

ATWATER KENT

RADIO

SERVICE MANUAL

The following pages have been prepared with the idea of enabling the Atwater Kent Radio Dealer to more thoroughly understand the product he is engaged in merchandising, and to more readily locate and correct any condition which might interfere with the proper functioning thereof.

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Table of Contents

	Page
Introduction	3
Section I. Theory of Radio Receivers.....	4
Section II. Planning the Service Department.....	13
Section III. Using the Service Equipment.....	17
Section IV. Troubles Due to Equipment, Location and Installation.....	21
Section V. Outside Interferences—Causes and Remedies.....	23
Section V-a. Descriptive List of Atwater Kent Receivers.....	24
Section VI. Servicing Receivers and A. C. Power Units.....	25
Explanation of Abbreviations.....	25
Model 10B Set.....	26
Model 10 Set.....	27
Model 12 Set.....	28
Model 20 Set.....	29
Model 20 Compact Set.....	30
Models 30, 35 and 48 Sets.....	32
Model 32 Set.....	36
Models 33 and 49 Sets.....	38
Model 50 Set.....	41
Model 36 Set.....	44
"Y" Power Unit (Below Serial No. 260,000).....	48
"Y" Power Unit (Above Serial No. 260,000).....	50
Model 37 Set.....	52
Model 38 Set.....	56
Power Units in Models 37 and 38.....	60
Models 40, 42 and 52 Sets.....	63
Model 44 Set.....	66
Power Units in Models 40, 42, 44 and 52.....	69
Table of Voltages of A. C. Sets.....	71
Section VII. Servicing the B Power Unit.....	72
Section VIII. Chart of Troubles and Probable Causes.....	76
Section IX. Troubles Most Frequently Encountered.....	78
Section X. Servicing Atwater Kent Speakers.....	79
Section XI. Miscellaneous Service Information.....	84
Use of Power Tubes in Battery Type Sets.....	84
Replacement of Rheostat (Battery Type Sets).....	84
Synchronizing Condensers in One-Dial Receivers.....	85
Adjusting Belt Tension.....	86

INTRODUCTION

1. Purpose of Service Manual

The object of the Service Manual is to assist the retailer of Atwater Kent radio products in giving prompt and efficient service to the consumer-owner. Since in accordance with our Radio Service Policy, service on Atwater Kent radio products is to be handled by Atwater Kent dealers and distributors only, this publication should be considered confidential and except in special cases, is furnished only to regularly appointed outlets of Atwater Kent radio merchandise.

2. Importance of Service

Service has "come into its own" during the past few years and its importance is continually becoming more widely recognized. The value of prompt and courteous service by the dealer cannot be over-emphasized. Service is closely linked with sales—in fact the one depends on the other. The radio dealer who has foresight will build for the future by maintaining a neat and efficient repair department and employing a competent service personnel consistent with the size of his organization. There is no better step toward building good-will for Atwater Kent products in his immediate locality.

3. Dealer Service Procedure

The dealer who has a reasonably well equipped service shop will find that he is in a position to handle the servicing of practically any set which comes to him for repair, since the bulk of repairs will not be of a difficult nature.

In the event that he is unable to perform a certain repair, the set or unit should be returned to his local distributor, who maintains a complete service department similar to that of the factory. The distributor will furnish his dealers with complete instructions for return of material, such as making out of return report blanks and other routine in connection with the handling of service matters.

4. Dealer's Parts Stock

We strongly urge that every dealer carry in stock a supply of such repair parts as may be most commonly required for the more popular types of Atwater Kent sets and speakers. This will eliminate the possibility of a dissatisfied customer, resulting from the delay necessarily involved in ordering a part from the distributor.

Newly appointed dealers should consult their distributor regarding a suitable initial stock to be carried.

Repair parts must be purchased from the distributor. No parts are sold direct from factory to dealer.

5. Repair Charges—Warranty Repairs

The charge on a repair job for the consumer, on a set beyond the warranty, may be based on the consumer price of the repair parts used, plus a charge for the time required, at a definite rate per hour. The time charge will cover the time consumed in testing the set when repaired, and in calling for and delivering the set, if this is done.

Our factory warranty on new products, involves the replacement of parts defective in workmanship or mate-

rial, and covers a reasonable length of time. Our distributors are notified by bulletin when certain models pass beyond the warranty period, so that in case of doubt, definite information can always be obtained from the distributor, as to whether a warranty adjustment is in order on a certain model.

In many cases the dealer will find it of advantage to adopt a written "Service Agreement" with the consumer, whereby a charge is made for service calls and repair work after a certain length of time. This will protect both dealer and consumer.

6. Service Policy

A complete printed "Service Policy," definitely outlining the factory's plan on service matters, is sent once a year to our distributors, and such information from this as is required by the dealer will be passed on to him by the distributor. A definite understanding between dealer and distributor on all matters pertaining to service will be the means of preventing much conflict and controversy. It cannot be too strongly urged that all instructions from the distributor be carefully followed, so that complete co-operation will exist. Written instructions, such as bulletins, etc., should be kept handy in a loose-leaf note book.

7. Service Literature

The dealer will do well to keep readily available, ALL literature pertaining to service which comes into his place of business. In addition to the bulletins from your distributor, the factory has a special "Dealer Bulletin Service" which contains various suggestions and ideas along service lines.

There are several excellent monthly radio trade publications which are invaluable to the retail dealer, both from a sales and service standpoint. We believe the small price of annual subscription to several of these magazines will be more than repaid by the excellent information and ideas they contain.

Two or three good text books on radio will also not be out of place on the dealer's book shelf. An easily understandable book on the theory of radio and a practical book on general radio service and repairing are suggested.

8. Factory Service Course

One of the best ways in which the recognized Atwater Kent dealer (or his service man) can familiarize himself more completely with the correct methods of servicing Atwater Kent radio products, is to spend a week or two in our factory Service Department. We have mapped out a "Course" of training to be followed in this work, which completely covers the various steps in repairing, assembling, and testing all models of our Sets, Speakers, and Power Units.

The "Service Course" takes from one to three weeks depending on the ability of the individual. There is no charge for the instructions, but the dealer will naturally furnish the transportation and living expenses connected with this visit to Philadelphia. A letter of introduction from the local distributor is required and must be presented at the factory for identification purposes.

SECTION I

THEORY OF RADIO BROADCAST RECEIVERS

Knowledge of Theory Essential

While the primary purpose of the Service Manual is to instruct the dealer in the testing and repairing of Atwater Kent receiving sets, we believe that an understanding of the fundamental principles of radio and a knowledge of how our sets function will enable him to perform this work more intelligently. It is, of course, essential to know what to do to correct troubles, but a knowledge of the theory and functioning of the various units of the set will enable the repairman to locate the trouble more readily. If an unusual condition arises in a set, a repairman without a knowledge of the principles involved, can correct the trouble by "hit-or-miss" methods only. The service man who has this fundamental knowledge can analyze the condition and then determine the remedy.

Fundamental Principles of Electricity Applied to Radio

Radio is based on electricity and a few of the elementary conceptions of its fundamental principles should be understood before going further. Electricity shows many characteristics of a fluid such as water, but unlike water, it apparently has no substance, and its presence can be determined only by the effect. Its force, quantity and other properties, however, can be determined and measured by electrical instruments.

In the pipe line shown in Fig. 1, there is a complete circuit of water which is flowing through the pipes as a result of the force exerted by the pump. The left-hand sketch is a diagram of an electrical circuit in which the electricity is flowing as a result of the force exerted by the batteries. There is a definite amount of water flowing in the pipe line and there is likewise a definite amount of electricity flowing in the electrical circuit.

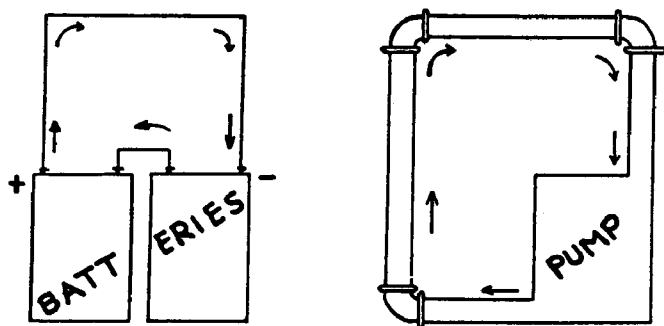


FIG. 1. COMPARISON OF ELECTRIC CURRENT WITH WATER.

The quantity of electricity flowing is measured in units called amperes.

The water has a certain pressure forcing it through the circuit. The electrical circuit likewise has a definite pressure, which is measured in units called volts. In the water circuit there is a certain amount of resistance due to the friction offered to the water by the sides of the pipe. This resistance is obviously greater in a small pipe than in a large one. The electrical circuit likewise has a resistance depending upon the gauge of the wire, its

length and the material of which it is made. Electrical resistance is measured in units called ohms.

In the diagram shown in Fig. 1, the water and electricity flow in one direction only. This type of electrical current and all currents produced by batteries is known as direct current.

Alternating Current

Alternating current may be compared to the sort of water flow illustrated in Fig. 2. Instead of being forced continuously in one direction by a pump, it is pushed first in one direction and then the other by the piston "P." If the rate at which the piston moves back and forth is constant, it corresponds to the frequency of an alternating current, which is generally expressed in "cycles" per second.

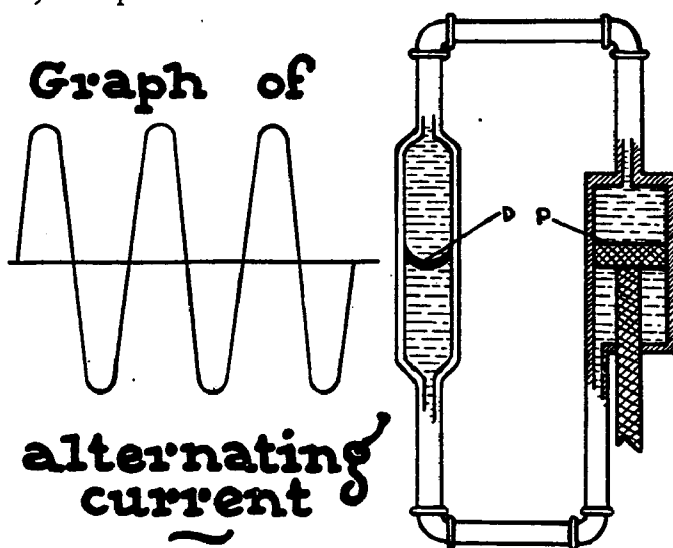


FIG. 2. ALTERNATING CURRENT IS SIMILAR TO ALTERNATING WATER FLOW.

The diagram (Fig 2) is a graphical representation of alternating current. The current is built up to a certain voltage in one direction, falls back to zero voltage, builds up an equal voltage in the other direction, and again returns to zero. The two directions are known as positive and negative, and alternating current consists of a series of such alternations in direction, expressed in cycles per second. In the case of "radio" frequency currents, these alternations are very rapid, the frequency ranging approximately from 500,000 to 1,500,000 cycles per second.

Condensers

The action of the flexible diaphragm "D" illustrates the action of a fixed condenser in a circuit of alternating current. The diaphragm would stop a direct flow of water, but allows it to surge back and forth. A condenser likewise acts as an insulator to a circuit of direct current, but not to a circuit of alternating current of high frequency. It will be seen later how this property of a fixed condenser is used in our receiving sets.

A condenser is fundamentally a unit for storing electricity, and its ability to do this is termed capacity, expressed in units called farads. This is a very large unit, however, and the practical unit of capacity is the micro-farad which is one millionth of a farad.

A fixed condenser (one of constant capacity) consists of two or more parallel metallic plates, which are separated from each other by mica, air or another insulator. The capacity of a condenser depends upon the number and size of the metal plates, the distance between them and the insulating material. In the case of our by-pass condenser, which must have a comparatively large capacity, the metallic portion consists of two layers of thin, pure tinfoil, separated by special impregnated linen tissue. The system of layers is then wrapped as shown in Fig. 3. A condenser made with mica insulators, having the capacity of this by-pass condenser, would be very impractical because it would necessarily be very large.

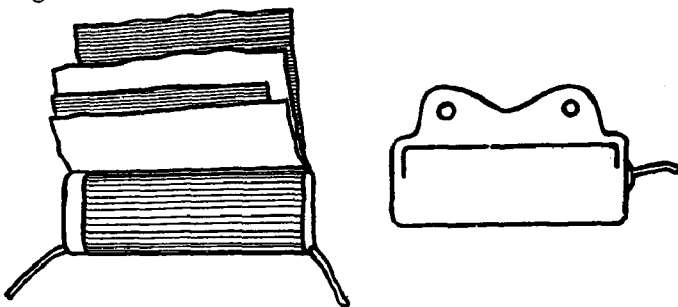


FIG. 3. CONSTRUCTION OF TYPICAL FIXED CONDENSER.

A variable condenser (Fig. 4) is so called because the capacity can be varied. This is accomplished by having two sets of metal plates interleaved with each other and one set revolving on a shaft so that any desired area of the plates can be interleaved. By turning the shaft and revolving one set of plates, the capacity of the condenser is changed to any desired amount within the limits of its total capacity.

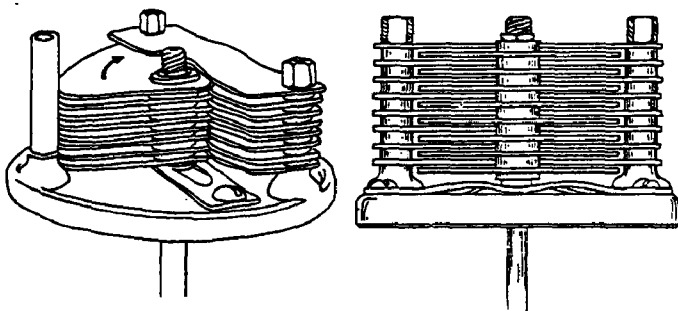


FIG. 4. CONSTRUCTION OF VARIABLE CONDENSER.

Transformers

Transformers are a very important part of a receiving set and when used in connection with a radio tube, serve as a method of amplifying the broadcast signal after it has been picked up. The theory briefly is this: A coil of wire which has an alternating, intermittent, or pulsating current passing through it, sets up a constantly changing electro-magnetic field (lines of force having both electric and magnetic properties). (See Fig. 5.) If another coil of wire is placed in this electro-magnetic field, a current will arise in and flow through this second coil,

even though there is no physical connection to the first. This transfer of electric energy takes place by what is called "induction." The voltage "induced" in the second

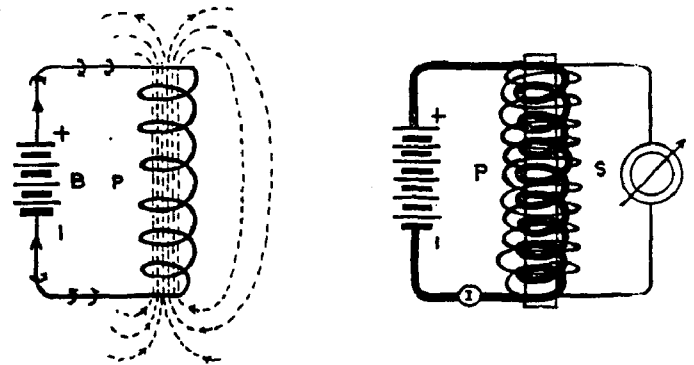


FIG. 5. ELECTROMAGNETIC INDUCTION—ACTION OF A TRANSFORMER.

coil may be made considerably greater than that in the first coil by having a greater number of turns of wire in the second. For ordinary alternating and intermittent current, the two coils of wire (which are called primary and secondary) are wound around a soft iron core, which greatly strengthens the electro-magnetic field and increases the efficiency of the transformer. The two windings are insulated from each other and also from the core.

Audio Frequency Transformers

Our audio transformer No. 7661 (See Fig. 6) consists of a soft iron core made of a number of soft iron wires, a primary winding of about 6,000 turns of wire and a secondary of 15,000 turns of wire (gauge 40). The ratio of the number of turns of secondary to primary is 2.5 to 1, which is likewise the ratio of output to input. The first stage transformer (No. 8060) has a ratio of about 4 to 1. (Fig. 7).

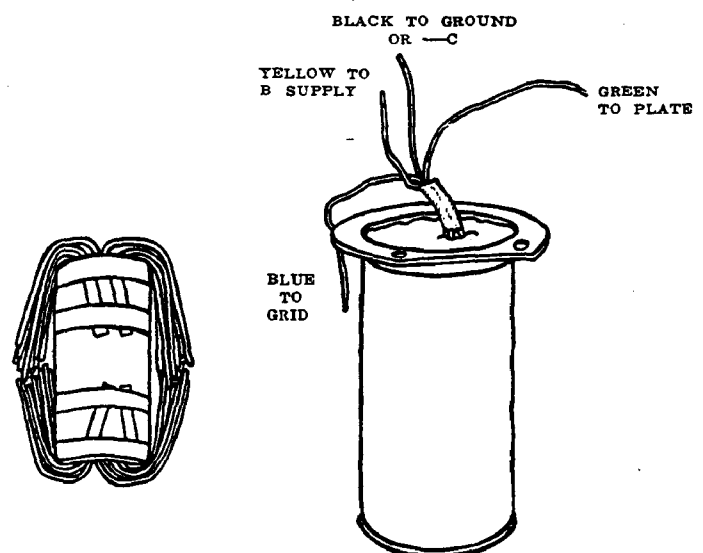


FIG. 6. AN ATWATER KENT AUDIO FREQUENCY TRANSFORMER (2d stage).

The iron core of a transformer builds up an electro-magnetic field which varies the same as the current in the windings. However, an iron core cannot respond efficiently to currents which vary at a rate of over 500,000 cycles per second, which is the case of radio frequency current, and radio frequency transformers are,

therefore, usually made without a solid core, and are termed "air-core" R. F. transformers.

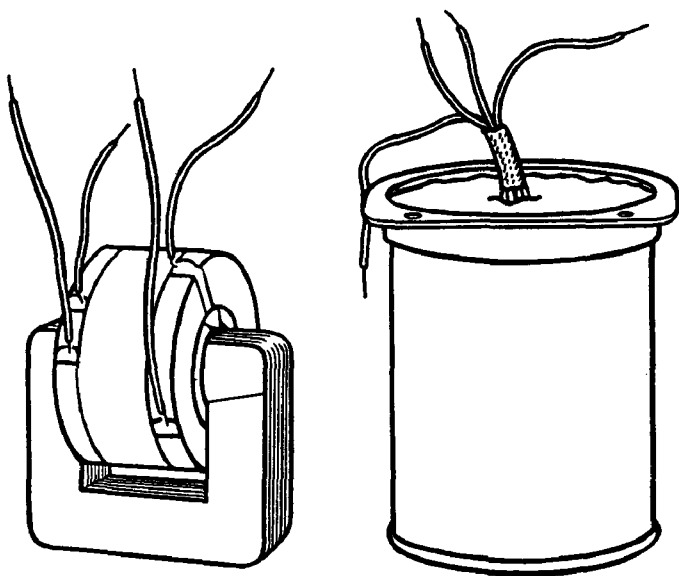


FIG. 7. ANOTHER TYPE OF ATWATER KENT AUDIO TRANSFORMER (1st stage).

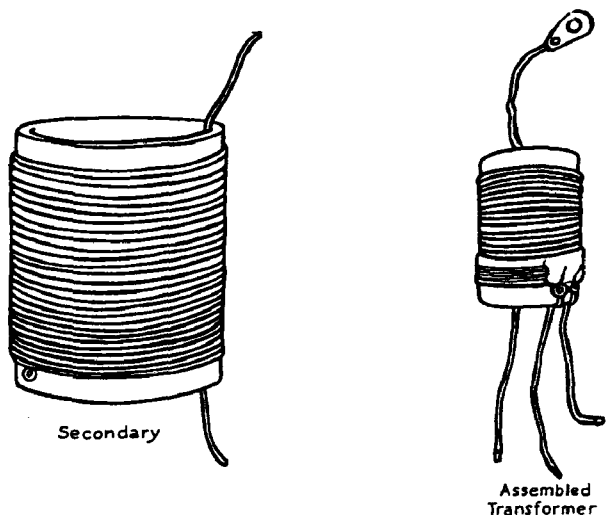


FIG. 8. TWO TYPES OF ATWATER KENT RADIO FREQUENCY TRANSFORMERS.

Fig. 8 shows the types of transformers used in our sets to amplify the radio frequency signals. As can be seen, these transformers do not have an iron core.

Radio Tubes—Construction

The radio tube is undoubtedly one of the most important units used in radio reception. We are all more or less familiar with the external appearance of common radio tubes, and in Fig. 9, we see how the tube is constructed internally. Most of the present-day tubes are vacuum tubes, but some of special type are filled with a rare gas which is chemically and electrically inactive. The filament of a vacuum tube is made of tungsten, thoriated tungsten or other metals coated with a chemical, which, when heated, emits electrons (negatively charged particles) in a vacuum. Tungsten, when it contains thorium, emits a greater number of electrons at a given temperature than plain tungsten, and consequently requires less current. The plate is made of thin metal,

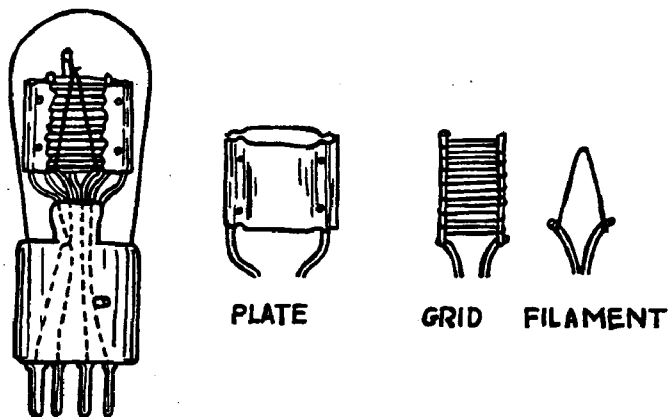


FIG. 9. CONSTRUCTION OF A TYPICAL RADIO TUBE.

stamped in the form shown in the illustration. The grid is of fine wire, so placed that it forms a sort of lattice work between the filament and the plate.

Internal Action of the Tube

The diagram on the right (Fig. 10) is a schematic symbol representing a vacuum tube. The diagram on

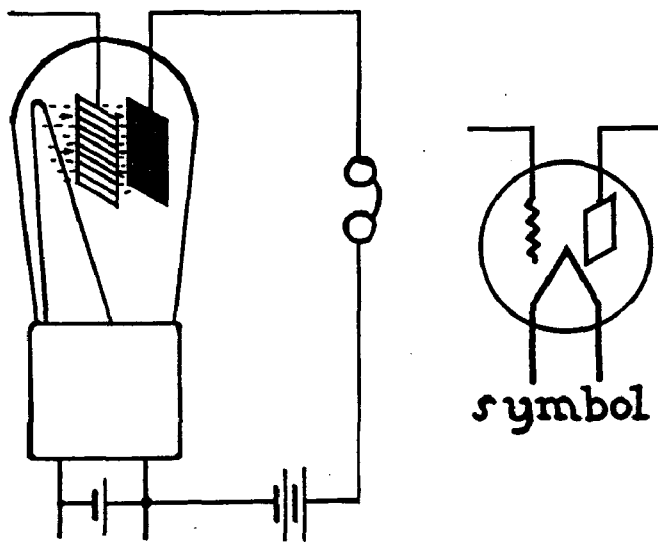


FIG. 10. PATH OF FLOW OF ELECTRONS IN VACUUM TUBE.

the left is also more or less schematic, so as to show more clearly just how the tube functions. The two ends of the filament wire are attached to the "A" or storage battery, which heats the wire so as to create the desired amount of electronic emission. These electrons would ordinarily fly off in all directions, but the plate of the tube being connected to the positive side of a "B" battery, has a high positive potential, and the electrons are attracted by, and flow to the plate. The grid is placed between the filament and the plate, and when the potential on the grid is comparatively positive it assists in causing the electrons to flow to the plate. When the grid is negative it repels the electrons on their way to the plate and when sufficiently negative, may stop the flow.

The negative side of the "B" batteries is connected to the filament and as mentioned before, the positive side is connected to the plate. In the particular illustration shown there is also a 'phone unit placed in the circuit. When a stream of electrons flows between the filament and plate, the "B" battery circuit is completed across this gap and a current passes through the 'phone unit. However, as previously stated, the potential on the grid

determines the intensity of the electron stream between the filament and plate, consequently as the potential on the grid varies, the current in the plate circuit and therefore in the 'phone unit also varies. The incoming broadcast signal is the factor which causes the potential of the grid to vary. Thus the current in the broadcast transmitter, varied by a voice or sound in a microphone at the broadcasting station and radiated in the form of high frequency alternating current, eventually controls the current which flows through the speaker unit at the receiving set and similar sounds are consequently reproduced. As a small voltage impressed on the grid controls a large current in the plate circuit, the tube may be used as a means of amplifying radio signals.

Action of Tube as Detector

The radio frequency currents which pass into the set from the antenna are of extremely high frequency, between 500,000 and 1,500,000 cycles per second. If a speaker unit were installed directly in this circuit with the current varying with such rapidity, it would be mechanically impossible for the diaphragm to respond to the variations in current. If it did respond, the pitch of the sound waves created would be so high that the sound would not be audible to the human ear.

It is, therefore, necessary to convert the radio frequency current to an audio frequency current which will operate a speaker unit and produce sound waves audible to the human ear. This is accomplished by the detector tube, which through the action of the grid condenser and grid leak, rectifies the radio frequency current. The potential on the grid of this tube is affected not only by the alternations of the radio frequency signal, but also by the charge which is stored up by the grid condenser. The current produced in the plate circuit of this tube has the same characteristics as the radio frequency current, but at a lower frequency.

Principles of Radio Wave Transmission

Some of the fundamentals of electricity and the units used in a radio set have now been discussed, and the question that arises in the minds of many is, "How does the radio frequency current generated by the broadcasting station reach the receiving set?"

Electrical energy in the form of a radio frequency wave which has been modulated by a voice or music, is radiated in all directions by the broadcasting antenna.

An analogous mechanical phenomenon will illustrate what takes place. When a tuning fork is made to vibrate, waves are sent out and any tuning fork within

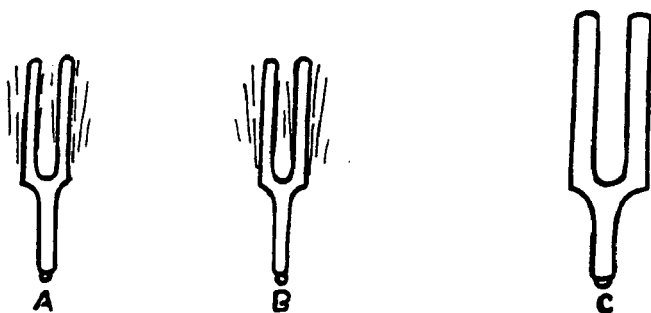


FIG. 11. TRANSFER OF MECHANICAL VIBRATIONS BETWEEN UNITS HAVING SAME FREQUENCY OF VIBRATION.

range having the same period of vibration will be affected and start to vibrate also. The tuning fork "A" (Fig. 11) is caused to vibrate by striking it, and the tuning fork "B," which has exactly the same period of vibration as the tuning fork "A," also starts to vibrate. The tuning fork "C," however, has a different period of vibration and is therefore not affected.

Purpose of the Antenna

A similar action takes place in the broadcasting and reception of radio. The radio frequency wave radiated by the broadcasting antenna sets up a corresponding radio frequency current in the antenna of a receiving set when it is tuned to the same frequency. The frequency of the wave is expressed in kilocycles or wave length, and since the tuning devices in the receiving set enable us to change the period of vibration or frequency of the set, we are able to receive waves from any broadcasting station within range. The radio frequency current in the broadcasting antenna is of such high frequency that a wave of electrical energy is radiated from it, and if the receiving antenna has the same period of vibration, it responds to this wave in such a way that a radio frequency current is set up in the antenna circuit. The purpose of the receiving antenna is therefore to convert the waves of electrical energy that are in the air to radio frequency current in the receiving set.

The alternating currents set up in the antenna circuit are of extremely high frequency, ranging between 500,000 and 1,500,000 cycles per second. As mentioned before, it is impossible to convert alternating current of such high frequency directly into sound waves, and it is therefore necessary to convert this current to a pulsating current of audio frequency. We have already explained how this is accomplished by the action of the detector tube.

Necessary Elements of Receiving Set

From the various points discussed so far, we can see that the simplest receiving set would consist of an antenna, to convert the electrical energy to radio frequency current; a tuning device, to bring the set to resonance with the desired wave; a detector, to convert the radio frequency current to an audio frequency current; and a 'phone unit to convert the audio frequency current to sound. It is highly desirable to amplify the signals received so that the sound waves produced will be of considerable strength.

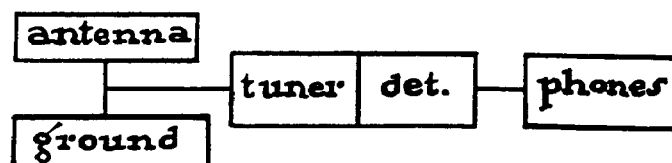


FIG. 12. FUNDAMENTAL UNITS OF A RECEIVING SET.

Circuit and Construction of Model 20 Compact Set

The Model 20 Compact three-dial receiving set has two stages of radio frequency amplification, a detector and two stages of audio frequency amplification. In

explaining what takes place in each stage, schematic diagrams will be referred to using the symbols shown in Fig. 13.

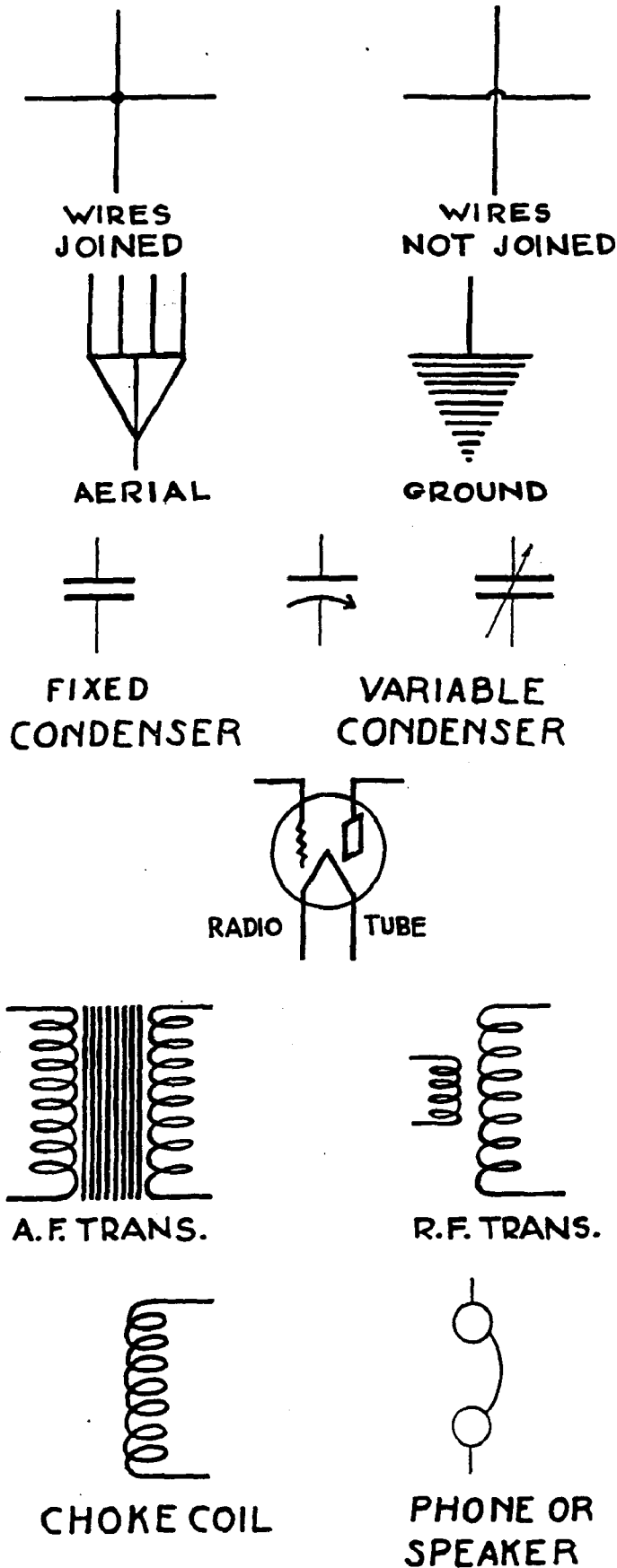


FIG. 13. SYMBOLS USED IN SCHEMATIC RADIO DIAGRAMS.



