

## PART THREE

### Vacuum Tube Transmission for the Radio Amateur and Experimenter

*With Data on*

Radiotron Transmission

Kenotron Rectification

Transmitting Tube Circuits

Transmitting Apparatus

# RADIOTRON TRANSMISSION

## THE USE OF RADIOTRONS IN EXPERIMENTAL CONTINUOUS WAVE TELEGRAPH AND TELEPHONE SETS

CURRENT literature devoted to amateur radio activities affords sufficient evidence that the era of continuous wave transmission has arrived. It has long been known that continuous wave sending apparatus would provide a greater radio transmission range than a spark transmitter of the same power to the antenna, and also that the use of continuous waves would permit the adoption of more efficient methods of reception than the spark system.

The only suitable form of undamped wave generator for short wave transmission is the oscillating vacuum tube. The expenditure of large sums of money in painstaking research conducted by America's foremost scientific experts has enabled the production of reliable and efficient power tubes—RADIOTRONS—which may be employed as generators of continuous oscillations, of any frequency used in radio communication. The vacuum tube is better adapted to radio transmission at wavelengths in the region of 200 meters than the spark system, for the spark system has certain inherent characteristics which place a very definite practical limit upon the amount of energy that can be put into an antenna at short

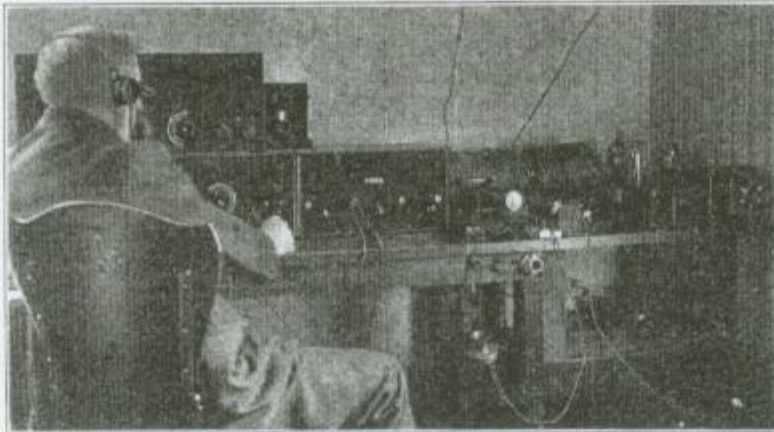
wavelengths and therefore at high frequencies.

The vacuum tube transmitter using the Radio Corporation's Power Tubes is comparatively simple, both in point of construction and in operation. It is no more difficult to adjust and to maintain than a spark transmitter, and it has many points of advantage over the spark set. There are, however, certain precautionary measures which must be considered in vacuum tube operation, and it is one of the objects of this bulletin to place before the amateur such information as will enable him to secure the

maximum results from a tube set. Moreover, as the operation of the tube transmitter becomes better known among amateur experimenters, it will occupy the premier position in amateur radio work.

Two prime advantages of continuous wave telegraphy should not be lost sight of: namely, the high

degree of selectivity, and the greatly increased range obtainable. It is usually possible to transmit two or three times the distance that can be covered by a spark set of the same antenna power, and in addition interference is reduced to an absolute minimum.



Station "8ZG" of Salem, Ohio, Equipped with a 100-Watt Radiotron Vacuum Tube Transmitter Made Up of RCA Parts.

## CONTINUOUS WAVE TELEGRAPHY (C. W.), INTERRUPTED CONTINUOUS WAVE TELEGRAPHY (I. C. W.) AND RADIO TELEPHONE TRANSMISSION

EVERY up-to-date radio experimenter wants a radio telephone; he will also want a long-distance radio telegraph set. With the same set, using the Radio Corporation's Power

Tubes, the amateur can telephone to the neighboring stations over moderate distances, and by shifting a few switches he can adapt the set for continuous wave telegraph transmission and

cover distances by telegraphy three to four times those possible by radio telephony. This is the modern way of doing things in the amateur station, and today there are already several thousand RADIOTRON Power Tubes in use at amateur stations throughout the United States.

The Vacuum Tube Transmitting not only permits wireless telephony, but also enables the amateur to make use of modulated or interrupted continuous wave telegraphy. Thus, if the energy supplied to an antenna by an oscillating tube set is modulated by a microphone transmitter, telephonic communication is possible; or if the antenna oscillations are modulated by a buzzer or preferably by some form of rotary grid chopper, the antenna will ra-

diate wave trains similar to those sent forth from the antenna of a spark transmitter. By a suitable arrangement of controls, either C. W. transmission, I. C. W. transmission or telephony may be had from the same set, simply by shifting a few switches.

In transmitting to crystal detector receiving stations with a tube transmitter the grid circuit is modulated by a rotary "chopper." Such a chopper is nothing more than a rotary interrupter designed to interrupt the grid circuit of an oscillating tube from 600 to 1,000 times per second. Tests have demonstrated that a tube set modulated in this way gives the same reception efficiency as a quenched spark set of the same power to the antenna.

### SOURCES OF ENERGY FOR TUBE TRANSMISSION

A VACUUM power tube requires a low voltage source to heat the filament and a high voltage source to energize the plate or anode circuit. The requisite e.m.f. for the plate circuit may be obtained in three ways:

- (1) From a high voltage D. C. generator.
- (2) From a rectified A. C. Source, using the Radio Corporation's KENOTRON, or two electrode, rectifier valves.
- (3) From an A. C. Source directly applied to the plate (self-rectification circuits).

If only a D. C. source, such as 110 or 220 volts, is available, a high voltage D. C. generator should be obtained. The motor should be supplied with slip rings to provide an alternating E.M.F. for the filament (through the medium of a step-down transformer). The generator should provide high voltage D. C. according to the rating of the power tube.

Amateurs having access to an A. C. source only should obtain an A. C. transformer and two of the Radio Corporation's KENOTRON Rectifier Valves arranged in a suitable circuit to rectify both valves of the A. C. cycle. The transformer should be provided with a high

voltage secondary for the plate circuit supply and with two additional secondaries providing a step-down voltage to light the filaments of the Power Tubes and Rectifier Valves. In addition, a reactance and condenser must be supplied to smooth out the ripple in the plate current, as shown in Figure 4.

In the third method two RADIOTRON Power Tubes may be connected in a type of circuit in which alternating current of suitable voltage can be applied directly to the plate circuits of the tubes. The tubes then act simultaneously as rectifiers and oscillators, using both halves of the impressed A. C. cycle. This is called the self-rectification method. By means of a smoothing-out reactance of suitable design, the variation in amplitude of the antenna oscillations may be reduced to a minimum value, giving all the advantages of C. W. transmission. The self-rectification circuit is recommended for telegraph use only. A suitable D. C. source obtained either from a Rectifier Unit or a D. C. generator should be used for telephony.

### NOTE ON C. W. POWER TRANSFORMERS

THE use of separate transformers for the lighting of power tube filaments is highly recommended for the reason that it is only by using such an arrangement that voltage variation in the different circuits is made possible. Where a combination transformer having a single primary winding connected to the power source is used, variation of the voltage is only possible in this primary winding and the sec-

ondary windings, regardless of their number, are all affected at the same time. The cost of individual transformer units for this work is approximately 75 per cent. higher than the cost of a single transformer designed to perform a multiplicity of duties. However, more satisfactory operation results and the former is recommended.

## THE PRACTICAL USE OF TRANSMITTING TUBES

Although the principles of construction and operation in the larger power tubes are no different from those applying in the case of the smaller ones, many effects that are negligible in the latter are somewhat magnified in the case of the larger tubes, and certain precautions are therefore necessary. The majority of accidents to power tubes and to their auxiliary apparatus occur during the period of development of circuits and testing and adjustment, rather than during operation, and a little

care in making these adjustments will prove of advantage.

The following points, briefly enumerated, are all of importance and should be studied by the amateur before putting his set into operation. Limited space prevents us from giving in detail the reasons for some of the instructions herein laid down, but the amateur may be assured that they are the result of practical observation and experiment and that he cannot well afford to ignore them.

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### MODULATION OF AN OSCILLATING TUBE'S OUTPUT

One method of modulation employed in a vacuum tube radio transmitting equipment utilizes a tube as a modulator in addition to the oscillator tube, the plate current for these two tubes being fed through an audio-frequency reactor. In a radio telephone transmitting equipment the degree of modulation is of equal importance to the amount of antenna current as far as the strength of the received speech is concerned. The antenna ammeter does not usually indicate whether the output is being modulated in a normal manner. One simple

method of keeping a check on this is to insert a miniature lamp in the plate circuit of the modulator. This flashes up when the microphone is spoken into and acts as an operating indicator of the microphone and modulation circuits. A type of lamp should be chosen that will show a low degree of brilliancy with the plate currents obtained on the tube used. Even for the 5-watt size of tube such lamps are easily obtainable. Automobile types of miniature lamps are recommended.

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### SAFETY GAPS AND GENERAL PROTECTIVE MEASURES

In order to guard against excessive transient voltages in connection with RADIOTRONS UV-203 and UV-204 a protective gap should be provided at or near the socket terminals between the grid and terminal and one of the filament terminals. One-sixteenth of an inch is correct for UV-203 and one-eighth of an inch for UV-204.

Occasionally in the parallel operation of RADIOTRON power tubes, ultra high frequency oscillations develop in the plate and grid circuits, which prevent the realization of full

output, and cause excessive plate and grid currents. This effect may be avoided by inserting an inductance of a few micro-henries (10 turns in one layer on a tube one inch in diameter is suggested) in one or more of the individual grid leads of each tube as close to the grid terminal of the socket as possible. The protective gap mentioned in a paragraph above should be placed between this coil and the grid terminal of the socket. The best arrangement is to mount the gap directly on the socket terminals and one terminal of the coil directly to the grid terminal of the socket.

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### TUBE SUSPENSION

The life of RADIOTRON power tubes may be prolonged by mounting them in the proper position. RADIOTRONS UV-202 and UV-203 should be operated in a vertical position, whereas RADIOTRON UV-204 may be operated in either a vertical or horizontal position. If mounted horizontally, the plates should lie in a vertical plane, with the seal-off tip down.

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### OSCILLATING CIRCUITS

In powerful C. W. transmitting sets the circuits should be so arranged that the center tap on the filament coil and also the negative lead of the direct current high voltage source are both at ground potential relative to high frequency potentials in order to insure safety.

Great care should be taken to thoroughly insulate the grid and plate leads to the tube and the coil sections connected to these leads or any apparatus in them.

### INADVISABILITY OF FORCING POWER TUBES

It is unwise to overload a RADIOTRON power tube continuously, as its operating life will be seriously curtailed. It is a much better plan and more economical to operate two tubes in parallel than it is to force one tube to deliver a power output far in excess of what it is rated for; in fact great economy will result from burning tubes slightly below normal brightness. For instance, it can be shown that to double the filament emission will reduce the operating life of the tube to one-fourth, whereas, by operating the filament at 95% of its rated voltage, the life will be doubled.

*When first testing the circuit, or when the set has not been operated for some time, it is wise to cut down all voltages to one-third*

*of the normal voltage. This will greatly reduce the possibility of burning out the tube through a wrong connection which has been overlooked, as a fault will then instantly be detected before the damage is done.*

In a radio telephone transmitting circuit of the usual type a modulator tube is employed and a buzzer is often substituted for the microphone when it is desired to send out interrupted continuous waves. This imposes voltage strains on the oscillator tube and if an over-voltage is also applied to its plate the voltage between grid and filament may be excessive. The protective gaps described in a previous paragraph are a safeguard against breakdown due to this voltage.

### RESISTANCE OF THE ANTENNA AND GROUND CIRCUIT

Remember it is the antenna charging current at the transmitter that produces the signals at the receiver, and in order to get a large antenna current with tube sets, the resistance of antenna systems must be reduced to a minimum. In addition to the usual metallic earth plate a counterpoise, consisting of a number of wires spread on the ground underneath the

antenna will materially reduce the total antenna resistance. The antenna should be constructed and supported so that its electrical period will not vary through swinging, for, as will be seen, most of the tube circuits shown in this catalogue use the antenna as the capacity element of the oscillating system.

### FILAMENT EXCITATION OF POWER TUBES

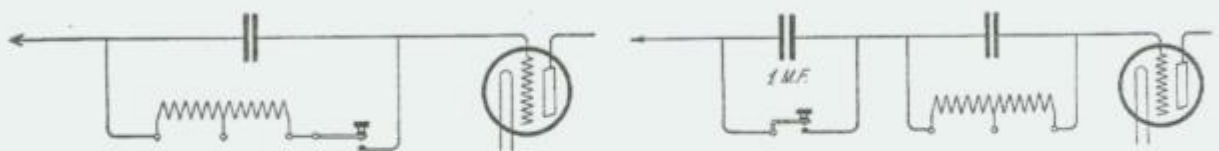
The filaments of power bulbs are preferably energized by alternating current, which gives an added factor of safety and prolongs the filament life.

In adjusting the temperature of a filament the amateur should always use a voltmeter rather than an ammeter, and the voltmeter should be connected directly to the socket connections, in order that the voltage drop across the filament may be measured. If tung-

sten filaments are operated at constant voltage rather than constant current, it may increase their life by 300%.

If alternating current is not available the filaments may, of course, be energized from a D. C. source of suitable E. M. F. It is emphasized, however, that the life of a vacuum tube is considerably prolonged by A. C. filament excitation, and particularly if the filament voltage is maintained at constant value.

### LOCATION OF THE TELEGRAPH KEY IN C. W. CIRCUITS



The proper location of the telegraph key in C. W. transmitting circuits is determined by the size of the RADIOTRON power tubes used. In circuits employing one or more UV-202 RADIOTRONS, satisfactory keying can be obtained by inserting the key in series with the grid leak resistance as shown in the diagram.

If, however, one or more UV-203 RADIOTRONS are used, the most satisfactory keying will be obtained if a 1 mfd. condenser is inserted in series with the parallel circuit containing the grid leak resistance and grid condenser, and the key shunted around the 1 mfd. condenser as shown above.

## TRANSMITTING TUBE CIRCUITS

TO show the radio amateur or experimenter how to utilize RADIOTRONS in certain of the well-known oscillating circuits, there is given on the following pages a set of circuit diagrams for radio transmission, together with the component parts of a set for either 5, 50 or 250 watt tubes. Power tubes can be used in a variety of circuits, but the ones shown have been found to give maximum efficiency. Current radio literature discloses numerous tube transmitting circuits which will be found serviceable.

The attention of the amateur who does not possess a high voltage D. C. motor generator set to supply plate voltage is directed to the self-rectification telegraph circuits shown, in which RADIOTRONS may be energized directly from an A. C. source. In these circuits power tubes act simultaneously as rectifiers and oscillators. A suitable source of D. C. may be obtained from an A. C. source by the use of the Radio Corporation KENOTRON Rectifier Valves.

## CIRCUIT NO. 1

Figure 1 shows a simple, yet modern type of radio telephone circuit, wherein two Radiotron power tubes are connected in parallel as oscillators. The plate circuit is energized by using full wave Kenotron rectification from an A. C., 110 volt supply. The antenna energy is modulated for radio telephony by the Radio Corporation of America's Magnetic Modulator.

## CIRCUIT NO. 2

Figure 2 illustrates a method for using Radiotrons UV-202 or 203 for C. W. and I. C. W. radio telegraphy from a D. C. supply. The filaments of the transmitter tubes in this case are heated by a storage battery and the voltage necessary for the plates is supplied by a special motor generator according to the rating indicated at the foot of the page describing this circuit. Where I. C. W. is employed, the Radio Corporation of America's Grid Chopper Model PX-1638 is employed.

## CIRCUIT NO. 3

Figure 3 illustrates a full wave self-rectifying transmitter for C. W. telegraphy using A. C. as a source of power throughout. This circuit is applicable to 5 and 50 watt Radiotrons, UV-202 and UV-203, respectively. The plate circuit is energized from the Radio Corporation of America's new high voltage transformer, which is designed to operate from a source of 110 volt, 50 or 60 cycle A. C.

## CIRCUIT NO. 4

Figure 4 illustrates one of the correct methods for employing a 10-20 or 50-100 watt radio telephone set, using two Radiotrons UV-202 or UV-203, one as an oscillator and the other as a modulator. Two of the Radio Corporation of America's Kenotrons, Model UV-216 or Model UV-217, provide D. C. plate excitation from an A. C. supply. An R. C. A. microphone transformer with "side tone" winding is used to control the grid potential of the modulator tube, which in turn varies the energy imposed upon the antenna circuit.

