampere
R-F Grid Current	30 amperes
Plate Input	8,000 watts
Plate Dissipation	5,000 watts

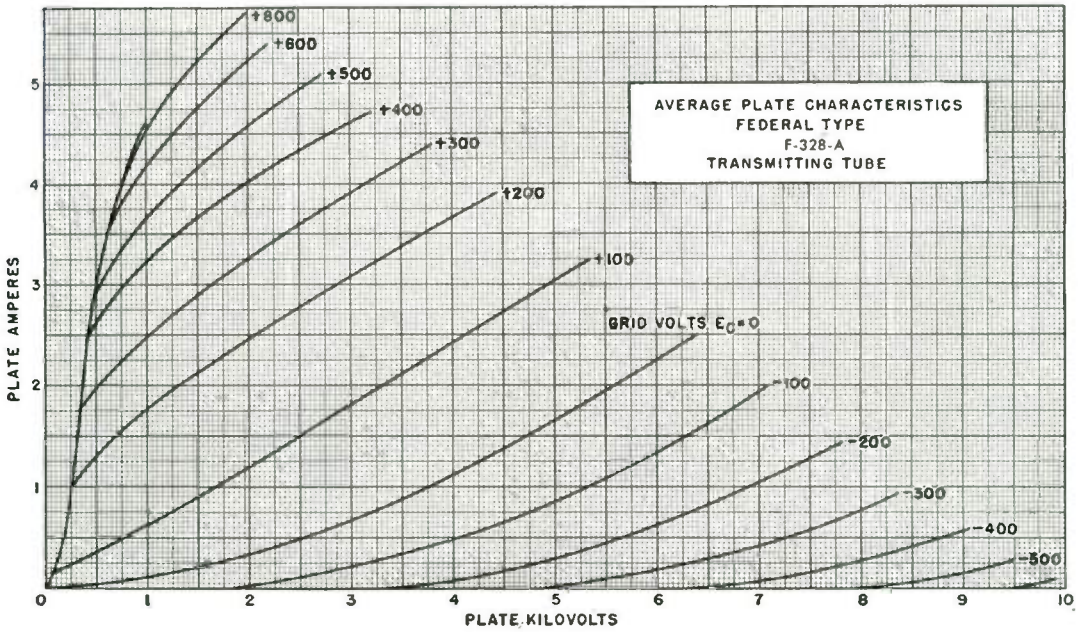
Typical Operation

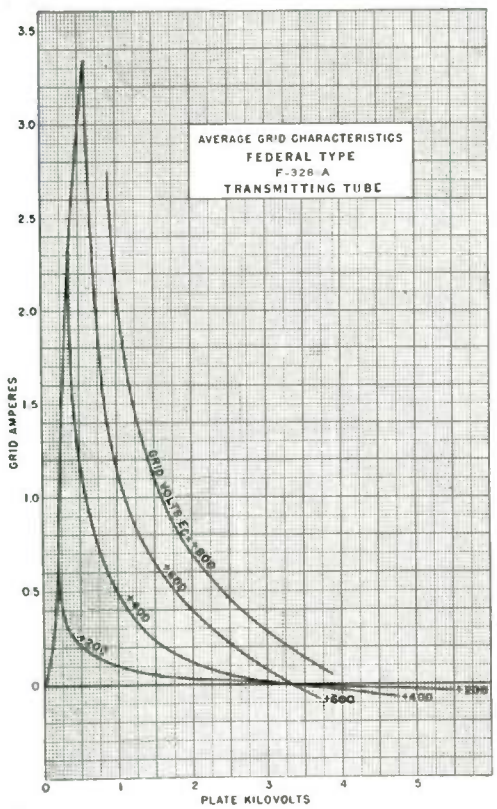
DC Plate Voltage	6,000 volts
DC Grid Voltage	—350 volts (approx.)
Peak R-F Grid Input Voltage	420 volts (approx.)
DC Plate Current	0.540 ampere
DC Grid Current	0.002 ampere
Driving Power*	83 watts (approx.)
Load Impedance	2,950 ohms
Power Output	1,060 watts (approx.)

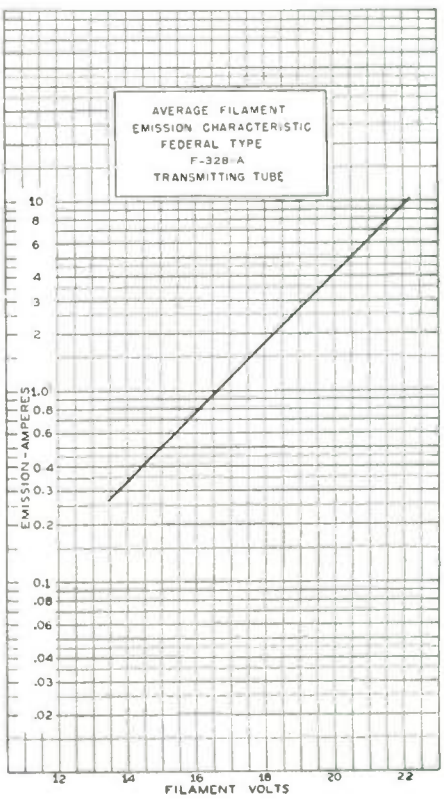
*At crest of A-F cycle.

TRANSMITTING TUBE TYPE F-328-A

5 Kilowatts Plate Dissipation

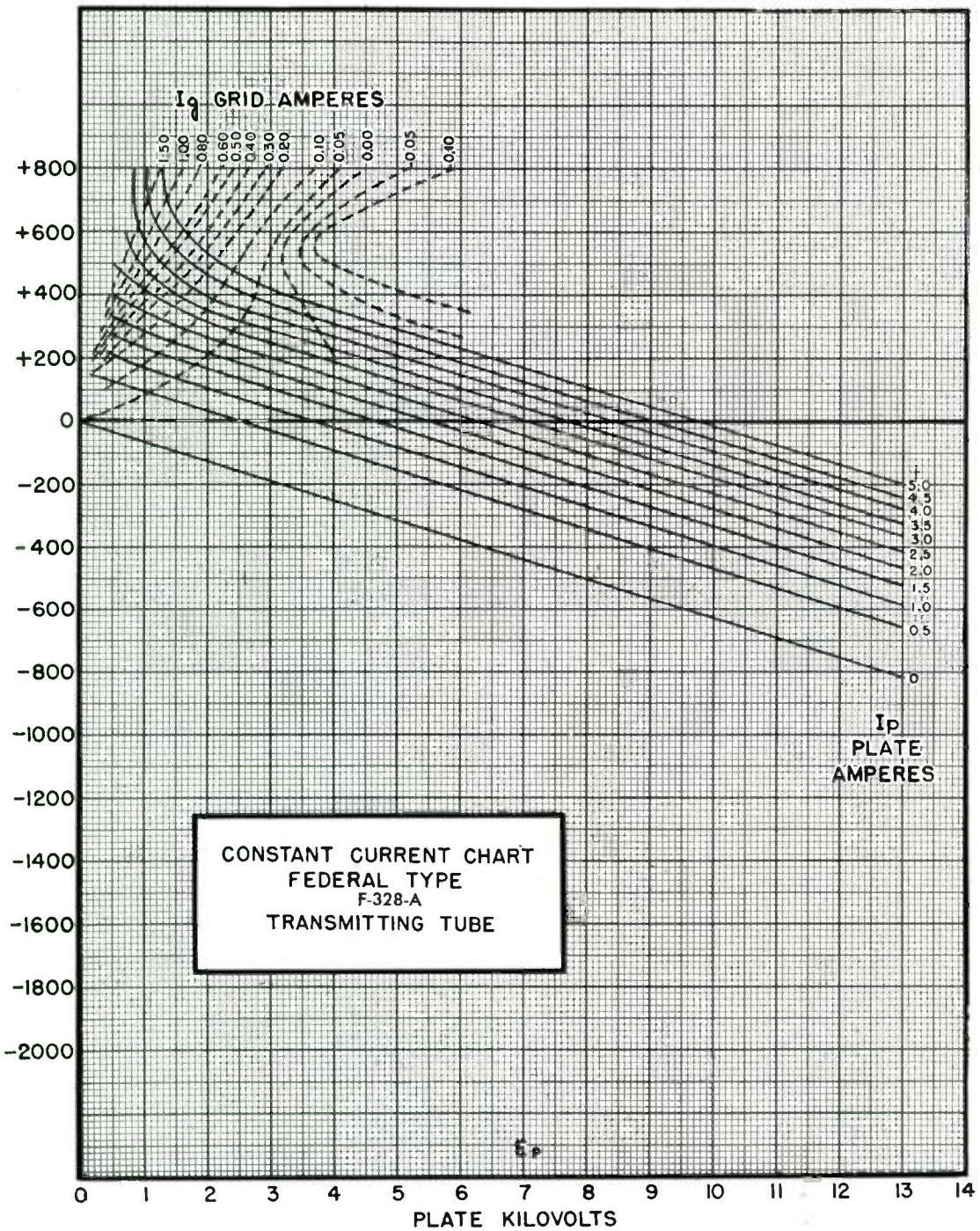






TRANSMITTING TUBE TYPE F-328-A

5 Kilowatts Plate Dissipation

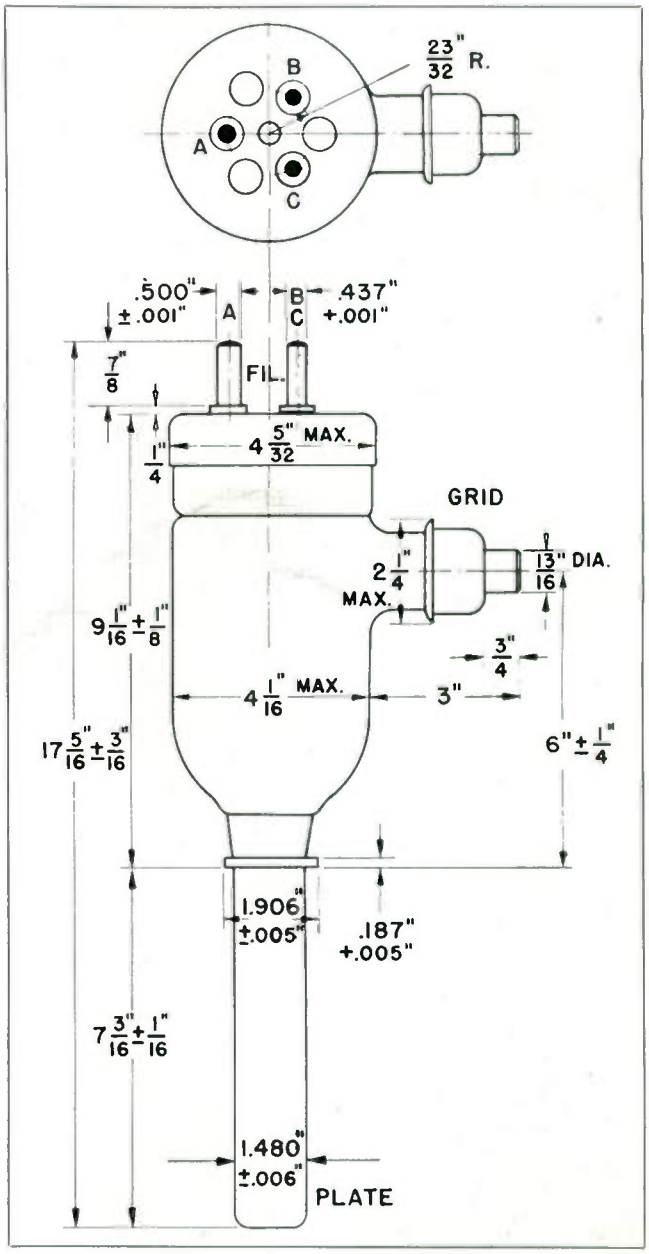


TRANSMITTING TUBE TYPE F-328-B

5 Kilowatts Plate Dissipation

TECHNICAL DATA

Main Use	R-F Power Amplifier, Class B Modulator
Number of Electrodes	3
Filament Voltage	21.5 volts
Current	41 amperes
Type	Tungsten
Thermionic Emission	7.5 amperes
Amplification Factor	16
Approximate Direct Inter-electrode Capacitances	
Plate to Grid	28 $\mu\mu f$
Grid to Filament	20 $\mu\mu f$
Plate to Filament	3 $\mu\mu f$
Type of Cooling	Water
Minimum Flow	3 G.P.M.
Water Jacket	Standard or Federal Type F-1006



TRANSMITTING TUBE TYPE F-328-B

5 Kilowatts Plate Dissipation

Maximum Ratings and Typical Operation Data

For maximum frequency of 3.0 megacycles

CLASS B AUDIO AMPLIFIER OR MODULATOR

Maximum Ratings

DC Plate Voltage	8,000 volts
Max. Signal DC Plate Current	1.0 ampere
Max. Signal Plate Input	8,000 watts
Plate Dissipation	4,000 watts

CLASS C R-F AMPLIFIER— TELEPHONY—PLATE MODULATED

(Carrier conditions per tube for use with modulation factor up to 1.0)

Maximum Ratings

DC Plate Voltage	5,000 volts
DC Plate Current	1.1 amperes
DC Grid Current	0.20 ampere
R-F Grid Current	30 amperes
Plate Input	5,000 watts
Plate Dissipation	3,500 watts

CLASS B R-F POWER AMPLIFIER— TELEPHONY

(Carrier conditions per tube for use with modulation factor up to 1.0)

Maximum Ratings

DC Plate Voltage	8,000 volts
DC Plate Current	1.0 ampere
R-F Grid Current	30 amperes
Plate Input	8,000 watts
Plate Dissipation	5,000 watts

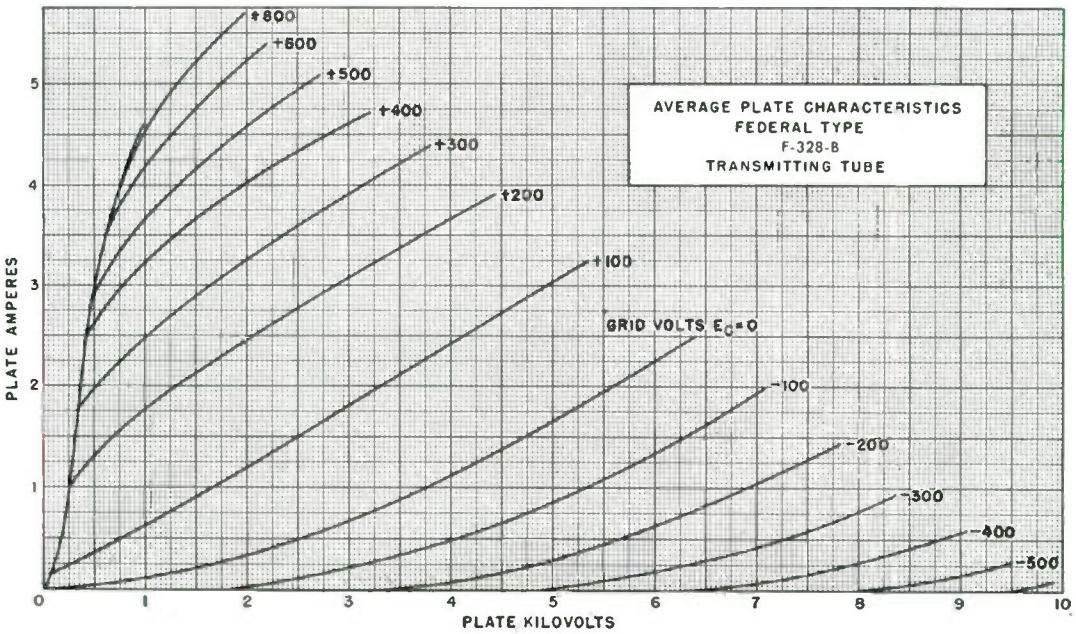
Typical Operation

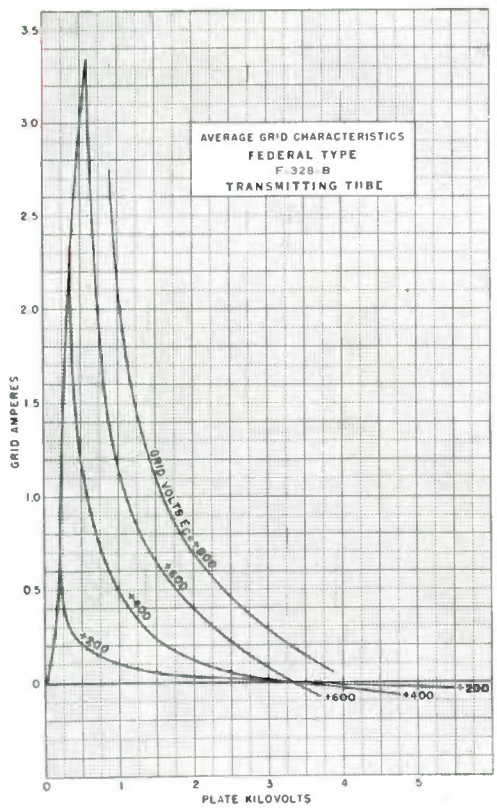
DC Plate Voltage	6,000 volts
DC Grid Voltage	—350 volts (approx.)
Peak R-F Grid Input Voltage	420 volts (approx.)
DC Plate Current	0.540 ampere
DC Grid Current	0.002 ampere
Driving Power*	83 watts (approx.)
Load Impedance	2,950 ohms
Power Output	1,060 watts (approx.)

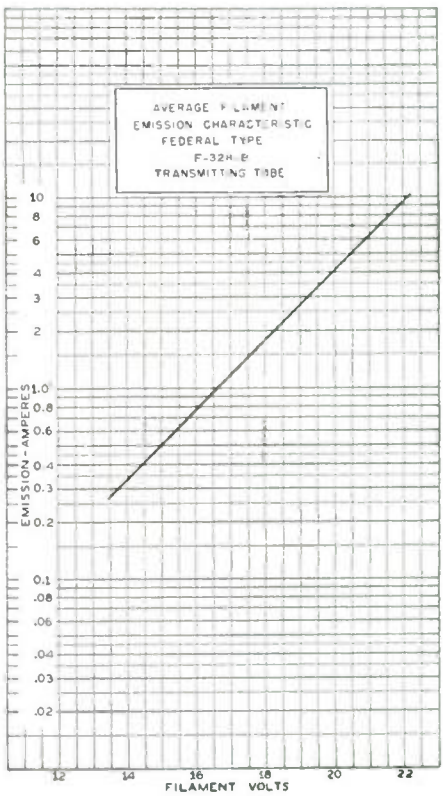
*At crest of A-F cycle.

TRANSMITTING TUBE TYPE F-328-B

5 Kilowatts Plate Dissipation

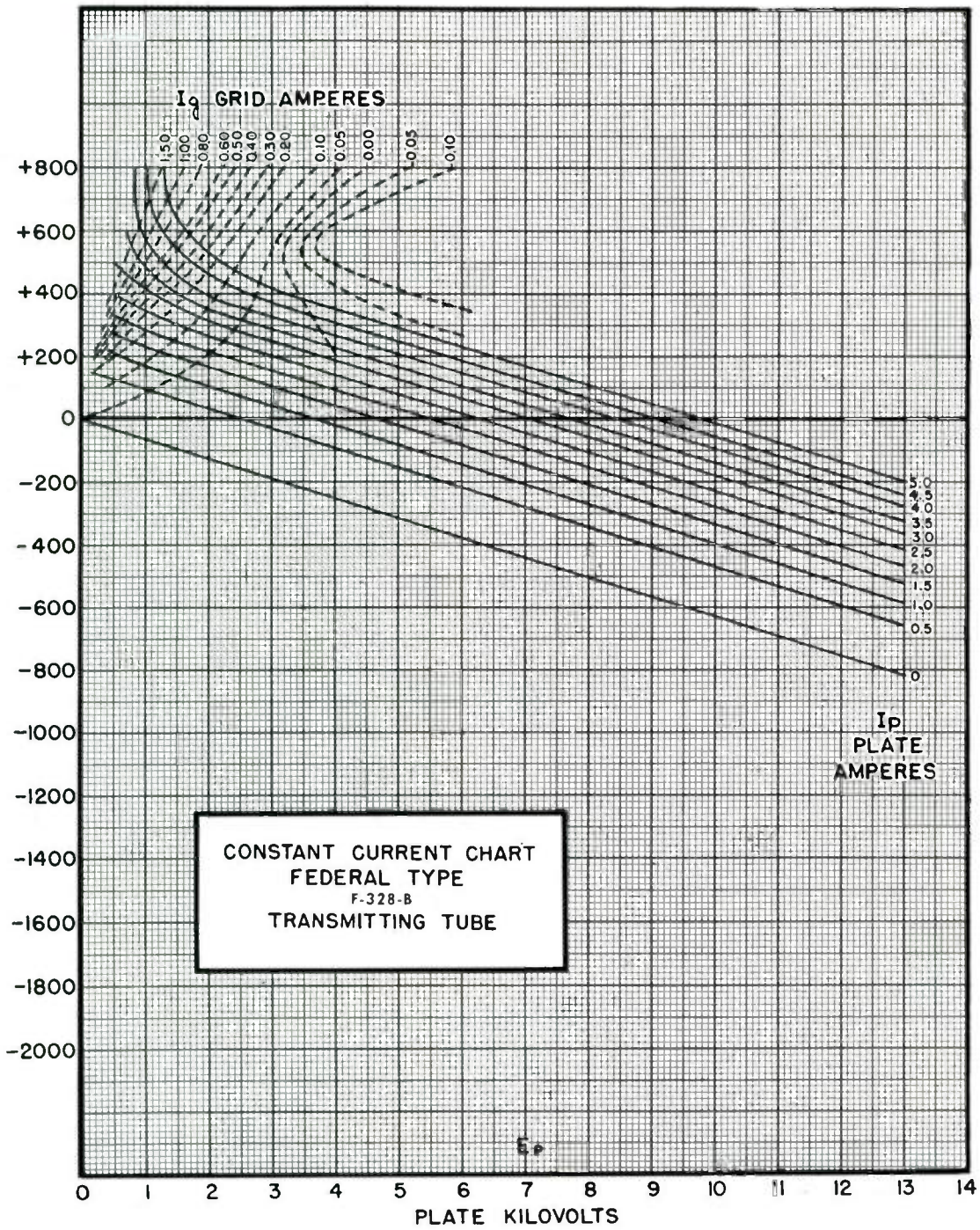






TRANSMITTING TUBE TYPE F-328-B

5 Kilowatts Plate Dissipation



Federal Telephone and Radio Corporation

Vacuum Tube Products — An IT&T Associate — Newark 4, New Jersey

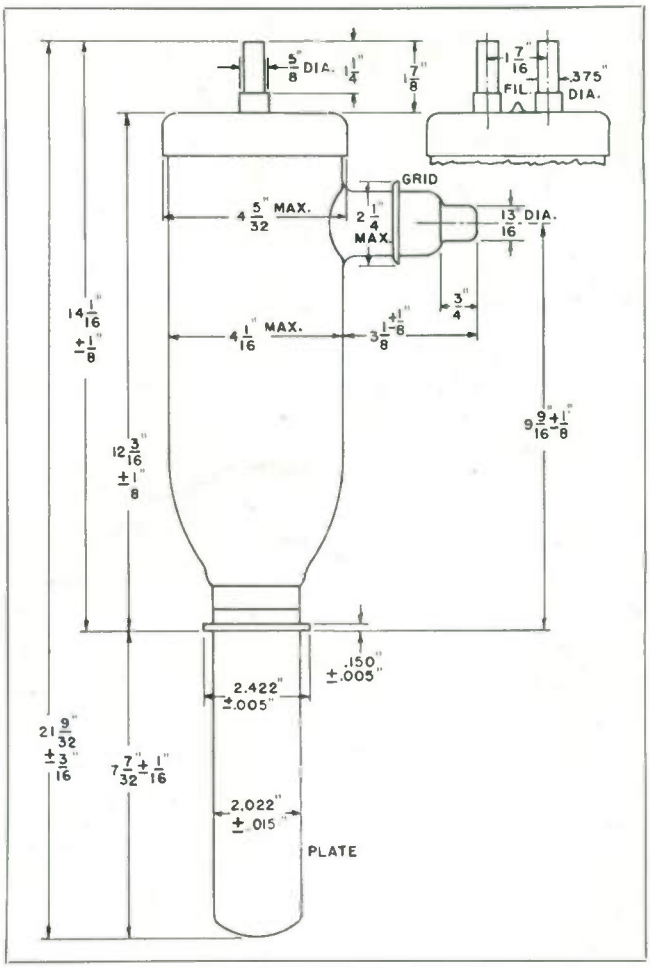
Printed in U.S.A. Form F-180

TRANSMITTING TUBE TYPE F-342-A

25 Kilowatts Plate Dissipation

Technical Data

Main Use	R-F Power Amplifier, Oscillator
Number of Electrodes	3
Filament Voltage	20 volts
Current	71 amperes
Type	Tungsten
Thermionic Emission	13.5 amperes
Amplification Factor	40
Approximate Direct Inter-electrode Capacitances	
Plate to Grid	27 $\mu\mu f$
Grid to Filament	19 $\mu\mu f$
Plate to Filament	2.5 $\mu\mu f$
Type of Cooling	Water
Minimum Flow	10 G.P.M.
Water Jacket	Standard or Federal Type F-1005



TRANSMITTING TUBE TYPE F-342-A

25 Kilowatts Plate Dissipation

Maximum Ratings and Typical Operation Data

For maximum frequency of 4.0 megacycles

CLASS B R-F POWER AMPLIFIER TELEPHONY

(Carrier conditions per tube for use with modulation factor up to 1.0)

Maximum Ratings

DC Plate Voltage	20,000 volts
DC Plate Current	2.0 amperes
R-F Grid Current	40 amperes
Plate Input	30,000 watts
Plate Dissipation	20,000 watts

Typical Operation

DC Plate Voltage	17,500 volts
DC Grid Voltage	—430 volts (approx.)
Peak R-F Grid Input Voltage	760 volts (approx.)
DC Plate Current	1.55 amperes
DC Grid Current	0.021 amperes
Driving Power**	28 watts (approx.)
Load Impedance	2,780 ohms
Power Output	8,250 watts (approx.)

**At crest of A-F cycle.

CLASS C R-F POWER AMPLIFIER TELEPHONY — PLATE MODULATED

(Carrier conditions per tube for use with modulation factor up to 1.0)

Maximum Ratings

DC Plate Voltage	14,000 volts
DC Plate Current	2.0 amperes
DC Grid Current	0.30 ampere
R-F Grid Current	40 amperes
Plate Input	40,000 watts
Plate Dissipation	15,000 watts

CLASS C R-F POWER AMPLIFIER AND OSCILLATOR — TELEGRAPHY

*(Key-down conditions per tube without modulation)**

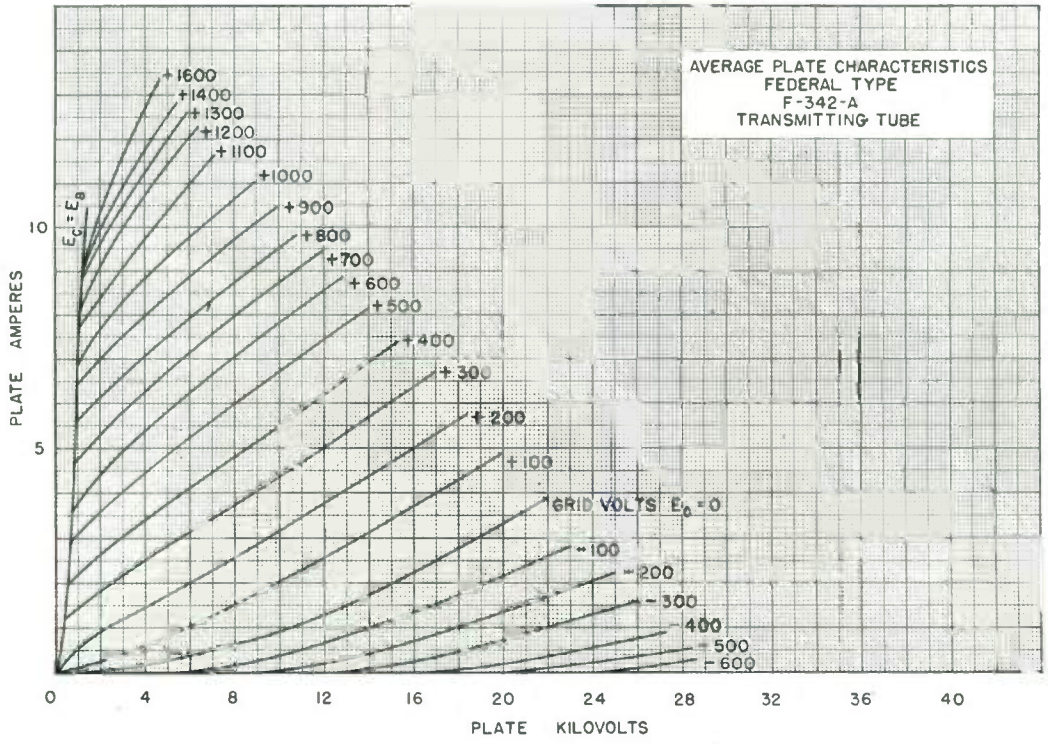
Maximum Ratings

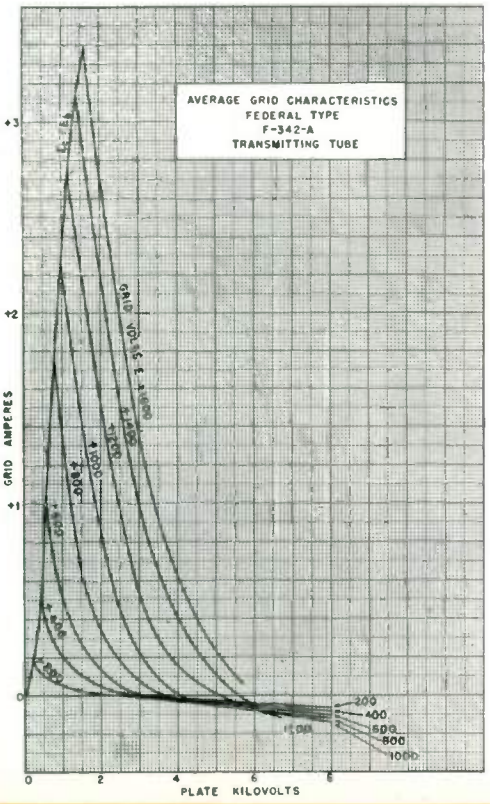
DC Plate Voltage	20,000 volts
DC Grid Voltage	–5,000 volts
DC Plate Current	3.0 amperes
DC Grid Current	0.30 ampere
R-F Grid Current	40 amperes
Plate Input	50,000 watts
Plate Dissipation	25,000 watts

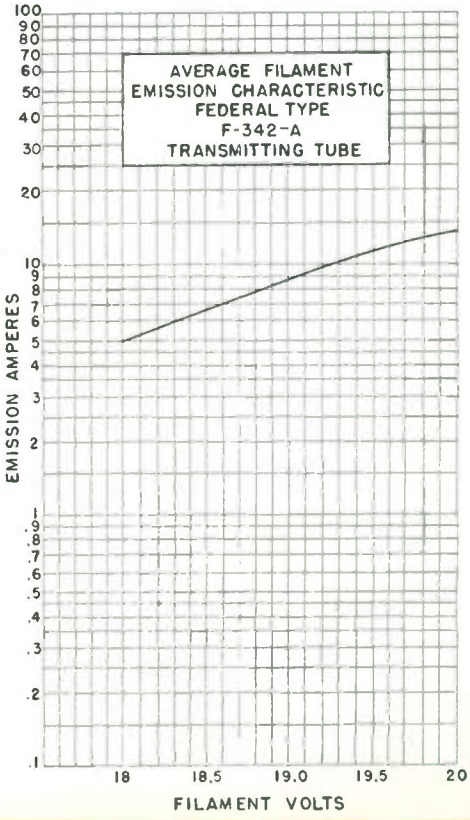
*Modulation essentially negative, may be used if the positive peak of the audio frequency envelope does not exceed 115% of the carrier condition value.

