PHILCO

RADIO MANUAL
of
Useful Information

1928-1929

PHILADELPHIA STORAGE BATTERY COMPANY
Ontario and C Streets
PHILADELPHIA, PA., U. S. A.

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It is the purpose of this Manual to give Philco Dealers information which will help them understand, sell, install and service Philco Radio Receivers and Speakers.

The entire Manual should be studied by salesmen as the information will be found very helpful in selling. The technical information should enable installation and service men to do their work quickly and correctly.

The Manual is arranged in four parts as follows:

Part I explains what is required of a radio receiver and speaker and how the Philco meets every requirement.

Part II contains a technical description of the parts and the circuit used.

Part III explains how to install the Philco in the home.

Part IV covers the testing and servicing.

Part I
General Information

The radio art is still young and yet, so rapid has been the development, a vast majority of the radio receivers in use and many that are being offered for sale today may truly be called ancient and obsolete. To meet present-day requirements and qualify as "modern," a radio receiver must come up to high standards in all the following points: range (sensitivity), selectivity, tone quality, power, convenience, appearance, dependability.

Philco has been able to produce at a moderate price, an advanced type of Electric Radio Receiver, setting new standards in all the above points. This has been possible because Philco engineers, starting with a wide knowledge of radio and a free hand, have been able to combine and extend the best developments of the past and to add thereto many valuable improvements. Philco designers have not been hampered by patents or by past production, nor have they had to utilize any left-over stock or old production equipment designed for battery type receivers.

One must examine and use the Philco Radio Receiver to appreciate it. It is impossible to do it justice in words. The following information it is hoped will help make clear how such results are possible:

Range or Sensitivity

The Philco Radio Receiver is so sensitive to weak signals that it will pick up and amplify to loud speaker volume any signal that is louder than the static noise of the atmosphere. This means that in the Fall and Winter, when the static noise is at a minimum, stations 3000 or more miles distant

can be received with a good antenna provided the location is not an unfavorable one.

This long working range is due to the advanced design of the radio-frequency amplifier with its tuned antenna circuit and three balanced tuned radio-frequency stages, and to the careful methods used in matching and aligning the four tuning condensers and radio-frequency transformers. The hair-like tuning made possible by the Range Control also contributes to the remarkable distance-getting ability.

Selectivity

The selectivity of the Philco Receiver is one of its most remarkable features. To appreciate this it is only necessary to use the Receiver. This extreme selectivity is needed today not only in cities having a number of broadcasting stations but with a Receiver having the range of the Philco it is important for all locations.

With the single Station Selector it is possible to tune in the desired program from among a large number of stations. For the more distant stations the Range Control permits extra sharp tuning and the cleanest possible separation of stations. This will be found of particular advantage in separating and bringing out stations toward the high frequency (low wave length) end of the broadcasting band. With the Range Control turned to the left, in the "short range" position, the Receiver has remarkable ability to receive clearly and separate cleanly the many strong local stations operating in each of the big cities.

The four specially designed and perfectly aligned and counterbalanced tuning condensers, operated by the one Station Selector, the Range Control, the matched Radio-Frequency Transformers, the thorough shielding and various refinements in design all contribute to the unusual selectivity of the Philco Receiver.

Tone Quality

The combination of a Philco Receiver and Speaker reproduces with fidelity every sound that enters the broadcast microphone. Not only the fundamental bass notes which are so much talked of but the high notes and overtones, so often neglected, are faithfully recreated. The result is a naturalness of speech and music that is a revelation.

The Receiver, due to a careful choice and arrangement of parts, together with correct by-passing and filtering, delivers to the Speaker the full range of undistorted impulses needed for truthful reproduction. Contributing largely to the fine tone quality are the special audio-frequency transformers and the output filter, which provides for the best operation of the power tube and keeps the direct current of the plate supply out of the Speaker, thus preventing distortion.

The usual and easy way to keep down hum in an AC electric receiver is to use audio transformers so poor that they will not pass the lower audio frequencies. This suppresses not only the hum but the low fundamental frequencies which give to music much of its richness. Philco has not resorted to this method but has eliminated hum by scientific though costly methods.

The Range Control and adequate Volume Control of the Philco Receiver make it unnecessary to detune to reduce the volume of strong local stations, thus preserving the tone quality under all conditions. With some electric receivers, it is often necessary to detune to control the volume and this distorts and takes away that fullness of tone which is obtained only when a station is properly tuned.

The Philco Speaker covers the entire range of musical tones and is correctly matched with the Philco Receiver. The Speaker will be found to give exceptionally clear and natural reproduction with any receiver but when used with the Philco

Receiver the results are remarkable. In the console and cabinet models the low notes are brought out in relatively greater volume with most pleasing results.

The jack provided for connection to a phonograph pick-up is a feature that will be greatly appreciated after hearing your favorite records reproduced through the Philco Receiver and Speaker.

Power

A thoroughly good Receiver and Speaker combination must have ample power in the radio-frequency amplifier, in the detector, in the audio-frequency amplifier and in the Speaker to reproduce the programs of both local and distant stations at home volume without overloading any of the tubes or the Speaker to the point of audible distortion. Nothing is gained by providing part of the system with extra power when by so doing another part is overloaded.

The Philco Receiver and Speaker have "matched power" and will give without distortion all the volume that can be used in the home. The pleasing tone of the Philco Speaker is maintained even when operating at great volume.

Experienced radio users will be surprised by the manner in which distant stations come in. Very often these stations are mistaken for locals when judging by volume alone.

Convenience

To install Philco Electric Radio it is only necessary to connect the alternating current attachment plug to a house receptacle after first inserting the tubes and connecting the antenna, the ground and the Speaker.

If desired, the terminal post marked "LOC" can be connected to the "ANT" post in place of an antenna. This feature makes it possible to move the Receiver from place to place and with the convenient ground clamp and lead, furnished with the Receiver, reception can be had in a few minutes' time.

There are no batteries or liquid devices, and no parts except the tubes to wear out.

The operation of the Philco Receiver is so simple that everyone will be able to enjoy programs from distant cities that, in the past, either could not be tuned in or else required too much time and fussing. The single Station Selector can be used to bring in almost any station. After getting a distant station, the signal may be brought out more clearly by use of the Range Control. The Volume Control will be found smooth in action, giving a continuous gradual control from minimum to maximum volume on both strong and weak signals.

There are no taps, plugs or other adjustments with which the user must tinker. Any of the three controls can be turned in any direction regardless of the position of the others without making the Receiver "squeal" or "whistle" and without any possibility of injury to the tubes or Receiver. The Station Selector controlling the four-gang condenser will be found to operate smoothly and without lost motion.

A carefully shaded pilot light gives uniform illumination of the scale, making the tuning pleasant and easy. It also indicates whether the Receiver is turned on or off.

Appearance

A great deal of attention has been given to the design and finish of the Philco Radio Receiver, the Philco Speaker and the Philco Furniture. In addition to the designers and artists of the Philco staff, many others have been consulted and employed for special work. Hundreds of sample cabinets were finished and submitted for criticism to both connoisseurs and laymen before the color designs were finally chosen. The colors and

decorations, we are assured, are in good taste and will blend with other fine furnishings of the home.

The cabinets for table use have exceptionally pleasing lines and are as small in size as is consistent with good internal design.

Dependability

All parts of the Philco Receiver and the Philco Speaker have been designed with the utmost care for dependable, trouble-free service. The best of materials are used throughout. The tube sockets—a source of much trouble in the past—are designed to maintain for all time perfect electrical contacts with the tube prongs. The wiring is all done in a permanent manner in accordance with the best practice. The inspection and testing of all parts and of the completed product is most thorough, ensuring continued satisfactory performance.

After installation, no adjustments or replacements of any kind other than the replacement of tubes should ever be needed.

Part II

Technical Description

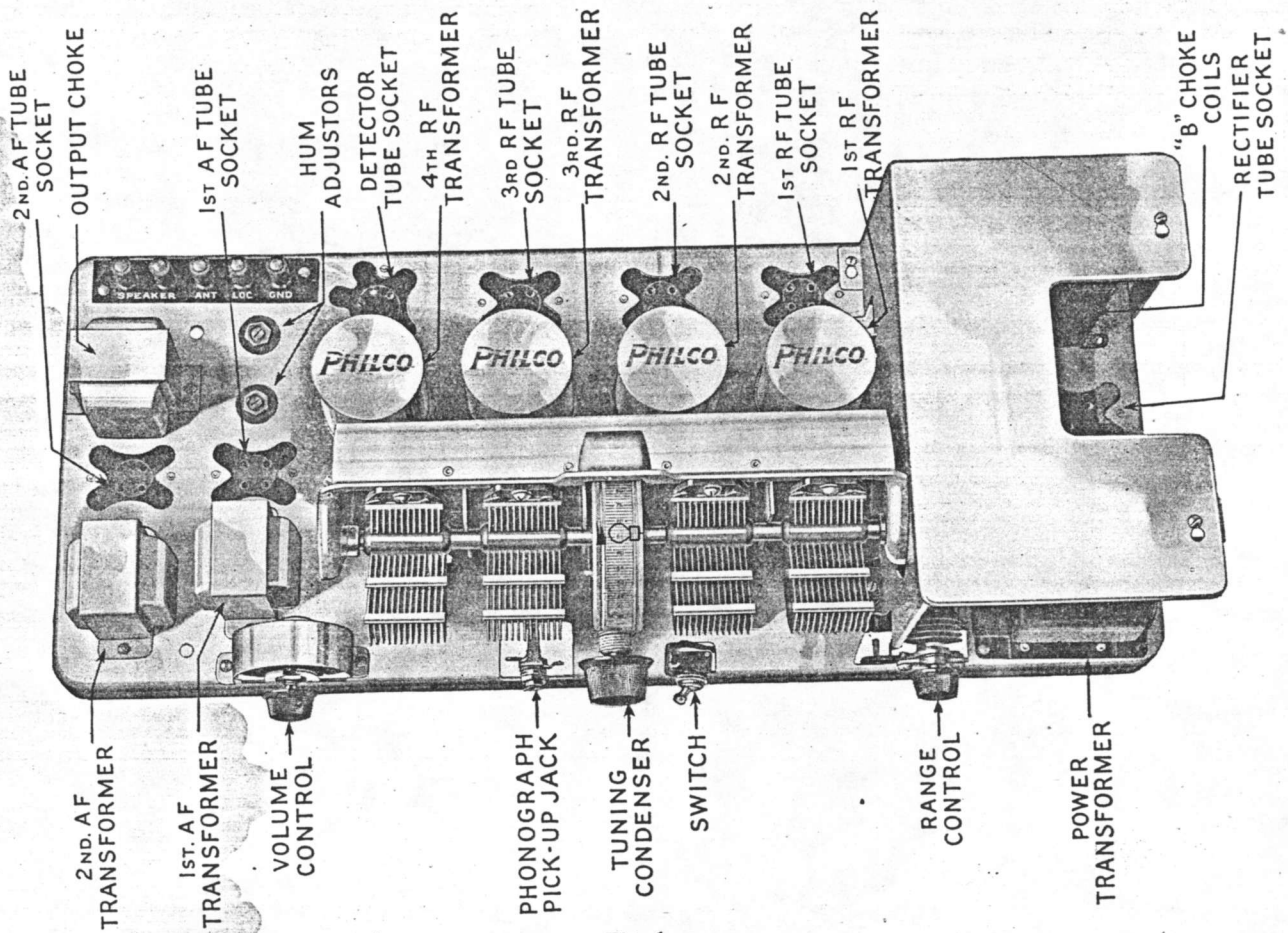


Fig. 1

Component Parts

Following are brief specifications of some of the parts used in the Philco Radio Receiver:

Tuning Condenser

The Tuning Condenser consists of four condensers built up into a single unit. Each one consists of a set of stator plates permanently soldered to three brass tie bars, and a set of rotor plates soldered to a brass hub which is rigidly mounted on a solid steel shaft. In addition to being held at the hub, each set of rotor plates has two tie bars so arranged that the plates are rigidly held parallel. All of the plates are accurately punched from high quality brass and the shaft on which the rotors are mounted is strongly supported by a heavy shoulder bearing

and two guide bearings. This shaft is made of solid stainless steel, carefully ground to size to fit the bearings. Neither the stainless steel shaft nor the bronze bearings can rust or corrode, even at the seashore, so that there is no possibility of the condenser tightening up and making the tuning difficult.

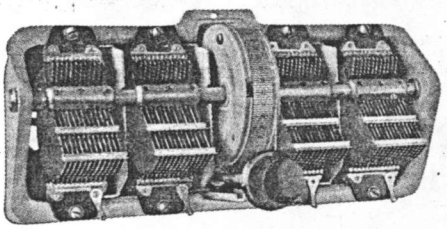


Fig. 2

The tuning unit is counterbalanced to make the turning easy in both directions. A positive cable drive is used in which any slack due to wear is automatically taken up by tension springs.

