PART TWO

Receiver Accessories

With Data on

Receiving Circuits
Audio Frequency Amplification
Radio Frequency Amplification
Vacuum Tubes and Their Use
Receiving Antenna Equipment
Special High Grade Receivers
And other information for the
Radio Enthusiast desiring to
assemble experimental units

RECEIVING CIRCUITS

A Simple Vacuum Tube Circuit

CONTRARY to general opinion, receiving circuits in which vacuum tubes are employed are quite simple. The following descriptions include several standard receiving circuits which have proved satisfactory after long usage and which may readily be made up by the experimenter who follows the simple directions.

Fig. 1 is a simple receiving set, wherein a loose coupler is used for tuning. As will be seen, there are two distinct coils in a loose coupler, one called the primary, L 1, and the other the secondary, L 2. One end of the primary is connected to a binding post which in turn is connected to the antenna. The other end of the winding is free, but a sliding contactor is provided in order to connect as many turns between the binding post to which the end of the coil is attached and the free end as may be necessary. This sliding contact is indicated in the diagram by an arrow. A switch is often employed instead of the slider. Such a switch is made with many contact points, each point being connected to a different part of the primary or secondary winding. For the most satisfactory tuning, a variable condenser, C-1, should be inserted between this slider or switch and the ground connection.

A variable condenser, C-2, is placed between the two terminals of the secondary. As indicated by C-3, a small condenser, called a Grid Condenser, because it is inserted in the grid circuit, is placed between the Grid terminal (marked "G") of the socket, UR-542, and one terminal of the secondary.

For the best reception some vacuum tubes require what is known as a grid leak resistance. This is shown in the diagram R-3. Various tubes require different values of resistance in this position. The Radio Corporation grid leaks (UP-509 to UP-527) with the mounting UX-543 are recommended for this work.

The opposite side of the loose coupler is connected to the negative side of the Filament of the vacuum tube indicated in the diagram by F—. Where a vacuum tube is used in conjunction with a Radio Corporation socket UR-542, this connection is made to one of the binding screws on the vacuum tube socket marked F. To this post, as will be seen, two other connections—one from the minus or negative pole of the six volt storage battery, indicated by "A", and the other from one outside terminal of the "A" Battery Potentiometer, R2, are made. The opposite side of the "A" Battery is connected to one terminal of the Filament Rheostat, R, the second terminal of the rheostat being connected to the vacuum tube socket, UR-542, at the point F+. The remaining outside terminal of the Potentiometer is connected to the positive or plus side of the "A" battery. This Potentiometer is provided with a third terminal which is connected to the 18-volt tap of the "B" battery (Burgess No. 2156). The positive terminal of the "B" Battery is connected to one side of the condenser C-4 with the opposite side of this condenser being connected to the terminal P of the vacuum tube socket, UR-542. The tips of the telephone cords are also connected one each to the binding posts of the condenser C-4. This completes what is known as a straight vacuum tube detection circuit. A great improvement over this circuit is obtained by using the arrangement shown in Fig 2 although it is not quite so simple.

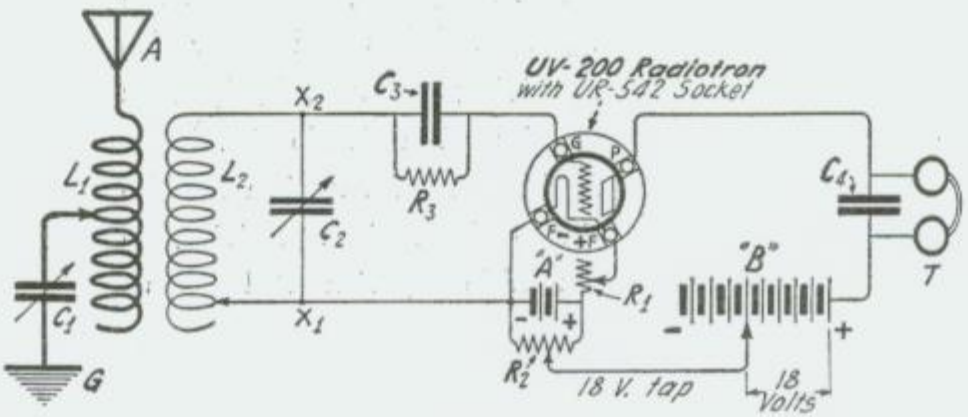


Figure 1
A simple vacuum tube receiving circuit employing a loose coupled tuner.

C 1—Variable condenser, .0006 mfd. max. UC-1820.
C 2—Secondary tuning variable condenser .001, .005 mfds., UC-1819.
C 3—Grid condenser (fixed or variable), .00025 mfd., UC-567 with UX-543 mounting or UC-1820 variable condenser.
C 4—Telephone condenser, fixed, value optional. UC-569 with UX543 mounting.

L 1—Primary of any loose coupler (sometimes called receiving transformer).
L 2—Secondary of loose coupler.
R 1—Filament control rheostat, PR-535.
R 2—"A" battery potentiometer, PR-536.
R 3—Standard grid leak resistance, .5 to 2 megohms, UP-518 519 or 523 with UX-543 mounting.
T—Telephone receivers, Western Electric No. 1002-A.

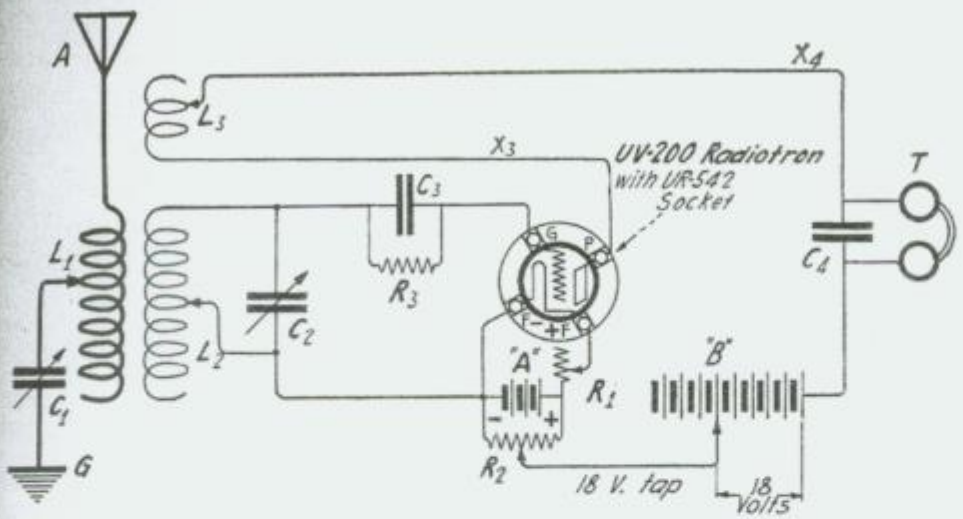


Figure 2 A simple vacuum tube circuit similar to Figure 1 but employing a "tickler" coil for regeneration.

C 1—Antenna tuning variable condenser, .0006 mfd. max. UC-1820.
C 2—Secondary tuning condenser, .0001-.005 mfds., UC-1819.
C 3—Grid condenser (fixed or variable), .00025 mfds., UC-567 with UX-543 mounting or UC-1820 variable condenser.
C 4—Telephone condenser, value optional, UC-569, with UX-543 mountings.
L 1—Primary of loose coupler.
L 2—Secondary of loose coupler.
L 3—Tickler coil.
"A"—6-volt filament lighting battery. Exide, 3-LX-9-1.
"B"—20 to 30-volt plate battery. Burgess No. 2156.
R 1—Standard Filament rheostat, PR-535.
R 2—Standard "A" battery potentiometer, 04-536.
R 3—Standard grid leaks resistance .5 to 2 megohms, UP-516, 19 pr. 23 with UX-543 mounting.
T—Telephone receivers, Western Electric No. 1002-A.

Note: Where the UC-1820 is used for the grid condenser no UX-543 mounting is necessary for inserting the grid leak resistance as this condenser is equipped with clips which will fit any of the RC standard grid leak resistance.

A Simple Regenerative Circuit

In Fig. 2 it will be observed that all the important elements are identical to those shown in Fig. 1. However, this arrangement permits very much greater selectivity in receiving as well as providing for amplifying the incoming signals by what is known as the regenerative method.

The only difference between Fig. 1 and Fig. 2 is, that a coil of wire L3, is connected in the circuit between the two points indicated by X3 and X4. This coil is used to carry the current back to the secondary of the loose-coupler and when properly adjusted causes amplification to take place. This coil is called a "tickler" coil. Its size depends upon the particular class of receiving to be carried on. The size of this coil for these various applications may be obtained by referring to any good book written for wireless experimenters. This circuit forms what is known as a standard regenerative receiver. In some instances the value of the "tickler" or feed-back circuit is made variable. There are several ways of varying this value. Regeneration is generally controlled in this type of circuit by changing the position of L3 with relation to L2, or varying the inductance of the circuit itself.

Amateur Regenerative Circuit

Fig. 3 shows the circuit generally used where a vario-coupler and two variometers are employed as the variable tuning elements in regenerative receivers. This character of receiving equipment is more or less confined

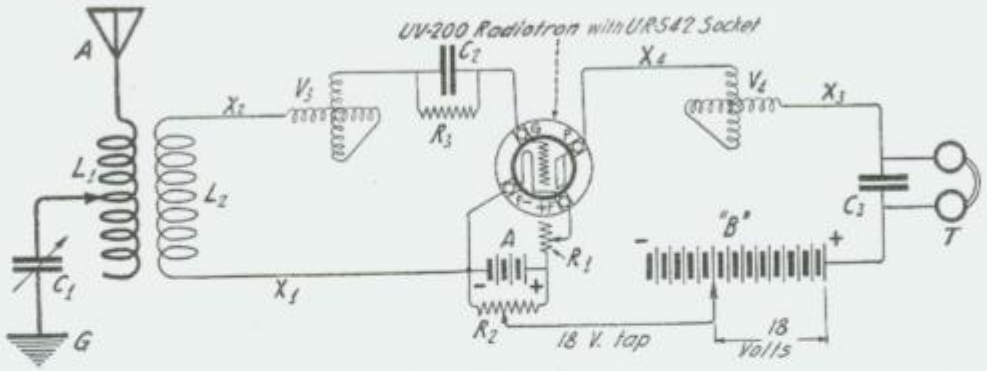


Figure 3. Short wave regenerative circuit employing a vario-coupler and two variometers for controlling wave length and regeneration.

C 1—Antenna variable condenser, .0006 mfd. max., UC-1820.
C 2—Grid condenser, fixed or variable, .00025 mfd., UC-567 with UX-543 mounting or UC-1820 variable air condenser.
C 3—Telephone condenser, value optional, UC-569, with UX-543 mounting.
"A"—6-volt filament lighting battery, Exide, 3-LX-9-1.
"B"—20 to 30-volt plate battery, Burgess 2156.
L 1—Primary of any vario-coupler.
L-2—Secondary of any vario-coupler.
L 3—Grid variometer.
L 4—Plate variometer.
R 1—Standard filament control rheostat, PR-535.
R 2—Standard "A" battery potentiometer, PR-536.
R 3—Standard grid leak resistance, .5 to 2 megohms, UP-516, 519 or 523 with UX-543 mounting.
T—Telephone receivers, Western Electric, 1002-A.

Note: Where the UC-1820 is used for the grid condenser it is not necessary to use the mounting UX-543 for the grid leak resistance, for the condenser is fitted with mountings for standard R.C. grid leak resistances.

to short waves from 150 to 600 or 700 meters. It will be seen that the inductance, L-2, in this case is not shunted by a variable capacity as was the case in Figs. 1 and 2. However, the variometer, V-1, is employed which comprises one stationary and one movable coil, is arranged so that the rotation of the movable coil with reference to the stationary coil has the effect of increasing or decreasing the wavelength of the circuit and permits a very selective control.

From the points indicated by X-1 and X-2, by making a comparison of Figs. 2 and 3, it will be found that Fig. 3 differs from the first two only in that the condenser, C-2, is not used and the variometer V-3, is placed between the upper terminal of the secondary of the loose-coupler and the grid condenser.

The third tuning circuit which controls the regeneration or amplification is also made variable by means of a variometer, V-4. This variometer is placed in the circuit between the points marked X-3 and X-4. It takes the place of the coil L-3 in Fig. 1, and forms one method of changing the value of this tertiary or plate circuit.

Where it is desired to use some form of loud-speaking device or where the distance over which signals are to be received is exceptionally long, the experimenter must use some method of increasing the intensity of the received signal. The most common method for accomplishing this is found in what is termed, "audio frequency amplification."

