SCIENCE and MECHANICS

33 Construction Projects • SWL

RADIO-TV EXPERIMENTER

75c No. 576

Amplifier Input/Output Comparison with 'Scope Attachment, page 47

VHF RECEIVER

TRANSISTOR TESTER

VOLT-OHMMETER

MULTI-LAB

TELEPHONE SENTRY

OPINION METER

MAKING TRANSFORMERS

PARABOLIC MIKE

BATTERY RECHARGER

FIELD STRENGTH INDICATOR

CODE PRACTICE EQUIPMENT

and

WHITE'S RADIO LOG

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AM-FM-TV STATIONS

WORLD-WIDE SHORT WAVE

SPRING 1961

RADIO-TV EXPERIMENTER

Spring 1961 Edition

Lloyd Darkwell

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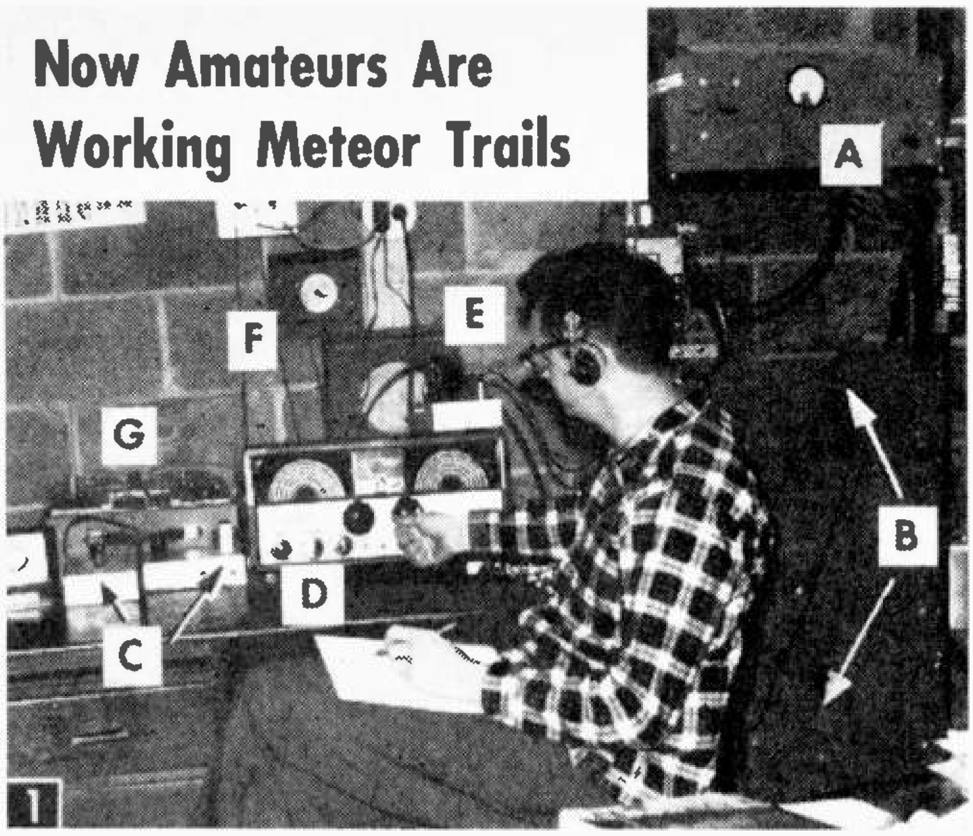
Now Amateurs Are Working Meteor Trails



Here Walter Bain demonstrates the equipment needed to get into meteor trail work: A) transmitter; B) transmitter power supply; C) frequency marker; D) communications receiver; E) crystal controlled converter; F) clock with sweep second hand; G) tape recorder (optional).

By S. DAVID PURSGLOVE

RADIO amateurs have joined communications engineers and military planners in looking at meteors with a new interest. These tiny fragments burning as they whiz through the atmosphere make possible communication over longer distances and at lower power than can normally be achieved by conventional radio techniques.

A transmitter constantly directs a radio signal at a portion of the sky known to exhibit good meteor activity for that time of day. A receiver up to 1,400 miles away listens for a reflected signal from that part of the sky.

When a meteor trail crosses the transmitted signal and reflects the signal to the intended receiver, the receiving station's own transmitter notifies the sending station.

As soon as the station wanting to send a message receives confirmation that its signal is being received, it releases a high-speed taped message in a rapid burst (hence the name often applied to the technique—"meteor burst").

The use of meteor trail communication on VHF bands means there will be more channels available. This is especially important in the near future, since we are in the fifth year of an 11 year sun spot cycle. Six years from now there will be only about ½ to ⅔ as many high frequency channels available.

Walter F. Bain operates W4LTV on 144 mc from his home in Springfield, Va. Like most meteor trail amateurs, he usually has arrangements made with another station to go into operation during one of the larger meteor showers.

What does an amateur need for meteor trail work? Here is Bain's answer:

1. Transmitter. A VHF transmitter of at least 100 watts, 500 is better (although some amateurs have operated over long distances with as little as 25 watts when the meteors have been large). It should have good frequency stability, and the operator must be able to measure the frequency accurately so he can notify his intended listener exactly of the frequency to monitor.

2. Receiver. Don't pinch pennies—get a good communications receiver with a low noise converter. The receiver also should have good frequency stability since the receiving operator will be listening for a message that usually will last only five to 15 seconds. Frequencies at both ends of the system must be accurate—there is no way to search for the sender.

3. Switch. Each rig should be equipped to switch easily and rapidly from transmitting to sending and *vice versa* since each station's function will alternate usually four times per minute.

4. Antenna. The antenna must have at least 10 db actual gain. It can always be simple, such as Bain's four sets of 12 element Yagis, each mounted on an 18 ft. boom. W2NLY set the 144 mc distance record with eight 12-element Yagi stacked four high and two wide. It does not have to be a Yagi antenna. Another good configuration is a 16-element broadside colinear antenna. Any of these will give a 13 db gain or better.

5. Clock. An accurate clock—the larger the face the better—with a sweep second hand so you can accurately time the alternating 15 seconds transmitting and listening periods.

6. Key. Any standard or semi-automatic key will suffice, just so it permits the highest keying speed that can be copied conveniently.

7. Optional Equipment. The only major equipment you may want to use beyond the essentials would be some automatic aid to message transmitting and copying since the message period of a meteor reflection is so brief and since you will be repeating messages over and over every 15 seconds. An automatic key or a toothed wheel coded with a standard message helps. Probably best is a tape recorder that rapidly plays a message that was recorded slowly and that can record

the other party's messages for slower playback and copying later.

Bain believes an ingenious amateur who is able to buy items from surplus stocks or make much of his own equipment can get well into VHF meteor trail work for under $500. The largest single expense will be $200 or more for a good receiver. Bain's antenna cost only $120: $50 for aluminum pipes and rods, $80 for a tower for which other operators might find a substitute.

The time of day, the season and the latitude dictate the number of meteors that will pass through a portion of the atmosphere per minute. In the Northern hemisphere, Fall is the most active time, while Spring is the least active. Meteoric bombardment is 20 times as high at sunrise as it is at sunset.

Meteors are far more common during several annual meteor showers. It is during these widely publicized showers that amateurs have their greatest success. Table A lists the major showers, their dates, the times during which they are faced by North America, and the times during which an operator should transmit to get the best results in various directions. The shower in August which appears to come from the constellation Perseids is the best shower for ham operation. Nearly as good, though, is the December shower that appears to come from the Geminids. The Perseids offer about 100 meteors per hour. When meteors collide with molecules of the atmosphere, they leave a trail of metallic ions and free electrons. Radio signals can be reflected from these ionized trails just as they reflect from ionized layers of the atmosphere.

The direction from which a meteor or shower of meteors seems to be coming is called the radiant. For the Perseids shower, the constellation Perseids is the radiant since the shower appears to be coming from that direction. The large meteors will scatter a radio signal in all directions and the operator need only transmit during a good shower to be sure of hitting a few large meteors. However, the small meteors call for a special meteor trail geometry to be applied for communications. Stated most simply, the geometric rule is this: Work on a path at a right angle to the radiant.

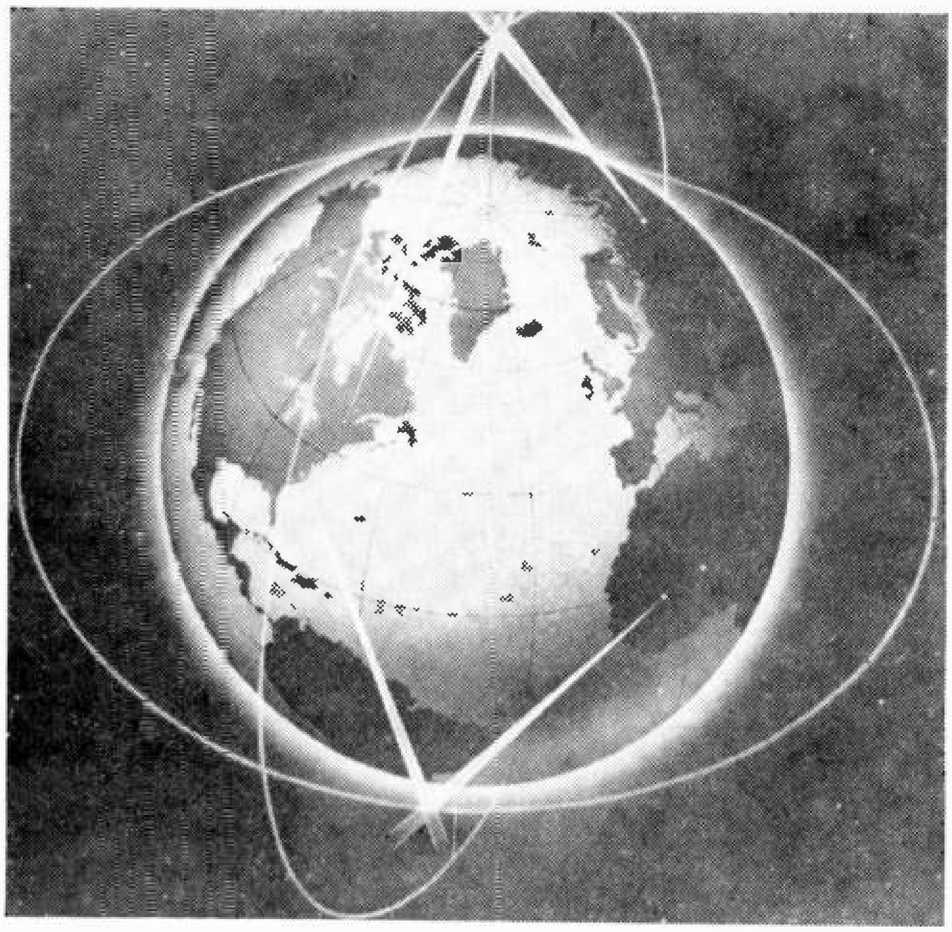
This rule has been taken into account by Walter Bain who prepared Table A. For example, if you wish to contact a station Northwest of you during the October Orionids shower, consult the table and you will see that the earth will be so located between 4:30 and 6:00 a.m. that your SE-NW transmission direction will be at right angle to the shower's apparent direction.

Here is another example. You are in New York and wish to contact Chicago late in July. This is during the Aquarids shower. Your path is East-West, so the information in column 3 is applicable. The best activity is between 1:00 and 3:00 a.m., local standard time. Remember that there is a one-hour time difference between New York and Chicago. If the peak of activity is 2:00 local time (this is not necessarily true) this means that so far as you in New York are concerned, the peak for New York is 2:00 a.m., New York time, but, also in New York time the peak for Chicago is 3:00 (2:00 Chicago time).

Once you have selected the day and time for communication, arrange for one station to transmit the first and third 15 seconds of each minute while the other listens. The second station transmits the second and fourth 15 second period while the first station listens.

TABLE A—THE METEOR SHOWERS

Date and Shower	Time Visible	Best Times for Transmission Over Various Paths: E-W	NW-SE	SW-NE	N-S
January 1-4 Quadrantide	11am-6pm	8-9pm	3-8am	9am-2pm	—
April 19-23 Lyrids	9pm-11am	—	11:30pm-1am	7-8:30am	2:30-5:30am
May 1-6 Aquarids	3am-12noon	6:30-8:30am	8:30-10am	5-6:30am	—
July 26-31 Aquarids	10pm-6am	1-3am	3-5am	mid-1am	—
August 10-14 Perseids	at all times	3-8am	11:30pm-3am	6-11:30am	—
October 9 Giacobinids	6am-3am	4-5pm	11am-4pm	5-10pm	—
18-23 Orionids	11:30pm-9:30am	3:30-4:30am	4:30-6am	2-3:30am	mid-8am
November 14-18 Leonids	mid-12:30pm	—	—	—	3-5am and 8-10am
December 10-14 Geminids	7pm-9am	—	9:30-11pm	5-6:30am	mid-3:30am
DAYLIGHT METEOR SHOWERS					
May 19-21 Cetids	5:30am-2:30pm	9-11am	11am-2.30pm	7:30-9am	—
June 4-6 Perseids	5am-5:30pm	—	—	—	8-10am and 1-3pm
8 Arietids	3:30am-3:30pm	—	—	—	6-8am and 11am-1pm
June 30-July 2 Taurids	5am-5pm	10:30-11:30am	11:30am-1pm	9-10:30am	7-9am and 1-3pm



Two orbital scatter belts placed east-west over the equator and north-south over the poles will relay world-wide long-distance radio messages under a new communication system that will replace the presently used ionized layer of atmosphere.

ORBITING NEEDLES To Aid Communication

A MAN-MADE ionosphere—composed of millions of tiny metal needles—soon may replace the ionized layer of atmosphere presently used in radio communication.

The artificial ionosphere, actually two narrow bands of needles, 3,000 to 6,000 miles from Earth, will make possible for the first time reliable, high-quality and low-cost, television, voice radio and teletype communication between any two points on Earth.

Unlike the natural ionosphere, the bands will stay at the same distance from Earth, have a constant density and the same radio-reflecting qualities undisturbed by storms and sunspots. The system has been developed by the Massachusetts Institute of Technology and the Air Force Air Research and Development Command.

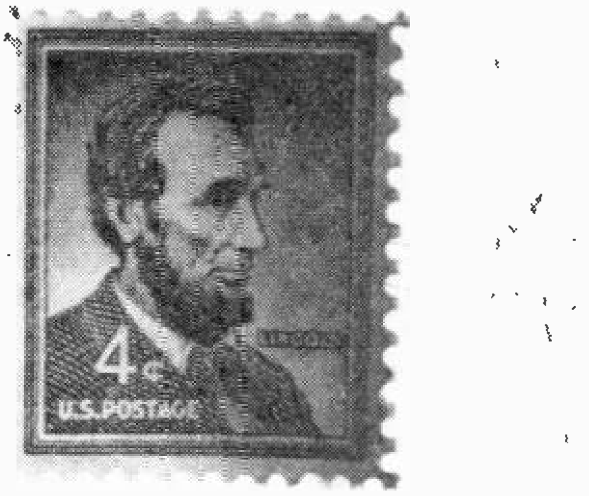
The metal fibers are about ½ in. long and ⅓ the thickness of a human hair. They will work in space much as conventional dipole antennas.

When "Project Needles" goes operational the dipole needles will be made of copper and will last for two to three years before they have to be replaced. However, the needles orbited in a test early in 1961 probably will be made of white tin so they will disintegrate within a year. This is to meet the objections of some astronomers who believe the artificial ionosphere bands will hamper optical and radio telescopes.

The system's developers though, W. E. Morrow, Jr., of MIT and Harold Meyer of Thompson-Ramo-Wooldridge Corp., say there will be no interference. The tiny particles will be hundreds of feet apart in orbit. The bands will be only five miles wide and 20 miles thick. They will reduce the light from stars (in the few instances when the band lies between a star and the telescope) by only one ten-billionth. Radio telescope reception will be reduced by only a millionth.

Orbital scatter has several additional advantages over other long distance communications techniques being tried. Two small rockets can orbit the cannisters that will dispense the dipole needles.

Also, just 9 oz. of the metallic fluff has the same radio wave reflection quality as the 100-ft. dia. Echo balloon. Moreover, communications satellites have to be tracked steadily by special rotating transmitters and receivers; orbital scatter calls for just a few degrees of predictable shift each day. And a single belt of dipole needles can handle many more channels than can a communications satellite.—S. DAVID PURSGLOVE.



Fine metallic fibers like these at the right of the postage stamp will be placed in orbit around the earth to relay radio messages. Two of these fibers will reflect as much radio energy as a flat surface the size of the stamp.

CUT OUT AND MAIL TODAY

SCIENCE and MECHANICS' DO-IT-YOURSELF LIBRARY

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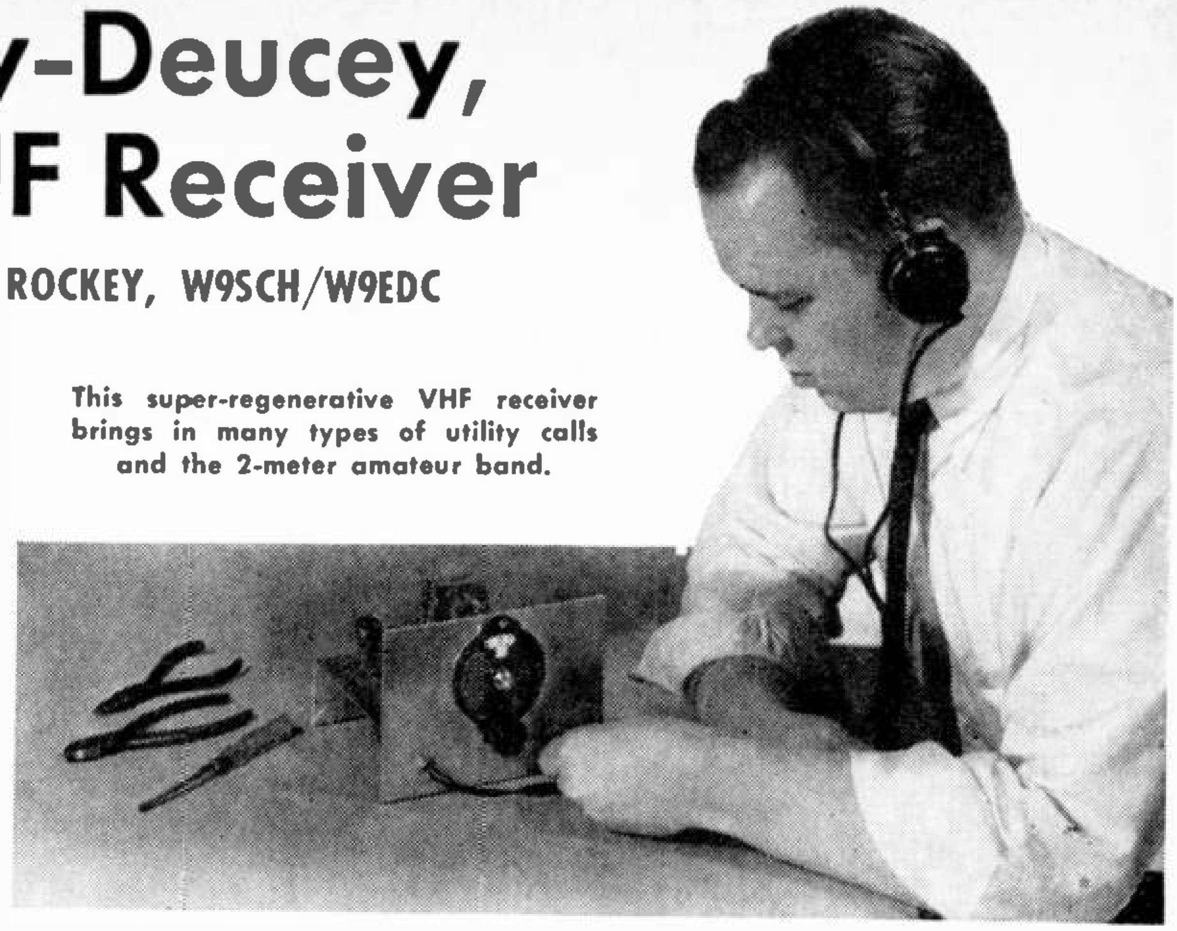
A Davis Publication
450 East Ohio Street
Chicago 11, Illinois

Acey-Deucey, A VHF Receiver

BY C. F. ROCKEY, W9SCH/W9EDC



This super-regenerative VHF receiver brings in many types of utility calls and the 2-meter amateur band.

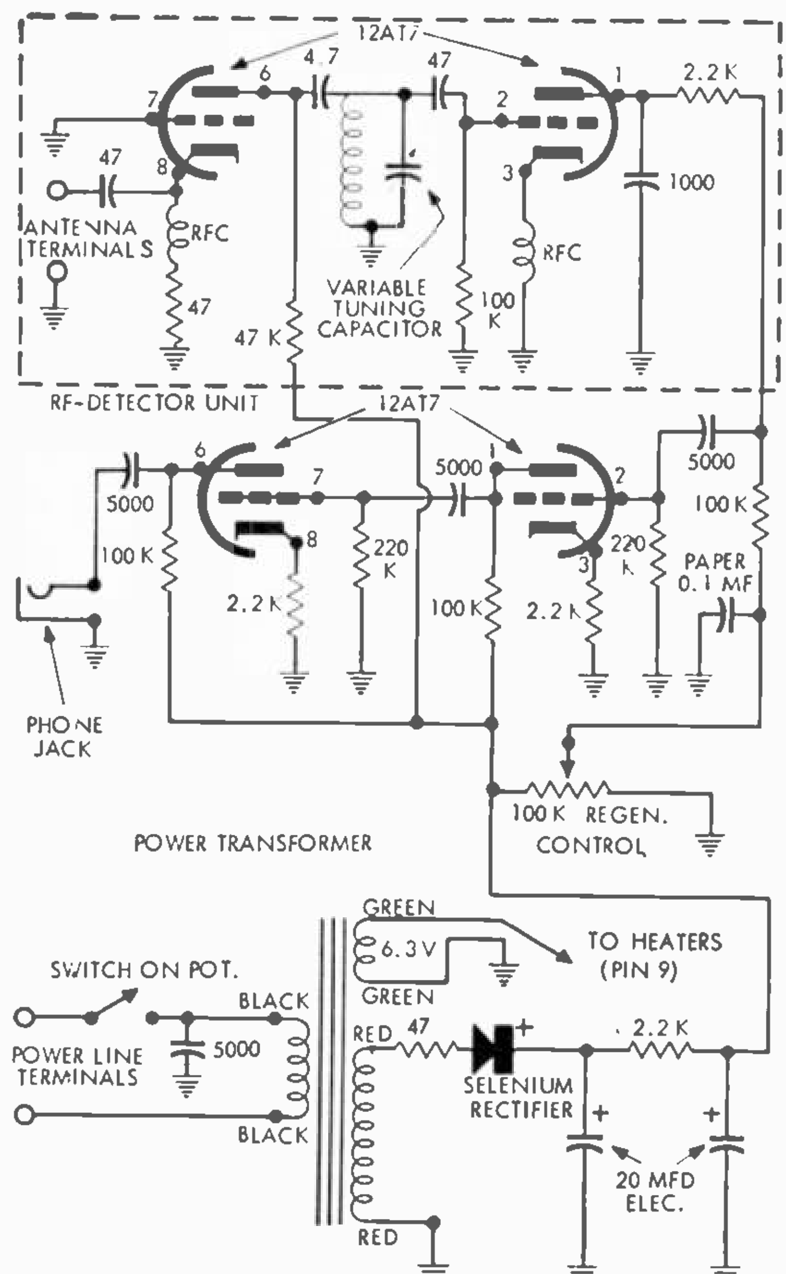
THE ordinary SW frequencies below 30 mc. are becoming more crowded with routine operations every day, so these are now largely old hat. The VHF's the thing today, and this little receiver will introduce you to an interesting slice of the VHF at modest cost. With it you can eavesdrop upon aircraft communications, taxicab dispatchers, police-calls, industrial communications, and that great source of interest to all experimenters, the 144-mc, 2-meter amateur band.

While it can hardly compare with a good VHF superheterodyne, you will be pleasantly surprised with its performance, especially as you grow more proficient in tuning. And you can build it for only about $20. The RF amplifier minimizes interfering radiation to other sets.

Begin construction by bending-up the aluminum chassis (Fig. 3) from a flat cookie-sheet or sheet aluminum. Or you can buy a 5 x 7-in. chassis. Punch the socket hole in the chassis with a ¾-in. socket punch, and drill the holes for the potentiometer, 'phone jack and tuning capacitor shaft with a ⅛-in. drill, and ream to ⅜ in. with the tang of a mill file or a taper-reamer. Drill the jack and pot holes in the front panel, then use the panel as a template to drill the chassis. This will assure proper matching. Do not mount the panel upon the chassis until the very last; it will get in the way of wiring and assembly.

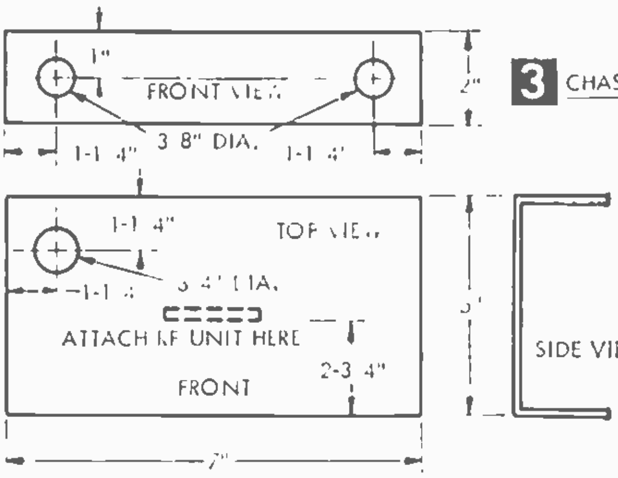
Mount the power transformer under the chassis (Fig. 5) using the transformer as template for drilling holes to take the 6-32 screws. Then mount the 4-terminal Cinch-Jones strip. Deburr the holes for the power line leads. Now, mount the tube (AF) socket with 4-36 screws and nuts using the socket as guide for drilling. Put a lug under one of the screws to be used as a ground.

Now mount the selenium rectifier by its mounting screw in the position shown in Fig. 5. Also mount the 100K regeneration control potentiometer temporarily in its hole, as you'll need to make connections to its switch

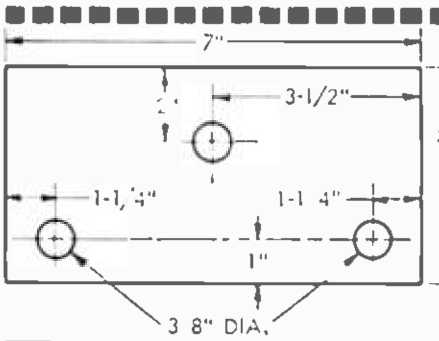


ALL RESISTORS IN OHMS
ALL CAPACITORS IN MMF, UNLESS OTHERWISE STATED

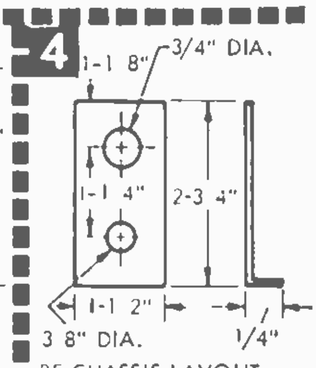
2 SCHEMATIC



3 CHASSIS LAYOUT



3 FRONT PANEL LAYOUT



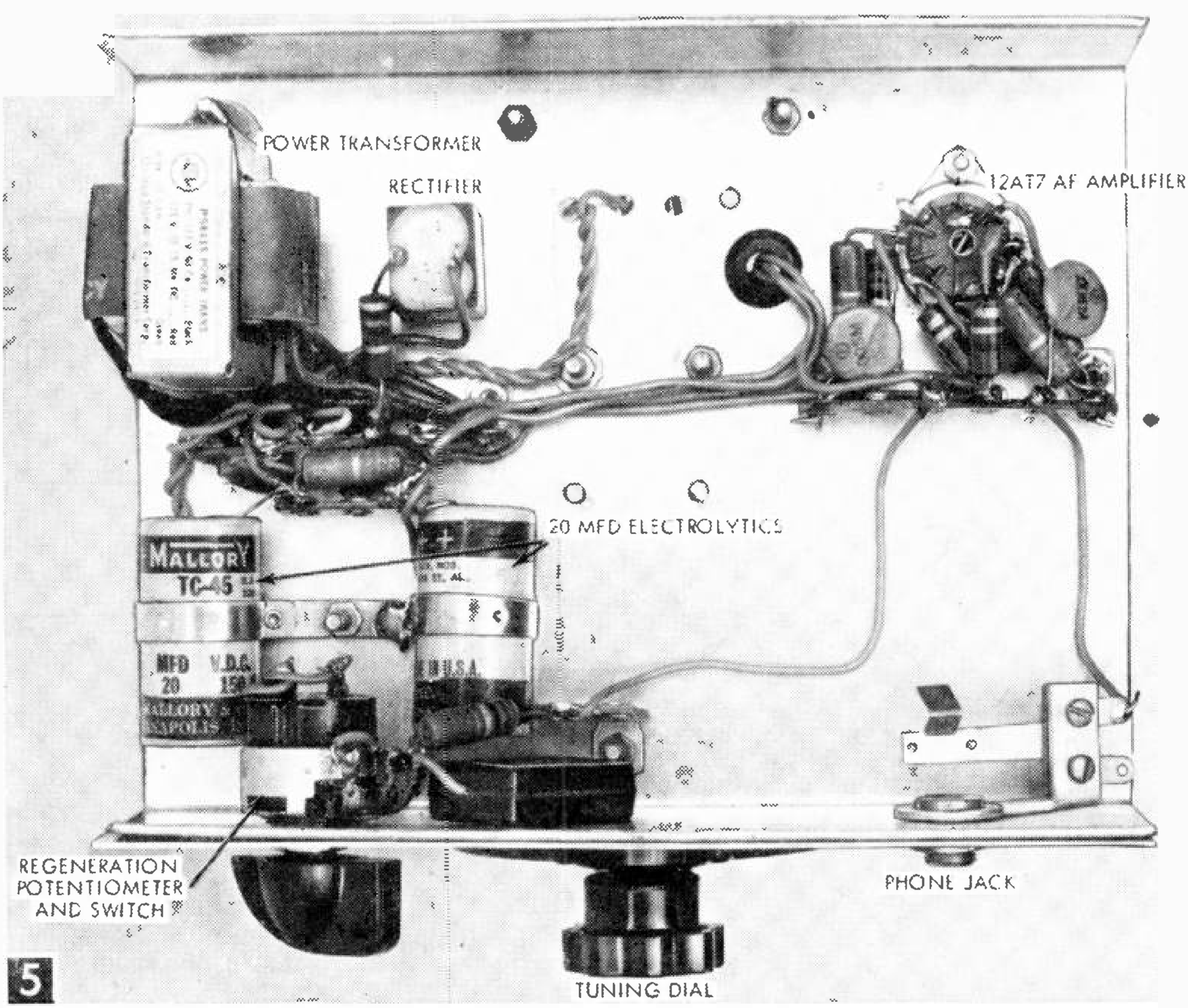
4 RF CHASSIS LAYOUT

Under chassis view of receiver shows parts layout and wiring.

right away. Next, wire the power supply, using the schematic (Fig. 2) as a guide. Start with the power leads associated with the primary (black) leads of the power transformer. Connect these through the potentiometer switch to the power line terminals on the terminal strip. Don't forget the 5000 mmfd capacitor (filters line hum) from one side of the line to ground. Use insulated tie-lugs to hold the wiring in place.

Next, connect in the selenium rectifier and the electrolytic filter capacitors. Be extremely careful to observe polarity of both the rectifier and of the electrolytics. Hold the filter capacitors in place by their brackets and by fastening their hot leads to an insulated tie lug. When the power supply is wired, with an ohmmeter measure the resistance from the hot terminals of each electrolytic to chassis ground. Readings of at least 10,000 ohms indicates no shorts.

Connect the line cord to the line terminals upon the terminal strip. Plug the cord into a power outlet and turn on the pot switch. A voltmeter connected from the hot side of the output (farthest from rectifier) filter capacitor should indicate a dc voltage of 100-200 v., usually about 150.



5

Now, wire the audio amplifier. Temporarily install the 'phone jack, and wire the output audio amplifier stage.

Tie lugs 4 and 5 together and connect to ground. Connect the ungrounded green (6.3 v.) lead from the transformer to pin 9 (the heater connection). Then wire in the grid, plate and cathode circuits. Use insulated tie lugs as needed.

Plug in a good 12AT7 tube. Connect the power cord to the line, turn on the switch, and plug a pair of headphones into the 'phone jack. Holding onto the blade, touch a screwdriver tip to pin No. 7. A buzzy click indicates that the stage is OK.

Now complete wiring the first stage of the audio amplifier. Use insulated tie lugs as needed.

When done and checked, insert tube, 'phone plug and line cord. When tube is warm, touch screwdriver blade to pin Number 2. A much louder clicky buzz should come from the 'phones, indicating success.

Next, wire in the connections to the potentiometer, the 100K detector load resistor and the coupling capacitor (5000 mmfd) to the grid of the first audio amplifier.

The rf-detector unit is built upon a 1½ x 3-in. aluminum angle piece, cut, bent and drilled according to Fig. 4. The ⅜-in. hole is for the tuning capacitor, the ¾-in. hole is for the 12AT7 socket. Fasten a double insulated tie lug under each socket mounting screw to serve as terminals for the leads to the rest of the circuitry and to hold small parts firmly in place. Mount the tuning capacitor last.

Wire the rf-detector unit. All of the circuitry enclosed within the dotted enclosure on the schematic is on the rf-detector unit.

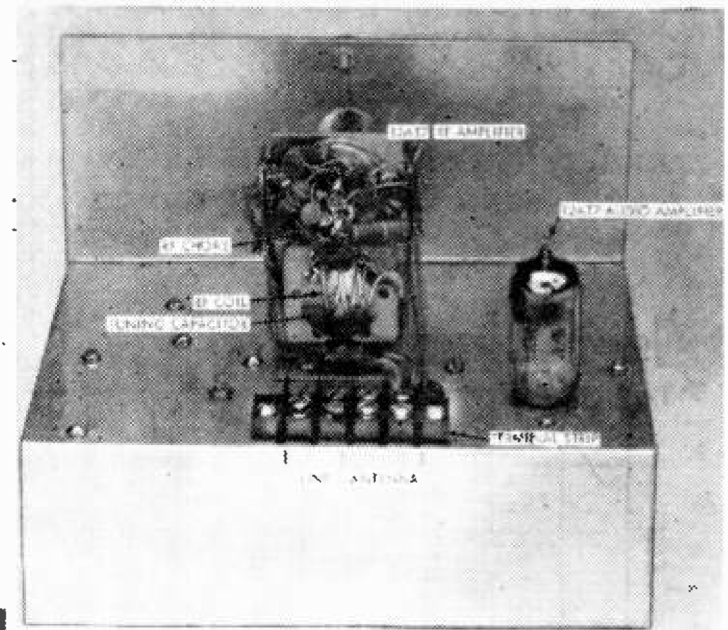
Remove one rotor plate from the variable capacitor by grasping it firmly with long-nose pliers, leaving only one rotary plate in the unit. Check carefully to see that this plate does not touch the stator plates at any point of its rotation, and then mount it and wire it into the unit.

Complete the unit by winding and installing the coil (Fig. 7) between the rotor and stator connection lugs of the variable capacitor. This coil consists of three turns of #14 wire. Wind the turns around a ⅜-in. twist drill shank or a fountain pen. Keeping the leads as short as possible, connect this coil directly across the tuning capacitor.

Fasten the rf unit to the chassis with 6-32 screws. Then complete the connections to the power supply and audio amplifier. Bring these leads through a ½-in. grommeted hole. Loosely twist two pieces of hookup wire together and connect this twisted pair to the antenna terminals. One side of the other end of this pair goes to the 47 mmfd capacitor, the other to ground, as close by the input circuit as possible. This completes the wiring.

Insert the tubes, connect power, and plug in phones. As the regeneration control potentiometer is advanced, the circuit breaks into superregeneration, as indicated by a smooth, strong hiss. As the regeneration control is adjusted throughout its range, it is possible to vary the strength of this hiss from inaudible through medium level to strong.

Drill the mounting holes in the front panel



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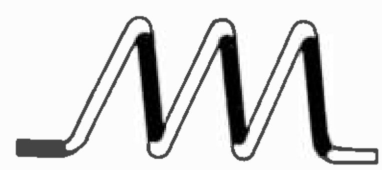
The RF detector unit is in the center in this top-chassis view. This unit is wired in late in construction.

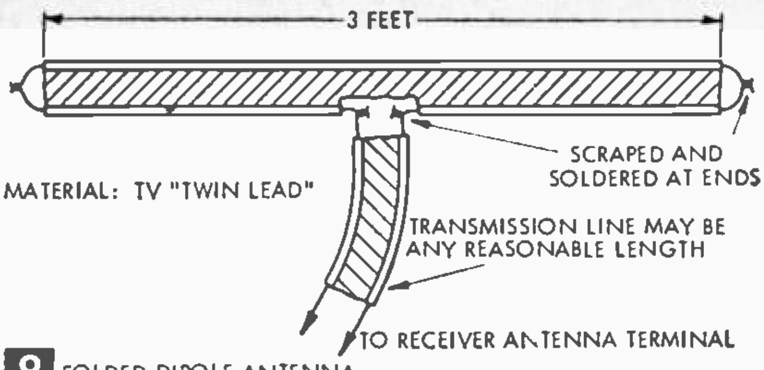


3 TURNS # 14 WIRE   3/8" INSIDE DIAMETER

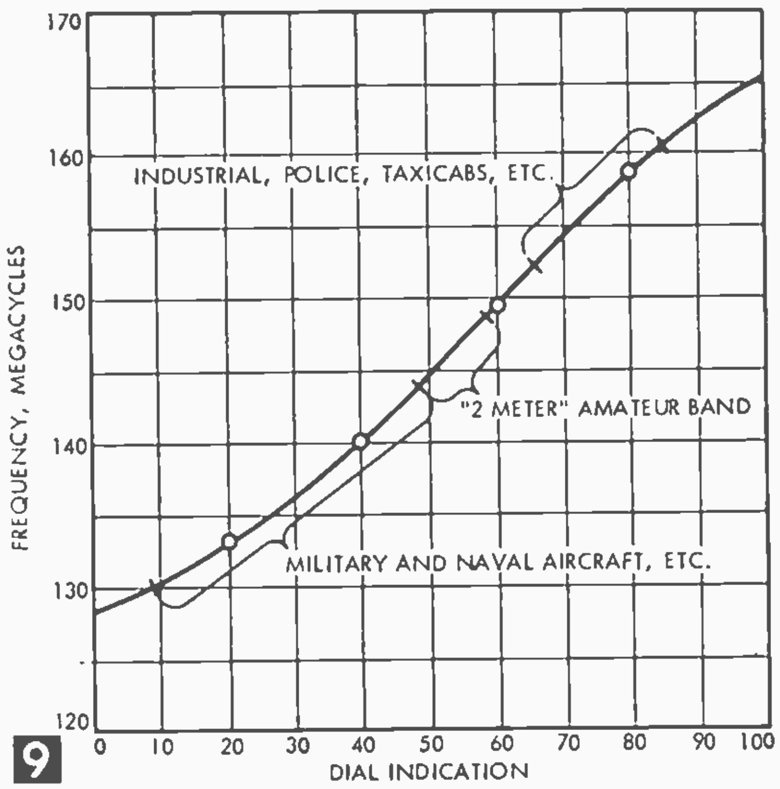
7 COIL:

MATERIALS LIST—VHF RECEIVER

No. Req'd.	Size and Description
1 pc	16 ga. x 7 x 9" aluminum for chassis
1 pc	16 ga. x 5 x 7" aluminum for panel
1 pc	16 ga. x 1½ x 3" aluminum for rf unit
1	venier dial (National type BM)
1	bar knob
1	100K linear-taper potentiometer with switch (IRC)
1	single-circuit 'phone jack (Mallory)
1	shaft coupling, ¼" to ¼"
1 pc	plastic, rod, ¼" dia. x 2½" long
2	9-pin miniature sockets (Amphenol)
1	Cinch-Jones 4-terminal barrier strip, about 1" wide
1	variable capacitor (Hammarlund type HF-15)
1	power transformer (Stancor No. PS-8415)
1	selenium rectifier (Sarkes-Tarzian Model 50)
2	electrolytic capacitors, 20 mfd., 150 W.V. (Mallory type TC-45)
1	0.1 mfd., 200 W.V. paper capacitor (Mallory)
1	line cord and plug
1	pair headphones (Trimm "Dependable")
1	phone plug
2	12AT7 vacuum tubes
2	Miller type 4605, 2.5 microhenry, RF chokes (or can use Ohmite Z-144 1.8 microhenry)
4	2.2K ohm, 1-w. carbon resistor
1	47K ohm, 1-w. carbon resistor
4	100K ohm, 1-w. carbon resistor
2	220K ohm, 1-w. carbon resistor
2	47 ohm, 1-w. carbon resistor
2	47 mmfd disc ceramic capacitor
1	4.7 mmfd disc ceramic capacitor
1	1000 mmfd disc ceramic capacitor
4	5000 mmfd disc ceramic capacitor
	300-ohm twin-lead for antenna, if needed
	hook-up wire, rosin-core solder, screws and nuts, No. 14 tinned wire, 3 and 4-point insulated tie lugs, soldering lugs, rubber grommet.



8 FOLDED DIPOLE ANTENNA



9

Approximate calibration curve of author's receiver.

for the tuning dial using the template supplied by the manufacturer. Then, install the panel. It is held firmly in place by clamping tightly under the potentiometer and 'phone jack binding nuts.

Place the shaft coupler upon the capacitor shaft, then pass a length of plastic or fiber rod through the hole in the dial and into the coupler. Tighten down all setscrews firmly, setting the dial so that the indicator points to 100 when the tuning capacitor plates are fully unmeshed (all the way out) then saw off the plastic rod flush with the end of the dial bushing and insert the bushing cover.

If your present TV antenna is high and pointed in the right direction, you will probably have fairly good results when used with this receiver. Or, you may make a suitable antenna by following Fig. 8. Be sure that your antenna is high, as your receiving range depends directly upon its height.

As in the case with all simple receivers, the number of and distance of signals you hear will depend directly upon the skill with which you use this little set.

Correct use of the regeneration control is often a key to good results. Always adjust the regeneration to the lowest possible level consistent with signal clarity. This is particularly true when receiving the narrow-band FM transmitters, widely used by police and industrial services. If the regeneration control is advanced too far, all you'll hear is an unmodulated, blank carrier.

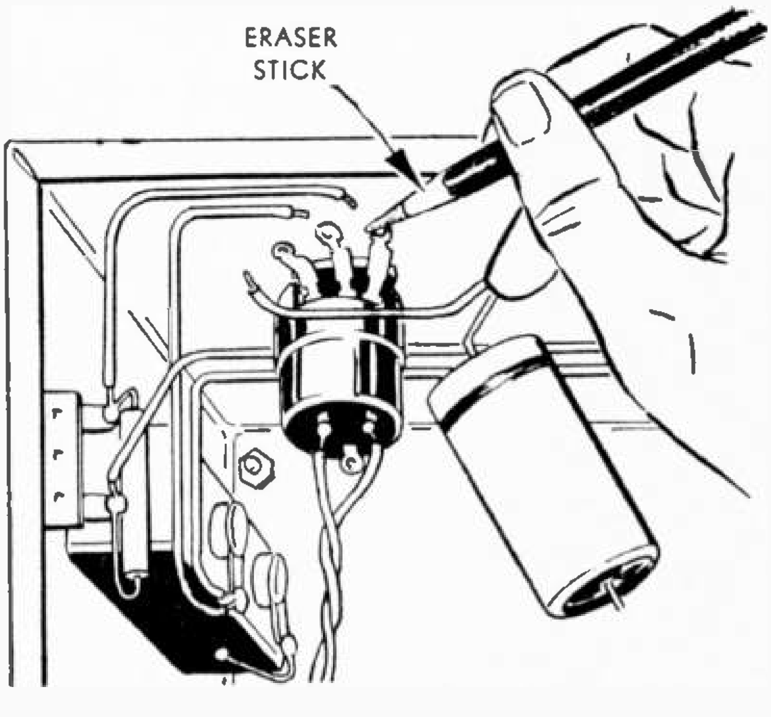
If you particularly wish to hear 2-meter amateur signals, you may spread-out the number of dial divisions occupied by the amateur band, if you remove all but one rotary and one stationary plate from the variable capacitor. This will demand some readjustment of the coil. In this case, make final tuning-range adjustments with a grid-dip meter.

Figure 9 represents the frequency calibration of the author's receiver. Yours will be somewhat near, but probably not exactly the same, due to minor construction differences. You may calibrate your receiver by use of the grid dip meter.

You may alter the tuning range of this receiver by soldering-in coils of either more or less turns than those specified. Due to differences in lead length, etc., it is impractical to predict just how many turns would be required to tune over a specified range with your layout; a grid dip meter will enable you to make these determinations in your own individual case. By such coil changes it should be possible to cover from about 100 to about 200 mc. Do not try to incorporate coil switching into this circuit; the increased capacity and inductance introduced by the switch will probably completely spoil the set's operation, particularly at higher frequencies.

Eraser Cleans Terminals

• If the terminals or lugs in a radio circuit are scoured clean of dirt and oxidation before wires are soldered to them, there's less likeli-



hood of obtaining a troublesome cold solder joint. To clean terminals deep down among wiring where sandpaper cannot reach, use a pencil-shaped eraser.—John A. Comstock.

Transistor Tester

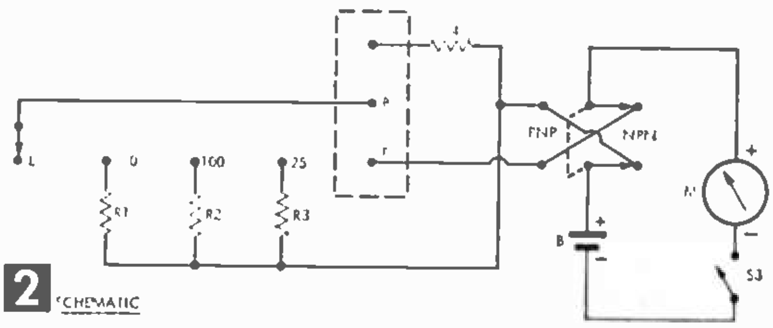
Compact unit indicates leakage current and beta

By FORREST H. FRANTZ, Sr.

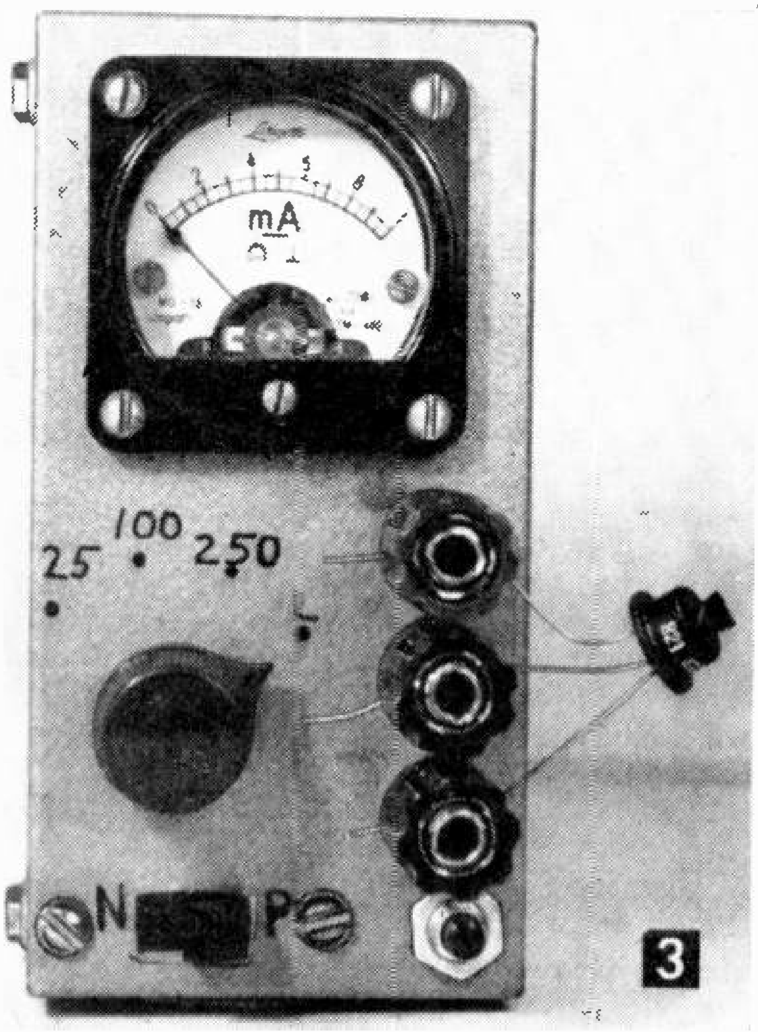
IF you experiment with electronics you have or you will get into transistor circuit experimentation and construction. The condition of the transistor which you use in your circuits will determine the quality of the operation of your circuits. It's heartbreaking to search for circuit troubles only to find a bad transistor after a considerable expenditure of time. Many difficulties can be avoided by testing transistors before you place them in circuits. This transistor tester will do the job.

Not all transistor testers are alike. There are desirable features which transistor testers should possess to be most useful. One important feature is provision for universal connection of any type of transistor. Testing under collector current conditions approximating those under which transistor characteristics are compiled (most often 1 ma.) is another desirable feature. The tester should be off unless the on-off switch is depressed. Other desirable features (most transistor testers have these) are npn-pnp selector switch, range-leakage switch, and direct reading beta scale.

Many of the features of larger units are to be found in this transistor tester.



SCHEMATIC

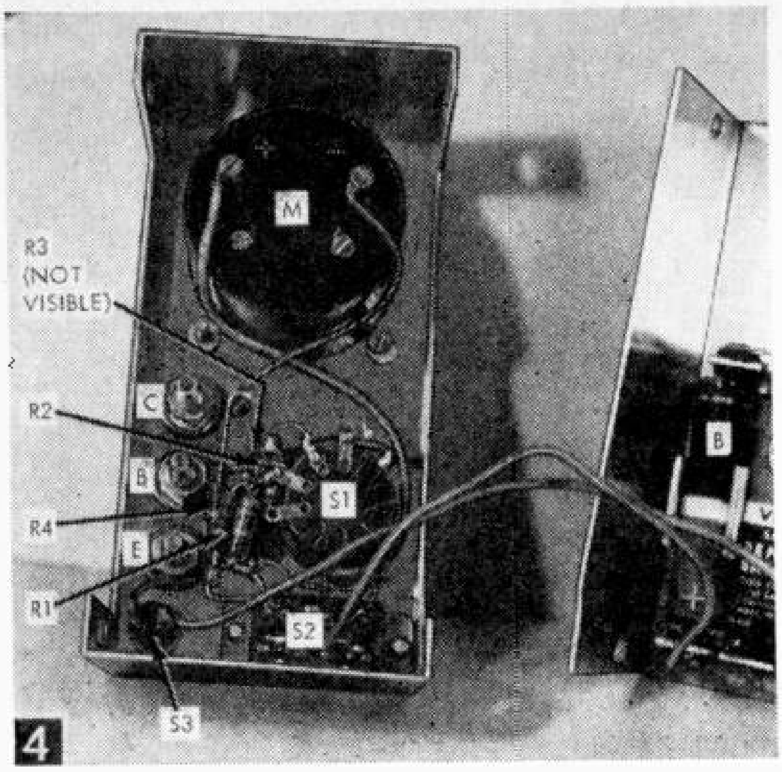


Front view of the tester with a transistor connected for test.

This compact transistor tester has these features, and in addition is small enough to fit in your pocket (case is only 1⅝ x 2⅛ x 4 in.). The case is a rugged aluminum box that can stand rough handling. And the batteries are penlite cells—easy to obtain anywhere.

The hole layout for the case is shown in Fig. 5. All holes except the meter and switch hole are made with a ⅛-in. drill. A taper reamer may be used to enlarge holes where greater diameters are required. The large meter hole may be made with a hole punch, a fly cutter or by drilling a series of holes with a small drill and smoothing to size with a small file. The rectangular hole for the npn-pnp switch can be made by drilling several ⅛-in. holes and smoothing to size with a small file. It's a good idea to fasten the back to the case for extra support before drilling holes.

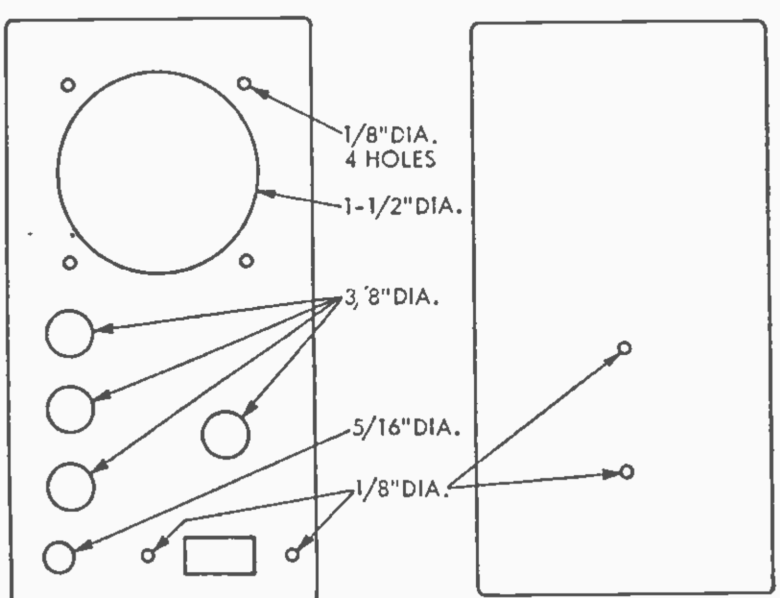
Mount the switches, terminal posts and meter on the front of the case, following Figs. 3 and 4. Mount the battery holder on the case back. Turn the battery holder lugs over till they touch, and solder for series connection. Fill the battery holder eyelets with solder to assure good connection to the batteries. Then



This inside panel view shows parts mounting and wiring.

MATERIALS LIST—COMPACT TRANSISTOR TESTER

Desig.	Description
R4	2.2K, ½-w. carbon resistor (10%)
R3	15K, ½-w. carbon resistor (10%)
R2	600K (680K and 4.7 meg. ½-w. carbon in parallel)
R1	1.5 meg. (3.3 meg. and 2.7 meg. ½-w. carbon in parallel)
S1	SP4T miniature rotary switch (Grayhill 5001-4)
S2	DPDT slide switch (Lafayette SW-17)
S3	SPST normally open momentary contact sw. (Grayhill 30-1)
M	0-1 ma. dc meter (Lafayette TM-400)
B	four 1.5 v. penlite cells in series (Burgess #7)
	battery holder (Lafayette MS-170)
	binding posts (Grayhill, 1 red 29-3R and 2 black 29-3B)
	1⅝ x 2⅛ x 4" aluminum case (Bud CU-2102-A)
	knob (Lafayette KN-19)



REAR VIEW OF FRONT PANEL 5 REAR VIEW OF BACK PANEL

proceed with the wiring of the tester according to the schematic (Fig. 2) and Fig. 4.

Note that a 3.3 megohm and a 2.7 meg. resistor are connected in parallel to produce a resistance of 1.5 megs. (R1). A 680K and 4.7 meg. resistor are connected in parallel to obtain a resistance of 600K (R2). If you compute the actual values of these parallel combinations, you'll find that they differ slightly from the values cited, but they're sufficiently close for all practical purposes.

Markings may be made on the front of the transistor tester case with India ink. Cement four small rubber grommets to the back of the case to serve as feet for the tester.

Operation. To use the transistor tester align the transistor leads and insert them in the terminal posts. The red (top) terminal post is the collector terminal. The base connects to the middle terminal, and the emitter connects to the lower terminal.

Set the npn-pnp switch for the type of transistor to be tested. Set the range switch to the leakage (L) position. Depress the on-off switch. The meter reading is the leakage current for the common emitter configuration.

Next, rotate the range switch to the range which gives the fullest scale reading when the on-off switch is depressed without deflecting the meter off scale. The beta of the transistor is the meter reading the range switch multiplier.

Example 1: A GE 2N107 transistor was tested. Leakage current was .1 ma. (100 microamperes). On the 100 range, the meter read .35. Beta was .35 x 100 or 35. The beta was relatively low in this case.

Example 2: A GE 2N508 transistor was tested. Leakage was .15 ma. The meter read .5 on the 250 scale. Beta was .5 x 250 or 125. Beta was relatively high in this case, a good argument for using the better entertainment grade transistors in preference to experimenter grade transistors.

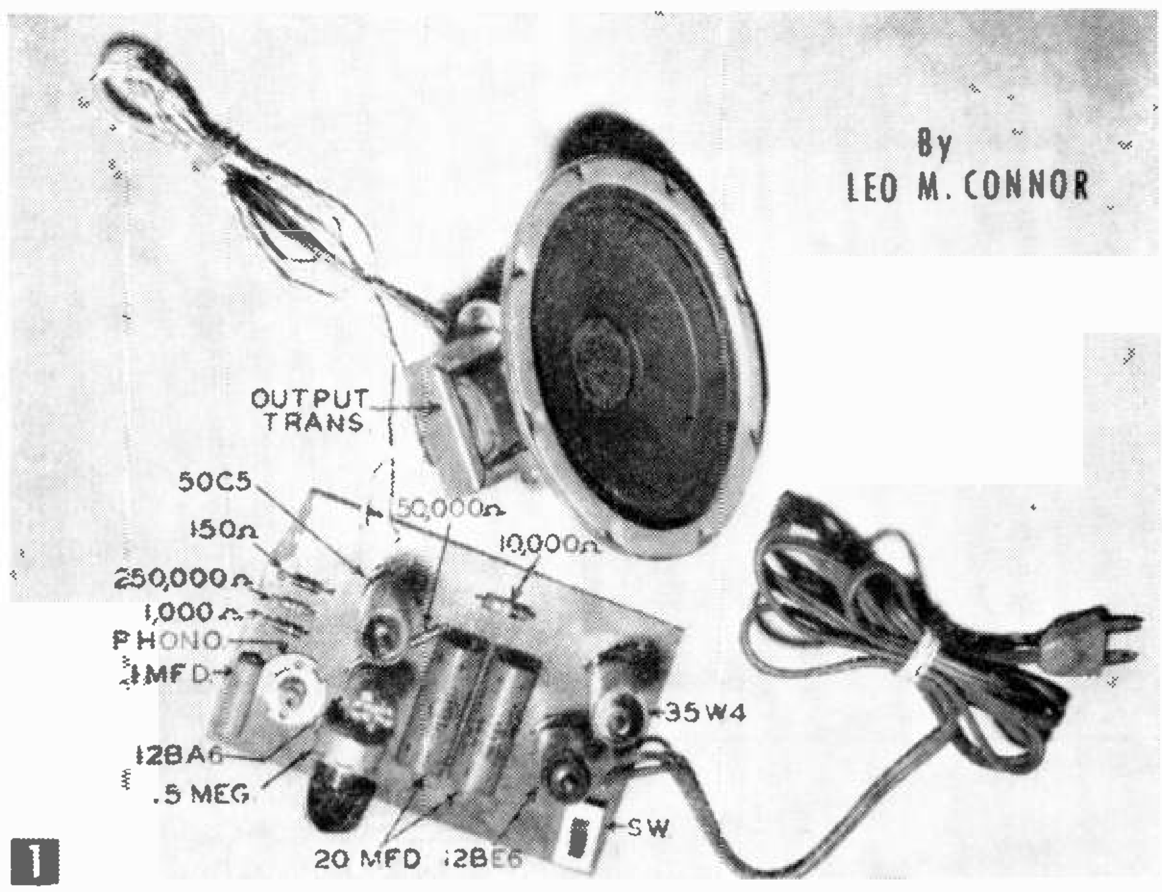
Your compact transistor tester will help you to get the most out of your transistor work. It will emphasize transistor qualities that make transistor circuits perform well or otherwise. This tester will save you time and trouble.

The figure of merit of a transistor that is most commonly recognized is Beta. Beta is collector current divided by base current in the common emitter circuit configuration. Resistors R1, R2 and R3 provide base currents of 40, 10 and 4 microamps respectively for full meter deflection on the 25, 100 and 250 beta ranges. The base is left open for the leakage measurement. Leakage current for the common base configuration, frequently referred to as Ico, may be computed by dividing leakage current by beta. Thus, Ico in example 1 was 100/35 or approximately 3 microamps. In example 2, Ico was 150/125 or approximately 1 microamp.

The 2.2K resistor in series with the collector terminal limits meter current to a safe value if a short circuited transistor is placed in the tester. The double-pole double-throw switch reverses battery polarity to provide proper biases for npn or pnp transistors.

PRINTED CIRCUIT Phono Amplifier

By
LEO M. CONNOR



1

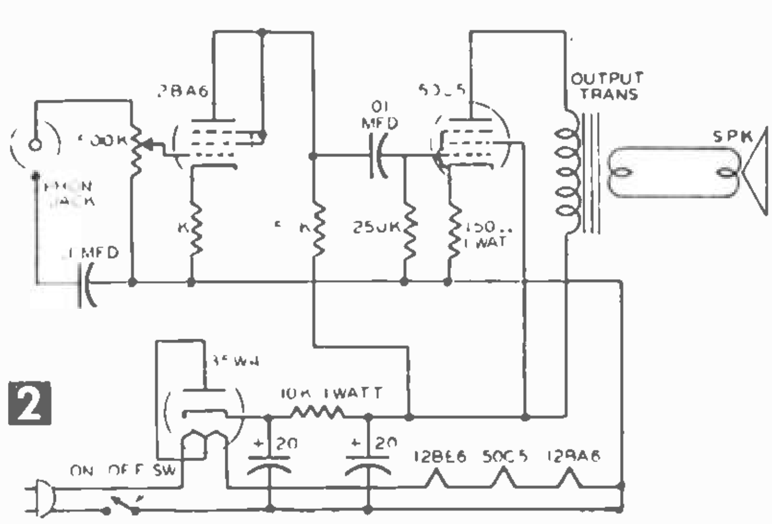
You can play your crystal-cartridge record player through this printed circuit phono amplifier. Or, with a crystal mike it makes a dandy PA system.

WANT to try your hand at making a printed circuit? Here's an easy one to start out with. Figure 3 shows the phono amplifier etched circuit pattern actual size. Try your parts on the pattern to make sure they will fit. The parts will be on top of the board and the pattern under the board.

You will need pencil carbon (not typewriter carbon) to trace the circuit. This paper is coated on both sides and feels soft. Place the circuit board, copper side up, under the carbon paper, the drawing over the carbon and Scotch-tape all together.

Use a 4H pencil with a sharp point. Outline all the dark areas of Fig. 3. For the long, straight lines, place a ruler along the line as a guide for the pencil. Use plenty of pressure on the pencil. First, trace all horizontal marks using a straightedge as a guide. Next trace the vertical lines and then all lines that are at an angle. The circles are traced last. The small circles centered throughout the drawing are hole centers. These may be traced or a small prick punch may be used to mark through the paper and into the copper. In either case, the centers must be accurately located so that the tube socket pins will line up properly.

After all lines have been traced and the hole centers marked, loosen the drawing and carbon paper at one end so you can check and make sure you have not left out any connections. The board is now ready for inking with acid resistant. Apply it to the copper with a pen or small brush. Completely cover all copper that is to be preserved (the dark areas of Fig. 3). The sharpness of the finished pattern will be determined by the sharpness of the ink work, so use care in getting smooth lines. Should you make an error, wait until the ink dries and then erase the line with a hard eraser. For small patterns, ordinary wax crayon can be used instead of acid resistant ink. If this method is used, the pattern can be made like a stencil and the crayon rubbed over the openings. It is advisable to warm the board slightly if you use crayon as an acid resist.



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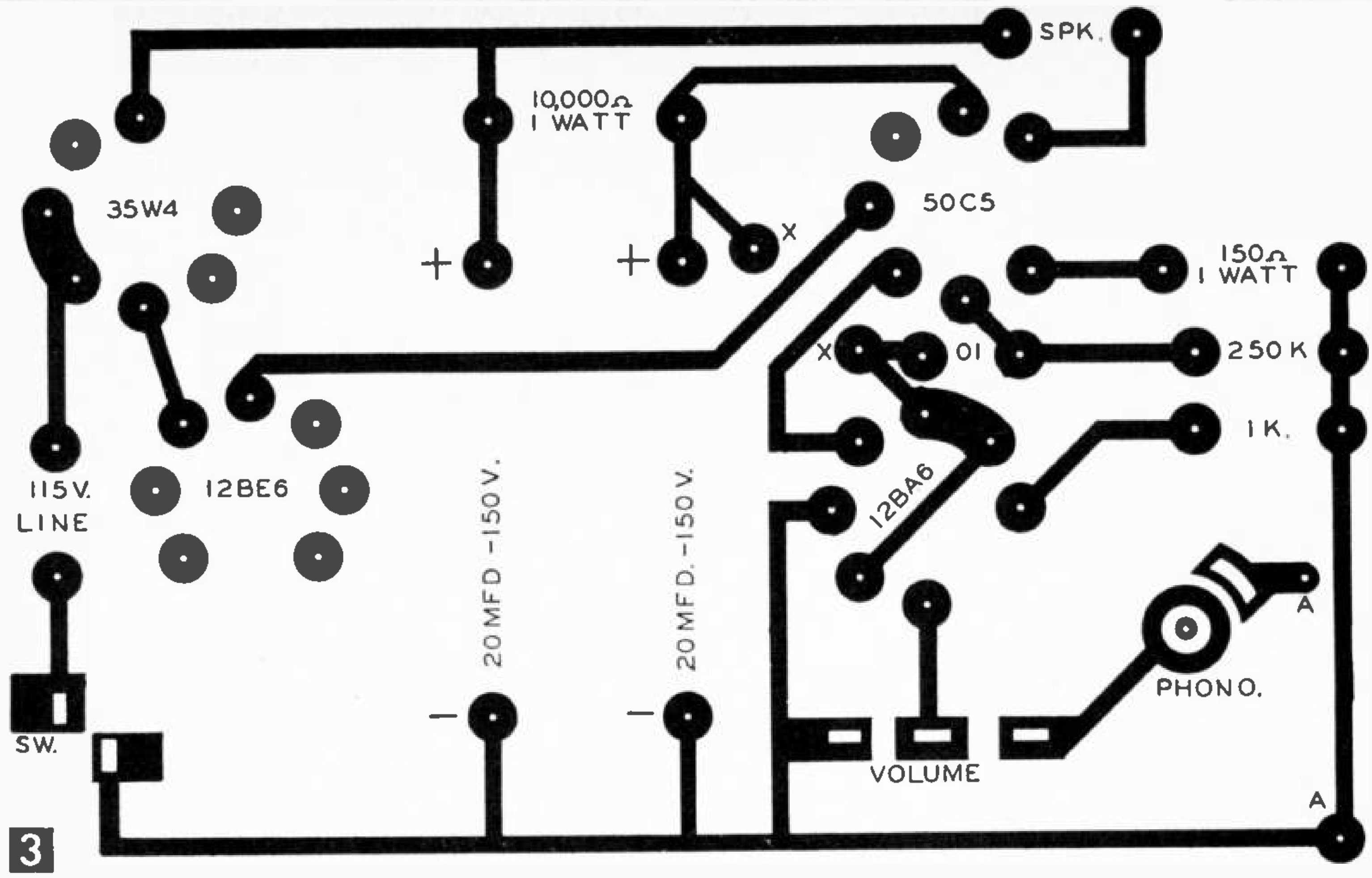


3

MATERIALS LIST—PHONO AMPLIFIER

No. Reqd.	Description
1	1,000 ohm, ½-watt resistor
1	50,000 ohm, ½-watt resistor
1	250,000 ohm, ½-watt resistor
1	150 ohm, 1-watt resistor
1	10,000 ohm, 1-watt resistor
2	20 mfd, 150 v electrolytic capacitor
1	.01 mfd, disc ceramic capacitor
1	.1 mfd, 400 v paper capacitor
1	12BA6 tube
1	12BE6 tube
1	35W4 tube
1	50C5 tube
1	phono connector and plug
1	500,000-ohm audio taper volume control
1	SPST slide switch
1	power cord and plug
1	5" PM speaker
1	output transformer
4	printed circuit tube sockets (Allied 42H411)
	Circuit board and etching materials (Allied 43N069 kit contains all materials, costs $3.38)

If you have punched the hole locations (white dots) be sure that the punch marks are filled with ink. Otherwise, the acid will work there.

The unwanted copper is removed with etchant. Wear rubber gloves and old clothes when working with this acid. Place the etching solution in a glass or enamel pan which is slightly larger than the circuit board.

Etching can be speeded by holding the board in the gloved hand and rocking it so that the acid runs back and forth over the board.

Remove the board from the acid and rinse it in cold running water. Then remove the ink with scouring powder.

The holes for tube socket pins and wire leads are drilled with a #40 drill. Use the centering holes as starting marks for the drill. The only larger hole is for the center connection of the phono jack. Use a ⅛-in. bit after first drilling a pilot hole with the small drill.

The slots for the switch contacts, the volume control and the phono jack ground connection are made by first drilling #40 holes at the ends of the slots and then drilling as many holes as possible between the end holes. Finish the slots with a rat-tail file.

Figure 1 shows all parts except the .01 *mfd* ceramic coupling capacitor. This part is between the 50C5 tube and the 12BA6 tube. Note that all parts are on the side of the board opposite the pattern. Start by mounting the tube sockets. To mount the socket, line up the holes and pins and push the pins through the holes from the top of the board. Solder the pins to the pattern using a light iron, preferably 25 watts, and rosin core solder. Work carefully because too much heat will loosen the foil from the board.

Push filter capacitor leads through, observing polarity, and solder leads to pattern. The mounting flaps of the on-off switch may be cut off with a hack saw and the rough edges removed with a file before mounting the switch. Push switch lugs through the slots in the board. Bend the lugs down against the copper and solder.

Mount the phono jack next. After pushing the terminals through the board, flow solder around the flat part of the center connection but leave the angled sides of this terminal free to expand so that the plug can be inserted later. Now, mount the volume control.

Mount the resistors. The 50,000 *ohm* plate load resistor for the 12BA6 tube should be mounted in the holes marked X-X.

The .01 *mfd* disc ceramic capacitor is mounted in holes A-A standing on edge.

The output transformer is mounted on the speaker. The voice coil leads are connected to the secondary of the transformer and the transformer primary is connected, by a pair of stranded wires, to the holes marked SPK on the drawing.

The power cord is connected last. Push the bare ends of the leads through the holes in the board until the rubber insulation is tight against the board. Solder the leads to the pattern and cut off the excess length.

The mounting of parts is now completed and the tubes can be placed in their sockets. The 12BE6 tube is used solely as a filament dropping resistor. It costs no more than a high wattage resistor and generates less foil-loosening heat.

Before applying power to the circuit, block the board up so that the circuit cannot come in contact with something on the work bench. After plugging the cord into an outlet, turn the switch ON. All tubes should light up. The volume control should then be advanced about half way and the center terminal of the phono jack touched with the finger. You should hear a loud buzz when this is done.

If the amplifier checks out this far, you are ready to connect a crystal type record player to the input. It is also possible to connect a crystal microphone to the input and use the amplifier as a small PA system.

The amplifier may be mounted in any convenient manner provided there is enough ventilation to carry away the heat generated by the tubes. Any mounting can be used for the speaker. A 5-in. speaker mounted in a scaled down Carlson enclosure and this amplifier will provide surprisingly good quality.

Wire Soldering Technique

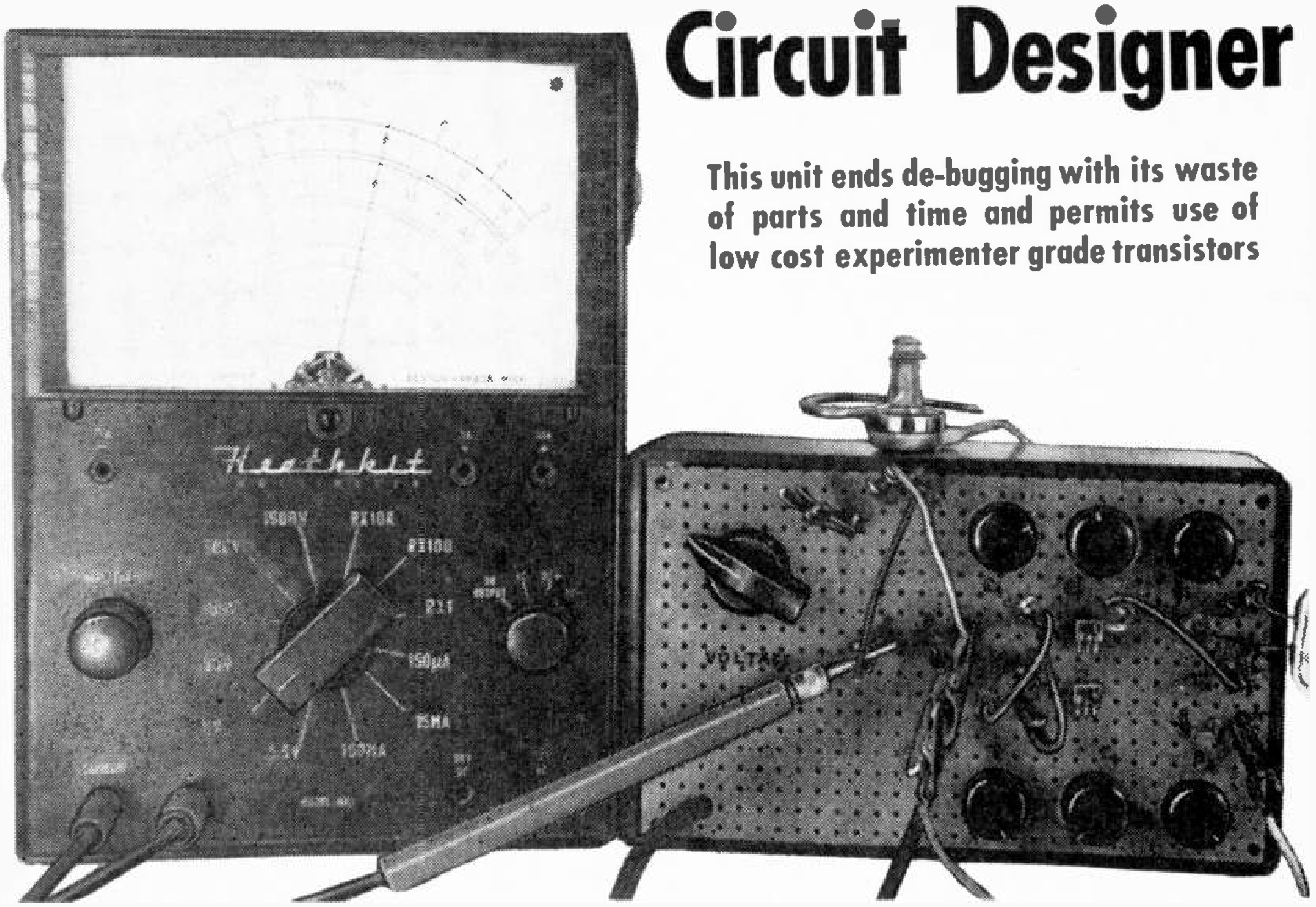
• When joining electrical wires or wires in electronic circuits, it is frequently difficult to hold two wires and the soldering iron or gun in position for a good solder joint. This problem can be considerably eased by tinning both wires before placing in contact. This then becomes a sweating rather than a soldering technique, which takes less heat for less time because the work does not have to be brought up to soldering temperature. Touch the wires lightly and apply the iron for just an instant to melt the solder and complete the joint. The joint will have sufficient mechanical strength and, if the resin core type of solder is used, it will carry current efficiently.

"Man out here with the latest bookshelf equipment, dear."

Transistor Circuit Designer

This unit ends de-bugging with its waste of parts and time and permits use of low cost experimenter grade transistors

The circuit designer with a test amplifier on the board. The voltmeter aids voltage setting. A headphone is the amplifier load.

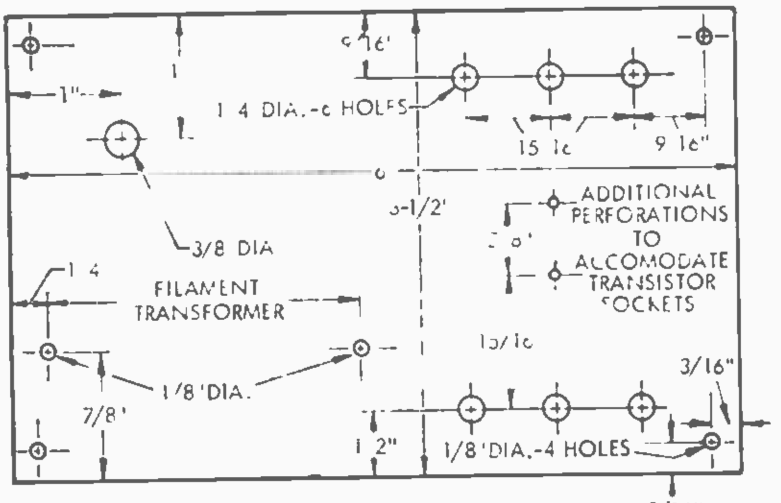


By FORREST H. FRANTZ, Sr.

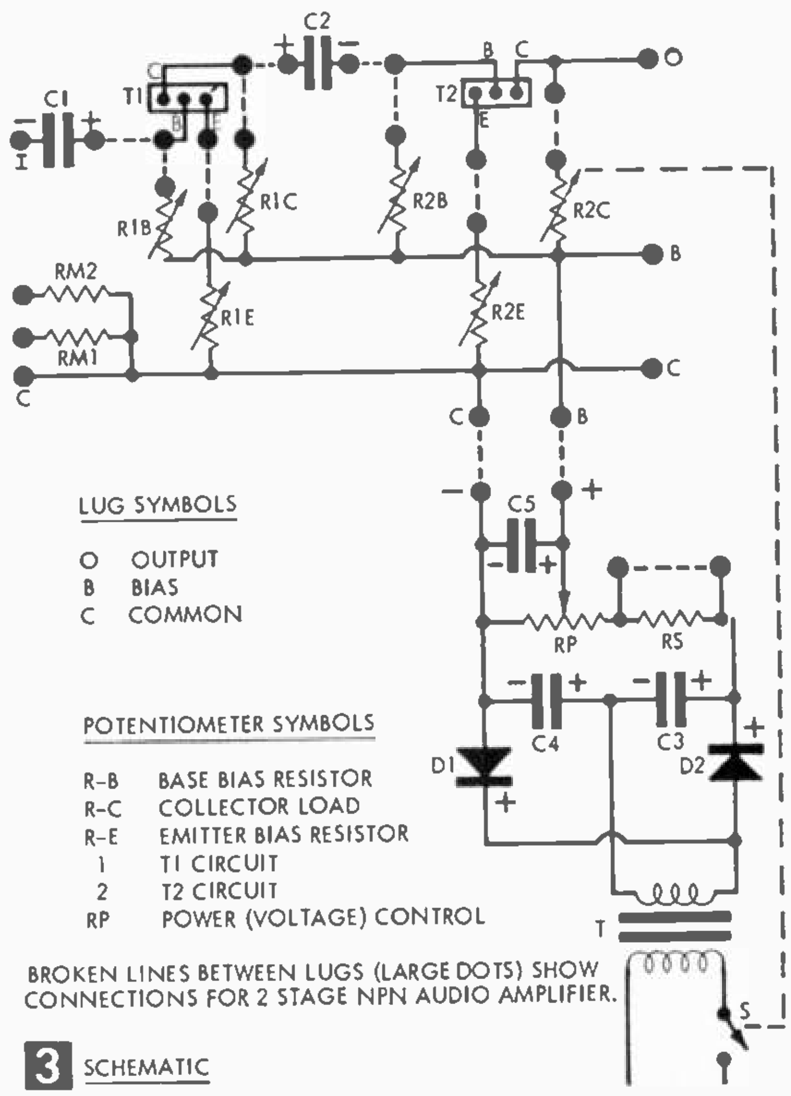
THIS instrument permits the design of one and two stage transistor amplifiers and facilitates rapid measurement of their characteristics. The unit, costing $10 to build, is also useful as an auxiliary power supply and amplifier for other transistor equipment.

The unit is enclosed in a 2 x 3¾ x 6¼-in. Bakelite case. The circuit is constructed on the perforated Bakelite board front panel.

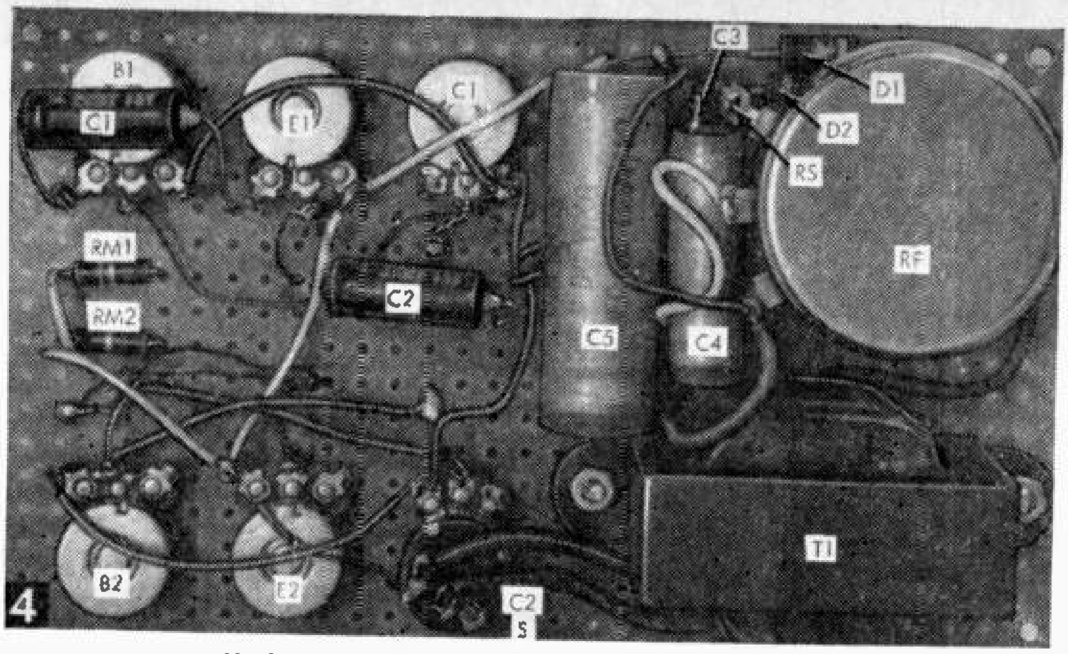
The power supply is a 6.3 v. filament transformer, two diodes in a voltage doubler cir-



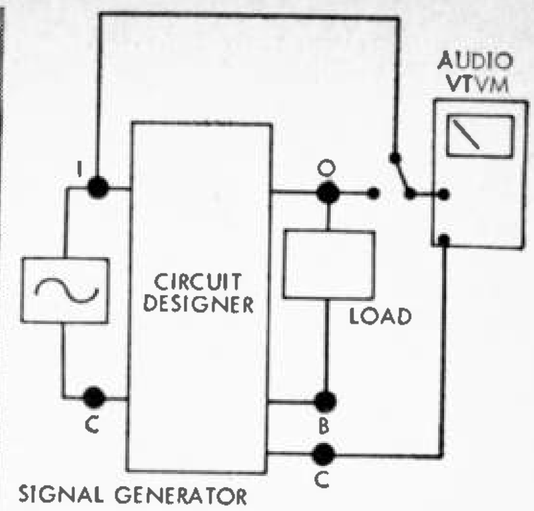
2 PANEL LAYOUT



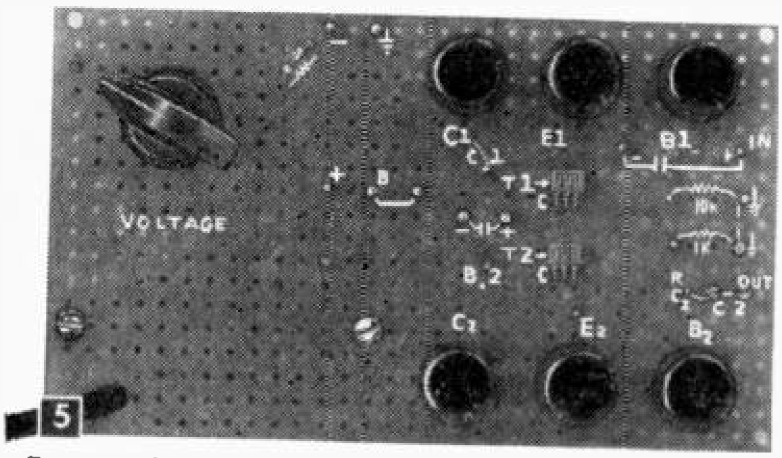
3 SCHEMATIC



Under-panel view, showing parts and wiring.



6 INPUT - OUTPUT CIRCUIT INSTRUMENTATION FOR HIGH GAIN AMPLIFIER DESIGN AND FREQUENCY RESPONSE MEASUREMENTS



Top-panel view. Experimental component connections are marked.

cuit, a voltage output control and filters.

On the top of the front panel are the two test circuit transistor sockets and leads from two electrolytics for the test circuit and two resistors to determine input impedance. The six potentiometers adjust collector load, emitter bias and base bias for the test transistors.

The transistor sockets are connected for the common emitter configuration, but other configurations may be readily investigated by switching transistor leads in the sockets. The power supply may be connected for either pnp or npn transistors. Connections between experimental components are made with mini-gator clip leads.

The front panel is cut and drilled as in Fig. 2. Mount power transformer and pots first. Then wire the power supply according to schematic (Fig. 3) and Fig. 4. Push leads through board holes and solder. Some lead ends will serve as lugs for attachment of test clips and are shown in schematic. Splice on #18 wire if leads aren't long enough.

Attach transistor sockets to panel with Duco cement. Solder leads to the transistor sockets and pass them through the panel and wire in.

Operation. We will use a grounded emitter circuit. Resistor RS in the power supply is shorted with a jumper wire, except when control of voltages of less than a volt is required. When this resistor is shorted, the power supply provides about 10 v. for a load drawing 20 ma. and about 5 v. for a 50 ma. load. The voltage may be monitored with a voltmeter.

This power supply may be used with npn transistors by connecting the − power supply lug to the adjacent ground lug and the + lug to the adjacent B lug. Reverse the connections for pnp transistors. The power supply may also be used as a power supply for other transistor equipment.

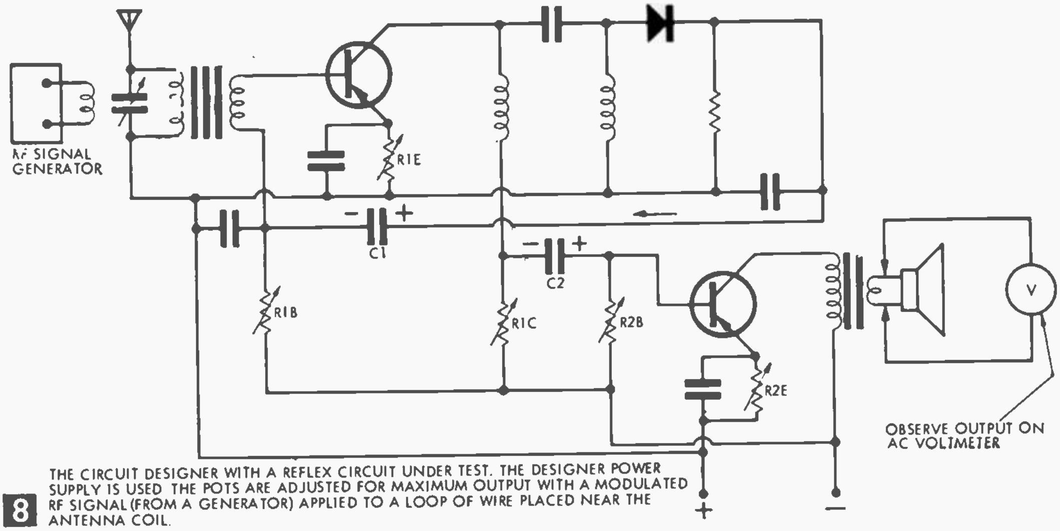
The circuit to be designed is wired up on the designer with clip heads, and best bias and load resistance values are found by adjusting the dials. In the schematic (Fig. 3) a two-transistor stage audio amplifier is on the designer.

The emitter bias pots which stabilize the transistor dc operating points also introduce negative feedback. This flattens the amplifier frequency response, but also decreases amplifier gain. If frequency response is unimportant, the emitter bias pots (R1E and R2E)

MATERIALS LIST—CIRCUIT DESIGNER

Desig.	Description
RP	500 ohm, 3 w. potentiometer (Clarostat 58-500)
R1E, R2E	1K potentiometer (Lafayette VC-32)
R1C	10K potentiometer (Lafayette VC-34)
R2C, S	10K potentiometer with switch (Lafayette VC-28)
R1B, R2B	1 megohm potentiometer (Lafayette VC-38)
RS, RM1	1K, ½-w. carbon resistors
RM2	10K, ½-w. carbon resistor
C1, C2	20 mfd., 15 v. electrolytic capacitor (Lafayette CF-123)
C3, C4	100 mfd., 15 v. electrolytic capacitor (Lafayette CF-126)
C5	160 mfd., 25 v. electrolytic capacitor (Lafayette CF-145)
D1, D2	germanium diodes (General Electric 1N64)
T	6.3 v. filament transformer (Lafayette TR-11)
6	knobs (Lafayette MS-185)
T1, T2	transistor sockets (Lafayette MS-149)
1	perforated Bakelite board (cut from Lafayette MS-305)
1	Bakelite case (Lafayette MS-216)

Parts are available from Lafayette Radio Co., Dept. SM, 165-08 Liberty Ave., Jamaica 33, N. Y.



8 THE CIRCUIT DESIGNER WITH A REFLEX CIRCUIT UNDER TEST. THE DESIGNER POWER SUPPLY IS USED THE POTS ARE ADJUSTED FOR MAXIMUM OUTPUT WITH A MODULATED RF SIGNAL (FROM A GENERATOR) APPLIED TO A LOOP OF WIRE PLACED NEAR THE ANTENNA COIL.

may be bypassed with electrolytic capacitors (about 10 mfd) for increased gain. The desired dc stabilization will be retained.

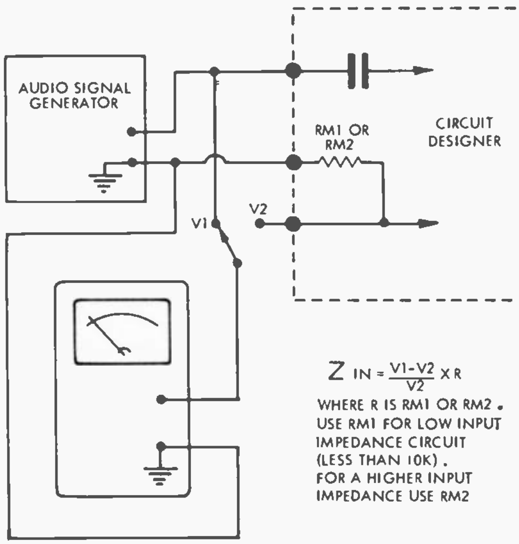
Note that the actual load, say a headphone or a loudspeaker and output transformer, may be connected to lugs O and B for the design adjustments. Furthermore, the device which is to drive the amplifier, a broadcast tuner for example, may be connected to the input terminals for performance checks.

For more critical circuit design where highest gain is desired, the input-output circuit arrangement of Fig. 6 should be used. With a 1000-cycle signal input, adjust the designer pots for maximum output indication on the audio voltmeter.

This circuit is also used for obtaining the desired frequency response if this characteristic is of importance to you. Frequency response is improved by increasing the emitter resistances R1E and R2E. Simply record the output for various frequencies as you vary the audio signal generator frequency—then plot the frequency response. If you want to do a fast design job, though, you can check the output only at the lowest and the highest frequency to which the amplifier is to be flat against the output at 1,000 cycles.

The resistors RM1 and RM2 were provided for determining input impedance of an amplifier under design or for designing an amplifier with a given input impedance. Figure 7 shows the circuit and calculations. Input impedance may be increased by increasing emitter bias resistance of the first transistor.

The designer may also be used for designing RF, IF, and reflex circuits. The instrument shown in the photographs does not have this provision. This instrument was designed primarily for evaluating audio amplifiers and does not contain all of the connection lugs shown in the schematic (Fig. 3). But, if



7 INPUT IMPEDANCE MEASURING CIRCUIT AND CALCULATIONS

you'll provide all of the lugs shown in Fig 3, you can evaluate RF, IF and reflex circuits. The circuit arrangement for a typical reflex receiver is shown in Fig. 8. External coils and capacitance must be used, and the arrangement becomes quite crowded.

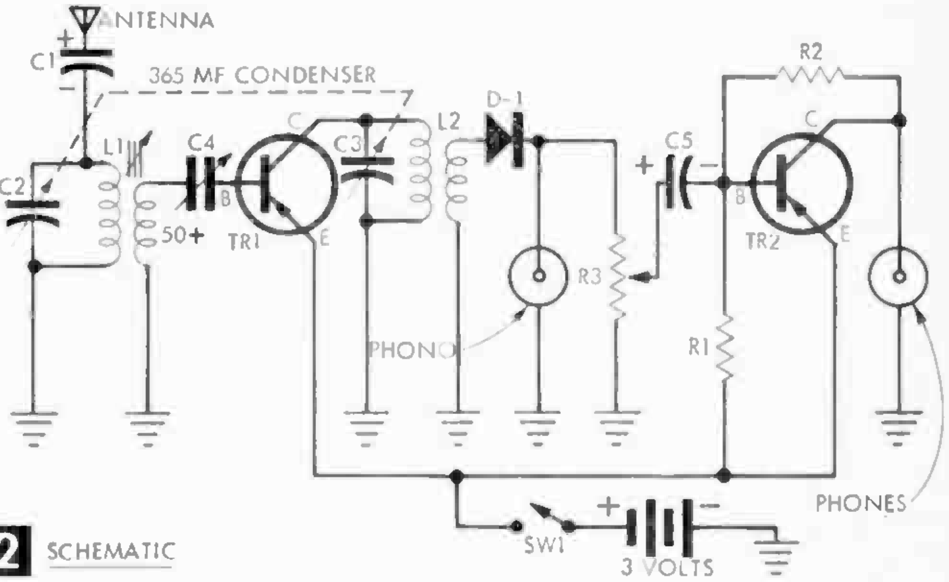
One note of caution: The miniature potentiometers that I used in the circuit designer are of the audio taper type. To obtain bias and load resistance values for the equipment which is to be constructed, measure resistance values of all controls after optimum settings have been made. Linear resistance scales for these controls would be misleading, but you can provide these pots with scales by calibrating with an ohmmeter.

The Little Cub Receiver

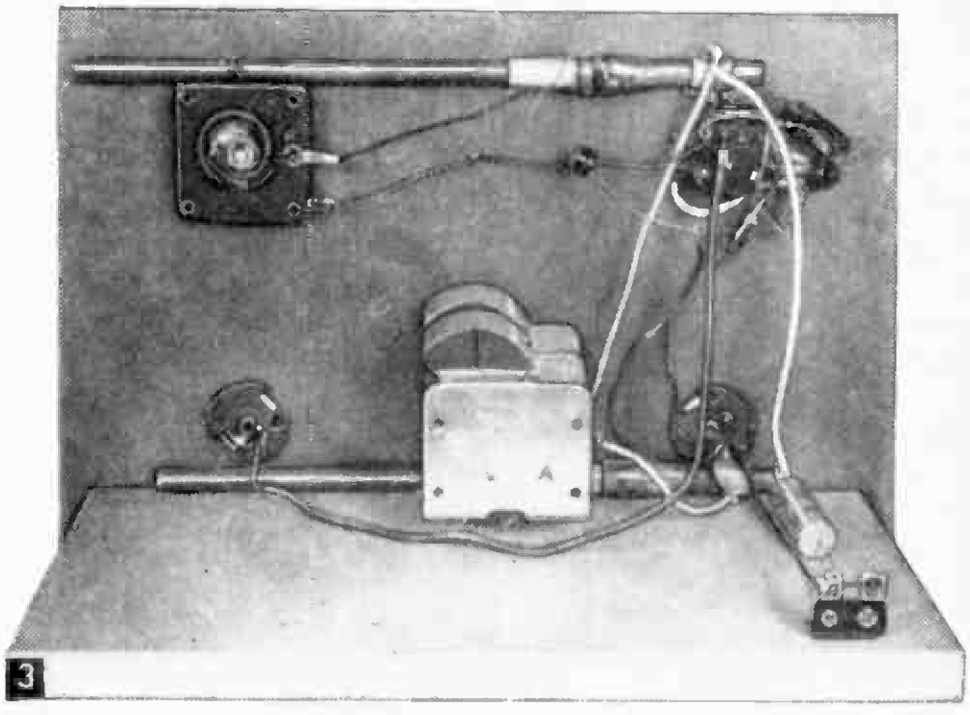
By HOMER L. DAVIDSON

Transistorized printed circuitry combined with simple construction makes the Little Cub receiver an ideal project for boys, individually or in groups.

1



2 SCHEMATIC

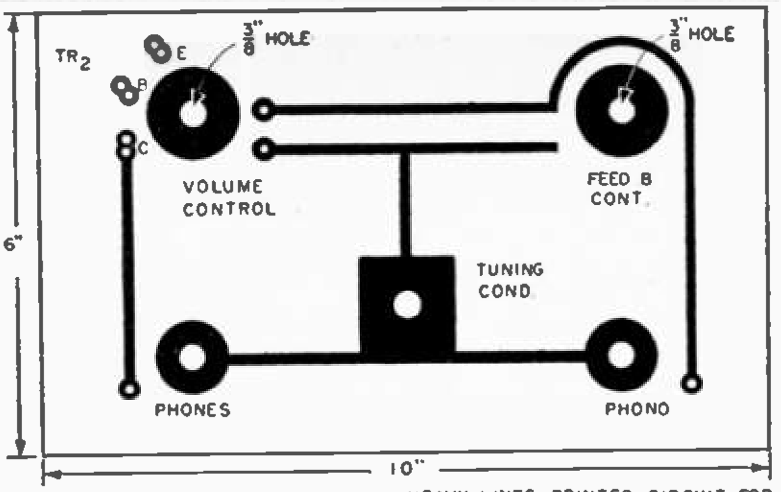


3

THE circuit of this small receiver is very simple; technically it is nothing more than a tuned grid and tuned plate feedback circuit, and youngsters will have a lot of enjoyment building it and using it. The antenna is capacity-coupled to a tuned tank circuit with a 50-turn secondary wound over a commercial ferrite coil. This output is coupled through a tuning capacitor to the base terminal of the first transistor (TR 1). Feedback is also obtained through this capacitor and transistor, and a second tuned circuit is found in the collector circuit of TR 1. A small audio transistor (TR 2) stage adds volume to the receiver's operation, and a phone jack enables record playing through it. Both emitter terminals of the transistors are tied to the positive terminals of the battery (See Figs. 2 and 3).

Construction. The front panel is constructed from a 6x10-in. printed-circuit board. First, roughly lay out the lines and hole dimensions on the copper plate. Make sure that the plate is clean. If not, wash it with soap and water. All straight lines were made with the black resist tape and joined with liquid paint resist. The PRLT pens (see materials list) are of the ball-pen type. Simply hold the pen in the hand and push down on the ball of the pen and liquid will start to flow. You can use any color of resist you wish, although black shows up the best. Let circuits dry for several hours before placing in the etching solution.

As an etching container, use a large flat glass baking dish. Place the copper board in the bottom of the dish and pour just enough liquid etchant solution over it to cover. (If the solution gets on your hands, wash it off with soap and water. Clothing will be



4 FRONT PANEL P.C. BOARD

HEAVY LINES PRINTED CIRCUIT-FOR TRIM, OTHER LINES CAN BE ADDED AS SHOWN IN FIG 1 INSERT

MATERIALS LIST—LITTLE CUB

Desig.	Description
C1	.01 capacitor, 200 V
C2, C3	365 mfd variable capacitor, two-gang TRF (Lafayette MS142)
C4	365 mfd, variable capacitor (Lafayette MS215)
C5	10 mfd, 50 V elect. capacitor
R1	12,000 ohm carbon fixed resistor
R2	220,000 ohm carbon fixed resistor
R3	10,000 ohm variable resistor with S.P.S.T. switch (SWI)
TR1	2N414A Raytheon transistor
TR2	2N107 GE transistor
D1	1N64 fixed diode
L1, L2	Superex 7" loopstick with 50 turns of 28EN wire over original winding
2	phono jacks
2	penlite cells
	Printed Circuit Materials
1	Technicians Kit #5002P, or
1	PCA copper-laminated board 9 x 12 in.
1 pt.	PE5 etchant liquid
1 roll	tape resist PRT-1
1	liquid ball-point pen PRLT

There will be a quantity of tape, etchant liquid and pen resist left over from this experiment so all that would be needed to construct other experiments would be to purchase extra copper-laminated boards.

Printed circuit material available from Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, New York, or direct from Techniques, Inc., Dept. C, P. O. Box 85, Hackensack, N. J.

soiled with a brownish color if the solution comes in contact with it, but this solution is not dangerous in any form.)

To help the solution etch the copper plate more rapidly, rock the container. The etching process takes about 45 minutes. Pull the board up every few minutes and view the etching process. All of the copper will be gone when the process is complete. The only remaining copper will be under the paint resist.

When etching is complete, wash the board in clear water, pour the etchant liquid back into its bottle (it can be used over and over again) and wash the glass container in soap and water. Pull off the resist tape and, with any kind of cleaning solution such as carbon-tet, or by scraping, remove the resist paint. Be extremely careful that you do not injure the copper circuit lines. Now, drill all of the holes required (See Fig. 4).

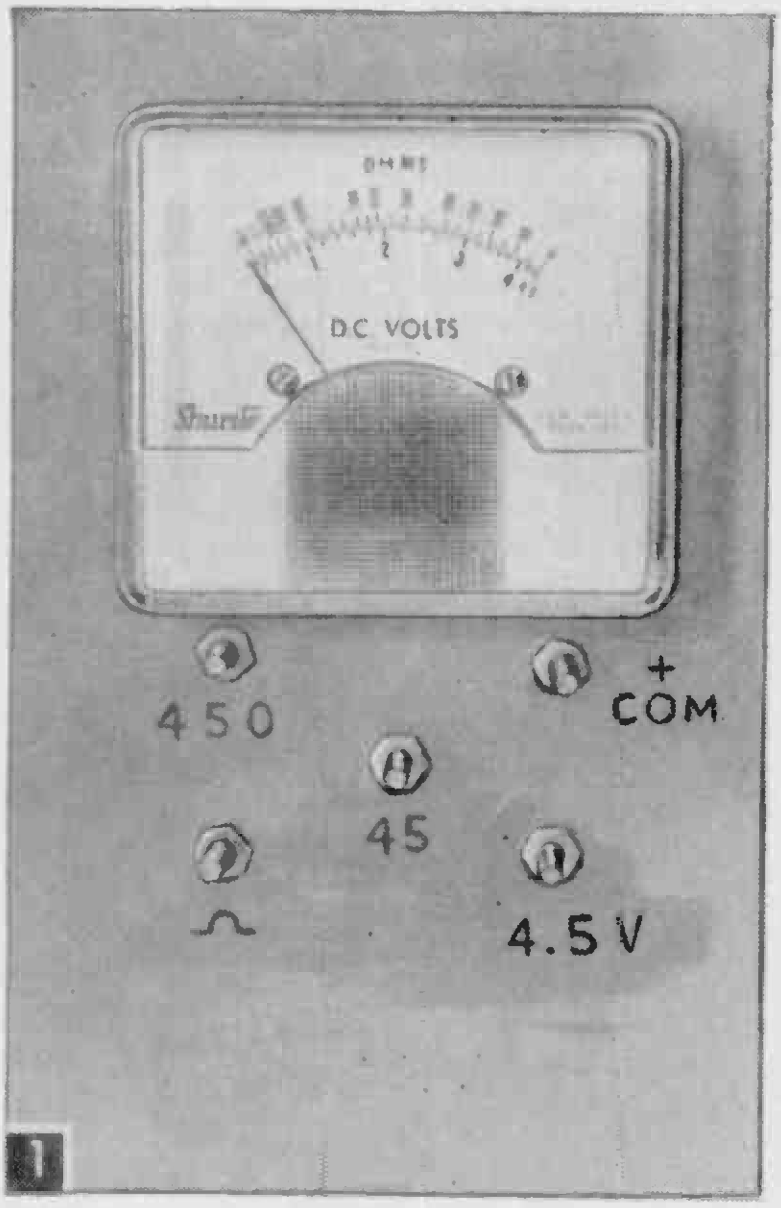
After the front panel has been etched, mount components. The large parts, such as the variable capacitor and volume control, are mounted first. TRI is wired directly to the feedback capacitor and then On-Off switch. Mount coil L1 at the top of the panel with the grounded side soldered to the ground lug of the volume control. The collector tank coil (L2) is mounted at the bottom of the chassis with its grounded side soldered to one side of the phone jack. A two-lug insulator is screwed to the plywood base, for antenna and ground connections, as is the battery holder. Finally solder small components in place.

The coils are the 7-in. superex ferrite type with an extra winding of 50 turns of No. 28 enameled wire added over the original winding.

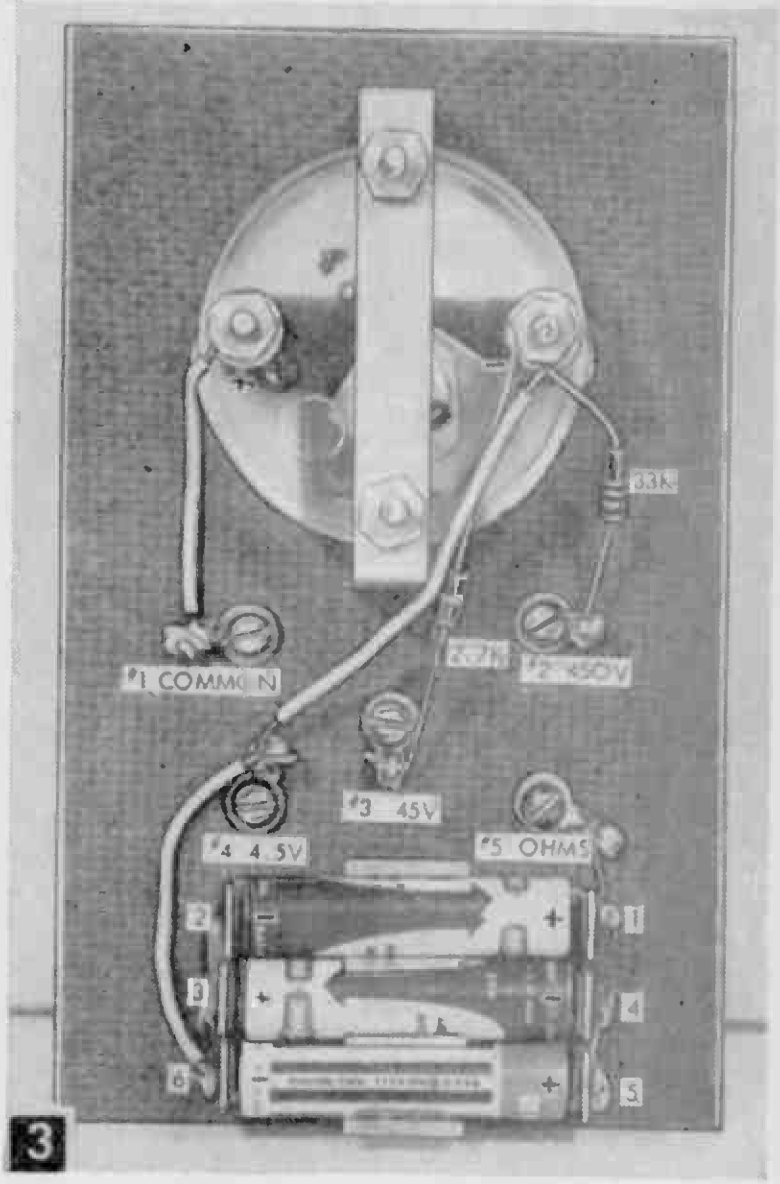
Operation. To test, plug in phones and record player. Turn set on and with recording on turntable, it should be heard. (The volume can be raised or lowered with the volume control.) Unplug record player and hook up the long-wire antenna system. Tune for a station in the middle of the band. When a station is located, turn up the feedback control and a loud squeal will result. Lower this control's setting until the station is audible. Now tune L1 by pushing its core in and out. The station will get louder—and oscillation may occur. If it does, turn the feedback control down. Next, adjust L2 for maximum signal. (This adjustment is not as critical as L1.) Go over adjustments again until the best signal is heard and stations can be received at both ends of the band. Feedback should occur over all of the band.

Beginner's Volt-Ohmmeter

By FORREST H. FRANTZ, SR.



1 This inexpensive volt-ohmmeter employs machine screws as terminals for Mini-Gator clips on test leads.



3 Parts mounting. Piece of #18 wire (arrow) supports battery holder.

THIS DC volt-ohmmeter costs about $3.50 to make. It will serve to introduce the beginner to the use of volt-ohmmeters.

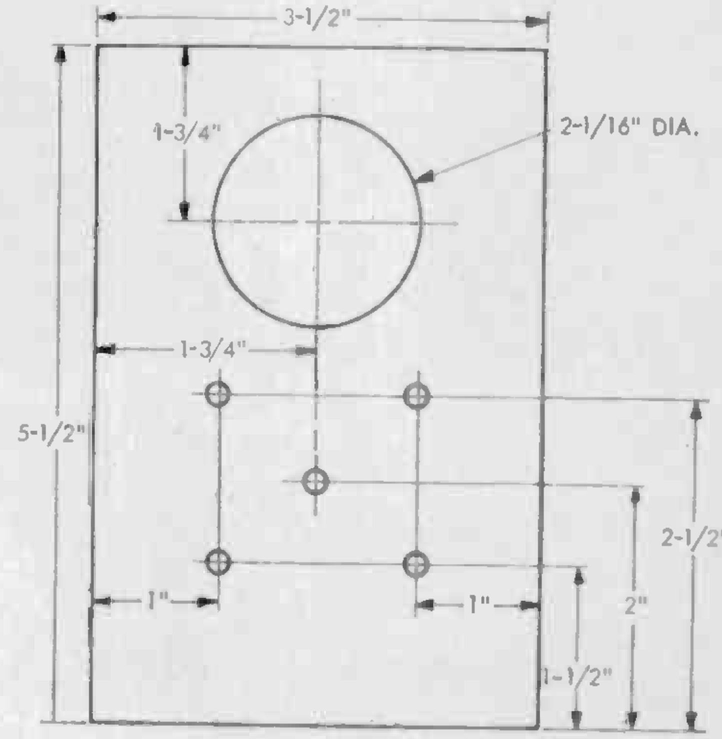
All parts are mounted on a panel made of a scrap piece of Masonite 3½ x 5½ in. or larger.

The panel layout is shown in Fig. 2. Cut the 2⅙-in. meter hole with a coping saw or hacksaw after drilling starting holes. Smooth with a round file. Give the panel a coat of gray enamel.

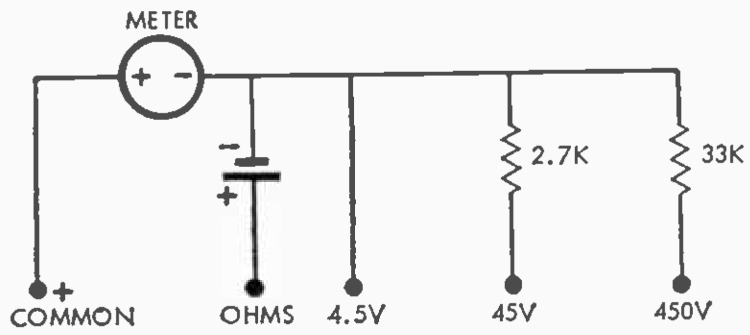
Mount the meter, first removing the U-shaped panel clamp fastened to the back of the meter. Push the meter through the hole on the panel and replace the U-clamp on the back of the meter. Before you tighten it all the way against the back of the panel, be sure you have the meter lined up properly on the front of the panel. Next, mount the five machine screws on the panel. Place soldering lugs under the screws.

Wire according to Fig. 3 and the schematic, Fig. 4.

The connections to the meter are not sol-



2 PANEL LAYOUT



4 SCHEMATIC

MATERIALS LIST—VOLT-OHMMETER

No. Req'd	Description
1	ohms-volts meter (Shurite 8701)
1	3 cell battery holder (Lafayette MS169)
3	pen lite cells (Burgess #7 or equivalent)
1	2.7K, ½ W carbon resistor (±10%)
1	33K, ½ W carbon resistor (±10%)
	machine screws, hook up wire, rosin core solder

dered. Be careful not to let your soldering iron touch the plastic meter case accidently while you're working.

Mark the front panel with india ink. Or you may type labels and fasten them to the panel with Scotch tape.

To wind up the job, insert the batteries in the holder observing the polarities shown in Fig. 3. The batteries are connected in series—plus to minus. Therefore, the three 1.5 v. batteries will deliver 4.5 v. This is the full scale deflection voltage of the basic meter and the lowest voltage range of your instrument.

To use the meter, clip a lead to the common terminal and connect the other lead to the terminal which identifies the range you want to use. Mueller Mini-Gator clips work nicely for this purpose. Make a set of leads 6-in. long and another set 24-in. long. To measure volts with the meter, connect lead from common (+) to high (+) side of voltage to be measured. Connect negative lead to the highest range first, and move progressively down until you're on the proper range.

Measure ohms only when there is no electrical energy being applied to the resistance being measured. When you measure volts, do not touch terminals or uninsulated leads with your body, at risk of a bad shock.

Don't lay the meter on a metal object when you make measurements, because the back terminals are exposed. It would be a good idea to place the meter in a wood case or a small cardboard box.

And a final precaution: The volt ranges are dc voltage ranges. Don't attempt to measure ac volts with this meter.

What-Is-It?

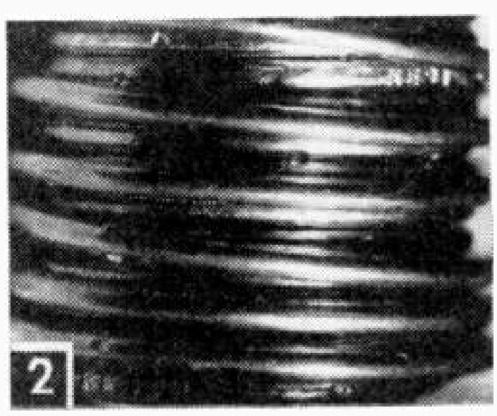
By JOHN A. COMSTOCK

Do you think you can correctly identify the objects in the photos? Try your luck, and then check your answers with those on page 53.

1.__________ 3.__________ 5.__________

2.__________ 4.__________ 6.__________

1



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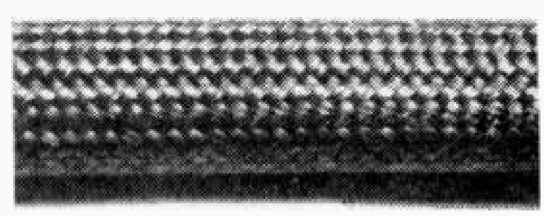

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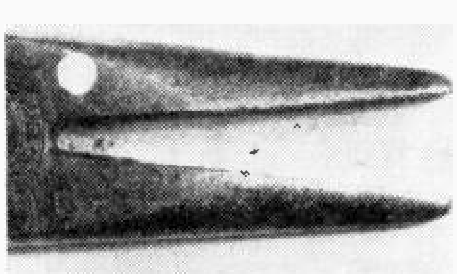

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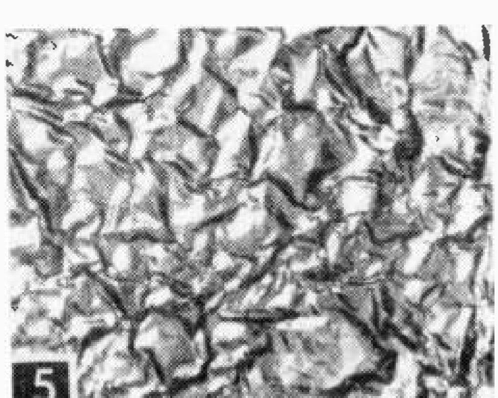

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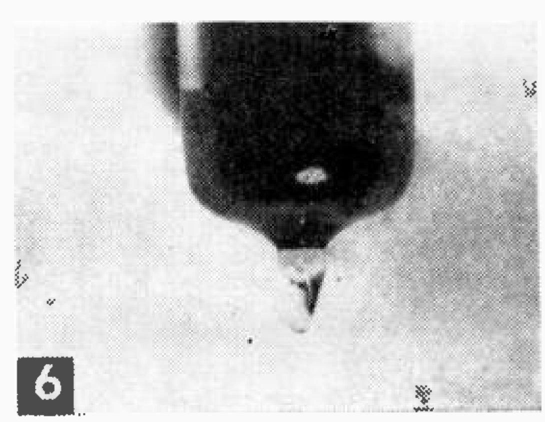
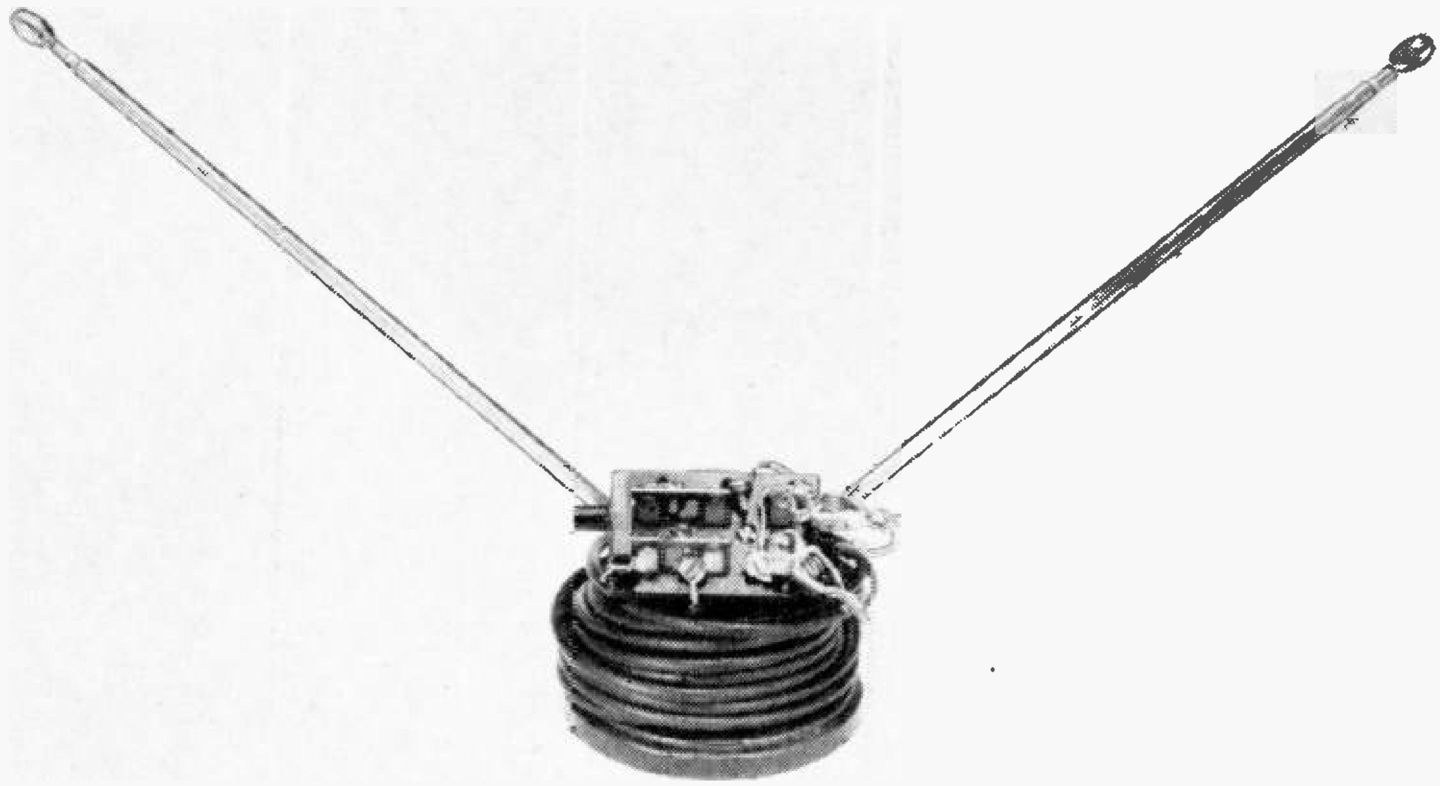


6

Hams: convert that rabbit-ears into a

Field Strength Indicator

By C. F. ROCKEY, W9SCH



1

You can easily check the radiation of your station with this field-strength indicator.

EVERY amateur knows how convenient it is to tune a transmitter for maximum radiated output with a field strength indicator. And one cannot make significant adjustments upon a directional, "beam" antenna without one.

If you have an old rabbit-ears indoor TV antenna, you can convert it for field-intensity indications for a dollar or two. Furthermore, at the flick of a switch, you have the rabbit-ears available for its original use.

We used a *Radion* indoor TV receiving antenna for our model. Any similar antenna will work as well, as long as it is a true rabbit-ears, that is, not one of those fancy things sometimes sold with tuning stubs or other similar gimmicks attached.

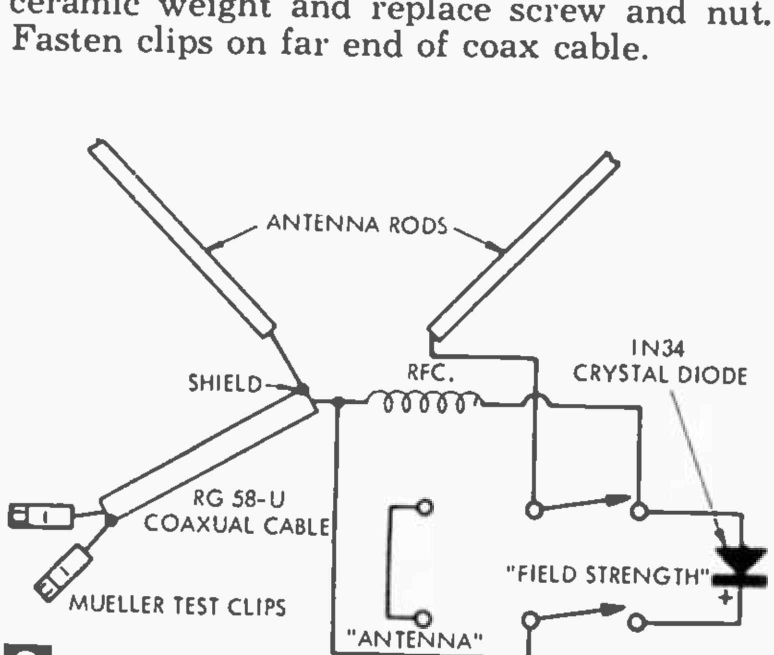
First, disassemble the unit by removing the long machine screw which passes horizontally through the support. Then remove the felt from the base with a razor blade. Remove the ceramic weight within the base by running the razor blade around the weight. The two halves of the base will then come apart, freeing the two antenna rods.

One of the halves has two cast recesses in it to receive the antenna support rods. Mount the DPDT knife switch upon the "forehead" of the piece with two 6-32 x ¾-in. machine screws, first drilling two ⅛-in. holes ¾-in. apart (each ⅜ in. from center) and ⅞ in. down from the antenna rod slot. Then drill three ¼-in. holes, two near the ends of the rod slots, and one near the base (Fig. 3).

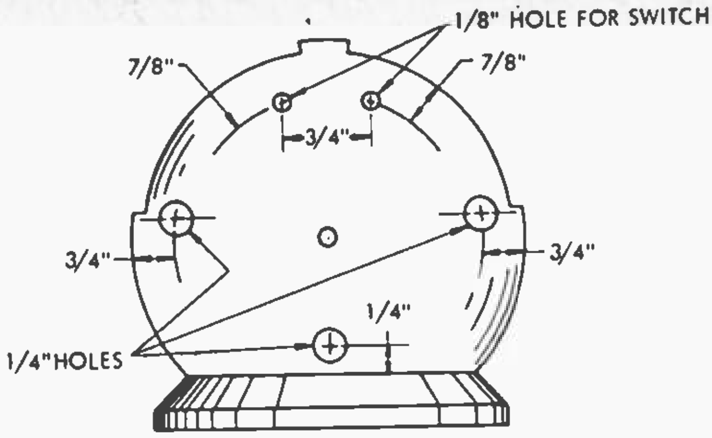
Complete wiring, leaving connections to dipole elements till last (Fig. 2). Pass the coax cable through the hole near bottom of base.

Insert the antenna element support rods into their recesses and make connections by soldering directly to these rods. Be sure to make the leads to these rods flexible enough to allow easy adjustment of the antenna rod angle after assembly.

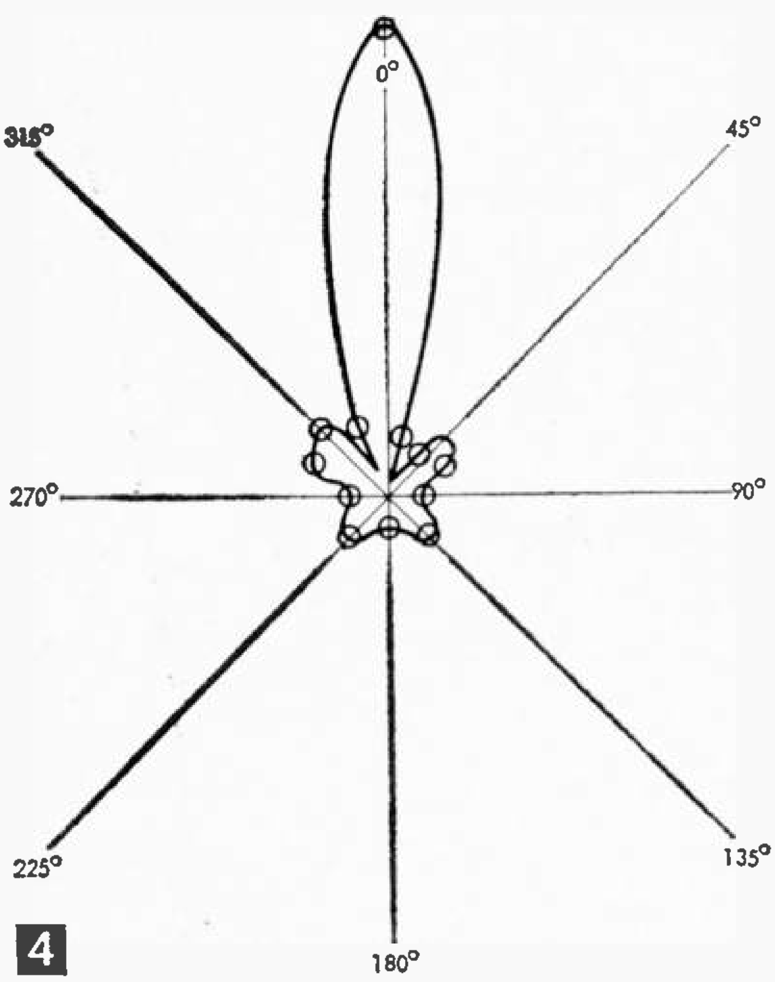
Reassemble the two base halves, insert the ceramic weight and replace screw and nut. Fasten clips on far end of coax cable.



2 SCHEMATIC



3 DRILLING DIAGRAM



4

MATERIALS LIST—FIELD STRENGTH INDICATOR

No. Reqd.	Description
1	Radion or similar indoor rabbit-ears TV antenna
10 ft	RG 58-U or RG 58-AU coax cable
1	2.5 millihenry RF choke (National Type R-100)
1	DPDT, plastic base, knife switch
1	1N34 crystal diode
2	Mueller spring clips
	machine screws and nuts, rosin core solder, hookup wire, microammeter or VOM (see text)

Throw the switch into "antenna" position and connect to your TV set as a test. Now throw the switch into "field strength" position and connect the coax to a microammeter or low-range milliammeter. Set the unit near your transmitting antenna, and bring the coax and meter away so that you do not get into the RF field, and put the transmitter into operation. You should get a definite reading on the micro- or milliammeter. For low-frequency operation (below 50 mc) extend the antenna rods as long as possible; for 50 mc or 144 mc use, adjust the two rods to give maximum indication, keeping both rods equal in length. If you have a vertical transmitting antenna, put one rod as nearly vertical and the other as nearly horizontal as possible. If your transmitting antenna is horizontal, put both rods as near horizontal as possible. If meter swings backward, reverse leads.

The amount of indication you will get depends upon the power output of your transmitter and the distance between the transmitting antenna and the ears. With a low power 144-mc transmitter connected to a directional antenna, the author was able to get a deflection of over 100 microamperes at a distance of over 100 ft. from the antenna. Of course, at this frequency it is necessary to elevate the ears above ground (for instance, on top of a 6-ft. stepladder) to get a representative indication.

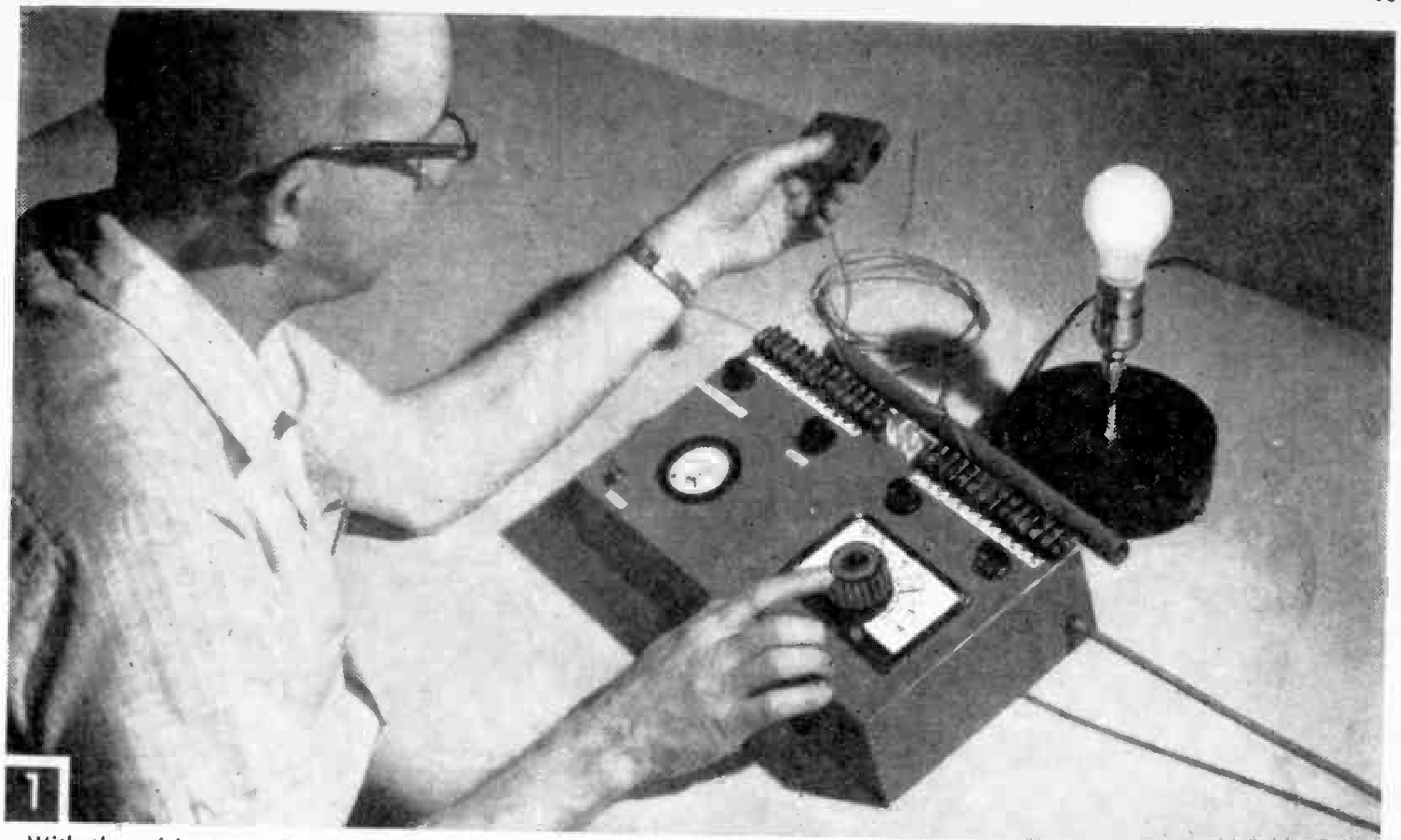
Such technique would be proper for the adjustment of a directional beam antenna. Use a 0-200, or smaller, microammeter; set the rabbit-ears on the stepladder, placed at least 100 ft. from the antenna, and run the coax down and away so the observer's presence does not affect the field distribution appreciably. Station an observer at the meter and, with transmitter running at low power (50 watts input or less), adjust the beam antenna to produce maximum deflection on the meter. When this deflection is a maximum, you can be reasonably sure that your beam antenna is operating at or near optimum effectiveness.

If you do not have a microammeter you can use the fundamental movement of your VOM. Most VOMs have a pair of terminals or a switch position which will make this movement directly usable in this manner.

You can use this device to determine the radiation pattern of your directive antenna system by setting up as described above. Then, keeping the power input to your transmitter constant, rotate your antenna through 360° and have the observer write down the meter reading each 15 or 20° as you go around. Then, using polar-coordinate graph paper (available at draftsmen's supply stores), plot the meter reading at each angle as a distance outward from the center. Choose a reasonable scale, of course. Then connect the points with a smooth curve and you have the radiation pattern of your antenna. This will prove handy in correctly aiming it at that distant station you wish to work. A directional pattern, drawn for the author's antenna, appears as Fig. 4.

Removing Radio Knobs

• To remove obstinate radio knobs of the "pull-off" variety, hook a handkerchief back of the knob and rest your fore-finger against the cabinet as a fulcrum. Pull on remainder of handkerchief, held firmly in your hand.



1

With the wiring completed, check operation with a Polaris photocell. The circuitry also doubles duty as a burglar alarm and electronic counter.

All-Purpose Multi-Testing Lab

THOUGH designed by inventor Gus Wesenfeld primarily as a science lab, the Multi-Lab is also a workhorse around the home, shop, garage and photo-darkroom. For instance, after we describe construction of the Multi-Lab, we explain how to use thermistors to read temperatures from 0 to 600°F. Or with a photocell and lamp attachment, you can set up a smoke monitor on your chimney that tells you how to set the controls of your furnace for best combustion.

With Multi-Lab, you can read the condition of each cell of your car battery separately under actual load conditions. An optional relay circuit with Multi-Lab's built-in power supply and sensitivity control gives you a dependable light beam annunciator, an emergency fire alarm, or burglar alarm. The experimenter can read electrical resistance down to 1%, and use the bridge circuit to check impedance of loudspeakers, and test radio and TV tubes.

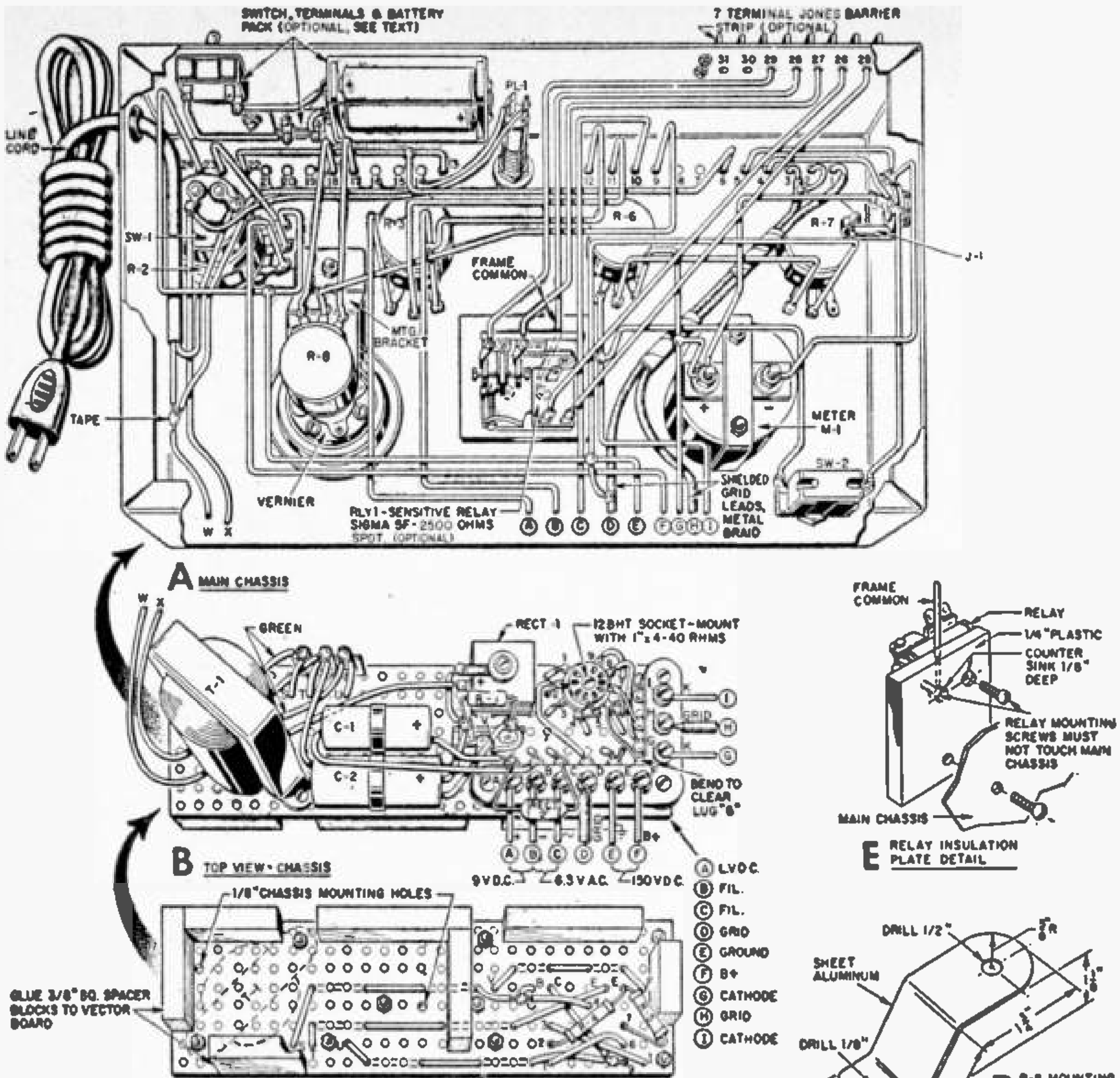
The chassis is a core unit to which you can add attachments. You use the terminal strips at the top of the panel to connect photocells, temperature detectors, strain gages, etc.

While Multi-Lab is a measuring device, unlike a scale or micrometer, it does not indicate a direct reading in units. Rather, it *compares*. The null meter tells you whether the electrical input is more, less, or equal to a predetermined "standard."

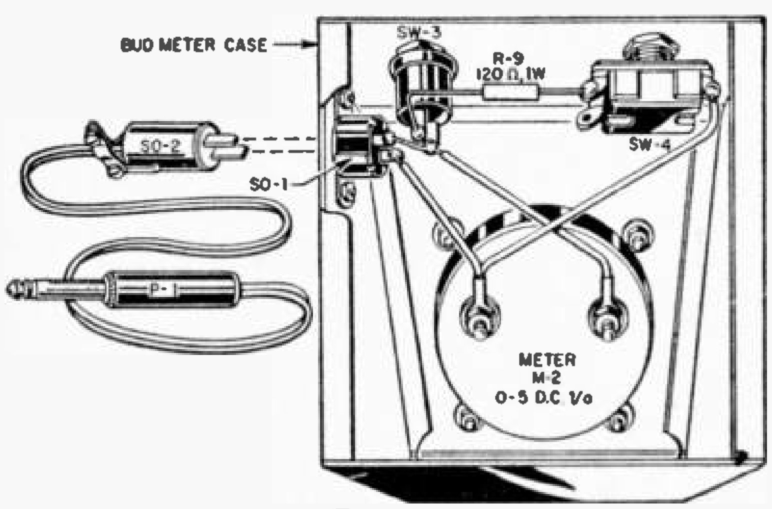
Use a combination square to lay out the hole centers (Fig. 2) and then drill all the holes except those behind the terminal strips. Your only tough steps are the large holes for the meter and the vernier dial. If you are working without a drill press and hole saw, just outline the circles with a compass. Then drill starting holes and finish the job with a coping saw and file.

Temporarily mount the terminal strips with 4-40 screws and nuts. Then remove the terminal screws (those to which inside wiring feeds) and use the terminal strip's holes as a template to drill 3/32-in. pilot holes through the steel box. Remove the terminal strips and re-drill the holes to enlarge them up to 3/16 in. Clean up any remaining burrs and then mount all parts and terminal strips. The National Co. type MCN vernier dial comes packed with a mounting template. Follow this pattern exactly except for drilling the top two holes 1/16 in. instead of 1/8 in. Then, using sheet metal screws in place of the machine screws ordinarily used, you'll be able to easily interchange the cardboard dials.

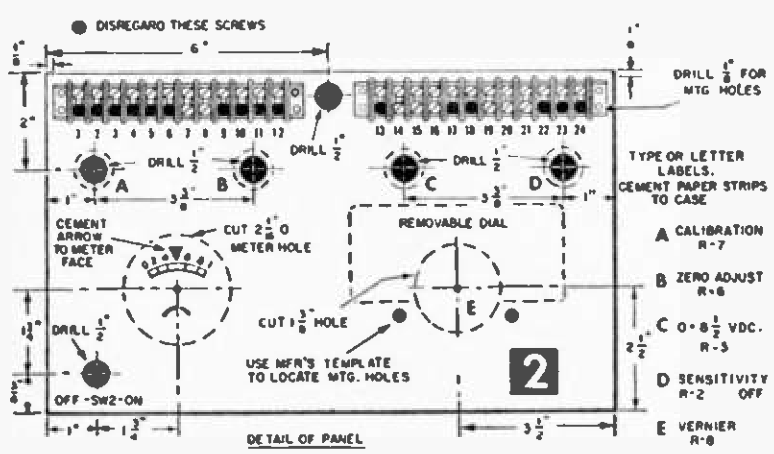
Assemble the Power Supply and amplifier circuit on the perforated Vectorboard (Fig. 3B). A few of the Vectorboard holes will need enlarging with a 1/8-in. drill. Use the parts to be mounted themselves as templates.



3 PICTORIAL



F AUXILIARY METER



2

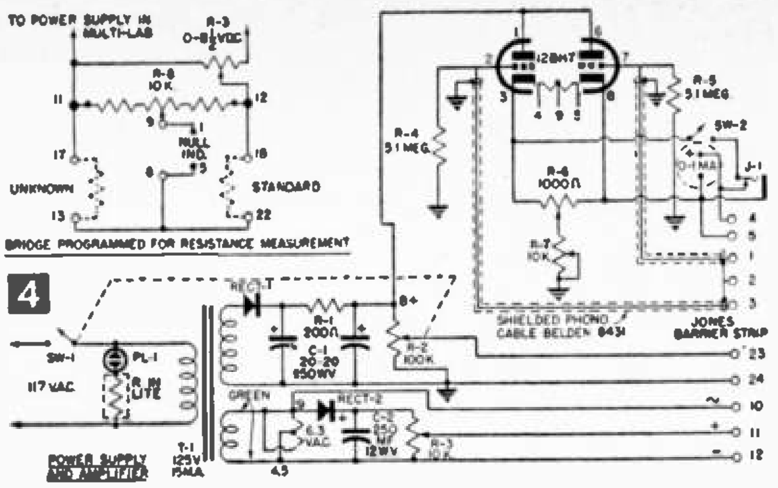
Before you install this sub-chassis in the main cabinet, check it as follows: temporarily connect an ac line cord to the black leads of the transformer insulating your splices with electrical tape. Use a VOM to take a reading between terminals E (−) and F (+). A 20,000 ohms/v. VOM should show about 150 v. while a 1,000 ohms/v. meter would read about 140. Across terminals B and C, you should get a 6.3 v. ac reading. Terminals A and B should deliver about 9 v. dc.

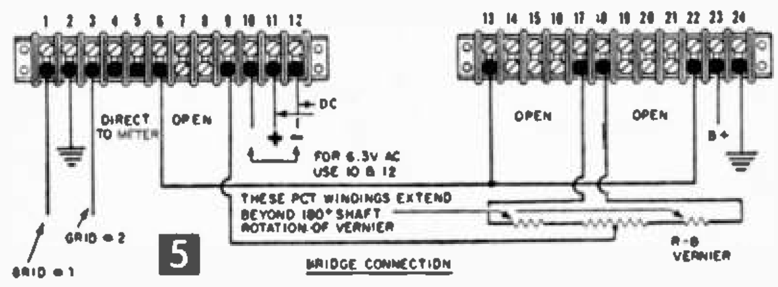
Now finish the test by connecting a 0-10 milliammeter across terminals G and I. Touch terminals D and H with a metal screwdriver. On each touch, the milliammeter should move showing the voltmeter circuit is operating. If any one of these checkouts fails to agree, go over your wiring to find the mistake. Then run the test again.

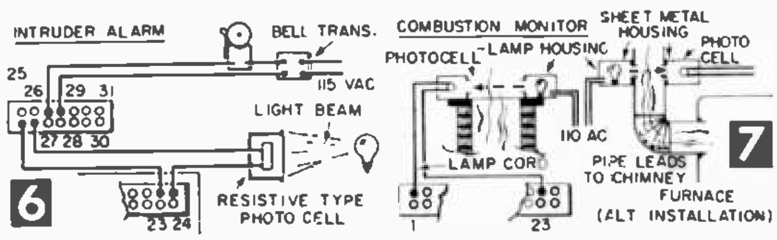
Mount the chassis in the bottom of the cabinet using the wooden spacer blocks (Fig. 3C) and then proceed with the cabinet wiring. Use bus wire, solid push back wire, or common hook-up wire. The bus wire is tougher to use . . . you have to clean the ends with a fine file and pre-tin before soldering—but it does make it easier to trace your circuit. Wires that run up to the terminal strips must not short against the holes in the face of the cabinet. Run these leads through, trim, and solder from the front of the terminal strip discarding the unused terminal screws. The tube's grid leads must be shielded with metal braid to prevent stray current pickup. Solder this braid (Fig. 3A) to terminal 2 at one end and to H on the sub chassis.

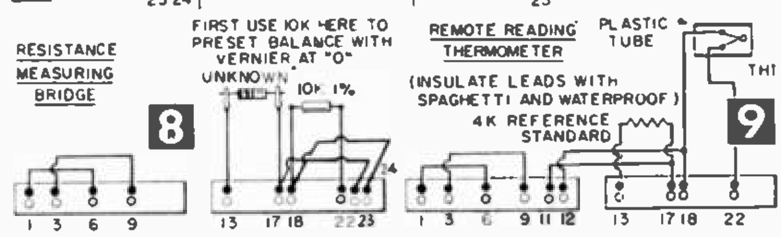
A battery pack is shown on Fig. 3A but need not be installed immediately. It supplies 2.8 volts for a reflection densitometer attachment (a future article).

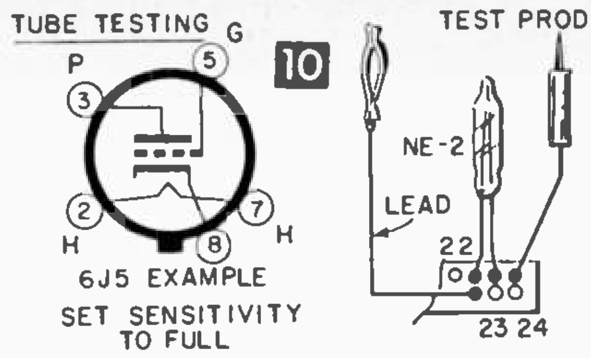
RLYI (optional) is a Sigma type SF 2500 ohm SPDT sensitive relay (Fig. 3E). Insulate it by mounting on a 2-in. square piece of plastic. Be sure the relay frame is isolated. External ac feeding through the frame to Multi-Lab's case would be dangerous. Run wire leads from the coil and contact solder lugs up to the 7-terminal Jones barrier strip on the top edge of the case (Fig. 3A). You'll be using this relay to operate external circuits for fire alarms, annunciators, counters, etc. A less expensive relay can be used.











TUBE TESTING PROCEDURE

1. Turn sensitivity to full right position. (This also turns Multi-Lab power on)
2. Clip lead to pin #2 of tube.
3. Touch test prod to pin #7. If filament is good, NE2 will glow brightly.
4. With clip lead attached to pin #2, touch test prod to pin #8. NE-2 might glow softly. If NE2 glows bright, tube has heater-cathode short.
5. Move clip lead to pin #8. Touch pin #5. If NE2 glows, tube is either shorted or gassy.
6. With clip lead on pin #8, touch pin #3. If NE2 glows, tube is either shorted or gassy.

As you wire, you'll note that the toggle switch beneath the meter is arranged to cut the meter off for safety during setting up and standby. The tube filament stays on since it is controlled by the switch mounted on the sensitivity control pot, R2. The 100K potentiometer R2 is used as a voltage divider and provides a 0-150 variable DC voltage to #23 and #24 on the external terminal strip. Pot R6 acts (zero adjust) as a balance control between the two cathodes of tube 12BH7. Pot R3 delivers 0 to 8.5 volts DC to the bridge. R8, is the "slide wire" of the Wheatstone bridge and is operated by the vernier dial.

Check Your Completed Chassis as follows:

MATERIALS LIST MULTI-LAB

No. Req'd	Size and Description
1	R1—200 ohm, 1 watt 5% resistor
1	R2—100M Mallory type U-41 Midgetrol w. #4 linear taper (Lafayette*)
1	SW1—attachable switch for R2, Mallory type US 26 (Lafayette*)
3	R3, R7, R8—10K 2 watt wirewound pot, Mallory type R10 ML, linear (Lafayette*)
2	R4, R5—5.1 meg, ½ watt 1% carbon precision resistors Aerovox type CPL½ (Lafayette*)
1	R6—1K, 2 watt wirewound pot, linear Mallary type R1000L (Lafayette*)
1	C1—250 mfd/12 wv Sprague dry electrolytic type TVA or equal (Lafayette #Z70)
	C2—20-20 mf, 150 wv tubular electrolytic
1	Rect 1—50 ma. Silicon rectifier, Sarkes Tarzian M-150
1	Rect 2—65 ma. 130 VAC selenium rectifier (Lafayette #RE12)
1	SW2—SPST Toggle Switch (Lafayette #SW21)
1	T1—125 Vct. 15 ma. Stancor type PS 8415 (Lafayette*)
1	PL1—Neon lamp, Drake Type 105 Postlite (Lafayette*)
1	M1—0-1 DC milliammeter, Shurite panel type (Lafayette #MT-100)
1	Vernier dial—5 to 1 drive for ¼" shaft, with removable scales National type MCN (Lafayette*)
1	Perforated board chassis, 2 7/16 x 8½", Vector type 32AA9 (Newark #38F420)
1	Term strip, 6 screw type (Newark #28F664)
1	Term strip, 3 screw type (Newark #28F661)
2	Term strips, 12 double terminals ea. Jones Barrier type 12-140 (Newark #28F710)
1	7 x 12 x 3" Black wrinkle steel chassis, Bud No. CB 792 (Lafayette*)
1	Bottom cover plate, steel, for above Bud No. BP-539 (Lafayette*) (Note: Order aluminum chassis, same size as above if working without electric drill, etc.)
1	9 pin miniature tube socket
1	V1—12BH7 tube
4	Knobs, black plastic, ¼" (Lafayette KN-37)
Misc.	AC power cord, hardware, scrap aluminum bracket, bus bar, or hookup wire, alligator clips, test prod wire, ½ x 11" elec. conduit handle, shielded cable for grid leads.

AUXILIARY METER

1	R9—120 ohm/ 1 W 10% Carbon (Lafayette* RS11*)
1	SW3—Push button, N.C. Grayhill type 4002 (Lafayette*)
1	SW4—Toggle switch, SPST (Lafayette #SW21)
1	S01—Socket, Cinch Jones type P-302-AB (Newark #39F220)
1	S02—Plug, Cinch Jones type S-302-CCT (Newark #39F200)
1	P1—Phone plug (Newark #39F792)
1	Meter case, Bud type CM-1935 with center hole knockout (Newark #91F598)
1	M2—0-50 D.C. Microammeter (Lafayette #TM70)

STANDARDS AND ATTACHMENTS

1	Photocell, Polaris "Maji" cadmium sulphide resistor type (Allied #78E711)
1	TH1 2000 ohm Probe style Thermistor Fenwal #GB32P2 (Allied #9E927)
1 ea.	1K, 2K, 4K, 8K, 100K 1% precision resistors IRC type DCC or equiv. (Allied #1MM493)
2 ea.	10K 1% precision resistors, as above.

SOURCES*

(Lafayette*) Order using Mfrs. numbers listed. Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N. Y.
(Newark) Use Newark nos. Newark Electronics Corp., 223 W. Madison, Chicago 6, Ill.
(Allied) Allied Radio, 100 N. Western Ave., Chicago 80, Ill.

close switch SW2 to put the meter switch in the circuit, and then turn on the power. As the amplifier warms up, turn calibration control R7 clockwise up to full, and slowly rock the zero adjust control back and forth. You should get a meter deflection. If not, turn switch SW2 on and off to make sure the meter circuit is operative. Then turn R7 to the other extreme. If there still is no reading on the meter, turn power off and recheck your wiring.

All controls, with the exception of vernier R8 are "polarized." This means that you turn a knob to the right, the attached control either causes an increase in voltage or current, or the meter increases its reading.

Now take part R8 and fasten it tightly to the sheet metal bracket with the mounting nuts (Fig. 3D). Set your vernier dial exactly to #50 on the dial, and then center the pot's slider electrically. You can do it with a VOM set to a 10K range. Read the resistance from center tap to one side, and then to the other side. If necessary, turn the shaft slightly to equalize the resistance legs, and then bolt the bracket into the case, and tighten the shaft setscrews.

Testing Multi-Lab with Photocell. With wiring and construction completed, you're ready to test operating controls. Connect a resistive type photocell (not the sun battery type) such as the *Polaris* cell in the Materials List, across terminals 1 and 23 as in Fig. 6. Arrange a light as in Fig. 1. Turn the sensitivity control R2 to its minimum setting, and then cut the meter into the circuit with switch SW2. If the needle swings off scale, turn the zero adjust until the needle centers. Now slowly turn R2 until it's about three-quarters up, continuing to center the meter needle with the zero adjust.

Now block the light from the photocell. The meter should swing down scale. If it swings up scale, switch the lead from terminal 1 to terminal 3. Remember, whenever you are making changes or adjustments, switch your meter to prevent a burn out.

This photocell setup not only demonstrates the basic Multi-Lab adjustments, but you can easily use it as a temporary burglar alarm or light-beam annunciator as in Fig. 6. A bell or light will serve as a signaling device, and sensitive relay RLY 1 instead of your meter does the work.

The Smoke Monitor (Fig. 7) is a timesaver when you want to adjust your draft or stoker controls to save fuel, prevent smog, etc. All you need is a lamp housing made of scrap metal, and a holder for the photocell. When the best furnace adjustment is obtained, disconnect the cell from your stack and insert a metal cover in its place.

Now The Bridge Unit. Set it up with two 10K resistors as in Fig. 8. With the vernier dial on 0, R7 full up and R2 three-quarters up, switch in the meter and center the needle with the zero adjust. These steps are basic to the operation of Multi-Lab. Practice until you can do them fast. *From here on, remember that you'll be working only with the vernier. Don't touch the calibration control or the sensitivity control.*

Then turn off the meter switch, and replace the 10K resistor across terminals 13 and 17 with a smaller resistor, say 560 *ohms*. Switch the meter back on briefly. Now readjust the vernier until the meter is again exactly centered. Your reading on the vernier now represents the value of the unknown resistor. If you get no meter response as you adjust the vernier, check the bridge and setup to find your mistake.

The Resistance Measuring Method detailed under Fig. 8 is typical of most operations that you will want to do later on with Multi-Lab. Following the instructions, program the bridge, connect in your standard resistors, center the meter, and mark the dial. Repeat the procedure to get a series of calibration points on the dial. By connecting your resistor standards in series-parallel combinations you can obtain more intermediate points. This bridge performs best in the 200 *ohm* 2M range; however, any calibration range will cover only a 1 to 10 resistance ratio. Remember not to upset any of the controls while calibrating or measuring—work only with the vernier.

The 0-1 ma. meter on the Multi-Lab panel is sensitive enough for most preliminary experiments. For example, it gives you about 4% accuracy with the bridge. The auxiliary meter (Fig. 3F) is a 0-50 microamp meter that can increase your accuracy within ½ of 1%. Of course, your readings are always only as accurate as your standards. You can use any precise microammeter with the Multi-Lab. But until you are completely familiar with operation, it's best to protect expensive instruments by starting the experiment with the panel meter.

With a Thermistor, (Fig. 9) you can read outdoor temperatures from 20 below up to 100°F. Calibrate your dial by immersing the thermistor—it must be waterproofed with varnish—in ice water. Set the vernier at 32 and balance the bridge with the zero adjust. Then place the thermistor outdoors next to an accurate thermometer. A range of readings will establish the scale on your dial. You can also use thermistors to read oven temperatures up to 700°F, provided that you use asbestos wire leads.

The Tube Checking Circuit, (Fig. 10), takes advantage of Multi-Lab's built-in power supply to give you a high voltage-through-resistance check for filament continuity, interelement shorts and gas. Manufacturer's tube manuals will give you pin connections for all tube types.

What To Listen For On Short Wave

Spring and Summer 1961

By C. M. STANBURY II

July 12, 1960. The Belgian Congo has just gained its independence, the army mutinies and attacks the formerly elite European. In the States, an SWL tunes to 9835 kc for Leopoldville. Instead he hears a jammer and a quick check of reference lists reveals that it could only be intended for the Congo transmitter. Obvious question, who and why?

It could have come from the secessionist Katanga province but this was a real jammer and the rebel Elizabethville government did not have time to set up such equipment. Which left the Russians and a tipoff that Mr. K was going to jump into the mess with both feet. And this SWL's guess was right. First premier Lumumba requested American troops, the Soviets opened fire propaganda-wise, and Washington discreetly turned down the request. Then the Congo government switched to the Soviet side of the fence and what do you think happened? That's right, the jamming disappeared.

The above illustrates the most effective method of SWLing. With the help of a good reference log such as *White's,* tune to the world's hot spots and interpret what you hear via comparison and logic rather than be hand-fed propaganda.

Of course, not every international broadcast is pure propaganda, in fact most propaganda is mixed with truth, and a few stations come close to painting an unbiased picture. Such a station is Radio Brazzaville, operated by the French government in the Congo Republic (formerly French Equatorial Africa). The Congo Republic which should not be confused with the Republic of the Congo, is an independent state but within the French community. Possibly this dual control is responsible for its almost objective approach to the news. During the Congo emergency, this station just across the river from Leopoldville appeared to provide complete, often first hand information.

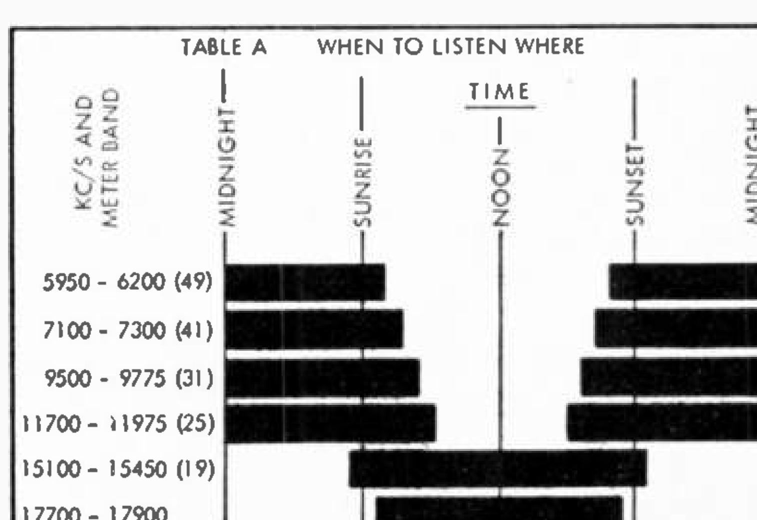
This policy contrasts sharply with the propaganda blasts coming from Brussels on 11855 kc and other frequencies. While the Belgian attitude may have its merits, propaganda is propaganda and of little use to the SWL.

Radio Brazzaville illustrates another important point. Its signal on 11970 kc consistently topped those of Radio Moscow, which used the same channel. Both transmitters were beamed to North America, so what's the difference? Answer, the Auroral Zone. Signal from Russia must pass near the North

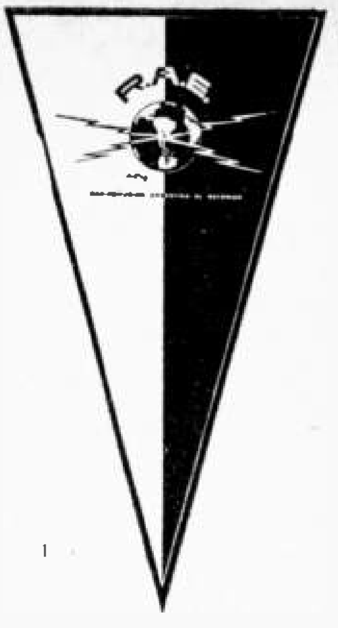
QSL card from Radio Brazzaville. In French and Belgian both Congo Republic and Republic of the Congo are written Republique du Congo.

pole and Northern lights (Aurora Borealis) before reaching us. Tropical stations do not. The Aurora Borealis increases absorption, weakening signals, even under normal reception conditions. During ionospheric disturbances (magnetic storms) the signal drop becomes severe. Thus Brazzaville's advantage over Moscow.

But is this polar block always advantageous? No, it is frequently a major short



wave problem. Since 1958 the number of tropical transmitters on 25 and 31 meters has at least doubled, making pleasant listening from Europe increasingly difficult with many broadcasts to North America blocked or seriously impaired. To mention just a few, Radio Ankara and Radio Denmark.



Pennant from RAE (Argentina).

What does seriously impaired mean? Well, that's up to you as a listener—how much interference will you tolerate? Apparently the average SWL won't stand for much because even with an advantageous location, Radio Brazzaville still found it necessary to switch back to 11725 kc, clear of Moscow. To sum this technical dilemma up, either there will have to be better use of channels in these key night-time bands, or SWLs will have to become better DXers.

But let's look and see what, band by band, the listener can expect this spring and summer. First, 16 and 19 meters will be open to Europe and Africa during daylight hours on the east coast, and to Asia in the morning and early evening. Out west these bands will be open to all continents around 9 am PST, to Asia and the Pacific from late afternoon until past midnight. In every part of the U.S. there will be a scattering of Latin American signals anytime these bands are open except after 1 am EST when such stations have gone to bed.

Twenty-five and 31 meters are primarily night-time bands, open to every part of the world and subject to that tremendous interference we mentioned. Europe and Africa will be clearest late afternoons and early evenings with Asia and the Pacific gradually taking over after midnight.

Forty-one meters, not used for broadcasting in the Americas, will provide limited European reception evenings, equally limited Oriental DX toward dawn. Forty-nine meters will provide good Latin American reception during the hours of darkness until such stations sign off.