## CIRCUIT NO. 5

Figure 5 illustrates a circuit specially designed to provide constant antenna frequency. This is desirable because it prevents changes in

the wave length of the transmitting station and permits consistent operation over longer distances than is otherwise possible. Two Radiotron power tubes are employed as oscillators, their plates being energized by the Kenotron Rectifier combination, which provides full wave rectification from the A. C. supply.

## CIRCUIT NO. 6

Figure 6 shows a typical radio telephone transmitting circuit, employing three Radiotrons UV-203 as oscillator, modulator, and speech amplifier, respectively. Plate excitation is obtained from a D. C. high voltage generator and the plate potential for normal operation should range between 750 and 1000 volts. This circuit may be employed for C. W., I. C. W., or radio telephone transmission.

## CIRCUIT NO. 7

Figure 7 illustrates a typical circuit for use in connection with four Radiotrons UV-202 and four Kenotrons UV-216. Two of the Radiotrons act as modulators and two act as oscillators, while the four Kenotrons permit full wave rectification from the A. C. supply. The Radio Corporation of America's Power Transformer provides the filament and plate current for the eight tubes.

## CIRCUIT NO. 8

Figure 8 illustrates a suitable arrangement for using full wave rectification for four Radiotrons UV-202 and four Kenotrons UV-216. This is a constant frequency circuit of the same character illustrated in Fig. 5. The coupling arrangement between the oscillation transformer and antenna inductance permits an accurate adjustment by means of the Special Faradon Condenser UC-1846 which provides three different capacities.

## CIRCUIT NO. 9

Figure 9 shows a radio telegraph self-rectifying transmitting circuit for two Radiotrons UV-204. The energy supply for this circuit must be A. C. and individual transformers for filament heating and plate supply are used. A circuit of this character may be employed to communicate over long distances by self-rectified continuous wave telegraphy.

FIG. 1. Radio Telephone Circuit, Using Full Wave Rectification From A. C. Supply and Magnetic Modulator

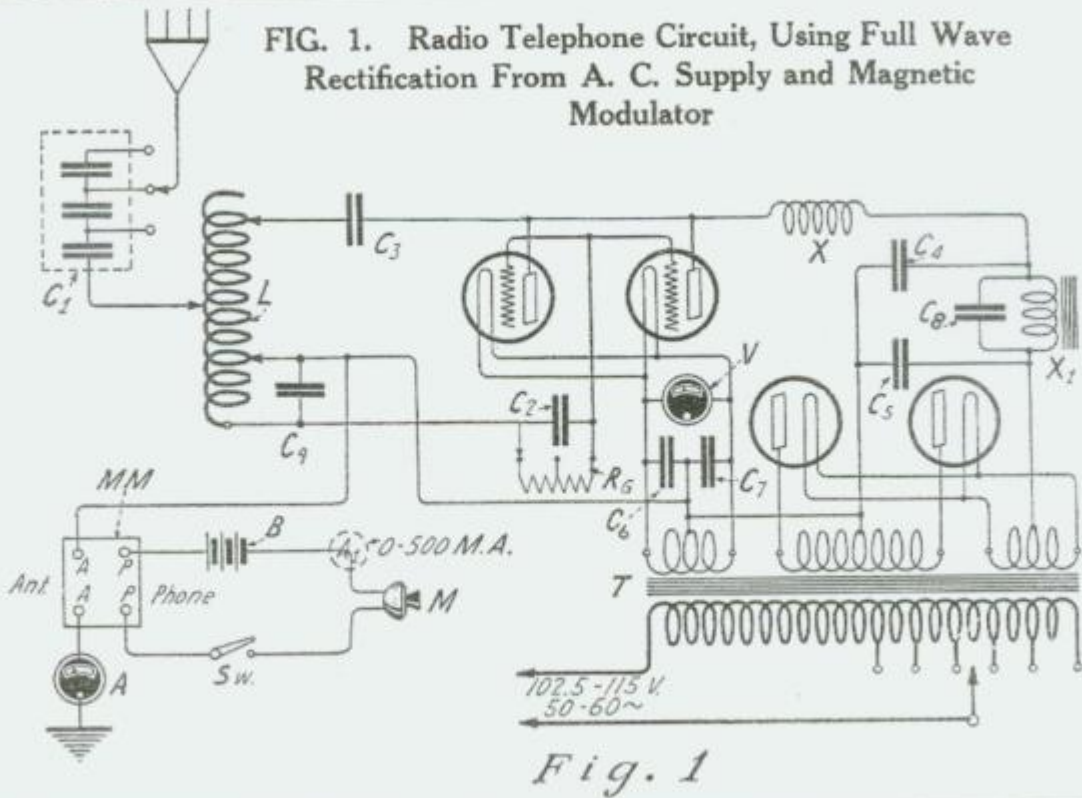


Fig. 1

LIST OF MATERIAL	Circuit Symbol	RATING OF RADIOTRONS			
		5-WATT TUBES		50-WATT TUBES	
		Model	Price	Model	Price
1 One or more RADIOTRON Power Tubes		UV-202	\$8.00 each	UV-203	\$30.00 each
2 One or more RADIOTRON Power Sockets		UR-542	1.00 "	UT-541	2.50 "
3 Two KENOTRON Rectifier Tubes		UV-216	15.00	UV-217	53.00
4 Two KENOTRON Tube Sockets		UR-542	2.00	UT-541	5.00
5 Antenna Series Condenser	C <sub>1</sub>	UC-1015	5.75	UC-1015	5.75
6 Magnetic Modulator	MM	(See Note 1)		(See Note 3)	
7 Magnetic Modulator Battery	*B	6 Volts		6 Volts	
8 Microphone	†M	WE-284-W		WE-284-W	
9 Antenna Ammeter	A	UM-530	6.00	UM-533	6.25
10 Grid Condenser	C <sub>2</sub>	UC-1014	2.25	UC-1014	2.25
11 Blocking Condenser	C <sub>3</sub>	UC-1014	2.50	UC-1014	2.50
12 Filter Condenser	C <sub>4</sub>	2-UC-490	5.00	2-UC-490	5.00
13 Filter Condenser	C <sub>5</sub>	(In parallel)		(In parallel)	
14 Transmitter Grid Leak	R <sub>g</sub>	UP-1719	1.10	UP-1718	1.65
15 A. C. Filament Voltmeter	V	0-15 Volts		0-15 Volts	
16 Power Transformer	T	UP-1368	25.00	UP-1016	38.50
17 Radio Frequency Choke	X	UL-1655	3.85	UL-1655	3.85
18 Filter Reactor	X <sub>1</sub>	UP-1653	12.50	UP-1654	18.00
19 Oscillation Transformer	L	UL-1008	11.00	UL-1008	11.00
20 Microphone Milliammeter	A <sub>1</sub>				
21 Microphone Battery Switch	SW	S. P. S. T.		S. P. S. T.	
22 Filament By-Pass Condenser	C <sub>6</sub> & C <sub>7</sub>	2-WE-21-R		2-WE-21-R	
		(As shown)		(As shown)	
23 Trap Condenser	C <sub>8</sub>	WE-21-U		WE-21-U	
24 Grid Tuning Condenser	C <sub>9</sub>	UC-1831	9.00	UC-1831	9.00

NOTE 1:—Proper Size of Magnetic Modulator

No. of Tubes	UV-202	No. of Tubes	UV-203
1	UT-1643	1	UT-1357
2	UT-1643	2	UT-1367
3	UT-1357	3	UT-1367
4	UT-1357		

\* Four Dry Cells or 6-Volt Storage Battery.  
 † Western Electric No. 284-W is recommended.

REMEMBER—It is not necessary to purchase a motor-generator if you have a source of 110-volt A. C. lighting current, for it can be converted to D. C. by using KENOTRON rectifiers.

FIG. 2. C. W. and I. C. W. (Grid Chopper) Circuit for Operation From D. C. Supply With Radiotrons UV-202 or UV-203

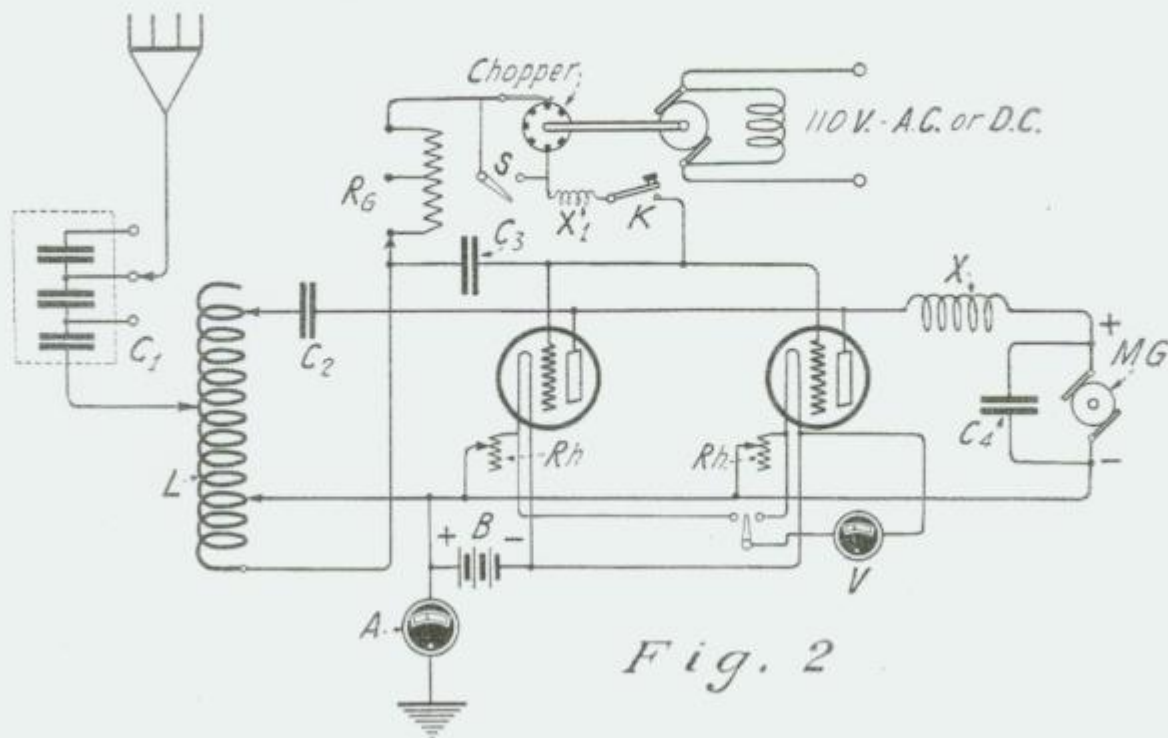


Fig. 2

LIST OF MATERIAL	Circuit Symbol	RATING OF RADIOTRONS			
		5-WATT TUBES		50-WATT TUBES	
		Model	Price	Model	Price
1 One or more RADIOTRON Power Tubes		UV-202	\$8.00 each	UV-203	\$30.00 each
2 One or more RADIOTRON Tube Sockets		UR-542	1.00 "	UT-541	2.50 "
3 Oscillation Transformer	L	UL-1008	11.00	UL-1008	11.00
4 Antenna Series Condenser	C <sub>1</sub>	UC-1015	5.75	UC-1015	5.75
5 Blocking Condenser	C <sub>2</sub>	UC-1014	2.50	UC-1014	2.50
6 Transmitter Grid Leak	R <sub>g</sub>	UP-1719	1.10	UP-1718	1.65
7 Grid Condenser	C <sub>3</sub>	UC-1014	2.50	UC-1014	2.50
8 Transmitting Key	K	UQ-809	3.00	UQ-809	3.00
9 Chopper	Chopper	PX-1638	7.25	PX-1638	7.25
10 Radio Frequency Chokes	X	UL-1655	3.85	UL-1655	3.85
11 D. C. Filament Voltmeter	V	O-15 Volts		O-16 Volts	
12 Filament Rheostat	R <sub>h</sub>	PR-535	3.00	PT-537	10.00
13 Filament Battery	B	10 Volts		12 Volts	
14 Protective Condenser	C <sub>4</sub>	UC-490	2.50	UC-490	2.50
15 Motor Generator	MG	(See Note 1)		(See Note 1)	
16 Antenna Ammeter	A	UM-530	6.00	UM-533	6.25
17 Radio Frequency Choke	X <sub>1</sub>	UL-1655	3.85	UL-1655	3.85
18 Switch for CW Telegraphy	S	S. P. S. T.			

NOTE 1:—Rating of Motor Generators

UV-202

No. of Tubes	Watts M. G.	Plate Volts
1 or 2	100	350
2 or 4	200	350

UV-203

No. of Tubes	Watts M. G.	Plate Volts
1	200	750-1000
2 or 3	500	750-1000

REMEMBER—In general a grid chopper gives the same kind of a signal at the receiving station as a spark set, but usually over much greater distances.



FIG. 3. Method of Using 5- or 50-Watt Radiotron Power Tubes With 60-Cycle A. C. Source for C. W. Tone Telegraphy—(Full Wave Self-Rectification)

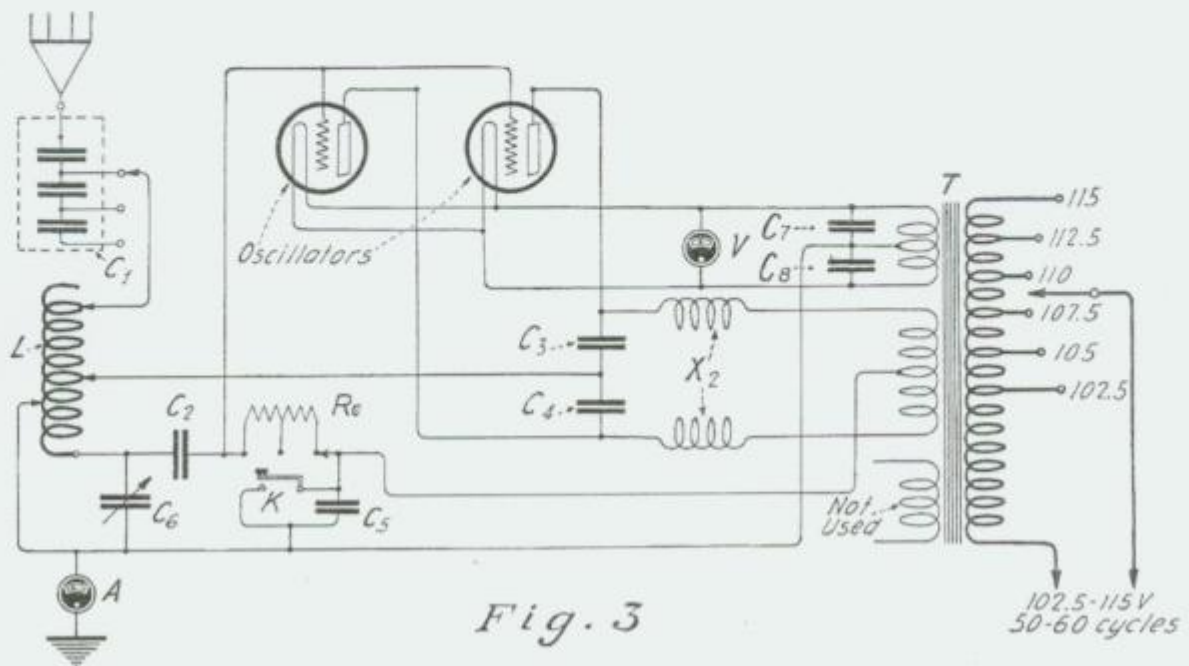


Fig. 3

LIST OF MATERIAL	Circuit Symbol	RATING OF RADIOTRONS			
		5-WATT TUBES		50-WATT TUBES	
		Model	Price	Model	Price
1 Two RADIOTRON Power Tubes (Note 1)		UV-202	\$16.00	UV-203	\$60.00
2 Two Power Tube Sockets		UR-542	2.00	UT-541	5.00
3 Power Transformer	T	UP-1368	25.00	UP-1016	38.50
		(See Note 1)			
4 Oscillation Transformer	L	UL-1008	11.00	UL-1008	11.00
5 Two By-Pass Condensers	C <sub>2</sub> , C <sub>4</sub>	UC-1014	5.00	UC-1014	5.00
6 Grid Condenser	C <sub>1</sub>	UC-1014	2.50	UC-1014	2.50
7 Grid Leak	R <sub>g</sub>	UP-1719	1.10	UP-1718	1.65
8 Antenna Series Condenser	C <sub>3</sub>	UC-1015	5.75	UC-1015	5.75
9 A. C. Filament Voltmeter	V	0-15 Volts		0-15 Volts	
10 Antenna Ammeter	A	UM-530	6.00	UM-533	6.25
11 Key	K	UQ-809	3.00	UQ-809	3.00
12 Radio Frequency Chokes	X <sub>2</sub>	2-UL-1655	7.70	2-UL-1655	7.70
13 Keying Condenser	C <sub>5</sub>	UC-1014	2.50	UC-1014	2.50
14 Grid Tuning Condenser	C <sub>4</sub>	2-UC-1014	5.00	2-UC-1014	5.00
		In Series or (UC-1831) variable		In Series-Fixed or (UC-1831) variable	
15 By-Pass Condensers	C <sub>1</sub> & C <sub>3</sub>	WE21-R		WE21-R	
		(Connected as shown)		(Connected as shown)	

NOTE 1:—Transformer UP-1368 is capable of handling a total of four UV-202 tubes in a self-rectifying circuit. In order to obtain a 20-watt set, it is only necessary to add two additional UV-202 tubes, one in parallel with each of the tubes shown in the circuit.

