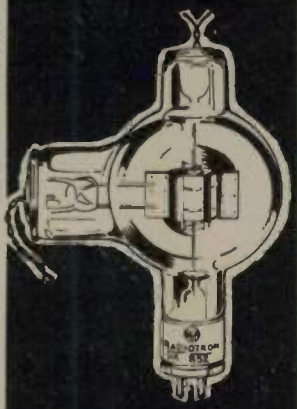


RCA

RADIOTRONS

AMATEUR TRANSMITTING TYPES

The technical information given in this booklet for RCA-10, UX-250, UX-841, UX-842, RCA-852, RCA-865 and RCA-866 also applies to the corresponding Cunningham types C-10, CX-350, C-841, C-842, C-852, C-865 and C-966.

Commercial Engineering Section
RCA RADIOTRON CO., Inc.
Harrison, New Jersey

Printed in U.S.A.

RCA Radiotron

RCA-10

A-F and R-F Power Amplifier

Type 10 is a general-purpose, three-electrode amplifier tube capable of delivering large undistorted power output to the loudspeaker. In amateur transmitting circuits, the tube is especially suited for use as an oscillator and as a radio-frequency amplifier. It may also be employed as a modulator.

CHARACTERISTICS

General

FILAMENT VOLTAGE (A.C. or D.C.)			7.5	Volts
FILAMENT CURRENT			1.25	Amperes
GRID-PLATE CAPACITANCE			7	µµf.
GRID-FILAMENT CAPACITANCE			4	µµf.
PLATE-FILAMENT CAPACITANCE			3	µµf.
MAXIMUM OVERALL LENGTH			5-5/8"	
MAXIMUM DIAMETER			2-3/16"	
BULB			S-17	
BASE			Medium 4-Pin Bayonet	

As Audio-Frequency Class A Amplifier

PLATE VOLTAGE			425 *max.*	Volts
PLATE DISSIPATION			12 *max.*	Watts
TYPICAL OPERATION:				
Filament Voltage (A.C.)			7.5	Volts
Plate Voltage	250	350	425	Volts
Grid Voltage	-22	-31	-39	Volts
Plate Current	10	16	18	Milliamp.
Plate Resistance	6000	5150	5000	Ohms
Amplification Factor	8	8	8	
Mutual Conductance	1330	1550	1600	Micromhos
Load Resistance	13000	11000	10200	Ohms
Undistorted Power Output	400	900	1600	Milliwatts

As Class A Modulator

PLATE VOLTAGE	425 *max.*	Volts	
PLATE DISSIPATION	12 *max.*	Watts	
TYPICAL OPERATION:			
Filament Voltage (A.C.)	7.5	Volts	
Plate Voltage	350	Volts	
Grid Voltage	-35	Volts	
Modulation Factor	0.5		
D-C Plate Current	10	Milliamp.	
Peak Grid Swing	31	Volts	
Oscillator Input Per Modulator Tube	6.5	Watts	

As Radio-Frequency Class B Amplifier

PLATE VOLTAGE	450 *max.*	Volts
D-C PLATE CURRENT (Unmodulated)*	30 *max.*	Milliamp.
PLATE DISSIPATION	15 *max.*	Watts
R-F GRID CURRENT	5 *max.*	Amperes
TYPICAL OPERATION:		
Filament Voltage (A.C.)	7.5	Volts
Plate Voltage	350	Volts
Grid Voltage (Approximate)	-39	Volts

* Limited by maximum plate dissipation.

D-C Plate Current (Unmodulated)	43	Milliamp.
Peak Power Output	12	Watts
Carrier Output (Mod. Factor 1.0)	3	Watts
As Radio-Frequency Class C Amplifier (Oscillator)		
D-C PLATE VOLTAGE (Modulated)	350 *max.*	Volts
D-C PLATE VOLTAGE (Unmodulated)	450 *max.*	Volts
D-C PLATE CURRENT	60 *max.*	Milliamp.
PLATE DISSIPATION	15 *max.*	Watts
R-F GRID CURRENT	5 *max.*	Amperes
D-C GRID CURRENT	15 *max.*	Milliamp.
TYPICAL OPERATION:		
Filament Voltage (A.C.)	7.5	Volts
Plate Voltage	350	Volts
Grid Voltage (Approximate)	-100	Volts
Power Output	10	Watts

INSTALLATION

The *base* pins of the 10 fit the standard 4-contact socket. The socket should be installed so that the tube will operate in a vertical position with the base down. If it is necessary to place the tube in a horizontal position, the socket should be mounted with the filament pin openings one vertically above the other. For socket connections, see page 4.

The *bulb* of this tube becomes quite hot during continuous operation. Sufficient ventilation should be provided around the tube to prevent overheating.

The *filament* of the 10 is usually operated from the a-c line through a step-down transformer. Most satisfactory operating performance of the tube will be obtained at the rated filament voltage.

Overheating of this tube by severe overload decreases filament emission. Unless the overload has liberated a large amount of gas, the activity of the filament may be restored by operating it at rated voltage for ten minutes or more without plate or grid voltage. This reactivation process may be accelerated by raising the filament voltage to 9 volts.

The *grid and plate circuit returns* should be connected to the center tap on the filament winding of the transformer, or to the midpoint of a center-tapped resistor across the filament terminals. In Class B and Class C radio-frequency service when d.c. is used on the filament, the grid and plate returns should be connected to the negative filament terminal.

A milliammeter in the plate circuit of the tube is desirable so that the plate-input power will always be known. Under no condition should the d-c plate current exceed the maximum values as given under CHARACTERISTICS. In order to prevent overheating due to improper circuit adjustments or to overload, a 5-ampere fuse should be placed in series with the plate lead of this tube. No fuse should be used in the grid lead since its opening would leave the tube without grid bias.

When a new circuit is tried out, or when adjustments are being made, the plate voltage should be reduced in order to prevent damage to the tube or associated apparatus in case the circuit adjustments are incorrect.

APPLICATION

As an *audio-frequency amplifier (Class A)*, the 10 should be operated as shown under CHARACTERISTICS.

Grid-bias for audio-frequency service may be obtained from a separate voltage source or by means of the voltage drop in a resistor connected in the negative plate-return lead (self-bias). The latter method is preferable as it compensates automatically for variation in the plate current of individual tubes. The proper value of this resistor for a single tube is 2200 ohms at a plate voltage of 250 volts; 1935 ohms for a plate voltage of 350 volts; and 2360 ohms for a plate voltage of 425 volts. The self-biasing resistor should be shunted by a suitable filter network to avoid degenerative effects at low audio-frequencies.

If more audio output is desired than can be obtained from a single 10, two type 10's may be operated either in parallel or push-pull. The parallel connection provides twice the output of a single tube without an increase in grid signal voltage. The push-pull connection will give twice the output at the same grid bias, but requires twice the input signal. Output slightly greater than twice the single tube value can be obtained from the push-pull connection by increasing the bias. In the latter case, the output is limited almost entirely by 3rd harmonic distortion. When two type 10's are operated together (parallel or push-pull), the values of the self-biasing resistors will be approximately one-half the values given above for a single tube. When two type 10's are operated in push-pull, the filter network across the self-biasing resistor may be omitted.

An *output device* should be used to transfer power efficiently to the windings of the reproducing unit when this tube is used as an audio-frequency power-amplifier.

As a *modulator*, the 10 should be operated as shown under CHARACTERISTICS.

As a *Class B and Class C radio-frequency amplifier*, the 10 should be operated as shown under CHARACTERISTICS.

Grid bias for this tube as a Class B r-f amplifier should be obtained from a battery or from a generator; it should never be obtained from a high-resistance supply such as a grid leak or from a rectifier with a high resistance voltage-divider. Grid bias for the 10 as a Class C r-f amplifier may be obtained from a battery, or from a grid leak of about 10000 ohms. Since grid-bias values are not particularly critical, correct circuit adjustment may be obtained with considerably different values.

The *d-c grid current* must never be greater than 15 milliamperes. The exact value will vary with individual tubes and circuits.

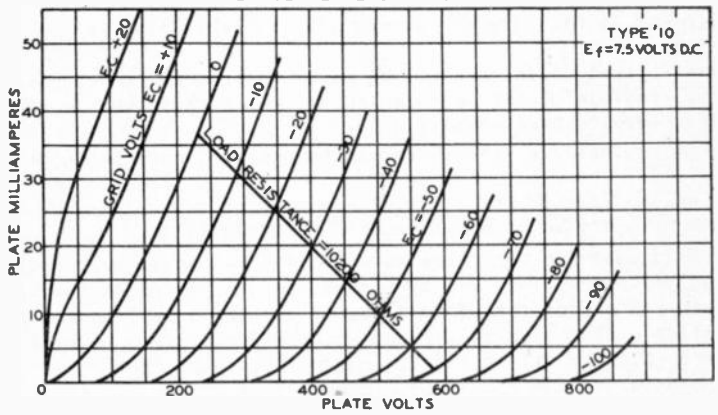
When the 10 is used in circuits at frequencies above 3000 kilocycles, special precautions should be taken so that the tube is not harmed by abnormal conditions. At these higher frequencies the interelectrode-capacity reactances are greatly reduced with the result that the radio-frequency currents may become excessive. Common effects produced by such excessive currents are opening of the interior grid or plate lead and glass-stem puncture. Under no condition of operation should the grid or plate ever be allowed to reach such a temperature that it shows color.

In general, the 10 may be used satisfactorily as a radio-frequency Class B and Class C r-f amplifier at frequencies as high as 30000 kilocycles under the following limiting values.

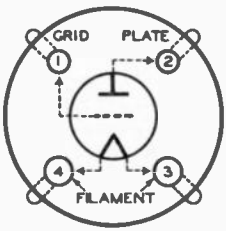
PLATE VOLTAGE	350 *max.* Volts
PLATE DISSIPATION	10 *max.* Watts
R-F GRID CURRENT	5 *max.* Amperes

If more radio-frequency output is desired than can be obtained from a single 10, two of these tubes may be operated either in parallel or push-pull connection. The parallel connection provides twice the output of a single tube without an increase in exciting voltage, while the push-pull connection gives twice the output at the same bias, but requires twice the exciting voltage. The push-pull circuit is advantageous in reducing total grid-plate capacity. This reduction is desirable when the tube is operated at high frequencies. When two or more 10's are operated in parallel as an r-f amplifier, a small r-f choke, or better still, a resistance of 10 to 100 ohms should be placed in series with the grid lead of each tube as close to the grid as possible in order to prevent parasitic oscillations. The use of the resistance in the grid lead of either an oscillator or a radio-frequency power amplifier will result in a slight decrease in efficiency.

AVERAGE PLATE CHARACTERISTICS



Tube Symbol and Top View of Socket Connections



RCA Radiotron
UX-250

Power Amplifier

Type '50 is a power amplifier tube designed for use primarily in the last stage of an audio-frequency amplifier (either singly or in push-pull) employing transformer coupling. It is to be used where an unusually large amount of undistorted power output is desired. The '50 is also useful as a modulator in amateur radio telephone transmitters.

CHARACTERISTICS

General

FILAMENT VOLTAGE (A.C. or D.C.)	7.5	Volts
FILAMENT CURRENT	1.25	Amperes
GRID-PLATE CAPACITANCE	9	μμf.
GRID-FILAMENT CAPACITANCE	5	μμf.
PLATE-FILAMENT CAPACITANCE	3	μμf.
MAXIMUM OVERALL LENGTH	6-1/4"	
MAXIMUM DIAMETER	2-11/16"	
BULB	S-21	
BASE	Medium 4-Pin Bayonet	

As Audio-Frequency Class A Amplifier

FILAMENT VOLTAGE (A.C.)			7.5	Volts
PLATE VOLTAGE	350	400	450 *max.*	Volts
GRID VOLTAGE*	-63	-70	-84	Volts
PLATE CURRENT	45	55	55	Milliamp.
PLATE RESISTANCE	1900	1800	1800	Ohms
AMPLIFICATION FACTOR	3.8	3.8	3.8	
MUTUAL CONDUCTANCE	2000	2100	2100	Micromhos
LOAD RESISTANCE	4100	3670	4350	Ohms
UNDISTORTED POWER OUTPUT	2.4	3.4	4.6	Watts

As Class A Modulator

FILAMENT VOLTAGE (A.C.)	7.5	Volts
PLATE VOLTAGE	450 *max.*	Volts
PLATE DISSIPATION	25 *max.*	Watts
GRID BIAS VOLTAGE (Approximate*)	-100	Volts
PEAK GRID SWING	96 *max.*	Volts
PLATE CURRENT (Approximate)	30	Milliamp.
OSCILLATOR INPUT PER MODULATOR TUBE	14**	Watts
MODULATION FACTOR (Approximate)	0.74	

* Measured from mid-point of a-c operated filament.

** The above data is for an oscillator (or R-F Amplifier) plate current of 40 ma. at 350 volts.

INSTALLATION

The *base* pins of the '50 fit the standard four-contact socket which should be mounted to hold the tube in a vertical position. For socket connections, see page 3.

