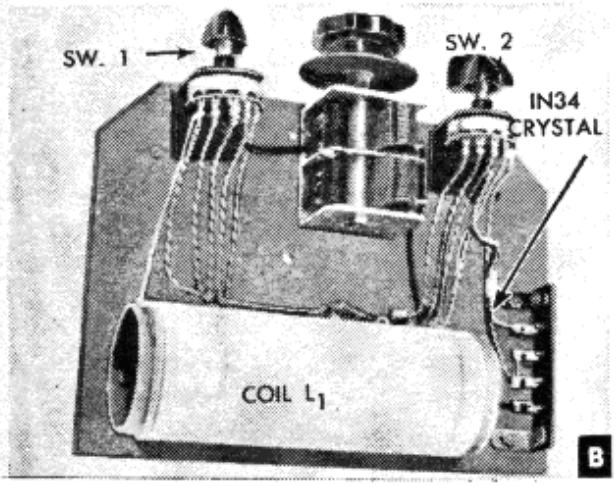
RADIO RECEIVERS



SINCE a crystal set is the simplest form of radio receiver, it is the logical starting point for the student or junior experimenter. Unlike other types of receivers a crystal set uses no batteries or power-line supply, therefore the sound that emerges from the headphones is derived entirely from radio energy picked up by the antenna. Use a long, high antenna and a ground connection to a cold-water pipe.

The selective tapped-coil crystal receiver illustrated in photos A and B employs adjustable loading in a simple tuning arrangement that is very effective when used with a good sensitive pair of headphones. A schematic circuit diagram and the coil-winding details appear in Fig. 1; pictorial wiring diagram in Fig. 2 shows all connections clearly.

The 2-gang variable-condenser stator plates (S), are connected in parallel; the rotor plates (R) are common with the frame. This lead goes to the lever of switch No. 1; the lever of switch No. 2 is connected to one side of the 1N34 germanium crystal, and the headphones are in series.

When winding the coil, place a toothpick or

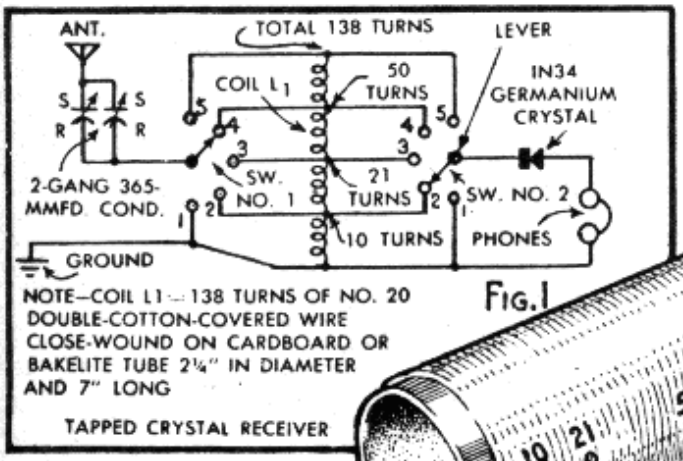


FIG. 1

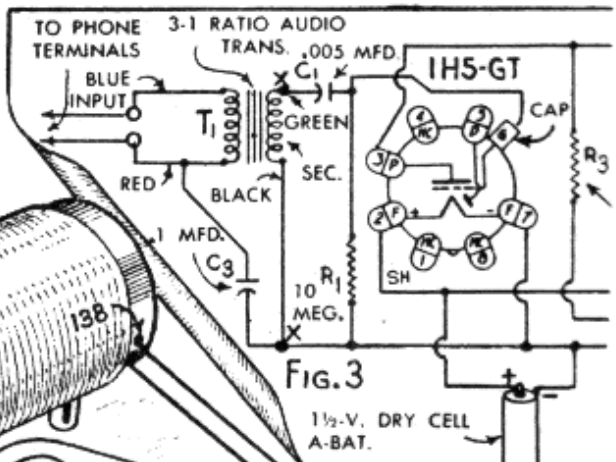


FIG. 3

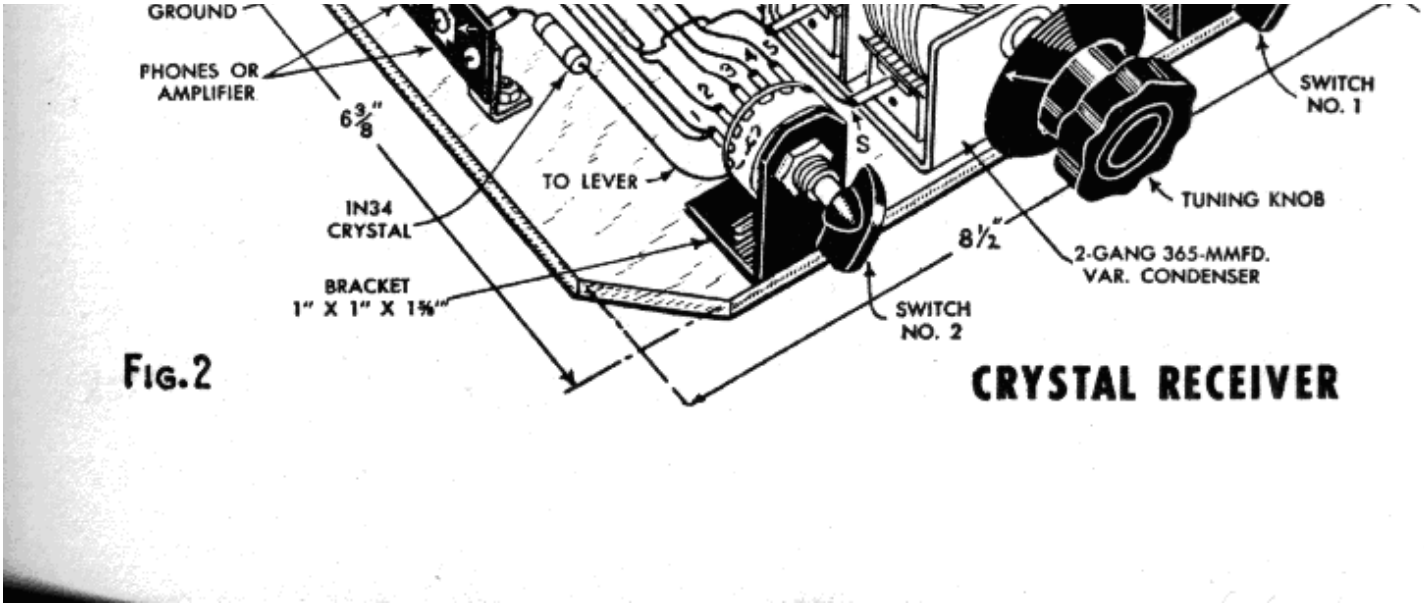
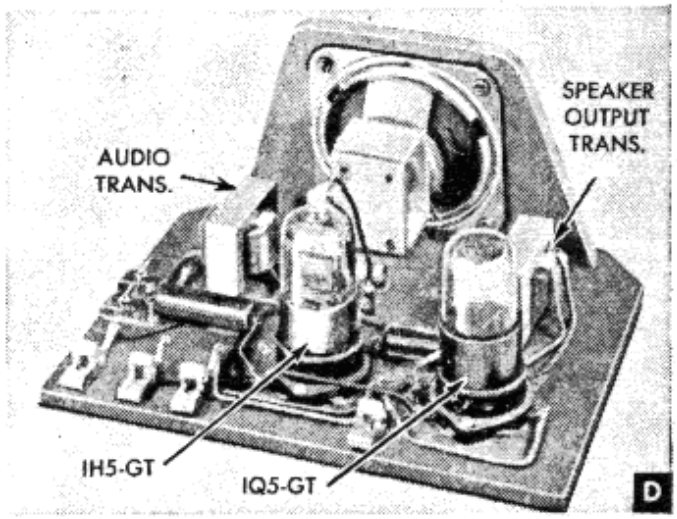


FIG. 2 CRYSTAL RECEIVER

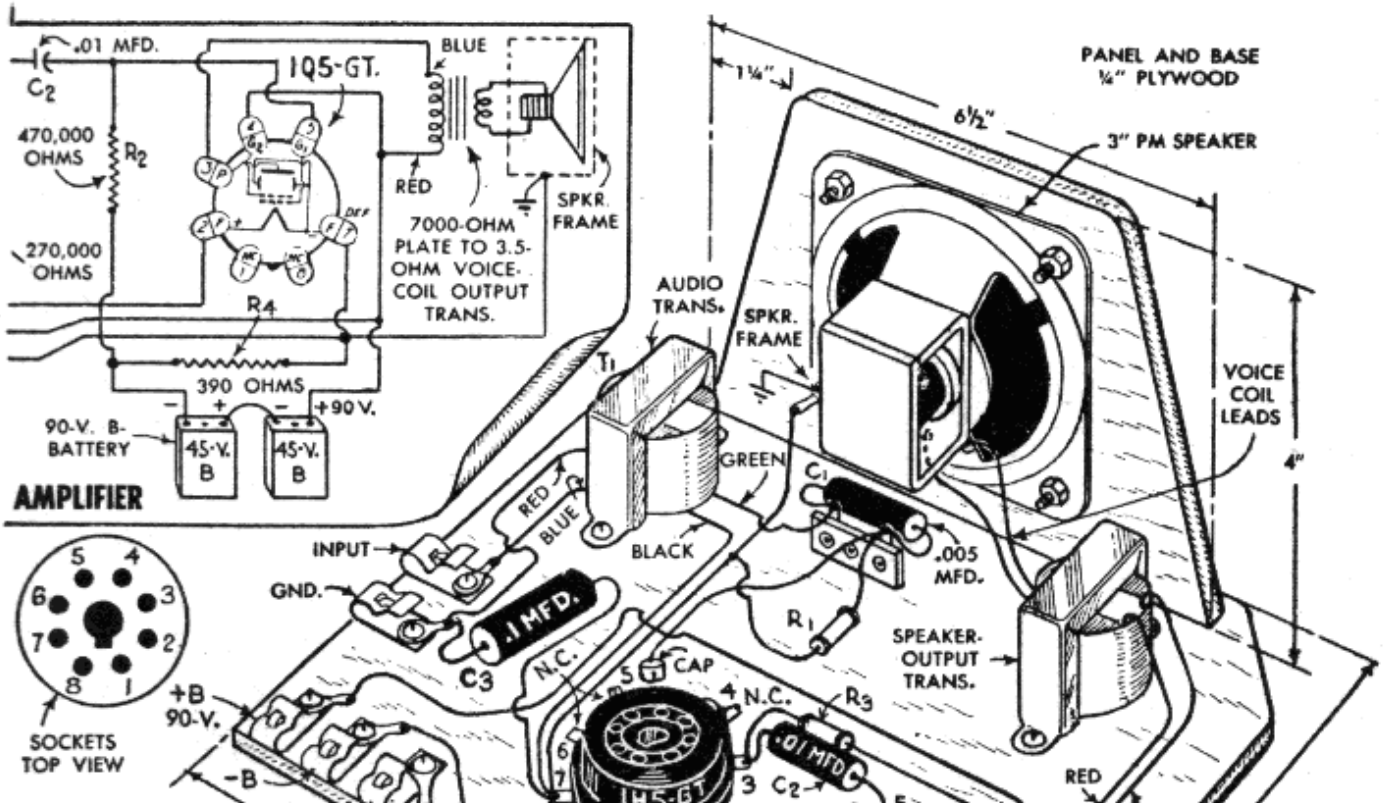
BATTERY-OPERATED AMPLIFIER

matchstick under the turns which are to be tapped; this aids in the removal of the insulation where the leads are to be soldered for switch points at 10, 21 and 50 turns. Later, if you wish to discard the headphones and use a small loudspeaker you can do so by adding the 2-tube audio amplifier shown in photos C and D. The schematic circuit diagram is given in Fig. 3. All construction details for this amplifier unit are shown in the pictorial wiring diagram in Fig. 4. When connecting the units together, the grounded phone terminal on the crystal set connects to the ground clip on the audio amplifier; the insulated phone terminal on the crystal set is then connected to the input-terminal clip on the amplifier. The antenna and external ground leads on the crystal set remain the same. To turn the amplifier "on" and "off" either disconnect the positive (+) A-battery lead, or, insert a large s.p.s.t. toggle switch in this lead. The switch was omitted here to keep cost down to minimum. Two 45-volt B-batteries and a large 1½-volt dry cell A-battery provide power. No volume control is used.


C



D



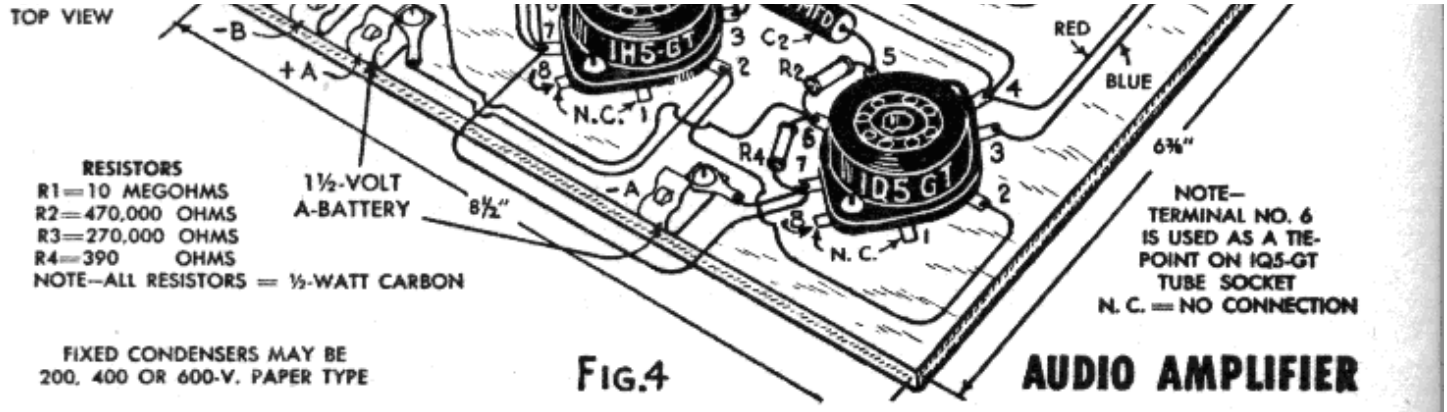
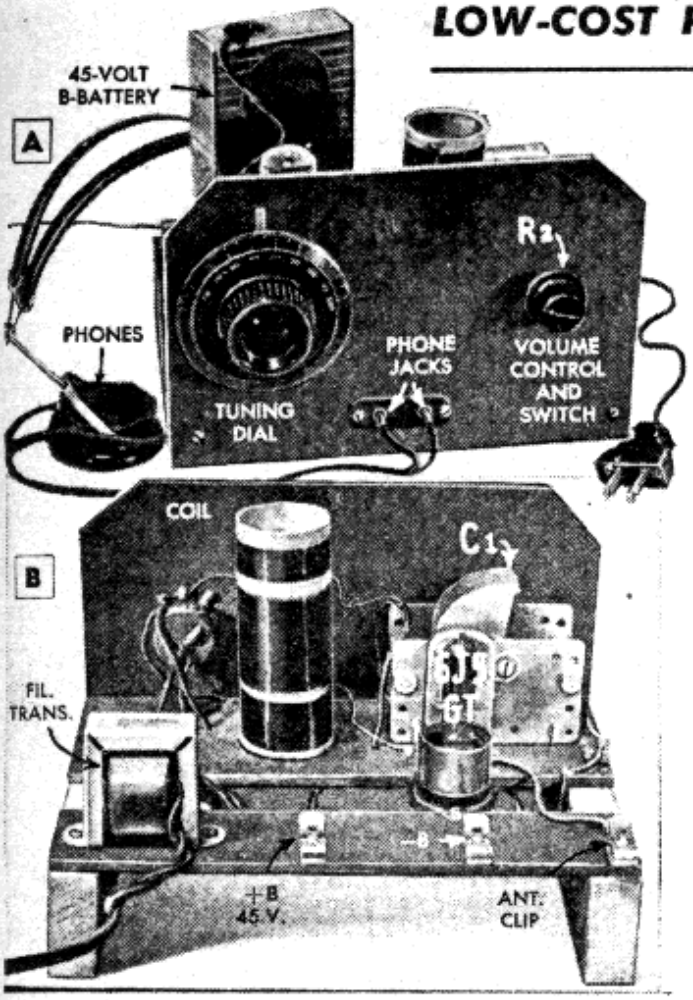


FIG.4

AUDIO AMPLIFIER

LOW-COST PROGRESSIVE RECEIVER



SPECIALLY planned for the beginner, this 1-tube set is easy to build and simple to operate. It employs a type 6J5-GT tube and has sufficient sensitivity to give good headphone reception on standard broadcast stations up to about 400 miles at night. In addition to being an excellent 1-tube receiver in its own right, this little set can be easily converted to a 4-tube a.c. three-band receiver without wasting parts or even making any extensive changes in the layout, other than adding additional sockets, coils and parts. The 4-tube set which is described beginning on page 86 tunes the short-wave bands as well as the broadcast band and has sufficient volume to operate a magnetic speaker at good output. Each set is a complete construction article.

Various views of the first set are shown in photos A, B, C and D; the base and panel details are given in Fig. 1. This set is built up in a semibreadboard layout on a chassis made of pressed wood, with two wooden strips which support the base. Note that the chassis is made in two pieces which permits the tube socket to be mounted without drilling large holes. The schematic circuit diagram appears in Fig. 2, and the simplified wiring diagram in Fig. 3.

The coils are close-wound on the cardboard tube with the number of turns indicated. Punch holes as shown in Fig. 3 so that the start and finish ends of each coil may be threaded in and out to anchor the winding, leaving sufficient wire at each end for the circuit connections. The finished coil is mounted with ordinary china cement. An octal-type tube socket having a metal mounting plate is mounted across the space between the hard-pressed-wood strips. Care must be taken that all tube

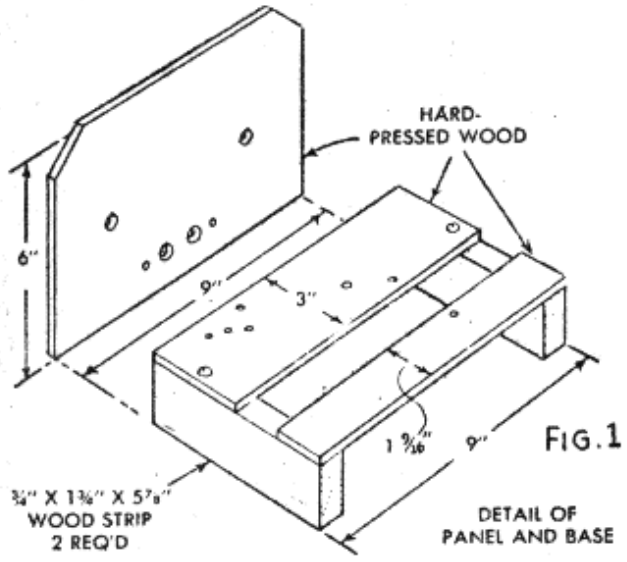
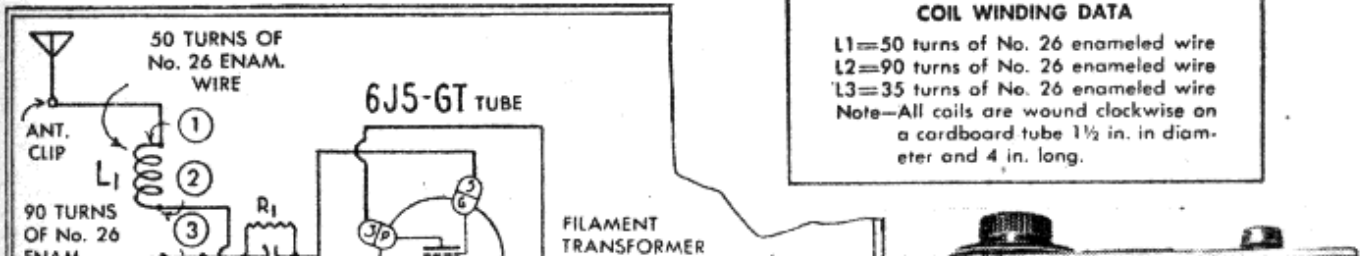
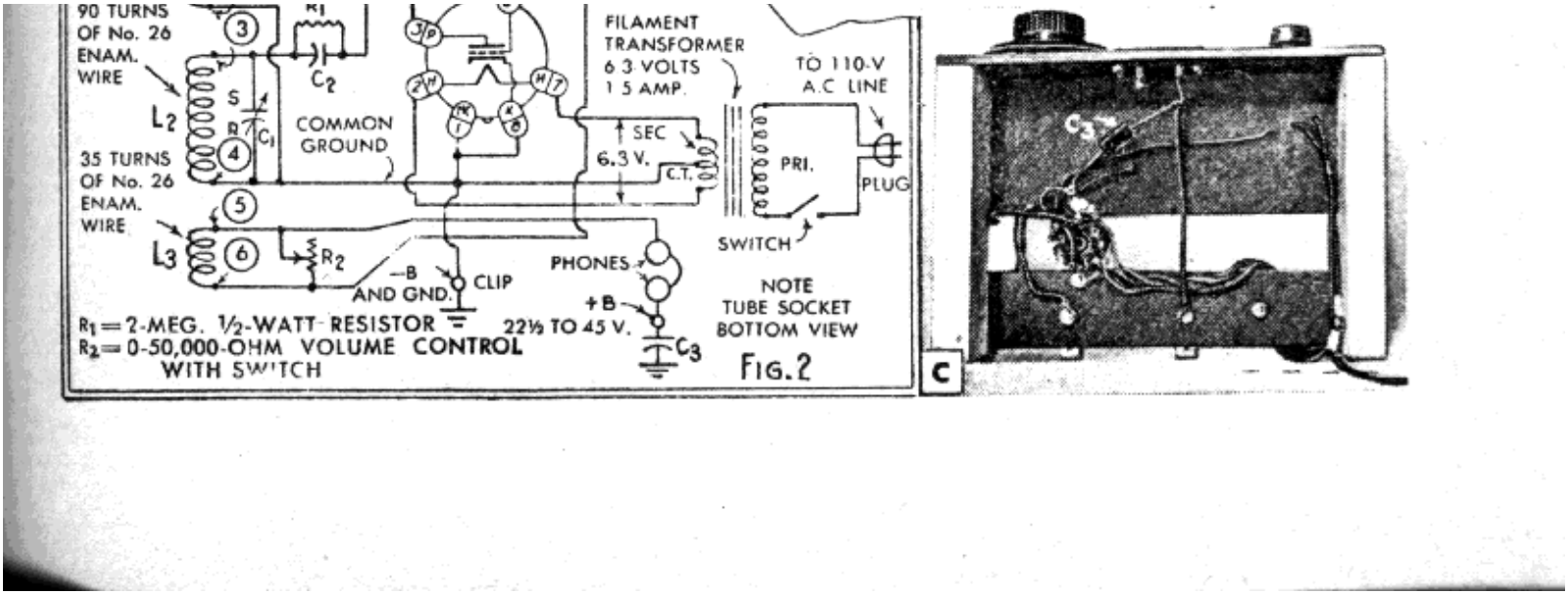


FIG. 1

COIL WINDING DATA

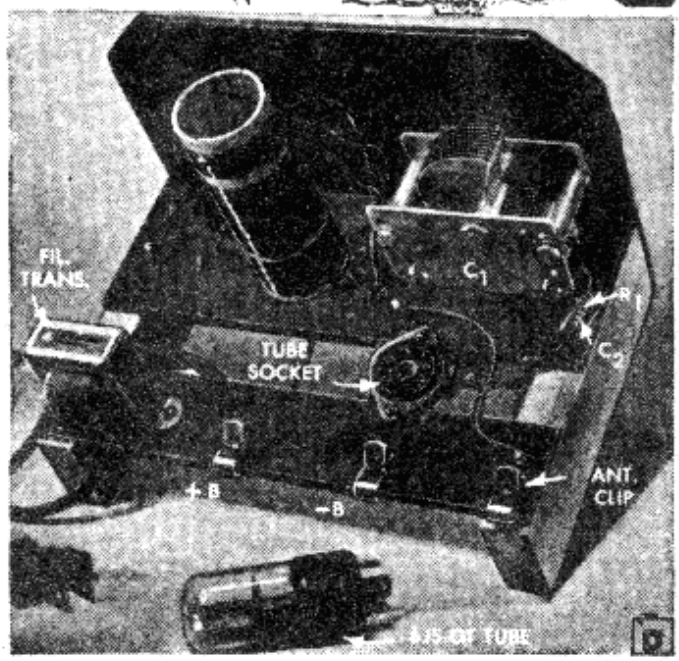
L1=50 turns of No. 26 enameled wire
L2=90 turns of No. 26 enameled wire
L3=35 turns of No. 26 enameled wire
Note—All coils are wound clockwise on a cardboard tube 1½ in. in diameter and 4 in. long.