Referring to Fig. 14, the antenna circuit, which consists of aerial, primary of the first radio frequency transformer and ground, converts the waves of electrical energy in the air to radio frequency current. The aerial wire and the primary winding of the transformer give this circuit a certain amount of inductance. In general, and up to a certain limit, a long aerial and considerable inductance in the coil winding will pick up the greatest amount of energy. Too much inductance, however, lessens the selectivity and since it is impractical to shorten or lengthen the aerial wire to regulate this, we change the number of turns in the primary winding of the first coil by means of the tapped switch and thus accomplish the same thing. Placing the switch blade on the first tap (Fig. 14), puts fewer turns of wire in the circuit and increases the selectivity at a slight sacrifice in volume. Using the third tap, which uses all the turns of wire of the primary winding, increases the volume considerably, at a sacrifice of selectivity. The center tap is a medium between the first and third.

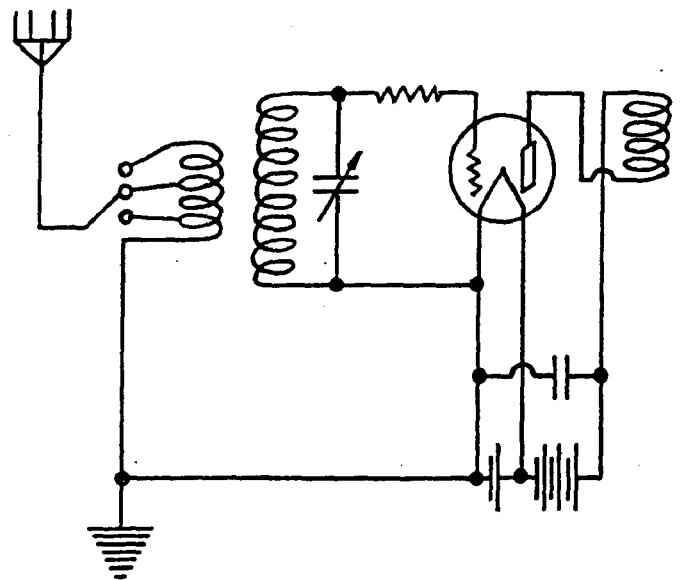


FIG. 14. ANTENNA CIRCUIT AND FIRST STAGE OF R. F. AMPLIFICATION—MODEL 20 COMPACT.

Detector Circuit—Action of Grid Leak and Condenser

After passing through the three radio frequency circuits, the signal which is still a radio frequency current as it was originally set up in the antenna circuit, but considerably amplified by the R. F. transformers, is impressed upon the grid of the detector tube (Fig. 15). The function of this tube as explained under tube action, is to rectify the radio frequency current to a pulsating current of audio frequency, and which has the same characteristics as the original current. This tube may be the same type as those used for amplifiers and the fact that it rectifies the current, instead of merely amplifying it, is due to the action of the grid condenser and grid leak. The grid condenser collects a charge and the

accumulated charge is impressed upon the grid of the tube. The grid leak prevents this charge from becoming too great by allowing it to leak off slowly to the filament circuit.

The grid leak is connected to either the positive or negative filament circuit, but experiments by our laboratory have shown that the detector circuit offers least resistance to weak signals when the grid leak is connected to a slightly negative potential. To accomplish this, a fixed resistance of about 450 ohms is installed directly across the positive and negative filament circuit, and the grid leak is connected to the two-fifths point, nearest the negative side.

The radio frequency current impressed on the grid of the detector tube is, by the above process, rectified to an audio frequency current in the plate circuit of this tube,

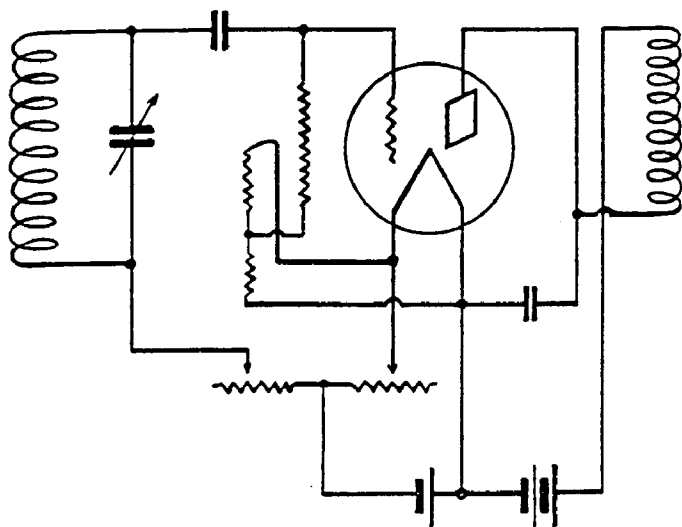


FIG. 15. DETECTOR CIRCUIT.

and if a 'phone unit were connected in series with this circuit, the broadcast signal would be converted to sound. However, for purposes of loud-speaker reproduction, it is desirable to amplify this signal to greater strength, and accordingly the primary winding of an audio frequency transformer is placed in this circuit instead. This plate circuit is completed through the "B" battery to the filament circuit.

Purpose of "Phone Condenser"

There is a small component of radio frequency current which is passed to the plate circuit of the detector tube from the grid circuit. If this current were allowed to pass through the "B" batteries and audio transformer with the audio frequency current, it would cause some distortion. A small fixed condenser called a 'phone condenser is therefore connected between the plate and the filament of the detector, which shunts this radio frequency current across the audio transformer and "B" batteries. No direct current from the batteries and none of the audio frequency current can go through this condenser.

Action of Audio Frequency Transformers

The pulsating current in the primary circuit is induced and amplified in the secondary circuit and is again impressed upon the grid of the next tube (Fig 16). It is amplified to the plate circuit of this tube, in which

circuit is placed the primary of the second audio frequency transformer. The signal is then induced and amplified in the secondary of this transformer and is again sent into the grid circuit of the next and last tube. The sound unit of the radio speaker is installed in the

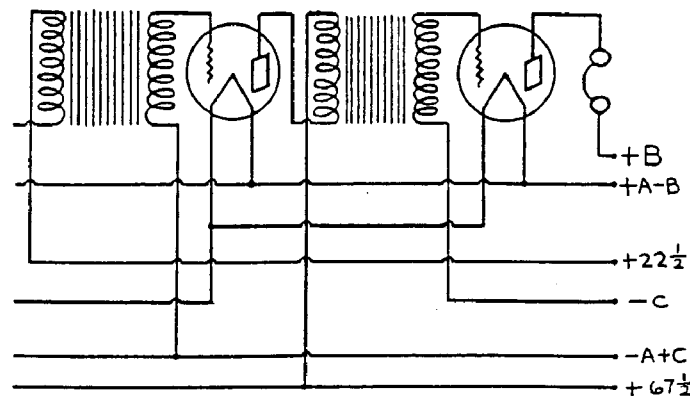


FIG. 16. AUDIO FREQUENCY CIRCUIT.

output or plate circuit of this second audio frequency amplifier tube, and the variations in current cause the diaphragm to vibrate and send out sound waves which have the same characteristics as the wave of the pulsating current sent through the sound unit. The characteristics of this electrical current were determined by the sounds sent into the microphone at the broadcasting station. The theory and construction of speaker units is described in Section X of this Manual.

Use of "C" Battery

One lead from the secondary of the first audio transformer is connected to the grid of the following tube and the other lead, called the grid return, is connected to the filament of the same tube. The grid return of the second audio transformer, however, is connected to the filament of the last tube through a "C" battery, this grid return being connected to the negative side of the battery. As explained under tube action, the potential on the grid of the tube determines the flow of "B" battery current across the plate and filament, the flow being less when the grid is comparatively negative. By placing a negative potential supplied by the "C" battery on the grid, considerable "B" battery current is saved, and amplification without distortion obtained.

Power Tubes

Power tubes are tubes especially designed to handle the considerable volume of signal reaching the last stage of audio amplification and at the same time give improved tone quality. They require additional "B" battery voltage on the plate, and also a fairly high negative voltage on the grid, to prevent the tube from becoming overloaded, which would cause distortion. The "C" battery is connected so as to operate on the last tube only, so that the desired negative voltage may be used on the grid of this tube without affecting the first audio tube, which would not function properly if used with the negative grid voltage required by a power tube.

Grid Resistances and By-pass Condenser

Two units which have not as yet been discussed and which are essential to the operation of the set are the

grid resistance unit and by-pass condenser. A grid resistance is connected in the grid circuit of each of the radio frequency amplifier tubes and is one of the means used to keep these tubes stabilized.

The by-pass condenser is shunted across the "B" power supply of the radio frequency tubes and allows the plate circuits of these tubes to be completed directly to the negative filament circuit. This likewise assists in stabilizing the set and preventing distortion.

Filament Connection of Tubes

There are two fundamental methods of connecting several electrical units in the same circuit, namely series and parallel (see Fig. 17). Each method has its own particular advantages and is used accordingly. In the case of a parallel connection of units, each unit can receive the voltage of the source of current and can be operated and controlled independently of the others. For this reason the tubes in our sets, in fact in most radio sets, are connected in parallel (see Fig. 19).

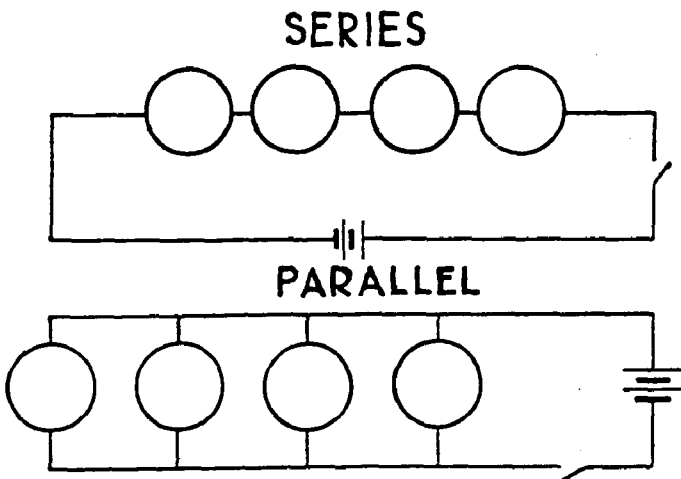


FIG. 17. THE TWO FUNDAMENTAL METHODS OF CONNECTING SEVERAL ELECTRICAL UNITS TOGETHER.

Arrangement of Rheostats

A variable resistance, or rheostat, is connected in series with one of the main filament battery leads to the radio frequency tubes, which permits the control of the filament current supplied to these tubes independently of the other tubes. Another rheostat is connected in series with the detector tube to control it separately.

The audio frequency tubes require a definite voltage to operate at maximum volume. A lower voltage will reduce the volume, but while this is sometimes desirable,

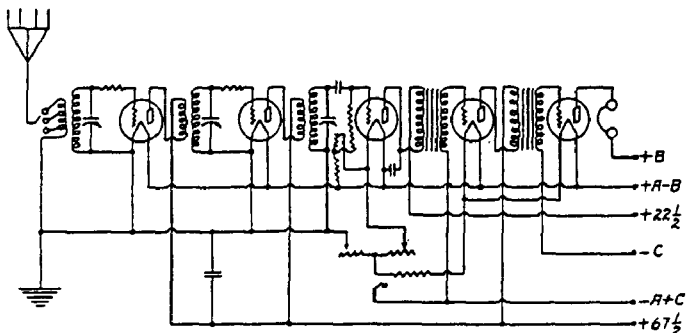


FIG. 18. SCHEMATIC WIRING DIAGRAM OF MODEL 20 COMPACT SET.

it also impairs the tone quality. A higher voltage does not improve the tone or the volume and our sets are therefore equipped with a fixed resistance rather than a rheostat for these audio tubes. The volume of the set is readily controlled by the radio frequency rheostat.

Plate Voltage on Different Tubes

The plate of each tube is connected through the primary of the transformer following it, to the positive side of the "B" batteries. Tubes functioning in different circuits of the set required different plate voltages and the plates are therefore connected to different terminals of the source of "B" voltage (batteries or "B" power unit). The plates of the radio frequency tubes and the first audio tube are connected to positive 67 1/2 volts, the detector to 22 1/2 volts, and the last audio tube to plus 90 or a higher voltage, according to the type of tube used.

Model 30—Circuit and Operation

The general circuit of the Model 30 set (Fig 19) is very similar to that of the Model 20 Compact No. 7960,

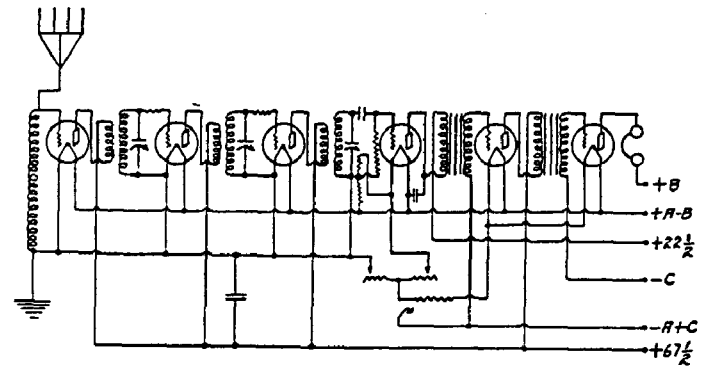


FIG. 19. SCHEMATIC WIRING DIAGRAM OF MODEL 30 SET.

but being operated by one dial, certain additions are necessary. The radio frequency transformers are substantially the same as those in the three-dial sets and have approximately the same inductance. However, these transformers are not taken indiscriminately and installed on sets, but each set of coils is selected after their inductances and other characteristics have been determined by special apparatus. A set of variable condensers is likewise carefully selected to be used with these transformers.

"Synchronizing" the Condensers

The variable condensers are controlled simultaneously by having the rotor shafts driven by belts, which are connected to a common pulley, which is turned by the single or center dial (Fig. 20). As the dial is turned, the capacities of the three variable condensers are changed uniformly, and the respective circuits which they tune are all brought into resonance with the same frequency of current. Because these condensers and transformers have all been accurately matched, this condition holds good over the entire wave length band.

Condensers, so adjusted that one movement will tune all their circuits, are termed "synchronized." The method used in the Atwater Kent single-dial sets is licensed under Hogan Patent Number 1014002.

On the three-dial sets it was observed that as the condensers were tuned for various wave-lengths, the dial settings of the three condensers were approximately the same. By the system of matching already explained, the slight difference in setting is overcome, and synchronism is established.

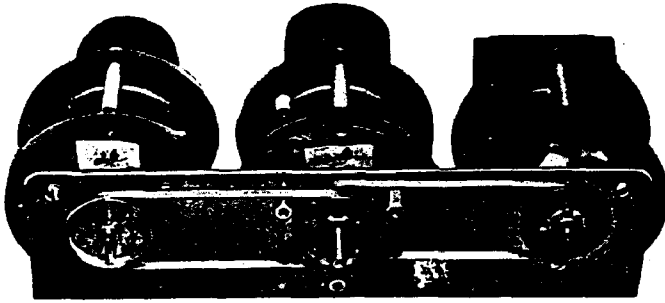


FIG. 20. METHOD OF CONNECTING VARIABLE CONDENSERS BY BELTS.

Eliminating the Antenna Tuning Device

It was also observed in the case of the three-dial receivers that the setting of the first dial varied according to the length of the aerial used, while the other two dial settings were unaffected. Since we cannot tune the aerial circuit independently in a one-dial receiver, we must overcome this condition in some other way. An additional tube, which is installed in the antenna circuit, takes care of this.

This tube has very little value in amplifying the signals, being used simply to transfer all signals from the antenna circuit to a position where any desired one can be selected and amplified to maximum by the synchronized tuning control before it reaches the detector. It also eliminates the effect of the antenna circuit on the tuning of the succeeding circuits by the dial.

Model 35

The Model 35 set is considerably different from the Model 30 in the mechanical design, which requires certain changes in the electrical design. The circuit, however, is identical with that of the Model 30, with the exception of the detector rheostat. (Fig. 21.) In the other sets, the radio frequency tubes are controlled by one rheostat, the detector tube by another, and the audio exception of the detector rheostat. (Fig. 21.) In the set, the radio frequency tubes are controlled by a rheostat, and the detector and audio frequency tubes are controlled by a fixed resistance.

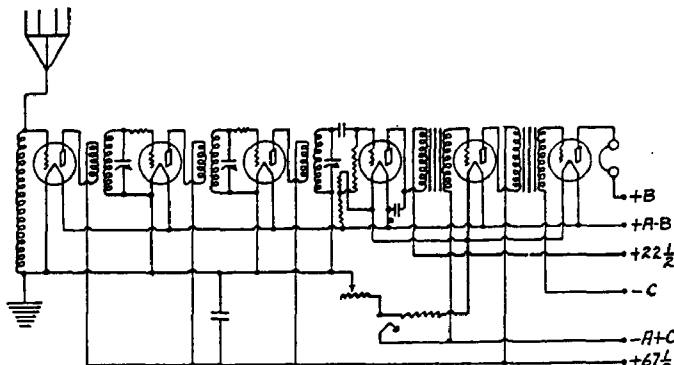


FIG. 21. SCHEMATIC WIRING DIAGRAM OF MODEL 35 SET.

Model 32

The Model 32 set has an additional stage of radio frequency amplification which necessitates a fundamental change in the type of radio frequency transformer used. In the Model 20, 30 and 35 sets, which have three radio frequency transformers, the transformers are mounted at right angles to each other, to prevent an electrical coupling between them. However, the Model 32 set has an additional radio frequency transformer, and since there are only three mutually perpendicular planes, we must use a different method to prevent a coupling between these transformers.

The circuit and functioning of this set is identical with that discussed for the Model 30, except for the additional stage of radio frequency amplification, which requires an additional transformer, tube socket and variable condenser. This stage of R. F. amplification increases the selectivity, sensitivity and volume of the set. The extra condenser is tuned by a third belt, also connected with the main or single control dial shaft. There are therefore three belts controlled by the tuning dial of the Model 32.

Model 33

The Model 33 set is a six-tube outfit, combining some features of both the Model 20 Compact and the Model 30 sets. It has three stages of radio frequency amplification, controlled by a single dial similar to the Model 30. However, instead of the untuned antenna circuit, an inductance or antenna coil is connected between the antenna and ground and provided with two taps connected to binding posts, so that part or all of the coil can be placed in the circuit, depending on the length of the antenna used. In addition to this, one of the rotary plates of the first variable condenser is controlled by a separate small knob at the left side of the panel, so that perfect resonance is obtainable in the antenna circuit regardless of the length of antenna. This set is therefore more selective than the Model 30, and easier to tune than the Model 20 Compact, at the same time being more efficient than either. A schematic diagram of the Model 33 will be found in Section VI of this Manual.

A.C. Type Receivers

During the summer of 1927 a new type of tube was developed, the outstanding characteristic of which was the fact that it was designed to operate with alternating current on the filament instead of direct. The producing of these tubes meant that it was possible to design a set to operate direct from the A. C. electric socket without batteries, since the only necessary step was to reduce the voltage of the A. C. line to the correct value for the tube filaments, which is easily accomplished by means of a "step-down" transformer. The B voltage requirements of these tubes being practically the same as those of the previous type D. C. tubes, the incorporation of a B power unit in the set along with the step-down transformer results in a completely light-socket-operated set.

The theory of function of the A. C. tubes is very similar to that of the D. C. tubes, and will not be discussed here. In general performance they compare very favorably with the D. C. tubes. The filament voltage requirements are slightly different, however, an A. C. voltage of $1\frac{1}{2}$ being required for the amplifier tubes and $2\frac{1}{2}$ volts for the detector tube. The power tube used is a regular D. C. type requiring the standard 5 volts, since by the use of a center-tapped resistance across its filament terminals, the effect of the A. C. fluctuations is effectively balanced out in this particular circuit.

The A. C. detector tube differs from the D. C. tubes in having an extra element known as the "cathode." This necessitates a five-prong socket for this tube. The cathode is a cylinder of special metal surrounding the filament, and performs the same function as the filament in a D. C. tube. The filament in the A. C. tube is used only to warm the cathode so it can function. Owing to the material and construction of the cathode, a period of about 30 seconds after the set is turned on, is required before it warms sufficiently to function and allow signals to come through the set.

Power Units In the A.C. Receivers

The power units used in Atwater Kent A. C. receiving sets furnish direct current "B" supply for the plate circuits, direct current "C" supply for the grid circuits, and alternating current of the proper values for the filaments of the A. C. tubes. Every power unit consists of the following essential parts:

(1) A power transformer to change the voltage of the 110 volt A. C. line to the required higher and lower values. This transformer has a primary, a high-voltage center-tapped secondary winding, a low voltage secondary winding for the filament supply of the rectifier tube, and three other low voltage secondary windings for the filament supply of the receiving tubes.

(2) A double-wave filament-type rectifying tube that converts the high voltage A. C. to pulsating D. C. The tube has two separate plate electrodes which are connected to opposite ends of the high-voltage winding. The center tap of this winding is connected to ground, which is equivalent to $-B$. When the outside circuit between the filament of the rectifying tube (equivalent to $+B$) and the center tap of the high voltage winding is completed through the filter and the plate circuits of the radio set, electrons flow from the filament to whichever plate is positive. As the rectifier plates are alternatively positive, electrons flow from the filament almost continually. This flow of electrons constitutes a steady flow of pulsating direct current.

(3) A filter section consisting of audio frequency chokes and high-capacity fixed condensers, serving to smooth out the pulsating direct current delivered by the rectifying tube and make it pure and noiseless in action.

(4) Resistances of the correct value to reduce the high rectified voltage to the values required by the first A. F. and detector plate circuits. By-pass condensers are connected to these resistances.

(5) A grid bias resistance connected between the ground and the second A. F. filament circuit, and another bias resistance connected between the ground and the R. F.—first A. F. filament circuit. The plate currents flow through these resistances and cause a voltage drop across them, the filament end of each resistance being positive with respect to the ground end. By connecting the grid return leads of the amplifying tubes to ground, the grids are maintained at a negative voltage with respect to the filaments.

(6) Three separate "step-down" filament windings or secondaries on the power transformer. These reduce the 110 volt A. C. supply to the voltages required by the filaments of the tubes, about $1\frac{1}{2}$ volts for the R. F. and first A. F. filaments, $2\frac{1}{2}$ volts for the detector filament, and about 5 volts for the second A. F. filament.

Connections between the filament circuits and the set are made to a center tap on resistances of low value shunted across each filament supply winding. The purpose of these center-tapped resistances is to provide a neutral voltage point which does not vary in value. The voltage on either side of the filaments is alternating (A. C.), and if the grid-return leads were connected to either side of the filament circuits, this A. C. voltage would be impressed on the grids of the tubes, causing a loud hum in reception. The center tap on each shunt filament resistance is like the pivotal or center point on a see-saw, it does not move up or down, but remains steady.

(7) A speaker or output choke. One end of this choke is connected to the rectified and filtered high voltage supply and the other end is connected (through the set cable) to the plate of the second A. F. tube. The choke offers but little resistance to direct current, but it has a high effective resistance or impedance to audio frequency variations, tending to make audio frequency variations of the plate current flow through the speaker, which is coupled to the plate of the second A. F. tube through a fixed condenser (the speaker filter condenser). The return lead from the speaker is connected to the center tap of the second A. F. filament shunt resistance. With this arrangement no direct current flows through the speaker, but only the audio frequency or A. C. component of the plate current.

(8) A panel assembly which contains the terminals for connection to the cable card of the receiving set. On all power units except that used with the early Model 36 sets, the grid biasing resistance and the plate circuit and filament shunt resistances also are mounted on this panel.

(9) A line voltage regulating resistance is used on some of the recent models. This resistance is connected in series with one side of the 110 volt supply line, and it serves to maintain a constant voltage across the primary of the power transformer, automatically compensating for line voltage variations and fluctuations. The resistance of this regulator increases if the line voltage increases above normal, and the resistance decreases if the line voltage goes below normal. This device is mounted on the left-hand side of the power unit container.

SECTION II

PLANNING THE SERVICE DEPARTMENT

1. The Service Room

The first thought of the dealer, once he has been "sold on the idea" of rendering real service, will be a suitable workshop or service room in which to carry on this work, and also the tools and equipment he will require to perform radio service completely and efficiently.

In most cases it will be necessary for the dealer to utilize for his service room whatever location may be available for this purpose under the conditions of his present floor layout, but where there is a choice, or in case of the occupying of new quarters where any desired layout can be planned, it is suggested that the service and parts stock room be arranged adjoining or convenient to the rear of the sales and display room. With this arrangement, customers bringing sets in for service can be referred promptly to the "Service Department," which will avoid unnecessary delay and conflict with the work of the floor salesmen. The dealer's "outside service man" can, of course, enter the shop by the rear entrance.

The service room need not be large, but should be well lighted. If possible to have outside light directly on the service bench or table from one side or the rear, it will enable the service man to work in greater comfort and consequently to produce more efficient results.

2. The Repair Bench

The service bench or "repair table" should be four or five feet long and about twenty inches deep. The height should be about thirty-six inches, so as to permit the repairman to work at it conveniently while standing. The top of the table should be of fairly heavy pine wood, and the legs should be heavy enough to insure the bench being absolutely firm and free from vibration. One or two round-topped stools can be provided for the men when working on jobs requiring some considerable time.

3. Suggestions for Service Equipment

A reasonably complete outfit of meters and tools, which will cover the making of any ordinary tests and repairs, is suggested as an initial equipment for the dealer's service room, and consists of the following:

- Voltmeter for testing circuits, 0-50 Volts D. C.
- Thermo-galvanometer for "test stand," 0-100 scale.
- High resistance triple range voltmeter 0-200 Volts D. C., 1,000 ohms per volt.
- D. C. Ammeter, 0-5 Amps. D. C.
- A. C. Voltmeter, 0-5 volts.
- A. C. line-voltage meter 0-150 volts.
- Milliammeter 0-100 M. A.
- Tube testing device.
- Hydrometer.
- Soldering iron and equipment.
- Testing prongs with cables (several pair).
- Set of small open-end hex. wrenches.
- Set of small socket type hex. wrenches.

Assortment of screw drivers, pliers and wire cutters.
Assortment of spring type clips for quick connections.
Assortment of small fuses (1 and 2 Amp. and 100 M. A.).

Pair of special wrenches for removing cone of E speaker (Part No. 9255).

Open end wrench for toggle switch (for $\frac{5}{8}$ -inch hex. nut).

Note: A magnetized screw driver is of great assistance in removing and inserting screws in places which are ordinarily difficult to get at, and it is suggested the dealer keep one handy. To magnetize a screw driver, simply insert the blade inside a coil about 50 turns of No. 18 or other insulated wire, the terminals of which are connected to a 6 volt battery (see illustration No. 22) and close the circuit for a moment.

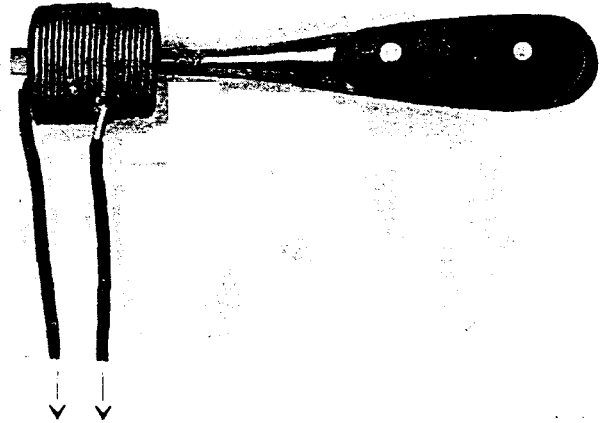


FIG. 22. MAGNETIZING A SCREW DRIVER.

4. Arranging the Equipment

All tools frequently used should be kept in a definite place where they will be accessible without delay. A row of hooks at one end of the work table or on the wall handy can be recommended for this.

It is suggested that the testing meters listed in paragraph 3, with the exception of the galvanometer, low range ammeter and A. C. line voltage meter, be mounted in a row on a wooden or bakelite panel extended up vertically from the rear of top of test table.

Two flexible leads should be attached to the terminals of each meter, these leads being of sufficient length to reach practically to either end of the test table and fitted with testing prongs at the lower terminals. A small single-throw knife switch, mounted just below the meter, had best be inserted in series with one lead from each meter, and a 45 volt dry B battery should be included in series with the 0-50 D. C. voltmeter for continuity tests of circuits. The switches should be left open when the meters are not in use.

The other three meters are used in connection with the "Test-Stand" and their use will be described later on.

5. Locating Repair Parts Stock and Repair Material

The best method of arranging the stock of repair parts is to keep them in rows of small wooden bins or in glass jars on sets of shelves on the wall. Each bin or jar should be carefully labeled with the part number and name.

It will also be advisable to have an additional set of shelves for complete sets and speakers—for example a shelf for jobs "to be repaired," one for sets "ready for delivery," and one for sets "awaiting instructions" from the owner or waiting for parts which have been ordered.

6. Equipment for the Outside Service Man

The amount and type of equipment provided for the dealer's "outside service man" will depend on the total investment being made in service equipment, and the ability of the outside man in using meters, etc., to locate and perhaps repair minor troubles in the customer's home.

As a rule it is preferable to make only the external tests in the customer's home, and if trouble is found to be within the set or speaker they can be loaded into the service truck and brought to the shop. This avoids the bad psychological effect of making an actual set repair in the presence of the owner.

There are several complete set testing outfits on the market made by reliable companies such as Jewell, Weston, etc., ranging in price from \$50.00 to \$200.00 or more (retail price). These include all necessary voltmeters, ammeters, tube testers and, in some cases, an oscillator for making reception available when there is no broadcasting.

If the dealer does not feel able to invest in one of these outfits, the following set of articles is suggested. Additions can be made as found advisable:

- Soldering iron.
- Screw drivers, several sizes.
- Wrenches, hex., several sizes.
- Combination pliers and wire cutters.
- Hydrometer.
- Voltmeter (preferably high resistance type).
- Tubes—One or two of each type.
- Headphones or speaker.

The above equipment will provide for checking all batteries, tubes and the speaker, as well as the output voltage of a B Power Unit. Any troubles outside the set can thereby be immediately detected and if the difficulty is traced down to the set it can be disconnected and brought to the service shop for the usual routine circuit and voltage tests, and necessary repairs.

7. Keeping Records on Service

This feature is one which the dealer cannot afford to neglect if a smooth-running Service Department is to be maintained, and if the avoidance of misunderstandings with the customer and unnecessary correspondence with the distributor is desired.