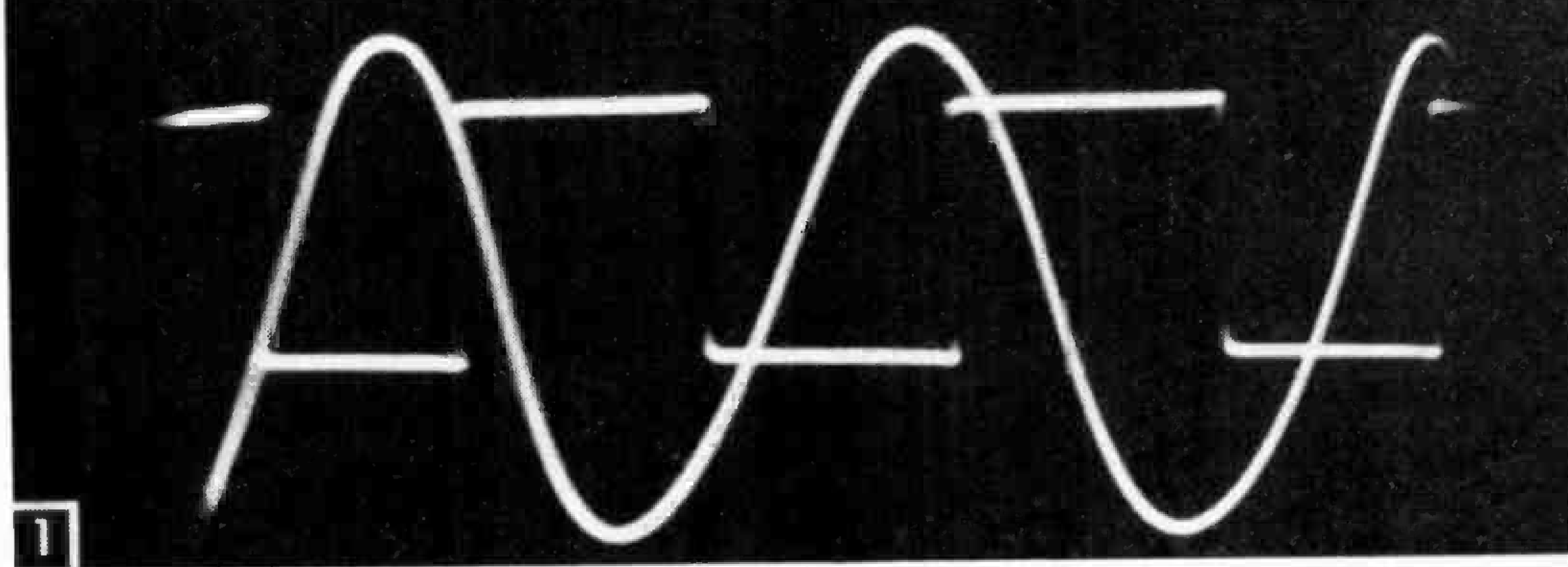
As you've undoubtedly gathered from this rundown, there is no single peak period for transmission to North America from either Eurafrica or the Orient. Usually two broadcasts are required, one for our east coast, a second for the Pacific and Rocky Mountain areas. Here, the Westerner has an advantage. Most Europeans have dual broadcasts, Asians only one, and shortly after 9 pm PST, a much better time for the West than the East. A major exception is Radio Japan (see Table A) and even this powerful station's signals are often weak in the Eastern U.S. There is not too much the Asiatic broadcaster can do about this because ideal conditions over such a path only prevail between 3 and 6 am EST and the SWL can't do much listening while asleep.

TABLE B—STATIONS TO START WITH

COUNTRY	FREQUENCY IN KC/S	TIME (EST)*	PROGRAM
CONGO REPUBLIC	11725	2015-2100	African news (see text), World news from a French viewpoint, French language lessons and once a week, Congolese music.
UNITED ARAB REPUBLIC	15475	Daylight hours until 1830	This listing is an experiment. No English is transmitted here, and if there were any, it would be propaganda. But you will hear a fine selection of Near East music, probably reflecting the mood of this area quite accurately.
MOZAMBIQUE	11760	2230 until fadeout	This is a semi-local broadcaster on an international frequency. Take a listen and see what the Dutch, English-speaking inhabitants of Southern Africa consider entertainment.
SWITZERLAND	11865, 9535	2030-2215, 2315-2400	News (governmental) and newspaper editorials from the world's one neutralist nation.
GREAT BRITAIN	Many frequencies	1600-2200	This is the best of conservative Western thought and programming.
NETHERLANDS	15220 11855, 9715	1615-1705 2130-2210	International news and topical talks, from a leading West European Nation.
WINDWARD ISLANDS	15395 11715	1600-1745 1800-2115	A chance to observe programming in the West Indies which blend Caribbean, British and American.
ARGENTINA	9690	2200-2300, 0000-0100	South American news from at least a different viewpoint. Also covers Argentine literature.
JAPAN	11800, 15235, 17825	1930-2015	News and commentary from Asia's number one democracy. Limited amount of Japanese music.
AUSTRALIA	11710 11810	0714-0845 1014-1145	This is the only station in the Pacific actually beamed to North America. Best here is news. Remainder of program is primarily entertainment.

* Time is given on the 24-hour clock. 1200 is 12 noon, 1300 is 1 pm, 2400 is midnight, and so on. In other words, for times past noon subtract 1200 to get Eastern Standard Time.

Combined Voltage Calibrator And Electronic Switch



1

Sine and square wave seen simultaneously with aid of electronic switch unit.

Single unit multiplies oscilloscope usage

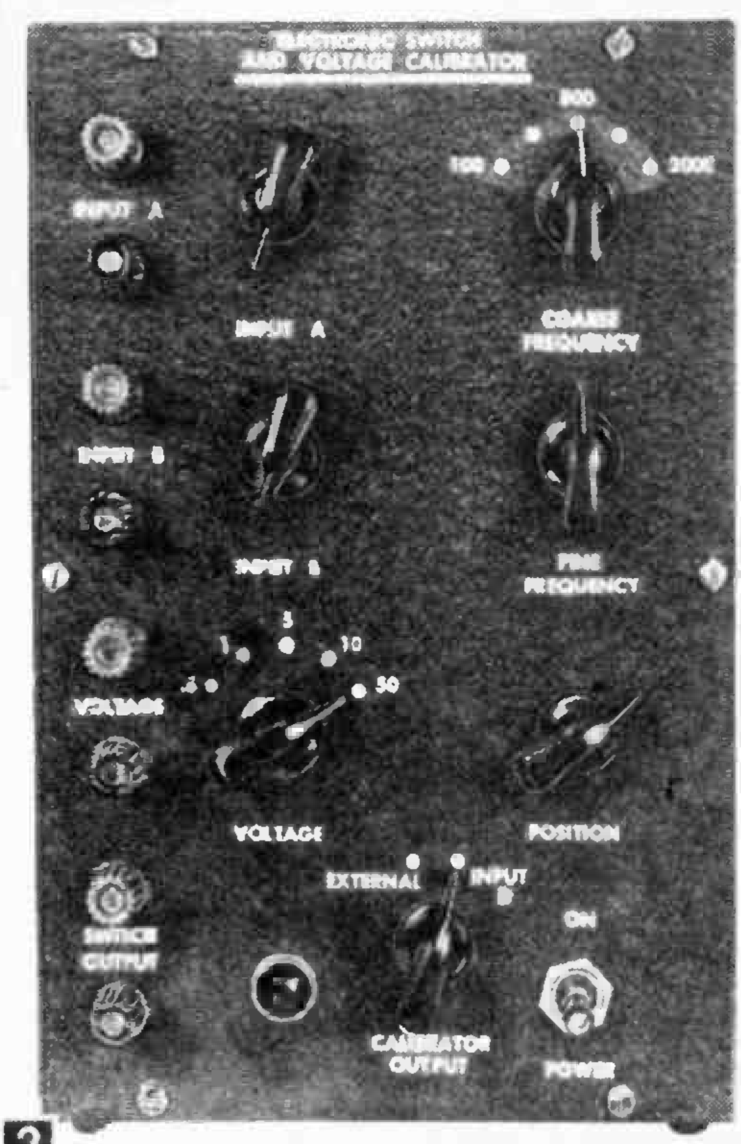
By W. F. GEPHART

THE unit shown in Fig. 2 combines two useful 'scope accessories: 1) an electronic switch which permits viewing of two signal patterns simultaneously (Fig. 1), and 2) a voltage calibrator, allowing the 'scope to be used for ac voltage measurements. The first accessory, the switch, permits both the input and output of an amplifier to be viewed together to check fidelity, for example. The second accessory, the voltage calibrator, gives the magnitude of a signal as the wave form is viewed.

Our unit has a special switching system that permits the calibrated voltage signal to be one of the signals seen simultaneously.

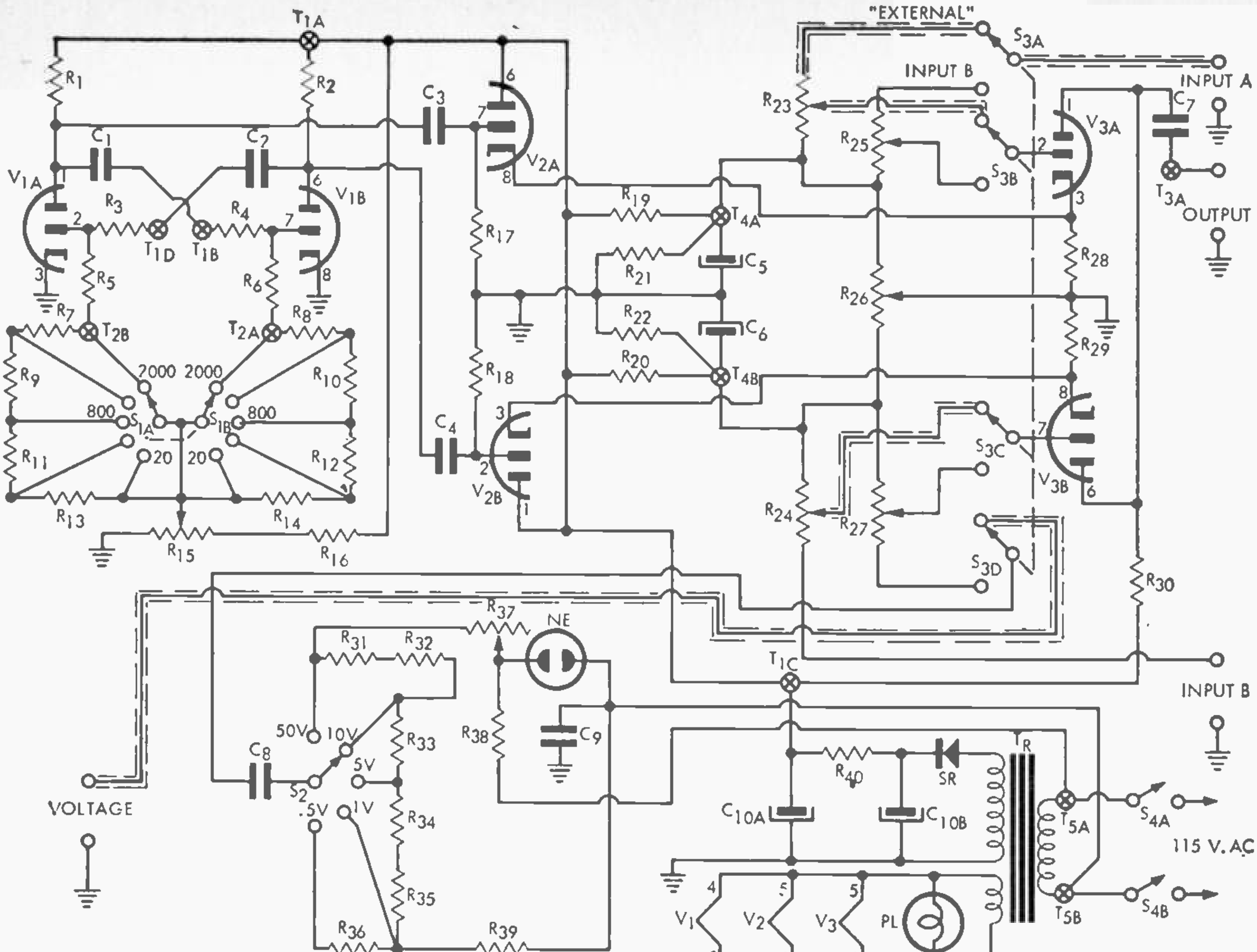
An electronic switch switches signals so fast that both images appear on the oscilloscope together, due to the persistence of the cathode ray tube. A multivibrator type oscillator switches amplifier tubes "on" and "off" so they conduct alternately. Separate signals are fed into each amplifier tube, whose output is common. This output is actually both signals, presented alternately.

Figure 3 shows the schematic, in which V1 is a twin triode multivibrator. It generates square waves, with frequencies between about 20 and 2000 cycles, as set by SW1 and R15, the frequency controls. The multivibrator drives the grids of a second twin triode (V2), which acts as a switching tube. The two plates of the multivibrator are connected to the two grids of the switching tube. Since the signals on the plates of V1 are 180° out of phase, the two halves of V2 conduct alternately. The output of the multivibrator is a square wave and quite high. Thus, when the plate of V1a is positive, the grid of V2a is positive and V2a conducts. At the same time, the plate of V1b and grid of V2b are negative,

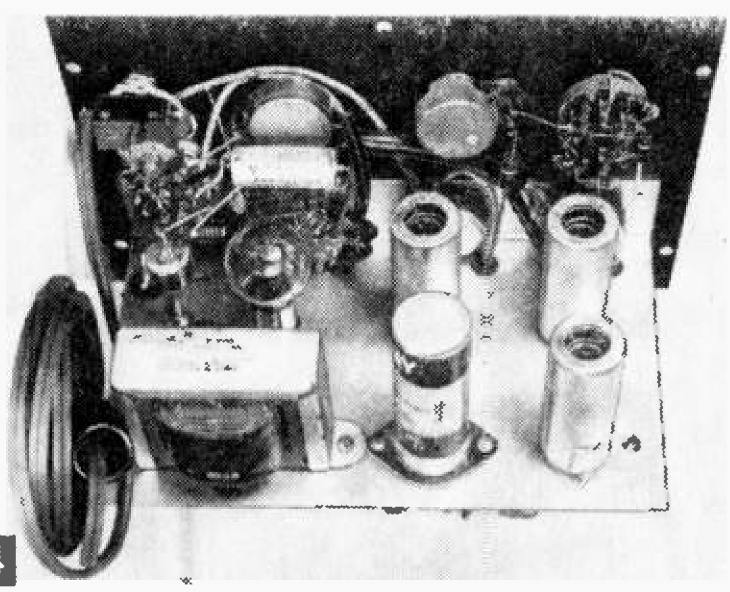


2

Front view of the completed unit.

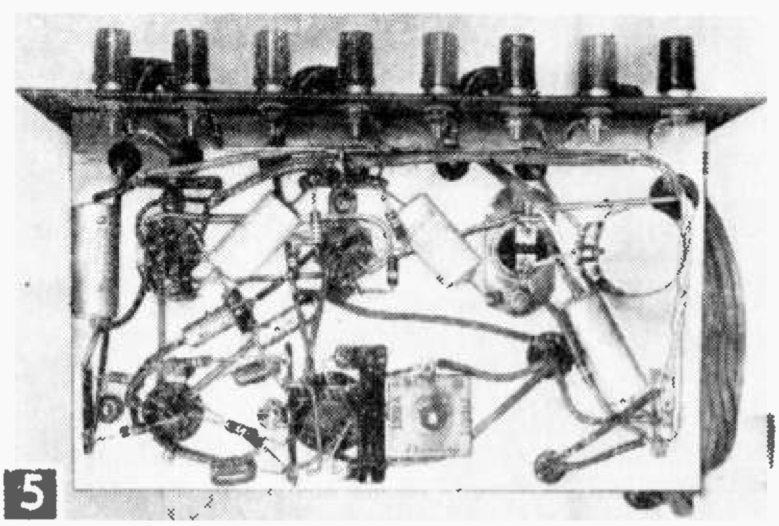


3 SCHEMATIC



4

Back-of-panel view shows miniature pots mounted by stiff wire leads.

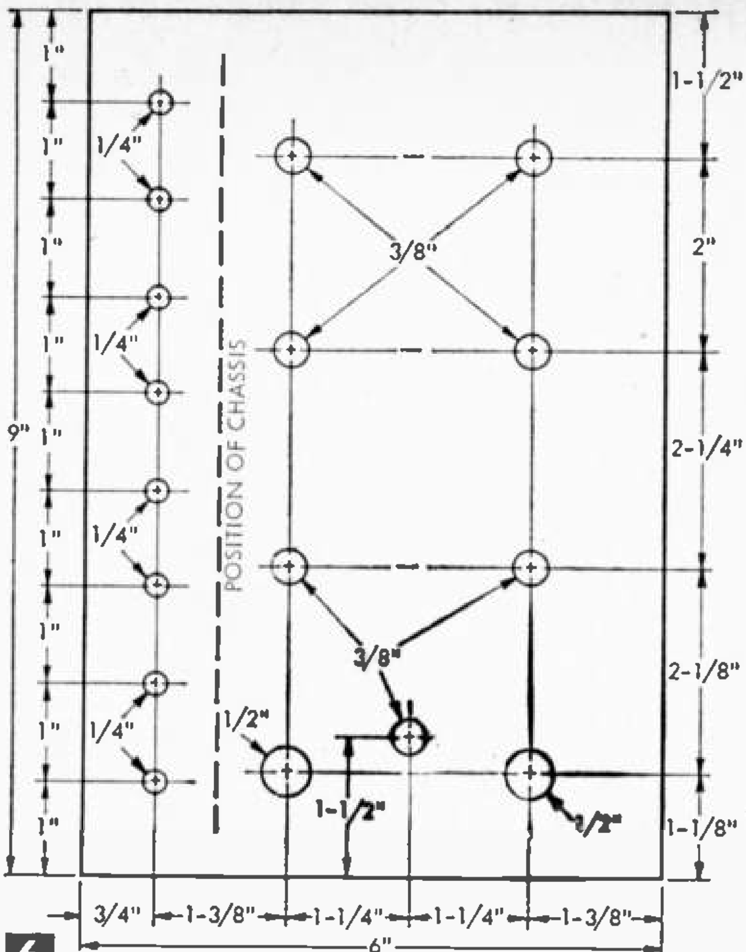


5

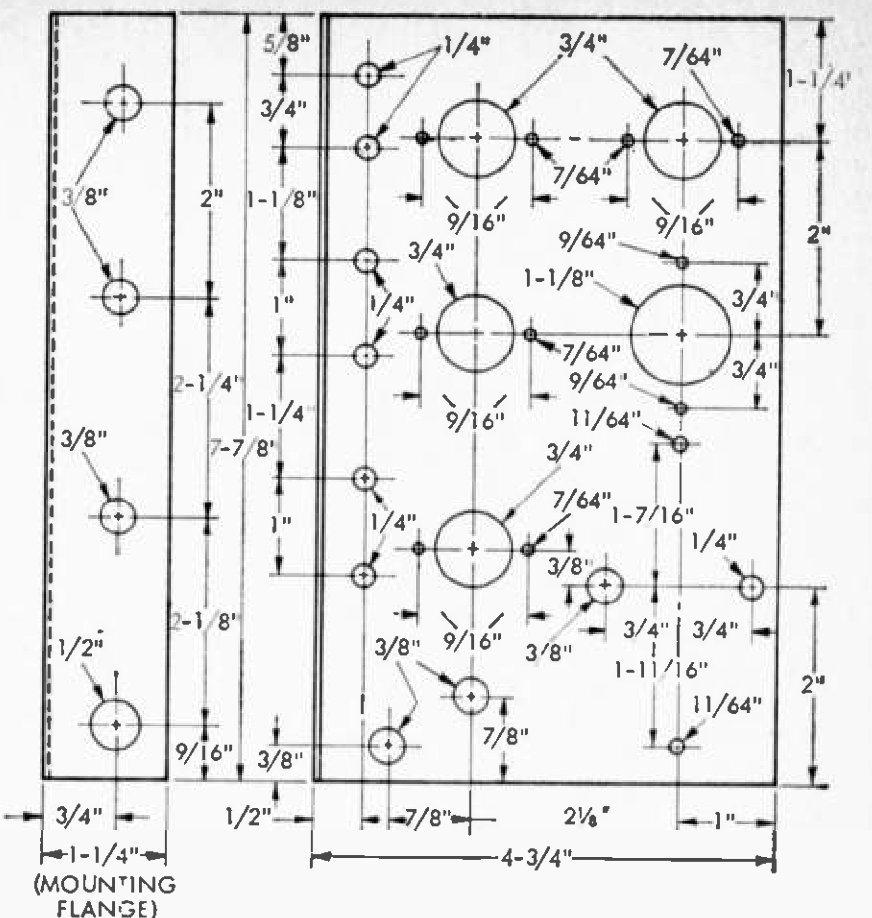
Under-chassis view shows shielded lead attached to common negative lead of binding posts.

which prevents V2b from conducting. At the half-cycle point, the situation instantly reverses (since the multivibrator is a square wave generator), and V2b conducts and V2a cuts off.

As the two halves of V2 alternately conduct, the current they draw flows through the cathode resistors (R28 and R29) of V3a and V3b. The twin triode amplifier (V3) is two ordinary amplifiers, biased at a normal operating point by cathode bias. If the cathodes of the switching tube were not connected to their cathodes, both halves of V3 would amplify equally. However, as the two halves of V2 draw current, this current flowing through the related cathode resistor of V3a or V3b biases that half of the amplifier tube (V3) to cut-off. In this way, the two halves of the amplifier tube (V3a and V3b) are alternately switched on and off at a rate equal to the multivibrator frequency. Therefore, the two input signals take turns appearing at the out-



6 PANEL LAYOUT



7 CHASSIS LAYOUT

put terminals. But, due to the persistence of the fluorescence of the CR tube and the rapid switching rate, both signals appear on the CRT at the same time.

By adjusting the dc potential of the grid of the amplifier tubes, the position on the CRT screen of each signal can be changed. This is done by having a dc voltage from twin voltage dividers R19-R21 and R20-R22 across potentiometer R26 (Position). Adjusting this control varies the voltage on each grid by changing the grounding point.

The voltage calibrator section uses a neon bulb to get square waves at line voltage frequency. Neon bulbs ignite at a certain voltage, and if a resistor is connected in series with the bulb, the voltage drop across the bulb will be constant. The ignition voltage of the NE32 bulb used is approximately 60 v., and gives square waves of 60 v. in this circuit. On the positive half of the cycle, the voltage increases until the ignition point (about 60 v.) is reached. The tube then fires, and starts drawing current. As the voltage increases, more current is drawn, but the voltage drop across the resistor in series with the tube (R38) holds the voltage across the tube constant. As the voltage passes the peak and decreases below the ignition point, the bulb goes out, and current stops flowing through the resistor. The voltage drop across the tube then follows the pattern of the cycle, and the process is repeated on the negative half of the cycle. In this way, fairly good square waves are obtained.

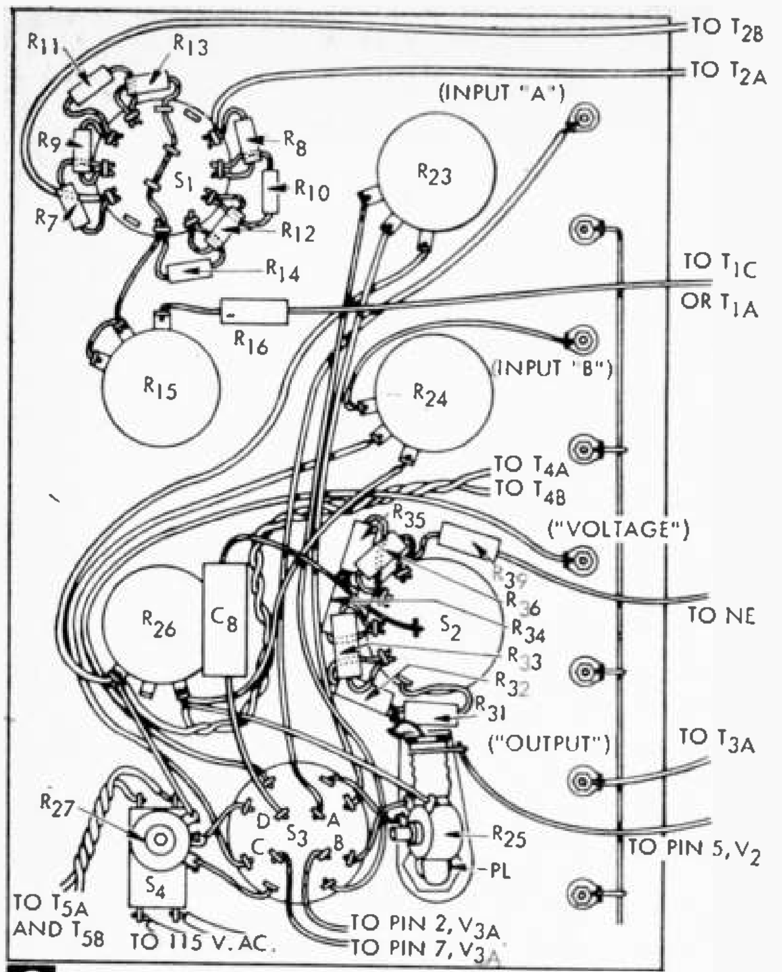
The ignition voltage is reduced to a reference level by R37, and subsequently divided for other ranges by R31 through R35. For oscilloscope use, these levels are usually set at peak-to-peak values rather than the RMS values shown on meters.

Switch S3 and potentiometers R25 and R27 permit the output of the calibrator to be used as one of the electronic switch inputs. The usual method of using a calibrator is to note the height of the calibrator pattern, remove it and connect the signal to the 'scope, and compare the heights of the patterns. By switching the calibrator output into the electronic switch, the calibrator voltage pattern remains on the screen to be compared directly with the signal pattern.

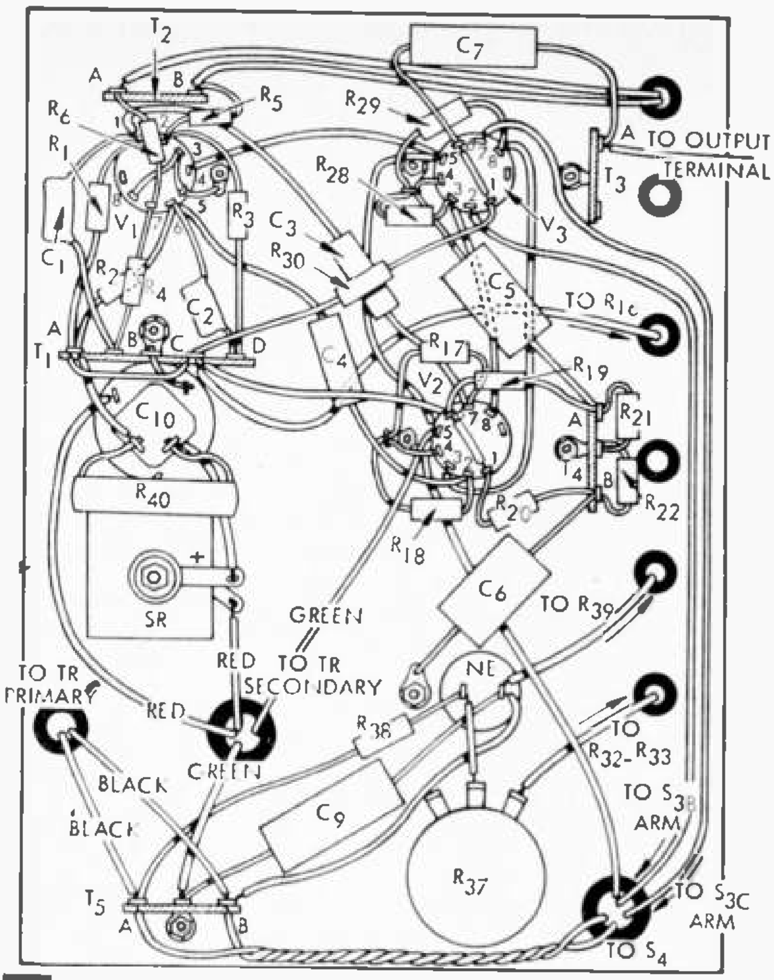
Potentiometers R25 and R27 are required to keep conditions constant when using the calibrator through the electronic switch. If the calibrator were fed directly into Input-B terminals, the output of V3b would vary with the setting of B-gain and the amplification of V3b. Potentiometer R27 is set so the output of V3b is equal to the input.

Since the magnitude of the signal to be measured must not be altered in this case, potentiometer R25 is set so that the output of V3a is equal to the input, making it a 1:1 amplifier. This prevents the electronic switch from affecting the magnitude of the signal whose voltage is to be measured by comparing it with the calibrator signal.

The unit is built on a vertical arrangement to minimize bench space required, as shown in Figs. 4 and 5. The panel and chassis layouts are shown in Figs. 6 and 7, with pictorial wiring shown in Figs. 8 and 9. Notice that R25 and R27 are miniature units, supported



8 PANEL WIRING



9 CHASSIS WIRING

by stiff (#16) wire leads.

The power supply and filaments are wired first, followed by the neon bulb circuit. In mounting resistors on the voltage switch (S2), be sure they will clear the neon bulb. No particular care is required in wiring, except that certain leads (as shown on the schematic) should be shielded, and care used that the grounded shield does not short out any terminals.

After wiring, output of the calibrator must be set. Connect a vacuum tube voltmeter between R37 and ground, and set the voltage switch S2 on 50. Calibration should be for peak-to-peak voltages, so the reading on the VTVM should be .3535 of the values shown on S2. Turn the unit on, and adjust R37 so the voltmeter reads 17.7 v., which is .3535 of the 50 v. indicated on S2. Due to the divider, other readings will be appropriate.

Next, potentiometer R27 should be set. With Calibrator Output S3 on External, set Voltage S2 on 5, and connect the Voltage terminals to the vertical input of the 'scope.

MATERIALS LIST—'SCOPE CALIBRATOR AND SWITCH
(All resistors 1/2 watt and 10% unless shown)

Desig.	Description
R1, R2	51K, 5%
R3, R4	12K
R5, R6	.22 meg.
R7, R8	1 meg.
R9, R10	3.3 meg.
R11, R12	4.3 meg., 5%
R13, R14	5.1 meg., 5%
R15	.1 meg. potentiometer (Fine Frequency)
R16	.15 meg.
R17, R18	.1 meg.
R19, R20	.33 meg.
R21, R22	15K
R23, R24	.1 meg. potentiometer (Input A and Input B)
R25, R27	1 meg. miniature potentiometer (Clarostat Series 48)
R26	50K potentiometer (Position)
R28, R29	1000 ohm
R30	33K, 1 watt
R31	68K, 1%
R32	12K, 1%
R33	10K, 1%
R34, R35	4K, 1%
R36, R39	1K, 1%
R37	50K potentiometer
R38	10K
R40	250 ohm, 10 watt, wirewound

Desig.	Description
C1, C2	.001 mfd., 200 v.
C3, C4	.047 mfd., 200 v.
C5, C6	25 mfd., 25 v. electrolytic
C7, C8, C9	.5 mfd., 200 v.
C10	40-40 mfd., 150 v. electrolytic (Mallory FP-221 or equiv.)
S1	2-pole, 5-pos. rotary switch (Coarse Freq.) Mallory 3226J
S2	1-pole, 5-pos. rotary switch (Voltage) Mallory 3215J
S3	4-pole, 2-pos. rotary switch (Calibrator Output) Mallory 3242J
S4	DPST toggle switch (Power)
PL	6.3 v., .15 amp. pilot light (#40 or #47)
SR	65 ma. selenium rectifier
T	power transformer, 120 v. @ 50 ma., 6.3 v. @ 1 amp. (Merit P-3045)
NE	NE 32 neon bulb
V1, V2, V3	6CG7 vacuum tubes
	5 x 6 x 9" utility cabinet (Bud CU-1099)
	three 9-pin miniature sockets
	neon bulb socket
	pilot light holder
	8 binding posts
	7 knobs
	miscellaneous hardware

Turn both units on, and adjust the vertical gain control on the 'scope to give a pattern of convenient height, and note the height of the image on the CRT. Do not touch the vertical gain control on the 'scope after this.

Move the leads from the 'scope to the Output terminals, set Frequency controls S1 and R15 to mid-position, and adjust Position R26 so a single trace appears on the CRT. Switch Calibrator Output to Input-B and adjust R27 so that the trace height on the CRT is the same as the voltage trace height found above. Seal R27 shaft with nail polish.

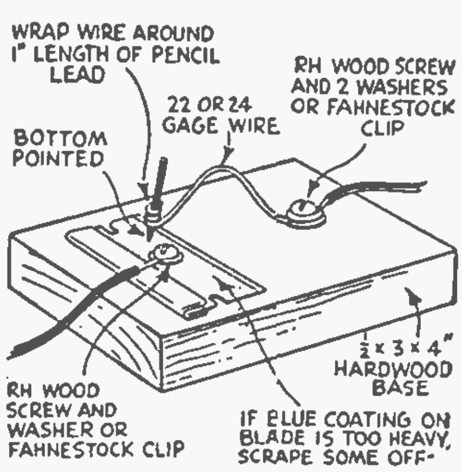
To set R25, feed a low gain signal from an AF oscillator or other unit into the vertical input of the 'scope, adjust the vertical gain for a convenient height, and note the trace height. Then connect the 'scope to the Output Terminals instead of the signal source and adjust the Position control to get a single trace on the CRT.

Remove the neon bulb and set S3 to Input-B. Connect the AF oscillator to Input-A terminals, and adjust R25 to give the same trace height as given when the signal was connected directly to the 'scope. Seal R25 shaft with nail polish and replace the neon bulb.

It will be found that adjustment of the position control will affect signal magnitudes somewhat, so the voltage calibrator section should be used through the electronic switch section only when approximate results are sufficient. When using the unit in this manner, the Position control should be set so the signal pattern is superimposed over the voltage calibrator pattern, and ready comparison can be made. Also, most accurate results can be obtained when the two signals are superimposed. For more precise work, the electronic switch section is not used. Output from the Voltage terminals is connected to the 'scope, the vertical gain set, and trace height noted. The leads from the Voltage terminals are removed, and the signal is then connected directly to the 'scope. A comparison of the trace height produced by the signal, with the noted height of the voltage calibrator trace will then give a precise peak-to-peak voltage measurement.

In using the electronic switch, the two signals to be viewed are connected to Input A and Input B, and the Output is connected to the vertical input of the 'scope. The frequency controls of both the 'scope and the electronic switch are adjusted for proper frequency, and the gain controls on the switch adjust the individual trace heights. By use of the Position control on the switch, the two patterns can be shown separately or superimposed (as in Fig. 1).

Improved Razor-Blade Detector



• Here is a more rugged version of the familiar fox-hole razor-blade "crystal" detector. The original was a piece of pencil lead bridged across the edges of two razor-blades and sometimes used by G.I's in fox-holes to pick up local broadcasting stations. This was fairly sensitive, but it was very difficult to hold an adjustment, as the least vibration or jar caused the lead to rock and roll on the blade edges, resulting in erratic and noisy reception. For the arrangement shown, blue steel single edge or double edge blades (such as *Pal* razors) seem to be the most sensitive, but many other blades also have sensitive spots on them. Use with a conventional circuit and a good antenna and ground.—Arthur Trauffer.

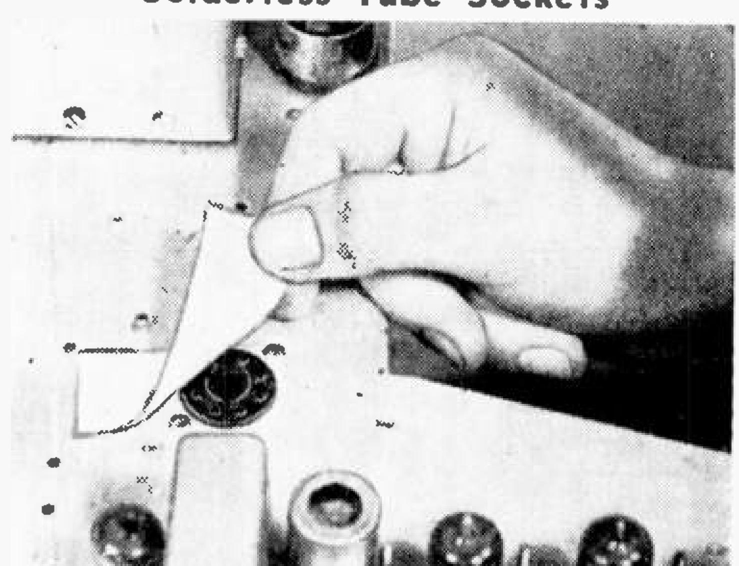
Removing Enamel Wire Insulation

• To remove enamel insulation on magnet and hook-up wire quickly and cleanly, wrap a piece of sandpaper around the wire and give a twisting, rotary motion.—E. L. Burner.

Pointed-End for Radio Ground Pipe

• A simple pointed end makes it easier to drive a radio ground pipe. Insert the lathe-turned point into the bottom end of the pipe to keep dirt from plugging the pipe. Holes drilled through the pipe for soil wetting reduce electrical resistance between ground pipe and soil.—Arthur Trauffer.

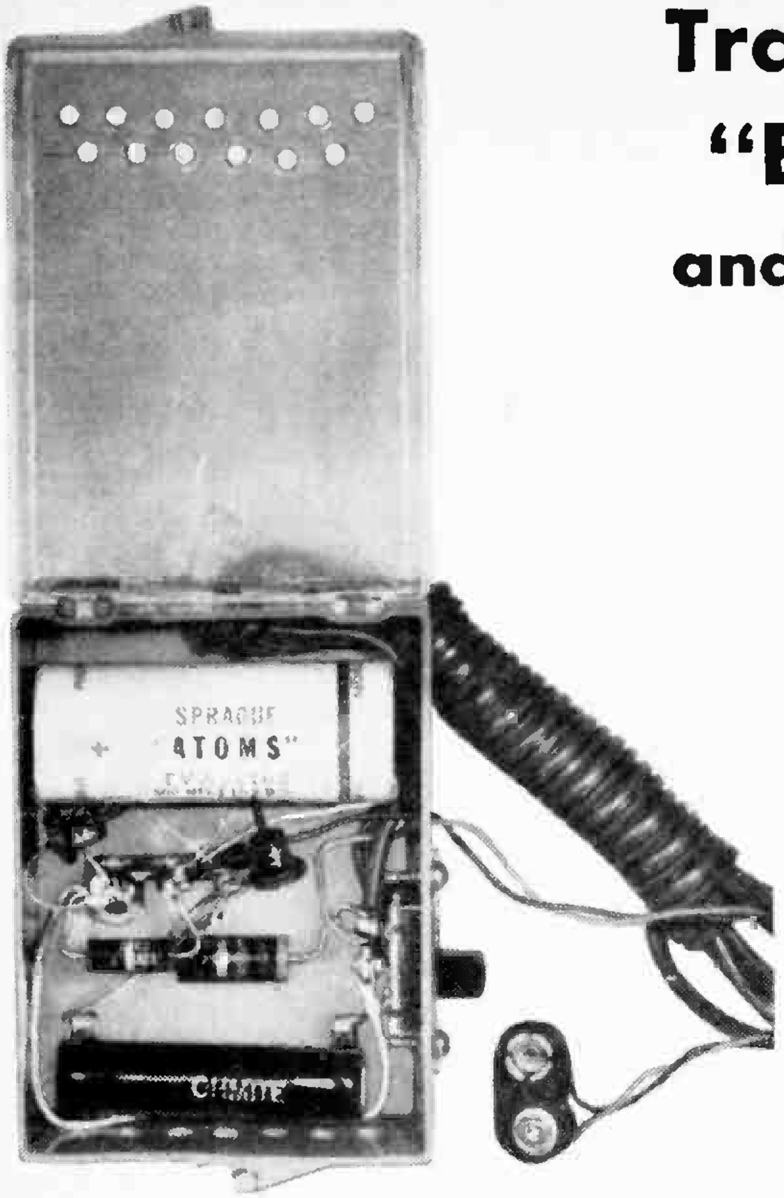
Solderless Tube Sockets



• When soldering on top side of radio or TV chassis, dropping solder in an open tube socket can cause trouble. Eliminate this possibility by placing a strip of wide adhesive tape over the open socket.—H. Leeper.

Transistor Radio "B" Eliminator
and Battery Charger

By GEORGE D. PHILPOTT



House-current is converted by this unit to power transistor radios. If battery is left in radio, unit will charge it while powering the radio.

ONE hour of your spare time, a few inexpensive components, and you will have not only a reliable transistor power supply capable of operating a 6-8 transistor receiver from house-current, but a means of recharging batteries for extra hours service. The set may be off while recharging.

There is no chance of damage to the radio from too much voltage because of these design features: low current rectifiers, a low operating voltage filter capacitor, and a resistor voltage dividing network at the input to the rectifiers.

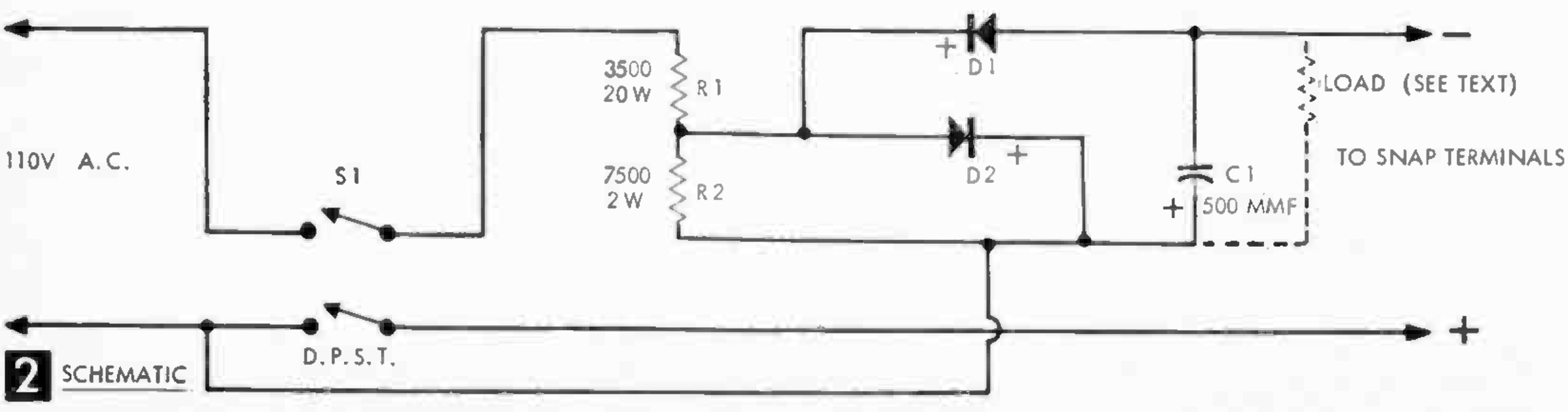
Necessarily this means a 20-watt resistor must be used (R1, 3500 ohms) in the top leg of the divider. During operation this resistor gets warm and should be mounted slightly apart from other components in the plastic case (as from the case itself) and several small holes for ventilation should be drilled in the case near this component.

Resistor R2, electrically connected as the bottom half of the input voltage divider, operates coolly. Current flows here only on the half-cycle when rectifier D2 is not conducting. By changing the value of this resistor a few hundred ohms the voltage output of the power supply can be varied sufficiently to meet most 9-v. receiver current-voltage demands.

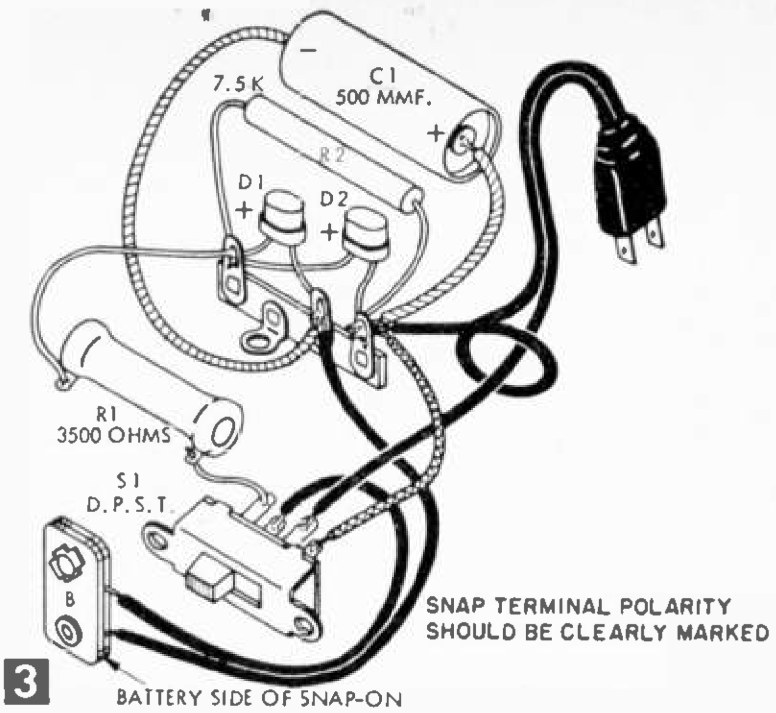
The rectifiers must be capable of supplying at least a 5-ma continuous load. International 1V1 diodes are satisfactory, but larger capacity units such as the GE 1N91, or Sylvania SR 200 silicons will give better voltage regulation under most class A loads.

The 500 mmfd electrolytic provides filtering action at the output, limiting ac ripple to approximately 0.1%, more than adequate for transistor usage. Its low (15 V.) operating voltage is a form of insurance to prevent damage to the radio in case of resistor or rectifier failure in the voltage divider network. The battery is a definite load across the output line until the power supply output is equal to, or slightly above, battery voltage (the latter condition that of recharging the battery) thus keeping the load current to an approximate constant value, preventing possible damaging surges.

As shown by the schematic, a DPST switch disconnects the output of the power supply from the receiver as well as the input voltage, preventing unnecessary battery drain by the relatively high internal resistance of the filter



2 SCHEMATIC



3

MATERIALS LIST—TRANSISTOR "B" ELIMINATOR

Desig.	Description
R1	3500-Ohm, 20-w. wire-wound resistor—IRC 2D (DG)
R2	7500-ohm, 2-w. metalized resistor (IRC BTB-2)
C1	500 mmfd., 15-v. capacitor (Sprague "Atom" TVA 1162, or equiv.)
D1, D2	silicon, selenium or germanium rectifiers (GE 1N91, Sylvania silicon SR 200, or International type 1V1 selenium)
SW	DPST slide switch (Wirt SW725, Allied Radio Co.)
	one 3-terminal tie-point
	two battery snap-on's (salvaged from used batteries)
	plastic case (Sprague Difilm .5-600 v. cap. 4 unit package container, or equiv.)
	ac line cord and plug

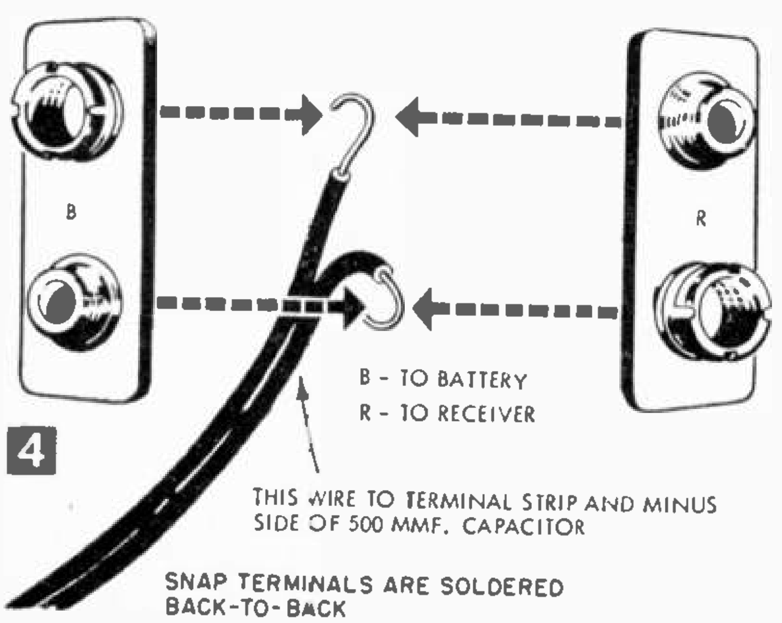
capacitor and diode rectifiers when the receiver is not operating.

Locate parts to fit the plastic box that you have. Wiring is shown in Fig. 3. A typical box layout is shown in Fig. 1.

The battery-receiver snap-ons (Fig. 4) which fasten to the battery inside of the receiver must be marked to avoid placing the wrong voltage potential from the power supply across the receiver and battery effectively canceling the voltage output.

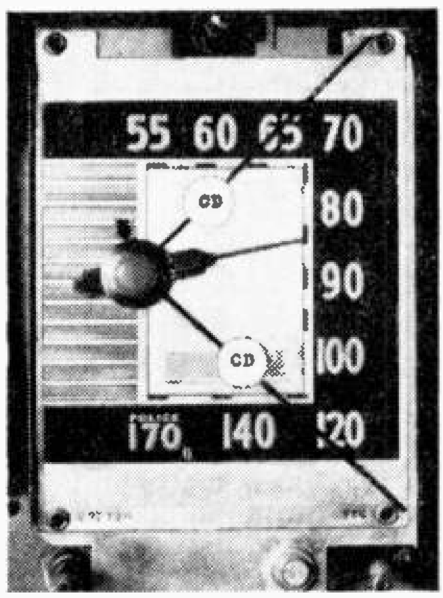
If it is necessary to operate the receiver without a battery across the load, thus stabilizing the current output of the power supply, a 2200-ohm, 1-watt resistor (as shown by the dotted lines in the schematic) must be inserted across the "B" eliminator output. However, for a 2- or 4-transistor radio use a 1200-ohm resistor in this position at all times, even when using while batteries are in the radio.

A word of caution before closing: Necessarily, such an economy power supply is not electrically isolated from the ac line. A lethal shock hazard is thus present at any point where the hand might contact either side of the line. Do not connect any mounting bolts extending through the case to the internal circuitry. One last word. Transistor radios are usually small and light—easily toppled from a chair or table. Tuck your extending earphone and power supply wires well away from the reaches of small feet. A trip through the air may take the pep out of your pet receiver.



4

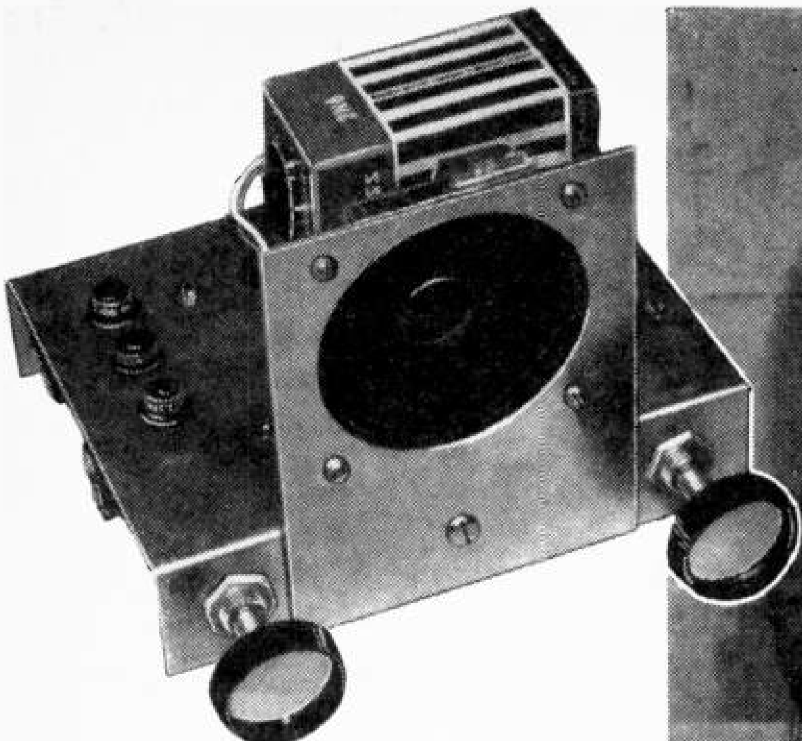
Marking Your Radio for CD Bands



• In the event of an enemy attack on the U. S., the only radio broadcasts will be made by Civil Defense on a frequency of 640 or 1240 kc. To mark your radio now for pinpoint emergency tuning, first remove the knobs and chassis-holding screws and slide chassis out of cabinet, being careful not to ground an *ac-dc* chassis. Using a signal generator (your radio serviceman can do this) mark the exact 640 and 1240 kc spots on the dial with a sharp-pointed pencil. Pull the line plug for safety, and draw the lines across the face of the dial with black India ink, or white ink if dial is black, or you can stretch threads secured at each end with *Duco* cement across dial. Type the letters "CD" on white paper, cut out and cement on top of lines, or post a typed notice such as "Civil Defense, 640 kc, 1240 kc" on cabinet.—Arthur Trauffer.

Solution to What-Is-It? Photo Quiz on Page 38

1) Bayonet base of pilot lamp
2) Spool of wire solder
3) Spaghetti
4) Sharp nose pliers
5) Aluminum foil
6) Top of miniature tube

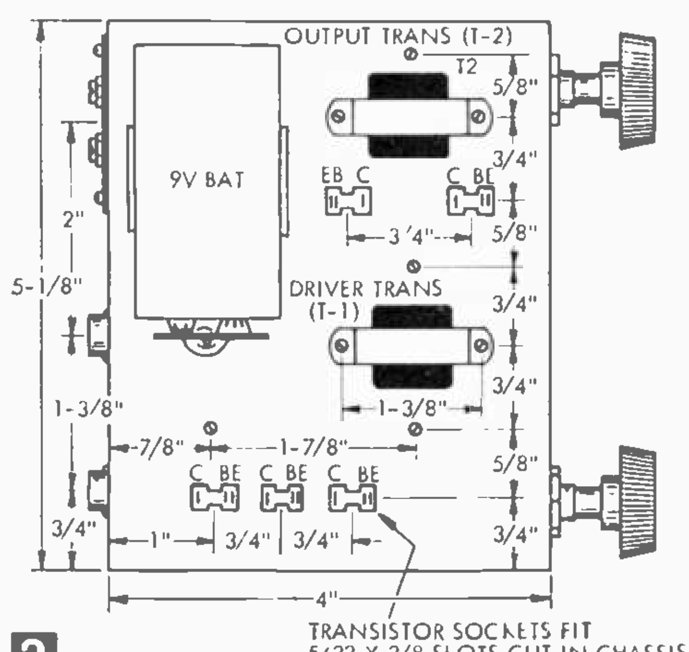


Here's a complete sound system that operates without a-c power. A built-in pre-amp permits use of dynamic mikes, reluctance type pickups as well as crystal phono pickups.

By THOMAS A. BLANCHARD

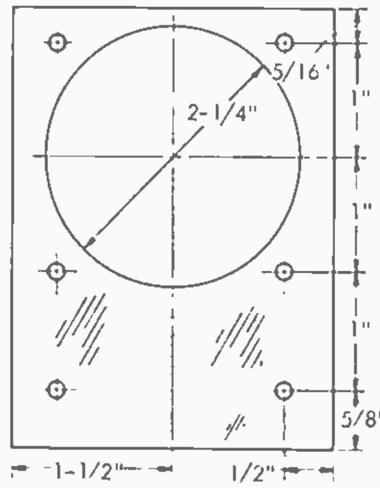
5-Transistor Audio Amplifier

IT weighs only 18 ounces complete, and yet this tiny amplifier delivers loudspeaker volume and has inputs for both low and high impedance pickups.



2

You can bend the 5⅛ x 4 x 1-in. chassis from a 5⅛ x 6-in. of sheet aluminum, or use a Bud miniature chassis (see Materials List). A 3 x 4-in. aluminum panel supports a tiny 2½-in. PM speaker (Fig. 1). Omit this panel if you intend to use the amp with larger speakers.



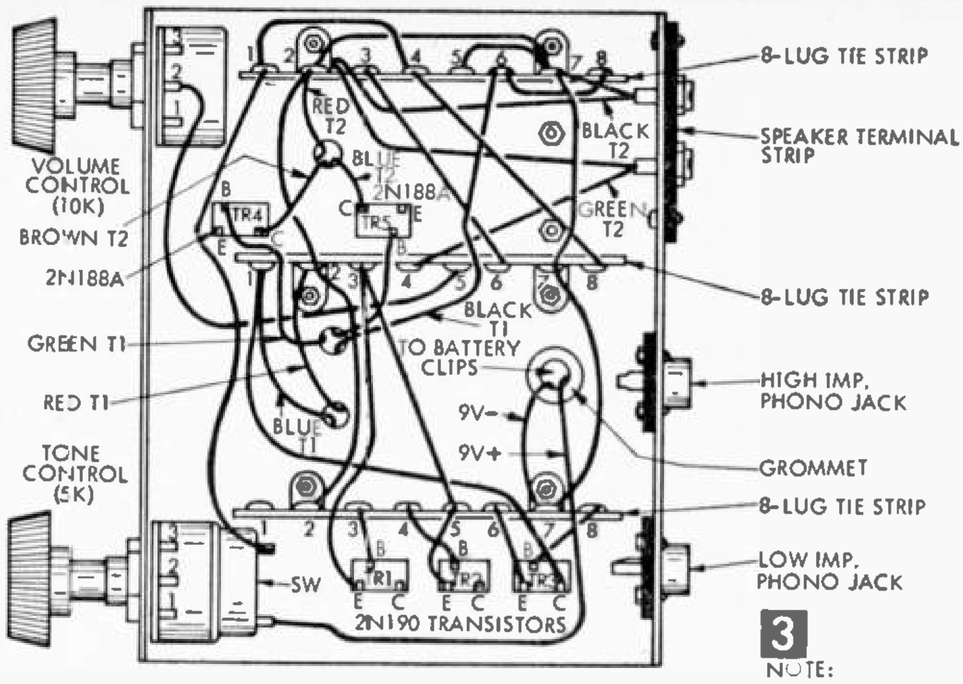
SPEAKER MOUNTING PLATE (OPTIONAL)

Drill all chassis holes according to the layout (Fig. 2). Mount the driver and audio output transformers on top of the chassis with 4-40 x ¼-in. machine screws and nuts. Then fasten the three 8-lug tie strips to the inside of the chassis. These strips support the resistors, capacitors and wiring in a neat uncrowded way. Color code the tie lugs, and you'll have a chassis that is ideal for class or lab demonstration.

Mount the 5K tone control at the left side of the chassis, and the 10K volume control at the right. Fit the two RCA type phono jacks to the rear of the chassis. The shells of these jacks are self-grounding, so they require only one connection to the center pin.

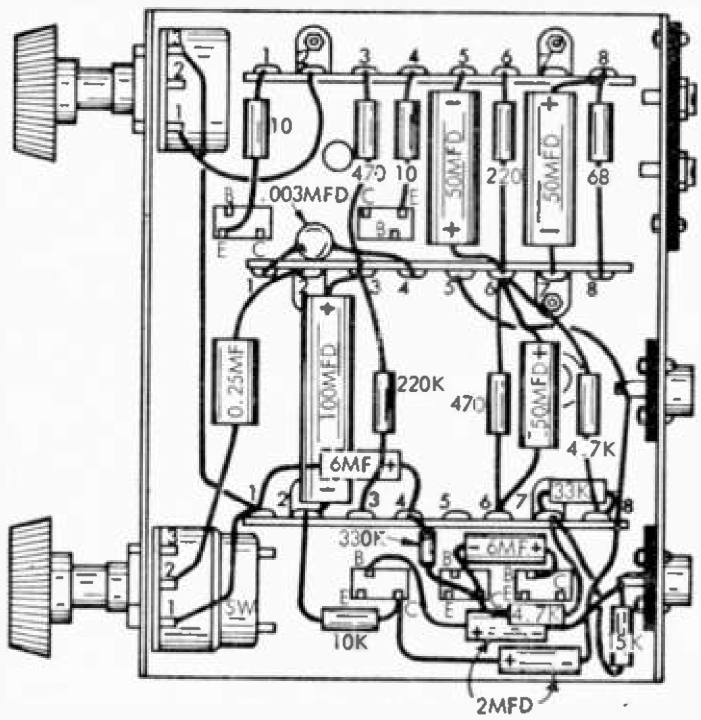
Next complete all of the lead connections as shown in Fig. 3. Lugs #2 and #7 on each strip are your terminals for all grounded leads. Then, wire in the capacitors and resistors (Fig. 4). You can use either the rectangular type of 9-volt battery shown in Fig. 1A with connector clips at one end, or the round type with a connector snap at each end. Fasten the battery to the chassis with a strip of aluminum.

Operation. The low impedance input jack is intended for use with magnetic mikes or phono pickups. As shown in Fig. 5, TR1



3

NOTE:
MAKE ALL CONNECTIONS SHOWN HERE FIRST. THEN ADD PARTS SHOWN IN FIGURE 4. COLOR CODED T1 AND T2 LEADS FEED TO TRANSFORMERS.



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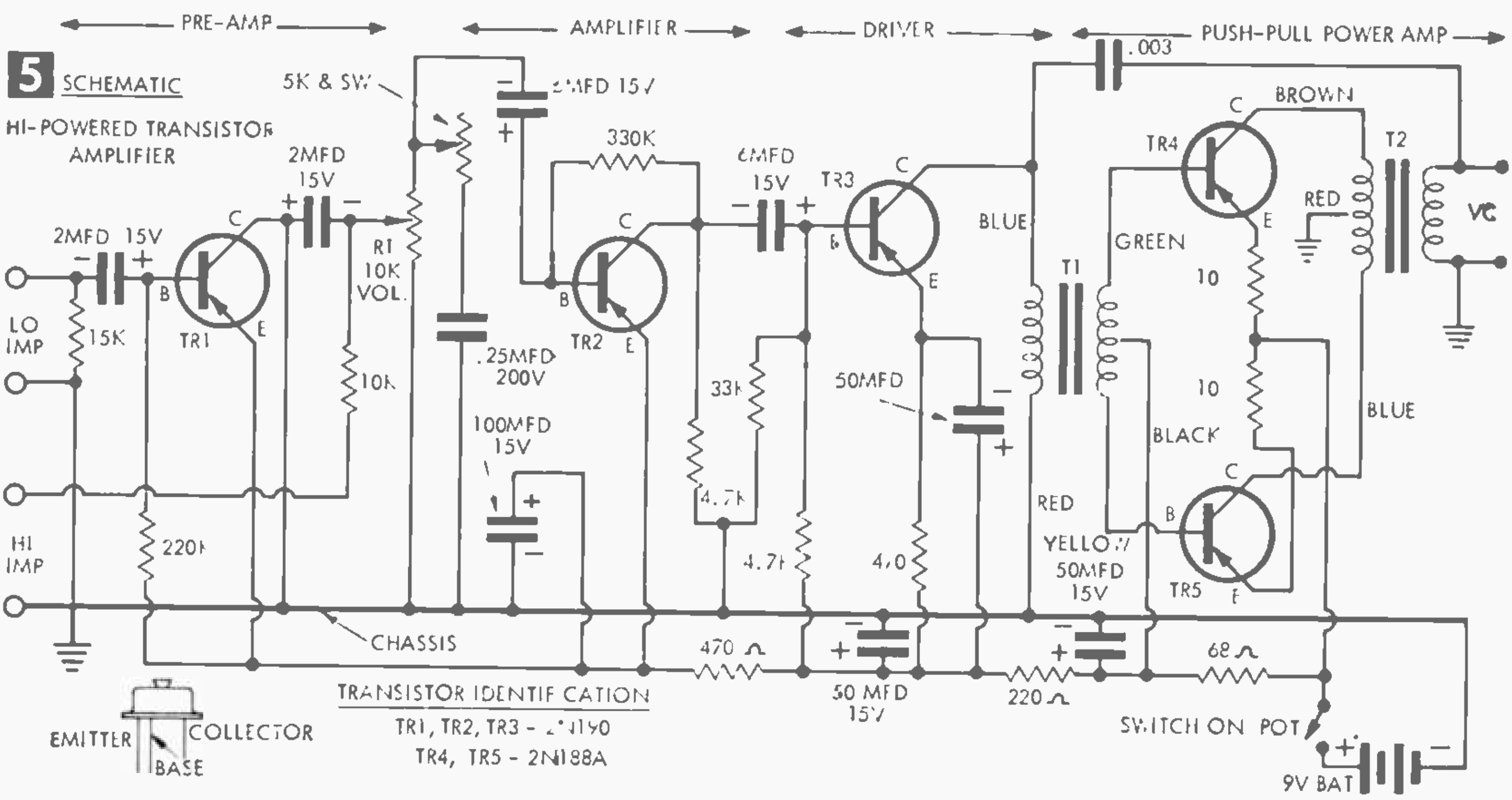


5 SCHEMATIC
HI-POWERED TRANSISTOR AMPLIFIER

MATERIALS LIST—AUDIO AMP.

Amt. Req'd.	Size and Description
1	5⅝ x 4 x 1" aluminum chassis (Bud #CB-1619)*
1	3 x 4" aluminum plate for speaker
1	2½" dia. 3.2 ohm PM speaker (Argonne #SK-65)*
1	T1 audio driver transformer, 5K primary impedance, 3K CT sec. impedance (Argonne #AR 173)*
1	T2 audio output transformer, 125 ohm C.T. pri 3.2 ohm sec. (Argonne #AR 174)*
3	TR1, TR2, TR3-GE 2N190 transistors (or equiv. type 2N189)*
2	TR4, TR5-GE 2N188A transistors (or equiv. types 2N186A or 2N187A)*
	Capacitors
2	2mfd./15 V midget electrolytics
2	6mfd./15 V midget electrolytics
3	50mfd./15V midget electrolytics
1	100mfd./15V midget electrolytic
1	.003mfd. ceramic capacitor
1	.25mfd./200 V miniature paper capacitor Aerovox type P82Z or equal*
	Resistors
1	R1—10K pot, linear (for vol. control)
1	R2—5K pot, linear with switch (for tone control)
2	10 ohm/½ watt carbon resistors
1	68 ohm/½ watt carbon resistor
1	220 ohm ½ watt carbon resistor
2	470 ohm/½ watt carbon resistors
2	4.7K/½ watt carbon resistors
1	10K/½ watt carbon resistor
1	15K/½ watt carbon resistor
1	33K/½ watt carbon resistor
1	220K/½ watt carbon resistor
1	330K/½ watt carbon resistor
	Miscellaneous
3	8-lug tie strips
1	2-screw terminal strip
2	RCA type phono jacks
1	Burgess 2N6 (or equal) 9V battery
1 pr.	snap connectors for above
1	battery mtg. clip
5	retainer mtg. ring transformer sockets
2	push-on knobs for ¼" shaft
1	rubber grommet

* These parts are listed in the mail-order catalog of Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N. Y.

acts as a pre-amp. When you plug high impedance reproducers such as crystal type phono pickups into the high impedance jack, they feed directly into the TR2 amplifier stage.

Transistor TR3 acts as a driver, with transistors TR4 and TR5 operating as a push-pull power amp. All of the transistors are low-priced types, and your circuit will perform equally well with the substituted transistors shown in the materials list.

Any PM speaker with a 3.2 ohm voice-coil can be connected to the amplifier output terminals. To use speakers with 8 ohm voice coils, substitute an Argonne #176 output transformer for the #174 shown.

AC Line Voltage Regulator

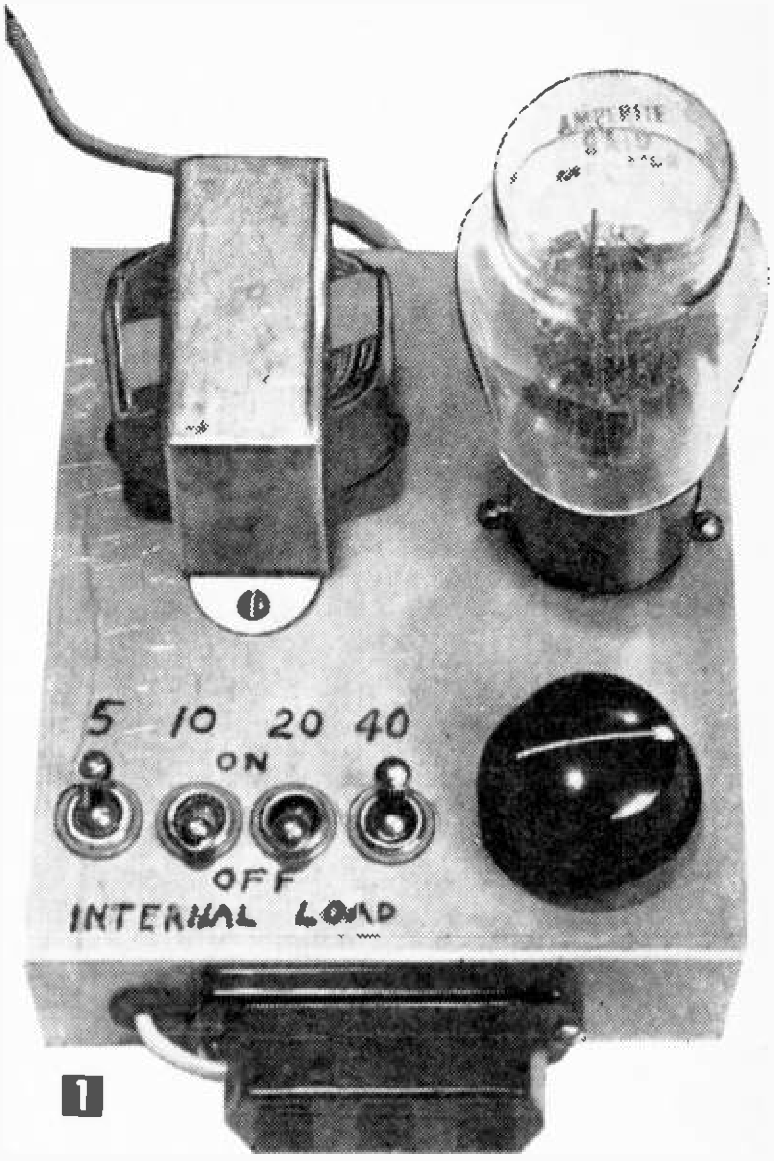
By FORREST H. FRANTZ, Sr.

THE experimenter faces a difficult challenge in attempting to provide a constant ac line voltage for critical experiments. The line voltage varies considerably due to variations in load with time, variation in loads over small segments of the power distribution system, and the voltage drop in the wiring from the line service connection. Variations from 110 to 120 v. are common, and variations from 105 to 130 v. sometimes occur during the course of a day.

This situation is not healthy because it causes you to lose control of your test and experiment procedures. A regulated line voltage is essential for certain work. I developed an inexpensive scheme for first approximation regulation that will work beautifully and meet the requirements of most experimenters.

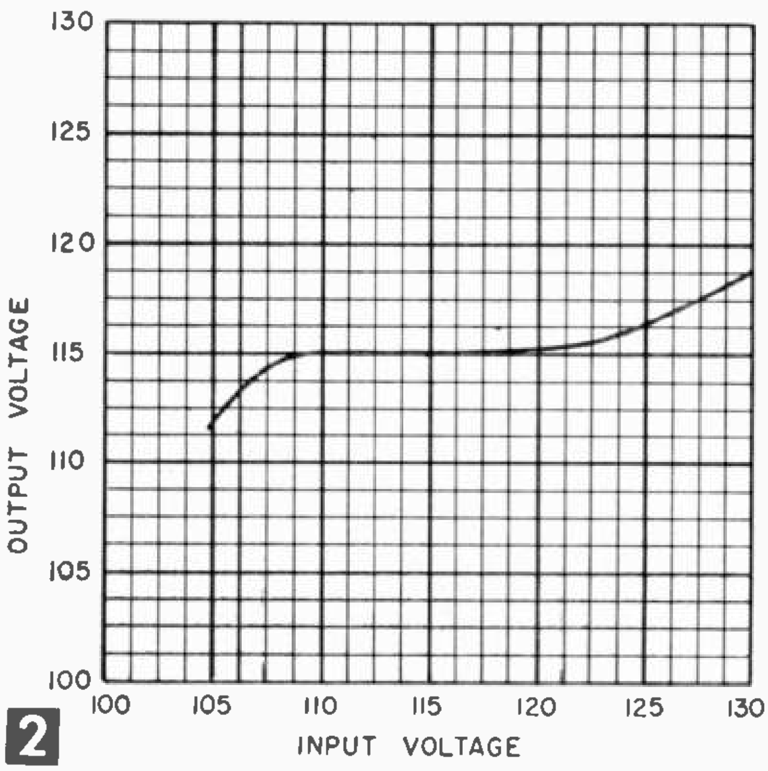
The regulating heart of the device is an Amperite ballast regulating tube. This tube is a non-linear resistor that maintains current constant over a considerable range of input voltage regulation. It may be thought of as a rheostat that automatically adjusts itself to a high resistance value when input voltage increases and to a lower resistance value when voltage decreases.

The use of the ballast tube, with the attendant voltage drop and the fact that for low voltage a greater output voltage is required, necessitates the employment of a step-up device. A 25-v. filament transformer connected series aiding is employed for this purpose. The internal parallel resistance loading network allows the total load to be adjusted to the proper ballast regulator tube operating current. Fig. 2 shows the voltage output vs. input curve of the regulator for the circuit shown in Fig. 3.



1

This line voltage regulator assures constant voltage for experiments.



2

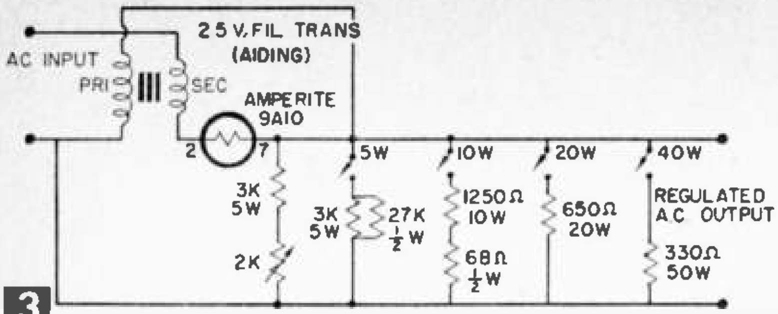
OUTPUT VS. INPUT VOLTAGE FOR REGULATOR

The circuit of Fig. 3 employs an Amperite 9A10 ballast and can handle loads rated from 30 to 100 watts. If loads no greater than 45 watts are to be handled, an Amperite 5H10 ballast regulator tube should be used, and the 400-ohm, 50-W resistor and associated switch may be eliminated.

Follow Figs. 1, 3 and 4 in constructing the 100-watt regulator. Any available chassis may be used. The tube socket hole may be cut with a hole punch, fly cutter, or by drilling a series of small holes and completing the job with a file. The switch holes are ½-in. dia., the outlet wire and transformer lead holes are ⅜-in. dia., and all other holes are ⅛-in. dia.

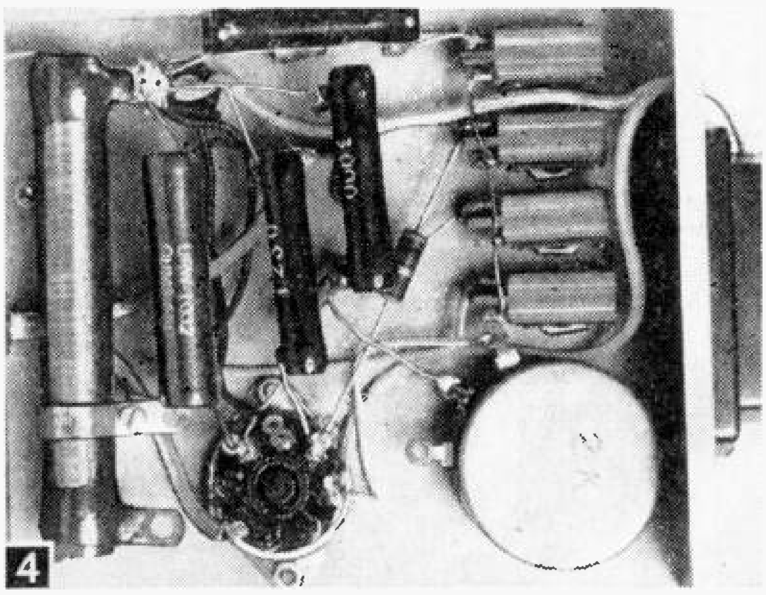
Make firm mechanical connections and use a large soldering iron and rosin core solder.

The internal loading system provides loads of 5, 10, 20 and 40 watts controlled by individual switches so that internal loading may be varied from 5 to 75 watts in 5-watt incre-



3

SCHEMATIC



4

Completed voltage regulator shows parts mounting and wiring.

ments. The potentiometer provides a small continuously variable increment. This potentiometer and the associated 3K resistor may be omitted for reasons of economy on the 100 watt version without serious limitations. The loading system is used in this way: if a 55-watt device is connected to the regulator, an internal load of 100—55 watts must be provided. This value is 45 watts. The photo (Fig. 1) shows the switch settings for this condition.

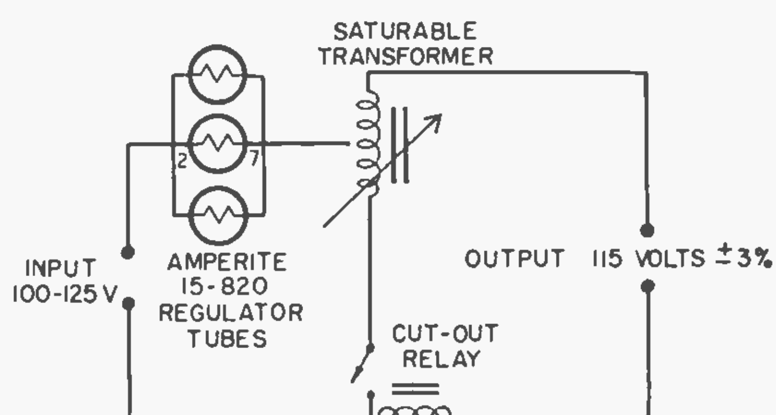
The regulator is used in the following way: Observe the power rating marked on the device to be operated, and add enough internal load to bring the total load to 100 watts. Plug the regulator in, and measure the line input voltage. If it is 115 v., adjust the internal load until the 9A10 ballast regulator has a slight glow. If the input line voltage is greater than 115 v., the load should be adjusted for a brighter regulator tube glow. If the input line voltage is less than 115 v., internal load should be increased until the ballast tube just starts to glow, and then decreased a small amount. This procedure is simple, and the adjustment need only be made once for a given load. The purpose of this adjustment is to establish the current at a value that will be maintained constant through the input line voltage variation range.

It should be noted that there is a small time lag in the operation of the regulator. A large change in line voltage, for example, an instantaneous jump from 110 v. to 125 v. will not be regulated instantaneously. The output voltage may rise from 115 v. to 120 v. and require a second or two to settle to the regulated value. Since most line voltage changes are not this large in a given instant, the small time lag is not detrimental to regulation.

The 100-watt regulator may be built for about $10, the 45-watt for $8. With surplus parts, the cost may be cut in half. This is the lowest cost line voltage regulator scheme available at this time. To increase the capacity of the unit to handle television sets, several tubes may be used in parallel in conjunction with a transformer capable of supplying a greater current demand.

A disadvantage is apparent in this scheme. The regulation, although it is automatic, requires an initial regulator setting for the load to be handled. And if the load demand changes substantially with time, regulation may not be too good. To overcome this objection, a saturable transformer may be employed in the regulator.

One commercial unit, the Microtran LVS-153 employs this idea. This unit is capable of maintaining the voltage within ±3% for line voltage variations from 100 to 125 v. and within ±5% for line voltages of 95 to 130 v. This regulator will handle loads up to 300 watts. The circuit is shown in Fig. 5. There are no preliminary adjustments for loads required except that one of the regulator tubes must be removed for loads of less than 200 watts. The cut out relay shown in the circuit automatically turns the regulator off when there is no load.



5

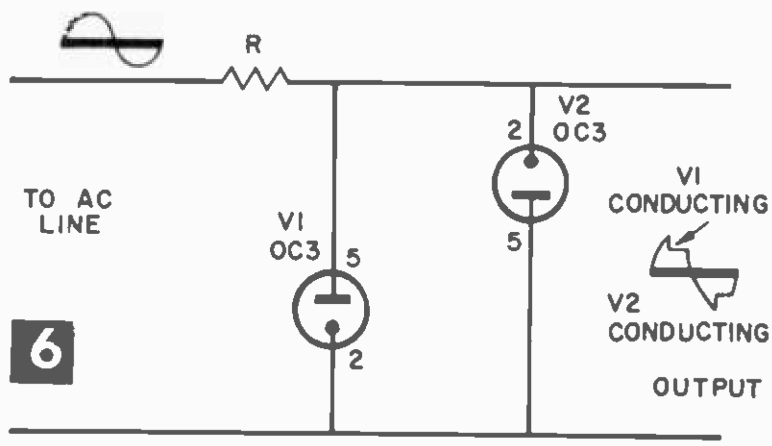
CIRCUIT OF MICROTRAN LVS-153 LINE VOLTAGE REGULATOR

MATERIALS LIST—LINE VOLTAGE REGULATOR

No. Req'd.	Description
1	68-ohm resistor, ½ w., 10%
1	27K resistor, ½ w., 10%
2	3K resistors, 5 w., wirewound
1	1250-ohm resistor, 10 w., wirewound
1	650-ohm resistor, 20 w., wirewound
1	450-ohm adjustable resistor, 50 w., wirewound (adjusted to 330 ohms)
1	2K potentiometer, 3 w.
4	SPST switches
1	octal socket
1	25-v. filament transformer (Stancor P-6469)
1	9A10 ballast regulator tube (Amperite)
1	triple outlet (Monowatt 1240)
1	1½ x 4¾ x 5¾" chassis

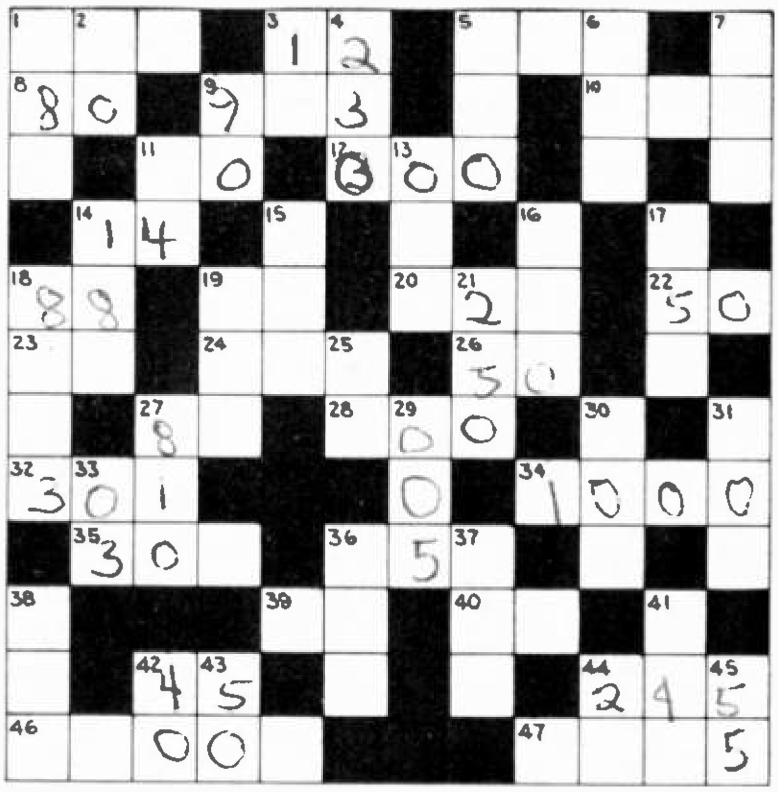
Parts available from Allied Radio Co. or Lafayette Radio Co.

Another scheme (Fig. 6), uses two gas-filled VR tubes such as the OC3 (VR105). The tubes are wired in parallel in opposite conduction directions. The OC3 fires at 133 v. and extinguishes at 105 v. An rms line voltage of 110 v. has a peak value of 156 v. The effect of the voltage regulator tubes on the ac line voltage is shown. The output voltage is reduced, and a step-up transformer is needed. Since the ac waveform is distorted with a gaseous discharge regulator tube, this arrangement cannot be used where observation of the sine waveform is essential. A further disadvantage is that regulation is limited to a small range.



AC REGULATOR SCHEME EMPLOYING GASEOUS VR TUBES. R IS DETERMINED BY LOAD OUTPUT IS APPROXIMATELY 95 VOLTS

Amateur Radio Numbersgram



ACROSS:

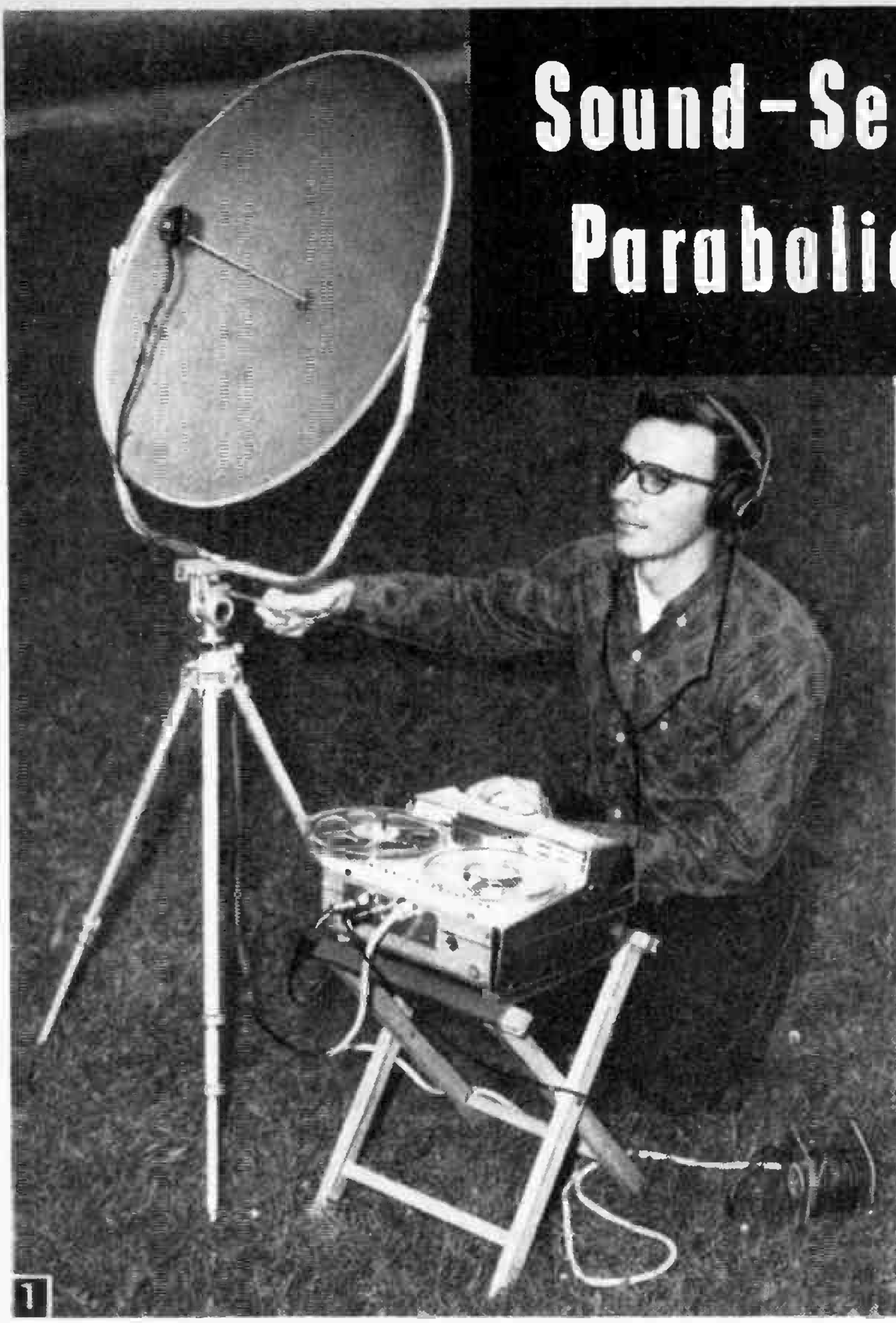
1) The amateur band between 1.8 and 2 mc.
3) Total voltage of eight 1½-v. batteries in series.
5) To find the average value of an ac current or voltage, we multiply the effective value by this decimal.
8) Amateur band between 7 and 7.3 mc.
9) Inductive reactance of a .1 henry inductor at 15 kc.
10) The peak value of a sine wave is equal to —.—— times the average value.
11) Unmodulated carrier (letter and number).
12) The number of zeros represented by "k" in designating resistor values.
14) To obtain a General License you have to transmit code at this WPM.
18) Lower limit of the FM broadcast band in mc.
19) Ham band between 14 and 14.35 mc.
20) One dit-four dahs, two dits-three dahs, five dahs.
22) The filament voltage of a 50L6.
23) The number of digits represented by red in the resistor color code.
24) The resistance of a circuit when applied voltage is 475 v., current flow 1 amp.
26) Total resistance of two 25-ohm resistors in series.
27) The ham band which has an upper limit of 3.8 mc.
28) The frequency of a 750-meter signal.
32) Decimal multiplier used when converting from cycles to kc.
34) One-kilowatt in watts.
35) Upper limit of VHF band.
36) A common am superhet if frequency.
39) Maximum wattage output permitted the holder of a Novice License.
40) Total capacitance of 20 mfd and 30 mfd in parallel.
42) The current flowing in an ac circuit when applied voltage is 450 v., impedance 10 ohms.
44) 245,000 cps converted to kc.
46) Upper limit in mc. of the SHF band.
47) Upper limit of the 20-meter ham band.

DOWN:

1) Upper frequency limit of the 2-meter ham band.
2) Ripple frequency output of a ½-wave single phase rectifier.
3) Lower frequency limit of the 20-meter amateur band.
4) The voltage dropped when 1 amp. flows through 230-ohms resistance.
5) The wavelength in meters of a 500-kc signal.
6) The total resistance of 10-ohms in parallel with 12 ohms, in series with 66 ohms.
7) The wavelength of a 800-kc transmitter.
9) The number of electrical degrees in ¼ cycle of an ac signal.
11) Am radiotelephony.
13) To convert kc to mc, we must multiply by this decimal.
14) The number of electrical degrees that plate current flows in a class B amplifier.
15) The effective to peak value of a sine wave.
16) International distress frequency used by ships and aircraft.
17) The difference frequency produced when a 1,000-kc signal is mixed with a 50-kc signal.
18) The output frequency of a transmitter having a basic frequency of 2017.5 and two frequency doubler stages.
19) The ouput ripple frequency of a full-wave 2-phase rectifier.
21) The total voltage dropped across a series circuit when applied voltage is 250 v., current flow 1 amp.
25) The upper limit of the 6-meter ham band.
27) The value of a resistor color-coded gray-brown-brown.
29) 5 milliamps converted to amps.
30) The maximum modulation permitted in am transmission.
31) The frequency in kc of a 375-meter transmitter.
33) 30,000 mmfd converted to mfd.
36) The impedance of an ac circuit when applied voltage is 450 v., current flow 1 amp.
37) The voltage applied to an ac circuit when total impedance is 65 ohms, current flow 10 amps.
38) The total inductance of 60 and 80 microhenries in parallel (no mutual coupling).
41) The conductance of a circuit when current flow is 0.86 amps, applied voltage 2 v.
42) The total wattage dissipated by two 20-ohm, 20-watt resistors in series.
43) The amount of voltage that will send a current of 1 amp through 50-ohms resistance.
44) Two dozen decibels.
45) .055 millihenries converted to microhenries.

Solution on Page 62.

Sound-Searching Parabolic Mike



1

With earphones plugged into the output jack of a recorder, you can monitor the incoming sound. A disc (not shown) should be mounted in front of the mike to absorb unwanted sound.

Whispers 100-feet away, bird calls 150 feet away—these are only two of many fascinating experiments you can try with this unit

By JACK B. THORNTON

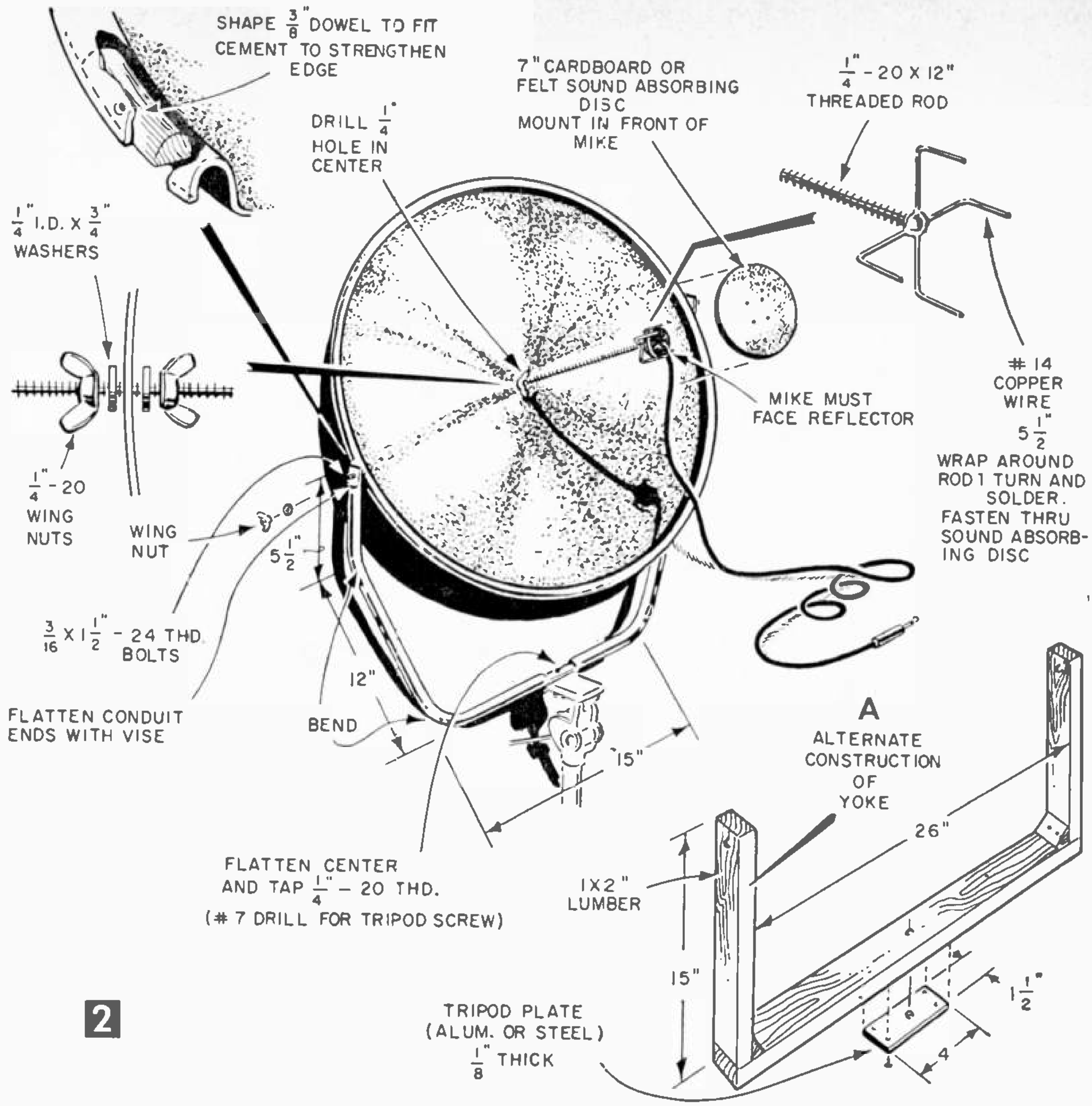
A PARABOLIC reflector made of a $4 disc sled performs like equipment used in broadcast and detective work to pick up sounds hundreds of feet away.

With a VM tape recorder and an Astatic JT-30 mike this parabolic mike detected whispers at 100 feet and normal speech at 150 feet. Bird calls were recorded at 150 feet, although the disc is not selective enough to pick out a single bird call among many. For broadcast use, the unit was set up on top of the grandstand at a football game, and allowed radio broadcast of band music from the other side of the field which was almost drowned out by other noise picked up by a standard microphone.

The bright orange sled, with the station call letters painted on, was quite an attention getter. The operator wears phones connected to the broadcast amplifier so he can monitor the aiming of the dish, pointing it in any direction the announcer may call for.

This dish gives a definite boost to mike sensitivity. Gear was not available to determine exactly how much, but tests run by Electro-Voice indicated that a good 3-ft. parabola gave a 10 DB gain, or a voltage gain of 3.16 times; and a 10 times boost in power output.

The Reflector is Made of a "Flying Disc" fiberglass sled manufactured by Kalamazoo Sled Company. You can order one through Sears Roebuck for under $4. Remove the



2

handles, and locate the center of the 26-in. dish by laying a yardstick across at the widest point and drawing a line. Then lay the yardstick across again, at a right angle to the first line and mark an X at the disc's center. Drill a ¼-in. hole for the threaded microphone support rod.

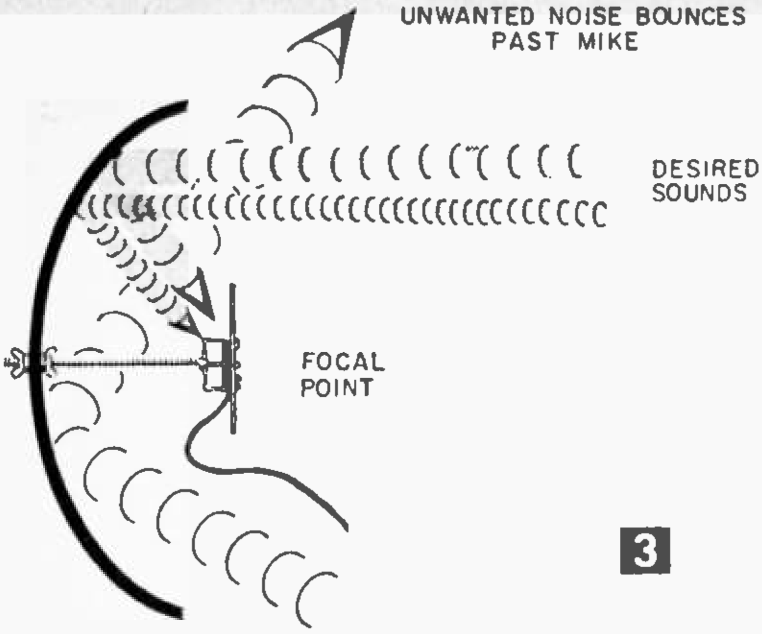
Make the U-shaped yoke by bending a 4-ft. length of ½-in. electrical conduit (Fig. 2). An electrician's conduit bender makes the job easy. (You can also make the yoke of three lengths of 1 x 2-in. lumber, Fig. 2A) Flatten the bottom center part of the U and tap a ¼-20 thread

EDITOR'S NOTE: Testing the 26-in. dish in our backyard (Fig. 1) we found the author's claims ultra-conservative. We picked up a neighbor's whisper four houses away, and a baby crying a block and a half away. With our setup out in the back alley, our helper paced out a hundred yards counting each pace in a normal tone of voice. At first the sound level decreased rapidly. Then from 20 paces out to about 100, there was very little change. At 110 paces out, his voice started to fade until he got to about 130. Then strangely, he came in loud and clear all the way out to 220 yards.

We found we could vary the performance by making minor adjustments on the mike mounting screw, and also that we could beam sound out almost 150 yards by playing the tape recorder through a small 3-in. loudspeaker substituted for the mike.

for camera tripod mounting. Also flatten the top ends of the U and drill the 3/16-in. holes for the swivel screws. Attach the yoke to the disc by drilling 3/16-in. holes on each side for 3/16-14 thread x 1½-in. bolts and wingnuts. Tighten these nuts just enough so that the assembly is free enough to swivel.

Your Microphone and Amplifier should have as much gain as possible. Most tape recorders will work, and allow recording while you monitor with earphones plugged into the output jack or the monitor jack. A PA amplifier will work if it has



MATERIALS LIST—PARABOLIC MICROPHONE

No. Req.	Size and Description
1	"Flying Disc" sled, 26" dia. Sears Roebuck catalog #8317 ($3.72)
4	½" electrical conduit
12"	¼"—20 threaded rod with wingnuts and 2 washers. Available hardware stores.
2	1½ x ³⁄₁₆"—24 thread bolts with wingnuts
16"	#14 bare copper wire
Misc.	Electrical tape, ¼—20 tap, #7 drill, 7" sound absorbing disc of cardboard, felt or fiberglass
	Suggested Microphones
	Lapel Microphone PA-9, high impedance type. $1.95*
	or
	3-way Crystal Microphone #PA-31, high impedance type, $3.95*
	*These microphones are listed in the 1960 Lafayette Radio Catalog, Box 1000, Jamaica 31, New York.

provision for earphones instead of a loudspeaker. Your regular recorder mike can be used unless it is unusually large or heavy. Lapel mikes (see Materials List) will also do the job.

If you decide to order a mike, be sure to specify the proper impedance for your tape recorder or amplifier. Most tape recorders are high impedance, and if the figure is not mentioned in your instruction book, take the unit to an expert, or to your dealer for matching.

Make the mike support rod (Fig. 2) of a 12-in. length of threaded rod obtainable at hardware stores. Solder two 8-in. lengths of #12 or #14 bare copper wire in an X across the end of the rod. Bend the wires forward and tape them to four points around the edge of the mike, keeping the mike's face an inch or two from the end of the rod with the live side facing the disc. Then you can bend the copper wires to center the mike on the rod.

Mount the yoke on a photographer's tripod, or improvise a pipe stand and you're ready for a test. Set up the gear in a quiet location outdoors. Remember to take safety precautions in using no equipment that has a hot chassis that can be connected to either side of the 120 volt supply cord. Also avoid working on damp ground.

Screw a wingnut on the mike support rod to about 4 in. from the mike. Place a washer on the rod, and push it through the hole in the disc. Mount another washer and nut on the back side. Set up your amplifier and listen on earphones as you point to a constant sound source about 50 feet away, such as a code oscillator or someone counting in a normal voice. Slowly adjust the threaded rod in and out until you find the point at which the sound is clearest.

You'll find that the sound is more brilliant at the focus, becoming slightly "bassy" on either side of the focal point. When you find it, lock the rod assembly. No further adjustment is needed unless you change microphones. Many mikes can be improved a bit in some locations by adding a 6- or 7-in. disc of felt or fiberglass to the dead side to block out unwanted sound (Fig. 2).

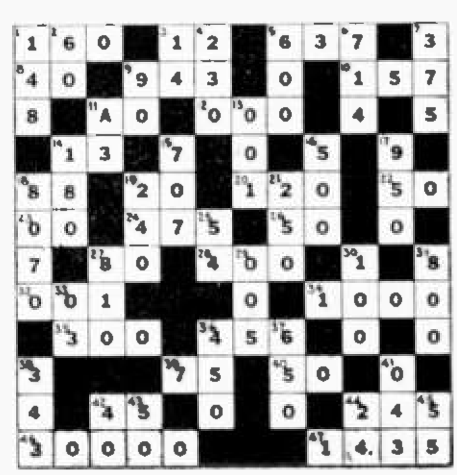
The Principle of the Sound Detecting mike is that the curved surface reflects sound waves from directly in front to a focal point (Fig. 3). Unwanted noise from angles to the side is bounced back out. The dead side of the microphone is toward the source of sound, so what you record is only by reflection.

Parabolic microphones have been also made from surplus radar reflectors which use a similar principle. Also, small pickups can be made from old style automobile headlight reflectors as well as from electric heater reflectors—the old type that had a bowl at least a foot in diameter.

Invert Aerial to Speed Installation

• The neighbors may think you're crazy if you start the installation of a TV or radio aerial upside down, but doing this will help you to quickly and easily align a bracket on the edge of your house. By having the mast parallel a corner of the building, one of the windows, or some other vertical part, it is easy to sight the alignment while adjusting the mounting bracket. Then you need only reverse the mast to finish the job.

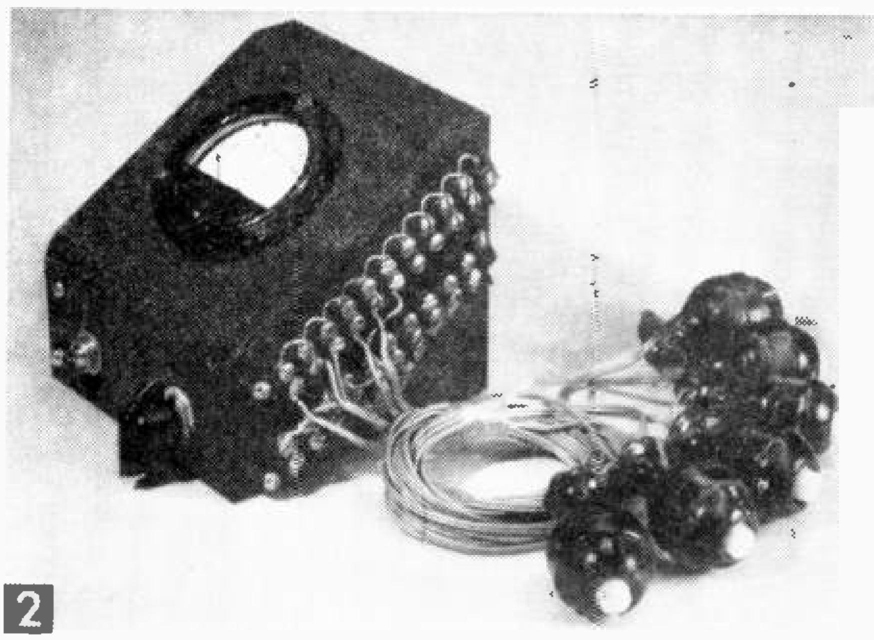
Solution to Amateur Radio Numbersgram, Page 59



Opinion Meter

By C. F. ROCKEY

1



2

CALLED the *Group Thinkometer* by its inventors, this electronic device registers your opinion. You can vote against the boss, and nobody will be the wiser.

Let's say that around a conference table are gathered engineers, scientists, test pilots and designers. The project leader points to a chart and says, "All those in favor of this nozzle design vote *Yes* by pressing the button." Instantly, the total vote in favor is indicated on a dial.

This idea was developed and experimentally marketed by the Harwald Company of Evanston, Ill., and it was found that the "Thinkometer" does more than just speed up a voting procedure. The chairman can instantly determine the group opinion at any moment during a discussion. And of course, the vote is completely secret, as long as each person conceals the button in his hand. The "personality factor" in voting is eliminated, and each person is free to express his opinion, in favor or against, without fear of offending a friend, a co-worker, or a boss.

We suggest that you build a Thinkometer and try it at a club meeting, or in a class discussion. You may find that it gives you a much more accurate reflection of what people think about controversial issues. Someday perhaps, legislatures may vote electronically, with equipment much like the Thinkometer.

Construction can be completed in an evening if you use the Premier metal case (Fig. 2). It comes predrilled with a 2-in. hole that needs only a little filing to fit the body of the meter. Drill 7/64-in. holes for mounting the meter and outside terminal strips, using these parts themselves as drilling templates.

Now take two of the five-point tie strips and make a 5-rung ladder, using 10,000-ohm resistors as each rung (Fig. 3). Solder each resistor lead carefully at each end. At one side of the ladder, tie all of the resistors together and bring out one lead. At the other side solder a 6-in. lead to each resistor.

Next make another ladder assembly just like the first one, so that you have two assemblies of five resistors each. Fasten these assemblies to the inside rear of the case using 6-32 x ½-in. machine screws and nuts. Lace the 10 individual resistor leads together into a cable and pass it out through the 3/8-in. grommeted hole on the right side of the case.

On the front of the case, you will find two pre-stamped knockouts for the switch and pot. Pry the holes out with a screwdriver and mount the SPDT switch with the two-lug end downwards. Then assemble the on-off switch on the pot following manufacturer's directions, and mount it on the right. Next fasten the two 10 terminal strips on the right side of the case. Mount the battery clip inside with the positive end facing the switches. Temporarily insert the meter so you can arrange enough clearance while you complete

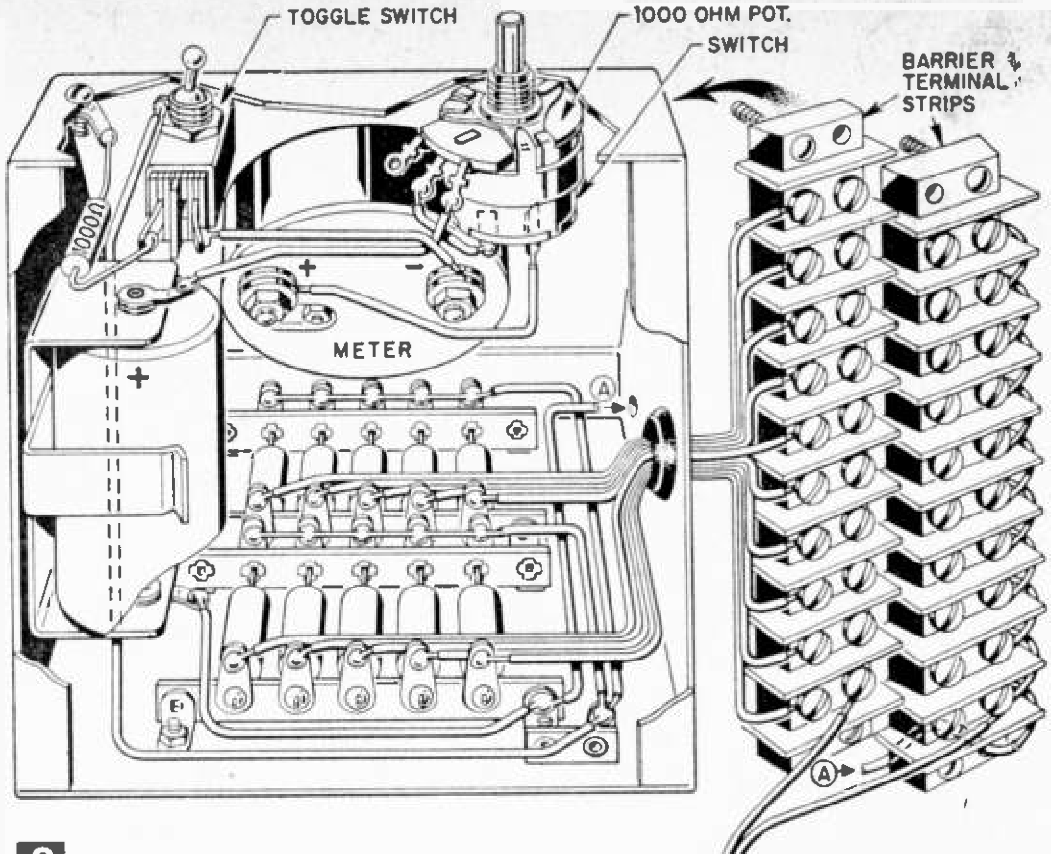
TABLE A

Dial Marking	Scale Reading in. ma.
0	0
1	0.13
2	0.27
3	0.39
4	0.50
5	0.60
6	0.69
7	0.77
8	0.86
9	0.93
10	1.0

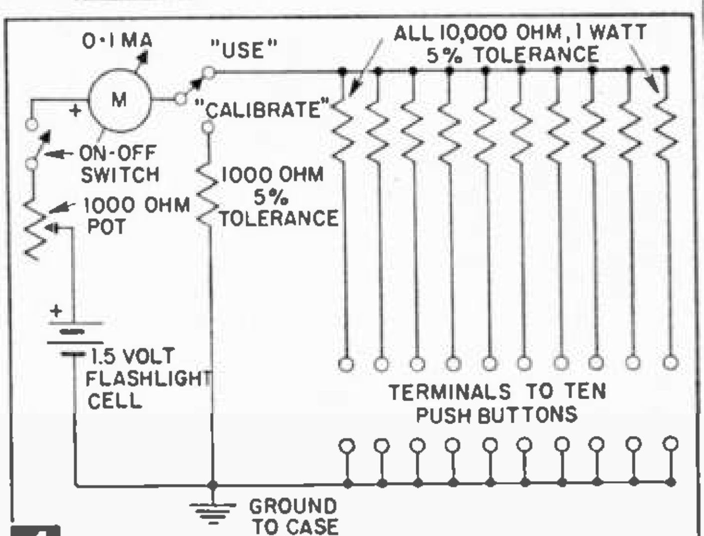
wiring (Fig. 4). Since all of the resistors are 10,000 ohms, there is no need to connect them in order on the terminal strips. When all the wiring is complete, check each connection carefully. Then temporarily connect the meter, and test the operation.

How It Works. As you press more buttons, more current flows through the milliammeter, but not quite in direct proportion, since there is a constant resistance of about 500 ohms in series with the meter at all times. To test the meter, you connect the cables to the terminal strips and insert a fresh battery (polarity must be correct).

With the power switch on, throw the toggle switch to *Calibrate,* its down position.



3 PICTORIAL



4 SCHEMATIC

MATERIALS LIST—OPINION METER

Amt. Req.	Size and Description
1	meter case, Premier No. SPC-23 (NE #91F861)*
1	0-1 ma. milliammeter, Triplett #221-T, 2" round (NE #55F1691)
1	1,000 ohm pot with switch, Mallory type U-4 Midgetrol (NE #9F134 and 9F194)
1	battery clip, 1 cell, Keystone #175 (NE #28F858)
1	toggle switch SPDT, AH&H (NE #23F024)
2	10 position Jones Type 10-140 barrier terminal strips (NE #28F708)
10	10,000 ohm, 1 watt, 5% resistors
1	1,000 ohm, 1 watt, 5% resistor
4	5 lug insulated Jones #2000 Terminals (NE #28F683)
1	knob, bar type, Bakelite Davies #2300 (NE #26F100)
50 ft	#24 double strand speaker extension wire, Belden #8782 (NE #36F105B)
10	push buttons Eagle Electric Type 185B. Available local electric dealers or mail order from Contact Electric Supply Inc., 2030 N. Milwaukee Ave., Chicago 47, Ill. Cost postpaid, $6.50.
Misc.	1 doz. 6-32 x ½" machine screws and nuts, 10' hookup wire, solder, rubber grommet, battery

* NE nos. refer to catalog items, Newark Electronics, 223 W. Madison, Chicago 6, Ill., and 4747 W. Century Blvd., Inglewood, Calif.

Now turn the pot clockwise until the meter reads exactly full scale. Then throw the switch to the *Use* position. The meter should now indicate the number of buttons pressed as in Table A. If there is serious error, recheck your wiring. If you used parts other than those in the Materials List, you may have to do your own calibration.

After testing the opinion meter, you are ready to add the scale markings to the meter face. Working in a clean dry room, remove the meter from its housing by taking out the three tiny screws near the back and pulling the movement straight back. Remove the two screws which hold the meter dial in place, and taking care not to damage the needle, remove the dial and add the markings (Table A). You can use pencil, or India Ink and a fine lettering pen. Then reassemble. If you used the parts in the Materials List, especially the 5% tolerance resistors, your calibration will remain accurate as long as the battery is reasonably fresh.

Dual Capacitor Substitution Box

Simple unit provides over 600 values with only 36 capacitors

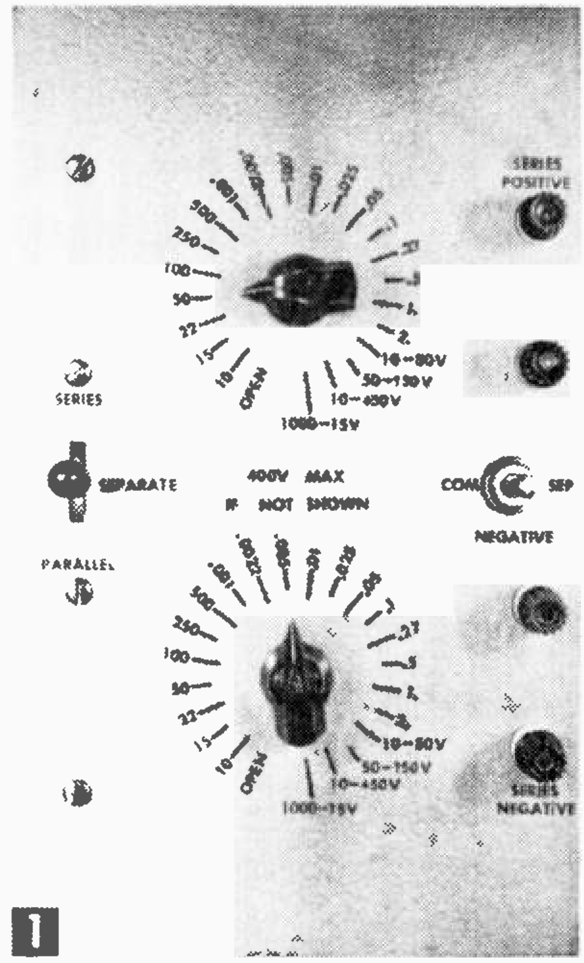
By W. F. GEPHART

IN SERVICING work, it is often necessary to replace a capacitor whose markings are illegible, and unless manufacturer's data is available, replacement must be made by trial and error until the correct value is found. In experimental and design work, various size capacitances must be tried for optimum results, and often matched pairs are required for multivibrator and bridge circuits. The capacitor substitution box shown in Fig. 1 will provide virtually all values needed and provides matched pairs for the most common values.

Two sets of 18 bypass capacitors are used, with separate switches, providing 18 values in matched pairs for multivibrator and bridge work. By the use of a switch, however, any two capacitors can be connected in series or in parallel, which gives a total of over 600 different capacity values that can be obtained with the 36 capacitors. Table A shows how 76 normally-needed capacity values are secured. In addition to the bypass values, the box also includes two sets of electrolytics, of voltage rating and capacity most often needed, for power supply substitution or experimentation.

As can be seen by the schematic (Fig. 2), the box consists of two 23-position switches, which select the capacitor required. Normally, capacitors for each rotary switch are connected to a separate set of binding posts, so two isolated values can be used simultaneously. If desired, the negative side of the two values may be made common by switch S4. When a value other than that included in the unit is needed, the two sections are connected together, either in series or parallel, by S1, which is a 3-position switch. When this switch is used, S4 must be in the "Separate" position, and the top and bottom binding posts must be used.

If at all possible, similar capacitor values for each switch assembly should be matched, so they can be used in matched pairs. High tolerance capacitors are quite expensive, but reasonably well-matched values can be secured in two ways. If you have access to a capacity bridge, capacitors from your junk box (or dealer's stock) can be checked for

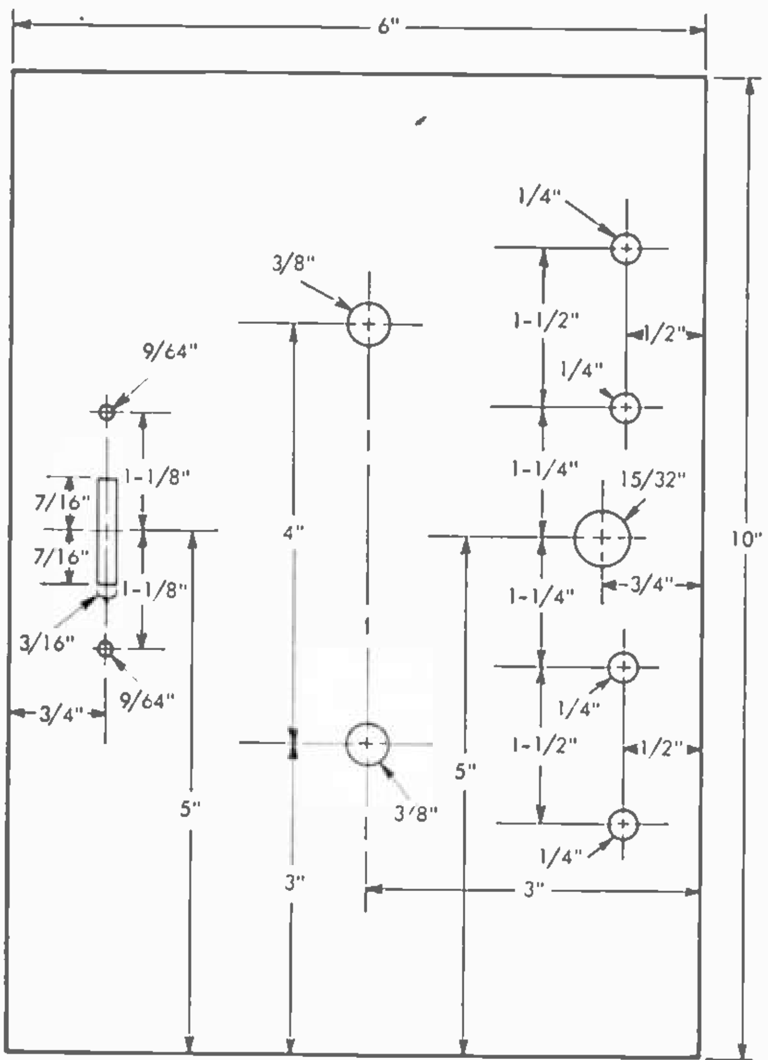


A must for the service man, the capacitor substitution box tells the value when markings are illegible.

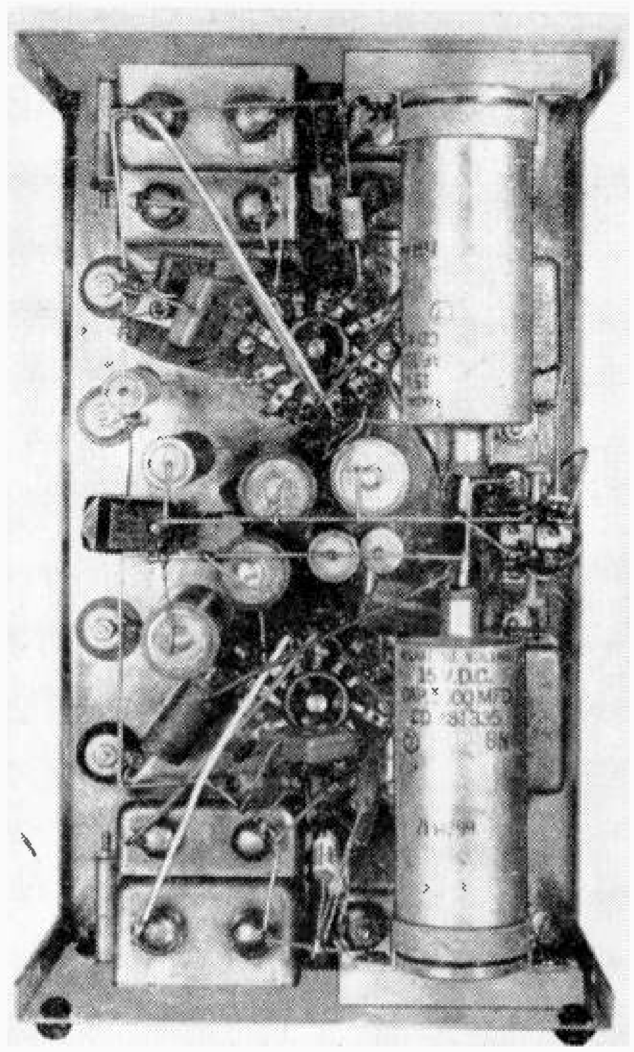
matching. Another means is to order the capacitors together, specifying manufacturer and type. While the values furnished may not be the exact value labeled, they will tend to be equally high or low, and therefore fairly well matched.

Unless special precautions are taken, and a low capacity bridge is available for checking, the lower values (below 100 mmf) should be omitted, or it should be recognized that such values will not be wholly accurate. Any instrument has certain inherent capacity, and a box such as this could have an internal capacity up to 60 or 70 mmf, which precludes a setting below that. To minimize internal capacity, special precautions, such as using porcelain insulators for the binding posts, use of a special switch in the series-parallel circuit, and careful wiring techniques must be taken. All leads should be as short as possible, and the low-capacity capacitors should not touch each other.

Even with special precautions, the minimum internal capacity of the box will be somewhere from 3 to 10 mmf per section, primarily due to the capacity of the rotary switches. If a low-capacity capacitance bridge is available, the internal capacity of each section can be checked, and allowances made in selecting capacitors for the low values. In the unit shown, undersize or odd values had to be used for the 10, 15 and 22 mmf capaci-



3 PANEL LAYOUT

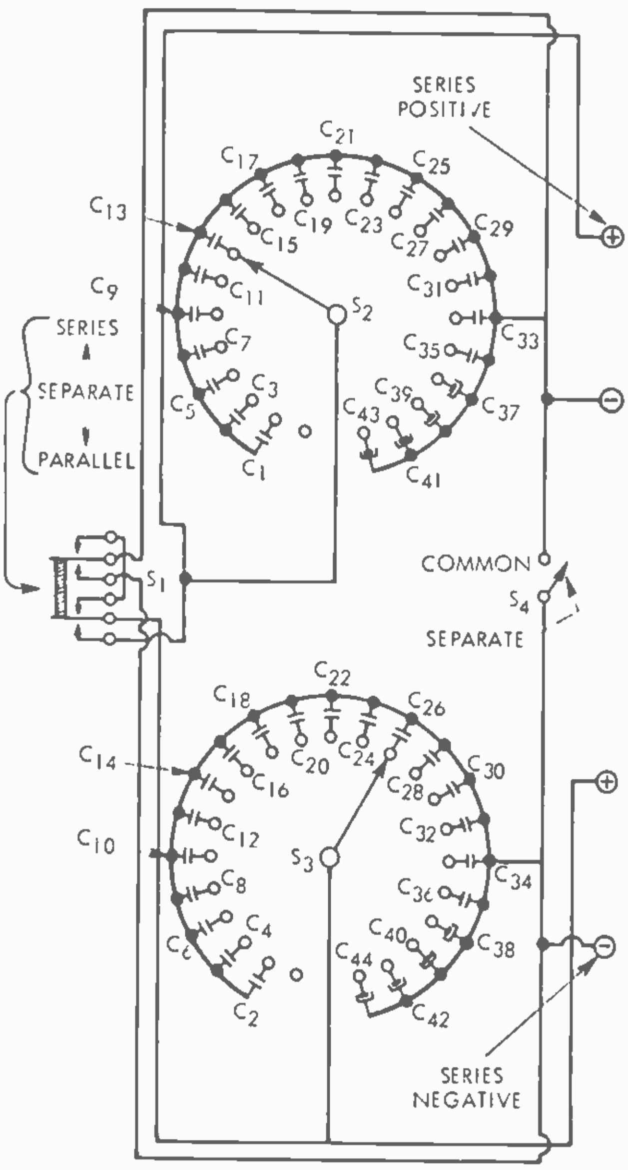


4 Back-of-panel view of the capacitor substitution box.

TABLE A—SECURING VALUES

Value MMF	Series Conn.	Parallel Conn.
5	10 & 10	
10	Included in Unit	
12	15 & 100	
15	Included in Unit	
20		10 & 10
22	Included in Unit	
25	50 & 50	10 & 15
30		15 & 15
33	50 & 100	
37		15 & 22
40	50 & 250	
47	50 & .001	
50	Included in Unit	
60		50 & 10
65		50 & 15
70	100 & 250	
83	100 & 500	
91	100 & .001	
100	Included in Unit	
110		100 & 10
125	250 & 250	
150		50 & 100
160	250 & 500	
200	250 & .001	
220	250 & .0022	
240	250 & .005	
250	Included in Unit	
272		250 & 22
300		250 & 50
330	500 & .001	
350		250 & 100
400	500 & .0022	
470	500 & .01	
500	Included in Unit	
510		500 & 10
522		500 & 22
550		500 & 50
600		500 & 100
680	.001 & .0022	
750		500 & 250
820	.001 & .005	

Value MFD	Series Conn.	Parallel Conn.
.001	Included in Unit	
.0011	.0022 & .0022	
.0015		500 & .001
.0018	.0022 & .01	
.002	.0022 & .025	
.0022	Included in Unit	
.0025	.005 & .005	
.0027		.0022 & 500
.0033	.005 & .01	
.005	Included in Unit	
.0051		.005 & 100
.0055		.005 & 500
.006		.005 & .001
.0082	.01 & .05	
.01	Included in Unit	
.015		.005 & .01
.02		.01 & .01
.025	Included in Unit	
.035		.01 & .025
.05	Included in Unit	
.068	.1 & .27	
.1	Included in Unit	
.15		.05 & .1
.2		.1 & .1
.25	.5 & .5	
.27	Included in Unit	
.33	.5 & 1.0	
.5	Included in Unit	
.68	1.0 & 2.0	
1.0	Included in Unit	
1.5		.5 & 1.0
2.0	Included in Unit	
2.5		.5 & 2.0
3.0		1.0 & 2.0
4.0		2.0 & 2.0



2 SCHEMATIC

MATERIALS LIST—CAPACITOR SUBSTITUTION BOX

DESIG.	Description
C1, C2	10 mmf ceramic or disc
C3, C4	15 mmf ceramic or disc
C5, C6	22 mmf ceramic or disc
C7, C8	50 mmf ceramic or disc
C9, C10	100 mmf mica
C11, C12	250 mmf mica
C13, C14	500 mmf mica
C15, C16	.001 mfd mica
C17, C18	.0022 mfd mica
C19, C20	.005 mfd mica
C21, C22	.01 mfd mica
C23, C24	.025 mfd metallized
C25, C26	.05 mfd "bathtub"
C27, C28	.1 mfd "bathtub"
C29, C30	.27 mfd metallized
C31, C32	.5 mfd "bathtub"
C33, C34	1.0 mfd "bathtub"
C35, C36	2.0 mfd "bathtub"
C37, C38	10 mfd 50 v. electrolytic
C39, C40	50 mfd 150 v. electrolytic
C41, C42	10 mfd 450 v. electrolytic
C43, C44	1000 mfd 15 v. electrolytic
S1	DPDT anti-capacity lever switch (Federal 1425) or DPDT center-off toggle switch (see text)
S2, S3	23-position (Centralab 1443) or 17-position (Mallory 32117J) single pole rotary switch (see text)
S4	SPST toggle switch
	3½ x 6 x 10 in. Minibox (Bud CU-2110), 2 knobs, 4 binding posts, porcelain insulators for binding posts (see text), rubber feet, miscellaneous hardware as required.

NOTE: This list specifies capacitors actually used. Similar values in paper capacitors will also work. All ratings should be 400 v. or higher.

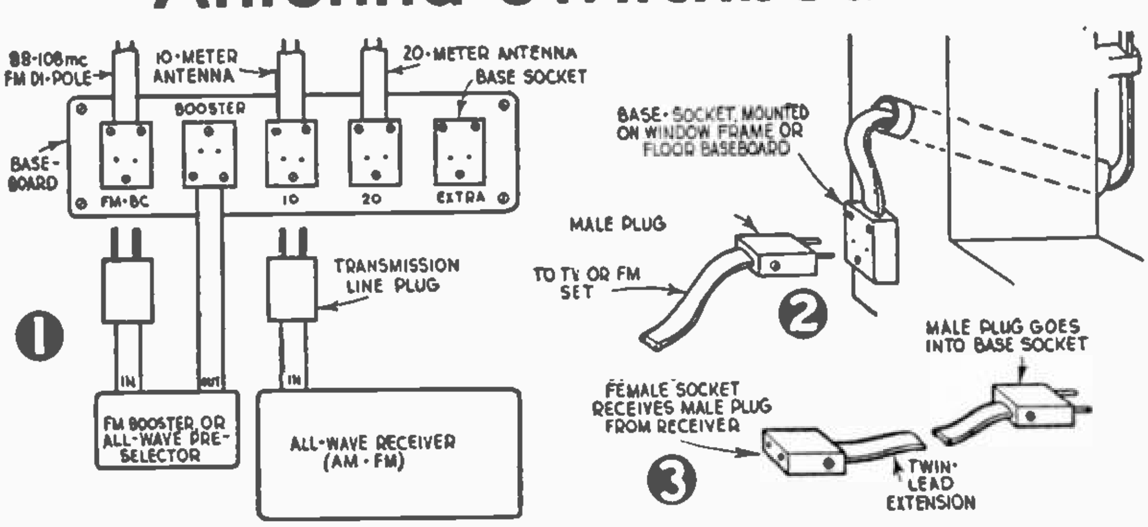
tors to offset the internal capacity of the section. If this cannot be done, it is best to eliminate the values of "Open," 10, 15, 22, 50 and 100 mmf, and use the 17 position switches alternately specified in the Materials List.

In the box shown, a number of "bathtub" capacitors were used because they were available in surplus stocks. Paper capacitors will work satisfactorily, and are easier to mount. In wiring, a heavy negative bus wire should circle the area for each switch section, to permit short leads and to support the capacitors. This negative bus cannot touch the chassis, since all wiring must be isolated from the chassis to allow switching the negative leads as required. Any metal can capacitor (where the can is negative) must be insulated from the chassis also.

Figure 3 shows the drilling diagram for the front panel, using the anti-capacity lever switch for S1. If low values are not used, an ordinary DPDT center-off switch may be used, and a 15/32-in. hole drilled on the left side of the panel to match the one on the right side. Also, mounting holes for the bathtub capacitors used in this unit are not shown, since the capacitors actually used may vary in individual cases.

To save bench space, the unit is designed vertically, and has four rubber feet on the bottom. A small-scale copy of Table A is pasted on the back to give the intermediate values usually required.

Low-Loss Uniform-Impedance Antenna Switchboard

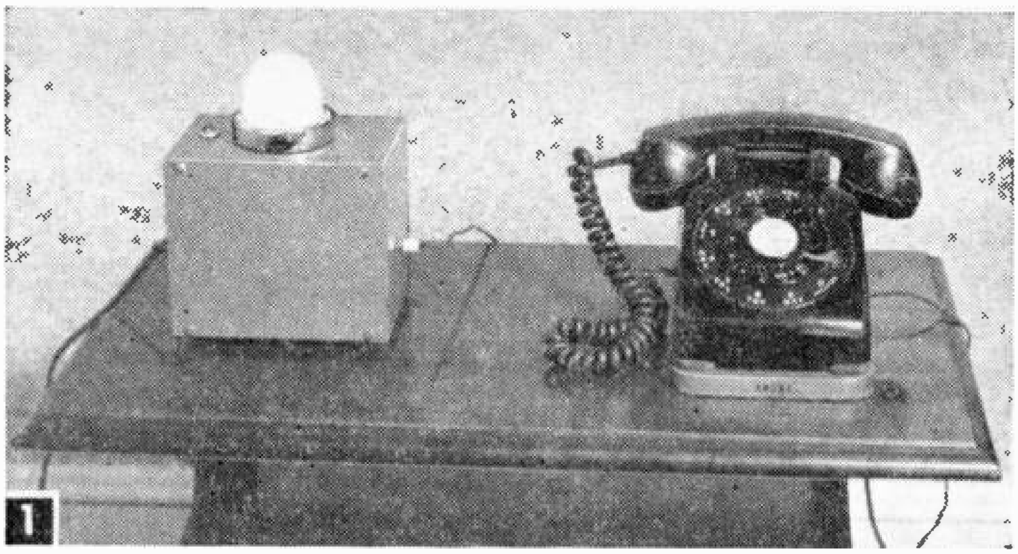


DX radio hobbyists, hams and experimenters can solve the problem of antenna switching and booster in-and-out switching by the use of Mosley polystyrene 300-ohm twin-lead male plugs, and female base-sockets (Fig. 1). This switchboard does away with the common haywire switching arrangements using knife-switches or toggle switches, which often result in UHF losses and impedance changes due to poor insulation and capacitances in the switches. By this method, many different combinations are possible whereby boosters, ham-band preselectors, AM-FM receivers and transmitters may be plugged in or out of various dipole antennas for highest efficiency. Mount sockets on a hardwood baseboard and label sockets as shown. Place the switchboard for shortest leads to apparatus. Use 300-ohm ribbon twin-lead for all connections shown.

Low-Loss Uniform-Impedance Antenna Connectors for TV Sets

When connecting outdoor antennas to TV sets, insert a pair of Mosley 300-ohm transmission line connectors in the twin-lead between window and set. Mount a 311 socket on window frame or floor baseboard, and connect a 301 plug to lead going to receiver (Fig. 2). Thus, the set may be quickly disconnected when the housewife wants to move the receiver for cleaning, or a twin-lead extension may be added easily when you want to move the receiver to another place in the room. In the latter case, connect a female socket to one end of extension, and a male plug to other (Fig. 3).—A. T.

Telephone Sentry



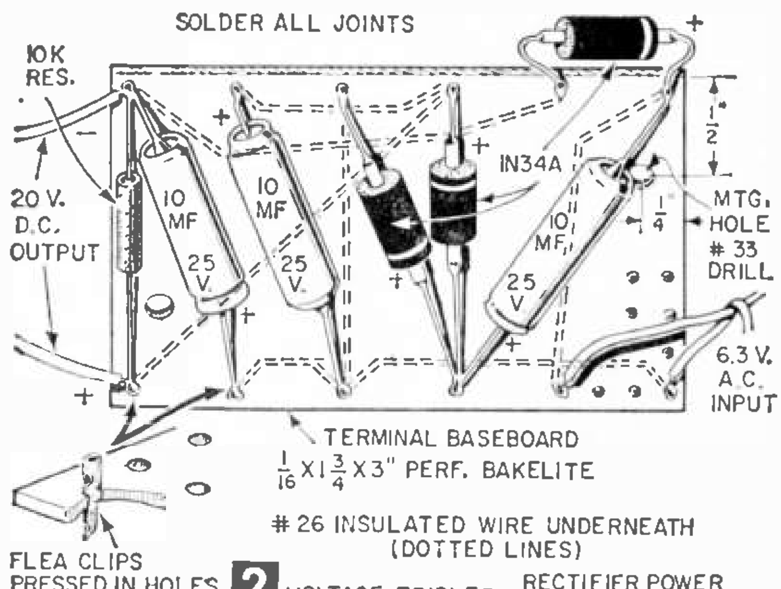
Transistorized telephone sentry lights with each ring of the bell and ignores other line disturbances if pick-up coil is properly located.

Now you can "see" the rings, if you can't hear them. And baby doesn't need to be awakened by the bell

By HAROLD P. STRAND

IF faulty hearing or noisy quarters cause you to miss incoming phone calls, a telephone sentry installed wherever you're most likely to see it will eliminate much of the difficulty.

The compact unit in Fig. 1 flashes brightly for the duration of each ring of your phone and is always ready to signal you since there is no battery to run down. When the bell rings, an inductive pick-up unit placed under the phone base receives a low energy current and passes it along to a special transistorized amplifier. This activates a relay to operate a 7½-watt, 125-volt lamp which produces a strong light signal when installed in an automobile backup light.



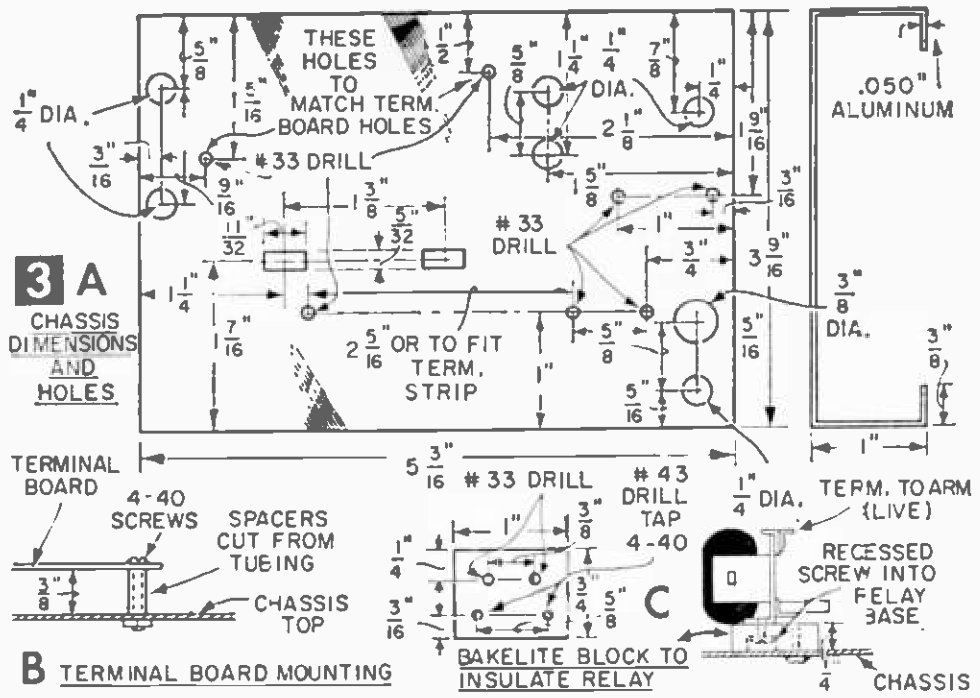
2 VOLTAGE TRIPLER-RECTIFIER POWER SUPPLY

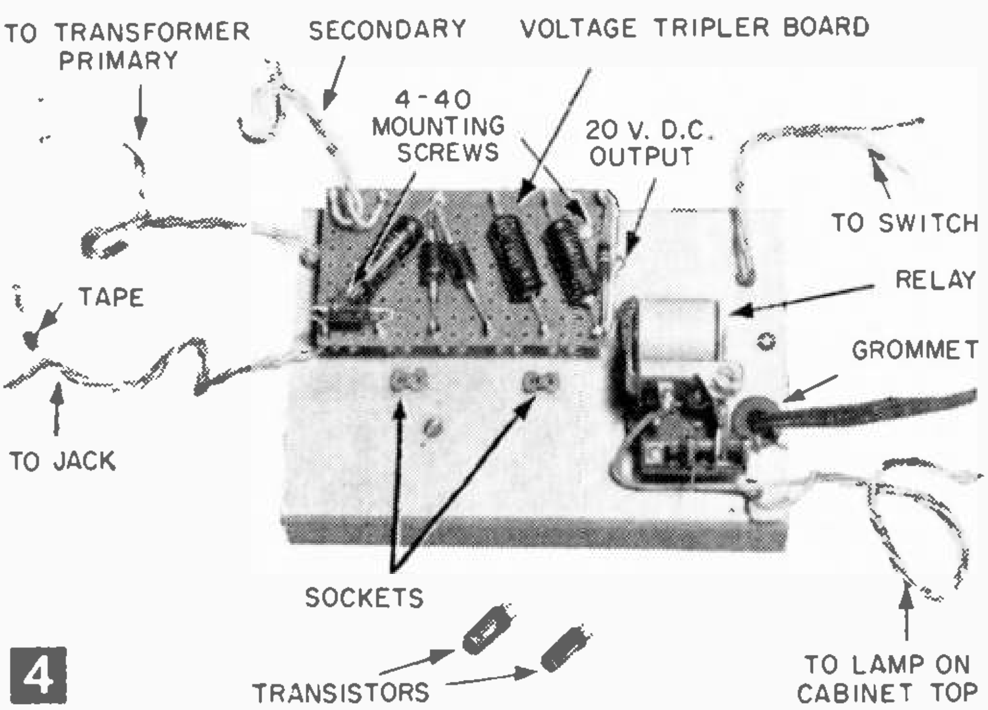
For increased versatility, the unit has a side outlet. You may expect a call while working in your yard or relaxing on your terrace some distance from the phone. An ex-

MATERIALS LIST—TELEPHONE SENTRY

No. Req'd	Size and Description
1	4 x 5 x 6" gray hammertone aluminum cabinet (Bud AU-1029-HG)
1	flush power outlet receptacle with mounting plate (Amphenol 61-F1)
1	3-amp, SPST toggle switch
1	miniature plug and jack set (MS370)
1	flat rubber or plastic-covered line cord with attached plug
1	angle bracket-type pilot lamp assembly for miniature screw base lamp, with ½" red jewel (Dialco series 510-121)
1	6-8-volt miniature base pilot lamp (#46)
1	120-volt primary and 6.3 volts at 1 amp secondary filament transformer (Thordarson 21F08)
1	8,000-ohm sensitive relay (Sigma 4-F)
4	diodes (CBS 1N34-A or equivalent)
2	transistors (RCA 2N-109)
2	transistor sockets (MS-275)
2	2-terminal barrier strips (Cinch-Jones 2-140)
1	8-terminal chassis strip (Cinch-Jones 56-C)
1	3-terminal chassis strip (Cinch-Jones 53-E)
2	2-terminal chassis strip (Cinch-Jones 51-A, 52)
1 pc	1/16" perforated Bakelite board cut to 1¾ x 3" (MS-304)
12	flea clips for above board (1 pkg. MS-263)

No. Req'd	Size and Description
1	100,000-ohm ½-watt resistor (Ohmite)
1	10,000-ohm ½-watt resistor (Ohmite)
3	10 mfd 25-volt miniature electrolytic capacitors (CF-142)
1	6 mfd 25-volt miniature electrolytic capacitor (CF-141)
1	.1 mfd 200-volt midget capacitor (Sprague 68-F17 or Cornell-Dubilier MP2P1)
1	telephone pick-up coil (MS-16)
	All parts above are available from Lafayette Electronics, 165-08 Liberty Ave., Jamaica 33, N. Y.
1	auto backup light (auto supply store—see photos for type wanted)
1	sign-type receptacle for lamp (H&H #9154, Leviton #9885 or similar-electrical supply store)
1 pc	.050 x 5 3/16 x 6 7/16" sheet aluminum ¼ or ½ hard for chassis (Try for scrap piece at sheet metal or metalworking shop)
Misc.	7½-watt 125-volt lamp, ½" wood stock for base, 1/16" felt for pick-up base and recess, small piece ¼" Bakelite, 3/16" dia. metal tubing for 2⅜" collars, 8' plastic-covered #26 stranded hookup wire (small size for transistor circuit wiring), grommets for six ¼" holes and two ⅜" holes, 4½"-dia. rubber mounting feet, miscellaneous screws and nuts





Compact terminal board is mounted ⅜-in. above chassis. It changes a-c to d-c and triples the transformer voltage to do the work of a battery constantly and without need for frequent replacement.

tension cord plugged into the outlet will flash your calls through a window or from some other desirable point so you can see them.

Cost of all parts will range from $24 to $30, depending on sources of supply (see Materials List), and what you have on hand.

Build a Voltage Tripler Circuit to eliminate the need for a 22½-volt battery and allow unit to remain turned on all day. Cut a 1¾ x 3-in. terminal baseboard from thin, perforated Bakelite board and drill two mounting holes as in Fig. 2. Then insert 6 evenly-spaced flea clips on each side and solder the diodes and capacitors to clips as in Figs. 2 and 4.

Unless you are very quick at this, it is advisable to hold leads with thin-nosed pliers while soldering to absorb heat which might otherwise damage the diodes. Note that plus terminals are so marked on the capacitors and indicated by a line on the diodes.

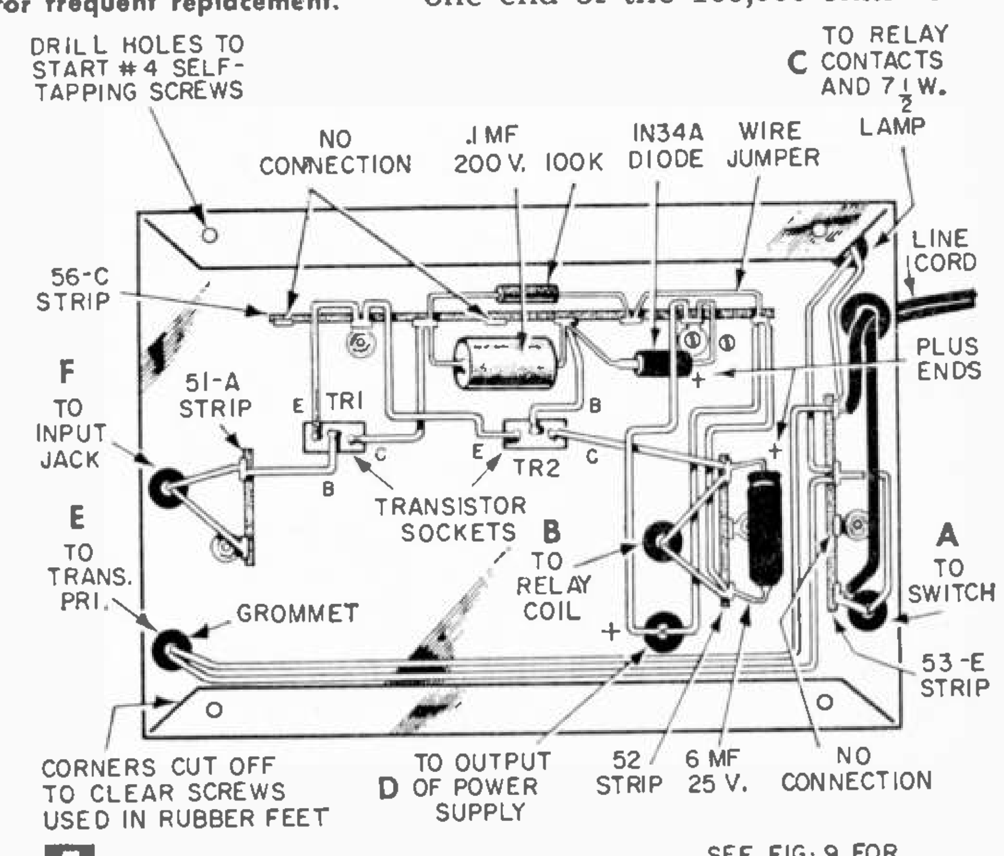
A 10,000-ohm resistor across the output terminals will stabilize the circuit, which has an actual load from the two transistors of only about 4 milliamperes maximum.

On the back of the board, wire soldered connections to flea clips (dotted lines in Fig. 2), using #26 insulated wire.

Form the chassis from sheet aluminum as in Fig. 3A and drill holes. Make rectangular openings for transistors by drilling holes within marked-off areas and filing to size.

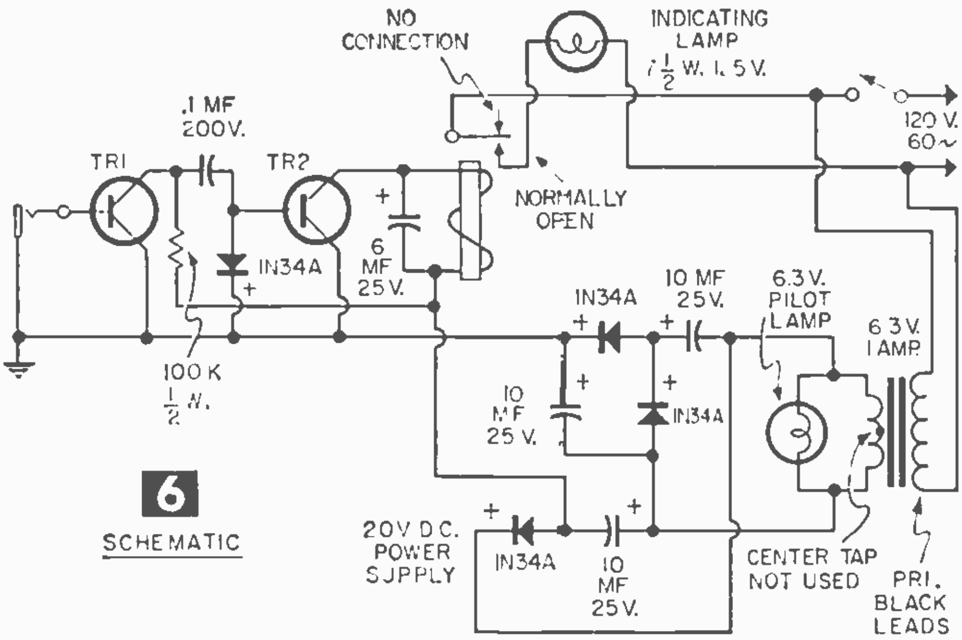
Mount chassis components with 4-40 screws (Fig. 4). Use metal tubing for spacers as in Fig. 3B to keep terminal board wiring clear and a small Bakelite block (Fig. 3C) to insulate the relay. Bend transistor socket terminals apart slightly to give more room for connections and be sure to position the diode and 6 mfd 25-volt capacitor underneath chassis for correct polarity.

Solder all chassis wiring connections (Fig. 5) and check against the schematic drawing (Fig. 6). One mistake could ruin the transistors when power is applied. Note that mounting feet of the long terminal strip ground two terminals to the chassis. Run a short wire jumper (Fig. 5) from one end of the 100,000-ohm resis-

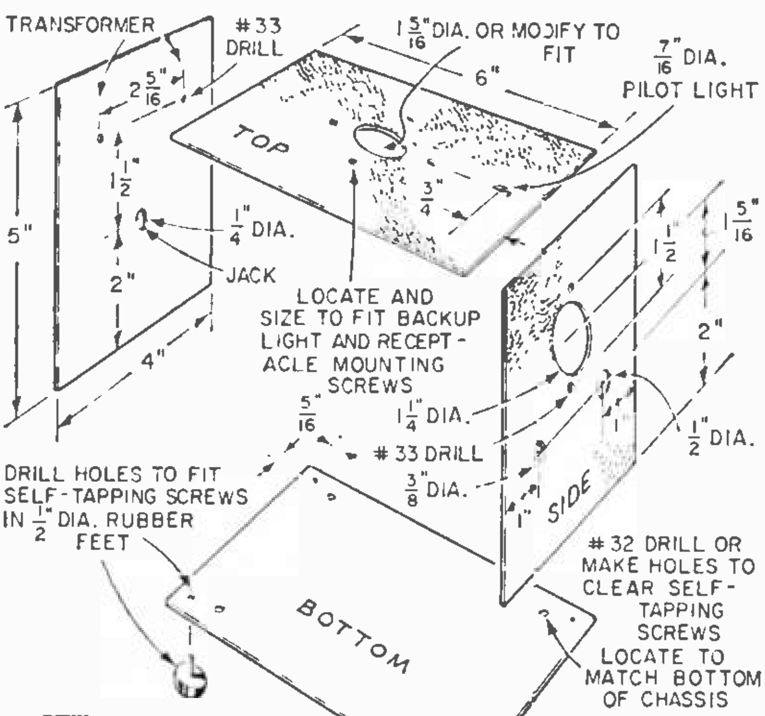


5 PICTORIAL - CHASSIS UNDERSIDE

SEE FIG. 9 FOR TERMINATION OF KEYED LEADS



6 SCHEMATIC



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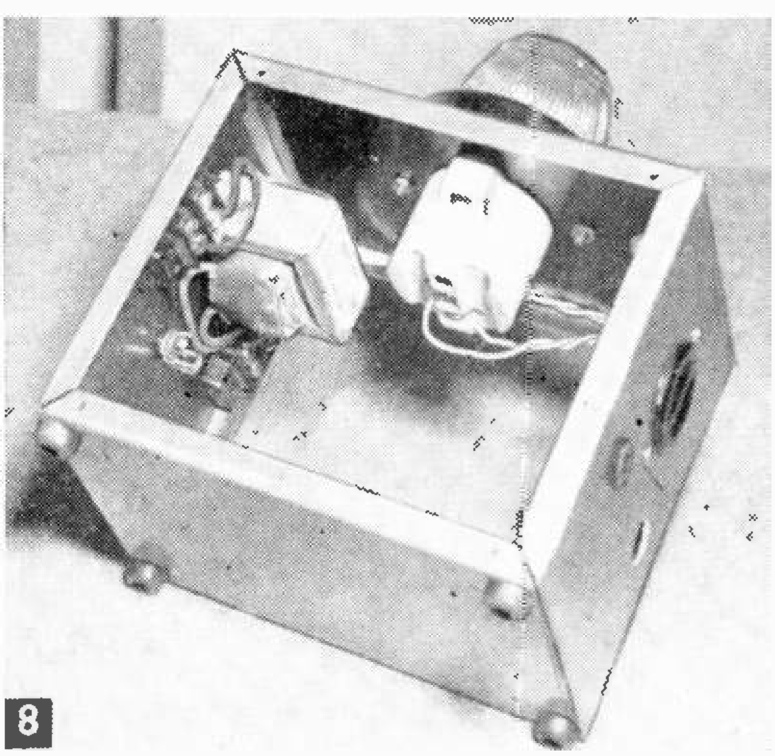


8

Cabinet with side panels removed, showing end-mounted transformer with barrier terminal strip each side and miniature jack just below. Top receptacle for lamp is wired in parallel with outlet on right side.

tor to negative terminal on the strip, making the junction on a vacant terminal.

Use #26 hookup wire, leaving long leads for connections to points on cabinet or top of the chassis as in Fig. 4. Twist pairs of leads together for easy identification. If each wire in a pair must be identified, such as the leads to the input jack, mark one with a narrow tape band (Fig. 4).

Cabinet Assembly. Drill all box holes as in Fig. 7, modifying top center to mount a sign-type receptacle with body inside and practically flush on top, as in Fig. 8. Install pilot lamp assembly in other top hole.

On one side, fasten the transformer so that each clamping screw also holds a barrier-type terminal strip as in Figs. 8 and 9. The miniature jack goes in directly below the transformer. On the opposite side, install toggle switch in the ½-in.-dia. hole and a rubber grommet in the small opening.

Connect the transformer primary leads (black) to barrier strip adjoining. Attach the 6.3-volt leads to opposite strip (Fig. 9) and run #26 hookup wires from the same posts to pilot lamp assembly. Cut off and tape up the unused transformer center tap.

Run the line cord through grommets in cabinet and chassis and knot cord to forestall an accidental tug which might break the connection. Attach cord to 53-E terminal strip under chassis as in Fig. 5.

Locate and attach the chassis in cabinet (Fig. 10), using #4 self-tapping screws. Connect A, B, C, D, E, and F leads from chassis (Fig. 5) to cabinet mountings according to similar designations in Fig. 9.

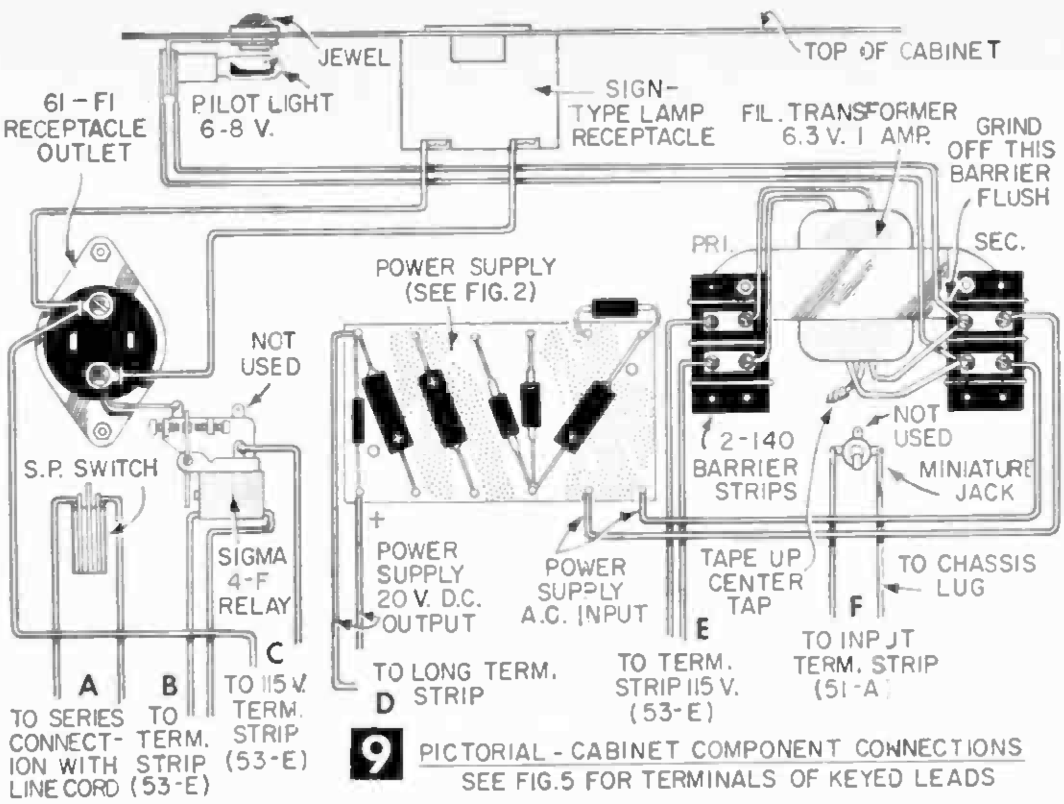
Enlarge the hole in base of an automobile backup light to clear lamp socket as in Fig. 11. Insert 7½-watt lamp, locate glass dome and fasten with screws furnished. If short, use longer #8-32 screws and enlarge chrome top holes a bit for firm assembly.

Install a 6-8-volt pilot lamp and insert transistors. Fasten ½-in.-dia. rubber feet underneath cabinet as in Figs. 7 and 8. Attach side panels.

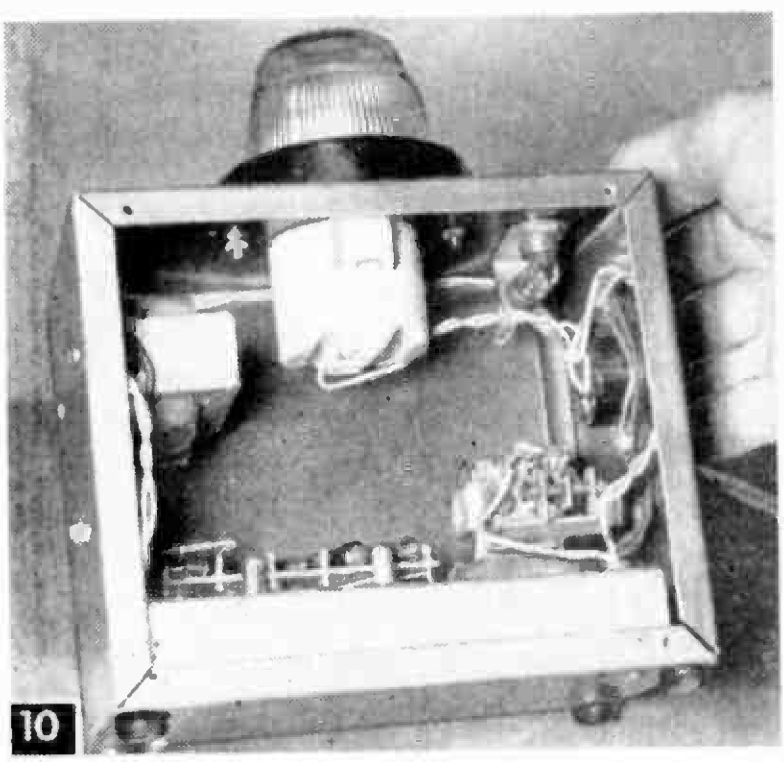
Caution: Before attempting operation, give the wiring a thorough check against the schematic (Fig. 6).

Do not exceed the 7½-watt size. Most larger bulbs will not fit within the dome but, more important, the sensitive relay contacts have limited capacity. Contacts may burn and stick if overloaded. However, a second 7½-watt bulb can be used satisfactorily in an extension plugged into the side outlet.

Permanent Base for Phone Pick-Up. The telephone sentry will signal your incoming calls when the pick-up coil is placed almost any-



9 PICTORIAL - CABINET COMPONENT CONNECTIONS
SEE FIG. 5 FOR TERMINALS OF KEYED LEADS

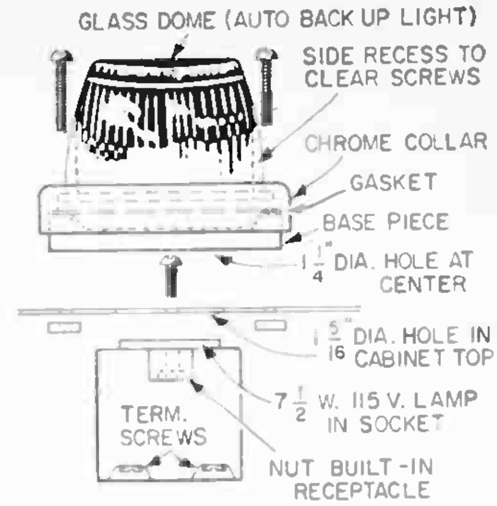


10 Looking toward outlet end with chassis in place and all leads attached to components. Transistors are in front of terminal board at left.

where along the telephone line or instrument case. But unless the coil is located at one particular point, the voice as well as dial calls made from your phone will also cause the light to flash.

To eliminate this problem, you can make an attractive, permanent pick-up base of ½-in. hardwood plywood as in Fig. 1. If your phone is the new type shown, cut plywood to size, round corners and dress smooth as in Fig. 12. Cut recess with a sharp chisel to fit coil as in Fig. 13 and place pick-up under the bell magnets for least interference.

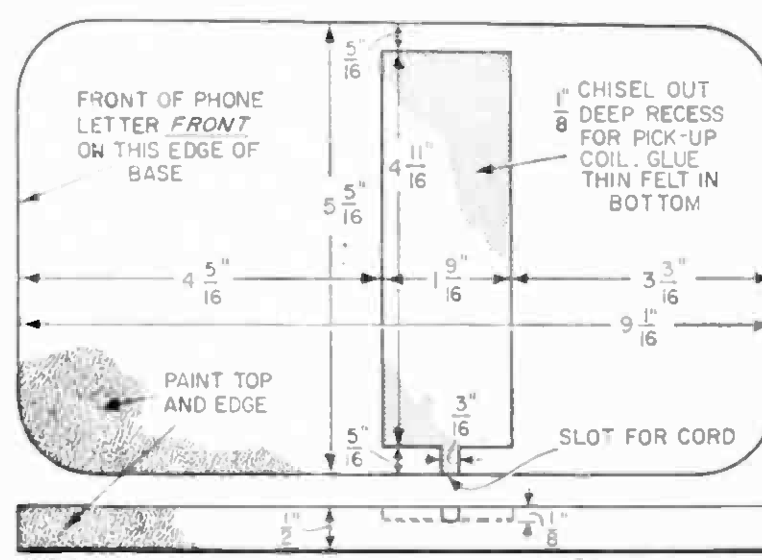
If your phone is an older type with a shorter rectangular base, shorten length to 7⅝ in. and start recess cut exactly 4 in. back from front. Also shape corners to a ¼-in. radius. If your phone is a wall type, tape pick-up to right side of the case, near the bottom.