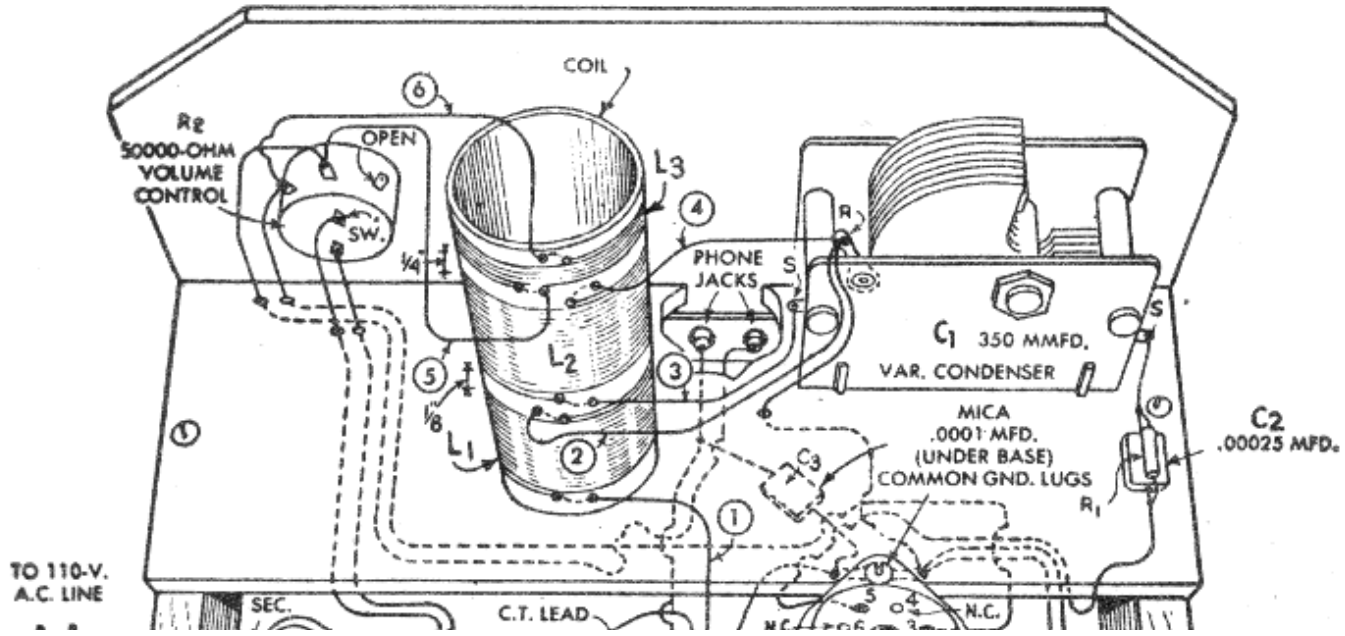



90 TURNS
OF No. 26
ENAM.
WIRE
35 TURNS
OF No. 26
ENAM.
WIRE
L2
L3
C2
C1
R1
R2
COMMON
GROUND
FILAMENT
TRANSFORMER
6.3 VOLTS
1.5 AMP.
SEC
6.3 V.
C.T.
PRI.
TO 110-V
A.C. LINE
PLUG
SWITCH
PHONES
CLIP
-B
AND GND.
+B
22½ TO 45 V.
C3
NOTE
TUBE SOCKET
BOTTOM VIEW
C
R1 = 2-MEG. ½-WATT RESISTOR
R2 = 0-50,000-OHM VOLUME CONTROL
WITH SWITCH
FIG. 2

socket connections are made just as shown. A short metal strap is used to tie down the power cord running to the 6.3-volt filament transformer. Either a 22½ or 45-volt B-battery may be used to supply the plate voltage. The 6.3-volt filament transformer is an inexpensive 1.5-amp., or higher, type listed in all radio parts house catalogues. This is mounted on the rear strip which also carries the Fahnestock clips for the B-battery, ground and antenna leads. The "S" or stator connections on the variable condenser are common lugs on each side; the "R" or rotor lug is directly on the frame. This variable condenser can be any capacity between 350 mmfd. and 500 mmfd.

To test the set, be sure that your line supply is a.c., then plug the line cord into a wall socket; switch on the volume control and turn up this control until you hear a soft "plop" in the headphones. Next rotate tuning condenser C_1 until you hear a whistle, indicating a station. Now back off the volume control until the station comes in clear and loud. An indoor antenna will receive strong local stations but best results will be obtained with a good, high, outdoor antenna. The external ground connection at the negative-B clip can be made on a cold-water pipe or any convenient ground.





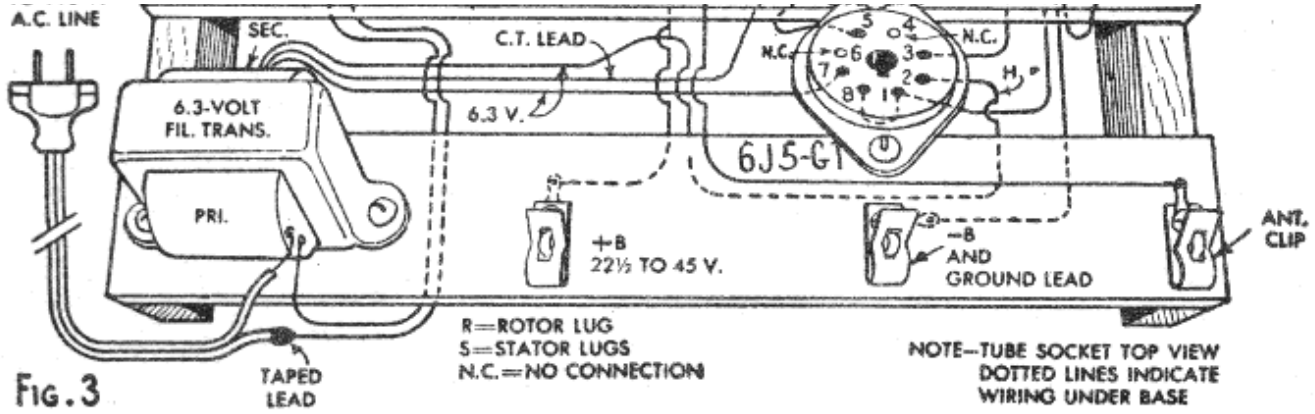
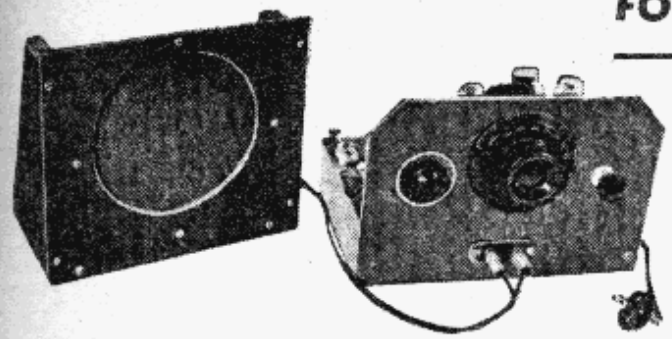
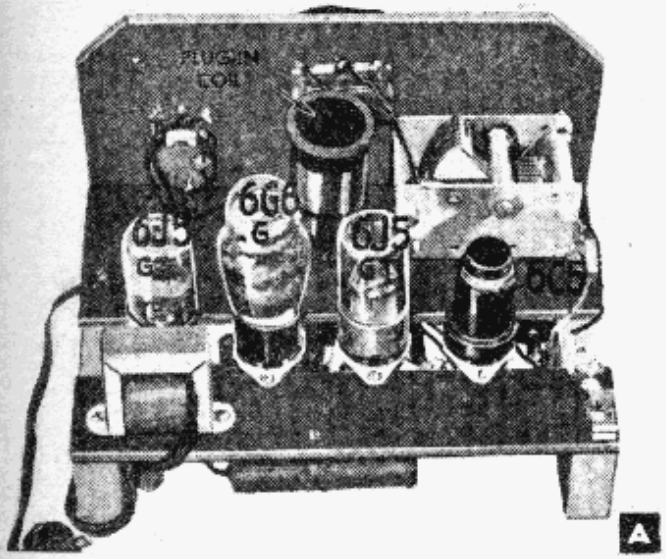

A.C. LINE
SEC.
C.T. LEAD
6.3-VOLT
FIL. TRANS.
6.3 V.
PRI.
6J5-GT
N.C.
N.C.
H
+B
22½ TO 45 V.
-B
AND
GROUND LEAD
ANT.
CLIP
TAPED
LEAD
R=ROTOR LUG
S=STATOR LUGS
N.C.=NO CONNECTION
NOTE--TUBE SOCKET TOP VIEW
DOTTED LINES INDICATE
WIRING UNDER BASE

FIG. 3

FOUR-TUBE PROGRESSIVE RECEIVER

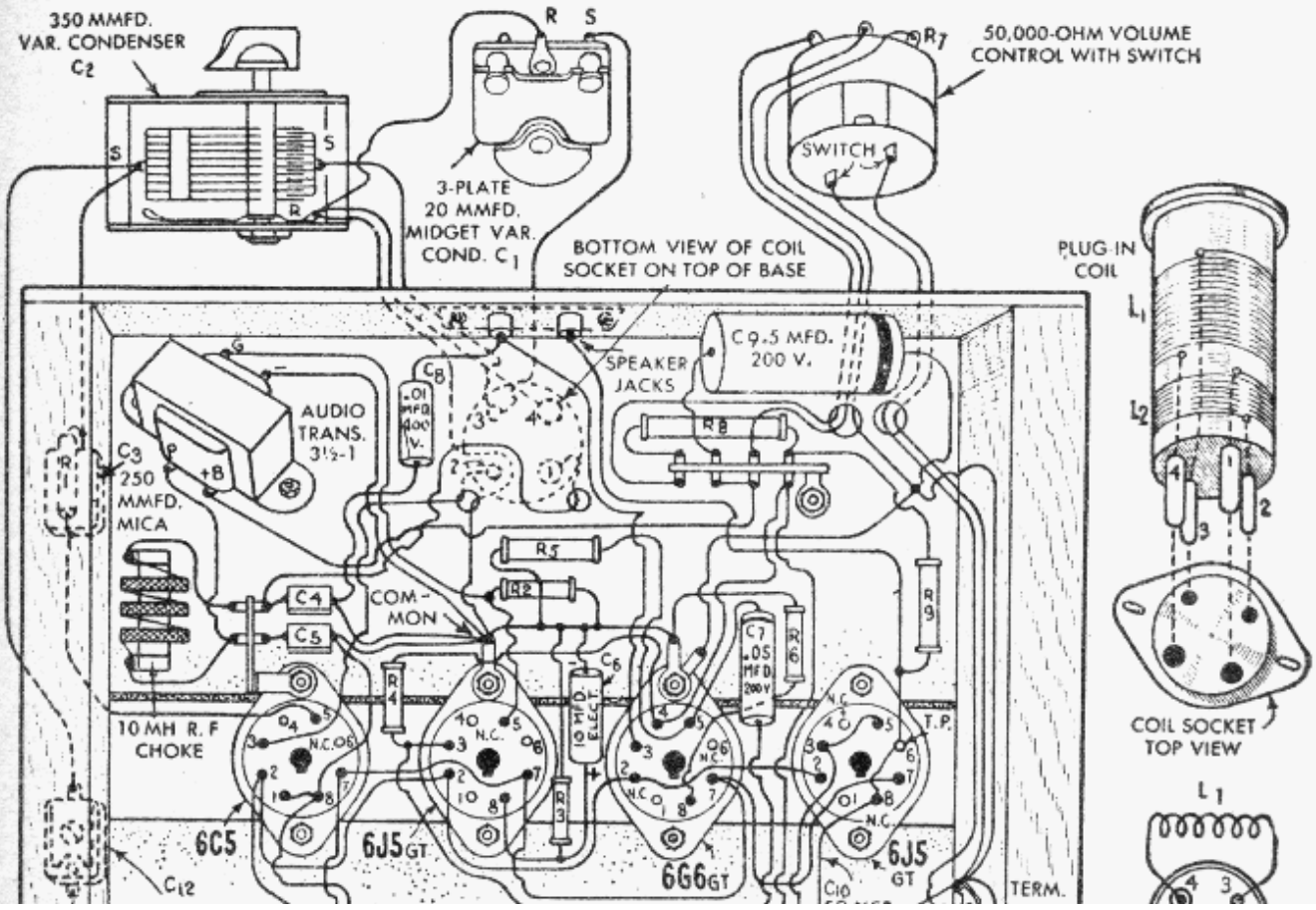




A

ALTHOUGH primarily designed for beginners, this low-cost unit is not intended to be easy. It is entirely different from the one-tube receiver previously described and employs 3 plug-in coils that tune from 550 to 18 meters, or, in other words, from about 545 to 16,670 kilocycles. All parts used in the 1-tube set are renumbered and again specified, except for the coil. The chassis base and panel details are exactly the same. Therefore, those who built set No. 1 will need only the additional tubes, audio transformer, speaker, plug-in coil forms and small parts.

Self-powered by using a 6J5 as a rectifier tube, no B-battery or external ground is used and the set has sufficient audio output to operate a loudspeaker. On the short-wave bands it is an excellent performer, bringing in stations at surprising distances. Placement of parts is not critical but, in order to prevent confusion in wiring, the builders of the 1-tube receiver are advised



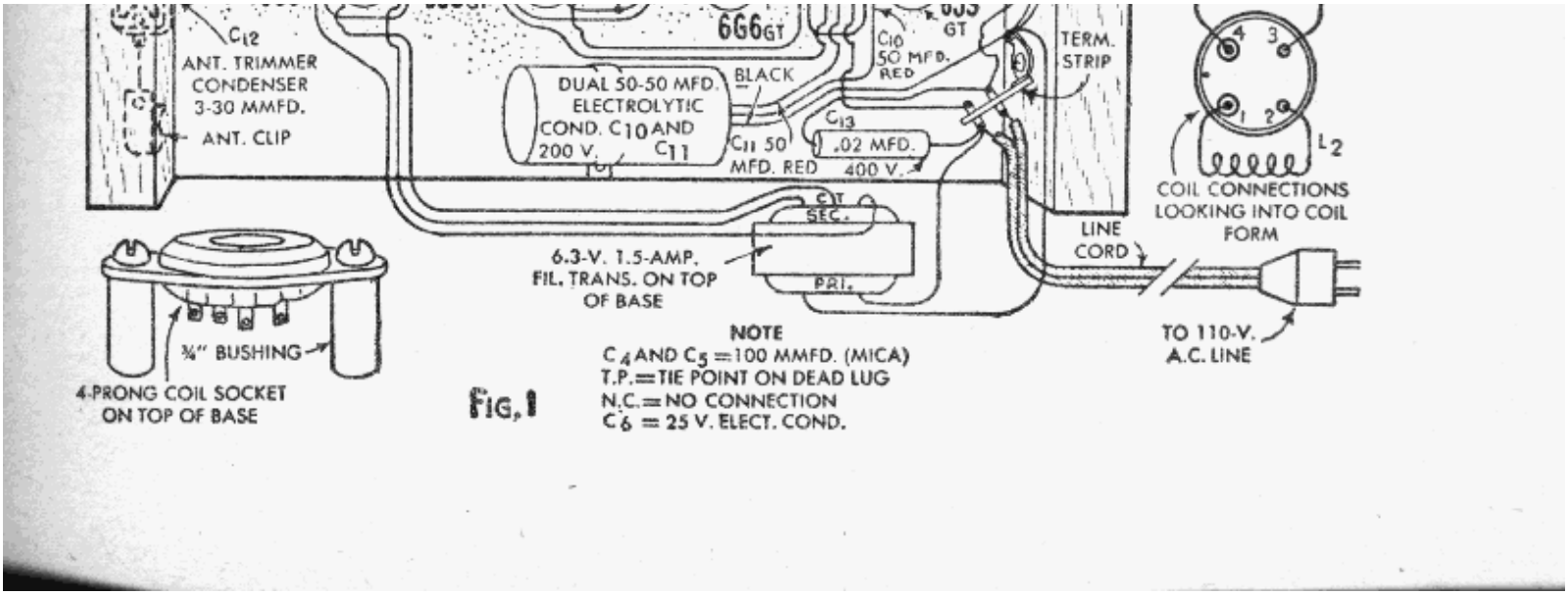


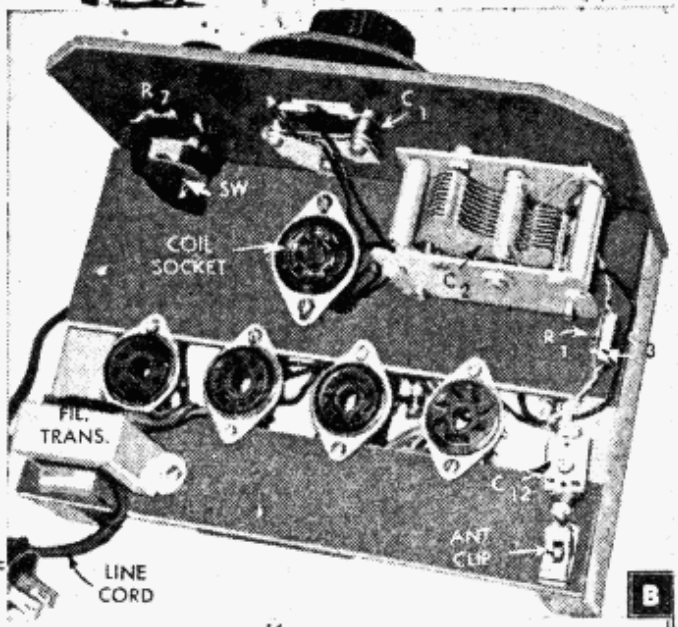
FIG. 1

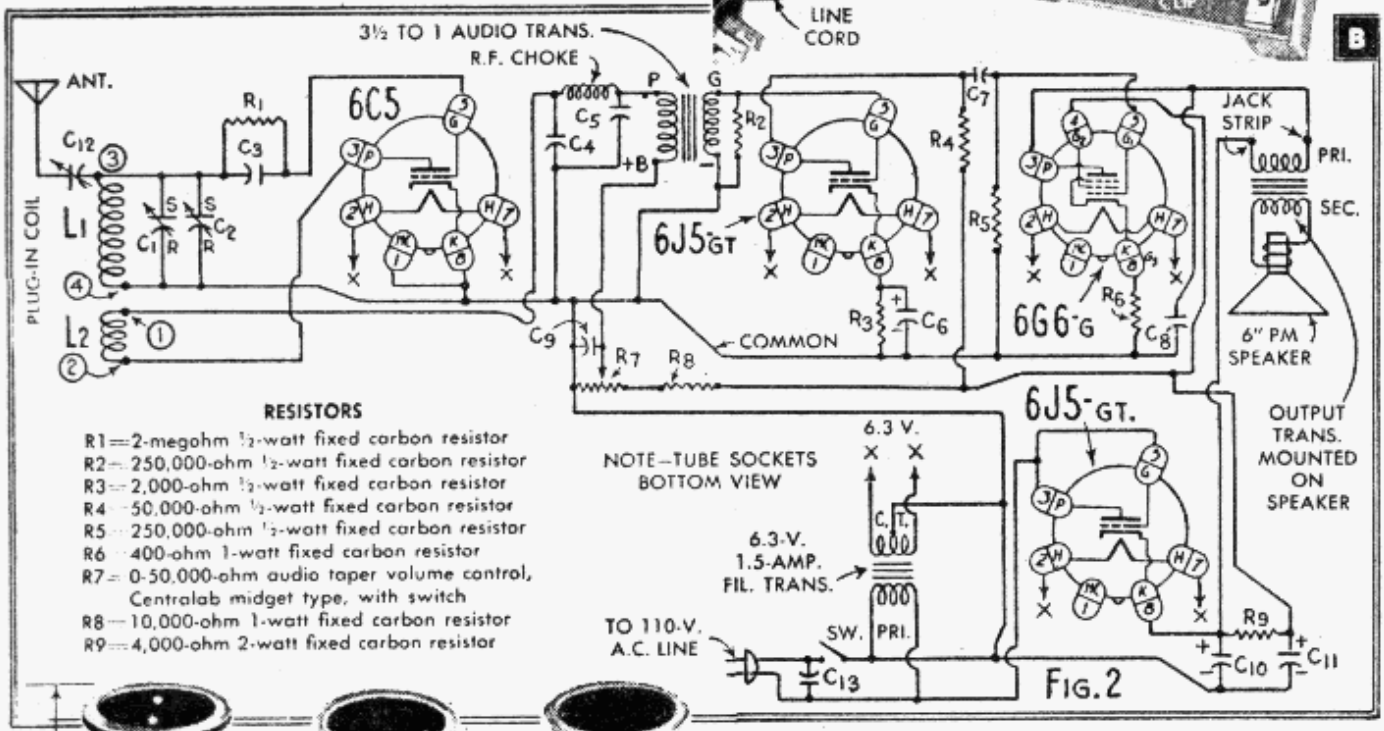
NOTE
C_4 AND C_5 = 100 MMFD. (MICA)
T.P. = TIE POINT ON DEAD LUG
N.C. = NO CONNECTION
C_6 = 25 V. ELECT. COND.

to remove all of the No. 1 set wiring and make a fresh start. The variable condenser, volume control and 6.3-volt filament transformer remain in the same positions.

The separate speaker unit is a 6-in. permanent-magnet type and a universal output transformer is mounted on the speaker. Voice coil connections are made on transformer taps Nos. 1 and 4.

When wiring the set, check each lead with pictorial diagram, Fig. 1, and schematic circuit diagram, Fig. 2. The 3 coils are wound on standard 4-prong plug-in coil forms, and overlap to cover the short-wave radio bands. The hardboard speaker baffle is ⅛ in. by 7 in. by 8 in. For receiving local broadcasting stations a 10-ft. indoor antenna is best for selectivity; an outdoor antenna is best for distance. Condenser C2 is for the broadcast band; it also acts as a band-set condenser for short waves, and is set for the approximate frequency. All fine tuning is done with the small band-spread condenser C1.