Pads of printed forms, serially numbered and with sufficient copies for office records and the customer, should be used for handling repair jobs, and the date on which a set is brought in for repair, date repair is made, and also delivery date with customer's signature obtained, should be carefully entered. The serial and model numbers of the set must always be noted in order to avoid question as to whether the repair is a warranty job.

If a repair "invoice" is made out separately, the number of the repair tag and all other data should be placed on the invoice.

All expenditures in the line of service should be recorded carefully in a book, so that at the end of the year a comparison can be made between the cost of maintenance of the department and the total income from repair work done. The latter will, of course, be made up of the profit in repair parts and the amount charged out for labor on repair work.

We also recommend the keeping of a careful "inventory" of the stock of repair parts. A "perpetual inventory" is the best if care is taken to keep it up to date. A record card should be maintained for each item kept in stock, and the quantity of this item and date received from the distributor recorded, as well as the date and repair number whenever one is used on a repair job. By going over the stock once a month or so, and checking the inventory, any items on which the stock is getting low can be ordered from the distributor and thus an adequate stock of all parts may be kept on hand at all times.

It is also a good plan to keep a complete "service record" of every new set sold, the date of each service call made being noted, together with the adjustments or repairs required. The service expense (or profit) on each set sold can therefore, be determined at a glance.

Some dealers find it well to establish a form of "service contract" with the customer, whereby free service is provided within a certain period, and a nominal charge made thereafter. A printed form signed by both dealer and customer with a duplicate copy for the customer, is necessary for this purpose. A similar "service contract" plan could be arranged equally well for any customer desiring to obtain service for his set on the contract plan, a slightly different form being required in such cases. Such contracts usually cover a year's time and provide for a limited number of service calls at a certain cost, an extra charge being made for additional calls.

8. Service Personnel—the Psychology of Service

In the selection of a man or men to handle the Service Department of his store, the dealer should consider three main factors:

- 1—Education and experience.
- 2—Natural ability on radio repair work.
- 3—Ability to meet the customer.

It is self-evident that to perform satisfactory work as a radio service man, experience along radio lines and ability along the lines of electrical and mechanical repair

work are essential. The third factor, however, is not usually given due consideration, in fact too often it is sadly overlooked.

The Service Department, rather than being looked upon as a necessary evil (as it was several years ago before the dealer had been educated to its true value), is now considered one of the biggest factors for building good-will and indirectly increasing sales that the dealer can possibly have. But this is not possible unless the service man takes the proper attitude toward the customers and his own work. He should always assume the attitude that "the customer is right." He should listen politely to his story of his trouble and endeavor to assure him cheerfully and convincingly that his difficulty will soon be a thing of the past. Confidence in the product and in his own ability will be a powerful factor in the service man's favor in this connection. He should never argue with a customer and never make promises he cannot fulfill. All appointments made should be kept without fail.

All in all, a proper understanding of the psychology of service on the part of the service man will help to make the Service Department a still greater asset to the eventual success of the radio dealer's business.

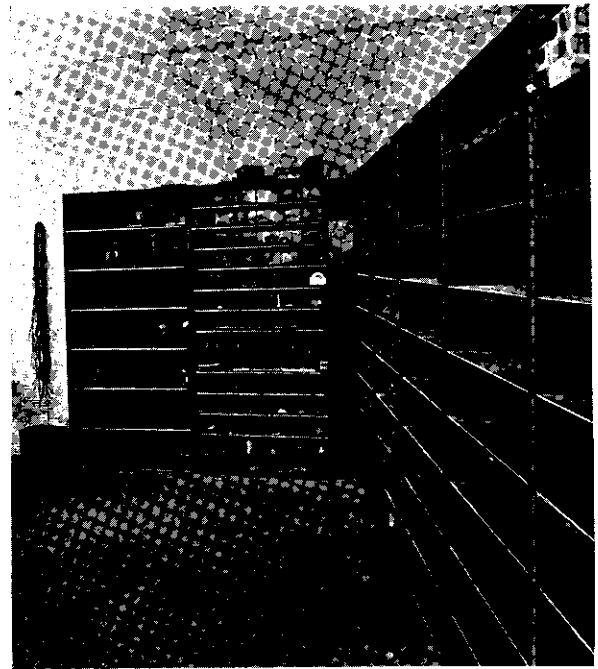


FIG. 23. TWO VIEWS OF A WELL-LAID-OUT SERVICE ROOM.

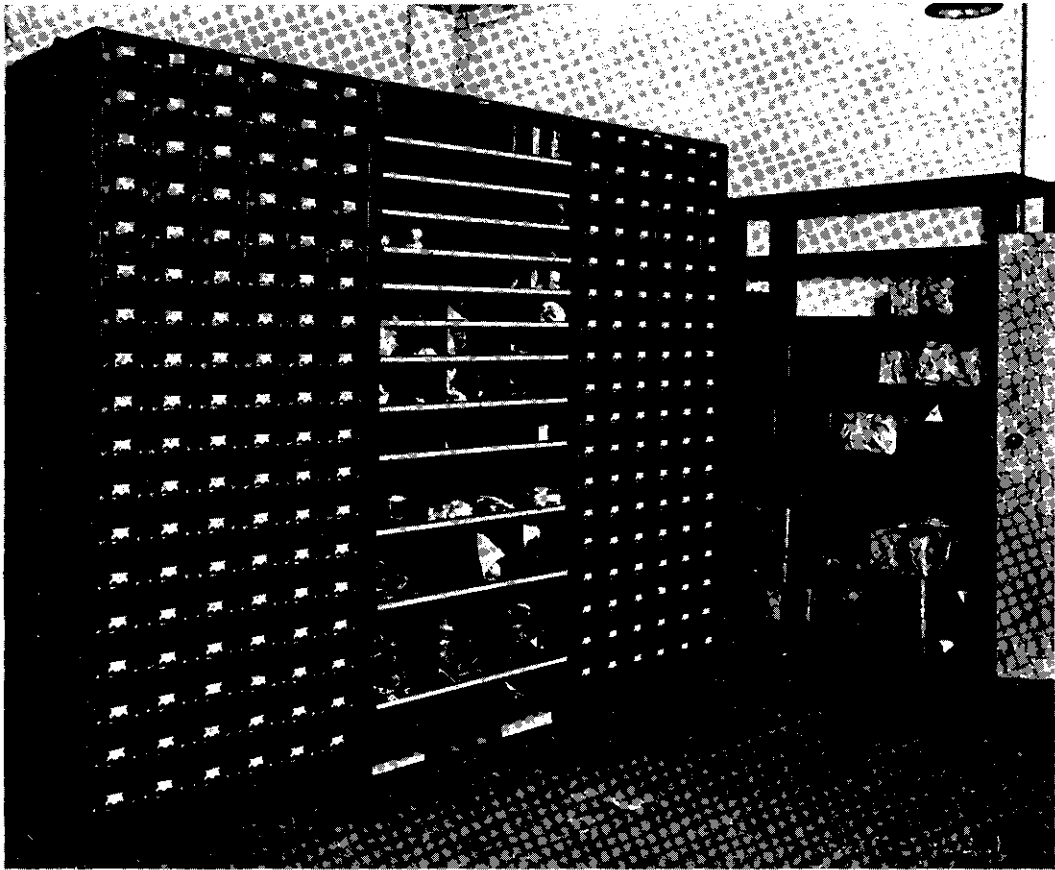
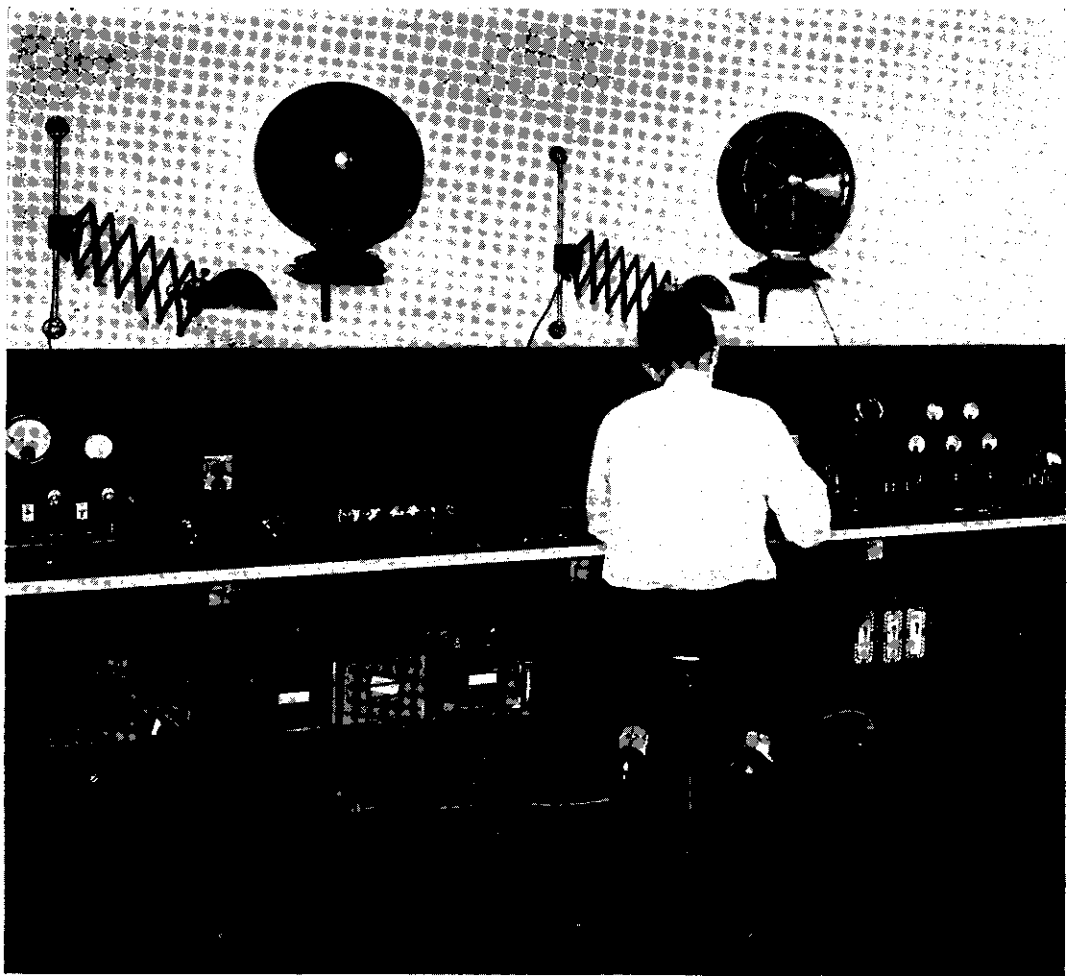


FIG. 24. ANOTHER WELL-ARRANGED SERVICE DEPARTMENT.

SECTION III

USING THE SERVICE EQUIPMENT

1. Continuity Testing with Voltmeter

One of the most important as well as the quickest and simplest methods of locating trouble in a set, is by testing the "continuity" of the various circuits, that is checking to see if the circuit is complete. This is done by means of the low range D. C. voltmeter, the type suggested in our "List of Equipment" being a meter reading from 0-50 volts. This is connected in series with a 45 volt dry B battery, and the terminals of this hook-up are fitted with test prongs which can readily be applied to any two points on a set.

Where the resistance of the circuit being tested is low, the meter should read practically the full voltage of the battery. In testing through the windings of a transformer or resistance unit, however, there will be a corresponding drop in voltage, and when testing across a condenser, which is, of course, an insulator for D. C. (direct current), no reading should be obtained. If the results experienced on a certain test vary from the above general outline, trouble in the circuit or unit being tested is indicated.

A complete set of continuity test charts for the circuits of our sets is contained in Section VI of this Manual.

2. Voltage and Current Tests during Operation

(a) Advantage of Voltage Tests

It is frequently desirable to test the actual voltages being delivered to the various circuits of the set by the power supply, while the set is under actual operating conditions. It is obvious that any factor which would cause the applied voltage to vary much from the correct value required by the tubes and the design of the set, would result in improper functioning and possibly damage to the set or tubes. Consequently, if incorrect voltage supply is suspected as the cause of an ailment it is well to make an immediate check with the proper instruments.

For testing both the A and B voltage of battery type sets, and the B voltage on A. C. sets, a high resistance volt-meter should be used. The best type is one having several ranges such as 0-10, 0-100 and 0-200, any one of which can be used by changing connections on the meter.

(b) Testing Filament Voltage—Battery Type Sets.

The low range 0-10 terminals are used when testing the A voltage delivered to the set, this voltage being obtained by applying test prongs from meter to the

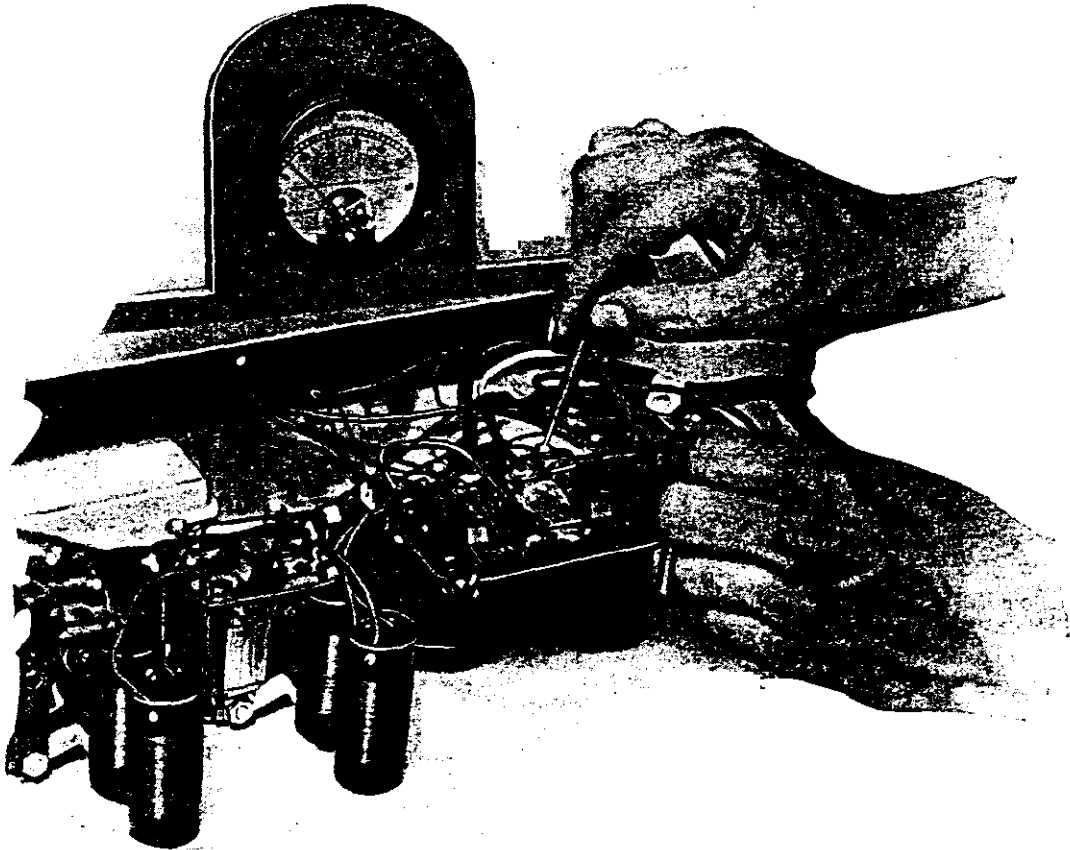


FIG. 25. TESTING CIRCUIT CONTINUITY WITH VOLTMETER.

"minus A" and "plus A" cable terminals of the set—or if the voltage on a particular tube is desired, the test prongs can be applied directly to the socket fingers (+F and -F) of that tube, assuming the set has been removed from the cabinet for testing purposes.

(c) Checking Plate or B Voltage

The high range terminals of the voltmeter are used for measuring the B voltage delivered to the tubes, either at the terminals of the B Power Unit, B batteries (or power unit in the A. C. sets), or across the tube socket plate "P" contact (corresponding to plus B) and the filament cable terminal. For example, to measure the plate or B voltage on the R. F. tubes, the test prongs should be applied to the white and either the red or black cable terminals of set, or for a particular R. F. tube one prong to contact "P" of that tube socket and the other to either one of the filament contacts of the same tube.

The intermediate range terminals on the meter can be used for measuring such voltages as the detector B voltage or the C voltage on a 171 type power tube.

(d) Filament Voltage—A. C. Sets

For testing the "A" or filament voltage on the tubes in A. C. sets, the low range A. C. voltmeter is used. It should be noted that the detector, amplifier, and power tubes in these sets receive different A voltages respectively. Each voltage is tested by applying the test prongs from this voltmeter to the proper corresponding pair of filament circuit terminals on the power unit (where connection is made from set to power unit), or at the tube socket contacts if the reading for a certain tube is desired. Individual voltage readings on each 226 tube can be taken without removing set from cabinet by inserting test prongs in eyelets at edge of socket, located over filament contact springs.

A complete voltage table for all sets will be found at the end of Section VI.

(e) "C" or Bias Voltage—A. C. Sets

This can be easily checked with the high resistance D. C. voltmeter, using the medium range scale for the last audio tube, and the low range for the first audio tube. Insert testing prongs into eyelets of tube socket corresponding to the grid and filament contact fingers.

(f) Milliammeter—Checking Plate Current

This instrument is chiefly used to check the amount of plate current being drawn by a tube or group of tubes in order to determine if it is normal. For example, an excessive plate current consumption by the R. F. tubes may indicate a leaky R. F. by-pass condenser, while an abnormal plate current being drawn by a power tube may indicate incorrect "C" or bias voltage. (It is assumed, of course, that the tubes themselves have been checked.)

To use this meter, place the test prongs from it in series with the particular plate circuit to be tested. The easiest way to do this is to disconnect the cable wire supplying that circuit at its lower terminal (at the source of power) then connect one meter test terminal to the end of cable thus released and the other to the post from which it was removed. Where there are several tubes in parallel on the same plate voltage supply, a test of

the plate circuit on one of them will require opening the plate circuit of that tube near the plate contact of socket and applying the testing terminals to the ends of the circuit thus opened.

(g) Testing Grid Leaks

The best way of testing a grid leak is by means of a special and rather expensive device known as a "megger." As it would hardly be economical for the dealer to purchase one of these, we suggest the following test. Connect the set up for receiving, tune in a loud broadcasting signal and place the hands on first and last R. F. transformers. This should stop the reception almost entirely. Upon removing hands from the transformers, the signal should return instantly. If it hesitates for just a second or more, this is an indication of a poor grid leak, and a replacement should accordingly be made.

3. Testing Repaired Sets—Output Measurement

The simplest method of testing a set which has been repaired is, of course, to try it out on broadcast reception, judging the volume by ear. This method, however, is not very accurate, and as broadcasting is not always available and it is usually desirable to test reception on several wave lengths, an outfit consisting of a device capable of producing a signal on any of several definite wave lengths, and a "galvanometer test stand" for comparative measurement of volume of reception, is recommended. As a matter of fact such an outfit is now standard equipment in practically every modern radio service shop.

(a) Signal-Producing Apparatus

There are several forms of set-up which can be used for producing a steady signal in a radio receiver for testing purposes, and it is not our policy to recommend any particular type here.

The best plan for the dealer who desires to purchase or build one of these outfits is to communicate with his territorial distributor, whose service men have been fully instructed by our factory field service men along these lines.

In the event that there is any difficulty in handling the matter in this way, the dealer is at liberty to purchase or build a standard outfit for the purpose as described and advertised in various radio magazines, and set it up himself in accordance with the instructions furnished.

For convenience in describing the use of the test stand in the following paragraphs, the signal-producing apparatus will be referred to as the "transmitter," however, it is understood that the signal produced is of sufficient strength for set testing only.

(b) The "Galvanometer Test Stand"

This apparatus is essentially a contrivance for measuring the volume with which the signal from the transmitter is obtained on a receiving set, thereby indicating the sensitivity and condition of the set. The chief element in this outfit is a thermo-coupled galvanometer, to which the set to be tested is connected through an additional (third) stage of audio amplification followed

by a special "step-down" transformer, the secondary terminals of the latter being connected to the galvanometer. It should be clearly understood that the reading obtained on the galvanometer when a set is tested is of value only as a comparative reading—that is when compared with a standard set with a predetermined standard value.

The photograph below shows a form of test stand used in our factory service department. A "standard" receiving set is permanently connected to this stand,

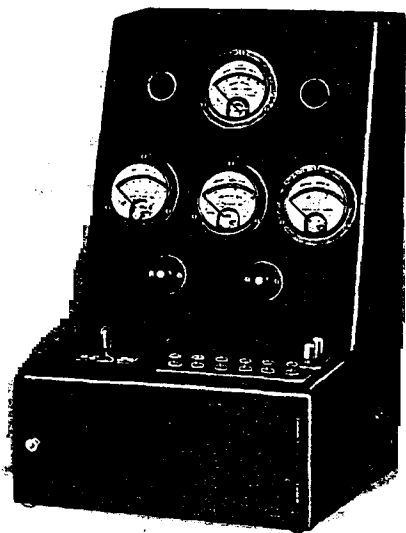


FIG. 26. TEST STAND.

thereby permitting the comparative output of any set of the same type to be readily checked. A standard anti-capacity switch is used to connect the galvanometer outfit to either the standard or test receiver, as shown on the schematic wiring diagram of the complete test stand which appears on the next page. This diagram shows two permanent sets of connecting posts, one for a standard set and one for the "test" set, of the battery type, with the necessary supply cable leading to the power supply source; and also a "triple tap" receptacle permitting two sets to be connected to the 110 volt A. C. line when an A. C. set is to be compared with a standard.

When changing from a battery type standard set to an A. C. standard (or vice versa), it is only necessary to transfer the output leads from the speaker posts of one standard to the other and the antenna wire of the transmitter, from the antenna post of one standard to the other. A D. P. D. T. and an S. P. D. T. knife switch can be installed to accomplish these changes quickly.

(c) Procedure for Testing Sets

A suitable transmitter and the test stand described above comprise a complete outfit for testing the performance of any set in a very short space of time.

In order to facilitate the testing of any type of set a "standard" should be maintained for each type—either an actual standard set, selected as having the average output of several sets of its type known to be in good condition, or simply a standard value of output can be

set as an arbitrary requirement. In describing the testing of a set below, it will be assumed that an actual standard set has been selected and is properly connected to the test stand.

To test a set, place it on the test bench convenient to the test stand, connect cable wires to proper binding posts on stand (if an A. C. set, simply plug in the "triple tap"), and antenna post to switch carrying antenna lead wire from transmitter. Turn on transmitter and adjust tuning control on same to a low wave length adjustment. Throw switch on test stand and antenna switch over to the standard set and "tune in" the signal on this set so that maximum reading is obtained on the galvanometer. Adjust tuning control of transmitter so that the signal comes in at 20 on the dial of the standard, then adjust position of antenna wire from transmitter till reading on test stand galvanometer is around 60, with volume control of set full on.

Now throw toggle switch and antenna switch over to the set being tested. If this is a battery set, the next procedure is to insert the tubes one at a time, noting by the filament ammeter "A" whether the proper current ($\frac{1}{4}$ amp. each) is being drawn by the tubes. If the set being tested is an A. C. type, the tubes should all be inserted before the A. C. power plug is pushed into the receptacle. Turn dial of set being tested to approximately 20, the volume control being turned full on. The maximum galvanometer reading obtained around this point will give the comparative output of the test set with the standard.

Next set the transmitter tuning control so that a medium wave length signal is sent out and repeat the above procedure, adjusting so that a maximum reading is obtained around 50 on the dial of the standard set. Then compare the output of the two sets on this wave length.

Repeat same again with transmitter adjusted to a high wave and secure comparative readings at 80 on the dial of each set.

By comparing the volume of output of a set with a standard on three wave lengths by the above method, a very accurate idea of the performance of the set is obtained, since any defect in the set, such as an open circuit, or incorrect adjustment of the condensers, will readily be indicated by an abnormally low volume reading on the galvanometer. A reading of 20% or so below standard is, however, allowable.

(d) Special Notes

- 1—Tubes used in the standard sets should be very carefully selected with the aid of the dealer's tube-testing equipment.
- 2—It will be noted that the ammeter listed in the "Suggestions for Service Equipment" (Section II, paragraph 3) is employed in the test stand, in addition to the galvanometer. Several small fuses and switches, the purpose of which is self-evident, are also employed in the test stand circuit. The voltmeter for checking A. C. line voltage is connected across the A. C. line through the "triple tap," the connection between the first and second taps being broken and a single throw knife switch inserted between them.

3—Note that a pair of headphones or a loudspeaker unit is inserted in series with the plate circuit of either set, for checking the volume and quality of the signal from the signal-producing apparatus.

4—If desired, switches can be installed to arrange for a test on outside broadcasting as well as on the test transmitter, thereby giving a still more complete test.

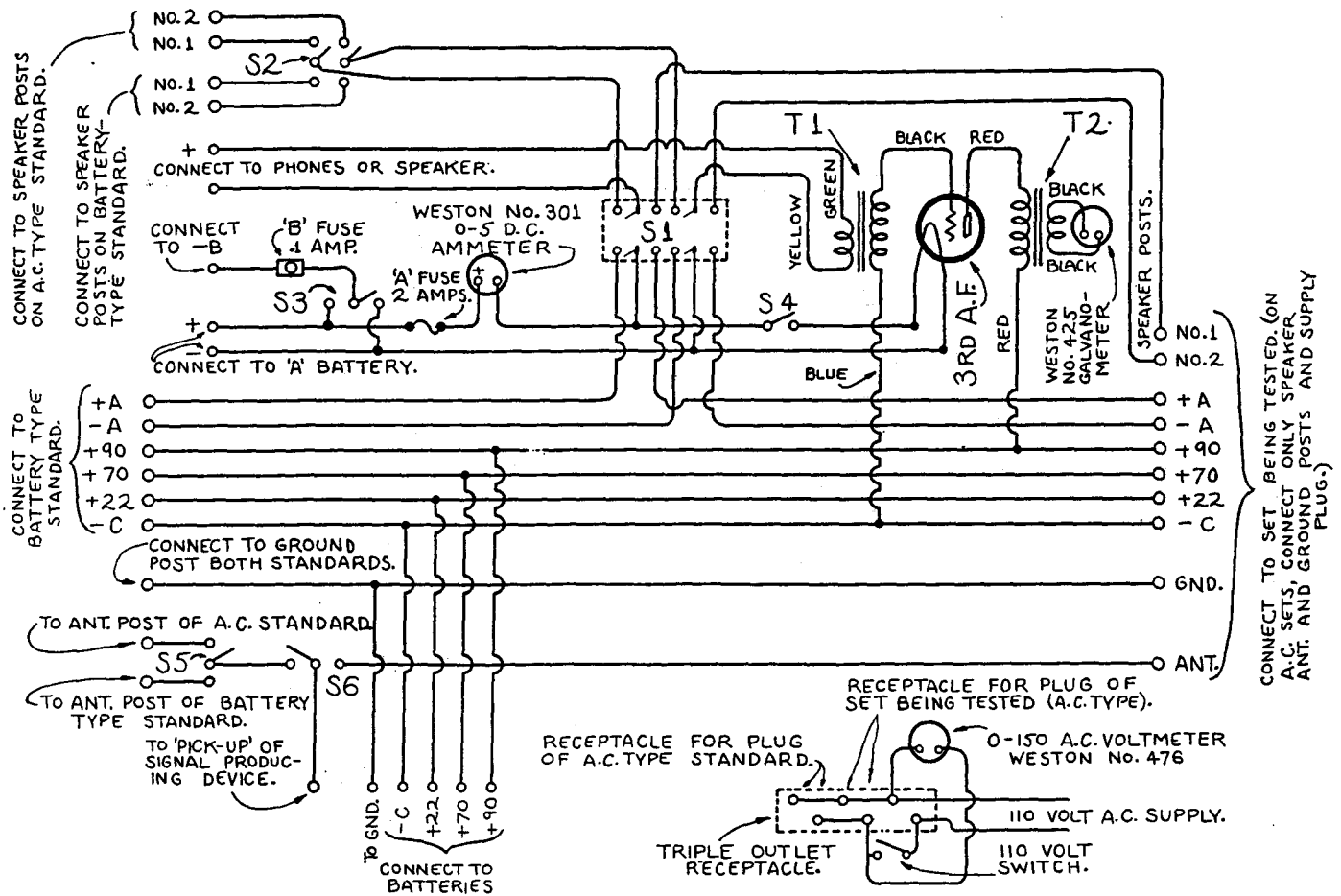


FIG. 27. WIRING DIAGRAM OF TEST STAND FOR A.C. AND BATTERY-TYPE RECEIVERS.

S1=Federal No. 1424 toggle switch (four pole, double throw) to switch phones and input of 3rd A.F. amplifier from standard to set being tested, and to change "A" battery from standard to set being tested (with battery-type sets).

S2=Double pole, double throw switch to change phones and input of 3rd A.F. amplifier from A.C. standard to battery-type standard.

S3=Single pole, double throw switch to change -B from +A to -A.

S4=Toggle switch to turn filament of 3rd A.F. amplifier "on" or "off."

S5=Single pole, double throw switch to change "pick-up" from A.C. type standard to battery-type standard. S5 and S2 may be combined to form a triple pole, double throw switch.

S6=Single pole, double throw switch to change "pick-up" from standard to set being tested.

T1=Atwater Kent No. 7660 audio frequency transformer.

T2=Atwater Kent special step-down audio frequency transformer.

NOTE.—The battery type standard may be a later-type Model 35 (with 17 plate variable condensers). The A.C.-type standard may be a Model 38 or 44.

NOTE.—Connect +C to -A.

SECTION IV

TROUBLES DUE TO EQUIPMENT, LOCATION AND INSTALLATION

1. Troubles Usually Not In Receiver

The first thought of the radio user, if his reception should deviate from its normal satisfactory functioning, is that the cause of the trouble is in his receiver.

The service man, however, will find in the majority of cases that something other than the set itself will be causing the trouble—either a defective tube, broken aerial or ground connection, battery trouble or some similar cause. Perhaps the customer himself is at fault, in not understanding the set, or he may be expecting the impossible. Perhaps the dealer who made the sale recklessly “oversold” the customer with unlimited promises of distant reception.

2. Method of Procedure In Locating Trouble

The accessories and installation should therefore be carefully checked first, and the general character of the location noted with a view to determining what sort of reception should be expected.

The method of procedure in locating the cause of a particular trouble will, of course, depend on the nature of the complaint. The dealer with even a moderate amount of experience in radio will instinctively know the step-by-step procedure in getting at the bottom of each type of complaint. In Section VIII will be found a “Chart of Troubles and Probable Causes” which will be of aid in doubtful cases, and below we are listing briefly the most frequent possible causes of trouble other than in the receiving set itself.

3. Classification of Troubles Due to Accessories

(a) Location

The conditions immediately surrounding the home in which a radio is installed will have a great influence on the success obtained in reception, particularly of distant stations.

In the immediate vicinity of numerous steel buildings, other aeriels, powerful local broadcasting stations, etc., maximum results cannot be expected, although sometimes surprisingly good reception is experienced under adverse conditions. The ideal location for clearness and distance is in the open country on high ground, with as few surrounding objects, electric wires, etc., as possible, in the immediate neighborhood, although remarkable results are frequently obtained in locations which would ordinarily appear somewhat unfavorable.

In many cases, it is rather difficult to explain these facts to the radio owner, who does not understand why his set, in a downtown apartment house, will not bring in the distant stations as clearly as his cousin's set of

exactly the same type located in the suburbs or the country. If, however, he can be induced to take his set to his cousin's home and connect it up there, his doubts will soon disappear, and he will be surprised at the performance of his set under the vastly improved local conditions.

(b) Aerial

May be (a) grounded, (b) touching foreign objects, (c) connections corroded; (d) lead-in may be broken inside insulation.