TRANSMITTING TUBE TYPE F-342-A

25 Kilowatts Plate Dissipation

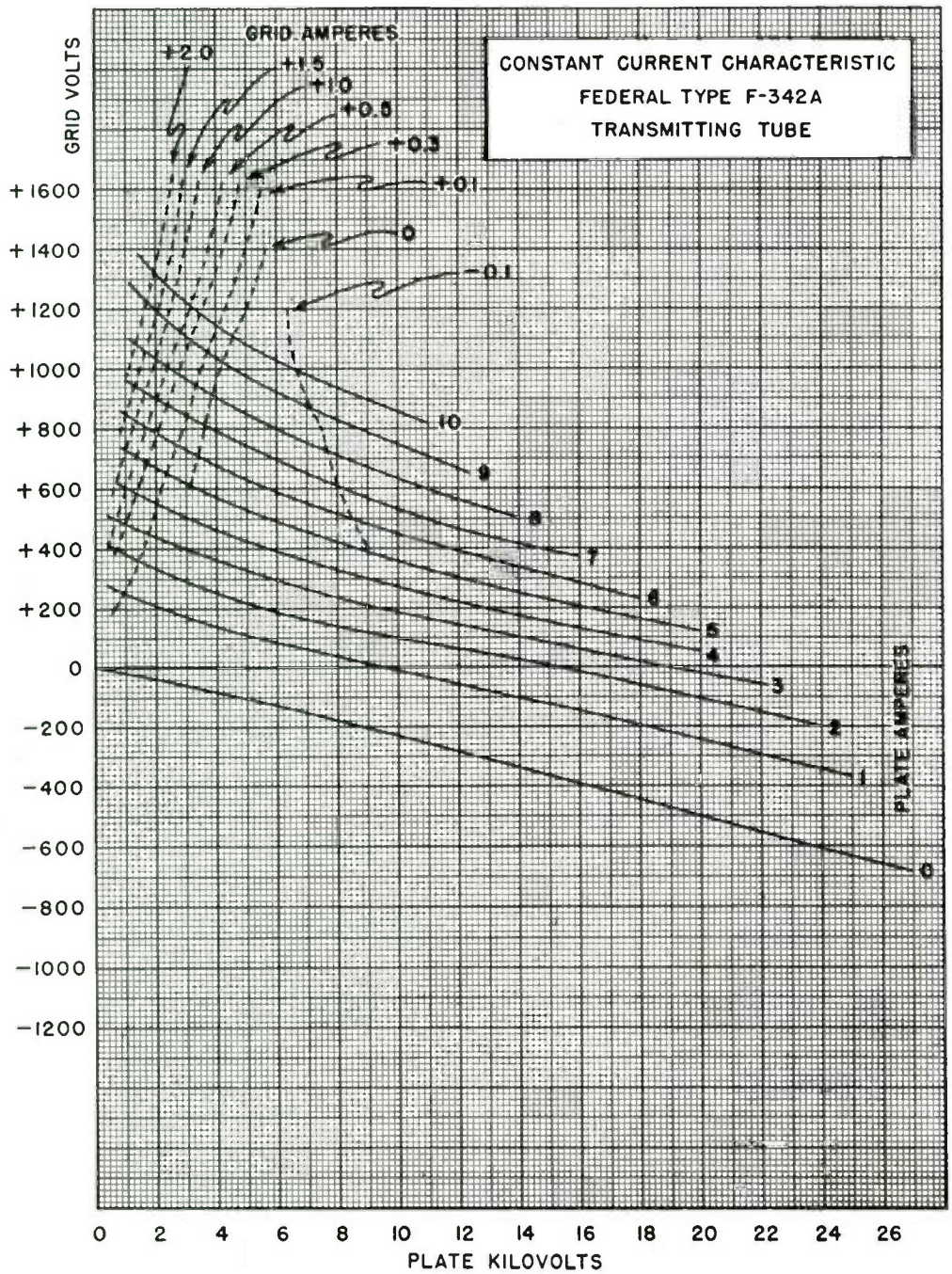






TRANSMITTING TUBE TYPE F-342-A

25 Kilowatts Plate Dissipation



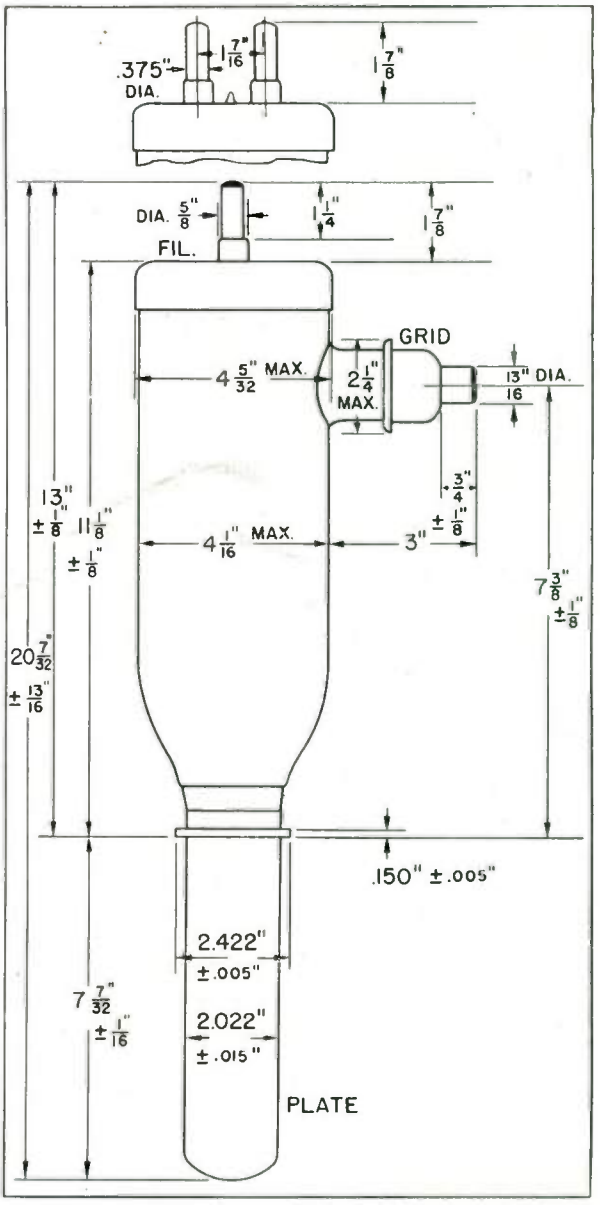
Printed in U. S. A.—Form F-185

TRANSMITTING TUBE TYPE F-343-A

10 Kilowatts Plate Dissipation

Technical Data

Main Use	R-F Power Amplifier
Number of Electrodes	3
Filament Voltage	21.5 volts
Current	58 amperes
Type	Tungsten
Thermionic Emission	10 amperes
Amplification Factor	40
Approximate Direct Inter-Electrode Capacitances	
Plate to Grid	25 μμf
Grid to Filament	17 μμf
Plate to Filament	2 μμf
Type of Cooling	Water
Minimum Flow	5 G.P.M.
Water Jacket	Standard or Federal Type F-1005



TRANSMITTING TUBE TYPE F-343-A

10 Kilowatts Plate Dissipation

Maximum Ratings and Typical Operation Data

For maximum frequency of 4.0 megacycles

CLASS B AUDIO AMPLIFIER OR MODULATOR

Maximum Ratings

DC Plate Voltage	15,000 volts
Max. Signal DC Plate Current	2 amperes
Max. Signal Plate Input	25,000 watts
Plate Dissipation	10,000 watts

CLASS B R-F POWER AMPLIFIER—TELEPHONY

(Carrier conditions per tube for use with modulation factor up to 1.0)

Maximum Ratings

DC Plate Voltage	14,000 volts
DC Plate Current	1.5 amperes
R-F Grid Current	30 amperes
Plate Input	15,000 watts
Plate Dissipation	10,000 watts

Typical Operation

(Carrier conditions per tube for use with modulation factor up to 1.0)

DC Plate Voltage	12,000 volts
DC Grid Voltage	—220 volts (approx.)
Peak R-F Grid Input Voltage	820 volts (approx.)
DC Plate Current	0.610 ampere
DC Grid Current	0.060 ampere
Driving Power*	47 watts (approx.)
Load Impedance	6,200 ohms
Power Output	2,500 watts (approx.)

*At crest of A-F cycle.

CLASS C R-F POWER AMPLIFIER—TELEPHONY—PLATE MODULATED

(Carrier conditions per tube for use with modulation factor up to 1.0)

Maximum Ratings

DC Plate Voltage	10,000 volts
DC Plate Current	1.5 amperes
DC Grid Current	0.25 ampere
R-F Grid Current	30 amperes
Plate Dissipation	8,000 watts

Typical Operation

(Carrier conditions per tube for use with modulation factor up to 1.0)

DC Plate Voltage	9,000 volts
DC Grid Voltage	—800 volts (approx.)
Peak R-F Grid Input Voltage	1,380 volts (approx.)
DC Plate Current	0.675 ampere
DC Grid Current	0.043 ampere
Driving Power	58 watts (approx.)
Power Output	5,000 watts (approx.)

CLASS C R-F POWER AMPLIFIER AND OSCILLATOR—TELEGRAPHY

*(Key-down conditions per tube without modulation)**

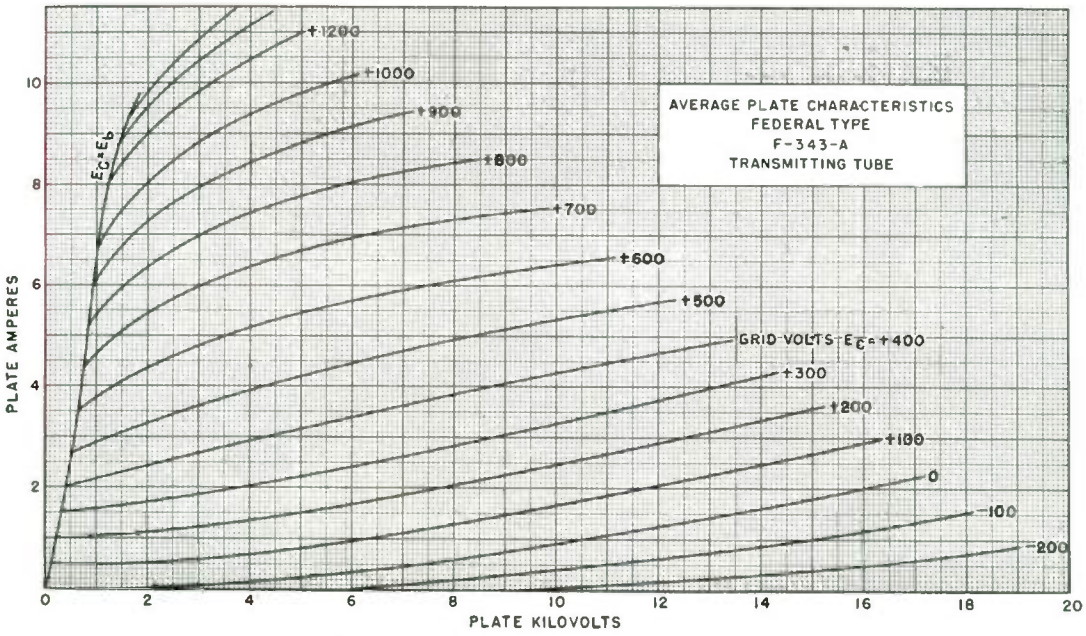
Maximum Ratings

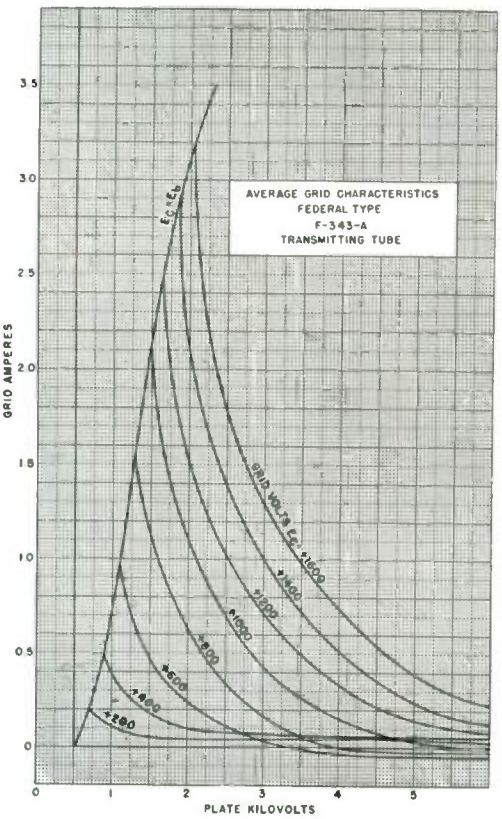
DC Plate Voltage	15,000 volts
DC Grid Voltage	–3,000 volts
DC Plate Current	2.0 amperes
DC Grid Current	0.30 ampere
R-F Grid Current	30 amperes
Plate Input	25,000 watts
Plate Dissipation	10,000 watts

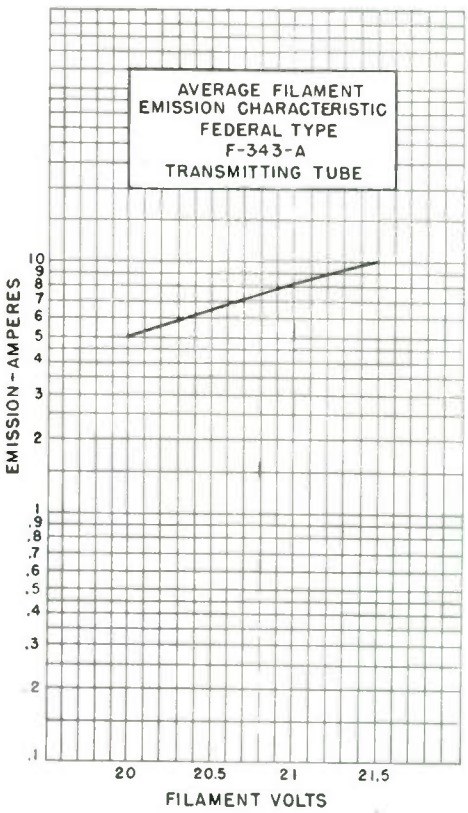
*Modulation, essentially negative, may be used if the positive peak of the audio frequency envelope does not exceed 115% of the carrier condition value.

TRANSMITTING TUBE TYPE F-343-A

10 Kilowatts Plate Dissipation

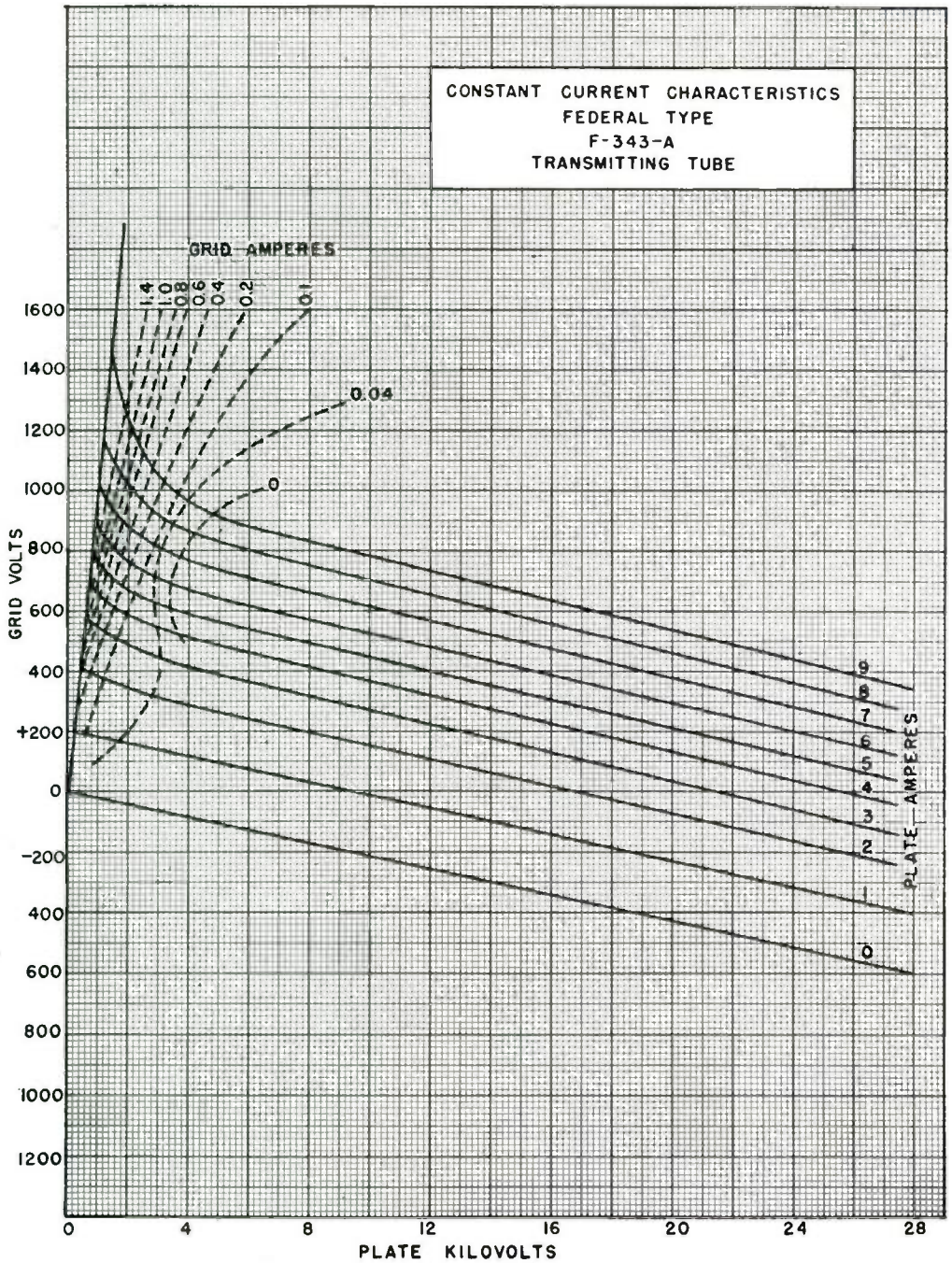






TRANSMITTING TUBE TYPE F-343-A

10 Kilowatts Plate Dissipation

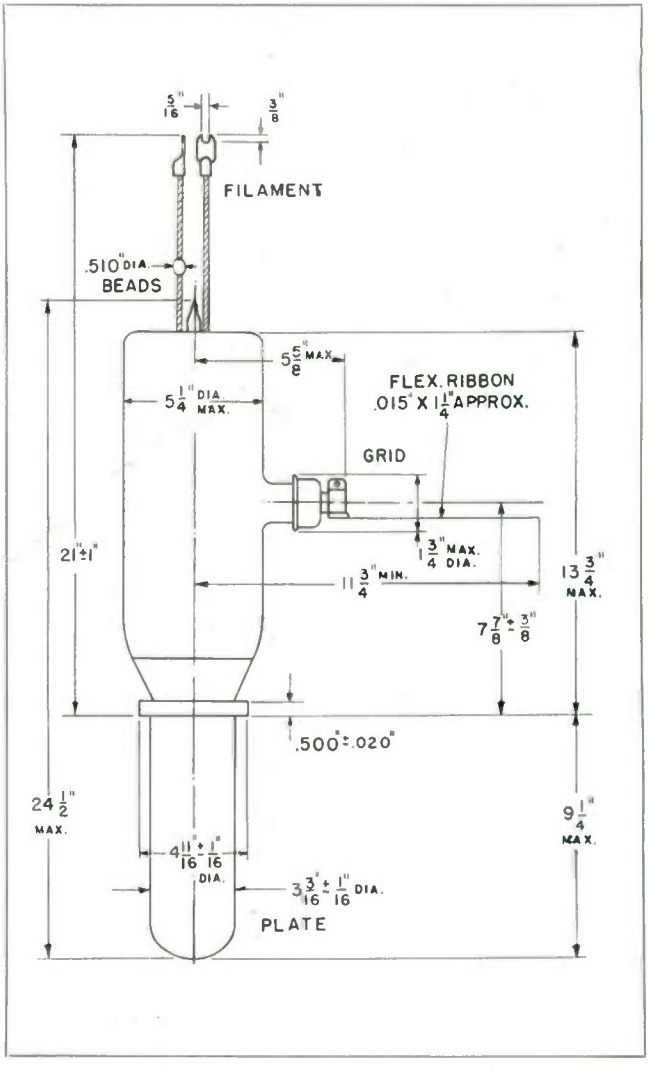


TRANSMITTING TUBE TYPE F-858

20 Kilowatts Plate Dissipation

Technical Data

Main Use	Oscillator or R-F Amplifier
Number of Electrodes	3
Filament Voltage	22 volts
Current	52 amperes
Type	Tungsten
Available Thermionic Emission	10 amperes
Amplification Factor	42
Approximate Direct Inter-electrode Capacitances	
Plate to Grid	18 $\mu\mu f$
Grid to Filament	16 $\mu\mu f$
Plate to Filament	2 $\mu\mu f$
Type of Cooling	Water
Minimum Flow	15 G.P.M.
Water Jacket	Federal Type F-1010



Maximum Ratings versus Operating Frequency

Operating Frequency Megacycles	Maximum Permissible Percentage of Maximum Rated Plate Voltage and Plate Input		
	Class B Telephony	Class C Telephony	Class C Telegraphy
1.5	100	100	100
20	85	75	75
40	65	50	50

TRANSMITTING TUBE TYPE F-858

20 Kilowatts Plate Dissipation

Maximum Ratings and Typical Operation Data

For maximum frequency of 1.5 megacycles

CLASS B
A-F POWER AMPLIFIER

Maximum Ratings

DC Plate Voltage	20,000 volts
Max. Signal DC Plate Current*	2.0 amperes
Max. Signal DC Plate Input*	40 kw
Plate Dissipation*	20 kw

Typical Operation

(Unless otherwise specified values are for 2 tubes)

DC Plate Voltage	12,000 volts
DC Grid Voltage	–140 volts
Peak A-F Grid-to-Grid Voltage	2,600 volts
Zero Signal DC Plate Current	0.05 ampere
Max. Signal DC Plate Current	3.6 amperes
Load Resistance (per tube)	1,800 ohms
Effective Load Resistance (plate to plate)	7,200 ohms
Max. Signal Driving Power	115 watts (approx.)
Max. Signal Power Output	26.5 kw (approx.)

*Averaged over any audio-frequency cycle

CLASS B TELEPHONY
R-F POWER AMPLIFIER

(Carrier conditions per tube for use with a maximum modulation factor of 1.0)

Maximum Ratings

DC Plate Voltage	20,000 volts
DC Plate Current	1.0 ampere
R-F Grid Current	48 amperes
Plate Input	20 kw
Plate Dissipation	15 kw

Typical Operation

DC Plate Voltage	18,000 volts
DC Grid Voltage	–300 volts
Peak R-F Grid Voltage	725 volts
DC Plate Current	0.9 ampere
Driving Power**	85 watts (approx.)
Power Output	5.6 kw (approx.)

**At crest of a-f cycle with modulation factor of 1.0

CLASS C TELEPHONY
PLATE MODULATED R-F POWER AMPLIFIER

(Carrier conditions per tube for use with a maximum modulation factor of 1.0)

Maximum Ratings

DC Plate Voltage	12,000 volts
DC Grid Voltage	–3,000 volts
DC Plate Current	1.0 ampere
DC Grid Current	0.25 ampere
R-F Grid Current	48 amperes
Plate Input	12 kw
Plate Dissipation	10 kw

Typical Operation

DC Plate Voltage	12,000 volts
DC Grid Voltage	–1,000 volts
Peak R-F Grid Voltage	1,950 volts
DC Plate Current	0.95 ampere
DC Grid Current	0.08 ampere (approx.)
Driving Power	150 watts (approx.)
Power Output	8 kw (approx.)

CLASS C TELEGRAPHY
R-F POWER AMPLIFIER AND OSCILLATOR

(Key-down conditions per tube without modulation)*

Maximum Ratings

DC Plate Voltage	20,000 volts
DC Grid Voltage	–3,000 volts
DC Plate Current	2.0 amperes
DC Grid Current	0.25 ampere
R-F Grid Current	60 amperes
Plate Input	40 kw
Plate Dissipation	20 kw

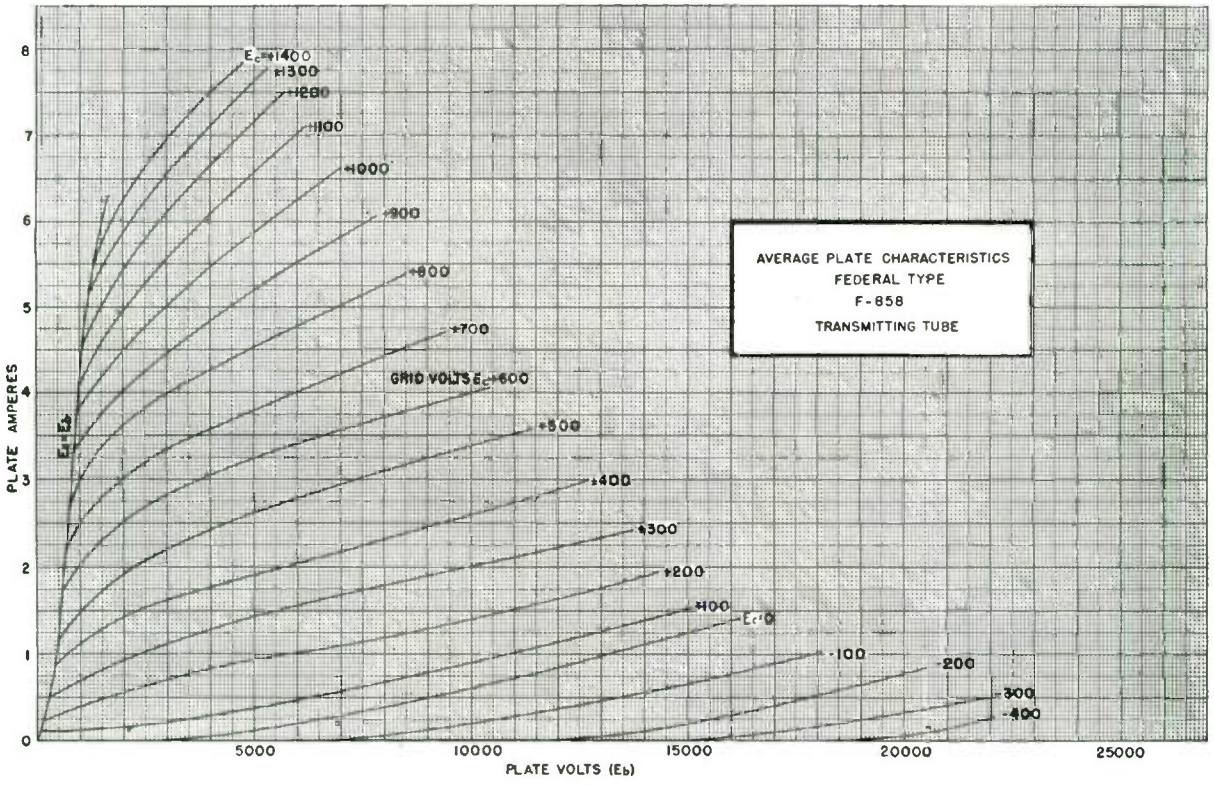
Typical Operation

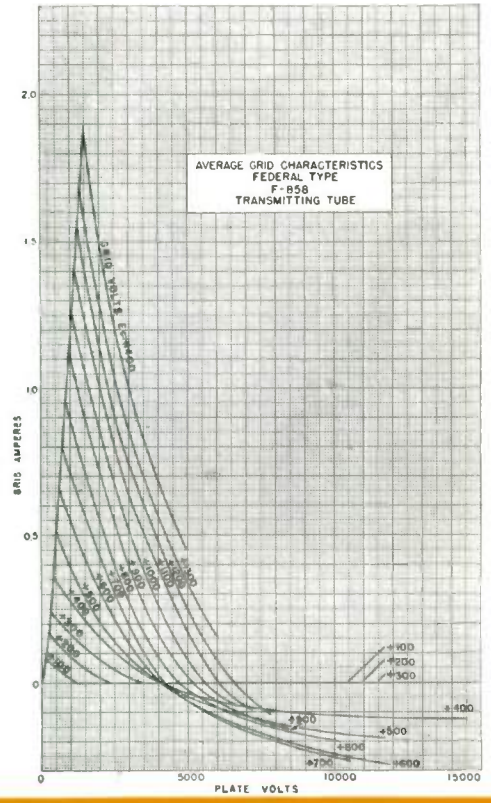
DC Plate Voltage	18,000 volts
DC Grid Voltage	–1,200 volts
Peak R-F Grid Voltage	2,600 volts
DC Plate Current	1.8 amperes
DC Grid Current	0.10 ampere (approx.)
Driving Power	250 watts (approx.)
Power Output	22.4 kw (approx.)

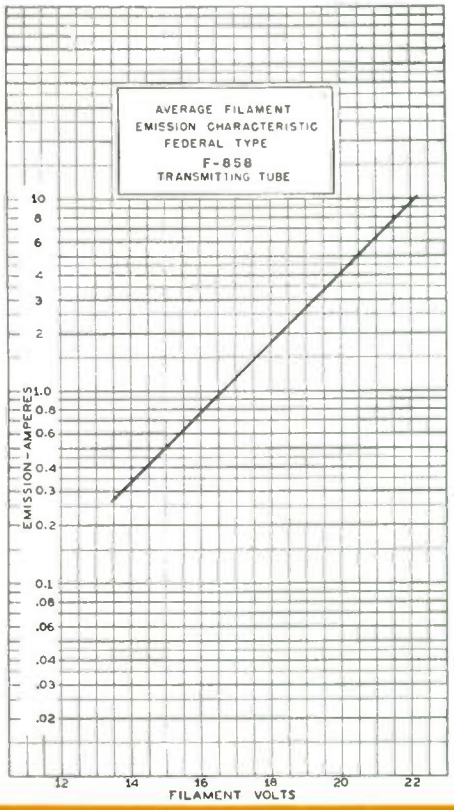
*Modulation essentially negative may be used if the positive peak of the audio-frequency envelope does not exceed 115% of the carrier conditions.

TRANSMITTING TUBE TYPE F-858

20 Kilowatts Plate Dissipation

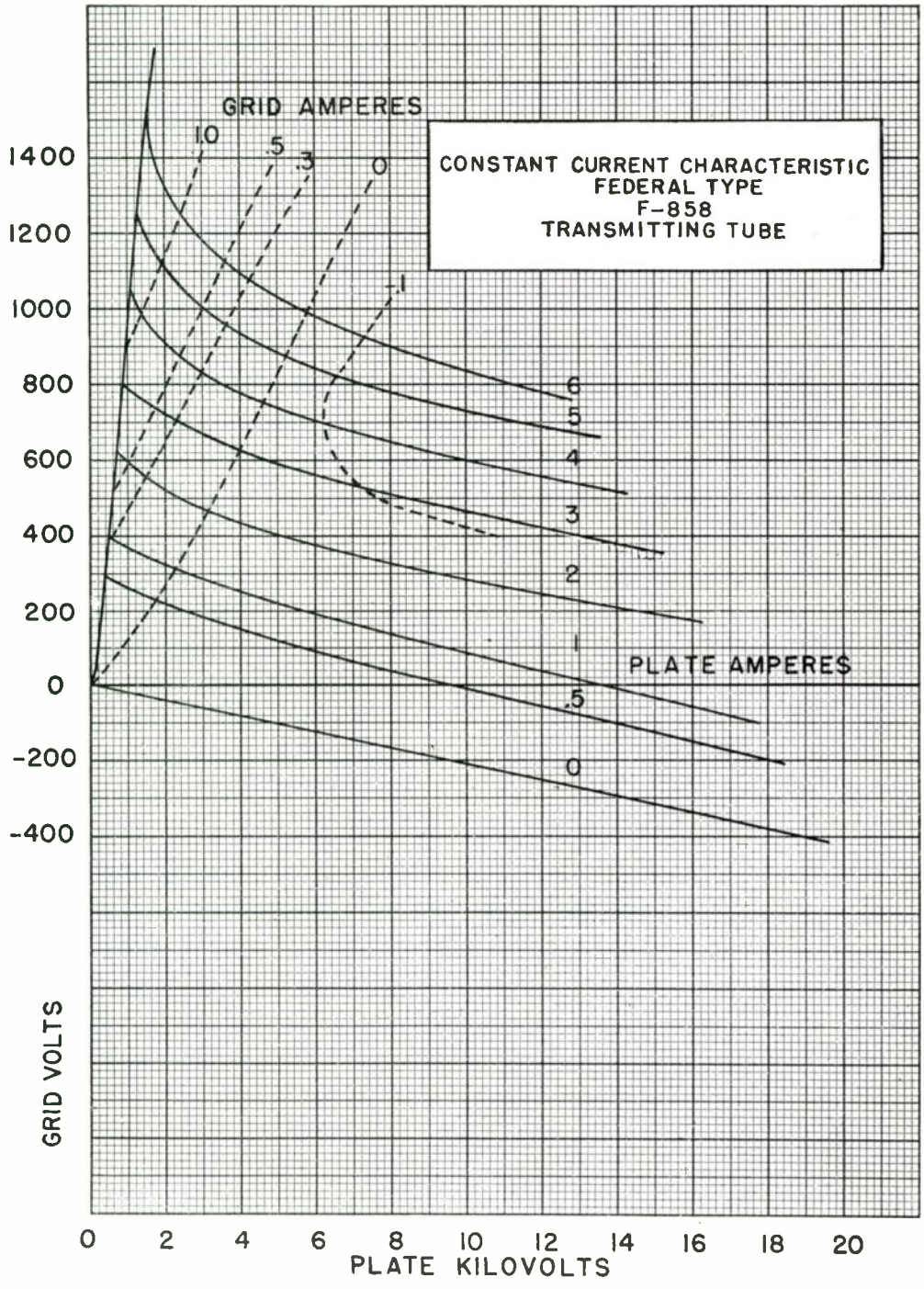






TRANSMITTING TUBE TYPE F-858

20 Kilowatts Plate Dissipation



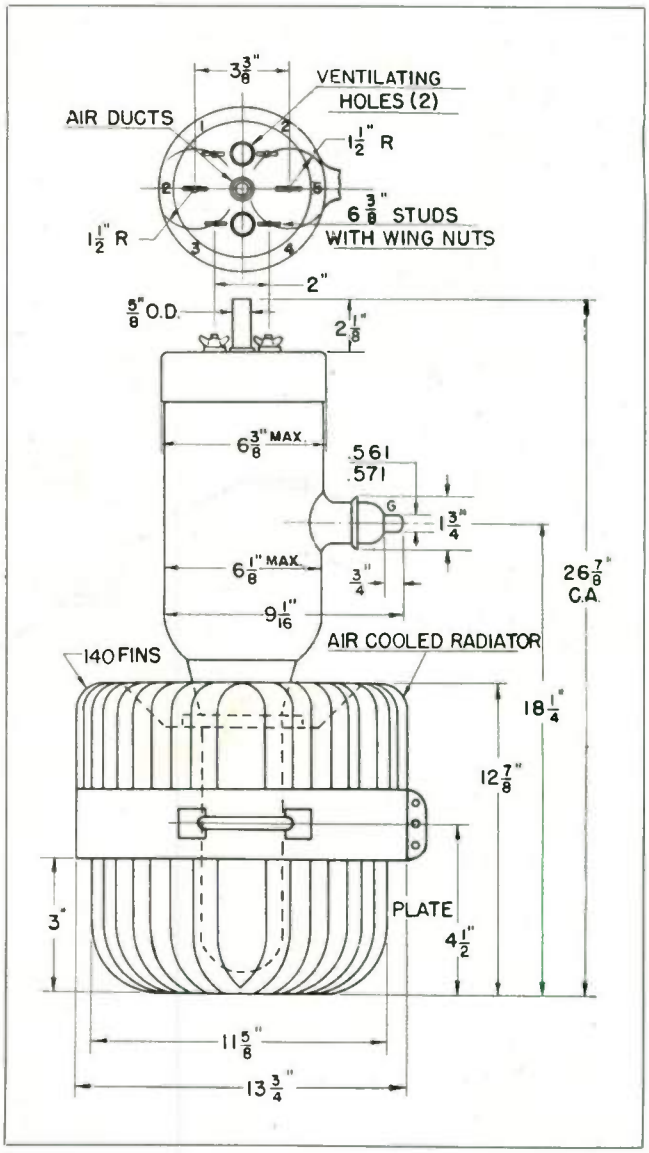
TRANSMITTING TUBE TYPE F-893-RA

20 Kilowatts Plate Dissipation

Technical Data

Main Use	R-F Power Amplifier Class B Modulator
Number of Electrodes	3
Filament Voltage Per Strand	10 volts
Current Per Terminal	61 amperes
Excitation	1, 3, or 6 A-C
Amplification Factor	36
Approximate Direct Inter-electrode Capacitances	
Plate to Grid	33 $\mu\mu$f
Grid to Filament	48 $\mu\mu$f
Plate to Filament	3.2 $\mu\mu$f
Mounting	Special
Type of Cooling	Forced Air

A vertical air flow of at least 1800 cu. ft./min. should be delivered by a blower to the cooling radiator. An air flow of about 2 cu. ft./min. should be supplied to the air nozzle in the filament base. Cooling must be adequate to limit the glass temperature to not more than 150°C at the hottest part. Air flow must start before the application of any voltages.



Maximum Ratings versus Operating Frequency

Operating Frequency Megacycles	Maximum Permissible Percentage of Maximum Rated Plate Voltage and Plate Input			
	Class B Telephony	Class C Telephony	Class C Telegraphy	
			Volt	Input
5	100	100	100	100
12	86	81	81	75
25	74	65	65	50

TRANSMITTING TUBE TYPE F-893-RA

20 Kilowatts Plate Dissipation

Maximum Ratings and Typical Operation Data

For a Maximum Frequency of 5 Megacycles

A-F POWER AMPLIFIER AND MODULATOR — CLASS B

Maximum Ratings

DC Plate Voltage	20,000 volts
Max. Signal DC Plate Current	4 amperes
Max. Signal Plate Input	60 kilowatts
Plate Dissipation	20 kilowatts

Typical Operation

Unless otherwise specified, values are for 2 tubes

DC Plate Voltage	18,000 volts
DC Grid Voltage	–450 volts
Peak A-F Grid to Grid Voltage	1,720 volts
Zero Signal DC Plate Current	0.8 amperes
Max. Signal DC Plate Current	5.5 amperes
Effective Load Resistance Plate to Plate	8,000 ohms
Driving Power	140 watts (approx.)
Max. Signal Power Output	70 kilowatts (approx.)

CLASS C R-F POWER AMPLIFIER TELEPHONY — PLATE MODULATED

(Carrier conditions per tube for use with modulation factor of 1.0)

Maximum Ratings

DC Plate Voltage	12,000 volts
DC Grid Voltage	–3,000 volts
DC Plate Current	2 amperes
DC Grid Current	0.4 amperes
Plate Input	24 kilowatts
Plate Dissipation	12 kilowatts

Typical Operation

DC Plate Voltage	12,000 volts
DC Grid Voltage	–1,000 volts
Peak R-F Grid Voltage	1,500 volts
DC Plate Current	2 amperes
DC Grid Current	0.14 amperes (approx.)
Driving Power	210 watts (approx.)
Power Output	18 kilowatts (approx.)