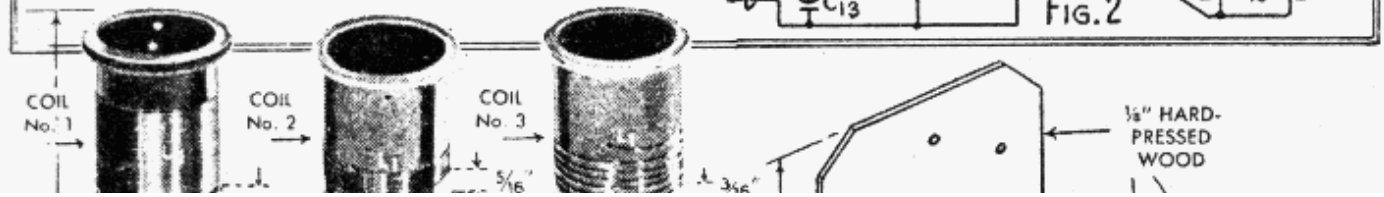


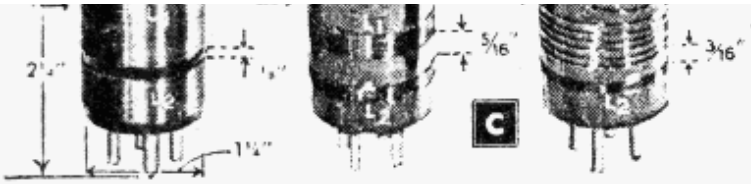


RESISTORS

R1—2-megohm ½-watt fixed carbon resistor
R2—250,000-ohm ½-watt fixed carbon resistor
R3—2,000-ohm ½-watt fixed carbon resistor
R4—50,000-ohm ½-watt fixed carbon resistor
R5—250,000-ohm ½-watt fixed carbon resistor
R6—400-ohm 1-watt fixed carbon resistor
R7—0-50,000-ohm audio taper volume control, Centralab midget type, with switch
R8—10,000-ohm 1-watt fixed carbon resistor
R9—4,000-ohm 2-watt fixed carbon resistor

FIG. 2

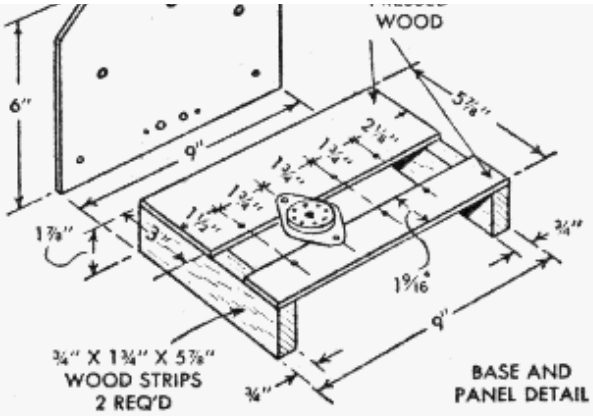




COIL WINDING CHART

Coil No. 1—L1 = 95 turns No. 30 enameled wire (close wound)
L2 = 45 turns No. 30 enameled wire (close wound)
Coil No. 2—L1 = 14 turns No. 26 enameled wire (close wound)
L2 = 9 turns No. 26 enameled wire (close wound)
Coil No. 3—L1 = 6 turns No. 26 enameled wire (space wound)
L2 = 5 turns No. 26 enameled wire (close wound)

Note—Turns for L1 are spaced 1/16 in. on this coil. All coil are wound clockwise, and the windings are anchored with Duco household cement.

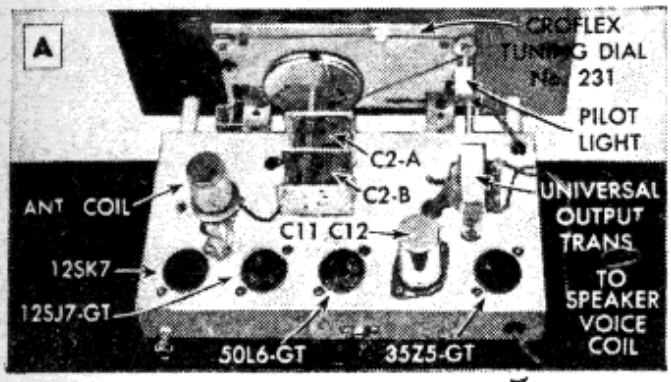


BASE AND PANEL DETAIL

T.R.F. DUAL-PURPOSE RECEIVER

ALTHOUGH simple enough for the beginner, the unusual performance and flexibility of this 4-tube tuned-radio-frequency broadcast-band receiver will interest any experienced builder. The set includes a phono-input jack and may be used as an amplifier for a record player. Furthermore, it makes an excellent AM tuner for a public-address system, or for use with any large audio amplifier and separate speaker. When tested in *Popular Mechanics* radio laboratory, the fidelity and sensitivity were highly satisfactory considering the low cost and simplicity of design.

The most expensive parts are the tuning-dial assembly and the 6-in. PM speaker. An inexpensive 3 or 3½-in., 0-100 flat cir-



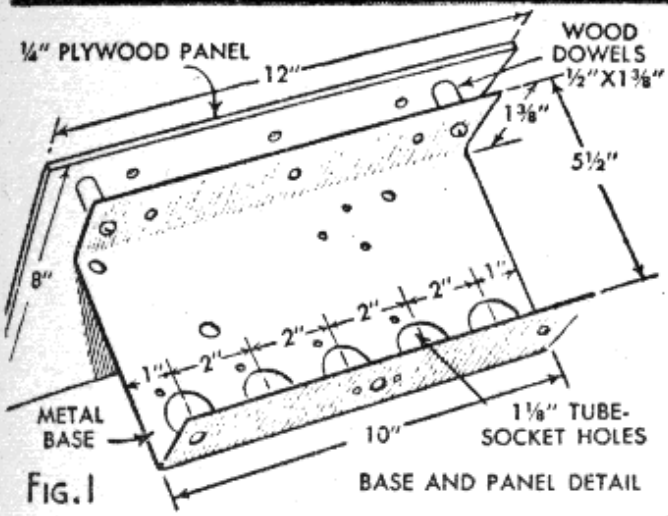
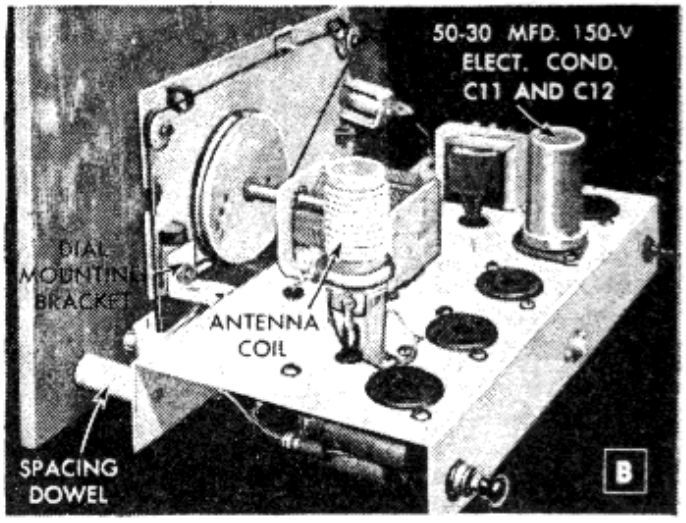


FIG. 1 BASE AND PANEL DETAIL



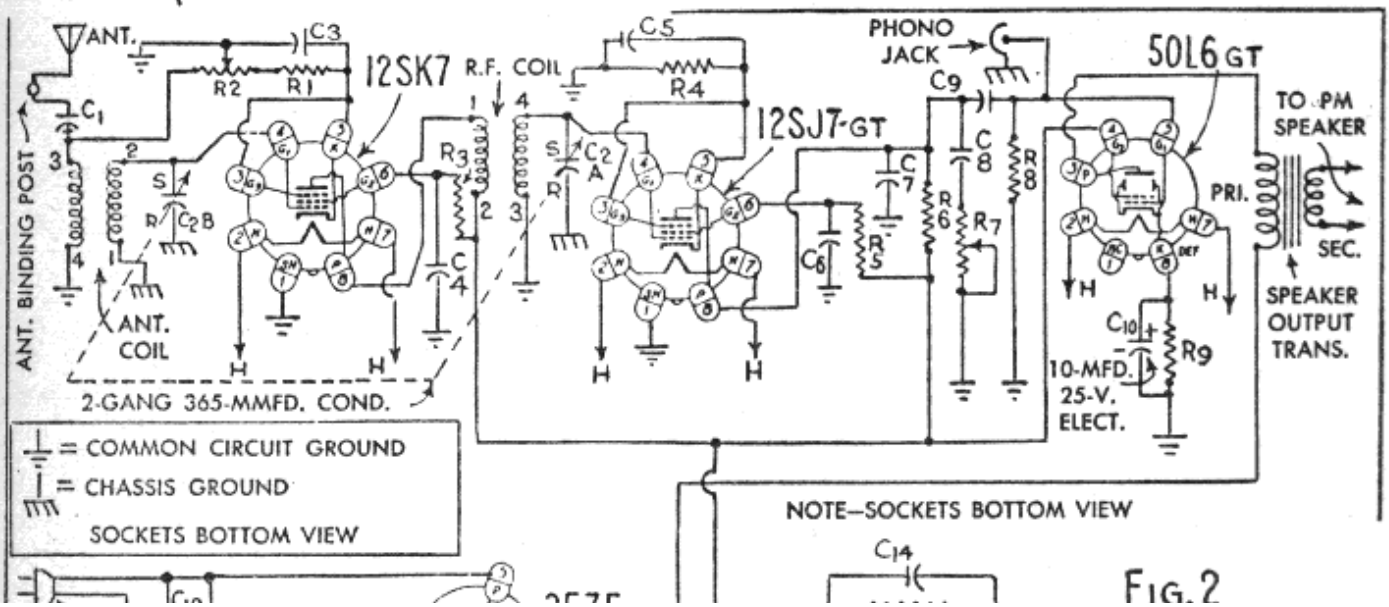


FIG. 2

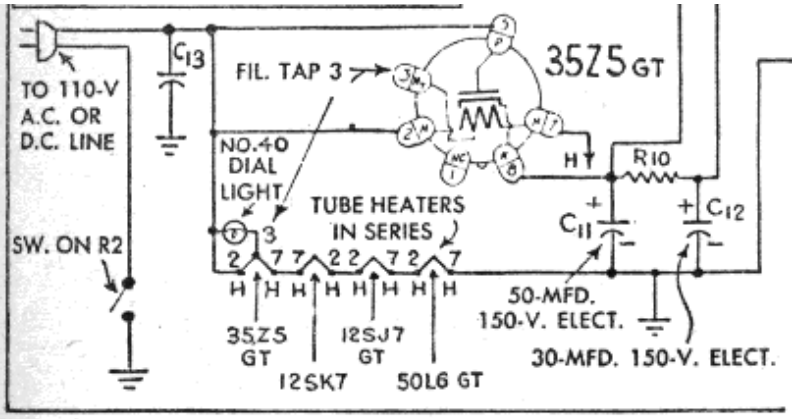


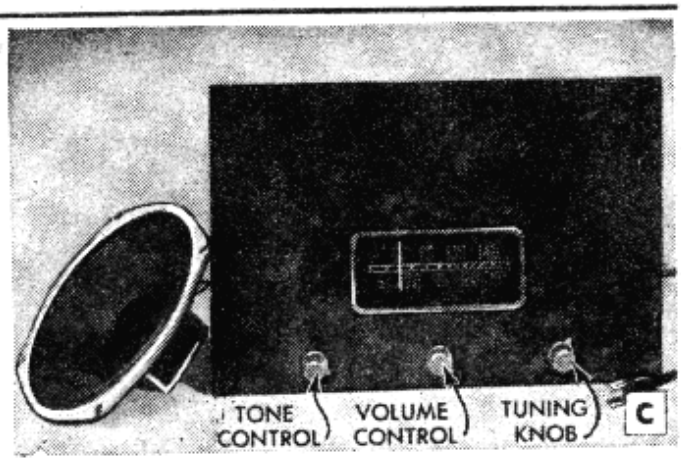
FIG. 2

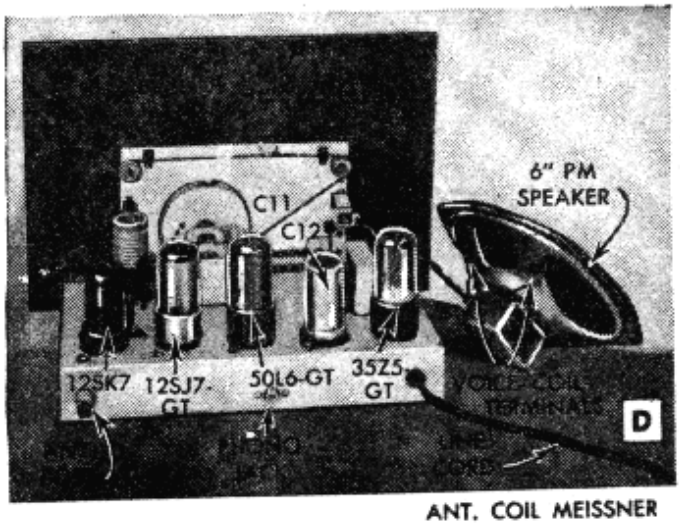
RESISTORS

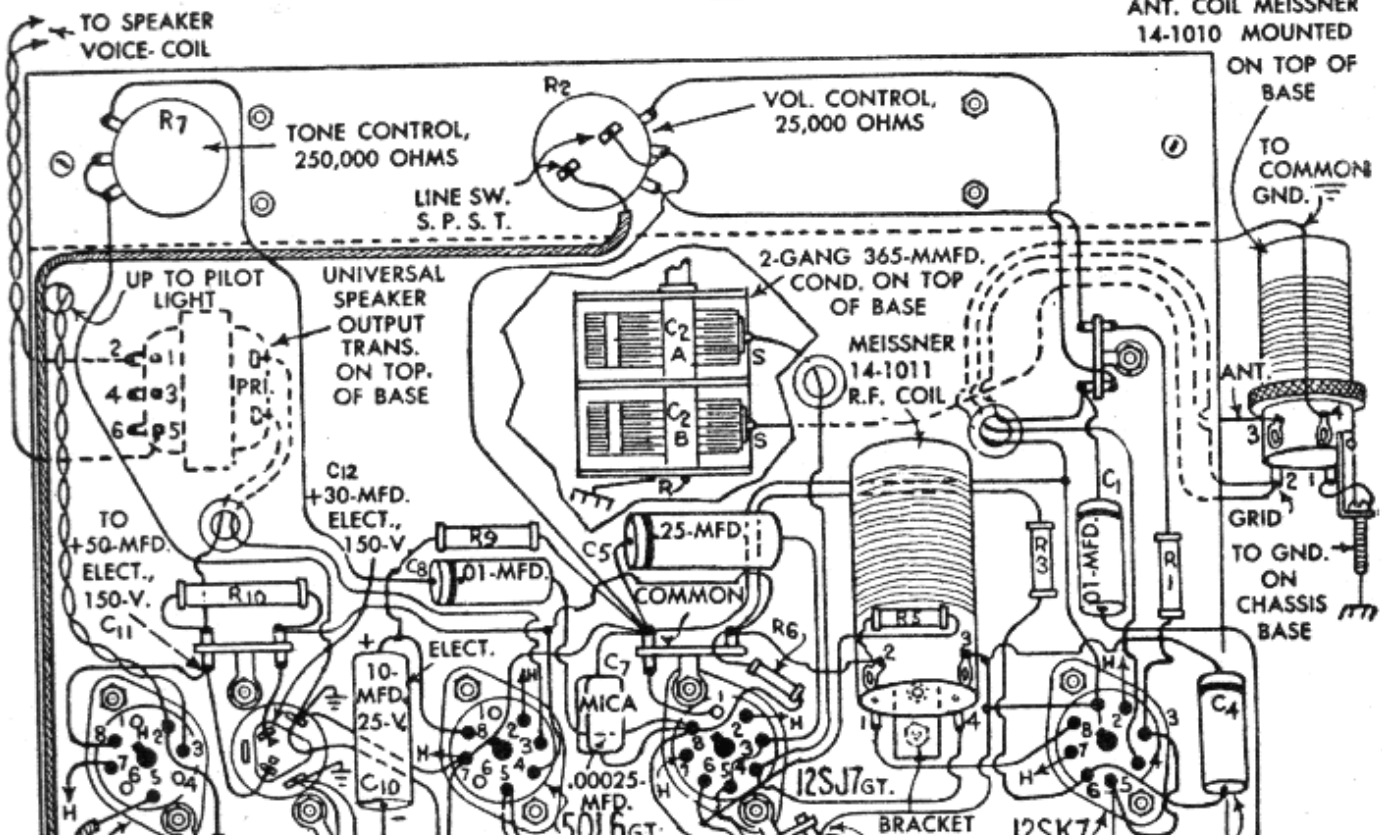
R1 = 330-ohm, 1-watt carbon
R2 = 25,000-ohm volume control audio taper, with switch
R3 = 22,000-ohm, ½-watt carbon
R4 = 47,000-ohm, ½-watt carbon
R5 = 2.2-megohm, ½-watt carbon
R6 = 470,000-ohm, ½-watt carbon
R7 = 250,000-ohm potentiometer for tone control
R8 = 470,000-ohm, ½-watt carbon
R9 = 150-ohm, 1-watt carbon
R10 = 12,000-ohm, 1-watt carbon
R11 = 220,000-ohm, ½-watt carbon

cular-type tuning dial may be substituted for the Croflex No. 231 tuning-dial assembly; both are listed in parts-house catalogues. The 6-in. PM (permanent magnet) speaker is a good size for this set; however, any 4-in. to 8-in. PM speaker that the builder has on hand may be used. The speaker should be mounted on a fairly large baffle in order to obtain good tonal quality. Speaker cabinets and enclosures are available in all standard sizes. Many students and experimenters prefer to construct their own. All parts specified and used in the model are of high grade and were carefully selected to insure good service.

Those who wish to make their own chassis base will find the construction details in Fig. 1. This sheet-metal base may be bent to shape by clamping the metal sheet between two blocks of wood in a vise and using a wooden mallet. The standard-size chassis base supplied by parts houses is 1½ x 5 x 9½ in. These blank bases are available in either 20-ga. steel or in .005-in.-thick aluminum. The location of the parts on the chassis base is not critical but







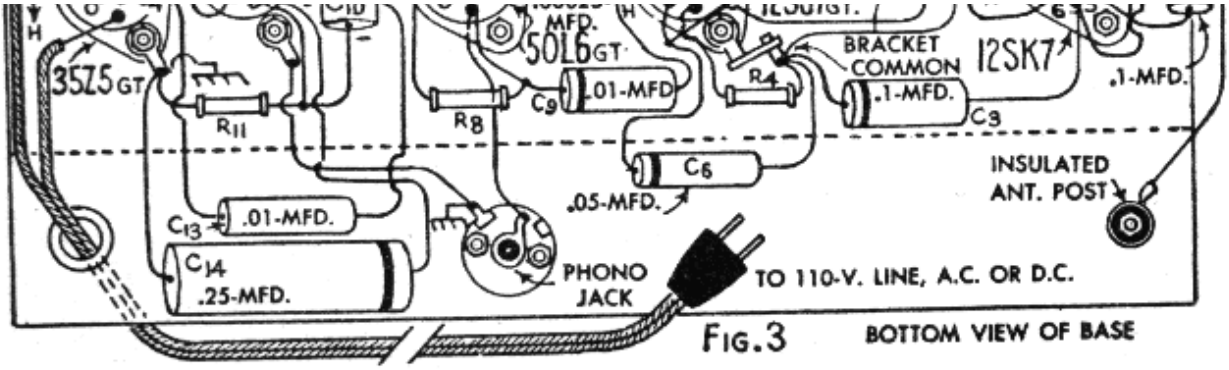
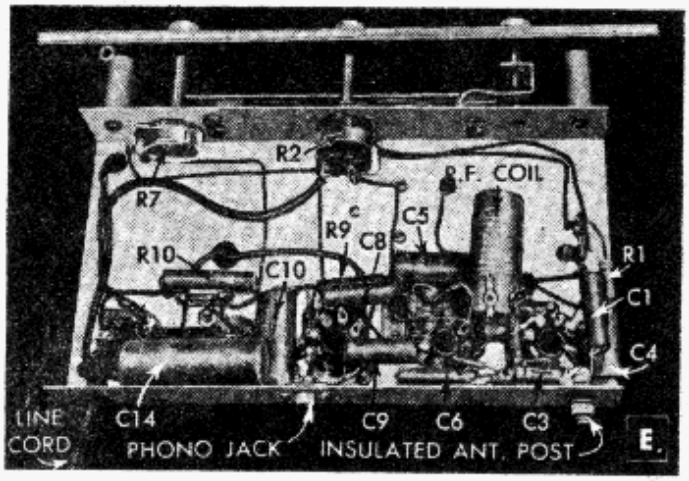


FIG.3 BOTTOM VIEW OF BASE

it is important that the tube sockets be mounted with the center keys in the position shown in the pictorial wiring diagram, Fig. 3. Photos A, B, C, D and E should be carefully studied before beginning construction. All parts are clearly identified in these photos and in the pictorial wiring diagram. Unmarked fixed condensers are 400 volt. Schematic circuit diagram, Fig. 2, carries the same coil-terminal key numbers and both diagrams should be checked as the wiring progresses. Use rosin-core wire solder and make certain that all soldered connections are neat and both mechanically and electrically strong. Please note that the common circuit grounds and the actual chassis grounds are clearly indicated and must be made as shown. No common circuit ground leads should touch the chassis. This entails a little extra wiring but it keeps the metal chassis from ever being "hot."



The antenna and R.F. coils are placed one below and the other on top of the chassis base and they are mounted at right angles to each other so that their corresponding fields will not cause oscillations. It will be noted that the antenna and the R.F. coil grid leads return to common ground while the variable-tuning condenser is to chassis ground; this also helps to prevent oscillations. If the Croflex tuning-dial assembly is not used, it will be necessary to mount the variable tuning condenser on the chassis so that the substituted circular dial will be centered on the front panel. In this case, the small tuning knob shown in the model will not be used. Therefore, the volume control can be shifted to its position to keep all the controls uniform on the ¼-in. walnut-finished plywood front panel. The dial-light bracket and socket are supplied with the Croflex tuning-dial assembly; therefore, if this type of tuning dial is not used, it will be

ed in the positions indicated, their terminal-numbering arrangement is as shown in the pictorial wiring diagram, Fig. 3. These standard coils are highly efficient, readily available, and should be used. The antenna coil is No. 14-1010 and the R.F. coil is No. 14-1011. The universal speaker-output transformer is a Stancor No. A-3856; the speaker voice-coil connections are made to secondary terminals 2 and 5 as the 50L6 tube should have a load impedance of about 2000 ohms.