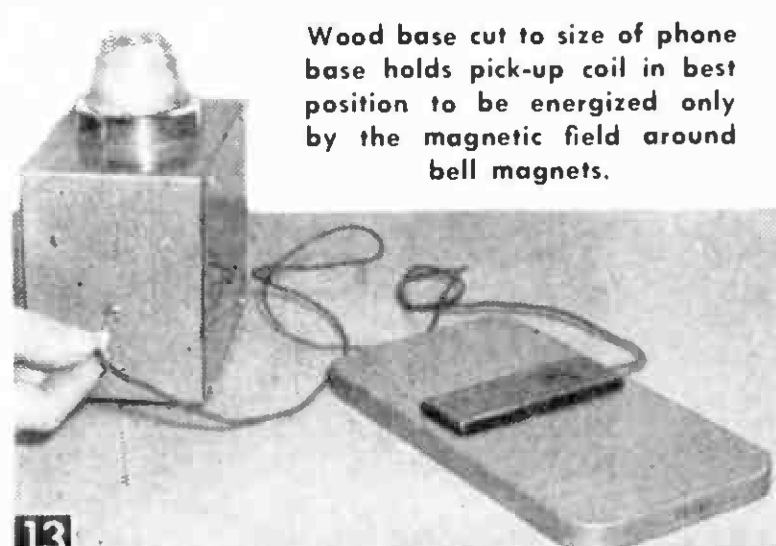
11 DETAIL OF LAMP FIXTURE

Finish top and edge of base to blend with unit or phone, after first masking bottom of recess to keep paint out. We used a hammertone variety of gray enamel from a spray can. When dry, remove masking tape and glue felt to bottom of base and in recess.

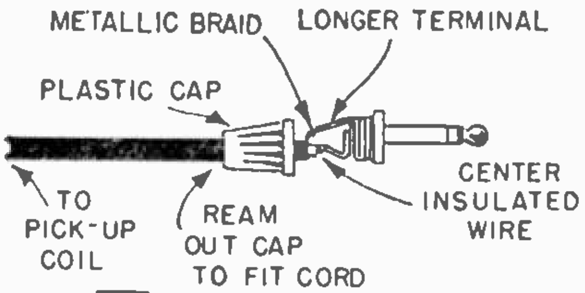
Attach the miniature plug to pick-up coil leads as in Fig. 14. Ream a hole through head of the removable plastic cap large enough to accommodate cord, using a small rat-tail file or, with extreme care, a twist drill. Thread cord through hole. Bare wire ends but 1/16



12 PICK-UP BASE TO FIT NEW STYLE PHONES



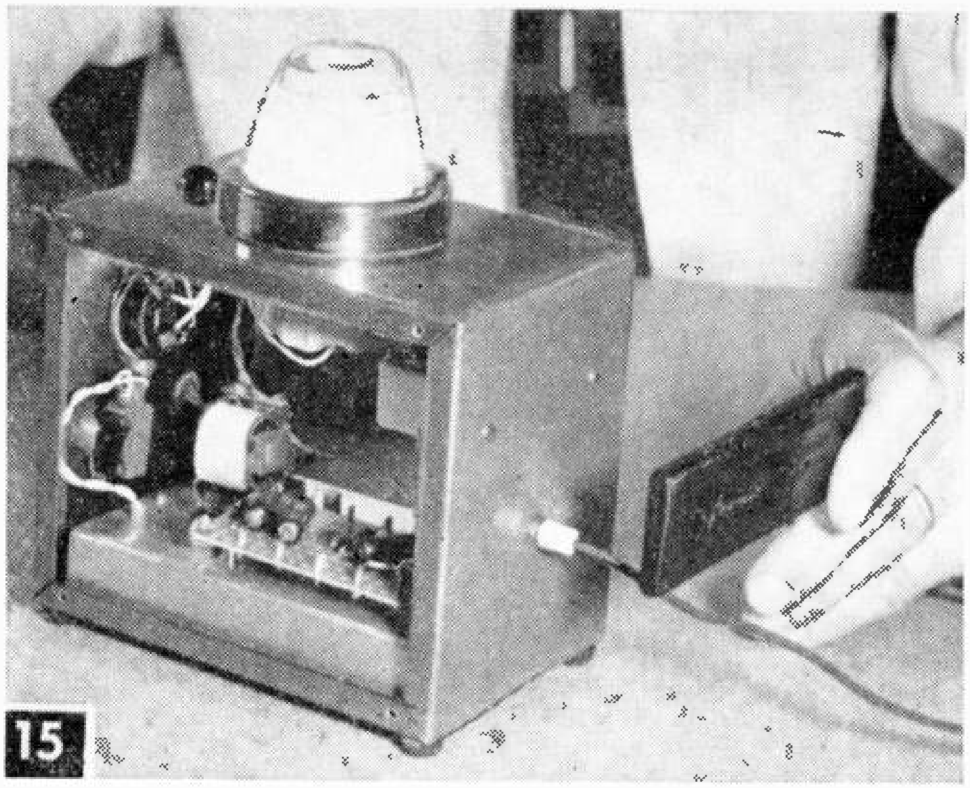
13 Wood base cut to size of phone base holds pick-up coil in best position to be energized only by the magnetic field around bell magnets.



14 MINIATURE PLUG CONNECTION

in., then solder insulated center wire to short terminal connected to end of plug. Solder metallic braid to the longer terminal, which is grounded. Snip off any stray ends to prevent touching the wrong terminal and screw cap in place over connections.

Tuning Up the Completed Sentry. When unit is turned on and line cord plugged in, the pilot lamp should light and remain on. Remove pick-up coil from base and hold it near transformer as in Fig. 15. If unit is working correctly, the field surrounding the transformer will energize the coil and light the lamp. Move coil away and the light should go out.



15 To test sentry, magnetic field around transformer will operate light upon approach of pick-up coil.

For more positive action, some adjustment of the relay may be desirable, but *pull the line cord out before making any changes.* You can receive a severe shock working around 115-volt current, especially on a grounded floor such as in a basement. Adjust side contact terminal screws to allow sufficient motion for relay armature. Allow about 1/32 in. between armature and fixed contacts when moving the armature with your fingers.

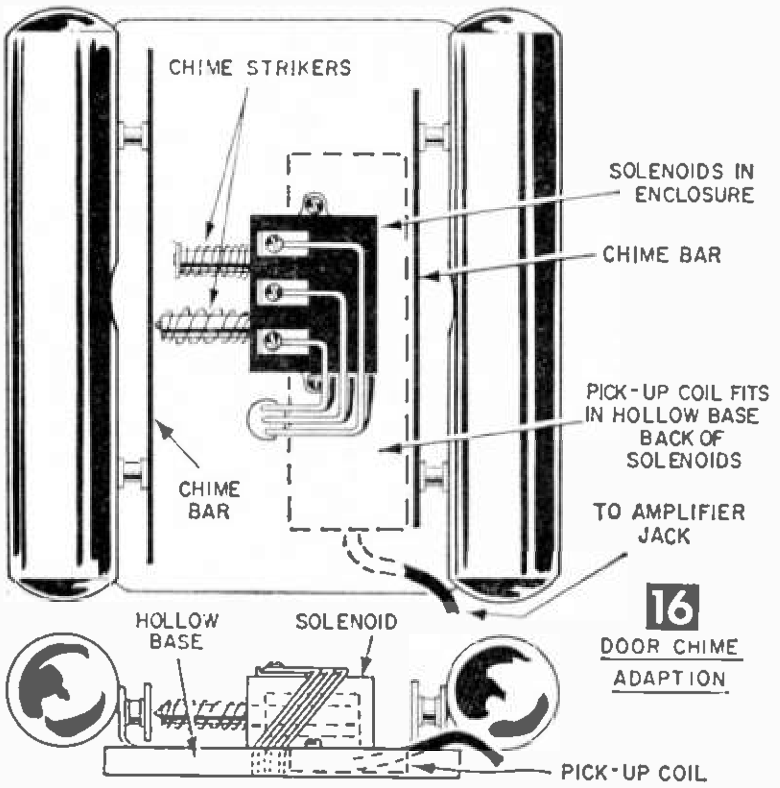
If you want the relay to pull in with less current, reduce tension by turning adjustment on top of the relay in a counterclockwise direction. Retain just enough tension so that the armature will pull away positively when coil is drawn away from transformer. After a little experimentation, the relay should operate perfectly.

If the unit does not operate, you may have a defective component. A leaking capacitor across the relay would short out the relay coil and make it inoperative.

A high resistance multimeter such as a Simpson Model 260 is a handy trouble shooter. Using its 50-volt d-c range, a test across output terminals on power supply board should read a little over 20 volts. The a-c reading at input should be about 6.5 volts. If you don't get such readings, one or more diodes and capacitors are either misplaced, wrongly wired or defective.

Move the relay armature with cord plugged in, using a thin piece of *dry* wood. If lamp turns on and off, the 115-volt circuit checks OK.

Once the light appears to flash normally,



16 DOOR CHIME ADAPTION

you are ready for the final test. Place the pick-up baseboard in position, telephone a friend and ask him to call you back. Then stand aside and see your first call come in. If light does not operate properly, experiment by moving pick-up coil baseboard a bit.

Signals Door Chimes Too. The sentry works equally well on door chimes whereas signaling attempts through direct wiring from chimes to a nearby lamp socket are largely unsuccessful because of the low current output of transformer. The lamp either robs the chimes of current or vice versa, depending on size of the lamp used.

The sentry light, however, flashes brightly when the inductance pick-up unit is fitted into the hollow base of the chime fixture as in Fig. 16 immediately behind and slightly below the solenoid.

Electrical Right-Wrong Game

A homemade computer with planned decisions that is simple to make and fun to use

By FORREST H. FRANTZ, Sr.

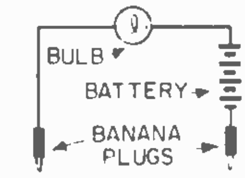
A project that youngsters will want to undertake—and simple enough so that they can—the Electrical Right-Wrong Game is both entertaining and educational.

THIS game can be constructed and assembled, complete with a number of question-answer sheets in a single evening. The only tools required are a pair of diagonal pliers, a soldering iron and a screwdriver. But before more is said about the construction of this interesting game, a few illustrations will help to bring out the principle of operation and the idea behind it.

Figure 2 is the circuit for a battery and flashlight bulb short circuit tester. If the banana plugs are touched together, the bulb lights. In effect you turn on a switch when you allow the plugs to touch. If you allow both plugs to touch a copper wire (or any other good conductor of electricity), the bulb will also light. The conductor becomes a part of a switch which controls the light bulb.

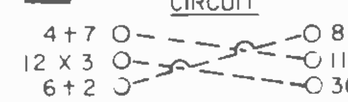
Now, visualize a board with six jacks connected as shown in Fig. 3. Suppose each jack is labelled on the left with a problem and each jack on the right with the corresponding answer. If you insert one plug of the short tester of Fig. 2 in the 2-plus-1 jack and the other plug in the 3 jack, the bulb will light. But, if you insert the second plug in the 7 or the 12 jack, the bulb will not light Similar observations apply to the two pairs of jacks.

Going a step further, and changing the wiring sequence of the jacks to that shown in Fig. 4, you have a simple three-question Right-Wrong Game.



2 CIRCUIT FOR SHORT TESTER

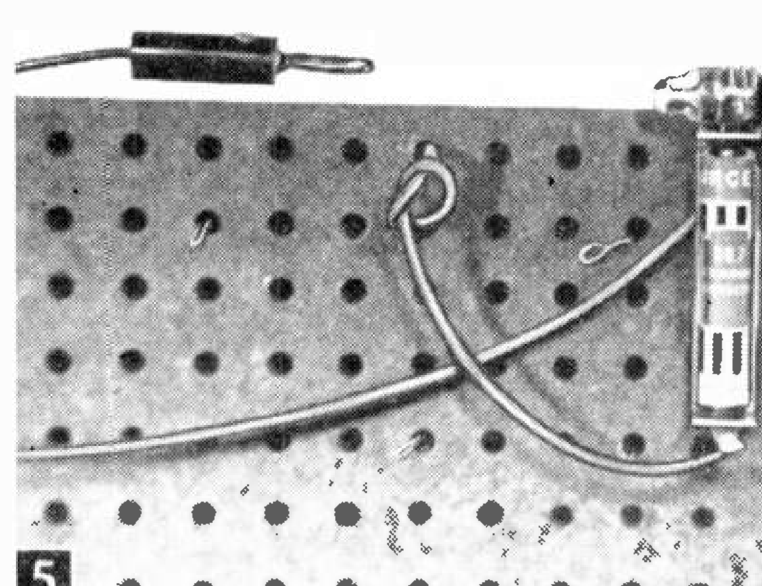
3 A SIMPLE RIGHT-WRONG CIRCUIT



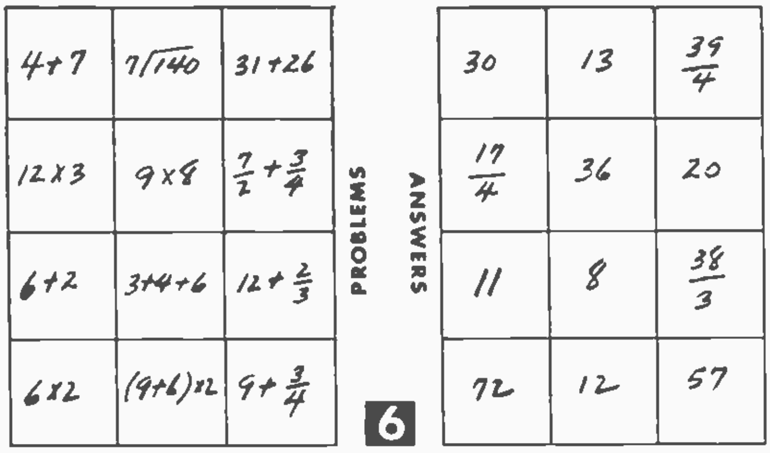
4 DEVELOPMENT OF THE RIGHT-WRONG GAME

But we want to make it possible to vary the questions. This is done by preparing removable sheets with a varied menu of problems and questions. To change the questions, you simply change the problem sheet. Still, the game would become dull—even for a child—with only three problems, because he would soon memorize the board arrangement. This means that there should be at least 12 questions instead of the original three. This would require 24 jacks, and construction of the game could become expensive as well as time consuming. Here's where perforated Masonite board comes in. It has holes spaced 1 in. apart that are just the right size for radio banana plugs.

To prepare the board, rule it off with nine holes to each square. Then choose a wiring sequence that uses the upper left hand hole in each square for the connection. Use #28 *dcc* magnet wire for the wiring, pushing the insulation back so that about 1½-in. of wire is bared at each end. Double the wire back over itself and insert through the appropriate holes. Bend the wire over in back to hold it



Short checker (indicator of right answers) mounts on the back of the board with bulb visible from front.



SAMPLE Q-A SHEET

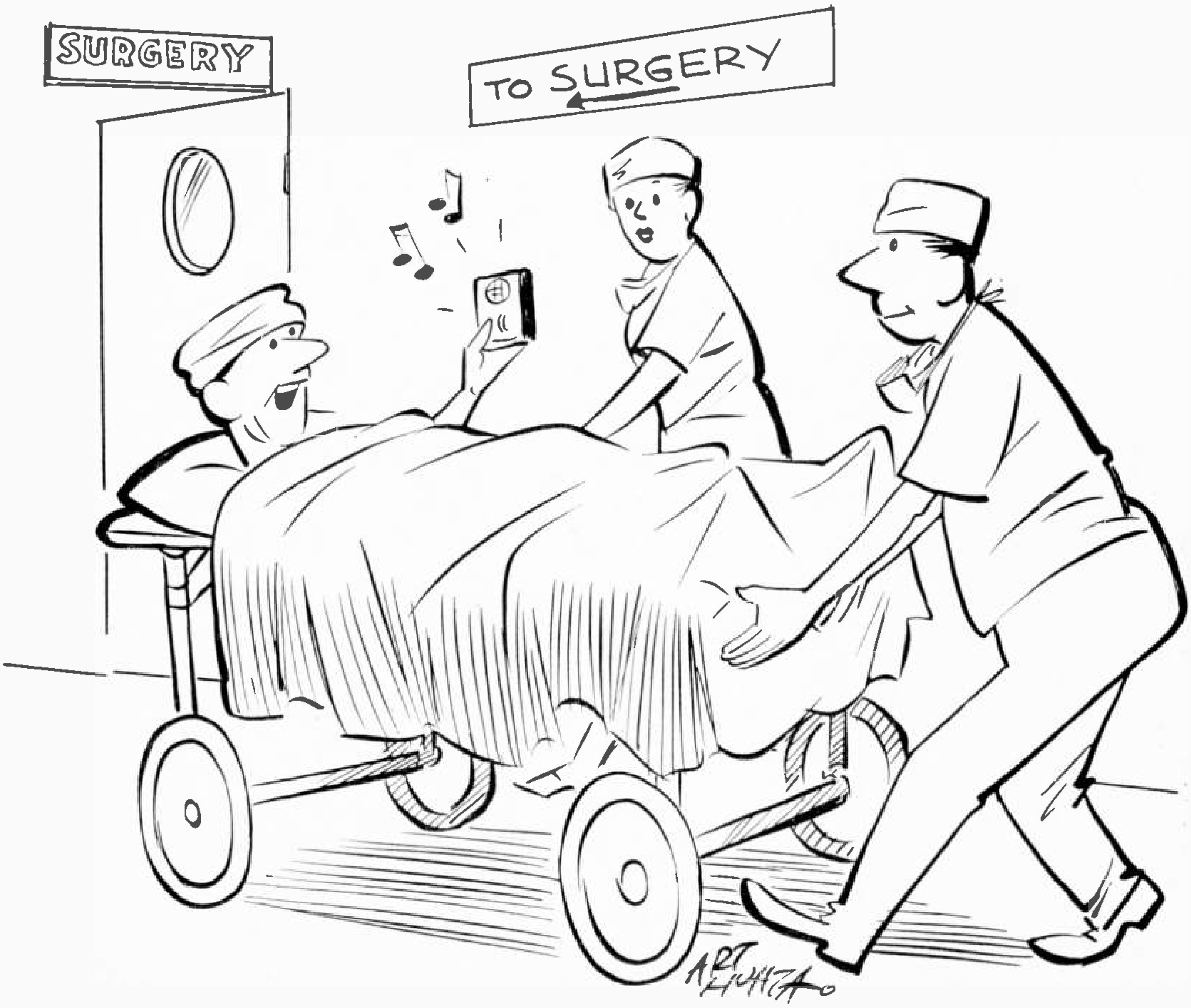
MATERIALS LIST—RIGHT-WRONG GAME

No. Req'd	Description
2	perforated Masonite sheets $7^{27}/_{32}$ x $11^{27}/_{32}$" (Lafayette ML-81)
2	insulated banana plugs (Lafayette MS-209)
1	battery holder (Lafayette MS-137)
1	type 112 flashlight bulb
	(Use flexible hook-up wire for short tester leads)

in place. It is important to have bare copper wire against the side of the hole so that the banana plug will make contact with it.

Next, bolt another perforated Masonite to the first to form a double thickness. This holds the wiring in place and conceals the wiring sequences. Be sure that holes are clear of cross wiring before you tighten the bolts. Now the switch circuit is in order, and the mounting of the short checker of Fig. 2 will complete the electrical work for the game. Figure 5 shows the short checker mounted on the back of the board with its bulb extending far enough above to be visible from the front. The bulb's brass threading is soldered to the terminal of the battery holder, a wire lead is soldered to the center contact of the bulb. Note that the leads pass through perforations to emerge at the top of the board. The knots in the wire leads prevent strain on the soldered connections.

Make problem sheets by fastening a sheet of paper to the front of the board with cellophane tape. Use a pencil to punch the paper from the rear of the board where the active holes are apparent from the wire ends (see Fig. 5). After the holes are punched, rule off the sheet. Then enter the questions and correctly placed answers on the sheet (see Fig. 6). If you want to make a 30-question game, use two sets of perforated boards.

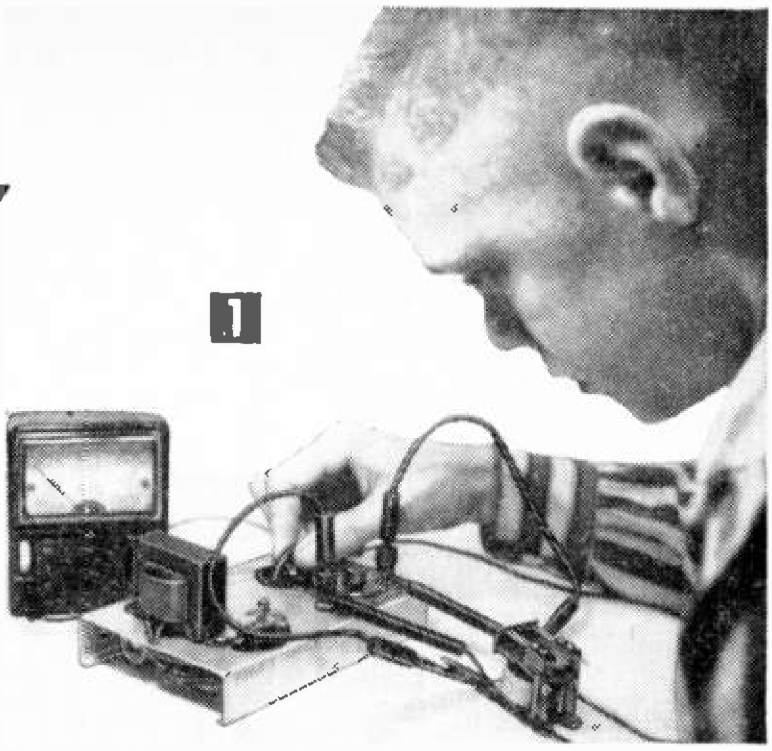


"I always go to sleep with music."

Low Voltage Power Supply

This low voltage power supply is useful for testing transistor circuits, small motors and relays

By FORREST H. FRANTZ, SR.



The low voltage power supply being used to determine operating voltage of a relay.

THE experimenter's instrument inventory is incomplete without a variable low voltage power supply. This unit will supply 0 to 8 v. dc or 6 v. ac. The cost of parts is less than $10, and the unit may be constructed in a few hours. The saving in battery costs and the versatility afforded by a variable control readily compensate for the cost and effort involved in the construction.

Converting ac line voltage to dc voltage involves two basic tasks: rectification and filtering. These are done after the transformer has set the voltage level.

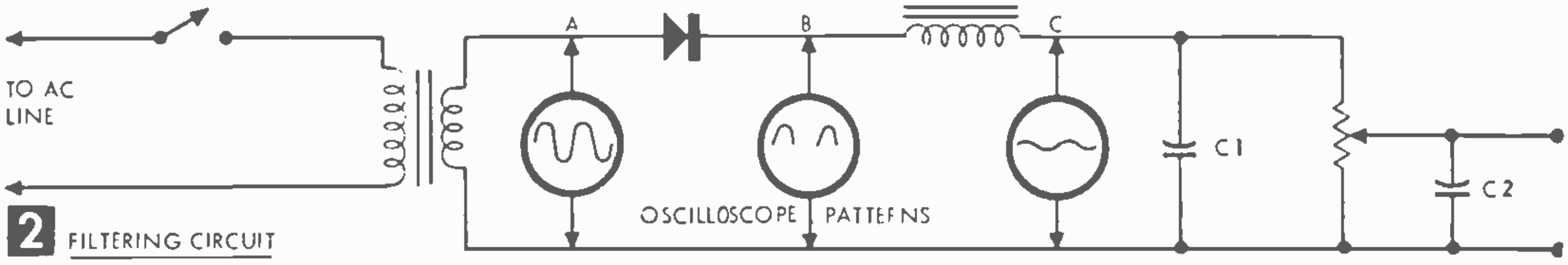
In Fig. 2, A is ac from the transformer (represented by the sinusoidal wave), B is the polarized, but pulsating dc after rectification and C is the non-pulsating dc after filtering.

The filter in Fig. 2 consists of an inductance and a capacitance. The inductance is series connected in one of the power supply legs and introduces inertia into the circuit to smooth the voltage just as a flywheel smoothes energy impulses from an engine to a rotating shaft. The capacitor (C1) action is similar to that of a spring in that it alternately stores and releases energy. The capacitor charges when voltage is increasing and discharges when voltage is decreasing or zero. Although the filtered voltage may not appear a straight line scope trace after filtering, it will be smoothed considerably (C in Fig. 2). The output voltage would be a straight line if filtering action were perfect.

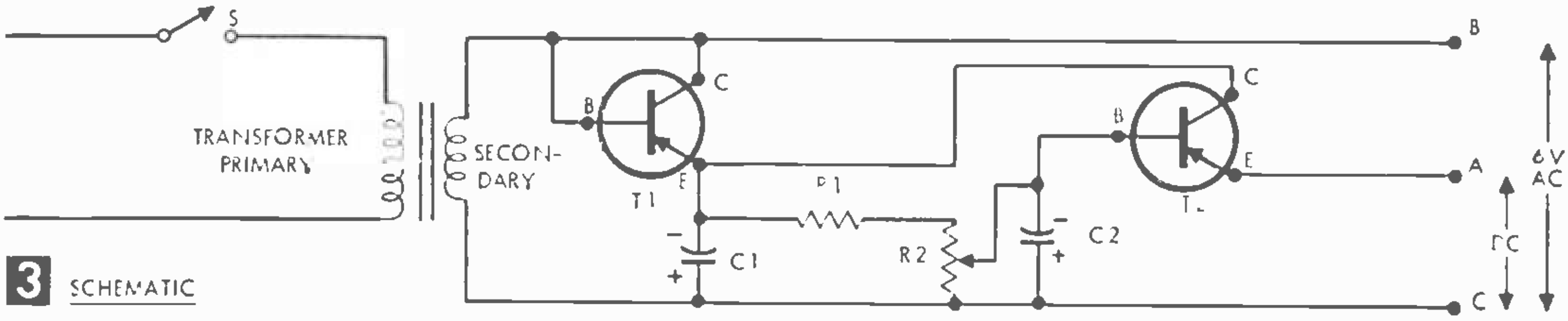
It was previously noted that the transformer sets a basic level. If the output level of the power supply is to be varied, the variable voltage divider scheme shown in Fig. 2 can do the job. The capacitor C2 provides additional filtering.

These features are apparent in the experimenter's inexpensive power supply, although some novel features have been incorporated in the circuit (Fig. 3). A 6.3 v. filament transformer (TRANS) sets the basic voltage level. A Sylvania 2N307 power transistor (T1) is employed as a rectifier by connecting the base and collector terminals together. This arrangement provides an efficient low voltage, high current rectifier. The heavy, expensive choke of Fig. 2 is eliminated, and a large but relatively inexpensive filter capacitor C1 performs the first filter action. R1, R2 and C2 provide additional filter action for the voltage applied to the base of T2.

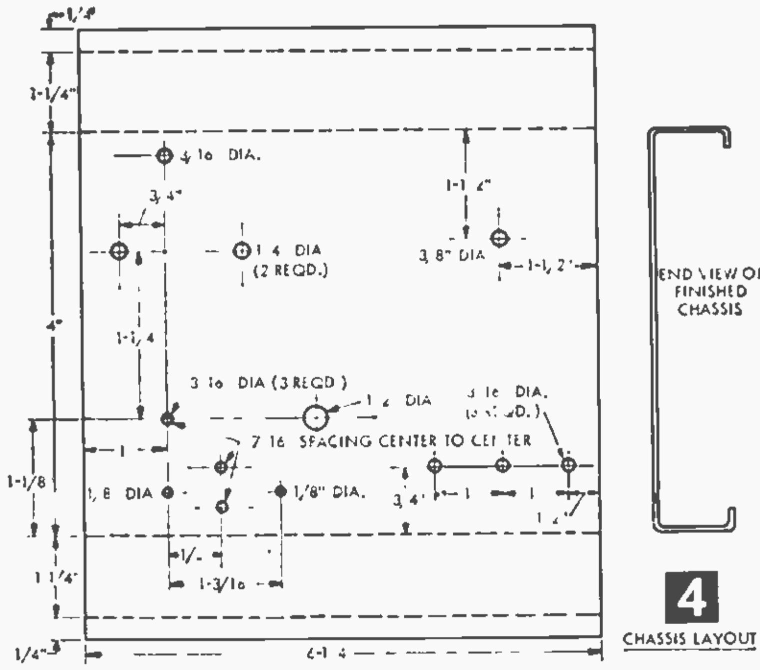
T2 is connected in an emitter follower cir-



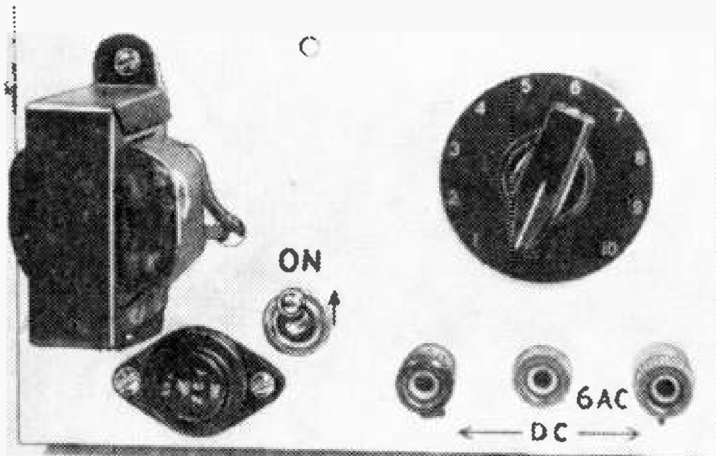
2 FILTERING CIRCUIT



3 SCHEMATIC



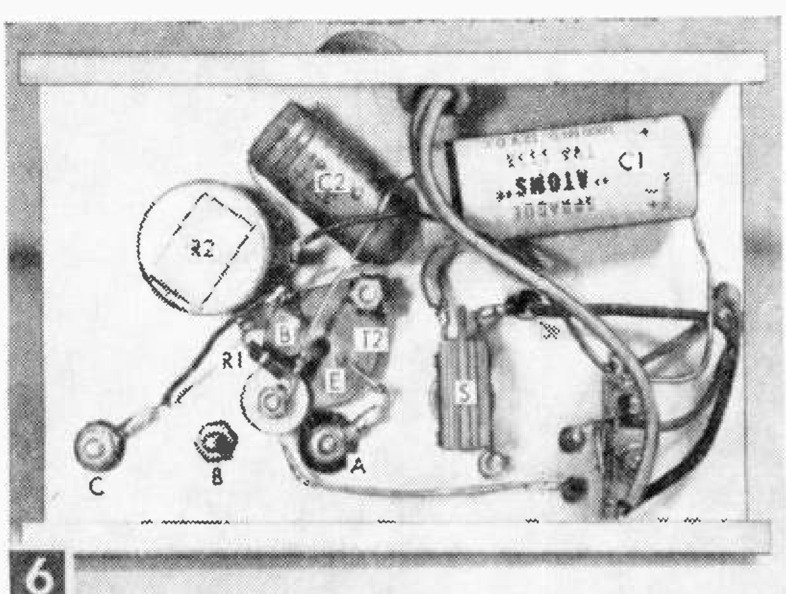
4 CHASSIS LAYOUT



5 Top view of the low voltage power supply.

cuit. The voltage on the emitter follows and is almost equal to the voltage on the base. But the current required by the base of T2 is a small fraction of the current delivered to a load by the emitter. Thus R1 and R2 may be inexpensive low power resistances; varying the setting of R2 varies the power supply voltage.

A terminal connected to the transformer makes the ac voltage of the transformer (not variable) available from the power supply.



6 Under-chassis view shows parts layout and wiring.

The chassis can be bent up from a 6¼ x 7-in. sheet of aluminum or a chassis can be bought. Chassis dimensions and drilling layout are shown in Fig. 4. If you don't have drills for the larger holes, use a taper reamer or a round file to enlarge smaller holes.

Mount the transformer, switch, transistor T1, tie down strip, dial plate and control R2. Saw the shaft of R2 to ½-in.

Mount the binding posts, A, B and C on the chassis. Insulate A and C from the chassis with fiber washers; terminal B is mounted directly to and makes electrical connection with the chassis. Enlarge the holes for A and C slightly if necessary to prevent the binding posts from shorting to the chassis. Transistor T2 must be insulated from the chassis. This is accomplished by supporting it on the base and emitter leads which should be connected to the center of R2 and terminal A respectively. A machine screw and nut should be fastened in one of the transistor shell holes. The shell connects to the collector.

Wire the circuit according to Figs. 3, 5 and 6. Avoid heat damage to transistors when soldering. Connect the power supply and try it out. The dc voltage between terminals A and C should vary between 0 to 8 v. as R2 is varied, and the voltage between terminals B and C should be about 6 v. ac.

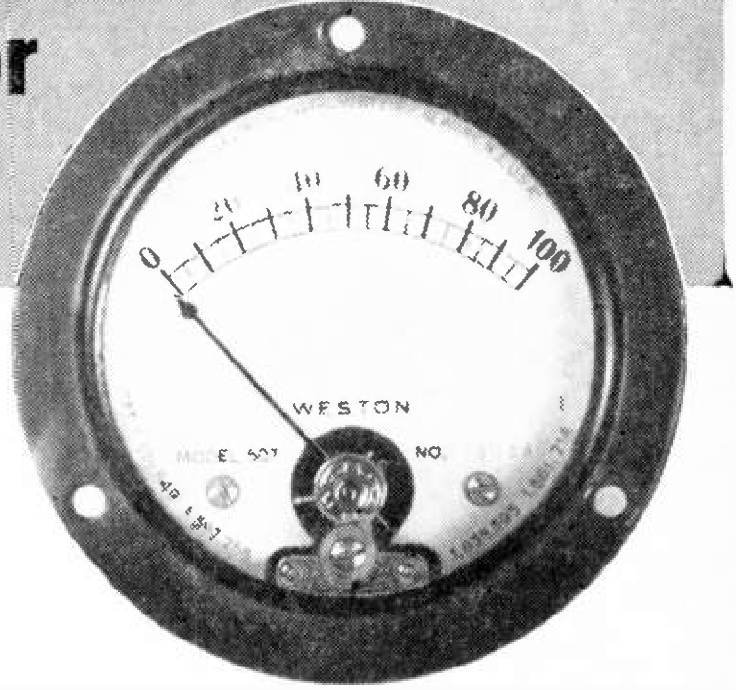
To use the power supply, simply connect the load to the appropriate terminals, and adjust R2 for the desired voltage. The dial-knob relationship for R2 can be chosen so that the pointer knobs give a rough idea of the voltage furnished to the load. There is some variation in the voltage for a given knob setting as the load is increased. For most accurate results, a voltmeter should be connected across the output terminals of the power supply.

The 6 v. ac output may be used for small ac operated devices or to supply heater voltage for electronic equipment using vacuum tubes. Devices requiring more than 500 ma. should not be connected to the ac terminals.

MATERIALS LIST—LOW VOLTAGE POWER SUPPLY

Desig.	Description
R1	22 ohm, ½ watt carbon resistor (10%)
R2	2.5K ohms, 2 watt wirewound potentiometer (Clarostat 43-2,500)
C2	160 mfd., 15 v. electrolytic capacitor (Lafayette CF-127)
C1	1000 mfd., 12 v. electrolytic capacitor (Sprague TVA-1133)
T1, T2	2N307 transistors (Sylvania)
Trans	6.3 v. filament transformer (Lafayette TR-11)
S	SPST switch (Cutler-Hammer 8280K16)
	binding posts (H. H. Smith 220 Red and 220 Black)
	dial plate (Mallory type 380)
	small pointer knob (Lafayette KN-43)
	chassis—6¼ x 7-in. sheet aluminum or ready-made
	line cord and plug
	3 terminal tie-down strips

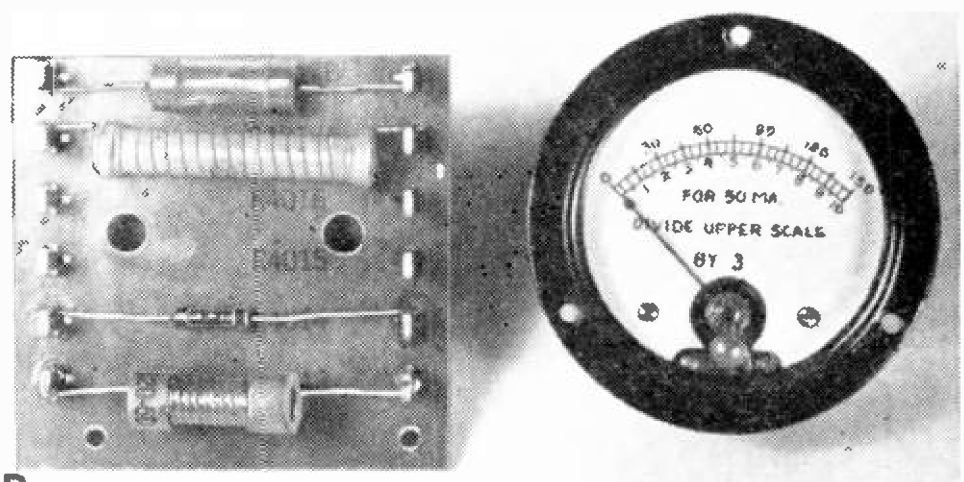
Adapting Meters for Test Equipment



How to provide built-in volt-milliammeters in test equipment

By W. F. GEPHART

The surplus meter (above) is adapted for specific ranges (below) with the resistors shown.



IN BUILDING test equipment, such as power supplies, oscillators, and so on, it is often desirable to include a built-in meter to measure output voltages and currents. This usually involves providing the correct shunt and multiplier resistances and re-calibrating the meter dial.

The minimum current that will give full-scale deflection on a meter is referred to as the basic movement. For most purposes, a 0-1 ma. basic movement is satisfactory, although higher or lower values can be used. The lower values are more expensive, and the higher values will draw more current from the circuit. Since any directly-connected meter draws current, there may be a slight variation in the output voltage of a circuit when a meter is connected or disconnected. For that reason, meters should be left in the circuit at all times when critical work is involved.

B

Many surplus meters are available that can be used for test equipment. If the basic meter movement is not known, it can be determined accurately with a precision resistor, vacuum tube voltmeter and a variable voltage source, as shown in Figure 2A. The voltage is adjusted to give full-scale deflection on the meter, and the voltage drop across the resistor is measured. By knowing the value of the resistor and the voltage drop across it, the current through it (hence, through the meter) can be determined by:

(Formula 1)

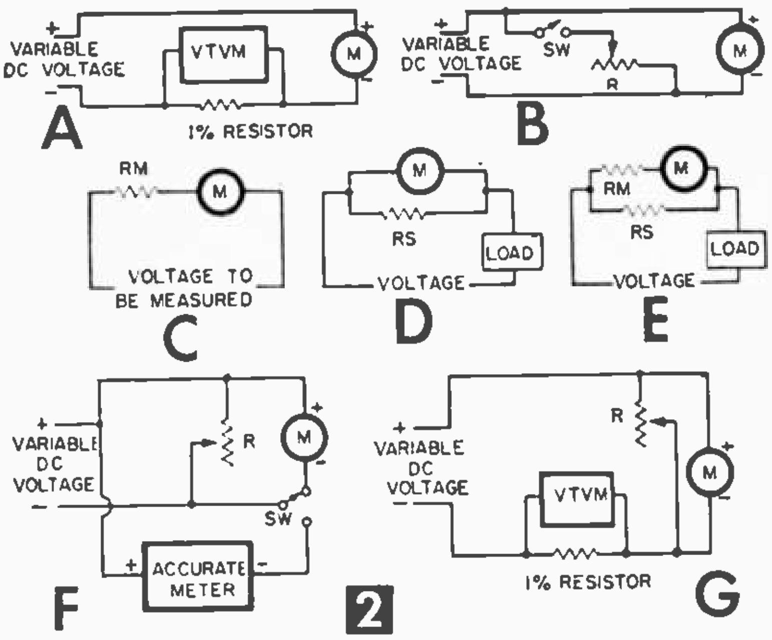
$$\text{full scale current } (I_d) = \frac{\text{voltage drop across resistor}}{\text{value of } 1\% \text{ resistor}}$$

To determine proper voltage multiplier and current shunt resistances, the internal resistance of the meter must be known. This data is usually not furnished with meters, but can be determined as shown in Fig. 2B. With the switch open, the voltage is adjusted to give full-scale deflection on the meter. (Unless extremely small voltages are available, a dropping resistor will probably be required.) Then the switch is closed, and the resistance adjusted to give exactly half-scale reading (without altering the input voltage). The value of the resistance in the circuit is then equal to the internal resistance of the meter, which will be referred to as R_i. By knowing the full-scale deflection (I_d) and the internal resistance (R_i), the voltage rating of the basic meter can be determined by:

(Formula 2) meter voltage rating $(E_m) = I_d x R_i$

The meter voltage rating is always very small, and to provide for measurement of the voltages normally used, a voltage multiplier resistor (R_m) must be connected in series with the meter (Fig. 2C). The voltage drop across this resistor must be the difference between the meter voltage rating (E_m) and the total voltage to be measured (E_t):

(Formula 3) multiplier resistor $(R_m) = \dfrac{E_t - E_m}{I_d}$



Schematics (A) for determining the basic meter movement, if unknown, (B) for determining internal resistance of a meter, (C) for determining a meter's voltage rating, (D) showing connection of meter shunt, (E) showing how to increase meter voltage rating by using a multiplier and current shunt, and (F and G) circuits for determining the amount of resistance wire to use in making meter shunts.

Since the meter voltage rating is very small, it can be ignored for higher voltage readings. When E_t is greater than 1000 times E_m, use this formula:

(Formula 4) $R_m = \frac{E_t}{I_d}$

Current shunts are resistors that bypass all current in excess of the basic meter's range, to permit measurement of higher currents, and are connected as shown in Figure 2D. The value of a current shunt (R_s) to read a maximum current of I_t is:

(Formula 5) shunt resistor (R_s) $= \frac{E_m}{I_t - I_d}$

Where the value of I_t is greater than 100 times I_d:

(Formula 6) $R_s = \frac{E_m}{I_t}$

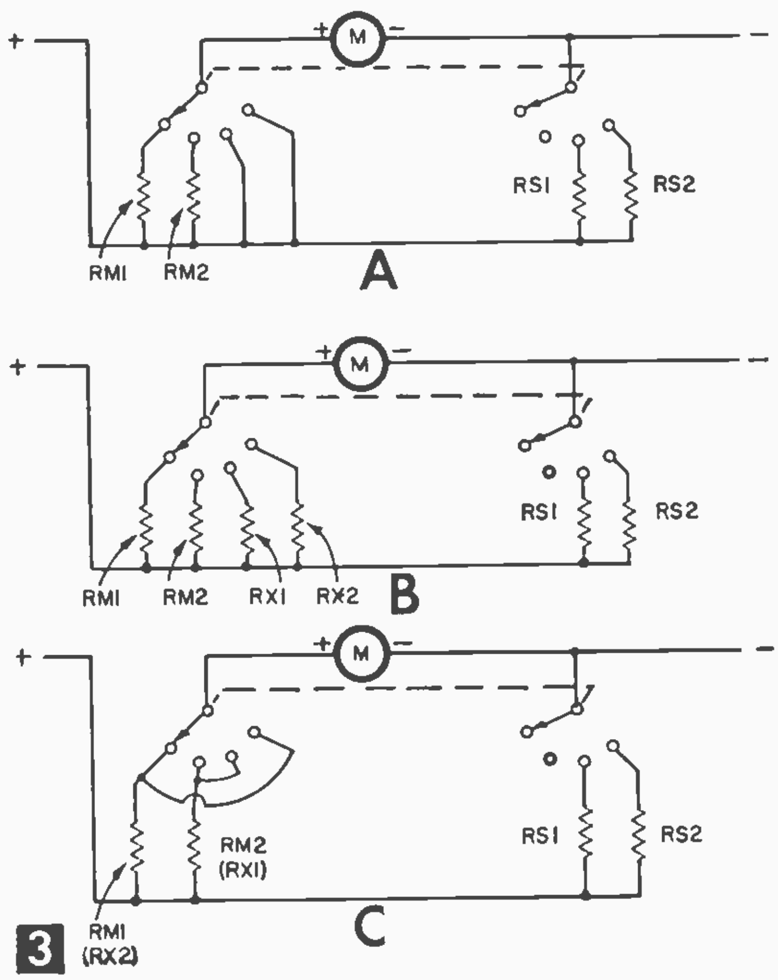
In applying these formulas for high current values, quite often the shunt resistor will be a small fraction of an ohm. It is sometimes easier to increase the meter voltage rating (E_m) by the addition of a multiplier, and then connect a current shunt across both the multiplier and meter, as shown in Fig. 2E. Using Formula 3 to determine a suitable multiplier resistor, and to establish an E_t, the value of the shunt for the combination resistor and meter can be determined by using Formula 5 or Formula 6, substituting the new E_t for the E_m in these formulas.

It will be found that voltage multiplier resistors will usually be values that are readily obtainable in 1% precision resistors, but that current shunts are often low, odd values. Sometimes it is desirable to wind your own low-value current shunts, using resistance wire, and a small rod or miniature coil form. The exact length of resistance wire can be obtained by either of the circuits shown in Figures 2F and 2G. Solder one end of the wire to one end of the form, and fasten this end to one meter terminal. Run the wire through a screw-type binding post which is connected to the other side of the circuit (the switch in 2F or the other side of the meter in 2G). Have only a short section of wire at the start, and adjust the voltage to set up the desired current in the circuit, as determined by the accurate meter in 2F (with switch "down") or by the voltage drop across the resistor in 2G. Then, by adjusting the length of the wire (turning the voltage off and tightening the binding post screw each time), the exact resistance required to give full-scale reading with the desired current can be found. The wire can then be wound around the form and soldered at the other end to give the proper low-resistance shunt.

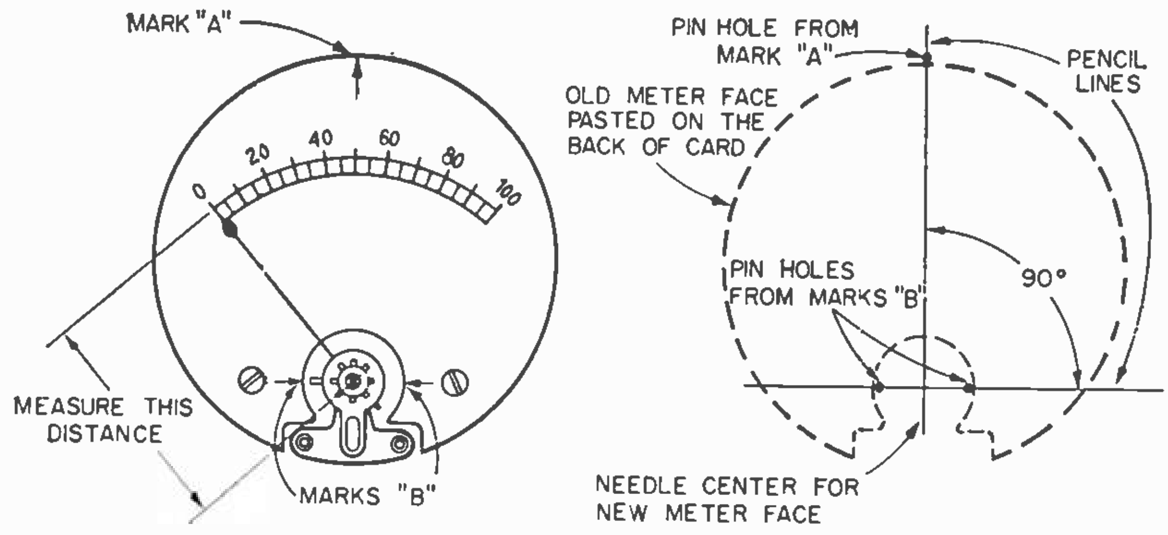
To illustrate the use of these formulas, assume we have a meter with a basic movement of 0-1 ma., and we have determined the internal resistance to be 50 ohms. With I_d .001 amp. and R_i 50 ohms, we find, substituting in Formula 2,

$$E_m = I_d \times R_i$$
$$E_m = .001 \times 50 = .05\text{v.},$$

Assume we want to make this meter read



Means of switching various multipliers and shunts into meter circuits: (A) when only multipliers and shunts are used, (B) for extending the voltage rating by using special multipliers, and (C) for extending voltage by using the voltage multipliers themselves.



4 **A** MARKING METER FACE **B** ESTABLISHING NEW NEEDLE CENTER POINT

How the radius and length of the meter scale can be transferred to the card stock pasted on the back of the dial plate.

0 to 10 v., 0 to 150 v., 0 to 50 ma., and 0 to 150 ma. To get the multiplier for the 10-volt scale, applying Formula 3:

$$R_m = \frac{E_t - E_m}{I_d}$$

$$R_m = \frac{10 - .05}{.001} = \frac{9.95}{.001} = 9950 \text{ ohms}$$

Since 150 v. is more than 1000 times the E_m of .05 v., Formula 4 is used for the 150 v. multiplier:

$$R_m = \frac{E_t}{I_d}$$

$$R_m = \frac{150}{.001} = 150{,}000 \text{ ohms}$$

For the 50 ma. shunt, applying Formula 5:

$$R_s = \frac{.05}{.050 - .001} = \frac{.05}{.049} = 1.02 \text{ ohms}$$

This is an odd value, but the use of 1 ohm would only give a 2% error, so it could be used.

Since 150 ma. is more than 100 times the I_d of 1 ma., Formula 6 can be used for the 150 ma. shunt:

$$R_s = \frac{E_m}{I_d}$$

$$R_s = \frac{.05}{.150} = .33 \text{ ohm}$$

Since this is a fractional value (that could be wound or secured by connecting three 1 ohm resistors in parallel), it might be well to see what value would be obtained in combination with the multiplier resistors we have calculated for the two voltage ranges. Applying Formula 6 again, using E_t's (total voltages) of 10 and 150 v. instead of E_m (meter voltage ratings), we substitute as follows:

$$R_s = \frac{10}{.15} = 66.67 \text{ ohms}$$

$$R_s = \frac{150}{.15} = 1000 \text{ ohms}$$

If it doesn't seem practical to wind the .33 ohm shunt for this range, the best method would be to measure the 150 ma. current with a 1000 ohm shunt across the meter and multiplier used for the 150 volt range, wired as in Figure 2E.

The means of switching various multipliers and shunts into the meter circuit are shown in Figure 3. In 3A, where only multipliers and shunts are used, the multipliers are on the left and the shunts on the right. In 3B, the voltage rating of the meter is extended by special multipliers (R_{x1} and R_{x2}) to get more reasonable values for shunt resistances. In 3C, the voltage multipliers themselves are used for the same purpose, similar to the case above, where it was possible to use the 150 v. multiplier in conjunction with a reasonable value 150 ma. shunt.

After determining the resistance values and switching circuit to be used, there remains only the matter of recalibrating the meter dial. The primary problem here is transferring the length and radius of the original scale to a new face. The new face may be made on a piece of light card stock glued to the back of the metal dial plate of the meter, mounted on the meter, reversed. Figure 4 shows how the radius and length of the meter scale can be transferred to the card stock pasted on the back of the dial plate.

Before removing the dial plate from the meter body, make three marks on the front of the dial, as shown in Figure 4A. The mark "A," at the top of the plate, should be in line with the center of the existing scale and the needle pivot point. The other marks ("B") should be on either side of the pivot point, making an imaginary line through the pivot point, at right angles to the line to mark A. The distance from the needle pivot to the outer line of the scale is measured, and a pair of dividers set to the distance between major markings (usually tenths) of the existing scale. The dial plate is then removed from the base, and a white index card is glued to its back.

When the glue has dried, carefully punch a small needle hole through the card at points A and B, right up against the plate. Turn the card over and draw a line between the two B needle holes, and another line at right angles to the first line, from the A needle hole, as shown in Fig. 4B. The intersection of these lines will be the needle pivot point. Using the distance measured, an arc can be swung from this point, giving a new scale. The center of the new scale will be where it crosses the line from needle hole A, and from this point the limits of the scale can be determined by stepping off the proper number of spaces with the preset dividers. Once the scale length and radius has been established, it can be divided into any convenient divisions, according to the value represented.

In the finished meter shown in Figure 1, the main scale is divided into ten parts, and each tenth is divided into thirds. This scale is used for 150 v. and 150 ma. ranges, and can be used for the 50 v. range by dividing readings by 3. A secondary scale is set below, divided into tenths, for the 10 v. range. Between each tenth mark, there is a small mark down from the major scale, so this scale for the 10 v. range can be read to .5 v.

The resistor board shown beside the finished meter in Figure 1 is a convenient means of mounting multiplier and shunts. It fastens to the back of the meter, the two large holes fitting over the meter terminals. The bottom resistor is a .33 ohm, wound on a uhf coil form.

Radio Hobbyist Anagram

How good is your radio-electronics word vocabulary? This anagram puzzle will put your radio lingo to the test. Many of the words, terms, and abbreviations have something to do with radio parts; others with circuits or tools used for making repairs or building circuits. Solution on page 142.

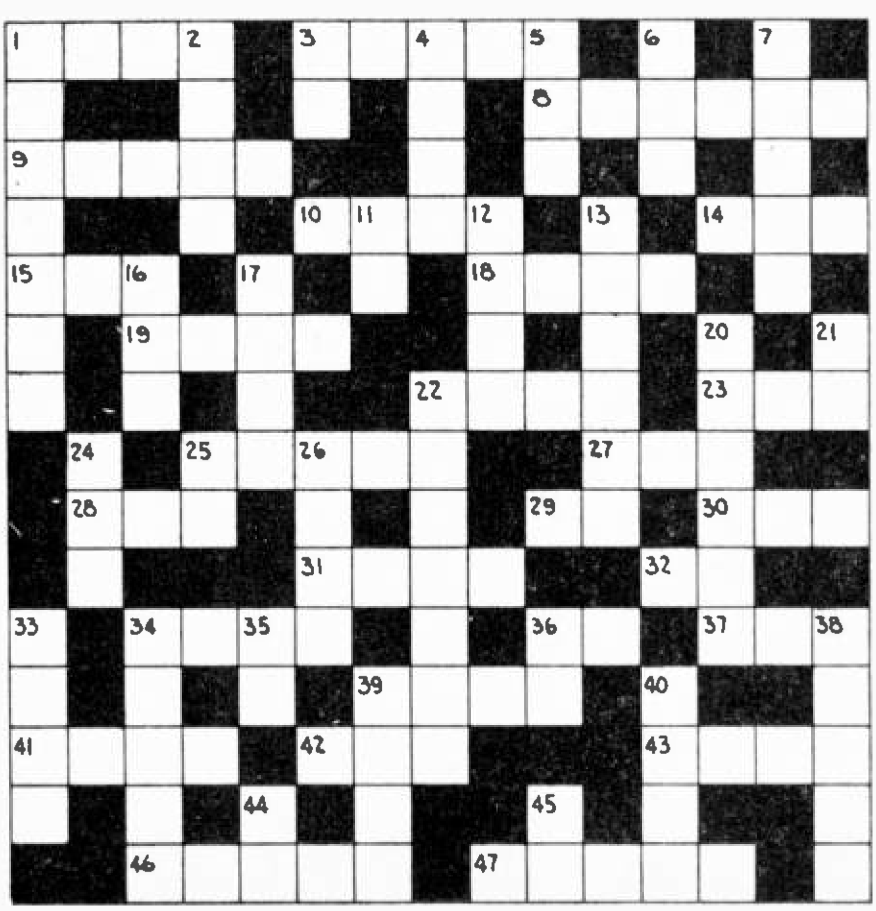
By JOHN A. COMSTOCK

ACROSS

1) Wire wound on an insulator form.
3) This type circuit can, and often does, blow fuses.
8) Captures passing radio waves from the atmosphere. Also, may transmit radio waves into the atmosphere.
9) Electronic switch controlled by current.
10) A group of radio frequencies.
14) Amateur radio operator.
15) Electron coupled oscillator (abbr).
18) Used for soldering.
19) Most radio parts give off — — — —.
22) Meaning to cut the top off a radio wave as done in a noise-limiter circuit.
23) The organization that regulates radio transmission in the United States.
25) Device used to measure current, voltage, power, etc.
27) Electromotive force (abbr).
28) Automatic volume control (abbr).
29) Voltage regulator (abbr).
30) The effect of capacitance to ground at the end of an antenna.
31) The — — — — on which all radio parts are mounted is called the chassis.
32) Broadcast (abbr.)
34) A conductor used to carry electric current from point to point.
36) Continuous wave (abbr).
37) Television interference (abbr).
39) Pole on which an antenna or aerial is mounted.
41) Movable iron core of a coil.
42) Unit of length equal to 1,000th of an inch.
43) A bulb.
46) A two-element vacuum tube.
47) A vacuum tube or transistor and all other parts necessary to make up a circuit having one input and output.

DOWN

1) Something that flows in electronic circuits and wires.
2) A length of wire.
3) Switch (abbr).
4) A circuit that is not continuous.
5) Connection to a coil or resistor.
6) Electrical discharge through the air.
7) Unit of capacitance.
11) Alternating current (abbr).
12) Used to select stations.
13) Metal used in wires.
16) Unit of resistance or opposition to current flow.
17) Often used to insulate bare wire splices.
20) The Edison — — — — — — is the flow of negative particles of electricity (electrons) between the cathode and plate in a vacuum tube.
21) Direct current (abbr).
22) Some part used in a crystal radio set.
24) Part of an antenna array.
25) Megacycle (abbr).
26) In the year 1904, Alexander Fleming invented the diode vacuum — — — — detector.
33) Circuit protector.
34) Wire — — — — — on a suitable insulated form is called a coil.
35) Radio frequency (abbr).
36) Center tap (abbr.)
38) The control grid is the — — — — — element of a vacuum tube.
39) Short for microphone.
40) A type of wire connector.
44) Power output (abbr).
45) Vacuum tube (abbr).

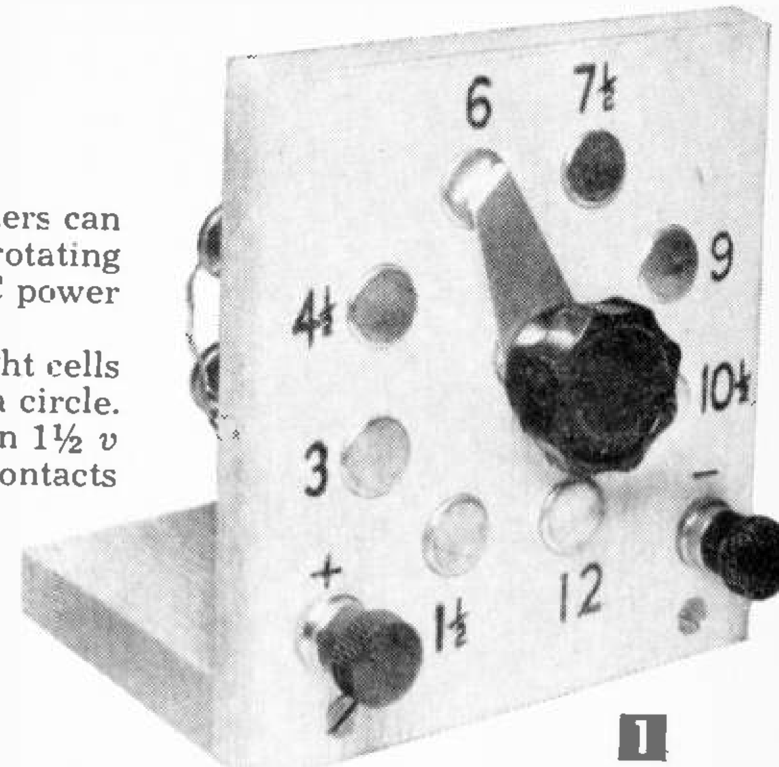


Variable DC Power Supply

By ART TRAUFFER

TRANSISTOR "bugs" and other experimenters can "dial" the voltage they want merely by rotating the switch in this novel and economical DC power supply.

A small wood panel holds eight "AA" flashlight cells wired in series and mounted "bottoms up" in a circle. You select the desired voltage from 1½ to 12 in 1½ *v* stages by turning a rotary switch blade which contacts the battery negative ends.



1

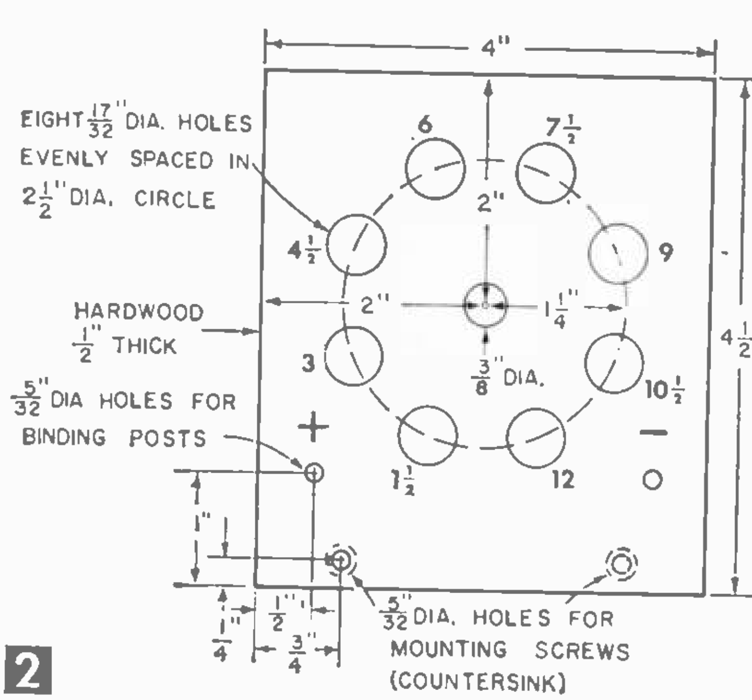
Bottoms of small flashlight cells act as rotary switch-points in simplified power supply designed especially for transistor experimenters.

If you prefer a smaller supply such as 1½ to 6 *v*, simply install four cells and leave the other four holes blank for future use. If you want an 18-*v* supply, bore 12 holes and put them closer together, or arrange in a larger diameter circle. In any case, be sure that space between cell ends is greater than the width of the switch blade end. The blade must never touch two cells at once as this will cause shorts which reduce the life of the cells.

The wood switch panel shown in Fig. 1 is ½x4x4½-in. white pine, but hardwood might be better. Center the point of a pencil compass 2 in. from the panel top and lightly draw a 2½-in. diameter circle (Fig. 2). Divide this circle into eight equal parts and mark each place with a center-punch. Using a sharp ½-in. bit, bore the eight battery holes through the panel.

Carefully ream each hole to about 17/32 in. or until a flashlight cell (with its leakproof plastic or paper jacket scraped off the bottom end) presses snugly into the holes. Fine-grit sandpaper wrapped around a ⅜-in. wood dowel will do an adequate reaming job.

Drill a ⅜-in. diameter hole for the rotary-switch bearing, and the four 5/32 in. diameter holes for the binding posts and panel-mounting wood screws. Before installing parts, label your panel with the numerals and "plus" and "minus" signs. The writer used an old ballpoint pen.



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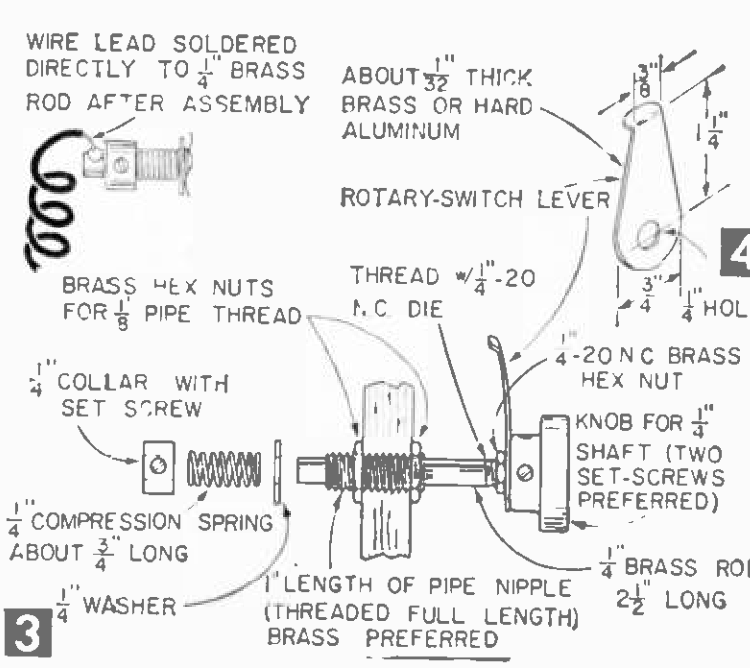

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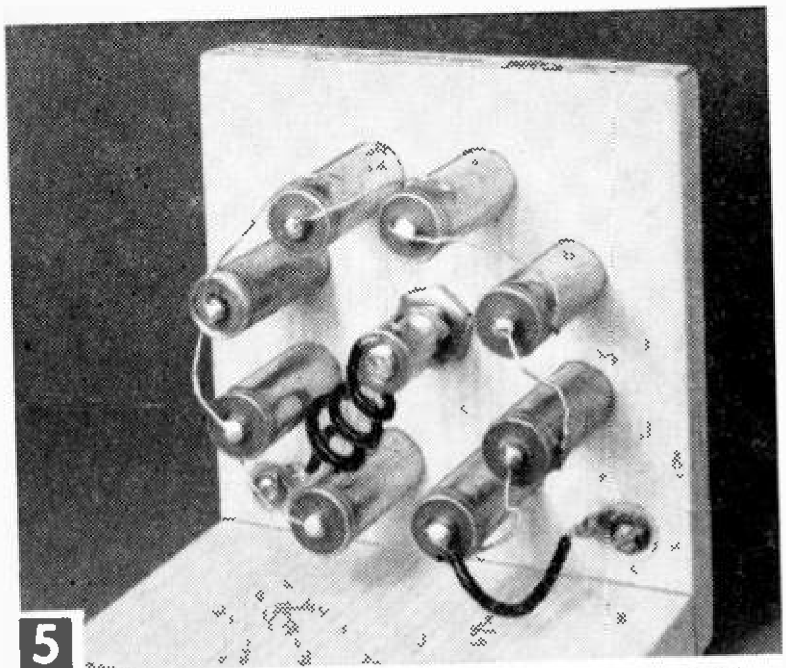
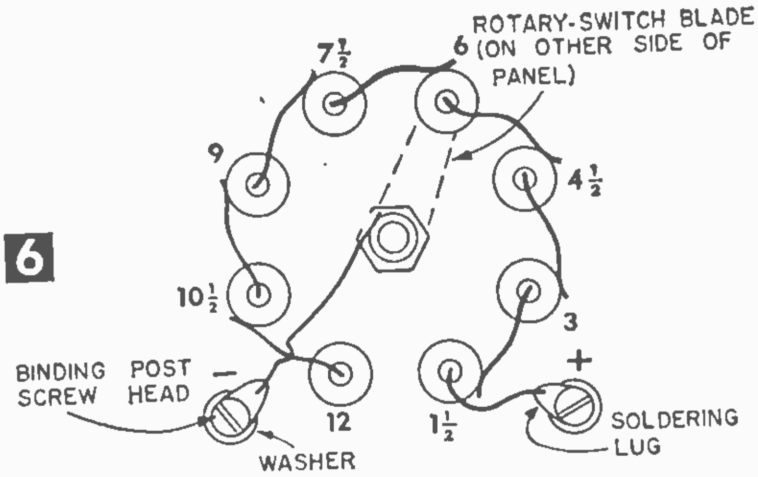


5

Flexible pigtail lead to end of switch assures reliable contact. A more rigid wire soldered to bearing might deliver unstable voltage due to corrosion between bearing and shaft.



6

MATERIALS LIST—DC POWER SUPPLY

No. Req.	Size and Description
1 pc	½ x 4 x 4½" hardwood for panel
1 pc	½ x 3 x 4" hardwood for base
8	AA flashlight cells
2	binding posts
1	brass ⅛-pipe nipple 1" long, threaded full length (available at electrical parts dealers)
2	brass ⅛-pipe hexagon nuts, to fit nipple
1	¼ x 2½" brass rod, threaded one end with ¼"-20 N.C. die
1	radio knob with ¼" socket (2 setscrews preferred)
1 pc	1/32 x 1 x 2" brass or hard aluminum
1	¼"-20 N.C. brass hexagon nut
1	compression spring about ¾" long, to fit ¼" shaft
1	collar with setscrew, to fit ¼" shaft (see text)
1	⅝" O.D. washer to fit ¼" shaft
2	washers to fit binding post screws
2	soldering lugs to fit binding post screws
2	flathead or ovalhead wood screws about 1¼" long
	24" hook-up wire (insulated), solder, soldering paste

The Rotary Switch. Assembly shown in Fig. 3 includes a 1-in.-long bearing of brass ⅛-pipe nipple having a bore of slightly over ¼ in. Mount the nipple securely in the ⅜-in. hole, using two brass hexagon nuts.

Cut the metal rotary-switch blade from brass or hard aluminum about 1/32-in. thick, then bend and drill as shown in Fig. 4. Make the right-angle bend on the end of the blade with a slant; this gives the blade a wider sweep which prevents the contact edge from wearing a groove in the soft metal ends of the cells.

Clamp the blade on threaded end of ¼ x 2½-in. brass shaft, securing it between a brass hexagon nut and a radio knob (Fig. 3), then slip the shaft into the bearing. Over the free end of the shaft, slip a ⅝-in. O.D. metal washer having a hole slightly over ¼ in.; a ¾ in.-long compression spring and a collar with setscrew. Adjust the collar against the spring for proper tension on the switch blade.

If you have difficulty in obtaining the collar, you can buy a brass coupling made for joining two ¼-in. shafts for about 15¢ at radio parts houses; then saw it in half. Or, as a substitute, simply thread the end of the shaft with a ¼"-20 N.C. die and tighten two hexagon nuts against each other.

Paper labels do not have to be removed from the cells as shown in Fig. 5. You need only scrape off enough around the bottoms to push the batteries into the holes and leave some of the metal jacket exposed for direct soldering of wire leads. If labels are the "leakproof" type with plastic top, foil and waxpaper tube and metal disc bottom, remove bottom half with a sharp penknife blade.

Wiring Up. Figures 5 and 6 show how cells, switch, and binding posts are wired together with soldered leads. Mount the two binding posts in their 5/32-in. holes, using soldering lugs and washers under the screw heads, as shown. If screws that come with the binding posts are too short for the ½-in. wood panel, replace with longer brass screws.

Looking at the panel from the back, connect the left-hand ("minus") binding post directly to the end of the ¼-in. brass shaft of the rotary switch (Figs. 3 and 5), using a very flexible pigtail lead. Then connect the right-hand ("plus") binding post to the center electrode of the cell nearest to the corner of the panel, using most any insulated or spaghetti-covered wire.

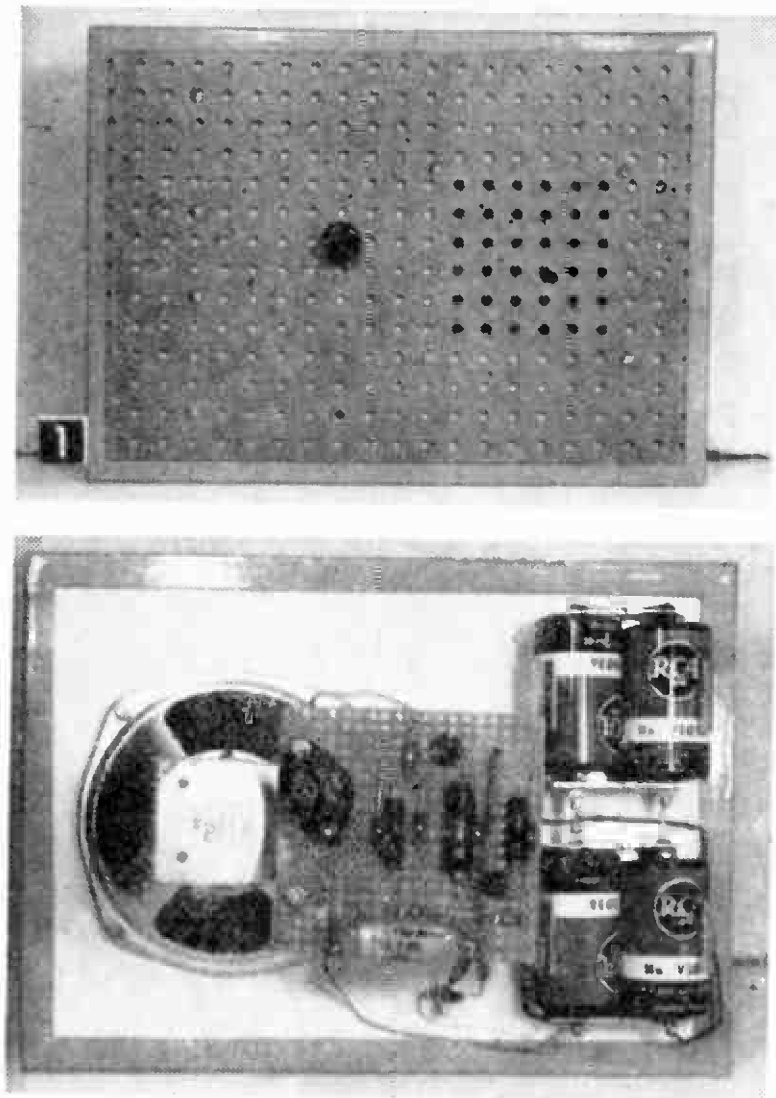
Solder all the cells in series, doing the job as quickly as possible because it doesn't do the cells any good to overheat them in spots. To speed the work cut the wire leads to right length and then "tin" the ends with solder. Scrape cells clean at places where you are going to solder and apply a little soldering paste to the spots. The paste makes the solder "hold" quickly, without overheating.

For the base, use a 3 x 4-in. piece of the same kind of wood used for the panel. Attach panel to base with two flathead or ovalhead wood screws.

When the batteries wear out, you will have to unsolder the wire leads and hook up a new set of cells. However, transistors put such a small drain on the cells that they should last nearly as long as their shelf life.

The soldered joints and the wiping action of the switch blade, which cleans the cell bottoms, assure steady voltages.

Amplifier that Drives Speaker Directly



Front (top) and rear of amplifier. Weight saved by omission of output transformer makes unit easily portable.

By FORREST H. FRANTZ, Sr.

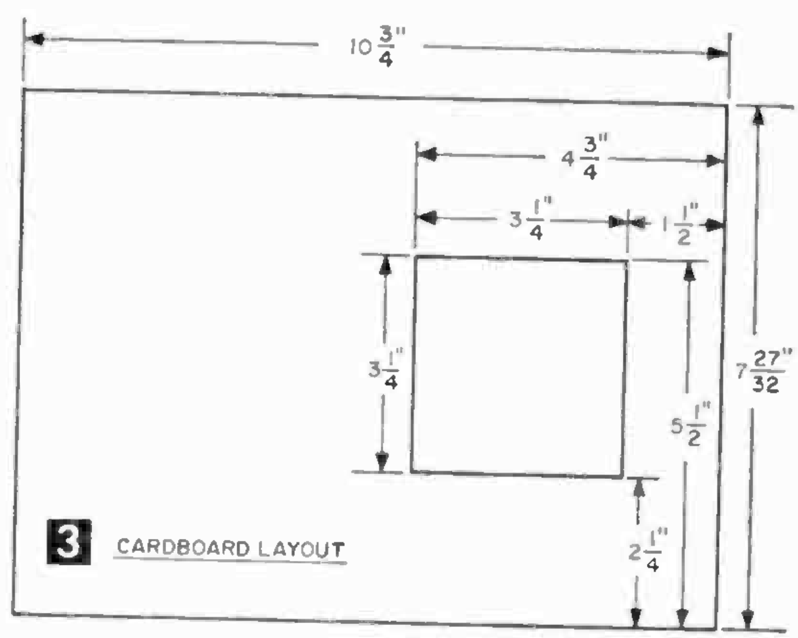
THIS transistorized amplifier drives a speaker without an intervening transformer. It may be used as a phonograph or microphone amplifier, with a tuner as the audio end of a receiver. The input may be high impedance or medium impedance. This amplifier uses only 3 transistors and costs under $15.

The secret of direct speaker drive from a single low cost power transistor is this: An intercom speaker is used, which has an impedance of 45 ohms—close to the 48 ohm output transformer impedance of the transistor. Thus steady dc flows through the speaker voice coil. The amplified output is a superimposed ac signal. The dc through the speaker voice coil displaces the speaker slightly from its normal center rest position. But this displacement is small.

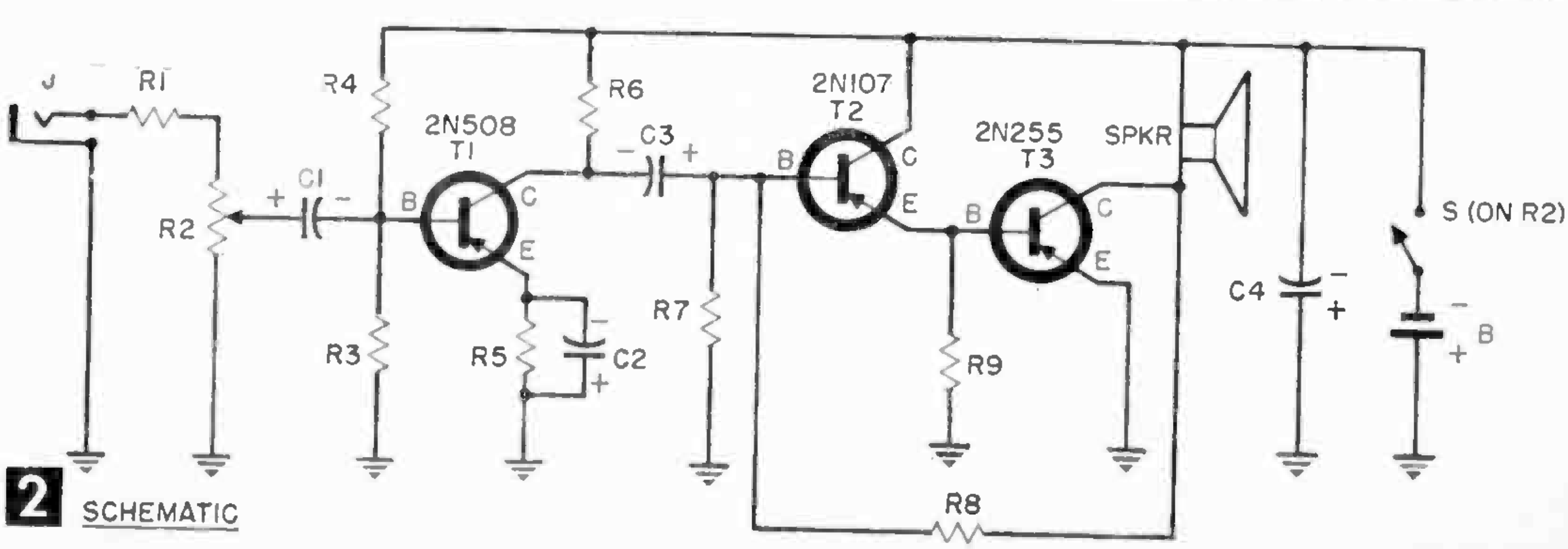
The output is 50-75 milliwatts. You can get 150 milliwatts by using a 48 ohm to 3.2 ohm transformer such as the AR-503 and a speaker with a 3.2 ohm voice coil.

This heavier (by 3 lbs.) set-up requires mounting the transformer on the back of the panel. The transformer primary leads connect to 2N255 collector and -6 v.; the secondary leads connect to the speaker terminals. Otherwise construction is as outlined below for the direct speaker drive amplifier.

The preamplifier transistor is a high gain pnp GE 2N508 in a common emitter circuit. C2 bypasses ac to keep the emitter at ac ground without affecting the dc stabilization. The preamp output is fed to the driver, a GE 2N107 in a common collector circuit, through C3. This stage keeps the low input impedance



3 CARDBOARD LAYOUT



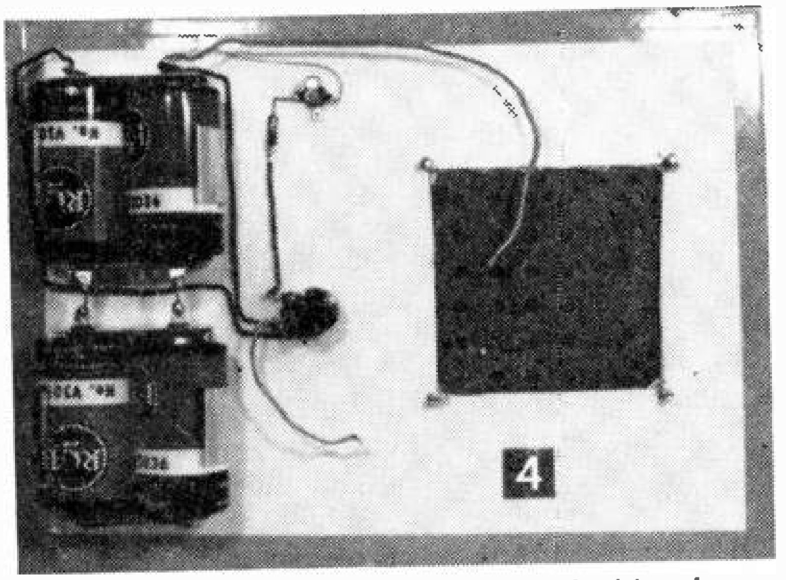
2 SCHEMATIC

of the 2N255 from overloading the preamp. The driver output from the emitter of the 2N107 is directly coupled to the 2N255. R8 provides dc stabilization and a considerable amount of audio feedback.

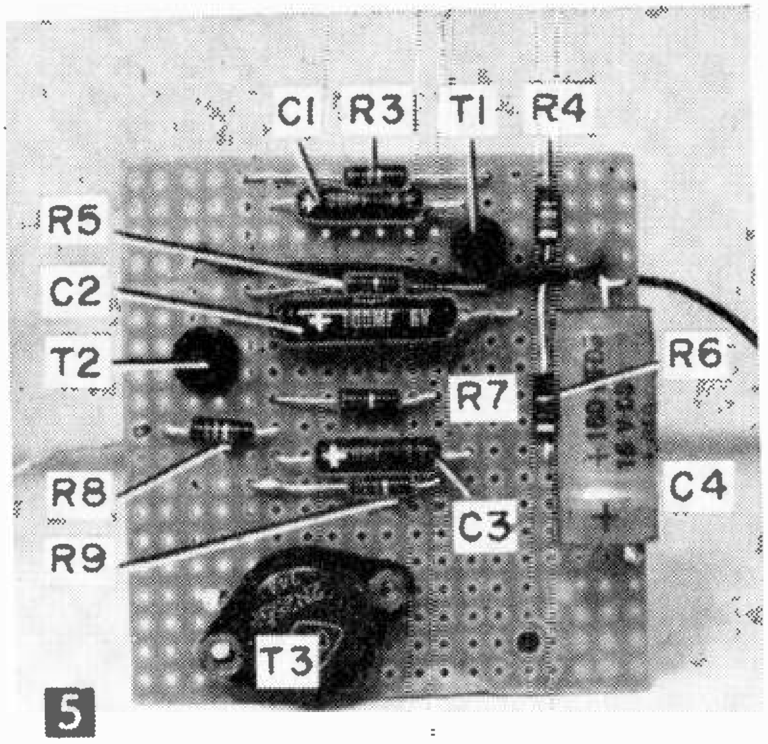
As for the amplifier input circuit, the value of R1 depends on the application: If the amplifier is to be used with a crystal mike (Lafayette PA-9) R1 is 27K. For a crystal phono pickup, R1 should be between 27K and 68K.

If the amplifier is to be used with a vacuum tube tuner, R1 should be 27K to 68K and a capacitor of .1 mfd, 600 v. should be provided in series with the jack and R1 if there's dc across the tuner output terminals. R1 is omitted when the amplifier is used with a transistorized tuner, and no capacitor is needed if the tuner has a decoupling capacitor in the output circuit. Otherwise, provide a series coupling capacitor of 10 to 30 mfd with a voltage rating equal to at least 6 v. if the tuner battery is less than 6 v. If the tuner battery voltage is greater than 6 v., select a capacitor with a voltage rating equal to or greater than the tuner battery voltage.

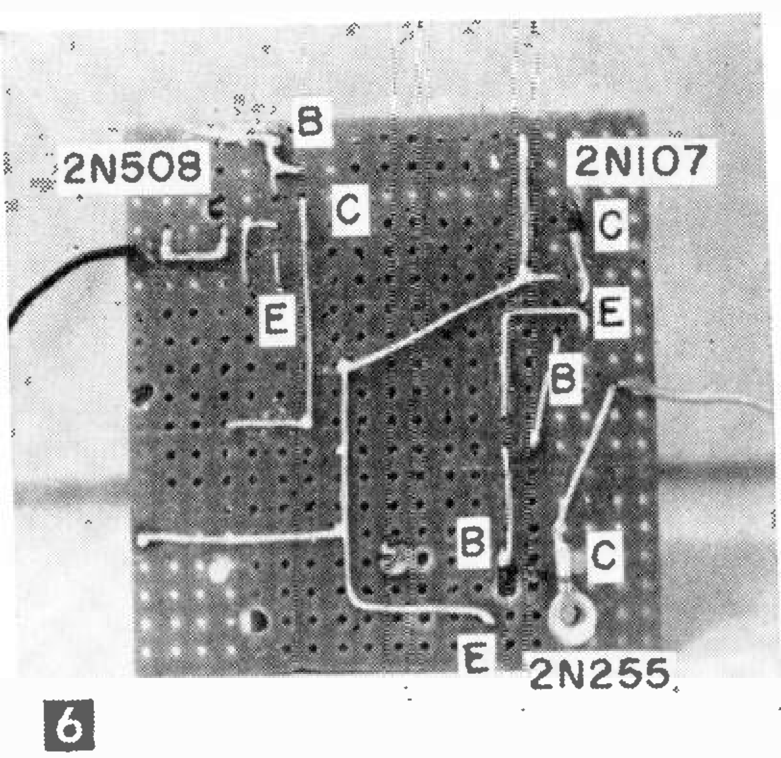
Cut a piece of stiff cardboard according to the layout in Fig. 3. Glue it to the back of the perforated Masonite board (shortened to 10¾ in.). The perforations in the Masonite are centers for all of the required holes except 2 speaker holes. Locate these by fastening the speaker on the panel through the two existing holes. The input jack and volume control holes must be enlarged to ¼ in. dia. Use the front panel view of the amplifier (Fig. 1) as a guide for your layout. After the panel drilling has been completed, fasten the



Panel-mounted components in place and wiring done, awaiting speaker and amplifier mounting.



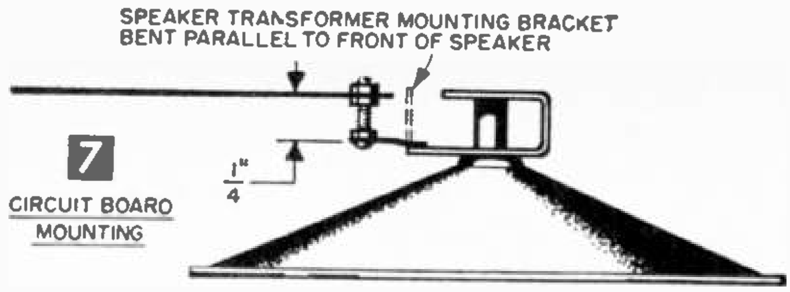
Amplifier parts are mounted on Bakelite piece.



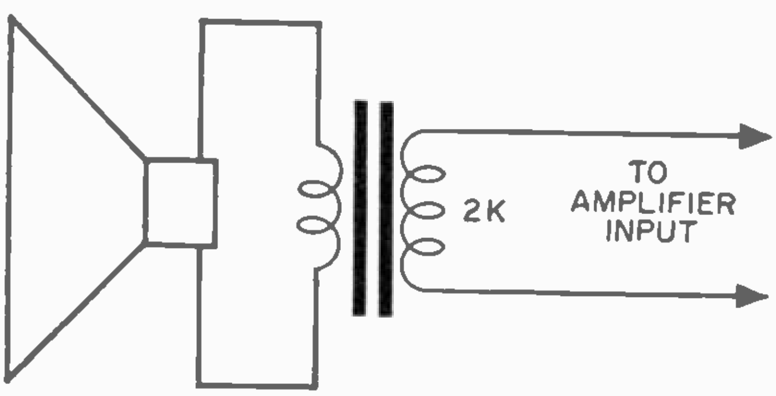
Underside view of amplifier chassis shows wiring.

MATERIALS LIST—AMPLIFIER

R9	270 ohms, ½-watt carbon resistor, 10%
R5	1K ohms, ½-watt carbon resistor, 10%
R6	4.7K ohms, ½-watt carbon resistor, 10%
R7	6.8K ohms, ½-watt carbon resistor, 10%
R3	10K ohms, ½-watt carbon resistor, 10%
R8	27K ohms, ½-watt carbon resistor, 10%
R4	47K ohms, ½-watt carbon resistor, 10%
R1	required for certain mike, phono or tube tuner applications (see text)
R2-S	10K volume control with switch (Lafayette VC-28)
C1, C3	30 mf. 6 v. miniature electrolytic capacitor (Lafayette CF-104)
C2	100 mf. 6 v. miniature electrolytic capacitor(Lafayette CF-106)
C4	160 mf. 15 v. miniature electrolytic capacitor (Lafayette CF-127)
T1	2N508 transistor (G E)
T2	2N107 transistor (G E)
T3	2N255 transistor (CBS)
SPKR	45 ohm intercom speaker (Quam 5A1Z45)
J	subminiature jack (Lafayette MS-282)
B	four 1.5 v. size D flashlight batteries, series connected (RCA VSO 36) two double battery holders (Lafayette MS-176)
	7²⁷⁄₃₂ x 11²⁷⁄₃₂ x ⅛ in. perforated Masonite Board (Lafayette ML-181)
	3¹¹⁄₁₆ x 6¾ in. perforated bakelite board, cut to 3¹¹⁄₁₆ x 3½" (Lafayette MS-305)
	miniature knob (Lafayette MS-185)
	rosin core solder, hookup wire
	Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N. Y., stocks all parts except the loudspeaker.
	Allied Radio, 100 N. Western Ave., Chicago 80. Ill., stocks all parts except those designed by Lafayette numbers.



7 CIRCUIT BOARD MOUNTING



8 MICROPHONE MADE OF LOUDSPEAKER AND OUTPUT TRANSFORMER

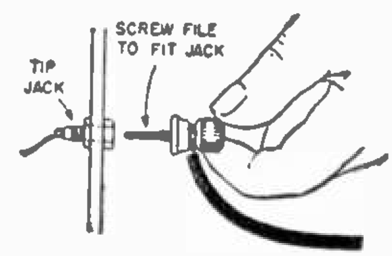
battery holders, volume control (with shaft length cut to ¼ in.) and jack on the panel and wire as shown in Fig. 4.

The transistor amplifier circuit is constructed on a miniature perforated Bakelite board (Fig. 5). Drill three 5/32 in. dia. holes—T3 mounting holes and holes to mount the board on the speaker (one hole does double-duty). The components are wired on the board by pushing the component pigtails through the perforations and soldering.

Bend the transformer mounting bracket on the speaker parallel to the front of the speaker. Fasten a 6-32 x ¾-in. machine screw with a nut in each of the two holes on the transformer mounting bracket. Set another nut on each of these screws so that the circuit board will be supported about ¼ in. above the bracket (Fig. 7). Make the final connections between the circuit board, front panel wiring and the loudspeaker.

If you want good volume with microphone, use one with an impedance of 1K to 2K. The Shure MC11 (about $7) is ideal. Or a microphone can be made of a loudspeaker connected through an output transformer (Fig. 9). If either of these microphones is used with the amplifier, omit R1.

Quick Wire Connections

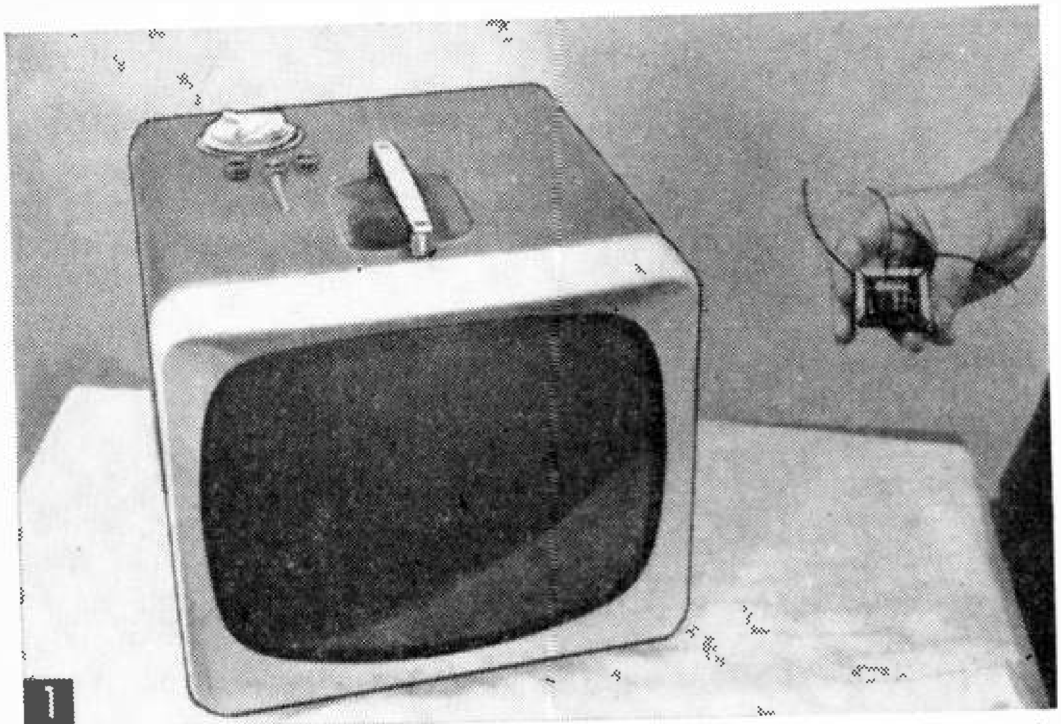


• Almost any wire can be quickly plugged into a pin jack in radio and electronics test and experimental work by altering binding post as shown below. Using a binding post with non-removable tops and molded-in screw-shanks (such as made by Eby), simply file the screw-shank to the same diameter as a phone cord tip.—A. TRAUFFER.

Wind-It-Yourself Brightener

You can make this picture tube brightener in an hour, install it and have plenty of time left to enjoy those late shows on a brighter TV

By GEORGE D. PHILPOTT



1 The CR tube brightener usually cures dimness, when the dimness is caused by low cathode emission.

THIS *autotransformer-type* brightener is made by winding a few hundred turns of magnet wire on the core-form from a small, audio output transformer. After a tube has 1000 or more hours service, cathode emission drops, and the required number of electrons fail to reach the phosphorous screen. Emission from a spent cathode can be increased by raising the filament temperature of the tube. The brightener does this by raising the CRT filament voltage from 6.3 v. to 8 v.

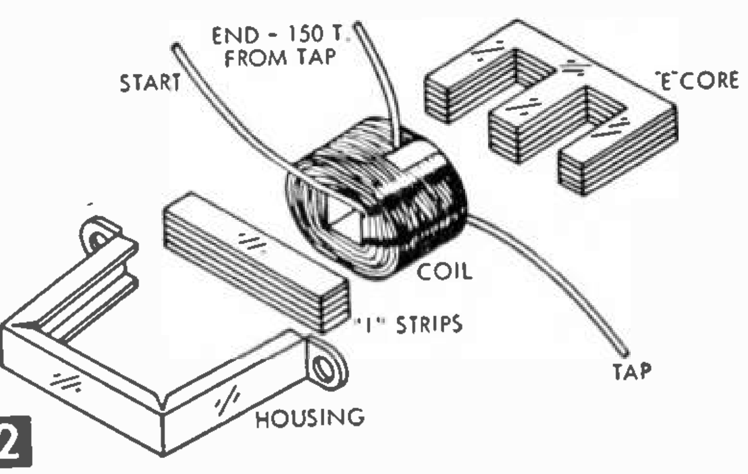
There is a risk, depending on the applied voltage increase, age of the tube, gas content (leakage), and the condition of the tungsten filament wire. Many tubes give a year of highly satisfactory service after a brightener has been installed. One tube out of twenty, will give a disappointing few hours or days of brightness. The brightener should be used only when causes of failure other than lowered emission are ruled out.

For example, troubles originating in the high-voltage section, such as an open current-limiting resistor in the anode lead, often are responsible for dimness. A weak rectifier will cause dimness and can be verified by advancing brightness control—if picture enlarges, rectifier is bad. Another cause of dimness is a gassy picture tube, which can be discovered by adjusting ion trap and checking picture for distortion and defocusing effects as trap is moved slowly.

Many series-string TV's use a thermistor (Glo-Bar) component to prevent filament burn-out from warm-up surges. Failing in its thermal function, this protective device may be the cause of sub-normal filament voltages throughout the receiver, resulting in dimness. If possible, check filament voltages when this part is suspected.

If you've ruled out the foregoing causes of dimness, low emission may be the cause of dimness and you can try a brightener.

First, find out whether your TV is a series-string job, or has parallel-wired tube filaments. The coil specifications of the brightener depend on the filament arrangement. If in doubt, check the tube-chart pasted on the back or inside panel of the receiver, and compare tube prefix numbers. The first number designates tube filament voltage. 6W4, 6BG6, 6K6, 6BC5, 6AL5 are tubes with 6.3 v. filaments. If set uses mostly



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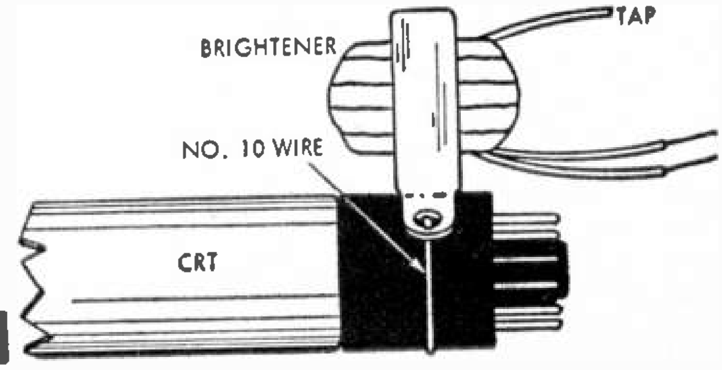

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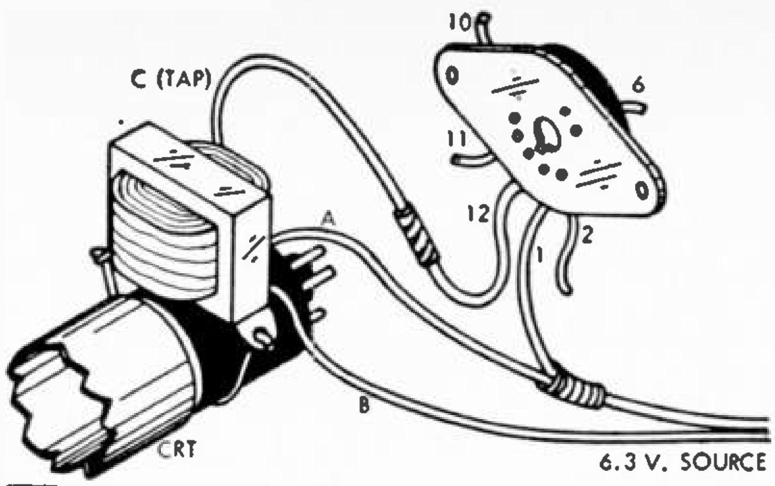
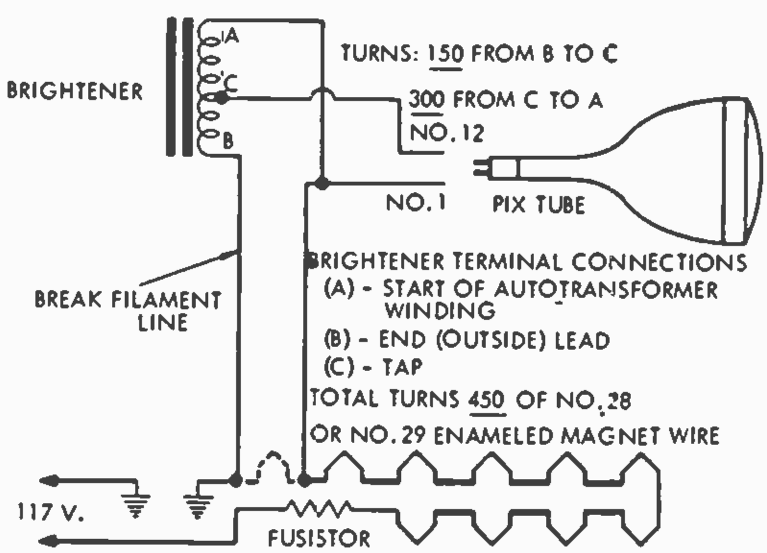
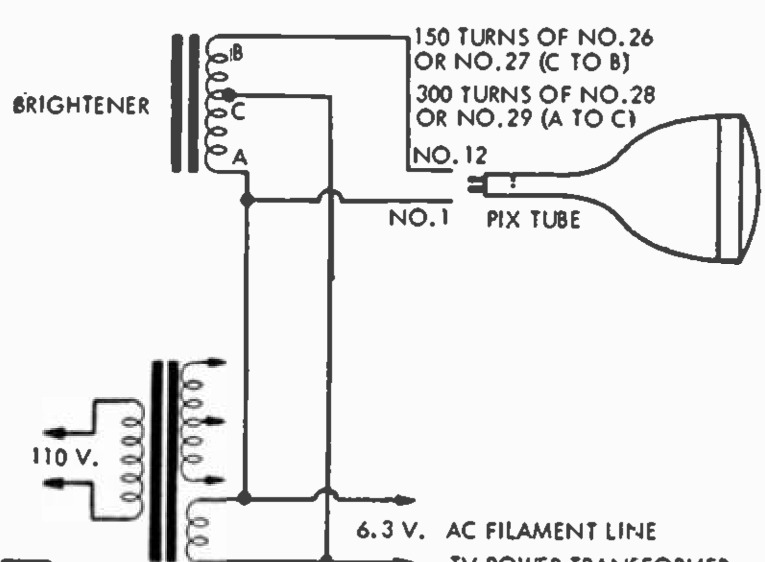


4 SERIES - STRING WIRING



5 SERIES - STRING SCHEMATIC



6 PARALLEL FILAMENTS SCHEMATIC

these types, it probably is a parallel type receiver. TV's with mixed filament-voltage prefixes—3AU6, 5U8, 25W6, 17BQ6—are series-string. Receivers with a power transformer are always parallel connected.

Next, locate a small audio output transformer that has been salvaged (preferably 1¼ x 1 x 5⁄16 in. lamination size) and begin. First, remove the core from its housing and slip the coil from the iron. Strip, or unwind coil down to the inside form. With this insulated sleeve fastened over a small tapered stick (winding handle), secure a 5-in. #28

TRANSFORMER THEORY

An autotransformer is basically the simplest type of transformer. Primary and secondary windings are combined and form a single, tapped coil. By reversing two leads, an auto-transformer may be used either as a step-up voltage device or a step-down transformer. One disadvantage is that it will not provide complete isolation between the primary and secondary circuits, because of the single winding. In Fig. 6, parallel operation, the 300 turn coil section is the primary. As voltage is applied to this winding, a magnetic flux builds in the primary and induces a voltage into the secondary, in direct proportion to the number of turns of the secondary. Because the single winding is, in effect, two coils coupled together and series-aiding insofar as voltage is concerned at the secondary terminals, this induced voltage adds to the input voltage of 6.3 v. and, being approximately half of 6.3 v. (less transformer losses which run comparatively high for this type unit) we get about 8 v. output.

If transformer is connected to a series-string receiver, Fig. 5, a different induction arrangement becomes apparent. Effectively in series only with the resistance of the picture tube filament, our small, 150-turn coil section now becomes the transformer primary. The larger, higher impedance winding (but having considerably less inductive reactance because of this filament resistance) now becomes the secondary. Induction from the primary adds to the voltage flowing through the 300 turns and thereby supplies the tube with a required voltage increase.

If possible, test the applied AC filament voltage from the brightener. It should not exceed 8.5 v. AC. The possibility of winding error or high line voltage makes it important to tube life that you lower too-high voltage by removing turns from the 150 turn coil section. Usually, 20 or 30 turns is sufficient. If voltage seems lower than expected, a few turns may be added to the same winding.

If you care to check the dc resistance of the coil sections before connecting to receiver, the parallel-type winding (#27) measures approximately .8 ohm; primary, 3.5 ohms. The series-string coils are: primary, 2.5 ohms, secondary 3.5 ohms.

or #29 enamel-covered magnet wire lead to the form with Scotch tape and start the winding. Scramble-wind 300 turns neatly without actually layer-winding, then make a loop-tap 5 in. long (C lead, Fig. 3). At this point, if brightener is to be used on a series-string type receiver, continue and wind another 150 turns and bring out the end lead. However, if unit is for a parallel filament hook-up, the wire size is changed at the tap to the slightly larger #26 or #27, insuring adequate current-carrying capacity of the coil. Depending on the actual wire-sizes involved, coil-form width, and neatness of turns, you may have to secure the winding bulk with cement to

MATERIALS LIST—CRT BRIGHTENER

No. Req.	Description
1	Used audio output transformer. Lamination size, approx. 1¼ x 1 x 5/16" (50L6GT type)
	For Series Brightener:
100 ft.	#28 or #29 enameled copper magnet wire
	For Parallel Brightener:
75 ft.	#28 or #29 enameled copper magnet wire
50 ft.	#26 or #27 enameled copper magnet wire
	Scotch tape, coil dope, speaker cement, etc.

overcome a tendency of underneath turns of slipping loose at the sides. After completing the required number of turns (450 total, tapped at 300), tape end lead to winding body and apply insulating varnish, coil dope or speaker cement.

Figure 2 shows a completed coil ready for insertion on the center-leg core laminations. The assembled transformer should be inspected to make sure that the outside housing clamps the I laminations securely to the E core pieces. A few additional drops of cement between the coil and laminations will prevent vibration-hum during operation.

A satisfactory method of mounting the brightener is shown in Fig. 3. When convenient, the brightener may be taped to the picture tube base by wrapping several turns around each. Figs. 4 and 5 show brightener wiring details and schematic for series-string operation. Sets with a power transformer are connected according to the schematic, Fig. 6.

Ham Radio Anagram

Calling all hams, SWL's and everyone interested in amateur radio. Think you can chop through the QRM and work this anagram puzzle? Read each clue very carefully—some are sure to give you some static! The empty blocks are to be filled with words, abbreviations or Q-signals.

Solution on Page 120

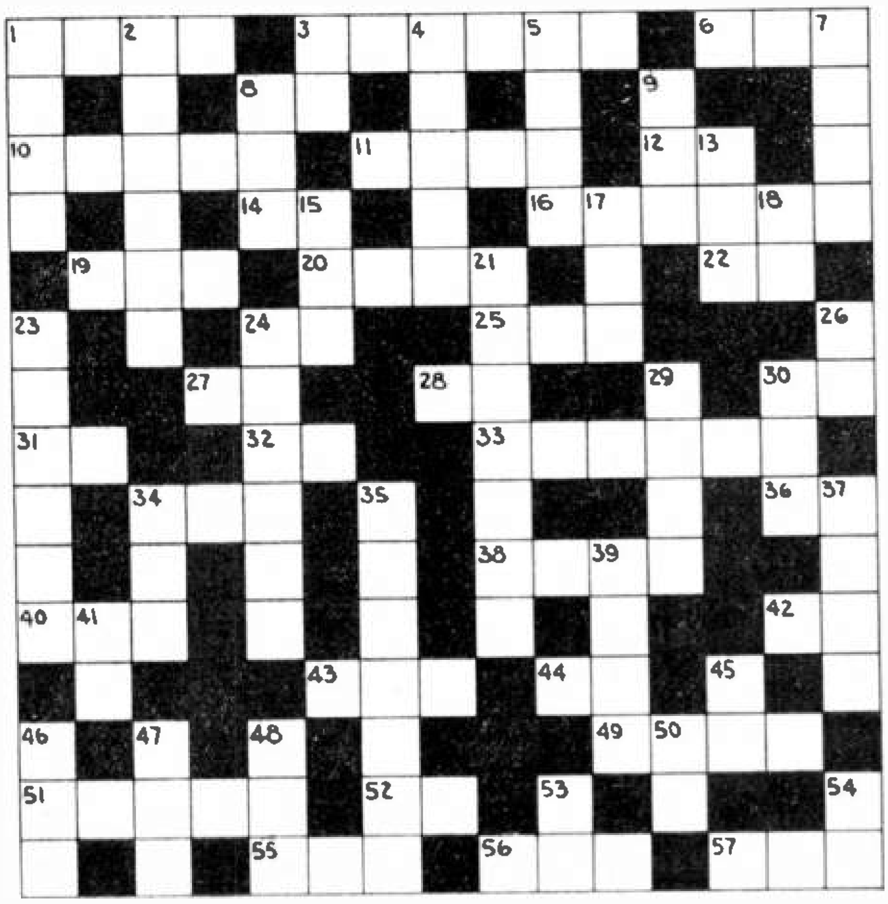
By JOHN A. COMSTOCK

ACROSS:

1) Something every ham must learn to send before he can obtain his ticket.
3) A type of antenna commonly used by amateurs.
6) A type of CW key.
8) Capacitive reactance.
10) A combination of antenna elements.
11) A type of transmitter circuit often used in ham rigs.
12) A tap in the center.
14) Opposite of high-voltage.
16) A directly excited antenna element.
19) CW that is interrupted.
20) A grid that's floating.
22) It flows in a vacuum-tube's plate circuit.
24) The oscillator found in a superhet.
25) Entries are made in it.
27) Plate load resistor.
28) "From."
30) Phase modulation.
31) Not an old lady.
32) Calling all stations.
33) A rig moved about by automobile.
34) The letter "A" in code is dit- — — — (supply missing letters).
36) A type of modulation.
38) A point of minimum voltage or current.
40) An international time standard.
42) Break.
43) Sent three-times, it's the CW safety signal.
44) A national defense organization.
49) A type of oscillator.
51) An interference which modulates a signal undesirably.
52) Grid potential.
55) Part of an antenna array.
56) Not desirable in the output signal of a transmitter.
57) Three times, dah dit dit dah.

DOWN:

1) A type of transmission line.
2) A current that flows in only one direction.
3) Abbreviation for the kind of current described in No. 2 down.
4) Some hams work — — — — —, others work CW.
5) The power that a transmitter delivers to its antenna.
7) An antenna with high — — — — is better for DXing than one with low — — — —.
8) A ham's wife.
9) Interference to standard broadcasts.
13) Interference to television.
15) When you want to work several bands easily, a — — — is a must.
17) Amateur radio gear.
18) Plate potential.
21) Part of an antenna.
23) What you are doing when you pound a bug.
24) Wires used to measure short wavelengths.
26) Not a young man (but could be).
29) A pure waveform.
30) A low-voltage lamp the size of a certain green vegetable.
34) What a dot (•) sounds like.
35) A type of oscillator.
37) Hams talk into one.
39) A type of switch.
41) A definite length of time.
45) Tube with a breakable envelope.
46) A broadcast listener.
47) Often it is used as a volume or tone control.
48) Transmitting only one sideband.
50) An amplifier that boosts power.
53) Thank you.
54) Long distance communication.



Nerve Tester

Here's a gadget that'll find who's got the steady nerves in your crowd

By FORREST H. FRANTZ, Sr.

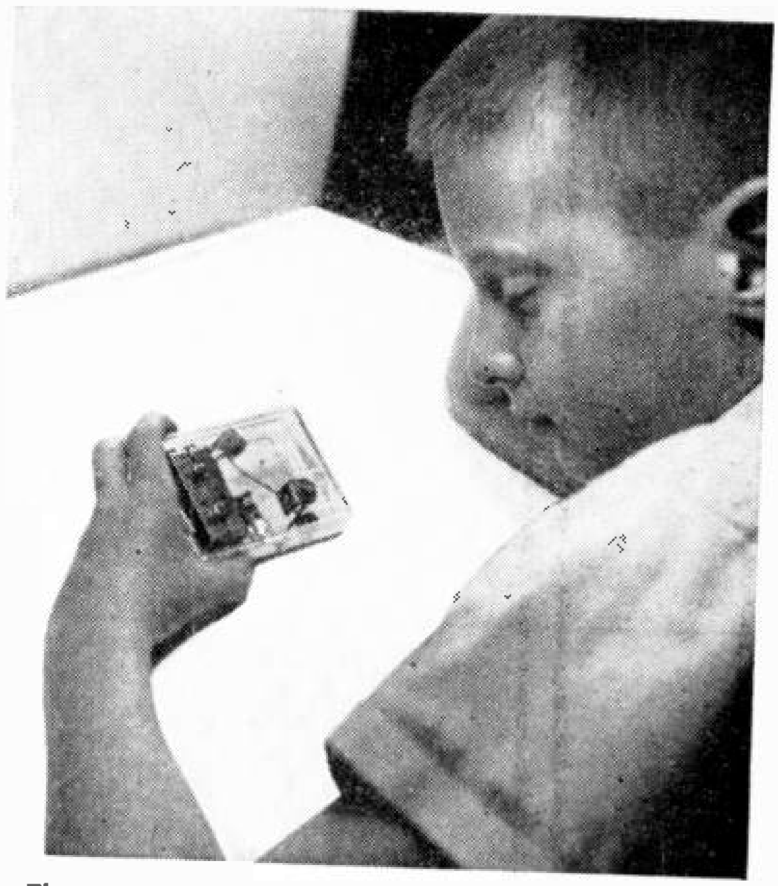
THE principle of operation of the nerve tester is extremely simple. The circuit is shown in Fig. 2. A weight is suspended on a short length of bare wire, forming a pendulum. The wire passes through a hole in a small metal bracket. This bracket and the wire which hold the weight form the two terminals of a switch. The pendulum will make contact with the bracket if the person holding the case is the least bit unsteady.

The pendulum switch is connected in series with a battery and a light bulb. The battery consists of two penlite cells connected in series so that the bulb will light brilliantly whenever the pendulum makes contact. The pendulum is skewed away from the case sides (Fig. 3) to make the correct orientation of the case more challenging. The lower bracket may be turned to decrease the effective size of the hole through which the pendulum passes and thus increase the sensitivity of the tester. The switch CS is a clip-switch consisting of a Mueller Minigator clip which is fastened to the positive battery holder terminal when the tester is not in use. The stiffness of the hook-up wire is sufficient to keep the clip from touching the battery when it is disconnected even under severe jostling.

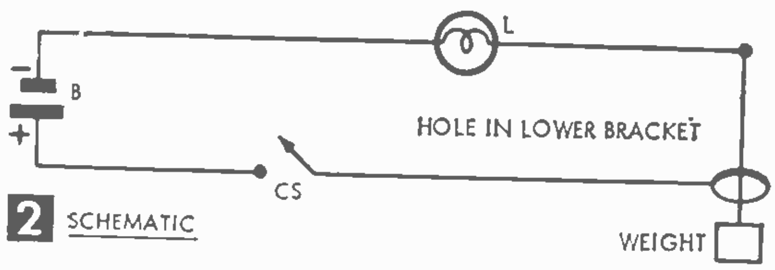
The unit can be constructed from parts costing about 75¢. The cost can be cut to about 25¢ if only one penlite cell is used and no battery holder. This may be done if the connections to the penlite cell are soldered. In this event, the minigator clip lead is soldered to the battery, and the clip connects and disconnects on the lower bracket.

Place the battery holder in the case in the approximate position indicated in Fig. 4, and make mounting holes by passing a heated ice pick through the case. The holes for the pendulum supporting bracket and the lower contact bracket are made the same way. (Drilling may crack case.) The positions for the bracket holes are not critical, but try to place them 1½ to 1¾ in. apart. After the plastic around the case holes has hardened, trim the edges with a pocket knife.

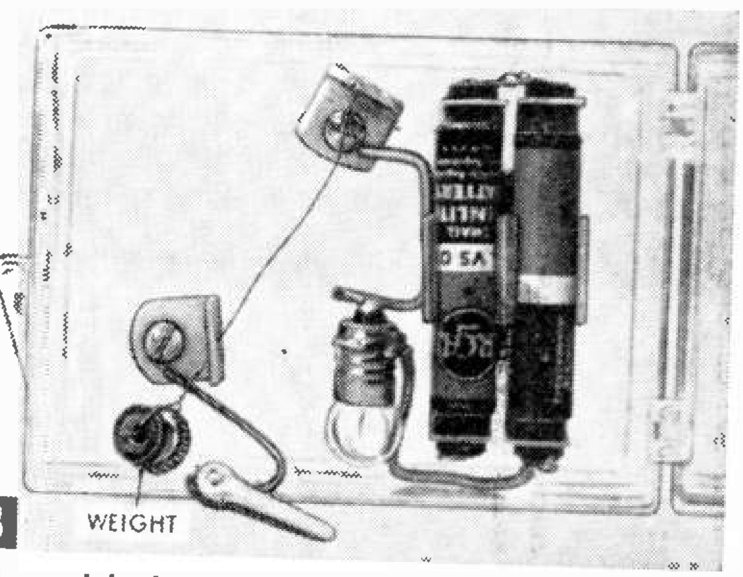
Next, fasten the battery holder and the brackets to the case The heads of the mounting screws can be placed on the inside of the case to prevent screws' interference with the pendulum. The brackets are available at hardware or radio stores, or you can make your own. They should be ¼- to ½-in. wide with each side of the angle ½- to ¾-in. long.



The nerve tester—challenge to the young in heart.



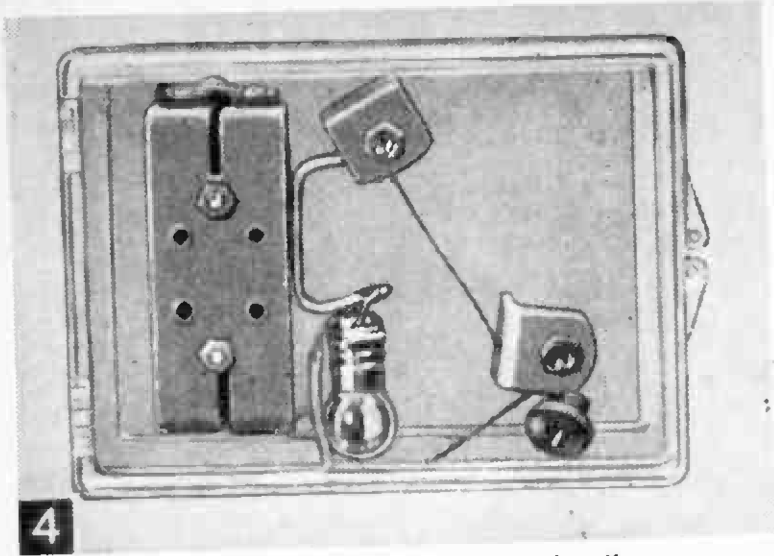
2 SCHEMATIC



3 The weight is suspended on the bare wire, which passes through the hole in the lower bracket. If wire touches bracket, bulb lights.

The holes should be ⅛-in. dia. or smaller, for best results.

Now, solder a piece of wire about 1½-in. long to one of bulb's terminals and a similar length to the other terminal. Connect one of these leads to the battery holder; connect the other to the pendulum support bracket. Turn the battery holder connection lugs at the other end of the battery holder toward each other and solder them together. Solder a 2-in. length of hookup wire to the Minigator clip



Back view shows mounting details.

MATERIALS LIST—NERVE TESTER

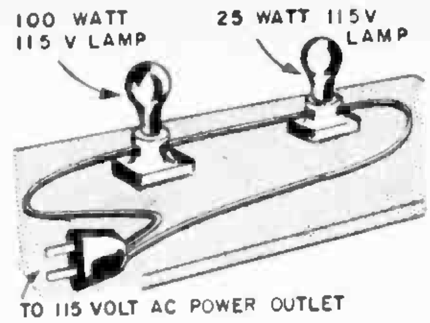
Desig.	Description
L	* flashlight bulb (GE #14)
B	2 penlite cells series connected (RCA VSO-74)
	2-cell battery holder (Lafayette MS-138)
	plastic case 3⅝ x 2⅝ x 1 in. (Lafayette MS-159)
CS	miniature clip (Mueller 30)
	2 brackets and hardware (see text)

* Get a bulb with a brass base. Some bulbs have aluminum bases and cannot be soldered readily.

and fasten the other end under the lower contact bracket mounting screw.

The pendulum wire should be sufficiently stiff and rugged to allow easy fastening and to assure long trouble-free operation—#28 is a good gauge. Solder a 3½-in. length to the suspending bracket, but go easy on the heat, or you'll melt the plastic case. Pass the wire through the lower contact bracket, and fasten the weight. This weight could be a nut, a washer or a fishing sinker. Insert the batteries in the holder and adjust the lower bracket for the desired sensitivity. Shut the case and you're ready to test your nerve.

Which Bulb Burns Brighter?



• Connect two ordinary cleat-type lamp sockets in series as shown in diagram, then screw a 100-watt bulb into one, a 25-watt bulb into the other. Now, before you connect the setup to a 115 volt *a-c* outlet, which of the bulbs do you think will burn brighter?

Most people instinctively choose the larger lamp, but the experiment proves otherwise. A bit of thought reveals the reason. In a series circuit, the identical stream of current flows through all parts. Thus, whether the current is large or small, it will be the same through both bulbs. However, the *voltage* across each lamp will be proportional to its resistance. The 25-watt bulb must have the higher resistance, since normally it consumes less current than the 100-watter when supplied by the same line voltage. Therefore, in a *series* circuit, the lowest-rated lamp burns more brightly since it receives the greater voltage.—C. F. ROCKEY.

Kink for Soldered Joints

• When soldering wires and cables in a radio receiver, immediately after the iron is removed from the soldered joint, paint the joint with lacquer-thinner, using a small brush. The rosin flux will evaporate immediately, leaving a clean joint. Using this kink, a cold-soldered joint will immediately show up, preventing future trouble.

"Would your ears mind listening in another spot—the carpet's wearing out!"

Trouble-Shooting Interference

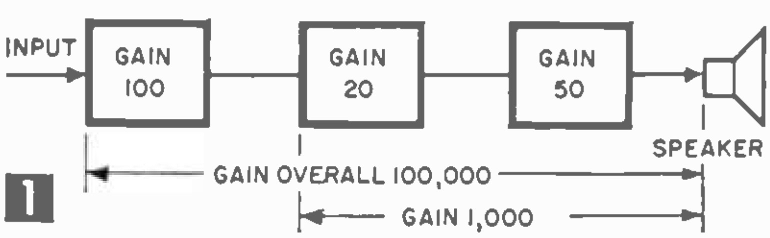
How to discover the source and eliminate noise in a radio or amplifier

By FORREST H. FRANTZ, Sr.

PUT a new LP on the phono and slump into the easy chair. The music is fine, but what's that d—— hum? The disturbing sizzle of a TV, the gasping of a hoarse, distorted radio or TV and the whine of a humming radio are other manifestations of interference. Fortunately, most of these troubles are easily recognized and fixed.

We usually differentiate interference as either hum, buzz, squeal, noise, distortion or station interference. Sometimes these are due to faults in the gear, sometimes to external sources. Frequent internal causes are: open, shorted or leaky capacitors, intermittent connections, intermittent short circuits, defective tubes and dampness. The antenna-ground system is also a frequent trouble spot. Externally caused disturbance is often traced to switches, thermostats, advertising signs, motors, radio stations and high voltage lines.

Let us look, first, at hi-fi audio amplifiers, remembering that this discussion is applicable also to the AF section of radios. Then we will cover radios specifically.



1

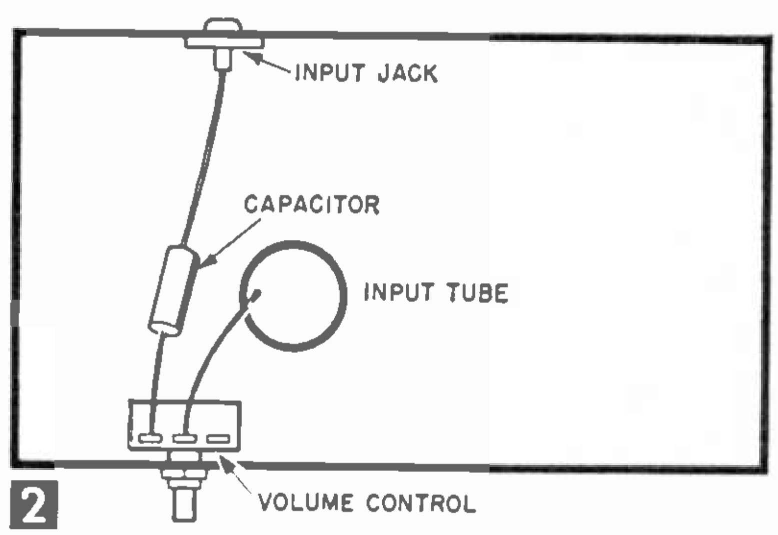
Hum introduced in first stage is amplified more than hum introduced in subsequent stages.

Audio Amplifiers. Amplifiers may exhibit interference in the form of hum, buzz, squeal, noise or distortion.

Hum in an amplifier is usually caused by insufficient shielding of the amplifier input circuit. The various stages of an amplifier have individual gains, which multiply as shown in Figure 1. The first stage usually has the highest gain. Thus, the gain from the first stage to the loudspeaker is much greater than the gain from any succeeding stage to the loudspeaker. If even a small portion of an amplifier input lead is unshielded, it acts as a capacitor to the ac line though it may be many feet away. A small amount of alternating current can therefore feed into the amplifier. The high gain of the amplifier multiplies this minute voltage into a sizeable signal at the loudspeaker.

Hum due to poor input shielding is easily recognized, since the loudness of the hum will decrease as the volume control setting is decreased. There are several steps to pinpointing and curing this. First, dress the input lead close to the chassis. The input lead can be traced from the input connector and usually goes to the high volume control terminal (possibly through a capacitor) as shown in Figure 2. The center terminal of the volume control goes to the grid of the input tube (possibly through a capacitor). In some amplifiers, a preamp stage precedes the volume control. If the input tube is glass, a shield may cure hum. Next, check the shell to chassis ground connection of the input connector. Then check the connection from the external input plug to the braided shield which encircles the unit's input lead (Figure 3). An open can cause hum.

Sometimes, in cheap construction, unshielded leads are used, and should be replaced. An open from shield to ground or at the chassis connector will result in loss of gain, because the shield is frequently the chassis ground return conductor. Finally, check the ground connection at the remote input device and look for short lengths of



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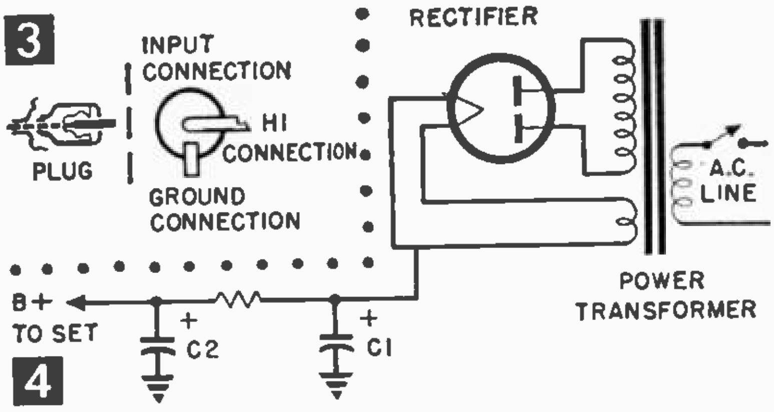
Leads likely to pick up hum. Remedy is to substitute shielded cable, dressed close to chassis.



3. A broken shield or disconnection from plug ground or a faulty or open input jack can cause hum pickup.
4. Filter capacitor (C1), which if open, causes hum in amplifier power supply. Leaky power supply output filter capacitor (C2) will cause hum or squeal.

input lead which may be unshielded.

Hum which occurs at all volume settings is often due to defective filter capacitors in the amplifier power supply, as shown in Figure 4. (The rectifier tube is connected to the power transformer and the high voltage electrolytic capacitors.) To test the filtering, bridge a 10 mfd. electrolytic (watch the polarity) across C1. The voltage rating should be equal to or greater than that of C1. If hum decreases, you're on the right track. Disconnect C1, and connect a replacement capacitor of the same or greater voltage and the same capacity in the circuit. If the hum is substantially reduced, replace C1 permanently. Otherwise, connect the original C1 back into the circuit, and bolster the filtering action with the 10 mfd. capacitor that scored the original improvement. If this isn't enough, try a 40 mfd. capacitor of adequate voltage rating across C2.

Caution! Don't work on an amplifier that has been used in the last few minutes—wait until capacitors discharge.

If you still haven't cured the hum, check for cathode to heater leakage in tubes, poor connections to chassis ground within the amplifier, and open or partially open capacitors elsewhere in the circuit (can usually be found by bridging with another capacitor).

Squeal in amplifiers may be due to open filter or bypass capacitors, which can be traced by employing the capacitor bridging technique described previously. Another cause of squeal is feedback caused by a high level signal lead being too close to an early amplifier stage lead—shorten the lead and dress it close to the chassis.

Noise may be due to a bad volume control, a microphonic, shorted or intermittent tube (which can often be located by tapping with a pencil eraser) or a rubbing loudspeaker voice coil (most readily checked by substitution of another speaker). Noise can also be caused by an intermittent capacitor (thump and jiggle the suspect), by poor connections which may be loose or intermittently shorted, by intermittently shorting output or interstage transformer windings or by arcs across rectifier or output tube sockets (usually indicated by a charred section of tube socket or a visible arc during operation).

Distortion in amplifiers is usually caused by leaky coupling capacitors (C4 in Figure 5). Coupling capacitors may be checked by substitution, but this requires disconnecting one end of the original capacitor. Other sources

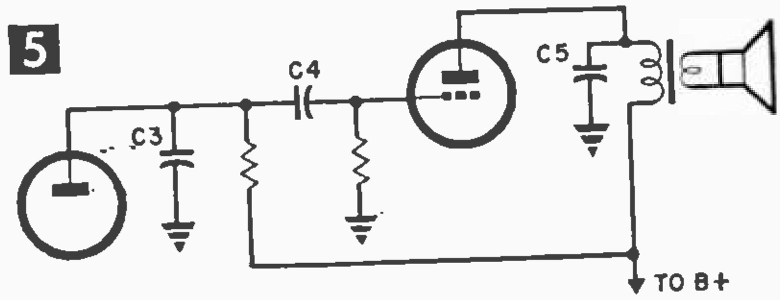


Plate bypass capacitors (C3 and C5) or coupling capacitor (C4) if leaky can cause distortion.

of distortion are leaky power supply output filter capacitors (C2 in Figure 4) and leaky bypass capacitors. Plate bypass capacitors (C3 and C5 in Figure 5) are likely offenders. In each of these cases, one end of the original capacitor must be disconnected before substitution of a similar capacitor is attempted. Another frequent cause of distortion in amplifiers is a gassy tube. Output tubes are the usual offenders.

Radios. Radios are subject to all the amplifier disturbances described, and the same solutions apply. In addition to amplifier troubles there are other possibilities.

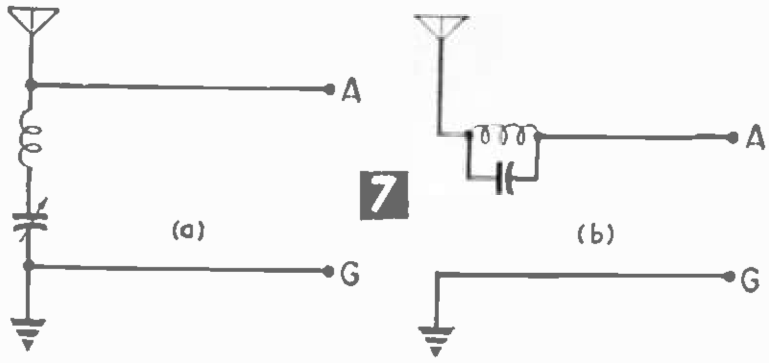
Hum caused by some strong local radio station can usually be cured by connecting a 0.05 mfd., 600 v. capacitor from one side of the ac line to chassis ground as shown in Figure 6A. If the set is ac-dc (no power transformer), the capacitor should be connected from the set side of the switch to the opposite side of the line as shown in Figure 6B.

Buzzing is due to external sources such as neon signs, motors, or high voltage lines.

Squeals may be caused by any of the things already discussed under audio amplifiers or may be due to open bypass capacitors, long unshielded RF or IF leads or other causes. Long leads on IF transformers are frequent causes of squealing.

Noise may be due to internal or external trouble. If the set uses an external antenna,

Suppressing a strong local station by connecting .05 mfd capacitor from one side of line to chassis ground for ac radio (a) and from set side of the switch to opposite side of line for AC-DC radio (b).



Suppressing an unwanted station with a wave trap, a tuned circuit across the antenna ground terminals (a) or in series with the antenna terminal (b).

disconnect it, and short the antenna terminal to ground. If the noise persists, it's in the receiver. Arc in the power supply, intermittent connections almost anywhere in the set or defective tubes are possibilities. Next, check the antenna by disconnecting it and connecting 20 ft. of wire to the antenna terminal. Noise in an antenna may be due to poor or corroded connections at the antenna, lightning arrestor, feed-in to the building, a break in the lead-in under the insulation or to the antenna or lead-in contacting metal such as the storm gutter.

Assuming noise to be external to the receiver, a capacitor connected as shown in Figure 6A or 6B may be helpful if your receiver doesn't already have one. If this doesn't help, try tracking down the external causes which were mentioned early in this article. For example, if noise occurs around meal times, it may be an electric stove or other appliance. Or, say the noise occurs only in winter—could be the thermostat.

The type of noise your receiver picks up is also a clue to its origin. Switches, relays, thermostats and poor electrical connections cause intermittent noise. Motors and industrial and medical electronic equipment produce a buzz or whine in nearby radios. High voltage lines produce a hum or buzz with a super-imposed crackle in radios. High voltage line noise is continuous, and the crackling is worse in damp weather.

A battery receiver, that has automatic volume control (which you must disconnect for this purpose) and a directional loop antenna, is helpful in tracking down noise.

When the source of noise is located, a commercial filter installed at the source of the noise will usually cure the trouble. These filters usually consist of capacitors or capacitors and inductors.

Distortion is usually due to AF section trouble. Refer to the previous discussion of distortion in connection with audio amplifiers.

An interfering radio station can be eliminated by a wave trap, a tuned circuit across the antenna-ground terminals (Figure 7A) or in series with the antenna terminal (Figure 7B) tuned to the frequency of the interfering station.

Curing Tape Recorder Noise

CHATTER, squeals, hum and fading are the symptoms of minor mechanical ills that you can cure without taking your tape recorder in for repairs.

Mystery Chatter. Here's an example of trouble that had both the owner and a service technician stumped. Whenever the tape was running they heard a mysterious chatter, but when the machine ran without tape on the reels the noise ceased. Finally, with an improvised "stethoscope" made of a cardboard mailing tube, they pinpointed the sound in the counter. Even though the moving parts were plastic, they rattled and chattered until the steel counter shaft was smeared with a bit of Vaseline petroleum jelly.

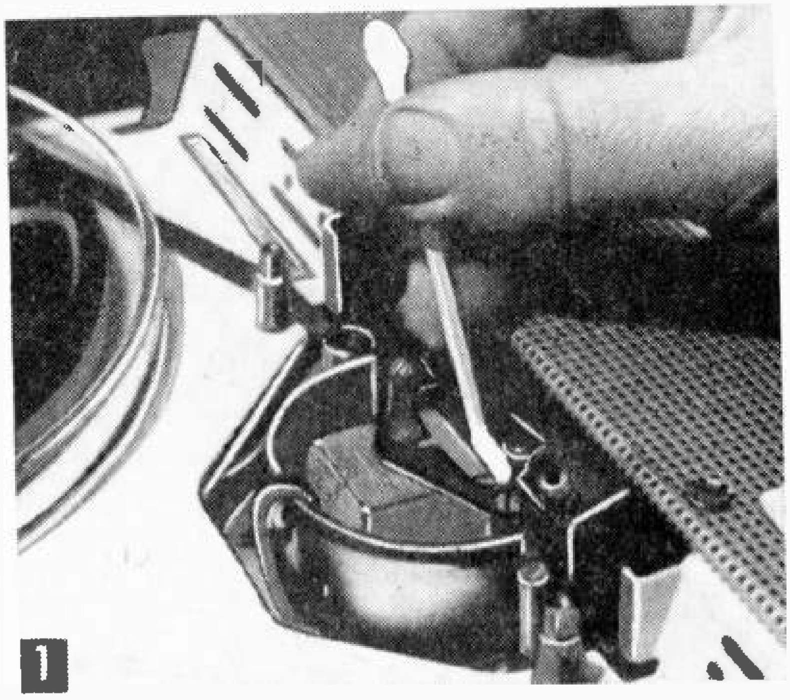
Poor Tape Gums Head. Sometimes the trouble may not even be in your recorder. The culprit may be poor tape, hard to spot when spliced in between lengths of superior quality tape. Some bargain tapes shed their red-colored coating, and gradually your recording heads gum up with a deposit. The effect is a gradual drop in recorded volume until you may not be able to record at all. The same tape coating residue deposited on the pressure pads and roller may cause squeaks. If the dirt won't come off with a clean, moist cloth, use alcohol or tape-head cleaning liquid (Fig. 1).

Pad Squeak. Dry pressure pads, even if they are clean, can cause squeaks. Isolate your noise by gently lifting the pad away from the tape as it passes the recording head. If the pad was causing it, touch it lightly with a tiny bit of petroleum jelly.

Ratio Flutter. Sometimes the difference in ratio between the O.D. and hub diameter of a 7-in. reel may cause a speed variation as you wind from a full reel down to an almost empty one. The effect is flutter and wow, and the answer is either to use a lot of leader ahead of your recording, or the new "flutter-free" reels that have larger hubs.

Rubbing, Stalling, Spilling. Bits of broken tape, dust and dirt will collect around the head and top mechanism to cause soft rubbing noises. A remedy is to cautiously take off the top cover plate and remove dust and tape chips with a small brush.

Most machines are permanently lubricated at the factory. But after a lot of heavy duty use, you may find dry bearings on the motor, flywheel, pressure roller or idler assemblies. These bearings can take an additional drop of #10 motor oil once a year if your machine is used a lot. But don't over oil. Oil that transfers to rubber belts, wheels and your flywheel can cause all kinds of braking, rewind, and fast forward troubles. Tape spill and a stalling of the take-up reel when it's almost full are common symptoms. Remove oil on belts and wheels with an alcohol dampened cloth.

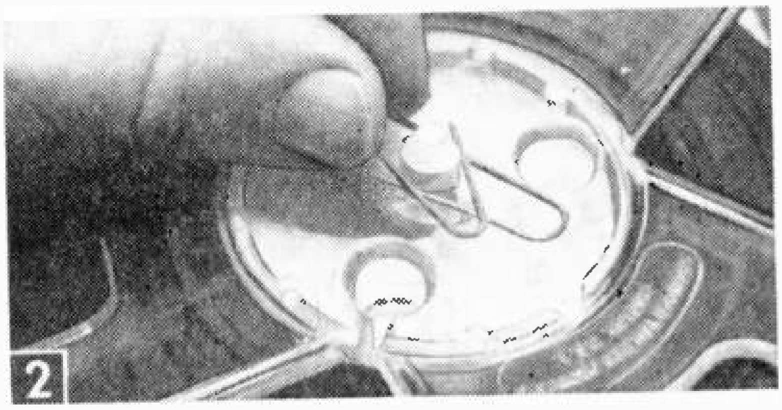


1

Every so often, clean your recording head, rollers and pads with a cotton medical swab. Use alcohol or tape-head cleaner to dissolve deposits of tape oxide.

If your recorder is stored away for months at a time, don't worry about noise problems or adjustments until after you run it a few hours. Rubber drive wheels, belts, etc., particularly if the recorder is accidentally left in forward or rewind for a long time, will develop bumps or flat spots which will disappear after a good warmup. Even your plastic spools will warp if stored improperly, and tape wound too tightly will "set."

If internal noises persist, remove bottom covers and look for loose set screws, scraping motor fan blades and rubbing shafts on the inside. Tie your tape reels in place with paper clips and run the recorder at various angles to spot vibration trouble. More advanced servicing steps are covered in service sheets usually supplied free on request from recorder manufacturers.—GLEN F. STILLWELL.



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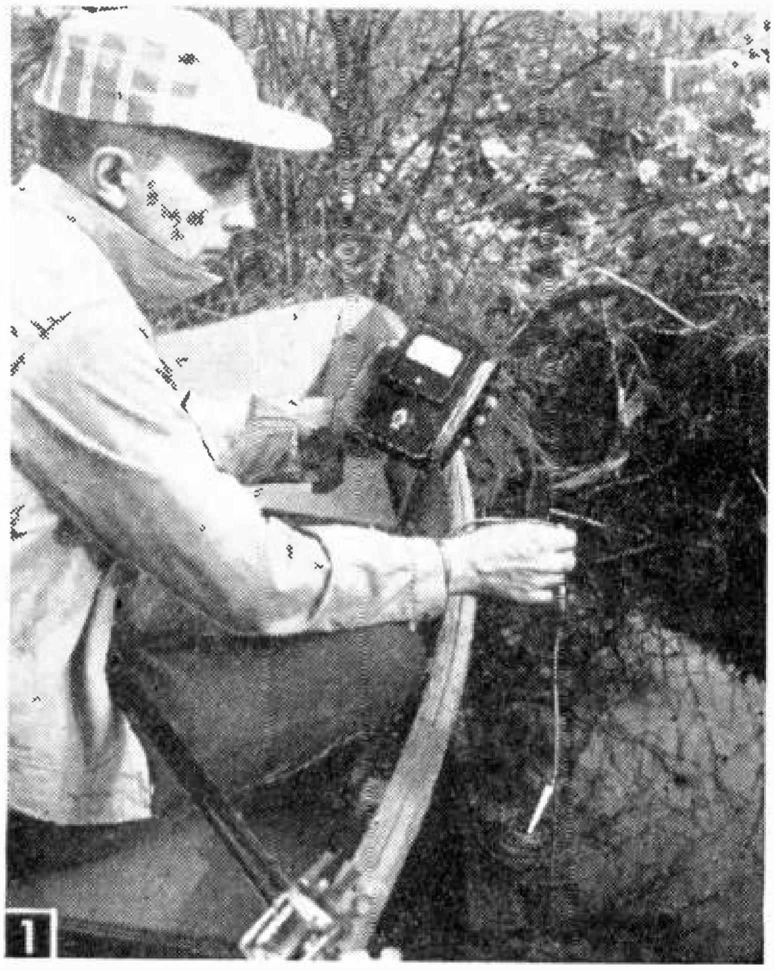
With the reels clipped in place, you can run the recorder tipped at various angles to pin down the source of rattles and vibrations.



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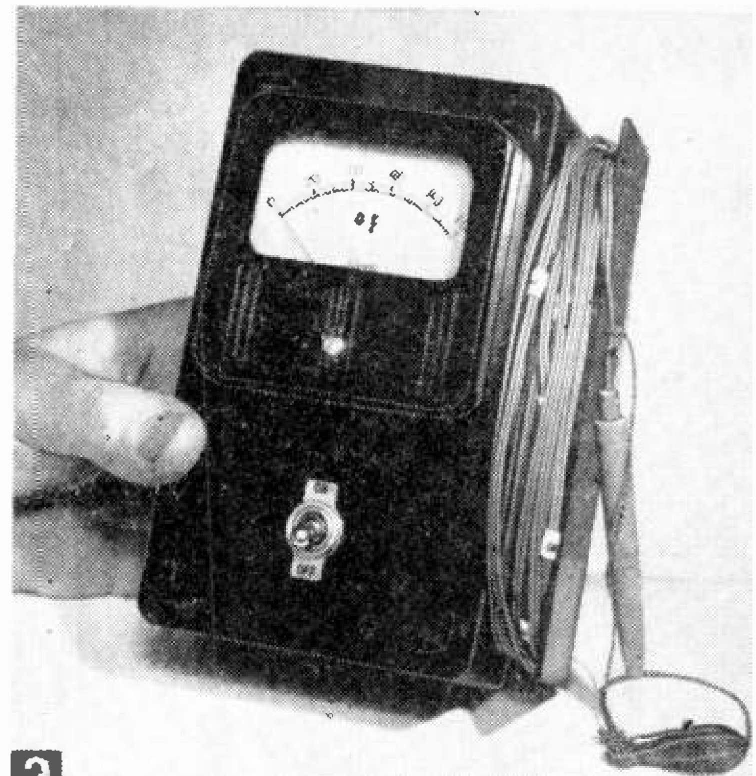

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Fig 1. Lower the probe into the water, flip the switch, and the meter instantly reads the temperature.
Fig. 2. The meter scale is labeled to read directly in degrees F. Left-handed fishermen will want to mount the wire reel on the opposite side.

Remote Reading

Electronic Fishing Thermometer

Because the fish play it cool, this will help you locate the spots where they bite

By JAMES E. PUGH

THE sensitive thermistor in the probe of this $11 instrument will give you temperature readings down to 50 or more feet below the surface of your favorite fishing waters. That is why you can use it to answer the question, "Where are they biting today?"

Fishing experts know that fish prefer waters within a certain temperature range; the exact range depending on the species (Table A). When the fish are in a level of water at the temperature they prefer, they are lively and will take lures readily. In warmer zones, they are more listless, often refusing bait altogether. The principle behind this fishy behavior is that any one kind of fish will seek water with the certain oxygen content that is most comfortable for him. Since the amount of absorbed oxygen in water depends largely on the water temperature (warm water holds less oxygen than cold water), the electronic remote thermometer will guide you to where your favorite fish are most likely to be found.

Preparing the Case. First lay out the hole locations on the black plastic case (Fig. 3). The arrangement of the wire reel shown in Fig. 2 is for right-handed fishermen. Southpaws should simply change the reel to the left side and the battery to the right. When you drill the holes, back up the underside of the case with a wooden block to prevent chipping. Use a circle cutter on a drill press to make the 2⅝-in. hole for the meter. Without a circle cutter, scribe the hole and drill a 3/16-in. hole just inside the circle. Then cut this section with a fine coping saw, and trim the hole with a fine half round file to fit the meter case exactly.

Next solder the junction of rivets and lugs on the battery holder (Fig. 4) to avoid possible trouble with a high resistance joint in the future. Also coat the inside surface of the rivet with solder where it contacts the battery, to avoid corrosion from battery leakage. Then mount the other parts and solder all connections (Fig. 5).

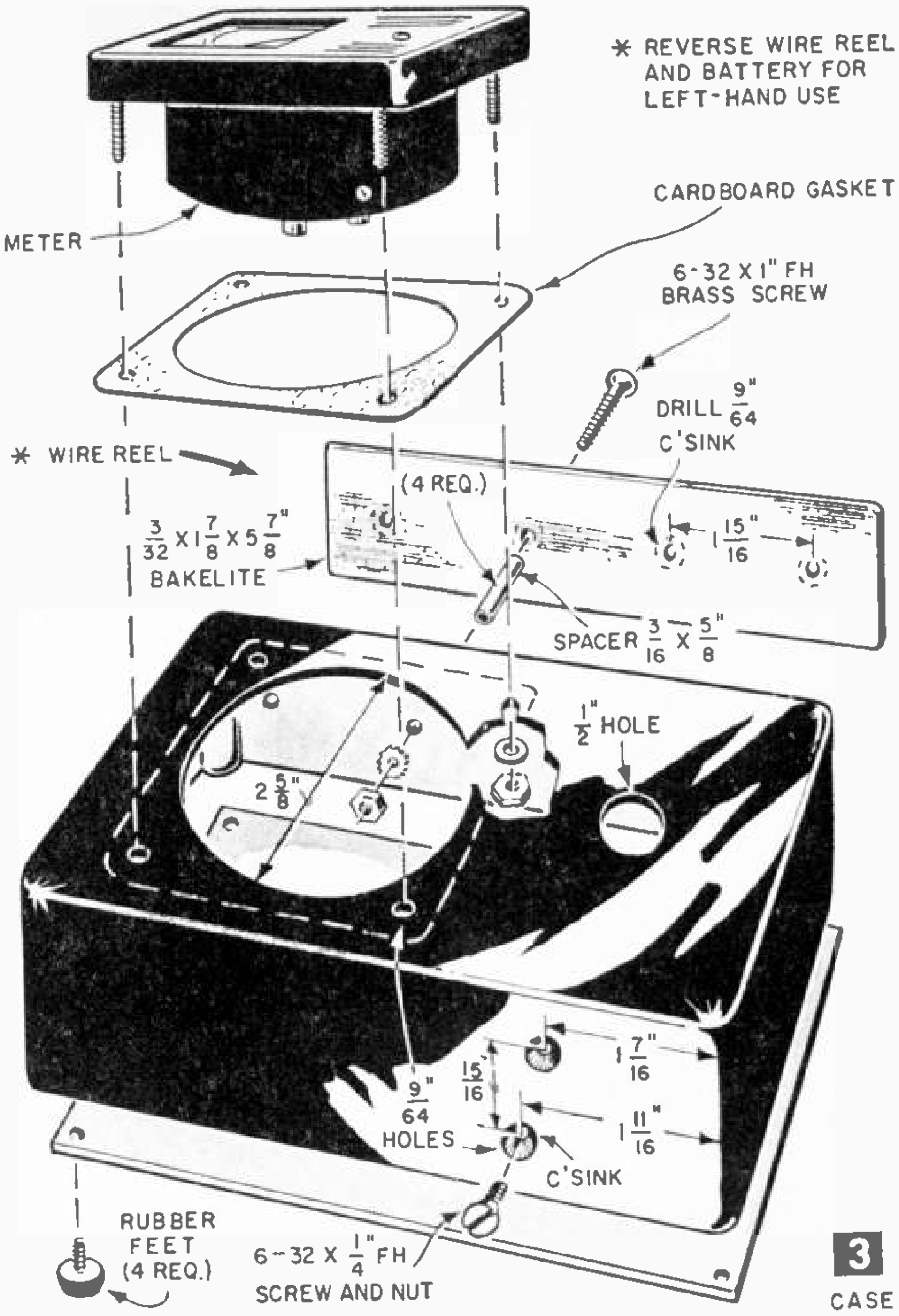
Be sure that your soldering iron is hot and clean, and use only rosin core solder. Apply the hot iron and a very small bit of solder to the joint at the same time. The layer of solder provides heat contact with the joint. After a moment when the joint is hot apply more solder. Remove the meter lugs when soldering to prevent damage to the meter, and use heat sinks to keep the small resistors cool.

Although our model is shown with 50 feet of cable you can use any length to suit local needs. Tie one end of the cable to one of the reel spacers (Fig. 5A) allowing about 1-ft., to pass through the grommet into the case. Solder the connections and wind up the length of cable on the reel.

Testing Meter Wiring. To check the work so far, strip about ¼-in. of insulation from the probe end of the cable. Place the battery in its holder and with the bare ends of the probe wire well separated, immerse them in a glass of water. The meter pointer should move upward on the scale, the amount of movement depending on the impurity of the water. If the meter reads backward, your battery is reversed in the holder. Remember that the positive terminal of this battery is not the same as that of a flashlight cell. Mercury cells have a positive shell and a negative center. Mark the positive terminal lug of the battery holder with a dab of nail polish, or red paint.

Making the Probe. With a fine coping saw, cut the threaded end off the lower half of a plastic ball point pen casing. Drill eight 1/16-in. holes around the pointed end (Fig. 6). Then shape a 2⅛-in. length of wood dowel so it fits snugly into the casing with about ½-in. projecting. You can turn a dowel down to the diameter needed by chucking it in an electric drill and removing excess wood with sandpaper. Carefully drill a ⅛-in. hole through the dowel, working from both ends to keep the hole centered. Notch the tapered end of the dowel (Fig. 6) to seat the plastic probe cable. Push the cable through, tie a single knot and dress the ends, tinning them with solder.

Handle Thermistor Carefully. Remove the thermistor from its shipping box and place it on a clean white paper so it can be seen. It is so small it can easily be lost. With the thermistor laying on the paper, hold one of the cable ends against one of the tiny leads. Use a small tweezer as a heat sink to keep soldering heat from damaging the thermistor, carefully touching your clean soldering iron tip to the wire until the solder melts.



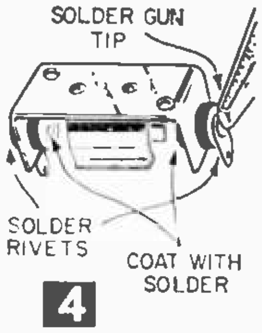
3 CASE

MATERIALS LIST—ELECTRONIC FISHING THERMOMETER

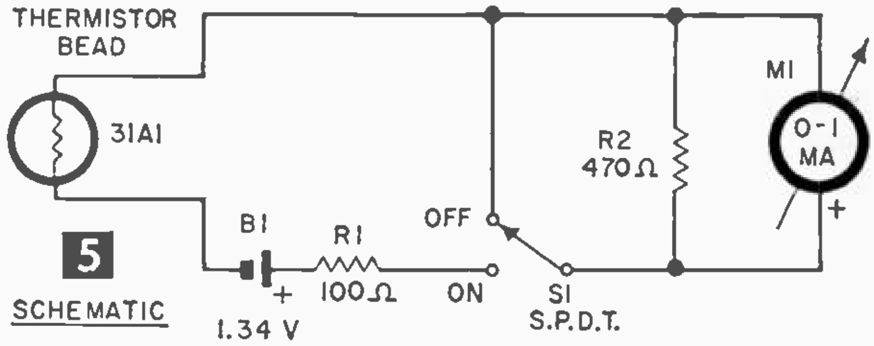
Part/ No. Req.	Size and Description
B1	1.34-volt mercury cell, Mallory RM-401R (Lafayette BA-239)
M1	0-1 ma. D.C. Milliammeter (Lafayette TM-60)
R1	100 ohm, ½ watt, 10% carbon resistor (Lafayette RS-10)
R2	470 ohm, ½-watt, 10% carbon resistor (Lafayette RS-10)
S1	SPDT toggle switch (Lafayette 8282k14)
TH	1250 ohm thermistor, Veco 31A1 (Lafayette 31A1)
1	6¼ x 3¾ x 2" Bakelite case (Lafayette MS-216)
1	panel for Bakelite case (Lafayette MS-217)
1	holder for RM-401R Mercury cell (Lafayette MS-388)
50'	miniature parallel cable, Belden 8782 (Newark Electronics 36F105B)
4	½" rubber feet (Lafayette P-249)
1	On-Off switch plate (Lafayette 827-228F3)
1	#1-33 wire markers. Brady B-500 (Newark 30F200)
1	#34-66 wire markers, Brady-500 (Newark 30F201)
Misc	machine screws, nuts, metal spacers, wood dowel, ball point pen casing, cement, sheet Bakelite, cardboard gasket, plastic electrical tape, wire and rosin core solder

Fig. 4. Solder the terminal rivets and also coat the contacts to prevent corrosion. Mark the positive terminal to insure correct battery polarity.

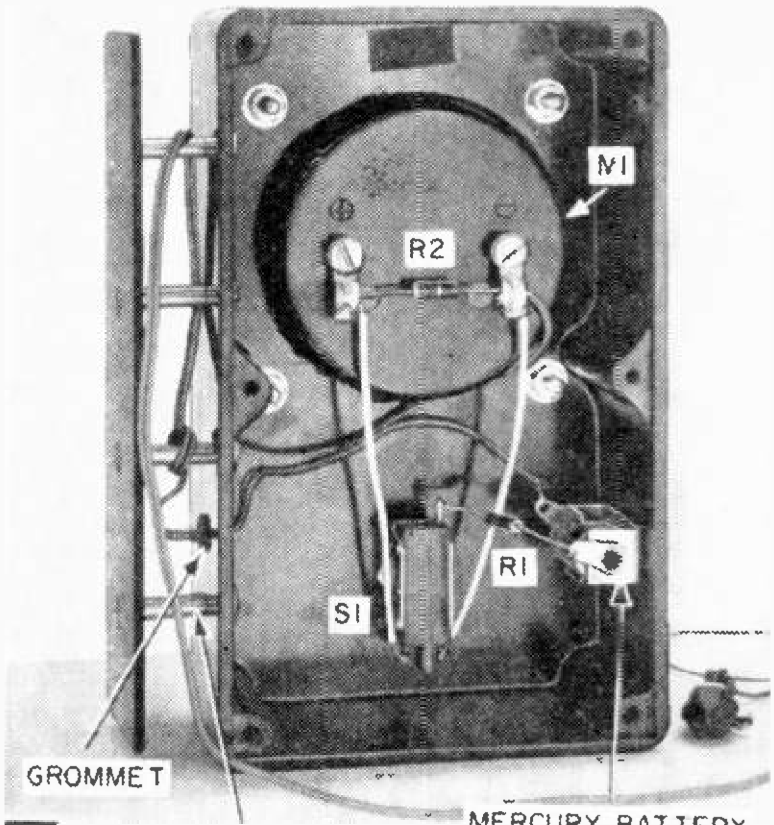
Fig. 5. Because the ohmage of thermistors varies in manufacture, you may need to alter the values of R1 and R2. See text.



4 BATTERY HOLDER



5 SCHEMATIC



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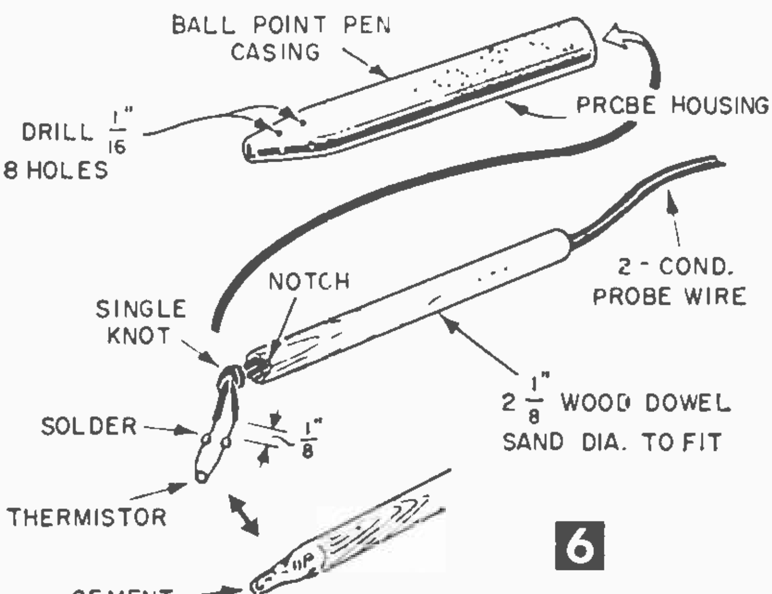


6 PROBE

After the joint is cool, with a needle or small probe gently bend the other thermistor lead until it lays parallel to the first one. Solder as before. Then carefully ease the bead end of the thermistor into a point about ⅛-in. across, so it projects straight forward from the section of wire feeding into the wood dowel.

Testing the Thermistor. Now with the battery in the holder and the switch on, the meter should read about ¾ full scale. If the pointer doesn't move, one of your leads is not perfectly soldered. Resolder, noting that the meter should deflect when a good joint is obtained. Blow lightly on the thermistor and the reading should change.

Waterproofing Probe. Coat about 3 inches of the probe cable with polystyrene coil dope, or model cement. Pull the cable, wet with the cement, back into the dowel until the knot rests firmly against the notched end and allow to dry for several hours. Then dip the thermistor and connections in the cement and dry for at least an hour. Apply additional coats and dry overnight. Then rub paraffin or beeswax on the wood dowel and insert gently into the plastic casing, so that the thermistor tip is slightly below the upper four holes in the tapered end. Now apply the adhesive wire markers to indicate each foot of depth on the cable.

Calibrating the Meter. Take the meter out of the plastic case, and remove the four tiny screws from the rear of the front flange. Working in a clean dust-free place, carefully take the cover off and apply numbers left over from the wire marker set, to the dial, so that your meter reads from 0 to 100. Then letter "degrees F." on a narrow strip of white adhesive tape and place it over the MA label on the meter face. Replace meter in case and reinstall using the waterproofing gasket (Fig. 3).

Remove the plastic probe cover and gently lay the tip of the probe against an ice cube. The meter should read 32. Now heat some water to 90° F, immerse the probe in it, and note the meter reading. Cool the water to 80° and check the meter reading. Repeat at each 10° step down to 40. The meter should indicate the correct water temperature within ± 2° from 32 to 80°. Above 80° the error becomes slightly higher.

If the meter reading is more than 1° off at 32 and 70° it can be corrected by changing the value of R1 and R2. To do this, simply change R2 to cause the reading to be correct at 32°, and R1 to give a correct reading at 70°. Use a smaller value R2 to decrease the reading near 32° and a larger value R1 to decrease the reading near 70°.

Since these two resistors interact it may be necessary to change them alternately until the correct readings are obtained. If you

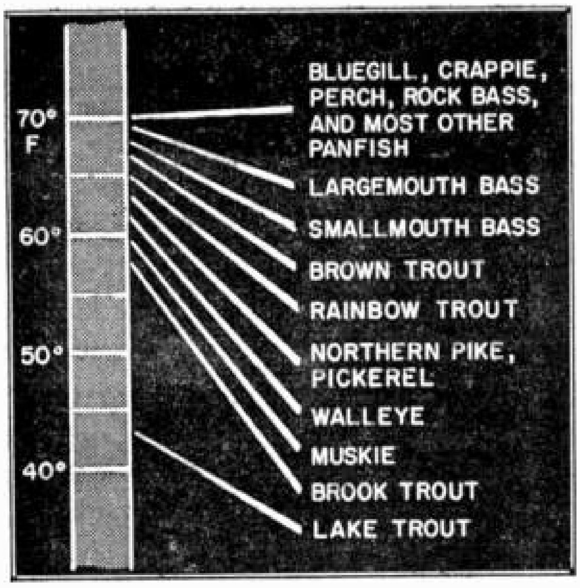
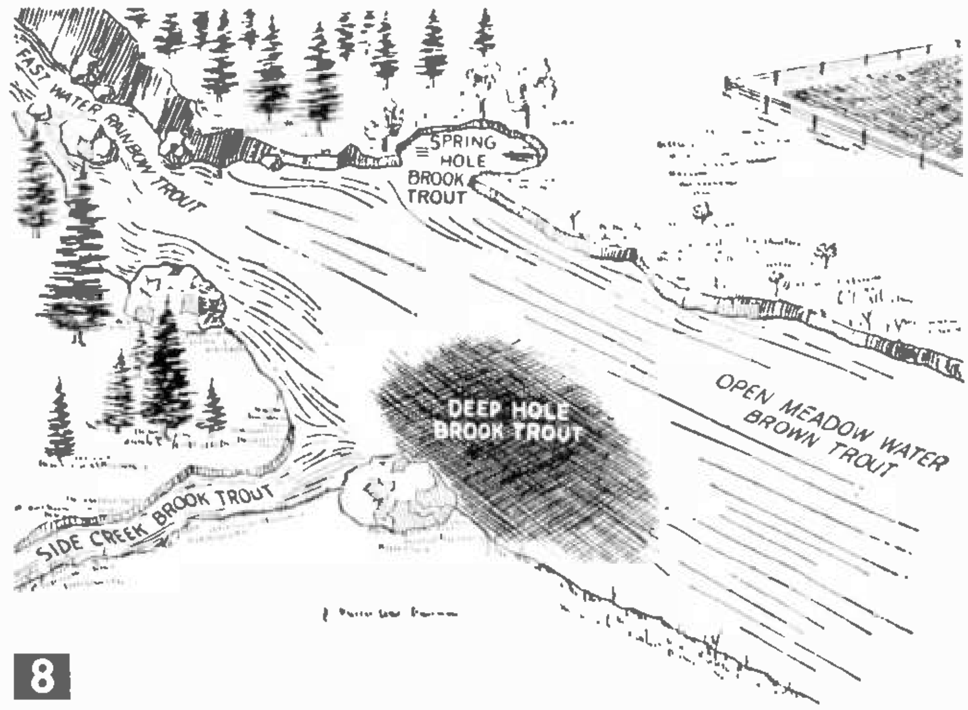


TABLE A.
Typical feeding temperatures.