REMEMBER—When using a motor-generator for plate supply to one or more power tubes, be sure that the watts output of the generator is sufficient to supply all the tubes. Do not use a 15-watt generator for plate supply to a 50-watt RADIOTRON. A table indicating the generator watts output for various numbers of tubes is shown under Fig. 2.

FIG. 4. Complete Diagram for Low Power Radio Telephone Set, Using Constant Current Modulation System with 5 or 50-Watt Radiotron Power Tubes Operating From 110-Volts A. C. Supply.

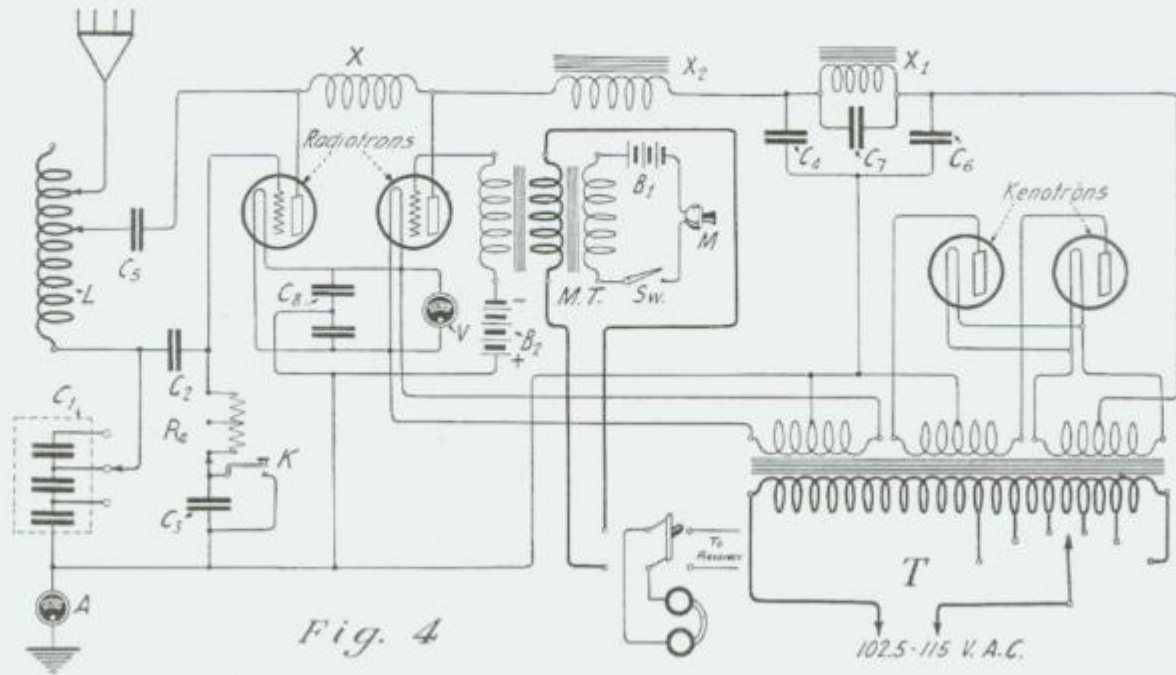


Fig. 4

LIST OF MATERIAL	Circuit Symbol	RATING OF RADIOTRONS			
		5-WATT TUBES		50-WATT TUBES	
		Model	Price	Model	Price
1 Two RADIOTRON Power Tubes.....		UV-202	\$16.00	UV-203	\$60.00
2 Two Power Tube Sockets.....		UR-542	2.00	UT-541	5.00
3 Power Transformer.....	T	UP-1368	25.00	UP-1016	38.50
4 Oscillation Transformer.....	L	UL-1008	11.00	UL-1008	11.00
5 Two KENOTRON Rectifier Tubes.....		UV-216	15.00	UV-217	53.00
6 Two KENOTRON Tube Sockets.....		UR-542	2.00	UT-541	5.00
7 Radio Frequency Choke Coil.....	X	UL-1655	3.85	UL-1655	3.85
8 Plate Reactor.....	X <sub>2</sub>	UP-415	5.75	UP-415	5.75
9 Filter Reactor.....	X <sub>1</sub>	UP-1653	12.50	UP-1654	18.00
10 Filter Circuit Condensers.....	C <sub>1</sub> -C <sub>8</sub>	2-UC-490 (In parallel)	5.00	2-UC-490 (In parallel)	5.00
11 Microphone Transformer.....	MT	UP-414	7.25	UP-414	7.25
12 Microphone Transmitter.....	*M	WE-284-W		WE-284-W	
13 Microphone Battery.....	*B <sub>1</sub>	6 Volts		6 Volts	
14 Microphone Switch.....	SW	S.P.S.T.		S.P.S.T.	
15 Grid Bias Battery.....	†B <sub>2</sub>	44 Volts		44 Volts	
16 A. C. Filament Voltmeter.....	V	O-15 Volts		O-15 Volts	
17 Transmitter Grid Leak.....	Rg	UP-1719	1.10	2-UP-1718 (In Series)	3.30
18 Antenna Series Condenser.....	C <sub>1</sub>	UC-1015	5.75	UC-1015	5.75
19 Antenna Ammeter.....	A	UM-530	6.00	UM-533	6.25
20 Blocking Condenser.....	C <sub>5</sub>	UC-1014	2.50	UC-1014	2.50
21 Grid Condenser.....	C <sub>2</sub>	2-UC-1014 (In Series)	5.00	2-UC-1014 (In Series)	5.00
22 Key Condenser.....	C <sub>3</sub>			UC-490	2.50
23 Trap Condenser.....	C <sub>7</sub>	WE-21-U		WE-21-U	
24 Filament By-Pass Condensers.....	C <sub>4</sub>	2-WE-21-R (Connected as shown)		2-WE-21-R (Connected as shown)	

\* Four Dry Cells or 6-Volt Storage Battery.  
† Two Blocks of Burgess' Battery 22½ volts each, No. 2156.

REMEMBER—All of the energy of your power tubes can be efficiently delivered to your antenna on wave lengths of 200 meters and lower.

FIG. 5. Radio Telephone or Telegraph Circuit, Using Full Wave Rectification From A. C. Supply With Constant Frequency (Intermediate) Circuit and Magnetic Modulator

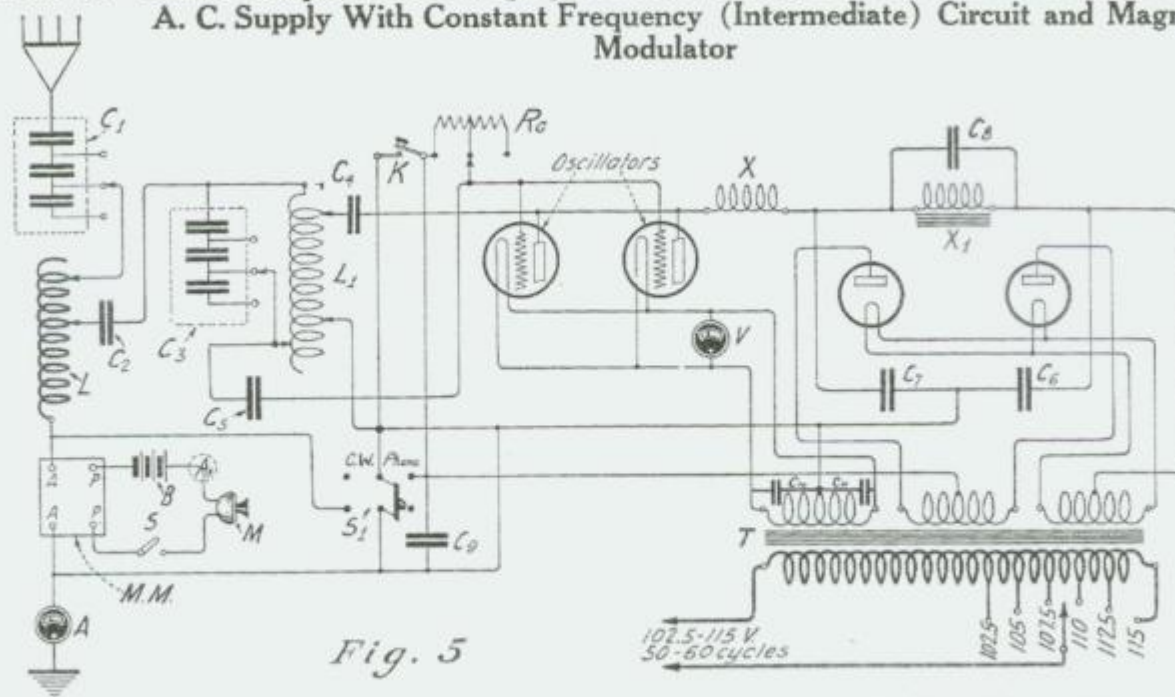


Fig. 5

LIST OF MATERIAL	Circuit Symbol	RATING OF RADIOTRONS			
		5-WATT TUBES		50-WATT TUBES	
		Model	Price	Model	Price
1 Two RADIOTRON Power Tubes.....		UV-202	\$16.00	UV-203	\$60.00
2 Two RADIOTRON Power Sockets.....		UR-542	2.00	UT-541	5.00
3 Two KENOTRON Rectifier Tubes.....		UV-216	15.00	UV-217	53.00
4 Two KENOTRON Tube Sockets.....		UR-542	2.00	UT-541	5.00
5 Antenna Series Condenser.....	C <sub>1</sub>	UC-1015	5.75	UC-1015	5.75
6 Magnetic Modulator.....	MM	(Note 1)		(Note 1)	
7 Magnetic Modulator Battery.....	B	6 Volts		6 Volts	
8 Microphone.....	M	WE-284-W		WE-284-W	
9 Antenna Ammeter.....	A	UM-530	6.00	UM-533	6.25
10 Coupling Condenser.....	C <sub>2</sub>	UC-1803	5.00	UC-1803	5.00
11 Intermediate Shunt Circuit Condenser.....	C <sub>3</sub>	UC-1015	5.75	UC-1015	5.75
12 Blocking Condenser.....	C <sub>4</sub>	UC-1014	2.50	UC-1014	2.50
13 Grid Condenser.....	C <sub>5</sub>	UC-1014	2.50	UC-1014	2.50
14 Filter Condenser.....	C <sub>6</sub>	2-UC-490	5.00	2-UC-490	5.00
15 Filter Condenser.....	C <sub>7</sub>	(In parallel) 2-UC-490	5.00	(In parallel) 2-UC-490	5.00
16 Trap Condenser.....	C <sub>8</sub>	WE-21-U		WE-21-U	
17 Grid Leak.....	R <sub>2</sub>	UP-1719	1.10	UP-1718	1.65
18 A. C. Filament Voltmeter.....	V	O-15 Volts		O-15 Volts	
19 Radio Frequency Choke.....	X	UL-1655	3.85	UL-1655	3.85
20 Filter Reactor.....	X <sub>1</sub>	UP-1653	12.50	UP-1654	18.00
21 Oscillation Transformer.....	L <sub>1</sub>	UL-1008	11.00	UL-1008	11.00
22 Antenna Inductance.....	L	UL-1008	11.00	UL-1008	11.00
23 Key.....	K	UQ-809	3.00	UQ-809	3.00
24 Key Condenser.....	C <sub>9</sub>	UC-1014	2.50	UC-1014	2.50
25 Signal Switch.....	S <sub>1</sub>	S.P.D.T.		S.P.D.T.	
26 Microphone Battery Switch.....	S	S.P.S.T.		S.P.S.T.	
27 Power Transformer.....	T	UP-1658	25.00	UP-1016	38.50
28 Filament By-Pass Condenser.....	C <sub>10</sub>	WE-21-R		WE-21-R	
29 Filament By-Pass Condenser.....	C <sub>11</sub>	WE-21-R		WE-21-R	
30 Microphone Milliammeter, 0-500 Milliamps.....	A <sub>1</sub>				

NOTE 1:—Proper size of Magnetic Modulator

No. of Tubes	UV-202	No. of Tubes	UV-203
1	UT-1643	1	UT-1357
2	UT-1643	2	UT-1367
3	UT-1357	3	UT-1367
4	UT-1357		

REMEMBER—It is not necessary to purchase a motor-generator if you have a source of 110-volt A. C. lighting current, for it can be converted to D. C. by using KENOTRON rectifiers.

FIG. 6. D. C. Radio Telephone Circuit, Using Radiotrons UV-203 for the Oscillator, Modulator and Speech Amplifier, With 1,000 Volts D. C. Plate Supply

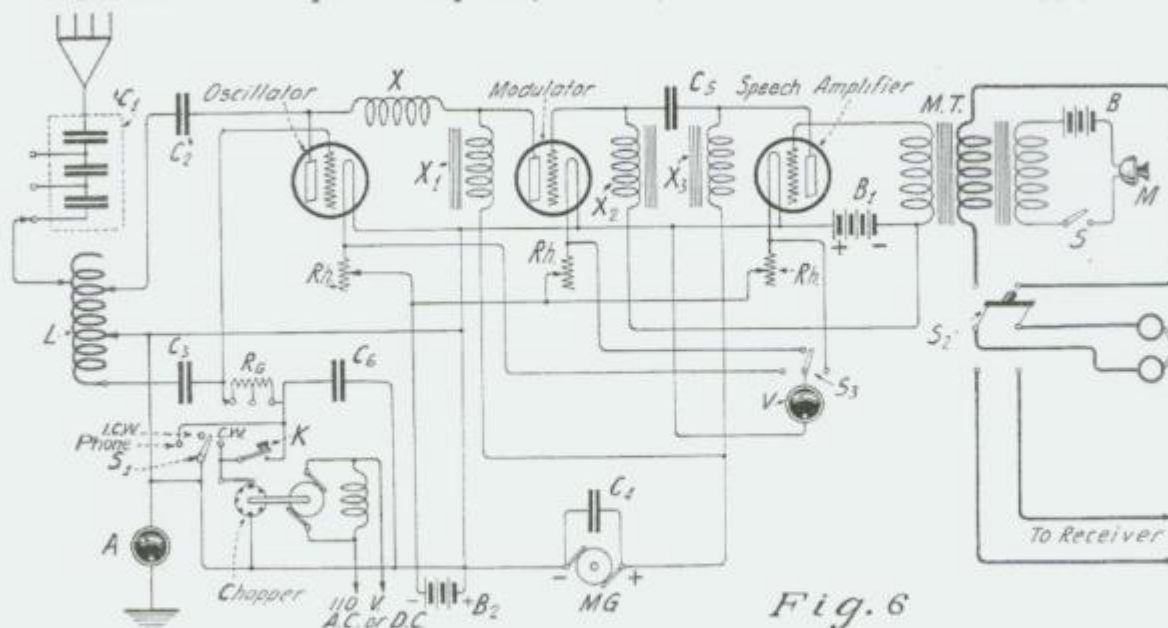


Fig. 6

LIST OF MATERIAL	Circuit Symbol	RATING OF RADIOTRONS 50-WATT TUBES	
		Model	Price
1 One RADIOTRON "Oscillator".....	OSC	UV-203	\$30.00
2 One RADIOTRON "Modulator".....	MOD	UV-203	30.00
3 One RADIOTRON "Speech Amplifier".....	SA	UV-203	30.00
4 Three Sockets.....		UT-541	7.50
5 Oscillation Transformer.....	L	UL-1008	11.00
6 Antenna Series Condenser.....	C <sub>1</sub>	UC-1015	5.75
7 Antenna Ammeter.....	A	UM-533	6.25
8 Blocking Condenser.....	C <sub>2</sub>	UC-1014	2.50
9 Grid Condenser.....	C <sub>3</sub>	UC-1014	2.50
10 Transmitter Grid Leak.....	R <sub>G</sub>	UP-1718	1.65
11 Radio Frequency Choke.....	X	UL-1655	3.85
12 Plate Reactor.....	X <sub>1</sub>	UP-415	5.75
13 Modulator Grid Reactor.....	X <sub>2</sub>	UP-415	5.75
14 Amplifier Plate Reactor.....	X <sub>3</sub>	UP-415	5.75
15 Protective Condenser.....	C <sub>4</sub>	UC-490	2.50
16 Motor Generator.....	MG	Note 1	
17 Grid Bias Battery.....	*B <sub>1</sub>	44 Volts	
18 Amplifier Coupling Condenser.....	C <sub>5</sub>	UC-489	1.60
19 Microphone Transformer.....	MT	UP-414	7.25
20 Microphone Battery.....	†B	6 Volts	
21 Microphone Transmitter.....	M	WE-284-W	
22 D. C. Filament Voltmeter.....	V	O-15 Volts	
23 Keying Condenser.....	C <sub>6</sub>	UC-1014	2.50
24 Key.....	K	UQ-809	3.00
25 Chopper.....	Chopper	PX-1368	7.25
26 Three Filament Rheostats.....	Rh	PT-537	30.00
27 Microphone Switch.....	S	S.P.S.T.	
28 Signal Switch.....	S <sub>1</sub>	S.P.D.T.	
29 Side Tone Switch.....	S <sub>2</sub>	D.P.D.T.	
30 Filament Battery.....	B <sub>2</sub>	12 Volts	
31 Voltmeter Switch.....	S <sub>3</sub>	T.P.S.T.	