CLASS B R-F POWER AMPLIFIER TELEPHONY

(Carrier conditions per tube for use with modulation factor of 1.0)

Maximum Ratings

DC Plate Voltage	20,000 volts
DC Plate Current	2 amperes
Plate Input	32 kilowatts
Plate Dissipation	20 kilowatts

Typical Operation

DC Plate Voltage	15,000 volts
DC Grid Voltage	–340 volts
Peak R-F Grid Voltage	450
DC Plate Current	2 amperes
Driving Power**	200 watts (approx.)
Power Output	10 kilowatts (approx.)

***At crest of A-F cycle with modulation factor of 1.0*

CLASS C R-F POWER AMPLIFIER AND OSCILLATOR-TELEGRAPHY

(Key-down conditions per tube without modulation)

Maximum Ratings

DC Plate Voltage	20,000 volts
DC Grid Voltage	–3,000 volts
DC Plate Current	4 amperes
DC Grid Current	0.4 amperes
Plate Input	70 kilowatts
Plate Dissipation	20 kilowatts

Typical Operation

DC Plate Voltage	18,000 volts
DC Grid Voltage	–1,000 volts
Peak R-F Grid Voltage	1,630 volts
DC Plate Current	3.6 amperes
DC Grid Current	0.21 amperes (approx.)
Driving Power	340 watts (approx.)
Power Output	50 kilowatts (approx.)

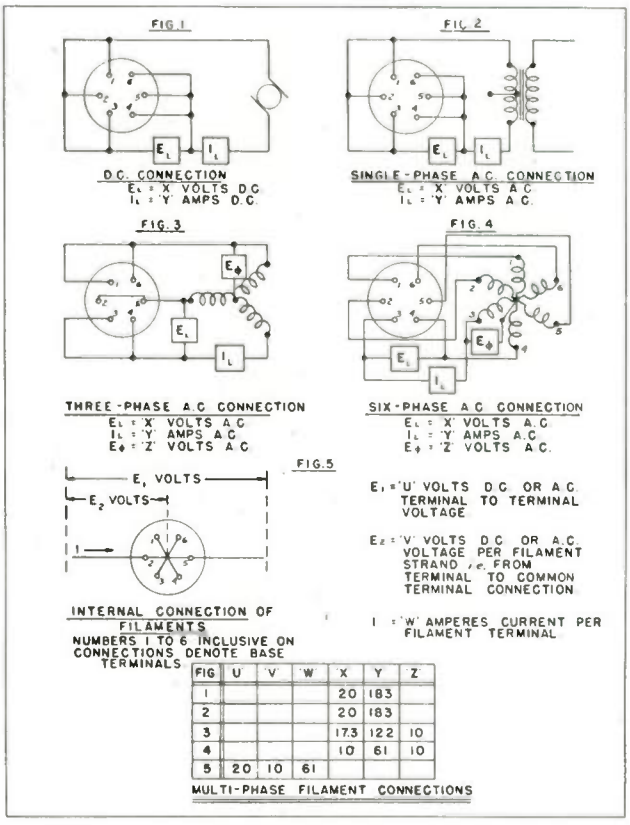
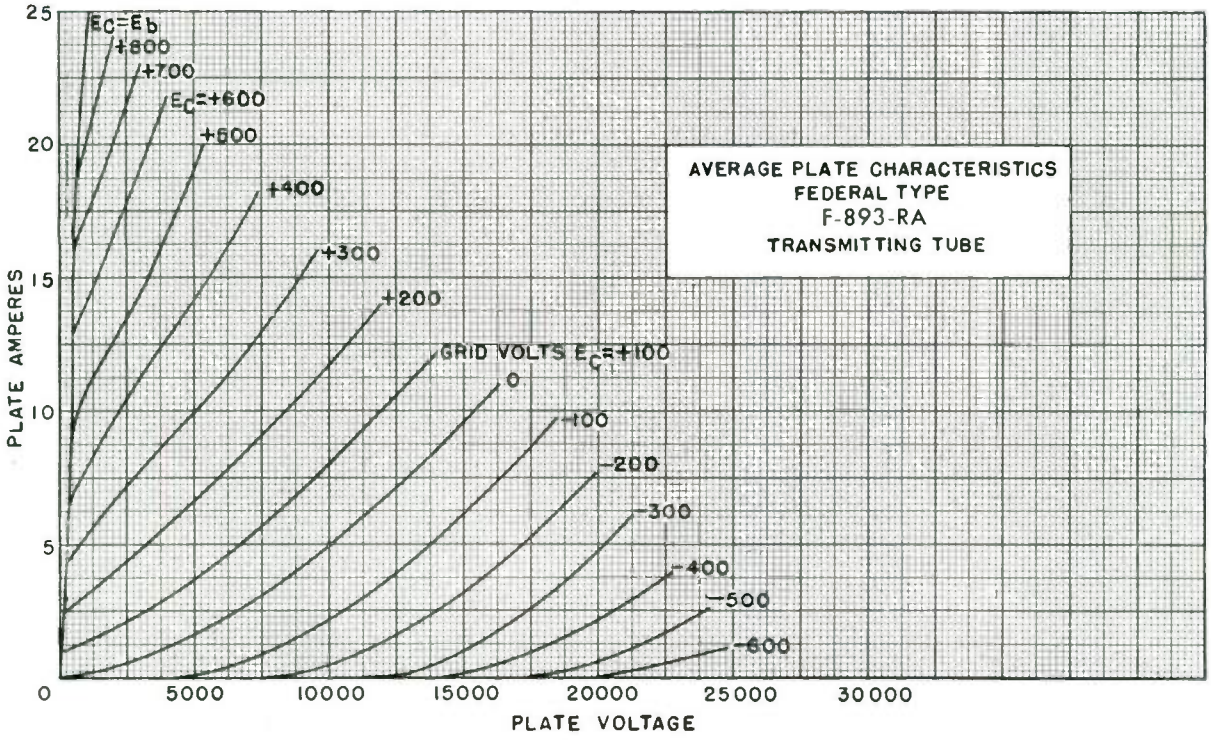


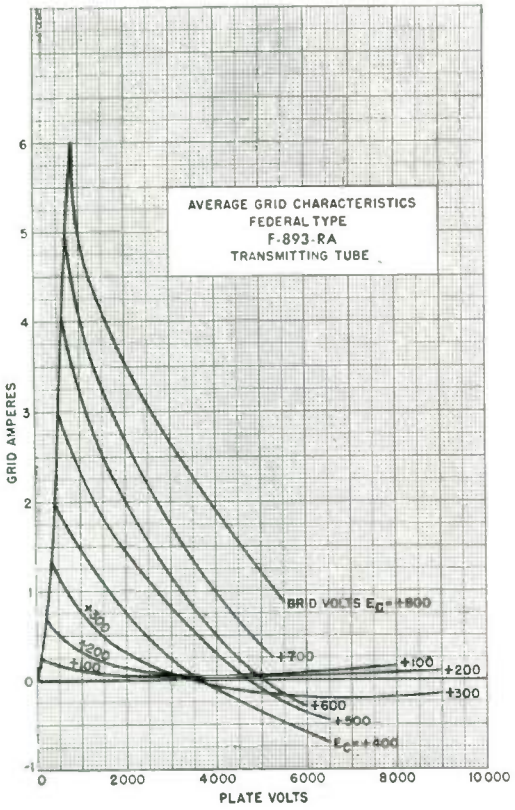
FIG	U	V	W	X	Y	Z
1				20	183	
2				20	183	
3				17.3	12.2	10
4				10	6.1	10
5	20	10	6.1			

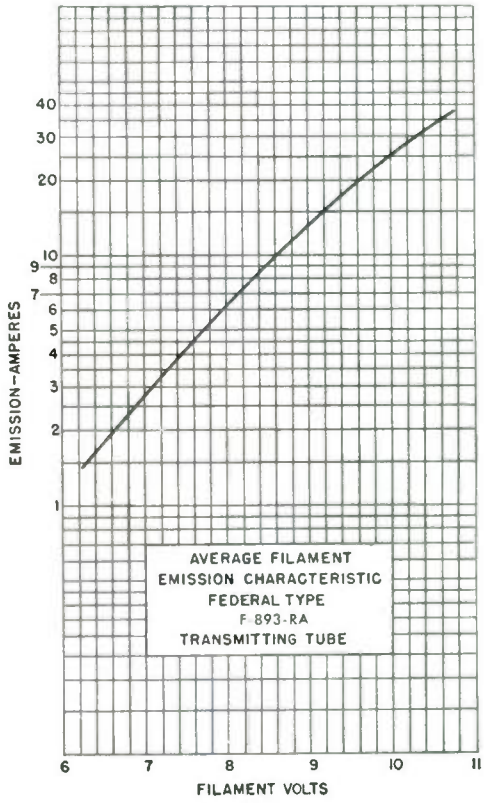
MULTI-PHASE FILAMENT CONNECTIONS

TRANSMITTING TUBE TYPE F-893-RA

20 Kilowatts Plate Dissipation

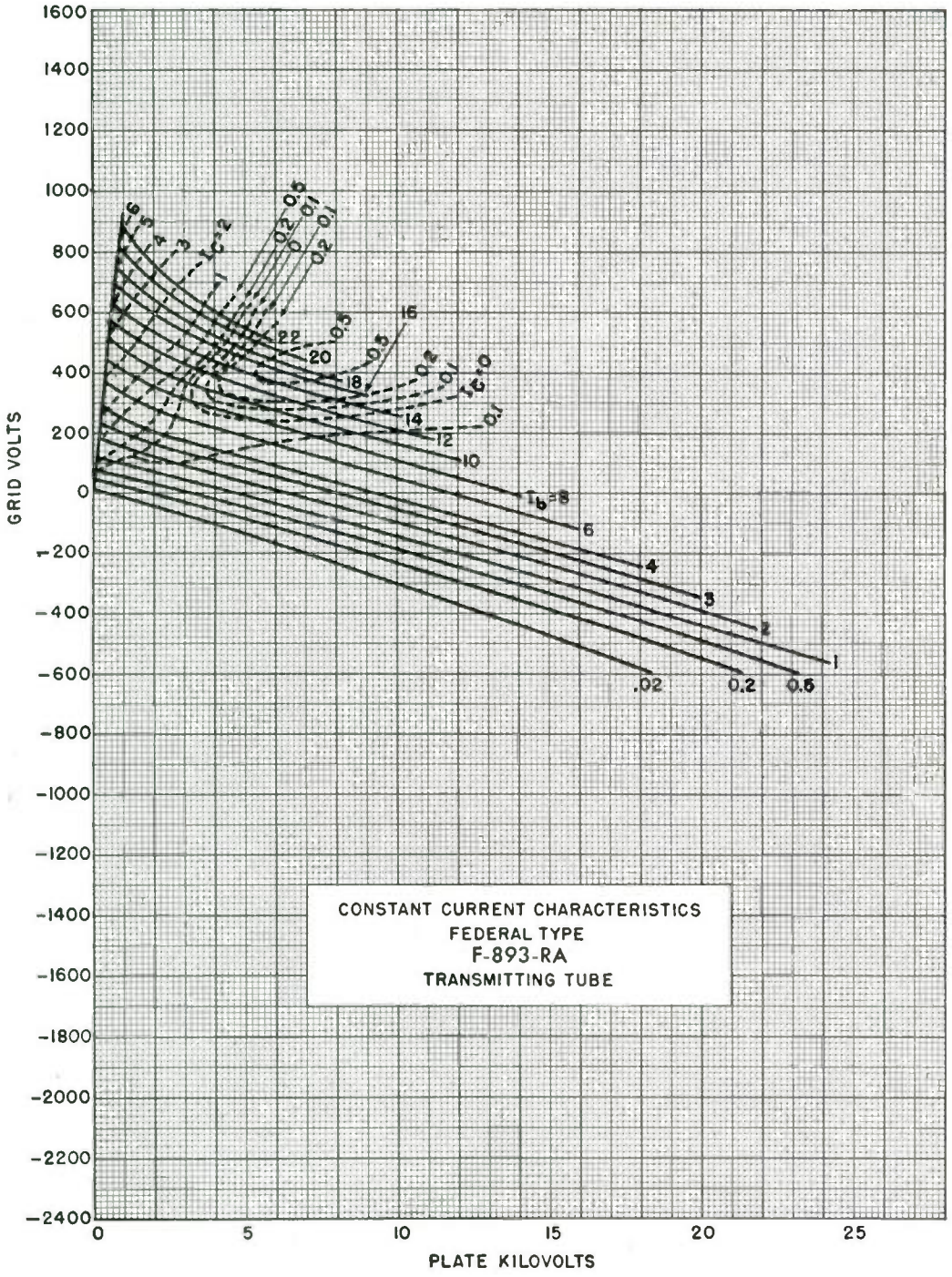






TRANSMITTING TUBE TYPE F-893-RA

20 Kilowatts Plate Dissipation

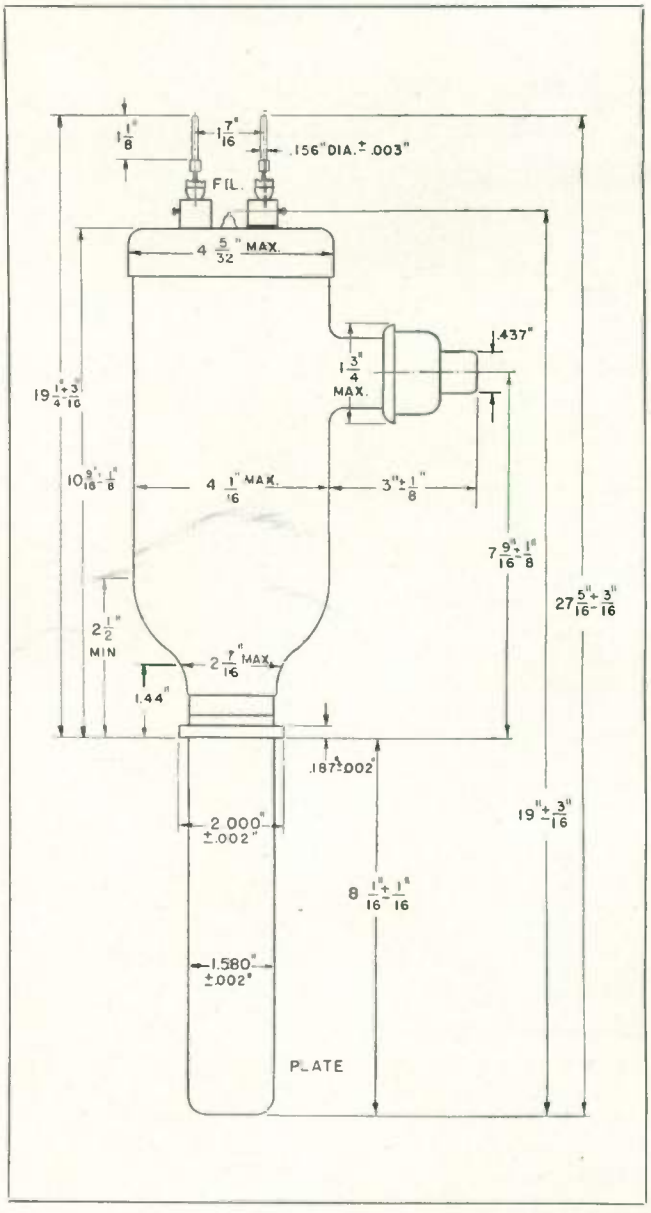


TRANSMITTING TUBE TYPE F-863

10 Kilowatts Plate Dissipation

Technical Data

Main Use	R-F Amplifier or Class B Modulator
Number of Electrodes	3
Filament Voltage	22 volts
Current	52 amperes
Type	Tungsten
Thermionic Emission	10 amperes
Amplification Factor	50
Approximate Direct Inter-electrode Capacitances	
Plate to Grid	27 $\mu\mu f$
Grid to Filament	18 $\mu\mu f$
Plate to Filament	2 $\mu\mu f$
Type of Cooling	Water
Minimum Flow	5 G.P.M.
Water Jacket	Standard or Federal Type F-1000



Maximum Rating versus Operating Frequency

Operating Frequency Megacycles	Maximum Permissible Percentage of Maximum Rated Plate Voltage and Plate Input		
	Class B Telephony	Class C Telephony	Class C Telegraphy
1.6	100	100	100
7.5	85	85	75
20	76	75	50

TRANSMITTING TUBE TYPE F-863

10 Kilowatts Plate Dissipation

Maximum Ratings and Typical Operation Data

For maximum frequency of 1.6 megacycles

CLASS B
A-F POWER AMPLIFIER AND MODULATOR

Maximum Ratings

DC Plate Voltage	15,000 volts
Max. Signal DC Plate Current*	2.0 amperes
Max. Signal Plate Input*	20 kw
Plate Dissipation*	7.5 kw

Typical Operation

(Unless otherwise specified, values are for 2 tubes)

DC Plate Voltage	12,500 volts
DC Grid Voltage	–190 volts
Peak A-F Grid-to-Grid Voltage	1,530 volts
Zero Signal DC Plate Current	0.4 amperes
Max. Signal DC Plate Current	2.8 amperes
Load Resistance (per tube)	2,500 ohms
Effective Load Resistance (plate to plate)	10,000 ohms
Max. Signal Driving Power	420 watts (approx.)
Max. Signal Power Output	22 kw (approx.)

*Averaged over any audio-frequency cycle of sine-wave form.

CLASS B TELEPHONY
R-F POWER AMPLIFIER

(Carrier conditions per tube for use with a maximum modulation factor of 1.0)

Maximum Ratings

DC Plate Voltage	15,000 volts
DC Plate Current	1.0 amperes
R-F Grid Current	24 amperes
Plate Input	15 kw
Plate Dissipation	10 kw

Typical Operation

DC Plate Voltage	14,000 volts
DC Grid Voltage	–210 volts
Peak R-F Grid Voltage	510 volts
DC Plate Current	0.95 amperes
Driving Power**	30 watts (approx.)
Power Output	4 kw (approx.)

**At crest of a-f cycle with modulation factor of 1.0

CLASS C TELEPHONY
PLATE MODULATED R-F POWER AMPLIFIER

(Carrier conditions per tube for use with a maximum modulation factor of 1.0)

Maximum Ratings

DC Plate Voltage	10,000 volts
DC Grid Voltage	–3,000 volts
DC Plate Current	1.0 amperes
DC Grid Current	0.25 amperes
R-F Grid Current	24 amperes
Plate Input	10 kw
Plate Dissipation	6.6 kw

Typical Operation

DC Plate Voltage	10,000 volts
DC Grid Voltage	–1,600 volts
Peak R-F Grid Voltage	2,400 volts
DC Plate Current	0.72 amperes
DC Grid Current	0.115 amperes (approx.)
Driving Power	260 watts (approx.)
Power Output	6 kw (approx.)

CLASS C TELEGRAPHY
R-F POWER AMPLIFIER AND OSCILLATOR

(Key-down conditions per tube without modulation)†

Maximum Ratings

DC Plate Voltage	15,000 volts
DC Grid Voltage	–3,000 volts
DC Plate Current	2.0 amperes
DC Grid Current	0.25 amperes
R-F Grid Current	30 amperes
Plate Input	30 kw
Plate Dissipation	10 kw

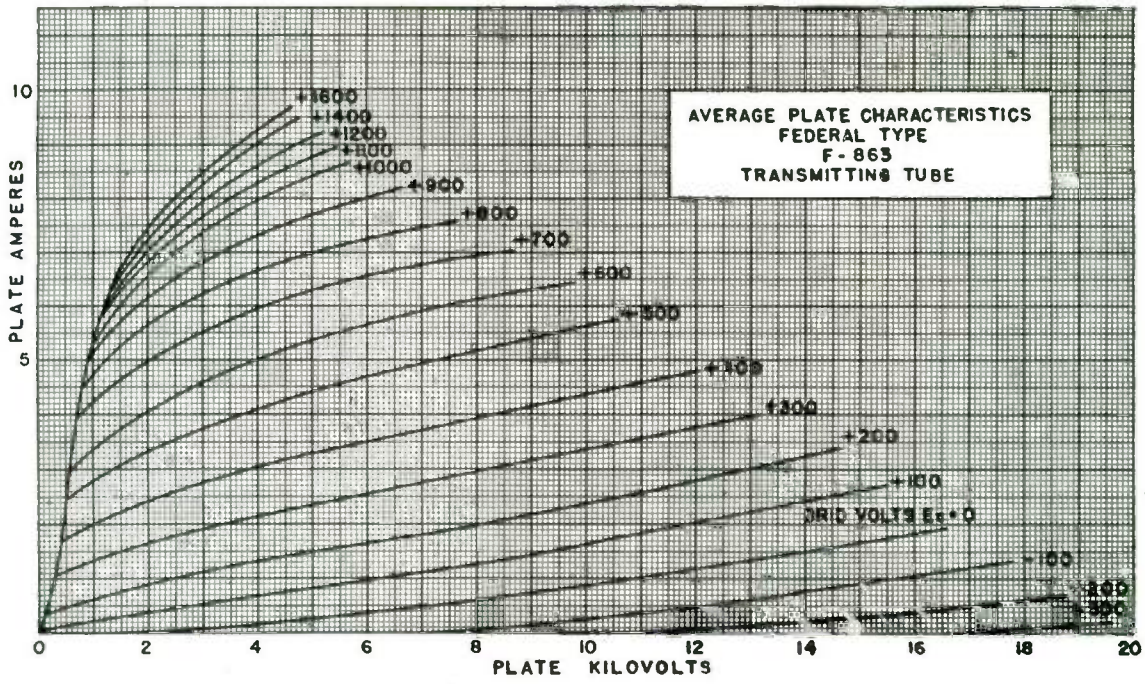
Typical Operation

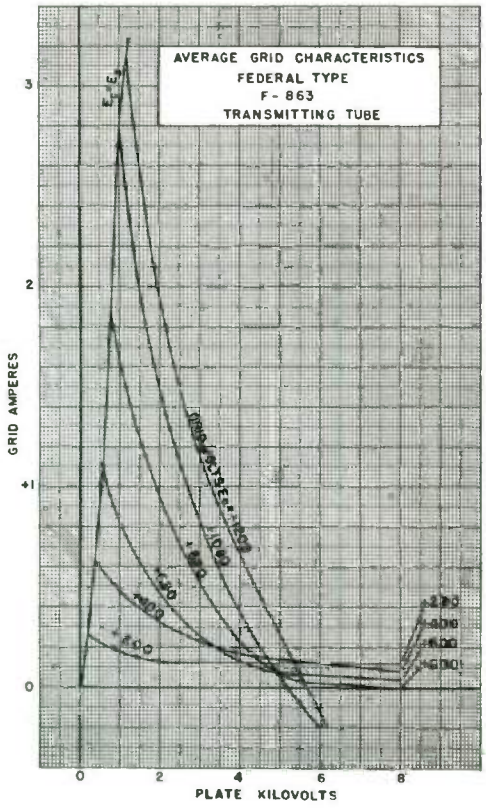
DC Plate Voltage	12,000 volts
DC Grid Voltage	–1,600 volts
Peak R-F Grid Voltage	2,800 volts
DC Plate Current	1.64 amperes
DC Grid Current	0.18 amperes (approx.)
Driving Power	500 watts (approx.)
Power Output	14 kw (approx.)

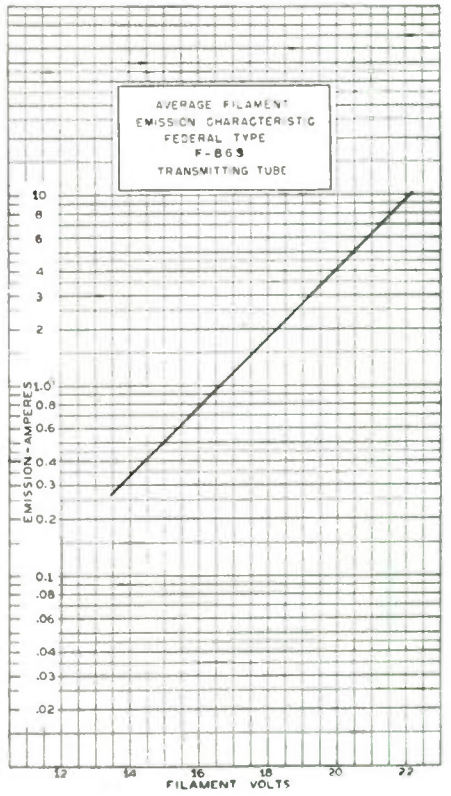
†Modulation essentially negative may be used if the positive peak of the audio-frequency envelope does not exceed 115% of the carrier conditions.

TRANSMITTING TUBE TYPE F-863

10 Kilowatts Plate Dissipation

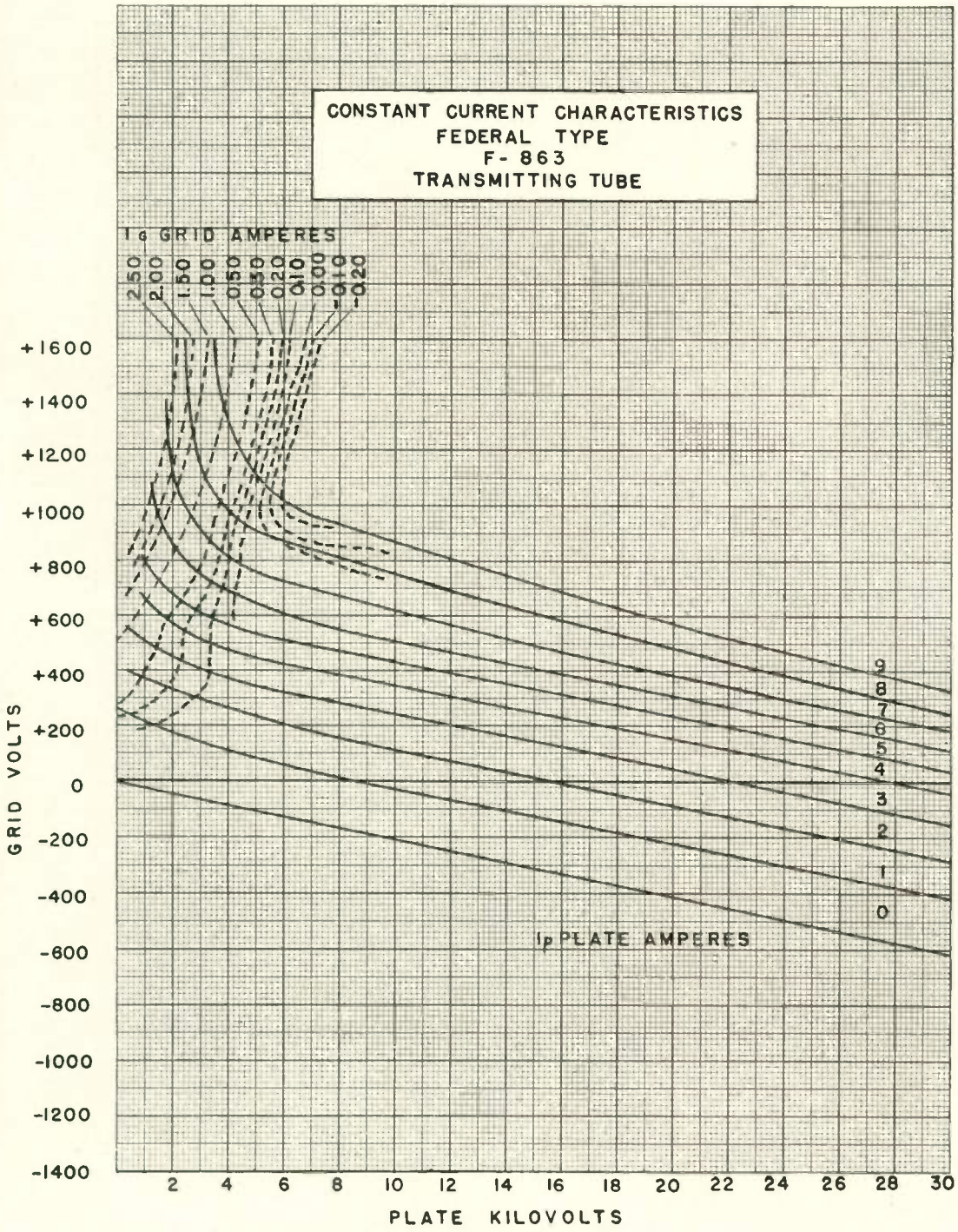






TRANSMITTING TUBE TYPE F-863

10 Kilowatts Plate Dissipation



Federal Telephone and Radio Corporation

Vacuum Tube Products — An IT&T Associate — Newark 4, New Jersey

Printed in U.S.A.—Form F-113

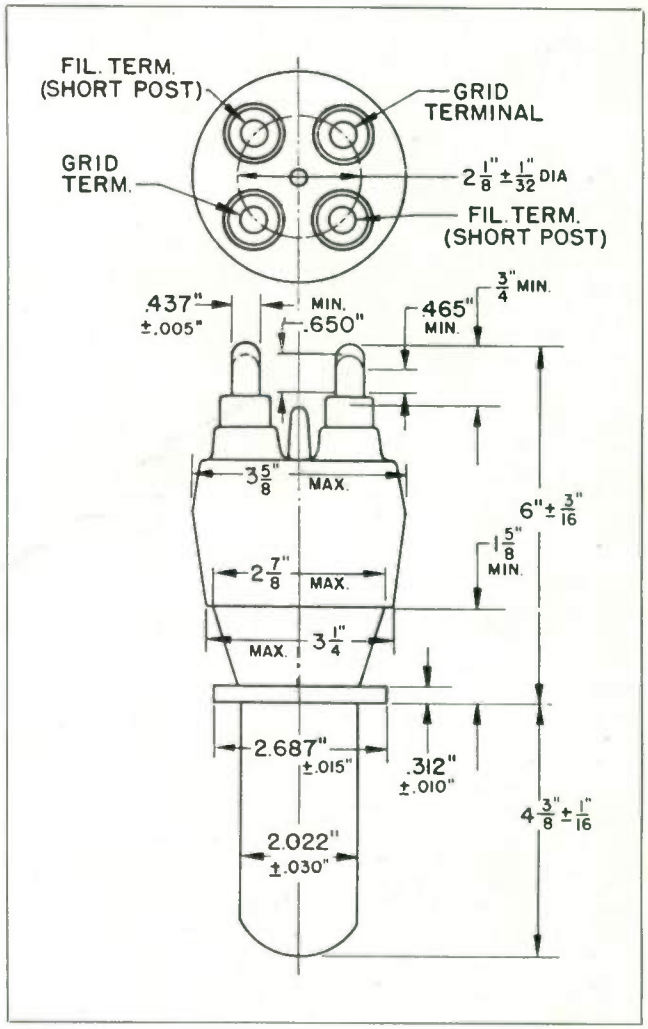
TRANSMITTING TUBE TYPE F-889-A

5 Kilowatts Plate Dissipation

TECHNICAL DATA

Main Use	Modulator or R-F Amplifier
Number of Electrodes	3
Filament Voltage	11 volts
Current	125 amperes
Type	Tungsten
Amplification Factor	21
Approximate Direct Inter-electrode Capacitances	
Plate to Grid	17.8 $\mu\mu f$
Grid to Filament	19.5 $\mu\mu f$
Plate to Filament	2.5 $\mu\mu f$
Type of Cooling	Water and Forced Air
Minimum Flow	5 G.P.M.
Water Jacket	Standard

Air flow of approximately 15 cu. ft./min. through 3-inch diameter nozzle directed at upper part of bulb is required to limit temperature of glass at hottest point to 150°C.



Maximum Ratings versus Operating Frequency

Operating Frequency Megacycles	Maximum Permissible Percentage of Maximum Rated Plate Voltage and Plate Input		
	Class B Telephony	Class C Telephony	Class C Telegraphy
50	100	100	100
100	65	75	75
150	72	50	50

TRANSMITTING TUBE TYPE F-889-A

5 Kilowatts Plate Dissipation

Maximum Ratings and Typical Operation Data

For maximum frequency of 50 megacycles

CLASS B
A-F POWER AMPLIFIER AND MODULATOR

Maximum Ratings

DC Plate Voltage	8,500 volts
Max. Signal DC Plate Current**	2 amperes
Max. Signal Plate Input**	12 kw
Plate Dissipation**	5 kw

Typical Operation

Unless otherwise specified, values are for 2 tubes

DC Plate Voltage	7,500 volts
DC Grid Voltage	—300 volts
Peak A-F Grid-to-Grid Voltage	1,700 volts
Zero Signal DC Plate Current	0.4 ampere
Max. Signal DC Plate Current	3.2 amperes
Effective Load Resistance (plate to plate)	5,000 ohms
Max. Signal Driving Power	150 watts (approx.)
Max. Signal Power Output	15 kw (approx.)

**Averaged over any audio-frequency cycle of sine-wave form.

CLASS B TELEPHONY
R-F POWER AMPLIFIER

(Carrier conditions per tube for use with a maximum modulation factor of 1.0)

Maximum Ratings

DC Plate Voltage	8,500 volts
DC Plate Current	1.0 ampere
Plate Input	7.5 kw
Plate Dissipation	5 kw

Typical Operation

DC Plate Voltage	7,500 volts
DC Grid Voltage	—300 volts
Peak R-F Grid Voltage	1,000 volts
DC Plate Current	0.9 ampere
Driving Power†	80 watts (approx.)
Power Output	2 kw (approx.)

†At crest of a-f cycle with modulation factor of 1.0.

CLASS C TELEPHONY
PLATE-MODULATED R-F POWER AMPLIFIER

(Carrier conditions per tube for use with a maximum modulation factor of 1.0)

Maximum Ratings

DC Plate Voltage	6,000 volts
DC Grid Voltage	—1,000 volts
DC Plate Current	1.0 ampere
DC Grid Current	0.25 ampere
Plate Input	6 kw
Plate Dissipation	3 kw

Typical Operation

DC Plate Voltage	6,000 volts
DC Grid Voltage	—900 volts
Peak R-F Grid Voltage	1,420 volts
DC Plate Current	1.0 ampere
DC Grid Current	0.1 ampere (approx.)
Driving Power	140 watts (approx.)
Power Output	4 kw (approx.)

