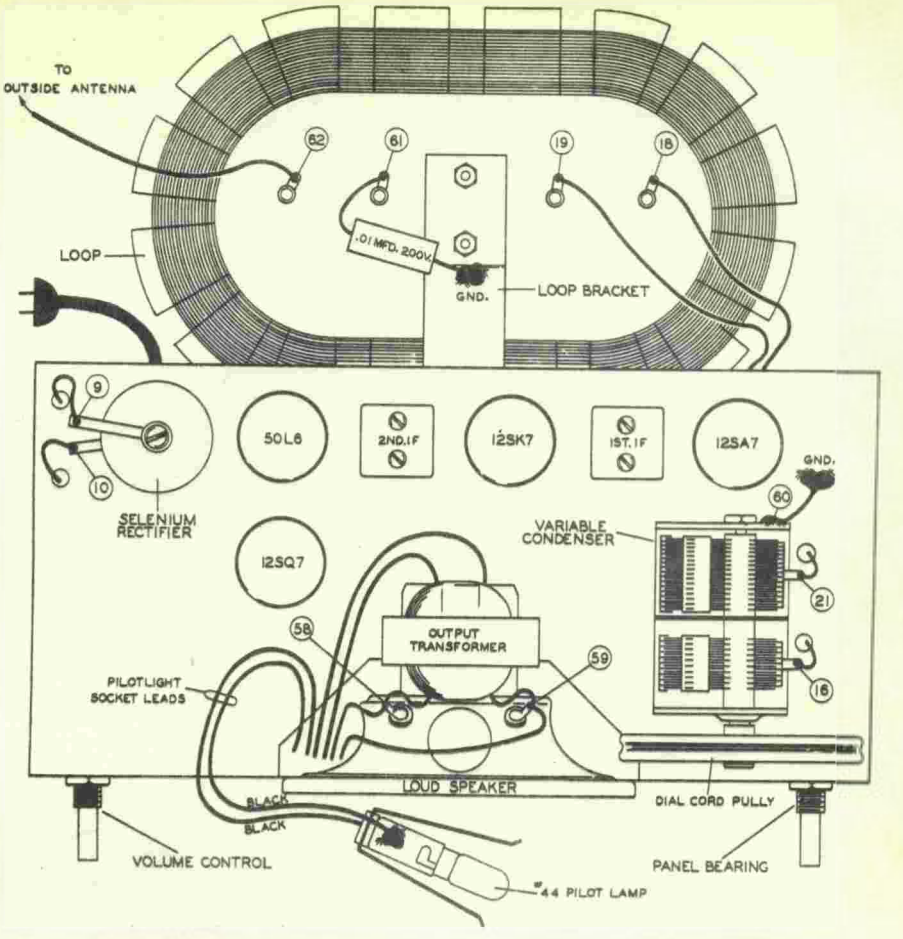

LESSON
17 RA

READING RADIO AND TELEVISION DIAGRAMS

RADIO-TELEVISION TRAINING SCHOOL, INC.
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READING RADIO AND TELEVISION DIAGRAMS WITH SYMBOLS

Introduction

Diagrams employing symbols, having special significance, are used by radiomen whether they be radio or television servicemen. These diagrams are read just like a special language having unique characters. With the aid of these diagrams, it is possible to show every connection and some of the electrical and mechanical characteristics of many parts used in a complicated circuit and within a comparatively small area on paper. In other words, several printed pages of a lesson would normally be necessary to give all of the information which may be presented in a diagram. A diagram is, therefore, a special chart with coded characters employed for a specific purpose. The reading of diagrams is easy and very interesting as well as educational. You too, can master the reading of diagrams and interpret much of the information presented in them.

Radio and television sets contain a combinationofparts (tubes, capacitors, resistors and coils) which are assembled in a way to obtain a certain type of performance. It is their values, method of connection, and the electrode voltages that give the type of performance desired. A large number of radio engineers have spent many thousands of hours developing special circuits and circuit combinations having special characteristics from simple parts such as resistors, capacitors, inductors, and tubes of various types. To read these diagrams and interpret the information they contain is one of the most fascinating and interesting things done by first-class radio and television servicemen.

First, become familiar with the symbols for individual parts in common use so you can, at a glance, determine what you wish to know about any one or a combination of the parts in a diagram of an entire set. It is not difficult to learn to read and trace large diagrams when you know the meaning of individual symbols. You will learn about the general characteristics of symbols in this lesson and more about them as you encounter others in advance lessons. You are not expected to memorize the meaning or exact foundation of each symbol, but you should remember their general characteristics well enough to read and trace circuits in a diagram of a set.

There are no specific rules which will enable you to read symbols quickly, however, it is generally understood that a straight line on paper usually indicates a conductor and when drawn in between two symbols, it indicates a conductor in the circuit. A circuit is a complete path through which electrons may traverse.

Symbols of parts by themselves generally have two lines (referred to as leads in a schematic diagram) attached to them. These lines are generally part of a straight vertical or a horizontal line. The shape of the symbol in between these lines must be taken into consideration with respect to any other marks associated with it. For example: A resistor is formed by a zigzag line joining two short lines representing leads. Then a coil is formed by a number of offset circles. This means that resistors are symbolized by zigzag lines and coils by a series of circles with joining short straight lines or

long lines to other circuit components. An arrowhead pointing toward one of the zigzag lines of a resistor or one of the circles of a coil indicates that the value of the resistor or coil is adjustable. In fact, the arrow is almost always an indication ofvariable control or adjustable connection.

The images or symbols within a circle generally indicate an area in which the items or electrodes are held. For example: The area or space about the electrodes of a tube may be shown by the use of a circle. Then the electrodes of a tube are also generally shown by certain symbols. For example: The grids of a tube may be shown by either a zig-zag or a dotted line. The plate electrode of a tube may be shown by either an inverted letter T or a rectangular box attached to a line. Then the filaments of tubes may be shown by the inverted letter V, and the cathodes for the indirectly heated type by a short horizontal line attached at one end to a line drawn downward.

Straight and curved arrows are generally used in symbols to indicate variables, or the fact that the circuit valves are adjustable. Often times these arrows have short lines with connecting dotted lines to indicate common coupling to another variable or adjustable item.

COMMONLY USED SYMBOLS

A large number of the symbols commonly used in identifying individual component parts employed in radio and television, as well as electronic equipment, are shown in Fig. 1. A word or two regarding the individual characteristics of each part is given here. The following symbols of parts are shown in column one of Fig. 1. Be sure to refer to each symbol as you read the brief discriptions given below.

AERIAL: The symbol of the aerial indicates wires (lines on paper) in free space properly insulated from earth.

COIL ("LOOP") AERIAL: The symbol of a coil, a loop aerial or an antenna is indicated by a number of turns of wire wound about a form and properly insulated from each other.

GROUND: The symbol for a ground connection consists of an image of a wire or conductor represented by a vertical line meeting a number of horizontal lines of gradually shortened length at the bottom.

COUNTERPOISE: The symbol for a counterpoise consists of a heavy line held above another line below it, having short vertical lines connected to it.

VARIABLE CONDENSER: The symbol for a variable condenser (often called a variable capacitor) is shown here. The arrow means variable or adjustable in this and many symbols of parts.

VARIABLE CONDENSER (MOVING PLATES INDICATED): The symbol of a variable condenser can, with the aid of a black dot at the junction of the wire to the lower plate, indicate that the rotor of the variable condenser is connected to the bottom lead.

TRIPLE VARIABLE CONDENSER (SAME STYLE FOR DOUBLE OR QUADRUPLE): The symbol of several variable condensers or variable capacitors mounted on a common control shaft is shown here.