NOTE 1:

RADIOTRONS UV-203

No. of Tubes	Watts M. G.	Plate Volts
1	200	750-1000
2 or 3	500	750-1000

\* Two Blocks of Burgess' Battery, No. 2156.

† Four Dry Cells or 6-Volt Storage Battery.

REMEMBER—The life of RADIOTRON power tubes depends upon proper operation. Do not use a greater voltage on the filament than that specified, and do not overload the plate by using an excessive plate voltage, that is IF YOU WANT LONG LIFE.

FIG. 7. Radio Telephone Circuit, Using Four Radiotrons UV-202 and Four Kenotrons, UV-216, for Telephony, With Constant Current System of Modulation

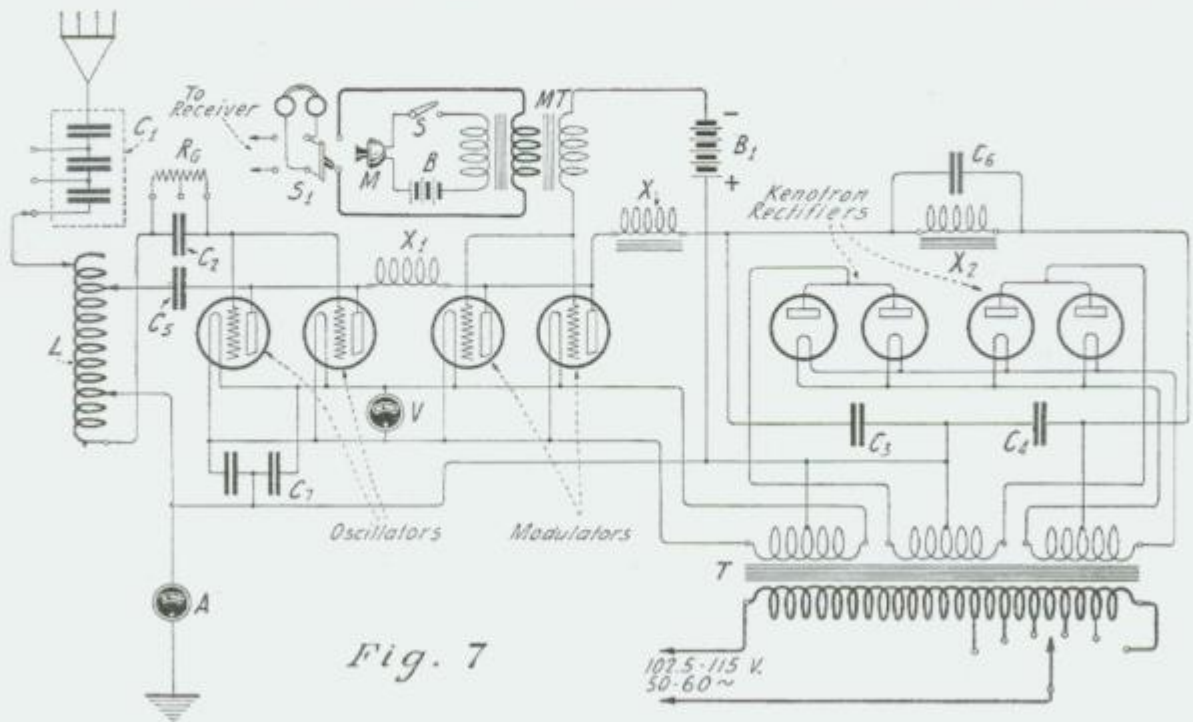


Fig. 7

LIST OF MATERIAL	Circuit Symbol	RATING OF RADIOTRONS 5-WATT TUBES	
		Model	Price
1 Two RADIOTRON Oscillator Tubes.....		UV-202	\$16.00
2 Two RADIOTRON Modulator Tubes.....		UV-202	16.00
3 Four KENOTRON Rectifier Tubes.....		UV-216	30.00
4 Eight Sockets.....		UR-542	8.00
5 Antenna Series Condenser.....		UC-1015	5.75
6 Antenna Ammeter.....	A	UM-530	6.00
7 Grid Condenser.....	C <sub>2</sub>	UC-1014	2.50
8 Transmitter Grid Leak.....	R <sub>G</sub>	UP-1719	1.10
9 Oscillation Transformer.....	L	UL-1008	11.00
10 Radio Frequency Choke.....	X <sub>1</sub>	UL-1655	3.85
11 Plate Reactor.....	X	UP-415	5.75
12 Microphone Transformer.....	MT	UP-414	7.25
13 Microphone Battery.....	*B	6 Volts	
14 Microphone.....	M	WE-284-W	
15 Grid Bias Battery.....	†B <sub>1</sub>	44 Volts	
16 Power Transformer.....	T	UP-1368	25.00
17 Filter Reactor.....	X <sub>2</sub>	UP-1653	12.50
18 Filter Condenser.....	C <sub>4</sub>	2-UC-490 (In parallel)	5.00
19 Filter Condenser.....	C <sub>1</sub>	2-UC-490 (In parallel)	5.00
20 Blocking Condenser.....	C <sub>6</sub>	UC-1014	2.50
21 A. C. Filament Voltmeter.....	V	0-15 Volts	
22 Microphone Switch.....	S	S.P.S.T.	
23 Side Tone Switch.....	S <sub>1</sub>	D.P.D.T.	
24 Trap Condenser.....	C <sub>3</sub>	WE-21-U	
25 Filament By-Pass Condenser.....	C <sub>5</sub>	2-WE-21-R	

\* Four Dry Cells or 6-Volt Storage Battery.  
 † Two Blocks of Burgess' Battery No. 2156.

REMEMBER—Power tube filament should be burned at constant voltage rather than constant current. This will prolong their useful life.

FIG. 8. Constant Frequency Circuit, Using Full Wave Rectification for Four Radiotrons UV-202 and Four Kenotrons, UV-216 for Telegraph and Telephone (Chopper and Magnetic Modulator)

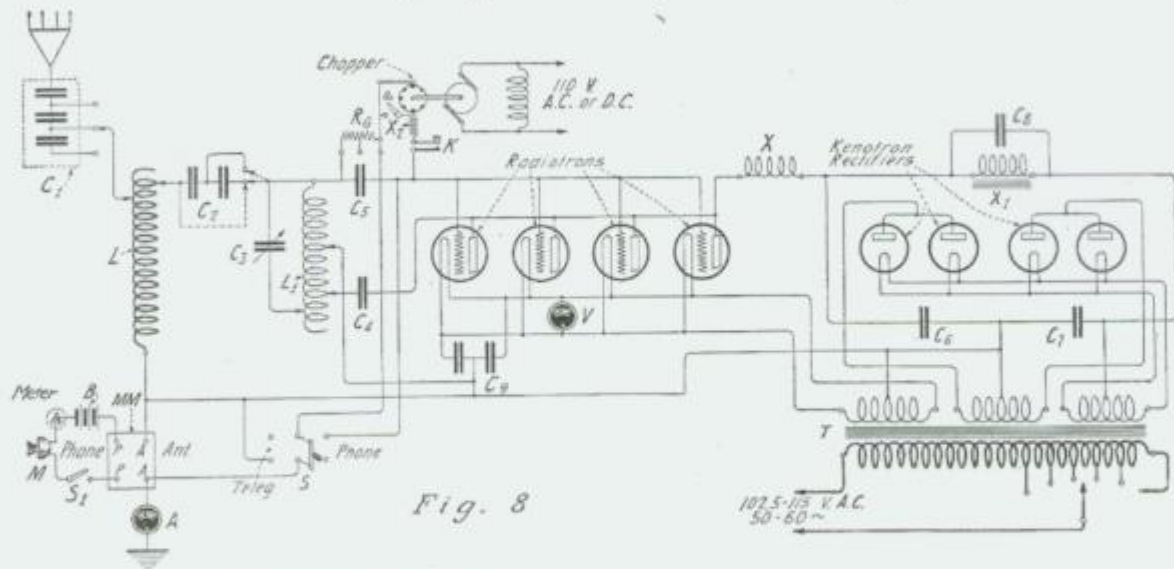


Fig. 8

LIST OF MATERIAL	Circuit Symbol	RATING OF RADIOTRONS 5-WATT TUBES	
		Model	Price
1 Four RADIOTRON Power Tubes.....		UV-202	\$32.00
2 Four KENOTRON Rectifier Tubes.....		UV-216	30.00
3 Eight RADIOTRON Sockets.....		UR-542	8.00
4 Antenna Series Condenser.....	C <sub>1</sub>	UC-1015	5.75
5 Magnetic Modulator.....	MM	(See Note 1)	
6 Magnetic Modulator Battery.....	*B	6 Volts	
7 Microphone.....	M	WE-284-W	
8 Antenna Ammeter.....	A	UM-530	6.00
9 Coupling Condenser.....	C <sub>2</sub>	UC-1846	10.00
10 Intermediate Shunt Circuit Condenser.....	C <sub>3</sub>	UC-1831	9.00
11 Oscillation Transformer.....	L <sub>1</sub>	UL-1008	11.00
12 Blocking Condenser.....	C <sub>4</sub>	UC-1014	2.50
13 Grid Condenser.....	C <sub>5</sub>	UC-1014	2.50
14 Filter Condenser.....	C <sub>6</sub>	2-UC-490 (in parallel)	5.00
15 Filter Condenser.....	C <sub>7</sub>	2-UC-490 (in parallel)	5.00
16 Antenna Inductance.....	L	UL-1008	11.00
17 Transmitter Grid Leak.....	R <sub>g</sub>	UP-1719	1.10
18 A. C. Filament Voltmeter.....	V	0-15 Volts	
19 Power Transformer.....	T	UP-1368	25.00
20 Radio Frequency Choke.....	X	UL-1655	3.85
21 Filter Reactor.....	X <sub>1</sub>	UP-1653	12.50
22 Telegraph-Telephone Switch.....	S	D.P.D.T.	
23 Grid Chopper.....	Chopper	PX-1638	7.25
24 Telegraph Key.....	K	UQ-809	3.00
25 Radio Frequency Choke.....	X <sub>2</sub>	UL-1655	3.85
26 Microphone Milliammeter, 0-500 Milliamps.....	A <sub>1</sub>		
27 Trap Condenser.....	C <sub>8</sub>	WE-21-U	
28 Filament By-Pass Condenser.....	C <sub>9</sub>	2-WE-21-R (In series)	
29 Microphone Switch.....	S <sub>1</sub>	S.P.S.T.	
30 Switch for CW-ICW Telegraphy.....	S <sub>2</sub>	S.P.S.T.	

NOTE 1:—Proper Size of Magnetic Modulator

No. of Tubes	UV-202	No. of Tubes	UV-203
1	UT-1643	1	UT-1357
2	UT-1643	2	UT-1367
3	UT-1357	3	UT-1367
4	UT-1357		

\*Four Dry Cells or 6-Volt Storage Battery.

REMEMBER—The life of the filament of RADIOTRON power tubes is dependent upon its temperature. A 3 per cent. increase in filament current will halve the life of your tubes, and a 3 per cent. decrease will DOUBLE THE LIFE.

FIG. 9. Self-Rectifying C. W. Telegraph Circuit, Using Two UV-204 Radiotrons 250-Watt Power Tubes

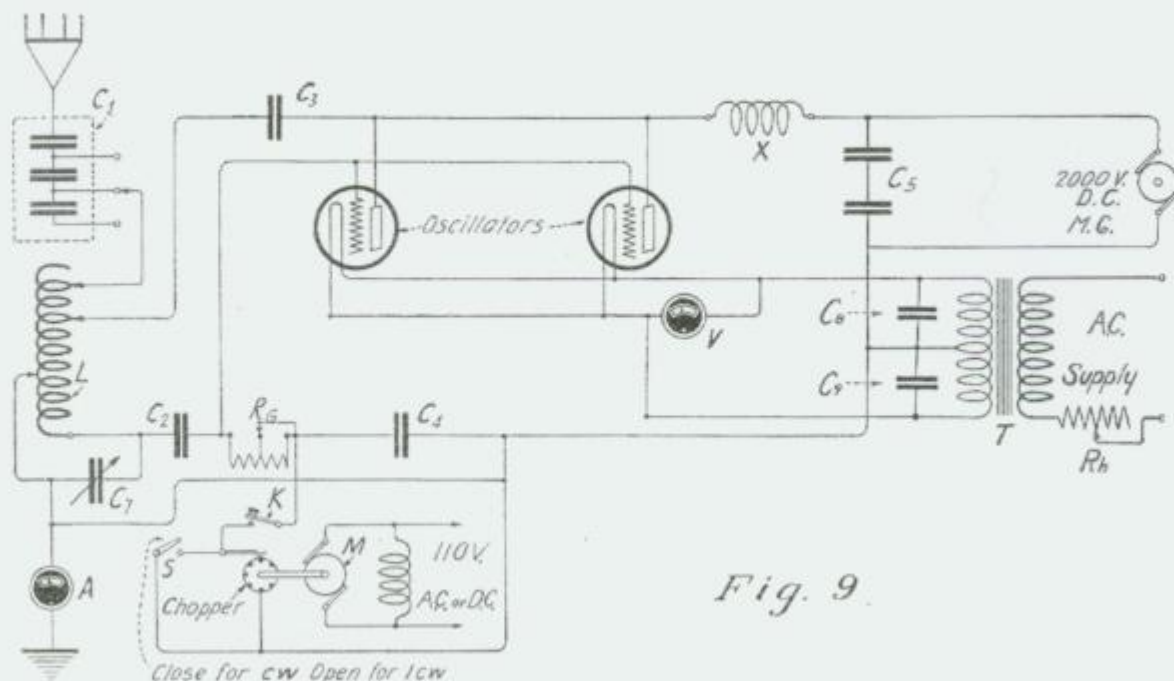


Fig. 9.

LIST OF MATERIAL	Circuit Symbol	RATING OF RADIOTRONS	
		Model	Price
1 One or Two RADIOTRON Power Tubes.....		UV-204	\$110.00 each
2 Tube Mountings.....		UT-501-502	2.00 pair
3 Antenna Series Condenser.....	C <sub>1</sub>	10 amps. (See Note 2)	
4 Oscillation Transformer.....	L	UL-1008	11.00
5 Tuning Condenser.....	C <sub>2</sub>	UC-1831	9.00
6 Blocking Condenser.....	C <sub>3</sub>	UC-1806	7.00
7 Grid Condenser.....	C <sub>4</sub>	UC-1014	2.50
8 Radio Frequency Choke.....	X	UL-1655	3.85
9 Smoothing Condenser.....	C <sub>5</sub>	2-UC-490 (in series)	5.00
10 Grid Leak.....	R <sub>g</sub>	UP-1718	1.65
11 Keying Condenser.....	C <sub>6</sub>	UC-1014	2.50
12 Chopper.....	Chopper	PX-1638	7.25
13 Key.....	K	UQ-809	3.00
14 Filament Transformer.....	T	(See Note 3)	
15 Filament Rheostat.....	R <sub>h</sub>	(GE. Cat. 1916228)	
16 Filament Voltmeter A. C.....	V	0-15 Volts	
17 Antenna Ammeter.....	A	0-10 amps.	
18 Signal Switch.....	S	S.P.S.T.	
19 By-Pass Condenser.....	C <sub>7</sub> & C <sub>8</sub>	2-WE-21-R	
20 Motor Generator.....	MG	(See Note 1)	

NOTE 1:—The high voltage generator for the above transmitter should be capable of delivering .5 ampere at from 1500 to 2000 volts.