The *bulb* of this tube becomes quite hot during continuous operation. Sufficient ventilation should be provided to prevent overheating.

The coated *filament* is usually operated from the a-c line through a step-down transformer. However, if desirable, it may be operated equally as well from a d-c source. In either case the voltage applied to the filament terminals should be the rated value of 7.5 volts.

The *grid and plate circuit returns* should be connected to the center tap on the filament winding of the transformer,or to the midpoint of a center-tapped resistor across the filament terminals. In cases where d.c. is used on the filament, the grid and plate returns should be connected to the negative filament terminal.

In experimental circuits, a milliammeter in the plate circuit of the tube is desirable so that the plate-input power will always be known. Under no condition should the d-c plate current exceed the maximum values as given under CHARACTERISTICS.

APPLICATION

As an *audio-frequency amplifier (Class A)*, the '50 should be operated as shown under CHARACTERISTICS.

Grid bias for audio-frequency service may be obtained from a separate voltage source or by means of the voltage drop in a resistor connected in the negative plate-return lead (self bias). The latter method is preferable as it compensates automatically for variation in the plate current of individual tubes. The proper value of this resistor for a single tube is 1400 ohms for a plate voltage of 350 volts; 1275 ohms for a plate voltage of 400 volts; and 1530 ohms for a plate voltage of 450 volts. The self-biasing resistor should be shunted by a suitable filter network to avoid degenerative effects at low audio-frequencies.

If more audio output is desired than can be obtained from a single '50, two '50's may be operated either in parallel or push-pull. The parallel connection provides twice the output of a single tube without an increase in grid signal voltage. The push-pull connection will give twice the output at the same grid bias, but requires twice the input signal. Output slightly greater than twice the single tube value can be obtained from the push-pull connection by increasing the bias. In the latter case, the output is limited almost entirely by 3rd harmonic distortion. When two '50's are operated together (parallel or push-pull), the values of the self-biasing resistors will be approximately one-half the values given above for a single tube. When two '50's are operated in push-pull, the filter network across the self-biasing resistor may be omitted.

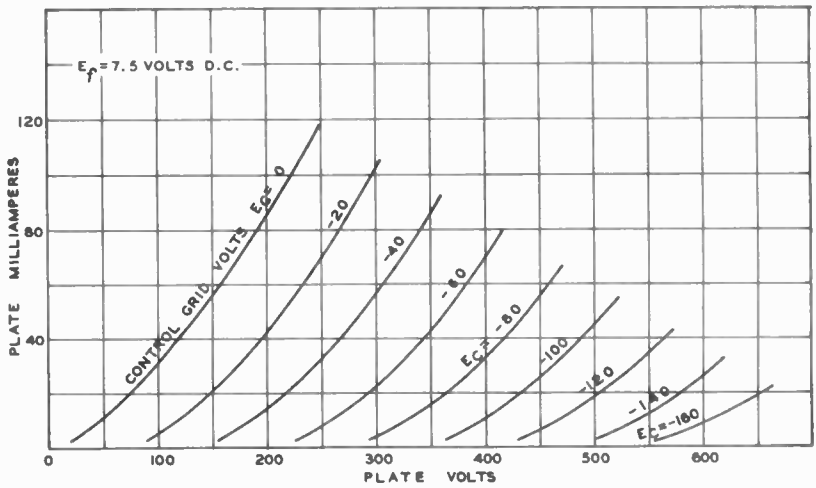
An *output device* should be used to transfer power efficiently to the windings of the reproducing unit when this tube is used as an audio-frequency power amplifier.

Resistance-coupled amplification is not recommended with this tube since the resistance in the grid circuit must be limited to 10000 ohms.

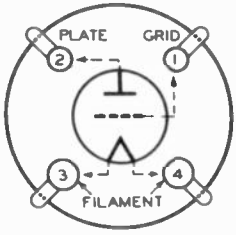
As a *modulator (Class A)*, the '50 should be operated as shown under CHARACTERISTICS. In such service, the tube is subject to the same general considerations as Class A Audio-Frequency Amplification.

Grid bias for the '50 as a modulator may be obtained from a separate voltage source or by means of a self-biasing resistor. The value of the self-biasing resistor is 3335 ohms at a plate voltage of 450 volts. When two or more '50's are operated in parallel or push-pull in the modulator stage, the value of self-biasing resistor will be approximately one-half that of a single tube. In either case the resistor should preferably be shunted by a suitable filter network to minimize grid-bias variations produced by current surges in the biasing resistor. If the parallel connection is used, a resistance of approximately 100 ohms should be placed in series with each grid lead, as near to the socket as possible to prevent parasitic oscillations.

AVERAGE PLATE CHARACTERISTICS



Tube Symbol and Bottom View of Socket Connections



RCA Radiotron

UV-203-A

Oscillator, R-F Power Amplifier, Class B Modulator

The 203-A is a three-electrode transmitting tube designed for use as an oscillator, r-f power amplifier, or Class B modulator.

CHARACTERISTICS

General

FILAMENT VOLTAGE (A.C.)	10.0	Volts
FILAMENT CURRENT	3.25	Amperes
AMPLIFICATION FACTOR	25	
GRID-PLATE CAPACITANCE	15	μμf.
GRID-FILAMENT CAPACITANCE	8	μμf.
PLATE-FILAMENT CAPACITANCE	7	μμf.
MAXIMUM OVERALL LENGTH	7-7/8"	
MAXIMUM DIAMETER	2-5/16"	
BULB (See page 4)	T-18	
BASE - Type #1839	Jumbo 4-Large Pin	

As Oscillator and R-F Power Amplifier - Class C

D-C PLATE VOLTAGE (Modulated)			1000 *max.*	Volts
D-C PLATE VOLTAGE (Unmodulated)			1250 *max.*	Volts
D-C PLATE CURRENT			175 *max.*	Milliamp.
PLATE DISSIPATION			100 *max.*	Watts
R-F GRID CURRENT			7.5 *max.*	Amperes
D-C GRID CURRENT			60 *max.*	Milliamp.
TYPICAL OPERATION:				
Filament Voltage (A.C.)			10.0	Volts
D-c Plate Voltage	750	1000	1250	Volts
Grid Voltage	-75	-100	-125 *approx.*	Volts
D-c Plate Current	150	150	150 *approx.*	Milliamp.
Power Output	65	100	130	Watts

As R-F Power Amplifier - Class B

D-C PLATE VOLTAGE			1250 *max.*	Volts
D-C PLATE CURRENT (Unmodulated)			150 *max.*	Milliamp.
PLATE DISSIPATION			100 *max.*	Watts
R-F GRID CURRENT			7.5 *max.*	Amperes
TYPICAL OPERATION:				
Filament Voltage (A.C.)			10.0	Volts
D-c Plate Voltage		1000	1250	Volts
Grid Voltage		-35	-45 *approx.*	Volts
D-c Plate Current (Unmodulated)		130	105 *approx.*	Milliamp.
Peak Power Output		160	170	Watts
Carrier Output (Mod. factor 1.0)		40	42.5	Watts

As Modulator - Class B

D-C PLATE VOLTAGE	1250 *max.*	Volts
AVERAGE D-C PLATE CURRENT*	175 *max.*	Milliamp.
AVERAGE PLATE DISSIPATION*	100 *max.*	Watts

TYPICAL OPERATION: (2 tubes)

Filament Voltage (D.C.)		10.0		Volts
D-c Plate Voltage	1000	1250		Volts
Grid Voltage	-35	-45	*approx.*	Volts
Static Plate Current (Per tube)	5	6		Milliamp.
Load Resistance (Plate-to-plate)	6800	9000		Ohms
Nominal Power Output (2 tubes)	200	260		Watts

* Averaged over any audio-frequency cycle.

INSTALLATION

The *base* of the 203-A fits a standard, transmitting, four-contact socket, such as the RCA type UT-541. The socket should be mounted so that the tube will operate in a vertical position, with the base end down. The outline dimensions and socket connections are shown on page 4.

The *bulb* of this tube becomes very hot during continuous operation. Free circulation of air should therefore be provided.

The *filament* of the 203-A should be operated from an a-c source whenever possible. In certain applications where freedom from hum is essential, the use of direct current is to be preferred. A filament voltmeter should be connected directly across the socket terminals so that the filament voltage can be kept at 10.0 volts. Rheostat control should be placed in the primary circuit of the filament transformer. During "standby" periods the filament voltage should be kept at its rated value.

The *grid and plate returns* should be connected to the center tap on the filament transformer winding, or to the mid-point of a center-tapped resistor across the filament terminals. If it is necessary to use direct current, these returns should be connected to the negative filament terminal.

The plate dissipation of the 203-A (the difference between input and output) should never exceed 100 watts. This value is indicated by a dull red color of the plate. The color can best be determined by opening the power supply switches with the tube operating. This avoids reflections from the lighted filament which otherwise would interfere with the observation.

Overheating of the 203-A by severe overload decreases the filament emission. Unless the overload has liberated a large amount of gas, the activity of the filament may be restored by operating it at rated voltage for ten minutes or more with no voltage on the plate or grid. This reactivation process may be accelerated by raising the filament voltage to 12 volts.

A milliammeter in the plate circuit of the 203-A is desirable in order that the plate current can always be known. Under no condition should the d-c plate current exceed the maximum values given under CHARACTERISTICS.

In order to prevent overheating due to improper circuit adjustments or to overloading, a 7.5-ampere fuse should be placed directly in series with the plate lead of this tube. No fuse should be placed in the grid lead since its opening would leave the tube without bias.

When a new circuit is tried out or when adjustments are being made, the plate voltage should be reduced in order to prevent damage to the tube or associated apparatus, in case the circuit adjustments are incorrect.

APPLICATION

As a *Class B and Class C radio-frequency amplifier*, the 203-A may be operated as shown under CHARACTERISTICS.

Grid bias for this tube as a Class B amplifier should be obtained from a battery or from a d-c generator. It should not be obtained from a high-resistance supply such as a grid leak, nor from a rectifier unless it has exceptionally good voltage regulation. For Class C service, grid bias may be obtained from a grid leak of about 5000 ohms, from a battery, from a rectifier of good regulation, or from a cathode-biasing resistor by-passed by a suitable condenser. Since grid-bias values are not particularly critical, correct circuit adjustment may be obtained with widely different values.

The *d-c grid current* should never exceed 60 milliamperes. The exact value will depend upon individual tubes and circuits.

The 203-A is capable of delivering full output at frequencies as high as 6000 kilocycles (50 meters). Although this tube is not constructed for operation at the higher frequencies and although other tube types are recommended for regular operation at such frequencies, satisfactory operation with reduced output has been obtained in experimental circuits at frequencies as high as 30000 kilocycles. When the 203-A is operated at frequencies in excess of 6000 kc., the plate voltage and power input should be reduced so that the plate current, plate dissipation and d-c grid current will not exceed 50 percent of the maximum ratings. In addition, special attention should be given to the matter of ventilation.

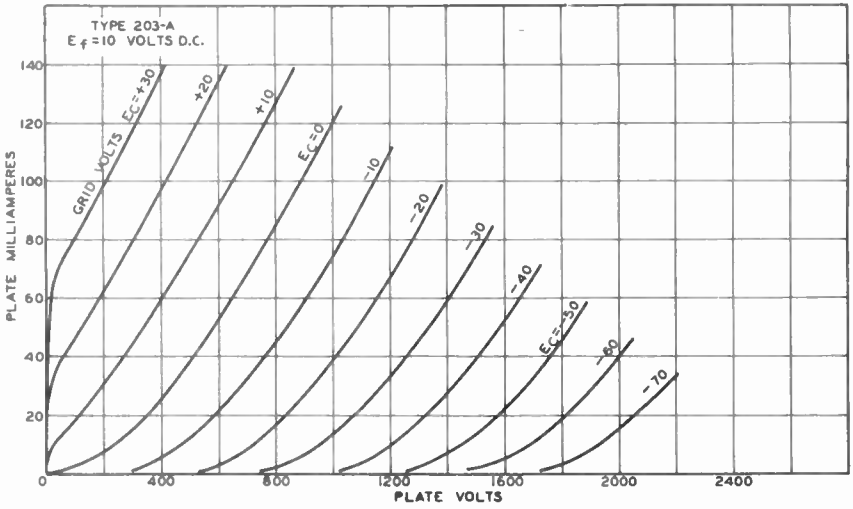
If more power output is desired than a single 203-A will deliver, two tubes may be operated either in parallel or push-pull. The parallel connection provides approximately twice the power output of a single tube without an increase in r-f exciting voltage, while the push-pull connection gives twice the output at the same bias, but requires twice the exciting voltage. The push-pull connection is advantageous in reducing the total grid-plate capacity, inasmuch as the tube capacities are in series. This reduction is especially desirable when the tubes are operated at the higher frequencies.