The insulating material used in the construction of the Tuning Condenser is the best grade of Bakelite. The complete unit is mounted in a drawn steel shell which is cadmium plated for rust protection. This steel mounting shell provides shielding and protection from mechanical injury.

The complete Condenser is assembled, inspected and tested electrically under very rigid supervision and its sturdy construction prevents it from getting out of adjustment. The design of this tuning condenser helps materially in separating the high frequency stations on the dial. Stations broadcasting on a frequency above 1000 kilocycles (below 300 meters) are not crowded together on the scale as is the case in so many receivers.

Compensating Condensers

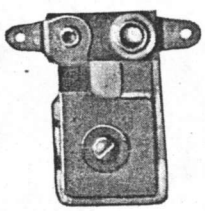


Fig. 3

Each one of the condenser units in the Tuning Condenser is paralleled by a small Compensating Condenser, the capacity of which can be varied by turning the nut with a wrench. These Compensating Condensers are carefully adjusted at the factory and locked in their correct position. There should not be any necessity for ever changing this adjustment. By means of these condensers differences in the distributed capacities and condenser capacities of the different tuning circuits are equalized.

Range Control

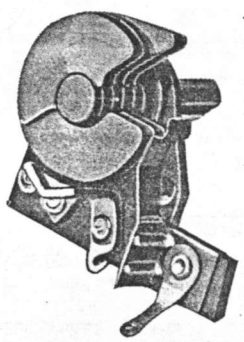


Fig. 4

The Range Control consists of a special small variable condenser with a spring switch on one side. For short range operation the Range Control is turned counter-clockwise as far as it will go, which disconnects and grounds the grid of the first R.-F. tube. This provides a highly selective system of reduced amplification in which two cascaded tuned circuits feed into the second R.-F. transformer and tube. For long range operation the Range Control is turned clockwise to the position that is found by trial to give the loudest signal. In this position the first tube is reconnected in the circuit and the little condenser acts as a "vernier" or fine tuner in the antenna circuit.

Radio-Frequency Transformers

The tubing used for the Radio-Frequency Transformers is of high quality Bakelite material accurately grooved, so that the turns of wire will be accurately spaced and immovable on a definite diameter. The primary winding is spaced from the secondary by thin celluloid.

The threading or grooving of the tubing makes it possible to build coils of great uniformity and means that all coils can be accurately matched, which is necessary for good results. Only coils with matched characteristics are used.

The terminal wires are soldered to lugs to insure lasting electrical contact. All coils are completely shielded to prevent interaction and undesired pick-up of signals.

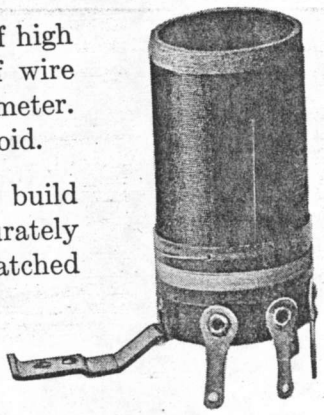


Fig. 5

Audio-Frequency Transformers

These Transformers are the result of much research and give uniform amplification without distortion over a very wide range of frequencies. The windings are heavy enough to prevent burn-outs or open-circuits. Each transformer is mounted in a cadmium plated steel housing. A series of tests is run on each of these Transformers before it is assembled in the Receiver.

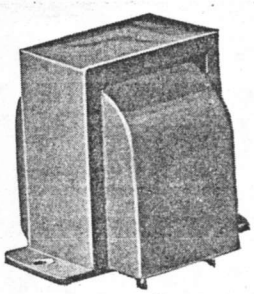
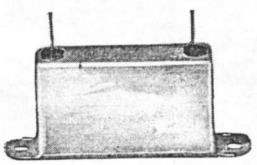


Fig. 6

Output Filter

The Output Filter, consisting of a high-inductance choke coil and a condenser insulates the Speaker from the direct current plate supply, by-passing the direct current directly to the power tube and thus eliminating the usual drop of voltage in the Speaker windings. This device filters from the output of the power tube the pure current pulsations representing the desired sound waves and feeds them to the Speaker free of the unwanted and harmful direct current. The Output Filter is carefully made and is given thorough electrical tests.



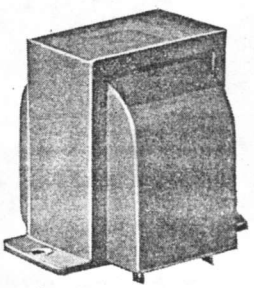


Fig. 7

Power Transformer

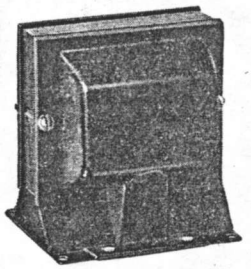


Fig. 8

The Power Transformer is the result of much testing and practical experience with AC tubes and has been designed with great care to deliver the correct values of voltage and current to the various tubes in the Receiver. The cores are bound together tightly to prevent any possibility of vibration or hum in the laminations. The windings and internal connections are carefully insulated. The taps from the various secondary windings come down to a Bakelite terminal panel at the bottom of the Transformer and the external connections are made to lugs supported by this panel. It is not possible to twist wires outside of the Transformer and cause breaks inside. Each Transformer is thoroughly tested electrically for output and for insulation between windings and between each winding and the housing.

Fixed Condensers

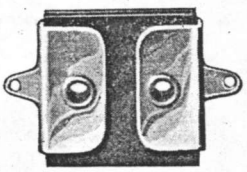


Fig. 9

The Filter and By-Pass Condensers are built to withstand a high overload voltage and are carefully designed for the work they have to do. Each Condenser is tested for its accuracy and given a breakdown test before being assembled in the Receiver.

Tube Sockets

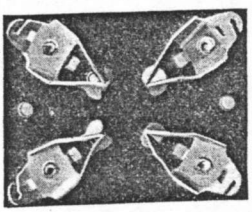


Fig. 10

The Tube Sockets are designed for low dielectric loss and made of the best materials. The contacts grip each tube prong tightly on two sides, thus ensuring perfect and lasting electrical contact.

Volume Control

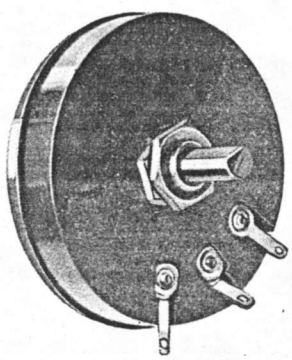


Fig. 11

The Volume Control is a special high-resistance potentiometer connected directly from the antenna to the ground. The variable tap connects to the primary winding of the first R.-F. coil and allows more or less of the received signal to pass to the R.-F. amplifier. When the variable tap is making contact with the grounded end of the resistance, the minimum signal passes through the Receiver. When the variable arm is at the antenna end of the resistance the full signal strength is fed to the Receiver. With the Volume Control in this position there is no loss of signal strength even though the antenna is connected to ground through the resistance. This is because the resistance is high enough to prevent any appreciable shunting of the signal.

By controlling the incoming signal strength in this way there is no possibility of overloading the detector and causing distortion. The volume is regulated instantaneously, the action being smooth and gradual, and when set at the desired point and left there is no fading or swelling.

Phonograph Pick-Up Jack

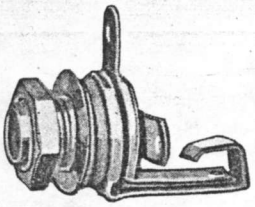


Fig. 12

This Jack is mounted in the bezel plate on the front panel. The two wires from the magnetic pick-up unit must be connected to a standard telephone plug such as was formerly used for loud speakers and head phones. To use the Pick-Up the plug is inserted in the Jack; to receive broadcast programs the plug is removed. No switching or removal of radio tubes is necessary to change from radio to phonograph reproduction.

Terminal Posts

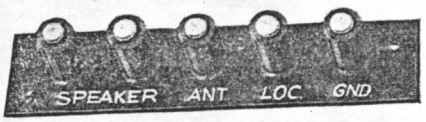


Fig. 13

The Terminal Posts at the back of the Receiver are of special Philco design providing exceptionally good contact with any kind of clean wire or cord tips. They are quick and easy to connect to as a downward pressure on the outer sleeve brings into view the large hole near the top of the post through which the wire or cord tip may readily be inserted.

Base

The Base of the chassis is of .050-inch pressed steel, providing a rigid support for all the parts. It is cadmium plated as a protection against rust and to ensure good grounding of all other metal parts. All the by-pass condensers, resistors and wiring are below this base. The only wires exposed above the base are the leads for the dial light.

Shielding

The Receiver parts are adequately shielded to prevent harmful coupling and interaction as well as to confine the pick-up of signals to the highly selective tuned antenna circuit. The wiring and small parts are shielded owing to the chassis design by which they are confined between the outer metal base and the inner sub-base. The four radio frequency transformers are shielded individually by one-piece cylinders of pure aluminum. The tuning condensers are amply shielded by the construction of their supporting shell. Other shielding of individual parts is provided wherever it has been found advantageous.

Cabinet

The pressed steel Cabinet has been designed for beauty combined with strength and rigidity. It is generally conceded to be a masterpiece of creative metalwork.

Philco Speaker

This Speaker is a worthy companion to the Philco Receiver and should be considered as a matched unit, without which Philco Radio is incomplete.

The construction of the Speaker is very rugged. The heavy balanced armature and its actuating coil are permanently supported and set so that no adjustment is ever desirable or needed after leaving the factory. The moving element is so mounted that it is well protected from dust and abuse in handling. The magnet is exceptionally large and made of the best magnet steel.

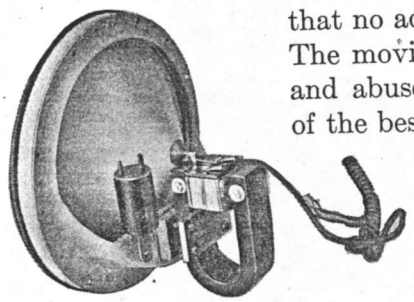


Fig. 14

The seven-inch cone is made of special acoustical parchment combining lightness with stiffness. It is floated in a ring of softest chamois which improves the tone quality by its slight dampening effect and by preventing interference between the sound waves generated at the back and at the front of the cone.

The entire construction is such that the wonderful clarity and naturalness of the Speaker will be preserved indefinitely under all conditions.

Circuit Description

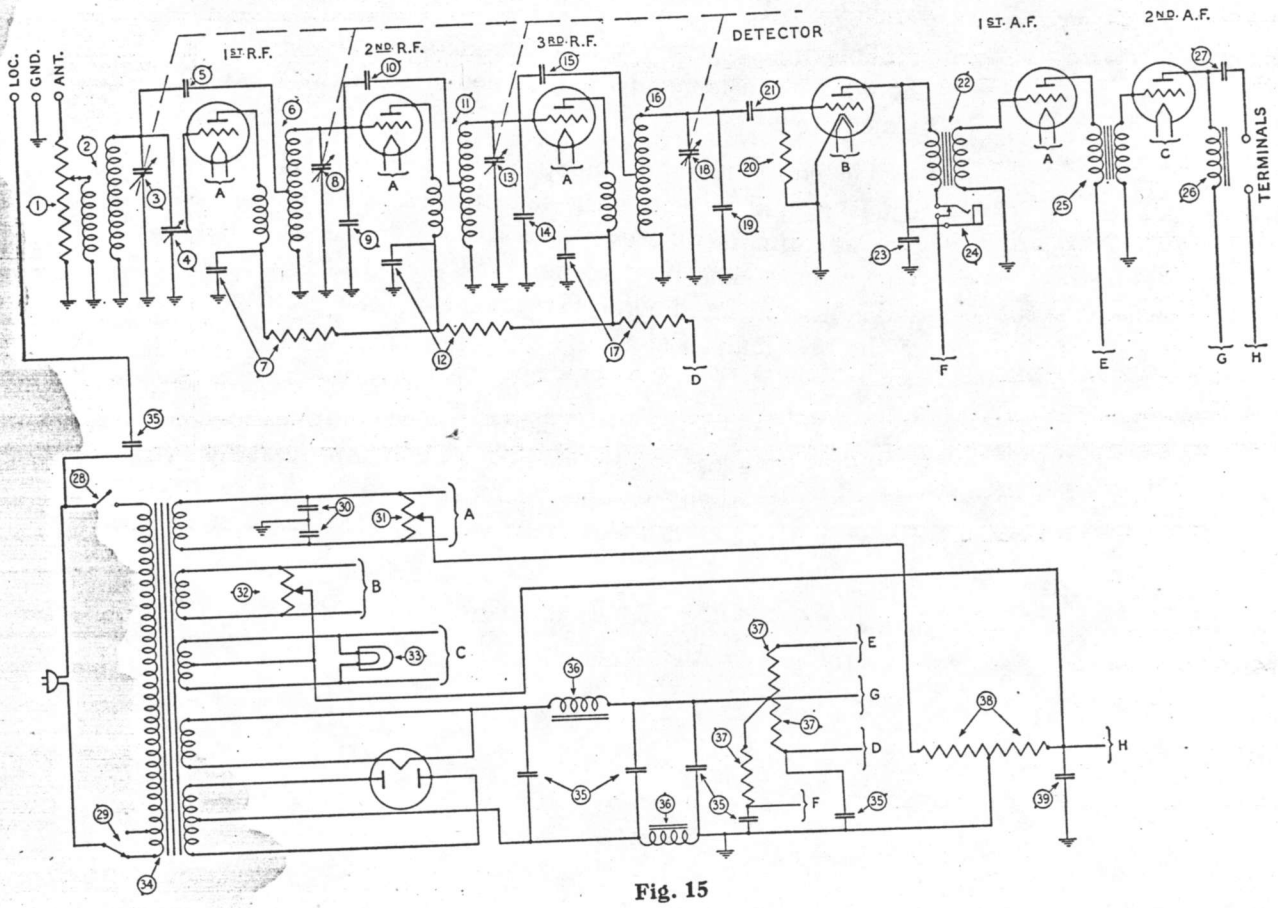


Fig. 15

The wiring diagram, Fig. 15, shows the complete circuit of the Philco Electric Radio Receiver. It is a six-tube neutrodyne Receiver, employing antenna tuning, three stages of tuned radio-frequency amplification, detector and two stages of transformer-coupled audio-frequency amplification. A few of the features of this circuit will be pointed out.