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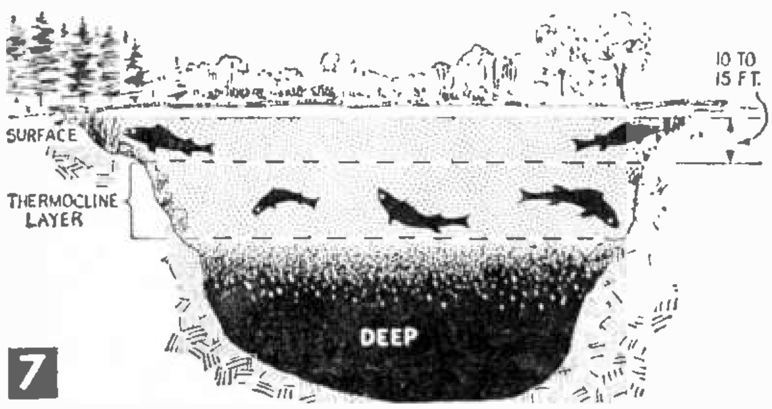

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wish, these two fixed resistors can be replaced with variable controls. Replace R1 with a Mallory Type U-2, 500 ohm control, and R2 with a Mallory Type U-4, 1000 ohm control—both available at Lafayette Radio.

Seal the rear surface of the meter flange and the bottom cover of the case with plastic tape. Cement the meter movement adjustment screw on the front and the instrument is completed.

How Circuit Works. The temperature sensing probe is a special kind of resistor known as a thermistor. When this fast-acting thermistor is heated its resistance goes down, and when it is cooled its resistance goes up. Wired in series with the meter and battery it will cause the meter to read lower as the temperature becomes lower, and higher as the temperature becomes higher. The meter reading therefore shows the temperature at the probe.

Resistors R1 and R2 proportion the current so as to give a convenient meter reading, and switch S1, in the Off position, damps the meter movement to prevent damage to the pointer while the unit is being carried.

Fishing Hints. Tie several fishing sinkers to the cable just above the probe. Allow enough string so they hang below the probe to prevent damaging it. Lower the probe into the water and turn the switch on. Almost immediately the meter will indicate temperature. As the probe sinks down, temperature will normally decrease gradually for the first 10 to 15 feet. Then, you'll go through a second thermocline layer where the temperature drops more rapidly, followed by a third layer which reaches to the bottom and again decreases slowly in temperature (Fig. 7). This is the normal pattern for quiet lakes, ponds and rivers. Near currents, springs and disturbed water, the pattern will take another form.

Now you can make a plot of your fishing spot, being on the lookout for cool springs that can easily be tracked down to their point of entry by following colder than normal areas back to their origin. Near such cool springs, many fish such as muskie gather on hot days. Drop your line in such a spot and they'll bite often.

Other places to check are river openings and spots where deep depressions have been formed on the bottom by currents (Fig. 8). Such deeper water will be cooler and thus more attractive to fish on hot days. After you plot your spots, noting the temperature where fish bite the best, you'll be able to go back any day, hot or cool, and get results after spot checking the temperature.

The exact temperature range preferred by various species will vary from Table A when local conditions are unusual. For example, rushing water will contain more oxygen than still water, and therefore, the fish will seek a warmer temperature. Also, when barometric pressure is high, the water will absorb more oxygen. When the barometer is high, the fish will seek a warmer range and when the pressure is heavy and depressing, they will prefer a cooler temperature.

Clip the chart from the page, and fasten it to the back of your thermometer case with tape and a few coats of varnish. The tiny mercury battery should last for over 800 hours, and since its output is constant at 1.34 volts, your readings should remain accurate throughout the season. But at season's end remove the battery to avoid damage due to battery leakage.

Battery-Powered Portable Record Player

By FORREST H. FRANTZ, Sr.

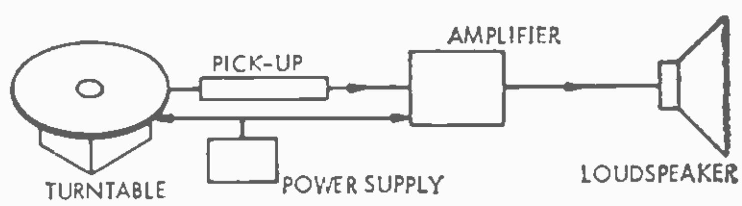
A PORTABLE record player adds zest to picnics, barbecues, beach trips and other outdoor activities. With the younger set, a portable record player has always been symbolic of good times. But, till the mighty miniature electronic marvel—the transistor—came along, the outdoor record playing crowd squeaked along with low volume, non-electronic amplifiers or went broke buying B batteries. And, generally, you cranked a spring type motor by hand.

Today, however, you can get plenty of volume with reasonable fidelity from a transistor amplifier, and low current 6-v. motors are available to relieve the strain on your cranking arm. The record player described in this article can be built for approximately $25. (You can cut the cost to about $20 by making some compromises that I'll describe.) Construction time is six to 20 hours depending on your skill and the tools you work with. Operating energy for the record player is supplied by four inexpensive regular size D (#2) flashlight batteries. You can expect a set of batteries to last for roughly 40 hours of playing under ordinary interrupted usage.

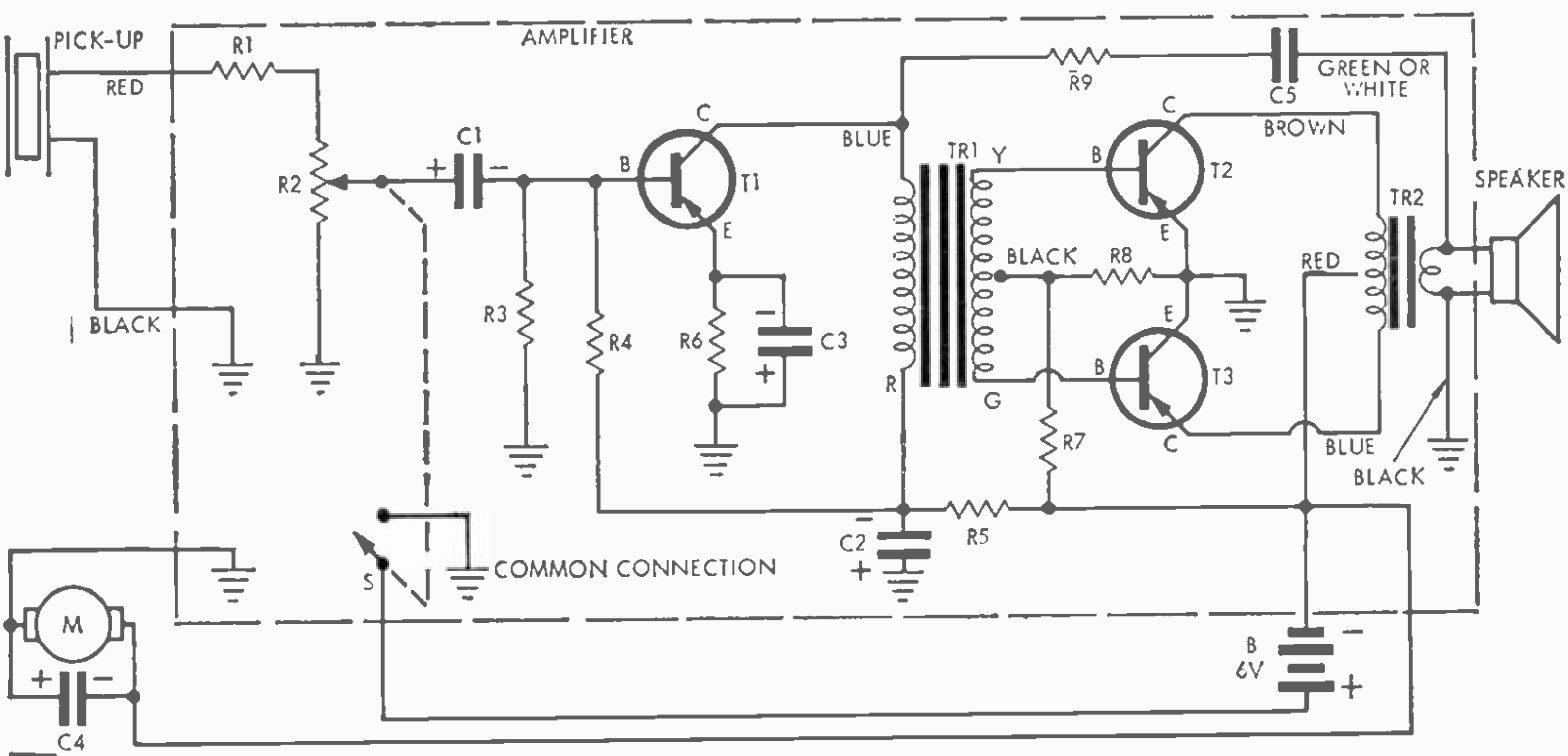
There are five major electrical and electronic components in a record player system (Fig. 2). The turntable imparts the "timing" and the mechanical forcing of the record grooves for transfer to the pick-up. This mechanical energy is changed to electrical voltage by the crystal. The voltage is applied to the amplifier (powered by the power supply) which supplies amounts of this power to the speaker in proportion to the pick-up voltage.

1

This record player will provide many hours of outdoor entertainment.



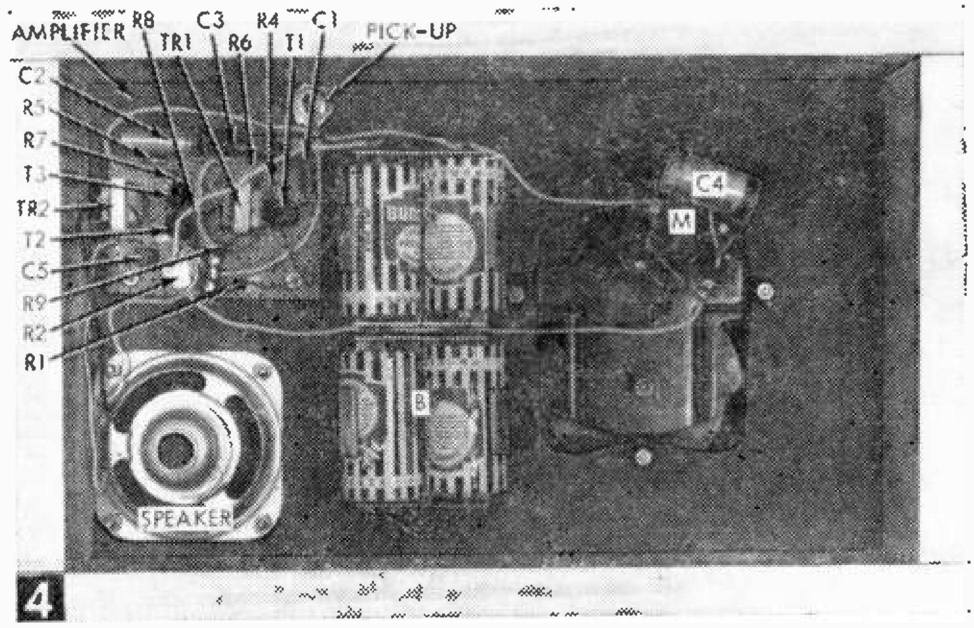
2 RECORD PLAYER SYSTEM



3 SCHEMATIC

In this record player, the turntable speeds are 16, 33⅓, and 45 rpm. The turntable is operated by a small 6-v. dc motor. The motor and turntable assembly are obtained as a single complete unit.

The pick-up should contain a high output crystal cartridge (1 v. or more) and it should be of the turnover variety, which contains a large needle for 78 rpm records, a smaller needle for slower speed records. A pick-up of this type can be obtained more readily and at a lower cost than a slow speed pick-up, and in addition the cartridge may be turned to the 78 rpm position to prevent damage to the slow-speed needle while transporting the record player.



Bottom view of the completed record player.

The first transistor in the amplifier (see schematic, Fig. 3) is the driver stage for a pair of transistors in the output stage. The output stage is designed so that the power that the batteries must supply is approximately proportional to the signal. This feature conserves battery power.

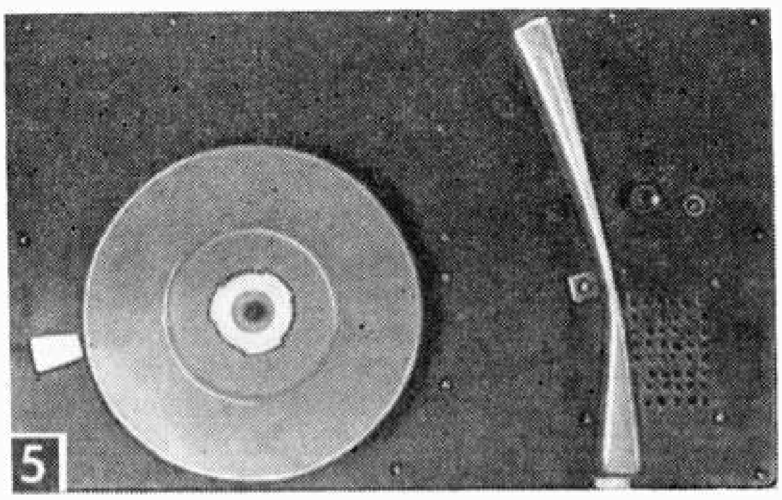
I used a 3-in. speaker, but left enough room on the panel for a larger speaker if desired.

Panel and Mounting Base. The panel layout is shown in Fig. 6. The panel material is ⅛-in. tempered Masonite, both surfaces smooth. Lay out the dimensions on the panel before you start drilling and sawing. When you drill the holes, place a piece of scrap Masonite or hardwood under the panel so that the back edges of the holes come out clean without burring or flaking. Use a 5/32-in. drill for all the holes and enlarge these to other dimensions where required with a taper reamer.

Cut the turntable opening by drilling several starter holes and sawing with a hacksaw blade. If you have a jig saw or a band saw, you can save some time by using it to cut this hole. The edges of the turntable hole may be dressed down with a file.

The mounting base is made from 1-in. pine which has a dressed thickness of ¾-in. It is ripped to a width of 2¼ in. Two pieces are cut to a length of 14 in. and two pieces are cut to a length of 7¼ in. They are nailed together as in Fig. 7 to form the base.

The Amplifier. The circuit diagram is shown in Fig. 3. Pictorial views of the wiring are shown in Fig. 8 (top of wiring board) and 9 (bottom of wiring board). The wiring board is the right size as purchased. Two holes must be drilled in this perforated board. One is for mounting the volume control and the other two are to mount the wiring board on the record player panel. These holes are ¼-in. in dia. and may be located from Fig. 8. The centers of these holes coincide with perforations on the wiring board.

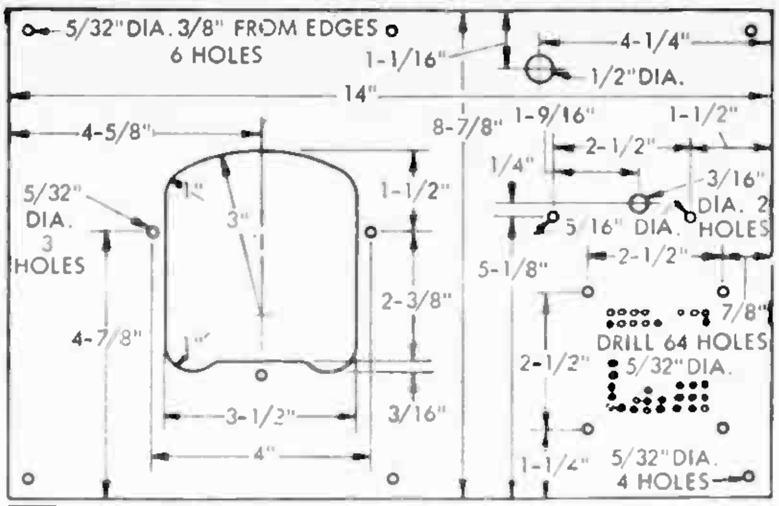


Top view of the record player panel.

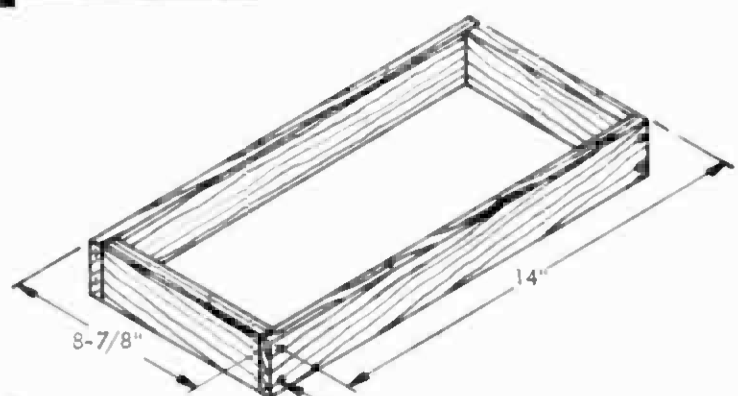
You may also want holes to mount the two transformers instead of the slots shown in Fig. 4. The choice will depend on whether you obtain transformers with tabs designed for mounting in slots or with holes for fastening with small screws and bolts. My output transformer was equipped with tabs. But, you'll note that the driver transformer which I used was equipped for screw mounting, and I bent mounting lugs down so that it could be tab mounted. If you tab mount the transformer, cut the slots with a hacksaw blade.

Mount the volume control (R2) and the transformers (TR1 and TR2) first. Next, mount capacitors C1, C2, and C3 and resistors R1, R3, R4, R5, R6, R7, R8 and R9. These components are mounted by pushing the pigtails through the wiring board perforations. The same applies to transistors T1, T2 and T3. Now wire the amplifier. The only additional part which will have to be mounted on the wiring board is C5. Mount it when you get to it in the wiring. Some of the connections were made by passing the component pigtails through the same perforation. Other connections were made by twisting pigtails together. The leads were soldered together to complete the connection work. Protect transistors with heat sinks.

The lead to the − battery terminal is about



6 PANEL LAYOUT (TOP)



7 RECORD PLAYER BASE

6½ in. The lead from the ground terminal on the switch to the motor is about 9 in., and the lead from the switch to the + terminal of the battery is about 4½ in. The lead from the ground terminal on the switch to the speaker is about 3 in., and the lead from C5 to the speaker is about 4½ in. These leads should be fastened to the wiring board before it's mounted on the record player panel.

Panel Mounting. Mount the speaker on the panel first. Be sure there aren't any burrs on the sound perforations on the underside of the panel. The speaker terminals should be oriented as in Fig. 4. Note that the pick-up arm rest fastens under one of the speaker mounting screws. Then, mount the battery holders. The machine screws which are used to mount the battery holders should be not over ⅜-in. long, or you may have some difficulty with short circuits between the battery holder frames and the batteries.

Now, mount the turntable assembly. The turntable must be removed from the assembly for mounting. Pull the retaining pin (Fig. 10) on the bottom of the turntable assembly. The turntable may then be removed from the assembly by lifting it up out of the bushing. Mount the turntable with 6-32 x ¾-in. machine screws and nuts. Place a washer under the screw head and another between the bottom side of the panel and the nut on each of the three mounting holes. Don't pull these screws too tight because the turntable should float on the rubber shock mounts.

Check for places where the turntable frame may be touching the panel, and push the speed positions to be sure that none of this mechanism hits the panel in any position. If you find any contact between the turntable assembly frame and the panel, dress the edges of the hole till this contact is eliminated. Replace the turntable on the assembly and fasten it in place with the retaining pin.

Next, mount the pick-up arm on the panel, and orient the pick-up arm rest so that the arm will fit in it properly. Turn the cartridge to position needles horizontally for now.

The last component to be mounted is the amplifier. Place grommets, washers or layers of cardboard ¼-in. thick between the perforated wiring board and the panel for mounting. Use 6-32 x ¾-in. machine screws and place washers under the screw heads and hex nuts. Fasten the knob on the volume control. Turn the volume control to the left till the switch is off.

Connect the leads from the amplifier to the loudspeaker. Solder together the lugs on the inner sides of the two battery holders. Connect the two outer battery holder lugs on the holder nearest the speaker. Connect the single lead from the switch to + terminal of the battery holder assembly, and connect the − battery lead from the amplifier to the battery holder − terminal. Run a lead from this − battery holder terminal to the motor, and connect the long ground lead to the other motor terminal and the motor case. Connect C4 observing the polarity shown in Fig. 3. Then connect the black lead from the pick-up arm to the ground terminal on the switch and connect the red lead from the pick-up arm to R1.

Fasten the panel to the wooden base with wood screws and place the batteries in the holders. Place the speed control lever on the

MATERIALS LIST—RECORD PLAYER

Desig.	Description
R8	47-ohm, ½-w. carbon resistor, 10%
R6	470-ohm, ½-w. carbon resistor, 10%
R5	1K-ohm, ½-w. carbon resistor, 10%
R7	2.2K-ohm, ½-w. carbon resistor, 10%
R9	4.7K-ohm, ½-w. carbon resistor, 10%
R3	10K-ohm, ½-w. carbon resistor, 10%
R4	68K-ohm, ½-w. carbon resistor, 10%
R1	100K-ohm, ½-w. carbon resistor, 10%
R2	25K volume control with switch (Lafayette VC-25)
C5	.01 mfd., 75 v. capacitor (Lafayette C-612)
C1	30 mfd., 6 v. capacitor (Lafayette CF-104)
C3	100 mfd., 6 v. capacitor (Lafayette CF-106)
C4	100 mfd., 15 v. capacitor (Lafayette CF-126)
C2	160 mfd., 15 v. capacitor (Lafayette CF-127)
TR1	driver transformer—10,000 ohm pri to 2,000 ohm sec (Lafayette TR-96)
TR2	output transformer—500 ohms to 3.2 ohms (Lafayette TR-95)
SPKR	3-in. loudspeaker (Jensen 3J6)
	Phono pick-up (Lafayette PK-88)
M	3-speed 6 v. turntable (Lafayette ML-9)
	perforated wiring board (Lafayette MS-304)
	two double #2 battery holders (Lafayette MS-382)
	knob (Lafayette MS-185)
T1	transistor (GE 2N192)
T2, T3	transistors (GE 2N241A)
B	four #2 flashlight batteries in series
	9 x 14-in. piece of Masonite

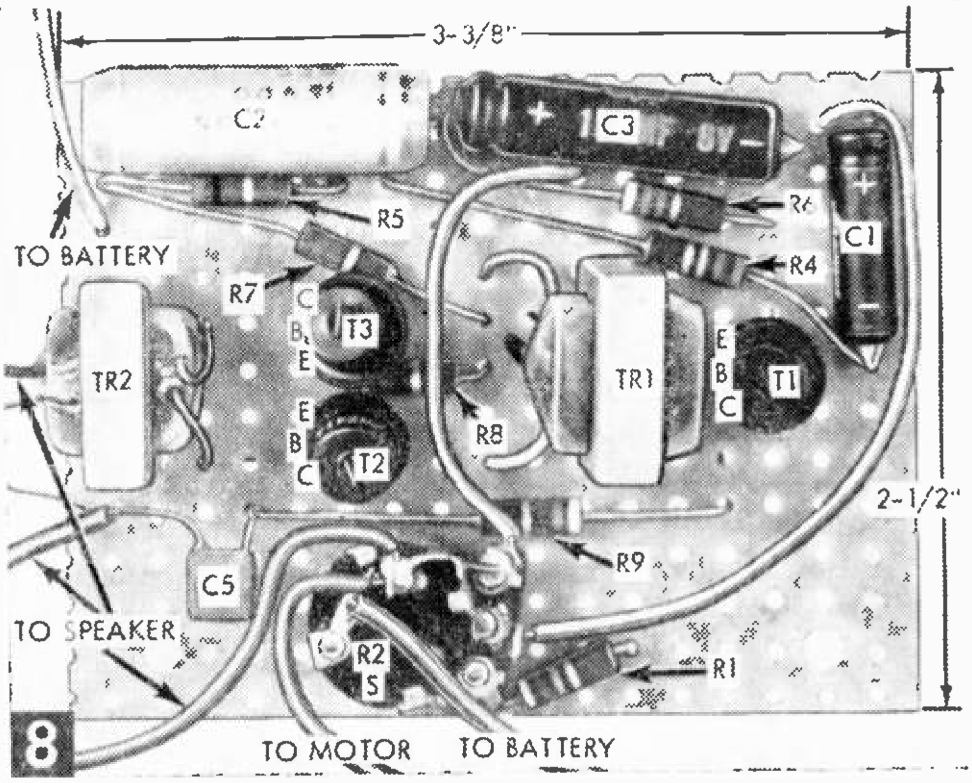
Components for this project may be obtained from Lafayette Radio, 165-08 Liberty Avenue, Jamaica 33, N. Y.

turntable in the 45 rpm position and raise the 45 rpm center adapter by turning it counter-clockwise.

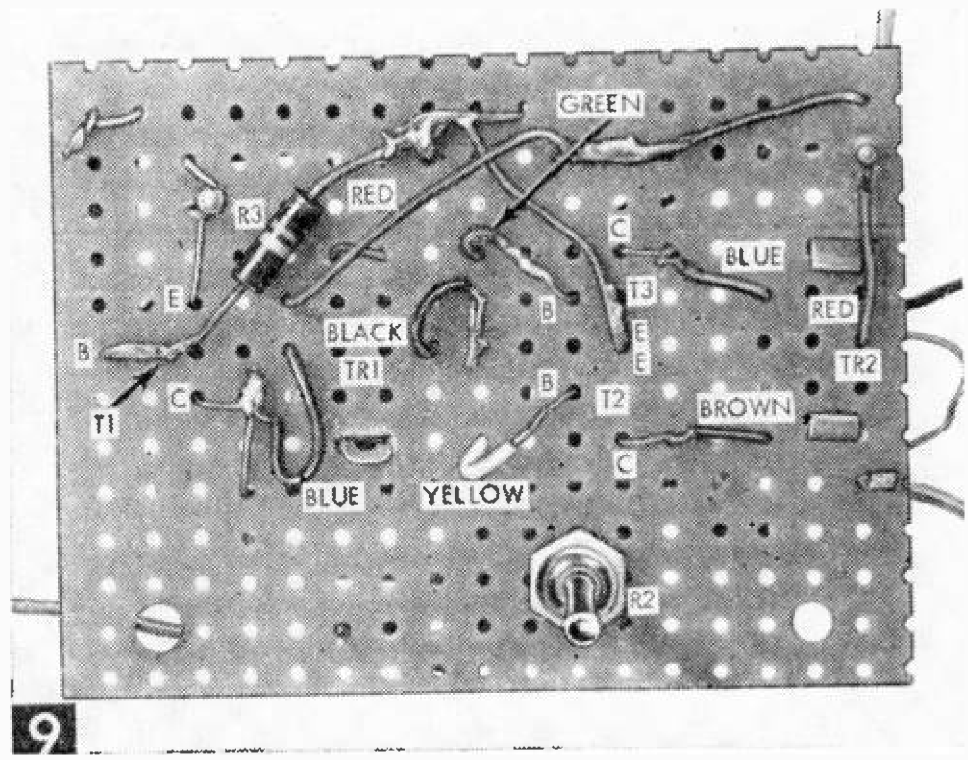
Place the record player with the end containing the amplifier protruding out over the edge of a table. Place your fingers on T2 and T3 and turn the switch on. The turntable should rotate and T2 and T3 should not get hot. Then feel T1. If any of these 3 transistors gets hot, turn the switch off, and look for trouble in the wiring. If the transistors don't get hot, turn the cartridge to the 33-45 position in the tone arm and place the tone arm on the record. If you did everything right, there should be music.

To play 33⅓ rpm records, change the speed lever to 33⅓ rpm. Let the turntable get up speed before you place the arm on the record. The 33⅓ rpm records are heavy by comparison to the 45 rpm records. And because of the larger diameter of the 33⅓ rpm records, there's more torque on the turntable bushing due to the tone arm pressure.

If the 45 rpm record sounds slow or seems to play at variable speed, check the speed change lever to be sure that it's in the correct position. If this isn't the cause of the difficulty, remove the turntable retaining pin and turntable, and put a few drops of household oil on the turntable spindle. Also check the vertical position of the rubber turntable rim drive wheel with respect to the plastic drive on the motor (see Fig. 10). This should clear up any difficulty that you might have.



Top view of amplifier shows parts mounting and wiring.



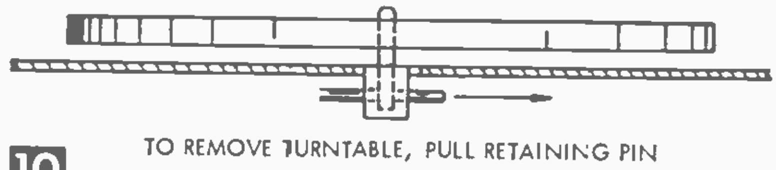
Bottom view of amplifier shows wiring.

Bear in mind however, that as the batteries go down, some reduction in speed will occur. It may be noticeable at 33⅓ rpm while it may not be noticeable at 45 rpm because of the difference in record size and weight.

You can economize on the parts cost of the record player. GE 2N107 or RCA 2N109 transistors may be used in place of those specified. C3 may be eliminated if R6 is changed to 100 ohms and R1 is decreased to 47K. Almost any crystal pick-up may be used in place of the 2-v. unit specified, as long as it has an output of 1 v. or more. For lower output units, you may have to decrease the value of R1. The really ambitious economy-minded builder might want to make his own turntable unit. You can buy the required motor for a dollar or two. I didn't have such extremes in mind of course, when I suggested that you could cut the cost to $20. If you go that far, you can probably get down close to $10!

On the luxury improvement side, you can add a tone control by replacing R9 with a 10K volume control. Use one of the end and the center terminals. Another improvement would be a larger speaker.

To make the record player look its best, the base may be painted or upholstered with cloth or plastic. Do this before you mount the parts. Or, you can staple the material on corrugated cardboard panels and cut them to fit over the panel and sides. This way, the screws will be hidden. The panels can be fastened with a sparing amount of glue so that they can be removed and replaced as



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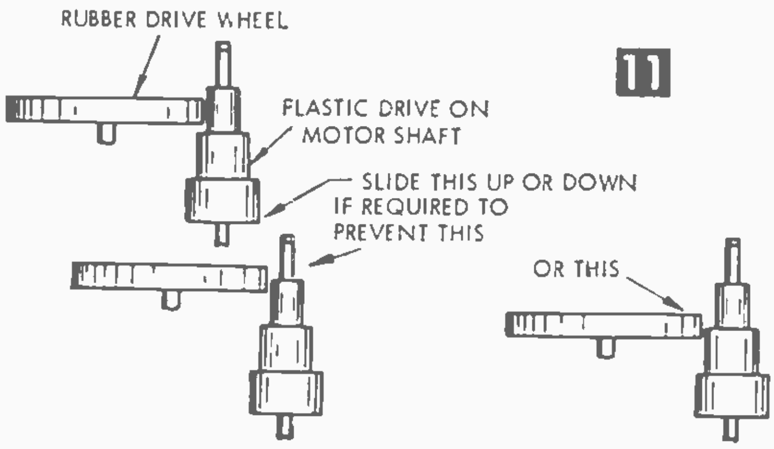

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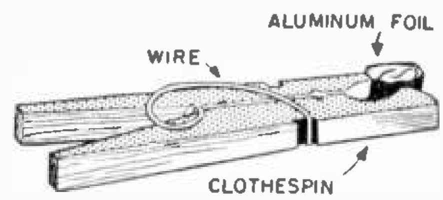
required for maintenance.

To make the record player truly portable, you need a case. I found an old beat-up over-night case in the attic that was just right. Note that the base is fastened to the original lid of the case. This allows freedom to play larger records; you couldn't play them if you mounted the base on the actual bottom of the case which has high sides.

If the case does not come down against the pick-up when it is closed, add a piece of wood in the top of the case that will come down snugly on the arm when the case is closed. This will prevent the arm from swinging off of the rest and being damaged when the record player gets rough treatment en route to your favorite picnic spot.

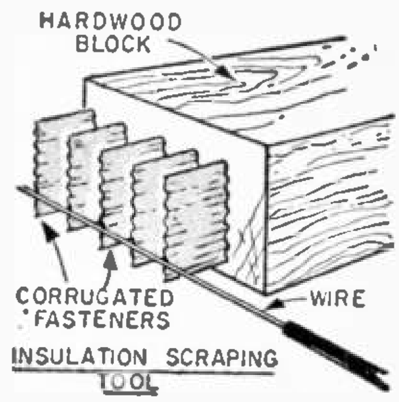
Emergency Battery Clip



• If you run out of battery clips while doing an electrical project, make a substitute clip by wrapping aluminum foil around the tips of a spring-type clothespin. Wrap wire around foil.—J. HARVEY.

Insulation Scraping Tool

• This simple and long-lasting tool is practical for scraping and cleaning insulated wire to make firm solder connections. To make it, simply drive several corrugated fasteners into the end of a hardwood block.—G. E. HENDRICKSON.

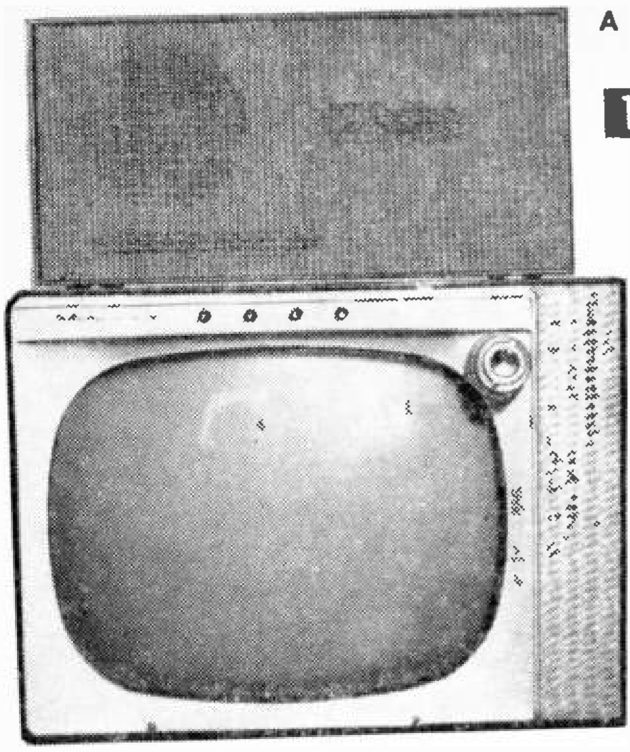


Miniature Plugs and Jacks

• Those tiny snap-fasteners used on clothing make good miniature plugs and jacks for pocket radios, hearing aids, and the like. You can mount either the plug or jack on the set's case with plastic cement or you can fuse the connector in place by heating it with a soldering iron. The connectors can be used for either external headphone or antenna lead connections.

"It's just until I get the kit assembled, Honey."

A typical hi-fi speaker addition to a TV set.



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Add A Speaker System to Your TV

Hi-fi reception from your TV or radio! It's yours by adding a speaker system and inverse feedback

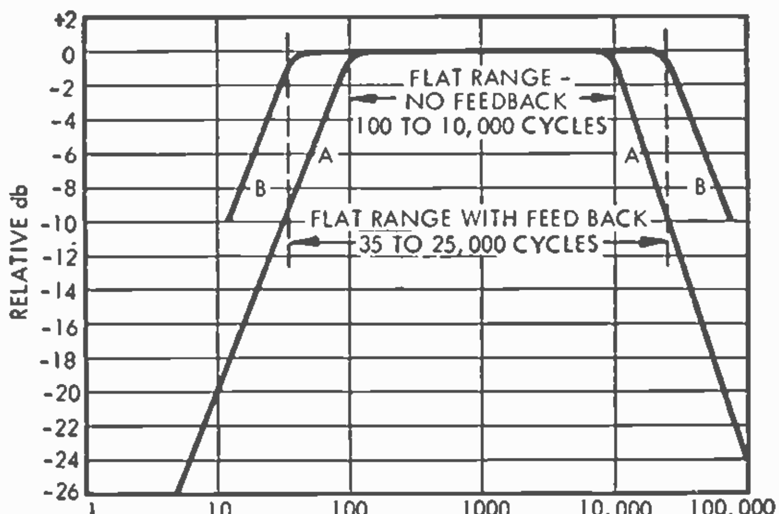
By FORREST H. FRANTZ, Sr.

MOST of the TV sets selling for $300 or less contain a small 4-6 in. loudspeaker. You can't expect good quality sound from such a small speaker. Even if you have a larger speaker it may not sound good on high frequencies. Also, few low-price TVs and radios have speaker enclosures designed for best fidelity.

You can buy a speaker system kit that will put you in the hi-fi business. One of the least expensive ($29.50) ducted port bass reflex speaker systems available is the handsome Windhaven System (Windhaven Radio Co., Box 74, Baroda, Michigan). This has an impedance of 3-4 ohms which matches most inexpensive radio and TV set output transformers. The frequency response is ± 5 db from 60 to 8000 cycles.

For better frequency response you have to pay more in dollars and time. The Heathkit SS-3 at $34.95 is within ± 5 db from 50 to 12,000 cycles. This speaker system contains an 8-in. woofer and a tweeter. A little work on the cabinet and fifty cents worth of grille cloth and trim will produce a neat piece of equipment.

The SS-3 is intended for hi-fi systems and has 16 ohms impedance, so you will have to replace the 3-4 ohm impedance output transformer on a low-price TV. At the same time you can improve the quality of the amplifier on your TV set or radio by incorporating inverse feedback into it.



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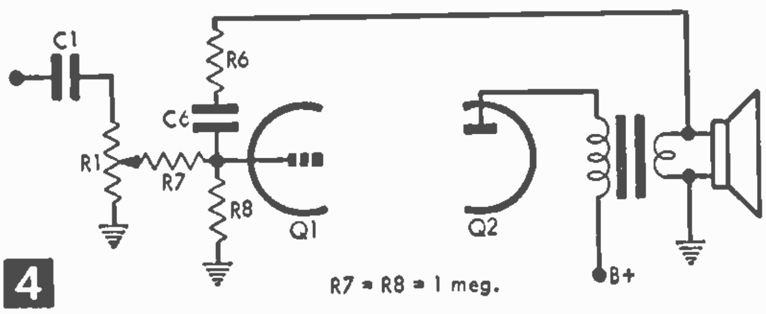

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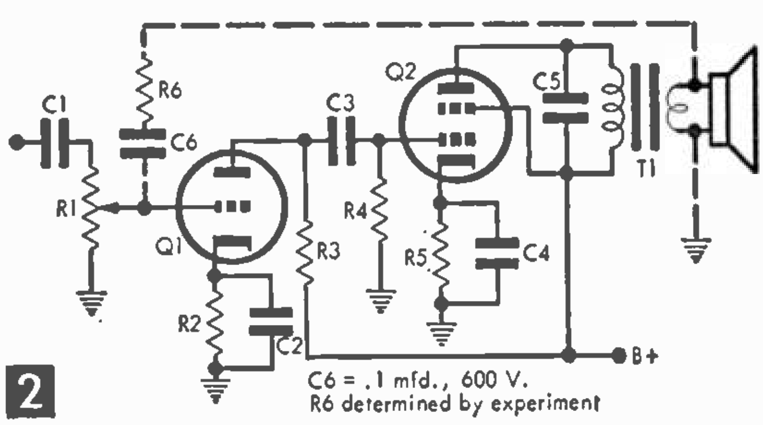
Figure 2 shows a typical TV or radio audio amplifier stage. The amplifier is resistance-capacitance coupled. Capacitor C1 transfers the signal from the detector tube (usually a diode, and frequently within the same envelope as tube Q1) to the volume control R1. The setting of R1 determines the amount of signal voltage that is applied to the grid of Q1. Q1 is a high gain amplifier tube which usually has a voltage gain of about 50. The signal, amplified about 50 times, appears at the plate of Q1.

This signal is fed to Q2 thru capacitor C3 which passes only the audio signal but iso-



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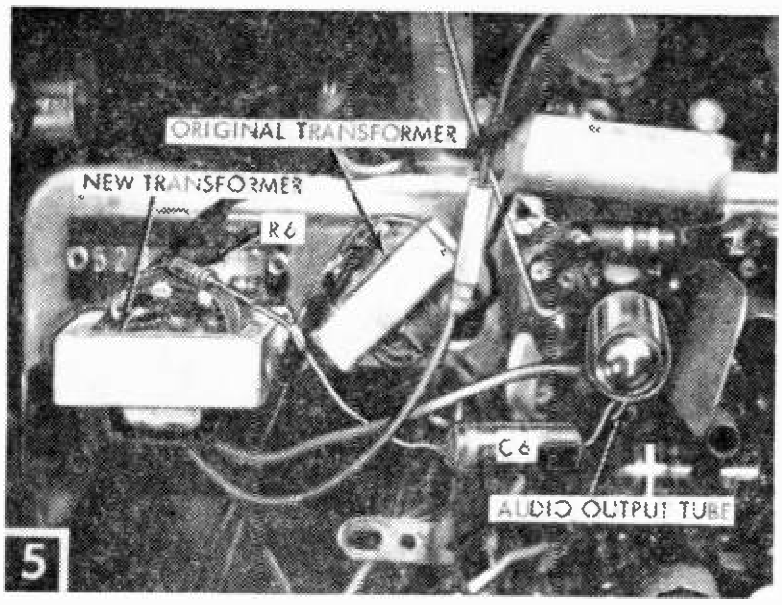

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Mounting details of the substitution of a higher impedance output transformer to match the 16-ohm impedance of the hi-fi speakers.

lates the dc grid bias voltage for Q2 from the high plate voltage of Q1. Q2 amplifies the signal voltage about 30 times. But, the load impedance of Q2 is much less than the input impedance, and there is therefore a large current gain in this stage too. Power gain is voltage × current gain, and this stage is therefore usually referred to as the power output stage.

The impedance of dynamic loudspeakers is very low in contrast to the load impedance required for a vacuum tube, so the speaker is coupled to the output stage through an output transformer (T2).

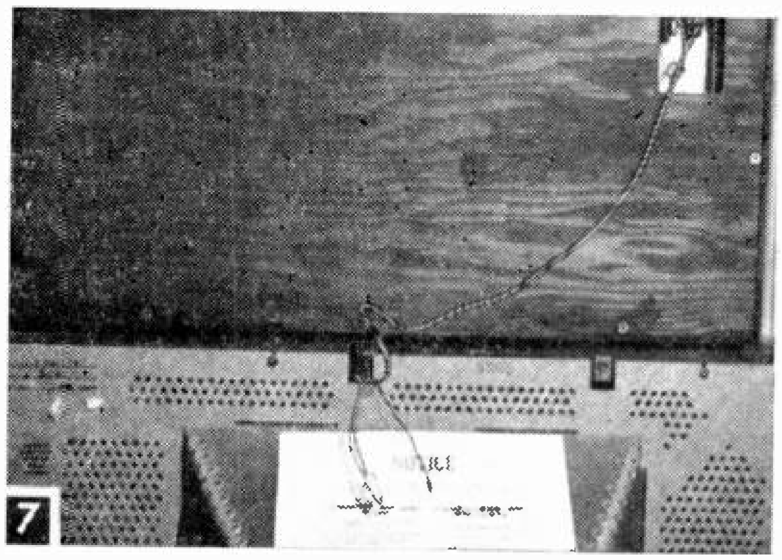
A good speaker and output transformer are expensive, so most inexpensive TV's and radios don't have good ones. To get good fidelity you have to replace both.

Then only the fidelity of the amplifier limits the fidelity of the system. The coupling capacitors C1 and C3 and the cathode by-pass capacitors C2 and C4 (usually electrolytics) limit the low frequency response. Capacitors that are in parallel with the signal (such as C5) limit the high frequency response. The capacitance of C1, C2, C3 and C4 should be increased to improve the low frequency response, and C5 should be decreased or removed entirely to increase the high frequency response.

But you can improve fidelity more than this by incorporating inverse feedback. In most cases you can get away with merely increasing C1 and C3 by a factor of 10 and by removing C5 if you incorporate inverse feedback.

Inverse feedback is graphed in Fig. 3. Curve A is a typical response curve for a low quality amplifier. If a part of the output signal is fed back to the input of the amplifier in opposition to the input signal, it will flatten the curve out to curve B. More signal feeds back at the mid-frequency range than at the high or low frequency ends of the curve where gain drops off. This flattening action gives better frequency response. Also, distortion which occurs during the amplification process is cancelled.

How do you incorporate inverse feedback in your amplifier? The dotted lines in Fig. 2 show a simple scheme for incorporating inverse feedback in an amplifier that does not already have it. One side of the output transformer secondary is grounded. The other side of the secondary is connected via C6 and R6 to the grid of Q1. The value of C6 should be about 0.1 mfd. at 600 v. The value of R6 and the value and setting of R1 determine the amount of feedback that will be obtained.



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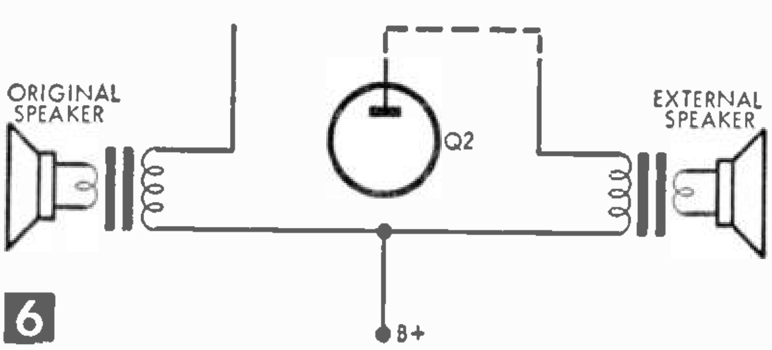
Showing the lamp cord used to connect the substitute output transformer to the crossover network of the hi-fi speaker cabinet.

Choose R6 so that you can get sufficient volume to meet your requirements on the weakest station when R1 is set to full volume.

The matter of which side of the speaker to connect to ground and which side to use for feedback doesn't present a problem. If you connect it the wrong way, you'll have positive feedback and the result will be an increase in volume or squealing. When the proper connections are made, volume with feedback is lower than volume without feedback.

It is desirable to have inverse feedback independent of the volume control setting. In Fig. 4 two fixed 1 meg. resistors (R7 and R8) have been added to the input circuit. R7 reduces the variations in input resistance from the grid of Q1 to ground. R8 performs as part of the feedback voltage divider which includes R6.

Typical Installation. Figure 5 shows a typi-



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cal set of changes made in a TV set to incorporate inverse feedback and permit the connection of a 16-ohm speaker system to the set. The transformer that was added in the set in this case was a relatively inexpensive Lafayette TR-12 universal replacement transformer.

A piece of lamp cord connects from the secondary to the external speaker (Fig. 7). The feedback resistor is connected to one of the transformer secondary taps. The other end of the feedback resistor connects through capacitor C6 to the grid of the output stage. Feedback in this case is only around one tube since the detector output drives the single audio stage in this set.

The transformer primary can be connected to the same points where the original output transformer leads were connected. The original transformer primary leads should be disconnected in this event.

However, you'll be able to change from the external to the internal speaker without having to remove the back of the set if you use the arrangement of Fig. 6. A lead from the plate of the output tube and the plate end of each transformer is brought out through the rear cover. The plate lead and the new transformer lead are twisted together and taped. The original transformer plate lead is taped.

If at any time you wish to disconnect the external speakers and use the internal speaker, you simply disconnect the plate lead of the new transformer from the TV set output tube plate lead, and connect the output tube plate lead to the other transformer lead. The leads should of course be taped.

When you install the new output transformer you'll have to select secondary taps that meet the impedance matching requirements between the output stage and the speaker. If you don't know the load impedance that the output stage has been designed for, assume it to be 2000 ohms. Then select the transformer connections that match 2000 ohms to the impedance of the new speaker according to the connection sheet furnished with the transformer. This will generally do the trick. You can do some experimenting then to see if another connection arrangement affords any improvements.

Eliminating Power Hum

• An extra 10-mfd., 450-v. electrolytic capacitor connected in parallel with the input filter capacitor of a radio receiver will often reduce or eliminate an annoying power hum. Capacitor values add when in parallel, so you are adding 10 mfd. to whatever capacity value is already in the set. Be sure to observe correct polarity of connections—plus to plus, and minus to minus. The black lead is usually minus.

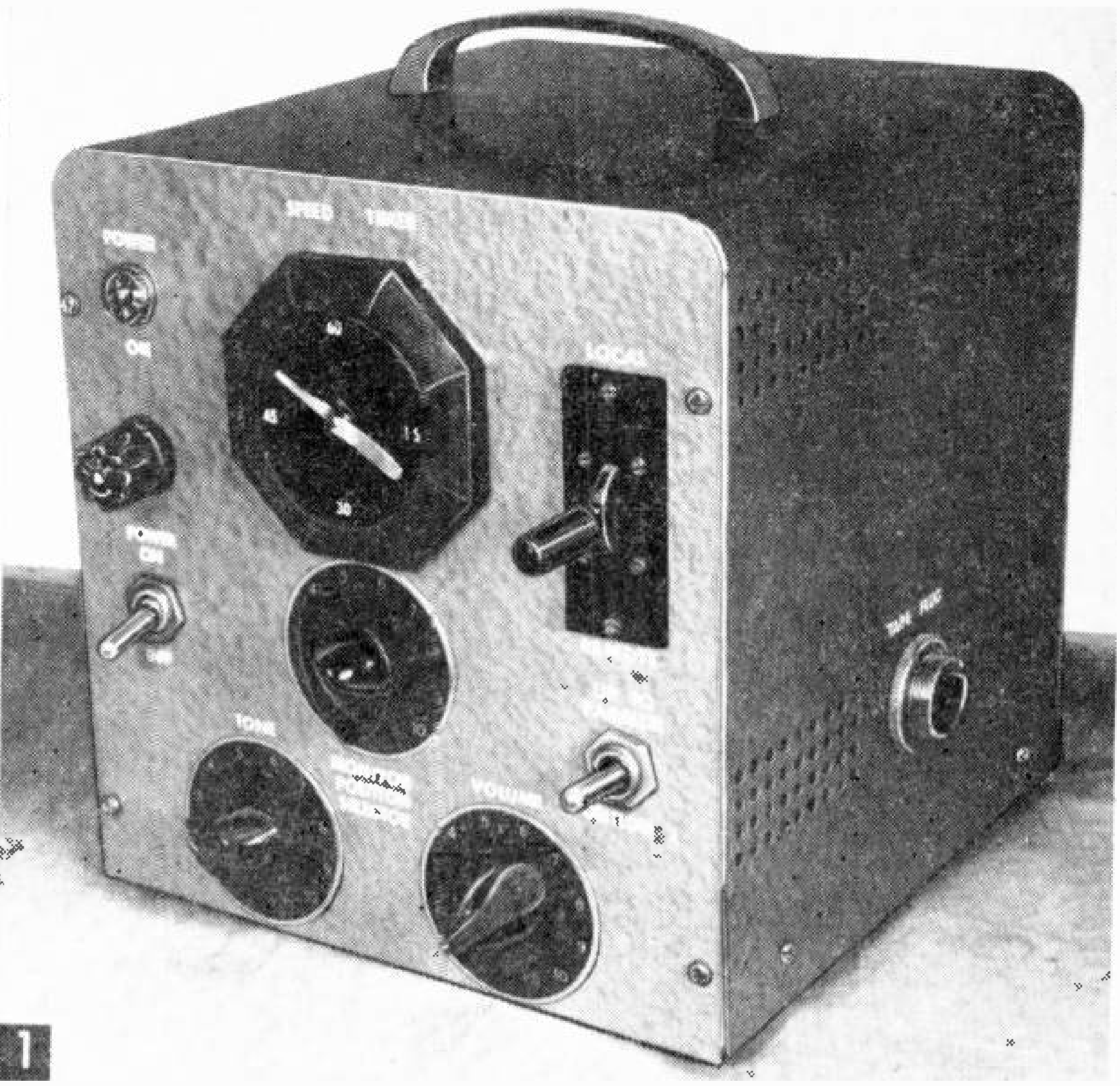
"It's not often a soap-box orator can hold a crowd like that."

Versatile Code Practice Equipment

By
HOWARD S. PYLE

THE teaching of code to a group of students is made easy with this control unit. The control unit (Fig. 1) with connections to a key and an ac supply line, is a keyed audio oscillator of variable tone and volume, with the resultant tone reproduced in a loud speaker with sufficient audibility to handle a group of up to thirty students.

The control unit is housed in a Hamcab #12. Layout the front panel, chassis and the rear panel according to Fig. 2 and cut the holes for the components. Several holes in the sides of the cabinet are also required. Mount the components (see Materials List). Wire the unit according to the schematic, Fig. 3. The isolation transformer is mounted inside the cabinet.



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This control panel is a versatile aid in group code instructions.

When you have completed the control unit and have selected a space for the students' table (Fig. 4), make the table of plywood, suitably supported. Wire the table in accordance with schematic (Fig. 5) and Fig. 6.

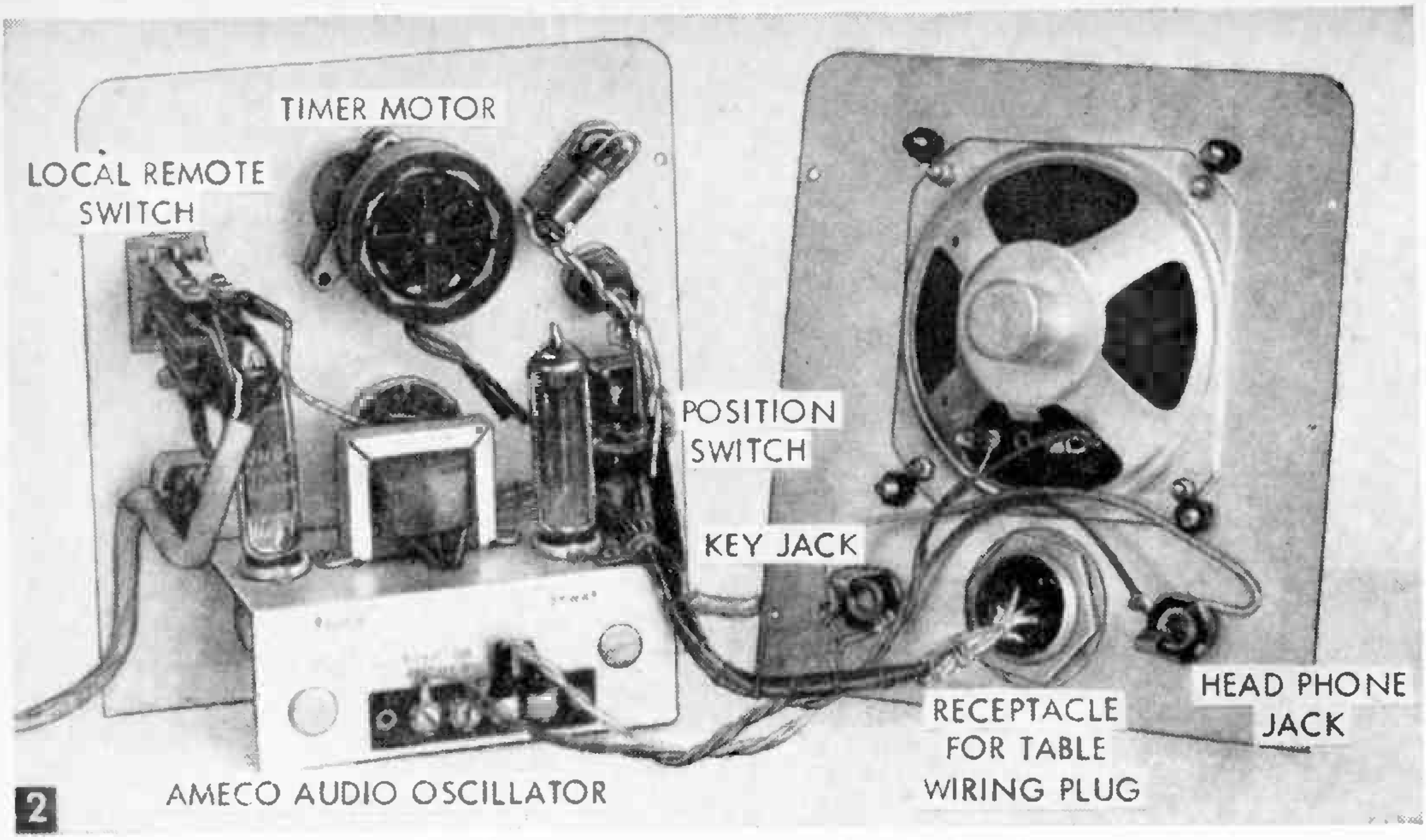
Through the plug P-1, provided on the table cord, connect the table wiring to the instructor's control unit through the multi-terminal jack, J-2. With the instructor's switch S-2 in the LOCAL position, the audio oscillator is keyed and the reproduction emanates from the loud speaker. All of the table circuits are now connected to the control unit through the cord and plug. Any student whose toggle switch SX is placed in the A position, now has his key in parallel with the instructor's and he, too, may then key the oscillator.

One or all students may be so switched in through their SX switches and have keying control of the oscillator, with loud speaker reproduction. The instructor may then send to all students or work with any one or more students two-way, with the rest of the class monitoring.

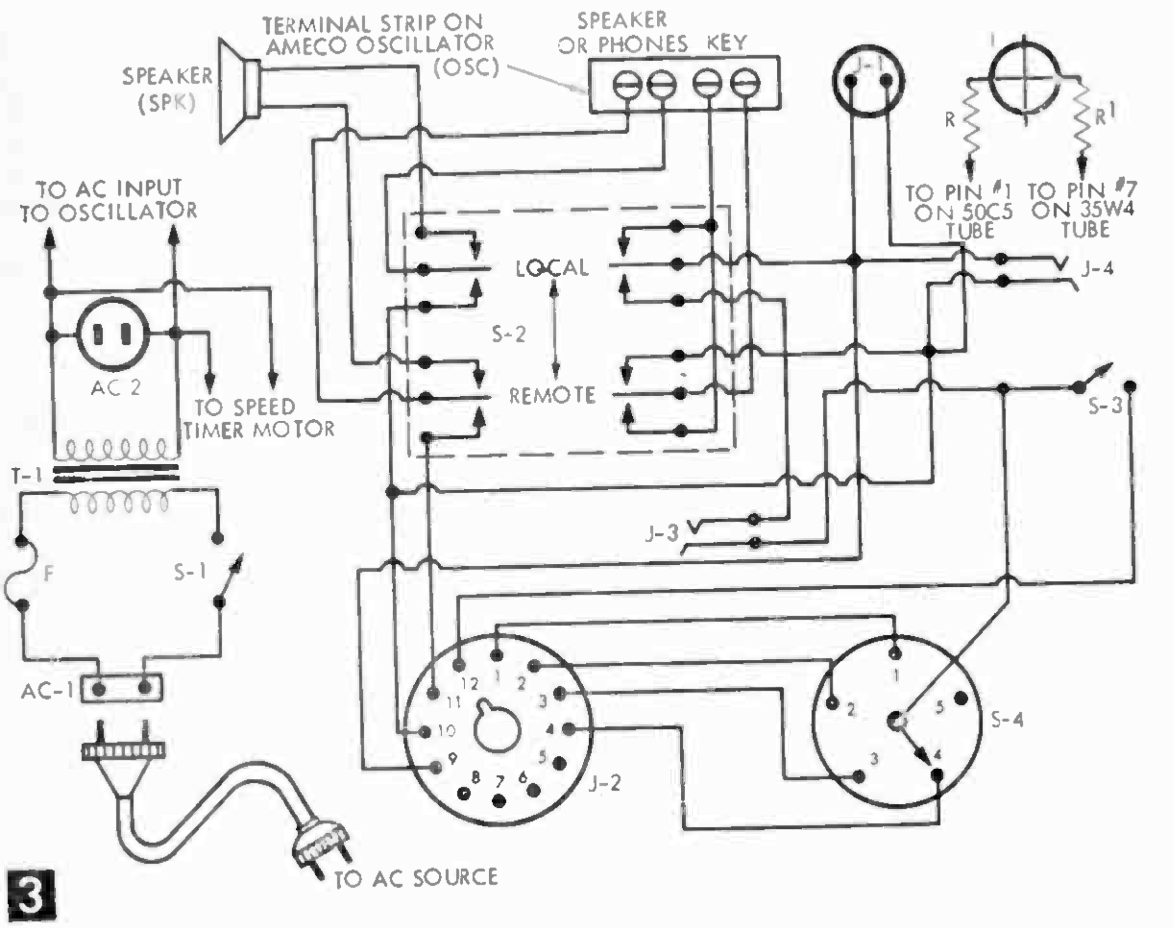
Any two or more students may work each other, simulating on-the-air operation and, as the reproduction is still from the loud speaker, the remainder of the class may still monitor all sending and, if desired, may break in on the communication as can the instructor.

Now let's throw the instructor's switch S-2, to the REMOTE position. This immediately disconnects the loud speaker from the circuit and at the same time shorts the instructor's key, thereby producing a continuous, steady audio tone which is fed through J-2 and P-1 to the tables and made available to all students through their keys and head telephone receivers, provided each student has thrown his toggle switch SX to the B position. The second switch S at each student position, if all thrown to the ON position, will parallel all positions, and the same conditions existing when the instructor's switch S-2 was in the LOCAL position will appear except that reproduction will now be in the head telephone receivers rather than through the loud speaker.

Suppose now that we leave the instructor's switch, S-2, in the Remote position and that



2 Parts layout and wiring of instructor's control panel



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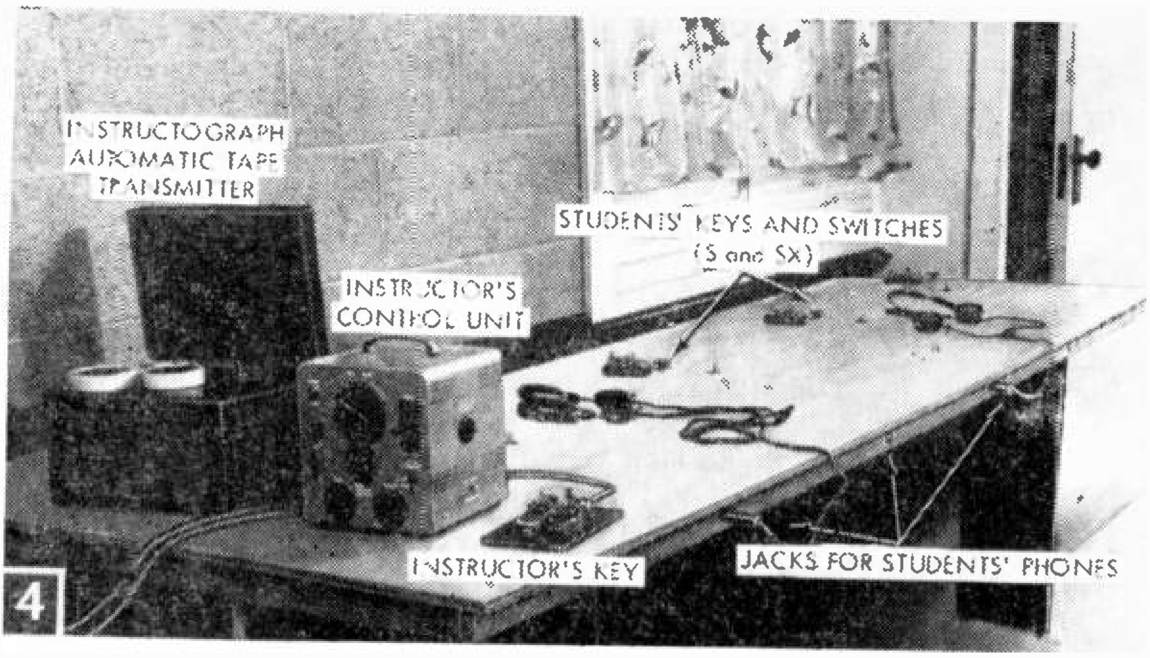
all student switches S are placed in the open position. Each student may then practice sending by himself with reproduction in only his own headphones and without interfering with any other student who may be engaged the same way. In other words, each and every student may conduct sending practice and listen to himself in his headphones while all other students are doing likewise simultaneously and with no inter-position interference.

Now, suppose student #2 wants to work two-way with student #3 at the same time that all of the others are engaged in independent individual sending practice. Student #2 need merely throw his switch S to the ON position which will parallel him with student #3 and they may then work together without causing or receiving interference from any of the others! Perhaps student #4 wants to join this group (#2 and #3). He merely asks student #3 to close his S switch to the ON position and he, too, is in!

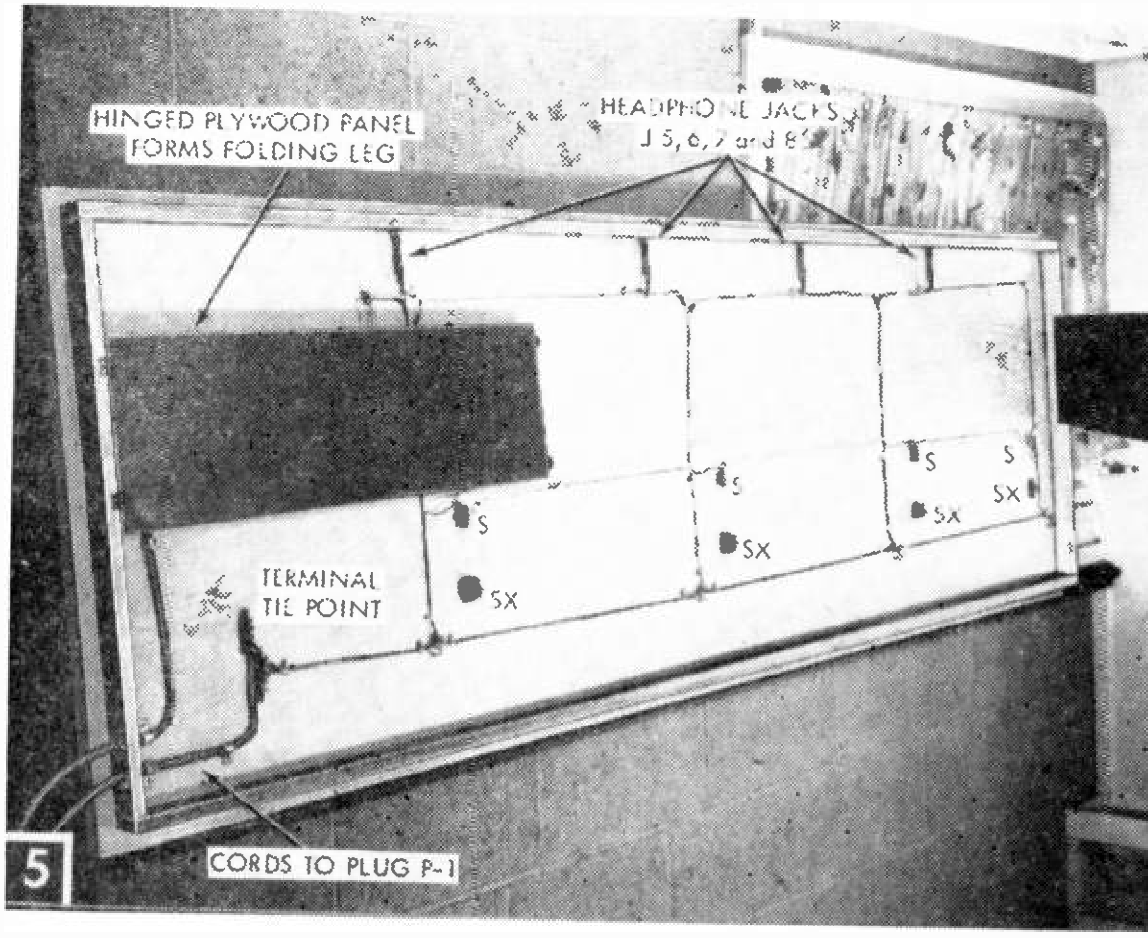
Student #1 may come in also, if desired, merely by closing his S switch to ON.

And the instructor may listen to any individual student, any pair or more who may be working together and may break in on any position or any group of paralleled positions by merely placing his monitor position selector switch S4 on the single position he wishes to monitor or work, or to any of the positions which are paralleled.

The speed timer is a standard electric clock movement and motor—in this case a new Telechron from one of the mail order electronic supply houses (cost $1.95) without hands or face. The octagon shaped dial shown in the photos is made by removing the clear plastic cover from a box of dressmaker's pins purchased at the local variety store. Give it a coat of black enamel and fit small white decals, procurable at any amateur radio supply store, to indicate the 15, 30, 45 and 60 second points. A light strip of aluminum is cut and fitted to the central shaft of the clock driving mechanism or a standard sweep hand may be procured from a local watchmaker. This makes one revolution every 60 seconds; five times around equals five minutes and enables the instructor to time code speed.



Complete equipment as set up in the author's home class-room. This arrangement uses a four position table hinged to wall and with folding plywood wing legs.



Wiring of the students' table.

The audio oscillator is an Ameco or other brand purchased in kit form and the cabinet discarded after removing the speaker. Unfortunately these oscillators are of the ac-dc type and require installation of a small 1/1 ratio isolation transformer on the inside of the control cabinet, feeding the oscillator, clock motor and an ac outlet from the secondary side and with the primary connected externally to the 115 ac line through the power switch and fuse on the control panel. The ac outlet AC-2, of conventional chassis mounting type, is installed on the side of the cabinet to provide a convenient point at which to plug in the ac supply to an automatic tape transmitter, if one is used. If you use a tape transmitter (such as Instructograph) the contacts of the tape transmitter are paralleled across the instructor's key through a two conductor cord and plug with a matching socket mounted on one side of the control cabinet.

For the indicator lamp (I) use an NE-51 neon bulb connected through a 47 K resistor in each leg, to pin 1 of the 50C5 tube and to pin 7 of the 35W4. The NE-51 element will not fire until the neon gas has become sufficiently heated, which will take a few seconds. Conversely, the bulb will also require a few seconds to extinguish after the ac switch is placed in the off position. This is an added safety factor in that the false indication that the unit is still hot allows any stray high voltage in the oscillator to bleed off before you touch exposed terminals.

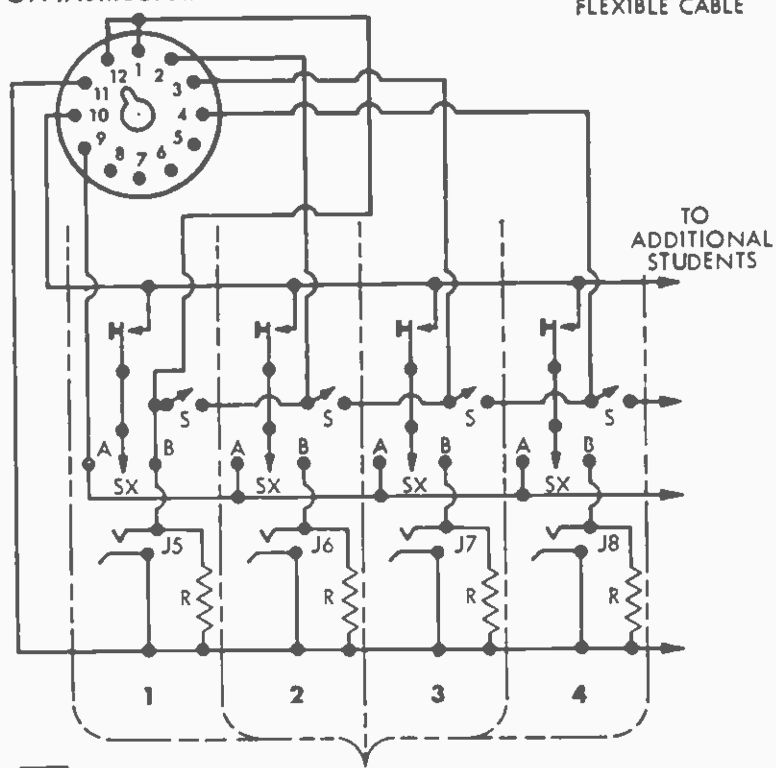
If, due to use of high impedance headphones (2000 ohms) with the oscillator, there is an annoying undertone of audio feed-back when unkeyed, place a 670-ohm (not critical value) ½ watt resistor across each headphone jack.

MATERIALS LIST—GROUP CODE EQUIPMENT
INSTRUCTOR'S CONTROL UNIT

Design.	Description
AC-2	110 V. AC chassis type receptable (Amphenol 61-F)
T-1	115/115 V. isolation transformer (Triad N-51X)
F	panel mounted fuse holder, insert type (Buss HKP)
S-1/S-3	SPST bat-handled toggle sws. (Cutler-Hammer 8098)
AC-1	recessed 115 V. AC plug (Cinch-Jones 2RP)
SPK	4" PM dynamic speaker (incld. in Ameco oscil. kit)
OSC	code practice oscillator (Ameco CPS-KL Deluxe)
S-2	locking type lever switch (Switchcraft 60012-L)
J-3/J-4	open circuit phone jacks (Mallory LA-1 Midget)
J-2	terminal jack (Amphenol Military type AN 12 for up to 8 students or Cinch-Jones Series 300)
J-1	single contact, male microphone receptacle. Insulate from cabinet with extruded fibre washers. (Walsco 1882 or equivalent)
S-4	rotary switch (Mallory 3215J for 4 students, 32112J for 8 students)
I	jewel light assembly with NE-51 neon bulb (Drake 10)
R-R1	47K-ohm resistors, ½-watt
	cabinet with chassis—mount chassis upside down in cabinet to form rigid base plate. (Hamcab 12, L. M. Bender Co., 2528 W. 9th St., L. A. 6, Calif. or supplier)
SPEEDTIMER	Telechron electric clock motor with sweep hand

PRACTICE TABLE EQUIPMENT (FOR 4 STUDENTS)

P-1	plug to match J-2 on Instructor's control unit.
S	SPST toggle switches—1 for each student (Cutler-Hammer 8098)
Sx	SPDT toggle switches—1 for each student (Cutler-Hammer 7140)
KEYS	military surplus or builder's choice
J-5, J-6, etc.	midget open-circuit phone jacks (Mallory LA-1)
R	670-ohm, ½-watt swamping resistors, one for each student
CABLE	12-conductor (for up to 8 students) flexible cable to reach from table to J-2. Conductors may be unshielded. (Belden 8747 intercom cable)



6 Wiring for one four-position table; additional tables are wired identically.

"I feel sure that your circuit has not been already patented!"

Quintuplet Duty For Your Radio

1

How to modify your a-c radio for 20¢ to produce a crystal set amp, earphone radio, AM/FM tuner, record amp, or signal tracer

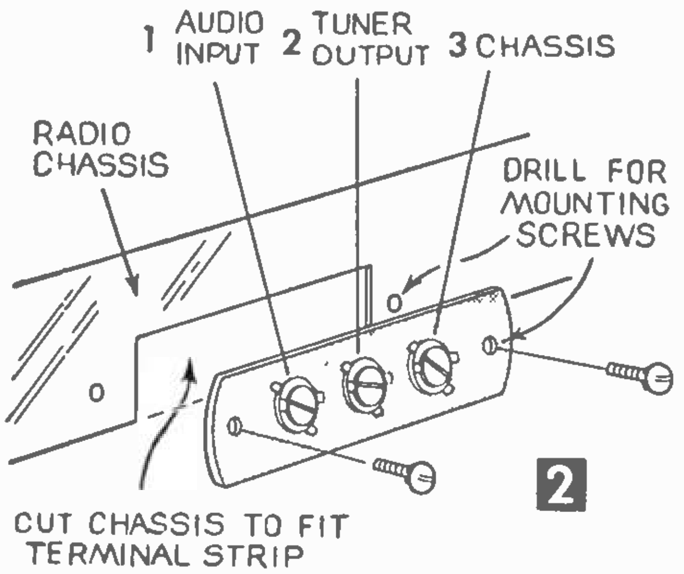
By ART TRAUFFER

A half hour's work, a 20¢ terminal strip, and the changing of a few connections make it possible for your radio to take on any one of five different jobs.

Run two leads from your volume control out to the terminal strip (Fig. 1) and in effect, you cut your radio in half so you can use either the tuner section or the amplifier-speaker as separate useful devices.

You will need a 3-terminal strip, (Fig. 2) and can get it at any radio supply store or mail order house. Mount it in an uncrowded place on the back of your radio chassis. Protect the chassis wiring with paper taped in place, and cut the slot away with a hand nibbler, or tin snips. You can simply cut narrow strips of the chassis metal, and break them away with pliers. Then drill two holes for the mounting screws. Letter or type the paper terminal label, and cement to the chassis.

Wire the Terminal Strip into the volume control circuit (Fig. 3). These instructions apply mainly to the better-built type of a-c radios—that have power transformers instead of the line resistors and "hot chassis" type of construction. But more about this later.



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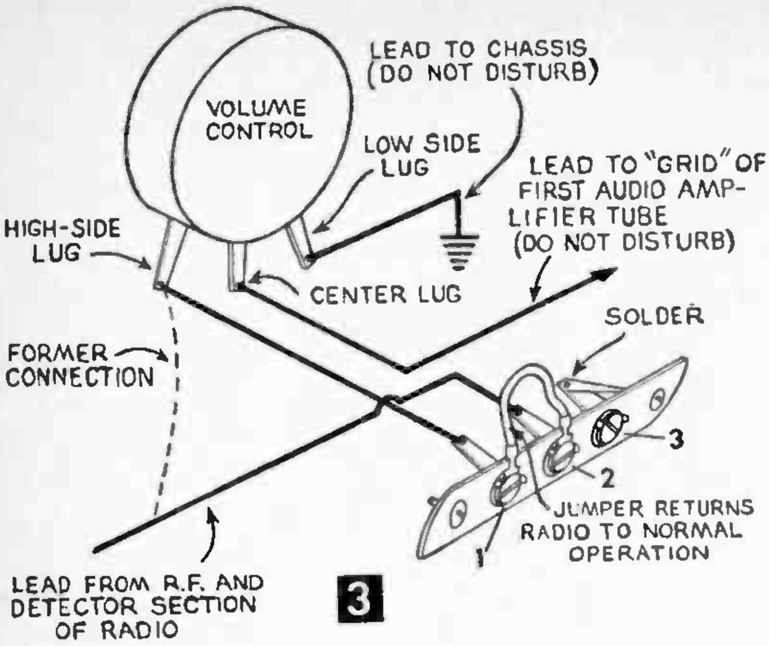
Unsolder the r-f lead from the high side lug of the volume control (Fig. 3) and solder it to the lug on the "tuner output terminal." Then solder one end of a length of insulated hook-up wire to the audio input terminal lug and the other end of the wire to the high side lug of the volume control.

Solder the chassis terminal lug to a second soldering lug placed under the nut of the terminal strip mounting screw. This completes the wiring, except for a jumper. Make it by soldering a short wire to two spade lugs. Connected across the Audio and Tuner terminals, it puts the radio back into normal operation.



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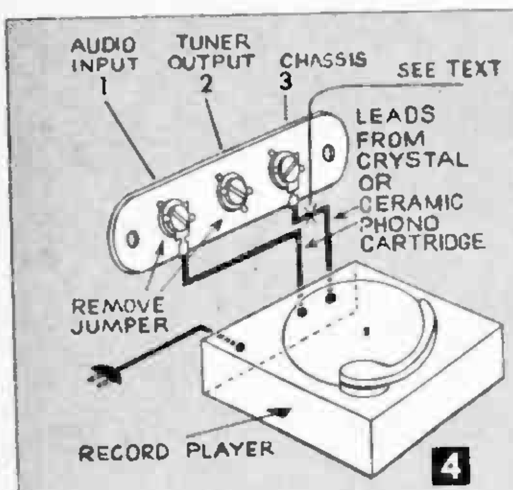
Radio Now Works as Phono Amp. Connect the leads of a crystal or ceramic phono pickup to the Audio and Ground terminals (Fig. 4); if your radio has a good *a-f* section and a respectable speaker, you'll get quality music. If your amp section is low gain, use a high output crystal, or ceramic phono cartridge. Otherwise, if your amp section has plenty of gain, you can use the higher quality low voltage crystals, or ceramic cartridges as are made by Ronette, Electro-Voice and Sonotone.

Record Player. Since the radio already has a volume control, none is needed on the record player. If you get *a-c* hum pickup, use shielded phono cable to make the connections, with the shield running to the chassis terminal. *Caution.* If you use an a-c/d-c type table radio with a hot chassis, connect a .05 *mfd.* 600-volt blocking capacitor at X (Fig. 4) in series with the chassis lead. This will isolate the phono pickup from the *a-c* line voltage.

Tuner Section Can Feed Hi-Fi. With the jumper removed and the connections in Fig. 5, you can route the radio's output into your hi-fi amp and speaker for real volume. If the radio has an FM band, you'll have fine static-free music. Connect the chassis terminal to the chassis terminal on the hi-fi amplifier, and the tuner output to your amplifier's tuner input. If you get hum, use shielded cable, grounded to the chassis terminals of both units.

Crystal Input for AM Fidelity. Run the output of a crystal radio through the audio amplifier and speaker (Fig. 6) and you'll get better quality sound because the detector tube element noises has been eliminated. Also a crystal radio has a wider bandpass and less distortion than a superhet radio. If your amp section has high gain, a short antenna on the crystal set will do the job. No ground connection is needed, because the crystal set is automatically grounded by capacitance when connected to an *a*-c type radio. With an *a-c*/*d-c* type radio, use a .05 600-volt blocking capacitor to get line isolation.

Tuner Is Right for Earphones. Late listening will be a pleasure because you'll get less hum and distortion than with the common across-the-speaker method of connecting phones. Use a pair of high impedance magnetic or dynamic earphones. Of course, the radio volume control will not function because the connection is ahead of it in the circuit. Don't try this on an *a-c*/*d-c* type radio be-



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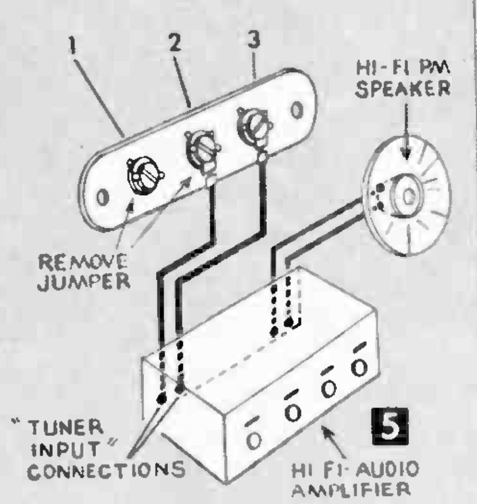

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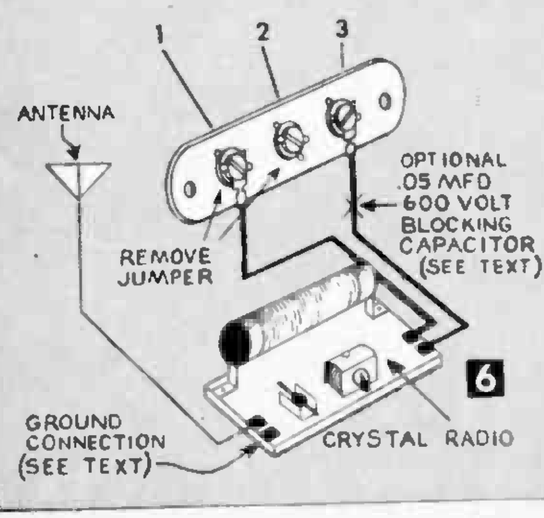

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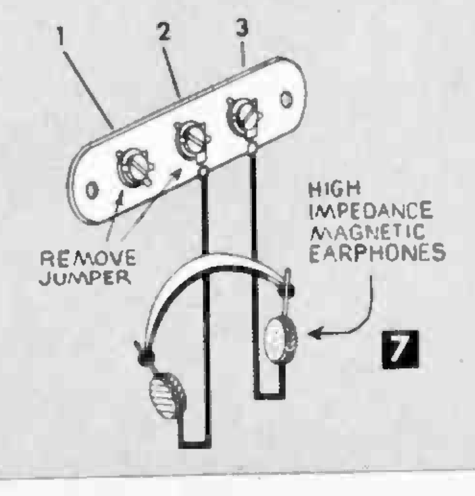

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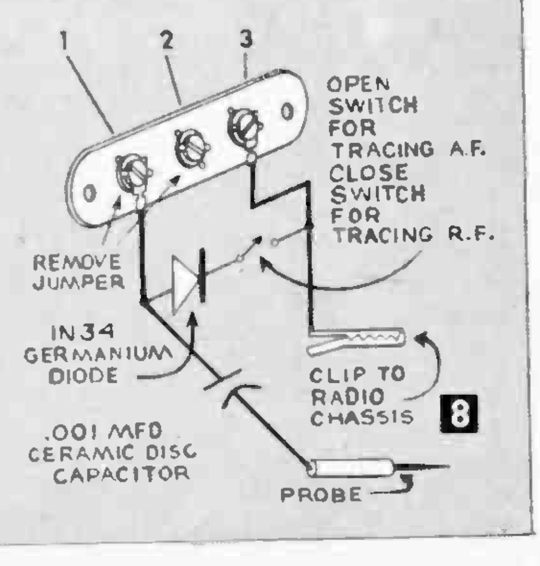

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cause a shock hazard would be involved unless you observe precautions noted later.

Radio as Signal Tracer. Less than $2 worth of parts that you may have in the scrap box will give you an *rf/af* signal tracer (Fig. 8). You can mount the parts on a block of wood, or in a small plastic case. Use insulated flexible wire for the probe and clip. When tracing *af*, open the switch to take the diode out of the circuit. Close the switch for tracing rf. Your radio volume control will regulate the speaker volume to a comfortable level. If your radio is an *ac-dc* model, note precautions given in next paragraphs.

Using AC-DC Type Radios. The reason for avoiding the use of a-c/d-c radios for these applications is the danger of shock hazard. If you are not sure of your connections, ask a radio expert. The *a-c* radio has a transformer which completely isolates the chassis from the line voltage, and so it is safe. But the *a-c/d-c* set usually is wired with the tube filaments in series, and thus when the plug is one way in the wall, the metal chassis is connected directly to the "hot" line voltage. You can test by connecting a voltmeter, or lamp between the chassis and any grounded water pipe. Correct this situation by reversing the plug so the chassis is on the ground side of the power line. Plug and outlet can be marked, or you could use a polarized plug and outlet so it will always be correct. Another remedy is to isolate the hot *ac-dc* chassis from the power line with an isolation transformer. (A 50-watt size is available from radio dealers for about $6.)

The DX Strip

The Bahaman waterways offer exciting listening

By C. M. STANBURY II

APRIL 24, 1960 and the 42-ft. cabin cruiser "White Star" is grounded on Elbow Cay. Signaling with a mirror, it attracts the attention of the "Muriel III" who comes to the rescue. Only this script wasn't written that way because when it arrives the White Star's one man crew seizes her, disposes of the captain and sails away in the plundered vessel. Who said piracy is dead?

Where did it happen? The China Sea or maybe the Indian Ocean? No, right next door in the Bahamas, in the DX strip extending from Little Bimini (less than 50 miles east of Fort Lauderdale, Florida) to Inagua, approximately 50 miles from Haiti and Cuba. While such locals as Nassau and Bimini are well civilized, much of this territory consists of rocky uninhabited islets accessible only by boat. Elbow Cay is such a place.

Have you heard this first class DX target yet? Chances are, unless you happen to be an eastern BCB DXer, these fine loggings have escaped you.

The only broadcasting station in the Bahamas is ZNS at Nassau (Z is pronounced Zed outside of the U.S.). It operates on 1540 kc and according to international treaty (the North American Radio Broadcasting Agreement) is supposed to use only 5000 watts. Instead ZNS has boosted power to 20,000 watts. The increase has been protested via the State Department by U.S. stations which share this channel at night. Indications are that ZNS is getting out, certainly good news for DXers.

The best way to log this station is via "Sunset skip," that mysterious process by which signals, particularly those from Latin America, appear with unusual signal strength for a brief period, either at sunset or during the three hours following, depending upon frequency and conditions. ZNS is usually best between 6 and 7 at this time of year in the east and a little earlier (local time) in the Midwest.

Reports should go to the Chief Engineer and at last report he was verifying by letter. Return postage which must always be enclosed, may be sent via International Reply Coupon obtainable at any post office for 15¢.

Above the Broadcast Band. Now if you live out west, for some reason don't like BCB DXing or just plain want to stick to shortwave, the frequencies for you are those used by aeronautical services in the Bahamas. Daytime this means 13344.5 and 8871 kc., during the first couple hours past sunrise, the hour before sunset and early evening period, you should monitor 6537 and 5566.5. The night channel is 2966, a fine medium-wave DX spot except during the static laden summer.

Call letters for Nassau Aeradio are ZQA but it identifies simply as Nassau. At last report, the station, which is government owned and operated, verified by letter and reports should go to Officer in Charge, Nassau Aeradio, International Aerodrome, Nassau.

But there is no reason to limit your aeronautical DXing to Nassau. Numerous planes pass over the Bahamas every day. On the Miami-San Juan route, one of the Caribbean's busiest, Great Exuma Island is a reporting point, that is, an aircraft passing over reports it's position on one of the frequencies listed below. Number one airline here is Pan American World Airways, whose flights identify as "Clipper." Reports should go to the Assistant Division Communications Supt., PAA, International Airport, Miami 48, along with a prepared card. We'll discuss these in a moment.

Similarly, Little Abaco Island is a reporting point between Nassau and New York City. Reports for airlines using this route should be addressed to the respective communications superintendents in New York. This office is preferable to Nassau because U.S. stamps may be enclosed as return postage.

While we're on the subject of communications stations, there is even more interesting Bahaman DX to be heard but on medium-wave frequencies, 2118 and 2031.5 kc., thus more difficult to bag. These channels are used by ships contacting the Miami Marine Telephone facility and over half the vessels you'll log here will be yachts in the Bahamas, in many cases the only means of communication on tiny islets. Examples of this would be the "Walker's Baby" transmitting from Walker's Cay or WJ7710, yacht "Grand Cay" from the key of the same name.

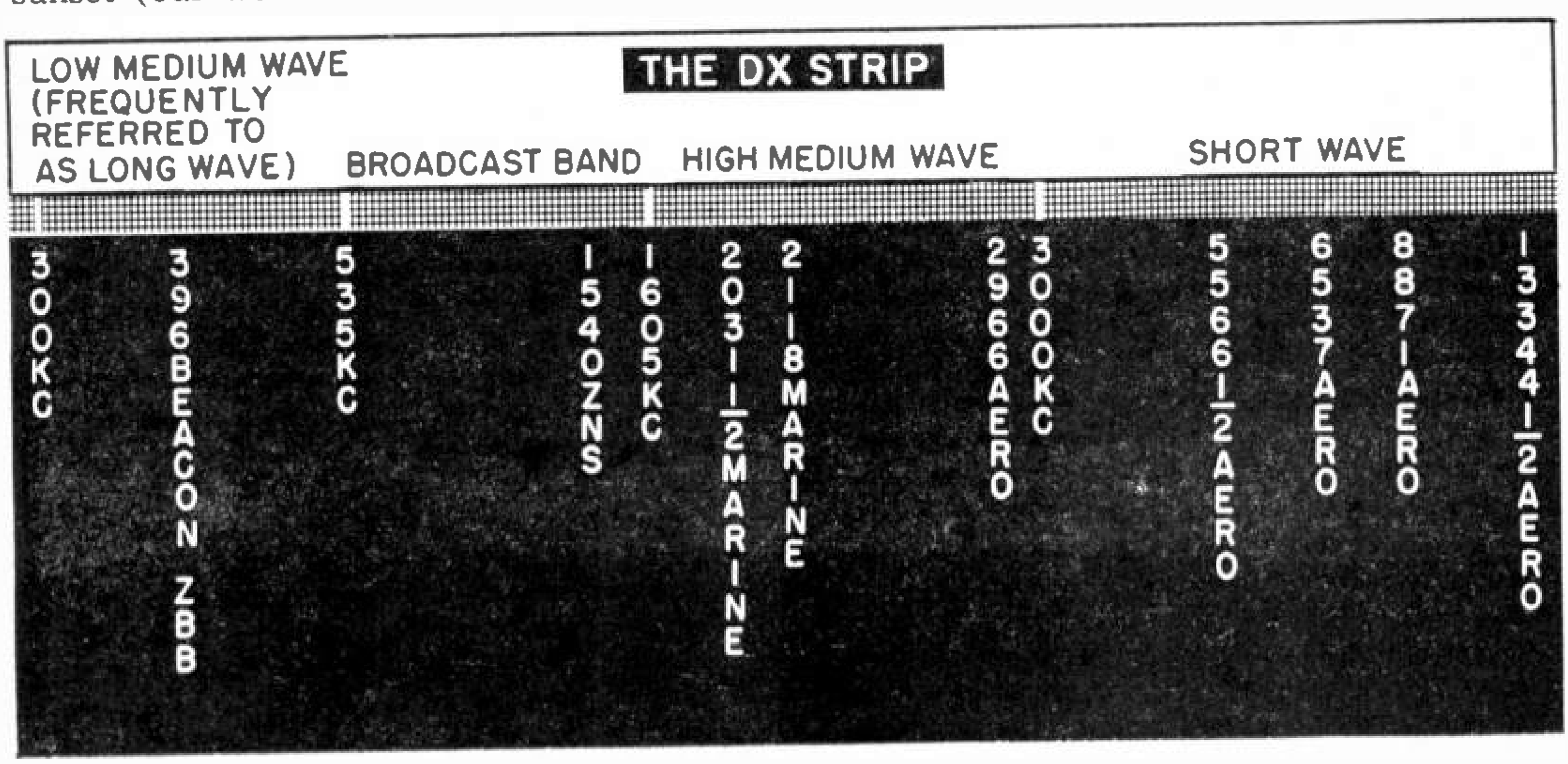
Prospects for fascinating listening are unlimited. In fact at one time you might have received signals from the now notorious "White Star." But remember, all transmissions are confidential. You are absolutely free to listen but may repeat or put in a reception report only the name of vessel, call letters, date and time, frequency, station called, location, signal strength, interference and other reception conditions.

Best time to tune these channels is around sunset (our western readers should listen a little earlier), that's right, sunset skip again. However, finding a proper address will be even more of a problem than favorable DX conditions. *Merchant Vessels of the United States* contains most and you can write to the Supt. of Documents, GPO, Washington 25, D. C. for the date and price of latest edition, but we warn you right now, it's expensive. Yachts in the Bahamas can be addressed directly for example: Master, Yacht Grand Cay, Grand Cay, Bahamas.

In order to verify, most marine radio operators require that you enclose a returnable card with reception data with your report. They can be made either by purchasing a toy printing set or via the method described in Madge Roemer's book "Fun with Your Typewriter," published by Fleetwing Press. For American ships, they can be made on U. S. post cards.

Below the Broadcast Band. About 125 miles southwest of Grand Cay lies Port Royal on South Bimini. Port Royal is a Fort Lauderdale real estate development and, more important to DXers, home of powerful beacon ZBB. This station which originally came on the air as VSC2, can be heard most evenings on 396 kc throughout the East, Midwest and South. Of course you will have to acquire a Long Wave set to hear it but if you live in one of the above areas, ZBB is an excellent excuse for doing just that. The best buy in LW receivers can be found in war surplus but for the beginner inexpensive sets manufactured by Admiral and RCA and Philips (Canada) will do.

To verify a beacon, note the length of time it takes to transmit the identifier, in this instance ZBB (--.. -... -...) and the period of silence following. These measurements should be accurate to the half second. Reports should be addressed to Officer in Charge, Radio Facility ZBB, Federal Aviation Agency, Port Royal, Little Bimini, Bahamas.



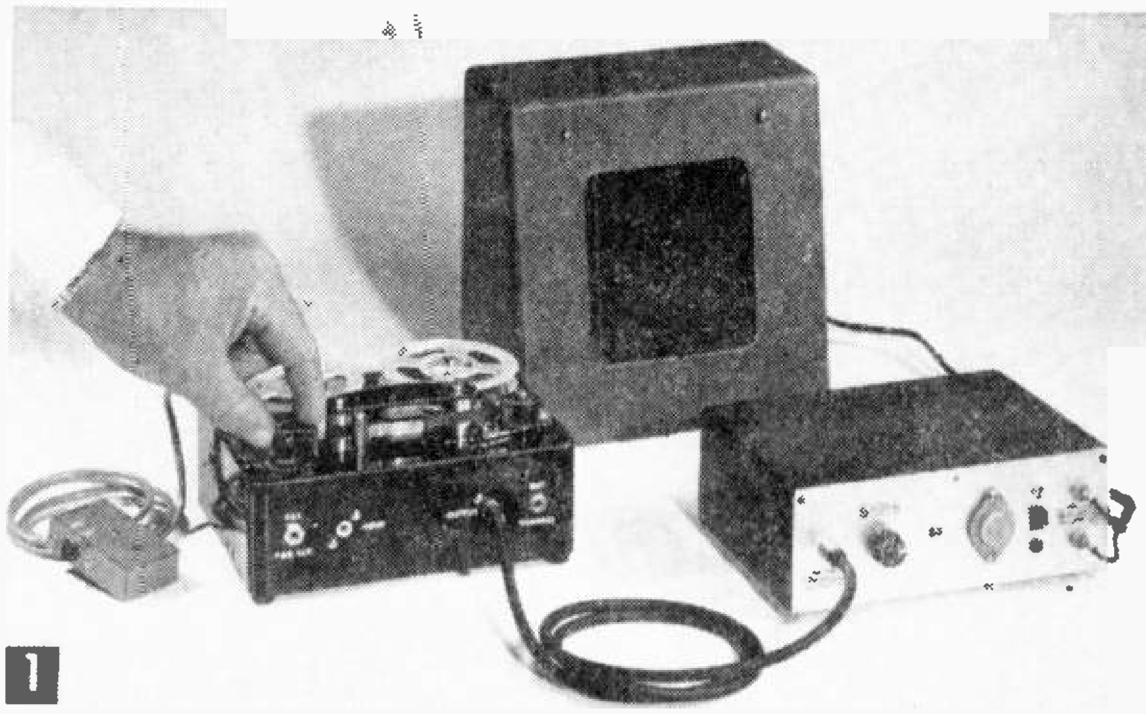
Transistorized Audio Amplifier

Lightweight battery-operated amp delivers loudspeaker volume

By ART TRAUFFER

THIS two-pound battery-operated amp will add loudspeaker volume to a phono pickup or portable tape recorder (Radio-TV #569). Or it will put more "reach" into earphone radio reception. It can be built for about $13.

While the ¼-watt output would never win a hi-fi volume contest, with a good crystal phono pickup (Fig. 2) and an efficient speaker, you get enough volume to fill a room. Frequency response is excellent and the transformerless design means that money saved can be spent on high quality entertainment-type transistors.

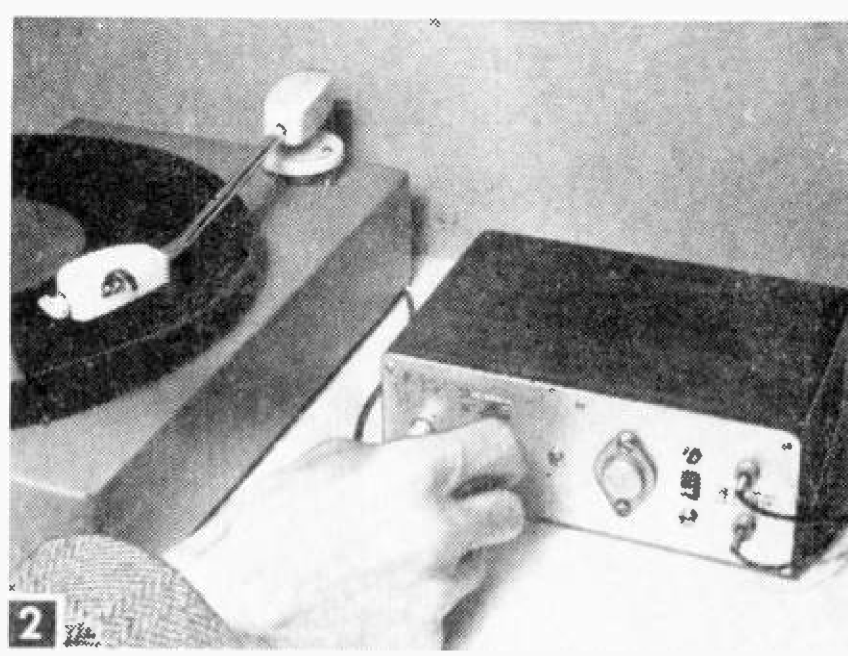


1

Plug in the transistorized amplifier and you boost the tape recorder output up to loudspeaker volume.

How It's Built. First bend a 7 x 7½-in. piece of 20-gage aluminum for the chassis (Fig. 3). For a "pro" look, have your local tinsmith make the bend on a brake. You can also use anodized store front aluminum, available from window glass dealers. Its smooth matte surface is ideal for panels provided that you remember to scrape off the surface at every point where the parts must connect electrically to the chassis.

The location of the mounting holes (Fig. 3A) is not critical, but be sure to allow enough room on the edges for the wood cabinet fit. Make the opening for the slide switch by drilling two 5/16-in. holes and filing the opening with a small square file.

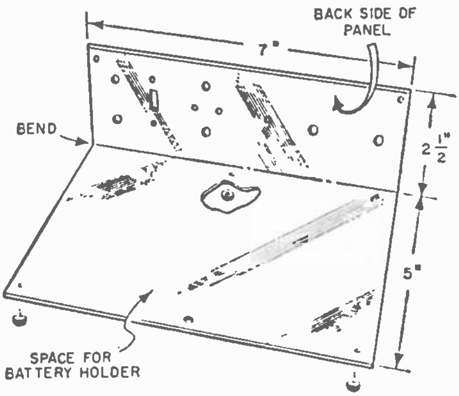


2

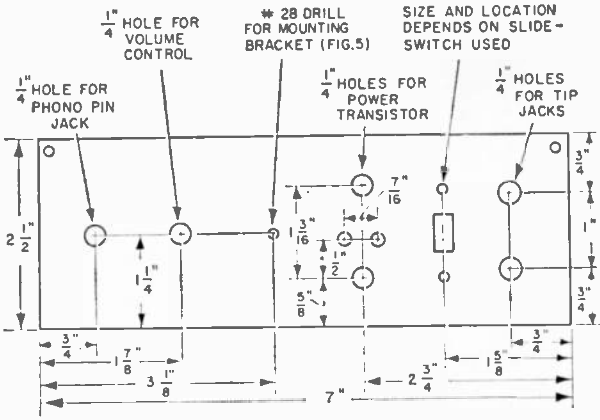
With a crystal pickup and an extended range 8 or 12-in. speaker, reproduction is crisp and clear with volume to fill a room.

Make the wooden case (Fig. 4), using small wire brads and cabinet glue to fasten the parts together. File and sand the edges of the case and chassis round and drill holes for the *rh* wood screws which hold the chassis and cabinet together. Three rubber feet in triangular arrangement will permit the amplifier to rest solidly on uneven surfaces. Drill small holes in the chassis, and use three rubber tack bumpers fastened with Duco cement.

Mount the panel parts, using lock washers under nuts and screw heads. Scrape away the aluminum coating at each connection to chassis. Make the transistor socket bracket (Fig. 5) of thin aluminum. File each slot for a tight clamp fit around the transistor socket, and fasten with cement. Mount the 2N301 power transistor to the chassis with a layer of thin mica (Fig. 6). The mica and the insulating washers which are cemented to the inside of the panel serve to insulate the mounting screws and the transistor case (collector). Yet the thin mica permits the chassis to act as a heat sink to keep the transistor



3 CHASSIS - .040 ALUMINUM



A LAYOUT FOR MOUNTING HOLES ON METAL PANEL

cool.

Make the clip terminals for the 2N301 base and emitter pins by breaking apart an old 7 or 9-pin tube socket and removing the smallest terminal clips.

Wiring. Solder all of the connections according to Figs. 7 and 8. Make connections with #22 solid hook-up wire with push back insulation and use small spaghetti on every resistor and capacitor lead where there is danger of shorting. The 2N217 transistors are easily damaged by heat, or improper connection. Mark their sockets with a spot of red paint on the collector side to prevent wrong insertion.

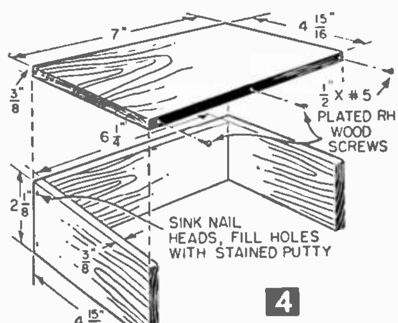
How It Works. The crystal phono pickup feeds into a high-Beta 2N217 transistor using a grounded emitter circuit. Potentiometer R2 serves as volume control as well as part of the voltage divider network supplying bias to the transistor.

The 100K input resistor, R1, tends to reduce the high frequency response which is exaggerated in most transistor circuits, and flattens the response of the crystal pickup. The resistor presents high impedance to the higher frequencies.

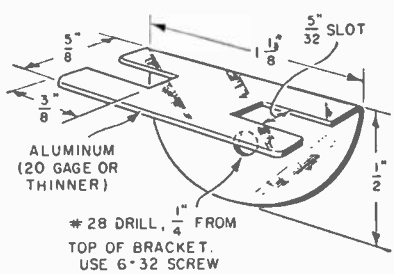
The driver transistor, T2, is direct coupled to the RCA 2N301 power transistor. Since output impedance of the 2N301 is very low, about 16-ohms in this circuit, no output transformer is needed. Thus there is less distor-

MATERIALS LIST—TRANSISTORIZED AUDIO AMPLIFIER

No. Req'd		Size and Description
2—	R1, R3	100K ½-watt 10% carbon resistor (see text)
1	R2	10K midget volume control
1	R4	2.2K ½ watt 10% carbon resistor
1	R5	6.8K ½ watt 10% carbon resistor
1	R6	39K ½ watt 10% carbon resistor
1	R7	240-ohm ½ watt 5% carbon resistor
1	R8	.82-ohm ½ watt 10% carbon resistor
1	R9	560-ohm ½ watt 10% carbon resistor
2	C1, C2	20-mfd 15-volt midget electrolytic capacitors, Cornell-Dubilier #746
2	T1, T2	RCA 2N217 transistors
1	T3	RCA 2N301 power transistor
		HARDWARE
1		Switchcraft single hole mounting phono-pin jack
2		Johnson nylon-insulated tip jacks
1		SPST slide switch, miniature
2		sockets for 2N217 transistors
1		knob to fit ⅛" volume control shaft
2		½" O.D. insulating washers for power transistor
4		battery holders for size D flashlight cells, Lafayette Catalog #MS-175.
5		6-32 x ⅜" mach. screws and hex nuts
8		4-36 x ¼" rh mach. screws and nuts
2		clips for power transistor terminals (see text)
3		½" x #5 plated rh wood screws
4		Eveready #950 D size flashlight cells, or 1 6-volt block to fit space
Misc.		soldering lugs, hookup wire, spaghetti, scrap aluminum: "PHONOGRAPH," "VOLUME" and "SPEAKER" nameplates; small piece 1/32" fiber or mica, for 2N301 mtg.
1		7 x 7½ x .040" sheet aluminum chassis (see text)
		CABINET
		(Use hardwood or pine covered with plastic veneer)
1		7 x 4 15/16 x ⅜" (top)
2		4 15/16 x 2⅛ x 7/16" (sides)
1		6⅛ x 2⅛ x 7/16" (back)



4 CASE - USE HARDWOOD, OR PINE COVERED WITH PLASTIC VENEER



5 BRACKET FOR TRANSISTOR SOCKETS

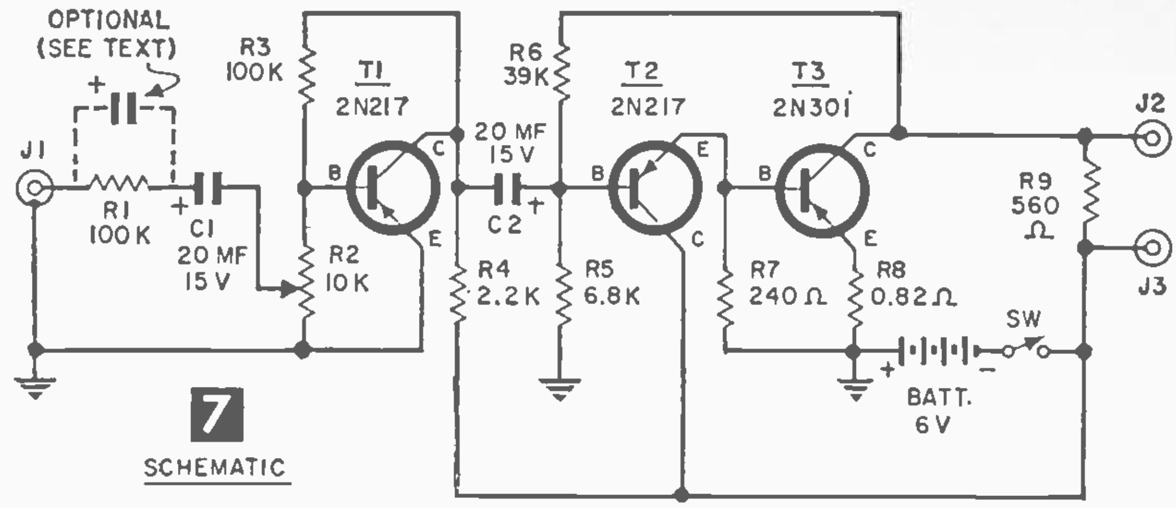
tion, improved frequency response, and less cost in the circuit.

A 16-ohm speaker will give the best results with your amplifier. A second choice would be a Jensen P12-RX ($12.40) 12-inch extended range speaker. Otherwise any 8-ohm speaker also will work well, and you will get fair results with even a 4-ohm speaker. The 560-ohm resistor (R9) across the speaker terminals protects the transistors in case power is turned on with speaker disconnected.

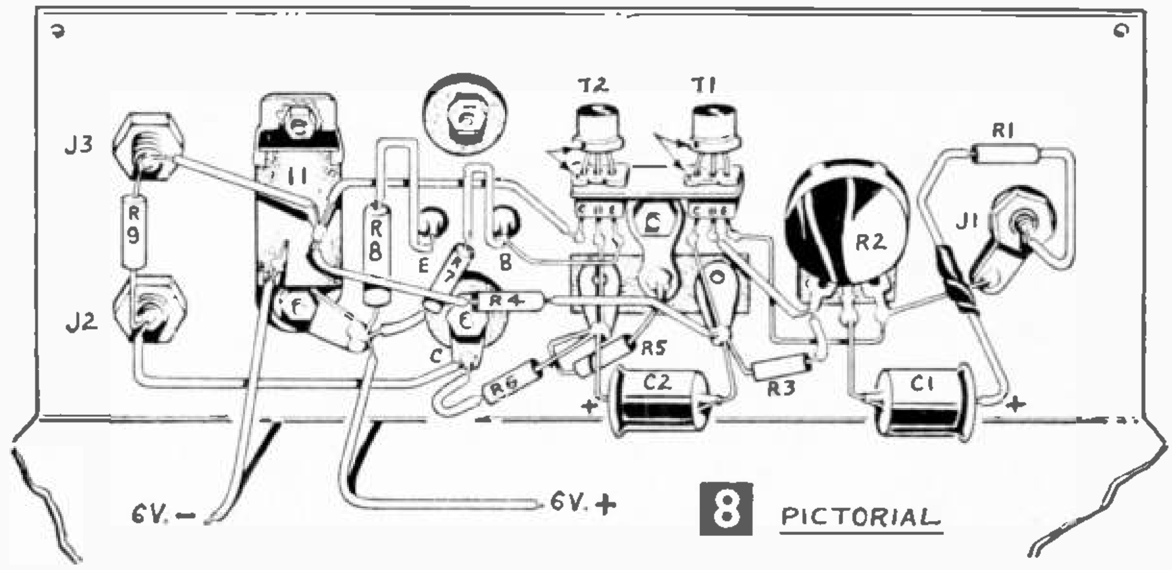
Any good crystal or ceramic phono cartridge mounted on a free-moving arm can be used. The cartridge shown in Fig. 2 is a Ronette TO-284-P mounted on a Ronette 12-in. arm. This kind of pickup has relatively low output, with very low intermodulation distortion. Turntable selection depends on how much quality you want to buy. For a low budget system, 3-speed turntables such as Alliance Model JPT8 and General Industries Model-SS are offered in the $6 bracket.

The amplifier was designed to use the high quality entertainment transistors specified. If you use the lower-priced experimental transistors, performance will suffer. You may want to experiment with the size of input resistor R1. The higher its resistance, the more it attenuates the high frequency response. You can try values between 10K and 1 megohm. A 10K resistor worked best with the S&M portable tape recorder.

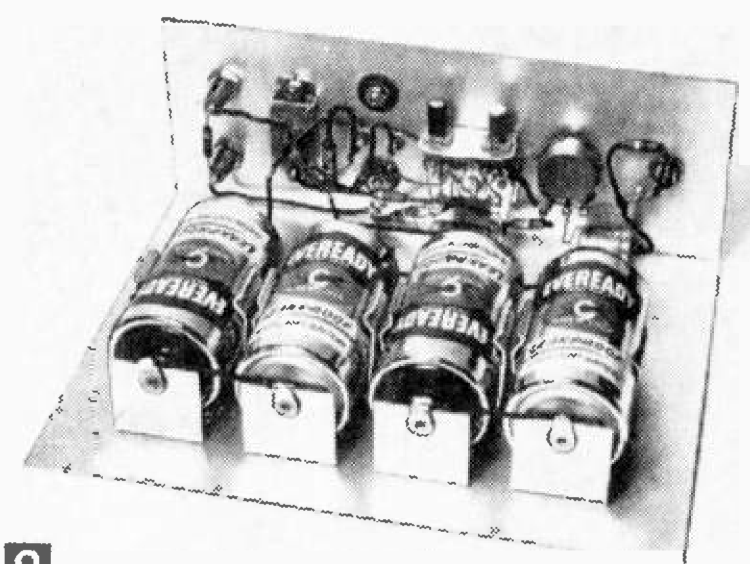
When the amplifier is used to boost the output of a crystal set or a single transistor radio, you will get bell-like clarity from local AM stations. It works well with good FM tuners, and you could also use two of the units for stereo.



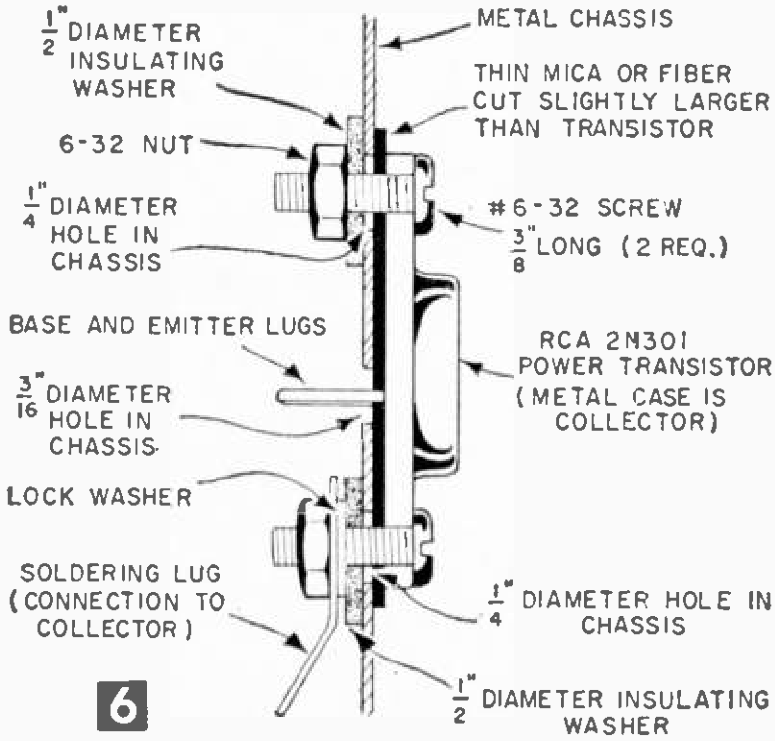
7 SCHEMATIC



8 PICTORIAL

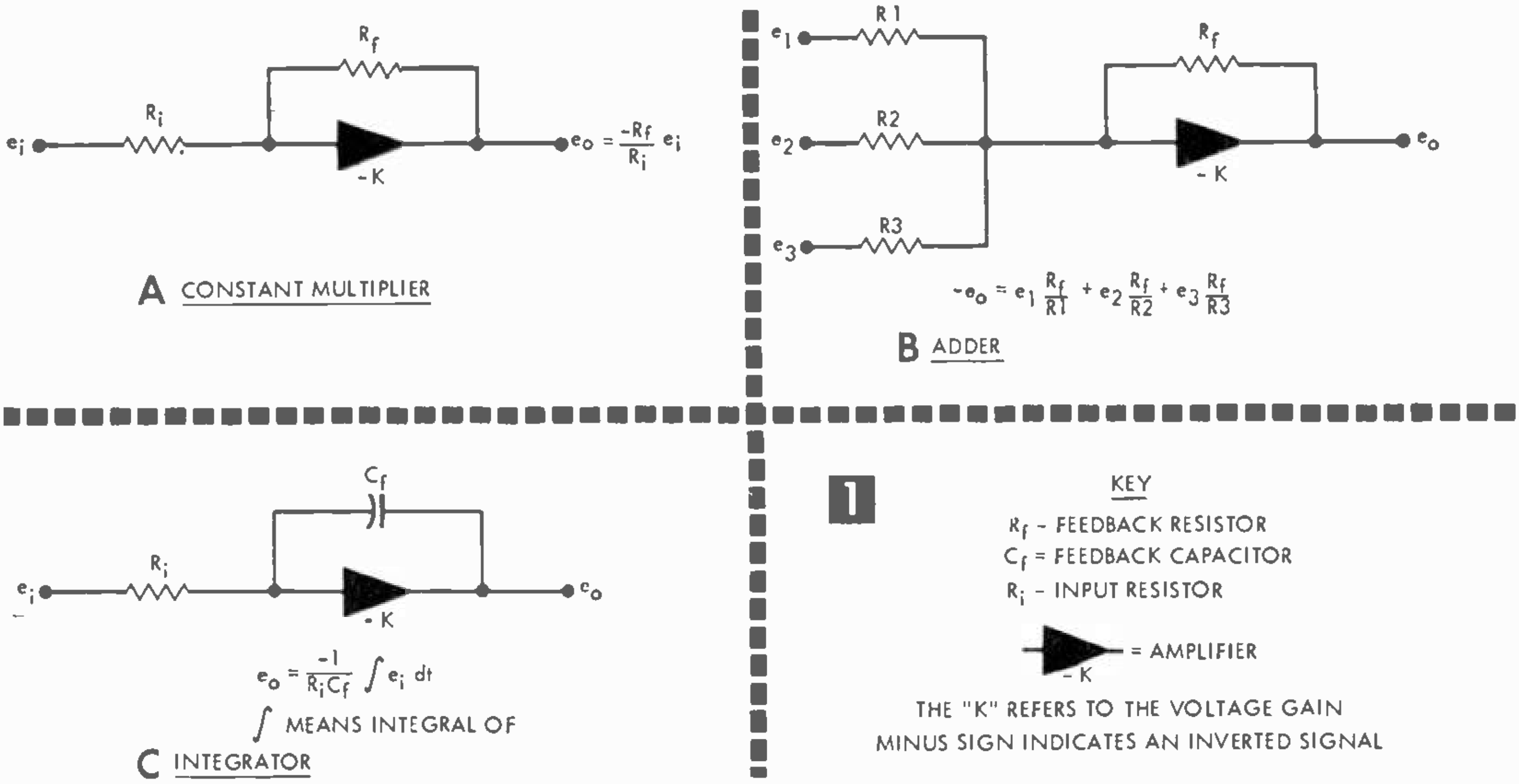


9 Four D-size flashlight batteries wired in series give you 6 volts of power. Battery life is 100 to 200 hours.



6 HOW TO MOUNT POWER TRANSISTOR TO METAL CHASSIS

Analog Computer Theory



By FORREST H. FRANTZ, SR.

ELECTRONIC analog computers are valuable tools in product research and development. Scientists and engineers use them to study the mathematics and behavior of physical phenomena and physical systems. The analog computer is favored over the digital computer for programming simplicity and for the ease with which results may be interpreted.

Digital computers are used when extreme accuracy is required or exceedingly complex problems are to be solved. Several manufacturers offer small desk top electronic analog computers that cost in the vicinity of a thousand dollars. One of these computers, properly used, can pay for itself in a month in many industries.

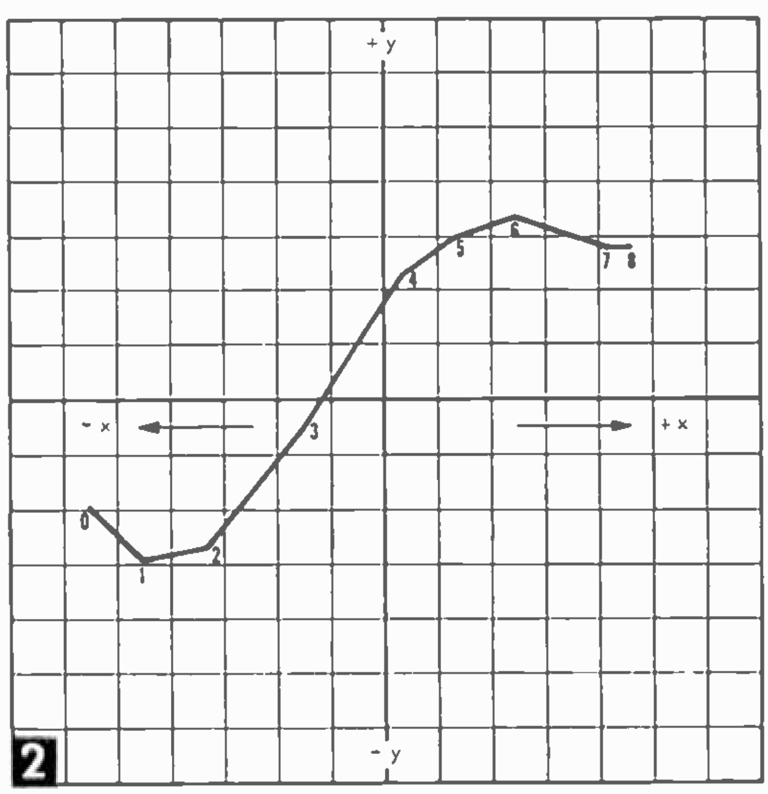
The main components of an analog computer are operational amplifiers, coefficient potentiometers, reference and initial conditions power supplies, function generators, and computing resistors and capacitors.

The operational amplifier is the basic analog computer building block. In the Heathkit ES-400 it is a high gain (50,000) direct coupled (dc) amplifier. This amplifier must be able to amplify very small signals, and at the same time must be able to handle large signals without overloading. The amplifier must have very low drift. Drift is a problem in dc amplifiers because a very small voltage change in the input tube is amplified and appears as a signal voltage at the output tube.

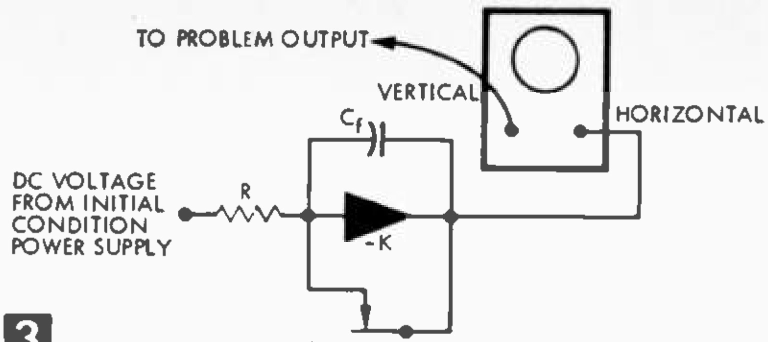
The input impedance must be high, the output impedance low. And the operational amplifier must be linear over its operating range.

The principal difference between this type of amplifier and an audio amplifier is the direct coupling, the more elaborate precision voltage dividers, and the output arrangement to allow negative as well as positive dc outputs.

Operational amplifiers are used with feedback resistors and capacitors and input resistors. Appropriate combinations form con-



Finding the curve of a non-linear function. If more points were known, an even curve would result.



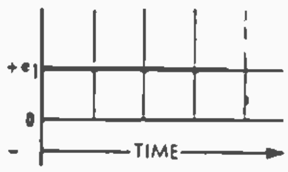
3

An integrator can generate sweep voltage for CRO display.

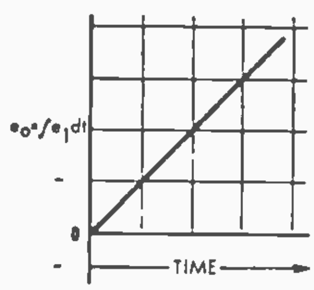
stant multipliers (Fig. 1a), adders (1b), and integrators (1c). Note that the ratio of the feedback and input components can be chosen to reduce the overall gain to 1 or less. The operation and use of the constant multipliers, adders, and integrators will be discussed later.

The coefficient potentiometers are used to set constant multipliers into problems and to keep signal levels within the operational amplifier linearity limits.

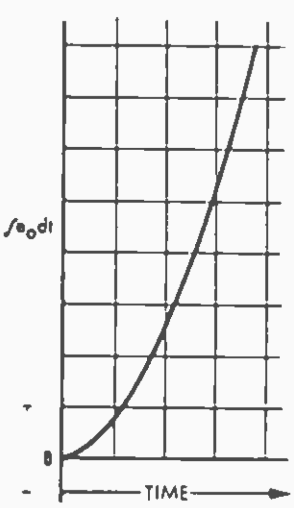
The coefficient potentiometers, amplifier inputs and outputs, reference and initial condition voltages, relays, diodes and function generator are terminated on a patch board.



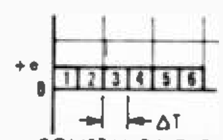
A e_1 IS APPLIED TO AN INTEGRATOR AT ZERO TIME



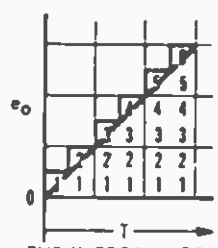
B THE INTEGRATOR OUTPUT INCREASES LINEARLY WITH TIME



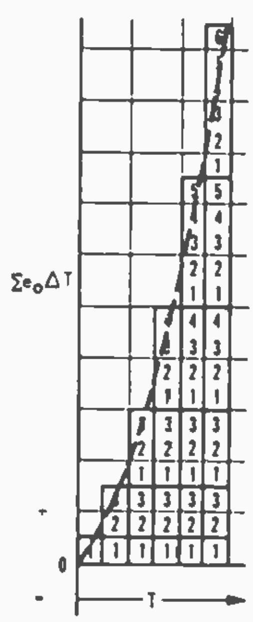
4 C THE INTEGRAL OF THE RAMP FUNCTION



A CONSTANT VOLTAGE IS DIVIDED BY EQUAL TIME SEGMENTS



B THE INTEGRAL OF e AT ANY TIME IS e_o, THE SUM OF THE $e \times \Delta T$ PRODUCTS



5 C SECOND INTEGRATION

The problem is entered into the computer by interconnecting the various components on the patch board. The computing resistors and capacitors are mounted on plugs that fit these jacks.

Separate power supplies furnish the heater and B voltages for the operational amplifiers, reference power (plus and minus voltages), and initial condition power (plus and minus).

A function generator is used to generate non-linear response functions. Mathematical functions such as logarithms, sines, and cosines, can be approximated with this unit. These non-linear functions cannot be produced too readily. But their curves may be approximated by setting the slope and break points of 8 straight line segments as shown in Fig. 2. Diodes and bridge circuits form the basic function generator set-up.

If a problem is to run a long time, a pen recorder is generally employed with an analog computer. Another approach to display and recording is to solve the problem in a short time (less than a second), and repeat the solution continuously for display on an oscilloscope. A repetitive oscillator is used to reset initial problem conditions and the horizontal sweep for the scope. The horizontal sweep may be derived from an integrator as shown in Fig. 3. Subsequent discussion will explain the operation.

Computation Building Blocks. The operational amplifier is the basis of the computation building blocks which are basically adders and integrators. The classification can be broken down further to include sign changers and constant multipliers. The constant multiplier is simply a special case of the adder with only one input resistor. The sign changer is a special case of the constant multiplier where R_F/R_I equals 1. Note that there is always a change of sign when a signal passes through an operational amplifier.

The mathematics behind the computer building blocks shown in Fig. 1 is based on feedback theory. The gain from input to output may be readily adjusted to very low values by the choice of the ratio of R_F/R_I. For best results, this ratio should never exceed 50, and upper limits of 20 or 30 are preferable. Since problems are readily scaled to convenient numbers, these limits don't impose any problem restrictions.

The adder of Fig. 1b has more than one input resistor (R_I). The several input re-

TABLE A—BIBLIOGRAPHY

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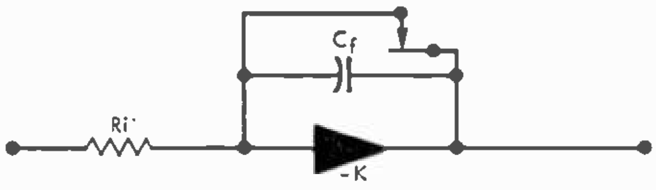


6

When initial condition is zero, the integrator capacitor is shorted by a relay until computation begins.

sistors are designated as R1, R2, R3, etc., for convenient identification. If any of the inputs is to be subtracted, it is introduced in the negative form. Thus the adder is also a subtractor. Note that the choices of R1, R2, R3 etc. allows multiplication of each of the adder inputs by a different constant. Or, the same result may be accomplished by setting all of input resistors equal and using a coefficient pot to adjust the constant multiplier at each of the inputs.

Integration warrants some explanation. Figure 4a shows the plot of a voltage that is constant with respect to time. If a constant voltage is applied to an integrator input, the output plotted against time is the sloped straight line of Fig. 4b. A simplified way of explaining an integrator is to say that the input is multiplied by small segments of time, and the resulting products are added to all others (Figs. 5a and b). The analog integrator is continuous of course, and the small time segments or increments approach zero. If you didn't study calculus in college, don't be too alarmed if you find integration hard to understand.

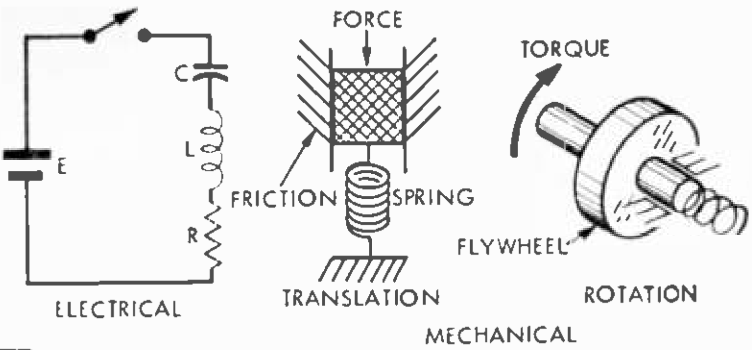
If the integrator output of Fig. 4b is the input to a second integrator, a second integration is performed. The integral of the ramp voltage of Fig. 4b is shown in Fig. 4c. Figure 5c shows the incremental representation.

Integration is begun by opening a relay which has the integrator initial condition set on the feedback capacitor and by applying the input voltage to the integrator. If the initial condition is zero, the capacitor is shorted till integration is to begin as shown in Fig. 6. If the initial condition is some value other than zero, this voltage is connected across the capacitor till integration is to begin.

Problem Solving. Electronic analog computers solve differential equations. Differential equations describe the behavior of many physical systems. Figure 7 shows the electrical LCR circuit, a mechanical translational, and a mechanical rotational system. All of these systems are described by the same differential equation describing that input = reactions + losses:

$$\text{Input} = A\frac{d^2x}{dt^2} + B\frac{dx}{dt} + Cx$$

The computer hook-up is the same for all three systems. The constants A, B, and C are not the same but there are simple different coefficient potentiometer settings or different



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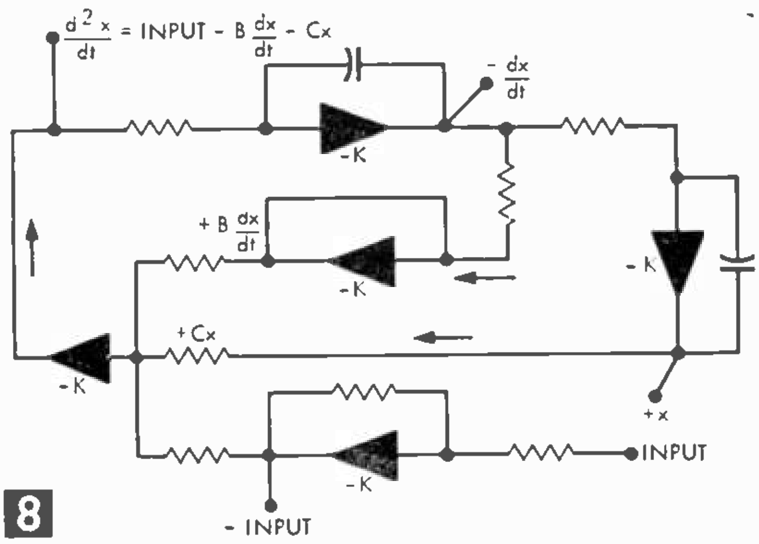

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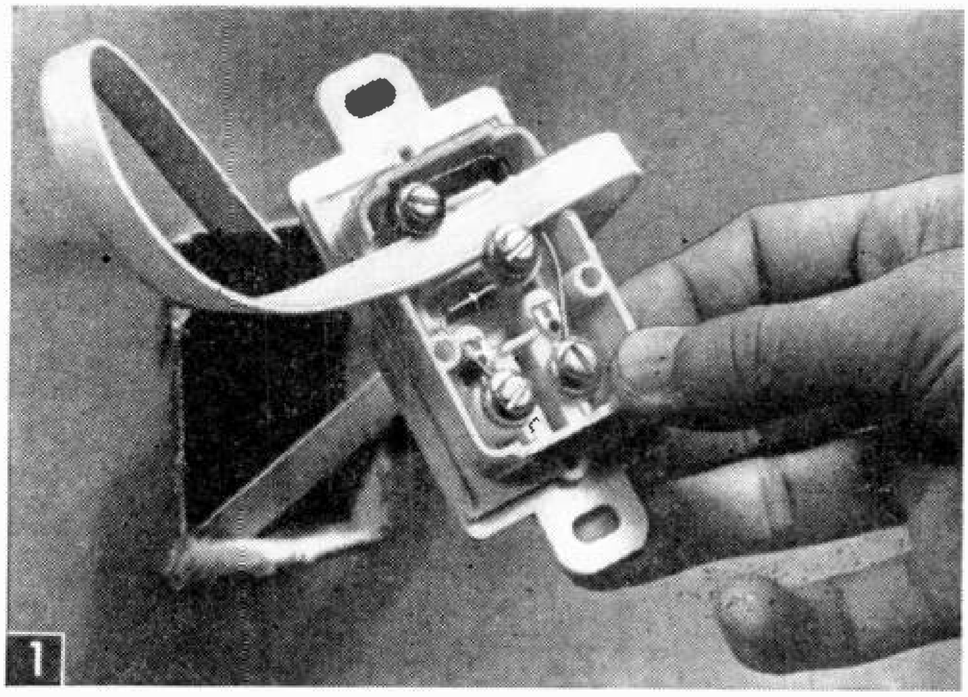
ratios of input and feedback resistors and capacitors in the hook-up. The computer hook-up for solving this differential equation is shown in Fig. 8. The initial conditions are assumed to be zero at the beginning of the problem in this case, and A equals 1.

To set up any problem for computer solution, you begin by assuming you have the highest derivative term, d^2X/dt^2 in this case or this term and its coefficient $A(d^2X/dt^2)$ in this case. Isolate this term, i.e., find out what it's equal to. Then integrate this term to form the lower derivatives. Thus the integral of d^2X/dt^2 is dx/dt; the integral of dx/dt is x. Again, this is college level math. If you have trouble understanding it, try to get help from an engineer or math teacher.

Space limitations do not permit a thorough treatment of dc electronic analog computers in this article. Many books and papers have been written on the subject. For those who are interested in learning more about analog computers, a bibliography is presented (Table A).

Solution to Ham Radio Anagram, Page 88

Installing Plug-In TV Antenna and Booster Systems



You can install TV line outlets in any kind of wall, or along the baseboard. No soldering is required.

This type of antenna system lets you move your TV from room to room; it also banishes signal traps and improves picture quality

By ELMER A. WOLFORD

INSTALL a wired-in-the-wall type of antenna line system, and you'll get rid of TV signal traps, improve picture quality, and be able to use your portable TV and FM receivers in any room. Also, you'll eliminate unsightly indoor antennas and dust collecting coils of wire that have been plaguing your wife.

Cost of the system depends on the number of outlets (also called taps or plates) that you decide to use. These outlets range in price from $1.50 to $2.-81 each. The typical layout (Fig. 2) cost $8.20 for parts (available any electronic supply house) and took a few hours to install.

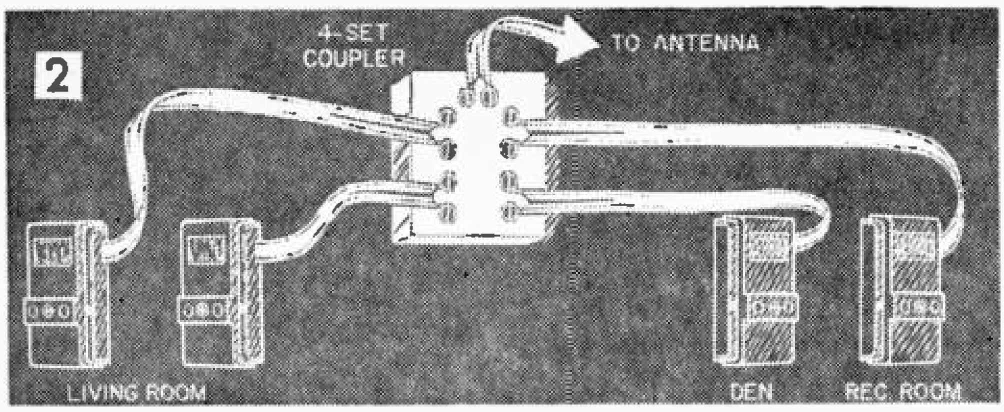
First, sketch exactly where you want your outlets. The 2- or 4-set couplers (Fig 2) will allow you to use all of the outlets at the same time with no interference. An FM radio in your den will not disturb the TV sets in the living room and recreation room, or the FM-AM hi-fi combination.

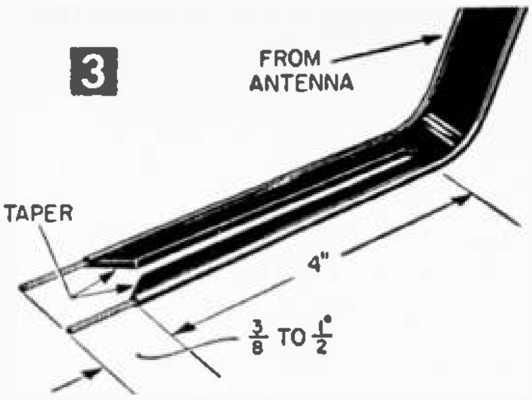
You can choose one of three ways to bring an antenna lead into your house: (1) through the basement to all locations, (2) into the attic and down the walls, or (3) through the outside wall to the antenna wire coming down the side of the building. Pick the route that requires the shortest leads. For example, if you have a tri-level, bring the wires in through the basement.

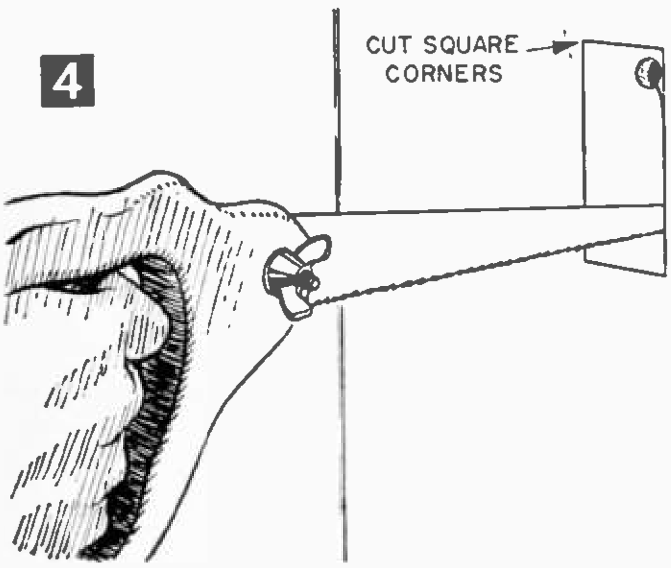
Let's run through a typical basement installation. Start by drilling a ½-in. hole through the wall. Slant the hole upward as you drill from the outside to keep water from running in. Use a masonry drill on brick, stone, or cement walls. Either use an extra-long electrician's type bit, or have a welding shop add a 12-in. extension to your drill bit.

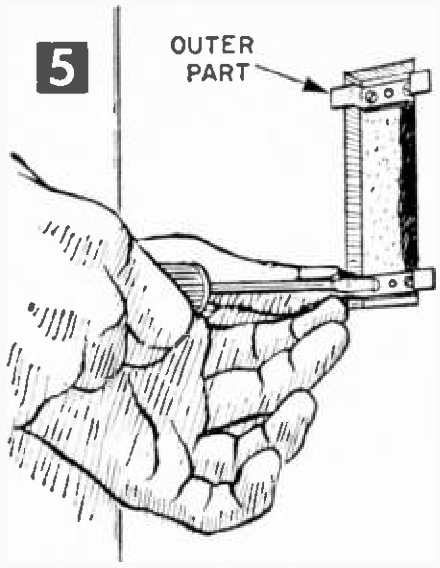
Next bring the wires through a feed-in tube and connect them to your antenna coupler. At no point should the

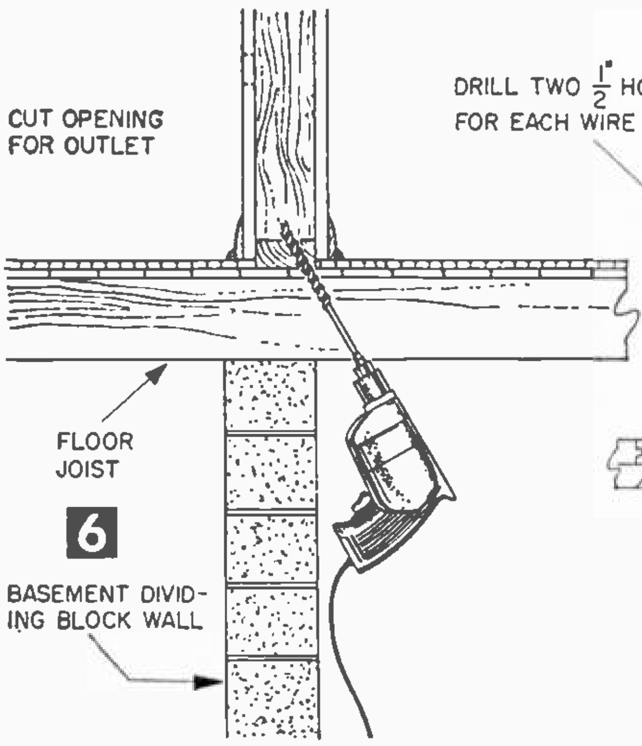
> EDITORS NOTE: The plug-in antenna systems described in this article are not to be confused with the plug-in "antenna eliminators" which are claimed to turn your house wiring into a giant antenna system. Such TV "antenna eliminators" do not always provide consistently strong signals for good viewing on all channels, though some people living close to transmitter have installed the units and effected an improvement, often particularly on sets that previously were running with no antenna, or with standard antennas in poor repair.
>
> Antenna eliminators can also become a shock hazard, in those instances where they include a capacitor circuit that isolates the TV set from the line. In such cases, if one of the capacitors shorts out while the antenna circuit of your TV is plugged into one leg of the house a-c line, it may make all metal chassis and cabinet parts, "hot."

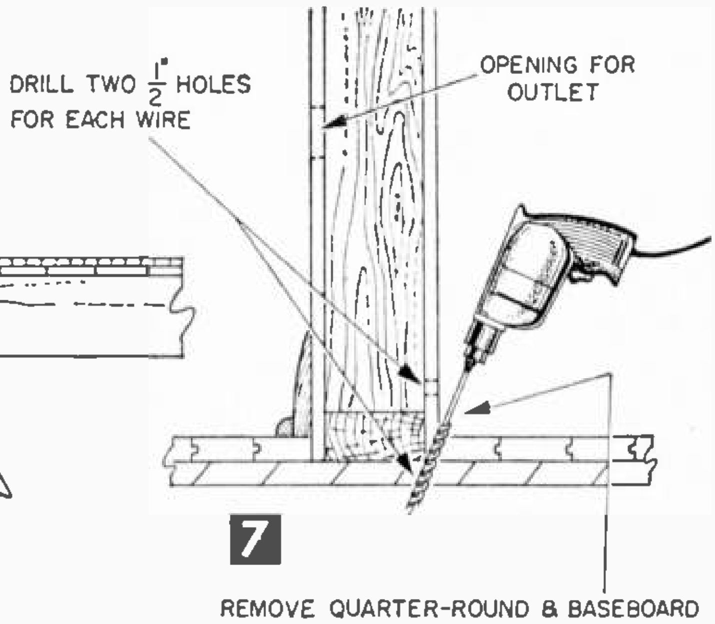












TV transmission line run through pipe, metal conduit, or jacket, since metal around the line will cause a loss in signal strength.

If you follow the Fig. 2 layout, but live in a fringe area where you use two antennas, you will need two 4-set couplers and two line outlet plates. Pick a spot in the basement where the wires from the coupler will be as nearly equal in length as possible. Trim the incoming antenna lead as in Fig. 3. Connect to the coupler terminals marked ANT, and fasten the coupler to the floor joist with wood screws.

Making the Wall Openings is next. In the living room, mark a $1\frac{3}{4}$ x 4-in. rectangle for each outlet, at the same height as your electrical outlets for neat appearance. Tap sharply on the wall to be sure you won't hit a stud, and then drill a starting hole and cut the wallboard or plaster with a keyhole saw (Fig. 4). Mount the brackets (Fig. 5), spacing them to match the holes in the outlet plate.

To spot the holes feeding into the basement, use electrical conduits or heating ducts as guides to find your partition centers. Drill a $\frac{1}{2}$-in. hole directly beneath your outlet opening. Or temporarily remove the baseboard (Fig. 7) and drill through.

Trim the wire end (Fig. 3) and connect to terminals marked SET 1, on the coupler. Follow the most direct route possible between the coupler and the outlet holes, tacking the wire to the joists with wall stand-off insulators. When the wire is up to your hole under the outlet, clip it off with about 4 feet extra remaining. Straighten a metal coat hanger, tape the wire to it, and have your helper pull the line up through the outlet hole in the wall. Again trim the wire end as in Fig. 3, and connect to the terminals on back of the outlet plate. Follow the same procedure installing the outlets in the other rooms.

For a Double Antenna System, locate the second coupler near the first, and run all four outlet lines as before, bringing them up to your two-line outlet plates. Whenever more than one line is connected to an antenna, there is some loss of signal due to stub effect. If you do not need the convenience of using two or more outlets at the same time, you can save money by using polarized plugs (Fig. 8) with which you can quickly connect any desired outlet.

When a TV set is connected into any outlet other than the last of several outlets wired in series, the antenna wire beyond that outlet produces a signal loss. A new kind of switching outlet (Mosley) automatically disconnects the system beyond the outlet in use.

Where TV Signal Strength Is Low, multiple outlets may weaken reception to the extent that pictures are snowy and dull, with poor sound at the receiver. One home system kit (Jerrold $43.98) provides for five TV or FM outlets, and includes an amplifier (Fig. 9). Another system (Blonder-Tongue Co. $57.33) which includes an amplifier and provides for up to eight TV sets, is the answer for apartment buildings, motels and rooming houses. Even larger systems providing for up to 500 outlets are available, but require experienced installers.

Through the Attic Installation is the answer if you have no basement. Drill a ½-in. hole through the roof for each wire and push the wires inside. Mosely *Roof-Thru* or Javex *Tenna-Shingles* permit feeding the antenna wire directly through the roof for short direct connections with less signal loss. Copper flashing inserts (Fig. 10) under the roof shingles prevent water from running into the attic. Black plastic roof cement can also be used to seal these fittings and guarantee no leaks.

For through-the-attic installation, connect your antenna lighting arrestors near the entrance holes and run a ground wire as in Fig. 10. An important advantage of plug-in TV antenna systems is that you can disconnect your TV sets during electrical storms. Lightning has been known to split open the finest arrestors and then the TV set. While you are away on vacation, you can be worry-free knowing that your TV is completely disconnected.

Select the locations for your outlets and drill ½-in. holes above each (Fig. 11). Tie a string to a nut and drop it through the hole to check for obstructions in the walls. If the nut hits bottom, there is no problem, but if there is an obstruction, try another location. Or run the wire through a closet on the other side of the wall, and then out the wall opening. Complete the outlet installations as described before.

The Magic Carpet antenna (Jerrold Electronics Corp.) is a 2½ x 6-ft. flat flexible printed circuit (Fig. 12). You can staple it to the attic floor or joists, to the ceiling of a utility room or closet, or even slip it under a rug. But remember that metal will shield an antenna. If there are large areas of your roof or walls covered with aluminum insulation, particularly along a line between your antenna and the TV station, your signal strength will suffer.

Through the Wall Installation may be the only answer in some homes. Drill a ¾-in.

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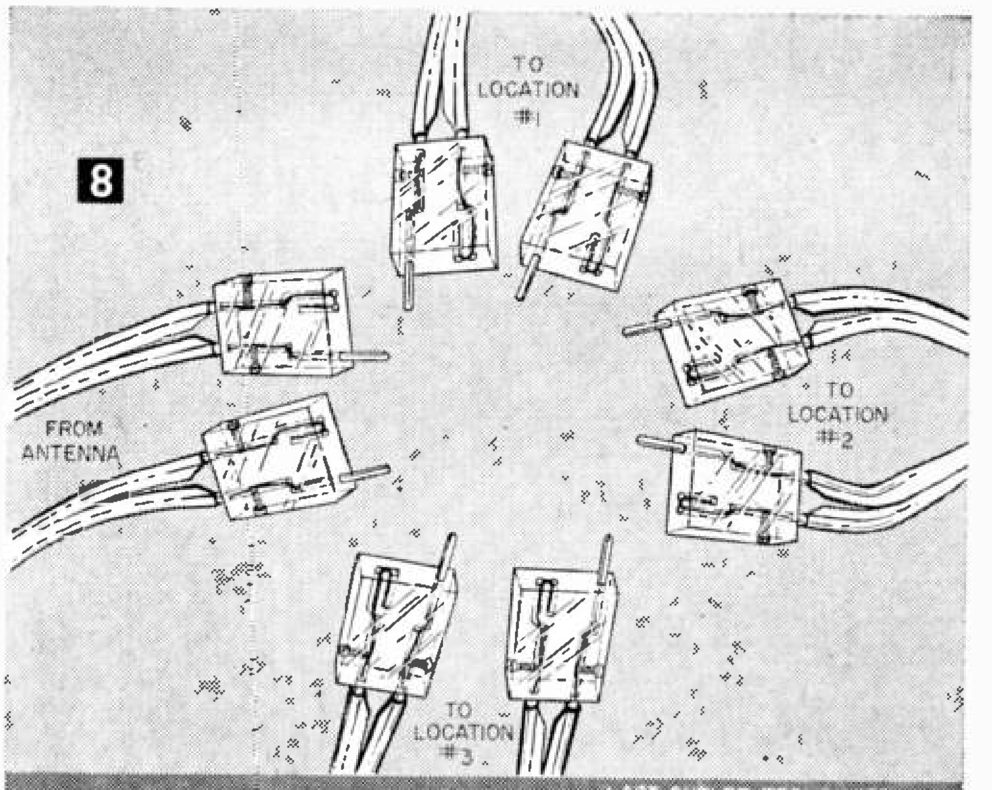

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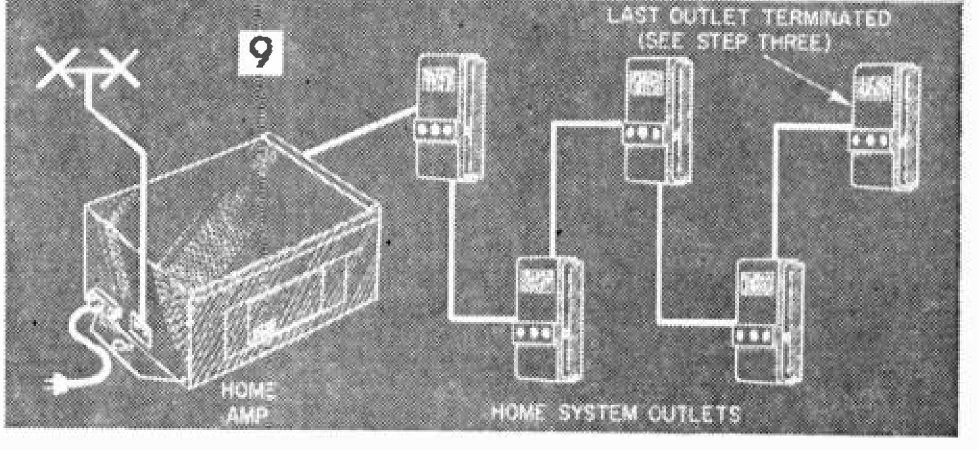

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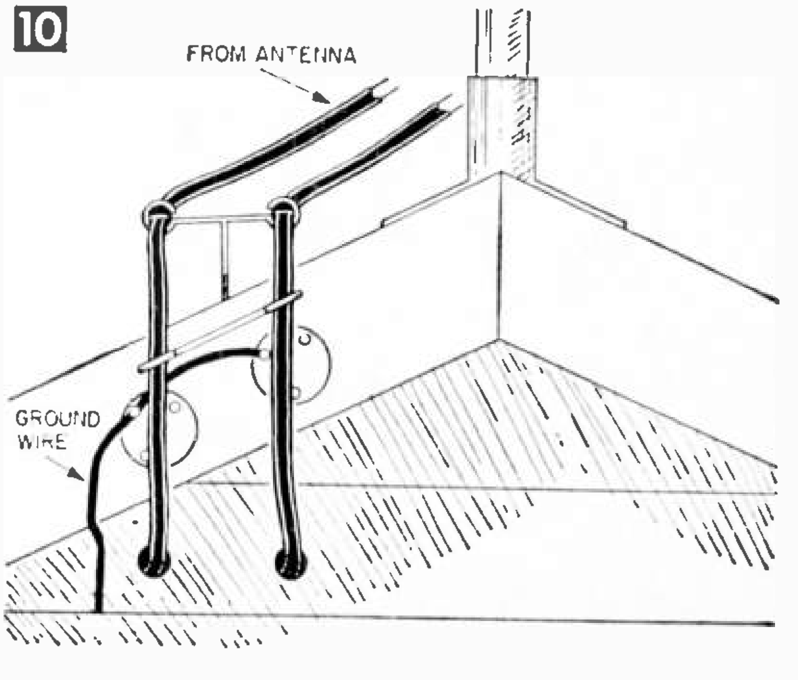

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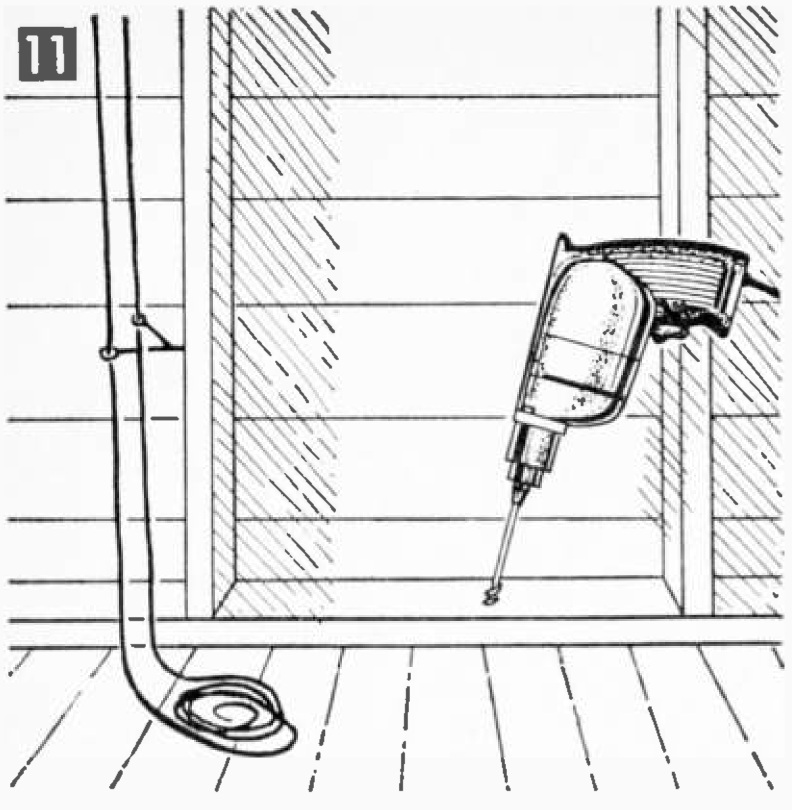
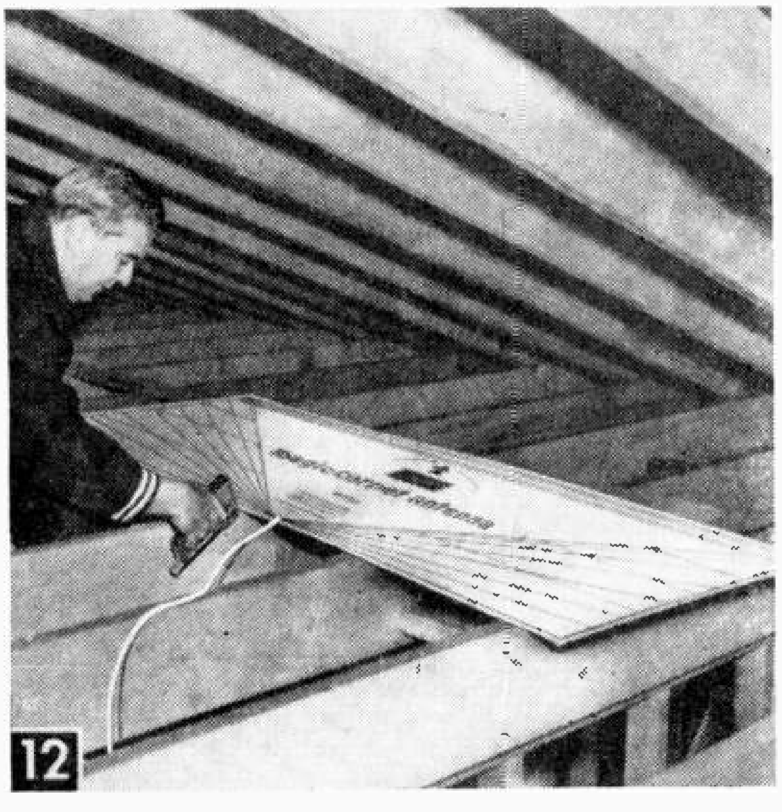


hole through the wall all the way. Insert the Wall-Thru fitting (Mosley Electronics, Inc.) mark it for length, and cut off the excess. A socket mounts directly to the fitting on the inside wall. Re-insert the wall-thru, run the wire through and trim as in Fig. 3. Connect the wires to the socket, and then mount the socket to plate of the wall-thru fitting. Connect to your outlet plug.

Multiple Family Dwellings can be spared the "forest" of many antennas littering the roof top, if multi-set arrangements are used. All-weather TV set couplers can be mounted on the antenna mast or at the eaves. If your area has both low band (channels 2-6) and high band (channels 7-13) stations transmitting, you can couple the two lines together and run one line only by using a high-band, low-band VHF coupler (Fig. 13). This requires that you bring in only one wire to the 2-set or 4-set couplers in various apartments. Cost per outlet will be less. Also, couplers are available for connecting separate VHF and UHF antennas to a single line. These couplers are also excellent for homes.



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Performance of this printed circuit antenna is comparable to outdoor antennas up to 35 miles from the TV station.

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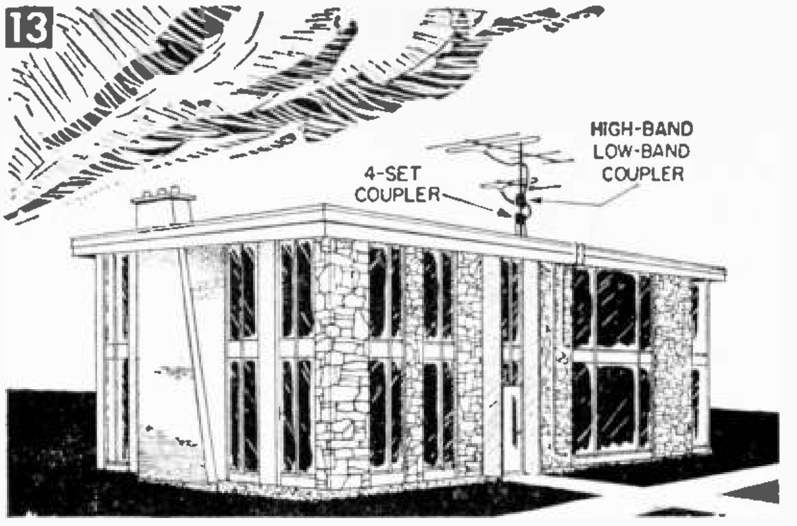


Use either double or single stand-off insulators as you run the wire down the antenna mast, across the roof and down the sides to the apartments. Insert the insulators about every 10 feet. Apply a dab of black plastic roof cement around the stem of each to prevent leaks. Also, install a lightning arrestor on each wire at the point where it enters the building, and run a line down to a ground rod as close as possible to the building.

Custom TV Wiring. New home builders can save money by installing custom TV wiring while the house is under construction. By planning ahead, you can also install your telephone wires and terminate the lines in wall sockets. Install a plaster ring for each outlet location so it will be flush with the plaster board or plaster. In some areas, the code may require a plastic wall box. Also, wall plates are available which provide for both power and antenna connections. A metal barrier plate in the box separates the antenna socket from house wiring to comply with the code, and the plugs are polarized to prevent improper insertion.

Antenna Rotor Controls can also be fed to TV outlet plates. You'll find either four, five or eight wires in the rotor cable. Connections must be correct or you'll burn up the control box, so sketch the hookup and note the color of wire at each terminal before you disconnect anything. Connect the sockets and plugs so that each wire mates color to color.

Chromed outlet plates are also available but are not recommended for fringe area installations. Instead use low-loss polystyrene wall plates. Always, the wire between outlet plates and the TV set should be as short as possible, preferably under 4-ft. in length, for optimum reception.

Electronics Father and Son Hobby

By FORREST H. FRANTZ, SR.

SOME people tell us that modern family life has been torn to shreds. Too many cars, too many television sets, too many widely scattered activities and hobbies shoot the members of a family in different directions, they say.

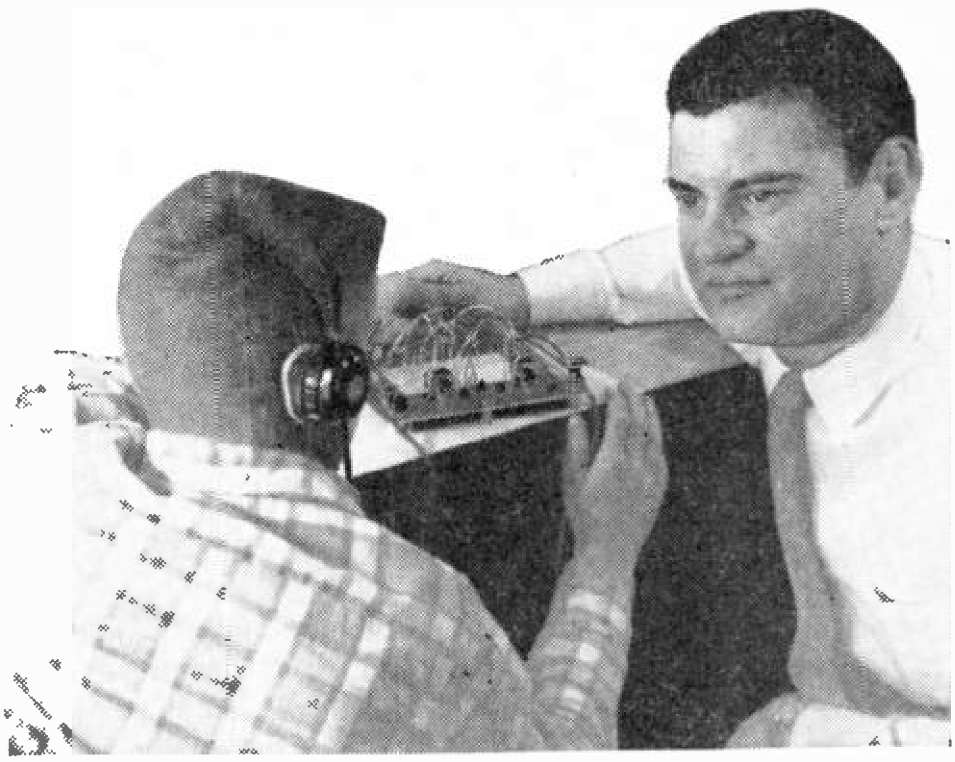
Bunk! In our family, we benefit from these activities and find them a mutual basis for enjoyment. The hobby? Well, that's one of the best friendship cements there is. And I don't know of any hobby that tends to keep a father and son as close to each other as electronics.