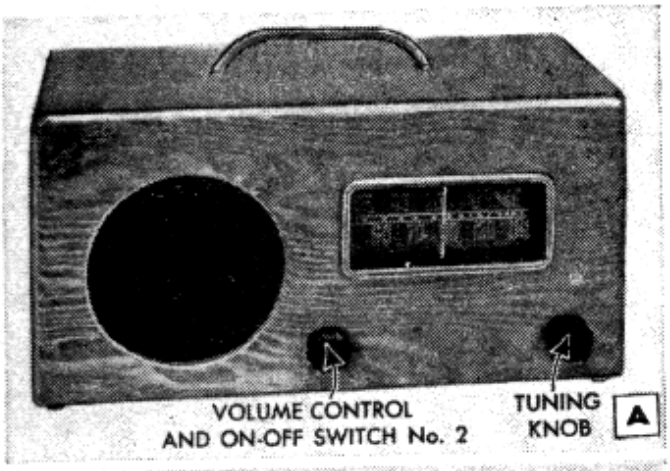
If oscillations occur on the high end of the band when lining up the set after it is completely wired, it may be necessary to remove the "gimmick," which is a single-turn wire connected to the primary and wound around the secondary of the antenna coil. Merely clip it off where it is connected to the primary. When aligning the set, adjust the trimmers on the variable tuning condenser C2-A and C2-B on a station at the high end of the broadcast band for maximum output. Then adjust them at the low end of the band for maximum output. Again return to the high end to see if maximum output is still obtainable. If not, reach a medium between the high and low ends. An indoor or outdoor antenna may be used depending upon location. Where there are a number of powerful broadcasting stations, a 15 or 20-ft. indoor antenna may be used. For distant reception, a good outdoor antenna will give the best results. No external ground wire should be used on this a.c.-d.c. receiver.

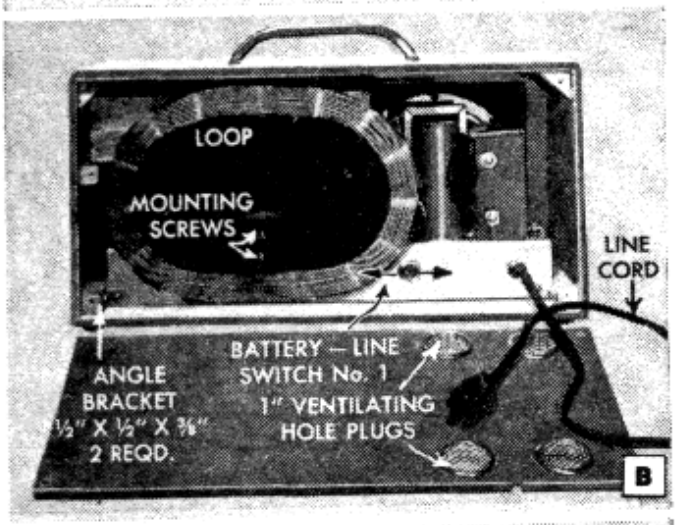
If the set is to be used as a tuner in connection with a large amplifier and speaker, turn the set volume control to maximum to keep hum level at the lowest possible point. Volume is then controlled at the larger amplifier in the usual manner. Also when you use this receiver as a tuner in connection with a larger amplifier and speaker

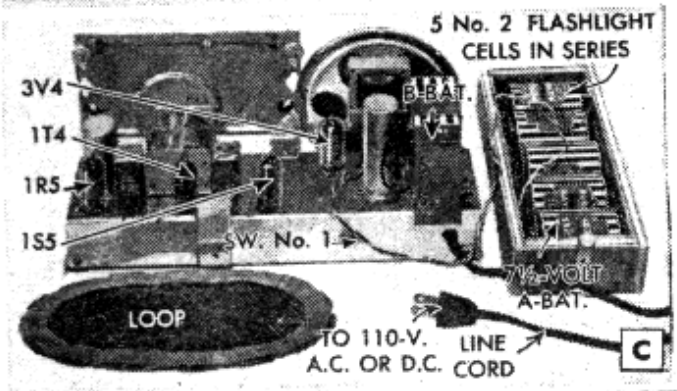
tuning-dial assembly; therefore, if this type of tuning dial is not used, it will be necessary to purchase a dial-light bracket with a screw-base socket and jewel and mount it on the plywood front panel at any convenient point. A good location would be at the upper left-hand corner when facing the panel. If the Croflex dial is used, the builder will find that complete assembly instructions come with it. The Meissner antenna and R.F. coils are provided with mounting brackets; when they are mount-

you use this receiver as a tuner in connection with a larger amplifier and speaker, remove the set speaker and replace it with a 5-ohm, 5 or 10-watt wire-wound resistor. Use a shielded connecting lead with a phono plug and ground the shield on the plug cap. Connect this lead to the phono jack on the set and to the input of the large amplifier. Adjust the set volume control and the amplifier volume control for the desired volume and lowest possible hum level.

THREE-WAY PORTABLE SUPER

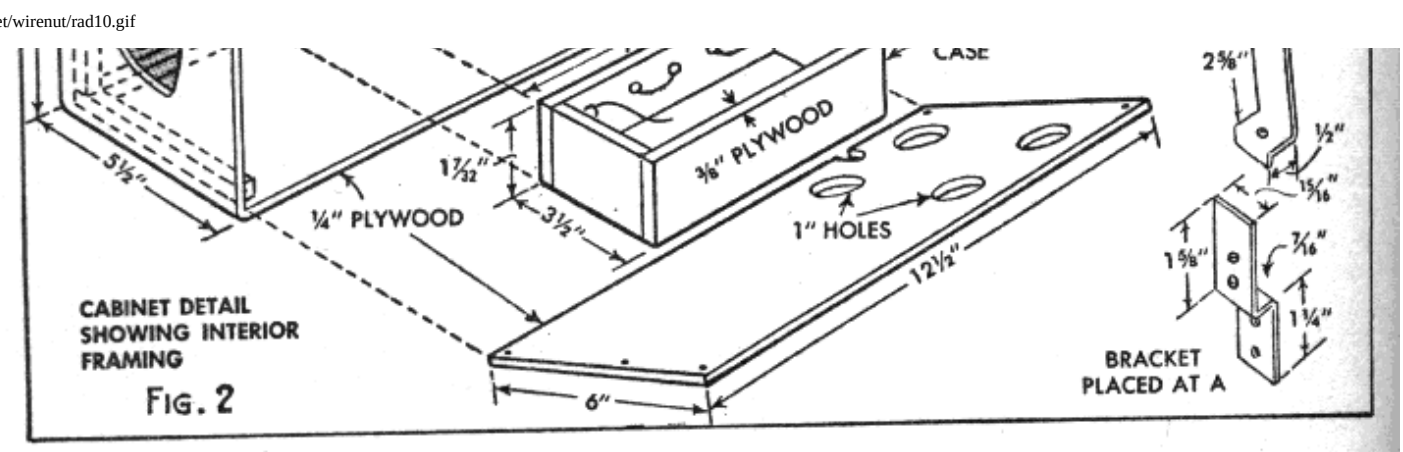






FULL 5-tube performance is obtained with this versatile 4-tube portable receiver because no rectifier tube is employed. A 100-ma. Federal selenium 5-plate rectifier converts a.c. to d.c. when operating from 110-volt lines. The switching circuit from battery to a.c.-d.c. operation is quite simple. It is done by means of a double-pole, double-throw toggle switch located on the rear of the chassis base. No special parts are used and all the components are available from radio parts houses for this compact 3-way portable vacation receiver.

Although definitely not designed for beginners, construction is not difficult if the builder uses care in placing the major component parts in the proper positions on the base so that all leads may be kept as short as possible. The miniature i.f. transformers are provided with color-coded lugs on the bottom. A red dot indicates a "B plus" connection, a blue dot the plate, a green dot the grid or diode-plate connection. A black dot identifies the ground or AVC terminal lug. The miniature tube sockets are 7-pin Amphenol No. 147-500 type. A metal shell in the center of each socket acts as a shield and may be used for a common ground tie



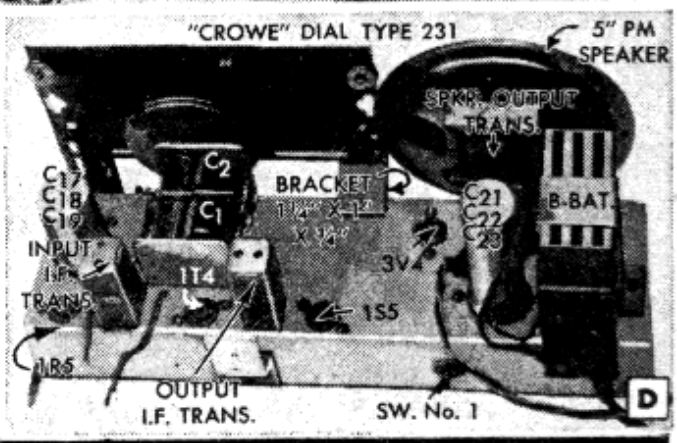
CABINET DETAIL SHOWING INTERIOR FRAMING

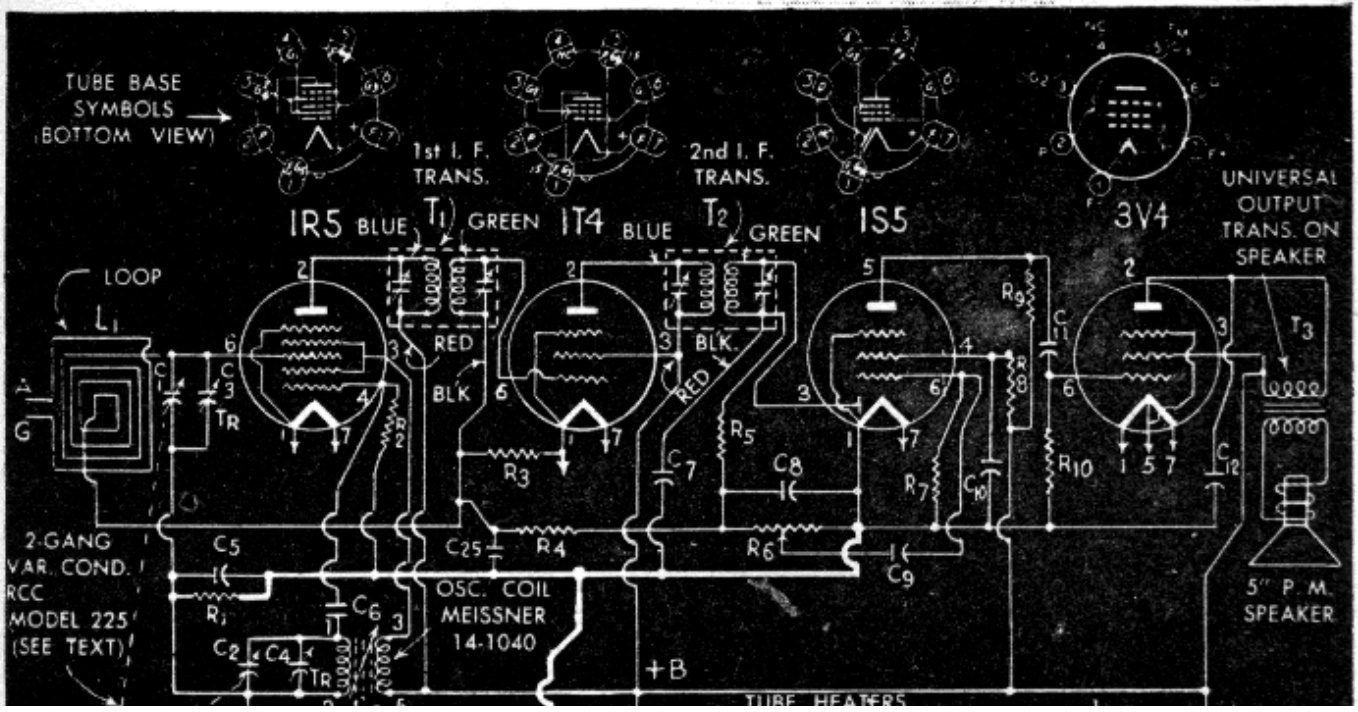
FIG. 2

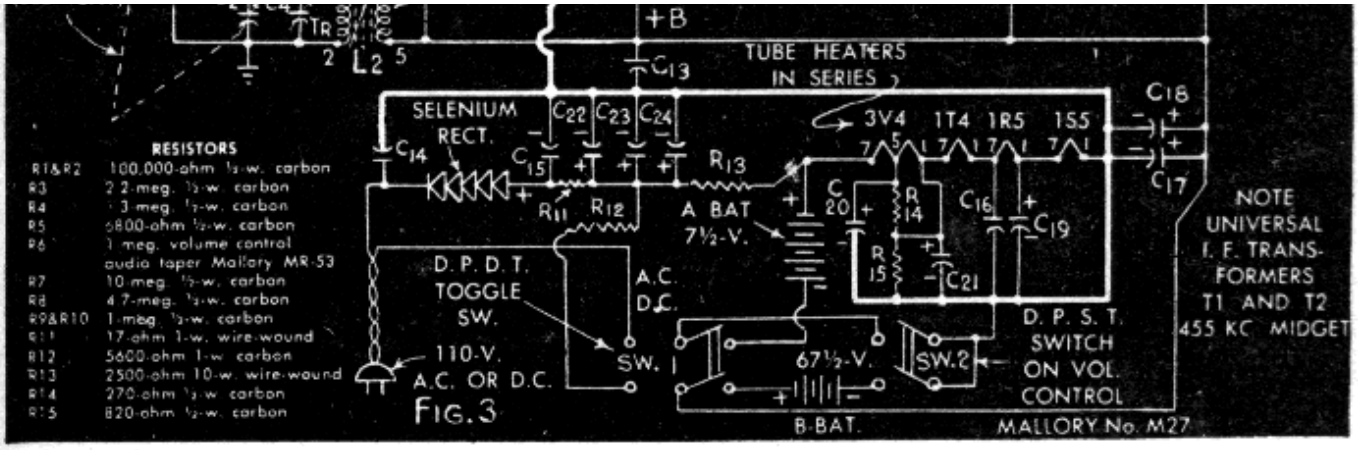
THREE-WAY PORTABLE SUPER

point. The 1/16-in. sheet-aluminum chassis base is detailed in Fig. 1. This base is quite simple and may be formed over a block of wood clamped in a vise. The brackets are cut from the same material. Photos A, B, C, D and E show various views of the completed set.

Wire the filament circuit and filament supply first, and keep all wiring short and as close to the chassis as possible. Leave the tubular paper condensers and resistors






+B
TUBE HEATERS IN SERIES
SELENIUM RECT.
3V4
1T4
1R5
1S5
A BAT 7½-V.
D. P. D. T. TOGGLE SW.
A.C.
D.C.
110-V. A.C. OR D.C.
SW. 1
67½-V.
SW. 2
D. P. S. T. SWITCH ON VOL. CONTROL
B-BAT.
MALLORY No. M27
NOTE UNIVERSAL I. F. TRANSFORMERS T1 AND T2 455 KC MIDGET
RESISTORS
R1&R2 100,000-ohm ½-w. carbon
R3 2.2-meg. ½-w. carbon
R4 .3-meg. ½-w. carbon
R5 6800-ohm ½-w. carbon
R6 1 meg. volume control audio taper Mallory MR-53
R7 10-meg. ½-w. carbon
R8 4.7-meg. ½-w. carbon
R9&R10 1-meg. ½-w. carbon
R11 17-ohm 1-w. wire-wound
R12 5600-ohm 1-w. carbon
R13 2500-ohm 10-w. wire-wound
R14 270-ohm ½-w. carbon
R15 820-ohm ½-w. carbon
FIG. 3

until all other wiring is completed. The schematic circuit diagram appears in Fig. 3. Use No. 20 or smaller hookup wire and rosin-core wire solder for the circuit. As the terminals on the tube sockets are small and may require several connections, care must be taken in soldering. Be careful that excess solder does not run down the terminals, touch another terminal or the chassis to cause a short. Always connect the outside foil of paper-type condensers to common ground when they are used as screen by-pass or AVC filter condensers; for fixed condenser values see Fig. 4. The Crowe dial comes with complete instructions for stringing the dial and cutting the panel hole in the cabinet. Complete details for the cabinet and A-battery case are given in Fig. 2. The cabinet is constructed of ¼-in. plywood and strips of ½ by ½-in. pine. All joints are glued and nailed with brads. The cabinet is given a thin coat of shellac, then stained any desired color. The final finish coat is a flat lacquer which is later polished with a heavy coating of paste floor wax. The handle is a dime-store chrome drawer pull. The A-battery case must slide easily in and out of the cabinet to prevent injury to the dial mechanism. Five 1½-volt No. 2 flashlight A-batteries are connected in series either by directly soldered connections, or phosphor-bronze spring clips, if preferred. To change the A-batteries, remove the two control knobs on the front and the two small angle brackets at the back of the chassis and pull the receiver partially out of the cabinet. Have the A-battery leads long enough to remove the case and be careful that they do not short on the chassis or any other wires or terminals in the set. Snap-clip leads are used on the 67½-volt B-battery. All tubes must be in their sockets when this set is operated on the 110-volt line. The A and B-batteries need not be in place but tape their leads to prevent shorts. To place the set in operation, throw switch No. 1 to the position for the type of power used and then turn on switch No. 2. The set will begin to play as soon as a station is tuned in. Very little adjustment of the i.f. transformers is required as they are pre-tuned

CONDENSERS (Fig. 4)

1—Two-gang variable condenser with cut-plate oscillator section Radio Condenser Corporation model 225, type CN825171 C1, C2 and trimmers C3, C4

7—.05-mfd. 400-v. paper-type condensers C5, C10, C13, C14, C15, C16 and C25

1—50-mmfd. mica-type condenser C6

2—100-mmfd. mica-type condensers C7 and C8

2—.01-mfd. 400-v. paper-type condensers C9 and C11

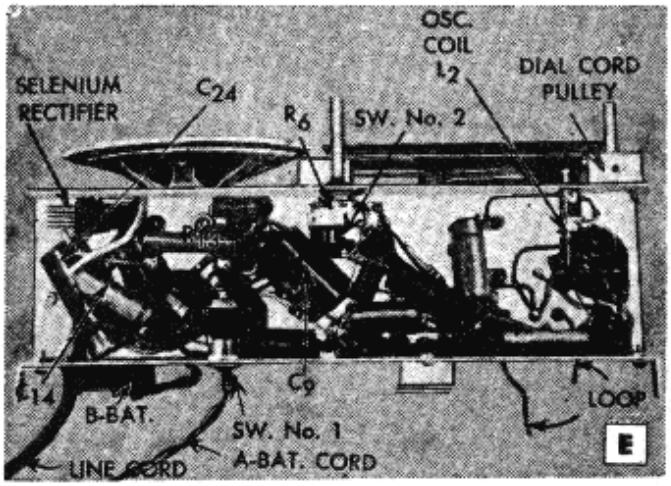
1—.005-mfd. 400-v. paper-type condenser C12

1—Mallory-type FP302 electrolytic condenser unit: 15-15 mfd. 150-v. C17 and C18; 1000-mfd. 2-v. C19

1—50-mfd. 25-v. electrolytic condenser C20

1—Mallory-type FP309 electrolytic condenser unit: 100-mfd. 25-v. C21; 50-mfd. 150-v. C22; 30-mfd. 150-v. C23. Note—both Mallory units have 3 sections

1—50-mfd. 150-v. electrolytic condenser C24

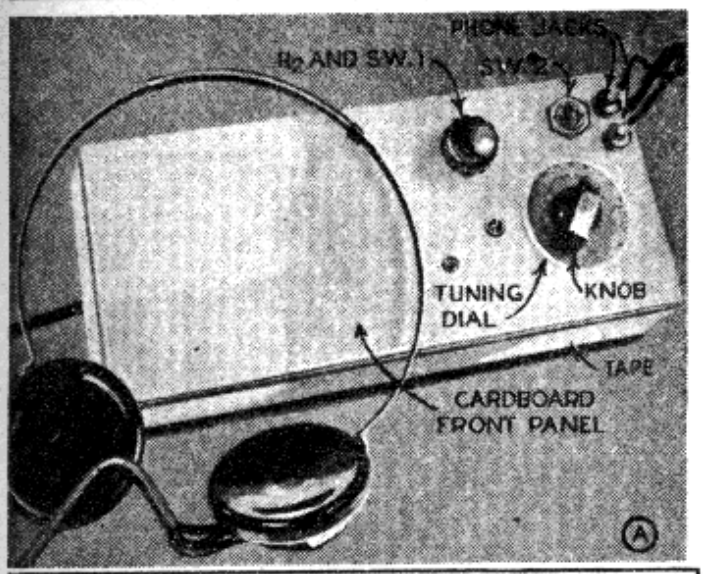


170.7 to 8.7-mmfd. oscillator section C2, until the reading is correct. The oscillator coil has a powdered iron-core slug that will now have to be adjusted with a small screwdriver to secure the proper dial readings in the middle of the dial. These last adjustments may have to be repeated several times to insure proper tracking over the entire dial. Finally adjust trimmer condenser C3 on section C1 of the 2-gang condenser for maximum volume; the capacity of the 27-plate section C1 is 431 to 11 mmfd. Terminals A and G on the loop antenna are for external antenna and ground connections if required in remote locations

Very little adjustment of the i.f. transformers is required as they are pre-tuned at the factory. Tune the set to a station at about 600 kc. and adjust the i.f. trimmer condensers for maximum volume. Loosen the dial drum on the variable-condenser shaft and move the dial pointer so that it reads the frequency of the station tuned in. Now tighten the dial drum and tune in a station at about 1400 kc. and check the frequency of the station on the dial. If it is not correct, adjust trimmer C4 and the 19-plate

are for external antenna and ground connections if required in remote locations. Two short machine screws are used to mount the loop on the rear chassis bracket. This makes an excellent three-way superheterodyne portable receiver for the experienced builder, and it is ideal for advanced radio classes working under supervision of an instructor. If parts specified are used, and care is taken in construction and wiring, the receiver will be highly satisfactory.