Starting at the input side of the Receiver, first is noticed the "LOC" terminal. When inconvenient to install an antenna, a connection can be made from the "ANT" terminal to the "LOC" terminal and excellent results will be obtained on all nearby stations and, in many cases, on distant stations. As can be seen in the diagram, the "LOC" terminal is connected through a small fixed condenser directly to one side of the electric light line. When using this terminal as an antenna, the AC attachment plug should be tried first one way and then the other, using it in the position which gives the loudest signal and the least hum.

The main Volume Control is a potentiometer resistance of 10,000 ohms connected from antenna to ground. The input to the set is connected to this resistance by means of a sliding contact, thereby allowing more or less of the signal strength to pass directly to the ground.

The Range Control is a unit having a spring contact on a small variable condenser used for tuning the antenna circuit, as shown

in the diagram. When this is rotated counter-clockwise, the grid of the first tube is disconnected from the input circuit and grounded. This is the short range position used for strong signals. For weak signals, it should be rotated clockwise to reconnect the grid to the input circuit. Further adjustment to the right allows finer tuning of the antenna circuit.

Four main tuning condensers are used in this Receiver, the one ahead of the first radio-frequency tube having the range control condenser in addition. The four tuning condensers provide maximum selectivity. The Range Control is especially valuable when tuning in stations broadcasting in the high frequency channels.

Each of the other three tuning condensers has a compensating or padding condenser shunted across it. These are small condensers, the capacity of which can be varied by adjusting them with a wrench. Although the four main condensers are carefully matched before being assembled, the compensating condensers provide a method of compensating for differences in the circuit capacities and bringing all the tuning condensers into perfect electrical alignment.

The three neutralizing condensers are shown, one above each of the radio-frequency tubes. These condensers are constructed the same as the compensating condensers so that their capacity can be adjusted with a wrench. The adjustment of both the compensating condensers and the neutralizing condensers must be made from the bottom of the Receiver. The user will not be able to tamper with these adjustments.

The extensive filtering and by-passing indicated by the little fixed condensers and resistors in the circuit diagram improve the stability of the Receiver and are responsible for much of the smoothness of operation and freedom from distortion and hum.

The phonograph pick-up jack is connected so that inserting the plug disconnects the output circuit of the detector tube and connects the pick-up to the first audio-frequency transformer. It is not necessary to remove the detector tube or any of the other tubes from their sockets or even to detune the Receiver when using the pick-up.

The choke coil and condenser type of output filter which is used has been found better in every way than an output transformer which is sometimes used. It passes the low frequencies freely and does not tend to distort. With this output filter built in the Receiver is adaptable to all types of Speakers. It does not make any difference which way the Speaker leads are connected.

On the primary side of the transformer is the power switch, the tap going to the condenser for the "LOC" terminal, and a primary tap switch, for voltage regulation, to take care of unusual line voltages. As the Receivers are shipped from the factory, the primary tap switch is set on the tap for high-line voltage, that is ready for operation on any AC line of 110 to 135 volts. If any condition is found where the line voltage is consistently below 110, the switch should be changed to the other tap.

The two low-resistance potentiometers or hum adjustors provide adjustable center-tap returns to the transformer secondary supplying the filaments for the radio-frequency and first audio-frequency tubes and to the secondary supplying the heater of the detector tube. By means of these hum adjustors it is possible to reduce the AC hum to a negligible point. The adjustment is made with a screw-driver with the Receiver detuned and the tubes warmed up. This need be done only when the set is first installed and then only if the hum seems excessive.

The filter circuit used for the plate supply is of ample capacity for the current used. The resistor network, providing the proper plate voltages for the various tubes, is different from the usual type of voltage

divider and prevents any coupling between the various circuits. As seen in the diagram, the first audio-frequency tube, although operating at the same plate voltage as the three radio-frequency tubes, is supplied through a separate resistor.

Very high amplification is obtained without oscillation or regeneration by employing the most advanced methods of Hazeltine balancing. "Loss" methods of stablizing, which broaden the tuning and greatly reduce the amplification over the major part of the broadcasting frequency band, are not used.

Part III

Installation of Philco Electric Radio Receiver and Speaker

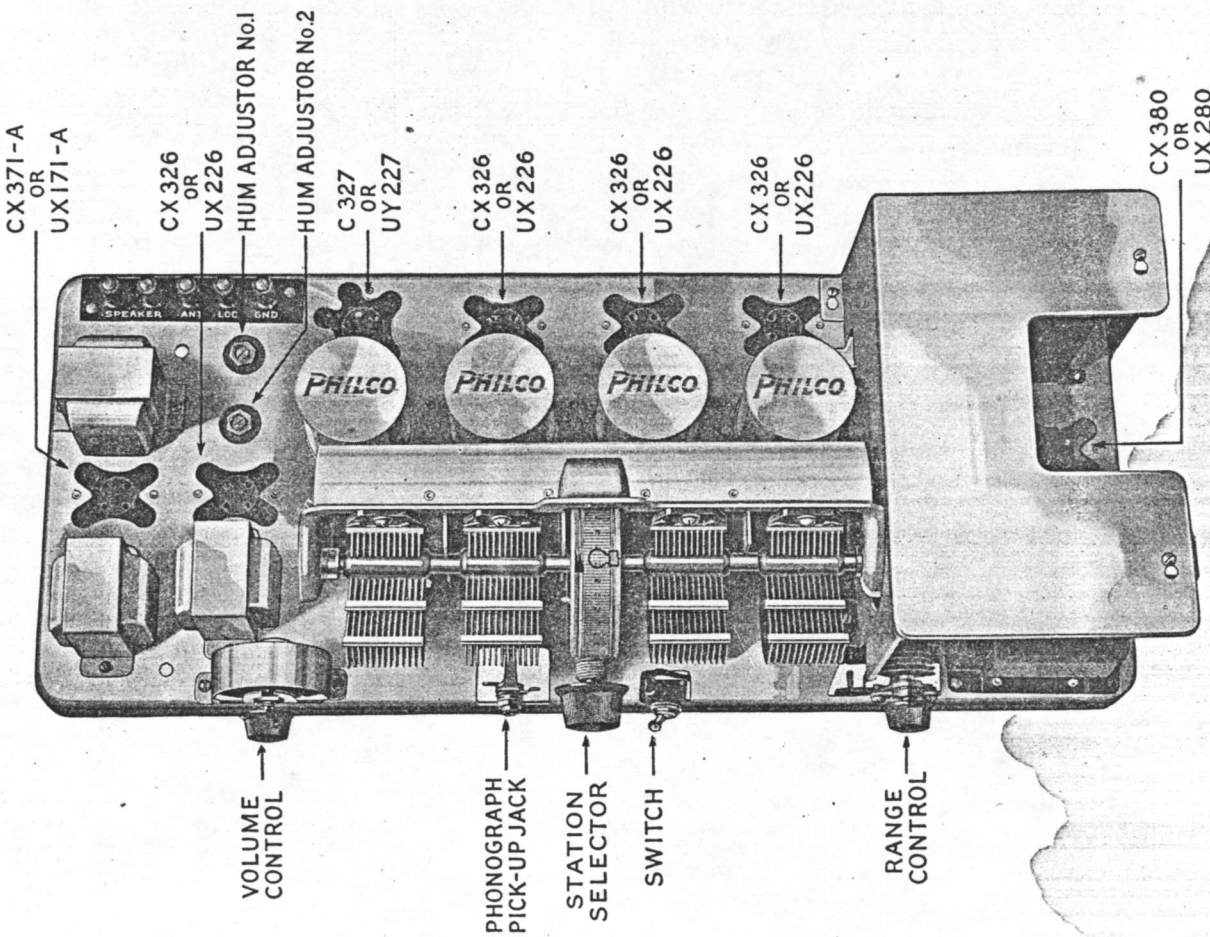


Fig. 16

Power Supply

Philco Electric Radio Receivers are made in two types. One for use on 95 to 135 volts, 50 or 60 cycle Alternating Current and the other for use on 95 to 135 volts, 25 to 40 cycle Alternating Current. Be sure that the right type of Receiver is used for each installation. Check this by the Receiver nameplate.

Unusual Line Voltages

All Philco Receivers are set at the factory for operation on 110 to 135-volt lighting circuits. In cases where the voltage at the house socket runs consistently below 110 volts, the primary tap switch setting on the Receiver should be changed by the dealer. To change this setting, turn off the Receiver and remove the rectifier tube at the extreme right end. Through the rectifier tube opening in the power shield will be seen a small toggle switch on the base of the Receiver. Throw this switch from the backward position to the forward position. With the switch thrown toward the back the Receiver is set for operation on 110 to 135 volts. With the switch thrown toward the front, the setting is for operation on 95 to 110 volts.

If the factory setting of the switch is changed in cases where the line voltage runs higher than 110 volts, the life of the radio tubes, especially of the 27 detector and 71 power tube, will be shortened.

In some few localities the line voltage will be found to run consistently higher than 135. In this case it will be necessary to connect a resistor unit in series between the A.C. attachment plug of the Receiver and one side of the house socket. Having the primary tap switch in the 110-135 volt position, the values of resistance required in series between the Receiver and the house socket for different line voltages are as follows:

Line Volts	Ohms Resistance
140	50
145	65
150	80

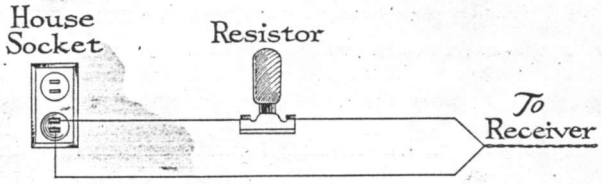


Fig. 17

Resistors for this purpose can be procured with Edison screw bases so that they will fit in a standard lamp socket. The lamp socket should then be connected in series with one side of the A.C. cord from the Receiver. Fig. 17 shows the resistor connection. If desired, a "series tap socket" can be purchased at a small cost which can be used to connect the resistor. It is not necessary to do any special wiring when a socket of this kind is used.

Tube Equipment Needed

4 CX-326 or UX-226 tubes.

1 C-327 or UY-227 detector tube.

1 CX-371-A or UX-171-A power amplifier tube.

1 CX-380 or UX-280 rectifier tube.

Each tube socket in the Receiver is plainly marked to indicate the correct type of tube to be used in it. Be sure that the correct type tube is used in every socket.

Insert the 71 power tube first. Its socket is made red to warn against the danger of burning out a 26 tube if placed therein.

Speaker

A Philco Speaker should be used with a Philco Radio Receiver to get the very best results. It is not necessary to pay any attention to the polarity of the Speaker leads because of the output filter built in the Receiver. Connect the Speaker leads to the terminals as shown in Fig. 16.

Antenna

An outdoor antenna from 50 to 80 feet long gives the best results under most conditions. It is not advisable to use an antenna longer than 80 feet except where the Receiver is located more than 50 miles from all powerful broadcasting stations. The lead-in wire is part of the antenna and the antenna length should always be measured from the Receiver to the insulator at the far end of the antenna wire. The outer end of the antenna should be as high as possible and the entire antenna should be spaced well away from trees and buildings and must be well insulated.

If it is not convenient to install an outdoor antenna, very good results can be obtained by the use of an indoor antenna at least 25 feet long. Number 18-gage stranded insulated copper wire will be found most suitable for an indoor antenna. This wire can be obtained in a neutral color and can be supported and insulated from the wall by glass push pins so that it will not be objectionable in appearance.

In place of an antenna, very satisfactory results will usually be obtained by connecting a wire from the "ANT" terminal post to the "LOC" terminal post of the Receiver. In this case it is not necessary to use an antenna of any kind as the signal is picked up by the electric light line. When using this connection, try reversing the attach-

ment plug in the house socket with the Receiver tuned to a distant station. Leave the plug in the position that gives the loudest reception and the least A.C. hum.