CLASS C TELEGRAPHY
R-F POWER AMPLIFIER AND OSCILLATOR

*(Key-down conditions per tube without modulation)**

Maximum Ratings

DC Plate Voltage	8,500 volts
DC Grid Voltage	—1,000 volts
DC Plate Current	2 amperes
DC Grid Current	0.25 ampere
Plate Input	16 kw
Plate Dissipation	5 kw

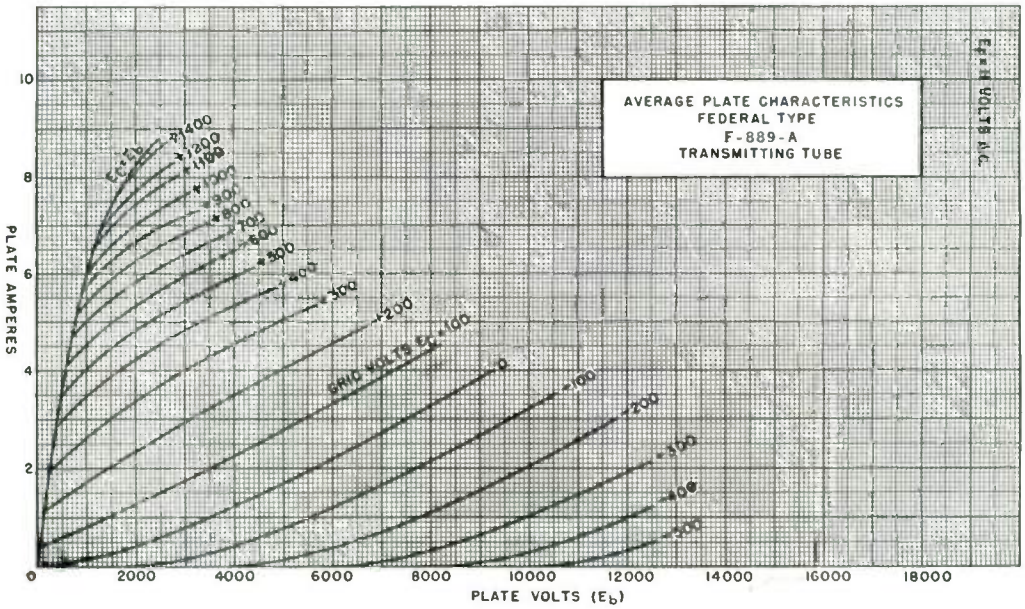
Typical Operation

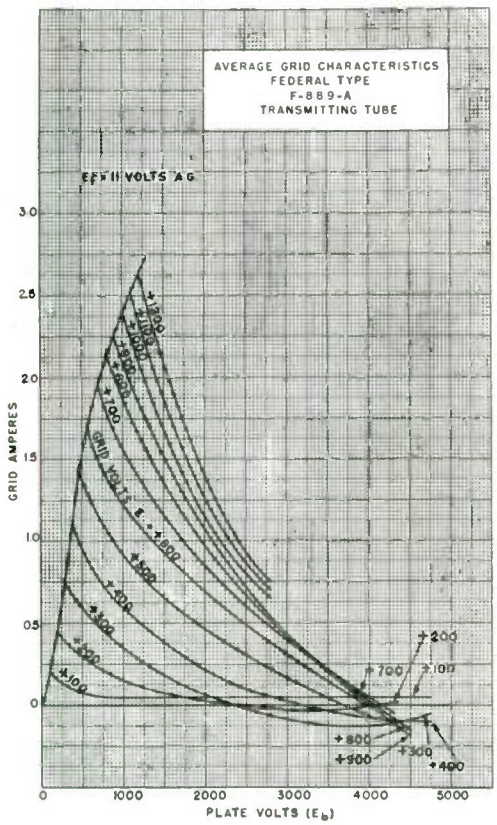
DC Plate Voltage	7,500 volts
DC Grid Voltage	—800 volts
Peak R-F Grid Voltage	1,830 volts
DC Plate Current	2 amperes
DC Grid Current	0.24 ampere (approx.)
Driving Power	400 watts (approx.)
Power Output	10 kw (approx.)

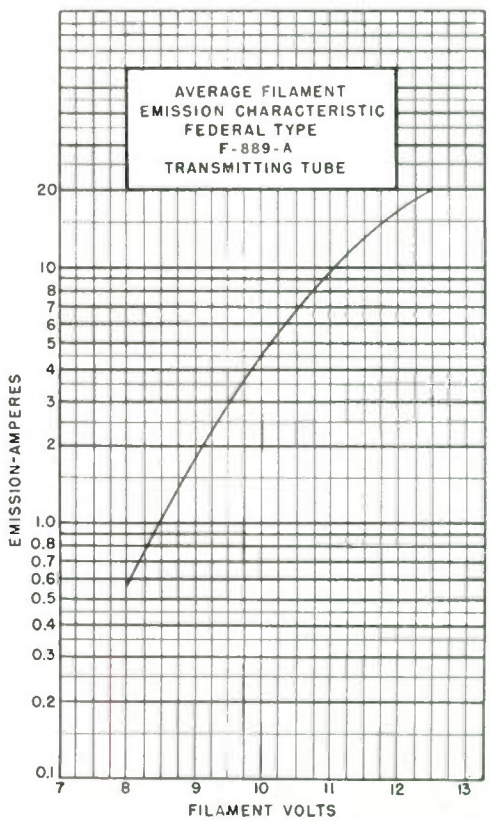
*Modulation essentially negative may be used if the positive peak of the audio-frequency envelope does not exceed 115% of the carrier conditions.

TRANSMITTING TUBE TYPE F-889-A

5 Kilowatts Plate Dissipation

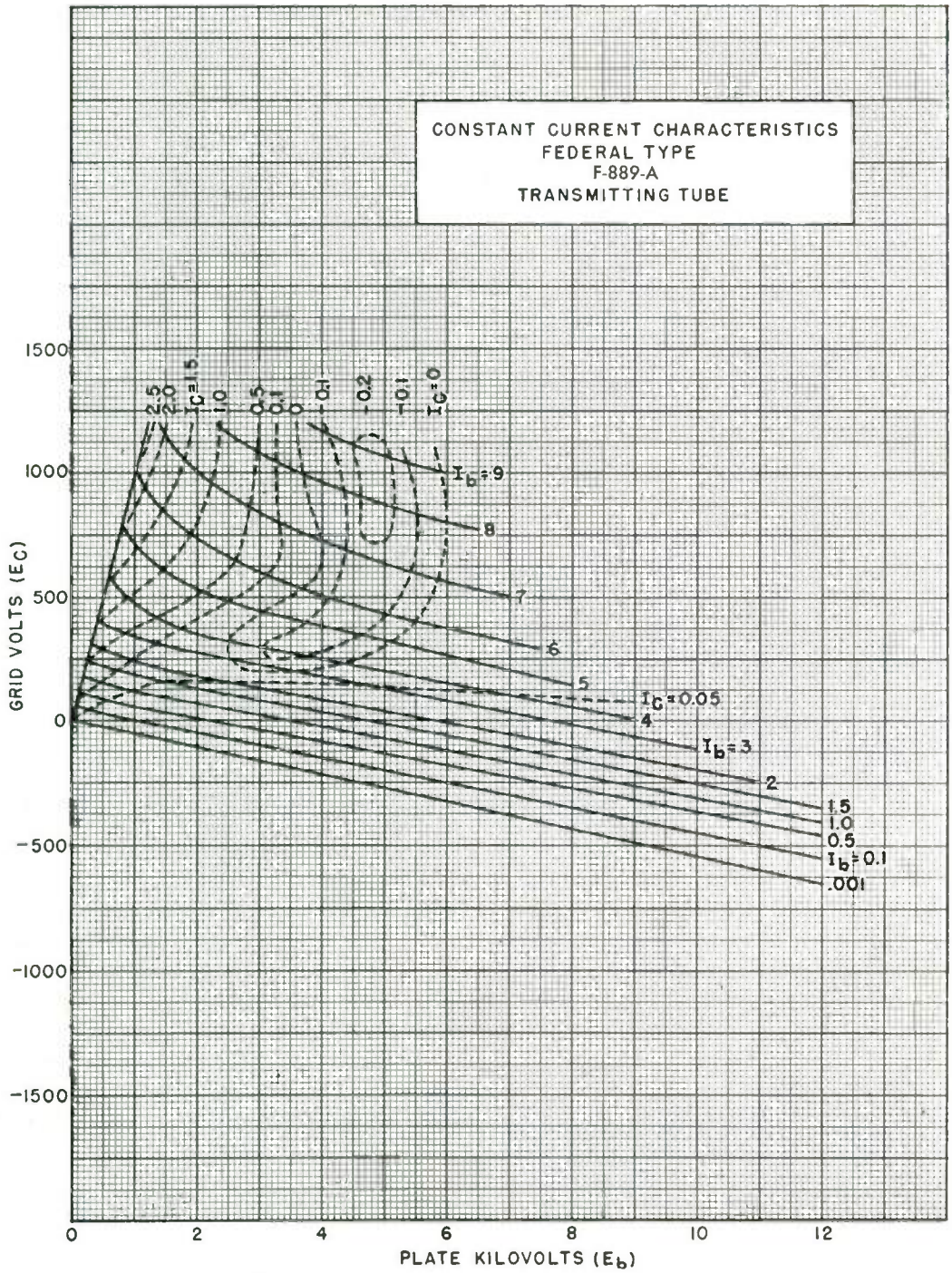






TRANSMITTING TUBE TYPE F-889-A

5 Kilowatts Plate Dissipation



Federal Telephone and Radio Corporation

Vacuum Tube Products — An IT&T Associate — Newark 4, New Jersey

Printed in U.S.A. Form F-177

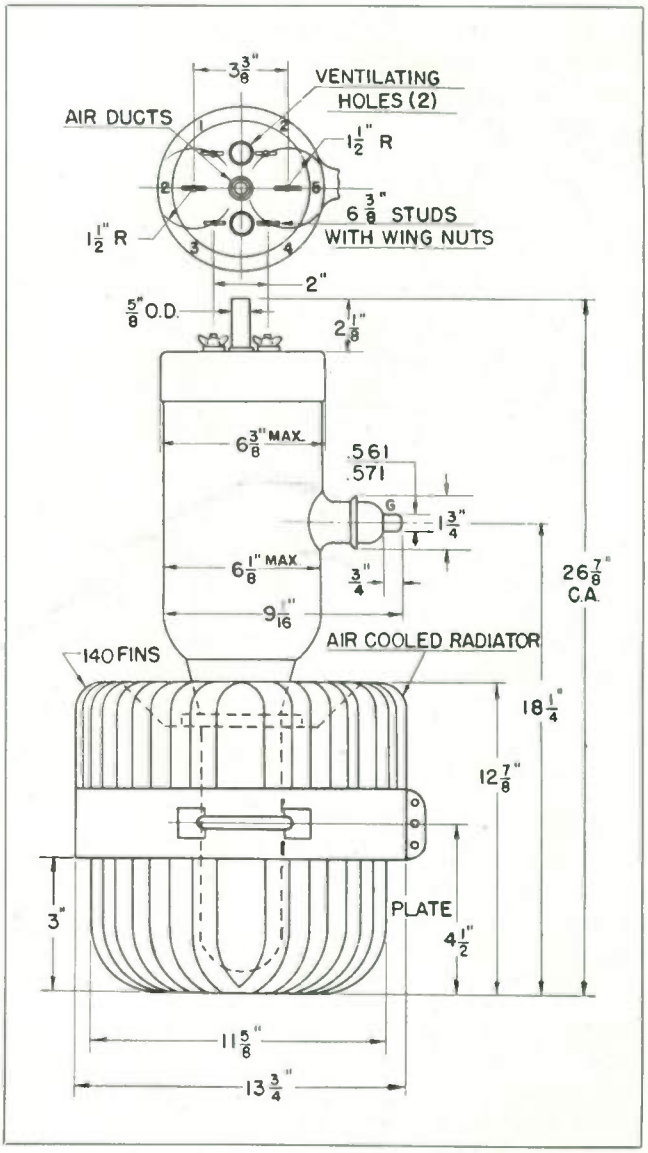
TRANSMITTING TUBE TYPE F-893-RA

20 Kilowatts Plate Dissipation

Technical Data

Main Use	R-F Power Amplifier Class B Modulator
Number of Electrodes	3
Filament Voltage Per Strand	10 volts
Current Per Terminal	61 amperes
Excitation	1, 3, or 6 A-C
Amplification Factor	36
Approximate Direct Inter-electrode Capacitances	
Plate to Grid	33 $\mu\mu f$
Grid to Filament	48 $\mu\mu f$
Plate to Filament	3.2 $\mu\mu f$
Mounting	Special
Type of Cooling	Forced Air

A vertical air flow of at least 1800 cu. ft./min. should be delivered by a blower to the cooling radiator. An air flow of about 2 cu. ft./min. should be supplied to the air nozzle in the filament base. Cooling must be adequate to limit the glass temperature to not more than 150° C at the hottest part. Air flow must start before the application of any voltages.



Maximum Ratings versus Operating Frequency

Operating Frequency Megacycles	Maximum Permissible Percentage of Maximum Rated Plate Voltage and Plate Input			
	Class B Telephony	Class C Telephony	Class C Telegraphy	
			Volt	Input
5	100	100	100	100
12	86	81	81	75
25	74	65	65	50

TRANSMITTING TUBE TYPE F-893-RA

20 Kilowatts Plate Dissipation

Maximum Ratings and Typical Operation Data

For a Maximum Frequency of 5 Megacycles

A-F POWER AMPLIFIER AND MODULATOR — CLASS B

Maximum Ratings

DC Plate Voltage	20,000 volts
Max. Signal DC Plate Current	4 amperes
Max. Signal Plate Input	60 kilowatts
Plate Dissipation	20 kilowatts

Typical Operation

Unless otherwise specified, values are for 2 tubes

DC Plate Voltage	18,000 volts
DC Grid Voltage	–450 volts
Peak A-F Grid to Grid Voltage	1,720 volts
Zero Signal DC Plate Current	0.8 amperes
Max. Signal DC Plate Current	5.5 amperes
Effective Load Resistance Plate to Plate	8,000 ohms
Driving Power	140 watts (approx.)
Max. Signal Power Output	70 kilowatts (approx.)

CLASS C R-F POWER AMPLIFIER TELEPHONY — PLATE MODULATED

(Carrier conditions per tube for use with modulation factor of 1.0)

Maximum Ratings

DC Plate Voltage	12,000 volts
DC Grid Voltage	–3,000 volts
DC Plate Current	2 amperes
DC Grid Current	0.4 amperes
Plate Input	24 kilowatts
Plate Dissipation	12 kilowatts

Typical Operation

DC Plate Voltage	12,000 volts
DC Grid Voltage	–1,000 volts
Peak R-F Grid Voltage	1,500 volts
DC Plate Current	2 amperes
DC Grid Current	0.14 amperes (approx.)
Driving Power	210 watts (approx.)
Power Output	18 kilowatts (approx.)

CLASS B R-F POWER AMPLIFIER TELEPHONY

(Carrier conditions per tube for use with modulation factor of 1.0)

Maximum Ratings

DC Plate Voltage	20,000 volts
DC Plate Current	2 amperes
Plate Input	32 kilowatts
Plate Dissipation	20 kilowatts

Typical Operation

DC Plate Voltage	15,000 volts
DC Grid Voltage	–340 volts
Peak R-F Grid Voltage	450
DC Plate Current	2 amperes
Driving Power**	200 watts (approx.)
Power Output	10 kilowatts (approx.)

***At crest of A-F cycle with modulation factor of 1.0*

CLASS C R-F POWER AMPLIFIER AND OSCILLATOR-TELEGRAPHY

(Key-down conditions per tube without modulation)

Maximum Ratings

DC Plate Voltage	20,000 volts
DC Grid Voltage	–3,000 volts
DC Plate Current	4 amperes
DC Grid Current	0.4 amperes
Plate Input	70 kilowatts
Plate Dissipation	20 kilowatts

Typical Operation

DC Plate Voltage	18,000 volts
DC Grid Voltage	–1,000 volts
Peak R-F Grid Voltage	1,630 volts
DC Plate Current	3.6 amperes
DC Grid Current	0.21 amperes (approx.)
Driving Power	340 watts (approx.)
Power Output	50 kilowatts (approx.)

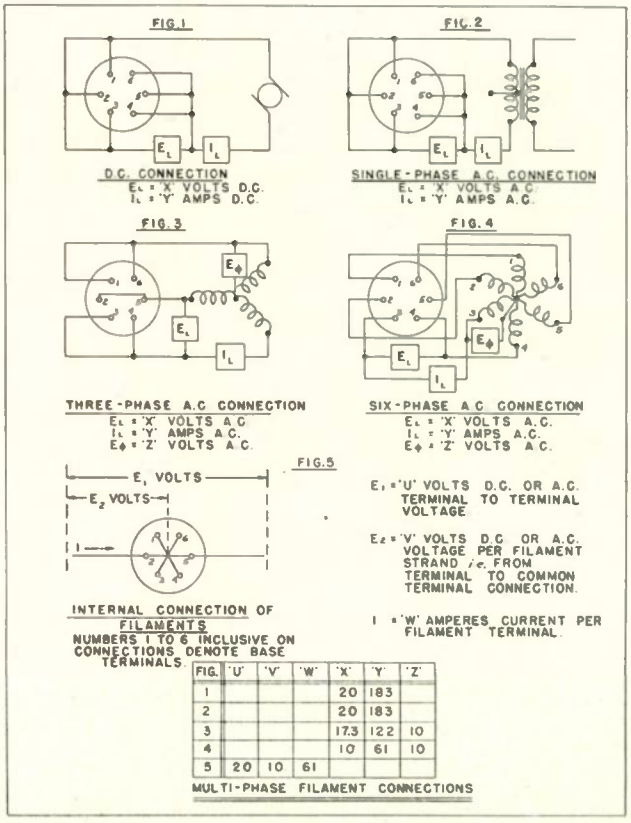
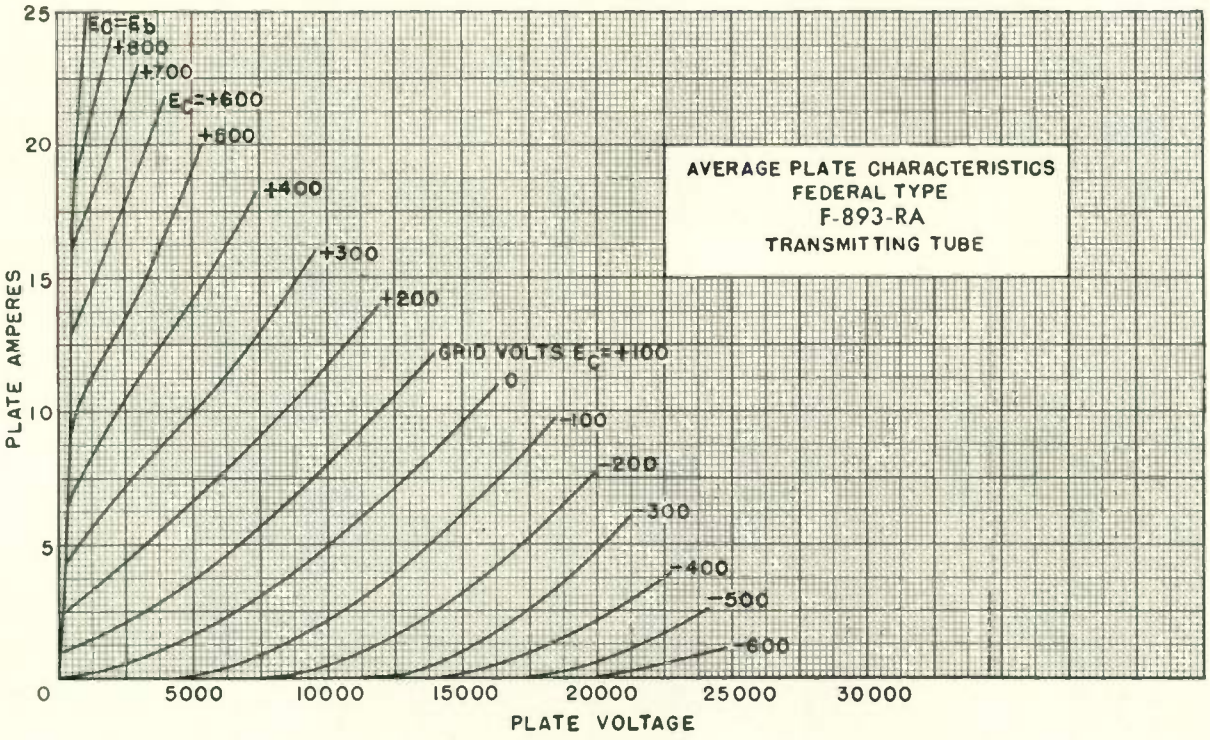


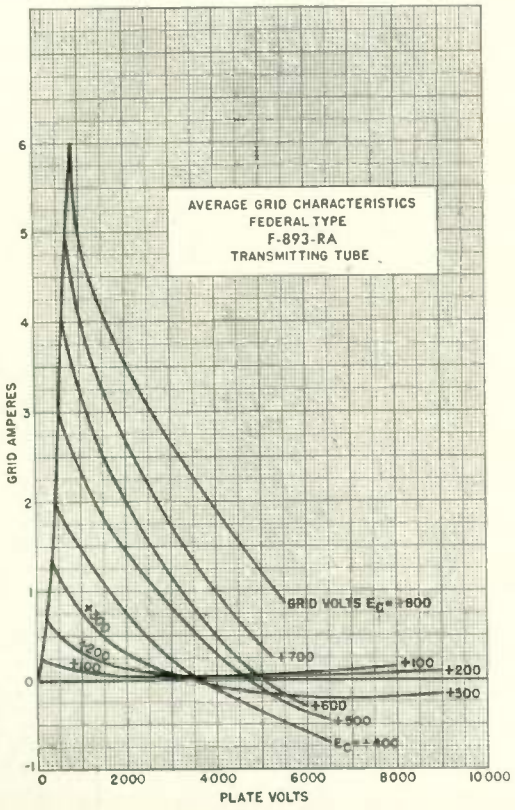
FIG.	'U'	'V'	'W'	'X'	'Y'	'Z'
1				20	183	
2				20	183	
3				17.3	122	10
4				10	61	10
5	20	10	61			

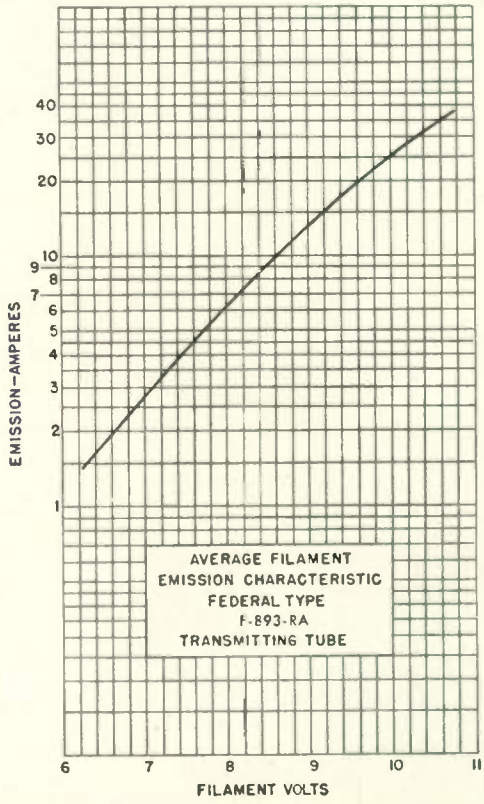
MULTI-PHASE FILAMENT CONNECTIONS

TRANSMITTING TUBE TYPE F-893-RA

20 Kilowatts Plate Dissipation

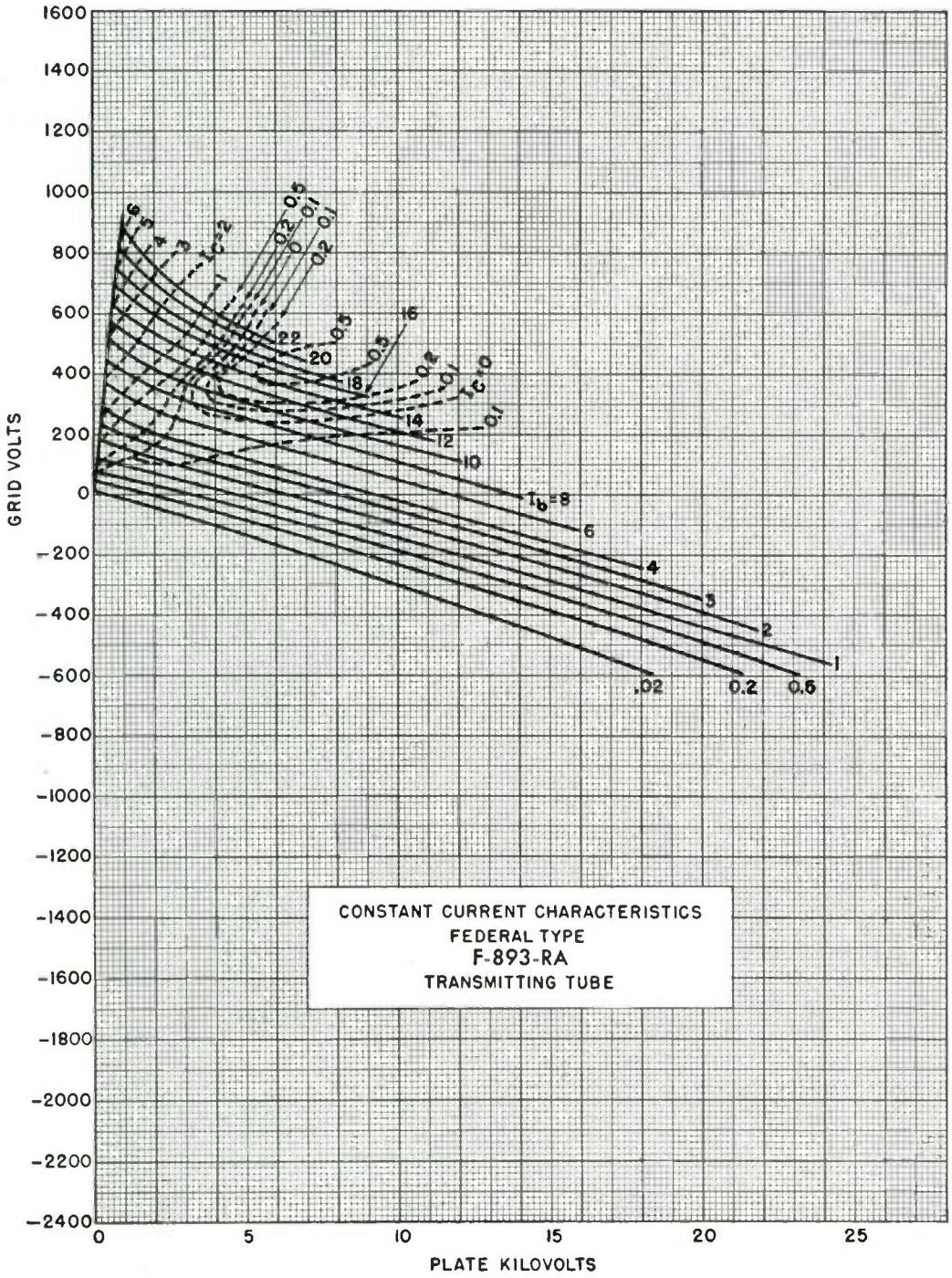






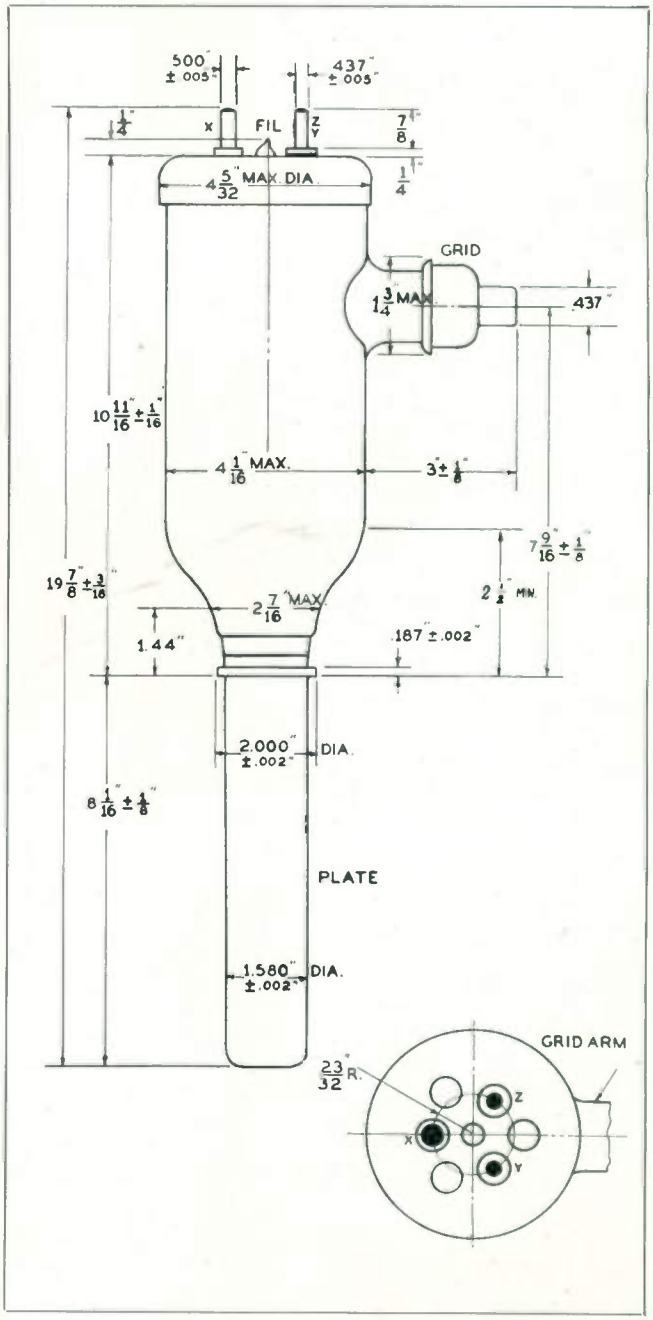
TRANSMITTING TUBE TYPE F-893-RA

20 Kilowatts Plate Dissipation



TRANSMITTING TUBE TYPE F-891

7.5 Kilowatts Plate Dissipation



Technical Data

Main Use	Modulator or R-F Amplifier
Number of Electrodes	3
Filament Voltage	22 volts
Current	60 amperes
Type	Tungsten, Two-Unit
Excitation	DC, Single or Two Phase AC
Thermionic Emission	10 amperes
Amplification Factor	8
Approximate Direct Inter-electrode Capacitances	
Plate to Grid	27 $\mu\mu f$
Grid to Filament	18 $\mu\mu f$
Plate to Filament	2 $\mu\mu f$
Type of Cooling	Water
Minimum Flow	5 G.P.M.
Water Jacket	Standard or Federal Type F-1000

Maximum Ratings versus Operating Frequency

Operating Frequency Megacycles	Maximum Permissible Percentage of Maximum Rated Plate Voltage and Plate Input		
	Class B Telephony	Class C Telephony	Class C Telegraphy
1.6	100	100	100
7.5	82	75	75
20	72	65	50

TRANSMITTING TUBE TYPE F-891

7.5 Kilowatts Plate Dissipation

Maximum Ratings and Typical Operation Data

For maximum frequency of 1.6 megacycles

CLASS A
A-F POWER AMPLIFIER AND MODULATOR

Maximum Ratings

DC Plate Voltage	12,000 volts
Plate Input	7.5 kw
Plate Dissipation	7.5 kw

Typical Operation

DC Plate Voltage	8,000 volts
DC Grid Voltage*	–630 volts
Peak A-F Grid Voltage	700 volts
DC Plate Current	0.9 amperes
Load Resistance	5,200 ohms
U.P.O. (5% second harmonic)	2 kw

*The DC resistance in the grid circuit should not exceed 100,000 ohms when cathode bias is used, or 50,000 ohms with fixed bias.

CLASS B
A-F POWER AMPLIFIER AND MODULATOR

Maximum Ratings

DC Plate Voltage	15,000 volts
Max. Signal DC Plate Current**	2.0 amperes
Max. Signal Plate Input**	20 kw
Plate Dissipation**	5 kw

Typical Operation

Unless otherwise specified, values are for 2 tubes

DC Plate Voltage	12,500 volts
DC Grid Voltage	–1,450 volts
Peak A-F Grid-to-Grid Voltage	3,960 volts
Zero Signal DC Plate Current	0.4 ampere
Max. Signal DC Plate Current	2.8 amperes
Load Resistance (per tube)	2,500 ohms
Effective Load Resistance (plate to plate)	10,000 ohms
Max. Signal Driving Power	350 watts (approx.)
Max. Signal Power Output	22 kw (approx.)

**Averaged over any audio-frequency cycle of sine-wave form.

CLASS B TELEPHONY
R-F POWER AMPLIFIER

(Carrier conditions per tube for use with a maximum modulation factor of 1.0)

Maximum Ratings

DC Plate Voltage	15,000 volts
DC Plate Current	1.0 ampere
R-F Grid Current	24 amperes
Plate Input	10 kw
Plate Dissipation	6 kw

Typical Operation

DC Plate Voltage	14,000 volts
DC Grid Voltage	–1,600 volts
Peak R-F Grid Voltage	1,000 volts
DC Plate Current	0.56 ampere
Driving Power†	0 watts (approx.)
Power Output	2.28 kw (approx.)

†At crest of a-f cycle with modulation factor of 1.0

CLASS C TELEPHONY
PLATE-MODULATED R-F POWER AMPLIFIER

(Carrier conditions per tube for use with a maximum modulation factor of 1.0)

Maximum Ratings

DC Plate Voltage	8,000 volts
DC Grid Voltage	–3,000 volts
DC Plate Current	1.0 amperes
DC Grid Current	0.15 amperes
R-F Grid Current	24 amperes
Plate Input	8 kw
Plate Dissipation	4 kw

Typical Operation

DC Plate Voltage	8,000 volts
DC Grid Voltage	–2,400 volts
Peak R-F Grid Voltage	3,100 volts
DC Plate Current	0.78 amperes
DC Grid Current	0.08 amperes (approx.)
Driving Power	260 watts (approx.)
Power Output	5 kw (approx.)

CLASS C TELEGRAPHY
R-F POWER AMPLIFIER AND OSCILLATOR

*(Key-down conditions per tube without modulation)**

Maximum Ratings

DC Plate Voltage	12,000 volts
DC Grid Voltage	–3,000 volts
DC Plate Current	2.0 amperes
DC Grid Current	0.15 amperes
R-F Grid Current	30 amperes
Plate Input	18 kw
Plate Dissipation	6 kw

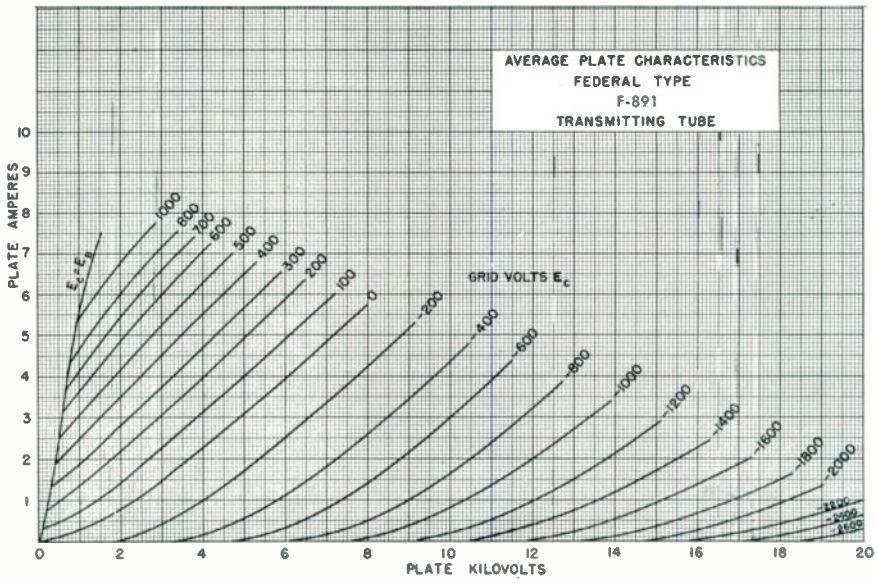
Typical Operation

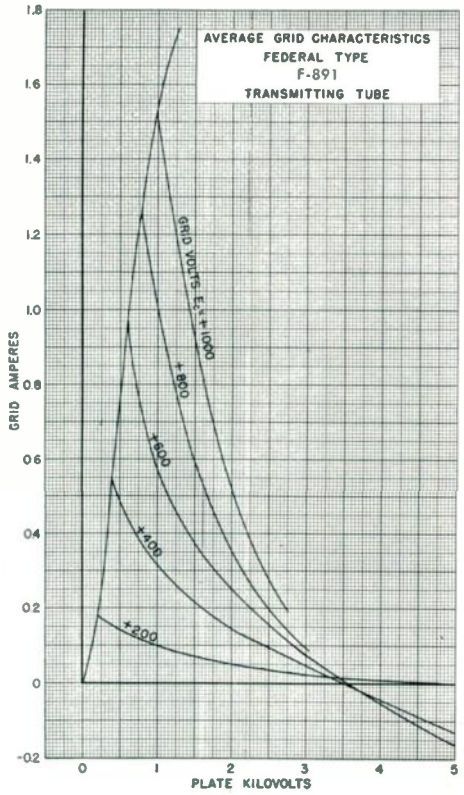
DC Plate Voltage	10,000 volts
DC Grid Voltage	–2,000 volts
Peak R-F Grid Voltage	2,900 volts
DC Plate Current	1.45 amperes
DC Grid Current	0.105 watts (approx.)
Driving Power	310 watts (approx.)
Power Output	10 kw (approx.)

