INSTRUCTIONS

for

Installation and Operation

of the

Federal

Type 61
RADIO RECEIVER

Federal Telephone & Telegraph Co.

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TYPE 61 RECEIVER

THE RECEIVER: The Type 61 Receiver combines within itself, the tuning and amplifying systems for making use of either open wire antennas of any kind, or loop antennas. This is made possible through the use of a two circuit tuning system and three stages of Radio Frequency amplification with the usual two stages of Audio Frequency amplification with transfer switches so devised that the tuning system may be connected to the loop or to the antenna and so that either one stage of R. F. amplification or three stages may be used. In addition to this a further control of the degree of amplification available is provided by another simply operated switch, whereby the degree of Audio Frequency amplification may be varied between very wide limits. Because of its flexibility it lends itself to a wider variety of uses than any other radio receiver that has been made available for radio broadcast reception.

The tuning system as it is used with either an antenna or a loop is designed for tuning to any wavelength between 225 and 550 meters, and the variation in amplification which is possible through the two simple amplification control switches is of such breadth as to give a degree of signal strength great enough for loud speaker reception from very remotely located broadcasting stations, or by the reduction of the degree of amplification to give moderately loud headset reception, on even very closely adjacent broadcasting stations. Because of the extraordinary flexibility of its tuning and amplifying systems this receiver will be found highly suitable to any set of conditions under which radio broadcast receiving is to be accomplished.

An examination of the arrangement of the panel of the receiver as shown in the illustration on the cover of this booklet indicates the presence of two types of controls,—those required for the manipulation of the tuning system and those required for the operation of the amplifying system.

TUNING CONTROLS: For loop reception; that is, for the reception of signals where a loop antenna is used and is connected to the "Loop" terminals and the tuning system transfer switch is thrown to the left or "Loop" position the secondary wavelength control knob is all that requires adjustment for the tuning of the system, although, the vernier control knob, which performs the same function as does the secondary control knob, but in a more gradual way, will be found to be of great assistance in the very careful tuning of the receiver to the signal that is being received. When an antenna and ground are used, however, and are connected to the "Antenna" and "Ground" terminals inside the receiver and the tuning system transfer switch is thrown to the "Antenna" position, the primary inductance switches and the primary condenser switch must be manipulated for proper tuning as well as the secondary wavelength control knob. In addition to these tuning controls, the manipulation of the selectivity control will be found to be useful for the elimination of undesired signals when an antenna is used, although, it is quite inoperative when a loop antenna is used.

AMPLIFICATION CONTROLS: For the control of the degree of amplification available in the receiver there are three control knobs provided:

The R. F. Amplification Selector Switch;

The R. F. Amplification Control Knob;

The A. F. Amplification Selector Switch.

The first of these serves merely to put in circuit, either one or three stages of R. F. amplification, the second of these allows of the very gradual variation of the degree of R. F. amplification; while the third of these allows of the variation of the degree of A. F. amplification in four steps.

The remainder of the controls are those which provide for the variation of the filament current of the vacuum tubes being used in the receiver.

In addition to these controls, the telephone jack—labelled "Phones"—is mounted on the panel so that telephones or loud speakers equipped with a telephone plug may be used, or where no telephone plug is used, such sound reproducing mechanism may be connected directly to the telephone binding posts—labelled "Phones."

This receiver requires for its operation an open antenna and connection to the ground or a loop antenna; six vacuum tubes; properly chosen storage or dry batteries and a headset or loud speaking telephones. These several required auxiliaries are described in the following:

LOOP ANTENNAS: Where it is desired to use a loop antenna, the size and shape of the loop will, in the main, be determined by the particular tastes of the user of the equipment, but it is to be borne in mind that the larger the loop, the greater will be the signal intensity and that wherever possible the loop should be so constructed and mounted as to be easily rotatable. If this is not done, the fact that the loop antenna receives with much greater intensity in the direction perpendicular to its axis will limit the range of reception of the receiver to the general direction in which the loop points while, on the other hand, if the loop is rotatably mounted, advantage can be taken of its directional receiving characteristics for the elimination of undesired signals by its rotation into a position where the undesired signals are eliminated. For those who have had no experience in the construction of loops, the illustration given below will suggest the suitable proportions for a loop antenna. Terminals must, of course, be supplied on such a loop antenna and connection must be made between these two terminals and the terminals marked "Loop" on the panel.