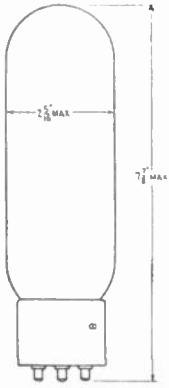
When two or more 203-A's are operated in parallel, a small r-f choke or a non-inductive resistance of 10 to 100 ohms should be placed in series with the grid lead of each tube, next to the socket, to prevent parasitic oscillations. The use of such a resistance will decrease the efficiency slightly.

In *Class B modulator* service, two 203-A's are used in a balanced circuit, each tube conducting only half the time. Two tubes, operating under the conditions shown for a 1000-volt plate supply, are capable of modulating 100 percent 400 watts of input to a radio-frequency amplifier. The output transformer should be so designed that the resistance load presented by the modulated amplifier is reflected into the plate circuit of the 203-A's as 6800 ohms, for the 1000-volt conditions.

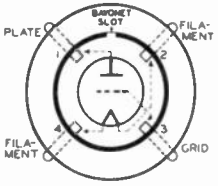
The driver stage may consist of two type 50's as a push-pull Class A amplifier. The input transformer should be designed to give good frequency response when operated into an open circuit, such as that represented by the grid circuit of the Class B stage when the signal amplitude is small, and also be able to handle the required input power for a strong signal.

AVERAGE PLATE CHARACTERISTICS





Tube Symbol and Top View
of
Socket Connections



RCA Radiotron

UV-211

Oscillator, R-F Power Amplifier, Modulator

The 211 is a three-electrode, general-purpose transmitting tube. It may be used as an oscillator, radio-frequency power amplifier, modulator, or audio-frequency amplifier.

CHARACTERISTICS

General

FILAMENT VOLTAGE (A.C.)	10.0	Volts
FILAMENT CURRENT	3.25	Amperes
AMPLIFICATION FACTOR	12	
GRID-PLATE CAPACITANCE	15	µµf.
GRID-FILAMENT CAPACITANCE	8	µµf.
PLATE-FILAMENT CAPACITANCE	7	µµf.
MAXIMUM OVERALL LENGTH	7-7/8"	
MAXIMUM DIAMETER	2-5/16"	
BULB (See page 4)	T-18	
BASE - Type #1839	Jumbo 4-Large Pin	

As Oscillator and R-F Power Amplifier - Class C

D-C PLATE VOLTAGE (Modulated)	1000 *max.*	Volts
D-C PLATE VOLTAGE (Unmodulated)	1250 *max.*	Volts
D-C PLATE CURRENT	175 *max.*	Milliamp.
PLATE DISSIPATION	100 *max.*	Watts
R-F GRID CURRENT	7.5 *max.*	Amperes
D-C GRID CURRENT	50 *max.*	Milliamp.
TYPICAL OPERATION:		
Filament Voltage (A.C.)	10.0	Volts
D-c Plate Voltage	1000	Volts
Grid Voltage	-200 *approx.*	Volts
D-c Plate Current	145 *approx.*	Milliamp.
Power Output	100	Watts

As R-F Power Amplifier - Class B

D-C PLATE VOLTAGE	1250 *max.*	Volts
D-C PLATE CURRENT (Unmodulated)	150 *max.*	Milliamp.
PLATE DISSIPATION	100 *max.*	Watts
R-F GRID CURRENT	7.5 *max.*	Amperes
TYPICAL OPERATION:		
Filament Voltage (A.C.)	10.0	Volts
D-c Plate Voltage	1000	Volts
Grid Voltage	-80 *approx.*	Volts
D-c Plate Current (Unmodulated)	130	Milliamp.
Peak Power Output	160	Watts
Carrier Output (Mod. factor 1.0)	40	Watts

As Modulator

D-C PLATE VOLTAGE	1250 *max.*	Volts
PLATE DISSIPATION	75 *max.*	Watts
TYPICAL OPERATION: Mod. Factor 0.6		
Filament Voltage (A.C.)	10.0	Volts
D-c Plate Voltage	1000	Volts
Grid Voltage	-73 *approx.*	Volts
D-c Plate Current	25	Milliamp.
Peak Grid Swing	68 *approx.*	Volts
Oscillator Input per Mod. Tube	40	Watts

As A-F Power Amplifier - Class A

D-C PLATE VOLTAGE	1250 *max.*	Volts
PLATE DISSIPATION	75 *max.*	Watts
TYPICAL OPERATION:		
Filament Voltage (A.C.)	10.0	Volts
D-c Plate Voltage	1000	Volts
Grid Voltage	-57 *approx.*	Volts
D-c Plate Current	65	Milliamp.
Peak Grid Swing	52 *approx.*	Volts
Load Impedance	7000	Ohms
Power Output (5% Second harmonic)	10.0	Watts

INSTALLATION

The *base* of the 211 fits a standard, transmitting, four-contact socket, such as the RCA type UT-541. The socket should be mounted so that the tube will operate in a vertical position with the base end down. The outline dimensions and socket connections are shown on page 4.

The *bulb* of this tube becomes very hot during continuous operation. Free circulation of air should therefore be provided.

The *filament* of the 211 should be operated from an a-c source whenever possible. In certain installations where freedom from hum is essential, the use of direct current is to be preferred. A filament voltmeter should be connected directly across the socket terminals so that the filament voltage can be kept at 10.0 volts. Rheostat control should be placed in the primary circuit of the filament transformer. During "standby" periods the filament voltage should be kept at its rated value.

The *grid and plate returns* should be connected to the center tap on the filament transformer winding, or to the mid-point of a center-tapped resistor across the filament terminals. If it is necessary to use direct current, these returns should be connected to the negative filament terminal.

The plate dissipation of the 211 (the difference between input and output) should never exceed 75 watts for a-f amplifier and modulator service, or 100 watts for radio-frequency amplifier service. These values are indicated by a dull red color on the plate. The color can best be determined by opening the power supply switches with the tube operating. This avoids reflections from the filament which otherwise would interfere with the observation.

Overheating of the 211 by severe overload decreases the filament emission. Unless the overload has liberated a large amount of gas, the activity of the filament may be restored by operating it at rated voltage for ten minutes or more with no voltage on the plate or grid. This reactivation process may be accelerated by raising the filament voltage to 12 volts.

A milliammeter in the plate circuit of the 211 is desirable in order that the plate current can always be known. Under no condition should the d-c plate current exceed the maximum values given under CHARACTERISTICS.

In order to prevent overheating due to improper circuit adjustments or to overloading, a 7.5-ampere fuse should be placed directly in series with the plate lead of this tube. No fuse should be placed in the grid lead since its opening would leave the 211 without bias. Because of its low plate resistance, the tube will destructively overheat almost immediately if it ceases to oscillate or loses its grid bias.

When a new circuit is tried out or when adjustments are being made, the plate voltage should be reduced in order to prevent damage to the tube or associated apparatus, in case the circuit adjustments are incorrect. This may be accomplished by the use of a protective resistance in series with the plate voltage lead.

APPLICATION

As a *Class B and Class C radio-frequency amplifier*, the 211 may be operated as shown under CHARACTERISTICS.

Grid bias for this tube as a Class B amplifier should be obtained from a battery or a d-c generator. It should not be obtained from a high-resistance supply such as a grid leak, nor from a rectifier unless it has exceptionally good voltage regulation. For Class C service, grid bias may be obtained from a grid leak of about 5000 ohms, from a battery, from a rectifier of good regulation, or from a cathode-biasing resistor by-passed by a suitable condenser. Since grid-bias values are not particularly critical, correct circuit adjustment may be obtained with widely different values.

The *d-c grid current* should never exceed 50 milliamperes. The exact value will depend upon individual tubes and circuits.

The 211 is capable of delivering full output at frequencies as high as 6000 kilocycles (50 meters). Although the 211 was not designed for operation at the higher frequencies and although other tube types are recommended for regular operation at such frequencies, satisfactory operation with reduced output has been obtained in experimental circuits at frequencies as high as 30000 kilocycles. When this tube is operated at frequencies in excess of 6000 kc., the plate voltage and power input should be reduced so that the plate current, plate dissipation and d-c grid current will not exceed 50 percent of the maximum ratings. In addition, special attention should be given to the matter of ventilation.

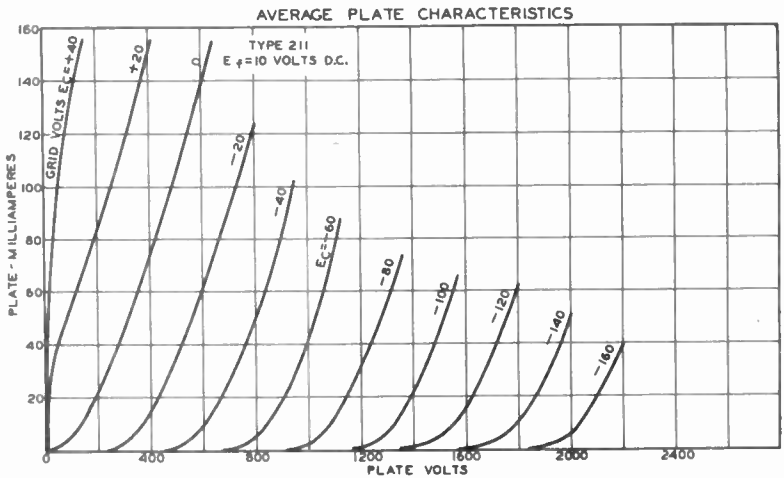
If more power output is desired than a single 211 will deliver, two tubes may be operated either in parallel or push-pull. The parallel connection provides approximately twice the power output of a single tube without an increase in r-f exciting voltage, while the push-pull connection gives twice the output at the same bias, but requires twice the exciting voltage. The push-pull connection is advantageous in reducing the total grid-plate capacity, inasmuch as the tube capacities are in series. This reduction is especially desirable when the tubes are operated at the higher frequencies.

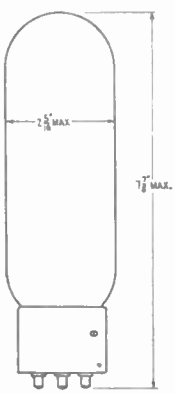
When two or more 211's are operated in parallel, a small r-f choke or a non-inductive resistance of 10 to 100 ohms should be placed in series with the grid lead of each tube, next to the socket, to prevent parasitic oscillations. The use of such a resistance will decrease the efficiency slightly.

As a *modulator*, the 211 is operated essentially the same as a Class A audio-frequency amplifier. Normal operating characteristics are given in the characteristics table under MODULATOR.

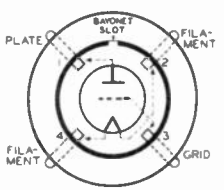
As an *audio-frequency amplifier*, the 211 will deliver an output of 10 watts. In general, a grid bias of 57 volts is sufficient to limit the plate current to 65 milliamperes at the normal plate voltage of 1000 volts. A value of plate current considerably higher than this is often an indication that the amplifier (or modulator) is oscillating at a high frequency, or that a high-frequency voltage from an r-f circuit is being induced into the grid circuit of the a-f tube.

When a group of 211's are operated as a-f amplifiers or modulators, it is desirable to provide an individual adjustment of grid bias to insure that the plate dissipation of any tube does not exceed the maximum value of 75 watts. The cathode-resistor method of obtaining separate bias adjustments is a convenient method if separate filament windings are used for each tube so biased. These resistors should, of course, be by-passed by large condensers.





Tube Symbol and Top View
of
Socket Connections



RCA Radiotron

RCA-841

Voltage Amplifier, R-F Power Amplifier, Oscillator

The 841 is a three-electrode, high-mu tube, designed primarily for use as a voltage amplifier in resistance-coupled circuits. In amateur transmitters it is useful not only as an oscillator (self-excited or crystal-controlled), but also as a radio-frequency doubler and amplifier.

CHARACTERISTICS

General

FILAMENT VOLTAGE (A.C. or D.C.)	7.5	Volts
FILAMENT CURRENT	1.25	Amperes
GRID-PLATE CAPACITANCE	7	μμf.
GRID-FILAMENT CAPACITANCE	4	μμf.
PLATE-FILAMENT CAPACITANCE	3	μμf.
MAXIMUM OVERALL LENGTH	5-5/8"	
MAXIMUM DIAMETER	2-3/16"	
BULB	S-17	
BASE	Medium 4-Pin Bayonet	

As Audio-Frequency Class A Amplifier

PLATE VOLTAGE		425 *max.*	Volts
PLATE SUPPLY VOLTAGE		1250 *max.*	Volts
PLATE DISSIPATION		12 *max.*	Watts
TYPICAL OPERATION:			
Filament Voltage (D.C.)		7.5	Volts
Plate Supply Voltage*	425	1000	Volts
Grid Voltage (Approximate)	-6	-9	Volts
Load Resistance	250000	250000	Ohms
Plate Current	0.7	2.2	Milliamperes
Plate Resistance	63000	40000	Ohms
Amplification Factor	30	30	
Mutual Conductance	450	750	Micromhos
Peak Grid Swing (Approximate)	6	9	Volts
Undistorted Voltage Output	126	225	Volts

As Radio-Frequency Class B Amplifier

PLATE VOLTAGE		450 *max.*	Volts
D-C PLATE CURRENT (Unmodulated)		50 *max.*	Milliamperes
PLATE DISSIPATION		15 *max.*	Watts
R-F GRID CURRENT		5 *max.*	Amperes
TYPICAL OPERATION:			
Filament Voltage (A.C.)		7.5	Volts
Plate Voltage	350	450	Volts
Grid Voltage (Approximate)**	-9	-12	Volts
D-C Plate Current (Unmodulated)	43	36	Milliamperes
Peak Power Output	12	16	Watts
Carrier Output (Mod. Fact. 1.0)	3	4	Watts

* Voltage effective at plate is less than supply voltage by an amount equal to voltage drop in load resistance.