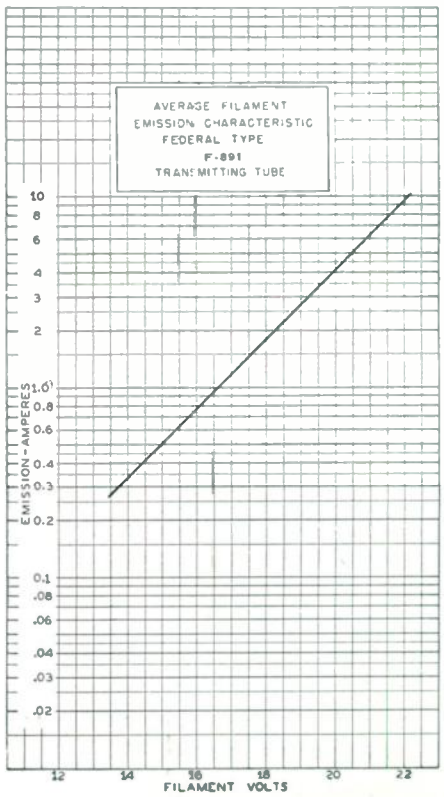
*Modulation essentially negative may be used if the positive peak of the audio-frequency envelope does not exceed 115% of the carrier conditions.

TRANSMITTING TUBE TYPE F-891

7.5 Kilowatts Plate Dissipation

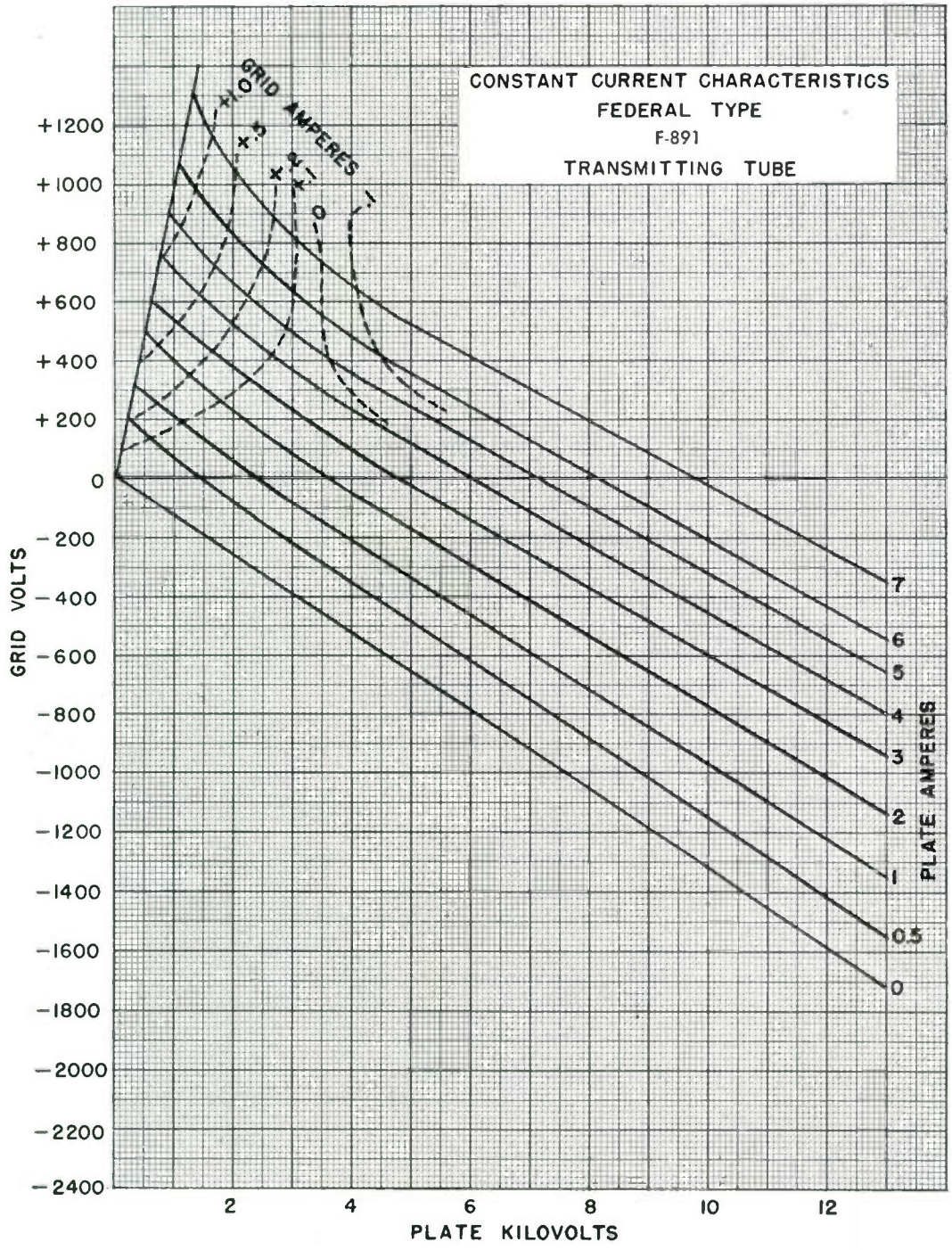






TRANSMITTING TUBE TYPE F-891

7.5 Kilowatts Plate Dissipation



TRANSMITTING TUBE TYPE F-891-R

4.0 Kilowatts Plate Dissipation

Technical Data

Main Use	Modulator or R.F. Amplifier
Number of Electrodes	3
Filament Voltage	22 volts
Current	60 amperes
Type	Tungsten, Two-Unit
Excitation	DC, Single or Two Phase AC
Thermionic Emission	10 amperes
Amplification Factor	8
Approximate Direct Inter-electrode Capacitances	
Plate to Grid	28.5 $\mu\mu f$
Grid to Filament	19 $\mu\mu f$
Plate to Filament	2.5 $\mu\mu f$
Type of Cooling	Forced Air
Mounting	Special

Maximum Rating versus Operating Frequency

Operating Frequency Megacycles	Maximum Permissible Percentage of Maximum Rated Plate Voltage and Plate Input		
	Class B Telephony	Class C Telephony	Class C Telegraphy
1.6	100	100	100
7.5	83	75	75
20	74	50	50

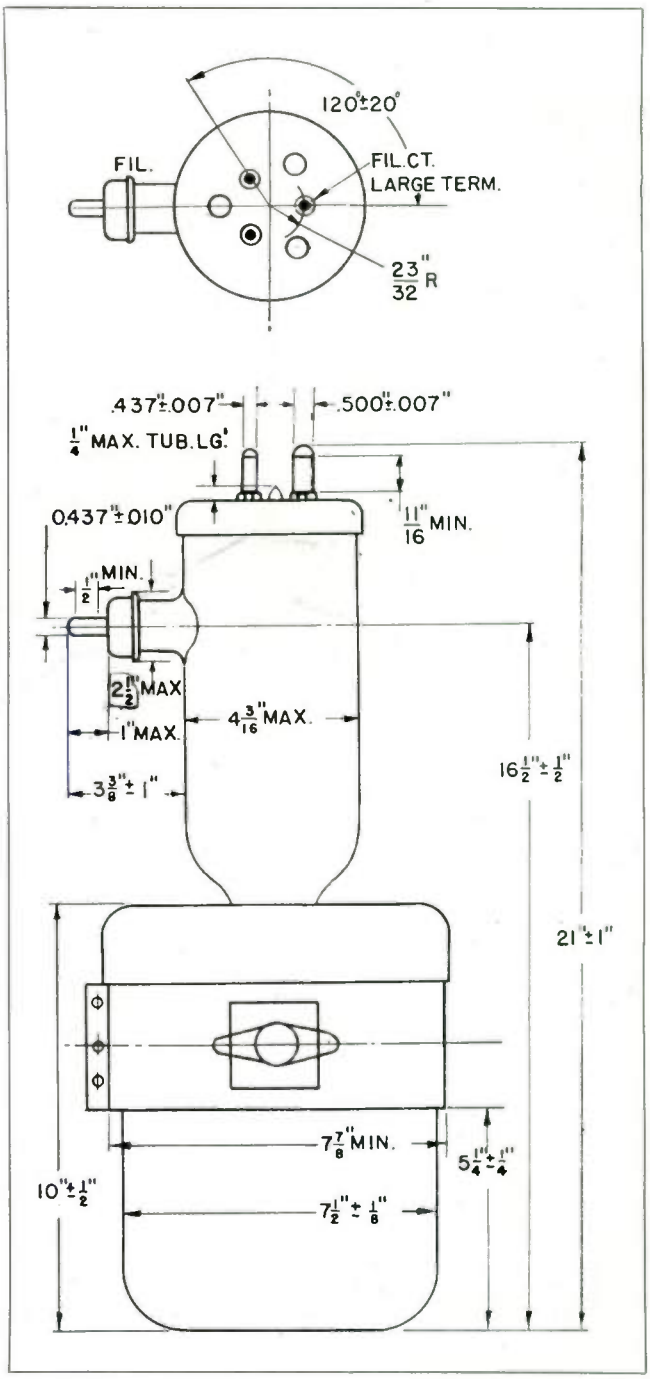
Air Requirements per Tube

(Maximum Intake Temperature 40° C.)

Net Anode Dissipation K.W. (1)	Minimum Recommended Air Flow Cu. Ft./Min.	Approx. Air Pressure Inches Water (2)	Average Air Velocity Thru Fin. Assy. Ft./Min.	Approx. Air Temp. Rise Degrees Cent.
3	350	0.17	1560	16
4	480	0.32	2140	15.5

(1) This is anode dissipation exclusive of filament power dissipated through anode.

(2) This pressure is measured at the base of tube mounting. Duct work must be considered to determine pressure against which blower must deliver required amount of air.



TRANSMITTING TUBE TYPE F-891-R

4.0 Kilowatts Plate Dissipation

Maximum Ratings and Typical Operation Data

CLASS B
A-F POWER AMPLIFIER AND MODULATOR

Maximum Ratings

DC Plate Voltage	10,000 volts
Max. Signal DC Plate Current	2.0 amperes
Max. Signal Plate Input	10.5 kw
Plate Dissipation	3.5 kw

Typical Operation

(Unless otherwise specified values are for 2 tubes)

DC Plate Voltage	8,000 volts
DC Grid Voltage	–800 volts
Peak A-F Grid-to-Grid Voltage	2,400 volts
Zero Signal DC Plate Current	0.5 amperes
Max. Signal DC Plate Current	2.1 amperes
Effective Load Resistance (plate to plate)	7,400 ohms (approx.)
Max. Signal Driving Power	100 watts (approx.)
Max. Signal Power Output	10 kw (approx.)

CLASS B
TELEPHONY R-F POWER AMPLIFIER

(Carrier conditions per tube for use with a maximum modulation factor of 1.0)

Maximum Ratings

DC Plate Voltage	10,000 volts
DC Plate Current	1.0 amperes
Plate Input	5.5 kw
Plate Dissipation	3.5 kw

Typical Operation

DC Plate Voltage	8,000 volts
DC Grid Voltage	–820 volts
Peak R-F Grid Voltage	700 volts
DC Plate Current	0.6 amperes
Driving Power*	0 watts (approx.)
Power Output	1.3 kw (approx.)

*At crest of A-F cycle with modulation factor of 1.0

CLASS C
TELEPHONY PLATE-MODULATED R-F POWER AMPLIFIER

(Carrier conditions per tube for use with a maximum modulation factor of 1.0)

Maximum Ratings

DC Plate Voltage	8,500 volts
DC Grid Voltage	–3,000 volts
DC Plate Current	1.0 amperes
DC Grid Current	0.15 amperes
Plate Input	8 kw
Plate Dissipation	2.5 kw

Typical Operation

DC Plate Voltage	6,000 volts
DC Grid Voltage	–2,000 volts
Peak R-F Grid Voltage	2,650 volts
DC Plate Current	0.75 amperes
DC Grid Current	0.1 amperes (approx.)
Driving Power	260 watts
Power Output	3.5 kw (approx.)

CLASS C TELEGRAPHY
R-F POWER AMPLIFIER AND OSCILLATOR

(Key-Down conditions per tube without modulation†)

Maximum Ratings

DC Plate Voltage	10,000 volts
DC Grid Voltage	–3,000 volts
DC Plate Current	2.0 amperes
DC Grid Current	0.15 amperes
Plate Input	15 kw
Plate Dissipation	4 kw

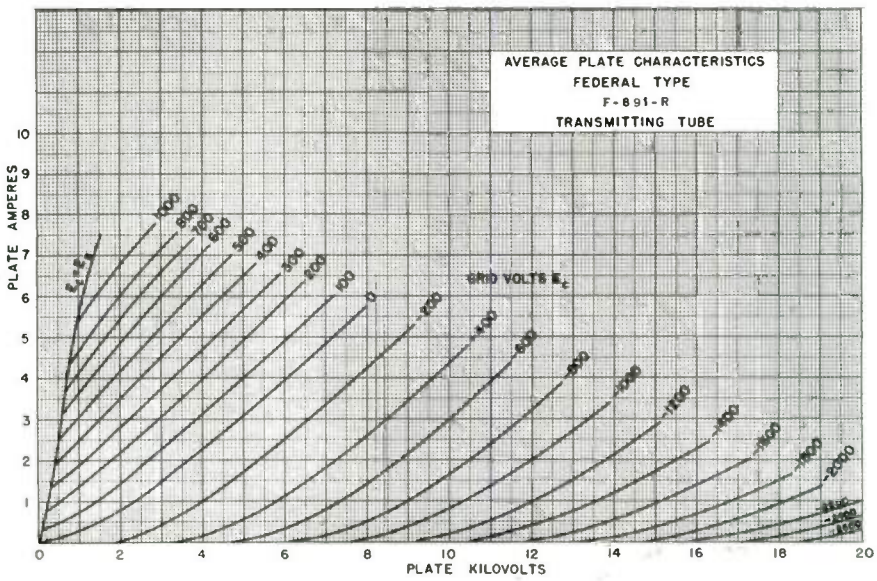
Typical Operation

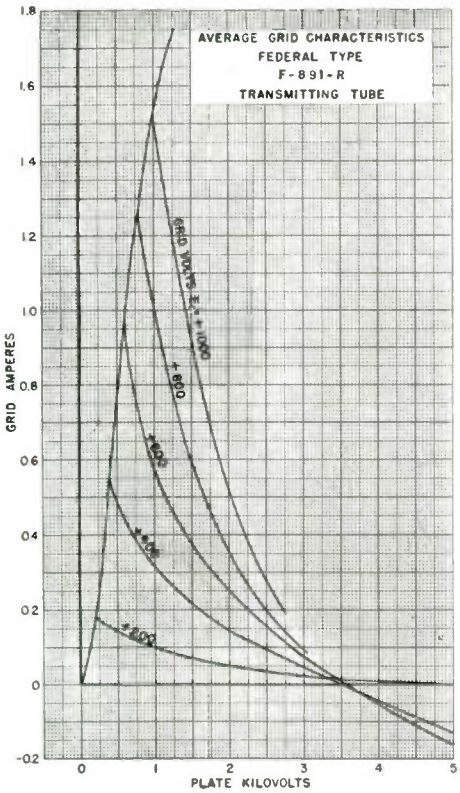
DC Plate Voltage	10,000 volts
DC Grid Voltage	–2, 000 volts
Peak R-F Grid Voltage	2,900 volts
DC Plate Current	1.4 amperes
DC Grid Current	0.1 amperes (approx.)
Driving Power	310 watts (approx.)
Power Output	10 kw (approx.)

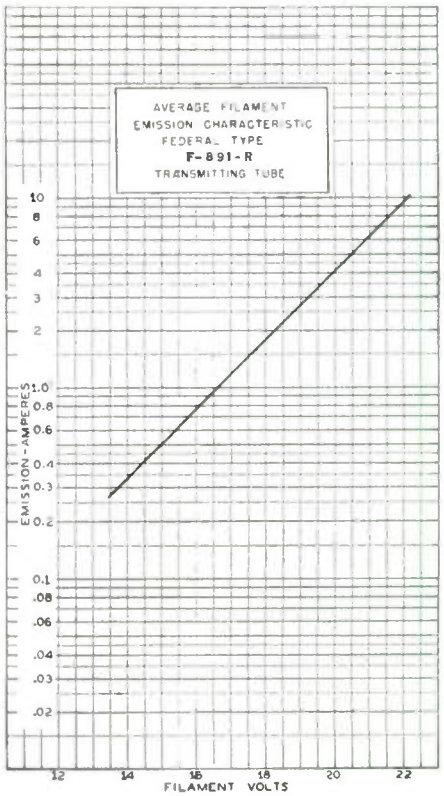
†Modulation essentially negative may be used if the positive peak of the audio-frequency envelope does not exceed 115% of the carrier conditions.

TRANSMITTING TUBE TYPE F-891-R

4.0 Kilowatts Plate Dissipation

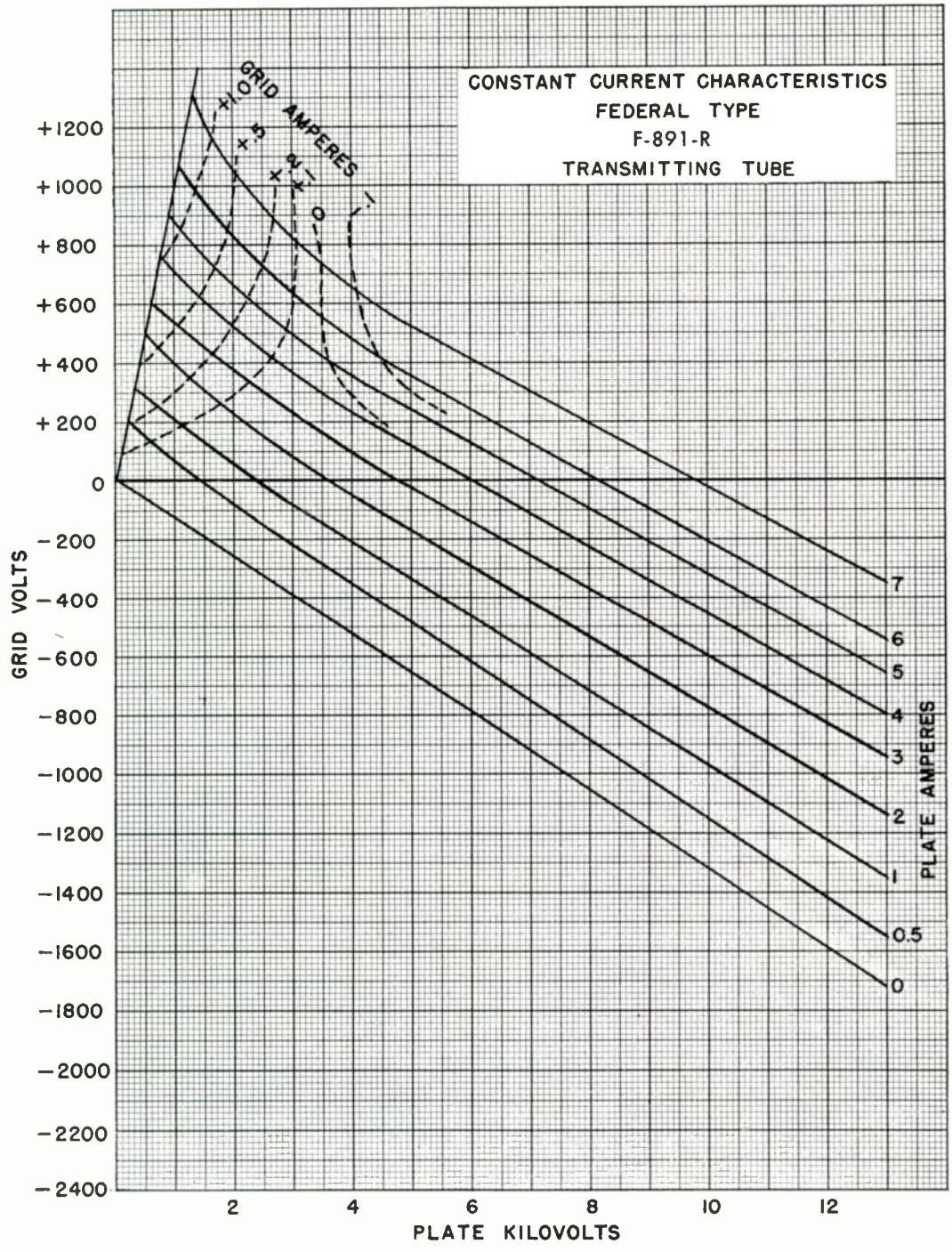






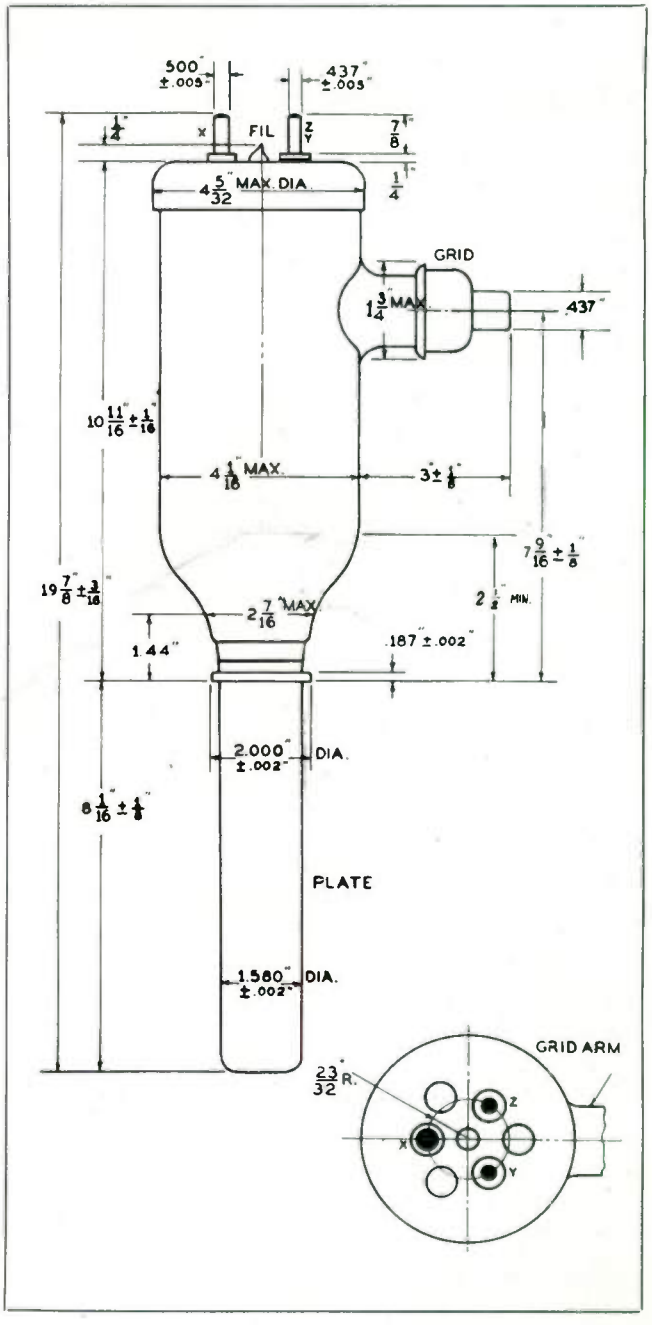
TRANSMITTING TUBE TYPE F-891-R

4.0 Kilowatts Plate Dissipation



TRANSMITTING TUBE TYPE F-892

10 Kilowatts Plate Dissipation



Technical Data

Main Use	R-F Amplifier or Class B Modulator
Number of Electrodes	3
Filament Voltage per terminal	11 volts
Current per strand	60 amperes
Type	Tungsten, Two-Unit
Excitation	DC, Single or Two Phase AC
Thermionic Emission	10 amperes
Amplification Factor	50
Approximate Direct Inter-electrode Capacitances	
Plate to Grid	27 $\mu\mu$f
Grid to Filament	18 $\mu\mu$f
Plate to Filament	2 $\mu\mu$f
Type of Cooling	Water
Minimum Flow	5 G.P.M.
Water Jacket	Standard or Federal Type F-1000

Maximum Rating versus Operating Frequency

Operating Frequency Megacycles	Maximum Permissible Percentage of Maximum Rated Plate Voltage and Plate Input		
	Class B Telephony	Class C Telephony	Class C Telegraphy
1.6	100	100	100
7.5	85	85	75
20	76	75	50

TRANSMITTING TUBE TYPE F-892

10 Kilowatts Plate Dissipation

Maximum Ratings and Typical Operation Data

For maximum frequency of 1.6 megacycles

CLASS B
A-F POWER AMPLIFIER AND MODULATOR

Maximum Ratings

DC Plate Voltage	15,000 volts
Max. Signal DC Plate Current*	2.0 amperes
Max. Signal Plate Input*	20 kw
Plate Dissipation*	7.5 kw

Typical Operation

(Unless otherwise specified, values are for 2 tubes)

DC Plate Voltage	12,500 volts
DC Grid Voltage	–170 volts
Peak A-F Grid-to-Grid Voltage	1,530 volts
Zero Signal DC Plate Current	0.4 amperes
Max. Signal DC Plate Current	2.8 amperes
Load Resistance (per tube)	2,500 ohms
Effective Load Resistance (plate to plate)	10,000 ohms
Max. Signal Driving Power	420 watts (approx.)
Max. Signal Power Output	22 kw (approx.)

*Averaged over any audio-frequency cycle of sine-wave form.

CLASS B TELEPHONY
R-F POWER AMPLIFIER

(Carrier conditions per tube for use with a maximum modulation factor of 1.0)

Maximum Ratings

DC Plate Voltage	15,000 volts
DC Plate Current	1.0 amperes
R-F Grid Current	24 amperes
Plate Input	15 kw
Plate Dissipation	10 kw

Typical Operation

DC Plate Voltage	14,000 volts
DC Grid Voltage	–190 volts
Peak R-F Grid Voltage	510 volts
DC Plate Current	0.95 amperes
Driving Power**	30 watts (approx.)
Power Output	4 kw (approx.)

**At crest of a-f cycle with modulation factor of 1.0

CLASS C TELEPHONY
PLATE-MODULATED R-F POWER AMPLIFIER

(Carrier conditions per tube for use with a maximum modulation factor of 1.0)

Maximum Ratings

DC Plate Voltage	10,000 volts
DC Grid Voltage	–3,000 volts
DC Plate Current	1.0 amperes
DC Grid Current	0.25 amperes
R-F Grid Current	24 amperes
Plate Input	10 kw
Plate Dissipation	6.6 kw (approx.)

Typical Operation

DC Plate Voltage	10,000 volts
DC Grid Voltage	–1,600 volts
Peak R-F Grid Voltage	2,400 volts
DC Plate Current	0.72 amperes
DC Grid Current	0.115 amperes (approx.)
Driving Power	260 watts (approx.)
Power Output	6 kw (approx.)

CLASS C TELEGRAPHY
R-F POWER AMPLIFIER AND OSCILLATOR

(Key-down conditions per tube without modulation)†

Maximum Ratings

DC Plate Voltage	15,000 volts
DC Grid Voltage	–3,000 volts
DC Plate Current	2.0 amperes
DC Grid Current	0.25 amperes
R-F Grid Current	30 amperes
Plate Input	30 kw
Plate Dissipation	10 kw

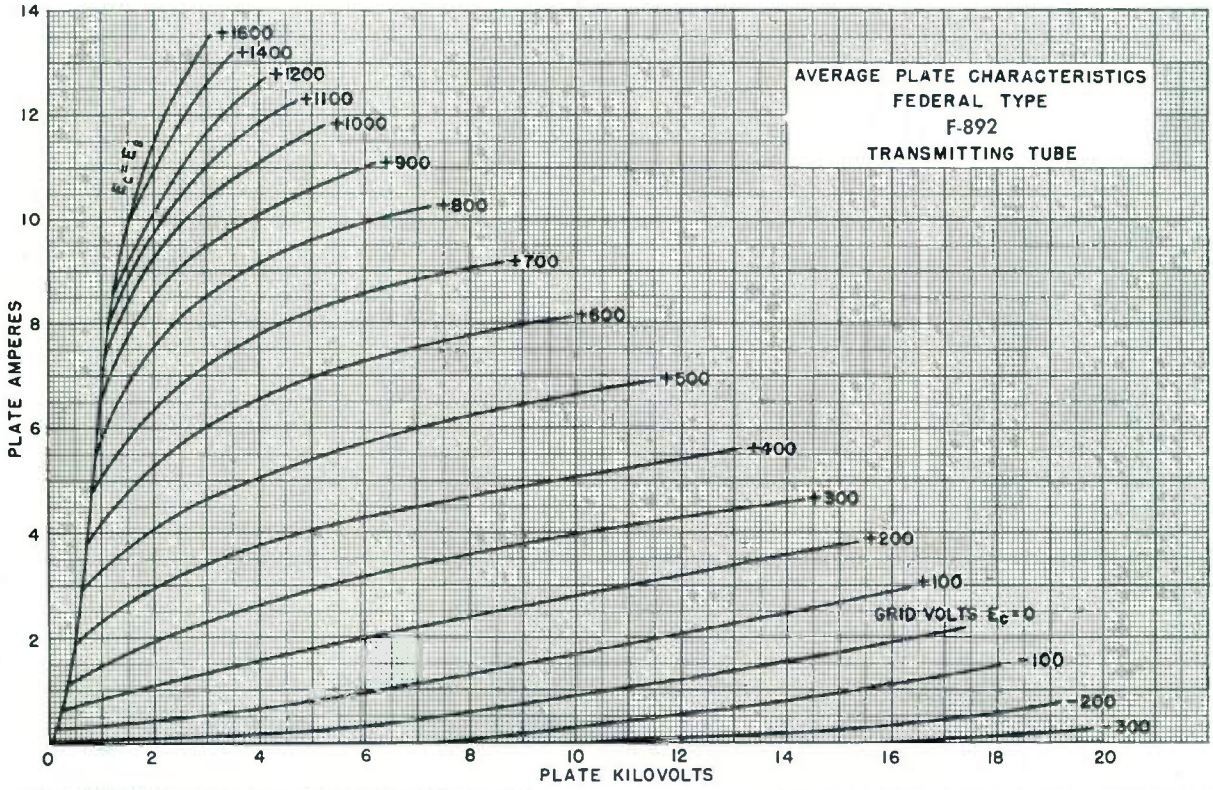
Typical Operation

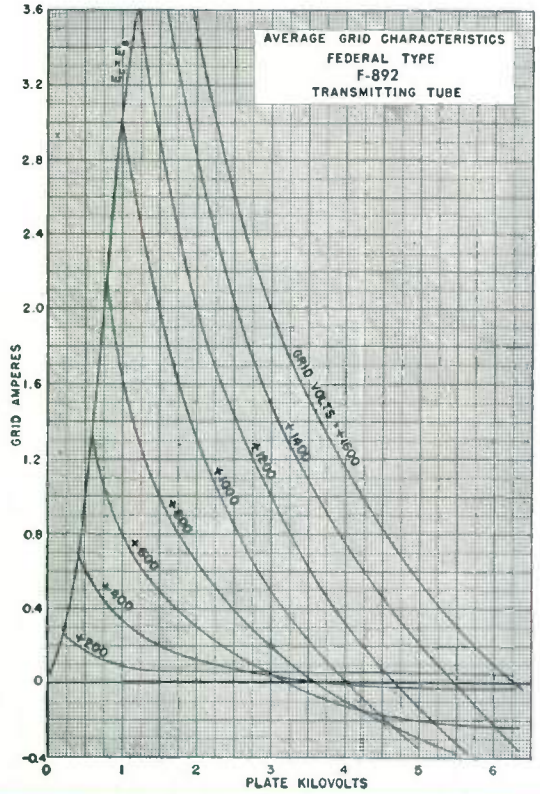
DC Plate Voltage	12,000 volts
DC Grid Voltage	–1,600 volts
Peak R-F Grid Voltage	2,800 volts
DC Plate Current	1.64 amperes
DC Grid Current	0.18 amperes (approx.)
Driving Power	500 watts (approx.)
Power Output	14 kw (approx.)

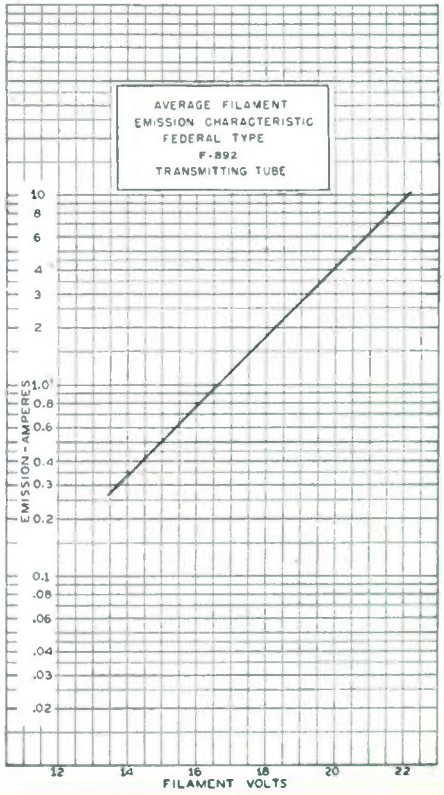
†Modulation essentially negative may be used if the positive peak of the audio-frequency envelope does not exceed 115% of the carrier conditions.