(c) Lightning Arrester

May be (a) leaky, or (b) short circuited.

(d) Ground Connection

May be (a) corroded where connected to pipe or other source of ground (b) ground lead may be broken inside insulation; (c) source of ground may be inefficient (dry earth, etc.).

(e) Batteries and Battery Eliminators

“A” or storage battery may be (a) discharged or run down—indicated by weak signals and necessity for advancing rheostats of set full on—temporarily relieved by turning off set for a short time if battery is not completely discharged. (b) Corroded connections at “A” battery terminals cause noisy and intermittent reception. Posts should be scraped clean and coated with vaseline to prevent further corrosion. (c) Reversed connections to the “A” battery will cause the set to be extremely weak. This simple trouble is found more frequently than might be thought possible, especially in cases where the battery is sent out to be recharged and is reconnected by the customer.

“A” battery eliminators. These are of various design and construction, and unless the dealer himself is handling them and has instructions for repair, it is better to refer the complaint to the seller or manufacturer of the device.

“B” batteries and “B” eliminators, particularly if of the liquid types, are often found to be the cause of a set becoming inoperative. Run down “B” batteries cause weak, noisy reception. A 45 volt dry “B” unit should be replaced when its voltage has dropped to 34 volts. This voltage should be measured with the set turned on.

Occasionally incorrect cable connections to the “B” battery will be found. All connections should be carefully checked by the service man, following the wiring diagram in the instruction book supplied with the particular set being tested.

One of the first steps the service man will make in testing for trouble, therefore, will be to test the voltage of the “B” batteries (dry or storage) with a voltmeter, and check the connections to them from the set.

"B" eliminators or power units are of many different types, the two main varieties being the tube rectifier type (such as our Model R) and the Electrolytic or liquid type. The voltage delivered by the unit should be checked with a high resistance voltmeter while the set is turned on, and if it is seriously incorrect, reference should be made to the service literature covering the particular make of unit, or the unit should be sent to the local representative for inspection.

(f) Tubes (D. C. and A. C.)

Defective tubes, both in A. C. and D. C. or battery type sets, are one of the most common causes of trouble in reception. A tube may light perfectly and yet be "dead" so far as reception is concerned, due to a loss of electronic filament emission.

In general, all tubes become weak or lose their sensitivity after a period of use, and the useful life of a radio tube generally ceases long before the filament actually burns out. Weak tubes can sometimes be brought back to normal functioning, at least temporarily, by the so-called "rejuvenators."

Occasionally, due to faulty interior construction, the internal elements of a tube will touch one another, causing a short circuit. If the grid and plate of a tube come in contact, due to their supports not being rigid or possibly to a slight jar to the set, while the set is connected up (but not necessarily turned on, if a battery set), the plate current will pass through the grid circuit, usually wholly or partly burning out the "grid resistance unit" and sometimes also the primary of the R. F. transformer. Unfortunately, when this occurs the filament of the tube is usually involved, resulting in its burning out, and rendering the tube unfit for further use. If the defective tube is in the first R. F. socket, the choke coil or coupling transformer will be the element of the set through which the plate current passes, consequently it will burn out.

There are also cases where this short circuit of the internal elements is only momentary, due to a slight shock or jar to the tube, unnoticed at the time by the set owner. In this case the damage may be only the partial or complete burning out of the grid resistance or choke coil, without damage to the tube itself. The latter will then function properly, but may again cause similar trouble at any time without warning. It is therefore very important that any tube which is suspected of having this defect, be located and replaced before further damage is done.

A. C. tubes, during the first few months after they appeared on the market, were subject to some rather peculiar troubles. The detector tube occasionally showed a tendency to develop trouble after a short period of use, under a line voltage only slightly in

excess of normal. This has been attributed to the heavy current surge through the filament the instant the set was turned on. This condition has recently been almost entirely overcome by changes in the internal design of the tube. A defective A. C. amplifier tube of the "226" type may cause a hum in reception.

For best results it is advisable to use standard tubes of established national reputation. Information relative to the use of "power tubes" in our various battery type sets is contained in Section XI.

(g) Speaker

In a small percentage of cases of trouble in reception, the speaker will be found at fault. An open circuit in the magnet coil winding will make reception practically impossible, while incorrect adjustment or other abnormal conditions may cause distortion or lack of volume.

For this reason it is always advisable for the outside service man to have a speaker or reproducing unit of some sort in his service kit, for comparison purposes.

Where an inferior brand of speaker has been sold with an Atwater Kent receiver, as is sometimes done in order to make possible a lower or "bargain" price on the complete outfit, the performance of the set will naturally suffer to some extent, and the service man should in all such cases suggest replacing the present speaker with an Atwater Kent cone type, demonstrating one on the spot if available.

(h) House Current Supply (A. C. Sets)

Successful performance of an A. C. set will not be possible under conditions of line voltage other than those for which the set was designed. It need hardly be mentioned that attempting to use our standard 110 volt, 60 cycle sets on 110 volts D. C., 220 volts A. C., 32 volt farm lighting systems or 25 cycle, 110 volt A. C. lines will have disastrous results.

An allowable limit of ten volts either way, is permissible on the A. C. sets. Voltages below 100 will permit maximum volume, while voltages above 120-125 would have a tendency to shorten the life of the tubes, except in the case of certain models, which are equipped with an automatic voltage regulator in the A. C. line, permitting line voltage variations up to 130 volts to be satisfactorily handled.

In localities where the A. C. line voltage runs from 10 to 20 volts or more above the standard value, at suitable resistance unit or voltage regulator may be used to bring the voltage to normal value. There are several such devices now being made by reputable concerns, and will be found advertised in current radio magazines. These devices are, of course, unnecessary with the sets having the automatic voltage regulator, unless the line voltage is excessively high (above 130 volts).

SECTION V

OUTSIDE INTERFERENCES—CAUSES AND REMEDIES

In addition to the cases in which unsatisfactory radio reception is due to faulty equipment or installation, there is also a considerable percentage of instances where disturbances due to external causes are responsible for the failure of a set to deliver satisfactory performance. In other words, a radio set will respond to other electrical radiations besides those of the broadcast stations, and in some cases these other radiations are of such intensity as to "drown out" distant, or in some cases, even local reception.

1. Determining if the Cause is External or Internal

The simple expedient of disconnecting the antenna and ground lead-in wires from the set, while it is in operation and the disturbance is being heard, will readily determine whether or not the noise is due to an external radiation or to some abnormal condition within the radio installation itself. If the noise disappears with the removal of the lead-in wires, it is undoubtedly due to external causes. The simplicity of this test will usually convince the most ignorant or skeptical radio owner.

2. Classification of External Causes

(a) Static

"Static" is a rather broad word used to cover the noises in reception caused by electrical discharges in the atmosphere due to natural causes. There is always a certain amount of this present, and the more sensitive the receiver is, the more readily it will be detected. A seven-tube tuned R. F. set will bring in static which might not be noticeable in a three-tube set, but, of course, the response to distant broadcast signals will be greater in the same proportion.

Static may be recognized as a crackling, crashing and rumbling sort of sound, usually intermittent and irregular in intensity. It is worse at night than during the day and worse in summer than through the winter. In the tropical localities it is present throughout a greater portion of the year.

The use of a long, low aerial, or even an "underground" aerial, one of the patent shielded types; or the disconnecting of the ground lead from the set, will frequently reduce the amount of static received, at some sacrifice in volume of the broadcast reception. It will be found best when listening under bad static conditions, to tune the desired station to maximum with the "station dial" and then turn down the volume control till a very moderate volume is obtained.

(b) Code Signals.

This noise is in the form of an intermittent buzzing or "peeping," resembling telegraphic code (dots and

dashes), and is due to the operation of a powerful wireless telegraph transmitter, either commercial or amateur, in the immediate vicinity. Even if this transmitter is sharply tuned, if it is sufficiently close and powerful it may cause interference through "forced oscillations," which cannot very well be prevented. If it is a case of an improperly tuned transmitter, this can be reported to the Federal Radio Commission.

(c) Radiating Receivers

The familiar squeal or "cat-call," varying in intensity and volume, which is sent out or broadcast, when a regenerative or other oscillating receiver is "tuned in," is gradually disappearing from among the annoyances to which the broadcast listener is subject, as this class of set is steadily becoming obsolete and being replaced by the "stabilized" types. Interference of this kind can only be eliminated at its source, by proper operation of the offending receiver. Such cases can best be handled personally, by using diplomacy and tact with the owner of the trouble-causing set.

(d) Electrical Apparatus and Wiring.

Electrical machinery in operation and defective electric wiring is probably responsible for more "background noise" in radio reception than any other cause, particularly in a city or town where there are always many electrical devices, appliances and machinery in more or less continuous operation.

The nature of the noise in each case will depend upon the type of machinery causing it and the nature of the defect or electrical discharge responsible for the radiation of the disturbance. Among the more common sources of trouble of this nature may be mentioned:

- Electric motors or generators,
- Arc lights,
- Household electric appliances,
- Flashing signs,
- X-ray or violet-ray machines,
- Battery chargers (vibrating type),
- Leaky electric power wiring,
- Farm lighting systems,
- Telephone bell-ringers,

and numerous other forms of electric apparatus, in fact any device which produces a spark while in operation.

The source of the noise can sometimes be found by careful investigation of the presence of electrical appliances, defective wiring, loose fuses or lamps, etc., in the building or the immediate neighborhood. For the tracing of larger and more obscure sources, however, the use of a small portable receiving set, operating from a loop antenna, can be resorted to. Tests made with such an outfit, located at various points in the neighborhood of the disturbance, noting the intensity of disturbance and direction the loop points, will often enable the origin of the interference to be located.

3. Remedies

It would not be possible here to attempt to suggest remedies for the various noises caused by different forms of electrical apparatus, however, we may say that generally speaking, the only satisfactory remedy in most cases consists of some sort of filter applied to the source of the disturbance, that is the sparking contacts from which the interfering radio frequency currents are radiated. This filter will consist of either a simple condenser, two condensers in series with a ground lead from

the point of their connection, or two condensers so connected, in conjunction with R. F. chokes.

In a few cases some improvement in reception is had by changing the position of the receiving aerial, but the most practical procedure is to locate the source and apply one of the forms of filter suggested.

For a detailed treatise on this subject the dealer is referred to the "Manual on Interference" published by the Radio Manufacturers' Association.

SECTION V-a DESCRIPTIVE LIST OF ATWATER KENT RECEIVERS

Part No.	Model No.	Tubes	"Open" or Board Type Battery Sets
4052	..	4	Type "11" tuner, 1 stage fixed R.F., det. and 2 stage amp. unit, potentiometer control.
4066	..	5	Type "11" tuner, 2 stages fixed R.F., det. and 2 stage amp. unit, potentiometer control.
4340	10	5	Two stages tuned R.F., 3 variable condensers, 3 R.F. transformers, detector, 2 stage unit and potentiometer. Gray-green condensers.
4445	9	4	One stage tuned R.F. amp., 2 tuners and det. 2 stage unit, potentiometer control.
4333	5	5	Type "11" tuner, 2 stages fixed R.F., det. and 2 audio—all tubes in one metal container.
4600	10	5	Two stages tuned R.F.—3 var. condensers, etc., same as No. 4340, but different wiring.
4550	10A & 10B	5	(10B has 3 tap ant. switch.) Similar to 4340. Brown conds., with battery cable attached.
4560	10A & 10B	5	(10B has 3 tap ant. switch.) Same as 4550, but black variable condensers.
4620	12	6	Two stages R.F., det. and 3 stages audio—3 variable condensers, cable attached.
4700	10	5	Similar to 4340 & 10B 4550-4560. No pot. One R.F. rheostat only for both R.F. tubes.
4910	12	6	Similar to 4620, but with switch to control last audio stage, and no potentiometer.
Cabinet Type Battery Sets			
4640	20	5	Two stages tuned R.F., large cabinet, 3 dials, 3 pt. ant. tap switch, 2 rheostats.
4880	19	4	One stage tuned R.F., large cabinet, 2 dials, 3 pt. ant. tap switch, 2 rheostats.
4920	24	5	Same as 4640, but in "deluxe" cabinet, with feet.
7570	20 Compact	5	Small mahogany cabinet, 3 dials, tap switch, battery cable attached.
7780	21	5	Same as No. 7570, but with sockets and rheostats for 3-volt dry cell tubes.
7960	20 Compact	5	Same as No. 7570, but with "UX" type sockets and other refinements.
8000	30	6	One tuning dial, small mahogany cabinet, two rheostats, 3 stages R.F.
8100	35	6	Metal cabinet, tubes inserted from bottom—one dial, one rheostat, ship-type name-plate.
8270	32	7	Long cabinet, one dial, two rheostats—4 stages R.F. double R.F. transformers.
8930	33	6	Small mahogany cabinet, one dial, ant. adj. knob, two rheostats, double R.F. transformers.
8500	50	7	Large deep mahogany cabinet, several metal shielded compartments inside, one dial, antenna adjusting knob, 2 rheostats.
9840	48	6	Similar to Model 30, but gold panel.
9360	49	6	Similar to Model 33, but gold panel.
A.C. Sets—Using "A.C. Tubes"			
9390	36	6 and rect.	Small mahogany cabinet, same as Model 33; Type Y (metal), A.C. power unit goes with Model 36 set.
9500	37	" " "	Metal cabinet contains set and power unit, 3 stages R.F., 1 dial, 1 volume control knob, ship-type nameplate.
9400	38	7 " "	Same as Model 37, but double R.F. transformers and 4 stages R.F. amp., 1 dial.
9800	40	6 " "	Same as Model 37, metal cabinet, but black dial and volume knob and other minor differences; modernistic nameplate.
9850	42	" " "	Same as Model 40, but with automatic voltage reg., ball feet, dial in 5 divisions.
9900	44	7 " "	Same as Model 42, but with double R.F. transformers, 4 stages R.F. amp.
9930	52	6 " "	Console type—metal stand, speaker in base, antenna and ground leads supplied; set chassis same as Model 42.
Direct Current (110-Volt) Sets			
9910	41	7	Metal cabinet contains set and power unit, 3 stages R.F., detector, 2 stages A.F. (last stage "push-pull" type, 2 tubes, one mounted on right-hand side of power unit). Filaments in series. Chassis similar in appearance to Models 37, 40, 42 and 52.

SECTION VI

SERVICING RECEIVERS AND A. C. POWER UNITS

When a thorough inspection of the customer's installation, etc., shows conclusively that the cause of the trouble lies within the set itself, the best plan is for the service man to disconnect the set and take it to his shop for test and repairs.

In a few cases, where the trouble is a very minor one, it would perhaps be permissible for the service man, if experienced and capable, to make repairs in the set owner's home, but with the full shop equipment and absence of a critical audience, a more satisfactory and permanent job can almost always be done.

Moreover, it is always well to apply a complete volt-meter test to a set which has given trouble, as well as to check the alignment of the condensers and thoroughly inspect the wiring with a view to eliminating the possibility of any future trouble developing.

The main tests to be applied to a set which comes in for repair, may be classified as follows, applied in order named:

- (1) Visual inspection.
- (2) Continuity tests, with volt-meter.
- (3) Voltage tests (A. C. sets only).

The conducting of these tests will now be outlined.

1. Visual Inspection

In order to make a satisfactory visual inspection of the wiring and condition of the parts in a receiver, it is necessary to remove the set from the cabinet. This presents no particular difficulties, and by following instructions given in connection with service data on individual sets, the procedure can be accomplished in a minimum of time.

Points for Inspection

The following features should be given special attention in making the general visual inspection:

- 1—**SOLDERED JOINTS**—examine for firmness. A poor physical joint means a poor electrical connection. Note especially ground lug connections.
- 2—**SCREWS, BOLTS AND NUTS**—must be all tight.
- 3—**INSULATION ON WIRING**—must be perfect and not cut or frayed through where it passes metal edges of tube contacts, etc.
- 4—**TUBE SOCKET FINGERS**—should be clean and tight.
- 5—**SWITCHES**—switch blades should be clean and make good contact.
- 6—**DIALS**—should not scrape on panel.
- 7—**GRID RESISTANCES**—note if intact and tightly riveted on.
- 8—**R. F. TRANSFORMERS**—examine for loose or damaged coils, or bad connections at terminals.
- 9—**VARIABLE CONDENSERS**—check for foreign particles between plates and note spacing between rotary and stationary plates.
- 10—**RHEOSTATS or VOLUME CONTROL**—must operate smoothly.

- 11—**POWER SUPPLY CABLE**—note condition of insulation on leads and condition of terminals at power end.
- 12—**POWER UNIT (A. C. SETS)**—cable connection panel must be bolted down tightly.
- 13—**SUPPLY CABLES (A. C. SETS)**—note if cut by power unit lid.

2. Continuity and Voltage Tests

After set has been thoroughly checked by visual inspection in accordance with paragraph 1, the next step toward locating possible defects will be to apply the series of circuit continuity tests. These tests should be made even though the condition which apparently caused the complaint has been located through the visual inspection.

In case of the A. C. sets, it will be necessary also to check the voltages supplied to the various circuits by the power unit. Voltage tests are unnecessary in the case of the battery type sets, since the batteries or other sources of voltage are usually checked individually before attempting to apply any tests to the set chassis.

The following pages contain complete sets of continuity tests for all A. K. receiving sets manufactured since 1924, and also for the power units used in the A. C. type receivers. A complete voltage table covering all A. C. sets will be found at the end of this section.

The following abbreviations are used in the continuity test charts:

Abbreviation	Meaning
1 R.....	1st radio frequency socket
2 R.....	2nd " " "
3 R.....	3rd " " "
4 R.....	4th " " "
D.....	Detector socket
1 A.....	1st audio frequency socket
2 A.....	2nd " " "
3 A.....	3rd " " "
+ F.....	Positive filament contact
— F.....	Negative " "
G.....	Grid contact
P.....	Plate "
C (in A. C. sets).....	Cathode "
R. F. T.....	Radio frequency transformer
A. F. T.....	Audio "

In the tables, to identify a certain contact of a certain socket, the abbreviation of the contact is combined with the abbreviation of the socket.

Thus the grid (G) contact of the third R. F. socket is referred to as G3R. The negative filament contact of the second A. F. socket is referred to as —F2A, the cathode of the detector socket (in A. C. sets) would be CD, P2A would mean the plate contact of the second audio frequency socket, and so on.

The use of these symbols will enable the service man quickly to recognize the corresponding socket on the set without having to refer to the chart or wiring diagram.

Model 10B Receiver—Test Chart, Continuity Table and Diagram

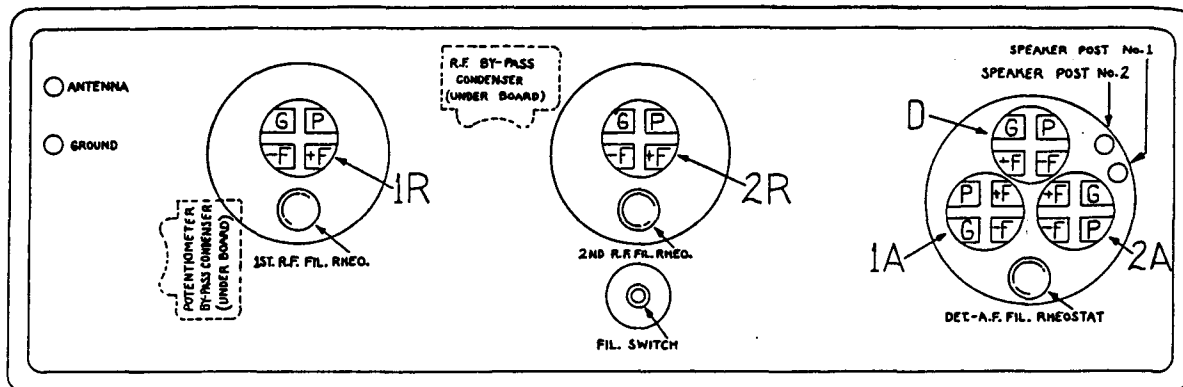


FIG. 28.

(For Following Tests, Place Filament Switch "On," Rheostats Barely "On" and Potentiometer Pointer to Left)
 NOTE: Unsolder +F Lead to Potentiometer, and One Lead to Potentiometer By-Pass Condenser.

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
Each cable lead end to corresponding soldered cable connection under board.	Full	Open in cable.	Examine cable for broken leads and short circuits. Repair or replace cable if necessary.
BLACK to —F1R —F2R —FD, —F1A, —F2A Ground Post. Antenna Post. G1R P1R, P2R PD, P1A G2R G1A, G2A	Full Full Full Full Full Full None None Full Partial	Open 1st R.F. fil. rheostat or connection. Open 2nd R.F. fil. rheostat or connection. Open Det.-A.F. fil. rheostat or connection. Open ground connection. Open antenna coil or connection. Open antenna coil or connection. No. 1, 2 R.F.T. primary circuit grounded. No. 1, 2 A.F.T. primary circuit grounded. Open secondary No. 1 R.F.T. None—Open secondary No. 1, 2 A.F.T.	Examine joints under board. Examine joints under board. Examine joints under board. Test with ant. switch on each tap. Check transformer connections. Examine connections. Full—Shorted secondary.
RED to +F of Each Socket. PD GD P1R	Full None None None	Open positive filament wire or connection. Shorted phone condenser. Shorted grid condenser. Shorted R.F. plate circuit by-pass condenser.	Examine joints under board. Located inside 3-tube container. Located inside 3-tube container. Install new type by-pass cond.
WHITE to { P1R P2R	Full Full	Open primary No. 1 R.F.T. Open primary No. 2 R.F.T.	
YELLOW to PD	Partial	None—Open primary No. 1 A.F.T.	Full—Shorted primary.
BROWN to P1A Speaker Post No. 2.	Partial Full	None—Open primary No. 2 A.F.T. Open connection.	Full—Shorted primary.
OTHER TESTS Across End Terminals of Potentiometer. Across Terminals of Potentiometer Cond. BLACK to Center Contact of Potentiometer (turn knob.)	Nearly Full None Nearly Full	None—Open potentiometer. Shorted potentiometer by-pass condenser. Open connection to slider.	Full—Shorted potentiometer. Located under board, left-front. Install new type by-pass cond.

Resolder Connections to Potentiometer and By-Pass Condenser.

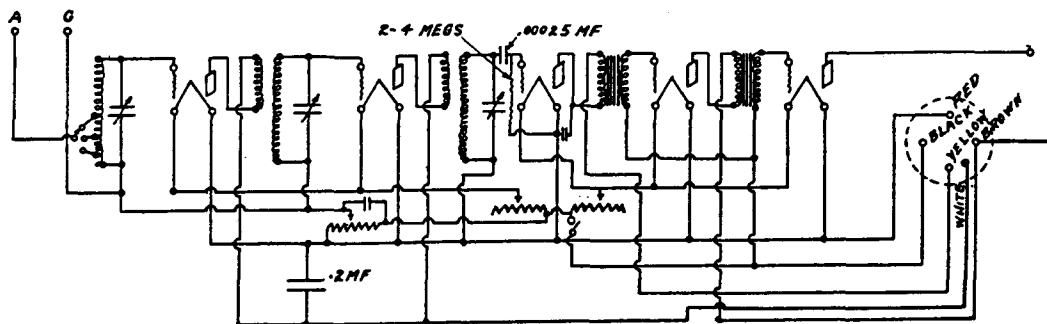


FIG. 29.

NOTE.—This set has two R.F. rheostats (one for each R.F. tube). —F1R connects to the slider lead of the 1st R.F. rheostat instead of to —F2R.

Model 10 Receiver—Test Chart, Continuity Table and Diagram

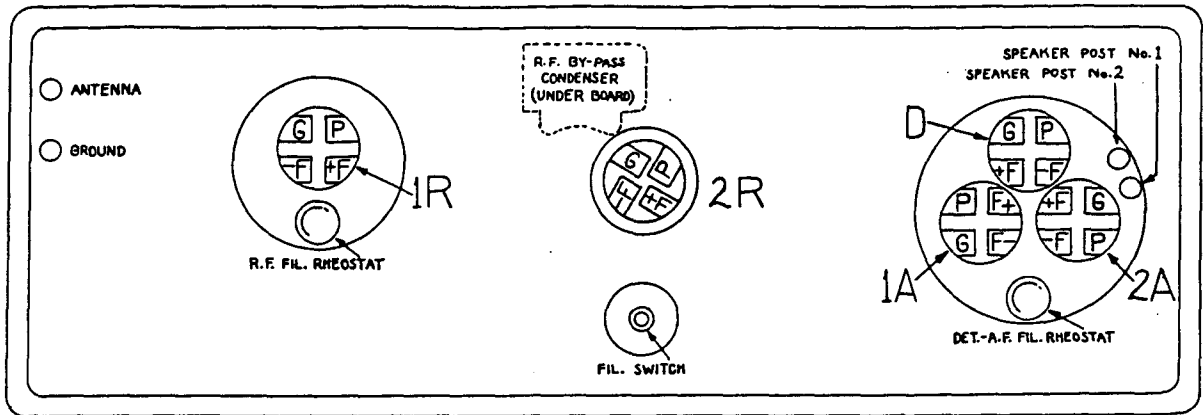


FIG. 30.

(For Following Tests, Place Filament Switch "On" and Rheostats Barely "On")

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
Each cable lead end to corresponding soldered connection under board.	<i>Full</i>	Open in cable.	Examine cable for broken leads and short circuits. Repair or replace cable if necessary.
BLACK to —F1R, —F2R —FD, —F1A, —F2A Ground Post. Antenna Post. G1R P1R, P2R PD, P1A G2R G1A G2A	<i>Full</i> <i>Full</i> <i>Full</i> <i>Full</i> <i>Partial</i> <i>None</i> <i>None</i> <i>Partial</i> <i>Partial</i> <i>Partial</i>	Open R.F. filament rheostat or connection. Open Detector-A.F. rheostat or connection. Open ground connection. Open antenna coil or connection. Open antenna coil or first grid resistance. No. 1, 2 R.F.T. primary circuit grounded. No. 1, 2 A.F.T. primary circuit grounded. Open sec. No. 1 R.F.T. or 2nd grid res. None—Open secondary No. 1 A.F.T. None—Open secondary No. 2 A.F.T.	Examine joints under board. Examine joints under board. Test with ant. switch on each tap. 1st grid resis. located inside ant. coil. Check transformer connections. Examine conn. in 3-tube container. No. 2 grid res. inside No. 1 R.F.T. Full—Shorted secondary. Full—Shorted secondary.
RED to +F of each Socket. PD GD P1R Ground Post.	<i>Full</i> <i>None</i> <i>None</i> <i>None</i> <i>None</i>	Open positive filament wire or connection. Shorted phone condenser. Shorted grid condenser. Shorted plate circuit by-pass condenser. Grounded positive filament circuit.	Examine joints under board. Located inside 3-tube container. Located inside 3-tube container. Located under board. Inspect wir. for accidental grounds.
YELLOW to PD	<i>Partial</i>	None—Primary No. 1 A.F.T. open.	Full—Pri. No. 1 A.F.T. shorted.
BROWN to P1R P2R P1A Speaker Post No. 2.	<i>Full</i> <i>Full</i> <i>Partial</i> <i>Full</i>	Primary No. 1 R.F.T. open. Primary No. 2 R.F.T. open None—Primary No. 2 A.F.T. open. Open connection.	Full—Pri. No. 2 A.F.T. shorted.
OTHER TESTS P2A to Spkr. Post No. 1.	<i>Full</i>	Open connection.	

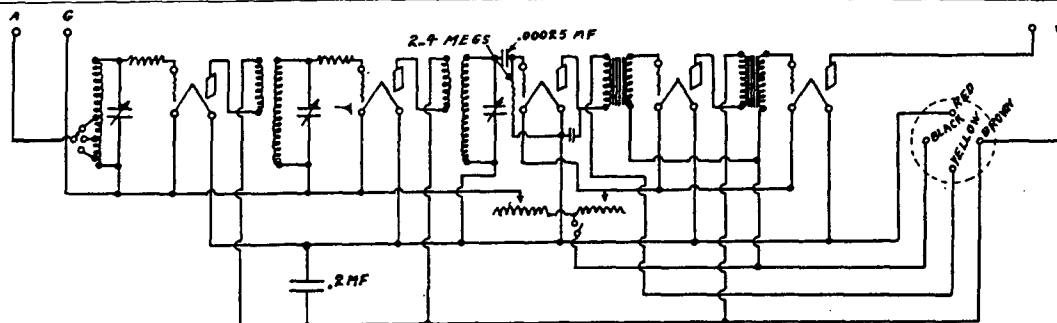


FIG. 31.

Model 12 Receiver—Test Chart, Continuity Table and Diagram

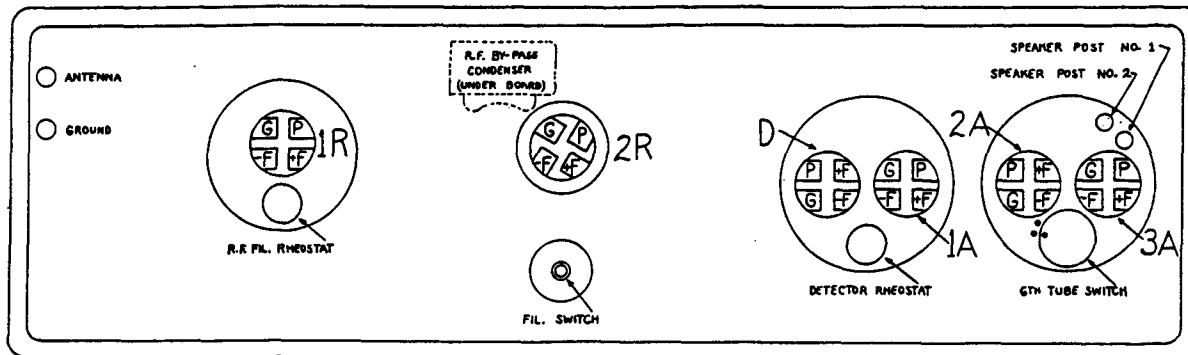


FIG. 32.

(For Following Tests, Place Filament Switch "On" and Rheostats Barely "On")

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
Each cable lead end to corresponding soldered end under board.	Full	Open in cable.	Examine cable for broken leads and short circuits. Repair or replace cable if necessary.
BLACK to —F1R, —F2R —FD, —F1A —F2A, —F3A Ground Post. Antenna Post. G1R P1R, P2R PD, P1A, P2A G2R G1A, G2A, G3A	Full Full Full Full Partial None None Partial Partial	Open R.F. filament rheostat or connection. Open Det.-1st A.F. fil. rheo. or connection. Open fixed resistance A.F. filament. Open ground connection. Open antenna coil or connection. Open antenna coil or first grid resistance. No. 1, 2 R.F.T. primary circuit grounded. No. 1, 2, 3 A.F.T. primary circuit grounded. Open sec. No. 1 R.F.T. or No. 2 grid res. None—Open secondary No. 1, 2, 3 A.F.T.	Examine joints under board. Examine joints under board. Located inside right hand container. Test with ant. switch on each tap. No. 1 grid resistance inside ant. coil. Check transformer connections. Examine conn. in 2-tube cases. No. 2 grid res. inside No. 1 R.F.T. Full—Shorted secondary.
RED to +F of R.F., Det., 1st and 2nd A.F. +F3A (6th Tube Switch to Rt.) PD GD P1R	Full Full None None None	Open positive filament wire or connection. Open wire or defective switch. Shorted phone condenser. Shorted grid condenser. Shorted R.F. plate circuit by-pass condenser.	Examine joints under board. No reading with switch turned left. Located inside Det.-1st A.F. case. Located inside Det.-1st A.F. case. Located under board.
YELLOW to PD	Partial	None—Open primary No. 1 A.F.T.	Full—Shorted primary.
BROWN to P1R P2R P1A P2A (6th Tube Switch to Rt.) Speaker Post No. 2.	Full Full Partial Partial Full	Open primary No. 1 R.F.T. Open primary No. 2 R.F.T. None—Open primary No. 2 A.F.T. None—Open primary No. 3 A.F.T. Open connection.	 Full—Shorted primary. Full—Shorted primary (no reading with switch turned left.)