**Grid voltages are given with respect to the mid-point of filament operated on a.c. If d.c. is used, each stated value of grid voltage should be decreased by 4.5 volts and should be referred to the negative end of the filament.

As Radio-Frequency Class C Amplifier (Oscillator)

D-C PLATE VOLTAGE (Modulated)			350 *max.*	Volts
D-C PLATE VOLTAGE (Unmodulated)			450 *max.*	Volts
D-C PLATE CURRENT			60 *max.*	Milliamperes
PLATE DISSIPATION			15 *max.*	Watts
R-F GRID CURRENT			5 *max.*	Amperes
D-C GRID CURRENT			20 *max.*	Milliamperes
TYPICAL OPERATION:				
Filament Voltage (A.C.)			7.5	Volts
Plate Voltage	250	350	450	Volts
Grid Voltage (Approximate)**	-24	-29	-34	Volts
Power Output	6	10	13	Watts

**Grid voltages are given with respect to the mid-point of filament operated on a.c. If d.c. is used, each stated value of grid voltage should be decreased by 4.5 volts and should be referred to the negative end of the filament.

INSTALLATION

The *base* pins of the 841 fit the standard 4-contact socket. The socket should be installed so that the tube will operate in a vertical position with the base down. If it is necessary to place the tube in a horizontal position, the socket should be mounted with the filament-pin openings one vertically above the other. For socket connections, see page 4.

The *bulb* of this tube becomes quite hot during continuous operation. Sufficient ventilation should be provided around the tube to prevent overheating.

The *filament* is designed to operate at 7.5 volts, a.c. or d.c. In certain installations where freedom from hum is essential, the use of direct current is to be preferred. Most satisfactory operating performance of this tube will be obtained at the rated filament voltage.

Overheating of this tube by severe overload decreases filament emission. Unless the overload has liberated a large amount of gas, the activity of the filament may be restored by operating it at rated voltage for ten minutes or more without plate or grid voltage. This reactivation process may be accelerated by raising the filament voltage to 9 volts.

The *grid and plate circuit returns* when the filament is d-c operated, should be connected to the negative filament terminal. When a.c. is used, these returns should be connected to the center-tap on the filament winding of the transformer, or to the mid-point of a center-tapped resistor across the filament terminals.

A milliammeter in the plate circuit of this tube when used as an r-f amplifier is desirable so that the plate-input power will always be known. Under no condition should the d-c plate current exceed the maximum values as given under CHARACTERISTICS. In order to prevent overheating due to improper circuit adjustments or to overload, a 5-ampere fuse should be placed in series with the plate lead of this tube. No fuse should be used in the grid lead since its opening would leave the tube without grid bias.

When a new circuit is tried out, or when adjustments are being made, the plate voltage should be reduced in order to prevent damage to the tube or associated apparatus in case the circuit adjustments are incorrect.

APPLICATION

As an *audio-frequency voltage amplifier (Class A)* in resistance-coupled circuits, the 841 should be operated according to the conditions given under CHARACTERISTICS.

Grid bias for audio-frequency service may be obtained from a separate voltage source or by means of the voltage drop in a resistor connected in the negative plate-return lead (self-bias). The latter method is preferable as it compensates automatically for variation in the plate current of individual tubes. The self-biasing resistor should be shunted by a suitable filter network to avoid degenerative effects at low audio-frequencies.

The maximum value of grid-leak resistance for the 841 when used as a resistance-coupled audio-frequency amplifier should not exceed 0.5 megohm. The use of resistance higher than this may cause the tube to lose bias due to grid current with the result that the plate current will rise to a value high enough to damage the tube. The condition just described will not be encountered if a grid choke of relatively low d-c resistance is employed in place of the grid-leak resistor.

As a *radio-frequency power amplifier (Class B or Class C)*, the 841 should be operated as shown under CHARACTERISTICS.

Grid bias for this tube as a Class B amplifier should be obtained from a battery; it should never be obtained from a high-resistance supply such as a grid leak or from a rectifier with a high resistance voltage-divider. Grid bias for the 841 as a Class C amplifier (or oscillator) may be obtained from a battery, or from a grid leak of about 5000 ohms. Since grid-bias values are not particularly critical, correct circuit adjustment may be obtained with considerably different values.

The d-c grid current must never be greater than 20 milliamperes. The exact value will vary with individual tubes and circuits.

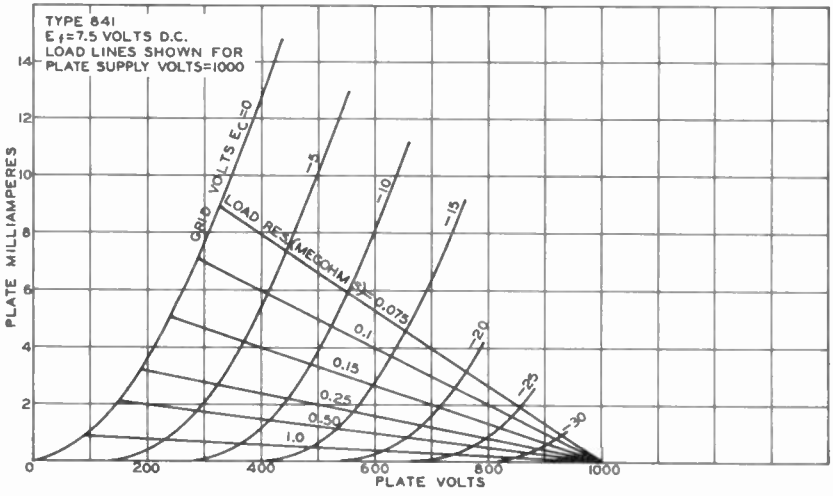
If the 841 is used in transmitting circuits at frequencies above 3000 kilocycles, special precautions should be taken so that the tube is not harmed by abnormal conditions. At these higher frequencies the interelectrode-capacity reactances are greatly reduced with the result that the radio-frequency currents may become excessive. Common effects produced by such excessive currents are opening of the interior grid or plate lead and glass-stem puncture. Under no condition of operation should the grid or plate ever be allowed to reach such a temperature that it shows color.

If more radio-frequency output is desired than can be obtained from a single 841, two of these tubes may be operated either in parallel or push-pull connection. The parallel connection provides twice the output of a single tube without an increase in exciting voltage, while the push-pull connection gives twice the output at

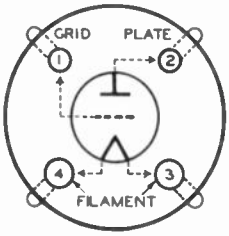
the same bias, but requires twice the exciting voltage. The push-pull circuit is advantageous in reducing total grid-plate capacity. This reduction is desirable when the tube is operated at high frequencies. When two or more 841's are operated in parallel in r-f amplifier service, a small r-f choke, or better still, a resistance of 10 to 100 ohms should be placed in series with the grid lead of each tube as close to the grid as possible in order to prevent parasitic oscillations. The use of resistance in the grid lead of either an oscillator or a radio-frequency power amplifier will result in a slight decrease in efficiency.

As a *crystal-controlled oscillator*, the 841 should be operated at a reduced plate voltage of approximately 225 volts to insure frequency stability as well as to prevent damage to the crystal due to excessive r-f grid current.

AVERAGE PLATE CHARACTERISTICS



Tube Symbol and Top View of Socket Connections



RCA Radiotron

RCA-842

A-F Power Amplifier, Modulator

The 842 is a three-electrode, low-mu tube for use primarily as a Class A power amplifier and as such is particularly useful as a modulator in amateur transmitting equipment.

CHARACTERISTICS

General

FILAMENT VOLTAGE (A.C. or D.C.)	7.5	Volts
FILAMENT CURRENT	1.25	Amperes
GRID-PLATE CAPACITANCE	7	μμf.
GRID-FILAMENT CAPACITANCE	4	μμf.
PLATE-FILAMENT CAPACITANCE	3	μμf.
MAXIMUM OVERALL LENGTH	5-5/8"	
MAXIMUM DIAMETER	2-3/16"	
BULB	S-17	
BASE	Medium 4-Pin Bayonet	

As Audio-Frequency Class A Amplifier

PLATE VOLTAGE		425 *max.*	Volts
PLATE DISSIPATION		12 *max.*	Watts
TYPICAL OPERATION:			
Filament Voltage (A.C.)		7.5	Volts
Plate Voltage	350	425	Volts
Grid Voltage*	-72	-100	Volts
Plate Current	34	28	Milliamperes
Plate Resistance	2400	2500	Ohms
Amplification Factor	3	3	
Mutual Conductance	1250	1200	Micromhos
Peak Grid Swing	67	95	Volts
Load Resistance	5000	8000	Ohms
Undistorted Power Output	2.1	3.0	Watts

As Class A Modulator

PLATE VOLTAGE		425 *max.*	Volts
PLATE DISSIPATION		12 *max.*	Watts
TYPICAL OPERATION:	*Case 1*	*Case 2*	
Filament Voltage (A.C.)		7.5	Volts
Plate Voltage	350	425	Volts
Grid Voltage*	-88	-101	Volts
Modulation Factor	0.6	0.68	
D-C Plate Current	14	25	Milliamperes
Peak Grid Swing	83	96	Volts
Oscillator Input per Mod. Tube	8	14	Watts

Case 1. With modulator and oscillator (or r-f amplifier) at same plate voltage.

Case 2. With oscillator (or r-f amplifier) operating at plate voltage of 350 and plate current of 40 milliamperes.

* Grid voltages are given with respect to the mid-point of filament operated on a.c. If d.c. is used, each stated value of grid voltage should be decreased by 5.0 volts and should be referred to the negative end of the filament.

INSTALLATION

The *base* pins of the 842 fit the standard 4-contact socket. The socket should be installed so that the tube will operate in a vertical position with the base down. If it is necessary to place the tube in a horizontal position, the socket should be mounted with the filament-pin openings one vertically above the other. For socket connections, see page 4.

The *bulb* of this tube becomes quite hot during continuous operation. Sufficient ventilation should be provided around the tube to prevent overheating.

The *filament* is designed to operate at 7.5 volts a.c. or d.c. In certain installations where freedom from hum is essential, the use of direct current is to be preferred. Most satisfactory operating performance of this tube will be obtained at the rated filament voltage.

Overheating of the 842 by severe overload may cause a decrease in the electron emission of the filament. Unless the overload has liberated a large amount of gas, the activity of the filament may be restored by operating it at rated voltage for ten minutes or more without plate or grid voltage. This reactivation process may be accelerated by raising the filament voltage to 9 volts.

The *grid and plate circuit returns* should be connected to the center-tap on the filament winding of the transformer, or to the midpoint of a center-tapped resistor across the filament terminals. When d.c. is used on the filament, these returns should be connected to the negative filament terminal.

When a new circuit is tried out, or when adjustments are being made, the plate voltage should be reduced in order to prevent damage to the tube or associated apparatus in case the circuit adjustments are incorrect.

APPLICATION

As an *audio-frequency power amplifier (Class A)*, the 842 should be operated as shown under CHARACTERISTICS.

Grid bias for audio-frequency service may be obtained from a separate voltage source, or by means of the voltage drop in a resistor connected in the negative plate-return lead (self-bias). The latter method is preferable as it compensates automatically for variation in the plate current of individual tubes. The proper value of this resistor for a single 842 is 2120 ohms for a plate voltage of 350 volts; and 3570 ohms for a plate voltage of 425 volts. The self-biasing resistor should be shunted by a suitable filter network to avoid degenerative effects at low audio-frequencies.