TRANSMITTING TUBE TYPE F-892

10 Kilowatts Plate Dissipation

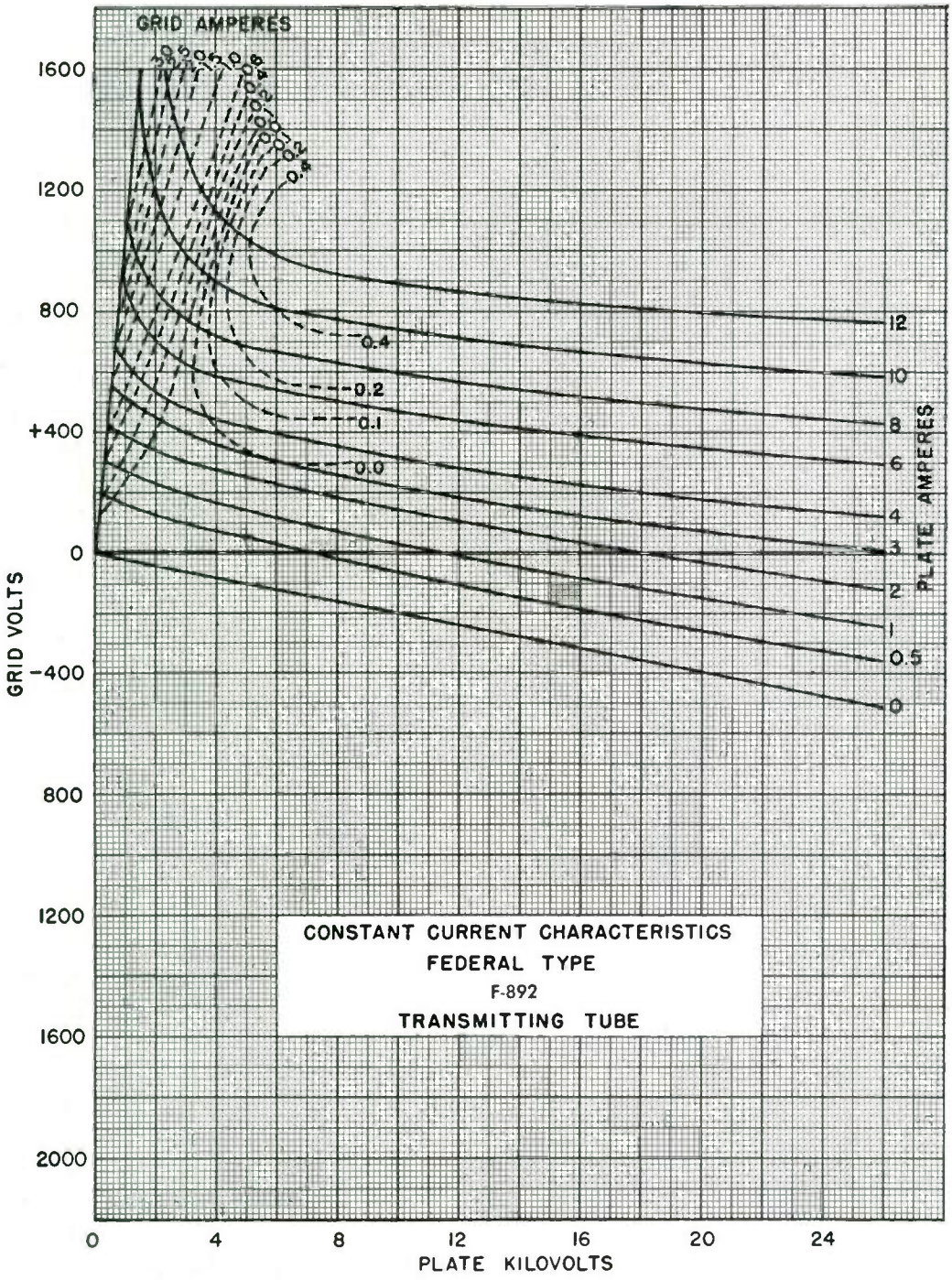






TRANSMITTING TUBE TYPE F-892

10 Kilowatts Plate Dissipation



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TRANSMITTING TUBE TYPE F-892-R

4 Kilowatts Plate Dissipation

Technical Data

Main Use	R.F. Power Amplifier, Oscillator, Class B Modulator
Number of Electrodes	3
Filament Voltage per Terminal	11 volts
Current per Strand	60 amperes
Type	Tungsten
Excitation	DC, Single or Two Phase AC
Thermionic Emission	10 amperes
Amplification Factor	50
Approximate Direct Inter-electrode Capacitances	
Plate to Grid	30 $\mu\mu f$
Filament to Grid	18 $\mu\mu f$
Plate to Filament	2 $\mu\mu f$
Type of Cooling	Forced Air
Mounting	Special

Transmitting Tube Ratings *versus* Operating Frequency

Operating Frequency Megacycles	Maximum Permissible Percentage of Maximum Rated Plate Voltage and Plate Input		
	Telephony		Telegraphy
	Class B, Class C Grid or Suppressor Modulated	Class C Plate-Modulated	Class C
1.6	100	100	100
7.5	85	75	75
20	76	50	50

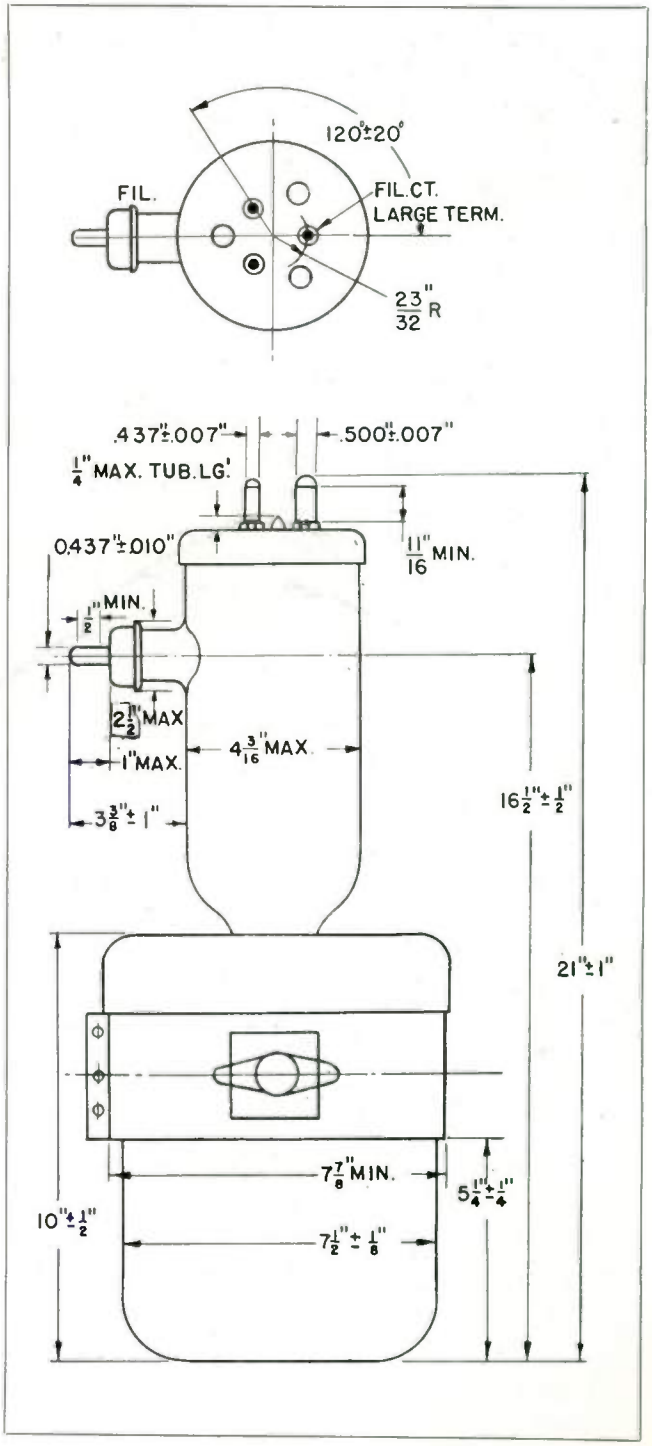
Air Requirements per Tube

(Maximum Intake Temperature 40° C.)

Net Anode Dissipation K.W. (1)	Minimum Recommended Air Flow Cu. Ft./Min.	Approx. Air Pressure Inches Water (2)	Average Air Velocity Thru Fin. Ass'y. Ft./Min.	Approx. Air Temp. Rise Degrees Cent.
3	350	0.17	1560	16
4	480	0.32	2140	15.5
5	650	0.60	2900	14

(1) This is anode dissipation exclusive of filament power dissipated through anode.

(2) This pressure is measured at the base of tube mounting. Duct work must be considered to determine pressure against which blower must deliver required amount of air.



TRANSMITTING TUBE TYPE F-892-R

4 Kilowatts Plate Dissipation

Maximum Ratings and Typical Operating Conditions

CLASS B
A-F POWER AMPLIFIER AND MODULATOR

Maximum Ratings

DC Plate Voltage	12,500 volts
Max. Signal DC Plate Current	2.0 amperes
Max. Signal Plate Input	12 kw
Plate Dissipation	4 kw

Typical Operation

(Unless otherwise specified, values are for 2 tubes)

DC Plate Voltage	8,000 volts
DC Grid Voltage	–60 volts
Peak A-F Grid-to-Grid Voltage	1,000 volts
Zero Signal DC Plate Current	0.5 amperes
Max. Signal DC Plate Current	2.3 amperes
Effective Load Resistance (plate to plate)	6,800 ohms
Max. Signal Driving Power	400 approx. watts
Max. Signal Power Output	10.5 approx. kw

CLASS B TELEPHONY
R-F POWER AMPLIFIER

(Carrier conditions per tube for use with a maximum modulation factor of 1.0)

Maximum Ratings

DC Plate Voltage	12,500 volts
DC Plate Current	1.0 amperes
Plate Input	6 kw
Plate Dissipation	4 kw

Typical Operation

DC Plate Voltage	8,000 volts
DC Grid Voltage	–40 volts
Peak R-F Grid Voltage	350 volts
DC Plate Current	0.71 amperes
Driving Power*	25 approx. watts
Power Output	1.7 approx. kw

*At crest of a-f cycle with modulation factor of 1.0

CLASS C TELEPHONY
PLATE-MODULATED R-F POWER AMPLIFIER

(Carrier conditions per tube for use with a maximum modulation factor of 1.0)

Maximum Ratings

DC Plate Voltage	10,000 volts
DC Grid Voltage	–3,000 volts
DC Plate Current	1.0 amperes
DC Grid Current	0.25 amperes
Plate Input	10 kw
Plate Dissipation	2.5 kw

Typical Operation

DC Plate Voltage	8,000 volts
DC Grid Voltage	–1,300 volts
Peak R-F Grid Voltage	2,000 volts
DC Plate Current	0.75 amperes
DC Grid Current	0.18 approx. amperes
Driving Power	350 approx. watts
Power Output	5 approx. kw

CLASS C TELEGRAPHY
R-F POWER AMPLIFIER AND OSCILLATOR

(Key-down conditions per tube without modulation)†

Maximum Ratings

DC Plate Voltage	12,500 volts
DC Grid Voltage	–3,000 volts
DC Plate Current	2.0 amperes
DC Grid Current	0.25 amperes
Plate Input	18 kw
Plate Dissipation	4 kw

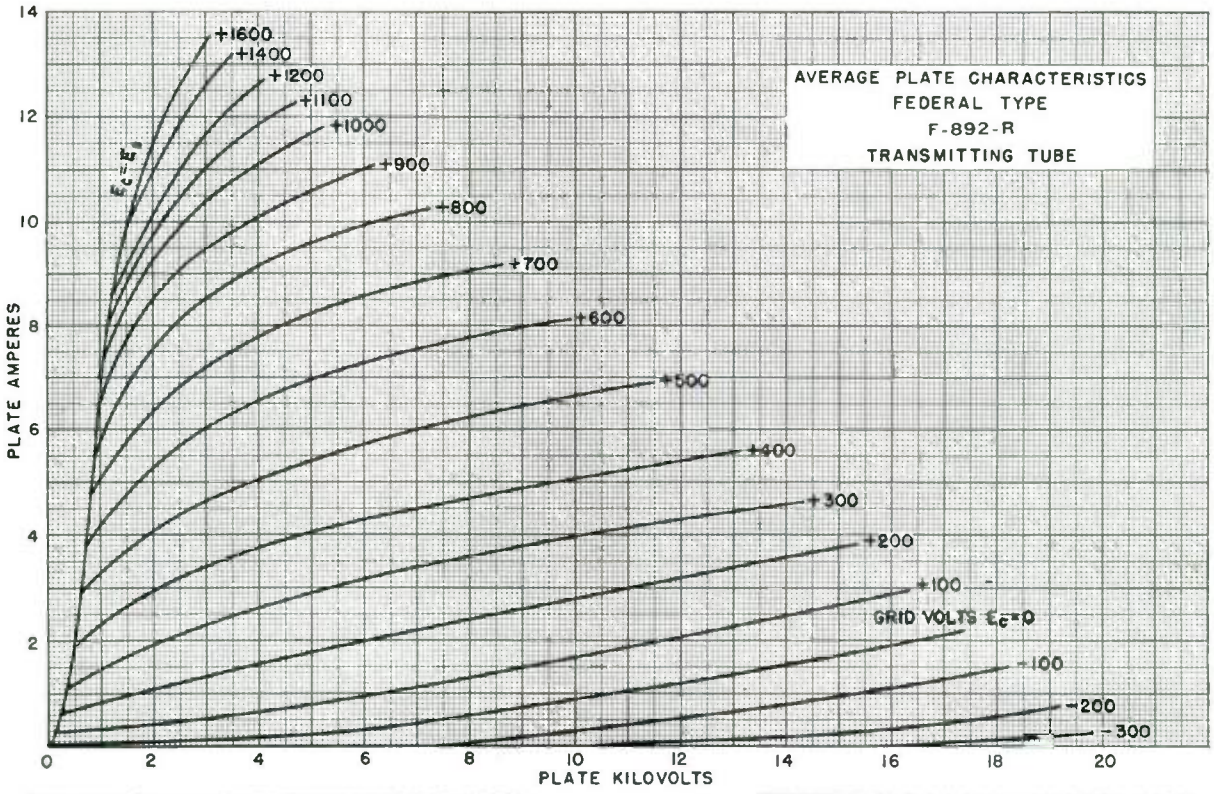
Typical Operation

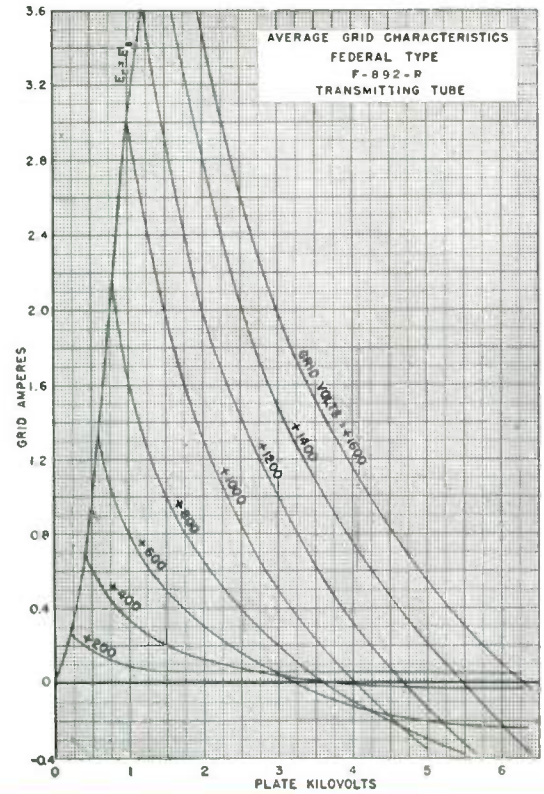
DC Plate Voltage	10,000 volts
DC Grid Voltage	–1,300 volts 7,200 approx. ohms
Peak R-F Grid Voltage	2,300 volts
DC Plate Current	1.4 amperes
DC Grid Current	0.18 approx. amperes
Driving Power	400 approx. watts
Power Output	10 approx. kw

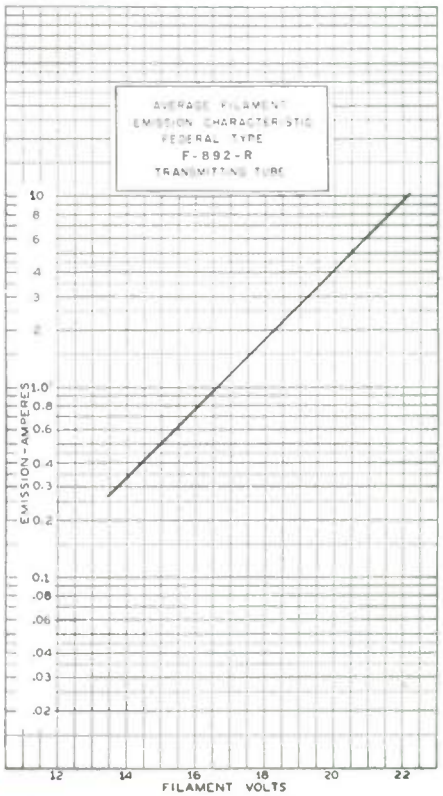
†Modulation essentially negative may be used if the positive peak of the audio-frequency envelope does not exceed 115% of the carrier conditions.

TRANSMITTING TUBE TYPE F-892-R

4 Kilowatts Plate Dissipation

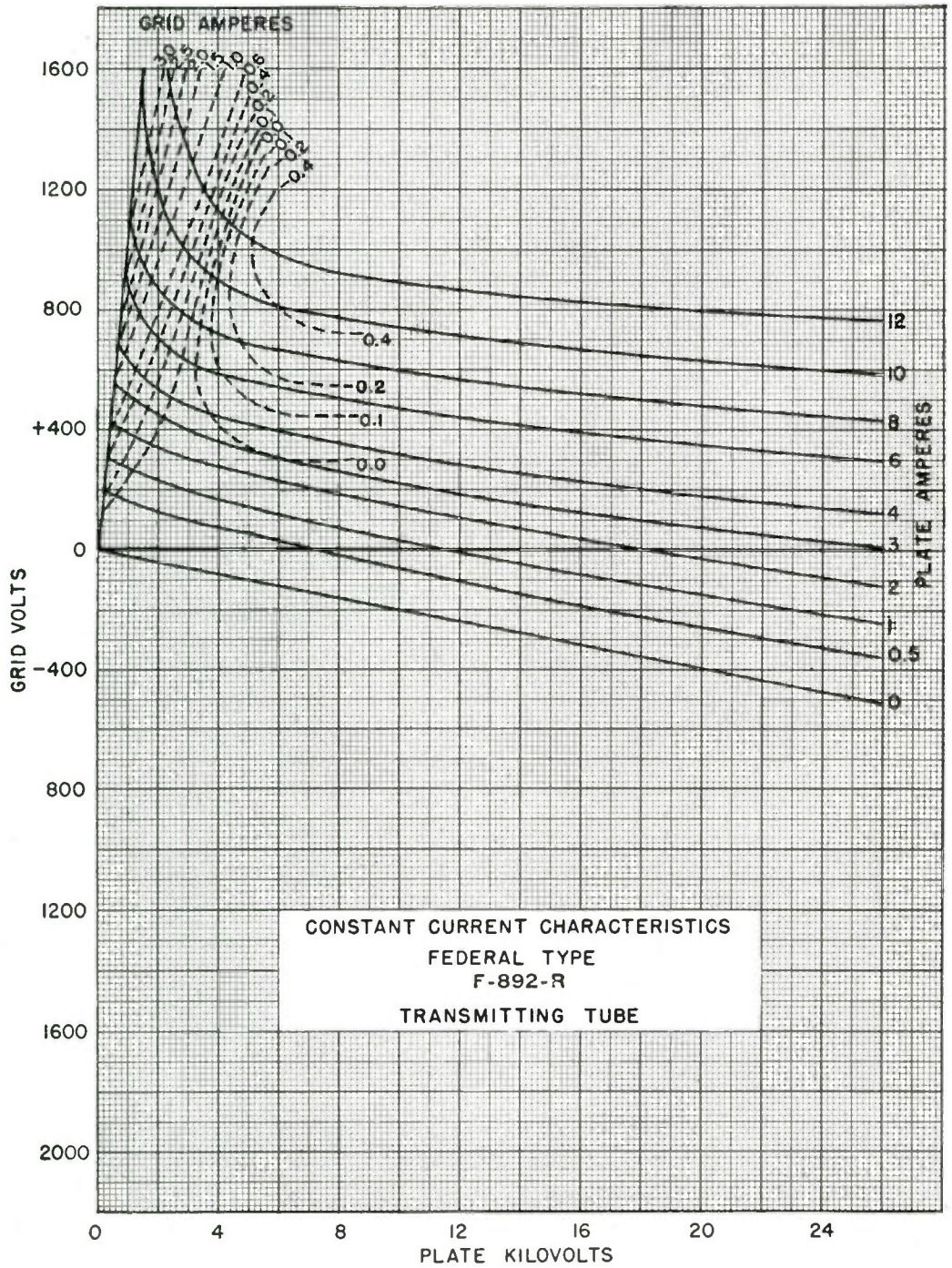






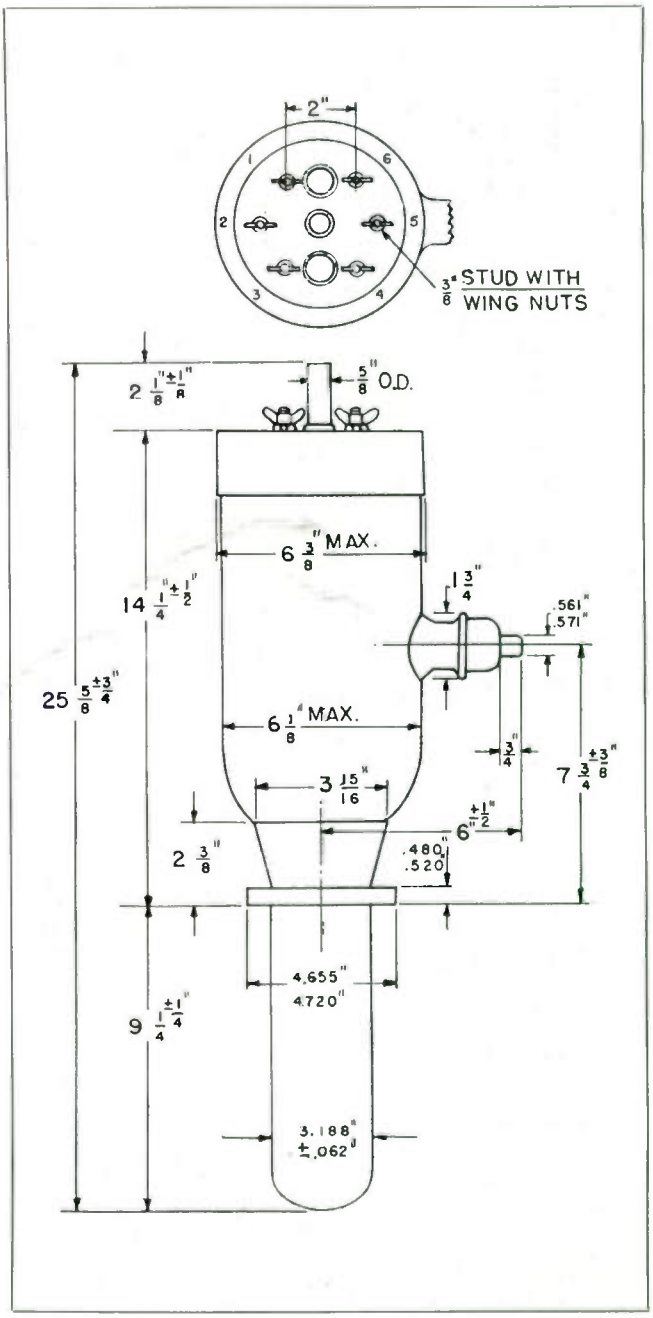
TRANSMITTING TUBE TYPE F-892-R

4 Kilowatts Plate Dissipation



TRANSMITTING TUBE TYPE F-893-A

20 Kilowatts Plate Dissipation



Technical Data

Main Use	General Purpose
Number of Electrodes	3
Filament Voltage per strand	10 volts
Current per terminal	61 amperes
Type	Tungsten
Thermionic Emission	25 amperes
Amplification Factor	36
Approximate Direct Inter-electrode Capacitances	
Plate to Grid	33 $\mu\mu$f
Grid to Filament	48 $\mu\mu$f
Plate to Filament	3.2 $\mu\mu$f
Type of Cooling	Water
Minimum Flow	15 G.P.M.
Water Jacket	Standard or Federal Type F-1010

Maximum Ratings versus Operating Frequency

Operating Frequency Megacycles	Maximum Permissible Percentage of Maximum Rated Plate Voltage and Plate Input					
	Class B Telephony		Class C Telephony		Class C Telegraphy	
	Voltage	Input	Voltage	Input	Voltage	Input
5	100	100	100	100	100	100
20	85	82	80	75	80	66
40	65	73	64	64	60	50

TRANSMITTING TUBE TYPE F-893-A

20 Kilowatts Plate Dissipation

Maximum Ratings and Typical Operation Data

For maximum frequency of 5 megacycles

CLASS B
A-F POWER AMPLIFIER AND MODULATOR

Maximum Ratings

DC Plate Voltage	20,000 volts
Max. Signal DC Plate Current*	4 amperes
Max. Signal Plate Input*	60 kw
Plate Dissipation*	20 kw

Typical Operation

Unless otherwise specified values are for 2 tubes

DC Plate Voltage	18,000 volts
DC Grid Voltage	–450 volts
Peak A-F Grid-to-Grid Voltage	1,720 volts (approx.)
Zero Signal DC Plate Current	0.8 amperes
Max. Signal DC Plate Current	5.5 amperes
Load Resistance (per tube)	
Effective Load Resistance (plate to plate)	8,000 ohms
Max. Signal Driving Power	140 watts (approx.)
Max. Signal Power Output	70 kw (approx.)

*Averaged over any audio-frequency of sine-wave form.

CLASS B TELEPHONY
R-F POWER AMPLIFIER

(Carrier conditions per tube for use with a maximum modulation factor of 1.0)

Maximum Ratings

DC Plate Voltage	20,000 volts
DC Plate Current	2.0 amperes
R-F Grid Current	48 amperes
Plate Input	32 kw
Plate Dissipation	20 kw

Typical Operation

DC Plate Voltage	15,000 volts
DC Grid Voltage	–340 volts
Peak R-F Grid Voltage	450 volts (approx.)
DC Plate Current	2.0 amperes
Driving Power**	200 watts (approx.)
Power Output	10 kw (approx.)

**At crest of audio-frequency cycle with modulation factor of 1.0

CLASS C TELEPHONY
PLATE MODULATED R-F POWER AMPLIFIER

(Carrier conditions per tube for use with a maximum modulation factor of 1.0)

Maximum Ratings

DC Plate Voltage	12,000 volts
DC Grid Voltage	–3,000 volts
DC Plate Current	2 amperes
DC Grid Current	0.4 amperes
R-F Grid Current	48 amperes
Plate Input	24 kw
Plate Dissipation	12 kw

Typical Operation

DC Plate Voltage	12,000 volts
DC Grid Voltage	–1,000 volts
Peak R-F Grid Voltage	1,500 volts (approx.)
DC Plate Current	2.0 amperes
DC Grid Current	0.14 amperes (approx.)
Driving Power	210 watts (approx.)
Power Output	18 kw (approx.)

CLASS C TELEGRAPHY
R-F POWER AMPLIFIER AND OSCILLATOR

(Key-down conditions per tube without modulation)†

Maximum Ratings

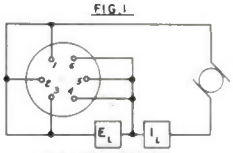
DC Plate Voltage	20,000 volts
DC Grid Voltage	–3,000 volts
DC Plate Current	4 amperes
DC Grid Current	0.4 amperes
R-F Grid Current	60 amperes
Plate Input	70 kw
Plate Dissipation	20 kw

Typical Operation

DC Plate Voltage	18,000 volts
DC Grid Voltage	–1,000 volts
Peak R-F Grid Voltage	1,630 volts (approx.)
DC Plate Current	3.6 amperes
DC Grid Current	0.21 amperes (approx.)
Driving Power	340 watts (approx.)
Power Output	50 kw (approx.)

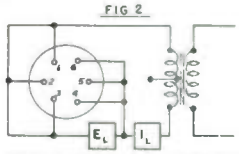
†Modulation essentially negative may be used if the positive peak of the audio-frequency envelope does not exceed 115% of the carrier conditions.

FIG. 1



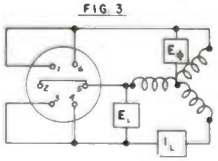
D.C. CONNECTION
E_L = 'X' VOLTS D.C.
I_L = 'Y' AMPS D.C.

FIG. 2



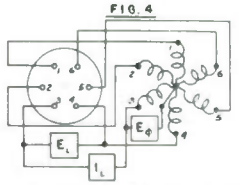
SINGLE-PHASE A.C. CONNECTION
E_L = 'X' VOLTS A.C.
I_L = 'Y' AMPS A.C.

FIG. 3



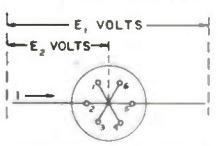
THREE-PHASE A.C. CONNECTION
E_L = 'X' VOLTS A.C.
I_L = 'Y' AMPS A.C.
E_ϕ = 'Z' VOLTS A.C.

FIG. 4



SIX-PHASE A.C. CONNECTION
E_L = 'X' VOLTS A.C.
I_L = 'Y' AMPS A.C.
E_ϕ = 'Z' VOLTS A.C.

FIG. 5



INTERNAL CONNECTION OF FILAMENTS
NUMBERS 1 TO 6 INCLUSIVE ON CONNECTIONS DENOTE BASE TERMINALS

E_1 = 'U' VOLTS D.C. OR A.C. TERMINAL TO TERMINAL VOLTAGE.

E_2 = 'V' VOLTS D.C. OR A.C. VOLTAGE PER FILAMENT STRAND i.e. FROM TERMINAL TO COMMON TERMINAL CONNECTION.

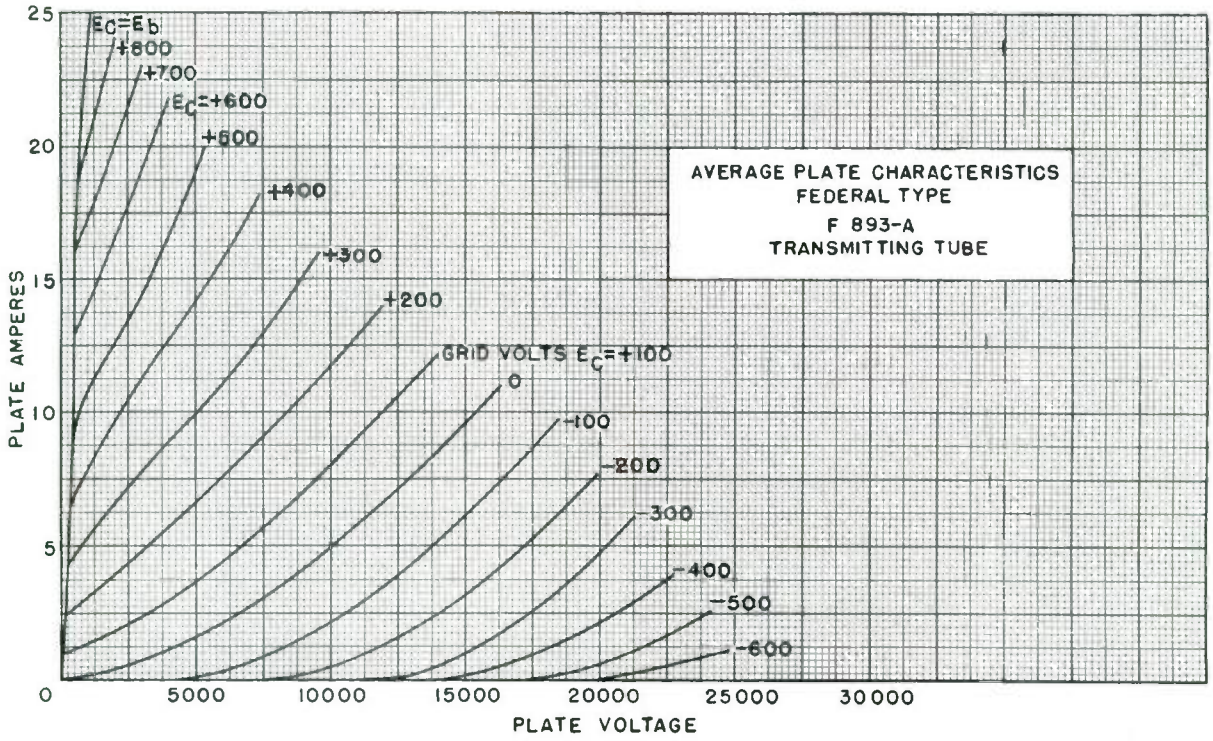
I = 'W' AMPERES CURRENT PER FILAMENT TERMINAL

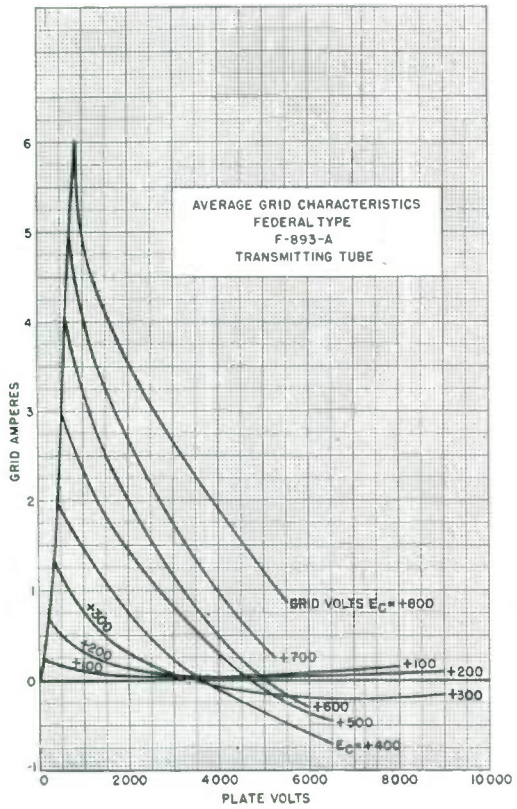
FIG	U	V	W	X	Y	Z
1				20	183	
2				20	183	
3				17.3	122	10
4				10	61	10
5	20	10	61			