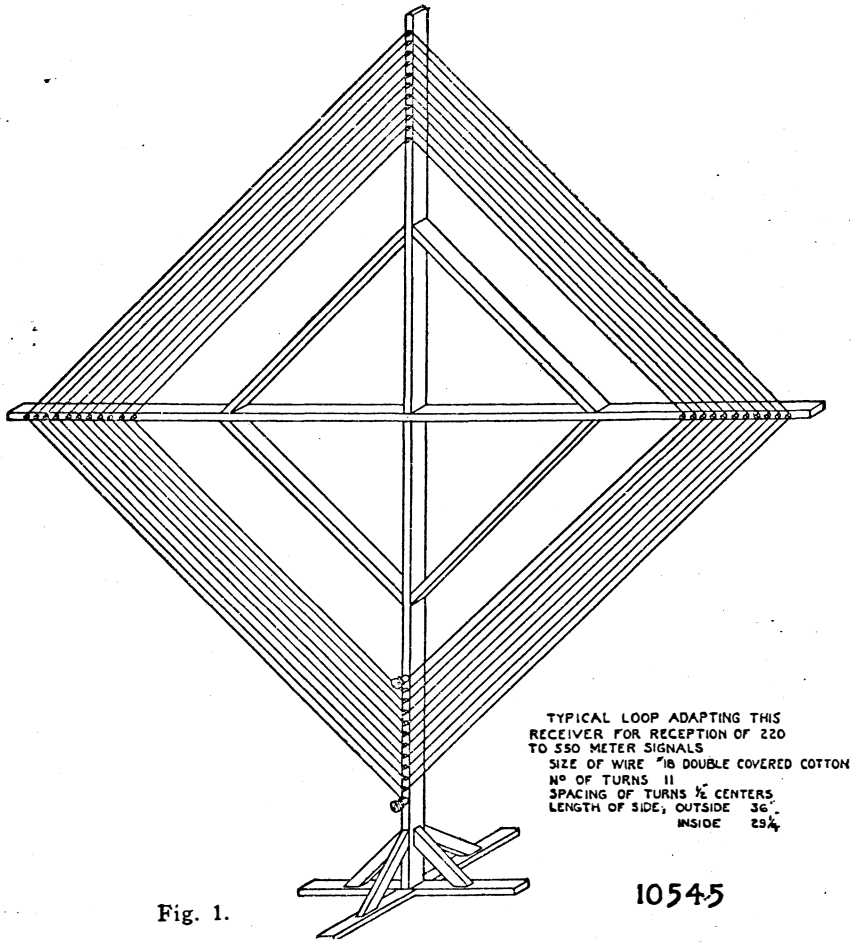


Fig. 1.

OUTDOOR ANTENNAS: Where an open wire antenna is to be used, best operation of this receiver will be secured through the use of an outdoor antenna suspended well above ground. This antenna can be erected most simply as shown in Fig. 2. It should be supported as high above ground as possible, and its length should not be less than 70 feet, nor more than 150 feet where a single wire is used.

Several wires secured to wooden spars may, of course, be substituted for the simple single wire antenna, and where such an antenna is used, it may be somewhat shorter than the single wire antenna. It is advisable however, that the antenna be as high above ground as possible, and that the space between it and the ground be free of trees, shrubs or structures of any kind. It must be carefully insulated at its points of support by means of any of the commonly available antenna insulators, and when one end of it is supported in a tree or near a metal structure, the antenna conductor should not be less than 10 feet away from the foliage of the tree or the metal of the structure. To this end it will be found best to use rope for supporting the antenna, so that the conductor of the antenna may be absolutely free from contact with the foliage, and be sufficiently removed from the influence of the metal structure.

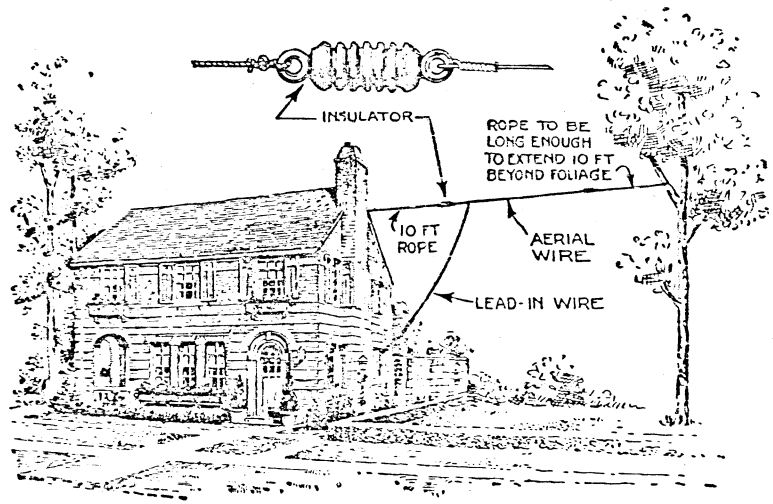


Fig. 2

A sturdy copper wire should be used for the antenna conductor. This should be not smaller in size than No. 16 B. & S. gauge, and the antenna should, if possible, be free of joints in the conductor. Where it is found impossible to make the antenna of one continuous piece of copper wire from its remote end to the apparatus, the joint should be carefully soldered and then protected against corrosion, by securely wrapping with tape. That part of the antenna conductor which connects the elevated portion of the antenna and the receiver should be as short as it is possible to make it. Where it passes through the walls of the house, use should be made of a porcelain or other insulating tube, and whenever it is supported it should be secured to porcelain or other insulators.