Where the experimenter wishes to take advantage of audio frequency amplification, there are two means at his disposal, namely: purchasing the amplifying units fully wired and ready for connecting them in the circuit, or procuring the parts which go to make up the units and assembling them. For the benefit of those who desire to assemble their own equipment the circuit shown in Fig. 1 is very strongly recommended for use in sections where receiving stations are closely located to one another. In congested city districts near the broadcasting stations, shunting a wire across the points X-3 and X-4, leaving out the tickler circuit. The circuit depicted in Fig. 4 is quite similar to those shown in Fig. 2 and Fig. 3, but two stages of amplification have been added. As may be observed this form of amplifier circuit may be added to any form of receiving circuit and need not be confined to the arrangement shown in Fig. 4.

It should be observed from a comparison of the last three circuits under consideration that where the audio frequency amplifiers are brought in play, the place ordinarily occupied by the telephone receivers is taken by the input circuit of the first stage of amplification and a variable condenser is substituted for the fixed condensers shown in the other three circuits, to increase the stability of operation. In other respects the fundamental parts of all three circuits are identical.

Regeneration, in this system, is obtained and controlled by the same method described in connection with Figs. 2 and 3. In Fig. 4 a standard method of regeneration is illustrated, but the arrangement shown in Fig. 3 may be employed. The circuit as in Fig. 4 shows a pair of telephone receivers in use, but it is often desirable to use a loud speaking device in their stead.

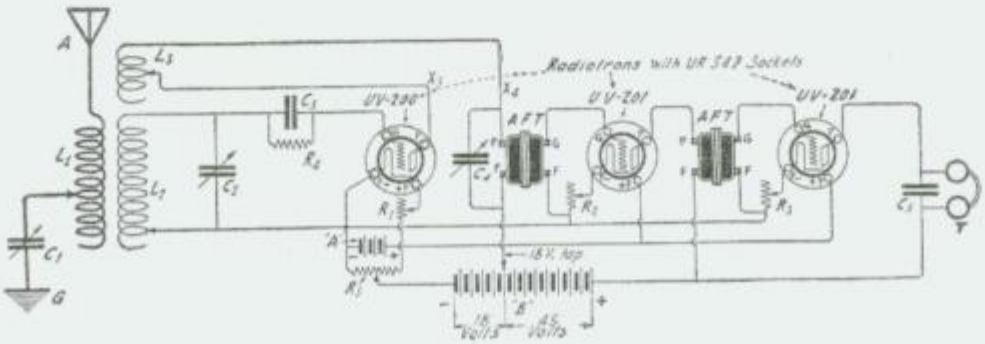


Figure 4. Standard regenerative receiving circuit employing two stages of audio frequency amplification.

C 1—Variable antenna tuning condenser, .0006 mfd. max., UC-1820.
C 2—Secondary tuning variable condenser, .0001-.005 mfds., UC-1819.
C 3—Standard tubular grid condenser, UC-567 with UX-543 mounting or UC-1820 precision variable air condenser.
C 4—Bi-pass condenser, variable, UC-1819 or UC-1820
C 5—Telephone condenser, value optional, UC-569, with UX-543 mounting.
L 1—Primary of loose coupler.
L 2—Secondary of loose coupler.
L 3—Ticker coil.
R 1, 2 and 3—Standard R. C. Filament control rheostats, PR-535.
R 4—Standard R. C. grid leak resistance unit, .2 to 5 megohms UP-516, 519 or 523, with mounting UX-543.
S—Standard R. C. Vacuum tube sockets, UR-542.
AFT—Standard R. C. Audio-frequency amplifying transformers, UV-712.
T—Telephone receivers, Western Electric, 1002-A.
"A"—6-volt filament lighting battery, Exide, 3-LX-9-1.
"B"—20 to 100-volt plate batteries, made of several Burgess 2156 units connected in series, with a tap taken off at the 18-volt point for operation of the detector tube.

Note: When UC-1820 precision variable air condenser is used for the grid condenser no mounting UX-543 is needed for the grid leak, for the mounting is made as a part of the condenser. It will accommodate any of the R. C. Standard grid leak resistances.

In order to employ a loud speaker it is merely necessary to remove the telephone receivers from the circuit and connect the two terminals of the loud speaker in their place. Adjustment of the variable condenser, C-4, may be used to clarify the tone of the signals. Some loud speakers require a battery for their operation, but the vast majority will function directly from the amplifier. Where the loud speaker does require such a battery, the directions which accompany the device must be strictly adhered to, in order to prevent the possibility of ruining the internal mechanism and connection may generally be made to the six-volt storage battery marked "A".

The effect of using two stages of amplification is to increase the intensity of the incoming radio signal, whether it be speech, music or code, many times. Each step of amplification increases the signal a certain number of times, depending upon the design and use of the amplifier, so it may be seen that where each step amplifies from six to ten times, the result of using two stages is an increased energy of from approximately 36 to 100 times its original value. In estimating the amplification factor of audio frequency devices it is safe to assume that the higher the voltage applied to the plates of the amplifier tubes, the greater is the resultant amplification. This does not hold true with detector tubes.

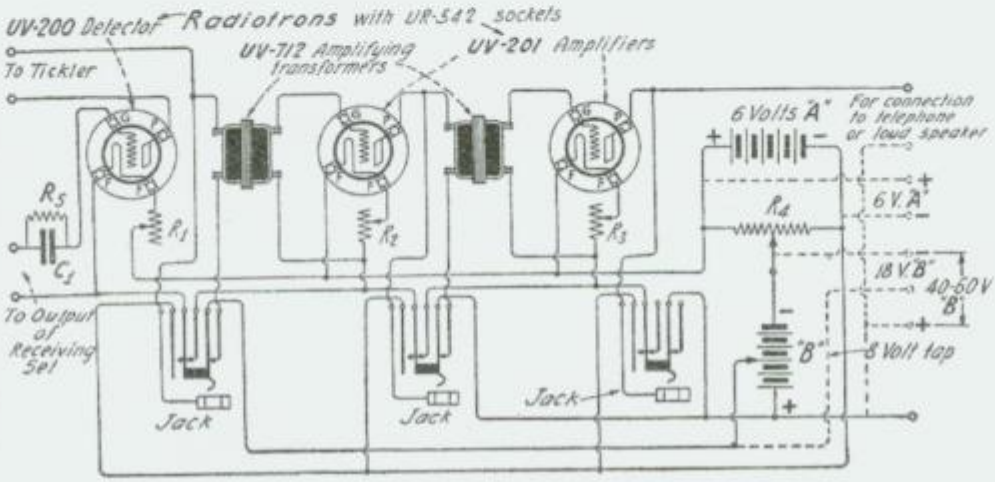


Figure 5.—The circuit is made up of one Radiotron UV-200 and two Radiotrons UV-201; three porcelain sockets UR-542; two UV-712 audio-frequency amplifying transformers; a standard Grid Condenser (UC-567 to UC-570) and a standard Grid Leak (UP-509 to UP-527) with two mountings UX-543 and three special telephone jacks having Filament Control Contactors.

Regenerative Amplifier Circuit

The arrangement illustrated in Fig. 4 may be used for obtaining satisfactory results over very long distances and it is recommended because it is simple to assemble and operate. This system is now being used by a great many experimenters throughout the world and one need have no fear of its dependability, where the values for the different units comprising the layout are properly followed.

Many modern receiving equipments include one or two stages of audio-frequency amplification. This is especially true where a "loud speaker" is employed or where extraordinary distances are being covered.

Where such amplifiers are used it is often found desirable to use less than the maximum amplification. To accomplish this ordinarily, it is necessary to alter several of the connections. An automatic system has been devised utilizing multi-bladed telephone jacks functioning with the conventional telephone plug. The blades and the jacks are so connected to the circuit that the necessary units are included when the plug is inserted in position.

Amplifier Circuit with Plug and Jack Control

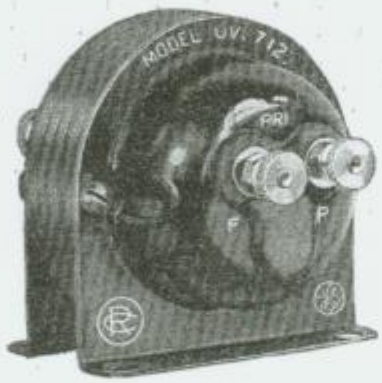
The circuit arrangement shown in Fig. 5 is one employing standard Radio Corporation amplifying parts, with Western Electric telephone jacks. When the plug is inserted in the first jack the detector tube alone functions; when the plug is inserted in the second jack the detector tube and the first amplifying circuit function together; when placed in the third jack three tubes are made to operate. As may be seen from the diagram, the Filament as well as the other circuits are operated by merely inserting the plug.

Where this layout is desired, the circuit should not be made to include the batteries indicated in the diagram, but should be made to run to a series of terminals or binding posts indicated by the dotted lines in the diagram.

Regulation of the voltage on the plate of the detector tube is accomplished by means of a Potentiometer shunted across the "A" battery with the arm connected to the negative terminal of the "B" battery. This Potentiometer when connected to the 18 volt tap of a Standard Burgess No. 2156 plate battery permits a voltage regulation of from 18 to approximately 24 volts. With some detector tubes it is necessary, in order to obtain best results, to connect to the 22.5 volt lead of the plate battery instead of the 18 volt lead. This is especially so with batteries which have been in use for a considerable period. In this case the voltage range is from approximately 22.5 volts to 28 volts.

FOR GENUINE AMPLIFICATION

TONE FREQUENCY INTERVALVE AMPLIFYING TRANSFORMER



Ideal for Broadcast Amplification

IT is a well known fact that for maximum amplification the characteristics of an intervalve tone frequency amplifying transformer must be such as to fit the output impedance of the preceding tube in a cascade amplifying set. There is an allowable variation of the constants of the transformer when loaded on the secondary by an amplifying tube, but nevertheless, the maximum signal is obtained from a transformer designed especially to fit the output impedance of the tubes with which it is used.

Designed for Radiotron Vacuum Tubes

Prior to the introduction of Transformer Model UV-712, amateur experimenters were compelled to employ intervalve transformers of various characteristics, none of which had been designed specifically for the Radio Corporation's detector tube, Radiotron UV-200, and the amplifier tube, Radiotron UV-201. Transformer UV-712 not only has been designed to fit these vacuum tubes, but special care has been taken to reduce the transformer losses to the lowest possible minimum.

Thousands Now in Use

The accompanying illustration shows the new amplifying transformer, of which there are several thousand now in daily use. Transformer UV-712 has been designed and manufactured strictly on a quality basis. It is precisely the same type used in the Corporation's commercial types of radio receiving sets. It is not to be compared with other types in which efficiency has been sacrificed to obtain compactness or to reduce manufacturing costs. Many experimenters report that the introduction of UV-712 into their receiving sets, has resulted in such a marked increase of signal audibility as to be nothing short of marvelous.

In general, a tone-frequency amplifier transformer should occupy the same position in the output circuit of a vacuum tube as the receiving telephont. The terminals P and F of Transformer UV-712 may be connected to the plate circuit terminals which ordinarily are connected to the telephone receiver. The secondary terminals should connect to the grid and filament of the following tube of a multi-stage amplifier.

In radio amplifier circuits using Transformer UV-712, the insulation of all apparatus connected to the secondary must be as perfect as possible. Leakage from the grid to the filament of amplifier tubes through the socket, mounting, panel, wiring or otherwise will decrease the amplification. The lead from terminal G should be kept reasonably short and in cascade amplifier sets adjacent transformers should not be mounted too close; a separation of at least four or five inches should be allowed.

PHYSICAL CHARACTERISTICS

1. **Totally enclosed**
2. **Net weight, 1 lb. 4½ oz.**
3. **Shipping weight, 1 lb. 7 oz.**
4. **Overall length, 3⅜ in.**
5. **Overall height, 2¾ in.**
6. **Base area, 2 x 2¾ in.**

ELECTRICAL CHARACTERISTICS

1. **Ratio of Secondary to Primary Turns, 9/1.**
2. **Useful frequency range, 60/3000 cycles.**
3. **Allowable current on each winding, 10 milliamperes.**
4. **Test voltage between windings and between core and windings, 300 volts at 60 cycles.**
5. **Terminal voltage limit of secondary winding, 300 volts.**

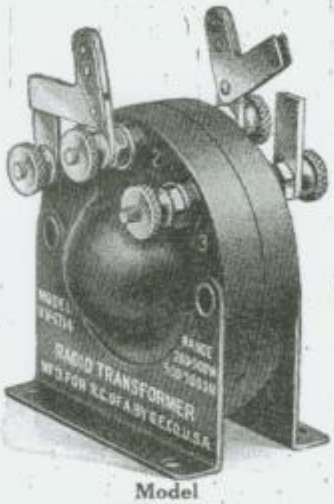
Model UV-712 is the only transformer designed specifically for use with Radiotrons.