If more audio output is desired than can be obtained from a single 842, two 842's may be operated either in parallel or push-pull. The parallel connection provides twice the output of a single tube without an increase in grid-signal voltage. The push-pull connection will give twice the output at the same grid bias, but re-

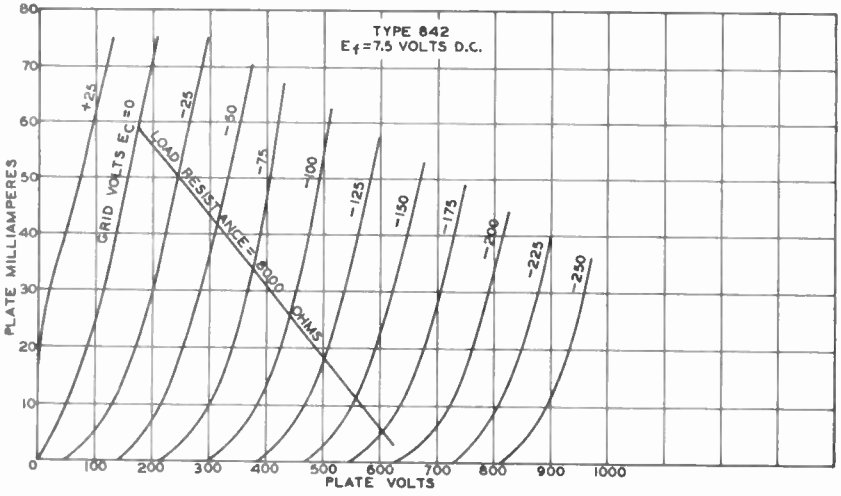
quires twice the input signal. Output slightly greater than twice the single tube value can be obtained from the push-pull connection by increasing the bias. In the latter case, the output is limited almost entirely by 3rd harmonic distortion. When two 842's are operated together (parallel or push-pull), the values of the self-biasing resistors will be approximately one-half the values given above for a single tube. When two 842's are operated in push-pull, the filter network across the self-biasing resistor may be omitted.

In cases where the 842 is employed in resistance-coupled circuits, the recommended safe maximum value of grid leak is 1.0 megohm when the self-biasing method of obtaining grid bias is used. With fixed bias, however, the d-c resistance should not exceed 0.25 megohm. The use of resistances higher than these may cause the tube to lose bias due to grid current with the result that the plate current will rise to a value sufficiently high to damage the tube.

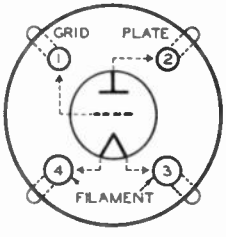
An *output device* should be used to transfer power efficiently to the windings of the reproducing unit when this tube is used as an audio-frequency power amplifier in transformer-coupled circuits.

As a *modulator*, the 842 should be operated as shown under CHARACTERISTICS. In this service, the tube is subject to the same general considerations as for Class A Audio-Frequency Amplification. The grid should remain positive throughout its swing and the audio output should not have more than 5% second harmonic distortion.

Grid bias for the 842 as a modulator should preferably be obtained by means of a self-biasing resistor. The value of this resistor is approximately 6285 ohms at a plate voltage of 350 volts; and 4040 ohms at a plate voltage of 425 volts. When two or more 842's are operated in parallel or push-pull in the modulator stage, the value of self-biasing resistor will be approximately one-half that of a single tube. In either case the resistor should preferably be shunted by a suitable filter network to minimize grid-bias variations produced by current surges in the biasing resistor. If the parallel connection is used, a resistance of approximately 100 ohms should be placed in series with each grid lead, as near to the socket as possible to prevent parasitic oscillations.



Tube Symbol and Top View of Socket Connections



RCA Radiotron

UV-845

Modulator and A-F Power Amplifier

The 845 is a three-electrode tube primarily designed for use as a modulator in transmitting equipment or as an audio-frequency amplifier. For radio-frequency applications, other tube types specially designed for the service are to be preferred.

CHARACTERISTICS

General

FILAMENT VOLTAGE (A.C.)	10.0	Volts
FILAMENT CURRENT	3.25	Amperes
AMPLIFICATION FACTOR	5	
GRID-PLATE CAPACITANCE	15	μμf.
GRID-FILAMENT CAPACITANCE	8	μμf.
PLATE-FILAMENT CAPACITANCE	7	μμf.
MAXIMUM OVERALL LENGTH	7-7/8"	
MAXIMUM DIAMETER	2-5/16"	
BULB (See page 4)	T-18	
BASE - Type #1839	Jumbo 4-Large Pin	

As A-F Power Amplifier - Class A

D-C PLATE VOLTAGE		1250 *max.*	Volts
PLATE DISSIPATION		75 *max.*	Watts
TYPICAL OPERATION:			
Filament Voltage (A.C.)		10.0	Volts
D-c Plate Voltage	750	1000	Volts
Grid Voltage	-98	-155	Volts
D-c Plate Current	95	65	Milliamp.
Load Impedance	3400	9000	Ohms
Power Output (5% Second harmonic)	14.7	21	Watts

As Modulator

D-C PLATE VOLTAGE		1250 *max.*	Volts
PLATE DISSIPATION		75 *max.*	Watts
TYPICAL OPERATION: Mod. factor 0.6			
Filament Voltage (A.C.)		10.0	Volts
D-c Plate Voltage	750	1000	Volts
Grid Voltage	-115	-155	Volts
D-c Plate Current	45	65	Milliamp.
Peak Grid Swing	110	150	Volts
Oscillator Input per Mod. Tube	57	110	Watts

INSTALLATION

The *base* of the 845 fits a standard, transmitting, four-contact socket, such as the RCA type UT-541. The socket should be mounted so that the tube will operate in a vertical position, with the base end down. The outline dimensions and socket connections are shown on page 4.

The *bulb* of this tube becomes very hot during continuous operation. Free circulation of air should therefore be provided.

The *filament* of the 845 should be operated from an a-c source whenever possible. In certain applications where freedom from hum is essential, the use of direct current is to be preferred. A filament voltmeter should be connected directly across the socket terminals so that the filament voltage can be kept at 10.0 volts. Rheostat control should be placed in the primary circuit of the filament transformer.

The *grid and plate returns* should be connected to the center tap on the filament transformer winding, or to the arm of a low-resistance potentiometer (20-40 ohms) connected across the filament terminals. If it is necessary to use direct current, these returns should be connected to the negative filament terminal.

The plate dissipation of the 845 (the difference between input and output) should never exceed 75 watts. This value is indicated by a dull red color of the plate. The color can best be determined by opening the power supply switches with the tube operating. This avoids reflections from the lighted filament which otherwise would interfere with the observation.

Overheating of the 845 by severe overload decreases the filament emission. Unless the overload has liberated a large amount of gas, the activity of the filament may be restored by operating it at rated voltage for ten minutes or more with no voltage on the plate or grid. This reactivation process may be accelerated by raising the filament voltage to 12 volts.

A milliammeter should be used in the plate circuit of the 845 in order that the plate current can always be known. A plate circuit fuse blowing at 0.25 ampere is also desirable.

When a new circuit is tried out or when adjustments are being made, the plate voltage should be reduced in order to prevent damage to the tube or associated apparatus, in case the circuit adjustments are incorrect. It is advisable to use a protective resistance in series with the plate lead during such adjustments.

APPLICATION

As an *a-f amplifier or modulator (Class A)*, the 845 may be operated as shown under CHARACTERISTICS.

Grid bias for this type of service may be obtained from a separate voltage source or by means of a cathode-biasing resistor. When a group of 845's are operated in parallel, it is necessary to make provision for individual adjustment of grid bias to insure that the

plate dissipation of any tube does not exceed the maximum value of 75 watts. This may be accomplished by means of a tapped "C" battery, or if self-bias is used, by means of a variable cathode resistor for each tube. Separate filament windings are necessary, of course, for each tube that is self-biased; each cathode resistor should be by-passed by a large condenser.

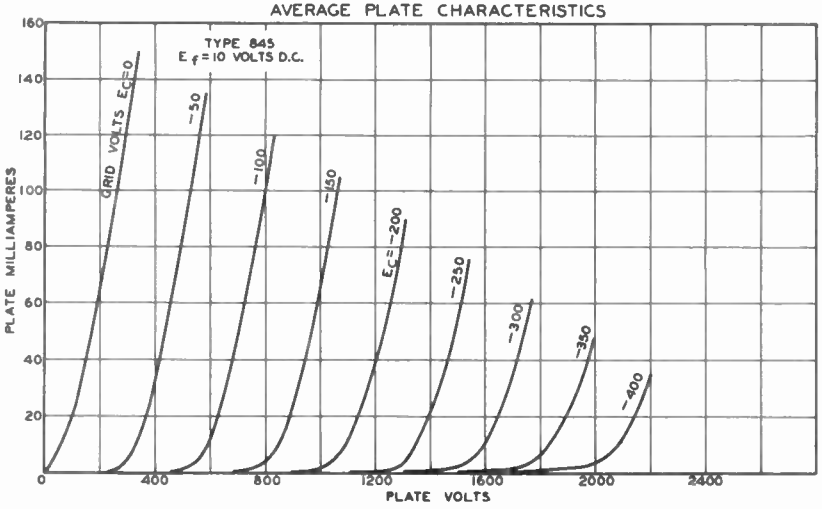
Two 845's may be used in push-pull in either audio-frequency or modulator service. Twice the output of a single tube, with almost negligible distortion, can be obtained with this type of operation.

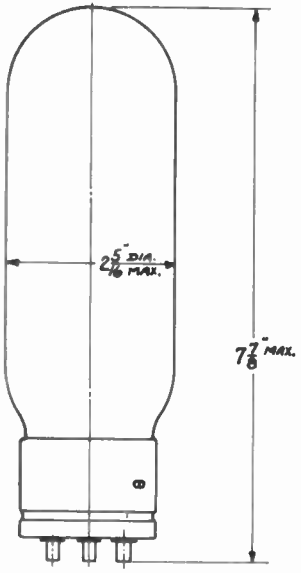
When a number of tubes are operated in parallel,a non-inductive resistance of 10 to 100 ohms should be placed in series with each grid lead, next to the socket, to prevent parasitic oscillations.

In cases where the input circuit to the 845 is resistance or impedance coupled, the resistance in the grid circuit should not be made too high. A resistance of one-half megohm for one 845 may be taken as a safe maximum when self-bias is used. Without self-bias, the grid resistance should not exceed 100000 ohms.

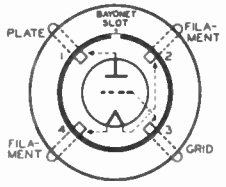
An *output device* should be used to transfer power efficiently to the windings of the reproducing unit when the 845 is used as an audio-frequency amplifier.

A value of plate current considerably higher than the rated value is often an indication that the tube is oscillating at a high frequency, or that a high-frequency voltage is being induced from a radio-frequency circuit into its grid circuit.





Tube Symbol and Top View of Socket Connections



RCA Radiotron

RCA-852

Oscillator, Radio-Frequency Power Amplifier

Type 852 is a three-electrode tube for use as an oscillator or a radio-frequency power amplifier in amateur transmitters, particularly at frequencies above 3000 kc. Each electrode is supported on its own stem and has its leads brought out of the bulb through a separate seal, thus insuring high insulation and low interelectrode capacities.

CHARACTERISTICS

General

FILAMENT VOLTAGE (A.C.)	10.0	Volts
FILAMENT CURRENT	3.25	Amperes
AMPLIFICATION FACTOR	12	
GRID-PLATE CAPACITANCE	3	μμf.
GRID-FILAMENT CAPACITANCE	2	μμf.
PLATE-FILAMENT CAPACITANCE	1	μμf.
MAXIMUM OVERALL LENGTH	8-3/4"	
MAXIMUM RADIUS	4-1/4"	
BULB (See page 4)	G-30 with arms	
BASE	Medium 4-Pin Metal Bayonet	

As Radio-Frequency Class B Amplifier

PLATE VOLTAGE		3000 *max.*	Volts
D-C PLATE CURRENT (Unmodulated)		85 *max.*	Milliamp.
PLATE DISSIPATION		100 *max.*	Watts
R-F GRID CURRENT		10 *max.*	Amperes
TYPICAL OPERATION:			
Filament Voltage (A.C.)		10	Volts
Plate Voltage	2000	3000 *max.*	Volts
Grid Voltage (Approx.)	-155	-250	Volts
D-c Plate Current (Unmod.)	60	43	Milliamp.
Plate Dissipation	90	90	Watts
Peak Power Output	120	160	Watts
Carrier Output (Mod. Fact. 1.0)	30	40	Watts

As Radio-Frequency Class C Amplifier (Oscillator)

D-C PLATE VOLTAGE (Modulated)	2000 *max.*	Volts
D-C PLATE VOLTAGE (Unmodulated)	3000 *max.*	Volts
D-C PLATE CURRENT	100 *max.*	Milliamp.
PLATE DISSIPATION	100 *max.*	Watts
R-F GRID CURRENT	10 *max.*	Amperes
D-C GRID CURRENT	40 *max.*	Milliamp.

TYPICAL OPERATION:

Filament Voltage (A.C.)				10	Volts
Plate Voltage	1500	2000	2500*	3000* *max.*	Volts
Grid Voltage	-200	-250	-300	-350	Volts
Plate Current	90	90	90	90	Milliamp.
D-C Grid Current**	25	25	25	25	Milliamp.
Driving Power**	12	13	14	15	Watts
Power Output	55	100	135	190	Watts

* Unmodulated service only.