INDOOR ANTENNAS: Where it is found impossible to erect a good outdoor antenna, the receiver may be used with antenna wires inside the building. Such an indoor antenna may be built by the use of wires strung about the room in which the receiver is located, the use of wires suspended in a room, or other space above the room in which the receiver is located or by the use of wires concealed in the partitions of the room or the building, or by any other means which make it possible for wires at an elevation above the receiver or at least well above ground to be connected to the antenna terminal of the receiver. Such an antenna will be found to serve perfectly satisfactorily, but in general, it will be found that the indoor antenna will invariably sacrifice something in distance of reception which might be realized by the use of an outdoor antenna. In either event the higher the antenna wires above ground and the further they are kept away from metal structures, buildings, power wires, etc., the greater will be the range of reception and the more satisfactory the operation of the receiver.

ANTENNA SUBSTITUTES: Where no other type of antenna can be installed the electric lighting system or telephone wires may be found useful. In general, it is not advisable to connect the antenna binding post of the receiver directly to such wires, since both the telephone wires and power wires are carrying current at voltages which may be dangerous. Such connection, however, may be made with safety if the telephone or power line is connected to one terminal of a small mica dielectric condenser, such as the Federal .005 M.F. Condenser, the other terminal of which is

connected to the antenna binding post of the receiver. The condenser should be located at the point where the power or telephone lines are exposed for connection and the connection between the condenser and the antenna posts of the receiver should then be made.

The use of these wires as antennas will always result in a serious sacrifice in the distance over which reception of signals can be accomplished, and their use should be avoided.

THE GROUND: The connection to the ground can best be made by providing a secure electrical contact to the water pipe, as near to the underground water pipe system as possible. For best operation it will be found that connection should be made to the pipe which leads from the water meter to the street, and this connection can be made most conveniently by means of a ground clamp as shown in Fig. 3. The connection from ground clamp to the receiver should be made with a sturdy copper conductor not smaller than No. 14 B. & S. gauge, run in as direct and short a line as possible.

It is advisable that this conductor be insulated, as is the antenna conductor, on porcelain insulators. Where it is impossible to make connection to the water system as described above, connection may be made to other portions of the water system, to gas pipes, heating system pipes, or to the metal structure of the building. These are given in the order of their effectiveness and it will be found that in any installation the cost and difficulty of making connection to the water system as described will be found well justified in the increased distance over which reception is possible.

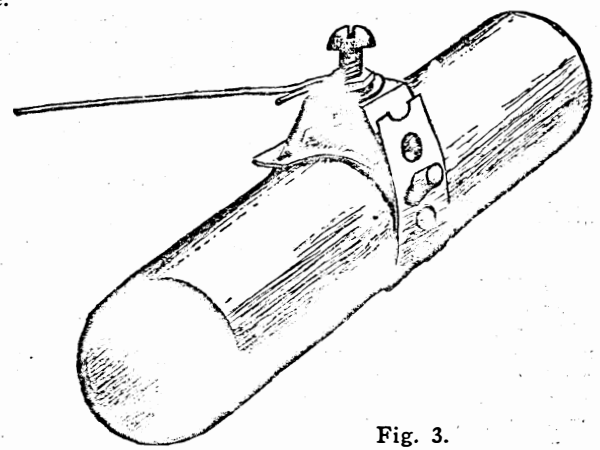


Fig. 3.

It is to be borne in mind that in making connection by means of a ground clamp, it is necessary that the pipe to which connection is made, be cleaned of all corrosion, and that the bright metal be exposed to contact with the ground clamp; that the ground clamp be very tightly secured to the pipe, and the copper connecting wire be scraped bright and clean, and then very securely fastened to the ground clamp. The expenditure of care in the proper laying out of the antenna and ground system will repay itself many times in the increased range of reception and the greater reliability in the operation of the receiving apparatus.

THE VACUUM TUBES: The filament rheostats of this receiver are so designed as to allow the use of any of the many available types of vacuum tubes when used with either dry or storage batteries not exceeding six volts and while this receiver will operate satisfactorily with various available types of tubes, the following choice of tubes is recommended for best operation. In the detector socket, which is the right rear socket, the Radiotron UV-200 or other gas detector tube, in all other sockets

the Radiotron UV-201A tubes or their equivalents. Where other types of tubes are to be used, it will be necessary that these tubes have standard size sockets; or, an adapter may be used to accommodate these tubes to the sockets.

Since the lack of positive electrical contact between the tube and socket springs will result in noisy operation, the contact surfaces of the tube contact pins should be carefully cleaned before inserting them into their respective sockets. This is a common source of annoying noise in the operation of the receiver which may be easily avoided by this simple expedient.

THE BATTERIES: For the operation of the Type 61 Receiver two separate batteries are required, one for lighting the filaments of the vacuum tubes—commonly called the "A" battery—and one for supplying the plate circuits of the tubes—commonly called the "B" battery.

The type of "A" battery which will be used will depend upon the type of tube which is used. The purchaser of this receiver should determine for himself what type of battery he wishes to use with his tube. The rheostats, with which the receiver is supplied, are such that any type of battery having a voltage not in excess of six volts will serve to supply any type of tube, but it will usually be found most economical to use a battery, either storage or dry, having a voltage not greatly in excess of that required by the tubes.