Ground Connection

A good ground connection to a water pipe or radiator is essential. This can be made conveniently by means of the detachable ground clamp included with the Receiver.

Initial Adjustments

After the aerial, ground and speaker connections are made and all the tubes are in place, pass the A.C. plug and cord through the hole in the back of the cabinet and plug it into a convenient floor receptacle.

Snap the power switch of the Receiver to the ON position, that is, toward the right. The pilot lamp indicates whether or not the power is turned on. The Receiver uses about 50 watts of current when turned on. When the switch is turned off, no power is used and the attachment plug need not be withdrawn.

Allow a few minutes for the tubes to become thoroughly heated, then turn the Volume Control (left knob) counter-clockwise as far as it will go and turn the Range Control (right knob) clockwise as far as it will go. Then turn the Station Selector (center knob) to a point at or near 100 on the scale where no broadcasting can be heard. Now while listening carefully to the A.C. hum in the Speaker reverse the attachment plug in the house socket. Leave it in the position that gives the least hum.

Next, with the controls in the positions described, turn with a screw-driver the screw of hum adjustor Number 1 (see Fig. 16), first one way then the other, leaving it in the position where the hum is reduced to a minimum. Repeat this operation with hum adjuster Number 2.

The hum adjustors are connected as follows: Number 1 with the 27 detector tube; Number 2 with the 26 tubes. If the detector tube is changed a readjustment of the Number 1 hum adjustor may be necessary. A readjustment of the Number 2 hum adjustor may be necessary if the first audio tube is changed. Changing any of the other tubes in the Receiver will not affect the adjustment.

Radio Broadcast Reception

The Receiver is now ready for use and stations can be tuned in by turning up the Volume Control (clockwise rotation) and turning the Station Selector. On distant stations the Range Control should be used for fine tuning after a station is brought in with the Station Selector. The Range Control will be found particularly valuable in bringing in distant stations at the high frequency (low wave length) end of the broadcasting band.

The Range Control may also be used to decrease the volume of powerful local stations. When listening to such stations, set this Control in the "short range" position by turning it counter-clockwise as far as it will go and then regulate the volume with the regular Volume Control. When tuning in distant stations, first tune with the Station Selector, as closely as possible, then rotate the Range Control clockwise, tuning it to the point that gives the loudest signal. Except when set in the "short range" position, the Range Control acts as a fine tuner in the antenna circuit and often makes possible the selection and bringing in of a distant station that otherwise could not be separated from other stations of nearly the same frequency or wave length.

Never reduce the volume of a station by detuning with the Station Selector as this may spoil the tone quality. Always tune sharply and use the Volume Control and Range Control to regulate the volume to the desired point. The tone quality is unaffected by the operation of either of these controls.

The chart on this page shows, in the center column, the tuning scale used in the Philco Receiver. On either side of this scale the letters of a number of key stations are marked to show the approximate points on the scale where they may be tuned in if within range. In the two outer columns are given the approximate frequency and wavelength figures that correspond to the main divisions on the tuning scale. The station settings are given in accordance with their frequency assignments of May, 1928.

Phonograph Record Reproduction

With a good phonograph pick-up of the magnetic type and any kind of a turntable, phonograph records may be reproduced with remarkable fidelity and tone quality through the Philco Radio Receiver and Speaker. To do this simply insert the plug of the phonograph pick-up in the jack on the front of the Receiver having the Receiver turned on and all tubes in their sockets. The Volume Control on the Receiver should be turned off and the volume regulated by means of the special control connected with the pick-up.

If the pick-up comes equipped with a plug like a tube base, cut the wires from this plug and connect them to a standard telephone plug such as was formerly used for loud speakers and head phones. The pick-up jack on the Philco Receiver is made to take such a plug.

To change back from phonograph to radio, simply remove the plug from the jack and use the Receiver as usual. Never leave the plug part way in the jack when receiving radio programs.

Station Log

(as of May 1928)

KILO-CYCLES	STATIONS	PHILCO SCALE	STATIONS	METERS
540		100		550
	WFAA, WPTF		KSD	
560	WTIC	95	WHO	535
	KYW		WNYC	
580	CNRE	90	WMC	515
	KLX		WEEI	
	KTHS		WBAP	
610	KGW	85	WEAF	490
	KFDM		WJAR	
	WSB		WSUI	
640	KFI	80	WRC	470
	KUOM		WNAC	
	WJZ		KFRC	
	WMAQ		KFOA	
680	WJR	75	WCX	440
	CFCN		CNRO	
	KPO, WOS		WLW, WOR	
	WGN		WLIB	
730	CKCD	70	CNRM	410
	WCCO		WFI, WLIT	
	WTAM		PWX	
	KWKH		KTW	
780	WMBF	65	KGO	385
	WGY		WOC	
	WDAF		KHQ	
830	WSAI	60	WEBH, WCSH	360
	CKLC		CFCA	
	WWJ		WEW	
	WIP, WGBS		KVOO, KJR	
880	WJAX	55	WSM	340
	WBZ			
			KOA	
930	WHAS	50	KFAB	320
	KOIL			
	KDKA			
	WABC		WHT	
990	WGR	45	KSL	300
			KMOX	
	WTMJ		WSMB	
			CKSM	
1050	KFAU	40	WBAL	285
	WAIU		WHAM, WOAI	
	KEX			
	WFBM		WPG	
	KFJF			
1120	KGU	35	WOI, KTSA	265
	WDAG		WFIW	
	WCAU		WBT	
	WFBL		KTNT	
	WRVA			
1200		30	WCOA	250
			WIOD	
	WDOD		KFH	
			KSCJ	
1260	WBAW	25	WADC	240
	WPOR		WTAR	
	WBRL		KFEQ	
	WOWO			
1330	WDAD	20	WLAC	225
			WCAM	
	KSTP			
1390	WOKO	15	KOW	215
			KWEA	
	KSOO			
1460		10	WLBZ	205
	WKEN			
1490	WRUF	5	WTFF	200
	KPOF			
1520		0		195

Part IV
Testing and Servicing

Before attempting to find any trouble in a Receiver that is not performing as it should, make sure that the trouble is not due to some external condition, such as a bad antenna or ground, or to a defective tube. If these things are found to be right, proceed to check the Receiver as follows:

Warning: Never remove more than one tube from the Receiver while the power switch is turned on. Having more than one tube out at a time will subject the condensers to higher than normal voltages.

A. C. Set Tester

There are several makes of A.C. radio set testers on the market that can be used to good advantage by a radio service man. The Weston, the Jewel, the Hickok, and the R.K. are examples of instruments of this type. These testers consist of A.C. and D.C. meters with a tube socket and connecting plug and cable so arranged that any one of the radio tubes can be removed from the Receiver and placed in the socket of the tester. The tester plug is then inserted in the tube of the Receiver. By throwing switches on the tester it is possible to read filament voltage, plate voltage, grid bias voltage and the plate current of the tube and socket under test. The A.C. voltmeter can also be used to check the voltage of the house lighting line.

Separate voltmeters and milliammeters can, of course, be used if a complete tester is not available.

Table 1 gives the approximate normal values for all of the tubes used in the Philco Receiver.

Table 1

Line Volts		A.C. Volts on Filament				Plate Voltage				Grid Bias Voltage		Plate Current Milliamperes		
Primary Tap Switch Setting		326 226	327 227	371A 171A	380 280	326 226	327 227	371A 171A	380 280	326 226	371A 171A	326 226	327 227	371A 171A
Front	Back													
95		1.34	2.19	4.34	4.34	81.0	31.5	122	339 A.C.	5.4	24.4			
100		1.41	2.30	4.57	4.57	86.0	34.0	129	357 A.C.	5.7	25.7	3.5	1.5	15
105		1.48	2.42	4.80	4.80	90.0	35.0	135	375 A.C.	6.0	27.0	to	to	to
110		1.55	2.54	5.02	5.02	94.0	36.7	141	393 A.C.	6.3	28.3	4.0	1.8	17
115		1.62	2.65	5.26	5.26	98.7	38.3	148	411 A.C.	6.57	29.6			
	110	1.28	2.13	4.23	4.23	79.0	30.8	119	330 A.C.	5.3	23.8			
	115	1.36	2.23	4.42	4.42	83.0	32.2	124	345 A.C.	5.5	24.8			
	120	1.42	2.32	4.60	4.60	86.5	33.6	129	360 A.C.	5.75	26.0	3.5	1.5	15
	125	1.48	2.42	4.80	4.80	90.0	35.0	135	375 A.C.	6.0	27.0	to	to	to
	130	1.54	2.52	4.99	4.99	93.5	36.4	140	390 A.C.	6.24	28.0	4.0	1.8	17
	135	1.58	2.62	5.18	5.18	97.5	37.8	146	405 A.C.	6.08	29.2			

Variations in line voltage make very little difference in plate current as the plate voltage and grid bias voltage change together.

The instructions furnished with the test sets described above explain fully how to make the tests. It is important that all tubes are in their respective sockets with the exception of the tube under test at the time the readings are taken.

In servicing Philco Receivers it is necessary to take into account the effect a variation in one of the values will have upon another. For instance, a high plate current is read. This could be caused by high filament voltage, high plate voltage or low or reversed grid bias voltage. Any one or a combination of these would cause high plate current. The reverse is also true, low filament voltage, low plate voltage, or high grid bias voltage or a combination of these would cause low plate current. Any unusual demand on the plate voltage caused by a shunt or ground will automatically reduce the voltage on the rest of the tubes.

After making the recommended tube and voltage tests, trouble, if present, can easily be located by means of a properly conducted continuity test. Trouble, as indicated by standard "A.C. Test Sets," will confine itself usually to one portion of the receiver circuit and can be easily traced.

The continuity test given below is based on the results of the test with the meters as described above. This will save the service man a lot of time as the set tester will usually show what part of the circuit is giving the trouble and the continuity test need be made only on that part of the circuit to find the exact source of the trouble.

Continuity Test

The tests made in this section must be made with good tubes in their respective sockets. The A.C. attachment cord must be connected to a live socket and the power switch turned to the "ON" position, that is, to the right.

There are a few common troubles that the service man will invariably meet, such as poor aerial, often grounded; poor ground connection; aerial and ground reversed to the Receiver; A.C. plug in a dead receptacle or one with poor spring contacts; poor or defective Loud Speaker; open Loud Speaker cord; plug left in the phonograph pick-up jack. Some tubes may not make good contact in the sockets. All these things must be checked before going into any extensive continuity test.

In looking for trouble make a careful visual inspection to find if some wire or part has become displaced, grounding out on the base.

Trouble that disappears when the bottom shield is removed is due to some part or wire grounding on the shield. If any part has become disarranged, make sure that sufficient clearance is allowed before replacing the shield.

A classification of the troubles as found with the A.C. set tester will enable the service man to pick out the one applicable to the particular problem. These are listed in Table 3.