TWO-TUBE "POCKETTE" PORTABLE



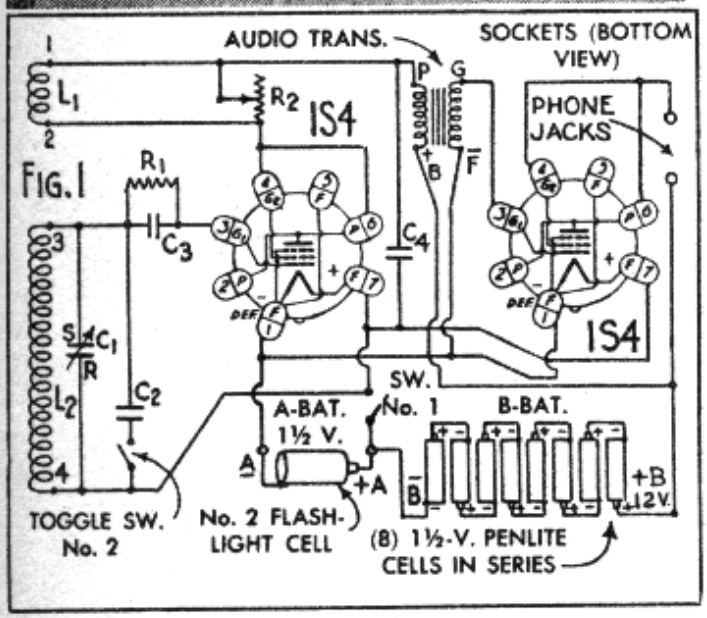
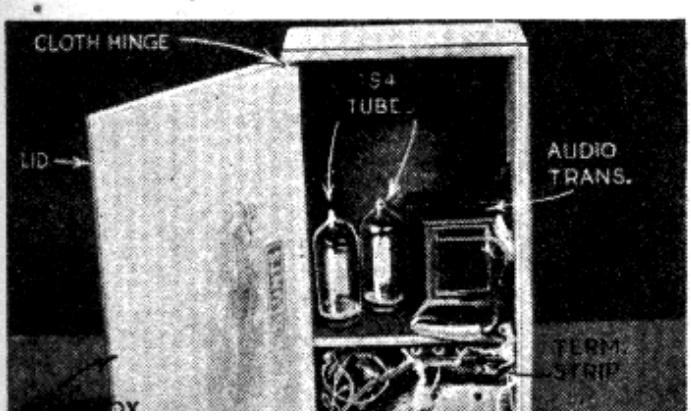


FIG. 1

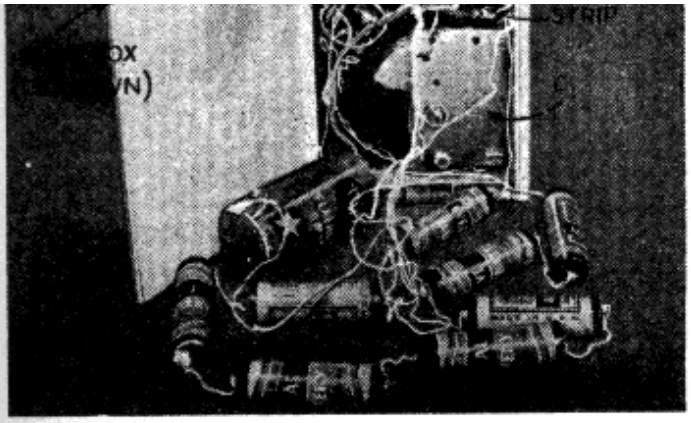
R1=2 meg. ½ watt resistor
R2=0-10,000-ohm vol. control
C1=350 mmfd. var. condenser
C2, C3 and C4=.00025 mfd. mica or paper type
L1=15 turns No. 24 d.c.c. wire
L2=20 turns No. 24 d.c.c. wire
Note—Either No. 22, 24 or 26 wire may be used



ALTHOUGH slightly larger than some of the new subminiature-tube pocket receivers, this two-tube personal-type receiver is still small enough to slip into your coat pocket, with just enough extending out the top for tuning purposes. Using a built-in loop antenna and operating without external connections this pocket set brings in local broadcasting stations with excellent volume and clarity for a small portable 2-tube receiver. It also includes a high-low switch and fixed-condenser tuning arrangement with the result that it tunes all of the broadcast band with an additional range on both ends of the dial.

Designed for the student experimenter and built from odds and ends of spare parts, it is easy to duplicate. All parts specified are to be found in any radio catalogue. The variable condenser C1 is a midget type that can be any capacity from 350 to 500 mmfd. Despite its small size this set employs a tiny chassis base or tube-mounting panel of hard-pressed wood. This helps to keep the leads short and supports the tube sockets firmly. The schematic circuit diagram, Fig. 1, and simplified wiring diagram, Fig. 2, show all construction details. The builder should check each wiring detail with both diagrams in order to avoid errors.

Two type 1S4 miniature tubes are employed in a standard regenerative circuit. It consists of a regenerative detector transformer-coupled to a single audio output stage. The oustanding feature of the "pockette" set is the coil, which consists of two windings made directly on the outside of the wooden case. This coil provides a loop antenna for reception and, like all loops, it is directional. Although No. 22 cotton-covered wire is preferred, any small wire such as No. 24 or No. 26 may be used. In this model No. 24 d.c.c. wire was used for the coil and practically all of the circuit connections. Please note that the A and B-battery leads are soldered directly to the positive and negative ends of the flashlight cells. Battery clip arrangements are not ad-

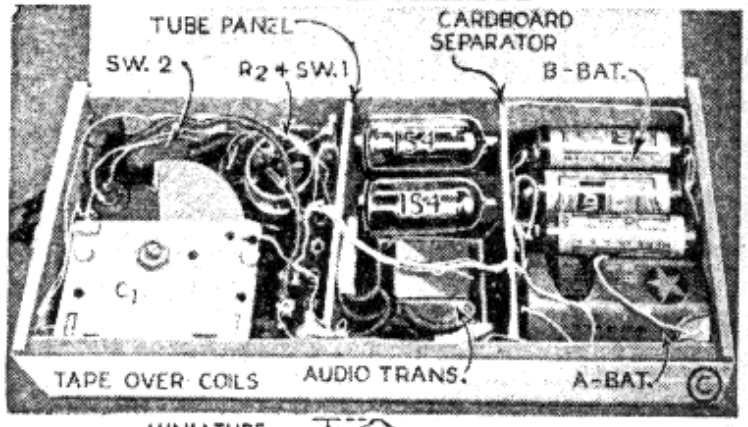


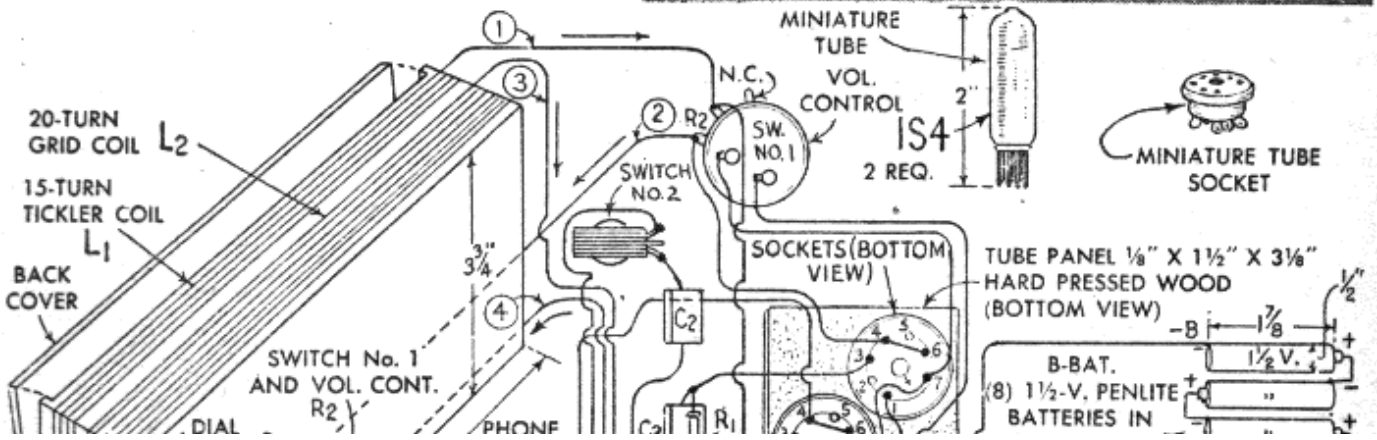
and negative ends of the flashlight cells. Battery clip arrangements are not advised as they usually fail to make good mechanical and electrical contacts. Eight "penlite" cells connected in series provide 12 volts for the B supply. The A-battery consists of a single standard-size (No. 2) flashlight cell. In this compact pocket set no attempt is made to cable the battery leads; all other circuit leads should be kept as short as possible.

Photos A, B and C clearly show how the

various controls and parts are arranged. The tube-mounting panel is supported on the back of the cardboard front panel by means of a small angle bracket and a short machine screw so that the bottoms of the miniature tube sockets will just clear the combination midget volume control and switch No. 1. The audio transformer should be an open-frame single-plate to single-grid midget type. This is mounted by means of a short 6-32 machine screw, the mounting lug extending through the notch cut in the end of the tube-socket panel. The case is made by cutting down a cigar box to the dimensions given in Fig. 2. The depth may be increased slightly depending upon the size of your parts. Do not change the width or length dimensions or the loop antenna coil will not function properly with the midget variable condenser specified. Both coils are close-wound in the same clockwise direction, and are spaced ⅛ in. apart.

When the set is completed and working, the coils should be completely covered with adhesive tape; the entire cabinet may be covered with black oilcloth or other material if desired. In doing this be careful no moisture reaches the coils; this is important. With switch No. 2 thrown to the position that adds fixed condenser C_2 to the circuit the set tunes from approximately 530 kc. to about 900 kc. With C_2 switched out of the circuit the receiver tunes from 900 kc. to approximately 1600 kc. For distant stations an external antenna wire can be attached to stator (S) on condenser C_1.





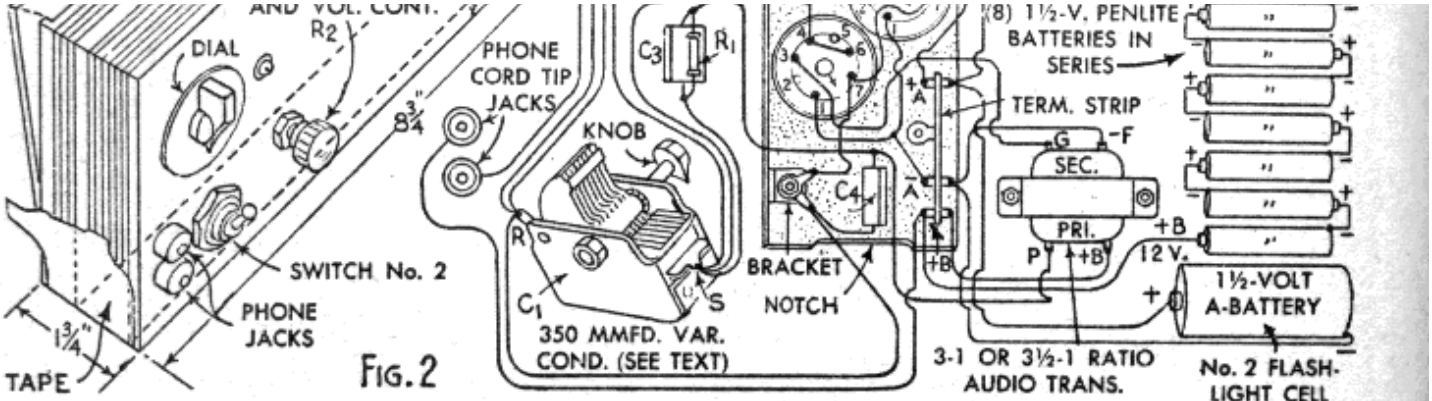
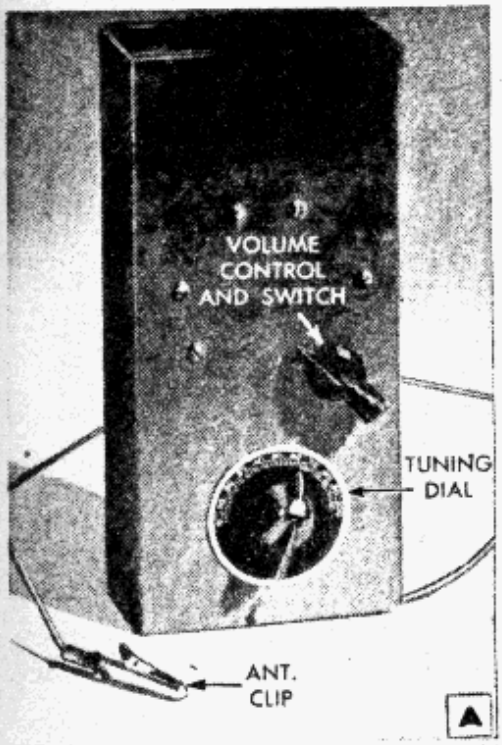

AND VOL. CONT.
R2
DIAL
8¾"
PHONE CORD TIP JACKS
C3
R1
KNOB
(8) 1½-V. PENLITE BATTERIES IN SERIES
TERM. STRIP
G
-F
SEC.
PRI.
+B
P
+B
12 V.
1½-VOLT A-BATTERY
SWITCH No. 2
PHONE JACKS
1¾"
TAPE
R
C1
S
350 MMFD. VAR. COND. (SEE TEXT)
BRACKET
NOTCH
C4
+A
-A
+B
3-1 OR 3½-1 RATIO AUDIO TRANS.
No. 2 FLASH-LIGHT CELL

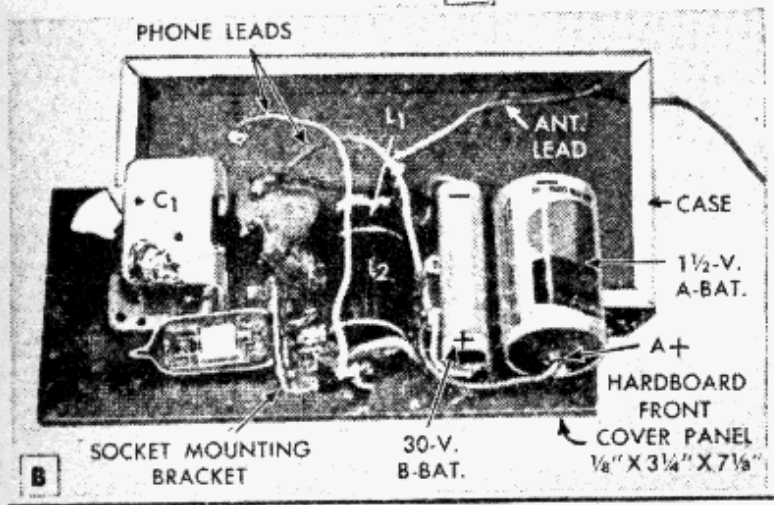
FIG. 2

ONE-TUBE *EMERGENCY RECEIVER*

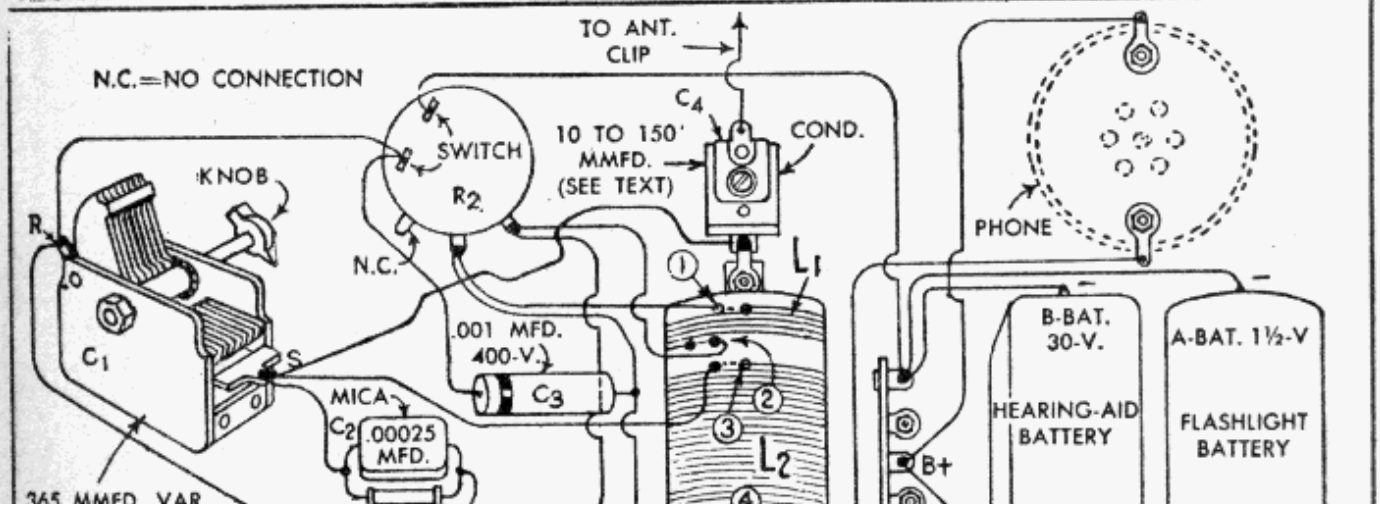


ONLY ONE miniature tube is used in this "handi-talkie" type battery-operated receiver. It is ideal for use during power-line failures, blackouts, hurricanes and similar emergencies. Small enough to slip into a coat pocket, it will bring in local broadcasting stations with only an emergency antenna. The short antenna lead shown in photo A terminates in a clip that can be clipped to the finger stop on a dial telephone, a metal lamp base, as shown in photo C, a metal window screen or any other metallic object in the home. Outdoors, any metal railing, wire fence or other large piece of metal provides an emergency antenna.

All parts are inexpensive standard materials. The case is made of ¼-in. pine or plywood and the top and bottom covers are made of ⅛-in. hardboard. The over-all dimensions of the case are given in photo D. Most of the parts are mounted directly on the hardboard front panel as shown in photos B and E. The single earphone, which is from a 2000-ohm headset, should be a type that has outside terminals. It is mounted on the back panel by means of its terminal screws.



The coil for the set is hand-wound on a cardboard case from a "C"-size flashlight cell, as in Fig. 3. Coils L1 and L2 are both close-wound in the same clockwise direction as shown in pictorial diagram Fig. 1 and diagram Fig. 3. Two small holes are punched in the cardboard form to anchor the wire at the start and finish end of each coil. The schematic circuit diagram appears in Fig. 2; No. 18 or 20 flexible insulated hook-



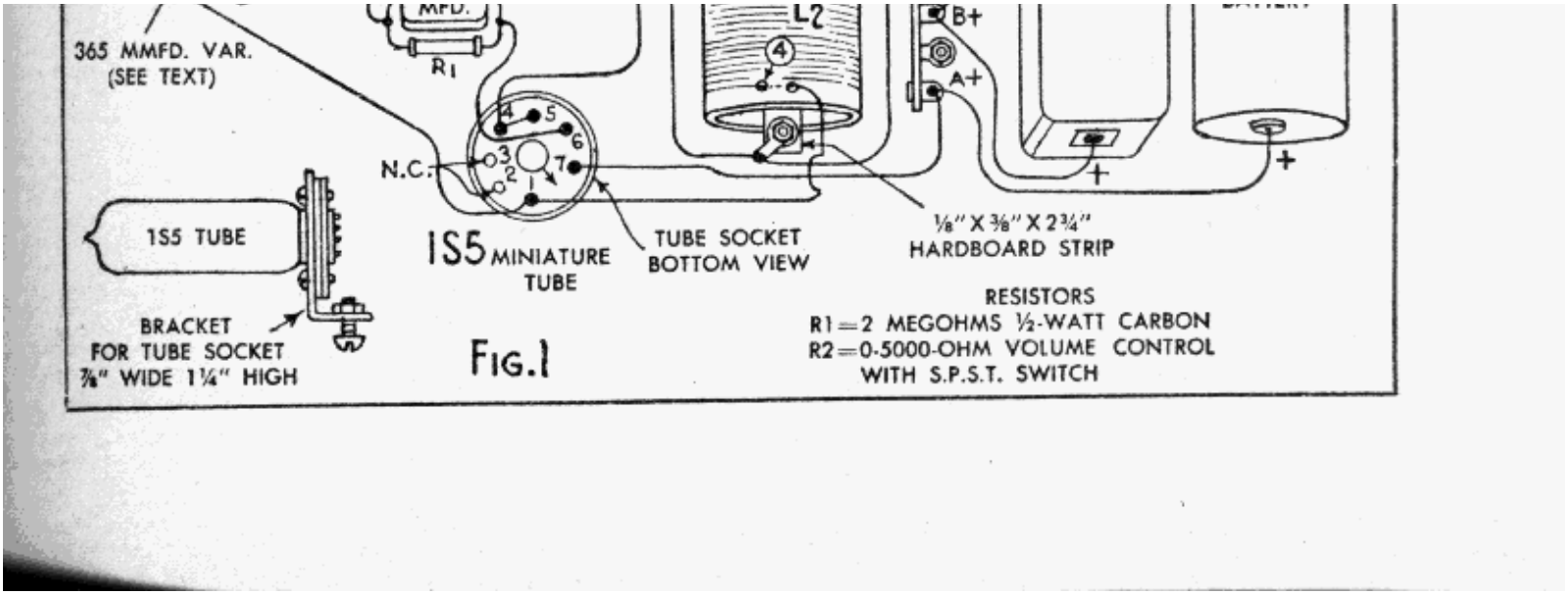
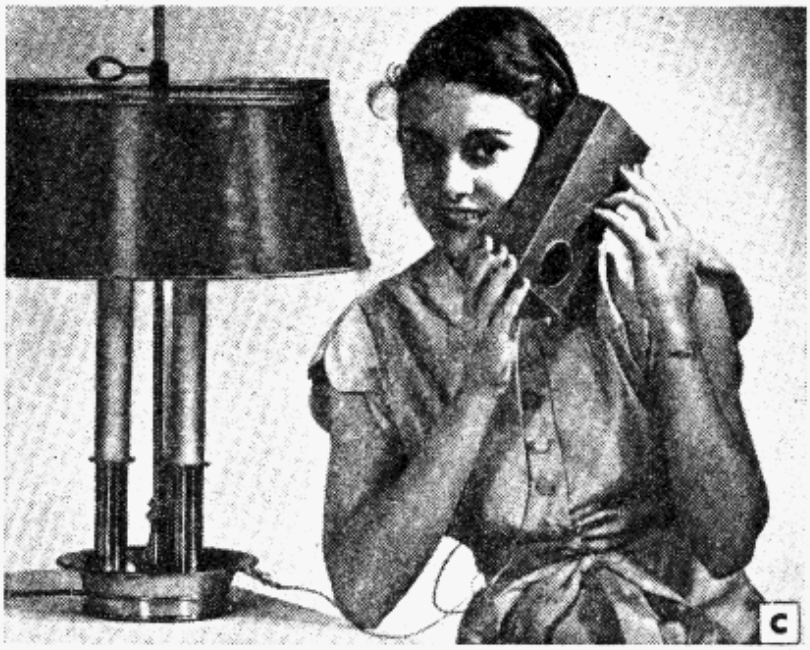
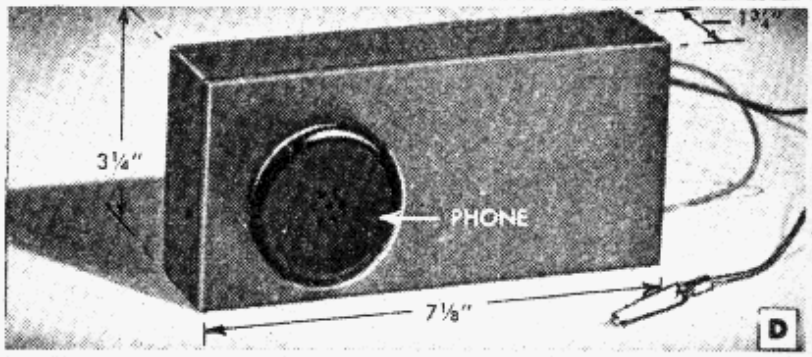

365 MMFD. VAR.
(SEE TEXT)
MFD.
R1
L2
4
B+
A+
N.C.
1S5 TUBE
1S5 MINIATURE TUBE
TUBE SOCKET BOTTOM VIEW
⅛" X ⅜" X 2¾"
HARDBOARD STRIP
BRACKET
FOR TUBE SOCKET
⅞" WIDE 1¼" HIGH
RESISTORS
R1 = 2 MEGOHMS ½-WATT CARBON
R2 = 0-5000-OHM VOLUME CONTROL
WITH S.P.S.T. SWITCH

FIG. 1

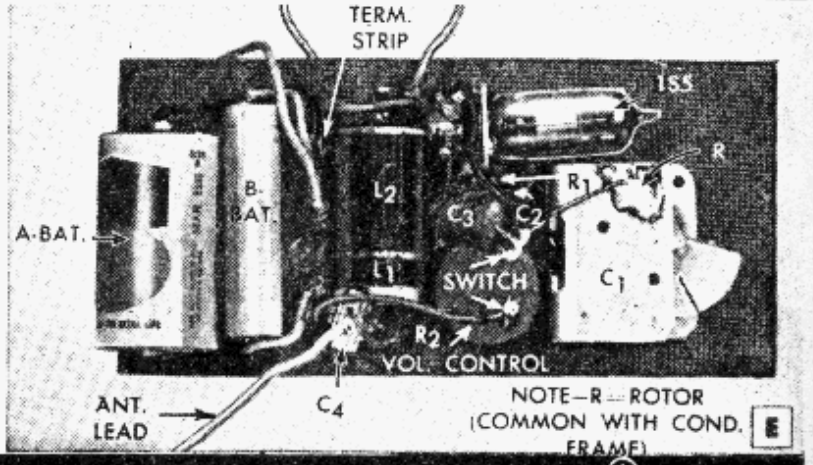
up wire is used for all connections except those to the coil, which are made with the coil wire ends. Be careful when wiring the terminals of the tube socket as a wrong connection here can result in a blown-out tube. The rotor plates of condenser C1 are common with the condenser frame; this is the terminal R. Power for the set is provided by one No. 2 standard-size flashlight cell and a 30-volt hearing-aid battery. Battery drain of the miniature 1S5 tube is very low.