The filament voltage and type of batteries required by the more commonly available vacuum tubes are given below:

Type of Tube	Voltage	Type of Battery
UV-200	5 volts	3 cell storage battery
UV-201-A	5 volts	3 cell storage battery
WD-12	1.1 volts	8 dry cells connected in parallel, or 1, 2 or 3 cell storage battery
WD-11	1.1 volts	8 dry cells connected in parallel, or 1, 2 or 3 cell storage battery
UV-199	3 volts	6 dry cells connected in series—parallel or 2 or 3 cell storage battery.

The proper methods of connecting the batteries for the various types of tubes are shown on the three illustrations below:

TYPE 61 RECEIVER

SHOWING BATTERY CONNECTIONS WHEN USING 3 VOLT TUBES SUCH AS UV-199

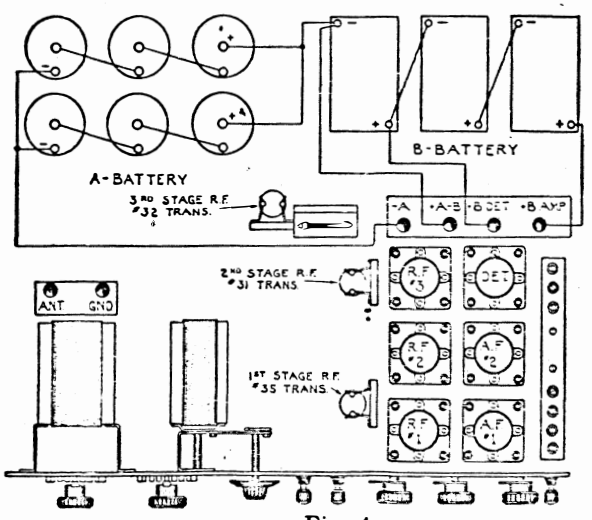


Fig. 4.

TYPE 61 RECEIVER

SHOWING BATTERY CONNECTIONS WHEN USING
6 VOLT TUBES SUCH AS UV-201A

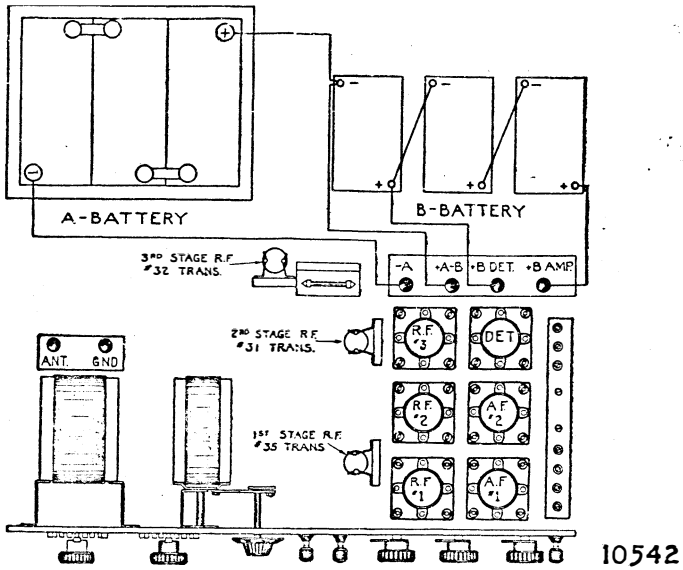


Fig. 5.

TYPE 61 RECEIVER

SHOWING BATTERY CONNECTIONS WHEN USING
1½ VOLT TUBES SUCH AS WD-12

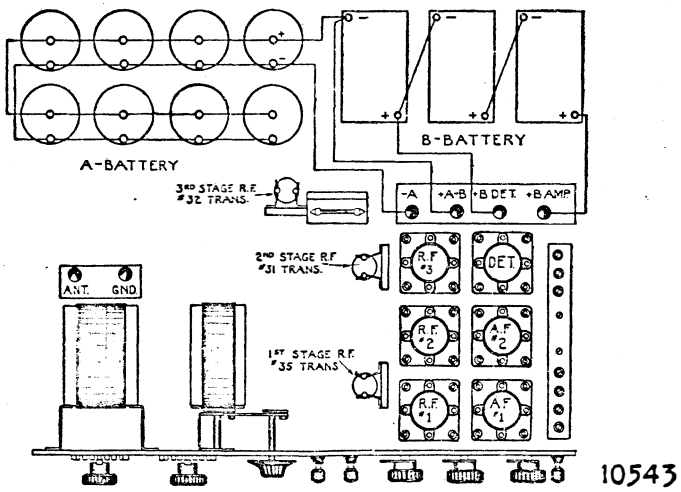


Fig. 6.

It will be found that for the proper operation of the receiver, with the most economical use of batteries, the connection between the "A" or filament supply battery and the receiving set should be made with a conductor not smaller than No. 14 B. & S. gauge. The battery should be so

located relative to the receiver, that these conductors need be no more than 3 feet long.

Where a storage battery is used, it is absolutely necessary to keep the storage "A" battery well charged at all times. Frequent charges for short periods are to be recommended, rather than allowing the battery to be discharged to the point where the set no longer functions normally. The ideal condition both for the operation of the set, as well as convenience, is obtained by the use of a home charging device thus enabling the charging to be conveniently accomplished after any long period of discharge.