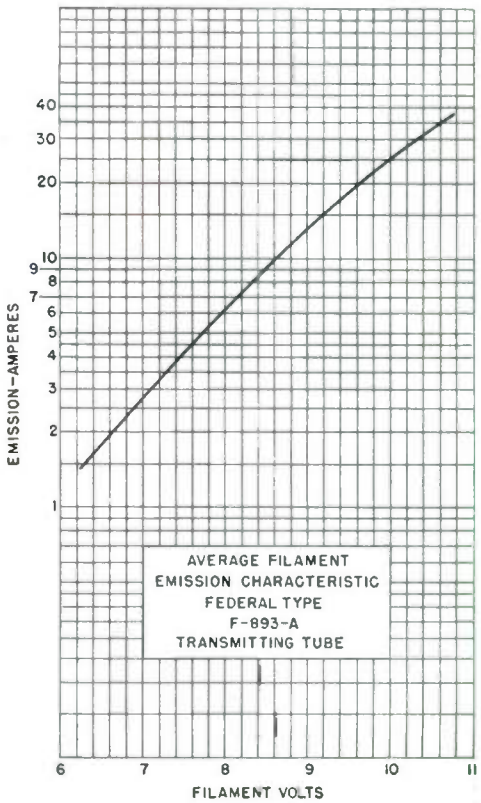
MULTI-PHASE FILAMENT CONNECTIONS

TRANSMITTING TUBE TYPE F-893-A

20 Kilowatts Plate Dissipation

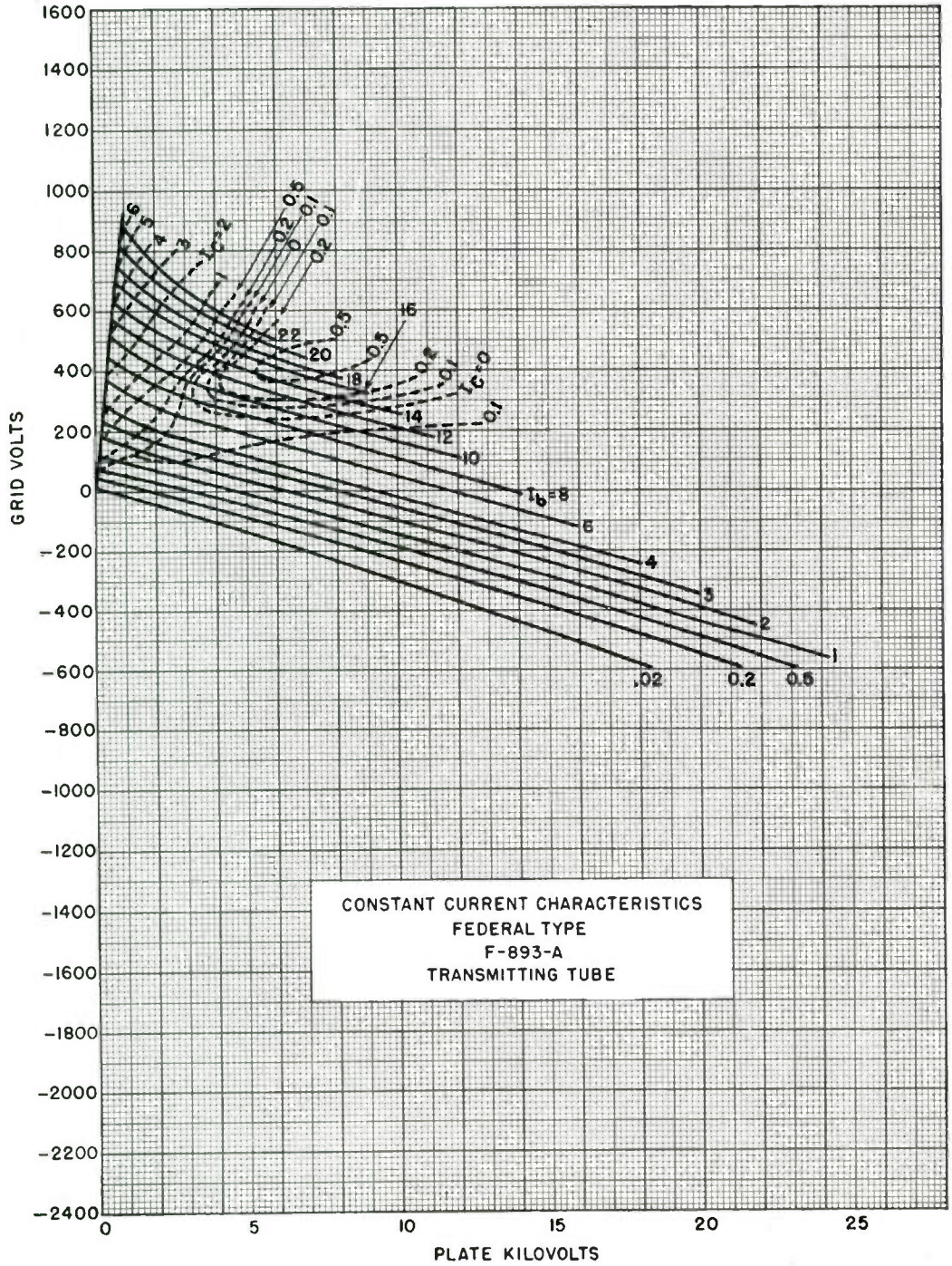






TRANSMITTING TUBE TYPE F-893-A

20 Kilowatts Plate Dissipation



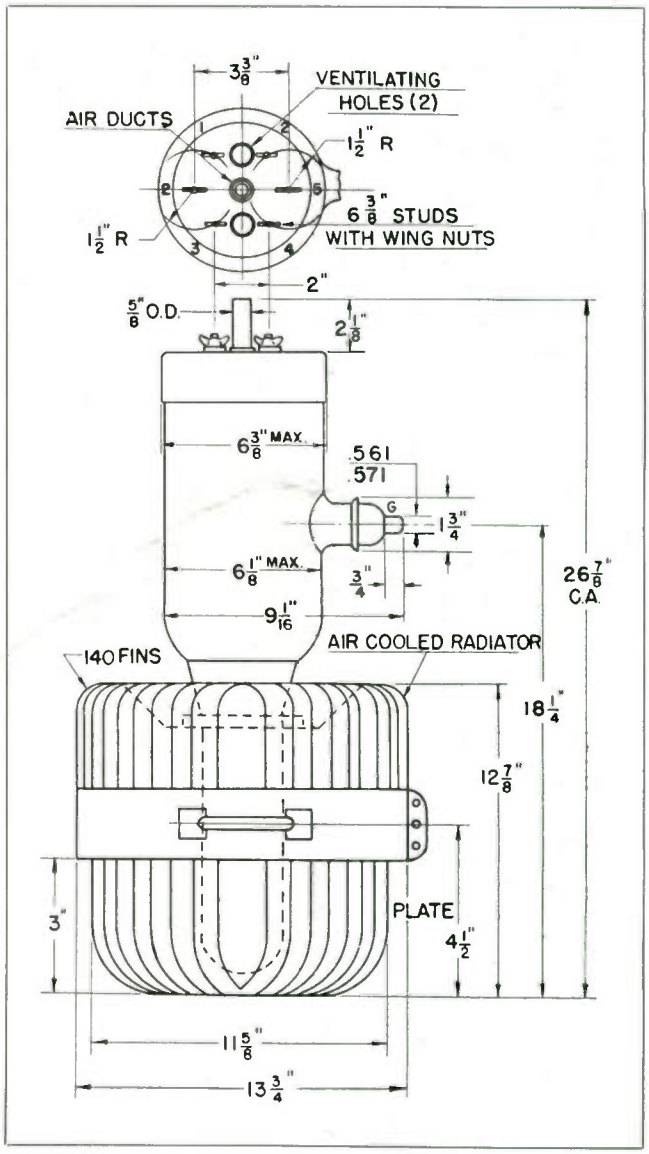
TRANSMITTING TUBE TYPE F-893-RA

20 Kilowatts Plate Dissipation

Technical Data

Main Use	R-F Power Amplifier Class B Modulator
Number of Electrodes	3
Filament Voltage Per Strand	10 volts
Current Per Terminal	61 amperes
Excitation	1, 3, or 6 A-C
Amplification Factor	36
Approximate Direct Inter-electrode Capacitances	
Plate to Grid	33 $\mu\mu f$
Grid to Filament	48 $\mu\mu f$
Plate to Filament	3.2 $\mu\mu f$
Mounting	Special
Type of Cooling	Forced Air

A vertical air flow of at least 1800 cu. ft./min. should be delivered by a blower to the cooling radiator. An air flow of about 2 cu. ft./min. should be supplied to the air nozzle in the filament base. Cooling must be adequate to limit the glass temperature to not more than 150°C at the hottest part. Air flow must start before the application of any voltages.



Maximum Ratings versus Operating Frequency

Operating Frequency Megacycles	Maximum Permissible Percentage of Maximum Rated Plate Voltage and Plate Input			
	Class B Telephony	Class C Telephony	Class C Telegraphy	
			Volt	Input
5	100	100	100	100
12	86	81	81	75
25	74	65	65	50

TRANSMITTING TUBE TYPE F-893-RA

20 Kilowatts Plate Dissipation

Maximum Ratings and Typical Operation Data

For a Maximum Frequency of 5 Megacycles

A-F POWER AMPLIFIER AND MODULATOR — CLASS B

Maximum Ratings

DC Plate Voltage	20,000 volts
Max. Signal DC Plate Current	4 amperes
Max. Signal Plate Input	60 kilowatts
Plate Dissipation	20 kilowatts

Typical Operation

Unless otherwise specified, values are for 2 tubes

DC Plate Voltage	18,000 volts
DC Grid Voltage	–450 volts
Peak A-F Grid to Grid Voltage	1,720 volts
Zero Signal DC Plate Current	0.8 amperes
Max. Signal DC Plate Current	5.5 amperes
Effective Load Resistance Plate to Plate	8,000 ohms
Driving Power	140 watts (approx.)
Max. Signal Power Output	70 kilowatts (approx.)

CLASS C R-F POWER AMPLIFIER TELEPHONY — PLATE MODULATED

(Carrier conditions per tube for use with modulation factor of 1.0)

Maximum Ratings

DC Plate Voltage	12,000 volts
DC Grid Voltage	–3,000 volts
DC Plate Current	2 amperes
DC Grid Current	0.4 amperes
Plate Input	24 kilowatts
Plate Dissipation	12 kilowatts

Typical Operation

DC Plate Voltage	12,000 volts
DC Grid Voltage	–1,000 volts
Peak R-F Grid Voltage	1,500 volts
DC Plate Current	2 amperes
DC Grid Current	0.14 amperes (approx.)
Driving Power	210 watts (approx.)
Power Output	18 kilowatts (approx.)

CLASS B R-F POWER AMPLIFIER TELEPHONY

(Carrier conditions per tube for use with modulation factor of 1.0)

Maximum Ratings

DC Plate Voltage	20,000 volts
DC Plate Current	2 amperes
Plate Input	32 kilowatts
Plate Dissipation	20 kilowatts

Typical Operation

DC Plate Voltage	15,000 volts
DC Grid Voltage	–340 volts
Peak R-F Grid Voltage	450
DC Plate Current	2 amperes
Driving Power**	200 watts (approx.)
Power Output	10 kilowatts (approx.)

***At crest of A-F cycle with modulation factor of 1.0*

CLASS C R-F POWER AMPLIFIER AND OSCILLATOR-TELEGRAPHY

(Key-down conditions per tube without modulation)

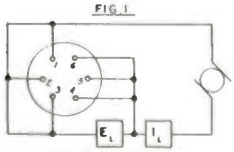
Maximum Ratings

DC Plate Voltage	20,000 volts
DC Grid Voltage	–3,000 volts
DC Plate Current	4 amperes
DC Grid Current	0.4 amperes
Plate Input	70 kilowatts
Plate Dissipation	20 kilowatts

Typical Operation

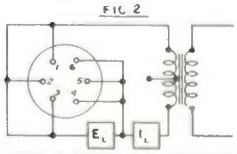
DC Plate Voltage	18,000 volts
DC Grid Voltage	–1,000 volts
Peak R-F Grid Voltage	1,630 volts
DC Plate Current	3.6 amperes
DC Grid Current	0.21 amperes (approx.)
Driving Power	340 watts (approx.)
Power Output	50 kilowatts (approx.)

FIG. 1



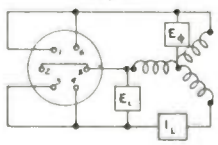
D.C. CONNECTION
E_L = 'X' VOLTS D.C
I_L = 'Y' AMPS D.C

FIG. 2



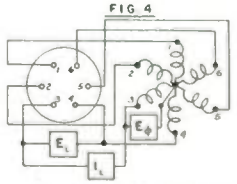
SINGLE-PHASE A.C. CONNECTION
E_L = 'X' VOLTS A.C
I_L = 'Y' AMPS A.C

FIG 3



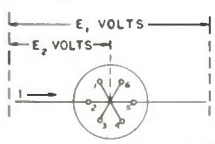
THREE-PHASE A.C. CONNECTION
E_L = 'X' VOLTS A.C
I_L = 'Y' AMPS A.C
E_ϕ = 'Z' VOLTS A.C

FIG 4



SIX-PHASE A.C. CONNECTION
E_L = 'X' VOLTS A.C
I_L = 'Y' AMPS A.C
E_ϕ = 'Z' VOLTS A.C.

FIG.5



INTERNAL CONNECTION OF FILAMENTS

NUMBERS 1 TO 6 INCLUSIVE ON CONNECTIONS DENOTE BASE TERMINALS

E_1 = 'U' VOLTS D.C. OR A.C. TERMINAL TO TERMINAL VOLTAGE

E_2 = 'V' VOLTS D.C. OR A.C. VOLTAGE PER FILAMENT STRAND i.e. FROM TERMINAL TO COMMON TERMINAL CONNECTION

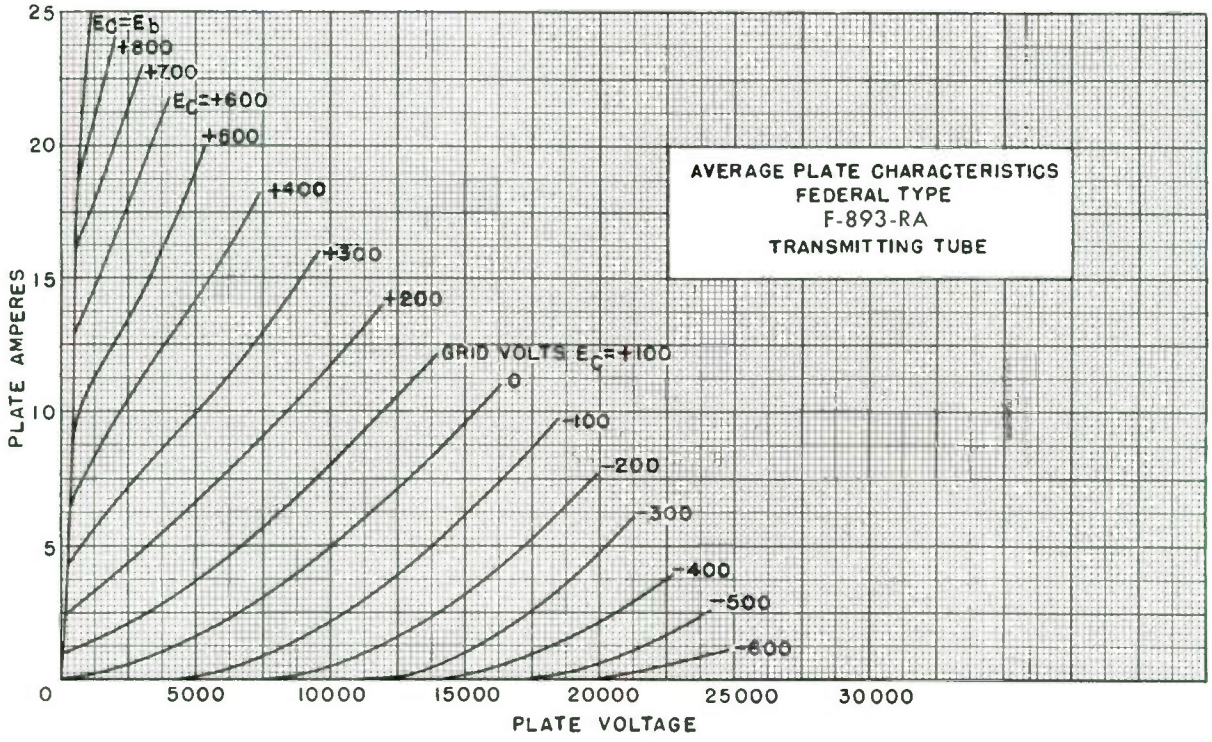
I = 'W' AMPERES CURRENT PER FILAMENT TERMINAL

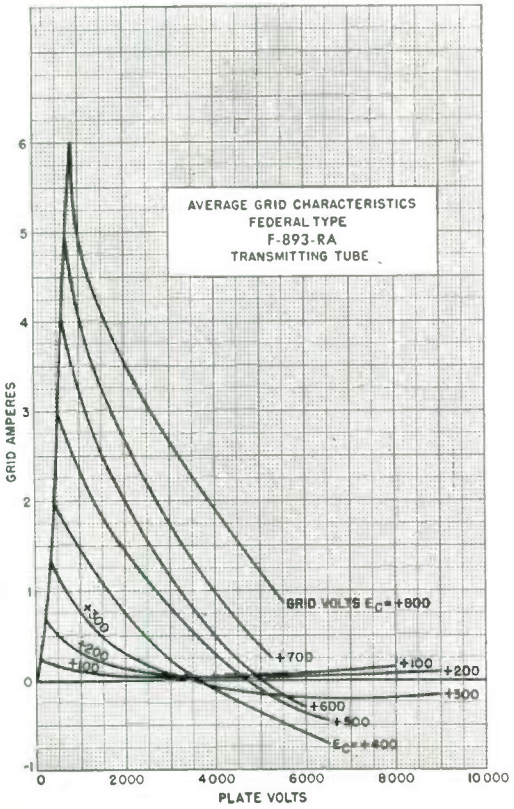
FIG	U	V	W	X	Y	Z
1				20	183	
2				20	183	
3				173	122	10
4				10	61	10
5	20	10	61			

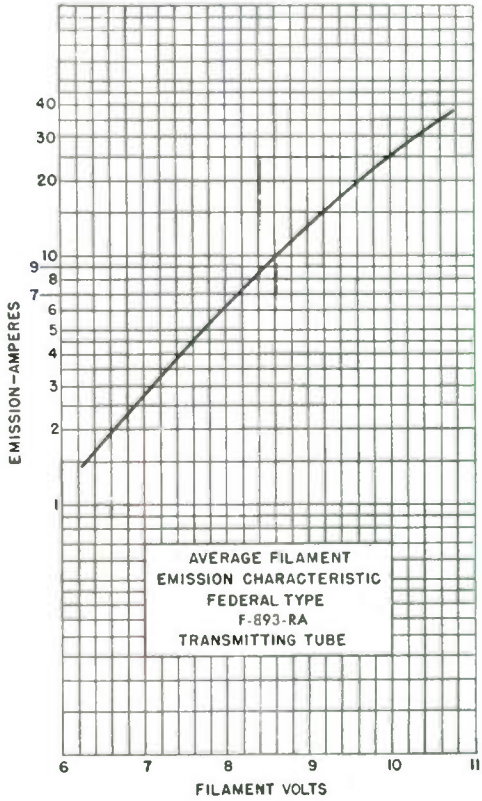
MULTI-PHASE FILAMENT CONNECTIONS

TRANSMITTING TUBE TYPE F-893-RA

20 Kilowatts Plate Dissipation

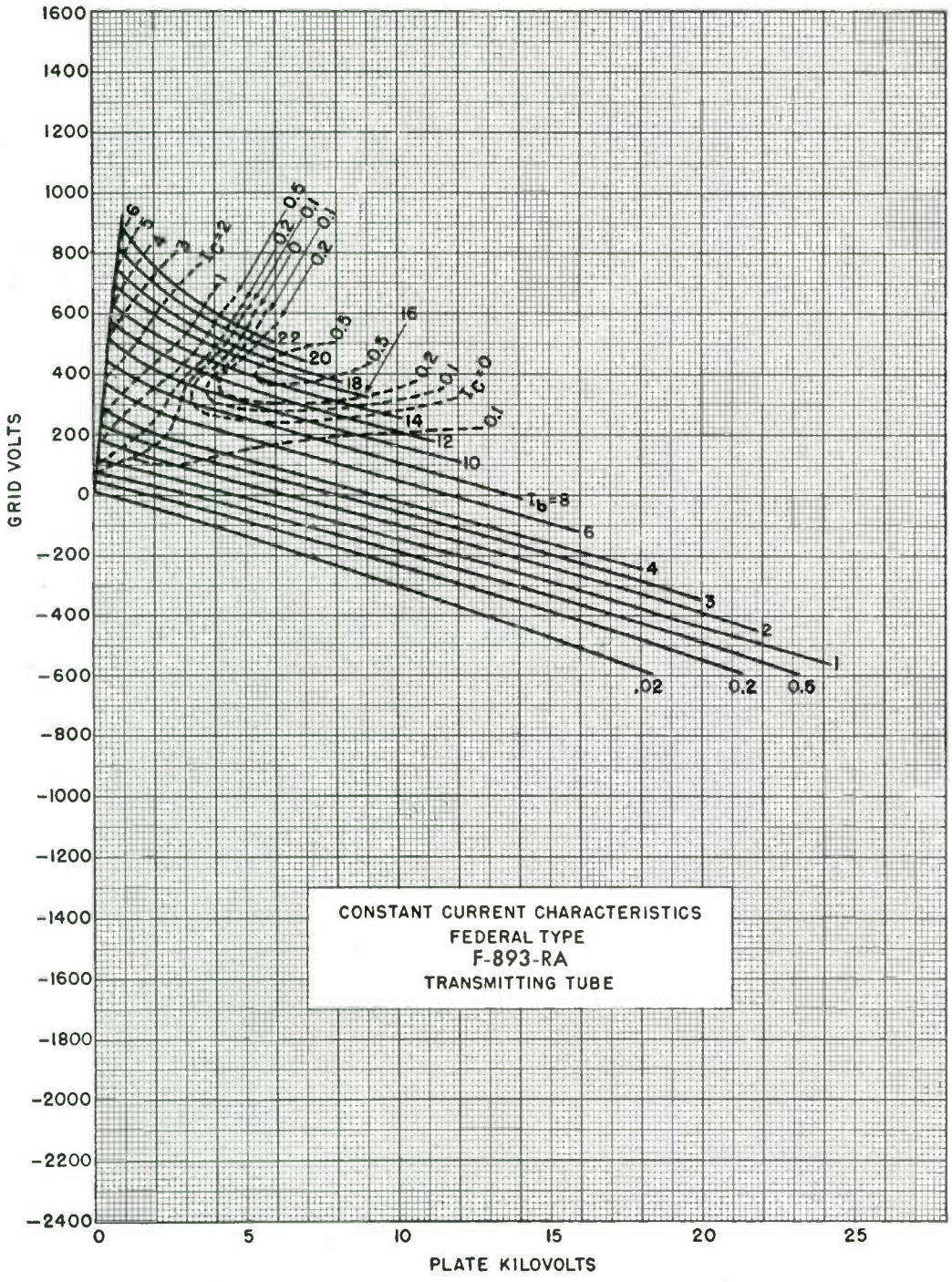






TRANSMITTING TUBE TYPE F-893-RA

20 Kilowatts Plate Dissipation



TRANSMITTING TUBE TYPE 6C22

Tentative Data

Filament Type	Thoriated Tungsten
Filament Voltage	6.5 Volts
Filament Current	18.5 Amperes
Available Peak Emission	5.0 Amperes

Approximate Characteristics

Amplification Factor	9
Mutual Conductance	15,000 Umhos

Type of Cooling	Water 0.5 GPM

Maximum Overall Dimensions

Length	4⅝ Inches
Diameter	2⅜ Inches

Approximate Direct Inter-Electrode Capacitances

Plate to Grid	6.0 $\mu\mu$f
Grid to Filament	6.5 $\mu\mu$f
Plate to Filament	0.4 $\mu\mu$f

Tentative Maximum Ratings and Typical Operation

Key-down conditions without amplitude modulation
Maximum ratings for frequency of 600 MC

DC Plate Voltage	2500 Volts
DC Plate Current	0.75 Amperes
DC Grid Current	.075 Amperes
Plate Input	1875 Watts
Plate Dissipation	1000 Watts

Typical operation — Self-excited oscillator

Frequency MC	*Plate Voltage volts*	*Plate Current amperes*	*Power Output watts*
300	2500	0.70	900
400	2500	0.65	800
500	2200	0.70	680
600	2000	0.65	500

Federal Telephone and Radio Corporation

Vacuum Tube Products An IT&T Associate *Newark 4, New Jersey*

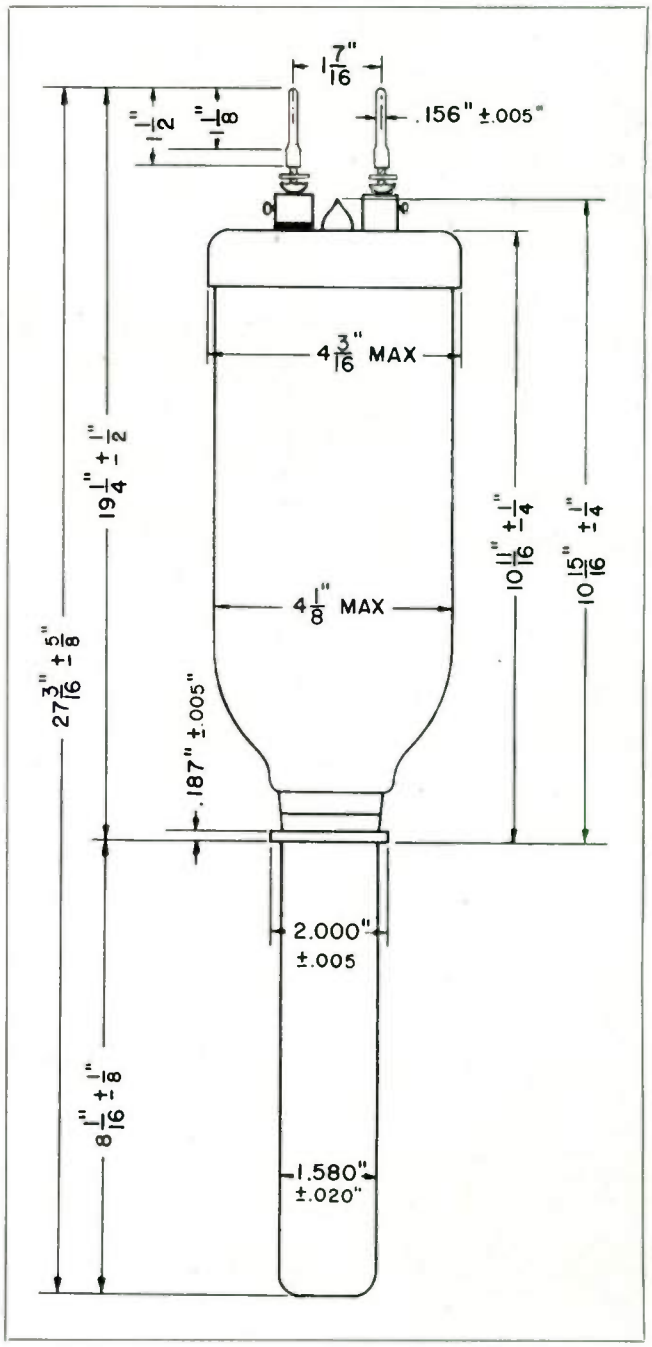
Printed in U.S.A. Form F-168

HIGH VACUUM TUBE TYPE F-214-A

Half Wave Rectifier

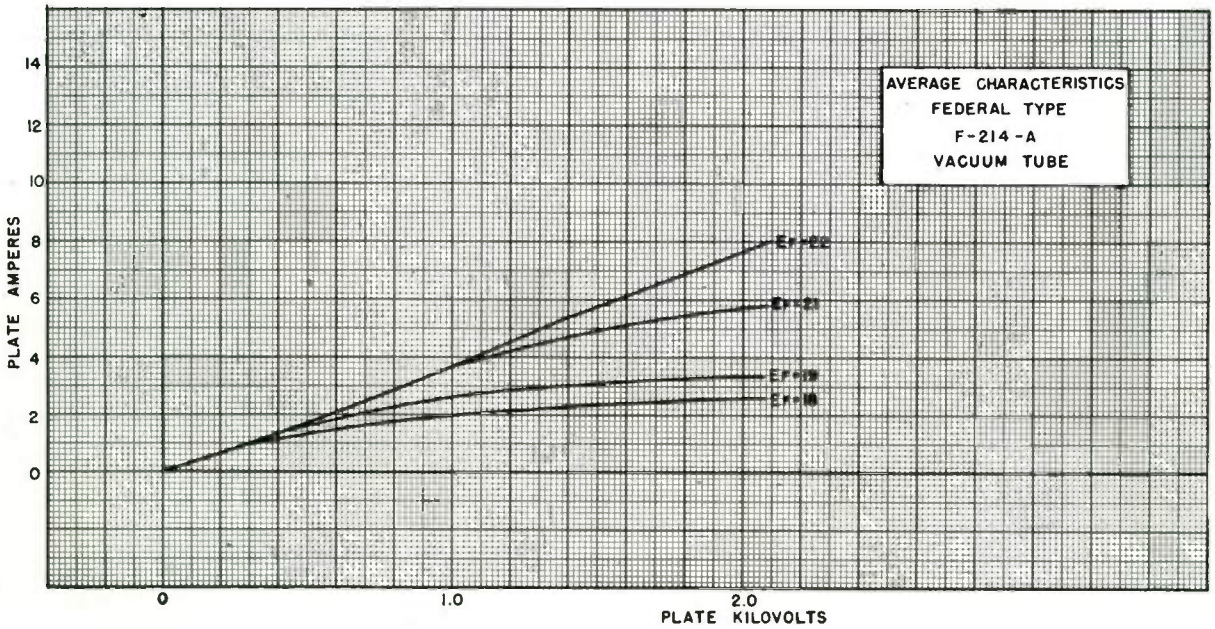
Technical Data

▸ No. of Electrodes	2
▸ Filament Voltage — Max. Peak Plate Current	
22 volts	7.5 amperes
21.5 volts	6.5 amperes
21 volts	5.5 amperes
20.5 volts	4.5 amperes
20 volts	3.4 amperes
▸ Filament Current	52 amperes
Type	Tungsten
▸ Maximum Peak Inverse Voltage	50,000 volts
▸ Type Base	Standard
▸ Type of Cooling	Water
▸ Recommended Water Flow	10 gal. per min.
▸ Water Jacket	Standard or Federal Type F-1000

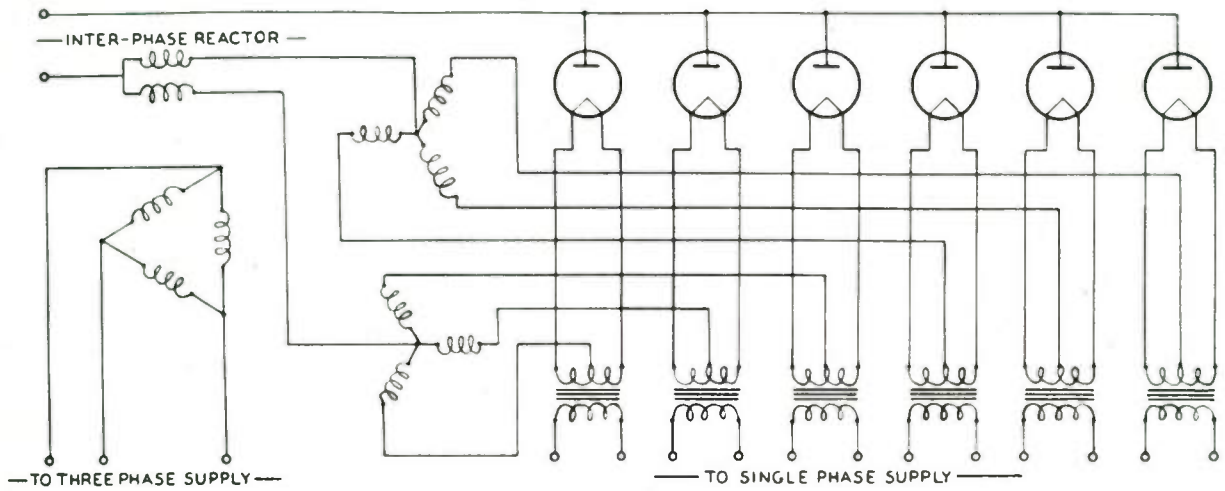


HIGH VACUUM TUBE TYPE F-214-A

Half Wave Rectifier



— TYPICAL RECTIFIER CIRCUIT —



Transformer secondary voltage per leg RMS	0.855
Transformer secondary current per leg RMS	0.289
Transformer secondary KVA	1.48
Transformer primary KVA	1.05
Peak inverse voltage across tubes	2.42
Peak current per tube	0.500

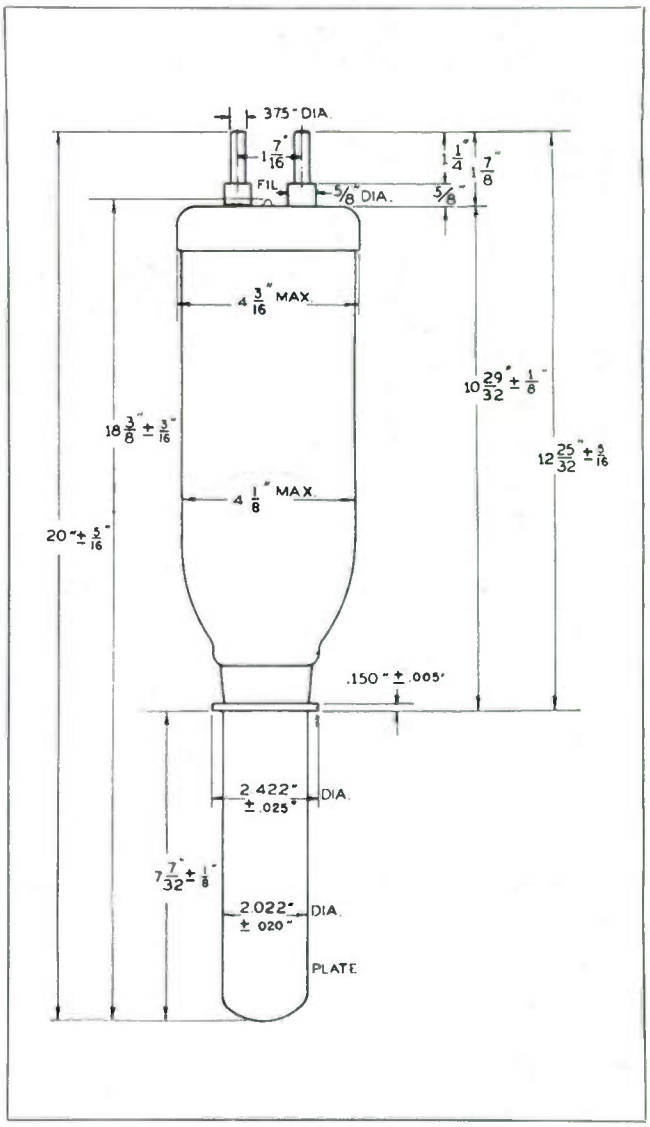
These values are given in terms of the average DC values and are based on the use of an input choke of sufficient inductance to hold the output current essentially constant. Tube voltage drop and transformer resistance are not taken into consideration in the above data. Tube voltage drop may be obtained from the above curves.