AMPLIFYING TRANSFORMER, MODEL UV-712 ..... $7.00

Dimensions: 2¾ in. x 3⅜ in. x 2 in. Shipping Weight: 1 lb. 7 oz.

RADIO FREQUENCY AMPLIFICATION

With The RCA Radio Frequency Intervalve Transformers



Model UV-1714, range 200 to 5000 meters

Greater Receiving Range with Less Distortion

Model UV-1716, range 5000 to 25000 meters

AMPLIFICATION in radio reception means increased signal audibility. The current developed in a radio receiving set from a distant transmitting station is not always of sufficient intensity to operate a telephone or a loud speaker. It is for this reason that radio frequency, audio frequency amplification or a combination of both must be resorted to. The radio frequency amplifier consists of a group of vacuum tubes in cascade, interconnected by specially designed transformers which increases the intensity of the signalling current in its original form. The audio frequency amplifier, on the other hand, amplifies the output of a detector tube which has changed the amplified high frequency current to a form which will operate a telephone receiver.

Where receiving sets are located within a comparatively short distance from a broadcasting station, ample signal strength may be secured by the use of a vacuum tube detector and a two-stage audio-frequency amplifier. However, where the receiving station is more remote, the incoming signal must be built up in order to properly actuate the detector tube. This building up of signal energy is accomplished by radio frequency amplification.

Ordinarily, very weak signals influence the detector so slightly that there is little or no rectification. Under this condition, audio frequency amplification is not always effective.

In general, more than two stages of audio frequency amplification proves unsatisfactory, for there is then a tendency to over-amplify tube noises and inductive disturbances from nearby lighting circuits.

The radio frequency method of amplification described here increases the strength of the incoming antenna current through successive stages until it becomes of sufficient intensity to enable detection to take place. Then with the addition of one or two stages of audio frequency amplification a current of sufficient strength will be generated which may be used to actuate either telephone receivers or loud speaking devices.

The design, however, of a radio frequency transformer suitable for amplification of signals at both long and short wavelengths has always presented a difficult problem, and it is only with the introduction of the Radio Corporation of America's new radio frequency transformers that amateurs and experimenters may take advantage of this means of amplification.

The radio frequency amplifier circuits illustrated and described here have been fully tested, and with the apparatus listed the broadcast enthusiast, the amateur and experimenter can at once enjoy radio reception without the necessity of using a high antenna, at the same time insuring minimum of interference from undesired stations.

Radio frequency amplification also permits the use of frame or loop aerials and provides, even with such limited antennae, a signal of great enough intensity to function properly with audio frequency amplifiers for the operation of loud speakers, within certain limits. It is particularly suited to the reception of radio music and speech for it tends to eliminate the distortion resulting from the use of several stages of audio frequency amplification. For the longer wave lengths, two or three stages in cascade will produce a very strong signal from foreign stations using an average amateur antenna for receiving.

In former attempts to obtain radio frequency

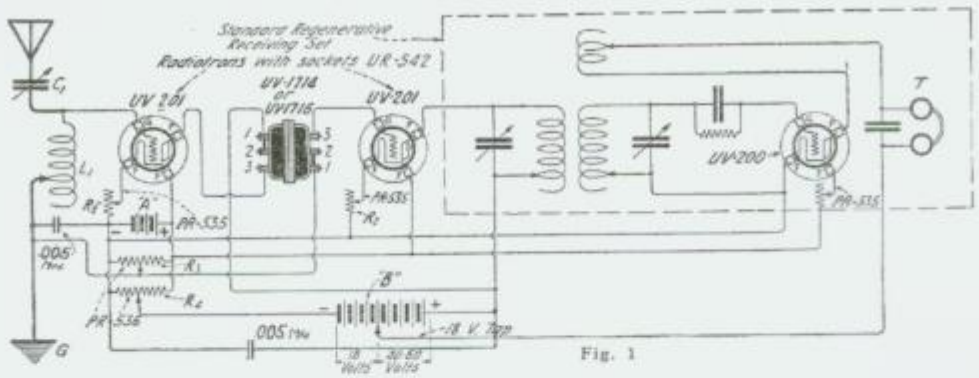


Fig. 1

"A"—Storge battery (6V-80 ampere-hour size or larger).
"B"—Standard 22.5 volt plate batteries, with 18 volt tap.
C—Variable antenna series condenser, UC-1820 (.0006 mfd. max.).
L 1—Simple tuning coil, either tapped or fitted with a slider.
R 1, R 2—Standard filament rheostats, PR-535.
R 3, R 4—Standard "A" battery potentiometers, PR-536.

NOTE:—The circuit within the dotted lines is a standard regenerative circuit.

amplification, it has been impossible to obtain maximum results on certain wave lengths without sacrificing on others. This is because transformers with characteristics which would be desirable for the long waves would not function properly on the shorter waves and vice versa. With Model UV-1714, a range of 200 to 500 meters is provided. To permit this very broad range, a tap has been made on each winding and connected to the terminal marked "2." For short wave reception, that is, from 200 to 500 meters, the connections illustrated in the accompanying diagrams are to be used. For the longer range of 500 to 5000 meters, the metal strap on each side of the transformer is disconnected and the entire windings from the terminals "1" to the terminals "3" are used.

2-Stage Radio Frequency Amplifier Circuit

Fig. 1 illustrates a satisfactory circuit for use in connection with several stages of radio frequency amplification for the reception of continuous waves.

In this case the antenna is tuned to the wave length of the desired signal and this selected signal is amplified through the primary of a standard receiving set connected to the plate circuit of the last frequency amplifier tube. It is then transferred through the secondary circuit to the detector tube, in which regeneration may be controlled as desired.

One decided advantage of using the circuit shown in Fig. 1 is that the oscillations in the detector tube circuit cannot find their way back through the radio frequency amplifier to the antenna circuit, therefore the antenna cannot radiate energy. If potentiometer R-3 is not used, the filament rheostat should be placed in the positive leg of the filament circuit instead of the negative.

Combined Radio-Audio Frequency Circuit

For general reception when an average outdoor amateur antenna and radio frequency amplification are used, the circuit shown in Fig. 2 is most highly recommended. This arrangement is quite similar to that shown in Fig. 1, but instead of the standard regenerative receiver, a vario-coupler and twin variometer receiver is employed, and two stages of audio-frequency amplification have been added for operating a loud speaker.

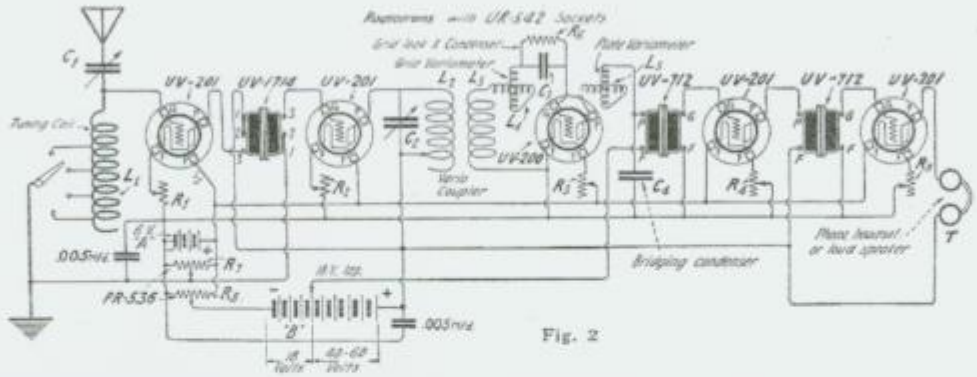


Fig. 2

"A"—Storage battery (6V-80 ampere-hour size or larger).
"B"—Standard 22.5 volt plate batteries, with 18 volt tap.
C 1—Variable antenna series condenser, UC-1820 (.0006 mfd. max.).
C 2—Variable condenser, UC-1819 (.0001 - .005 mfd.).
C 3—Grid condenser (fixed or variable) .00025 mfd., UC-567 with UX-543 mounting or UC-1820.
C 4—Telephone condenser, size optional, UC-567 to UC-570, with mounting, UX-543.
C 5 and C 6—.005-.01 mfd.
L 1—Simple tuning coil, either tapped or fitted with a slider.
L 2—Primary of vario-coupler.
L 3—Secondary of vario-coupler.
L 4—Grid variometer.
L 5—Plate variometer.
R 1, 2, 3, 4, 5—Standard filament rheostats, PR-535.
R 6—Standard grid leak, .5 to 2 megohms, UP-516, 519 or 523, with UX-543 mounting.
T—Head telephones.
R 7 and R 8—Standard "A" battery potentiometers, PR-536.

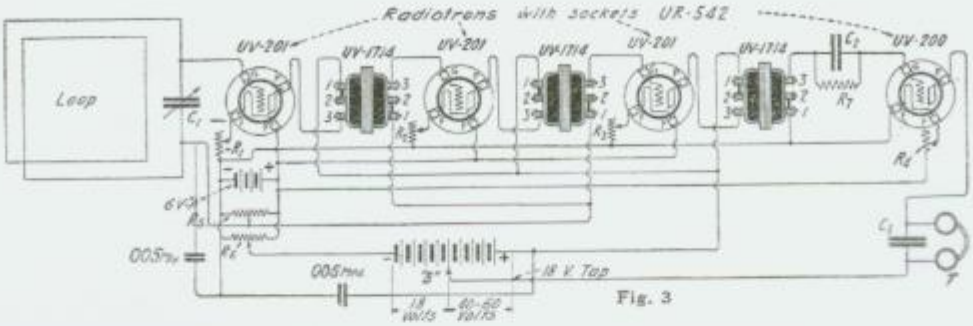


Fig. 3

"A"—Storage battery (6V-80 ampere-hour size or larger).
"B"—Standard 22.5 volt plate batteries, with 18 volt tap.
C 1—Variable loop tuning condenser, UC-1820, .0006 mfd. max.
C 2—Grid condenser (fixed or variable), .00025 mfd., UC-567, with mounting UX-543 or UC-1820.
C 3—Telephone condenser, UC-567 to UC-570, with mounting UX-543. The use of this condenser is optional.
Loop—Fully described above.
R 1, R 2, R 3—Standard filament rheostats, PR-535.
R 4, R 5—Standard "A" battery potentiometers, PR-536.
R 6—Standard grid leak .5 to 2 megohms, UP-516, 519 or 523, with UX-543 mounting.
T—Head telephones.

As is the case with the former circuit, the circuit shown in Fig. 2 utilizes separate antenna tuning, by means of the simple tuning coil L_1. This tuning coil permits the antenna circuit to be adjusted to resonance with the desired incoming signals, and the signal, thus selected, is carried through the radio frequency amplifier circuit and the primary of the vario-coupler to the detector tube circuit, where it is rectified and brought to an audible frequency. This audio-frequency current is then passed through two stages of audio frequency amplification.

In using this circuit, the first two tubes should not be permitted to oscillate, but merely to amplify the incoming signal, for the oscillation and regeneration is most satisfactorily controlled by tuning the detector tube plate variometer in the customary manner. Where this circuit is employed DO NOT GROUND the negative lead of the 6-volt "A" battery. If potentiometer R-7 is not used, the filament rheostat should be placed in the positive leg of the filament circuit instead of the negative.

Loop Antenna and 3-Stage Radio Frequency Amplifier

Fig. 3 shows a method of reception using a loop antenna and three stages of radio frequency amplification. This type of receiving set will bring in signals over several hundred miles and interference is considerably reduced, as the loop possesses properties which enable signals to be received from a given direction to the exclusion of unwanted stations. Static is also considerably reduced.

A very satisfactory loop for this purpose may be made by using a frame three feet square wound with five or six turns of No. 14 B. & S. lamp cord, each turn being spaced ½ to ¾ of an inch. A tap should be provided on each turn. The loop should be shunted by a variable condenser (UC-1820) having a capacity of .00004 to .0006 mfd.

With this arrangement, the incoming signals are of an intensity slightly greater than is obtained with an ordinary amateur antenna and a single detector tube. By the addition of two stages of audio frequency amplification, we have a method of obtaining a greater signal intensity than is possible with the outdoor antenna, while the interference from undesired stations is considerably reduced. For fine tuning, the condenser shunted across the active turns of the loop should be equipped with a vernier, although this is not absolutely essential.

Where a radio frequency amplifier of two or more stages is desired, it should be built in a metal box, or in a box lined with metal, and should preferably have a separate compartment for each radio frequency amplifier tube and its transformer. In completing such an amplifier, it is also important to ground the negative side of the filament battery, except with single circuit tuners, to the metal case or metal lining. This insures stability.