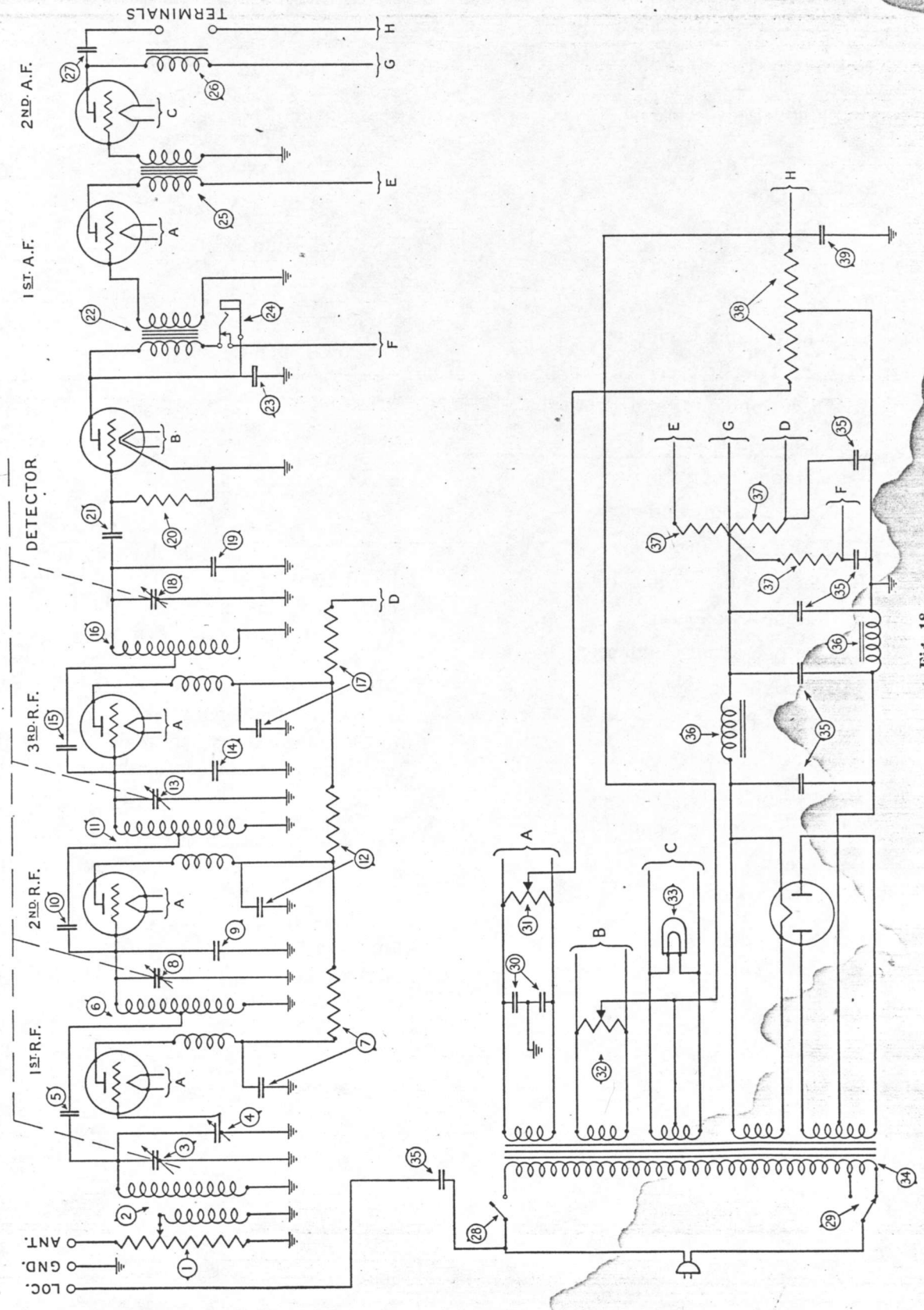

TERMINALS
2ND. A.F.
1ST. A.F.
DETECTOR
3RD. R.F.
2ND. R.F.
1ST. R.F.
ANT.
GND.
LOC.

Fig. 18

Fig. 18 is a schematic diagram of the Receiver. The numbers shown in circles on the schematic diagram refer to the different parts used. Table 2 lists these numbers and the equipment which they indicate.

Table No. 2

① Volume Control
② 1st R.F. Transformer
③ 1st Tuning Condenser
④ Range Control
⑤ 1st Neutralizing Condenser
⑥ 2d R.F. Transformer
⑦ By-Pass Condenser and Resistance
⑧ 2d Tuning Condenser
⑨ 1st Compensating Condenser
⑩ 2d Neutralizing Condenser
⑪ 3d R. F. Transformer
⑫ By-Pass Condenser and Resistance
⑬ 3d Tuning Condenser
⑭ 2d Compensating Condenser
⑮ 3d Neutralizing Condenser
⑯ 4th R. F. Transformer
⑰ By-Pass Condenser and Resistance
⑱ 4th Tuning Condenser
⑲ 3d Compensating Condenser
⑳ Grid Leak Resistor
㉑ Grid Condenser
㉒ 1st A. F. Transformer
㉓ By-Pass Condenser
㉔ Phonograph Pick-Up Jack
㉕ 2d A. F. Transformer
㉖ Output Choke Coil
㉗ Output Filter Condenser
㉘ Power Switch
㉙ Primary Tap Switch
㉚ Filament Filter Condenser
㉛ No. 2 Hum Adjustor
㉜ No. 1 Hum Adjustor
㉝ Pilot Lamp
㉞ Power Transformer
㉟ Power Condenser Block
㊱ B Choke Coils
㊲ B Resistors
㊳ C Resistors
㊴ By-Pass Condenser

Fig. 19 is a sketch showing the parts of the Philco Receiver. The sketch and the schematic diagram both show the same circuit but use different symbols for the parts. For instance, a radio frequency transformer is indicated on the schematic diagram by the conventional figure showing the primary and the secondary windings. In the sketch this same transformer is shown as it looks.

Fig. 20 is a photographic reproduction of the base of the Philco Receiver. Both the parts and the terminals are numbered. As in the schematic diagram the numbers within the circles designate the apparatus. The other numbers indicate the terminals of the apparatus and are referred to throughout the section on continuity test.

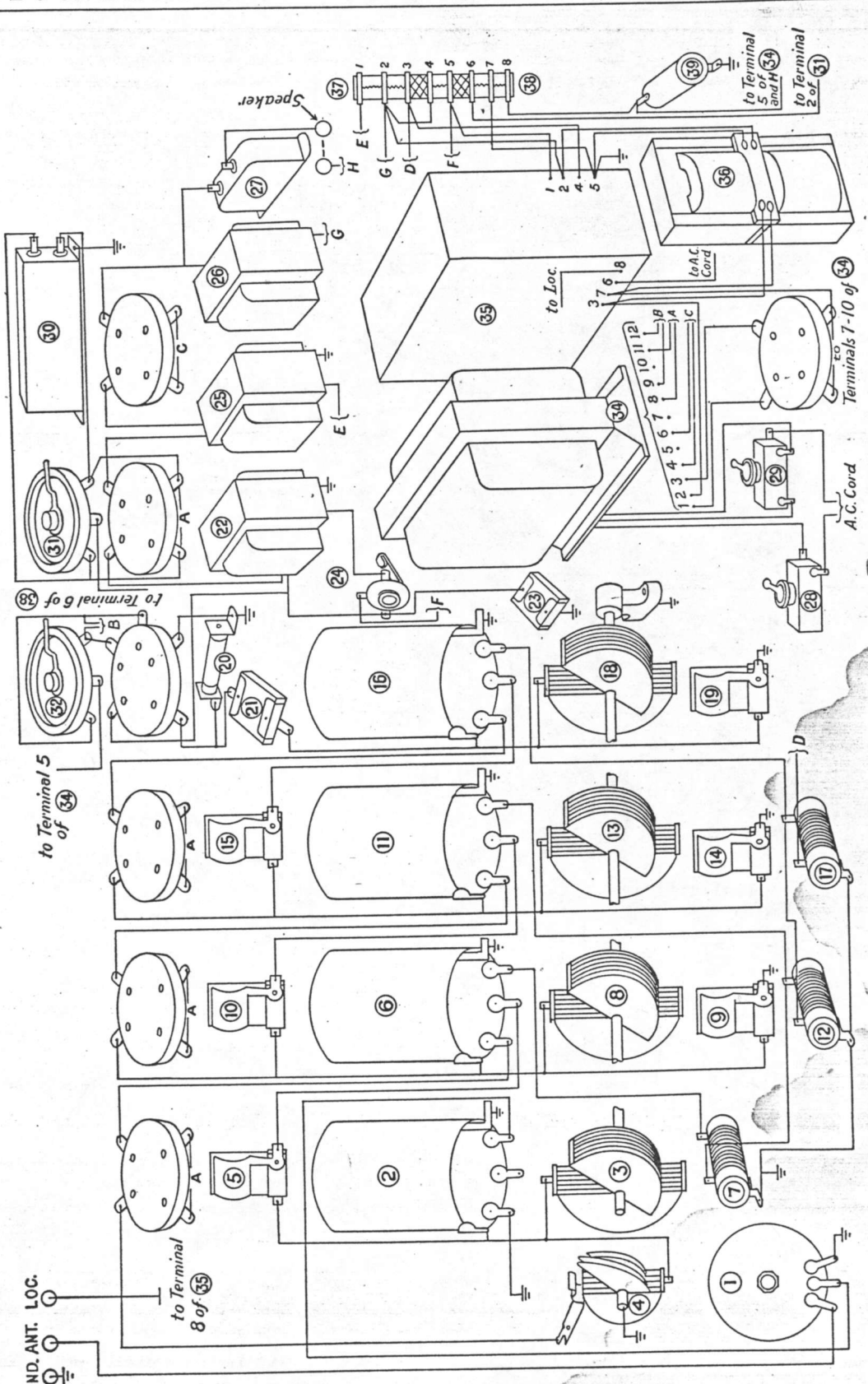

GND. ANT. LOC.
to Terminal 8 of 35
to Terminal 5 of 34
to Terminal 6 of 33
Speaker
to Loc.
to A.C. Cord
A.C. Cord
Terminals 7-10 of 34
to Terminal 5 of 34 and H
to Terminal 2 of 31

Fig. 19

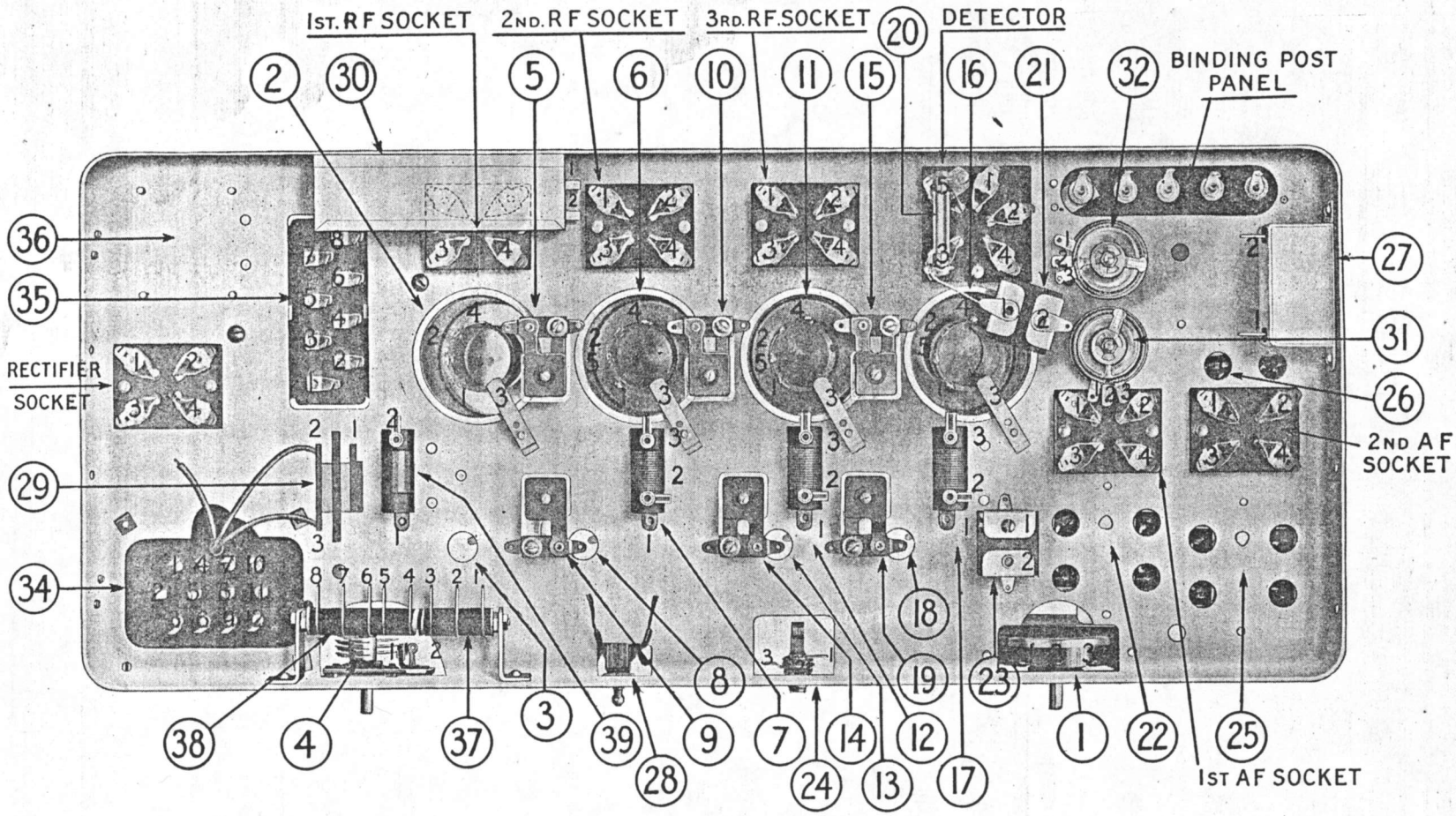

1ST. R F SOCKET
2ND. R F SOCKET
3RD. R F. SOCKET
DETECTOR
BINDING POST PANEL
RECTIFIER SOCKET
2ND A F SOCKET
1ST AF SOCKET
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 34 35 36 37 38 39

Fig. 20

The sub-headings in this section are numbered to correspond with Table 3. By consulting this table the proper test can be readily found.