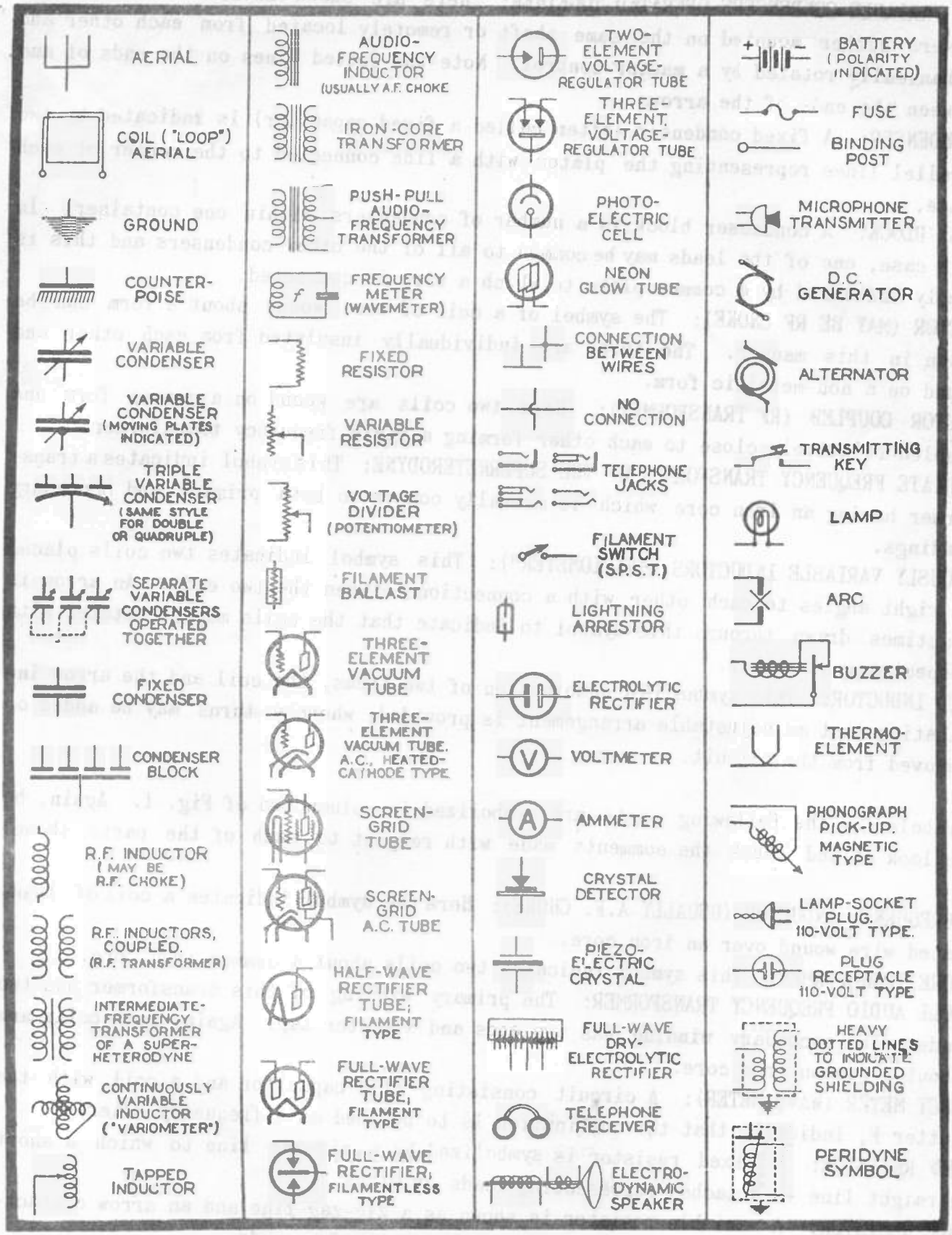

FIG. 1. Many of the commonly used radio symbols are shown above. Note that the symbols within this figure are divided into 4 sections and shall be referred to in this lesson as columns 1, 2, 3 and 4. Symbols are presented about condensers, inductors, transformers, tubes, connections, meters, batteries, resistors, fuses, generators, phonograph pickups and a large number of other radio parts.

SEPARATE VARIABLE CONDENSERS OPERATED TOGETHER: Here are shown several variable condensers either mounted on the same shaft or remotely located from each other and mechanically rotated by a master control. Note the dotted lines on the ends of and between the ends of the arrows.

FIXED CONDENSER: A fixed condenser (often called a fixed capacitor) is indicated by two parallel lines representing the plates with a line connected to the center of each plate.

CONDENSER BLOCK: A condenser block is a number of condensers within one container. In this case, one of the leads may be common to all of the other condensers and this is simply indicated by a common plate to which a wire is connected.

RF INDUCTOR (MAY BE RF CHOKE): The symbol of a coil of wire wound about a form can be shown in this manner. The turns are individually insulated from each other and wound on a non-metallic form.

RF INDUCTOR COUPLED (RF TRANSFORMER): Here two coils are wound on a common form and coupled relatively close to each other forming a radio frequency transformer.

INTERMEDIATE FREQUENCY TRANSFORMER OF THE SUPERHETERODYNE: This symbol indicates a transformer having an iron core which is mutually common to both primary and secondary windings.

CONTINUOUSLY VARIABLE INDUCTORS ("VARIOMETER"): This symbol indicates two coils placed at right angles to each other with a connection between the two ends. An arrow is sometimes drawn through this symbol to indicate that the coils may be rotated with respect to each other.

A TAPPED INDUCTOR: This symbolisa combination of two items, the coil and the arrow indicating that an adjustable arrangement is provided, whereby turns may be added or removed from the circuit.

Symbols for the following parts are symbolized in column two of Fig. 1. Again, be sure to look at and check the comments made with respect to each of the parts shown.

AUDIO FREQUENCY INDUCTOR (USUALLY A.F. CHOKE): Here the symbol indicates a coil of insulated wire wound over an iron core.

IRON-CORE TRANSFORMER: This symbol indicates two coils about a common iron core.

PUSH-PULL AUDIO FREQUENCY TRANSFORMER: The primary winding of this transformer has two ends. The secondary winding has two ends and a center tap. Again, both coils are about a common iron core.

FREQUENCY METER (WAVE METER): A circuit consisting of a capacitor and a coil with the letter F, indicates that the combination is to be used as a frequency meter.

A FIXED RESISTOR: A fixed resistor is symbolized by a zig-zag line to which a short straight line is attached representing leads or wires.

VARIABLE RESISTOR: A variable resistor is shown as a zig-zag line and an arrow contacting the resistance element at some point between its free ends.

VOLTAGE DIVIDER (POTENTIOMETER): Since a voltage divider can be a resistor, this symbol consists of a fixed resistor and the arrow contacting the resistor element at some point between the two free ends.

FILAMENT BALLAST: A filament ballast is shown as a fixed resistor within a rectangular box.

THREE-ELEMENT VACUUM TUBE: The grid of a vacuum tube is symbolized by a zig-zag line. The plate is either a rectangular image or alineto which is connected another line representing a lead. The filament is represented by the letter V upside down.

THREE ELEMENT VACUUM TUBE (AC HEATED CATHODE TYPE): This symbol is very similar to the three element vacuum tube symbol. Here the cathode is shown as the indirectly heated type.

SCREEN GRID TUBES: Note this variation in the shape of the filament which is to the left of the grid entering the circle by a tube contact cap. Note also that the zig-zag lines are joined by a horizontal line and then a vertical line, representing the common lead going outside of the envelope of the tube as indicated by the circle.

SCREEN GRID AC TUBE: The cathode is heated by the heater as indicated by this symbol.

HALF-WAVE RECTIFIER TUBES; FILAMENT TYPE: Within the circle is shown the inverted V representing the filament of the tube. The plate electrode is shown as the rectangular shaped object which has a lead connected to it.

FULL-WAVE RECTIFIER TUBE; FILAMENT TYPE: Here is shown the inverted V representing the filament and the two rectangular plates with individual leads going through the circle representing a full wave rectifier tube.

FULL-WAVE RECTIFIER; FILAMENT LESS TYPE: This symbol indicates a rectifier having two arrows pointing toward a common element within the circle. The arrows indicate the direction of electron flow.

Now you shall learn how symbols may be used in showing voltage regulators, photo electric cells, neon glow tubes, wire connections, telephone jacks and several other items including meters, detectors, telephone receivers and loudspeakers. Symbols for these items are shown in column three in Fig. 1. Check each one for special characteristics listed below.

TWO-ELEMENT VOLTAGE REGULATOR TUBE: This special symbol indicates an arrow as the cathode-electrode of two diodes forming a tube. Note that two leads connect to the elements within a circle representing a tube.

THREE ELEMENT VOLTAGE-REGULATOR TUBE: Here two arrows indicate two elements of the tube having a common electrode.

PHOTOELECTRIC CELL: This symbol shown here is of a photoelectric cell which consists of an inner wire having a small loop or circle at the top end of the center electrode. The other electrode is a half circle and has a line connected to it.

NEON GLOW TUBE: Here two rectangular images placed within a circle with lines leaving the circle symbolize a glow tube.

CONNECTION BETWEEN WIRES: Two different ways of showing connections between conductors are shown here. The inverted T shows how one lead (line) connects to another. The cross or plus sign with a ball at the center indicates a connection between two wires at a crossing in a circuit. This ball may be considered as a soldered connection.

NO CONNECTION: Here the horizontal line representing a wire does not contact the vertical line or wire. It appears to be jumping over the horizontal line.

TELEPHONE JACKS: Four telephone jacks are shown in this combination. The two jacks at the top arethetype where the outside sleeve of the plug on the telephone cord contacts

the frame of the jack. The center conductor or tip of the jack contacts the upper spring or hook. The telephone jack which is shown at the upper right has one additional contact than the jack at the upper left. When the telephone plug is inserted in this jack from the right, the upper spring is raised and the circuit is broken between the upper spring and the contactor just below it. Thisjack is used in special circuits where a circuit is to be opened as the telephone plug is inserted. The telephone jack shown at the lower left consists of two insulated spring contactors having bent springs at their ends for contacting the outer and inner leads of the plug. When the telephone plug is inserted, contacts are made to these two outer springs, while two contacts are broken to the two inner contactors. The two lower telephone jacks are insulated from the chassis or ground. Thetelephone jack at the right just has the two outer spring contactors.

FILAMENT SWITCH (S.P.S.T.): This symbol shows how a filament switch may be drawn and shown as a single pole, single throw switch. Asingle pole represents one conductor or wire and single throw represents the closure of only one circuit upon the operation of the switch.

LIGHTNING ARRESTOR: This symbol indicates two conductors within a rectangular area held a given distance apart.

ELECTROLYTIC RECTIFIER: This symbol indicates two plates within a container (a circle) one filled in plate, usually negative, while the other plate has an open area usually indicating the positive plate.

VOLTMETER: A voltmeter is symbolized by a circle in which is placed the capital letter V. Two leads (wires) connect to opposite sides of the circle.

AMMETER: The ammeter is symbolized by a circle in which is placed the capital letter A. The two leads connect to opposite sides of the circle.

CRYSTAL DETECTOR: The symbol for a crystal detector consists of an arrow representing the upper contactor resting on the crystal, and the latter resting on a plate, the lower contactor.

PIEZO-ELECTRIC CRYSTAL: The symbol indicates contactors attached to lines and separated by the crystal.

FULL-WAVE, DRY-ELECTROLYTIC RECTIFIER: Here is symbolized a number of discs of copper placed on a shaft, the latter resting in a horizontal line having a number of lines (leads) connected to it.