In general, the foregoing instructions also apply to the radio frequency intervalve transformer, UV-1716, which is designed for use in connection with long wave reception. The turn ratio, however, in this transformer is approximately 1 to 3 for the reason that a step-up is advantageous for the long wave range. No intermediate tap is used on this transformer as it functions satisfactorily over the entire wave length range of 5000 to 25,000 meters.

Note: In figures 1, 2 and 3 it will be observed that there are two additional condensers each designated with a capacity of .005 mfd. It has been found that the use of these considerably improves radio frequency amplification.

Features of Both Models

1. Receiving ranges may be doubled and even tripled.
2. News and music broadcasted by distant stations are received with remarkable clearness.
3. Distortion is greatly reduced.
4. Selectivity is considerably increased.

5. Vacuum Tube noises are practically eliminated.
6. These transformers are designed especially for, and will function at maximum efficiency only, when used with Radiotron Amplifier Tube UV-201.

Physical Characteristics

Model UV-1714

1. Base Dimensions 2 9/16" x 1 11/16".
2. Overall Height 2¾".
3. Net Weight 7 oz.
4. Shipping Weight 10 oz.

Model UV-1716

1. Base Dimensions 2 9/16" x 2¼".
2. Overall Height 2¾".
3. Net Weight 12 oz.
4. Shipping Weight 1 lb.

Electrical Characteristics

Model 1714

1. Ratio of primary to secondary turns, 1 to 1.
2. Tap on each winding provides for two wave length ranges: 200 to 500 meters and 500 to 5000 meters.
3. Especially designed for use with Radiotron amplifier tube UV-201.

Model 1716

1. Ratio of primary to secondary turns, 1 to 3 (approximate).
2. Entire wave length range 5000 to 25,000 meters available without taps.
3. Especially designed for use with Radiotron amplifier tube UV-201.

Radio Frequency Amplifying Transformer, 200 to 5000 meters, Model UV-1714.... $6.50
Radio Frequency Amplifying Transformer, 5000 to 25,000 meters, Model UV-1716.. 8.50

GRID LEAKS FOR RECEIVING SETS

The grid of any vacuum tube, whether employed as a detector or an amplifier, is the controlling member of the tube, that is to say, it controls the current flowing between the plate and filament. The character of the control depends directly upon the bias potential maintained upon the grid. Thus one value of grid potential will be found most suitable for radio detection, while still another value must be maintained to secure maximum amplification. The requisite bias potential for varied conditions of use may be obtained in several ways, the most common of which are: (a) to insert in series with the grid circuit a small battery usually called a "C" battery; (b) to tap one terminal of the grid circuit from a fixed resistance in series with the filament rheostat through which the filament current flows; (c) to employ a GRID LEAK connected across the grid condenser or the grid and the filament.

The function of the grid leak is to present a leakage path across the grid condenser so that the potential of the grid member in respect to a terminal of the filament may be maintained at some desired value. The potential maintained on the grid is computed by Ohm's Law and it is therefore equal to the grid current times the grid resistance. With a grid resistance of two megohms (2,000,000 ohms) and a grid current of one microampere, the bias negative potential will be two volts.

Different detection and amplification circuits require grid leaks of different values and in order that the experimenter may have access to a complete line of resistance units from 100,000 ohms to 6,000,000 ohms, the Radio Corporation has standardized a number of different values which are certain to meet all the requirements for radio reception.

The proper capacity for the grid condenser should be determined by experimenting with different values between .0002 and .0004 microfarad.

The grid leak unit which will give the proper biasing potential on the grid may vary between ½ megohm (500,000 ohms) and 3 megohms (3,000,000 ohms). Various values can be obtained by purchasing three of the Radio Corporation grid leak units, approximating ½, 1 and 2 megohms, respectively. The experimenter can then try three values by employing them singly, in series, in parallel or in series-parallel. Eight or more different values between ½ to 3½ megohms may in this way be obtained.

The Radio Corporation Grid Leak Units are manufactured in the following sizes:

Model	Ohms	Megohms
UP-509	50,000	.05
UP-510	100,000	.1
UP-511	150,000	.15
UP-512	200,000	.2
UP-513	250,000	.25
UP-514	300,000	.3
UP-515	400,000	.4
UP-516	500,000	.5
UP-517	600,000	.6
UP-518	750,000	.75
UP-519	1,000,000	1.
UP-520	1,250,000	1.25
UP-521	1,500,000	1.5
UP-522	1,750,000	1.75
UP-523	2,000,000	2.
UP-524	2,500,000	2.5
UP-525	3,000,000	3.
UP-526	4,000,000	4.
UP-527	5,000,000	5.

Grid Leak Mounting, Model UX-543..... $0.50
Grid Leak Units, Models UP-509 to UP-527..... .75

RADIOTRONS FOR RELIABLE RECEPTION

RADIOTRONS form the center of a system of radio communication which would be entirely impossible without them. These vacuum tubes are manufactured by the General Electric Co. and the Westinghouse Lamp Company for the Radio Corporation of America. There are so many shining examples of great distances covered by Radiotron reception and transmission that enumeration here would be impossible. With a single Radiotron, experimenters in Florida and another in Cuba have listened to the concerts sent out by a radio broadcasting station located in the vicinity of New York City.

The Radiotron detector tube was used by Mr. Paul F. Godley in his successful attempt to hear American amateur transmitting stations at the station he erected in Ardrossan, Scotland.

The electrical characteristics of all Radiotrons are practically uniform. This is made possible by the highly standardized method of production utilized by the manufacturers at their various factories for the production of Radiotrons. For this reason, the experimenter, in using Radiotrons, is assured of a uniform reliability, as every tube is made to pass a severe test and is rejected unless the high standard set for it is obtained.

There are many functions for the Radiotron to perform in connection with radio reception and only its great versatility permits it to be confined to two forms which cover perfectly the varied tasks they are called upon to perform. These two forms are the detector and amplifier Radiotrons UV-200 and UV-201, respectively.

PRICE—$5.00

Overall dimensions, 1¾ in. x 4¼ in. Shipping weight, 1 lb.

THE UV-200 DETECTOR TUBE

Radiotron UV-200 may be called upon to perform a great variety of duties as shown in the accompanying illustrations. In any receiving circuit either simple or complex, Radiotron UV-200 is the detector which embodies all the characteristics necessary for faultless performance. The circuits which appear throughout this book show some of the common uses made of this wonderful vacuum tube which has made communication over thousands of miles a fact by means of the code and speech to say nothing of music. Where long distances are to be covered, where stability of operation is desired, where long life and its resultant low cost are desired, where detector tubes of uniform characteristics are required for critical receiving adjustments, in fact wherever real results are sought, there is but one answer to the detector tube question —Radiotron UV-200.

The Radiotron UV-200 is made with a standard four prong bayonet base designed to fit the Radio Corporation standard VT sockets UR-542, and UP-552.

How to Use Radiotron UV-200

In using Radiotron UV-200 for a detector, a grid condenser of approximately .00025 mfd. or thereabouts should be connected in series with the grid. Many experimenters prefer a variable grid condenser which is of value in regenerative circuits. In addition to the grid condenser one of the Radio Corporation's standard grid leaks should be connected across the grid condenser as shown in diagrams. In this case the Radio Corporation's standard Grid Leak and Condenser Mountings, UX-543 should be employed.

Note: Where a variable grid-condenser is used, the UC-1820, fully described on page 50, is recommended; with this condenser no grid leak mounting is required, for the condenser is fitted with a mounting which will hold any of the Radio Corporation's standard grid leaks.

Where the desired voltage is not more than 22½, the "A" Battery Potentiometer PR-536 permits an extension of the life of the "B" battery. When the normal voltage of the 18 volt tap is too low, the connection from the potentiometer may be made to the 22½ volt tap, thus using the cells between the 18 volt tap and the 22½ volt tap previously idle.

It is sometimes necessary to use more than 22½ volts with the UV-200 and when this is the case, instead of connecting the lead through the potentiometer to the 18 volt tap of the plate battery it should be connected to the negative or 22½ volt terminal of the plate battery. This permits an adjustment of from 22½ to about 28 volts on the plate circuit.

Voltages in excess of 28 to 30 should not be applied to the plate of a Radiotron UV-200.

If the experimenter prefers to adjust the filament by indicating instruments, it should be done by a voltmeter and not by an ammeter. All tungsten filaments show a decrease of current during their life and if constant current is maintained in the filament rather than constant voltage across it, the life will be greatly decreased and no better signals obtained. The normal voltage to be maintained at the filament terminals of RADIOTRON UV-200 lies within the range of 5 to 5.4 volts.

RADIOTRONS FOR SATISFACTORY AMPLIFICATION

Radiotron UV-201

WHERE it is desired to use loud speakers, in order to eliminate the necessity of listening to radio with the head telephones, sufficient energy must be provided to actuate the loud speaking device. A most suitable means for providing this energy is found in audio frequency amplification, which is the combination of Radiotrons and amplifying transformers functioning with a local source of current.

The incoming radio signals affect the vacuum tube in such a way as to draw current from the local source; this local current is then used to actuate the loud speaking device.

As may be seen from the following description, the amplification factor ordinarily obtained where this method is employed is between 6 and 10; so that for each stage of amplification, the incoming signal is multiplied from 6 to 10 times. Where several stages are used, the signal may reach 36 to 100 times its original intensity.

PRICE—$6.50

Overall dimensions, 1¾ in. x 4¼ in. Shipping weight, 1 lb.

RADIOTRONS FOR AUDIO AND RADIO FREQUENCY AMPLIFICATION

Radio frequency amplification differs greatly from audio frequency amplification in that the increase of the signal intensity takes place before it has been reduced to suitable characteristics for operating a telephone receiver or loud speaker. Both radio and audio frequency amplification and circuits illustrating their most valuable uses, may be found in the section of this book devoted to receiving circuits.

For such circuits, the Radiotron UV-201, may be counted upon for reliable performance. Radiotron UV-201 may be used in any circuit where vacuum tubes are used as amplifiers. This remarkable amplifying tube has been designed to function with the Radio Corporation's audio frequency transformer UV-712 and the radio frequency amplifying transformers UV-1714 and 1716, both described elsewhere in this book.

The normal plate voltage of Radiotron UV-201 is 40, although increased amplification is possible with plate voltage up to 100. With 40 volts on the plate, the amplification constant varies between 6.5 to 8, but with 100 volts on the plate, this constant is from 8 to 10. The output impedance of Radiotron UV-201 varies in value from 15,000 to 25,000 ohms, with 40 volts on the plate and from 10,000 to 15,000 with 100 volts on the plate, the normal filament current for Radiotron UV-201 is approximately one ampere. The filament is designed for operation from a 6-volt storage battery with a standard filament rheostat in series.

To obtain maximum amplification with UV-201, means should be provided for imposing negative potential on the grid although good amplification may be secured without this special provision. The requisite negative grid potential for this purpose may be secured by connecting a "C" battery of 2 or 3 volts in the grid circuit shunted by a 200 to 400 ohm potentiometer, or by placing a 2 ohm resistance in series with the negative terminal of the filament and connecting the "low potential" terminal of the tuner secondary to include this resistance in the grid circuit.

Important Facts Concerning UV-201

Because the UV-201 has been designed for use especially with the Radio Corporation's audio and radio frequency transformers, circuits employing these standard units are found to give absolute satisfaction, even under severe operating conditions. The Radiotron UV-201 permits very great amplification without distortion. This feature is especially desirable where reception is carried on at short wavelengths. Heretofore, it has been a very difficult problem to obtain vacuum tubes and radio frequency amplifying transformers which would give satisfaction on the wavelengths used for amateur communication. The perfection of the Radiotron with its allied units now permits radio reception over distances hitherto considered impossible, on all wavelengths.

Circuits and data fully covering the application of Radiotron UV-201 to both Radio Frequency and Audio Frequency Amplification as well as various combinations of both have been presented at length in previous pages.

AERIOTRON VACUUM TUBES

(Westinghouse Products)

Aeriotron Amplifier Tube Model WR-21-A, for Use with Aeriola Grand Receiver

This is a specially designed and carefully selected tube for use in the amplifying circuits of the Aeriola Grand and may be placed in any of the three front receptacles from left to right.

The filament current for this tube is approximately .8 of an ampere and the drop across the filament is about 4 volts. A six volt storage battery with a rheostat or ballast tube control will, therefore, furnish satisfactory power for heating the filament to its normal operating temperature.

The plate impedance of this tube is from 60,000 to 80,000 ohms, making it adaptable to resistance coupled amplification.