If it is found advisable to locate the storage battery at a great distance from the receiver, a much heavier conductor must be used. If the battery is so located it will be found convenient to install the storage battery charging equipment in close proximity to the storage battery. Under these conditions, however, care must be taken to make it impossible for the receiver to be connected to the storage battery while it is being charged, since if this occurs, either the tubes or the receiver or both will be burned out in the process. The installation of a double pole, double throw switch as shown in Fig. 7 will make this impossible and make the charging of the battery more convenient.

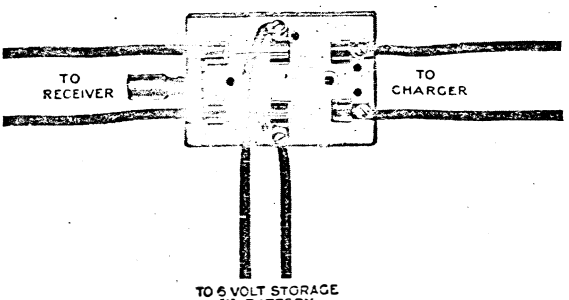


Fig. 7.

Where dry "A" batteries are used it will be found that the signal strength available from the receiver is largely dependent upon the condition of this battery and care should be taken to replace the battery with a new one as soon as the strength of the signals received is found to be reduced. The mere fact that the battery still has sufficient power to light the tube filament is no measure of its effectiveness for reception of signals, since a proper and rather high degree of brilliancy is required for the reception of signals. The use of additional batteries connected in series with the exhausted batteries, so as to give the proper vacuum tube filament brilliancy is to be avoided, since the life of the exhausted batteries is increased only very slightly, and their presence will make it necessary to readjust the receiver so frequently as to make operation most inconvenient.

For the plate supply battery, dry or storage "B" batteries may be used. These batteries should be connected with one another as shown in Figs. 4, 5 and 6. The terminals of these batteries are usually labelled as to the polarity, the positive terminal being marked with a plus (+) sign, while the negative is marked with a minus (—) sign. In most types of batteries the polarity is indicated by colored terminal wires, the positive usually being red. In inter-connecting them, the positive terminal of each battery should be connected to the negative of each suceeding battery, and the negative terminal of the whole group of batteries should be connected to the "+A-B" terminal of the receiver. The positive terminal of this same single battery should then be connected to the "+B DET" terminal and the positive terminal of the entire group of batteries to the "+B AMP" terminal on the receiving set.

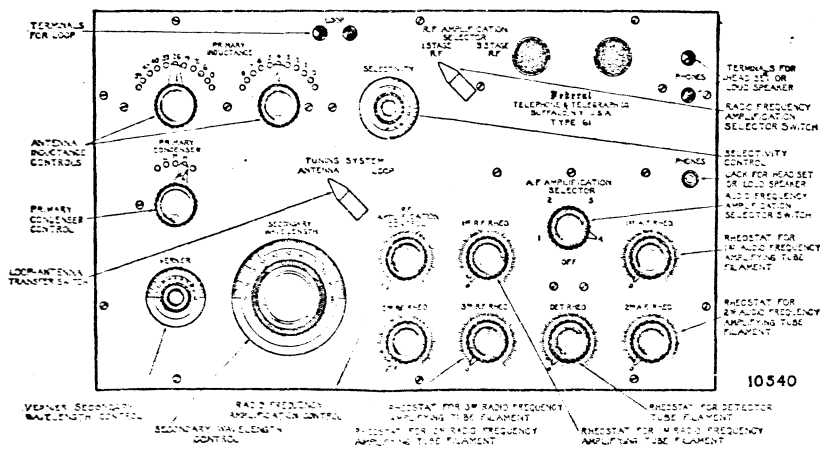
These inter-connecting wires should be just long enough to connect conveniently to the terminals of the receiver, and should be made with a conductor sturdy enough to be proof against breaking, due to flexure, but need not be made of as heavy a conductor as is used for the connection of the storage battery. These connecting wires, should, however, be very carefully insulated from one another, since the voltage difference between them is rather high, and damage may result from accidental contact between them unless care is taken in the installation. For the operation of the receiver with head telephones three "B" batteries in series giving a total voltage of approximately 60 volts will be found sufficient.

It is to be noted that serious difficulty will be encountered in the operation of the receiver if "B" batteries, the normal life of which has expired, are used. This will make itself evident by a slight reduction in signal strength, by the presence of "hissing" or "rumbling" noises in the telephones or loud speaker, or by an uncontrollable "singing" or "howling" of the receiver. When these make themselves evident, it is necessary that the "B" batteries be replaced with fresh ones at once. Any attempt to prolong life of already exhausted "B" batteries by the use of one or more fresh batteries in series with the exhausted will fail, since the noises incidental to the presence of exhausted "B" batteries will still be present, even though the signal intensity may have been restored to normal.

THE PHONES: The **Federal** Type 61 Receiver may be used with either **Federal** STANDARD HEAD TELEPHONES or with a loud speaker. A telephone plug is supplied with the receiver for making connection between the phones or the loud speaking device, and the receiver itself. The receiver is supplied with a telephone jack suited to this plug, and connection is made by the mere insertion of the plug into the jack.