Table No. 3

1. No Filament Voltage on Receiver and Pilot Lamp not lit.
2. No Plate Voltage on Receiver.
3. No Filament Voltage on 1st R. F., 2d R. F., 3d R.F. and 1st A. F.
4. No filament Voltage on Detector.
5. No Filament Voltage on 2d A. F. and Pilot Lamp not lit.
6. No Filament Voltage on 2d A. F.—Pilot Lamp lit.
7. No Plate Voltage—Filament of Rectifier Tube not lit
8. No Plate Voltage on one or more Tube Sockets.
9. No Plate Voltage on 1st R. F., 2d R. F., 3d R. F.
10. No Plate Voltage on 1st A. F.
11. No Plate Voltage on Detector.
12. No Plate Voltage on 2d A.F.
13. Low Plate Voltage on all Sockets.
14. Low Plate Voltage on 1st R. F., 2d R. F., 3d R. F.
15. Low Plate Voltage on Detector.
16. Low Plate Voltage on 1st A. F.
17. No Grid Bias Voltage on Sockets.
18. Incorrect Grid Bias Voltage to 1st R. F., 2d R. F., 3d R. F., 1st A. F. and 2d A. F.
19. No Plate Voltage and no Grid Bias Voltage to 1st R. F., 2d R. F., 3d R. F. and 1st A. F.
20. No Grid Bias Voltage on 1st R. F., 2d R. F., 3d R. F. and 1st A. F.
21. No Grid Bias Voltage on 1st R. F., 2d R. F. or 3d R. F.
22. No Grid Bias Voltage on 1st. A. F.
23. No Grid Bias Voltage on 2d A. F.
24. Plate Current Low or High with all Tube Voltages Correct
25. Pilot Lamp not lit.
26. Fixed Condensers.
27. Voltage Drop across "B - C" Resistors.
28. General.

Before proceeding with the continuity test, it will be necessary to remove the metal plate which covers the bottom of the receiver. On the wood cabinet models the chassis must be removed from the cabinet in order to do this.

To remove the chassis, first, remove the back of the wood cabinet. With this back off two stops will be seen on the drawer which holds the receiver to prevent it from being pulled out too far. Remove these stops so that the drawer can be taken out. After taking out the drawer the chassis can be removed easily by loosening the four hold-down bolts.

1. No Filament Voltage on Receiver and Pilot Lamp Not Lit—Make sure the socket to which the radio set is connected is alive and in good condition. This can be done by means of a 25-watt lamp connected to an A.C. plug. Insert the test lamp in the socket and move it around in the socket to make sure the spring contacts do not cut out.

Check the radio receiver power switch to make sure that the switch is not defective. With the receiver plug in the socket and the switch in the "ON" position (to the right), an A.C. Voltmeter reading across the switch leads indicates a defective switch. With the switch in the "OFF" position (to the left) no reading indicates an open transformer primary winding, open A.C. lead or a defective primary tap switch.

With the power switch in the "ON" position (to the right) and the primary tap

switch in the LOW position (to the front) with an A.C. voltmeter check across terminals (1 - 3) of the primary tap switch. A reading indicates an open switch or poor contact. With the switch in the HIGH position (to the rear) a reading across terminals (1 - 2) indicates an open switch or poor contact.

The A.C. cord is connected to the terminal (1) of the primary tap switch and spliced to the lead of the power switch. The green and red leads from the power transformer are connected to terminals (2 - 3) of the primary tap switch respectively. If no reading is obtained on either of these terminals, check with an A.C. voltmeter across terminal (6) of the condenser ㉟ and terminal (1) of the primary tap switch. A reading indicates that the cord and receptacle are O.K. and that the transformer primary is open.

2. No Plate Voltage on Receiver—Try another rectifier tube which is known to be good. If the rectifier tube filaments are lit and no difference is noted in the results proceed according to No. 8.

3. No Filament Voltage on 1st R. F., 2d R. F., 3d R. F., and 1st A. F.—If filament voltage is obtained on one or more of these sockets but not on all then the trouble is due to connections between the sockets. Look for loose connections or wires broken off the terminals (1 or 2) of the tube socket.

If no filament voltage is obtained on any of these sockets, check the power transformer terminals (8 - 11) with an A.C. voltmeter. If the correct reading is secured here the trouble lies in the connections between the transformer terminals and the terminals (1 - 2) of the ~~1st R. F. socket.~~ 3rd R.F. Socket

No reading at the transformer terminals indicates a defective transformer secondary. Remove wires from transformer terminals and verify at the transformer terminals again. A reading after the leads have been lifted indicates a shunt in the leads or across the terminals of hum adjuster ㉛.

4. No Filament Voltage on Detector—Check the power transformer terminals (9 – 12). If the correct reading is obtained, the trouble lies between the transformer terminals (9 – 12) and terminals (1 – 2) of the socket.

No voltage indicates a defective transformer. Remove the wires from the terminals and verify at the transformer again. A reading after the leads have been lifted indicates a shunt in the leads, or across terminals of hum adjuster ㉜.

5. No Filament Voltage on 2d A. F. and Pilot Lamp Not Lit—With an A.C. voltmeter, check the terminals (4 – 6) of the transformer. If the correct reading is obtained, the trouble lies between the transformer terminals (4 – 6) and terminals (1 – 2) of the socket.

No voltage indicates a defective transformer. Remove the wires from the terminals and verify. A reading after the leads have been lifted indicates a shunt in the filament leads or in the leads to the dial lamp.

6. No Filament Voltage on 2d A. F.—Pilot Lamp Lit—There must be an open circuit between the transformer terminal (4 – 6) and the socket terminals (1 – 2). Locate with an A.C. voltmeter.

7. No Plate Voltage—Filament of Rectifier Tube Not Lit—If a check of the terminals (1 – 2) of the rectifier tube socket shows no filament voltage, check the transformer terminals (7 – 10) with an A.C. voltmeter. A reading indicates an open between the transformer and the socket. No reading indicates a defective secondary.

8. No Plate Voltage on One or More Tube Sockets—If one or more tube sockets, but not all, have plate voltage then the trouble lies between the terminal (2) of the large block condenser and the socket ter-

positive prod on the terminal to be tested. If no plate voltage is obtained on the detector socket terminal (4), check the voltage on terminal (2) of the 1st A. F. transformer. A reading here indicates an open between the transformer and the socket. If no reading is obtained here, test to terminal (1) of the transformer. A reading here will then indicate an open primary winding.

If no reading is obtained here, test to the spring terminal (3) of the phonograph pick-up jack. A reading indicates an open between the spring and the transformer. If no reading is obtained on the spring terminal (3), check to the spring terminal (2). A reading here indicates poor or open contact between springs (2) and (3) of the phonograph pick-up jack. If no reading is obtained on spring terminal (2), check to terminal (1) of the ㉟ condenser. A reading indicates an open between the condenser and the spring terminal (2).

If no reading is obtained on condenser terminal (1), check terminal (5) of the ㊲ resistor. A reading here but not on the condenser indicates an open in the wiring between the resistor and the condenser.

If a reading is obtained on terminal (4) of the resistor, but not on terminal (5), then the resistor is faulty. No reading on terminal (4) of the resistor indicates an open between the resistor and condenser terminal (2).

Terminals (4) and (5) may be either on a separate unit with a separate mounting or with terminals (1), (2) and (3) of the ㊲ resistor. In either case the test should be conducted as outlined above. When terminals (4) and (5) are in the same unit as (1), (2) and (3), terminals (4) and (2) are strapped together.

12. No Plate Voltage on 2d A. F.—Test with a high resistance D.C. voltmeter, placing the negative prod on the center tap terminal (2) of hum adjuster ㉜ and the positive prod on the terminal to be tested.

If a plate voltage reading is obtained on terminal (1) of the audio choke, but not on terminal (2), a defective choke coil is present. If correct readings are obtained on both terminals, there must be an open between the terminal (2) and the socket terminal (4).

No reading on terminal (1) of the audio choke coil indicates an open between terminal (2) of condenser ㉟ and the audio choke ㉖.

13. Low Plate Voltage on all Sockets—If there is low plate voltage on all tubes, first try a rectifier tube which is known to be good. If the trouble is not in the tube it must be either the power transformer or a leaky condenser.

To check the transformer, test with an A.C. voltmeter across the terminals (1 – 2) and (2 – 3). With normal line voltage both readings should be 187.5 volts.

Condenser ㉟ can be checked according to Table 4.

14. Low Plate Voltage on 1st R. F., 2d R. F. and 3d R. F.—This will be caused by a defective ㊲ resistor. Check between terminals (2 – 3) of the resistor ㊲.

15. Low Plate Voltage on Detector—This is probably due to faulty resistor, terminals (4–5) of ㊲.

16. Low Plate Voltage on 1st A. F.—This is probably due to faulty resistor, terminals (1–2) of ㊲.

17. No Grid Bias Voltage on Sockets—If there is no grid bias voltage on any of the sockets, then there is an open circuit between the ground and terminal (5) of condenser ㉟ or between terminal (5) of the condenser and terminal (7) of the ㊳ resistor.

18. Incorrect Grid Bias Voltage to 1st R. F., 2d R. F., 3d R. F., 1st A. F. and 2d A. F.—If the grid bias voltages on all the sockets are incorrect, it is due to a reversal of the center tap leads to the hum adjusters ㉛ and ㉜.

minals. Proceed as indicated under the proper heading.

If, with a good rectifier tube in place, no plate voltage is obtained, test with a high resistance, high scale D.C. voltmeter, placing the negative prod on the transformer terminal (2) and the positive prod on the terminal (2) of the rectifier tube socket. No reading here indicates an open transformer secondary. Verify by removing the wires from terminals (1 and 3). Test with an A.C. voltmeter across terminals (1 - 2) and terminals (2 - 3). No reading at either set of these terminals indicates a defective transformer secondary.

A shunted filter condenser, if present, will cause either low or no plate voltage. With the transformer terminals connected again and the high resistance D.C. voltmeter connected across the transformer terminal (2) and the socket terminal (2), disconnect the wires from the condenser terminals one at a time in the following order: First, terminal (7); second, terminal (3); third, terminal (2). Watch the voltmeter to see which operation removes the trouble.

9. No Plate Voltage on 1st R. F., 2d R. F., 3d R. F.—If plate voltage is obtained on any one of these sockets but not on all, the trouble must be in the connections between the sockets, in the R. F. coils or in the resistors ⑦, ⑫, or ⑰ which are in series between these stages. Test with a high resistance D.C. voltmeter, placing the negative prod on terminal (6) of the resistor ㊳ and the positive prod on the terminal to be tested. If a reading is obtained on the R. F. coil terminal (2), there is an open between this terminal and the socket terminal (4). If the reading is obtained on the R. F. coil terminal (1) but not on (2), then the R. F. coil primary winding is open.

If reading is obtained on terminal (2) of the ⑦, ⑫ or ⑰ resistors but not on terminal (3), then the resistor is open.

If a reading is obtained on the ⑦, ⑫ or ⑰ resistor terminal (3) but not on the R. F. coil terminal (1), then there is an open between the resistor and the coil.

The resistor terminal (2) is connected to the resistor terminal (3) in the succeeding R. F. stage. Any open in these resistors or in the wiring between them can be readily detected by means of the voltmeter test as outlined above.

If no plate voltage is obtained on any of the R. F. sockets, check with a high resistance D.C. voltmeter, placing the negative prod on terminal (6) of the ㊳ resistor and the positive prod on the terminal to be tested. A reading on terminal (2) of ⑰ but not on terminal (3), indicates an open resistor. No reading on terminal (2) of ⑰ but the correct reading on (3) of the ㊲ resistor, indicates an open between the resistor ㊲ and the resistor ⑰. A reading on terminal (2) but not (3) of the ㊲ resistor indicates a defective resistor.

10. No Plate Voltage on 1st A. F.—Test with a high resistance D.C. voltmeter, placing the negative prod on the terminal (6) of the ㊳ resistor and the positive prod on the terminal to be tested. If no plate voltage is obtained on the socket terminal (4), check voltage on the audio transformer terminal (2). A reading here indicates an open between the audio transformer and the socket. If a reading is obtained on the transformer terminal (1) but not on (2), then the primary winding of the transformer is open. If no reading is obtained on the audio transformer terminal (1), test the terminal (1) of the ㊲ resistor. A reading here denotes an open between this resistor and the A. F. transformer terminal (1). If a reading is obtained on terminal (2) of the ㊲ resistor, but not on terminal (1), then this resistor is open. A reading on condenser terminal (2), but not on the resistor terminal (2), indicates an open between the condenser and the resistor.

11. No Plate Voltage on Detector—Test with a high resistance D.C. voltmeter, placing the negative prod on the center tap terminal (2) of the hum adjuster ㉜ and the

positive prod on the terminal to be tested. If no plate voltage is obtained on the detector socket terminal (4), check the voltage on terminal (2) of the 1st A. F. transformer. A reading here indicates an open between the transformer and the socket. If no reading is obtained here, test to terminal (1) of the transformer. A reading here will then indicate an open primary winding.

If no reading is obtained here, test to the spring terminal (3) of the phonograph pick-up jack. A reading indicates an open between the spring and the transformer. If no reading is obtained on the spring terminal (3), check to the spring terminal (2). A reading here indicates poor or open contact between springs (2) and (3) of the phonograph pick-up jack. If no reading is obtained on spring terminal (2), check to terminal (1) of the ㉟ condenser. A reading indicates an open between the condenser and the spring terminal (2).