NOTE 2:—New condenser, .0003, .0004 and .0005 mfd., 10 amps. at 200 meters. Do not use UC-1015. Information on request.

NOTE 3:—400 watt 12/6 V Transformer, 50-60 cycles, 110/220 volts—not stocked by R. C. A.

REMEMBER—On any tube or group of tubes delivering over 50 watts of alternating current energy, or operating at a plate potential above 2,000 volts, a safety spark gap should be provided between the grid and filament terminals at or near the tube socket or mounting. This gap should be adjusted to between 1/32 in. and 1/4 in., depending upon the plate voltage employed and the number of tubes and types of tubes used.

RADIOTRON UV-204—250-WATT TRANSMITTER

**R**ADIOTRON UV-204 is the most powerful tube of the RADIOTRON series at present sold for experimental transmission purposes. This tube is equipped with a special filament which gives exceptionally long operating life, and it will be widely used by experimenters desiring to obtain large oscillating outputs. It is particularly adapted for experimental measurements in laboratories and in powerful C. W. radio telegraph and telephone sets for experimental use. Several experimenters using one UV-204 in oscillating circuits have obtained antenna charging currents of from five to six amperes.

UV-204 will be found serviceable in the self-rectifying and other circuits shown elsewhere in this book, and such a circuit will ap-

peal to experimenters because of its simplicity.

Two points are worthy of special mention—namely, the large current input to the antenna that can be obtained with these tubes, and the greatly increased operating life over former tubes of this type.

This tube has been used constantly at the official broadcasting station of the Bureau of Standards. It was also employed in the powerful radio telephone set installed by the Radio Corporation in the Delaware, Lackawanna and Western Railroad Radio Station at Hoboken, New Jersey, which sent out the news of the Dempsey-Carpentier Boxing Bout. The Radio Corporation of America employs the same tube in its new types of commercial radio telegraph and telephone sets.

**METHOD OF SHIPMENT**

Each RADIOTRON UV-204 is packed for shipment in a separate crate, the dimensions of which are approximately 11 in. x 11 in. x 25 in. high. The net weight of the tube is approximately 1 1/4 pounds, and the shipping weight, crated, 7 1/2 pounds.

The tubes are suspended in the crate by ticking.

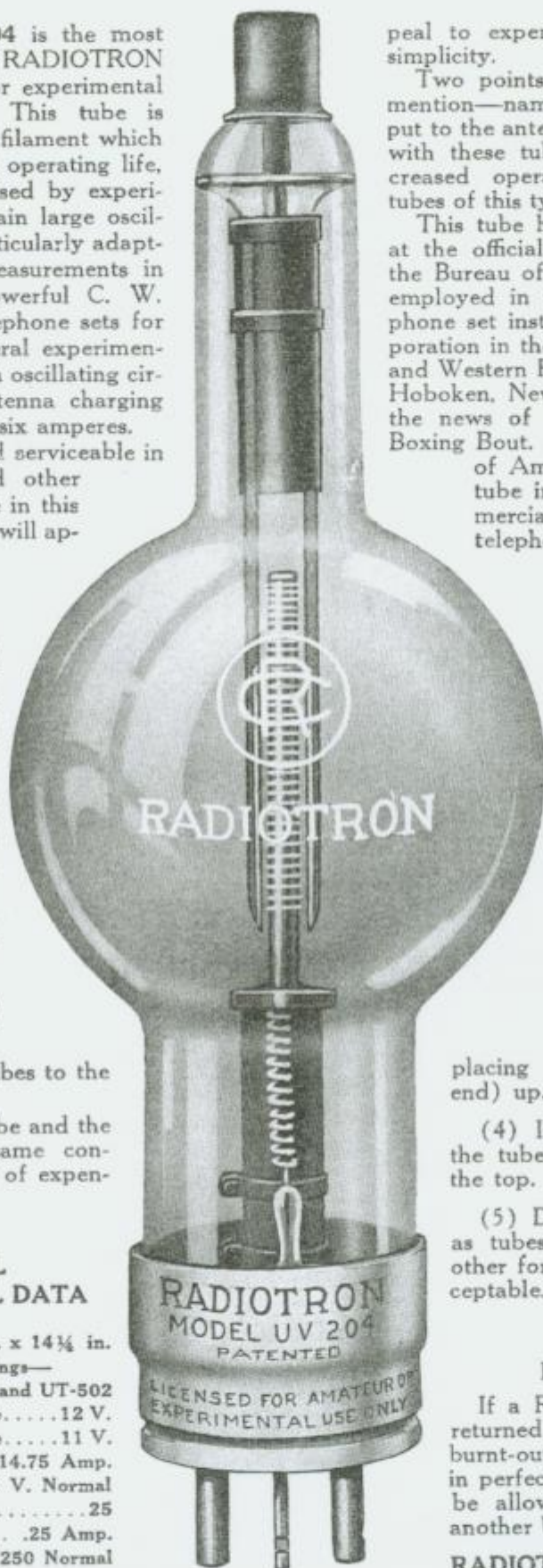
The safest way to store the tubes is in the crates as received.

Do not expose the tubes to the weather.

Handle the crated tube and the tube itself with the same consideration as any piece of expensive glassware.

**ELECTRICAL AND MECHANICAL DATA**

Overall Dimensions... 5 in. x 14 1/4 in.  
 Base—Special End Mountings—  
     UT-501 and UT-502  
 Voltage of Filament Source..... 12 V.  
 Filament Terminal Voltage..... 11 V.  
 Filament Current..... 14.75 Amp.  
 Plate Voltage..... 2000 V. Normal  
 Amplification Constant..... 25  
 Plate Current..... .25 Amp.  
 Watts Output..... 250 Normal



**HOW TO UNPACK UV-204**

(1) The slats on one side of the crate are fastened with screws. Open this side of the crate by means of a screw-driver.

(2) Remove the three screws which secure the upper strip of ticking and slip the ticking off the upper end of the tube. Then remove the tube from the crate.

(3) In crating a tube to be returned, simply reverse the operations, placing the cathode (the large end) up.

(4) Instructions for operating the tube are inside the crate at the top.

(5) Do not destroy the crate, as tubes returned to us in any other form of packing are not acceptable.

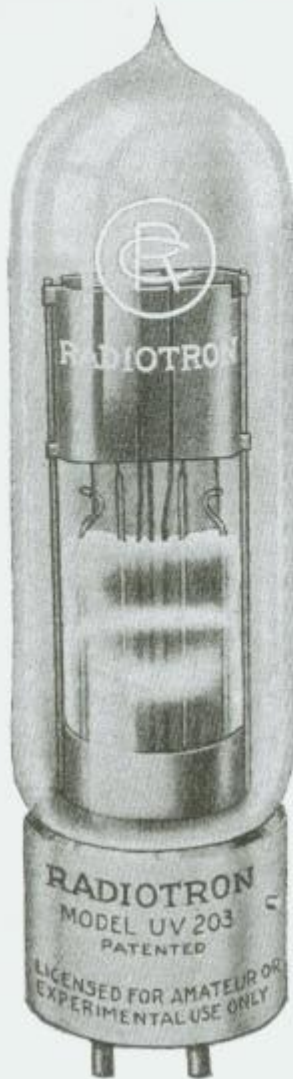
**REPLACEMENT**

If a RADIOTRON UV-204 is returned to our warehouse with a burnt-out filament, but otherwise in perfect condition, a rebate will be allowed on the purchase of another UV-204.

RADIOTRON UV-204, \$110.00



### RADIOTRON UV-203—50-WATT TRANSMITTER



THE 50-watt RADIOTRON is universally used by amateurs for long-distance telephony and telegraphy. Two 50-watt tubes connected in a self-rectifying or in straight D. C. plate excitation circuit will give antenna currents of three to four amperes at amateur wave lengths.

A single tube operated from a D. C. source or a rectified A. C. source will put two and a half to three amperes in the amateur's aerial. Hundreds of these tubes are already in use at amateur transmitting stations throughout the country, and distances up to 1900 miles have been covered by using two tubes in parallel in an appropriate oscillating circuit.

Since these tubes have been specially designed with a view to securing uniformity, several of them may be operated in parallel and large antenna charging currents may thus be generated. Using a number of RADIOTRONS CV-203, speech may be sent out over ranges of hundreds of miles.

A suitable power transformer for use with the 50-watt RADIOTRON is described on page 89.

This tube is a favorite with experimental laboratories.

#### ELECTRICAL AND MECHANICAL DATA

Overall Dimensions . . . . . 2 in. x 7 1/2 in.	Plate Voltage . . . . . 1000 V. Normal
Base . . . . . Four Prong Special	Plate Current . . . . . .15 Amp.
Voltage of Filament Source . . . . . 12 V.	Amplification Constant . . . . . 15
Filament Terminal Voltage . . . . . 10 V.	Watts Output . . . . . 50 Normal
Filament Current . . . . . 6.5 Amp.	

#### SHIPMENT

RADIOTRON UV-203 is shipped to the customer in a standard wooden box in which the bulb is suspended in a special way to protect it from mechanical shocks or vibration. Shipping weight: 1 1/2 lb.

RADIOTRON UV-203 . . . . . \$30.00

### RADIOTRON UV-202—5-WATT TRANSMITTER

THIS transmitting tube is a popular one for low power radio telephone sets and for amateur C. W. telegraph sets for transmission up to distances of two hundred miles. Two 5-watt tubes in parallel will put from one and one-quarter to one and three-quarters amperes in the amateur's antenna. Using one of these tubes as a modulator and the other as an oscillator for experimental radio telephony, distances up to forty miles can be covered, and at least four times that distance when the two tubes are connected in parallel for C. W. telegraphy. Four or five 5-watt RADIOTRONS can be operated in parallel with increased range.

The 5-watt tubes may also be used as power amplifiers in radio receiving circuits. The energy amplification obtained therefrom is particularly useful for the operation of loud speakers.

#### ELECTRICAL AND MECHANICAL CHARACTERISTICS

Overall Dimensions . . . . . 2 1/4 in. x 5 in.	Plate Voltage . . . . . 350 V. Normal
Base . . . . . Four Prong Standard	Plate Current . . . . . .045 Amp.
Voltage of Filament Source . . . . . 10 V.	Output Impedance . . . . . 4000 Ohms
Filament Terminal Voltage . . . . . 7.5 V.	Amplification Constant . . . . . 8
Filament Current . . . . . 2.35 Amp.	Watts Output . . . . . 5 Normal

#### SHIPMENT

RADIOTRON UV-202 is shipped in a standard cardboard carton in which the tube is well protected from mechanical shock or vibration. Shipping weight: 1 lb.

RADIOTRON UV-202 . . . . . \$8.00



**KENOTRON RECTIFIER, UV-217**

**K**ENOTRON UV-217 is primarily intended for use with the 50-watt power tubes, to produce a D. C. plate supply from an A. C. source. It is rated at 150 watts. UV-217 should be used in connection with POWER TRANSFORMER UP-1016, listed on page 89. The combination of these two units constitutes the simplest and most practical means of obtaining direct current for the plate circuit excitation of power tubes. Remember that these rectifier valves are manufactured with the same care and accuracy as RADIOTRON power tubes, under the supervision of the same experts.

The output energy from this KENOTRON Rectifier is at a maximum when the load is such that the D. C. potential is between 900 and 1100 volts. At no load, under an A. C. voltage of 1250 volts, the D. C. voltage will rise to about 1750. On short circuit, the current will rise to about three-quarters of an ampere. It is recommended, therefore, that the D. C. circuit from the KENOTRON system be properly fused, so as to protect the KENOTRONS in case of short circuit.

Using two KENOTRONS UV-217 in a full wave rectification circuit, the D. C. current and watts output will be doubled, but the voltage at which maximum output can be obtained will be between the same limits. The output drops slightly at lower and higher D. C. voltage. This assumes a fixed A. C. input voltage of 1250.

KENOTRON UV-217 is identical in appearance with RADIOTRON UV-203, and it may be used in the same type of socket, Model UT-541. There are, of course, no connections to the grid binding post of the socket.

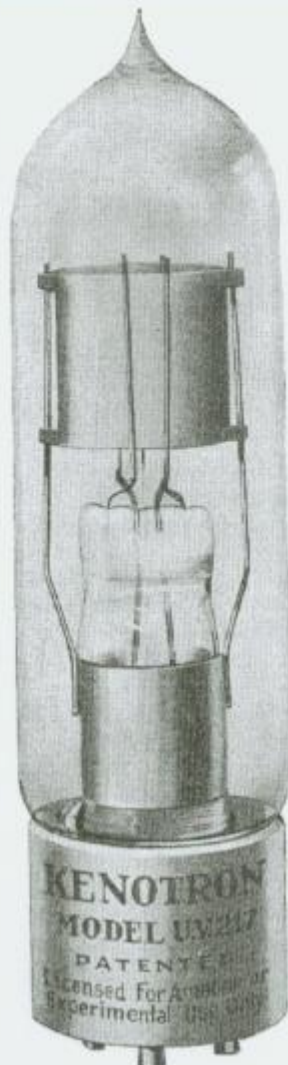
**ELECTRICAL DATA**

Voltage of Filament Source.....	12 V.
Filament Terminal Voltage.....	10 V.
Filament Current.....	6.5 Amp.
A. C. Input Voltage.....	1250 V.
D. C. Output.....	150 Watts at 1000 Volts D. C.

**SHIPMENT**

KENOTRON UV-217 is shipped to the customer in a standard wooden box in which the tube is suspended in a special way to protect it from mechanical shocks or vibration. Shipping weight: 1½ lbs.

**KENOTRON UV-217..... \$26.50**



**KENOTRON RECTIFIER, UV-216**

**K**ENOTRON UV-216 is primarily intended for use with the 5-watt power tubes, and is rated at 20 watts. The output energy is at a maximum for these tubes when the load is such that the D. C. voltage is between 350 and 400 volts. Using two tubes in a full wave rectification circuit the D. C. current and the watts output will be doubled, but the voltage at which maximum output can be obtained will be between the same limits. The output drops slightly at lower and higher D. C. voltages, so that at 200 and 550 volts it is about 15 watts per tube. This assumes a fixed A. C. input voltage of 550. If the A. C. input voltage is raised, the voltage at which maximum power is obtained will be increased correspondingly. This will decrease the life of the KENOTRON, and lower the factor of safety.

At no load, under the A. C. voltage specified above, the D. C. voltage will rise to about 750 volts. On short circuit the current will rise to about 100 milliamperes. The insulation of the KENOTRON is designed to withstand the first condition, and the anode will take care of the excess energy of the second condition for a considerable time.

KENOTRON UV-216 is identical in appearance with RADIOTRON UV-202, and it may be used in the same type of socket, Model UR-542.

A special Power Transformer, Model UP-1368, has been developed for use with the 20-watt KENOTRON and the 5-watt transmitting tube.

Shipping weight: 1 lb.

**ELECTRICAL DATA**

Voltage of Filament Source.....	10 V.	A.C. Input Voltage.....	550 V.
Filament Terminal Voltage.....	7.5 V.	D.C. Output, 20 Watts at 350 Volts D.C.	
Filament Current.....	2.35 Amp.		

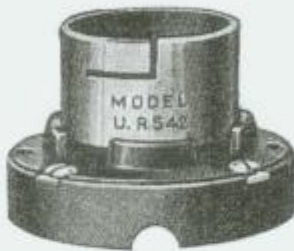
**KENOTRON UV-216..... \$7.50**



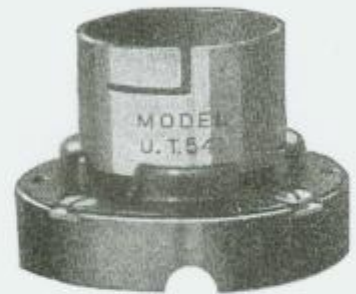
**PORCELAIN SOCKETS, UT-541 AND UR-542**

These two sockets have been specially designed to meet the need for a reasonably priced socket which should at the same time be constructed of the very best insulating material obtainable, and should bear the stamp of quality throughout. They are direct duplicates of the types used in commercial radio sets.

Porcelain is the ideal material for use in these devices, on account of its low specific inductive capacity and its high insulating qualities. Production in great quantities enables us to keep the selling price unusually low.