TELEPHONE RECEIVER: Two circles representing the earphones held together by a head band.

ELECTRO-DYNAMIC SPEAKER: Here two coils are shown wound over the stem of a funnel representing the diaphram of the speaker. The left hand winding being used for the purpose of supplying magnetic energy to the pole pieces of the speaker, while the right hand winding is the voice coil attached directly to the cone (funnel) of the speaker.

In Fig. 1 and in column 4 you will now see and note the important characteristics of such items as a battery, fuse, binding post, microphone, generator, alternator, key, lamp and many other items including a phonograph pickup and lamp-socket plug.

BATTERY (POLARITY INDICATED): Aseries of narrow and wide vertical lines placed alter-

nately from left to right represent a battery containing a number of cells. Note the polarity is indicated by the plus and minus signs.

FUSE: The fuse is symbolized by a curve resembling the letter S having balls at its ends that are connected to two leads.

BINDING POST: The binding post is represented by a pin having an open head, and the shaft of the pin representing the conductor leaving the post.

MICROPHONE OR TRANSMITTER: Two wires running to a half circle supporting a cone shaped funnel symbolizes the microphone.

D.C. GENERATOR: The symbol for a d.c. generator is that of a circle representing the commutator on which two lines placed at an angle are resting. The latter two lines represent the brushes.

ALTERNATOR: The symbol of an alternator is shown very similar to that of a d.c. generator, however, two circles are used, one inside the other, with each having a line resting at an angle on them.

TRANSMITTING KEY: Here is symbolized a transmitting key, a conductor going to the long arm of the key at the upper left with a knob at the arm. Directly below the knob on the arm is shown a short vertical line indicating a contact to the horizontal conductor.

LAMP: One turn of a coil within a circle represents the filament of a lamp with two horizontal lines.

ARC: The letter X indicates the point where the arc would occur in an arc lamp. The wide vertical lines represent the electrodes, while the horizontal lines are the conductors.

BUZZER: The buzzer is shown as a combination of symbols. The electro magnet of the buzzer is shown like an audio frequency inductor. The vibrating element of the buzzer is represented by an inverted pin having the head of the pin serve as the flexible joint. The vibrating element is in contact with an arrow that connects to the right end lead of the inductor.

THERMO-ELEMENT: This is a device through which the flow of electrons produces heat, and this heat in turn develops a voltage for the operation of an electrical meter movement. The two lines going upwards attach to the meter while the horizontal leads are connected in the circuit.

PHONOGRAPH PICKUP-MAGNETIC TYPE: Here the inductor coil supported at an angle has, as its common core, an arrow representing the needle riding in a groove of the record. This symbolizes a magnetic pickup.

LAMP-SOCKET PLUG 110 VOLT TYPE: The conventional power cord plug is symbolized by two twisted leads and the two prongs on a power cord plug.

PLUG RECEPTACLE-110 VOLT TYPE: Within a circle are shown two vertical items separate from each other, representing the receptacle for the two prongs on the power cord plug.

HEAVY DOTTED LINES TO INDICATE GROUND SHIELDING: Shielding is generally represented by dotted lines. The two inductors of coils represent a transformer.

PERIDYNE SYMBOL: Here an inductor is symbolized as having a variable amount of inductance. A line representing an adjustable iron plate is connected to a vertical line symbolizing the adjustable core. Notethe entire arrangement is held within a shielded

container as indicated by the dotted lines.

It is suggested that you now practice drawing symbols of the following items and without referring to Fig. 1. Draw a ground, a variable condenser, a fixed condenser, a coil or R.F. inductor, an R.F. transformer, a fixed resistor and a variable resistor, a tube, a meter, a battery and a fuse. After drawing the symbols for these items, you should compare your images of them with those shown in Fig. 1.

A COMBINATION OF SYMBOLS

As previously pointed out, parts are used in various ways to give certain results. Now you shall learn how a combination of parts may be connected, and at the same time, learn how to readortrace the connections between the various circuits used in a typical 4 tube ac-dc superheterodyne radio receiver.

A 4 TUBE AC-DC SUPERHETERODYNE RADIO RECEIVER

Let's imagine you have a typical midget 4 tube ac-dc superheterodyne radio receiver within its cabinet. This set employs a loudspeaker, a ruler type dial, a tuning knob and a volume control knob. Then, looking at the rear of the set you may see a power cord having a plug, and there may be a short length of wire used as the antenna. As you turn the set around, you may notice a sheet of paper about the size of the cabinet of the set. This paper is cut so that a number of turns of insulated wire is held in place. These turns of wire represent the loop antenna.

Now let's imagine you are going to remove the chassis from the cabinet. First, pull out the power cord plug and then remove the knobs from the volume control and the tuning control shaft. Then, after removing several screws from the bottom of the cabinet, pull the chassis out.

PICTURE WIRING - TOP VIEW

A visual inspection will show the items indicated in the picture wiring diagram shown in Fig. 2. You will find the loop antenna at the top with the 4 connecting points numbered 62, 61, 19 and 18. The loop antenna is supported by the metal loop bracket. Point 62 has a short length of wire connected to it. This lead is to be connected to the outside antenna. Point61 is connected to the .01 mfd. 200 V. capacitor. The points 19 and 18 are connected to two wires which pass into the bottom of the chassis.

In the upper left hand corner of the chassis you find a selenium rectifier with the two points numbered 9 and 10. These points of connections provide a circuit for electrons and join leads or wires which pass down into the chassis. Then we notice the 4 tubes are identified by the type numbers 12SQ7, 50L6, 12SK7 and 12SA7. The first IF and second IF transformers each have their own primary and secondary adjustable screws. At the right and top of the chassis will be seen the variable condenser having two sections with the

lugs 16 and 21 connected to wires passing down into the chassis. The connection numbered 60 is to the frame of the variable condenser and the lead to this connection is shown

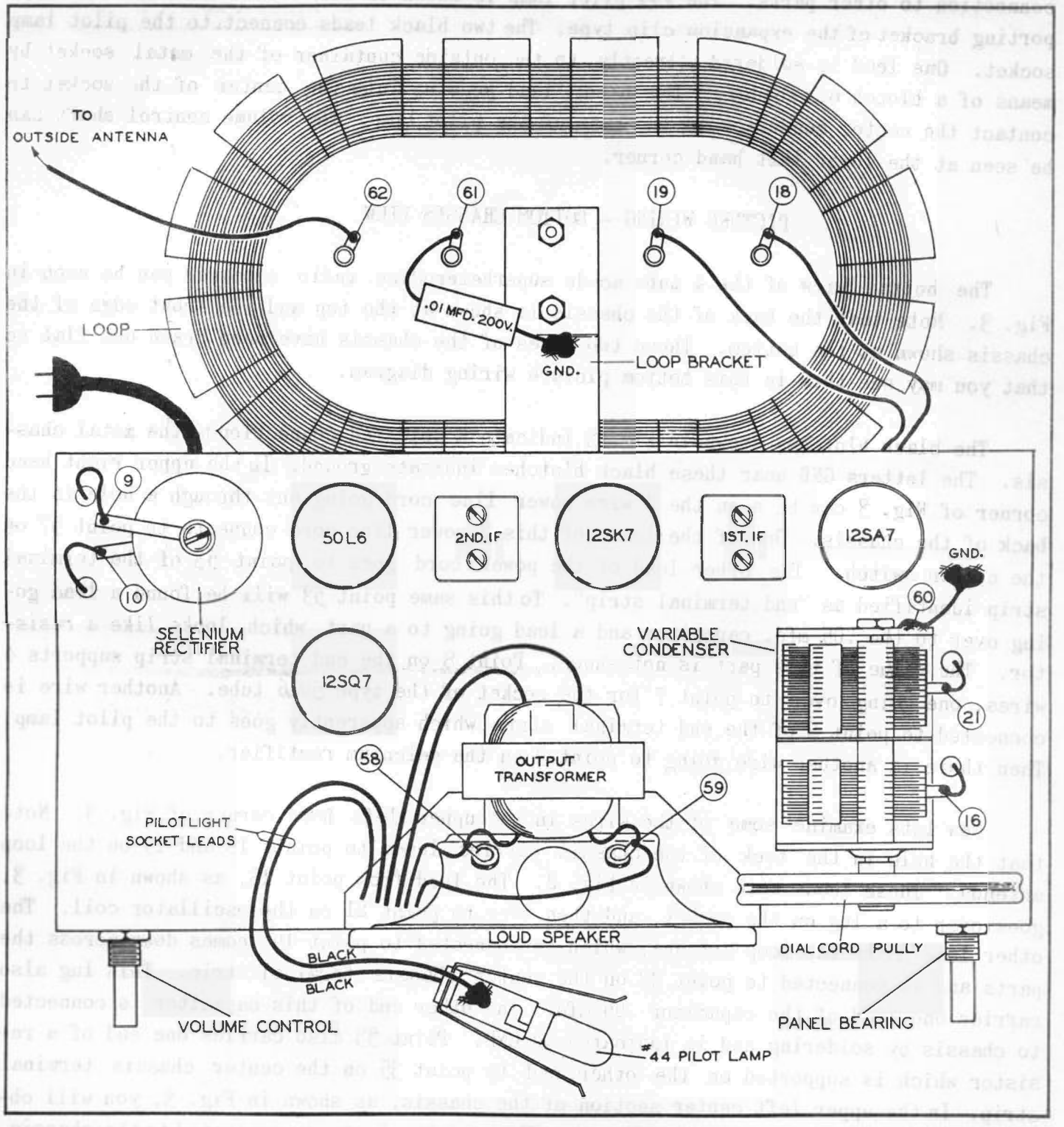

FIG. 2. Picture wiring diagram of a 4 tube ac-dc superheterodyne radio receiver. Top view.

connected to the ground or metal chassis by the letters GND. Note the blotch of solder at the end of the lead. On the shaft of the variable condenser is mounted a dial cord pully. Then, in the lower right of the chassis will be found the panel bearing which holds the shaft for the tuning dial knob. Directly in the center and near the front edge of the chassis will be seen the loudspeaker and its output transformer. The points 58

and 59 indicate connections to the voice coil and also the secondary leads of the output transformer. Two primary leads from the output transformer go down below the chassis for connection to other parts. The #44 pilot lamp is shown in its socket as well as a supporting bracket of the expansion clip type. The two black leads connect to the pilot lamp socket. One lead is soldered directly to the outside container of the metal socket by means of a blotch of solder. The other lead goes up into the center of the socket to contact the center conductor in the base of the pilot lamp. The volume control shaft can be seen at the lower left hand corner.