WR-21-A Amplifier Tube for Aeriola Grand Receiver $7.50

Dimensions: 4½ in. x 1¼ in.
Weights: Net, 4 oz.; Shipping, 1 lb.

Aeriotron Detector Tube. Model WR-21-D, for Use with Aeriola Grand Receiver

This tube is designed especially for use with the Aeriola Grand Receiver and when so used gives excellent receiving results. It is provided with a special base which prevents its being used in equipment with which it will not properly function. Aeriotron WR-21-D has a green tip marking and is designed for use as the detector tube in Aeriola Grands, and should be placed in the right-hand front receptacle.

The filament current for this tube is approximately .8 of an ampere and the drop across the filament is about 4 volts. A six volt storage battery with a rheostat or ballast tube control will, therefore, furnish satisfactory power for heating the filament.

Aeriotron Detector Renewal Tube, Model WR-21-D for Aeriola Grand Receiver . . . $7.50

Dimensions: 4½ in. x 1¼ in.
Weights: Net, 4 oz.; Shipping, 1 lb.

Aeriotron Ballast Renewal Tube Model WB-800 for Aeriola Grand Filament Circuits

This vacuum tube has been especially designed for use with the Aeriola Grand Receiver. It functions as a control element in the filament circuit of the detector and amplifier tubes. By the use of these control tubes, accurate adjustment of the filament current is automatically taken care of and filament rheostats are not required.

Aeriotron Ballast Renewal Tube, Model WB-800 for Aeriola Grand Filament Circuit, $3.50

Dimensions: 4½ in. x 1¼ in.
Weights: Net, 4 oz.; Shipping, 1 lb.

Aeriotron Detector Tube Model WD-11, For Use with Aeriola Sr. Receivers

Aeriotron Detector tube, Model WD-11, is designed for use with the Aeriola Sr. Receiver. It is provided with a special base to preclude the possibility of its being placed in a circuit other than that for which it has been designed.

The filament current consumed by this tube is .25 of an ampere which may be supplied from a single 1.5 volt standard dry cell. However, it is inadvisable to connect the tube directly across the terminals of such a battery, and for this reason a suitable rheostat for controlling the filament temperature is provided with the Aeriola Sr.

The WD-11 Aeriotron tube operates quite satisfactorily as a detector when 22.5 volts are applied to its plate.

Aeriotron Detector Renewal Tube, Model WD-11 for Aeriola Sr. Receiver $8.00

Dimensions: 4½ in. x 1¼ in. **Weights:** Net, 4 oz.; Shipping, 1 lb.

Caution: The Aeriotron WD-11 has a special coated filamentand must not be burned brighter than a DULL RED.

VARIABLE CONDENSERS FOR RECEIVING CIRCUITS

General

A VARIABLE condenser is an essential element for sensitive reception.

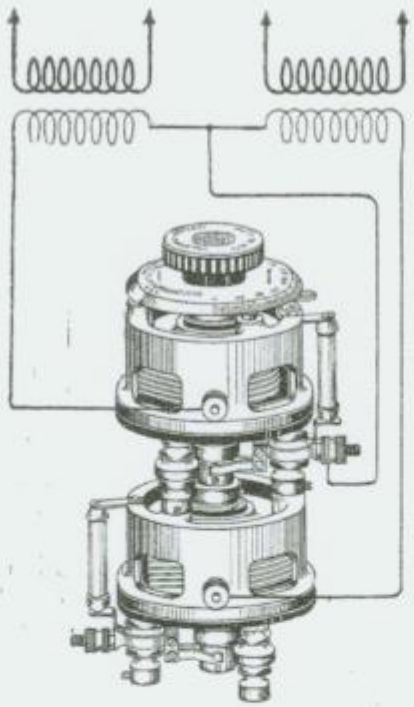
In general, variable condensers afford a reliable and simple method of altering the values of receiving circuits in order to bring about a point of resonance, thus enabling one to select, at will, stations operating on different wave lengths.

When two or more circuits are in resonance they are of the same electrical wave length and the altering of the values of capacity or inductance in them to secure a certain wave length is called tuning.

When one desires to receive from a transmitting station, it is necessary to tune the receiving instrument to resonance with the wave length of the station one wishes to hear—whether it be radio telephony or radio telegraphy.

There are so many types of variable condensers, each designed for a certain purpose and a few remarks may be of value in assisting the experimenter to make a correct selection for the various types of receiving circuits commonly employed.

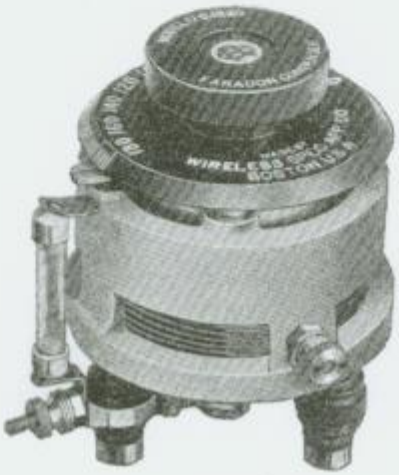
Different usages require condensers of various designs and the types described here are of unusual construction, providing a degree of accuracy and reliability hitherto unattained, and may be relied upon to fill every need.



Illustrating the use of two Faradon UC-1820 nested on a single shaft for controlling two circuits simultaneously

FARADON PRECISION VARIABLE CONDENSER MODEL UC-1820

In any radio circuit where a variable capacity from .00004 to .0012 mfd. is required, the Faradon Condenser UC-1820 will be found indispensable. This condenser has a capacity range from .00004 to .0006 mfd., but it is so constructed that it is possible to join two condensers together controlling them from a single dial knob. By such an arrangement, three distinct maximum capacities may be found by the condenser units of .0003, .0006, and .0012 mfd. respectively, as shown in the accompanying sketches.



Faradon UC-1820

Adding Other Capacities

Additional capacity variations may be obtained by adding to the variable condenser unit the Radio Corporation's tubular condensers UC-567-8-9-70 having capacities of .00025, .0005, .001, and .0025 respectively, the variable condenser acts as a vernier in this instance. The UC-1820 is provided with clips into which these fixed condensers may be placed. With these condensers it will be seen that the capacity range of the UC-1820 combination cannot be duplicated by any other condenser or combination of condensers now on the market.

There are quite a few important properties that may be obtained by the chain connected condensers. One very marked advantage is that the system will permit simultaneous tuning of two circuits with one knob.

If the circuits have a common lead an inductance may be connected between the fixed system of one condenser to the common movable system and a second equal inductance system may be connected between the fixed system of the second unit to the movable system as shown

in the figure on previous page. If the dial is rotated the periods of both circuits will vary simultaneously.

Construction

The movable and fixed elements comprising the UC-1820 are die castings exact to 1/1000 of an inch. The housing of the condenser is likewise cast with great exactness. The movable element is fastened to a steel shafting. This shafting is fitted with bronze bearings and a suitable arrangement is provided for the centering of the fixed and movable elements. The spacing between the plates is 10/1000 of an inch. The insulation between the fixed and movable systems for their relative support has been reduced to a minimum area in order to avoid dielectric losses. Connection from the movable system is made from a double split brush fitted to one of the base insulators.

Clip Mounting Feature

The clip mounting, in addition to furnishing possible variations of capacity by the use of fixed condensers as previously described, furnishes a ready means for inserting a standard Radio Corporation grid leak resistance. (UP-507 to UP-509) where the UC 1820 is used as a variable grid condenser. This method permits a rapid change of grid leak resistance as well as a variable grid capacity, making for very accurate control of this circuit.

This condenser may be mounted in any position and provision is made to allow for panel thickness up to 5/16 of an inch, or on a base of any thickness.

Faradon Condensers have an efficiency of over 99—7/10% and they represent a standard of quality and efficiency that is rarely attained in any electrical device.

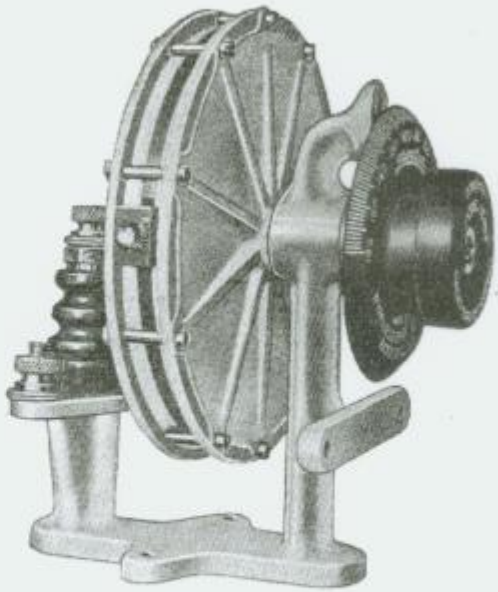
Faradon Precision Variable Condenser

Model UC-1820 ..... **$7.50**
Capacity: .00004—.0006 mfd.
Dimensions: 4 in. by 3¾ in.
Weights: 10 oz. Shipping 2 lbs.

FARADON VARIABLE MICA CONDENSER MODEL UC-1819

It is impossible to realize without having used one of these condensers, the satisfaction it makes possible in any form of receiving circuit for accurate, reliable and selective operation. A very marked difference between variable condensers of the older type and this new condenser is the fact that the capacity from minimum to maximum is increased in a uniform manner dependent upon the position of the variable element with respect to the fixed or stationary element. This relation is controlled by rotating a single calibrated control knob.

Wide Range of Capacities



Faradon UC-1819 for fine receiving work

Another and equally astounding fact concerning the Faradon UC-1819 is the very great range of capacity it covers—from .0001 to .005 mfd., which is a ratio of 50 to 1. No other condenser of similar size covers any such range as this.

A special grade of selected mica forms the dielectric of this condenser which is vastly different from the forms of mica condensers heretofore used, in that the capacity is continuously variable while the older types were variable in certain fixed steps, necessitating changes in the wiring or operated by a switching device.

Scientifically Constructed

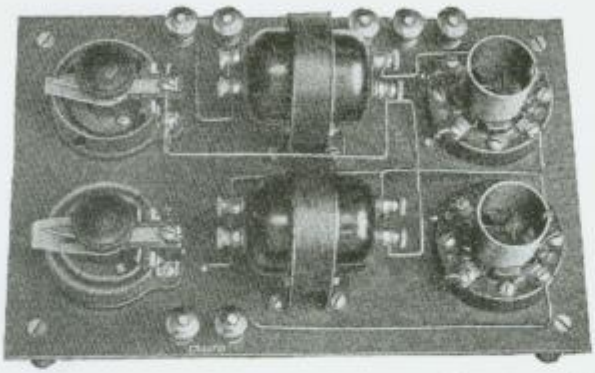
The Faradon UC-1819 is the embodiment of advanced construction methods coupled with supreme engineering technique. Every detail has been scientifically considered and the completed unit marks a new period in radio reception. Here, at last, is a condenser which may be counted upon to perform satisfactorily under the most trying receiving conditions.

The Faradon UC-1819 condenser is of the form shown in the accompanying illustration. It lends itself to any style of mounting, for it may be attached to the surface of any panel up to 5/16 of an inch in thickness with the shaft projecting through or it may be screwed to a base where that form of mounting is preferred. In either case an indicator is included to facilitate the lining up of the rotary element with the calibrated dial knob.

Faradon UC-1819 Variable Mica Condenser, $8.75

Capacities: .0001—.005 mfd.
Dimensions: 4½ in. x 6 in. x 4¼ in.
Weights: 14 oz. Shipping 2 lbs.

COMPONENT PART TWO STAGE AUDIO-AMPLIFIER MODEL AA-485



Special Stabilizer Control eliminates distortion of speech and music.

HERE is the ideal instrument for the advanced amateur who wishes to carry on experiments in amplification and thus study at first hand the action of various forms of radio receiving circuits.

Audio-Amplifier AA-485 is exceptionally well adapted for this purpose, for it is an open-wired set of very simple make-up incorporating unusual features of design and workmanship. It consists of two stages of audio frequency amplification and is made up of standard RCA receiving units, designed to function in perfect accord.

All the units are mounted on a strong bakelite dilecto panel, which in turn is supported by heavy legs. The units are placed in positions which are scientifically correct.

Terminals for the connection of the storage and plate batteries, as well as the input and output circuits, are conveniently located and distinctly marked, so as to preclude the possibility of making wrong connections. An "A" battery potentiometer is provided in order that the grid bias potential may be controlled, avoiding distortion, and to adapt it to various operating conditions.