Why electronics? While he certainly can profit from your wisdom in matters of sportsmanship, your son probably can do fine on his own from the standpoint of athletic skill. When it comes to electronics and other scientific-engineering hobbies, however, he will need your help. And activities such as these can lead your son to a career in which he can one day support his family very comfortably. More important, an interest in electronics stimulates an understanding of science that is essential in our technological age.

There's another important angle to electronics as a father and son hobby: it will keep *you* interested, too. If your son engages exclusively in activities that don't appeal to you, it's hard for you to be the kind of buddy you should be. You've got to be an enthused participant rather than a tolerating one.

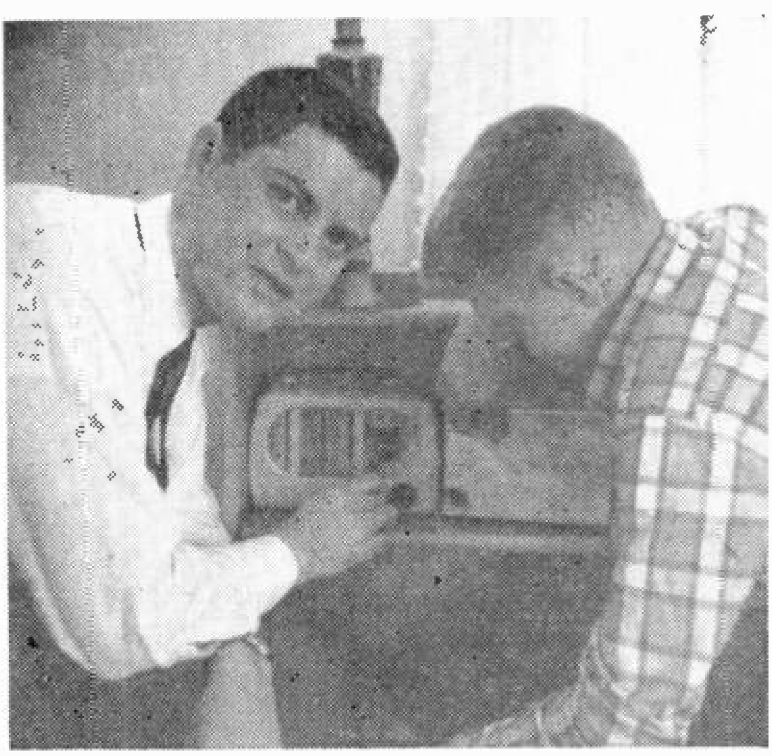
Incidentally, Junior, if you're reading this, there's a good reason for getting Dad in on your electronics hobby, in addition to the obvious one that you like the guy and want to do things with him. Although you can do a lot in electronics with a limited budget, you can do a great deal more if the purse strings aren't too tight. Get Dad interested in electronics, and he'll soon realize this.

As a matter of fact, you can show him how he can make some big savings by letting you build home intercoms, hi-fi amplifiers, receivers, battery chargers, and other modern living essentials from kits. Chances are he'll be wrestling with you for the soldering iron when the kits arrive. If that's the case, give him a chance because it's your opportunity to get him into electronics in a solid way.

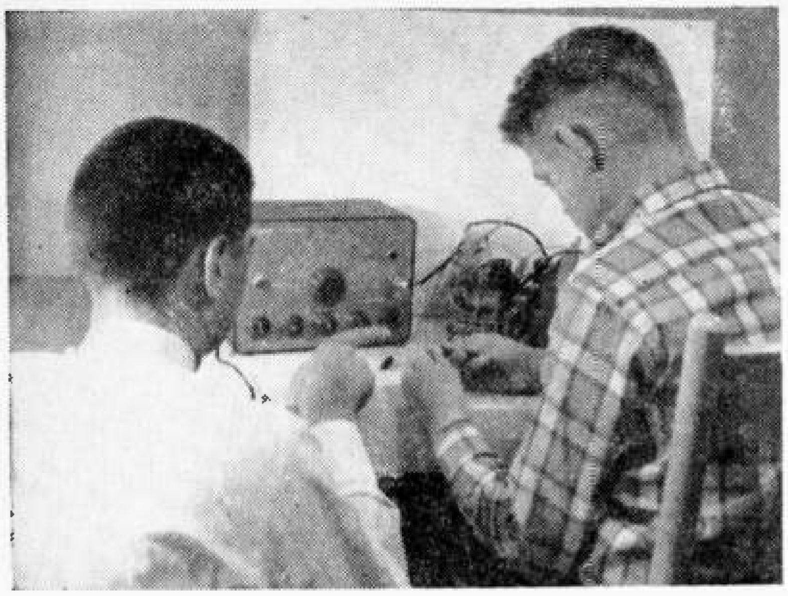


An electronic lab type kit which features a number of construction projects is a good investment for beginners.

Assuming we want to get started on a father and son basis, what are the ground rules? In the first place, you can't cram a hobby down someone's throat. Create interest by exciting curiosity and enthusiasm. A boy who can show his father a clever electronic device that he built for a few dollars will usually find his father's interest and pocketbook available. A father who can show his son a very compact radio or other elec-



Short wave converters and radios are excellent projects after the beginner has acquired some know-how.



Learning how to build test equipment for use in trouble shooting radios and construction projects is important.

tronic device usually has a ready and willing partner for the next construction project.

Where do you start? Age and "do-it-yourself" know-how have considerable bearing on this question. A boy under ten years of age might well start on a crystal set such as the Allied-Knight 83Y261 ($2.50) and then progress to a code practice set such as the Lafayette KT-72 ($2.99) or the Knight 83Y239 ($3.95), which provide an opportunity to learn code. After this he may progress to the point where an older boy might start—the experimental stage. An experimental kit may be a home-rolled job or a professional one such as the Allied-Knight 83Y299 Transistor Lab Kit ($15.75).

A project that is usually best reserved till after the Lab Kit is a short wave converter kit such as the Lafayette KT-123 ($9.80). This converter brings in short wave on a broadcast receiver without any receiver changes. In lieu of the converter a simple short wave receiver such as the Knight 83YX259 "Space Spanner" ($19.95) might go well. The short wave converter or receiver approach is a good one because it creates an extracurricular electronics interest that is broadening and doesn't eat up additional kit or parts dollars.

At this stage of the game, you're ready to go on to test equipment. A multimeter is a must for the serious electronics hobbyist. The Lafayette TK-10 Kit ($11.95) or the Heathkit MM-1 ($29.95) are representative kits. A signal generator such as the Knight 83Y145 RF Signal Generator ($19.75) is also an important instrument to acquire.

If the kit prices seem to amount to a lot of money when you add them up, bear in mind that this number might represent a year's investment.

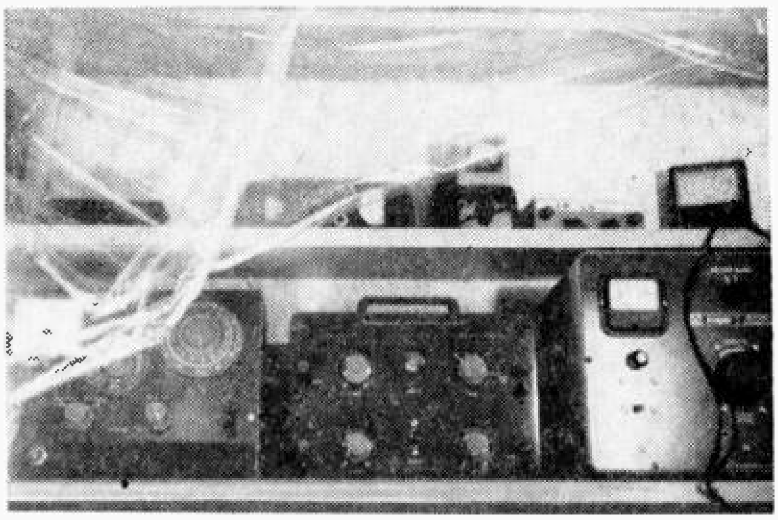
In some cases, of course, the father and son team will want to move faster. Regardless of the rate at which you pursue your electronics hobby, remember that every dollar you spend for kits or construction parts is buying know-how, skill and experience, as well as equipment for future use.

At this point in the father-son electronics pursuit, you're ready to tackle magazine construction projects. Generally speaking, this kind of construction is more educational than kit construction. But kits are recommended for earliest projects because construction success comes easily with a minimum amount of know-how and time.

One word of caution. Don't get so wrapped up in turning out construction projects that you neglect to learn electronic principles. To get the most out of your hobby, back the construction with reading in electronic theory. Some good books on the fundamentals will help considerably. Try to understand how circuits work. This will give you a fuller understanding of your hobby and a better basis for a future in electronics.

Good luck to both of you on your electronic hobby. And by the way—maybe mother and sister would like to get in on the fun, too.

Protect Instruments with Polyethylene Film



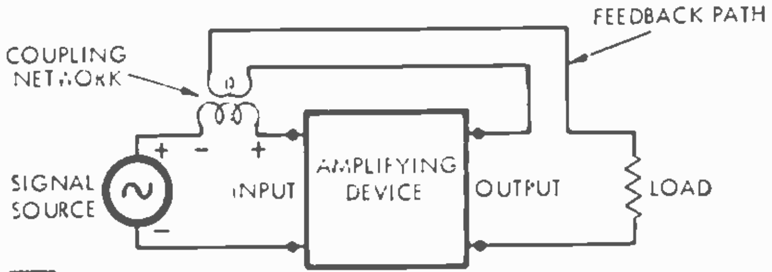
• Dust and other air pollution poses a threat to instruments. This pollution readily enters ventilation openings and can eventually cause trouble. But the more visible effects on the exterior of instruments are likely to become annoying in a much shorter time. Greasy particles tend to make dirt stick to instruments and cause a film to form. In a short time the once shiny instrument has lost its luster. This dirt film is not easy to remove, and sometimes the required cleaning will damage the instrument finish.

A sheet of polyethylene film fastened to the front of your instrument shelf will protect your instruments and minimize the effects of pollution in the air. The polyethylene film protects the instruments and yet allows you to see them. Simply throw it back to use the instruments.

The polyethylene film may be obtained from Sears-Roebuck or it may be salvaged by splitting a polyethylene clothing bag.

Using Positive Feedback

By C. F. ROCKEY



1 DIAGRAM OF AMPLIFIER EMPLOYING FEEDBACK

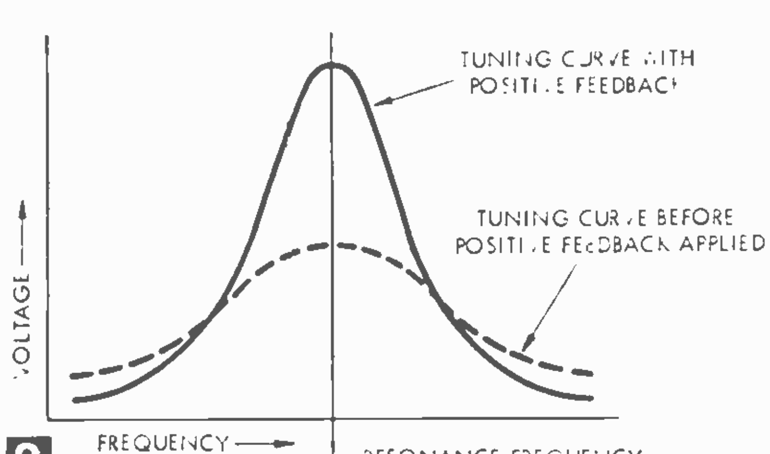
ONE of the truly valuable techniques available to the small-receiver designer is positive feedback, or regeneration. Most small receiver projects utilize it; in fact, all truly sensitive receivers using less than five tubes or transistors probably apply this principle.

Positive feedback owes its effectiveness to the reduction of circuit losses which it accomplishes. All apparatus contributes some loss of energy to a radio signal as it passes through; even one inch of hookup wire has measurable resistance. This unavoidable extraction of signal energy reduces both the available amplification and the selectivity of a receiver. Positive feedback takes a little of the relatively strong signal appearing in the output of an amplifier and transfers it around to the input, overcoming some of the losses in the circuit (Fig. 1).

Thus the losses of the circuit are reduced, and in effect the resistance of the tuning circuit or other circuit is reduced. In the case of the tuning circuit, since selectivity is an inverse function of its resistance, the tuning curve will be sharpened considerably (Fig. 2).

By "positive" feedback is meant that the feedback path and coupling network are arranged to make the feed-back voltage add to the original signal voltage at any instant. Such a connection enhances the gain and reduces the bandwidth of the circuit involved.

The additional gain is expressed in this formula:



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$$\text{Gain with Positive Feedback} = \frac{\text{Normal gain}}{1 - \text{Normal gain} \times \text{Feedback Ratio}}$$

The feedback ratio is the ratio of the voltage fed back over the output voltage. It is always a number smaller than one.

Even though you've let your algebra slip, you can still see that as the feedback ratio (amount of voltage fed-back, in effect) is increased the denominator of the fraction grows smaller. And as the denominator grows smaller, you will recall, the whole quantity becomes larger, since the numerator remains constant. This means that a comparatively small amount of feedback will give a large increase in gain.

Suppose we have an amplifier with a normal, non-feedback gain of five. Now, let us arrange that 1/10 of the amplifier's output voltage will be additively (positively) fed-back into the input. Substituting these values into our equation we see that:

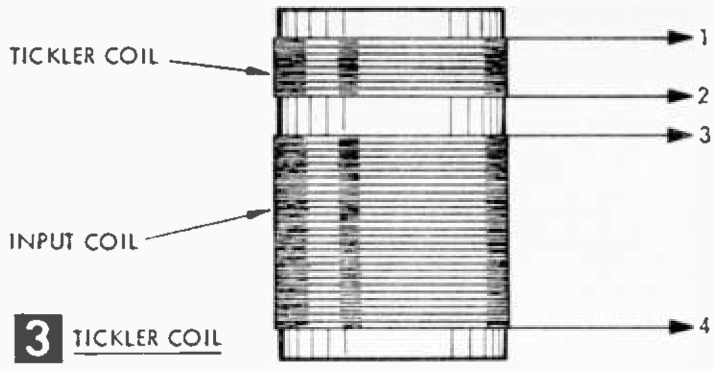
$$\text{Gain with Feedback} = \frac{5}{1 - (5 \times 1/10)} = \frac{5}{5/10} = 10$$

Thus we see that even this comparatively small amount of feedback has doubled the actual amplification of our system. Some calculated gain values obtained from this same hypothetical amplifier with various values of feedback are tabulated below:

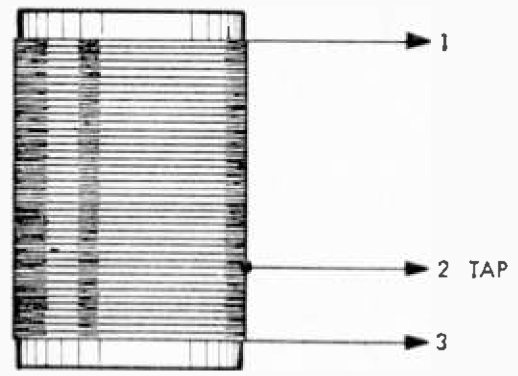
Ratio (Feedback Voltage / Output Voltage)	Effective Circuit Amplification
Without Feedback	5.0
0.05	6.7
0.10	10.0
0.125	13.7
0.150	20.0
0.175	40.0
0.195	200.0

The value of feedback is limited by the fact that when the product of the normal gain times the feedback ratio becomes equal to one, the system breaks into oscillation. As the feedback is increased toward the maximum value, the circuit adjustment becomes exceedingly critical. But positive feedback makes it possible to obtain as much amplification from one tube or transistor as would be gotten from two or three without it, so it is well worth the drawbacks.

Positive feedback is always employed in the



3 TICKLER COIL



4 TAPPED INPUT COIL

TABLE A—TICKLER COIL CONNECTIONS

Type of Circuit	Connection Numbers			
	1	2	3	4
Vacuum Tube Grounded Cathode	Plate	B+	Ground	Grid
Vacuum Tube "Hot" Cathode	Ground	Cathode	Ground	Grid
Grounded Emitter Transistor	Emitter	Battery	Ground	Base
Grounded Base Transistor	Battery	Collector	Ground	Emitter

TABLE B—TAPPED INPUT COIL CONNECTIONS

Type of Circuit	Connection Numbers		
	1	(Tap)2	3
Vacuum Tube Grounded Cathode	Plate	Cathode	Grid
Vacuum Tube "Hot" Cathode	Grid	Cathode	Ground
Grounded Emitter Transistor	Collector	Emitter	Base
Grounded Base Transistor	Collector	Emitter	Base

higher frequency circuitry of a receiver, since the bandwidth-limiting action makes its use in the audio section inadvisable. While most often employed in the detector circuit, regeneration often also improves the operation of if or rf amplifiers; here it increases both sensitivity and sharpness of tuning to a marked degree.

In any case, the requirements for successful application of positive feedback may be summarized as follows:

1. The feedback must add to the signal input voltage at all times. This means the phasing or polarity of the coupling circuit must be correct.
2. The magnitude of the feedback's effect must be under perfect control and smooth at all times.
3. Normal control of feedback must have a minimum effect upon the frequency to which the circuit is tuned.

Most often, an inductive feedback system is used wherein the energy is transferred via a magnetic field.

The first method of inductive feedback employs a tickler coil, connected in series with the output circuit and coupled magnetically to the tuned input coil. If the two coils, tickler and input coil are wound in the same direction and on the same form, they must be connected according to Fig. 3 and Table A.

The tickler coil should be spaced as closely to the input coil as possible, and should contain the fewest possible turns, determined by experiment.

Another commonly-used arrangement for providing positive feedback is by the use of a tapped input coil. This is shown in Fig. 4, connections in Table B.

Again, exact placement of the tap along the coil must be determined experimentally in new designs; in most cases, however, the number of turns between connections one and two will be appreciably greater than between two and three.

Although physical arrangements may vary, other taps may be used in certain applications, particularly with transistors, but the identical principles apply in coil connections.

Control of the effects of feedback is most often accomplished by controlling the gain of the circuit rather than by varying the feedback coupling. This is because most feedback variations tend to influence the tuning of the circuit at the same time.

The most widely-used method for controling the effect of feedback involves varying of either the dc plate voltage (with triodes) or the screen-grid voltage (with pentode tubes). With transistors, current practice involves variation of the dc base bias in most instances. This is practically done with a well-bypassed volume control potentiometer. When set up properly, these means provide absolutely smooth and reproducible control of the effects of feedback with a minimum of influence upon circuit tuning. This, along with a little circuit savvy and shielding, suffices for requirement three that we stated earlier.

From the operational standpoint, these two rules should be observed:

1. For maximum gain, adjust the effective feedback as closely to the oscillation point as possible. The oscillation-point is manifested by a click or plunk, followed by evidences of instability or reduction or gain as the feedback is advanced.

2. If for any reason it is desirable to operate the circuit in an oscillating condition; as for CW radiotelegraph reception with the simple receiver, for instance, again always operate as close to the oscillation-point as expedient.

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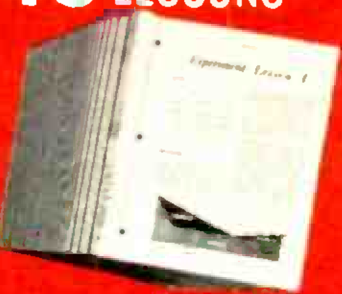

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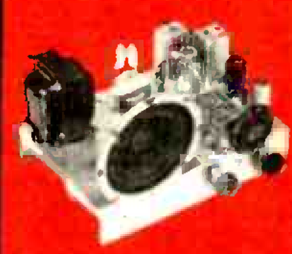

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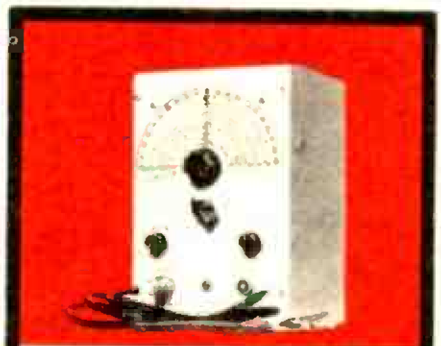

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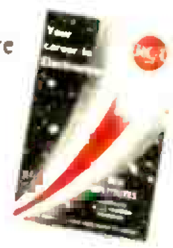

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G	Audio-Hi Fidelity	V-3 or equivalent	Eve. 3 mos.
H	Video Tape	V-3 or equivalent	Eve. 3 mos.
I	Technical Writing (V-10)	V-3 or equivalent	Eve. 3-18 mos.
J	Computer Programming	High School grad	Day 6 weeks Eve. 24 weeks Sat. 30 weeks
K	Radio Code (V-4)	8th Grade	Eve. as desired
L	Preparatory Math & Physics (P-C)	1 yr. High School	Day 3 mos.
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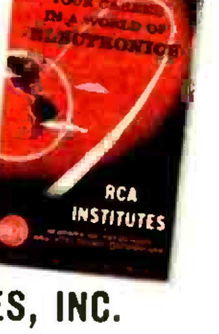

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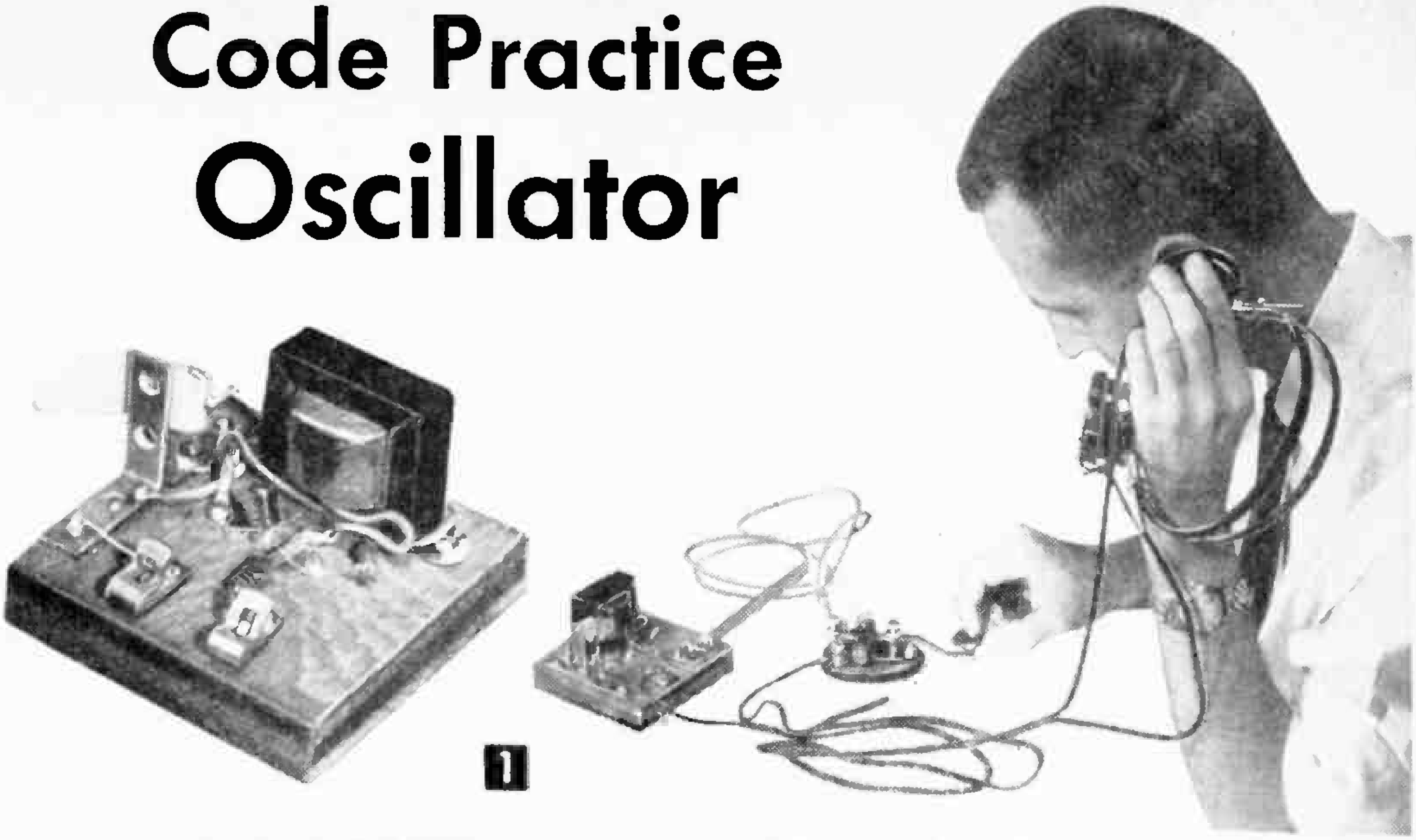
Code Practice Oscillator



By C. F. ROCKEY

A quick dip of the blotting paper, place it between the brackets, and you've set the set to buzzing, ready to key off for code practice.

AYE, LADDIE, if you've got a bit of the Scots in you—or even if you haven't—you'll ken this thrifty little oscillator. Its source of power is tap water—or spit—and it's just the thing for code practice, for circuit continuity testing, for capacitor checking, and for use as a signal source when adjusting hi-fi or public address amplifiers.

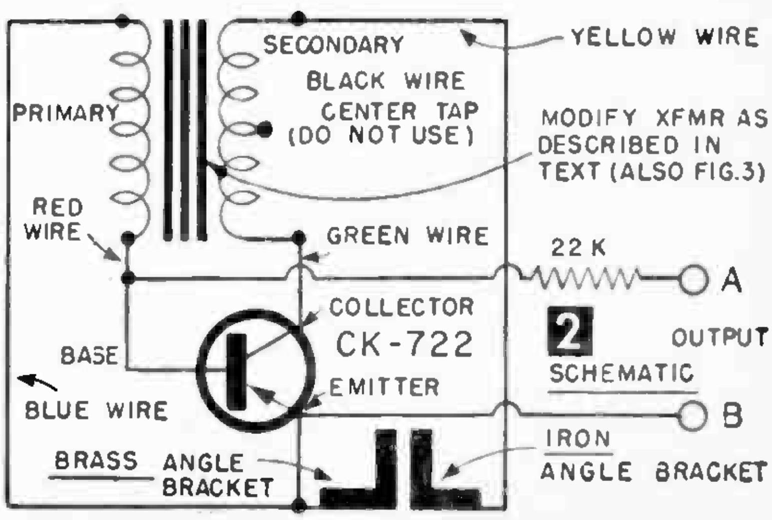
To build it, first saw, sand smooth and shellac a ¾-in. piece of soft pine or plywood to a 4 x 4 in. block. This is your oscillator's chassis. Next, physically modify the driver transformer by bending the bottom fastening lugs away from the core and removing the mounting frame, finding the dividing point between the "E" and the "I" sections of the core (see Fig. 3) and—carefully—prying up and removing the "I" section. Set the "I" section aside, re-insert the modified core in the transformer's frame and bend the fastening lugs in place.

We used a Thordarson 14-D-93 interstage audio coupling transformer (4:1) that we had on hand, but this type has been discontinued by the manufacturer. Its closest present Thordarson equivalent is the 20-A-16 interstage transformer. This —or any similar transformer made by any other manufacturer—will work just as well in the oscillator's ultra-simple circuit.

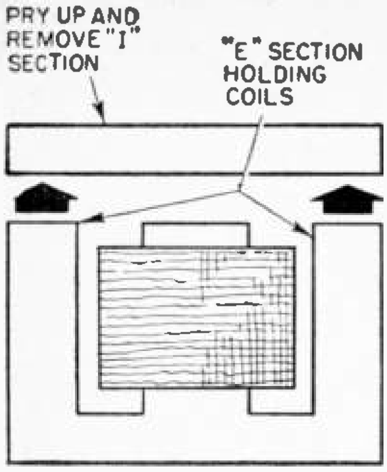
When transformer is modified, mount it and all other circuit components except the angle brackets on the wood-block chassis (see Fig. 4), with ½-in. #6 r.h. wood screws. Before mounting the two angle brackets, clean their facing surfaces carefully with sandpaper or steel wool. Mount them with faces about 1/16 in. apart.

Make all connections to the transistor connecting lugs before mounting the transistor to avoid any possibility of damaging the transistor with soldering heat. When all wiring is complete (see Fig. 2) and checked, put the transistor into the circuit by clamping its leads under the appropriate soldering lugs and screwing them tight. (The transistor lead adjacent to the red dot is the Collector, the center lead is the Base, the remaining lead is the Emitter.)

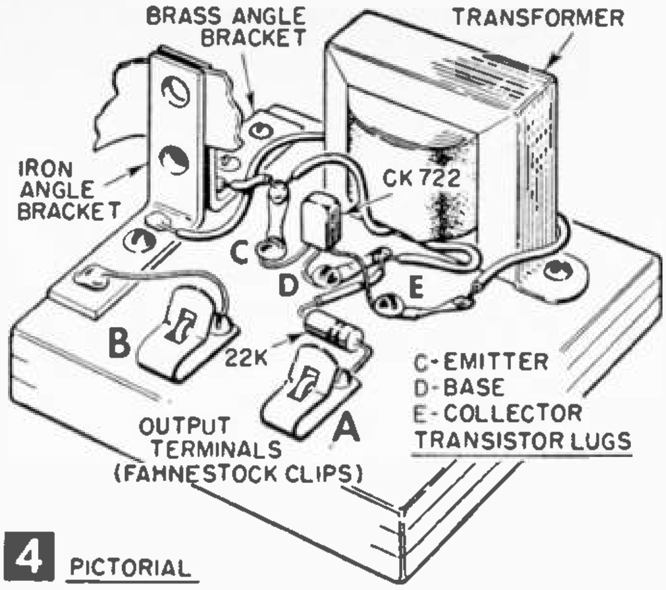
Spit Power. Strictly speaking, the source of power for this oscillator is not spit or water. Water is simply the electrolyte of a simple voltage generating cell whose plates are the dissimilar metal faces of the iron and brass brackets. Immerse a piece of blotting paper (about ½ x 1½ in.) in tap water, or moisten the paper with saliva, insert it between the bracket faces and you will have a source of power for your oscillator. What you're doing, is duplicating one of the first steps taken by Alessandro Volta (1755-1837) in developing the world's first battery (or *pila*, as Volta called it). Volta found that if two dissimilar metal plates (he used copper and zinc) were separated by moist paper, a current would



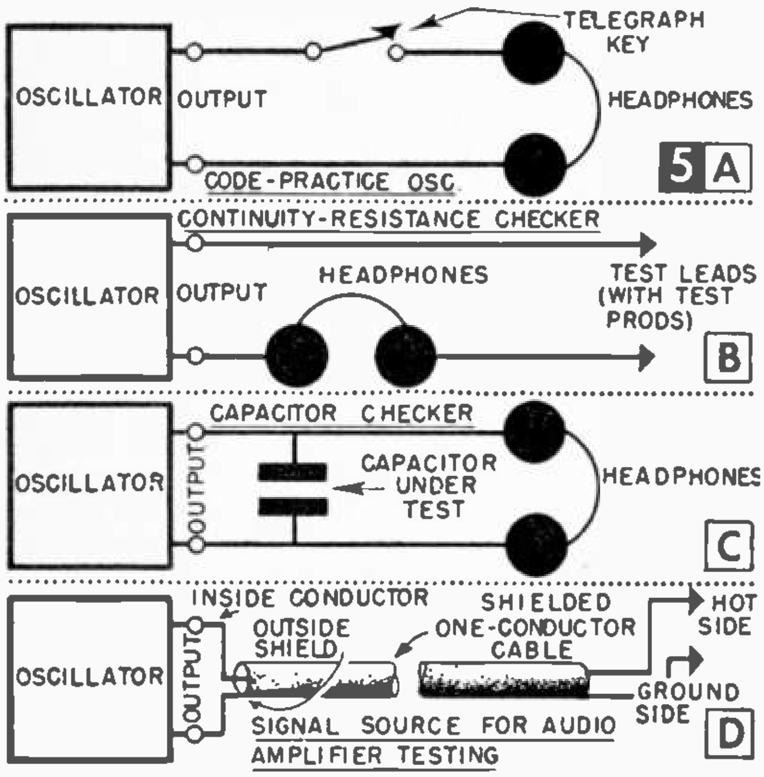
2 SCHEMATIC



3 MODIFICATION OF TRANSFORMER



4 PICTORIAL



MATERIALS LIST—SCOTSMAN'S DELIGHT

No. Req'd	Description
1 pc	¾x4x4" pine or plywood
9	#6x½" r.h. wood screws
1	brass angle bracket, 1½" arms
1	iron angle bracket, 1½" arms
2	Fahnestock clips
1	CK722 Raytheon transistor
1	Thordarson 20-A-16 transformer (or Stancor A-53 or Triad A-31X)
1	22,000 ohm, ½ watt resistor
1 pr	2000-4000 ohm headphones (Trimm "Featherweight" standard or "Professional"—Allied cat. no's. 59J000, 59J020, or 59J021)
1 pc	blotting paper

flow between them when their outer surfaces were connected together.

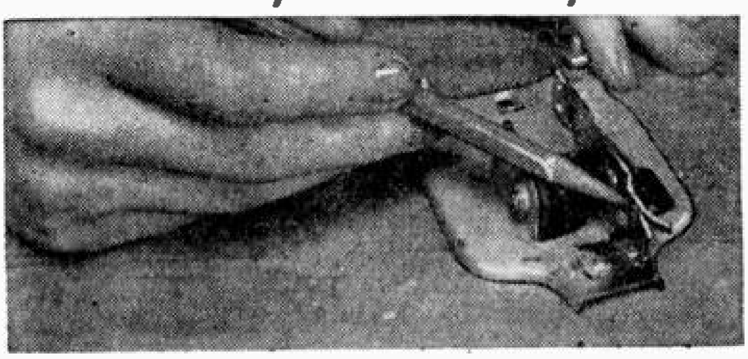
Ordinary tap water usually contains enough impurities to act as an electrolyte; saliva, too. But if you don't get oscillation with either used as an electrolyte, do as Volta did, use a dilute salt solution, ½ teaspoonful of table salt in a small glass of water.

To test the unit for oscillation, connect a high-impedance (2000 to 4000 ohms) pair of earphones across the output terminals and listen for a clear, smooth tone of about 500-1500 c.p.s. If you don't hear such a tone, check the wiring and transistor connections for correctness and if these are as they should be insert a 1½v. dry cell temporarily across the brackets (plus side of cell to the brass bracket). This will give you a check on the transistor's condition. If it's good, oscillation will certainly occur. If not, substitute a new transistor in the circuit. (CK722's have proved unusually reliable in this simple circuit, but any other good PNP transistor may also be used.) Also, if you have used a transformer other than those specified in the Materials List, see if reversing its primary connections helps the tone.

With the unit operating, it can be used as a code-practice oscillator (see Fig. 5A); as a continuity-resistance checker to locate open circuits (Fig. 5B)—in circuits up to 10-megohms resistance if you use sensitive phones; as a capacitor checker (Fig. 5C); and as a signal source for audio amplifier testing (Fig. 5D). If too much hum is present for best audio amplifier testing, put the oscillator in a grounded coffee can and bring the shielded cable out through a hole in the can's top cover.

In capacitor testing, a good paper or mica capacitor in the capacity range of .001 mfd to .1 mfd will slightly weaken the signal and noticeably change its frequency. An open capacitor will have no effect on the signal, a shorted capacitor will kill it. (It is not recommended that you test electrolytic capacitors with the oscillator.)

Heavy Current Relay



• This little relay will handle as much as two amps. without trouble. Remove stationary contact of an electric bell or buzzer and turn it around. When current flows through coil, armature is pulled in and it makes contact with stationary member.—R.F.Y.

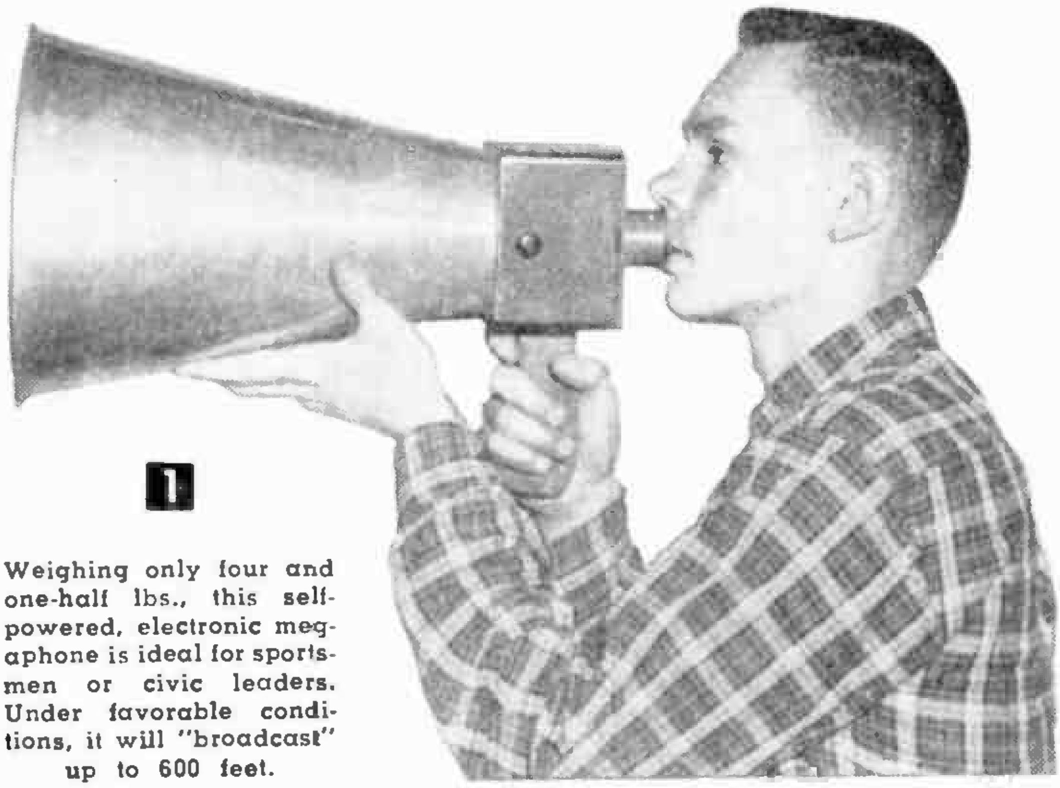
Better Soldering

• When using non-corrosive soldering paste flux for radio work, first warm the joint slightly with the soldering iron, then apply the paste with a piece of wire. The small amount of flux which melts on the joint is entirely adequate. Excessive flux spreads to adjacent insulation, causing leakage.

Transistorized Electronic Megaphone

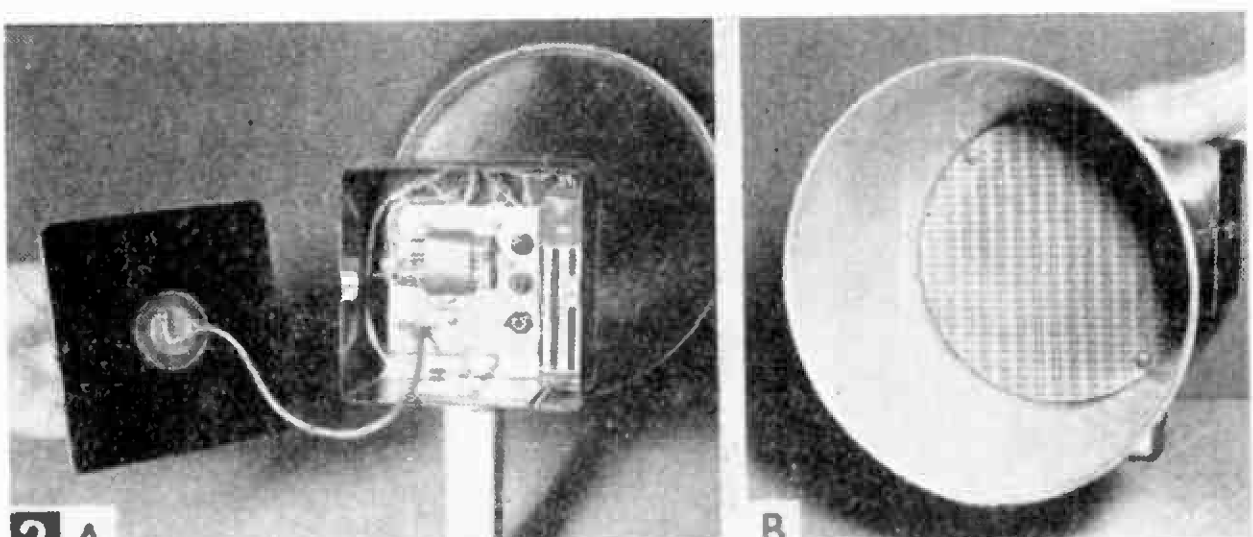
Highly portable, self-contained P.A. with a 500-ft. plus range

By HAROLD P. STRAND



1

Weighing only four and one-half lbs., this self-powered, electronic megaphone is ideal for sportsmen or civic leaders. Under favorable conditions, it will "broadcast" up to 600 feet.



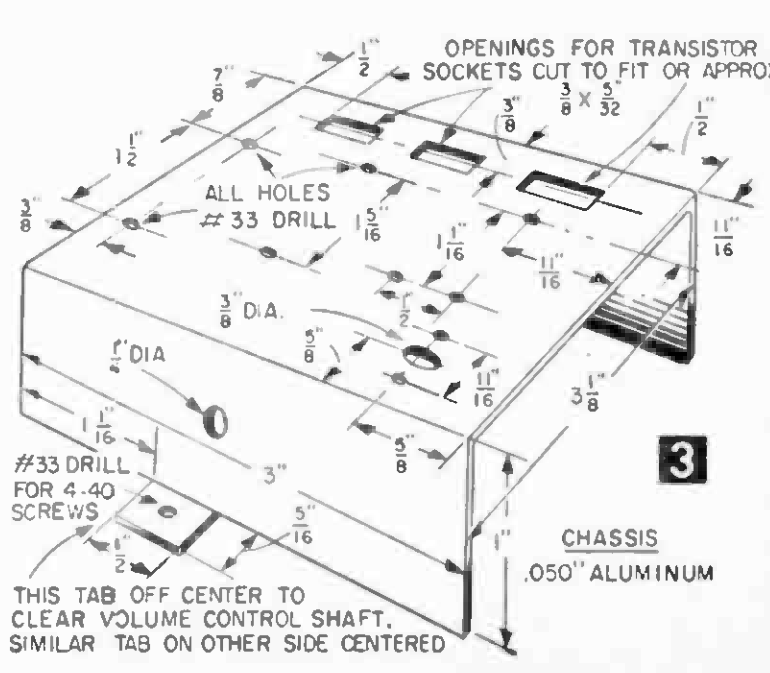
2 A B

Fig. 2A (Left) Cover removed to show housing components (detailed in Figs. 3 and 4). Note small microphone mounted in cover plate at left, with its leads plugged into amplifier chassis. Fig. 2B (Right) Front of megaphone, showing how grille cloth mounted over wooden ring holding speaker presents neatly finished appearance.

WHETHER you skipper your own cabin cruiser, or are active in local civic groups which hold or sponsor sports events, public meetings or rallies, you'll find this highly portable, self-contained "public address" system mighty handy for long distance hollering. Come to think of it, this megaphone might be just what your wife would like to have for summoning the children for supper. It will "broadcast" intelligible speech from 500 to 600 feet, depending on weather conditions.

This unit is designed for medium level voice amplification. Transistors employed in an amplifier circuit allow the use of small, light batteries contained in an attached housing back of the horn (Fig. 2). It has a volume control, although raising or lowering the voice level usually serves to control the output volume. A push-button switch on the pistol grip handle is controlled by the forefinger. Holding the switch closed turns the power on from the 22½ volt battery and the 3 volt bias battery. Releasing the switch eliminates power drain when megaphone is not in use.

Since the *in-use* maximum current drain at the loudest volume level is about 40-50 milliamperes from the 22½ volt battery, and about 2.5 from the 3 volt battery (used as



3

MATERIALS LIST—ELECTRONIC MEGAPHONE

Electronic parts listed below were supplied by Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N. Y.

- 1 6" P.M. speaker. 2:15 oz., magnet. Oxford 6EVS 3.2 ohm voice coil or Utah equivalent, with 4-6 watts rating
- 1 Shure microphone, MC-11 controlled reluctance type, 1" diameter
- 3 transistor sockets MS-275
- 3 G. E. 2N44 transistors
- 1 RCA type phono jack and plug
- 10" shielded cable, small diameter (about 1/8" O.D.)
- 1 10,000 ohm miniature volume control VC-34
- 1 Burgess XX15 B battery, 22½ volt
- 2 Burgess #Z penlight cells
- 1 three-prong plug to fit XX15 battery
- 1 AR-109 driver transformer
- 1 AR-138 output transformer
- 1 Argonne 8 mfd 15 volt capacitor, 15v
- 1 47 ohm ½ watt resistor
- 1 22,000 ohm ½ watt resistor
- 1 1200 ohm ½ watt resistor
- 1 #6 solder lug or more if needed for ground conn. (see below)
- 1 Bakelite terminal strip 7 terminals, two grounded, Jones 55-C
- 2 Bakelite terminal strips 2 terminals, one grounded, Jones 51-A (Note: You can use 5 terminals on first and 1 terminal on second strip mentioned above, all lugs to be insulated and use solder lugs under chassis screws for ground connections)
- 1 miniature knob for 1/8" shaft MS-185
- 1 piece plastic grille cloth about 7 x 7"
- 1 D.P.S.T. push leaf switch, Switchcraft 1004 or Mallory 1014
- 1 speaker cone made of half-hard .032 sheet alum., riveted or with lock seam, front end rolled bead, 12¾" long, 9½" O.D. large end, 4" O.D. small end. Robert Towne, 49 Abbott Avenue, Everett, Mass., will make them for our readers for $7.25 P.P. in U.S., express or money order

BAKELITE—supplied by Forest Products Co., 131 Portland Street, Cambridge, Mass., for $3.00 P.P. in U.S., express or money order.

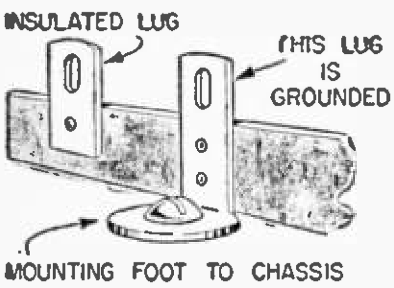
- 1 pc black paper base ¼ x 5 x 5". Cut and dress to tightly fit inside housing
- 1 pc black paper base 1/8 x 5 x 5". Cut and dress to fit on outside front of housing
- 2 pcs linen base natural finish 1/8 x 5 x 2¼" (handle sides)
- 1 pc paper base natural finish tubing 1½" O.D., 1/16" wall, 1⅞" long (mouthpiece)

MISCELLANEOUS METAL AND WOOD STOCK (Try local metal-working and cabinet shops)

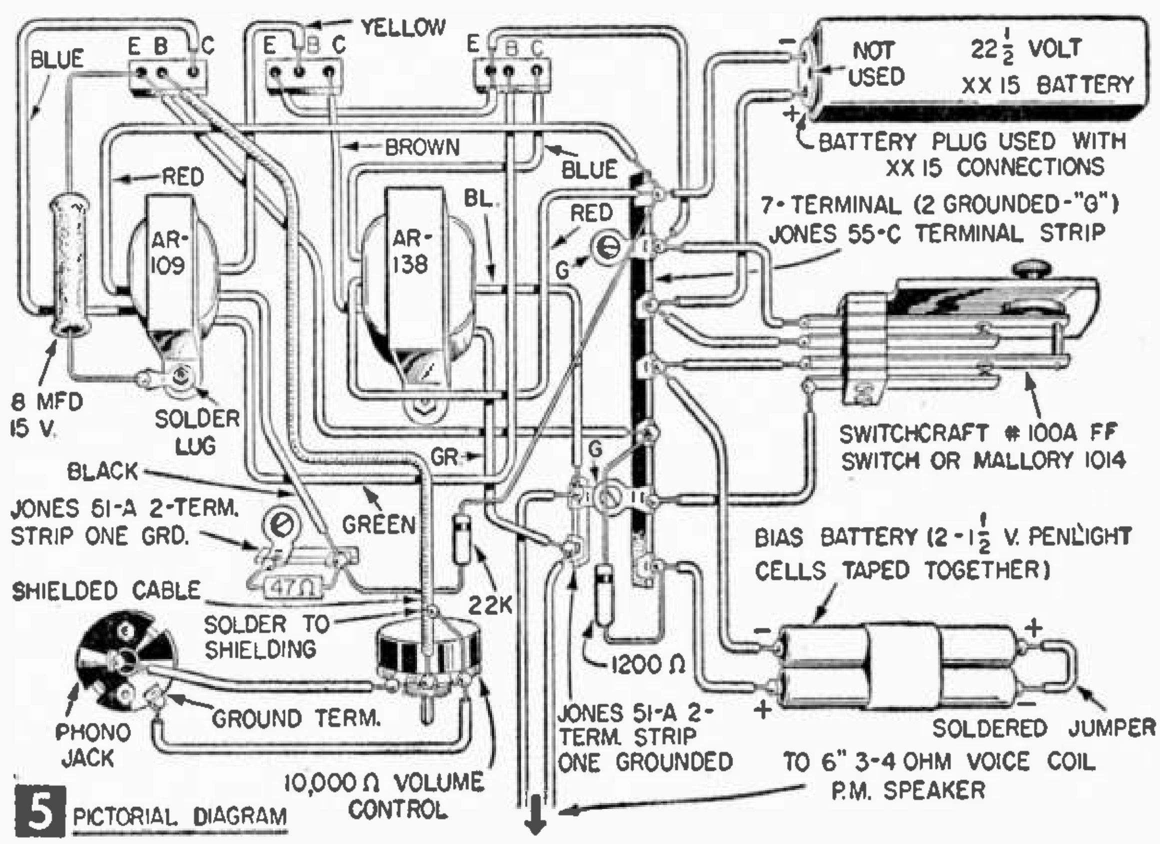
- 1 pc aluminum about .050 x 3 x 5¾" (chassis)
- 1 pc aluminum half-hard alloy or material that can be bent but has reasonable rigidity, 1/8" x 13/16" x about 11¾" (handle frame)
- 1 pc aluminum half-hard alloy about .040-.045 x 3 9/16 x 18½" (housing) can also use soft sheet steel about .034"
- 1 pc aluminum half-hard alloy 3/32 or 1/8" x ⅝" x about 17". Bend to form speaker U bracket support
- 1 pc hard brass or phosphor bronze about .010 x 2⅜ x ⅞" (clip for bias battery)
- 1 pc dry maple or birch ¾ x 4½ x 4½". Turn to tapered disc to fit tightly in small end of cone
- 1 pc hardwood plywood such as birch ¼ x 7 x 7". Cut-out ring to hold speaker in cone

Misc. hook-up wire, screws, nuts, paint. Pliobond cement, etc.

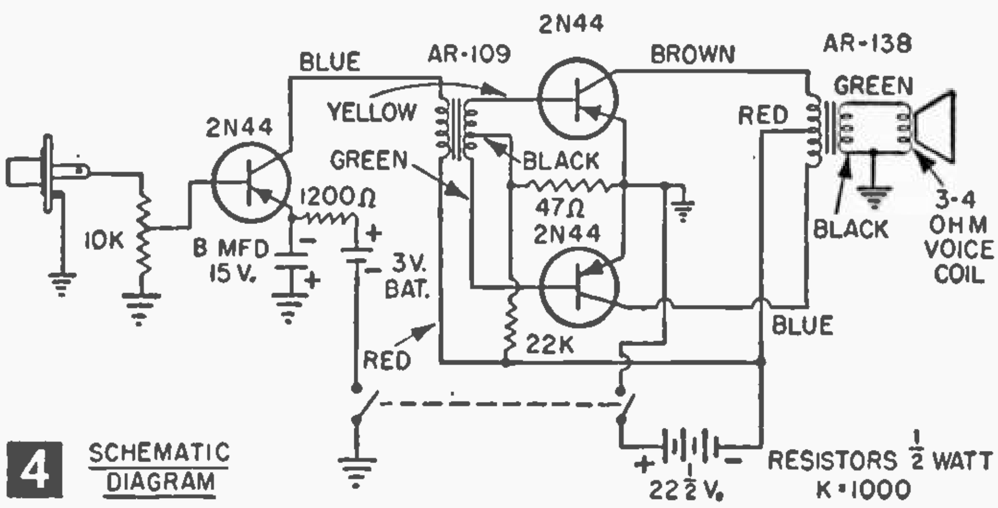
Note—Pure aluminum bends too easily for our purpose. What is commonly called half-hard can be formed or bent but is strong and rigid. Some trade numbers are 3003H14 half-hard, 11H14 half-hard and 5052H34 quarter-hard. Any similar type could be used where a test shows it workable for bending but as rigid as soft steel. Lightness of aluminum makes it ideal for keeping megaphone light. Usually supply houses do not sell small quantities so it has to be picked up in shops using this stock.



Terminal strips 55-C and 51-A have grounded lugs as shown above for connection of leads going to ground. If strips with all lugs insulated are used, simply use solder lugs under chassis screws for ground connections, as at AR-109 transformer feet.



5 PICTORIAL DIAGRAM

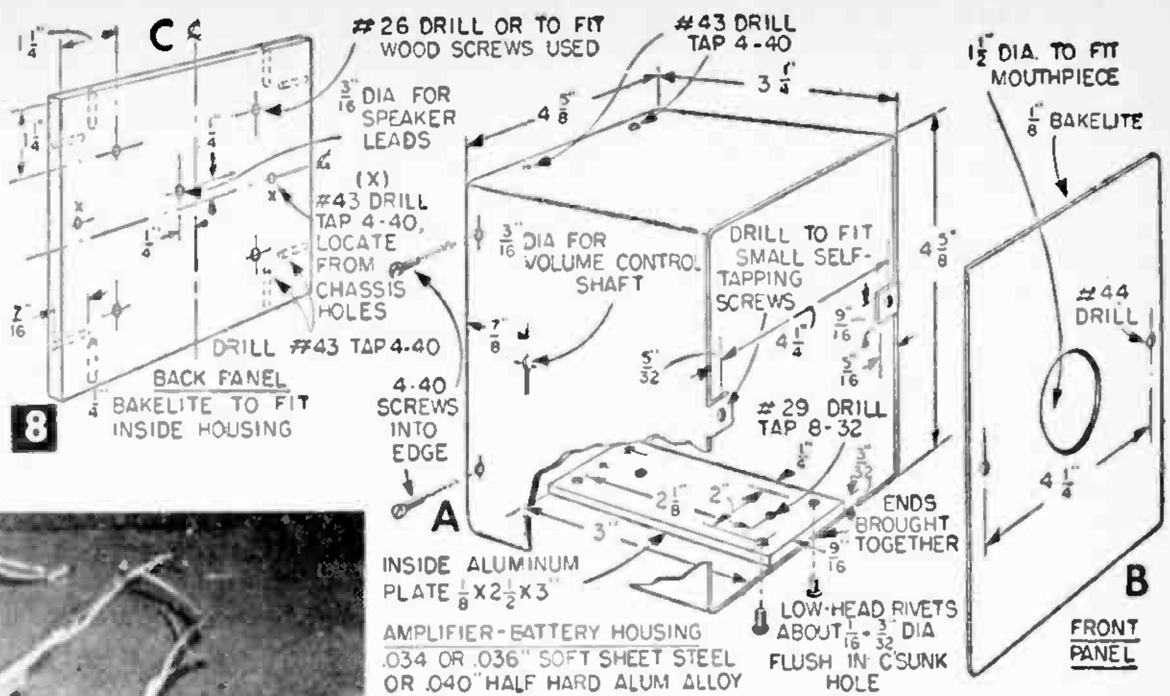


4 SCHEMATIC DIAGRAM

bias in the emitter of the driver stage), battery life should be quite high.

The Shure controlled-reluctance type microphone has an output level of —71 *db* below one volt per microbar, and an impedance of 1000 ohms. It is only one inch in diameter. It is mounted in a Bakelite tube, which also serves as the mouthpiece (Fig. 2).

The 6 in. permanent magnet type speaker with its 2.15 ounce Alnico magnet is fixed part way down in the cone as in Fig. 2. The three G.E. 2N44 transistors in a push-pull circuit which power the unit, have much higher collector power dissipation than ordinary transistor radio types, such as the 2N107. In addition, the AR-138 output transformer, used can handle more power than the AR-119 or 120 as usually used in radios. Thus you get a surprising volume from this miniature equipment.



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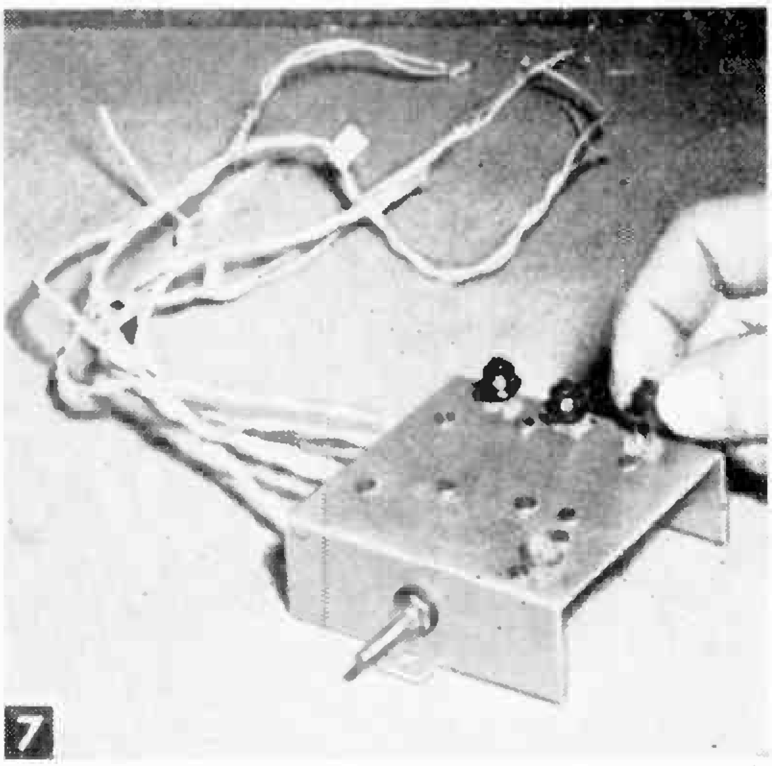


7

Test-mounting three audio transistors in their sockets. Leads from these transistors will need to be cut off to about 7/16-in. length with diagonal pliers, but transistors should not be permanently placed in sockets until megaphone assembly is complete, ready for cover plate to be put on (Fig. 2A). Wire leads to batteries, switch and speaker are identified with marked tabs of white tape to assure correct connections. Plus battery lead is also marked to avoid error.

Parts for this megaphone should cost you from $35 to $40, which is only about two-thirds the cost of a typical commercial unit.

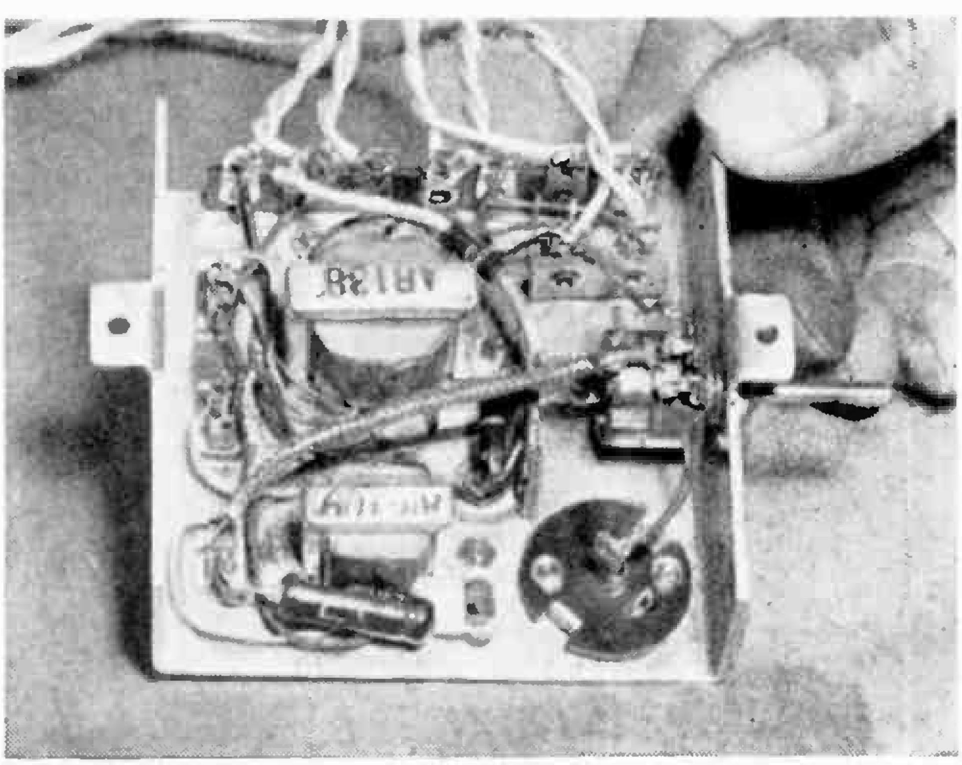
Building the Amplifier. Bend up the chassis from sheet aluminum and drill openings for components as in Fig. 3. Figs. 6 and 7 show both sides of this chassis with all parts mounted. Note terminal strip at one end (Fig. 6) for leads to battery, speaker and switch. The input from the mike is at a phono jack in the top of the chassis and the volume control is placed in a side opening, where its shaft will project through the housing for an outside control with a knob.

Use a short piece of shielded wire from volume control to base of first transistor, since this is a sensitive input lead and grounding the shield prevents or minimizes possible hum. Place two small terminal strips in the chassis as in Fig. 5, to provide tie points for soldering leads.

You won't need much hook-up wire in this circuit as the transformers come equipped with leads that are carried to the proper points and soldered. Use only rosin-core solder and apply enough heat from a small iron or soldering gun to fully flow the solder. In making connections to terminal strips, make sure the lugs grounded to the chassis are used for ground connections *only*, as indicated in Fig. 5. If you use other types of terminals by the way, where all lugs are insulated, provide small solder lugs under chassis screws for ground connections.

Next lay out pattern for the amplifier housing (Fig. 8) on sheet aluminum or soft sheet steel (about .034 in.). Housing can be bent over a piece of angle iron in the vise (Fig. 9). Make sure the box is square.

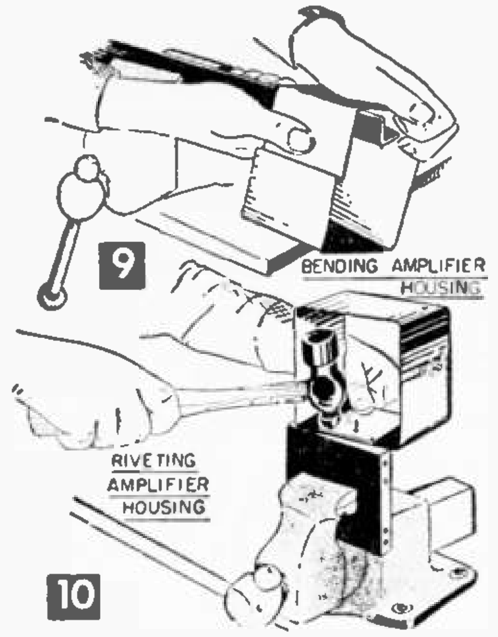
After bending up the housing, bring its two edges together and rivet a piece of 1/8 in. thick aluminum placed inside over the joint (Fig. 10). Drill holes for the short 3/32 in. brass

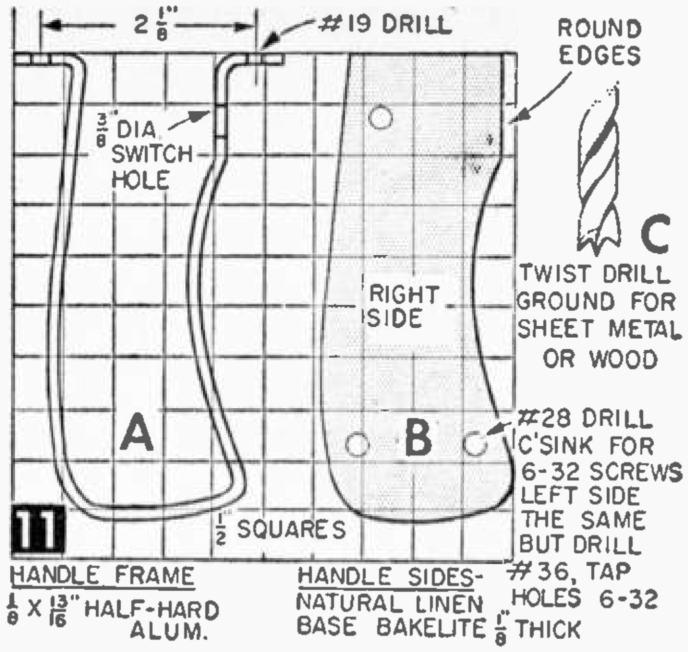


6 Underside of amplifier chassis, with parts mounted and wired according to Figs. 4 and 5.

Forming the amplifier's sheet metal housing, using the rounded edge of a piece of angle iron held in the vise.

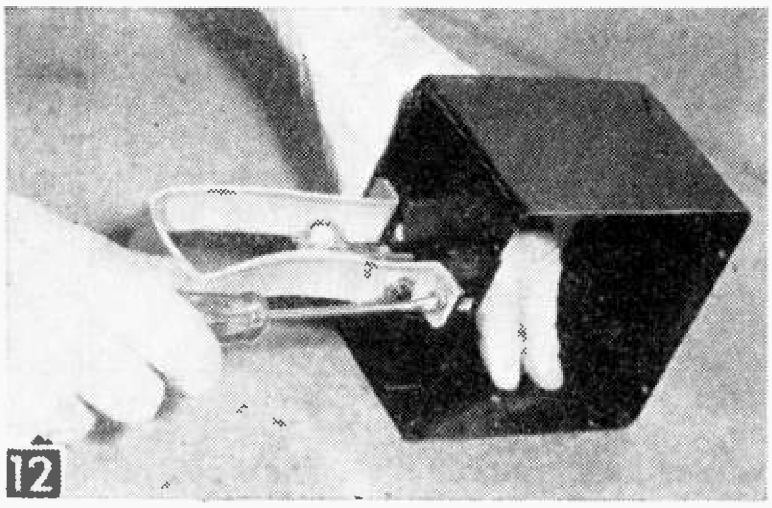
Edges of shaped housing are brought together and riveted to an aluminum plate.





rivets, and head the rivets over on the inside in countersunk holes so that the rivets will come flush.

To form the frame for the pistol grip handle



After fastening switch through its hole in handle with locknuts, attach handle frame to amplifier housing. Note that housing has been finished with primer, then black enamel lightly rubbed with steel wool.

which is of aluminum stock about 3/32 to 1/8 in. thick and soft enough to be bent, lay out the pattern (Fig. 11A) on paper with 1/2 in. squares. Then, carefully bend the aluminum stock to its proper shape over various forming pieces held in the vise.

Install the switch in its hole with locknuts and attach the handle frame to the housing, using two 8-32 machine screws in holes drilled and tapped into the housing and inside plate (Fig. 12).

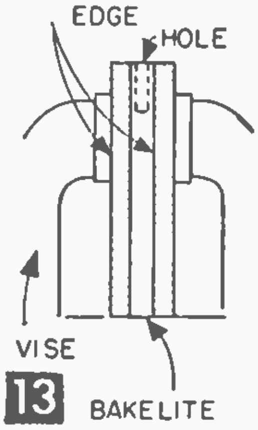
Because the aluminum cone could be difficult for an amateur to make we recommend you purchase one as indicated in the materials list, or have your local tinsmith make one up for you (Fig. 1). These commercial ones have a neat rolled bead at the front end which helps to stiffen the cone.

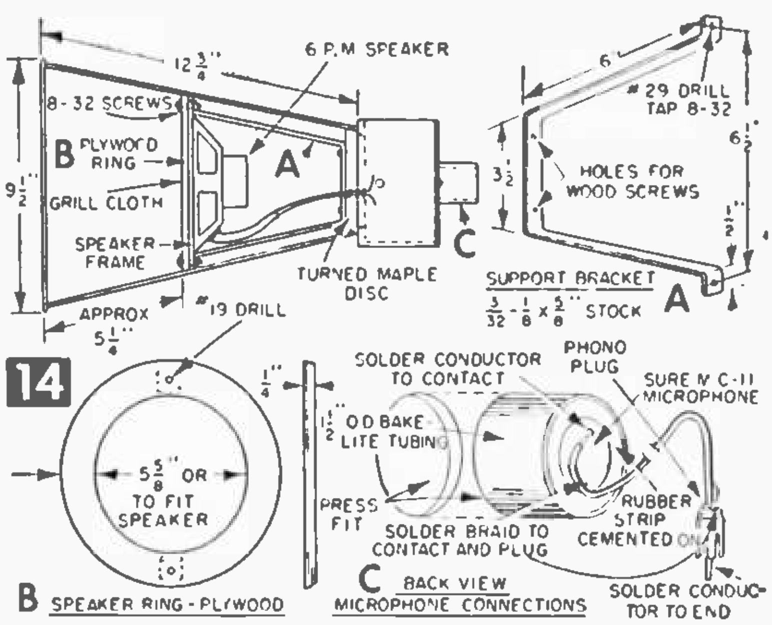
To assemble the speaker, you'll need a hardwood disc which fits tightly in the 4 in. end of the cone (Fig. 14). Turn this from maple in any woodturning lathe, giving it a taper to properly fit and come flush with the end. Insert it from the large end of the cone, tapping it down into place. Fasten it with four 3/8 or 1/2 in. #7 flathead brass wood screws, inserted through the aluminum and into the wood disc in holes spaced and drilled equally around the circumference.

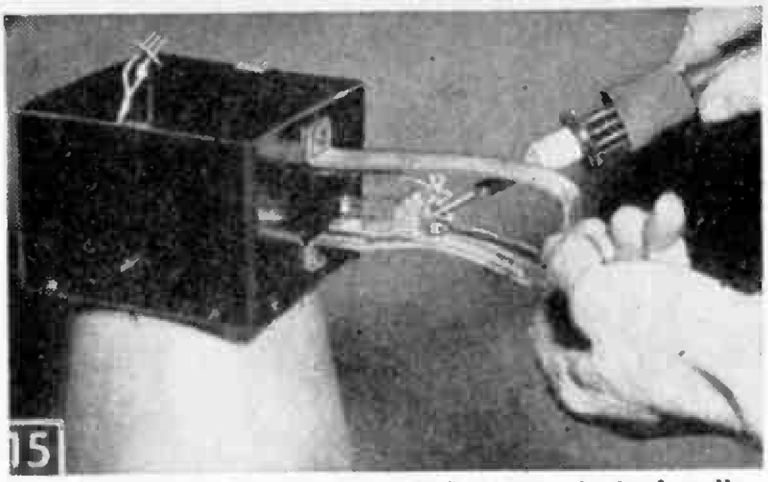
Pliobond cement on the disc edges will further insure its remaining in place.

Figure 14 shows how a piece of 1/4 in. thick black Bakelite, which was carefully cut and fitted to the inside dimensions of the housing as in Fig. 8E, is attached to the maple disc in the end of the cone, using four 3/4 in. #9 roundhead wood screws. Holes for these screws must also be drilled in the maple block so you won't split the wood. Next fit the Bakelite panel into the amplifier housing until it is flush with the edge, and use 4-40 machine screws in drilled and tapped holes to secure it.

Make sure when doing this fitting the switch button is on side of housing nearest speaker cone, and tabs on housing are on the end of housing away from cone. When drilling and tapping Bakelite in its edge, by the way, clamp the Bakelite in a vise so the tap will not tend to split the material, since it splits rather easily in end grain. You can drill the required holes in the metal with







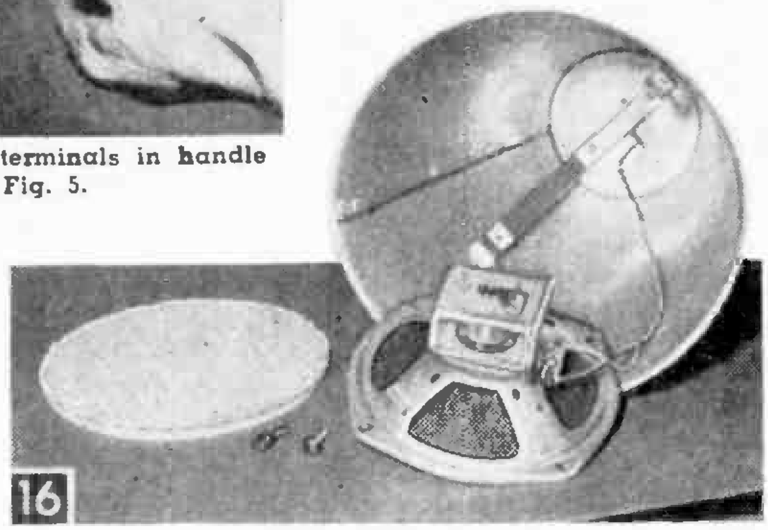
Soldering connections to switch terminals in handle of megaphone—see Fig. 5.

Bakelite in place, but only allow drill enough of a depression in the Bakelite to mark where to drill for tapping. Use a #33 drill through the metal and then change to a #43 drill for making the holes in the piece of Bakelite. Then use a 4-40 tap in each drilled hole.

Before fitting the amplifier to the Bakelite piece you have already attached to the cone, first drill a #29 drill hole through the Bakelite *and* also the wood disc in the cone just off the center (Fig. 8E), for the speaker wires. Pass the speaker leads through this hole and then fit the amplifier chassis against the Bakelite piece and secure it (Figs. 2A and 3), making sure the control knob shaft is allowed to project through the hole for it drilled in the side of the housing. The chassis should also be so located in the housing so that the 22½ volt XX15 battery will fit between the chassis and the housing (Fig. 2A) when wedged with a folded piece of cardboard.

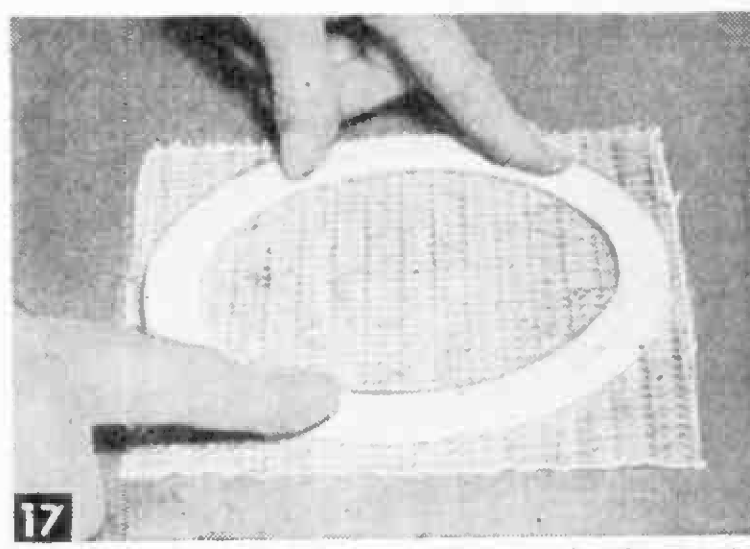
The switch contact wires are brought through their hole (Fig. 8C) in bottom of the case, and connected as shown in Fig. 5 and Fig. 15. Solder a plug to the two leads that go to the battery and make a knot in one of them which will easily identify the *plus* lead for you. Examination of the way the three-prong plug fits in the battery quickly shows which terminal of the plug is plus.

Mounting the Speaker. Figure 14 shows how the speaker is held part way down in the cone by mounting it to a support that is bent up from any light metal, as in Fig. 14A. Since the size of the cone and the speaker size may vary a little, the exact length of the bracket is not given. But it should be such that the screws used to secure the speaker ring (Fig. 14) will pull the ring down tightly in the taper of the cone, coming to rest with the speaker against the support at two of its mounting holes. Fig. 16 shows the bracket support attached to the wood disc at the base of the cone. Note that the leads have already been soldered to the speaker terminals.

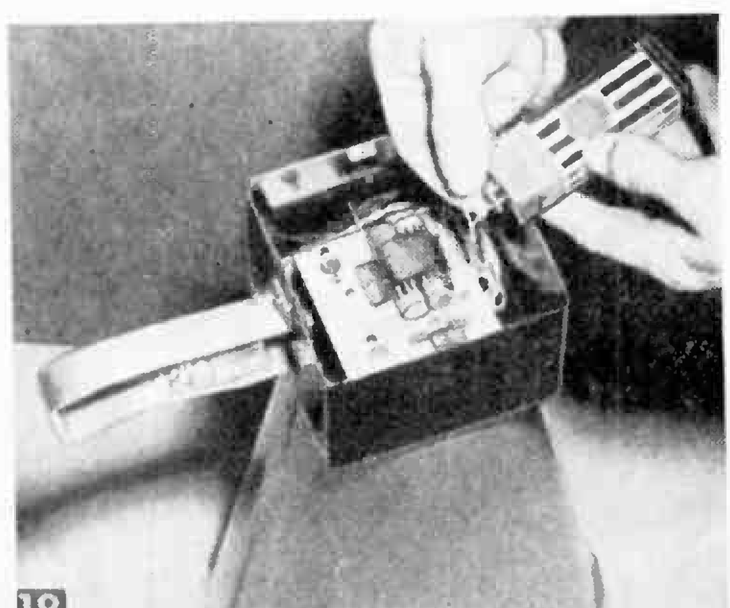


Note speaker supporting U-bracket attached to wood disc at far end of horn. Speaker will mount against this bracket and grille cloth-covered wood ring at left will cover front of speaker. Note connected speaker leads going back through wood disc to amplifier.

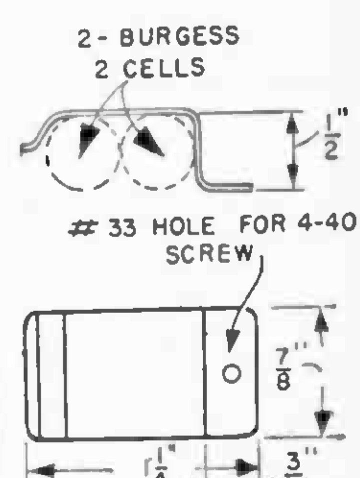
After jigsawing out the plywood ring which fits over the front of the speaker (Fig. 14), cement plastic grille cloth to the ring with Pliobond cement (Fig. 17). After this dries, trim off cloth around the ring with scissors. Make two holes in the ring for the two 8-32 machine screws that turn into the ends of the speaker support in tapped holes.



Pressing plywood ring, coated with Pliobond cement, down firmly onto square of grille cloth.



Installing 22½ volt B-battery in amplifier housing. See Fig. 2A for battery position in housing.



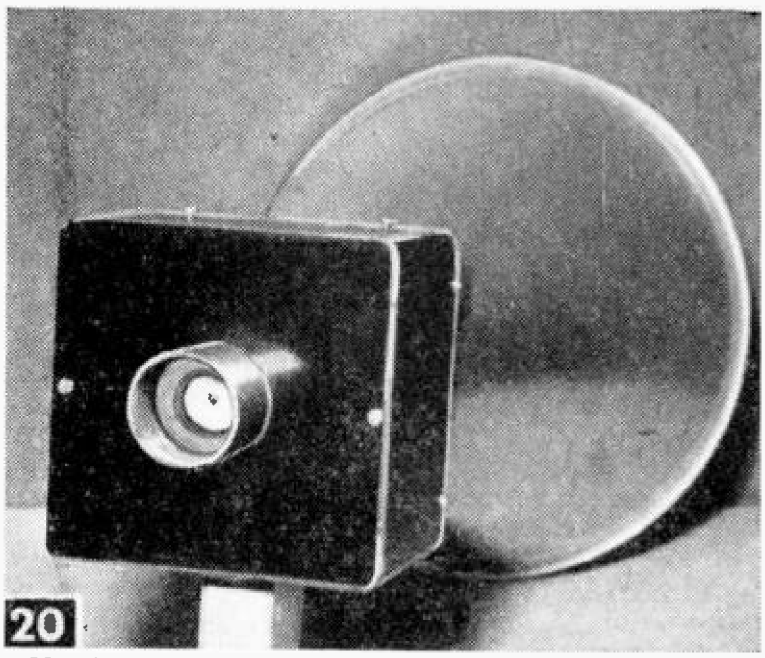
CLIP HOLDER FOR BIAS BATTERY MATERIAL— .010" HARD BRASS OR PHOSPHOR BRONZE

You can now connect the 22½ volt battery and place it between the chassis and the housing (Fig. 18) using folded cardboard to wedge it tightly in place. You can also place the transistors in their sockets now.

Mounting the Mike. The microphone mounts in a rubber strip which in turn is cemented into a 1½ in. diameter Bakelite tubing mouthpiece (Fig. 2A, 14A and C, and 19). The mouthpiece then fits tightly in a hole made in the front Bakelite housing cover, using a fly cutter in the drill press. Before installing mike in the mouthpiece tube, connect a 6 in. length of shielded flexible wire to the terminals and a phonoplug to the other end (Fig. 2A and 14C). Make up the strip into which the mike will mount from the type of sponge rubber used to seal car trunks and doors; it is sold in auto supply stores. This rubber should be about ¼ in. thick, ½ in. wide and long enough to be formed around the mike and have its ends meet. Apply Pliobond cement to outside edge of mike and one surface of the rubber. Then, after a few seconds wrap the piece around the mike, tie with string and let dry for about an hour. Then untie string, apply cement to outside surface of rubber, and press the assembly of mike and rubber in mouthpiece tube until about flush with the end (Fig. 20).

Attach the 3-volt bias battery, consisting of two penlight cells in series, to the chassis under a spring clip bent up from thin hard brass or phosphor bronze (Fig. 18A). The leads were soldered to the battery terminals (Fig. 5). To enclose the megaphone handle, make up Bakelite sides as shown in Fig. 11C, and attach to handle frame with screws and Pliobond cement.

Using the Megaphone. If you test the megaphone indoors in a small room, you may find a whistle will develop when you press the push-button and try to talk. This is because sound bounces from walls and enters the microphone to set up a series of oscillations—a common occurrence where a high-gain amplifier, a mike and a speaker are in close proximity to each other. When used outdoors or in large areas, however, this sound has less chance to rebound and there should be little tendency to whistle.



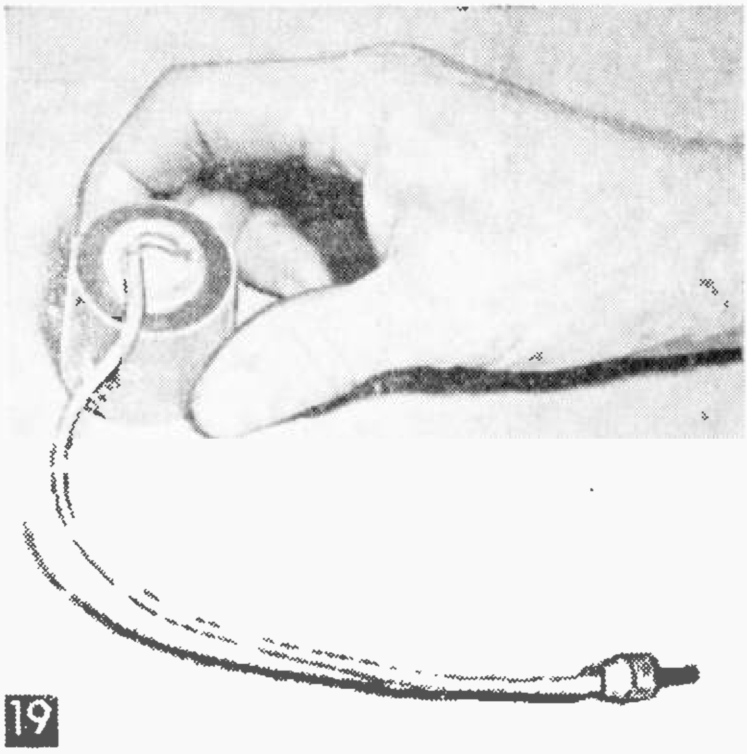
20

Mouthpiece with mike and its rubber ring inserted, mounted to Bakelite panel.

You can use the volume control setting to keep the gain down enough to eliminate whistle when testing indoors. Or, if you want to cut down any tendencies to whistle, line the space inside the cone back of the speaker, and the interior of the box housing the amplifier, with felt. Also cement a piece of felt to the inside surface of the cover. I used a standard dress goods or fabric store type of felt and Permatite Liquid Adhesive R-6229 (from Sears).

For longer battery life, you can place a second XX15 battery in the housing and connect it in parallel with the other one. Simply splice on two leads from the original two battery wires and connect a plug to them, making connections so that the batteries will be plus to plus and minus to minus or parallel. You'll get the same 22½ volts but double the current capacity. The second battery can be taped in place where convenient in the roomy housing.

When using the megaphone, talk close to the mike, even placing the lips directly up to the mouthpiece. This will give maximum volume and also help to prevent stray sounds from entering to cause undesirable oscillations. Avoid taking deep breaths through the mouth while it is close to the mike but rather breathe through the nose. With a little practice, you'll be able to transmit intelligible speech under good atmospheric conditions for distances of 500 to 600 feet, depending on the direction and force of the wind.



19

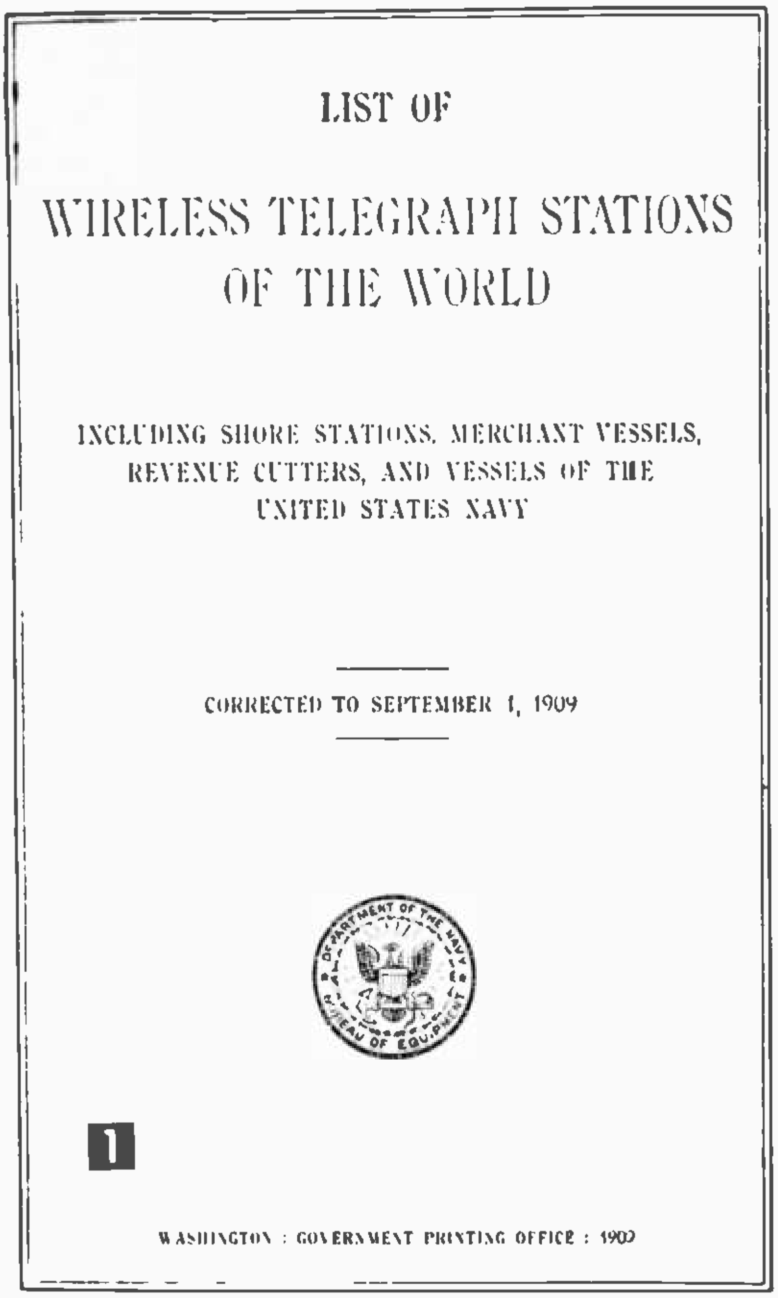
Microphone mounted in insulating rubber ring, which in turn is fitted into Bakelite tubing mouthpiece.

Draftsman's Tape Holds Tight

• Draftsman's tape makes an excellent "third hand" to hold electronic components together during assembly or soldering. Due to its high insulation, the tape can be left on permanently, or can be peeled off easily.—J. A. McRoberts.

Grandpappies of the Call Books

By HOWARD S. PYLE



LIST OF

WIRELESS TELEGRAPH STATIONS OF THE WORLD

INCLUDING SHORE STATIONS, MERCHANT VESSELS, REVENUE CUTTERS, AND VESSELS OF THE UNITED STATES NAVY

CORRECTED TO SEPTEMBER 1, 1909

WASHINGTON : GOVERNMENT PRINTING OFFICE : 1909

1

One of the earliest official lists of call letters of merchant vessels and shore stations of the world, as well as naval and other government vessels of the United States.

IMAGINE, if you can, a telephone in your home but no directory—aside from the numbers which you have memorized or jotted down, your phone would be of little value to you. Yet not too long ago this situation existed.

About the time the Spanish-American War ended, Bell's "magic box" was a thrilling novelty. Two hand-cranked long rings brought almost instant response from the widow Sprightly. A short and a long put you in touch with gruff Doc Grouch. The thing caught on.

But it wasn't long before even the keenest memories became confused in attempting to recall what ring for who(m). Scribbled lists were soon replaced by printed pages. And today? Today in any metropolitan center it almost calls for two hands to lift the telephone directory.

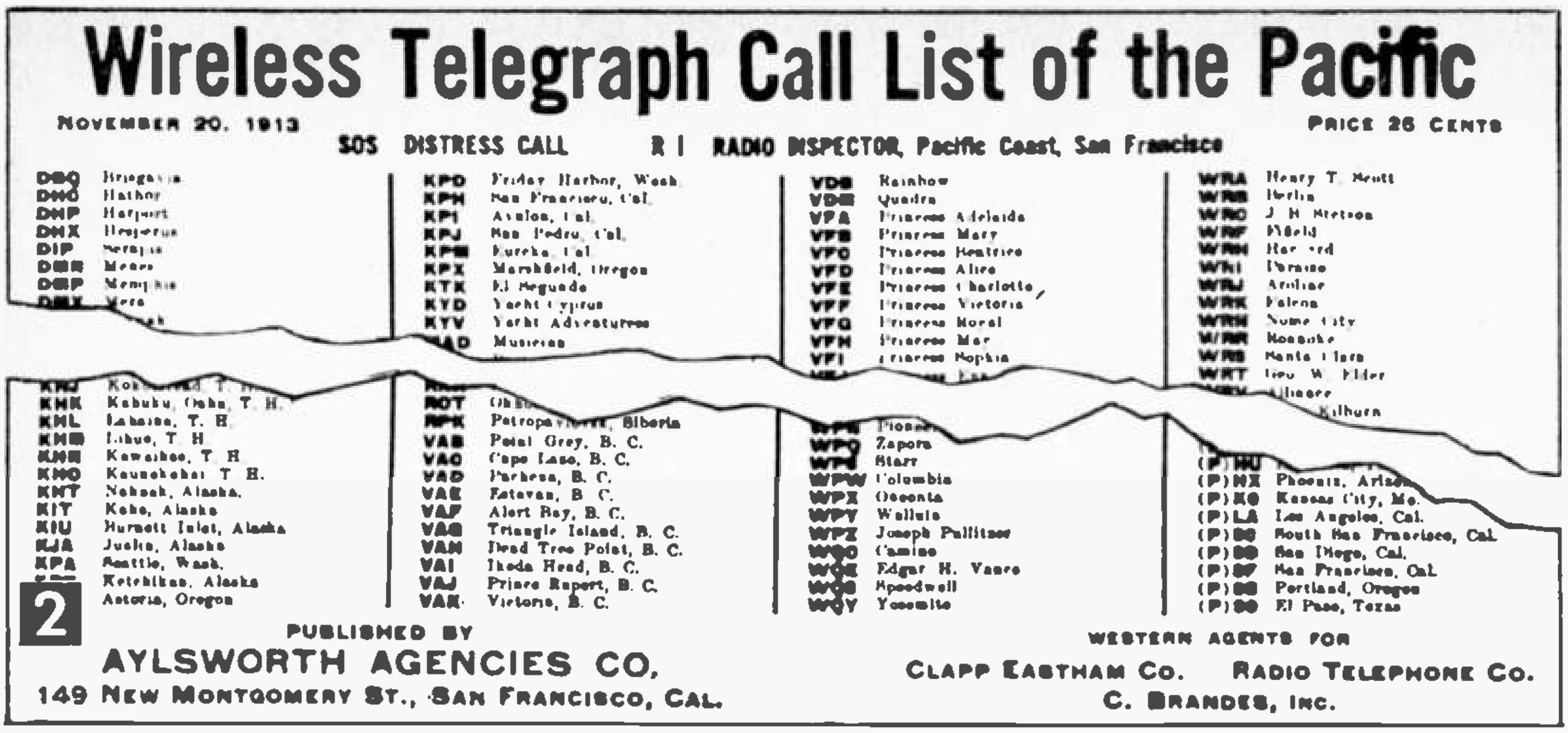
When Guglielmo Marconi popularized the use of "wireless" telegraphy, the same problem soon arose. Ships were being rapidly equipped with this new marvel; wireless telegraph stations were being established ashore to provide a link with land.

Early wireless operators kept pencilled notes of the names of various vessels equipped with Marconi's apparatus and the locations of stations ashore. It immediately became evident that the slow and laborious process of calling a ship or land station by spelling out its name in the characters of the Morse code was inadequate; such calls must be shortened. Vessels and wireless stations ashore followed the pattern of the older Morse telegraph lines and adopted two and three letter designations for calling each other.

On the surface it appeared that the problem had been satisfactorily solved, but soon chaos developed. Wireless operating companies discovered that much duplication of these "call letters," as they became known, had developed between the various companies as well as between independent operators. It became immediately apparent that some orderly selection of non-duplicating calls must be adopted and that published lists, similar to telephone directories, must be arranged for.

But individual operating companies were reluctant to absorb the expense of listing call letters and other identifying characteristics of competing interests. Consequently, each operating company published printed lists which included only the ships and shore stations using their system and under their control. A United Wireless Telegraph Co. operator aboard a sea-going vessel could identify only the stations on shore which were also under UWT control. Out of range of a United station, the United operator had no communication with land except perhaps, by the then laborious method of "relaying" through other United equipped ships, if available.

Wireless telegraphy, during its inception and early development years, was primarily a marine communication system. It not only made the sea-lanes safer by enabling a vessel in distress to call for assistance, but it gave the ship-owner an economic advantage in that he had contact with the vessels of his fleet while they were at sea and could divert them to his economic advantage. Very early in the development of wireless signalling it also be-



Wireless Telegraph Call List of the Pacific

NOVEMBER 20, 1913 — PRICE 25 CENTS

SOS DISTRESS CALL — R I RADIO INSPECTOR, Pacific Coast, San Francisco

DBQ Briegavia
DHO Hathor
DHP Harport
DHX Hesperus
DIP Serapis
DMR Meros
DSP Memphis
DMX Mera

KHK Kahuku, Oahu, T. H.
KHL Lahaina, T. H.
KHB Lihue, T. H.
KHM Kawaihae, T. H.
KHO Kaunakakai T. H.
KHT Nohash, Alaska.
KIT Koho, Alaska
KIU Hurnett Inlet, Alaska
KJA Juneau, Alaska
KPA Seattle, Wash.
Ketchikan, Alaska
Astoria, Oregon

KPD Friday Harbor, Wash.
KPH San Francisco, Cal.
KPI Avalon, Cal.
KPJ San Pedro, Cal.
KPM Eureka, Cal.
KPX Marshfield, Oregon
KTK El Segundo
KYD Yacht Cyprus
KYV Yacht Adventuress
Musician

ROT
RPK Petropavlovsk, Siberia
VAB Point Grey, B. C.
VAC Cape Lazo, B. C.
VAD Pachena, B. C.
VAE Estevan, B. C.
VAF Alert Bay, B. C.
VAG Triangle Island, B. C.
VAH Dead Tree Point, B. C.
VAI Ikeda Head, B. C.
VAJ Prince Rupert, B. C.
VAK Victoria, B. C.

VDB Rainbow
VDE Quadra
VFA Princess Adelaide
VFB Princess Mary
VFC Princess Beatrice
VFD Princess Alice
VFE Princess Charlotte
VFF Princess Victoria
VFG Princess Royal
VFH Princess May
VFI Princess Sophia

WPO Zapora
Starr
WPW Columbia
WPX Oceonta
WPY Wellula
WPZ Joseph Pullitzer
Camino
Edgar H. Vance
Speedwell
Yosemite

WRA Henry T. Scott
Berlin
WRC J. H. Stetson
Fifield
Harvard
Paraiso
WRJ Aroline
WRK Falcon
Nome City
Noanoke
Santa Clara
WRT Geo. W. Elder
Kilburn

(P)NX Phoenix, Arizona
(P)KC Kansas City, Mo.
(P)LA Los Angeles, Cal.
(P) South San Francisco, Cal.
(P) San Diego, Cal.
(P) San Francisco, Cal.
(P) Portland, Oregon
(P) El Paso, Texas

2

PUBLISHED BY
AYLSWORTH AGENCIES CO,
149 NEW MONTGOMERY ST., SAN FRANCISCO, CAL.

WESTERN AGENTS FOR
CLAPP EASTHAM CO. RADIO TELEPHONE CO.
C. BRANDES, INC.

This 1913 list contained the call letters and names of ships and shore stations under United States control, as well as the Japanese and Canadian stations both afloat and ashore.

came increasingly apparent to the navies of the world that a strategic military advantage was evident in this method of communication with war vessels. The United States Navy was one of the first to recognize what a tremendous advantage this would be to naval strategy.

With this in mind, the U. S. Navy Department decided to publish a consolidated list of naval vessels and their associated wireless call letters. They felt that the wireless call letters together with the names of merchant vessels which plied the high seas should be included as well, as such ships would probably become auxiliary naval vessels in the event of hostilities. The final result was a complete listing of the wireless communication facilities not only of the U. S. Navy, afloat and ashore, but of all of the sea-going vessels of United States as well as foreign registry, and their companion stations ashore (see Fig. 1).

Such a listing proved of immeasurable benefit not only to U. S. naval vessels and shore stations and the U. S. merchant marine, but to other countries of the world as well whose merchant vessels frequently entered U. S. ports. Other countries rapidly made their publications available to U. S. ship-owners without regard to the particular system of wireless telegraphy employed.

And now, how about the "amateurs" . . . the several hundred experimenters who were enjoying daily the thrill of communication through space without a visible connecting medium? It had become necessary for them too to adopt some brief identification for their equipment. Many of them simply used the initials of their name. Again, "who is who and where are you located?" became an immediate problem. Again a publication of some kind was dictated which contained the answer to *both* questions.

Recognizing this, Hugo Gernsback, then publisher of *Modern Electrics,* the world's first wireless magazine, published his *Wireless Blue Book* as an adjunct to his *Wireless Association of America.* In this booklet were included the self-chosen call letters of amateur stations.

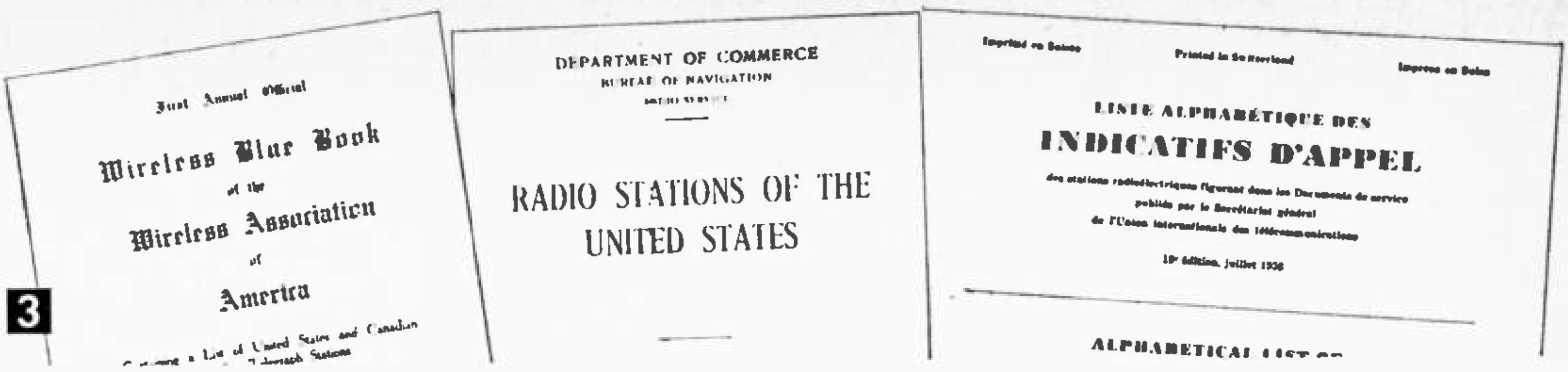
From the author's records and information from other sources, it appears that Hugo Gernsback's *Blue Books* were the first listing of amateur radio stations to appear in printed form (see Fig. 3).

With the passage of the Radio Act of 1912, control of radio communication in the United States, both amateur and commercial, passed from the Navy Department to the Department of Commerce. As a result, naval and military call letters, although chosen by the Army and Navy, were of necessity co-ordinated with the Commerce Department to insure that they were non-conflicting with other services.

With transfer of jurisdiction over radio services from the Navy Department to the Department of Commerce, it became the responsibility of the Department of Commerce to publish radio call books. These new call books confined the commercial and military listings to United States vessels and shore stations only, and in place of foreign ships and stations they included amateur listings. This was, of course, a boon to the U. S. amateur and, together with issuance of formal licenses to qualified persons, gave the amateur Government recognition (see Fig. 3).

The growth of radio was phenomenal. Installation of equipment on sea-going vessels progressed rapidly. Keeping pace, the number of shore stations with which to communicate with such ships grew by leaps and bounds. Experimenters increased proportionately as this fascinating science caught on.

Soon it became obvious to the Commerce



3

Left to right, title page of the first formally published call book of amateur wireless telegraph stations, the Department of Commerce list of all radio stations of the United States, and the "Berne-list," in three languages.

Department that to include the names, addresses and call letters of all of the radio services in one publication was impractical. The result was a splitting of the initial call books into two parts, one listing only the commercial and military vessels and shore stations, the other only the amateur class. Such an arrangement served for some time in a satisfactory manner, but with the continued expansion of radio services it soon became a monumental task to compile, revise and publish the call books. Departmental appropriations and staffing were inadequate.

For several years it had been recognized that wireless communication was no longer a local problem. Wireless signals knew no boundaries; vessels of foreign nations habitually sailed in U. S. waters and vice versa. Even shore stations overlapped with their signals between countries. The problem was international.

International Radio Telegraph conferences developed and from them it was determined that publication of an international call book, listing the ships, both naval and commercial, of the world, together with their companion shore stations, was a vital need. A Bureau, agreed on by all nations participating in the conference, was set up in Berne, Switzerland and was charged with the publication of an *International* list of ship and shore stations of the *world*, both commercial and military. The Berne Bureau discharged its obligation to international agreements, and the annual issues of the Berne Bureau are now of such bulk and contain so many listings that they are published in *three* massive volumes and in three languages (see Fig. 3).

But what about the amateur? Growth of this hobby in the United States alone has reached such phenomenal proportions that it was evident that the Department of Commerce, with its limited facilities and funds, would be unable to continue publication of even the amateur call book for much longer. Radio broadcasting had also entered the picture both in the United States and abroad. They, like the amateur, deserved a separate listing.

In 1924, Charles deWitt White assembled and published "The Rhode Island Call Book" in Providence, R. I., a compilation of radio broadcast stations in that area. This was shortly followed by a more comprehensive publication which he called "White's Triple List of Radio Broadcast Stations." He soon introduced a number of related publications and they were shortly combined into *one* which appeared under various titles from time to time. They retained, however, the basic "log" or listing of radio broadcasting stations, both domestic and foreign. Eventually titled "White's Radio Log," this listing was published annually for 34 continuous years. Shortly after White's death his daughter Mrs. W. R. Washburn, disposed of all right in this publication to Science and Mechanics Publishing Company, who were entrusted with continuance of her father's work.

While the excellent listings appearing in "White's Radio Log" adequately cover its field, what about the *amateur* stations? In the fall of 1920, Charles O. Stimpson, himself an active amateur founded the "Citizen's Amateur Call Book." Today the Radio Amateur Call Book, as it has been re-titled is still a quarterly publication. In 1956 an IBM electronic system was installed to speed up the processing of an average of 100 new call letters issued each week.

In 1959 the size of the volume began to approach the bulk of a telephone directory in a large metropolitan city, and it became necessary to split the book into *two* volumes, each of impressive size. The American section, containing over 500 pages, lists some 200,000 U. S. amateur stations. The second section, which lists some 50,000 foreign amateur stations, is issued semi-annually rather than quarterly. The Radio Amateur Call Book remains the only publication in the field listing licensed radio amateurs throughout the world.

A history of the evolution of the call book is a chronological history of the growth of wireless, radio and TV. Without the call letter directories for the various services, radio communication and broadcasting as well as television would be a chaotic groping in the dark.

Unscrewing the Inscrutable

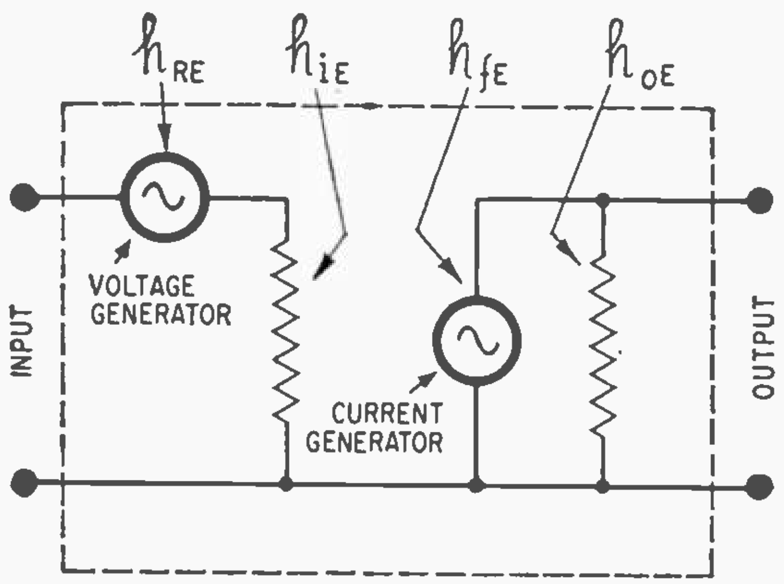
by Ol' Rock

Transistor Hybrid Parameters

WHEN an experimenter builds a piece of gear, he can play around with component values to his heart's content. If the gadget doesn't work right, he can change the circuit until it does. Not so the professional engineer. If he wants to hold his job, he'd better have a darn good idea of just how the circuit will work long before the fumes of rosin arise.

The best engineer is helpless without adequate performance data for the transistors with which he works, and an effective design method. One of the most effective designing tools is the *equivalent* circuit. When an engineer designs a transistor circuit, he usually forgets about the exact details of the transistor's innards, thinking instead in terms of a simplified device that behaves in the same way. The useful numerical properties of this equivalent circuit are called its *parameters*.

There are a number of possible equivalent circuits from which an engineer may choose



A EQUIVALENT INTERNAL CIRCUIT OF GROUNDED-EMITTER CONNECTED, JUNCTION TRANSISTOR

but the one shown in Fig. A is one of the most popular.

Obviously the inside of a grounded-emitter connected junction transistor does not *look* like this, but it *acts* as if it does.

The important quantitative properties, or parameters of this particular circuit are:

1) The resistance between the input terminals, A and B, as "seen" by the input signal source. This is often called hie.

2) The internal *conductance*, seen by the output, or load circuit, called hoe.

3) The ratio between the output voltage across the load and the voltage internally fed-back from the output to the input circuit, through interaction within the transistor. This is symbolized by hre and called, "Reverse Voltage Transfer Ratio."

4) The *current gain* of the transistor, a ratio between input and output signal currents. This is often also called "beta" in the literature, or hfe, as a hybrid parameter.

Why "hybrid" parameters? Well, you'll observe that there are three *different* electrical quantities involved; a resistance, a conductance, and two pure ratios, without units. Hybrid means mixed, the philologists tell us, and these certainly represent a mixture of quantities.

Of what significance are these parameters to the circuits engineer? The first parameter tells the engineer whether he can connect his signal source directly into the transistor, or whether some sort of an impedance-matching or coupling network is necessary. The second tells him much as to the proper load resistor necessary to obtain maximum performance from this particular transistor. For instance, one theoretically gets the best output when the load resistance is made equal to $\frac{1}{hoe}$. The third, "reverse voltage ratio," tells the engineer what effect the load circuit will have upon input circuit conditions, and also often whether he may anticipate oscillation troubles in a particular circuit.

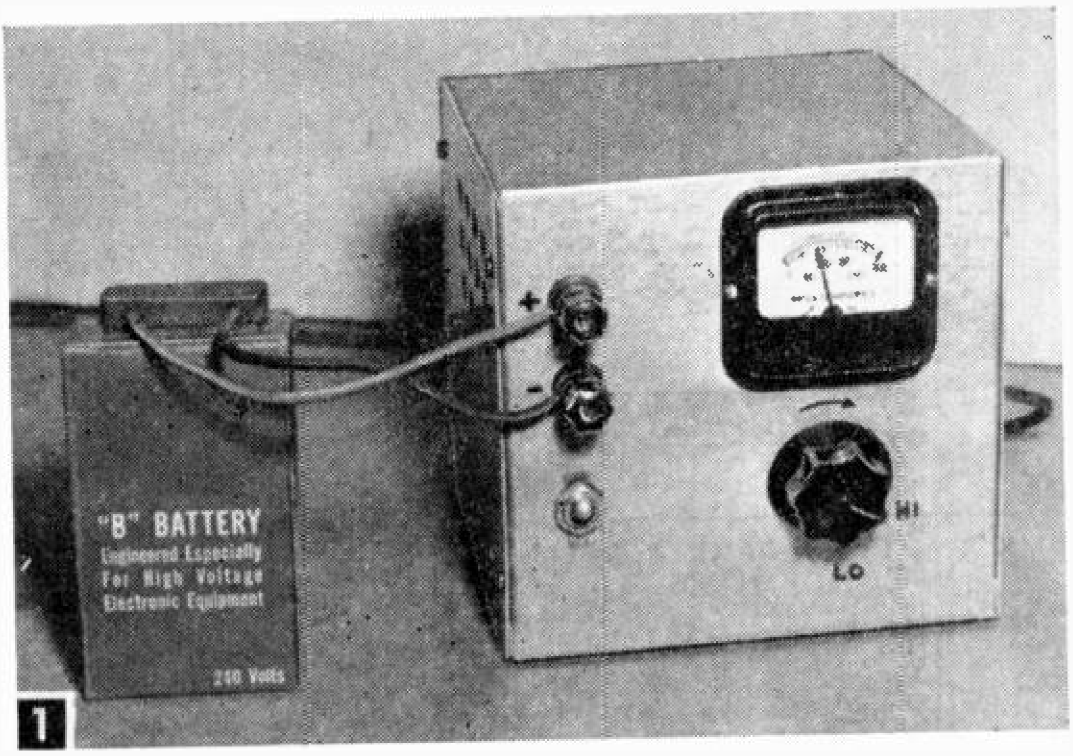
The fourth parameter is perhaps the most important of all, for this tells the circuit designer directly how much amplification he may expect in the circuit he contemplates. Will it be sufficient to meet "the specs"? The parameter hfe will tell him. It is actually the "figure of merit" of the transistor.

Of course, electronics is still an art as well as a science. No human can predict the exact performance of any circuit; a prototype must be built for the final checks. But the parameters will tell the engineer whether the prototype will be worth building, and this is a prediction that can save thousands of dollars.

Solution to Radio Hobbyist Anagram on Page 80

Recharger for Dry Batteries

Timely booster shots from this quick-charging power unit will renew B-batteries and strobe batteries



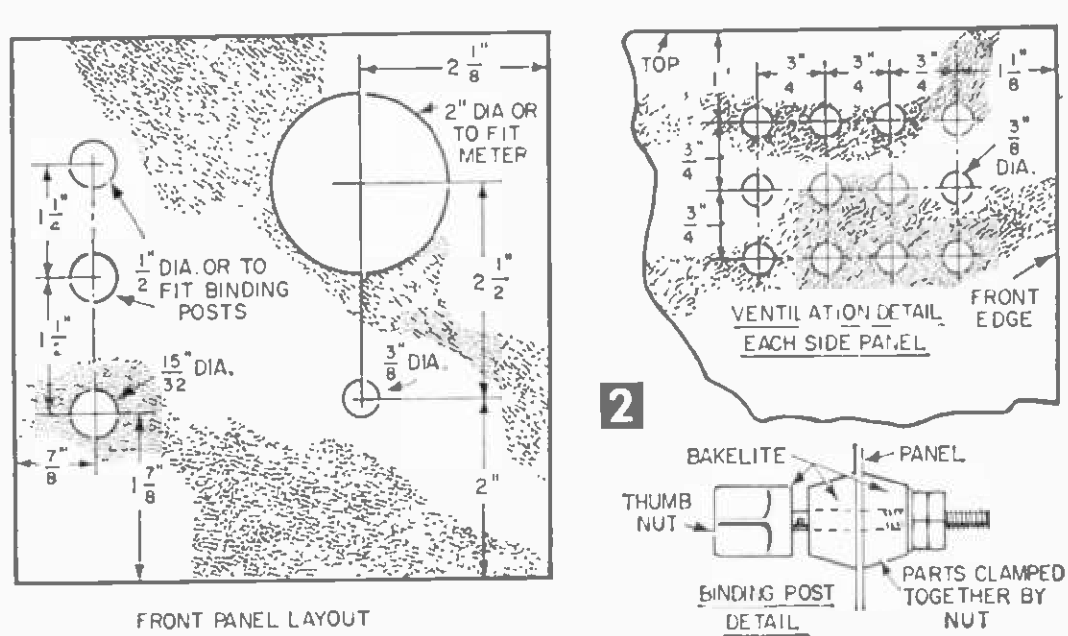
In just two minutes, the *d-c* power supply unit stepped up the charge in this 240-volt photo strobe dry battery from 200 to a steady 230 volts at 100 milliamperes. Connector was adapted to fit battery.

By HAROLD P. STRAND

PROLONGING the useful life of dry cell batteries is not only possible but very practical these days if you have several pieces of battery-powered equipment.

You can revive the expensive, high voltage "B" batteries used in portable radios and industrial laboratories with the 350- 400-*volt* power supply in Fig. 1—if you don't wait too long. In a matter of minutes, this simply-made charging unit will boost the slipping output of the popular 240-*volt* batteries used in pairs in battery-operated electronic flash outfits and retailing for about $7.50 each.

The same power supply can also be used for numerous lab test applications where up to 400-*volt d-c* at 70-90 milliamperes (*ma*) may be required.



You can use a healthy 6- or 12-*volt* storage battery, in place of the power unit, to recharge standard 1½-*volt* dry cells or other batteries rated at substantially less voltage than that of the source of your charge.

How Long Will the Boost Last? Success of the job depends almost entirely on condition of the batteries when treated. Old units with bulging walls or corroded zinc casings are beyond hope, but many appearing in good shape are simply in a state of partial exhaustion and can be boosted to near-original voltage.

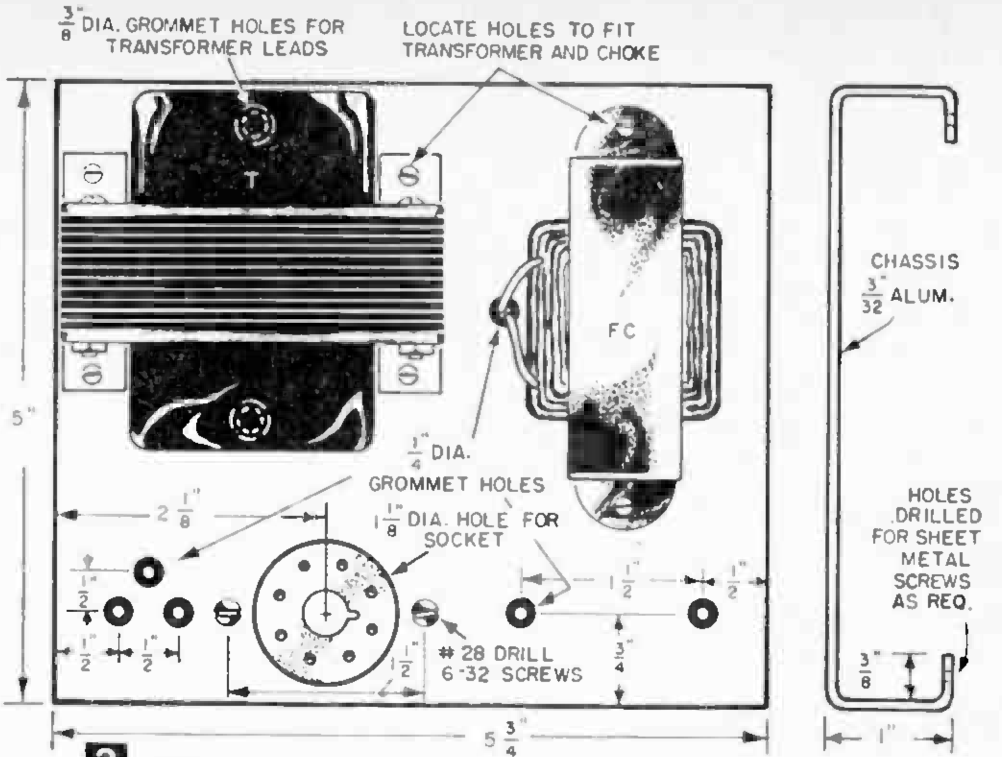
Generation of electrical energy, or a voltage in a primary cell is accomplished by a basic law stating that when two dissimilar materials (such as the two metal elements or metal and carbon in a battery) are placed in an electrolyte or chemical solution, an electro-motive force will be developed.

When a battery is delivering current, the chemical reaction in theory, frees hydrogen gas which collects around the carbon rod or positive electrode. Since this gas is an insulator, electrical output is substantially reduced as it continues to build up on the rod and increase resistance. To slow down this polarization, the electrolyte paste filler within the battery case includes manganese dioxide, a substance with which hydrogen readily combines. Whenever the battery stands idle after use, some gas is drawn away from the carbon pole by the attraction of the electrolyte. As the resistance declines, the battery gradually recovers its strength. This action continues until the cell has become chemically exhausted, or severely polarized, or both.

In cases where service demands for current cause appreciable voltage drop due to excessive polarization, and chemical decomposition is only minor, you can save the battery by recharging or —more accurately—depolarizing it.

Recharging reverses *d-c* current flow through the cells to drive the hydrogen off of the carbon electrode and back into the electrolyte mixture. As the internal resistance is lowered, voltage immediately rises and the ability of the depolarizing agent to "take care of it" is resumed.

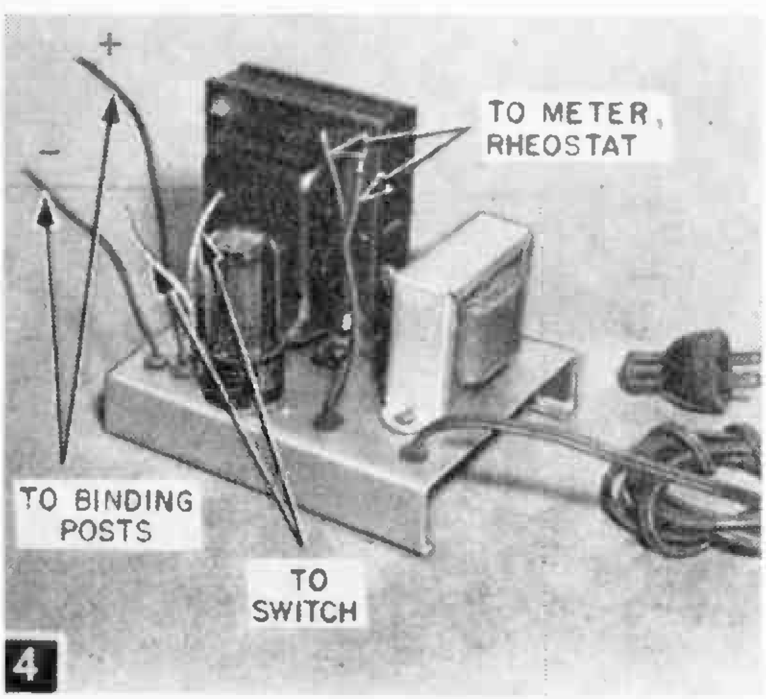
In any event, recharging can be repeated as often as



3 CHASSIS TOP DETAIL

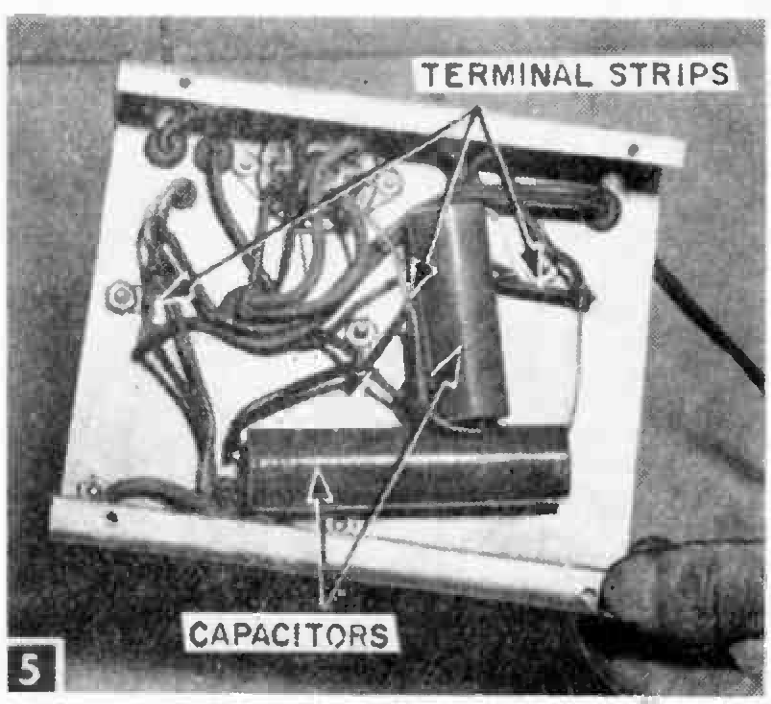
MATERIALS LIST—BATTERY CHARGER

Desig. or No. Req.	Size and Description
C1, C2	8 *mfd*, 500 *v* electrolytic capacitors, Cornell #850 (Allied #14L000)
R1	2,500-ohm, 25-watt power rheostat, Ohmite type H-0160 (A#74M334)
R2	150,000-ohm, 1-watt bleeder resistor, IRC GBT-1 (A #1MM020) (optional—see text)
T	700 *v* at 90 *ma* power transformer with 5 *v* 2 *amp* and 6.3 *v* 3 *amp* filament supply, Stancor PC-8409 (A #64G185)
FC	3 hy, 150 ma, 90-ohm filter choke, Stancor C2309 (A #64G457)
M	0-300 scale panel *d-c* milliammeter, Shurite MT-314
S1, CS2	two terminal chassis strips (A #41H500)
CS3	three-terminal chassis strip (A #41H501)
S	SPST toggle switch, Arrow H&H #20994EW (A #34B195)
1	indicating toggle switch plate for above (A #34B157)
1	black binding post, Superior type DF30BC (A #41H177)
1	red binding post, Superior type DF30RC (A #41H178)
1	6 x 6 x 6" gray hammertone aluminum cabinet, Bud AU1039 (A #88P551)
	Above items available at Allied Radio, 100 N. Western Ave., Chicago 80, Ill.
1 pc	3/32 x 5¾ x 8" sheet aluminum
V	5Y3GT rectifier tube
Misc	7' #18 flat rubber or plastic lamp cord, a-c power plug, octal socket, 2 rubber grommets for 3/8" hole, 6 rubber grommets for 1/4" hole, solder, hookup wire



4

Top view of power supply shows components used. Wires through grommets lead to panel mountings.



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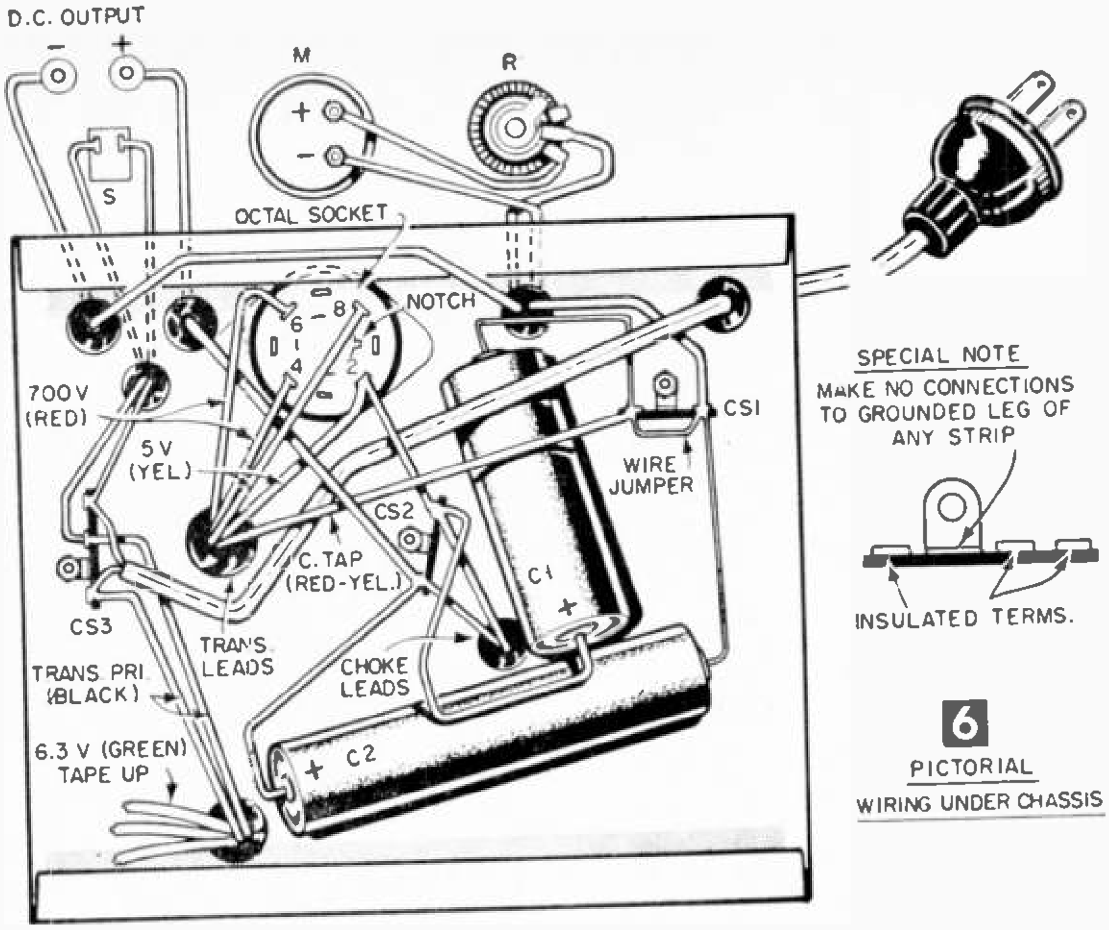
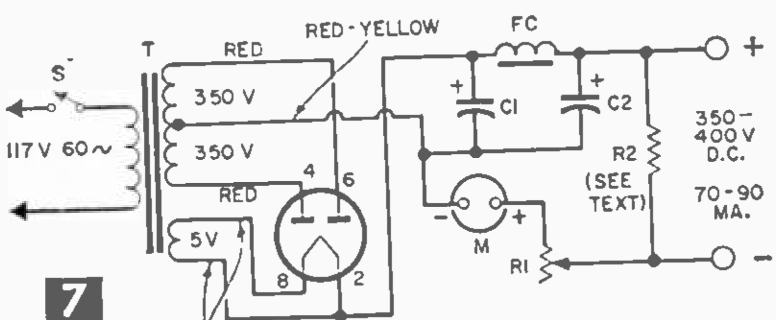
All normally grounded leads go to insulated terminal strip at right. No leads should touch chassis.



6 PICTORIAL WIRING UNDER CHASSIS



7 SCHEMATIC

desired, until a battery finally reaches a state of exhaustion. While results depend on the individual battery, they will usually double or triple its life span.

Building the Power Supply. Begin by checking the front panel hole locations given in Fig. 2, modifying size of each to fit the components you are using and drill the holes in cabinet front. Shape the chassis from 3/32-in. sheet aluminum, then locate and drill holes for components and grommets as in Fig. 3. Mount transformer, filter choke and octal socket as in Figs. 3 and 4. Run all leads through rubber grommets to underside of chassis and tape up the transformer 6.3-*volt* leads since they are not used.

Install the two 8-*mfd.* 500-*volt* capacitors and three terminal strips on chassis underside as in Fig. 5 and wire connections as in Figs. 6 and 7. For safety reasons, avoid grounding the chassis. Instead, run all leads which normally would be grounded to an insulated terminal strip (CS1) serving as a common connection point.

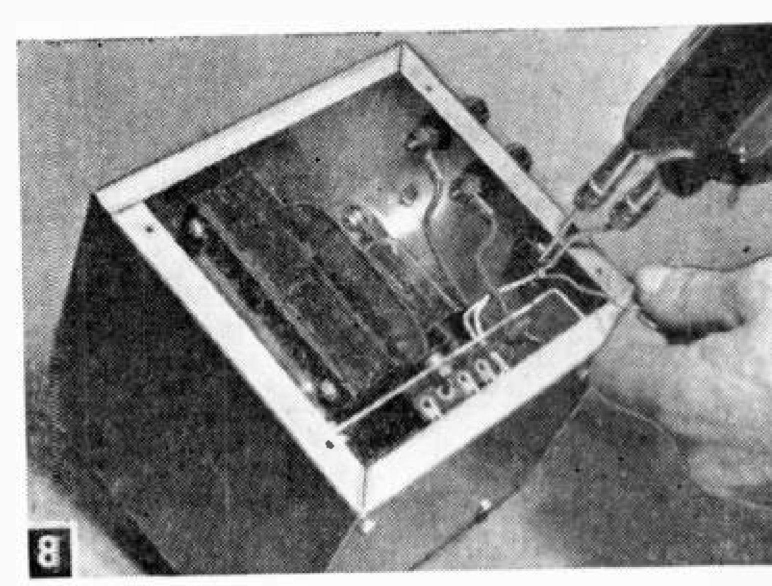
Slide assembled chassis into cabinet, notching part of cabinet edge as in Fig. 9, if necessary, for transformer clearance. Secure chassis with sheet metal or self-tapping screws through bottom of cabinet. Mount switch and binding posts to front panel, using red post for the positive lead. Connect switch and high voltage leads as in Fig. 8.

Mount the milliammeter and rheostat and wire leads through other open end of cabinet. Drill ventilation holes in each side panel as in Fig. 2, ream edges of holes and touch up with gray paint. Knot the line cord about 4 in. above chassis grommet and pull free end of cord through a grommet-insulated hole cut through cabinet side panel as in Fig. 9.

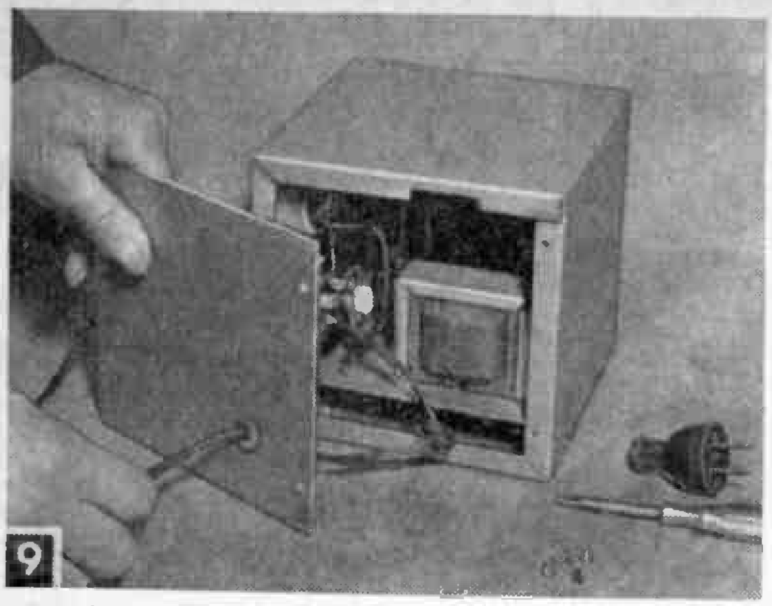
Insert rectifier tube in octal socket and attach panels with screws furnished. Connect plug to end of the line cord. For positive identification, letter binding post terminals and rheostat knob positions.

High-Voltage Charging. For any battery not equipped with screw or clamp terminals, it will be time-saving and more convenient to make a special terminal block for quick and safe connections. Figure 10 shows such a block designed to fit the 240-*volt* electronic flash batteries (Burgess U160, Eveready 491, etc.). For other cell types, modify brass pin diameters and spacing to fit.

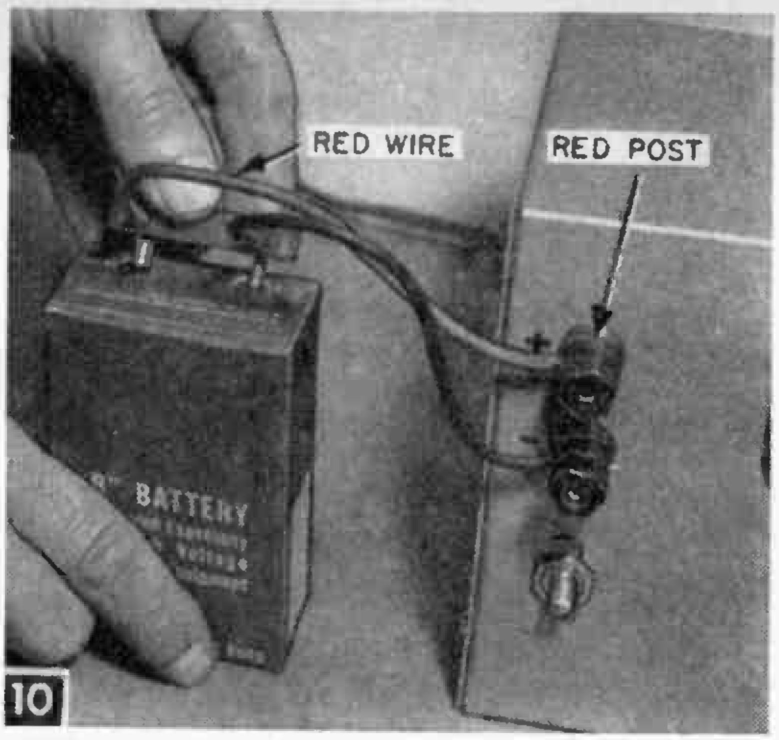
To charge, connect the battery to the power unit with rheostat set at "LO." When you



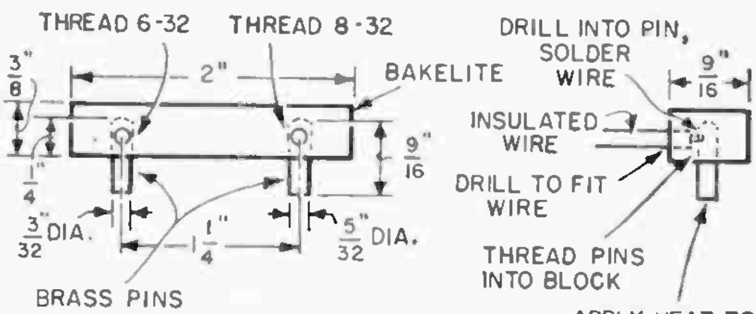
8 After chassis is placed in cabinet, panel connections are easy to complete through side openings.



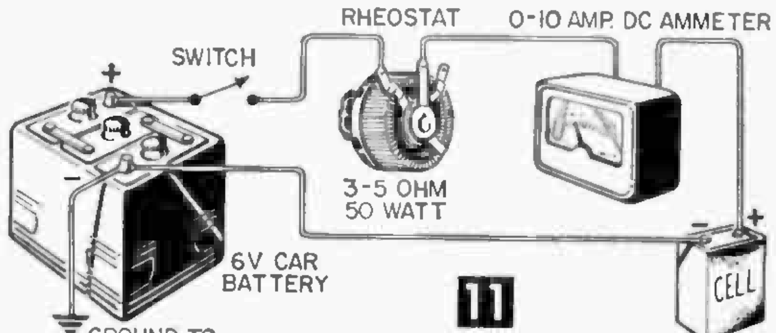
9 Notch in cabinet to clear transformer will be covered when side panel is attached. Note knot in line cord to prevent any unintentional strain from loosening input connections.



10 Difference of pin diameters insures right hookup for high voltage charge. As further safety measure, positive lead has red covering, matching color of positive terminal on panel.



10 A CONNECTION BLOCK FOR 240 V BATTERY



11 CIRCUIT FOR RECHARGING LOW-VOLTAGE BATTERIES

turn on the line switch, the meter should read but a few *ma*. Advance the rheostat towards "HI," cutting out some of the resistance and the *ma* value will rise. If battery is badly exhausted, this reading may be about 50 or 60 *ma* at the start, but in about two minutes 100 *ma* should be indicated with the rheostat further advanced. Turn off the switch and disconnect battery. You can now test it with a high-resistance voltmeter to compare with pre-charging voltage.

Carefully feel the battery during charging. If it seems more than just slightly warm, either discontinue charging or reduce the rate until it has cooled down.

Batteries that are quite well up and only being given a boost will read about 80-90 *ma* at the start and need but a half-minute or so of charging to advance to 100 *ma*.

You can charge B batteries with this unit in similar fashion, but for 45-*volt* and smaller sizes you will first have to reduce the current to a reasonable level. This can be done without disturbing the unit by mounting another 2,500-ohm, 25-watt variable resistance on a stand and connecting it in series between positive terminals of the unit and the battery.

Remember to test B batteries and photoflash batteries with a voltmeter only. When we tested the one in Fig. 10, voltage had dropped from a normal 240 to 200. After the two-minute charging period, voltage jumped to 245, then quickly dropped to 240. The next day, it had leveled out to 230 volts. Some batteries may not respond so well if they have one or more cells that have depreciated chemically, and milliammeter readings will vary, too. While it may not be possible to get voltage past 225, even that will allow some extra service.

Low-Voltage Charging is adequately accomplished with the aid of storage batteries, using the hookup in Fig. 11. To revive 6-*volt* "hot shot" ignition and electric fence batteries, substitute a 12-*volt* storage battery.

Adjust the rheostat to apply 1 to 3 amperes, since these large batteries can stand such current for a short time without heating. Disconnect after two or three minutes and test momentarily with an 0-25 scale ammeter. Check with a quick touch of the terminals since this meter short circuits the battery and will quickly drain it if left in contact. If less than 15-20 *amps* are indicated, put it back on charge. It may take as long as five or six minutes to bring the battery up sufficiently for good service.

Here's what happened when we charged a well-used #6 dry cell testing 1.4 *volts* but only 2-3 *amps!* After a minute at 3 *amps*, voltage measured 1.6 and the current was 4½ *amps*. Put back on charge for two more minutes, the readings were 1.7 *volts* and 17 *amps*, quite satisfactory for such a depleted cell and enough to team up with another recharged cell to ring the door bells again.

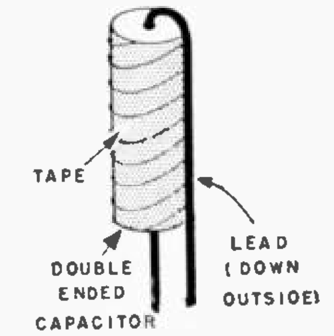
Caution: Do not permit the battery to get very warm to the touch. Current tends to heat the cells if its value is too large or charging continues for too long a time. The smaller the battery, the less current should be put through it. Overheating will dry out the electrolyte and build up pressure which may blow out the internal mixture at the sealed end.

Generally, the voltage value used in charging should be nearly twice that rated for the battery, applied through a variable resistance. More voltage may be needed, however, to force a satisfactory current through at the start where the battery is heavily polarized.

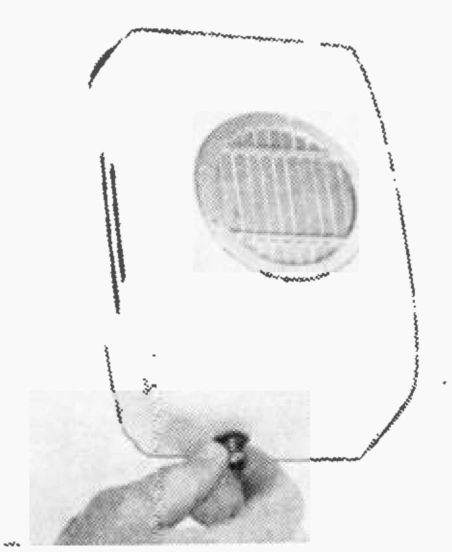
To prolong life in batteries, it's a good idea to apply a short charge at frequent intervals to depolarize them and thus keep them in fresher condition. Such a boost may require only a half minute or so—just long enough for the meter to rise up to 100-125 *ma*. And while voltage will always drop a bit right after the battery is removed from the charger, it should remain substantially higher than before.

After the unit is turned off and *before touching the binding posts*, be sure to discharge the capacitors by shorting across the posts with a well-insulated screwdriver. If you change connections often, it's a good idea to eliminate this potential shock hazard permanently by connecting a 150,000-ohm, 1-watt bleeder resistor across the output posts just inside the cabinet. With this setup (Fig. 7), the resistor will drain off the charge in a minute or two.

Capacitor Modified for Printed Circuit



• When you need a single-ended capacitor for a printed circuit and none is available, modify a regular double-ended capacitor of the same value to serve the purpose. Bend the lead at one end over, and down the outside of the capacitor housing. If necessary, solder on an extra length of wire to extend the lead. Wrap the capacitor body with electrical tape to avoid any possibility of the bare wire lead accidentally shorting out to other adjacent components. This modification brings both leads out at one end, thus converting the component into a single-ended one, useable in printed circuits.—John A. Comstock.



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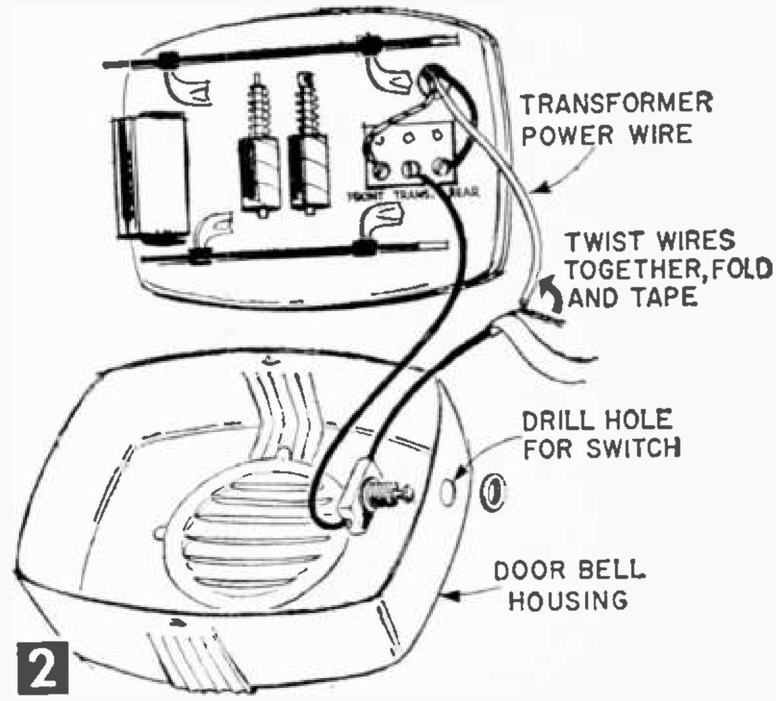


2

Door Bell Silencer

HERE'S a simple way of silencing that door bell so that it won't wake babies taking afternoon naps.

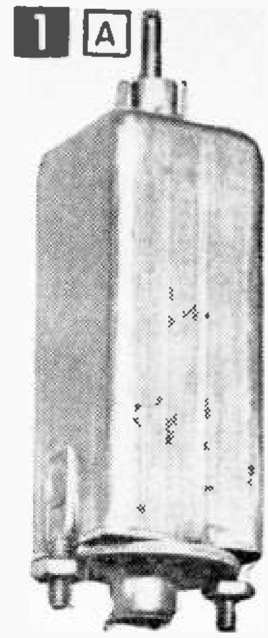
Obtain a small twist switch with threaded shaft and nut for mounting from your hardware store. Remove the cover or housing from your door bell and drill a hole through it large enough to pass the threaded shaft on the switch (Fig. 2). Make sure the switch parts inside the housing won't interfere with the bell mechanism.

Remove the wire coming from the bell transformer from its terminal and connect one of the pigtail wires on the switch to the transformer terminal. Then connect the transformer wire to the other pigtail wire on the switch by twisting them together and taping.

You don't have to turn off the house current for this job—house bell circuits carry only 6 volts.

Replace bell housing, and have someone press door bell button so you will know if the switch is in the "on" or "off" position.

A midget IF transformer can (inset) housed the original phono surface noise and scratch filter, but other more common types of tin containers can be used. To use filter, merely plug unit into line between record player and amplifier or radio phono jack.



Noise Filter for Record Playing

RECORDS, both old and new, frequently suffer a common disease—surface noise. Here's a filter that should help to cut down that distracting scratching, so that you can enjoy even those old favorite records made before the advent of electronic recording.

This record filter plugs into the input line of the phono amplifier (Fig. 1) so that in most instances no internal circuit changes are required, either at the record player or amplifier. The original unit was housed in a miniature IF transformer can (Fig. 1A), but any small metal container may be used.

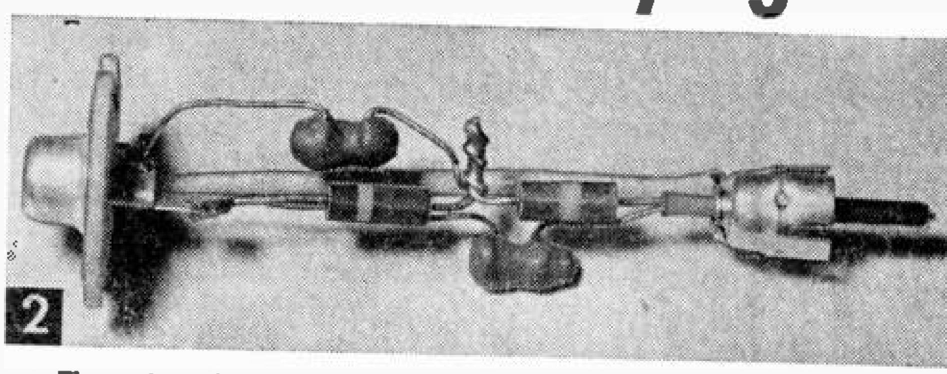
Drill a 7/32-in. hole in one end of the can; this hole will be just large enough for you to insert the neck of the ICA-type phono plug shell. Solder the shell to the can. If the housing is made of aluminum, first "tin" the areas around the 7/32-in. hole with aluminum solder. You can then solder the shell to the aluminum with regular lead/tin alloy radio solder.

Drill a 3/8-in. hole in the opposite end of the can, along with two 1/8-in. holes for mounting an ICA-type phono jack. When screwed down with 1/4 x 4-40 machine screws, the jack shell is automatically grounded to the metal container.

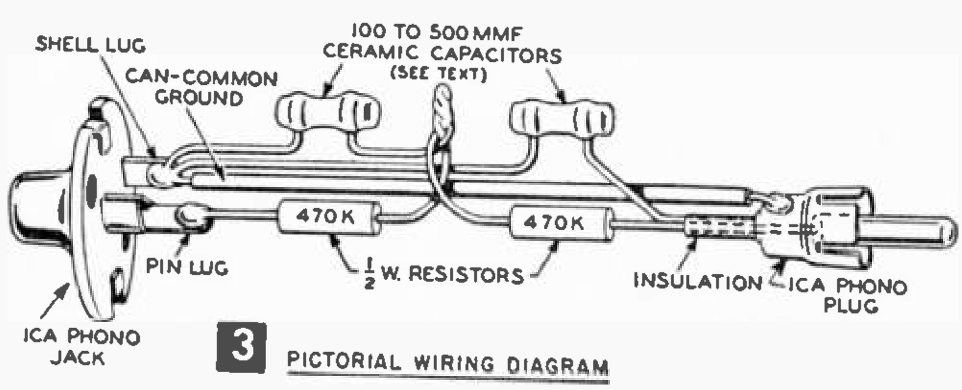
The filter network (Figs. 2 and 3) consists of two 470k (470,000) ohm 1/2-watt resistors and two ceramic capacitors with an identical capacity of 100 to 500 *mmf* each. Where surface noise is only slight, use capacitors of 100 *mmf* to 250 *mmf*. For old, scratched discs, use capacitors of about 500 *mmf*. The larger capacitors will somewhat increase the bass response of records, and suppress the highs, but at least you'll be able to hear both bass and treble far better with the annoying surface noise suppressed.

If you are very ambitious, substitute a pair of adjustable mica trimmer capacitors with a range of about 100-500 *mmf* for the fixed ceramic types. Then with a screwdriver, you can adjust the capacitances to suit the condition of the record.

When wiring up the filter, be sure the resistor and capacitor lead to the phono-plug pin does not accidentally ground to the shell since this would render the phono inoperative. A short length of radio "spaghetti" or other insulation will prevent this.—T. A. BLANCHARD.



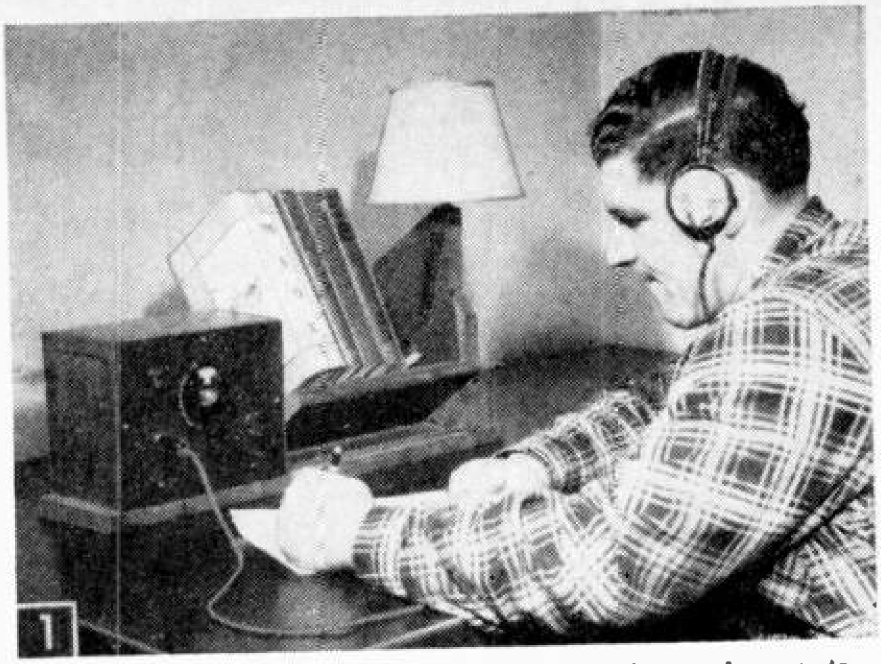
The noise filter consists of six inexpensive radio components listed in Fig. 3.



3 PICTORIAL WIRING DIAGRAM

MATERIALS LIST—RECORD NOISE FILTER

1	small friction lid can, or IF transformer shell
1	ICA type phono plug
1	ICA type phono jack
2	470k (470,000) ohm, 1/2-watt composition resistors
2	fixed ceramic capacitors or adjustable trimmers (see text)
2	1/4 x 4-40 rh machine screws and nuts



Designed primarily for use by the student ham who wants to keep up his code speed, the *Student's Special* can be modified to receive the standard broadcast band.

SW Receiver

By C. F. ROCKEY

Here's a project for the radio-minded high school or college student, or for the man whose son is such a student—an inexpensive short-wave receiver for the study desk

THIS receiver employs an untuned radio frequency amplifier, a regenerative detector, and an audio amplifier. In addition to increasing the unit's sensitivity, the RF amplifier isolates the detector from the antenna, thus minimizing hand-capacity effects. A voltage regulator tube also makes a big contribution to overall stability. This circuit thus offers the maximum in short-wave receiving satisfaction at minimum cost. And, since a large resistance unit is required to drop the heater voltage, a lamp bulb is used for this purpose, a lamp that normally burns only slightly less brightly than normal and does double duty as a close-in reading lamp. In addition, a sturdy book trough, capable of holding half a dozen textbooks, is included.

Build the receiver unit itself first; then, the book trough and lamp assembly. Begin by laying out the chassis as shown in Fig. 2. Set the tubes and coil in position in order to assure proper clearance, then drill all small holes with a No. 27 drill, large enough to clear the body of a 6-32 screw. Punch socket holes with a $1\frac{3}{16}$-in. Greenlee socket punch (available from any large radio supply house).

Next, take the 7 x 10-in. front panel (see Materials List) to your neighborhood sheet-metal shop and have the tinsmith cut exactly 1 in. from it, making it 7 x 9 in. He can do this on his foot-powered shear much more neatly than you can with a hacksaw. If no such facilities are available, however, you'll have to use the saw; this metal is too tough for hand tin shears. Finish the raw edge of the panel with black automobile "touch-up" enamel.

Now lay out and drill holes for the front-panel mountings (Fig. 3). Consult the instructions and template enclosed with the tuning dial when drilling mounting holes for it. Then fasten the sockets, terminal strip and selenium rectifier to the chassis, using 6-32 steel machine screws and hex nuts (buy 1-in. screws, cutting them shorter where too long with diagonal cutters and pliers) and secure to the chassis the insulated tie points for holding the electrolytic filter capacitors. Insert other tie points as the wiring progresses.

Figure 4 gives the schematic for the wiring; Fig. 5, the pictorial. Heater and plate-supply leads can be as long as convenient; you can even group these together cable-like if you wish. Keep these wires close to the chassis, however, in order to avoid hum troubles later.

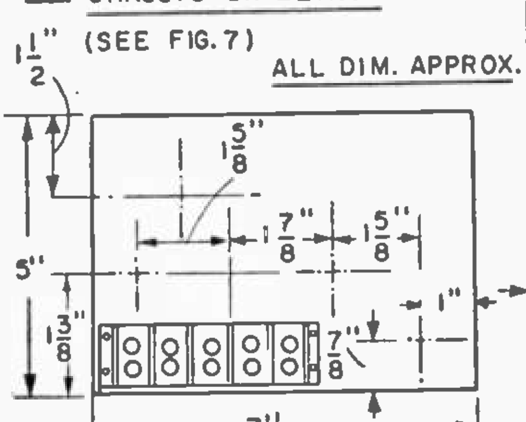
Keep plate, grid and other signal-carrying leads as short and direct as possible. Except for the electrolytic and large paper capacitors (which should be hung between tie points) the resistors and capacitors can be wired-in directly without other mounting precautions.

Care is the only preventer of wiring errors. Mark over the schematic as wires are inserted; check each stage or circuit as it is completed. Carefully observe polarity on electrolytic capacitor and selenium rectifier connections. Finally, have one of your radio-minded friends recheck the wiring for you, before plugging-in to eliminate those annoying mistakes a person misses when checking his own work.

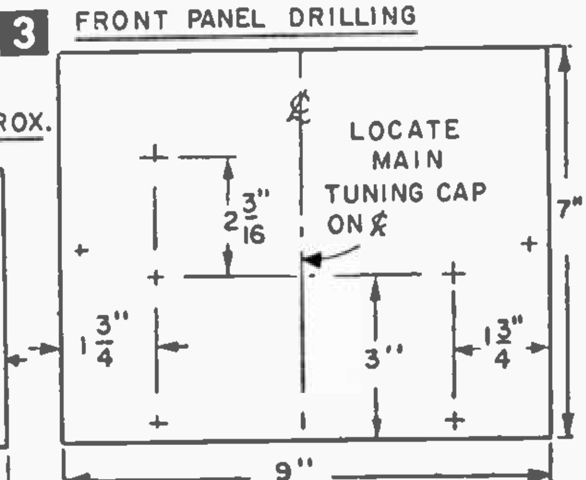
When you are sure that the under-chassis wiring is complete and correct, mount the variable capacitors, dial, potentiometer and phone jack securely on the panel. Then fasten the chassis and panel together, and complete the wiring.

When all wiring has been completed and checked, insert

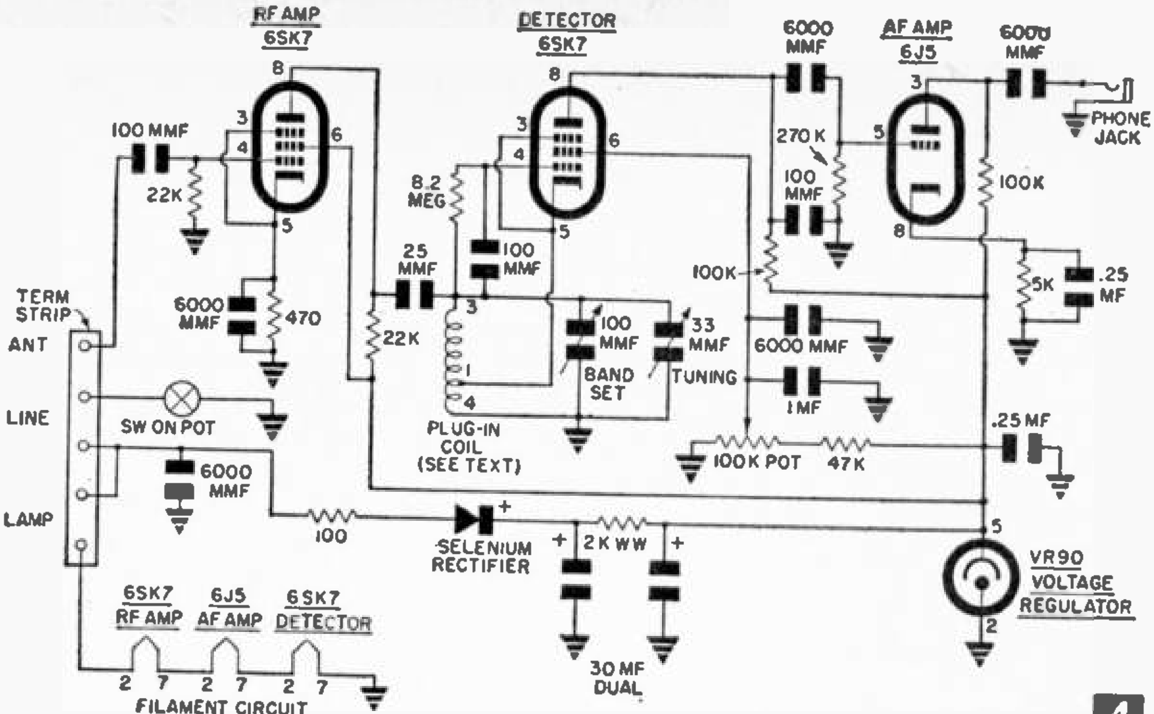
2 CHASSIS DRILLING



3 FRONT PANEL DRILLING



the voltage regulator tube into socket (insert *only* the VR tube, no others). Then plug in the line cord and turn on the line switch. A bright pink glow inside of the VR tube indicates that the plate voltage supply is satisfactory. If such a glow is not observed, pull the plug instantly and recheck the wiring. If it is correct, try a different VR tube, check electrolytic and shunting .25 *mf* paper capacitors for short circuits with an ohmmeter and try another selenium rectifier unit. One of these checks will turn up the trouble.



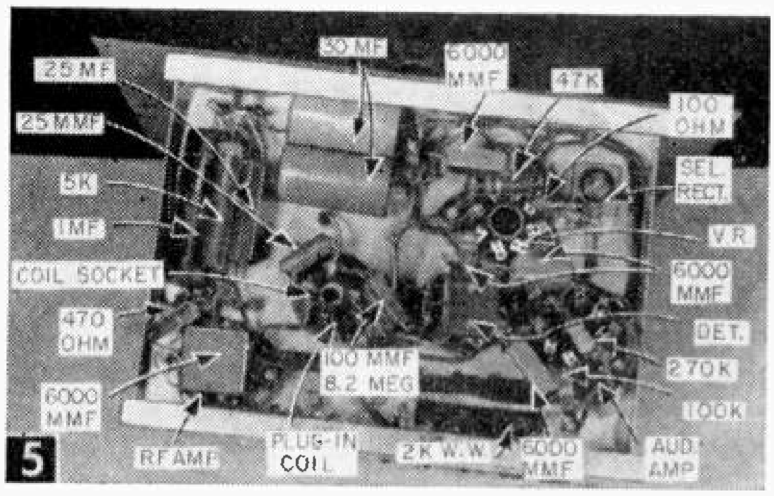
SCHEMATIC 4

When the VR tube lights up properly, remove the line-cord plug and insert the rest of the tubes in their sockets. Connect a *40-watt* lamp bulb (any other size bulb may damage tubes) to the terminals marked "lamp" in Fig. 4. Plug into the line again and turn on the line switch. If the filament circuit is satisfactory, the 40-watt lamp bulb should light up to nearly full brilliancy. Removing any tube except the voltage regulator will cause the lamp to go out.

If the lamp does not light, recheck the wiring, then check the lamp bulb and tube filaments for open circuits to locate the trouble.

When the filament circuit has been checked out satisfactorily, wind the coils. Figure 6 illustrates the construction of the short-wave coils and gives the turn specifications for the various frequency bands. (For those who like occasional standard-broadcast reception, coil specifications are given for the broadcast band. However, many features desirable in broadcast reception have been sacrificed here for best possible short-wave reception. Only local broadcast stations can be received satisfactorily). When making the cathode tap, be sure that you don't short circuit adjacent turns. Wind and check each coil's operation before beginning another. Start with the lowest-frequency (25-turn) short-wave coil.

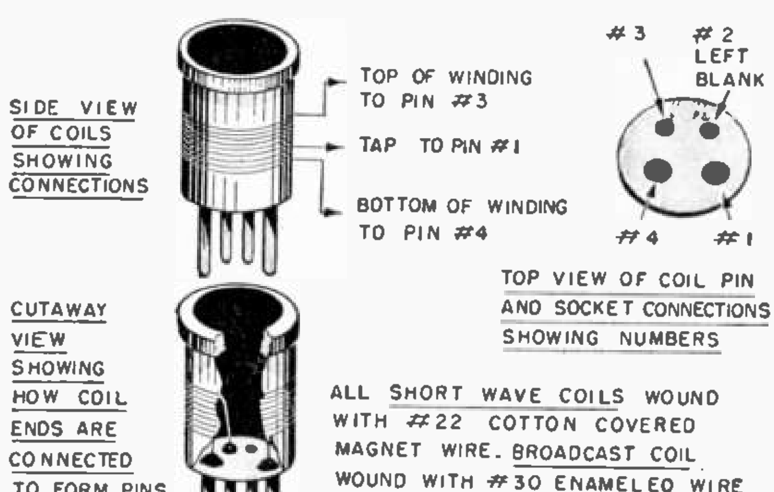
When your first coil is finished and checked, plug it into the four-prong, plug-in coil socket. Then insert the phone plug into its front-panel jack, plug the line cord in and turn on the line switch. After allowing a reasonable warm-up period, put on the headphones. With the potentiometer knob at its extreme counterclockwise position, slowly rotate clockwise. With the control knob between one-third and two-thirds fully rotated, you should hear a soft "swish," followed by an increase in the hiss level. The "swish" is the receiver's point of oscillation. If it is not heard, carefully recheck the wiring, and



5 Under-chassis pictorial view of receiver.

test the tubes in a good, reliable tube tester. Then re-examine the plug-in coil and its connections. One of these is at fault if oscillation does not occur.