**Subject to wide variations depending on the impedance of the load circuit. High impedance load circuits require more grid current and driving power to obtain the desired output. Low impedance circuits need less grid current and driving power, but plate circuit efficiency is sacrificed. The driving stage should have a tank circuit of good regulation and should be capable of delivering considerably more than the required driving power.

INSTALLATION

The *base* pins of the 852 fit the standard four-contact socket. The socket should be installed so that the tube will operate in a vertical position. In order to adequately handle the large circulating current which flows at high-frequencies, both stranded leads from each arm terminal should always be used. For socket and arm connections, see page 4.

The *bulb* of this tube becomes very hot during continuous operation. Free circulation of air should therefore be provided. The installation of all wires and connections should be made to allow at least several inches of free space around the tube in order to avoid corona discharge which might puncture the bulb.

The *filament* of this tube should be operated preferably from an a-c source. Filament voltage adjustment should be provided in the primary circuit of the filament transformer. A suitable voltmeter should be connected permanently across the socket terminals so that the filament voltage can be held at 10 volts. Deviation from the rated voltage will result in loss of filament emission. During "standby" periods, the filament should be maintained at its rated voltage.

The *grid and plate circuit returns* should be connected to the center tap on the filament winding of the transformer, or to the mid-point of a center-tapped resistor across the filament terminals. In cases where d.c. must be used on the filament, the grid and plate returns should be connected to the negative filament terminal.

The plate dissipation of the 852 (the difference between input and output) should never exceed 100 watts. This value is indicated by a dull red color on the plate. The color can best be determined by opening the power supply switches with the tube operating. This avoids reflections from the filament which otherwise would interfere with the observation.

Overheating of the 852 by severe overload decreases filament emission. Unless the overload has liberated a large amount of gas, the activity of the filament may be restored by operating it at rated voltage for ten minutes or more with no voltage on the plate or grid. This reactivation process may be accelerated by raising the filament voltage to 12 volts.

An ammeter in the plate circuit of the tube is desirable in order that the plate-input power will always be known. Under no condition should the d-c plate current exceed the maximum value of 100 milliamperes.

In order to prevent overheating due to improper circuit adjustments or to overloading, a 10-ampere fuse should be placed in series with the plate lead of the 852. No fuse should be used in the grid lead since its opening would leave the tube without grid bias.

When a new circuit is tried out or when adjustments are being made, the plate voltage should be reduced in order to prevent damage to the tube or associated apparatus in case the circuit adjustments are incorrect.

APPLICATION

As a *Class B and C radio-frequency amplifier,* the 852 should be operated as shown under CHARACTERISTICS.

Grid bias for this tube as a Class B amplifier should be obtained from a battery or from a generator. It should not be obtained from a high resistance supply such as a grid leak nor from a rectifier with a high resistance voltage divider. Grid bias for the 852 as a Class C amplifier may be obtained from either a battery or a grid leak of about 10000 ohms. Since grid-bias values are not particularly critical, correct circuit adjustment may be obtained with widely different values.

The *d-c grid current* must never be greater than 40 milliamperes. The exact value will vary with individual tubes and circuits.

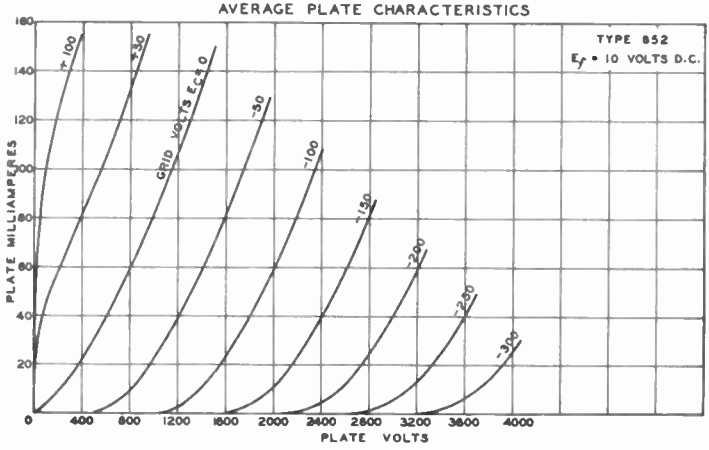
The 852 is capable of giving full output at frequencies as high as 30000 kc. At higher frequencies, the available output will decrease. The tabulation below shows the approximate output of this tube at frequencies between 60 and 150 mc. (5 to 2 meters).

FREQUENCY	60	90	120	150	Megacycles
PLATE VOLTAGE (max.)	2400	1900	1500	1200	Volts
POWER OUTPUT (approx.)	100	95	65	35	Watts

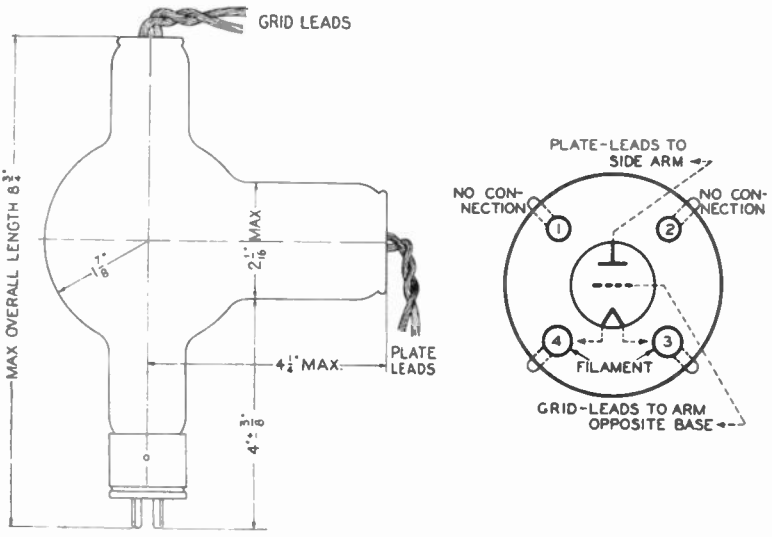
If more power output is desired than can be obtained from a single 852, two 852's may be operated either in parallel or push-pull connection. The parallel connection provides twice the output of a single tube without an increase in exciting voltage,while the push-pull connection gives twice the output at the same bias, but requires twice the exciting voltage. The push-pull connection is advantageous in reducing grid-plate capacity. This reduction is

desirable when operating the tube at high frequencies. When two or more 852's are operated in parallel,a small r-f choke,or better still, a resistance of 10 to 100 ohms should be placed in series with the grid lead of each tube as close to the grid as possible in order to prevent the setting up of parasitic oscillations. The use of the resistance in the grid lead of either an oscillator or a radio-frequency power amplifier will result in a slight decrease in efficiency.

Careful handling and conservative operation of this tube will increase its life and will give more satisfactory performance.



Tube Dimensions, Tube Symbol and Top View of Socket Connections



RCA Radiotron

UX-860

Screen Grid R-F Power Amplifier

The 860 is a screen grid tube for use primarily as a radio-frequency power amplifier, particularly at frequencies greater than 3000 kc. The grid, plate and screen are supported on separate stems so that their leads are brought out of the bulb through separate seals, thus insuring high insulation and low interelectrode capacities. Neutralization to prevent feedback and self-oscillation is generally unnecessary when this tube is used in adequately shielded circuits.

CHARACTERISTICS

General

FILAMENT VOLTAGE (A.C.)	10.0	Volts
FILAMENT CURRENT	3.25	Amperes
AMPLIFICATION FACTOR	200	
GRID-PLATE CAPACITANCE	0.05	µµf.
INPUT CAPACITANCE	8.5	µµf.
OUTPUT CAPACITANCE	9.0	µµf.
MAXIMUM OVERALL LENGTH	8-3/4"	
MAXIMUM RADIUS	4-1/4"	
BULB (See page 4)	G-30 with arms	
BASE	Medium 4-Pin Metal Bayonet	

As Radio-Frequency Class B Amplifier

PLATE VOLTAGE		3000 *max.*	Volts
D-C PLATE CURRENT (Unmodulated)		85 *max.*	Milliamp.
PLATE DISSIPATION		100 *max.*	Watts
SCREEN DISSIPATION		10 *max.*	Watts
R-F GRID CURRENT		10 *max.*	Amperes
TYPICAL OPERATION:			
Filament Voltage (A.C.)		10	Volts
Plate Voltage	2000	3000	Volts
Screen Voltage (Approx.)	300	300	Volts
Grid Voltage (Approx.)	-55	-55	Volts
D-c Plate Current	60	43	Milliamp.
Peak Power Output	120	160	Watts
Carrier Output (Mod. factor 1.0)	30	40	Watts

As Radio-Frequency Class C Amplifier (Oscillator)

D-C PLATE VOLTAGE (Modulated)	2000 *max.*	Volts
D-C PLATE VOLTAGE (Unmodulated)	3000 *max.*	Volts
D-C PLATE CURRENT	100 *max.*	Milliamp.
PLATE DISSIPATION	100 *max.*	Watts
R-F GRID CURRENT	10 *max.*	Amperes
D-C GRID CURRENT	40 *max.*	Milliamp.
TYPICAL OPERATION:		
Filament Voltage	10	Volts

Plate Voltage	1500	2000	2500*	3000*	Volts
Screen Voltage (Approx.)	300	300	300	300	Volts
Grid Voltage (Approx.)	-200	-200	-200	-200	Volts
Plate Current	90	90	90	90	Milliamp.
Power Output	55	100	135	190	Watts

* Unmodulated service only.

INSTALLATION

The *base* pins of the 860 fit the standard four-contact socket. The socket should be installed so that the tube will operate in a vertical position. In order to adequately handle the large circulating current which flows at high frequencies, both stranded leads from each arm terminal should always be used. For socket and arm connections, see page 4.

The *bulb* of this tube becomes very hot during continuous operation. Free circulation of air should therefore be provided. The installation of all wires and connections should be made to allow at least several inches of free space around the tube in order to avoid corona discharge which might puncture the bulb.

The *filament* of the 860 should be operated preferably from an a-c source. Filament voltage adjustment should be provided in the primary circuit of the filament transformer. A suitable voltmeter should be connected permanently across the socket terminals so that the filament voltage can be held at 10 volts. Deviation from the rated voltage will result in loss of filament emission. During "standby" periods, the filament should be maintained at its rated voltage.

The *grid and plate circuit returns* should be connected to the center tap on the filament winding of the transformer, or to the mid-point of a center-tapped resistor across the filament terminals In cases where d.c. must be used on the filament, the grid and plate returns should be connected to the negative filament terminal.

The plate dissipation of the 860 (the difference between input and output) should never exceed 100 watts. This value is indicated by a dull red color on the plate. The color can best be determined by opening the power supply switches with the tube operating. This avoids reflections from the lighted filament which otherwise would interfere with the observation.

Overheating of the 860 by severe overload decreases filament emission. Unless the overload has liberated a large amount of gas, the activity of the filament may be restored by operating it at rated voltage for ten minutes or more with no voltage on the plate or grid. This reactivation process may be accelerated by raising the filament voltage to 12 volts.

A milliammeter in the plate circuit of the tube is desirable in order that the plate current will always be known. Under no condition should the d-c plate current exceed the maximum value of 100 milliamperes.

The *screen voltage* for this tube may be obtained either from a separate source or from the plate supply through a series resistance In the case of the latter method, the resistance should be chosen to reduce the high-voltage supply to 300 volts at the screen. The screen should never be allowed to attain a temperature corresponding

to more than a dull red color (approximately 10 watts dissipation). The following tabulation gives the *minimum* values of resistance (ohms) for various supply voltages.

SUPPLY VOLTS	1000	1500	2000	2500	3000
SERIES RESISTOR (ohms)	25000	60000	100000	160000	225000

The resistance method for obtaining screen voltage is generally to be preferred since it serves to maintain the proper screen current. With this method, however, it is important that the high-voltage-supply switch be opened before the filament circuit is opened; otherwise, full supply voltage will be placed on the screen. If the screen voltage is obtained from a separate source, or from a potentiometer, plate and screen voltage should be applied simultaneously in order not to exceed the screen dissipation rating of 10 watts.

The common high-voltage plate and screen lead of the 860 should be provided with a protective device to prevent the tube from drawing excessive load current. This device should preferably remove the high-voltage supply when the d-c plate current reaches a value 50% greater than normal.

Adequate *shielding* of the 860 circuit is necessary if optimum results are to be obtained. The impedance between the screen and filament must be kept as low as possible by the use of a by-pass condenser.

When a new circuit is tried out, or when adjustments are being made, the plate voltage should be reduced in order to prevent damage to the tube or associated apparatus in case the circuit adjustments are incorrect.

APPLICATION

As a *Class B and Class C radio-frequency amplifier*, the 860 may be operated as shown under CHARACTERISTICS on pages 1 and 2.