In addition to the telephone jack the receiver is supplied with two telephone binding posts, labelled "Phones," to which either telephones or loud speaker may be connected in the event that these devices are equipped with connecting cords having pin, spade, or other types of terminals. The receiver is equipped with an amplification selector switch whereby the telephones or loud speaker are automatically transferred from the detector to either of the three degrees of A. F. amplification available in the receiver. This switch not only changes the amplification which is being applied to the signal as it is heard in the telephones or in the loud speaker, but

FACE PLAN of TYPE 61 RECEIVER



automatically lights the filaments of the particular tubes the operation of which is necessary for the particular degree of amplification desired.

It will be found that the use of a loud speaker connected to either the telephone terminals or telephone jack will serve quite satisfactorily for the reception of signals of comparatively nearby stations, but where the maximum possible range of reception is to be accomplished **Federal** STANDARD HEAD TELEPHONES should be used.

THE INSTALLATION OF SET: The receiver should be located in such a position that where an open wire antenna is used, the connection to the ground and the antenna wires be as short and direct as possible. Where a loop is used, loop should be mounted directly above the receiver and the connections between the loop proper and the loop terminals on receiver should be as short and direct as possible. The receiver should be protected from moisture, excessive heat, dust and vibration, since all these things will make the operation of the device less satisfactory, and ultimately work it permanent harm. It will be found that the beauty of finish of the receiver and the dignity of its plainness will make it an acceptable part of any setting, and by its location in a most accessible place, so that the receiver will be most freely and frequently used, it will perform to the utmost its function as an entertainment and an educational device of the highest order of usefulness.

Having located the receiver, the connection of the antenna and ground, or of the loop to the terminals on the receiver so labelled should be made. Then the connections from the storage battery to the two "A" Bat. terminals should be made. It is essential that the positive terminal of the storrage battery be connected to the receiver terminal marked "+A" and that the negative terminal of the battery be connected to the terminal marked "—A." The storage battery terminals themselves will usually be found properly labelled, either with the words "Pos." or "Neg." "+" or"—" or with a red mark on the positive terminal.

It is to be noted in connecting the batteries that if the filament battery and plate battery are interchanged, the connection of the plate battery to the filament battery terminals will invariably burn out the vacuum tubes, so that great care should be taken to avoid this error.

If the procedure described above is followed, that is, if the "A" battery is first connected as described, then the Amplification Selector Switch rotated to position labelled "4" and the rheostats are turned in a clockwise direction, the filaments should light and become more brilliant as the rheostats are turned more and more in the clockwise direction. When the "A" battery has been so connected, the "B" battery should be connected as described above. The operator should then listen to the sounds in the headset or loud speaker to assure himself that the "B" batteries are properly connected. This can be determined if the connection to the "+B AMP." terminal is opened and the connecting wire touched to the terminal. This should result in a loud noise in the telephone, as should the making and breaking of the connection between the "B" battery and the "+B DET" terminal of the receiver. If no noise is heard the connection between the several batteries which constitute the "B" battery should be examined as well as the connecting wires to the receiver, and assurance made that all connections are quite secure. If these connections have been properly made the receiver is ready for operation.

Before adjusting the receiver, however, the operator should accustom himself to the fact that the rotation of any one of three rheostats in a clockwise direction increases the brilliancy of the filaments of the vacuum tubes, while its rotation in a counter clockwise direction reduces the brilliancy, and if the rotation is far enough in this direction, it will extinguish the filaments.

ADJUSTMENT OF THE RECEIVER: It will be found that the expenditure of a little effort in accustoming the operator to the manipulation of the controls will well justify itself in the greater range of the reception and absolute reliability of operation which can be accomplished with this receiver. It is, therefore, recommended that the following procedure be followed in tuning the Type 61 Receiver:

No attempt should be made to secure signals over long distances until the operator has learned to use the receiver on nearby stations, and for this reason it is suggested that the procedure given below be used when a nearby station is known to be in operation.

HOW TO ADJUST RECEIVER WHEN OUTDOOR ANTENNA IS USED. Where an antenna is used, the "Tuning System" transfer switch is set on the position labelled "Antenna," the "Selectivity" control knob should be first set at 0 and the "Primary Inductance" controls set in mid position. The "Primary Condenser" switch at the left of the panel should then be set. The position of this switch is largely dependent upon the size of the antenna which is used with the receiver. Where an extremely long, high, outdoor antenna is used, the switch should be set on contact stud "L." Where a small indoor wire of not more than 20 or 30 feet in length is used, it should be set on contact stud "H;" while for a large indoor antenna or a small outdoor antenna, it should be set on position "M."

Having adjusted the Primary switch, the vacuum tubes should be adjusted thus: The antenna should first be temporarily disconnected to facilitate the adjustment of the detector tube filament to its proper brilliancy. The telephone plug should be inserted in the telephone jack, or the headset should be connected to the telephone terminals. The A. F. amplification selector switch should be rotated to position "4" and the two rheostat knobs on the extreme right of the panel should be rotated clockwise until the vacuum tubes in the two right hand foremost sockets are lighted at a reasonable brilliancy. Then, the detector tube—right rear socket—should be lighted. When a gas detector tube, such as the UV-200 is used, it will be found that as the detector rheostat is rotated in a clockwise direction, a position will be found in which a very audible "hiss" is heard and that rotation beyond or back from this position will cause the "hiss" to disappear. This rheostat should then be rotated in a counter clockwise direction until the "hiss," as heard in the headset, barely disappears and when in this condition the detector tube will be found to be extremely sensitive.