UR-542



UT-541

Model UR-542 is designed to accommodate RADIOTRON UV-200, UV-201 and UV-202, as well as KENOTRON UV-216. Model UT-541 is designed for RADIOTRON UV-203, the 50-watt power tube, and KENOTRON UV-217, the 150-watt rectifier tube.

**PORCELAIN SOCKET, UR-542** ..... \$1.00

Dimensions: 7 $\frac{1}{8}$  in. x 6 $\frac{1}{4}$  in. x 9 $\frac{3}{8}$  in. Shipping Weight: 8 oz.

**PORCELAIN SOCKET, UT-541** ..... 2.50

Dimensions: 3 $\frac{3}{8}$  in. x 2 $\frac{3}{4}$  in. Shipping Weight: 1 lb.

**END MOUNTINGS FOR UV-204**

FILAMENT END, UT-501

PLATE END, UT-502

These mountings are designed not only to furnish perfect contact with the elements of RADIOTRON UV-204, but also to act as a substantial support for the tube itself.

One end of the tube is slipped into mounting UT-501, which carries contacts for the Filaments and grid connections. The other mounting, UT-502, makes contact with the plate of the tube.

Both ends are firmly held by spring clips. On the filament-end mounting is a safety gap for protecting the tube from transient voltages which might arise if the circuits were not properly adjusted, or if a lead wire were accidentally removed.

Each mounting is provided with two screw holes so that the tube may be mounted in either a vertical or horizontal position.

PLATE END  
UT-502



FILAMENT END  
UT-501



**END MOUNTINGS UV-501-502**

Each ..... \$1.00

Per Pair ..... 2.00

**ANTENNA AMMETERS**

An antenna ammeter is a positive necessity in a C. W. transmitting set. Only by the use of such a meter can the amateur hold proper check on the operation of a tube transmitter. At a considerable expense the Radio Corporation has developed a type which, in addition to being low-priced, provides long operating life.

These ammeters are of the hot wire type. They have been designed with a view to accuracy and sensitivity to slight current variations; moreover, particular care has been taken to insure their remaining accurate through a long period of use.

As shown in the illustration, the ammeters are so constructed that they may be mounted flush with the transmitting panel, and are of the back-connected type. A special adjustment for taking care of temperature variations has been provided.



UM-530

Dimensions: 2 11/32 in. x 3/4 in.

Length of Studs: 3/4 in.

Shipping Weight: 1 lb.

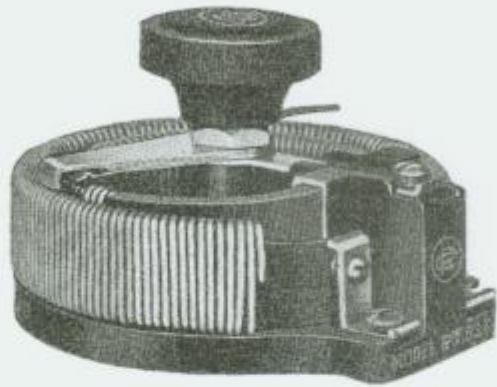
**AMMETER, UM-530—0-2.5 amp. . . . \$6.00**

**AMMETER, UM-533—0-5.0 amp. . . . 6.25**

FILAMENT RHEOSTATS, PR-535 AND PT-537



**FIRE-PROOF FEATURE**  
 Body is composed of insulating material containing a large percentage of asbestos, thereby reducing fire hazard.

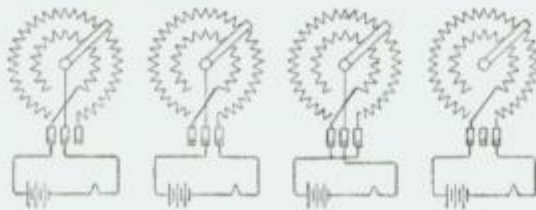


**R**HEOSTAT, Model **PR-535**, consists of a moulded base, approximately 2½ in. in diameter, on which are secured two concentric windings held securely in place by clamping screws. Connection is made to these windings by means of two sliding contacts of phosphor bronze, which form a circuit between the outside and inside windings.

Model **PR-535** is designed for use with **RADIOTRONS UV-200, 201, 202** and **KENOTRON UV-216**.

Rheostat, Model **PT-537**, is designed for use with the **UV-203** and **UV-204 RADIO-TRON** transmitting tubes, as well as with **KENOTRON UV-217**. In general the design is the same as Model **PR-535**, but with increased dimensions.

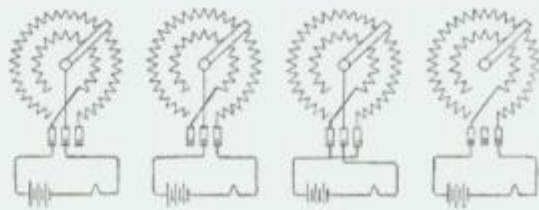
**RHEOSTAT PR-535 GIVES FOUR DIFFERENT RESISTANCE VALUES DEPENDING ON CONNECTIONS**



2.5 ohms, 1.2 amps.    3.5 ohms, 1.2 amps.    1.5 ohms, 2.5 amps.    6 ohms, 1.2 amps.

**Filament Rheostat, PR-535 . . . . . \$3.00**  
 Size: 2 in. x 2½ in. x 2¾ in. Shipping weight: 1 lb.

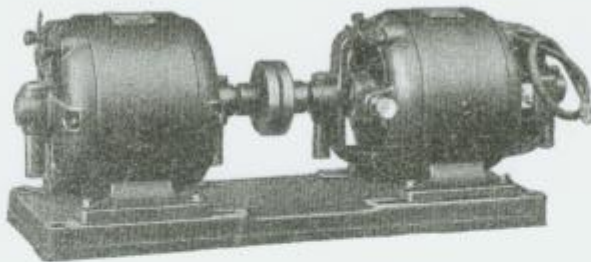
**RHEOSTAT PT-537 GIVES FOUR DIFFERENT RESISTANCE VALUES DEPENDING ON CONNECTIONS**



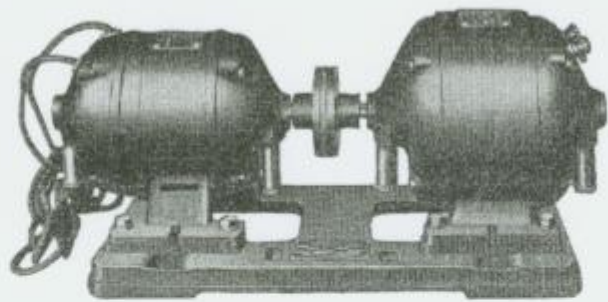
.25 ohm, 7.5 amps.    .25 ohm, 7.5 amps.    Parallel connection for UV-204, .15 ohm, 15 amps.    Series connection for UV-203, .69 ohm, 7.3 amps.

**Filament Rheostat, PT-537 . . . . . \$10.00**  
 Size: 4¼ in. x 4½ in. x 2¾ in. Shipping weight: 2 lbs.

**MOTOR GENERATORS FOR V. T. TRANSMISSION**



Model ME—100 Watts

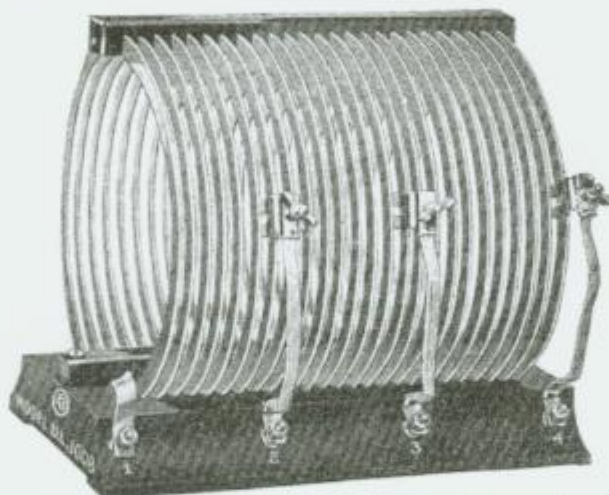


Model MH—250 Watts

Where it is desired to employ motor generator to obtain the required plate excitation in Radiotron transmission, the Radio Corporation of America offers two Westinghouse units having the ratings of 100 and 250 watts respectively.

**Motor Generator, Model ME, 100 watts, 500 volts D. C., 110 volts, 60 cycle, single phase**  
 Motor, complete . . . . . **\$85.00**  
**Motor Generator, Model MH, 250 watts, 1,000 Volts D. C., 110 volts, 60 cycle, single phase**  
 Motor, complete . . . . . **\$170.00**

OSCILLATION TRANSFORMER, UL-1008



Clips may be attached to and removed from turns with minimum effort.

Positively hold their position on the coil, and cannot be accidentally moved or detached.

**T**HIS transformer was developed primarily for use in circuits utilizing RADIOTRONS as generators of radio frequency oscillations. It may be used, however, in any set-up using conductively coupled circuits, such as an oscillation transformer coupling the primary and secondary circuits in spark transmitters.

The transformer consists of 25 turns of .060 in. x 3/8 in. copper strip, nickel-plated, with edges rounded, mounted on a wooden base which includes four binding posts, to three of which are secured flexible conductors and clips for selecting tap points on the transformer.

The clips supplied for tapping on the transformer have been specially designed to overcome the difficulties which have been experienced in the past with such connections. These clips are readily connected to or taken off the turns of the transformer and when secured to **OSCILLATION TRANSFORMER, UL-1008**.

the transformer by tightening the wing nut are positive in holding their position on the coil. These clips were developed primarily for use with commercial transmitters, so that the TRANSFORMER UL-1008 includes the same form of clip as the Radio Corporation's commercial transmitters. This feature is of fundamental importance, since it is believed that these clips are the first to be developed which include the above features of design.

All metal parts of the transformer are nickel-plated. The base has a polished black finish, and the overall appearance of the unit is very pleasing.

The coil is liberally designed to withstand the potentials developed in circuits utilizing RADIOTRONS. Holes are provided in the base to permit mounting the transformer in any desired place.

Dimensions: 7 7/8 in. x 6 1/4 in. x 9 3/8 in. Shipping Weight: 7 lbs.

\$11.00

TRANSMITTING GRID LEAKS, UP-1718 AND UP-1719

**T**HE purpose of these grid leaks is to limit the potential accumulating on the grid of an oscillating tube and thus govern the output to the antenna and also the character of the antenna oscillations.

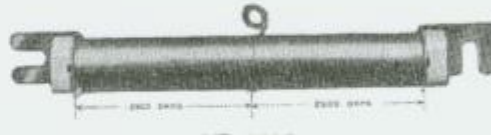
These resistors consist of a conductor wound upon a heat-resisting silicate compound body developed to resist sudden and extreme temperature changes without becoming cracked, weakened, or in any way injured. After being

wound upon this compound it is embedded in a blue vitreous enamel which is fused to a dense, uniform, glassy structure at a temperature of about 1,000 degrees Centigrade.

A metal foot is provided at each end of the grid leak to which the resistor windings are connected, and through which external connections are made. In addition, a mid-tap is provided for securing half the resistance of the whole unit.



UP-1719



UP-1718

**GRID LEAK, UP-1719**.....

For use with 5-watt RADIOTRONS. Resistance—5,000 ohms, with mid-tap at 2,500 ohms. Dimensions: 5 in. x 1 1/4 in. Shipping Weight: 1 lb.

\$1.10

**GRID LEAK, UP-1718**.....

For use with 50-watt and 250-watt RADIOTRONS. Resistance—5,000 ohms, with mid-tap at 2,500 ohms. Dimensions: 8 1/2 in. x 1 1/2 in. Shipping Weight: 1 lb.

\$1.65

POWER TRANSFORMERS FOR TRANSMITTING TUBE SETS

Model UP-1368  
Model UP-1016

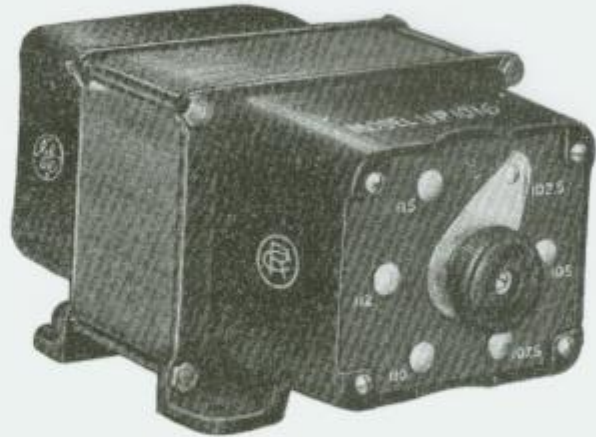
Maximum Input 325 Watts  
Maximum Input 750 Watts

For 5-Watt Tubes  
For 50-Watt Tubes

**I**N designing the above transformers the engineers of the Radio Corporation have given the amateur radio experimenters two rugged and flexible units which can be utilized in numerous RADIOTRON circuits.

The transformers permit operation from a 50/60 cycle alternating current source for (1) continuous wave telegraphy, on either a self-rectification circuit, (2) interrupted continuous wave telegraphy, with or without KENOTRON rectified A. C., (3) radio telephony.

The use of alternating current provides an excellent and flexible means of supplying power for continuous wave telegraph and telephone sets. It is especially adaptable for the amateur radio experimenter because a wide range of experimentation is opened to him, at a low first cost. These units have no maintenance cost, and their life is unlimited. The advantages over a motor generator set are obvious. Continuous wave energy may be supplied the antenna from an A. C. self-rectification circuit such as shown on page 76. Rectified A. C. may be obtained from such a circuit by rectifying the plate supply with KENOTRON rectifying tubes, see page 85.



The model UP-1368 transformer has sufficient capacity to handle safely one to four UV-202 RADIOTRONS as oscillators. Model UP-1016 will supply one or two UV-203 RADIOTRONS as oscillators. A winding is provided for lighting the filaments and a winding for the plate source. In addition, a filament winding for the KENOTRON filaments is supplied.

ELECTRICAL CHARACTERISTICS

MODEL UP-1368

**Plate Winding:** Output 175 watts, 1,100 volts between outside wires, midtap at 550 volts.

**RADIOTRON Filament Winding:** Output 75 watts, 7.5 volts, with midtap at 3.75 volts. The capacity of this transformer will supply filament current to four RADIOTRONS UV-202 (5 watt tubes).

**KENOTRON Filament Winding:** Output 75 watts, 7.5 volts with midtap at 3.75 volts. Windings insulated for 1,100 volts. The capacity of this transformer will supply current for four KENOTRONS UV-216.

**Primary Winding:** For operation from a 50/60 cycle supply with voltage from 102.5 to 115 volts. Provision is made for voltage adjustment in steps of 2.5 volts between 102.5 and 115 volts. This is accomplished by means of taps brought out from the primary winding of the transformer to studs on a dial switch. This feature eliminates the need of filament rheostats, since it provides filament voltage adjustment in steps of approximately 2.5 volts.



MODEL UP-1016

**Plate Winding:** Output 450 watts, 3,000 volts between outer wires with midtap at 1,500 volts.

**RADIOTRON Filament Winding:** Output 140 watts, 10.5 volts between outer wires with midtap at 5.25 volts. The capacity of this transformer will supply current for two RADIOTRONS UV-203 (50-watt tube).

**KENOTRON Filament Winding:** Output 140 watts, 10.5 volts between outer wires with midtap at 5.25 volts. The capacity of this transformer will supply filament current for two KENOTRONS UV-217.

**Primary Winding:** Operation from a 50/60-cycle supply at a voltage from 102.5 to 115 volts. Provision is made for voltage adjustment in steps of 2.5 volts between 102.5 and 115 volts, eliminating the need of separate rheostats.

A complete rectifier set for tube operation consists of the following:

- (1) Power Transformer
  - (a) 325 watt, Model UP-1368
  - (b) 750 watt, Model UP-1016
- (2) Tube Sockets
- (3) KENOTRON Valves
- (4) Filter Reactor
- (5) Filter Condensers

POWER TRANSFORMER, UP-1368 325 WATTS .....\$25.00

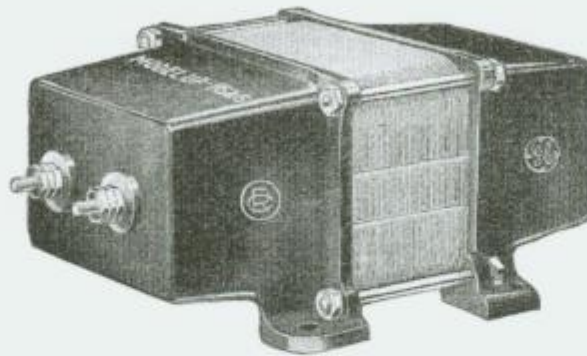
Dimensions: 9 3/64 in. x 5 11/12 in. x 4 1/4 in.  
Shipping weight: 15 lbs.