Grid bias for this tube as a Class B amplifier should be obtained from a battery or from a generator; it should never be obtained from a high-resistance supply such as a grid leak or from a rectifier with a high-resistance voltage-divider. Grid bias for the 860 as a Class C amplifier may be obtained either from a battery or from a grid leak of about 10000 ohms. Since grid-bias values are not particularly critical, correct circuit adjustment may be obtained with widely different values.

The *d-c grid current* of the 860 must never be greater than 40 milliamperes. The operating value below this maximum will depend upon individual tubes and circuits.

As a plate-modulated amplifier, the 860 is capable of being modulated 100%. Best results can usually be obtained by using a separate source of screen voltage of about one-sixth of the plate voltage. The screen voltage should be simultaneously modulated with the plate voltage so that the percentage changes in both voltages are approximately equal. The series-resistance method for supplying the screen voltage to the modulated tube may also be used, provided the screen by-pass condenser is not larger than 0.1 μf., approximately. Values smaller than this may result in excessive feed-back from plate to grid. The best value of series-resistance, by-pass condens-

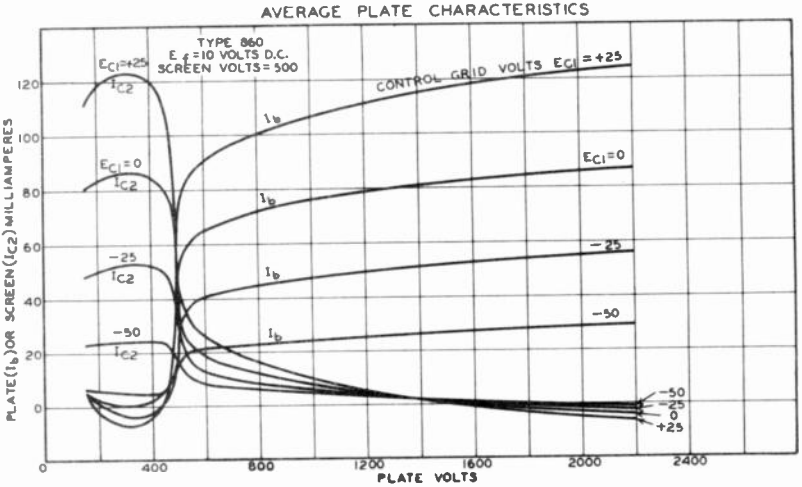
er and general operating adjustments will depend on the general transmitter design including the frequency or wavelength to be used and the fidelity required of the output signal.

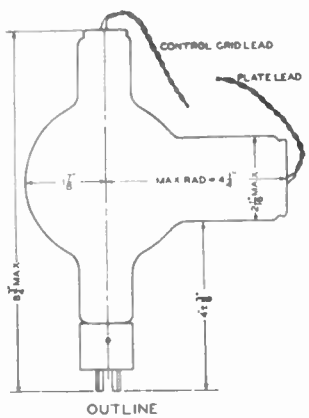
As an oscillator, the screen of the 860 should be connected the same as in amplifier operation.

The 860 is capable of giving full output at frequencies as high as 30 megacycles. With proper circuit design it will operate as high as 40 mc., provided that the plate power input is reduced approximately 20% and the d-c grid current (determined by the grid excitation) is limited to 20 milliamperes.

If more power output is desired than can be obtained from a single 860, two 860's may be operated either in parallel or push-pull connection. The parallel connection provides twice the output of a single tube without an increase in r-f exciting voltage, while the push-pull connection gives twice the output at the same bias, but requires twice the exciting voltage. The push-pull connection is advantageous in reducing the total grid-plate capacity. This reduction is desirable when operating the tube at high frequencies. When two or more 860's are operated in parallel, a small r-f choke, or better still, a resistance of 10 to 100 ohms should be placed in series with the grid lead of each tube as close to the control grid as possible. This prevents the setting up of parasitic oscillations. The use of such a resistance will decrease the efficiency slightly.

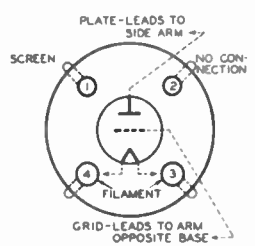
AVERAGE PLATE CHARACTERISTICS





OUTLINE

Tube Symbol and Top View of Socket Connections



RCA Radiotron

RCA-865

Screen Grid R-F Power Amplifier

The 865 is a screen grid transmitting tube designed primarily for use as a power amplifier at radio frequencies greater than 3000 kilocycles.

CHARACTERISTICS

GENERAL

FILAMENT VOLTAGE (A.C.)	7.5	Volts
FILAMENT CURRENT	2.0	Amperes
EFFECTIVE GRID-PLATE CAPACITANCE	0.05 max.	μμf.
INPUT CAPACITANCE	10.0	μμf.
OUTPUT CAPACITANCE	7.5	μμf.
MAXIMUM OVERALL LENGTH	6-1/4"	
MAXIMUM DIAMETER	2-3/16"	
BULB	S-17	
CAP	Small Metal	
BASE	Medium 4-Pin Bayonet	

As Radio-Frequency Class B Amplifier

PLATE VOLTAGE		750 max.	Volts
D-C PLATE CURRENT (Unmodulated)		50 max.	Milliamp.
PLATE DISSIPATION		15 max.	Watts
SCREEN DISSIPATION		3 max.	Watts
R-F GRID CURRENT		5 max.	Amperes
TYPICAL OPERATION:			
Filament Voltage (A.C.)		7.5	Volts
Plate Voltage	500	750	Volts
Screen Voltage (Approx.)	125	125	Volts
Grid Voltage (Approx.)	-30	-30	Volts
D-C Plate Current (Unmod.)	30	22	Milliamp.
Plate Dissipation	12	12	Watts
Peak Power Output	12	18	Watts
Carrier Output (Mod.Fact. 1.0)	3	4.5	watts

As Radio-Frequency Class C Amplifier

D-C PLATE VOLTAGE (Modulated)	500 max.	Volts
D-C PLATE VOLTAGE (Unmodulated)	750 max.	Volts
D-C PLATE CURRENT	60 max.	Milliamp.
PLATE DISSIPATION	15 max.	Watts
SCREEN DISSIPATION	3 max.	Watts
R-F GRID CURRENT	5 max.	Amperes
D-C GRID CURRENT	15 max.	Milliamp.

TYPICAL OPERATION:

Filament Voltage				7.5	Volts
Plate Voltage	375	500	625*	750*max.	Volts
Screen Voltage (Approx.)	125	125	125	125	Volts
Grid Voltage	-75	-75	-75	-75	Volts
Plate Current	50	50	43	38	Milliamp.
Power Output	8.5	12.5	14.0	16.0	Watts

* Unmodulated service only.

INSTALLATION

The *base* pins of the 865 fit the standard four-contact socket. The socket should be installed so that the tube will operate in a vertical position. The plate lead of the tube is brought out at the top of the bulb to a metal cap. For socket connections, see page 4.

The *bulb* of the 865 becomes very hot during continuous operation. Free circulation of air should therefore be provided. The installation of all wires and connections should be made to allow at least several inches of free space around the tube in order to avoid corona discharge which might puncture the bulb.

The *filament* of this tube should be operated preferably from an a-c source. Filament voltage adjustment should be provided in the primary circuit of the filament transformer. A suitable voltmeter should be connected permanently across the filament circuit at the socket terminals so that the filament voltage can be held at 7.5 volts. Deviation from the rated voltage will result in loss of filament emission. During "standby" periods, the filament should be maintained at its rated voltage.

The *grid and plate circuit return* should be connected to the center tap on the filament winding of the transformer, or to the mid-point of a center-tapped resistor across the filament terminals In cases where d.c. is used on the filament, the grid and plate returns should be connected to the negative filament terminal.

The plate dissipation of the 865 (the difference between input and output) should never exceed 15 watts.

Overheating the 865 by severe overload decreases filament emission. Unless the overload has liberated a large amount of gas, the activity of the filament may be restored by operating it at rated voltage for ten minutes or more with no voltage on the plate, grid, or screen. This reactivation process may be accelerated by raising the filament voltage to 9 volts.

An ammeter in the plate circuit of this tube is desirable in order that the plate-input power will always be known. Under no condition should the d-c plate current ever exceed the maximum value

of 60 milliamperes.

In order to prevent overheating due to improper circuit adjustments or to overloading, a 5-ampere fuse should be placed in series with the plate lead of the 865. No fuse should be used in the grid lead since its opening would leave the tube without grid bias.

The *screen* voltage for this tube may be obtained either from a separate source or from the plate supply through a series resistance. In the case of the latter method, the resistance should be chosen to reduce the high voltage supply to 125 volts at the screen. The following tabulation gives the *minimum* values of resistance (ohms) for various supply voltages.

SUPPLY VOLTS	250	375	500	625	750
SERIES RESISTOR (ohms)	5000	12000	20000	32000	45000

The resistance method for obtaining screen voltage is generally to be preferred since it serves to maintain the proper screen current. With this method, however, it is important that the high voltage supply switch be opened before the filament circuit is opened; otherwise, full supply voltage will be placed on the screen. If the screen voltage is obtained from a separate source, or from a potentiometer, plate and screen voltage should be applied simultaneously in order not to exceed the screen dissipation rating of 3 watts.

Complete *shielding* of the 865 circuit is necessary if maximum stability and gain per stage is to be obtained. The impedance between the screen and filament must be kept as low as possible by the use of a by-pass condenser.

When a new circuit is tried out, or when adjustments are being made, the plate voltage should be reduced in order to prevent damage to the tube or associated apparatus in case the circuit adjustments are incorrect.

APPLICATION

As a *Class B and Class C radio-frequency amplifier*, the 865 should be operated as shown under CHARACTERISTICS on pages 1 and 2.

Grid bias for this tube as a Class B amplifier should be obtained from a battery or from a generator; it should never be obtained from a high resistance supply such as a grid leak or from a rectifier with a high resistance voltage-divider. Grid bias for the 865 as a Class C amplifier may be obtained either from a battery or from a grid leak of about 10000 ohms. Since grid-bias values are not particularly critical, correct circuit adjustment may be obtained with widely different values.

The *d-c grid current* of the 865 must never be greater than 15 milliamperes. The operating value below this maximum will vary with individual tubes and circuits.

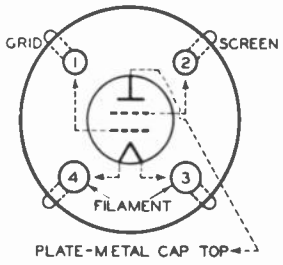
As a *plate modulated amplifier*, the 865 is capable of being modulated 100%. Best results can usually be obtained by using a separate source of screen voltage of about one-sixth of the plate voltage. The screen voltage should be simultaneously modulated with the plate voltage so that the percentage changes in both voltages are approximately equal. The series-resistance method for supplying the screen voltage to the modulated tube may also be used, provided the screen by-pass condenser is not larger than 0.02 µf., approximately. Values smaller than this may result in excessive feed-back from plate to grid. The best value of series resistance, by-pass condenser, and general operating adjustments will depend on the general transmitter design including the frequency or wavelength to be used and the fidelity required of the output signal.

The 865 is capable of giving full output at frequencies as high as 15000 kilocycles. At higher frequencies the available output will decrease.

If more power output is desired than can be obtained from a single 865, two 865's may be operated either in parallel or push-pull connection. The parallel connection provides twice the output of a single tube without an increase in exciting voltage; while the push-pull connection gives twice the output at the same bias, but requires twice the exciting voltage. The push-pull connection is advantageous in reducing grid-plate capacity. This reduction is desirable when operating the tube at high frequencies. When two or more 865's are operated in parallel, a small r-f choke, or better still, a resistance of 10 to 100 ohms should be placed in series with the grid lead of each tube as close to the control grid as possible. This prevents the setting up of parasitic oscillations. The use of resistance in the grid lead of either an oscillator or a radio-frequency power amplifier will result in a slight decrease in efficiency.

Careful handling and conservative operation of this tube will increase its life and give more satisfactory performance.

Tube Symbol and Top View of Socket Connection



RCA Radiotron

RCA-866

Half-Wave Mercury-Vapor Rectifier

The RCA-866 is a half-wave, mercury-vapor rectifier tube of the hot-cathode type. It is intended for use in high-voltage rectifying devices designed to supply d-c power of uniform voltage. Full-wave rectification is accomplished by using two RCA-866's.

CHARACTERISTICS

FILAMENT VOLTAGE (A.C.)	2.5 Volts
FILAMENT CURRENT	5.0 Amperes
PEAK INVERSE VOLTAGE	7500 *max.* Volts
PEAK PLATE CURRENT	600 *max.* Milliamperes
TUBE VOLTAGE DROP (Approximate)	15 Volts
MAXIMUM OVERALL LENGTH	6-5/8"
MAXIMUM DIAMETER	2-7/16"
BULB	S-19
CAP (0.5" diameter, 0.5" length.)	Medium Metal
BASE	Medium 4-Pin Bayonet

INSTALLATION

The *base* pins of the RCA-866 fit the standard four-contact socket which should be installed to hold the tube in a vertical position with the base down. For socket connections, see page 3. Only a socket making very good filament contact and capable of carrying 5 amperes continuously should be used with the RCA-866.