Test the set first with a standard outdoor antenna or a long indoor wire. Assemble it in the case temporarily; open the setscrew on the small trimmer condenser C4 as far as it will go. The on-off switch is combined with the volume control. Turn this control "full on" and rotate the variable condenser until you hear a whistle indicating a station. Now back off the volume control very slowly until the whistle disappears and the station comes in clear. After the set is in working order with the standard antenna, connect it to any convenient emergency antenna such as the lamp base, or the stop on a dial phone, and adjust condenser C4 to be as far closed as possible without eliminating the oscillation whistle at the low (550 kc.) end of the band. The case cover is now closed with two small brads. This emergency set is designed for local stations; it is not intended for distant reception. Case may be stained and varnished if desired.

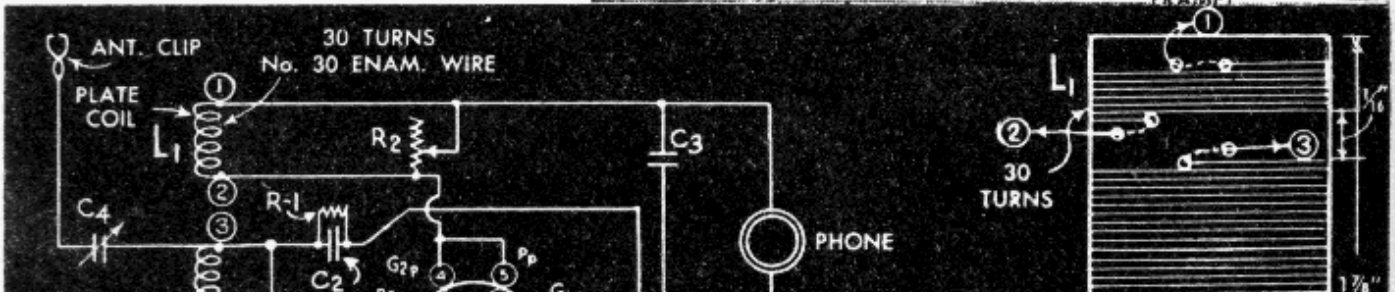

C



D



E



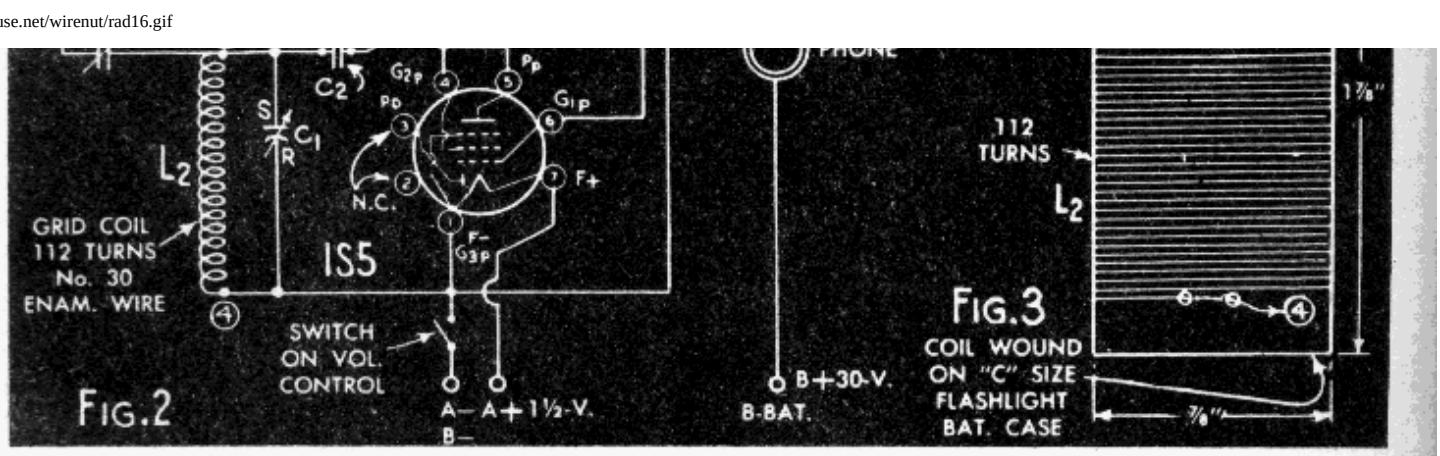
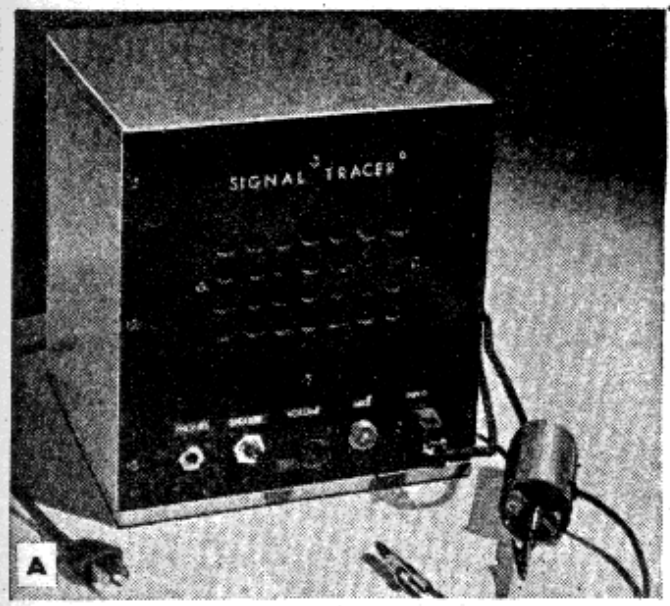
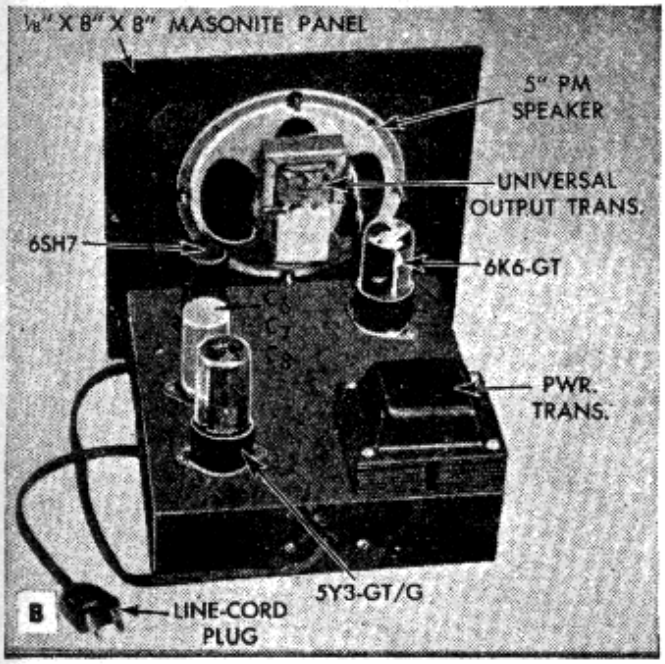


FIG.2

FIG.3
COIL WOUND
ON "C" SIZE
FLASHLIGHT
BAT. CASE

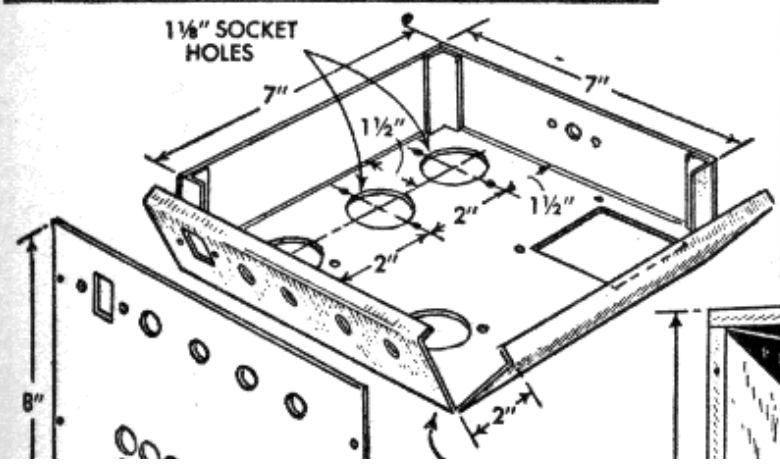
RADIO TESTING UNITS





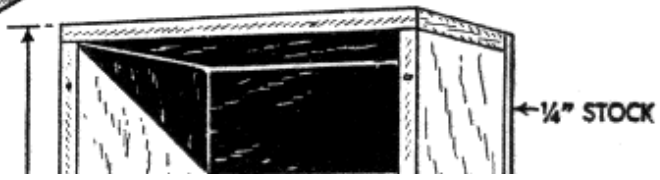
SIGNAL tracing means to sample or examine the signal at any specified point on its journey through the various stages in a receiver to the loudspeaker. It is a modern method of servicing radio sets; when you pass from a point of normal signal to the point at which this "electronic bloodhound" verifies or confirms the complaint, you have just passed into or through the defective stage. In other words, this signal tracer will quickly enable you to locate the defective stage and, in many cases, the defective part itself. It also enables you to listen to the actual signal as it is traced through the set and provides a means for checking the quality of the signal at each sampling point. This approved method of set servicing is in common use.

It is easy to build and simple to use as it is merely an audio amplifier with a built-in power supply and a nonlinear detector in the form of a probe. The unit illustrated consists of two amplifying stages employing one 6SH7 tube and one type 6K6-GT tube. The nonlinear detector probe, which is housed in a short length of Bakelite tubing, is connected to a 6-ft. length of 3-conductor cable, in which one lead is shielded. It employs a 6C4 tube; the cable terminates in a type P-303-CCT Jones plug. Since this is a grid-leak type of detector, it also adds considerably to the signal amplification. A 5Y3-GT/G tube is used in the conventional built-in power supply, with the additional condensers C11 and C12 employed to take



RESISTORS

1—10-megohm, ½-watt carbon, R1
1—510,000-ohm, ½-watt carbon, R2
1—4.7-megohm, ½-watt carbon, R3
1—510,000-ohm, ½-watt carbon, R4
2—1-megohm, ½-watt carbon, R5 and R6
1—680-ohm, 1-watt carbon, R7
1—10,000-ohm, ½-watt carbon, R8
1—100,000-ohm, ½-watt carbon, R9
1—3.3-megohm, 2-watt carbon, R10
1—500,000-ohm, audio taper volume control R11, with s.p.s.t. switch. (Mallory-type MR 48 with Mallory M26 switch used in model)



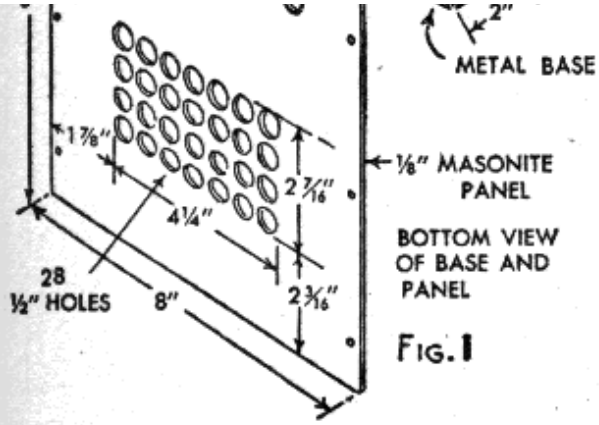
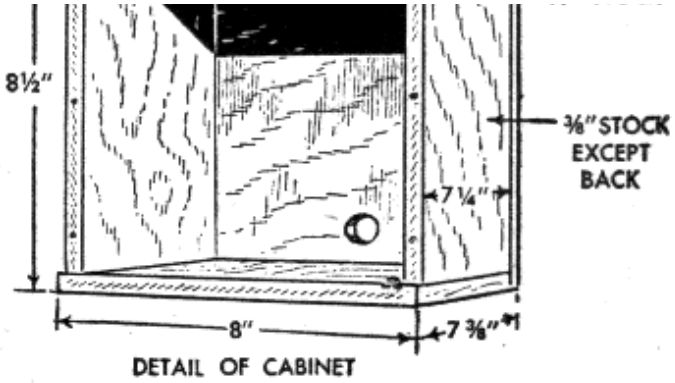


FIG. 1

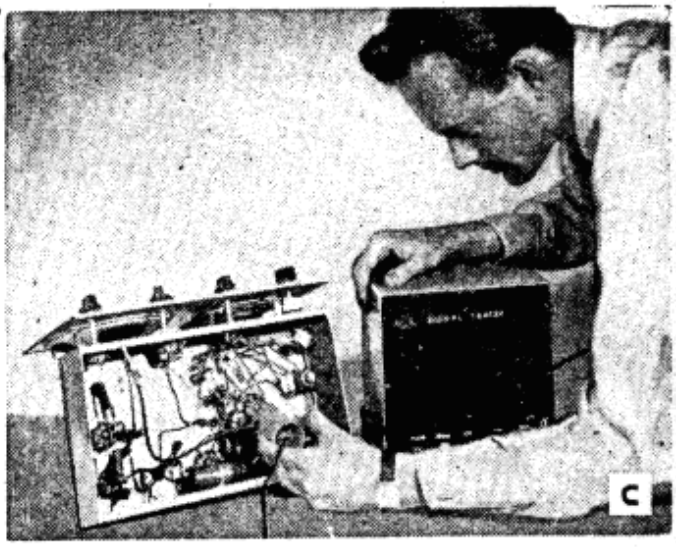


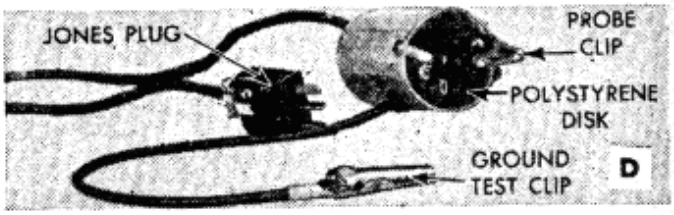
DETAIL OF CABINET

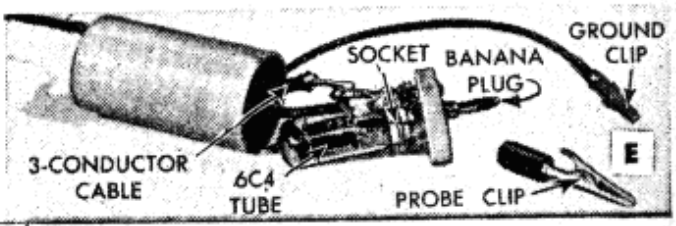
FIG. 2

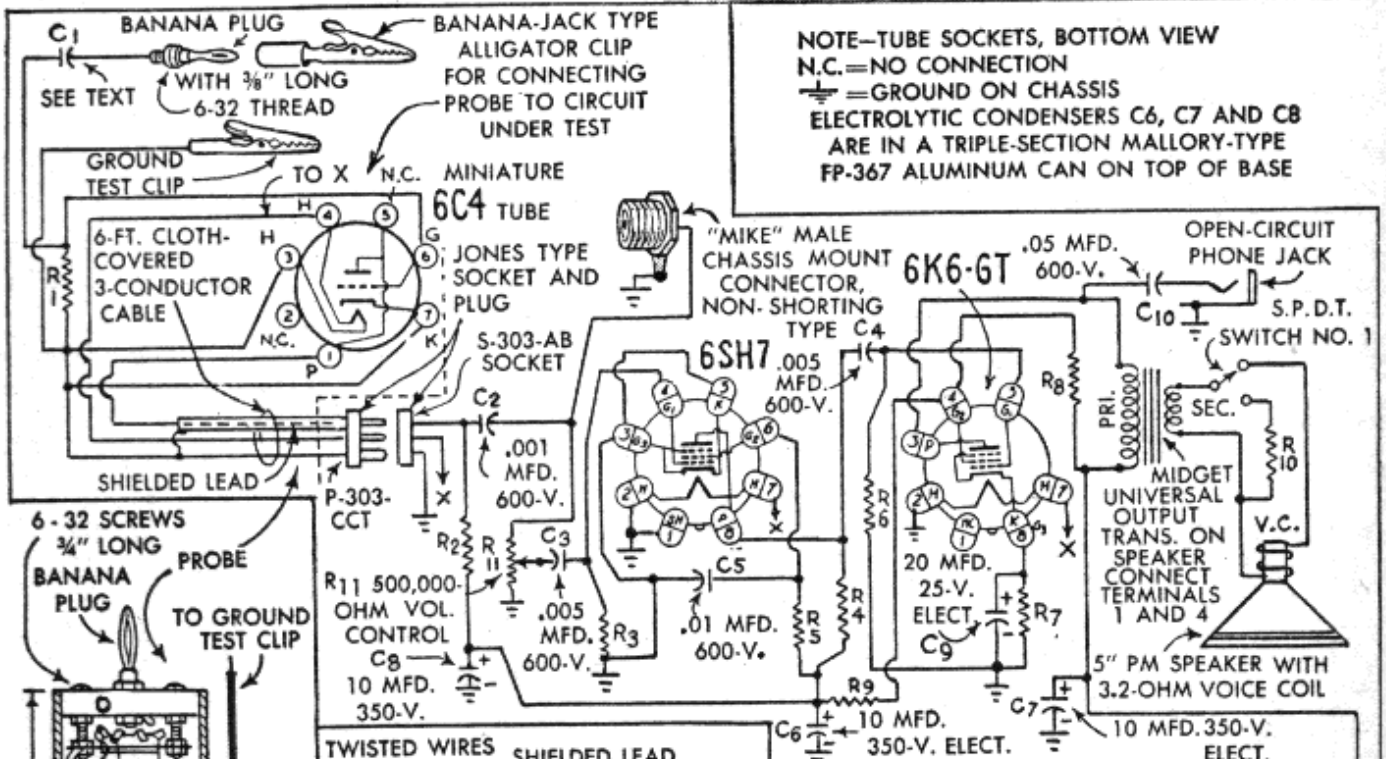
SIGNAL TRACER FOR RADIO SERVICING

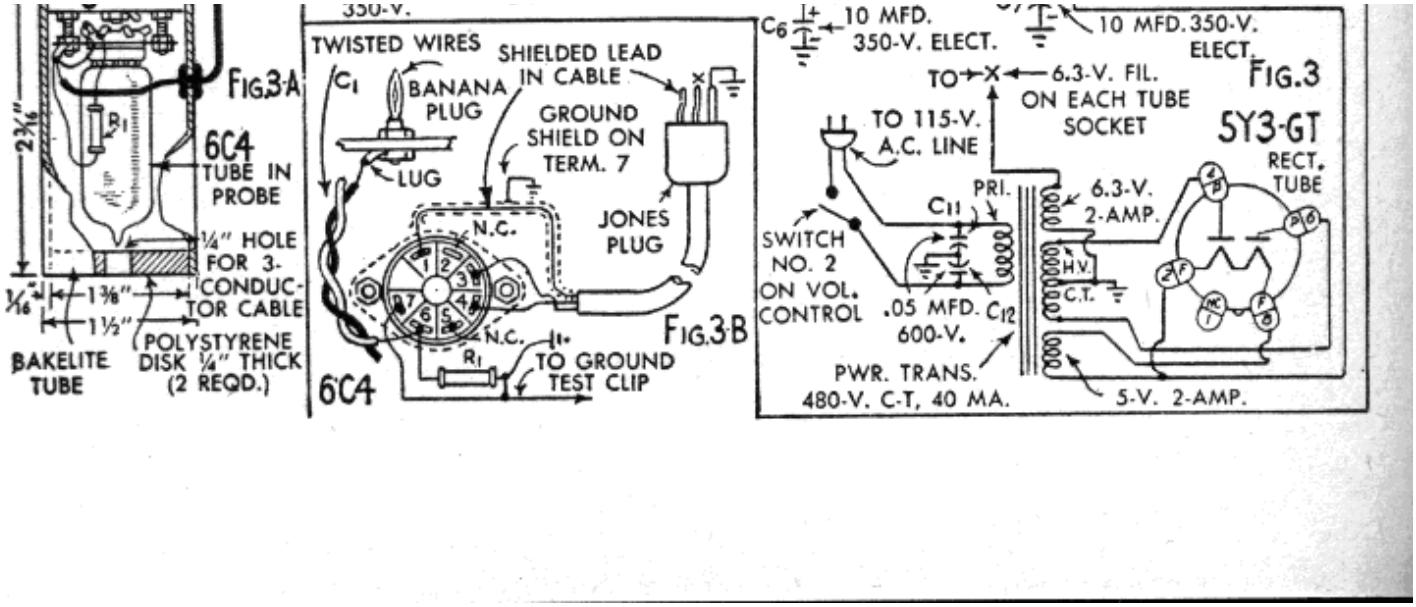
out line noises which might appear in the signal tracer, because of its high amplification. Photos A, B, F, G and H show various views of the completed instrument. The metal chassis base, Masonite panel, and cabinet are all carefully detailed in Figs. 1 and 2. A complete schematic circuit diagram is given in Fig. 3. Pictorial wiring diagrams of the 6C4 tube socket, probe and cable connections are shown in Figs. 3-A and 3-B. Condenser C1, resistor R1 and the 6C4 miniature tube are all contained within a 1½-in.-dia. piece of Bakelite tubing which is closed at each end with a disk of ¼-in. polystyrene. This is a clear plastic insulating material that is available from all radio-parts houses. Condenser C1 consists of two pieces of insulated hookup wire 1¼ in. long twisted together to provide a necessary small capacity; note that only one end of each wire is connected, as indicated in Fig. 3-B. Photos D and E show the completed probe and cable. The banana plug is the actual probe which is used to contact the various parts of the receiver. It picks off either an r.f., i.f., or audio signal. For r.f. or i.f., the signal can be