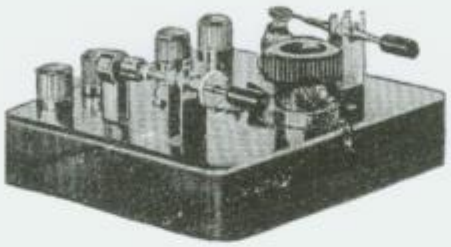
Two Stage Component-Part Audio Frequency Amplifier, Model AA-485 . . . . . $45.00
Dimensions: 12½ in. x 7⅞ in. x 5in..
Weights—Net, 5½ lbs.; Shipping, 7 lbs.

Note—For prices of Complete Receiver Combinations, see page 35.

TYPE DB CRYSTAL DETECTOR, STYLE NO. 307216

IN the base of this detector what is known as a blocking condenser is connected across the telephone terminals, thus making a very compact and complete unit.

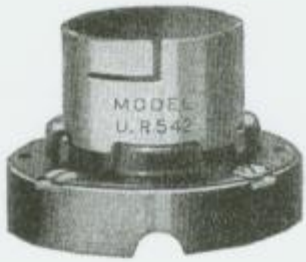
The two types of detectors used on this unit are what is known as the "Pressure" type and the "Cat Whisker" type. In the former two selected minerals are held in pressed contact with each other. In the second type but a single crystal is used, the adjustment being made by means of a fine wire which may be moved about the crystal to locate sensitive spots.



Westinghouse Supersensitive Crystal Detector, Model DB $6.50
Dimensions: 4⅜ in. x 4¼ in. x 2 in.
Weights: Net, 1 lb.; Shipping, 1½ lbs.
Spare Crystals (Pressure Type) Model DE, $1.00
Spare Crystals (Cat Whisker) Model DD, $1.00

Note: Crystal Detector, type DB, may be very satisfactorily employed with any standard receiving outfit and it has been specially designed for use with the type RA Tuner, described in the first part of this book.

PORCELAIN SOCKET UR-542



THIS socket has 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. It is a direct duplicate of the type 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.

Model UR-542 is designed to accommodate RADIOTRONS UV-200, UV-201 and UV-202, as well as KENOTRON UV-216.

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

Size: 2¾ in. x 2 in.
Shipping Weight: 8 oz.

"A" BATTERY POTENTIOMETER
PR-536

It is impossible to over-estimate the desirability of using a potentiometer in connection with the Radio Corporation's gas-content detector, Radiotron UV-200. Only in this way can proper detector action and resulting increase of signal audibility be obtained.

It is inadvisable to use any type of potentiometer across a standard "B" battery, as it will exhaust the cells in a relatively short time. To overcome this difficulty the Radio Corporation developed this instrument.

In appearance, POTENTIOMETER PR-536 closely resembles the Radio Corporation's Rheostat PR-535. It is provided with three contacts. Two of these are shunted across the "A" battery, while the third is connected to a tap on the negative side of the plate battery, giving eighteen volts. This connection gives a plate voltage variation from eighteen to twenty-four volts.

"A" Battery Potentiometer $2.00

Dimensions: 2 in. x 1½ in. x 2 7/16 in.
Shipping Weight, 1 lb.

BAKELITE SOCKET
UP-552

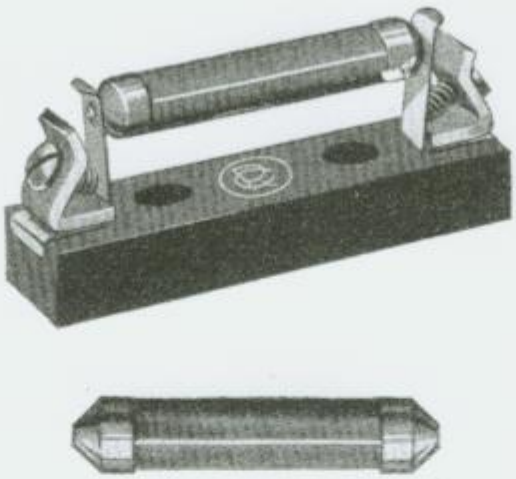
Some amateurs may prefer to use a Bakelite socket rather than our standard porcelain socket, Model UR-542, described on page 52. This socket has enjoyed unusual popularity for several years past. It is durably constructed and of fine appearance. One particular feature is the ease with which connection may be made, since the connecting clamps are unusually accessible and provide ample space for permanent contacts. Socket UR-542 will take Radiotrons UV-200, UV-201 and UV-202.

Bakelite Socket, UP-552 . . . . . $1.50

Dimensions: 1½ in. x 1½ in. x 1½ in.
Shipping Weight, 1 lb.

TUBULAR GRID AND PLATE CONDENSER

There has been an insistent demand in the amateur field for fixed condenser units of various capacities, suitable for amateur receiving sets. The Radio Corporation of America has evolved the four models herein listed, which are designed to fit its Standard Grid Leak Mounting. These condensers are recommended for use in the grid circuit, or as a by-pass condenser in the plate circuit, of standard vacuum tube receiving sets. They are especially useful as a unit of fixed capacity to be shunted to any standard variable air condenser.



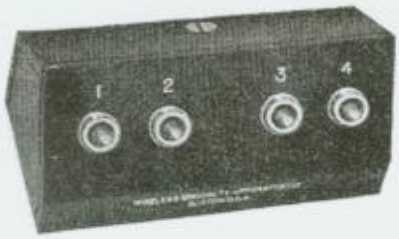
The complete condenser unit is sealed in a glass tube fitted with end caps, in the same manner as the Standard Grid Leaks. Every amateur station should have at least one complete set for general experimental purposes. Nothing equally satisfactory to the four models listed here has been produced for mounting in receiving set cabinets, for if one value of capacity is found unsatisfactory for the purposes at hand, another suitable value may be immediately inserted in its place.

Dimensions: 1⅜ in. x ⅜ in.
Shipping Weight: 4 oz.

AN INDIVIDUAL COLOR FOR EACH CAPACITY

Condenser, UC-570—.0025 Mfd., White $2.00
Condenser, UC-569—.001 Mfd., Orange 1.50
Condenser, UC-568—.0005 Mfd., Green 1.35
Condenser, UC-567—.00025 Mfd., Black 1.20
Condenser Mounting, UX-543 50

THE FOUR POINT TELEPHONE JACK MODEL UD-486



ONCE a radio broadcasting receiving set has been installed, it does not take long for one's friends to hear of it and they are wont to drop in of an evening to hear something of the concerts and news which may be received from the ether. In such cases, it is desirable to provide some means to permit these friends to listen without interfering with one's own pleasure. A more convenient way for connecting several sets of radio head receivers than the UD-486 cannot be made.

As may be seen from the illustration, this little unit is merely connected to the receiving set by two wires. There are little openings on its face through which the sets of head receivers may be plugged in.

Ordinarily, the connecting of more than one pair of telephones is a rather difficult task for the cord tips cannot be joined together very readily. By connecting each pair to the telephone plug UD-824, however, any desired number of head sets up to four may be put in operation by using the four point telephone jack.

The interior connections on this jack are so arranged as to permit connection of one to four pairs of telephones at will. The UD-486 will accommodate four plugs; each plug is in turn connected to a pair of receivers so that four sets may be used. As each set is made up of two individual receivers, it may be seen that eight persons may listen simultaneously using a single receiving set.

When one or more plugs are withdrawn from the four point jack the circuit is automatically rearranged to leave the telephone receivers connected to the remaining plugs in an operative condition.

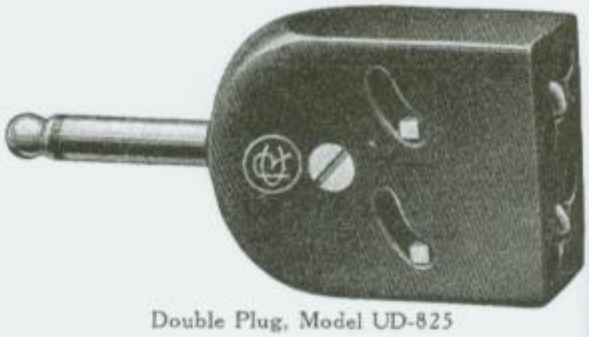
Four Point Telephone Jack, Model UD-486 ..... **$7.25**

Dimensions: 4½ in. x 2¼ in. x 2 in.
Weights: Net, 5 oz.; Shipping, 1 lb.

By using the four-point jack and double plugs illustrated here, many persons may listen in.

SINGLE AND DOUBLE TELEPHONE PLUGS, MODELS UD-824 AND UD-825

Single Plug, Model UD-824



Double Plug, Model UD-825

THESE telephone plugs are so connected that ordinary telephone cords may be inserted in them without having to take off the cord tips. The plugs are particularly useful in connection with radio where multi-stage amplifiers are used, for, without the necessity of making special soldered connections, the user has at his disposal a ready means for applying any pair of telephone receivers to a plug and jack system.

There are two models: one for connecting a single pair of telephone receivers, one for use with two pair. To apply these plugs it is merely necessary to place the cord tips in the openings provided and locking them in place by moving the tip sleeve.

Single Telephone Plug, Model UD-484 ..... **$1.75**

Double Telephone Plug, Model UD-485 ..... **$2.60**

"VOCAROLA"—THE LOUD SPEAKER

WHERE broadcasted music and speech is being received and it is desired to have volume enough to fill a room so that many persons may hear, the Vocarola may be employed to advantage. It is but necessary to remove the plug of the telephones from the jack in the amplifier unit, placing the loud speaker plug in its place.

Vocarola is equipped with a supersensitive sound producing device which changes the incoming electrical impulses into sound waves. This sounding element is attached to an attractively finished tone chamber in the form of a horn from which the sound emerges.

The Vocarola, when used with suitable amplifying equipment, furnishes music and speech with a tone clarity identical to that of the transmitted music or speech.

Vocarola, Model LV.

Vocarola Loud Speaker, Model LV **$30.00**

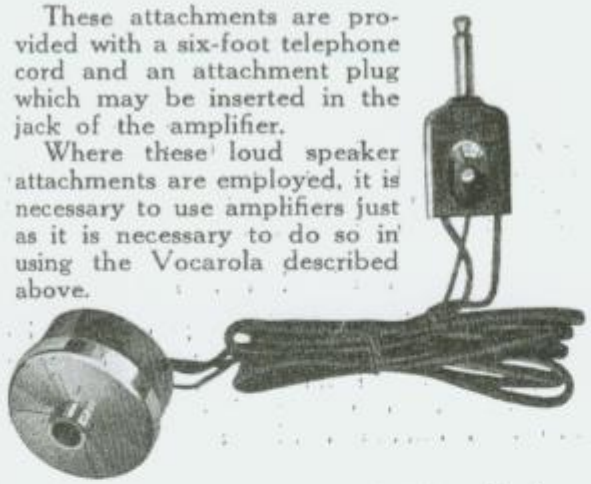
Dimensions—10 in. x 8 in. x 7½ in.

Weights—Net, 2 lbs., Shipping, 5 lbs.

PHONOGRAPH LOUD SPEAKER ATTACHMENTS

These attachments are provided with a six-foot telephone cord and an attachment plug which may be inserted in the jack of the amplifier.

Where these loud speaker attachments are employed, it is necessary to use amplifiers just as it is necessary to do so in using the Vocarola described above.



BY employing a phonograph attachment it is possible to convert your phonograph into a loud speaking device for radio reception where the music is to be heard by a number of people throughout the room.

In order to use this new attachment it is but necessary to remove the reproducer or "sound box" as it is called, from the tone arm of the talking machine, replacing it by the phonograph attachment which is designed to easily slip into place. There are two models, one for Victrolas and the other for Graphonolas. The Victrola model, in addition to fitting Victor machines, will fit any other talking machine having the same size tone arm.

Victrola Loud Speaker Attachment, Complete with Cord and Plug, Model LS **$18.00**

Graphonola Loud Speaker Attachment, Complete with Cord and Plug, Model LS **18.00**

Dimensions: 2¾ in. x 3 in.

Weights: Net 1 lb.; Shipping, 1½ lbs.

Note: In ordering, the make of phonograph should be specified.