When oscillation occurs freely and regularly, connect roughly 25 ft. of wire to the antenna



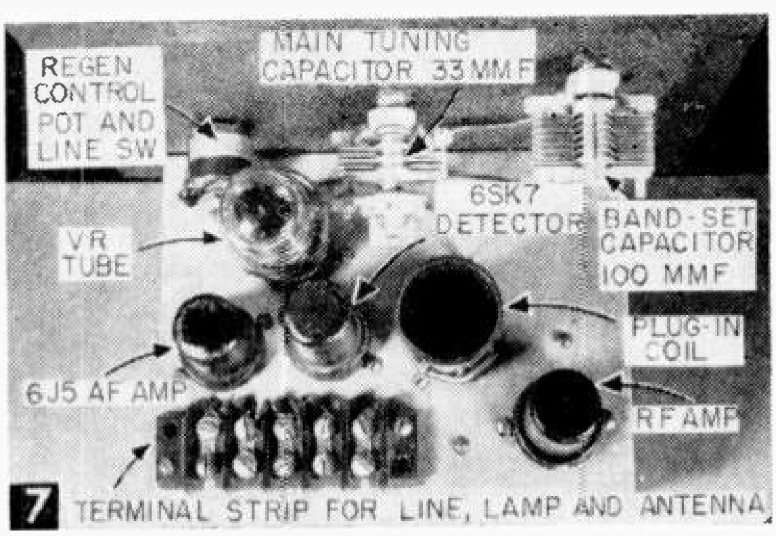
6 COIL WINDING DATA

APPROXIMATE FREQUENCY RANGE	NO. TURNS ON COIL	NO OF TURNS BETWEEN BOTTOM END OF COIL AND CATHODE TAP
9 TO 16 MEGACYCLES	5	1
5 TO 10 MEGACYCLES	12	1½
3.3 TO 6 MEGACYCLES	25	2
HIGH FREQ END OF BROADCAST BAND	75	5
LOW FREQ. END OF BROADCAST BAND	175	10

MATERIALS LIST—SHORT-WAVE RECEIVER

No.	Description
1	7 x10" steel panel (Bud Radio Corp.)
1	chassis, steel, 1½ x 5 x 7" (Bud Radio Corp.)
1	terminal strip, 5-terminal barrier type (Allied Radio Corp., catalog no. 41-H-673)
1	vernier tuning dial, national type BM
2	knobs, ¼" shaft
1	100 mmf variable band-set capacitor (Bud Radio Corp., type #1855)
1	33 mmf variable main tuning capacitor (Bud Radio Corp., type #1852)
1	100K linear taper potentiometer, with S.P.S.T. switch
4	8-prong (octal) socket, amphenol, type "MIP"
1	4-prong socket, amphenol, type "MIP"
1	single circuit headphone jack (Mallory type 701)
1	phone plug (Mallory type 75)
1	selenium rectifier, half-wave, 65 ma (Selectron)
6	insulated tie-points, 2 insulated lugs
	coil forms, 4-prong (I.C.A. type 2158) one for each coil desired
2	6SK7 tubes (metal type preferable; "GT" type may be used) 6SG7 tubes may be used instead of 6SK7's if available
1	6J5 tube (a 6L5 may be used; metal type preferred)
1	VR 90 tube (sometimes called 0B-3)
	wire, screws and solder as required

No.	Description
	Capacitors Required
	Mica ("postage stamp" type)
3	100 mmf
5	6000 mmf
1	25 mmf
	Paper (200 v. working voltage)
2	0.25 mf tubular
1	1.0 mf tubular
	Electrolytic (150 v. working voltage, tubular type)
2	30 mfd
	Resistors Required
	Carbon type (all 1-watt size unless otherwise stated) All values in ohms (K-1000 ohms)
2	22K
2	100K
1	470
1	100
1	8.2 megohm
1	270K
1	47K
1	5K, 2-watt
	Wire-wound type:
1	2K, 10 watt
1	40-watt, Mazda lamp, 110 volt, with socket.
	Headphones required: Trimm "dependable," or any other good high-impedance double headset. Crystal phones may be used, but are expensive and not necessary here.
1	line cord and plug



7

Top of chassis view.

post on the terminal strip. With the potentiometer set just above the oscillation point (slightly on the "hiss" side), rotate the band-set capacitor. Whistling, indicating the presence of signals, should be heard. For best reception of code signals, the potentiometer should be set just on the oscillating point; for voice signals, just below the oscillation point.

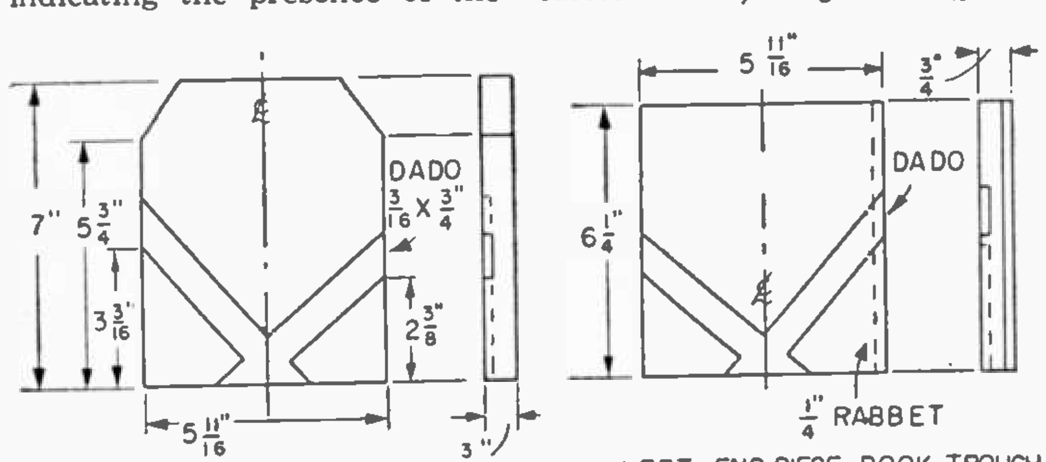
The correct technique for tuning-in a voice signal is first to tune for the steady whistle, indicating the presence of the "carrier wave," then gradually back down the potentiometer until the whistle just stops. Finally, carefully and slowly readjust the tuning control until the voice or music comes in the best. Much as with playing the violin, a little practice is prerequisite to good results.

The band-set, band-spread tuning system used in this receiver enables you to spread a narrow section of the spectrum, such as an amateur or a short-wave broadcasting band, over the whole dial. When used properly, this vastly improves tuning, and enables you to hear many stations which otherwise would be missed completely.

As designed, this receiver is for use with headphones. This is to avoid barraging a non-radiotic roommate with irritating "noise." However, many strong amateur and short-wave broadcasting stations (the Voice of America, the British Broadcasting stations, and occasionally Russia) come in strong enough to work a small PM speaker when coupled through a plate-to-voice coil output transformer. Stick to the 'phones for regular work, however. You'll hear many more stations with them.

Oh yes, the set is automatically grounded through the power line. *Do not use an outside ground* (you may blow a line fuse). And, if the hum-level seems high, reverse the plug. If you want to use a doublet antenna instead of the straight wire, connect one side to the antenna terminal and the other to the chassis.

Building the Book Trough Unit. Make this unit from clear white pine unless you are equipped for and experienced in working with hard woods. Begin by cutting and dadoing the book trough end pieces (see Fig. 8). Then make



8 RIGHT END PIECE - BOOK TROUGH

LEFT END PIECE-BOOK TROUGH (RIGHT END PIECE-RCVR. CABINET)

MATERIALS LIST—BOOK TROUGH

No.	Description
7 linear ft.	¾ x 5 and 11/16" white pine stock, clear
11"	1 x 1" white pine
3'	rubber covered lamp cord
12¼"	lamp tubing, threaded
1	nut to fit lamp tubing
1	keyless lamp socket
1	clip-on-bulb lamp shade, 8" dia. at bottom
Nails, insulated staples, finishing materials	

the front and back pieces for the book trough (Fig. 9A). If you don't have dadoing equipment, nail the book trough directly to the ends, shortening the back and front pieces by about ½ in. in order to keep the overall proportions correct and omit the panel recess shown in Fig. 9A in the book trough front piece. Sand these parts and assemble, using 3d finishing nails.

Next, make the left-hand receiver cabinet end pieces, and the top piece for the receiver cabinet (Fig. 9B). You can simplify this part of the project by not recessing the cabinet back or by omitting the back entirely if you don't need its dust-proofing protection.

Now cut off 25 in. of the 5 11/16-in. stock for the base (Fig. 10A), drill the ½-in. and ¼-in. holes, and groove the bottom for the lamp cord.

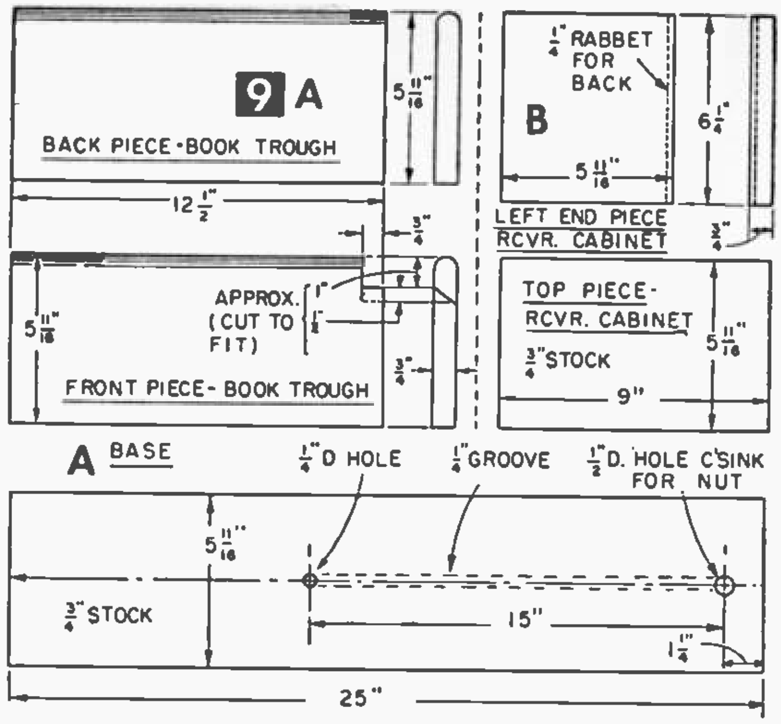
Begin the general assembly (Fig. 11) by first nailing the left-hand cabinet end to the baseboard, with its outside edge ¾-in. from the left end of the baseboard. Then nail the left-hand end of the book trough (right-hand end of the cabinet) to the base with its right-hand edge exactly 9 in. from the outside edge of the previously nailed end piece. Then nail down the right-hand end of the book trough.

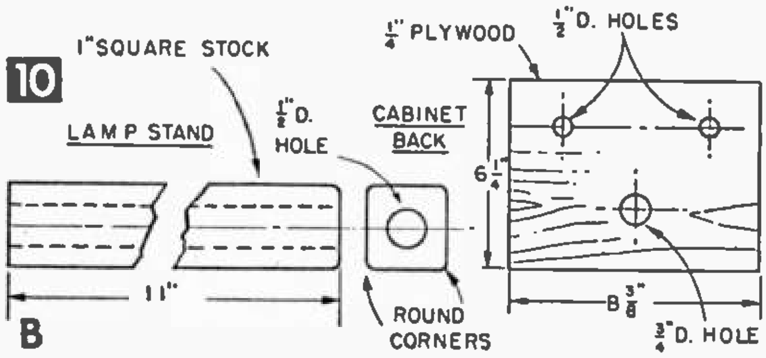
After the cabinet top has been nailed on, make the lamp stand (Fig. 10B) from an 11-in. piece of 1x1 stock. Carefully drill a ½-in. hole (lengthwise) through this piece, using a long, electrician's auger bit, or drill halfway from each end with a regular auger bit. Round the corners at the upper end.

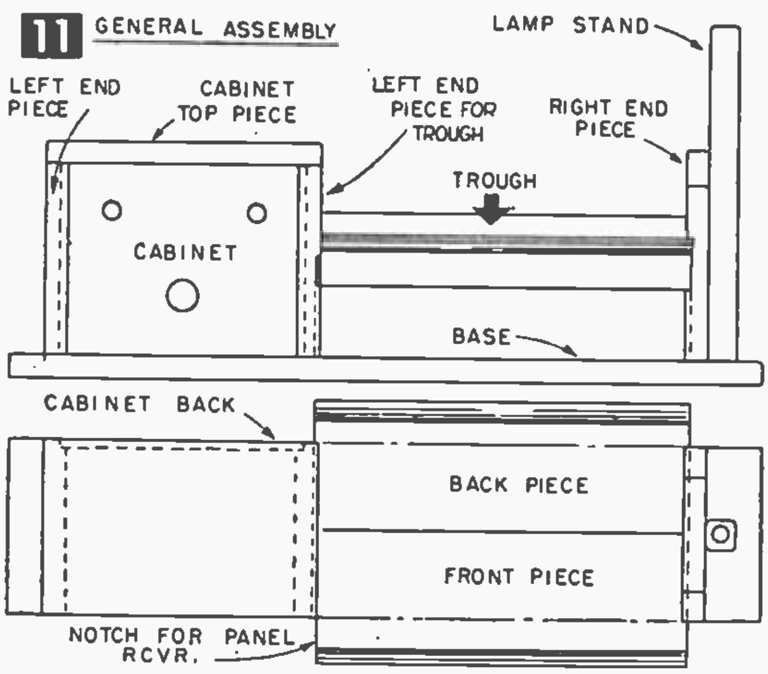
From your local electrical supply store get 12¼-in. of lamp tubing (long, threaded steel pipe through which the cord is passed in nearly every table lamp), and a nut to fit. Pass this lamp tubing through the lampstand and through the ½-in. hole at the right-hand end of the base. Screw the nut on to the bottom of the lamp tubing, thus fastening the lampstand on to the base. Next, screw the shank of a lamp socket on to the upper end of the lamp tubing until it presses firmly on the upper end of the wooden lampstand. Now nail the lampstand to the right-hand end of the book trough. Remove the lamp socket to facilitate finishing the woodworking. Cutting, drilling and installing the back of the cabinet completes the woodwork.

This unit may be finished either by painting or by staining and varnishing.

When the finish is dry, screw the lamp socket back on the upper end of the lamp tubing, con-





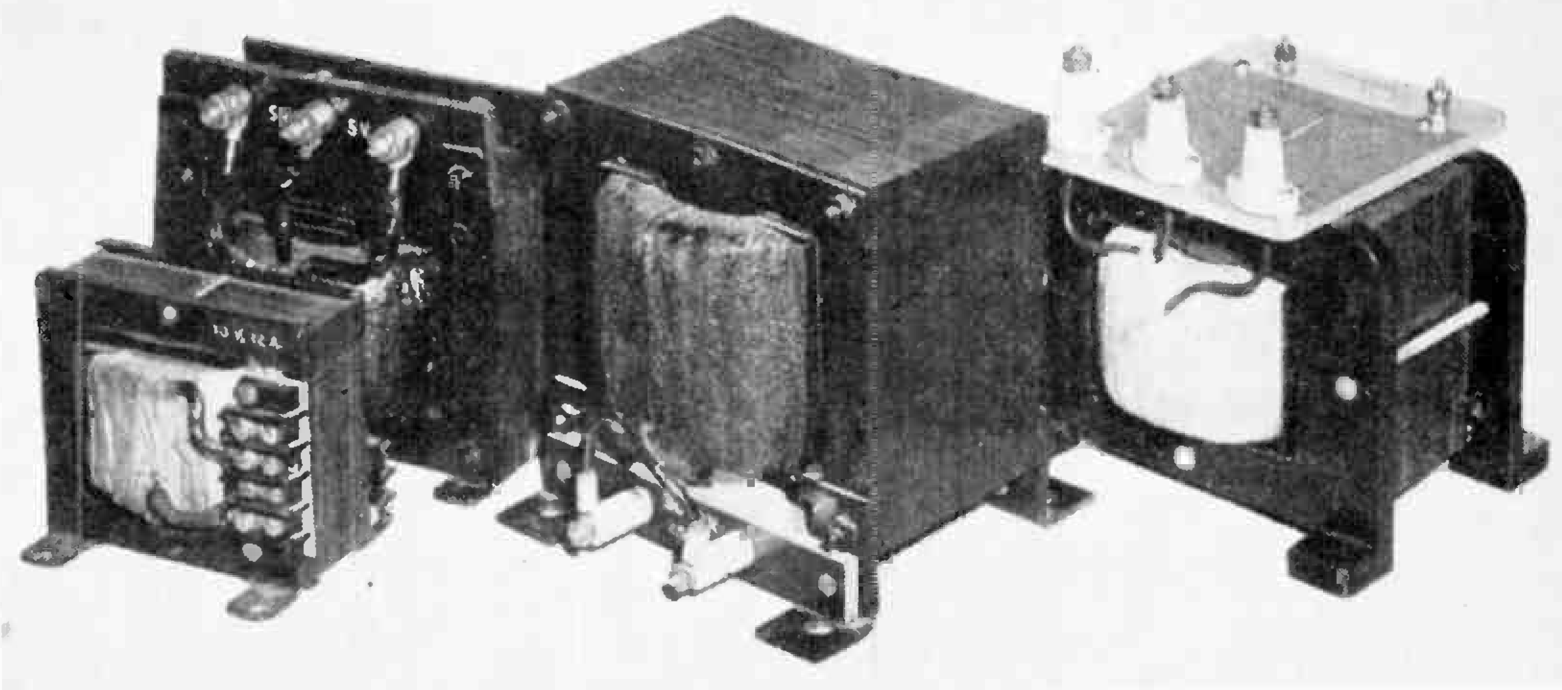


nect about 3 ft. of rubber-covered lamp cord to the socket and assemble after passing the cord down through the lamp tubing to the bottom of the base. Run the lamp cord through the groove and pass it up through the ¼-in. hole into the cabinet.

Fasten the cord into the groove with small insulated staples, at several places, being careful not to pierce the insulation on the lamp cord.

Now make lamp, power line, and antenna connections to the terminal strip on the back of the receiver chassis and fasten the receiver panel to the front of the cabinet. Screw a 40-watt lamp bulb into the lamp socket, put an appropriate shade on this bulb, and your *Student's Special* is complete.

Custom-Making TRANSFORMERS



Transformers built using methods described in this two-part article. Left to right: a 10 V 12 amp filament transformer; a 10 V 25 amp filament transformer; a 3000 V 400 ma. plate transformer; a 2000 V 350 ma. transformer for large Tesla coil.

How to make your own special transformers for ham radio, high voltage experiments, welding, plating, and special electronic equipment

By HAROLD P. STRAND

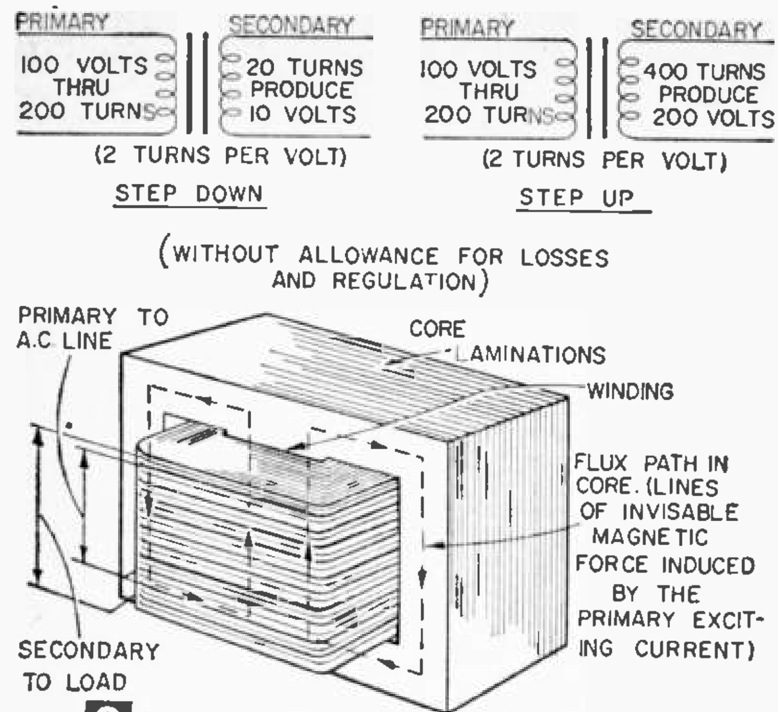
IF YOU need a certain voltage and amperage not available in a stock transformer, you can get exactly what you need by salvaging core metal from a discarded transformer. Then, by winding your own coils, you have a tailor-made job, at a fraction of the cost of having a special transformer made to order.

A transformer consists of a laminated core of special silicon steel (Fig. 2) on which is placed a primary and secondary coil. Depending on design needs, primary and secondary windings can be wound on top of one another as a unit, or placed side by side on the core.

Your first step in design is to decide exactly what transformer output voltage and amperage you need. You determine what size laminated metal core to use, by means of Table A. A formula gives you the wire size and number of turns for the windings. Varnishing, baking and testing completes the job.

Obtaining Laminations. Let's start with the transformer's metal core. We'll assume that you want to get set to make up practically any type of transformer. Usually, large metal stamping companies are not anxious to handle orders for transformer laminations in small lots. But you can pick up old transformers from electrical equipment, radio and TV sets, sometimes for the asking, in repair shops and junk yards. We suggest that you obtain a variety of used or burned out transformers in all sizes.

Suspend the transformers over an incinerator or steel drum, with wires attached to a ½-in. steel rod (Fig. 3). If the transformers have side enclosures, they should be removed before burning, but brackets and clamping parts can be left on. Work away from buildings because the fumes and odor are objectionable. A little fuel oil sprinkled over paper



2 BASIC TRANSFORMER PRINCIPLES

TABLE A—TRANSFORMER CORE AREAS

Approximate cross sectional area in inches for Silicon steel transformer laminations.

Output in volt-amperes	25 cycles	50 cycles	60 cycles
5	0.6	0.3	0.25
10	1.0	0.5	0.4
15	1.2	0.6	0.5
20	1.4	0.7	0.6
25	1.8	0.8	0.7
50	2.8	1.4	1.2
75	4.0	2.0	1.8
100*	4.8*	2.4*	2.2*
125	5.2	2.6	2.4
150	5.6	2.8	2.6
200	6.0	3.0	2.8
250	6.8	3.4	3.2
300	7.6	3.8	3.6
350	8.0	4.0	3.8
400	8.4	4.2	4.0
500	9.6	4.8	4.6

* Text example.

will get a good fire started. Keep the heat up for a half hour by adding more paper and scrap wood. The heat will burn away all old insulation and wrapping material, but will not harm the laminations. In fact, it will tend to anneal the steel, resulting in lower magnetic losses, an important factor in good quality transformers. Quench the fire with a garden hose, and cool the transformers so they can be handled.

Now you can remove the laminations (Fig. 4). If you have an "E and bar" type transformer, pull alternately from each side. Another kind of core has one-piece laminations (Fig. 5B) with a joint open at one side. Take it apart by carefully lifting the side pieces first. Then pull the laminations alternately from each side, one at a time. Clean the metal with a stiff brush, and wipe clean with cloth.

Planning Core Size is easy. You need a mass of metal in the center big enough to provide an adequate path for the magnetic flux in relation to the volt-ampere rating of the transformer. The window opening must be big enough to take the wound coil. Table A lists transformers from 5 to 500 volt amperes. The core area minimum figures refer to the width of the center leg, times the thickness of the stacking in inches (Fig. 5A). You need not follow the table exactly. A variation of 20% plus or 5% minus is allowable.

Theoretically, the best core would have a square cross-sectional area, for example 1.5 x 1.5-in. In practice, many coils will not fit in such a stack. Your core should not vary from the square more than by a factor of 1.75 for the best designs. For example, it would measure 1-in. by a maximum of 1.75 in. But if a certain required coil size would not fit into such a stacking, you might have to exceed the 1.75 ratio.

This will happen when your coils have unusually large numbers of turns, or where large size wire is being used. In such cases, use more stacking or larger laminations and then recalculate the winding with the larger core area; this in turn will result in a smaller coil with less turns. When designing transformers, you may have to recalculate several times with different core dimensions, before you can be certain that the finished coil will fit into the core space.

Window Opening. The second important design factor to consider is the length times the width of one of the rectangular openings in a lamination (Fig. 5A). A good transformer design is thus the best combination of three factors: core size, window opening area, and coil size. Common rectangular cores can be mounted either horizontally or vertically (Fig. 7A, B). In some amplifier circuits where two transformers are to be mounted close together on a chassis, their cores are placed at right angles to each other. This reduces the flux linkage between them to minimize hum and other bad effects.

Building a Transformer. Let's run through a typical design problem and build a transformer. We're making a rectifier unit that runs on 120-*ac* line voltage. The circuit requires 16.5 volts at 5 amps. So we multiply secondary voltage (16.5) times secondary amperage (5), to get the volt-amp rating (82.5 v.a.), which is equal to watts. This, of course, is provided that the future load of the equipment is non-inductive.

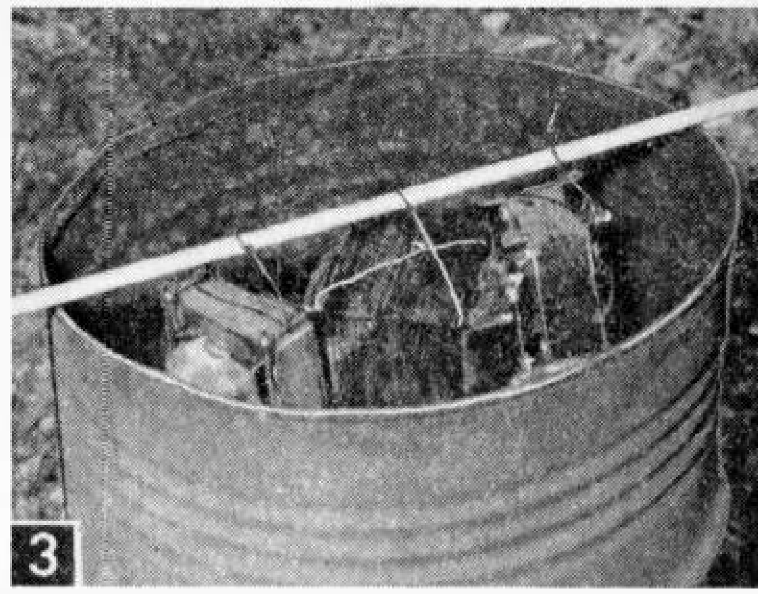
In Table A you will find that the nearest core size is 100 v.a., calling for 2.2-sq. in. core area. This area is an average and we can be under 5% or over 2%. From our stock of salvaged laminations, we select a suitable group with a center leg width of the "E", 1.25-in. Stacking these laminations to 1.75-in. thick, and multiplying the two dimensions, (Fig. 5A) we get 2.18 sq. in. The window opening measures ⅝-in. x 1⅞-in. or an area of 1.17 sq. in.—the space into which the coil cross section must fit.

Now calculate the coil windings (Fig. 7C).

TABLE B—WIRE SIZES AND TURNS PER SQUARE INCH

Heavy Formvar Diameter (Nominal)	Wire size in B&S Gage	Cross-sectional area (bare) in circular mils	Turns per square inch with average insulation, layer wound
.1055	10	10,380	90
.0942	11	8,226	112
.0842	12	6,529	140
.0753	13	5,184	177
.0673	14	4,109	220
.0602	15	3,260	276
.0538	16	2,580	346
.0482	17	2,052	428
.0431	18	1,624	534
.0386	19	1,289	665
.0346	20	1,024	835
.0310*	21*	812*	1,042*
.0377	22	640	1,310
.0249	23	511	1,600
.0223	24	404	1,980
.0200	25	320	2,470
.0179	26	253	3,090
.0161	27	201.6	3,870
.0145	28	158.8	4,830
.0131	29	127.7	5,920
.0116	30	100	7,430
.0104	31	79.21	9,120
.0094	32	64	10,000
.0084	33	50.41	13,900
.0075	34	39.69	17,700
.0067	35	31.36	22,200
.0060	36	25	27,700

* Text example.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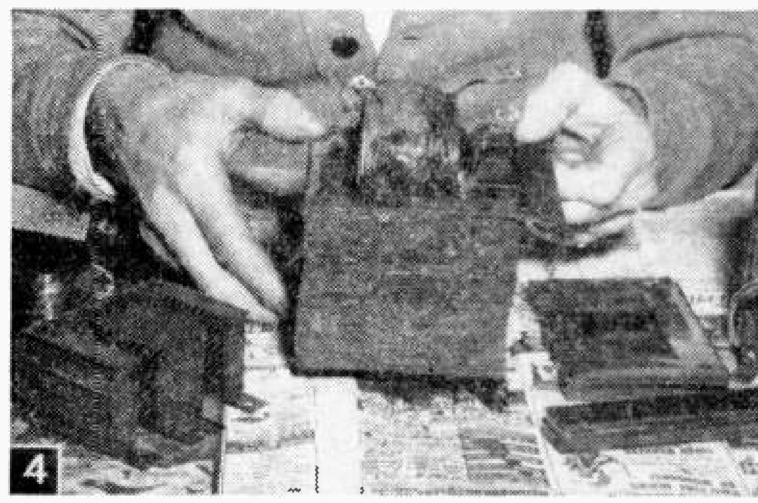
Burning a half hour will loosen the insulation and wrappings so that core laminations can easily be removed.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The heat has reduced the insulated wire to bare copper and laminations that are easily pulled out.

Volt-amperes required (83) are divided by line voltage (120), to get the amperage which must flow through the primary circuit. But since small transformers usually operate at 85% efficiency in transferring electromagnetic energy from primary to secondary, we must add 15% more current to compensate. This totals .79, or .8 amp (with decimal rounded off).

Figuring for constant duty, a value of 1,000 circular mills per ampere is satisfactory. In wire Table B, #21 wire has 812 c.m. area. Therefore you point off three decimal places to the left for the current carrying capacity, .812. For intermittent duty, or if the transformer is to be used only at partial load, one smaller size wire, #22, can be used.

Your next step is to find out how many turns of wire will be required for the primary. The formula is:

$$N = \frac{10^8 \times E}{4.44 \times f \times A \times B_m}$$

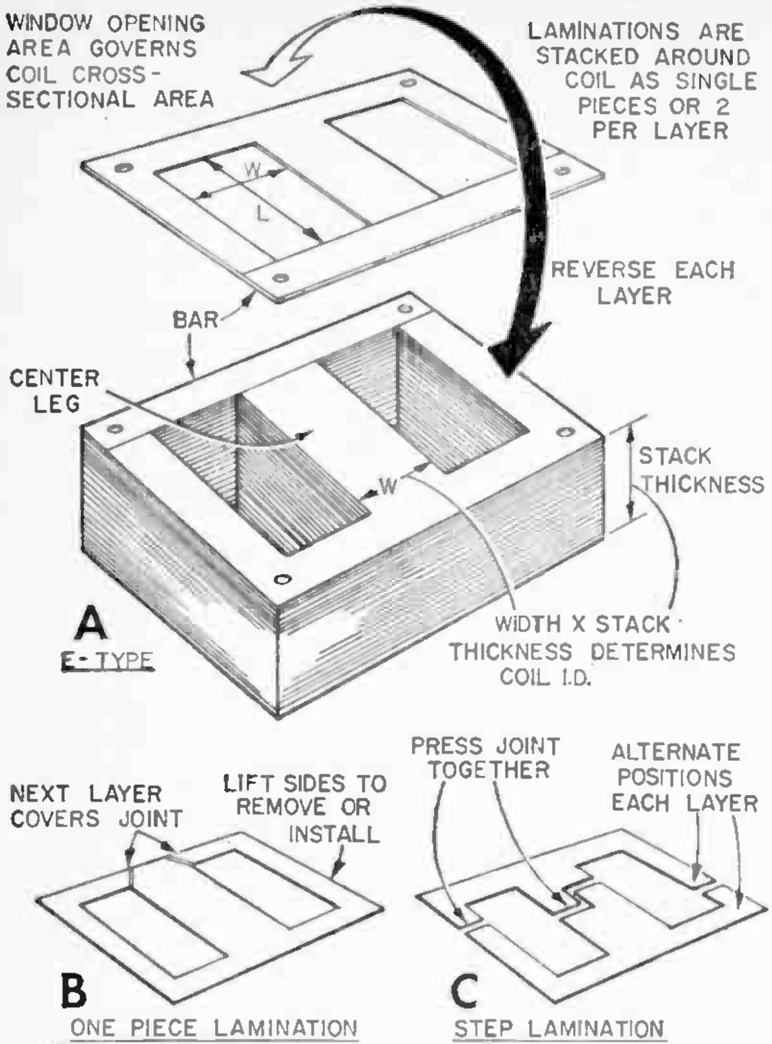
N is number of turns, E is counter electromotive force (line volts), 4.44 is a multiplying factor, f is frequency in cycles per second, B_m is maximum flux density in lines per sq. in., A is area of core in sq. in.

B_m (maximum flux density) is the value of the flux or magnetic lines of force set up in the core by the primary exciting current (Fig. 8). If the density is too high, the transformer will heat excessively and waste power. Various values are selected by a designer according to the use. In some electronic transformers it may be as low as 20,000; in some cases a density of 80,000 has been used, especially for intermittent duty. A value of 60,000 lines is a good average for small power transformers.

$$\text{Thus turns} = \frac{100{,}000{,}000 \times 120}{4.44 \times 60 \times 2.18 \times 60{,}000} = 344$$

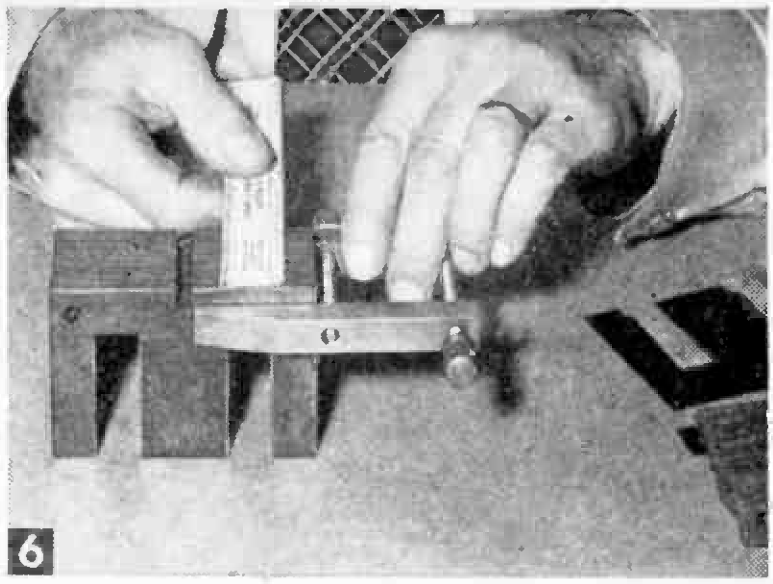
We now have the primary winding calculated as having 344 turns of #21 wire which would operate with little temperature rise.

Now figure the turns-per-volt in the primary to determine how many turns will be required in the secondary. Divide primary turns (344) by line voltage (120), which is 2.87 turns per volt. As 16.5 secondary volts are required, multiply by 2.87, resulting in 47.3 turns. There will be some iron and copper losses, however, which average about 4%, and there will also be a normal voltage drop when the load is added so, if we want the stated voltage at full load, about 2% more turns must be added—or a total of 6% additional turns. The exact values of losses and regulation (the % difference between no load voltage and full load voltage) are difficult to estimate in advance. In commercial applications where the voltage under load must be exact, it is often necessary to construct a second pilot model after tests on the first one show more or less is involved in the loss and regulation factors. In our case the



5 PUNCHED TRANSFORMER LAMINATIONS

STACKED LAMINATIONS ARE #26-#29 GAGE, SILICON TRANSFORMER STEEL. FOR 60-400 CYCLES, USE #29 GAGE TO LOWER LOSSES. (#29 MAY BE USED ON LOWER FREQUENCIES)



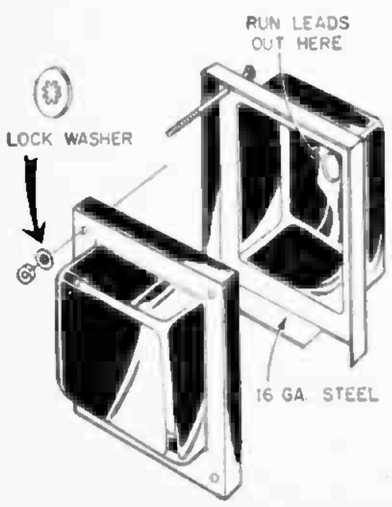
Clamp the stack of transformer laminations tightly together when you measure thickness. The thickness x the center leg width is the cross sectional area of core.

voltage is not too critical, so the addition of 6% is sufficient in the calculated turns, making 50.1 (50) turns for the secondary winding. This winding will be tapped at 25 turns.

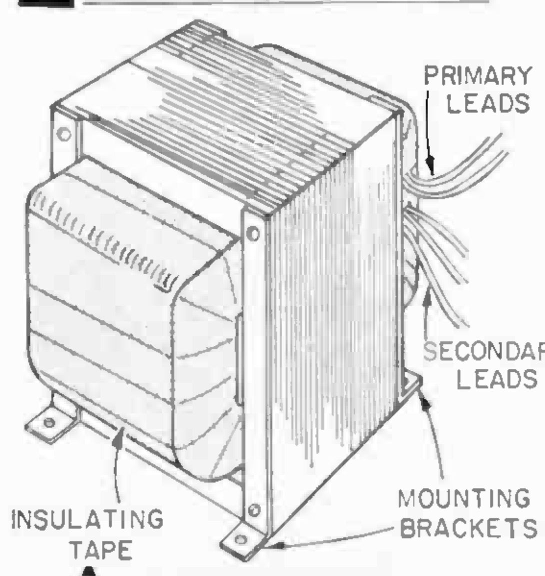
The wire size of this winding is the next consideration. The transformer winding is to carry a current of 5 amperes. Table "B" lists #13 wire with 5184 circular mils, or as having 5.184 amp capacity at 1000 circular mils per amp. Since this is heavy wire to wind, use two wires wound on together, three sizes smaller, or #16, which will have the same area and be easier to wind. (For intermittent duty, you could use one #15 wire.) Formvar magnet wire is recommended for its tough enamel insulation and minimum required space.

The final problem is to estimate the size of the finished coil to make sure it will fit in the lamination window openings (Fig. 7C). To do this, refer to Table "B" in the "turns per sq. in." column. We are using 344 turns of #21, so divide 344 by 1042, resulting in .33. Figure the 50 turns of double #16 singly first, then the result doubled: 50 divided by 344 is .14 times 2 equals .28. Add this to .33 for a total of .61. To this must be added a figure which represents the approximate space taken by the insulation between primary and secondary, between secondary turns if any, and out-

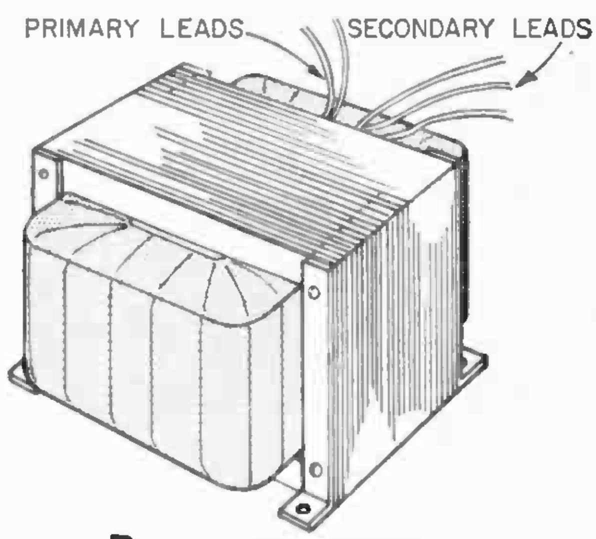
7 SMALL TRANSFORMER DESIGN



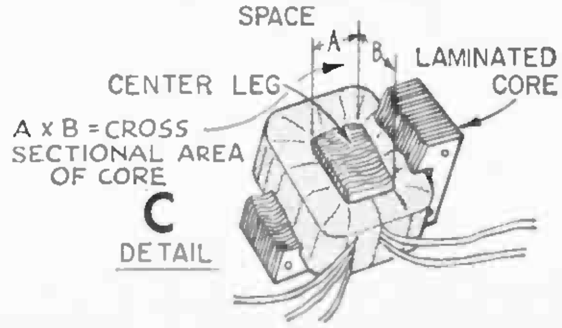
TYPICAL TRANSFORMER ENCLOSURE



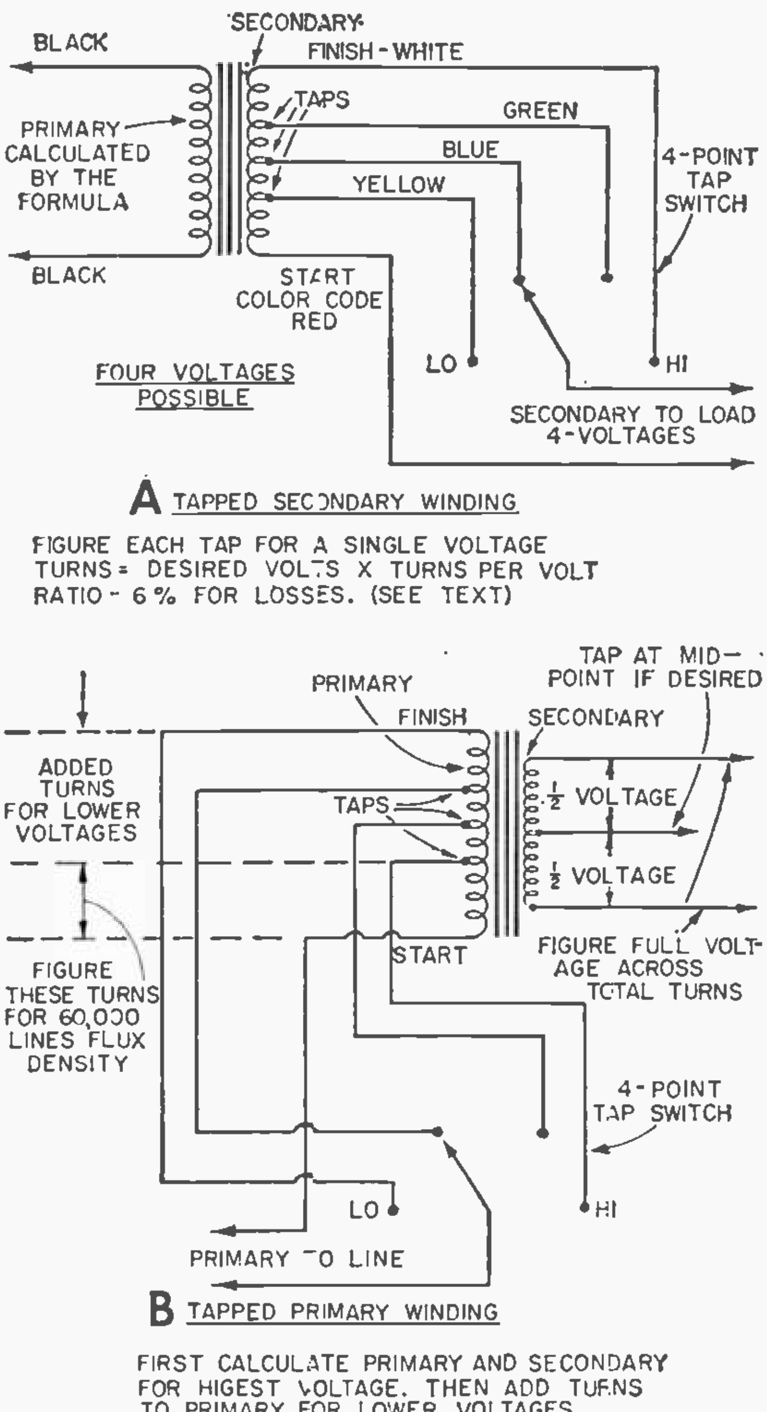
A VERTICAL MOUNTING
REQUIRES MORE HEIGHT



B HORIZONTAL MOUNT
REQUIRES MORE BASE SPACE



C DETAIL



8 VARIABLE VOLTAGE TAPS.

side taping of coil. Another factor is that the turns may not be wound in flat layers, but may be "random" wound, which is easier for the amateur. This type of winding, while satisfactory, takes up more space. Therefore, an estimate of 25% must be added to the figures previously obtained as the probable total space required for the finished coil. This totals .76 sq. in. As the window opening in the core (⅝ x 1⅞ in) is 1.17 sq. in., the coil should fit in place if it is neatly and tightly wound.

Transformer designs which must be quite exact, usually include a stacking factor for the core, since a stack of laminations 2-in. high does not necessarily have the same area as 2-in. of solid steel. Therefore, .9, another multiplier, is added to the row of figures below the line in the formula. For practical purposes, however, this figure can be omitted in most cases.

A transformer is often needed which has several output voltages, obtained with a multi-point switch or so-called tap switch. There are two ways of doing this. You can design the secondary winding with taps at the turns to deliver the desired voltages, each of which can be calculated by the methods already described, and bring out leads at these points (Fig. 8). Or the primary winding can be tapped. This is especially desirable when the size wire in the secondary is large and it is impossible to make taps there without adding considerable bulk. To tap the primary, first calculate the primary winding by the method described for single-voltage transformers.

Then, figure the number of turns for the secondary for the *highest* voltage required, using the primary turn-per-volt ratio as the multiplier plus the added percentage for losses and regulation. This will establish the number of secondary turns. In order to get several lower voltages, more turns must be added to the primary with taps at each of the points to be determined.

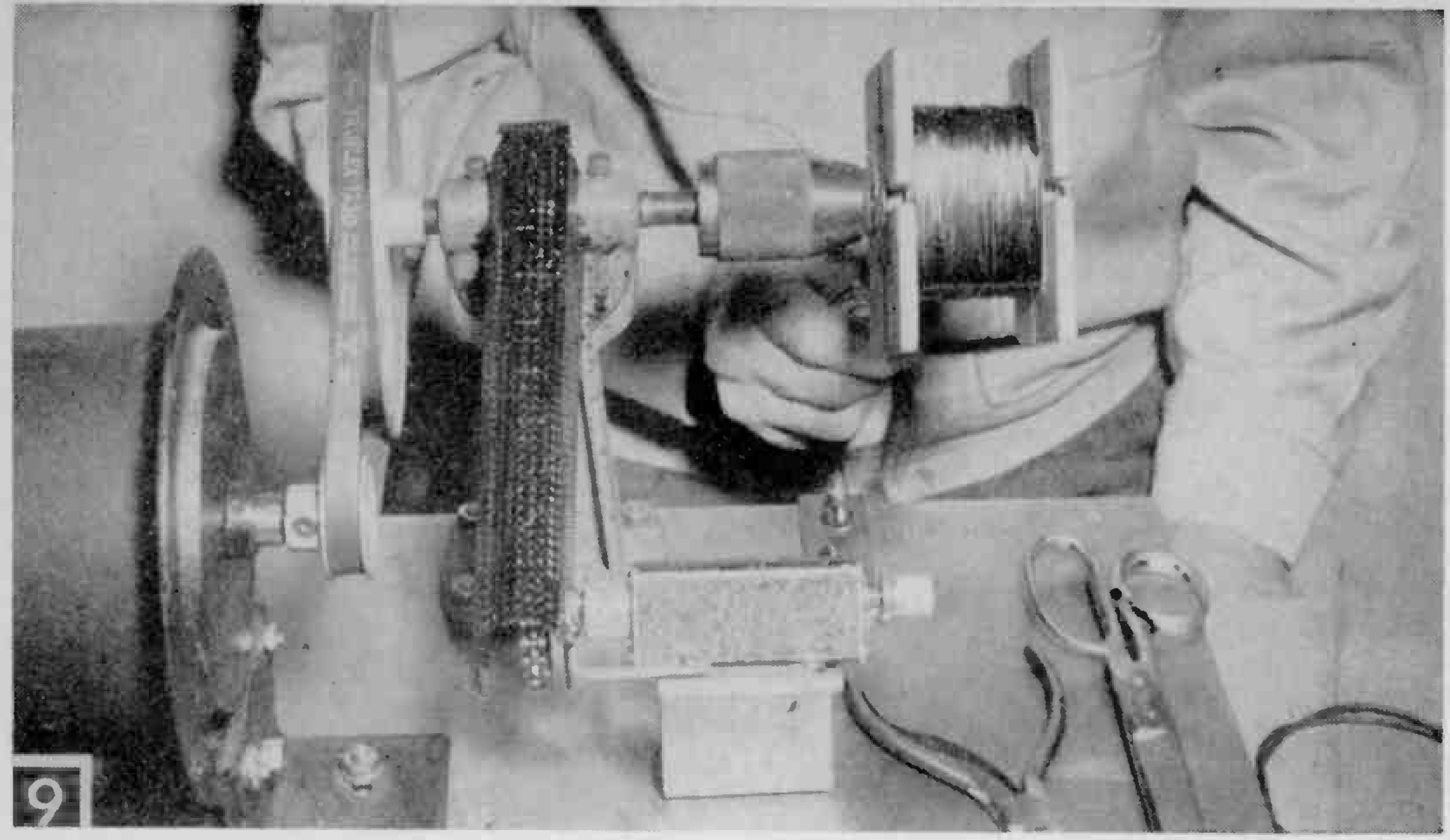
Supposing that we wish to have 24, 18, 12 and 10 volts through the use of a tap switch on the primary. A particular transformer with a certain core, for example, is figured to require 350 primary turns for a 60,000 flux density.

Dividing this by the line voltage (120), we get a turn-per-volt ratio of 2.9. Multiplying this by the highest secondary voltage (24), the turns for the secondary—with 6% added for losses and regulation—will be 73.77 (74) turns. Eighteen volts will be the next objective, so 70 is divided by 18 which is 4.1. Multiply this by line voltage (120) and the result is 492 primary turns as the next tapping point.

Repeat this procedure for each secondary voltage and the last figure obtained will be the total primary turns required, with the point for each tap indicated.

With so many primary turns, the coil when wound will be comparatively large, so careful selection of the laminations must be considered to provide a suitable space for the coil. When the transformer is operating on the tap which produces the highest secondary voltage (24), the flux density in the core will be at its highest—60,000 lines.

The taps which cut in *more* primary turns will *reduce* the secondary voltage and the exciting current and hence the flux, so the transformer will not be in danger of overheating on any of the taps. If you tapped the basic 350 turns in an attempt to get variable secondary voltage, the result would be an increase in flux density for each tap used, and the flux density would reach a point where the core would overheat, and the line current become excessive.



This homemade machine makes transformer and coil winding easy. Speed is controlled by a foot pedal.

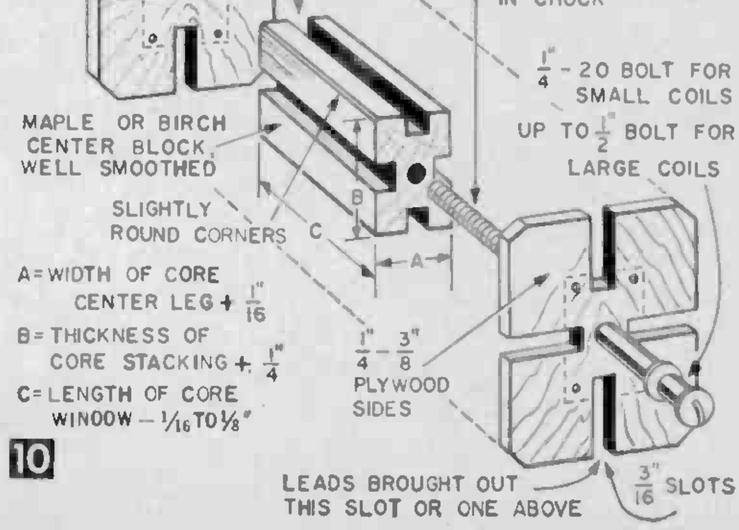
We have described the steps in designing cores and coils for making your own special transformers for rectifiers, plating, ham radio as well as high voltage and electronic experiments.

Laminations were salvaged from discarded transformers, and complete calculations were shown for designing a special rectifier transformer which is to step down 120 line voltage to 16.5 volts at 5 amperes. The continuous duty primary coil was calculated to require 344 turns of #21 Formvar magnet wire; the secondary winding requires 50 turns of two #16 Formvar magnet wires wound together in parallel, with a center tap at the 25th turn. The basic procedure which follows can be used to wind any kind of similar transformer.

Start by making the winding form (Fig. 9) with a center block cut slightly larger than the core center of your transformer laminations. The grooves and the slots in the coil form (Fig. 10) are used for temporarily binding completed turns of wire with cord. Sand the wood smooth, slightly rounding the corners, and then coat with shellac. When dry, sand lightly and apply paste wax to make it easy to remove the coil after winding.

The home-made machine (Fig. 9) includes a variable-speed foot pedal which controls a vacuum cleaner motor. If you plan to make a number of transformers, or coils, you will save time by building an electrical coil winding machine (such as the one shown in Craftprint 265, $1). Otherwise, you can chuck the winding form in a lathe that has slow speeds, or rig up a hand crank. For any winding method, you need a positive way to count turns, such as a mechanical counter tied in with sprockets and chain.

To insulate the coil from the laminations first place a turn of lapped .007 Duro insulating paper around the form. Fit the paper tightly with 1/16-in. brought up on all sides (Fig. 12). Secure with a strip of Scotch masking tape. Then slip a length of spaghetti tubing over the end of your #21 Formvar magnet wire, for the starting lead of the primary. Allow at least a foot of this wire and bring the spaghetti in through a side slot into the coil form about 1/4-in. Secure the end of the



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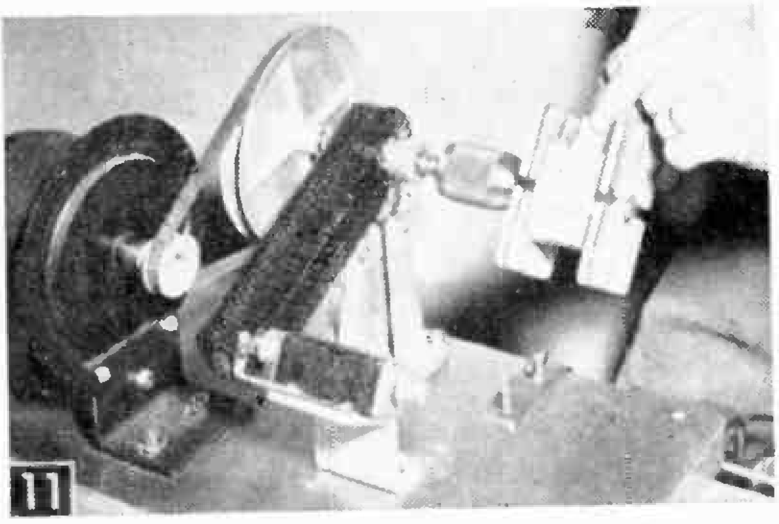
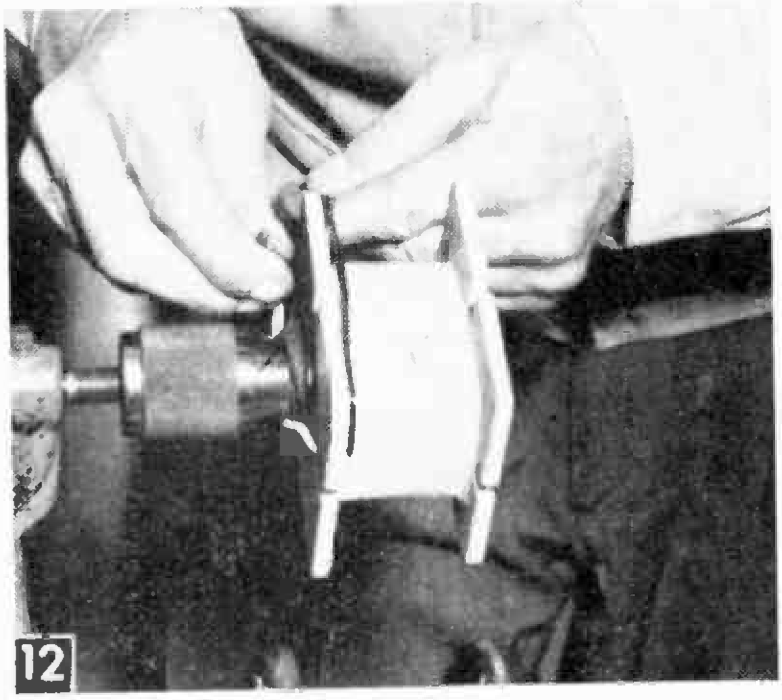
wire by taking a few turns around the bolt on the chuck side of the form. Set your counter at zero and wind back and forth as evenly as possible to avoid unnecessary wire crossings. When the counter reads 344, cut about a foot beyond the last turn, slip on spaghetti tubing, and bring the lead out through the same slot used at the start. Again, secure the lead with paper Scotch tape and a few turns taken around the bolt.

Start the secondary winding with a turn of .007 Duro insulating paper placed over the primary. Follow the same procedure as before (Fig. 11). But after you slip the spaghetti tubing over the lead of your pair of #16 secondary wires, run them through the opposite slot on the coil winding form. Set counter to zero and wind 25 turns, flat and even because your space in the laminations is limited. After the 25th turn, use tape around the turns to temporarily hold them in place. Scrape ⅝-in. insulation from both wire ends and solder on a flexible #16 insulated lead (Fig. 13). Insulate with a folded piece of the .007 Duro paper and secure with paper masking tape. Then wind another 25 turns, cut the wires, slip on spaghetti, and bring the last lead out the same slot used to start the secondary winding.



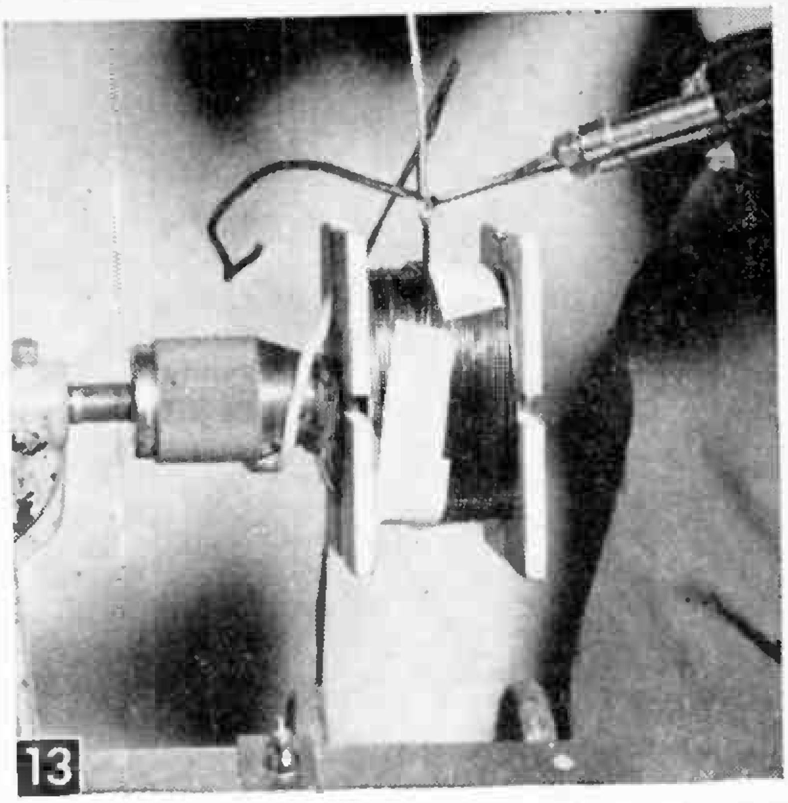
11

Use Duro insulating paper, brought up at the sides and fastened with tape to insulate the coil from the laminations.



12

When primary winding is finished, bring out the leads and wrap around the mounting bolt. The paper insulates primary from secondary winding.



13

With tape temporarily holding the windings, solder a flexible lead wire to make your first tap.

Now you are ready to remove the coil from the form. Make a fish wire and thread some strong cord through the slots (Fig. 14). Gently tap the windings with a block of wood and tightly bind the coil with secure knots. Unchuck, tap out the coil block, and check the coil size with a lamination. Coils have a tendency to spread out at the center after removal from the form, but can be compressed slightly with tape, or in a vise with two blocks of wood.

Use cotton coil tape, the kind specially sold for this purpose, to wrap the coil. Pull it tight each turn, and overlap the tape half its' width. Avoid bunching tape excessively at the corners, which might interfere with the laminations. When you come to a tie cord, cut it, and continue taping (Fig. 15). Run the cotton tape tightly around the leads and sew with needle and thread to keep tight. Also secure the ends of the tape with sewing.

COIL WINDING—SOURCES OF SUPPLY

Formvar Magnet Wire*

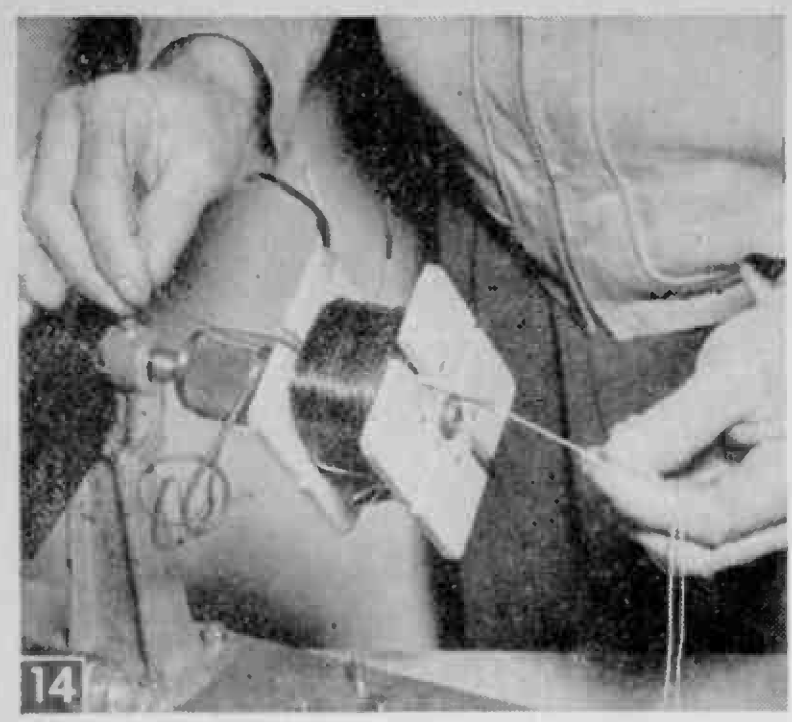
1-lb. spools; Allied Radio, 100 N. Western Ave., Chicago 80, Ill. 5 lb. #21, 10-lb., #16 minimum orders; Huse Liberty Mica Co., Lynfield Street, Peabody, Mass.

Insulation*

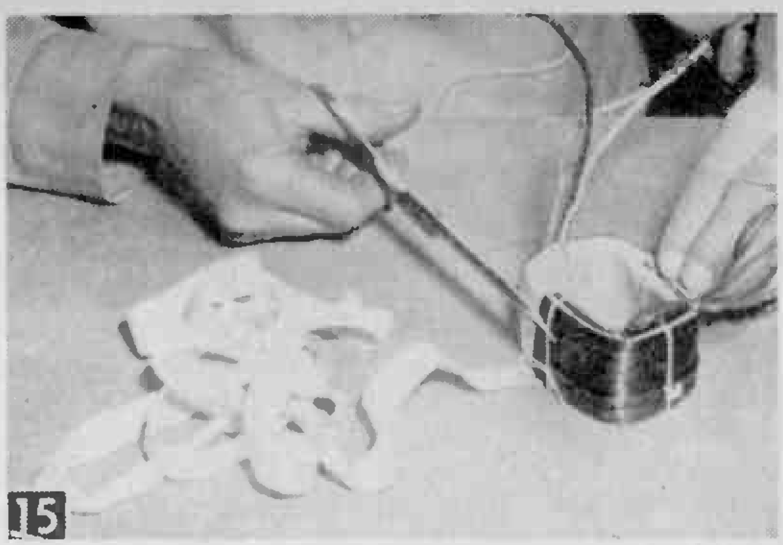
Duro insulating paper .007 or .010" thick in 24 x 46" sheets; cotton coil tape, .007 x ¾" wide rolls; clear baking varnish, 1 gal. cans.; Huse Liberty Mica Co.
Spaghetti tubing, heat-resistant; assorted sizes available most electronic supply houses. Assorted bundle, 8" lengths, Allied Radio Cat. No. 49 T220. ($ .25)
Scotch masking tape, paper; hardware and paint stores.

Flexible Insulated Lead Wire

Braided, heat resisting type; electrical and electronic supply houses.
*Many of these items in small quantities can be purchased through motor winding shops.



Use a small fish made of a short piece of wire to thread through the slots to tie the finished windings.



Pull each turn of the cotton coil tape tightly, and avoid bunching the tape at the corners.

Before you can install the laminations, the coil must be dipped in heat-reactive clear coil baking varnish, and baked. First be sure the coil is free of moisture, dirt etc. Use a can with enough varnish to completely submerge the coil. Wait 20 minutes or until all bubbling ceases, and then hang it up over the can to drain.

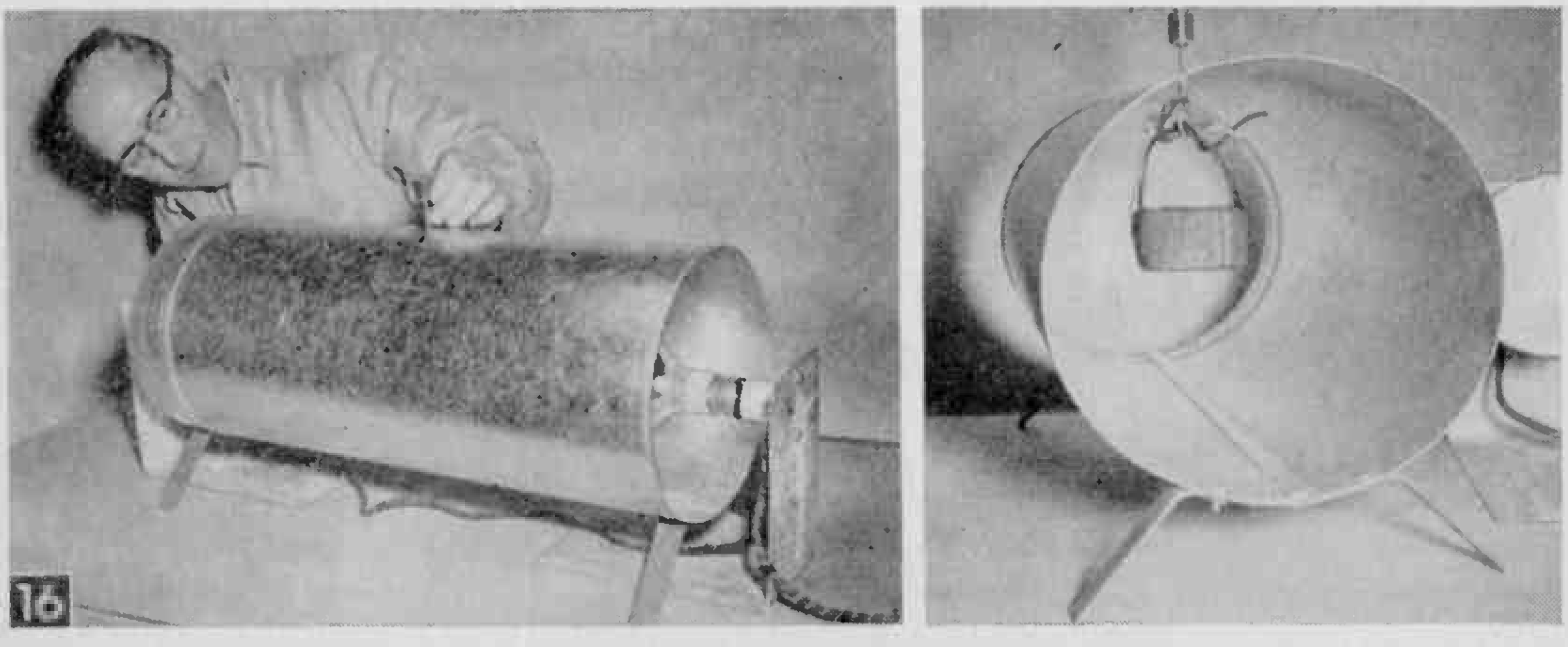
The Baking Oven (Fig. 16) uses two 250-watt infra-red lamps and has a hook fitted through the center of the large galvanized stove pipe for turning the coil during baking. Use asbestos cord for the leads to the lamps, and bind the asbestos fibers with carpet thread to prevent fraying. The infra-red heat rays penetrate down through the windings to the bottom layer, and so baking time will vary with the size of coil and make of varnish. Two or three hours should be enough, provided that you turn the coil a few times.

Assemble the laminations as soon as the coil is cool. You can insert two laminations per layer at once, but be sure to alternate the direction of the "E" for each layer (Fig. 17). When the stack is complete, insert the longer "E" pieces (keepers) which generally are used to cover the last laminations. If such keepers were not part of your original core assembly, disregard. They are not essential.

Now insert core assembly bolts through the laminations and tighten temporarily. Drive Bakelite or fiber wedges into the spaces between the winding and "E" legs to pre-

MATERIALS LIST—BAKING OVEN

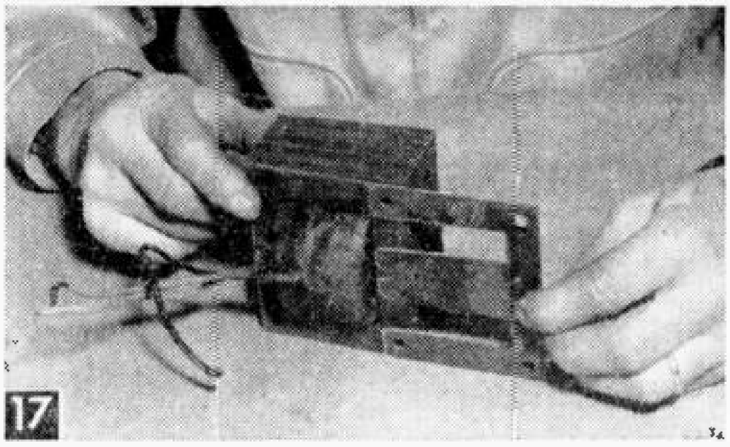
Amt. Req.	Size and Description
1	10 x 24" length, galvanized stove pipe
2	1 x 25 x 1/8" strips, mild steel (legs)
2	1/16 x 6 x 18" pieces aluminum, or galv. sheet steel. (bend 90° for lamp brackets)
1	1/8 x 6" steel rod (coil support)
1	3/4 x 1" Bakelite rod (coil support knob)
4	6-32 x 1/2" rh machine screws and nuts (leg stove pipe assembly)
4	6-32 x 3/4" rh machine screws, washers and nuts (lamp socket assembly)
4	8-32 nuts, (rod-hook assembly)
2	250-watt infra-red lamps
2	lamp sockets, porcelain surface type
12'	#16 braided asbestos-covered appliance cord
1	a-c plug

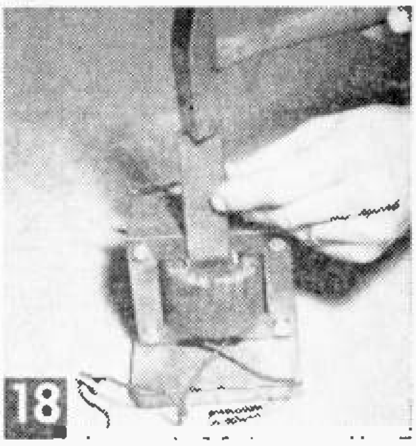


Use a 10-inch stovepipe and two 250-watt infrared lamps to make the oven. With the knob you can turn the coil during baking.

vent the laminations from vibrating. Square up your laminations and drive the joints together with a hammer, with the assembly resting on a steel block (Fig. 18).

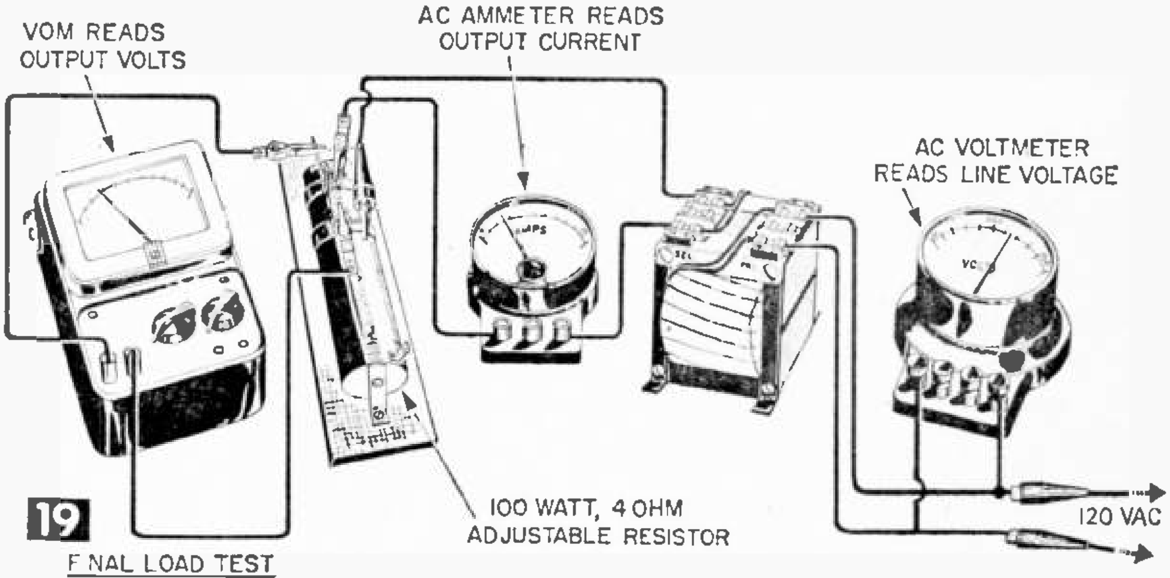
Terminal strips are a practical necessity on this type of experimental transformer (Fig. 19), because you can make and break connections quickly. Use Jones #3-140 barrier terminal strips, and make two sheet metal brackets that just clear the top of the laminations. Complete construction by bolting the terminal assembly, the laminations, and transformer mounting brackets together. Carefully clean the ends of your lead wires and loop around the terminal screws, or solder permanently.





17 18

Left. Assemble the laminations alternating the E each layer. Usually longer E pieces cover the ends. Right. Fiber wedges driven into the open center spaces prevent vibration of the laminations.



19 FINAL LOAD TEST

Insulation Tests. A high voltage transformer is generally used to check for grounds, or electrical leakage to core. A commercial "Megger" insulation tester, will also tell you whether you have perfect insulation. Make the test by applying the high voltage between one primary terminal and frame, and one secondary terminal and frame. Also test across one primary terminal and one secondary terminal.

Apply the high voltage for only an instant and of course, never between terminals of either winding. The leakage will show on the test transformer lamp, or on a megger, the meter will register value of insulation resistance.

Make the No-Load Test by connecting an ammeter in series with one line wire to the primary. A well designed transformer should draw hardly any current with no load on the secondary. Our transformer read .160 amps, which is a satisfactory value. A high current would indicate insufficient primary turns, or that there are shorts between turns. Either of these faults will require rewinding of the coil.

A final test is with a secondary load. For our model, we used an adjustable 100-watt resistor (Fig. 19) capable of carrying the output amperage (5 amps) with a 4-ohm resistance. Connect the resistor with an ammeter in series with one side of the secondary, and a voltmeter in parallel. Also connect a voltmeter across the line. An a-c ammeter to indicate line current, connected in series with one of the primary leads, would also be helpful. Adjust resistor band so secondary ammeter reads exactly 5 amps. Secondary voltage on our model read 16.4 volts, and reading primary amps, we found that full load current was exactly .75 amps. We found the finished transformer voltage was within 1% of our original calculations (using the right line voltage for the test).

You can use the method demonstrated in this article to wind any low voltage transformer. When you build high voltage transformers, you will need to use many turns of fine wire, which usually require insulation between layers to prevent breakdown. On factory winding machines, the insulation is applied automatically over perfectly even layers. On a hand winding machine, use a turn of paper every 500 turns to break up the otherwise continuous winding. Transformers up to 3,000 volts can be built by this method. As an added precaution with high-voltage types, thoroughly impregnate the coils and bake and varnish twice. Also, especially with high voltage transformers, use your infra-red oven to pre-bake the coil for 10 minutes to dry out any moisture that otherwise might be sealed in by the varnish.

WHITE'S RADIO LOG

QUICK REFERENCE INDEX

Remote TV- Radio Sound Silencer

You won't need to dash madly to the TV before answering the phone, nor smash the picture tube when a hammy huckster goes into his commercial pitch

FOR no more than the cost of a push button from your dime store and some fixture wire, you can squelch the TV sound or a radio from your telephone stand or table near your favorite chair. The installation takes only a moment, and the silencer neither shuts off the radio or TV set requiring it to warm up when turned *On* again, nor connects to any 110-volt power line or high voltages within the set.

Because there are no high voltages involved, you can run the squelcher's cord under a carpet without worrying about fire or shock. TV twin-wire lead-ins are excellent because they lay flat.

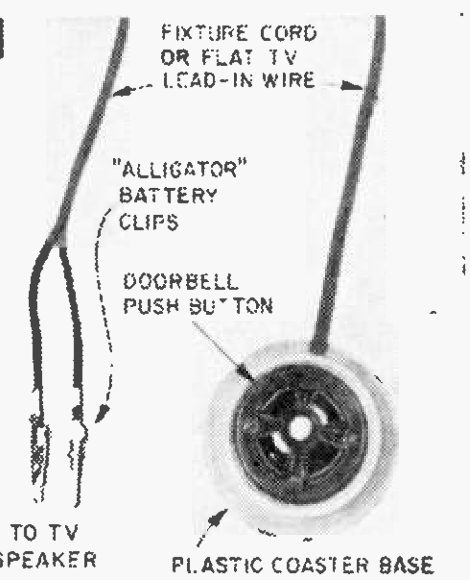
Mount a doorbell push button with two #4-40 x ½-in. machine screws and nuts on a plastic coaster (Fig. 2) after cutting a hole in the side to let the cord through. Determine the required run of connecting fixture cord or TV lead-in and attach alligator clips to the ends opposite the push-button.

To install the squelcher, merely attach a clip to each of the lugs on the set's speaker (Fig. 3). Do not disturb any wires already soldered to these lugs. When the push-button is depressed, it shorts out the secondary (voice coil) of the set's output transformer. Voltages are too slight to feel. In some instances this device may not completely kill the sound, but will reduce it to a whisper.—T.A.B.

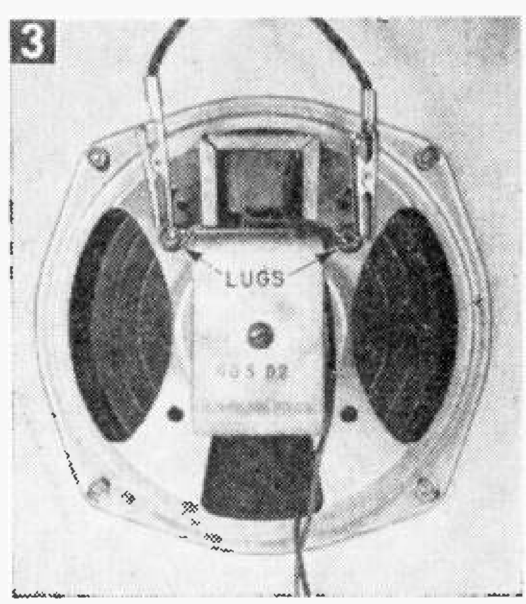
1

Silencer button by telephone eliminates conversation being drowned out by radio or TV set.

2



3



Left, doorbell button, plastic coaster and cord are dime store items. Auto shops have clips. Right, Some sets have output transformer mounted on speaker; concealed in others. Regardless, attach clips to the lugs on speaker.

WHITE'S RADIO LOG

An up-to-date broadcasting directory
AM, FM, TV and Short-Wave Stations

Vol. 38 No. 1

U. S. and Canadian AM Stations by Frequency

U.S. stations listed alphabetically by states within groups, Canadian stations precede U.S.
Abbreviations: Kc., frequency in kilocycles; W.P., watt power; d—operates daytime only. Wave length is given in meters

Kc.	Wave Length	W.P.
540—555.5		
CBK	Regina, Sask.	50000
KVIP	Redding, Calif.	1000d
KFMB	San Diego, Calif.	5000
WGTO	Cypress Gardens, Florida	50000d
WDAK	Columbus, Ga.	5000
KBRV	Soda Springs, Idaho	500d
KWMT	Ft. Dodge, Iowa	1000d
WDMV	Pocomoke City, Md.	500d
WBIC	Islip, N.Y.	250d
WETC	Wendell-Zebulon, N.C.	250d
WCNG	Canonsburg, Pa.	250d
WYNN	Florence, S.C.	250
WDXN	Clarksville, Tenn.	1000d
WRIC	Richlands, Va.	1000d
550—545.1		
CFNB	Fredericton, N.B.	50000
CFBR	Sudbury, Ont.	1000
CHLN	Three Rivers, Que.	5000
CKPG	Prince George, B.C.	250
KENI	Anchorage, Alaska	5000
KOY	Phoenix, Ariz.	5000
KAFY	Bakersfield, Calif.	1000
KRAI	Craig, Colo.	1000
WAYR	Orange Park, Fla.	1000d
WGGA	Gainesville, Ga.	5000
KMVI	Wailuku, Hawaii	1000
KFRM	Concordia, Kansas	5000d
WCBI	Columbus, Miss.	1000
KSD	St. Louis, Mo.	5000
KOPR	Butte, Mont.	1000
WGR	Buffalo, N.Y.	5000
WDBM	Statesville, N.C.	500d
KFYR	Bismarck, N.Dak.	5000
WKRC	Cincinnati, Ohio	5000
KOAC	Corvallis, Oreg.	5000
WHLM	Bloomsburg, Pa.	1000
WPAB	Ponce, P.R.	5000
WPAW	Pawtucket, R.I.	500
KCRS	Midland, Tex.	5000
KTSA	San Antonio, Tex.	5000
WDEV	Waterbury, Vt.	5000
WSVA	Harrisonburg, Va.	5000
KARI	Blaine, Wash.	500d
WSAU	Wausau, Wis.	5000
560—535.4		
CBY	Corner Brook, N.F.	1000
CFRA	Ottawa, Ont.	5000
CJKL	Kirkland Lake, Ont.	5000
CFOS	Owen Sound, Ont.	1000
WOOF	Dothan, Ala.	5000d
KYUM	Yuma, Ariz.	1000
KSFO	San Fran., Calif.	5000
KLZ	Denver, Colo.	5000
WQAM	Miami, Fla.	5000
WIND	Chicago, Ill.	5000
WMIK	Middlesboro, Ky.	500d
WGAN	Portland, Maine	5000
WHYN	Springfield, Mass.	1000
WQTE	Monroe, Mich.	500d
WEBC	Duluth, Minn.	5000
KWTO	Springfield, Mo.	5000
KMON	Great Falls, Mont.	5000
WGAI	Elizabeth City, N.C.	1000
WFIL	Philadelphia, Pa.	5000
WIS	Columbia, S.C.	5000
WHBQ	Memphis, Tenn.	5000
KFDM	Beaumont, Tex.	5000
KPQ	Wenatchee, Wash.	5000
WJLS	Beckley, W.Va.	5000
570—526.0		
CKEK	Cranbrook, B.C.	1000
CKCQ	Quesnel, B.C.	1000
CFCB	Corner Brook, N.F.	1000
CJEM	Edmundston, N.B.	1000
WAAX	Gadsden, Ala.	5000
KCNO	Alturas, Calif.	1000
KLAC	Los Angeles, Calif.	5000
WGMS	Washington, D.C.	5000
WACL	Waycross, Ga.	5000
WKYB	Paducah, Ky.	1000
WVMI	Biloxi, Miss.	1000d
KGRT	Las Cruces, N.Mex.	5000d
WMCA	New York, N.Y.	5000
WSYR	Syracuse, N.Y.	5000
WWNC	Asheville, N.C.	5000
WSHE	Raleigh, N.C.	500d
WKBN	Youngstown, Ohio	5000
WNAX	Yankton, S.Dak.	5000
WFAA	Dallas, Tex.	5000
WBAP	Ft. Worth, Tex.	5000
KLUB	Salt Lake City, Utah	5000
KVI	Seattle, Wash.	5000
WMAM	Marinette, Wis.	5000
580—516.9		
CJFX	Antigonish, N.S.	5000
CKEY	Toronto, Ont.	5000
CKPR	Ft. William, Ont.	5000
CKUA	Edmonton, Alta.	10000
CKY	Winnipeg, Man.	50000
WABT	Tuskegee, Ala.	500d
KTAN	Tucson, Ariz.	5000
KMJ	Fresno, Calif.	5000
KUBC	Montrose, Colo.	5000
WDBO	Orlando, Fla.	5000
WGAC	Augusta, Ga.	5000
KFXD	Nampa, Idaho	5000
WILL	Urbana, Ill.	5000d
KSAC	Manhattan, Kans.	5000
WIBW	Topeka, Kans.	5000
KALB	Alexandria, La.	5000
WTAG	Worcester, Mass.	5000
WELO	Tupelo, Miss.	1000
WAGR	Lumberton, N.C.	500d
WHP	Harrisburg, Pa.	5000
WKAQ	San Juan, P.R.	5000
KOBH	Hot Springs, S.Dak.	500d
WRKH	Rockwood, Tenn.	1000d
KDAV	Lubbock, Tex.	500d
WLES	Lawrenceville, Va.	500d
WCHS	Charleston, W.Va.	5000
WKTY	LaCrosse, Wis.	5000
590—508.2		
CFAR	Flin Flon, Man.	1000
CKAR	Huntsville, Ont.	1000
CKRS	Jonquiere, Que.	1000
VOCM	St. Johns, N.F.	10000
WRAG	Carrollton, Ala.	1000d
KBHS	Hot Springs, Ark.	5000d
KFXM	San Bernardino, Cal.	1000
KCSJ	Pueblo, Colo.	1000
WDLP	Panama City, Fla.	1000
WPLO	Atlanta, Ga.	5000
KGMB	Honolulu, Hawaii	5000
KID	Idaho Falls, Idaho	5000
WVLK	Lexington, Ky.	5000
WEEI	Boston, Mass.	5000
WKZO	Kalamazoo, Mich.	5000
WOW	Omaha, Nebr.	5000
WROW	Albany, N.Y.	5000
WGTM	Wilson, N.C.	5000
KUGN	Eugene, Oreg.	5000
WARM	Scranton, Pa.	5000
WMBS	Uniontown, Pa.	1000
KTBC	Austin, Tex.	5000
KSUB	Cedar City, Utah	1000
WLVA	Lynchburg, Va.	1000
KHQ	Spokane, Wash.	5000
600—499.7		
CFCF	Montreal, Que.	5000
CFCH	North Bay, Ont.	10000
CFQC	Saskatoon, Sask.	5000
CJOR	Vancouver, B.C.	5000
CKCL	Truro, N.S.	1000
WIRB	Enterprise, Ala.	1000
KCLS	Flagstaff, Ariz.	5000
KVCV	Redding, Calif.	1000
KFSD	San Diego, Calif.	5000
WICC	Bridgeport, Conn.	1000
WPDQ	Jacksonville, Fla.	5000
WMT	Cedar Rapids, Iowa	5000
KSCB	Liberal, Kans.	500
WWOM	New Orleans, La.	1000d
WFST	Caribou, Maine	5000d
WCAO	Baltimore, Md.	5000
WLST	Escanaba, Mich.	1000d
WTAC	Flint, Mich.	1000
KGEZ	Kalispell, Mont.	2000
WCVP	Murphy, N.C.	1000d
WSJS	Winston-Salem, N.C.	5000
KSJB	Jamestown, N.D.	5000
WFRM	Coudersport, Pa.	1000d
WAEL	Mayaguez, P.R.	1000
WREC	Memphis, Tenn.	5000
KROD	El Paso, Tex.	5000
KERB	Kermit, Tex.	1000d
KTBB	Tyler, Tex.	1000
610—491.5		
CHNC	New Carlisle, Que.	5000
CJAT	Trail, B.C.	1000
CKKL	Thompson, Man.	1000
CKTB	St. Catharines, Ont.	5000
WSGN	Birmingham, Ala.	5000
KAVL	Lancaster, Calif.	1000
KFRC	San Francisco, Calif.	5000
WCKR	Miami, Fla.	5000
WDEB	Pensacola, Fla.	500d
WCEH	Hawkinsville, Ga.	500d
WRUS	Russellville, Ky.	500d
KDAL	Duluth, Minn.	5000
WDAF	Kansas City, Mo.	5000
KOJM	Havre, Mont.	1000
WGIR	Manchester, N.H.	5000
KGGM	Albuquerque, N.Mex.	5000
WAYS	Charlotte, N.C.	5000
WTVN	Columbus, Ohio	5000
WIP	Philadelphia, Pa.	5000
KILT	Houston, Tex.	5000
KVNU	Logan, Utah	1000
WSLS	Roanoke, Va.	5000
KEPR	Kennewick, Wash.	5000
620—483.6		
CFCL	Timmins, Ont.	10000
CKCK	Regina, Sask.	5000
KTAR	Phoenix, Ariz.	5000
KNGS	Hanford, Calif.	1000
KWSD	Mt. Shasta, Calif.	1000d
KSTR	Grand Junction, Colo.	5000d
WSUN	St. Petersburg, Fla.	5000
WTRP	LaGrange, Ga.	1000d
KWAL	Wallace, Idaho	1000
KMNS	Sioux City, Iowa	1000
WTMT	Louisville, Ky.	500d
WLBZ	Bangor, Maine	5000
WJDX	Jackson, Miss.	5000
WVNJ	Newark, N.J.	5000
WHEN	Syracuse, N.Y.	5000
WDNC	Durham, N.C.	5000
KGW	Portland, Oreg.	5000
WHJB	Greensburg, Pa.	1000
WCAY	Cayce, S.C.	500d
WATE	Knoxville, Tenn.	5000
KWFT	Wichita Falls, Tex.	5000
WCAX	Burlington, Vt.	5000
WWNR	Beckley, W.Va.	1000
WTMJ	Milwaukee, Wis.	5000
630—475.9		
CFCO	Chatham, Ont.	1000
CHLT	Sherbrooke, Que.	10000
CFCY	Charlottetown, P.E.I.	5000
CJET	Smith Falls, Ont.	1000
CKRC	Winnipeg, Man.	5000
CKOV	Kelowna, B.C.	1000
CKYL	Peace River, Alta.	1000
WAVU	Albertville, Ala.	1000d
WJDB	Thomasville, Ala.	1000d
KJNO	Juneau, Alaska	1000
KVMA	Magnolia, Ark.	1000d
KIDD	Monterey, Calif.	1000
KHOW	Denver, Colo.	5000
WMAL	Washington, D.C.	5000
WSAV	Savannah, Ga.	5000
KIDO	Boise, Idaho	5000
WLAP	Lexington, Ky.	5000
KTIB	Thibodaux, La.	500
WJMS	Ironwood, Mich.	1000
KDWB	So. St. Paul, Minn.	5000
KXOK	St. Louis, Mo.	5000
KGVW	Belgrade, Mont.	1000d
KOH	Reno, Nev.	5000
KLEA	Lovington, N.Mex.	500
WIRC	Hickory, N.C.	1000d
WMFD	Wilmington, N.C.	1000
KWRO	Coquille, Oreg.	5000d
WEJL	Scranton, Pa.	500d
WKYN	Rio Piedras, P.R.	1000d
WPRO	Providence, R.I.	5000
KGFX	Pierre, S.Dak.	250
KMAC	San Antonio, Tex.	5000
KSXX	Salt Lake City, Utah	1000d
KGDN	Edmunds, Wash.	5000d
KZUN	Opportunity, Wash.	500d
640—468.5		
CBN	St. John's, N.F.	10000
KFI	Los Angeles, Calif.	50000
WOI	Ames, Iowa	5000d
WHLO	Akron, Ohio	1000
WNAD	Norman, Okla.	1000d
650—461.3		
KKAA	Honolulu, Hawaii	10000
WSM	Nashville, Tenn.	50000
KRCT	Baytown, Texas	250d
660—454.3		
KFAR	Fairbanks, Alaska	10000
KMEO	Omaha, Nebr.	500d
WNBC	New York, N.Y.	50000
WESC	Greenville, S.C.	10000d
KSKY	Dallas, Tex.	1000
670—447.5		
WMAQ	Chicago, Ill.	50000
680—440.9		
CHFA	Edmonton, Alta.	5000
CHLO	St. Thomas, Ont.	1000
CJOB	Winnipeg, Man.	10000
CKGB	Timmins, Ont.	10000
KNBC	San Fran., Calif.	50000
WPIN	St. Petersburg, Fla.	1000d
WCTT	Corbin, Ky.	1000
WCBM	Baltimore, Md.	10000
WNAC	Boston, Mass.	50000
WDBC	Escanaba, Mich.	1000

Kc. Wave Length W.P.

KFEQ St. Joseph, Mo. 5000
WINR Binghamton, N.Y. 1000
WRVM Rochester, N.Y. 250d
WPTF Raleigh, N.C. 50000
WISR Butler, Pa. 250d
WAPA San Juan, P.Rico 10000
WMPS Memphis, Tenn. 10000
KENS San Antonio, Tex. 50000
KOMW Omak, Wash. 1000d
WCAW Charleston, W.Va. 250

690—434.5

CBU Vancouver, B.C. 10000
CBF Montreal, Que. 50000
WVOK Birmingham, Ala. 50000d
KVNA Flagstaff, Ariz. 1000
KEVT Tucson, Ariz. 250d
KBBA Benton, Ark. 250d
KAPI Pueblo, Colo. 250d
WAOS Ansonia, Conn. 500d
WAPE Jacksonville, Fla. 25000d
KULA Honolulu, Hawaii 10000
KBLI Blackfoot, Idaho 1000d
KGGF Coffeyville, Kans. 10000
WTIX New Orleans, La. 50000
KSTL St. Louis, Mo. 1000d
KRCO Prineville, Oreg. 1000d
KUSD Vermillion, S.Dak. 1000d
KHEY El Paso, Tex. 10000
KPET Lamesa, Tex. 250
KZEY Tyler, Tex. 250d
WCYB Bristol, Va. 10000d
WNNT Warsaw, Va. 250d
WELD Fisher, W.Va. 500d

700—428.3

WLW Cincinnati, Ohio 50000

710—422.3

CJSP Leamington, Ont. 1000d
CFRG Gravelbourg, Sask. 5000d
CKVM Ville Marie, Que. 1000
WKRG Mobile, Ala. 1000
KMPC Los Angeles, Calif. 50000
KICN Denver, Colo. 5000
WGBS Miami, Fla. 50000
WROM Rome, Ga. 1000d
KEEL Shreveport, La. 10000
WHB Kansas City, Mo. 10000
WOR New York, N.Y. 50000
DZRH Manila, P.I. 10000
WKJB Mayaguez, P.Rico 1000
WTPR Paris, Tenn. 250d
KGNC Amarillo, Tex. 10000
KURV Edinburg, Tex. 250
KIRO Seattle, Wash. 50000
WDSM Superior, Wis. 5000

720—416.4

WGN Chicago, Ill. 50000

730—410.7

CJNR Blind River, Ont. 1000
CKAC Montreal, Que. 50000
CKDM Dauphin, Man. 10000
CKLG No. Vancouver, B.C. 10000
KFQD Anchorage, Alaska 10000
WJMW Athens, Ala. 1000d
WKTG Thomasville, Ga. 1000d
KBLR Goodland, Kans. 1000d
WFMW Madisonville, Ky. 250d
WMTC Van Cleve, Ky. 1000d
KTRY Bastrop, La. 250d
WARB Covington, La. 250d
WMMS Bath, Maine 500d
WACE Chicopee, Mass. 1000d
KWRE Warrenton, Mo. 500d
KWOA Worthington, Minn. 1000d
KURL Billings, Mont. 500d
KMGM Albuquerque, N.Mex. 1000d
WDOS Oneonta, N.Y. 1000d
WFMC Goldsboro, N.C. 1000d
WOHS Shelby, N.C. 1000d
WHRW Bowling Green, Ohio 250d
KBOY Medford, Oreg. 1000d
WNAK Nanticoke, Pa. 1000d
WPIT Pittsburgh, Pa. 1000d
WPAL Charleston, S.C. 1000d
WLIL Lenoir, Tenn. 1000d
KKSN Grand Prairie, Tex. 500d
KSVN Ogden, Utah 1000d
WPIK Alexandria, Va. 1000d
WMNA Gretna, Va. 1000d
KULE Ephrata, Wash. 1000d
WXMT Merrill, Wis. 1000d

740—405.2

CBXA Edmonton, Alta. 250
CBL Toronto, Ont. 50000
WBAM Montgomery, Ala. 50000d
KUEQ Phoenix, Ariz. 1000d
KBIG Avalon, Calif. 10000d
KCBS San Francisco, Calif. 50000
KSSS Colo. Springs, Colo. 1000
KVFC Cortez, Colo. 250
WKIS Orlando, Fla. 5000
KYME Boise, Idaho 500d
WVLN Olney, Ill. 250d
KBOE Oskaloosa, Iowa 250d
WNOP Newport, Ky. 1000d

WFRB Frostburg, Md. 250d
WTAO Cambridge, Mass. 250d
KPBM Carlsbad, N.Mex. 1000d
WGSM Huntington, N.Y. 1000d
WMBL Morehead City, N.C. 1000d
WPAQ Mount Airy, N.C. 10000d
KRMG Tulsa, Okla. 50000
WVCH Chester, Pa. 1000d
WIAC San Juan, P.Rico 10000d
WBAW Barnwell, S.C. 1000d
WIRJ Humboldt, Tenn. 250d
WJIG Tullahoma, Tenn. 250d
KTRH Houston, Tex. 50000
WBCI Williamsburg, Va. 500d

750—399.8

WSB Atlanta, Ga. 50000
WBMD Baltimore, Md. 1000d
KMMJ Grand Island, Neb. 1000
WHEB Portsmouth, N.H. 1000
KSEO Durant, Okla. 250d
KXL Portland, Oreg. 50000
WPDX Clarksburg, W.Va. 1000d

760—394.5

KGU Honolulu, Hawaii 10000
WJR Detroit, Mich. 50000
WCPS Tarboro, N.C. 1000
WORA Mayaguez, P.R. 1000

770—389.4

KUOM Minneapolis, Minn. 5000d
WCAL Northfield, Minn. 5000d
WEW St. Louis, Mo. 1000d
KOB Albuquerque, N. Mex. 50000
WABC New York, N.Y. 50000
KXA Seattle, Wash. 1000

780—384.4

WBBM Chicago, Ill. 50000
WJAG Norfolk, Neb. 1000
WCKB Dunn, N.C. 1000d
WBBO Forest City, N.C. 1000d
KSPI Stillwater, Okla. 250d
WARL Arlington, Va. 1000d

790—379.5

CKMR Newcastle, N.B. 1000
CKSO Sudbury, Ont. 10000
WTUG Tuscaloosa, Ala. 500d
KCEE Tucson, Ariz. 1000d
KOSY Texarkana, Ark. 1000
KDAN Eureka, Calif. 5000d
KABC Los Angeles, Calif. 5000
WLBE Leesburg, Fla. 5000
WMBM Miami Beach, Fla. 5000
WPFA Pensacola, Fla. 1000d
WQXI Atlanta, Ga. 5000
WGRA Cairo, Ga. 1000d
KEST Boise, Idaho 1000d
WRMS Beardstown, Ill. 500d
KXXX Colby, Kans. 5000d
WAKY Louisville, Ky. 5000
WRUM Rumford, Me. 1000d
WSGW Saginaw, Mich. 1000
KGHL Billings, Mont. 5000
WWNY Watertown, N.Y. 1000
WLSV Wellsville, N.Y. 1000d
WTNC Thomasville, N.C. 1000d
KXGO Fargo, N.Dak. 5000
KWIL Albany, Oreg. 1000
WAEB Allentown, Pa. 500
WPIC Sharon, Pa. 1000d
WEAN Providence, R.I. 5000
WWBD Bamberg, S.C. 1000d
WETB Johnson City, Tenn. 1000d
WMC Memphis, Tenn. 5000
KTHT Houston, Tex. 5000
KFYO Lubbock, Tex. 5000
KUTA Blanding, Utah 1000d
WSIG Mount Jackson, Va. 1000d
WTAR Norfolk, Va. 5000
KVOS Bellingham, Wash. 5000
KNEW Spokane, Wash. 5000
WEAQ Eau Claire, Wis. 5000

800—374.8

CHAB Moose Jaw, Sask. 10000
CKOK Penticton, B.C. 10000
CFOB Ft. Frances, Ont. 1000
CJLX Ft. William, Ont. 5000
CJBQ Belleville, Ont. 1000
CKLW Windsor, Ont. 50000
CHRC Quebec, Que. 10000
CJAD Montreal, Que. 10000
VOWR St. Johns, N.F. 1000
WHOS Decatur, Ala. 1000d
WMGY Montgomery, Ala. 1000d
KINY Juneau, Alaska 5000
KAGH Crossett, Ark. 250d
KVOM Morrilton, Ark. 250d
KUZZ Bakersfield, Calif. 250d
KDAD Weed, Calif. 1000d
KBRN Brighton, Colo. 500d
WLAD Danbury, Conn. 250d
WSUZ Palatka, Fla. 1000d
WJAT Swainsboro, Ga. 1000d
KXIC Iowa City, Iowa 1000d
WBOK New Orleans, La. 1000d
WCCM Lawrence, Mass. 1000d
KREI Farmington, Mo. 1000d
KDBM Dillon, Mont. 1000d
WKDN Camden, N.J. 1000d
KJEM Okla City, Okla. 250d
KPDQ Portland, Oreg. 1000d

WCHA Chambersburg, Pa. 1000d
WDSC Dillon, S.C. 1000d
WEAB Greer, S.C. 250d
WDEH Sweetwater, Tenn. 1000d
KDDD Dumas, Tex. 250d
KBUH Brigham City, Utah 250d
WSVS Crewe, Va. 1000d
WKEE Huntington, W.Va. 1000d
WDUX Waupaca, Wis. 1000d

810—370.2

CFAX Victoria, B.C. 1000d
KGO San Francisco, Calif. 50000
WABW Annapolis, Md. 250d
KCMO Kansas City, Mo. 50000
WGY Schenectady, N.Y. 50000
WKBC N.Wilkesboro, N.C. 1000d
WCEC Rocky Mount, N.C. 1000d
WEDO McKeesport, Pa. 1000d
WKVM San Juan, P.R. 25000

820—365.6

WAIT Chicago, Ill. 5000d
WIKY Evansville, Ind. 250d
WOSU Columbus, Ohio 5000d
KIKI Honolulu, Hawaii 250
WFAA Dallas, Tex. 50000
WBAP Ft. Worth, Tex. 50000

830—361.2

WCCO Minneapolis, Minn. 50000
KBOA Kennett, Mo. 1000d
WNYC New York, N.Y. 1000d

840—356.9

WKAB Mobile, Ala. 1000d
WKNB New Britain, Conn. 1000d
WHAS Louisville, Ky. 50000
WVPO Stroudsburg, Pa. 250d

850—352.7

CKVL Verdun, Que. 50000
CKRD Red Deer, Alta. 1000
WYDE Birmingham, Ala. 10000
KICY Nome, Alaska 5000
KOA Denver, Colo. 50000
WRUF Gainesville, Fla. 5000
WEAT W. Palm Beach, Fla. 1000
KIMO Hilo, Hawaii 1000
WHDH Boston, Mass. 50000
WKBZ Muskegon, Mich. 1000
KFUO St. Louis, Mo. 5000d
WKIX Raleigh, N.C. 10000
WJW Cleveland, Ohio 5000
WEEU Reading, Pa. 1000
WABA Aguadilla, P.R. 250
WRAP Norfolk, Va. 5000
KTAC Tacoma, Wash. 1000

860—348.6

CJBC Toronto, Ont. 50000
WHRT Hartselle, Ala. 250d
WAMI Opp, Ala. 1000d
KIFN Phoenix, Ariz. 1000d
KOSE Osceola, Ark. 1000d
KWRF Warren, Ark. 250d
KTRB Modesto, Calif. 10000
WOWW Naugatuck, Conn. 250d
WAZE Clearwater, Fla. 500d
WKKO Cocoa, Fla. 1000d
WERD Atlanta, Ga. 1000d
WDMG Douglas, Ga. 5000d
WMRI Marion, Ind. 250d
KWPC Muscatine, Iowa 250d
KOAM Pittsburg, Kans. 10000
WSON Henderson, Ky. 500d
WAYE Dundalk, Md. 500d
WSBS Gt. Barrington, Mass. 250d
KNUJ New Ulm, Minn. 1000d
WMAG Forest, Miss. 500d
WFMO Fairmont, N.C. 1000d
WAMO Pittsburgh, Pa. 1000d
WTEL Philadelphia, Pa. 250d
WLBG Laurens, S.C. 1000d
WIVK Knoxville, Tenn. 1000d
WMTS Murfreesboro, Tenn. 250d
KFST Ft. Stockton, Tex. 250d
KPAN Hereford, Tex. 250d
KSFA Nacogdoches, Tex. 1000d
KONO San Antonio, Tex. 5000
KWHO Salt Lake City, Utah 1000d
WEVA Emporia, Va. 1000d
WOAY Oak Hill, W.Va. 10000d
WFOX Milwaukee, Wis. 250d

870—344.6

KIEV Glendale, Calif. 250d
KAIM Kalmuki, Hawaii 1000
WWL New Orleans, La. 50000
WKAR E. Lansing, Mich. 5000d
WHCU Ithaca, N.Y. 1000d
WGTL Kannapolis, N.C. 1000d
WHOA San Juan, P.R. 5000
KJIM Ft. Worth, Tex. 250d
WFLO Farmville, Va. 1000d

880—340.7

WCBS New York, N.Y. 50000
WRRZ Clinton, N.C. 1000d
WRFD Worthington, Ohio 5000d

890—336.9

WLS Chicago, Ill. 50000
WHNC Henderson, N.C. 1000d
KBYE Okla. City, Okla. 1000d

900—333.1

CKTS Sherbrooke, Que. 1000
CHML Hamilton, Ont. 5000
CHNO Sudbury, Ont. 10000
CJBR Rimouski, Que. 10000
CKJL St. Jerome, Que. 1000
CJVI Victoria, B.C. 10000
CKBI Prince Albert, Sask. 10000
WATV Birmingham, Ala. 1000d
WGOK Mobile, Ala. 1000d
WOZK Ozark, Ala. 1000d
KPRB Fairbanks, Alaska 10000
KHOZ Harrison, Ark. 1000d
KBIF Centerville, Calif. 1000d
WJWL Georgetown, Del. 1000d
WSWN Belle Glade, Fla. 1000d
WMOP Ocala, Fla. 1000d
WCGA Calhoun, Ga. 1000d
WCRY Macon, Ga. 250d
WJIV Savannah, Ga. 1000d
KTEE Idaho Falls, Ida. 1000d
KSIR Wichita, Kan. 250
WKYW Louisville, Ky. 1000d
WLSI Pikeville, Ky. 1000d
KREH Oakdale, La. 250d
WCME Brunswick, Maine 1000d
WATC Gaylord, Mich. 1000d
KTIS Minneapolis, Minn. 1000d
WDDT Greenville, Miss. 1000d
KFAL Fulton, Mo. 1000d
KJSK Columbus, Nebr. 1000d
WOTW Nashau, N.H. 1000d
WBRV Boonville, N.Y. 1000d
WSPN Saratoga Sprgs., N.Y. 250d
WAYN Rockingham, N.C. 1000d
WIAM Williamston, N.C. 1000d
KFNW Fargo, N.Dak. 1000d
WAND Canton, Ohio 500d
WFRO Fremont, Ohio 500d
WCPA Clearfield, Pa. 1000d
WFLN Philadelphia, Pa. 1000d
WKXV Knoxville, Tenn. 1000d
WCOR Lebanon, Tenn. 500d
KALT Atlanta, Tex. 1000d
KMCO Conroe, Tex. 500d
KFLD Floydada, Tex. 250d
KCLW Hamilton, Tex. 250d
WODY Bassett, Va. 500d
WAFC Staunton, Va. 1000d
KUEN Wenatchee, Wash. 500
WATK Antigo, Wis. 250d

910—329.5

CJDV Drumheller, Alta. 1000
CKLY Lindsay, Ont. 1000
CBO Ottawa, Ont. 5000
CFJC Kamloops, B.C. 10000
CHRL Roberval, Que. 1000
KPHO Phoenix, Ariz. 5000
KLCN Blytheville, Ark. 5000d
KAMD Camden, Ark. 1000
KDEO El Cajon, Calif. 1000
KEWB Oakland, Calif. 5000
KOXR Oxnard, Calif. 1000d
KPOF nr. Denver, Colo. 5000
WHAY New Britain, Conn. 5000
WPLA Plant City, Fla. 1000d
WGAF Valdosta, Ga. 5000
KBGN Caldwell, Ida. 1000d
WAKO Lawrenceville, Ill. 500d
WSUI Iowa City, Iowa 5000
WLCS Baton Rouge, La. 1000
WABI Bangor, Maine 5000
WFDF Flint, Mich. 5000
WCOC Meridian, Miss. 5000
KOYN Billings, Mont. 1000d
KYSS Missoula, Mont. 1000d
KBIM Roswell, N.Mex. 5000d
WLAS Jacksonville, N.C. 1000d
KCJB Minot, N.Dak. 1000
WPFB Middletown, Ohio 1000
KGLC Miami, Okla. 1000
KURY Brookings, Oreg. 1000d
WAVL Apollo, Pa. 1000d
WGBI Scranton, Pa. 1000
WSBA York, Pa. 1000
WPRP Ponce, P.R. 5000
WORD Spartanburg, S.C. 1000
WJCW Johnson City, Tenn. 5000
WEPG S. Pittsburgh, Tenn. 500d
KNAF Fredericksburg, Tex. 1000d
KRIO McAllen, Tex. 1000
KRRV Sherman, Tex. 1000
KALL Salt Lake City, Utah 1000
WWRJ White River Junction, Vermont 1000d
WRNL Richmond, Va. 5000
WHYE Roanoke, Va. 1000d
KDRD Pasco, Wash. 1000d
KUDY Renton, Wash. 1000
KISN Vancouver, Wash. 1000
WHSM Hayward, Wis. 1000d
WDOR Sturgeon Bay, Wis. 500d

920—325.9

CJCH Halifax, N.S. 10000
CJCJ Woodstock, N.B. 1000
CKNX Wingham, Ont. 2500

Kc.	Wave Length	W.P.
WCTA	Adalusia, Ala.	5000
WWWR	Russellville, Ala.	1000d
KARK	Little Rock, Ark.	5000
KDES	Palm Springs, Calif.	1000d
KVEC	San Luis Obispo, Cal.	1000
KREX	Grd. Junction, Colo.	5000
KLMR	Lamar, Colo.	1000
WMEG	Eau Gallie, Fla.	1000d
WGST	Atlanta, Ga.	5000
KAHU	Waiphau, Hawaii	1000
WMOK	Metropolis, Ill.	1000d
WBAA	W. Lafayette, Ind.	5000
KFNF	Shenandoah, Iowa	1000
WTCW	Whitesburg, Ky.	1000d
WBOX	Bogalusa, La.	1000d
KTOC	Jonesboro, La.	500d
WPTX	Lexington Pk., Md.	500d
WMPL	Hancock, Mich.	1000d
KDHL	Faribault, Minn.	1000
KWAD	Wadena, Minn.	1000
KRAM	Las Vegas, Nev.	1000
KOLO	Reno, Nev.	1000
KQEO	Albuquerque, N.Mex.	1000
WTTM	Trenton, N.J.	1000
WKRT	Cortland, N.Y.	1000
WGHQ	Saugerties, N.Y.	1000d
WBBB	Burlington, N.C.	5000d
WMNI	Columbus, Ohio	500
KGAL	Lebanon, Oreg.	1000
WKVA	Lewistown, Pa.	1000d
WJAR	Providence, R.I.	5000
WTND	Orangeburg, S.C.	1000d
KEZU	Rapid City, S.Dak.	1000d
WLIV	Livingston, Tenn.	1000d
KELP	El Paso, Tex.	1000
KECK	Odessa, Tex.	1000
KTLW	Texas City, Tex.	1000d
KITN	Olympia, Wash.	1000d
KXLY	Spokane, Wash.	5000
WMMN	Fairmont, W.Va.	5000
WOKY	Milwaukee, Wis.	1000

930—322.4

Kc.	Wave Length	W.P.
CFBC	Saint John, N.B.	5000
CJCA	Edmonton, Alta.	10000
CJON	St. John's, N.F.	10000
WETO	Gadsden, Ala.	1000d
KTKN	Ketchikan, Alaska	1000
KAPR	Douglas, Ariz.	1000d
KHJ	Los Angeles, Calif.	5000
KMET	Paradise, Calif.	500d
KIUP	Durango, Colo.	5000
WKSB	Milford, Del.	500d
WHAN	Haines City, Fla.	500d
WJAX	Jacksonville, Fla.	5000
WKXY	Sarasota, Fla.	1000
WMGR	Bainbridge, Ga.	5000d
KSEI	Pocatello, Idaho	5000
WTAD	Quincy, Ill.	5000
WKCT	Bowling Green, Ky.	1000
WFMD	Frederick, Md.	1000
WREB	Holyoke, Mass.	500d
WBCK	Battle Creek, Mich.	1000
WSLI	Jackson, Miss.	5000
KWOC	Poplar Bluff, Mo.	1000
KOFI	Kalispell, Mont.	5000d
KOGA	Ogallala, Nebr.	500d
WWNH	Rochester, N.H.	5000d
WPAT	Paterson, N.J.	5000
WBEN	Buffalo, N.Y.	5000
WSOC	Charlotte, N.C.	5000
WRRF	Washington, N.C.	5000
WEOL	Elyria, Ohio	1000
WKY	Oklahoma City, Okla.	5000
KAGI	Grants Pass, Oreg.	1000
WCNR	Bloomsburg, Pa.	1000d
KSDN	Aberdeen, S.D.	1000
WSEV	Sevierville, Tenn.	5000d
KDET	Center, Tex.	1000d
KITE	San Antonio, Tex.	5000
KENY	Bellingham-Ferndale Wash.	1000d
WSAZ	Huntington, W.Va.	5000
WLBL	Stevens Point, Wis.	5000d

940—319.0

Kc.	Wave Length	W.P.
CBM	Montreal, Que.	50000
CJGX	Yorkton, Sask.	10000
CJIB	Vernon, B.C.	1000
KMBO	Tucson, Ariz.	250
KFRE	Fresno, Calif.	50000
WINZ	Miami, Fla.	50000
WMAZ	Macon, Ga.	50000
WMIX	Mt. Vernon, Ill.	1000
KIOA	Des Moines, Iowa	10000
WYLD	New Orleans, La.	1000
KGRL	Bend, Oreg.	1000d
WESA	Charleroi, Pa.	250
WGRP	Greenville, Pa.	1000d
WIPR	San Juan, P.R.	10000
KIXZ	Amarillo, Tex.	5000

950—315.6

Kc.	Wave Length	W.P.
CKNB	Campbellton, N.B.	1000
CKBB	Barrie, Ont.	10000
WRMA	Montgomery, Ala.	1000d
KXJK	Forrest City, Ark.	5000d
KFSA	Ft. Smith, Ark.	1000
KAHI	Auburn, Calif.	1000d
KIMN	Denver, Colo.	5000
WNUE	Ft.Walton Sch., Fla.	1000d
WLOF	Orlando, Fla.	5000
WGTA	Summerville, Ga.	1000d
WGOV	Valdosta, Ga.	5000
KBOI	Boise, Idaho	5000
KLER	Orofino, Idaho	500d
WAAF	Chicago, Ill.	1000d
WXLW	Indianapolis, Ind.	5000d
KOEL	Oelwein, Iowa	1000
KJRG	Newton, Kans.	500d
WBVL	Barbourville, Ky.	1000d
WAGM	Presque Isle, Maine	5000
WORL	Boston, Mass.	5000d
WWJ	Detroit, Mich.	5000
KRSI	St. Louis Park, Minn.	1000d
WBKH	Hattiesburg, Miss.	5000d
KLIK	Jefferson City, Mo.	5000d
WBBF	Rochester, N.Y.	1000
WIBX	Utica, N.Y.	5000
WPET	Greensboro, N.C.	500d
WNCC	Barnesboro, Pa.	500d
WPEN	Philadelphia, Pa.	5000
WSPA	Spartanburg, S.C.	5000
KWAT	Watertown, S.Dak.	1000
WAGG	Franklin, Tenn.	1000d
KOSX	Denison, Tex.	500
KPRC	Houston, Tex.	5000
KSEL	Lubbock, Tex.	5000
WXGI	Richmond, Va.	1000d
KJR	Seattle, Wash.	5000
WERL	Eagle River, Wis.	1000d
WKAZ	Charleston, W.Va.	5000
WKTL	Sheboygan, Wis.	500d

960—312.3

Kc.	Wave Length	W.P.
CFAC	Calgary, Alta.	10000
CHNS	Halifax, N.S.	10000
CKWS	Kingston, Ont.	5000
WBRC	Birmingham, Ala.	5000
WMOZ	Mobile, Ala.	1000
KOOL	Phoenix, Ariz.	5000
KAVR	Apple Valley, Calif.	5000d
KNEZ	Lompoc, Calif.	500
KABL	Oakland, Calif.	1000
WELI	New Haven, Conn.	5000
WGRO	Lake City, Fla.	500d
WJCM	Sebring, Fla.	1000d
WJAZ	Albany, Ga.	5000d
WRFC	Athens, Ga.	5000
KSRA	Salmon, Idaho	1000d
WDLM	E. Moline, Ill.	1000d
WSBT	South Bend, Ind.	5000
KMA	Shenandoah, Iowa	5000
WPRT	Prestonsburg, Ky.	1000d
KROF	Abbeville, La.	1000d
WBOC	Salisbury, Md.	5000
WFGM	Fitchburg, Mass.	1000
WHAK	Rogers City, Mich.	5000d
KLTF	Little Falls, Minn.	500d
WABG	Greenwood, Miss.	1000
KFVS	Cape Girardeau, Mo.	1000
KNEB	Scottsbluff, Nebr.	1000
KWYK	Farmington, N.Mex.	1000d
WEAV	Plattsburg, N.Y.	5000
WCFT	Dallas, N.C.	1000d
WFTC	Kinston, N.C.	5000
WWST	Wooster, Ohio	1000d
KGWA	Enid, Okla.	1000
KLAD	Klamath Falls, Oreg.	5000d
WHYL	Carlisle, Pa.	5000d
WADP	Kane, Pa.	1000d
WATS	Sayre, Pa.	1000d
WBEU	Beaufort, S.C.	1000d
WBMC	McMinnville, Tenn.	500d
KIMP	Mt. Pleasant, Tex.	1000d
KGKL	San Angelo, Tex.	5000
KOVO	Provo, Utah	5000
WDBJ	Roanoke, Va.	5000
KALE	Richland, Wash.	1000
WTCH	Shawano, Wis.	1000

970—309.1

Kc.	Wave Length	W.P.
CKCH	Hull, Que.	5000
WERH	Hamilton, Ala.	5000d
WTBF	Troy, Ala.	5000
KNEA	Jonesboro, Ark.	1000d
KBIS	Bakersfield, Calif.	1000
KCHV	Coachella, Calif.	1000d
KBEE	Modesto, Calif.	1000
KFEL	Pueblo, Colo.	1000d
WFLA	Tampa, Fla.	5000
WIIN	Atlanta, Ga.	5000d
WVOP	Vidalia, Ga.	5000d
KHBC	Hilo, Hawaii	1000
KAYT	Rupert, Idaho	1000d
WMAY	Springfield, Ill.	1000
WAVE	Louisville, Ky.	5000
KSYL	Alexandria, La.	1000
WCSH	Portland, Maine	5000
WAMD	Aberdeen, Md.	500d
WESO	Southbridge, Mass.	1000d
WJAN	Ishpeming, Mich.	5000d
WKHM	Jackson, Mich.	1000
KQAQ	Austin, Minn.	5000d
KOOK	Billings, Mont.	5000
KJLT	No. Platte, Nebr.	5000d
WNTA	Newark, N.J.	5000
WEBR	Buffalo, N.Y.	5000
WCHN	Norwich, N.Y.	500d
WRCS	Ahoskie, N.C.	1000d
WWIT	Canton, N.C.	1000d
WDAY	Fargo, N.Dak.	5000
WREO	Ashtabula, Ohio	5000
WATH	Athens, Ohio	1000d
KAKC	Tulsa, Okla.	1000
KOIN	Portland, Oreg.	5000
WWSW	Pittsburgh, Pa.	5000
WJMX	Florence, S.C.	5000
KASE	Austin, Tex.	1000d
KNOK	Ft. Worth, Tex.	1000d
WIVI	Christiansted, V.I.	1000
WDTI	Danville, Va.	500d
KREM	Spokane, Wash.	5000
WWYO	Pineville, W.Va.	1000d
WHA	Madison, Wis.	5000d

980—305.9

Kc.	Wave Length	W.P.
CKNW	New Westminster, Brit. Columbia	10000
CFPL	London, Ont.	10000
CKGM	Montreal, Que.	10000
CBV	Quebec, Que.	5000
CHEX	Peterboro, Ont.	5000
CKRM	Regina, Sask.	10000
WKLF	Clanton, Ala.	1000d
KINS	Eureka, Calif.	5000
KEAP	Fresno, Calif.	500d
KFWB	Los Angeles, Calif.	5000
KGLN	GlenwoodSprgs.,Colo.	1000d
WSUB	Groton, Conn.	1000
WRC	Washington, D.C.	5000
WDVH	Gainesville, Fla.	5000d
WTOT	Marianna, Fla.	1000d
WBOP	Pensacola, Fla.	1000d
WLOD	Pompano Beach, Fla.	1000d
WKLY	Hartwell, Ga.	1000d
WPGA	Perry, Ga.	500d
WRIP	Rossville, Ga.	500d
KUPI	Idaho Falls, Idaho	1000d
WITY	Danville, Ill.	1000
KOKA	Shreveport, La.	5000d
WCAP	Lowell, Mass.	1000d
WPBC	Minneapolis, Minn.	1000d
WAPF	McComb, Miss.	1000d
KMBC	Kansas City, Mo.	5000
KSGM	Ste. Genevieve, Mo.	500
KVER	Clovis, N.Mex.	1000
KMIN	Grants, N. Mex.	1000d
WTRY	Troy, N.Y.	5000
WKLM	Wilmington, N.C.	500d
WAAA	Win.-Salem, N.C.	1000d
WONE	Dayton, Ohio	5000
WILK	Wilkes-Barre, Pa.	5000
KDSJ	Deadwood, S.Dak.	1000
WSIX	Nashville, Tenn.	5000
KFRD	Rosenberg, Tex.	1000d
KSVC	Richfield, Utah	5000
WFHG	Bristol, Va.	5000
WMEK	Chase City, Va.	500d
KUTI	Yakima, Wash.	5000d
WHAW	Weston, W.Va.	1000d
WCUB	Manitowoc, Wis.	1000d
WPRE	Prairie du Chien, Wis.	500d

990—302.8

Kc.	Wave Length	W.P.
CBW	Winnipeg, Man.	50000
CBT	Grand Falls, N.F.	1000
WWWF	Fayette, Ala.	1000d
WTCB	Flomaton, Ala.	500d
KTKT	Tucson, Ariz.	1000
KKIS	Pittsburg, Calif.	5000
KGUO	Santa Barbara, Calif.	1000d
KLIR	Denver, Colo.	1000d
WBZY	Torrington, Conn.	1000d
WFAB	Miami, Fla.	5000
WHOO	Orlando, Fla.	10000
WDWD	Dawson, Ga.	1000d
KOOD	Honolulu, Hawaii	1000
WCAZ	Carthage, Ill.	1000d
WITZ	Jasper, Ind.	1000d
KAYL	Storm Lake, Iowa	250d
KRSL	Russell, Kans.	250d
WJMR	New Orleans, La.	250d
KRIH	Rayville, La.	250d
WCRM	Clare, Mich.	250d
WABO	Waynesboro, Miss.	250d
KRMO	Monett, Mo.	250d
KSVP	Artesia, N.Mex.	1000
WEEB	Southern Pines, N.C.	1000d
WJEH	Gallipolis, Ohio	1000d
WTIG	Massillon, Ohio	250d
KABY	Albany, Oreg.	250d
WIBG	Philadelphia, Pa.	50000
WVSC	Somerset, Pa.	250d
WPRA	Mayaguez, P.R.	10000
WLKW	Providence, R.I.	50000
WAKN	Aiken, S.C.	1000d
WNOX	Knoxville, Tenn.	10000
KWAM	Memphis, Tenn.	1000d
KTRM	Beaumont, Tex.	1000
KAML	Kenedy, Tex.	250
KSYD	Wichita Falls, Tex.	10000
KDYL	Tooele, Utah	1000d
WNRV	Narrows, Va.	1000d
WANT	Richmond, Va.	1000d
WKLJ	Sparta, Wis.	250

1000—299.8

Kc.	Wave Length	W.P.
CKBW	Bridgewater, N.S.	1000
WCFL	Chicago, Ill.	50000
KTOK	Okla. City, Okla.	5000
KSTA	Coleman, Tex.	250d
KGRI	Henderson, Tex.	250d
WHWB	Rutland, Vt.	1000d
KOMO	Seattle, Wash.	50000

1010—296.9

Kc.	Wave Length	W.P.
CBX	Edmonton, Alta.	50000
CFRB	Toronto, Ont.	50000
KINK	Phoenix, Ariz.	500d
KVNC	Winslow, Ariz.	1000
KLRA	Little Rock, Ark.	10000
KCHJ	Delano, Calif.	5000
KCMJ	Palm Sprgs., Calif.	1000
KSAY	San Fran., Calif.	10000d
WCNU	Crestview, Fla.	1000d
WZRO	Jacksonville Beach, Florida	1000d
WINQ	Tampa, Fla.	50000d
WGUN	Decatur, Ga.	50000d
WCSI	Columbus, Ind.	500d
KSMN	Mason City, Iowa	1000d
KIND	Independence, Kans.	250d
KDLA	DeRidder, La.	1000d
WSID	Baltimore, Md.	1000d
KCHI	Chillicothe, Mo.	250d
KXEN	Festus, Mo.	50000d
KRVN	Lexington, Nebr.	25000d
WCNL	Newport, N.H.	250d
WINS	New York, N.Y.	50000
WABZ	Albermarle, N.C.	1000d
WELS	Kinston, N.C.	1000d
WIOI	New Boston, Ohio	1000d
KBEV	Portland, Oreg.	1000d
WITT	Lewisburg, Pa.	250d
WHIN	Gallatin, Tenn.	1000d
WORM	Savannah, Tenn.	250d
KBUY	Amarillo, Tex.	5000
KMLW	Marlin, Tex.	250d
WELK	Charlottesville, Va.	1000d
WMEV	Marion, Va.	1000d
WCST	Berkeley Sprgs., W.Va.	250d
WSPT	Stevens Pt., Wis.	1000d

1020—293.9

Kc.	Wave Length	W.P.
KGBS	Los Angeles, Calif.	50000
WCIL	Carbondale, Ill.	1000d
WPEO	Peoria, Ill.	1000d
KDKA	Pittsburgh, Pa.	50000

1030—291.1

Kc.	Wave Length	W.P.
WBZ	Boston, Mass.	50000
WBZA	Springfield, Mass.	1000
KOB	Albuquerque, N.Mex.	10000
KCTA	Corpus Christi, Tex.	50000d

1040—288.3

Kc.	Wave Length	W.P.
KHVH	Honolulu, Hawaii	5000
WHO	Des Moines, Iowa	50000
KIXL	Dallas, Tex.	1000d

1050—285.5

Kc.	Wave Length	W.P.
CFGP	Grande Prairie, Alta.	10000
CKSB	St. Boniface, Man.	10000
CJIC	Sault Ste. Marie, Ont.	10000
CHUM	Toronto, Ont.	5000
WRFS	Alexander City, Ala.	1000d
WCRI	Scottsboro, Ala.	250d
KVWM	Show Low, Ariz.	250d
KVLC	Little Rock, Ark.	1000d
KOFY	San Mateo, Calif.	1000d
KWSO	Wasco, Calif.	1000d
KLMO	Longmont, Colo.	250d
WSUG	Clewiston, Fla.	250d
WJSB	Crestview, Fla.	1000d
WIVY	Jacksonville, Fla.	1000d
WHBO	Tampa, Fla.	250d
WRMF	Titusville, Fla.	500d
WAUG	Augusta, Ga.	1000d
WBIE	Marietta, Ga.	500d
KZIN	Coeur D'Alene, Idaho	250d
WDZ	Decatur, Ill.	1000d
KNCO	Garden City, Kans.	1000d
WNES	Central City, Ky.	500d
WZIP	Covington, Ky.	1050
KLPL	Lake Providence, La.	250d
KCIJ	Shreveport, La.	250d
KVPI	Villa Platte, La.	250d
WQMR	Silver Sprg., Md.	1000d
WPAG	Ann Arbor, Mich.	1000d
KLOH	Pipestone, Minn.	1000d
WACR	Columbus, Miss.	1000d
KMIS	Portageville, Mo.	250d
KSIS	Sedalia, Mo.	1000d
KRBO	Las Vegas, Nev.	500d
WBNC	Conway, N.H.	1000d
WSEN	Baldwinsville, N.Y.	250d
WSTS	Massena, N.Y.	1000d
WMGM	New York, N.Y.	50000
WBTL	Farmville, N.C.	250d
WFSC	Franklin, N.C.	500d
WLON	Lincolnton, N.C.	1000d
WWGP	Sanford, N.C.	1000d
KCCO	Lawton, Okla.	250d
KFMJ	Tulsa, Okla.	1000d
KUBE	Pendleton, Oreg.	1000d
KEED	Springfield, Oreg.	1000d
WBUT	Butler, Pa.	250d
WLYC	Williamsport, Pa.	1000d
WRJS	San German, P.R.	250
WSMT	Sparta, Tenn.	1000d
KLEN	Killeen, Tex.	250d
KWLD	Liberty, Tex.	250d
KPLA	Plainview, Tex.	1000d
WGAT	Gate City, Va.	250d
WBRG	Lynchburg, Va.	1000d
WCMS	Norfolk, Va.	1000d
KNBX	Kirkland, Wash.	1000d
WCEF	Parkersburg, W.Va.	1000d
WECL	Eau Claire, Wis.	1000d
WLIP	Kenosha, Wis.	250d
KWIV	Douglas, Wyo.	250d

Kc.	Wave Length	W.P.

1060—282.8

CFCN	Calgary, Alta.	10000
CJLR	Quebec, Que.	5000
KUPD	Tempe, Ariz.	500
KPAY	Chico, Calif.	10000
WNOE	New Orleans, La.	50000
WHFB	Benton Harbor, Mich.	1000d
WMAP	Monroe, N.C.	250d
WCMW	Canton, Ohio	1000d
WRCV	Philadelphia, Pa.	50000

1070—280.2

CBA	Sackville, N.B.	50000
CHOK	Sarnia, Ont.	5000
WAPI	Birmingham, Ala.	50000
KNX	Los Angeles, Calif.	50000
WVCG	Coral Gables, Fla.	1000d
WIBC	Indianapolis, Ind.	50000
KIRL	Wichita, Kans.	10000
KHMO	Hannibal, Mo.	5000
WHPE	High Point, N.C.	1000d
WFLI	Lookout Mtn., Tenn.	10000
WDIA	Memphis, Tenn.	50000
KOPY	Alice, Tex.	1000
WKOW	Madison, Wis.	10000

1080—277.6

CHED	Edmonton, Alta.	10000
KSCO	Santa Cruz, Calif.	1000
WTIC	Hartford, Conn.	50000
WKLO	Louisville, Ky.	5000
WOAP	Owosso, Mich.	250d
WYSL	Kenmore, N.Y.	1000d
WEWO	Laurinburg, N.C.	1000d
KWJJ	Portland, Oreg.	10000
WEEP	Pittsburgh, Pa.	1000d
KRLD	Dallas, Tex.	50000

1090—275.1

CHEC	Lethbridge, Alta.	5000
CHIC	Brampton, Ont.	250
CHRS	St. Jean, Que.	1000
KTHS	Little Rock, Ark.	50000
WCRA	Effingham, Ill.	250d
KNWS	Waterloo, Iowa	1000d
WBAL	Baltimore, Md.	50000
WILD	Boston, Mass.	1000d
WMUS	Muskegon, Mich.	1000d
KING	Seattle, Wash.	50000

1100—272.6

KFAX	San Francisco, Calif.	1000d
WLBB	Carrollton, Ga.	250d
WHLI	Hempstead, N.Y.	10000d
KYW	Cleveland, Ohio	50000
WGPA	Bethlehem, Pa.	250d

1110—270.1

CFML	Cornwall, Ont.	1000
CFTJ	Galt, Ont.	250
KRLA	Pasadena, Calif.	10000
WALT	Tampa, Fla.	50000d
KIPA	Hilo, Hawaii	1000
WMBI	Chicago, Ill.	5000d
KFAB	Omaha, Nebr.	50000
WBT	Charlotte, N.C.	50000
KBND	Bend, Oreg.	5000
WNAR	Norristown, Pa.	500d
WVJP	Caguas, P.R.	250
WHIM	Providence, R.I.	1000d

1120—267.7

WUST	Bethesda, Md.	250d
KMOX	St. Louis, Mo.	50000
WWOL	Buffalo, N.Y.	1000d
KCLE	Cleburne, Tex.	250d

1130—265.3

CKWX	Vancouver, B.C.	50000
KSDO	San Diego, Calif.	5000
KWKH	Shreveport, La.	50000
WCAR	Detroit, Mich.	50000
WDGY	Minneapolis, Minn.	50000
WNEW	New York, N.Y.	50000

1140—263.0

CFTK	Terrace, B.C.	1000
CKXL	Calgary, Alta.	10000
KRAK	Sacramento, Calif.	5000
WMIE	Miami, Fla.	10000
KGEM	Boise, Idaho	10000
WSIV	Pekin, Ill.	1000d
KLPR	Oklahoma City, Okla.	1000d
WITA	San Juan, P.R.	500
KSOO	Sioux Falls, S.Dak.	10000
KORC	Mineral Wells, Tex.	250
WRVA	Richmond, Va.	50000

1150—260.7

CKSA	Lloydminster, Alta.	1000
CHSJ	Saint John, N.B.	10000
CKOC	Hamilton, Ont.	10000
CKX	Brandon, Man.	10000
CKTR	Three Rivers, Que.	5000
WBCA	Bay Minette, Ala.	1000d
WGEA	Geneva, Ala.	1000d
WJRD	Tuscaloosa, Ala.	5000
KCKY	Coolidge, Ariz.	1000
KXLR	No. Little Rock, Ark.	5000
KFSG	Los Angeles, Calif.	2500
KRKD	Los Angeles, Calif.	5000
KJAX	Santa Rosa, Calif.	5000
KGMC	Englewood, Colo.	1000d
WCNX	Middletown, Conn.	500d
WDEL	Wilmington, Del.	5000
WNDB	Daytona Bch., Fla.	1000
WTMP	Tampa, Fla.	5000d
WFPM	Fort Valley, Ga.	1000d
WJEM	Valdosta, Ga.	1000d
WGGH	Marion, Ill.	5000d
WJRL	Rockford, Ill.	500d
KWKY	Des Moines, Iowa	1000
KSAL	Salina, Kans.	5000
WMST	Mt. Sterling, Ky.	500d
WLOC	Mumfordville, Ky.	1000d
WJBO	Baton Rouge, La.	5000
WGHM	Skowhegan, Maine	5000d
WCOP	Boston, Mass.	5000
WCEN	Mt. Pleasant, Mich.	1000
KASM	Albany, Minn.	1000d
WXTN	Lexington, Miss.	500d
KRMS	Osage Beach, Mo.	1000d
KSEN	Shelby, Mont.	1000
KDEF	Albuquerque, N.Mex.	1000d
WRUN	Utica, N.Y.	5000
WBAG	Burlington, N.C.	1000d
WGBR	Goldsboro, N.C.	5000
WCUE	Akron, Ohio	1000d
WIMA	Lima, Ohio	1000
KNED	McAlester, Okla.	1000
KAGO	Klamath Falls, Oreg.	5000
WHUN	Huntingdon, Pa.	1000d
WLPS	Lehighton, Pa.	1000d
WKPA	New Kensington, Pa.	1000d
WRNO	Orangeburg, S.C.	5000
WTYC	Rock Hill, S.C.	1000d
WSNW	Seneca Township, South Carolina	1000d
WAPO	Chattanooga, Tenn.	5000
WCRK	Morristown, Tenn.	1000
WTAW	Bryan, Tex.	1000d
KCCT	Corpus Christi, Tex.	1000d
KIZZ	El Paso, Tex.	1000d
KVIL	Highland Park, Tex.	500d
KJBC	Midland, Tex.	1000d
KPNG	Port Neches, Tex.	1150
KOLJ	Quanah, Tex.	500d
KOFE	Pullman, Wash.	1000d
KAYO	Seattle, Wash.	5000
KKEY	Vancouver, Wash.	1000d
WELC	Welch, W.Va.	1000d
WAXX	Chippewa Falls, Wis.	5000d
WISN	Milwaukee, Wis.	5000

1160—258.5

WJJD	Chicago, Ill.	50000
KSL	Salt Lake City, Utah	50000

1170—256.3

CFNS	Saskatoon, Sask.	1000
WCOV	Montgomery, Ala.	10000
KCBQ	San Diego, Calif	50000
KLOK	San Jose, Calif.	10000
KOHO	Honolulu, Hawaii	1000
WLBH	Mattoon, Ill.	250d
KSTT	Davenport, Iowa	1000
KVOO	Tulsa, Okla.	50000
WLEO	Ponce, P.R.	250
KPUG	Bellingham, Wash.	1000
WWVA	Wheeling, W.Va.	50000

1180—254.1

WLDS	Jacksonville, Ill.	1000d
WHAM	Rochester, N.Y.	50000

1190—252.0

KEZY	Anaheim, Calif.	1000
KNBA	Vallejo, Calif.	250d
WOWO	Ft. Wayne, Ind.	50000
WANN	Annapolis, Md.	10000d
WKOX	Fram'gham, Mass.	1000d
WLIB	New York, N.Y.	1000d
KEX	Portland, Oreg.	50000
KLIF	Dallas, Tex.	50000

1200—249.9

WOAI	San Antonio, Tex.	50000
KDWT	Stamford, Tex.	250

1210—247.8

WCNT	Centralia, Ill.	1000d
WKNX	Saginaw, Mich.	10000d
WADE	Wadesboro, N.C.	1000d
WAVI	Dayton, Ohio	250d
WCAU	Philadelphia, Pa.	50000

1220—245.8

CJOC	Lethbridge, Alta.	10000
CKDA	Victoria, B.C.	10000
CJRL	Kenora, Ont.	1000
CKCW	Moncton, N.B.	10000
CJSS	Cornwall, Ont.	1000
CKSM	Shawinigan, Quebec	1000
WEZB	Birmingham, Ala.	1000d
WPRN	Butler, Ala.	1000d
KVSA	McGehee, Ark.	1000d
KIBE	Palo Alto, Calif.	1000d
KKAR	Pomona, Calif.	250d
KFSC	Denver, Colo.	1000d
WDEE	Hamden, Conn.	1000d
WQTY	Arlington, Fla.	250d
WKBX	Kissimmee, Fla.	250d
WFEC	Miami, Fla.	250d
WCLB	Camilla, Ga.	1000d
WPLK	Rockmart, Ga.	250d
WSFT	Thomaston, Ga.	250d
WLPO	LaSalle, Ill.	1000d
WKRS	Waukegan, Ill.	1000d
WSLM	Salem, Ind.	1000d
KJAN	Atlantic, Iowa	250d
KOUR	Independence, Iowa	250d
KOFO	Ottawa, Kans.	250d
WFKN	Franklin, Ky.	250d
KBCL	Shreveport, La.	250d
WLBI	Denham Springs, La.	250d
WSME	Sanford, Maine	1000d
WBCH	Hastings, Mich.	250d
WAVN	Stillwater, Minn.	1000d
WMDC	Hazlehurst, Miss.	250d
KBHM	Branson, Mo.	1000d
KGMO	Cape Girardeau, Mo.	250d
KLPW	Union, Mo.	1000d
WKBK	Keene, N.H.	1000d
WGNY	Newburgh, N.Y.	1000d
WSOQ	N. Syracuse, N.Y.	1000d
WKMT	Kings Mtn., N.C.	1000d
WREV	Reidsville, N.C.	250d
WENC	Whiteville, N.C.	1000d
KEYD	Oakes, N.Dak.	1000d
WGAR	Cleveland, Ohio	50000
WERT	Van Wert, Ohio	250d
KGYN	Guymon, Okla.	1000d
WJUN	Mexico, Pa.	250d
WRIB	Providence, R.I.	1000d
WALD	Walterboro, S.C.	1000d
WFWL	Camden, Tenn.	250
WCPH	Etowah, Tenn.	1000d
WHEY	Millington, Tenn.	250
KVLL	Livingston, Tex.	250d
KZEE	Weatherford, Tex.	250d
WLSD	Big Stone Gap, Va.	1000d
WFAX	Falls Church, Va.	1000d
KASY	Auburn, Wash.	250d
KOZI	Chelan, Wash.	1000d

1230—243.8

CFCW	Camrose, Alta.	1000
CHFC	Churchill, Man.	250
CFKL	Schefferville, Que.	250
CFGR	Gravelbourg, Sask.	250
CFYT	Dawson City, Yukon T.	100
CFPA	Port Arthur, Ont.	1000
CKLO	Thetford Mines, Que.	250
CKMP	Midland, Ont.	250
VOAR	St. John's, Nfld.	100
CKVD	Val D'Or, Que.	250
WAUD	Auburn, Ala.	250
WJBB	Haleyville, Ala.	250
WBHP	Huntsville, Ala.	250
WNUZ	Talledega, Ala.	250
WTBC	Tuscaloosa, Ala.	250
KIFW	Sitka, Alaska	250
KSUN	Bisbee, Ariz.	250
KAAA	Kingman, Ariz.	250
KRIZ	Phoenix, Ariz.	250
KCON	Conway, Ark.	250
KFPW	Ft. Smith, Ark.	250
KBTM	Jonesboro, Ark.	250
KGEE	Bakersfield, Calif.	250
KWTC	Barstow, Calif.	250
KIBS	Bishop, Calif.	250
KXO	El Centro, Calif.	250
KDAC	Ft. Bragg, Calif.	250
KGFJ	Los Angeles, Calif.	250
KPRL	Paso Robles, Calif.	250
KRDG	Redding, Calif.	250
KWG	Stockton, Calif.	250
KEXO	Grand Junc., Colo.	250
KLVC	Leadville, Colo.	250
KDZA	Pueblo, Colo.	250
KGEK	Sterling, Colo.	250
WINF	Manchester, Conn.	250
WGGG	Gainesville, Fla.	250
WONN	Lakeland, Fla.	250
WMAF	Madison, Fla.	250
WSBB	New Smyrna Bch., Fla.	250
WNVY	Pensacola, Fla.	250
WCNH	Quincy, Fla.	250
WJNO	W. Palm Beach, Fla.	250
WBIA	Augusta, Ga.	250
WBLJ	Dalton, Ga.	250
WXLI	Dublin, Ga.	250d
WFOM	Marietta, Ga.	250
WSOK	Savannah, Ga.	250
WAYX	Waycross, Ga.	250
KBAR	Burley, Idaho	250
KORT	Grangeville, Idaho	250
KRXK	Rexburg, Idaho	250
WJBC	Bloomington, Ill.	250
WQUA	Moline, Ill.	250
WHCO	Sparta, Ill.	250
WJOB	Hammond, Ind.	250
WSAL	Logansport, Ind.	250
WTCJ	Tell City, Ind.	250
WBOW	Terre Haute, Ind.	250
KFJB	Marshalltown, Iowa	250
WHIR	Danville, Ky.	250
WHOP	Hopkinsville, Ky.	250
WMLF	Pineville, Ky.	250
KLIC	Monroe, La.	250
WJBW	New Orleans, La.	250
KSLO	Opelousas, La.	250
WQDY	Calais, Maine	250
WITH	Baltimore, Md.	250
WCUM	Cumberland, Md.	250
WMNB	No. Adams, Mass.	250
WESX	Salem, Mass.	250
WNEB	Worcester, Mass.	250
WJEF	Grand Rapids, Mich.	500
WIKB	Iron River, Mich.	250
WMPC	Lapeer, Mich.	250
WSOO	Slt. Ste. Marie, Mich.	1000
WSTR	Sturgis, Mich.	250
WKLK	Cloquet, Minn.	250
KGHS	Internat'l Falls, Minn.	100
KYSM	Mankato, Minn.	250
KTRF	Thief Riv. Flls., Minn.	250
KWNO	Winona, Minn.	250
WCMA	Corinth, Miss.	250
WHSY	Hattiesburg, Miss.	250
WSSO	Starkville, Miss.	250
WAZF	Yazoo City, Miss.	250
KODE	Joplin, Mo.	250
KLWT	Lebanon, Mo.	250
KNCM	Moberly, Mo.	250
KANA	Anaconda, Mont.	250
KBMN	Bozeman, Mont.	250
KXLO	Lewiston, Mont.	250
KLCB	Libby, Mont.	250
KTNC	Falls City, Nebr.	100
KHAS	Hastings, Nebr.	250
KELY	Ely, Nev.	250
KLAS	Las Vegas, Nev.	250
KDOT	Reno, Nev.	250
WMOU	Berlin, N.H.	250
WTSV	Claremont, N.H.	250
WCMC	Wildwood, N.J.	100
KALG	Alamogordo, N.Mex.	250
KOTS	Deming, N.Mex.	250
KYVA	Gallup, N.Mex.	250
KFUN	Las Vegas, N.Mex.	250
KSWS	Roswell, N.Mex.	250
WNIA	Cheektowaga, N.Y.	250
WENY	Elmira, N.Y.	1000
WHUC	Hudson, N.Y.	250
WLFH	Little Falls, N.Y.	250
WFAS	White Plains, N.Y.	250
WSKY	Asheville, N.C.	250
WFAI	Fayetteville, N.C.	250
WMFR	High Point, N.C.	250
WISP	Kinston, N.C.	250
WNNC	Newton, N.C.	250
WCBT	Roanoke Rap., N.C.	250
KDIX	Dickinson, N.Dak.	250
WCPO	Cincinnati, Ohio	250
WCOL	Columbus, Ohio	250
WIRO	Ironton, Ohio	250
WTOL	Toledo, Ohio	250
KAOA	N. of Ada, Okla.	250
WBBZ	Ponca City, Okla.	250
KVAS	Astoria, Oreg.	250
KRNS	Burns, Oreg.	250
KDOS	Coos Bay, Oreg.	250
KGRO	Gresham, Oreg.	250
KYJC	Medford, Oreg.	1000
KQIK	Lakeview, Oreg.	250
KLUU	Toledo, Oreg.	250
WBVP	Beaver Falls, Pa.	250
WEEX	Easton, Pa.	250
WKBO	Harrisburg, Pa.	250
WCRO	Johnstown, Pa.	250
WBPZ	Lock Haven, Pa.	250
WNIK	Arecibo, P.R.	250
WERI	Westerly, R.I.	250
WAIM	Anderson, S.C.	250
WNOK	Columbia, S.C.	250
WOLS	Florence, S.C.	250
KISD	Sioux Falls, S.Dak.	250
WMMT	McMinnville, Tenn.	250
KSIX	Corpus Christi, Tex.	250
KDLK	Del Rio, Tex.	250
KNUZ	Houston, Tex.	250
KERV	Kerrville, Tex.	250
KLVT	Levelland, Tex.	250
KEEE	Nacogdoches, Tex.	250
KOSA	Odessa, Tex.	250
KHHH	Pampa, Tex.	250
KSEY	Seymour, Tex.	250
KCMC	Texarkana, Tex.	250
KSST	Sulphur Sprgs., Tex.	250
KWTX	Waco, Tex.	250
KMUR	Murray, Utah	250
KOAL	Price, Utah	250
WJOY	Burlington, Vt.	250
WBBI	Abingdon, Va.	250
WCFV	Clifton Forge, Va.	250
WFVA	Fredericksburg, Va.	250
WNOR	Norfolk, Va.	250
KQTY	Everett, Wash.	1000
KLYK	Spokane, Wash.	250
KREW	Sunnyside, Wash.	250
WLOG	Logan, W.Va.	250
WTAP	Parkersburg, W.Va.	250
WHBY	Appleton, Wis.	250
WCLO	Janesville, Wis.	250
WHVF	Wausau, Wis.	250
KVOC	Casper, Wyo.	250

1240—241.8

CFLM	La Tuque, Que.	1000
CFNW	Norman Wells, Northwest Terr.	100
CFPR	Prince Rupert, B.C.	250
CFWH	Whitehorse, Y.T.	250
CJAV	Port Alberni, B.C.	250
CJCS	Stratford, Ont.	250
CJRW	Summerside, P.E.I.	250
CKBS	St. Hyacinthe, Que.	250
CKCQ	Williams Lake, B.C.	250
CKLS	LaSarre, Que.	250
WEBJ	Brewton, Ala.	250

Kc. Wave Length W.P.

WULA Eufaula, Ala. 250
WOWL Florence, Ala. 250
WARF Jasper, Ala. 250
KZOW So. of Globe, Ariz. 250
KOFA Yuma, Ariz. 250
KVRC Arkadelphia, Ark. 250
KWAK Stuttgart, Ark. 250
KPLY Crescent City, Calif. 250
KRDU Dinuba, Calif. 250
KMBY Monterey, Calif. 250
KPPC Pasadena, Calif. 100
KRKS Ridgecrest, Calif. 250
KROY Sacramento, Calif. 250
KRNO San Bernardino, Calif. 250
KSON San Diego, Calif. 250
KSMA Santa Maria, Calif. 250
KSUE Susanville, Calif. 250
KRDO Colo. Sprgs., Colo. 250
KDGO Durango, Colo. 250
KSLV Monte Vista, Colo. 250
KCRT Trinidad, Colo. 250
WWCO Waterbury, Conn. 250
WBGC Chipley, Fla. 250
WLCO Eustis, Fla. 250
WINK Fort Myers, Fla. 250
WMMB Melbourne, Fla. 250
WFOY St. Augustine, Fla. 250
WBHB Fitzgerald, Ga. 250
WDUN Gainesville, Ga. 1000
WLAG LaGrange, Ga. 250
WBML Macon, Ga. 250
WWNS Statesboro, Ga. 250
WPAX Thomasville, Ga. 250
WTWA Thomson, Ga. 250
KLEI Kailua, Hawaii 250
KVNI Coeur d'Alene, Idaho 250
KWIK Pocatello, Idaho 250
WCRW Chicago, Ill. 100
WEOC Chicago, Ill. 250
WSBC Chicago, Ill. 250
WEBQ Harrisburg, Ill. 250
WTAX Springfield, Ill. 250
WSDR Sterling, Ill. 100
WHBU Anderson, Ind. 250
KDEC Decorah, Iowa 250
KWLC Decorah, Iowa 250
KBIZ Ottumwa, Iowa 250
KICD Spencer, Iowa 250
KIUL Garden City, Kans. 250
KAKE Wichita, Kans. 250
WINN Louisville, Ky. 250
WFTM Maysville, Ky. 250
WPKE Pikeville, Ky. 250
WSFC Somerset, Ky. 250
KASO Minden, La. 250
KANE New Iberia, La. 250
WCOU Lewiston, Maine 250
WCEM Cambridge, Md. 250
WJEJ Hagerstown, Md. 250
WHAI Greenfield, Mass. 250
WOCB W. Yarmouth, Mass. 250
WATT Cadillac, Mich. 250
WCBY Cheboygan, Mich. 250
WJPD Ishpeming, Mich. 250
WJIM Lansing, Mich. 250
WMFG Hibbing, Minn. 250
WJON St. Cloud, Minn. 250
WMPA Aberdeen, Miss. 250
WGRM Greenwood, Miss. 250
WGCM Gulfport, Miss. 250
WMOX Meridian, Miss. 250
WMIS Natchez, Miss. 250
KFMO Flat River, Mo. 250
KWOS Jefferson City, Mo. 250
KNEM Nevada, Mo. 250
KBMY Billings, Mont. 250
KLTZ Glasgow, Mont. 250
KXLJ Helena, Mont. 250
KFOR Lincoln, Nebr. 250
KODY North Platte, Nebr. 250
KELK Elko, Nev. 1000
WSNJ Bridgeton, N.J. 250
KAVE Carlsbad, N.Mex. 250
KCLV Clovis, N.Mex. 250
WGBB Freeport, N.Y. 250
WGVA Geneva, N.Y. 250
WJTN Jamestown, N.Y. 250
WVOS Liberty, N.Y. 250
WNBZ Saranac Lake, N.Y. 250
WSNY Schenectady, N.Y. 250
WATN Watertown, N.Y. 250
WPNF Brevard, N.C. 250
WIST Charlotte, N.C. 250
WCNC Elizabeth City, N.C. 250
WJNC Jacksonville, N.C. 250
WRAL Raleigh, N.C. 250
KDLR Devils Lake, N.Dak. 250
WBBW Youngstown, Ohio 250
WHIZ Zanesville, Ohio 250
KVSO Ardmore, Okla. 250
KBEK Elk City, Okla. 250
KBEL Idabel, Okla. 250
KOKL Okmulgee, Okla. 250
KFLY Corvallis, Oreg. 1000d
KKIO Pendleton, Oreg. 250
KPRB Redmond, Oreg. 250
KQEN Roseburg, Oreg. 250
WRTA Altoona, Pa. 250
WLEM Emporium, Pa. 1000
WHUM Reading, Pa. 250
WKOK Sunbury, Pa. 250
WBAX Wilkes-Barre, Pa. 250
WALO Humacao, P.R. 250
WWON Woonsocket, R.I. 250
WKDK Newberry, S.C. 250
WDXY Sumter, S.C. 250
WBEJ Elizabethton, Tenn. 250
WEKR Fayetteville, Tenn. 250

Kc. Wave Length W.P.

WBIR Knoxville, Tenn. 250
WKDA Nashville, Tenn. 250
WENK Union City, Tenn. 250
KVLF Alpine, Tex. 250
KEAN Brownwood, Tex. 100
KORA Bryan, Tex. 250
KOCA Kilgore, Tex. 250
KSOX Raymondville, Tex. 250
KXOX Sweetwater, Tex. 250
WSKI Montpelier, Vt. 250
WSSV Petersburg, Va. 1000
WROV Roanoke, Va. 250
WTON Staunton, Va. 250
KXLE Ellensburgh, Wash. 250
KGY Olympia, Wash. 250
WKOY Bluefield, W.Va. 250
WTIP Charleston, W.Va. 250
WDNE Elkins, W.Va. 1000
WOMT Manitowoc, Wis. 250
WIBU Poynette, Wis. 250
WOBT Rhinelander, Wis. 250
WJMC Rice Lake, Wis. 250
KFBC Cheyenne, Wyo. 250
KLUK Evanston, Wyo. 250
KASL Newcastle, Wyo. 250
KRAL Rawlins, Wyo. 250
KTHE Thermopolis, Wyo. 250

1250—239.9

CHWO Oakville, Ont. 1000
CKBL Matane, Que. 5000
WZOB Ft. Payne, Ala. 1000d
WETU Wetumpka, Ala. 5000d
KWCX Willcox, Ariz. 1000d
KFAY Fayetteville, Ark. 500d
KAJI Little Rock, Ark. 1000
KAKA Wickenburg, Ariz. 500d
KHOT Madera, Calif. 500d
KTMS Santa Barbara, Calif. 1000
KXXI Golden, Colo. 1000d
WNER Live Oak, Fla. 1000d
WRIM Pahokee, Fla. 500d
WDAE Tampa, Fla. 5000
WYTH Madison, Ga. 1000d
WIZZ Streator, Ill. 500d
WGL Ft. Wayne, Ind. 1000
WRAY Princeton, Ind. 1000d
KCFI Cedar Falls, Iowa 500d
KFKU Lawrence, Kans. 5000
WREN Topeka, Kans. 5000
WLCK Scottsville, Ky. 500d
WGUY Bangor, Maine 5000d
WARE Ware, Mass. 1000
WWBC Bay City, Mich. 1000d
KOTE Fergus Falls, Minn. 1000
KCUE Red Wing, Minn. 1000d
WHNY McComb, Miss. 5000
KVLV Fallon, Nev. 1000d
WKBR Manchester, N.H. 5000
WMTR Morristown, N.J. 1000d
WIPS Ticonderoga, N.Y. 1000d
WFAG Farmville, N.C. 500d
WBRM Marion, N.C. 1000d
WCHO Washington Court House, Ohio 500d
KRXL Roseburg, Oreg. 5000d
WPEL Montrose, Pa. 1000d
WCAE Pittsburgh, Pa. 5000
WNOW York, Pa. 1000d
WTMA Charleston, S.C. 5000
WKBL Covington, Tenn. 1000d
WNTT Tazewell, Tenn. 500d
KFTV Paris, Tex. 500d
KPAC Port Arthur, Tex. 5000
KUKA San Antonio, Tex. 500d
KSML Seminole, Tex. 1000d
KVEL Vernal, Utah 1000d
WDVA Danville, Va. 5000
WYSR Franklin, Va. 1000d
WNRG Grundy, Va. 1000d
KWSC Pullman, Wash. 5000
KTW Seattle, Wash. 1000
WEMP Milwaukee, Wis. 5000

1260—238.0

CFRN Edmonton, Alta. 10000
DYBU Cebu, P.I. 1000
WCRT Birmingham, Ala. 5000d
KPIN Casa Grande, Ariz. 1000d
KCCB Corning, Ark. 500d
KBHC Nashville, Ark. 500d
KGIL San Fernando, Calif. 5000
KYA San Francisco, Calif. 5000
WMMM Westport, Conn. 1000d
WWDC Washington, D.C. 5000
WFTW Fort Walton Beach, Florida 1000d
WMMA Miami, Fla. 5000d
WWPF Palatka, Fla. 1000
WHAB Baxley, Ga. 5000d
WBBK Blakely, Ga. 1000d
WTJH East Point, Ga. 5000d
KIFI Idaho Falls, Idaho 5000
KWEI Weiser, Ida. 1000d
WIBV Belleville, Ill. 1000d
WFBM Indianapolis, Ind. 5000
KFGQ Boone, Iowa 250d
KWHK Hutchinson, Kans. 1000
WXOK Baton Rouge, La. 1000d
WEZE Boston, Mass. 5000
WALM Albion, Mich. 500
WJBL Holland, Mich. 5000d
KROX Crookston, Minn. 1000
KDUZ Hutchinson, Minn. 1000d
WGVM Greenville, Miss. 1000d
WNSL Laurel, Miss. 1000d

Kc. Wave Length W.P.

KGBX Springfield, Mo. 5000
KIMB Kimball, Nebr. 1000d
WBUD Trenton, N.J. 5000
KVSF Santa Fe, N.Mex. 1000
WBNR Beacon, N.Y. 1000d
WNDR Syracuse, N.Y. 5000
WGWR Asheboro, N.C. 1000d
WCDJ Edenton, N.C. 1000d
WDOK Cleveland, Ohio 5000
WNXT Portsmouth, Ohio 5000
KWSH Wewoka-Seminole, Oklahoma 1000
KMCM McMinnville, Oreg. 1000
WERC Erie, Pa. 5000
WPHB Philipsburg, Pa. 1000d
WISO Ponce, P.R. 1000
WMUU Greenville, S.C. 1000d
WJOT Lake City, S.C. 1000d
KWYR Winner, S.Dak. 5000d
WNOO Chattanooga, Tenn. 1000d
WMCH Church Hill, Tenn. 1000d
WDKN Dickson, Tenn. 1000d
WCLC Jamestown, Tenn. 1000d
KSPL Diboll, Tex. 1000d
KBLP Falfurrias, Tex. 500d
KWFR San Angelo, Tex. 1000d
KTUE Tulia, Tex. 1000d
KTAE Taylor, Tex. 1000d
WCHV Charlottesville, Va. 5000
WBCR Christiansburg, Va. 1000d
KWIQ Moses Lake, Wash. 1000d
WVVW Grafton, W.Va. 500d
WWIS Black River Falls, Wis. 1000d
WEKZ Monroe, Wis. 1000d
KPOW Powell, Wyo. 5000

1270—236.1

CHAT Medicine Hat, Alta. 1000
CHWK Chilliwack, B.C. 10000
CJCB Sydney, N.S. 5000
CFGT St. Joseph d'Alma, Quebec 1000
WGSV Guntersville, Ala. 1000d
WAIP Prichard, Ala. 1000d
KBYR Anchorage, Alaska 1000
KDJI Holbrook, Ariz. 1000d
KADL Pine Bluff, Ark. 5000d
KPAP Redding, Calif. 1000d
KCOK Tulare, Calif. 1000
WNOG Naples, Fla. 500d
WHIY Orlando, Fla. 5000d
WTAL Tallahassee, Fla. 5000
WGBA Columbus, Ga. 5000d
WJJC Commerce, Ga. 1000d
KNDI Honolulu, Hawaii 5000
KTFI Twin Falls, Idaho 5000
WEIC Charleston, Ill. 1000d
WHBF Rock Island, Ill. 5000
WCMR Elkhart, Ind. 5000
WWCA Gary, Ind. 1000
WORX Madison, Ind. 1000d
WAIN Columbia, Ky. 1000d
WFUL Fulton, Ky. 1000d
KVCL Winnfield, La. 1000d
WSPR Springfield, Mass. 1000
WXYZ Detroit, Mich. 5000
KWEB Rochester, Minn. 500d
WVOM Iuka, Miss. 1000d
WLSM Louisville, Miss. 1000d
KUSN St. Joseph, Mo. 1000d
KBUB Sparks, Nev. 1000d
WTSN Dover, N.H. 5000
WDVL Vineland, N.J. 500d
KRAC Alamogordo, N.Mex. 1000d
WHLD Niagara Falls, N.Y. 5000d
WDLA Walton, N.Y. 1000d
WCGC Belmont, N.C. 1000
WMPM Smithfield, N.C. 5000d
KBOM Mandan, N.Dak. 1000
WILE Cambridge, Ohio 1000d
KWPR Claremore, Okla. 500d
KAJO Grants Pass, Oreg. 1000d
WLBR Lebanon, Pa. 1000
WBHC Hampton, S.C. 1000d
KIHO Sioux Falls, S.Dak. 1000
WLIK Newport, Tenn. 5000d
KIOX Bay City, Tex. 1000
KHEM Big Spring, Tex. 1000d
KEPS Eagle Pass, Tex. 1000d
KFJZ Fort Worth, Tex. 5000
WTID Newport News, Va. 1000d
WHEO Stuart, Va. 1000d
KCVL Colville, Wash. 1000d
KBAM Longview, Wash. 1000d
WKYR Keyser, W.Va. 5000d

1280—234.2

CHIQ Hamilton, Ont. 5000
CJMS Montreal, Que. 10000
CKCV Quebec, Que. 5000
WPID Piedmont, Ala. 1000d
WNPT Tuscaloosa, Ala. 5000
KHEP Phoenix, Ariz. 1000d
KNBY Newport, Ark. 1000d
KFOX Long Beach, Calif. 1000
KCJH San Luis Obispo, Cal. 500d
KJOY Stockton, Calif. 1000
KTLN Denver, Colo. 5000
WSUX Seaford, Del. 1000d
WDSP DeFuniak Springs, Florida 5000d
WQIK Jacksonville, Fla. 5000d
WIPC Lake Wales, Fla. 1000d

Kc. Wave Length W.P.