PICTURE WIRING - BOTTOM CHASSIS VIEW

The bottom view of the 4 tube ac-dc superheterodyne radio receiver can be seen in Fig. 3. Note that the back of the chassis is shown at the top and the front edge of the chassis shown at the bottom. These two edges of the chassis have been drawn out flat so that you may see them in this bottom picture wiring diagram.

The black blotches shown in Fig. 3 indicate a soldered connection to the metal chassis. The letters GND near these black blotches indicate ground. In the upper right hand corner of Fig. 3 can be seen the 2 wire power line cord going out through a hole in the back of the chassis. One of the leads of this 2 power line cord connects to point 57 on the off-on switch. The other lead of the power cord goes to point 53 of the terminal strip identified as "end terminal strip". To this same point 53 will be found a lead going over to the .05 mfd. capacitor and a lead going to a part which looks like a resistor. The value of this part is not shown. Point 8 on the end terminal strip supports 4 wires, one going over to point 7 for the socket of the type 50L6 tube. Another wire is connected to point 8 of the end terminal strip which apparently goes to the pilot lamp. Then there is another wire going to point 9 on the selenium rectifier.

Now lets examine some of the wires in the upper left hand corner of Fig. 3. Note that the hole in the back of the chassis carries leads to points 18 and 19 on the loop antenna. These leads were shown in Fig. 2. The lead from point 18, as shown in Fig. 3, goes over to a lug on the socket, and then over to point 21 on the oscillator coil. The other lead from the loop antenna, which is connected to point 19, comes down across the parts and is connected to point 33 on the center chassis terminal strip. This lug also carries one lead of the capacitor .05 mfd. The other end of this capacitor is connected to chassis by soldering and is indicated as GND. Point 33 also carries one end of a resistor which is supported on the other end by point 35 on the center chassis terminal strip. In the upper left center section of the chassis, as shown in Fig. 3, you will observe the socket for the type 12SK7 tube. Three of its lugs are connected to the chassis.

So far, we have identified a number of items on the top and bottom of the chassis of this 4 tube ac-dc superheterodyne receiver. In every case, we cannot determine just how each part is connected in the set. We cannot determine what purpose it serves with respect to all other parts. The pictures are so incomplete because so many of the items are not visible.

In a schematic wiring diagram we can show, through the use of symbols, a large amount of information which would normally require several pages occupying the same amount of space. In other words, a schematic wiring diagram gives the radio man many

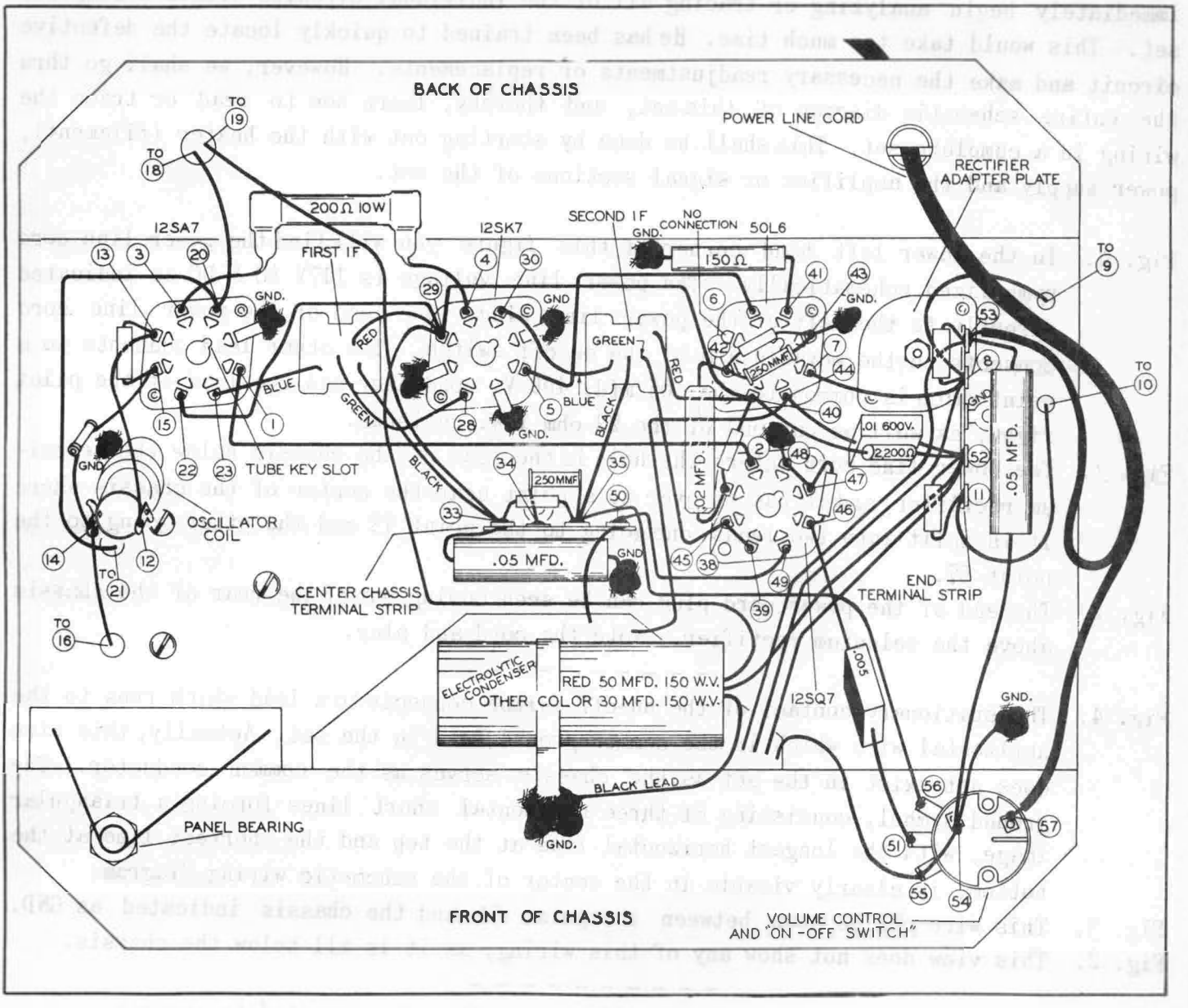

FIG. 3. Picture wiring diagram of the 4 tube ac-dc superheterodyne radio receiver. Bottom view.

times the information which can be presented on a single page.

In Fig. 4 is shown the schematic wiring diagram for the 4 tube ac-dc superheterodyne radio receiver. When looking at a schematic diagram of a set with a large number of parts for the first time, it is difficult to start tracing the wiring in the set. However, with the aid of the Fig. 2 and 3 we shall compare a section of the wiring of

the set with the information given in Fig. 4. Remember that Fig. 4 gives the information provided by the schematic diagrams and Fig. 2 and 3 give information in picture form.

READING OR TRACING A SCHEMATIC WIRING DIAGRAM

Whenever a serviceman has a radio or a television receiver to service, he does not immediately begin analyzing or tracing all of the individual circuits within a complete set. This would take too much time. Hehas been trained to quickly locate the defective circuit and make the necessary readjustments or replacements. However, we shall go thru the entire schematic diagram of this set, and thereby, learn how to read or trace the wiring in a complete set. This shall be done by starting out with the heater (filament), power supply and the amplifier or signal sections of the set.

Fig. 4. In the lower left hand corner of this figure you will find the power line cord symbolized schematically. The power line voltage is 117V AC & DC as indicated directly to the left of the power line plug. One lead of the power line cord connects to the movable arm of the on-off switch. The other lead connects to a point which is common to the .05 mfd. 400 V. condenser and one lead of the pilot light, as well as one end of the 22 ohm 1 W. resistor.

Fig. 3. The power line cord enters the hole in the rear of the chassis below the selenium rectifier, and it passes over to a point near the center of the chassis where it is split into two leads, one going to the point 53 and the other going to the point 57.

Fig. 2. The end of the power cord plug can be seen coming outofthe rear of the chassis above the selenium rectifier. Note the cord and plug.

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Fig. 4. The stationary contact of the on-off switch connectstoa lead which runs to the horizontal wire which is the common ground lead in the set. Actually, this wire does not exist in the set as the chassis serves as the common conductor. The ground symbol, consisting of three horizontal short lines forming a triangular image, with the longest horizontal line at the top and the shortest line at the bottom, is clearly visable in the center of the schematic wiring diagram.

Fig. 3. This wire can be seen between the point 54 and the chassis indicated as GND.

Fig. 2. This view does not show any of this wiring, as it is all below the chassis.

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Fig. 4. The upper lead of the .05 mfd. 400 V. capacitor is connected to chassis.