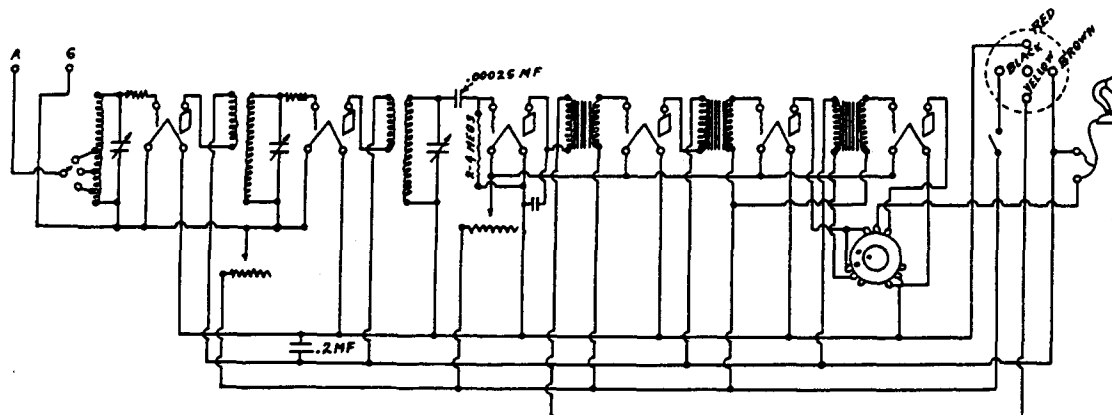


FIG. 33.

(Diagram shows one rheostat controlling detector and all three A.F. tubes. In actual set, rheostat controls detector and 1st audio only, 2nd and 3rd audio tubes being on separate fixed resistances.)

Model 20 No. 4640 Receiver—Test Chart, Continuity Table and Diagram

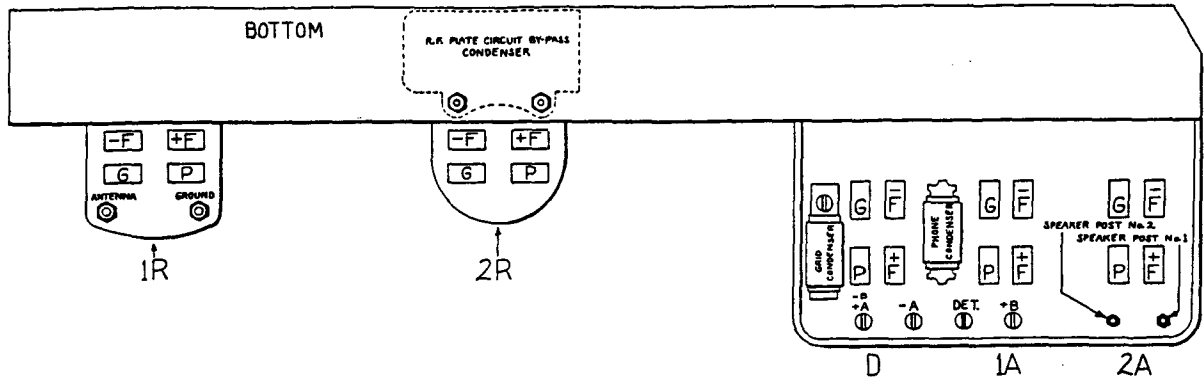


FIG. 34.

(For Following Tests, Place Filament Switch "On" and Rheostats Barely "On")

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
-A POST to -F1R, -F2R, Ground Post. -FD, -F1A, -F2A Antenna Post. +B Post.	Full Full Full None	Open in R.F. filament rheo. or connections. Open in Det.-A.F. fil. rheo. or connections. Open antenna coil or connection. Shorted R.F. by-pass condenser or grounded R.F.-1st A.F. plate circuit.	Test with antenna switch on each of 3 points. If necessary, unsolder by-pass condenser connection and test separately. Examine plate circuits for accidental grounds.
G1R	Nearly Full	Open antenna coil or first grid resistor.	Test sec. and grid res. separately. Grid resistors are mounted on back of R.F. var. condensers.
G2R	Nearly Full	Open secondary No. 1 R.F.T. or open second grid resistor.	Test sec. and grid res. separately. Grid resistors are mounted on back of R.F. var. condensers.
GD G1A G2A	None Partial Partial	Shorted detector grid condenser. None—Open secondary No. 1 A.F.T. None—Open secondary No. 2 A.F.T.	Full—Shorted secondary. Full—Shorted secondary.
Stator of Detector Variable Condenser.	Full	Open secondary No. 2 R.F.T.	
+A, -B POST to +F of All Sockets. PD	Full None	Open positive filament circuit. Shorted phone condenser.	
+20 (DET.) POST to PD	Partial	None—Open primary No. 1 A.F.T.	Full—Shorted primary.
+B POST to P1R P2R P1A Speaker Post No. 2.	Full Full Partial Full	Open primary No. 1 R.F.T. Open primary No. 2 R.F.T. Open primary No. 2 A.F.T. Open connection.	Full—Shorted primary.

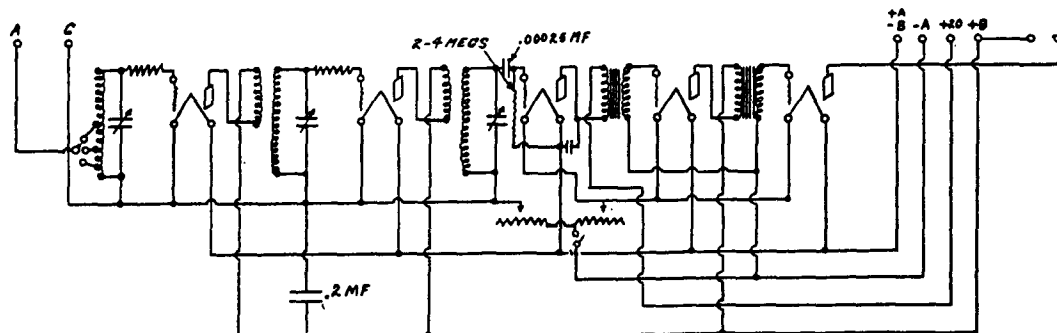


FIG. 35.

Model 20 Compact Receiver—Continuity Table

(For Following Tests, Place Filament Switch "On" and Rheostats Barely "On")

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
			NOTE: Examine cable for broken leads, broken connections and short circuits. Repair or re-place cable if necessary.
BLACK to —F1R, —F2R, Ground Post. —FD (7960 Set). —F1A, —F2A (7960 Set). —FD, —F1A, —F2A (7570 Set). +FD (7960 Set). Antenna Post.	Full Full Full Full Nearly Full Full	Open R.F. rheostat or connection. Open detector rheostat or connection. Open A.F. filament fixed resistance. Open Detector-A.F. filament rheostat or connection. Open detector grid bias resistance. Open primary antenna transformer or defective tap switch.	R.F. rheostat at left. Detector rheostat at right. Green insulated wire between rheostat assembly and —F1A. Detector-A.F. rheostat at right.
G1R	Partial	Open secondary antenna transformer or open first grid resistance.	Test with antenna switch on each of 3 taps. Test secondary and grid resistor separately. Grid resistors mounted on back of R.F. variable condensers.
P1R, P2R	None	No. 1, 2 R.F.T. primary circuit grounded.	Or shorted by-pass condenser. (Unsolder lead and test condenser separately.)
PD	None	No. 1 A.F.T. primary circuit grounded.	Or shorted phone condenser (on 7960 set).
P1A G2R	None Partial	No. 2 A.F.T. windings grounded. None—Open secondary No. 1 R.F.T. or open grid resistor.	Examine transformer connections. Full—Shorted grid circuit or shorted grid resistor.
GD G1A (7960 Set). Stator of Detector Variable Condenser.	None Partial Full	Shorted grid condenser. None—Open secondary No. 1 A.F.T. Open secondary No. 2 R.F.T.	Mounted on det. var. condenser. Full—Shorted secondary.
RED to +F of All Sockets. PD (7570 Set).	Full None	Open positive filament circuit. Shorted phone condenser.	
WHITE to P1R P2R P1A (7960 Set).	Full Full Partial	Open primary No. 1 R.F.T. Open primary No. 2 R.F.T. None—Open primary No. 2 A.F.T.	Full—Shorted primary.
YELLOW to PD	Partial	None—Open primary No. 1 A. F. T.	Full—Shorted primary.
BROWN to Speaker Post No. 2. P1A (7570 Set).	Full Partial	Open cable lead or connection. None—Open primary No. 2 A.F.T.	Full—Shorted primary.
OTHER TESTS P2A to Speaker Post No. 1. —C Lead to G2A —C Lead to G1A (on 7570 Set).	Full Partial Partial	Open connection. None—Open secondary No. 2 A.F.T. None—Open secondary No. 1 A.F.T.	Full—Shorted secondary. Full—Shorted secondary.

Model 20 Compact Receiver—Test Chart and Diagrams

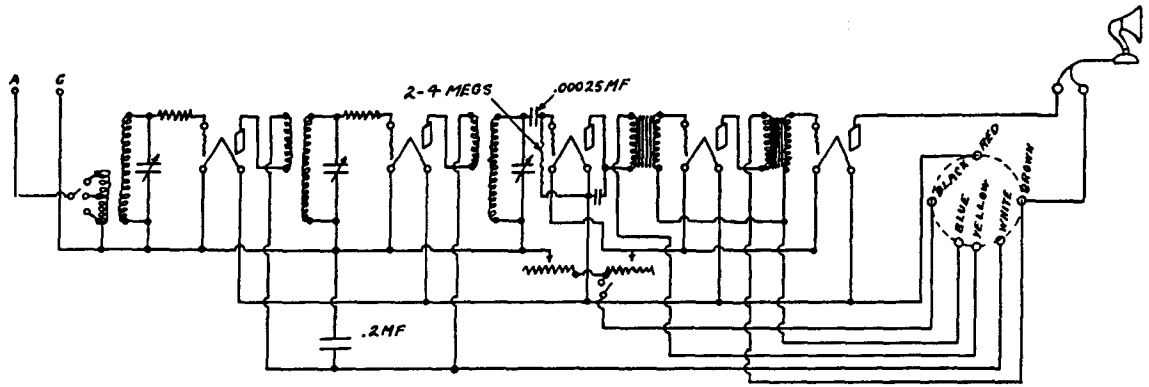


FIG. 36. MODEL 20 COMPACT SET NO. 7570. WIRING DIAGRAM.

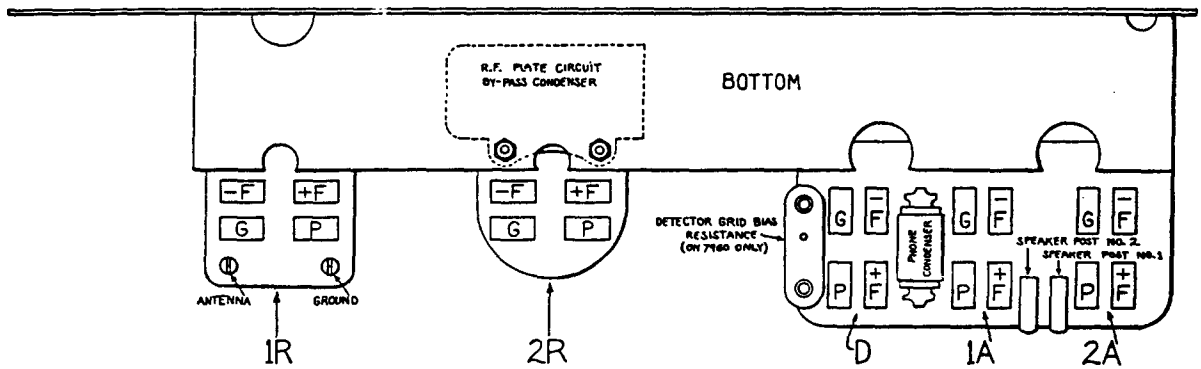


FIG. 37. TESTING CHART FOR MODEL 20 COMPACT (BOTH TYPES).

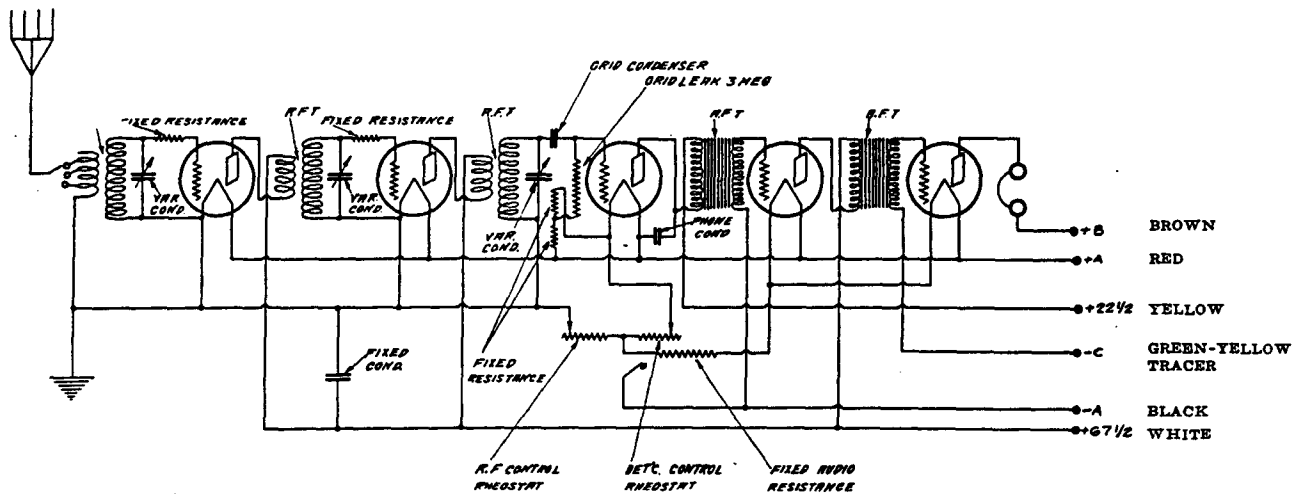


FIG. 38. MODEL 20 COMPACT SET NO. 7960. WIRING DIAGRAM.

Models 30, 35 and 48 Receiving Sets

General Description

The circuits of Models 30, 35 and 48 receivers are practically identical. Each has six tubes and single dial control. There are three stages of radio frequency amplification, a tuned detector, and two stages of audio frequency amplification. The first R. F. stage is untuned, being used as an antenna coupling tube for the purpose of eliminating the effect of different sizes of antenna systems on the synchronism of the three tuned circuits.

In Models 30 and 48 one rheostat controls the filaments of the three R. F. tubes, and another rheostat controls the detector filament. A fixed resistance is connected in series with the filaments of the two A. F. tubes.

In Model 35 one rheostat controls the three R. F. filaments and a fixed resistance is connected in series with the filaments of the detector and two A. F. tubes.

Model 30 (Early Type) has moulded end-plate variable condensers and three separate sockets for the R. F. tubes. Model 30 (Later Type) has metal frame variable condensers and a single moulded base for the three R. F. sockets.

Model 48 is similar to the later Model 30, but has a gold-finished panel and other minor refinements.

The chassis of Model 35 is similar in appearance to the later Model 30 and to Model 48, but it is mounted inverted inside a metal cabinet that is open on the bottom.

1. Model 35. Removing Chassis from Cabinet

Remove dial and vernier knob. Unscrew six bolts holding bottom rim to cabinet and remove rim. Remove six screws, three in a row at each end of the vertical side of metal frame. (Use magnetized screw driver.)

With top of cabinet on table, pull chassis back slightly to clear condenser shaft and rheostat knob, then lift set up and out, tilting chassis so the filament switch knob is inclined away from the table in order that the switch knob will clear the cabinet.

2. Model 30 (Later Type) and Model 48. Removing Chassis from Panel

Remove dial and vernier knob. Remove six screws, three in a row at each end of vertical side of metal frame. The panel may then be removed.

3. Model 30 (Early Type). Replacing Sub-Panel Assembly

Remove set from cabinet. Remove dial and vernier knob. Unsolder leads from sub-panel assembly. Remove three screws in front panel at center variable condenser and four screws along the bottom. It is necessary to remove bolts on the third R. F. socket and remove fixed by-pass condenser in order to change the sub-panel assembly. (If the by-pass condenser is of old style—brown color—replace with No. 8685.) Remove sub-panel assembly.

Attach the replacement sub-panel assembly, without tightening screws, and replace the fixed condenser, which is held by the two bolts passing through the third R. F. socket. The edge of the by-pass condenser must not be caught under the bottom angle of the sub-panel frame. Tighten screws holding sub-panel, solder connections exactly as the original, assemble set, and synchronize condensers. (See Section XI.)

4. Replacing Condenser Group in Models 30 (Later Type), 35 and 48

Remove chassis from cabinet or panel. Loosen nine screws holding condensers to front of metal frame. Note how pulleys and belts are arranged and then remove them. Replace one condenser at a time. Do not mix old condensers with the replacements.

Remove two nuts on back of first variable condenser, which clamp grid resistor (grid condenser on third variable condenser) and lug of secondary lead. Remove three screws holding condenser to chassis and lift out the condenser.

Put in the replacement condenser and its three screws, without tightening screws. Attach grid resistor and lug of secondary lead to top and bottom bolts respectively on back of condenser. Repeat procedure with other two variable condensers. When the replacement condensers are installed, put on the pulleys and belts, adjust belt tension and synchronize condensers. (See Section XI.)

5. Replacing R. F. Amplifier Assembly in Models 30 (Later Type), 35 and 48

Remove chassis from cabinet or panel. The R. F. amplifier assembly consists of three R. F. transformers mounted on a moulded three-socket base. The filament contacts are wired and have two leads for connection to rest of set; the plate circuits are wired and have one lead for connection to the +B, R. F. (white) cable lead. A lead from the grid-end of each R. F. transformer secondary is soldered to a lug which is to be fastened to the bottom bolt on back of the variable condenser in front of each R. F. transformer.

In replacing R. F. amplifier assembly, remove the old assembly by unsoldering the R. F. by-pass condenser lead, lead from grid of first R. F. socket, leads from grid resistors (unsolder at grid contacts of socket), two filament circuit leads (at points where they connect to rest of set), and the +B, R. F. lead. Remove secondary wire lug from bottom bolt on each variable condenser. Unsolder, at grid contact of detector socket, the lead from grid condenser, which passes through a hole in the R. F. base. Unsolder lead from ground lug to negative side of R. F. filament circuit. Remove five bolts holding R. F. base to metal chassis and remove the old R. F. amplifier assembly.

Reassemble with replacement R. F. amplifier, reversing above procedure.

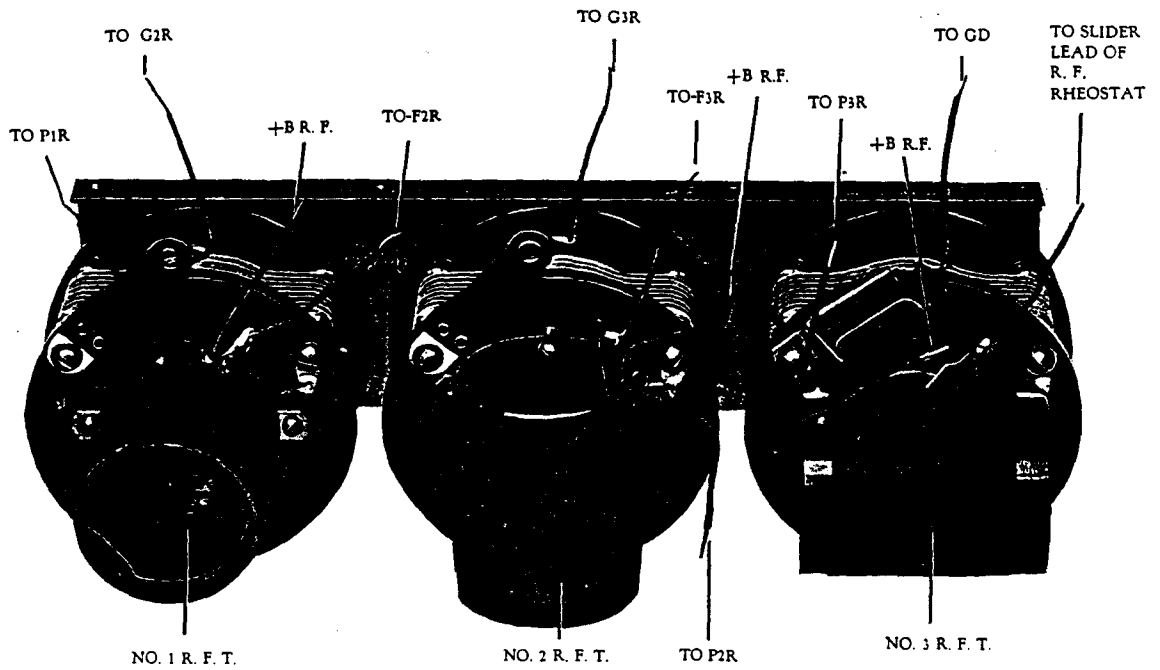


FIG. 39. VIEW OF SUB-PANEL ASSEMBLY MODEL 30 (Early Type), SHOWING WHERE EACH LEAD IS TO BE CONNECTED.

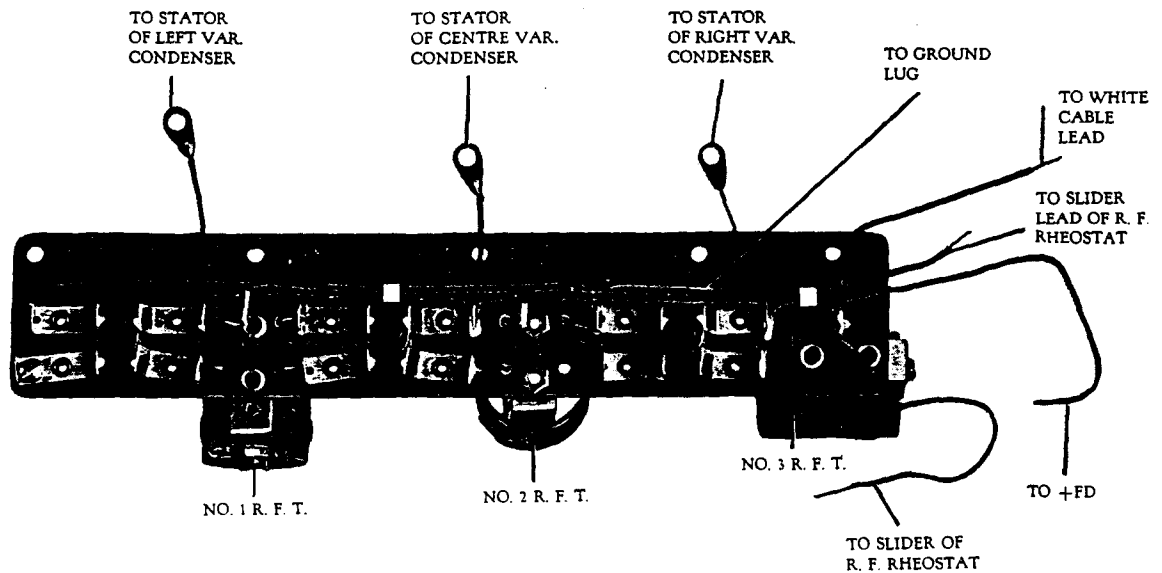


FIG. 40. VIEW OF R.F. AMPLIFIER ASSEMBLY IN MODELS 30 (Later Type), 35 AND 48, SHOWING WHERE EACH LEAD IS TO BE CONNECTED.

Replacing R. F. Transformers, Variable Condensers or Grid Resistors in Models 30, 35 and 48

MODEL OF SET	If One R. F. Transformer is Defective	If One Variable Condenser is Defective	If One Grid Resistor is Defective
MODEL 30 (with moulded end-plate condensers)	Replace Sub-panel Assembly No. 8,185. This consists of a metal frame, three variable condensers, three R. F. transformers, two grid resistors, and one grid condenser, all mounted in place, with pulleys and belts adjusted.	Replace Sub-panel Assembly No. 8,185.	Replace defective resistor No. 8,092.
MODEL 30 (with metal frame condensers)	Replace R. F. Amplifier Assembly No. 8,449 for sets between Serial Nos. 636,101 and 639,358. No. 9,030 for sets above Serial No. 644,351.	Replace group (No. 9,100) of three variable condensers. Use pulleys and belts of original group.	Replace defective resistor No. 8,439.
MODEL 35	Replace R. F. Amplifier Assembly No. 8,108 for sets previous to Serial No. 900,000. No. 8,440 for sets between Serial Nos. 900,000 and 955,700. No. 9,020 for sets after Serial No. 955,700.	Replace group of three variable condensers. No. 9,201 (13 plates) for sets previous to Serial No. 900,000. No. 9,100 (17 plates) for sets after Serial No. 900,000. Use pulleys and belts of original group.	Replace defective resistor No. 8,225 for sets previous to Serial No. 900,000. No. 8,439 for sets after Serial No. 900,000.
MODEL 48	Replace R. F. Amplifier Assembly No. 9,030.	Replace group of three variable condensers. No. 9,100. Use pulleys and belts of original group.	Replace defective resistor No. 8,439.

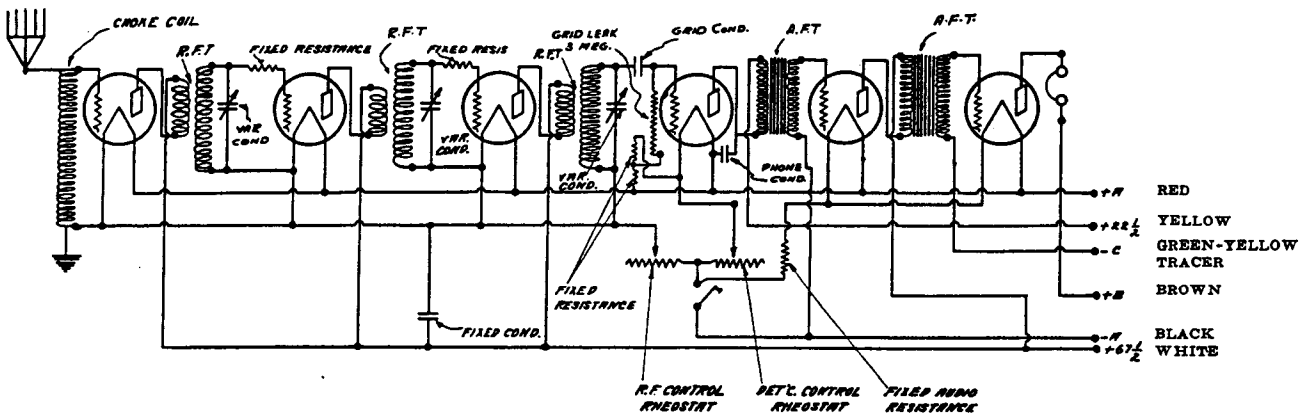


FIG. 41. WIRING DIAGRAM OF MODELS 30, 35 AND 48. (In Model 35, one rheostat controls the three R.F. filaments and a fixed resistance is connected in series with the detector and two A.F. filaments.)

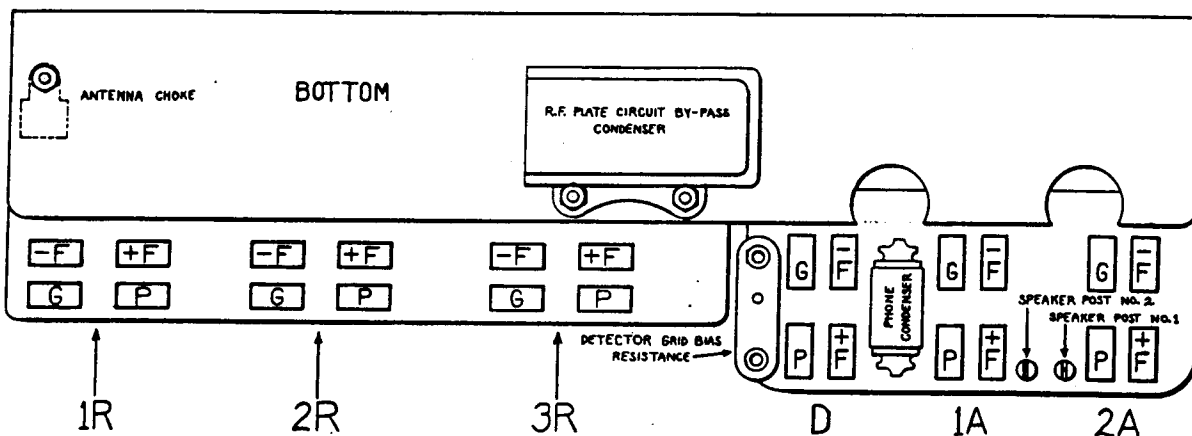


FIG. 42. TEST CHART FOR MODELS 30, 35 AND 48.

NOTE.—Early Model 30 Sets have separate R.F. sockets, but the socket contacts are in same relative position as shown in above chart.

Continuity Test Table—Models 30, 35 and 48

(For Following Tests, Place Filament Switch "On" and Rheostats Barely "On")

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
			Examine cable for open leads, broken connections and short circuits. Repair or replace cable if necessary.
BLACK to			
—F of R.F. Sockets.	<i>Full</i>	Open R.F. filament rheo. or connections.	R.F. filament rheostat at left (on Models 30 and 48).
—F of A.F. Sockets.	<i>Full</i>	Open A.F. fil. fixed resis. or connections.	Green insulated wire from rheostat assembly to —F1A.
—FD	<i>Full</i>	Open detector filament rheostat or connections. (Models 30 and 48.)	Or open connection to det.-A.F. fil. fixed resis. (Model 35).
Ground Post.	<i>Full</i>	Open connection.	
Antenna Post.	<i>Full</i>	Open antenna choke coil or connection.	
G1R	<i>Full</i>	Open connection.	
P of R. F. Sockets.	<i>None</i>	No. 1, 2, 3 R.F.T. primary circuit grounded.	Or shorted R.F. plate circuit by-pass condenser. (Unsolder lead and test condenser separately.)
PD	<i>None</i>	No. 1 A.F.T. primary circuit grounded.	Or shorted phone condenser. (Unsolder lead and test condenser separately.)
P1A	<i>None</i>	No. 2 A.F.T. primary circuit grounded.	Inspect transformer connections.
G2R	<i>Partial</i>	None—Open secondary No. 1 R.F.T. or open grid resistor.	Full—Shorted grid resistor.
G3R	<i>Partial</i>	None—Open secondary No. 2 R.F.T. or open grid resistor.	Full—Shorted grid resistor.
GD	<i>None</i>	Shorted detector grid condenser.	Mounted on back of last var. cond.
G1A	<i>Partial</i>	None—Open secondary No. 1 A.F.T.	Full—Shorted secondary.
Stator of Detector Variable Condenser.	<i>Full</i>	Open secondary No. 3 R.F.T.	
RED to			
+F of All Sockets.	<i>Full</i>	Open positive filament circuit.	
Black	<i>Nearly Full</i>	None—Open detector grid bias resistance.	Full—Shorted bias resistor or grounded +F circuit.
WHITE to			
P of R.F. Sockets.	<i>Full</i>	Open primary No. 1, 2, 3 R.F.T.	
P1A	<i>Partial</i>	Open primary No. 1 A.F.T.	Full—Shorted primary.
YELLOW to			
PD	<i>Partial</i>	None—Open primary No. 1 A.F.T.	Full—Shorted primary.
BROWN to			
Speaker Post No. 2.	<i>Full</i>	Open connection.	
OTHER TESTS			
—C Lead (Green-Yellow Tracer) to G1A	<i>Partial</i>	None—Open secondary No. 2 A.F.T.	Full—Shorted secondary.
P2A to Speaker Post No. 1.	<i>Full</i>	Open connection	

Model 32 Receiving Set

General Description

The Model 32 is a seven-tube, single dial, battery type receiver, having four stages of radio frequency amplification, a tuned detector, and two stages of audio frequency amplification. The first R. F. amplifying tube is not tuned, being used as an antenna coupling tube for the purpose of preventing different sizes of antenna from disturbing the synchronism of the succeeding tuned circuits.