HIGH VACUUM TUBE TYPE F-222-A

Half Wave Rectifier

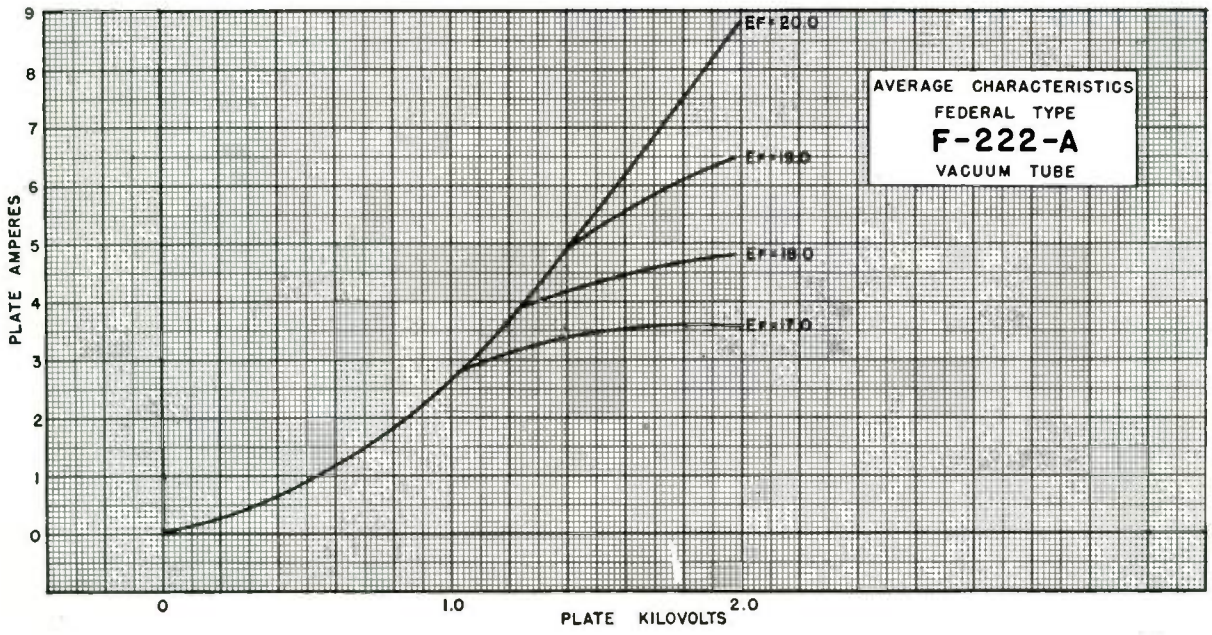
Technical Data

▸ No. of Electrodes	2
▸ Filament Voltage — Max. Peak Plate Current	
21.5 volts	5.5 amperes
20 volts	4.5 amperes
20.5 volts	3.5 amperes
20 volts	2.8 amperes
19.5 volts	2 amperes
▸ Filament Current	41 amperes
Type	Tungsten
▸ Maximum Peak Inverse Voltage	50,000 volts
▸ Type Base	Standard
▸ Type of Cooling	Water
▸ Recommended Water Flow	8 gal. per min.
▸ Water Jacket	Standard or Federal Type F-1005

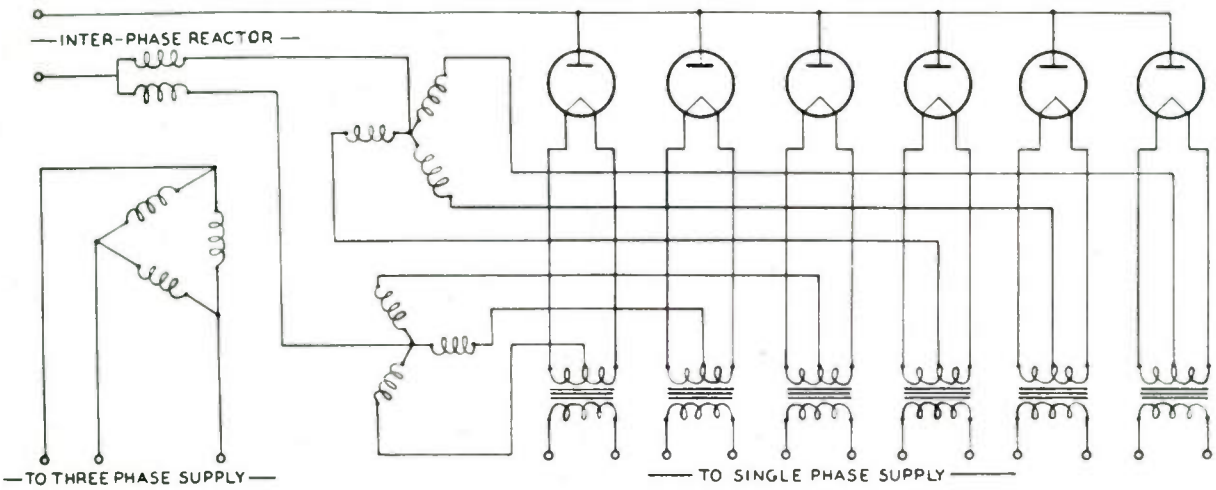


HIGH VACUUM TUBE TYPE F-222-A

Half Wave Rectifier



— TYPICAL RECTIFIER CIRCUIT —



Transformer secondary voltage per leg RMS	0.855
Transformer secondary current per leg RMS	0.289
Transformer secondary KVA	1.48
Transformer primary KVA	1.05
Peak inverse voltage across tubes	2.42
Peak current per tube	0.500

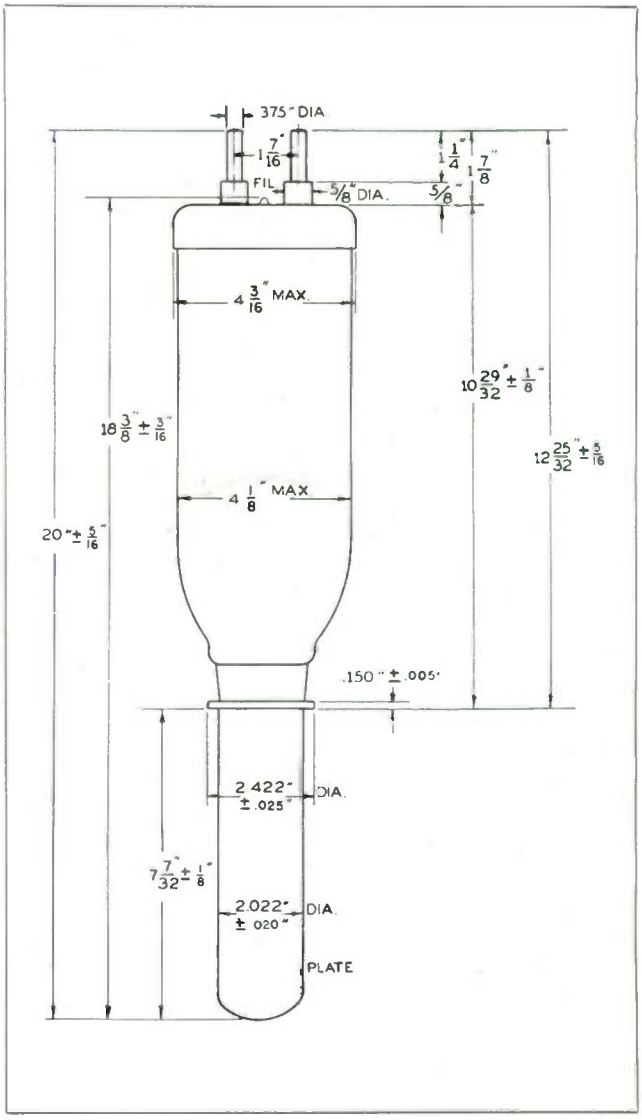
These values are given in terms of the average DC values and are based on the use of an input choke of sufficient inductance to hold the output current essentially constant. Tube voltage drop and transformer resistance are not taken into consideration in the above data. Tube voltage drop may be obtained from the above curves.

HIGH VACUUM TUBE TYPE F-237-A

Half Wave Rectifier

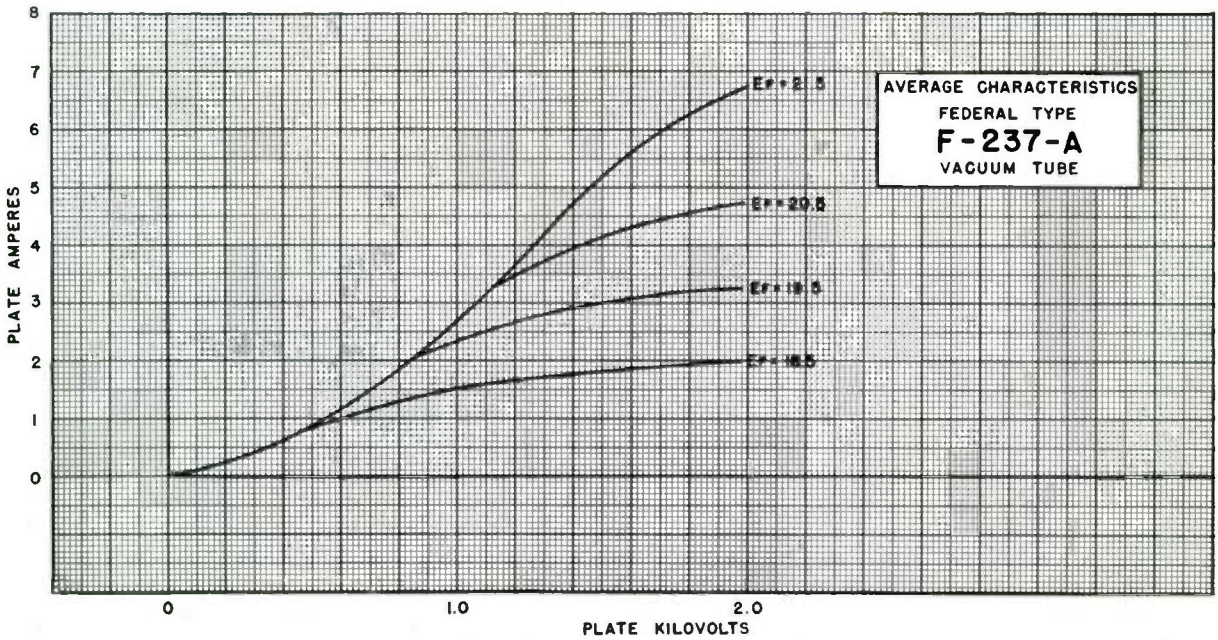
Technical Data

▸ No. of Electrodes	2
▸ Filament Voltage — Max. Peak Plate Current	
20 volts	8 amperes
19.5 volts	6.5 amperes
19 volts	5 amperes
18.5 volts	4.25 amperes
18 volts	3.5 amperes
▸ Filament Current	61 amperes
Type	Tungsten
▸ Maximum Peak Inverse Voltage	50,000 volts
▸ Type Base	Standard
▸ Type of Cooling	Water
▸ Recommended Water Flow	12 gal. per min.
▸ Water Jacket	Standard or Federal Type F-1005

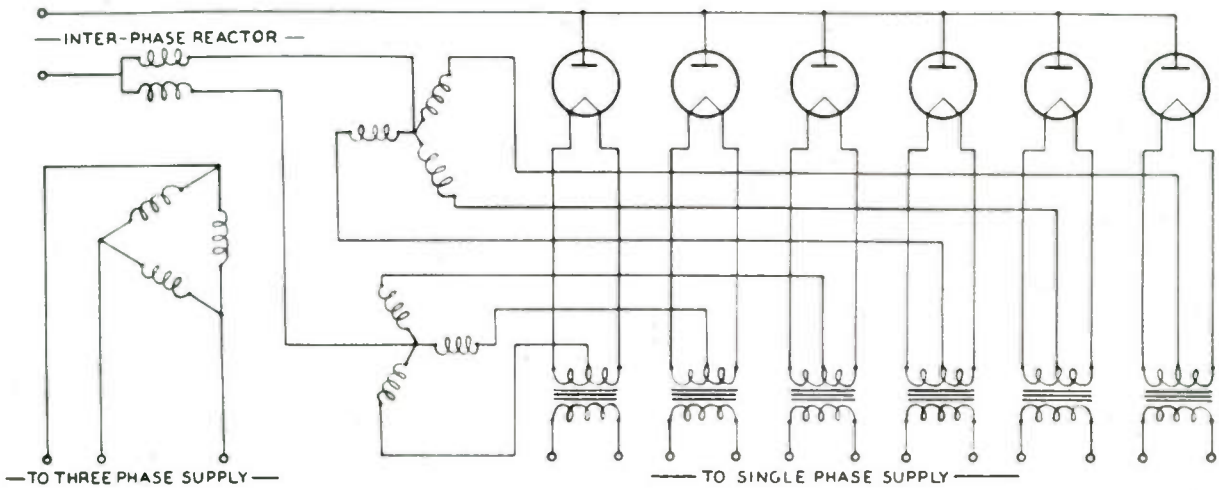


HIGH VACUUM TUBE TYPE F-237-A

Half Wave Rectifier



— TYPICAL RECTIFIER CIRCUIT —



Transformer secondary voltage per leg RMS	0.855
Transformer secondary current per leg RMS	0.289
Transformer secondary KVA	1.48
Transformer primary KVA	1.05
Peak inverse voltage across tubes	2.42
Peak current per tube	0.500

These values are given in terms of the average DC values and are based on the use of an input choke of sufficient inductance to hold the output current essentially constant. Tube voltage drop and transformer resistance are not taken into consideration in the above data. Tube voltage drop may be obtained from the above curves.

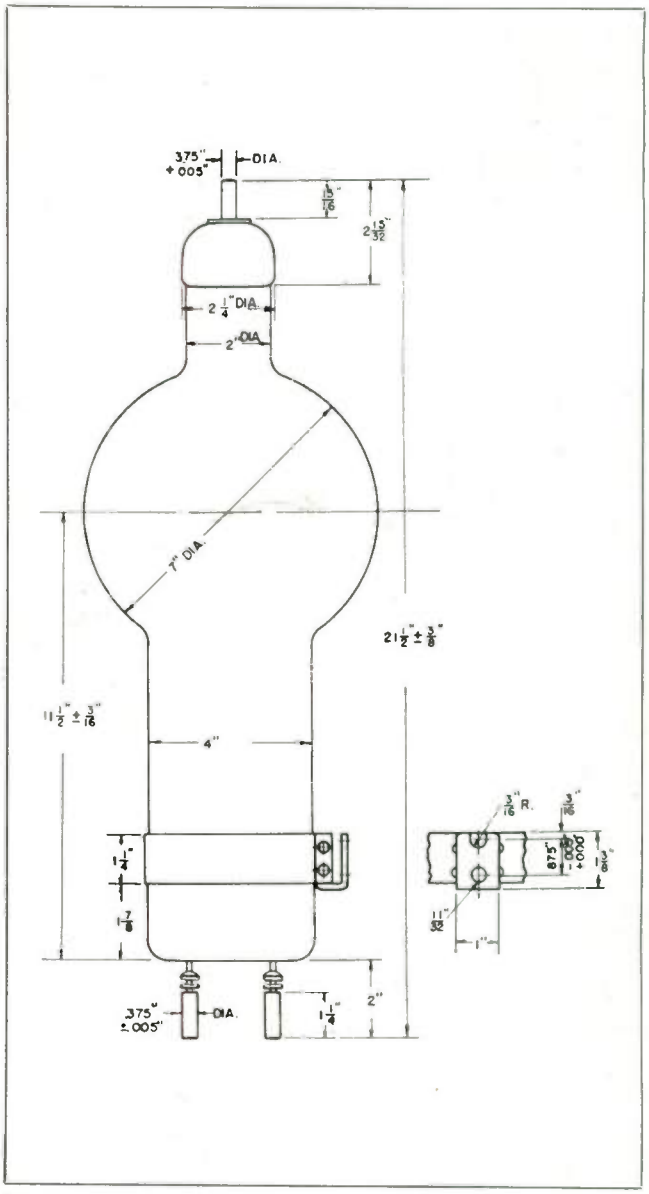
MERCURY VAPOR TUBE TYPE F-266-B

Half Wave Rectifier

Technical Data

▸ No. of Electrodes	2
▸ Filament Voltage	5 volts
Current	30 amperes
Heating Time	120 seconds
▸ Maximum Average Current	10 amperes
▸ Maximum Peak Current	40 amperes
▸ Maximum Peak Inverse Voltage	
Ambient Temperature	
30°—40°C.	22,000 volts
15°—50°C.	10,000 volts
▸ Type Base and Cap	Standard
▸ Mounting	Standard
▸ Recommended Condensed Mercury Temperature Range	15°—50°C.

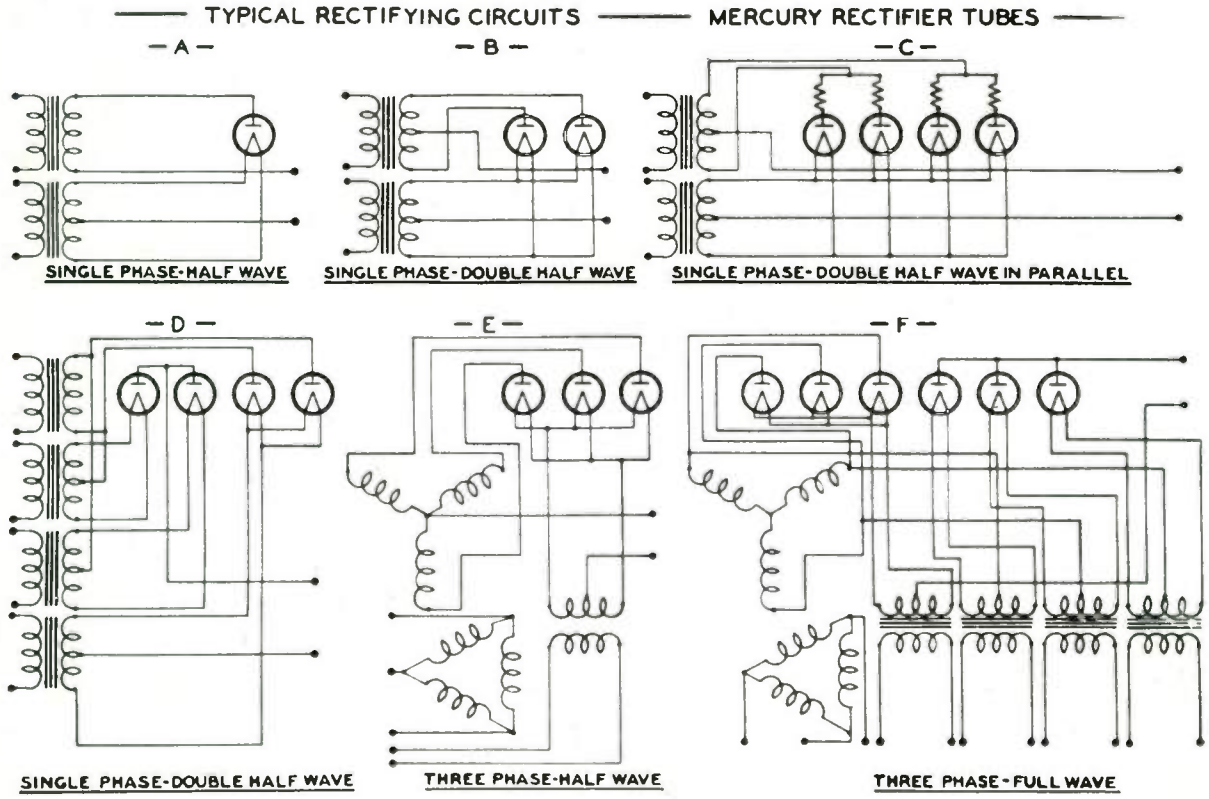
* For plate potentials in excess of 10,000 V. peak inverse, temperature regulated forced air cooling must be employed.



NOTE: An increase in maximum average load current is permitted in some cases by quadrature connection of the tube filament. Inquiries on specific applications are invited.

MERCURY VAPOR TUBE TYPE F-266-B

Half Wave Rectifier



Typical rectifying circuits in which Type F-266-B may be employed are illustrated above. The approximate DC output current and voltage for each type of rectifying circuit shown, when tubes are operated at maximum permissible space current and inverse voltages, are given in the following table:

Circuit	No. of Tubes	Input Voltage R.M.S.	Approx. DC Output	
			Volts	Amperes
A	1	15,500 per tube	7,000	10
B	2	7,750 per tube	7,000	20
C	4	7,750 per tube	7,000	40
D	4	15,500 per 2 tubes	14,000	20
E	3	9,000 per leg	10,500	30
F	6	9,000 per leg	21,000	30

The above values are for rectifiers working into filters the input inductance of which is sufficient to maintain the output current substantially constant. Pure sine waveform of the power source is assumed. Transformer regulation and voltage drops in tubes and filter are neglected.

Federal Telephone and Radio Corporation

Vacuum Tube Products — Newark 4, New Jersey

Printed in U.S.A. Form F-186

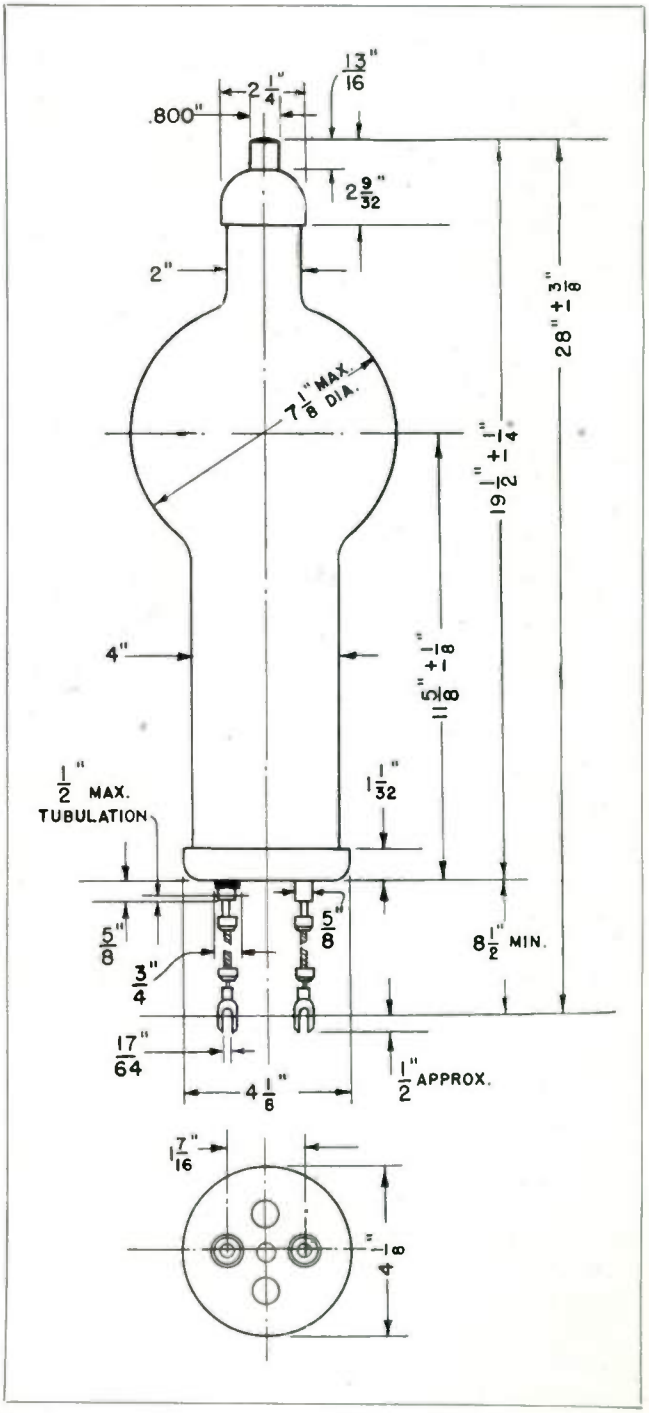
MERCURY VAPOR TUBE TYPE F-857-B

Half Wave Rectifier

Technical Data

▸ No. of Electrodes	2
▸ Filament Voltage	5 volts
Current	30 amperes
Heating Time	120 seconds
▸ Maximum Average Current	10 amperes
▸ Maximum Peak Current	40 amperes
▸ Maximum Peak Inverse Voltage*	
Ambient Temperature	
30°—40°C.	22,000 volts
25°—60°C.	10,000 volts
▸ Type Base and Cap	Standard
▸ Mounting	Standard
▸ Recommended Condensed Mercury Temperature Range	25°—50°C.

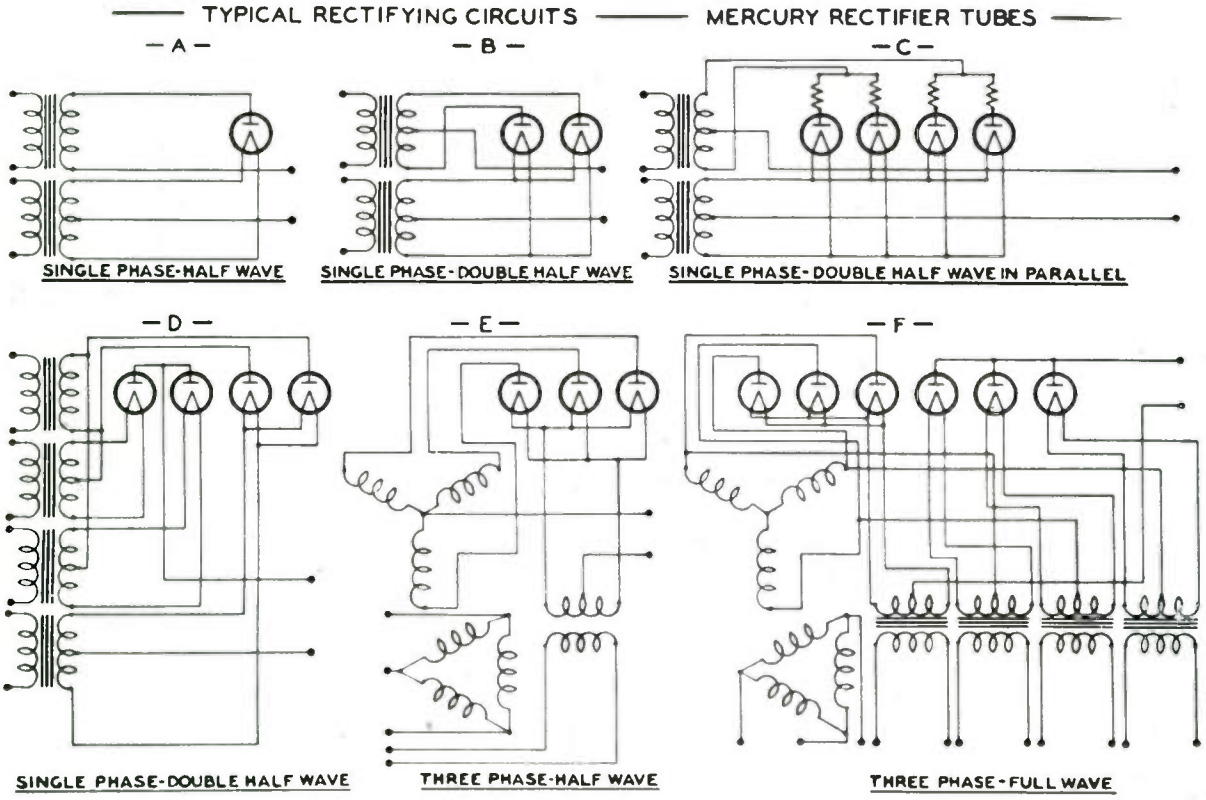
* For plate potentials in excess of 10,000 V. peak inverse, temperature regulated forced air cooling must be employed.



NOTE: An increase in maximum average load current is permitted in some cases by quadrature connection of the tube filament. Inquiries on specific applications are invited.

MERCURY VAPOR TUBE TYPE F-857-B

Half Wave Rectifier



Typical rectifying circuits in which Type F-857-B may be employed are illustrated above. The approximate DC output current and voltage for each type of rectifying circuit shown, when tubes are operated at maximum permissible space current and inverse voltages, are given in the following table:

Circuit	No. of Tubes	Input Voltage R.M.S.	Approx. DC Output	
			Volts	Amperes
A	1	15,500 per tube	7,000	10
B	2	7,750 per tube	7,000	20
C	4	7,750 per tube	7,000	40
D	4	15,500 per 2 tubes	14,000	20
E	3	9,000 per leg	10,500	30
F	6	9,000 per leg	21,000	30

The above values are for rectifiers working into filters the input inductance of which is sufficient to maintain the output current substantially constant. Pure sine waveform of the power source is assumed. Transformer regulation and voltage drops in tubes and filter are neglected.

Federal Telephone and Radio Corporation

Vacuum Tube Products — An IT&T Associate — Newark 4, New Jersey

Printed in U.S.A. Form F-188

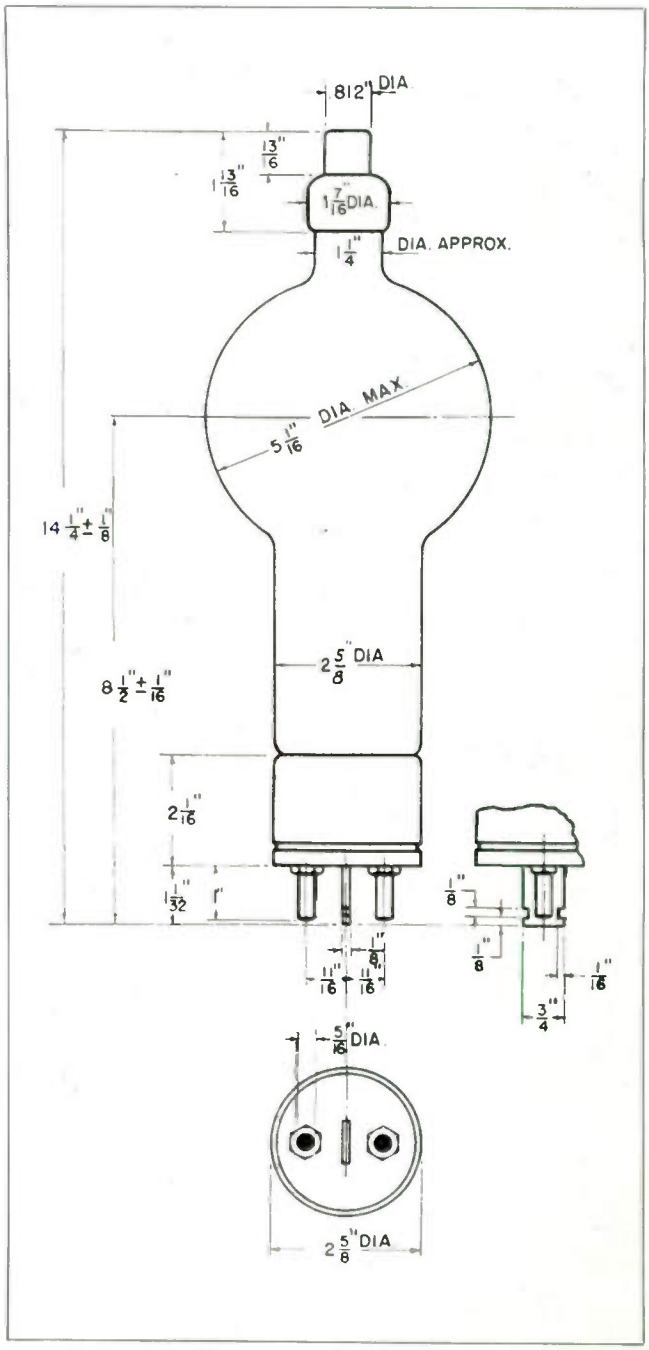
MERCURY VAPOR TUBE TYPE F-869-B

Half Wave Rectifier

Technical Data

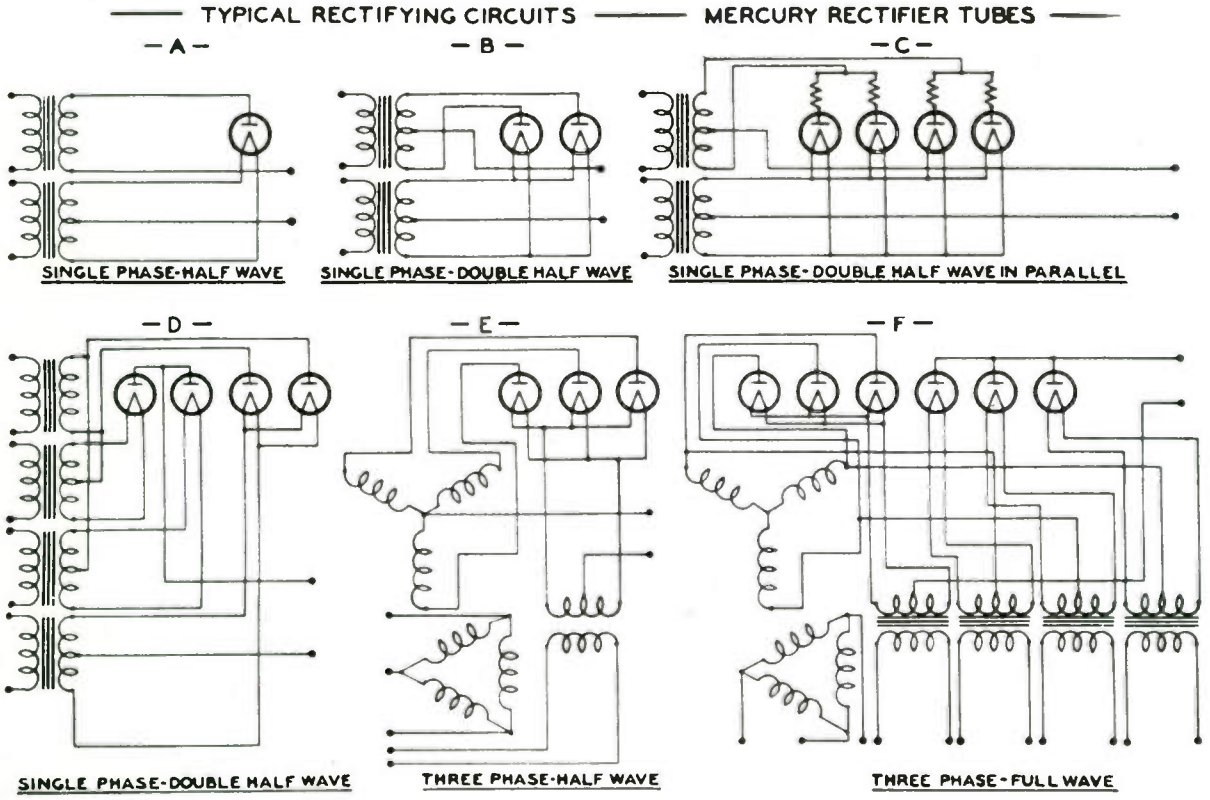
▸ No. of Electrodes	2
▸ Filament Voltage	5 volts
Current	20 amperes
Heating Time	60 seconds
▸ Maximum Average Current	2.5 amperes
▸ Maximum Peak Current	10 amperes
▸ Maximum Peak Inverse Voltage Ambient Temperature	
30°—45° C.	20,000 volts
15°—50° C.	16,000 volts
▸ Type Base and Cap	Standard
▸ Mounting	Standard
▸ Recommended Condensed Mercury Temperature Range	15°—50° C.

NOTE: An increase in maximum average load current is permitted in some cases by quadrature connection of the tube filament. Inquiries on specific applications are invited.



MERCURY VAPOR TUBE TYPE F-869-B

Half Wave Rectifier



Typical rectifying circuits in which Type F-869-B may be employed are illustrated above. The approximate DC output current and voltage for each type of rectifying circuit shown, when tubes are operated at maximum permissible space current and inverse voltages, are given in the following table:

Circuit	No. of Tubes	Input Voltage R.M.S.	Approx. DC Output	
			Volts	Amperes
A	1	14,000 per tube	6,300	2.5
B	2	7,000 per tube	6,300	5
C	4	7,000 per tube	6,300	10
D	4	14,000 per 2 tubes	12,500	5
E	3	8,250 per leg	9,500	7.5
F	6	8,250 per leg	19,200	7.5

The above values are for rectifiers working into filters the input inductance of which is sufficient to maintain the output current substantially constant. Pure sine waveform of the power source is assumed. Transformer regulation and voltage drops in tubes and filter are neglected.

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INDUSTRIAL TUBE TYPE 7C25

Tentative Data

Filament Type	Thoriated Tungsten
Filament Voltage	11.0 Volts
Filament Current	27.5 Amperes
Available Peak Emission	10 Amperes

Characteristics at
E_b=3000 Volts; I_b=0.200 Amperes; E_f=11.0 Volts

Grid Voltage (approx.)	–50 Volts
Amplification Factor	25
Mutual Conductance	4700 Microhms
Plate Resistance	5320 Ohms
Type of Cooling	Forced Air 150 CFM Minimum

Maximum Overall Dimensions

Length	7 Inches
Diameter	3.5 Inches
Net Weight	5¼ Pounds

Approximate Direct Inter-Electrode Capacitances

Plate to Grid	12.0 μμf
Grid to Filament	12.5 μμf
Plate to Filament	1.7 μμf

Tentative Maximum Ratings for Maximum Frequency of 50 Megacycles

Class C Power Amplifier and Oscillator
Key-down conditions without modulation

D-C Plate Voltage	4500 Volts
D-C Grid Voltage	–1000 Volts
D-C Plate Current	1.25 Amperes
D-C Grid Current	0.15 Amperes
Plate Input	5600 Watts
Plate Dissipation	2500 Watts
Anode Temperature	180° Centigrade

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INDEX TO FEDERAL PRODUCTS