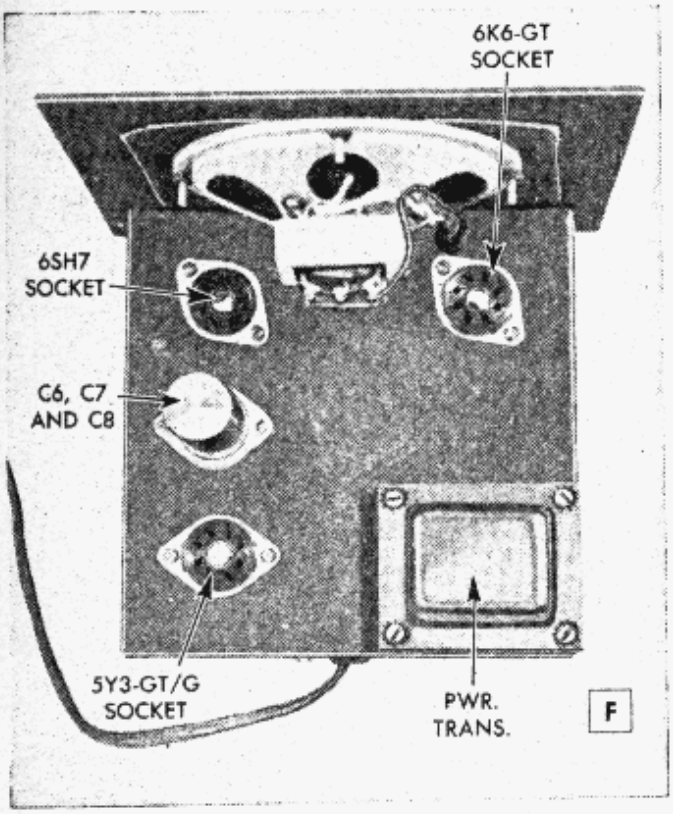


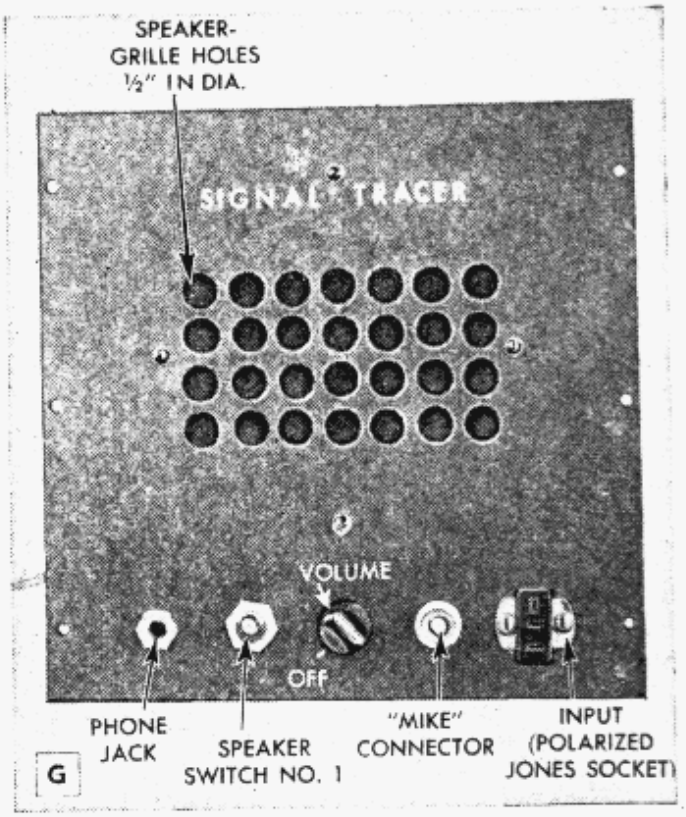





2 3/16"
R1
6C4
TUBE IN PROBE
1/4" HOLE FOR 3-CONDUCTOR CABLE
1/16"
1 3/8"
1 1/2"
BAKELITE TUBE
POLYSTYRENE DISK 1/4" THICK (2 REQD.)
FIG.3-A
350-V.
TWISTED WIRES
C1
BANANA PLUG
SHIELDED LEAD IN CABLE
GROUND SHIELD ON TERM. 7
LUG
JONES PLUG
N.C.
N.C.
R1
TO GROUND TEST CLIP
6C4
FIG.3-B
C6
10 MFD. 350-V. ELECT.
10 MFD. 350-V. ELECT.
TO
X
6.3-V. FIL. ON EACH TUBE SOCKET
FIG.3
TO 115-V. A.C. LINE
5Y3-GT
RECT. TUBE
PRI.
C11
6.3-V. 2-AMP.
SWITCH NO. 2 ON VOL. CONTROL
H.V.
C.T.
.05 MFD. C12 600-V.
PWR. TRANS. 480-V. C-T, 40 MA.
5-V. 2-AMP.

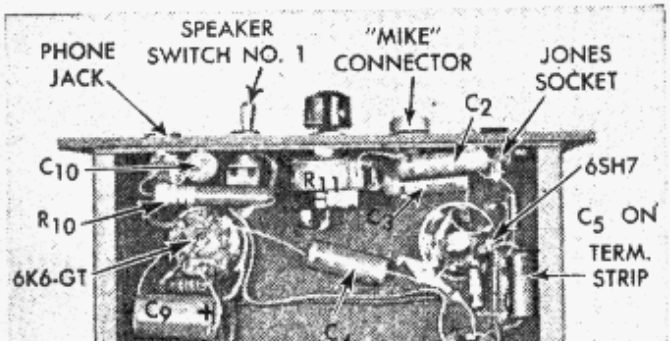
SIGNAL TRACER FOR RADIO SERVICING

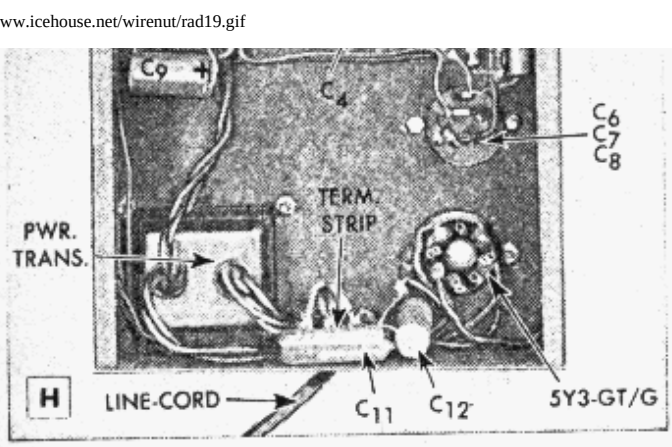




detected in the 6C4 tube and converted to audio where it is further amplified in the other two tubes for operating either a loudspeaker or a set of headphones. Switch No. 1 cuts in dummy load when phones are used. With the microphone connector you have a 2-stage public-address amplifier should the emergency ever arise.

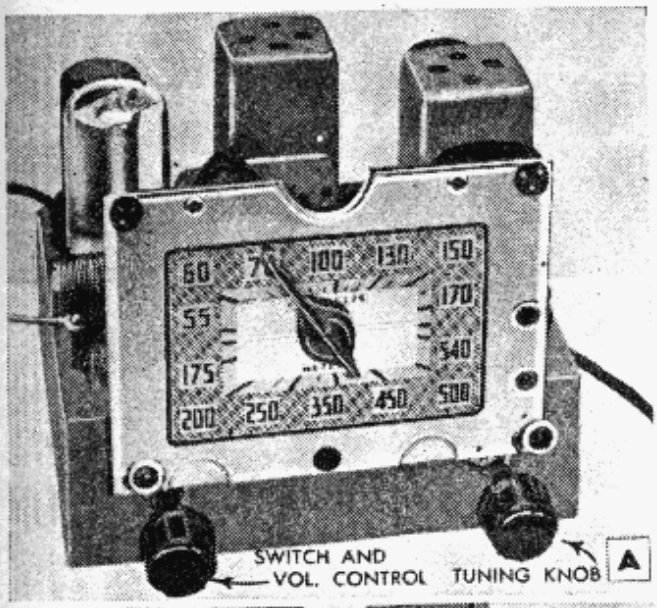
When arranging the parts on the chassis base, mount them so as to make all connections between the various terminals as short as possible. All "hot" wires associated with the output circuit, such as the plate side of the 6K6-GT, must be well separated from any wires associated with the input or grid side of the 6SH7 tube. Leads and components connected to grids or plates of either tube should have the shortest possible length; clip the pigtails of resistors and condensers where necessary to keep these leads short. In common practice, the signal tracing procedure is to work backwards from the loudspeaker towards the antenna circuit. Always guard against possible shock by disconnecting the receiver from the power line and use the alligator clips to make the necessary circuit connections each time the probe is moved. Assuming that you have a "dead" receiver but your meter indicates plate and filament voltage to the tubes, you begin with your signal tracer by connecting the ground clip to the chassis of the set and check at the speaker voice-coil leads. Then go to the plate terminal of the output stage and next to the grid terminal of the output stage, etc., until something is heard in the loudspeaker of the signal tracer. The best points of contact are usually the grids or plates of each of the tubes (except the power-supply rectifier tube), checking every tube all the way back down the line until the signal is heard. When the signal is heard, this is your indication that imme-

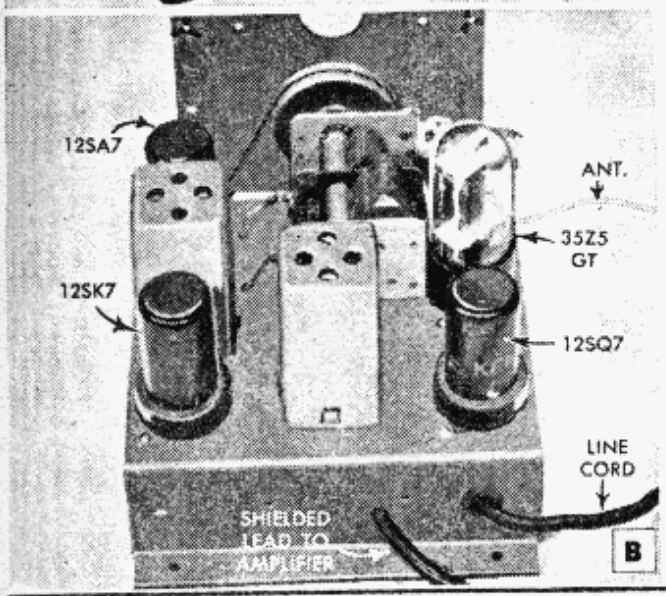




heard, this is your indication that immediately following this point, there is a failure in the receiver itself. Thus, by process of elimination, you are able to find the cause of the trouble. The instrument is light and easily portable. A chrome drawer-pull handle can be mounted on the top of the case. The rugged case as detailed in the diagram Fig. 2, will stand up under rough handling.

RADIO TUNING UNITS





UNUSUALLY compact and highly efficient, this AM super tuner will provide the owner of any public-address system with a means for supplying "on the spot" radio music, news and public events at picnics, ball games, meetings or wherever PA systems are used. It also makes an ideal addition to sound installations of the type used in industrial plants for playing recordings for employees. It may be employed as a remote tuner for any radio receiver that is equipped with phono input jacks or with any audio amplifier. The antenna coil is a Carron No. S407 or any small universal type; the intermediate-frequency (i.f.) transformers and oscillator coil are all Meissner types. Note in photo C that the antenna coil is mounted horizontally above the base by soldering its ground terminal, No. 4, directly to the front of the

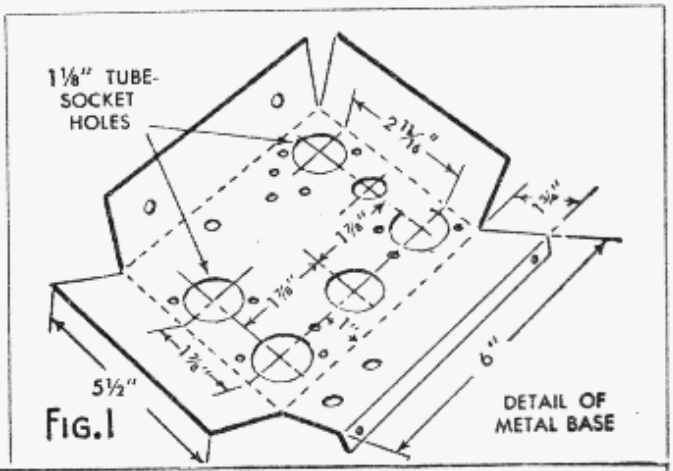
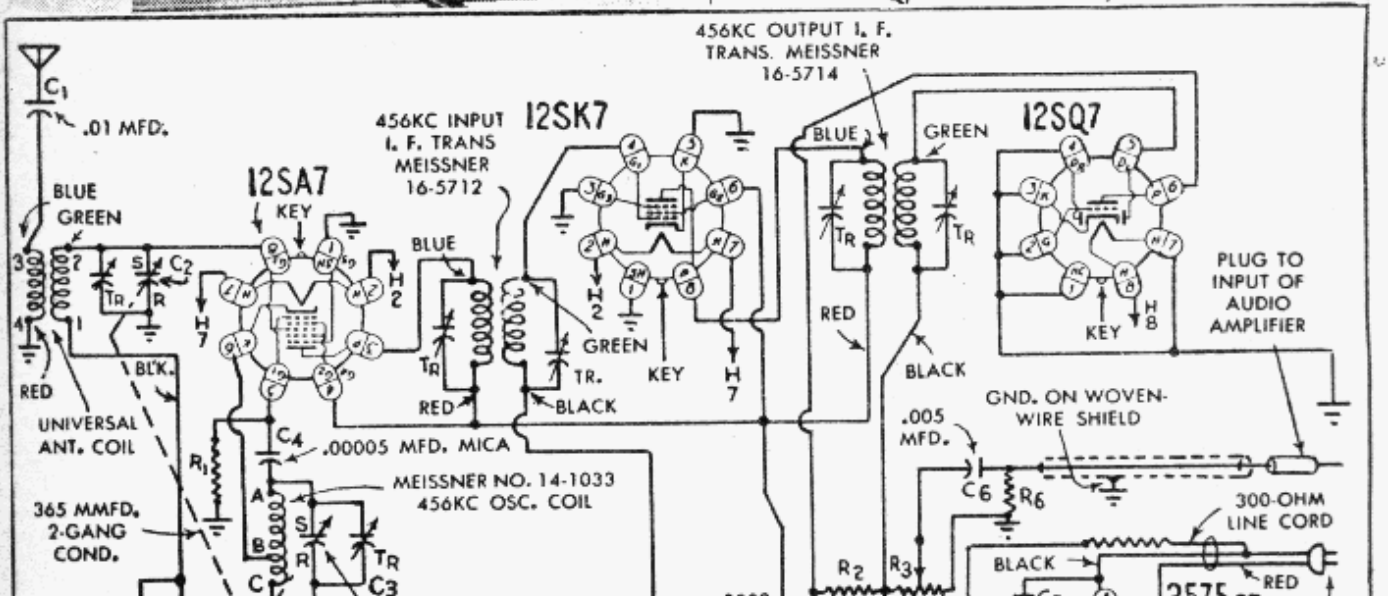


FIG. 1



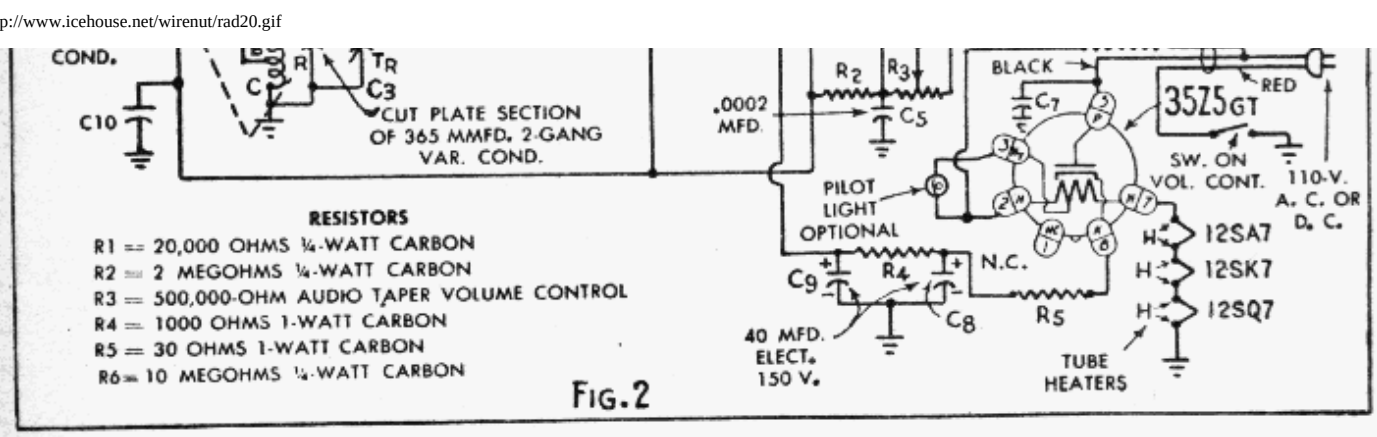
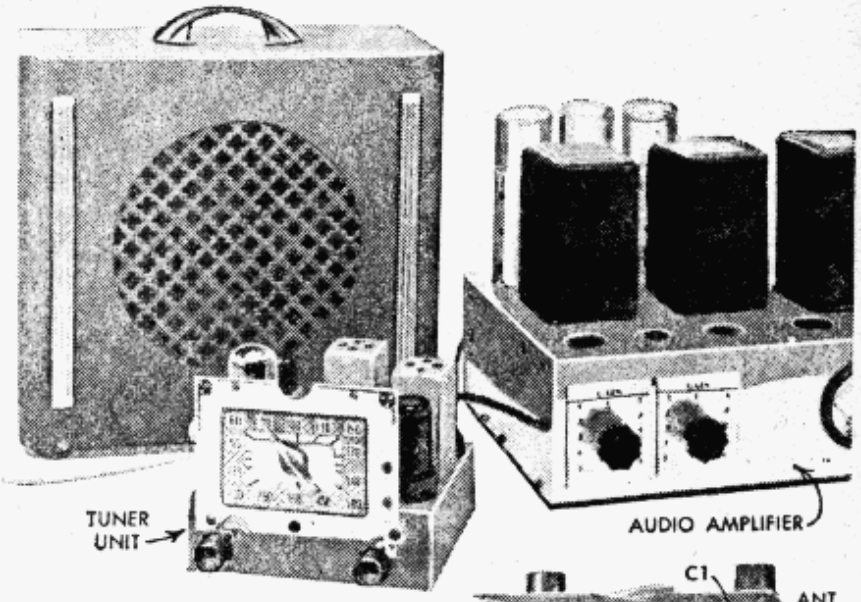

COND.
C10
C
R
TR
C3
CUT PLATE SECTION
OF 365 MMFD. 2-GANG
VAR. COND.
.0002
MFD.
R2
R3
C5
BLACK
C7
RED
35Z5GT
SW. ON
VOL. CONT.
110-V.
A. C. OR
D. C.
PILOT
LIGHT
OPTIONAL
N.C.
C9
R4
C8
R5
40 MFD.
ELECT.
150 V.
TUBE
HEATERS
12SA7
12SK7
12SQ7
RESISTORS
R1 = 20,000 OHMS ¼-WATT CARBON
R2 = 2 MEGOHMS ¼-WATT CARBON
R3 = 500,000-OHM AUDIO TAPER VOLUME CONTROL
R4 = 1000 OHMS 1-WATT CARBON
R5 = 30 OHMS 1-WATT CARBON
R6 = 10 MEGOHMS ¼-WATT CARBON

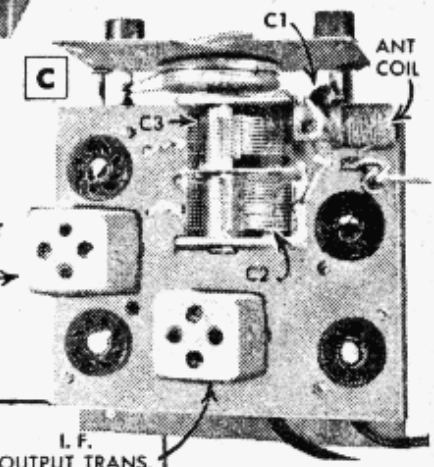
FIG. 2

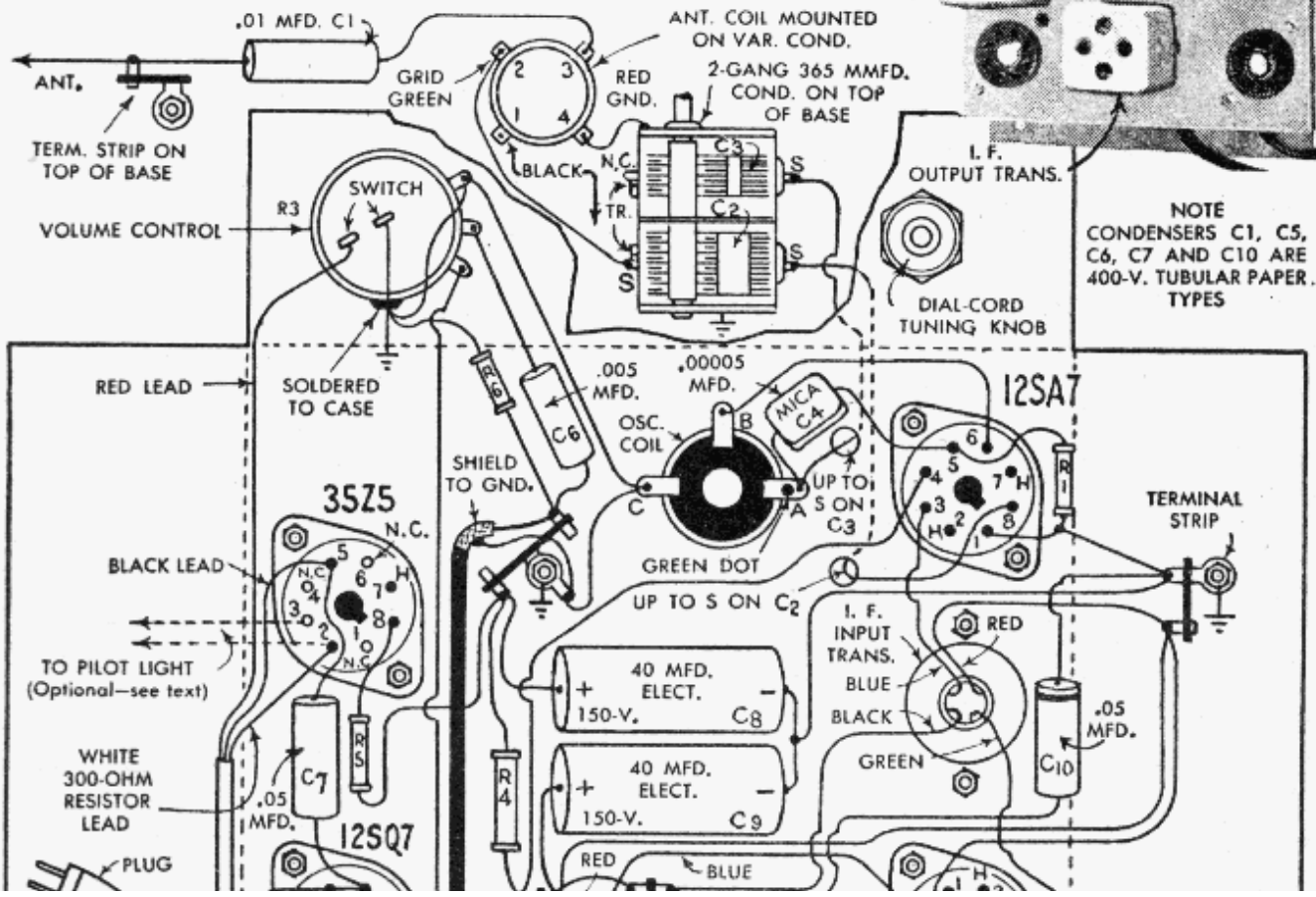
variable condenser frame. This connection is indicated with a wire lead in Fig. 3.