POWER TRANSFORMER, UP-1016 750 WATTS .....\$38.50

Dimensions: 9 27/32 in. x 7 3/8 in. x 6 in.  
Shipping weight: 30 lbs.

FILTER REACTORS, UP-1653 AND UP-1654

UP-1653  
160 Milliamperes



UP-1654  
300 Milliamperes

WHEN the plate circuit of a valve transmitting set is energized by a high voltage rectified A. C., using the Radio Corporation's KENOTRON valves and power transformers, a suitable filter unit, to smooth out the rectified pulses must be provided. It has been customary heretofore to provide a relatively small inductance unit in combination with a group of condensers of rather large capacity. It is more economical, however, to provide a large inductance unit and a relatively small group of condensers, and as a consequence the two special reactors here listed have been specially developed for the purpose.

These filter reactors are of the "iron clad type," designed for use with the Radio Corporation's KENOTRON rectifier sets. Liberal copper allowance insures the minimum of losses and no change in value through use. Particular attention has been given to its insulation.

Model UP-1653, 160 milliamperes is designed to operate with any circuit, either A. C. or D. C., employing from one to four 5-watt power tubes, RADIOTRON UV-202. It can be used in connection with either UC-1631 or UC-1632 filter condensers, on any kind of a circuit within the specified voltage and power rating.

Model UP-1654, 300 milliamperes, is designed to operate on any circuit, either A. C. or D. C., employing from one to two 50-watt power tubes, RADIOTRON UV-203. It can be used in connection with either of the models UC-1634 or UC-1635 filter condensers on any kind of a circuit within its voltage and power rating. UP-1654 may also be used as a "smoothing-out" reactance. For 50-watt tubes, one will suffice; for 250-watt tubes, two in series should be employed.

MODEL UP-1653—160 MILLIAMPERES . . . . . \$12.50  
Dimensions: 7 31/32 in. x 5 1/16 in. x 4 1/16 in. Shipping weight: 10 lbs.

MODEL UP-1654—300 MILLIAMPERES . . . . . 18.00  
Dimensions: 9 7/32 in. x 5 11/16 in. x 4 15/16 in. Shipping weight: 18 lbs.

FILTER CONDENSERS

THESE Filter Condensers are manufactured especially for the Radio Corporation of America's KENOTRON rectifier sets. They are intended for use with the REACTORS Model UP-1653 and UP-1654, described above.

Transmitting circuits, Figs. 1 to 9, in preceding pages, show the manner in which the Filter Reactors and Condensers are connected in rectifying tube sets. The number of condensers required depends upon the type of circuit employed. This is fully explained in the data given under the circuit diagrams.

UC-487—750 Volts . . . \$1.40  
Capacity 0.5 MFD.

UC-489—1750 Volts . . . \$1.60  
Capacity 0.5 MFD.

UC-488—750 Volts . . . 2.25  
Capacity 1.0 MFD.

UC-490—1750 Volts . . . 2.50  
Capacity 1.0 MFD.

**PLATE CIRCUIT REACTOR, UP-415**

**S**TANDARD radio telephone circuits using one or more tubes as oscillators and one or more additional tubes as modulators require a reactor in series to the plate circuit to maintain the D. C. supply voltage to the plate at constant value, even though the output of the set is modulated at audible frequencies.

REACTOR UP-415 was designed for this purpose and for circuits using 5-watt RADIOTRONS. The reactor, in general, is built on the same lines as MICROPHONE TRANSFORMER UP-414. It is intended primarily for use in the common positive plate lead to the oscillating and modulating tubes, and as stated above provides a constant current system of modulation. This unit has an inductance of 1 henry at audio frequencies. The D. C. resistance is approximately 64 ohms. It is well insulated between layers.



**DIMENSIONS**

Net Weight .....	1 lb. 3 1/2 oz.	Overall Height .....	2 3/4 inches
Shipping Weight .....	1 lb. 6 oz.	Area of Base of Mounting .....	2 inches x 2 3/4 inches
Overall Length .....	3 7/8 inches	Test Voltage between Winding and Core	1300 volts at 60 cycles

**PLATE REACTOR, UP-415.....\$5.75**

**SENDING KEY, UQ-809**



**T**HIS key is especially serviceable for C. W. transmitting sets. The contacts are made of 1/8-inch sterling silver and, besides being interchangeable, are easily replaced. The lever arm is both light and durable and is designed to permit an operator to secure the utmost speed possible. The frame and other metal parts are brass, finely lacquered.

**SENDING KEY, UQ-809.....\$3.00**  
 Dimensions: 5 in. x 2 3/4 in.      Shipping Weight: 1 lb.

**MICROPHONE TRANSFORMER, UP-414**

**A**LTHOUGH the Radio Corporation has developed a magnetic device for modulating the output of vacuum tube transmitters, many amateurs prefer to use prior methods of modulation where one or more bulbs are employed to modulate the plate circuit energy of the oscillating tubes; but, in order to obtain efficient modulation from such circuits, it is necessary to couple the grid circuit of the modulating tube to the microphone through the medium of a voltage amplifying transformer. The turn-ratio of the microphone transformer has been selected to give the most effective excitation of the grid of the modulator tubes based upon the characteristics of RADIOTRONS, when used as modulators. They are exactly the same type as used in the Radio Corporation's commercial sets.



The characteristics of the transformer are such that with a suitable microphone and a battery of four dry cells connected in series with the primary coil, a secondary voltage is obtained which will provide effective control of the radiated energy. The transformer is also provided with a side tone winding, which may be connected to the telephone of a receiving set during the periods of speech transmission, thus enabling the operator to check the operation of his microphone.

Model UP-414 has the same appearance and dimensions as the Radio Corporation's INTER-VALVE AMPLIFYING TRANSFORMER, UV-712.

**MICROPHONE TRANSFORMER WITH SIDE TONE WINDING, UP-414.....\$7.25**  
 Dimensions: 2 3/4 in. x 3 7/8 in. x 2 in.      Shipping Weight: 1 lb. 7 oz.



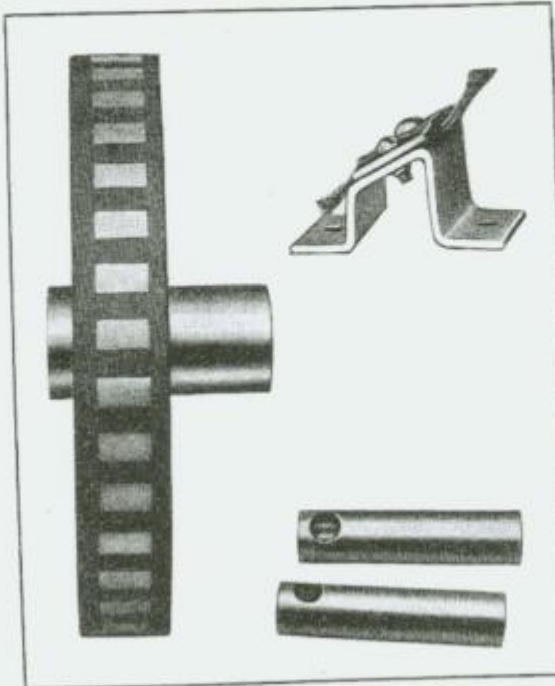
**MOTOR-DRIVEN CHOPPER, PX-1638**

For C. W. Vacuum Tube Transmitters

LONG experience in the use of audio frequency buzzers to modulate the output of a tube set to produce damped wave trains has proven that this method is not entirely satisfactory, principally for the reasons that the operation of the buzzer is not constant, necessitating frequent adjustment, and that great care is required in adjusting the circuit to obtain 100 per cent. modulation.

The ROTARY CHOPPER PX-1638 has been developed primarily to overcome the above objections. It may, however, be used in numerous circuits for this or other purposes where an interrupter is required. When used to secure I. C. W. telegraphy, the motor-driven interrupter, or rotary grid chopper, has the following inherent advantages over the other methods:

(a) Gives positive interruption requiring no adjustments. The note obtained can be varied to any desired pitch by changing the driving motor speed.



- (b) This system of securing damped wave trains does not require modulating tubes, the interrupter being used in series with the transmitting key.
- (c) The system inherently gives 100 per cent modulation, since oscillations can be completely started and stopped at audio frequencies.
- (d) The output obtained from a given number of oscillators is in general greater than if some of the tubes are used as modulators.

The equipment includes the following parts:

- (a) Interrupter Wheel, Model PX-1638.
- (b) 2 Bushings, so that the wheel may be mounted on motor shafts 1/4 in., 5/16 in., or 3/8 in. diameter.
- (c) Brush Holder and Brush.

The interrupter wheel is built with 34 conducting and 34 insulating segments, making 34 interruptions per revolution. The insulating segments are molded in a single piece.

**MOTOR DRIVEN CHOPPER, PX-1638** .....\$7.25  
 Dimensions: 4 in. x 1 3/4 in. Shipping weight: 3 lbs.  
**SHAFT BUSHINGS, Model PX-1640, for 5/16 in. or PX-1641, 1/4 in. Motor Shaft**...each .20



**RADIO FREQUENCY CHOKE, UL-1655**

This is a universal radio frequency choke designed for use in conjunction with the types of transmitting circuits illustrated in this book. Because of its special characteristics, it may be employed in a number of places where, heretofore, it has been necessary to employ radio frequency chokes of different values.

**Radio Frequency Choke, Model UL-1655**.....\$3.85

Dimensions—3 1/4 in. x 3 in.

Weights—Net, 10 oz.; Shipping, 1 lb.

## MAGNETIC MODULATORS FOR RADIO TELEPHONY



Magnetic Modulator UT-1367

ONE of the most important inventions brought forth in the field of amateur radio telephony during the past year is the MAGNETIC MODULATOR. This development has resulted from the Radio Corporation's experiments with the Alexanderson Magnetic Amplifier, a device which is used at all its high-power transoceanic stations to control the output of 200-KW radio frequency alternators. The same fundamental principle has been adopted in the three magnetic modulators herewith described, and for the first time the amateur experimenter has at his disposal a simple yet thoroughly reliable means of modulating the antenna oscillations of any low-power vacuum tube radio telephone set.

#### Require No Adjustment

Once connected to a radio telephone set, these modulators positively require no further adjustment or attention. This assures the experimenter that at all times he is obtaining the best possible results from his apparatus. It makes possible practical and reliable radio telephone transmission from a tube transmitter even on the part of an experimenter having a very limited knowledge of radio telephony.

The Radio Corporation's MAGNETIC MODULATOR is a device which utilizes the properties of iron at radio frequencies to control or modulate the output of an oscillating vacuum tube or any other undamped wave generator. It is the result of a number of years of research and development work both by the Radio Corporation and the General Electric Company. The device is extremely simple in nature as well as in operation. It simply acts as a variable resistance connected in series with the antenna circuit of any high frequency oscillating system.

#### Ideal for Radiotron Telephone Operation

The great advantage of the MAGNETIC MODULATOR over other methods of modulation is that it gives the best and only non-distorting method of controlling the output of a **single tube** for radio telephony. Furthermore, it permits the parallel use of a number of tubes as oscillators and thus eliminates the use of special modulator tubes with their necessary additional accessories and critical adjustments.

The MAGNETIC MODULATOR is designed specially for the amateur to fill the long desired place for a simple non-destructive and fool-proof device to make a C. W. set into a radiophone set without the use of more tubes or other delicate or costly apparatus.

Three modulators of different current carrying capacity are supplied. The precaution should be taken to select the type of modulator possessing a current carrying capacity within the range of the average antenna current to be expected from a given radiophone transmitter.

Model UT-1643 is designed for antenna currents varying between  $\frac{1}{2}$  to  $1\frac{1}{2}$  amperes; UT-1357 for antenna currents between  $1\frac{1}{2}$  and  $3\frac{1}{2}$  amperes; UT-1367 for antenna currents of  $3\frac{1}{2}$  to 5 amperes.

Model UT-1643 and UT-1357 are, therefore, applicable to tube transmitters giving outputs of 5 to 50 watts. In general, Model UT-1367 should be employed with a tube transmitter equipped with two 50 watt Radiotrons UV-203.

For antenna outputs in excess of 5 amperes, two or more of Model UT-1367 may be used in parallel.

#### Practical Uses of the Magnetic Modulator

In general the magnetic modulator functions most satisfactorily in an antenna circuit of less than 15 ohms resistance. It should be connected on the low potential side of a tube transmitter, in the ground lead and as near to the actual earth connection as possible.

In order to obtain an antenna resistance of less than 15 ohms, it is usually necessary to employ an insulated counterpoise and to eliminate the earth ground. The counterpoise should be swung underneath the aerial and in general it should extend a few feet beyond the end of the flat top portion of the antenna.

#### Control Current

The normal microphone control current, when the microphone is idle, should not exceed 500 milliamperes. It should preferably have an average value of 300 milliamperes. When the microphone is spoken into, the control current may vary from 100 to 650 milliamperes.

#### Tuning

During the initial installation of a tube transmitter, the transmitting set should be first tuned for a maximum antenna current with the secondary terminals of the magnetic modulator on short circuit. Then the speech microphone and microphone battery should be connected in the primary circuit, and the secondary terminals of the modulator connected in series with the earth wire. Next, the short circuit on

the modulator should be removed and the transmitting set retuned for resonance, with normal current flowing through the microphone-control circuit. Generally, the antenna current should be somewhat less with the modulator in the circuit (25 to 30 per cent. of the normal value when it is not in the circuit) as it introduces an additional series antenna resistance. When the microphone is spoken into, the antenna resistance is varied according to the inflections of the human voice and the wave emission varies in amplitude accordingly.

**I. C. W. Transmission**

Telegraph transmission by modulated waves (I. C. W.) can be obtained with the modulator by substituting a small buzzer for the microphone. In general, the battery and buzzer should pass an average value of 1 to 1½ amperes through the control circuit of the modulator. The buzzer can be replaced by a rotary grid chopper, provided a regulating resistance is placed in series with the central coil so that the average value of 1½ amperes is not exceeded.

**C. W. Transmission With the Modulator**

It is possible to control the output of a tube set and to transmit by C. W. telegraphy, by sending a direct current, controlled by a telegraph key, through the primary circuit. The control current should not exceed two amperes. With this method double wave emission will be obtained, one wavelength being radiated with the telegraph key in the "open" position and the other when the key is closed. If then the receiving operator tunes his apparatus to the wave radiated when the key is closed, proper telegraph transmission will result.

**Trap Circuit**

It is often possible to secure more effective modulation from the magnetic modulator by placing a variable condenser across the antenna terminals. This condenser should have a maximum capacity of .003 mfd. With the condenser set at the zero position and with normal current flowing through the microphone and the primary winding of the modulator, the antenna circuit should be tuned for maximum current. While the transmitter is in operation the capacity of the condenser connected across the secondary should be gradually increased

until the antenna current is reduced to ½ or possibly ¼ of its normal value. The secondary of the modulator and the shunt condenser then constitute a "trap" circuit which filters out a portion of the antenna circuit. Then when the microphone is spoken into, the impedance of the "trap" circuit varies according to the vibrations of the human voice and therefore, the antenna current varies proportionately.

**Filtering Features**

This circuit will also be found to eliminate to a marked extent the "A. C. hum" generated by tube transmitters excited by rectified alternating current and which are perhaps not provided with the proper "filter" system.

In the use of this special "trap" circuit, care should be taken not to "filter" out too much of the antenna current, as otherwise distortion of the voice will result.

**Reduces Distortion**

Experiments have shown that the modulator provides less distortion of the human voice than any other form of modulation. This coupled with its simplicity of operation and stability makes it the ideal device for amateur stations.

With an antenna of proper design and of minimum resistance energized by a transmitter using two 50 watt tubes as oscillators, the modulator has given a fluctuation of the antenna current of 2 amperes while the microphone is spoken into.

The degree of modulation can often be increased by shifting the position of the grid tap of the oscillator tube on the oscillation transformer.



Magnetic Modulator UT-1643

**MAGNETIC MODULATOR, UT-1643—½ to 1½ AMPERES.....\$9.50**

Dimensions: 4¼ in. x 2⅞ in. x 3⅛ in. Shipping weight: 2 lbs.

**MAGNETIC MODULATOR, UT-1357—1½ to 3½ AMPERES.....12.00**

Dimensions: 5⅛ in. x 3⅛ in. x 3⅝ in. Shipping weight: 3 lbs.