RECEIVING ANTENNA OUTFITS

(With Complete Instructions For Installation)

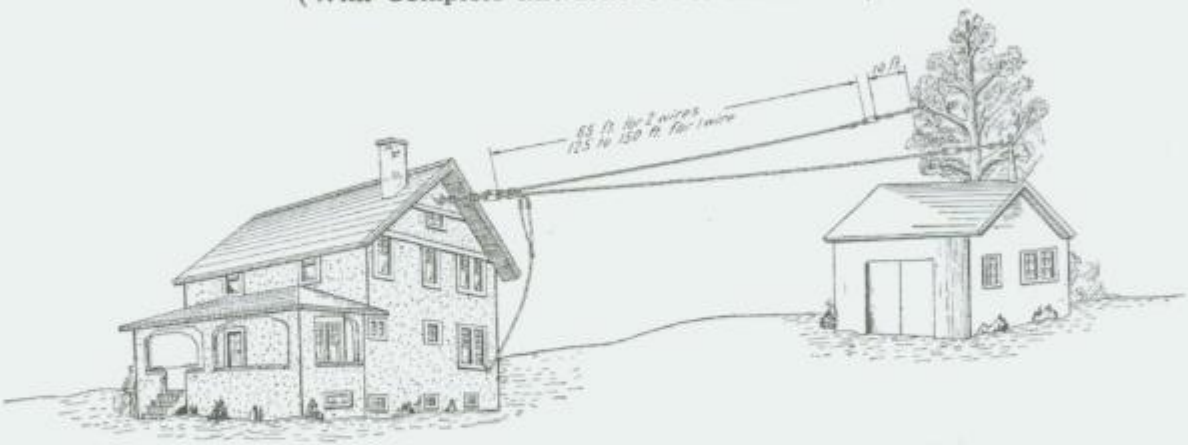


Fig. 1—Illustrating method of installing a one or two wire antenna for broadcast reception.

THESE antenna outfits have been especially designed for the radio broadcasting sets described in this catalog. The following instructions apply in general to all classes of receivers but especially to broadcasting reception.

Selecting the Location

The number of miles over which a given broadcasting receiving outfit will respond depends upon a number of important factors. In order to get the most satisfactory results with any of the receiving outfits described here the antenna, or aerial, as it is sometimes called, should consist of one or two wires 50 to 150 feet long. Good reception often can be obtained with two wires of a shorter length, separated from each other by three-foot wooden spreaders. See Fig. 3. Care should be taken to keep the antenna as far as possible from trees and buildings, especially where the latter have a steel frame-work, and the lead-in wire should never be brought down a narrow air-shaft. Where an antenna is supported by a house at one end and a tree at the other end, care should be taken to have an insulator, such as provided with Model AD outfit, extend a distance of at least 10 feet beyond the tree's branches. Where one end of the antenna is fastened to a building having a metal roof this same precaution should be followed, for should the antenna come in contact with the objects mentioned, the incoming signals will be reduced in strength by electrical leakage.

Raising the Antenna

The method of raising the antenna after the location has been decided upon, where a single wire antenna is to be used, is as follows: Take one of the screw eyes furnished with the antenna equipment in the building or tree, which is to support the free end of the antenna, that is, the end away from the receiving outfit. A piece of copper wire is passed through this screw eye as shown in Fig. 2. This wire is then left long enough to extend 10 feet beyond the roof of the building or the branches of the tree holding the screw-eye and to it is attached an insulator. The other end of this insulator is used for fastening the end of the antenna wire itelf as shown in Fig. 2.

The wire is then run from this point to a point directly beneath that section of the house in which the receiving set is to be placed. This end of the antenna is put in place by inserting another screw eye in some part of the house, preferably as high as possible. In this instance the insulator is attached to the antenna wire at a point estimated to be approximately 10 feet from the side or roof of the house. To the opposite end of this insulator is connected another tie wire as illustrated in Fig. 2. The opposite end of this tie wire is then drawn through the screw eye on the house, and fastened by twisting. In this way by tightening the second tie wire the antenna is raised above the ground. It should not be drawn too tight, but a certain amount of slack should be permitted.

The Lead-In Wire

The end of the wire leading to the receiving set must be fastened to the end of the antenna wire before the antenna is raised from the ground. The connection between these two wires is made as follows:

Fig. 2—To the left shows method of connecting the antenna to the lead-in wire. To the right shows the free end of the antenna and manner of fastening to support.

A metal connector is supplied with this type of antenna outfit. In its original condition it resembles two hollow, metal tubes fastened together. Through one of these tubes the end of the antenna wire passes in one direction while the end of the insulated lead-in wire, from which six inches of the insulation has been removed, passes through the other tube in the opposite direction. By grasping each end of this connector with a pair of pliers and twisting, the two wires are bound together in this metal sleeve in the manner shown in Fig. 2 eliminating the necessity of soldering.

The lead-in wire should run in as near a direct line as possible from the antenna to that part of the house in which the receiving set is to be placed. Right angle turns in the lead-in wire should be avoided, in so far as possible. Where it is necessary to have the lead-in wire run along the side of a building it should be raised on porcelain knobs as shown in Fig. 4. This wire should be isolated from surrounding objects as far as possible.

Where the lead-in wire is to enter the building it is essential to bore a hole in the wall (if the building is frame), or through the window casing in other types of buildings. This hole may be drilled with a 5/8-inch bit. The insulating bushing furnished with these outfits is then inserted in this hole through the building. The hole through the building should be made on an angle as shown in Fig. 4. The lead-in wire is then passed through the tube from the outside and a small loop should be left outside the building to permit the rain water to drop off both the lead-in and the insulating bushing.

Description of Window Board

A suitable method for making connections from a radio receiving antenna is illustrated by Fig. 4. This method is especially desirable in apartment houses for the reason that it obviates the necessity of drilling holes through the wall or window frames.

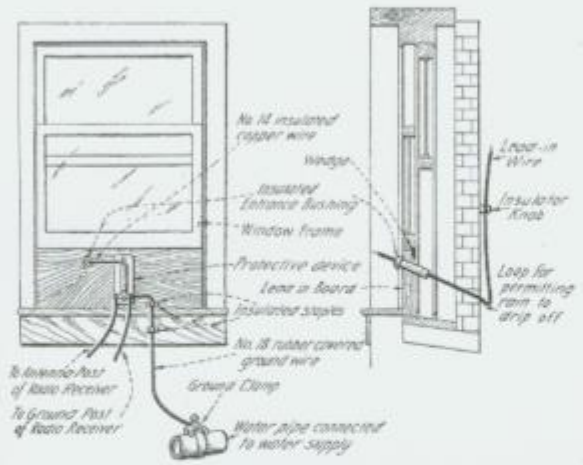


Fig. 4—Window board arrangement for leading in antenna wire to instrument.

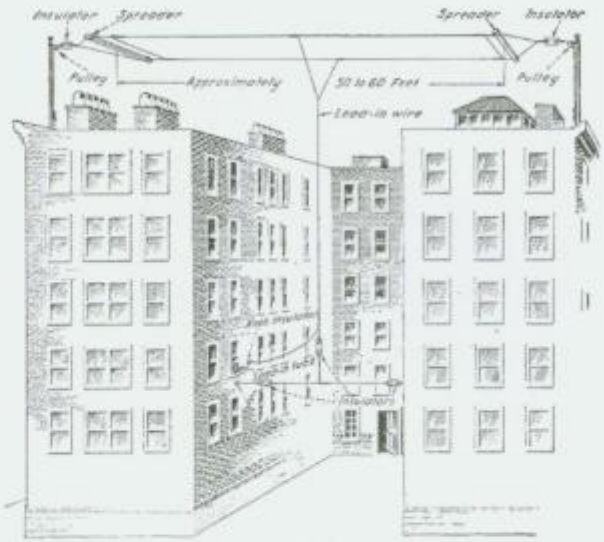


Fig. 3—Illustrating a method of installing an antenna on the roof of an apartment house.

A piece of board 10 or 11 inches wide and just long enough to extend across the window is held in place by a wedge placed at either side of the window casing as shown. A hole is drilled through the board and the lead-in insulator passed through this hole. The protective device is screwed directly to this board in the position indicated and the lead-in wire is permanently attached to the terminal A of the protective device. The terminals R and G of the protective device are used for connection to the receiving set and the latter is also connected to the ground wire as described elsewhere.

Where this method is employed, the window may be opened or closed without interfering with the lead-in wire or the wires running to the receiving apparatus, and the protective device may be attached to the board without in any way mutilating the window casing or walls of the house.

The Installation of the Protective Device

This device is used to protect the receiving instruments as well as the house itself from possible damage caused by lightning flashes. It is a combination of a very small spark gap and fuse. It should be placed in some inconspicuous place, either on the wall or under the window frame, not far from the point at which the lead-in wire enters the building. The lead-in wire is fastened to one terminal of the protective device as shown in Fig. 4. To the other two terminals are connected the wires which run to the receiving set. It will be noticed in Fig. 4 that one of these two terminals is made to carry two wires. The second wire is called the ground wire and is made from a portion of the 50 feet of rubber-covered ground wire, supplied with the antenna equipment. This wire may be run through the house by using some of the insulated staples supplied with the outfit.

Attaching the Ground Clamp and Running the Ground Wire

The ground clamp is a strip of metal made to fasten around a pipe and held in place by a clamping device. It is important that the pipe itself be scraped very clean, either by a knife, file or a coarse grade of sand-paper. After being sure that the pipe to which the clamp is to be attached is thoroughly cleaned, the ground clamp may be installed. It must fit over the pipe as tightly as possible. The ground wire, which runs from one terminal of this clamp to the protective device, as shown in Fig. 4, should be as short as possible. As is the case with the antenna lead-in wire, the ground wire should be as free from angles as possible, the ideal condition being found when the ground wire is very short and straight. With these instructions and references to the accompanying illustrations no difficulty should be experienced in erecting an antenna which will give satisfaction under almost any conditions.

The Protective Device

The protective device does away with the necessity of having a large antenna grounding switch on the exterior of the building and precludes the possibility of the operator forgetting to throw this switch when the receiving equipment is not in use. This protective device is more thoroughly described on page 59.

In large cities it is sometimes difficult to find a location where either a single or double wire, as shown in Fig. 1, can be erected. Fig. 3 gives a very good idea of the method which may be used in placing antennae on apartment houses or office buildings. Where the building is 100 feet high or more and the receiving outfit is to be located on one of the lower floors, a single wire running from the roof to a point opposite, the location of the receiving apparatus will suffice to cover the ranges previously mentioned with regard to the sets described in this catalog. Where a building is lower than this it is sometimes advisable to run a wire across the roof supported by any convenient object such as a water tower, a clothes pole, or a high chimney. This wire is then connected to the lead-in wire which may be run to the receiving outfit. Where this method is employed care must be taken to keep both the flat-top section of the antenna as well as the lead-in wire as far as possible from adjoining buildings.

The details of any receiving antenna may be worked out from observation of the foregoing instructions and no difficulty should be experienced in getting satisfactory results.

The following antenna outfits comprise everything essential for installation. The outfits are packed complete with full instructions.

Westinghouse Receiving Antenna Outfit

Antenna Outfit Model AD **$7.50**
Includes 150 feet No. 14 Copper Weld Antenna Wire.
50 ft. No. 18 Copper Ground Wire.
50 ft. No. 14 Copper Lead-in Wire.
1 PA Protector.
1 Entrance Bushing.
2 Antenna Insulators.
2 Screw Eyes.
1 Ground Clamp.
3 Porcelain Knobs.
1 Connector.
12 Insulated Staples.

G. E. Receiving Antenna Outfit

Antenna Outfit, Model AG-788 ..... **$7.50**
Includes 175 feet No. 14 Copper Weld Antenna Wire.
50 feet No. 14 Copper lead-in wire.
25 feet No. 14 Copper Ground wire.
1 Protector.
1 Porcelain Entrance Bushing.
3 Antenna Insulators.
3 Screw Eyes.
1 Ground Clamp.
3 Porcelain Knobs.
12 Insulated Staples.
8 Wood Screws.

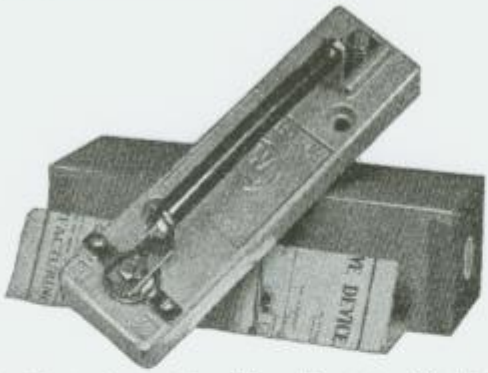
RECEIVING ANTENNA PROTECTIVE DEVICES

THESE devices are standard units supplied with R. C. receiving antenna outfits. However, they may be used satisfactorily with any other type of receiving antenna equipment. Their purpose is to supply a means for protecting the receiving station as well as the building in which it is located from any serious effects which might be caused by lightning.

The G. E. Vacuum Type Protector Model UQ-1310

Heretofore, it has been necessary to have a large switch mounted on the outside of the building with a heavy wire running to an outside ground connection. Although this switch formed a satisfactory method for carrying electrical charges to the earth, there was always the possibility of the operator forgetting to throw the switch after he had finished receiving. With the protective device no such possibility as this can arise, for there is no switch to be thrown. Once it has been installed it functions wihout further attention.