If no reading is obtained on condenser terminal (1), check terminal (5) of the ㊲ resistor. A reading here but not on the condenser indicates an open in the wiring between the resistor and the condenser.

If a reading is obtained on terminal (4) of the resistor, but not on terminal (5), then the resistor is faulty. No reading on terminal (4) of the resistor indicates an open between the resistor and condenser terminal (2).

Terminals (4) and (5) may be either on a separate unit with a separate mounting or with terminals (1), (2) and (3) of the ㊲ resistor. In either case the test should be conducted as outlined above. When terminals (4) and (5) are in the same unit as (1), (2) and (3), terminals (4) and (2) are strapped together.

12. No Plate Voltage on 2d A. F.—Test with a high resistance D.C. voltmeter, placing the negative prod on the center tap terminal (2) of hum adjuster ㉜ and the positive prod on the terminal to be tested.

If a plate voltage reading is obtained on terminal (1) of the audio choke, but not on terminal (2), a defective choke coil is present. If correct readings are obtained on both terminals, there must be an open between the terminal (2) and the socket terminal (4).

No reading on terminal (1) of the audio choke coil indicates an open between terminal (2) of condenser ㉟ and the audio choke ㉖.

13. Low Plate Voltage on all Sockets—If there is low plate voltage on all tubes, first try a rectifier tube which is known to be good. If the trouble is not in the tube it must be either the power transformer or a leaky condenser.

To check the transformer, test with an A.C. voltmeter across the terminals (1 – 2) and (2 – 3). With normal line voltage both readings should be 187.5 volts.

Condenser ㉟ can be checked according to Table 4.

14. Low Plate Voltage on 1st R. F., 2d R. F. and 3d R. F.—This will be caused by a defective ㊲ resistor. Check between terminals (2 – 3) of the resistor ㊲.

15. Low Plate Voltage on Detector—This is probably due to faulty resistor, terminals (4–5) of ㊲.

16. Low Plate Voltage on 1st A. F.—This is probably due to faulty resistor, terminals (1–2) of ㊲.

17. No Grid Bias Voltage on Sockets—If there is no grid bias voltage on any of the sockets, then there is an open circuit between the ground and terminal (5) of condenser ㉟ or between terminal (5) of the condenser and terminal (7) of the ㊳ resistor.

18. Incorrect Grid Bias Voltage to 1st R. F., 2d R. F., 3d R. F., 1st A. F. and 2d A. F.—If the grid bias voltages on all the sockets are incorrect, it is due to a reversal of the center tap leads to the hum adjusters ㉛ and ㉜.

19. No Plate Voltage and no Grid Bias Voltage to 1st R. F., 2d R. F., 3d R. F. and 1st A. F.—When this condition is noted there must be an open resistor ㊳, terminals (6–7), the lead from the resistor to the ㉛ hum adjuster is open or an open in the leads from the 1st A. F. socket to the ㉛ hum adjuster.

20. No Grid Bias Voltage on 1st R. F., 2d R. F., 3d R. F. and 1st A. F.—When this condition is noted there is a ground on the filament circuit, a grounded ㉛ hum adjuster, a ground in the lead from the resistor to the hum adjuster or the terminal (6) of the ㊳ resistor is grounded.

21. No Grid Bias Voltage on 1st R. F., 2d R. F. or 3d R. F.—If grid voltage is obtained on one or more, but not all of these sockets, check with a high resistance, low-scale D.C. voltmeter, placing the positive prod on the terminal (6) of the ㊳ resistor and the negative prod on the terminal to be tested. Test to the grid terminal (3) of the socket. If no reading is obtained then there is an open between the grid terminal (3) of the socket and the ground terminal (3) of the R. F. transformer. This open might be between the socket terminal (3) and the coil terminal (4), the ground connection at the coil terminal (3) or an open winding of the transformer. Verify the location with the voltmeter. A reading on the transformer terminal (3) or (5), but not on (4), indicates an open coil.

The wiring to the 1st R. F. grid is special. The grid lead is connected to the bronze switch spring mounted on the range control ④. This continuously makes contact with either the stator or the rotor. When making contact with the rotor, the R. F. coil is cut out and the grid grounded through the rotor. When making contact with the stator, the grid is grounded through the R. F. coil. When testing, be sure to test with the switch spring in both positions.

22. No Grid Bias Voltage on 1st A. F.—Test with a high resistance, low-scale D.C. voltmeter, placing the positive prod on the terminal (6) of the ㊳ resistor and the negative prod on the terminal to be tested. Test to the 1st A. F. socket terminal (3). If no reading is obtained, then there is an open between the grid terminal (3) of the socket and the transformer terminal (4), the ground connection at the transformer terminal (3) or an open secondary winding of the transformer. Verify the location with a voltmeter. A reading on the terminal (3) but not on terminal (4) indicates an open A. F. transformer.

23. No Grid Bias Voltage on 2d A. F.—Test with a high resistance, low-scale D.C. voltmeter, placing the positive prod on terminal (8) of the ㊳ resistor and the negative prod on the terminal to be tested. Test to the 2d A. F. socket terminal (3). If no reading is obtained, then there is an open between the grid terminal (3) of the socket and the transformer terminal (4), the ground connection at the transformer terminal (3) or an open secondary winding of the transformer. Verify the location with a voltmeter. A reading on the terminal (3) but not on terminal (4) indicates an open A. F. transformer.

24. Plate Current Low or High with all Tube Voltages Correct—If filament, plate and grid bias voltages are correct and the plate current is either high or low, there must be a defective tube. Check this by replacing it.

25. Pilot Lamp Not Lit—If there is filament voltage on the 2d A. F. socket but the pilot lamp is not lit, remove the lamp and insert one that is known to be good. If the good lamp does not light, test with an A.C. voltmeter across the terminals of the lamp socket. No reading indicates an open between the lamp socket and the power transformer terminals (4 – 6).

26. Fixed Condensers—With the receiver turned on all of the fixed condensers can be checked by reading the D.C. voltage

across each one with a high resistance D.C. voltmeter. Table 4 shows what the normal voltage reading should be across each condenser.

Table No. 4

D.C. Voltage Across Condensers

Condenser No.	Terminal No.	Capacity	Use	Number Used	Voltage With Normal A.C. Line
㉟	3 – 7	2 mf.	B Filter	1	178
㉟	2 – 3	3 mf.	B Filter	1	170
㉟	2 – 5	4 mf.	B Filter	1	162
㉟	4 – 5	1 mf.	B Filter	1	96
㉟	1 – 5	.4 mf.	B Filter	1	35
㉗	1 – 2	.5 mf.	Output	1	135
⑦, ⑫, ⑰	1 – 3	.1 mf.	R. F. Plate	3	90
㉚	1 – Gnd. 2 – Gnd.	.5 mf.	R. F. Filament	2	5.5
㊴	1 – 2	.1 mf.	C	1	27
㉓	1 – 2	.001 mf.	Det.	1	33

Note: In addition to the D.C. voltage on condenser ㉗, there will be impressed an A.C. voltage of approximately 90.

Condenser ㉚ terminals should each show a reading of 5.5 volts to ground. Failure to get this reading will be due to a poor ground connection on the condenser, a loose connection to the terminals (1 or 2) of the 2d R. F. socket or a defective condenser.

Condensers ⑦, ⑫ and ⑰ should show a 90-volt reading across their terminals. Failure to get this reading will be due to a poor ground connection to the condenser, a poor connection to the terminal (1) of the R. F. transformer or a shorted condenser. If a shorted condenser is present it will affect the plate voltage of the Receiver.

Condenser ㉓ should show a 33-volt reading across its terminals. Failure to get this reading will be due to a poor ground connection on the condenser, a poor connection to terminal (2) of the 1st A. F. transformer or a shunted condenser. A shunted condenser will cause motor-boating and no plate voltage.

Condenser ㉗ should show a reading of 135 volts across its terminals. Failure to get this reading will be due to a poor connection between the condenser and the loud speaker jack, between the condenser and the terminal (2) of the audio choke coil or a shunted condenser. A shunted condenser will cause low or no voltage on the receiver.

27. Voltage Drop Across "B-C" Resistors—Table 5 shows what the voltage drop should be across the various sections of resistors ㊲ and ㊳.

Use a high resistance D.C. voltmeter for these readings.

Table No. 5

Lug Numbers	Voltage Drop
1 – 2	66
2 – 3	66
4 – 5	127
6 – 7	6
7 – 8	27

28. General—When a careful tube and set test does not reveal any cause for trouble and still the Receiver will not operate, the following suggestions might help.

A grounded aerial terminal will kill all signals. Make sure the radio set is connected to a live socket and the switch is in the ON (to the right) position. Testing with a high resistance D.C. voltmeter, place the positive prod on one of the loud speaker terminals and the negative prod on the aerial terminal. Have the volume control knob turned clockwise to the position of maximum signal strength and note the reading. Then turn the volume control knob counter-clockwise to the position of minimum signal strength. The voltage reading should be lower. If the same reading is obtained with the volume control knob in both positions, either the aerial binding post is grounded or the aerial itself is grounded. Disconnect the aerial lead-in from the set and verify.

An open in the aerial circuit will diminish the signal strength so that only the most powerful stations will be audible. To locate, place the positive prod on one of the speaker terminals and the negative on the aerial terminal. A reading indicates a closed circuit to ground. To verify, turn the volume control clockwise to the position of maximum signal strength and note the reading. Then turn the volume control counter-clockwise to a position of minimum signal strength. No decrease in the reading indicates an open ground connection on terminal (1) of the 1st R. F. coil, open winding or an open between terminal (2) of the 1st R. F. coil ② and terminal (2) of the volume control.

A grounded hum adjuster will cause an A.C. hum, faint and distorted signals and low grid and plate voltages.

If the receiver will not tune sharply, examine the tuning condensers visually to note that the wires connected to the terminals at the base of the condensers are securely soldered. Next, note whether or not the stators and the 4 rotors are in the same relative position when the dial is set at 100; at 0.

CAUTION: Do not attempt to align the rotors of the tuning condenser. This can be done only by the use of very delicate apparatus which is not available in the field. If positive that the trouble lies in the alignment of the condenser rotors, remove the entire condenser and return for adjustment.

The small compensating condensers are adjusted and sealed at the factory. If there is positive evidence these have been disturbed, re-adjust. Full instructions are given on page 34.

The neutralizing condensers have been adjusted and sealed at the factory. Unless there is positive evidence these have been disturbed and that the radio stages are not correctly neutralized, do not touch. When absolutely certain, readjust. Follow closely the instructions given on page 33.

If the sleeve and springs of the phonograph pick-up jack are shunted, no signal will be heard in the receiver. Check with a high resistance D.C. voltmeter, placing the positive prod on terminal (2) and the negative prod on terminal (1) of the phonograph pick-up jack. A reading of 2 volts indicates a normal drop in the transformer primary. No reading indicates a shunted jack. To verify, remove the wire from terminal (1) of the pick-up jack. Place the positive prod on terminal (2) of the jack and the negative prod on terminal (2) of the 1st A. F. transformer. No reading indicates that the primary winding of the 1st A. F. transformer is shunted. A 2 volt reading indicates the transformer is right but the trouble is in the jack.

If the sleeve is grounded the receiver will motor-boat and the plate voltage will be zero. If the spring is grounded the receiver will be dead and there will be no plate voltage.

Oscillator

A simple and effective A.C. oscillator which operates on the A.C. lighting line can be made with little expense in the following manner:

Wrap 100 turns of No. 22 wire on a Formica or Bakelite tube 1¾ inches by 4 inches long. Start the winding ¼ inch in from the end of the tube and loop for a center tap on the fiftieth turn. Keep the winding tight, smooth and free from kinks.

An R. F. choke can be made up of No. 28 wire in the form of a small doughnut coil. This coil can be wound on the fingers and consists of 100 turns. The finished coil should be about 1¼ inches outside diameter. The windings can be held in place by covering with a narrow strip of friction tape.

The rest of the equipment needed is:

A variable condenser—almost any variable condenser with capacity .0003 to .0005 mfd. will do.

201-A tube and tube socket.

25-watt, 115-volt lamp and lamp socket.

A fixed condenser, .001 mfd. capacity.

115-volt A.C. switch.

Attachment plug and cord.

The apparatus, with the exception of the switch and variable condenser, can be mounted on a base board 5 inches by 6½ inches. The apparatus should be housed in a metal can so that it is completely shielded. The condenser and switch can be mounted on the side of the can.