**MAGNETIC MODULATOR, UT-1367—3½ to 5 AMPERES.....17.00**

Dimensions: 8¾ in. x 3⅛ in. x 3⅝ in. Shipping weight: 5 lbs.

## CONDENSERS FOR C. W. TRANSMITTING SETS

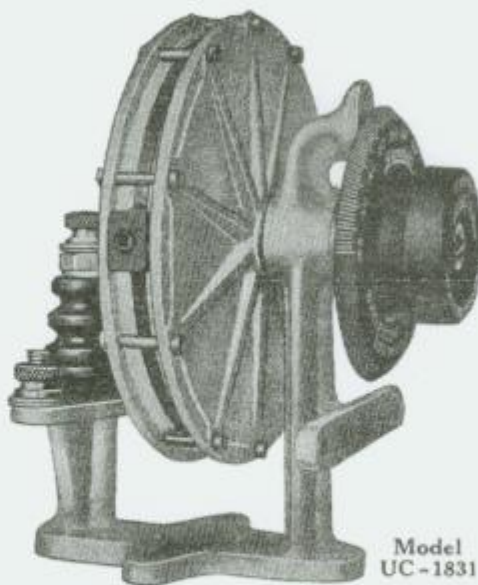


Model UC-1803

**FARADONS FOR  
Better C. W.  
Transmission**

**Highest Grade Con-  
densers Available for  
Amateur Work**

**Designed Especially for  
Radiotron Power  
Tubes**



Model UC-1831

**T**HE use of **RADIOTRONS** as generators of radio frequency oscillators in radio telegraphy and telephony has brought about the need for comparatively small transmitting condensers, which will stand continuous operation with the voltages used on such tube sets.

Due to the far greater effectiveness of C. W. over spark methods of transmission, ampere for ampere in the antenna, ranges are obtainable with **RADIOTRON** Transmitters equal to those of spark sets of considerably higher power.

There has been developed for the Radio Corporation a series of the **FARADON** type of condensers which have been especially designed to fit the circuits illustrated in this book, and which will be found the best condensers of their type on the market today.

### SIX TYPES ARE NOW AVAILABLE

**Model UC-1014**, rated at 3,000 volts effective, has a capacity of .002 mfd. This condenser was developed primarily for use as a grid condenser, radio frequency by-pass condenser or blocking condenser for circuits utilizing **RADIOTRONS UV-202** and **UV-203**.

**Model UC-1015**, rated at 3,000 volts effective, has three capacities, .0003, .0004 and .0005 mfd., and a current-carrying capacity of 4 amperes at 200 meters maximum. At lower or higher frequencies the current-carrying capacity is greater or less, respectively. This condenser is applicable as a series antenna condenser and an intermediate circuit condenser in circuits using **RADIOTRONS UV-202** or **UV-203**.

Both of the above condensers find numerous other applications in the great number of circuits available for C. W. transmission. Their capacities are exact within 2 per cent. and their losses are negligible. They are built with mica dielectric and include the most recent developments in high voltage condenser design.

**Model UC-1803** is intended for use as a blocking or coupling condenser, as shown in the various diagrams shown in this book. It is rated at 10,000 volts and has a capacity of .000025 mfd. It is the only compact condenser on the market satisfactory for these purposes.

**Model UC-1806**, rated at 6,000 volts effective, has a capacity of .002 mfd. and is intended for use as a by-pass condenser in circuits in which the voltages rise to 6,000 volts.



Model UC-1015



Model UC-1806

**Model UC-1831** is a variable type condenser, essential for tuning of CW transmitters. Designed as a series antenna condenser and will stand five amperes of CW at its maximum capacity setting. Will vary the radiated wave length by 50 to 100 meters. Minimum .0001 mfd, maximum, .0012 mfd. This condenser is rated at 400 volts.

**Model UC-1846** is a special antenna coupling condenser permitting a selection of three capacities, viz., .000018, .000037 and .000075 mfd. It is tested to 10,000 volts. This con-

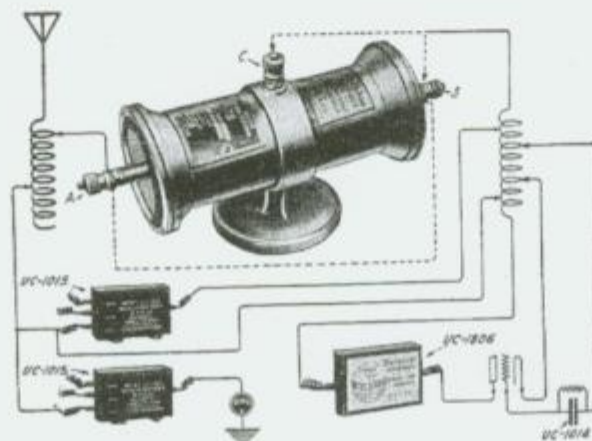
denser allows more accurate adjustment of the antenna circuit than is possible with the Model UC-1803. A full description of the use of Model UC-1846 is shown below.

All of the above condensers may be employed in radio receiving circuits as well as in transmission circuits, although they were primarily designed for use with RADIOTRON transmitter tube sets. Experimenters should bear in mind that the break-down voltages of all condensers listed herein are considerably greater than the voltage at which they are rated.

### FARADON SPECIAL ANTENNA COUPLING CONDENSER

FOR closer regulation of the antenna circuit than is possible with the 1803 antenna coupling condensers, the use of the UC-1846 is recommended. As may be seen from the accompanying diagram, this condenser permits the

the points C or B. Where connection is made to the point B, both condensers are in series, and the resultant capacity is .000018. Where connection is made to the point C, one-half of the condenser is employed, having a capacity



Illustrating a constant frequency vacuum tube transmitter circuit employing the Faradon special antenna coupling condenser UC-1846

use of three distinct capacities, viz., .000018, .000037 and .000075 mfd.

In order to obtain these values, the connections are made as follows: The point A is permanently connected to one adjustable clip of the antenna inductance, while a lead from one end of the oscillating inductance is attached to a two point switch, permitting connection to

of .000037. The third possible capacity combination is formed by connecting to the point C, and placing a shunt around the points A B, as indicated by the dotted lines in the diagram with a resultant capacity of .000075 mfd. By this arrangement both halves of the unit are therefore connected in parallel.

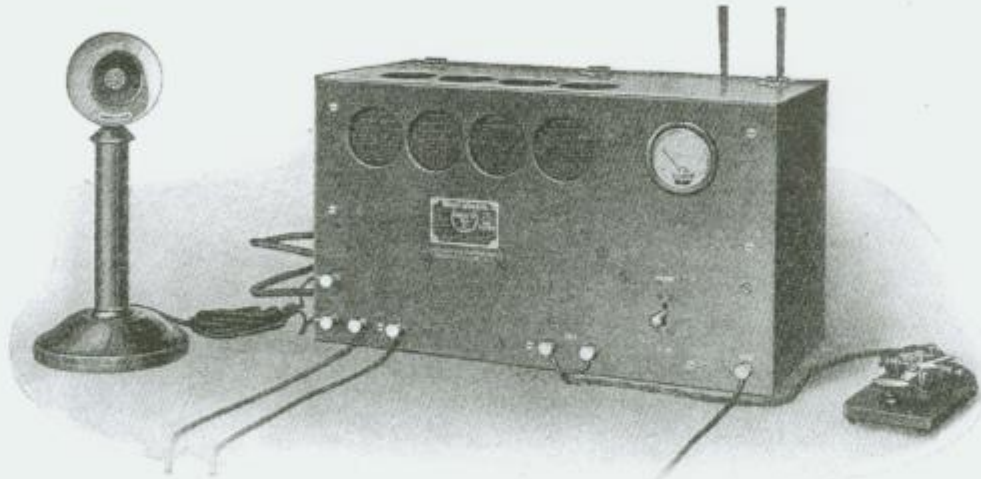
#### Specifications and Prices

MODELS	CAPACITY	VOLTAGE	DIMENSIONS	SHIPPING WEIGHT	PRICES
UC-1014	.002 mfd.	3,000 Volts	2 1/4 in. x 1 1/2 in. x 7/8 in.	1 lb.	\$2.50
UC-1015	.0003, .0004, .0005 mfd.	7,500 Volts	2 1/4 in. x 1 1/2 in. x 7/8 in.	1 lb.	5.75
UC-1803	.000025 mfd.	10,000 Volts	3 in. x 3 in. x 4 in.	1 1/2 lbs.	5.00
UC-1806	.002 mfd.	6,000 Volts	2 1/4 in. x 1 1/2 in. x 7/8 in.	1 lb.	7.00
UC-1831	.001-.0012 Variable	4,000 Volts	5 1/2 in. x 5 1/4 in. x 4 1/2 in.	2 lb.	9.00
UC-1846	.000018, .000037, .000075 mfd.	10,000 Volts	2 7/8 in. x 4 1/4 in. x 8 1/2 in.	5 lb.	10.00

NOTE: Model UC-1014 bears the same size and appearance as Model UC-1806.

## WESTINGHOUSE 20-WATT V. T. TRANSMITTER, MODEL TF

A Complete Vacuum Tube Radio Telephone and Radio Telegraph Transmitter Especially Designed for the Amateur



VACUUM tube transmitter set, Model TF, is designed for radio telephony and continuous wave telegraphy, a switch on the front of the panel permitting the use of either at will. When used for continuous wave telegraphy, four 5-watt oscillating tubes supplying approximately 20 watts of oscillating energy are used whereas when used for telephony, two of the tubes are connected as oscillators and two as modulators.

#### Simple But Effective Circuit Employed

All of the mechanism of the transmitter proper is contained within a highly polished mahogany cabinet 19 inches long, 8 inches high, and 8 inches wide, provided with a Micarta panel. All of the parts are attached to this panel and may be removed from the cabinet as a unit. The top of the cabinet is hinged to facilitate insertion of tubes and adjustment of tuning.

The circuit that is used is extremely simple and at the same time effective. There is only one inductance to which the connected antenna, counterpoise, ground, and the plates, grids and filaments of the modulator and oscillating tubes are connected. Using an antenna 60 to 80 feet long and 25 to 50 feet high, the transmitter can be tuned to any wave length between 180 and 230 meters. When the installation is made the entire tuning operation is accomplished by adjusting clips on the inductance.

The filaments are supplied with alternating current from a transformer contained within the cabinet. The primary of the transformer is wound for alternating current of sixty cycles and will accommodate 105 to 115 volts.

The plate voltage is furnished by a motor generator operated from a 110-volt, 60-cycle AC lighting circuit. The generator is arranged to furnish voltages of 350 or 500 volts. A block of resistance is connected in series with the generator field, two wires being connected to either side of this resistance and brought outside of the machine. By connecting these two wires together, the block of resistance is short circuited and the machine will furnish 500 volts. By disconnecting these two wires the resistance is connected in the field circuit and the machine will then furnish 350 volts. The two voltages that are thus available make it possible to adjust the transmitter to the range desired. For short distances the 350 volt connection is used and for greater distances 500 volts may be used if desired.

#### Works Best With Counterpoise

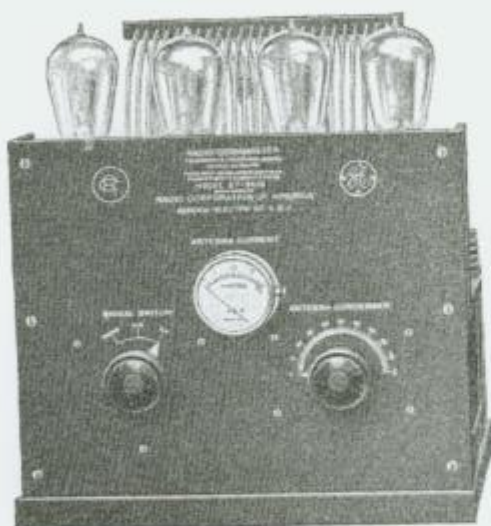
With each transmitting set there is furnished a microphone mounted on a desk stand and also a telegraph key. The microphone circuit and the key relay circuit require six volts direct current which may be furnished from the six-volt storage battery used to supply the filaments of the receiving tubes or five cells of dry battery connected in series may be used.

The transmitter is provided with a connection for using a counterpoise. A counterpoise is strongly recommended in all cases where it can conveniently be erected as the output and resultant range of the transmitter is considerably increased.

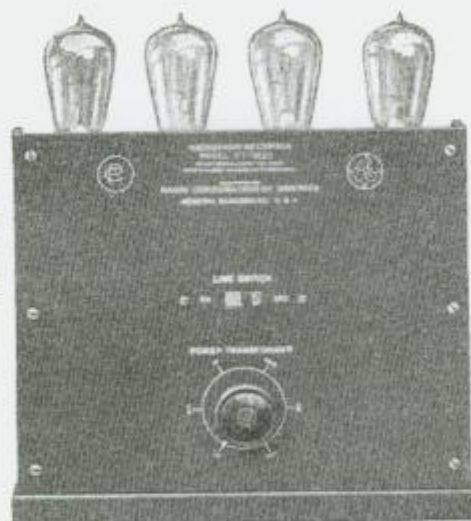
Although it is extremely difficult to make any statements regarding transmitting range, under reasonably good conditions a range of fifteen miles with telephony and one hundred miles continuous wave telegraphy may be obtained.

Complete Amateur Radio Telephone and Telegraph Transmitting Set, Model TF, including four 5-watt Radiotron vacuum tubes, one desk microphone, one telegraph key and 100-watt motor-generator unit.....\$305.00

G. E. 20-WATT V. T. TRANSMITTER, MODEL ET-3619



To the left is the Radiotron Transmitter Unit; to the right the Kenotron Rectifier Unit



THIS radio telephone and telegraph transmitting outfit has been designed for use in conjunction with the Kenotron Rectifier unit described below. This transmitter, however, may be used with direct current where a motor generator set is available.

With the exception of the power supply everything necessary for a 20-watt transmitter is mounted on a sturdy panel and base made of heavy diletto, artistically engraved, as may be seen from the accompanying photograph. The 20-watt rate on this equipment is based on the same consideration as commercial wireless telephone transmitters, that is, four Model UV-202 5-watt Radiotrons are used as oscillators.

**Designed for Radiotron Vacuum Tubes**

The transmitter is built for operation on telephone, continuous wave (C.W.) telegraphy or interrupted continuous wave (I. C. W.) telegraphy. The method of signalling is controlled by a rotary switch having three positions.

This transmitter requires the following supply for operation at full output: .160 amperes at 350 volts D. C. for the plate supply, and 10 amperes at 8 volts A. C. for the filament supply.

Model ET-3619 transmitter is entirely self-contained with the exception of the following units, which may be connected externally:

- (a) Send-receive Switch; (b) Telegraph Key; (c) Microphone Transmitter and Desk stand; (d) Motor Battery. (Not supplied as part of this transmitter.) (e) Microphone Battery.

Substantial terminals are provided for connecting the above units in circuit. All these terminals are numbered to agree with the connections indicated in the diagrams which accompany the book of instructions supplied.

Terminals are also provided so that the units not supplied with this transmitter may also be connected in circuit: such as—

- (a) Magnetically controlled Send-Receive Switch; (b) Control button for the above switch; (c) Magnetically controlled "Break In" Key; (d) Chopper for obtaining I. C. W. transmission.

Wave length control is obtained by means of a variable condenser in series with the antenna circuit adjusted by a control on the panel.

**KENOTRON RECTIFIER UNIT  
MODEL ET-3620**

This equipment has been designed to operate in connection with the above 20-watt transmitter, or as a separate unit for other transmitting circuits. It is designed to give full wave rectification from a 110-volt, 50 or 60 cycles A. C. supply. It utilizes four Model UV-216 Kenotron Rectifier Tubes. The unit contains suitable filter condensers and reactor, so that the rectified A. C. is smoothed out for satisfactory telephone transmission.

This unit also contains a combined plate and filament transformer for supplying power at the proper voltage for heating all the vacuum tube filaments and furnishing the necessary plate potential for the transmitter.

G. E. 20-Watt Telephone and Telegraph Transmitter, Model ET-3619 including Transmitting Panel, 4 Radiotrons UV-202, Telegraph Key UQ-809, Send-Receive Switch, W. E. Desk Stand with Microphone 284W and 4 dry cell microphone battery .....	\$235.00
G. E. Kenotron Rectifier Unit, Model ET-3620, including 4 Kenotrons UV-216 .....	\$150.00
Complete Transmitter and Rectifier as Above .....	\$385.00
Dimensions of each unit: Height, 14 in.; Width, 12½ in.; Depth, 11½ in.	