Two types of antenna protective devices are available. Model UQ-1310, illustrated above, is the vacuum type; Model PA, shown below, is the fuse type. Both are suitable for receiving purposes, but not for transmission.



The Westinghouse Fuse Type Protector Model PA

G. E. Receiving Antenna Protective Device, Model UQ-1310 . . . . . $2.50

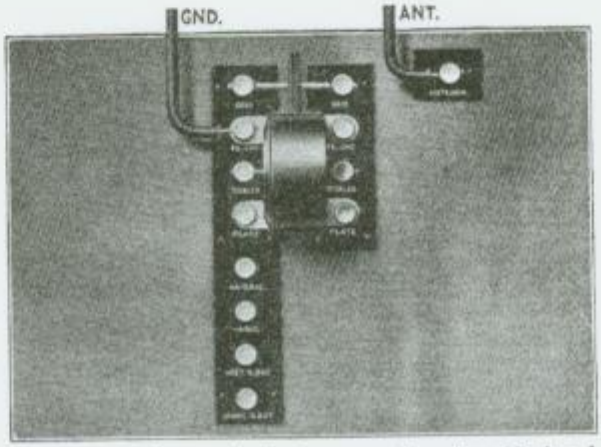
Westinghouse Receiving Antenna Protective Device, Model PA $2.00

Dimensions: 7½ in. x 2½ in. x 1½ in.

Weights: Net, 10 oz.; Shipping, 1 lb.

LOAD COIL MODEL CB (1800-2800 METERS) FOR USE WITH RC RECEIVER OR RA AND DA COMBINATION

BY using this coil in conjunction with the RC Receiver or the RA tuner, and DA amplifier previously described, it is possible to receive signals on wave lengths up to 2800 meters. This is particularly valuable as it enables one to hear the time signals from the United States Navy Station at Radio, Va. for distances of several hundred miles. Watch repair shops and jewelers will find this twice-a-day service from the United States Observatory in Washington invaluable for checking watches and clocks as the time may be received with less than one-tenth of a second error. Dealers throughout the country are availing themselves of this service, some going so far as to arrange small time balls for their windows by which passers-by are given an opportunity to check their watches.



Illustrating the method of connection for CB Load Coil in conjunction with Model RC Receiver

For wavelengths between 170 and 700 meters the switch arm shown in the center of the picture should be raised. For wave lengths between 1800 and 2800 meters it is but necessary to push down on this arm. The CB Load Coil is arranged to supply the necessary inductance for both the antenna and tickler circuits.

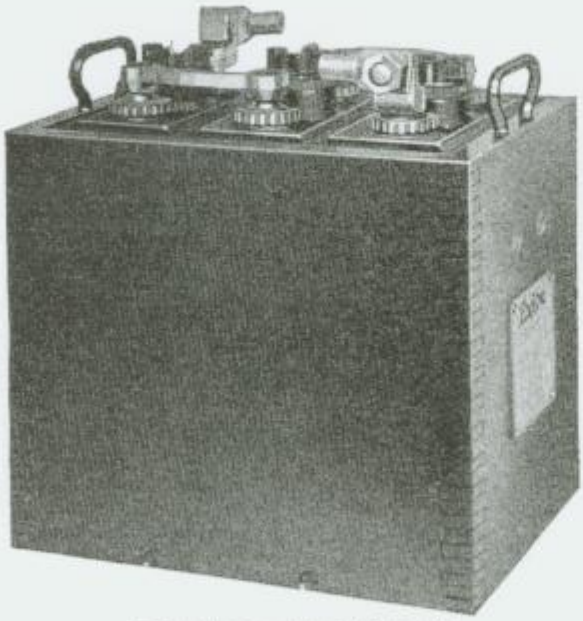
Caution—It is essential that the ground wire (G & D) be connected exactly as shown in the accompanying illustration.

Load Coil, Model CB, 1800-2800 Meters, $6.00

Dimensions: 6 in. x 4 in. x 5 in.

Weights: Net, 8 oz.; Shipping, 2 lbs.

STORAGE BATTERIES FOR RADIO USE



Exide Battery, Model 3LXL-9

WHERE vacuum tubes are used for receiving, the filaments must be heated by a storage battery. It has been common practice among Radio Amateurs to use almost any type of storage battery they can lay hands on, regardless of its capacity or design. Storage batteries, like every other electrical device, in order to function satisfactorily, must be designed with a given purpose in view. A very heavily constructed storage battery is not suitable for radio service as it is too heavy to be transported conveniently to a charging station, and a battery of too light construction, such as the automobile starting, lighting and ignition battery, will not give satisfactory life in this type of service.

Especially Designed for Radio Work

In vacuum tube receiving sets, the number of tubes generally employed is from one to three. The normal current consumption of each tube is approximately one ampere. It is obvious, therefore, that a storage battery for most satisfactory operation with radio must be capable of delivering the required ampere hour capacity at the rate of one to three amperes when in use. Most amateur stations are used intermittently and for this reason the duration of a single charge in the storage battery is considerably increased.

In order to provide a suitable storage battery for radio work, the Radio Corporation of America offers to the field the Exide battery, which has given entire satisfaction in marine service since wireless equipments were first installed on ship board.

This battery—the Exide—has behind it 34 years of battery-building experience. Its manufacturer, The Electric Storage Battery Company, since the beginning of the storage battery industry, has built storage batteries for every purpose, and this knowledge and experience have been put to good use in designing a battery especially for vacuum tube operation.

In this class of service batteries must be capable of withstanding numerous complete cycles of charge and discharge at low and intermittent rates.

The separators are made of a selected quality of hard and durable wood subjected to a special "treating process" which eliminates elements which would injure the batteries.

The jars and covers are made of the tough, semi-flexible "Giant Compound Rubber" and are practically unbreakable under service conditions.

Service Station Advantage

A very distinct advantage of this battery for radio work is that the user may call upon any of the Exide Service Stations, which thoroughly cover the United States and Canada, and extend into all civilized foreign countries, to have his battery properly charged, or for other service.

For domestic use the Exide batteries are shipped assembled, sealed and charged, and all ready to go into service. For export use, these batteries are especially packed for export shipment and are shipped assembled, sealed but unfilled, and they can readily be filled and put into service at destination.

The ampere hour capacity of the Exide Radio Battery varies as it does with all storage batteries, according to the current being consumed. The following table shows what may be expected of these batteries in vacuum tube work:

Ampere-Hour Capacity
Rate of Discharge

Type	Intermittent
3LXL-5	40 Amp. Hrs.
3LXL-9	80 Amp. Hrs.
3LXL-13	120 Amp. Hrs.

Specifications

Type	Length	Width	Height	Weight	Charging rate at start	Charging rate at finish
3LXL-5	5-11/16"	7-5/16"	9-5/8"	24½ lb.	6 amp.	3 amp.
3LXL-9	9- 1/16"	"	"	42½ "	13 "	6 "
3LXL-13	12- 7/16"	"	"	59½ "	18 "	9 "

Storage Battery, Model 3LXL-5.....$17.50 **Storage Battery, Model 3LXL-9.....$23.00**
Storage Battery, Model 3LXL-13.....$30.00

Prices packed for Domestic Shipment, f.o.b. Factory, Philadelphia.

THE WESTINGHOUSE UNION RADIO "A" BATTERY

THE Radio Corporation of America takes pleasure in offering to the Radio public the Westinghouse Type H.R. Radio Battery, and feels warranted in backing the claims made by the Westinghouse Union Battery Company for their product.

It was decided, after an extensive investigation and research in the radio field in conjunction with the largest manufacturers, to produce series of special radio batteries of entirely new design, rather than a conversion of previous types.

These Radio Batteries embody the most advanced engineering principles and the finest materials and workmanship possible in a battery. They are backed by the immense resources of the Westinghouse Air Brake Company, and affiliated Companies, and are built to meet and live up to the standard of quality and service established by its sponsors during the last 50 years.

Westinghouse Battery Model 6-HR-9

Features of Design

Heavy positive plates—3/16" thick—are used to insure ample capacity and long life. High rests to insure ample mud space and acid space are provided in order that the battery may function longer without recharging, while wide plate spacing reduces to a minimum the internal discharge. This feature alone justifies a special design as it helps limit the loss of power when the Radio equipment is not in service.

To prolong the life of the Radio Battery—rubber sheets are used on both sides of the positive plates—thereby retarding the breaking down of the separators. A rubber covered cable is moulded into the post thereby enabling connections to be made several inches from the battery and eliminating poor connections and corrosion.

Acid will settle in a fine spray on the top of the cells while the battery is being charged and in most batteries will seep between the jars, through the case and then on to the table or desk—destroying the finish or covering—but Westinghouse engineers have eliminated this on the type "HR" by completely sealing all cells together at the top so that the acid may be seen at once and wiped away.

Westinghouse Service

"Westinghouse Attention" is the improved type of service available at Westinghouse Battery Service Stations.

It is founded on Westinghouse ideals and guided by the experience of experts. Being based upon a fundamental plan, it is uniform everywhere.

It is co-ordinated by a comprehensive, factory-operated service organization which covers the entire country and insures that there shall be no falling away from the rigid standards.

Type "HR" Batteries ordered from the Radio Corporation will be delivered fully charged from the nearest Westinghouse distributor, thus insuring the user a battery that has been freshly charged and is instantly ready for use.

Ampere Hour Capacity

Type	Volts	Amp. Hrs. at 3 Amps. Intermittent Rate.
6-HR-5	6	50 A. H.
6-HR-9	6	100 A. H.
6-HR-13	6	150 A. H.

	Length	Width	Height	Weight	Charging rate Start	Finish
6-HR-5	5 7/8	7 3/8	9 13/16	30	4	1.75
6-HR-9	9 1/4	7 3/8	9 13/16	46	7.75	3.5
6-HR-13	12 5/8	7 3/8	9 13/16	65	11.75	5.25

Storage Battery Model 6-HR-5.....$18.00 **Storage Battery Model 6-HR-9.....$24.00**

Storage Battery Model 6-HR-13.....$33.50

Prices, packed for domestic shipment, f.o.b. nearest Westinghouse Battery Distributor.

RADIO BATTERY CHARGERS

TUNGAR BATTERY CHARGERS

MANY vacuum tube receiving sets require a storage battery for illumination of the tube filaments. When only a source of alternating current is available, the simplest and least troublesome device for battery-charging is the General Electric Company's Tungar Rectifier. Two sizes are recommended.

The 2-ampere Tungar has a capacity of 15 watts and will charge a 3-cell storage battery at 2 amperes or a 6-cell storage battery at one ampere.

The 1-battery Tungar has a capacity of 45 watts and will charge a 3-cell storage battery at 5 amperes, or a 6-cell, or two 3-cell batteries at 3 amperes.

2-AMPERE TUNGAR, Model No. 195529....$18.00
1-BATTERY TUNGAR, Model No. 219865...$28.00
RENEWAL BULB No. 195528 for Tungar Model No. 195529 .....$4.00
RENEWAL BULB No. 189048 for Tungar Model No. 219865 .....$8.00
Weights: No. 195529..8 lbs.—No. 219865..15 lbs.
No. 195528..4½ lb .—No. 189048.. 3 lbs.

RECTIGON BATTERY CHARGERS

THE Rectigon Battery Charger, manufactured by the Westinghouse Elec. Mfg. Co., forms a very satisfactory means of charging the filament storage battery from an alternating current source. There are no moving parts to this instrument and it is simple, safe and economical.

Style No. 282395, the 2½-ampere capacity Rectigon, is suitable for charging a 40-ampere-hour storage battery from 110-volt, 60-cycle mains. All the larger batteries should be charged with Style No. 285168, which is capable of delivering six amperes.

2½-AMPERE RECTIGON, Model No. 282395.$18.00
6-AMPERE RECTIGON, Model No. 285168.$28.00
RENEWAL BULB No. 277681 for Rectigon No. 282395 .....$4.00
RENEWAL BULB No. 289414 for Rectigon No. 285168 .....$8.00
Weights: No. 282395..9¼ lbs.—No. 285168..21 lbs.
No. 277681.. ½ lb. —No. 289414.. 3 lbs.

It is only necessary to connect the Chargers to any 60-cycle alternating current (110 volts) electric light socket, and attach the low voltage direct current terminals to the battery.

Illustrating the simplicity of battery charging when A. C. is available.

The outfits are so designed as to give rated normal currents at normal line voltage to 3 cells and about 2/3 this current at normal line voltage to 6 cells.