Fig. 3. The lead from the .05 mfd. capacitor at the right end of the chassis is connected to lug 54 on the volume control and off-on switch.

Fig. 2. All wiring for this item shown below chassis.

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Fig. 4. Note the common connections between the pilot light, the 22 ohm 1 W. resistor, the heater of the type 50L6 tube and the selenium rectifier. Observe this special symbol used by many radiomen to indicate ohms. The letter W is the abbreviation for the word watts.

Fig. 3. The lead from point 8 on the end terminal strip goes over to point 7 on the

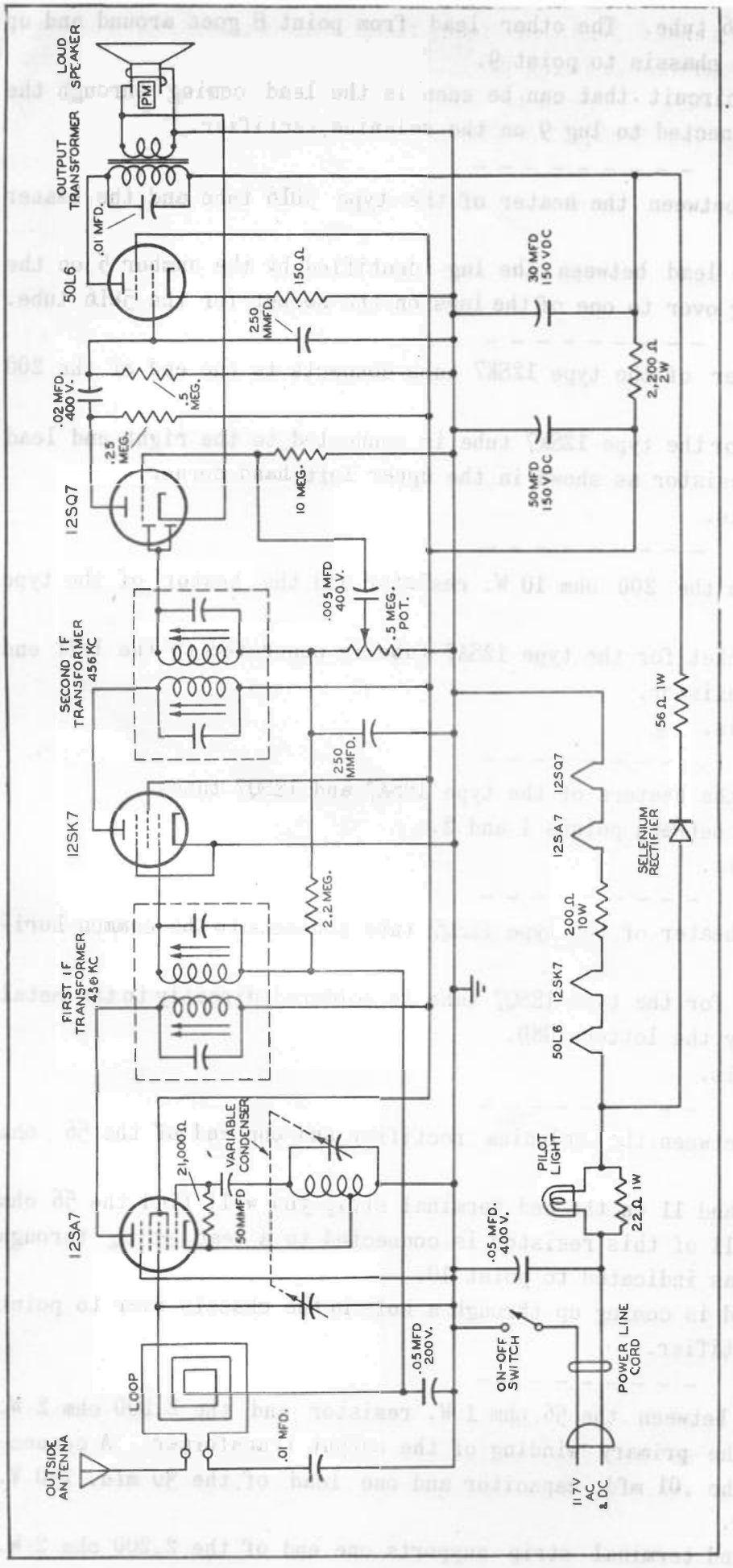

FIG. 4. Above is shown the schematic wiring diagram for the 4 tube ac-dc superheterodyne radio receiver using a type 12SA7 tube, a type 12SK7 tube, a type 12SQ7 tube and a 50L6 tube. The set also employs a loop antenna with provision for outside antenna and ground connection. A careful examination of the other equipment provided in the set will show that there is a pilot light, a selenium rectifier, two IF transformers which are tuned to 456 kc., an output transformer and a loudspeaker. The loudspeaker is one of the PM types which means that it is of the permanent magnet type. A variable condenser is used for the purpose of tuning the loop antenna as well as the oscillator coil connected to the cathode of the first tube, the type 12SA7 tube.

socket for the type 50L6 tube. The other lead from point 8 goes around and up through the hole in the chassis to point 9.

Fig. 2. The only part of this circuit that can be seen is the lead coming through the hole in the chassis connected to lug 9 on the selenium rectifier.

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Fig. 4. There is a connection between the heater of the type 50L6 tube and the heater of the type 12SK7 tube.

Fig. 3. This connection is the lead between the lug identified by the number 5 on the 12SK7 tube socket going over to one of the lugs on the socket for the 50L6 tube.

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Fig. 4. The lead from the heater of the type 12SK7 tube connects to one end of the 200 ohm 10 W. resistor.

Fig. 3. Point 4 on the socket for the type 12SK7 tube is connected to the right end lead of the 200 ohm 10 W. resistor as shown in the upper left hand corner.

Fig. 2. All wiring below chassis.

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Fig. 4. The connection between the 200 ohm 10 W. resistor and the heater of the type 12SA7 tube is shown.

Fig. 3. Note point 3 of the socket for the type 12SA7 tube is connected to the left end of the 200 ohm 10 W. resistor.

Fig. 2. All wiring below chassis.

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Fig. 4. Note the lead between the heaters of the type 12SA7 and 12SQ7 tubes.

Fig. 3. This lead is connected between points 1 and 2.

Fig. 2. All wiring below chassis.

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Fig. 4. Note the lead from the heater of the type 12SQ7 tube connects to the common horizontal ground lead.

Fig. 3. Point 48 on the socket for the type 12SQ7 tube is soldered directly to the metal chassis as indicated by the letters GND.

Fig. 2. All wiring below chassis.

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Fig. 4. Note the connection between the selenium rectifier and one end of the 56 ohm 1 W. resistor.

Fig. 3. Between the points 52 and 11 on the end terminal strip you will find the 56 ohm 1 W. resistor. Point 11 of this resistor is connected to a lead going through a hole in the chassis as indicated to point 10.

Fig. 2. Note one end of the lead is coming up through a hole in the chassis over to point 10 on the selenium rectifier.

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Fig. 4. There is a connection between the 56 ohm 1 W. resistor and the 2,200 ohm 2 W. resistor, as well as the primary winding of the output transformer. A connection is also made to the .01 mfd. capacitor and one lead of the 30 mfd. 150 V. electrolytic condenser.

Fig. 3. Note point 52 on the end terminal strip supports one end of the 2,200 ohm 2 W.

resistor and one of the leads to the .01 mfd. 600 V. condenser. This lead is just above the ground lead in this figure. It is, however, not actually a wire in the set. We shall, however, call this lead the B plus lead as it delivers the high screen and plate supply voltages to the amplifier tubes. Another lead also leaves this point and goes through the opening in the chassis to one lead of the primary winding of the output transformer.

Fig. 2. There are 2 leads on the top edge of the output transformer. The lead coming from the upper right hand corner of the output transformer goes over to the left and down through the opening in the chassis to point 52 on the end terminal strip.

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Fig. 4. The left end of the 2,200 ohm 2 W. resistor is connected to one lead of the 50 mfd. 150 V. electrolytic condenser and a lead or wire running horizontally in this figure.

Fig. 3. Note the left end of the 2,200 ohm resistor connects to a lug on the socket for the type 50L6 tube. This lug has three other leads connected to it, a red lead going over to the primary of the second IF transformer, and another lead going over to point 29 on the socket for the type 12SK7 tube. Another resistor is also connected to this lug of the socket for the type 50L6 tube socket and this is the .25 megohm resistor. Point 29 has three other leads, one going over to the primary of the first IF transformer colored red. Another lead goes over to point 22 on the socket for the type 12SA7 tube. This point 29 may be considered the entire length of the lead shown in Fig. 4 which is just above the ground lead.

Fig. 2. All wiring shown below chassis.

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At this point in the tracing of the circuits in this 4 tube ac-dc superheterodyne radio receiver, we shall start tracing the signal or amplifier circuits. This will be done by tracing the circuits from the antenna lead through the amplifiers to the voice coil of the loudspeaker. Before doing this, lets look at Fig. 5 which gives the tube electrode and basing diagrams for the four tubes used in the 4 tube ac-dc superheterodyne receiver. The tube base diagram shown as 7-AC is for the type 50L6 tube, then 8-N is for the type 12SK7 tube, then 8-Q for the type 12SQ7 tube, and then 8-R for the type 12SA7 tube. The tube basing diagrams are the bottom views of the sockets for the respective tubes shown in Fig. 4. The terminals to the lugs on the sockets for the four tubes have small numbers about them, as well as letters. The small numbers start with the number 1 just to the left of the index key and go around in the clockwise direction in accordance with the R.M.A. (Radio Manufacturers Association) specification. The index key is shown by a small arrow between the numbers 1 and 8.