WYND Sarasota, Fla. 5000d
WIBB Macon, Ga. 1000d
WMRO Aurora, Ill. 1000d
WGBF Evansville, Ind. 5000
KCOB Newton, Iowa 1000d
KSOK Arkansas City, Kans. 1000
WCPM Cumberland, Ky. 1000d
WDSU New Orleans, La. 5000
KWCL Oak Grove, La. 500d
WEIM Fitchburg, Mass. 5000
WFYC Alma, Mich. 1000d
WTCN Minneapolis, Minn. 5000
KVOX Moorhead, Minn. 1000
WSJC Magee, Miss. 500d
KDKD Clinton, Mo. 1000d
KYRO Potosi, Mo. 500d
KCNI Broken Bow, Nebr. 1000d
KTOO Henderson, Nev. 5000d
WHBI Newark, N.J. 2500
KZUM Farmington, N.Mex. 5000d
WADO New York, N.Y. 5000
WVET Rochester, N.Y. 5000d
WRSA Saratoga Sprgs., N.Y. 1000
WSAT Salisbury, N.C. 1000
WYAL Scotland Neck, N.C. 5000d
WONW Defiance, Ohio 500
WLMJ Jackson, Ohio 1000d
KLCO Poteau, Okla. 1000d
KERG Eugene, Oreg. 5000
WBRX Berwick, Pa. 500d
WHVR Hanover, Pa. 5000
WKST New Castle, Pa. 5000
WCMN Arecibo, P.R. 1000
WANS Anderson, S.C. 1000
WJAY Mullins, S.C. 1000d
WMCP Columbia, Tenn. 1000d
WDNT Dayton, Tenn. 1000d
KNIT Abilene, Tex. 500d
KWHI Brenham, Tex. 1000d
KLUE Longview, Tex. 1000d
KNAK Salt Lake City, Utah 5000
WYVE Wytheville, Va. 1000d
KIT Yakima, Wash. 5000
WVAR Richwood, W.Va. 1000d
WNAM Neenah, Wis. 1000

1290—232.4

CFAM Altona, Man. 5000
CKSL London, Ont. 5000
WTHG Jackson, Ala. 1000d
WMLS Sylacauga, Ala. 1000d
KEOS Flagstaff, Ariz. 1000
KCUB Tucson, Ariz. 1000
KDMS El Dorado, Ark. 5000d
KUOA Siloam Sprgs., Ark. 5000d
KHSL Chico, Calif. 5000
KPER Gilroy, Calif. 1000d
KITO San Bernardino, Calif. 5000
WCCC Hartford, Conn. 500d
WTUX Wilmington, Del. 1000d
WTMC Ocala, Fla. 5000
WSCM Panama City Beach, Florida 500d
WIRK W. Palm Bch., Fla. 5000
WDEC Americus, Ga. 1000d
WCHK Canton, Ga. 1000d
WTOC Savannah, Ga. 5000
KYTE Pocatello, Idaho 1000d
WIRL Peoria, Ill. 5000
WCBL Benton, Ky. 1000d
KJEF Jennings, La. 1000d
WHGR Houghton Lake, Mich. 5000
WNIL Niles, Mich. 500d
WOIA Saline, Mich. 500d
KBMO Benson, Minn. 500d
WBLE Batesville, Miss. 1000d
KALM Thayer, Mo. 1000d
KGVO Missoula, Mont. 5000
KOIL Omaha, Nebr. 5000
WKNE Keene, N.H. 5000
KSRC Socorro, N.M. 1000d
WGLI Babylon, N.Y. 1000
WNBF Binghamton, N.Y. 5000
WHKY Hickory, N.C. 5000
WEYE Sanford, N.C. 1000d
WOMP Bellaire, Ohio 1000d
WHIO Dayton, Ohio 5000
KUMA Pendleton, Oreg. 5000
KLIQ Portland, Oreg. 1000d
WFBG Altoona, Pa. 1000
WICE Providence, R.I. 5000
WFIG Sumter, S.C. 1000
WATO Oak Ridge, Tenn. 1000
KBLT Big Lake, Tex. 1000d
KIVY Crockett, Tex. 500d
KRGV Weslaco, Tex. 5000
KTRN Wichita Falls, Tex. 5000
WPVA Colonial Hgts., Va. 5000d
WAGE Leesburg, Va. 1000d
WKWS Rocky Mount, Va. 1000d
WVOW Logan, W.Va. 5000
WMIL Milwaukee, Wis. 1000d
KOWB Laramie, Wyo. 5000

1300—230.6

CBAF Moncton, N.B. 5000
CJME Regina, Sask. 1000
WAVC Boaz, Ala. 500d
WTLS Tallassee, Ala. 1000d
KWCB Searcy, Ark. 1000d
KROP Brawley, Calif. 1000

Kc. Wave Length	W.P.
KYNO Fresno, Calif.	5000
KWKW Pasadena, Calif.	1000
KVOR Colo. Sprgs., Colo.	1000
WAVZ New Haven, Conn.	1000
WRKT Cocoa Beach, Fla.	500d
WFFG Marathon, Fla.	500d
WSOL Tampa, Fla.	5000d
WMTM Moultrie, Ga.	5000d
WIMO Winder, Ga.	1000d
KOZE Lewiston, Idaho	5000
WTAQ LaGrange, Ill.	500
WFRX W. Frankfort, Ill.	1000d
WHLT Huntington, Ind.	500d
WMFT Terre Haute, Ind.	500d
KGLO Mason City, Iowa	5000
WBLG Lexington, Ky.	1000
WIBR Baton Rouge, La.	1000
KANB Shreveport, La.	1000d
WFBR Baltimore, Md.	5000
WJDA Quincy, Mass.	1000d
WOOD Grand Rapids, Mich.	5000
WRBC Jackson, Miss.	5000
KMMO Marshall, Mo.	1000d
KBRL McCook, Nebr.	1000d
KPTL Carson City, Nev.	5000
WAAT Trenton, N.J.	250d
WOSC Fulton, N.Y.	1000d
WGOL Goldsboro, N.C.	1000d
WSYD Mt. Airy, N.C.	5000
WERE Cleveland, Ohio	5000
WMVO Mt. Vernon, Ohio	500
KOME Tulsa, Okla.	5000
KDOV Medford, Oreg.	5000d
KACI The Dalles, Oreg.	1000d
WWCH Clarion, Pa.	500d
WTIL Mayaguez, P.R.	1000
WCKI Greer, S.C.	1000d
KOLY Mobridge, S.Dak.	1000d
WMTN Morristown, Tenn.	5000d
WMAK Nashville, Tenn.	5000
KVET Austin, Tex.	1000
KTFY Brownfield, Tex.	1000d
KKAS Silsbee, Tex.	500d
KOL Seattle, Wash.	5000
WCLG Morgantown, W.Va.	1000d
WKLC St. Albans, W.Va.	1000d

1310—228.9

CKOY Ottawa, Ont.	5000
CJRH Richmond Hill, Ont.	1000
WHEP Foley, Ala.	1000d
WJAM Marion, Ala.	5000d
KBUZ Mesa, Ariz.	5000
KBOK Malvern, Ark.	1000d
KPOD Crescent City, Calif.	1000d
KDIA Oakland, Calif.	1000
KTKR Taft, Calif.	500d
KFKA Greeley, Colo.	1000
WICH Norwich, Conn.	1000
WOOO Deland, Fla.	5000d
WAUC Wauchula, Fla.	500d
WBRO Waynesboro, Ga.	1000d
WBMK West Point, Ga.	1000
KLIX Twin Falls, Idaho	5000
WISH Indianapolis, Ind.	5000
KOKX Keokuk, Iowa	1000
WTTL Madisonville, Ky.	500d
WDOC Prestonsburg, Ky.	5000d
KIKS Sulphur, La.	500
KUZN W. Monroe, La.	1000d
WLOB Portland, Maine	1000d
WORC Worcester, Mass.	5000
WKMH Dearborn, Mich.	5000
WCCW Traverse City, Mich.	1000d
KRBI St. Peter, Minn.	1000d
WXXX Hattiesburg, Miss.	1000d
KFSB Joplin, Mo.	5000
KFBB Great Falls, Mont.	5000
WJLK Asbury Park, N.J.	250
WCAM Camden, N.J.	250
KARA Albuquerque, N.M.	1000d
WVIP Mt. Kisco, N.Y.	1000d
WTLB Utica, N.Y.	1000
WISE Asheville, N.C.	5000
WKTC Charlotte, N.C.	1000
WTIK Durham, N.C.	1000
KNOX Grand Forks, N.Dak.	5000
WFAH Alliance, Ohio	1000d
KNPT Newport, Oreg.	5000
WBFD Bedford, Pa.	1000d
WGSA Ephrata, Pa.	1000d
WNAE Warren, Pa.	5000d
WDKD Kingstree, S.C.	5000d
WDOD Chattanooga, Tenn.	5000
WDXI Jackson, Tenn.	5000
WBNT Oneida, Tenn.	1000d
KZIP Amarillo, Tex.	1000d
WRR Dallas, Tex.	5000
KOYL Odessa, Tex.	500d
KUBO San Antonio, Tex.	5000d
WEEL Fairfax, Va.	1000
WGH Newport News, Va.	5000
KARY Prosser, Wash.	1000d
WIBA Madison, Wis.	5000

1320—227.1

CHQM Vancouver, B.C.	10000
CKEC New Glasgow, N.S.	250
CJSO Sorel, P.Q.	1000
CKKW Kitchener, Ont.	1000
WAGF Dothan, Ala.	1000
WENN Birmingham, Ala.	5000d
KBLU Yuma, Ariz.	500d

Kc. Wave Length	W.P.
KWHN Fort Smith, Ark.	5000
KRLW Walnut Ridge, Ark.	1000d
KHSJ Hemet, Calif.	500d
KLAN Lemoore, Calif.	1000d
KUDE Oceanside, Calif.	500
KCRA Sacramento, Calif.	5000
KAVI Rocky Ford, Colo.	1000d
WATR Waterbury, Conn.	5000
WGMA Hollywood, Fla.	1000d
WZOK Jacksonville, Fla.	5000
WAMR Venice, Fla.	500d
WHIE Griffin, Ga.	5000d
WNEG Toccoa, Ga.	1000d
WKAN Kankakee, Ill.	1000d
KNIA Knoxville, Iowa	500d
KMAQ Maquoketa, Iowa	500d
KLWN Lawrence, Kans.	500d
WBRT Bardstown, Ky.	1000d
WNGO Mayfield, Ky.	1000d
KVHL Homer, La.	1000d
WICO Salisbury, Md.	1000d
WARA Attleboro, Mass.	1000
WILS Lansing, Mich.	5000
WDMJ Marquette, Mich.	1000
WCPC Houston, Miss.	5000d
WRJW Picayune, Miss.	5000d
KXLW Clayton, Mo.	1000d
KOLT Scottsbluff, Nebr.	5000
WWHG Hornell, N.Y.	5000d
WAGY Forest City, N.C.	500d
WCOG Greensboro, N.C.	5000
KQDY Minot, N.Dak.	1000d
WHOK Lancaster, Ohio	1000d
KWOE Clinton, Okla.	1000d
WKAP Allentown, Pa.	1000
WGET Gettysburg, Pa.	250
WAMP Pittsburgh, Pa.	5000
WSCR Scranton, Pa.	1000
WRIO Rio Piedras, P.R.	5000
WMSC Columbia, S.C.	1000
KELO Sioux Falls, S.Dak.	5000
WKIN Kingsport, Tenn.	5000d
WMSR Manchester, Tenn.	1000d
KVMC Colo. City, Tex.	1000d
KXYZ Houston, Tex.	5000
KCPX Salt Lake City, Utah	5000
WEET Richmond, Va.	1000d
KXRO Aberdeen, Wash.	1000
KHIT Walla Walla, Wash.	1000d
WQMN Superior, Wis.	1000d
WFHR Wisconsin Rapids, Wis.	5000

1330—225.4

WROS Scottsboro, Ala.	1000d
KMOP Tucson, Ariz.	500d
KFAC Los Angeles, Calif.	5000
WARN Ft. Pierce, Fla.	1000d
WYSE Lakeland, Fla.	1000d
WEBY Milton, Fla.	5000d
WMEN Tallahassee, Fla.	5000d
WMLT Dublin, Ga.	5000d
WEAW Evanston, Ill.	1000d
WRAM Monmouth, Ill.	1000d
WRRR Rockford, Ill.	1000d
WJPS Evansville, Ind.	5000
KWWL Waterloo, Iowa	5000
KFH Wichita, Kans.	5000
WMOR Morehead, Ky.	1000d
KVOL Lafayette, La.	1000
WASA Harve deGrace, Md.	1000d
WCRB Waltham, Mass.	5000
WTRX Flint, Mich.	5000
WLOL Minneapolis, Minn.	5000
WCRR Corinth, Miss.	500d
WJPR Greenville, Miss.	1000
WDAL Meridian, Miss.	1000d
KUKU Willow Springs, Mo.	500d
KGAK Gallup, N.Mex.	5000
WEVD New York, N.Y.	5000
WPOW New York, N.Y.	5000
WEBO Owego, N.Y.	1000d
WHAZ Troy, N.Y.	1000
WFIN Findlay, Ohio	1000d
WKOV Wellston, Ohio	500d
KPOJ Portland, Oreg.	5000
WBLF Bellefonte, Pa.	500
WICU Erie, Pa.	5000
WLAT Conway, S.C.	5000d
WFBC Greenville, S.C.	5000
WAEW Crossville, Tenn.	1000d
WTRO Dyersburg, Tenn.	500d
KMIL Cameron, Tex.	500d
KSWA Graham, Tex.	500d
KINE Kingsville, Tex.	1000d
KVKM Monahans, Tex.	1000
KDOK Tyler, Tex.	1000d
WBTM Danville, Va.	5000
WESR Tasley, Va.	1000d
KFKF Bellevue, Wash.	1000d
KCFA Spokane, Wash.	5000d
WETZ New Martinsville, W.Va.	1000d
WHBL Sheboygan, Wis.	1000
KOVE Lander, Wyo.	1000

1340—223.7

CBH Halifax, N.S.	100
CFGB Goose Bay, Nfld.	250
CJAF Cabano, Que.	250
CFSL Weyburn, Sask.	1000
CFYK Yellow Knife, N.W.T.	250
CHAD Amos, Que.	250
CJLS Yarmouth, N.S.	250
CHRD Drummondville, Que.	250
CJQC Quebec, Que.	250

Kc. Wave Length	W.P.
CKAR-1 Parry Sound, Ont.	250
CKOX Woodstock, Ont.	250
WKUL Cullman, Ala.	250
WJOI Florence, Ala.	250
WGWC Selma, Ala.	250
WFEB Sylacauga, Ala.	250
KIBH Seward, Alaska	250
KIKO Miami, Ariz.	250
KNOG Nogales, Ariz.	250
KPGE Page, Ariz.	250
KZOK Prescott, Ariz.	250
KBTA Batesville, Ark.	250
KBRS Springdale, Ark.	250
KENL Arcata, Calif.	250
KMAK Fresno, Calif.	250
KDOL Mojave, Calif.	250
KSFE Needles, Calif.	250
KATY San Luis Obispo, Calif.	250
KIST Santa Barbara, Calif.	250
KOMY Watsonville, Calif.	250
KDEN Denver, Colo.	250
KVRH Salida, Colo.	250
WNHC New Haven, Conn.	250
WOOK Washington, D.C.	250
WTAN Clearwater, Fla.	250
WROD Daytona Bch., Fla.	250
WDSR Lake City, Fla.	250
WTYS Marianna, Fla.	250
WQXT Palm Beach, Fla.	250
WSEB Sebring, Fla.	250
WNSM Valparaiso-Niceville, Fla.	250
WGAU Athens, Ga.	250
WAKE Atlanta, Ga.	250
WBBQ Augusta, Ga.	250
WGAA Cedartown, Ga.	250
WOKS Columbus, Ga.	250
WBBT Lyons, Ga.	250
WTIF Tifton, Ga.	250
KPST Preston, Idaho	250
KSKI Sun Valley, Idaho	250
WSOY Decatur, Ill.	250
WJPF Herrin, Ill.	250
WJOL Joliet, Ill.	250
WBIW Bedford, Ind.	250
WTRC Elkhart, Ind.	250
WLBC Muncie, Ind.	250
KROS Clinton, Iowa	250
KLIL Estherville, Iowa	250
KCKN Kansas City, Kans.	250
KSEK Pittsburg, Kans.	250
WCMI Ashland, Ky.	250
WBGN Bowling Green, Ky.	250
WNBS Murray, Ky.	250
WEKY Richmond, Ky.	250
KVOB Bastrop, La.	250
KRMD Shreveport, La.	250
WFAU Augusta, Maine	1000
WHOU Houlton, Maine	250
WGAW Gardner, Mass.	250
WNBH New Bedford, Mass.	250
WBRK Pittsfield, Mass.	250
WLEW Bad Axe, Mich.	250
WLAV Grand Rap., Mich.	250
WCSR Hillsdale, Mich.	100
WMTE Manistee, Mich.	250
WAGN Menominee, Mich.	250
WMBN Petoskey, Mich.	250
WEXL Royal Oak, Mich.	250
KDLM Detroit Lakes, Minn.	250
WEVE Eveleth, Minn.	250
KROC Rochester, Minn.	1000
KWLM Willmar, Minn.	250
WJMB Brookhaven, Miss.	250
WAML Laurel, Miss.	250
KXEO Mexico, Mo.	250
KSMO Salem, Mo.	250
KICK Springfield, Mo.	250
KCAP Helena, Mont.	250
KPRK Livingston, Mont.	250
KATL Miles City, Mont.	250
KQTE Missoula, Mont.	250
KFGT Fremont, Nebr.	100
KGFW Kearney, Nebr.	250
KSID Sidney, Nebr.	250
KORK Las Vegas, Nev.	250
KBET Reno, Nev.	250
WDCR Hanover, N.H.	250
WMID Atlantic City, N.J.	250
KNDE Aztec, N.M.	250
KYAP Ruidoso, N.M.	250
KSIL Silver City, N.Mex.	1000
WMBO Auburn, N.Y.	1000
WENT Gloversville, N.Y.	250
WJOC Jamestown, N.Y.	250
WUSJ Lockport, N.Y.	250
WMSA Massena, N.Y.	250
WALL Middletown, N.Y.	250
WIRY Plattsburg, N.Y.	250
WJRI Lenoir, N.C.	250
WTSB Lumberton, N.C.	250
WOXF Oxford, N.C.	250
WOOW Greenville, N.C.	250
WGNI Wilmington, N.C.	250
WAIR Winston-Salem, N.C.	250
KGPC Grafton, N.D.	250
WNCO Ashland, Ohio	250
WOUB Athens, Ohio	250
WIZE Springfield, Ohio	250
WSTV Steubenville, Ohio	250
KIHN Hugo, Okla.	250
KOCY Okla. City, Okla.	250
KLOO Corvallis, Oreg.	250
KWVR Enterprise, Oreg.	250
KIHR Hood River, Oreg.	250
KBBR North Bend, Oreg.	250
WCVI Connellsville, Pa.	250
WSAJ Grove City, Pa.	100

Kc. Wave Length	W.P.
WKRZ Oil City, Pa.	250
WHAT Philadelphia, Pa.	250
WRAW Reading, Pa.	250
WTRN Tyrone, Pa.	250
WBRE Wilkes-Barre, Pa.	250
WWPA Williamsport, Pa.	250
WGRF Aguadilla, P.R.	250
WOKE Charleston, S.C.	250
WRHI Rock Hill, S.C.	250
WSSC Sumter, S.C.	250
KIJV Huron, S.D.	250
KRSD Rapid City, S.Dak.	250
WBAC Cleveland, Tenn.	250
WKRM Columbia, Tenn.	250
WGRV Greeneville, Tenn.	250
WKGN Knoxville, Tenn.	250
WHHM Memphis, Tenn.	250
WCDT Winchester, Tenn.	250
KWKC Abilene, Tex.	250
KAND Corsicana, Tex.	250
KSET El Paso, Tex.	250
KDUB Lubbock, Tex.	250
KRBA Lufkin, Tex.	250
KPDN Pampa, Tex.	250
KOLE Port Arthur, Tex.	250
KTXL San Angelo, Tex.	250
KVIC N. of Victoria, Tex.	250
WTWN St. Johnsbury, Vt.	250
WKEY Covington, Va.	1000
WHAP Hopewell, Va.	250
WJMA Orange, Va.	250
KAGT Anacortes, Wash.	250
KPKW Pasco, Wash.	250
KAPA Raymond, Wash.	250
KMEL Wenatchee, Wash.	250
WHAR Clarksburg, W.Va.	250
WEPM Martinsburg, W.Va.	250
WMON Montgomery, W.Va.	250
WOVE Welch, W.Va.	250
WLDY Ladysmith, Wis.	1000
WRIT Milwaukee, Wis.	250
KWOR Worland, Wyo.	250

1350—222.1

CHOV Pembroke, Ont.	1000
CJDC Dawson Creek, B.C.	1000
CJLM Joliette, Que.	1000
CHGB St. Anne de la Pocatiere, Que.	1000
CKLB Oshawa, Ont.	10000
CKEN Kentville, N.S.	1000
WELB Elba, Ala.	1000d
WGAD Gadsden, Ala.	5000
KAAB Hot Springs, Ark.	1000
KLYD Bakersfield, Calif.	1000d
KCKC San Bernardino, Calif.	500
KSRO Santa Rosa, Calif.	1000
KGHF Pueblo, Colo.	5000
WNLK Norwalk, Conn.	500
WINY Putnam, Conn.	1000d
WEZY Cocoa, Fla.	1000
WDCF Dade City, Fla.	1000d
WRPB Warner Robins, Ga.	1000d
KRLC Lewiston, Idaho	5000
WAAP Peoria, Ill.	1000
WJBD Salem, Ill.	500d
WIOU Kokomo, Ind.	1000
KRNT Des Moines, Iowa	5000
KMAN Manhattan, Kans.	500d
WLOU Louisville, Ky.	5000d
WSMB New Orleans, La.	5000
WDEA Ellsworth, Me.	1000d
WHMI Howell, Mich.	500
KDIO Ortonville, Minn.	1000d
WCMP Pine City, Minn.	1000d
WKOZ Kosciusko, Miss.	5000d
KCHR Charleston, Mo.	1000d
KBRX O'Neill, Nebr.	1000d
WLNH Laconia, N.H.	5000d
KABQ Albuquerque, N.M.	5000
WCBA Corning, N.Y.	1000d
WRNY Rome, N.Y.	500d
WHIP Mooresville, N.C.	1000d
WLLY Wilson, N.C.	1000d
KQDI Bismarck, N.D.	500d
WADC Akron, Ohio	5000
WCHI Chillicothe, Ohio	500d
KRHD Duncan, Okla.	250
KTLQ Tahlequah, Okla.	1000d
WORK York, Pa.	5000
WDAR Darlington, S.C.	500d
WGSW Greenwood, S.C.	1000d
WRKM Carthage, Tenn.	500d
KCAR Clarksville, Tex.	500d
KTXJ Jasper, Tex.	1000d
KCOR San Antonio, Tex.	5000
WBLT Bedford, Va.	1000d
WFLS Fredericksburg, Va.	500d
WNVA Norton, Va.	5000d
WAVY Portsmouth, Va.	5000
WPDR Portage, Wis.	1000d

1360—220.4

WWWB Jasper, Ala.	1000d
WLIQ Mobile, Ala.	5000d
WMFC Monroeville, Ala.	1000d
WELR Roanoke, Ala.	1000d
KRUX Glendale, Ariz.	5000
KLYR Clarksville, Ark.	500d
KFFA Helena, Ark.	1000
KFIV Modesto, Calif.	1000
KRCK Ridgecrest, Calif.	1000d
KGB San Diego, Calif.	5000
WDRC Hartford, Conn.	5000
WOBS Jacksonville, Fla.	5000d
WKAT Miami Beach, Fla.	5000
WSFR Sanford, Fla.	500d

Kc.	Wave Length	W.P.
WINT	Winter Haven, Fla.	1000d
WAZA	Bainbridge, Ga.	1000d
WLAW	Lawrenceville, Ga.	1000d
WLBK	DeKalb, Ill.	500d
WVMC	Mt. Carmel, Ill.	500d
KHAK	Cedar Rapids, Iowa	1000d
KXGI	Ft. Madison, Iowa	1000d
KSCJ	Sioux City, Iowa	5000
KBTO	El Dorado, Kans.	500d
WFLW	Monticello, Ky.	1000d
KOBC	Mansfield, La.	1000d
KVIM	New Iberia, La.	1000d
KTLD	Tallulah, La.	500d
WEBB	Dundalk, Md.	5000d
WLYN	Lynn, Mass.	1000d
WKMI	Kalamazoo, Mich.	5000
KLRS	Mountain Grove, Mo.	1000d
WNNJ	Newton, N.J.	1000d
WWBZ	Vineland, N.J.	1000
WKOP	Binghamton, N.Y.	5000
WMNS	Olean, N.Y.	1000d
WCHL	Chapel Hill, N.C.	1000d
KEYZ	Williston, N.D.	5000
WSAI	Cincinnati, Ohio	5000
WWOW	Conneaut, Ohio	500d
KUIK	Hillsboro, Oreg.	1000d
WMCK	McKeesport, Pa.	1000
WPPA	Pottsville, Pa.	1000
WELP	Easley, S.C.	1000d
WLCM	Lancaster, S.C.	1000d
WNAH	Nashville, Tenn.	1000d
KRAY	Amarillo, Tex.	500d
KACT	Andrews, Tex.	1000d
KWBA	Baytown, Tex.	1000
KRYS	Corpus Christi, Tex.	1000
KXOL	Ft. Worth, Tex.	5000
WBOB	Galax, Va.	1000d
WHBG	Harrisonburg, Va.	5000d
KFDR	Grand Coulee, Wash.	1000d
KMO	Tacoma, Wash.	5000
WHJC	Matawan, W.Va.	1000d
WMOV	Ravenswood, W.Va.	1000d
WBAY	Green Bay, Wis.	5000
WISV	Viroqua, Wis.	500d
WMNE	Menomonie, Wis.	1000d
KVRS	Rock Springs, Wyo.	1000

1370—218.8

WBYE	Calera, Ala.	1000d
KTPA	Prescott, Ark.	500d
KBUC	Corona, Calif.	1000
KEEN	San Jose, Calif.	5000
KGEN	Tulare, Calif.	1000d
WHYS	Ocala, Fla.	1000d
WCOA	Pensacola, Fla.	5000
WAXE	Vero Beach, Fla.	1000d
WBGR	Jesup, Ga.	1000d
WFDR	Manchester, Ga.	1000d
WKLE	Washington, Ga.	1000d
WPRC	Lincoln, Ill.	500d
WTTS	Bloomington, Ind.	5000
WGRY	Gary, Ind.	500d
KDTH	Dubuque, Iowa	1000
KGNO	Dodge City, Kans.	5000
WGOH	Grayson, Ky.	5000d
WTKY	Tompkinsville, Ky.	1000d
KAPB	Marksville, La.	1000d
WKIK	Leonardtown, Md.	1000d
WGHN	Grand Haven, Mich.	500d
KSUM	Fairmont, Minn.	1000
WDOB	Canton, Miss.	1000d
KWRT	Boonville, Mo.	1000d
KCRV	Caruthersville, Mo.	1000d
KXLF	Butte, Mont.	5000
KAWL	York, Nebr.	500d
WFEA	Manchester, N.H.	5000
WALK	Patchogue, N.Y.	500d
WSAY	Rochester, N.Y.	5000
WLTC	Gastonia, N.C.	1000d
WTAB	Tabor City, N.C.	5000d
KFJM	Grand Forks, N.D.	1000d
WSPD	Toledo, Ohio	5000
KAST	Astoria, Oreg.	1000
WOTR	Corry, Pa.	1000
WPAZ	Pottstown, Pa.	1000d
WKMC	Roaring Sprgs., Pa.	1000d
WIVV	Vieques, P.R.	1000
WDEF	Chattanooga, Tenn.	5000
WDXE	Lawrenceburg, Tenn.	1000d
WRGS	Rogersville, Tenn.	1000d
KOKE	Austin, Tex.	1000d
KFRO	Longview, Tex.	1000
KUKO	Post, Tex.	500d
KSOP	Salt Lake City, Utah	1000d
WBTN	Bennington, Vt.	500d
WHEE	Martinsville, Va.	5000d
WJWS	South Hill, Va.	5000d
KPOR	Quincy, Wash.	1000d
WMOD	Moundsville, W.Va.	1000d
WCCN	Neillsville, Wis.	5000d
KVWO	Cheyenne, Wyo.	1000

1380—217.3

CFDA	Victoriaville, Que.	1000
CKPC	Brantford, Ont.	10000
CKLC	Kingston, Ont.	5000
WGYV	Greenville, Ala.	1000d
KDXE	N. Little Rock, Ark.	1000d
KBVM	Lancaster, Calif.	1000d
KGMS	Sacramento, Calif.	1000
KSBW	Salinas, Calif.	5000
KFLJ	Walsenburg, Colo.	1000d
WAMS	Wilmington, Del.	1000
WLIZ	Lake Worth, Fla.	500d
WQXQ	Ormond Bch., Fla.	1000d
WLCY	St. Petersburg, Fla.	5000
WAOK	Atlanta, Ga.	5000
WRWH	Cleveland, Ga.	500d
KPOI	Honolulu, Hawaii	5000
WITE	Brazil, Ind.	500d
WKJG	Ft. Wayne, Ind.	5000
KCIM	Carroll, Iowa	1000
WMTA	Central City, Ky.	500d
WWKY	Winchester, Ky.	1000d
WYNK	Baton Rouge, La.	500d
WKTJ	Farmington, Me.	1000d
WTTH	Port Huron, Mich.	1000
WPLB	Greenville, Mich.	500d
KLIZ	Brainerd, Minn.	1000d
KAGE	Winona, Minn.	1000d
WDLT	Indianola, Miss.	500d
KUDL	Kansas City, Mo.	1000d
KWK	St. Louis, Mo.	5000
KUVR	Holdredge, Nebr.	500d
WBBX	Portsmouth, N.H.	1000d
WAWZ	Zarephath, N.J.	5000
WBNX	New York, N.Y.	5000
WLOS	Asheville, N.C.	5000
WTOB	Winston-Salem, N.C.	5000
WWIZ	Lorain, Ohio	500d
WPKO	Waverly, Ohio	1000d
KSWO	Lawton, Okla.	1000
KMUS	Muskogee, Okla.	1000
KBCH	Ocean Lake, Oreg.	1000d
KSRV	Ontario, Oreg.	5000
WACB	Kittanning, Pa.	1000d
WARC	Milton, Pa.	1000d
WAYZ	Waynesboro, Pa.	1000d
WNRI	Woonsocket, R.I.	1000d
WAGS	Bishopville, S.C.	1000d
WGUS	N. Augusta, S.C.	500
KOTA	Rapid City, S.Dak.	5000
KJET	Beaumont, Tex.	1000d
KBWD	Brownwood, Tex.	1000
KCRN	Crane, Tex.	1000d
KTSM	El Paso, Tex.	1000
KMUL	Muleshoe, Tex.	500d
KBOP	Pleasanton, Tex.	1000d
WSYB	Rutland, Vt.	5000
WMBG	Richmond, Va.	5000
KRKO	Everett, Wash.	1000
WBEL	Beloit, Wis.	5000

1390—215.7

CKLN	Nelson, B.C.	1000
WHMA	Anniston, Ala.	5000
KDQN	DeQueen, Ark.	500d
KAMO	Rogers, Ark.	1000d
KGER	Long Beach, Calif.	5000
KTUR	Turlock, Calif.	1000
KFML	Denver, Colo.	1000d
WAVP	Avon Park, Fla.	1000d
WGES	Chicago, Ill.	5000
WFIW	Fairfield, Ill.	500d
WJCD	Seymour, Ind.	1000d
KCLN	Clinton, Iowa	1000d
KCBC	Des Moines, Iowa	1000
KNCK	Concordia, Kans.	500d
WANY	Albany, Ky.	1000d
WKIC	Hazard, Ky.	5000d
KFRA	Franklin, La.	500d
KNOE	Monroe, La.	5000
WEGP	Presque Isle, Me.	5000d
WCAT	Orange, Mass.	1000d
WPLM	Plymouth, Mass.	5000d
WCER	Charlotte, Mich.	1000d
KRFO	Owatonna, Minn.	500d
WROA	Gulfport, Miss.	1000d
WQIC	Meridian, Miss.	5000d
KENN	Farmington, N.Mex.	5000
KHOB	Hobbs, N.Mex.	5000d
WEOK	Poughkeepsie, N.Y.	5000d
WRIV	Riverhead, N.Y.	1000d
WFBL	Syracuse, N.Y.	5000
WFNC	Fayetteville, N.C.	5000
WKRK	Murphy, N.C.	1000d
WEED	Rocky Mount, N.C.	5000
WADA	Shelby, N.C.	500d
KLPM	Minot, N.Dak.	5000
WOHP	Bellefontaine, Ohio	500d
WMPO	Middleport-Pomroy, Ohio	1000d
WFMJ	Youngstown, Ohio	5000
KCRC	Enid, Okla.	1000
KSLM	Salem, Oreg.	5000
WLAN	Lancaster, Pa.	1000
WHPB	Belton, S.C.	500d
WCSC	Charleston, S.C.	5000
KJAM	Madison, S.D.	1000d
WTJS	Jackson, Tenn.	5000
KULP	El Campo, Tex.	500d
KBEC	Waxahachie, Tex.	500d
KLGN	Logan, Utah	500
WEAM	Arlington, Va.	5000
WWOD	Lynchburg, Va.	5000
KLOQ	Yakima, Wash.	1000
WTMB	Tomah, Wis.	500d

1400—214.2

CKBC	Bathurst, N.B.	250
CKDH	Amherst, N.S.	250
CKCY	Sault Ste. Marie, Ont.	250
CJFP	Riviere-du-Loup, Que.	1000
CKRN	Rouyn, Que.	250
CKSW	Swift Current, Sask.	250
WMSL	Decatur, Ala.	250
WXAL	Demopolis, Ala.	250
WFPA	Ft. Payne, Ala.	250
WJLD	Homewood, Ala.	250
WJHO	Opelika, Ala.	250
KSEW	Sitka, Alaska	250
KCLF	Clifton, Ariz.	250
KXIV	Phoenix, Ariz.	250
KTUC	Tucson, Ariz.	250
KVOY	Yuma, Ariz.	250
KELD	El Dorado, Ark.	250
KCLA	Pine Bluff, Ark.	250
KWYN	Wynne, Ark.	250
KRE	Berkeley, Calif.	250
KREO	Indio, Calif.	250
KSDA	Redding, Calif.	250
KSLY	San Luis Obispo, Cal.	250
KSPA	Santa Paula, Calif.	250
KHOE	Truckee, Calif.	1400
KUKI	Ukiah, Calif.	250
KONG	Visalia, Calif.	250
KRLN	Canon City, Colo.	250
KDTA	Delta, Colo.	250
KFTM	Ft. Morgan, Colo.	250
KBZZ	La Junta, Colo.	250
WSTC	Stamford, Conn.	250
WILI	Willimantic, Conn.	250
WFTL	Ft. Lauderdale, Fla.	250
WIRA	Ft. Pierce, Fla.	250
WRHC	Jacksonville, Fla.	250
WPRY	Perry, Fla.	250
WTRR	Sanford, Fla.	250
WCQS	Alma, Ga.	250
WSGC	Elberton, Ga.	250
WNEX	Macon, Ga.	250
WMGA	Moultrie, Ga.	250
WCOH	Newnan, Ga.	250
WGSA	Savannah, Ga.	250
KART	Jerome, Idaho	250
KRPL	Moscow, Idaho	250
KSPT	Sandpoint, Idaho	250
WDWS	Champaign, Ill.	250
WGIL	Galesburg, Ill.	250
WEOA	Evansville, Ind.	250
WBAT	Marion, Ind.	250
KCOG	Centerville, Iowa	100
KVFD	Fort Dodge, Iowa	250
KVOE	Emporia, Kans.	250
KAYS	Hays, Kans.	250
WCYN	Cynthiana, Ky.	100
WIEL	Elizabethtown, Ky.	250
WFTG	London, Ky.	250
WFPR	Hammond, La.	250
KAOK	Lake Charles, La.	250
WRDO	Augusta, Maine	250
WIDE	Biddeford, Maine	250
WWIN	Baltimore, Md.	250
WALE	Fall River, Mass.	250
WLLH	Lowell, Mass.	250
WHMP	Northampton, Mass.	250
WELL	Battle Creek, Mich.	250
WJLB	Detroit, Mich.	250
WHDF	Houghton, Mich.	250
WMAB	Munising, Mich.	250
WSAM	Saginaw, Mich.	250
WSJM	St. Joseph, Mich.	250
WTCM	Traverse City, Mich.	250
KEYL	Long Prairie, Minn.	250
KMHL	Marshall, Minn.	250
WMIN	Mpls.-St. Paul, Minn.	250
WHLB	Virginia, Minn.	250
WBIP	Booneville, Miss.	250
WNAG	Grenada, Miss.	250
WFOR	Hattiesburg, Miss.	250
WJQS	Jackson, Miss.	250
WMBC	Macon, Miss.	250
KFRU	Columbia, Mo.	250
KSIM	Sikeston, Mo.	250
KTTS	Springfield, Mo.	250
KXGN	Glendive, Mont.	250
KARR	Great Falls, Mont.	1000
KCOW	Alliance, Nebr.	250
KLIN	Lincoln, Nebr.	250
KBMI	Henderson, Nev.	250
KWNA	Winnemucca, Nev.	250
WTSL	Hanover, N.H.	250
KGFL	Roswell, N. Mex.	250
KTRC	Santa Fe, N.Mex.	250
KCHS	Truth or Consequences, New Mexico	250
KTNM	Tucumcari, N.Mex.	250
WOND	Pleasantville, N.J.	250
WABY	Albany, N.Y.	1000
WBNY	Buffalo, N.Y.	250
WSLB	Ogdensburg, N.Y.	1000
WBMA	Beaufort, N.C.	250
WGBG	Greensboro, N.C.	250
WKDX	Hamlet, N.C.	250
WSIC	Statesville, N.C.	250
WLSE	Wallace, N.C.	250
WHCC	Waynesville, N.C.	250
WCNF	Weldon, N.C.	250
KEYJ	Jamestown, N.Dak.	250
WMAN	Mansfield, Ohio	250
WPAY	Portsmouth, Ohio	250
KWON	Bartlesville, Okla.	250
KTMC	McAlester, Okla.	250
KNOR	Norman, Okla.	250
KWIN	Ashland, Oreg.	250
KNND	Cottage Grove, Oreg.	250
WEST	Easton, Pa.	250
WJET	Erie, Pa.	250
WHGB	Harrisburg, Pa.	250
WJAC	Johnstown, Pa.	250
WKBI	St. Marys, Pa.	250
WICK	Scranton, Pa.	250
WRAK	Williamsport, Pa.	250
WPCC	Clinton, S.C.	500
WCOS	Columbia, S.C.	1000
WGTN	Georgetown, S.C.	250
WTHE	Spartanburg, S.C.	250
WJZM	Clarksville, Tenn.	250
WHUB	Cookeville, Tenn.	250
WLSB	Copper Hill, Tenn.	250
WKPT	Kingsport, Tenn.	250
WGAP	Maryville, Tenn.	250
WHAL	Shelbyville, Tenn.	250
KRUN	Ballinger, Tex.	250
KBYG	Big Spring, Tex.	100
KUNO	Corpus Christi, Tex.	250
KILE	nr. Galveston, Tex.	250
KGVL	Greenville, Tex.	250
KEBE	Jacksonville, Tex.	250
KIUN	Pecos, Tex.	250
KEYE	Perryton, Tex.	250
KVOP	Plainview, Tex.	250
KTEM	Temple, Tex.	250
KTFS	Texarkana, Tex.	250
KVOU	Uvalde, Tex.	250
KIXX	Provo, Utah	250
WDOT	Burlington, Vt.	250
WINA	Charlottesville, Va.	250
WLOW	Portsmouth, Va.	250
WHLF	So. Boston, Va.	1000
WINC	Winchester, Va.	250
KWLK	Longview, Wash.	250
KRSC	Othello, Wash.	250
KTNT	Tacoma, Wash.	250
WCAW	Charleston, W.Va.	250
WBOY	Clarkesburg, W.Va.	250
WRON	Ronceverte, W.Va.	250
WKWK	Wheeling, W.Va.	250
WBTH	Williamson, W.Va.	250
WATW	Ashland, Wis.	250
WBIZ	Eau Claire, Wis.	250
WDUZ	Green Bay, Wis.	250
WRJN	Racine, Wis.	250
WRDB	Reedsburg, Wis.	250
WRIG	Wausau, Wis.	250
KATI	Caspar, Wyo.	250
KODI	Cody, Wyo.	250

1410—212.6

CFUN	Vancouver, B.C.	10000
CHLP	Montreal, Que.	10000
WALA	Mobile, Ala.	5000
WCHP	Tuscumbia, Ala.	500d
KTCS	Fort Smith, Ark.	500d
KERN	Bakersfield, Calif.	500
KRML	Carmel, Calif.	500d
KMYC	Marysville, Calif.	5000
KCAL	Redlands, Calif.	1000d
KCOL	Ft. Collins, Colo.	1000
WPOP	Hartford, Conn.	5000
WDOV	Dover, Del.	1000d
WMYR	Fort Myers, Fla.	5000
WBIL	Leesburg, Fla.	1000d
WRIX	Griffin, Ga.	1000d
WDAX	McRae, Ga.	1000d
WLAQ	Rome, Ga.	1000
WRMN	Elgin, Ill.	500d
WTIM	Taylorville, Ill.	1000d
WAZY	Lafayette, Ind.	1000d
KGRN	Grinnell, Iowa	500d
KLEM	LeMars, Iowa	1000d
KCLO	Leavenworth, Kans.	5000d
KWBB	Wichita, Kans.	5000
WLBJ	Bowling Green, Ky.	5000
WHLN	Harlan, Ky.	5000d
KDBS	Alexandria, La.	1000d
WGRD	Grand Rap., Mich.	1000d
KLFD	Litchfield, Minn.	500d
WDSK	Cleveland, Miss.	1000d
WBKN	Newton, Miss.	500d
WHTG	Eatontown, N.J.	500d
WDOE	Dunkirk, N.Y.	500
WELM	Elmira, N.Y.	1000
WSET	Glen Falls, N.Y.	1000d
WOTT	Watertown, N.Y.	5000
WEGO	Concord, N.C.	1000d
WSRC	Durham, N.C.	1000d
WING	Dayton, Ohio	5000
KPAM	Portland, Oreg.	5000d
WLSH	Lansford, Pa.	1000d
KQV	Pittsburgh, Pa.	5000
WYMB	Manning, S.C.	1000d
WCMT	Martin, Tenn.	1000d
KBUD	Athens, Tex.	1000d
KBAN	Bowie, Tex.	500d
KVLB	Cleveland, Tex.	500
KXIT	Dalhart, Tex.	500d
KADO	Marshall, Tex.	500
KRIG	Odessa, Tex.	1000
KBAL	San Saba, Tex.	500d
KNAL	Victoria, Tex.	500
WRIS	Roanoke, Va.	5000d
WKBH	LaCrosse, Wis.	5000
KWYO	Sheridan, Wyo.	1000

1420—211.1

CKPT	Peterborough, Ont.	1000
CJMT	Chicoutimi, Que.	1000
CKOM	Saskatoon, Sask.	5000
WACT	Tuscaloosa, Ala.	5000d
KHFH	Sierra Vista, Ariz.	1000d
KPOC	Pocahontas, Ark.	1000d
KSTN	Stockton, Calif.	5000
WLIS	Old Saybrook, Conn.	500d
WBRD	Bradenton, Fla.	1000
WDBF	Delray Beach, Fla.	5000d
WSTN	St. Augustine, Fla.	1000d
WAVO	Avondale Estates, Ga.	500d
WRBL	Columbus, Ga.	5000
WPEH	Louisville, Ga.	1000d
WLET	Toccoa, Ga.	5000d
WINI	Murphysboro, Ill.	500d
WIMS	Michigan City, Ind.	5000d
WOC	Davenport, Iowa	5000
KJCK	Junction City, Kans.	1000d

Kc.	Wave Length	W.P.
WTCR	Ashland, Ky.	5000d
WHBN	Harrodsburg, Ky.	1000d
WVJS	Owensboro, Ky.	1000
KPEL	Lafayette, La.	1000
WBSM	New Bedford, Mass.	1000
WBEC	Pittsfield, Mass.	1000
WAMM	Flint, Mich.	1000d
WKPR	Kalamazoo, Mich.	1000d
KTOE	Mankato, Minn.	5000
WSUH	Oxford, Miss.	1000d
WQBC	Vicksburg, Miss.	1000
KBTN	Neosho, Mo.	500d
KOOO	Omaha, Nebr.	1000d
KSYX	Santa Rosa, N.Mex.	1000d
WALY	Herkimer, N.Y.	1000d
WACK	Newark, N.Y.	500
WLNA	Peekskill, N.Y.	1000d
WMYN	Mayodan, N.C.	500
WGAS	S. Gastonia, N.C.	500d
WVOT	Wilson, N.C.	1000
WHK	Cleveland, Ohio	5000
KTJS	Hobart, Okla.	1000d
KYNG	Coos Bay, Oreg.	1000d
WCOJ	Coatesville, Pa.	5000
WCED	DuBois, Pa.	5000
WEUC	Ponce, P.R.	1000
WCRE	Cheraw, S.C.	1000d
KABR	Aberdeen, S.D.	1000d
WEMB	Erwin, Tenn.	5000d
WKSR	Pulaski, Tenn.	1000
KFYN	Bonham, Tex.	250d
KTRE	Lufkin, Tex.	1000
KGNB	New Braunfels, Tex.	1000d
KPEP	San Angelo, Tex.	1000d
WWSR	St. Albans, Vt.	1000d
WDDY	Gloucester, Va.	1000d
WKCW	Warrenton, Va.	5000d
KITI	Chehalis, Wash.	1000d
KUJ	Walla Walla, Wash.	5000
WPLY	Plymouth, Wis.	500d

1430—209.7

Kc.	Wave Length	W.P.
CKFH	Toronto, Ont.	5000
WFHK	Pell City, Ala.	1000d
KHBM	Monticello, Ark.	1000d
KAMP	El Centro, Calif.	1000d
KARM	Fresno, Calif.	5000
KALI	Pasadena, Calif.	5000
KOSI	Aurora, Colo.	5000
WSDB	Homestead, Fla.	500d
WLAK	Lakeland, Fla.	5000
WPCF	Panama City, Fla.	5000
WGFS	Covington, Ga.	1000d
WRCD	Dalton, Ga.	1000d
WWGS	Tifton, Ga.	1000
WCMY	Ottawa, Ill.	500d
WIRE	Indianapolis, Ind.	5000
KASI	Ames, Iowa	1000d
KMRC	Morgan City, La.	500d
WNAV	Annapolis, Md.	5000
WHIL	Medford, Mass.	5000d
WION	Ionia, Mich.	500d
WBRB	Mt. Clemens, Mich.	500d
WLAU	Laurel, Miss.	5000d
KAOL	Carrollton, Mo.	500d
WIL	St. Louis, Mo.	5000
KRGI	Grand Island, Nebr.	1000
WNJR	Newark, N.J.	5000
WENE	Endicott, N.Y.	5000
WMNC	Morganton, N.C.	5000d
WRXO	Roxboro, N.C.	1000d
WFOB	Fostoria, Ohio	1000
WCLT	Newark, Ohio	500d
KALV	Alva, Okla.	500
KTUL	Tulsa, Okla.	5000
KGAY	Salem, Oreg.	5000d
WVAM	Altoona, Pa.	1000
WFRA	Franklin, Pa.	500d
WBLR	Batesburg, S.C.	5000d
WATP	Marion, S.C.	1000d
KBRK	Brookings, S. Dak.	1000d
WFCT	Fountain City, Tenn.	1000d
WENO	Madison, Tenn.	5000d
WHER	Memphis, Tenn.	1000
KSTB	Breckenridge, Tex.	1000d
KSIJ	Gladewater, Tex.	1000d
KCOH	Houston, Tex.	1000d
KLO	Ogden, Utah	5000
WDYL	Ashland, Va.	1000d
KBRC	Mt. Vernon, Wash.	5000
WEIR	Weirton, W.Va.	1000
WBEV	Beaver Dam, Wis.	1000d

1440—208.2

Kc.	Wave Length	W.P.
CFCP	Courtenay, B.C.	1000
WHHY	Montgomery, Ala.	5000
KPOK	Scottsdale, Ariz.	5000d
KHOG	Fayetteville, Ark.	250
KOKY	Little Rock, Ark.	5000d
KVON	Napa, Calif.	500
KPRO	Riverside, Calif.	1000
KCOY	Santa Maria, Calif.	1000
WBIS	Bristol, Conn.	500d
WABR	Winter Park, Fla.	5000
WWCC	Bremen, Ga.	1000d
WGIG	Brunswick, Ga.	5000
WRAJ	Anna, Ill.	500d
WPRS	Paris, Ill.	500d
WGEM	Quincy, Ill.	1000
WROK	Rockford, Ill.	1000
WPGW	Portland, Ind.	500d
KCHE	Cherokee, Iowa	500d
KJAY	Topeka, Kans.	5000
WKLX	Paris, Ky.	1000d
WEZJ	Williamsburg, Ky.	500d
KMLB	Monroe, La.	5000
WJAB	Westbrook, Me.	5000d
WAAB	Worcester, Mass.	5000
WBCM	Bay City, Mich.	1000
WDOW	Dowagiac, Mich.	500d
WCHB	Inkster, Mich.	1000d
KEVE	Golden Valley, Minn.	5000
WHHT	Lucedale, Miss.	1000d
WMVB	Millville, N.J.	1000d
WBAB	Babylon, N.Y.	500d
WJJL	Niagara Falls, N.Y.	1000d
WBLA	Elizabethtown, N.C.	1000d
WBUY	Lexington, N.C.	5000d
KILO	Grand Forks, N.D.	1000
WHHH	Warren, Ohio	5000
KMED	Medford, Oreg.	5000
KODL	The Dalles, Oreg.	1000
WCDL	Carbondale, Pa.	5000d
WNPV	Lansdale, Pa.	500d
WGCB	Red Lion, Pa.	1000d
WQOK	Greenville, S.C.	5000
WZYX	Cowan, Tenn.	1000d
WHDM	McKenzie, Tenn.	500d
KFDA	Amarillo, Tex.	5000
KEYS	Corpus Christi, Tex.	1000
KDNT	Denton, Tex.	5000
KETX	Livingston, Tex.	1000d
WKLV	Blackstone, Va.	5000d
WHIS	Bluefield, W.Va.	5000
WAJR	Morgantown, W.Va.	5000
WJPG	Green Bay, Wis.	5000

1450—206.8

Kc.	Wave Length	W.P.
CBG	Gander, Nfld.	250
CFAB	Windsor, N.S.	250
CFJR	Brockville, Ont.	1000
CHEF	Granby, P.Q.	1000
WDNG	Anniston, Ala.	250
WYAM	Bessemer, Ala.	250
WDIG	Dothan, Ala.	250
WFUN	Huntsville, Ala.	250
WLAY	Muscle Shoals City, Ala.	250
KLAM	Cordova, Alaska	250
KAWT	Douglas, Ariz.	250
KNOT	Prescott, Ariz.	250
KOLD	Tucson, Ariz.	250
KENA	Mena, Ark.	250
KYOR	Blythe, Calif.	250
KOWN	Escondido, Calif.	250
KPAL	Palm Springs, Calif.	250
KTIP	Porterville, Calif.	250
KSAN	San Francisco, Calif.	250
KROG	Sonora, Calif.	250
KVEN	Ventura, Calif.	250
KAGR	Yuba City, Calif.	100
KGIW	Alamosa, Colo.	250
KYOU	Greeley, Colo.	250
WNAB	Bridgeport, Conn.	250
WILM	Wilmington, Del.	250
WOL	Washington, D.C.	250
WWJB	Brooksville, Fla.	250
WMFJ	Daytona Beach, Fla.	250
WSKP	Miami, Fla.	250
WBSR	Pensacola, Fla.	250
WSPB	Sarasota, Fla.	250
WSTU	Stuart, Fla.	250
WTNT	Tallahassee, Fla.	250
WGPC	Albany, Ga.	250
WBHF	Cartersville, Ga.	250
WCON	Cornelia, Ga.	250
WKEU	Griffin, Ga.	250
WMVG	Milledgeville, Ga.	1000
WCCP	Savannah, Ga.	250
WVLD	Valdosta, Ga.	250
KEOK	Payette, Idaho	250
KEEP	Twin Falls, Idaho	250
WHFC	Cicero, Ill.	250
WKEI	Kewanee, Ill.	100
WCVS	Springfield, Ill.	250
WANE	Ft. Wayne, Ind.	250
WASK	Lafayette, Ind.	250
WAOV	Vincennes, Ind.	250
KPIG	Cedar Rapids, Iowa	250
KWBW	Hutchinson, Kans.	250
WTCD	Campbellsville, Ky.	250
WWXL	Manchester, Ky.	250
WPAD	Paducah, Ky.	250
KSIG	Crowley, La.	250
KNOC	Natchitoches, La.	250
WNPS	New Orleans, La.	250
WRKD	Rockland, Maine	250
WKTQ	South Paris, Maine	250
WTBO	Cumberland, Md.	250
WMAS	Springfield, Mass.	250
WATZ	Alpena Township, Mich.	250
WHTC	Holland, Mich.	250
WMIQ	Iron Mtn., Mich.	250
WIBM	Jackson, Mich.	250
WKLA	Ludington, Mich.	250
WHLS	Port Huron, Mich.	250
KATE	Albert Lea, Minn.	250
KBUN	Bemidji, Minn.	250
KBMW	Breckenridge, Minn.	250
WELY	Ely, Minn.	1000
KFAM	St. Cloud, Minn.	250
WROX	Clarksdale, Miss.	250
WCJU	Columbia, Miss.	250
WJXN	Jackson, Miss.	250
WOKK	Meridian, Miss.	1000
WNAT	Natchez, Miss.	250
WROB	West Point, Miss.	250
WMBH	Joplin, Mo.	250
KIRX	Kirksville, Mo.	250
KOKO	Warrensburg, Mo.	250
KWPM	West Plains, Mo.	250
KXXL	Bozeman, Mont.	1000
KUDI	Great Falls, Mont.	1000
KXLL	Missoula, Mont.	250
KVCK	Wolf Point, Mont.	250
KWBE	Beatrice, Nebr.	250
KCSR	Chadron, Nebr.	250
KONE	Reno, Nev.	250
WKXL	Concord, N.H.	250
WFPG	Atlantic City, N.J.	250
WCTC	New Brunswick, N.J.	250
KLOS	Albuquerque, N.Mex.	250
KLMX	Clayton, N.Mex.	250
KOBE	Las Cruces, N.Mex.	250
KENM	Portales, N.Mex.	250
WCLI	Corning, N.Y.	250
WWSC	Glen Falls, N.Y.	250
WHDL	Olean, N.Y.	1000
WKIP	Poughkeepsie, N.Y.	250
WKAL	Rome, N.Y.	250
WATA	Boone, N.C.	250
WGNC	Gastonia, N.C.	250
WHVH	Henderson, N.C.	250
WHKP	Hendersonville, N.C.	250
WHIT	New Bern, N.C.	250
WJER	Dover, Ohio	250
WMOH	Hamilton, Ohio	250
WLEC	Sandusky, Ohio	250
KWHW	Altus, Okla.	250
KGFF	Shawnee, Okla.	250
KSIW	Woodward, Okla.	250
KORE	Eugene, Oreg.	250
KFLW	Klamath Falls, Oreg.	250
KLBM	La Grande, Oreg.	250
KBPS	Portland, Oreg.	250
WLEU	Erie, Pa.	250
WDAD	Indiana, Pa.	250
WPAM	Pottsville, Pa.	250
WMPT	So. Williamsport, Pa.	250
WMAJ	State College, Pa.	250
WJPA	Washington, Pa.	250
WNEL	Caguas, P.R.	250
WWRI	W. Warwick, R.I.	250
WQSN	Charleston, S.C.	250
WCRS	Greenwood, S.C.	250
WMYB	Myrtle Beach, S.C.	250
WHSC	Hartsville, S.C.	250
KBFS	Belle Fourche, S.Dak.	250
KYNT	Yankton, S.Dak.	250
WLAR	Athens, Tenn.	250
WOGA	Chattanooga, Tenn.	250
WDSG	Dyersburg, Tenn.	250
WLAF	LaFollette, Tenn.	100
WGNS	Murfreesboro, Tenn.	250
KRIC	Beaumont, Tex.	250
KBEN	Carrizo Sprgs., Tex.	250
KCTI	Gonzales, Tex.	250
KMBL	Junction, Tex.	250
KCYL	Lampasas, Tex.	250
KMHT	Marshall, Tex.	250
KCMR	McCamey, Tex.	250
KNET	Palestine, Tex.	250
KSNY	Snyder, Tex.	250
KURA	Moab, Utah	250
KEYY	Provo, Utah	250
KDXU	St. George, Utah	250
WSNO	Barre, Vt.	250
WTSA	Brattleboro, Vt.	250
WFTR	Front Royal, Va.	250
WREL	Lexington, Va.	250
WMVA	Martinsville, Va.	1000
KBKW	Aberdeen, Wash.	250
KCLX	Colfax, Wash.	250
KONP	Port Angeles, Wash.	250
KAYE	Puyallup, Wash.	250
WPAR	Parkersburg, W.Va.	250
KFIZ	Fond du Lac, Wis.	250
WDLB	Marshfield, Wis.	250
WPFP	Park Falls, Wis.	250
WRCO	Richland Center, Wis.	250
KBBS	Buffalo, Wyo.	250
KWRL	Riverton, Wyo.	250

1460—205.4

Kc.	Wave Length	W.P.
CJOY	Guelph, Ont.	10000
CKRB	Ville St. Georges, Quebec	10000
CJNB	N. Battleford, Sask.	10000
WFMH	Cullman, Ala.	5000d
WPNX	Phenix City, Ala.	5000
KCCL	Paris, Ark.	500d
KTYM	Inglewood, Calif.	1000d
KDON	Salinas, Calif.	5000
KYSN	Colo. Sprgs., Colo.	1000
WBAR	Bartow, Fla.	1000d
WZEP	DeFuniak Springs, Florida	1000d
WMBR	Jacksonville, Fla.	5000
WOMF	Buford, Ga.	1000d
WROY	Carmi, Ill.	1000d
WKAM	Goshen, Ind.	1000d
WOCH	North Vernon, Ind.	500d
KSO	Des Moines, Iowa	5000
KCRB	Chanute, Kans.	1000d
WRVK	Mt. Vernon, Ky.	500d
WAIL	Baton Rouge, La.	5000
KBSF	Springhill, La.	1000d
WEMD	Easton, Md.	500d
WBET	Brockton, Mass.	1000
WBRN	Big Rapids, Mich.	1000d
WPON	Pontiac, Mich.	500
KDMA	Montevideo, Minn.	1000
WELZ	Belzoni, Miss.	1000d
KADY	St. Charles, Mo.	5000d
KRNY	Kearney, Nebr.	5000d
KENO	Las Vegas, Nev.	1000
WOKO	Albany, N.Y.	5000
WVOX	New Rochelle, N.Y.	500d
WHEC	Rochester, N.Y.	5000
WFVG	Fuquay Sprgs., N.C.	1000d
WMMH	Marshall, N.C.	500d
WBNS	Columbus, Ohio	5000
WPVL	Painesville, Ohio	500d
KPLK	Dallas, Oreg.	1000d
WMBA	Ambridge, Pa.	500d
WCMB	Harrisburg, Pa.	5000
WBCU	Union, S.C.	1000
WGOG	Walhalla, S.C.	500d
WJAK	Jackson, Tenn.	1000d
WEEN	Lafayette, Tenn.	1000d
KBRZ	Freeport, Tex.	500d
KLLL	Lubbock, Tex.	1000d
WACO	Waco, Tex.	1000
WPRW	Manassas, Va.	500d
WRAD	Radford, Va.	5000
WLPM	Suffolk, Va.	1000
KIMA	Yakima, Wash.	5000
WBUC	Buckhannon, W.Va.	1000d
WRAC	Racine, Wis.	500d
WTOJ	Tomah, Wis.	1000d

1470—204.0

Kc.	Wave Length	W.P.
CHOW	Welland, Ontario	1000
CFOX	Pointe Claire, Que.	1000
WBLO	Evergreen, Ala.	1000d
KBLO	Hot Springs, Ark.	1000d
KBMX	Coalinga, Calif.	500d
KUTY	Palmdale, Calif.	1000d
KXOA	Sacramento, Calif.	5000
WMMW	Meriden, Conn.	1000d
WPOM	Pompano Beach, Fla.	5000d
WDCL	Tarpon Sprgs., Fla.	5000d
WAAG	Adel, Ga.	1000d
WDOL	Athens, Ga.	1000d
WCLA	Claxton, Ga.	1000
WRGA	Rome, Ga.	5000
WMBD	Peoria, Ill.	5000
WHUT	Anderson, Ind.	1000d
KTRI	Sioux City, Iowa	5000
KWVY	Waverly, Iowa	1000d
KARE	Atchison, Kans.	1000
KLIB	Liberal, Kans.	500d
WSAC	Fort Knox, Ky.	1000d
KPLC	Lake Charles, La.	5000
WLAM	Lewiston, Maine	5000
WJOY	Salisbury, Md.	5000d
WTTR	Westminster, Md.	1000d
WSRO	Marlborough, Mass.	1000d
WNBP	Newburyport, Mass.	500d
WKMF	Flint, Mich.	5000
WKLZ	Kalamazoo, Mich.	500d
KAND	Anoka, Minn.	1000d
WCHJ	Brookhaven, Miss.	1000d
WNAU	New Albany, Miss.	500d
KGHM	Brookfield, Mo.	500d
KTCB	Malden, Mo.	1000d
WTKO	Ithaca, N.Y.	1000d
WPDM	Potsdam, N.Y.	1000d
WBIG	Greensboro, N.C.	5000
WPNC	Plymouth, N.C.	1000d
WTOE	Spruce Pine, N.C.	1000d
WOHO	Toledo, Ohio	1000
KVLH	Pauls Valley, Okla.	250d
KVIN	Vinita, Okla.	500d
KRDP	Reedsport, Oreg.	5000d
WSAN	Allentown, Pa.	5000
WFAR	Farrell, Pa.	1000d
WNML	Portage, Pa.	500d
WOIC	Columbia, S.C.	5000d
WEAG	Alcoa, Tenn.	1000d
WVOL	Berry Hill, Tenn.	5000
KRBC	Abilene, Tex.	5000
KWRD	Henderson, Tex.	500d
KCNY	San Marcos, Tex.	250d
KELA	Centralia, Wash.	5000
KSEM	Moses Lake, Wash.	5000
WPLH	Huntington, W.Va.	5000d
WBKV	West Bend, Wis.	500d
KTWO	Casper, Wyo.	5000

1480—202.6

Kc.	Wave Length	W.P.
WABB	Mobile, Ala.	5000
KHAT	Phoenix, Ariz.	500
KGLU	Safford, Ariz.	1000
KTCN	Berryville, Ark.	1000
KIEM	Eureka, Calif.	5000
KYOS	Merced, Calif.	5000
KWIZ	Santa Ana, Calif.	1000
KTUX	Pueblo, Colo.	1000d
WSDR	Windsor, Conn.	500d
WAPG	Arcadia, Fla.	1000d
WREA	E. Palatka, Fla.	500d
WTHR	Panama Beach, Fla.	500d
WYZE	Atlanta, Ga.	5000d
WRDW	Augusta, Ga.	5000
WJBM	Jerseyville, Ill.	500d
WTHI	Terre Haute, Ind.	1000
WRSW	Warsaw, Ind.	500
KLEE	Ottumwa, Iowa	500d
KBKC	Mission, Kans.	1000d
KLEO	Wichita, Kans.	5000
WKOA	Hopkinsville, Ky.	1000d
WNKY	Neon, Ky.	1000d
WTLO	Somerset, Ky.	1000d
KJOE	Shreveport, La.	1000d
WSAR	Fall River, Mass.	5000
WMAX	Grand Rapids, Michigan	1000d
WIOS	Tawas City, Mich.	1000d
KAUS	Austin, Minn.	1000
KGCX	Sidney, Mont.	5000

Kc. Wave Length W.P.

KLMS Lincoln, Nebr. 1000
KWEW Hobbs, N. Mex. 5000
WLEA Hornell, N.Y. 1000d
WHOM New York, N.Y. 5000
WREM Remsen, N.Y. 1000d
WWOK Charlotte, N.C. 1000d
WYRN Louisburg, N.C. 500d
WMSJ Sylva, N.C. 5000d
WHBC Canton, Ohio 5000
WCIN Cincinnati, Ohio 5000
WTRA Latrobe, Pa. 500d
WDAS Philadelphia, Pa. 5000
WISL Shamokin, Pa. 1000
WLOK Memphis, Tenn. 5000d
KBOX Dallas, Tex. 5000
KLVL Pasadena, Tex. 1000
KAPE San Antonio, Tex. 500d
KONI Spanish Fork, Utah 1000d
WCFR Springfield, Vt. 1000d
WBBL Richmond, Va. 5000
WLEE Richmond, Va. 5000
WBLU Salem, Va. 5000d
KVAN Camas, Wash. 1000d
KAYG Lakewood, Wash. 1000d
WISM Madison, Wis. 5000
KRAE Cheyenne, Wyo. 1000d

1490—201.2

CFRC Kingston, Ont. 100
CKCR Kitchener, Ont. 250
CKBM Montmagny, Que. 250
WANA Anniston, Ala. 250
WAJF Decatur, Ala. 250
WRLD Lanett, Ala. 250
WHBB Selma, Ala. 250
KYCA Prescott, Ariz. 1000
KAIR Tucson, Ariz. 250
KXAR Hope, Ark. 250
KTLO Mtn. Home, Ark. 250
KDRS Paragould, Ark. 250
KOTN Pine Bluff, Ark. 250
KXRJ Russellville, Ark. 250
KMAP Bakersfield, Calif. 250
KPAS Banning, Calif. 250
KBLA Burbank, Calif. 250
KICO Calexico, Calif. 250
KOWL Lake Tahoe, Calif. 250
KAFP Petaluma, Calif. 250
KBLF Red Bluff, Calif. 250
KDB Santa Barbara, Calif. 250
KSYC Yreka, Calif. 250
KBOL Boulder, Colo. 250
KRUC Gunnison, Colo. 250
KCMS Manitou Sprgs., Colo. 100
KOLR Sterling, Colo. 250
WNLC New London, Conn. 250
WTOR Torrington, Conn. 250
WTRL Bradenton, Fla. 250
WJBS DeLand, Fla. 250
WMET Miami Beach, Fla. 250
WSRA Milton, Fla. 250
WRGR Starke, Fla. 250
WTTB Vero Beach, Fla. 250
WSIR Winter Haven, Fla. 250
WMOG Brunswick, Ga. 250
WMJM Cordele, Ga. 250
WMRE Monroe, Ga. 250
WSFB Quitman, Ga. 250
WSNT Sandersville, Ga. 250
WSYL Sylvania, Ga. 250
KTOH Lihue, Hawaii 250
KCID Caldwell, Idaho 250
WKRO Cairo, Ill. 250
WOAN Danville, Ill. 250
WAMV East St. Louis, Ill. 250
WOPA Oak Park, Ill. 250
WKBV Richmond, Ind. 250
WNDU South Bend, Ind. 250
KBUR Burlington, Iowa 250
WDBQ Dubuque, Iowa 250
KRIB Mason City, Iowa 250
KKAN Phillipsburg, Kans. 250
KTOP Topeka, Kans. 250
WFKY Frankfort, Ky. 250
WKAY Glasgow, Ky. 250
WOMI Owensboro, Ky. 250
WSIP Paintsville, Ky. 1000
WIKC Bogalusa, La. 250
KEUN Eunice, La. 250
KCIL Houma, La. 250
KRUS Ruston, La. 250
WPOR Portland, Maine 250
WTVL Waterville, Maine 250
WARK Hagerstown, Md. 250
WHAV Haverhill, Mass. 250
WMRC Milford, Mass. 250
WTXL W. Springfield, Mass. 250
WABJ Adrian, Mich. 250
WCBQ Fremont, Mich. 250
WMDN Midland, Mich. 250
KXRA Alexandria, Minn. 250
KOZY Grand Rapids, Minn. 250
KLGR Redwd. Falls, Minn. 100
WLOX Biloxi, Miss. 250
WCLD Cleveland, Miss. 250
WHOC Philadelphia, Miss. 250
WTUP Tupelo, Miss. 250
WVIM Vicksburg, Miss. 250
KDMO Carthage, Mo. 250
KTTR Rolla, Mo. 250
KDRO Sedalia, Mo. 250
KBOW Butte, Mont. 1000
KBON Omaha, Nebr. 250
WEMJ Laconia, N.H. 250
WLDB Atlantic City, N.J. 250
KRSN Los Alamos, N.Mex. 250
KRTN Raton, N.Mex. 250

Kc. Wave Length W.P.

WCSS Amsterdam, N.Y. 250
WBTA Batavia, N.Y. 250
WKNY Kingston, N.Y. 250
WICY Malone, N.Y. 250
WDLC Port Jervis, N.Y. 250
WOLF Syracuse, N.Y. 250
WSSB Durham, N.C. 250
WFLB Fayetteville, N.C. 250
WLOE Leaksville, N.C. 250
WRNB New Bern, N.C. 250
WRMT Rocky Mount, N.C. 250
WSTP Salisbury, N.C. 250
KNDC Hettinger, N.Dak. 250
KOVC Valley City, N.Dak. 250
WBEX Chillicothe, Ohio 250
WJMO Cleveland Hghts., Ohio 250
WOHI E. Liverpool, Ohio 250
WMOA Marietta, Ohio 250
WMRN Marion, Ohio 250
KWRW Guthrie, Okla. 100
KBIX Muskogee, Okla. 250
KBKR Baker, Oreg. 250
KRNR Roseburg, Oreg. 250
KBZY Salem, Oreg. 250
WESB Bradford, Pa. 250
WAZL Hazleton, Pa. 250
WARD Johnstown, Pa. 250
WGAL Lancaster, Pa. 250
WBCB Levittown, Pa. 250
WMRF Lewiston, Pa. 250
WMGW Meadville, Pa. 250
WNBT Wellsboro, Pa. 250
WMDD Fajardo, P.R. 250
WGCD Chester, S.C. 250
WMRB Greenville, S.C. 250
KORN Mitchell, S.Dak. 250
WOPI Bristol, Tenn. 250
WDXB Chattanooga, Tenn. 250
WROL Fountain City, Tenn. 250
WJJM Lewisburg, Tenn. 250
WDXL Lexington, Tenn. 250
KNOW Austin, Tex. 250
KIBL Beeville, Tex. 250
KBST Big Spring, Tex. 250
KHUZ Borger, Tex. 250
KNEL Brady, Tex. 250
KSAM Huntsville, Tex. 250
KVOZ Laredo, Tex. 250
KZZN Littlefield, Tex. 250
KPLT Paris, Tex. 250
KGKB Tyler, Tex. 250
KVWC Vernon, Tex. 250
KVOG Ogden, Utah 250
WKVT Brattleboro, Vt. 250
WIKE Newport, Vt. 250
WCVA Culpeper, Va. 250
WVEC Hampton, Va. 250
WAYB Waynesboro, Va. 250
KBRO Bremerton, Wash. 250
KLOG Kelso, Wash. 250
KENE Toppenish, Wash. 250
KTEL Walla Walla, Wash. 250
WHMS Charleston, W.Va. 250
WTCS Fairmont, W.Va. 250
WLOH Princeton, W.Va. 250
WGEZ Beloit, Wis. 250
WLCX LaCrosse, Wis. 250
WIGM Medford, Wis. 250
WOSH Oshkosh, Wis. 250
KIML Gillette, Wyo. 250
KRTR Thermopolis, Wyo. 250
KGOS Torrington, Wyo. 250

1500—199.9

CHUC Port Hope, Ont. 1000
KXRX San Jose, Calif. 1000
WTOP Washington, D.C. 50000
WKIZ Key West, Fla. 250
WJBK Detroit, Mich. 10000
KSTP St. Paul, Minn. 50000
WMNT Manati, P.R. 250
KTXO Sherman, Tex. 250

1510—199.1

CKOT Tillsonburg, Ont. 1000d
KASK Ontario, Calif. 1000
KTIM San Rafael, Calif. 1000d
KMOR Littleton, Colo. 1000
WKAI Macomb, Ill. 250d
WMEX Boston, Mass. 5000
KANS Independence, Mo. 1000d
WRAN Dover, N.J. 1000
WLAC Nashville, Tenn. 50000
KCTX Childress, Tex. 250d
KSTV Stephenville, Tex. 250d
KGA Spokane, Wash. 50000
WAUX Waukesha, Wis. 250d

1520—197.4

KACY Port Hueneme, Calif. 250
WHOW Clinton, Ill. 1000d
KSIB Creston, Iowa 1000d
WKBW Buffalo, N.Y. 50000
WFYI Mineola, N.Y. 10000d
KOMA Okla. City, Okla. 50000
KGON Oregon City, Oreg. 10000
WWWW Rio Piedras, P.R. 250

1530—196.1

KFBK Sacramento, Calif. 50000
WCKY Cincinnati, Ohio 50000
KGBT Harlingen, Tex. 50000

Kc. Wave Length W.P.

1540—195.0

ZNS Nassau, B.W.I. 5000
KPOL Los Angeles, Calif. 10000
WSMI Litchfield, Ill. 1000d
WBNL Boonville, Ind. 250d
WLOI LaPorte, Ind. 250d
KXEL Waterloo, Iowa 50000
KNEX McPherson, Kans. 250d
KLKC Parsons, Kans. 250d
WDON Wheaton, Md. 250d
WPTR Albany, N.Y. 50000
WIFM Elkin, N.C. 250d
WABQ Cleveland, Ohio 1000d
WJMJ Philadelphia, Pa. 50000d
WPTS Pittston, Pa. 1000d
WPME Punxsutawney, Pa. 1000d
WADK Newport, R.I. 1000d
KCUL Ft. Worth, Tex. 10000
KGBC Galveston, Tex. 1000
WTKM Hartford, Wis. 500d

1550—193.5

CBE Windsor, Ont. 10000
WAAY Huntsville, Ala. 5000
KSWC Tucson, Ariz. 50000d
KQBY San Fran., Calif. 10000
KBRB Arvada, Colo. 10000d
WORT New Smyrna Bch., Fla. 250
WJIL Jacksonville, Ill. 1000d
WCTW New Castle, Ind. 250
WIRV Irvine, Ky. 1000d
KREB Shreveport, La. 10000
KRES St. Joseph, Mo. 5000
WBAZ Kingston, N.Y. 500d
WTYN Tryon, N.C. 1000d
KUTT Fargo, N.D. 5000d
WDLE Delaware, Ohio 500d
WLOA Braddock, Pa. 1000d
WTTC Towanda, Pa. 500d
WBSC Bennetsville, S.C. 10000
WESN N. Augusta, S.C. 1000d
WBOF Virginia Beach, Va. 5000d
KOQT Bellingham, Wash. 1000d

1560—192.3

CFRS Simcoe, Ont. 250d
KPMC Bakersfield, Calif. 10000
WBYS Canton, Ill. 250d
KSWI Council Bluffs, Iowa 500d
WDXR Paducah, Ky. 1000
WQXR New York, N.Y. 50000
WTNS Coshocton, Ohio 1000d
WTOD Toledo, Ohio 1000d
KWCO Chickasha, Okla. 1000
WENA Bayamon, P.R. 250
KHBR Hillsboro, Tex. 250d
KHOQ Hoquiam, Wash. 1000d

1570—191.1

CHUB Nanaimo, B.C. 10000
CFRY Portage la Prairie, Manitoba 250d
CBI Sidney, N.S. 1000
CFOR Orillia, Ont. 10000
WCRL Oneonta, Ala. 250d
WRWJ Selma, Ala. 1000d
KBRI Brinkley, Ark. 250d
KBJT Fordyce, Ark. 250d
KRKC King City, Calif. 250d
KCVR Lodi, Calif. 1000d
KACE Riverside, Calif. 1000d
KLOV Loveland, Colo. 250d
WTWB Auburndale, Fla. 1000d
WPAP Fernandina Beach, Florida 1000d
WJOE Ward Ridge, Fla. 250d
WGHC Clayton, Ga. 1000d
WEAS College Park, Ga. 1000d
WGSR Millen, Ga. 250d
WOKZ Alton, Ill. 1000d
WFRL Freeport, Ill. 1000d
WBEE Harvey, Ill. 1000d
WTAY Robinson, Ill. 250d
WILO Frankfort, Ind. 250d
WAWK Kendallville, Ind. 250d
WOWI New Albany, Ind. 1000d
KMCD Fairfield, Iowa 250d
KJFJ Webster City, Iowa 250d
KNDY Marysville, Kans. 250d
KWSK Pratt, Kans. 250d
WKKS Vanceburg, Ky. 250d
WABL Amite, La. 500d
KLLA Leesville, La. 250d
KMAR Winnsboro, La. 500d
WAQE Towson, Md. 1000d
WPEP Taunton, Mass. 1000d
WDEW Westfield, Mass. 1000d
WMRP Flint, Mich. 1000d
WFUR Grand Rapids, Michigan 1000d
KMRS Morris, Minn. 1000d
WONA Winona, Miss. 1000d
KLEX Lexington, Mo. 250d
WFLR Dundee, N.Y. 1000d
WBUZ Fredonia, N.Y. 250d
WAPC Riverhead, N.Y. 1000d
WNCA Siler City, N.C. 1000d
WHOT Campbell, Ohio 1000d
WCLW Mansfield, Ohio 250d
WPTW Piqua, Ohio 250d
KTAT Frederick, Okla. 250d

Kc. Wave Length W.P.

KOLS Pryor, Okla. 1000d
KWAY Forest Grove, Oreg. 1000d
KOHU Hermiston, Oreg. 1000d
WBUX Doylestown, Pa. 1000d
WSHH Latrobe, Pa. 1000d
WMLP Milton, Pa. 1000d
WFGN Gaffney, S.C. 250d
WLSC Loris, S.C. 1000d
WHLP Centerville, Tenn. 1000d
WCLE Cleveland, Tenn. 1000d
WTRB Ripley, Tenn. 1000d
KZOL Farwell, Tex. 250d
KVLG La Grange, Tex. 250d
KTER Terrell, Tex. 250d
WKIC Salt Lake City, Utah 500d
WSWV Pennington Gap, Va. 1000d
WYTI Rocky Mount, Va. 1000d
WEER Warrenton, W.Va. 500d
WAPL Appleton, Wis. 1000d

1580—189.2

CBJ Chicoutimi, Que. 10000
WJHB Talladega, Ala. 1000d
KYND Tempe, Ariz. 10000d
KPCA Marked Tree, Ark. 250d
KFDF Van Buren, Ark. 1000d
KPON Anderson, Calif. 1000d
KWIP Merced, Calif. 500d
KDAY Santa Monica, Cal. 50000d
KPIK Colorado Sprgs., Colo. 5000d
WWIL Ft. Lauderdale, Fla. 1000
WGRC Green Cove Springs, Florida 500d
WMDF Mount Dora, Fla. 1000d
WCCF Punta Gorda, Fla. 1000d
WRFB Tallahassee, Fla. 5000d
WCLS Columbus, Ga. 1000d
WLBA Gainesville, Ga. 5000d
WKKD Aurora, Ill. 250d
WDQN DuQuoin, Ill. 250d
WBBA Pittsfield, Ill. 250d
WKID Urbana, Ill. 250d
WCNB Connersville, Ind. 250d
WJVA South Bend, Ind. 1000d
WAMW Washington, Ind. 250d
KCHA Charles City, Iowa 500d
KWNT Davenport, Iowa 500d
KDSN Denison, Iowa 500d
WAXU Georgetown, Ky. 10000d
WMTL Leitchfield, Ky. 250d
WPKY Princeton, Ky. 250d
KLUV Haynesville, La. 250d
KLOU Lake Charles, La. 1000
WPGC Bradbury Hgts., Md. 10000d
WOWE Allegan, Mich. 250d
WJUD St. Johns, Mich. 1000d
KDOM Windom, Minn. 250d
WAMY Amory, Miss. 5000d
WGLC Centreville, Miss. 250d
WESY Leland, Miss. 1000
WPMP Pascagoula, Miss. 1000d
KBIA Columbia, Mo. 250d
KNIM Maryville, Mo. 250d
WCRV Washington, N.J. 500d
KHAM Albuquerque, N.Mex. 1000d
WPAC Patchogue, N.Y. 10000d
KZKY Albemarle, N.C. 250d
WVKO Columbus, Ohio 1000d
KLTR Blackwell, Okla. 250d
WCOY Columbia, Pa. 500d
WANB Waynesburg, Pa. 250d
WBPD Orangeburg, S.C. 1000d
WYCL York, S.C. 250d
WLIJ Shelbyville, Tenn. 1000d
KGAF Gainesville, Tex. 250d
KIRT Mission, Tex. 1000d
KTLU Rusk, Tex. 500d
KWED Seguin, Tex. 1000d
KBYP Shamrock, Tex. 250d
WILA Danville, Va. 1000d
WPUV Pulaski, Va. 5000d
WTTN Watertown, Wis. 1000d

1590—188.7

WATM Atmore, Ala. 5000d
WVNA Tuscumbia, Ala. 5000d
KPBA Pine Bluff, Ark. 1000d
KLIV San Jose, Calif. 1000
KUDU Ventura, Calif. 1000
WBRY Waterbury, Conn. 5000
WOWY Clewiston, Fla. 500d
WILZ St. Petersburg Beach, Florida 1000d
WELE S. Daytona Bch., Fla. 1000d
WALG Albany, Ga. 1000
WLFA Lafayette, Ga. 5000d
WNMP Evanston, Ill. 1000d
WAIK Galesburg, Ill. 5000d
WGEE Indianapolis, Ind. 5000d
WPCO Mt. Vernon, Ind. 500d
KWBG Boone, Iowa 1000
KVGB Great Bend, Kans. 5000
WLBN Lebanon, Ky. 1000d
KEVL White Castle, La. 1000d
WETT Ocean City, Md. 1000
WTVB Coldwater, Mich. 5000
WDOG Marine City, Mich. 1000d
WMIC St. Helen, Mich. 500d

Kc.	Wave Length	W.P.
KRAD	E. Grand Forks, Minn.	1000d
WOKJ	Jackson, Miss.	5000d
KDEX	Dexter, Mo.	1000d
KPRS	Kansas City, Mo.	1000d
KCLU	Rolla, Mo.	1000d
WSMN	Nashua, N.H.	5000
WERA	Plainfield, N.J.	500d
WAUB	Auburn, N.Y.	500d
WEHH	Elmira Heights-Horseheads, N.Y.	500d
WGGO	Salamanca, N.Y.	1000d
WGTC	Greenville, N.C.	5000d
WNOS	High Point, N.C.	1000d
WAKR	Akron, Ohio	5000
WSRW	Hillsboro, Ohio	500d
KHEN	Henryetta, Okla.	500d
KTIL	Tillamook, Oreg.	250
WCBG	Chambersburg, Pa.	5000d
WEEZ	Chester, Pa.	1000
WXRF	Guayama, P.R.	1000
WYNG	Warwick, R.I.	1000d
WABV	Abbeville, S.C.	1000d
WACA	Camden, S.C.	1000d
KCCR	Pierre, S.Dak.	1000d
WJSO	Jonesboro, Tenn.	5000d
WDBL	Springfield, Tenn.	1000d
KGAS	Carthage, Tex.	1000d
KERC	Eastland, Tex.	500d
KINT	El Paso, Tex.	1000d
KYOK	Houston, Tex.	5000
KCBD	Lubbock, Tex.	1000
KBUS	Mexia, Tex.	500d
KTOD	Sinton, Tex.	1000d
WEZL	Richmond, Va.	5000d
KTIX	Seattle, Wash.	5000d
WIXK	New Richmond, Wis.	5000d
WSWW	Platteville, Wis.	1000d
WTRW	Two Rivers, Wis.	1000d
KCHY	Cheyenne, Wyo.	1000d

1600—187.5

Kc.	Wave Length	W.P.
CHVC	Niagara Falls, Ont.	5000
WEUP	Huntsville, Ala.	5000d
WAPX	Montgomery, Ala.	1000
KGST	Fresno, Calif.	1000d
KWOW	Pomona, Calif.	1000
KUBA	Yuba City, Calif.	1000
KLAK	Lakewood, Colo.	1000
WKEN	Dover, Del.	500d
WKTX	Atlantic Beach, Fla.	1000d
WKWF	Key West, Fla.	500
WHEW	Riviera Beach, Fla.	1000
WOKB	Winter Garden, Fla.	1000d
WGKA	Atlanta, Ga.	1000d
WNGA	Nashville, Ga.	1000d
WCGO	Chicago Hgts., Ill.	1000d
WMCW	Harvard, Ill.	500d
WBTO	Linton, Ind.	500d
WARU	Peru, Ind.	1000d
KLGA	Algona, Iowa	5000d
KCRG	Cedar Rapids, Iowa	5000
KMDO	Ft. Scott, Kans.	500d
WSTL	Eminence, Ky.	500d
KFNV	Ferriday, La.	1000d
KLFT	Golden Meadow, La.	1000d
WINX	Rockville, Md.	1000
WBOS	Brookline, Mass.	5000
WTYM	East Longmeadow, Mass.	5000d
WHRV	Ann Arbor, Mich.	1000
WTRU	Muskegon, Mich.	5000
WKDL	Clarksdale, Miss.	1000d
KATZ	St. Louis, Mo.	5000
KTTN	Trenton, Mo.	500d
KNCY	Nebraska City, Nebr.	500d
KRFS	Superior, Nebr.	500d
WONG	Oneida, N.Y.	1000d
WWRL	Woodside, N.Y.	5000
WGIV	Charlotte, N.C.	500
WIDU	Fayetteville, N.C.	1000d
WFRC	Reidsville, N.C.	1000
WKSK	W. Jefferson, N.C.	1000d
WBLY	Springfield, Ohio	1000d
WTTF	Tiffin, Ohio	500d
KUSH	Cushing, Okla.	1000d
KASH	Eugene, Oreg.	1000
KOHI	St. Helens, Oreg.	1000d
WHOL	Allentown, Pa.	500d
WEZN	Elizabethtown, Pa.	500d
WFIS	Fountain Inn, S.C.	1000d
WHBT	Harriman, Tenn.	5000d
WKBJ	Milan, Tenn.	1000d
KBBB	Borger, Tex.	500d
KBOR	Brownsville, Tex.	1000
KWEL	Midland, Tex.	1000
KCFH	Cuero, Tex.	500d
KMAE	McKinney, Tex.	1000d
KOGT	Orange, Tex.	1000
KBBC	Centerville, Utah	1000d
WHLL	Wheeling, W.Va.	5000d
WCWC	Ripon, Wis.	5000d

U. S. and Canadian AM Stations by Location

Abbreviations: C.L., call letters; Kc., frequency in kilocycles; N.A., network affiliation—A: American Broadcasting Co., C: Columbia Broadcasting System, Inc.; M: Mutual Broadcasting System; N: National Broadcasting Co., Inc.

Location	C.L.	Kc.	N.A.
Abbeville, La.	KROF	960	
Abbeville, S.C.	WABV	1590	
Aberdeen, Md.	WAMD	970	
Aberdeen, Miss.	WMPA	1240	
Aberdeen, S.Dak.	KABR	1420	
	KSDN	930	A
Aberdeen, Wash.	KBKW	1450	
	KXRO	1320	M
Abilene, Tex.	KRBC	1470	A
	KNIT	1280	
	KWKC	1340	M
Abingdon, Va.	WBBI	1230	
Ada, Okla.	KADA	1230	A
Adel, Ga.	WAAG	1470	
Adrian, Mich.	WABJ	1490	A
Aguadilla, P.R.	WABA	850	
	WGRF	1340	
Ahoskie, N.C.	WRCS	970	
Aiken, S.C.	WAKN	990	
Akron, Ohio	WAKR	1590	A
	WADC	1350	C
	WCUE	1150	
	WHLO	640	M
Alamogordo, N.M.	KALG	1230	M
	KRAC	1270	
Alamosa, Colo.	KGIW	1450	M
Albany, Ga	WALG	1590	A
	WGPC	1450	C
	WJAZ	960	
Albany, Ky.	WANY	1390	
Albany, Minn.	KASM	1150	
Albany, N.Y.	WABY	1400	
	WOKO	1460	M
	WPTR	1540	A
	WROW	590	C
Albany, Oreg.	KWIL	790	M
	KABY	990	
Albemarle, N.C.	WABZ	1010	
	WZKY	1580	
Albert Lea, Minn.	KATE	1450	A
Albertville, Ala.	WAVU	630	
Albion, Mich.	WALM	1260	
Albuquerque, N.M.	KABQ	1350	
	KDEF	1150	
	KGGM	610	C
	KOB	770	N
	KQEO	920	M
	KARA	1310	
	KMGM	730	
	KLOS	1450	
	KHAM	1580	A
Alcoa, Tenn.	WEAG	1470	
Alexander City, Ala.	WRFS	1050	
Alexandria, La.	KALB	580	A
	KDBS	1410	
	KSYL	970	N
Alexandria, Minn.	KXRA	1490	A
Alexandria, Va.	WPIK	730	M
Algona, Iowa	KLGA	1600	
Alice, Tex.	KOPY	1070	
Allegan, Mich.	WOWE	1580	
Allentown, Pa.	WHOL	1600	
	WAEB	790	
	WKAP	1320	
	WSAN	1470	C
Alliance, Nebr.	KCOW	1400	
Alliance, Ohio	WFAH	1310	
Alma, Ga.	WCQS	1400	
Alma, Mich.	WFYC	1280	
Alpena Township, Mich.	WATZ	1450	
Alpine, Tex.	KVLF	1240	M
Alton, Ill.	WOKZ	1570	
Altona, Man.	CFAM	1290	
Altoona, Pa.	WFBG	1290	N
	WRTA	1240	A
	WVAM	1430	C
Alturas, Calif.	KCNO	570	
Altus, Okla.	KWHW	1450	
Alva, Okla.	KALV	1430	
Amarillo, Tex.	KBUY	1010	M
	KFDA	1440	A
	KGNC	710	N
	KIXZ	940	C
	KRAY	1360	
	KZIP	1310	
Ambridge, Pa.	WMBA	1460	
Americus, Ga.	WDEC	1290	
Ames, Iowa	KSAI	1430	
	WOI	640	
Amherst, N.S.	CKDH	1400	
Amite, La.	WABL	1570	
Amory, Miss.	WAMY	1580	
Amos, Que.	CHAD	1340	
Amsterdam, N.Y.	WCSS	1490	
Anaconda, Mont.	KANA	1230	
Anacortes, Wash.	KAGT	1340	
Anaheim, Calif.	KEZY	1190	
Anchorage, Alaska	KBYR	1270	
	KFQD	730	C-A
	KENI	550	A-M-N
Andalusia, Ala.	WCTA	920	
Anderson, Calif.	KPON	1580	
Anderson, Ind.	WHUT	1470	M
	WHBU	1240	C
Anderson, S.C.	WAIM	1230	C
	WANS	1280	M
Andrews, Tex.	KACT	1360	
Annapolis, Md.	WANN	1190	
	WABW	810	
	WNAV	1430	
Ann Arbor, Mich.	WHRV	1600	A
	WPAG	1050	
Anna, Ill.	WRAJ	1440	
Anniston, Ala.	WANA	1490	
	WDNG	1450	A
	WHMA	1390	
Anoka, Minn.	KANO	1470	
Ansonia, Conn.	WADS	690	
Antigo, Wis.	WATK	900	
Antigonish, N.S.	CJFX	580	
Apollo, Pa.	WAVL	910	
Apple Valley, Cal.	KAVR	960	
Appleton, Wis.	WAPL	1570	
	WHBY	1230	M
Arcadia, Fla.	WAPG	1480	
Arcata, Calif.	KENL	1340	
Ardmore, Okla.	KVSO	1240	A
Arecibo, P.R.	WCMN	1280	
	WMIA	1070	
	WNIK	1230	
Arkadelphia, Ark.	KVRC	1240	M
Arkan. City, Kans.	KSOK	1280	
Arlington, Fla.	WQTY	1220	
Arlington, Va.	WARL	780	
	WEAM	1390	
Artesia, N.M.	KSVP	990	M
Arvada, Colo.	KBRB	1550	
Asbury Park, N.J.	WJLK	1310	
Asheboro, N.C.	WGWR	1260	
Asheville, N.C.	WISE	1310	
	WLOS	1380	N-M-A
	WSKY	1230	
	WWNC	570	C
Ashland, Ky.	WCMI	1340	C
	WTCR	1420	
Ashland, Ohio	WNCO	1340	
Ashland, Oreg.	KWIN	1400	M
Ashland, Va.	WDYL	1430	
Ashland, Wis.	WATW	1400	
Ashtabula, Ohio	WREO	970	
Astoria, Oreg.	KAST	1370	M
	KVAS	1230	
Atchison, Kans.	KARE	1470	
Athens, Ala.	WJMW	730	
Athens, Ga.	WGAU	1340	C
	WDOL	1470	
	WRFC	960	
Athens, Ohio	WATH	970	
	WOUB	1340	
Athens, Tenn.	WLAR	1450	M
Athens, Tex.	KBUD	1410	
Atlanta, Ga.	WPLO	590	C
	WAKE	1340	
	WAOK	1380	
	WERD	860	
	WGKA	1600	
	WGST	920	A
	WIIN	970	
	WQXI	790	
	WSB	750	N
	WYZE	1480	M
Atlanta, Tex.	KALT	900	
Atlantic, Iowa	KJAN	1220	
Atlantic Beach, Fla.	WKTX	1600	
Atlantic City, N.J.	WFPG	1450	C
	WLDB	1490	M
	WMID	1340	A
Atmore, Ala.	WATM	1590	
Attleboro, Mass.	WARA	1320	
Auburn, Ala.	WAUD	1230	A
Auburn, Calif.	KAHI	950	
Auburn, N.Y.	WMBO	1340	M
	WAUB	1590	
Auburn, Wash.	KASY	1220	
Auburndale, Fla.	WTWB	1570	
Augusta, Ga.	WAUG	1050	
	WBBQ	1340	M
	WBIA	1230	N
	WGAC	580	A
	WRDW	1480	C
Augusta, Maine	WRDO	1400	N
	WFAU	1340	M
Aurora, Colo.	KOSI	1430	
Aurora, Ill.	WMRO	1280	
	WKKD	1580	
Austin, Minn.	KAUS	1480	M
	KQAQ	970	
Austin, Tex.	KNOW	1490	A
	KASE	970	
	KTBC	590	C
	KOKE	1370	
	KVET	1300	M
Avalon, Calif.	KBIG	740	
Avon Park, Fla.	WAVP	1390	
Avondale Estates, Ga.	WAVO	1420	
Aztec, N. Mex.	KNDE	1340	
Babylon, N.Y.	WBAB	1440	
	WGLI	1290	
Bad Axe, Mich.	WLEW	1340	
Bainbridge, Ga.	WMGR	930	
	WAZA	1360	
Baker, Oreg.	KBKR	1490	
Bakersfield, Calif.	KAFY	550	M
	KBIS	970	
	KERN	1410	C
	KGEE	1230	
	KUZZ	800	
	KLYD	1350	
	KMAP	1490	
	KPMC	1560	A
Baldwinsville, N.Y.	WSEN	1050	
Ballinger, Tex.	KRUN	1400	
Baltimore, Md.	WBAL	1090	N
	WBMD	750	
	WCAO	600	
	WCBM	680	C
	WFBR	1300	
	WITH	1230	
	WSID	1010	
	WWIN	1400	A-M
Bamberg, S.C.	WWBD	790	
Bangor, Maine	WABI	910	A-M
	WGUY	1250	C
	WLBZ	620	N
Banning, Calif.	KPAS	1490	
Barboursville, Ky.	WBVL	950	
Bardstown, Ky.	WBRT	1320	
Barnesboro, Pa.	WNCC	950	
Barnwell, S.C.	WBAW	740	
Barre, Vt.	WSNO	1450	
Barrie, Ont.	CKBB	950	
Barstow, Calif.	KWTC	1230	A
Bartlesville, Okla.	KWON	1400	M
Bartow, Fla.	WBAR	1460	
Bassett, Va.	WODY	900	
Bastrop, La.	KTRY	730	
	KVOB	1340	
Batavia, N.Y.	WBTA	1490	M
Batesburg, S.C.	WBLR	1430	
Batesville, Ark.	KBTA	1340	
Batesville, Miss.	WBLE	1290	
Bath, Maine	WMMS	730	
Bathurst, N.B.	CKBC	1400	
Baton Rouge, La.	WAIL	1460	M
	WYNK	1380	
	WIBR	1300	
	WJBO	1150	N
	WLCS	910	
	WXOK	1260	
Battle Creek, Mich.	WBCK	930	
	WELL	1400	A
Baxley, Ga.	WHAB	1260	
Bay City, Mich.	WBCM	1440	A
	WWBC	1250	
Bay City, Tex.	KIOX	1270	M
Bay Minette, Ala.	WBCA	1150	
Bayamon, P.R.	WENA	1560	
Baytown, Tex.	KRCT	650	
	KWBA	1360	
Beacon, N.Y.	WBNR	1260	
Beardstown, Ill.	WRMS	790	
Beatrice, Nebr.	KWBE	1450	
Beaufort, N.C.	WBMA	1400	
Beaufort, S.C.	WBEU	960	
Beaumont, Tex.	KFDM	560	A
	KJET	1880	
	KRIC	1450	
	KTRM	990	
Beaver Dam, Wis.	WBEV	1430	
Beaver Falls, Pa.	WBVP	1230	
Beckley, W. Va.	WJLS	560	C
	WWNR	620	
Bedford, Ind.	WBIW	1340	
Bedford, Pa.	WBFD	1310	
Bedford, Va.	WBLT	1350	
Beeville, Tex.	KIBL	1490	
Belgrade, Mont.	KGVW	630	
Bellaire, Ohio	WOMP	1290	M
Bellefontaine, Ohio	WOHP	1390	
Bellefonte, Pa.	WBLF	1330	
Bell Fourche, S.Dak.	KBFS	1450	
Belle Glade, Fla.	WSWN	900	
Belleville, Ont.	CJBQ	800	
Belleville, Ill.	WIBV	1260	
Bellevue, Wash.	KFKF	1330	
Bellingham, Wash.	KPUG	1170	M
	KVOS	790	A
	KOQT	1550	
Bellingham-Ferndale, Wash.	KENY	930	
Belmont, N.C.	WCGC	1270	M-A
Beloit, Wis.	WBEL	1380	
	WGEZ	1490	M
Belton, S.C.	WHPB	1390	
Belzoni, Miss.	WELZ	1460	
Bemidji, Minn.	KBUN	1450	M
Bend, Oreg.	KBND	1110	A
	KGRL	940	
Bennetsville, S.C.	WBSC	1550	M
Bennington, Vt.	WBTN	1370	
Benson, Minn.	KBMO	1290	
Benton, Ark.	KBBA	690	
Benton, Ky.	WCBL	1290	
Benton Harbor, Mich.	WHFB	1060	

Location	C.L.	Kc.	N.A.
Berkeley, Calif.	KRE	1400	
Berkeley Springs, W.Va.	WCST	1010	
Berlin, N.H.	WMOU	1230	
Berry Hill, Tenn.	WVOL	1470	
Berryville, Ark.	KTCN	1480	
Berwick, Pa.	WBRX	1280	
Bessemer, Ala.	WYAM	1450	
Bethesda, Md.	WUST	1120	
Bethlehem, Pa.	WGPA	1100	
Biddeford, Maine	WIDE	1400	M
Big Lake, Tex.	KBLT	1290	
Big Rapids, Mich.	WBRN	1460	
Big Sprg., Tex.	KBST	1490	A
	KHEM	1270	
	KBYG	1400	M
Big Stone Gap, Va.	WLSD	1220	
Biloxi, Miss.	WLOX	1490	M
	WVMI	570	
Billings, Mont.	KBMY	1240	M
	KGHL	790	N
	KOOK	970	C
	KOYN	910	
	KURL	730	
Binghamton, N.Y.	WINR	680	N
	WKOP	1360	M
	WNBF	1290	C
Birmingham, Ala.	WAPI	1070	N
	WBRC	960	A
	WCRT	1260	A
	WEZB	1220	
	WENN	1320	M
	WATV	900	
	WSGN	610	
	WYDE	850	
	WVOK	690	
Bisbee, Ariz.	KSUN	1230	A
Bishop, Calif.	KIBS	1230	A
Bishopville, S.C.	WAGS	1380	
Bismarck, N.Dak.	KFYR	550	N
	KQDI	1350	
Bismarck-Mandan, N.Dak.	KBOM	1270	
Black River Falls, Wis.	WWIS	1260	
Blackfoot, Idaho	KBLI	690	
Blackstone, Va.	WKLV	1440	
Blackwell, Okla.	KLTR	1580	
Blaine, Wash.	KARI	550	
Blakely, Ga.	WBBK	1260	
Blanding, Utah	KUTA	790	
Blind River, Ont.	CJNR	730	
Bloomington, Ill.	WJBC	1230	A
Bloomington, Ind.	WTTS	1370	A
Bloomsburg, Pa.	WCNR	930	
	WHLM	550	
Bluefield, W.Va.	WHIS	1440	N
	WKOY	1240	M
Blythe, Calif.	KYOB	1450	A
Blytheville, Ark.	KLCN	910	
Boaz, Ala.	WAVC	1300	
Bogalusa, La.	WIKC	1490	N
	WBOX	920	
Boise, Idaho	KBOI	950	C
	KEST	790	
	KGEM	1140	M
	KIDO	630	N
	KYME	740	
Bonham, Tex.	KFYN	1420	
Boone, Iowa	KFGQ	1260	
	KWBG	1590	
Boone, N.C.	WATA	1450	
Boonville, Ind.	WBNL	1540	
Boonville, Mo.	KWRT	1370	
Booneville, Miss.	WBIP	1400	A
Boonville, N.Y.	WBRV	900	
Borger, Tex.	KHUZ	1490	M
	KBBB	1600	
Boston, Mass.	WBZ	1030	
	WCOP	1150	
	WILD	1090	
	WNAC	680	
	WEZE	1260	N
	WEEI	590	C
	WHDH	850	
	WMEX	1510	
	WORL	950	M
Boulder, Colo.	KBOL	1490	
Bowie, Tex.	KBAN	1410	
Bowling Green, Ky.	WKCT	930	A
	WBGN	1340	
	WLBJ	1410	M
Bowl. Green, Ohio	WHRW	730	
Bozeman, Mont.	KXXL	1450	N
	KBMN	1230	
Bradbury Hgts., Md.	WPGC	1580	
Braddock, Pa.	WLOA	1550	
Bradenton, Fla.	WTRL	1490	
	WBRD	1420	
Bradford, Pa.	WESB	1490	M
Brady, Tex.	KNEL	1490	
Brainerd, Minn.	KLIZ	1380	
Brampton, Ont.	CHIC	1090	
Brandon, Man.	CKX	1150	
Branson, Mo.	KBHM	1220	
Brantford, Ont.	CKPC	1380	
Brattleboro, Vt.	WTSA	1450	
	WKVT	1490	
Brawley, Calif.	KROP	1300	A
Brazil, Ind.	WITE	1380	
Breckenridge, Minn.	KBMW	1450	
Breckenridge, Tex.	KSTB	1430	
Bremen, Ga.	WWCC	1440	
Bremerton, Wash.	KBRO	1490	
Brenham, Tex.	KWHI	1280	
Brevard, N.C.	WPNF	1240	M-N
Brewton, Ala.	WEBJ	1240	M
Bridgeport, Conn.	WICC	600	M
	WNAB	1450	A

Location	C.L.	Kc.	N.A.
Bridgeton, N.J.	WSNJ	1240	
Bridgewater, N.S.	CKBW	1000	
Brigham City, Utah	KBUH	800	
Brighton, Colo.	KBRN	800	
Brinkley, Ark.	KBRI	1570	
Bristol, Conn.	WBIS	1440	
Bristol, Tenn.	WOPI	1490	N
Bristol, Va.	WCYB	690	A
	WFHG	980	M
Brockton, Mass.	WBET	1460	
Brockville, Ont.	CFJR	1450	
Broken Bow, Nebr.	KCNI	1280	
Brookfield, Mo.	KGHM	1470	
Brookhaven, Miss.	WCHJ	1470	
	WJMB	1340	M
Brookings, Oreg.	KURY	910	
Brookings, S.Dak.	KBRK	1430	
Brookline, Mass.	WBOS	1600	
Brooksville, Fla.	WWJB	1450	
Brownfield, Tex.	KTFY	1300	
Brownsville, Tex.	KBOR	1600	A
Brownwood, Tex.	KBWD	1380	M
	KEAN	1240	
Brunswick, Ga.	WGIG	1440	A
	WMOG	1490	
Brunswick, Maine	WCME	900	
Bryan, Tex.	KORA	1240	M
	WTAW	1150	
Buckhannon, W.Va.	WBUC	1460	
Buffalo, N.Y.	WBEN	930	C
	WBNY	1400	
	WEBR	970	M
	WGR	550	
	WKBW	1520	N
	WWOL	1120	A
Buffalo, Wyo.	KBBS	1450	
Buford, Ga.	WDMF	1460	
Burbank, Calif.	KBLA	1490	
Burley, Idaho	KBAR	1230	A-M
Burlington, Iowa	KBUR	1490	A
Burlington, N.C.	WBBB	920	M
	WBAG	1150	
Burlington, Vt.	WCAX	620	N
	WDOT	1400	
	WJOY	1230	A
Burns, Oreg.	KRNS	1230	
Butler, Ala.	WPRN	1220	
Butler, Pa.	WBUT	1050	
	WISR	680	
Butte, Mont.	KBOW	1490	C
	KOPR	550	M
	KXLF	1370	N
Cabano, Que.	CJAF	1340	
Cadillac, Mich.	WATT	1240	M
Caguas, P.R.	WNEL	1450	
	WVJP	1110	
Cairo, Ga.	WGRA	790	
Cairo, Ill.	WKRO	1490	
Calais, Maine	WQDY	1230	N
Caldwell, Idaho	KCID	1490	
	KBGN	910	
Calera, Ala.	WBYE	1370	
Calexico, Calif.	KICO	1490	A
Calgary, Alta.	CFAC	960	
	CFCN	1060	
	CKXL	1140	
Calhoun, Ga.	WCGA	900	
Camas, Wash.	KVAN	1480	
Cambridge, Md.	WCEM	1240	
Cambridge, Mass.	WTAO	740	A
Cambridge, Ohio	WILE	1270	
Camden, Ark.	KAMO	910	
Camden, N.J.	WCAM	1310	
	WKDN	800	
Camden, S.C.	WACA	1590	
Camden, Tenn.	WFWL	1220	
Cameron, Tex.	KMIL	1330	
Camilla, Ga.	WCLB	1220	
Campbell, Ohio	WHOT	1570	
Campbellsville, Ky.	WTCO	1450	
Campbellton, N.B.	CKNB	950	
Camrose, Alta.	CFCW	1230	
Canon City, Colo.	KRLN	1400	M
Canonsburg, Pa.	WCNG	540	
Canton, Ga.	WCHK	1290	
Canton, Ill.	WBYS	1560	
Canton, Miss.	WDOB	1370	
Canton, N.C.	WWIT	970	
Canton, Ohio	WAND	900	
	WCMW	1060	
	WHBC	1480	A
Cape Girardeau, Mo.	KFVS	960	
	KGMO	1220	
Carbondale, Ill.	WCIL	1020	
Carbondale, Pa.	WCDL	1440	
Caribou, Maine	WFST	600	
Carlisle, Pa.	WHYL	960	
Carlsbad, N.Mex.	KAVE	1240	C
	KPBM	740	
Carmel, Calif.	KRML	1410	
Carmi, Ill.	WROY	1460	
Carrizo Springs, Tex.	KBEN	1450	
Carroll, Iowa	KCIM	1380	
Carrollton, Ala.	WRAG	590	
Carrollton, Ga.	WLBB	1100	
Carrollton, Mo.	KAOL	1430	
Carson City, Nev.	KPTL	1300	
Cartersville, Ga.	WBHF	1450	M
Carthage, Ill.	WCAZ	990	
Carthage, Mo.	KDMO	1490	
Carthage, Tenn.	WRKM	1350	
Carthage, Tex.	KGAS	1590	
Caruthersville, Mo.	KCRV	1370	
Casa Grande, Ariz.	KPIN	1260	
Casper, Wyo.	KTWO	1470	C
	KATI	1400	
	KVOC	1230	A-M
Cayce, S.C.	WCAY	620	
Cedar City, Utah	KSUB	590	C

Location	C.L.	Kc.	N.A.
Cedar Falls, Iowa	KCFI	1250	
Cedar Rapids, Iowa	KCRG	1600	M
	KHAK	1360	
	KPIG	1450	
	WMT	600	C
Cedartown, Ga.	WGAA	1340	
Center, Tex.	KDET	930	
Centerville, Calif.	KBIF	900	
Centerville, Iowa	KCOG	1400	
Centerville, Tenn.	WHLP	1570	
Centerville, Utah	KBBC	1600	
Central City, Ky.	WNES	1050	
	WMTA	1380	
Centralia, Ill.	WCNT	1210	
Centralia & Chehalis, Wash.	KELA	1470	
Centreville, Miss.	WGLC	1580	
Chadron, Nebr.	KCSR	1450	
Chambersburg, Pa.	WCHA	800	
	WCBG	1590	
Champaign, Ill.	WDWS	1400	C
Chanute, Kans.	KCRB	1460	
Chapel Hill, N.C.	WCHL	1360	
Charleroi, Pa.	WESA	940	
Charles City, Iowa	KCHA	1580	
Charleston, Ill.	WEIC	1270	
Charleston, Mo.	KCHR	1350	
Charleston, S.C.	WCSC	1390	C
	WOKE	1340	A-M
	WPAL	730	
	WQSN	1450	
	WTMA	1250	N
Charleston, W.Va.	WCAW	680	
	WCHS	580	C
	WHMS	1490	A
	WKAZ	950	N
	WTIP	1240	M
Charlotte, Mich.	WCER	1390	
Charlotte, N.C.	WBT	1110	C
	WAYS	610	A
	WGIV	1600	
	WKTC	1310	
	WSOC	930	M
	WIST	1240	N
	WWOK	1480	
Charlottesville, Va.	WCHV	1260	A
	WELK	1010	
	WINA	1400	M
Charlottetown, P.E.I.	CFCY	630	
Chase City, Va.	WMEK	980	
Chatham, Ont.	CFCO	630	
Chattanooga, Tenn.	WOGA	1450	M
	WAPO	1150	A
	WDEF	1370	N
	WDOD	1310	C
	WDXB	1490	
	WNOO	1260	
Cheboygan, Mich.	WCBY	1240	
Cheektowaga, N.Y.	WNIA	1230	
Chehalis, Wash.	KITI	1420	
Chelan, Wash.	KOZI	1220	
Cheraw, S.C.	WCRE	1420	
Cherokee, Iowa	KCHE	1440	
Chester, Pa.	WEEZ	1590	
	WVCH	740	
Chester, S.C.	WGCD	1490	
Cheyenne, Wyo.	KFBC	1240	A
	KCHY	1590	
	KRAE	1480	
	KVWO	1370	M
Chicago, Ill.	WAAF	950	
	WAIT	820	
	WBBM	780	C
	WCFL	1000	
	WCRW	1240	
	WEDC	1240	
	WGES	1390	
	WGN	720	M
	WIND	560	
	WJJD	1160	
	WLS	890	A
	WMAQ	670	N
	WMBI	1110	
	WSBC	1240	
Chicago Hgts., Ill.	WCGO	1600	
Chickasha, Okla.	KWCO	1560	
Chico, Calif.	KHSL	1290	C
	KPAY	1060	
Chicopee, Mass.	WACE	730	
Chicoutimi, Que.	CBJ	1580	
	CJMT	1420	
Childress, Tex.	KCTX	1510	
Chillicothe, Mo.	KCHI	1010	
Chillicothe, Ohio	WBEX	1490	A
	WCHI	1350	
Chilliwack, B.C.	CHWK	1270	
Chipley, Fla.	WBGC	1240	
Chippewa Falls, Wis.	WAXX	1150	
Christiansburg, Va.	WBCR	1260	
Christiansted, V.I.	WIVI	970	
Church Hill, Tenn.	WMCH	1260	
Churchill, Man.	CHFC	1230	
Cicero, Ill.	WHFC	1450	
Cincinnati, Ohio	WCKY	1530	
	WCIN	1480	
	WCPO	1230	
	WKRC	550	C
	WLW	700	N-A
	WSAI	1360	
Clanton, Ala.	WKLF	980	
Clare, Mich.	WCRM	990	
Claremore, Okla.	KWPR	1270	
Claremont, N.H.	WTSV	1230	
Clarion, Pa.	WWCH	1300	
Clarksburg, W.Va.	WBOY	1400	N
	WHAR	1340	M
	WPDX	750	

Location	C.L.	Kc.	N.A.
Clarksdale, Miss.	WROX	1450	M
	WKDL	1600	
Clarksville, Ark.	KLYR	1360	
Clarksville, Tenn.	WJZM	1400	M
	WDXN	540	
Clarksville, Tex.	KCAR	1350	
Claxton, Ga.	WCLA	1470	
Clayton, Ga.	WGHC	1570	
Clayton, Mo.	KXLW	1320	
	KFUO	850	
Clayton, N.Mex.	KLMX	1450	
Clearfield, Pa.	WCPA	900	
Clearwater, Fla.	WTAN	1340	
	WAZE	860	
Cleburne, Tex.	KCLE	1120	
Cleveland, Ga.	WRWH	1380	
Cleveland, Miss.	WCLD	1490	
	WDSK	1410	
Cleveland, Ohio	KYW	1100	
	WDOK	1260	M
	WERE	1300	
	WGAR	1220	C
	WHK	1420	
	WABQ	1540	
	WJW	850	N
Cleveland, Tenn.	WBAC	1340	M
	WCLE	1570	
Cleveland, Tex.	KVLB	1410	
Cleve. Hgts., Ohio	WJMO	1490	A
Clewiston, Fla.	WSUG	1050	
	WOWY	1590	
Clifton, Ariz.	KCLF	1400	A
Clifton Forge, Va.	WCFV	1230	
Clinton, Ill.	WHOW	1520	
Clinton, Iowa	KCLN	1390	
	KROS	1340	M
Clinton, Mo.	KDKD	1280	
Clinton, N.C.	WRRZ	880	A
Clinton, Okla.	KWOE	1320	
Clinton, S.C.	WPCC	1400	
Cloquet, Minn.	WKLK	1230	
Clovis, N.Mex.	KCLV	1240	
	KVER	980	
Coachella, Calif.	KCHV	970	
Coalinga, Calif.	KBMX	1470	
Coatesville, Pa.	WCOJ	1420	
Cocoa, Fla.	WKKO	860	
	WEZY	1350	
Cocoa Beach, Fla.	WRKT	1300	
Cody, Wyo.	KODI	1400	A
Coeur d'Alene, Ida.	KVNI	1240	M
	KZIN	1050	
Coffeyville, Kans.	KGGF	690	A
Colby, Kans.	KXXX	790	
Coldwater, Mich.	WTVB	1590	
Coleman, Tex.	KSTA	1000	
Colfax, Wash.	KCLX	1450	
College Park, Ga.	WEAS	1570	
Colonial Heights, Va.	WPVA	1290	
Colorado City, Tex.	KVMC	1320	
Colo. Sprgs., Colo.	KRDO	1240	
	KPIK	1580	
	KVOR	1300	C
	KSSS	740	
	KYSN	1460	M
Columbia, Ky.	WAIN	1270	
Columbia, Miss.	WCJU	1450	M
Columbia, Mo.	KFRU	1400	A
	KBIA	1580	
Columbia, Pa.	WCOY	1580	
Columbia, S.C.	WCOS	1400	A
	WIS	560	N
	WMSC	1320	C
	WNOK	1230	
	WOIC	1470	
Columbia, Tenn.	WMCP	1280	
	WKRM	1340	
Columbus, Ga.	WDAK	540	N
	WRBL	1420	C
	WGBA	1270	M
	WCLS	1580	
	WOKS	1340	
Columbus, Ind.	WCSI	1010	
Columbus, Miss.	WACR	1050	
	WCBI	550	M
Columbus, Nebr.	KJSK	900	
Columbus, Ohio	WBNS	1460	C
	WCOL	1230	A
	WMNI	920	A
	WOSU	820	
	WTVN	610	
	WVKO	1580	
Colville, Wash.	KCVL	1270	
Commerce, Ga.	WJJC	1270	
Concord, N.H.	WKXL	1450	C
Concord, N.C.	WEGO	1410	
Concordia, Kans.	KNCK	1390	
	KFRM	550	A
Conneaut, Ohio	WWOW	1360	
Connellsville, Pa.	WCVI	1340	
Connersville, Ind.	WCNB	1580	
Conroe, Tex.	KMCO	900	
Conway, Ark.	KCON	1230	
Conway, N.H.	WBNC	1050	
Conway, S.C.	WLAT	1330	M
Cookeville, Tenn.	WHUB	1400	C
Coolidge, Ariz.	KCKY	1150	C
Coos Bay, Oreg.	KOOS	1230	M
	KYNG	1420	
Copper Hill, Tenn.	WLSB	1400	
Coquille, Oreg.	KWRO	630	
Coral Gables, Fla.	WVCG	1070	
Corbin, Ky.	WCTT	680	M
Cordele, Ga.	WMJM	1490	M
Cordova, Alaska	KLAM	1450	

Location	C.L.	Kc.	N.A.
Corinth, Miss.	WCMA	1230	
	WCRR	1330	
Cornelia, Ga.	WCON	1450	
Corner Brook, Nfld.	CBY	560	
	CFCB	570	
Corning, Ark.	KCCB	1260	
Corning, N.Y.	WCBA	1350	
	WCLI	1450	A
Cornwall, Ont.	CJSS	1220	
	CFML	1110	
Corona, Calif.	KBUC	1370	
Corpus Christi, Tex.			
	KCTA	1030	M
	KCCT	1150	
	KEYS	1440	
	KRYS	1360	N
	KSIX	1230	A-C
	KUNO	1400	
Corry, Pa.	WOTR	1370	
Corsicana, Tex.	KAND	1340	
Cortez, Colo.	KVFC	740	
Cortland, N.Y.	WKRT	920	
Corvallis, Oreg.	KOAC	550	
	KFLY	1240	
	KLOO	1340	
Coshocton, Ohio	WTNS	1560	
Cottage Grove, Ore.	KNND	1400	
Coudersport, Pa.	WFRM	600	
Council Bluffs, Iowa			
	KSWI	1560	M-A
Courtenay, B.C.	CFCP	1440	
Covington, Ga.	WGFS	1430	
Covington, Ky.	WZIP	1050	M
Covington, La.	WARB	730	
Covington, Tenn.	WKBL	1250	
Covington, Va.	WKEY	1340	A
Cowan, Tenn.	WZYX	1440	
Craig, Colo.	KRAI	550	
Cranbrook, B.C.	CKEK	570	
Crane, Tex.	KCRN	1380	
Crescent City, Calif.	KPLY	1240	
	KPOD	1310	
Creston, Iowa	KSIB	1520	
Crestview, Fla.	WCNU	1010	
	WJSB	1050	
Crewe, Va.	WSVS	800	
Crockett, Tex.	KIVY	1290	
Crookston, Minn.	KROX	1260	
Crossett, Ark.	KAGH	800	
Crossville, Tenn.	WAEW	1330	
Crowley, La.	KSIG	1450	M
Cuero, Tex.	KCFH	1600	
Cullman, Ala.	WFMH	1460	
	WKUL	1340	
Culpeper, Va.	WCVA	1490	M
Cumberland, Ky.	WCPM	1280	
Cumberland, Md.	WCUM	1230	C
	WTBO	1450	
Cushing, Okla.	KUSH	1600	
Cypress Gardens, Fla.	WGTO	540	
Cynthiana, Ky.	WCYN	1400	
Dade City, Fla.	WDCF	1350	
Dalhart, Tex.	KXIT	1410	
Dallas, N.C.	WCFT	960	
Dallas, Oreg.	KPLK	1460	
Dallas, Tex.	KRLD	1080	C
	KIXL	1040	
	KSKY	660	
	KLIF	1190	
	WFAA	570	A
	WFAA	820	N
	KBOX	1480	
	WRR	1310	M
The Dalles, Oreg.	KACI	1300	
	KODL	1440	A
Dalton, Ga.	WBLJ	1230	M
	WRCD	1430	
Danbury, Conn.	WLAD	800	
Danville, Ill.	WDAN	1490	C
	WITY	980	
Danville, Ky.	WHIR	1230	M
Danville, Va.	WBTM	1330	A
	WDTI	970	
	WDVA	1250	M
	WILA	1580	
Darlington, S.C.	WDAR	1350	
Dauphin, Man.	CKDM	1050	
Davenport, Iowa	WOC	1420	N
	KWNT	1580	
	KSTT	1170	M
Dawson, Ga.	WDWD	990	
Dawson, Yukon T.	CFYT	1230	
Dawson Creek, B.C.	CJDC	1350	
Dayton, Ohio	WHIO	1290	C
	WING	1410	
	WONE	980	
	WAVI	1210	
Dayton, Tenn.	WDNT	1280	
Daytona Beach, Fla.			
	WNDB	1150	M-A
	WMFJ	1450	
	WROD	1340	
Deadwood, S.Dak.	KDSJ	980	
Dearborn, Mich.	WKMH	1310	
Decatur, Ala.	WHOS	800	
	WAJF	1490	
	WMSL	1400	M
Decatur, Ga.	WGUN	1010	
Decatur, Ill.	WDZ	1050	
	WSOY	1340	C
Decorah, Iowa	KDEC	1240	
	KWLC	1240	
Defiance, Ohio	WONW	1280	
De Funiak Springs, Fla.			
	WDSP	1280	
	WZEP	1460	
De Kalb, Ill.	WLBK	1360	
De Land, Fla.	WJBS	1490	
	WODD	1310	
Delano, Calif.	KCHJ	1010	
Delaware, Ohio	WDLE	1550	
Delray, Bch., Fla.	WDBF	1420	
Del Rio, Tex.	KDLK	1230	
Delta, Colo.	KDTA	1400	
Deming, N.Mex.	KOTS	1230	
Demopolis, Ala.	WXAL	1400	M
Denham Sprgs., La.	WLBI	1220	
Denison, Iowa	KDSN	1580	
Denison, Tex.	KDSX	950	
Denton, Tex.	KDNT	1440	
Denver, Colo.	KDEN	1340	
	KFML	1390	
	KHOW	630	A
	KIMN	950	M
	KLIR	990	
	KLZ	560	C
	KICN	710	
	KOA	850	N
	KPOF	910	
	KFSC	1220	
	KTLN	1280	
De Queen, Ark.	KDQN	1390	
DeRidder, La.	KDLA	1010	
Des Moines, Iowa	KCBC	1390	A
	KIOA	940	
	KRNT	1350	C
	KSO	1460	
	KWKY	1150	M
	WHO	1040	N
Detroit, Mich.	WCAR	1130	
	WJBK	1500	
	WJLB	1400	
	WJR	760	
	WWJ	950	N
	WXYZ	1270	A
Detroit Lakes, Minn.			
	KDLM	1340	
Devils Lake, N.Dak.			
	KDLR	1240	M
Dexter, Mo.	KDEX	1590	
Diboll, Tex.	KSPL	1260	
Dickinson, N.Dak.	KDIX	1230	
Dickson, Tenn.	WDKN	1260	
Dillon, Mont.	KDBM	800	
Dillon, S.C.	WDSC	800	A
Dinuba, Calif.	KRDU	1240	
Dodge City, Kans.	KGNO	1370	M
Dothan, Ala.	WAGF	1320	
	WDIG	1450	M
	WDOF	560	
Douglas, Ariz.	KAWT	1450	M
	KAPR	930	
Douglas, Ga.	WDMG	860	
Douglas, Wyo.	KWIV	1050	
Dover, Del.	WDOV	1410	
	WKEN	1600	
Dover, N.H.	WTSN	1270	
Dover, N.J.	WRAN	1510	
Dover, Ohio	WJER	1450	
Dowagiac, Mich.	WDOW	1440	
Doylestown, Pa.	WBUX	1570	
Drumheller, Alta.	CJDV	910	
Drummondville, Que.			
	CHRD	1340	
Dublin, Ga.	WMLT	1330	
	WXLI	1230	
Du Bois, Pa.	WCED	1420	C
Dubuque, Iowa	KDTH	1370	A
	WDBQ	1490	M
Duluth, Minn.	KDAL	610	C
	WEBC	560	
Dumas, Tex.	KDDD	800	
Duncan, Okla.	KRHD	1350	M
Dundalk, Md.	WAYE	860	
	WEBB	1360	
Dundee, N.Y.	WFLR	1570	
Dunkirk, N.Y.	WDOE	1410	
Dunn, N.C.	WCKB	780	
Du Quoin, Ill.	WDQN	1580	
Durango, Colo.	KIUP	930	
	KDGO	1240	
Durant, Okla.	KSEO	750	
Durham, N.C.	WDNC	620	C
	WSRC	1410	
	WSSB	1490	
	WTIK	1310	A
Dyersburg, Tenn.	WDSG	1450	
	WTRO	1330	
Eagle Pass, Tex.	KEPS	1270	
Eagle River, Wis.	WERL	950	
Easley, S.C.	WELP	1360	
E. Grand Forks, Minn.			
	KRAD	1590	
Eastland, Tex.	KERC	1590	
E. Lansing, Mich.	WKAR	870	
E. Liverpool, Ohio	WOHI	1490	A
East Longmeadow, Mass.			
	WTYM	1600	
E. Moline, Ill.	WDLM	960	
E. Palatka, Fla.	WREA	1480	A
E. Point, Ga.	WTJH	1260	
E. St. Louis, Ill.	WAMV	1490	A
Easton, Md.	WEMD	1460	
Easton, Pa.	WEEX	1230	
	WEST	1400	N
Eatontown, N.J.	WHTG	1410	
Eau Claire, Wis.	WEAQ	790	N
	WBIZ	1400	M
	WECL	1050	
Eau Gallie, Fla.	WMEG	920	
Edenton, N.C.	WCDJ	1260	
Edinburg, Tex.	KURV	710	
Edmonds, Wash.	KGDN	630	
Edmonton, Alta.	CBX	1010	
	CBXA	740	
	CFRN	1260	
	CHED	1080	
	CHFA	680	
	CJCA	930	
	CKUA	580	
Edmundston, N.C.	CJEM	570	
Effingham, Ill.	WCRA	1090	
Elba, Ala.	WELB	1350	
Elberton, Ga.	WSGC	1400	
El Cajon, Calif.	KDEO	910	A
El Campo, Tex.	KULP	1390	
El Centro, Calif.	KXO	1230	M
	KAMP	1430	
El Dorado, Ark.	KDMS	1290	
	KELD	1400	A
Eldorado, Kans.	KBTO	1360	
Elgin, Ill.	WRMN	1410	
Elizabeth City, N.C.			
	WCNC	1240	
	WGAI	560	
Elizabethton, Tenn.	WBEJ	1240	
Elizabethtown, Ky.	WIEL	1400	
Elizabethtown, N.C.			
	WBLA	1440	
Elizabethtown, Pa.	WEZN	1600	
Elk City, Okla.	KBEK	1240	A
Elkhart, Ind.	WTRC	1340	N
	WCMR	1270	
Elkin, N.C.	WIFM	1540	
Elkins, W.Va.	WDNE	1240	
Elko, Nev.	KELK	1240	M
Ellensburg, Wash.	KXLE	1240	
Ellsworth, Me.	WDEA	1350	
Elmira, N.Y.	WELM	1410	A-C
	WENY	1230	N
Elmira Heights-Horseheads, N.Y.			
	WEHH	1590	M
El Paso, Tex.	KROD	600	C
	KELP	920	
	KHEY	690	
	KINT	1590	
	KIZZ	1150	
	KSET	1340	M
	KTSM	1380	N
Ely, Minn.	WELY	1450	M
Ely, Nev.	KELY	1230	
Elyria, Ohio	WEOL	930	
Eminence, Ky.	WSTL	1600	
Emporia, Kans.	KVOE	1400	
Emporia, Va.	WEVA	860	
Emporium, Pa.	WLEM	1240	
Endicott, N.Y.	WENE	1430	A
Englewood, Colo.	KGMC	1150	
Enid, Okla.	KCRC	1390	A
	KGWA	960	M
Enterprise, Ala.	WIRB	600	
Enterprise, Oreg.	KWVR	1340	
Ephrata, Pa.	WGSA	1310	
Ephrata, Wash.	KULF	730	
Erie, Pa.	WERC	1260	A
	WICU	1330	N
	WJET	1400	
	WLEU	1450	
Erwin, Tenn.	WEMB	1420	
Escanaba, Mich.	WDBC	680	M
	WLST	600	A
Escondido, Calif.	KOWN	1450	
Estherville, Iowa	KLIL	1340	
Etowah, Tenn.	WCPH	1220	
Eufaula, Ala.	WULA	1240	M
Eugene, Oreg.	KORE	1450	M
	KASH	1600	A
	KERG	1280	C
	KUGN	590	N
Eunice, La.	KEUN	1490	M
Eureka, Calif.	KINS	980	C
	KDAN	790	
	KIEM	1480	M
Eustis, Fla.	WLCO	1240	
Evanston, Ill.	WEAW	1330	
	WNMP	1590	
Evanston, Wyo.	KLUK	1240	
Evansville, Ind.	WEOA	1400	C
	WGBF	1280	N
	WIKY	820	
	WJPS	1330	A
Eveleth, Minn.	WEVE	1340	M
Everett, Wash.	KRKO	1380	
	KQTY	1230	
Evergreen, Ala.	WBLO	1470	
Fairbanks, Alaska			
	KFAR	660	A-M-N
	KFRB	900	C-A
Fairfax, Va.	WEEL	1310	
Fairfield, Ill.	WFIW	1390	
Fairfield, Iowa	KMCD	1570	
Fairmont, Minn.	KSUM	1370	M
Fairmont, N.C.	WFMO	860	
Fairmont, W.Va.	WMMN	920	C
	WTCS	1490	A
Fajardo, P.R.	WMDD	1490	
Falfurrias, Tex.	KPSO	1260	
Fallon, Nev.	KULV	1250	
Fall River, Mass.	WALE	1400	M
	WSAR	1480	A
Falls Church, Va.	WFAX	1220	
Falls City, Nebr.	KTNC	1230	
Fargo, N.Dak.	WDAY	970	N
	KFNW	900	
	KUTT	1550	
	KXGO	790	A
Faribault, Minn.	KDHL	920	
Farmington, Me.	WKTJ	1380	
Farmington, Mo.	KREI	800	
Farmington, N.M.	KENN	1390	
	KWYK	960	
	KZUM	1280	
Farmville, N.C.	WBTL	1050	
	WFAG	1250	
Farmville, Va.	WFLO	870	
Farrell, Pa.	WFAR	1470	
Farwell, Tex.	KZDL	1570	
Fayette, Ala.	WWWF	990	
Fayetteville, Ark.	KHOG	1440	
	KFAY	1250	M
Fayetteville, N.C.	WFAI	1230	C
	WFNC	1390	M
	WFLB	1490	A
	WIDU	1600	
Fayetteville, Tenn.			
	WEKR	1240	M
Fergus Falls, Minn.			
	KOTE	1250	M
Fernandina Beach, Fla.			
	WPAP	1570	
Ferriday, La.	KFNV	1600	
Festus, Mo.	KXEN	1010	
Findlay, Ohio	WFIN	1330	
Fisher, W.Va.	WELD	690	A
Fitchburg, Mass.	WEIM	1280	M
	WFGM	960	
Fitzgerald, Ga.	WBHB	1240	M
Flagstaff, Ariz.	KCLS	600	N
	KVNA	690	A
	KEOS	1290	
Flat River, Mo.	KFMD	1240	M
Flin Flon, Man.	CFAR	590	
Flint, Mich.	WFDF	910	N
	WTRX	1330	A
	WAMM	1420	
	WMRP	1570	
	WKMF	1470	
	WTAC	600	A
Flomaton, Ala.	WTCB	990	
Florence, Ala.	WJOI	1340	M
	WOWL	1240	A
Florence, S.C.	WJMX	970	A
	WOLS	1230	
	WYNN	540	
Floydada, Tex.	KFLD	900	
Foley, Ala.	WHEP	1310	
Fond du Lac, Wis.	KFIZ	1450	M
Fordyce, Ark.	KBJT	1570	
Forest, Miss.	WMAG	860	
Forest City, N.C.	WBBO	780	
	WAGY	1320	
Forest Grove, Oreg.	KWAY	1570	
Forrest City, Ark.	KXJK	950	
Ft. Bragg, Calif.	KDAC	1230	
Ft. Collins, Colo.	KCOL	1410	
Ft. Dodge, Iowa	KVFD	1400	M
	KWMT	540	A
Ft. Frances, Ont.	CFOB	800	
Ft. Knox, Ky.	WSAC	1470	
Ft. Lauderdale, Fla.	WFTL	1400	
	WWIL	1580	
Ft. Madison, Iowa	KXGI	1360	
Ft. Morgan, Colo.	KFTM	1400	
Ft. Myers, Fla.	WINK	1240	C
	WMYR	1410	
Ft. Payne, Ala.	WFPA	1400	
	WZOB	1250	
Ft. Pierce, Fla.	WARN	1330	
	WIRA	1400	
Ft. Scott, Kans.	KMDO	1600	
Ft. Smith, Ark.	KFPW	1230	C
	KFSA	950	A
	KTCS	1410	M
	KWHN	1320	
Ft. Stockton, Tex.	KFST	860	
Ft. Valley, Ga.	WFPM	1150	
Ft. Walton Beach, Fla.			
	WNUE	950	
	WFTW	1260	
Ft. Wayne, Ind.	WGL	1250	A
	WOWO	1190	
	WANE	1450	C
	WKJG	1380	N
Ft. William, Ont.	CKPR	580	
	CJLX	800	
Ft. Worth, Tex.	KJIM	870	
	KCUL	1540	
	KFJZ	1270	
	KNOK	970	
	WBAP	570	A
	WBAP	820	N
	KXOL	1360	
Fostoria, Ohio	WFOB	1430	
Fountain City, Tenn.			
	WFCT	1430	
	WROL	1490	
Fountain Inn, S.C.	WFIS	1600	
Framingham, Mass.	WKOX	1190	
Frankfort, Ind.	WILO	1570	
Frankfort, Ky.	WFKY	1490	M
Franklin, Ky.	WFKN	1220	
Franklin, La.	KFRA	1390	
Franklin, N.C.	WFSC	1050	
Franklin, Pa.	WFRA	1430	
Franklin, Tenn.	WAGG	950	
Franklin, Va.	WYSR	1250	
Frederick, Md.	WFMD	930	C
Frederick, Okla.	KTAT	1570	
Fredericksburg, Tex.			
	KNAF	910	M
Fredericksburg, Va.	WFVA	1230	A
	WFLS	1350	
Fredericton, N.B.	CFNB	550	
Fredonia, N.Y.	WBUZ	1570	
Freeport, Ill.	WFRL	1570	
Freeport, N.Y.	WGBB	1240	
Freeport, Tex.	KBRZ	1460	
Fremont, Mich.	WCBQ	1490	
Fremont, Nebr.	KHUB	1340	

Location	C.L.	Kc.	N.A.
Fremont, Ohio	WFRO	900	
Fresno, Calif.	KARM	1430	A
	KEAP	980	
	KFRE	940	C
	KGST	1600	
	KMAK	1340	
	KMJ	580	N
	KYNO	1300	
Front Royal, Va.	WFTR	1450	M
Frostburg, Md.	WFRB	740	
Fulton, Ky.	WFUL	1270	
Fulton, Mo.	KFAL	900	
Fulton, N.Y.	WOSC	1300	
Fuquay Sprgs., N.C.	WFVG	1460	
Gadsden, Ala.	WGAD	1350	A
	WETO	930	M
	WAAX	570	
Gaffney, S.C.	WFGN	1570	
Gainesville, Fla.	WDVH	980	
	WGGG	1230	A
	WRUF	850	M
Gainesville, Ga.	WGGA	550	M
	WDUN	1240	
	WLBA	1580	
Gainesville, Tex.	KGAF	1580	
Galax, Va.	WBOB	1360	M
Galesburg, Ill.	WGIL	1400	
	WAIK	1590	
Gallatin, Tenn.	WHIN	1010	
Gallipolis, Ohio	WJEH	990	
Gallup, N. Mex.	KGAK	1330	A
	KYVA	1230	
Galt, Ont.	CKGR	1110	
Galveston, Tex.	KILE	1400	
	KGBC	1540	
Gander, Nfld.	CBG	1450	
Garden City, Kans.	KNCO	1050	
	KIUL	1240	M
Gardner, Mass.	WGAW	1340	
Gary, Ind.	WWCA	1270	
	WGRY	1370	
Gastonia, N.C.	WGNC	1450	A
	WLTC	1370	
Gate City, Va.	WGAT	1050	
Gaylord, Mich.	WATC	900	
Geneva, Ala.	WGEA	1150	
Geneva, N.Y.	WGVA	1240	A
Georgetown, Del.	WJWL	900	
Georgetown, Ky.	WAXU	1580	
Georgetown, S.C.	WGTN	1400	M
Gettysburg, Pa.	WGET	1320	
Gillette, Wyo.	KIML	1490	
Gilroy, Calif.	KPER	1290	
Gladewater, Tex.	KSIJ	1430	
Glasgow, Ky.	WKAY	1490	
Glasgow, Mont.	KLTZ	1240	
Glendale, Ariz.	KRUX	1360	
Glendale, Calif.	KIEV	870	
Glendive, Mont.	KXGN	1400	
Glen Falls, N.Y.	WSET	1410	
	WWSC	1450	A
Glenwood Sprgs., Colo.	KGLN	980	M
Globe, Ariz.	KZOW	1240	A
Gloucester, Va.	WDDY	1420	
Gloversville-Johnston, N.Y.	WENT	1340	C
Golden, Colo.	KXXI	1250	
Golden Meadow, La.	KLFT	1600	
Golden Valley, Minn.	KEVE	1440	M
Goldsboro, N.C.	WFMC	730	
	WGBR	1150	A
	WGOL	1300	
Gonzales, Tex.	KCTI	1450	
Goodland, Kans.	KBLR	730	M
Goose Bay, Nfld.	CFGB	1340	
Goshen, Ind.	WKAM	1460	
Grafton, N.D.	KGPC	1340	
Grafton, W.Va.	WVVW	1260	
Graham, Tex.	KSWA	1330	
Granby, Que.	CHEF	1450	
Grand Coulee, Wash.	KFDR	1360	
Grande Prairie, Alta.	CFGP	1050	
Grand Falls, Nfld.	CBT	990	
Grand Forks, N.D.	KFJM	1370	
	KILO	1440	C
	KNOX	1310	M
Grand Haven, Mich.	WGHN	1370	
Grand Island, Nebr.	KMMJ	750	A
	KRGI	1430	
Grand Junction, Colo.	KREX	920	M
	KEXO	1230	
	KSTR	620	
Grand Prairie, Tex.	KKSN	730	
Grand Rapids, Mich.	WJEF	1230	C
	WFUR	1570	
	WGRD	1410	
	WLAV	1340	A
	WMAX	1480	M
	WOOD	1300	N
Grand Rapids, Minn.	KOZY	1490	M
Grangeville, Idaho	KORT	1230	
Grants, N.Mex.	KMIN	980	
Grants Pass, Oreg.	KAGI	930	M
	KAJO	1270	
Gravelbourg, Sask.	CFGR	1230	
	CFRG	710	
Grayson, Ky.	WGOH	1370	
Gt. Barrington, Mass.	WSBS	860	
Gt. Bend, Kans.	KVGB	1590	N
Gt. Falls, Mont.	KFBB	1310	C
	KUDI	1450	
	KMON	560	M
	KARR	1400	N
Greeley, Colo.	KFKA	1310	
	KYOU	1450	
Green Bay, Wis.	WBAY	1360	C
	WJPG	1440	M
	WDUZ	1400	A
Green Cove Springs, Fla.	WGRC	1580	
Greeneville, Tenn.	WGRV	1340	
Greenfield, Mass.	WHAI	1240	M
Greensboro, N.C.	WBIG	1470	C
	WCOG	1320	
	WGBG	1400	A
	WPET	950	
Greensburg, Pa	WHJB	620	
Greenville, Ala.	WGYV	1380	
Greenville, Mich.	WPLB	1380	
Greenville, Miss.	WJPR	1330	
	WDDT	900	
	WGVM	1260	
Greenville, Pa.	WGRP	940	
Greenville, N.C.	WGTC	1590	M
	WOOW	1340	
Greenville, S.C.	WESC	660	
	WFBC	1330	N
	WMRB	1490	A-M
	WMUU	1260	
	WQOK	1440	C
Greenville, Tex.	KGVL	1400	
Greenwood, Miss.	WABG	960	A
	WGRM	1240	N
Greenwood, S.C.	WCRS	1450	N
	WGSW	1350	
Greer, S.C.	WEAB	800	
	WCKI	1300	A
Grenada, Miss.	WNAG	1400	M
Gresham, Oreg.	KGRD	1230	
Gretna, Va.	WMNA	730	
Griffin, Ga.	WKEU	1450	M
	WHIE	1320	
	WRIX	1410	
Grinnell, Iowa	KGRN	1410	
Groton, Conn.	WSUB	980	
Grove City, Pa.	WSAJ	1340	
Grundy, Va.	WNRG	1250	
Guayama, P.R.	WXRF	1590	
Guelph, Ont.	CJOY	1460	
Gulfport, Miss.	WROA	1390	
	WGCM	1240	A
Gunnison, Colo.	KGUC	1490	
Guntersville, Ala.	WGSV	1270	
Guthrie, Okla.	KWRW	1490	
Guymon, Okla.	KGYN	1220	
Hagerstown, Md.	WARK	1490	C
	WJEJ	1240	A-M
Haines City, Fla.	WHAN	930	
Haleyville, Ala.	WJBB	1230	M
Halifax, N.S.	CBH	1340	
	CHNS	960	
	CJCH	920	
Hamden, Conn.	WDEE	1220	
Hamilton, Ala.	WERH	970	
Hamilton, Ohio	WMOH	1450	
Hamilton, Ont.	CHIQ	1280	
	CHML	900	
	CKOC	1150	
Hamilton, Tex.	KCLW	900	
Hamlet, N.C.	WKDX	1400	
Hammond, Ind.	WJOB	1230	
Hammond, La.	WFPR	1400	
Hampton, S.C.	WBHC	1270	
Hampton, Va.	WVEC	1490	
Hancock, Mich.	WMPL	920	
Hanford, Calif.	KNGS	620	
Hannibal, Mo.	KHMO	1070	
Hanover, N.H.	WTSL	1400	
	WDCR	1340	
Hanover, Pa.	WHVR	1280	
Harlan, Ky.	WHLN	1410	
Harlingen, Tex.	KGBT	1530	
Harriman, Tenn.	WHBT	1600	
Harrisburg, Ill.	WEBQ	1240	
Harrisburg, Pa.	WHGB	1400	A
	WCMB	1460	M
	WHP	580	C
	WKBO	1230	N
Harrison, Ark.	KHOZ	900	
Harrisonburg, Va.	WHBG	1360	
	WSVA	550	N
Harrodsburg, Ky.	WHBN	1420	
Hartford, Conn.	WDRC	1360	C
	WCCC	1290	
	WPOP	1410	M-A
	WTIC	1080	N
Hartford, Wis.	WTKM	1540	
Hartselle, Ala.	WHRT	860	
Hartsville, S.C.	WHSC	1450	M
Hartwell, Ga.	WKLY	980	
Harvard, Ill.	WMCW	1600	
Harvey, Ill.	WBEE	1570	
Hastings, Mich.	WBCH	1220	
Hastings, Nebr.	KHAS	1230	
Hattiesburg, Miss.	WBKH	950	
	WFOR	1400	N
	WHSY	1230	A
	WXXX	1310	
Haverhill, Mass.	WHAV	1490	
Havre, Mont.	KOJM	610	M
Havre de Grace, Md.	WASA	1330	
Hawkinsville, Ga.	WCEH	610	
Haynesville, La.	KLUV	1580	
Hays, Kans.	KAYS	1400	
Hayward, Wis.	WHSM	910	
Hazard, Ky.	WKIC	1390	M
Hazlehurst, Miss.	WMDC	1220	
Hazleton, Pa.	WAZL	1490	N-M
Helena, Ark.	KFFA	1360	M
Helena, Mont.	KCAP	1340	M
	KXLJ	1240	N
Hemet, Calif.	KHSJ	1320	
Hempstead, N.Y.	WHLI	1100	
Henderson, Ky.	WSON	860	
Henderson, Nev.	KBMI	1400	
	KTOO	1280	
Henderson, N.C.	WHNC	890	M
	WHVH	1450	
Henderson, Tex.	KGRI	1000	
	KWRD	1470	
Hendersonville, N.C.	WHKP	1450	A
Henryetta, Okla.	KHEN	1590	
Hereford, Tex.	KPAN	860	
Herkimer, N.Y.	WALY	1420	
Hermiston, Oreg.	KOHU	1570	
Herrin, Ill.	WJPF	1340	M
Hettinger, N.Dak.	KNDC	1490	
Hibbing, Minn.	WMFG	1240	N
Hickory, N.C.	WHKY	1290	A
	WIRC	630	
Highland Park, Tex.	KVIL	1150	
High Point, N.C.	WMFR	1230	A
	WNOS	1590	
	WHPE	1070	
Hillsboro, Ohio	WSRW	1590	
Hillsboro, Oreg.	KUIK	1360	
Hillsboro, Tex.	KHBR	1560	
Hillsdale, Mich.	WCSR	1340	
Hilo, Hawaii	KHBC	970	C
	KIPA	1110	
	KIMO	850	M
Hobart, Okla.	KTJS	1420	
Hobbs, N.Mex.	KWEW	1480	M
	KHOB	1390	
Holbrook, Ariz.	KDJI	1270	
Holdredge, Nebr.	KUVR	1380	
Holland, Mich.	WHTC	1450	
	WJBL	1260	
Hollywood, Fla.	WGMA	1320	
Holyoke, Mass.	WREB	930	
Homer, La.	KVHL	1320	
Homestead, Fla.	WSDB	1430	
Homewood, Ala.	WJLD	1400	
Honolulu, Hawaii	KGMB	590	C
	KPOI	1380	
	KIKI	830	
	KGU	760	N
	KHVH	1040	
	KKAA	650	M
	KNDI	1270	
	KOHO	1170	
	KOOD	990	
	KULA	690	A
Hood River, Oreg.	KIHR	1340	
Hope, Ark.	KXAR	1490	
Hopewell, Va.	WHAP	1340	
Hopkinsville, Ky.	WHOP	1230	C
	WKOA	1480	
Hoquiam, Wash.	KHOQ	1560	
Hornell, N.Y.	WWHG	1320	
	WLEA	1480	M
Hot Springs, Ark.	KAAB	1350	A
	KBHS	590	
	KBLO	1470	M
Hot Springs, S. Dak.	KOBH	580	
Houghton, Mich.	WHDF	1400	
Houghton Lake, Mich.	WHGR	1290	
Houlton, Maine	WHOU	1340	
Houma, La.	KCIL	1490	N
Houston, Miss.	WCPC	1320	
Houston, Tex.	KCOH	1430	
	KILT	610	
	KNUZ	1230	
	KPRC	950	N
	KTHT	790	
	KTRH	740	C
	KXYZ	1320	A
	KYOK	1590	
Howell, Mich.	WHMI	1350	
Hudson, N.Y.	WHUC	1230	
Hugo, Okla.	KIHN	1340	
Hull, Que.	CKCH	970	
Humacao, P.R.	WALO	1240	
Humboldt, Tenn.	WIRJ	740	
Huntingdon, Pa.	WHUN	1150	
Huntington, Ind.	WHLT	1300	
Huntington, N.Y.	WGSM	740	
Huntington, W.Va.	WPLH	1470	M
	WKEE	800	M-A
	WSAZ	930	N
Huntsville, Ala.	WBHP	1230	M
	WEUP	1600	
	WFUN	1450	
	WAAY	1550	A
Huntsville, Ont.	CKAR	590	
Huntsville, Tex.	KSAM	1490	
Huron, S.Dak.	KIJV	1340	
Hutchinson, Kans.	KWBW	1450	N
	KWHK	1260	
Hutchinson, Minn.	KDUZ	1260	
Idabel, Okla.	KBEL	1240	
Idaho Falls, Idaho	KID	590	C
	KIFI	1260	A-M
	KTEE	900	
Independence, Ia.	KUPI	980	
	KOUR	1220	
Independence, Kans.	KIND	1010	M
Independence, Mo.	KANS	1510	
Indiana, Pa.	WDAD	1450	C
Indianapolis, Ind.	WFBM	1260	A
	WGEE	1590	
	WIBC	1070	
	WIRE	1430	N
	WISH	1310	C
	WXLW	950	M
Indianola, Miss.	WDLT	1380	
Indio, Calif.	KREO	1400	A
Inglewood, Calif.	KTYM	1460	
Inkster, Mich.	WCHB	1440	
International Falls, Minn.	KGHS	1230	
Ionia, Mich.	WION	1430	
Iowa City, Iowa	KXIC	800	
	WSUI	910	
Iron Mtn., Mich.	WMIQ	1450	A
Iron River, Mich.	WIKB	1230	M
Ironton, Ohio	WIRO	1230	M
Ironwood, Mich.	WJMS	630	M
Irvine, Ky.	WIRV	1550	
Ishpeming, Mich.	WJPD	1240	
	WJAN	970	
Islip, N.Y.	WBIC	540	
Ithaca, N.Y.	WHCU	870	C
	WTKO	1470	A
Iuka, Miss.	WVOM	1270	
Jackson, Ala.	WTHG	1290	M
Jackson, Mich.	WIBM	1450	A
	WKHM	970	M
Jackson, Miss.	WJDX	620	N
	WJQS	1400	C
	WJXN	1450	
	WOKJ	1590	
	WRBC	1300	M
	WSLI	930	
Jackson, Ohio	WLMJ	1280	
Jackson, Tenn.	WDXI	1310	
	WJAK	1460	
	WTJS	1390	A
Jacksonville, Fla.	WJAX	930	
	WAPE	690	
	WZOK	1320	A
	WIVY	1050	
	WMBR	1460	C
	WOBS	1360	
	WPDQ	600	
	WQIK	1280	
	WRHC	1400	
Jacksonville, Ill.	WJIL	1550	
	WLDS	1180	
Jacksonville, N.C.	WJNC	1240	M
	WLAS	910	
Jacksonville, Tex.	KEBE	1400	
Jacksonville Bch., Fla.	WZRO	1010	
Jamestown, N.Dak.	KEYJ	1400	M
	KSJB	600	C
Jamestown, N.Y.	WJTN	1240	A
	WJOC	1340	M
Jamestown, Tenn.	WCLC	1260	
Janesville, Wis.	WCLO	1230	M
Jasper, Ala.	WWWB	1360	
	WARF	1240	
Jasper, Ind.	WITZ	990	
Jasper, Tex.	KTXJ	1350	
Jefferson City, Mo.	KLIK	950	
	KWOS	1240	M
Jennings, La.	KJEF	1290	
Jerome, Idaho	KART	1400	
Jerseyville, Ill.	WJBM	1480	
Jesup, Ga.	WBGR	1370	
Johnson City, Tenn.	WJCW	910	C
	WETB	790	M
Johnstown, Pa.	WJAC	1400	N
	WARD	1490	C
	WCRO	1230	M
Joliet, Ill.	WJOL	1340	
Joliette, Que.	CJLM	1350	
Jonesboro, Ark.	KBTM	1230	M
	KNEA	970	
Jonesboro, La.	KTDC	920	
Jonesboro, Tenn.	WJSO	1590	
Jonquiere, Que.	CKRS	590	
Joplin, Mo.	WMBH	1450	M
	KFSB	1310	
	KODE	1230	C
Junction, Tex.	KMBL	1450	
Junc. City, Kans.	KJCK	1420	
Juneau, Alaska	KINY	800	C-A
	KJNO	630	A-M-N
Kailua, Hawaii	KLEI	1240	
Kaimuki, Hawaii	KAIM	870	
Kalamazoo, Mich.	WKPR	1420	
	WKZO	590	C
	WKLZ	1470	M
	WKMI	1360	
Kalispell, Mont.	KGEZ	600	M
	KOFI	930	
Kamloops, B.C.	CFJC	910	
Kane, Pa.	WADP	960	
Kankakee, Ill.	WKAN	1320	
Kannapolis, N.C.	WGTL	870	
Kans. City, Kans.	KCKN	1340	
Kansas City, Mo.	KCMO	810	C
	KMBC	980	A
	KPRS	1590	
	KUDL	1380	
	WDAF	610	N
	WHB	710	
Kearney, Nebr.	KGFW	1340	M
	KRNY	1460	
Keene, N.H.	WKNE	1290	N
	WKBK	1220	
Kelowna, B.C.	CKOV	630	
Kelso, Wash.	KLOG	1490	
Kendallville, Ind.	WAWK	1570	

Location	C.L.	Kc.	N.A.
Kenedy, Tex.	KAML	990	
Kenmore, N.Y.	WYSL	1080	
Kennett, Mo.	KBOA	830	
Kennewick-Pasco-Richland, Wash.	KEPR	610	C
Kenora, Ont.	CJRL	1220	
Kenosha, Wis.	WLIP	1050	
Kentville, N.S.	CKEN	1350	
Keokuk, Iowa	KOKX	1310	
Kermit, Tex.	KERB	600	
Kerrville, Tex.	KERV	1230	
Ketchikan, Alaska	KTKN	930	C-A
Kewanee, Ill.	WKEI	1450	
Keyser, W.Va.	WKYR	1270	
Key West, Fla.	WKWF	1600	M
	WKIZ	1500	
Kilgore, Tex.	KOCA	1240	
Killeen, Tex.	KLEN	1050	M
Kimball, Nebr.	KIMB	1260	
King City, Calif.	KRKC	1570	
Kingman, Ariz.	KAAA	1230	A
Kings Mountain, N.C.	WKMT	1220	
Kingsport, Tenn.	WKIN	1320	
	WKPT	1400	N
Kingston, N.Y.	WBAZ	1550	
	WKNY	1490	M
Kingston, Ont.	CFRC	1490	
	CKLC	1380	
	CKWS	960	
Kingstree, S.C.	WDKD	1310	
Kingsville, Tex.	KINE	1330	
Kinston, N.C.	WELS	1010	
	WFTC	960	A
	WISP	1230	M
Kirkland, Wash.	KNBX	1050	
Kirkland Lake, Ont.	CJKL	560	
Kirksville, Mo.	KIRX	1450	A
Kissimmee, Fla.	WKBX	1220	
Kitchener, Ont.	CKCR	1490	
	CKKW	1320	
Kittanning, Pa.	WACB	1380	
Klamath Falls, Oreg.	KAGO	1150	M
	KFLW	1450	A-C
	KLAD	960	
Knoxville, Iowa	KNIA	1320	
Knoxville, Tenn.	WBIR	1240	A
	WIVK	860	
	WATE	620	N
	WKGN	1340	M
	WKXV	900	
	WNOX	990	C
Kokomo, Ind.	WIOU	1350	C
Kosciusko, Miss.	WKOZ	1350	A
Laconia, N.H.	WLNH	1350	
	WEMJ	1490	
LaCrosse, Wis.	WKBH	1410	N
	WLCX	1490	
	WKTY	580	A
Ladysmith, Wis.	WLDY	1340	
Lafayette, Ga.	WLFA	1590	
Lafayette, Ind.	WASK	1450	M
	WAZY	1410	
	WBAA	920	
Lafayette, La.	KPEL	1420	A
	KVOL	1330	N
Lafayette, Tenn.	WEEN	1460	
LaFollette, Tenn.	WLAF	1450	
LaGrande, Oreg.	KLBM	1450	
LaGrange, Ga.	WLAG	1240	M
	WTRP	620	
LaGrange, Ill.	WTAQ	1300	
LaGrange, Tex.	KVLG	1570	
LaJunta, Colo.	KBZZ	1400	M
Lake Charles, La.	KLOU	1580	
	KPLC	1470	N
	KAOK	1400	M
Lake City, Fla.	WDSR	1340	
	WGRO	960	
Lake City, S.C.	WJOT	1260	
Lakeland, Fla.	WLAK	1430	N
	WONN	1230	M
	WYSE	1330	
Lake Providence, La.	KLPL	1050	
Lake Tahoe, Calif.	KOWL	1490	
Lakeview, Oreg.	KQIK	1230	
Lake Wales, Fla.	WIPC	1280	
Lakewood, Colo.	KLAK	1600	
Lakewood, Wash.	KAYG	1480	
Lake Worth, Fla.	WLIZ	1380	
Lamar, Colo.	KLMR	920	M
Lamesa, Tex.	KPET	690	
Lampasas, Tex.	KCYL	1450	
Lancaster, Calif.	KAVL	610	
	KBVM	1380	
Lancaster, Ohio	WHOK	1320	
Lancaster, Pa.	WGAL	1490	N
	WLAN	1390	A-M
Lancaster, S.C.	WLCM	1360	
Lander, Wyo.	KOVE	1330	M
Lanett, Ala.	WRLD	1490	A
Lansdale, Pa.	WNPV	1440	
Lansford, Pa.	WLSH	1410	
Lansing, Mich.	WILS	1320	
	WJIM	1240	A-N
Lapeer, Mich.	WMPC	1230	
LaPorte, Ind.	WLOI	1540	
Laramie, Wyo.	KOWB	1290	M
Laredo, Tex.	KVOZ	1490	M
LaSalle, Ill.	WLPO	1220	
LaSarre, Que.	CKLS	1240	
LasCruces, N.Mex.	KOBE	1450	
	KGRT	570	
Las Vegas, Nev.	KENO	1460	A
	KLAS	1230	C
	KORK	1340	M
	KRAM	920	
	KRBO	1050	
Las Vegas, N.Mex.	KFUN	1230	A
Latrobe, Pa.	WSHH	1570	M
	WTRA	1480	
LaTuque, Que.	CFLM	1240	
Laurel, Miss.	WAML	1340	N
	WLAU	1600	A
	WNSL	1260	
Laurens, S.C.	WLBG	860	
Laurinburg, N.C.	WEWO	1080	
Lawrence, Kans.	KFKU	1250	
	KLWN	1320	
Lawrence, Mass.	WCCM	800	M
Lawrenceburg, Tenn.	WDXE	1370	
Lawrenceville, Ga.	WLAW	1360	
Lawrenceville, Ill.	WAKO	910	
Lawrenceville, Va.	WLES	580	
Lawton, Okla.	KSWO	1380	A
	KCCO	1050	
Leadville, Colo.	KLVC	1230	
Leaksville, N.C.	WLOE	1490	M
Leamington, Ont.	CJSP	710	
Leavenworth, Kans.	KCLO	1410	
Lebanon, Ky.	WLBN	1590	
Lebanon, Mo.	KLWT	1230	
Lebanon, Oreg.	KGAL	920	
Lebanon, Pa.	WLBR	1270	
Lebanon, Tenn.	WCOR	900	
Leesburg, Fla.	WLBE	790	M
	WBIL	1410	
Leesburg, Va.	WAGE	1290	
Leesville, La.	KLLA	1570	
Lehighton, Pa.	WLPS	1150	
Leitchfield, Ky.	WMTL	1580	
Leland, Miss.	WESY	1580	
LeMars, Iowa	KLEM	1410	
Lemoore, Calif.	KLAN	1320	
Lenoir, N.C.	WJRI	1340	M
Lenoir, Tenn.	WLIL	730	
Leonardtown, Md.	WKIK	1370	
Lethbridge, Alta.	CJOC	1220	
	CHEC	1090	
Levelland, Tex.	KLVT	1230	
Levittown, Pa.	WBCB	1490	
Lewisburg, Pa.	WITT	1010	
Lewisburg, Tenn.	WJJM	1490	M
Lewiston, Idaho	KRLC	1350	M
	KOZE	1300	
Lewiston, Maine	WCOU	1240	M
	WLAM	1470	A
Lewistown, Mont.	KXLO	1230	M
Lewistown, Pa.	WKVA	920	A
	WMRF	1490	N
Lexington, Ky.	WLAP	630	
	WBLG	1300	A
	WVLK	590	M
Lexington, Miss.	WXTN	1150	
Lexington, Mo.	KLEX	1570	
Lexington, Nebr.	KRVN	1010	
Lexington, N.C.	WBUY	1440	
Lexington, Tenn.	WOXL	1490	
Lexington, Va.	WREL	1450	N
Lexington Pk., Md.	WPTX	920	
Libby, Mont.	KLCB	1230	M
	KLIB	1470	
Liberal, Kans.	KSCB	600	
Liberty, N.Y.	WVOS	1240	
Liberty, Tex.	KWLO	1050	
Lihue, Hawaii	KTOH	1490	
Lima, Ohio	WIMA	1150	A
Lincoln, Ill.	WPRC	1370	
Lincoln, Nebr.	KFOR	1240	A
	KLIN	1400	
	KLMS	1480	
Lincolnton, N.C.	WLON	1050	
Lindsay, Ont.	CKLY	910	
Linton, Ind.	WBTO	1600	
Litchfield, Ill.	WSMI	1540	
Litchfield, Minn.	KLFD	1410	
Little Falls, Minn.	KLTF	960	
Little Falls, N.Y.	WLFH	1230	
Littlefield, Tex.	KZZN	1490	
Little Rock, Ark.	KARK	920	N
	KAJI	1250	M
	KLRA	1010	A
	KOKY	1440	
	KTHS	1090	C
	KVLC	1050	
Littleton, Colo.	KMOR	1510	
Live Oak, Fla.	WNER	1250	
Livingston, Mont.	KPRK	1340	M
Livingston, Tenn.	WLIV	920	
Livingston, Tex.	KETX	1440	
	KVLL	1220	
Lloydminster, Alta.	CKSA	1150	
Lock Haven, Pa.	WBPZ	1230	M
Lockport, N.Y.	WUSJ	1340	
Lodi, Calif.	KCVR	1570	
Logan, Utah	KVNU	610	M
	KLGN	1390	
Logan, W.Va.	WLOG	1230	M
	WVOW	1290	
Logansport, Ind.	WSAL	1230	M
Lompoc, Calif.	KNEZ	960	
London, Ky.	WFTG	1400	
London, Ont.	CFPL	980	
	CKSL	1290	
Long Beach, Calif.	KFOX	1280	
	KGER	1390	
Longmont, Colo.	KLMO	1050	
Long Prairie, Minn.	KEYL	1400	
Longview, Tex.	KFRO	1370	A
	KLUE	1280	
Longview, Wash.	KEDO	1400	A
	KBAM	1270	
Lookout Mtn., Tenn.	WFLI	1070	
Lorain, Ohio	WWIZ	1380	A
Loris, S.C.	WLSC	1570	
Los Alamos, N.Mex.	KRSN	1490	A
Los Angeles, Calif.	KABC	790	A
	KFI	640	N
	KHJ	930	M
	KFSG	1150	
	KFWB	980	
	KGFJ	1230	
	KFAC	1330	
	KLAC	570	
	KMPC	710	
	KNX	1070	C
	KPOL	1540	
	KGBS	1020	
	KRKD	1150	
Louisburg, N.C.	WYRN	1480	
Louisville, Ga.	WPEH	1420	
Louisville, Ky.	WAVE	970	N
	WAKY	790	M
	WHAS	840	C
	WKLO	1080	A
	WINN	1240	
	WKYW	900	
	WLOU	1350	
	WTMT	620	
Louisville, Miss.	WLSM	1270	
Loveland, Colo.	KLOV	1570	
Lovington, N.Mex.	KLEA	630	
Lowell, Mass.	WCAP	980	
	WLLH	1400	
Lubbock, Tex.	KCBD	1590	M-N
	KDAV	580	
	KDUB	1340	
	KFYO	790	C
	KLLL	1460	M
	KSEL	950	A
Lucedale, Miss.	WHHT	1440	
Ludington, Mich.	WKLA	1450	A
Lufkin, Tex.	KRBA	1340	A
	KTRE	1420	M
Lumberton, N.C.	WAGR	580	
	WTSB	1340	M
Lynchburg, Va.	WLVA	590	A
	WWOD	1390	M-N
	WBRG	1050	
Lynn, Mass.	WLYN	1360	
Lyons, Ga.	WBBT	1340	
Macomb, Ill.	WKAI	1510	
Macon, Ga.	WBML	1240	
	WCRY	900	
	WIBB	1280	
	WMAZ	940	C
	WNEX	1400	A-M
Macon, Miss.	WMBC	1400	
Madera, Calif.	KHOT	1250	
Madison, Fla.	WMAF	1230	
Madison, Ga.	WYTH	1250	
Madison, Ind.	WORX	1270	
Madison, S.D.	KJAM	1390	
Madison, Tenn.	WENO	1430	
Madison, Wis.	WHA	970	
	WIBA	1310	N
	WISM	1480	A-M
	WKOW	1070	C
Madisonville, Ky.	WFMW	730	
	WTTL	1310	
Magee, Miss.	WSJC	1280	
Magnolia, Ark.	KVMA	630	M
Malden, Mo.	KTCB	1470	
Malone, N.Y.	WICY	1490	M
Malvern, Ark.	KBOK	1310	
Manassas, Va.	WPRW	1460	
Manati, P.R.	WMNT	1500	
Manchester, Conn.	WINF	1230	
Manchester, Ga.	WFDR	1370	
Manchester, Ky.	WWXL	1450	
Manchester, N.H.	WFEA	1370	
	WGIR	610	C
	WKBR	1250	
Manchester, Tenn.	WMSR	1320	
Manhattan, Kans.	KSAC	580	
	KMAN	1350	
Manistee, Mich.	WMTE	1340	
Manitou Springs, Colo.	KCMS	1490	
Manitowoc, Wis.	WCUB	980	
	WOMT	1240	M
Mankato, Minn.	KYSM	1230	N
	KTOE	1420	A
Manning, S.C.	WYMB	1410	
Mansfield, La.	KDBC	1360	
Mansfield, Ohio	WMAN	1400	A
	WCLW	1570	
Maquoketa, Iowa	KMAQ	1320	
Marathon, Fla.	WEFG	1300	
Marianna, Fla.	WTYS	1340	M
	WTOT	980	
Marietta, Ga.	WFOM	1230	
	WBIE	1050	
Marietta, Ohio	WMOA	1490	M
Marine City, Mich.	WDOG	1590	
Marinette, Wis.	WMAM	570	N
Marion, Ala.	WJAM	1310	
Marion, Ill.	WGGH	1150	
Marion, Ind.	WBAT	1400	A
	WMRI	860	
Marion, N.C.	WBRM	1250	
Marion, Ohio	WMRN	1490	A
Marion, S.C.	WATP	1430	
Marion, Va.	WMEV	1010	A
Marked Tree, Ark.	KPCA	1580	
Marksville, La.	KAPB	1370	
Marlborough, Mass.	WSRO	1470	
Marlin, Tex.	KMLW	1010	
Marquette, Mich.	WDMJ	1320	M
Marshall, Minn.	KMHL	1400	A
Marshall, Mo.	KMMO	1300	
Marshall, N.C.	WMMH	1460	
Marshall, Tex.	KMHT	1450	
	KADO	1410	
Marshalltown, Iowa	KFJB	1230	
Marshfield, Wis.	WDLB	1450	
Martin, Tenn.	WCMT	1410	
Martinsburg, W.Va.	WEPM	1340	
Martinsville, Va.	WHEE	1370	
	WMVA	1450	N
Marysville, Calif.	KMYC	1410	M
Marysville, Kans.	KNDY	1570	
Maryville, Mo.	KNIM	1580	
Maryville, Tenn.	WGAP	1400	
Mason City, Iowa	KGLO	1300	C
	KRIB	1490	
	KSMN	1010	
Massena, N.Y.	WMSA	1340	A
	WSTS	1050	
Massillon, Ohio	WTIG	990	
Matane, Que.	CKBL	1250	
Matawan, W.Va.	WHJC	1360	
Mattoon, Ill.	WLBH	1170	
Mayaguez, P.R.	WAEL	600	
	WKJB	710	
	WORA	760	
	WPRA	990	
	WTIL	1300	
Mayfield, Ky.	WNGO	1320	
Mayodan, N.C.	WMYN	1420	
Maysville, Ky.	WFTM	1240	M
McAlester, Okla.	KTMC	1400	
	KNED	1150	
McAllen, Tex.	KRIO	910	M
McCamey, Tex.	KCMR	1450	
McComb, Miss.	WHNY	1250	A
	WAPF	980	
McCook, Nebr.	KBRL	1300	M
McGehee, Ark.	KVSA	1220	
McKeesport, Pa.	WEDO	810	C
	WMCK	1360	
McKenzie, Tenn.	WHDM	1440	
McKinney, Tex.	KMAE	1600	
McMinnville, Oreg.	KMCM	1260	
McMinnville, Tenn.	WBMC	960	
	WMMT	1230	M
McPherson, Kans.	KNEX	1540	
McRae, Ga.	WDAX	1410	
Meadville, Pa.	WMGW	1490	
Medford, Mass.	WHIL	1430	
Medford, Oreg.	KMED	1440	A
	KDOV	1300	
	KBOY	730	
	KYJC	1230	A-C
Medford, Wis.	WIGM	1490	M
Medicine Hat, Alta.	CHAT	1270	
Melbourne, Fla.	WMMB	1240	M
Memphis, Tenn.	WHBQ	560	M
	WHER	1430	
	WMC	790	N
	WDIA	1070	
	WMPS	680	
	WHHM	1340	A
	WLOK	1480	
	WREC	600	C
	KWAM	990	
Mena, Ark.	KENA	1450	
Menominee, Mich.	WAGN	1340	A
Menomonie, Wis.	WMNE	1360	
Merced, Calif.	KYOS	1480	M
	KWIP	1580	
Meriden, Conn.	WMMW	1470	
Meridian, Miss.	WCOC	910	C
	WOAL	1330	
	WMOX	1240	
	WOKK	1450	A
	WQIC	1390	
Merrill, Wis.	WXMT	730	
Mesa, Ariz.	KBUZ	1310	
Metropolis, Ill.	WMOK	920	
Mexia, Tex.	KBUS	1590	
Mexico, Mo.	KXEO	1340	M
Mexico, Pa.	WJUN	1220	
Miami, Ariz.	KIKO	1340	
Miami, Fla.	WGBS	710	C
	WCKR	610	N
	WFAB	990	
	WFFC	1220	
	WAME	1260	
	WMIE	1140	
	WQAM	560	
	WSKP	1450	
	WINZ	940	
Miami, Okla.	KGLC	910	
Miami Beach, Fla.	WMET	1490	
	WKAT	1360	M-A-C
	WMBM	790	
Michigan City, Ind.	WIMS	1420	
Middleport-Pomroy, Ohio	WMPO	1390	
Middlesboro, Ky.	WMIK	560	
Middletown, Conn.	WCNX	1150	
Middletown, N.Y.	WALL	1340	
Middletown, Ohio	WPFB	910	
Midland, Mich.	WMDN	1490	
Midland, Ont.	CKMP	1230	
Midland, Tex.	KCRS	550	A
	KJBC	1150	
	KWEL	1600	
Milan, Tenn.	WKBJ	1600	
Miles City, Mont.	KATL	1340	M
Milford, Del.	WKSB	930	
Milford, Mass.	WMRC	1490	
Milledgeville, Ga.	WMVG	1450	M
Millen, Ga.	WGSR	1570	