To balance the tuner unit, connect the antenna and audio amplifier; tune in a station at about 670 kc. The i.f. transformers are factory peaked and require very little adjusting—just a slight trimmer adjustment to bring in the station at maximum volume. While still tuned to this station, adjust the trimmer on C3, the oscillator cut-plate section, to bring in the station at the proper dial reading. Now tune in a station at about 1400 kc. and adjust trimmer C2 on the antenna-tuning condenser section until station comes in at maximum volume.

This is one of the simplest and most useful general-purpose superheterodyne broadcast-band tuners used in *Popular Mechanics* radio and electronics laboratory.







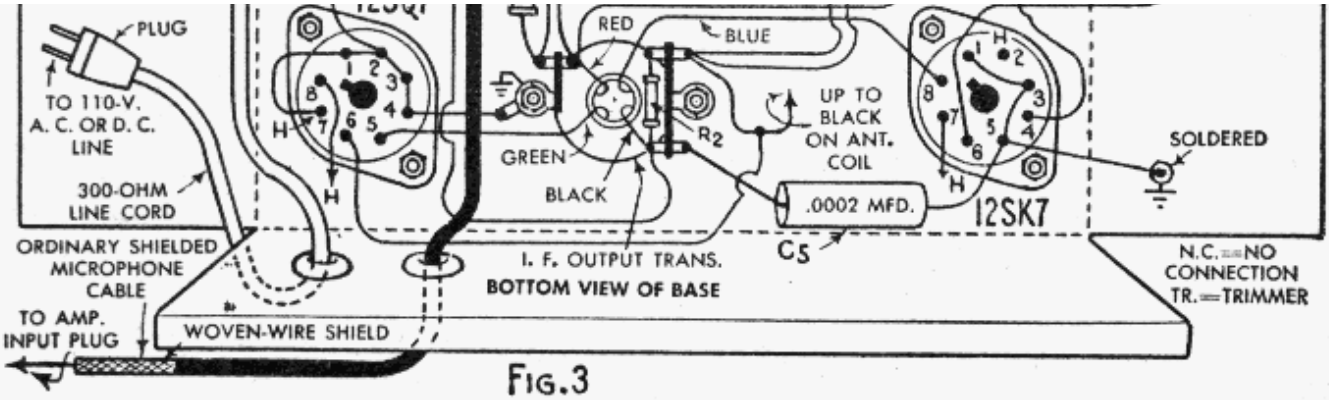
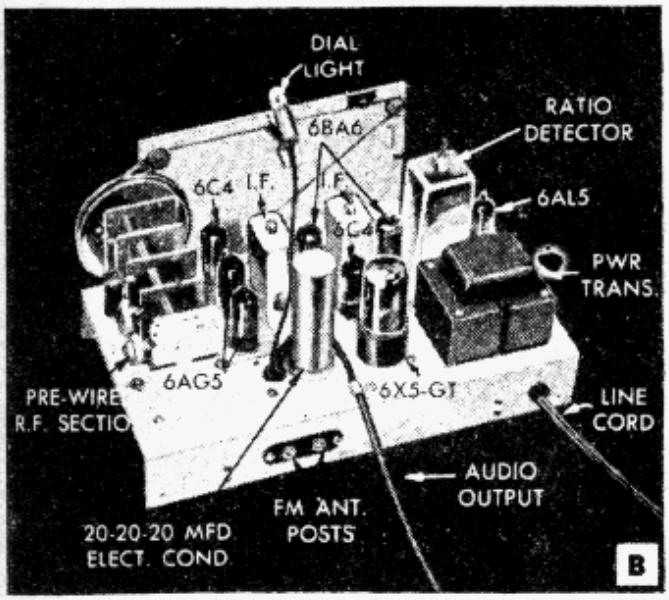
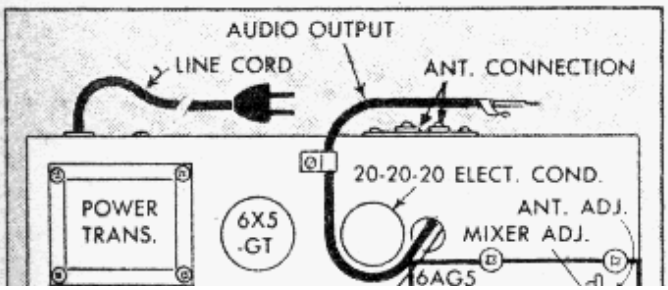

PLUG
TO 110-V. A. C. OR D. C. LINE
300-OHM LINE CORD
ORDINARY SHIELDED MICROPHONE CABLE
TO AMP. INPUT PLUG
WOVEN-WIRE SHIELD
RED
BLUE
GREEN
BLACK
R2
UP TO BLACK ON ANT. COIL
.0002 MFD.
C5
I. F. OUTPUT TRANS.
BOTTOM VIEW OF BASE
12SK7
SOLDERED
N.C.=NO CONNECTION
TR.=TRIMMER

FIG.3

HIGH-FIDELITY FM TUNER UNIT





HERE IS an excellent FM tuner of advanced design that can be used with any good audio amplifier. It is easy to build as the r.f. front end is assembled and the i.f. coils are prealigned. This r.f. section comes in a compact prewired unit that mounts on the chassis base which is available cut, drilled and ready for mounting all parts just as shown in the photos.

The parts are available in complete kit form from radio-parts houses and are standard in every respect. Although not intended for beginners, the construction is not difficult for experienced builders, and the results when used with a good audio amplifier are highly satisfactory even to critical music lovers. Photo A shows the completed tuner connected to an audio amplifier and a good loudspeaker in an adequate enclosure. Photo B is a rear view of the chassis showing the binding post strip for an FM dipole antenna, and the audio output cable which is fastened to the chassis base by means of a clamp. A front view of the completed FM tuner appears in photo C. It may be housed in a standard stock cabinet or installed in a custom-made or home-built console combination. The chassis layout is shown in Fig. 1 and the dial-string detail in Fig. 2. A complete schematic circuit diagram appears in Fig. 3. All coils are of the reliable Meissner type, and every part is carefully selected to insure maximum results. Very little leeway in specifications can be tolerated in high-frequency FM circuits and the parts specifications given in Fig. 3 are those that are supplied in the complete kit shown in photo D. Those who do not wish to purchase the complete Meissner T-8CK kit shown in photo D can buy foundation parts which consist of the essential Meissner units. These are as follows: FM tuning assembly (catalogue number 13-7628) with dial parts and hardware; main chassis base (No. 05965-A); power transformer (No. 29501); FM-i.f. transformers (No. 05452), and the ratio detector coil (No. 05453). The i.f. coils and the ratio detector, when supplied separately, are not prealigned.

A bottom view of the completed FM

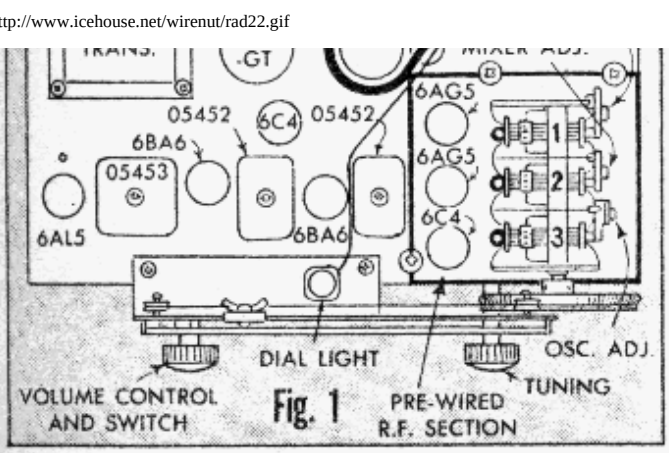
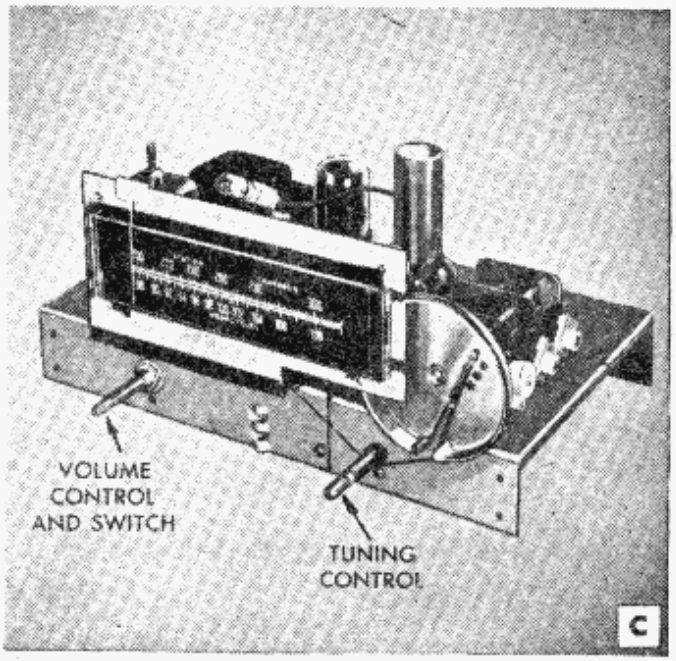


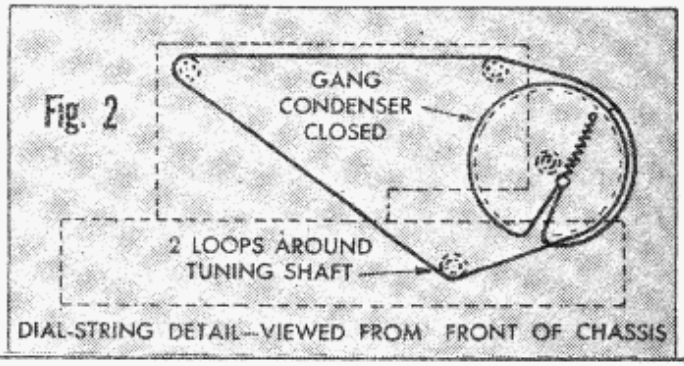
Fig. 1

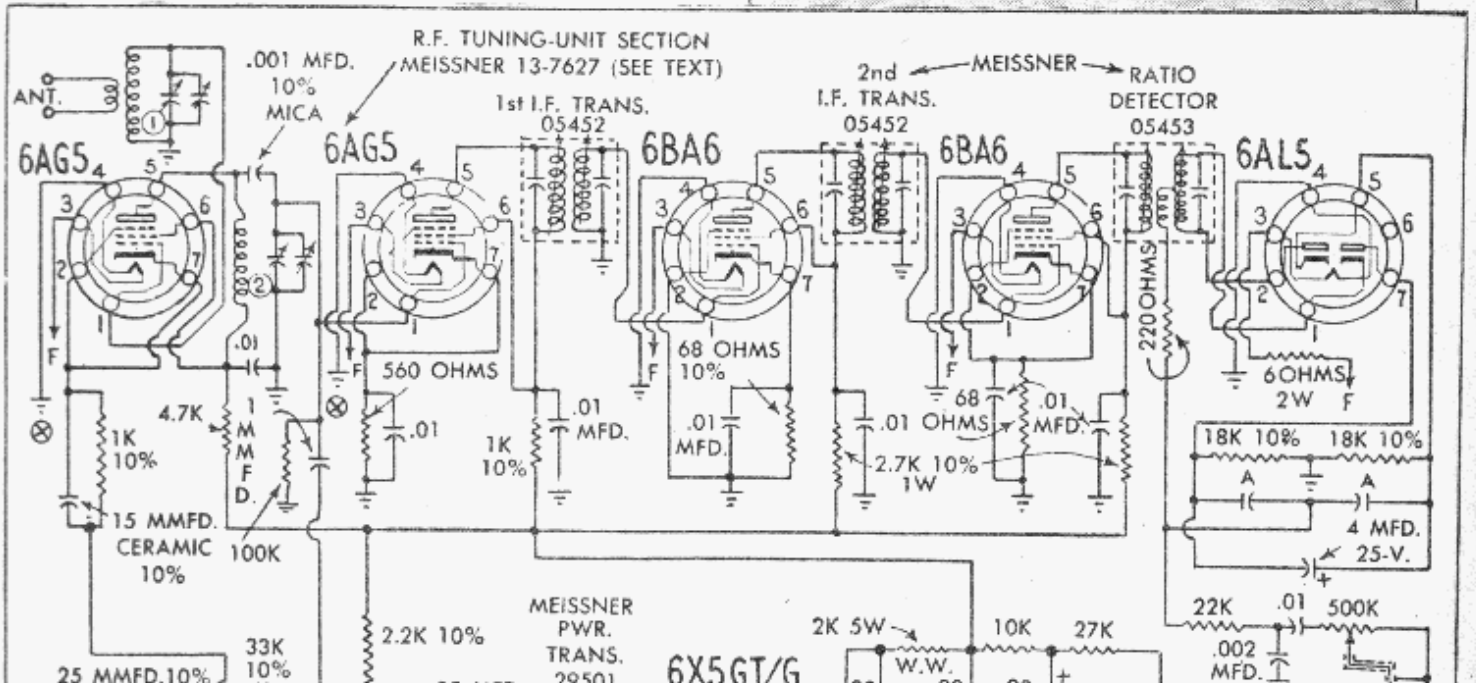
A bottom view of the completed FM tuner unit is shown in photo E. Before the operation of an FM receiver is described, it is well to review briefly the theory of FM transmission. Unlike amplitude-modulated (AM) transmission in which the r.f. wave varies in amplitude to correspond with the impressed audio signal, frequency-modulated transmission does not affect the amplitude of the wave. It permits the wave amplitude to remain constant but varies

wave frequency in accordance with the modulated signal, as illustrated in Fig. 4. If the carrier frequency of an FM broadcast station is, for example, 88 megacycles, its frequency under modulation may shift as high as 88,075 kc. and as low as 87,925 kc., a swing above and below 88 megacycles (88,000 kc.) of 150 kc. From this it can be seen that a single FM broadcasting station may cover a band width in the radio-frequency spectrum of as much as 150 kc. This is why FM broadcasting stations are located in the ultra-high-frequency bands where there is a great deal more room for wide-range high-fidelity transmission than in the regular broadcast band.

Designed by well-known radio engineers especially for students and experimenters, this FM tuner circuit employs a double converter system which greatly reduces image response. The detector circuit, built around the 6AL5 tube, is called a "ratio detector." It develops an audio voltage that is proportional to the ratio of the swing in frequency above and below the average frequency, during frequency-modulation (FM). It responds only to FM signals, not to amplitude-modulated (AM) signals and, since static and other electric disturbances







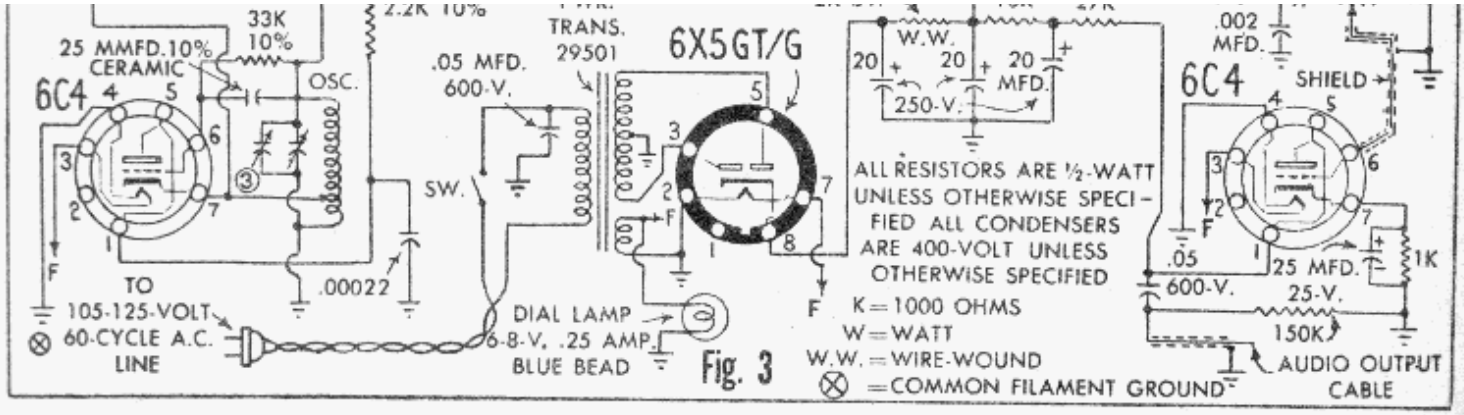
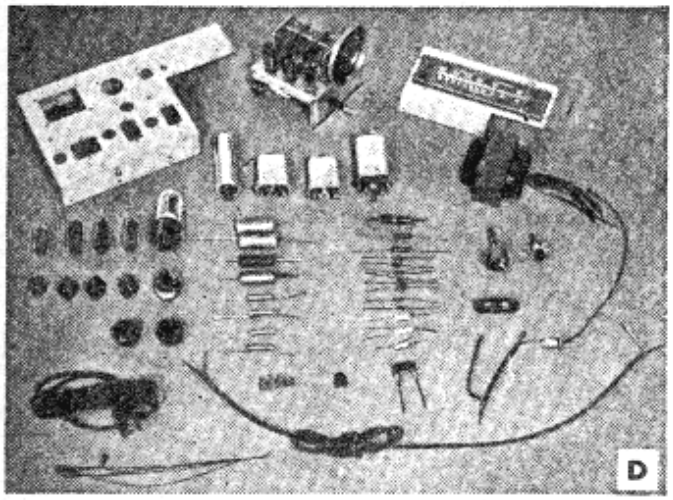
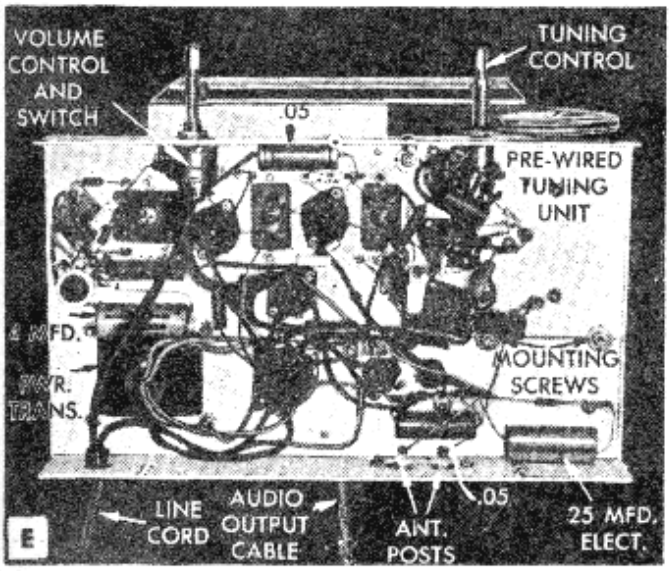

33K
10%
25 MMFD.10%
CERAMIC
6C4
OSC.
TRANS.
29501
.05 MFD.
600-V.
6X5GT/G
W.W.
20
20
20
MFD.
250-V.
.002
MFD.
6C4
SHIELD
SW.
.00022
TO
105-125-VOLT
60-CYCLE A.C.
LINE
DIAL LAMP
6-8-V, .25 AMP.
BLUE BEAD
ALL RESISTORS ARE ½-WATT
UNLESS OTHERWISE SPECI-
FIED ALL CONDENSERS
ARE 400-VOLT UNLESS
OTHERWISE SPECIFIED
K = 1000 OHMS
W = WATT
W.W. = WIRE-WOUND
= COMMON FILAMENT GROUND
.05
600-V.
25 MFD.
25-V.
1K
150K
AUDIO OUTPUT
CABLE

Fig. 3

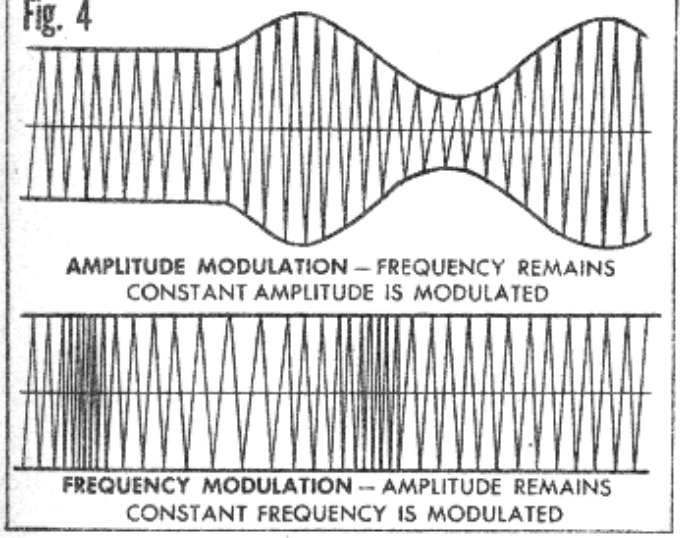


D



E

Fig. 4



are principally amplitude modulated, they

the first 6AG5, and in shunt with the input grid of the second 6AG5 tube. After the second 6AG5, the signal is at 10.7-megacycle frequency and is amplified by the two following 6BA6 i.f. tubes.

Just above and to the left of the 6C4 audio-amplifier tube, shown at lower right in the circuit diagram, is a 22,000-ohm resistor and a .002-mfd. condenser. This is the de-emphasis circuit of the FM receiver. FM signals are transmitted by the station with the higher frequencies accentuated. At the receiver these higher frequencies must be attenuated to provide a perfectly flat response. Any noise in the circuit is also reduced at this point.

A full-wave rectifier is employed in the a.c. power supply, and the filter circuit is a resistor-condenser type. The output of the 6C4 amplifier tube is approximately 7 watts maximum. This is just right for use with any phono amplifier, power amplifier or good radio set having phono input terminals. Because of the high frequencies involved in FM reception, it is desirable to use a standard outdoor FM antenna, which should be mounted as high as possible. Those who wish to make an indoor FM dipole antenna that will give good results in strong FM signal areas can do so by using a short length of 300-ohm Amphenol twin lead. This is the same transmission-line material that is used for both FM and TV antenna lead-ins. Cut off a 57-in. length of the twin lead and bare the wires at each end just enough to twist them together and then solder these ends. Then lay the twin lead out flat and cut the lower wire in the exact center; bare the ends of this wire about ½-in. and tin them for soldering to the twin-lead transmission line to the receiver. This transmission line can be any length up to about 100 ft. You can fasten the antenna to any table or baseboard with the dipole broadside to the station.

This is often a good solution for the antenna problem when a roof installation is not practical; the twin-lead dipole can be tied with string to a horizontal collar beam in the attic. A twin-lead dipole of this description makes a good emergency FM an-

are principally amplitude modulated, they are not reproduced, thus the performance of the FM receiver is noise-free.

The input or antenna coil tunes the entire FM band from 88 to 108 megacycles. The oscillator involving the 6C4 tube, shown at lower left in the circuit diagram, beats with the incoming signal to produce a lower frequency signal. The oscillator voltage is fed into the main receiver circuit at two points, in series with the cathode of

in the attic. A twin-lead dipole of this description makes a good emergency FM antenna in an apartment house where roof antenna systems are not permitted. Merely fasten it to the picture molding with thumbtacks on the wall of the room that is broadside to the FM station. In some cases on upper floor apartments it can even be placed under a rug if there are powerful FM stations broadcasting in the vicinity. The length of the dipole is cut to 56½ in. as this is about the center of the FM band.