The letters just inside of the pin numbers 1 to and including 8 identify the different electrodes of the tubes as shown below.

H -- Heater lugs or pins
G -- Control grid pins
P -- Plate pins

K -- Cathode pins
Gs -- Screen grid pins
Go -- Oscillator pins
Su -- Supressor grid pins
Dp -- Diode plate pins

The letter S over the letters NC indicates the metal shell, while the letters NC indicate no connection. When there is no electrode connected to a pin, then no letter is indicated. For example, the pin 6 for the basing diagram shown in 7AC for tye type 5016 tube has no letter.

It is now possible to look at Fig. 5 and the basing diagram 8-R. Check the identification of the lugs for the type 12SA7 tube. Now look at the bottom of the socket for the type 12SA7 tube as shown in Fig. 3. Note that pin 1, which is just to the right of the key slot, is soldered to the chassis marked GND. This is the Spin showing that the shield (metal shell of a metal tube) is connected directly to the chassis through pin 1 of the octal socket. This same method of locating and identifying pins and the leads connecting to them can be followed for all of the sockets used in this and other sets. Of course, you must obtain the tube basing diagram connection information from a tube manual.

Now lets proceed and continue to read the signal or amplifier circuits in Fig. 4. Compare the information given in this figure with respect to the picture wiring diagrams shown in Fig. 2 and 3.

Fig. 4. The symbol, consisting of the triangular shaped object and located in the upper left hand corner of this figure, is the outside antenna connected to a black circle representing a connection on the loop for this set. Remember a similar symbol was shown in Fig. 1.
Fig. 3. This outside antenna connection is not shown here since it is above the chassis.
Fig. 2. Note there is a lead to the outside antenna connected to point 62. The latter is supported by the paper spider-like form holding the turns of the loop antenna.

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Fig. 4. Note that the upper and outer turn of the loop antenna is connected to the lower turn going over to the terminal represented by the small circle in the lead.
Fig. 3. Since all connections are shown above the chassis, this bottom view gives no additional information.
Fig. 2. Point 61 shows a lug connected to the lower half of the outer turn for the loop antenna wire. This turn is connected directly into the antenna circuit.

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Fig. 4. The lower terminal of the single outer turn of the loop is connected to the upper lead of the .01 mfd. 200 V. capacitor.
Fig. 3. All connections shown above chassis.
Fig. 2. Point 61 has one lead of the .01 mfd. 200 V. capacitor connected to it.

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Fig. 4. Note the lower lead of the .01 mfd. 200 V. capacitor is connected to the left end of the common ground lead.

Fig. 3. All connections shown above chassis.

Fig. 2. Note the right end of the .01 mfd. 200 V. capacitor is connected, that is soldered, to the vertical metal loop bracket by a blotch of solder marked GND.

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Fig. 4. The center loop winding consists of two and a half turns. The upper lead of this winding is connected to the upper terminal of the left hand section of the variable condenser and also the signal injection grid for the type 12SA7 tube.

Fig. 3. The point 20 on the socket for the type 12SA7 tube has a lead connected to it which goes up to 18 on the loop antenna. The other lead leaving point 20 goes to the left and up to the chassis to 21.

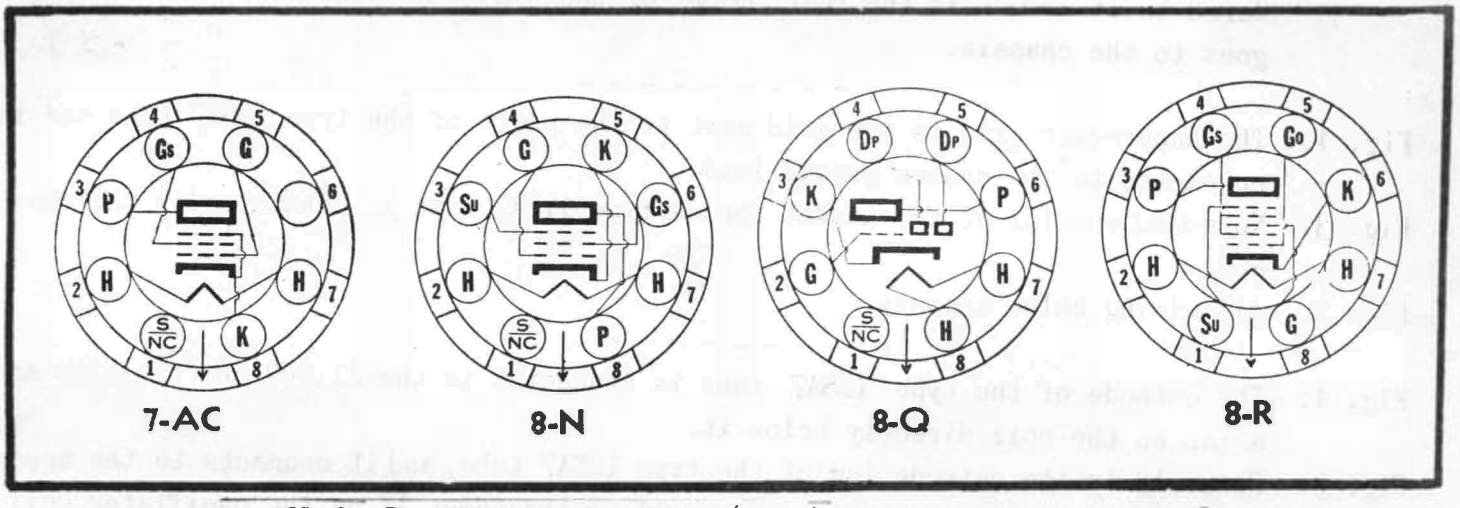

FIG. 5. The tube electrode and base (socket) diagrams for the four tubes used in the ac-dc superheterodyne radio receiver are shown above.

Fig. 2. Note the lug 18 on the loop has a wire connected to it. Point 21 near and on the upper variable condenser section has a lead connected to it coming from under the chassis.

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Fig. 4. Note the center turn of the loop is connected to the upper terminal of the .05 mfd. 200 V. capacitor, and there is a lead which goes over to the left end of the 2.2 meg. resistor, and this in turn has a lead going up to the lower end of the secondary winding, right hand winding, of the first IF transformer. Another lead leaves this point going to the lower end of the capacitor connected across the secondary winding of the first IF transformer.

Fig. 3. Point 33 on the left of the center chassis terminal strip has four leads going to it. One lead goes to the point 19 on the loop through the hole in the back of the chassis. Another lead goes to the secondary winding of the first IF transformer, and it is black. Then the left hand end of the .05 mfd. capacitor also connects to point 33. Above the point 33 can be seen a lead going to the 2.2 meg. resistor.

Fig. 2. The point 19 has a solder lug on the loop antenna, and the lead connected to it.

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Fig. 4. The lower end of the .05 mfd. capacitor is connected to ground.

Fig. 3. The right end of the .05 mfd. capacitor is connected to the chassis.

Fig. 2. No connections shown here as they are all below the chassis.

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Fig. 4. Note the arrows of the two variable condensers are joined by dotted lines which indicates that they move together mechanically. The arrows indicate that the condenser is variable. The lower leads of these two variable condensers are connected to leads which connect to the common ground lead running across the schematic diagram.

Fig. 3. Since the variable condenser is mounted above the chassis, it cannot be seen in this picture.

Fig. 2. The variable condenser has two sections which are mechanically coupled by a common shaft to the dial cord pulley. Note also that the point 60 has a wire soldered to it which is the rear frame of the variable condenser, and this wire goes to the chassis.

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Fig. 4. The suppressor grid is the grid next to the plate of the type 12SA7 tube and is connected to the common ground lead.

Fig. 3. Note that one lug of the socket for the type 12SA7 tube is connected to the chassis.

Fig. 2. All wiring below chassis.

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Fig. 4. The cathode of the type 12SA7 tube is connected to the 21,000 ohm resistor and a tap on the coil directly below it.

Fig. 3. Point 13 is the cathode lug of the type 12SA7 tube, and it connects to the upper lead of the 21,000 ohm resistor as well as the point 12 on the oscillator coil.

Fig. 2. All connections below chassis.

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Fig. 4. The lower end of the oscillator coil is connected to the common ground lead, and the upper end of this coil is connected to the upper lead of the variable condensers tuning this circuit, and a lead also goes up to the 50 mmfd. capacitor.

Fig. 3. The ground connection on the oscillator coil is indicated by the black (ground) blotch. The upper lead of the oscillator coil is point 14 which has two leads connected to it, one going over to the 50 mmfd. capacitor and the other lead going to point 16 up to the chassis.

Fig. 2. Note the leads coming through the chassis to point 16 on the oscillator variable capacitor section.

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Fig. 4. Note that the upper end of the 50 mmfd. capacitor connects to the right end of the 21,000 ohm resistor and also to the first grid in the type 12SA7 tube.

Fig. 3. Point 15 on the socket for the type 12SA7 tube is the first grid lug and connects to the lower end of the 21,000 ohm resistor and the upper end of the 50 mmfd. capacitor.

Fig. 2. All connections below chassis.

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Fig. 4. The first IF transformer is indicated as having a resonant frequency of 456 kc.

This item is within the dotted area indicating shielding. The shield can be mounted on the chassis. The double arrows to the left of the primary and to the right of the secondary windings of this IF transformer indicate that the inductance of the coil is variable through the use of an iron slug.

Fig. 3. The opening in the chassis below the first IF transformer is indicated between the type 12SA7 and the type 12SK7 tube sockets.