The *bulb* becomes hot during continuous operation. Free circulation of air should, therefore, be provided. The normal operating air-temperature range for this tube is 32° to 122°F. When operated under load, the tube has a characteristic blue glow. In service the bulb will eventually darken, but this change has no effect on the performance of the tube.

The *filament* is of the coated type and is intended for a-c operation from a secondary winding of a power transformer. This winding, provided with a center-tap or center-tap-resistor, should supply at the filament terminals the rated voltage of 2.5 volts under operating conditions. All connections in the filament circuit should be of low resistance and of adequate current-carrying capacity. Less than this recommended voltage may cause a high voltage drop with consequent bombardment of the filament and eventual loss of emission. Greater than the rated voltage will shorten the life of the filament.

The filament of the RCA-866 should always be allowed to come up to operating temperature before the plate voltage is applied. For average conditions, the delay should be approximately 30 seconds. If there is any evidence of sparking in the tube, the time delay should be increased before applying full plate voltage. During "standby" periods, the filament should be kept at its rated voltage to avoid delay in "coming back". A protective relay having an obtainable delay period of one minute is desirable in the plate circuit to prevent automatically the application of plate voltage until the filament has reached operating temperature.

Caution should be observed when measuring filament voltage because the filament winding is at high potential.

When an RCA-866 is first placed in service, its filament should be operated at normal voltage for approximately 15 minutes without plate voltage in order to distribute the mercury properly. This procedure need not be repeated unless, during subsequent handling, the mercury is spattered onto the filament and plate.

Shields and r-f filter circuits should be provided for the RCA-866 if it is subjected to extraneous high-voltage or high-frequency fields when in operation. These fields tend to produce break-down effects in mercury vapor and are detrimental to tube life and performance. Shielding is employed when the tube is in proximity to high-voltage fields. R-f filters are employed to prevent the damage caused by radio-frequency currents which might otherwise be fed back into the rectifier tubes. The presence of such currents may sometimes be detected by a glow appearing in the tube with no applied plate voltage. However, the absence of glow does not necessarily mean freedom from these harmful r-f currents.

APPLICATION

As a *single-phase or multiphase rectifier*, the RCA-866 should be operated under conditions such that the maximum rated values under CHARACTERISTICS are not exceeded. Maximum Peak Inverse Voltage* and Maximum Peak Plate Current** are the fundamental limitations in the operation of this tube.

Filter circuits of either the condenser-input or the choke-input type may be employed. If the condenser-input type of filter is used, special consideration must be given to the instantaneous peak value of the a-c input voltage (see Maximum Peak Inverse Voltage) which is about 1.4 times the RMS value as measured with an a-c voltmeter. It is important, therefore, that the filter condensers (especially the input condenser) have a sufficiently high breakdown rating to withstand this instantaneous peak value. With the condenser-input type of filter, the peak plate current of the tube is considerably higher than the load current. When choke input to the filter is used, the peak plate current is considerably reduced. This type of circuit is preferable from the standpoint of obtaining the maximum continuous d-c output current from the RCA-866 under the most favorable conditions.

* *Maximum peak inverse voltage* is the highest peak voltage that a rectifier tube can safely stand in the direction opposite to that in which it is designed to pass current. In other words, it is the safe arc-back limit with the tube operating within the specified temperature range. In single-phase circuits, the peak inverse voltage on a rectifier tube is approximately 1.4 times the RMS value of the plate voltage applied to the tube. This value is based on the assumption that the voltage is sinusoidal. In polyphase circuits, the peak inverse voltage must be determined vectorially.

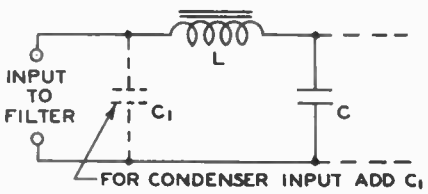
** *Maximum peak plate current* is the highest peak current that a rectifier tube can safely stand in the direction in which it is designed to pass current. If a large choke is used in the filter circuit next to the rectifier tube, the peak plate current is not much greater than the load current, but if a large condenser is used in the filter next to the rectifier tube, the peak current is often as much as four times the load current. In order to determine accurately the peak current in any circuit, the best procedure usually is to measure it with a form of peak meter or to use an oscillograph.

Table I gives empirical values of choke inductance (L) and condenser capacity (C) for choke-input-to-filter circuits which will keep the peak plate current below the recommended maximum, provided the average d-c load current for any installation does not exceed the value given in the table. The load-current values are based on primary sinusoidal voltage and current. If the wave forms are distorted, these values may not be reached without exceeding the peak ratings of the tube. The average load current may be read on a d-c ammeter placed in series with the load.

The capacitance (C) given in the table is small enough to prevent excessive surges when power is first applied to the circuit, and yet large enough to give adequate filtering. If the inductance (L) is increased, it is permissible to increase the capacitance in the same proportion. In a two-section filter with two inductances of unequal value, the larger inductance should be placed next to the rectifier tubes. With such an arrangement, the maximum value of each capacitance should be determined on the basis of the value of the inductance preceding it.

The first three circuits (Figs. 1, 2, 3) of Table I will give a ripple voltage of less than 5% when used with a two-section filter having a minimum of inductance and the corresponding maximum of capacitance. For most purposes this is adequate filtering. Similarly, the next two circuits (Figs. 4, 5) will give a ripple voltage of less than 1%. The last set of conditions in the table applies to a single-phase, full-wave system using two tubes with condenser input to the filter. It will be noted that the maximum d-c output voltage available at the filter is 25% higher than for the choke-input system (Fig. 1); but the permissible d-c load current is 45% less. Similarly, these same percentages will hold for the single-phase, full-wave system using four tubes (Fig. 2).

For any of these circuits, better filtering may be obtained with inductances larger than the minimum given in the table. For these larger inductances, the corresponding capacitances may be increased by the same percent as the inductances to give still better results. For example, with a 100% increase in the inductance (L) next to the rectifier tubes, the d-c load current may be increased by 50%. A 200% increase permits an increase of 67% in load current. The use of additional sections in the filter, of course, is another way of obtaining greater smoothing.



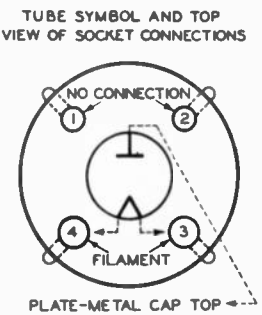


Table I

CIRCUIT	A-C INPUT VOLTS (RMS)	MAX. D-C OUTPUT VOLTS TO FILTER	CHOKE INPUT ONE-SECTION FILTER		MAX. D-C LOAD CURRENT AMPERES
			MIN. CHOKE (L) HENRYS	MAX. CONDENSER (C) uf	
SINGLE-PHASE FULL-WAVE (2 Tubes-Fig. 1)	2650 *max.* per tube	2385	10.0	1.0	0.3
	2000 per tube	1800	8.3	1.1	0.3
	1500 per tube	1350	5.6	1.7	0.3
	1000 per tube	900	3.7	2.6	0.3
SINGLE-PHASE FULL-WAVE (4 Tubes-Fig. 2)	5300 *max.* total	4770	20.0	0.5	0.3
	4500 total	4050	16.9	0.6	0.3
	4000 total	3600	15.0	0.7	0.3
	3000 total	2700	11.3	0.8	0.3
THREE-PHASE HALF-WAVE (3 Tubes-Fig. 3)	3065 *max.* per leg	3585	3.7	1.1	0.3
	2500 per leg	2925	3.0	1.4	0.3
	2000 per leg	2340	2.4	1.8	0.3
	1500 per leg	1755	1.8	2.4	0.3
THREE-PHASE HALF-WAVE DOUBLE Y (6 Tubes-Fig. 4)	3065 *max.* per leg	3585	1.8	0.6	1.2
	2500 per leg	2925	1.5	0.7	1.2
	2000 per leg	2340	1.2	0.9	1.2
	1500 per leg	1755	0.9	1.2	1.2
THREE-PHASE FULL-WAVE (6 Tubes-Fig. 5)	3065 *max.* per leg	7175	2.5	0.5	0.6
	2564 per leg	6000	2.0	0.5	0.6
	2136 per leg	5000	1.7	0.6	0.6
	1709 per leg	4000	1.3	0.8	0.6
SINGLE-PHASE FULL-WAVE (2 Tubes-Fig. 1)*	2650 *max.* per tube	3000	-	-	0.165
	2000 per tube	2260	-	-	0.165
	1500 per tube	1700	-	-	0.165
	1000 per tube	1150	-	-	0.165

* With Condenser Input.

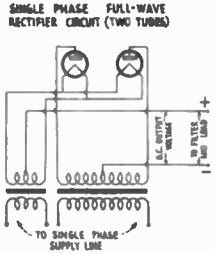


Fig. 1

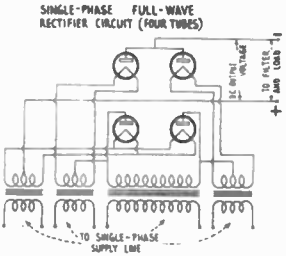


Fig. 2

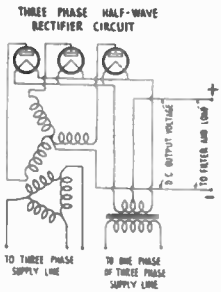


Fig. 3

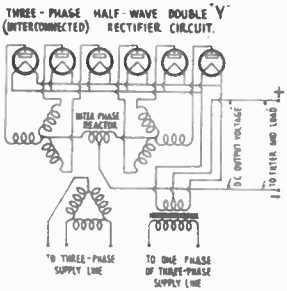


Fig. 4

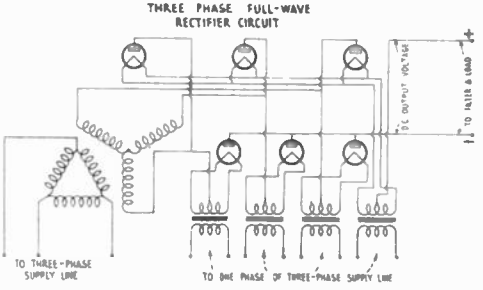


Fig. 5

ADDITIONAL RCA RADIOTRONS FOR RADIO AMATEUR TRANSMITTING USE

Radiotron UV-204-A is a 3-electrode, 250-watt oscillator and radio-frequency amplifier tube. Filament volts 11.0. Normal plate volts 2000.

Radiotron RCA-831 is a high-power 3-electrode tube designed for use as an oscillator and r-f amplifier, particularly at frequencies above 3000 kc. Filament volts 11.0. Normal plate volts 3000. Power Output (Class C) 500 watts.

Radiotron RCA-843 is a 3-electrode, low-power tube of the heater-cathode type similar in characteristics to RCA-10. It is for use as an oscillator, a-f amplifier and r-f amplifier. Heater volts 2.5. Power Output (Class C) 5 watts.

Radiotron RCA-844 is a screen grid, low-power tube of the heater-cathode type, similar in characteristics to RCA-865. It is for use as a radio-frequency amplifier, particularly at frequencies above 3000 kc. Heater volts 2.5. Power Output (Class C) 5 watts.

Radiotron UV-849 is a general purpose, 3-electrode tube especially adaptable to modulator or audio-frequency amplifier service. It may also be used with excellent results as an oscillator or r-f amplifier. Filament volts 11.0. Oscillator power input per modulator tube 400 watts (Plate volts 2500; modulation factor 0.6).

Radiotron RCA-850 is a screen grid tube of the medium power type for use as a radio-frequency amplifier. Filament volts 10. Plate volts 1000. Power Output (Class C) 100 watts.

Radiotron UV-851 is a general purpose, high-power tube of the 3-electrode type especially suited as a modulator and audio-frequency amplifier or as a radio-frequency power amplifier. Filament volts 11.0. Oscillator input per modulator tube 400 watts (Plate volts 2000; modulation factor 0.6).

Radiotron UV-861 is a high-power tube of the screen grid type designed for use as a radio-frequency amplifier. It is particularly useful at frequencies above 3000 kc. Filament volts 11.0. Normal plate volts 3000. Power Output (Class C) 500 watts.

Radiotron UV-872 is a heavy-duty, half-wave, mercury-vapor rectifier tube of the hot-cathode type. Filament volts 5.0. Maximum peak inverse volts 7500. Maximum peak plate current 2.5 amperes.

Radiotron UV-872-A is a heavy-duty, half-wave, mercury-vapor rectifier tube of the hot-cathode, mercury-vapor type. Filament volts 5.0. Maximum peak inverse volts 10000. Maximum peak plate current 2.5 amperes.

Additional technical information on these types, or receiving types, may be obtained by writing to

COMMERCIAL ENGINEERING SECTION
RCA RADIOTRON CO. INC.
HARRISON, NEW JERSEY