Having adjusted the detector tube filament, the "R. F. Amplification Selector" switch should be set on "1 Stage R.F." Then the "R. F. Amplification" control knob should be rotated in a clockwise direction through about three quarters of the range of its rotation and the "1st R. F. Rheo." rotated in a clockwise direction and the tube thereby lighted until a dull thud is heard in the telephones at a particular position of this rheostat and at this point the rotation of the rheostat should be stopped. If, then, the "R.F. Amplification Control" knob is rotated back and forth from the position of its previous setting a dull thud should be heard at each successive rotation. This indicates that the amplifying system of the receiver is operating properly and it then remains only to adjust the tuning system to receive the desired signal.

Now vary the "Secondary Wavelength" control knob until either a signal or a musical note is heard. Then, by the manipulation of the "Primary Inductance" control knobs the receiver may be tuned until the signal or musical note is heard at maximum intensity. Then, by the adjustment of the "R. F. Amplification" control knob the signal may be augmented in its intensity or the musical note caused to disappear, leaving only the signal.

It will probably be found that an increase of amplification can be secured after these preliminary adjustments have been made by a slight

readjustment of the several rheostats and the "R. F. Amplification" control. This control should be rotated for a short distance in either direction and the position of maximum signal noted and at the same time the vernier should be slowly rotated so that the operator may be assured that the receiver is operating at maximum amplification.

The intensity of signals will not be seriously affected by the rotation of audio frequency amplifying tube rheostats labelled "1st A. F. Rheo." and "2nd A. F. Rheo.", but once the signal is heard, the brilliancy of the filaments of the tubes controlled by these rheostats should be reduced until further reduction in brilliancy causes a reduction in signal. The operation of the tubes in this condition will give maximum possible tube life and require the least frequent charging or replacement of batteries.

The "Primary Inductance" control knob must be manipulated for each change in the adjustment of the "Secondary Wavelength" knob and if interference from undesired signals is to be avoided, the "Selectivity" control knob must also be adjusted. Where little interference is present, this control knob may be set on the lower end of its scale, but where serious interference betwen two or more transmitting stations is observed, the setting of the "Selectivity" control knob should be increased until by the successive adjustments of the Secondary Wavelength" knob, the "R. F. Control" knob and the "Primary Inductance" knob, the desired signal is heard to the exclusion of all undesired signals.

This sequence of readjustments may be repeated for a higher degree of selectivity as indicated by the elimination of interfering signals and it may be found that further increase of the setting of the "Selectivity" control knob will seriously reduce the signal. When this condition is found, there is little or nothing to be gained by further increase of the "Selectivity" control knob, and if interference is still present there is nothing that can be done except by the substitution of a loop for the antenna and the elimination thereby, of the adjustment of the "Primary Inductance" and "Selectivity" controls.

See "General Instructions."

HOW TO ADJUST RECEIVER WHEN INDOOR ANTENNA IS USED: For reception from local stations the same general procedure as that given in instructions on operation in connection with outdoor antennas is to be followed. Where the broadcasting stations are low powered and where the receiving equipment is at some distance, or where the construction of the building is such that metal causes a considerable absorption, three stages of radio frequency amplification will be found to give greater signal intensity than where one stage of radio frequency amplification is employed. It is to be advised that the novice learn to operate the set on one stage of radio frequency amplification where a station is known to be operating within a reasonable distance. Under these conditions, the exact instructions as given under the above notes on the operation of the set when using an outdoor antenna may be followed. After the operator has accustomed himself to the reception of signals in that manner, greater distance range may be accomplished by the method which will now be given.

After adjusting the tubes and tuning system as given above, place the "R.F. Amplification" control switch in the position marked "3 R.F. Stage." Rotate the "2nd R.F. Rheo." and "3rd R.F. Rheo." in a clockwise direction until the tube filament which these rheostats control are lighted to a cherry red color.

The operation of the tuning system is now identical to that given under instructions on the operation when using an outdoor antenna. The location of the various tubes can be obtained from Figure 5. A slight readjustment of the "2nd R. F. Rheo." and "3rd R.F. Rheo" may be found to increase signal strength. However, it should be borne in mind that these

rheostats should be turned as far as possible in a counter clockwise direction without losing signal strength. This precaution will greatly prolong tube life and will decrease, somewhat, the current drain on the "A" battery and thereby prolonging its life, or in the case of the storage battery, increase the period over which it may be used without requiring recharging. Once these two rheostats are set, it will not be necessary to touch them, except perhaps at hourly intervals to turn them slightly in a clockwise direction. This is particularly required when the charge of the storage battery has become so diminished that its voltage drops rapidly with the consumption of current by the tubes. When this battery condition is indicated one should test the "A" battery to determine its need for recharging or replacement.