Fig. 2. The top view of the first IF transformer can be seen within the rectangular area marked accordingly having two screw heads for the purpose of changing the placement of the iron core slugs.

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Fig. 4. The upper lead of the secondary winding of the first IF transformer is connected to the first grid of the type 12SK7 tube.

Fig. 3. Point 28 is the end of the green lead coming from the secondary of the first IF transformer, and is the grid for the type 12SK7 tube.

Fig. 2. All wiring below chassis.

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Fig. 4. The suppressor grid and cathode of the type 12SK7 tube are connected to the common ground lead.

Fig. 3. The lugs for the pins 1, 3 and 5 of the type 12SK7 tube are soldered directly to the chassis. You may use the drawing shown at 8-N in Fig. 5 in checking the basing diagram to these pins.

Fig. 2. All wiring below chassis.

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Fig. 4. The right end of the 2.2 meg. resistor is connected to the upper lead of the 250 mmfd. capacitor which in turn is connected to the upper end of the .5 meg. pot. (potentiometer) and the lower end of the secondary winding of the second IF transformer, which is peaked at 456 kc.

Fig. 3. The right end of the 2.2 meg. ohm resistor is connected to point 35 which in turn is connected to the 250 mmfd. capacitor. A lead goes from point 35 of the center chassis terminal strip over to point 56 which is one lug on the volume control, the .5 meg. potentiometer. Another lead leaves point 35, colored black, and goes to the opening in the chassis below the second IF transformer.

Fig. 2. Only the top view of the second IF transformer is shown here.

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Fig. 4. The bottom lead of the 250 mmfd. capacitor is connected to the common ground lead and so is the lower lead of the .5 meg. pot. connected to the common ground lead.

Fig. 3. Point 55 on the volume control is connected to point 54 which in turn is wired to ground. Point 34, on the center chassis terminal strip is mounted directly to the chassis by means of the rivet or screw giving us the ground circuit to the chassis.

Fig. 2. All wiring below chassis.

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Fig. 4. Note that the plate of the type 12SA7 tube is connected to the upper terminal of the primary winding of the first transformer.

Fig. 3. Point 23 of the socket (which is lug 3) for the type 12SA7 tube has a blue wire

connected to it going over to the bottom of the first IF transformer.

Fig. 2. All wiring is below the chassis, that is, not shown here.

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Fig. 4. Note the plate lead of the type 12SK7 tube is connected to the upper terminal of the primary winding of the second IF transformer.

Fig. 3. Note the point 30 of the socket for the type 12SK7 tube has a blue wire connected to it. This lead goes through the hole in the chassis below the second IF transformer.

Fig. 2. All wiring below chassis.

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Fig. 4. Note the upper lead of the .25 meg. resistor is connected to the plate of the type 12SQ7 tube and also one lead of the .02 mfd. 400 V. capacitor.

Fig. 3. Note point 45 of the socket for the type 12SQ7 tube is common to the plate of the tube, the .02 mfd. capacitor and the .25 meg. resistor.

Fig. 2. All connections below chassis.

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Fig. 4. The upper end of the .5 meg. resistor is connected to the right end of .02 mfd. 400 V. capacitor and the grid of the 50L6 tube as well as the upper end of the 250 mmfd. capacitor.

Fig. 3. Note that point 42 is the grid lug of the socket for the type 50L6 tube and carries leads to the .02 mfd. capacitor and the 250 mmf. capacitor as well as the left end of the .5 meg. resistor.

Fig. 2. All connections shown below chassis.

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Fig. 4. Note the lower end of the 250 mmfd. capacitor connected to the common ground lead.

Fig. 3. Note that point 43 has the right end of the 250mmfd. capacitor connected to it.

Fig. 2. All connections shown below chassis.

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Fig. 4. Note that the lower end of the .5meg. resistor is connected to the ground lead.

Fig. 3. The point 47 on the socket for the type 12SQ7 tube is connected by a wire over to point 48 which is also on the socket for the type 12SQ7 tube and a wire goes from this point to chassis.

Fig. 2. All connections shown below chassis.

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Fig. 4. The upper end of the 10 meg. resistor is connected to the right end of the .005 mfd. 400 V. capacitor and the grid of the type 12SQ7 tube.

Fig. 3. Note point 46 is the other end of the 10meg. resistor and the lead going to the .005 mfd. capacitor. The point 46 being the grid lug of the socket for the type 12SQ7 tube.

Fig. 2. All connections shown below chassis.

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Fig. 4. Note the bottom end of the 150 ohm resistor is connected to the common ground lead.

Fig. 3. Point 43 of the socket for the 50L6 tube has a wire connected to it that goes over to the chassis.

Fig. 2. All wiring below chassis.

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Fig. 4. Note the bottom end of the .5 meg. resistor is connected to the ground lead.

Fig. 3. Point 43 has a lead connected to it going over to the resistor as shown directly above the 250 mmfd. capacitor.

Fig. 2. All connections shown below chassis.

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Fig. 4. The upper lead of the 150 ohm resistor is connected to the cathode of the type 50L6 tube.

Fig. 3. Point 41 shows the connection of the right end of the 150 ohm resistor.

Fig. 2. All connections below chassis.

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Fig. 4. Note the plate of the type 50L6 tube is connected to the upper terminal of the primary winding of the output transformer and one lead of the .01 mfd. capacitor.

Fig. 3. Note point 44 on the socket for the type 50L6 tube has 2 leads connected to it, one going over to the .01 600 V. capacitor. The other lead leaving this plate lug of the tube goes over to the opening in the bottom of the chassis up to the output transformer above the chassis.

Fig. 2. Note this lead connects to the upper left hand corner of the output transformer.

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Fig. 4. The secondary winding of the output transformer is connected to the two leads of the voice coil of the permanent magnet loudspeaker indicated as PM loudspeaker.

Fig. 3. Loudspeaker not shown here as it is above the chassis.

Fig. 2. The output transformer and the loudspeaker are shown, and the points 58 and 59 show the lugs connected to the voice coil. The leads leaving these lugs that go to the output transformer are connected to the secondary winding.

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Fig. 4. Note the two additional leads leaving the common ground connection between the secondary winding of the output transformer and the winding on the voice coil of the loudspeaker. One lead goes over to the cathode of the type 12SQ7 tube, and the other lead goes to the common ground lead.

Fig. 3. Point 49 on the socket for the type 12SQ7 tube has a lead connected to it which runs over to point 50 on the right end of the center chassis terminal strip. A lead leaves this connection and goes toward the front of the chassis up through the opening in the chassis. Point 55 is connected to point 54, and this connection is wired to the chassis. The lead going to the left from point 55 goes up through the opening in the chassis to one of the points 58 or 59.

Fig. 2. Note the leads leaving the point 58 and 59 go down through the opening in the chassis to the left of the loudspeaker.

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Fig. 4. The long horizontal line just above the common ground lead connects to the screen grids of the type 12SA7, the 12SK7 and 50L6 tubes.

Fig. 3. The points 29, 22 and 40 are joined together by leads. The point 29 being common

to the other two points.

Fig. 2. None of the leads are shown here because all leads are below the chassis.

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Fig. 4. The 30 mfd. 150V. DC capacitor is shown connected to the common ground lead and its positive terminal is connected to the right end of the 2,200 ohm 2 W. resistor.

Fig. 3. The negative terminal of the 30 mfd. 150 W.V. section of the electrolytic condenser is shown in the lower center section of this figure. Its common ground lead is the black lead going to GND. Its positive lead runs up over to point 52 on the end terminal strip.

Fig. 2. Not shown here.

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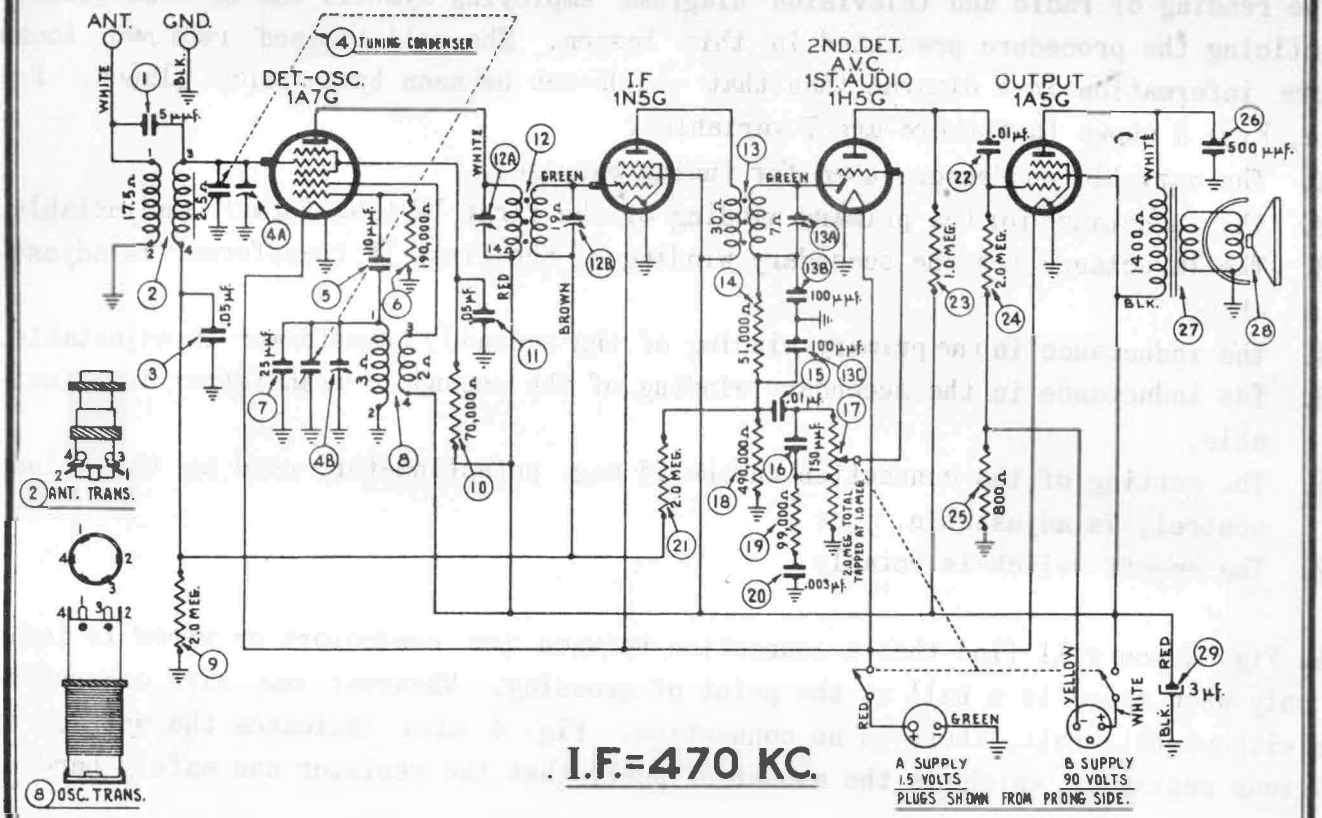
PRACTICAL SERVICE DATA