Location	C.L.	Kc.	N.A.
Millington, Tenn.	WHEY	1220	
Millville, N.J.	WMVB	1440	
Milton, Fla.	WEBY	1330	M
	WSRA	1490	
Milton, Pa.	WMLP	1570	
	WARC	1380	
Milwaukee, Wis.	WEMP	1250	
	WFOX	860	M
	WRIT	1340	
	WISN	1150	A
	WMIL	1290	
	WOKY	920	
	WTMJ	620	N
Minden, La.	KASO	1240	
Mineral Wells, Tex.	KORC	1140	
Mineola, N.Y.	WFYI	1520	
Minneapolis, Minn.	WCCO	830	C
	WLOL	1330	
	WMIN	1400	
	WDGY	1130	
	WPBC	980	
	WTCN	1280	A
	KTIS	900	
	KUOM	770	
Minot, N.Dak.	KLPM	1390	M
	KQDY	1320	
	KCJB	910	C
Mission, Kans.	KBKC	1480	
Mission, Tex.	KIRT	1580	
Missoula, Mont.	KGVO	1290	C
	KXLL	1450	N
	KQTE	1340	M
	KYSS	910	
Mitchell, S.Dak.	KORN	1490	M
Moab, Utah	KURA	1450	
Moberly, Mo.	KNCM	1230	
Mobile, Ala.	WALA	1410	N
	WABB	1480	A
	WGOK	900	
	WKAB	840	
	WKRG	710	C
	WLIQ	1360	
	WMOZ	960	
Mobridge, S.Dak.	KOLY	1300	
Modesto, Calif.	KTRB	860	
	KBEE	970	
	KFIV	1360	A
Mojave, Calif.	KDOL	1340	
Moline, Ill.	WQUA	1230	A
Monahans, Tex.	KVKM	1330	M
Moncton, N. B.	CBAF	1330	
	CKCW	1220	
Monett, Mo.	KRMD	990	
Monmouth, Ill.	WRAM	1330	
Monroe, Ga.	WMRE	1490	
Monroe, La.	KMLB	1440	A-N
	KLIC	1230	M
	KNOE	1390	
Monroe, Mich.	WQTE	560	
Monroe, N.C.	WMAP	1060	
Monroe, Wis.	WEKZ	1260	
Monroeville, Ala.	WMFC	1360	
Monterey, Calif.	KIDD	630	
	KMBY	1240	C
Montevideo, Minn.	KDMA	1460	A
Monte Vista, Colo.	KSLV	1240	
Montgomery, Ala.	WBAM	740	
	WCOV	1170	C
	WAPX	1600	A
	WHHY	1440	N
	WMGY	800	
	WRMA	950	
Montgomery, W.Va.	WMON	1340	M
Monticello, Ark.	KHBM	1430	
Monticello, Ky.	WFLW	1360	
Montmagny, Que.	CKBM	1490	
Montpelier-Barre, Vt.	WSKI	1240	A
Montreal, Que.	CBF	690	
	CBM	940	N
	CFCF	600	A
	CHLP	1410	
	CJAD	800	
	CJMS	1280	
	CKAC	730	C
	CKGM	980	
Montrose, Colo.	KUBC	580	
Montrose, Pa.	WPEL	1250	
Mooresville, N.C.	WHIP	1350	
Moorhead, Minn.	KVOX	1280	M
Moosejaw, Sask.	CHAB	800	
Morehead, Ky.	WMOR	1330	
Morehead City, N.C.	WMBL	740	
Morgan City, La.	KMRC	1430	M
Morganton, N.C.	WMNC	1430	
Morgantown, W.Va.	WAJR	1440	N
	WCLG	1300	
Morrilton, Ark.	KVOM	800	
Morris, Minn.	KMRS	1570	
Morristown, N.J.	WMTR	1250	
Morristown, Tenn.	WCRK	1150	M
	WMTN	1300	
Moscow, Idaho	KRPL	1400	
Moses Lake, Wash.	KSEM	1470	
	KWIQ	1260	
Moultrie, Ga.	WMGA	1400	A
	WMTM	1300	
Moundsville, W.Va.	WMOD	1370	
Mountain Grove, Mo.	KLRS	1360	
Mountain Home, Ark.	KTLO	1490	
Mt. Airy, N.C.	WPAQ	740	
	WSYD	1300	M
Mt. Carmel, Ill.	WVMC	1360	
Mt. Clemens, Mich.	WBRB	1430	
Mt. Dora, Fla.	WMDF	1580	
Mt. Jackson, Va.	WSIG	790	
Mt. Kisco, N.Y.	WVIP	1310	

Location	C.L.	Kc.	N.A.
Mt. Pleasant, Mich.	WCEN	1150	
Mt. Pleasant, Tex.	KIMP	960	
Mt. Shasta, Calif.	KWSD	620	
Mt. Sterling, Ky.	WMST	1150	
Mt. Vernon, Ill.	WMIX	940	
Mt. Vernon, Ind.	WPCO	1590	
Mt. Vernon, Ky.	WRVK	1460	
Mt. Vernon, Ohio	WMVO	1300	
Mt. Vernon, Wash.	KBRC	1430	
Muleshoe, Tex.	KMUL	1380	
Mullins, S.C.	WJAY	1280	
Muncie, Ind.	WLBC	1340	C
Munfordville, Ky.	WLOC	1150	
Munising, Mich.	WMAB	1400	
Murfreesboro, Tenn.	WGNS	1450	
	WMTS	860	
Murphy, N.C.	WCVP	600	
	WKRK	1390	
Murphysboro, Ill.	WINI	1420	
Murray, Ky.	WNBS	1340	
Murray, Utah	KMUR	1230	
Muscatine, Iowa	KWPC	860	
Muscle Shoals City, Alabama	WLAY	1450	
Muskegon, Mich.	WKBZ	850	A
	WTRU	1600	
	WMUS	1090	
Muskogee, Okla.	KBIX	1490	A
	KMUS	1380	
Myrtle Beach, S.C.	WMYB	1450	
Nacogdoches, Tex.	KEEE	1230	A
	KSFA	860	
Nampa, Idaho	KFXD	580	
Nanaimo, B.C.	CHUB	1570	
Nanticoke, Pa.	WNAK	730	
Napa, Calif.	KVON	1440	
Naples, Fla.	WNOG	1270	
Narrows, Va.	WNRV	990	
Nashua, N.H.	WOTW	900	
	WSMN	1590	
Nashville, Ark.	KBHC	1260	
Nashville, Ga.	WNGA	1600	
Nashville, Tenn.	WKDA	1240	
	WLAC	1510	C
	WMAK	1300	
	WNAH	1360	M
	WSIX	980	A
	WSM	650	N
Natchez, Miss.	WMIS	1240	N
	WNAT	1450	M
Natchitoches, La.	KNOC	1450	M
Naugatuck, Conn.	WOWW	860	
Nebraska City, Nebr.	KNCY	1600	
Needles, Calif.	KSFE	1340	
Neenah, Wis.	WNAM	1280	
Neillsville, Wis.	WCCN	1370	
Nelson, B.C.	CKLN	1390	
Neon, Ky.	WNKY	1480	
Neosho, Mo.	KBTN	1420	
Nevada, Mo.	KNEM	1240	
New Albany, Ind.	WOWI	1570	
New Albany, Miss.	WNAU	1470	
Newark, N.J.	WNTA	970	
	WHBI	1280	
	WNJR	1430	
	WVNJ	620	
Newark, N.Y.	WACK	1420	
Newark, Ohio	WCLT	1430	
New Bedford, Mass.	WBSM	1420	
	WNBH	1340	M
New Bern, N.C.	WHIT	1450	M
	WRNB	1490	
Newberry, S.C.	WKDK	1240	
New Boston, Ohio	WIOI	1010	
New Braunfels, Tex	KGNB	1420	
New Britain, Conn.	WHAY	910	A
	WKNB	840	
New Brunswick, N.J.	WCTC	1450	
Newburgh, N.Y.	WGNY	1220	
Newburyport, Mass	WNBP	1470	
New Carlisle, Que.	CHNC	610	
New Castle, Ind.	WCTW	1550	
Newcastle, N.B.	CKMR	790	
New Castle, Pa.	WKST	1280	M
Newcastle, Wyo.	KASL	1240	
New Glasgow, N.S.	CKEC	1320	
New Haven, Conn.	WAVZ	1300	
	WELI	960	
	WNHC	1340	A
New Iberia, La.	KANE	1240	
	KVIM	1360	
New Kensington, Pa.	WKPA	1150	
New London, Conn.	WNLC	1490	M
New Martinsville, W.Va.	WETZ	1330	M
Newnan, Ga.	WCOH	1400	M
New Orleans, La.	WDSU	1280	N
	WJBW	1230	
	WJMR	990	
	WBOK	800	
	WNOE	1060	
	WSMB	1350	A
	WNPS	1450	
	WTIX	690	
	WWL	870	C
	WWOM	600	
	WYLD	940	M
Newport, Ark.	KNBY	1280	
Newport, Ky.	WNOP	740	
Newport, N.H.	WCNL	1010	
Newport, Oreg.	KNPT	1310	
Newport, R.I.	WADK	1540	
Newport, Tenn.	WLIK	1270	
Newport, Vt.	WIKE	1490	
Newport News, Va.	WGH	1310	A
	WTID	1270	

Location	C.L.	Kc.	N.A.
New Richmond, Wis.	WIXK	1590	
New Rochelle, N.Y.	WVOX	1460	
New Smyrna Beach, Fla.	WSBB	1230	M
	WORT	1550	
Newton, Iowa	KCOB	1280	
Newton, Kans.	KJRG	950	
Newton, Miss.	WBKN	1410	
Newton, N.J.	WNNJ	1360	
Newton, N.C.	WNNC	1230	
New Ulm, Minn.	KNUJ	860	
New Westminster, B.C.	CKNW	980	
New York, N.Y.	WABC	770	A
	WBNX	1380	
	WCBS	880	C
	WEVD	1330	
	WHOM	1480	
	WINS	1010	
	WLIB	1190	
	WMCA	570	
	WMGM	1050	
	WNEW	1130	
	WNYC	830	
	WOR	710	M
	WADO	1280	
	WPOW	1330	
	WQXR	1560	
	WNBC	660	N
Niagara Falls, N.Y.	WHLD	1270	
	WJJL	1440	
Niagara Falls, Ont.	CHVC	1600	
Niles, Mich.	WNIL	1290	
Nogales, Ariz.	KNOG	1340	A
Nome, Alaska	KICY	850	
Norfolk, Nebr.	WJAG	780	
Norfolk, Va.	WTAR	790	C
	WCMS	1050	
	WNOR	1230	
	WRAP	850	
Norman, Okla.	WNAD	640	
	KNOR	1400	
Norman Wells, Northwest Territory	CFNW	1240	
Norristown, Pa.	WNAR	1110	
N. Adams, Mass.	WMNB	1230	
N. Augusta, S.C.	WGUS	1380	
	WESN	1550	
N. Battleford, Sask.	CJNB	1460	
North Bay, Ont.	CFCH	600	
North Bend, Oreg.	KBBR	1340	C
Northfield, Minn.	WCAL	770	
Northampton, Mass.	WHMP	1400	M
N. Little Rock, Ark.	KDXE	1380	A
	KXLR	1150	
North Platte, Nebr.	KJLT	970	
	KODY	1240	N
No. Syracuse, N.Y.	WSOQ	1220	M
No. Vancouver, B.C.	CKLG	730	
N. Vernon, Ind.	WOCH	1460	
No. Wilkesboro, N.C.	WKBC	810	
Norton, Va.	WNVA	1350	M
Norwalk, Conn.	WNLK	1350	
Norwich, Conn.	WICH	1310	
Norwich, N.Y.	WCHN	970	
Oakdale, La.	KREH	900	
Oakes, N.Dak.	KEYD	1220	
Oak Grove, La.	KWCL	1280	
Oak Hill, W.Va.	WOAY	860	
Oakland, Calif.	KEWB	910	
	KABL	960	
	KDIA	1310	
Oak Park, Ill.	WOPA	1490	
Oak Ridge, Tenn.	WATO	1290	
Oakville, Ont.	CHWO	1250	
Ocala, Fla.	WMOP	900	
	WTMC	1290	N
	WHYS	1370	
Ocean City, Md.	WETT	1590	
Oceanlake, Oreg.	KBCH	1380	
Oceanside, Calif.	KUDE	1320	
Odessa, Tex.	KECK	920	
	KOSA	1230	C
	KOYL	1310	
	KRIG	1410	M
Oelwein, Iowa	KOEL	950	
Ogallala, Nebr.	KOGA	930	
Ogden, Utah	KLO	1430	M
	KSVN	730	
	KVOG	1490	
Ogdensburg, N.Y.	WSLB	1400	M
Oil City, Pa.	WKRZ	1340	
Okla. City, Okla.	KBYE	890	A
	KLPR	1140	
	KOCY	1340	
	KOMA	1520	
	KTOK	1000	M
	KJEM	800	
	WKY	930	
Okmulgee, Okla.	KOKL	1240	
Old Saybrook, Conn.	WLIS	1420	
Olean, N.Y.	WMNS	1360	
	WHDL	1450	A
Olney, Ill.	WVLN	740	
Olympia, Wash.	KGY	1240	M
	KITN	920	
Omaha, Nebr.	KBON	1490	
	KFAB	1110	N
	KOIL	1290	
	KOOO	1420	
	KMEO	660	
	WOW	590	C
Omak, Wash.	KOMW	680	
Oneida, N.Y.	WONG	1600	
Oneida, Tenn.	WBNT	1310	

Location	C.L.	Kc.	N.A.
O'Neill, Nebr.	KBRX	1350	
Oneonta, Ala.	WCRL	1570	
Oneonta, N.Y.	WDOS	730	
Ontario, Calif.	KASK	1510	
Ontario, Oreg.	KSRV	1380	
Opelika, Ala.	WPHO	1400	M
Opelousas, La.	KSLO	1230	A
Opp, Ala.	WAMI	860	
Opportunity, Wash.	KZUN	630	
Orange, Mass.	WCAT	1390	
Orange, Tex.	KOGT	1600	
Orange, Va.	WJMA	1340	
Orangeburg, S.C.	WDIX	1150	A
	WBPD	1580	
	WTND	920	
Orange Park, Fla.	WAYR	550	
Oregon City, Oreg.	KGON	1520	M
Orillia, Ont.	CFOR	1570	
Orlando, Fla.	WDBO	580	C
	WHOO	990	M
	WHIY	1270	
	WLOF	950	
	WKIS	740	N
Ormond Bch., Fla.	WQXQ	1380	
Orofino, Idaho	KLER	950	
Ortonville, Minn.	KDIO	1350	
Osage Bch., Mo.	KRMS	1150	
Osceola, Ark.	KOSE	860	
Oshawa, Ont.	CKLB	1350	
Oshkosh, Wis.	WOSH	1490	A
Oskaloosa, Iowa	KBOE	740	
Othello, Wash.	KRSC	1400	
Ottawa, Ill.	WCMY	1430	
Ottawa, Kans.	KOFO	1220	
Ottawa, Ont.	CBO	910	
	CFRA	560	
	CKOY	1310	
Ottumwa, Iowa	KBIZ	1240	A
	KLEE	1480	
Owatonna, Minn.	KRFO	1390	
Owego, N.Y.	WEBO	1330	
Owensboro, Ky.	WOMI	1490	M
	WVJS	1420	A
Owen Sound, Ont.	CFOS	560	
Owosso, Mich.	WOAP	1080	
Oxford, Miss.	WSUH	1420	
Oxford, N.C.	WOXF	1340	
Oxnard, Calif.	KOXR	910	
Ozark, Ala.	WOZK	900	
Paducah, Ky.	WKYB	570	N-M
	WDXR	1560	
	WPAD	1450	C
Page, Ariz.	KPGE	1340	
Pahokee, Fla.	WRIM	1250	
Painesville, Ohio	WPVL	1460	
Paintsville, Ky.	WSIP	1490	M
Palatka, Fla.	WWPF	1260	
	WSUZ	800	
Palestine, Tex.	KNET	1450	
Palm Bch., Fla.	WQXT	1340	A
Palm Sprgs., Calif.	KCMJ	1010	C
	KDES	920	
	KPAL	1450	
Palmdale, Calif.	KUTY	1470	
Palo Alto, Calif.	KIBE	1220	
Pampa, Tex.	KPDN	1340	M
	KHHH	1230	
Panama City, Fla.	WDLP	590	
	WPCF	1430	M
Panama City Beach, Fla.	WTHR	1480	
	WSCM	1290	
Paradise, Calif.	KMET	930	
Paragould, Ark.	KDRS	1490	
Paris, Ark.	KCCL	1460	
Paris, Ill.	WPRS	1440	
Paris, Ky.	WKLX	1440	
Paris, Tenn.	WTPR	710	
Paris, Tex.	KPLT	1490	A
	KFTV	1250	
Parkersburg, W.Va.	WCEF	1050	
	WPAR	1450	C
	WTAP	1230	A
Park Falls, Wis.	WPFP	1450	
Parry Sound, Ont.	CKAR-1	1340	
Parsons, Kans.	KLKC	1540	
Pasadena, Calif.	KALI	1430	
	KPPC	1240	
	KRLA	1110	
	KWKW	1300	
Pasadena, Tex.	KLVL	1480	
Pascagoula, Miss.	WPMP	1580	A
Pasco, Wash.	KORD	910	
	KPKW	1340	
Paso Robles, Calif.	KPRL	1230	M
Patchogue, L.I., N.Y.	WALK	1370	
	WPAC	1580	
Paterson, N.J.	WPAT	930	
Pauls Valley, Okla.	KVLH	1470	
Pawtucket, R.I.	WPAW	550	A
Payette, Idaho	KEOK	1450	
Peace River, Alta.	CKYL	630	
Pecos, Tex.	KIUN	1400	M
Peekskill, N.Y.	WLNA	1420	
Pekin, Ill.	WSIV	1140	
Pell City, Ala.	WFHK	1430	
Pembroke, Ont.	CHOV	1350	
Pendleton, Oreg.	KKID	1240	A
	KUBE	1050	
	KUMA	1290	A
Pennington Gap, Va.	WSWV	1570	

Location	C.L.	Kc.	N.A.
Pensacola, Fla.	WBOP	980	
	WDEB	610	
	WBSR	1450	C
	WNVY	1230	A
	WCOA	1370	N
	WPFA	790	
Penticton, B.C.	CKOK	800	
Peoria, Ill.	WAAP	1350	N
	WMBD	1470	C
	WIRL	1290	M
	WPEO	1020	
Perry, Fla.	WPRY	1400	
Perry, Ga.	WPGA	980	
Perryton, Tex.	KEYE	1400	M
Peru, Ind.	WARU	1600	
Petaluma, Calif.	KAFP	1490	
Peterborough, Ont.	CHEX	980	
	CKPT	1420	
Petersburg, Va.	WSSV	1240	M
Petoskey, Mich.	WMBN	1340	
Phenix City, Ala.	WPNX	1460	A
Philadelphia, Miss.	WHOC	1490	
Philadelphia, Pa.	WCAU	1210	C
	WDAS	1480	
	WFIL	560	A
	WFLN	900	
	WHAT	1340	
	WIBG	990	
	WIP	610	
	WJMJ	1540	
	WPEN	950	
	WRCV	1060	N
	WTEL	860	
Philipsburg, Pa.	WPHB	1260	
Phillipsburg, Kans.	KKAN	1490	
Phoenix, Ariz.	KIFN	860	
	KXIV	1400	
	KHAT	1480	
	KHEP	1280	
	KINK	1010	
	KOY	550	A
	KOOL	960	C
	KPHO	910	A
	KUEQ	740	
	KRIZ	1230	
	KTAR	620	N
Picayune, Miss.	WRJW	1320	
Piedmont, Ala.	WPID	1280	
Pierre, S.Dak.	KGFX	630	
	KCCR	1590	
Pikeville, Ky.	WLSI	900	
	WPKE	1240	M
Pine Bluff, Ark.	KCLA	1400	
	KADL	1270	
	KOTN	1490	M
	KPBA	1590	
Pine City, Minn.	WCMP	1350	
Pineville, Ky.	WMLF	1230	
Pineville, W.Va.	WWYO	970	
Pipestone, Minn.	KLOH	1050	
Piqua, Ohio	WPTW	1570	
Pittsburg, Calif.	KKIS	990	
Pittsburg, Kans.	KOAM	860	N
	KSEK	1340	
Pittsburgh, Pa.	KDKA	1020	
	KQV	1410	C
	WCAE	1250	
	WEEP	1080	
	WAMO	860	
	WAMP	1320	N
	WPIT	730	
	WWSW	970	
Pittsfield, Ill.	WBBA	1580	
Pittsfield, Mass.	WBEC	1420	A
	WBRK	1340	M
Pittston, Pa.	WPTS	1540	
Plainfield, N.J.	WERA	1590	
Plainview, Tex.	KVOP	1400	M
	KPLA	1050	
Plant City, Fla.	WPLA	910	
Platteville, Wis.	WSWW	1590	
Plattsburg, N.Y.	WEAV	960	A-N
	WIRY	1340	M
Pleasanton, Tex.	KBOP	1380	
Pleasantville, N.J.	WOND	1400	
Plymouth, Mass.	WPLM	1390	
Plymouth, N.C.	WPNC	1470	
Plymouth, Wis.	WPLY	1420	
Pocahontas, Ark.	KPOC	1420	
Pocatello, Idaho	KSEI	930	N
	KWIK	1240	M
	KYTE	1290	
Pocomoke City, Md.	WDMV	540	
Pointe Claire, Que.	CFOX	1470	
Pomona, Calif.	KWOW	1600	
	KKAR	1220	
Pompano Beach, Fla.	WLOD	980	
	WPOM	1470	A
Ponca City, Okla.	WBBZ	1230	M
Ponce, P.R.	WPRP	910	
	WEUC	1420	
	WPAB	550	
	WLEO	1170	
	WISO	1260	
Pontiac, Mich.	WPON	1460	
Poplar Bluff, Mo.	KWOC	930	
Portage, Pa.	WWML	1470	
Portage, Wis.	WPDR	1350	
Portage la Prairie, Man.	CFRY	1570	
Portageville, Mo.	KMIS	1050	
Port Alberni, B.C.	CJAV	1240	
Portales, N.Mex.	KENM	1450	
Port Angeles, Wash.	KONP	1450	
Port Arthur, Ont.	CFPA	1230	
Port Arthur, Tex.	KOLE	1340	
	KPAC	1250	M
Porterville, Calif.	KTIP	1450	A
Port Hope, Ont.	CHUC	1500	
Port Hueneme, Calif.	KACY	1520	
Port Huron, Mich.	WHLS	1450	
	WTTH	1380	A
Port Jervis, N.Y.	WDLC	1490	
Portland, Ind.	WPGW	1440	
Portland, Maine	WCSH	970	N
	WGAN	560	C
	WLOB	1310	
	WPOR	1490	A-M
Portland, Oreg.	KBPS	1450	
	KBEV	1010	
	KLIQ	1290	
	KEX	1190	
	KGW	620	N
	KOIN	970	C
	KPAM	1410	
	KPDQ	800	
	KPOJ	1330	
	KWJJ	1080	A
	KXL	750	
Port Neches, Tex.	KPNG	1150	
Portsmouth, N.H.	WBBX	1380	
	WHEB	750	
Portsmouth, Ohio	WPAY	1400	C
	WNXT	1260	A
Portsmouth, Va.	WLOW	1400	A
	WAVY	1350	N
Post, Tex.	KUKO	1370	
Poteau, Okla.	KLCO	1280	
Potosi, Mo.	KYRO	1280	
Potsdam, N.Y.	WPDM	1470	
Pottstown, Pa.	WPAZ	1370	
Pottsville, Pa.	WPAM	1450	
	WPPA	1360	M
Poughkeepsie, N.Y.	WEOK	1390	
	WKIP	1450	A
Powell, Wyo.	KPOW	1260	M
Poynette, Wis.	WIBU	1240	
Prairie du Chien, Wis.	WPRE	980	
Pratt, Kans.	KWSK	1570	
Prescott, Ariz.	KYCA	1490	N
	KNOT	1450	A
	KTPA	1370	
	KZOK	1340	
Presque Isle, Me.	WAGM	950	
	WEGP	1390	
Preston, Idaho	KPST	1340	
Prestonsburg, Ky.	WPRT	960	
	WDOC	1310	
Price, Utah	KOAL	1230	M
Prichard, Ala.	WAIP	1270	
Prince Albert, Sask.	CKBI	900	
Prince George, B.C.	CKPG	550	
Prince Rupert, B.C.	CFPR	1240	
Princeton, Ind.	WRAY	1250	
Princeton, Ky.	WPKY	1580	
Princeton, W.Va.	WLOH	1490	A
Prineville, Oreg.	KRCO	690	
Prosser, Wash.	KARY	1310	
Providence, R.I.	WEAN	790	C
	WHIM	1110	
	WICE	1290	
	WJAR	920	N
	WLKW	990	
	WPRO	630	
	WRIB	1220	M
Provo, Utah	KIXX	1400	A
	KEYY	1450	
	KOVO	960	M
Pryor, Okla.	KOLS	1570	
Pueblo, Colo.	KDZA	1230	
	KAPI	690	
	KFEL	970	
	KGHF	1350	A-M
	KCSJ	590	
	KTUX	1480	
Pulaski, Tenn.	WKSR	1420	A
Pulaski, Va.	WPUV	1580	
Pullman, Wash.	KWSC	1250	
	KOFE	1150	
Punta Gorda, Fla.	WCCF	1580	
Punxsutawney, Pa.	WPME	1540	
Putnam, Conn.	WINY	1350	
Puyallup, Wash.	KAYE	1450	
Quanah, Tex.	KOLJ	1150	
Quebec, Que.	CBV	980	
	CHRC	800	
	CJLR	1060	
	CJQC	1340	
	CKCV	1280	
Quesnel, B.C.	CKCQ	570	
Quincy, Fla.	WCNH	1230	M
Quincy, Ill.	WGEM	1440	A
	WTAD	930	C
Quincy, Mass.	WJDA	1300	
Quincy, Wash.	KPOR	1370	
Quitman, Ga.	WSFB	1490	
Racine, Wis.	WRAC	1460	
	WRJN	1400	A
Radford, Va.	WRAD	1460	
Raleigh, N.C.	WKIX	850	A
	WPTF	680	N
	WSHE	570	
	WRAL	1240	
Rapid City, S.Dak.	KOTA	1380	C
	KRSD	1340	
	KEZU	920	
Raton, N.Mex.	KRTN	1490	A
Ravenswood, W.Va.	WMOV	1360	
Rawlins, Wyo.	KRAL	1240	M
Raymond, Wash.	KAPA	1340	
Raymondville, Tex.	KSOX	1240	
Rayville, La.	KRIH	990	
Reading, Pa.	WEEU	850	A
	WHUM	1240	C
	WRAW	1340	N
Redding, Calif.	KROG	1280	M
	KPAP	1270	
	KSDA	1400	
	KVCV	600	C
	KVIP	540	
Red Bluff, Calif.	KBLF	1490	
Red Deer, Alta.	CKRD	850	
Redlands, Calif.	KCAL	1410	
Red Lion, Pa.	WGCB	1440	
Redmond, Oreg.	KPRB	1240	
Red Wing, Minn.	KCUE	1250	
Redwood Falls, Minn.	KLGR	1490	
Reedsburg, Wis.	WRDB	1400	
Reedsport, Oreg.	KROP	1470	
Regina, Sask.	CBK	540	
	CJME	1300	
	CKCK	620	
	CKRM	980	
Reidsville, N.C.	WFRC	1600	A
	WREV	1220	
Remsen, N.Y.	WREM	1480	
Reno, Nev.	KOH	630	N
	KBET	1340	M
	KOLO	920	C
	KONE	1450	
	KDOT	1230	
Renton, Wash.	KUDY	910	
Rexburg, Idaho	KRXK	1230	
Rhinelander, Wis.	WOBT	1240	
Rice Lake, Wis.	WJMC	1240	
Richfield, Utah	KSVC	980	
Richland, Wash.	KALE	960	
Richland, Wis.	WRCO	1450	
Richlands, Va.	WRIC	540	
Richmond, Ind.	WKBV	1490	A
Richmond, Ky.	WEKY	1340	M
Richmond, Va.	WANT	990	
	WBBL	1480	
	WEZL	1590	
	WLEE	1480	N
	WEET	1320	
	WMBG	1380	A
	WRNL	910	M
	WRVA	1140	N
	WXGI	950	
Richmond Hill, Ont.	CJRH	1310	
Richwood, W.Va.	WVAR	1280	
Ridgecrest, Calif.	KRCK	1360	
	KRKS	1240	
Rimouski, Que.	CJBR	900	
Rio Piedras, P.R.	WRIO	1320	
	WKYN	630	
	WWWW	1520	
Ripley, Tenn.	WTRB	1570	
Ripon, Wis.	WCWC	1600	
Riverhead, N.Y.	WRIV	1390	
	WAPC	1570	
Riverside, Calif.	KPRO	1440	
	KACE	1570	
Riverton, Wyo.	KWRL	1450	M
Riviera Beach, Fla.	WHEW	1600	
Riviere du Loup, Que.	CJFP	1400	
Roanoke, Ala.	WELR	1360	
Roanoke, Va.	WDBJ	960	C
	WRIS	1410	M
	WHYE	910	
	WROV	1240	A
	WSLS	610	N
Roanoke Rapids, N.C.	WCBT	1230	M
Roaring Sprgs., Pa.	WKMC	1370	
Roberval, Que.	CHRL	910	
Robinson, Ill.	WTAY	1570	
Rochester, Minn.	KROC	1340	N
	KWEB	1270	
Rochester, N.H.	WWNH	930	
Rochester, N.Y.	WBBF	950	M
	WHAM	1180	N
	WHEC	1460	C
	WRVM	680	
	WSAY	1370	
	WVET	1280	A
Rockford, Ill.	WROK	1440	A
	WJRL	1150	
	WRRR	1330	
Rock Hill, S.C.	WRHI	1340	M
	WTYC	1150	
Rockingham, N.C.	WAYN	900	
Rock Island, Ill.	WHBF	1270	C
Rockland, Maine	WRKD	1450	A
Rockmart, Ga.	WPLK	1220	
Rock Springs, Wyo.	KVRS	1360	M
Rockville, Md.	WINX	1600	
Rockwood, Tenn.	WRKH	580	
Rocky Ford, Colo.	KAVI	1320	
Rocky Mount, N.C.	WCEC	810	
	WEED	1390	A
	WRMT	1490	
	WKWS	1290	
Rocky Mount, Va.	WYTI	1570	
Rogers, Ark.	KAMO	1390	
Rogers City, Mich.	WHAK	960	
Rogersville, Tenn.	WRGS	1370	
Rolla, Mo.	KCLU	1590	
	KTTR	1490	
Rome, Ga.	WLAQ	1410	A
	WRGA	1470	M
	WROM	710	
Rome, N.Y.	WKAL	1450	A
	WRNY	1350	
Ronceverte, W.Va.	WRON	1400	
Roseburg, Oreg.	KRNR	1490	C
	KRXL	1250	
	KQEN	1240	A
Rosenberg, Tex.	KFRD	980	
Rossville, Ga.	WRIP	980	
Roswell, N.Mex.	KSWS	1230	
	KGFL	1400	M
	KBIM	910	
Rouyn, Que.	CKRN	1400	
Roxboro, N.C.	WRXO	1430	
Royal Oak, Mich.	WEXL	1340	
Ruidoso, N.M.	KYAP	1340	
Rumford, Me.	WRUM	790	
Rupert, Idaho	KAYT	970	
Rushton, La.	KRUS	1490	
Rusk, Texas	KTLU	1580	
Russell, Kans.	KRSL	990	
Russellville, Ala.	WWWR	920	
Russellville, Ark.	KXRJ	1490	
Russellville, Ky.	WRUS	610	
Rutland, Vt.	WHWB	1000	
	WSYB	1380	M
Sackville, N.B.	CBA	1070	
Sacramento, Calif.	KCRA	1320	N
	KFBK	1530	A
	KGMS	1380	M
	KRAK	1140	
	KROY	1240	C
	KXOA	1470	
Safford, Ariz.	KGLU	1480	A
Saginaw, Mich.	WKNX	1210	
	WSAM	1400	N
	WSGW	790	M
St. Albans, Vt.	WWSR	1420	
St. Albans, W.Va.	WKLC	1300	
St. Augustine, Fla.	WFOY	1240	C
	WSTN	1420	
St. Boniface, Man.	CKSB	1050	
St. Catherines, Ont.	CKTB	610	
St. Charles, Mo.	KADY	1460	
St. Cloud, Minn.	KFAM	1450	N
	WJON	1240	
Ste. Anne de la Pocatiere, Que.	CHGB	1350	
St. George, Utah	KDXU	1450	
Ste. Genevieve, Mo.	KSGM	980	
St. Helen, Mich.	WMIC	1590	
St. Helens, Oreg.	KOHI	1600	
St. Hyacinthe, Que.	CKBS	1240	
St. Jean, Que.	CHRS	1090	
St. Jerome, Que.	CKJL	900	
Saint John, N.B.	CFBC	930	
	CHSJ	1150	
St. Johns, Mich.	WJUD	1580	
St. John's, Nfld.	CBN	640	
	CJON	930	
	VOAR	1230	
	VOCM	590	
	VOWR	800	
St. Johnsbury, Vt.	WTWN	1340	
St. Joseph, Mich.	WSJM	1400	
St. Joseph, Mo.	KFEQ	680	
	KRES	1550	M
	KUSN	1270	
St. Joseph d'Alma, Que.	CFGT	1270	
St. Louis, Mo.	KATZ	1600	
	KFUO	850	
	KMOX	1120	C
	KSD	550	N
	KSTL	690	
	KWK	1380	
	KXOK	630	
	WEW	770	M
	WIL	1430	A
St. Louis Park, Minn.	KRSI	950	
St. Mary's, Pa.	WKBI	1400	
St. Paul, Minn.	KSTP	1500	N
	KDWB	630	M
St. Peter, Minn.	KRBI	1310	
St. Petersburg, Fla.	WPIN	680	
	WSUN	620	A
	WLCY	1380	M
St. Petersburg Beach, Fla.	WILZ	1590	
St. Thomas, Ont.	CHLO	680	
Salamanca, N.Y.	WGGO	1590	
Salem, Ill.	WJBD	1350	
Salem, Ind.	WSLM	1220	
Salem, Mass.	WESX	1230	M
Salem, Mo.	KSMO	1340	
Salem, Oreg.	KSLM	1390	A
	KBZY	1490	N
	KGAY	1430	
Salem, Va.	WBLU	1480	
Salida, Colo.	KVRH	1340	M
Salina, Kans.	KSAL	1150	M
Salinas, Calif.	KDON	1460	
	KSBW	1380	M
Saline, Mich.	WOIA	1290	
Salisbury, Md.	WBOC	960	
	WICO	1320	A
	WJDY	1470	
Salisbury, N.C.	WSTP	1490	M
	WSAT	1280	A
Salmon, Idaho	KSRA	960	
Salt Lake City, Utah	KALL	910	M
	KCPX	1320	N
	KLUB	570	A
	KNAK	1280	
	KSL	1160	C
	KSOP	1370	
	KSXX	630	
	KWHO	860	
	KWIC	1570	
San Angelo, Tex.	KTXL	1340	
	KGKL	960	A
	KPEP	1420	
	KWFR	1260	

Location	C.L.	Kc.	N.A.
San Antonio, Tex.	KAPE	1480	
	KCOR	1350	
	KENS	680	C
	KIKK	1150	
	KITE	930	
	KUKA	1250	
	KUBO	1310	
	KMAC	630	A
	KONO	860	
	KTSA	550	
	WOAI	1200	
San Bernardino, Calif.			
	KCKC	1350	
	KFXM	590	
	KRNO	1240	
	KITO	1290	M
Sandersville, Ga.	WSNT	1490	
San Diego, Calif.	KCBQ	1170	
	KFMB	540	C
	KFSD	600	N
	KGB	1360	A
	KSON	1240	
	KSDO	1130	
Sandpoint, Idaho	KSPT	1400	
Sandusky, Ohio	WLEC	1450	M
San Fernando, Calif.	KGIL	1260	
Sanford, Fla.	WTRR	1400	
	WSFR	1360	
Sanford, Me.	WSME	1220	
Sanford, N.C.	WEYE	1290	
	WWGP	1050	
San Francisco, Calif.	KFRC	610	M
	KCBS	740	C
	KFAX	1100	
	KGO	810	
	KNBC	680	N
	KQBY	1550	M
	KSAY	1010	
	KSAN	1450	
	KSFO	560	
	KYA	1260	
San German, P.R.	WRJS	1050	
San Jose, Calif.	KLOK	1170	
	KLIV	1590	
	KEEN	1370	
	KXRX	1500	
San Juan, P.R.	WAPA	680	M
	WHOA	870	
	WIAC	740	
	WIPR	940	
	WKAQ	580	C
	WKVM	1230	
	WITA	1140	
San Luis Obispo, Calif.			
	KATY	1340	
	KCJH	1280	
	KSLY	1400	
	KVEC	920	M
San Marcos, Tex.	KCNY	1470	
San Mateo, Calif.	KOFY	1050	
San Rafael, Calif.	KTIM	1510	
San Saba, Tex.	KBAL	1410	
Santa Ana, Calif.	KWIZ	1480	
Santa Barbara, Cal.	KDB	1490	
	KGUD	990	
	KIST	1340	N
	KTMS	1250	A-M
Santa Cruz, Calif.	KSCO	1080	
Santa Fe, N.Mex.	KTRC	1400	A
	KVSF	1260	C
Santa Maria, Cal.	KCOY	1400	
	KSMA	1240	
Santa Monica, Cal.	KDAY	1580	
Santa Paula, Calif.	KSPA	1400	
Santa Rosa, Calif.	KSRO	1350	
	KJAX	1150	
Santa Rosa, N.Mex.	KSYX	1420	
Saranac Lake, N.Y.	WNBZ	1240	A
Sarasota, Fla.	WKXY	930	
	WSPB	1450	C
	WYND	1280	
Saratoga Springs, N.Y.			
	WSPN	900	
	WRSA	1280	
Sarnia, Ont.	CHOK	1070	
Saskatoon, Sask.	CFQC	600	
	CFNS	1170	
	CKOM	1420	
Saugerties, N.Y.	WGHQ	920	
Sault Ste. Marie, Michigan	WSOO	1230	
Sault Ste. Marie, Ontario	CJIC	1050	
	CKCY	1400	
Savannah, Ga.	WCCP	1450	M
	WJIV	900	
	WSAV	630	N
	WSGA	1400	
	WTOC	1290	C
	WSOK	1230	A
Savannah, Tenn.	WORM	1010	
Sayre, Pa.	WATS	960	
Schefferville, Que.	CFKL	1230	
Schenectady, N.Y.	WGY	810	N
	WSNY	1240	
Scotland Neck, N.C.	WYAL	1280	
Scottsbluff, Nebr.	KNEB	960	M
	KOLT	1320	C
Scottsboro, Ala.	WCRI	1050	
	WROS	1330	
Scottsdale, Ariz.	KPOK	1440	
Scottsville, Ky.	WLCK	1250	
Scranton, Pa.	WARM	590	A
	WEJL	630	
	WGBI	910	C
	WICK	1400	
	WSCR	1320	N

Location	C.L.	Kc.	N.A.
Seaford, Del.	WSUX	1280	
Searcy, Ark.	KWCB	1300	
Seaside, Oreg.	KSRG	730	
Seattle, Wash.	KAYO	1150	
	KING	1090	A
	KIRO	710	C
	KJR	950	
	KOL	1300	
	KOMO	1000	N
	KTIX	1590	
	KTW	1250	
	KVI	570	
	KXA	770	
Sebring, Fla.	WJCM	960	
	WSEB	1340	
Sedalia, Mo.	KDRO	1490	
	KSIS	1050	
Seguin, Tex.	KWED	1580	
Selma, Ala.	WGWC	1340	C
	WHBB	1490	
	WRWJ	1570	
Seminole, Tex.	KSML	1250	
Seneca Township, S.C.	WSNW	1150	
Sevierville, Tenn.	WSEV	930	
Seward, Alaska	KIBH	1340	C-A
Seymour, Ind.	WJCD	1390	
Seymour, Tex.	KSEY	1230	
Shamokin, Pa.	WISL	1480	
Shamrock, Tex.	KBYP	1580	
Sharon, Pa.	WPIC	790	
Shawano, Wis.	WTCH	960	
Shawinigan, Que.	CKSM	1220	
Shawnee, Okla.	KGFF	1450	M
Sheboygan, Wis.	WHBL	1330	A
	WKTL	950	
Shelby, Mont.	KSEN	1150	M
Shelby, N.C.	WOHS	730	M
	WADA	1390	
Shelbyville, Tenn.	WHAL	1400	
	WLIJ	1580	
Shenandoah, Iowa	KFNF	920	
	KMA	960	A
Sherbrooke, Que.	CHLT	630	
	CKTS	900	
Sheridan, Wyo.	KWYO	1410	M
Sherman, Tex.	KRRV	910	M
	KTXO	1500	
Show Low, Ariz.	KVWM	1050	
Shreveport, La.	KANB	1300	
	KBCL	1220	
	KCIJ	1050	
	KEEL	710	
	KREB	1550	M
	KJOE	1480	
	KOKA	980	
	KRMD	1340	A
	KWKH	1130	C
Sidney, Mont.	KGCX	1480	M
Sidney, Nebr.	KSID	1340	A
Sierra Vista, Ariz.	KHFH	1420	A
Sikeston, Mo.	KSIM	1400	
Siler City, N.C.	WNCA	1570	
Siloam Sprgs., Ark.	KUOA	1290	M
Silsbee, Tex.	KKAS	1300	
Silver City, N.Mex.	KSIL	1340	C
Silver Sprgs., Md.	WQMR	1050	
Simcoe, Ont.	CFRS	1560	
Sinton, Tex.	KTOO	1590	
Sioux City, Iowa	KSCJ	1360	A
	KMNS	620	
	KTRI	1470	
Sioux Falls, S.Dak.	KISD	1230	
	KELO	1320	
	KIHO	1270	
	KSOO	1140	A
Sitka, Alaska	KIFW	1230	C-A
	KSEW	1400	
Skowhegan, Maine	WGHM	1150	
Smithfield, N.C.	WMPM	1270	
Smiths Falls, Ont.	CJET	630	
Snyder, Tex.	KSNY	1450	M
Socorro, N.Mex.	KSRC	1290	
Soda Sprgs., Idaho	KBRV	540	
Somerset, Ky.	WSFC	1240	M
	WTLO	1480	
Somerset, Pa.	WVSC	990	
Sonora, Calif.	KROG	1450	
Sorel, P.Q.	CJSO	1320	
So. Bend, Ind.	WNDU	1490	A
	WJVA	1580	M
	WSBT	960	C
Southbridge, Mass.	WESO	970	
So. Boston, Va.	WHLF	1400	A
Southern Pines, N.C.	WEEB	990	
South Daytona Beach, Florida	WELE	1590	
So. Gastonia, N.C.	WGAS	1420	
So. Paris, Me.	WKTQ	1450	
So. Pittsburg, Tenn.	WEPG	910	
So. St. Paul, Minn.	WISK	630	M
So. Williamsport, Pa.	WMPT	1450	
Spanish Fork, Utah	KONI	1480	
Sparks, Nev.	KBUB	1270	
Sparta, Ill.	WHCO	1230	
Sparta, Tenn.	WSMT	1050	
Sparta, Wis.	WKLJ	990	
Spartanburg, S.C.	WTHE	1400	M
	WORD	910	N
	WSPA	950	C
Spencer, Iowa	KICD	1240	
Spokane, Wash.	KGA	1510	A
	KLYK	1230	
	KPEG	1380	
	KHQ	590	N
	KNEW	790	M
	KREM	970	

Location	C.L.	Kc.	N.A.
	KXLY	920	C
	KCFA	1330	
Springdale, Ark.	KBRS	1340	A
Springfield, Ill.	WCVS	1450	A-M
	WMAY	970	N
	WTAX	1240	C
Springfield, Mass.	WBZA	1030	
	WHYN	560	C
	WMAS	1450	M
	WSPR	1270	
Springfield, Mo.	KGBX	1260	N
	KICK	1340	
	KTTS	1400	C
	KWTO	560	A
Springfield, Ohio	WIZE	1340	A
	WBLY	1600	
Springfield, Oreg.	KEED	1050	
Springfield, Tenn.	WDBL	1590	
Springfield, Vt.	WCFR	1480	
Springhill, La.	KBSF	1460	
Spruce Pine, N.C.	WTOE	1470	
Stamford, Conn.	WSTC	1400	A
Stamford, Tex.	KDWT	1200	
Starke, Fla.	WRGR	1490	
Starkville, Miss.	WSSO	1230	
State College, Pa.	WMAJ	1450	M
Statesboro, Ga.	WWNS	1240	
Statesville, N.C.	WSIC	1400	
	WDBM	550	
Staunton, Va.	WTON	1240	A
	WAFC	900	
Stephenville, Tex.	KSTV	1510	
Sterling, Colo.	KGEK	1230	
	KOLR	1490	
Sterling, Ill.	WSDR	1240	
Steubenville, Ohio	WSTV	1340	M
Stevens Point, Wis.	WSPT	1010	
	WLBL	930	
Stillwater, Minn.	WAVN	1220	
Stillwater, Okla.	KSPI	780	
Stockton, Calif.	KJOY	1280	
	KSTN	1420	
	KWG	1230	A-M
Storm Lake, Iowa	KAYL	990	
Stratford, Ont.	CJCS	1240	
Streator, Ill.	WIZZ	1250	
Stroudsburg, Pa.	WVPO	840	
Stuart, Fla.	WSTU	1450	M
Stuart, Va.	WHEO	1270	
Sturgeon Bay, Wis.	WOOR	910	
Sturgis, Mich.	WSTR	1230	
Stuttgart, Ark.	KWAK	1240	M
Sudbury, Ont.	CKSO	790	
	CFBR	550	
	CHNO	900	
Suffolk, Va.	WLPM	1460	A
Sulphur, La.	KIKS	1310	
Sulphur Sprgs., Tex.	KSST	1230	
Summerside, P.E.I.	CJRW	1240	
Summerville, Ga.	WGTA	950	
Sumter, S.C.	WFIG	1290	M
	WDXY	1240	
	WSSC	1340	A
Sunbury, Pa.	WKOK	1240	C
Sunnyside, Wash.	KREW	1230	
Sun Valley, Ida.	KSKI	1340	
Superior, Nebr.	KRFS	1600	
Superior, Wis.	WDSM	710	N
	WQMN	1320	
Susanville, Calif.	KSUE	1240	
Swainsboro, Ga.	WJAT	800	
Sweetwater, Tenn.	WDEH	800	
Sweetwater, Tex.	KXOX	1240	
Swift Current, Sask.	CKSW	1400	
Sydney, N.S.	CBI	1570	
	CJCB	1270	
Sylacauga, Ala.	WFEB	1340	M
	WMLS	1290	
Sylva, N.C.	WMSJ	1480	
Sylvania, Ga.	WSYL	1490	
Syracuse, N.Y.	WHEN	620	C
	WFBL	1390	
	WNDR	1260	
	WOLF	1490	A
	WSYR	570	N
Tabor City, N.C.	WTAB	1370	
Tacoma, Wash.	KMO	1360	
	KTAC	850	
	KTNT	1400	
	KVI	570	M
Taft, Calif.	KTKR	1310	
Tahlequah, Okla.	KTLQ	1350	
Talladega, Ala.	WJHB	1580	
	WNUZ	1230	M
Tallahassee, Fla.	WMEN	1330	
	WRFB	1580	
	WTAL	1270	
	WTNT	1450	A-M-C
Tallassee, Ala.	WTLS	1300	
Tallulah, La.	KTLD	1360	
Tampa, Fla.	WALT	1110	
	WOAE	1250	C
	WZST	1550	
	WFLA	970	N
	WHBO	1050	
	WINQ	1010	
	WTMP	1150	
	WSOL	1300	
Tarboro, N.C.	WCPS	760	
Tarpon Sprgs., Fla.	WDCL	1470	
Tasley, Va.	WESR	1330	
Taunton, Mass.	WPEP	1570	
Tawas City, Mich.	WIOS	1480	
Taylor, Tex.	KTAE	1260	
Taylorville, Ill.	WTIM	1410	
Tazewell, Tenn.	WNTT	1250	
Tell City, Ind.	WTCJ	1230	
Tempe, Ariz.	KUPD	1060	
	KYND	1580	

Location	C.L.	Kc.	N.A.
Temple, Tex.	KTEM	1400	
Terrace, B.C.	CFTK	1140	
Terre Haute, Ind.	WBOW	1230	N
	WMFT	1300	
	WTHI	1480	C
Terrell, Tex.	KTER	1570	
Texarkana, Ark.	KOSY	790	M
Texarkana, Tex.	KCMC	1230	A
	KTFS	1400	
Texas City, Tex.	KTLW	920	
Thayer, Mo.	KALM	1290	
The Dalles, Oreg.	KODL	1440	
	KRMW	1300	
Thermopolis, Wyo.	KRTR	1490	M
	KTHE	1240	
Thief River Falls, Minn.	KTRF	1230	
Thetford Mines, Que.	CKLD	1230	
Thibodaux, La.	KTIB	630	
Thomaston, Ga.	WSFT	1220	
Thomasville, Ala.	WJDB	630	
Thomasville, Ga.	WPAX	1240	
	WKTG	730	
Thomasville, N.C.	WTNC	790	
Thomson, Ga.	WTWA	1240	M
Three Rivers, Que.	CHLN	550	
	CKTR	1150	
Ticonderoga, N.Y.	WIPS	1250	
Tiffin, Ohio	WTTF	1600	
Tifton, Ga.	WTIF	1340	
	WWGS	1430	
Tillamook, Oreg.	KTIL	1590	
Tillsonburg, Ont.	CKOT	1510	
Timmins, Ont.	CFCL	620	
	CKGB	680	
Titusville, Fla.	WRMF	1060	
Toccoa, Ga.	WLET	1420	M
	WNEG	1320	
Toledo, Ohio	WOHO	1470	M
	WSPD	1370	N
	WTOD	1560	C
	WTOL	1230	A
Toledo, Oreg.	KLUU	1230	
Tomah, Wis.	WTMB	1460	
Tompkinsville, Ky.	WTKY	1370	
Tooele, Utah	KOYL	990	
Topeka, Kans.	WIBW	580	C
	KJAY	1440	
	WREN	1250	A
	KTOP	1490	M
Toppenish, Wash.	KENE	1490	
Toronto, Ont.	CBL	740	N
	CFRB	1010	C
	CHUM	1050	
	CJBC	860	
	CKEY	580	M
	CKFH	1430	
Torrington, Conn.	WBZY	990	
	WTOR	1490	M
Torrington, Wyo.	KGOS	1490	
Towanda, Pa.	WTTC	1550	
Towson, Md.	WAQE	1570	
Trail, B.C.	CJAT	610	
Traverse City, Mich.	WTCM	1400	
	WCOW	1310	
	WCCW	1310	
Trenton, Mo.	KTTN	1600	
Trenton, N.J.	WAAT	1300	
	WBUD	1260	
	WTTM	920	N
Trinidad, Colo.	KCRT	1240	M
Troy, Ala.	WTBF	970	M
Troy, N.Y.	WHAZ	1330	
	WTRY	980	
Truckee, Calif.	KHOE	1400	
Truro, N.S.	CKCL	600	
Truth or Consequences, New Mexico	KCHS	1400	
Tryon, N.C.	WTYN	1550	M
Tucson, Ariz.	KTUC	1400	A
	KAIR	1490	
	KCEE	790	
	KTAN	580	A
	KCUB	1290	N
	KEVT	690	
	KMBO	940	
	KMOP	1330	
	KSWC	1550	
	KTKT	990	
	KOLD	1450	C
Tucumcari, N.Mex.	KTNM	1400	M
Tulare, Calif.	KCOK	1270	M
	KGEN	1370	
Tulia, Tex.	KTUE	1260	
Tullahoma, Tenn.	WJIG	740	
Tulsa, Okla.	KAKC	970	
	KOME	1300	
	KRMG	740	
	KTUL	1430	C
	KVOO	1170	N
	KFMJ	1050	
Tupelo, Miss.	WELO	580	M
	WTUP	1490	A
Turlock, Calif.	KTUR	1390	
Tuscaloosa, Ala.	WJRD	1150	
	WACT	1420	
	WNPT	1280	A
	WTUG	790	
	WTBC	1230	M
Tuscumbia, Ala.	WVNA	1590	
	WCHP	1410	
Tuskegee, Ala.	WABT	580	
Twin Falls, Idaho	KTFI	1270	N
	KLIX	1310	M
	KEEP	1450	
Two Rivers, Wis.	WTRW	1590	

Location	C.L.	Kc.	N.A.
Tyler, Tex.	KDOK	1330	
	KGJB	1490	M
	KTBB	600	A
	KZEY	690	
Tyrone, Pa.	WTRN	1340	
Ukiah, Calif.	KUKI	1400	
Union, Mo.	KLPW	1220	
Union, S.C.	WBCU	1460	
Union City, Tenn.	WENK	1240	
Uniontown, Pa.	WMBS	590	C
Urbana, Ill.	WILL	580	
	WKID	1580	
Utica, N.Y.	WIBX	950	C
	WRUN	1150	
	WTLB	1310	A
Uvalde, Tex.	KVOU	1400	
Val D'Or, Que.	CKVD	1230	
Valdosta, Ga.	WGOV	950	M
	WGAF	910	A
	WJEM	1150	
	WVLD	1450	
Vallejo, Calif.	KNBA	1190	
Valley City, N.Dak.	KOVC	1490	M
Valparaiso-Niceville, Fla.	WNSM	1340	
Van Buren, Ark.	KFDF	1580	
Van Cleve, Ky.	WMTC	730	
Van Wert, Ohio	WERT	1220	
Vanceburg, Ky.	WKKS	1570	
Vancouver, B.C.	CBU	690	
	CFUN	1410	
	CHQM	1320	
	CJOR	600	
	CKWX	1130	M
Vancouver, Wash.	KKEY	1150	
	KISN	910	
Venice, Fla.	WAMR	1320	
Ventura, Calif.	KVEN	1450	M
	KUDU	1590	
Verdun, Que.	CKVL	850	
Vermillion, S.Dak.	KUSD	690	
Vernal, Utah	KVEL	1250	
Vernon, B.C.	CJIB	940	
Vernon, Tex.	KVWC	1490	
Vero Beach, Fla.	WAXE	1370	
	WTTB	1490	A
Vicksburg, Miss.	WQBC	1420	M
	WVIM	1490	
Victoria, B.C.	CJVI	900	
	CFAX	810	
	CKDA	1220	
Victoria, Tex.	KNAL	1410	
	KVIC	1340	M
Victoriaville, Que.	CFDA	1380	
Vidalia, Ga.	WVOP	970	
Vieques, P.R.	WIVV	1370	
Ville Marie, Que.	CKVM	710	
Ville Platte, La.	KVPI	1050	
Ville St. Georges, Que.	CKRB	1460	
Vincennes, Ind.	WAOV	1450	M
Vineland, N.J.	WWBZ	1360	
	WDVL	1270	
Vinita, Okla.	KVIN	1470	
Virginia, Minn.	WHLB	1400	N
Virginia Bch., Va.	WBOF	1550	
Viroqua, Wis.	WISV	1360	
Visalia, Calif.	KONG	1400	
Waco, Tex.	WACO	1460	A
	KWTX	1230	M
Wadena, Minn.	KWAD	920	M
Wadesboro, N.C.	WADE	1210	
Wailuku, Hawaii	KMVI	550	N
Waipahu, Hawaii	KAHU	920	
Walhalla, S.C.	WGOG	1460	
Wallace, Idaho	KWAL	620	M
Wallace, N.C.	WLSE	1400	
Walla Walla, Wash.	KHIT	1320	
	KUJ	1420	M
	KTEL	1490	A

Location	C.L.	Kc.	N.A.
Walnut Ridge, Ark.	KRLW	1320	
Walsenburg, Colo.	KFLJ	1380	
Walterboro, S.C.	WALD	1220	A
Waltham, Mass.	WCRB	1330	
Walton, N.Y.	WDLA	1270	
Ward Ridge, Fla.	WJOE	1570	
Ware, Mass.	WARE	1250	M
Warner Robbins, Ga.	WRPB	1350	
Warren, Ark.	KWRF	860	
Warren, Ohio	WHHH	1440	
Warren, Pa.	WNAE	1310	
Warrensburg, Mo.	KOKO	1450	
Warrenton, Mo.	KWRE	730	
Warrenton, Va.	WEER	1570	
	WKCW	1420	
Warsaw, Ind.	WRSW	1480	
Warsaw, Va.	WNNT	690	
Warwick-E.Greenwich, R.I.	WYNG	1590	
Wasco, Calif.	KWSO	1050	
Washington, D.C.	WGMS	570	
	WMAL	630	A
	WOL	1450	M
	WOOK	1340	
	WWDC	1260	
	WRC	980	N
	WTOP	1500	C
Washington, Ga.	WKLE	1370	
Washington, Ind.	WAMW	1580	
Washington, N.J.	WCRV	1580	
	WRRF	930	A
Washington, Pa.	WJPA	1450	M
Washington Court House, Ohio	WCHO	1250	
Waterbury, Conn.	WATR	1320	A
	WBRY	1590	C
	WWCO	1240	M
Waterbury, Vt.	WDEV	550	M
Waterloo, Iowa	KXEL	1540	A
	KNWS	1090	
	KWWL	1330	M
Watertown, N.Y.	WATN	1240	
	WOTT	1410	
	WWNY	790	C
Watertown, S.Dak.	KWAT	950	M
Watertown, Wis.	WTTN	1580	
Waterville, Me.	WTVL	1490	A
Watsonville, Calif.	KOMY	1340	
Wauchula, Fla.	WAUC	1310	
Waukegan, Ill.	WKRS	1220	
Waukesha, Wis.	WAUX	1510	
Waupaca, Wis.	WDUX	800	A
Wausau, Wis.	WRIG	1400	N
	WSAU	550	A
	WHVF	1230	
Waverly, Iowa	KWVY	1470	
Waverly, Ohio	WPKO	1380	
Waxahachie, Tex.	KBEC	1390	
Waycross, Ga.	WACL	570	
	WAYX	1230	M
Waynesboro, Ga.	WBRO	1310	
Waynesboro, Miss.	WABO	990	
Waynesboro, Pa.	WAYZ	1380	
Waynesboro, Va.	WAYB	1490	M
Waynesburg, Pa.	WANB	1580	
Waynesville, N.C.	WHCC	1400	
Weatherford, Tex.	KZEE	1220	
Webster City, Iowa	KJFJ	1570	
Weed, Calif.	KDAD	800	
Weirton, W.Va.	WEIR	1430	
Weiser, Idaho	KWEI	1260	
Welch, W.Va.	WELC	1150	
	WOVE	1340	M
Weldon, N.C.	WCNF	1400	
Welland, Ontario	CHOW	1470	
Wellsboro, Pa.	WNBT	1490	M
Wellston, Ohio	WKOV	1330	
Wellsville, N.Y.	WLSV	790	
Wenatchee, Wash.	KPQ	560	A
	KUEN	900	
	KMEL	1340	M

Location	C.L.	Kc.	N.A.
Wendell-Zebulon, N.C.	WETC	540	
Weslaco, Tex.	KRGV	1290	N
W. Bend, Wis.	WBKV	1470	
Westbrook, Me.	WJAB	1440	
W. Frankfort, Ill.	WFRX	1300	
West Jefferson, N.C.	WKSK	1600	
W. Monroe, La.	KUZN	1310	
W. Palm Beach, Fla.	WEAT	850	N
	WJNO	1230	C
	WIRK	1290	M
West Plains, Mo.	KWPM	1450	
West Point, Ga.	WBMK	1310	
West Point, Miss.	WROB	1450	M
Westport, Conn.	WMMM	1260	
W. Springfield, Mass.	WTXL	1490	A
W. Yarmouth, Mass.	WOCB	1240	M
Westerly, R.I.	WERI	1230	M
Westfield, Mass.	WDEW	1570	
Westminster, Md.	WTTR	1470	
Weston, W.Va.	WHAW	980	M
W. Warwick, R.I.	WWRI	1450	
Wetumpka, Ala.	WETU	1250	
Wewoka-Seminole, Okla.	KWSH	1260	A
Weyburn, Sask.	CFSL	1340	
Wheaton, Md.	WDON	1540	
Wheeling, W.Va.	WHLL	1600	
	WKWK	1400	A
	WWVA	1170	C
White Castle, La.	KEVL	1590	
White Plains, N.Y.	WFAS	1230	
White River Junc., Vt.	WWRJ	910	
Whitehorse, Y.T.	CFWH	1240	
Whitesburg, Ky.	WTCW	920	
Whiteville, N.C.	WENC	1220	
Wichita, Kans.	KAKE	1240	M
	KLEO	1480	
	KIRL	1070	N
	KFH	1330	C
	KSIR	900	
	KWBB	1410	
Wichita Falls, Tex.	KSYD	990	M
	KTRN	1290	
	KWFT	620	C
Wickenburg, Ariz.	KAKA	1250	
Wildwood, N.J.	WCMC	1230	
Wilkes-Barre, Pa.	WBAX	1240	M
	WBRE	1340	N
	WILK	980	A
Willcox, Ariz.	KWCX	1250	
Williamsburg, Ky.	WEZJ	1440	
Williamsburg, Va.	WBCI	740	
Williams Lake, B.C.	CKCQ-1	1240	
Williamson, W.Va.	WBTH	1400	M
Williamsport, Pa.	WLYC	1050	
	WRAK	1400	N
	WWPA	1340	C
Williamston, N.C.	WIAM	900	
Willimantic, Conn.	WILI	1400	
Williston, N.D.	KEYZ	1360	
Willmar, Minn.	KWLM	1340	A
Willow Springs, Mo.	KUKU	1330	
Wilmington, Del.	WAMS	1380	M
	WDEL	1150	N
	WILM	1450	A
	WTUX	1290	
Wilmington, N.C.	WMFD	630	A
	WKLM	980	
	WGNI	1340	M
Wilson, N.C.	WGTM	590	C
	WLLY	1350	
	WVOT	1420	M
Winchester, Ky.	WWKY	1380	

Location	C.L.	Kc.	N.A.
Winchester, Tenn.	WCDT	1340	
Winchester, Va.	WINC	1400	A
Winder, Ga.	WIMO	1300	
Windom, Minn.	KDOM	1580	
Windsor, Conn.	WSOR	1480	
Windsor, N.S.	CFAB	1450	
Windsor, Ont.	CBE	1550	
	CKLW	800	M
Wingham, Ont.	CKNX	920	
Winnemucca, Nev.	KWNA	1400	
Winnfield, La.	KVCL	1270	
Winner, S.Dak.	KWYR	1260	
Winnipeg, Man.	CBW	990	
	CKRC	630	
	CKY	580	
	CJOB	680	
Winnsboro, La.	KMAR	1570	
Winona, Minn.	KWNO	1230	A
	KAGE	1380	
Winona, Miss.	WONA	1570	
Winslow, Ariz.	KVNC	1010	A
Winston-Salem, N.C.	WAAA	980	
	WAIR	1340	
	WSJS	600	N
	WTOB	1380	M-C
Winter Garden, Fla.	WOKB	1600	
Winter Haven, Fla.	WSIR	1490	M
	WINT	1360	
Winter Park, Fla.	WABR	1440	M
Wisconsin Rapids, Wis.	WFHR	1320	M
Wolf Pt., Mont.	KVCK	1450	M
Woodside, N.Y.	WWRL	1600	
Woodstock, N.B.	CJCJ	920	
Woodstock, Ont.	CKOX	1340	
Woodward, Okla.	KSIW	1450	
Woonsocket, R.I.	WNRI	1380	
	WWON	1240	
Wooster, Ohio	WWST	960	
Worcester, Mass.	WAAB	1440	M-N-A
	WNEB	1230	
	WORC	1310	
	WTAG	580	C
Worland, Wyo.	KWOR	1340	M
Worthington, Minn.	KWOA	730	
Worthington, Ohio	WRFD	880	
Wynne, Ark.	KWYN	1400	
Wytheville, Va.	WYVE	1280	
Yakima, Wash.	KIT	1280	
	KIMA	1460	C
	KUTI	980	
	KYAK	1390	M
Yankton, S.D.	KYNT	1450	
	WNAX	570	C
Yarmouth, N.S.	CJLS	1340	
Yazoo City, Miss.	WAZF	1230	
Yellowknife, N.W.T.	CFYK	1340	
York, Nebr.	KAWL	1370	
York, Pa.	WNOW	1250	
	WORK	1350	N
	WSBA	910	A-M
York, S.C.	WYCL	1580	
Yorkton, Sask.	CJGX	940	
Youngstown, Ohio	WBBW	1240	A
	WFMJ	1390	N
	WKBN	570	C
Yreka, Calif.	KSYC	1490	
Yuba City, Calif.	KUBA	1600	
	KAGR	1450	
Yuma, Ariz.	KOFA	1240	
	KBLU	1320	
	KVOY	1400	A
	KYUM	560	N
Zanesville, Ohio	WHIZ	1240	N
Zarephath, N.J.	WAWZ	1380	

United States FM Stations

Abbreviations: Mc., megacycles, asterisk (*) indicates educational station

Location	C.L.	Mc.
ALABAMA		
Albertville	WAVU-FM	105.1
Alexander City	WRFS-FM	106.1
Andalusia	WCTA-FM	98.1
Anniston	WHMA-FM	100.5
Athens	WJOF	104.3
Birmingham	WAPI-FM	99.5
	WBRC-FM	106.9
	WSFM	93.7
Clanton	WKLF-FM	100.9
Cullman	WFMH-FM	101.1
Decatur	WHOS-FM	102.1
Homewood	WJLN	104.7
Huntsville	WAHR	99.1
Mobile	WKRG-FM	99.9
Sylacauga	WMLS-FM	98.3
Tuscaloosa	WTBC-FM	95.7
	WUOA	*91.7
ALASKA		
Anchorage	KTVA-FM	105.5
ARIZONA		
Globe	KWJB-FM	100.3

Location	C.L.	Mc.
Mesa	KBUZ-FM	104.7
Phoenix	KELE	95.5
	KFCA	*88.5
	KOOL-FM	94.5
	KYEW	93.3
Tempe	KUPD-FM	97.9
Tucson	KFMM	99.5
ARKANSAS		
Blytheville	KLCN-FM	96.1
Ft. Smith	KFPW-FM	94.9
Jonesboro	KBTM-FM	101.9
	KASU	91.9
Mammoth Springs	KAMS	103.9
Osceola	KOSE-FM	98.1
Pine Bluff	KOTN-FM	92.3
Siloam Springs	KUOA-FM	105.7
CALIFORNIA		
Alameda	KJAZ	92.7
Arlington	KNFP	*89.7
Atherton	KPEN	101.3
Bakersfield	KERN-FM	94.1
	KQXR	101.5
Berkeley	KPFA	94.1
	KPFB	*89.3
	KRE-FM	102.9

Location	C.L.	Mc.
Claremont	KSPC	*88.9
El Cajon	KUFM	93.3
Eureka	KRED-FM	96.3
Fresno	KARM-FM	101.9
	KMJ-FM	97.9
	KRFM	93.7
Glendale	KFMU	97.1
	KUTE	101.9
Hayward	KBBM	101.7
Inglewood	KTYM-FM	103.9
Lodi	KCVR-FM	97.7
Long Beach	KFOX-FM	102.3
	KLON	*88.1
	KNOB	97.9
Los Angeles	KABC-FM	95.5
	KBBI	107.5
	KBCA	105.1
	KBMS	105.9
	KCBH	98.7
	KFAC-FM	92.3
	KGLA	*103.5
	KHJ	101.1
	KMLA	100.3
	KNX-FM	93.1
	KBIQ	104.3
	KPOL-FM	93.9
	KRHM	94.7
	KRKD-FM	96.3
	KUSC	*91.5

Location	C.L.	Mc.
	KXLU	*88.7
	KHOF	99.5
Marysville	KMYC-FM	99.9
Modesto	KBEE-FM	103.3
	KTRB-FM	104.1
Mountain View	KFJC	*88.5
Oakland	KAFE	98.1
Ontario	KASK-FM	93.5
Oxnard	KAAR	104.7
Palm Springs	KPSR	92.1
Pasadena	KPCS	89.3
Riverside	KPLI	99.1
	KACE-FM	92.7
	KDUO	97.5
Sacramento	KCRA-FM	96.1
	KFBK-FM	96.9
	KEBR	100.5
	KHIQ	105.1
	KJML	95.3
	KSFM	96.9
	KXRQ	98.5
	KXOA-FM	107.9
Salinas	KSBW-FM	102.5
San Bernardino	KVCR	*91.9
	KFMW	99.9
	KEBS	*89.5
San Diego	KFSD-FM	94.1
	KFMB-FM	100.7
	KFMX-FM	96.5

Location	C.L.	Mc.
	KGB-FM	101.5
	KITT	105.3
	KSDS	*88.3
San Francisco	KALW	*91.7
	KBAY-FM	104.5
	KCBS-FM	98.9
	KDFC	102.1
	KEAR	97.3
	KGO	103.7
	KNBC-FM	99.7
	KHIP	106.9
	KRON-FM	96.5
	KSFR	94.9
	KQBY-FM	95.7
	KYA-FM	93.3
San Jose	KSJO-FM	92.3
	KRPM	98.5
San Luis Obispo	KATY-FM	96.1
San Mateo	KCSM	*90.9
Santa Ana	KWIZ-FM	96.7
	KFIL	106.3
Santa Barbara	KRCW	97.5
Santa Clara	KSCU	*90.1
Santa Maria	KEYM	99.1
	KSMA-FM	102.5
Santa Monica	KCRW	*89.9
Stockton	KCVN	*91.3
Walnut Creek	KWME-FM	92.1
West Covina	KSGV	98.3

COLORADO

Location	C.L.	Mc.
Boulder	KRNW	97.3
Colorado Springs	KRCC	*91.3
	KFMH	96.5
	KSHS	*90.5
	KVOR-FM	92.9
Denver	KFML-FM	98.5
	KDEN-FM	99.5
	KLIR-FM	100.3
	KTGM	105.1
Grand Junction	KREX-FM	92.3
Manitou Springs	KCMS-FM	102.7

CONNECTICUT

Location	C.L.	Mc.
Brookfield	WGHF	95.1
Danbury	WLAD-FM	98.3
Hartford	WHCN	105.9
	WDRC-FM	102.9
	WRTC-FM	*89.3
	WTIC-FM	96.5
Meriden	WBMI	95.7
New Haven	WNHC-FM	99.1
Stamford	WSTC-FM	96.7
Storrs	WHUS	*90.5

DELAWARE

Location	C.L.	Mc.
Dover	WDOV-FM	94.7
Wilmington	WDEL-FM	93.7
	WJBR	99.5

D. C.

Location	C.L.	Mc.
Washington	WASH-FM	97.1
	WFAN	100.3
	WGMS-FM	103.5
	WMAL-FM	107.3
	WOL-FM	98.7
	WRC-FM	93.9
	WTOP-FM	96.3
	WWDC-FM	101.1

FLORIDA

Location	C.L.	Mc.
Coral Gables	WVCG-FM	105.1
Daytona Beach	WNOB-FM	94.5
Fort Lauderdale	WWIL-FM	103.5
	WFLM	105.9
Gainesville	WRUF-FM	*104.1
Jacksonville	WJAX-FM	95.1
	WZFM	96.9
	WMBR-FM	96.1
Miami	WAFM	93.1
	WCKR-FM	97.3
	WGBS-FM	96.3
	WTHS	*91.7
	WWPB-FM	101.5
Miami Beach	WKAT-FM	93.1
	WMET-FM	93.9
Orlando	WDBO-FM	92.3
	WHOO-FM	96.5
	WKIS-FM	100.3
Palm Beach	WQXT-FM	97.9
Tallahassee	WFSU-FM	*91.5
Tampa	WDAE-FM	100.7
	WFLA-FM	93.3
	WPKM	104.7
	WTUN	*88.9
Winter Park	WPRK	*91.5

GEORGIA

Location	C.L.	Mc.
Athens	WGAU-FM	102.5
Atlanta	WABE	*90.1
	WPLO-FM	103.3
	WGKA-FM	92.9
	WSB-FM	98.5
Augusta	WAUG-FM	105.7
	WBBQ-FM	03.7
Columbus	WRBL-FM	93.3
Gainesville	WOUN-FM	103.9
Lagrange	WLAG-FM	104.1
Macon	WMAZ-FM	99.1
Marietta	WBIE-FM	101.5
Newnan	WCOH-FM	96.7

Location	C.L.	Mc.
Savannah	WTOC-FM	97.3
Swainsboro	WJAT-FM	101.7
Toccoa	WLET-FM	106.1

HAWAII

Location	C.L.	Mc.
Honolulu	KAIM-FM	95.5
	KVOK	*88.1

ILLINOIS

Location	C.L.	Mc.
Anna	WRAJ-FM	92.7
Arlington Heights	WNWC	92.7
Bloomington	WJBC-FM	101.5
Carmi	WROY-FM	97.3
Champaign	WDWS-FM	97.5
Chicago	WBBM-FM	96.3
	WBEZ	*91.5
	WCLM	101.9
	WDHF	95.5
	WEBH	93.9
	WEFM	99.5
	WEHS	97.9
	WENR-FM	94.7
	WFMF	100.3
	WFMQ	107.5
	WFMT	98.7
	WKFM	103.5
	WMAQ-FM	101.1
	WMBI-FM	*90.1
	WNIB	97.1
	WSBC-FM	93.1
	WSEL	104.3
Decatur	WSOY-FM	102.9
DeKalb	WNIC	*91.1
E. St. Louis	WAMV-FM	101.1
Effingham	WSEI	95.7
	WELG	103.9
	WRMN-FM	94.3
Elgin	WEPS	*88.1
Elmwood Park	WXFM	105.9
Evanston	WEAW	105.1
	WNUR	*89.3
Harrisburg	WEBQ-FM	99.9
Jacksonville	WLDS-FM	100.5
	WAJP	93.5
Joliet	WJOL-FM	96.7
Litchfield	WSMI-FM	106.1
Macomb	WWKS	*91.3
Mattoon	WLBH-FM	96.9
Mt. Vernon	WMIX-FM	94.1
Oak Park ●	WOPA-FM	102.7
Olney	WVLN-FM	92.9
Paris	WPRS-FM	98.3
Park Ridge	WMTH	*88.5
Peoria	WMBD-FM	92.5
Quincy	WGEM-FM	105.1
	WTAD-FM	99.5
Rockford	WROK-FM	97.5
Rock Island	WHBF-FM	98.9
Springfield	WTAX-FM	103.7
Urbana	WILL-FM	*90.9

INDIANA

Location	C.L.	Mc.
Bloomington	WFIU	*103.7
	WTTV-FM	92.3
Columbus	WCSI-FM	98.3
Connersville	WCNB-FM	100.3
Crawfordsville	WBBS-FM	106.3
Elkhart	WCMR-FM	95.1
	WTRC-FM	100.7
Evansville	WIKY-FM	104.1
	WEVC	*91.5
	WPSR	90.7
Fort Wayne	WPTH	95.1
Gary	WGVE	*88.1
Goshen	WGCS	91.1
Greencastle	WGRE	*91.7
Hammond	WJOB-FM	92.3
Hartford City	WHCI	*91.9
Huntington	WVSH	*91.9
Indianapolis	WAJC	*104.5
	WFBM-FM	94.7
	WFMS	95.5
	WIAN	*90.1
Jasper	WITZ-FM	104.7
Madison	WCRX-FM	96.7
Marion	WMRI-FM	106.9
	WBST	*90.7
Muncie	WMUN	104.1
	WWHI	*91.5
New Albany	WNAS	*88.1
New Castle	WCTW-FM	102.5
	WYSN	*91.1
South Bend	WETL	*91.9
Terre Haute	WTHI-FM	99.9
Wabash	WSKS	*91.3
Warsaw	WRSW-FM	107.3
Washington	WFML	106.5

IOWA

Location	C.L.	Mc.
Ames	WOI-FM	*90.1
Boone	KFGQ	*99.3
Cedar Falls	KTCF	*88.1
Clinton	KBOS-FM	96.1
Davenport	WOC-FM	103.7
Des Moines	KOPS	*88.1
	WHO-FM	100.3
Dubuque	WDBQ	103.3
Iowa City	KSUI	*91.7
Mason City	KGLO-FM	101.1
Muscatine	KWPC-FM	99.7
Storm Lake	KAYL-FM	101.5
Waverly	KWAR	89.1

KANSAS

Location	C.L.	Mc.
Emporia	KSTE	*88.7
Kansas City	KCJC	98.1
Lawrence	KANU	*91.5
Manhattan	KSDB-FM	*88.1
Newton	KJRG-FM	92.1
Ottawa	KTJO-FM	*88.1
Parsons	KPPS-FM	*91.1
Wichita	KFH-FM	100.3
	KMUW	*89.1

KENTUCKY

Location	C.L.	Mc.
Ashland	WCMI-FM	93.7
Central City	WNES-FM	101.9
Fulton	WFUL-FM	104.9
Hazard	WKIC-FM	96.5
Henderson	WSON-FM	99.5
Hopkinsville	WRLX	98.7
Lexington	WBKY	*91.3
	WLAP-FM	94.5
Louisville	WFPK	*91.9
	WFPL	*89.3
	WLVL	97.5
Madisonville	WFMW-FM	93.9
	WNGO-FM	94.7
Owensboro	WOMI-FM	92.5
	WVJS-FM	96.1
Paducah	WPAD-FM	96.9
	WKYB-FM	93.3

LOUISIANA

Location	C.L.	Mc.
Alexandria	KALB-FM	96.9
Baton Rouge	WJBO-FM	98.1
Monroe	KMLB-FM	104.1
New Orleans	WBEH	89.3
	WDSU-FM	105.3
	WRCM	97.1
	WMMT	95.7
Shreveport	KRMD-FM	101.1
	KBCL-FM	96.5
	KWKH-FM	94.5

MAINE

Location	C.L.	Mc.
Brunswick	WBOR	*91.1
Caribou	WFST-FM	97.7
Lewiston	WCOU-FM	93.9
Portland	WLOB-FM	97.9

MARYLAND

Location	C.L.	Mc.
Annapolis	WNAV-FM	99.1
	WXTC	107.9
	WAQE-FM	101.9
Baltimore	WBJC	*88.1
	WCAO-FM	102.7
	WCBM-FM	106.5
	WFMM-FM	93.1
	WBAL-FM	97.9
	WITH-FM	104.3
Bethesda	WJMO	106.3
Bradbury Heights	WPGC	95.5
Cumberland	WCUM-FM	102.9
Hagerstown	WJEJ-FM	104.7
	WARK-FM	106.9
Havre de Grace	WASA-FM	103.7
Oakland	WBUZ	95.5
Westminster	WTTR-FM	100.7

MASSACHUSETTS

Location	C.L.	Mc.
Amherst	WAMF	*88.1
	WMUA	*91.1
Boston	WBUR	*90.9
	WBCN	104.1
	WBZ-FM	106.7
	WCOP-FM	100.7
	WEEI-FM	103.3
	WERS	*88.9
	WHDH-FM	94.5
	WRKO-FM	98.5
	WXHR	96.9
Brockton	WBET-FM	97.7
Brookline	WBOS-FM	92.9
Cambridge	WGBH-FM	*89.7
	WHRB-FM	95.3
Fitchburg	WFGM-FM	104.7
Framingham	WKOX-FM	105.7
Greenfield	WHAI-FM	98.3
Haverhill	WHAV-FM	92.5
Lawrence	WGHJ	93.7
Lowell	WLLH-FM	99.5
New Bedford	WBSM-FM	97.3
	WNBH-FM	98.1
S. Hadley	WMHC	*88.5
Springfield	WHYN-FM	93.1
	WEDK	*91.7
	WMAS-FM	94.7
Waltham	WCRB-FM	102.5
W. Yarmouth	WOCB-FM	94.3
Williamstown	WCFM	*90.1
Winchester	WHSR-FM	*91.9
Worcester	WTAG-FM	96.1

MICHIGAN

Location	C.L.	Mc.
Ann Arbor	WUOM	*91.7
Benton Hrbr.	WHFB-FM	99.9
Coldwater	WTVB-FM	98.3
Dearborn	WKMH-FM	100.3
Detroit	WDET-FM	*101.9
	WABX	99.5
	WOTR	*90.9
	WHFI	94.7
	WJBK-FM	93.1
	WMUZ	103.5
	WMZK	97.9
	WJR-FM	96.3
	WQRS-FM	105.1
	WWJ-FM	97.1
	WXYZ-FM	101.1
E. Lansing	WKAR-FM	*90.5
	WSWM	99.1
Flint	WFBE	*95.1
Grand Rapids	WFRS	92.5
	WFUR-FM	102.9
	WJEF-FM	93.7
	WLAV-FM	96.9
Highland Pk.	WHPR	*88.1
Jackson	WBBC	94.1
Kalamazoo	WMCR	*102.1
Lansing	WJIM-FM	97.5
Oak Park	WLDM	95.5
Royal Oak	WOAK	*89.3
	WOMC	104.3
Saginaw	WSAM-FM	98.1
Sturgis	WSTR-FM	103.1

MINNESOTA

Location	C.L.	Mc.
Brainerd	KLIZ-FM	95.7
Mankato	KYSM-FM	103.5
Minneapolis	KTIS-FM	*98.5
	KWFM	97.1
	WLOL-FM	99.5
	WPBC-FM	101.3
St. Cloud	KFAM-FM	104.7
St. Paul	KNOF	95.3

MISSISSIPPI

Location	C.L.	Mc.
Jackson	WJDX-FM	102.9
Laurel	WNSL-FM	100.3
Meridian	WMMI	*88.1

MISSOURI

Location	C.L.	Mc.
Clayton	KFUO-FM	99.1
Joplin	WMBH-FM	96.1
Kansas City	KCMO-FM	94.9
	KCMK	93.3
	KCUR-FM	89.3
	KXTR	96.5
Kennett	KBOA-FM	98.9
Poplar Bluff	KWOC-FM	94.5
St. Louis	KCFM	93.7
	KADI	96.5
	KSLH	*91.5
	KSTL-FM	98.1
	KWIX	102.5
Springfield	KTTS-FM	94.7
West Plains	KWPM-FM	93.9

NEBRASKA

Location	C.L.	Mc.
Kearney-Holdrege		
	KHOL-FM	98.9
Lincoln	KFMQ	95.3
Omaha	KQAL-FM	94.3
	KOIL-FM	96.1

NEVADA

Location	C.L.	Mc.
Reno	KNEV	95.5

NEW HAMPSHIRE

Location	C.L.	Mc.
Berlin	WMOU-FM	103.7
Claremont	WTSV-FM	106.1
Manchester	WKBR-FM	95.7
Mt. Washington	WMTW-FM	94.9
Nashua	WOTW-FM	106.3

NEW JERSEY

Location	C.L.	Mc.
Asbury Park	WJLK-FM	94.3
Bridgeton	WSNJ-FM	98.9
E. Orange	WFMU	*91.1
Hackettstown	WNTI	*91.9
Newark	WNTA-FM	94.7
	WBGO	*88.3
New Brunswk.	WCTC-FM	98.3
Paterson	WPAT-FM	93.1
Princeton	WPRB	103.9
South Orange	WSOU	*89.5
Trenton	WTOA	97.5
Wildwood	WCMC-FM	100.7
Zarephath	WAWZ-FM	99.1

NEW MEXICO

Location	C.L.	Mc.
Albuquerque	KANW	*89.1
	KHFM	96.3
Aztec	KNDE-FM	94.9
Los Alamos	KRSN-FM	98.5
Mountain Park	KMFM	97.9
Roswell	KBIM-FM	97.1

NEW YORK

Location	C.L.	Mc.
Albany	WAMC	*90.7
Auburn	WMBO-FM	96.1
Babylon	WGLI-FM	103.5
Binghamton	WNBF-FM	98.1
	WKOP-FM	95.3
Brooklyn	WNYE	*91.5
Buffalo	WBEN-FM	106.5
	WGR-FM	96.9
	WBNY-FM	92.9
	WKOL-FM	104.1

Location	C.L.	Mc.
Cherry Valley	WRRC	101.9
Corning	WCLI-FM	106.1
Cortland	WKRT-FM	99.9
DeRuyter	WRRD	105.1
Elmira	WECW	*88.1
Floral Park	WSHS	*90.3
Hempstead	WHLI-FM	98.3
Hornell	WWHG-FM	105.3
Ithaca	WHCU-FM	97.3
	WICB	*91.7
	WRRA-FM	103.7
	WVBR-FM	101.7
Jamestown	WJTN-FM	93.3
Kenmore	WYSL-FM	103.3
Massena	WMSA-FM	105.3
Mt. Kisco	WRNW	107.1
New Rochelle	WVOX-FM	93.5
New York	WABC-FM	95.5
	WBAI	99.5
	WBFM	101.9
	WCBS-FM	101.1
	WEVD-FM	97.9
	WFUV	*90.7
	WHOM-FM	92.3
	WKCR-FM	*89.9
	WNCN	104.3
	WNEW-FM	102.7
	WNYC-FM	93.9
	WNYE	91.5
	WOR-FM	98.7
	WQXR-FM	96.3
	WNBC-FM	97.1
	WRFM	105.1
Niagara Falls	WHLD-FM	98.5
Olean	WHOL-FM	95.7
Patchogue	WALK-FM	97.5
	WPAC-FM	106.1
Peekskill	WLNA-FM	100.7
Poughkeepsie	WKIP-FM	104.7
Rochester	WHFM	98.9
	WIRQ	*90.9
	WROC-FM	97.9
Schenectady	WGFM	99.5
South Bristol	WRRE	95.1
Springville	WSPE	*88.1
Syracuse	WAER	*88.1
	WDDS-FM	93.1
	WONO	100.9
	WSYR-FM	94.5
Troy	WFLY	92.3
	WRPI	91.5
Utica	WRUN-FM	105.7
Wethersfield	WRRL	107.7
White Plains	WFAS-FM	103.9

NORTH CAROLINA

Albemarle	WABZ-FM	100.9
Asheboro	WGWR-FM	92.3
Asheville	WLOS-FM	104.3
Burlington	WBBB-FM	101.1
	WFNS-FM	93.9
Chapel Hill	WUNC	*91.5
Charlotte	WSOC-FM	103.5
Clingman's Pk.	WMIT	106.9
Durham	WONC-FM	105.1
Elkin	WIFM-FM	100.9
Fayetteville	WFNC-FM	98.1
Forest City	WBBO-FM	93.3
Gastonia	WGNC-FM	101.9
Goldsboro	WEQR	96.9
Greensboro	WGPS	*89.9
	WMDE	98.7
Greenville	WWWS	*91.3
Henderson	WHNC-FM	92.5
	WHKP-FM	102.5
Hendersonville	WHKP-FM	102.5
Hickory	WHKY-FM	102.9
High Point	WHPE-FM	95.5
	WHPS	*89.3
	WMFR-FM	99.5
	WNOS-FM	100.3
Laurinburg	WEWO-FM	96.5
Leaksville	WLOE-FM	94.5
Lexington	WBUY-FM	94.3
Raleigh	WKIX-FM	96.1
	WPTF-FM	94.7
	WRAL-FM	101.5
Reidsville	WREV-FM	102.1
Rocky Mount	WEED-FM	92.1
	WFMA	100.7
Roxboro	WRXO-FM	96.7
Salisbury	WSTP-FM	106.5
Sanford	WWGP-FM	105.5
Shelby	WOHS-FM	96.9
Statesville	WFMX	105.7
Tarboro	WCPS-FM	104.3
Thomasville	WTNC-FM	98.3
Winston-Salem	WAIR-FM	93.1
	WSJS-FM	104.1

OHIO

Akron	WAKR-FM	97.5
	WAPS	*89.1
Alliance	WFAH-FM	101.7
Ashland	WNCO-FM	101.3
Ashtabula	WREO-FM	103.7
Athens	WOUB-FM	*91.5
Bellaire	WOMP-FM	100.5
Berea	WBWC	*88.3
Bowling Green	WBGU	*88.1
Canton	WHBC-FM	94.1

Location	C.L.	Mc.
Cincinnati	WCPO-FM	105.1
	WAEF-FM	104.3
	WKRC-FM	101.9
	WSAI-FM	102.7
Cleveland	KYW-FM	105.7
	WABQ-FM	106.5
	WBOE	*90.3
	WCRF-FM	103.3
	WDOK-FM	102.1
	WERE-FM	98.5
	WGAR-FM	99.5
	WHK-FM	100.7
	WJW-FM	104.1
	WNOB	107.9
Cleveland Hts.	WCUY-FM	95.3
Columbus	WCBE	*90.5
	WBNS-FM	97.1
	WCOL-FM	92.3
	WOSU-FM	*89.7
	WTVN-FM	96.3
	WVKO	94.7
Dayton	WHIO-FM	99.1
	WIFE	104.7
Delaware	WSLN	*91.1
East Liverpool	WOHI-FM	104.3
Elyria	WEOL-FM	107.3
Findlay	WFIN-FM	100.5
Fostoria	WFOB	96.7
Fremont	WFRO-FM	99.3
Hamilton	WQMS	96.7
	WHOH	103.5
Kent	WKSU-FM	*88.1
Lancaster	WHOK-FM	95.5
Lima	WIMA-FM	102.1
Marietta	WCMO	*89.3
Marion	WMRN-FM	106.9
Middletown	WPFB-FM	105.9
Mt. Vernon	WMVO-FM	93.7
Newark	WCLT-FM	100.3
Oxford	WMUB	*88.5
	WOXR	97.7
Portsmouth	WPAY-FM	104.1
Salem	WSOM-FM	105.1
Sandusky	WLEC-FM	102.7
Springfield	WBLY-FM	103.9
Steubenville	WSTV-FM	103.5
Toledo	WSPD-FM	101.5
	WMHE	92.5
	WTDS	*91.3
	WTOL-FM	104.7
	WTRT	99.9
Wooster	WWST-FM	104.5
Youngstown	WKBN-FM	98.9
	WBBW-FM	93.3
	WRED	101.1

OKLAHOMA

Durant	KSEO-FM	107.3
Norman	WNAD-FM	*90.9
Oklahoma City	KOKH	*88.9
	KEFM	94.7
	KYFM	98.9
Shawnee	KBGC	*89.9
Stillwater	KAMC-FM	*91.7
	KSPI-FM	93.9
Tulsa	KWGS	*90.5
	KIHI	95.5
	KOCW	97.5
	KOGM-FM	92.9

OREGON

Eugene	KRVM	*91.9
	KEED-FM	93.1
	KUGN-FM	99.1
	KWAX	*91.1
Grants Pass	KGPO	96.9
Medford	KBOY-FM	95.3
Oretech	KTEC	*88.1
Portland	KEX-FM	92.3
	KGMG	95.5
	KOIN-FM	101.1
	KPFM	97.1
	KPOJ-FM	98.7
	KQFM	100.3
	KRRC	*89.3

PENNSYLVANIA

Allentown	WFMZ	100.7
Altoona	WVAM-FM	100.1
Beaver Falls	WBVP-FM	106.7
Bethlehem	WGPA-FM	95.1
Bloomsburg	WHLM-FM	106.5
Braddock	WLOA-FM	96.9
Butler	WBUT-FM	97.7
Carlisle	WHYL-FM	102.3
Chambersburg	WCHA-FM	95.1
Dubois	WCED-FM	102.1
Easton	WEST-FM	107.9
	WEEX-FM	99.9
Erie	WERC-FM	99.9
Glenside	WIFI	92.5
Harrisburg	WHP-FM	97.3
Havertown	WHHS	*89.3
Hazleton	WAZL-FM	97.9
Johnstown	WARD-FM	92.1
	WJAC-FM	95.5
Lancaster	WGAL-FM	101.3
	WDAC	94.5
	WLAN-FM	96.9
Lebanon	WLBR-FM	100.1
Meadville	WMGW-FM	100.3
Oil City	WDJR	98.5

Location	C.L.	Mc.
Palmyra	WJWR	92.1
Philadelphia	WCAU-FM	98.1
	WDAS-FM	105.3
	WFIL-FM	102.1
	WFLN	95.7
	WHAT-FM	96.5
	WHYY	*90.9
	WIBG-FM	94.1
	WIP-FM	93.3
	WPEN-FM	102.9
	WPWT	*91.7
	WQAL	106.1
	WRTI-FM	*90.1
	WXPN	*88.9
Pittsburgh	KDKA-FM	92.9
	WCAE-FM	96.1
	WDUQ	*91.5
	WFMP	99.7
	WKJF	93.7
	WPIT-FM	101.5
	WWSW-FM	94.5
Pottsville	WPPA-FM	101.9
Red Lion	WGCB-FM	96.1
Scranton	WGBI-FM	101.3
	WUSV	*88.9
Sharon	WPIC-FM	102.9
State College	WDFM	*91.1
Sunbury	WKOK-FM	94.1
Towanda	WTTC-FM	92.7
Warren	WRRN	92.3
Washington	WJPA-FM	104.3
Waynesboro	WAYZ-FM	101.5
Wilkes-Barre	WBRE-FM	98.5
	WYZZ	103.3
Williamsport	WLYC-FM	105.1
	WRAK-FM	100.3
York	WNOW-FM	105.7

RHODE ISLAND

Location	C.L.	Mc.
Cranston	WLOV	99.9
Providence	WPJB-FM	105.1
	WPFM	95.5
	WPRO-FM	92.3
	WXCN	101.5
Woonsocket	WWON-FM	106.3

SOUTH CAROLINA

Anderson	WCAC	101.1
Charleston	WCSC-FM	96.9
	WTMA-FM	95.1
Columbia	WCOS-FM	97.9
	WNOK-FM	104.7
	WUSC-FM	*89.9
Dillon	WOSC-FM	92.9
Greenville	WESC-FM	92.5
	WFBC-FM	93.7
Seneca	WSNW-FM	98.1
Spartanburg	WSPA-FM	98.9

TENNESSEE

Bristol	WOPI-FM	96.9
Chattanooga	WDOD-FM	96.5
Greeneville	WGRV-FM	94.9
Jackson	WTJS-FM	104.1
Johnson City	WJHL-FM	100.7
Kingsport	WKPT-FM	98.5
Knoxville	WBIR-FM	93.3
	WKCS	*91.1
	WUOT	*91.9
Memphis	WMCF	99.7
	WMPS-FM	97.1
	WQMM	95.5
Nashville	WFMB	105.9
	WSIX-FM	97.5
Abilene	KACC-FM	*91.1

TEXAS

Amarillo	KGNC-FM	93.1
Austin	KHFI	98.3
	KAZZ	95.5
Beaumont	KRIC-FM	97.5
Brownwood	KHPC	88.1
Cleburne	KCLE-FM	94.9
Corpus Christi	KOMC	95.5
Dallas	KIXL-FM	104.5
	KNER	*88.1
	KRLD-FM	92.5
	WRR-FM	101.1
	KVTT	*91.7
Denton	KDNT-FM	106.3
DiBoll	KSPL-FM	95.5
El Paso	KVOF-FM	*88.5
	KHMS	94.7
Ft. Worth	WBAP-FM	96.3
	KFJZ-FM	97.1
Gainesville	KGAF-FM	94.5
Harlingen	KELT	94.5
Hillsboro	KHBR-FM	102.3
Houston	KHGM	102.9
	KHUL	95.7
	KFMK	97.9
	KRBE	104.1
	KTRH-FM	101.1
	KUHF	*91.3
Lubbock	KRKH-FM	93.7
	KBFM	96.3
Midland	KNFM	92.3
Plainview	KHBL	*88.1
Port Arthur	KFMP	93.3

Location	C.L.	Mc.
San Antonio	KISS	99.5
	KEEZ	97.3
	KITY	92.9
Texarkana	KCMC-FM	98.1
Waco	KEFC	95.5
Waxahachie	KBEC-FM	93.5

UTAH

Ephraim	KEPH	*88.9
Logan	KVSC	*88.1
Provo	KBYU-FM	*88.9
Salt Lake City	KCPX-FM	98.7
	KSL-FM	100.3

VIRGINIA

Arlington	WARL-FM	105.1
	WCCV-FM	95.7
Charlottesville	WINA-FM	95.3
	WTJU	91.3
Crewe	WSVS-FM	104.7
Fredericksburg	WFVA-FM	101.5
Harrisonburg	WEMC	*91.7
	WSVA-FM	100.7
Lynchburg	WWOD-FM	100.1
Martinsville	WMVA-FM	96.3
Newport News	WGH-FM	97.3
Norfolk	WMTI	*91.5
	WRVC	102.5
	WYFI-FM	99.7
Richmond	WCOD	98.1
	WRFK	91.1
	WRVA-FM	94.5
	WRNL-FM	102.1
Roanoke	WDBJ-FM	94.9
	WROV-FM	103.7
	WSLS-FM	99.1
South Boston	WHLF-FM	97.5
South Norfolk	WFOS	*90.5
Staunton	WAFC-FM	93.3
Williamsburg	WCWM	89.1
Winchester	WRFL	92.5
Woodbridge	WBVA	105.9

WASHINGTON

Bellingham	KGMI	92.9
Cheney	KEWC-FM	*89.9
Edmonds	KGFM	105.3
Seattle	KING-FM	98.1
	KETO-FM	101.5
	KGMJ	95.7
	KIRO-FM	100.7
	KISW	99.9
	KLSN	96.5
	KMCS	98.9
	KUOW	94.9
Spokane	KREM-FM	92.9
	KXLY-FM	99.9
Tacoma	KCPS	90.9
	KLAY-FM	106.3
	KTNT-FM	97.3
	KTOY	*91.7
	KTWR	103.9

WEST VIRGINIA

Beckley	WBKW	99.5
Charleston	WKAZ-FM	97.5
	WKNA	98.5
Huntington	WKEE-FM	100.5
Martinsburg	WEPM-FM	94.3
Morgantown	WAJR-FM	99.3
Oak Hill	WOAY-FM	94.1
Parkersburg	WAAM-FM	106.5
Wheeling	WKWK-FM	97.3
	WWVA-FM	98.7

WISCONSIN

Appleton	WLFM	*91.1
Chilton	WHKW	*89.3
Colfax	WHWC	*88.3
Delafield	WHAD	*90.7
Eau Claire	WIAL	94.1
Fort Atkinson	WFAW	107.3
Greenfield Twp.	WWCF	94.9
Highland	WHHI	91.3
Highland Twp.	WHSA	*89.9
Janesville	WCLO-FM	99.9
La Crosse	WHLA	*90.3
Madison	WHA-FM	*88.7
	WISZ-FM	98.1
	WMFM	104.1
	WRVB-FM	102.5
Merrill	WLIN	100.7
Milwaukee	WFMR	96.5
	WMIL-FM	95.7
	WMKE	102.1
	WQFM	93.3
	WTMJ-FM	94.1
Monroe	WEKZ-FM	93.7
Racine	WRJN-FM	100.7
Rice Lake	WJMC-FM	96.3
Sparta	WCOW-FM	97.1
Wausau	WHRM	*91.9
West Bend	WBKV-FM	92.5
Wisc. Rapids	WFHR-FM	103.3

Canadian FM Stations

Location	C.L.	Mc.
Brampton, Ont.	CHIC-FM	102.1
Brantford, Ont.	CKPC-FM	92.1
Cornwall, Ont.	CJSS-FM	104.5
Edmonton, Alta.	CFRN-FM	100.3
	CJCA-FM	99.5
	CKUA-FM	98.1
Ft. William, Ont.	CKPR-FM	94.3
Halifax, N.S.	CHNS-FM	96.1
Kingston, Ont.	CFRC-FM	91.9
	CKLC-FM	99.5
	CKWS-FM	96.3
Kitchener, Ont.	CKCR-FM	96.7
Lethbridge, Alta.	CHEC-FM	100.9
London, Ont.	CFPL-FM	95.9
Montreal, Que.	CBF-FM	95.1
	CBM-FM	100.7
	CFCF-FM	106.5
Oshawa, Ont.	CKLB-FM	93.5
Ottawa, Ont.	CBO-FM	103.3
	CFRA-FM	93.9
Quebec, Que.	CHRC-FM	98.1
Rimouski, Que.	CJBR-FM	101.5
St. Catharines, Ont.	CKTB-FM	97.7
Timmins, Ont.	CKGB-FM	94.5
Toronto, Ont.	CBC-FM	99.1
	CFRB-FM	99.9
	CHFI-FM	98.1
	CJRT-FM	91.1
Vancouver, B.C.	CBU-FM	105.7
	CHQM-FM	103.5
Verdun, Que.	CKVL-FM	96.9
Victoria, B.C.	CKDA-FM	98.5
Windsor, Ont.	CKLW-FM	93.9
Winnipeg, Man.	CJOB-FM	103.1

United States Television Stations

(Territories and possessions follow states). Chan., channel number; asterisk (*) indicates educational station.

ALABAMA

Location	C.L.	Chan.
Andalusia	WAIQ	*2
Birmingham	WAPI-TV	13
	WBIQ	*10
	WBRC-TV	6
Decatur	WMSL-TV	23
Dothan	WTVY	9
Florence	WOWL	15
Huntsville	WAFG-TV	31
Mobile	WALA-TV	10
	WKRG-TV	5
Montgomery	WCOV-TV	20
	WSFA-TV	12
Munford	WCIQ	*7
Selma	WSLA	8

ALASKA

Location	C.L.	Chan.
Anchorage	KENI-TV	2
	KTVA	11
Fairbanks	KFAR-TV	2
	KTVF	11
Juneau	KINY-TV	8

ARIZONA

Location	C.L.	Chan.
Phoenix	KOOL-TV	10
	KPHO-TV	5
	KTVK	3
	KVAR	12
Tucson	KGUN-TV	9
	KOLD-TV	13
	KVOA-TV	4
	KUAT	*6
Yuma	KIVA	11

ARKANSAS

Location	C.L.	Chan.
El Dorado	KTVE	10
Ft. Smith	KFSA-TV	5
Little Rock	KARK-TV	4
	KTHV	11
	KATV	7
Texarkana	KCMC-TV	6

CALIFORNIA

Location	C.L.	Chan.
Bakersfield	KBAK-TV	29
	KERO-TV	10
	KLYD-TV	17
Chico	KHSL-TV	12
El Centro	XEM-TV	3
Eureka	KIEM-TV	3
	KVIQ-TV	6
Fresno	KFRE-TV	30
	KJEO	47
	KMJ-TV	24
Los Angeles	KABC-TV	7
	KCOP	13
	KHJ-TV	9
	KNXT	2
	KRCA	4
	KTLA	5
	KTTV	11
Oakland	KTVU	2
Redding	KVIP-TV	7
Sacramento	KXTV	10
	KCRA-TV	3
	KVIE	*6
Salinas	KSBW-TV	8
San Diego	KFMB-TV	8
	KFSD-TV	10
(Tijuana, Mex.)	XETV	6
San Francisco	KGO-TV	7
	KPIX	5
	KQED	*9
	KRON-TV	4
San Jose	KNTV	11
San Luis Obispo	KSBY-TV	6
Santa Barbara	KEY-T	3
Stockton	KOVR	13

COLORADO

Location	C.L.	Chan.
Colorado Springs	KKTV	11
	KRDO-TV	13
Denver	KBTV	9
	KLZ-TV	7
	KOA-TV	4
	KRMA-TV	*6
	KTVR	2
Grand Junction	KREX-TV	5
Montrose	KREY-TV	10
Pueblo	KCSJ-TV	5
Bridgeport	WICC-TV	43
Hartford	WTIC-TV	3
	WHCT	18

CONNECTICUT

Location	C.L.	Chan.
New Britain	WHNB-TV	30
New Haven	WNHC-TV	8
Waterbury	WATR-TV	53

DIST. OF COLUMBIA

Location	C.L.	Chan.
Washington	WMAL-TV	7
	WRC-TV	4
	WTOP-TV	9
	WTTG	5

FLORIDA

Location	C.L.	Chan.
Daytona Beach	WESH-TV	2
Fort Pierce-Vero Beach		19
Fort Myers	WINK-TV	11
Gainesville	WUFT	*5
Jacksonville	WFGA-TV	12
	WJCT	*7
	WJXT	4
Miami	WCKT	7
	WLBW-TV	10
	WTHS-TV	*2
	WTVJ	4
Orlando	WDBO-TV	6
	WLOF-TV	9
Palm Beach	WPTV	5
Panama City	WJDM-TV	7
Pensacola	WEAR-TV	3
St. Petersburg	WSUN-TV	38
Tallahassee	WFSU-TV	*11
Tampa	WFLA-TV	8
	WEDU	*3
	WTVT	13
W. Palm Beach	WEAT-TV	12

GEORGIA

Location	C.L.	Chan.
Albany	WALB-TV	10
Athens	WGTV	*8
Atlanta	WAGA-TV	5
	WSB-TV	2
	WETV	*30
	WLW-A	11
Augusta	WJBF	6
	WRDW-TV	12
Columbus	WRBL-TV	3
	WTVM	9
Macon	WMAZ-TV	13
Savannah	WSAV-TV	3
	WEGA-TV	*9
	WTOC-TV	11
Thomasville	WCTV	6
Waycross	WEGS-TV	*8

HAWAII

Location	C.L.	Chan.
Hilo	KHBC-TV	9
	KHJK	13
Honolulu	KGMB-TV	9
	KONA	2
	KULA-TV	4
Wailuku	KMAU	3
	KALA	7
	KMVI-TV	12

IDAHO

Location	C.L.	Chan.
Boise	KBOI-TV	2
	KTVB	7
Idaho Falls	KID-TV	3
Lewiston	KLEW-TV	3
Nampa	KCIX-TV	6
Pocatello	KTLE	6
Twin Falls	KLIX-TV	11

ILLINOIS

Location	C.L.	Chan.
Champaign	WCIA	3
	WCHU	33
Chicago	WBBM-TV	2
	WBKB	7
	WGN-TV	9
	WNBQ	5
	WTTW	*11
Danville	WICD	24
Decatur	WTVP	17
Harrisburg	WSIL-TV	3
La Salle	WEEQ-TV	35
Peoria	WEEK-TV	43
	WMBD	31
	WTVH	19
Quincy	WGEM-TV	10
Rockford	WREX-TV	13
	WTVO	39
Rock Island	WHBF-TV	4
Springfield	WICS	20
Urbana	WILL-TV	*12

INDIANA

Location	C.L.	Chan.
Bloomington	WTTV	4
Elkhart	WSJV-TV	28
Evansville	WFIE-TV	14
	WEHT	50
	WTVW	7
Ft. Wayne	WANE-TV	15
	WKJG-TV	33
	WPTA	21
Indianapolis	WFBM-TV	6
	WLWI	13
	WISH-TV	8
Lafayette	WFAM-TV	18
Muncie	WLBC-TV	49
South Bend	WNDU-TV	16
	WSBT-TV	22
Terre Haute	WTHI-TV	10

IOWA

Location	C.L.	Chan.
Ames	WOI-TV	5
Cedar Rapids	KCRG-TV	9
	WMT-TV	2
Davenport	WOC-TV	6
Des Moines	KRNT-TV	8
	KDPS-TV	*11
	WHO-TV	13
Fort Dodge	KQTV	21
Mason City	KGLO-TV	3
Ottumwa	KTVO	3
Sioux City	KTIV	4
	KVTV	9
Waterloo	KWWL-TV	7

KANSAS

Location	C.L.	Chan.
Ensign	KTVC	6
Garden City	KGLD	11
Goodland	KBLR-TV	10
Great Bend	KCKT	2
Hays	KAYS-TV	7
Hutchinson	KTVH	12
Pittsburg	KOAM-TV	7
Topeka	WIBW-TV	13
Wichita	KAKE-TV	10
	KARD-TV	3

KENTUCKY

Location	C.L.	Chan.
Lexington	WLEX-TV	18
	WKYT	27
Louisville	WAVE-TV	3
	WFPK-TV	*15
	WHAS-TV	11
	WQXL-TV	41
Paducah	WPSD-TV	6

LOUISIANA

Location	C.L.	Chan.
Alexandria	KALB-TV	5
Baton Rouge	WAFB-TV	28
	WBRZ	2
Lafayette	KLFY-TV	10
Lake Charles	KPLC-TV	7
	KTAG-TV	25
Monroe	KNOE-TV	8
	KLSE	*13
New Orleans	WDSU-TV	6
	WVUE	13
	WWL-TV	4
	WYES	*8
Shreveport	KSLA-TV	12
	KTBS-TV	3

MAINE

Location	C.L.	Chan.
Bangor	WABI-TV	5
	WLBZ-TV	2
Poland Spring	WMTW-TV	8
Portland	WCSH-TV	6
	WGAN-TV	13
Presque Isle	WAGM-TV	8

MARYLAND

Location	C.L.	Chan.
Baltimore	WJZ-TV	13
	WBAL-TV	11
	WMAR-TV	2
Salisbury	WBOC-TV	16

MASSACHUSETTS

Location	C.L.	Chan.
Adams	WCDC	19
Boston	WBZ-TV	4
	WGBH-TV	*2
	WHDH-TV	5
	WNAC-TV	7
Greenfield	WRLP	32
Springfield	WHYN-TV	40
	WWLP	22
Worcester	WWOR-TV	14

MICHIGAN

Location	C.L.	Chan.
Bay City	WNEM-TV	5
Cadillac	WWTV	13
Cheboygan	WTOM-TV	4
Detroit	WJBK-TV	2
	WTVS	*56
	WWJ-TV	4
	WXYZ-TV	7
(Windsor, Ont.)	CKLW-TV	9
Flint	WJRT	12
Grand Rapids	WOOD-TV	8
Kalamazoo	WKZO-TV	3
Lansing	WJIM-TV	6
Marquette	WLUC-TV	6
Onondaga	WILX-TV/WMSB	10
Saginaw	WKNX-TV	57
Traverse City	WPBN-TV	7

MINNESOTA

Location	C.L.	Chan.
Alexandria	KCMT	7
Austin	KMMT	6
Duluth	KDAL-TV	3
	WDSM-TV	6
Mankato	KEYC-TV	12
Minneapolis	KMSP	9
	WCCO-TV	4
	WTCN-TV	11
Rochester	KROC-TV	10
St. Paul	KSTP-TV	5
	KTCA-TV	*2

MISSISSIPPI

Location	C.L.	Chan.
Columbus	WCBI-TV	4
Greenwood	WABG-TV	6
Jackson	WJTV	12
	WLBT	3
Laurel	WDAM-TV	7
Meridian	WTOK-TV	11
	WCOC-TV	30
Tupelo	WTWV	9

MISSOURI

Location	C.L.	Chan.
Cape Girardeau	KFVS-TV	12
Columbia	KOMU-TV	8
Hannibal	KHQA-TV	7
Jefferson City	KRCG-TV	13
Joplin	KODE-TV	12
Kansas City	KCMO-TV	5
	KMBC-TV	9
	WDAF-TV	4
Kirksville	KTVO	3
St. Joseph	KFEQ-TV	2
St. Louis	KETC	*9
	KMOX-TV	4
	KSD-TV	5
	KTVI	2
	KPLR-TV	11
Sedalia	KMOS-TV	6
Springfield	KTTS-TV	10
	KYTV	3

MONTANA

Location	C.L.	Chan.
Billings	KOOK-TV	2
	KGHL-TV	8
Butte	KXLF-TV	4
Glendive	KXGN-TV	5
Great Falls	KFBB-TV	5
	KRTV	3
Helena	KXLJ-TV	12
Kalispell	KULR	9
Missoula	KMSO-TV	13

NEBRASKA

Location	C.L.	Chan.
Hastings	KHAS-TV	5
Hay Springs	KDUH-TV	4
Hayes Center	KHPL-TV	6
Kearney	KHOL-TV	13
Lincoln	KOLN-TV	10
	KUON-TV	*12
McCook	KOMC	8
North Platte	KNOP	2
Omaha	KMTV	3
	KETV	7
	WOW-TV	6
Scottsbluff	KSTF	10

NEVADA

Location	C.L.	Chan.
Henderson	KLRJ-TV	2

Location	C.L.	Chan.
Las Vegas	KLAS-TV	8
	KSHO-TV	13
Reno	KOLO-TV	8

NEW HAMPSHIRE

Location	C.L.	Chan.
Durham	WENH-TV	*11
Manchester	WMUR-TV	9

NEW JERSEY

Location	C.L.	Chan.
Newark	WNTA-TV	13

NEW MEXICO

Location	C.L.	Chan.
Albuquerque	KGGM-TV	13
	KNME-TV	*5
	KOAT-TV	7
	KOB-TV	4
Carlsbad	KAVE-TV	6
Clovis	KVER-TV	12
Roswell	KSWS-TV	8

NEW YORK

Location	C.L.	Chan.
Albany	WTEN	10
	WAST	13
	WTRI	35
	WCDA	41
Binghamton	WINR-TV	40
	WNBF-TV	12
Buffalo	WBEN-TV	4
	WNED-TV	*17
	WGR-TV	2
	WKBW-TV	7
Carthage	WCNY-TV	7
Elmira	WSYE-TV	18
New York	WABC-TV	7
	WNEW-TV	5
	WCBS-TV	2
	WOR-TV	9
	WPIX	11
	WNBC-TV	4
Plattsburg	WPTZ-TV	5
Rochester	WHEC-TV	10
	WROC-TV	5
	WVET-TV	10
Schenectady	WRGB	6
Syracuse	WHEN-TV	8
	WSYR-TV	3
Utica	WKTV	2

NORTH CAROLINA

Location	C.L.	Chan.
Asheville	WISE-TV	62
	WLOS-TV	13
Chapel Hill	WUNC-TV	*4
Charlotte	WBTV	3
	WSOC-TV	9
Durham	WTVD	11
Greensboro	WFMY-TV	2
Greenville	WNCT	9
Raleigh	WRAL-TV	5
Washington	WITN	7
Wilmington	WECT	6
Winston-Salem	WSJS-TV	12

NORTH DAKOTA

Location	C.L.	Chan.
Bismarck	KBMB-TV	12
	KFYR-TV	5
Dickinson	KDIX-TV	2
Fargo	WDAY-TV	6
	KXGO-TV	11
Grand Forks	KNOX-TV	10
Minot	KXMC-TV	13
	KMOT	10
Pembina, N.D.		12
Valley City	KXJB-TV	4
Williston	KUMV-TV	8

OHIO

Location	C.L.	Chan.
Akron	WAKR-TV	49
Cincinnati	WCET	*48
	WCPO-TV	9
	WKRC-TV	12
	WLW-T	5
	WCIN-TV	54
Cleveland	KYW-TV	3
	WEWS	5
	WJW-TV	8
Columbus	WBNS-TV	10
	WLW-C	4
	WOSU-TV	*34
	WTVN-TV	6
Dayton	WHIO-TV	7
	WLW-D	2
Lima	WIMA-TV	35
Oxford	WMUB-TV	14
Steubenville	WSTV-TV	9
Toledo	WSPD-TV	13
	WGTE-TV	*30
	WTOL-TV	11
Youngstown	WFMJ-TV	21
	WKBN-TV	27
	WKST-TV	33
	WXTV	45
Zanesville	WHIZ-TV	18

OKLAHOMA

Location	C.L.	Chan.
Ada	KTEN	10
Ardmore	KXII	12
Enid	KOCO-TV	5
Lawton	KSWO-TV	7
Oklahoma City	KETA	*13
	KOKH-TV	25
	KWTV	9
	WKY-TV	4
Tulsa	KOTV	6
	KOED-TV	*11
	KTUL-TV	8
	KVOO-TV	2

OREGON

Location	C.L.	Chan.
Coos Bay	KCBY-TV	11
Corvallis	KOAC-TV	*7
Eugene	KVAL-TV	13
Klamath	KOTI	2
Medford	KBES-TV	5
Portland	KGW-TV	8
	KHTV	27
	KOIN-TV	6
	KPTV	12
Roseburg	KPIC	4

PENNSYLVANIA

Location	C.L.	Chan.
Altoona	WFBG-TV	10
Erie	WICU	12
	WSEE-TV	35
Harrisburg	WHP-TV	55
	WTPA	27
Johnstown	WARD-TV	56
	WJAC-TV	6
Lancaster	WGAL-TV	8
Lebanon	WLVH-TV	15
Lockhaven	WBPZ-TV	32
New Castle	WKST-TV	45
Philadelphia	WCAU-TV	10
	WFIL-TV	6
	WHYY-TV	*35
	WPCA-TV	17
	WRCV-TV	3
Pittsburgh	KDKA-TV	2
	WIIC	11
	WQED	*13
	WQEX	*16
	WTAE	4
Scranton	WNEP-TV	16
	WDAU-TV	22
Wilkes-Barre	WBRE-TV	28
York	WSBA-TV	43

RHODE ISLAND

Location	C.L.	Chan.
Providence	WJAR-TV	10
	WPRO-TV	12

SOUTH CAROLINA

Location	C.L.	Chan.
Anderson	WAIM-TV	40
Charleston	WCSC-TV	5
	WUSN-TV	2
Columbia	WIS-TV	10
	WNOK-TV	67
Florence	WBTW	8
Greenville	WFBC-TV	4
Spartanburg	WSPA-TV	7

SOUTH DAKOTA

Location	C.L.	Chan.
Aberdeen	KXAB-TV	9
Deadwood	KDSJ-TV	5
Florence	KDLO-TV	3
Mitchell	KORN-TV	5
Rapid City	KOTA-TV	3
	KRSD-TV	7
Reliance	KPLO-TV	6
Sioux Falls	KELO-TV	11
	KSOO-TV	13
Vermilion	KUSD-TV	*2

TENNESSEE

Location	C.L.	Chan.
Chattanooga	WDEF-TV	12
	WRGP-TV	3
	WTVC	9
Jackson	WDXI-TV	7
Johnson City	WJHL-TV	11
Knoxville	WATE-TV	6
	WBIR-TV	10
	WTVK	26
Memphis	WHBQ-TV	13
	WKNO	*10
	WMCT	5
	WREC-TV	3
Nashville	WLAC-TV	5
	WSIX-TV	8
	WSM-TV	4

TEXAS

Location	C.L.	Chan.
Abilene	KRBC-TV	9
Amarillo	KFDA-TV	10
	KGNC-TV	4
	KVII	7
Austin	KTBC-TV	7
Beaumont	KFDM-TV	6
Big Spring	KEDY-TV	4
Bryan	KBTX-TV	3
Corpus Christi	KRIS-TV	6
	KZTV	10
Dallas	KRLD-TV	4
	KERA-TV	*13
	WFAA-TV	8
El Paso	KELP-TV	13
	KROD-TV	4
	KTSM-TV	9
(Ciudad Juarez, Mex.)	XEJ-TV	5
Ft. Worth	KTVT	11
	WBAP-TV	5
Harlingen	KGBT-TV	4
Houston	KPRC-TV	2
	KHOU-TV	11
	KTRK-TV	13
	KUHT	*8
Laredo	KGNS-TV	8
Lubbock	KCBD-TV	11
	KDUB-TV	13
Lufkin	KTRE-TV	9
Midland	KMID-TV	2
Monahans	KVKM-TV	9
Odessa	KOSA-TV	7
Port Arthur-Beaumont	KPAC-TV	4
Richardson	KRET-TV	*23
San Angelo	KCTV	8
San Antonio	KCOR-TV	41
	KENS-TV	5
	KONO-TV	12
	WOAI-TV	4
Sweetwater	KPAR-TV	12
Temple	KCEN-TV	6
Texarkana	KCMC-TV	6
Tyler	KLTV	7
Waco	KWTX-TV	10
Weslaco	KRGV-TV	5
Wichita Falls	KFDX-TV	3
	KSYD-TV	6

UTAH

Location	C.L.	Chan.
Ogden	KVOG-TV	9
	KWCS-TV	*18
Provo	KLOR-TV	11
Salt Lake City	KSL-TV	5
	KCPX-TV	4
	KUED	*7
	KUTV	2

VERMONT

Location	C.L.	Chan.
Burlington	WCAX-TV	3

VIRGINIA

Location	C.L.	Chan.
Bristol	WCYB-TV	5
Hampton	WVEC-TV	13
Harrisonburg	WSVA-TV	3
Lynchburg	WLVA-TV	13
Norfolk	WTAR-TV	3
Petersburg	WXEX-TV	8
Portsmouth	WAVY-TV	10
Richmond	WRVA-TV	12
	WTVR	6
Roanoke	WDBJ-TV	7
	WSLS-TV	10

WASHINGTON

Location	C.L.	Chan.
Bellingham	KVOS-TV	12
Ephrata	KBAS-TV	16
Pasco	KEPR-TV	19
Seattle	KCTS-TV	*9
	KING-TV	5
	KIRO-TV	7
	KOMO-TV	4
Spokane	KHQ-TV	6
	KREM-TV	2
	KXLY-TV	4
Tacoma	KTNT-TV	11
	KPEC-TV	*56
	KTPS	*62
	KTVW	13
Walla Walla	KNBS	22
Yakima	KIMA-TV	29
	KNDO-TV	23

WEST VIRGINIA

Location	C.L.	Chan.
Bluefield	WHIS-TV	6
Charleston	WCHS-TV	8
Clarksburg	WBOY-TV	12
Huntington	WHTN-TV	13
	WSAZ-TV	3
Oak Hill	WOAY-TV	4
Parkersburg	WTAP-TV	15
Wheeling	WTRF-TV	7

WISCONSIN

Location	C.L.	Chan.
Eau Claire	WEAU-TV	13
Green Bay	WBAY-TV	2
	WFRV	5
La Crosse	WKBT	8
Madison	WHA-TV	*21
	WISC-TV	3
	WKOW-TV	27
	WMTV	33
Marinette	WMBV-TV	11
Milwaukee	WISN-TV	12
	WITI-TV	6
	WMVS-TV	*10
	WTMJ-TV	4
	WXIX	18
Wausau	WSAU-TV	7

WYOMING

Location	C.L.	Chan.
Casper	KTWO-TV	2
Cheyenne	KFBC-TV	5
Riverton	KWRB-TV	10

PUERTO RICO

Location	C.L.	Chan.
Aguadilla	WOLE-TV	12
Caguas	WKBM-TV	11

Canadian Television Stations

ALBERTA

Location	C.L.	Chan.
Calgary	CHCT-TV	2
	CFCN-TV	4
Edmonton	CFRN-TV	3
Lethbridge	CJLH-TV	7
Lloydminster	CHSA-TV	2
Medicine Hat	CHAT-TV	6
Red Deer	CHCA-TV	6

BRITISH COLUMBIA

Location	C.L.	Chan.
Dawson Creek	CJDC-TV	5
Kamloops	CFCR-TV	4
Kelowna	CHBC-TV	2
	CHGP-TV-1	72
Oliver	CHBC-TV-3	8
Penticton	CHBC-TV	13
Vancouver	CBUT	2
Vernon	CHBC-TV	7
Victoria	CHEK-TV	6

LABRADOR

Location	C.L.	Chan.
Goose Bay	CFLA-TV	8

MANITOBA

Location	C.L.	Chan.
Baldy Mountain	CKOS-TV-1	8
Brandon	CKX-TV	5
Winnipeg	CBWT	3
	CBWFT	6

NEW BRUNSWICK

Location	C.L.	Chan.
Campbellton	CKAM-TV	12
Moncton	CKCW-TV	2
	CBAFT	11
Saint John	CHSJ-TV	4

NEWFOUNDLAND

Location	C.L.	Chan.
Argentia	CJOX-TV	10
Corner Brook	CBYT	5
	CHEK-TV	6
Grand Falls	CJCN-TV	4
St. John's	CJON-TV	6
Stephenville	CFSN-TV	8

NOVA SCOTIA

Location	C.L.	Chan.
Halifax	CBHT	3
Inverness	CJCB-TV-1	6
Liverpool	CBHT-1	12
New Glasgow	CFCY-TV-1	7
Shelburne	CBHT-2	8
Sydney	CJCB-TV	4
Yarmouth	CBHT-3	11

ONTARIO

Location	C.L.	Chan.
Barrie	CKVR-TV	3
Cornwall	CJSS-TV	8
Elk Lake	CFCL-TV-2	2
Elliot Lake	CKSO-TV-1	3
Hamilton	CHCH-TV	11
Kapuskasing	CFCL-TV-1	3
Kenora	CBWAT	8
Kingston	CKWS-TV	11
Kitchener	CKCO-TV	13
London	CFPL-TV	10
North Bay	CKGN-TV	10
Peterborough	CHEX-TV	12
Ottawa	CBOFT	9
	CBOT	4
Port Arthur	CFCJ-TV	2
Sault Ste. Marie	CJIC-TV	2
Sudbury	CKSO-TV	5
Timmins	CFCL-TV	6
Toronto	CBLT	6
Windsor	CKLW-TV	9
Wingham	CKNX-TV	8

PRINCE EDWARD ISLAND

Location	C.L.	Chan.
Charlottetown	CFCY-TV	13

QUEBEC

Location	C.L.	Chan.
Carleton	CHAU-TV	5
Clermont	CFCV-TV-1	75
Estcourt	CJES-TV-1	70
Jonquiere	CKRS-TV	12
Matane	CKBL-TV	9
Montreal	CBFT	2
	CBMT	6
Quebec	CFCM-TV	4
	CKMI-TV	5
Rimouski	CJBR-TV	3
Rouyn	CKRN-TV	4
Sherbrooke	CHLT-TV	7
Three Rivers	CKTM-TV	13

SASKATCHEWAN

Location	C.L.	Chan.
Moose Jaw	CHAB-TV	4
Prince Albert	CKBI-TV	5
Regina	CKCK-TV	2
Saskatoon	CFQC-TV	8
Swift Current	CFJB-TV	5
Yorkton	CKOS-TV	3

World-Wide Short-Wave Stations

Most international broadcasting is done within frequency limits agreed upon at international conventions. These frequency ranges are listed here, at the right, expressed both in frequency and by meter bands (wave-length).

Reception in the various bands varies according to the time of day and season of the year. Reception in the 60, 49 and 41 meter bands is best at night during the winter months. Reception in the 31 and 25 M. bands is best at night, but all year. Reception in the 19, 16, 13 and 11 M. bands is best during the day, also at night during the summer in the 16 and 19 M. bands.

Abbr.: AIR—All India Radio; RAI—Radiotelevisione Italiana; RTF—Radiodiffusion Television Francaise; VOA—Voice of America; RFE—Radio Free Europe. ● denotes stations beaming evening (U.S.) broadcasts to the U.S., † morning or afternoon broadcasts.

METER BANDS

4750 to 5060 kc/s	(60 meter band)
5950 to 6200 kc/s	(49 meter band)
7100 to 7300 kc/s	(41 meter band)
9500 to 9775 kc/s	(31 meter band)
11700 to 11975 kc/s	(25 meter band)
15100 to 15450 kc/s	(19 meter band)
17700 to 17900 kc/s	(16 meter band)
21450 to 21750 kc/s	(13 meter band)
25600 to 26100 kc/s	(11 meter band)

Kcs.	Call and Location
4630	HCGBI, Quito, Ecua.
4765	HJEF, Cali, Col.
4770	ELWA, Monrovia, Lib.
4770	YVMW, Punto Fiji, Ven.
4775	Libreville, Gabon Rep.
4780	YVLA, Valencia, Ven.
4790	YVQN, Puerto La Cruz, Ven.
4795	Rangoon, Burma
4805	ZYS8, Manaus, Braz.
4810	YVMG, Maracaibo, Ven.
4830	YVOA, San Cristobal, Ven.
4835	HJKE, Bogota, Col.
4840	Lourenco Marques, Moz.
4840	YVOI, Valera, Ven.
4845	HJGF, Bucaramanga, Col.
4850	YVMS, Barquisimeto, Ven.
4870	Cotonou, Dahomey Rep.
4880	YVKF, Caracas, Ven.
4893	Dakar, Mali Fed.
4895	PRF6, Manaus, Braz.
4898	HJAG, Barranquilla, Col.
4900	YVKP, Caracas, Ven.
4905	HRQN, Puerto Cortes Hon.
4910	HCIMI, Quito, Ecua.
4910	Conakry, Guinea
4915	Accra, Ghana
4920	VLM4, Brisbane, Aus.
4920	YVKR, Caracas, Ven.
4930	HCIRC, Quito, Ecua.
4935	HJLF, Ibague, Col.
4940	Abidjan, Ivory Coast
4940	YVMO, Barquisimeto, Ven.
4945	HJCW, Bogota, Col.
4945	Paradys, So. Afr.
4950	Dakar, Mali Fed.
4950	YVMM, Coro, Ven.
4955	CR6RZ, Luanda, Ang.
4960	YVQA, Cumana, Ven.
4970	YVLK, Caracas, Ven.
4975	Yaounde, Cameroun
4990	Lagos, Nigeria
4990	YVMQ, Barquisimeto, Ven.
5010	HCRCX, Quito, Ecua.
5010	St. George, Grenada, B.W.I.
5020	HJFW, Manizales, Col.
5020	Niamey, Niger Rep.
5030	YVKM, Caracas, Ven.
5040	YVMA, Maracaibo, Ven.
5045	Lome, Togo
5050	YVKD, Caracas, Ven.
5075	HJGC, Bogota, Col.
5873	HRN, Tegucigalpa, Hond.
5940	Moscow, U.S.S.R.
5952	TGNA, Guatemala, Guat.
5954	TIQ, Puerto Limon, C. R.
5960	HJCF, Bogota, Col.
5965	YNWW, Granada, Nic.
5980	TGAR, Guatemala, Guat.
5981	Georgetown, Br. Guiana
5982	4VB, Port-au-Prince, Haiti
5990	Andorra, Andorra
5990	TGJA, Guatemala, Guat.
5995	Fort-de-France, Mart.
6002	4VEC, Cap Haitien, Haiti
6005	RIAS, Berlin, Ger.
6006	TIHBG, San Jose, C. R.
6010	XEOL, Mexico City, Mexico
6015	PRA8, Recife, Braz.
6020	Amman, Jordan
6020	Kiev, Ukrainian S.S.R.
6025	Kuala Lumpur, Malaya
6025	Hilversum, Neth.
6030	Baghdad, Iraq
6035	Rangoon, Burma
6035	HRTL, Tegucigalpa, Hond.
6037	TIFC, San Jose, C. R.
6037	Monte Carlo, Mon.
6040	HJLB, Ibague, Col.
6045	YOF, Djakarta, Indon.
6045	HOU31, David, Pan.
6050	HCJB, Quito, Ecua.
6050	BBC, London, Eng.
6055	HJEX, Cali, Col.
6055	JOZ2, Tokyo, Japan
6060	RAI, Caltanissetta, It.
6065	XEXG, Leon, Mex.
6065	Horby, Sweden
6070	Sofia, Bulgaria
6070	BBC, London, Eng.
6075	Norden, Ger.
6080	ZL7, Wellington, N.Z.
6082	OAX4Z, Lima, Peru
6085	Munich, Ger.
6090	VLI6, Sydney, Aus.
6090	Luxembourg, Lux.
6090	XECMT, C. El Mante, Mex.
6095	ZYB7, Sao Paulo, Braz.
6100	VOA, Munich, Ger.
6100	Belgrade, Yugo.
6103	Peking, China
6105	XEQM, Merida, Mex.
6105	Tunis, Tunisia
6110	BBC, London, Eng.
6115	ZYC7, Rio de Jan., Braz.
6115	Khabarovsk, U.S.S.R.
6120	LRX1, Buenos Aires
6120	BBC, Limassol, Cyprus
6130	Port Moresby, New Guinea
6130	Madrid, Spain ●
6135	HRMF, La Ceiba, Hond.
6135	Papeete, Tahiti
6135	Singapore, Sing.
6140	HCOV5, Azogues, Ecua.
6140	VLW6, Perth, Aus.
6145	Algiers, Algeria
6147	PRL9, Rio de Jan., Braz.
6150	VLR6, Melbourne, Aus.
6150	BBC, London, Eng.
6155	4VWA, Cap Haitien, Haiti
6155	VOA, Salonika, Greece
6160	HJKJ, Bogota, Col.
6160	FEN, Tokyo, Japan
6165	HER3, Bern, Switz. ●
6165	XEWW, Mexico City, Mex.
6165	Saigon, Vietnam
6170	BBC, Limassol, Cyprus
6170	Cayenne, Fr. Guiana
6175	RTF, Paris, France
6180	BBC, London, England
6185	HJCT, Bogota, Col.
6190	VOA, Munich, Ger.
6190	HVJ, Vatican City
6195	HJEZ, Cali, Col.
6195	HRD2, La Ceiba, Hond.
6195	Pyongyang, N. Korea
6200	HI2LR, C. Trujillo, D.R.
6200	4VHW, Port-au-Prince, Haiti
6208	TGHC, Guatemala, Guat.
6215	Pyongyang, N. Korea
6225	Peking, China
6305	Andorra, Andorra
6327	COCF, Havana, Cuba
6345	Ulan Bator, Mong.
6373	Lisbon, Port.
6790	BBC, Limassol, Cyprus
7105	Madrid, Spain
7110	VOA, Colombo, Ceylon
7110	BBC, London, England
7115	Rabat, Morocco
7115	RFE, Germ.
7120	BBC, London, England
7120	BBC, Singapore
7125	Warsaw, Poland
7140	Monte Carlo, Monaco
7145	RFE, Ger.
7150	Khabarovsk, U.S.S.R.
7160	RTF, Paris, France
7160	VOA, Tangier, Mor.
7165	RFE, Germ.
7170	Algiers, Alg.
7180	Baghdad, Iraq
7185	BBC, London, Eng.
7200	BBC, London, Eng.
7200	R. Malaya, Sing.
7200	Omdurman, Sudan
7205	VOA, Salonika, Gr.
7210	BBC, London, Eng.
7210	Dakar, Mali Fed.
7210	Khabarovsk, U.S.S.R.
7220	VLD7, Melbourne, Aus.
7220	Budapest, Hung.
7230	BBC, London, Eng.
7235	Taipei, Taiwan, China
7235	VOA, Munich, Ger.
7240	RTF, Paris, France
7250	BBC, London, Eng.
7255	Sofia, Bulg.
7260	Saigon, Vietnam
7270	Motola, Sweden
7270	Magadan, U.S.S.R.
7275	RAI, Rome, It.
7280	Teheran, Iran
7280	HVJ, Vat. City
7285	Ankara, Turk.
7290	RAI, Rome, It.
7295	Makassar, Celebes
7295	RFE, Ger.
7320	BBC, London, Eng.
7398	Damascus, U.A.R.
7505	Peking, China
7650	YNMS, Leon, Nic.
7670	Sofia, Bulg.
7850	Tirana, Alb.
8002	Beirut, Leb.
8900	HCJC3, Zaruma, Ecua.
9009	Tel Aviv, Israel
9026	COBZ, Havana, Cuba
9065	Peking, China
9210	Leopoldville, Congo
9360	Madrid, Spain ●
9363	COBC, Havana, Cuba
9380	Alma Ata, Kazakh S.S.R.
9385	Leopoldville, Congo
9410	BBC, London, Eng.
9440	CP38, La Paz, Bol.
9458	Peking, China
9500	XEWW, Mexico City, Mex.
9500	Magadan, U.S.S.R.
9500	Moscow, U.S.S.R.
9505	PRB22, Sao Paulo, Braz.
9505	Rabat, Mor.
9505	HDLA, Colon, Pan.
9510	Peking, China
9510	VOA, Tangier, Mor.
9515	RAI, Caltanissetta, It.
9515	Ankara, Turkey ●
9520	Colombo, Ceylon
9520	Copenhagen, Den. ●
9520	VOA, Salonika, Gr.
9520	OAX8E, Iquitos, Peru
9523	Paradys, S. Afr.
9525	BBC, London, Eng.
9525	JOB9, Tokyo, Japan
9525	Warsaw, Poland
9530	COCO, Havana, Cuba
9530	VOA, Munich, Ger.
9530	AIR, Delhi, India
9530	VOA, Courier, Rhodes
9530	YVMZ, Maracaibo, Ven.
9535	Lagos, Nigeria
9535	VOA, Manila, P.I.
9535	HER4, Bern, Switz. ●
9540	ZL2, Wellington, N.Z.
9540	Warsaw, Poland
9540	Omdurman, Sudan
9545	ZYS43, Curitiba, Braz.
9545	HED5, Bern, Switz.
9950	Prague, Czecho. ●
9550	AIR, Bombay, India
9550	OAX1Z, Tumbes, Peru
9555	CP6, La Paz, Bol.
9555	BBC, London, Eng.
9555	XETT, Mexico City, Mex.
9560	RTF, Paris, France
9560	Tokyo, Japan
9563	OAX4R, Lima, Peru
9565	ZYK3, Recife, Braz.
9565	Radio Liberty, Ger.
9565	Khabarovsk, U.S.S.R.
9570	Bucharest, Rom. ●
9575	ZYZ27, Rio de Jan., Braz.
9575	Taipei, Formosa
9575	RAI, Rome, Italy ●
9580	VLA9, Melbourne, Aus.
9580	BBC, London, Eng.
9585	ZYR56, Sao Paulo, Braz.
9585	RTF, Paris, France
9588	Peking, China
9590	Djakarta, Indon.
9590	Hilversum, Neth.
9590	Bucharest, Rom. ●
9595	JOZ3, Tokyo, Japan
9598	CE960, Santiago, Chile
9600	BBC, London, Eng.
9605	Cologne, Ger.
9607	Athens, Greece
9610	VLX9, Perth, Aus.
9610	ZYC8, Rio de Jan., Braz.
9610	Oslo, Norway ●
9610	OAX8C, Iquitos, Peru
9615	VOA, Tangier, Morocco
9620	ZYR98, Sao Paulo, Braz.
9620	Peking, China
9620	VOA, Tangier, Mor.
9620	Saigon, Vietnam
9625	Brazzaville, Equat. Un.
9625	BBC, London, Eng.
9625	OAX8K, Iquitos, Peru
9625	Moscow, U.S.S.R.
9630	CR6RL, Luanda, Ang.
9630	VLG9, Melbourne, Aus.
9630	RAI, Rome, Italy
9630	Komsomolsk, U.S.S.R.
9635	ZYR83, Aparecida, Braz.
9635	VOA, Munich, Ger.
9635	Lisbon, Portugal ●
9640	BBC, London, Eng.
9640	Cologne, Germany ●
9640	Accra, Ghana
9640	HLK5, Seoul, Korea
9640	Moscow, U.S.S.R.
9645	TIFC, San Jose, C.R.
9645	HVJ, Vatican City
9650	BBC, Limassol, Cyprus
9655	Radio Free Europe, Ger.
9660	LRX, Buenos Aires, Arg.
9660	VLQ9, Brisbane, Aus.
9660	Radio Liberty, Ger.
9660	Teheran, Iran
9660	Komsomolsk, U.S.S.R.
9665	Moscow, U.S.S.R.
9667	Hargeisa, Somalia
9667	TGNA, Guatemala, Guat. ●
9670	COCQ, Havana, Cuba
9670	Prague, Czecho.
9675	BBC, London, Eng.
9675	RTF, Paris, France
9675	JOB9, Tokyo, Japan
9675	Warsaw, Poland ●
9680	VLH9, Melbourne, Aus.
9680	XEQQ, Mexico City, Mex.
9680	VOA, Tangier, Mor.
9680	Paradys, S. Afr.
9685	Algiers, Algeria
9690	LRA, Buenos Aires, Arg. ●
9690	BBC, London, Eng.
9690	BBC, Singapore
9700	Sofia, Bulgaria ●
9700	Rabat, Morocco
9705	Kabul, Afghan.
9705	Brussels, Belg.
9705	AIR, Delhi, India
9705	Radio Free Europe, Port.
9710	BBC, London, Eng.
9710	RAI, Rome, It.
9715	Hilversum, Neth. ●
9715	Radio Free Europe, Ger.
9720	Paradys, S. Afr.
9725	Tel Aviv, Israel
9725	RFE, Port.
9725	BBC, Singapore
9730	Brazzaville, Equat. Un.
9730	Leipzig, E. Ger.
9730	DZH7, Manila, P.I.
9735	Peking, China
9735	BBC, London, Eng.
9735	Cologne, Germany
9735	AIR, Madras, India
9740	VOA, Tangier, Mor.
9742	LRS1, Buenos Aires, Arg.
9743	Brussels, Belg.
9745	HCJB, Quito, Ecua. ●
9745	Ankara, Turk.
9745	Moscow, U.S.S.R.
9750	BBC, London, Eng.
9750	Radio Free Europe, Port.
9750	Khabarovsk, U.S.S.R.
9755	ZYW23, Goiania, Braz.
9755	RTF, Paris, France
9755	Saigon, Vietnam
9760	BBC, London, Eng.
9762	Hanoi, N. Vietnam
9765	Moscow, U.S.S.R.
9770	Brazzaville, Equat. Un.
9770	BBC, London, Eng.
9775	Moscow, U.S.S.R.

Kcs.	Call and Location
9795	Cairo, U.A.R. ●
9800	Peking, China
9800	Moscow, U.S.S.R.
9805	Cairo, U.A.R.
9825	BBC, London, Eng. ●
9833	Budapest, Hung. ●
9840	Hanoi, N. Vietnam
9850	AIR, Delhi, India
9860	Peking, China
9870	Djakarta, Indon.
9895	Bengazi, Libya
9915	BBC, London, Eng.
9973	Peking, China
10335	Ulan Bator, Mong.
10530	Alma Ata, Kazakh S.S.R.
11280	Peking, China
11570	Moscow, U.S.S.R.
11600	Peking, China
11630	Moscow, U.S.S.R.
11650	Peking, China
11665	Cairo, U.A.R.
11675	Peking, China
11675	Karachi, Pak.
11680	BBC, London, Eng.
11685	HVJ, Vat. City
11690	Moscow, U.S.S.R. ●
11700	RTF, Paris, France
11705	JOA11, Tokyo, Japan
11705	Horby, Sweden
11705	Moscow, U.S.S.R.
11710	VLB11, Melbourne, Aus. †
11710	AIR, Delhi, India
11710	WBOU, New York, N.Y.
11715	VOA, Munich, Ger.
11715	Moscow, U.S.S.R.
11717	Athens, Greece
11720	Brazilia, Brazil
11720	BBC, Limassol, Cyprus
11725	Brazzaville, Equat. Un.
11725	Prague, Czecho.
11725	BBC, Singapore
11730	Hilversum, Neth. ●
11735	Rabat, Morocco
11735	Moscow, U.S.S.R. ●
11740	VLC11, Melbourne, Aus.
11740	CE1174, Santiago, Chile
11740	Peking, China
11740	VOA, Tangier, Mor.
11745	RFE, Germ.
11750	BBC, London, Eng.
11750	FEN, Tokyo, Japan
11755	RFE, Port.
11755	Hilversum, Neth. ●
11755	Komsomolsk, U.S.S.R.
11760	VLB11, Melbourne, Aus.
11760	VOA, Munich, Ger.
11760	VOA, Tangier, Mor.
11760	Lourenco Marques, Moz.
11760	Hanoi, N. Vietnam
11765	ZYB8, Sao Paulo, Braz.
11765	Berlin, E. Germany
11770	Colombo, Ceylon
11770	BBC, London, Eng.
11775	ZYZ28, Rio de Jan., Braz.
11775	Moscow, U.S.S.R.
11780	BBC, London, Eng. ●
11785	Djakarta, Indon.
11785	VOA, Tangier, Morocco
11790	BBC, London, Eng.
11790	VOA, Manila, P.I.
11790	Moscow, U.S.S.R.
11795	Cologne, Ger. ●
11795	Djakarta, Indon.
11800	BBC, London, Eng.
11802	Warsaw, Poland ●
11805	RAI, Rome, It.
11805	VOA, Courier, Rhodes
11810	VLB11, Melbourne, Aus. †
11810	RAI, Rome, It.
11810	Amman, Jordan
11810	Bucharest, Rom. ●
11810	Horby, Sweden ●
11815	Madrid, Spain
11820	Peking, China
11820	BBC, London, Eng.
11820	XEBR, Hermosillo, Mex.
11825	ELWA, Monrovia, Lib.
11830	WRUL, Boston, U.S.A.
11830	Moscow, U.S.S.R.
11835	Algiers, Alg.
11835	VOA, Colombo, Ceylon
11835	CXA19, Montevideo, Urug.
11840	Prague, Czecho.
11840	VOA, Tangier, Mor.
11840	Lisbon, Port. ●
11840	Khabarovsk, U.S.S.R.
11840	Hanoi, N. Vietnam
11845	RTF, Paris, France
11845	Karachi, Pak.
11850	Sofia, Bulg.
11850	AIR, Bombay, India
11850	Oslo, Norway ●
11855	Brussels, Belg. ●
11855	Radio Free Europe, Ger.
11855	DZH8, Manila, P.I.
11860	Peking, China
11860	BBC, London, Eng.
11860	Moscow, U.S.S.R.
11865	PRA8, Recife, Braz.
11865	VOA, Tangier, Mor.
11865	HER5, Bern, Switz. ●
11865	Tunis, Tun.
11870	Moscow, U.S.S.R.
11875	ZYN32, Salvador, Braz.

Kcs.	Call and Location
11875	VOA, Colombo, Ceylon
11875	VOA, Tangier, Mor.
11880	BBC, London, Eng.
11880	XEHH, Mexico City, Mex.
11885	Peking, China
11885	Karachi, Pak.
11885	Radio Free Europe, Ger.
11890	Moscow, U.S.S.R.
11895	Dakar, Mali Fed.
11895	VOA, Tangier, Mor.
11895	VOA, Manila, P.I.
11900	Bucharest, Rumania ●
11900	CXA10, Montevideo, Ur.
11900	Moscow, U.S.S.R.
11905	RAI, Rome, Italy ●
11905	WDSI, New York, U.S.A.
11910	BBC, London, Eng.
11910	Budapest, Hung. ●
11910	Bangkok, Thai.
11915	HCJB, Quito Ecua. ●
11915	Hilversum, Neth.
11920	RAI, Paris, France
11920	DXF2, Manila, P.I.
11920	WLWO, Cincinnati, U.S.A.
11925	ZYR78, Sao Paulo, Braz.
11925	HLK6, Seoul, Korea †
11925	Warsaw, Pol.
11925	Moscow, U.S.S.R.
11930	BBC, London, Eng.
11930	BBC, Singapore
11935	Radio Liberty, Ger.
11940	CE1190, Valparaiso, Chile
11940	JOB11, Tokyo, Japan
11945	Peking, China
11945	BBC, London, Eng.
11945	Cologne, Germany ●
11950	Warsaw, Poland
11950	Jidda, Saudi Arab.
11950	Moscow, U.S.S.R.
11955	BBC, London, Eng.
11955	BBC, Singapore
11960	CE1196, Santiago, Ch.
11960	Moscow, U.S.S.R. ●
11965	Radio Liberty, Ger.
11970	Caracas, Ven.
11972	Brazzaville, Equat. Un. ●
11975	Peking, China
11975	Moscow, U.S.S.R. ●
11985	Moscow, U.S.S.R.
11986	ELWA, Monrovia, Lib. ●
11990	Prague, Czecho.
12000	Moscow, U.S.S.R.
12010	Hanoi, Vietnam
12020	AIR, Delhi, India
12020	Moscow, U.S.S.R.
12040	BBC, London, Eng.
12050	Cairo, U.A.R.
12095	BBC, London, Eng.
15020	Hanoi, N. Vietnam
15030	Peking, China
15060	Peking, China
15070	BBC, London, Eng.
15085	Grenada, Windward Is., BWI
15095	Peking, China
15100	Lisbon, Port.
15100	Moscow, USSR
15105	ZYZ32, Rio de Jan., Braz.
15105	AIR, Delhi, India
15110	BBC, London, Eng.
15110	Moscow, USSR ●
15115	HCJB, Quito, Ecuador ●
15115	Peking, China
15120	Colombo, Ceylon
15120	RAI, Rome, Italy
15120	Warsaw, Poland †
15120	HVJ, Vatican City
15120	ZYN31, Salvador, Brazil
15125	Prague, Czecho.
15125	Seoul, Korea ●
15125	VOA, Manila, P.I.
15125	Lisbon, Portugal ●
15130	RTF, Paris, France
15130	VOA, Manila, P.I.
15130	KCBR, Delano, Calif.
15130	WBOU, New York, USA
15130	Moscow, USSR
15135	PRB23, Sao Paulo, Braz.
15135	JOB15, Tokyo, Japan
15135	Radio Free Europe, Port.
15140	Peking, China
15140	BBC, London, Eng.
15140	AIR, Delhi, India
15140	Komsomolsk, USSR
15145	ZYK33, Recife, Brazil
15145	Radio Free Europe, Port.
15148	CE1515, Santiago, Chile
15150	Djakarta, Indonesia
15150	Lourenco Marques, Moz.
15150	Lisbon, Portugal
15150	Moscow, USSR ●
15153	OAX4T, Lima, Peru
15155	ZYB9, Sao Paulo, Brazil
15155	Karachi, Pakistan
15155	VOA, Manila, P.I.
15155	WBOU, New York, USA
15155	Moscow, USSR
15160	VLA15, Melbourne, Aus.
15160	RTF, Paris, France
15160	XEWW, Mexico City, Mex.
15160	Ankara, Turkey
15160	Moscow, USSR
15165	ZYN7, Fortaleza, Braz.
15165	Copenhagen, Denmark
15165	Damascus, UAR
15170	Tromso, Norway

Kcs.	Call and Location
15170	OBX4C, Lima, Peru
15170	Radio Free Europe, Port.
15175	Peking, China
15175	Oslo, Norway ●
15180	BBC, London, Eng.
15180	AIR, Delhi, India
15180	Moscow, USSR
15185	VOA, Manila, P.I.
15185	Radio Free Europe, Port.
15185	WDSI, New York, USA
15190	Brazzaville, Congo Rep.
15190	Helsinki, Finland †
15190	Komsomolsk, USSR
15190	Moscow, USSR
15195	Prague, Czecho.
15195	Radio Free Europe, Ger.
15195	Ankara, Turkey
15200	Paradys, South Africa
15200	WDSI, New York, USA
15200	Moscow, USSR
15205	XESC, Mexico City, Mex.
15205	WDSI, New York, USA
15210	VLG15, Melbourne, Aus.
15210	VOA, Manila, P.I.
15210	KCBR, Delano, Cal., USA
15210	Moscow, USSR
15215	Radio Free Europe, Port.
15215	VOA, Okinawa, Ryukyu Is.
15220	Hilversum, Neth. †
15225	Taipei, Taiwan, China
15225	Radio Liberty, Germany
15225	Moscow, USSR
15230	VLH15, Melbourne, Aus.
15230	VOA, Colombo, Ceylon
15230	BBC, London, Eng.
15235	JOB15, Tokyo, Japan
15235	VOA, Tangier, Morocco
15235	Komsomolsk, USSR
15240	VLA15, Melbourne, Aus.
15240	Horby, Sweden
15240	Moscow, USSR
15240	Belgrade, Yugoslavia
15245	ZYE21, Belem, Brazil
15250	VOA, Manila, P.I.
15250	Bucharest, Rumania ●
15250	WLWO, Cincinnati, USA
15255	Radio Free Europe, Port.
15257	FEN, Tokyo, Japan
15260	BBC, London, England
15265	Colombo, Ceylon
15265	Moscow, USSR
15270	Peking, China ●
15270	AIR, Bombay, India
15270	VOA, Tangier, Morocco
15270	WBOU, New York, (VOA)
15270	WDSI, New York, USA
15275	Cologne, Germany
15275	Karachi, Pakistan
15275	VOA, Manila, P.I.
15275	Warsaw, Poland ● †
15280	ZL4, Wellington, N.Z.
15280	Moscow, USSR
15285	Brussels, Belgium
15285	Prague, Czecho.
15285	AIR, Bombay, India
15285	WBOU, New York, USA
15290	LRU, Buenos Aires, Arg.
15290	Peking, China
15290	KCBR, Delano, Cal., USA
15290	WLWO, Cincinnati, USA
15295	Rio de Janeiro, Brazil
15295	RTF, Paris, France
15295	VOA, Tangier, Morocco
15295	Moscow, USSR ●
15300	BBC, London, Eng. †
15300	DZH9, Manila, P.I.
15305	Dacca, Pakistan
15305	Moscow, USSR
15310	BBC, London, England ●
15310	BBC, Singapore
15310	KCBR, Delano, Cal., USA
15315	VLC15, Melbourne, Aus.
15315	Peking, China
15315	HEU6, Bern, Switz. ●
15315	Moscow, USSR
15320	VLC15, Melbourne, Aus.
15320	AIR, Delhi, India
15320	VOA, Tangier, Morocco
15325	ZYR228, Sao Paulo, Braz.
15325	RAI, Rome, Italy
15325	JOB15, Tokyo, Japan ●
15330	VOA, Munich, Germany
15330	VOC, Salonika, Greece
15330	WBOU, New York, USA
15330	WGEO, Schenectady, USA
15335	Brussels, Belgium †
15335	ZYU68, Porto Alegre, Braz.
15335	Karachi, Pakistan
15335	VOA, Manila, P.I.
15335	Komsomolsk, USSR
15340	Radio Liberty, Germany
15340	Moscow, USSR
15345	LRA, Buenos Aires, Arg.
15345	Taipei, Taiwan, China
15345	Athens, Greece
15345	Rabat, Morocco
15350	RTF, Paris, France
15350	WLWO, Cincinnati, USA
15355	Radio Free Europe, Port.
15360	BBC, London, England
15360	Moscow, USSR
15365	WLWO, Cincinnati, Ohio
15370	ZYC9, Rio de Jan., Braz.
15370	Radio Liberty, Germany
15375	BBC, London, Eng.
15375	Cologne, Germany †
15380	VOA, Tangier, Morocco

Kcs.	Call and Location
15380	VOA, Okinawa, Ryukyu Is.
15380	WRUL, Boston, USA
15385	DZF3, Manila, P.I.
15385	CXA60, Montevideo, Urug.
15385	Moscow, USSR
15390	BBC, London, Eng.
15390	Moscow, USSR
15395	Radio Liberty, Germany
15400	RTF, Paris, France
15400	RAI, Rome, Italy
15405	Cologne, Germany
15405	Moscow, USSR
15407	Paramaribo, Surinam
15410	Prague, Czecho. ●
15410	Radio Liberty, Germany
15410	VOA, Tangier, Morocco
15415	AFRS, Munich, Germany
15415	Budapest, Hungary ●
15417	Peking, China
15420	Brazzaville, Congo Rep.
15417	BBC, London, Eng.
15420	Madrid, Spain
15420	Moscow, USSR
15425	VLX15, Perth, Aus.
15425	Hilversum, Neth.
15430	Peking, China ●
15430	Cairo, UAR
15430	Moscow, USSR
15435	BBC, London, Eng.
15435	BBC, Singapore
15440	VOA, Munich, Germany
15440	Moscow, USSR
15445	Brazzaville, Congo Rep.
15445	Hilversum, Neth.
15447	BBC, London, Eng.
15450	Komsomolsk, USSR
15465	Paramaribo, Surinam
15470	Moscow, USSR
15475	Cairo, UAR
15480	Peking, China
15480	AIR, Delhi, India
15520	Peking, China
15555	Peking, China
15610	Peking, China
17605	Peking, China
17675	Peking, China
17690	Cairo, UAR
17695	BBC, London, Eng.
17700	BBC, London, Eng.
17700	Moscow, USSR
17705	AIR, Delhi, India
17705	VOA, Tangier, Morocco
17710	VLG17, Melbourne, Aus.
17710	WLWO, Cincinnati, USA
17710	Moscow, USSR
17715	BBC, London, Eng. ●
17715	VOA, Colombo, Ceylon
17720	Peking, China ●
17720	Brazzaville, Congo Rep.
17720	Radio Liberty, Germany
17720	Moscow, USSR
17722	San Jose dos Campos, Braz.
17725	Radio Free Europe, Port.
17725	AIR, Delhi, India
17730	BBC, London, Eng.
17730	Radio Liberty, Germany
17735	Radio Free Europe, Port.
17735	KCBR, Delano, Calif.
17735	HVJ, Vatican City
17740	WLWO, Cincinnati, USA
17740	BBC, London, Eng.
17740	Moscow, USSR
17745	BBC, London, Eng.
17745	Karachi, Pakistan
17745	VOA, Manila, P.I.
17747	Peking, China ●
17750	WRUL, Boston, USA
17750	VOA, Tangier, Morocco
17750	Moscow, USSR
17755	Prague, Czecho.
17755	BBC, Singapore
17760	WGEO, Schenectady, USA
17760	AIR, Delhi, India
17760	Moscow, USSR
17765	RTF, Paris, France
17765	Peking, China ●
17770	RAI, Rome, Italy
17770	Radio Free Europe, Port.
17770	KCBR, Delano, Cal., USA
17773	Athens, Greece
17775	Hilversum, Neth.
17780	WBOU, New York, USA
17780	VOA, Manila, P.I.
17780	Moscow, USSR
17785	HER7, Berne, Switz.
17785	AIR, Delhi, India
17788	Taipei, Formosa, China
17790	BBC, London, Eng.
17790	Prague, Czecho.
17790	AIR, Delhi, India
17795	KGEI, San Fran., USA
17795	WLWO, Cincinnati, USA
17795	Moscow, USSR
17795	CR6RZ, Luanda, Angola
17800	Helsinki, Finland †
17800	RAI, Rome, Italy
17800	Warsaw, Poland †
17805	Radio Free Europe, Port.
17805	DZ16, Manila, P.I.
17810	BBC, London, Eng. †
17810	AIR, Delhi, India
17810	Hilversum, Neth.
17810	Moscow, USSR
17815	Prague, Czecho.
17815	Cologne, Germany
17815	KCBR, Delano, Calif.