The filaments of the R. F. tubes are controlled by one rheostat. Another rheostat controls the detector filament, and a fixed resistance is connected in series with the two A. F. filaments.

The Model 32 may be recognized by its four double R. F. transformers and four moulded end-plate variable condensers.

Replacing Sub-Panel Assembly No. 8296

If one of the R. F. transformers or one of the variable condensers is defective, the entire sub-panel assembly

must be replaced. This assembly consists of a metal frame, four moulded end-plate variable condensers, four double R. F. transformers, three grid resistors and a detector grid condenser, all mounted in place with pulleys and belts adjusted.

Remove dial and vernier knob. Unsolder leads from sub-panel assembly. Remove three screws in front panel at second variable condenser and five screws along the bottom. Remove two bolts holding fourth R. F. socket and remove by-pass condenser. (If by-pass condenser is of old style—brown color—replace with No. 8685.) Lift out old assembly.

Screw the replacement sub-panel assembly into position, without tightening screws, and replace the by-pass condenser, which is held by two bolts passing through the fourth R. F. socket. The edge of the condenser must not be caught under the bottom angle of the sub-panel frame. Tighten screws holding sub-panel. Solder connections exactly like original, assemble set and synchronize condensers. (See Section XI.)

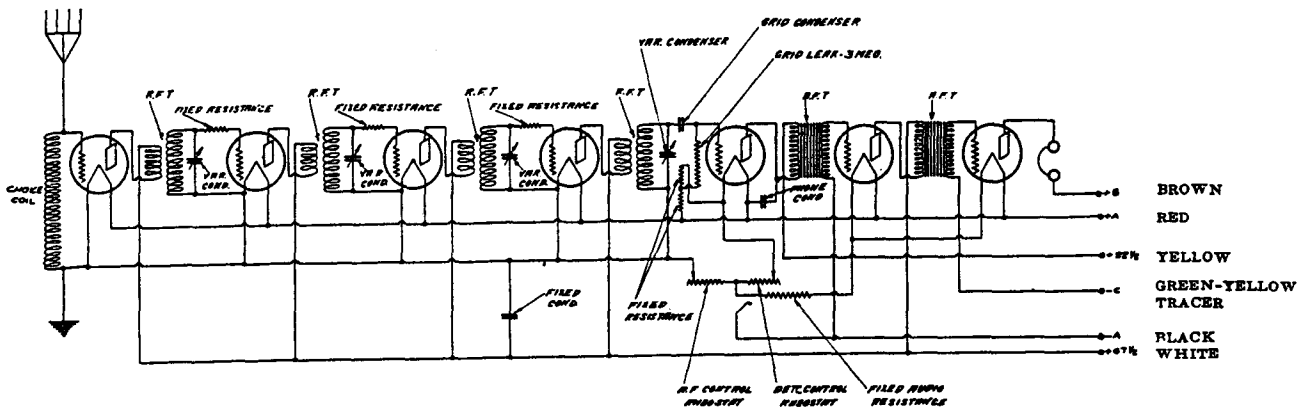


FIG. 43. WIRING DIAGRAM OF MODEL 32.

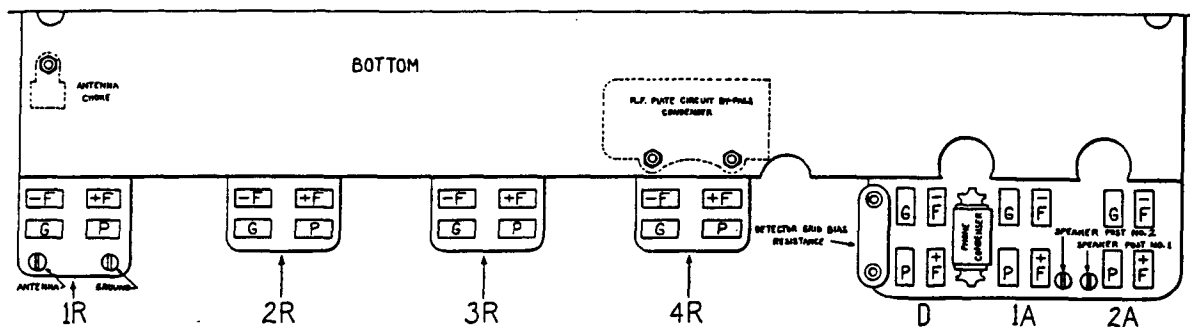


FIG. 44. TESTING CHART FOR MODEL 32.

Continuity Test Table—Model 32

(For Following Tests, Place Filament Switch "On" and Rheostats Barely "On")

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
			Examine cable for broken leads or short circuits. Repair or re-place cable if necessary.
BLACK to —F of R.F. Sockets. —FD —F of A.F. Sockets.	<i>Full</i> <i>Full</i> <i>Full</i>	Open in cable, connection, or R.F. rheo. Open connection or detector rheostat. Open connection or A.F. fil. fixed resistance.	R.F. rheostat at left. Detector rheostat at right. A.F. resistance—green insulated wire from rheostat assembly to —F1A.
Ground Post. Antenna Post. G1R P1R, P2R, P3R, P4R PD P1A Red	<i>Full</i> <i>Full</i> <i>Full</i> <i>None</i> <i>None</i> <i>None</i> <i>Nearly Full</i>	Open ground connection. Open antenna choke coil or connection. Open connection. No. 1, 2, 3, 4 R.F.T. pri. circuit grounded. No. 1 A.F.T. primary circuit grounded. No. 2 A.F.T. primary circuit grounded None—Open detector grid bias resistance.	Or shorted R.F. by-pass condenser. Or shorted phone condenser. Full—Shorted bias or grounded positive filament circuit.
G2R, G3R, G4R	<i>Nearly Full</i>	None—Open secondary No. 1, 2, 3 R.F.T. or open No. 1, 2, 3 grid resistance.	Full—Shorted grid resistor. (Resistors mounted on back of R.F. variable condensers).
Stator of Detector Variable Condenser. G1A	<i>Full</i> <i>Partial</i>	Open secondary No. 4 R.F.T. None—Open secondary No. 1 A.F.T.	Full—Shorted secondary.
RED to +F of All Sockets.	<i>Full</i>	Open in cable or connection.	
WHITE to Plate of Each R.F. Socket. P1A	<i>Full</i> <i>Partial</i>	Open primary No. 1, 2, 3, 4 R.F.T. None—Open primary No. 2 A.F.T.	Full—Shorted primary.
YELLOW to PD	<i>Partial</i>	None—Open primary No. 1 A.F.T.	Full—Shorted primary.
BROWN to Speaker Post No. 2.	<i>Full</i>	Open in cable or connection.	
OTHER TESTS P2A to Speaker Post No. 1. Green-Yellow Tracer to G2A	<i>Full</i> <i>Partial</i>	Open connection. None—Open secondary No. 2 A.F.T.	Full—Shorted secondary.

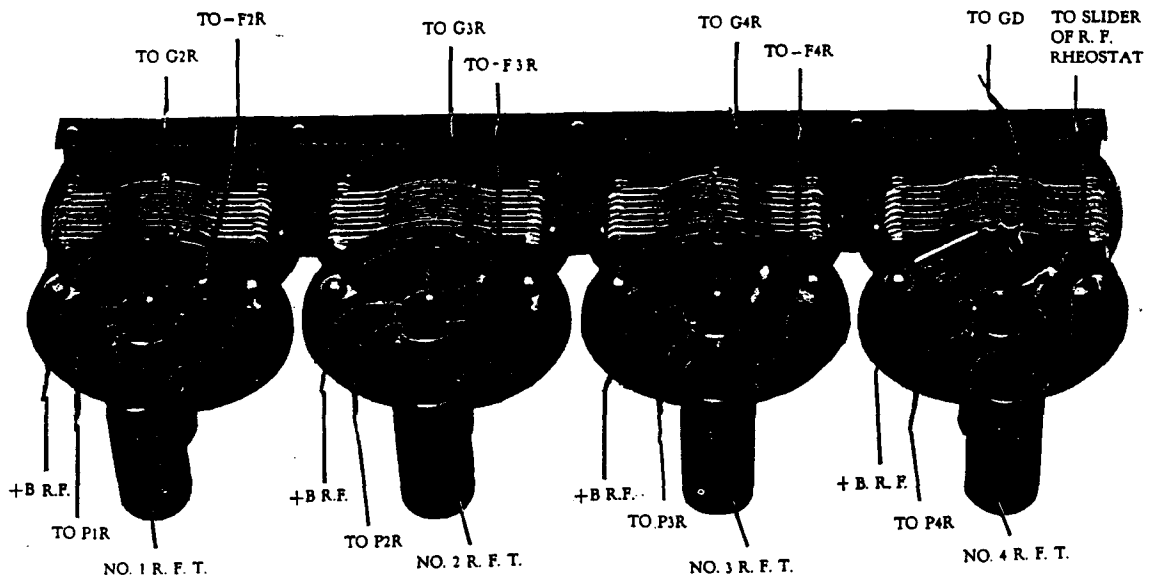


FIG. 45. VIEW OF SUB-PANEL ASSEMBLY MODEL 32, SHOWING WHERE EACH LEAD IS TO BE CONNECTED.

Models 33 and 49 Sets

General Description

The Model 33 is a six-tube, single-dial, battery-type receiver, having three stages of tuned radio frequency amplification, a tuned detector, and two stages of audio frequency amplification. The first variable condenser, tuning the secondary of the antenna transformer, has an extra independently variable plate controlled by a small knob at the left (antenna adjustment knob). This compensates for different size of antenna and makes it possible to maintain synchronism between this circuit and the other three tuned circuits.

The three R. F. filaments are controlled by one rheostat, the detector filament by another rheostat, and a fixed resistance is connected in series with the two A. F. filaments.

Model 49 is similar to Model 33, but has a gold-finished panel.

Removing Chassis from Panel—Loosen set screws in antenna adjustment knob and in the tuning dial. Remove vernier knob, tuning dial, and antenna adjustment knob. Remove six screws, three in a row at each end of the vertical side of the metal frame. Remove one screw near the center of the vertical side of metal frame. The panel may then be lifted clear of the chassis, taking care not to break the connections from rheostat assembly. (In removing set from cabinet it is sometimes necessary to slide the set out toward the left in order that the

by-pass condenser will come at a place where the bottom wood strip, which holds panel screws, is cut away.)

Replacing Variable Condensers

If one of the variable condensers is defective, replace entire group of four. Part No. 9190. Use pulleys and belts of original group.

Procedure: Loosen twelve screws holding variable condensers to metal frame. Note how pulleys and belts are arranged and then remove them. Replace one condenser at a time. Do not mix up the old condensers with the replacements.

Remove the double R. F. transformers which are mounted on backs of variable condensers (do not unsolder transformer leads), at the same time removing the grid resistors, the grid condenser and the lugs of secondary leads, which are held to the condensers by the same nuts that hold the R. F. transformer brackets.

Remove the three screws holding first condenser, lift out the condenser and put in replacement without tightening screws. Mount the first R. F. transformer, the first grid resistor and the secondary lead lug, on the two bolts on back of the condenser. Make certain that the axes or long sides of the transformer coils are vertical. This may be checked by seeing that the sides of coils are parallel to the vertical metal strip on the back of the condenser. (Continued on page 40.)

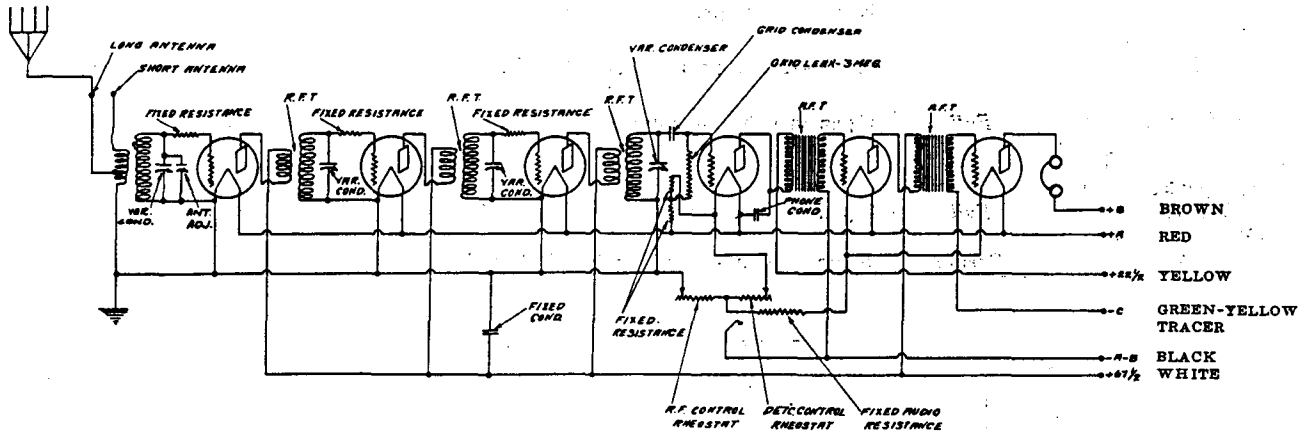


FIG. 46. WIRING DIAGRAM—MODELS 33 AND 49.

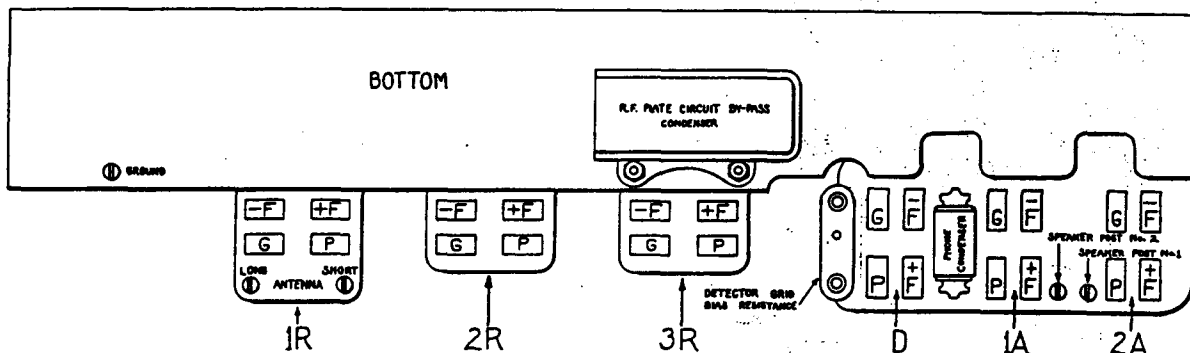


FIG. 47. TESTING CHART—MODELS 33 AND 49.

Continuity Test Table—Models 33 and 49

(For Following Tests, Place Filament Switch "On" and Rheostats Barely "On")

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
			Examine cable for open leads, broken connections and short circuits. Repair or replace cable if necessary.
BLACK to —F of R.F. Sockets. —F of A.F. Sockets.	<i>Full</i> <i>Full</i>	Open R.F. filament rheostat or connection. Open A.F. fil. fixed resis. or wiring.	R.F. rheostat at left. Fixed A.F. filament resistance is green insulated wire between rheo. assembly and —F1A.
—FD Ground Post. Each Antenna Post.	<i>Full</i> <i>Full</i> <i>Full</i>	Open detector rheostat or connection. Open connection. Open primary of antenna transformer.	Detector rheostat at right.
G1R	<i>Partial</i>	None—Open secondary antenna transformer or open grid resistor.	Full—Shorted grid circuit or shorted grid resistor.
P1R, P2R, P3R	<i>None</i>	No. 1, 2, 3 R.F.T. primary circuit grounded.	Or shorted R.F. plate circuit bypass condenser. (Unsolder condenser lead and test condenser separately.)
PD	<i>None</i>	No. 1 A.F.T. primary circuit grounded.	Or shorted phone condenser. (Unsolder condenser lead and test condenser separately.)
P1A	<i>None</i>	No. 2 A.F.T. primary circuit grounded.	Inspect transformer connections.
G2R	<i>Partial</i>	None—Open secondary No. 1 R.F.T. or open grid resistor.	Full—Shorted grid circuit or shorted grid resistor.
G3R	<i>Partial</i>	None—Open secondary No. 2 R.F.T. or open grid resistor.	Full—Shorted secondary circuit or grid resistor.
G1A Stator of Detector Variable Condenser.	<i>Partial</i> <i>Full</i>	None—Open secondary No. 1 A.F.T. Open secondary of last (No. 3) R.F.T.	Full—Shorted secondary.
RED to +F of All Sockets. Black.	<i>Full</i> <i>Nearly Full</i>	Open positive filament circuit. None—Open detector grid bias resistance.	Full—Shorted bias resistance or grounded +F circuit.
WHITE to P of R.F. Sockets. P1A	<i>Full</i> <i>Partial</i>	Open primary No. 1, 2, 3 R.F.T. None—Open primary No. 2 A.F.T.	Full—Shorted primary.
YELLOW to PD	<i>Partial</i>	None—Open primary No. 1 A.F.T.	Full—Shorted primary.
BROWN to Speaker Post No. 2.	<i>Full</i>	Open cable lead or connection.	
OTHER TESTS P2A to Speaker Post No. 1. —C Lead Green-Yellow Tracer to G2A	<i>Full</i> <i>Partial</i>	Open connection. None—Open secondary No. 2 A.F.T.	Full—Shorted secondary.

Repeat procedure with each condenser and when all four are in place, put on the pulleys and belts, adjust belt tension and synchronize condensers. (See Section XI.)

Replacing R. F. Transformers

If one of the double R. F. transformers is defective, replace entire group of four. Part No. 9220.

In replacing double R. F. transformers, substitute one transformer at a time, mounting and connecting the replacement exactly like the original. Do not mix up the old coils with the replacements. Remove two nuts on back of first variable condenser which hold R. F. transformer brackets, unsolder transformer connections and

remove old transformer. Put replacement transformer in position, seeing that the grid resistor and lug of secondary lead are replaced properly, and tighten the two nuts. The transformer angle brackets must be arranged so that the axis or long sides of the coil are vertical. This may be checked by seeing that the long sides of the coils are parallel to the vertical metal strip on the back of the variable condenser. Solder leads exactly like the original. Repeat procedure with each R. F. transformer.

The antenna transformer may be identified by its five leads; other R. F. transformers have four leads.

- No. 1 R. F. T. has one green lead.
- No. 2 R. F. T. has one yellow lead.
- No. 3 R. F. T. has one blue lead.

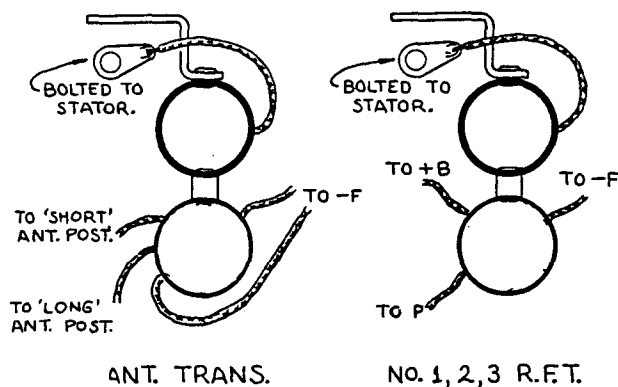


FIG. 48. SKETCH SHOWING HOW LEADS FROM ANTENNA TRANSFORMER AND FROM R.F. TRANSFORMERS ARE TO BE CONNECTED.

Model 50 Set

General Description

The Model 50 employs seven tubes, having four stages of radio frequency amplification, a detector, and two stages of audio frequency amplification. The four stages of radio frequency are not tuned, the R. F. transformers being of a special air-core design, which covers the entire wave-length band efficiently. These transformers therefore do not have variable condensers connected across their secondaries.

A special method of tuning is used to couple the antenna circuit to the grid circuit of the first R. F. stage. This consists of a series or cascade of three tuned circuits loosely coupled together, tuned by three condensers geared together by belts similar to those used in the tuned R. F. sets. (See schematic diagram.)

The distance between the three tuning coils and the angle at which they are suspended relatively to each other, is worked out to give a selective filter between antenna and the first R. F. stage. As in the Model 33, two posts are provided for connection to the antenna coil, and one plate of the condenser across the secondary of the antenna circuit is separately adjustable, in order to compensate for different antenna lengths which may be used.

The selected signal which is tuned in by the station dial is passed through the four R. F. stages where it is amplified to considerable volume before reaching the detector. The detector and audio portion of this set is practically the same as in other Atwater Kent receivers.

In order to obtain selectivity and stability of operation, the various R. F. sections of the set (tuning stage, first and second R. F. stages, third and fourth R. F. stages and detector), are separately encased in grounded metal containers, and the entire set is enclosed in a single grounded metal housing that fits in the mahogany cabinet.

This shielding helps prevent interaction between the fields of the various coils, but its main purpose is to prevent any signal from outside entering the amplifying stages direct, without having passed through the antenna tuning system. The elimination of undesired signals is thereby readily obtained, and external "pick-up" reduced to a minimum. Pick-up of signals by the battery cable

is eliminated by a by-pass condenser connected across the "A" battery circuit at the upper end of cable, and and by a choke-coil in the R. F. positive "B" voltage lead, the terminals of this choke being shunted to the ground by two additional by-pass condensers. (See schematic diagram, Fig. 50.)

One rheostat (left-hand knob) controls the filaments of the four R. F. tubes, a separate rheostat (right-hand knob) controls the detector filament, and a fixed resistor is connected in series with the filaments of the two A. F. tubes.

Removing Set from Mahogany Cabinet

Remove set from wood cabinet by taking out four round-head wood screws which hold bottom of metal case to the wood cabinet. Then take wood screws out of front panel, and slide metal case out of cabinet.

Removing Set from Metal Case

Remove the fourteen filister-head screws along bottom and sides and one screw at center top which hold the set to the metal case. The set, with its attached cable, may then be slid out of the metal case.

Testing Model 50

The continuity tests may be applied to Model 50 set without removing the set from its mahogany cabinet. The test prongs (in the voltmeter-battery testing circuit) should be long and sufficiently narrow at the pointed ends to fit down through the socket holes and make connection with the socket contacts. A test table and photographic chart for the Model 50 appear on the following pages.

Replacements

After applying the continuity tests and determining the source of trouble, the set may be removed from its metal case and repaired. In making replacements, first carefully study the manner in which the defective material is mounted and connected, then substitute the replacement, mounting and connecting it in exactly the same way as the original.

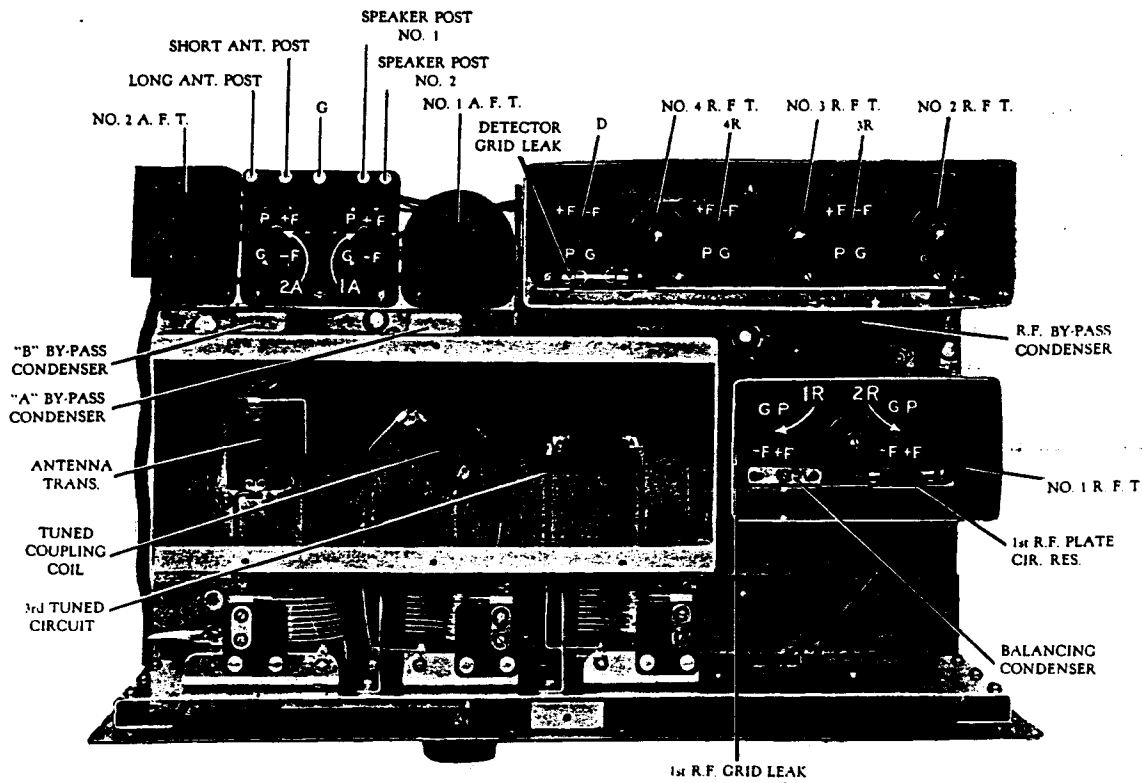


FIG. 49. TESTING CHART FOR MODEL 50.

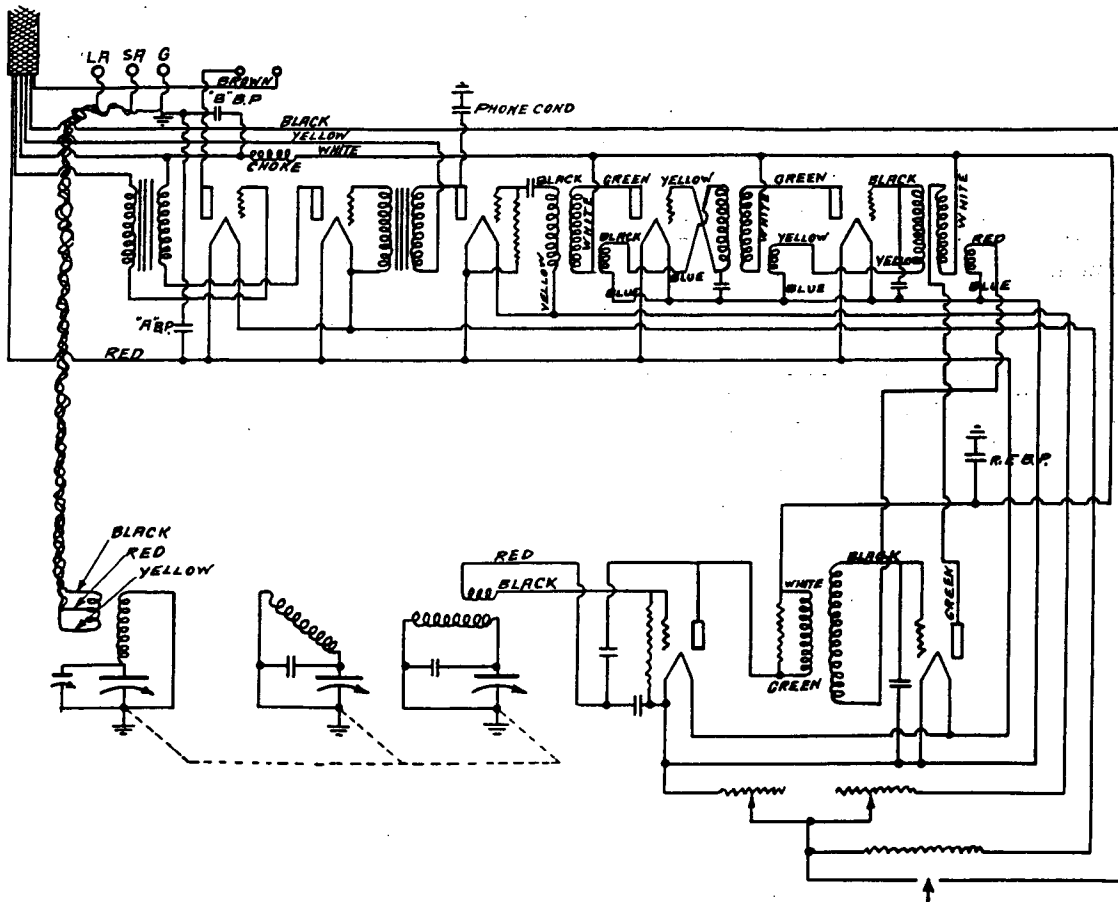


FIG. 50. WIRING DIAGRAM OF MODEL 50.

NOTE.—Black lead (—F) is grounded—not shown in diagram. Most of Model 50 Sets also have an R.F. choke between plate of second audio tube and speaker post No. 1.

Continuity Test Table—Model 50
(Colors Refer to Cable Leads, Unless Otherwise Specified)

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
(For following tests place Filament Switch "on" and Rheostats barely "on.")			Examine cable for open leads, broken connections and short circuits. Repair or replace cable if necessary.
BLACK to			
—F of each R.F. socket.	<i>Full</i>	Open in cable, wiring or R.F. rheostat.	R.F. rheostat at left.
—FD	<i>Full</i>	Open connection or open det. rheostat.	Detector rheostat at right.
—F of each A.F. socket.	<i>Full</i>	Open con. or open A.F. fil. fixed resis.	
Ground Post.	<i>Full</i>	Open ground connection.	
Each Antenna Post	<i>Full</i>	Open antenna coil or connection.	
Stator of each Variable Condenser.	<i>Full</i>	Open sec. ant. trans., or open tuned coupling coil, or open primary 3rd tuned circuit.	Located in container at rear of variable condensers.
Plate of each R.F. socket.	<i>None</i>	Nos. 1, 2, 3, 4 R.F.T. pri. circuit grounded.	Or shorted "B" or R.F. by-pass condenser, or shorted balancing condenser.
PD	<i>None</i>	No. 1 A.F.T. primary circuit grounded.	Or shorted phone condenser.
Red	<i>None</i>	Grounded positive filament circuit or shorted "A" by-pass condenser.	
P1A	<i>None</i>	No. 2 A.F.T. primary circuit grounded.	
G2R	<i>Nearly Full</i>	None—Open secondary No. 1 R.F.T. or open auxiliary coil No. 2 R.F.T.	Full—Shorted secondary or shorted fixed secondary condenser.
G3R	<i>Nearly Full</i>	None—Open secondary No. 2 R.F.T. or open auxiliary coil No. 3 R.F.T.	Full—Shorted secondary or shorted fixed secondary condenser.
G4R	<i>Nearly Full</i>	None—Open secondary No. 3 R.F.T. or open auxiliary coil No. 4 R.F.T.	Full—Shorted secondary or shorted fixed secondary condenser.
GD	<i>None</i>	Shorted detector grid condenser.	
Black sec. lead of No. 4. R.F.T.	<i>Nearly Full</i>	Open secondary No. 4 R.F.T.	Full—Shorted secondary.
G1A	<i>Partial</i>	None—Open secondary No. 1 A.F.T.	Full—Shorted sec. No. 1 A.F.T.
G2A	<i>None</i>	Grounded secondary circuit No. 2 A.F.T.	
RED to			
+F of all sockets.	<i>Full</i>	Open cable lead or connection.	
WHITE to			
Plate of each R.F. socket.	<i>Nearly Full</i>	None—Open cable lead or primary No. 1, 2, 3, or 4 R.F.T., or open R.F. choke coil.	
P1A	<i>Partial</i>	None—Open primary No. 2 A.F.T.	Full—Shorted primary.
YELLOW to			
PD	<i>Partial</i>	None—Open pri. No. 1 A.F.T.	Full—Shorted primary.
BROWN to			
Speaker Post No. 2	<i>Full</i>	Open cable lead or connection.	
OTHER TESTS			
P2A to Speaker Post No. 1	<i>Nearly Full</i>	Open connection or open output R.F. choke.	
Green-Yellow Tracer to G2A	<i>Partial</i>	None—Open cable lead or sec. No. 2 A.F.T.	Full—Shorted secondary.
G1R to Center Screw of Balancing Condenser.	<i>Nearly Full</i>	None—Open secondary 3rd tuned circuit.	
Center Screw of Balancing Condenser to —F1R	<i>None</i>	Shorted grid section of balancing condenser.	