See "General Instructions:"

HOW TO ADJUST RECEIVER WHEN LOOP IS USED: Set the "Transfer Switch" on "Loop." This disconnects the "Primary Inductance," and the "Primary Condenser," which leaves only the "Secondary Wavelength" and "Vernier" remaining in the tuning system. It will, therefore, be useless to attempt adjustment of the "Primary Inductance," "Selectivity," and "Primary Condenser."

Now temporarily disconnect the loop from the "Loop" terminals to facilitate the adjustment of the detector tube filament to its proper brilliancy. The "A. F. Amplification Selector" switch should be rotated to position "4" and the two rheostat knobs at the extreme right of the panel should be rotated clockwise until the vacuum tubes in the two right hand foremost sockets are lighted at a reasonable brilliancy,—this will be at a cherry red or bright red color, when such tubes as the WD-12 and UV-201-A or similar tubes are used. Then, the detector tube—right rear socket—should be lighted. When a gas detector tube, such as the UV-200 is used, it will be found that, as the detector rheostat is rotated in a clockwise direction, a position will be found in which a very audible hiss is heard, and, that rotation beyond or back from this position will cause the hiss to disappear. This rheostat should then be rotated in a counter clockwise direction until the hiss as heard in the headset barely disappears and in this position the detector tube will be found to be extremely sensitive.

Having adjusted the detector tube filament and the A. F. amplifying tube filaments the "R. F. Amplification Selector" should be set on "3 R. F. Stages." The loop should be reconnected to the "loop" terminals. Then, the "R. F. Amplification" control knob should be rotated in a clockwise direction through about three quarters of the range of its rotation and the radio frequency amplifying tube rheostats should be rotated in a clockwise direction until the tubes controlled by these rheostats are burning at a bright red. The "1st R. F. Rheo." should be the last R. F. rheostat to be rotated. As this "1st R. F. Rheo." is rotated in a clockwise direction and the tube thereby lighted, a dull thud will be heard in the telephones at a particular position of this rheostat and at this point the rotation of the rheostat should be stopped. If then the "R. F. Amplification" control knob is rotated back and forth from the position of its previous setting a dull thud should be heard at each successive rotation. This indicates that the radio frequency amplifying system of the receiver is operating properly and it then remains only to adjust the tuning system to receive the desired signal.

The "Secondary Wavelength" dial should be rotated until either a signal is heard or a musical whistle or note is easily audible. Then, by the manipulation of the R. F. amplification control knob the intensity of this signal may be brought to its maximum. Once the signal is audible, the rotation of the "Vernier" control knob and the simultaneous adjustment of the "R. F. Amplification" control knob will make it possible to adjust the receiver for maximum possible signal.

It will probably be found that an increase of amplification can be secured by slight readjustment of the several rheostats and the "R. F. Amplification" control. This control should be rotated for a short distance in either direction and the position of maximum signal noted. At the same time the "Vernier" should be slowly rotated so that the operator may be assured that the receiver is operating at maximum sensitivity. The intensity of signals will not be seriously affected by the rotation of audio frequency amplifying tube rheostats labelled "1st A. F. Rheo." and "2nd A. F. Rheo." but once the signal is heard the brilliancy of the filaments of the tubes controlled by these rheostats should be reduced until further reduction in brilliancy causes a reduction in signal. The operation of the tubes in this condition will give maximum possible tube life and require the least frequent charging or replacement of batteries.

TROUBLES AND THEIR REMEDIES.

Failure of tubes to light:

1. "A" battery not connected or in discharged condition. Examine "A" battery connections, or, recharge or replace "A" battery.

2. A. F. amplification selector switch on "O" position. On position "1" all tubes may be lighted with the exception of the two foremost right hand tubes. On position "2" all tubes may be lighted except the foremost right hand tube. On positions "3" and "4" all tubes may be lighted.

3. Rheostat on "off" position. Rotate rheostat corresponding to tube to be lighted in clockwise direction.

4. Tube filament burned out. Replace with undamaged tube.

5. Tips of tube base prongs dirty. Remove foreign matter by means of sandpaper or sharp instrument.

Continuous Howling:

1. Tubes not lighted or lighted too dimly. Adjust rheostats to proper tube brilliancy.

2. An open-circuit within the receiver. Trace and repair.

Noisy Operation:

1. Dirty tube base prongs. Remove all tubes and use emery or sand paper or sharp instrument. Remove foreign matter from contact surfaces of tube base prongs.

2. Atmospheric electrical disturbances. No remedy, except that these disturbances will be less pronounced when indoor antenna or loop is employed.

3. Proximity of electric power or telephone wires or electrical machinery. Attempt to discover source of trouble. If power lines, particularly if trolley wires, the annoyance will be greater at certain periods during the day or when a trolley car passes in the vicinity. The nearest point of the antenna should be removed from the power lines to as great a distance as possible and the flat top portion of an outdoor antenna should be run at right angles to the direction of the power line. If a loop is used, certain positions of the loop will be found where the noise is reduced to a minimum. If the disturbances are being introduced to the receiving set because of the proximity of telephone wires or instruments in the house, the placing of the receiver at a greater distance from the telephone apparatus will decrease the disturbances. Often times the use of some other means of grounding the set will eliminate the trouble.