Radio and television servicemen often must refer to the practical service data provided by either the manufacturer of a set or an organization specializing in the preparation of such data. Atypical and practical service data sheet is shown in Fig. 6. This figure is a reprint of page 10-27 of volume 10 "Perpetual Trouble Shooters Manual" published by the John F. Rider Publishers Inc., located at 480 Canal Street, New York City 13, New York. The information given provides the essential service data on a 4 tube battery operated radio set made by the Philco Radio and Television Corporation. It is their model 39-80 having the code number121indicating the type of chassis construction.

In addition to the schematic diagram, Fig. 6 also shows the socket terminal pin connections, the trimmer capacitors numbered 4A and 4B, and then the "Replacement Parts", as well as the compensator (Parts 4A and 4B) and other part locations as viewed from the underside (bottom) of the chassis. It is important that you observe the similarity between the symbols you have seen in the earlier pages of this lesson and those employed in this figure. You can do this by reading all of the descriptions for the replacement parts and finding the corresponding part numbers as shown by the numbers within the circles near the respective symbols in the schematic diagram. You should also note that the colors of many of the leads are given. The numbers next to each one of the windings of the various transformers indicates the resistance in ohms of the winding as measured with an ohmmeter. The ohmic values of the resistors and the capacitance of the capacitors are given. The terminal lugs to the antenna transformer and the oscillator transformer coil forms are identified. Note also that the plugs for the A and B battery connections are indicated as 1.5 and 90 volts respectively. The plugs are shown when viewed from the prong side. Then note the fact that the Part 17, the volume control has a two section on-off switch mechanically coupled to it as shown by the dotted lines.

This Philco Model 39-80 radio set employs a type 1A7G tube as the first detector and oscillator, a type 1N5G tube as the IF amplifier, a type 1H5G tube as the second detector, automatic volume control and the first audio amplifier tube and the type 1A5G tube is employed as the output tube driving the loudspeaker which is a permanent magnet type of figure as indicated by the half circle. All this information is shown in Fig. 6.



SCHEMATIC DIAGRAM MODEL 39-80

Replacement Parts Model 39-80, Code 121

Schem. No.	Description	Part No.
1	Condenser (mica, 5 mmf.—Part of No. 2)	30-1097
2	Antenna Trans.	32-3080
3	Condenser (tubular, .05 mf.)	30-4519
4	Tuning Cond.	31-2300
5	Condenser (mica, (110 mmf.)	30-1031
6	Resistor (190,000 ohms, ½ watt)	33-419339
7	Condenser (mica, 25 mmfd.)	30-1067
8	Oscillator Trans.	32-3019
9	Resistor (2.0 meg., ½ watt)	33-520339
10	Resistor (70,000 ohms, ½ watt)	33-370339
11	Condenser (tubular, .05 mf.)	30-4444
12	1st I. F. Trans. Assy.	32-2841
13	2nd I. F. Trans. Assy.	32-3081
14	Resistor (51,000 ohms, ½ watt)	33-351339
15	Condenser (tubular, .01 mf.)	30-4572
16	Condenser (mica, 150 mmf.)	30-1033
17	Volume Control and On-Off Switch.	33-5238
18	Resistor (490,000 ohms, ½ watt)	33-449339
19	Resistor (99,000 ohms, ½ watt)	33-399339
20	Condenser (tubular, .003 mf.)	30-4580
21	Resistor (2.0 meg., ½ watt)	33-520339
22	Condenser (tubular, .01 mf.)	30-4479
23	Resistor (1.0 meg., ½ watt)	33-510339
24	Resistor (2.0 meg., ½ watt)	33-520339
25	Resistor (800 ohms, ½ watt)	33-180339
26	Condenser (mica, 500 mmf.)	30-1114
27	Output Trans.	32-7984
28	Cone Assy. for Speaker 36-1410	36-4093
	Cone Assy. for Speaker 36-1436	36-4094
29	Electrolytic Condenser (3 mfd.)	30-2346
	Bezel Assy.	40-6374
	Bezel Screw	W-1834
	Brkt. (Mtg. Set in XF Cabinet)	56-1058
	Cable (Battery)	41-3437
	Dial	27-5413
	Dial Pointer	56-1091
	Dial Drive Cord	31-2318
	Dial Drive Cord Spring	28-8751

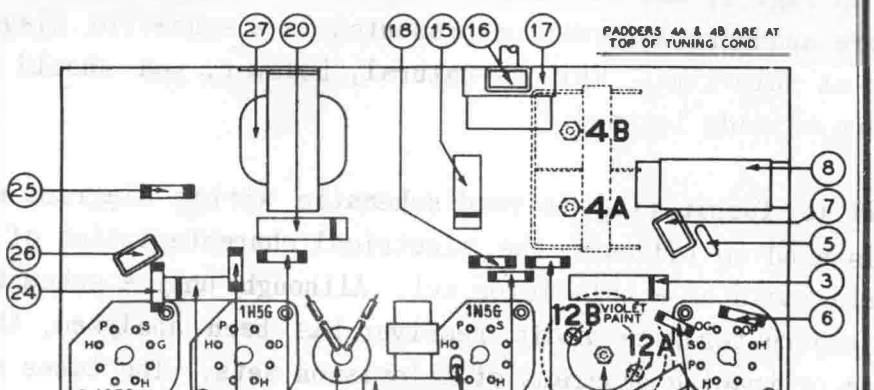


Fig. 3. Compensator and Part Locations
Model 39-80, Code 121
Underside of Chassis

Description	Part No.
Knob	27-4604
On-Off Indicator Parts—	
Hub and Lever	38-9658
Toggle Link and Brkt. Assy.	38-9701
Spring (Toggle Assy.)	28-8925
Snap Fastener	56-1156
Pulley (Tuning Condenser)	28-6662
Pulley Screw (Tuning Condenser)	W-1400
Shaft Assy. (Tuning)	31-2290
*Speaker (El Cabinet)	36-1410
*Speaker (XF Cabinet)	36-1436
Socket (6 prong)	27-6086
Socket (7 prong)	27-6087
Socket (Speaker)	27-6115

Courtesy John F. Rider, Publisher

FIG. 6. Practical service data about the Philco Model 39-80 is given above.

SUMMARY

The reading of radio and television diagrams employing symbols can be done quickly by practicing the procedure presented in this lesson. The well trained radioman looks for more information in a diagram than that which can be seen by a quick glance. For example, Fig. 4 shows that there are 7 variables.

1. The variable condensers used for tuning purposes.
2. The inductance for the primary winding of the first IF transformer is adjustable.
3. The inductance for the secondary winding of the first IF transformer is adjustable.
4. The inductance in the primary winding of the second IF transformer is adjustable.
5. The inductance in the secondary winding of the second IF transformer is adjustable.
6. The setting of the connection on the .5 meg. potentiometer, used as the volume control, is adjustable.
7. The on-off switch is rotable.

In Fig. 4 you will find that a connection between two conductors or wires is indicated only when there is a ball at the point of crossing. Whenever one wire crosses another without this ball, there is no connection. Fig. 4 also indicates the wattage of the various resistors which is the amount of power that the resistor can safely handle.

A tremendous amount of information is presented in the schematic wiring diagram shown in Fig. 4, and it will be found that as you progress with your studies, you will see more and more information presented in a schematic diagram than that which you can obtain at this time. This is natural, however, you should try to detect the many items you have already learned.

It is fascinating to read schematic wiring diagrams and to interpret the various symbols used to indicate the electrical characteristics of a component or part used in either a radio or a television set. Although only a schematic wiring diagram of a 4 tube ac-dc superheterodyne radio receiver has been analyzed, the same procedure is used in reading or tracing diagrams of television sets. The tubes are shown in the same manner in the various circuits. You should observe the slight variations in the symbols shown in Fig. 4. and those shown in Fig. 1. of this lesson. Also note that the heaters are shown separated from their cathodes. This is a practice used by radiomen. Slight variations are permissable and will be found. Radio design engineers select different types of symbols to indicate additional information to them in the design of a set, and often times this additional information gets into the service data and you should, therefore, be looking for additional information in diagrams as you progress with your studies.

EXAMINATION QUESTIONS ON FOLLOWING PAGES