Model 36 Set

General Description

Model 36 is a six-tube, single-dial receiver designed for A. C. tubes, with filament, plate and grid voltages supplied by type "Y" Atwater Kent power unit.

Model 36 has three stages of tuned radio frequency amplification, a tuned detector circuit and two stages of audio frequency amplification, the second audio stage being designed for a power tube. The R. F. transformers are of the double-coil type. The first variable condenser has an independently variable plate which is adjustable to compensate for the effects of different antenna sizes.

Connections from the set to power unit are made by means of a heavy cable terminating in a cable connection panel which fits over the corresponding terminals on the power unit. The power unit is provided with a cord and plug for insertion in the A. C. lighting socket. The power unit is designed for use on standard house supply of electricity, 110 volts, 60 cycle alternating current.

The volume of reception in the Model 36 is controlled by means of a double resistance coil, so connected as to by-pass equally from the plates of the first two R. F. tubes, any desired amount of energy, thereby giving a smooth and accurate control of volume. In a few of the earlier sets, the volume was controlled by varying a series capacity in the plate circuit of the first R. F. tube, by means of a tap-switch controlling a group of fixed condensers connected in series.

The correct grid bias voltage is supplied to the various tubes by grounding all the grid returns and then connecting the ground to the filament circuit of the various tubes, through resistances of the correct value in each case. Since the negative of the "B" voltage output of the rectifier is grounded, and the filament voltage relatively positive, the resulting "C" voltage secured on the grid from the ground will be negative. It should be noted (see schematic diagram) that since an A. C. voltage is being applied to each side of the filament of the tube, it is necessary in order to get a constant voltage value from the filament to obtain a connection from the center of the filament. This is done by taking a tap-off at the mid-point of a resistance shunted across the filament terminals. The lead from this tap is connected through a resistance of the correct value in each case to the minus B or ground, to which all grid returns are connected.

A protective choke and condenser are used to keep the high-voltage direct current supplied to the plate of the last audio tube, from passing through the magnet windings of the speaker. This also improves the quality of reception.

The "B" power supply incorporated in the "Y" power unit is very much the same as the regular Model "R"

"B" power unit, except that a standard filament type rectifier tube is used. The filament of this tube performs the same function as the grid electrode in the A. K. rectifier tube, a connection leading out from the filament, through the required chokes, to the positive "B" voltage supply terminal. (See Section VII.)

The starting and stopping of the set is accomplished by a toggle switch connected in series with the primary of the A. C. transformer, which is the same as being in series with the 110 volt A. C. house line.

Information about A. C. sets in general and power units is given in Section I.

Diagrams and test tables for Model 36 are given on pages 46 and 47. The "Y" type power unit is described on pages 48, 49, 50 and 51.

Removing Set from Cabinet and Panel

Place set on table with panel facing up, remove wood screws from around edges of panel and then lift set out vertically, inserting the finger nails under edge of panel. Do not lift by dial or other parts. See that cable can pass freely through hole in back of cabinet as set is being lifted out. It will be necessary to slide the chassis slightly to the left before it can be lifted out, to allow the by-pass condenser to clear.

The chassis is attached to the panel by seven screws, three in a row at each end and one near the centre of the vertical side of the metal frame. Remove these screws, remove the dial, the vernier knob and the antenna adjustment knob (at left end). The panel may then be lifted clear of the chassis. If it is desired to separate the panel from the chassis, unsolder the two cable connections to toggle switch, and also, in the case of old style condenser-type volume controls, unsolder the leads from volume control.

Replacing Variable Condensers

If one variable condenser is defective, replace entire group of four condensers. Part No. 9190. Use pulleys and belts of original group.

Procedure: Remove chassis from panel. Loosen twelve screws holding variable condensers to metal frame. Note how pulleys and belts are arranged and then remove them. Replace one condenser at a time. Do not mix the old condensers with the replacements.

Remove the double R. F. transformers which are mounted on backs of variable condensers (do not unsolder transformer leads), at the same time removing the grid resistors, the grid condenser and the lugs of secondary leads which are held to the condensers by the same nuts that hold the R. F. transformer brackets.

Remove the three screws holding first condenser, lift out the condenser and put in replacement without tightening screws. Mount the first R. F. transformer, the first grid resistor and the secondary lead lug, on the two bolts on back of the condenser. Make certain that the axes or long sides of the transformer coils are vertical. This may be checked by seeing that the sides of coils are parallel to the vertical metal strip on the back of the condenser.

Repeat procedure with each condenser and, when all four are in place, put on the pulleys and belts, adjust belt tension and synchronize condensers. (See Section XI.)

Replacing R. F. Transformers

If one double R. F. transformer is defective, replace entire group of four transformers. Part No. 9590.

The antenna transformer may be identified by its white lead.

- No. 1 R. F. T. has one green lead.
- No. 2 R. F. T. has one yellow lead.
- No. 3 R. F. T. has one blue lead.

In replacing double R. F. transformers, substitute one transformer at a time, mounting and connecting the replacement exactly like the original. Do not mix up the old coils with the replacements.

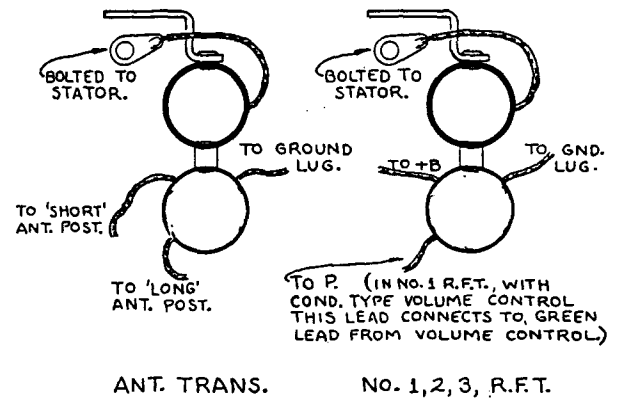


FIG. 51. SKETCH SHOWING CONNECTIONS FROM ANTENNA TRANSFORMER AND FROM R. F. TRANSFORMERS.

Remove two nuts on back of the first variable condenser which hold R. F. transformer brackets, unsolder transformer connections and remove old transformer. Put replacement transformer in position, seeing that the grid resistor and lug of secondary lead are replaced properly, and tighten the two nuts. The transformer angle brackets must be arranged so that the axis or long sides of the coil are vertical. This may be checked by seeing that the long sides of the coils are parallel to the vertical metal strip across the back of the variable condenser. Solder leads exactly like the original. Repeat procedure with each R. F. transformer.

Diagrams and Test Table for Model 36 are given on Pages 46 and 47.

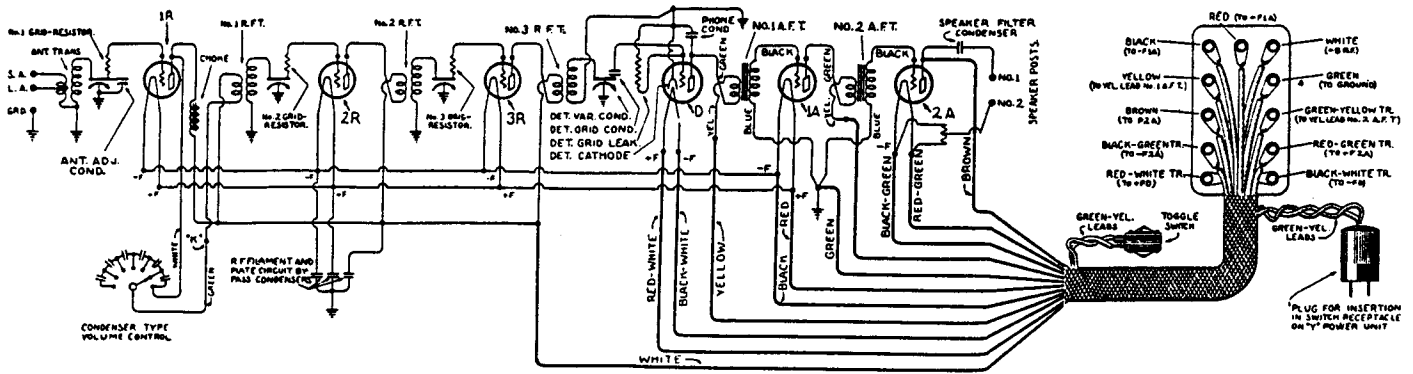


FIG. 52. WIRING DIAGRAM OF MODEL 36 WITH CONDENSER TYPE VOLUME CONTROL AND CABLE CONNECTION PANEL FOR EARLY MODEL "Y" POWER UNIT. (Note that the +B 1st A.F. cable lead is green with a yellow tracer. In some Model 36 sets, and in all other Atwater Kent A.C. receivers, a black-red tracer is used for this connection.)

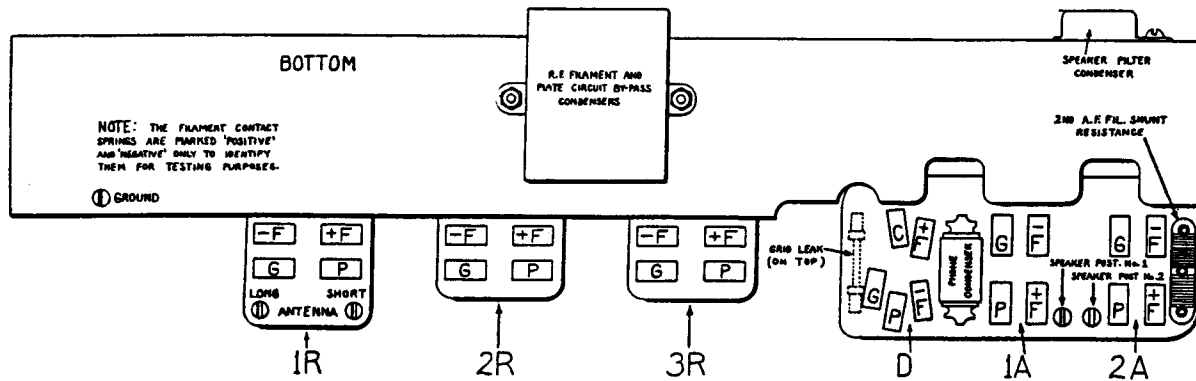


FIG. 53. TEST CHART FOR MODEL 36.

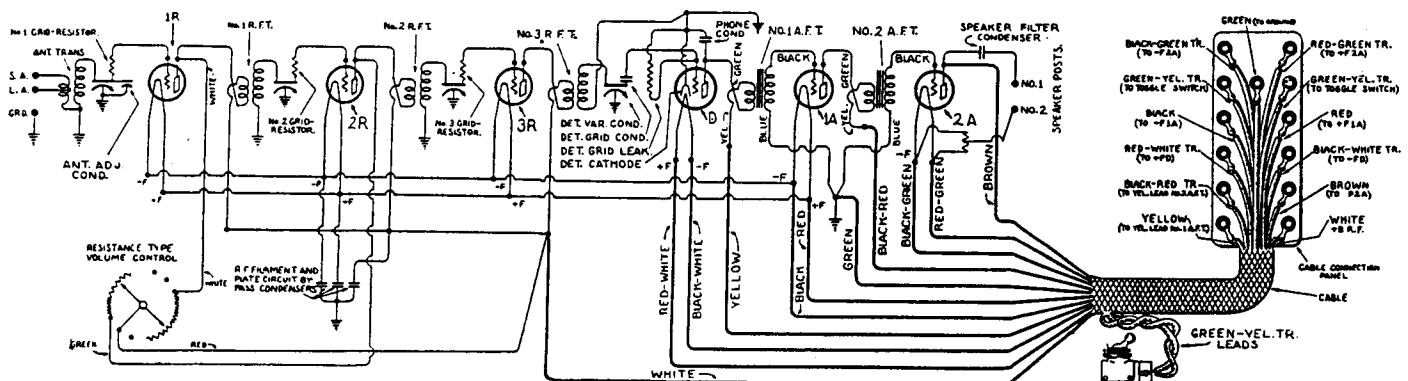


FIG. 54. WIRING DIAGRAM OF MODEL 36 WITH RESISTANCE TYPE VOLUME CONTROL AND CABLE CONNECTION PANEL FOR LATER MODEL "Y" POWER UNIT. (Note that the red and the black cable leads feed the R.F. filaments as well as the 1st A.F. filament. In some Model 36 sets the +B 1st A.F. cable lead is green with a yellow tracer.)

Continuity Test Table—Model 36

(Colors Refer to Cable Leads)

For Following Tests Remove Cable Panel from Power Unit

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
Red-Green Tr. to +F2A Black-Green Tracer to -F2A Red-White Tr. to +FD Black-White Tracer to -FD Red to +F1A Black to -F1A Green to Ground Post. Brown to P2A	<i>Full</i>	Open in cable or connection.	Examine soldered connections at cable connection panel and set.
GREEN to P1A PD P3R +F3R, -F3R +FD, -FD +F2A, -F2A G1R, G2R, G3R G1A G2A Stator of Detector Variable Condenser. CD	<i>None</i> <i>None</i> <i>None</i> <i>None</i> <i>None</i> <i>None</i> <i>None</i> <i>Partial</i> <i>Partial</i> <i>Partial</i> <i>Full</i> <i>Full</i>	Grounded 1st A.F. plate circuit. Grounded detector plate circuit. Grounded R.F. plate circuit. Grounded R.F. 1st A.F. filament circuit. Grounded detector filament circuit. Grounded 2nd A.F. filament circuit. None—Open grid res. or open sec. of ant. transformer or No. 1 or 2 R.F.T. None—Open secondary No. 1 A.F.T. None—Open secondary No. 2 A.F.T. Open secondary last R.F.T. Open cathode lead.	Or shorted phone condenser. Or shorted R. F. by-pass condenser. Or shorted R. F. by-pass condenser. Full—Shorted grid resistor. Test resistors separately. (Mounted on back of R.F. variable condensers.) Full—Shorted grid circuit. Full—Shorted grid circuit.
WHITE to P1R, P2R, P3R (Volume Control Turned Full Right.)	<i>Full</i>	Open primary No. 1, 2, 3 R.F.T.	Or open plate circuit choke in cond.-choke type volume control.
YELLOW to PD	<i>Partial</i>	None—Open primary No. 1 A.F.T.	Full—Shorted primary.
+B 1st A.F. Lead (Black-Red, or Green-Yellow) to P1A	<i>Partial</i>	None—Open primary No. 2 A.F.T.	Full—Shorted primary.
OTHER TESTS GD to Stator Last Variable Condenser. P2A to Speaker Post No. 1. Green to each Ant. Post. Speaker Post No. 2 to -F2A, +F2A Across Switch Plug Contacts. (Before Serial No. 2,610,000.) (Toggle Switch "On.") Across Green-Yellow Tracer Leads on Cable Connection Panel. (After Serial No. 2,610,000.) (Toggle Switch "On.") Res. Type Vol. Control. P1R to P2R (Turn Knob.) Condenser-Choke Type Volume Control. White to Point K (on Primary No. 1 R.F.T.) P1R to Point K (Unsold One Choke Lead.)	<i>None</i> <i>None</i> <i>Full</i> <i>Full</i> <i>Full</i> <i>Full</i> <i>Nearly Full</i> <i>Full</i> <i>None</i>	Shorted grid condenser. Shorted speaker filter condenser. Open primary antenna transformer. Open connection or open 2nd A.F. filament shunt resistance. Open in switch leads or connection. Open in switch leads or connections. Defective resistance winding or slider. Open primary No. 1 R.F.T. Shorted condenser in volume control.	Mounted on back of detector variable condenser. No reading with toggle switch "off." No reading with toggle switch "off." No reading with knob turned full right. Test with volume control switch on each tap. Resolder lead.

Model "Y" Power Units below Serial No. 260,000

(Used with Model 36 Sets below Serial No. 2,610,000)

General Description

Model "Y," below Serial No. 260,000, is a complete power unit enclosed in a metal case separate from the receiving set. It is designed to operate from 110 volt, 60 cycle, alternating current and furnish complete filament, plate, and grid voltages to Model 36 sets bearing serial numbers below 2,610,000. (Model 36 receiving sets above Serial No. 2,610,000 used a later type of "Y" power unit which is described on the next pages.)

Information about Atwater Kent power units is given in the first section of this manual.

In Model "Y" power units below Serial No. 260,000, a potentiometer is connected across the R. F. first A. F. filament circuit. It is to be adjusted with the slider at approximately the center point for least hum in reception.

A receptacle in series with one side of the 110 volt A. C. line is mounted on the front of the unit case. A toggle switch on the panel of the set is connected to this receptacle through two green-yellow tracer leads in the set cable. The leads are connected to a plug for

insertion in the receptacle. The toggle switch on the set turns the 110 volt A. C. supply on or off.

A regulating or "load" resistance in the unit is connected across the B+ and B- output terminals. This resistance is wound on a form on which two grid bias resistances are also wound.

The unit has four separate metal containers, one for the power transformer, one for the filter chokes, a third for the fixed condensers and a fourth for the speaker (output) choke and for a by-pass condenser that is connected to the first A. F. plate circuit resistance.

Removing Power Unit from Case

Remove the four screws around cover, the four felt-headed feet and the single round-head machine screw at the bottom of the case. Remove the three screws holding potentiometer and the four screws at corners of the panel assembly. Unsolder connections to switch receptacle and unsolder the connection between one line of 110 volt cable and one lead from the primary of the power transformer. Unscrew the hexagon nut from back of receptacle and remove receptacle. Pull the 110 volt cable up and take out the knot. Pull cable out of

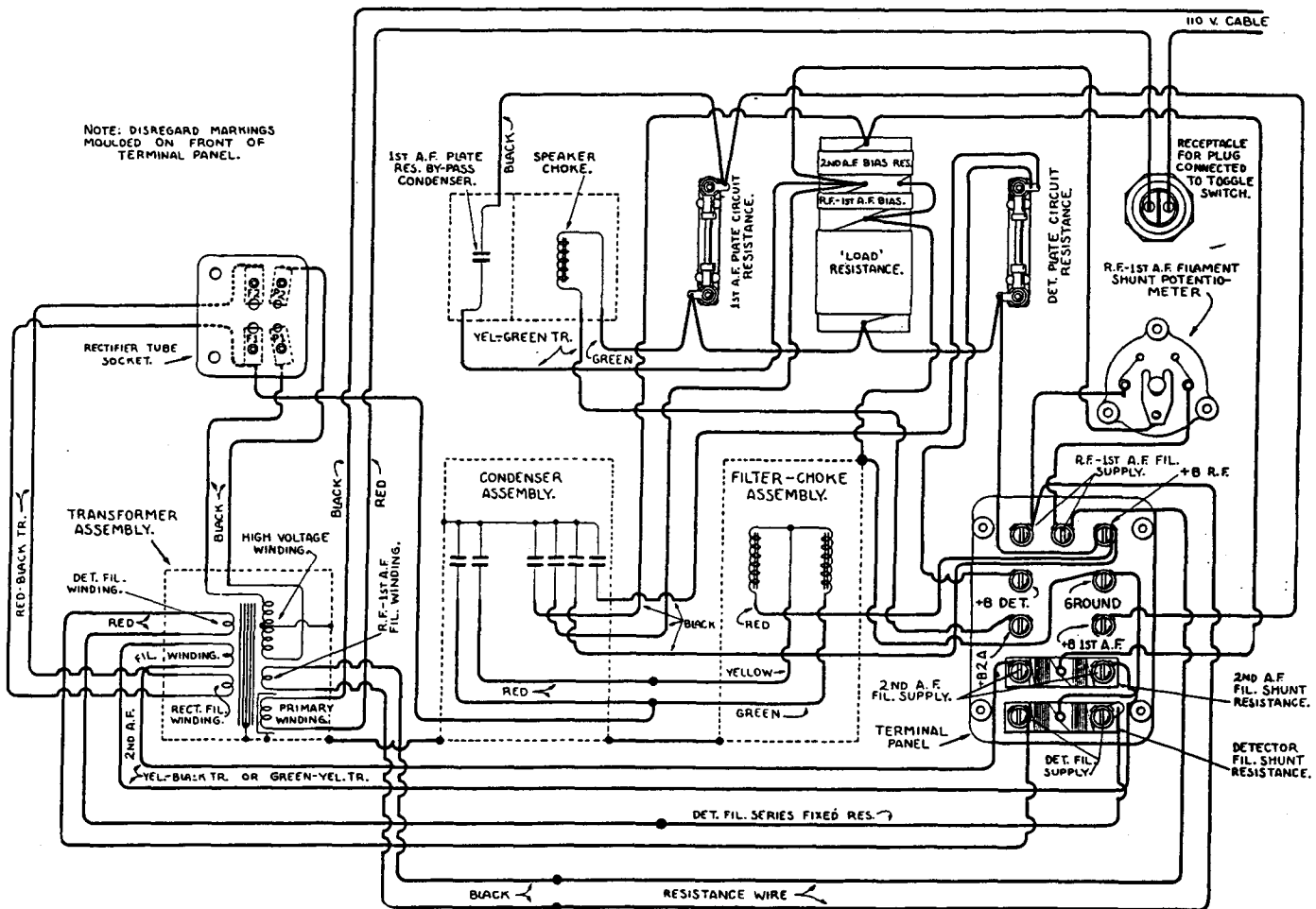


FIG. 55. WIRING DIAGRAM OF "Y" POWER UNIT BELOW SERIAL No. 260,000. (The two leads to any one secondary winding may be reversed without affecting results.) This diagram shows the APPROXIMATE relative position of leads from the sealed containers.

case and remove soft rubber bushing through which cable enters unit. Push the potentiometer and panel assembly back so the unit may be withdrawn from the case. Leads from the different sections come out on one side; rest the case on opposite side and carefully draw out the unit.

A brief inspection will show that loosening the nuts on the three long bolts releases the various sections. Note how the flexible metal strips from each section are soldered together, and that the flexible metal strip at the top of the condenser section is laid under the heavy

metal strip which clamps the choke and the condenser sections to the base.

Testing

Apply the continuity tests given in the table on this page. If the tests indicate that one section of the unit is defective, replace that section, connecting it exactly as the original.

When replacing the unit in its case make certain that all soldered joints on loose wires are insulated with tubing or with electrician's tape.

Continuity Test Table—"Y" Power Unit (Early Type)

TEST	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
Across 2nd A.F. Filament Supply.	<i>Full</i>	None—Open 2nd A.F. fil. winding and open 2nd A.F. filament shunt resistance.	Nearly Full—Open filament winding. (Unsolder one filament winding connection and test winding and filament shunt resistance separately.)
Across R.F.-1st A.F. Filament Supply.	<i>Full</i>	None—Open R.F.-1st A.F. fil. winding and open filament shunt potentiometer.	Nearly Full—Open filament winding. (Unsolder one filament winding connection and test winding and filament shunt resistance separately.)
Across Detector Filament Supply.	<i>Full</i>	None—Open det. fil. winding and open detector filament shunt resistance.	Nearly Full—Open filament winding. (Unsolder one filament winding connection and test winding and filament shunt resistance separately.)
From Ground to each Metal Container.	<i>Full</i>	Open ground connection.	
FROM +B R.F. to +B 2nd A.F. +B 1st A.F. +B Detector. Ground.	<i>Partial</i> <i>Small</i> <i>Very Small</i> <i>Partial</i>	None—Open speaker (output) choke. None—Open 1st A.F. plate circuit resis. None—Open detector plate circuit resistance. None—Open regulating resistance.	Full—Shorted choke. Full—Shorted regulating resistance, or shorted filter condenser.
F1 (on Rectifier Tube Socket.)	<i>Partial</i>	None—Open plate supply filter choke.	
FROM GROUND to +B 1st A.F. +B Detector.	<i>Small</i> <i>Very Small</i>	Full—Shorted by-pass condenser. Full—Shorted by-pass condenser.	(NOTE: If any of the condensers is thought to be defective, unsolder leads from the rest of the circuit and test each condenser separately. The plate supply filter chokes may be tested in the same manner.)
One Side of 2nd A.F. Filament Supply.	<i>Partial</i>	None—Open 2nd A.F. grid bias resistance.	Full—Shorted grid bias resistance or shorted by-pass condenser.
One Side of R.F.-1st A.F. Filament Supply.	<i>Partial</i>	None—Open R.F.-1st A.F. grid bias resis.	Full—Shorted grid bias resistance or shorted by-pass condenser.
One Side of Detector Filament Supply	<i>Full</i>	None—Open connection to center-tap of detector filament shunt resistance.	Examine connections under panel assembly.
P1, P2 (on Rectifier Tube Socket.)	<i>Nearly Full</i>	None—Open high voltage secondary winding or connections.	
Both Terminals of A.C. Plug.	<i>None</i>	Grounded primary of power transformer.	Inspect cable and primary leads for accidental grounds.
OTHER TESTS			
Across Terminals of A.C. Plug. (Short Circuit the Terminals of the Switch Receptacle.)	<i>Full</i>	Open primary circuit of power transformer.	
F1 to F2 (on Rectifier Tube Socket.)	<i>Full</i>	Open rectifier fil. winding or connection	

Model "Y" Power Units Above Serial No. 260,000

(Used with Model 36 Sets above Serial No. 2,610,000)

General Description

Model "Y," above Serial No. 260,000, is a complete power unit enclosed in a metal case separate from the receiving set. It is designed to operate from 110 volt alternating current and to furnish complete filament, plate, and grid voltages to Model 36 receivers bearing serial numbers above 2,610,000. (Model 36 sets below Serial No. 2,610,000 use the earlier type "Y" power unit which is described on the preceding pages.)

The panel assembly of the later type unit is mounted inside the metal case of the unit. This assembly contains terminals for connection to the set "cable connection panel," three center-tapped filament shunt resistances, two grid bias resistances, a resistance in series with the detector plate circuit and a resistance in series with the first A. F. plate circuit. Two of the terminals connect, through the set cable, to a toggle switch mounted on the panel of the set. This toggle switch turns the 110 volt A. C. supply on or off.

The unit has three metal containers, one for the power transformer, one for the filter and speaker choke, and one for the fixed condensers.

Removing Unit From Case

Remove the four felt-headed feet and the single round-head machine screw at the bottom of the cabinet. Leads from the various sections come out on one side; rest cabinet on opposite side and carefully draw out the unit. The various sections are held to the base by three long bolts and two heavy metal strips. The panel assembly is mounted on one of the metal strips by two bolts and nuts—one the ground terminal and the other at the center toward the opposite end of the panel assembly. Note how the flexible metal strips from the containers are soldered together and that the strip at the top of the condenser section is laid under the heavy metal strip which holds down the condenser and choke coil sections.

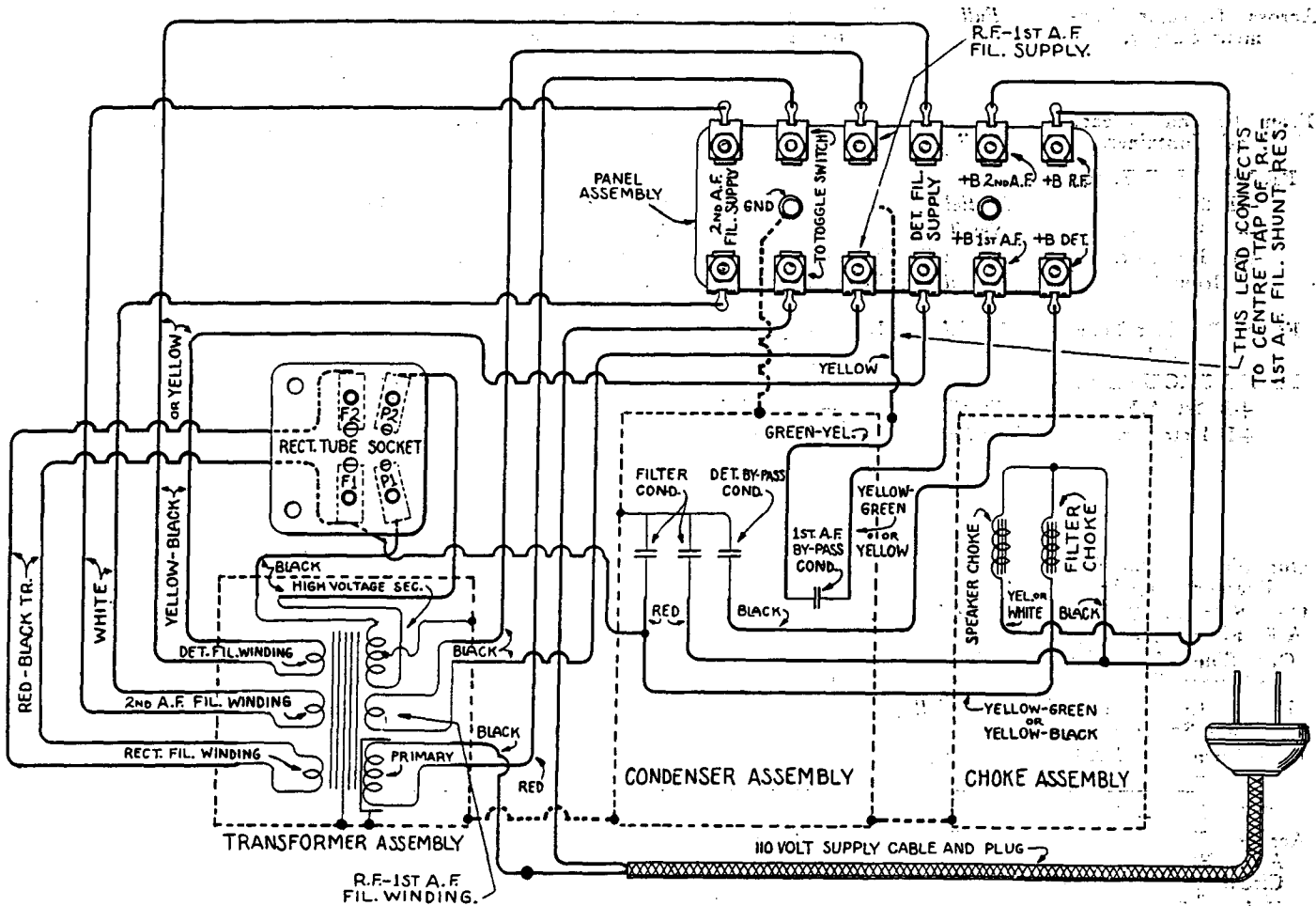


FIG. 56. WIRING DIAGRAM OF "Y" POWER UNIT ABOVE SERIAL NO. 260,000. (The connection to the ground terminal is made indirectly through a flexible metal strip. A rear view of the panel assembly is shown in the description of the power unit for Model 37 and 38 receivers. The above diagram shows the APPROXIMATE relative position of leads from the sealed containers.)