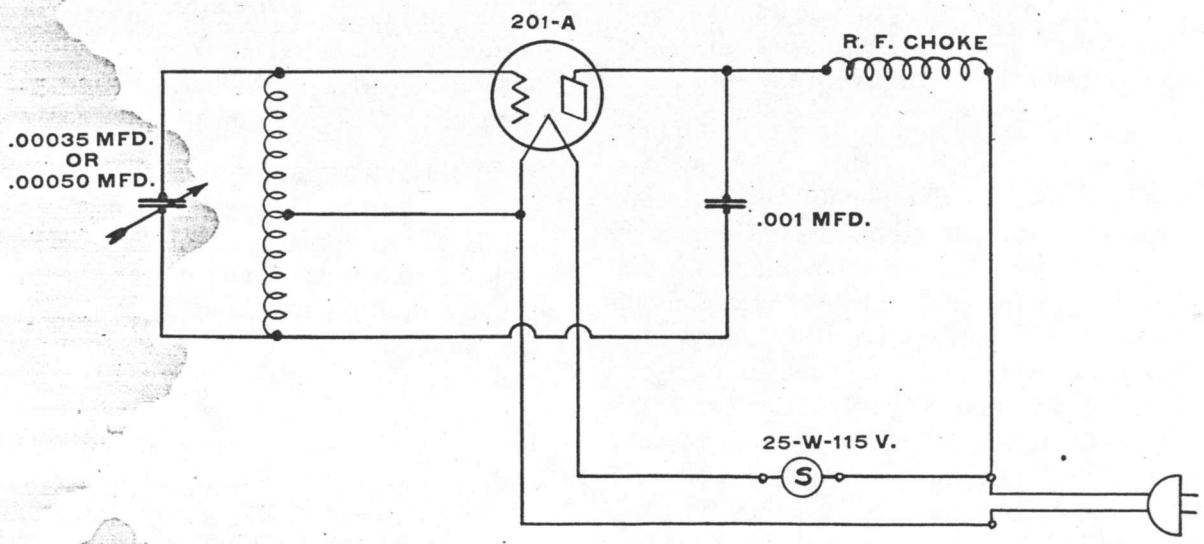


Fig. 21

Adjusting Neutralizing and Compensating Condensers

Neutralizing Condensers—The best method of adjusting these is by means of a dummy tube using an oscillator. A full description of a simple but useful dummy tube is given on page 34.

When adjusting the neutralizing condensers use an antenna consisting of a single wire 25 feet long, supported by insulators at least two feet away from any parallel wall or floor, and a good ground connection. Connect the attachment plug to a live socket and have the switch in the ON position (to the right). Set the Station Selector between 40 and 50. Adjust the oscillator until the signal is heard in the Speaker, then tune the Receiver to the strongest signal. The final

setting of the Receiver scale should be approximately 45. Turn the Volume Control to full volume.

Remove the third (next to the detector) R. F. tube (326 or 226 type) and insert the dummy tube. With the regular tube removed, the signal should be strong. When the dummy tube is inserted, the volume should diminish. The correct adjustment of the neutralizing condenser is obtained when the minimum signal point is reached. This adjustment is quite critical and should be made using a special wrench made of fibre or some other insulating material. (The neutralizing condensers can be located on Fig. 20 and are adjusted from the bottom of the Receiver.)

Repeat this procedure for the 2d R. F. and the 1st R. F. stage. It is important that the neutralizing be done with the Volume Control on full and with the Receiver scale setting between 40 and 50. After neutralizing in this manner, the Receiver should not oscillate at any point of the scale.

Dummy Neutralizing Tube—Select a UX-226 or CX-326 tube which gives normal results when used in a Philco Receiver. Saw off one of the filament prongs about ⅛ inch below the Bakelite base of the tube. With the prong cut off at this point it will not make contact in the socket so the filament of the tube will not light.

It is very important to carefully select the tube that is to be used for this purpose. Test a number of tubes by using them in one of the R. F. stages of the Receiver and select one which gives average normal results.

Compensating Condensers—When adjusting the compensating condensers use an antenna consisting of a single wire 25 feet long, supported by insulators at least two feet away from any parallel wall or floor, and a good ground connection. Connect the attachment plug to a live socket and have the switch in the ON position (to the right). Set the Station Selector between 40 and 50. Turn the Range Control so that the rotor is meshed half way with the stator. Do not change this position throughout the adjustment. Adjust the oscillator until the signal is heard in the Speaker, then tune the Receiver to the strongest signal without changing the setting of the Range Control. The final setting should be approximately 45. The regular tubes are to be used in the Receiver throughout this adjustment.

Using a special wrench made of fibre or some other dielectric, turn the adjusting screws of the compensating condensers. (The compensating condensers can be located in Fig. 20 and are adjusted from the bottom of the Receiver.)

Using the Volume Control, cut down the volume until the signal is barely audible. Then adjust each one of the three compensating condensers until the maximum volume is obtained. It is not necessary to adjust the three in any special order—simply make sure that each is adjusted for maximum signal strength.

After adjusting the three compensating condensers as explained above, disconnect the oscillator and then turn the Volume Control of the Receiver on full and test the Receiver to see whether or not it is oscillating. Do this by turning the Station Selector knob slowly over the complete scale from 0 to 100.

If the Receiver oscillates at any point on the scale, give the first compensating condenser (No. ⑨ as shown in Fig. 20) ⅛ to ¼ of a turn in the clockwise direction. Do not turn it more than ¼ of a turn, usually less will be sufficient to prevent oscillating.

If this does not stop the oscillating, recheck both the neutralizing and compensating condensers.

If both neutralizing and compensating condensers are to be adjusted, do the neutralizing first.

Speaker

If a Philco Speaker is thought to be defective, compare the reception with that obtained when using another one.

The Philco Speaker unit itself is not adjustable but the Speaker tone filter can be checked and, if necessary, replaced. To check this filter remove the wires from the two lower lugs of the tone filter. This is the small cylindrical unit that is mounted on the left side of the Speaker driving unit. Splice these wires together and test Speaker again. If the Speaker operates satisfactorily there is condenser trouble in the tone filter and the tone filter must be replaced with a new one.

If no improvement is noticed remove the wires from the two top lugs and splice together. If the Speaker operates satisfactorily there is trouble in the tone filter choke coil and the tone filter unit must be replaced. If the trouble is still present the Speaker unit is defective.

There are no adjustments to be made to the Philco Speaker unit. If a table model Speaker unit is not operating as it should, return the complete Speaker. If a Speaker unit in one of the cabinet models is defective, remove the Speaker unit from the cabinet and return it. Care should be taken in packing so that the cone is not damaged.

Polishing Cabinets

Philco cabinets can be re-polished with any first-class furniture polish, or preferably wax polish. The following will apply to either wax or furniture polish. Moisten a soft cloth with the furniture polish or wax and rub in a circular motion all over the woodwork, including the corners. After this is done, it should be thoroughly wiped off with a soft, clean cloth, making sure that all the polish is cleaned out of the corners and carvings. The harder the woodwork is rubbed with a soft, clean cloth, the better the results.

Interference

The Philco Receiver has been designed as well as possible to eliminate noises. The selectivity of the Receiver has cut down to a minimum the interference caused by stations broadcasting in adjacent channels but in some sections interference produced by causes other than radio itself is annoying. The correction of a number of these causes of interference is fortunately quite simple. The noises caused by household appliances can be corrected at the radio user's home. The other troubles must be taken up with the proper people.

Following are listed some of the more common causes.

Household Appliances—Small motors, such as those used for oil burners, refrigerators, washing machines, vacuum cleaners and other portable appliances found in the home, are quite often the cause of interference noise. It will generally be found that the connection of a high-test condenser of about ¼ mfd. capacity across the commutator will end the noises. It is also suggested that the commutator and the brushes be cleaned thoroughly as a further protection against sparking.

Interference caused by a resistance wire heating element such as an electric iron is generally the result of bad insulation and can be eliminated by the repair of the unit.

A bad contact is a common cause of noises in a radio set and this contact may be in any one of a number of places around the house. Loose fuses, loose connections, electric lamps partly unscrewed from their sockets and similar things will cause the trouble. A vibrating rectifier or any other equipment with a make and break contact can be quieted by connecting a 1 mfd. condenser across the terminals.

Heating pads, refrigerators, oil heaters and similar types of appliances are often controlled by thermostats. The operation of

the thermostat is at widely separated periods but if they do become annoying a ¼ mfd. condenser across the input will usually help. On most thermostats it is possible to get at the contacts of the thermostat itself and put the condenser directly across the contacts.

Industrial Applications—The interference caused by industrial equipment can usually be traced down to its source by noting the time of hearing. The arc lights are occasional offenders but it is not difficult to check the time the noise starts with the time the lights are lit. If the trouble appears to be caused by these lights the local electric light company should be notified and in practically all cases will do everything possible to correct it.

Street cars frequently cause interference and this again can be checked by noting whether the noise is heard at the time a car is passing. The operating company should again be notified if the cars cause the trouble.

Motors in industrial plants cause interference which must be taken care of at the machine itself. If, from the time of occurrence, the noise is traced to an industrial plant the management will in most cases be glad to suppress it. This can usually be done by means of filters consisting of either one condenser across the brushes or two condensers across the brushes with a tap between the two grounded. In some cases a choke in one of the leads in addition to the two condensers grounded as above is needed.

Sign flashers or other equipment with make and break contacts can usually be quieted by connecting a 1 mfd. condenser across the terminals.

Power Circuits—Street lighting circuits may cause considerable interference noise due to bad transformers or leaky insulation. The electric light company will be glad to co-operate in finding and correcting trouble of this kind.

Parts List

Number as given in Figure 20	Name of Part	Factory Part Number (Order by this Number)
①	Volume Control	3076
②	R. F. Transformer (Antenna Tuning)	3075-B
③ – ⑪ – ⑯	R. F. Transformer	3075-A
④	Range Control	3133
	Tuning Condenser (complete with drum and shield)	3001-B
⑤ – ⑩ – ⑮	Neutralizing Condenser	3025-A
⑨ – ⑭ – ⑲	Compensating Condenser	3025-B
⑦ – ⑫ – ⑰	By-Pass Condenser .1 mfd. with Plate Resistance Winding	3114-A
㉓	By-Pass Condenser .001 mfd.	3081
㉚	Filament By-Pass Condenser (2 sections .5 mfd.)	3080
⑳	Grid Leak	3083
㉑	Grid Condenser	3082
㉒ – ㉕	A. F. Transformer	3077
㉔	Phonograph Pick-Up Jack	3087
㉖	Output Filter Choke	3078
㉗	Output Filter Condenser .5 mfd	3079
㉘	Power Switch—Toggle	3117
㉙	Primary Tap Switch	3116
㉛	6-ohm Hum Adjustor	3096
㉜	20-ohm Hum Adjustor	3086
㉝	Pilot Lamp	3105
	Pilot Lamp Socket Assembly	3043-A
	Tube Socket Assembly—4-hole	3051-A
	Tube Socket Assembly—5-hole	3157-A
	Tube Socket Insulator 4-hole—red	3124
	Tube Socket Insulator 4-hole—brown	3070
	Tube Socket Insulator 5-hole—brown	3158
㉞	Power Transformer—50 – 60 cycle	3073
㉞	Power Transformer—25 – 40 cycle	3106
㉟	Filter Condenser Block—50 – 60 cycle	Z-354
㉟	Filter Condenser Block—25 – 40 cycle	Z-381
㊱	Filter Choke Coils	Z-224
㊲ – ㊳	B-C 5-section Resistor	3088 (A)
㊲ – ㊳	B-C 4-Section Resistor	3088 (W)
㊲	B Resistor 70,000 ohms	Z-129
㊴	By-Pass Condenser .1 mfd	3114
	Terminal Panel Assembly	3084-A
	Control Knob-Tuning Condenser	3035-A
	Control Knob—Volume and Range Control	3036-A
	A.C. Attachment Cord and Plug	L-943-A
	Wiring Cable	L-946
	Speaker Tone Filter	2946-B
	Fibre Adjusting Wrench	3164

PHILCO OFFICES

Atlanta, Ga.	665 Glenn Street, S. W.
Boston, Mass.	1123 Commonwealth Ave.
Buffalo, N. Y.	Philadelphia Storage Battery Co. of N. Y. 1669 Main St.
Chicago, Ill.	3335-45 W. 47th St.
Cincinnati, Ohio	Tri-State Ignition Bldg., 212 E. 8th St.
Cleveland, Ohio	510 Commercial Bank Bldg
Dallas, Texas	Philadelphia Storage Battery Co. of Texas, Shannon Bldg., 2403 S. Harwood St.
Kansas City, Mo.	2008-10 McGee St.
Los Angeles, Calif.	Merchants Fire Despatch Bldg., 1149-51 Wall St.
Minneapolis, Minn.	216 3d Ave., N.
New York City	Philadelphia Storage Battery Co. of N. Y., 47 Christopher St.
Pittsburgh, Pa.	218 Park Bldg., 5th Ave. and Smithfield Sts.
Portland, Oregon	54 N. 10th St.
San Francisco, Calif.	218 Fremont St.
St. Louis, Mo.	423 Louderman Bldg., 11th and Locust Sts.
Seattle, Wash.	2024-26 3d Ave.
Syracuse, N. Y.	Philadelphia Storage Battery Co., of N. Y., 202 O. C. S. Bank Bldg.

PHILADELPHIA STORAGE BATTERY CO.

Ontario and C Streets

Philadelphia, Pa.