Testing

Apply the continuity tests given in the table on this page. If the tests indicate that one of the sections is defective, that section should be replaced, mounting and connecting the replacement exactly as the original.

When replacing the unit in its case, make certain that all soldered joints on loose wires are insulated with tubing or with electrician's tape.

Continuity Test Table—"Y" Power Unit (Later Type)

TEST	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
From Ground to Each Metal Container. Across 2nd A.F. Filament Supply.	<i>Full</i> <i>Full</i>	Open ground connection. None—Open 2nd A.F. fil. winding and open 2nd A.F. filament shunt resistance.	Nearly Full—Open filament winding. (Unsolder one filament winding connection and test winding and filament shunt resistance separately.)
Across R.F.-1st A.F. Filament Supply.	<i>Full</i>	None—Open R.F.-1st A.F. filament winding and open filament shunt resistance.	Nearly Full—Open filament winding. (Unsolder one filament winding connection and test winding and filament shunt resistance separately.)
Across Detector Filament Supply.	<i>Full</i>	None—Open detector filament winding and open detector filament shunt resistance.	Nearly Full—Open filament winding. (Unsolder one filament winding connection and test winding and filament shunt resistance separately.)
FROM +B R.F. to +B 2nd A.F. +B 1st A.F. +B Detector. Ground. F1 (on Rectifier Socket).	<i>Partial</i> <i>Small</i> <i>Very Small</i> <i>None</i> <i>Partial</i>	None—Open speaker output choke. None—Open 1st A.F. plate circuit resistance. None—Open detector plate circuit resistance. Shorted filter condenser. None—Open plate supply filter choke.	Full—Shorted speaker choke.
FROM GROUND to +B 1st A.F. +B Detector.	<i>None</i> <i>None</i>	Shorted by-pass condenser. Shorted by-pass condenser.	(NOTE: If either of the by-pass condensers is thought to be defective, unsolder its lead from the rest of the circuit and test the condenser separately.)
One Side of 2nd A.F. Filament Supply.	<i>Partial</i>	None—Open 2nd A.F. grid bias resistance.	Full—Shorted grid bias resistance.
One Side of R.F.-1st A.F. Filament Supply.	<i>Partial</i>	None—Open R.F.-1st A.F. grid bias resis.	Full—Shorted grid bias resistance.
One Side of Detector Filament Supply.	<i>Full</i>	Open connection to center-tap of detector filament shunt resistance.	Examine connections under panel assembly.
P1, P2 (on Rectifier Tube Socket.)	<i>Nearly Full</i>	None—Open high voltage secondary winding or connections.	
Each Terminal of A.C. Plug.	<i>None</i>	Grounded primary of power transformer.	Examine primary connections for accidental grounds.
OTHER TESTS			
Across Terminals of A.C. Plug. (Short Circuit Toggle Switch Terminals on Panel Assembly.)	<i>Full</i>	Open primary power transformer or open leads.	
F1 to F2 (on Rectifier Tube Socket).	<i>Full</i>	Open rectifier fil. winding or connections.	

Model 37 Set

General Description

Model 37 is a six-tube, single-dial, A. C. type radio receiver with a complete power unit incorporated in the metal cabinet that houses the set. The power unit operates from 110 volt, 60 cycle, alternating current (special model for 25 cycle current) and supplies complete filament, plate and grid voltages to the set.

Model 37 has three stages of radio frequency amplification, the first stage acting as an untuned coupling tube, in order to eliminate the detuning effect of different antenna sizes, which would otherwise disturb synchronism of the three tuned circuits.

The volume control in the Model 37 consists of a variable resistance connected directly between the antenna and ground posts of the set. When the knob of this control is full "on" the slider passes off the coil,

cutting the latter out of the circuit entirely. As the control is turned back, less and less resistance is included between the aerial and ground, so that more and more of the energy of the incoming signal is shunted to the ground instead of passing into the set—thereby the volume is reduced as desired.

Removing Chassis from Cabinet

First remove cover from power unit by taking out the two screws at its lower outside ends, and four screws at bottom of front. Lift cover off vertically, exposing set cable connection panel. Remove nuts from bolts which pass through holes in cable connection panel and lift connection panel off, releasing cable from power unit.

Take out the six screws, three in a row at each end, which clamp the metal frame of chassis to brackets at inside front of cabinet. Remove vernier knob and
(Continued on page 54.)

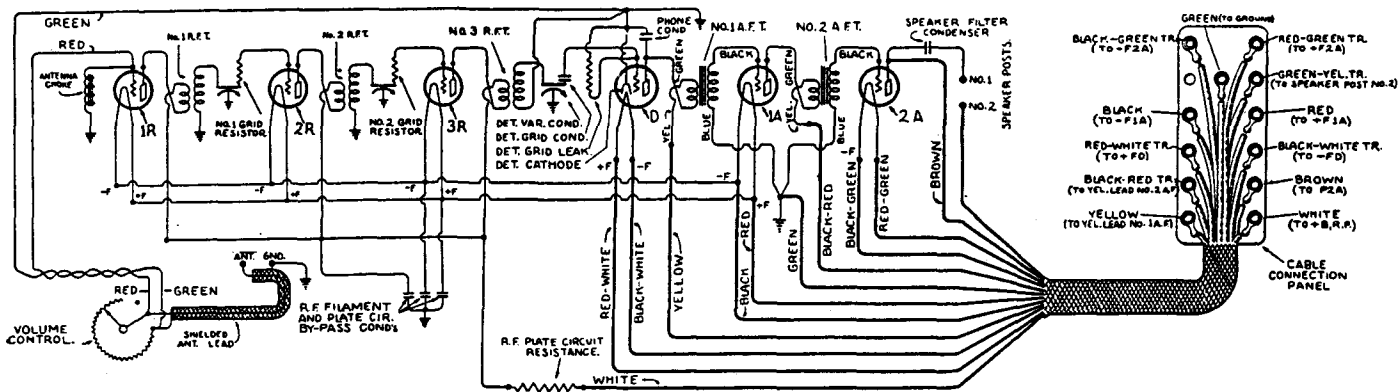


FIG. 57. WIRING DIAGRAM OF MODEL 37. (A 2nd A.F. filament shunt resistance is used before Serial No. 1,385,000, in which case speaker post No. 2 connects to the centre-tap of this resistance, and the green-yellow tracer lead is not used. The R.F. plate circuit resistance is used after Serial No. 1,385,000. Note that the red and the black cable leads feed the R.F. filaments as well as the 1st A.F. filament.)

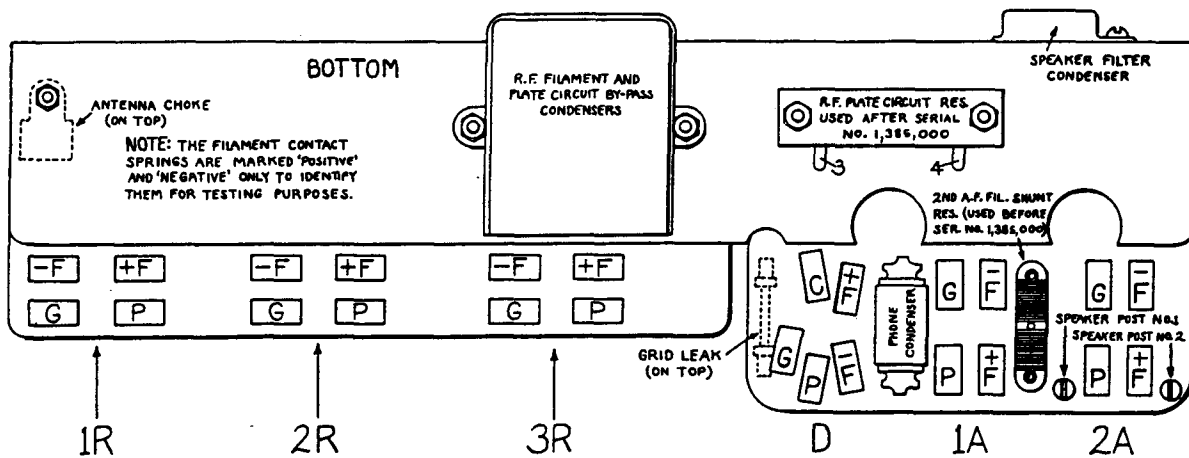


FIG. 58. TESTING CHART FOR MODEL 37.

Continuity Test Table—Model 37

Colors Refer to Cable Leads

For Following Tests Remove Cable Panel from Power Unit

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
Red-Green Tr. to +F2A Black-Green Tracer to -F2A Red-White Tr. to +FD Black-White Tracer to -FD Red to +F1A Black to -F1A Green-Yellow Tracer to Speaker Post No. 2. (After Serial No. 1,385,000.) Green to Ground Post. Brown to P2A. White to 4 (on R.F. Plate Resistance. (After Serial No. 1,385,000.))	<i>Full</i>	Open in cable or connection.	Examine soldered connections at cable connection panel and set.
GREEN to P1A PD P3R +F3R, -F3R +FD, -FD +F2A, -F2A G2R, G3R G1R (Volume Control Full Right.) G1A G2A Stator of Detector Variable Condenser CD	<i>None</i> <i>None</i> <i>None</i> <i>None</i> <i>None</i> <i>None</i> <i>Partial</i> <i>Full</i> <i>Partial</i> <i>Partial</i> <i>Full</i> <i>Full</i>	Grounded 1st A.F. plate circuit. Grounded detector plate circuit. Grounded R.F. plate circuit. Grounded R.F. 1st A.F. filament circuit. Grounded detector filament circuit. Grounded 2nd A.F. filament circuit. None—Open grid resistor or secondary No. 1, 2 R.F.T. Full—Shorted grid circuit. Open antenna choke. None—Open secondary No. 1 A.F.T. None—Open secondary No. 2 A.F.T. Open secondary last R.F.T. Open cathode lead.	Or shorted phone condenser. Or shorted R.F. by-pass condenser. Or shorted R.F. by-pass condenser. Test across resistors and secondaries separately. (Resistors mounted on back of R.F. var. conds.) Full—Shorted secondary. Full—Shorted secondary.
WHITE to 3 (on R.F. Plate Res.) (After Serial No. 1,385,000.) P1R, P2R, P3R.	<i>Partial</i> <i>Partial*</i>	None—Open R.F. plate circuit resistance. Open primary No. 1, 2, 3 R.F.T.	Full—Shorted R.F. plate circuit res.
YELLOW to PD	<i>Partial</i>	None—Open primary No. 1 A.F.T. (or open in cable connection).	Full—Shorted primary.
Black-Red Tr. to P1A	<i>Partial</i>	None—Open primary No. 2 A.F.T. (or open in cable connection).	Full—Shorted primary.
OTHER TESTS GD to Stator of Last Condenser. P2A to Speaker Post No. 1. G1R to Antenna Post. Speaker Post No. 2 to -F2A, +F2A (Before Serial No. 1,385,000.) To Test Volume Control, Unsolder Lead from Antenna Choke to G1R and Test Across Antenna and Ground Posts, Turning Control Knob.	<i>None</i> <i>None</i> <i>Full</i> <i>Full</i> <i>Smooth and Nearly Full</i>	Shorted grid condenser. Shorted speaker filter condenser. Open antenna connection. Open connection or open 2nd A.F. Filament shunt resistance. No reading—open resistance winding. Erratic reading—damaged resistance winding or slider.	Mounted on back of det. var. cond. If found defective, repair or install new control. Resolder antenna choke lead.

* The reading from **WHITE** to the plate of each R.F. tube is "full" in Model 37 sets prior to Serial No. 1,385,000.

tuning dial. Remove two screws which hold antenna-and-ground post bracket on inside back of cabinet. This bracket is not used on some Model 37 sets. Pull sub-panel straight back horizontally to allow volume control knob and dial shaft to clear, then lift set up and out.

Replacing Variable Condensers

If one variable condenser is defective, replace entire group of three variable condensers.

No. 9100 for Model 37 sets previous to Serial No. 1,360,000.

No. 13170 for Model 37 sets after Serial No. 1,360,000.

Use pulleys and belts of original group.

Procedure: Loosen nine screws holding condensers to front of metal frame. Note how pulleys and belts are arranged and then remove them. Replace one condenser at a time.

Remove two nuts on back of first variable condenser, which clamp grid resistor (grid condenser on last variable condenser) and lug of secondary lead. Remove three screws holding condenser to chassis and lift out the condenser.

Put in the replacement condenser and its three screws, without tightening screws, attach grid resistor and lug of secondary lead to top and bottom bolts respectively on back of condenser. Repeat procedure with other two variable condensers. When the replacement condensers are installed, put on the pulleys and belts, adjust belt tension and synchronize condensers. (See Section XI.)

Replacing R. F. Transformers

If one R. F. transformer is defective, replace R. F. amplifier assembly.

No. 9660 for sets below Serial No. 1,265,000.

No. 13030 for sets between Serial Nos. 1,265,000 and 1,385,000.

No. 13160 for sets above Serial No. 1,385,000.

Procedure: The R. F. amplifier assembly consists of three R. F. transformers mounted on a three-socket moulded base. The filament contacts are wired and have two leads for connection to filament contacts of first A. F. socket. The plate circuits are wired and have one lead for connection to the +B, R. F. (white) cable lead (in Model 37 sets up to Serial No. 1,385,000) or to the left-hand contact (No. 3) on the R. F. plate circuit resistance in Model 37 sets after Serial No. 1,385,000. A lead from the grid-end of each R. F. transformer is soldered to a lug which is to be fastened to the bottom bolt on back of the variable condenser immediately in front of each R. F. transformer. The three return leads from secondaries of R. F. transformers are to be soldered to (ground) lugs which are held by bolts that clamp the R. F. amplifier base to the frame of set.

In replacing R. F. amplifier assembly, the chassis must be removed from the cabinet or front panel. Unsolder three leads from by-pass condenser, leads from grid contact of the first R. F. socket, leads from the grid resistor (unsolder at grid contacts of sockets) two filament circuit leads (at filament contacts of first A. F. socket), and the +B, R. F. lead. Remove secondary wire lug from bottom bolt on each variable condenser. Unsolder, at grid contact, the lead from grid condenser, which lead passes through a hole in the R. F. base. Unsolder three leads from secondaries of R. F. transformer where they are soldered to lugs under bolts holding R. F. base to metal frame. Remove five bolts holding R. F. base to metal chassis and remove the old R. F. amplifier assembly.

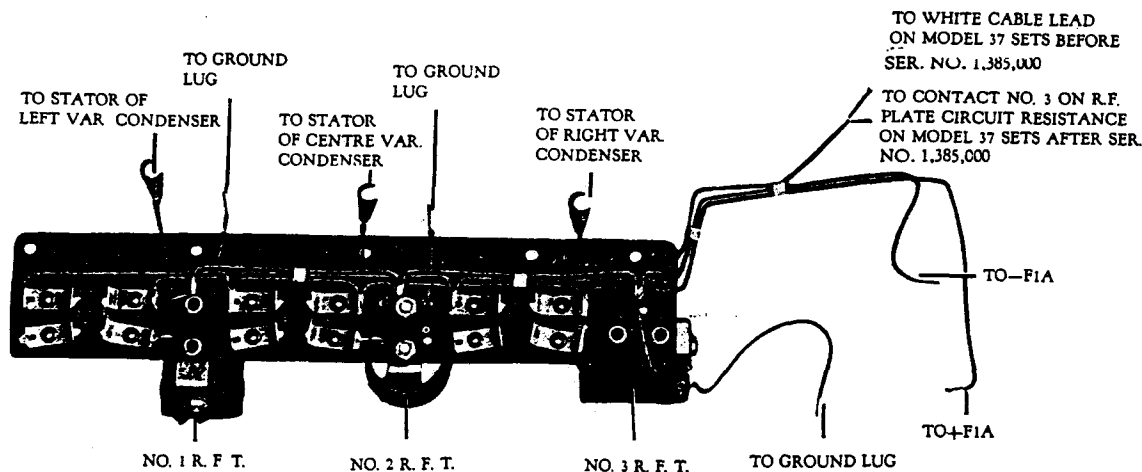


FIG. 59. VIEW OF R.F. AMPLIFIER, SHOWING WHERE EACH WIRE IS TO BE CONNECTED.

Reassemble with replacement R. F. amplifier, reversing above procedure.

Replacing Volume Control

No. 9510 for Model 37 sets below Serial No. 1,265,000.

No. 13020 for Model 37 sets above Serial No. 1,265,000.

In replacing the volume control, the chassis must be removed from the cabinet.

The control is held to the front of the vertical side of the chassis by two screws and nuts, and it is mounted in such a way that the terminals of the control are at the right-hand side when looking at the chassis in its normal position. Remove the two screws, using a long-nose pliers to grip the nut on the bottom screw, which is somewhat hidden by the first audio transformer.

A red lead is soldered to the center (slider contact) of the three screws on the right-hand side of the control. The other end of this red lead is connected to the grid contact of the first R. F. socket.

A green lead is soldered to the lower one of the three screws. The other end of the green lead is soldered to a (ground) lug held under the right-hand bolt that clamps the R. F. amplifier assembly base to

the metal frame. On earlier models the green lead is soldered to a lug under ground binding post.

Model 37 sets after Serial No. 1,265,000 employ a shielded antenna lead. The braided shield is clamped to the lower of the three screws on the right-hand side of the control, and the antenna lead (which runs inside the shield) is soldered to the center of the three screws. The other end of the shield is clamped to the ground terminal on the antenna-ground post bracket. The other end of the antenna lead is soldered to the antenna terminal on the bracket.

In Model 37 sets below Serial No. 1,265,000 the antenna post is mounted directly through the grid contact of the first R. F. socket. The ground post is held on a metal angle extending under the first R. F. socket.

Inspect the volume control carefully. If the resistance unit is damaged, replace with resistance unit No. 9788. Bend the slider so it will make firm contact with the resistance wire. Clean off the contact end of the slider and see that the top edge of resistance unit is free from dirt. If resistance unit is of old style with two sizes of wire, replace with new style (same part number) which has one size of resistance wire with increased spacing at one end. Also see that slider is of latest style.

When installing the new volume control, connect the leads in the manner specified above.

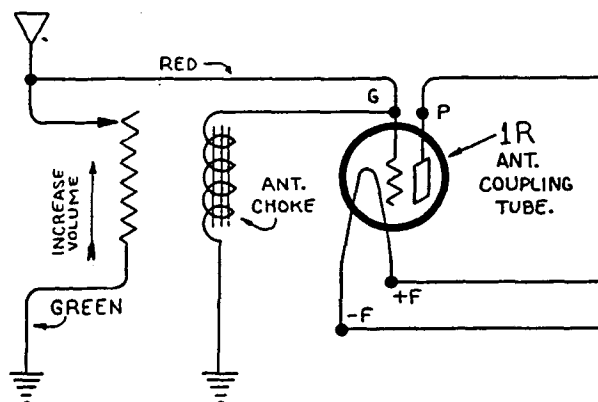


FIG. 60. SCHEMATIC DIAGRAM OF VOLUME CONTROL IN MODELS 37 AND 38.

Model 38 Set

General Description

Model 38 is a seven-tube, single dial, A. C. receiver, with a power unit incorporated in the metal cabinet that houses the set.

The circuit has four stages of radio frequency amplification (with double coil type R. F. transformers), a tuned detector, and two stages of audio frequency amplification. The first R. F. tube is not tuned and acts as an antenna coupling tube. The second A. F. stage is of the power type with condenser-choke coupling to the speaker.

Since the volume provided by this powerful set is ordinarily more than required for local reception, a special switch (the "local-distance" toggle switch), is provided on the front of the cabinet, to open the plate circuit of the second R. F. amplifying tube, thereby reducing the volume materially.

The volume control consists of an adjustable resistance connected from antenna to ground.

Removing Set from Cabinet

First remove cover from power unit by taking out the two screws at its lower outside ends, and four bolts at bottom of front. Lift cover off vertically, exposing set cable connection panel. Remove nuts from terminals which pass through holes in cable connection panel and lift off latter, releasing cable from power unit.

Remove the dial and vernier knob. Then unscrew the eight machine screws which clamp the chassis to the cabinet. All of these machine screws are reached from inside the cabinet; three are at each end in a vertical row, the seventh is near the center of the vertical side of the metal frame of the set, and the eighth is near the center of the horizontal side of the frame. A magnetized screw driver will be found of great assistance in removing and replacing these screws. Remove two screws holding antenna-and-ground post bracket on inside back of cabinet.

(Continued on page 58.)

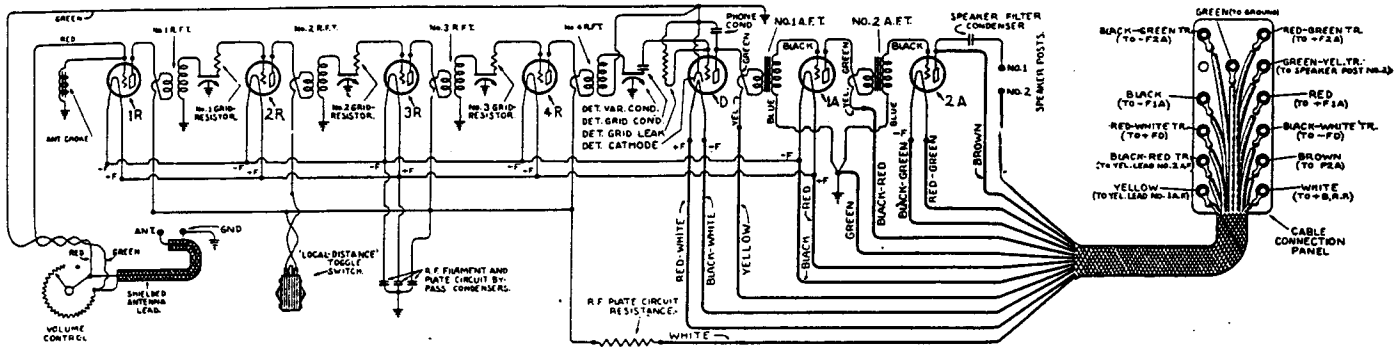


FIG. 61. WIRING DIAGRAM OF MODEL 38

A 2nd A. F. filament shunt resistance is used before Serial No. 1,752,000 and the green-yellow tracer cable lead is not used. Connections for this resistance are shown in dotted lines in the diagram on page 71. Note that the black and the red cable leads feed the R. F. filaments as well as the 1st A. F. filament. A schematic diagram of the volume control is shown in Fig. 60.

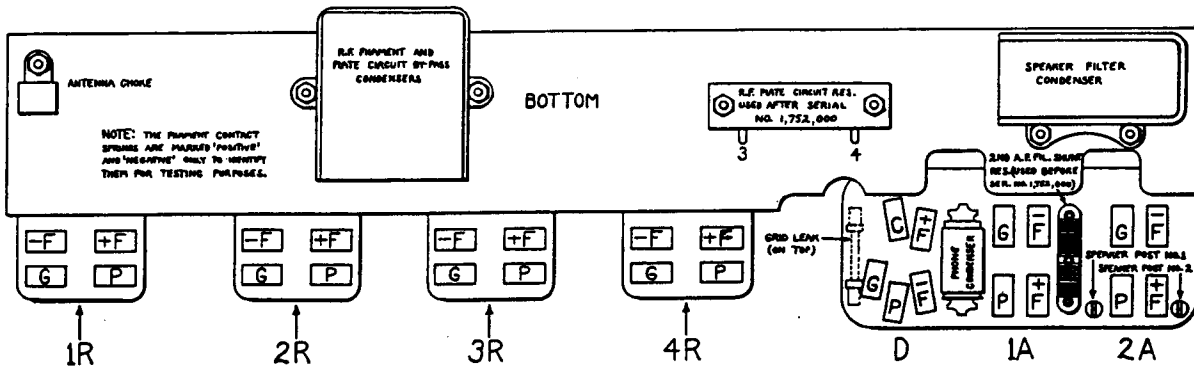


FIG. 62. TEST CHART FOR MODEL 38

Continuity Test Table—Model 38

Colors Refer to Cable Leads

For Following Tests Remove Cable Panel from Power Unit

TEST FROM	Correct Reading	WRONG READING INDICATES	REMARKS and FURTHER POSSIBILITIES
Red-Green Tr. to +F2A Black-Green Tracer to -F2A Red-White Tr. to +FD Black-White Tracer to -FD Red to +F1A Black to -F1A Green-Yellow Tracer to Speaker Post No. 2. Green to Ground Post. Brown to P2A White to 4 (on R.F. Plate Resistance.) (After Serial No. 1,752,000.)	<i>Full</i>	Open in cable or connection.	Examine soldered connections at cable connection panel and set.
GREEN to P1A PD P3R +F3R, -F3R +FD, -FD +F2A, -F2A G2R, G3R, G4R G1A G2A G1R (Volume Control Full Right.) Stator of Detector Variable Condenser. CD	<i>None</i> <i>None</i> <i>None</i> <i>None</i> <i>None</i> <i>None</i> <i>Partial</i> <i>Partial</i> <i>Partial</i> <i>Full</i> <i>Full</i> <i>Full</i>	Grounded 1st A.F. plate circuit. Grounded detector plate circuit. Grounded R.F. plate circuit. Grounded R.F.-1st A.F. filament circuit. Grounded detector filament circuit. Grounded 2nd A.F. filament circuit. None—Open grid resistance or secondary No. 1, 2, 3 R.F.T. Full—Shorted grid circuit. None—Open secondary No. 1 A.F.T. None—Open secondary No. 2 A.F.T. None—Open antenna choke. Open secondary last R.F.T. Open cathode lead.	Or shorted phone condenser. Or shorted by-pass condenser. Or shorted by-pass condenser. Test across grid resistors separately. (Mounted on back of R.F. variable condensers.) Full—Shorted secondary. Full—Shorted secondary.
WHITE to 3 (After Serial No. 1,752,000.) P1R, P2R, P3R, P4R ("Local-Distance" Switch "on.")	<i>Partial</i> <i>Partial*</i>	None—Open R.F. plate circuit resistance. None—Open primary No. 1, 2, 3, 4 R.F.T.	Full—Shorted R.F. plate circuit res. No reading to P2R with switch "off."
YELLOW to PD	<i>Partial</i>	None—Open primary No. 1 A.F.T.	Full—Shorted primary No. 1 A.F.T.
Black-Red Tr. to P1A	<i>Partial</i>	None—Open primary No. 2 A.F.T.	Full—Shorted primary No. 2 A.F.T.
OTHER TESTS GD to Stator of Last Variable Condenser. P2A to Speaker Post No. 1. G1R to Antenna Post. Speaker Post No. 2 to -F2A, +F2A. (Before Serial No. 1,752,000.) To Test Volume Control, Unsolder Connection from Antenna Choke to G1R and Test from Antenna to Ground Post, Turning Knob.	<i>None</i> <i>None</i> <i>Full</i> <i>Full</i> <i>Smooth and Nearly Full</i>	Shorted grid condenser. Shorted speaker filter condenser. Open antenna connection. Open connection or open 2nd A.F. Filament shunt resistance. No reading—open in resistance winding. Erratic reading—damaged resistance wire or slider.	Mounted on back of det. var. cond. If found defective, repair or install new control. Resolder antenna choke lead.

*NOTE.—The reading from WHITE to each R. F. plate is "full" in Model 38 sets, prior to Serial No. 1,752,000

When the screws have been removed pull the set straight back horizontally so that the condenser shaft and volume control clear the cabinet and then lift the set up carefully and rest it on top of the cabinet while removing the "local-distance" toggle switch from the front of the cabinet. Loosen hexagon nut on toggle switch with an open-end wrench and unscrew knurled lock nut from front of toggle switch with fingers. Never use a wrench or pliers on the knurled nut.

Replacing Variable Condensers

If one variable condenser is defective, replace entire group of four variable condensers.

No. 13210 for Model 38 sets below Serial No. 1,752,000.

No. 13200 for Model 38 sets above Serial No. 1,752,000.

Use pulleys and belts of original group.

Procedure: Loosen twelve screws holding variable condensers to metal frame. Note how pulleys and belts are arranged and then remove them. Replace one condenser at a time.

Remove the double R. F. transformers which are mounted on backs of variable condensers (do not unsolder transformer leads), at the same time removing the grid resistors, the grid condenser and the lugs of secondary leads, which are held to the condensers by the same nuts that hold the R. F. transformer brackets.

Remove the three screws holding first condenser, lift out the condenser and put in replacement without tightening screws. Mount the first R. F. transformer, the first grid resistor and the secondary lead lug, on the two bolts on back of the condenser. Make certain that the axes or long sides of the transformer coils are vertical. This may be checked by seeing that the sides of the coils are parallel to the vertical metal strip on the back of the condenser.

Repeat procedure with each condenser and, when all four are in place, put on the pulleys and belts, adjust belt tension and synchronize condensers. (See Section XI.)

Replacing R. F. Transformers

If one double R. F. transformer is defective, replace entire group of four double R. F. transformers. Part No. 13220.

One lead on each transformer has a distinctive color, as follows:

No. 1 has a white lead.

No. 2 has a green lead.

No. 3 has a yellow lead.

No. 4 has a blue lead.

Procedure: In replacing double R. F. transformers, substitute one transformer at a time, mounting and connecting the replacement exactly like the original. Do not mix up the old coils with the replacements.

Remove two nuts on back of first variable condenser which hold R. F. transformer brackets, unsolder transformer connections and remove old transformer. Put replacement transformer in position, seeing that the grid resistor and lug of secondary lead are replaced properly, and tighten the two nuts. The transformer angle brackets must be arranged so that the axes or long sides of the coil are vertical. This may be checked by seeing that the long sides of the coils are parallel to the vertical metal strip on the back of the variable condenser. Solder leads exactly like the original.

Repeat procedure with each R. F. transformer.

Replacing Volume Control (No. 13,018)

In replacing the volume control, the chassis must be removed from the cabinet.

The control is held to the chassis by two screws and nuts, and it is mounted in such a way that the terminals of the control are at the right-hand side when looking at the chassis in its normal position. Remove the two screws, holding the bottom nut with a long-nose pliers as this nut is somewhat closed in by the first A. F. transformer.

A red lead is soldered to the center (slider contact) of the three screws on the right hand side of the control. The other end of this red lead is connected to the grid contact of the first R. F. socket.

A green lead is soldered to the lower one of the three screws. The other end of this green lead is soldered to a (ground) lug held under the right hand one of the two screws that clamp the fourth R. F. socket to the metal frame.

The lead from the antenna post is run through a braided metal shield and connects to the center of the three screws on the volume control. One end of the braided shield is clamped to the lower one of the three screws on the volume control and the other end

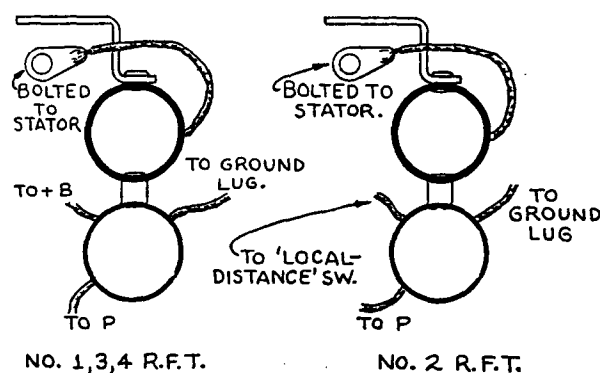


FIG. 63. SKETCH SHOWING CONNECTIONS FROM R. F. TRANSFORMERS